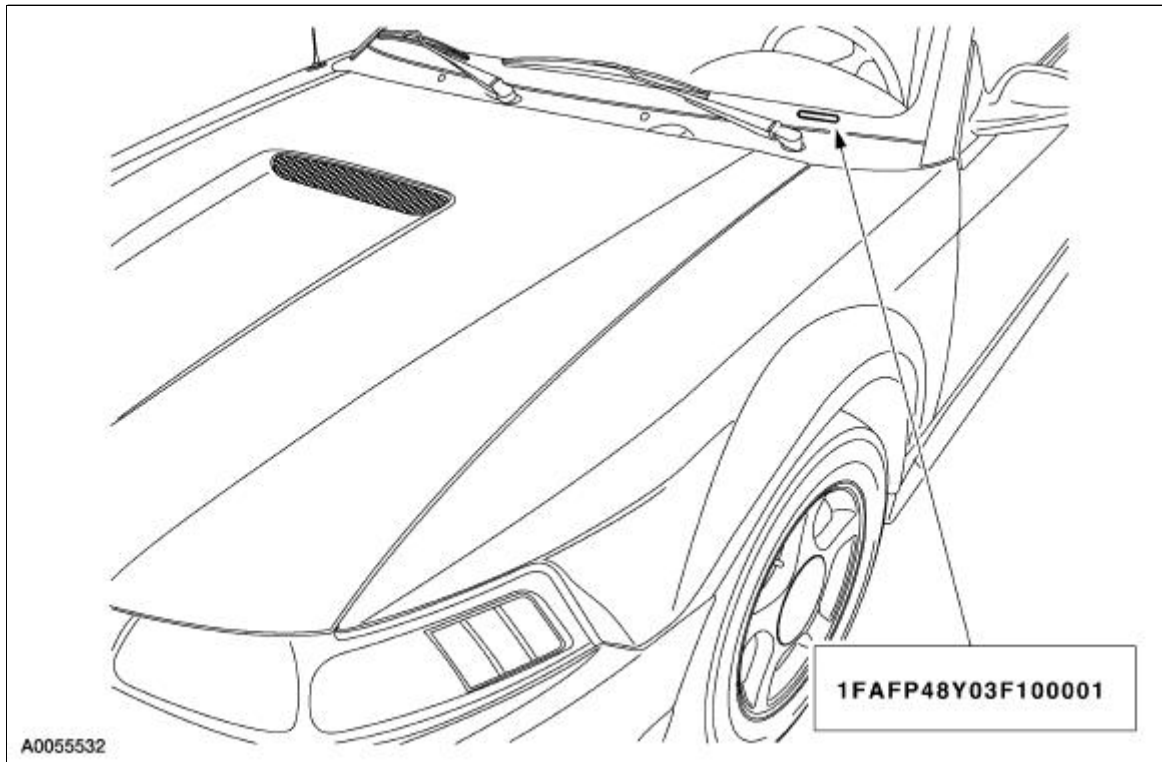
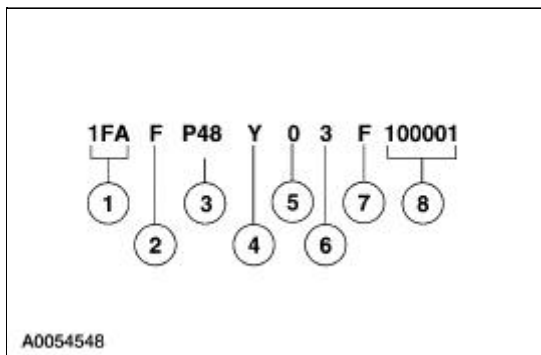


Identification Codes

Vehicle Identification Number (VIN) Locator



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

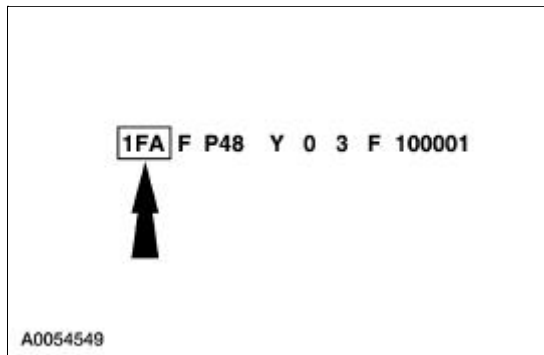


Item	Description
1	World manufacturer identifier (WMI)
2	Restraint type code
3	Line, series, body type (passenger car)
4	Engine code

5	Computer generated VIN check digit
6	Model year code
7	Assembly plant code
8	Production sequence number

Vehicle Identification Number

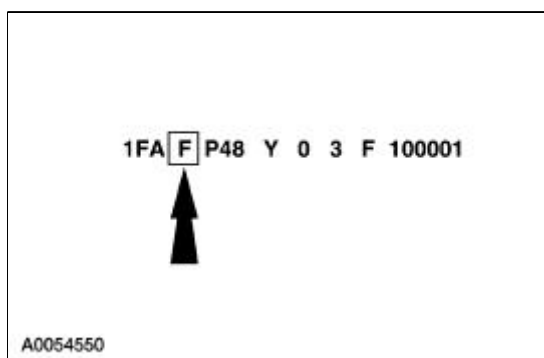
World Manufacturer Identifier (WMI)



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

- 1FA — Ford, USA, passenger car

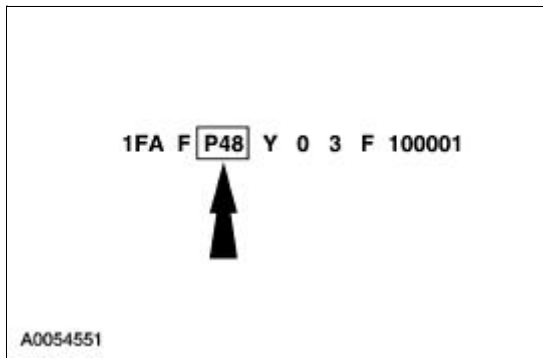
Restraint Type Code



The fourth VIN position is the vehicle restraint system type code.

- F — Active safety belts — all positions, driver and front passenger air bags

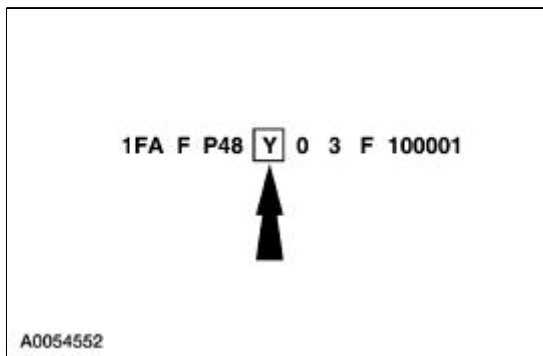
Line, Series and Body Type Code



Positions 5 through 7 indicate vehicle line, series and body type.

- P40 — Two-door coupe
- P42 — Two-door coupe, GT (Mach One available in GT Coupe only)
- P44 — Two-door convertible
- P45 — Two-door convertible, GT
- P48 — Two-door coupe, Cobra
- P49 — Two-door convertible, Cobra

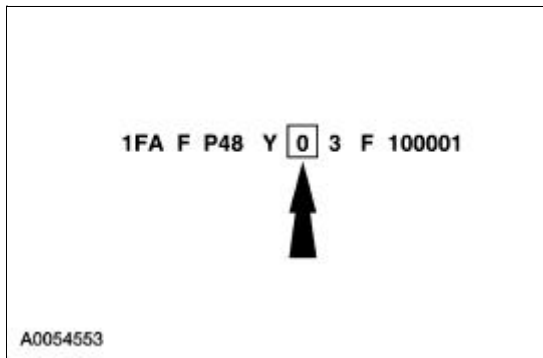
Engine Code



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

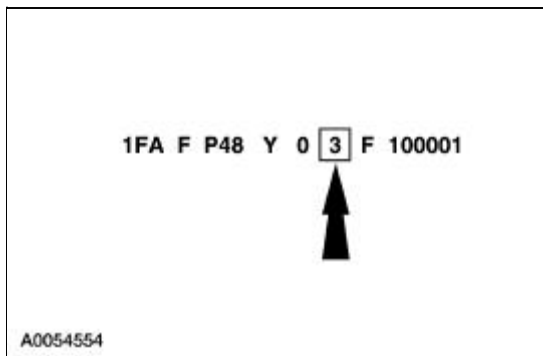
- 4 — 3.8L, OHV, EFI, six cylinder
- R — 4.6L, DOHC, EFI, eight cylinder (Mach One)
- X — 4.6L, SOHC, EFI, eight cylinder
- Y — 4.6L, DOHC, S/C, EFI, eight cylinder (Cobra)

Computer Generated Check Digit



The ninth VIN position is a government assigned, computer-generated check digit code (0-9).

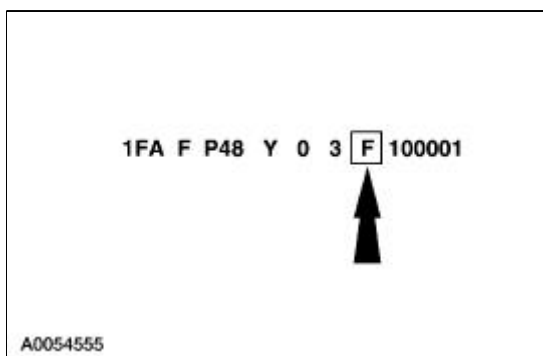
Model Year Code



The tenth VIN position is the model year code.

- 3 — 2003

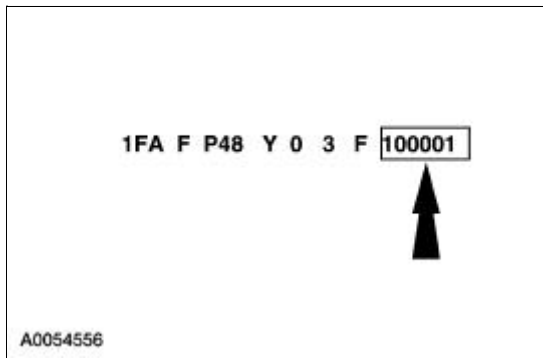
Assembly Plant Code



The eleventh VIN position is the assembly plant code.

- F — Dearborn, Michigan (USA)

Production Sequence Number

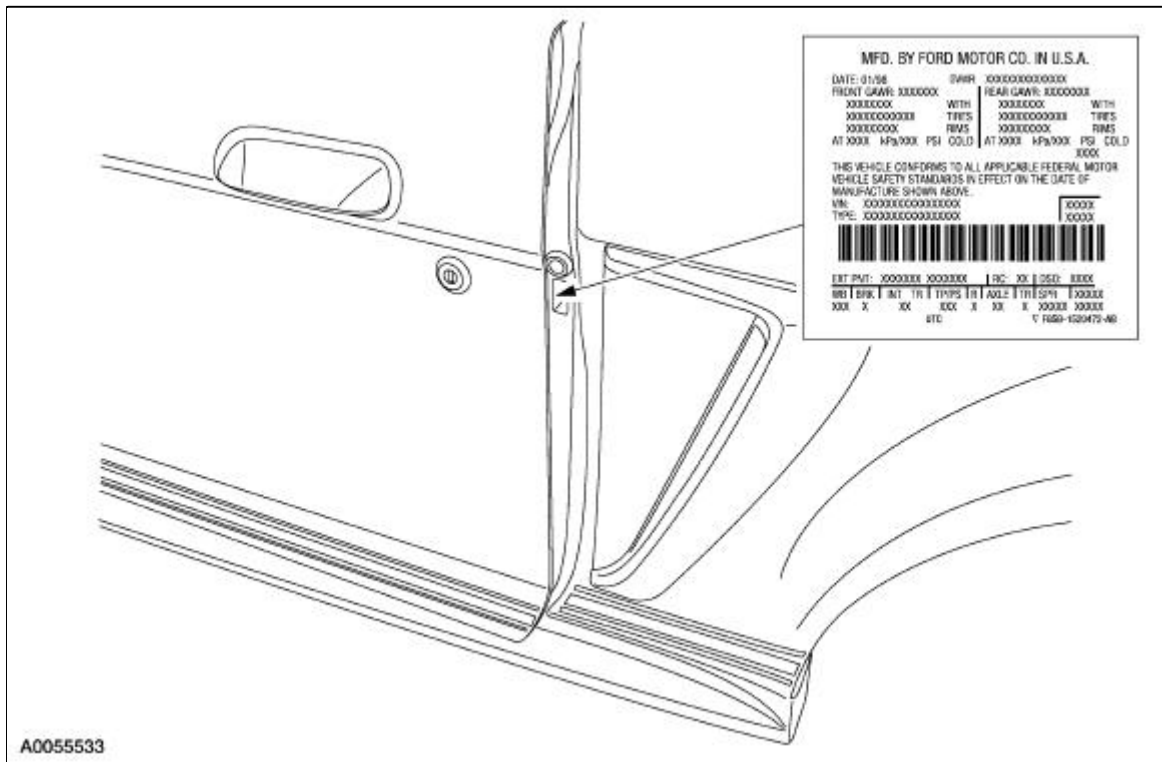


The last six VIN positions are the production sequence number. This number is also used as the vehicle serial and warranty number.

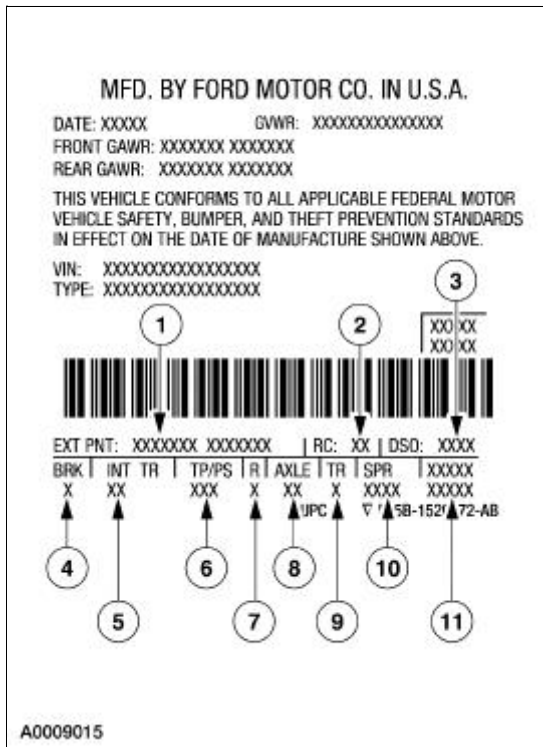
- 100001-599999

Vehicle Certification (VC) Label

Vehicle Certification (VC) Label Locator



The upper portion of the vehicle certification (VC) label contains the manufacturer name, the month and year of manufacture, the certification statement and the VIN. It also includes gross vehicle weight ratings (GVWR). The VC label is located on the left-hand door jamb.



Item	Description
1	Exterior paint color code
2	Region code
3	Special order code (DSO — domestic special order FSO — foreign special order PTO — paint, tire option special order)
4	Brake type code
5	Interior trim code
6	Tape/paint stripe code
7	Radio type code
8	Axle ratio code
9	Transmission code
10	Spring code
11	Powertrain calibration code

Vehicle Certification (VC) Label Reference

Paint Codes


MFD. BY FORD MOTOR CO. IN U.S.A.


DATE: XXXX GVWR: XXXXXXXXXXXXXXXX
FRONT GAWR: XXXXXX XXXXXX
REAR GAWR: XXXXXX XXXXXX

THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR
VEHICLE SAFETY, BUMPER, AND THEFT PREVENTION STANDARDS
IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.

VIN: XXXXXXXXXXXXXXXX
TYPE: XXXXXXXXXXXXXXXX

XXXXX
XXXXX





EXT PNT:		XXXXXXXX	XXXXXXXX	RC:	XX	DSO:	XXXX	
BRK	INT	TR	TP/PS	R	AXLE	TR	SPR	XXXXX
X	XX		XXX	X	XX	X	XXXX	XXXXX

UPC ▽ F85B-1520472-AB

A0009016

The first set of paint code letters/numbers listed indicate the vehicle primary body color. The second set of paint code letters/numbers listed (if applicable) indicate a two-tone or accent body color.

- B7 — Zinc Yellow (clear coat)
- CX — Dark Shadow Gray Metallic
- D3 — Colorado Red (clear coat)
- G2 — Redfire (water based) clear coat
- L2 — True Blue (water based) clear coat
- L5 — Azure Blue (water based) clear coat (Mach One only)
- SN — Sonic Blue (water based) clear coat
- SU — Amazon Green (water based) clear coat
- UA — Ebony (clear coat)
- YN — Silver Metallic (water based) clear coat
- Z1 — Oxford White (clear coat)


Brake Codes

MFD. BY FORD MOTOR CO. IN U.S.A.

DATE: XXXXX GVWR: XXXXXXXXXX
FRONT GAWR: XXXXXX XXXXXX
REAR GAWR: XXXXXX XXXXXX

THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY, BUMPER, AND THEFT PREVENTION STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.


VIN: XXXXXXXXXXXXXXXXXX
TYPE: XXXXXXXXXXXXXXXXXX



EXT PNT: XXXXXXX XXXXXXX | RC: XX | DSO: XXXX

BRK	INT	TR	TP/PS	R	AXLE	TR	SPR	XXXXX
X	XX		XXX	X	XX	X	XXXX	XXXXX

UPC ∇ F85B-1520472-AB



A0009017

The brake type codes are:

- 2 — Four-wheel disc with anti-lock brake system (ABS)
- 3 — Traction control
- 5 — Four-wheel disc with anti-lock brake system (ABS) and traction control


Interior Trim Codes

MFD. BY FORD MOTOR CO. IN U.S.A.

DATE: XXXXX GVWR: XXXXXXXXXX
FRONT GAWR: XXXXXX XXXXXX
REAR GAWR: XXXXXX XXXXXX

THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY, BUMPER, AND THEFT PREVENTION STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.


VIN: XXXXXXXXXXXXXXXXXX
TYPE: XXXXXXXXXXXXXXXXXX



EXT PNT: XXXXXXX XXXXXXX | RC: XX | DSO: XXXX

BRK	INT	TR	TP/PS	R	AXLE	TR	SPR	XXXXX
X	XX		XXX	X	XX	X	XXXX	XXXXX

UPC ∇ F85B-1520472-AB



A0009018

The interior trim codes are listed below. The first letter/number is for the interior fabric. The second letter is for the interior color.

- 9 — Quantum/Rhodes cloth (base coupe)
- A — Link weave cloth (Mach One)
- M — Nudo Leather (Cobra)
- T — Lea cloth with vinyl (base coupe/convertible)
- U — Shadow/Twill cloth (GT)
- X — Lea cloth with vinyl (GT)

The interior trim colors are:

- 2 — Medium Graphite
- 2 — Medium Graphite/Midnight Black (Cobra)
- H — Medium Parchment
- H — Midnight Black/Medium Parchment (Cobra)
- R — Midnight Black/Colorado Red (Cobra)
- W — Midnight Black
- Z — Oxford White

Tape/Paint Stripe Codes


MFD. BY FORD MOTOR CO. IN U.S.A.

DATE: XXXX GVWR: XXXXXXXXXXXXXXXX
FRONT GAWR: XXXXXXX XXXXXXX
REAR GAWR: XXXXXXX XXXXXXX

THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY, BUMPER, AND THEFT PREVENTION STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.

VIN: XXXXXXXXXXXXXXXXXXXX
TYPE: XXXXXXXXXXXXXXXXXXXX

XXXXX
XXXXX




EXT PNT: XXXXXXX XXXXXXX RC: XX DSD: XXXX

BRK	INT	TR	TP/PS	R	AXLE	TR	SPR	XXXXX
X	XX		XXX	X	XX	X	XXXX	XXXXX

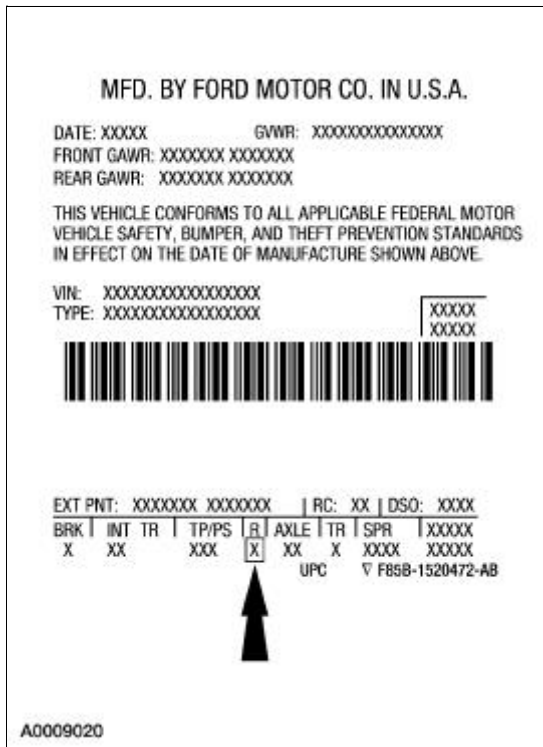
UPC V F85B-1520472-AB

A0009019



- P — White/Gray (tape applique emblem)
- X — Black (hood and body tape stripe) — Mach One

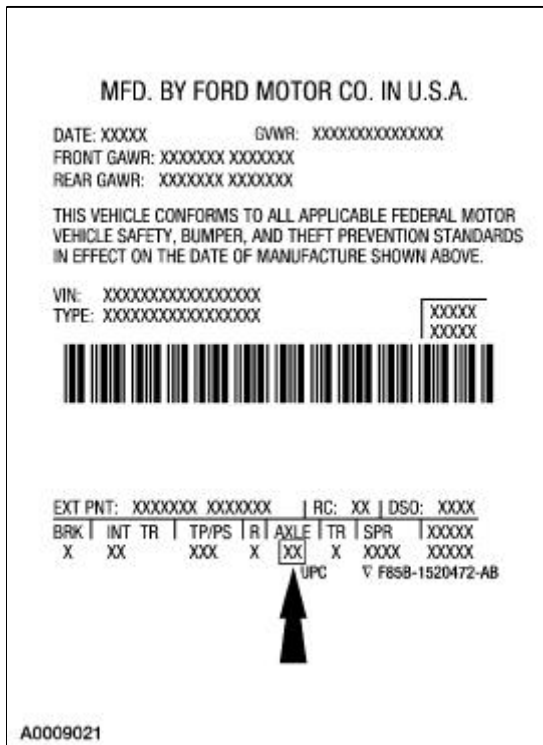
Radio Codes



The radio type codes are:

- 2 — Premium electronic AM/FM stereo with compact disc (CD) player and clock
- 9 — CDX6+, AM/FM stereo with 6-disc compact disc (CD) changer and MACH 460 subwoofer sound system
- Z — AM/FM stereo, dual media (MP3) with compact disc (CD) player

Axle Ratio Codes



The axle ratio is:

- X5 — 3.8L, non-ABS, 3.27 ratio
- Z5 — 3.8L, ABS, 3.27 ratio
- ME — 4.6L, Mach One, 3.55 ratio
- LE — 4.6L, VX, 3.27 ratio
- TE — 3.55 locker (with independent rear suspension) — Cobra

Transmission Codes


MFD. BY FORD MOTOR CO. IN U.S.A.

DATE: XXXXX GVWR: XXXXXXXXXXXXXXXX
FRONT GAWR: XXXXXXX XXXXXXX
REAR GAWR: XXXXXXX XXXXXXX

THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR
VEHICLE SAFETY, BUMPER, AND THEFT PREVENTION STANDARDS
IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.

VIN: XXXXXXXXXXXXXXXXXXXX
TYPE: XXXXXXXXXXXXXXXXXXXX

XXXXX
XXXXX



EXT PNT: XXXXXXX XXXXXXX | RC: XX | DSO: XXXX

BRK	INT	TR	TP/PS	R	AXLE	TR	SPR	XXXXX
X	XX		XXX	X	XX	X	XXXX	XXXXX

UPC ▽ F85B-1520472-AB

A0009022

The transmission code is:

- 5—Five-speed manual (T5OD/TR3150) — base
- B—Six-speed manual (T56), Cobra
- K—Five-speed manual (TR3650), GT
- U—Four-speed automatic (AODE/4R70W)

Spring Codes


MFD. BY FORD MOTOR CO. IN U.S.A.

DATE: XXXX GVWR: XXXXXXXXXXXXXXXX
FRONT GAWR: XXXXXX XXXXXX
REAR GAWR: XXXXXX XXXXXX


THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY, BUMPER, AND THEFT PREVENTION STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.

VIN: XXXXXXXXXXXXXXXXXXXX
TYPE: XXXXXXXXXXXXXXXXXXXX

XXXXX
XXXXX



EXT PNT: XXXXXX XXXXXX		RC: XX	DSO: XXXX
BRK	INT TR	TP/PS	R AXLE
X	XX	XXX	X XX X
			SPR
			XXXXX
			XXXXX
			UPC
			V 15B-1520472-AB



A0009023

The spring code portion of the vehicle certification (VC) label identifies both the front and rear springs. The first letter/number indicates the front spring code. The second letter/number indicates the rear spring code.

- Front springs — base part number — 5310 (RH/LH)
- Rear springs — base part number — 5560 (RH/LH)

Powertrain Calibration Information


MFD. BY FORD MOTOR CO. IN U.S.A.

DATE: XXXX GVWR: XXXXXXXXXXXXXXXX
FRONT GAWR: XXXXXX XXXXXX
REAR GAWR: XXXXXX XXXXXX


THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY, BUMPER, AND THEFT PREVENTION STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.

VIN: XXXXXXXXXXXXXXXXXXXX
TYPE: XXXXXXXXXXXXXXXXXXXX

XXXXX
XXXXX



EXT PNT: XXXXXX XXXXXX		RC: XX	DSO: XXXX
BRK	INT TR	TP/PS	R AXLE
X	XX	XXX	X XX X
			SPR
			XXXXX
			XXXXX
			UPC
			V F85B-152772-AB

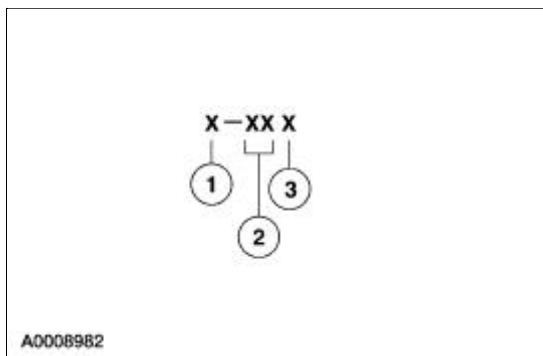


A0009024

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

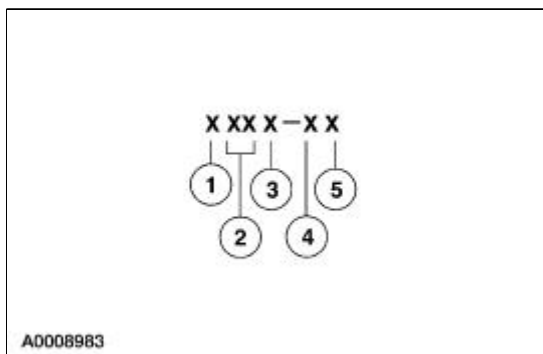
Powertrain calibration information is printed in the lower right corner of the Vehicle Certification Label. Only the base calibration information is printed. Revision levels will not appear, however, this information can be found in the On Line Automotive Service Information System (OASIS). For the current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

Protocol 1



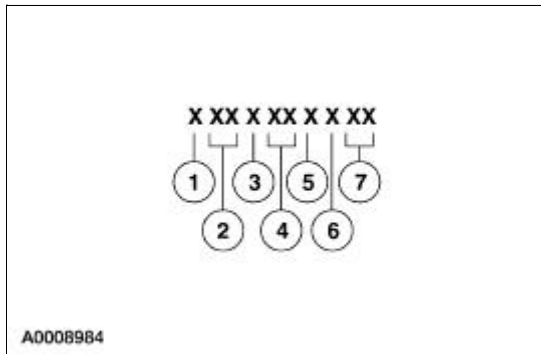
Item	Description
1	Model year (model year in which calibration strategy was first introduced)
2	Engine code
3	Engine revision level

Protocol 2



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

Protocol 3



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

Protocol 3

The following offers a more detailed explanation of the coding strategy used for protocol 3.

Model Year

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

Vehicle Line

- ZE — Mustang

Transmission

- 1 — Automatic transmission
- 2 — Manual transmission

Unique Calibration

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

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

Fleet Code

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

Certification Region

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

Revision Level (not printed on label)

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

Jacking

! **WARNING:** Never run the engine with one wheel off the ground, such as when changing a tire. The wheel still on the ground could cause the vehicle to move.

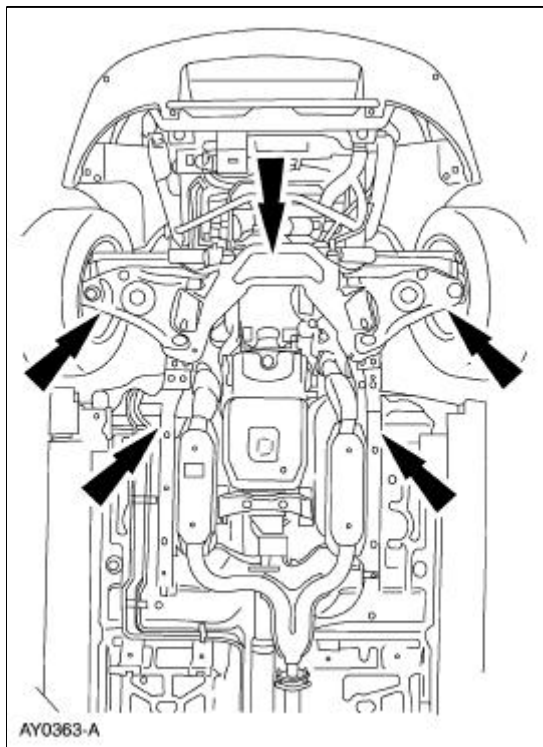
! **CAUTION:** The jack (17080) provided with the vehicle is intended to be used in an emergency for changing a deflated tire. To avoid damage to the vehicle, never use the jack to lift the vehicle for any other purpose. Refer to the Owner Guide when using the jack supplied with the vehicle.

! **CAUTION:** Under no circumstances should the vehicle ever be lifted by the suspension arm brackets, rear stabilizer or differential housing or convertible cross brace. Severe damage to the vehicle could result.

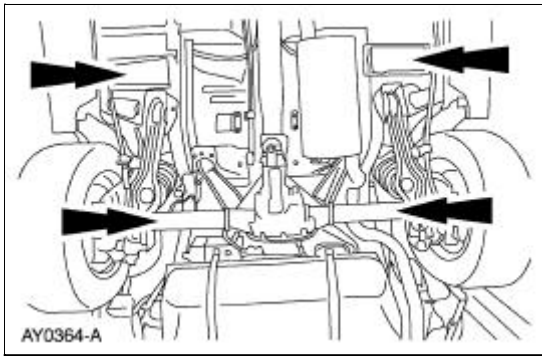
! **CAUTION:** Do not attempt to use jack pressure on either the front bumper (17757) or the rear bumper (17906) of any vehicle. Damage to the bumper covers will occur.

Lift the vehicle using the Jacking Points procedure in this section.

Jacking Points




To lift the front or either side of the front end, position the floor jack under the front frame lift points.



To lift the rear or either side of the rear end, position the floor jack under the rear lift points.

Lifting


 **CAUTION:** Do not allow the lift adapters to contact the steering linkage, suspension arms, stabilizer arms, or to compress the lower suspension arm stabilizer bar insulator (5493). Damage to the suspension, exhaust and steering linkage components may occur if care is not exercised when positioning the hoist adapters prior to lifting the vehicle.

 **CAUTION:** Never use the differential housing as a lift point. Damage to the differential housing and cover may occur.

 **CAUTION:** Do not lift vehicle on rocker panel pinch flange or convertible cross brace. Body damage may occur.

Lift the vehicle using the Lifting Points procedure in this section.

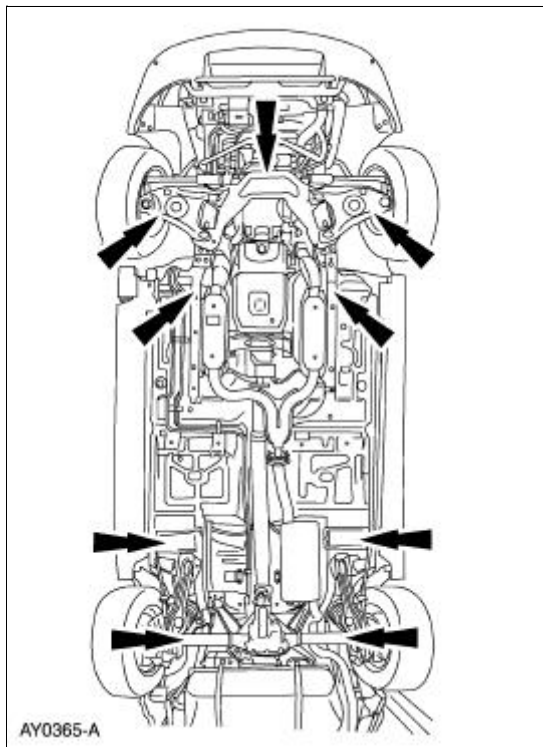
Lifting Points—Drive On Lift

 **CAUTION:** To prevent possible damage to the underbody, do not drive the vehicle onto the drive on lift without first checking for possible interference.

Check for interference between the upright flanges of the hoist rails and the underbody.

If an interference exists, modify the hoist flanges or build up the approach ramps as necessary to provide clearance.

Lifting Points—Frame Contact Lift, Single Post Lift, Two Post Lift



 **CAUTION:** Do not position lift pads under the No. 3 crossmember.

 **CAUTION:** Do not lift vehicle on rocker panel pinch flange or convertible cross brace.
Body damage may occur.

NOTE: Adapters may be necessary to clear vehicle components to lift the vehicle safely. The adapters must be placed at the four designated contact points. Position the adapters so they are center on the adapter contact area.

Lift the vehicle at the applicable lift points.

Maintenance Schedule —Vehicles with Gasoline Engines

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

General Maintenance Information

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

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

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

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

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

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

Special Operating Condition Requirements

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

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

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

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

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

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

When operating in off-road conditions:

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

Checks and Services

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

Maximum Oil Change Interval (Normal Schedule)

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

Maximum Oil Change Interval (Special Operating Conditions)

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

Monthly Checks

Check each of the following items every month:

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

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

Six Month Checks

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

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

Special Checks (Mustang Only)

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

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

Normal Schedule

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

8,000 Km (5,000 Miles)

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

16,000 Km (10,000 Miles)

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

24,000 Km (15,000 Miles)

- Change engine oil and install a new oil filter.

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

32,000 Km (20,000 Miles)

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

40,000 Km (25,000 Miles)

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

48,000 Km (30,000 Miles)

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

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

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

56,000 Km (35,000 Miles)

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

64,000 Km (40,000 Miles)

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

72,000 Km (45,000 Miles)

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

80,000 Km (50,000 Miles)

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

88,000 Km (55,000 Miles)

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

96,000 Km (60,000 Miles)

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

equipped.

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

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

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

104,000 Km (65,000 Miles)

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

112,000 Km (70,000 Miles)

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

120,000 Km (75,000 Miles)

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

128,000 Km (80,000 Miles)

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

136,000 Km (85,000 Miles)

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

144,000 Km (90,000 Miles)

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

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

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

152,000 Km (95,000 Miles)

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

160,000 Km (100,000 Miles)

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

168,000 Km (105,000 Miles)

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

176,000 Km (110,000 Miles)

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

184,000 Km (115,000 Miles)

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

192,000 Km (120,000 Miles)

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

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

200,000 Km (125,000 Miles)

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

208,000 Km (130,000 Miles)

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

216,000 Km (135,000 Miles)

- Change engine oil and install a new oil filter.

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

224,000 Km (140,000 Miles)

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

232,000 Km (145,000 Miles)

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

240,000 Km (150,000 Miles)

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

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

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

Exceptions To Normal Schedule

Yellow Coolant

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

Natural Gas and Propane Vehicles

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

Normal Vehicle Axle Maintenance

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

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

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

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

Police and Taxi Vehicle Axle Maintenance

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

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

Noise, Vibration and Harshness (NVH)

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

Acceptable Noise, Vibration and Harshness

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

Diagnostic Theory

The shortest route to an accurate diagnosis results from:

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

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

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

Glossary of Terms

Acceleration-Light

An increase in speed at less than half throttle.

Acceleration-Medium

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

Acceleration-Heavy

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

Ambient Temperature

The surrounding or prevailing temperature.

Amplitude

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

Backlash

Gear teeth clearance.

Boom

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

Bound Up

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

Brakes Applied

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

Buffet/Buffeting

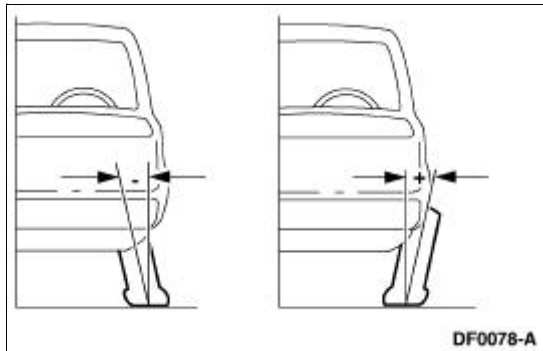
Strong noise fluctuations (less than 1000 Hz) caused by gusting winds. An example would be wind gusts against the side glass.

Buzz

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

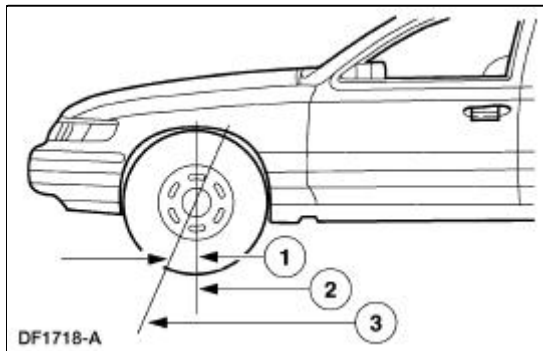
Camber

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



Caster

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



Item	Description
1	Positive caster
2	True vertical
3	Steering axis

Chatter

A pronounced series of rapidly repeating rattling or clicking sounds.

Chirp

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

Chuckle

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

Click

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

Clonk

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

Clunk/Driveline Clunk

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

Coast/Deceleration

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

Coast/Neutral Coast

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

Constant Velocity (CV) Joint

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

Controlled Rear Suspension Height

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

Coupling Shaft

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

CPS

Cycles per second. Same as hertz (Hz).

Cracks

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

Creak

A metallic squeak.

Cruise

Constant speed on level ground; neither accelerating nor decelerating.

Cycle

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

starting point.

Decibel

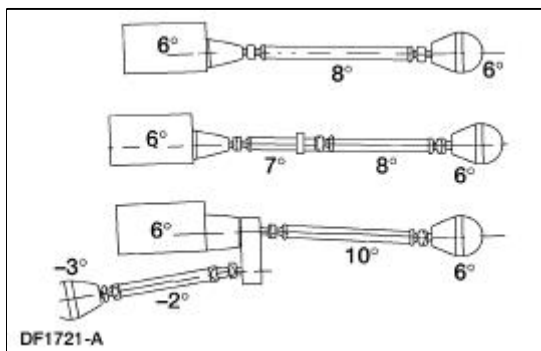
A unit of measurement, referring to sound pressure level, abbreviated dB.

Drive Engine Run-Up (DERU) Test

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

Driveline Angles

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



Driveshaft

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

Drivetrain

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

Drivetrain Damper

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

Drone

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

Drumming

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

Dynamic Balance

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

Engine Imbalance

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

Engine Misfire

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

Engine Shake

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

Flexible Coupling

A flexible joint.

Float

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

Flutter

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

Frequency

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

Gravelly Feel

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

Grind

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

Hiss

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

Hoot

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

Howl

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

Hum

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

Hz

Hertz; a frequency measured in cycles per second.

Imbalance

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

Inboard

Toward the centerline of the vehicle.

Intensity

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

Isolate

To separate the influence of one component to another.

Knock

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

Moan

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

Neutral Engine Run-Up (NERU) Test

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

Neutralize/Normalize

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

Outboard

Away from the centerline of the vehicle.

Ping

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

Pinion Shaft

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

Pitch

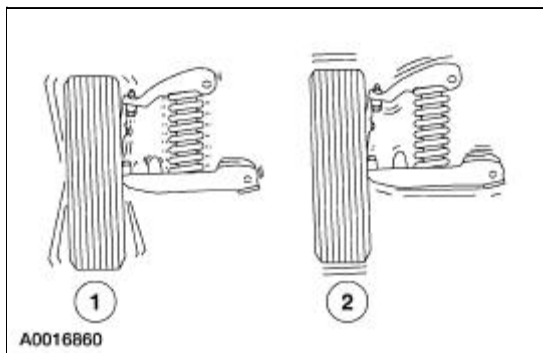
The physical quality of sound that relates to its frequency. Pitch increases as frequency increases and vice versa.

Pumping Feel

A slow, pulsing movement.

Radial/Lateral

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



Item	Description
1	Lateral runout
2	Radial runout

Rattle

A random and momentary or short duration noise.

Ring Gear

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

Road Test

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

Roughness

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

Runout

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

Rustling

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

Shake

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

Shimmy

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

Shudder

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

Slap

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

Slip Yoke/Slip Spline

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

Squeak

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

Squeal

A long-duration, high-pitched noise.

Static Balance

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

Tap

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

Thump

A dull beat caused by two items striking together.

Tick

A rhythmic tap, similar to a clock noise.

Tip-In Moan

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

TIR

The acronym for total indicated runout is TIR.

Tire Deflection

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

Tire Flat Spots

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

Tire Force Vibration

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

Transient

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

Two-Plane Balance

Radial and lateral balance.

Vibration

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

Whine

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

Whistle

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

Wind Noise

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

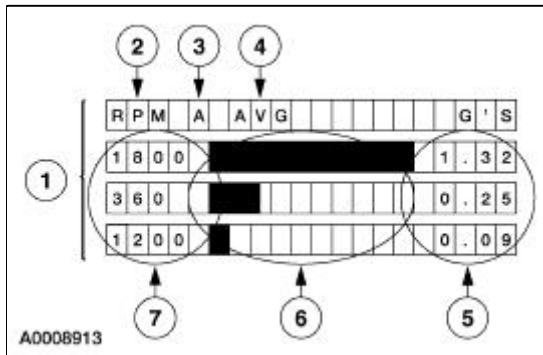
WOT

The acronym for wide open throttle is WOT.

Tools and Techniques

Electronic Vibration Analyzer (EVA)

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



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

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

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

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

Vibrate Software®

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

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

Combination EngineEAR/ChassisEAR

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

EngineEAR Basic Unit

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

Ultrasonic Leak Detector

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

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

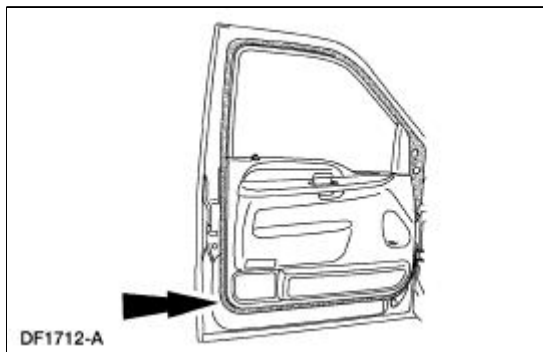
Squeak and Rattle Repair Kit

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

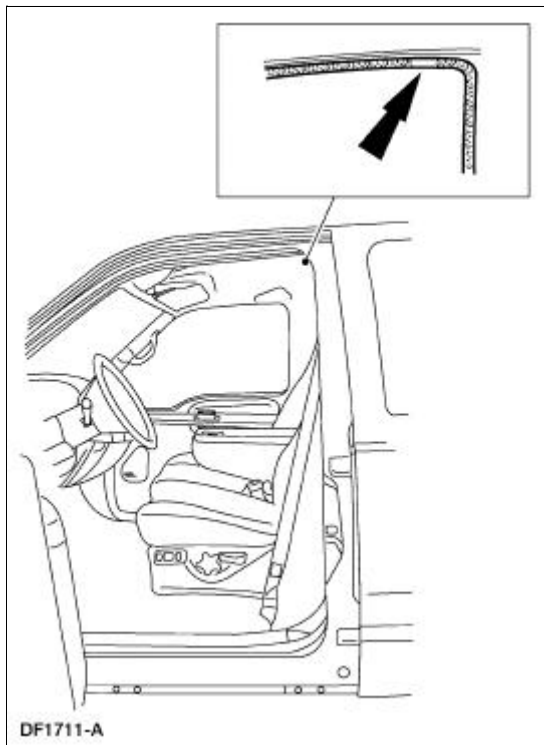
- PVC (soft foam) tape
- Urethane (hard foam) tape
- Flocked (black fuzzy) tape
- UHMW (frosted) tape
- Squeak and rattle oil tube
- Squeak and rattle grease tube

Tracing Powder

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

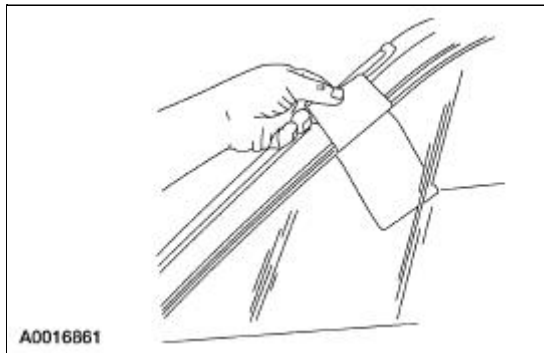


- a. Clean the weatherstrip.
- b. Spray the tracing powder on the mating surface only.
- c. Close the door completely. Do not slam the door.
- d. Open the door. An imprint is made where the weatherstrip contacted the mating surface seal. Gaps or a faint imprint will show where there is poor contact with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







Index Card

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



Noise, Vibration and Harshness (NVH)

Special Tool(s)

 <p>ST2048-A</p>	ChassisEAR 107-R2102 or equivalent
 <p>ST2311-A</p>	Electronic Vibration Analyzer 100-F027 (014-00344) or equivalent
 <p>ST2312-A</p>	EngineEAR 107-R2100 or equivalent
 <p>ST2314-A</p>	Ultrasonic Leak Detector 134-R0135 or equivalent

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

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



"WRITE-UP" JOB AID

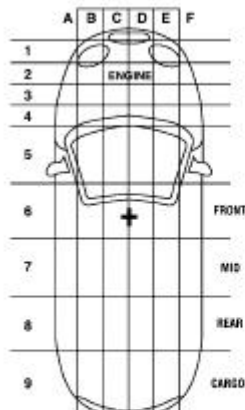
REPAIR ORDER # _____
 CUSTOMER CONCERN # _____

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

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

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

	SEE YES <input type="checkbox"/>		FEEL YES <input type="checkbox"/>
	HEAR YES <input type="checkbox"/>		SMELL YES <input type="checkbox"/>



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

DEALER VERIFICATION	WHAT THE CUSTOMER SAID
SERVICE ADVISOR YES <input type="checkbox"/> NO <input type="checkbox"/>	_____
SHOP FOREMAN YES <input type="checkbox"/> NO <input type="checkbox"/>	_____
SERVICE MANAGER YES <input type="checkbox"/> NO <input type="checkbox"/>	_____
QC MANAGER YES <input type="checkbox"/> NO <input type="checkbox"/>	_____
TECHNICIAN YES <input type="checkbox"/> NO <input type="checkbox"/>	_____
VERIFIED WITH CUSTOMER YES <input type="checkbox"/> NO <input type="checkbox"/>	_____
OASIS SYMPTOM CODE(S)	VIN NUMBER
<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>

NVH DIAGNOSTIC GUIDE

Dealer: _____ Date: _____

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

Owner's Name: _____ Address: _____

Phone No. Home: _____ Work: _____

Vehicle Make: _____ Model: _____ Year: _____

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

OWNER'S DESCRIPTION OF COMPLAINT:

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

How Did Condition Begin? Gradually Suddenly

At What Mileage Did it Occur Or Begin Occuring? _____

Which Driving Conditions Affect The Vehicle?

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

Is Vibration Noticed? If So, Where:

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

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

If So, Describe The Sound :

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

PREDRIVE CHECKS

Tire Condition/Pressure: _____

Vehicle Body Damage? _____

Other: _____

ROAD TEST:

Vibration/Noise Occurs:

Vehicle Speed _____ Accel _____ Vibration/Frequency _____ Hz/RPM
Gear Range _____ Decel/Coast _____ Engine Speed _____ RPM

ENGINE RUN-UP TESTS

Neutral Engine Run-Up (NERU) Yes / No Engine RPM _____ Vibration/Frequency _____ Hz/RPM

Drive Engine Run-Up (DERU) Yes / No Engine RPM _____ Vibration/Frequency _____ Hz/RPM

Drivetrain Run-Up (DTRU) Yes / No Engine RPM _____ Vibration/Frequency _____ Hz/RPM

Indicate Suspected Area of Concern:

- Tire/Wheel/Brakes Engine/Accessory Rear
Driveline/Axle Susp/Steering Right
Body Front Left
Other _____

Equipment Used:

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

WHEEL/TIRE/BRAKES CHECK:Balance Check **Yes / No**

Maximum Runout Allowed:

Wheel: Radial _____ Lateral _____

Tire: Radial _____ Lateral _____

Measured Runout:

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

Lateral: LF _____ LR _____ RF _____ RR _____

Wheel Only Radial: LF _____ LR _____ RF _____ RR _____

Lateral: LF _____ LR _____ RF _____ RR _____

SUSPENSION INSPECTION:Can Cause: Shimmy Clunk Squeak Harshness Suspension Bushings: Loose Worn Missing OK Front Upper Control Arm Stabilizer (sway bar) Rear Lower Control Arm Front Lower Control Arm Rear Upper Control Arm Rear Upper Control Arm

Other _____

Suspension/Steering Components:

Loose Worn Missing OK

Ball Joints Idler Arm Pitman Arm Shock Absorbers F/R Center Link Steering Gear Springs F/R Tie Rod Ends/Sleeve Steering Coupler **DRIVESHAFT CONDITION:**Noise Vibration Balance Weights Missing/Other Visual Defects? **Yes / No**

Maximum Allowable Runout: _____

Actual Runout: Front _____ Middle _____ Rear _____

Two-Piece Driveshaft Runout: Front _____ Rear _____

Middle Support Bearing: Loose Damaged Worn Other _____

Suspect Driveshaft Balanced?

Yes / No**Pinion Angle:** Engine Height: Specification _____ Actual _____

Pinion Angle: Specification _____ Actual _____

Driveline Angle - Truck: Specification _____ Actual _____**ENGINE/ACCESSORY CHECK:**

Visual Inspection for Damage or Grounded Condition:

Powertrain Mounts Fuel Lines A/C Lines Power Steering/Cooler Lines Air Intake Accessories Exhaust Radiator/Condensor **BODY (NOISE/RATTLE)**Indicate Suspected Area of Concern: Doors Windows Dash Panel Other _____

Tests Used to Isolate

NVH Concern: Vacuum/Leak Detector Ultrasonic Leak Detector Tracing Powder Electronic Noise Detector Other _____**ROAD/ENGINE RUN-UP TESTS:** Improved? **Yes / No** Vehicle Acceptable? **Yes / No**

Comments: _____

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Customer Interview

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

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

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

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

Pre-Drive Check

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

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

Preparing for the Road Test

Observe the following when preparing for the road test:

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

Verify the Customer Concern

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

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

Road Test

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

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

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

Slow Acceleration Test

To carry out this test, proceed as follows:

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

Heavy Acceleration Test

To carry out this test, proceed as follows:

- Accelerate hard from 0-64 km/h (0-40 mph).
- Decelerate in a lower gear.
- The concern is torque related if duplicated while carrying out this test.
- Proceed as necessary.

Neutral Coast Down Speed Test

To carry out this test, proceed as follows:

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

Downshift Speed Test

To carry out this test, proceed as follows:

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

Steering Input Test

To carry out this test, proceed as follows:

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

Brake Test

To carry out this test, proceed as follows:

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

Road Test Over Bumps

To carry out this test, proceed as follows:

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


Neutral Engine Run-Up (NERU) Test


To carry out this test, proceed as follows:

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

Drive Engine Run-Up (DERU) Load Test

To carry out this test, proceed as follows:

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


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


Block the front and rear wheels.

- Apply the parking brake and the service brake.
- Install a tachometer.
- Shift the transmission into DRIVE, and increase and decrease the engine rpm between an idle to approximately 2000 rpm. Note the engine rpm and, if possible, determine the vibration frequency.
- Repeat the test in REVERSE.
- If the vibration/noise is duplicated when carrying out this test, inspect the engine and transmission or transaxle mounts.
- If the concern is definitely engine speed-related, carry out the Engine Accessory Test to narrow down the source.
- Proceed as necessary.

Engine Accessory Test

To carry out this test, proceed as follows:

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

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


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

Remove the accessory drive belts.

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

Vehicle Cold Soak Procedure

To carry out this procedure, proceed as follows:

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

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

- GO to [Symptom Chart — Idle Noise/Vibration](#) to assist with the diagnosis.

6: Check OASIS/TSBs/Repair History

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

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

7: Diagnostic Procedure

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

- Verify the "symptom".
- Determine which "system(s)" can cause the "symptom".
 - If a vibration concern is vehicle speed related, the tire and wheel rpm/frequency or driveshaft frequency should be calculated.
 - If a vibration concern is engine speed related, the engine, engine accessory or engine firing frequencies should be calculated.

- After determining the "system", use the diagnostic tools to identify the worn or damaged "components".
- After identifying the "components", try to find the "cause" of the failure.

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

NVH Condition and Symptom Categories

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

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

Operating Condition—Vehicle is Not Moving

1. Static operation
 - Noise occurs during component/system functioning. GO to [Symptom Chart — Squeak and Rattle](#) .
2. While cranking
 1. Grinding or whine, differential ring gear or starter motor pinion noise. GO to [Symptom Chart — Engine Noise/Vibration](#) .
 2. Rattle. Exhaust hanger, exhaust heat shield or A/C line noise. GO to [Symptom Chart — Squeak and Rattle](#) .
 3. Vibration. Acceptable condition.
3. At idle
 - Idle noise. GO to [Symptom Chart — Idle Noise/Vibration](#) .
 - Idle vibration or shake. GO to [Symptom Chart — Idle Noise/Vibration](#) .
4. During Gear Selection
 1. Vehicle parked on a steep incline. Acceptable noise.
 2. Vehicle parked on a flat surface. GO to [Symptom Chart — Driveline Noise/Vibration](#) .
 3. Vehicle with a manual transmission. GO to [Symptom Chart — Transmission \(Manual\) and Transfer Case Noise/Vibration](#) .

Operating Condition—Vehicle is Moving

1. Depends more on how the vehicle is operated
 1. Speed related
 - Related to vehicle speed
 - Pitch increases with vehicle speed. GO to [Symptom Chart — Tire Noise/Vibration](#) .
 - Noise occurs at specific vehicle speed. A high-pitched noise (whine). GO to [Symptom Chart — Driveline Noise/Vibration](#) .

- Loudness proportional to vehicle speed. Low-frequency noise at high speeds, noise and loudness increase with speed. GO to [Symptom Chart — Driveline Noise/Vibration](#) .
 - A low-pitched noise (drumming). GO to [Symptom Chart — Engine Noise/Vibration](#) .
 - Vibration occurs at a particular speed (mph) regardless of acceleration or deceleration. GO to [Symptom Chart — Tire Noise/Vibration](#) .
 - Noise varies with wind/vehicle speed and direction. GO to [Symptom Chart — Air Leak and Wind Noise](#) .
 - Related to engine speed.
 - Noise varies with engine rpm. GO to [Symptom Chart — Engine Noise/Vibration](#) .
 - Vibration occurs at a particular speed (mph) regardless of engine speed (rpm).
2. Acceleration
- Wide open throttle (WOT)
 - Engine induced contact between components. Inspect and repair as necessary.
 - Noise is continuous throughout WOT. Exhaust system or engine ground out. GO to [Symptom Chart — Engine Noise/Vibration](#) .
 - Light/moderate acceleration
 - Tip-in moan. Engine/exhaust noise. GO to [Symptom Chart — Engine Noise/Vibration](#) .
 - Knock-type noise. GO to [Symptom Chart — Engine Noise/Vibration](#) .
 - Driveline shudder. GO to [Symptom Chart — Driveline Noise/Vibration](#) .
 - Engine vibration. GO to [Symptom Chart — Engine Noise/Vibration](#) .
3. Turning noise. GO to [Symptom Chart — Steering Noise/Vibration](#) .
4. Braking
- Clicking sound is signaling ABS is active. Acceptable ABS sound.
 - A continuous grinding/squeal. GO to [Symptom Chart — Brake Noise/Vibration](#) .
 - Brake vibration/shudder. GO to [Symptom Chart — Brake Noise/Vibration](#) .
5. Clutching
- A noise occurring during clutch operation. GO to [Symptom Chart — Transmission \(Manual\) and Transfer Case Noise/Vibration](#) .
 - Vibration. GO to [Symptom Chart — Transmission \(Manual\) and Transfer Case Noise/Vibration](#) .
6. Shifting
- Noise or vibration condition related to the transmission (automatic). GO to [Symptom Chart — Transmission \(Automatic\) Noise/Vibration](#) .
 - Noise or vibration related to the transmission (manual). GO to [Symptom Chart — Transmission \(Manual\) and Transfer Case Noise/Vibration](#) .
7. Engaged in four-wheel drive. GO to [Symptom Chart — Transmission \(Manual\) and Transfer Case Noise/Vibration](#) .
8. Cruising speeds
- Accelerator pedal vibration. GO to [Symptom Chart — Engine Noise/Vibration](#) .
 - Driveline vibration. GO to [Symptom Chart — Driveline Noise/Vibration](#) .
 - A shimmy or shake. GO to [Symptom Chart — Tire Noise/Vibration](#) .
9. Driving at low/medium speeds

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

Symptom Charts

Symptom Chart — Air Leak and Wind Noise

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● Air leak around door perimeter 	<ul style="list-style-type: none"> ● Loose fit seal. ● Seal installed incorrectly. ● Door misaligned. ● Scuff plate installed incorrectly. ● Seal or seal push pins damaged. 	<ul style="list-style-type: none"> ● PINCH the seal carrier to improve retention on the seal flange. ● REINSTALL the seal. ● REALIGN the door. CHECK door gaps and fit in the door opening and ADJUST as necessary. ● REINSTALL the scuff plate. ● INSTALL a new seal.
<ul style="list-style-type: none"> ● Air leak around glass run 	<ul style="list-style-type: none"> ● Door glass misaligned. ● Glass run installed incorrectly. ● Leak path behind glass run. ● Glass run channel spread wide. ● Blow-out clip bent or contacting door glass. ● Glass run damaged. 	<ul style="list-style-type: none"> ● ADJUST the door glass. ● ADJUST the glass run. INSERT foam in the glass run carrier. ● INSTALL foam rope behind the glass run. ● PINCH the glass run channel to reduce the size of the opening. ● ADJUST the blow-out clip or INSTALL a new glass run/blow-out clip molding assembly. ● INSTALL a new glass run.
<ul style="list-style-type: none"> ● Air leak at inner belt line 	<ul style="list-style-type: none"> ● Belt line seal installed incorrectly on flange. ● Belt line seal integrated with door trim installed incorrectly (no glass contact). 	<ul style="list-style-type: none"> ● ADJUST the seal. (Do not bend the flange.) ● REINSTALL the door trim.

	<ul style="list-style-type: none"> ● No contact with side glass. ● No contact with glass runs at both ends of belt line seal. ● Belt line seal damaged. 	<ul style="list-style-type: none"> ● ADJUST the door glass. ● ADJUST the belt line seal or ADD foam at the seal ends. ● INSTALL a new seal.
<ul style="list-style-type: none"> ● Air leak at outer belt line 	<ul style="list-style-type: none"> ● Belt line seal installed incorrectly on flange (no glass contact). ● Belt line seal does not contact the glass. ● No contact with glass runs at both ends of belt line seal. ● Belt line seal damaged. 	<ul style="list-style-type: none"> ● ADJUST the seal. ● ADJUST the door glass. ● ADJUST the belt line seal/ADD foam at the seal ends. ● INSTALL a new seal.
<ul style="list-style-type: none"> ● Draft at inner door handle/speaker opening 	<ul style="list-style-type: none"> ● Hole in watershield. ● Watershield misaligned. ● Exterior door handle seal misaligned/damaged. 	<ul style="list-style-type: none"> ● SEAL the hole with a suitable tape. ● REALIGN the watershield. INSTALL a new watershield if the pressure sensitive adhesive fails. ● REALIGN or INSTALL a new seal as necessary.
<ul style="list-style-type: none"> ● Wind noise from side view mirror 	<ul style="list-style-type: none"> ● Outside mirror housing misaligned. ● Mirror sail gasket folded/misaligned. ● Mirror housing trim cap installed incorrectly. ● Air leak through mirror housing hinge. ● Inner sail trim installed incorrectly. ● Inner sail gasket/barrier installed incorrectly. ● Air path through wiring bundle/fastener access holes. ● Exposed fastener access hole on mirror housing/sail. 	<ul style="list-style-type: none"> ● REALIGN with the edges shingled correctly and no gaps. ● REINSTALL with the gasket unfolded and aligned correctly. ● REINSTALL with the edges shingled to the air flow. ● Fully ENGAGE the mirror into its operating position/USE foam to block the air path through the hinge. ● REINSTALL the sail trim/ADJUST the door trim. ● REINSTALL the trim cover with the gasket/barrier aligned correctly. ● BLOCK the air path(s) with foam/tape. ● INSTALL a new cap if it is missing.
<ul style="list-style-type: none"> ● Air leak around perimeter of fixed 	<ul style="list-style-type: none"> ● Gaps in the sealant bead. 	<ul style="list-style-type: none"> ● APPLY approved sealant.

glass	<ul style="list-style-type: none"> ● Air traveling up windshield molding along A-pillar. ● Windshield/backlite misaligned or not installed correctly. ● Rear hood seal at base of windshield misaligned/damaged. 	<ul style="list-style-type: none"> ● INSTALL foam rope the full length of the A-pillar. ● REINSTALL the windshield/backlite. ● REALIGN or INSTALL a new seal as necessary.
<ul style="list-style-type: none"> ● Air leak at cowl 	<ul style="list-style-type: none"> ● Cowl gasket misaligned/damaged. 	<ul style="list-style-type: none"> ● REALIGN or INSTALL a new seal as necessary.
<ul style="list-style-type: none"> ● Air leak around liftgate perimeter 	<ul style="list-style-type: none"> ● Loose fit seal. ● Seal misaligned. ● Liftgate misaligned. ● Scuff plate misaligned. ● Seal or seal push pins damaged. 	<ul style="list-style-type: none"> ● PINCH the seal carrier to improve retention on the seal flange or INSERT foam in the carrier. ● REINSTALL the seal. ● REALIGN the liftgate. CHECK the liftgate fit in the body opening and ADJUST as necessary. ● REINSTALL the scuff plate. ● INSTALL a new seal.
<ul style="list-style-type: none"> ● Air leak around the liftgate flip window perimeter 	<ul style="list-style-type: none"> ● Loose fit seal. ● Seal misaligned. ● Glass misaligned. ● Seal damaged. 	<ul style="list-style-type: none"> ● PINCH the seal carrier to improve the retention to the seal flange. ● REINSTALL the seal. ● REALIGN the glass. ● INSTALL a new seal.
<ul style="list-style-type: none"> ● Wind noise from antenna 	<ul style="list-style-type: none"> ● Shape of antenna. ● Air leak around antenna cable access hole. 	<ul style="list-style-type: none"> ● INSTALL an antenna boot or a spiral antenna. ● INSPECT the antenna access hole grommet. REPAIR as necessary.
<ul style="list-style-type: none"> ● Air leak from closed roof opening panel 	<ul style="list-style-type: none"> ● Seal installed incorrectly. ● Roof opening panel glass/door misaligned. ● Roof opening panel damaged. 	<ul style="list-style-type: none"> ● REINSTALL the seal. ● REALIGN the roof opening panel glass/door. ● INSTALL a new roof opening panel.
<ul style="list-style-type: none"> ● Buffeting from an open roof opening panel 	<ul style="list-style-type: none"> ● Wind deflector inoperative/damaged. ● Wind deflector height incorrect. 	<ul style="list-style-type: none"> ● REPAIR or INSTALL a new wind deflector as necessary. ● ADJUST the wind deflector higher.
<ul style="list-style-type: none"> ● Wind noise created by airflow over or behind body panels 	<ul style="list-style-type: none"> ● Fender splash shield misaligned. 	<ul style="list-style-type: none"> ● REALIGN the fender splash shield.

	<ul style="list-style-type: none"> ● Body panel misaligned (exposed edge). ● Hood misaligned (front margin). ● Front grille edge noise. 	<ul style="list-style-type: none"> ● REALIGN the appropriate body panel. ● CHECK hood gaps and fit. ADJUST the hood as necessary. ● APPLY foam in the hollow areas behind the louvers.
<ul style="list-style-type: none"> ● Wind noise created by grille opening panel 	<ul style="list-style-type: none"> ● Grille relationship to leading edge on hood. ● Sharp edges due to material imperfections. 	<ul style="list-style-type: none"> ● ADJUST the grille opening panel forward to eliminate wind noise. ● REMOVE the sharp edges (no damage to visible surface).
<ul style="list-style-type: none"> ● Wind noise from air extractor 	<ul style="list-style-type: none"> ● Air extractor housing seated incorrectly. ● Air extractor housing or flaps damaged. 	<ul style="list-style-type: none"> ● REINSTALL the air extractor housing. ● INSTALL a new air extractor.
<ul style="list-style-type: none"> ● Air leak at top of A-pillar — vehicles with a convertible top 	<ul style="list-style-type: none"> ● Seal at windshield header installed incorrectly. ● Seal pinched. ● Gap between side rail and header seal at A-pillar. 	<ul style="list-style-type: none"> ● REINSTALL the seal. ● FILL the seal with foam to reshape it. ● ADJUST the J-hook/vinyl top.
<ul style="list-style-type: none"> ● Air leak at rear quarter glass (division bar) — vehicles with a convertible top 	<ul style="list-style-type: none"> ● No contact between front side glass and quarter glass division bar. 	<ul style="list-style-type: none"> ● ADJUST the front side glass regulator and the rear quarter glass regulator.
<ul style="list-style-type: none"> ● Air leak or wind noise from top of side glass — vehicles with a convertible top 	<ul style="list-style-type: none"> ● Gap between side rail and vinyl top. ● Seal at windshield header installed incorrectly. ● Seal damaged between side rail and vinyl top. ● Vinyl top damaged. 	<ul style="list-style-type: none"> ● ADD additional foam tape to seal between the side rail and the vinyl top. ● REINSTALL the seal. ● INSTALL a new seal. ● INSPECT the vinyl top. INSTALL a new vinyl top as necessary.
<ul style="list-style-type: none"> ● Air leak or wind noise at windshield header — vehicles with a convertible top 	<ul style="list-style-type: none"> ● Vinyl top not flush with header. ● Seal at windshield header installed incorrectly. ● Header seal not flush 	<ul style="list-style-type: none"> ● ADJUST the J-hook to lower the top to achieve a flush condition. ● REINSTALL the seal. ● REINSTALL the seal.

	with header.	
<ul style="list-style-type: none"> ● Convertible top flapping with the top up 	<ul style="list-style-type: none"> ● Vinyl top contacting interior headliner. 	<ul style="list-style-type: none"> ● Working from front to back, INSTALL a 6.35 mm (0.25 in) foam sheet between the headliner and the vinyl top at the suspected area. Allow a clearance of 50 mm (2 in) - 75 mm (3 in) away from the roof bows and the side rails.
<ul style="list-style-type: none"> ● Noise from roof rack 	<ul style="list-style-type: none"> ● Roof rack rails or crossbars loose. ● Roof rack fasteners missing. ● Roof rack crossbars installed backward. ● Roof rack rub strips partially lifting from roof. ● Roof rack gaskets loose or misaligned. 	<ul style="list-style-type: none"> ● TIGHTEN the fasteners. ● INSTALL the approved fasteners. ● REINSTALL the crossbars. ● REAPPLY adhesive or fasteners or INSTALL new rub strips as necessary. ● REINSTALL the gasket.
<ul style="list-style-type: none"> ● Wind noise from bug shield/exterior windshield sun visor 	<ul style="list-style-type: none"> ● Turbulence created by location and shape. 	<ul style="list-style-type: none"> ● REMOVE per customer direction if it is a dealer installed option.

Symptom Chart—Brake Noise/Vibration

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● Rattling noise 	<ul style="list-style-type: none"> ● Caliper mounting bolts loose. ● Damaged or worn caliper pins or retainers. ● Missing or damaged anti-rattle clips or springs. ● Loose brake disc shield. 	<ul style="list-style-type: none"> ● CHECK the caliper bolts. TIGHTEN to specifications. REFER to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes. ● CHECK the caliper pins and retainers for lubrication and correct fit. LUBRICATE or INSTALL new components as necessary. ● CHECK the brake pads for missing clips or broken springs. INSTALL new components as necessary. REFER to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes. ● TIGHTEN the brake disc shield bolts to specification. REFER to Section 206-03.
<ul style="list-style-type: none"> ● Clicking noise—with brakes applied with ABS brakes 	<ul style="list-style-type: none"> ● ABS hydraulic control unit. 	<ul style="list-style-type: none"> ● Acceptable condition.
<ul style="list-style-type: none"> ● Squealing noise— 	<ul style="list-style-type: none"> ● Disc brake 	<ul style="list-style-type: none"> ● Acceptable condition.

occurs on first (morning) brake application	pads.	Caused by humidity and low disc brake pad temperature.
<ul style="list-style-type: none"> ● Squealing noise—a continuous squeal 	<ul style="list-style-type: none"> ● Disc brake pads or linings worn below minimum thickness. 	<ul style="list-style-type: none"> ● INSTALL new disc brake pads. REFER to Section 206-03 for front disc brake pads or Section 206-04 for rear disc brake pads.
<ul style="list-style-type: none"> ● Squealing noise—an intermittent squeal brought on by cold, heat, water, mud or snow 	<ul style="list-style-type: none"> ● Disc brake pad. 	<ul style="list-style-type: none"> ● Acceptable condition.
<ul style="list-style-type: none"> ● Groaning noise—occurs at low speeds with brake lightly applied (creeping) 	<ul style="list-style-type: none"> ● Disc brake pads. 	<ul style="list-style-type: none"> ● Acceptable condition.
<ul style="list-style-type: none"> ● Grinding noise—continuous 	<ul style="list-style-type: none"> ● Disc brake pads or linings worn below minimum thickness. 	<ul style="list-style-type: none"> ● INSPECT the disc brake pads, brake discs and attaching hardware for damage. REPAIR or INSTALL new components as necessary. REFER to Section 206-03 for front disc brakes and Section 206-04 for rear disc brakes.
<ul style="list-style-type: none"> ● Moaning noise 	<ul style="list-style-type: none"> ● Brake linings contaminated with grease or oil. 	<ul style="list-style-type: none"> ● INSPECT the brake pads and shoes for contamination. REPAIR or INSTALL new components as necessary. REFER to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.
<ul style="list-style-type: none"> ● Brake vibration/shudder—occurs when brakes are applied 	<ul style="list-style-type: none"> ● Uneven disc or drum wear. ● Uneven disc brake pad or lining transfer. ● Suspension components. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test A.
<ul style="list-style-type: none"> ● Brake vibration/shudder—occurs when the brake pedal is released 	<ul style="list-style-type: none"> ● Brake drag. 	<ul style="list-style-type: none"> ● INSPECT the disc brake pads or linings for premature wear. REPAIR or INSTALL a new caliper or wheel cylinder as necessary. REFER to Section 206-03 for front disc brakes and Section 206-04 for rear disc brakes.

Symptom Chart—Driveline Noise/Vibration

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● Axle howling or whine—front or rear axle 	<ul style="list-style-type: none"> ● Axle lubricant low. ● Axle housing 	<ul style="list-style-type: none"> ● CHECK the lubricant level. FILL the axle to specification. ● INSPECT the axle housing

	<p>damage.</p> <ul style="list-style-type: none"> ● Damaged or worn wheel bearings or axle bearings. ● Damaged or worn differential ring and pinion. ● Damaged or worn differential side or pinion bearings. ● Damaged or worn differential side gears and pinion gears. 	<p>for damage. REPAIR or INSTALL a new axle as necessary. REFER to Section 205-02A for Ford 7.5 rear axles or Section 205-02B for Ford 8.8 integral axles.</p> <ul style="list-style-type: none"> ● CHECK for abnormal wheel bearing play or roughness. REFER to Wheel Bearing Check in this section. ADJUST or INSTALL new wheel bearings as necessary. ● INSPECT the ring and pinion ring for abnormal wear patterns or broken teeth. INSTALL a new ring and pinion as necessary. REFER to Section 205-02A for Ford 7.5 rear axles or Section 205-02B for Ford 8.8 integral axles. ● CHECK for abnormal bearing play or roughness. INSTALL new bearings as necessary. ● DISASSEMBLE the differential carrier. INSPECT the side and pinion gears for abnormal wear patterns or broken teeth. INSTALL new gears as necessary. REFER to Section 205-02A for Ford 7.5 rear axles or Section 205-02B for Ford 8.8 integral axles.
<ul style="list-style-type: none"> ● Driveline clunk—loud clunk when shifting from reverse to drive 	<ul style="list-style-type: none"> ● Incorrect axle lubricant level. ● Excessive backlash in the axle or transmission. ● Damaged or worn pinion bearings. ● Damaged or worn universal joints (U-joints). ● Loose suspension components. 	<ul style="list-style-type: none"> ● CHECK the lubricant level. FILL the axle to specification. ● CARRY OUT a total backlash check. REFER to Section 205-00. ● CHECK for abnormal bearing play or roughness. INSTALL new bearings as necessary. REFER to Section 205-02A for Ford 7.5 rear axles or Section 205-02B for Ford 8.8 integral axles. ● INSPECT the U-joints for wear or damage. INSTALL new U-joints as necessary. REFER to Section 205-01. ● INSPECT the suspension for damage or wear. REPAIR or INSTALL new

	<ul style="list-style-type: none"> ● Broken powertrain mounts. ● Idle speed too high. 	<p>components as necessary.</p> <ul style="list-style-type: none"> ● INSPECT the powertrain mounts. INSTALL new mounts as necessary. REFER to Section 303-01A for 3.8L engines or Section 303-01B for 4.6L (2V) engines. ● CHECK for the correct idle speed.
<ul style="list-style-type: none"> ● Driveline clunk—occurs as the vehicle starts to move forward following a stop 	<ul style="list-style-type: none"> ● Worn or galled driveshaft slip-yoke splines. ● Worn or galled driveshaft and coupling shaft splines. ● Loose rear leaf spring U-bolts. 	<ul style="list-style-type: none"> ● CLEAN and INSPECT the splines of the yoke for a worn or galled condition. INSTALL a new yoke as necessary. REFER to Section 205-01. ● CLEAN and INSPECT the splines of the driveshaft and coupling shaft for a worn or galled condition. INSTALL a new driveshaft assembly as necessary. REFER to Section 205-01. ● CHECK the U-bolts for loose nuts. TIGHTEN to specification. REFER to Section 204-02.
<ul style="list-style-type: none"> ● Driveline clunk (FWD vehicles)—occurs during acceleration or from cruise to coast/deceleration 	<ul style="list-style-type: none"> ● Damaged or worn inboard constant velocity (CV) joint. 	<ul style="list-style-type: none"> ● INSPECT the inboard CV joint and boot. REPAIR or INSTALL a new CV joint as necessary.
<ul style="list-style-type: none"> ● Driveline clunk (4WD vehicles)—occurs during shift-on-the-fly engagement 	<ul style="list-style-type: none"> ● Clutch relay. ● Shift motor. ● Transfer case. ● GEM. 	<ul style="list-style-type: none"> ● CHECK the 4WD engagement system. REPAIR or INSTALL new components as necessary.
<ul style="list-style-type: none"> ● Clicking, popping or grinding—occurs while vehicle is turning 	<ul style="list-style-type: none"> ● Inadequate or contaminated lubrication in the (CV) joints. ● Another component contacting the halfshaft. ● Brake components. ● Steering components. ● Suspension components. 	<ul style="list-style-type: none"> ● CHECK the CV boots and joints for wear or damage. REPAIR or INSTALL new components as necessary. ● CHECK the halfshafts and the area around the halfshafts. REPAIR as necessary. ● INSPECT the front brakes for wear or damage. REPAIR as necessary. REFER to Section 206-03. ● INSPECT the drag link, inner and outer tie-rods or idler arm for wear or damage. REPAIR as necessary. REFER to Section 211-02. ● INSPECT the upper and lower ball joints for wear or damage. REPAIR as necessary. REFER to

	<ul style="list-style-type: none"> ● Damaged or worn wheel bearings 	<p>Section 204-01.</p> <ul style="list-style-type: none"> ● CHECK for abnormal wheel bearing play or roughness. Refer to Wheel Bearing Check in this section. ADJUST or INSTALL new wheel bearings as necessary.
<ul style="list-style-type: none"> ● Clicking or snapping—occurs when accelerating around a corner 	<ul style="list-style-type: none"> ● Damaged or worn outboard CV joint. 	<ul style="list-style-type: none"> ● INSPECT the outboard CV joint and boot. REPAIR or INSTALL a new CV joint as necessary.
<ul style="list-style-type: none"> ● High pitched chattering—noise from the rear axle when the vehicle is turning 	<ul style="list-style-type: none"> ● Incorrect or contaminated lubricant. ● Damaged or worn differential (differential side gears and pinion gears). 	<ul style="list-style-type: none"> ● CHECK the vehicle by driving in tight circles (5 clockwise, 5 counterclockwise). FLUSH and REFILL with the specified rear axle lubricant and friction modifier as necessary. ● DISASSEMBLE the differential assembly. INSPECT the differential case, pin and gears for wear or damage. REPAIR or INSTALL a new differential as necessary. REFER to Section 205-02A for Ford 7.5 rear axles or Section 205-02B for Ford 8.8 integral axles.
<ul style="list-style-type: none"> ● Buzz—buzzing noise is the same at cruise or coast/deceleration 	<ul style="list-style-type: none"> ● Damaged or worn tires. ● Incorrect driveline angles. 	<ul style="list-style-type: none"> ● CHECK for abnormal tire wear or damage. INSTALL a new tire as necessary. REFER to Section 204-04. ● CHECK for correct driveline angles. REPAIR as necessary. REFER to Section 205-00.
<ul style="list-style-type: none"> ● Rumble or boom—noise occurs at coast/deceleration, usually driveshaft speed related and noticeable over a wide range of speeds 	<ul style="list-style-type: none"> ● Driveshaft is out-of-balance. ● U-joints binding or seized. ● Excessive pinion flange runout. 	<ul style="list-style-type: none"> ● CHECK the driveshaft for damage, missing balance weights or undercoating. CHECK the driveshaft balance. CARRY OUT a driveline vibration test. REFER to Section 205-00. ● ROTATE the driveshaft and CHECK for rough operation or seized U-joints. INSTALL new U-joints as necessary. REFER to Section 205-01. ● CARRY OUT a runout check. REPAIR as necessary. REFER to Section 205-00.
<ul style="list-style-type: none"> ● Grunting—normally associated with a shudder experienced during acceleration 	<ul style="list-style-type: none"> ● Driveshaft slip yoke binding. 	<ul style="list-style-type: none"> ● CLEAN and LUBRICATE the male and female splines.

<p>from a dead stop</p>	<ul style="list-style-type: none"> ● Loose rear spring U-bolts. 	<ul style="list-style-type: none"> ● INSPECT the rear suspension. TIGHTEN the U-bolt nuts to specification. REFER to Section 204-02.
<ul style="list-style-type: none"> ● Howl—can occur at various speeds and driving conditions. Affected by acceleration and deceleration 	<ul style="list-style-type: none"> ● Incorrect ring and pinion contact, incorrect bearing preload or gear damage. 	<ul style="list-style-type: none"> ● CHECK the ring and pinion and bearings for damage. INSPECT the ring and pinion wear pattern. REFER to Checking Tooth Contact Pattern and Condition of the Ring and Pinion component test in this section. ADJUST or INSTALL new components as necessary. REFER to Section 205-02A for Ford 7.5 rear axles or Section 205-02B for Ford 8.8 integral axles.
<ul style="list-style-type: none"> ● Chuckle—heard at coast/deceleration. Also described as a knock 	<ul style="list-style-type: none"> ● Incorrect ring and pinion contact or by damaged teeth on the coast side of the ring and pinion. 	<ul style="list-style-type: none"> ● CHECK the ring and pinion for damage. INSPECT the ring and pinion wear pattern. REFER to Checking Tooth Contact Pattern and Condition of the Ring and Pinion component test in this section. ADJUST or INSTALL new components as necessary. REFER to Section 205-02A for Ford 7.5 rear axles or Section 205-02B for Ford 8.8 integral axles.
<ul style="list-style-type: none"> ● Knock—noise occurs at various speeds. Not affected by acceleration or deceleration 	<ul style="list-style-type: none"> ● Gear tooth damage to the drive side of the ring and pinion. ● Excessive axle shaft end play. (Vehicles with integral axles). 	<ul style="list-style-type: none"> ● CHECK the differential case and ring and pinion for damage. INSTALL new components as necessary. REFER to Section 205-02A for Ford 7.5 rear axles or Section 205-02B for Ford 8.8 integral axles. ● CHECK the axle end play using a dial indicator. INSTALL a new axle shaft or side gears as necessary. REFER to Section 205-02A for Ford 7.5 rear axles or Section 205-02B for Ford 8.8 integral axles.
<ul style="list-style-type: none"> ● Scraping noise—a continuous low pitched noise starting at low speeds 	<ul style="list-style-type: none"> ● Worn or damaged pinion bearings. 	<ul style="list-style-type: none"> ● CHECK the pinion bearings. INSTALL new pinion bearings as necessary. REFER to Section 205-02A for Ford 7.5 rear axles or Section 205-02B for Ford 8.8 integral axles.
<ul style="list-style-type: none"> ● Driveline shudder—occurs during acceleration from a slow speed or stop 	<ul style="list-style-type: none"> ● Rear drive axle assembly mispositioned. 	<ul style="list-style-type: none"> ● CHECK the axle mounts and the rear suspension for damage or wear. REPAIR as necessary.

	<ul style="list-style-type: none"> ● Loose rear spring U-bolts. ● Incorrect or high CV joint operating angle. ● Damaged or worn front suspension components. ● Driveline angles out of specification. ● U-joints binding or seized. ● Binding, damaged or galled splines on the driveshaft slip-yoke 	<ul style="list-style-type: none"> ● INSPECT the U-bolts. TIGHTEN the U-bolt nuts to specification. REFER to Section 204-02. ● CHECK vehicle ride height is within limits. REPAIR as necessary. REFER to Section 206-00. ● CHECK for a loose stabilizer bar, damaged or loose strut/strut bushings or loose or worn ball joints. INSPECT the steering linkage for wear or damage. REPAIR or INSTALL new components as necessary. ● CHECK for correct driveline angles. REPAIR as necessary. REFER to Section 205-00. ● ROTATE the driveshaft and CHECK for rough operation or seized U-joints. INSTALL new U-joints as necessary. REFER to Section 205-01. ● CLEAN and INSPECT the splines of the slip-yoke, driveshaft and coupling shaft for a worn, damaged or galled condition. INSTALL a new slip-yoke or driveshaft assembly as necessary. REPAIR as necessary. REFER to Section 205-01.
<ul style="list-style-type: none"> ● Driveline vibration—occurs at cruising speeds 	<ul style="list-style-type: none"> ● U-joints are worn. ● Worn or damaged driveshaft center bearing support. ● Loose axle pinion flange bolts. ● Excessive axle pinion flange runout. ● Driveshaft is out-of-balance. 	<ul style="list-style-type: none"> ● CHECK for wear or incorrect seating. INSTALL new U-joints as necessary. REFER to Section 205-01. ● CHECK the insulator for damage or wear. ROTATE the driveshaft and CHECK for rough operation. INSTALL a new center bearing support as necessary. REFER to Section 205-01. ● INSPECT the axle pinion flange. TIGHTEN the pinion flange bolts to specification. REFER to Section 205-01. ● CARRY OUT a Runout Check. REPAIR as necessary. REFER to Section 205-01. ● CHECK the driveshaft for damage, missing balance weights or undercoating. CHECK driveshaft balance.

	<ul style="list-style-type: none"> ● Binding or damaged splines on the driveshaft slip-yoke. ● Driveshaft runout. ● Incorrect lateral and radial tire/wheel runout. ● Driveline angles out of specification. ● Incorrectly seated CV joint in the front wheel hub. 	<p>CARRY OUT a driveline vibration test. REFER to Section 205-00 . REPAIR as necessary.</p> <ul style="list-style-type: none"> ● CLEAN and INSPECT the splines of the slip-yoke, driveshaft and coupling shaft for wear or damage. INSTALL a new slip-yoke or driveshaft assembly as necessary. REFER to Section 205-01 . REPAIR as necessary. ● CARRY OUT a Runout Check. REFER to Section 205-00 . REPAIR as necessary. ● INSPECT the tire and wheels. MEASURE tire runouts. REPAIR or INSTALL new components as necessary. REFER to Section 204-04 . ● CHECK for correct driveline angles. REPAIR as necessary. REFER to Section 205-00 . ● CHECK the outer CV joint for correct seating into the hub. REPAIR as necessary.
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Symptom Chart — Engine Noise/Vibration

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● Grinding noise—occurs during engine cranking 	<ul style="list-style-type: none"> ● Incorrect starter motor mounting. ● Starter motor. ● Incorrect starter motor drive engagement. 	<ul style="list-style-type: none"> ● INSPECT the starter motor for correct mounting. REPAIR as necessary. REFER to Section 303-06 . ● CHECK the starter motor. REPAIR or INSTALL a new starter motor as necessary. REFER to Section 303-06 . ● INSPECT the starter motor drive and flexplate/flywheel for wear or damage. INSTALL a new starter motor drive or flywheel as necessary. REFER to Section 303-06 .
<ul style="list-style-type: none"> ● Engine ticking noise 	<ul style="list-style-type: none"> ● Fuel injector. ● Fuel line. ● Oil pump. ● Valve lifter. ● Belt tensioner. ● Water pump. ● Obstruction of cooling fan. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test B .
<ul style="list-style-type: none"> ● Engine drumming 	<ul style="list-style-type: none"> ● Powertrain mount. 	<ul style="list-style-type: none"> ● CARRY OUT

<p>noise—normally accompanied by vibration</p>	<ul style="list-style-type: none"> ● Damaged or misaligned exhaust system. 	<p>Powertrain/Drivetrain Mount Neutralizing in this section.</p> <ul style="list-style-type: none"> ● INSPECT the exhaust system for loose or broken clamps and brackets. CARRY OUT Exhaust System Neutralizing in this section.
<ul style="list-style-type: none"> ● Whistling noise—normally accompanied with poor idle condition 	<ul style="list-style-type: none"> ● Air intake system. 	<ul style="list-style-type: none"> ● CHECK the air intake ducts, air cleaner, throttle body and vacuum hoses for leaks and correct fit. REPAIR or ADJUST as necessary. REFER to Section 303-12
<ul style="list-style-type: none"> ● Clunking noise 	<ul style="list-style-type: none"> ● Water pump has excessive end play or imbalance. ● Generator has excessive end play. 	<ul style="list-style-type: none"> ● CHECK the water pump for excessive end play. INSPECT the water pump with the drive belt off for imbalance. INSTALL a new water pump as necessary. REFER to Section 303-03A. ● CHECK the generator for excessive end play. REPAIR or INSTALL a new generator. REFER to Section 414-02.
<ul style="list-style-type: none"> ● Pinging noise 	<ul style="list-style-type: none"> ● Exhaust system leak. ● Gasoline octane too low. ● Knock sensor operation. ● Incorrect spark timing. ● High operating temperature. ● Foul-out spark plug. ● Catalytic converter. 	<ul style="list-style-type: none"> ● INSPECT the exhaust system for leaks. REPAIR as necessary. ● VERIFY with customer the type of gasoline used. CORRECT as necessary. ● CHECK the knock sensor. INSTALL a new knock sensor as necessary. REFER to Section 303-14. ● CHECK the spark timing. REPAIR as necessary. ● INSPECT cooling system for leaks. CHECK the coolant level. REFILL as necessary. CHECK the coolant for the correct mix ratio. DRAIN and REFILL as needed. CHECK engine operating temperature is within specifications. REPAIR as necessary. ● CHECK the spark plugs. REPAIR or INSTALL new spark plugs as necessary. ● Acceptable noise.
<ul style="list-style-type: none"> ● Knocking noise—light knocking noise, also 	<ul style="list-style-type: none"> ● Excessive clearance between the piston and the cylinder wall. 	<ul style="list-style-type: none"> ● Engine cold and at high idle. Using an EngineEAR, pull a spark plug or fuel

<p>described as piston slap. Noise is most noticeable when engine is cold with light to medium acceleration. Noise disappears as engine warms</p>		<p>injector connector until the noise goes away. CARRY OUT a cylinder bore clearance to piston check. INSTALL a new piston. REFER to Section 303-01A for 3.8L engines or Section 303-01B for 4.6L (2V) engines.</p>
<ul style="list-style-type: none"> ● Knocking noise—light double knock or sharp rap sound. Occurs mostly with warm engine at idle or low speeds in DRIVE. Increases in relation to engine load. Associated with poor lubrication history 	<ul style="list-style-type: none"> ● Excessive clearance between the piston and the piston pin. 	<ul style="list-style-type: none"> ● INSTALL a new piston or piston pin. REFER to Section 303-01A for 3.8L engines or Section 303-01B for 4.6L (2V) engines.
<ul style="list-style-type: none"> ● Knocking noise—light knocking noise is most noticeable when engine is warm. Noise tends to decrease when vehicle is coasting or in neutral 	<ul style="list-style-type: none"> ● Excessive clearance between the connecting rod bearings and the crankshaft. 	<ul style="list-style-type: none"> ● Engine warm and at idle. Using an EngineEAR, PULL a spark plug or fuel injector connector until the noise goes away. INSTALL new bearings. REFER to Section 303-01A for 3.8L engines or Section 303-01B for 4.6L (2V) engines.
<ul style="list-style-type: none"> ● Knocking—deep knocking noise. Noise is most noticeable when engine is warm, at lower rpm and under a light load and then at float 	<ul style="list-style-type: none"> ● Worn or damaged crankshaft main bearings. 	<ul style="list-style-type: none"> ● CARRY OUT DERU test. CHECK for noise with vehicle at operating temperature, during medium to heavy acceleration. CHECK at idle with injector disconnected, noise does not change. INSTALL new main bearings. REFER to Section 303-01A for 3.8L engines or Section 303-01B for 4.6L (2V) engines.
<ul style="list-style-type: none"> ● Knocking noise—occurs mostly with warm engine at light/medium acceleration 	<ul style="list-style-type: none"> ● Spark plugs. ● Carbon accumulation in combustion chamber. 	<ul style="list-style-type: none"> ● CHECK the spark plug for damage or wear. INSTALL new spark plugs as necessary. ● REMOVE carbon from combustion chamber.
<ul style="list-style-type: none"> ● Whine or moaning noise 	<ul style="list-style-type: none"> ● Air intake system. 	<ul style="list-style-type: none"> ● CHECK the air cleaner and ducts for correct fit. INSPECT the air intake system for leaks or damage. REPAIR as necessary.

	<ul style="list-style-type: none"> ● Generator electrical field or bearings. 	<ul style="list-style-type: none"> ● CARRY OUT generator load test. REPAIR or INSTALL a new generator as necessary. REFER to Section 414-02.
<ul style="list-style-type: none"> ● Drone type noise 	<ul style="list-style-type: none"> ● Exhaust system. ● A/C compressor. ● Powertrain mounts. 	<ul style="list-style-type: none"> ● CARRY OUT the Exhaust System Neutralizing in this section. REPAIR as necessary. ● CHECK for noise with vehicle at constant speeds. CYCLE the compressor on and off and listen for a change in pitch. REPAIR as necessary. REFER to Section 412-03. ● CARRY OUT the Powertrain/Drivetrain Mount Neutralizing in this section.
<ul style="list-style-type: none"> ● Sputter type noise—noise worse when cold, lessens or disappears when vehicle is at operating temperature 	<ul style="list-style-type: none"> ● Damaged or worn exhaust system components. 	<ul style="list-style-type: none"> ● INSPECT the exhaust system for leaks or damage. REPAIR as necessary. REFER to Section 309-00.
<ul style="list-style-type: none"> ● Rattling noise—noise from the upper engine (valve train). Worse when engine is cold 	<ul style="list-style-type: none"> ● Low oil level. ● Thin or diluted oil. ● Low oil pressure. ● Worn rocker arms/fulcrums or followers. ● Worn valve guides. 	<ul style="list-style-type: none"> ● CHECK oil level. FILL as necessary. ● INSPECT the oil for contamination. If oil is contaminated, CHECK for the source. REPAIR as necessary. CHANGE the oil and filter. ● CARRY OUT an oil pressure test. If not within specifications, REPAIR as necessary. REFER to Section 303-00. ● CARRY OUT a valve train analysis. INSTALL new valve train components as necessary. REFER to Section 303-01A for 3.8L engines or Section 303-01B for 4.6L (2V) engines. ● CARRY OUT a valve train analysis. INSTALL new valve guides as necessary. REFER to Section 303-01A for 3.8L engines or Section 303-01B for 4.6L (2V) engines.

	<ul style="list-style-type: none"> ● Excessive runout of valve seats on the valve face. 	<ul style="list-style-type: none"> ● CARRY OUT a valve seat runout test. INSPECT the valve face and seat. INSTALL new valves as necessary. REFER to Section 303-01A for 3.8L engines or Section 303-01B for 4.6L (2V) engines.
<ul style="list-style-type: none"> ● Rattling noise—from the bottom of the vehicle 	<ul style="list-style-type: none"> ● Loose muffler shields or catalytic converter shields. 	<ul style="list-style-type: none"> ● CHECK the exhaust system for loose exhaust shields. REPAIR as necessary.
<ul style="list-style-type: none"> ● Thumping noise—from the bottom of the vehicle, worse at acceleration 	<ul style="list-style-type: none"> ● Exhaust pipe/muffler grounded to chassis. 	<ul style="list-style-type: none"> ● CHECK the exhaust system to chassis clearance. CHECK the exhaust system hangers for damage. REPAIR as necessary. REFER to Section 309-00.
<ul style="list-style-type: none"> ● Whoosh—occurs during light vehicle acceleration. Heard inside the vehicle 	<ul style="list-style-type: none"> ● Throttling late, creating turbulence transmitted through the plastic manifold. 	<ul style="list-style-type: none"> ● CHECK for leaks or missing seal in the dash panel.
<ul style="list-style-type: none"> ● Engine vibration—increases intensity as engine rpm is increased 	<ul style="list-style-type: none"> ● Engine out-of-balance. 	<ul style="list-style-type: none"> ● CARRY OUT Neutral Engine Run-Up (NERU) Test. ROTATE the torque converter, 120° for 3 bolt and 180° for 4 bolt. INSPECT the torque converter pilot outer diameter to crankshaft pilot inner diameter. REPAIR as necessary. REFER to Section 307-01.
<ul style="list-style-type: none"> ● Engine vibration—is felt with increases and decreases in engine rpm 	<ul style="list-style-type: none"> ● Strain on exhaust mounts. ● Damaged or worn powertrain/drivetrain mounts. ● Engine or transmission grounded to chassis. 	<ul style="list-style-type: none"> ● CARRY OUT the Exhaust System Neutralizing procedure in this section. REPAIR as necessary. ● CHECK the powertrain/drivetrain mounts for damage. REPAIR as necessary. ● INSPECT the powertrain/drivetrain for correct clearances. REPAIR as necessary.
<ul style="list-style-type: none"> ● Engine vibration—vibration felt at all times 	<ul style="list-style-type: none"> ● Excessive engine pulley runout. ● Damaged or worn accessory component. 	<ul style="list-style-type: none"> ● CARRY OUT Engine Accessory Test. INSTALL a new engine pulley as necessary. REFER to Section 303-01A for 3.8L engines or Section 303-01B for 4.6L (2V) engines. ● CARRY OUT Engine Accessory Test. REPAIR or INSTALL a new component

		as necessary.
<ul style="list-style-type: none"> ● Accelerator pedal vibration—felt through the pedal as a buzz 	<ul style="list-style-type: none"> ● Throttle cable loose or misrouted. 	<ul style="list-style-type: none"> ● INSPECT the throttle cable. REPAIR as necessary. REFER to Section 310-02.
<ul style="list-style-type: none"> ● Engine vibration—mostly at coast/neutral coast. Condition improves with vehicle accelerating 	<ul style="list-style-type: none"> ● Combustion instability. 	<ul style="list-style-type: none"> ● CHECK the ignition system. INSTALL new components as necessary.
<ul style="list-style-type: none"> ● Engine vibration or shudder—occurs with light to medium acceleration above 56 km/h (35 mph) 	<ul style="list-style-type: none"> ● Worn or damaged spark plugs. ● Plugged fuel injector. ● Damaged spark plug wire. ● Contaminated fuel. ● Worn or damaged torque converter. 	<ul style="list-style-type: none"> ● INSPECT the spark plugs for cracks, high resistance or broken insulator. INSTALL a new spark plug (s) as necessary. ● REPAIR or INSTALL a new injector as necessary. REFER to Section 303-04A for 3.8L engines or Section 303-04B for 4.6L (2V) engines. ● INSPECT the spark plug wires for damage. INSTALL a new spark plug wire(s) as necessary. ● INSPECT the fuel for contamination. DRAIN the fuel system and refill. ● CHECK the torque converter. INSTALL a new torque converter as necessary. REFER to Section 307-01.

Symptom Chart—Idle Noise/Vibration

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● Idle air control (IAC) valve moan — occurs on throttle tip-out 	<ul style="list-style-type: none"> ● IAC valve is contaminated with oil. 	<ul style="list-style-type: none"> ● GO to Component Tests in this section.
<ul style="list-style-type: none"> ● Accessory drive belt chirp — occurs at idle or high idle, cold or hot. Most common occurrence is during humid weather 	<ul style="list-style-type: none"> ● Accessory drive belt worn, or pulley is misaligned or loose. 	<ul style="list-style-type: none"> ● INSPECT for loose or misaligned pulleys. CHECK the drive belt for wear or damage. INSTALL new pulley(s)/drive belt, or accessory drive components as necessary. REFER to Section 303-05.
<ul style="list-style-type: none"> ● Accessory drive bearing hoot — occurs at idle or high idle in cold temperatures of approximately +4°C 	<ul style="list-style-type: none"> ● Accessory drive idler or tensioner pulley bearing is experiencing stick/slip 	<ul style="list-style-type: none"> ● Go To Pinpoint Test C.

<p>(+40°F) or colder at first start of the day</p>	<p>between ball bearings and bearing race.</p>	
<ul style="list-style-type: none"> ● Power steering moan — occurs at high idle and possibly at idle during the first cold start of the day in temperatures of approximately -18°C (0°F) or colder. Noise can even be a severe screech for less than one minute in very cold temperatures of approximately -29°C (-20°F) or colder 	<ul style="list-style-type: none"> ● High fluid viscosity, or plugged reservoir screen in power steering reservoir starves pump causing cavitation. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test D.
<ul style="list-style-type: none"> ● Generator whine — during high electrical loads at idle or high idle, a high pitch whine or moan is emitted from the generator 	<ul style="list-style-type: none"> ● Generator electrical field noise. 	<ul style="list-style-type: none"> ● Using an EngineEAR, PROBE near the generator housing. LISTEN for changes in the noise level while changing electrical loads (such as rear defrost, headlamps, etc.). CARRY OUT a generator load test. If the system passes the load test, the noise is from the generator bearings, INSTALL new bearings. If the system fails the load test, INSTALL a new generator. REFER to Section 414-02.
<ul style="list-style-type: none"> ● Engine-driven cooling fan moan — occurs during the first start of the day. It is most objectionable near idle speeds up to 2000 rpm. The noise increases with rpm 	<ul style="list-style-type: none"> ● The viscous cooling fan clutch engages until the fluid in the clutch reaches normal operating temperature, causing the fan to fully engage. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test E.
<ul style="list-style-type: none"> ● Drumming noise — occurs inside the vehicle during idle or high idle, hot or cold. Very low-frequency drumming is very rpm dependent 	<ul style="list-style-type: none"> ● Exhaust system vibration excites the body resonances inducing interior noise. ● Engine vibration excites the body resonances inducing interior noise. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test F.
<ul style="list-style-type: none"> ● Hissing noise — occurs during idle or high idle that is apparent with the hood open 	<ul style="list-style-type: none"> ● Vacuum leak or idle air control (IAC) valve flow noise. 	<ul style="list-style-type: none"> ● Use the Ultrasonic Leak Detector/EngineEAR to locate the source. Scan the air intake system from the inlet to each cylinder intake

	<ul style="list-style-type: none"> ● Vehicles with a plastic intake manifold. 	<p>port. DISCARD the leaking parts, and INSTALL a new component.</p> <ul style="list-style-type: none"> ● Acceptable condition. Some plastic manifolds exhibit this noise, which is the effect of the plastic manifold.
<ul style="list-style-type: none"> ● Automatic transmission buzz or hiss 	<ul style="list-style-type: none"> ● Incorrect driveline angles. ● Worn or damaged main control solenoids or valves. 	<ul style="list-style-type: none"> ● CHECK for correct driveline angles. REPAIR as necessary. REFER to Section 205-00. ● Using a transmission tester, activate the solenoids to duplicate sound. INSTALL new components as necessary. REFER to Section 307-01.
<ul style="list-style-type: none"> ● Manual Transmission Clutch throw-out bearing whine. A change in noise pitch or loudness while depressing the clutch pedal 	<ul style="list-style-type: none"> ● Worn throw-out bearing. 	<ul style="list-style-type: none"> ● INSTALL a new throw-out bearing. REFER to Section 308-01.
<ul style="list-style-type: none"> ● Heating, vacuum and air conditioning (HVAC) system chirp — most audible inside the vehicle. Listen for a change in noise pitch or loudness while changing the HVAC system blower speed 	<ul style="list-style-type: none"> ● Damaged or worn HVAC blower bearing. 	<ul style="list-style-type: none"> ● INSTALL a new blower motor. REFER to Section 412-02.
<ul style="list-style-type: none"> ● Air conditioning (A/C) clutch ticking — occurs when the compressor clutch engages 	<ul style="list-style-type: none"> ● Acceptable noise. ● Incorrect air gap. 	<ul style="list-style-type: none"> ● LISTEN to the clutch to determine if the noise occurs with clutch engagement. A small amount of noise is acceptable. If the noise is excessive, CHECK the A/C clutch air gap. INSPECT the A/C clutch for wear or damage. INSTALL a new clutch as necessary. REFER to Section 412-03.
<ul style="list-style-type: none"> ● Intermittent rattle, or scraping/rubbing noise 	<ul style="list-style-type: none"> ● Loose exhaust heat shield(s). ● Wiring, hose or other part interfering with accessory drive belt or pulley. 	<ul style="list-style-type: none"> ● INSPECT the exhaust system for loose parts using a glove or clamps to verify cause. REPAIR as necessary. REFER to Section 309-00. ● INSPECT accessory drive system closely verifying there is adequate clearance to all rotating components. REPAIR as necessary.
<ul style="list-style-type: none"> ● Engine ticking or knocking noise — occurs during idle or 	<ul style="list-style-type: none"> ● Piston noise or valvetrain noise (bled down 	<ul style="list-style-type: none"> ● Go To Pinpoint Test G.

high idle during the first cold start of the day	lifter/lash adjuster).	
<ul style="list-style-type: none"> ● A continuous, speed-dependent rattle from the engine — occurs during idle or high idle during the first cold start of the day and disappears as the engine warms up 	<ul style="list-style-type: none"> ● Piston noise or valvetrain noise (bled down lifter/lash adjuster). 	<ul style="list-style-type: none"> ● Go To Pinpoint Test G.
<ul style="list-style-type: none"> ● Idle vibration—a low-frequency vibration (5-20 Hz) or mild shake that is felt through the seat/floorpan 	<ul style="list-style-type: none"> ● Cylinder misfire. ● Engine or torque converter out of balance. 	<ul style="list-style-type: none"> ● Using a scan tool, CHECK the ignition system. CARRY OUT a cylinder power test. REFER to Section 303-00. ● VERIFY the torque converter to crankshaft pilot clearance is correct, REPAIR as necessary. RE-INDEX the torque converter on the flex plate by 120° on a 3 bolt converter or 180° for a 4 bolt converter. REFER to Section 307-01. RETEST the vehicle.
<ul style="list-style-type: none"> ● Idle vibration—a high-frequency vibration (20–80 Hz) or buzz, that is felt through the steering wheel or seat 	<ul style="list-style-type: none"> ● Exhaust system mounts bound up. ● Body mounts loose. ● Power steering lines grounded out. 	<ul style="list-style-type: none"> ● VERIFY concern occurs at engine firing frequency. CHECK that the exhaust system vibrates at the same frequency as the engine. ADD 9–14 km (20–30 lb.) to the tail pipe to test, CARRY OUT Exhaust System Neutralizing in this section. ● INSPECT the body mounts. REPAIR as necessary. ● INSPECT that the power steering lines are not contacting the chassis or each other. REPAIR as necessary.

Symptom Chart—Squeak and Rattle

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● Squeak—heard inside the vehicle when closing/opening the door 	<ul style="list-style-type: none"> ● Insufficient lubrication on the door hinge or check strap. ● Internal door components loose, rubbing or misaligned. 	<ul style="list-style-type: none"> ● LUBRICATE the hinge or check strap. ● CHECK the inside of the door. TIGHTEN or ALIGN as necessary. USE the Rotunda Squeak and Rattle Kit to isolate any rubbing components.
<ul style="list-style-type: none"> ● Squeak—heard inside the vehicle when 	<ul style="list-style-type: none"> ● Worn or damaged glass run/channel. 	<ul style="list-style-type: none"> ● REPAIR or INSTALL a new glass run/channel. REFER to Section 501-11.

closing/opening the window		
<ul style="list-style-type: none"> ● Squeak—heard outside of vehicle when closing/opening the door 	<ul style="list-style-type: none"> ● Exhaust shield rubbing against the chassis or exhaust pipe. 	<ul style="list-style-type: none"> ● CHECK the exhaust system. REPAIR as necessary. REFER to Section 309-00.
<ul style="list-style-type: none"> ● Squeak—occurs with initial brake pedal application 	<ul style="list-style-type: none"> ● Disc brake pads. 	<ul style="list-style-type: none"> ● Under certain conditions, asbestos free pads can generate a squeak noise. This noise is normal and does not indicate a concern.
<ul style="list-style-type: none"> ● Squeak—a constant noise that occurs with brake pedal applications 	<ul style="list-style-type: none"> ● Damaged or worn disc brake pads. 	<ul style="list-style-type: none"> ● INSPECT the pads for oil, grease or brake fluid contamination. CHECK for glazed linings. A brake disc with hard spots will also cause a squeak type noise. REPAIR or INSTALL new pads as necessary. REFER to Section 206-03 for front disc brakes and Section 206-04 for rear disc brakes.
<ul style="list-style-type: none"> ● Squeak—noise occurs over bumps or when turning 	<ul style="list-style-type: none"> ● Worn control arm bushings. ● Worn or damaged shock absorber/strut. 	<ul style="list-style-type: none"> ● INSPECT the control arm bushings. Spray with lubricant and CARRY OUT a "bounce test" to determine which bushing. REPAIR as necessary. REFER to Section 204-01. ● INSPECT the shock absorber for damage. CARRY OUT a "bounce test" to isolate the noise. INSTALL a new shock absorber/strut as necessary. REFER to Section 204-01 for the front shock absorber/strut or Section 204-02 for the rear shock absorber/strut.
<ul style="list-style-type: none"> ● Rattle—heard when closing/opening the door or window 	<ul style="list-style-type: none"> ● Loose internal door mechanism, bracket or attachment. 	<ul style="list-style-type: none"> ● REPEAT the motion or CARRY OUT a "tap test" to duplicate the noise. INSPECT the door for loose components. TIGHTEN loose components or USE the Rotunda Squeak and Rattle Kit to isolate any rattling components.
<ul style="list-style-type: none"> ● Rattle — GT models only, noise occurs from the rear of the vehicle 	<ul style="list-style-type: none"> ● A loose or under torqued shock damper attaching nut. 	<ul style="list-style-type: none"> ● VERIFY the torque on the shock damper-to-axle nuts is 63 Nm (46 lb-ft). VERIFY the torque for the shock damper-to-rail bracket nuts is 90 Nm (66 lb-ft). Do not over torque. TIGHTEN as necessary.
<ul style="list-style-type: none"> ● Squeak or rattle—heard inside the vehicle over rough roads/bumps 	<ul style="list-style-type: none"> ● Misaligned glove compartment door/hinge. ● Instrument panel trim loose or 	<ul style="list-style-type: none"> ● ALIGN the glove compartment door. ● INSPECT the instrument panel trim for missing or loose clips or

	<p>misaligned.</p> <ul style="list-style-type: none"> ● Loose interior component or trim. 	<p>screws. REPAIR as necessary.</p> <ul style="list-style-type: none"> ● CARRY OUT a "touch test". ELIMINATE the noise by pressing or pulling on interior trim and components. USE the Rotunda Squeak and Rattle Kit to isolate any rattling/squeaking components.
<ul style="list-style-type: none"> ● Squeak or rattle—noise with a vibration concern 	<ul style="list-style-type: none"> ● Damaged or worn body mounts. ● Damaged or worn sub-frame mounts. 	<ul style="list-style-type: none"> ● INSPECT the upper and lower absorbers and washers for damage or wear. CHECK the body mount brackets for damage. CHECK the nuts and bolts are tightened to specifications. TIGHTEN as necessary. ● INSPECT the upper and lower absorbers for damage or wear. CHECK the sub-frame for damage. CHECK the nuts and bolts are tightened to specifications. TIGHTEN as necessary.

Symptom Chart—Steering Noise/Vibration

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● Steering grunt or shudder — occurs when turning into or out of a turn at low speeds (temperature sensitive) 	<ul style="list-style-type: none"> ● Steering gear or power steering hoses. 	<ul style="list-style-type: none"> ● GO to Steering Gear Grunt/Shudder Test component test in this section.
<ul style="list-style-type: none"> ● Steering System clonk—hydraulic knocking sound 	<ul style="list-style-type: none"> ● Air in the steering hydraulic system. 	<ul style="list-style-type: none"> ● CHECK for leaks in the system. PURGE the air from the system. REFER to Section 211-00.
<ul style="list-style-type: none"> ● Power steering pump moan — loud humming noise occurs when the steering wheel is rotated to the stop position. Produces a 120-600 Hz frequency that changes with rpm 	<ul style="list-style-type: none"> ● Power steering hose grounded out to chassis. ● Aerated fluid. ● Steering gear isolators. ● Low fluid. 	<ul style="list-style-type: none"> ● INSPECT the power steering hoses. REPAIR as necessary. ● CHECK for leaks in the system. PURGE the air from the system. REFER to Section 211-00. ● INSPECT the isolators for wear or damage. REPAIR as necessary. ● CHECK the fluid level.

	<ul style="list-style-type: none"> ● Power steering pump brackets loose or misaligned. 	<p>REFILL as necessary.</p> <ul style="list-style-type: none"> ● CHECK bolts, brackets and bracket alignment. TIGHTEN bolts to specification. REPAIR or INSTALL new brackets as necessary. REFER to Section 211-02.
<ul style="list-style-type: none"> ● Steering gear clunk — occurs only while cornering over a bump (can be temperature sensitive) 	<ul style="list-style-type: none"> ● Steering gear. 	<ul style="list-style-type: none"> ● INSPECT the steering gear for loose mounting bolts. TIGHTEN as necessary. REFER to Section 211-02.
<ul style="list-style-type: none"> ● Feedback (rattle, chuckle or knocking noise in the steering gear) — a condition where roughness is felt in the steering wheel when the vehicle is driven over rough surfaces 	<ul style="list-style-type: none"> ● Column intermediate/flexible shaft joints damaged or worn. ● Loose, damaged or worn tie-rod ends. ● Steering gear insulators or mounting bolts loose or damaged. ● Steering column intermediate shaft bolts are loose. ● Steering column damaged or worn. ● Loose suspension bushings, bolts or ball joints. 	<ul style="list-style-type: none"> ● INSTALL a new intermediate/flexible shaft. REFER to Section 211-04. ● TIGHTEN the nuts to specification or INSTALL new tie-rod ends as necessary. REFER to Section 211-02. ● TIGHTEN the bolts or INSTALL new bolts as necessary. REFER to Section 211-02. ● TIGHTEN the bolts to specification. REFER to Section 211-04. ● REPAIR or INSTALL a new steering column as necessary. REFER to Section 211-04. ● INSPECT the suspension system. TIGHTEN or INSTALL new components as necessary. REFER to Section 204-01.
<ul style="list-style-type: none"> ● Feedback (nibble at the steering wheel) — a condition where slight rotational movement is felt in the steering wheel when the vehicle is driven over rough or grooved 	<ul style="list-style-type: none"> ● Lateral runout in the tire or wheel. 	<ul style="list-style-type: none"> ● GO to Pinpoint Test H.

surfaces	<ul style="list-style-type: none"> ● Yoke spring in the steering gear. 	<ul style="list-style-type: none"> ● CHECK TSBs for revised yoke spring for applicable vehicles.
<ul style="list-style-type: none"> ● Accessory drive belt squeal/chirp—when rotating the steering wheel from stop to stop 	<ul style="list-style-type: none"> ● Loose or worn accessory drive belt. 	<ul style="list-style-type: none"> ● ADJUST or INSTALL a new accessory belt as necessary. REFER to Section 303-05.
<ul style="list-style-type: none"> ● Power steering gear hiss 	<ul style="list-style-type: none"> ● Steering column intermediate/flexible shaft-to-steering gear is binding or misaligned. ● Grounded or loose steering column boot at the dash panel. ● Damaged or worn steering gear input shaft and valve. 	<ul style="list-style-type: none"> ● REPAIR or INSTALL a new intermediate/flexible shaft as necessary. REFER to Section 211-04. ● REPAIR as necessary. ● REPAIR or INSTALL a new steering gear as necessary. REFER to Section 211-02.
<ul style="list-style-type: none"> ● Steering column rattle 	<ul style="list-style-type: none"> ● Loose bolts or attaching brackets. ● Loose, worn or insufficiently lubricated column bearings. ● Steering shaft insulators damaged or worn. ● Intermediate/flexible shaft compressed or extended. 	<ul style="list-style-type: none"> ● TIGHTEN the bolts to specifications. ● LUBRICATE or INSTALL new steering column bearings as necessary. REFER to Section 211-04. ● INSTALL new insulators. REFER to Section 211-04. ● INSPECT the rubber spider coupling for damage. INSTALL a new intermediate/flexible shaft. REFER to Section 211-04.
<ul style="list-style-type: none"> ● Steering column squeak or cracks 	<ul style="list-style-type: none"> ● Insufficient lubricated steering shaft bushings. ● Loose or misaligned steering column shrouds. ● Steering wheel rubbing against steering column shrouds. ● Insufficient lubricated speed control slip ring. ● Upper or lower bearing sleeve out of position. 	<ul style="list-style-type: none"> ● LUBRICATE the steering shaft and shaft tube seals. ● TIGHTEN or ALIGN the steering column shrouds. ● REPOSITION the steering column shrouds. ● LUBRICATE the speed control slip ring. ● REPOSITION the bearing sleeves.
<ul style="list-style-type: none"> ● Power steering pump noisy 	<ul style="list-style-type: none"> ● Incorrect assembly of components. ● Imperfections on the outside diameter or 	<ul style="list-style-type: none"> ● REPAIR or INSTALL a new power steering pump as necessary. REFER to Section 211-

	<p>end surface of the power steering pump rotor.</p> <ul style="list-style-type: none"> ● Damaged or worn power steering pump rotor splines. ● A crack on the inner surface of the power steering pump cam. ● Interference between the power steering pump rotor and cam. ● Damaged or worn power steering pump rotor and pressure plates. 	02 .
<ul style="list-style-type: none"> ● Power steering pump swish noise 	<ul style="list-style-type: none"> ● Power steering fluid flow into the bypass valve of the pump valve housing with fluid temperature below 54° C (130°F). 	<ul style="list-style-type: none"> ● Acceptable condition.
<ul style="list-style-type: none"> ● Power steering pump whine noise 	<ul style="list-style-type: none"> ● Aerated fluid. ● Damaged power steering pump cam. ● Damaged valve cover O-ring seal. 	<ul style="list-style-type: none"> ● PURGE the air from the system. REFER to Section 211-00. CHECK for a leak in the system. ● REPAIR or INSTALL a new power steering pump as necessary. REFER to Section 211-02. ● REPAIR or INSTALL a new power steering pump as necessary. REFER to Section 211-02.
<ul style="list-style-type: none"> ● Power steering pump clicking (mechanical) noise 	<ul style="list-style-type: none"> ● Power steering pump rotor slippers too long, excessive rotor slipper-to-slot clearance or damaged or worn rotor assembly. 	<ul style="list-style-type: none"> ● REPAIR or INSTALL a new power steering pump as necessary. REFER to Section 211-02.
<ul style="list-style-type: none"> ● Power steering pump clatter noise 	<ul style="list-style-type: none"> ● Damaged corners on the outside diameter or the power steering rotor or distorted rotor slipper ring. 	<ul style="list-style-type: none"> ● REPAIR or INSTALL a new power steering pump as necessary. REFER to Section 211-02.

Symptom Chart—Suspension Noise/Vibration

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● Squeak or grunt—noise from the front suspension, occurs more in cold ambient temperatures. More noticeable over rough roads or when turning 	<ul style="list-style-type: none"> ● Front stabilizer bar insulators. 	<ul style="list-style-type: none"> ● Under these conditions, the noise is acceptable. CHECK TSBs.

<ul style="list-style-type: none"> ● Clunk—noise from the front suspension, occurs in and out of turns 	<ul style="list-style-type: none"> ● Loose front struts or shocks. 	<ul style="list-style-type: none"> ● INSPECT for loose nuts or bolts. TIGHTEN to specifications. REFER to Section 204-01.
<ul style="list-style-type: none"> ● Clunk—noise from the rear suspension, occurs when shifting from reverse to drive 	<ul style="list-style-type: none"> ● Loose rear suspension components. 	<ul style="list-style-type: none"> ● INSPECT for loose or damaged rear suspension components. REPAIR or INSTALL new components as necessary. REFER to Section 204-02.
<ul style="list-style-type: none"> ● Click or pop—noise from the front suspension. More noticeable over rough roads or over bumps 	<ul style="list-style-type: none"> ● Worn or damaged ball joints. 	<ul style="list-style-type: none"> ● CARRY OUT a ball joint inspection. INSTALL new ball joints or control arms as necessary. REFER to Section 204-01.
<ul style="list-style-type: none"> ● Click or pop (FWD vehicles)—noise occurs when vehicle is turning 	<ul style="list-style-type: none"> ● Worn or damaged ball joints. 	<ul style="list-style-type: none"> ● CARRY OUT a ball joint inspection. INSTALL new ball joints or control arms as necessary.
<ul style="list-style-type: none"> ● Click or snap—occurs when accelerating around a corner 	<ul style="list-style-type: none"> ● Damaged or worn outboard CV joint. 	<ul style="list-style-type: none"> ● INSPECT the outboard CV joint and boot. REPAIR or INSTALL a new CV joint as necessary.
<ul style="list-style-type: none"> ● Front suspension noise—a squeak, creak or rattle noise. Occurs mostly over bumps or rough roads 	<ul style="list-style-type: none"> ● Steering components. ● Loose or bent front struts or shock absorbers. ● Damaged spring or spring mounts. ● Damaged or worn control/radius arm bushings. ● Worn or damaged stabilizer bar bushings or links. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test H.
<ul style="list-style-type: none"> ● Rear suspension noise—a squeak, creak or rattle noise. Occurs mostly over bumps or rough roads 	<ul style="list-style-type: none"> ● Loose or bent rear shock absorbers. ● Damaged spring or spring mounts. ● Damaged or worn control arm bushings. ● Worn or damaged stabilizer bar bushings or links. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test I.
<ul style="list-style-type: none"> ● Shudder—occurs during 	<ul style="list-style-type: none"> ● Rear drive axle 	<ul style="list-style-type: none"> ● CHECK the axle mounts

acceleration from a slow speed or stop	<p>assembly mispositioned.</p> <ul style="list-style-type: none"> ● Incorrect or high CV joint operating angle. ● Damaged or worn front suspension components. 	<p>and the rear suspension for damage or wear. REPAIR as necessary.</p> <ul style="list-style-type: none"> ● CHECK vehicle ride height is within limits. REPAIR as necessary. ● CHECK for a loose stabilizer bar, damaged or loose strut/strut bushings or loose or worn ball joints. INSPECT the steering linkage for wear or damage. REPAIR or INSTALL new components as necessary.
<ul style="list-style-type: none"> ● Shimmy—most noticeable on coast/deceleration. Also hard steering condition 	<ul style="list-style-type: none"> ● Excessive positive caster. 	<ul style="list-style-type: none"> ● CHECK the caster alignment angle. CORRECT as necessary. REFER to Section 204-00.

Symptom Chart—Tire Noise/Vibration

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● Tire noise—hum/moan at constant speeds 	<ul style="list-style-type: none"> ● Abnormal wear patterns. 	<ul style="list-style-type: none"> ● SPIN the tire and CHECK for tire wear. INSTALL a new tire as necessary. INSPECT for damaged/worn suspension components. CARRY OUT wheel alignment.
<ul style="list-style-type: none"> ● Tire noise—noise tone lowers as the vehicle speed is lowered 	<ul style="list-style-type: none"> ● Out-of-balance tire. 	<ul style="list-style-type: none"> ● BALANCE the tire and road test. INSTALL a new tire as necessary. REFER to Section 204-04.
<ul style="list-style-type: none"> ● Tire noise — ticking noise, changes with speed 	<ul style="list-style-type: none"> ● Nail puncture or stone in tire tread. 	<ul style="list-style-type: none"> ● INSPECT the tire. REPAIR as necessary.
<ul style="list-style-type: none"> ● Wheel and tire—vibration and noise concern is directly related to vehicle speed and is not affected by acceleration, coasting or decelerating 	<ul style="list-style-type: none"> ● Damaged or worn tire. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test J.
<ul style="list-style-type: none"> ● Tire wobble or shudder — occurs at lower speeds 	<ul style="list-style-type: none"> ● Damaged wheel bearings. ● Damaged wheel. 	<ul style="list-style-type: none"> ● SPIN the tire and CHECK for abnormal wheel bearing play or roughness. ADJUST or INSTALL new wheel bearings as necessary. REFER to Section 204-01. ● INSPECT the wheel for damage. INSTALL a new wheel as necessary. REFER to Section 204-

	<ul style="list-style-type: none"> ● Damaged or worn suspension components. ● Loose wheel nuts. ● Damaged or uneven tire wear. 	<p>01.</p> <ul style="list-style-type: none"> ● INSPECT the suspension components for wear or damage. REPAIR as necessary. ● CHECK the wheel nuts. TIGHTEN to specification. REFER to Section 204-04. ● SPIN the tire and CHECK for abnormal tire wear or damage. INSTALL a new tire as necessary. REFER to Section 204-04.
<ul style="list-style-type: none"> ● Tire shimmy or shake— occurs at lower speeds 	<ul style="list-style-type: none"> ● Wheel/tire out of balance. ● Uneven tire wear. ● Excessive radial runout of wheel or tire. ● Worn or damaged wheel studs or elongated stud holes. ● Excessive lateral runout of the wheel or tire. ● Foreign material between the brake disc and hub or in the brake disc fins. 	<ul style="list-style-type: none"> ● BALANCE the wheel/tire assembly. ● CHECK for abnormal tire wear. INSTALL a new tire as necessary. REFER to Section 204-04. ● CARRY OUT a radial runout test of the wheel and tire. INSTALL a new tire as necessary. REFER to Section 204-04. ● INSPECT the wheel studs and wheels. INSTALL new components as necessary. REFER to Section 204-01 for the front wheels or Section 204-02 for the rear wheels. ● CARRY OUT a lateral runout test of the wheel and tire. CHECK the wheel, tire and hub. REPAIR or INSTALL new components as necessary. ● CLEAN the mounting surfaces of the brake disc and hub. CHECK the brake disc fins for material.
<ul style="list-style-type: none"> ● High speed shake or shimmy—occurs at high speeds 	<ul style="list-style-type: none"> ● Excessive wheel hub runout. ● Damaged or worn tires. ● Damaged or worn wheel bearings. ● Worn or damaged suspension or steering linkage components. ● Brake disc or drum imbalance. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test K.

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

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● Clutch rattling noise—occurs with clutch engaged, noise changes/disappears with clutch pedal depressed 	<ul style="list-style-type: none"> ● Flywheel bolts, clutch housing bolts or clutch pressure plate bolts loose. 	<ul style="list-style-type: none"> ● TIGHTEN the bolts to specifications. CHECK the bolts for damage.
<ul style="list-style-type: none"> ● Clutch squeaking noise—noise is heard when the clutch is operated. Vehicle moves slowly or creeps when the clutch is disengaged. Can also be difficult to shift into first and reverse gear 	<ul style="list-style-type: none"> ● Pilot bearing seized or damaged. 	<ul style="list-style-type: none"> ● INSTALL a new pilot bearing. REFER to Section 308-01.
<ul style="list-style-type: none"> ● Clutch squeaking noise—occurs with clutch pedal depressed/released 	<ul style="list-style-type: none"> ● Worn clutch pedal shaft or bushings. 	<ul style="list-style-type: none"> ● INSPECT the clutch pedal for wear or damage. REPAIR as necessary. REFER to Section 308-02.
<ul style="list-style-type: none"> ● Clutch whirring/rattle noise—occurs when clutch pedal is depressed 	<ul style="list-style-type: none"> ● Worn, damaged or misaligned clutch release bearing. 	<ul style="list-style-type: none"> ● INSTALL a new clutch release bearing. REFER to Section 308-01.
<ul style="list-style-type: none"> ● Clutch grating/grinding noise—occurs when clutch pedal is depressed 	<ul style="list-style-type: none"> ● Clutch pressure plate fingers bent or worn. ● Contact surface of clutch release bearing worn or damaged. 	<ul style="list-style-type: none"> ● INSPECT the clutch pressure plate release fingers. INSTALL a new pressure plate as necessary. REFER to Section 308-01. ● INSTALL a new clutch release bearing. REFER to Section 308-01.
<ul style="list-style-type: none"> ● Clutch chatter—a small amount of noise when clutch pedal is released at initial take-off 	<ul style="list-style-type: none"> ● Clutch engagement. 	<ul style="list-style-type: none"> ● Acceptable operating condition.
<ul style="list-style-type: none"> ● Clutch chatter/grabs—in some cases a shudder is felt. Occurs with clutch pedal depressed/released 	<ul style="list-style-type: none"> ● Damaged or worn powertrain/driveline mounts. ● Binding or dragging plunger of the clutch master cylinder or slave cylinder. 	<ul style="list-style-type: none"> ● INSPECT the powertrain/drivetrain mounts. INSTALL new mounts as necessary. REFER to Section 303-01A for 3.8L engines or Section 303-01B for 4.6L (2V) engines. ● CHECK the master and slave cylinder operation. INSPECT the components for damage or wear. INSTALL a new master or slave cylinder as necessary. REFER to

	<ul style="list-style-type: none"> ● Grease or oil on the clutch disc facing. ● Clutch disc surface glazed or damaged. ● Damaged or worn clutch pressure plate. ● Flywheel surface damaged or glazed. 	<p>Section 308-02.</p> <ul style="list-style-type: none"> ● CHECK the input shaft seal and rear main oil seal. REPAIR as necessary. INSTALL a new clutch disc. REFER to Section 308-03A for T50D transmissions or Section 308-03B for TR3650 transmissions. ● INSPECT the clutch disc surface for a glazed, hardened or damage condition. CARRY OUT a disc check. INSTALL a new clutch disc as necessary. REFER to Section 308-01. ● INSPECT the clutch pressure plate for wear or damage. INSTALL a new clutch pressure plate as necessary. REFER to Section 308-01. ● INSPECT the flywheel for damage or wear. CARRY OUT a flywheel runout check. INSTALL a new flywheel as necessary. REFER to Section 303-01A for 3.8L engines or Section 303-01B for 4.6L (2V) engines.
<ul style="list-style-type: none"> ● Clutch chatter noise—noise when clutch pedal is released at initial take-off. Clutch is hard to engage and disengage 	<ul style="list-style-type: none"> ● Pilot bearing worn, damaged or not correctly aligned in bore. 	<ul style="list-style-type: none"> ● INSPECT the clutch pressure plate release fingers for uneven wear, clutch components burnt or a seized pilot bearing. INSTALL a new pilot bearing as necessary. REFER to Section 308-01.
<ul style="list-style-type: none"> ● Clutch vibration 	<ul style="list-style-type: none"> ● Loose flywheel bolts. ● Damaged or loose clutch pressure plate. ● Excessive flywheel runout. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test L.
<ul style="list-style-type: none"> ● Transmission rattling/clattering noise—noise at idle or on light acceleration from a stop. Gear selection difficult 	<ul style="list-style-type: none"> ● Gearshift lever joint worn or damaged. 	<ul style="list-style-type: none"> ● INSTALL a new gearshift lever. REFER to Section 308-03A for T50D transmissions or Section 308-03B for TR3650 transmissions.

	<ul style="list-style-type: none"> ● Gearshift lever loose. ● Gearshift linkage rods worn or damaged. 	<ul style="list-style-type: none"> ● TIGHTEN the bolts to specification. REFER to Section 308-03A for T50D transmissions or Section 308-03B for TR3650 transmissions. ● CHECK the linkage bushings for wear. INSTALL new linkage rods as necessary. REFER to the appropriate workshop manual for the service procedures.
<ul style="list-style-type: none"> ● Transmission rattling/clattering noise—occurs in neutral or in gear, at idle 	<ul style="list-style-type: none"> ● Incorrect fluid level or fluid quality. 	<ul style="list-style-type: none"> ● CHECK that the transmission is filled to the correct level and with the specified fluid. REFER to Section 308-03A for T50D transmissions or Section 308-03B for TR3650 transmissions.
<ul style="list-style-type: none"> ● Transmission rattling/clattering noise—noise at idle in neutral 	<ul style="list-style-type: none"> ● Worn or rough reverse idler gear. ● Rough running engine, cylinder misfire. ● Excessive backlash in gears ● Worn countershaft gears. 	<ul style="list-style-type: none"> ● CHECK the reverse idler gear. REPAIR as necessary. REFER to Section 308-03A for T50D transmissions or Section 308-03B for TR3650 transmissions. ● CHECK the ignition system. CARRY OUT a cylinder power test. REFER to Section 303-00. ● CHECK the gear backlash. ADJUST as necessary. REFER to Section 205-02A for Ford 7.5 rear axles or Section 205-02B for Ford 8.8 integral axles. ● REPAIR as necessary. REFER to Section 308-03A for T50D transmissions or Section 308-03B for TR3650 transmissions.
<ul style="list-style-type: none"> ● Transmission whine—a mild whine at extreme speeds or high rpm 	<ul style="list-style-type: none"> ● Rotating gears/geartrain. 	<ul style="list-style-type: none"> ● Acceptable noise.
<ul style="list-style-type: none"> ● Transmission whine—a high pitched whine, also described as a squeal 	<ul style="list-style-type: none"> ● Transmission gears are worn (high mileage vehicle). 	<ul style="list-style-type: none"> ● Result of normal gear wear. REPAIR as necessary. REFER to Section 308-03A for T50D transmissions or Section 308-03B for TR3650 transmissions.

	<ul style="list-style-type: none"> ● Mismatched gear sets. ● Damaged or worn transmission bearing. 	<ul style="list-style-type: none"> ● INSPECT the gear sets for an uneven wear pattern on the face of the gear teeth. REPAIR as necessary. REFER to Section 308-03A for T50D transmissions or Section 308-03B for TR3650 transmissions. ● INSPECT the transmission bearings. INSTALL new bearings as necessary. REFER to Section 308-03A for T50D transmissions or Section 308-03B for TR3650 transmissions.
<ul style="list-style-type: none"> ● Transmission growling/humming—noise occurs in the forward gears. The noise is more prominent when the gear is loaded. The problem gear can be located as the noise occurs in a specific gear position 	<ul style="list-style-type: none"> ● Gear is cracked, chipped or rough. 	<ul style="list-style-type: none"> ● INSPECT the transmission gears for damage or wear. INSTALL new gears as necessary. REFER to Section 308-03A for T50D transmissions or Section 308-03B for TR3650 transmissions.
<ul style="list-style-type: none"> ● Transmission hissing—noise in neutral or in forward gears. As bearings wear or break up, the noise changes to a thumping noise 	<ul style="list-style-type: none"> ● Damaged or worn bearings. 	<ul style="list-style-type: none"> ● INSPECT the transmission bearings. INSTALL new bearings as necessary. REFER to Section 308-03A for T50D transmissions or Section 308-03B for TR3650 transmissions.
<ul style="list-style-type: none"> ● Transmission knocking/thudding—noise at low speeds in forward gears 	<ul style="list-style-type: none"> ● Bearings with damaged balls or rollers or with pitted and spalled races. 	<ul style="list-style-type: none"> ● INSPECT the transmission bearings. INSTALL new bearings as necessary. REFER to Section 308-03A for T50D transmissions or Section 308-03B for TR3650 transmissions.
<ul style="list-style-type: none"> ● Transmission rumble/growl—noise at higher speeds in forward gears, more pronounced in a coast/deceleration condition 	<ul style="list-style-type: none"> ● Incorrect driveline angle. ● Driveshaft out of balance or damaged. 	<ul style="list-style-type: none"> ● CHECK the driveline angle. REPAIR as necessary. REFER to Section 205-00. ● CHECK the driveshaft for damage, missing balance weights or undercoating. Using the vibration analyzer (VA), CHECK the driveshaft balance. CARRY OUT a driveline vibration test. For additional

		information, REFER to Section 205-00 . REPAIR as necessary.
<ul style="list-style-type: none"> ● Transmission rumble/growl—noise at all speeds in forward gears, more pronounced in a heavy acceleration condition 	<ul style="list-style-type: none"> ● Damaged or worn transmission bearing or gears (high mileage vehicles). 	<ul style="list-style-type: none"> ● CHECK transmission fluid for excessive metal particles. REPAIR as necessary. REFER to Section 308-03A for T50D transmissions or Section 308-03B for TR3650 transmissions.
<ul style="list-style-type: none"> ● Transfer case whine—noise at all ranges 	<ul style="list-style-type: none"> ● Incorrect fluid level or fluid quality. ● Worn oil pump. ● Under-inflated or oversized tires. 	<ul style="list-style-type: none"> ● CHECK that the transfer case is filled to the correct level and with the specified fluid. REFER to Section 308-03A for T50D transmissions or Section 308-03B for TR3650 transmissions. ● DISASSEMBLE the transfer case. CHECK the oil pump for wear or damage. REPAIR as necessary. ● CONFIRM that the tires and wheels are correct for the vehicle. CHECK that the tire inflation pressures are correct.
<ul style="list-style-type: none"> ● Transfer case growl/rumble—noise at all ranges (A small amount of planetary noise can be heard when the transfer case is operated in low range.) 	<ul style="list-style-type: none"> ● Damaged or worn bearings or planetary gear. 	<ul style="list-style-type: none"> ● DISASSEMBLE the transfer case. CHECK the bearings or planetary gear for wear or damage. REPAIR as necessary.
<ul style="list-style-type: none"> ● Transfer case scraping/grating—noise at all ranges 	<ul style="list-style-type: none"> ● Excessively stretched drive chain hitting the case. 	<ul style="list-style-type: none"> ● DISASSEMBLE the transfer case. CHECK the drive chain for wear or damage. REPAIR as necessary.
<ul style="list-style-type: none"> ● Transfer case howl/hum—noise at all ranges or high range only 	<ul style="list-style-type: none"> ● Worn or damaged sun (input) gear, clutch pack (intermediate) gear or output shaft gear. 	<ul style="list-style-type: none"> ● DISASSEMBLE the transfer case. CHECK the gears for wear or damage. REPAIR as necessary.
<ul style="list-style-type: none"> ● Transfer case howl/hum—noise at low range only 	<ul style="list-style-type: none"> ● Worn or damaged intermediate gear and sliding gears (clutch pack). 	<ul style="list-style-type: none"> ● DISASSEMBLE the transfer case. CHECK the gears for wear or damage. REPAIR as necessary.
<ul style="list-style-type: none"> ● Transfer case vibration—vibration felt with vehicle in 4WD 	<ul style="list-style-type: none"> ● Transfer case mounting. ● Driveshaft out of balance. ● Excessive pinion 	<ul style="list-style-type: none"> ● Go To Pinpoint Test M.

flange runout.

Symptom Chart—Transmission (Automatic) Noise/Vibration

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● Rattle—occurs at idle or at light acceleration from a stop 	<ul style="list-style-type: none"> ● Damaged engine or transmission mounts. ● A loose front exhaust pipe heat shield. ● Loose inspection plate or dust cover plate. ● Loose flex plate to converter nuts. 	<ul style="list-style-type: none"> ● CHECK the powertrain/drivetrain mounts for damage. REPAIR or INSTALL new mounts as necessary. ● REPAIR or INSTALL a new heat shield as necessary. ● CHECK for loose bolts. TIGHTEN to specifications. REFER to Section 307-01. ● CHECK for loose nuts. TIGHTEN to specifications. REFER to Section 307-01.
<ul style="list-style-type: none"> ● Whine—pitch increases with vehicle speed. Starts in first and second gear, decreases or goes away at higher gears 	<ul style="list-style-type: none"> ● Damaged or worn low one-way clutch. ● Damaged or worn intermediate one-way clutch. ● Friction elements. ● Damaged or worn planetary or sun gear. 	<ul style="list-style-type: none"> ● INSPECT the transmission for wear or damage. REPAIR or INSTALL new components as necessary. REFER to Section 307-01.
<ul style="list-style-type: none"> ● Whine—the pitch changes with engine speed 	<ul style="list-style-type: none"> ● A worn or damaged accessory drive component. ● Incorrect fluid level. ● Partially blocked filter. ● Worn or damaged torque converter. ● Worn or damaged front pump. 	<ul style="list-style-type: none"> ● CARRY OUT the Engine Accessory Test. REPAIR or INSTALL new components as necessary. ● CHECK that the transmission is filled to the correct level. ADD fluid as necessary. REFER to Section 307-01. ● INSPECT the filter. CLEAN or INSTALL a new filter as necessary. REFER to Section 307-01. ● CARRY OUT the torque converter service and replacement check. REFER to Section 307-01. ● INSPECT the front pump. INSTALL a new front pump as necessary. REFER to Section 307-01.
<ul style="list-style-type: none"> ● Whine—pitch changes with vehicle speed 	<ul style="list-style-type: none"> ● Speedometer cable or gears. 	<ul style="list-style-type: none"> ● REPAIR or INSTALL new cables or gears as necessary.
<ul style="list-style-type: none"> ● Whine/moan type noise—pitch increases or changes with vehicle speed 	<ul style="list-style-type: none"> ● Damaged engine or transmission mount. ● U-joints worn or 	<ul style="list-style-type: none"> ● CHECK the powertrain/drivetrain mounts for damage. CARRY OUT Powertrain/Drivetrain Mount Neutralizing in this section. ● INSPECT the U-joints for

	<p>damaged.</p> <ul style="list-style-type: none"> ● Damaged or worn differential ring and pinion. ● Planetary gears nicked or chipped. 	<p>wear or damage. INSTALL new U-joints as necessary. REFER to Section 205-01.</p> <ul style="list-style-type: none"> ● INSPECT the differential ring and pinion for damage. CARRY OUT the Checking Tooth Contact Pattern and Condition of the Ring and Pinion component test in this section. REPAIR or INSTALL a new differential ring and pinion as necessary. REFER to Section 205-02A for Ford 7.5 rear axles or Section 205-02B for Ford 8.8 integral axles. ● CHECK the planetary gears for damage. INSTALL new components as necessary. REFER to Section 307-01.
<ul style="list-style-type: none"> ● Whistle—noise is high pitched, constant. Changes in pitch with throttle position 	<ul style="list-style-type: none"> ● Hydraulic pressure in the main control. ● Incorrect band/clutch apply pressure. ● Worn or damaged torque converter. 	<ul style="list-style-type: none"> ● INSPECT the main control. REPAIR or INSTALL new components as necessary. REFER to Section 307-01. ● CARRY OUT the line pressure tests. REPAIR or INSTALL components as necessary. REFER to Section 307-01. ● CARRY OUT the torque converter service and replacement check. REFER to Section 307-01.
<ul style="list-style-type: none"> ● Clunk—occurs when shifting from PARK to a drive or reverse position 	<ul style="list-style-type: none"> ● Damaged powertrain mounts. ● Damaged or worn pinion bearings. ● Worn or galled driveshaft slip yoke splines. ● Worn friction elements or excessive clutch pack end plate play. 	<ul style="list-style-type: none"> ● INSPECT the powertrain mounts for damage. INSTALL new mounts as necessary. ● CHECK for abnormal bearing play or roughness. INSTALL new bearings as necessary. REFER to Section 205-02A for Ford 7.5 rear axles or Section 205-02B for Ford 8.8 integral axles. ● CLEAN and INSPECT the splines of the yoke. INSTALL a new slip yoke as necessary. REFER to Section 205-01. ● INSPECT the transmission for wear. CHECK that all end play and clearances are within specification. REPAIR or INSTALL new components as necessary. REFER to Section 307-01.

<ul style="list-style-type: none"> ● Bump—occurs when shifting from PARK to a drive or reverse position. Similar to Clunk but with no sound 	<ul style="list-style-type: none"> ● Initial gear engagement. 	<ul style="list-style-type: none"> ● Acceptable condition.
<ul style="list-style-type: none"> ● Buzz or hiss 	<ul style="list-style-type: none"> ● Incorrect driveline angles. ● Worn or damaged main control solenoids or valves. 	<ul style="list-style-type: none"> ● CHECK for correct driveline angles. REPAIR as necessary. REFER to Section 205-00. ● Using a transmission tester, ACTIVATE the solenoids to duplicate sound. INSTALL new components as necessary. REFER to Section 307-01.
<ul style="list-style-type: none"> ● Vibration—a high frequency (20–80 Hz) that is felt through the seat or gear shifter. Changes with engine speed 	<ul style="list-style-type: none"> ● Transmission cooler lines grounded out. ● Flexplate to torque converter nuts loose. ● Fluid filler tube grounded out. ● Shift cable incorrectly routed, grounded out or loose. 	<ul style="list-style-type: none"> ● CHECK the transmission cooler lines. REPAIR as necessary. ● CHECK the flexplate nuts. TIGHTEN to specification. REFER to Section 307-01. ● CHECK the fluid filler tube. REPAIR as necessary. ● CHECK the shift cable. REPAIR as necessary. Section 307-05.
<ul style="list-style-type: none"> ● Shutter or chatter—occurs with light to medium acceleration from low speeds or a stop 	<ul style="list-style-type: none"> ● Electrical inputs/outputs. ● Vehicle wiring harness. ● Incorrect inputs/outputs from the powertrain control module (PCM), digital transmission range (TR) sensor, brake pedal position (BPP) sensor, throttle position (TP) sensor, transmission speed sensor (TSS), output speed shaft (OSS) sensor or the torque converter clutch (TCC). 	<ul style="list-style-type: none"> ● CARRY OUT a Torque Converter Clutch Operation Test. RUN on-board diagnostics or self-test. REFER to Section 307-01. CLEAR the DTC's, ROAD TEST and RERUN on-board diagnostics or self-test.



Pinpoint Tests

The pinpoint tests are a step-by-step diagnostic process designed to determine the cause of a

condition. It may not always be necessary to follow a pinpoint test to its conclusion. Carry out only the steps necessary to correct the condition. Then, test the system for normal operation. Sometimes, it is necessary to remove various vehicle components to gain access to the component requiring testing. Reinstall all components after verifying system operation is normal.

PINPOINT TEST A: BRAKE VIBRATION/SHUDDER

Test Step	Result / Action to Take
A1 ROAD TEST THE VEHICLE—LIGHT BRAKING	
<ul style="list-style-type: none"> ● Check that the wheel and tires are correct for the vehicle. Inspect the tires for abnormal wear patterns. ● Road test the vehicle. Warm the brakes by slowing the vehicle a few times from 80–32 km/h (50 to 20 mph) using light braking applications. At highway speeds of 89–97 km/h (55-60 mph), apply the brake using a light pedal force. ● Is there a vibration/shudder felt in the steering wheel, seat or brake pedal? 	<p>Yes GO to A4.</p> <p>No GO to A2.</p>
A2 ROAD TEST THE VEHICLE—MODERATE TO HEAVY BRAKING	
<ul style="list-style-type: none"> ● Road test the vehicle. At highway speeds of 89–97 km/h (55-60 mph), apply the brake using a moderate to heavy pedal force. ● Is there a vibration/shudder? 	<p>Yes For vehicles with ABS, GO to A3. For vehicles with standard brakes, GO to A4.</p> <p>No Vehicle is OK. VERIFY condition with customer. TEST the vehicle for normal operation.</p>
A3 NORMAL ACTUATION OF THE ABS SYSTEM DIAGNOSIS	
<ul style="list-style-type: none"> ● During moderate to heavy braking, noise from the hydraulic control unit (HCU) and pulsation in the brake pedal can be observed. Pedal pulsation coupled with noise during heavy braking or on loose gravel, bumps, wet or snowy surfaces is acceptable and indicates correct functioning of the ABS system. Pedal pulsation or steering wheel nibble, (frequency is proportioned to the vehicle speed) indicates a concern with a brake or suspension component. ● Is the vibration/shudder vehicle speed sensitive? 	<p>Yes GO to A5.</p> <p>No The brake system is operating correctly.</p>
A4 APPLICATION OF THE PARKING BRAKE	
<ul style="list-style-type: none"> ● NOTE: Begin at the front of the vehicle unless the vibration or shudder has been isolated to the rear. ● This test is not applicable to vehicles with drum-in-hat type parking brakes. For vehicles with drum-in-hat parking brakes, proceed to the next test. For all other vehicles, apply the parking brake to identify if the problem is in the front or rear brake. At highway speeds of 89–97 km/h (55-60 mph), lightly apply the parking brake until the vehicle slows down. Release the parking brake immediately after the test. ● Is there a vibration/shudder? 	<p>Yes GO to A7.</p> <p>No GO to A5.</p>
A5 CHECK THE FRONT WHEEL BEARINGS	
<ul style="list-style-type: none"> ● Check the front wheel bearings. Refer to Wheel Bearing Check in this section. ● Are the wheel bearings OK? 	<p>Yes GO to A6.</p>

	<p>No INSPECT the wheel bearings. ADJUST or REPAIR as necessary. TEST the system for normal operation.</p>
A6 CHECK THE FRONT SUSPENSION	
<ul style="list-style-type: none"> ● Check the front suspension for: <ul style="list-style-type: none"> ● Broken or loose bolts. ● Damaged springs. ● Worn or damaged upper and lower control arm bushings. ● Loose or rough front bearings. ● Uneven tire wear. ● Are all the suspension components in satisfactory condition? 	<p>Yes GO to A7.</p> <p>No REPAIR or INSTALL new components as necessary. TEST the system for normal operation.</p>
A7 RESURFACE THE FRONT BRAKE DISCS	
<ul style="list-style-type: none"> ●  CAUTION: Do not use a bench lathe to machine brake discs. ● NOTE: Follow the manufacturer's instructions to machine the brake discs. After machining, make sure the brake disc meets the thickness specification. ● Refer to Brake Disc Machining in this section. Resurface the front brake discs. Road test the vehicle. ● Is the vibration/shudder present? 	<p>Yes GO to A8.</p> <p>No Vehicle is OK.</p>
A8 CHECK THE REAR SUSPENSION	
<ul style="list-style-type: none"> ● Check the rear suspension for: <ul style="list-style-type: none"> ● Broken or loose bolts. ● Damaged or worn springs or spring bushings. ● Worn or damaged upper and lower control arm bushings. ● Worn or damaged trailing arms. ● Loose or rough rear bearings. ● Uneven tire wear. ● Are all the suspension components in satisfactory condition? 	<p>Yes GO to A9.</p> <p>No REPAIR or INSTALL new components as necessary. TEST the system for normal operation.</p>
A9 RESURFACE THE REAR BRAKE DISC OR DRUM	
<ul style="list-style-type: none"> ●  CAUTION: Do not use a bench lathe to machine brake discs. ● NOTE: Follow the manufacturers instructions to machine the brake discs. After machining, make sure the brake disc meets the thickness specification. ● Refer to Brake Disc Machining in this section. Resurface the rear brake discs or drums. Road test the vehicle. ● Is the vibration/shudder present? 	<p>Yes CHECK the front suspension for wear or damage. RESURFACE the front brake discs. TEST the system for normal operation.</p> <p>No Vehicle is OK.</p>

PINPOINT TEST B: ENGINE TICKING NOISE

Test Step	Result / Action to Take
B1 CHECK FOR TICKING NOISE AT THE FUEL RAIL	
<ul style="list-style-type: none"> ● Disconnect the first fuel line clip. 	Yes

<ul style="list-style-type: none"> ● Is the ticking noise gone? 	<p>CHECK for TSB for applicable vehicle. REPAIR as necessary. TEST the system for normal operation.</p> <p>No GO to B2.</p>
<p>B2 CHECK FOR TICKING NOISE AT THE FUEL INJECTOR</p>	
<ul style="list-style-type: none"> ● Using an EngineEAR, listen at the fuel injectors by placing a probe on each injector. To isolate the faulty injector, disconnect the injector electrical connector and listen for the noise. ● Is the fuel injector the source of the ticking noise? 	<p>Yes INSTALL a new fuel injector. REFER to Section 303-04A for 3.8L engines or Section 303-04B for 4.6L (2V) engines. TEST the system for normal operation.</p> <p>No GO to B3.</p>
<p>B3 CHECK THE BELT TENSIONER FOR TICKING NOISE</p>	
<ul style="list-style-type: none"> ● Inspect the accessory drive. Check for the belt tensioner bottoming at end of travel or not at end of stroke. ● Using an EngineEAR, listen at the belt tensioner. ● Is the belt tensioner the source of the noise? 	<p>Yes INSTALL a new belt tensioner. TEST the system for normal operation.</p> <p>No GO to B4.</p>
<p>B4 CHECK THE WATER PUMP FOR TICKING NOISE</p>	
<ul style="list-style-type: none"> ● Using an EngineEAR, listen at the water pump for ticking noise. ● Is the water pump the source of the noise? 	<p>Yes INSTALL a new water pump. REFER to Section 303-03A. TEST the system for normal operation.</p> <p>No GO to B5.</p>
<p>B5 CHECK FOR AN OBSTRUCTION OF THE COOLING FAN</p>	
<ul style="list-style-type: none"> ● Inspect the cooling fan for obstructions. ● Check the cooling fan and shroud for wear or damage. ● Was there an obstruction or does the cooling fan show signs of damage? 	<p>Yes REPAIR or INSTALL a new cooling fan. REFER to Section 303-03A. TEST the system for normal operation.</p> <p>No GO to B6.</p>
<p>B6 CHECK THE OIL PUMP FOR TICKING NOISE</p>	
<ul style="list-style-type: none"> ● Check the oil pump using EngineEARs and probe at the oil filter adapter to verify the oil pump as a source. ● Is the oil pump the source of the noise? 	<p>Yes INSTALL a new oil pump. REFER to Section 303-01A for 3.8L engines or Section 303-01B for 4.6L (2V) engines. TEST the system for normal operation.</p> <p>No GO to B7.</p>
<p>B7 CHECK VALVE LIFTERS OR LASH ADJUSTERS FOR CORRECT OPERATION</p>	
<ul style="list-style-type: none"> ● Check valve lifter/lash adjuster for correct operation, using EngineEARs. ● Are the valve lifters/lash adjusters 	<p>Yes VERIFY customer concern. CONDUCT a diagnosis of other suspect components.</p>

operating correctly?	No INSTALL a new valve lifter/lash adjuster (s). TEST the system for normal operation.
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PINPOINT TEST C: ACCESSORY DRIVE BEARING HOOT

Test Step	Result / Action to Take
C1 CHECK THE IDLER AND TENSIONER PULLEY BEARINGS	Yes INSTALL a new pulley/idler. CARRY OUT the Vehicle Cold Soak Procedure and TEST the system for normal operation. No CONDUCT a diagnosis on other suspect accessory drive components.
<ul style="list-style-type: none"> ● Carry out the Vehicle Cold Soak Procedure in this section. ● Key in START position. ● Place an EngineEAR probe directly on the pulley center post or bolt to verify which bearing is making the noise. ● Key in OFF position. ● Is either bearing making the noise? 	

PINPOINT TEST D: POWER STEERING MOAN

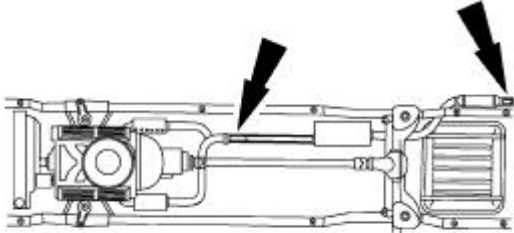
Test Step	Result / Action to Take
D1 CHECK THE POWER STEERING SYSTEM	Yes GO to D2 . No CONDUCT a diagnosis on other suspect accessory drive components.
<ul style="list-style-type: none"> ● Carry out the Vehicle Cold Soak Procedure in this section. ● Key in START position. ● Turn the steering wheel while the noise is occurring and listen for changes in sound pitch or loudness. ● Key in OFF position. ● Does the sound pitch or loudness change while turning the steering wheel? 	
D2 VERIFY THE SOURCE	Yes VERIFY that the supply tube to the pump is unobstructed. CHECK the fluid condition and level. DRAIN the fluid and REFILL. CARRY OUT the Vehicle Cold Soak Procedure and TEST the system for normal operation. REFER to Section 211-02 . No Normal system operation.
<ul style="list-style-type: none"> ● Key in START position. ● Place an EngineEAR probe near the power steering pump/reservoir while the noise is occurring. While an assistant turns the steering wheel, listen for changes in sound pitch or loudness. ● Key in OFF position. ● Does the sound pitch or loudness change while turning the steering wheel? 	

PINPOINT TEST E: ENGINE DRIVEN COOLING FAN MOAN

Test Step	Result / Action to Take
E1 CHECK THE ENGINE DRIVEN COOLING FAN AFTER A COLD SOAK	

<ul style="list-style-type: none"> ● Carry out the Vehicle Cold Soak Procedure in this section. ● Key in START position. ● Assess the airflow. ● Raise the engine speed to 1500 rpm while listening for the moan to increase in proportion to the airflow. ● Key in OFF position. ● Does the moan increase in proportion to the airflow? 	<p>Yes TEST the fan for normal operation. If the fan tests normal, GO to E2. Otherwise, REPAIR as necessary.</p> <p>No Normal system operation.</p>
<p>E2 CHECK THE ENGINE DRIVEN COOLING FAN AT NORMAL OPERATING TEMPERATURE</p>	<p>Yes Normal clutch operation.</p> <p>No INSTALL a new fan clutch. TEST the system for normal operation.</p>
<ul style="list-style-type: none"> ● Key in START position. ● Run the engine to normal operating temperature while listening for the moan to stop. ● Key in OFF position. ● Does the moan stop? 	

PINPOINT TEST F: DRUMMING NOISE

Test Step	Result / Action to Take
<p>F1 CHECK THE EXHAUST SYSTEM</p> <ul style="list-style-type: none"> ● Key in START position. ● Increase the engine rpm until the noise is the loudest. Note the engine rpm. ● Key in OFF position. ● Add approximately 9 kg (20 lb) of weight to the exhaust system. First place the weight at the tail pipe and test, then at the front pipe.  <p>DF1768-A</p> <ul style="list-style-type: none"> ● Key in START position. ● Increase the engine rpm and listen for the drumming noise. Note the engine rpm if the noise occurs. ● Key in OFF position. ● Using a vibration analyzer (VA), determine the amount of vibration that occurs with the drumming noise. ● Is the noise/vibration reduced or eliminated, or does the noise/vibration occur at a different rpm? 	<p>Yes CARRY OUT Exhaust System Neutralizing in this section. TEST the system for normal operation.</p> <p>No GO to F2.</p>
<p>F2 POWERTRAIN/DRIVETRAIN MOUNT NEUTRALIZING</p>	<p>Yes Vehicle OK. TEST the system for normal operation.</p> <p>No</p>
<ul style="list-style-type: none"> ● Carry out Powertrain/Drivetrain Mount Neutralizing in this section. Test the system for normal operation. ● Is the noise reduced or eliminated? 	


CONDUCT diagnosis of other suspect components.

PINPOINT TEST G: ENGINE TICKING, KNOCKING OR CONTINUOUS RATTLE

Test Step	Result / Action to Take
G1 CHECK FOR NOISE AT THE VALVE COVERS AND THE FRONT COVERS (OHC ENGINES) <ul style="list-style-type: none"> ● Carry out the Vehicle Cold Soak Procedure in this section. ● Key in START position. ● NOTE: For a short-duration ticking noise, multiple engine starts may be necessary. ● Using an EngineEAR, listen closely at the valve covers and the front covers (OHC engines) by placing the probe near the surface of the valve cover and then on the surface front cover. ● Key in OFF position. ● Is the noise source apparent? 	<p>Yes REMOVE the appropriate cover and INSPECT for loose, worn/broken components. REPAIR as necessary. TEST the system for normal operation.</p> <p>No GO to G2.</p>
G2 CHECK FOR NOISE AT THE CYLINDER BLOCK <ul style="list-style-type: none"> ● Key in START position. ● Using an EngineEAR, listen closely at the cylinder block by placing a probe on or near each freeze plug. ● Key in OFF position. ● Is the noise source apparent? 	<p>Yes REPAIR or INSTALL new components as necessary.</p> <p>No GO to G3.</p>
G3 CHECK FOR NOISE WHILE DISCONNECTING EACH FUEL INJECTOR ELECTRICAL CONNECTOR, ONE AT A TIME <ul style="list-style-type: none"> ● Key in START position. ● Disconnect each fuel injector electrical connector, one at a time, to decrease piston force and listen for the noise. ● Key in OFF position. ● Is the noise reduced or eliminated? 	<p>Yes INSTALL a new fuel injector. TEST the system for normal operation.</p> <p>No INSPECT accessory drive system or the transmission as a possible source.</p>


PINPOINT TEST H: FRONT SUSPENSION NOISE

Test Step	Result / Action to Take
H1 ROAD TEST THE VEHICLE <ul style="list-style-type: none"> ● Test drive the vehicle. ● NOTE: An assistant will be needed for this road test. ● During the road test, drive the vehicle over a rough road. Using ChassisEARs, determine from which area/component the noise is originating. ● Is there a squeak, creak or rattle noise? 	<p>Yes GO to H2.</p> <p>No The suspension system is OK. CONDUCT a diagnosis on other suspect systems.</p>
H2 INSPECT THE STEERING SYSTEM	<p>Yes</p>

<ul style="list-style-type: none"> ●  WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations. ● Raise and support the vehicle. ● Check the steering system for wear or damage. Carry out a steering linkage test. Refer Section 211-00. ● Inspect the tire wear pattern. Refer to Tire Wear Patterns chart in this section. ● Are the steering components worn or damaged? 	REPAIR the steering system. INSTALL new components as necessary. TEST the system for normal operation. No GO to H3 .
H3 FRONT SHOCK ABSORBER/STRUT CHECK	
<ul style="list-style-type: none"> ● Check the front shock absorbers/strut mounts for loose bolts or nuts. ● Check the front shock absorbers/struts for wear or damage. Carry out a "bounce test". ● Are the front shock absorbers/struts loose or damaged? 	Yes TIGHTEN to specifications if loose. INSTALL new front shock absorbers/struts if damaged. TEST the system for normal operation. No GO to H4 .
H4 CHECK THE FRONT SPRINGS	
<ul style="list-style-type: none"> ● Check the front spring and front spring mounts/brackets for wear or damage. ● Are the front springs or spring mounts/brackets worn or damaged? 	Yes REPAIR or INSTALL new components as necessary. TEST the system for normal operation. No GO to H5 .
H5 CHECK THE CONTROL ARMS/RADIUS ARMS	
<ul style="list-style-type: none"> ● Inspect the control arm bushings for wear or damage. ● Inspect for twisted or bent control/radius arm. ● Are the control/radius arms damaged or worn? 	Yes REPAIR or INSTALL new components as necessary. TEST the system for normal operation. No GO to H6 .
H6 CHECK THE STABILIZER BAR/TRACK BAR	
<ul style="list-style-type: none"> ● Check the stabilizer bar/track bar bushings and links for damage or wear. ● Check the stabilizer bar/track bar for damage. ● Check for loose or damaged stabilizer bar isolators or brackets. ● Are the stabilizer bar/track bar components loose, worn or damaged? 	Yes REPAIR or INSTALL new components as necessary. TEST the system for normal operation. No Suspension system OK. CONDUCT diagnosis on other suspect systems.


PINPOINT TEST I: REAR SUSPENSION NOISE

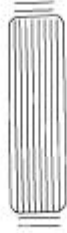
Test Step	Result / Action to Take
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I1 ROAD TEST THE VEHICLE	
<ul style="list-style-type: none"> ● Test drive the vehicle. ● NOTE: An assistant will be needed for this road test. ● During the road test, drive the vehicle over a rough road. Using ChassisEARS, determine from which area/component the noise is originating. ● Is there a squeak, creak or rattle noise? 	<p>Yes GO to 12.</p> <p>No The suspension system is OK. Conduct a diagnosis on other suspect systems.</p>
I2 REAR SHOCK ABSORBER/STRUT CHECK	
<ul style="list-style-type: none"> ●  WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations. ● Raise and support the vehicle. ● Check the rear shock absorber/strut mounts for loose bolts or nuts. ● Check the rear shock absorbers/struts for damage. Carry out a shock absorber check. ● Are the rear shock absorbers/struts loose or damaged? 	<p>Yes TIGHTEN to specifications if loose. INSTALL new rear shock absorbers/struts if damaged. TEST the system for normal operation.</p> <p>No GO to 13.</p>
I3 CHECK THE REAR SPRINGS	
<ul style="list-style-type: none"> ● Check the rear springs and rear spring mounts/brackets for wear or damage. ● Are the rear springs or spring mounts/brackets worn or damaged? 	<p>Yes REPAIR or INSTALL new components as necessary. TEST the system for normal operation.</p> <p>No GO to 14.</p>
I4 CHECK THE CONTROL ARMS/TRAILING ARMS	
<ul style="list-style-type: none"> ● Inspect the control arm/trailing arm bushings for wear or damage. Check for loose control arm/trailing arm bolts. ● Inspect for twisted or bent control arm/trailing arms. ● Are the control arm/trailing arms loose, damaged or worn? 	<p>Yes REPAIR or INSTALL new components as necessary. TEST the system for normal operation.</p> <p>No GO to 15.</p>
I5 CHECK THE STABILIZER BAR/TRACK BAR	
<ul style="list-style-type: none"> ● Check the stabilizer bar/track bar bushings and links for damage or wear. ● Check the stabilizer bar/track bar for damage. ● Check for loose or damaged stabilizer bar isolators or brackets. ● Are the stabilizer bar/track bar components loose, worn or damaged? 	<p>Yes REPAIR or INSTALL new components as necessary. TEST the system for normal operation.</p> <p>No Suspension system OK. CONDUCT diagnosis on other suspect systems.</p>

PINPOINT TEST J: WHEEL AND TIRE

Test Step	Result / Action to
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	Take
<p>J1 ROAD TEST THE VEHICLE</p> <ul style="list-style-type: none"> ● NOTE: Wheel or tire vibrations felt in the steering wheel are most likely related to the front wheel or tire. Vibration felt through the seat are most likely related to the rear wheel or tire. This may not always be true, but it can help to isolate the problem to the front or rear of the vehicle. ● Test drive the vehicle at different speed ranges. ● During the road test, if the vibration can be eliminated by placing the vehicle in neutral or is affected by the speed of the engine, the cause is not the wheels or tires. ● Is there a vibration and noise? 	<p>Yes GO to J2.</p> <p>No The wheel and tires are OK. CONDUCT a diagnosis on other suspect systems.</p>
<p>J2 CHECK THE FRONT WHEEL BEARINGS</p> <ul style="list-style-type: none"> ● Check the front wheel bearings. Refer to Wheel Bearing Check in this section. ● Are the wheel bearings OK? 	<p>Yes GO to J3.</p> <p>No INSPECT the wheel bearings. ADJUST or REPAIR as necessary. TEST the system for normal operation.</p>
<p>J3 INSPECT THE TIRES</p> <ul style="list-style-type: none"> ● Check the tires for missing weights. ● Check the wheels for damage. ● Inspect the tire wear pattern. Refer to the Tire Wear Patterns chart in this section. ● Do the tires have an abnormal wear pattern? 	<p>Yes CORRECT the condition that caused the abnormal wear. INSTALL new tire(s). TEST the system for normal operation.</p> <p>No GO to J4.</p>
<p>J4 TIRE ROTATION</p> <ul style="list-style-type: none"> ● Spin the tires slowly and watch for signs of lateral runout. <div style="text-align: center;">  </div> <p style="text-align: center;">DF1713-A</p> <ul style="list-style-type: none"> ● Spin the tires slowly and watch for signs of radial runout. 	<p>Yes GO to J5.</p> <p>No CHECK the wheel and tire balance. CORRECT as necessary. TEST the system for normal operation.</p>

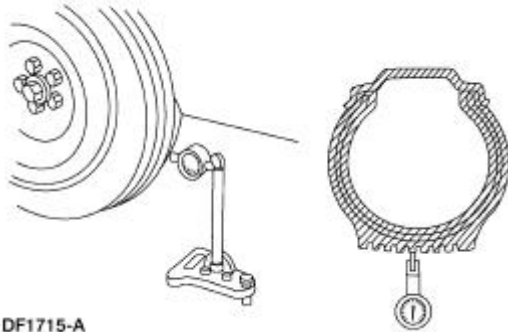


DF1714-A

- Are there signs of visual runout?

J5 RADIAL RUNOUT CHECK ON THE TIRE

- Measure the radial runout of the wheel and tire assembly. A typical specification for total radial runout is 0.045 inch.



DF1715-A

- Is the radial runout within specifications?

Yes
GO to [J8](#).

No
GO to [J6](#).

J6 RADIAL RUNOUT CHECK ON THE WHEEL

- Measure the radial runout of the wheel. A typical specification for total radial runout is 0.045 inch.
- Is the radial runout within specifications?

Yes
INSTALL a new tire.
TEST the system for normal operation.

No
GO to [J7](#).

J7 CHECK THE HUB/BRAKE DISC OR DRUM PILOT RUNOUT OR BOLT CIRCLE RUNOUT

- Measure the pilot or bolt circle runout. A typical specification for radial runout is:
 - Pilot runout— less than 0.15 mm (0.006 inch).
 - Bolt circle runout— less than 0.38 mm (0.015 inch).
- Is the radial runout within specifications?

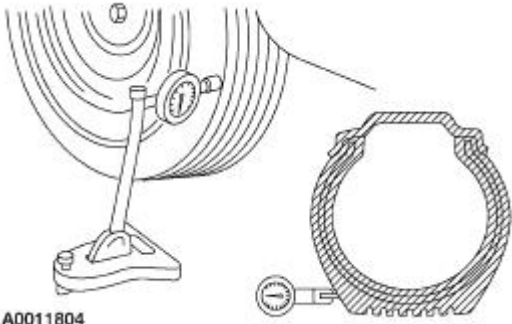
Yes
INSTALL a new wheel.
TEST the system for normal operation.

No
REPAIR or INSTALL new components as necessary. REFER to [Section 204-01](#) for the front wheels or [Section 204-02](#) for the rear wheels.

J8 LATERAL RUNOUT CHECK ON THE TIRE

- Measure the lateral runout of the wheel and tire assembly. A typical specification for total lateral runout is 1.14 mm (0.045 inch).

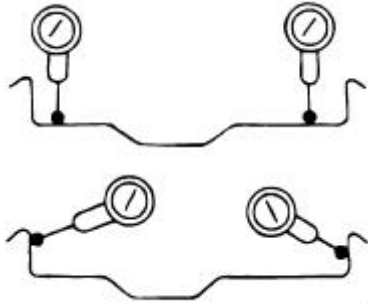
Yes
Wheel and tires OK.
CONDUCT diagnosis on other suspect systems.

 <p>A0011804</p> <ul style="list-style-type: none"> ● Is the lateral runout within specifications? 	<p>No GO to J9.</p>
<p>J9 LATERAL RUNOUT CHECK ON THE WHEEL</p>	
<ul style="list-style-type: none"> ● Measure the lateral runout of the wheel. A typical specification for total radial runout is 1.14mm (0.045 inch). ● Is the lateral runout within specifications? 	<p>Yes INSTALL a new tire. TEST the system for normal operation.</p> <p>No GO to J10.</p>
<p>J10 CHECK THE FLANGE FACE LATERAL RUNOUT</p>	
<ul style="list-style-type: none"> ● Measure the flange face lateral runout. A typical specification for lateral runout is: <ul style="list-style-type: none"> ● Hub/brake disc— less than 0.13 mm (0.005 inch). ● Axle shaft— less than 0.25 mm (0.010 inch). ● Is the lateral runout within specifications? 	<p>Yes INSTALL a new wheel. TEST the system for normal operation.</p> <p>No REPAIR or INSTALL new components as necessary. REFER to Section 204-01 for the front wheels or Section 204-02 for the rear wheels.</p>

PINPOINT TEST K: HIGH SPEED SHAKE OR SHIMMY

Test Step	Result / Action to Take
<p>K1 CHECK FOR FRONT WHEEL BEARING ROUGHNESS</p>	
<ul style="list-style-type: none"> ● Chock the rear wheels. ● Raise and support the front end of the vehicle so that the front wheel and tire assemblies can spin. ● Spin the front tires by hand. Refer to Wheel Bearing Check in this section. ● Do the wheel bearings feel rough? 	<p>Yes INSPECT the wheel bearings. REPAIR as necessary. TEST the system for normal operation.</p> <p>No GO to K2.</p>
<p>K2 CHECK THE END PLAY OF THE FRONT WHEEL BEARINGS</p>	
<ul style="list-style-type: none"> ● Check the end play of the front wheel bearings. Refer to Section 204-01. ● Is the end play OK? 	<p>Yes GO to K3.</p> <p>No ADJUST or REPAIR as necessary. TEST the system for normal</p>

	operation.
K3 MEASURE THE LATERAL RUNOUT AND THE RADIAL RUNOUT OF THE FRONT WHEELS ON THE VEHICLE	
<ul style="list-style-type: none"> ● Measure the lateral runout and the radial runout of the front wheels on the vehicle. Refer to Go To Pinpoint Test J. ● Are the measurements within specifications? 	<p>Yes GO to K4.</p> <p>No INSTALL new wheels as necessary and BALANCE the assembly. TEST the system for normal operation.</p>
K4 MEASURE THE LATERAL RUNOUT OF THE FRONT TIRES ON THE VEHICLE	
<ul style="list-style-type: none"> ● Measure the lateral runout of the front tires on the vehicle. Go To Pinpoint Test J. ● Is the runout within specifications? 	<p>Yes GO to K5.</p> <p>No INSTALL new tires as necessary and BALANCE the assembly. TEST the system for normal operation.</p>
K5 MEASURE THE RADIAL RUNOUT OF THE FRONT TIRES ON THE VEHICLE	
<ul style="list-style-type: none"> ● Measure the radial runout of the front tires on the vehicle. Go To Pinpoint Test J. ● Is the runout within specifications? 	<p>Yes BALANCE the front wheel and tire assemblies. If any tire cannot be balanced, INSTALL a new tire. TEST the system for normal operation.</p> <p>No GO to K6.</p>
K6 MATCH MOUNT THE TIRE AND WHEEL ASSEMBLY	
<ul style="list-style-type: none"> ● Mark the high runout location on the tire and also on the wheel. Break the assembly down and rotate the tire 180 degrees (halfway around) on the wheel. Inflate the tire and measure the radial runout. ● Is the runout within specifications? 	<p>Yes BALANCE the assembly. TEST the system for normal operation.</p> <p>No If the high spot is not within 101.6 mm (4 inches) of the first high spot on the tire, GO to K7.</p>
K7 MEASURE THE WHEEL FLANGE RUNOUT	
<ul style="list-style-type: none"> ● Dismount the tire and mount the wheel on a wheel balancer. Measure the runout on both wheel flanges. Go To Pinpoint Test J. 	<p>Yes LOCATE and MARK the low spot on the wheel. INSTALL the tire, matching the high spot on the tire with the low spot on the wheel. BALANCE the assembly. TEST the system for normal operation. If the condition</p>



DG0199-A

- Is the runout within specifications?

persists, GO to [K8](#).

No
 INSTALL a new wheel. CHECK the runout on the new wheel. If the new wheel is within limits, LOCATE and MARK the low spot. INSTALL the tire, matching the high spot on the tire with the low spot on the wheel. BALANCE the assembly. TEST the system for normal operation. If the condition persists, GO to [K8](#).

K8 CHECK FOR VIBRATION FROM THE FRONT OF THE VEHICLE



WARNING: If only one drive wheel is allowed to rotate, speed must be limited to 55 km/h (34 mph) using the speedometer reading, since actual wheel speed will be twice that indicated on the speedometer. Exceeding a speed of 55 km/h (34 mph) or allowing the drive wheel to hang unsupported can result in tire disintegration or differential failure, which can cause serious personal injury and extensive vehicle damage.

- Spin the front wheel and tire assemblies with a wheel balancer while the vehicle is raised on a hoist. Feel for vibration in the front fender or while seated in the vehicle.
- Is the vibration present?

Yes
 SUBSTITUTE known good wheel and tire assemblies as necessary. TEST the system for normal operation.

No
 GO to [K9](#).

K9 CHECK FOR VIBRATION FROM THE REAR OF THE VEHICLE



WARNING: If only one drive wheel is allowed to rotate, speed must be limited to 55 km/h (34 mph) using the speedometer reading, since actual wheel speed will be twice that indicated on the speedometer. Exceeding a speed of 55 km/h (34 mph) or allowing the drive wheel to hang unsupported can result in tire disintegration or differential failure, which can cause serious personal injury and extensive vehicle damage.

- Chock the front wheels.
- Raise and support the rear end of the vehicle so that the rear wheel and tire assemblies can spin.
- Engage the drivetrain and carefully accelerate the drive wheels while checking for vibration.
- Is the vibration present?

Yes
 GO to [K10](#).

No
 TEST the system for normal operation.

K10 CHECK THE DRIVETRAIN



WARNING: If only one drive wheel is allowed to rotate, speed must be limited to 55 km/h (34 mph) using the speedometer reading, since actual wheel speed will be twice that indicated on the speedometer. Exceeding a speed of 55 km/h (34 mph) or allowing the drive wheel to hang unsupported can result in tire disintegration or differential failure, which can cause serious personal injury and extensive vehicle damage.

- Remove the rear wheel and tire assemblies. Refer to the

Yes
 CHECK/TEST the drivetrain and driveline components. TEST the system for normal operation.

No
 SUBSTITUTE known good wheel and tire

- appropriate workshop manual for the service procedures.
- Secure the brake drums (if so equipped), by installing wheel hub bolt nuts, reversed.
- Carefully accelerate the drivetrain while checking for vibration.
- **Is the vibration present?**


assemblies as necessary.
TEST the system for normal operation.

PINPOINT TEST L: CLUTCH VIBRATION

Test Step	Result / Action to Take
<p>L1 CHECK ENGINE COMPONENTS FOR GROUNDING</p> <ul style="list-style-type: none"> ● NOTE: Make sure the clutch is the cause of the vibration concern. The vibration should occur during clutch operation. The clutch can also be difficult to engage or disengage. Eliminate all related systems before checking the clutch components. ● NOTE: Check the driveline angles and driveshaft runout before disassembling the clutch system. Refer to Section 205-00 for the correct driveline angle specifications. ● Check the powertrain/drivetrain mounts, exhaust manifolds or other engine components for grounding on the chassis. ● Are any mounts or engine components grounded? 	<p>Yes REPAIR as necessary. TEST the system for normal operation.</p> <p>No GO to L2.</p>
<p>L2 CHECK THE ACCESSORY DRIVE</p> <ul style="list-style-type: none"> ● Remove the accessory drive belt. ● Does the vibration stop with the accessory drive belt removed? 	<p>Yes DIAGNOSE the accessory drive components.</p> <p>No GO to L3.</p>
<p>L3 CHECK FOR LOOSE CLUTCH PRESSURE PLATE BOLTS</p> <ul style="list-style-type: none"> ● Check for loose clutch pressure plate bolts. Inspect the clutch pressure plate for damage or for material between the pressure plate and flywheel. ● Are there any loose bolts or damage? 	<p>Yes TIGHTEN the bolts to specifications or if damaged, INSTALL a new clutch pressure plate. REFER to Section 308-01. TEST the system for normal operation.</p> <p>No GO to L4.</p>
<p>L4 CHECK THE CLUTCH DISC SPRINGS</p> <ul style="list-style-type: none"> ● Check for worn, broken or loose clutch disc springs. ● Are the clutch springs worn, broken or loose? 	<p>Yes INSTALL a new clutch disc. REFER to Section 308-01. TEST the system for normal operation.</p> <p>No GO to L5.</p>
<p>L5 CHECK THE CLUTCH DISC SPLINES</p> <ul style="list-style-type: none"> ● Inspect the clutch disc splines for damage or wear. ● Is there damage or wear? 	<p>Yes INSTALL a new clutch disc. REFER to Section 308-01. TEST</p>

	the system for normal operation. No GO to L6 .
L6 CHECK THE FLYWHEEL BOLTS	
<ul style="list-style-type: none"> ● Check for loose flywheel bolts. ● Are the bolts loose? 	Yes TIGHTEN the bolts to specifications. REFER to Section 308-01 . TEST the system for normal operation. No GO to L7 .
L7 CHECK THE FLYWHEEL SURFACE	
<ul style="list-style-type: none"> ● Inspect the flywheel surface for wear or damage. Check the flywheel runout. ● Is there any damage or excessive wear? 	Yes INSTALL a new flywheel. TEST the system for normal operation. No Clutch system normal. CONDUCT a diagnosis on other suspect systems.

PINPOINT TEST M: TRANSFER CASE VIBRATION

Test Step	Result / Action to Take
M1 INSPECT THE TRANSFER CASE	
<ul style="list-style-type: none"> ●  WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations. ● Inspect the transfer case for loose or missing mounting bolts. Check for fluid seepage between the transfer case and the transmission. ● Are the mounting bolts missing or loose? 	Yes TIGHTEN to specifications or INSTALL new bolts as necessary. TEST the system for normal operation. No GO to M2 .
M2 INSPECT THE REAR DRIVESHAFT	
<ul style="list-style-type: none"> ● NOTE: Verify that the driveshaft and pinion flange index marks are aligned. ● Inspect the driveshaft for missing weights, damage or undercoating. ● Inspect the U-joints for freedom of movement. ● Check driveshaft runout and, if necessary, check the pinion flange runout. ● Is the driveshaft or U-joints worn or damaged or misaligned? 	Yes REPAIR or INSTALL a new driveshaft as necessary. TEST the system for normal operation. No GO to M3 .
M3 CHECK THE DRIVELINE ANGLES	
<ul style="list-style-type: none"> ● Measure the rear driveshaft and pinion angles. Refer to Section 205-00. ● Measure the front driveshaft and pinion angles. Refer to Section 205-00. ● Are the driveline angles incorrect? 	Yes REPAIR as necessary. TEST the system for normal operation. No

	GO to M4 .
M4 INSPECT THE FRONT DRIVESHAFT	
<ul style="list-style-type: none"> ● NOTE: Verify that the driveshaft and pinion flange index marks are aligned. ● Inspect the front driveshaft for missing weights, damage or undercoating. ● Inspect the U-joints and slip yoke for freedom of movement. ● Check driveshaft runout and, if necessary, check the pinion flange runout. ● Is the driveshaft or U-joints worn or damaged? 	<p>Yes REPAIR or INSTALL a new driveshaft as necessary. TEST the system for normal operation.</p> <p>No GO to M5.</p>
M5 ROAD TEST WITH THE FRONT DRIVESHAFT ONLY	
<ul style="list-style-type: none"> ● NOTE: Index mark the driveshaft to the pinion flange and to the output shaft before removal. ● Remove the rear driveshaft. ● Plug the transfer case with an output shaft seal plug. ● NOTE: Shift the transfer case into 4WD high so the vehicle is driven by the front driveshaft only. ● Test drive the vehicle. ● Is the vibration gone? 	<p>Yes INSTALL and BALANCE the rear driveshaft. TEST the system for normal operation.</p> <p>No GO to M6.</p>
M6 ROAD TEST WITH THE REAR DRIVESHAFT ONLY	
<ul style="list-style-type: none"> ● NOTE: Index mark the front driveshaft to the pinion flange. ● Remove the front driveshaft. ● Test drive the vehicle. ● Is the vibration gone? 	<p>Yes INSTALL and BALANCE the front driveshaft. TEST the system for normal operation.</p> <p>No GO to M7.</p>
M7 TRANSFER CASE TAIL SHAFT INSPECTION	
<ul style="list-style-type: none"> ● Inspect the splines of the output shaft for wear or damage. ● Inspect the splines of the driveshaft slip yoke for wear or damage. ● Are the splines worn or damaged? 	<p>Yes REPAIR or INSTALL new components as necessary. TEST the system for normal operation.</p> <p>No The transfer case is OK. CONDUCT a diagnosis on other suspect systems.</p>

Component Tests

Idle Air Control (IAC) Valve

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


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

Verify the condition by operating the vehicle for a short time.

3. Inspect the IAC valve. If physical evidence of contamination exists, install a new IAC valve.

4. While the noise is occurring, either place an EngineEAR probe near the IAC valve and the inlet tube, or create a 6.35 mm (0.25 in)-12.7 mm (0.50 in) air gap between the inlet tube and the clean air tube. If the IAC valve is making the noise, install a new IAC valve.
5. Test the vehicle for normal operation.

Steering Gear Grunt/Shudder Test

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

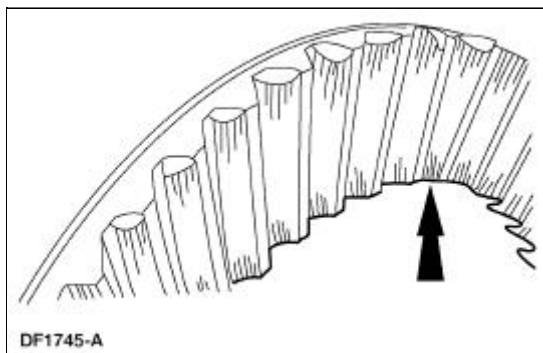
Rotate the steering wheel to the RH stop, then turn the steering wheel 90° back from that position. Turn the steering wheel slowly in a 15° to 30° arc.

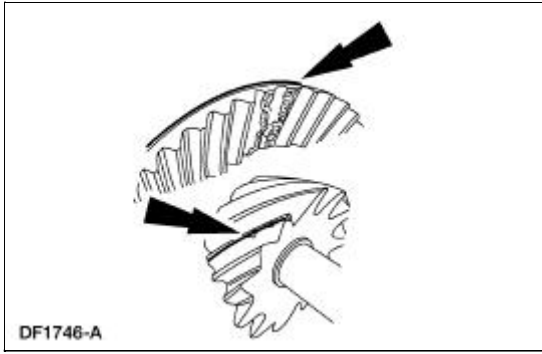
4. Turn the steering wheel another 90°. Turn the steering wheel slowly in a 15° to 30° arc.
5. Repeat the test with power steering fluid at different temperatures.
6. If a light grunt is heard or a low (50-200 Hz) shudder is present, this is a normal steering system condition.
7. If a loud grunt is heard,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

Checking Tooth Contact Pattern and Condition of the Ring and Pinion

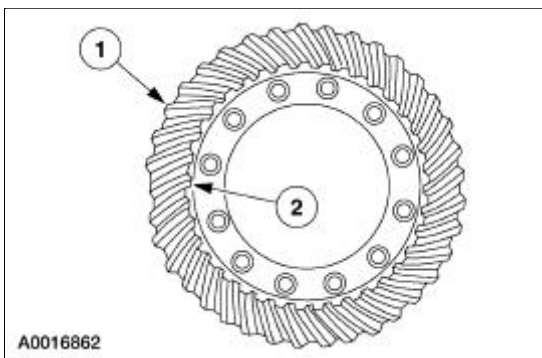
There are two basic types of conditions that will produce ring and pinion noise. The first type is a howl or chuckle produced by broken, cracked, chipped, scored or forcibly damaged gear teeth and is usually quite audible over the entire speed range. The second type of ring and pinion noise pertains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

1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Drain the axle lubricant. Refer to [Section 205-02A](#) for Ford 7.5 rear axles or [Section 205-02B](#) for Ford 8.8 integral axles.
3. Remove the carrier assembly or the axle housing cover depending on the axle type. Refer to [Section 205-02A](#) for Ford 7.5 rear axles or [Section 205-02B](#) for Ford 8.8 integral axles.
4. Inspect the gear set for scoring or damage.





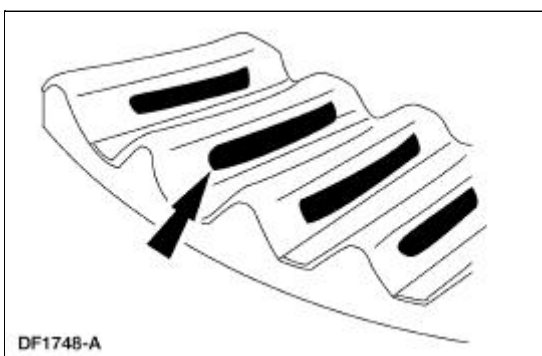
5. In the following steps, the movement of the contact pattern along the length is indicated as toward the "heel" or "toe" of the differential ring gear.



Item	Description
1	Heel
2	Toe

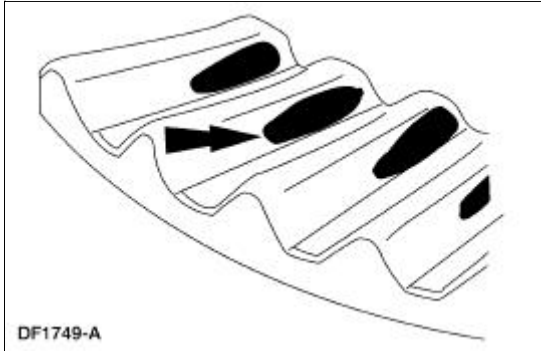
6. Apply a marking compound to a third of the gear teeth on the differential ring gear. Rotate the differential ring gear several complete turns in both directions until a good, clear tooth pattern is obtained. Inspect the contact patterns on the ring gear teeth.
7. A good contact pattern should be centered on the tooth. It can also be slightly toward the toe. There should always be some clearance between the contact pattern and the top of the tooth.

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



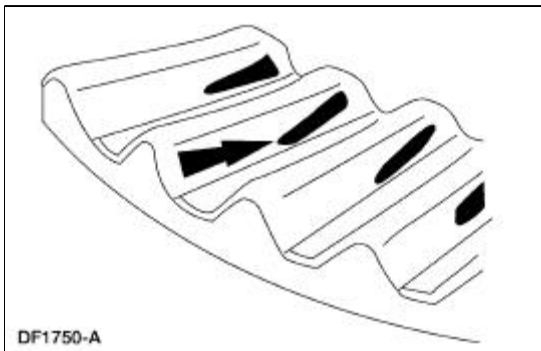
8. A high, thick contact pattern that is worn more toward the toe.

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



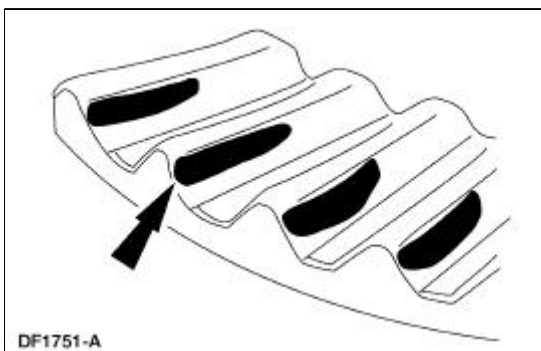
9. A high, thin contact pattern that is worn toward the toe.

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



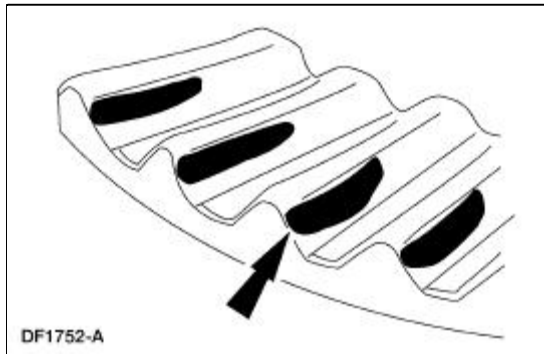
10. A contact pattern that is worn in the center of the differential ring gear tooth toward the heel.

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



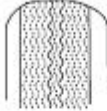
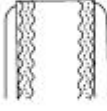
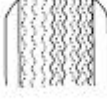




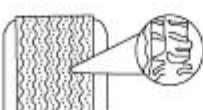
11. A contact pattern that is worn at the top of the differential ring gear tooth toward the heel.

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



Tire Wear Patterns and frequency calculations

Tire Wear Chart

TIRE WEAR	CONDITION	POSSIBLE CAUSES
	<ul style="list-style-type: none"> • Rapid wear at both shoulders. 	<ul style="list-style-type: none"> • Tires underinflated. • Worn suspension components. • Excessive cornering speeds. • Lack of rotation.
	<ul style="list-style-type: none"> • Rapid wear at the center. 	<ul style="list-style-type: none"> • Tires overinflated. • Lack of rotation. • Excessive toe on drive wheels. • Heavy acceleration on drive wheels.
	<ul style="list-style-type: none"> • Wear at one shoulder. 	<ul style="list-style-type: none"> • Toe adjustment out of specification. • Camber out of specification. • Damaged strut. • Damaged lower control arm.
	<ul style="list-style-type: none"> • Feather edges. 	<ul style="list-style-type: none"> • Toe adjustment out of specification. • Damaged or worn tie rods. • Damaged spindle or knuckle.
	<ul style="list-style-type: none"> • Bald spots or cupping. 	<ul style="list-style-type: none"> • Unbalanced wheel. • Excessive radial runout. • Worn strut or shock absorber.
	<ul style="list-style-type: none"> • Tire scalloped. 	<ul style="list-style-type: none"> • Toe adjustment out of specification. • Camber out of specification. • Worn or damaged suspension components.
	<ul style="list-style-type: none"> • Wear pattern - FWD vehicles. 	<ul style="list-style-type: none"> • Excessive toe on non-drive wheels. • Lack of rotation.
	<ul style="list-style-type: none"> • Wear pattern - FWD vehicles. • Edge of tread blocks worn. 	<ul style="list-style-type: none"> • Excessive toe on non-drive wheels. • Lack of rotation.

DF1717-A

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

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

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

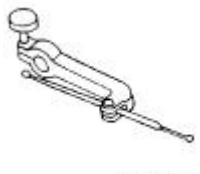

- Measure the diameter of the tire.
- Record the speed at which the vibration occurs.
- Obtain the corresponding tire and wheel rpm and frequency from the Tire Speed and Frequency Chart.
 - If the vehicle speed is not listed, divide the vehicle speed at which the vibration occurs by 16 km/h (10 mph).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

Tire Speed and Frequency Chart

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


Brake Disc Machining


Special Tool(s)

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

Material

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

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

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

1. Check wheel bearing end-play and correct as necessary.
2. **NOTE:** Begin at the front of the vehicle unless the vibration has been isolated to the rear.
 Remove the tire and wheel assembly.
3. Remove the brake caliper and the brake caliper anchor plate. Refer to the appropriate section in Group [206](#) for the procedure.
4. Inspect the brake linings. Install new brake linings if below specification. For additional information, refer to the appropriate brake section.
5. Measure and record the brake disc thickness. Install a new brake disc if the thickness after machining will be at or below specification. The specification is molded into the brake disc.
 - Do not machine a new brake disc.

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

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

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


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

8. Using the special tools, verify that the brake disc lateral runout is now within specification. For additional information, refer to [Section 206-00](#).
 9. Remove the special tool hub adapter.
 10. Remove any remaining metal chips from the machining operation.
 11. For vehicles with a two-piece hub and brake disc assembly:
 - Remove the brake disc from the hub.
 - Remove any remaining metal chips from hub and brake disc mounting surfaces and from the ABS sensor.
 - Apply a liberal amount of lubricant to the hub flange, pilot area and to the brake disc-to-hub mounting surface.
 - Using the match marks, mount the brake disc on the hub.
 12. Install the brake caliper anchor plate and the brake caliper.
 13. Install the tire and wheel assembly.
 14. Test the system for normal operation.
-

Powertrain/Drivetrain Mount Neutralizing



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

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

Move the vehicle in forward and reverse 0.6-1.2 meters (2-4 ft).

5. Raise and support the vehicle.
 6. Tighten the powertrain/drivetrain mount fasteners.
 7. Lower the vehicle.
 8. Test the system for normal operation.
-

Exhaust System Neutralizing




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



WARNING: Exhaust system components are hot.

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

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




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

Raise and support the vehicle.

2. Loosen all exhaust hanger attachments and reposition the hangers until they hang free and straight.
 3. Loosen all exhaust flange joints.
 4. Place a stand to support the muffler parallel to the vehicle frame with the muffler pipe bracket free of stress.
 5. Tighten the muffler connection.
 6. Tighten all the exhaust hanger clamps and flanges (tighten the exhaust manifold flange joint last).
 - Verify there is adequate clearance to prevent grounding at any point in the system. Make sure that the catalytic converter and heat shield do not contact the frame rails.
 - After neutralization, the rubber in the exhaust hangers should show some flexibility when movement is applied to the exhaust system.
 - With the exhaust system installed securely and cooled, the rear hanger should be angled forward.
 7. Lower the vehicle.
 8. Test the exhaust system for normal operation.
-

Wheel Bearing Check

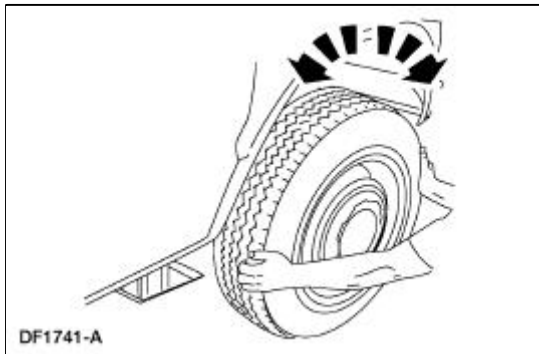
1.  **WARNING:** The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which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

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

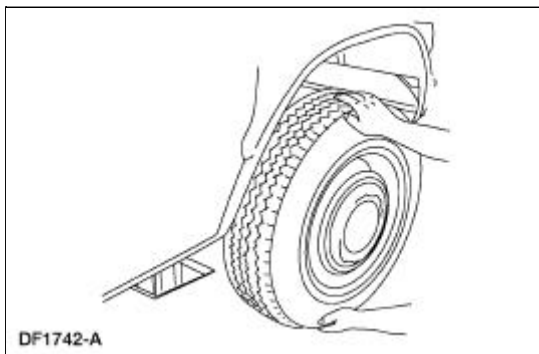
- Make sure the wheels are in a straight forward position.

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

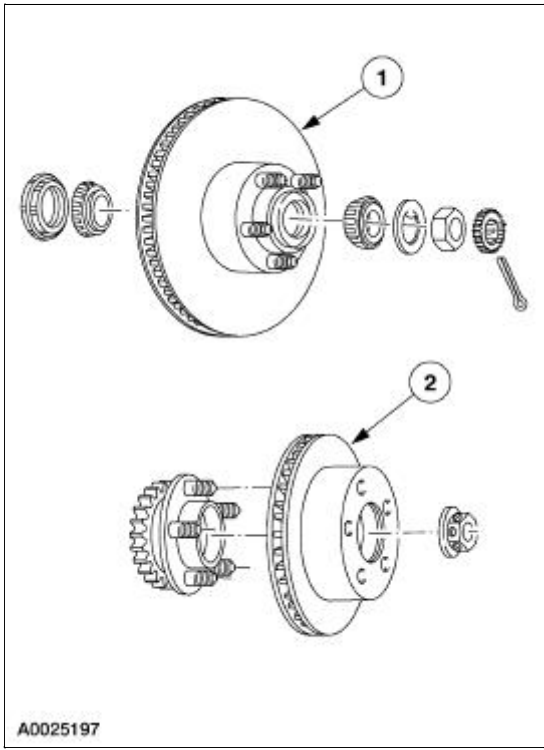
Spin the tire by hand to check the wheel bearings for roughness.



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



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



Alignment Specifications

Item	LH	RH	Total/Split
Front			
Caster	3.2° ± 0.75°	3.2° ± 0.75°	0° ± 0.75°
Camber— GT and Base	-0.50° ± 0.75°	-0.50° ± 0.75°	0° ± 0.75°
Camber— Cobra	-0.90° ± 0.40°	-0.90° ± 0.40°	0° ± 0.40°
Toe (positive value is toe-in, negative value is toe-out)	—	—	0.25° ± 0.25°
Rear, Cobra			
Caster	—	—	—
Camber	-0.8° ± 0.2°	-0.8° ± 0.2°	0° ± 0.50°
Toe (positive value is toe-in, negative value is toe-out)	—	—	0.20° ± 0.15°

General Specifications

Item	Specification
Front Ride Height	
Front	4 mm ± 7.6 mm (0.2 in. ± 0.3 in.)
Rear Ride Height	
Rear — GT and Base	128 mm (5 in.)
Rear — Cobra	18 mm ± 7.6 mm (1.4 in. ± 0.3 in.)
Vehicle Lean (Side-to-Side Differences)	
Front — maximum	13 mm (0.5 in.)
Rear — maximum	13 mm (0.5 in.)
Dogtracking	
Maximum	13 mm (0.5 in.)
Clear vision (negative value is counterclockwise)	-2° ± 3°
Ball Joint End Play	
Lower ball joint — maximum	0.8 mm (1/32 in.)

Torque Specifications

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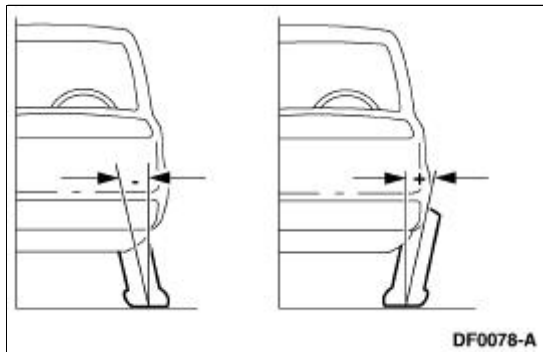
Description	Nm	lb-ft
Front suspension camber adjustment plate bolt	40	30
Front suspension camber adjustment plate nuts	40	30
Rear camber adjustment nut	90	66
Toe link jam nuts	55	41
Tie-rod jam nuts	55	41

Wheel Alignment Angles

Camber and toe are adjustable on the front suspension systems. Front camber is adjusted by moving the top of the strut and spring assembly. Rear camber is adjusted by means of eccentric cams on the rear upper arms. Caster is preset at the factory and should only be adjusted after all other possible sources have been inspected and corrected as necessary. Front toe is adjusted by the use of the front wheel spindle tie rod (3280).

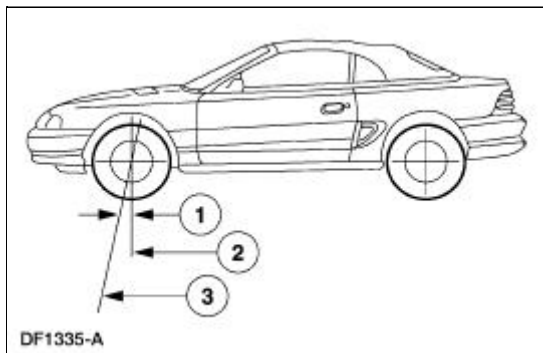
Camber

Negative and Positive Camber



Camber is the vertical tilt of the wheel (1007) when viewed from the front. Camber can be positive or negative and has a direct effect on tire wear.

Caster

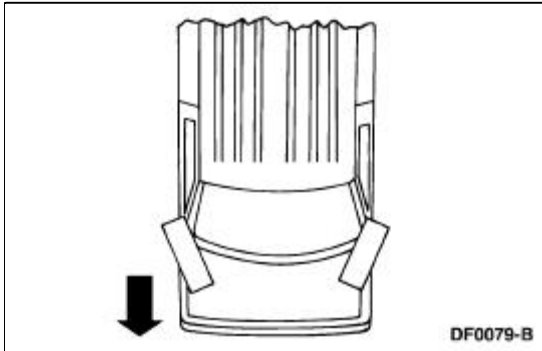


Item	Part Number	Description
1	—	Positive caster
2	—	True vertical
3	—	Steering axis

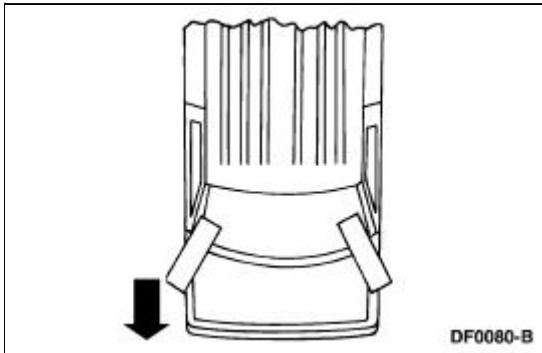
Caster is the deviation from vertical of an imaginary line drawn through the ball joints when viewed from the side. Caster specifications in this section will give the vehicle the best directional stability characteristics when loaded and driven. Caster setting is not related to tire wear.

Toe

Positive Toe (Toe In)



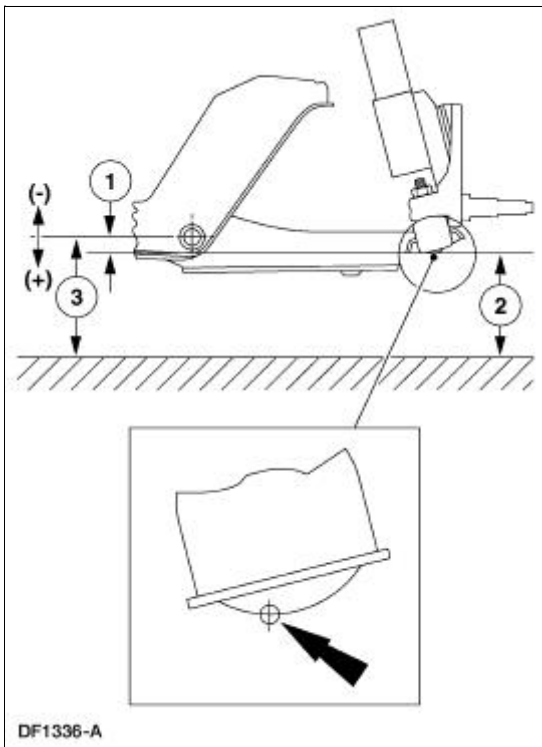
Negative Toe (Toe Out)



The vehicle toe setting affects tire wear and directional stability.

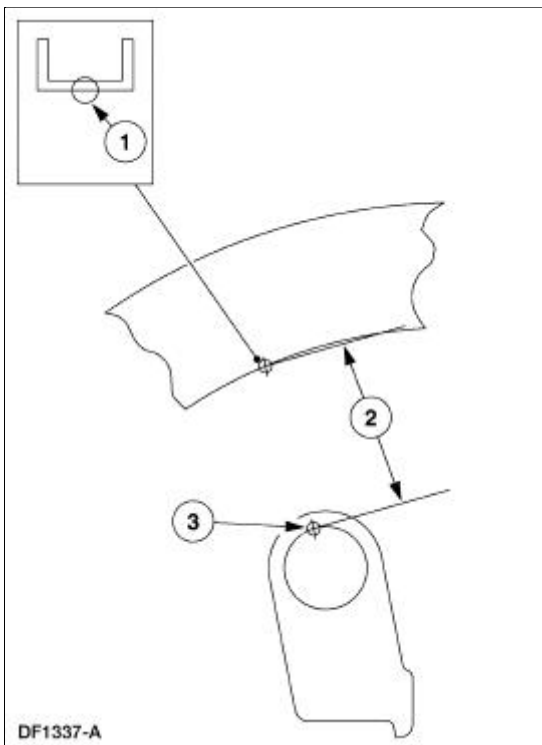
Ride Height

Front Ride Height Measurement



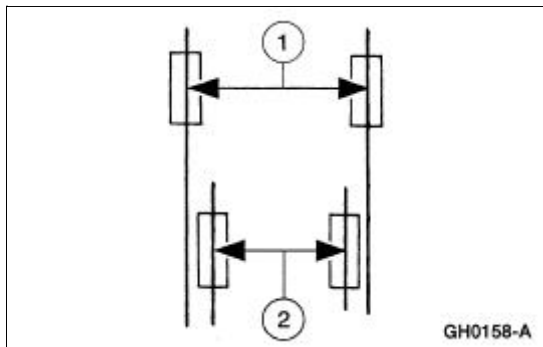
Item	Description
1	Ride height = $B - A$
2	Measurement A
3	Measurement B

Rear Ride Height Measurement — GT and Base



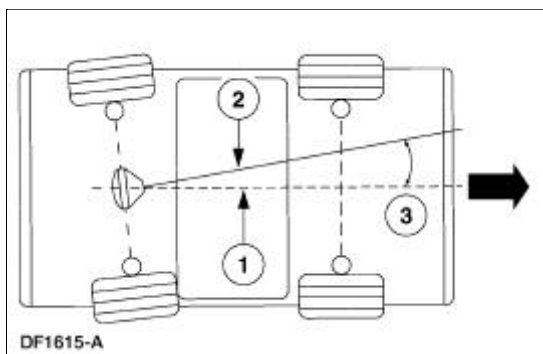
Item	Description
1	Body reinforcement
2	Ride height (shortest distance)
3	Rear axle

Wheel Track



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

Dogtracking



Item	Part Number	Description
1	—	Vehicle centerline
2	—	Axle centerline
3	—	Thrust angle

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

Wander

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

Shimmy

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

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

Nibble

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

Poor Returnability/Sticky Steering

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

Drift/Pull

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

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

- Drift/pull may be induced by conditions external to the vehicle (i.e., wind, road camber).

Poor Groove Feel

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

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

Suspension System

Inspection and Verification

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

All vehicles are equipped with gas-pressurized hydraulic shock absorbers. These shock absorbers are not adjustable or refillable and cannot be repaired.

 - Oil Leak: A light film of oil (weepage) on the upper portion of the shock absorber is permissible and is a result of correct shock lubrication. Weepage is a condition in which a film of oil accumulates on the thin tube (body) and is normally noticed due to the collection of dust in this area. If shock absorbers exhibit this weepage condition, they are functional units and new shock absorbers should not be installed. Leakage is a condition in which the entire shock absorber body is covered with oil and the oil will drip from the shock absorber onto the pavement. If condition exists:
 - Make sure fluid observed is not from sources other than the shock absorber.
 - Install a new shock absorber, if necessary.
 - Vehicle Sag: Many times new shock absorbers are installed in an effort to solve a vehicle sag concern. Shock absorbers by design are hydraulic damping units only and, unlike suspension springs, do not support any suspension loads. Therefore, installing a new shock absorber will not correct a vehicle sag concern.
 - Installment in Pairs: In the past it was recommended that new shock absorbers be installed in pairs if one unit became unrepairable. New shock absorbers no longer need to be installed in pairs when only one unit is not repairable.

Visual Inspection Chart

Mechanical

- Front wheel bearing(s)
- Loose or damaged front or rear suspension components
- Loose, damaged or missing suspension fastener(s)
- Damaged spring(s)
- Damaged or leaking strut and spring assemblies
- Damaged or leaking shock absorber(s)
- Worn or damaged suspension bushing(s)
- Loose, worn or damaged steering system components
- Damaged axle components

6. If an obvious cause for an observed or reported condition is found, correct the cause (if possible) before proceeding to the next step.
7. If the fault is not visually evident, determine the symptom and GO to [Symptom Chart](#).

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● Dogtracking 	<ul style="list-style-type: none"> ● Excessive rear thrust angle. ● Front or rear suspension components. ● Drive axle damaged. 	<ul style="list-style-type: none"> ● CHECK the wheel alignment. ADJUST as necessary. ● INSPECT the front and rear suspension system. REPAIR or INSTALL new suspension components as necessary. REFER to Section 204-01 or Section 204-02. ● REPAIR as necessary. Refer to the appropriate section in Group 205 for the procedure..
<ul style="list-style-type: none"> ● Drift/pull 	<ul style="list-style-type: none"> ● Unequal tire pressure. ● Excessive side-to-side difference in caster or camber. ● Tire forces. ● Unevenly loaded or overloaded vehicle. ● Steering components. ● Brake drag. 	<ul style="list-style-type: none"> ● ADJUST tire pressure. ● CHECK the wheel alignment. ADJUST as necessary. ● ROTATE tires front to rear. ● NOTIFY the customer of incorrect vehicle loading. ● REFER to Section 211-00. ● REFER to Section 206-00.
<ul style="list-style-type: none"> ● Front bottoming or riding low 	<ul style="list-style-type: none"> ● Strut(s). ● Front coil springs (5310). 	<ul style="list-style-type: none"> ● INSTALL new strut(s) as necessary. REFER to Section 204-01. ● CHECK ride height. INSTALL new springs as necessary. REFER to Section 204-01.
<ul style="list-style-type: none"> ● Incorrect tire wear 	<ul style="list-style-type: none"> ● Incorrect tire pressure (rapid center rib or inner and outer edge wear). 	<ul style="list-style-type: none"> ● ADJUST tire pressure.

	<ul style="list-style-type: none"> ● Excessive front or rear toe (rapid inner or outer edge wear). ● Excessive negative or positive camber (rapid inner or outer edge wear). ● Tires out of balance (tires cupped or dished). 	<ul style="list-style-type: none"> ● CHECK the wheel alignment. ADJUST as necessary. ● CHECK the wheel alignment. ADJUST as necessary. ● BALANCE tires.
<ul style="list-style-type: none"> ● Rough ride 	<ul style="list-style-type: none"> ● Strut(s). ● Shock absorber(s). ● Front coil springs or rear springs (5560). 	<ul style="list-style-type: none"> ● INSTALL new strut(s) as necessary. REFER to Section 204-01. ● INSTALL new shock absorber (s) as necessary. ● INSTALL new front coil springs or rear springs as necessary. REFER to Section 204-01 or Section 204-02.
<ul style="list-style-type: none"> ● Shimmy or wheel tramp 	<ul style="list-style-type: none"> ● Loose wheel nut(s). ● Loose front suspension fasteners. ● Front wheel bearing (s). ● Wheel or tire runout. ● Tire flatspotting. ● Shock absorber(s). ● Loose, worn or damaged ball joint (s). ● Loose, worn or damaged steering components. ● Front wheel alignment. 	<ul style="list-style-type: none"> ● TIGHTEN to specification. REFER to Section 204-04. ● TIGHTEN to specification. REFER to Section 204-01. ● REFER to Wheel Bearing Inspection in this section. ● REFER to Section 204-04. ● REFER to Section 204-04. ● INSTALL new shock absorber (s) as necessary. ● GO to the Ball Joint Inspection component test in this section. ● REFER to Section 211-00. ● CHECK the wheel alignment. ADJUST as necessary.
<ul style="list-style-type: none"> ● Sticky steering, poor returnability 	<ul style="list-style-type: none"> ● Ball joints. ● Steering components. 	<ul style="list-style-type: none"> ● GO to the Ball Joint Inspection component test in this section. ● REFER to Section 211-00.
<ul style="list-style-type: none"> ● Steering wheel off-center 	<ul style="list-style-type: none"> ● Unequal front or rear toe settings (side-to-side). ● Steering components. 	<ul style="list-style-type: none"> ● CHECK the wheel alignment. ADJUST as necessary. ● REFER to Section 211-00.
<ul style="list-style-type: none"> ● Sway or roll 	<ul style="list-style-type: none"> ● Overloaded, unevenly or incorrectly loaded vehicle. ● Loose wheel nut(s). 	<ul style="list-style-type: none"> ● NOTIFY the customer of incorrect vehicle loading. ● TIGHTEN to specification.

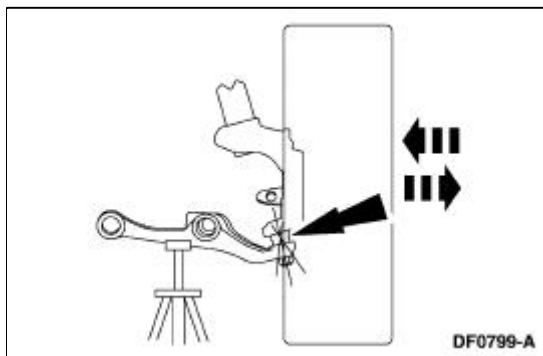
	<ul style="list-style-type: none"> ● Strut(s). ● Shock absorber(s). ● Loose front stabilizer bar (5482) or rear stabilizer bar (5A772). ● Worn stabilizer assembly bushing (s). ● Front coil spring(s) or rear spring(s). 	<p>REFER to Section 204-04 .</p> <ul style="list-style-type: none"> ● INSTALL new strut(s) as necessary. REFER to Section 204-01 . ● INSTALL new shock absorber (s) as necessary. ● TIGHTEN to specification. REFER to Section 204-01 or Section 204-02 . ● INSTALL new bushing(s) as necessary. REFER to Section 204-01 or Section 204-02 . ● INSTALL new front coil springs or rear springs as necessary. REFER to Section 204-01 or Section 204-02 .
<ul style="list-style-type: none"> ● Vehicle leans to one side 	<ul style="list-style-type: none"> ● Unevenly loaded or overloaded vehicle. ● Front or rear suspension components. ● Front coil springs or rear springs. ● Incorrect ride height. Lateral tilt out of specification. 	<ul style="list-style-type: none"> ● NOTIFY the customer of incorrect vehicle loading. ● INSPECT the front and rear suspension system. REPAIR or INSTALL new suspension components as necessary. REFER to Section 204-01 or Section 204-02 . ● INSTALL new front coil springs or rear springs as necessary. REFER to Section 204-01 or Section 204-02 . ● CHECK ride height. INSTALL new front coil springs or rear springs as necessary. REFER to Section 204-01 or Section 204-02 .
<ul style="list-style-type: none"> ● Vibration/noise 	<ul style="list-style-type: none"> ● Tire or wheel runout. ● Tire flatspotting. ● Wheel bearings. ● Wheel hubs. ● Brake components. ● Suspension components. ● Steering components. 	<ul style="list-style-type: none"> ● REFER to Section 100-04 .
<ul style="list-style-type: none"> ● Wander 	<ul style="list-style-type: none"> ● Unevenly loaded or overloaded vehicle. ● Ball joint(s). ● Front wheel bearing (s). ● Loose, worn or damaged suspension components(s). ● Loose suspension fasteners. 	<ul style="list-style-type: none"> ● NOTIFY the customer of incorrect vehicle loading. ● GO to the Ball Joint Inspection component test in this section. ● REFER to Wheel Bearing Inspection in this section. ● INSTALL new suspension components as necessary. REFER to Section 204-01 or Section 204-02 . ● TIGHTEN to specification. REFER to Section 204-01 or Section 204-02 .

	<ul style="list-style-type: none">● Steering components.● Wheel alignment.	<ul style="list-style-type: none">● REFER to Section 211-00.● CHECK wheel alignment. ADJUST as necessary (excessive total front toe out).
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Component Tests

Ball Joint Inspection

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



4. While an assistant pulls and pushes the bottom of the tire, observe the relative movement between the lower spindle arm and the front suspension lower arm ball joint. Any movement at or exceeding the specification indicates a worn or damaged lower ball joint. Install a new front suspension lower arm. Refer to [Section 204-01](#).
-

Wheel Bearing Inspection

1. Raise the vehicle until the tire is off the floor. For additional information, refer to [Section 100-02](#) .
2. **NOTE:** Make sure the wheel rotates freely and the brake pads are retracted sufficiently to allow movement of the tire and wheel assembly.

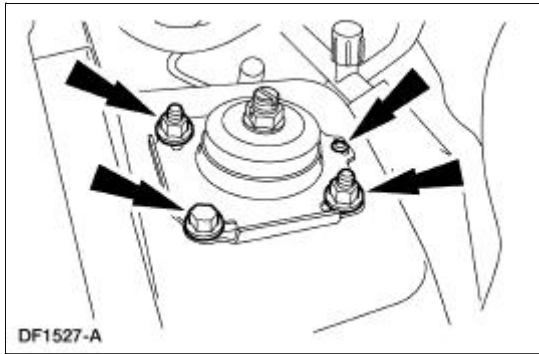
Grasp each tire at the top and bottom and move the wheel inward and outward while lifting the weight of the tire off the wheel bearing.

3. If the tire and wheel (hub) is loose on the wheel spindle or does not rotate freely, install a new front wheel hub (1104) as necessary. For additional information, refer to [Section 204-01](#) .
-

Camber and Caster Adjustment —Front

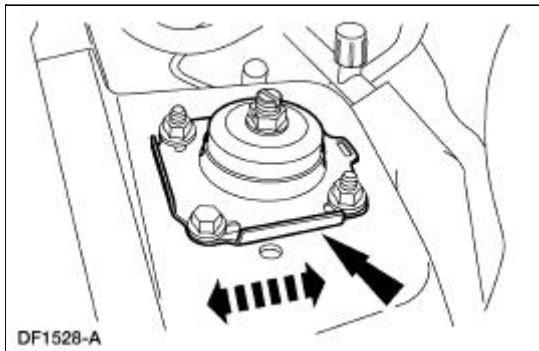
All vehicles

1. Remove the rivet. Loosen the nuts and bolt.



Vehicles requiring camber adjustment

2. Move the front suspension camber adjusting plate (3B391) to the required camber setting.



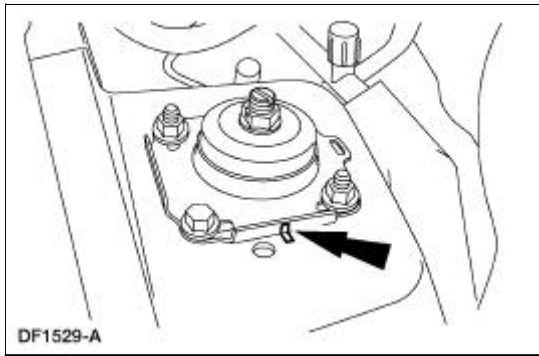
Vehicles requiring caster adjustment

3. **NOTE:** If caster adjustment is necessary to resolve a pull, or out of specification cross-caster split, then slotting the shock tower at the front shock absorber (18124) upper mounting point is an acceptable method. This procedure should not be routinely performed with all alignments and only after all other possible sources have been inspected and corrected as necessary.

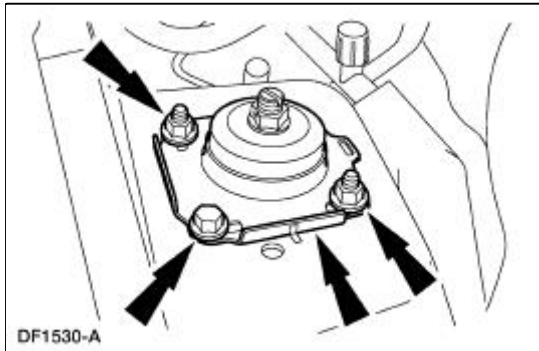
Determine the amount of caster adjustment needed.

- If no more than 0.6 degree is needed, only one shock tower needs to be slotted.

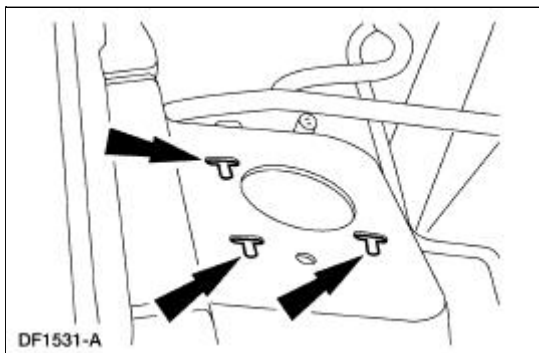
4. Mark the camber position of the front suspension camber adjusting plate (3B391).



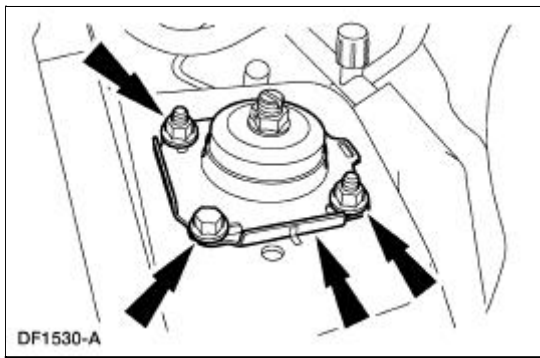
5. Remove the nuts, bolt and the front suspension camber adjusting plate.



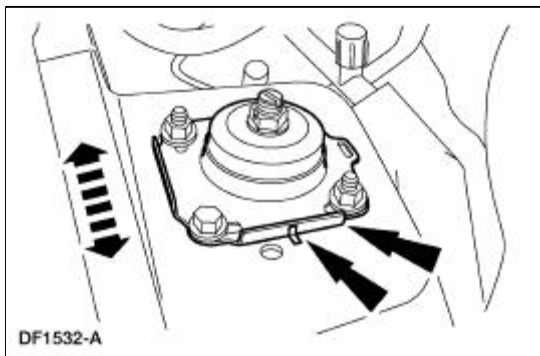
6. Raise the front end. Position the strut and spring assembly out of the way. For additional information, refer to [Section 100-02](#).
7. Cut slots perpendicular to the existing camber adjustment slots.
 - Moving the top of the front shock absorber toward the rear of the vehicle will increase the caster reading for that side.
 - Each millimeter of adjustment should yield approximately 0.12 degree of caster change.
 - Do not cut slots any longer than 5 mm (0.2 in.) in any direction.
 - Remove any burrs.
 - Clean and paint any exposed metal.



8. Position the strut and spring assembly. Lower the front end.
9. Install the front suspension camber adjustment plate, bolt and nuts. Hand tighten the bolt and nuts.

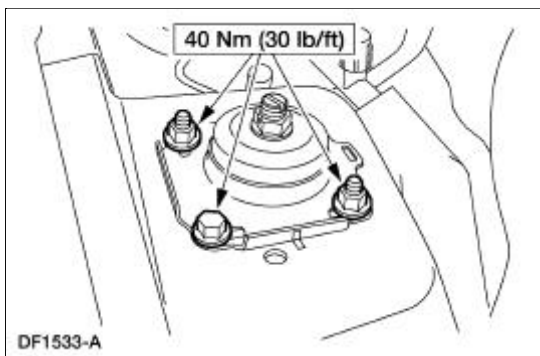


10. Align the camber marks and position the front suspension camber adjustment plate at the correct caster setting.



All vehicles

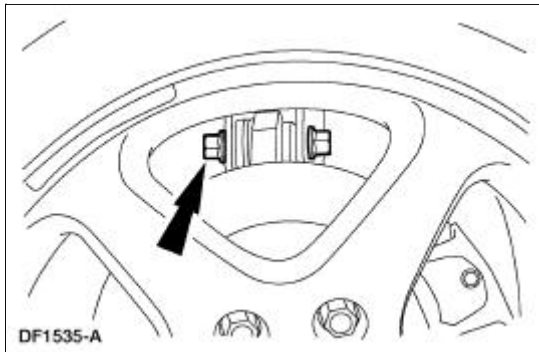
11. Tighten the nuts and bolt.



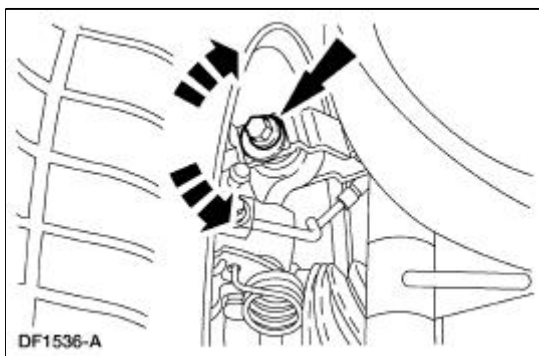
12. Recheck the wheel alignment. Follow the manufacturer's instructions. Adjust as necessary.
-

Camber Adjustment —Rear

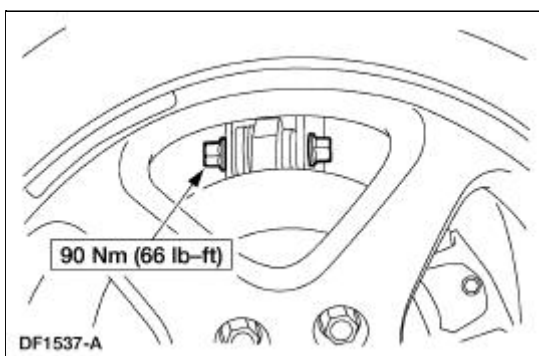
1. Loosen the nut.



2. Rotate the bolt and the cam to the correct camber setting.



3. Tighten the nut while holding the bolt and the cam stationary.



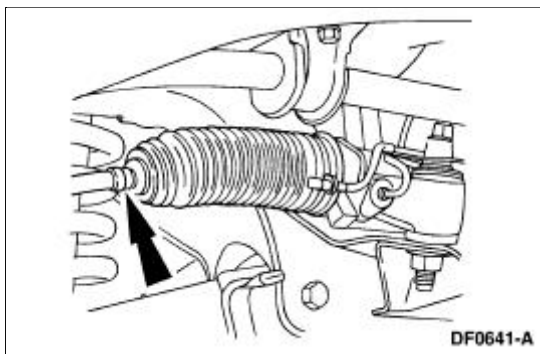
4. Recheck the wheel alignment. Follow the manufacturer's instructions. Adjust as necessary.

Toe Adjustment —Front

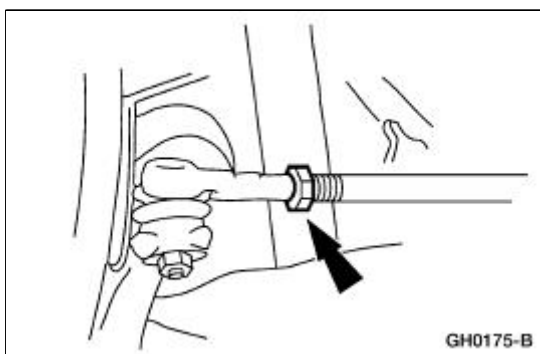
1. Start the engine and center the steering wheel.



2. Turn the engine off, and hold the steering wheel in the straight forward position by attaching a rigid link from the steering wheel to the seat.
3. Check the toe settings. Follow the manufacturer's instructions.
4. Remove the clamps.

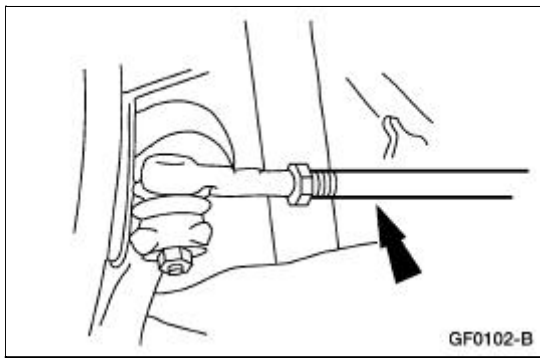


5. Loosen the nuts.
 - Clean and lubricate the nut(s) and front wheel spindle tie-rod threads.

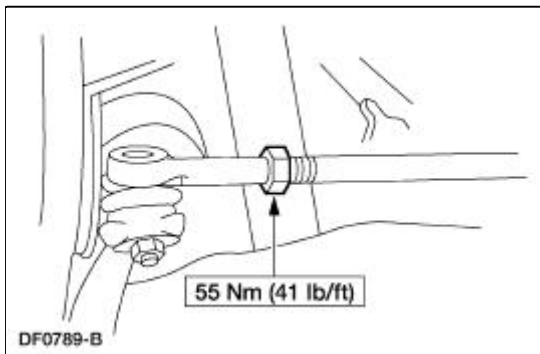


6. **NOTE:** Do not allow the steering gear bellows to twist when the front wheel spindle tie-rod (3280) is rotated.

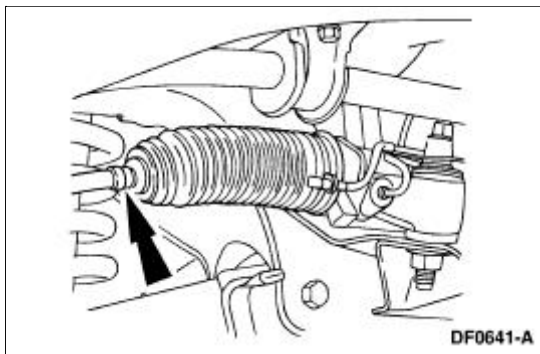
Rotate the front wheel spindle tie-rods.



7. Tighten the nuts.



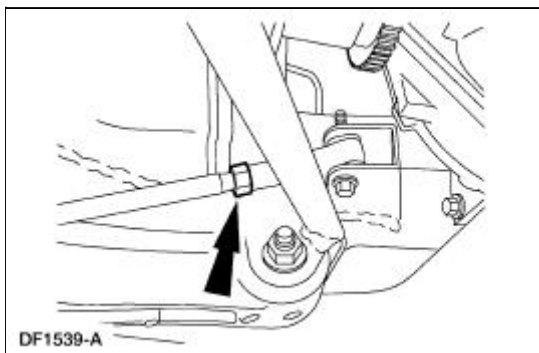
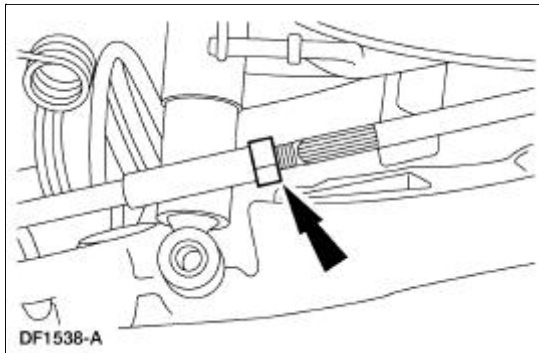
8. Install the clamps.



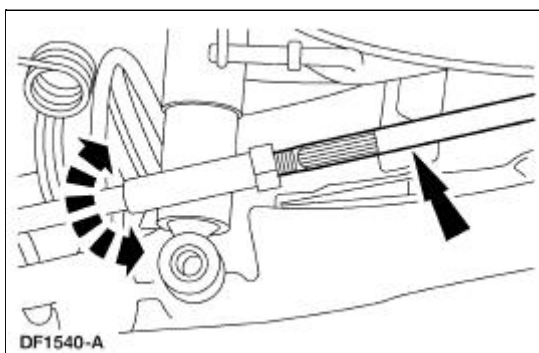
9. Recheck the toe settings. Follow the manufacturer's instructions.

Toe Adjustment —Rear

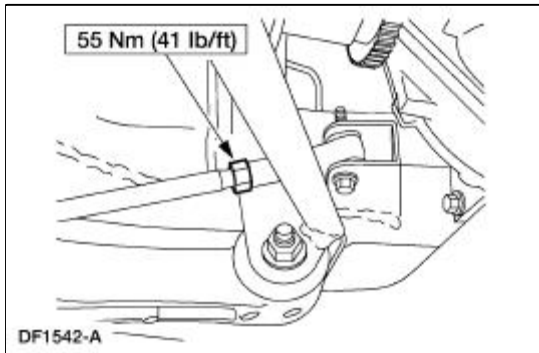
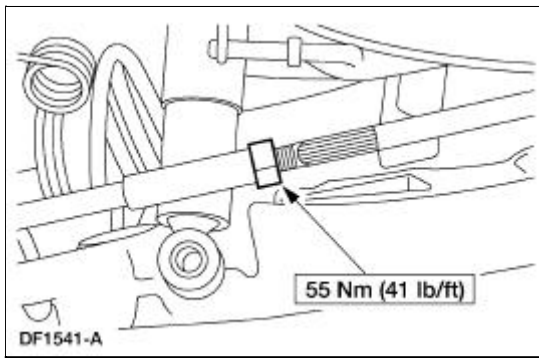
1. Loosen the nuts.
 - To prevent damage to the ball joints, hold the tie-rod ends while loosening the nuts.



2. Rotate the toe link to the correct toe setting.



3. Tighten the nuts.
 - To prevent damage to the ball joints, hold the tie-rod ends while tightening the nuts.



4. Recheck the toe settings. Follow the manufacturer's instructions.
-

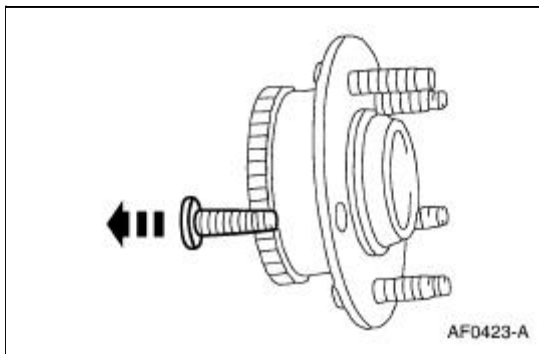
Torque Specifications

Description	Nm	lb-ft	lb-in
Front shock absorber upper nut	100	74	—
Front shock absorber-to-spindle nuts	200	148	—
Shock absorber upper mount-to-body nuts	40	30	—
Shock absorber upper mount-to-body bolt	40	30	—
Wheel hub and bearing retainer nut	350	258	—
Stabilizer bar bracket nuts	70	52	—
Stabilizer bar link nuts	19	14	—
Anti-lock brake sensor bolt	6	—	53
Anti-lock brake sensor wire bracket nut	28	21	—
Ball joint-to-front wheel spindle nut	175	129	—
Front suspension lower arm-to-body nuts	200	148	—
Tie-rod-to-spindle nuts	55	41	—
Steering gear-to-crossmember nuts	70	52	—
Wheel nuts	129	95	—

Wheel Studs

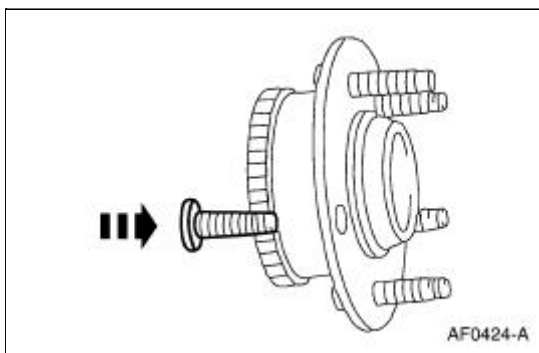
Removal

1. Remove the wheel hub (1104). For additional information, refer to [Wheel Hub and Bearing](#) in this section.
2. Using a press, remove the wheel stud (1107) from the wheel hub.



Installation

1. Using a press, install a new wheel stud.



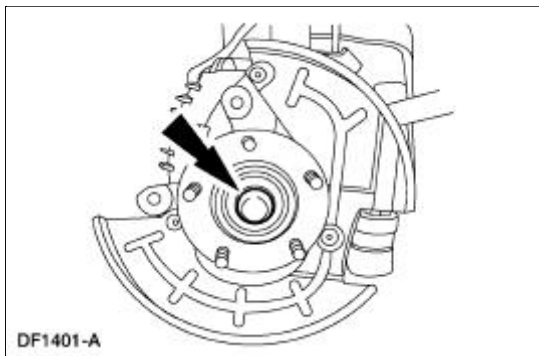
2. Install the wheel hub. For additional information, refer to [Wheel Hub and Bearing](#) in this section.
-

Wheel Hub and Bearing

Removal

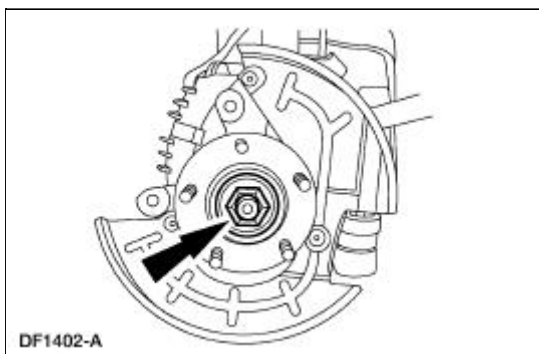
⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number or an equivalent part must be installed, if installation is necessary. Do not use a part of lesser quality or substitute design. Torque values must be used as specified during reassembly to ensure correct retention of these parts.

1. Raise the vehicle on a hoist. For additional information, refer to [Section 100-02](#).
2. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
3. Remove the front brake disc. For additional information, refer to [Section 206-03](#).
4. Remove and discard the front hub cap grease seal (1N135).

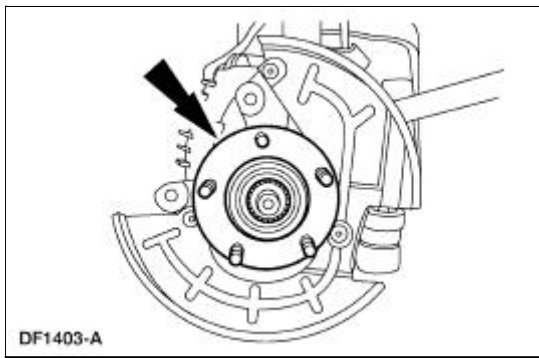


5. **⚠ CAUTION:** The wheel hub retainer (3B477) is a one time use item and must be replaced with a new retainer when removed. Failure to do so can cause the retainer to come loose during vehicle operation resulting in loss of vehicle control.

Remove and discard the front axle wheel hub retainer.



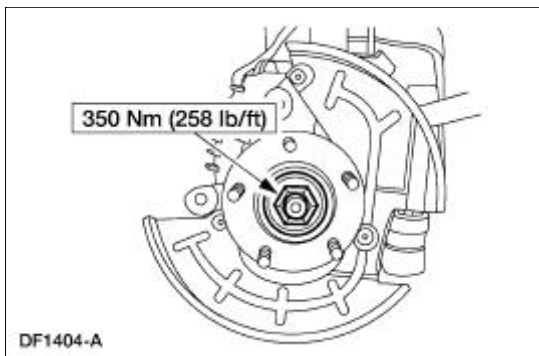
6. Remove the front wheel hub and bearing (1104).



Installation

1. **NOTE:** Use a new wheel hub retainer and hub cap grease seal.

To install, reverse the removal procedure.

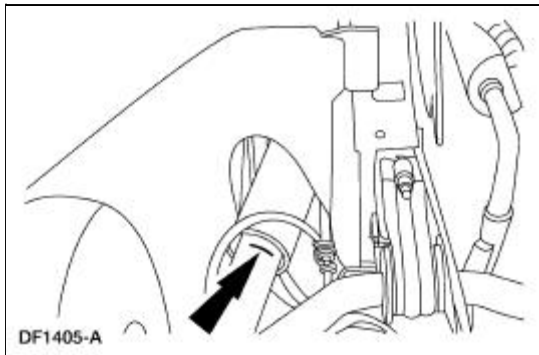


Arm —Lower

Removal

⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number or an equivalent part must be installed, if installation is necessary. Do not use a part of lesser quality or substitute design. Torque values must be used as specified during reassembly to ensure correct retention of these parts.

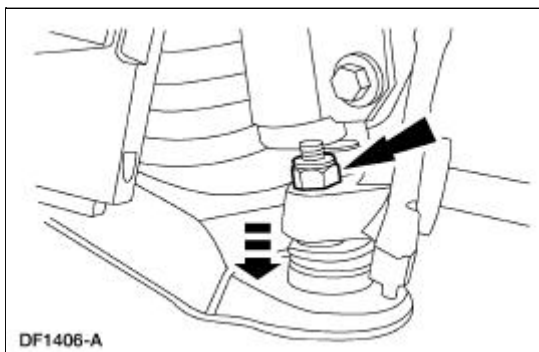
1. Mark the front shock absorber (18124) relative to the protective sleeve with the vehicle in a static, level ground position (curb height).



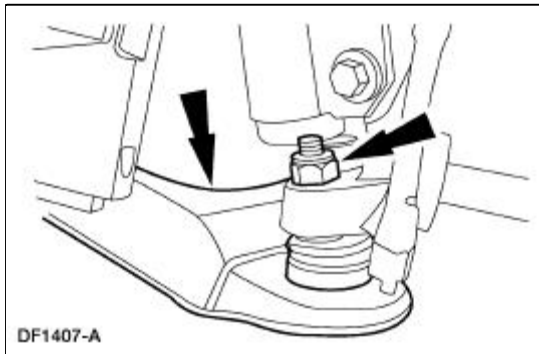
2. Raise the vehicle on a hoist. For additional information, refer to [Section 100-02](#).
3. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
4. Remove the front brake disc shield. For additional information, refer to [Section 206-03](#).
5. **⚠ CAUTION:** To prevent damage to the front suspension lower arm (3078) do not remove the nut from the ball joint (3050) at this time.

Disconnect the ball joint stud from the arm.

- Loosen the nut two or three turns.
- Sharply rap on the front wheel spindle (3105) at the ball joint connection to disconnect the ball joint stud.

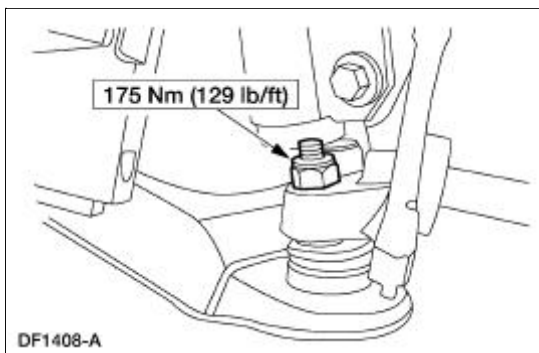


6. Remove the front coil spring (5310). For additional information, refer to [Spring](#) in this section.
7. Remove the nut and the front suspension lower control arm. Discard the nut.



Installation

1. To install, reverse the removal procedure.



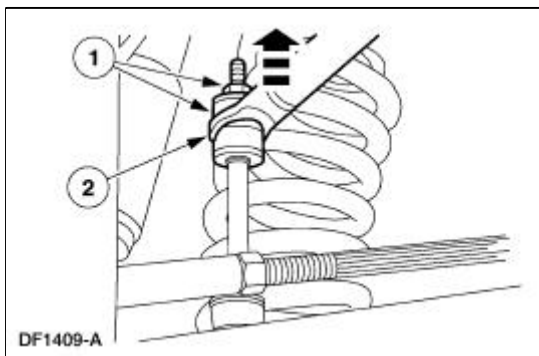
2. Check wheel alignment. Adjust if necessary. For additional information, refer to [Section 204-00](#).
-

Bar —Stabilizer

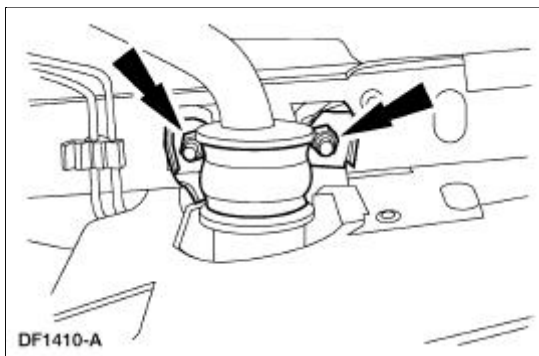
Removal

⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number or an equivalent part must be installed, if installation is necessary. Do not use a part of lesser quality or substitute design. Torque values must be used as specified during reassembly to ensure correct retention of these parts.

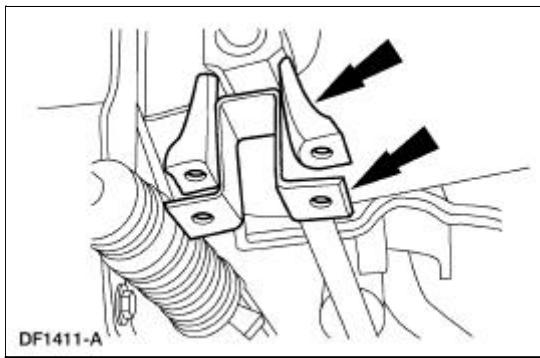
1. Raise the vehicle on a hoist. For additional information, refer to [Section 100-02](#).
2. Remove the wheel and tire assemblies. For additional information, refer to [Section 204-04](#).
3. Disconnect the front stabilizer bar links (5K483) from the front stabilizer bar (5482).
 1. Remove the nuts and bushings. Discard the nuts.
 2. Rotate the stabilizer bar to disconnect the links.



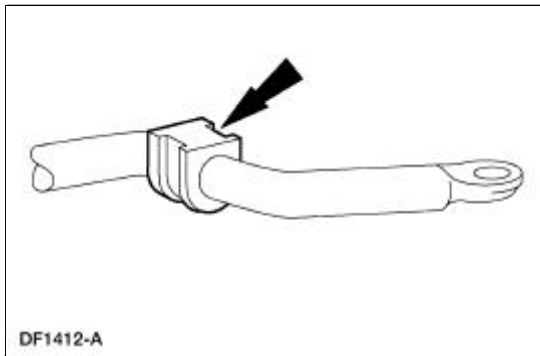
4. Remove and discard the nuts.



5. Remove the stabilizer bar brackets (5486) and the stabilizer bar mounting bracket adapters (5B482).



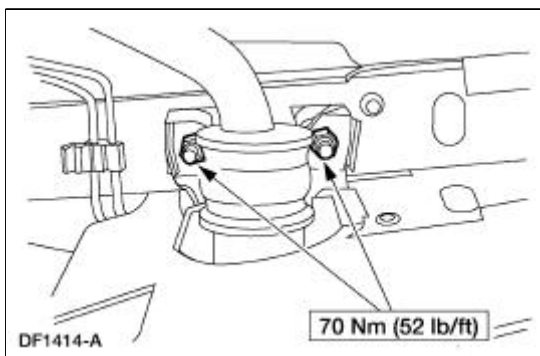
6. Remove the stabilizer bar.
7. If necessary, cut the stabilizer bar insulators (5493) from the stabilizer bar.

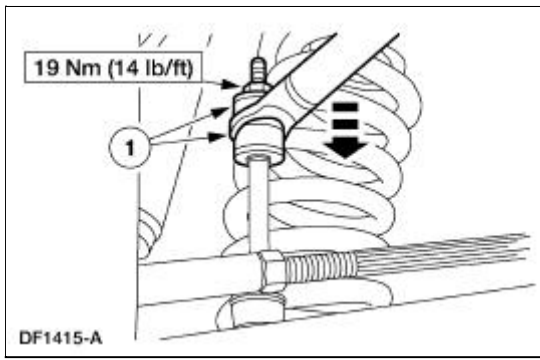


Installation

1. **NOTE:** To aid installation, coat the necessary parts of the front stabilizer bar and the inside diameter of the stabilizer bar bushing with Rubber Suspension Insulator Lube E25Y-19553-A or equivalent meeting Ford specification ESF-M99B112-A.

To install, reverse the removal procedure.



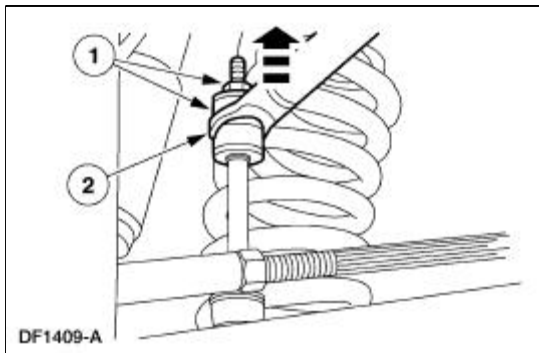


Link —Stabilizer Bar

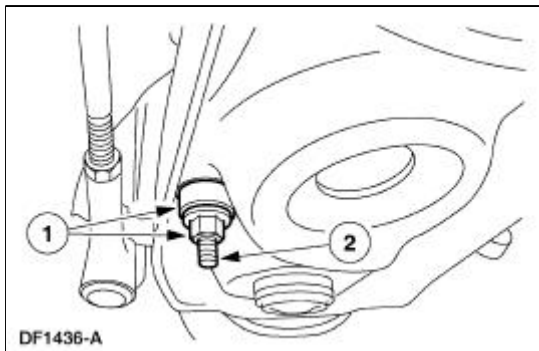
Removal

⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number or an equivalent part must be installed, if installation is necessary. Do not use a part of lesser quality or substitute design. Torque values must be used as specified during reassembly to ensure correct retention of these parts.

1. Raise the vehicle on a hoist. For additional information, refer to [Section 100-02](#).
2. Disconnect the front stabilizer bar links (5K483) from the front stabilizer bar (5482).
 1. Remove the nuts and bushings. Discard the nuts.
 2. Rotate the stabilizer bar to disconnect the links.

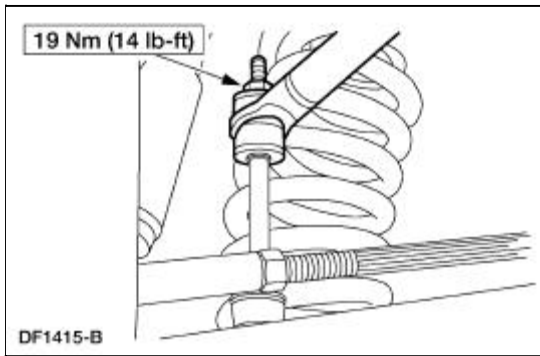
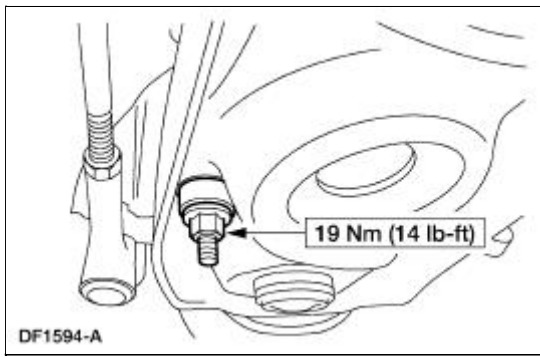


3. Remove the stabilizer bar links.
 1. Remove the nuts and bushings.
 2. Remove the stabilizer bar links.




Installation

1. To install, reverse the removal procedure.

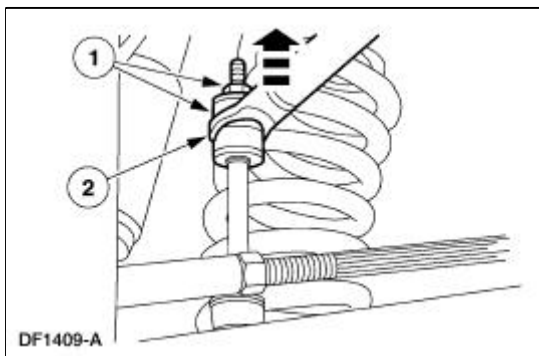


Bushing —Stabilizer Bar

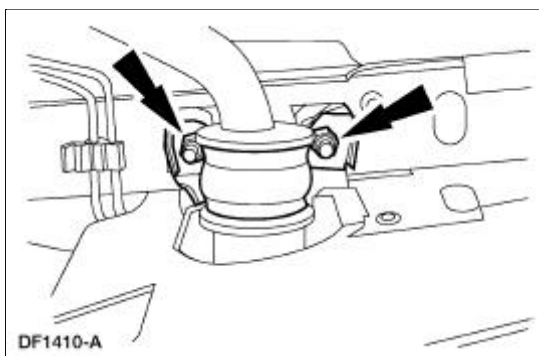
Removal

 **CAUTION:** Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number or an equivalent part must be installed, if installation is necessary. Do not use a part of lesser quality or substitute design. Torque values must be used as specified during reassembly to ensure correct retention of these parts.

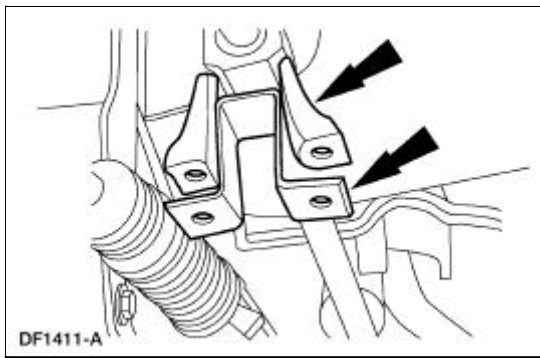
1. Raise the vehicle on a hoist. For additional information, refer to [Section 100-02](#).
2. Remove the wheel and tire assemblies. For additional information, refer to [Section 204-04](#).
3. Disconnect the front stabilizer bar links (5K483) from the front stabilizer bar (5482).
 1. Remove the nuts and bushings. Discard the nuts.
 2. Rotate the stabilizer bar to disconnect the links.



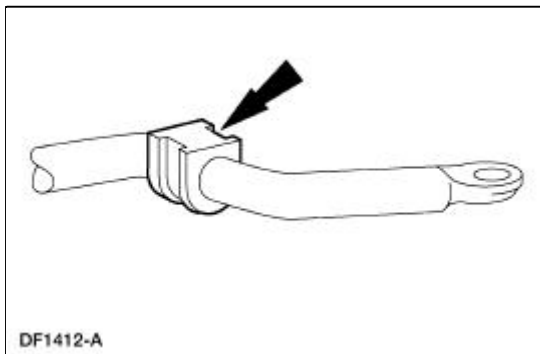
4. Remove and discard the nuts.



5. Remove the stabilizer bar bracket (5486) and the stabilizer bar mounting bracket adapter (5B482).



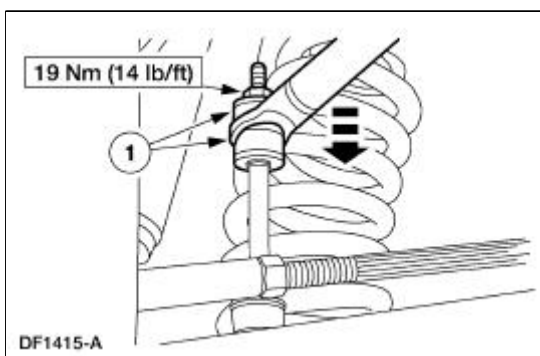
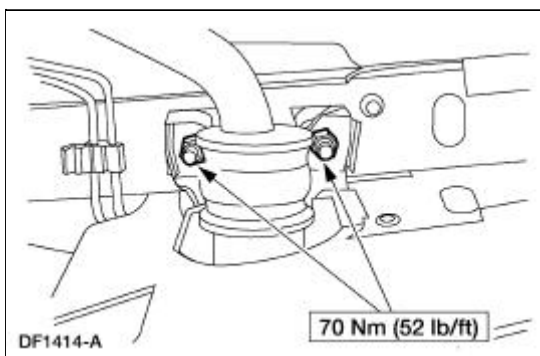
6. Cut the stabilizer bar insulators (5493) from the stabilizer bar.



Installation

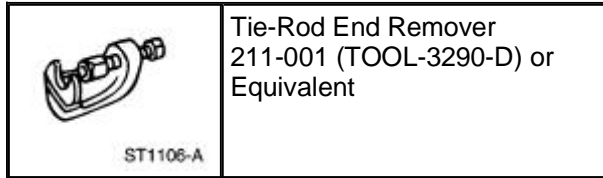
1. **NOTE:** To aid installation, coat the necessary parts of the front stabilizer bar and the inside diameter of the stabilizer bar bushing with Rubber Suspension Insulator Lube E25Y-19553-A or equivalent meeting Ford specification ESF-M99B112-A.

To install, reverse the removal procedure.



Spindle

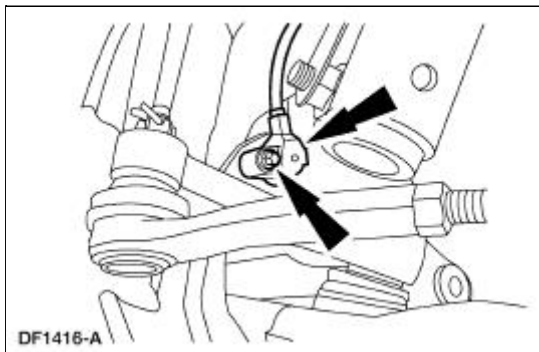
Special Tool(s)



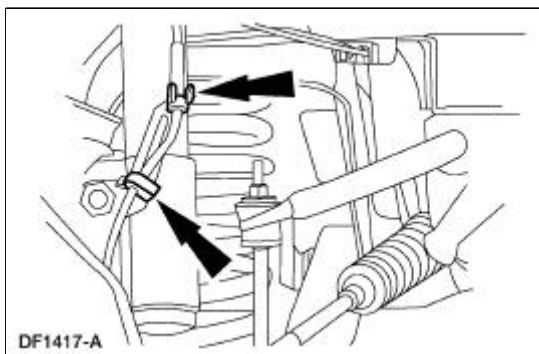
Removal

⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number or an equivalent part must be installed, if installation is necessary. Do not use a part of lesser quality or substitute design. Torque values must be used as specified during reassembly to ensure correct retention of these parts.

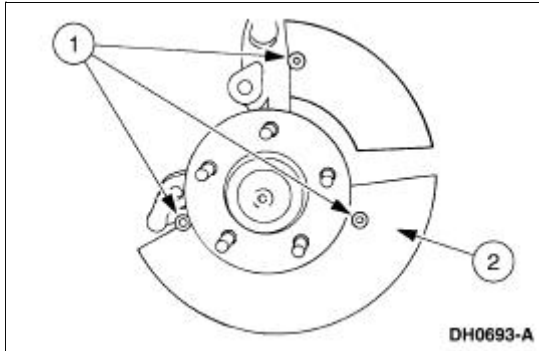
1. Raise the vehicle on a hoist. For additional information, refer to [Section 100-02](#).
2. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
3. Remove the front wheel hub (1104). For additional information, refer to [Wheel Hub and Bearing](#) in this section.
4. Remove the bolt and the ABS sensor.



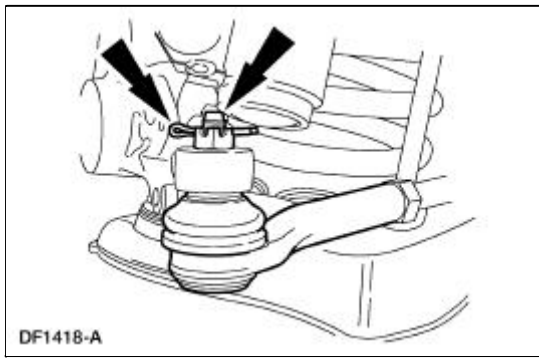
5. Unclip the ABS sensor wire from the bracket.



6. Remove the front brake disc shield.
 1. Remove the three shield rivets.
 2. Remove the shield.

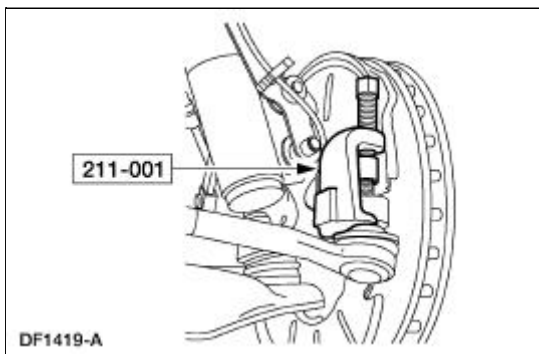



7. Remove the cotter pin and nut. Discard the cotter pin.



8.  **CAUTION: Use care not to damage the tie-rod end dust boot.**

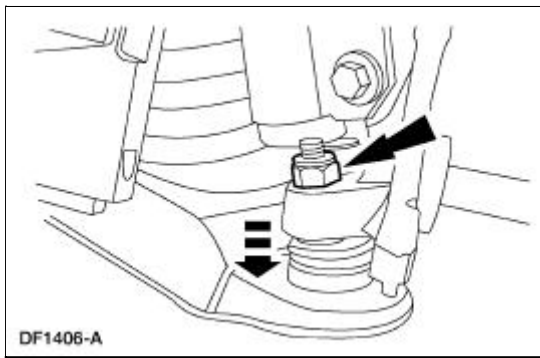
Using the special tool, disconnect the tie-rod end from the front wheel spindle.



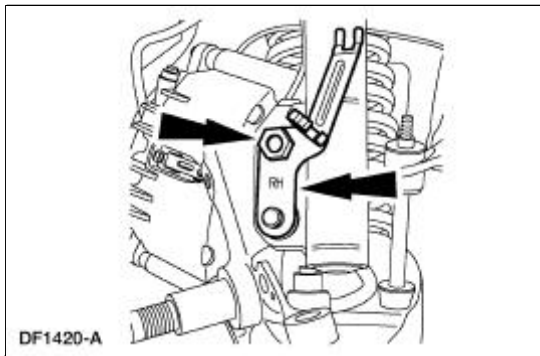
9.  **CAUTION: To prevent damage to the front suspension lower arm (3078), do not remove the nut from the ball joint (3050) at this time.**


Disconnect the ball joint stud from the front wheel spindle (3105).

- Loosen the ball joint stud two or three turns.
- Sharply rap on the spindle at the ball joint connection to disconnect the ball joint stud.



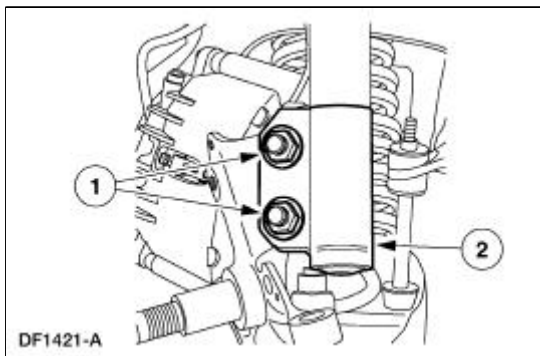
10. Support the front suspension lower arm with a jack stand.
11. Remove the nut and the ABS sensor wire bracket.



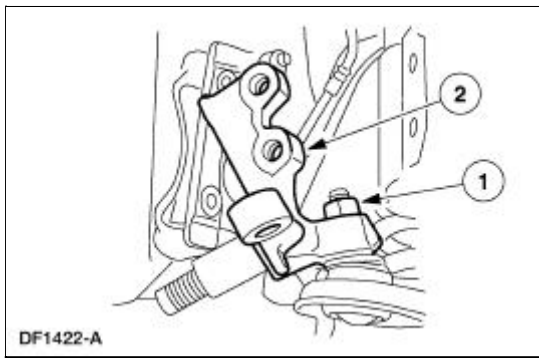
12.  **WARNING: All vehicles are equipped with gas pressurized shock absorbers which will extend unassisted. Do not apply heat or flame to the shock absorbers during removal or component servicing. Failure to follow these instructions can result in personal injury.**

Disconnect the front shock absorber (18124) from the spindle.

1. Remove and discard the nuts and bolts.
2. Disconnect the shock absorber.

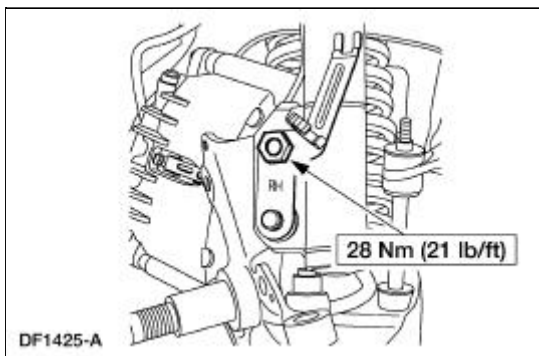
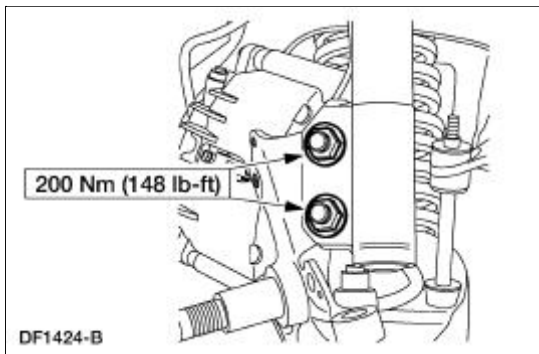
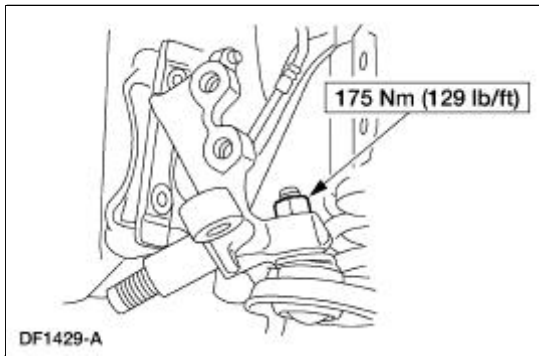


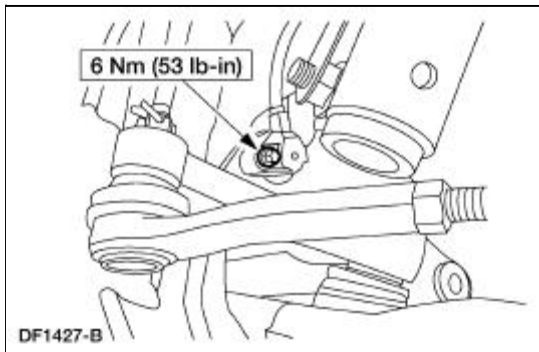
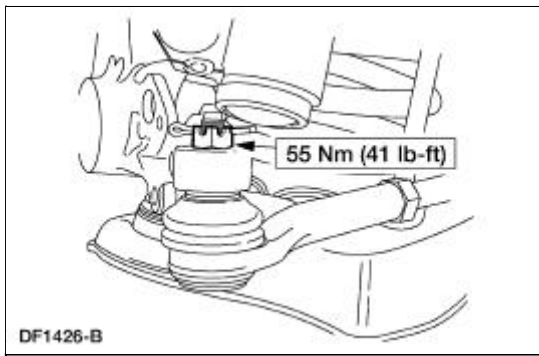
13. Remove the spindle.
 1. Remove and discard the nut.
 2. Remove the spindle.



Installation

1. To install, reverse the removal procedure.





2. Check wheel alignment. Adjust if necessary. For additional information, refer to [Section 204-00](#).
-

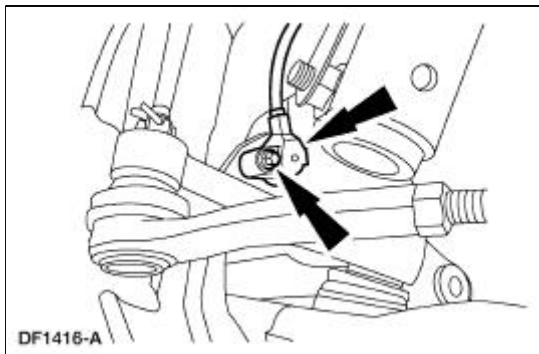
Shock Absorber

Removal

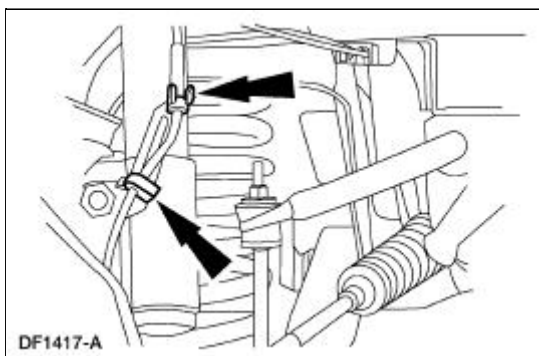
⚠ WARNING: All vehicles are equipped with gas pressurized shock absorbers which will extend unassisted. Do not apply heat or flame to the shock absorbers during removal or component servicing. Failure to follow these instructions can result in personal injury.

⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number or an equivalent part must be installed, if installation is necessary. Do not use a part of lesser quality or substitute design. Torque values must be used as specified during reassembly to ensure proper retention of these parts.

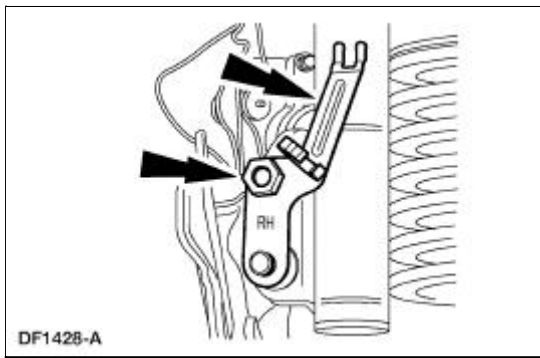
1. Raise the vehicle on a hoist. For additional information, refer to [Section 100-02](#).
2. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
3. Remove the front brake disc. For additional information, refer to [Section 206-03](#).
4. Remove the bolt and the ABS sensor.



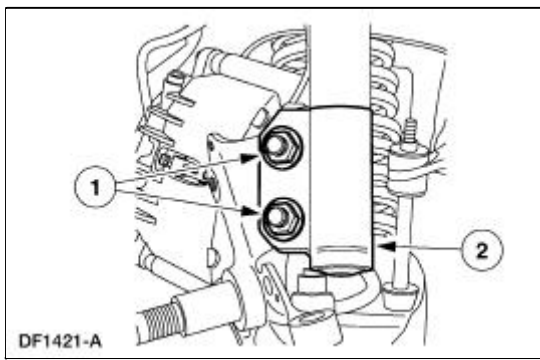
5. Unclip the ABS sensor wire from the bracket.




6. Remove the nut and the ABS sensor wire bracket.



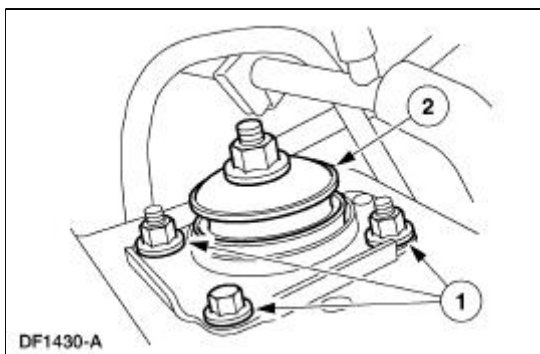
7. Support the front suspension lower arm (3078) with a jack stand.
8. Disconnect the shock absorber (18124) from the spindle (3105).
 1. Remove and discard the nuts and bolts.
 2. Disconnect the shock absorber.



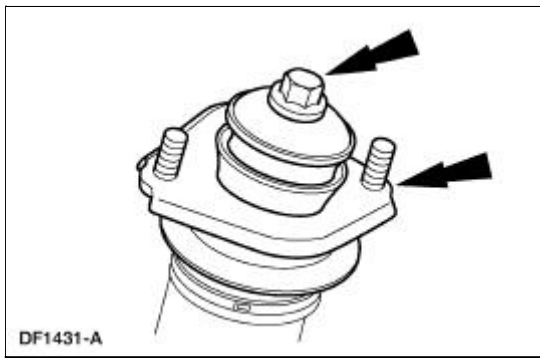
9. Carefully lower the front suspension lower arm and remove the jack stand.
10.  **CAUTION: Do not allow the weight of the vehicle to rest on the front brake disc shield. Damage to the shield can occur.**

Lower the vehicle to access the upper mount nuts and bolt.

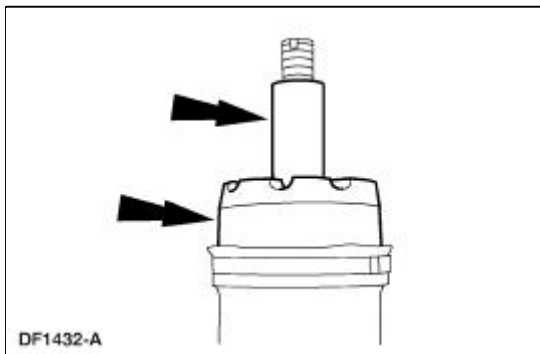
11. Remove the shock absorber.
 1. Remove the bolt and nuts. Discard the nuts.
 2. Remove the shock absorber.



12. Position the shock absorber in a vise.
13. Remove the nut and the front shock absorber mounting bracket (18183).

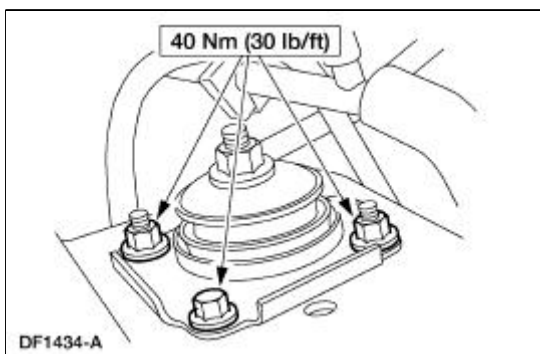
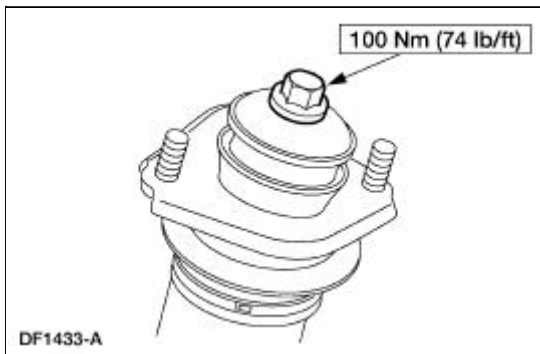


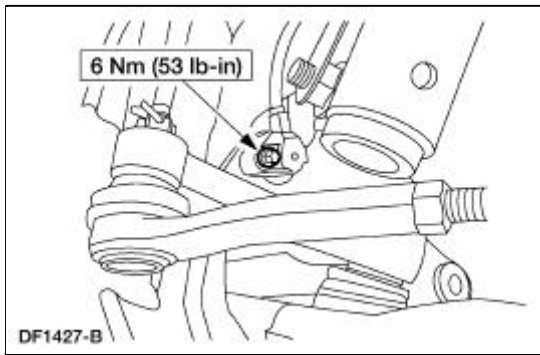
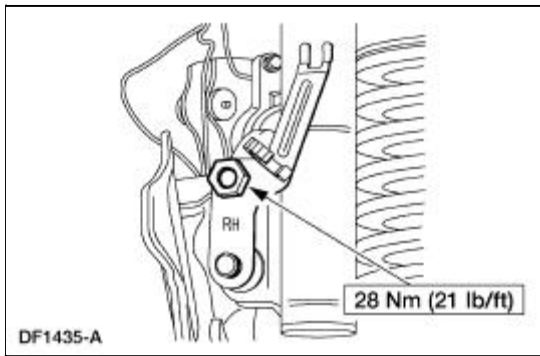
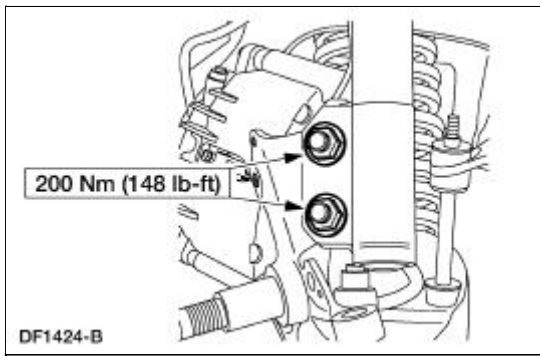
14. Remove the sleeve and the bushing.



Installation


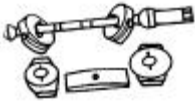
1. To install, reverse the removal procedure.






Spring

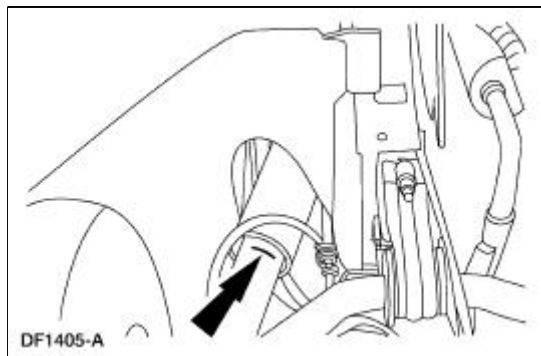
Special Tool(s)

 ST1106-A	Tie-Rod End Remover 211-001 (TOOL-3290-D) or Equivalent
 ST1352-A	Coil Spring Compressor 204-D001 (D78P-5310-A) or Equivalent

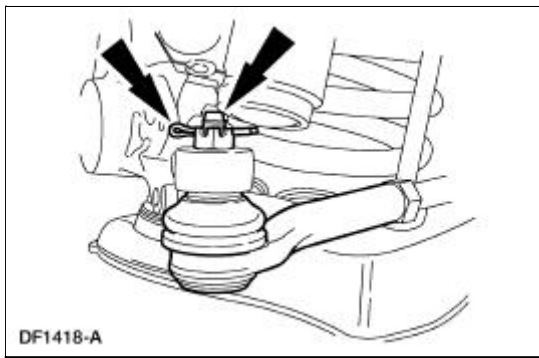
Removal

 **CAUTION:** Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number or an equivalent part must be installed, if installation is necessary. Do not use a part of lesser quality or substitute design. Torque values must be used as specified during reassembly to ensure proper retention of these parts.

1. Mark the front shock absorber (18124) relative to the protective sleeve with the vehicle in a static, level ground position (curb height).

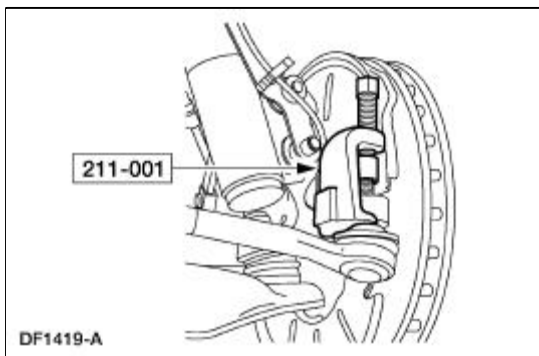


2. Raise the vehicle on a hoist. For additional information, refer to [Section 100-02](#).
3. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
4. Remove the cotter pin and nut. Discard the cotter pin.

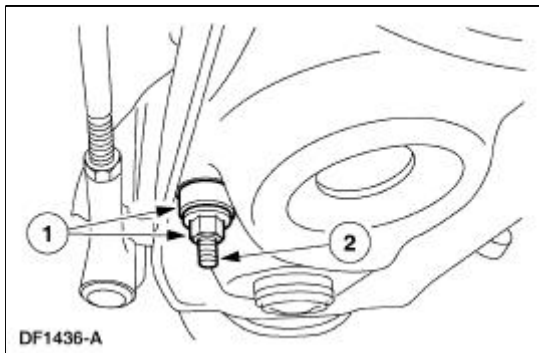



5.  **CAUTION: Use care not to damage the tie-rod end dust boot.**

Using the special tool, disconnect the tie-rod from the spindle.



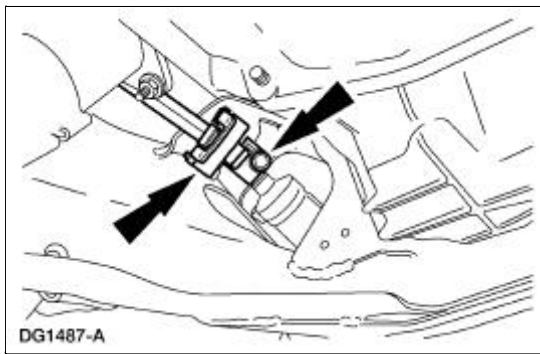
6. Disconnect the front stabilizer bar link (5K483) from the front suspension lower arm (3078).
1. Remove the nut and bushing.
 2. Disconnect the link.




7.  **CAUTION: Do not allow the intermediate shaft to rotate while it is disconnected from the gear or damage to the clockspring can occur. If there is evidence that the intermediate shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to [Section 501-20B](#).**

Remove the bolt and disconnect the intermediate shaft from the gear.

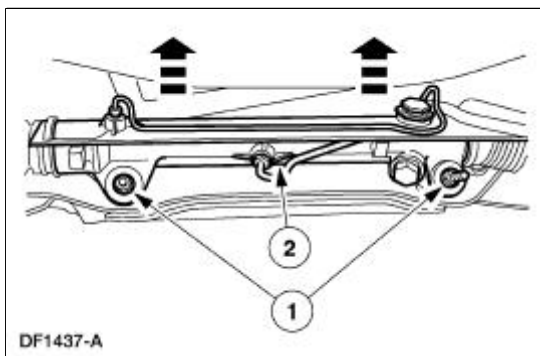
- Discard the bolt.



8.  **CAUTION:** Correctly support the power rack and pinion steering gear to avoid damaging the gear and hoses.

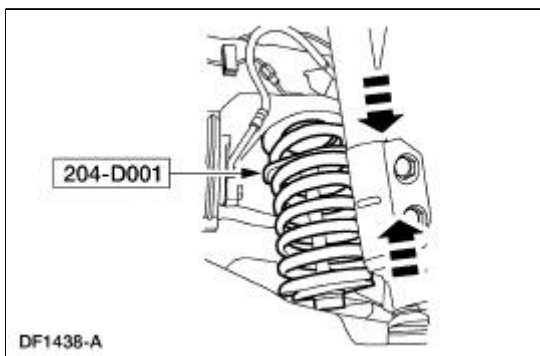
Position the power rack and steering gear out of the way.

1. Remove the nuts and bolts.
2. Position the steering gear so the front suspension lower arm front bolt can be removed.

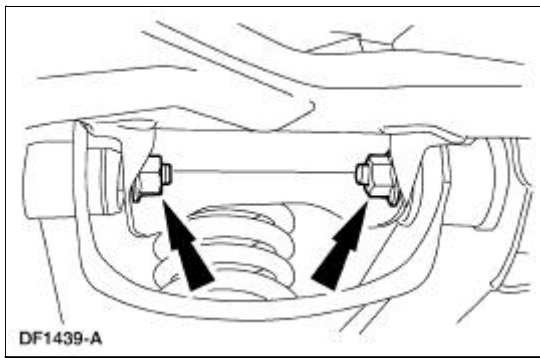


9. Support the front suspension lower arm with a jack stand inboard of the spring seat.
10. **NOTE:** Note position of the front coil spring (5310) in the lower arm spring seat. It must be installed in the same position.

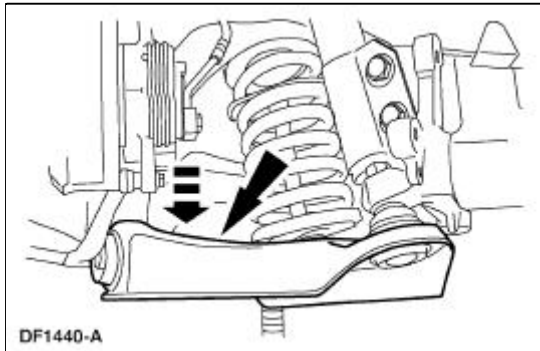
Using the special tool, compress the spring until it is loose in the spring insulator (5415).



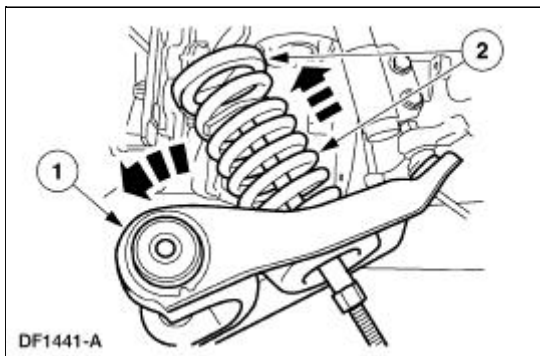
11. Remove the front suspension lower arm pivot nuts and bolts.



12. Lower the front suspension lower arm and remove the jack stand.

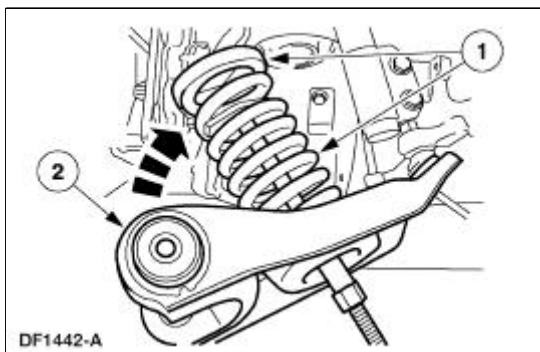


13. Remove the spring.
 1. Swing the front suspension lower arm out of the fender well.
 2. Remove the spring and the spring insulator.

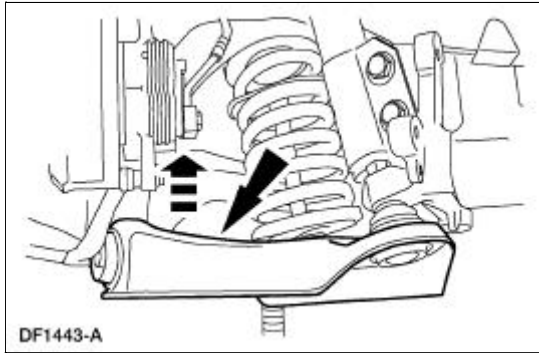


Installation

1. Install the spring.
 1. Position the spring and spring insulator in the front suspension lower control arm.
 2. Swing the arm into the fender well.

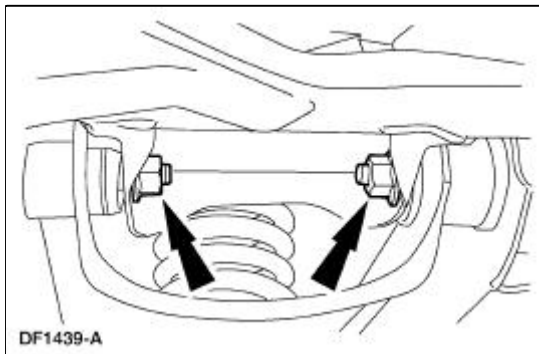


2. Position a jack stand under the front suspension lower control arm inboard of the spring seat and raise the arm into position.

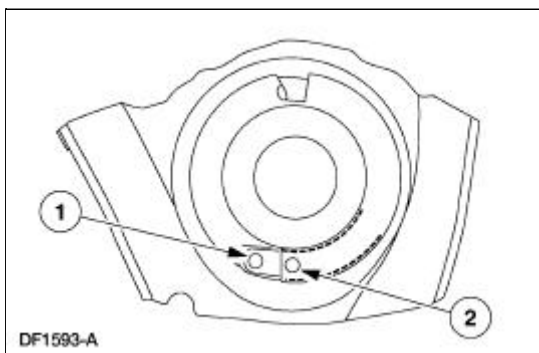


3. **NOTE:** The front suspension lower arm nuts must be tightened with the suspension at curb height.

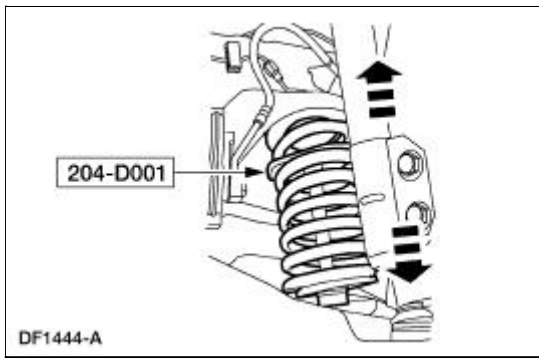
Install the bolts and nuts. Do not tighten the bolts at this time.



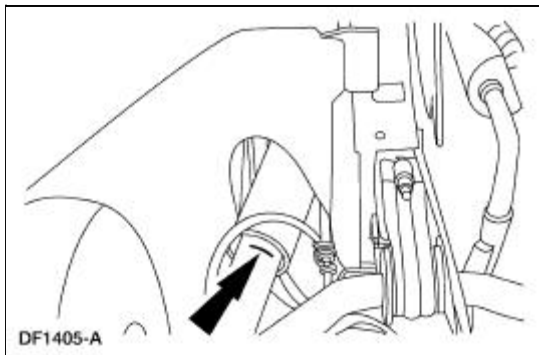
4. Make sure the spring is correctly positioned in the front suspension lower arm.
 1. Spring must not cover this hole.
 2. Spring must cover this hole.



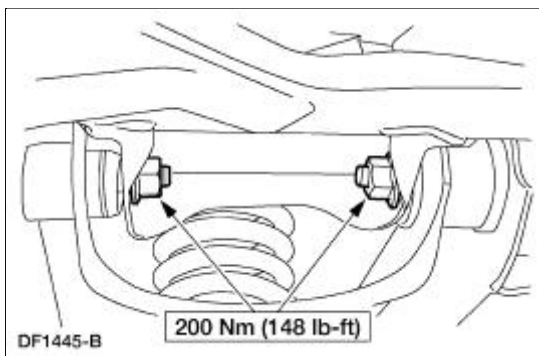
5. Remove the special tool.



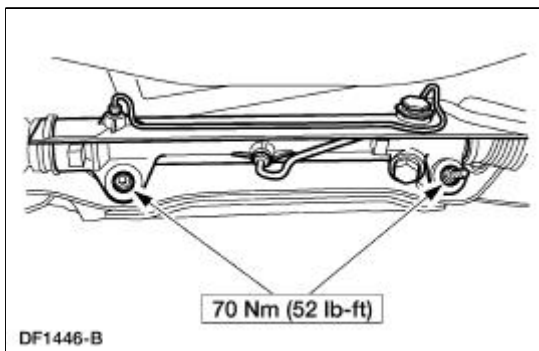
6. Move the jack stand under the front suspension lower arm ball joint and raise the suspension until the shock absorber is compressed to the previously established alignment mark (curb height).



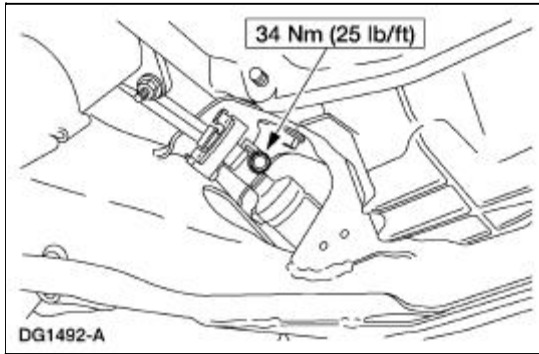
7. Tighten the nuts.



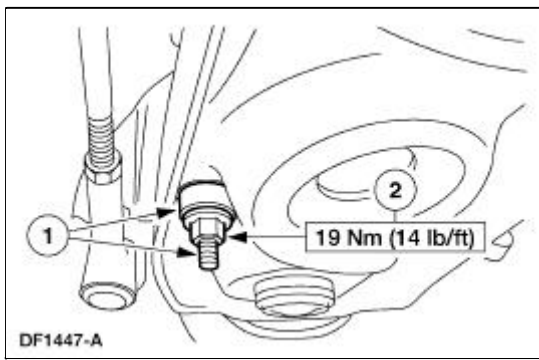
8. Remove the jack stand.
9. Install the power rack and pinion steering gear.



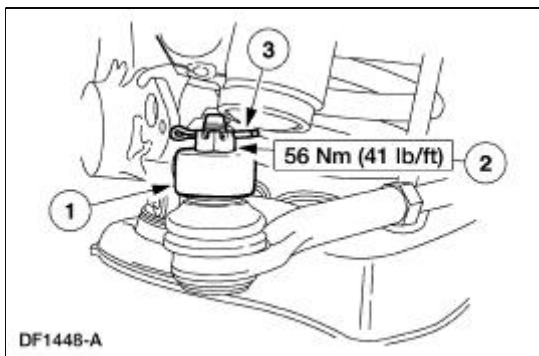
10. Position the intermediate shaft and install the bolt.



11. Connect the stabilizer bar link to the front suspension lower arm.
 1. Install the link and bushing.
 2. Install the nut.



12. Connect the tie-rod end to the spindle.
 1. Install the tie-rod end into the spindle.
 2. Install the nut.
 3. Install a new cotter pin.



13. Install the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
 14. Lower the vehicle.
 15. Check wheel alignment. Adjust if necessary. For additional information, refer to [Section 204-00](#).
-

Torque Specifications

Description	Nm	lb-ft	lb-in
Mustang			
Rear shock absorber (upper attachment)	40	30	—
Rear shock absorber (lower attachment)	80	59	—
Shock absorber clevis bracket-to-axle nut	108	80	—
Upper arm-to-frame bolt	97	72	—
Upper arm-to-axle bolt	111	82	—
Lower arm-to-body attachment bolt	150	111	—
Lower arm-to-axle bolt	150	111	—
Stabilizer bar-to-lower arm bolt	55	41	—
Parking brake cable bracket	55	41	—
Axle damper front bolt	90	66	—
Axle damper rear nut	90	66	—
Axle damper bracket-to-frame bolt	80	59	—
Pinion bumper mount-to-body bolts	14	10	—
Bracket assembly-to-differential housing bolt	48	35	—
Wheel nuts	129	95	—
Cobra			
Subframe-to-body bolts	103	76	—
Subframe-to-rear bracket bolts	103	76	—
Subframe rear bracket-to-body bolts	80	59	—
Shock absorber-to-lower arm and bushing bolts	133	98	—
Shock absorber-to-body nuts	40	30	—
Upper arm and bushing-to-subframe nuts	90	66	—
Upper arm and bushing-to-knuckle nut	90	66	—
Lower arm and bushing-to-subframe bolts	250	184	—
Lower arm and bushing-to-knuckle nut	115	85	—
Toe link-to-subframe nut	48	35	—
Toe link-to-knuckle nut	48	35	—
Stabilizer bar bracket bolt	55	41	—
Stabilizer bar link nuts	48	35	—
Rear axle differential rear insulator-to-axle housing bolts	103	76	—
Rear brake disc dust shield-to-knuckle bolts	10	—	89
Brake line-to-rear brake caliper bolt	40	30	—
Parking brake cable bracket-to-lower arm and bushing bolt	15	11	—
ABS sensor bolt	23	17	—

Axle shaft-to-hub retainer	325	240	—
Wheel nuts	129	95	—

Rear Suspension

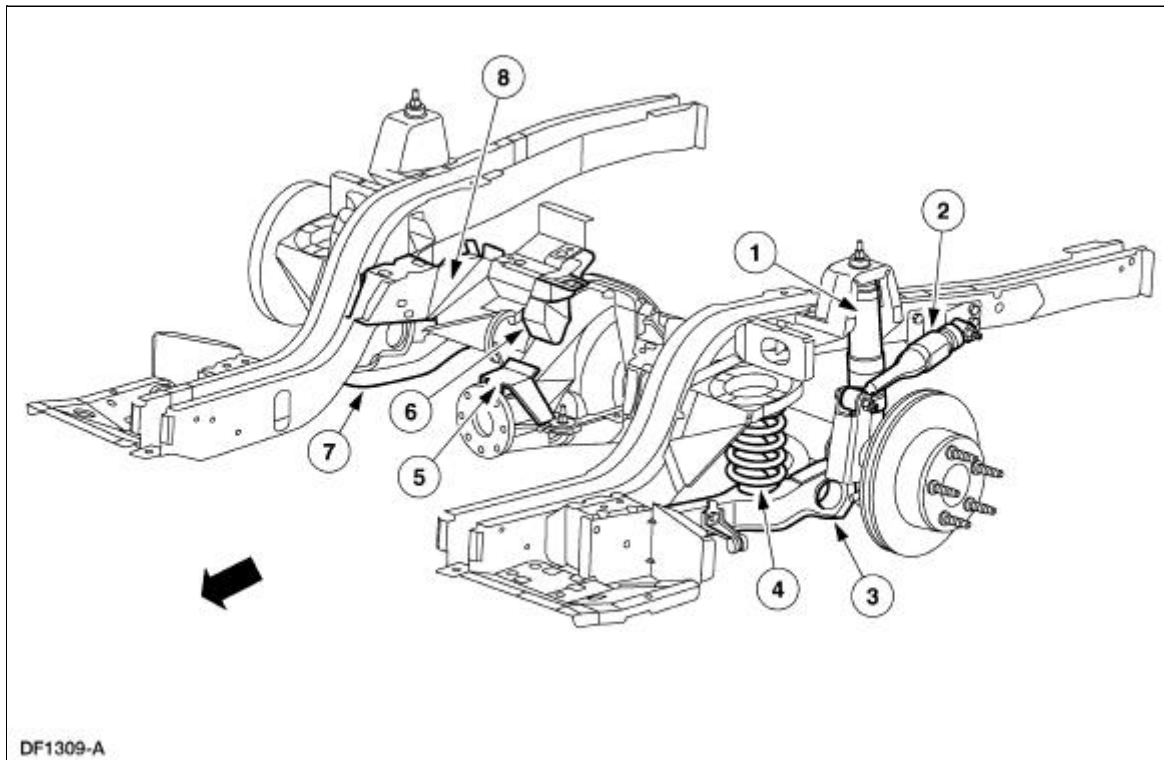
⚠ WARNING: All vehicles are equipped with gas pressurized shock absorbers which will extend unassisted. Do not apply heat or flame to the shock absorbers during removal or component servicing. Failure to follow these instructions can result in personal injury.

⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation becomes necessary. If substitution is necessary, the part must be of the same finish and property class. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

The rear suspension consists of the following components:

- rear spring (4460)
- rear shock absorber (18125)
- rear upper suspension arm and bushings (5500)
 - common LH and RH
- rear lower suspension arm and bushings (5A649)
 - common LH and RH
- rear stabilizer bar (5A772) (4.6 2V-equipped models only)
- axle drive line vibration dampers (4.6 2V-equipped models only)

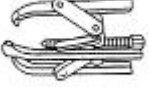

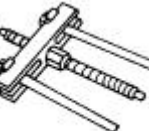




Rear Suspension

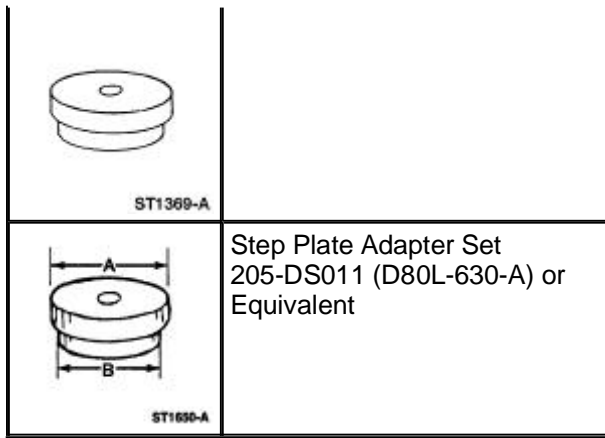


Item	Part Number	Description
1	18125	Rear shock absorber
2	—	Rear axle driveline vibration damper
3	5A649	Rear lower suspension arm and bushing (common LH and RH)
4	5560	Rear spring
5	4731	Rear axle bumper bracket
6	4905	Rear axle differential carrier bumper and bracket
7	5A772	Rear stabilizer bar
8	5500	Rear upper suspension arm and bushing (common LH and RH)

Wheel Hub —Cobra

Special Tool(s)

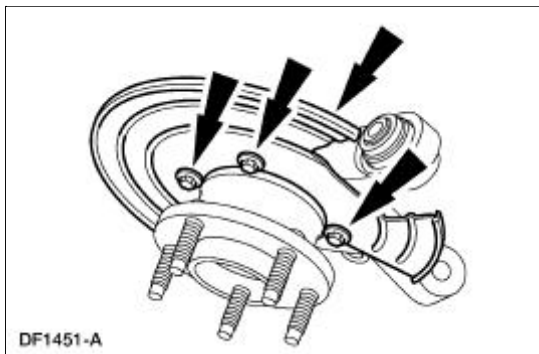
 <p>ST1184-A</p>	<p>2-3 Jaw Puller 205-D026 (D80L-1013-A) or Equivalent</p>
 <p>ST2266-A</p>	<p>Driver 205-199 (T83T-3132-A1)</p>
 <p>ST1516-A</p>	<p>Front Hub Remover Replacer 204-069 (T81P-1104-C)</p>
 <p>ST2264-A</p>	<p>Hub Bearing Remover 204-081 (T83P-1104-AH2)</p>
 <p>ST2265-A</p>	<p>Hub Dust Seal Replacer 205-289 (T89P-1249-A)</p>
 <p>ST2262-A</p>	<p>Rear Hub Remover 205-287 (T89P-1225-AH)</p>
 <p>ST2263-A</p>	<p>Receiving Cup 205-286 (T89P-1104-A)</p>
	<p>Step Plate Adapter 205-D016 (D80L-630-5) or Equivalent</p>



Removal

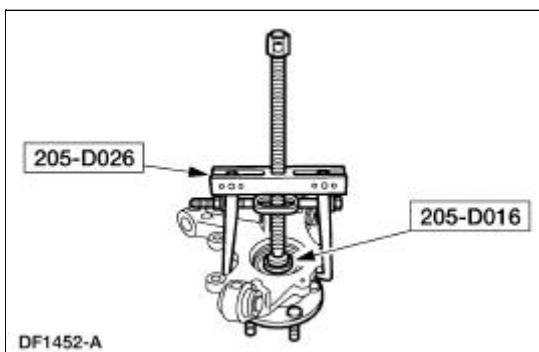
⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation becomes necessary. If substitution is necessary, the part must be of the same finish and property class. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

1. Remove the rear wheel knuckle (5A968/5A969). For additional information, refer to [Wheel Knuckle—Cobra](#) in this section.
2. Remove the bolts and the dust shield. Discard the bolts.

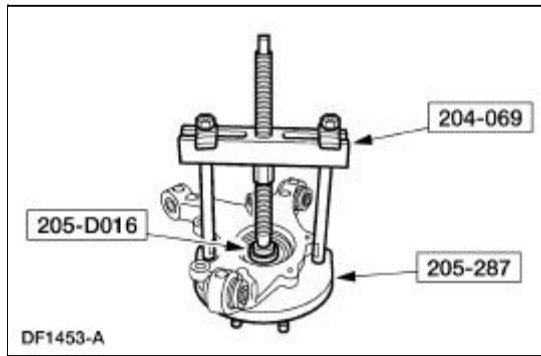


3. Position the knuckle in a vise.
4. **NOTE:** There are two methods for removing the rear hub (1109) from the rear wheel bearing (1A049). Both methods are shown.

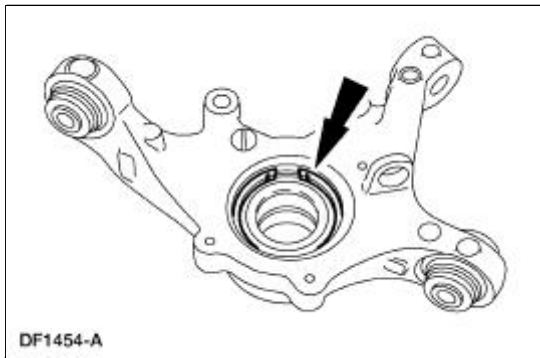
Method one. Using the special tools, remove the hub.



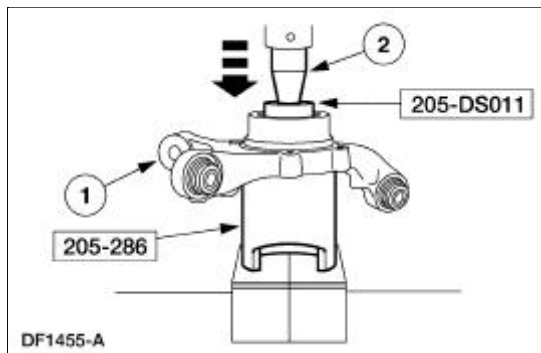
- Method two. Using the special tools, remove the hub.



- Remove the snap ring.

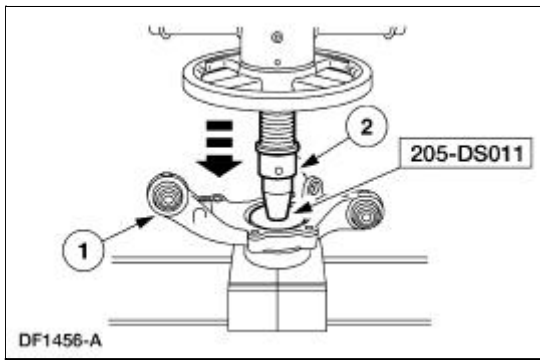


- Press the wheel bearing from the knuckle.
 - Position the knuckle on the press bed supported by the special tool.
 - Using the appropriate step plate adapter, press the bearing from the knuckle.

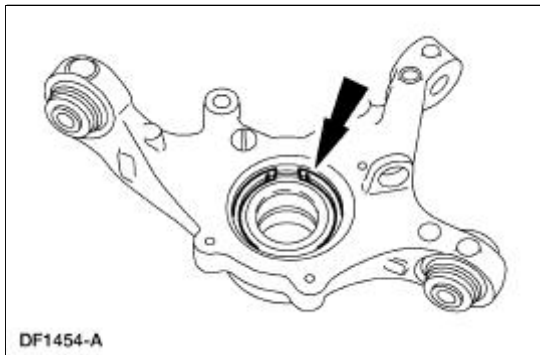



Installation

- Install the bearing.
 - Position the knuckle on the press.
 - Using the appropriate step plate adapter, press the bearing into the knuckle until the bearing clears the snap ring groove and bottoms out in the bore.



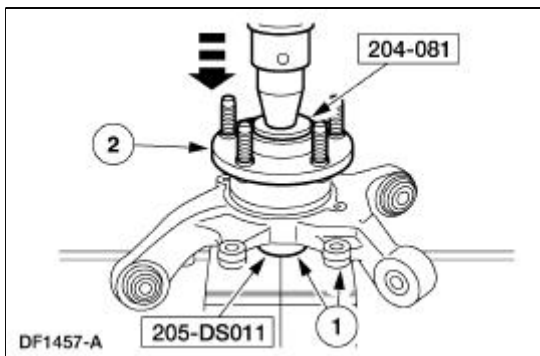
2. Install the snap ring.



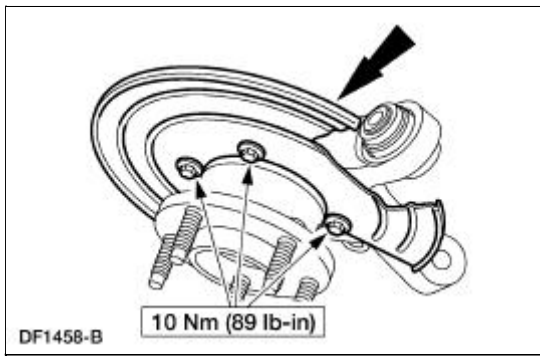
3.  **CAUTION: The bearing inner race must be supported during hub installation. Failure to follow these instructions can damage the bearing.**

Install the hub.

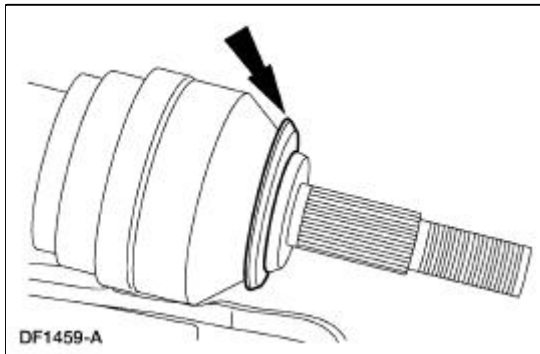
1. Position the knuckle in a press, making sure the wheel bearing inner race is supported with the appropriate step plate adapter.
2. Using the special tool, install the hub.



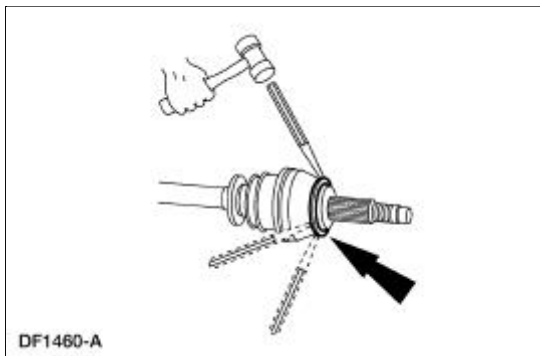
4. Install the dust shield and new bolts.



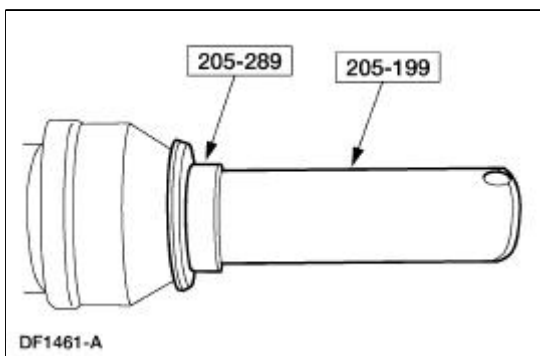
5. Inspect the bearing dust seal. If necessary, install a new dust seal.



6. Using a hammer and chisel, remove the dust seal.



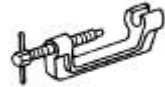
7. Using the special tools, install the dust seal.



8. Install the knuckle. For additional information, refer to [Wheel Knuckle—Cobra](#) in this section.
-

Wheel Studs

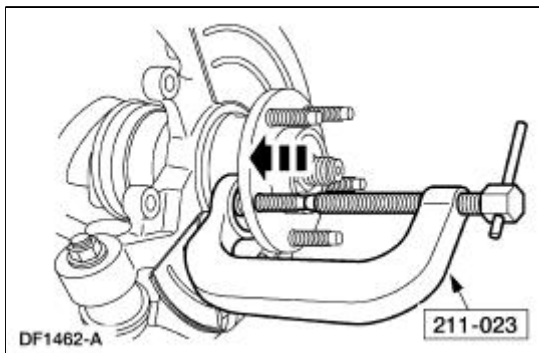
Special Tool(s)

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

⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation becomes necessary. If substitution is necessary, the part must be of the same finish and property class. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

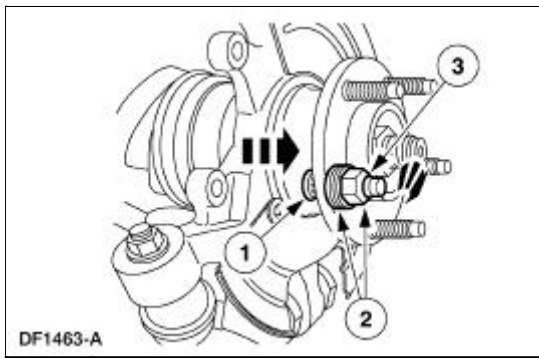
1. Raise the vehicle on a hoist. For additional information, refer to [Section 100-02](#).
2. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
3. Remove the rear brake disc. For additional information, refer to [Section 206-04](#).
4. Using the special tool, remove and discard the wheel stud.



Installation

⚠ CAUTION: Do not use air tools to install the wheel stud. The serrations in the hub flange can be stripped.


1. Install the wheel stud.
 1. Position a new wheel stud in the hub flange making sure the serrations on the stud line up with the serrations in the flange.
 2. Position washers and a reversed wheel nut on the wheel stud.
 3. Tighten the wheel nut until the wheel stud seats on the back of the hub flange.



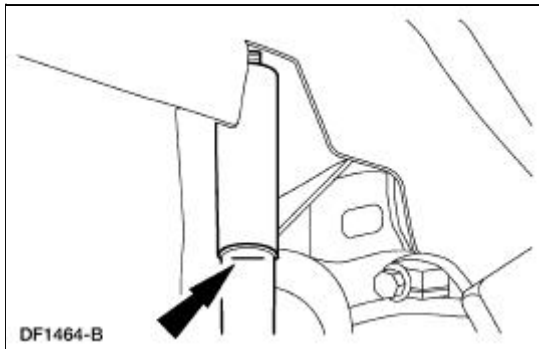
2. Remove the wheel nut and washers. Discard the nut.
 3. Install the rear brake disc. For additional information, refer to [Section 206-04](#).
 4. Install the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
 5. Lower the vehicle.
-

Upper Arm

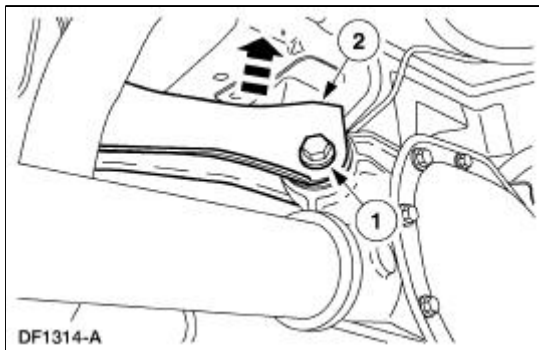
Removal

 **CAUTION:** Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation becomes necessary. If substitution is necessary, the part must be of the same finish and property class. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

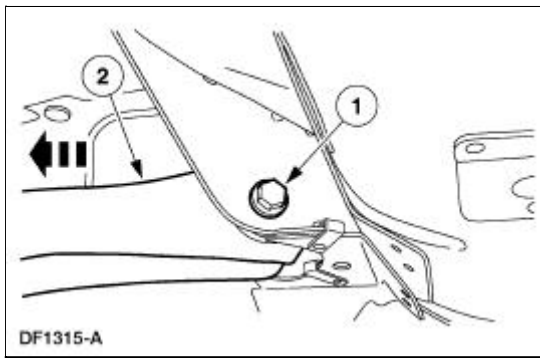
1. Mark the rear shock absorber (18125) relative to the protective sleeve with the vehicle in a static, level ground position (curb height).



2. Raise the vehicle on a hoist. For additional information, refer to [Section 100-02](#).
3. Support the differential housing with a jack stand.
4. Disconnect the upper arm and bushing (5500) from the axle.
 1. Remove and discard the nut and bolt.
 2. Disconnect the arm and bushing from the axle.

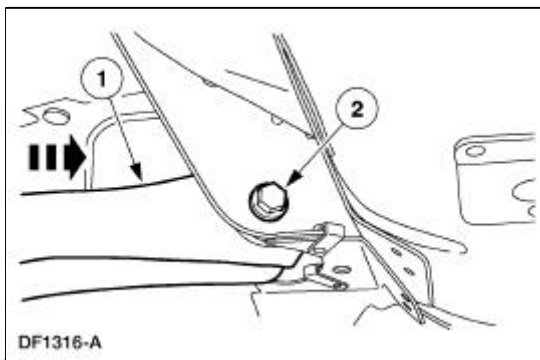


5. Remove the upper arm and bushing from the mounting bracket.
 1. Remove and discard the nut and bolt.
 2. Remove the arm and bushing.

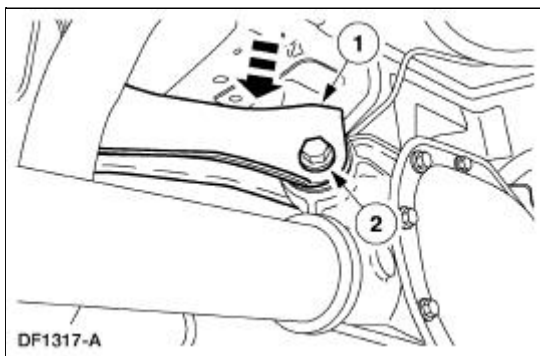


Installation

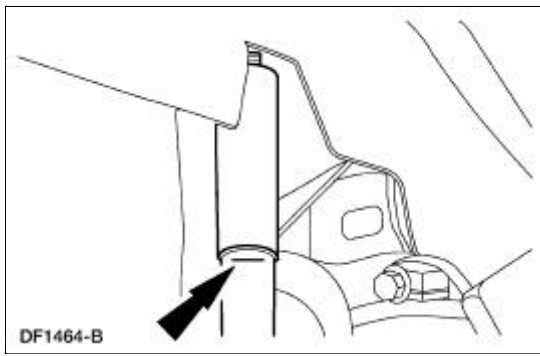
1. Install the upper arm and bushing to the mounting bracket.
 1. Position the arm and bushing.
 2. Install a new nut and bolt. Do not tighten at this time.



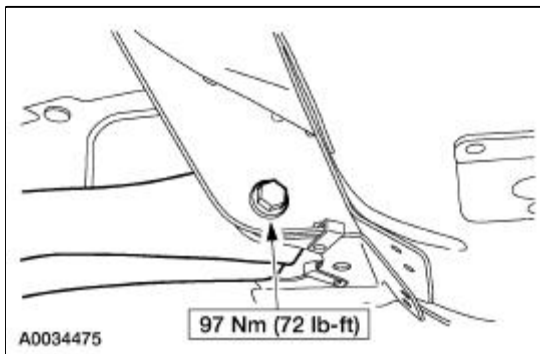
2. Connect the upper arm and bushing to the axle.
 1. Position the arm and bushing.
 2. Install a new nut and bolt. Do not tighten at this time.



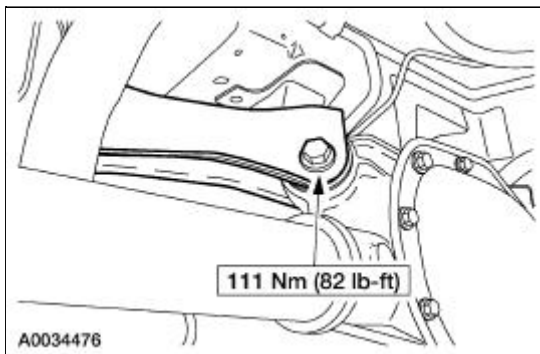
3. Raise the suspension until the shock absorber is compressed to the previously established alignment mark (curb height).



4. Tighten the arm and bushing-to-mounting bracket bolt.



5. Tighten the arm and bushing-to-axle bolt.



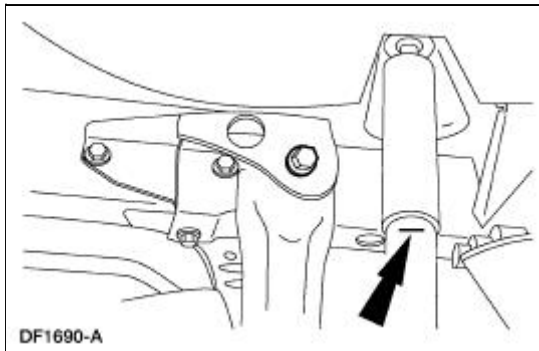
6. Lower the suspension and remove the jack stand.
 7. Lower the vehicle.
-

Upper Arm —Cobra

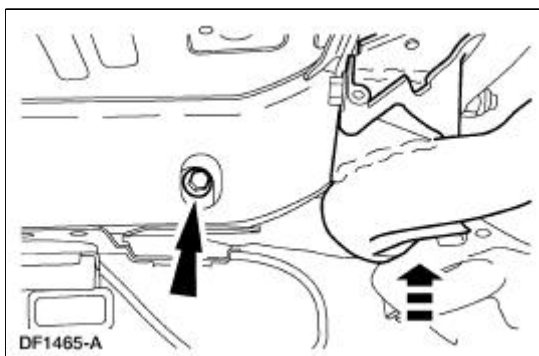
Removal

⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation becomes necessary. If substitution is necessary, the part must be of the same finish and property class. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

1. Mark the rear shock absorber (18125) relative to the protective sleeve with the vehicle in a static, level ground position (curb height).



2. Raise the vehicle on a hoist. For additional information, refer to [Section 100-02](#).
3. Remove both wheel and tire assemblies. For additional information, refer to [Section 204-04](#).
4. Remove the rear brake disc. For additional information, refer to [Section 206-04](#).
5. Remove the rear springs (5560). For additional information, refer to [Spring—Cobra](#) in this section.
6. Raise the subframe into position and remove the front bolts.



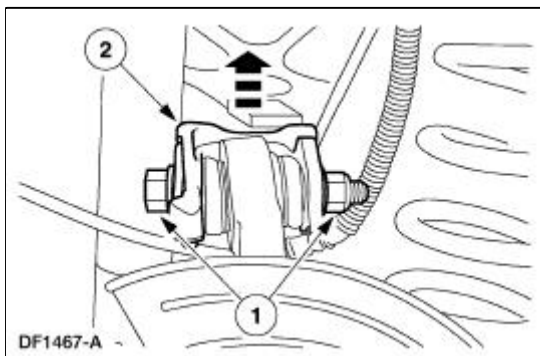
7. Lower the subframe from the vehicle.
8. Mark the cam bolt position relative to the upper suspension arm and bushing (5500).



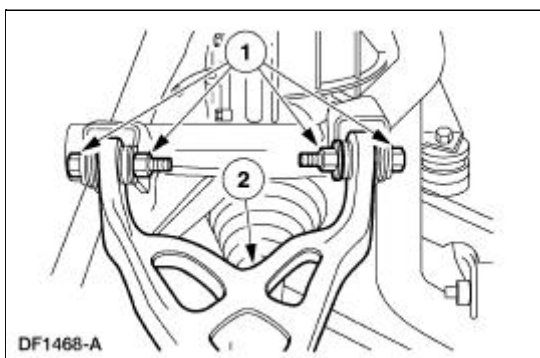
9. **NOTE:** Mark a new cam bolt in the same position as the old one for assembly reference before discarding the old bolt.

Disconnect the upper suspension arm and bushing from the knuckle (5A968/5A969).

1. Remove and discard the nut and bolt.
2. Disconnect the upper suspension arm and bushing.



10. Remove the upper suspension arm and bushing.
1. Remove and discard the nuts and bolts.
 2. Remove the upper suspension arm and bushing.



Installation

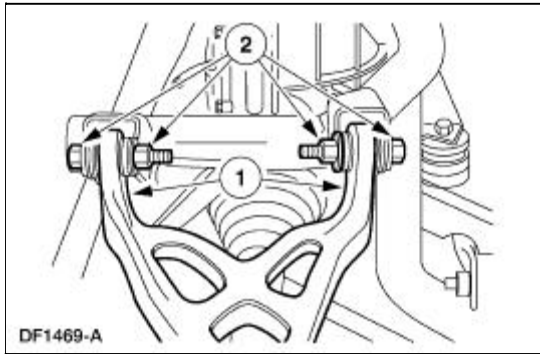


CAUTION: The upper suspension arm and bushing nuts must be tightened with the suspension at curb height. Failure to do so can result in bushing failure, resulting in poor ride and handling.

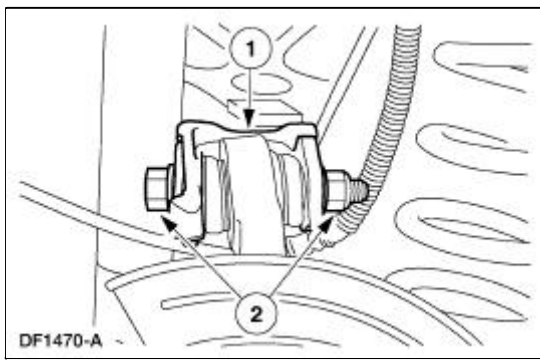
NOTE: If installing a new upper suspension arm and bushing, mark the cam bolt side of the new arm in the same position as the old arm for assembly reference.

1. Install the upper suspension arm and bushing.
 1. Position the arm and bushing on the subframe.

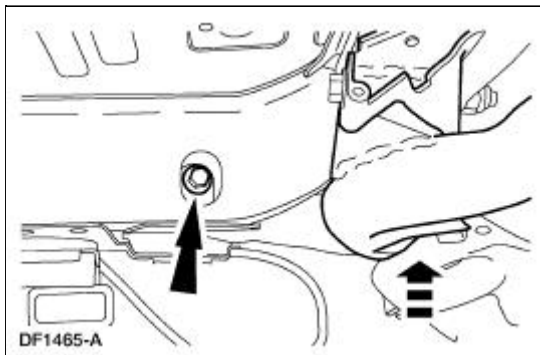
2. Install new bolts and nuts. Do not tighten the nuts at this time.



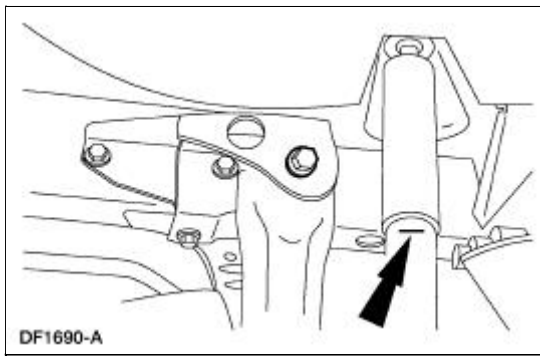
2. Connect the upper suspension arm and bushing to the knuckle.
 1. Position the arm and bushing.
 2. Install a new cam bolt and a new nut. Do not tighten the nut at this time.



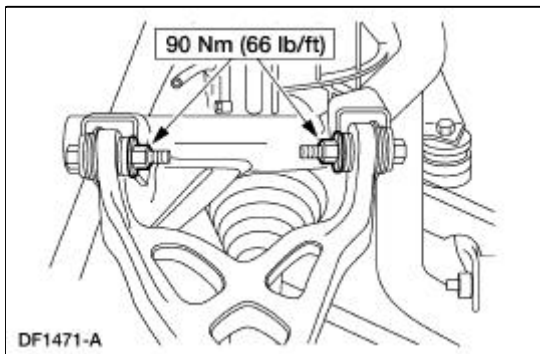
3. Raise the subframe into position and install new front bolts.



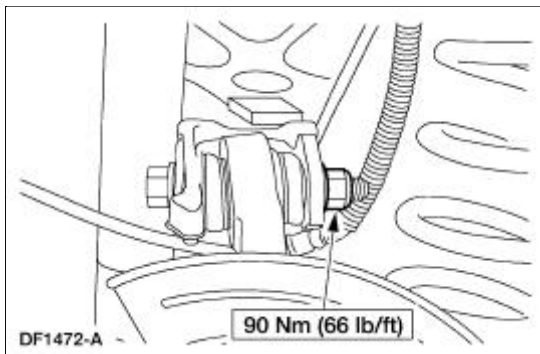
4. Install the springs. For additional information, refer to [Spring—Cobra](#) in this section.
5. Position a jack stand under the lower suspension arm and bushing.
6. Raise the suspension until the shock absorber is compressed to the alignment mark (curb height).



7. Tighten the nuts.




8. Position the cam bolt so the marks are aligned. Tighten the nut.



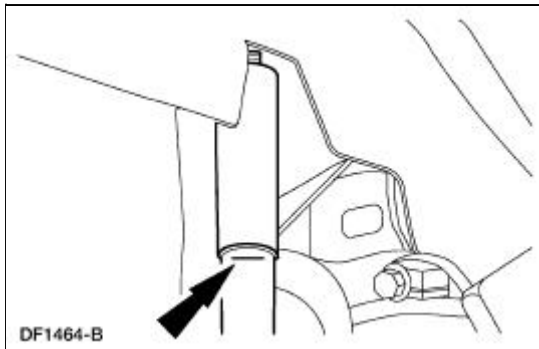
9. Lower the suspension and remove the jack stand.
 10. Install the rear brake disc. For additional information, refer to [Section 206-04](#).
 11. Install the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
 12. Lower the vehicle.
 13. Check wheel alignment, adjust if necessary. For additional information, refer to [Section 204-00](#).
-

Lower Arm

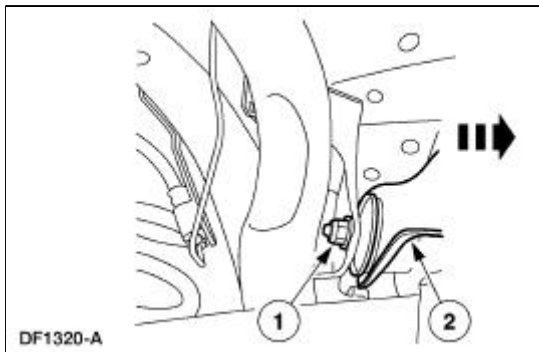
Removal

 **CAUTION:** Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation becomes necessary. If substitution is necessary, the part must be of the same finish and property class. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

1. Mark the rear shock absorber (18125) relative to the protective sleeve with the vehicle in a static, level ground position (curb height).

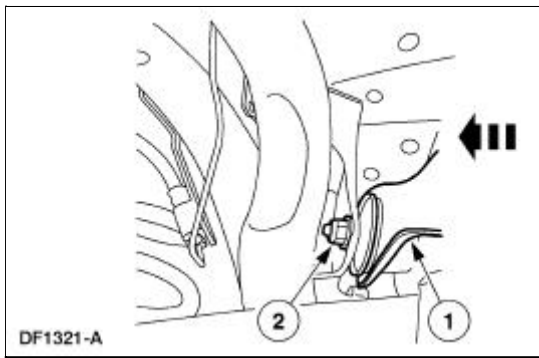


2. Remove the muffler assembly(ies). For additional information, refer to [Section 309-00](#).
3. Remove the rear spring (5560). For additional information, refer to [Spring—Coil](#) in this section.
4. Remove the lower suspension arm and bushing (5A649) from the body attachment.
 1. Remove and discard the bolt and nut.
 2. Remove the lower arm.



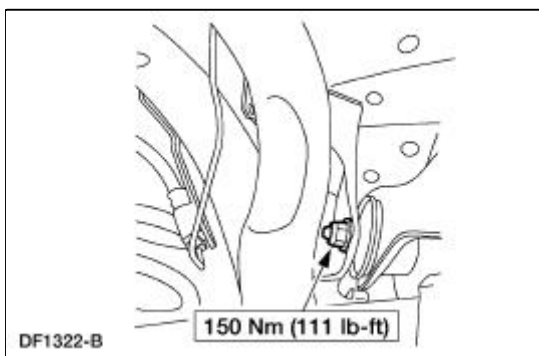
Installation

1. Install the lower suspension arm and bushing to the body attachment.
 1. Position the lower arm.
 2. Install a new bolt and a new nut. Do not tighten at this time.



2. **NOTE:** Tighten the lower suspension arm and bushing-to-body attachment bolt after installing the spring while the suspension is at curb height.


Install the rear spring. For additional information, refer to [Spring—Coil](#) in this section.



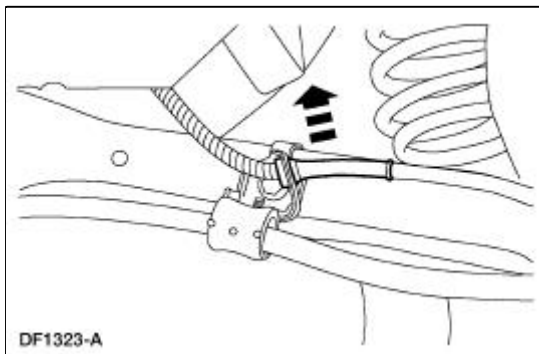
3. Install the muffler assembly(ies). For additional information, refer to [Section 309-00](#).
-

Stabilizer Bar

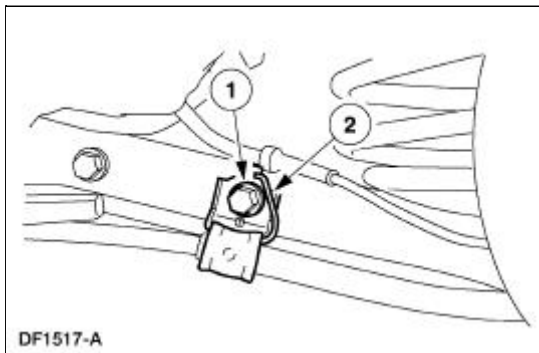
Removal

 **CAUTION:** Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation becomes necessary. If substitution is necessary, the part must be of the same finish and property class. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

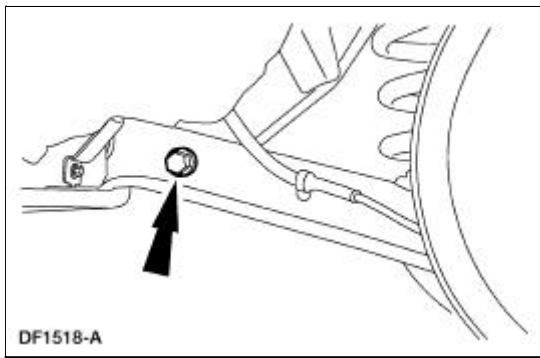
1. Raise the vehicle. For additional information, refer to [Section 100-02](#).
2. Disconnect the anti-lock brake sensor wires from the brackets.



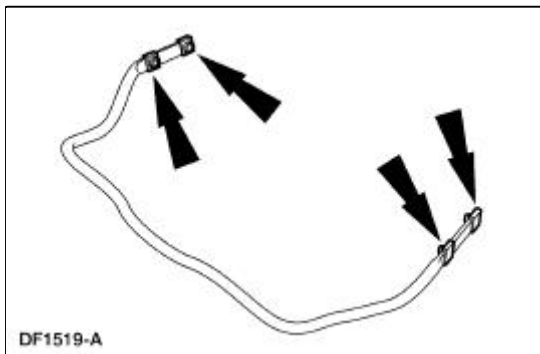
3. Remove the parking brake cable brackets.
 1. Remove and discard the bolts.
 2. Remove the parking brake cable brackets.



4. Remove the bolts and the stabilizer bar (5A772). Discard the bolts.



5. Remove and discard the nuts from the stabilizer bar.

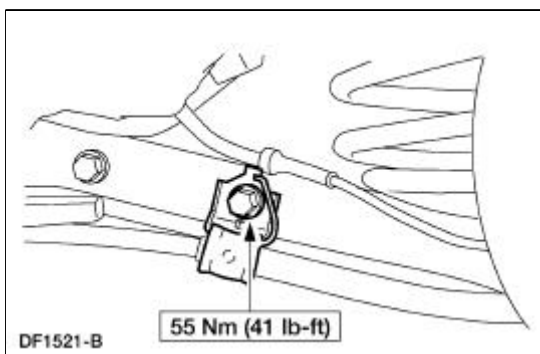
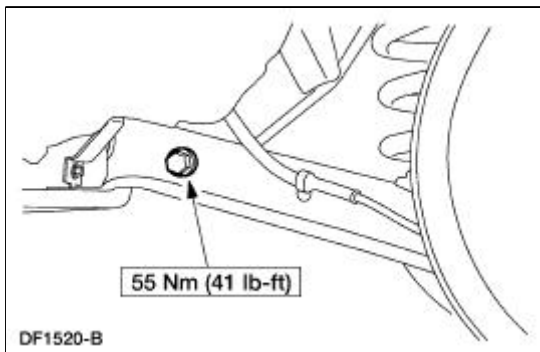


Installation

NOTE: Make sure the rear stabilizer bar is not installed upside down. A color code is provided on the right (passenger) side only as an aid for correct positioning.


NOTE: Use new fasteners when installing the stabilizer bar.

1. To install, reverse the removal procedure.

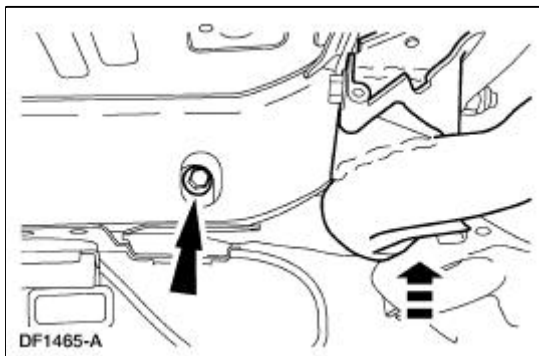


Stabilizer Bar —Cobra

Removal

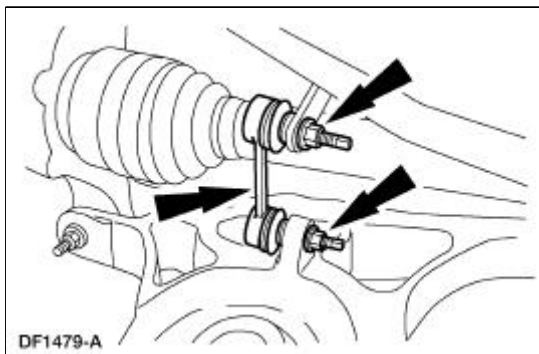
 **CAUTION:** Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation becomes necessary. If substitution is necessary, the part must be of the same finish and property class. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

1. Remove the rear coil springs (5560). For additional information, refer to [Spring—Cobra](#) in this section.
2. Raise the subframe into position and remove the front bolts.

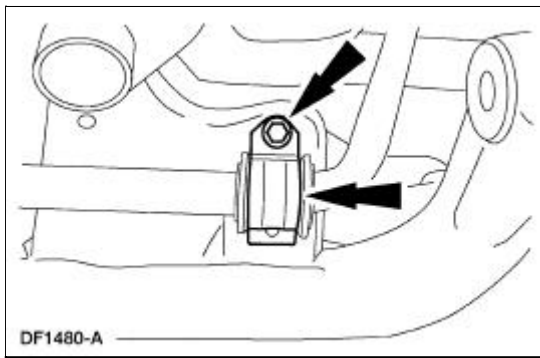


3. Lower the subframe out of the vehicle.
4. **NOTE:** To remove the stabilizer bar link nuts, first loosen the nut, then use the hex holding feature to prevent the stabilizer bar link ball joint from turning while removing the nut.

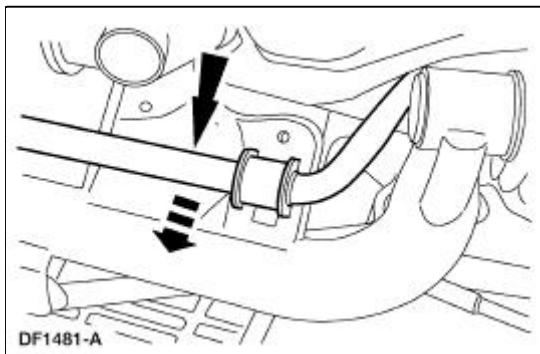
Remove the nuts and the stabilizer bar links (5C488). Discard the nuts.



5. Remove the bolts and the stabilizer bar brackets (4A047). Discard the bolts.



6. Remove the stabilizer bar (5A772) with the stabilizer bar bushings (5493).

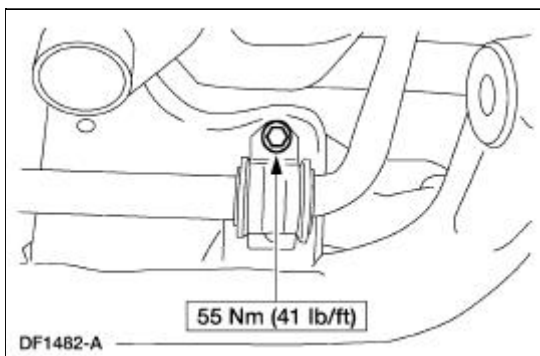


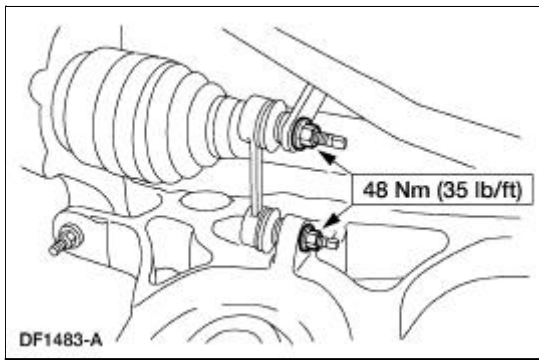
Installation

1. **NOTE:** The stabilizer bar bracket bolts and the nuts on the stabilizer bar links are of a torque prevailing design. New bolts and nuts must be used during installation.

NOTE: To install the stabilizer bar link nuts, first install the nuts until snug using the hex holding feature to prevent the stabilizer bar link ball joint from turning. Final tighten the nuts using a socket and a torque wrench.

To install, reverse the removal procedure.





2. Check wheel alignment. Adjust as necessary. For additional information, refer to [Section 204-00](#).
-

Link —Stabilizer Bar

Removal

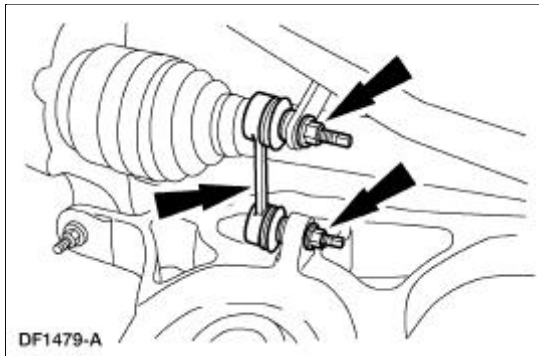


CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation becomes necessary. If substitution is necessary, the part must be of the same finish and property class. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

1. Raise the vehicle on a hoist. For additional information, refer to [Section 100-02](#).
2. **NOTE:** Spring is removed for clarity.

NOTE: To remove the nuts, first loosen the nut, then use the hex holding feature to prevent the stabilizer bar link ball joint from turning while removing the nut.

Remove the nuts and the stabilizer bar links (5C488). Discard the nuts.

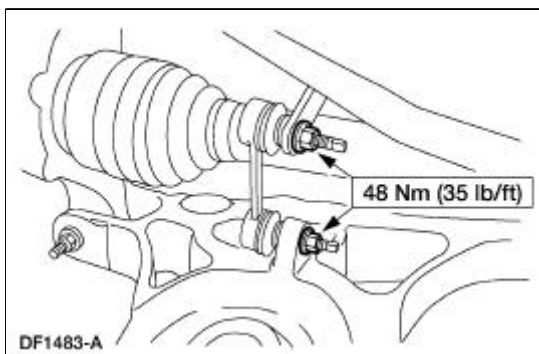


Installation

1. **NOTE:** The nuts on the stabilizer bar links are of a torque prevailing design. New nuts must be used during installation.



NOTE: To install the nuts, first install the nut until snug using the hex holding feature to prevent the stabilizer bar link ball joint from turning. Final tighten the nuts using a socket and a torque wrench.

To install, reverse the removal procedure.



Wheel Knuckle —Cobra

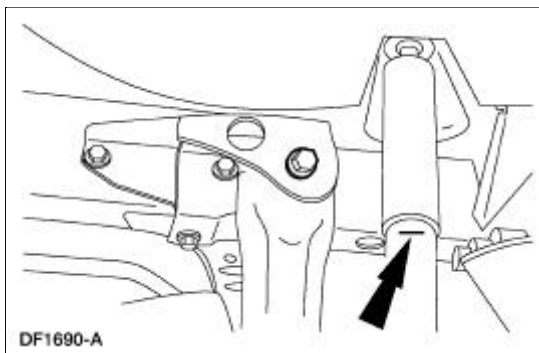
Special Tool(s)

 ST2272-A	Front Hub Remover 205-D070 (D93P-1175-B) or Equivalent
 ST2273-A	Steering Arm Remover 211-003 (T64P-9171-A)

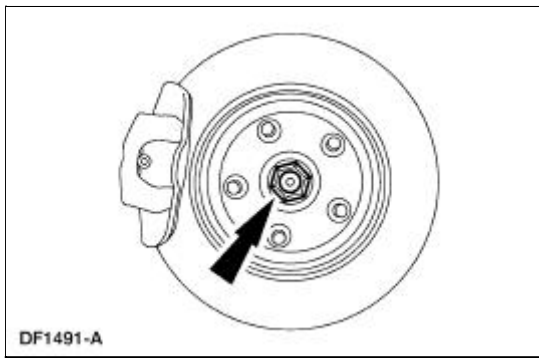
Removal

! **CAUTION:** Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation becomes necessary. If substitution is necessary, the part must be of the same finish and property class. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

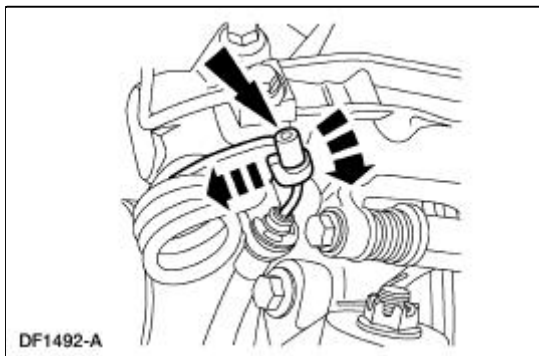
1. Mark the rear shock absorber (18125) relative to the protective sleeve with the vehicle in a static, level ground position (curb height).



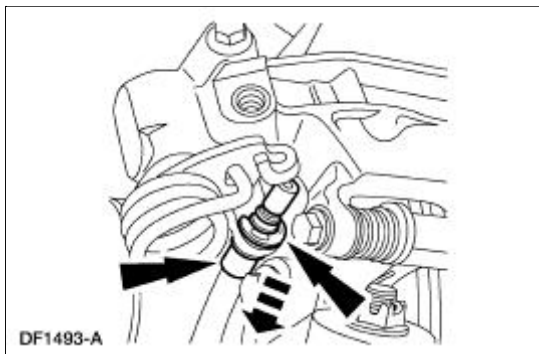
2. Raise the vehicle on a hoist. For additional information, refer to [Section 100-02](#).
3. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
4. Remove and discard the rear hub retainer (4B477).



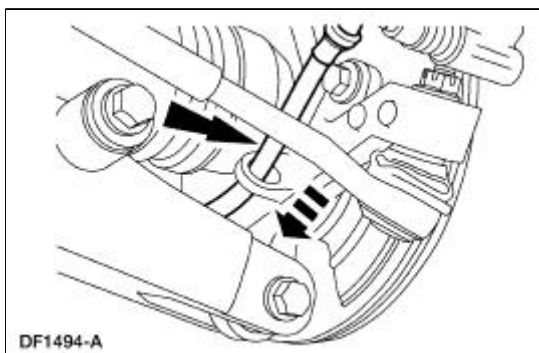
5. Disconnect the parking brake cable and conduit from the parking brake lever.



6. Remove the clip and disconnect the parking brake cable and conduit from the rear brake caliper.

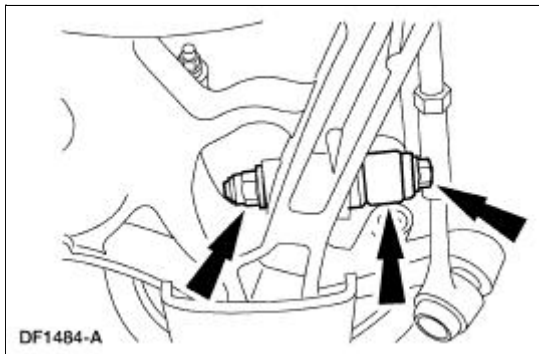


7. Disconnect the parking brake cable and conduit from the knuckle (5A968/5A969).

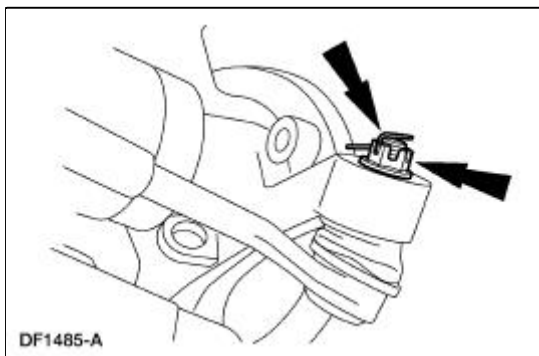



8. Remove the rear brake disc. For additional information, refer to [Section 206-04](#).
9. Support the lower suspension arm and bushing (5A649) with a jack stand.

10. Remove the nut and bolt and disconnect the shock absorber (18125) from the lower suspension arm and bushing. Discard the nut and bolt.

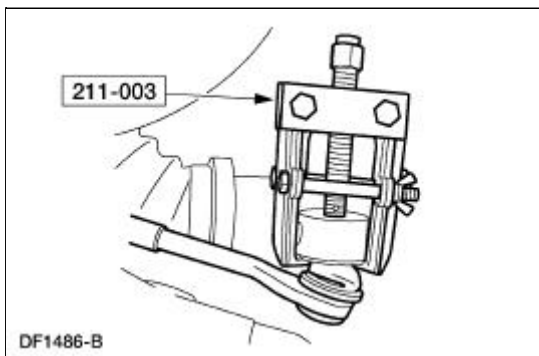


11. Remove and discard the cotter pin and nut.



12.  **CAUTION: Do not strike the toe link or the knuckle to disconnect the toe link. The toe link or the knuckle can be damaged.**

Using the special tool, disconnect the toe link (5K899) from the knuckle.



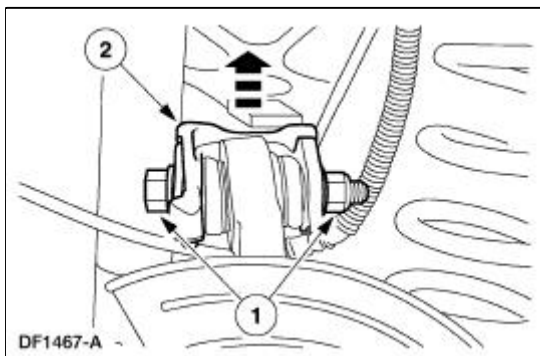
13. Mark the cam bolt position relative to the upper suspension arm and bushing (5500).



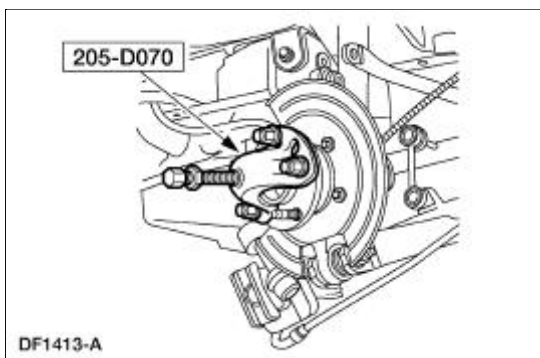
14. **NOTE:** Mark a new cam bolt in the same position as the old one for assembly reference before discarding the old bolt.

Disconnect the upper suspension arm and bushing from the knuckle.

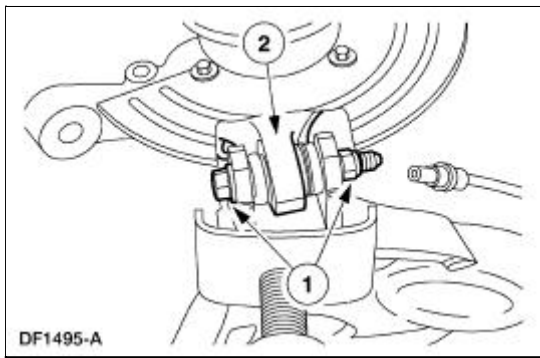
1. Remove and discard the nut and bolt.
2. Disconnect the arm and bushing from the knuckle.



15. Using the special tool, press the axle shaft from the hub (1109).



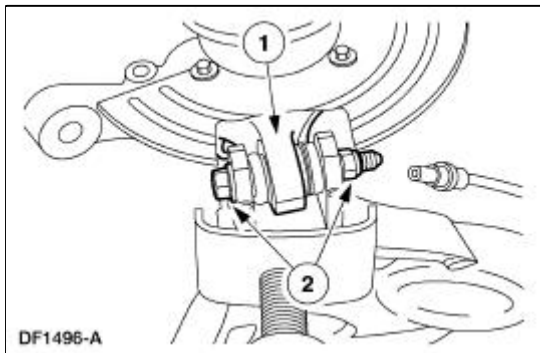
16. Remove the knuckle from the lower arm and bushing.
1. Remove and discard the nut and bolt.
 2. Remove the knuckle.



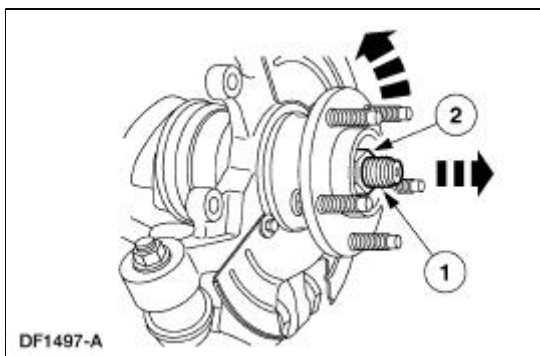
17. Remove the dust shield, hub, snap ring and bearing from the knuckle. For additional information, refer to [Wheel Hub—Cobra](#) in this section.

Installation

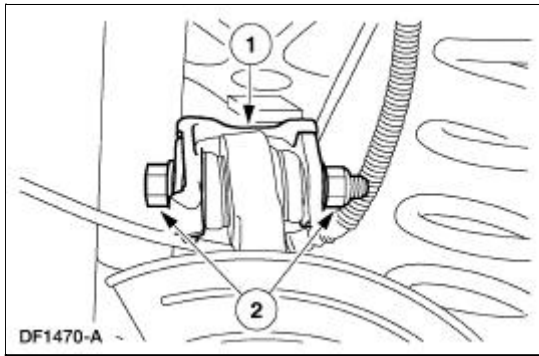
1. Install the bearing, snap ring, hub and dust shield. For additional information, refer to [Wheel Hub—Cobra](#) in this section.
2. Install the knuckle.
 1. Position the knuckle on the lower suspension arm and bushing.
 2. Install a new bolt and a new nut. Do not tighten the nut at this time.



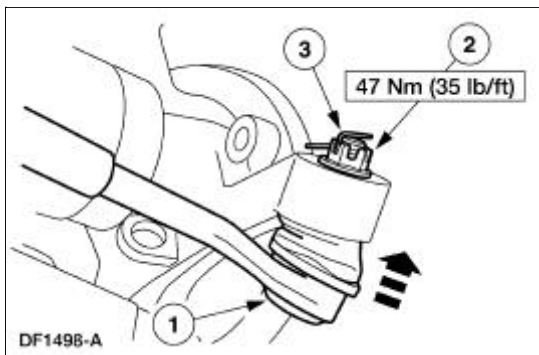
3. Connect the axle shaft to the hub.
 1. Making sure the splines on the shaft line up with the splines in the hub, install the axle shaft into the hub.
 2. Install a new retainer. Do not tighten the retainer at this time.




4. Connect the upper suspension arm and bushing to the knuckle.
 1. Position the upper suspension arm and bushing on the knuckle.
 2. Install a new cam bolt and a new nut. Do not tighten the nut at this time.

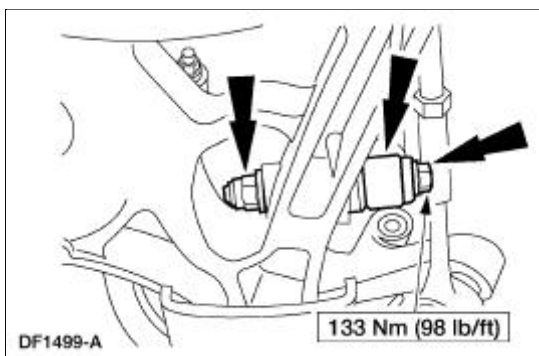


5. Connect the toe link to the knuckle.
 1. Position the toe link in the knuckle.
 2. Install a new nut.
 3. Install a new cotter pin.

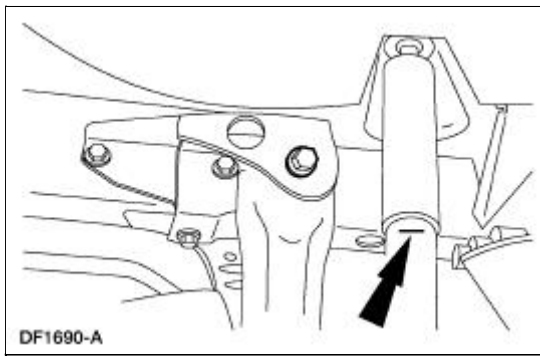


6.  **CAUTION: Make sure the hardened washer is installed between the lower suspension arm and bushing and the shock absorber. Failure to do so can result in damage and failure of the lower suspension arm and bushing.**

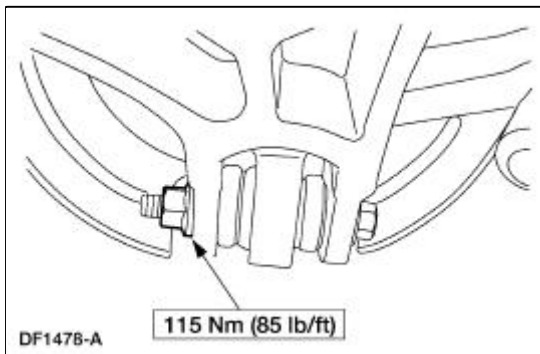
Connect the shock absorber to the lower suspension arm and bushing and install the bolt and a new nut.



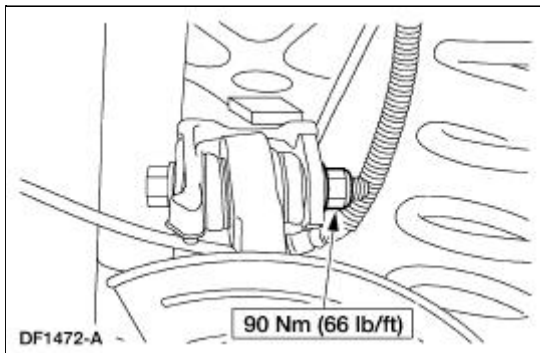
7. Raise the suspension until the shock absorber is compressed to the previously established alignment mark (curb height).



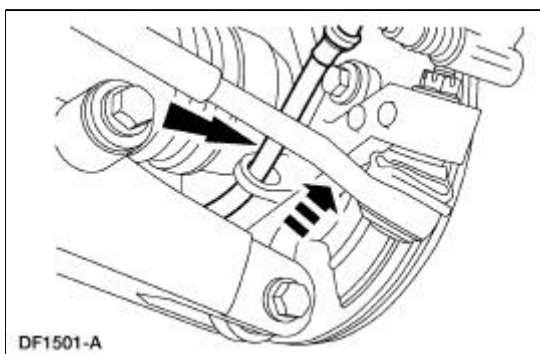
8. Tighten the nut.



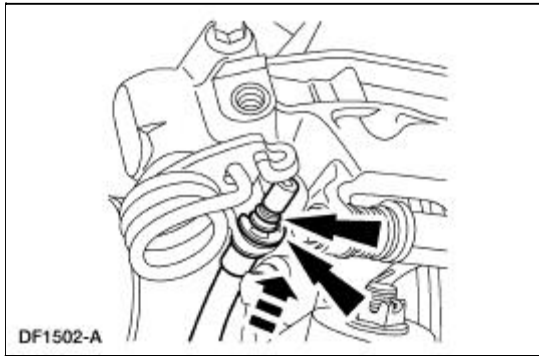
9. Make sure the marks on the cam bolt and the upper suspension arm and bushing made during removal are aligned, and tighten the nut.



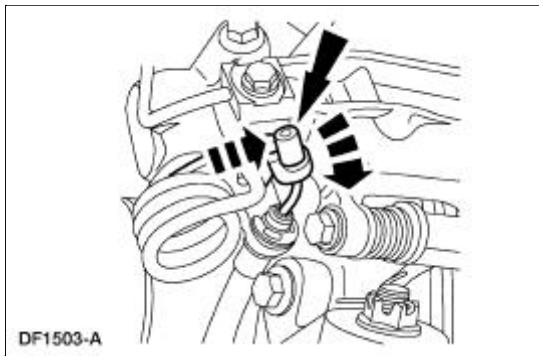
10. Lower the suspension and remove the jack stand.
11. Install the rear brake disc. For additional information, refer to [Section 206-04](#).
12. Install the parking brake cable and conduit into the knuckle.




13. Connect the parking brake cable and conduit to the rear brake caliper and install the clip.



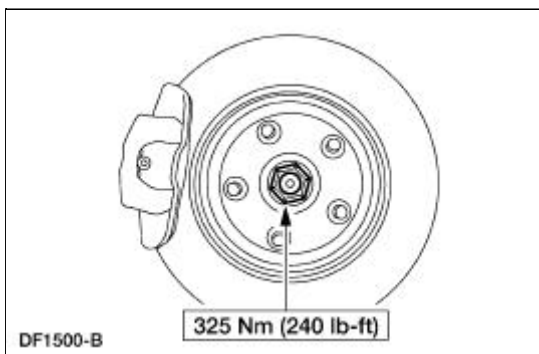
14. Connect the parking brake cable and conduit to the parking brake lever.



15.  **CAUTION:** The axle retainer must be tightened with the brakes applied and the wheels off the ground to make sure of correct bearing seating. Failure to do so can cause the retainer to loosen, causing extensive vehicle damage and loss of vehicle control.

Lower the vehicle and apply the parking brake or service brakes.

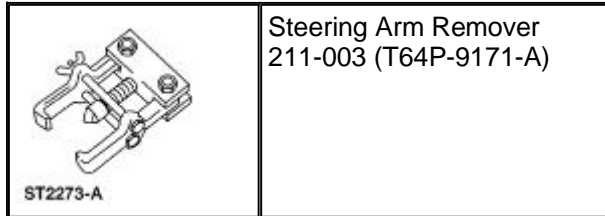
16. Tighten the retainer.



17. Install the wheel and tire assembly. For additional information, refer to [Section 204-04](#)
18. Lower the vehicle.
19. Check the wheel alignment. Adjust as necessary. For additional information, refer to [Section 204-00](#).

Toe Link —Cobra

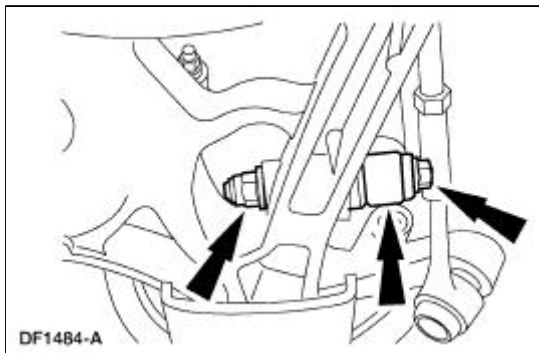
Special Tool(s)



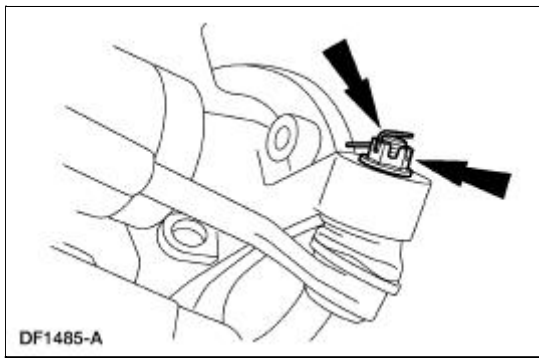
Removal


⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation becomes necessary. If substitution is necessary, the part must be of the same finish and property class. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

1. Raise the vehicle on a hoist. For additional information, refer to [Section 100-02](#).
2. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
3. Remove the rear brake disc. For additional information, refer to [Section 206-04](#).
4. Support the lower suspension arm and bushing (5A649) with a jack stand.
5. Remove the nut and bolt and disconnect the shock absorber (18125) from the lower suspension arm and bushing. Discard the nut and bolt.

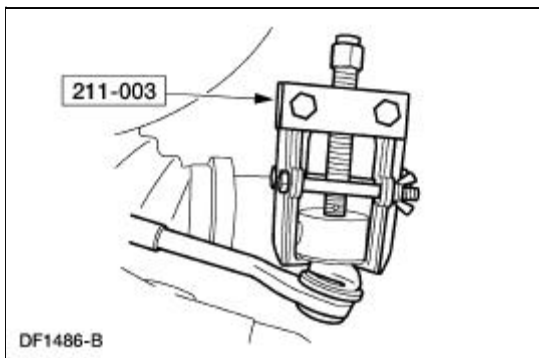


6. Remove and discard the cotter pin and nut.

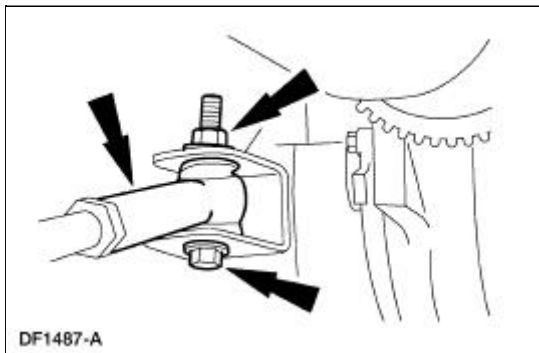


7.  **CAUTION:** Do not strike the toe link or the knuckle to disconnect the toe link. The toe link or the knuckle can be damaged.


Using the special tool, disconnect the toe link (5K848) from the knuckle (5A968/5A969).



8. Remove the nut, bolt and the toe link. Discard the bolt and nut.



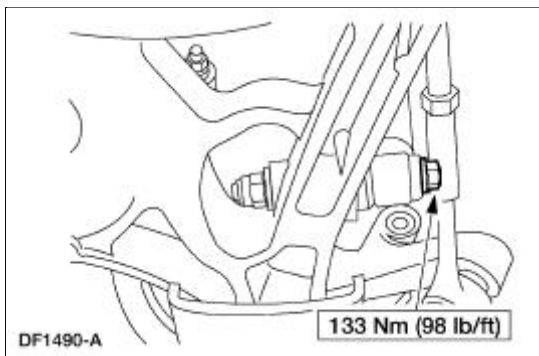
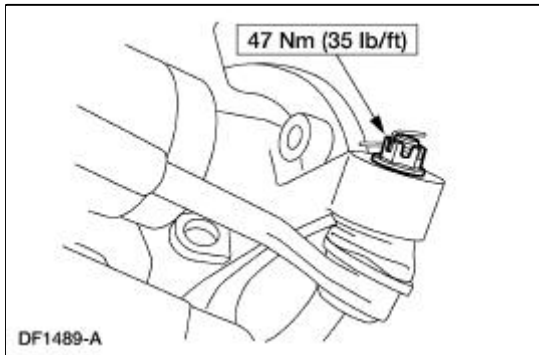
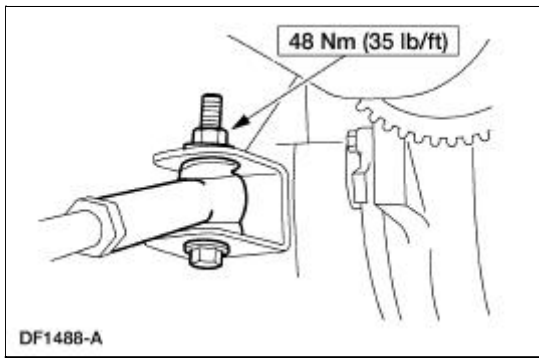
Installation

1.  **CAUTION:** Make sure the hardened washer is installed between the lower suspension arm and bushing and the shock absorber. Failure to do so can result in damage and failure of the lower suspension arm and bushing.

NOTE: The toe link bolt and nuts are of a torque prevailing design. A new bolt and new nuts must be installed.

NOTE: Use a new cotter pin.

To install, reverse the removal procedure.




2. Check wheel alignment. Adjust as necessary. For additional information, refer to [Section 204-00](#).
-

Spring —Coil

Special Tool(s)

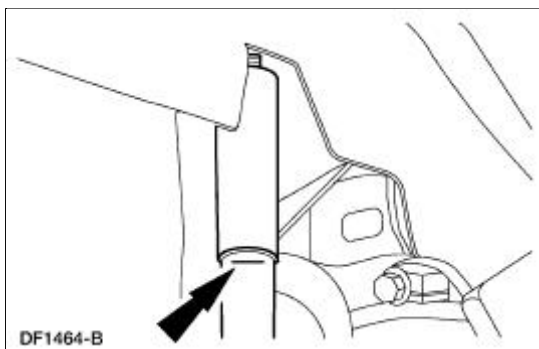
 ST1130-A	Hi-Lift Jack 014-00942 or Equivalent
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Removal

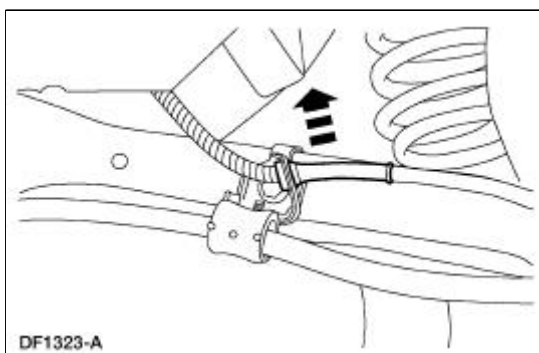
 **CAUTION:** Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation becomes necessary. If substitution is necessary, the part must be of the same finish and property class. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

All vehicles

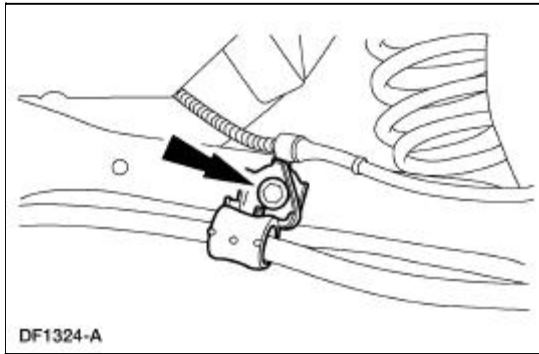
1. Mark the rear shock absorber (18125) relative to the protective sleeve with the vehicle in a static, level ground position (curb height).



2. Raise the vehicle. For additional information, refer to [Section 100-02](#).
3. Disconnect the anti-lock sensor wire.



4. Remove the bolt and the parking brake cable bracket. Discard the bolt.

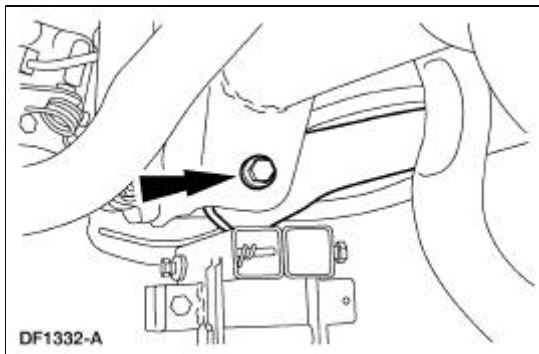


Vehicles equipped with a 4.6L 2V engine

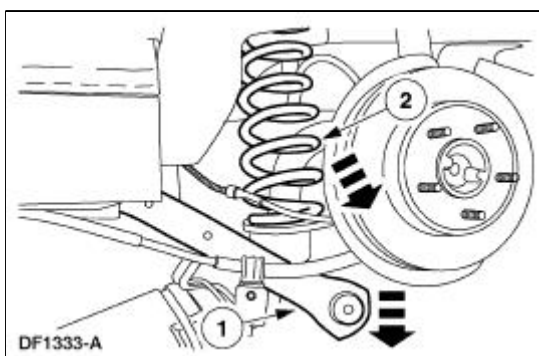
5. Remove the stabilizer bar (5A772). For additional information, refer to [Stabilizer Bar](#) in this section.

All vehicles

6. Support the differential housing with a jack stand.
7. Position the special tool 014-00942 under the rear lower suspension arm and bushing-to-axle pivot bolt.
8. Remove and discard the pivot bolt and nut.



9. Remove the spring (5560).
 1. Slowly lower the arm with the special tool 014-00942.
 2. Remove the rear spring and the rear spring insulators (5536).

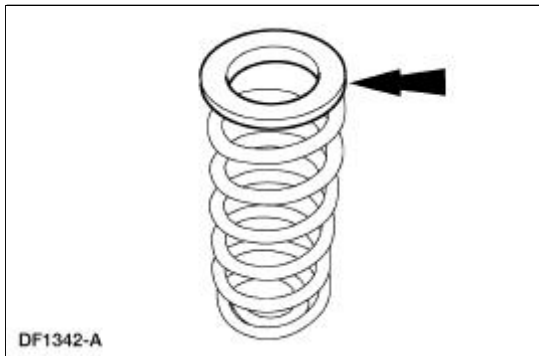


Installation

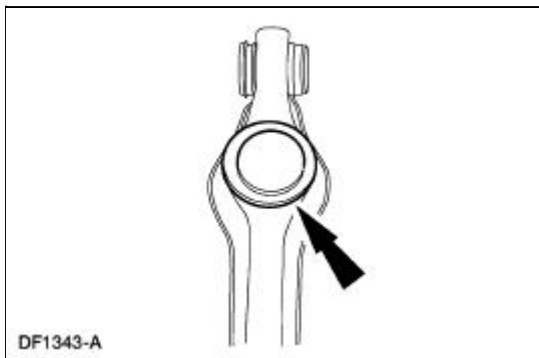
All vehicles

1. **NOTE:** Inspect the insulators for wear or damage. Install new insulators if necessary.

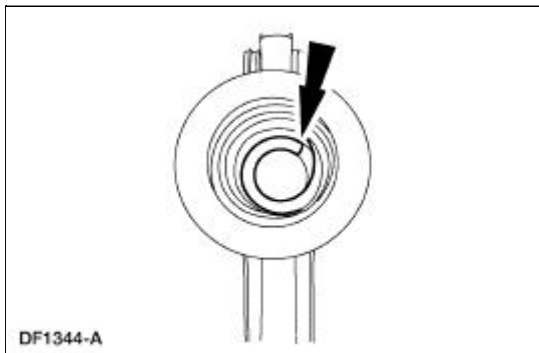
Install the upper insulator on the spring.



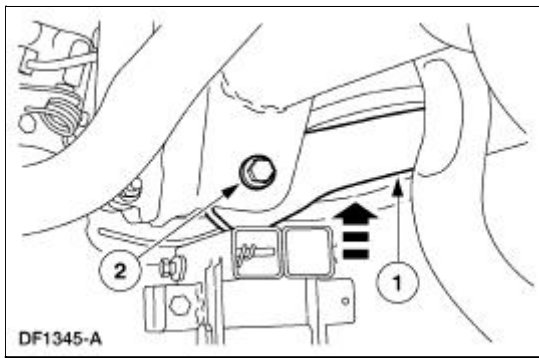
2. Install the lower insulator on the lower arm.



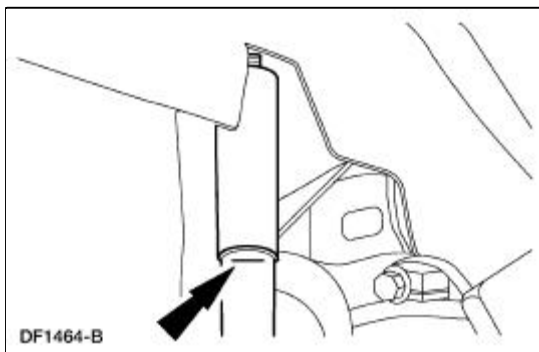
3. Install the rear spring. Make sure the pigtail on the lower arm is at the rear of the vehicle and pointing toward the left side of the vehicle.



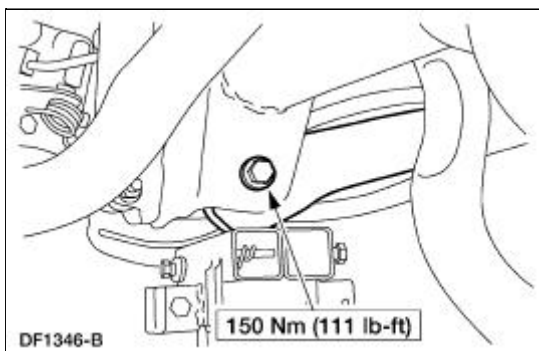
4. Install the pivot bolt.
 1. Carefully raise the lower arm into position with the special tool 014-00942.
 2. Install a new pivot bolt and nut. Do not tighten at this time.



5. Remove the special tool 014-00942.
6. Raise the suspension until the shock absorber is compressed to the alignment mark (curb height).



7. Tighten the lower arm-to-axle pivot bolt.



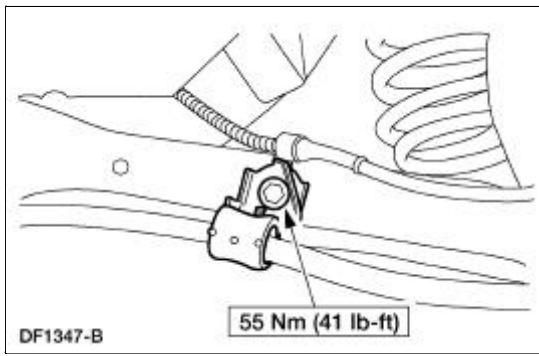
8. Lower the rear suspension and remove the jack stand.

Vehicles equipped with a 4.6L 2V engine

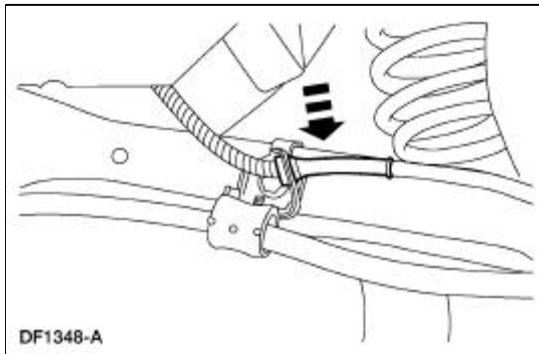
9. Install the stabilizer bar. For additional information, refer to [Stabilizer Bar](#) in this section.

All vehicles

10. Install the parking brake cable bracket and a new bolt.



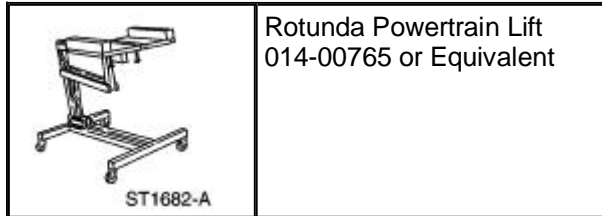
11. Connect the anti-lock sensor wire.



12. Lower the vehicle.
-

Spring —Cobra

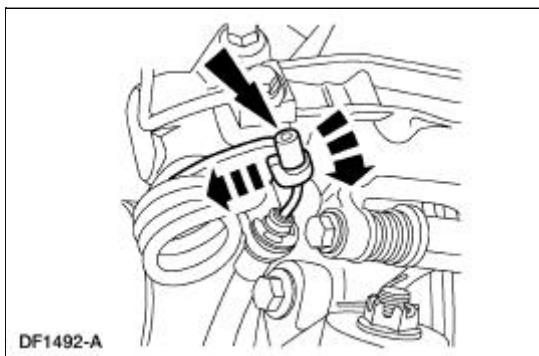
Special Tool(s)



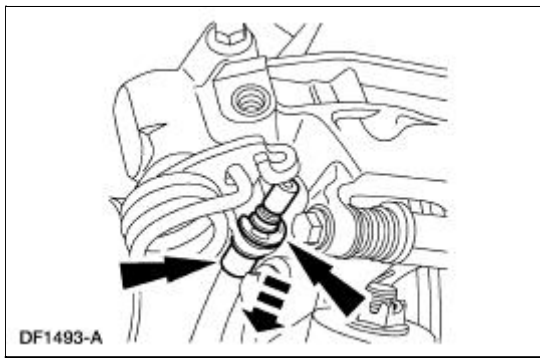
Removal

⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation becomes necessary. If substitution is necessary, the part must be of the same finish and property class. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

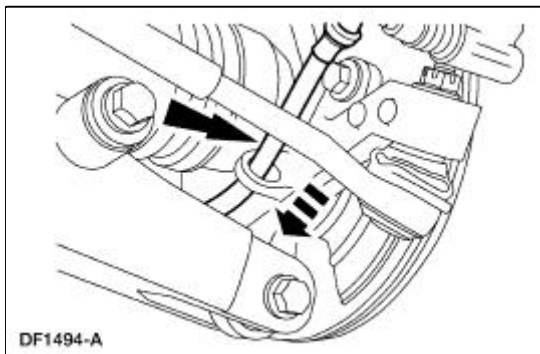
1. Raise the vehicle on a hoist. For additional information, refer to [Section 100-02](#).
2. Support the No. 1 crossmember with a jack stand.
3. Remove both wheel and tire assemblies. For additional information, refer to [Section 204-04](#).
4. Remove both mufflers. For additional information, refer to [Section 309-00](#).
5. Remove the driveshaft. For additional information, refer to [Section 205-01](#).
6. Disconnect the parking brake cable and conduits from the parking brake levers.



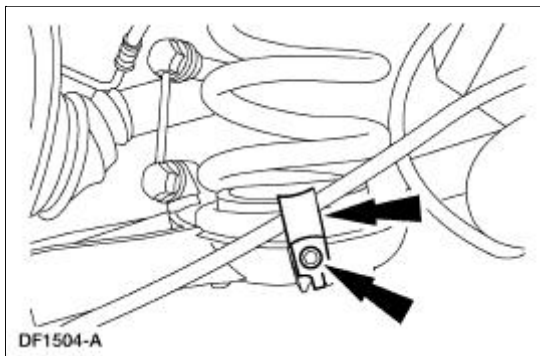
7. Remove the clip and disconnect the parking brake cable and conduits from the rear brake calipers.



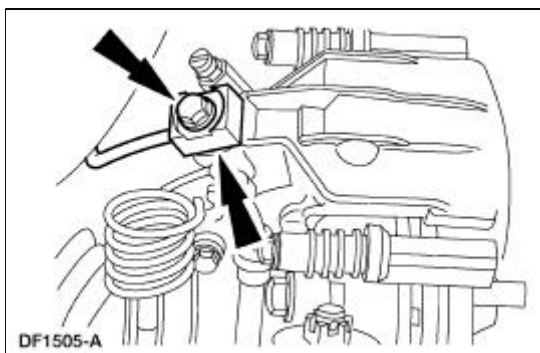
8. Disconnect the parking brake cable and conduits from the knuckles (5A968/5A969).



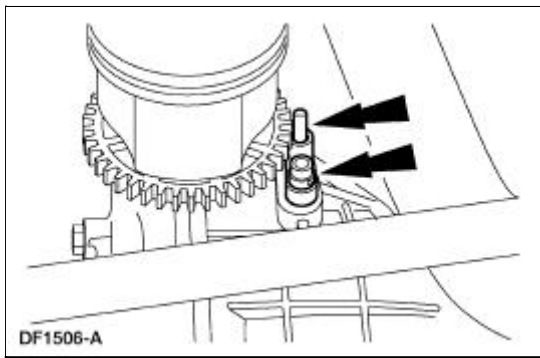
9. Remove the bolts and the parking brake cable brackets.



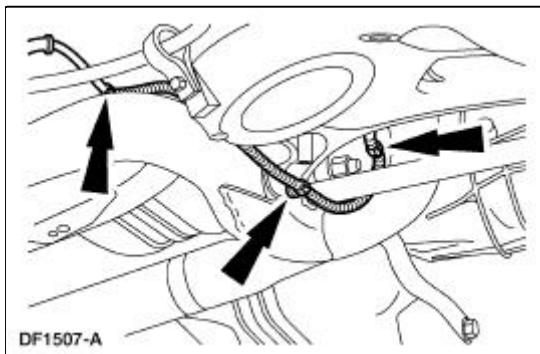
10. Remove the bolts and the rear brake lines.



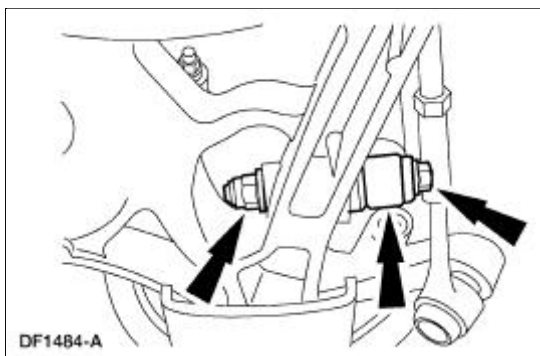
11. Remove the bolts and the ABS sensors.



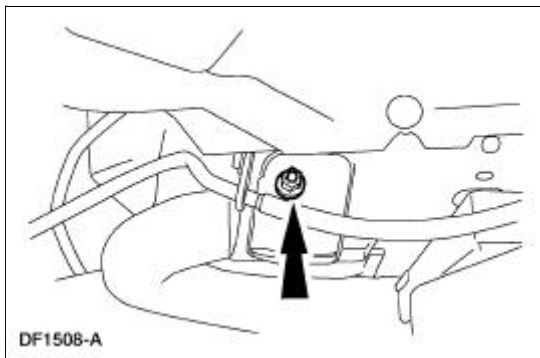
12. Unclip the ABS sensor wires from the subframe.



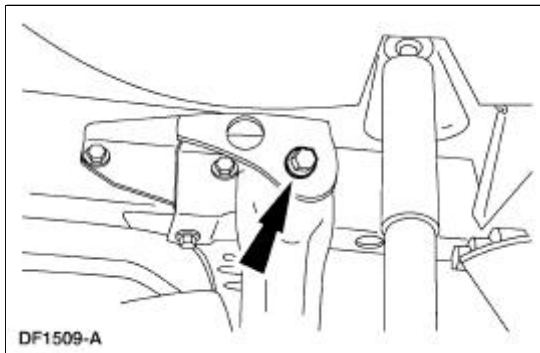
13. Support the lower suspension arm and bushings (5A649) with jack stands.
14. Remove the nuts, bolts and disconnect the shock absorbers (18125) from the lower suspension arm and bushings. Discard the bolts and nuts.



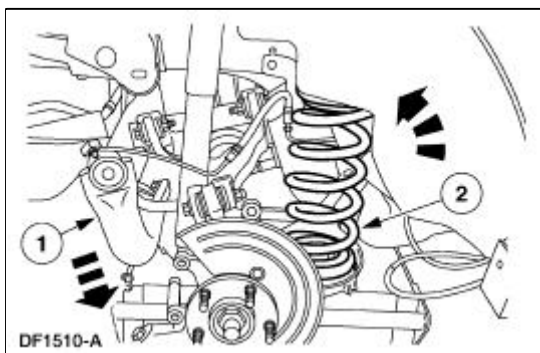
15. Lower the lower suspension arm and bushings and remove the jack stands.
16. Support the rear subframe using the special tool 014-00765.
17. Remove and discard the nuts from the subframe front bolts.



18. Remove and discard the subframe rear bolts.



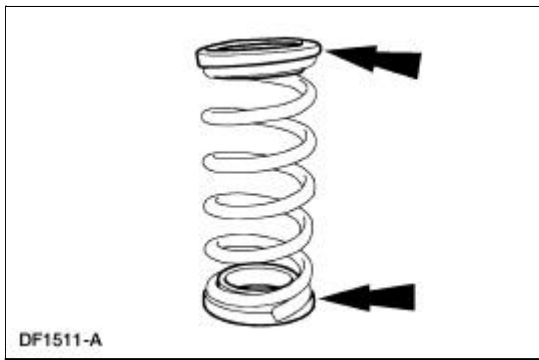
19. Remove the springs (5560).
 1. Carefully lower the subframe with the special tool 014-00765, allowing the subframe to pivot on the front bolts.
 2. Remove the springs and the spring insulators (5536).



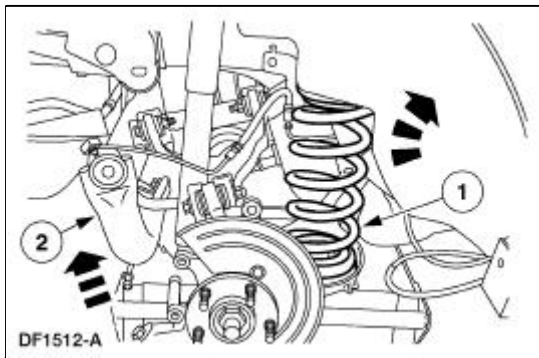
Installation

1. **NOTE:** Inspect the spring insulators for wear or damage. Install new spring insulators if necessary.

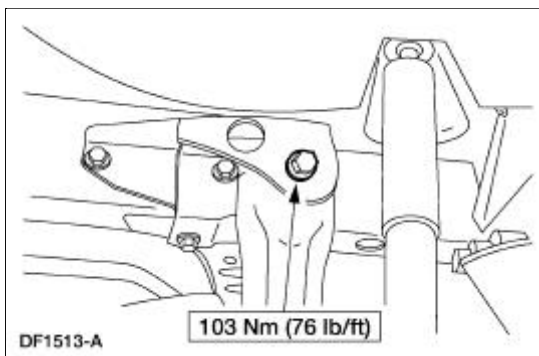
Make sure the spring insulators are correctly installed on the springs.



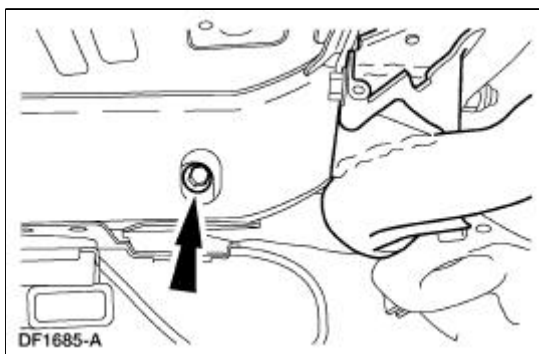
2. Install the springs.
 1. Position the springs.
 2. Raise the subframe using the special tool 014-00765.



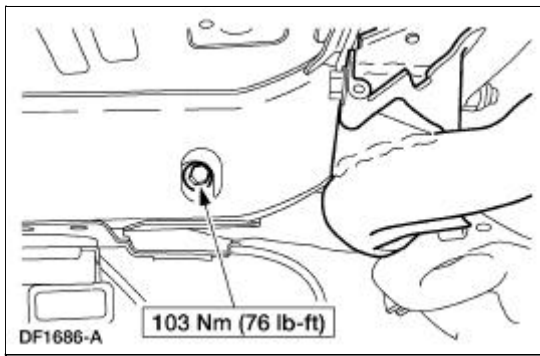
3. Install new bolts.



4. Remove and discard the subframe front bolts.

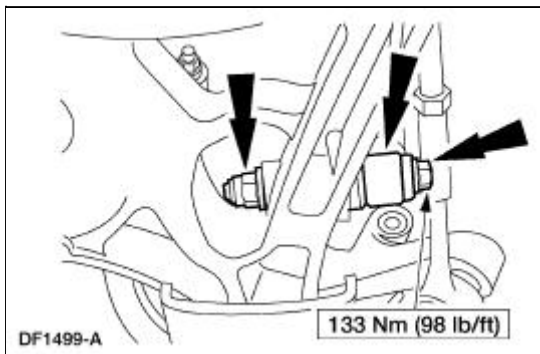


5. Install new bolts and nuts. Tighten the bolts.

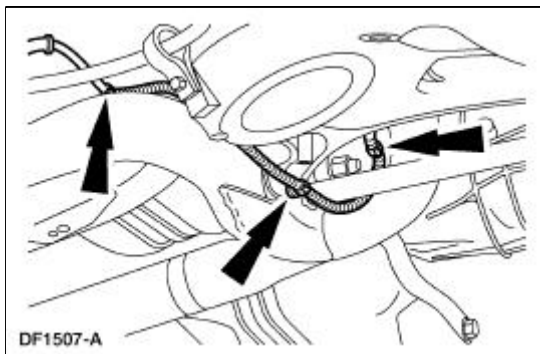


6. Remove the special tool 014-00765.
7. Support the lower suspension arm and bushings with jack stands.
8. **⚠ CAUTION: Make sure the hardened washer is installed between the lower suspension arm and bushing and the shock absorber. Failure to do so can result in damage and failure of the lower suspension arm and bushing.**

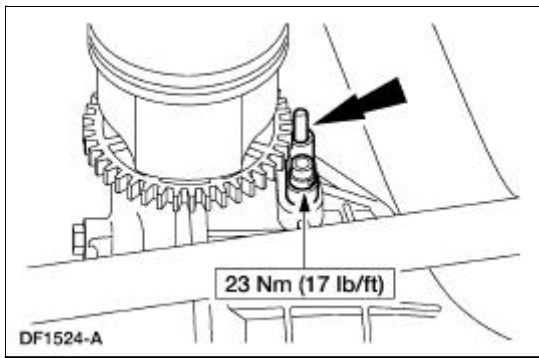
Connect the shock absorbers to the lower suspension arm and bushing and install new bolts and nuts.



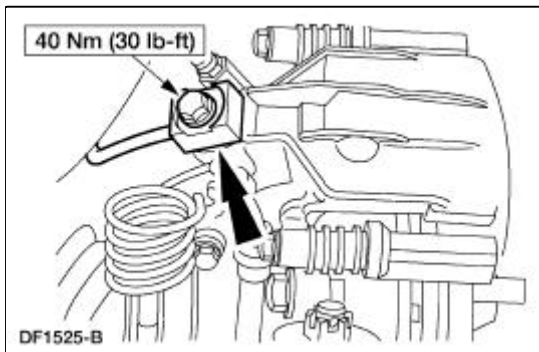
9. Clip the ABS sensor wires to the subframe.



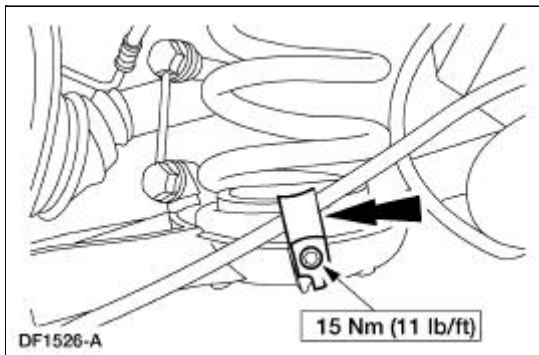
10. Install the ABS sensors and the bolts.



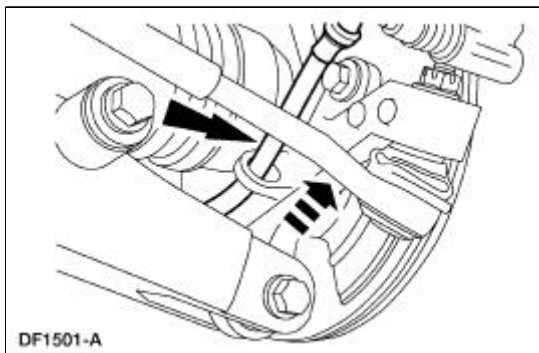
11. Connect the rear brake lines and install the bolts.



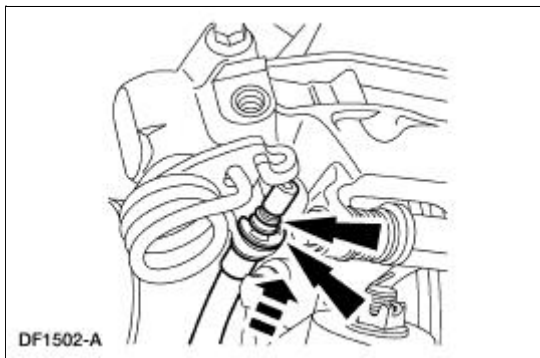
12. Connect the parking brake cable and conduits to the lower suspension arm and bushings and install the bolts.



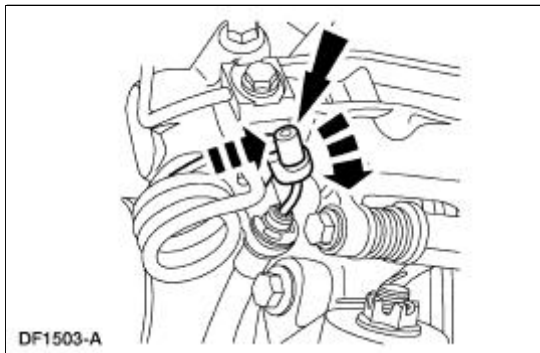
13. Connect the parking brake cable and conduits to the knuckles.



14. Connect the parking brake cable and conduits to the rear brake calipers and install the clips.



15. Connect the parking brake cable and conduit to the parking brake levers.



16. Install the driveshaft. For additional information, refer to [Section 205-01](#) .
 17. Install both mufflers. For additional information, refer to [Section 309-00](#) .
 18. Install both wheel and tire assemblies. For additional information, refer to [Section 204-04](#) .
 19. Remove the jack stand from the No. 1 crossmember.
 20. Bleed the brake system. For additional information, refer to [Section 206-00](#) .
 21. Check wheel alignment. Adjust if necessary. For additional information, refer to [Section 204-00](#) .
-

Shock Absorber

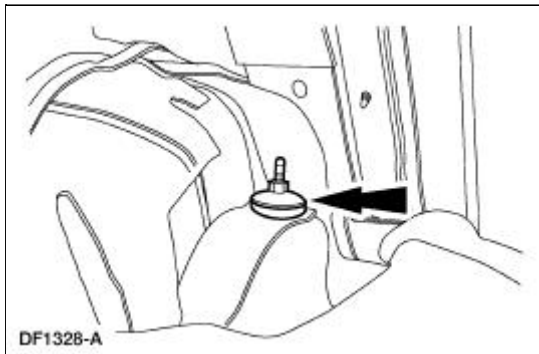
Removal

⚠ WARNING: All vehicles are equipped with gas pressurized shock absorbers which will extend unassisted. Do not apply heat or flame to the shock absorbers during removal or component servicing. Failure to follow these instructions can result in personal injury.

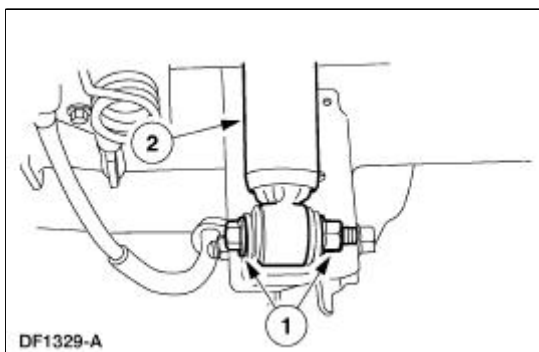
⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation becomes necessary. If substitution is necessary, the part must be of the same finish and property class. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

⚠ CAUTION: When using a hoist that lifts the vehicle by the frame, install new shock absorbers one at a time.

1. Open the luggage compartment lid. Position the carpet out of the way.
2. Remove and discard the retaining nut, washer and insulator assembly.

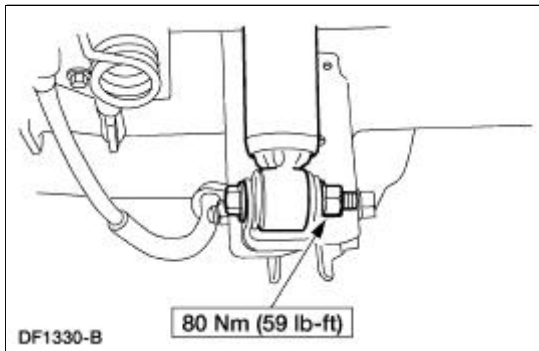


3. Raise the vehicle. For additional information, refer to [Section 100-02](#).
4. Remove the shock absorber (18125).
 1. Remove and discard the bolt and nut.
 2. Remove the shock absorber.



Installation

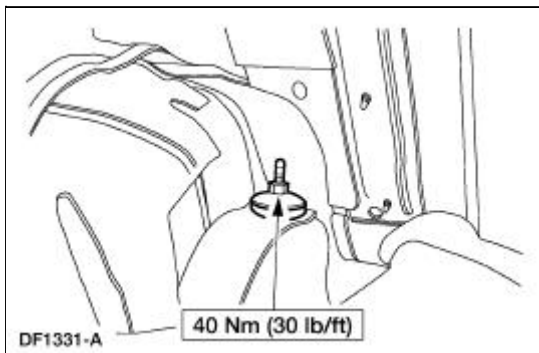
1. Correctly prime the new shock absorber. For additional information, refer to [Section 204-00](#).
2. Install a new washer and insulator on the shock absorber.
3. Position the shock absorber and install a new bolt and a new nut.



4. **NOTE:** When using a hoist that lifts the vehicle by the frame, have an assistant guide the shock absorber into the body while lowering the hoist.

Lower the vehicle.

5. Install a new insulator, washer and nut.



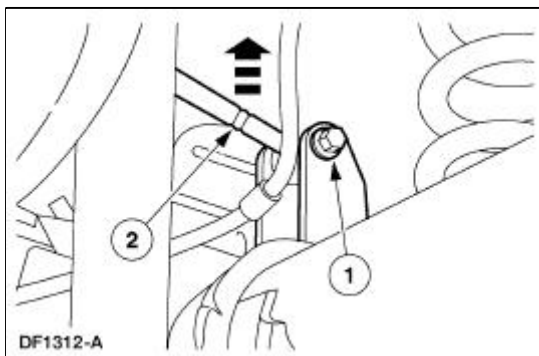
6. Position the carpet and close the luggage compartment lid.
-

Damper

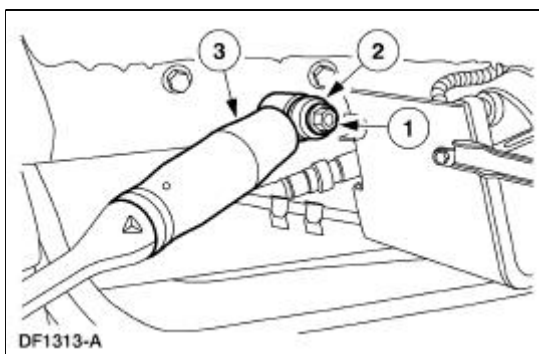
Removal

⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation becomes necessary. If substitution is necessary, the part must be of the same finish and property class. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

1. Raise the vehicle. For additional information, refer to [Section 100-02](#).
2. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
3. Disconnect the damper from the axle.
 1. Remove the bolt.
 2. Disconnect the damper.

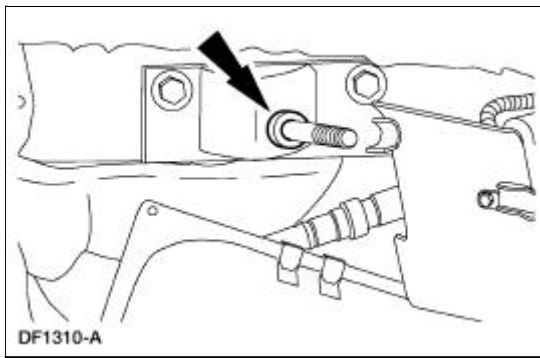


4. Remove the damper.
 1. Remove the nut.
 2. Remove the outer washer.
 3. Remove the damper.

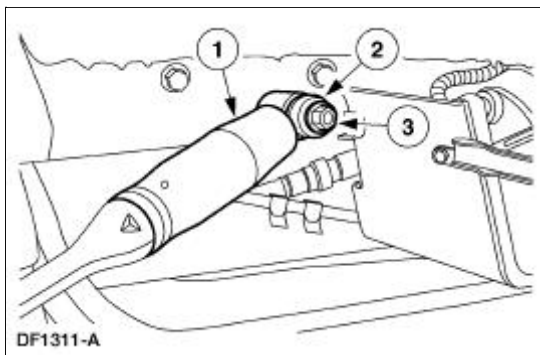


Installation

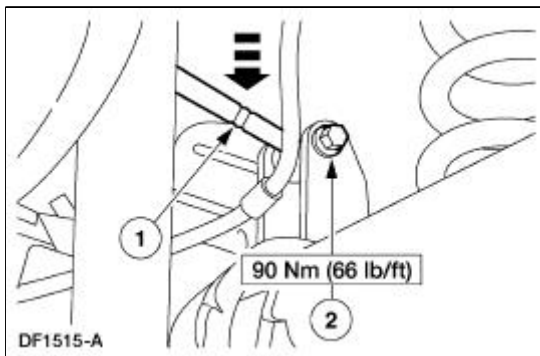
1. Make sure the inner washer is positioned on the stud.



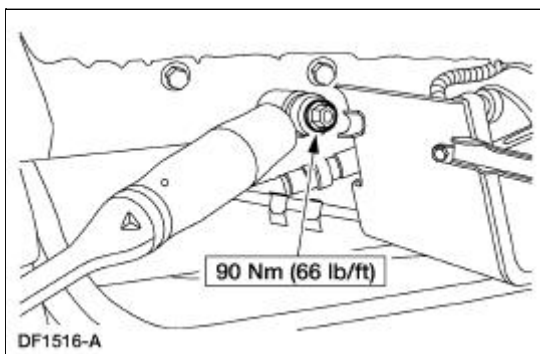
2. Install the damper.
 1. Install the damper on the rear bracket.
 2. Install the outer washer.
 3. Install the nut. Do not tighten the nut at this time.



3. Connect the damper to the axle.
 1. Position the damper.
 2. Install the bolt.



4. Tighten the nut.



5. Install the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
 6. Lower the vehicle.
-


General Specifications


Item	Specification
Lubricants	
Silicone Dielectric Compound D7AZ-19A331-A	ESE-M1C171-A
Cleaners	
Liquid Soap	ESR-M99B135-A
Professional Choke and Linkage Cleaner E8AZ-19A501-AA	ESR-M14P10-A
Custom Bright Metal Cleaner 8A-19522-A	ESR-M5B194-B
Aluminum Wheel Repair Compound E7AZ-19554-A	ESA-M4G280-A
Tire Balance Weight	
Max tire balance weight	140g (5 oz) per wheel 70g (2.5 oz) per flange
Tire inflation	
Tires	See safety certification sticker located inside glove compartment door

Torque Specifications

Description	Nm	lb-ft
Wheel nuts	129	95


Safety Precautions


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


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


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

 **WARNING:** Aftermarket wheel assemblies may not be compatible with the vehicle. Use of incompatible wheel assemblies can result in equipment failure and possible injury. Use only approved wheel assemblies.

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

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

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

 **CAUTION:** Reduce the air pressure as much as possible by pushing the valve core plunger in prior to removing the valve core. Avoid working in a position in which the face or body is directly over a tire in which there is pressure.

When performing any inspection or repair procedures on wheels (1007/1015) and tires, follow the preceding safety precautions.

Wheels And Tires



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

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

Tire and Wheel Runout

Excessive radial and lateral runout of a wheel and tire assembly can cause roughness, vibration, wheel tramp, tire wear, and steering wheel tremor.

Before checking runout, and to avoid false readings caused by temporary flat spots in the tires, check runout only after the vehicle has been driven far enough to warm the tires. For additional information, refer to [Section 100-04](#).

Wheels And Tires

Inspection and Verification



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



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



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

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

Road Test

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

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

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

Replacement tires must follow the recommended:

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

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

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

- wheel bearing life.
- brake cooling.

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

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

Wheel and tire assemblies are attached by six wheel nuts.

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

1. Inspect for signs of uneven wear that may indicate a need for balancing, rotation, front suspension alignment, damaged tie-rod, or steering components.
2. Check tires for:
 - cuts.
 - stone bruises.
 - abrasions
 - blisters.
 - embedded objects.
3. Tread wear indicators are molded into the bottom of the tread grooves. Install a new tire when the indicator bands become visible.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● Tires show excess wear on edge of tread 	<ul style="list-style-type: none"> ● Underinflated tires. ● Vehicle overloaded. ● High-speed cornering. ● Incorrect ride height. ● Incorrect wheel alignment. 	<ul style="list-style-type: none"> ● ADJUST air pressure in tires. ● RETURN vehicle. NOTIFY customer of overload condition. ● RETURN vehicle. NOTIFY customer of cause of condition. ● SET ride height. ● SET alignment to specification. REFER

	<ul style="list-style-type: none"> ● Incorrect tire rotation intervals. 	<ul style="list-style-type: none"> ● ADVISE customer of condition. ROTATE tires.
<ul style="list-style-type: none"> ● Tires show excess wear in center of tread 	<ul style="list-style-type: none"> ● Tires overinflated. 	<ul style="list-style-type: none"> ● ADJUST air pressure.
<ul style="list-style-type: none"> ● Other excessive tire wear problems 	<ul style="list-style-type: none"> ● Incorrect tire rotation intervals. ● Incorrect tire pressure. ● Loose or leaking shock absorbers. ● Incorrect wheel alignment. ● Loose, worn or damaged suspension components. ● Wheel and tire assembly out of balance. ● Excessive lateral or radial runout of wheel. 	<ul style="list-style-type: none"> ● ADVISE customer of condition. ROTATE tires. ● ADJUST pressure. ● TIGHTEN or INSTALL new shock absorbers as necessary. ● SET alignment to specification. REFER to Section 204-00. ● REFER to Section 204-00. ● BALANCE wheel and tire assembly. ● REFER to Section 100-04.
<ul style="list-style-type: none"> ● Wobble or shimmy 	<ul style="list-style-type: none"> ● Damaged wheel bearings. ● Loose or damaged suspension components. ● Bent wheel. ● Damaged tire. ● Loose wheel nuts. 	<ul style="list-style-type: none"> ● REFER to Section 204-00. ● REFER to Section 204-00. ● INSTALL a new wheel as necessary. ● INSTALL a new tire as necessary. ● TIGHTEN to specification.
<ul style="list-style-type: none"> ● High-speed shake 	<ul style="list-style-type: none"> ● Wheel hub face/pilot/bolt circle runout. ● Tires/wheels. ● Wheel bearings. ● Suspension/steering linkage. ● Engine. ● Transmission. ● Brake discs/imbalance. 	<ul style="list-style-type: none"> ● REFER to Section 100-04.
<ul style="list-style-type: none"> ● Vehicle vibration 	<ul style="list-style-type: none"> ● Driveline — engine. ● Tires. 	<ul style="list-style-type: none"> ● REFER to Section 100-04.

Wheel Leaks

Material

Item	Specification
Professional Choke and Linkage Cleaner F8AZ-19520-AB	WSS-M14P10-B
Aluminum Wheel Repair Compound	ESA-M4G280-A



WARNING: Wheel repairs that use welding or peening are not approved. An inner tube is not an acceptable repair for leaking wheels or tires.

If the air pressure in a tire mounted on an aluminum wheel is found to be low, perform the following procedure before considering installation of a new wheel.

1. Remove the tire and wheel assembly, and inspect the wheel for structural damage. If none exists, go to Step 2. If the wheel is damaged, install a new wheel.
2. With the tire mounted on the wheel, locate the air leak using a water bath or equivalent method, and mark the location. Check the complete wheel for possible additional leaks. When leaks are marked, dismount the tire marking valve location on the tire for correct indexing.
3. On the tire side of the wheel, thoroughly clean the leaking area with an appropriate choke cleaner or use sandpaper of approximately 80-grit to remove all contamination. Using the sandpaper, score the surface of the leaking area to improve adhesion of the sealer. If the valve stem is close to the area, remove it.
4. Use a clean cloth to remove all cleaner or sanding dust.
5. **NOTE:** Do not use a torch containing oxyacetylene.

Heat the prepared area with a Heat Gun or a propane torch until aluminum wheel repair compound flows. Apply the hot melt material over the prepared area using a liberal flow and wiping action. Repair is most effective when heat is applied to the brake side of the rim, and the sealer is melted by heat in the metal.

6. Apply only enough heat to melt the sealer, then remove the heat source. After repairing the leak, allow the wheel to cool until it can be handled safely.




7. **CAUTION:** Use caution when mounting the tire so as not to damage the sealer.

Index and assemble the tire and wheel. Inflate the tire to the recommended pressure as indicated on the tire pressure decal.

8. Repeat Step 2 to verify repair.
9. When the repair is completed, balance the assembly and install it on the vehicle.

Wheel And Tire

Removal

1.  **CAUTION: Do not use heat to loosen a seized wheel nut (1012). Heat can damage the wheel and wheel bearings.**

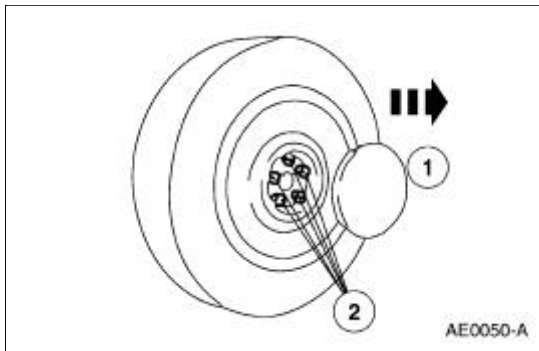
NOTE: To avoid damage or scratching to the center cap, place facing up when removed.

Loosen the wheel nuts.

1. **NOTE:** To avoid wheel damage, do not twist wrench when removing center cap.


Remove the center cap, if equipped.

2. Loosen, but do not remove, the wheel nuts.



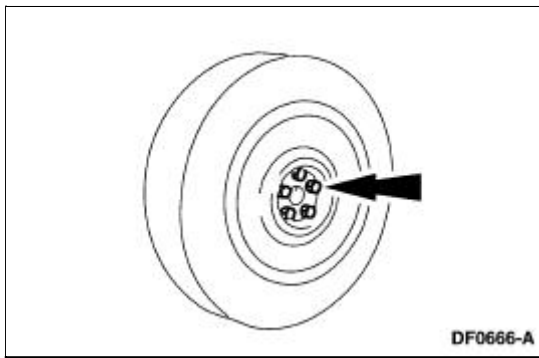
2.  **CAUTION: Never use the differential housing as a lifting point.**

Raise the vehicle until the tire clears the ground. For additional information, refer to [Section 100-02](#).

3.  **CAUTION: Do not use heat to loosen a seized wheel because heat can shorten the life of the wheel and damage the wheel bearings. If the wheel cannot be removed by hand, use a wheel puller to remove the seized wheel.**

Remove the wheel and tire assembly.

- Remove the wheel nuts.
- Remove the wheel and tire.



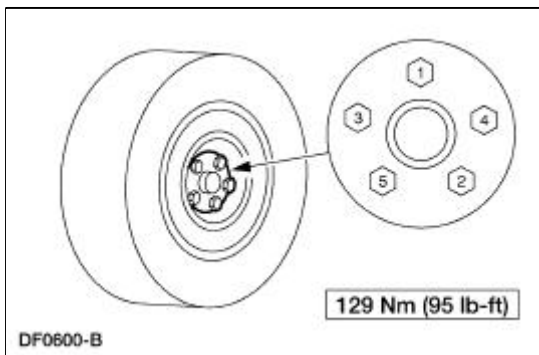
Installation

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

Position the wheel and tire on the vehicle.

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

Install the wheel nuts hand-tight, then lower the vehicle. Tighten the wheel nuts to specification in a star-pattern sequence.



3. Install the center cap, if so equipped.
-

Driveline Angles @ Curb Specifications

Engine (L)	Engine Angle (Deg)	Driveshaft Angle (Deg)	Pinion Angle (Deg)
3.8	4.0	2.95	0.55
4.6 (2V)	4.0	3.61	0.55

All driveshaft and pinion angles point downward.

General Specifications



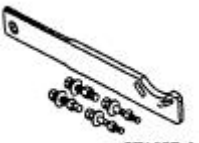

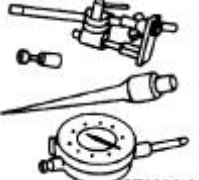


Item	Specification
Axle Capacities and Lubricant Specifications	
7.5 inch rear axle ^a	1.5 liters (3.5 pints)
8.8 inch rear axle ^a (base and GT vehicles)	1.9 liters (4.0/3.75 pints)
Traction-Lok ^b	118 ml (4 oz)
Premium Rear Axle Lubricant XY-80 W90-QL	WSP-M2C197-A
Additive Friction Modifier C8AZ-19B546-A	EST-M2C118-A
Premium Long-Life Grease XG-1-C	ESA-M1C75-B

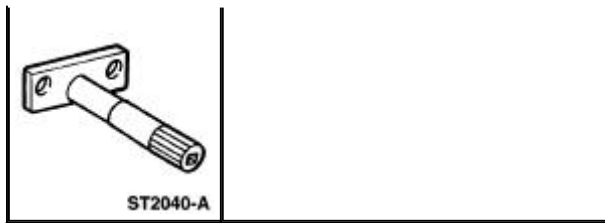
^a Service refill capacities are determined by filling the axle 6.3 mm (0.25 in [1/4 in]) to 14.3 mm (0.57 in [5/16 in]) below the bottom of the filler hole. The vehicle must be on a level surface.

^b Friction Modifier

Driveline System

Special Tool(s)

 <p>ST1268-A</p>	<p>Clamp Plate 205-320 (T92L-4851-C)</p>
 <p>ST1348-A</p>	<p>Clutch Housing Alignment Adapter 308-021 (T75L-4201-A)</p>
 <p>ST1257-A</p>	<p>Companion Flange Holding Tool 205-126 (T78P-4851-A)</p>
 <p>ST1267-A</p>	<p>Companion Flange Runout Gauge 205-319 (T92L-4851-B)</p>
 <p>ST1214-A</p>	<p>Dial Indicator with Bracketry 100-002 (TOOL-4201-C) or equivalent</p>
 <p>ST1266-A</p>	<p>Dial Indicator/Magnetic Base 100-D002 (D78P-4201-B) or equivalent</p>
 <p>ST2207-A</p>	<p>Vibration Analyzer 100-F027 (014-00344)</p>
	<p>Traction-Lok® Torque Tool 205-022 (T66L-4204-A)</p>



Inspection and Verification

Certain axle noise or vibration symptoms are also common to the engine, transmission, wheel bearings, tires, and other parts of the vehicle. For this reason, be sure that the cause of the trouble is in the axle before disassembling, adjusting or repairing the axle. Refer to [Section 100-04](#).

Certain driveshaft vibration symptoms are common to the front engine accessory drive (FEAD), the engine, transmission or tires. Be sure the cause of the concern is the driveshaft before repairing or installing a new driveshaft. Refer to [Section 100-04](#).

Certain symptoms may be caused by Traction-Lok® differentials (4026). Check the vehicle certification label and axle identification tag to determine the type of differential. Refer to [Section 100-01](#).

Noise Acceptability

NOTE: A gear-driven unit will produce a certain amount of noise. Some noise is acceptable and audible at certain speeds or under various driving conditions such as a newly paved blacktop road. Slight noise is not detrimental to the operation of the axle and is considered normal.

With the Traction-Lok® differential axle, slight chatter noise on slow turns after extended highway driving is considered acceptable and has no detrimental effect on the locking axle function.

Universal Joint (U-Joint) Inspection

Place the vehicle on a frame hoist and rotate the driveshaft (4602) by hand. Check for rough operation or seized U-joints. Install a new U-joint if it shows signs of seizure, excessive wear, or incorrect seating. Refer to [Section 205-01](#).

Analysis of Leakage

Clean up the leaking area enough to identify the exact source. An axle leak can be caused by the following.

- Axle lubricant level is too high.
- Worn or damaged axle shaft seals or differential seals.
- Differential housing is cracked.
- Flange yoke seat is worn or damaged.
- Pinion flange is scored or damaged.
- Axle cover is not sealed.
- Vent is plugged.

Repair the axle as necessary. Make sure the axle lubricant is at the correct level. Refer to Specifications in this section.

Axle Vent

NOTE: If a plugged vent cannot be cleared, install a new one.

A plugged vent will cause excessive seal lip wear due to internal pressure buildup. If a leak occurs, check the vent. Make sure the vent hose is not kinked. Remove the hose from the vent nipple and clear the hose of any foreign material. While the hose is removed, pass a length of mechanics wire in and out of the vent to clean it. Connect the hose when done.

Flange Yoke Seal

Leaks at the axle drive pinion seal originate for the following reasons:

- Seal was not correctly installed.
- Poor quality seal journal surface.

Any damage to the seal bore (dings, dents, gouges, or other imperfections) will distort the seal casing and allow leakage past the outer edge of the axle drive pinion seal.

The axle drive pinion seal can be torn, cut, or gouged if it is not installed carefully. The spring that holds the axle drive pinion seal against the pinion flange may be knocked out and allow leakage past the lip.

The rubber lips can occasionally become hard (like plastic) with cracks at the oil lip contact point. The contact point on the pinion flange may blacken, indicating excessive heat. Marks, nicks, gouges, or rough surface texture on the seal journal of the pinion flange will also cause leaks.

When a seal leak occurs, install a new seal and check the vent and the vent hose to make sure they are clean and free of foreign material.

Axle Shaft Seals

Axle shaft oil seals are susceptible to the same kinds of damage as axle drive pinion seals if incorrectly installed. The seal bore must be clean and the lip handled carefully to avoid cutting or tearing it. The axle shaft journal surface must be free of nicks, gouges, and rough surface texture.

Differential Seals

Refer to [Section 205-02A](#) or [Section 205-02B](#).

Analysis of Vibration



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

Few vibration conditions are caused by the rear axle. On a vibration concern, follow the diagnosis procedure in [Section 100-04](#) unless there is a good reason to suspect the axle.

Tires



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

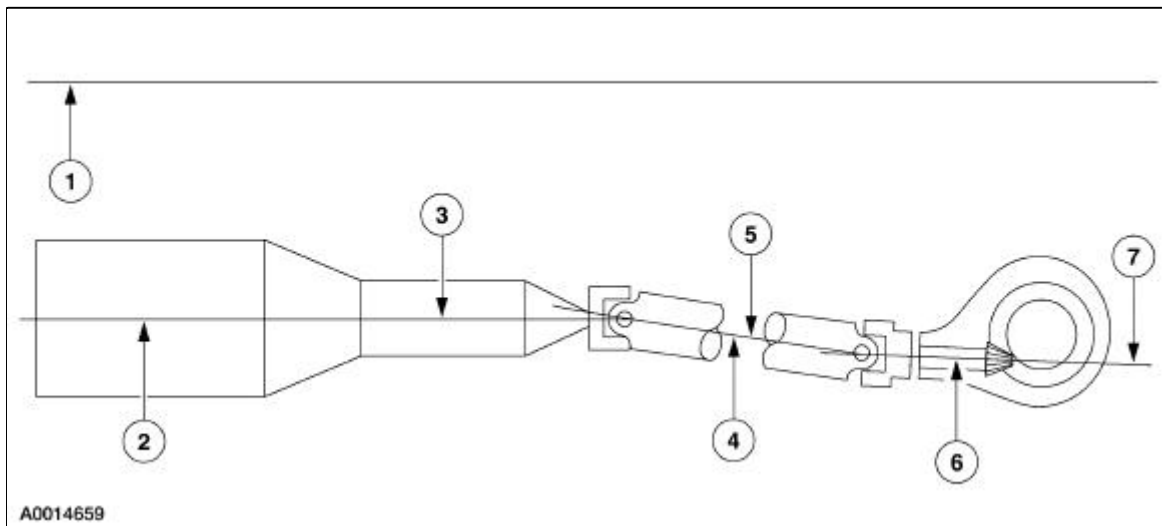
Most vibration in the rear end is caused by tires or driveline angle.

Vibration is a concern with modern, high-mileage tires if they are not "true" both radially and laterally. They are more susceptible to vibration around the limits of radial and lateral runout of the tire and wheel assembly. They also require more accurate balancing. Wheel and tire runout checks, truing and balancing are normally done before axle inspection. Refer to [Section 204-04](#).

Driveline Angle

Driveline angularity is the angular relationship between the engine crankshaft (6303), the driveshaft, and the rear axle pinion. Factors determining driveline angularity include ride height, rear spring, and engine mounts.

Driveline Angle



Item	Description
1	Bottom of the frame
2	Engine crankshaft centerline
3	Engine angle
4	Driveshaft and coupling shaft centerline
5	Driveshaft and coupling shaft angle
6	Rear axle pinion centerline
7	Axle pinion angle

An incorrect driveline (pinion) angle can often be detected by the driving condition in which the vibration occurs.

- A vibration during coastdown from 72 to 56 km/h (45 to 35 mph) is often caused by an excessive U-joint angle at the axle (pinion nose downward).
- A vibration during acceleration, from 56 to 72 km/h (35 to 45 mph) may indicate an excessive U-joint angle at the axle (pinion nose upward).

When these conditions exist, check the driveline angles as described in the General Procedures portion of this section.

If the tires and driveline angle are not the cause, carry out the NVH tests to determine whether the concern is caused by a condition in the axle. Refer to [Section 100-04](#).

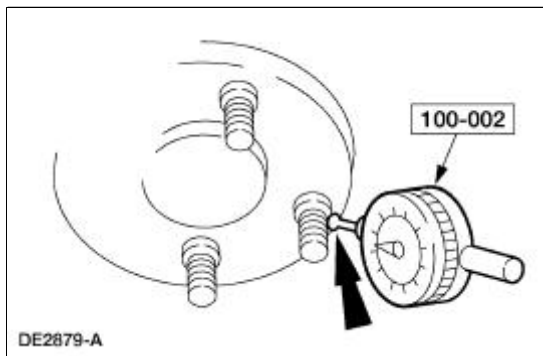
Universal Joint (U-Joint) Wear

Place the vehicle on a frame hoist and rotate the driveshaft by hand. Check for rough operation or seized U-joints. Install a new U-joint if it shows signs of seizure, excessive wear, or incorrect seating. Refer to [Section 205-01](#).

Wheel Hub or Axle Flange Bolt Circle Runout

NOTE: The brake discs must be removed to carry out all runout measurements.

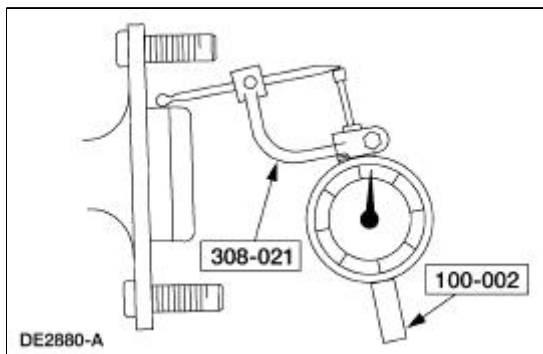
1. Position the special tool perpendicular to the wheel hub or axle flange bolt, as close to the hub or flange face as possible. Zero the indicator to allow the pointer to deflect either way.



2. Rotate the hub or flange until the next bolt is contacted. Record the measurement and continue until each bolt is checked. The difference between the maximum and minimum contact readings will be the total wheel hub or axle flange bolt pattern runout. The runout must not exceed 0.38 mm (0.015 inch).

Pilot Runout

1. Position the special tools as close to the hub or axle flange face as possible. Zero the indicator to allow the pointer to deflect either way.

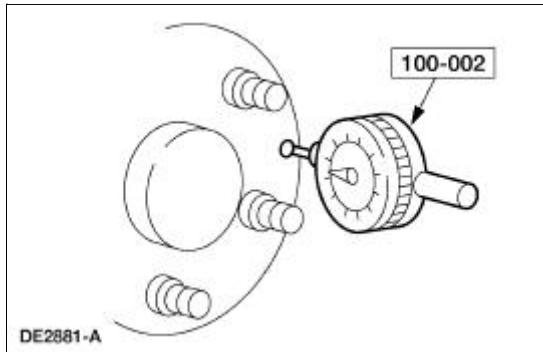


2. Rotate the hub or flange one full turn and note the maximum and minimum readings. The difference between the maximum and minimum readings will be the total pilot runout. Pilot runout must not exceed 0.15 mm (0.006 inch).

Wheel Hub or Axle Flange Face Runout

NOTE: If the axle shaft assembly is removed, check runout of the shaft itself. The forged (unmachined) part of the shaft is allowed to have as much as 3.0 mm (0.120 inch) runout. This alone will not cause a vibration condition.

1. Position the special tool on the wheel hub or axle flange face, as close to the outer edge as possible. Zero the indicator to allow the pointer to deflect either way.



2. Rotate the hub or flange one full turn and note the maximum and minimum readings. The difference between the maximum and minimum readings will be the total face runout. The runout must not exceed 0.127 mm (0.005 inch).

Drive Pinion Stem and Pinion Flange

Check the pinion flange runout when all other checks have failed to show the cause of vibration.

One cause of excessive pinion flange runout is incorrect installation of the axle drive pinion seal. Check to see if the spring on the seal lip has been dislodged before installing the ring gear and pinion.

Axle Noise

NOTE: Before disassembling the axle to diagnose and correct gear noise, eliminate the tires, exhaust, trim items, roof racks, axle shafts and wheel bearings as possible causes. Follow the diagnostic procedures in [Section 100-04](#).

The noises described as follows usually have specific causes that can be diagnosed by observation as the unit is disassembled. The initial clues are the type of noise heard during the road test.

Gear Howl and Whine

Howling or whining of the ring gear and pinion is due to an incorrect gear pattern, gear damage or incorrect bearing preload.

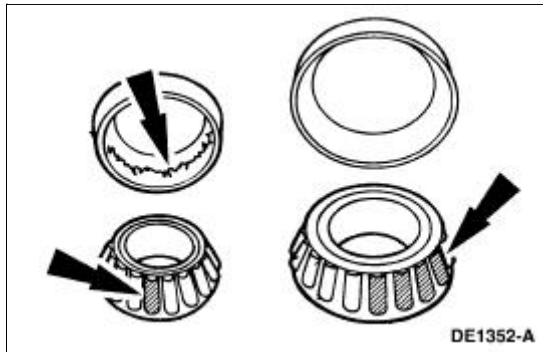
Bearing Whine

Bearing whine is a high-pitched sound similar to a whistle. It is usually caused by worn/damaged pinion bearings, which are operating at driveshaft speed. Bearing noise occurs at all driving speeds. This distinguishes it from gear whine which usually comes and goes as speed changes.

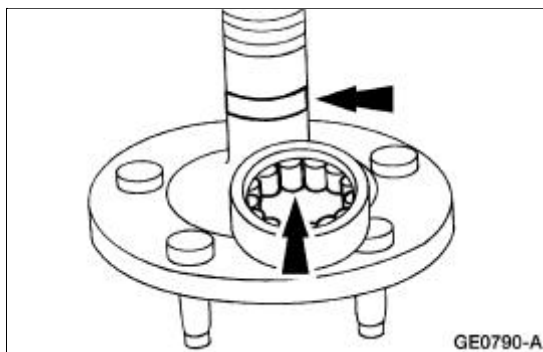
As noted, pinion bearings make a high-pitched, whistling noise, usually at all speeds. If however there is only one pinion bearing that is worn/damaged, the noise may vary in different driving phases. If pinion bearings are scored or damaged or there is a specific pinion bearing noise, new pinion bearings must be installed. A worn/damaged bearing will normally be obvious at disassembly. Examine the large end of the rollers for wear. If the pinion bearings original blend radius has worn to a sharp edge, a new pinion bearing must be installed.

NOTE: A low-pitched rumble normally associated with a worn/damaged wheel bearing can also be caused by tires.

A wheel bearing noise can be mistaken for a pinion bearing noise. Check the wheel bearing for a spalled cup, and spalled/damaged rollers. Check the wheel bearing for rotating smoothness and end play. Install a new wheel bearing if any of these concerns are detected.



If the wheel bearing is damaged, the roller surface on the axle shaft may also be damaged. Install a new axle shaft if any damage is detected.



Chuckle

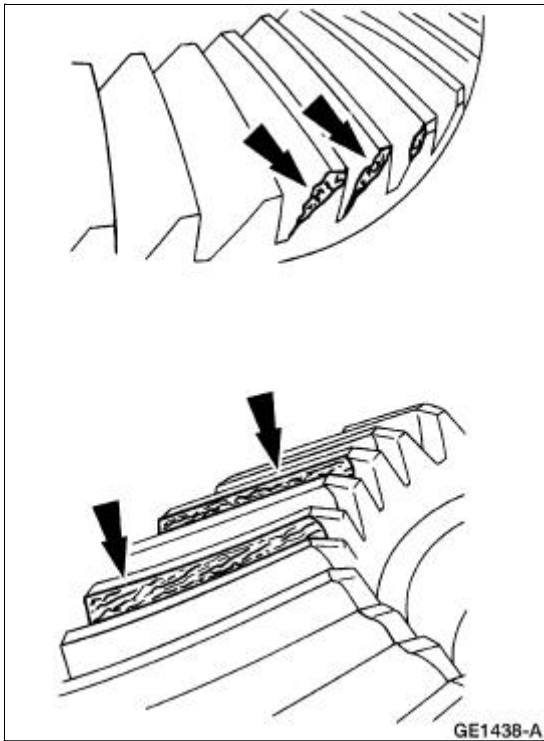
Chuckle that occurs on the coast driving phase is usually caused by excessive clearance between the differential gear hub and the differential case bore.

Damage to a gear tooth on the coast side can cause a noise identical to a chuckle. A very small tooth nick or ridge on the edge of a tooth can cause the noise.

Clean the gear tooth nick or ridge with a small grinding wheel. If the damaged area is larger than 3.2 mm (1/8 inch), install a new gearset.

To check the ring gear and pinion, remove as much lubricant as possible from the gears with clean solvent. Wipe the gears dry or blow them dry with compressed air. Look for scored or damaged teeth. Also look for cracks or other damage.

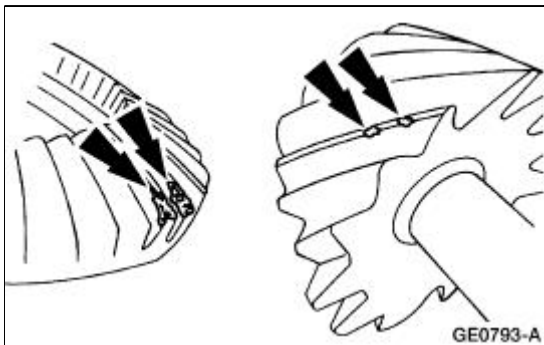
If either gear is scored or damaged badly, install a new ring gear and pinion.



If metal has broken loose, the axle housing must be cleaned to remove particles that will cause damage. At this time, any other new parts in the axle housing must also be installed, if necessary.

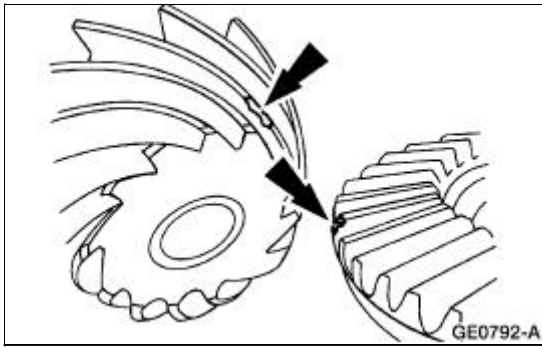
Knock

Knock, which can occur on all driving phases, has several causes including damaged teeth or gearset.



In most cases, one of the following conditions will occur:

1. A gear tooth damaged on the drive side is a common cause of the knock. This can usually be corrected by grinding the damaged area.



2. **NOTE:** Measure the end play with a Dial Indicator with Bracketry and not by feel.

Knock is also caused by excessive end play in the axle shafts. Up to 0.762 mm (0.030 inch) is allowed in semi-float axles. The frequency of the knock will be less because the axle shaft speed is slower than the driveshaft.

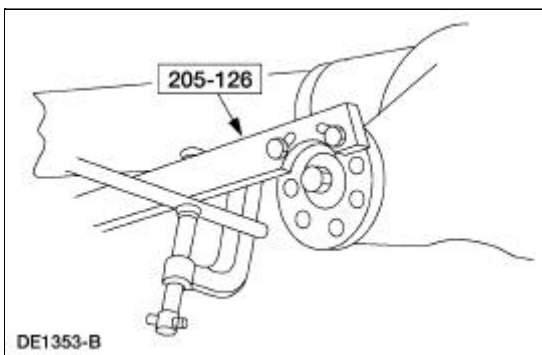
Clunk

Clunk is a metallic noise heard when the automatic transmission is engaged in REVERSE or DRIVE. The noise may also occur when throttle is applied or released. It is caused by backlash somewhere in the driveline or loose suspension components; it is felt or heard in the axle. Refer to Total Backlash Check in this section.

Additionally, clunk may be heard upon initial drive-away. This occurs as engine torque shifts vehicle weight, forcing changes in driveline angles, preventing the driveshaft slip-yoke from sliding on the output shaft. To correct for this condition, lubricate the slip-yoke splines.

Total Backlash Check

1. Raise and support the vehicle. Refer to [Section 100-02](#).
2. Remove the driveshaft. Refer to [Section 205-01](#).
3. Install the special tool.
 - Clamp a rigid bar or pipe to the tool. Clamp the other end of the bar or pipe to the frame or a body member in order to prevent movement of the rear axle pinion flange.



4. Lower the vehicle so that one rear wheel is resting on a wheel chock to prevent it from turning. The other rear wheel will be used to measure total rear axle backlash.
5. Rotate the free wheel slowly, by hand, until the feeling of driving the rear axle is encountered. Place a mark on the side of the tire, 305 mm (12 inches) from the center of the wheel, with a

crayon or chalk.

6. While holding the crayon or chalk against the tire, rotate the wheel slowly in the opposite direction until the feeling of driving the rear axle is encountered again.
7. Measure the length of the crayon or chalk mark on the tire.
 - If the length of the mark is 25.4 mm (1 inch) or less, the rear axle backlash is within allowable limits.
 - If the chalk mark is greater than 25.4 mm (1 inch), check for these conditions:
 - Elongation of the differential pinion shaft and holes in the differential case (4204).
 - Missing differential pinion thrust washer (4230) or differential side gear thrust washer (4228).
 - Galling of the differential pinion shaft (4211) and bore.
 - Excessive ring gear and pinion backlash. Follow the procedure for the type of rear axle to check backlash.

Axle Shaft Bearing Noise

Axle bearing shaft noise is similar to gear noise and differential pinion bearing whine. Axle shaft bearing noise will usually distinguish itself from gear noise by occurring in all driving modes (drive, coast, and float), and will persist with the transmission in NEUTRAL while the vehicle is moving at the speed in which the concern is occurring. If the vehicle makes this noise, remove the suspect axle shaft, install a new bearing and a new axle seal. Re-evaluate the vehicle for noise before removing any internal components.

Bearing Rumble

Bearing rumble sounds like marbles being tumbled. This condition is usually caused by a worn/damaged wheel bearing. The lower pitch is because the wheel bearing turns at only about one-third of the driveshaft speed. Wheel bearing noise also may be high-pitched, similar to gear noise, but will be evident in all four driving modes.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none">● Traction-Lok® does not work in snow, mud or on ice	<ul style="list-style-type: none">● Differential.	<ul style="list-style-type: none">● CARRY OUT the Traction-Lok® Differential Operation Check in this section. REPAIR as necessary. REFER to Section 205-02A or Section 205-02B.
<ul style="list-style-type: none">● Lubricant leaking from the pinion seal, axle shaft oil seals	<ul style="list-style-type: none">● Vent.● Damage in the seal contact area or damaged or worn seal.	<ul style="list-style-type: none">● CLEAN the axle housing vent.● INSTALL a new seal if damage is found.
<ul style="list-style-type: none">● Differential side gears/pinion gears are scored	<ul style="list-style-type: none">● Insufficient lubrication.● Incorrect or contaminated	<ul style="list-style-type: none">● INSTALL new gears. REFER to Section 205-02A or Section 205-02B. FILL the axle to specification.● INSTALL new gears. REFER to Section 205-02A or Section

	lubricant type.	205-02B . CLEAN and REFILL the axle to specification.
<ul style="list-style-type: none"> ● Axle overheating 	<ul style="list-style-type: none"> ● Lubricant level too low. ● Incorrect or contaminated lubricant type. ● Bearing preload adjusted too tight. ● Excessive gear wear. ● Incorrect ring gear backlash. 	<ul style="list-style-type: none"> ● CHECK the lubricant level. FILL the axle to specification. ● INSPECT the axle for damage. REPAIR as necessary. CLEAN and REFILL the axle to specification. ● CHECK the ring and pinion for damage. INSPECT the ring and pinion wear pattern. ADJUST the preload as necessary. ● INSPECT all the axle gears for wear or damage. INSTALL new components as necessary. ● INSPECT the ring gear for scoring. INSPECT the ring and pinion wear pattern. ADJUST the ring gear backlash as necessary.
<ul style="list-style-type: none"> ● Broken gear teeth on the ring gear or pinion 	<ul style="list-style-type: none"> ● Overloading the vehicle. 	<ul style="list-style-type: none"> ● INSTALL a new ring and pinion. REFER to Section 205-02A or Section 205-02B.
<ul style="list-style-type: none"> ● Axle shaft broken 	<ul style="list-style-type: none"> ● Overloading the vehicle. ● Misaligned axle shaft tube. 	<ul style="list-style-type: none"> ● INSTALL a new axle shaft. REFER to Section 205-02A or Section 205-02B. ● INSPECT the axle for damage. CHECK axle shaft tube alignment. INSTALL a new axle shaft. REFER to Section 205-02A or Section 205-02B.

Component Tests

Driveline Vibration

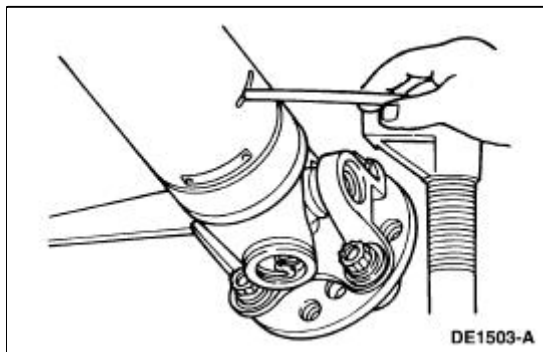
An analysis of driveline vibration can also be conducted using the Vibration Analyzer; follow the manufacturer's directions.

Driveline vibration exhibits a higher frequency and lower amplitude than does high-speed shake. Driveline vibration is directly related to the speed of the vehicle and is usually noticed at various speed ranges. Driveline vibration can be perceived as a tremor in the floorpan or is heard as a rumble, hum, or boom. Driveline vibration can exist in all drive modes, but may exhibit different symptoms depending upon whether the vehicle is accelerating, decelerating, floating, or coasting. Check the driveline angles if the vibration is particularly noticeable during acceleration or deceleration, especially at lower speeds. Driveline vibration can be duplicated by supporting the axle upon a hoist or upon jack stands, though the brakes may need to be applied lightly in order to simulate road resistance.

1. Raise the vehicle promptly after road testing. Use a twin-post hoist or jack stands to prevent tire flat-spotting. Engage the drivetrain and accelerate to the observed road test speed to verify the

presence of the vibration. If the vibration is not evident, check the non-driving wheels with a wheel balancer to rule out imbalance as a possible cause. If required, balance the non-driving wheels and repeat the road test. If the vibration is still evident, proceed to Step 2.

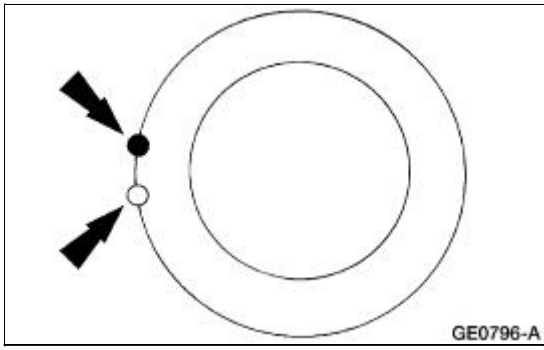
2. Mark the relative position of the drive wheels to the wheel nuts. Remove the wheels. Install all the nuts in the reversed position and repeat the road speed acceleration. If the vibration is gone, refer to the tire and wheel runout procedure in [Section 204-04](#). If the vibration persists, proceed to Step 3.
3. Inspect the driveshaft for signs of physical damage, missing balance weight, undercoating, incorrect seating, wear and binding universal joints. Clean the driveshaft and install new universal joints or a new driveshaft if damaged. Check the index marks (paint spots) on the rear of the driveshaft and pinion flange. If these marks are more than one-quarter turn apart, disconnect the driveshaft and re-index to align the marks as closely as possible. After any corrections are made, recheck for vibration at the road test speed. If the vibration is gone, reinstall the wheels and road test. If the vibration persists, proceed to Step 4.
4. Raise the vehicle on a hoist and remove the wheels. Rotate the driveshaft by turning the axle and measure the runout at the front, the center, and the rear of the driveshaft with the indicator. If the runout exceeds 0.89 mm (0.035 inch) at the front or center, a new driveshaft must be installed. If the front and center are within this limit, but the rear runout is not, mark the rear runout high point and proceed to Step 5. If the runout is within the limits at all points, proceed to Step 7.



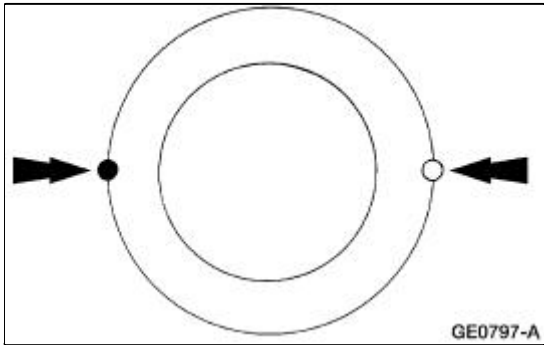
5. **NOTE:** Check the U-joints during re-indexing. If a U-joint feels stiff or gritty, install new U-joints.

Scribe alignment marks on the driveshaft and the pinion flange. Disconnect the driveshaft, rotate it one-half turn, and reconnect it. Circular pinion flanges can be turned in one-quarter increments to fine tune the runout condition. Check the runout at the rear of the driveshaft. If it is still over 0.89 mm (0.035 inch), mark the high point and proceed to Step 6. If the runout is no longer excessive, check for vibration at the road test speed. If vibration is still present, re-index the driveshaft slip yoke on the transmission output shaft one-half turn and road test the vehicle. If the vibration persists, proceed to Step 7.

6. Excessive driveshaft runout may originate in the driveshaft itself or in the pinion flange. To determine which, compare the two high points marked in Steps 4 and 5. If the marks are close together, within about 25 mm (1 inch), a new shaft must be installed and the vehicle road tested.

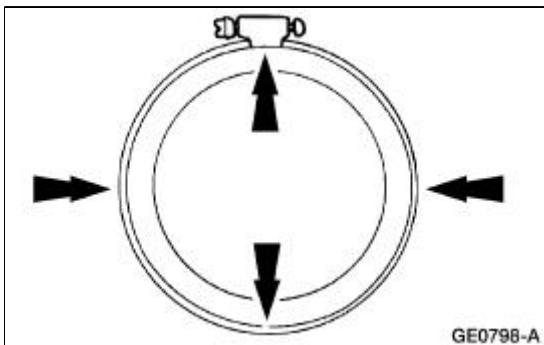


If the marks are on opposite sides of the driveshaft, the yoke or pinion flange is responsible for the vibration.



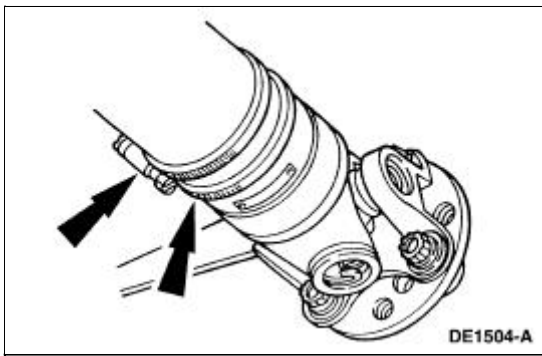
When installing a new pinion flange, the driveshaft runout must not exceed 0.89 mm (0.035 inch). When runout is within limits, recheck for vibration at road speed. If vibration persists, balance the driveshaft.

7. To balance the driveshaft, install one or two hose clamps on the driveshaft, near the rear. Position of the hose clamp head(s) can be determined by trial-and-error.
8. Mark the rear of the driveshaft into four approximately equal sectors and number the marks 1 through 4. Install a hose clamp on the driveshaft with its head at position No. 1.

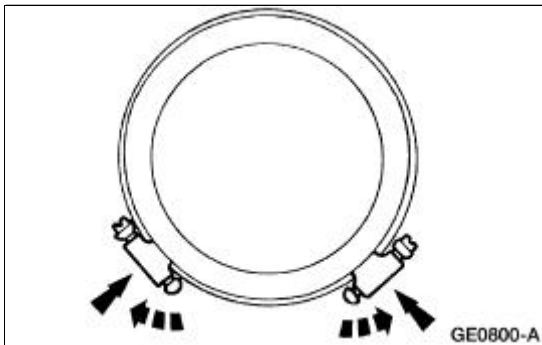


Check for vibration at road speed. Recheck with the clamp at each of the other positions to find the position that shows minimum vibration. If two adjacent positions show equal improvement, position the clamp head between them.

9. If the vibration persists, add a second clamp at the same position and recheck for vibration.



If no improvement is noted, rotate the clamps in opposite directions, equal distances from the best position determined in Step 8. Separate the clamp heads about 13 mm (1/2 inch) and recheck for vibration at the road speed.



Repeat the process with increasing separation until the best combination is found or the vibration is reduced to an acceptable level.

10. Install the wheels and road test (vibration noticeable on the hoist may not be evident during the road test). If the vibration is still not acceptable, install a new axle driveline vibration damper first, if so equipped. If the vibration is still not acceptable, refer to [Section 205-02A](#) or [Section 205-02B](#) for differential case and ring gear runout checks.

Driveshaft Vibrates

1. Road test the vehicle to determine the critical vibration points. Note the road speed, the engine RPM, and the shift lever positions at which the vibration occurs.
2. Stop the vehicle, place the transmission lever in neutral and run the engine through the critical speed ranges determined in Step 1.
3. If no vibration is felt, balance the driveshaft. Refer to Driveline Vibration in this section.

Traction-Lok® Differential Operation Check

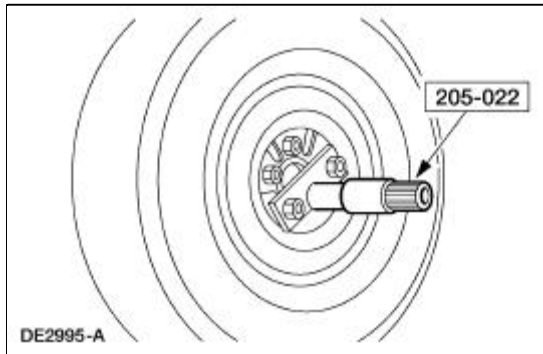
A Traction-Lok® differential can be checked for correct operation without removing it from the rear axle housing.



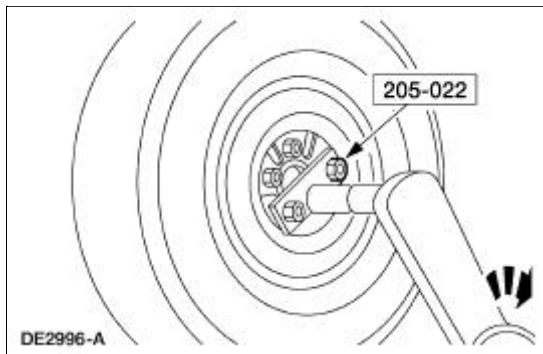
WARNING: A vehicle equipped with a Traction-Lok® differential will always have both wheels driving. If only one wheel is raised off the floor and the rear axle is driven by the engine, the wheel on the floor could drive the vehicle off the stand or jack. Be sure both rear wheels are

off the floor.

With the engine off, raise only one rear wheel. Install the special tool on the wheel nuts.



Use a torque wrench with a capacity of at least 271 Nm (200 lb-ft) to rotate the axle shaft. Be sure that the transmission is in NEUTRAL, and that one rear wheel is on the floor while the other rear wheel is raised off the floor. The breakaway torque required to start rotation must be at least 27 Nm (20 lb-ft). The initial breakaway torque may be higher than the continuous turning torque.



The axle shaft must turn with even pressure throughout the check without slipping or binding. If the torque reading is less than specified, check the differential case. Refer to [Section 205-02A](#) or [Section 205-02B](#).

Traction-Lok® Differential Check Road Test

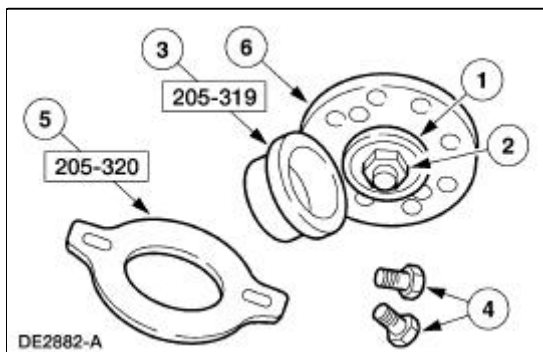
1. Place one wheel on a dry surface and the other wheel on ice, mud or snow.
2. Gradually open the throttle to obtain maximum traction prior to break away. The ability to move the vehicle demonstrates correct operation of a Traction-Lok® rear axle assembly.
3. When starting with one wheel on an excessively slippery surface, a slight application of the parking brake may be necessary to help energize the Traction-Lok® feature of the differential. Release the brake when traction is established. Use light throttle on starting to provide maximum traction.
4. If, with unequal traction, both wheels slip, the limited slip rear axle has done all it can possibly do.
5. In extreme cases of differences in traction, the wheel with the least traction may spin after the Traction-Lok® has transferred as much torque as possible to the non-slipping wheel.

Companion Flange Runout Check



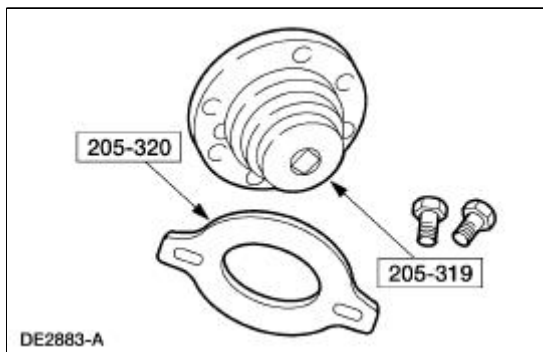
CAUTION: Pinion bearing preload must be reset if the pinion nut has been loosened or removed for pinion flange reindexing or installation.

1. Raise the vehicle on a twin-post hoist that supports the rear axle. Refer to [Section 100-02](#) .
2. Remove the driveshaft. Refer to [Section 205-01](#) .
3. Check the pinion flange for damage.
4. Position the Companion Flange Runout Gauge on the pinion flange.

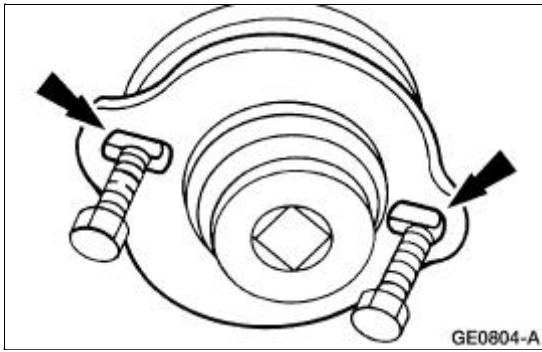


Item	Part Number	Description
1	—	Pilot (part of 205-319 [T92L-4851-B])
2	354845	Pinion nut
3	205-319 (T92L-4851-B)	Companion flange runout gauge
4	—	Bolts (2 Req'd) (Part of 205-320 [T92L-4851-C])
5	205-320	Clamp plate (T92L-4851-C)
6	4851	Pinion flange

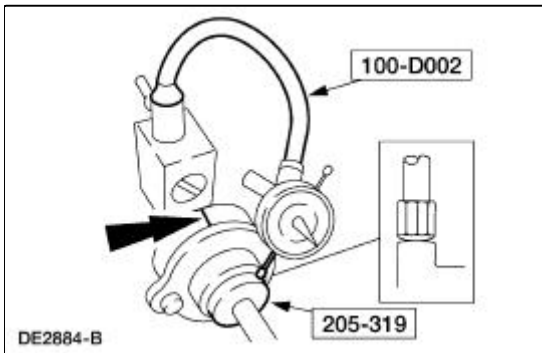
5. Position the special tools on the pinion flange.



6. Align the holes on the clamp plate with the holes in the pinion flange and install the bolts. Snug the bolts evenly.

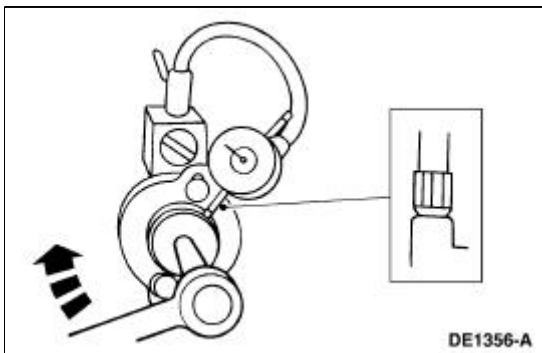


7. Position the special tool as shown. Turn the Companion Flange Runout Gauge, and locate and mark the high spot on the pinion flange with yellow paint.



If the flange runout exceeds 0.25 mm (0.010 inch), remove the pinion flange, reindex the flange one-half turn on the pinion, and reinstall it. Refer to [Section 205-02A](#) or [Section 205-02B](#).

8. Check the runout again. If necessary, rotate the flange until an acceptable runout is obtained. If the flange runout is still more than 0.25 mm (0.010 inch), install a new pinion flange.



9. If excessive runout is still evident after installing a new pinion flange, install a new ring and pinion. Repeat the above checks until the runout is within specifications.
10. Install the driveshaft. Refer to [Section 205-01](#).

Tooth Contact Pattern Check — Gearset

1. To check the gear tooth contact, paint the gear teeth with the special marking compound. A mixture that is too wet will run and smear; a mixture that is too dry cannot be pressed out from between the teeth.

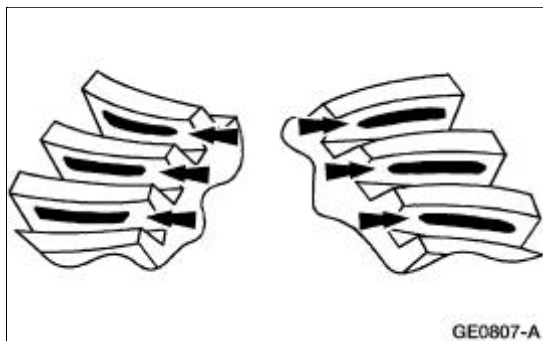
2. Use a box wrench on the ring gear bolts as a lever to rotate the ring gear several complete revolutions in both directions or until a clear tooth contact pattern is obtained.
3. Certain types of gear tooth contact patterns on the ring gear indicate incorrect adjustment. Incorrect adjustment can be corrected by readjusting the ring gear or the pinion.

Contact Pattern Location

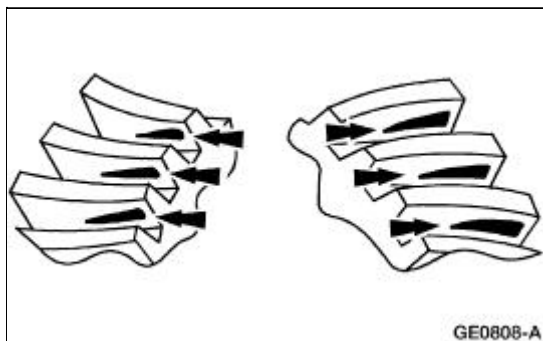
In general, desirable ring gear tooth patterns must have the following characteristics:

- drive pattern on the drive side ring gear well centered on the tooth
- coast pattern on the coast side ring gear well centered on the tooth
- clearance between the pattern and the top of the tooth
- no hard lines where the pressure is high

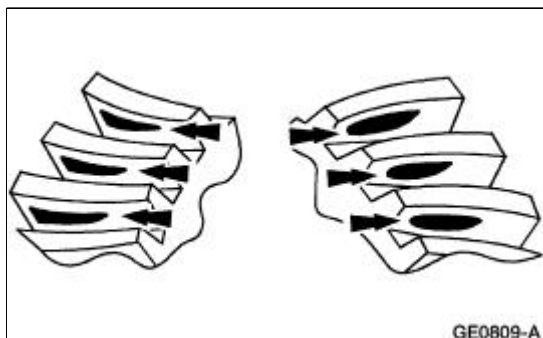
Acceptable ring gear tooth patterns for all axes.



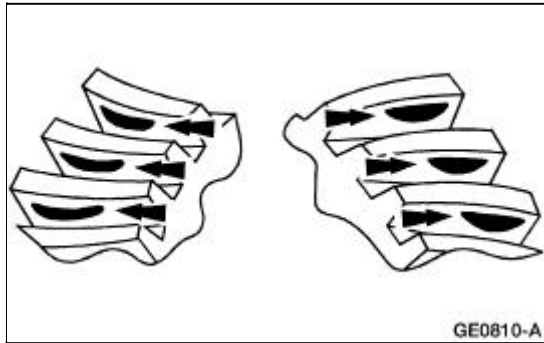
Correct backlash with a thinner pinion position shim required.



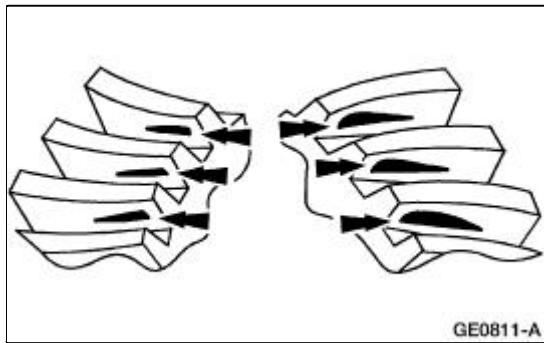
Correct backlash with a thicker pinion position shim required.



Correct pinion position shim that requires a decrease in backlash.

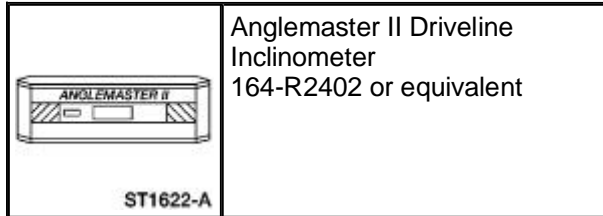


Correct pinion position shim that requires an increase in backlash.



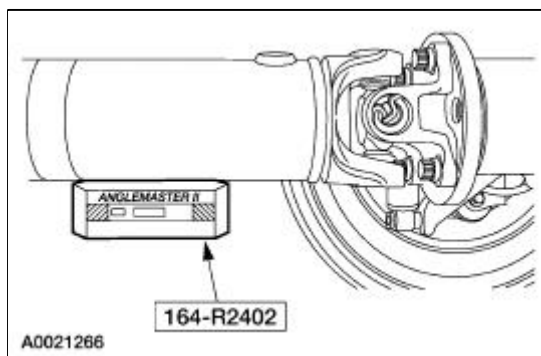
Driveline Angle Inspection

Special Tool(s)

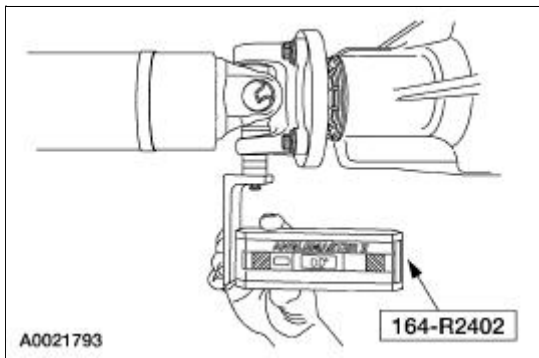


NOTE: An incorrect driveline angle can cause a vibration or shudder. For additional information, refer to [Section 100-04](#).

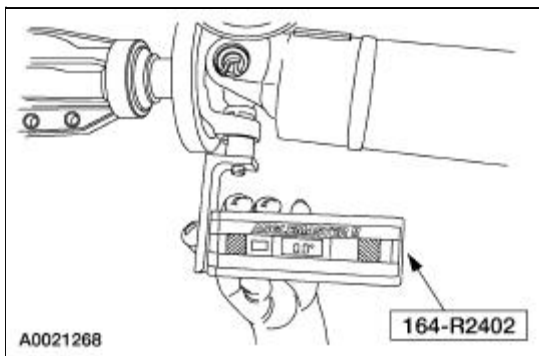
1. Check the vehicle for evidence of overload or sagging. Check for specified air pressures information in all four tires.
2. Normalize the suspension.
3. Drive the vehicle onto a drive-on hoist or back onto a front-end alignment rack.
4. Inspect the suspension and chassis. Verify that the vehicle curb position ride height is within specification. For additional information, refer to [Section 204-00](#).
 - Measure the curb position ride height with the vehicle empty and all fluids full.
5. Place the Inclinometer flush against the bottom of the driveshaft. After the tool has been held on the driveshaft surface for 5 seconds, push the ALT ZERO button to calibrate to zero degrees. Remove the tool.



6. To check the pinion angle, rotate the driveshaft so that the rear axle pinion flange yoke ear is parallel to the floor. Remove the U-joint snap ring, then install the special tool. Check and record the pinion angle reading.
 - If the angle is not within specification, repair or adjust to obtain the correct angle. Inspect the rear suspension, rear axle, rear axle mounting or the frame for wear or damage.



7. To check the engine angle, rotate the driveshaft so that the slip yoke ear is parallel to the floor. Remove the U-joint snap ring, then install the special tool. Check and record the engine angle reading.
 - If the angle is not within specifications, repair or adjust to obtain the correct angles. Inspect the powertrain/drivetrain mounts or frame rails for wear or damage.

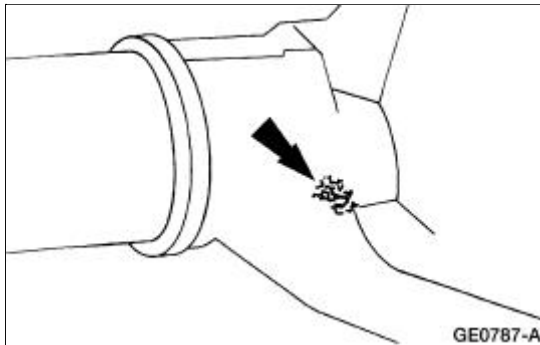


Axle Housing Casting Porosity (Holes in Casting) Repair

 **CAUTION:** To keep the axle's sound characteristics, do not disassemble the carrier.


NOTE: Casting porosity is a condition where occasionally gas bubbles will form during the casting process leaving small pockets in the metal that will cause the axle housing to leak.

1. To fill small pockets,peen in a small amount of body lead.



2. Seal the pocket.
 - Use epoxy sealer meeting Ford specification M-3D35A(E).
 3. To fill large pockets, drill and tap a shallow hole for a small setscrew. Install the setscrew and seal it.
 - Use epoxy sealer meeting Ford specification M-3D35A(E).
-

Axle Housing Weld Leaks Repair

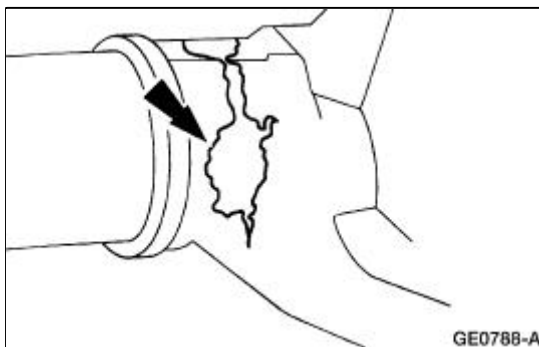
1.  **CAUTION:** To keep the axle's sound characteristics, do not disassemble the carrier.

 **CAUTION:** Rear axle housing straightness is too critical for field repair. Install a new axle housing if a weld is broken.

NOTE: Most minor weld leaks are repairable. This includes the puddle and fill welds that join the axle shaft tube to the axle housing on integral axles.

Seal the weld.

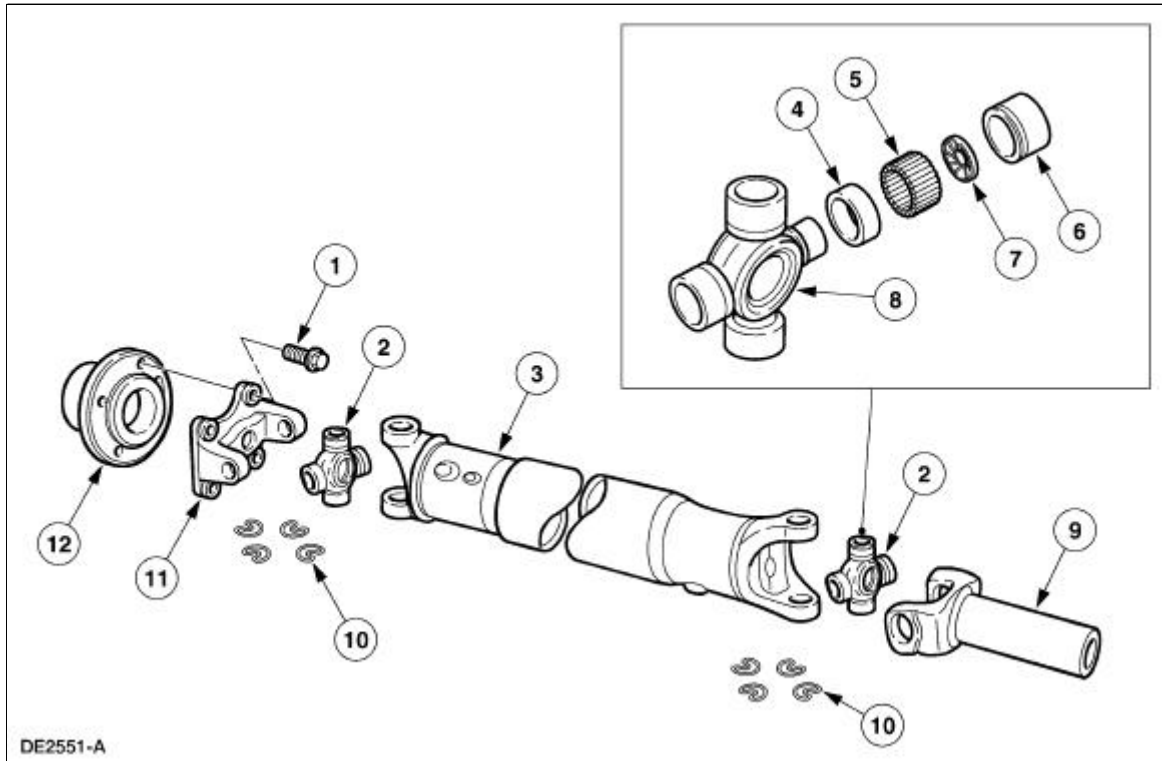
- Use Devcon Aluminum Liquid F2 or equivalent meeting Ford specification M-3D35A(E).



Torque Specifications

Description	Nm	lb-ft
Pinion flange bolts	112	83

Driveshaft



DE2551-A

Item	Part Number	Description
1	N800594-S100	Bolt (4 req'd)
2	4635	Universal joint (U-joint)
3	4602	Driveshaft
4	—	Grease seal (part of 4635)
5	—	Needle bearings (part of 4635)
6	—	Bearing cup (part of 4635)
7	—	Thrust washer (part of 4635)
8	—	Spider (part of 4635)
9	4841	Driveshaft slip yoke
10	—	Snap ring (4 req'd) (part of 4635)
11	4782	Driveshaft centering socket yoke
12	4851	Rear axle universal joint flange

NOTE: All driveshaft assemblies are balanced. If undercoating the vehicle, protect the driveshaft to prevent overspray of any undercoating material.

The driveshaft has the following features:

- A tubular shaft used to transfer engine torque from the transmission output shaft to the differential in the rear axle housing, which transmits torque through the axle shafts to the drive

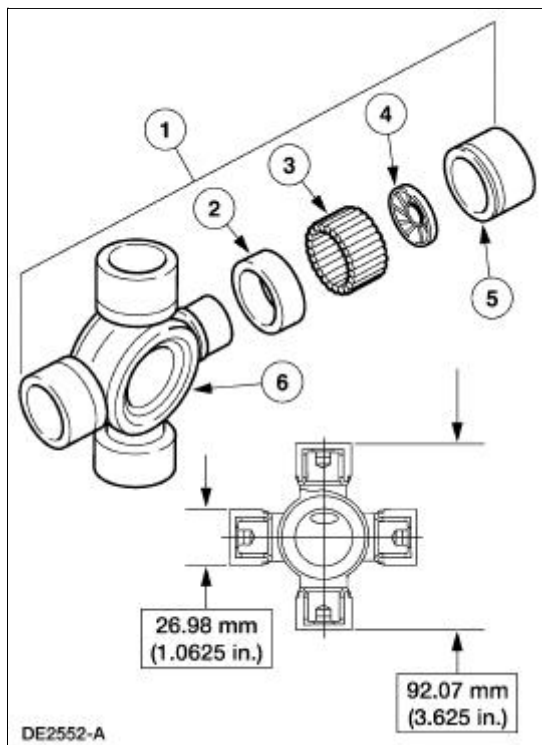
wheels.

- Consists of two single-cardan universal joints, a driveshaft slip yoke, a welded tube assembly and a driveshaft centering socket yoke.
 - The splined driveshaft slip yoke permits the driveshaft to move forward and rearward on the transmission output shaft during drivetrain movement and during driveshaft removal and installation.
-

Universal Joints

The universal joints are:

- lubed-for-life design and require no lubrication.
- equipped with nylon thrust washers, located at each base of the bearing cup, which control end play, position the needle bearing and improve grease movement.



Item	Part Number	Description
1	4635	Universal joint (U-joint)
2	—	Grease seal (part of 4635)
3	—	32 needle bearings (part of 4635)
4	—	Thrust washer (part of 4635)
5	—	Bearing cup (part of 4635)
6	—	Spider (part of 4635)

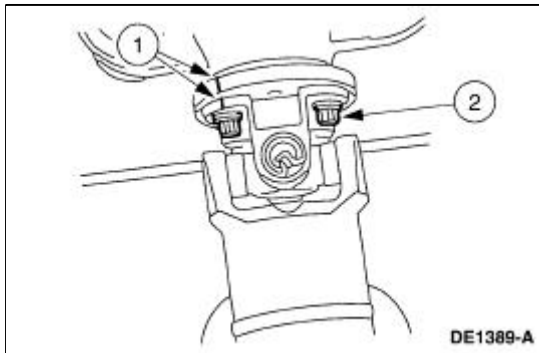
Driveshaft

Material

Item	Specification
Threadlock® and Sealer E0AZ-19554-AA	WSK-M2G351-A5 (type II)

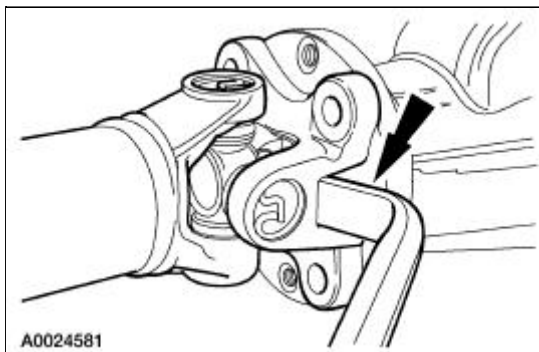
Removal and Installation

1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Carry out the following:
 1. Place an index mark on the rear axle pinion flange and the driveshaft centering socket yoke.
 2. Remove the four bolts.



3.  **CAUTION:** The driveshaft centering socket yoke fits tightly on the rear axle pinion flange pilot. Never hammer on the driveshaft or any of its components to disconnect the yoke from the flange. Pry only in the area shown, with a suitable tool, to disconnect the yoke from the flange.


Using a suitable tool as shown, disconnect the driveshaft centering socket yoke from the rear axle pinion flange.



4.  **CAUTION:** Do not allow the slip yoke to bottom on the transmission output shaft.

Lower the rear end of the driveshaft to clear the rear axle housing. Pull the driveshaft rearward until the driveshaft slip yoke clears the transmission extension housing.

- Place a paint index mark on the driveshaft slip yoke and the transmission output shaft.
- Place a commercially available plug in the extension housing to prevent fluid leakage.

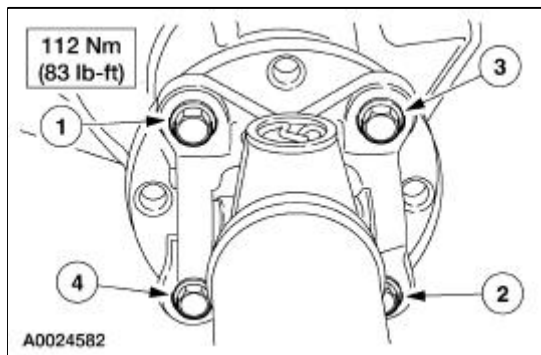
5.  **CAUTION: Install the driveshaft with new bolts. If new bolts are not available, apply threadlock and sealer to the threads of the original bolts.**

 **CAUTION: Do not allow the slip yoke to bottom on the transmission output shaft.**

 **CAUTION: The driveshaft centering socket yoke fits tightly on the rear axle pinion flange pilot. To make sure that the yoke seats squarely on the flange, tighten the bolts evenly in a cross pattern as shown.**

NOTE: Clean all foreign material from the yoke areas of the driveshaft.

To install, reverse the removal procedure.



Driveshaft —Cobra

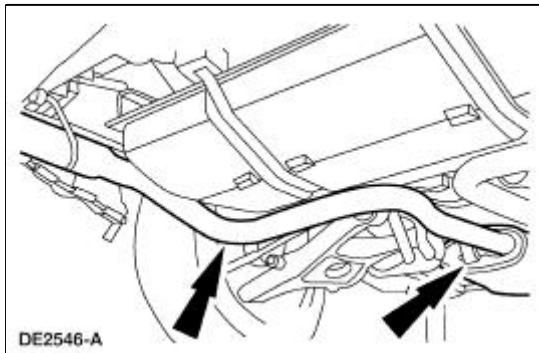
Material

Item	Specification
Threadlock® and Sealer E0AZ-19554-AA	WSK-M2G351-A5 (type II)
Silicone Lubricant (Aerosol) F5AZ-19553-AA	ESR-M13P4-A

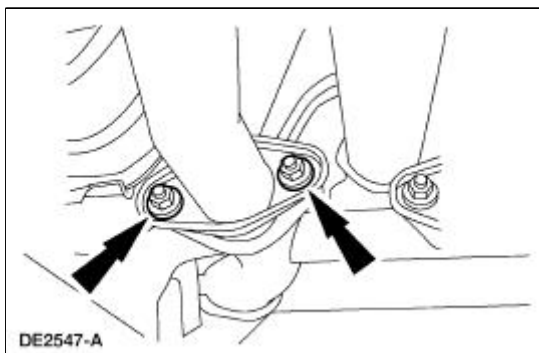
Removal and Installation

1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. **NOTE:** To aid disassembly and assembly, lubricate the exhaust hangers with silicone lubricant.

Remove the two exhaust hangers from the rubber mounts.

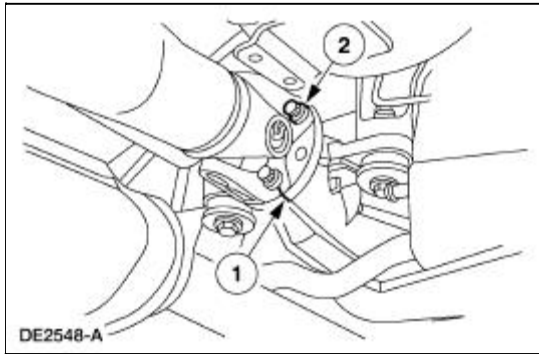


3. Remove the nuts on the left side exhaust.



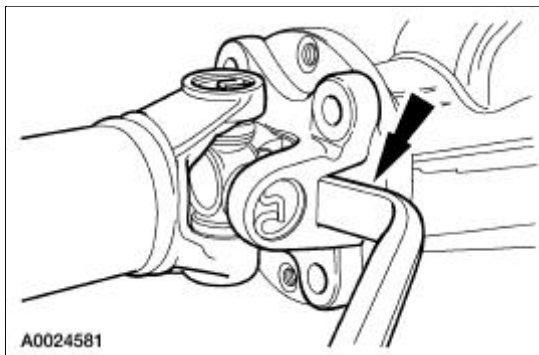
4. Lower the muffler pipe enough to clear the flange. Move the muffler assembly forward to disconnect the third exhaust hanger.
5. Carry out the following:
 1. Place an index mark on the rear axle pinion flange and the driveshaft centering socket yoke.

2. Remove the four bolts.



6.  **CAUTION:** The driveshaft centering socket yoke fits tightly on the rear axle pinion flange pilot. Never hammer on the driveshaft or any of its components to disconnect the yoke from the flange. Pry only in the area shown, with a suitable tool, to disconnect the yoke from the flange.

Using a suitable tool as shown, disconnect the driveshaft centering socket yoke from the rear axle pinion flange.



7.  **CAUTION:** Do not allow the slip yoke to bottom on the transmission output shaft.

Lower the rear end of the driveshaft to clear the rear axle housing. Pull the driveshaft rearward until the driveshaft slip yoke clears the transmission extension housing.

- Place a paint index mark on the driveshaft slip yoke and the transmission output shaft.
- Place a commercially available plug in the extension housing to prevent fluid leakage.

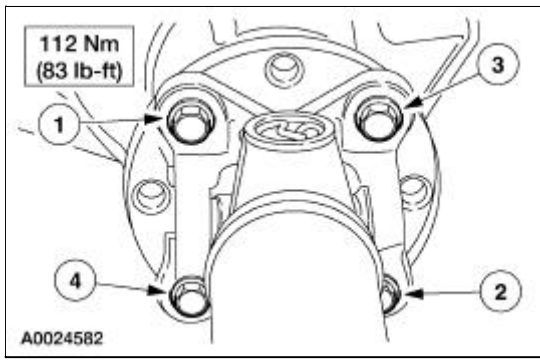
8.  **CAUTION:** Install the driveshaft with new bolts. If new bolts are not available, apply threadlock and sealer to the threads of the original bolts.

 **CAUTION:** Do not allow the slip yoke to bottom on the transmission output shaft.

 **CAUTION:** The driveshaft centering socket yoke fits tightly on the rear axle pinion flange pilot. To make sure that the yoke seats squarely on the flange, tighten the bolts evenly in a cross pattern as shown.

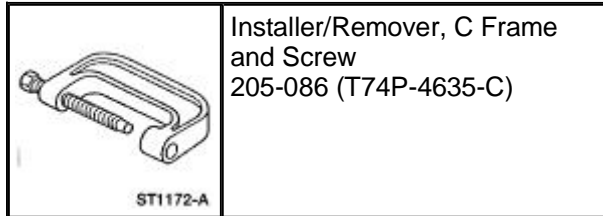
NOTE: Clean all foreign material from the yoke areas of the driveshaft.

To install, reverse the removal procedure.




Driveshaft Slip Yoke

Special Tool(s)



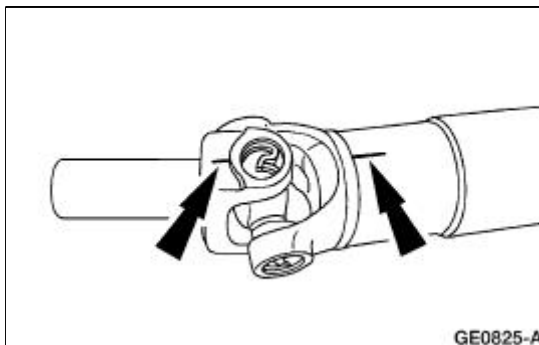
Disassembly

1. Remove the driveshaft (4602). For additional information, refer to [Driveshaft](#) in this section.
2.  **CAUTION:** Under no circumstances is the driveshaft assembly to be clamped in the jaws of a vise or similar holding fixture. Denting or localizing fracture can result, causing driveshaft failure during vehicle operation.

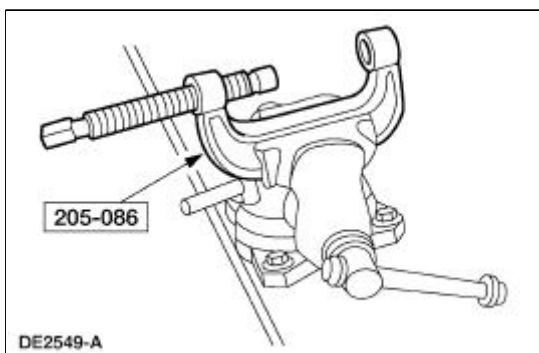
Place the driveshaft (4602) on a suitable workbench. Be careful not to damage the tube.

3. **NOTE:** If components are not marked and therefore installed incorrectly, driveline imbalance can occur.

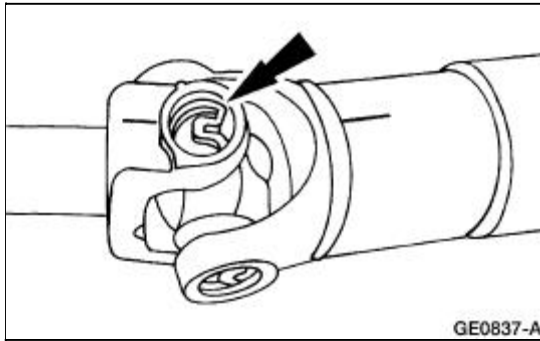
Index-mark the driveshaft components.



4. Clamp the special tool in a vise.



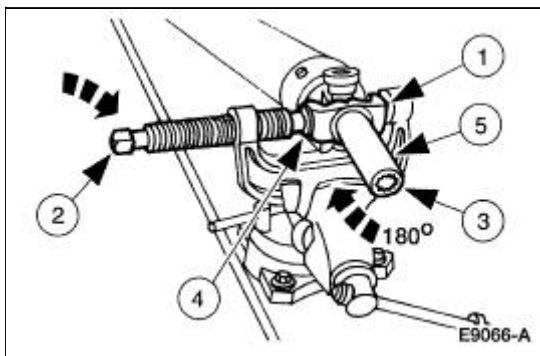
5. Remove all four of the snap rings.



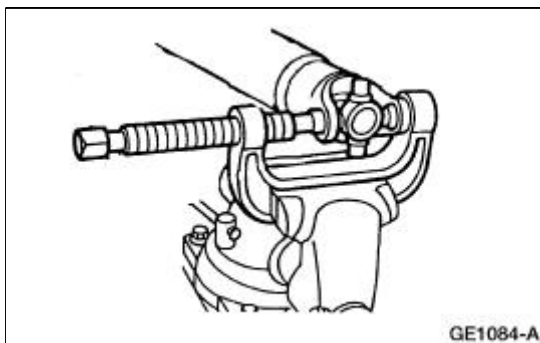
6. **NOTE:** If necessary, use a pair of pliers to remove a bearing cup if it cannot be pressed out all the way.

Remove the driveshaft slip yoke (4841).

1. Position the driveshaft slip yoke in the U-joint tool.
2. Press out a bearing cup.
3. Rotate the driveshaft slip yoke.
4. Press on the spider to remove the remaining bearing cup.
5. Remove the driveshaft slip yoke.



7. Repeat Step 5 to remove the remaining bearing cups and spider from the driveshaft.



8. Clean the yoke area at each end of the driveshaft.

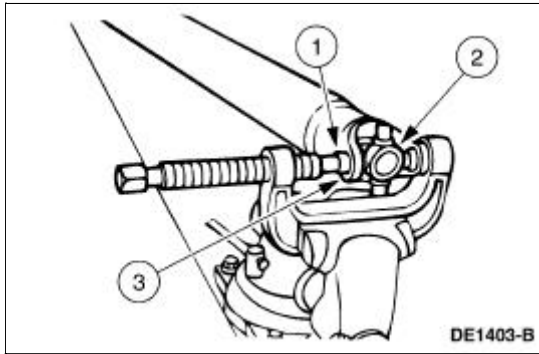
Assembly

1. **NOTE:** Universal joint service kits are to be installed as complete assemblies only. Do not mix components from other U-joint kits.

Install the bearing cup.

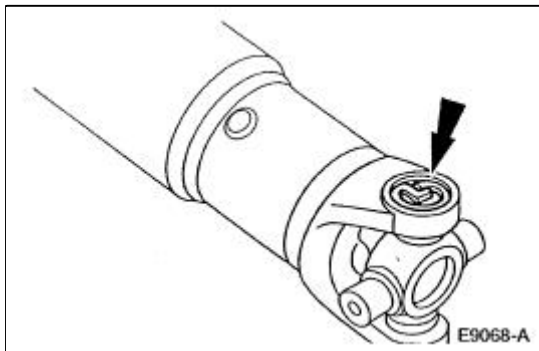
1. Start a new bearing cup into the driveshaft yoke.

- Check the needle bearings for correct positioning.
2. Position the new spider in the driveshaft yoke.
 3. Using the special tool, press the bearing cup to just below the snap ring groove.



2. **NOTE:** Use the yellow snap rings supplied in the kit to assemble the universal joint (U-joint). If difficulty is encountered with the yellow snap rings, install the black snap rings, as required.

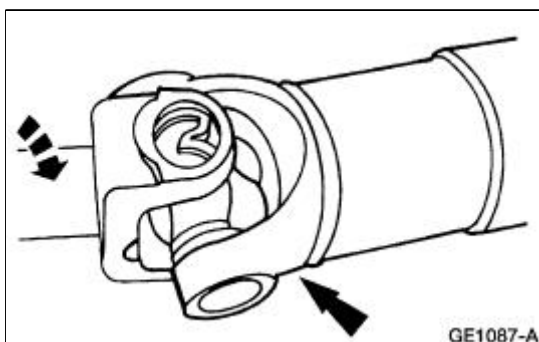
Remove the driveshaft from the special tool, and install the snap ring.



3. Repeat Steps 1 and 2 to install the opposite side of the driveshaft yoke.
4. Inspect the driveshaft slip yoke. Install new if necessary.
5. Repeat Steps 1 and 2 to install the remaining new bearing cups, spider, driveshaft slip yoke, and the snap rings.
6. **NOTE:** Do not strike the bearings.

Check the U-joints for freedom of movement.

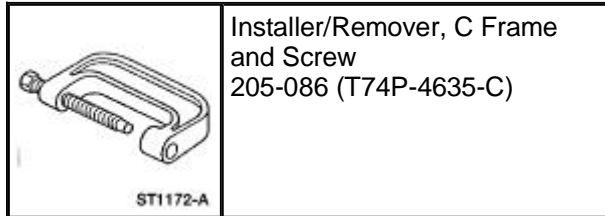
- If binding, strike the yoke with a brass or plastic hammer.




7. Install the driveshaft. For additional information, refer to [Driveshaft](#) in this section.

Universal Joint —Single Cardan, Flange Yoke

Special Tool(s)



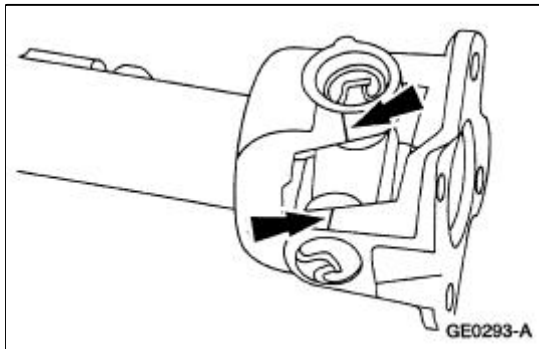
Disassembly

1. Remove the driveshaft (4602). For additional information, refer to [Driveshaft](#) in this section.
2.  **CAUTION:** Under no circumstances is the driveshaft assembly to be clamped in the jaws of a vise or similar holding fixture. Denting or localizing fracture can result, causing driveshaft failure during vehicle operation.

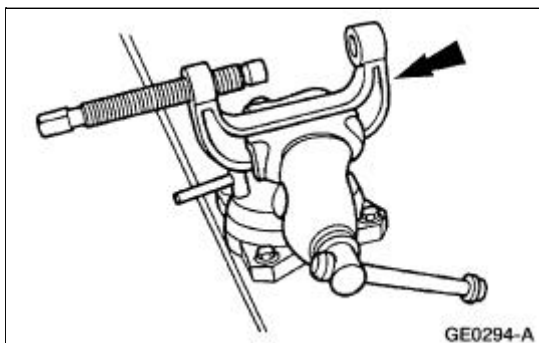
Place the driveshaft on a suitable workbench, being careful not to damage the tube.

3. **NOTE:** If components are not marked and installed correctly, driveline imbalance can occur.

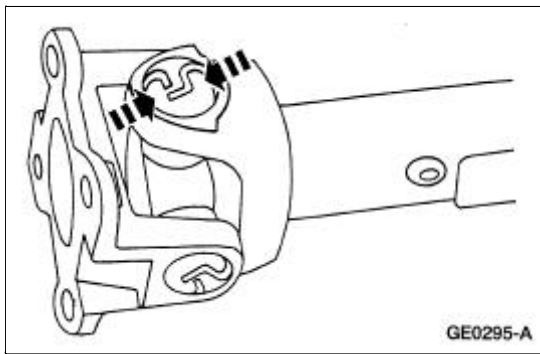
Index-mark the positions of the driveshaft components.



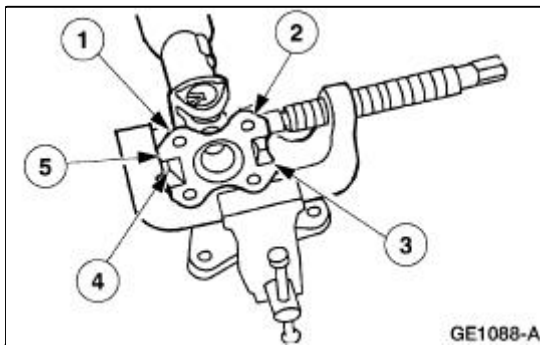
4. Clamp the U-joint tool in a vise.



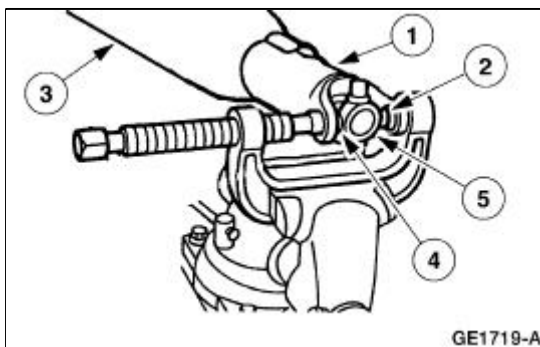
5. Remove all four of the snap rings.



6. Remove the driveshaft flange yoke.
 1. Position the driveshaft flange yoke in the U-joint tool.
 2. Press out a bearing cup.
 3. Remove the driveshaft flange yoke.
 4. Press on the spider to remove the remaining bearing cup.
 5. Remove the driveshaft flange yoke.



7. Remove the spider.
 1. Reposition the driveshaft in the U-joint tool.
 2. Press out the bearing cup.
 3. Rotate the driveshaft.
 4. Press on the spider to remove the remaining bearing cup.
 5. Remove the spider.



8. Clean the yoke area at the end of the driveshaft.

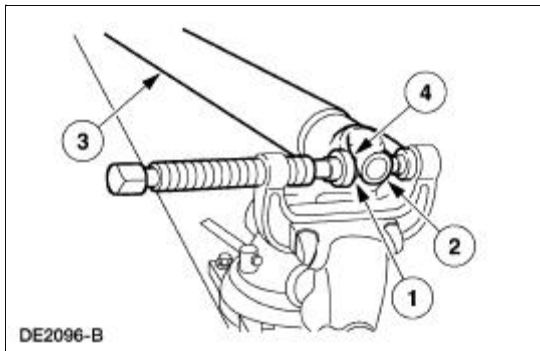
Assembly

1. **NOTE:** Universal joint kits are to be installed as complete assemblies only. Do not mix components from other U-joint kits.

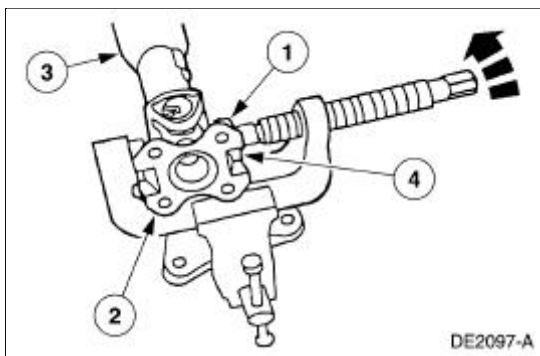
Install the spider.

1. Start a new bearing cup into the driveshaft yoke.
 - Check the needle bearings for correct positioning.

2. Position the new spider in the driveshaft yoke.
3. Position the driveshaft in the U-joint tool.
4. Press the bearing cup to just below the snap ring groove.
 - Repeat for the other bearing cup.

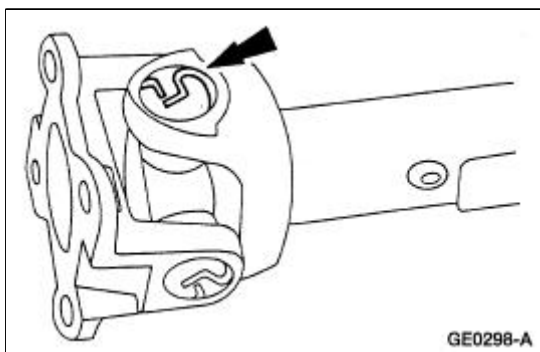


2. Inspect the driveshaft flange yoke. Install new if necessary.
3. Install the driveshaft flange yoke.
 1. Start a new bearing cup into the driveshaft flange yoke.
 - Check the needle bearings for correct positioning.
 2. Position the driveshaft flange yoke.
 3. Position the driveshaft in the U-joint tool.
 4. Press the bearing cup to just below the snap ring groove.
 - Repeat for the other bearing cup.



4. **NOTE:** Use the yellow snap rings supplied in the kit to assemble the universal joint (U-joint). If difficulty is encountered with the yellow snap rings, install the black snap rings, as required.

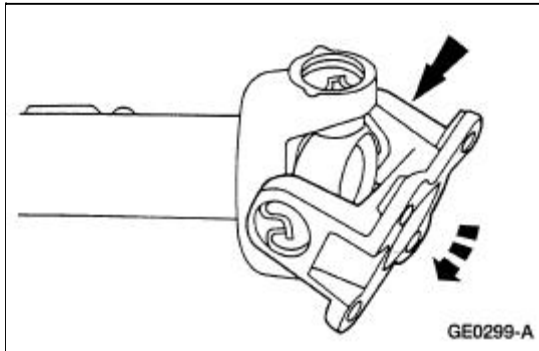
Remove the driveshaft from the U-joint tool, and install the four snap rings.



5. **NOTE:** Do not strike the bearings.

Check the U-joints for freedom of movement.

- If binding, strike the yoke with a brass or plastic hammer.



6. Install the driveshaft. For additional information, refer to [Driveshaft](#) in this section.
-

General Specifications

Item	Specification
Lubes and Sealers	
SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL	WSP-M2C197-A
Premium Long-Life Grease XG-1-C	ESA-M1C75-B
Rust Penetrant and Inhibitor F2AZ-19A501-A	ESR-M99C56-A
High Temperature Nickel Anti-Sieze Lubricant F6AZ-9L494-AA	ESE-M124A-A
Clear Silicone Rubber F7AZ-19554-CA	ESB-M4G92-A
Threadlock and Sealer EOAZ-19554-AA	WSK-M2G351-A5
Lubricant Fill Level Checks	
Approximate axle fill capacity ^a	1.54-1.66-liters (3.25-3.50-pints) 6.4-14.3-mm (1/4-9/16-in) below the bottom of the fill hole
Clearance, Tolerance and Adjustments	
Maximum ring gear back face runout	0.102 mm (0.004 in)
Maximum differential case runout	0.076 mm (0.003 in)
Differential side gear thrust washer thickness	0.762 mm - 0.813 mm (0.030 in - 0.032 in)
Differential pinion gear thrust washer thickness	0.762 mm - 0.813 mm (0.030 in - 0.032 in)
Maximum axle shaft end play	0.762 mm (0.030 in)
Ring gear backlash	0.203 mm-0.381 mm (0.008 in-0.015 in) [(0.305 mm-0.381 mm (0.012 in-0.015 in) preferred]
Variation between teeth maximum backlash	0.102 mm (0.004 in)
Pinion flange runout	0.25 mm (0.010 in) T.I.R.

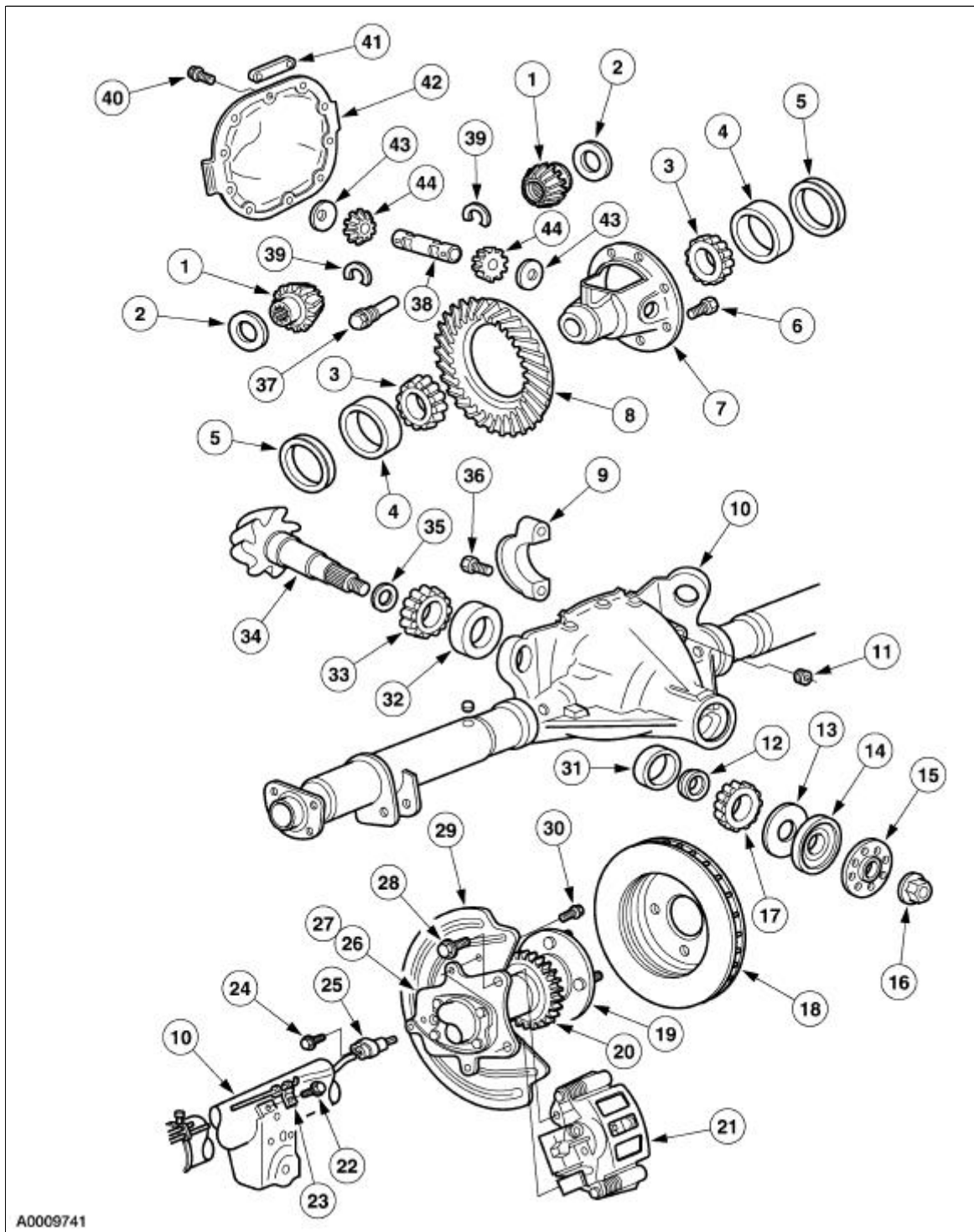
^a In-vehicle repair refill capacities are determined by filling the rear axle with the specified lubricant to 6.4-14.3-mm (1/4-9/16-in) below the bottom of the fill hole.

Torque Specifications

Description	Nm	lb-ft	lb-in
Bolt retaining the differential pinion shaft to the differential case	30	22	—
Bolt retaining the driveshaft yoke to the pinion flange	112	83	—
Bolt retaining the differential housing cover to the differential housing	44	32	—
Oil filler plug	30	22	—
Pinion bearing preload (used pinion bearings)	0.9-1.5	—	8-14
Pinion bearing preload (new pinion bearings)	1.8-3.3	—	16-29
Adapter for 205-S127	2.2	—	20

Bolt retaining the bearing cap to the differential case	105	77	—
Bolt retaining the ring gear to the differential case	105	77	—

Rear Drive Axle and Differential



Item	Part Number	Description
1	4236	Differential side gear
2	4228	Differential side gear thrust washer
3	4221	Differential bearing

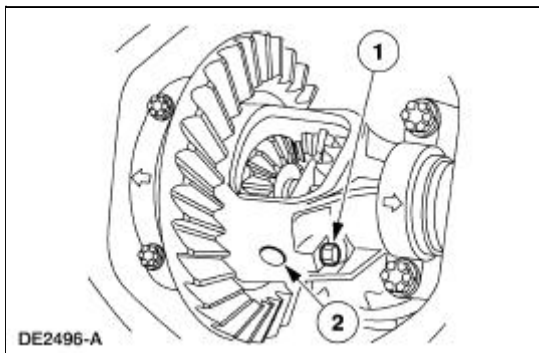
4	4222	Differential bearing cup
5	4067	Differential bearing shim
6	4216	Rear axle differential gear case bolt
7	4204	Differential case
8	—	Ring gear (part of 4209)
9	—	Bearing cap (part of 4010)
10	4010	Rear axle housing
11	373098-S	Filler plug
12	4662	Collapsible spacer
13	4670	Rear axle drive pinion shaft oil slinger
14	4676	Rear axle drive pinion seal
15	4851	Pinion flange
16	389546-S100	Pinion nut
17	4621	Differential pinion bearing
18	2C026	Rear brake disc
19	—	Axle shaft flange (part of 4234)
20	2C189	Rear brake anti-lock sensor indicator
21	2552	Rear disc brake caliper
22	N601951-S2	Bolt
23	N804361-S100	Clip
24	—	Bolt
25	2C190	Rear brake anti-lock sensor
26	2C101	Left hand rear disc brake adapter
27	2C100	Right hand rear disc brake adapter
28	N8015163-S190	Caliper anchor bolt
29	2C028	Rear wheel brake disc shield
30	N602726-S2	Bolt (3 req'd)
31	4616	Differential drive pinion bearing cup
32	4628	Rear axle pinion bearing cup
33	4630	Differential pinion bearing
34	—	Drive pinion gear (part of 4209)
35	4663	Drive pinion bearing adjustment shim
36	—	Bolt (part of 4010)
37	4241	Differential pinion shaft lock bolt
38	4211	Differential pinion shaft
39	4N237	U-washer
40	383548	Bolt
41	—	Rear axle identification tag
42	4033	Differential housing cover
43	4230	Differential pinion thrust washer
44	4215	Differential pinion gear

- The axle housing assembly consists of a cast center section with two steel tube assemblies and a stamped differential housing cover (4033). The differential housing cover uses silicone sealant as a gasket.
 - The hypoid-design gearset consists of 7.5-inch ring gear (4209) and a drive pinion gear (4209). Two opposed tapered roller bearings support the drive pinion in the axle housing (4010).
 - A collapsible spacer (4662), located on the differential pinion shaft, maintains pinion bearing preload. The pinion nut adjusts the preload.
 - Differential bearing shims (4067), located between the differential bearing cups (4222) and the rear axle housing, adjust the differential bearing preload and the ring gear backlash.
 - The differential case (4204) is a one-piece design with two openings to allow for assembly of the internal components and lubricant flow. Two opposed tapered roller bearings (differential bearings) (4221) support the differential case in the axle housing. Removable bearing caps (4010) retain the differential assembly in the axle housing.
 - Inside the differential case, the differential pinion shaft (4211) supports two differential pinion gears (4215). The pinion gears engage the differential side gears (4236), to which the axle shafts (4234) are splined. The differential pinion shaft lock bolt (4241) retains the differential pinion shaft in the differential case.
 - An embossed metal tag, bolted to the differential housing cover, contains rear axle identification.
-

Axle Shaft

Removal

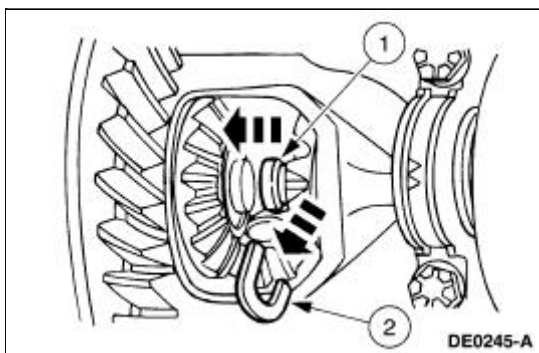
1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
3. Remove the rear brake disc (2C026). For additional information, refer to [Section 206-04](#).
4. Remove the differential housing cover (4033) and drain the lubricant. For additional information, refer to [Differential Housing Cover](#) in this section.
5. Remove the differential pinion shaft (4211).
 1. Remove the differential pinion shaft lock bolt (4241).
 2. Remove the differential pinion shaft.




6.  **CAUTION: Do not damage the rubber O-ring in the axle shaft groove.**

Remove the U-washer (4N237).

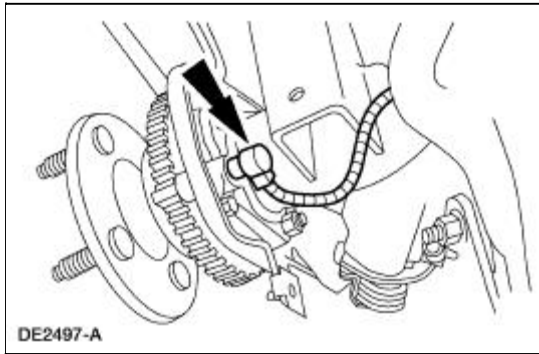
1. Push the axle shafts (4234) inboard.
2. Remove the U-washer.



7.  **CAUTION: Damage to the rear brake anti-lock sensor (2C190) may occur if it is not removed before the axle shaft.**

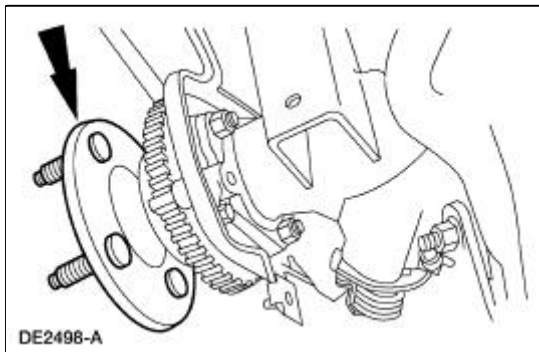
Carefully remove the rear brake anti-lock sensor. For additional information, refer to [Section](#)

[206-09A](#) .



8.  **CAUTION: Do not damage the wheel bearing oil seal.**

Remove the axle shaft.

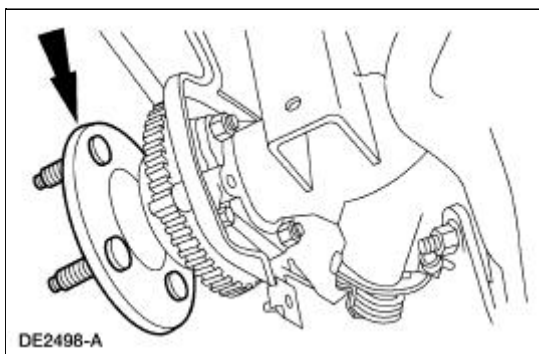


Installation

1. Lubricate the lip of the wheel bearing oil seal
 - Use Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B.

2.  **CAUTION: Do not damage the wheel bearing oil seal.**

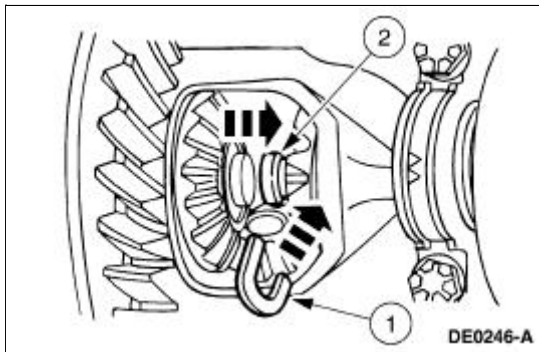
Install the two axle shafts.



3.  **CAUTION: Do not damage the rubber O-ring in the axle shaft groove.**

Install the U-washer.

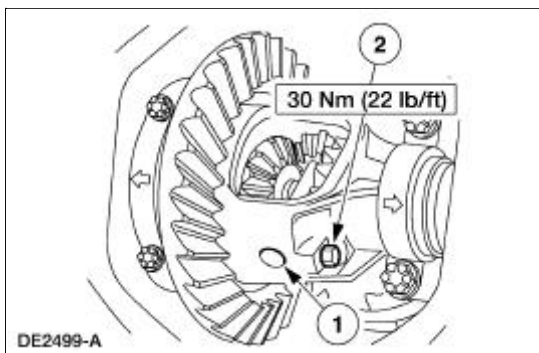
1. Position the two U-washers on the button end of the axle shaft.
2. Pull the axle shaft outward.



4. **NOTE:** If a new pinion shaft lock bolt is unavailable, coat the threads with Threadlock and Sealer EOAZ-19554-AA or equivalent meeting Ford specification WSK-M2G351-A5 prior to installation.

Install the differential pinion shaft.






1. Align the hole in the differential pinion shaft with the case lock bolt hole.
2. Install a new differential pinion shaft lock bolt.



5. Install the differential housing cover and fill the rear axle with the specified lubrication. For additional information, refer to [Differential Housing Cover](#) in this section.
 6. Install the rear brake anti-lock sensor. For additional information, refer to [Section 206-09A](#).
 7. Install the rear brakes. For additional information, refer to [Section 206-04](#).
 8. Install the tire and wheel assembly. For additional information, refer to [Section 204-04](#).
 9. Lower the vehicle.
-

Rear Wheel Bearing and Axle Shaft Oil Seal

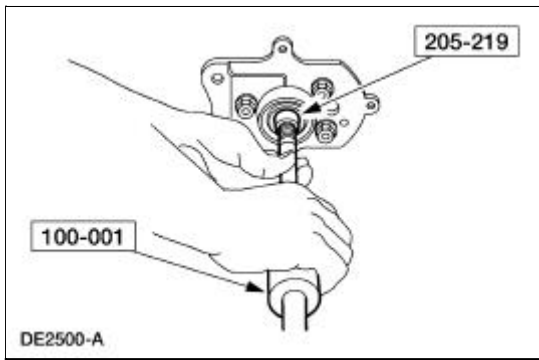
Special Tool(s)

 <p>ST1326-A</p>	Adapter for 303-224 205-153 (T80T-4000-W)
 <p>ST1514-A</p>	Installer, Axle Shaft Bearing 205-124 (T78P-1225-A)
 <p>ST2027-A</p>	Installer, Rear Axle Oil Seal 205-390 (T97T-1177-B)
 <p>ST2035-A</p>	Remover, Axle Bearing 205-219 (T85L-1225-AH)
 <p>ST1185-A</p>	Slide Hammer 100-001 (T50T-100-A)

Removal

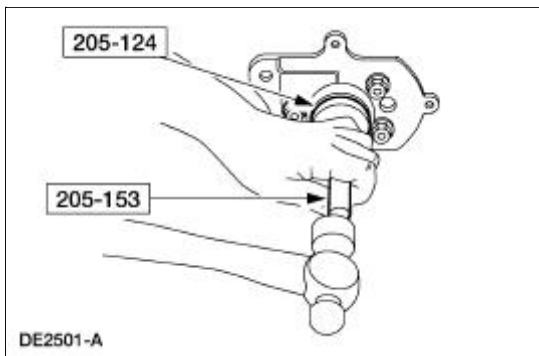
1. Remove the axle shaft (4234). For additional information, refer to [Axle Shaft](#) in this section.
2. **NOTE:** If the wheel bearing oil seal is leaking, the axle housing vent may be plugged.

Using the special tools, remove the rear wheel bearing and wheel bearing oil seal.

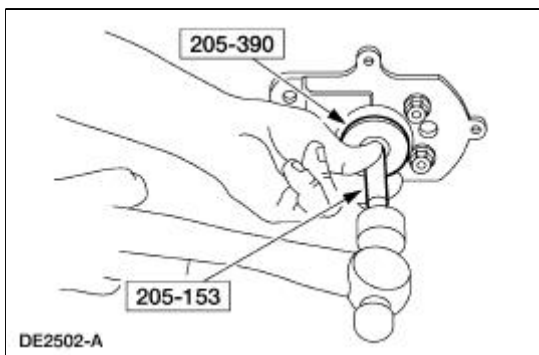


Installation

1. Lubricate the new rear wheel bearing with the specified lubricant.
2. Using the special tools, install the new rear wheel bearing.






3. Lubricate the lip of the new wheel bearing oil seal.
 - Use Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B.
4. Using the special tools, install the new wheel bearing oil seal.



5. Install the axle shaft. For additional information, refer to [Axle Shaft](#) in this section.
-


Drive Pinion Flange and Drive Pinion Seal

Special Tool(s)

 ST2026-A	2-Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1257-A	Holding Fixture, Drive Pinion Flange 205-126 (T78P-4851-A)
 ST1862-A	Installer, Drive Pinion Flange 205-002 (TOOL-4858-E) or equivalent

Removal


1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Remove the rear wheel and tire assemblies. For additional information, refer to [Section 204-04](#).

3.  **CAUTION:** Remove the rear brake calipers to prevent drag during the drive pinion bearing preload adjustment.

 **CAUTION:** Do not allow the calipers to hang from the brake hoses.

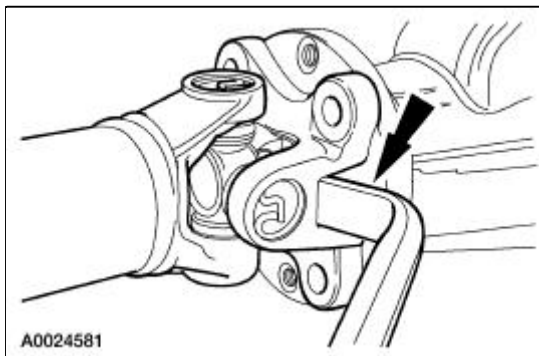
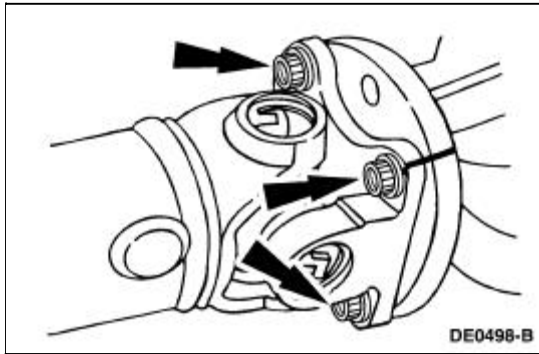
Remove the rear brake caliper and support bracket from the knuckle as an assembly. Wire the caliper and support bracket assembly out of the way. For additional information, refer to [Section 206-04](#).

4.  **CAUTION:** Index-mark the driveshaft flange and pinion flange (4851) to maintain initial balance during installation.

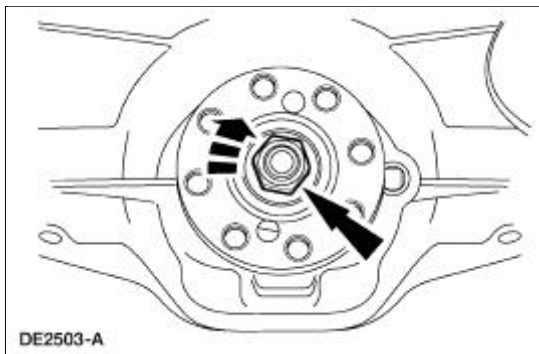
 **CAUTION:** The driveshaft centering socket yoke fits tightly on the pinion flange pilot. Never hammer on the driveshaft or any of its components to disconnect the yoke from the flange. Pry only in the area shown, with a suitable tool, to disconnect the yoke from the flange.


Disconnect and position the driveshaft out of the way. For additional information, refer to

[Section 205-01](#) .

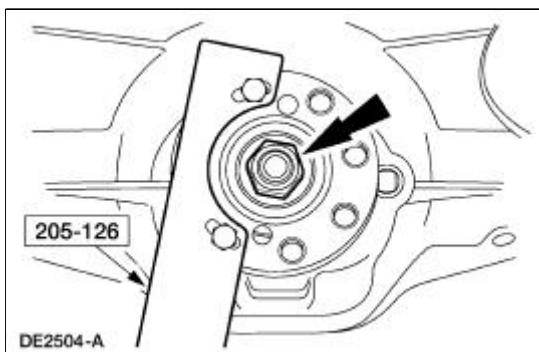


5. Install an Nm (inch/pound) torque wrench on the nut and record the torque necessary to maintain rotation of the drive pinion gear through several revolutions.



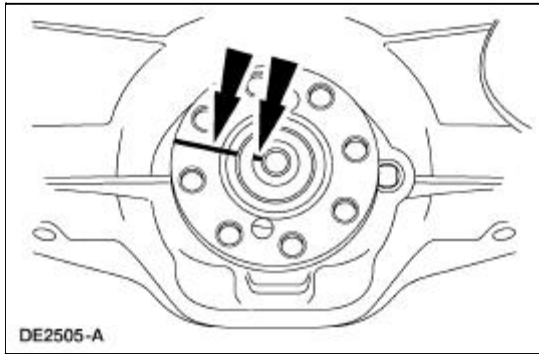
6.  **CAUTION:** After removing the nut, discard it. Use a new nut for installation.

Use the special tool to hold the pinion flange while removing the nut.

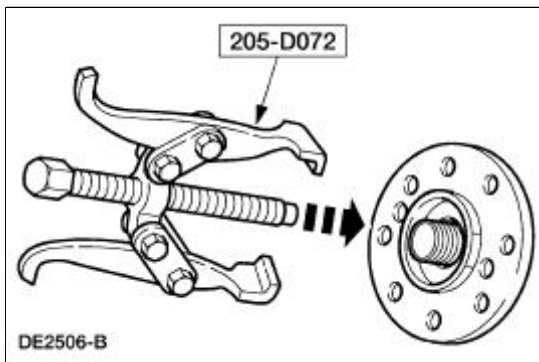


7. Index-mark the pinion flange and drive pinion gear stem to maintain initial balance during

installation.



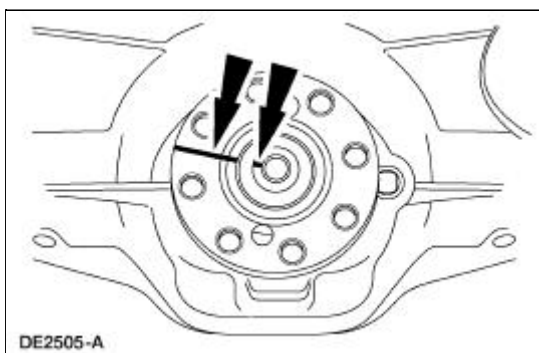
8. Using the special tool, remove the pinion flange.



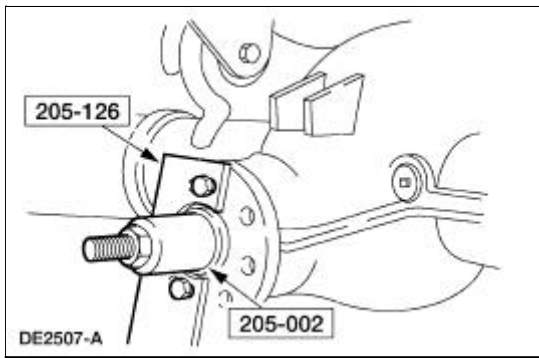
Installation

1. Inspect the pinion flange seal journal for rust, nicks, and scratches prior to installing the flange. Polish the seal journal with fine crocus cloth, if necessary.
2. Lubricate the pinion flange splines.
 - Use SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL or equivalent meeting Ford specification WSP-M2C197-A.
3. **NOTE:** Disregard the index marks if installing a new pinion flange.

Position the pinion flange.



4. Using the special tools, install the pinion flange.

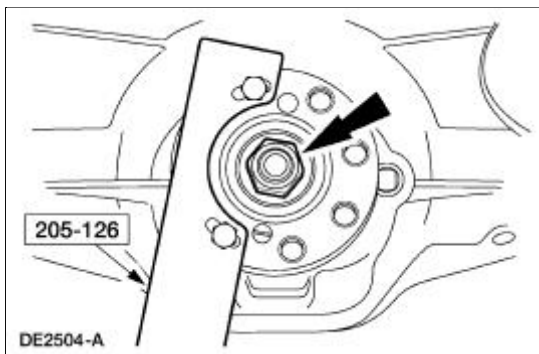


5.  **CAUTION:** Do not under any circumstance loosen the nut to reduce preload. If it is necessary to reduce preload, install a new collapsible spacer (4662) and nut.


 **CAUTION:** Remove the special tool while taking preload readings with the Nm (inch/pound) torque wrench.

Tighten the nut to set the preload.

- Rotate the drive pinion occasionally to make sure the differential pinion bearings (4630) (4621) seat correctly. Take frequent differential pinion bearing torque preload readings by rotating the drive pinion with a Nm (inch/pound) torque wrench.
- If the preload recorded prior to disassembly is lower than the specification for used bearings, then tighten the nut to specification. If the preload recorded prior to disassembly is higher than the specification for used bearings, then tighten the nut to the original reading as recorded.
- Refer to the torque specification for used differential pinion bearings in the Specifications portion of this section.

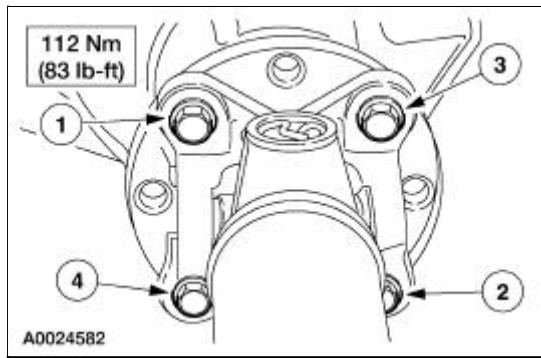


6.  **CAUTION:** Align the index marks.

 **CAUTION:** Install the driveshaft with new bolts. If new bolts are not available, apply Threadlock and Sealer EOAZ-19554-AA or equivalent meeting Ford specification WSK-M2G351-A5 to the threads of the original bolts.

 **CAUTION:** The driveshaft centering socket yoke fits tightly on the pinion flange pilot. To make sure that the yoke seats squarely on the flange, tighten the bolts evenly in a cross pattern as shown.

Connect the driveshaft. For additional information, refer to [Section 205-01](#).



7. Install the rear brake calipers. For additional information, refer to [Section 206-04](#).
 8. Install the rear wheel and tire assemblies. For additional information, refer to [Section 204-04](#).
 9. Lower the vehicle.
-

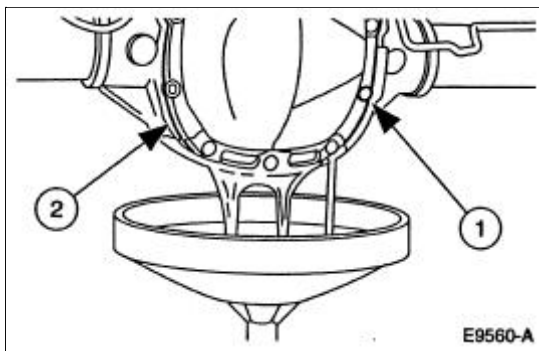
Differential Housing Cover

Removal

1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. **NOTE:** Empty the lubricant into a clean container for reuse.

Remove the differential housing cover (4033).

1. Remove the 10 bolts and drain the lubricant from the differential housing (4010).
2. Remove the differential housing cover.



Installation

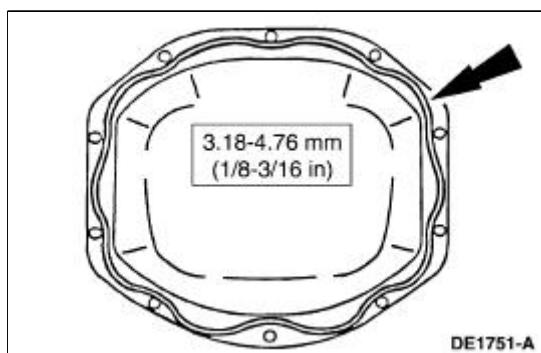
1. **CAUTION:** Make sure the machined surfaces on both the differential housing and the differential housing cover are clean and free of oil before applying the new silicone sealant. To prevent contamination, cover the inside of the rear axle (4001) prior to cleaning the machined surface.

Clean the differential housing and the differential housing cover gasket mating surfaces.

2. **CAUTION:** Install the differential housing cover within 15 minutes of applying the silicone, or it will be necessary to remove and reapply new sealant.

Apply a continuous bead of sealant of the specified thickness to the differential housing cover.

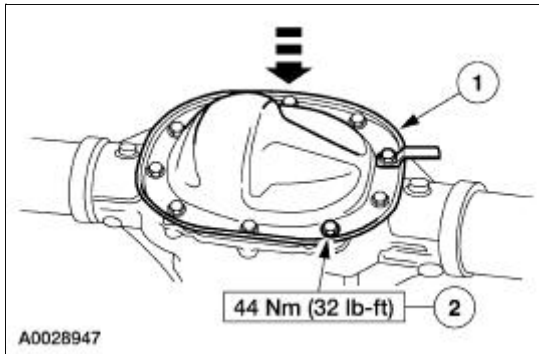
- Use Clear Silicone Rubber F7AZ-19554-CA or equivalent meeting Ford specifications ESB-M4G92-A.



3. **NOTE:** If possible, allow one hour before filling the axle with lubricant to make sure the silicone sealant has cured.

Install the differential housing cover.

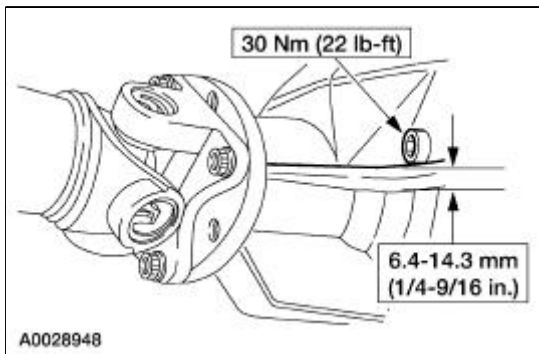
1. Install the differential housing cover.
2. Install the 10 bolts.



4. **NOTE:** In-vehicle repair refill capacities are determined by filling the rear axle with the specified lubricant to 6.4-14.3-mm (1/4-9/16-in) below the bottom of the fill hole.

Fill the rear axle to the level shown, approximately 1.54-1.66-liters (3.25-3.50-pints) of lubricant, and install the filler plug.

- Use SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL or equivalent meeting Ford specification WSP-M2C197-A.



5. Lower the vehicle.
-

Axle Housing Bushing

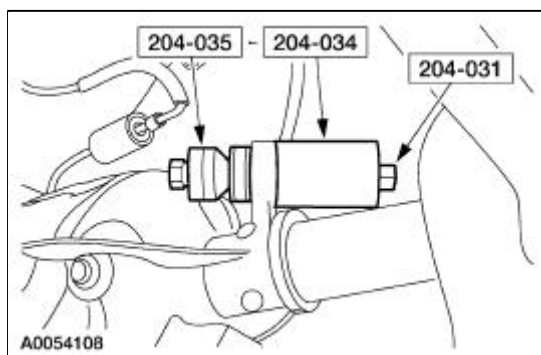
Special Tool(s)



Removal

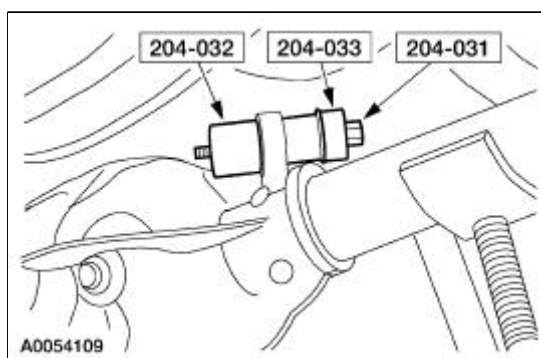
⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation becomes necessary. If substitution is necessary, the part must be of the same finish and property class. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

1. Remove the upper arm and bushing (5500). For additional information, refer to [Section 204-02](#).
2. Using the special tools, remove the bushing.

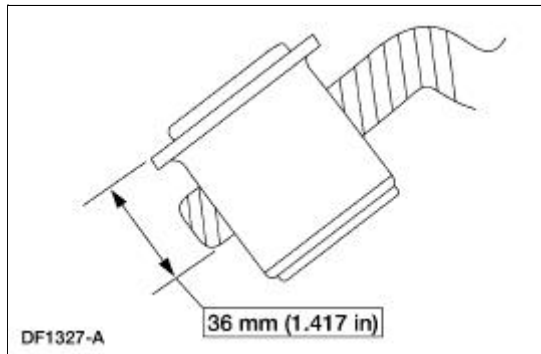


Installation

1. Using the special tools, install the bushing.



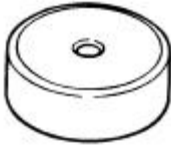

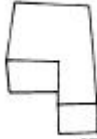

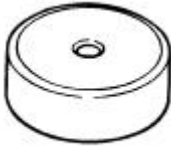
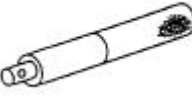

- Using a suitable calibrated micrometer, measure the bushing as shown. If not within specifications, adjust as necessary.






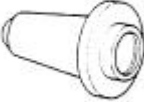
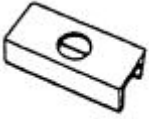
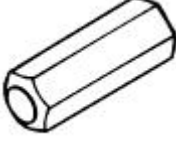


- Install the upper arm and bushing. For additional information, refer to [Section 204-02](#).
-

Drive Pinion

Special Tool(s)


 <p>ST1743-A</p>	<p>Adapter for 205-S127 205-105 (T76P-4020-A3)</p>
 <p>ST1429-A</p>	<p>Adapter for 205-S127 205-109 (T76P-4020-A9)</p>
 <p>ST1431-A</p>	<p>Adapter for 205-S127 205-110 (T76P-4020-A10)</p>
 <p>ST1432-A</p>	<p>Adapter for 205-S127 205-111 (T76P-4020-A11)</p>
 <p>ST1743-A</p>	<p>Adapter for 205-S127 205-125 (T78P-4020-A15)</p>
 <p>ST1326-A</p>	<p>Adapter for 303-224 205-153 (T80T-4000-W)</p>
 <p>ST1434-A</p>	<p>Gauge Tube 205-D034 (D80T-4020-F49) or equivalent</p>
	<p>Handle (Long) 205-D055 (D81L-4000-A) or</p>

 <p>ST1653-A</p>	<p>equivalent</p>
 <p>ST1257-A</p>	<p>Holding Fixture, Drive Pinion Flange 205-126 (T78P-4851-A)</p>
 <p>ST1367-A</p>	<p>Installer, Drive Pinion Bearing Cone 205-005 (T53T-4621-C)</p>
 <p>ST1678-A</p>	<p>Installer, Drive Pinion Bearing Cup 205-054 (T71P-4616-A)</p>
 <p>ST1862-A</p>	<p>Installer, Drive Pinion Flange 205-002 (TOOL-4858-E) or equivalent</p>
 <p>ST1325-A</p>	<p>Installer, Drive Pinion Oil Seal 205-133 (T79P-4676-A)</p>
 <p>ST1254-A</p>	<p>Plate, Bearing/Oil Seal 205-090 (T75L-1165-B)</p>
 <p>ST1744-A</p>	<p>Protector, Drive Pinion Thread 205-460</p>
	<p>Puller, Bearing 205-D064 (D84L-1123-A) or equivalent</p>



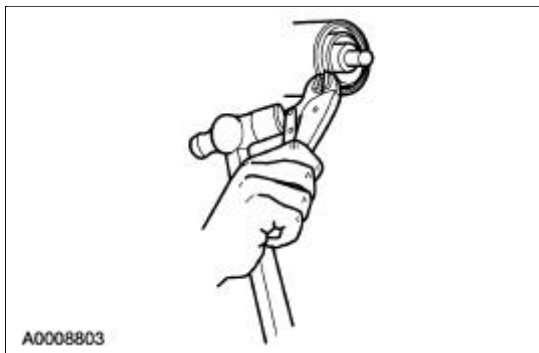
Removal

1. Remove the differential assembly from the differential housing. For additional information, refer to [Differential Case](#) in this section.

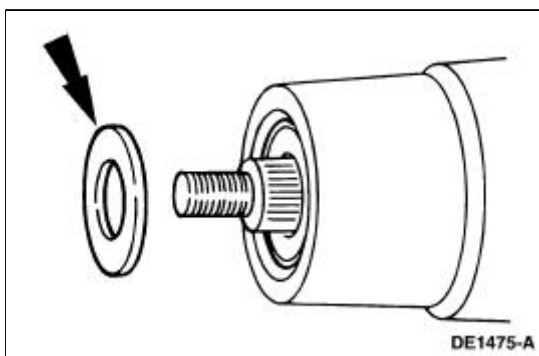
2.  **CAUTION:** Record the torque necessary to maintain rotation of the drive pinion gear through several revolutions prior to removing the pinion flange (4851).

Remove the pinion flange. For additional information, refer to [Drive Pinion Flange and Drive Pinion Seal](#) in this section.

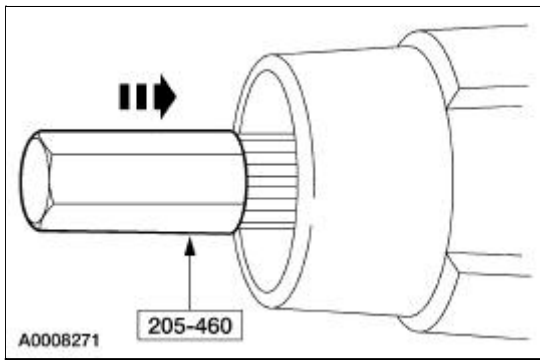
3. Force the rear axle drive pinion seal metal flange up. Install gripping pliers and strike with a hammer to remove the seal.



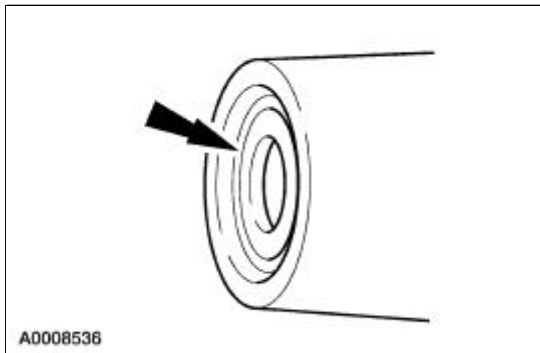
4. Remove the rear axle drive pinion shaft oil slinger (4670).



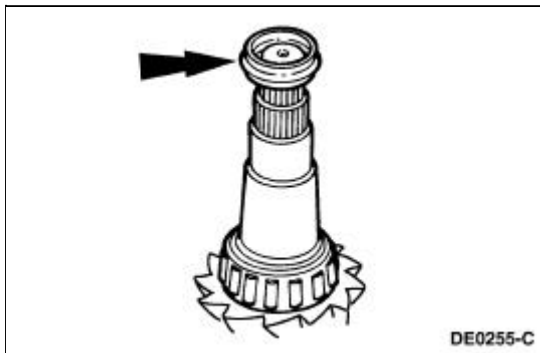
5. Using the special tool and a soft-faced hammer, drive the pinion assembly out of the outer differential pinion bearing (4621) and remove the drive pinion through the rear of the differential housing (4010).



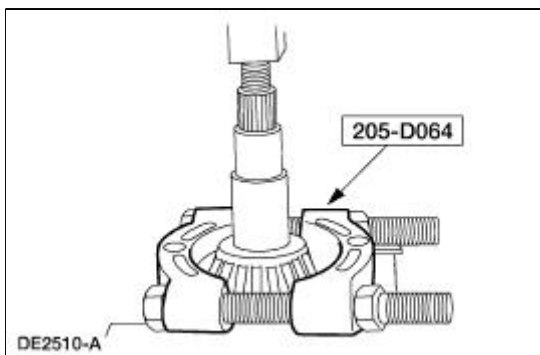
6. Remove the outer differential pinion bearing.



7. Remove and discard the collapsible spacer (4662).



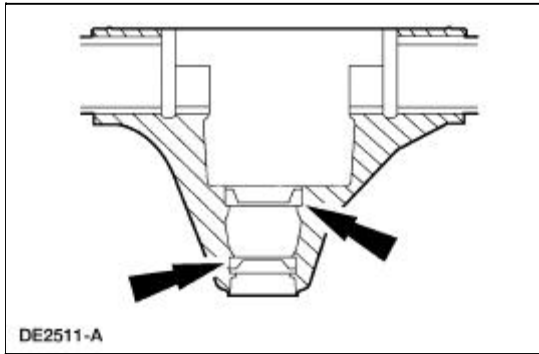
8. Using the special tool and a suitable press, remove the inner differential pinion bearing (4630).



9. **NOTE:** Do not remove the pinion bearing cups from the differential housing unless the cups are damaged.

To remove the bearing cups, tap alternately (with a brass drift of suitable length) on opposite

sides of the cup to prevent the cup from cocking in the casting.

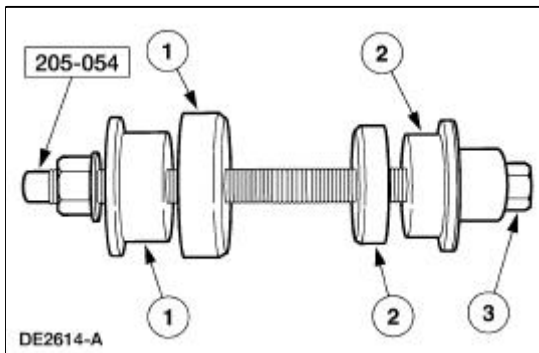


Installation

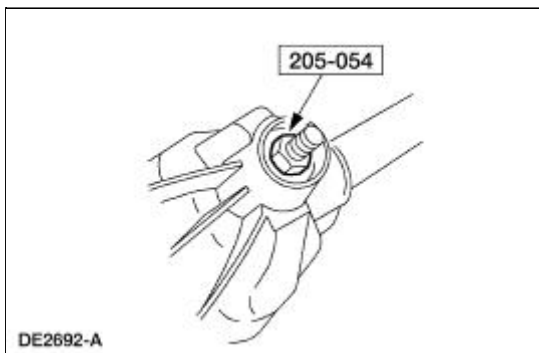
Using special tool 205-054

NOTE: This is the preferred method for installing the pinion bearing cups. If necessary, proceed to Using special tools 205-153, 205-054, and 205-D055 in this procedure for an alternate method.

1. Position the special tools and the inner and outer pinion bearing cups in their respective bores.
 1. After placing the inner and outer bearing cups in their bores, place the special tool on the inner bearing cup.
 2. Place the special tool on the outer bearing cup.
 3. Install the special tool.



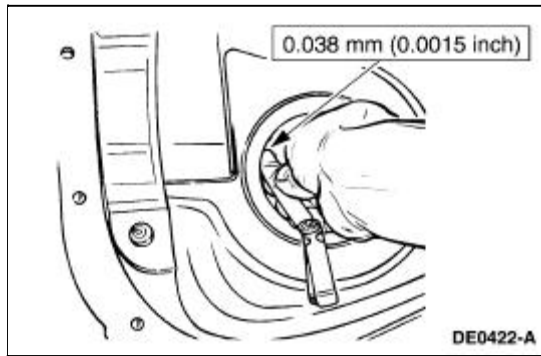
2. Tighten the special tool to seat the pinion bearing cups in their bores.



3.  **CAUTION:** Always install new differential pinion bearings when installing new pinion bearing cups.

NOTE: If the feeler gauge can fit between a cup and the bottom of its bore at any point around the cup, remove and reseat the cup.

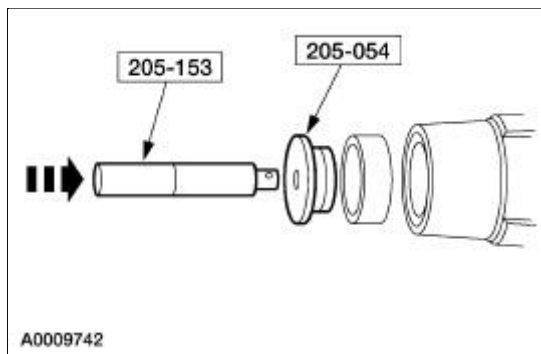
Check that the cups have seated correctly in their bores.



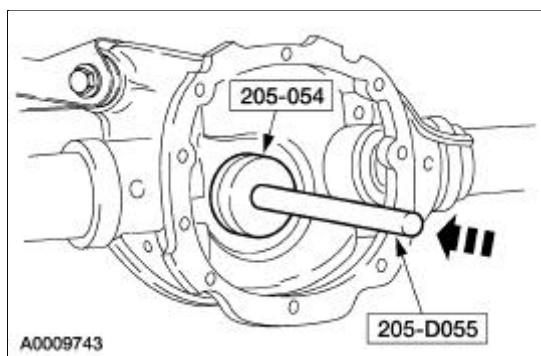
Using special tools 205-153, 205-054, and 205-D055

NOTE: This is an alternate method for installing the pinion bearing cups. Carry out this procedure if pinion bearing cup installation was not done in the previous steps.

4. Using the special tools, drive the outer differential drive pinion bearing cup (4616) into the differential housing.



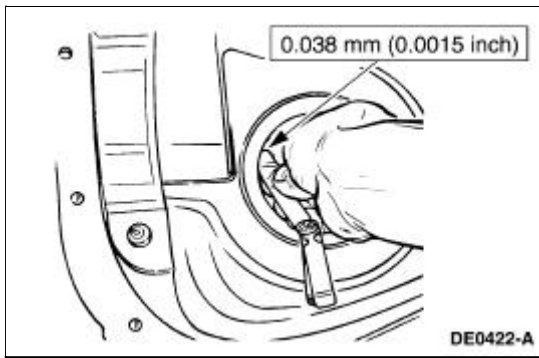
5. Using the special tools, drive the inner rear axle pinion bearing cup (4628) into the differential housing.



6.  **CAUTION:** Always install new differential pinion bearings when installing new pinion bearing cups.

NOTE: If the feeler gauge can fit between a cup and the bottom of its bore at any point around the cup, remove and reseal the cup.

Check that the cups have seated correctly in their bores.

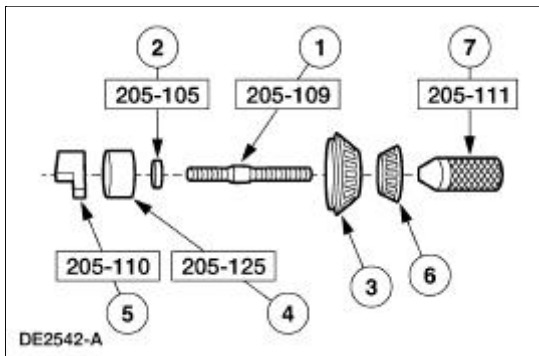


Setting pinion depth

7. **NOTE:** Apply only a light oil film on the differential pinion bearings before assembling the tools.

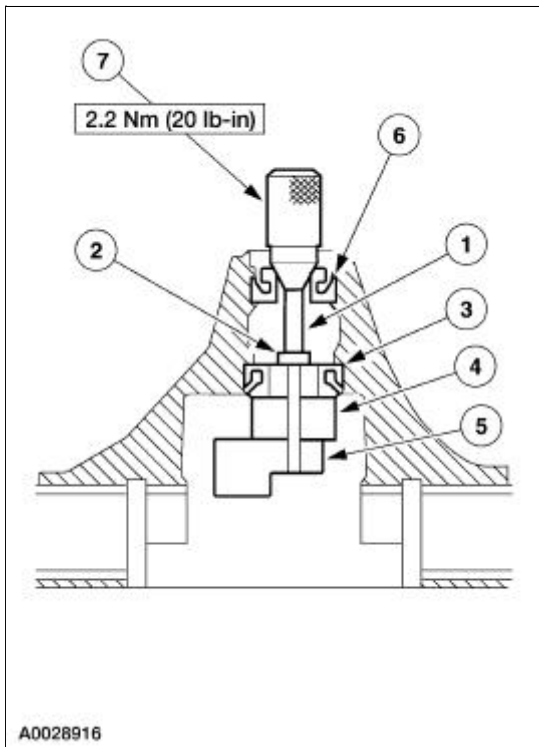
Assemble and position the following in the differential housing.

1. Position the Adapter for 205-S127.
2. Position the Adapter for 205-S127.
3. Position the inner pinion bearing.
4. Position the Adapter for 205-S127.
5. Position the Adapter for 205-S127.
6. Position the outer pinion bearing.
7. Thread on the Adapter for 205-S127.



8. **NOTE:** This step duplicates final differential pinion bearing preload.

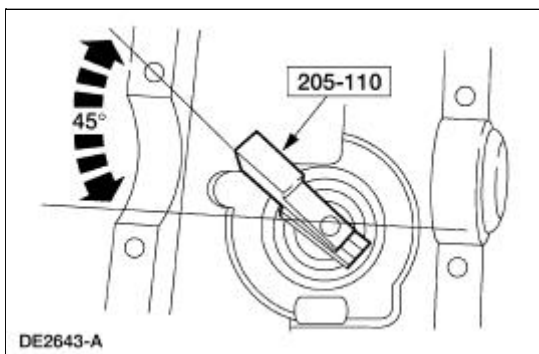
Using a Nm (inch/pound) torque wrench, tighten the special tool to specification.



Item	Part Number	Description
1	205-109	Adapter for 205-S127 (T76P-4020-A9)
2	205-105	Adapter for 205-S127 (T76P-4020-A3) (1.612 inch O.D.)
3	4630	Rear (inner) pinion bearing
4	205-125	Adapter for 205-S127 (T78P-4020-A15) (0.894 inch thick)
5	205-110	Adapter for 205-S127 (T76P-4020-A10) (1.7 inch thick)
6	4621	Front (outer) pinion bearing
7	205-111	Adapter for 205-S127 (T76P-4020-A11)

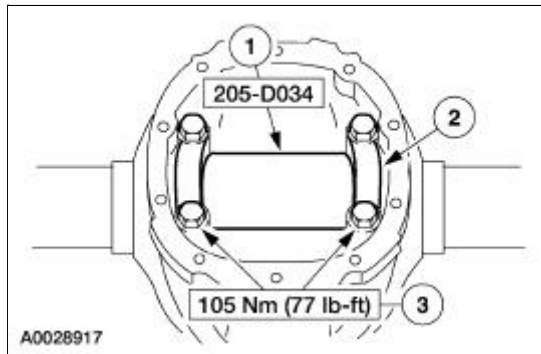
9. **NOTE:** Offset the special tool to obtain an accurate reading.

Rotate the special tool several half-turns to make sure the differential pinion bearings seat correctly and position the special tool as shown.



10. Install the special tool.
 1. Position the special tool.

2. Install the bearing caps.
3. Install the four bolts.

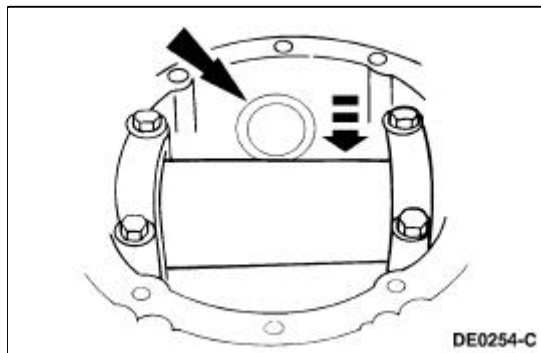


11. **NOTE:** Use only flat, clean drive pinion bearing adjustment shims (4663).

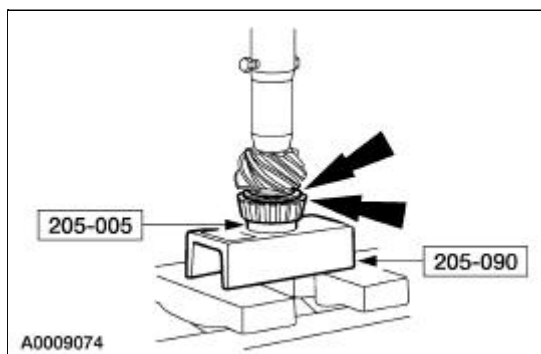
NOTE: Selection of too thick a shim results in a deep tooth contact at final assembly. Do not attempt to force the shim between the special tools. A slight drag indicates correct shim selection.

Use a drive pinion bearing adjustment shim as a gauge for shim selection.

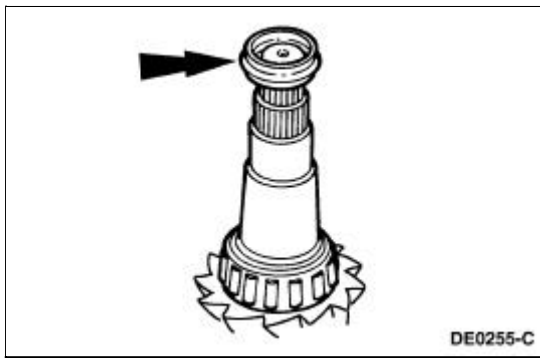
- After determining the correct shim thickness, remove the special tools.



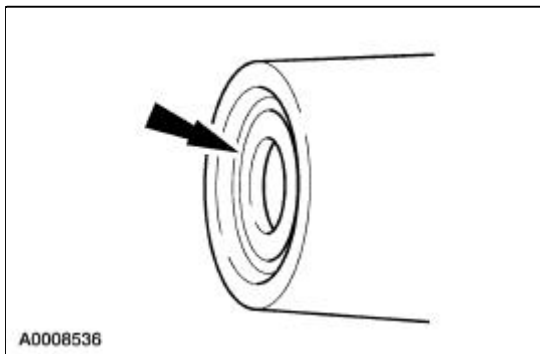
12. Position the correct thickness drive pinion bearing adjustment shim and the differential pinion bearing on the drive pinion gear. Using a suitable press and the special tools, press the differential pinion bearing until it seats firmly against the drive pinion gear.



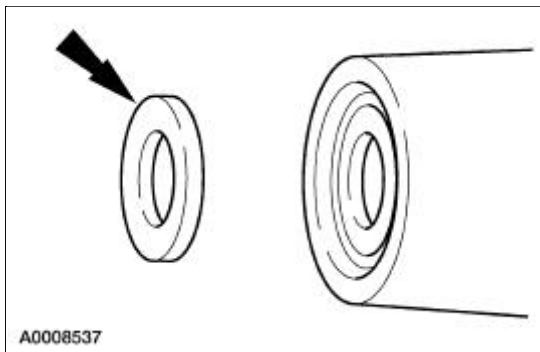
13. Place a new collapsible spacer on the pinion shaft against the pinion stem shoulder.



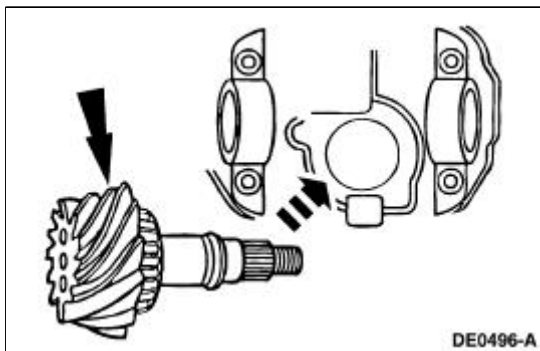
14. Install the outer differential pinion bearing.



15. Install the rear axle drive pinion shaft oil slinger.

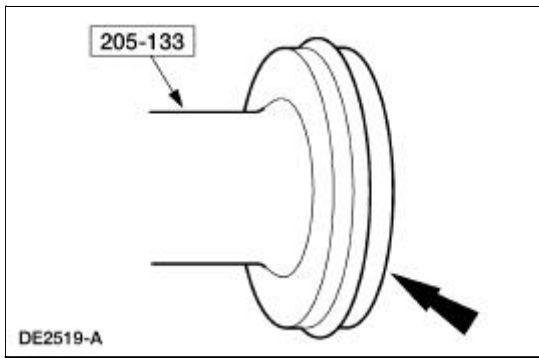


16. Install the drive pinion assembly (drive pinion, shims, bearing, and the collapsible spacer) into the differential housing bore.



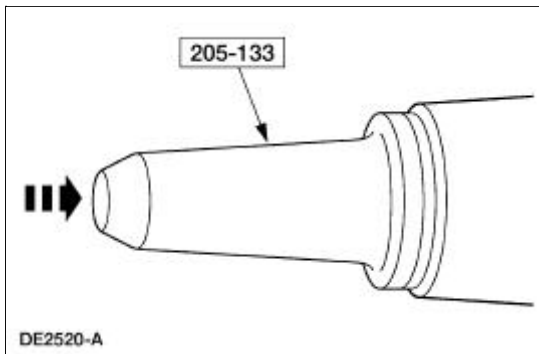
17. **NOTE:** Coat the rear axle drive pinion seal lips with Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B.

Place the rear axle drive pinion seal on the special tool.



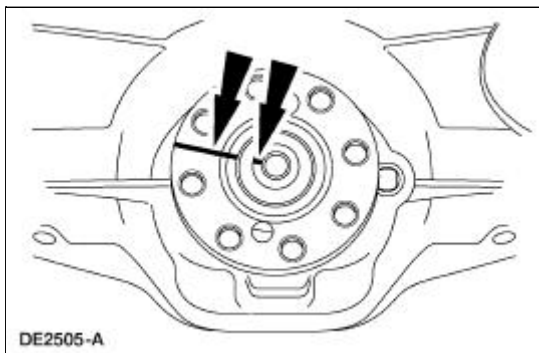
18.  **CAUTION:** If the rear axle drive pinion seal becomes misaligned during installation, remove it and install a new one.

Position the rear axle drive pinion seal in the seal bore, and use the special tool to drive the seal into place.

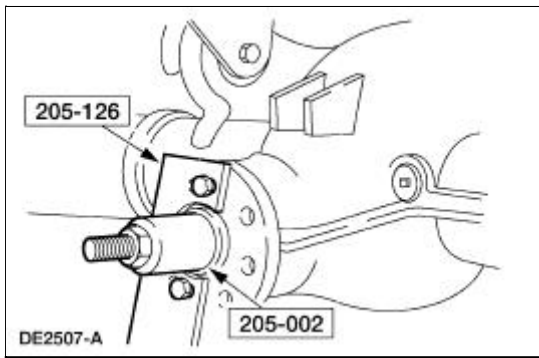


19. Lubricate the pinion flange splines.
- Use SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL or equivalent meeting Ford specification WSP-M2C197-A.
20. **NOTE:** Disregard the index marks if installing a new pinion flange.

Position the pinion flange.



21. Using the special tools, install the pinion flange.

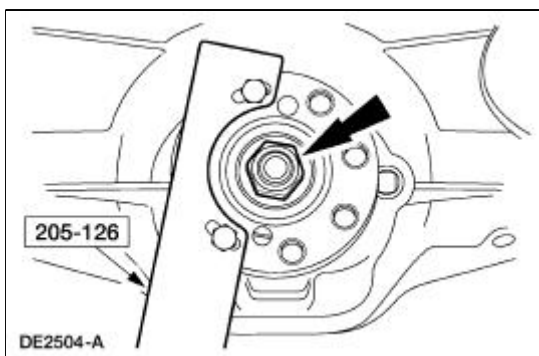


22.  **CAUTION:** Do not under any circumstance loosen the nut to reduce preload. If it is necessary to reduce preload, install a new collapsible spacer and nut.

 **CAUTION:** Remove the special tool while taking readings with the Nm (inch-pound) torque wrench.

Tighten the nut to set the preload.


- Rotate the drive pinion occasionally to make sure the differential pinion bearings seat correctly. Take frequent differential pinion bearing torque preload readings by rotating the drive pinion with a Nm (inch-pound) torque wrench.
- For new differential pinion bearings, tighten the nut to specification. Refer to torque specifications for new differential pinion bearings in the Specifications portion of this section.
- For used differential pinion bearings, if the preload recorded prior to disassembly is lower than the specification for used bearings, then tighten the nut to specification. Refer to torque specifications for used differential pinion bearings in the Specifications portion of this section.
- For used differential pinion bearings, if the preload recorded prior to disassembly is higher than the specification for used bearings, then tighten the nut to the original reading as recorded.




Final assembly

23. Install the differential assembly in the differential housing. For additional information, refer to [Differential Case](#) in this section.

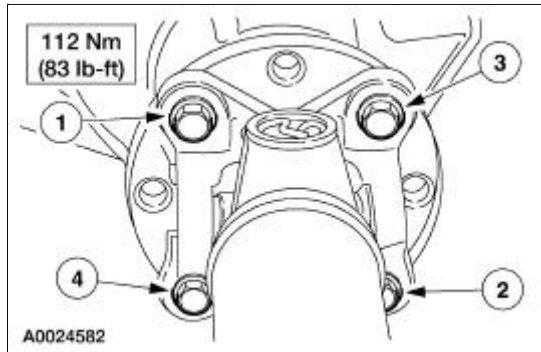
24.  **CAUTION:** Align the index marks.

 **CAUTION:** Install the driveshaft with new bolts. If new bolts are not available, apply Threadlock and Sealer EOAZ-19554-AA or equivalent meeting Ford specification WSK-

M2G351-A5 to the threads of the original bolts.

 **CAUTION:** The driveshaft centering socket yoke fits tightly on the pinion flange pilot. To make sure that the yoke seats squarely on the flange, tighten the bolts evenly in a cross pattern as shown.



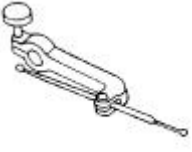

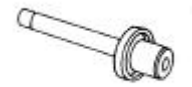

Connect the driveshaft. For additional information, refer to [Section 205-01](#) .




25. Lower the vehicle.

Differential Case

Special Tool(s)

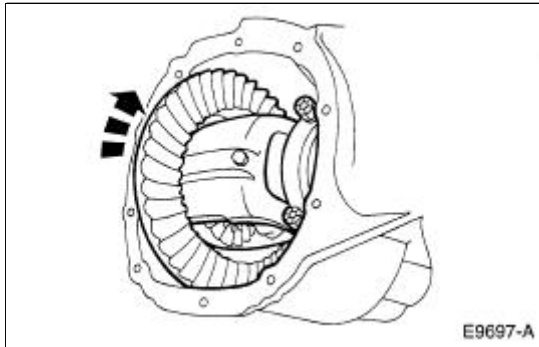
 ST2026-A	2-Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
 ST1348-A	Gauge, Clutch Housing 308-021 (T75L-4201-A) or equivalent
 ST1485-A	Installer, Differential Shim 205-220 (T85L-4067-AH)
 ST1375-A	Installer, Differential Side Bearing 205-009 (T57L-4221-A1)
 ST1543-A	Step Plate 205-D016 (D80L-630-5) or equivalent

Removal

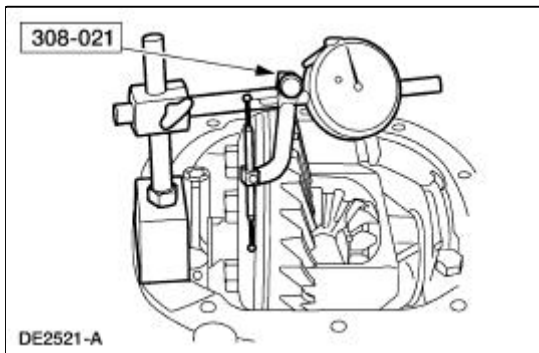
1. Remove the differential housing cover (4033) and drain the rear axle (4001). For additional information, refer to [Differential Housing Cover](#) in this section.
2.  **CAUTION:** Reinstall the differential pinion shaft (4211) and the bolt in the differential case (4204) after removing the axle shafts (4234).


Remove the axle shafts. For additional information, refer to [Axle Shaft](#) in this section.

3. Wipe the lubricant from the internal working parts and inspect the parts for wear and damage.
4. Rotate the differential assembly to check for roughness indicating bearing/gear damage.



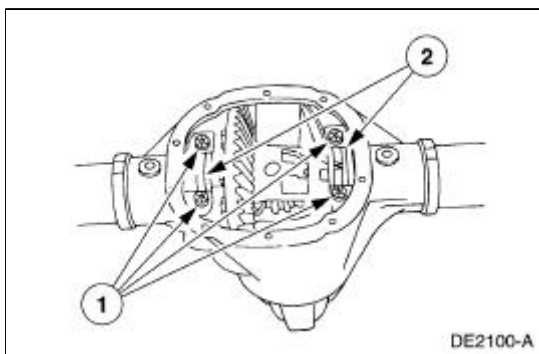
5. Using a suitable dial indicator and the special tool, measure and note the ring gear backface runout.




6.  **CAUTION:** Mark the position and location of the bearing caps, as the arrows may not be visible. Always install the bearing caps in their identical locations and positions.

Remove the bearing caps.

1. Remove the bolts.
2. Remove the bearing caps.

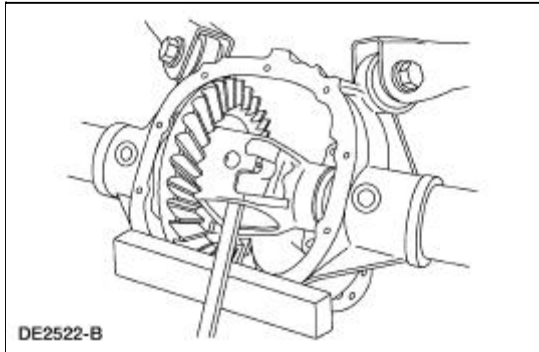


7.  **WARNING:** Do not allow the differential assembly to fall. Failure to follow these instructions may result in personal injury and component damage.

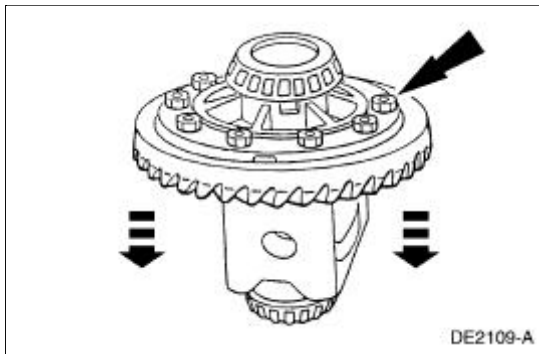
 **CAUTION:** Place a wood block between the pry bar and the differential housing

(4010) to protect the machined surface from damage.

Using a pry bar and a wood block, remove the differential assembly from the differential housing.

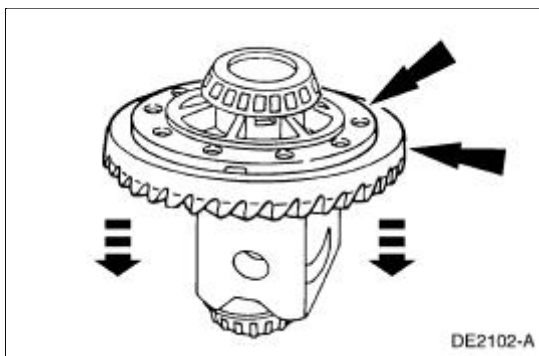


8. Remove the 10 bolts.

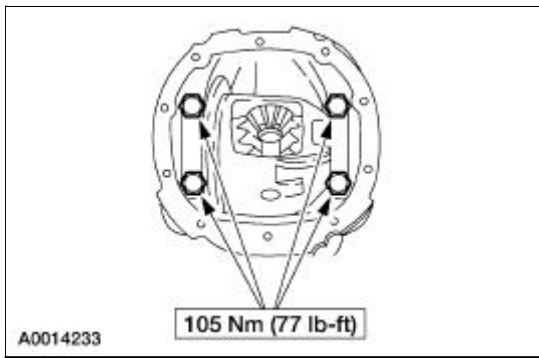


9.  **CAUTION: Do not damage the threads in the bolt holes.**

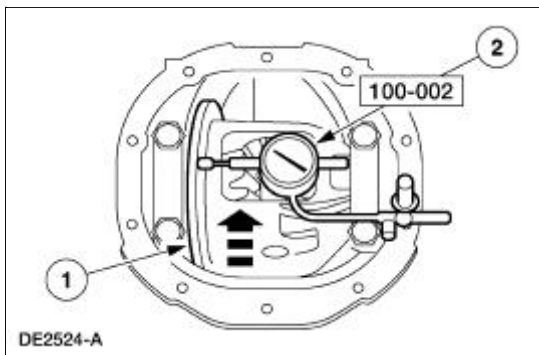
Insert a punch in the bolt holes, and drive off the ring gear.



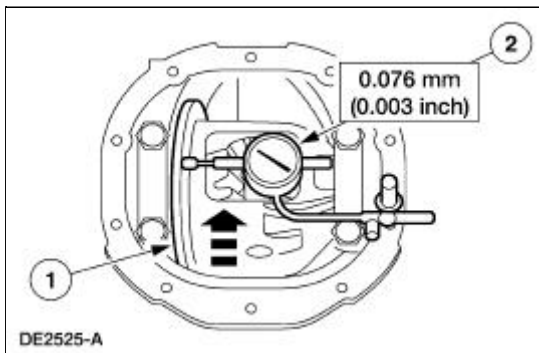
10. If the ring gear backface runout measurement, taken at the beginning of this procedure, did not exceed the specification, proceed to the appropriate procedure as necessary: [Drive Pinion](#), [Differential Case and Ring Gear](#) in this section, or to Installation in this procedure. If the ring gear backface runout measurement, taken at the beginning of this procedure, exceeds the specification, the cause may be a warped ring gear, differential case/differential bearing damage. Proceed as follows to verify the cause of the excessive runout.
11. Position the differential assembly, including the differential bearing cups (4222) and differential bearing shims (4067), in the differential housing. Install the bearing caps and bolts.



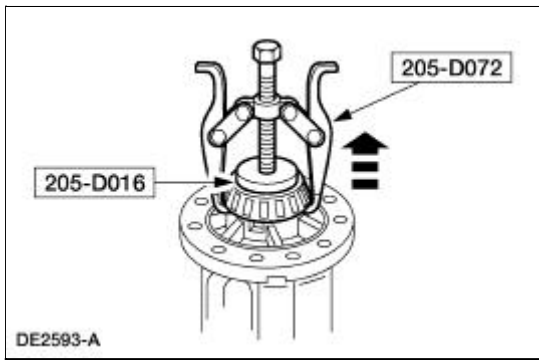
12. Position the special tool.
 1. Rotate the differential case to verify that the differential bearings (4221) have seated correctly.
 2. Position the special tool.



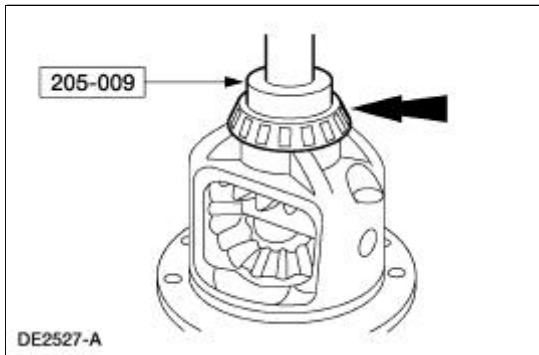
13. Measure and note the differential case runout.
 1. Rotate the differential case.
 2. Note the runout.
 - If the runout does not exceed the specification, install a new ring gear and drive pinion gear. For additional information, refer to [Drive Pinion](#) in this section and to Installation in this procedure.
 - If the runout exceeds the specification, the ring gear is true and the concern is due to either differential case/differential bearing damage. Proceed as follows.



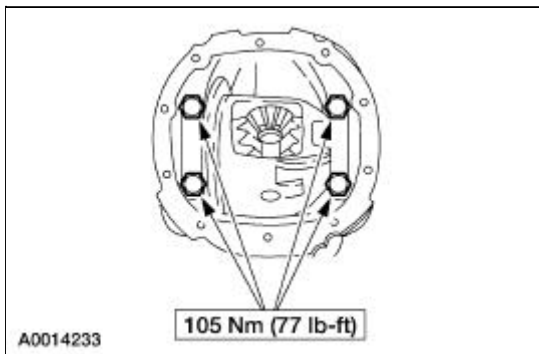
14. Remove the differential assembly from the differential housing.
15. Using the special tools, remove the differential bearings.



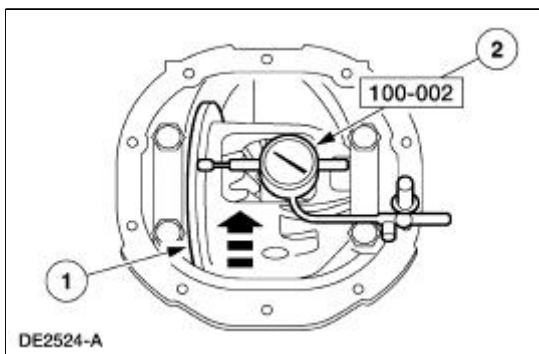
16. Using the special tool, install the new differential bearings.



17. Position the differential assembly, including the differential bearing cups and differential bearing shims, in the differential housing. Install the bearing caps and bolts.

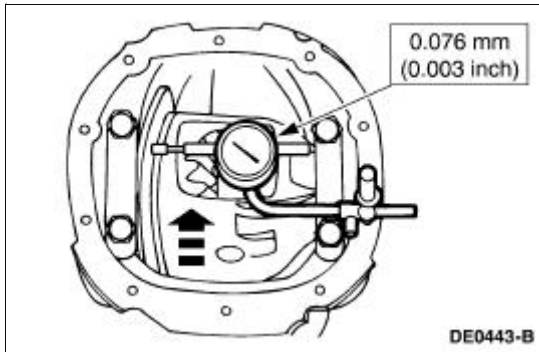


18. Position the special tool.
 1. Rotate the differential case to verify that the differential bearings have seated correctly.
 2. Position the special tool.



19. Measure the differential case runout.

- If the runout does not exceed the specification, use the new differential bearings for assembly.
- If the runout exceeds the specification, install a new differential case. For additional information, refer to [Differential Case and Ring Gear](#) in this section.

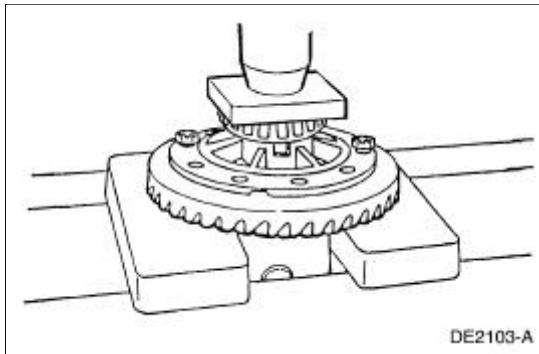


20. Remove the differential assembly from the differential housing.

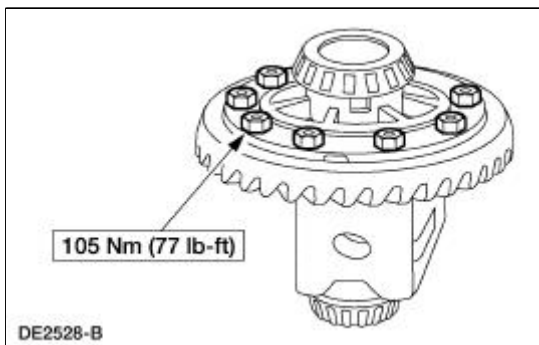
Installation

All axles

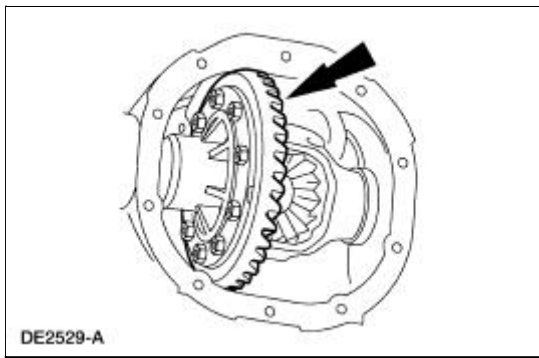
1. Position the ring gear and the differential case. Align the bolt holes by starting two bolts through the holes in the differential case and the ring gear. Press the ring gear on the differential case.



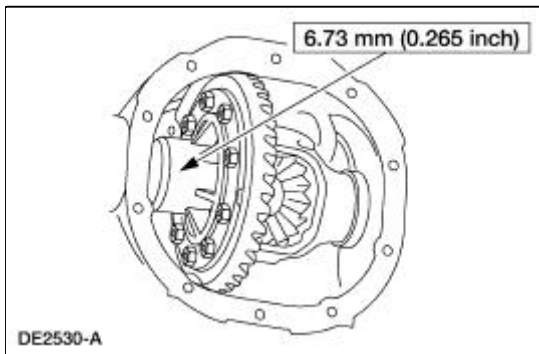
2. Install the bolts.
 - Apply Stud and Bearing Mount EOAZ-19554-BA or equivalent meeting Ford specification WSK-M2G349-A1 to the bolt threads.



3. With the pinion depth set and the pinion installed, place the differential assembly in the differential housing.



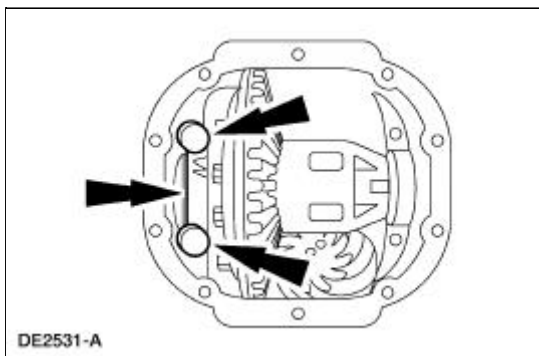
4. Install a differential bearing shim on the left side.



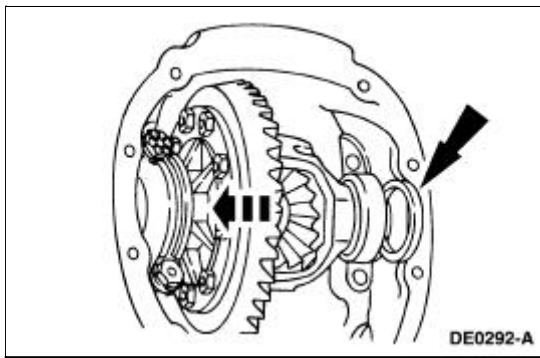
5.  **CAUTION:** Always install the bearing caps in their identical locations and positions.

NOTE: Apply pressure toward the left side to make sure the left differential bearing cup seats correctly.

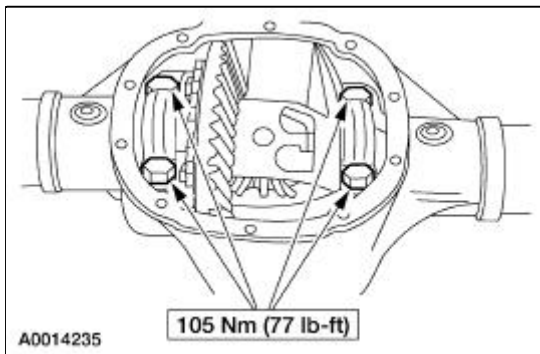
Install the left bearing cap and loosely install the bolts.



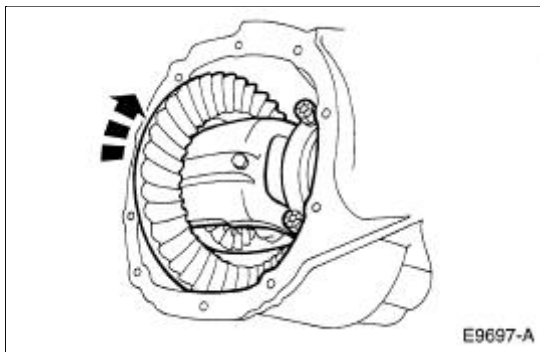
6. Install progressively larger differential bearing shims on the right side until the largest shim selected is installed by hand.



7. Install the right side bearing cap and tighten the left side and right side bolts to specification.



8. Rotate the differential assembly several times to verify that the differential bearings have seated correctly.

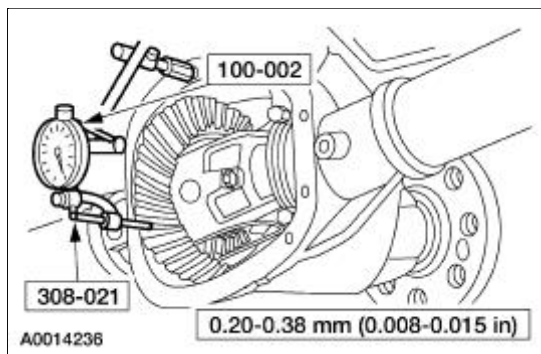


Measuring backlash

9. Using the special tools, measure the ring gear backlash.
 - If backlash is within the specification, refer to Backlash within specification in this procedure. The specification shown is the full allowable range. For the preferred range, refer to Specifications in this section.
 - If a zero backlash condition occurs, refer to Zero backlash in this procedure.
 - If backlash is not within the specification, refer to Backlash not within specification in this procedure.

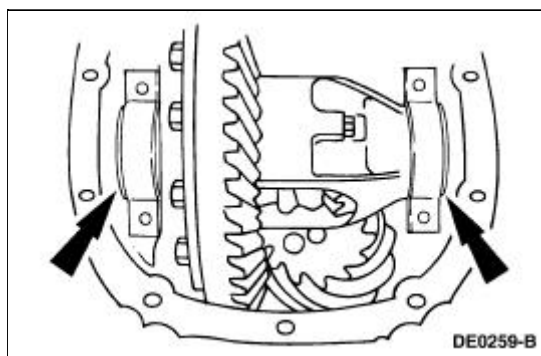
Backlash Change Required		Thickness Change Required	
mm	Inch	mm	Inch
0.025	0.001	0.050	0.002
0.050	0.002	0.050	0.002

0.076	0.003	0.101	0.004
0.101	0.004	0.152	0.006
0.127	0.005	0.152	0.006
0.152	0.006	0.203	0.008
0.177	0.007	0.254	0.010
0.203	0.008	0.254	0.010
0.228	0.009	0.304	0.012
0.254	0.010	0.355	0.014
0.279	0.011	0.355	0.014
0.304	0.012	0.406	0.016
0.330	0.013	0.457	0.018
0.335	0.014	0.457	0.018
0.381	0.015	0.508	0.020

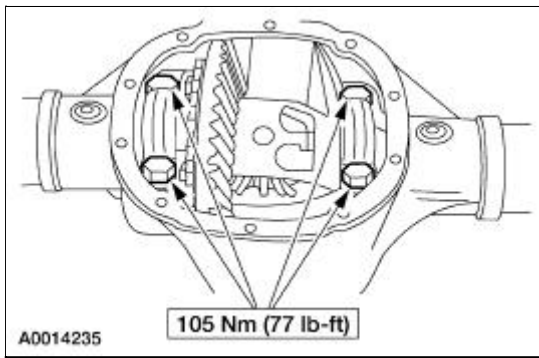


Zero backlash

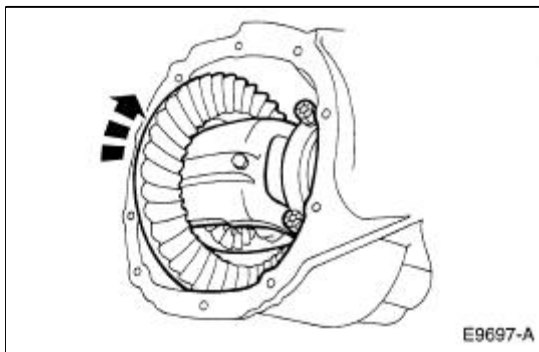
10. If a zero backlash condition occurs, remove the bearing caps and add 0.51 mm (0.020 inch) to the RH side and subtract 0.51 mm (0.020 inch) from the LH side to allow backlash indication.



11. Install the bearing caps and the bolts.



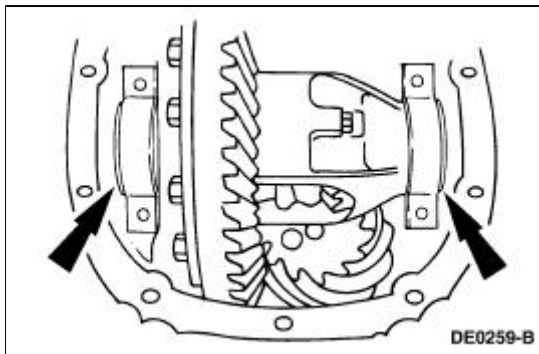
12. Rotate the differential assembly several times to verify that the differential bearings seated correctly.



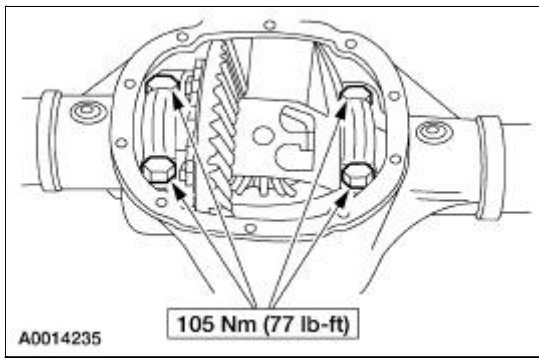
13. Measure the backlash. Refer to Measuring backlash in this procedure.

Backlash not within specification

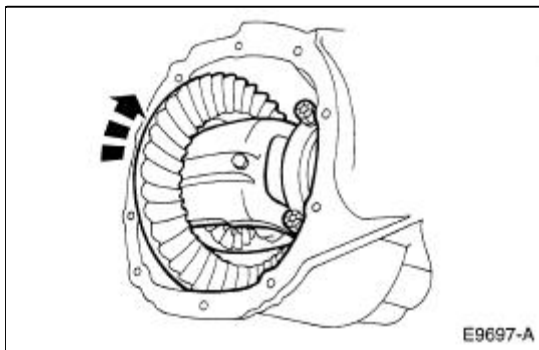
14. To increase or decrease the backlash, remove the bearing caps and install a thicker shim and thinner shim accordingly.
 - If backlash is not within the specification, increase the thickness of one differential bearing shim and decrease the thickness of the other differential bearing shim by the same amount.



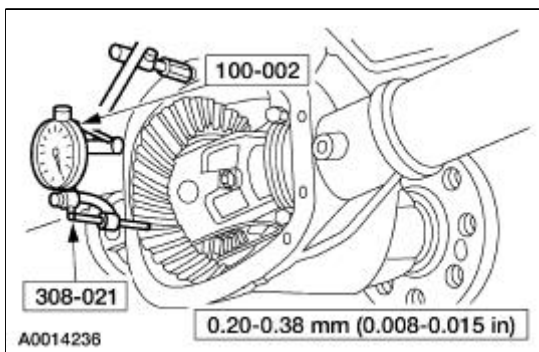
15. Install the bearing caps and the bolts.



16. Rotate the differential several times to verify that the differential bearings have seated correctly.

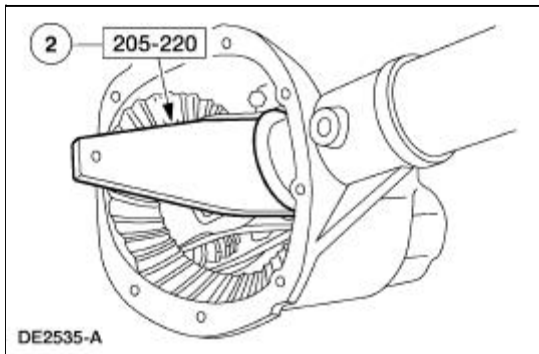
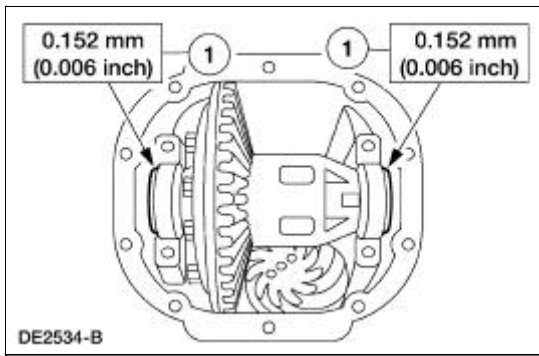


17. Using the special tools, recheck the backlash.
- If backlash is within the specification, refer to Backlash within specification in this procedure. If backlash is not within the specification, repeat Backlash not within specification in this procedure.
 - The specification shown is the full allowable range. For the preferred range, refer to Specifications in this section.

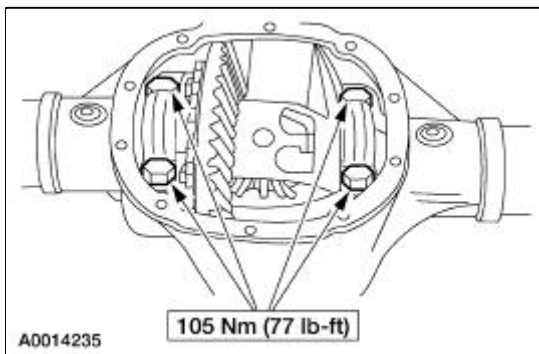


Backlash within specification

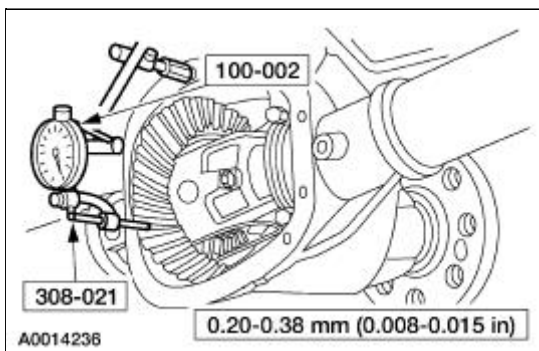
18. Remove the bolts and bearing caps.
19. Set the differential bearing preload.
1. To establish differential bearing preload, increase both left and right differential bearing shim sizes by the specification shown.
 2. Using the special tool, fully seat the differential bearing shims. Make sure the assembly rotates freely.



20. Install the bearing caps and bolts.



21. Using the special tools, recheck the backlash.
- The specification shown is the full allowable range. For the preferred range, refer to Specifications in this section.



22. Install the axle shafts. For additional information, refer to [Axle Shaft](#) in this section.
23. Install the differential housing cover and refill the rear axle with specified lubricant. For additional information, refer to [Differential Housing Cover](#) in this section.

24. Lower the vehicle.

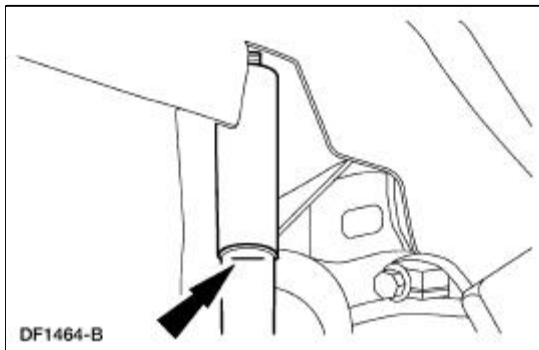
Axle Assembly


Removal and Installation


1.  **CAUTION:** The vehicle must be on level ground and at curb height.

Mark the rear shock absorbers relative to their protective sleeve.

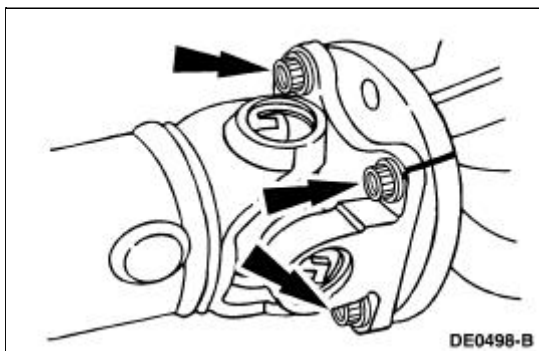
- During installation, raise the suspension to this reference mark before tightening the suspension fasteners.

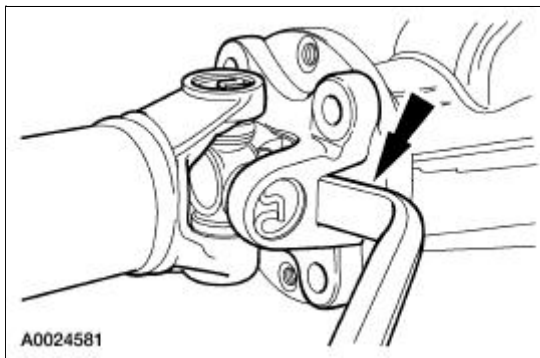


2. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
3. Remove the rear wheel and tire assemblies. For additional information, refer to [Section 204-04](#).
4.  **CAUTION:** Index-mark the driveshaft flange and pinion flange (4851) to maintain initial balance during installation.

 **CAUTION:** The driveshaft centering socket yoke fits tightly on the pinion flange pilot. Never hammer on the driveshaft or any of its components to disconnect the yoke from the flange. Pry only in the area shown, with a suitable tool, to disconnect the yoke from the flange.

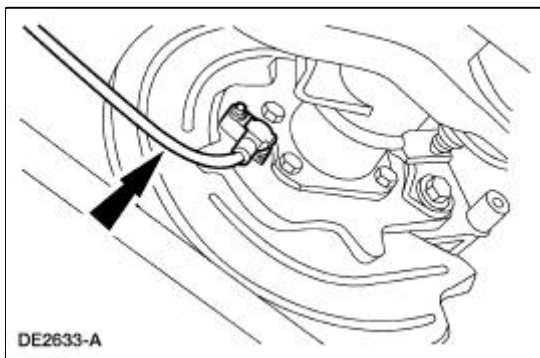
Disconnect and position the driveshaft out of the way. For additional information, refer to [Section 205-01](#).





5. **NOTE:** If necessary, use Rust Penetrant and Inhibitor F2AZ-19A501-A meeting Ford specification ESR-M99C56-A to loosen the sensor for removal.

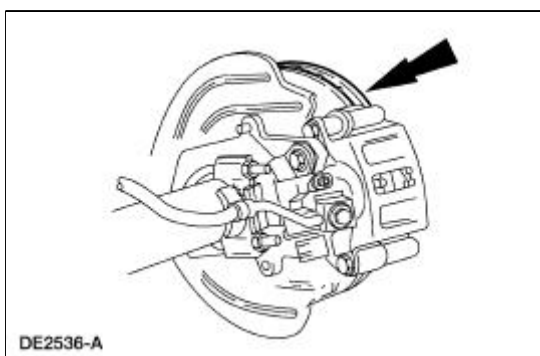
Remove the rear anti-lock brake sensors from the rear disc brake adapters. For additional information, refer to [Section 206-09A](#).



6.  **CAUTION:** Index-mark the brake discs and the wheel studs prior to brake disc removal.

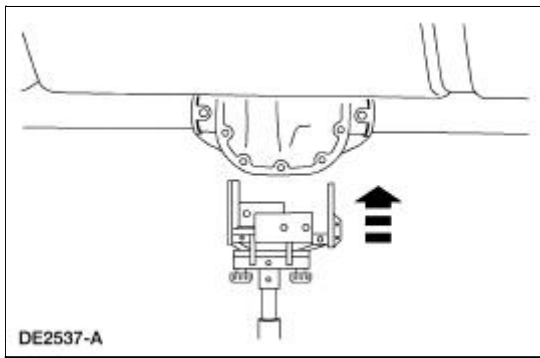
 **CAUTION:** Do not allow the calipers to hang from the brake hoses.

Remove the rear brake discs. For additional information, refer to [Section 206-04](#).

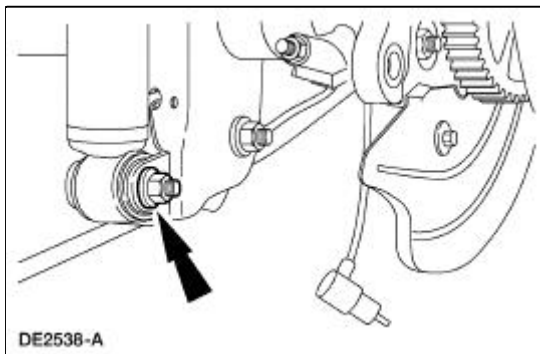


7.  **CAUTION:** Secure the differential housing (4010) to the jack with a suitable strap.

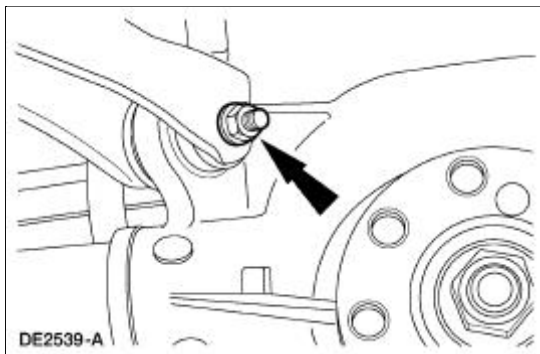
Support the differential housing with a suitable hi-lift jack.



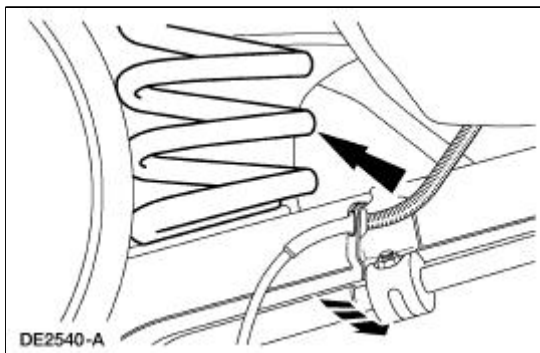
8. Remove and discard the nuts and bolts retaining the shock absorbers to the axle.



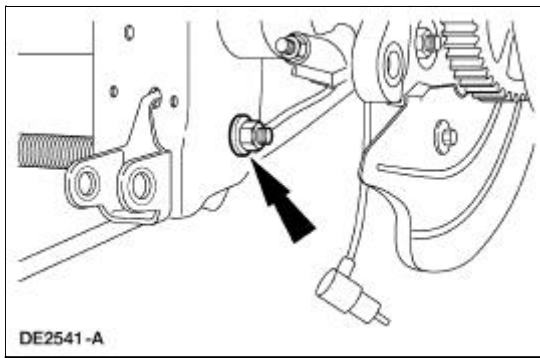
9. Remove and discard the nuts and bolts retaining the upper suspension arm and bushings to the differential housing.



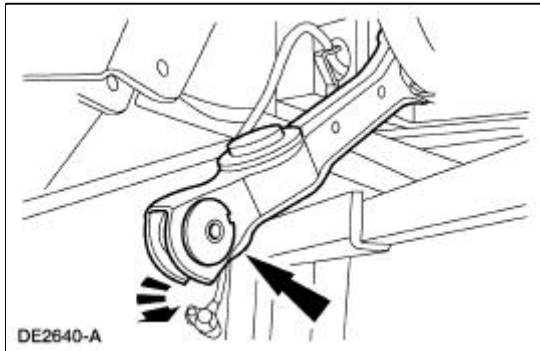
10. Lower the axle slightly, and remove the springs.



11. Remove and discard the nuts and bolts retaining the lower suspension arm and bushings to the axle.




12. Disconnect the lower suspension arm and bushings from the axle.



13. Remove the axle from the vehicle.

14.  **CAUTION:** Align the index marks on the driveshaft centering socket yoke and the pinion flange.

 **CAUTION:** Install the driveshaft with new bolts. If new bolts are not available, apply Threadlock and Sealer E0AZ-19554-AA or equivalent meeting Ford specification WSK-M2G351-A5 to the threads of the original bolts.

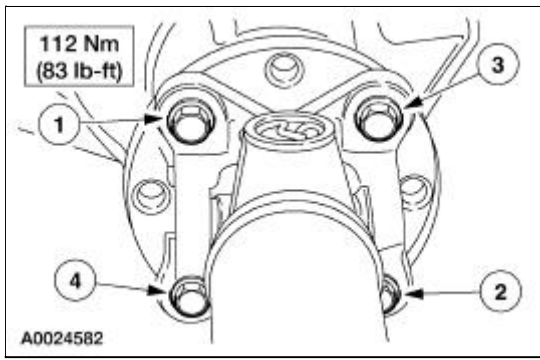
 **CAUTION:** The driveshaft centering socket yoke fits tightly on the pinion flange pilot. To make sure that the yoke seats squarely on the flange, tighten the bolts evenly in a cross pattern as shown.

 **CAUTION:** Raise the suspension to the reference marks on the rear shock absorbers before tightening the suspension fasteners.

NOTE: Apply High Temperature Nickel Anti-Sieze Lubricant F6AZ-9L494-AA meeting Ford specification ESE-M124A-A to the rear anti-lock brake sensor body where it will make contact when installed.


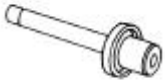

To install, reverse the removal procedure.

- Refer to [Section 204-02](#) for rear suspension fastener tightening specifications.
- Refer to [Section 204-04](#) for wheel nut tightening specification.
- Check and, if necessary, fill the axle with the specified lubricant to the specified level. For additional information, refer to Specifications in this section.



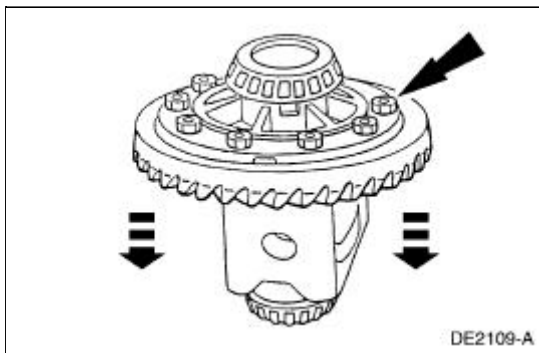
Differential Case and Ring Gear

Special Tool(s)

 ST2026-A	2-Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1375-A	Installer, Differential Side Bearing 205-009 (T57L-4221-A1)
 ST1543-A	Step Plate 205-D016 (D80L-630-5) or equivalent

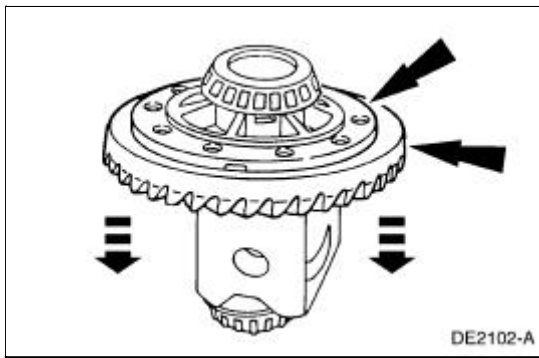
Disassembly

1. Remove the differential assembly from the differential housing. For additional information, refer to [Differential Case](#) in this section.
2. Remove the bolts.

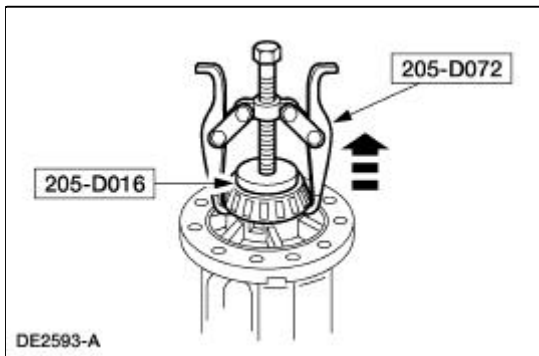


3.  **CAUTION: Do not damage the threads in the bolt holes.**

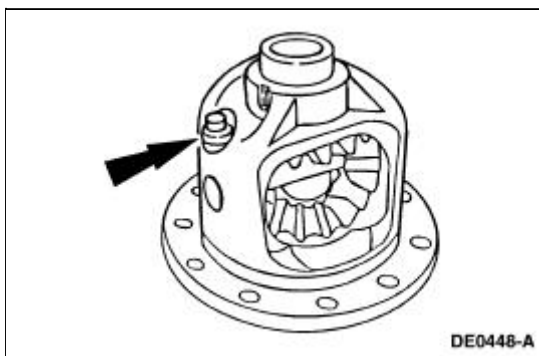
Insert a punch in the bolt holes and drive off the ring gear.



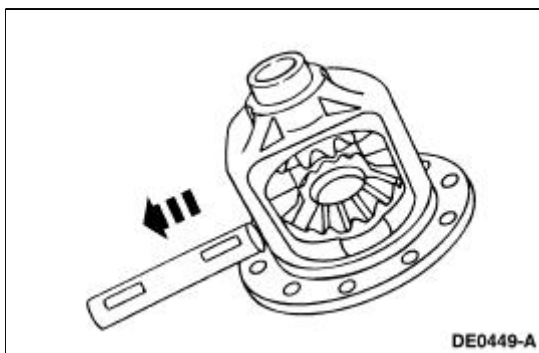
4. Using the special tools, remove the differential bearings (4221), if necessary.



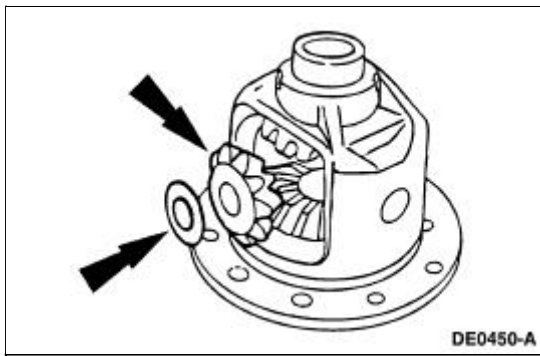
5. Remove the bolt.



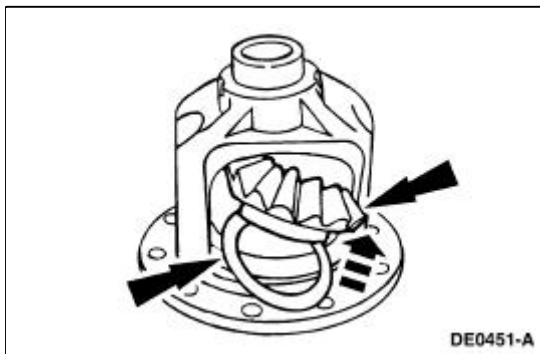
6. Remove the differential pinion shaft (4211).



7. Rotate and remove the differential pinion gears (4215) and differential pinion thrust washers (4230).

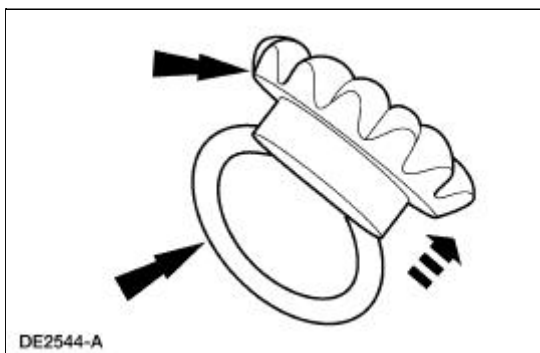


8. Remove the differential side gears (4236) and the differential side gear thrust washers (4228).

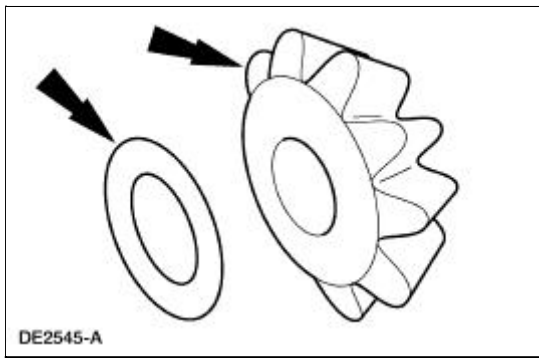


Assembly

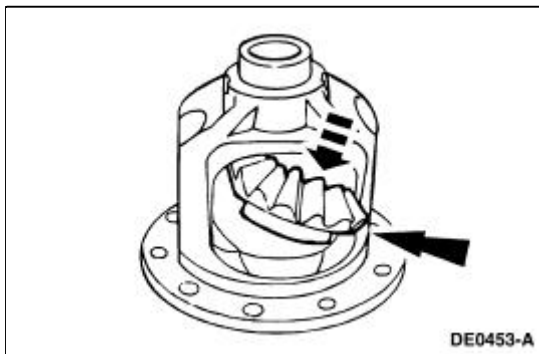
1. Lubricate the differential side gear thrust washers and the differential side gear journals, and assemble the washers to the gears.
 - Use SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL or equivalent meeting Ford specification WSP-M2C197-A.



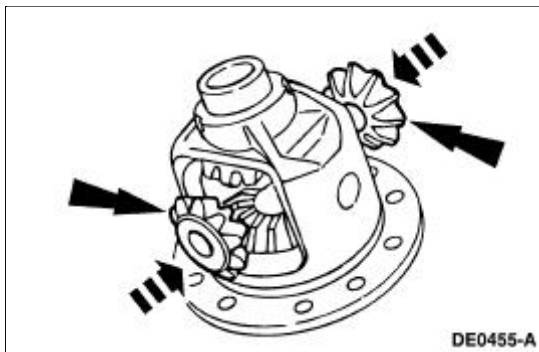
2. Lubricate the differential pinion thrust washers and the differential pinion gears, and assemble the washers to the gears.
 - Use SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL or equivalent meeting Ford specification WSP-M2C197-A.



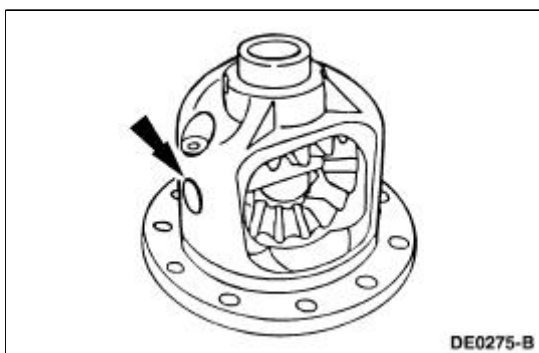
3. Position the differential side gear and thrust washer assemblies in the differential case.



4. Engage the differential pinion gears with the differential side gears and rotate the pinion gears to align with the differential pinion shaft bore.



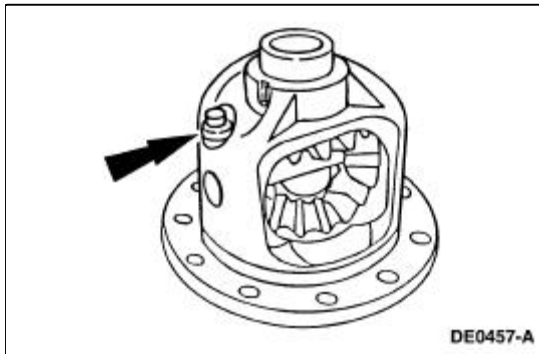
5. Insert the differential pinion shaft.
 - Align the hole in the differential pinion shaft with the hole in the differential case.



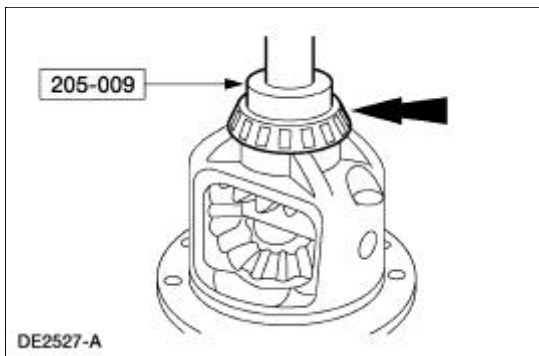
6. **NOTE:** If a new bolt is unavailable, coat the original bolt threads with Threadlock and Sealer EOAZ-19554-AA or equivalent meeting Ford specifications WSK-M2G351-A5 prior to

installation.

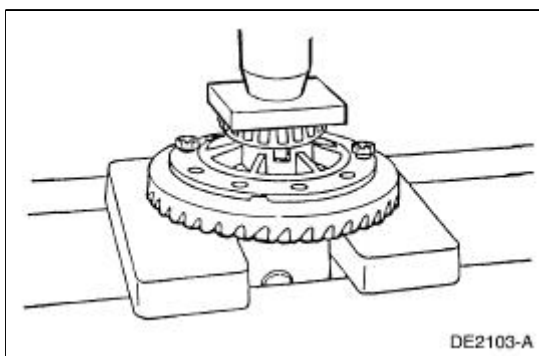
Install a new bolt finger-tight.



7. Using the special tool, install the new differential bearings, if removed.

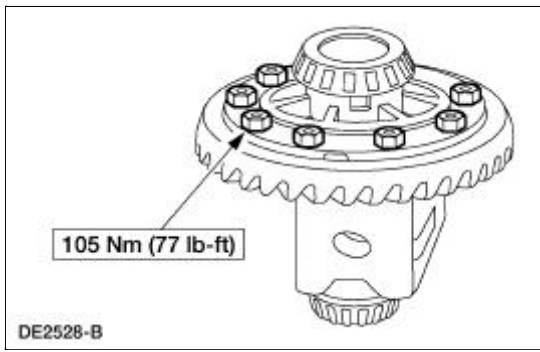


8. Position the ring gear and the differential case. Align the bolt holes by starting two bolts through the holes in the differential case and the ring gear. Press the ring gear on the differential case.



9. Install the bolts.

- Apply Stud and Bearing Mount EOAZ-19554-BA or equivalent meeting Ford specification WSK-M2G349-A1 to the bolt threads.



10. Install the differential case. For additional information, refer to [Differential Case](#) in this section.
-

General Specifications

Item	Specification
Lubes and Sealers	
SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B	WSL-M2C192-A
Premium Long-Life Grease XG-1-C	ESA-M1C75-B
Rust Penetrant and Inhibitor F2AZ-19A501-A	ESR-M99C56-A
High Temperature Nickel Anti-Sieze Lubricant F6AZ-9L494-AA	ESE-M124A-A
Additive Friction Modifier C8AZ-19B546-A	EST-M2C118-A
Clear Silicone Rubber D6AZ-19562-AA	ESB-M4G92-A
Threadlock and Sealer EOAZ-19554-AA	WSK-M2G351-A5
Lubricant Fill Level Checks	
Additive Friction Modifier	118 ml (4 oz)
Approximate axle fill capacity ^{a b}	1.66-1.77-liters (3.5-3.75-pints) 6.4-14.3-mm (1/4-9/16-in) below the bottom of the fill hole
Clearance, Tolerance and Adjustments	
Maximum ring gear back face runout	0.102 mm (0.004 in)
Maximum differential case runout	0.076 mm (0.003 in)
Differential side gear thrust washer thickness	0.762 mm - 0.813 mm (0.030 in - 0.032 in)
Differential pinion gear thrust washer thickness	0.762 mm -0.813 mm (0.030 in - 0.032 in)
Maximum axle shaft end play	0.762 mm (0.030 in)
Ring gear backlash	0.203 mm - 0.381 mm (0.305 mm - 0.381 mm preferred) 0.008 in - 0.015 in (0.012 in - 0.015 in preferred)
Variation between teeth maximum backlash	0.102 mm (0.004 in)
Pinion flange runout	0.25 mm (0.010 in) T.I.R.

^a If it is necessary to refill a Traction-Lok® axle with new lubricant, add 118 ml (4 oz) of Additive Friction Modifier C8AZ-19B546-A or equivalent meeting Ford specification EST-M2C118-A before filling the axle with the new lubricant.

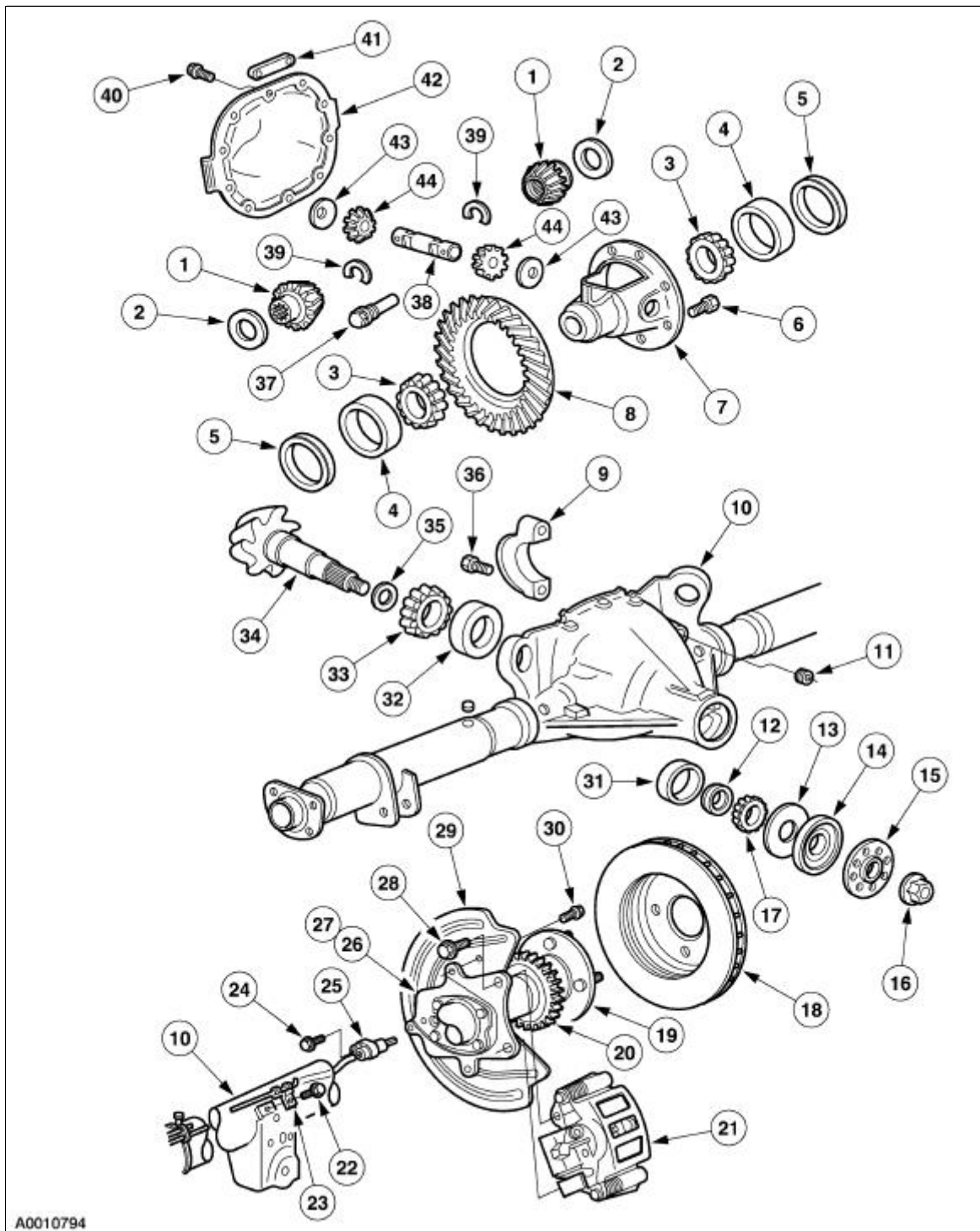
^b In-vehicle repair refill capacities are determined by filling the rear axle with the specified lubricant to 6.4-14.3-mm (1/4-9/16-in) below the bottom of the fill hole.

Torque Specifications

Description	Nm	lb-ft	lb-in
Bolt retaining the differential pinion shaft to the differential case	30	22	—
Bolt retaining the driveshaft yoke to the pinion flange	112	83	—
Bolt retaining the differential housing cover to the differential housing	44	32	—

Oil filler plug	30	22	—
Pinion bearing preload (used pinion bearings)	0.9-1.5	—	8-14
Pinion bearing preload (new pinion bearings)	1.8-3.3	—	16-29
Adapter for 205-S127	2.2	—	20
Bolt retaining the bearing cap to the differential case	105	77	—
Bolt retaining the ring gear to the differential case	105	77	—

Rear Drive Axle and Differential



A0010794

Item	Part Number	Description
1	4236	Differential side gear
2	4228	Differential side gear thrust washer
3	4221	Differential bearing

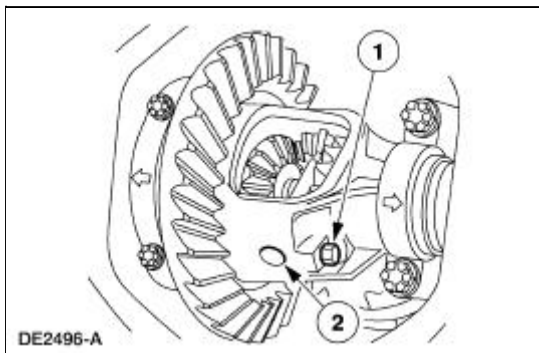
4	4222	Differential bearing cup
5	4067	Differential bearing shim
6	4216	Rear axle differential gear case bolt
7	4204	Differential case
8	—	Ring gear (part of 4209 gearset)
9	—	Bearing cap (part of 4010)
10	4010	Rear axle housing
11	373098-S	Filler plug
12	4662	Collapsible spacer
13	4670	Rear axle drive pinion shaft oil slinger
14	4676	Rear axle drive pinion seal
15	4851	Pinion flange
16	389546-S100	Pinion nut
17	4621	Differential pinion bearing
18	2C026	Rear brake disc
19	—	Axle shaft flange (part of 4234)
20	2C189	Rear brake anti-lock sensor indicator
21	2552	Rear disc brake caliper
22	N601951-S2	Bolt
23	N804361-S100	Clip
24	—	Bolt (part of 4010)
25	2C190	Rear brake anti-lock sensor
26	2C101	Left hand rear disc brake adapter
27	2C100	Right hand rear disc brake adapter
28	N8015163-S190	Caliper anchor bolt
29	2C028	Rear wheel brake disc shield
30	N602726-S2	Bolt (3 req'd)
31	4616	Differential drive pinion bearing cup
32	4628	Rear axle pinion bearing cup
33	4630	Differential pinion bearing
34	—	Drive pinion gear (part of 4209 gearset)
35	4663	Drive pinion bearing adjustment shim
36	—	Bolt (part of 4010)
37	4241	Differential pinion shaft lock bolt
38	4211	Differential pinion shaft
39	4N237	U-washer
40	383548	Bolt
41	—	Rear axle identification tag (part of 4001)
42	4033	Differential housing cover
43	4230	Differential pinion thrust washer
44	4215	Differential pinion gear

- The axle housing assembly consists of a cast center section with two steel tube assemblies and a stamped differential housing cover (4033). The differential housing cover uses silicone sealant as a gasket.
 - The hypoid-design gearset consists of 8.8-inch ring gear (4209) and a drive pinion gear (4209). Two opposed tapered roller bearings support the drive pinion in the axle housing (4010).
 - A collapsible spacer (4662), located on the differential pinion shaft, maintains pinion bearing preload. The pinion nut (389546-S100) adjusts the preload.
 - Differential bearing shims (4067), located between the differential bearing cups (4222) and the rear axle housing, adjust the differential bearing preload and the ring gear backlash.
 - The differential case (4204) is a one-piece design with two openings to allow for assembly of the internal components and lubricant flow. Two opposed tapered roller bearings (differential bearings) (4221) support the differential case in the axle housing. Removable bearing caps (4010) retain the differential assembly in the axle housing.
 - Inside the differential case, the differential pinion shaft (4211) supports two differential pinion gears (4215). The pinion gears engage the differential side gears (4236), to which the axle shafts (4234) are splined. The differential pinion shaft lock bolt (4241) retains the differential pinion shaft in the differential case.
 - An embossed metal tag, bolted to the differential housing cover, contains rear axle identification.
-

Axle Shaft

Removal

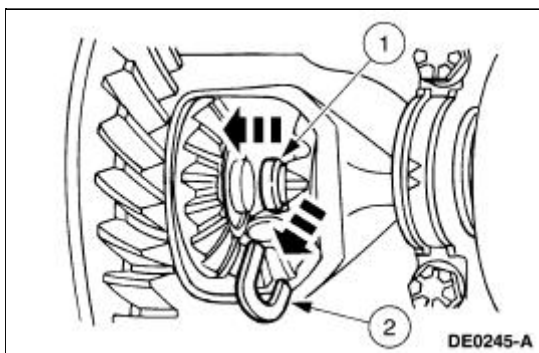
1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
3. Remove the rear brake disc (2C026). For additional information, refer to [Section 206-04](#).
4. Remove the differential housing cover (4033) and drain the lubricant. For additional information, refer to [Differential Housing Cover](#) in this section.
5. Remove the differential pinion shaft (4211).
 1. Remove the differential pinion shaft lock bolt (4241).
 2. Remove the differential pinion shaft.



6.  **CAUTION: Do not damage the rubber O-ring in the axle shaft groove.**

Remove the U-washer (4N237).

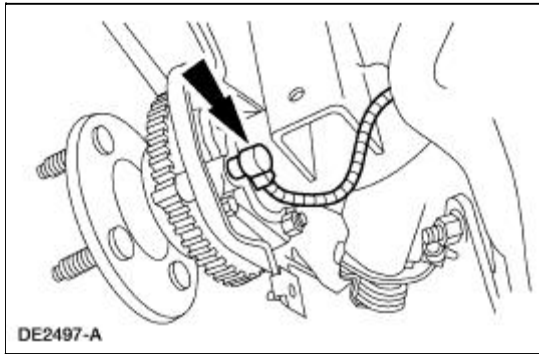
1. Push the axle shafts (4234) inboard.
2. Remove the U-washer.



7.  **CAUTION: Damage to the rear brake anti-lock sensor (2C190) may occur if it is not removed before the axle shaft.**

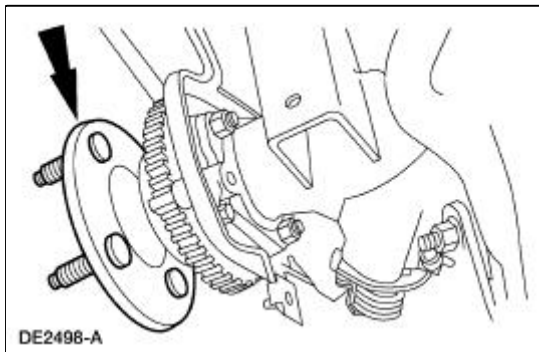
Carefully remove the rear brake anti-lock sensor. For additional information, refer to [Section](#)

[206-09A](#) .



8.  **CAUTION: Do not damage the wheel bearing oil seal.**

Remove the axle shaft.

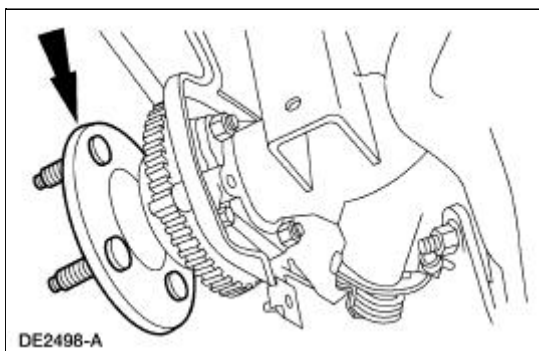


Installation

1. Lubricate the lip of the wheel bearing oil seal
 - Use Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B.

2.  **CAUTION: Do not damage the wheel bearing oil seal.**

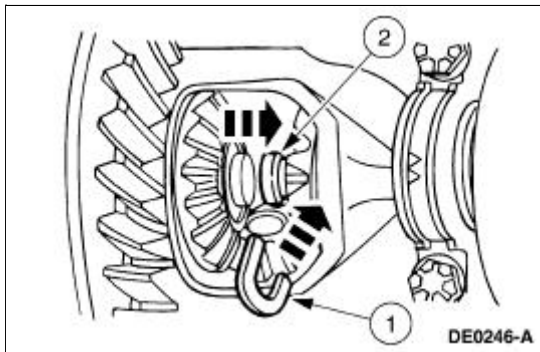
Install the two axle shafts.



3.  **CAUTION: Do not damage the rubber O-ring in the axle shaft groove.**

Install the U-washer.

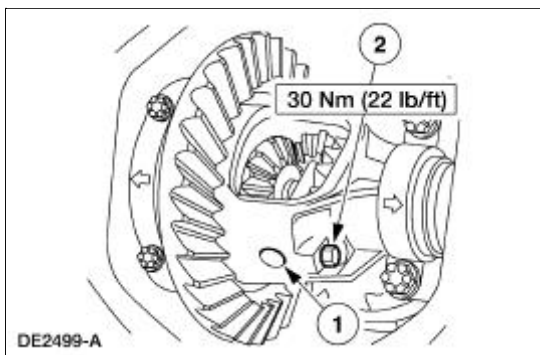
1. Position the two U-washers on the button end of the axle shaft.
2. Pull the axle shaft outward.



4. **NOTE:** If a new pinion shaft lock bolt is unavailable, coat the threads with Threadlock and Sealer EOAZ-19554-AA or equivalent meeting Ford specification WSK-M2G351-A5 prior to installation.

Install the differential pinion shaft.

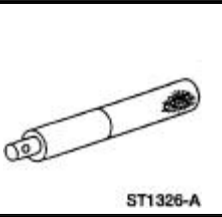

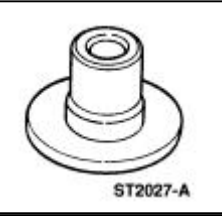
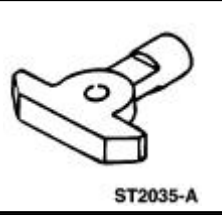

1. Align the hole in the differential pinion shaft with the case lock bolt hole.
2. Install a new differential pinion shaft lock bolt.



5. Install the differential housing cover and fill the rear axle with the specified lubrication. For additional information, refer to [Differential Housing Cover](#) in this section.
 6. Install the rear brake anti-lock sensor. For additional information, refer to [Section 206-09A](#).
 7. Install the rear brakes. For additional information, refer to [Section 206-04](#).
 8. Install the tire and wheel assembly. For additional information, refer to [Section 204-04](#).
 9. Lower the vehicle.
-

Rear Wheel Bearing and Axle Shaft Oil Seal

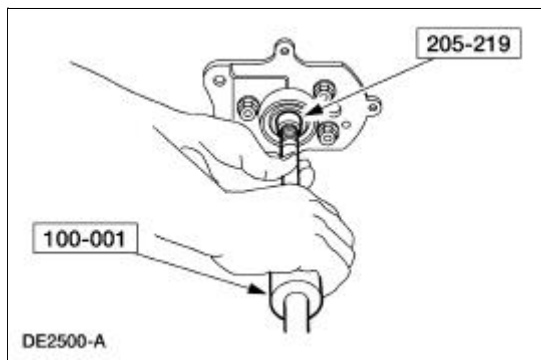
Special Tool(s)

 <p>ST1326-A</p>	Adapter for 303-224 205-153 (T80T-4000-W)
 <p>ST1514-A</p>	Installer, Axle Shaft Bearing 205-124 (T78P-1225-A)
 <p>ST2027-A</p>	Installer, Rear Axle Oil Seal 205-390 (T97T-1177-B)
 <p>ST2035-A</p>	Remover, Axle Bearing 205-219 (T85L-1225-AH)
 <p>ST1185-A</p>	Slide Hammer 100-001 (T50T-100-A)

Removal

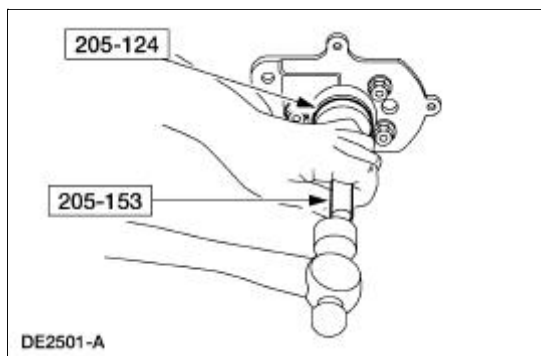
1. Remove the axle shaft (4234). For additional information, refer to [Axle Shaft](#) in this section.
2. **NOTE:** If the wheel bearing oil seal is leaking, the axle housing vent may be plugged.

Using the special tools, remove the rear wheel bearing and wheel bearing oil seal.

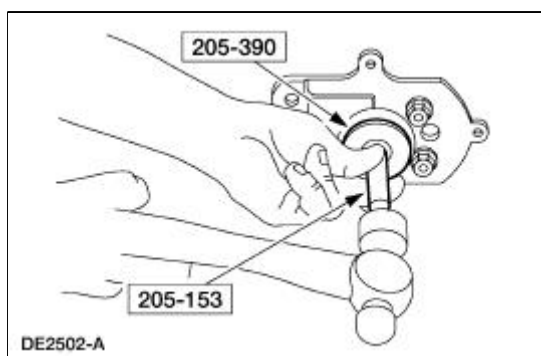


Installation

1. Lubricate the new rear wheel bearing with the specified lubricant.
2. Using the special tools, install the new rear wheel bearing.



3. Lubricate the lip of the new wheel bearing oil seal.
 - Use Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B.
4. Using the special tools, install the new wheel bearing oil seal.



5. Install the axle shaft. For additional information, refer to [Axle Shaft](#) in this section.
-

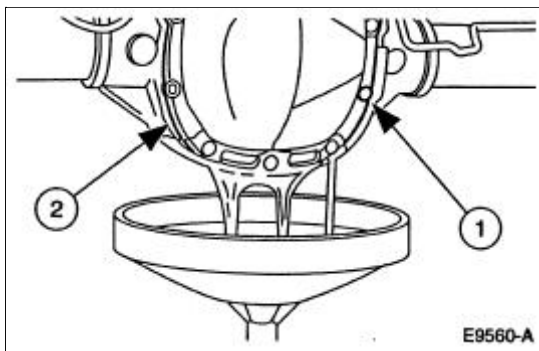
Differential Housing Cover

Removal

1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. **NOTE:** Empty the lubricant into a clean container for reuse.

Remove the differential housing cover (4033).

1. Remove the 10 bolts and drain the lubricant from the differential housing (4010).
2. Remove the differential housing cover.



Installation

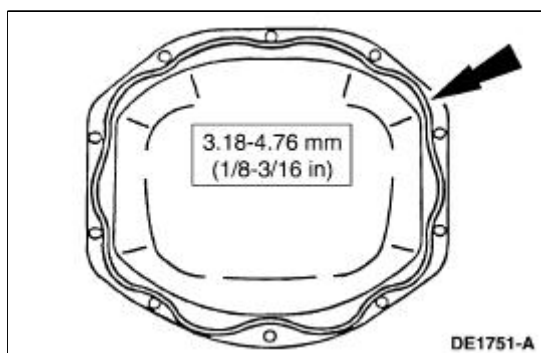
1. **CAUTION:** Make sure the machined surfaces on both the differential housing and the differential housing cover are clean and free of oil before applying the new silicone sealant. To prevent contamination, cover the inside of the rear axle (4001) prior to cleaning the machined surface.

Clean the differential housing and the differential housing cover gasket mating surfaces.

2. **CAUTION:** Install the differential housing cover within 15 minutes of applying the silicone, or it will be necessary to remove and reapply new sealant.

Apply a continuous bead of sealant of the specified thickness to the differential housing cover.

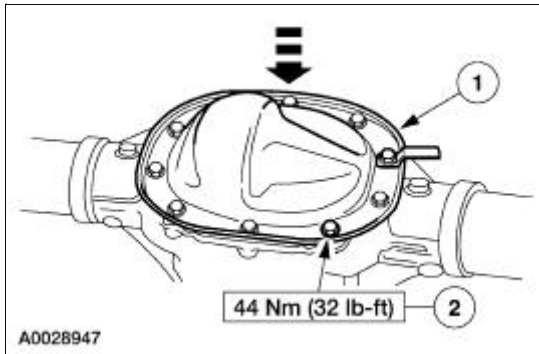
- Use Clear Silicone Rubber D6AZ-19562-AA or equivalent meeting Ford specifications ESB-M4G92-A.



3. **NOTE:** If possible, allow one hour before filling the axle with lubricant to make sure the silicone sealant has cured.

Install the differential housing cover.

1. Install the differential housing cover.
2. Install the 10 bolts.

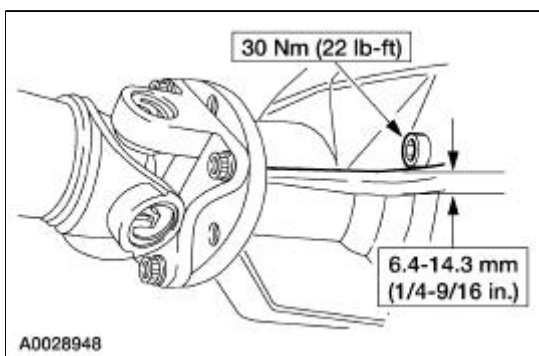


4. **NOTE:** If it is necessary to refill a Traction-Lok® axle with new lubricant, add 118 ml (4 oz) of Additive Friction Modifier C8AZ-19B546-A or equivalent meeting Ford specification EST-M2C118-A before filling the axle with the new lubricant.

NOTE: In-vehicle repair refill capacities are determined by filling the rear axle with the specified lubricant to 6.4-14.3-mm (1/4-9/16-in) below the bottom of the fill hole.

Fill the rear axle to the level shown, approximately 1.66-1.77-liters (3.5-3.75-pints) of lubricant, and install the filler plug.

- Use SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A.



5. Lower the vehicle.
-

Axle Housing Bushing

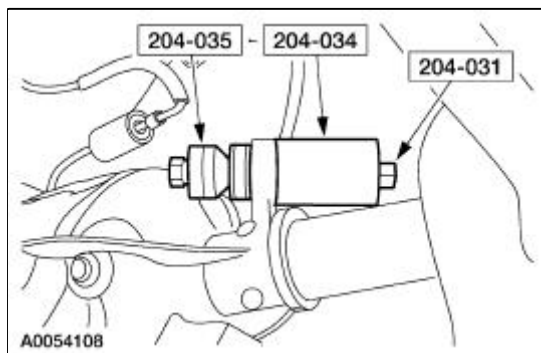
Special Tool(s)



Removal

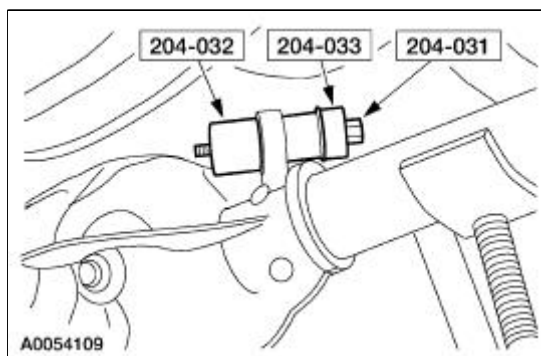
⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation becomes necessary. If substitution is necessary, the part must be of the same finish and property class. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

1. Remove the upper arm and bushing (5500). For additional information, refer to [Section 204-02](#).
2. Using the special tools, remove the bushing.

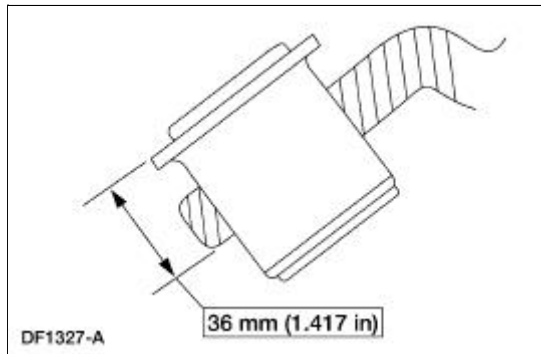


Installation

1. Using the special tools, install the bushing.



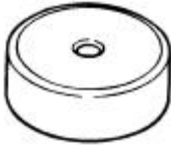

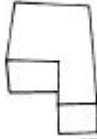

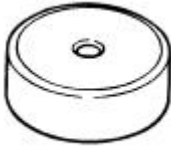

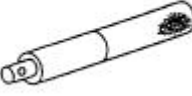
- Using a suitable calibrated micrometer, measure the bushing as shown. If not within specifications, adjust as necessary.







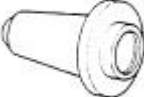
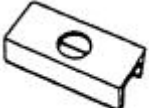


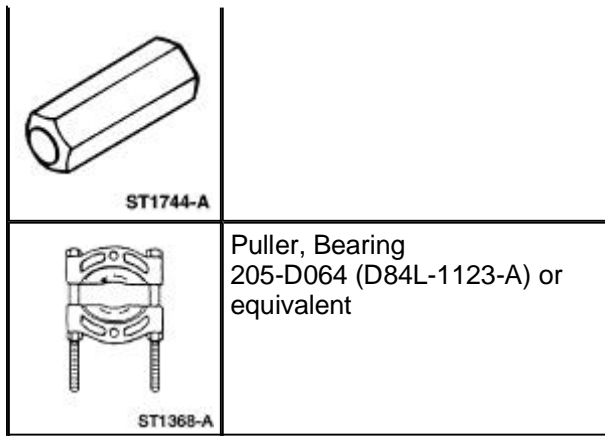
- Install the upper arm and bushing. For additional information, refer to [Section 204-02](#).
-

Drive Pinion

Special Tool(s)


 <p>ST1743-A</p>	<p>Adapter for 205-S127 205-105 (T76P-4020-A3)</p>
 <p>ST1429-A</p>	<p>Adapter for 205-S127 205-109 (T76P-4020-A9)</p>
 <p>ST1431-A</p>	<p>Adapter for 205-S127 205-110 (T76P-4020-A10)</p>
 <p>ST1432-A</p>	<p>Adapter for 205-S127 205-111 (T76P-4020-A11)</p>
 <p>ST1743-A</p>	<p>Adapter for 205-S127 205-129 (T79P-4020-A18)</p>
 <p>ST1434-A</p>	<p>Adapter for 205-S127 205-130 (T79P-4020-A19) or equivalent</p>
 <p>ST1326-A</p>	<p>Adapter for 303-224 (Short Handle) 205-153 (T80T-4000-W)</p>
	<p>Handle 205-D055 (D81L-4000-A) or</p>

 <p>ST1653-A</p>	<p>equivalent</p>
 <p>ST1257-A</p>	<p>Holding Fixture, Drive Pinion Flange 205-126 (T78P-4851-A)</p>
 <p>ST1367-A</p>	<p>Installer, Drive Pinion Bearing Cone 205-005 (T53T-4621-C)</p>
 <p>ST1678-A</p>	<p>Installer, Drive Pinion Bearing Cup 205-024 (T67P-4616-A)</p>
 <p>ST1860-A</p>	<p>Installer, Drive Pinion Bearing (Outer) 205-231 (T85T-4616-AH)</p>
 <p>ST1862-A</p>	<p>Installer, Drive Pinion Flange 205-002 (TOOL-4858-E) or equivalent</p>
 <p>ST1325-A</p>	<p>Installer, Drive Pinion Oil Seal 205-133 (T79P-4676-A)</p>
 <p>ST1254-A</p>	<p>Plate, Bearing/Oil Seal 205-090 (T75L-1165-B)</p>
	<p>Protector, Drive Pinion Thread 205-460</p>



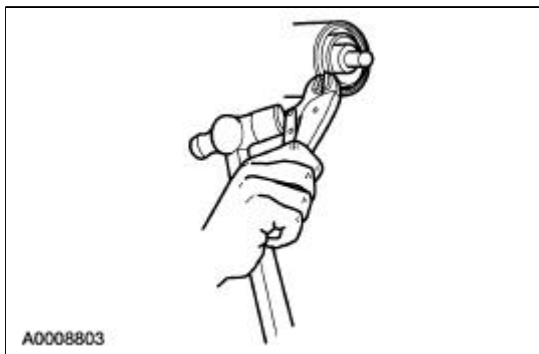
Removal

1. Remove the differential assembly from the differential housing. For additional information, refer to [Differential Case](#) in this section.

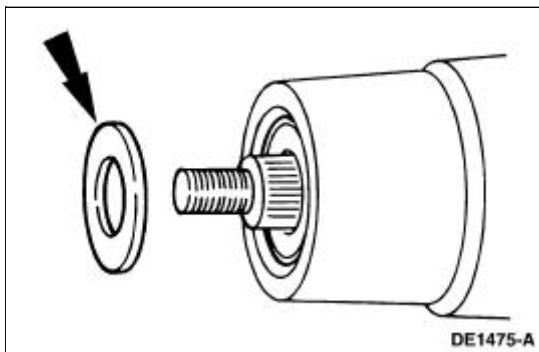
2.  **CAUTION:** Record the torque necessary to maintain rotation of the drive pinion gear through several revolutions prior to removing the pinion flange (4851).

Remove the pinion flange. For additional information, refer to [Drive Pinion Flange and Drive Pinion Seal](#) in this section.

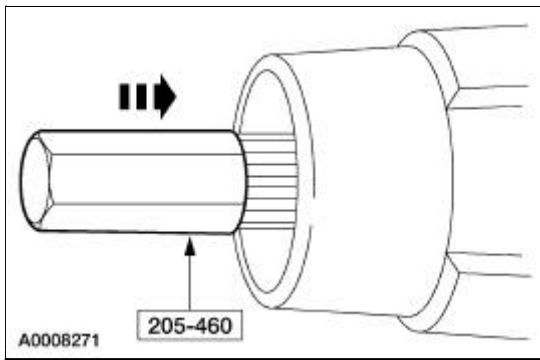
3. Force the rear axle drive pinion seal metal flange up. Install gripping pliers and strike with a hammer to remove the seal.



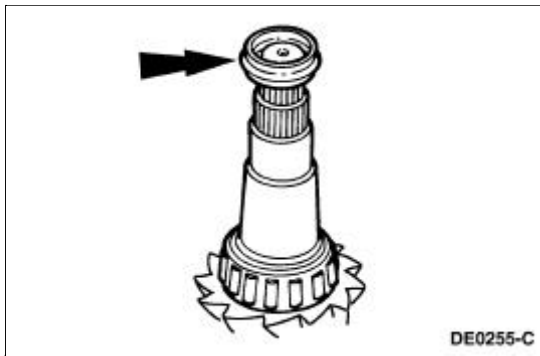
4. Remove the rear axle drive pinion shaft oil slinger (4670).



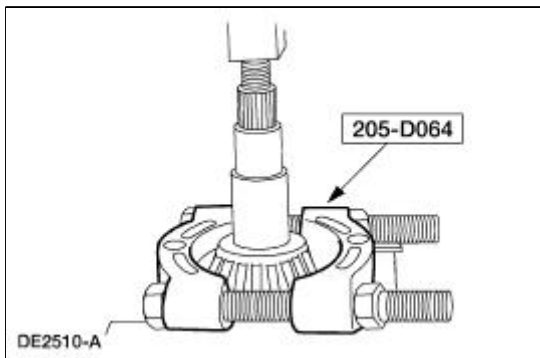
5. Using the special tool and a soft-faced hammer, drive the pinion assembly out of the outer differential pinion bearing (4621) and remove the drive pinion through the rear of the differential housing (4010).



6. Remove the outer differential pinion bearing.
7. Remove and discard the collapsible spacer (4662).

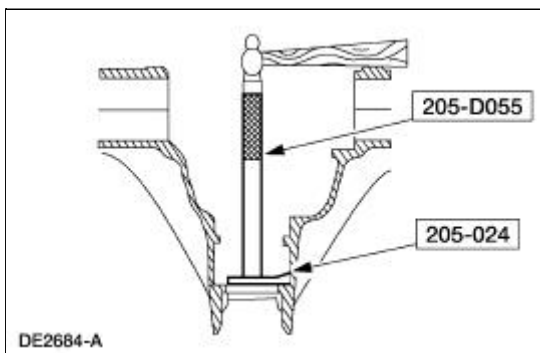


8. Using the special tool and a suitable press, remove the inner differential pinion bearing (4630).

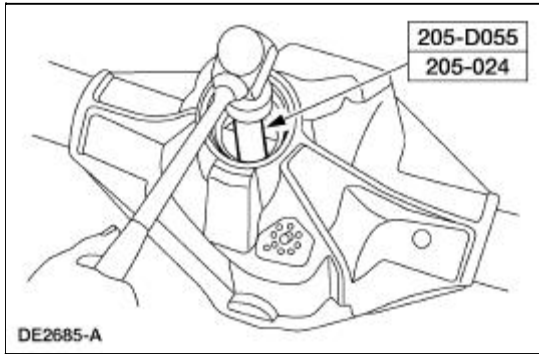


9. **NOTE:** Do not remove the pinion bearing cups from the differential housing unless the cups are damaged.

Using the special tools, remove the outer differential drive pinion bearing cup (4616).



- Using the special tools, remove the inner rear axle pinion bearing cup (4628).

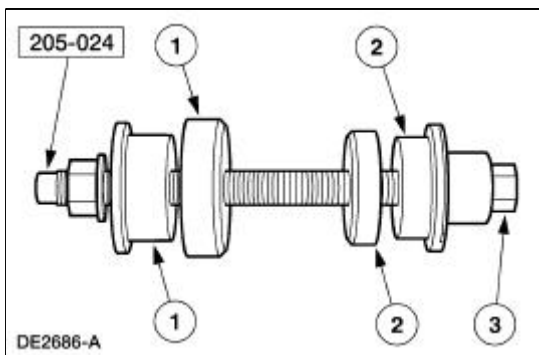


Installation

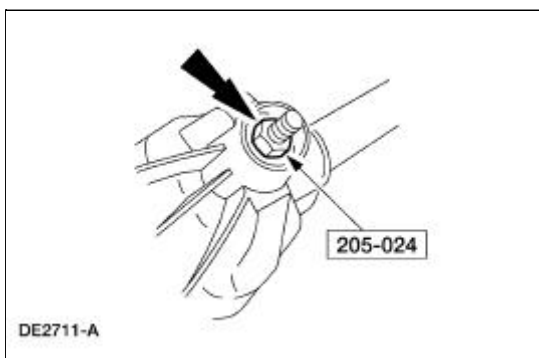
Using special tool 205-024


NOTE: This is the preferred method for installing the pinion bearing cups. If necessary, proceed to Using special tools 205-153, 205-024, 205-231, and 205-D055 in this procedure for an alternate method.

- Position the special tools and the inner and outer pinion bearing cups in their respective bores.
 - After placing the inner and outer bearing cups in their bores, place the special tool on the inner bearing cup.
 - Place the special tool on the outer bearing cup.
 - Install the special tool.



- Tighten the special tool to seat the pinion bearing cups in their bores.

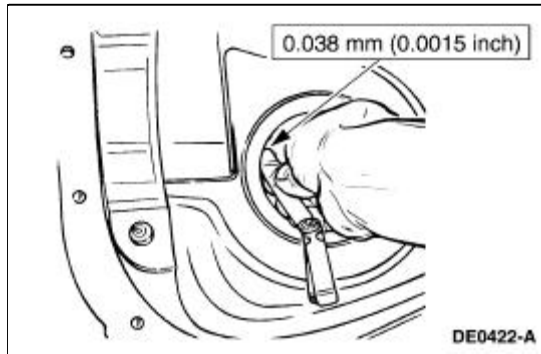


-  **CAUTION:** Always install new differential pinion bearings when installing new pinion bearing cups.

NOTE: If the feeler gauge can fit between a cup and the bottom of its bore at any point around

the cup, remove and reseat the cup.

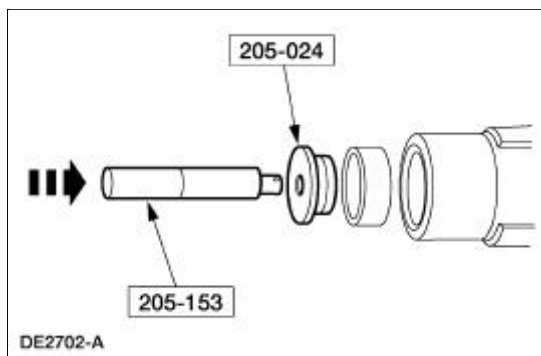
Check that the cups have seated correctly in their bores.



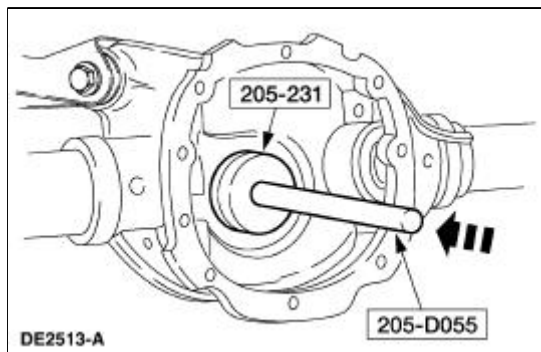
Using special tools 205-153, -024, -231, and -D055

NOTE: This is an alternate method for installing the pinion bearing cups. Carry out this procedure if pinion bearing cup installation was not done in the previous steps.

4. Using the special tools, drive the outer differential drive pinion bearing cup into the differential housing.



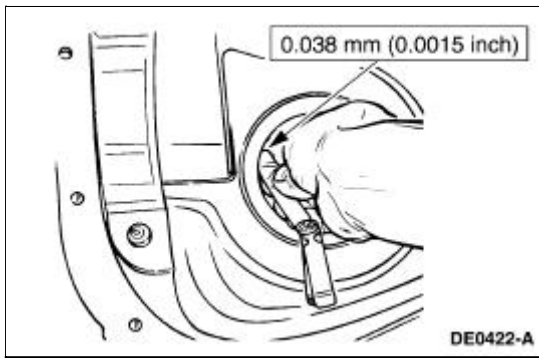
5. Using the special tools, drive the inner rear axle pinion bearing cup into the differential housing.



6. **⚠ CAUTION: Always install new differential pinion bearings when installing new pinion bearing cups.**

NOTE: If the feeler gauge can fit between a cup and the bottom of its bore at any point around the cup, remove and reseat the cup.

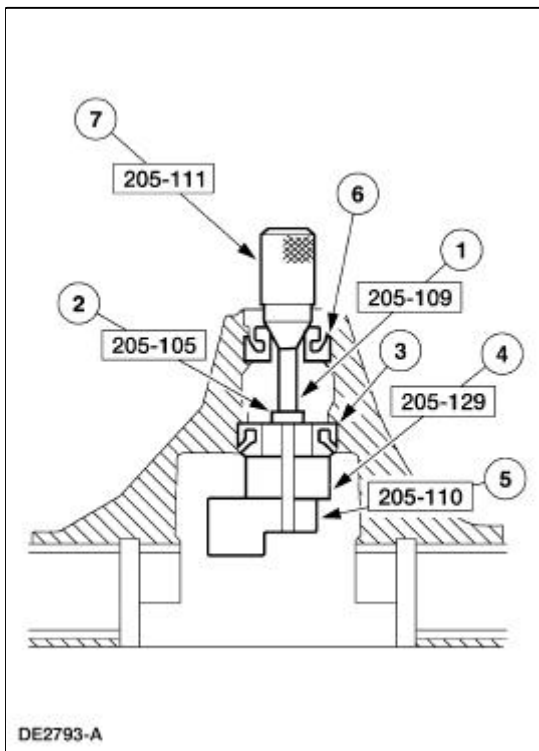
Check that the cups have seated correctly in their bores.



Setting pinion depth

7. **NOTE:** Apply only a light oil film on the differential pinion bearings before assembling the tools.

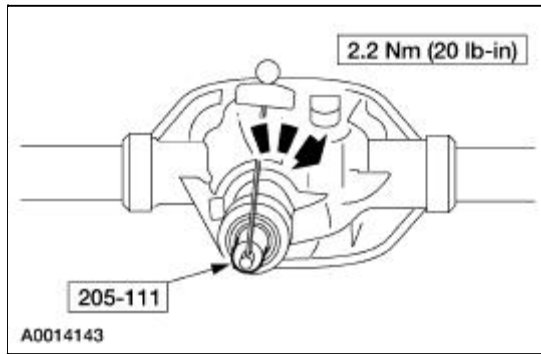
Assemble and position the following in the differential housing.



Item	Part Number	Description
1	205-109	Adapter for 205-S127 (T76P-4020-A9)
2	205-105	Adapter for 205-S127 (T76P-4020-A3) (1.612 inch O.D.)
3	4630	Rear (inner) pinion bearing
4	205-129	Adapter for 205-S127 (T79P-4020-A18) (1.1884 inch thick)
5	205-110	Adapter for 205-S127 (T76P-4020-A10) (1.7 inch thick)
6	4621	Front (outer) pinion bearing
7	205-111	Adapter for 205-S127 (T76P-4020-A11)

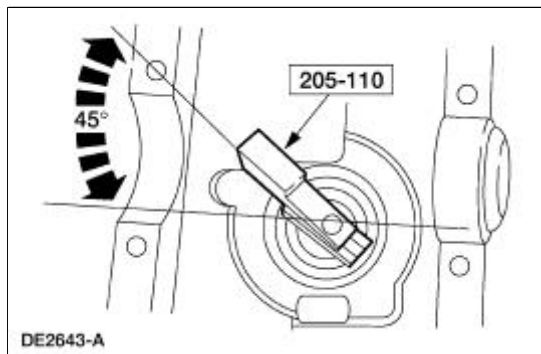
8. **NOTE:** This step duplicates final differential pinion bearing preload.

Tighten the special tool to specification.

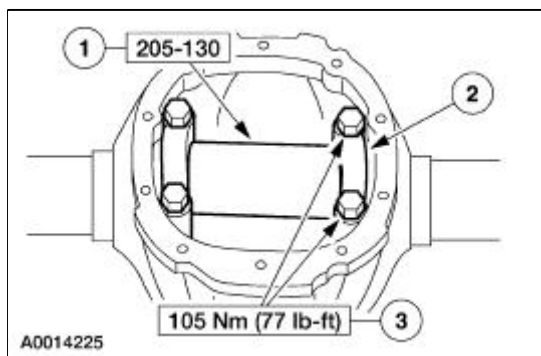


9. **NOTE:** Offset the special tool to obtain an accurate reading.

Rotate the special tool several half-turns to make sure the differential pinion bearings seat correctly and position the special tool as shown.



10. Install the special tool.
1. Position the special tool.
 2. Install the bearing caps.
 3. Install the four bolts.

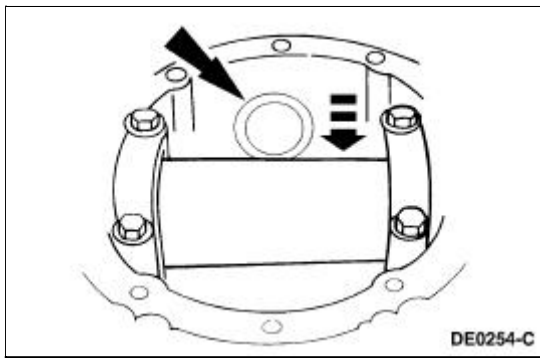


11. **NOTE:** Use only flat, clean drive pinion bearing adjustment shims (4663).

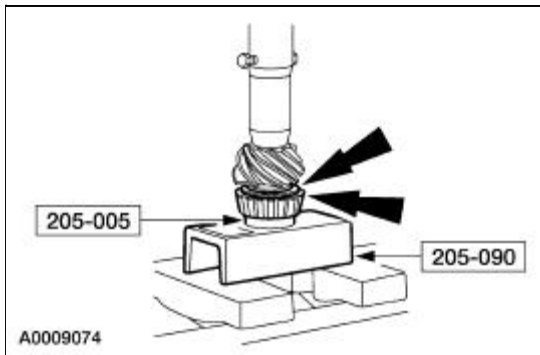
NOTE: Selection of too thick a shim results in a deep tooth contact at final assembly. Do not attempt to force the shim between the special tools. A slight drag indicates correct shim selection.

Use a drive pinion bearing adjustment shim as a gauge for shim selection.

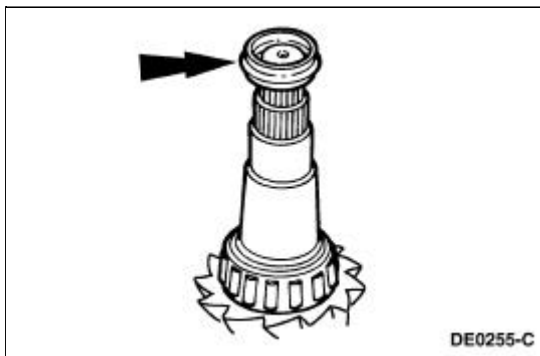
- After determining the correct shim thickness, remove the special tools.



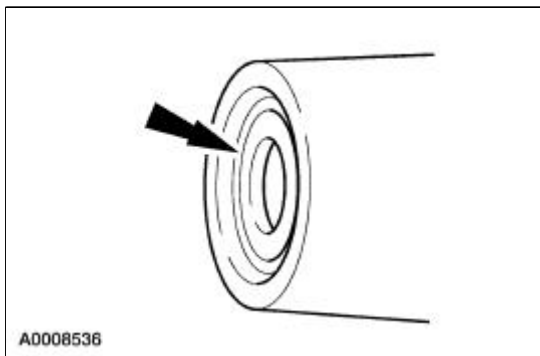
12. Position the correct thickness drive pinion bearing adjustment shim and the differential pinion bearing on the drive pinion gear. Using a suitable press and the special tools, press the differential pinion bearing until it seats firmly against the drive pinion gear.



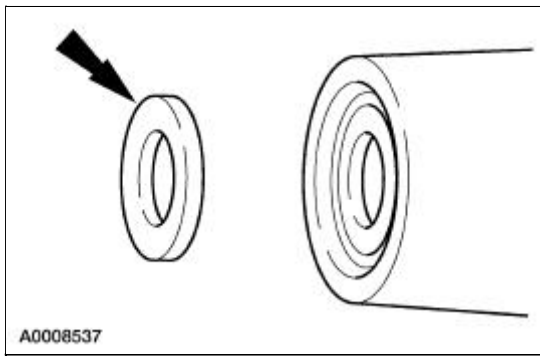
13. Place a new collapsible spacer on the pinion shaft against the pinion stem shoulder.



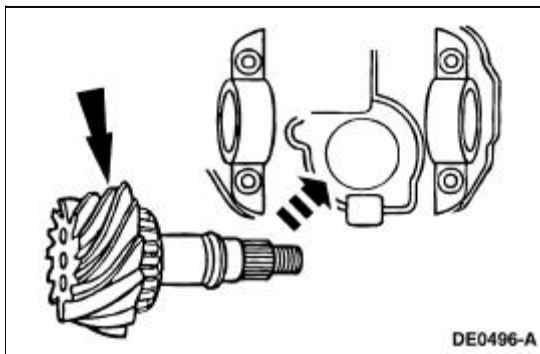
14. Install the outer differential pinion bearing.



15. Install the rear axle drive pinion shaft oil slinger.

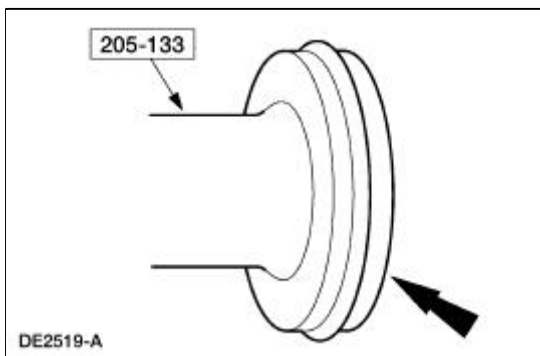


16. Install the drive pinion assembly (drive pinion, shims, bearing, and the collapsible spacer) into the differential housing bore.



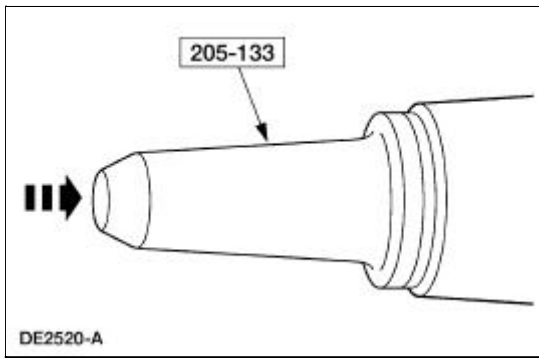
17. **NOTE:** Coat the rear axle drive pinion seal lips with Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B.

Place the rear axle drive pinion seal on the special tool.



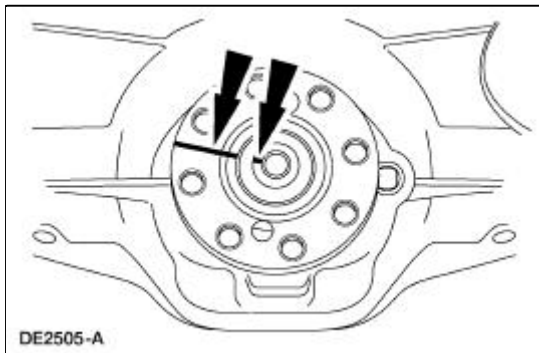
18. **⚠ CAUTION:** If the rear axle drive pinion seal becomes misaligned during installation, remove it and install a new one.

Position the rear axle drive pinion seal in the seal bore, and use the special tool to drive the seal into place.

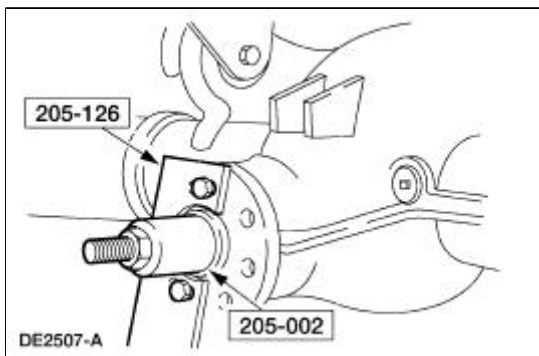


19. Lubricate the pinion flange splines.
 - Use SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A.
20. **NOTE:** Disregard the index marks if installing a new pinion flange.

Position the pinion flange.



21. Using the special tools, install the pinion flange.



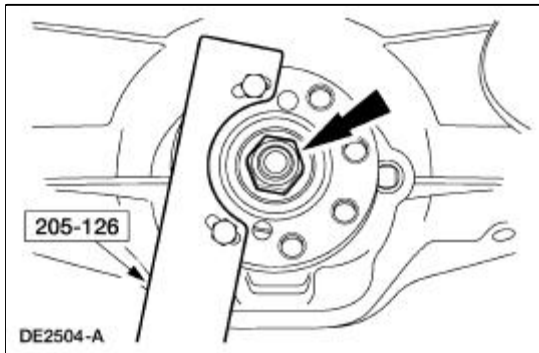
22.  **CAUTION:** Do not under any circumstance loosen the nut to reduce preload. If it is necessary to reduce preload, install a new collapsible spacer and nut.

 **CAUTION:** Remove the special tool while taking readings with the Nm (inch-pound) torque wrench.

Tighten the nut to set the preload.

- Rotate the drive pinion occasionally to make sure the differential pinion bearings seat correctly. Take frequent differential pinion bearing torque preload readings by rotating the drive pinion with a Nm (inch-pound) torque wrench.


- For new differential pinion bearings, tighten the nut to specification. Refer to torque specifications for new differential pinion bearings in the Specifications portion of this section.
- For used differential pinion bearings, if the preload recorded prior to disassembly is lower than the specification for used bearings, then tighten the nut to specification. Refer to torque specifications for used differential pinion bearings in the Specifications portion of this section.
- For used differential pinion bearings, if the preload recorded prior to disassembly is higher than the specification for used bearings, then tighten the nut to the original reading as recorded.




Final assembly

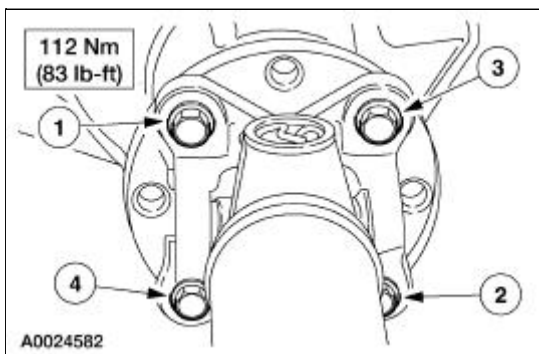
23. Install the differential assembly in the differential housing. For additional information, refer to [Differential Case](#) in this section.

24.  **CAUTION: Align the index marks.**

 **CAUTION: Install the driveshaft with new bolts. If new bolts are not available, apply Threadlock and Sealer EOAZ-19554-AA or equivalent meeting Ford specification WSK-M2G351-A5 to the threads of the original bolts.**

 **CAUTION: The driveshaft centering socket yoke fits tightly on the pinion flange pilot. To make sure that the yoke seats squarely on the flange, tighten the bolts evenly in a cross pattern as shown.**







Connect the driveshaft. For additional information, refer to [Section 205-01](#).




25. Lower the vehicle.

Differential Case

Special Tool(s)

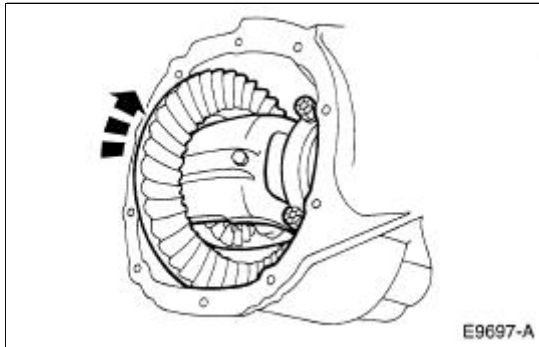
 <p>ST2026-A</p>	2-Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 <p>ST1214-A</p>	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
 <p>ST1348-A</p>	Gauge, Clutch Housing 308-021 (T75L-4201-A) or equivalent
 <p>ST1485-A</p>	Installer, Differential Shim 205-220 (T85L-4067-AH)
 <p>ST1375-A</p>	Installer, Differential Side Bearing 205-010 (T57L-4221-A2)
 <p>ST1543-A</p>	Step Plate 205-D061 (D83T-4205-C2) or equivalent

Removal

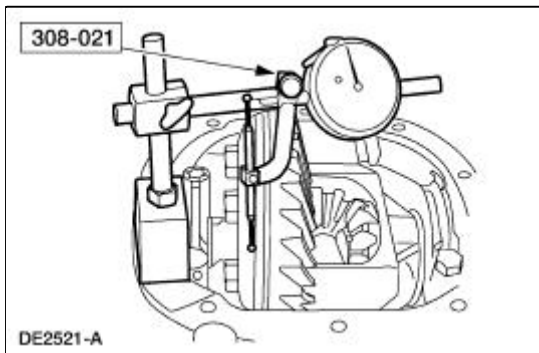
1. Remove the differential housing cover (4033) and drain the rear axle (4001). For additional information, refer to [Differential Housing Cover](#) in this section.
2.  **CAUTION:** Reinstall the differential pinion shaft (4211) and the bolt in the differential case (4204) after removing the axle shafts (4234).


Remove the axle shafts. For additional information, refer to [Axle Shaft](#) in this section.

3. Wipe the lubricant from the internal working parts and inspect the parts for wear and damage.
4. Rotate the differential assembly to check for roughness indicating bearing/gear damage.



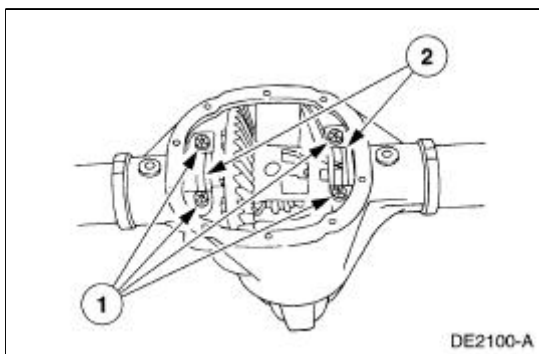
5. Using a suitable dial indicator and the special tool, measure and note the ring gear backface runout.




6.  **CAUTION:** Mark the position and location of the bearing caps, as the arrows may not be visible. Always install the bearing caps in their identical locations and positions.

Remove the bearing caps.

1. Remove the bolts.
2. Remove the bearing caps.

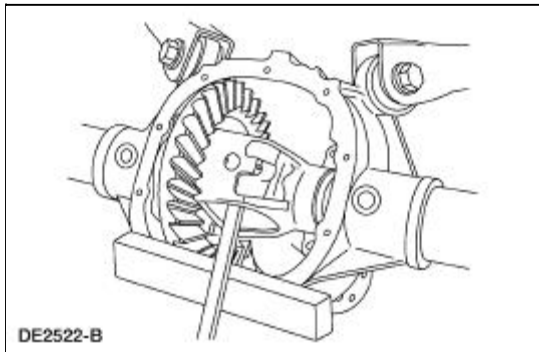


7.  **WARNING:** Do not allow the differential assembly to fall. Failure to follow these instructions may result in personal injury and component damage.

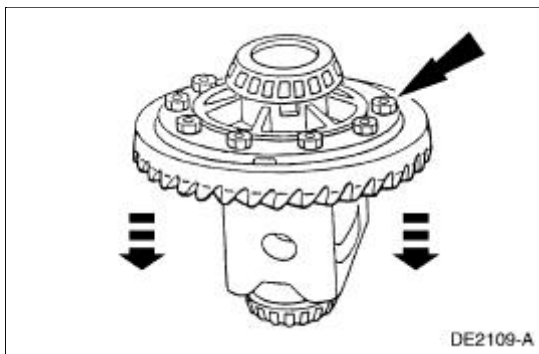
 **CAUTION:** Place a wood block between the pry bar and the differential housing

(4010) to protect the machined surface from damage.

Using a pry bar and a wood block, remove the differential assembly from the differential housing.

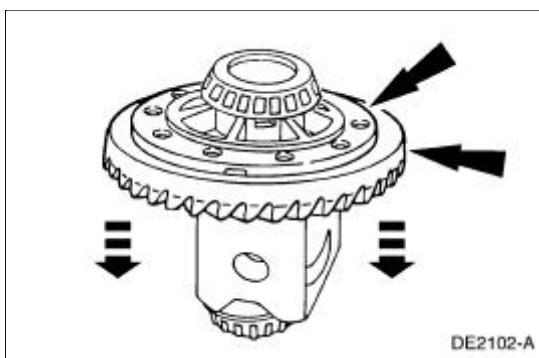


8. Remove the 10 bolts.

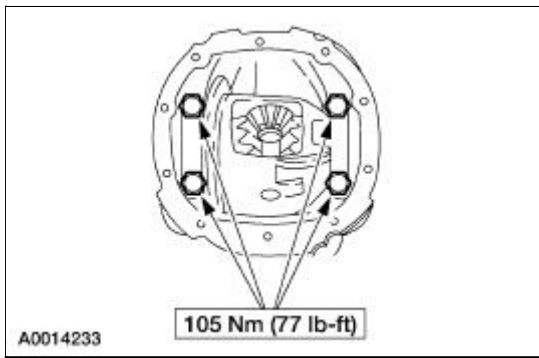


9.  **CAUTION: Do not damage the threads in the bolt holes.**

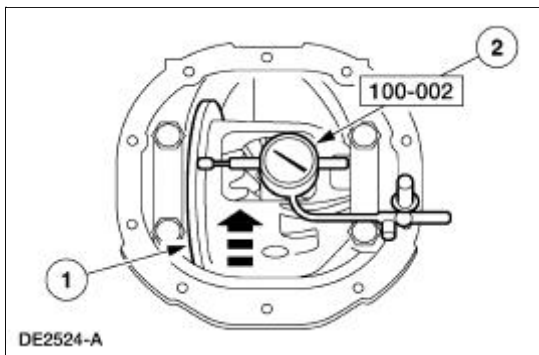
Insert a punch in the bolt holes, and drive off the ring gear.



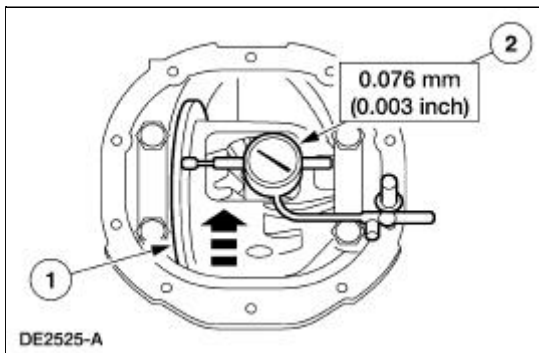
10. If the ring gear backface runout measurement, taken at the beginning of this procedure, did not exceed the specification, proceed to the appropriate procedure as necessary: [Drive Pinion](#), [Differential Case and Ring Gear—Conventional](#) or [Differential Case and Ring Gear—Traction-Lok®](#) in this section, or to Installation in this procedure. If the ring gear backface runout measurement, taken at the beginning of this procedure, exceeded the specification, the cause may be a warped ring gear, differential case/differential bearing damage. Proceed as follows to verify the cause of the excessive runout.
11. Position the differential assembly, including the differential bearing cups (4222) and differential bearing shims (4067), in the differential housing. Install the bearing caps and bolts.



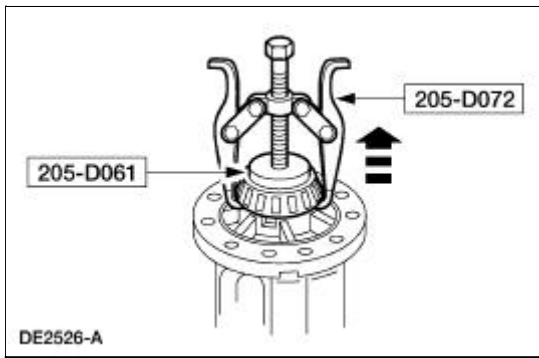
12. Position the special tool.
 1. Rotate the differential case to verify that the differential bearings (4221) have seated correctly.
 2. Position the special tool.



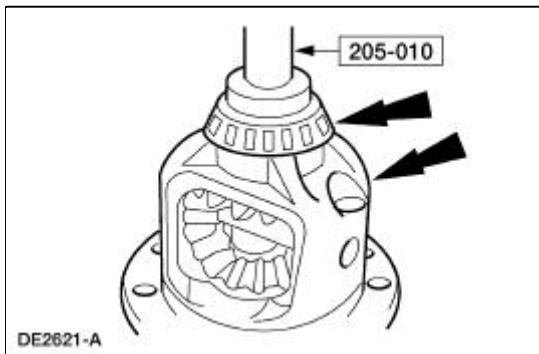
13. Measure and note the differential case runout.
 1. Rotate the differential case.
 2. Note the runout.
 - If the runout does not exceed the specification, install a new ring gear and drive pinion gear. For additional information, refer to [Drive Pinion](#) in this section and to Installation in this procedure.
 - If the runout exceeds the specification, the ring gear is true and the concern is due to either differential case/differential bearing damage. Proceed as follows.



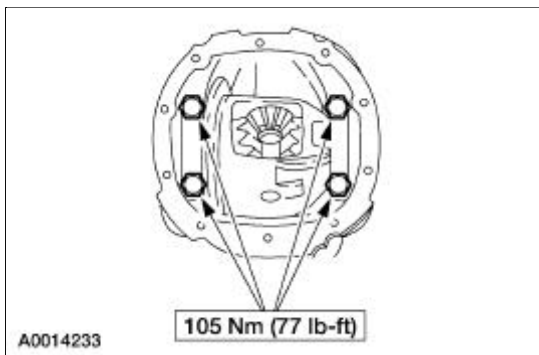
14. Remove the differential assembly from the differential housing.
15. Using the special tools, remove the differential bearings.



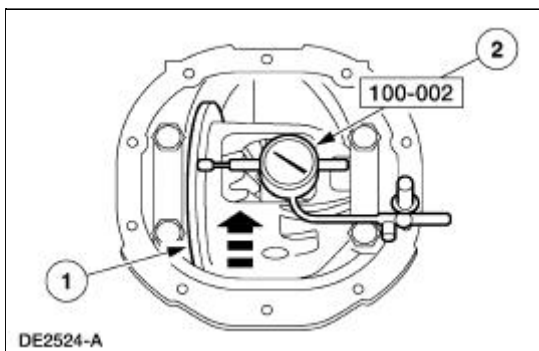
16. Using the special tool, install the new differential bearings.



17. Position the differential assembly, including the differential bearing cups and differential bearing shims, in the differential housing. Install the bearing caps and bolts.

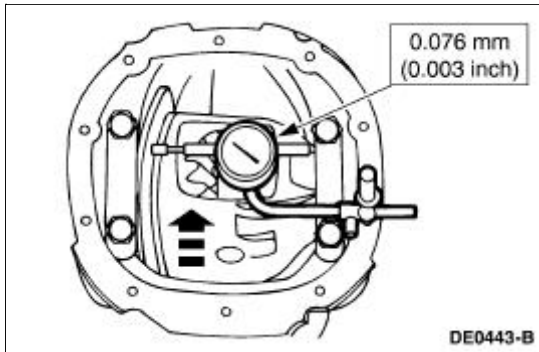


18. Position the special tool.
1. Rotate the differential case to verify that the differential bearings have seated correctly.
 2. Position the special tool.



19. Measure the differential case runout.

- If the runout does not exceed the specification, use the new differential bearings for assembly.
- If the runout exceeds the specification, install a new differential case. For additional information, refer to [Differential Case and Ring Gear—Conventional](#) or [Differential Case and Ring Gear—Traction-Lok®](#) in this section.

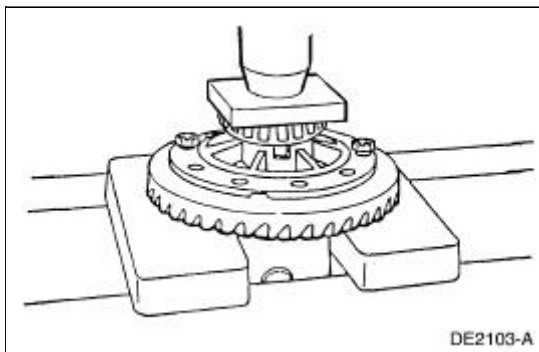


20. Remove the differential assembly from the differential housing.

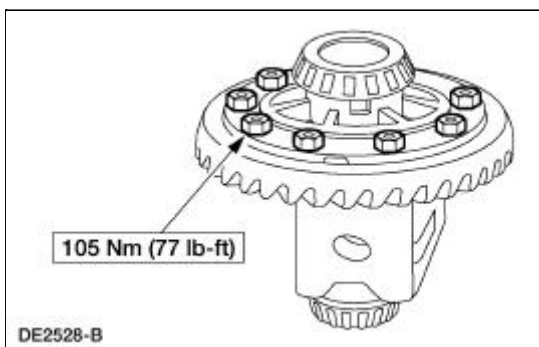
Installation

All axles

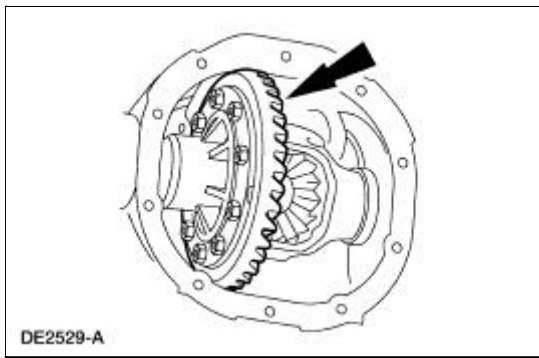
1. Position the ring gear and the differential case. Align the bolt holes by starting two bolts through the holes in the differential case and the ring gear. Press the ring gear on the differential case.



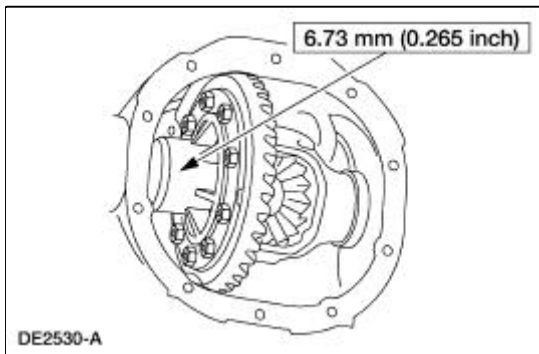
2. Install the bolts.
 - Apply Stud and Bearing Mount EOAZ-19554-BA or equivalent meeting Ford specification WSK-M2G349-A1 to the bolt threads.



3. With the pinion depth set and the pinion installed, place the differential assembly in the differential housing.



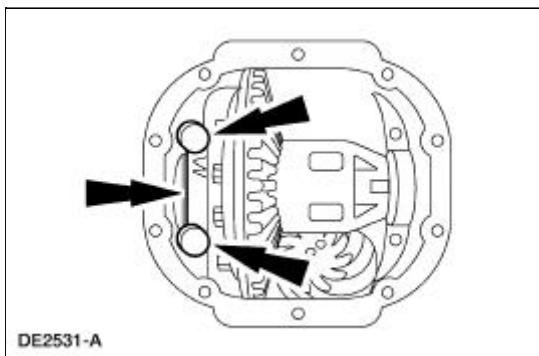
4. Install a differential bearing shim on the left side.



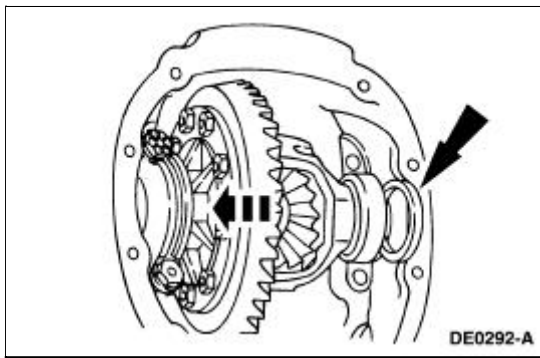
5.  **CAUTION:** Always install the bearing caps in their identical locations and positions.

NOTE: Apply pressure toward the left side to make sure the left differential bearing cup seats correctly.

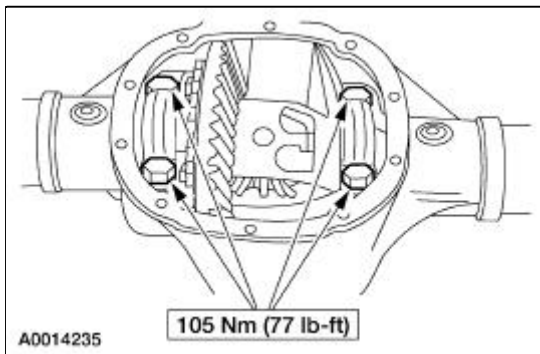
Install the left bearing cap and loosely install the bolts.



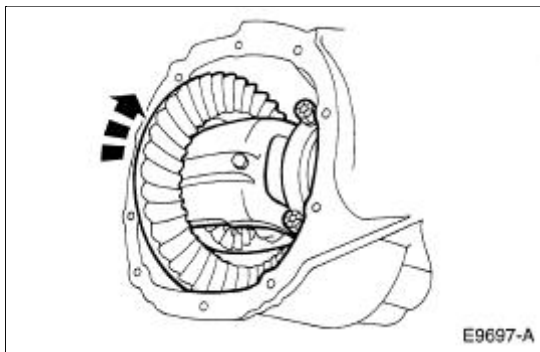
6. Install progressively larger differential bearing shims on the right side until the largest shim selected is installed by hand.



7. Install the right side bearing cap and tighten the left side and right side bolts to specification.



8. Rotate the differential assembly several times to verify that the differential bearings have seated correctly.

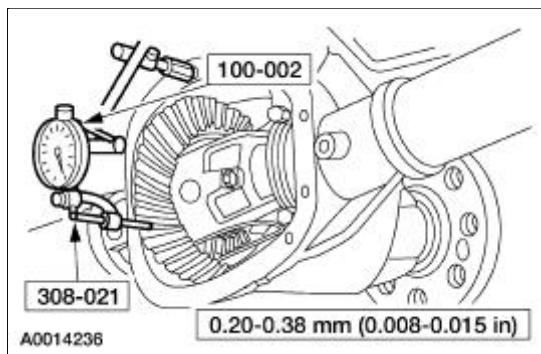


Measuring backlash

9. Using the special tools, measure the ring gear backlash.
 - If backlash is within the specification, refer to Backlash within specification in this procedure. The specification shown is the full allowable range. For the preferred range, refer to Specifications in this section.
 - If a zero backlash condition occurs, refer to Zero backlash in this procedure.
 - If backlash is not within the specification, refer to Backlash not within specification in this procedure.

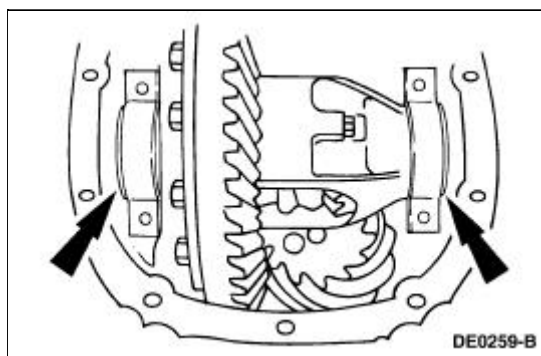
Backlash Change Required		Thickness Change Required	
mm	Inch	mm	Inch
0.025	0.001	0.050	0.002
0.050	0.002	0.050	0.002

0.076	0.003	0.101	0.004
0.101	0.004	0.152	0.006
0.127	0.005	0.152	0.006
0.152	0.006	0.203	0.008
0.177	0.007	0.254	0.010
0.203	0.008	0.254	0.010
0.228	0.009	0.304	0.012
0.254	0.010	0.355	0.014
0.279	0.011	0.355	0.014
0.304	0.012	0.406	0.016
0.330	0.013	0.457	0.018
0.335	0.014	0.457	0.018
0.381	0.015	0.508	0.020

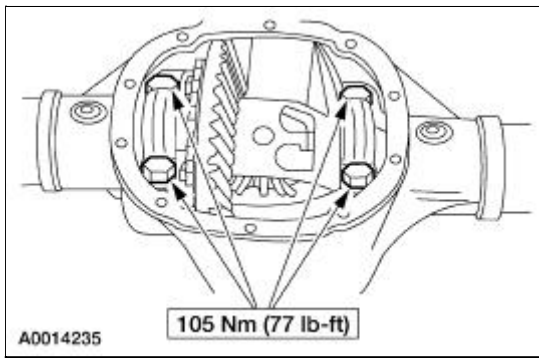


Zero backlash

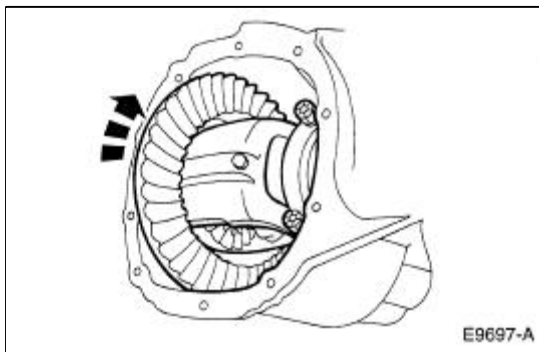
10. If a zero backlash condition occurs, remove the bearing caps and add 0.51 mm (0.020 inch) to the RH side and subtract 0.51 mm (0.020 inch) from the LH side to allow backlash indication.



11. Install the bearing caps and the bolts.



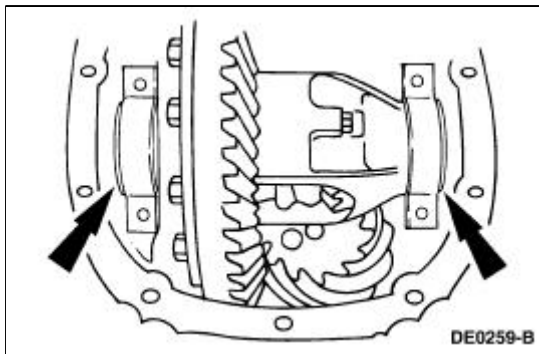
12. Rotate the differential assembly several times to verify that the differential bearings have seated correctly.



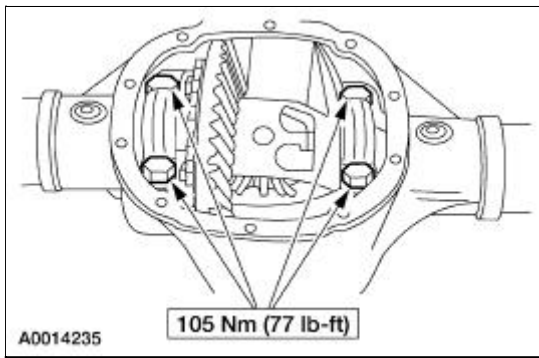
13. Measure the backlash. Refer to Measuring backlash in this procedure.

Backlash not within specification

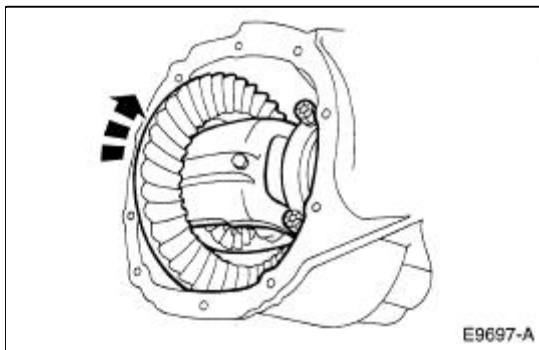
14. To increase or decrease the backlash, remove the bearing caps and install a thicker shim and thinner shim accordingly.
 - If backlash is not within the specification, increase the thickness of one differential bearing shim and decrease the thickness of the other differential bearing shim by the same amount.



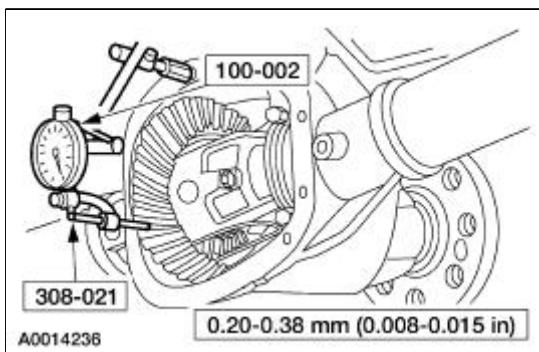
15. Install the bearing caps and the bolts.



16. Rotate the differential several times to verify that the differential bearings have seated correctly.

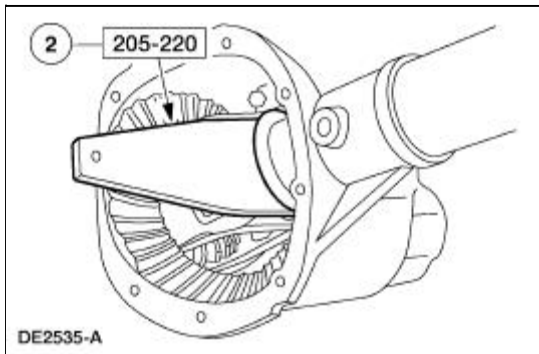
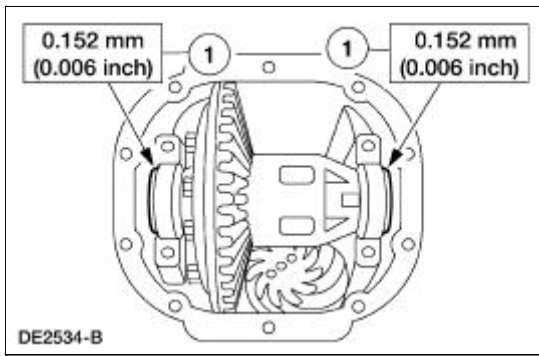


17. Using the special tools, recheck the backlash.
- If backlash is within the specification, go to Backlash within specification in this procedure. If backlash is not within the specification, repeat Backlash not within specification in this procedure.
 - The specification shown is the full allowable range. For the preferred range, refer to Specifications in this section.

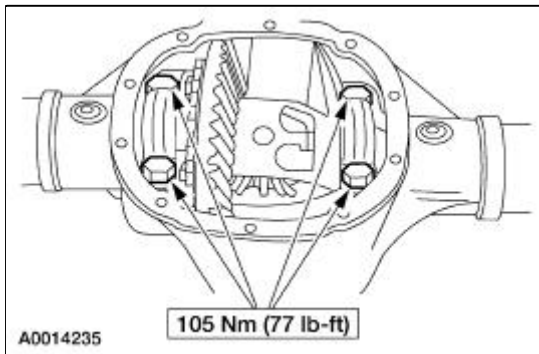


Backlash within specification

18. Remove the bolts and bearing caps.
19. Set the differential bearing preload.
1. To establish differential bearing preload, increase both left and right differential bearing shim sizes by the specification shown.
 2. Using the special tool, fully seat the differential bearing shims. Make sure the assembly rotates freely.

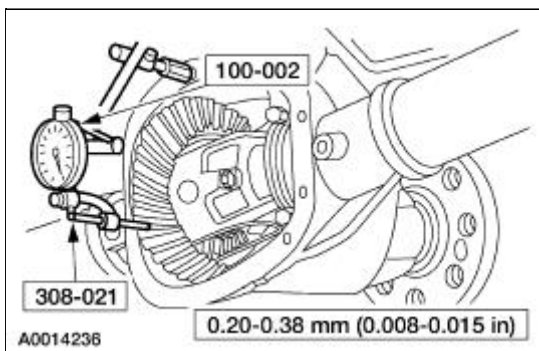


20. Install the bearing caps and bolts.



21. Using the special tools, recheck the backlash.

- The specification shown is the full allowable range. For the preferred range, refer to Specifications in this section.



22. Install the axle shafts. For additional information, refer to [Axle Shaft](#) in this section.

23. Install the differential housing cover and refill the rear axle with specified lubricant. For additional information, refer to [Differential Housing Cover](#) in this section.

24. Lower the vehicle.

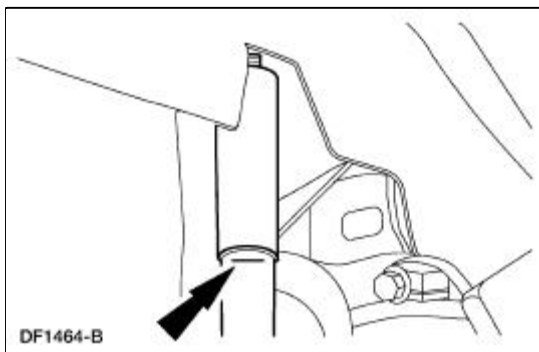
Axle Housing

Removal and Installation

1.  **CAUTION:** The vehicle must be on level ground and at curb height.

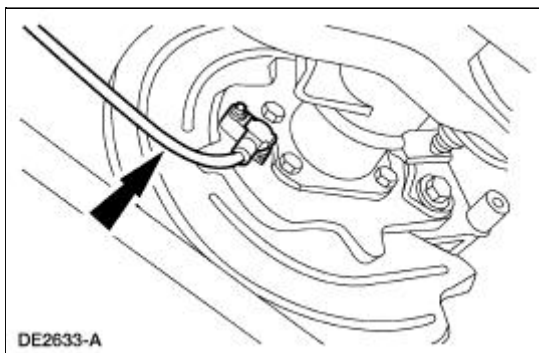
Mark the rear shock absorbers relative to their protective sleeve.

- During installation, raise the suspension to this reference mark before tightening the suspension fasteners.

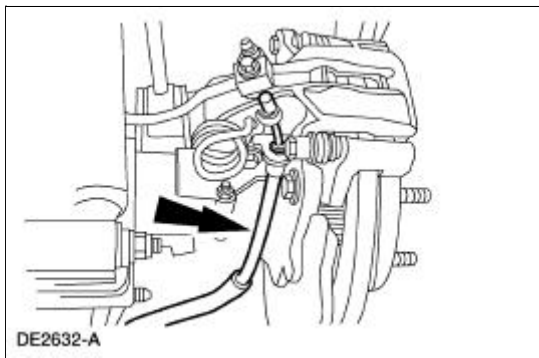


2. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
3. Remove the rear wheel and tire assemblies. For additional information, refer to [Section 204-04](#).
4. **NOTE:** If necessary, use Rust Penetrant and Inhibitor F2AZ-19A501-A meeting Ford specification ESR-M99C56-A to loosen the sensor for removal.

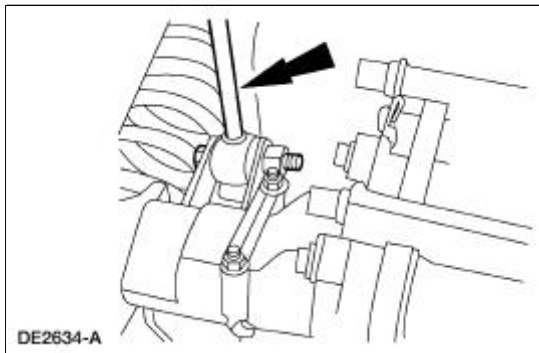
Remove the rear anti-lock brake sensors from the rear disc brake adapters. For additional information, refer to [Section 206-09A](#).



5. Disconnect the parking brake cables and conduits from the rear disc brake calipers. For additional information, refer to [Section 206-05](#).



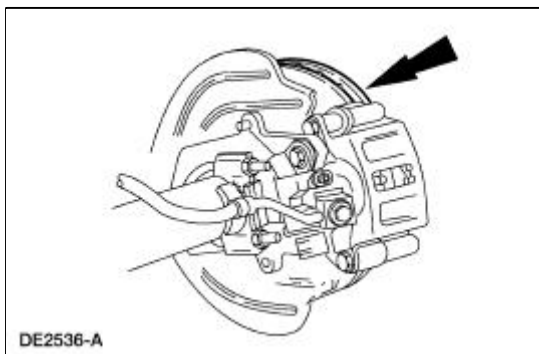
6. Disconnect the rear axle drive line vibration damper from the axle.




7.  **CAUTION:** Index-mark the brake discs and the wheel studs prior to brake disc removal.

 **CAUTION:** Do not allow the calipers to hang from the brake hoses.

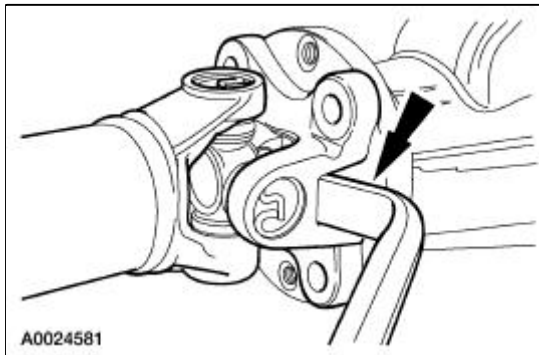
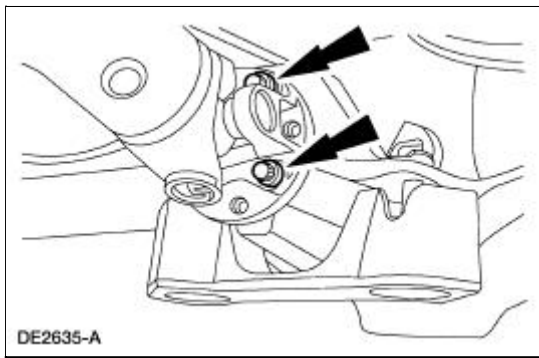
Remove the rear brake discs. For additional information, refer to [Section 206-04](#).



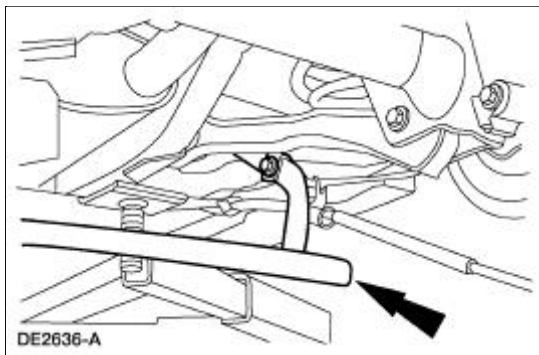
8.  **CAUTION:** Index-mark the driveshaft flange and pinion flange (4851) to maintain initial balance during installation.

 **CAUTION:** The driveshaft centering socket yoke fits tightly on the pinion flange pilot. Never hammer on the driveshaft or any of its components to disconnect the yoke from the flange. Pry only in the area shown, with a suitable tool, to disconnect the yoke from the flange.

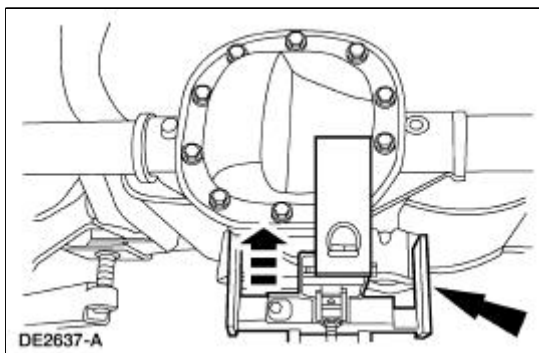
Disconnect and position the driveshaft out of the way. For additional information, refer to [Section 205-01](#).



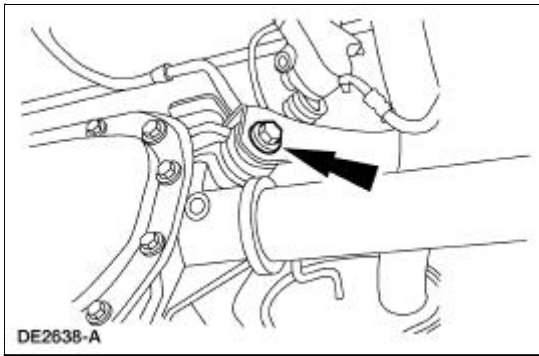
9. Remove the stabilizer bar. For additional information, refer to [Section 204-02](#).



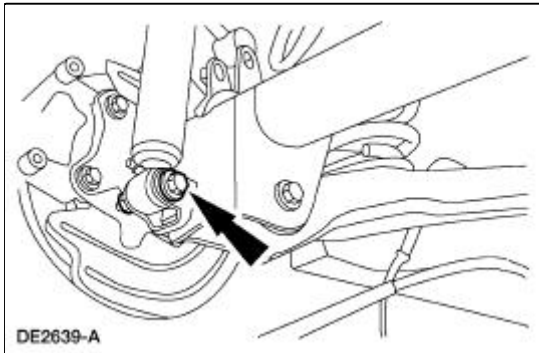
10. Position a suitable transmission jack under the differential housing (4010) for support and strap it securely in place.



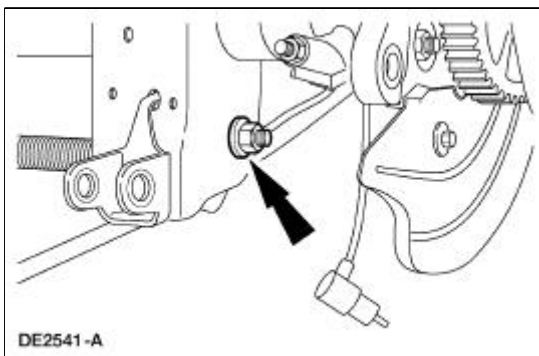
11. Remove and discard the nuts and bolts retaining the upper suspension arm and bushings to the differential housing.



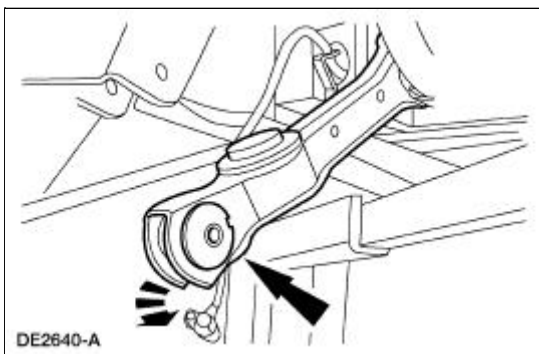
12. Remove and discard the nuts and bolts retaining the shock absorbers to the axle.



13. Lower the differential housing to unload the rear springs.
14. Remove the rear springs.
15. Remove and discard the nuts and bolts retaining the lower suspension arm and bushings to the axle.





16. Disconnect the lower suspension arm and bushings from the axle.



17. Remove the axle from the vehicle.

18.  **CAUTION:** Align the index marks on the driveshaft centering socket yoke and the pinion flange.

 **CAUTION:** Install the driveshaft with new bolts. If new bolts are not available, apply Threadlock and Sealer EOAZ-19554-AA or equivalent meeting Ford specification WSK-M2G351-A5 to the threads of the original bolts.

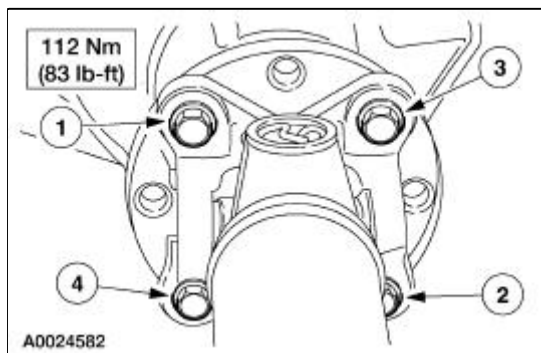
 **CAUTION:** The driveshaft centering socket yoke fits tightly on the pinion flange pilot. To make sure that the yoke seats squarely on the flange, tighten the bolts evenly in a cross pattern as shown.

 **CAUTION:** Raise the suspension to the reference marks on the rear shock absorbers before tightening the suspension fasteners.

NOTE: Apply High Temperature Nickel Anti-Sieze Lubricant F6AZ-9L494-AA meeting Ford specification ESE-M124A-A to the rear anti-lock brake sensor body where it will make contact when installed.


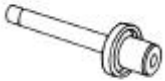

Follow the removal procedure in reverse order.

- Refer to [Section 204-02](#) for rear suspension fastener tightening specifications.
- Refer to [Section 204-04](#) for wheel nut tightening specification.



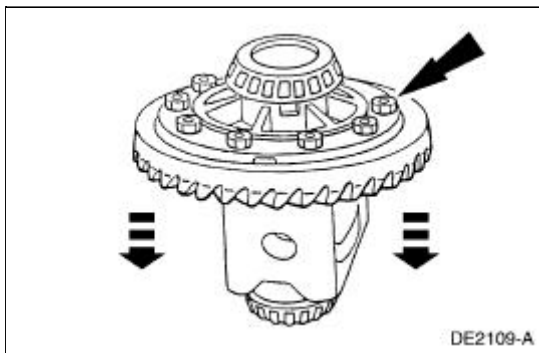
Differential Case and Ring Gear —Conventional

Special Tool(s)

 ST2026-A	2-Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1375-A	Installer, Differential Side Bearing 205-010 (T57L-4221-A2)
 ST1543-A	Step Plate 205-D061 (D83T-4205-C2) or equivalent

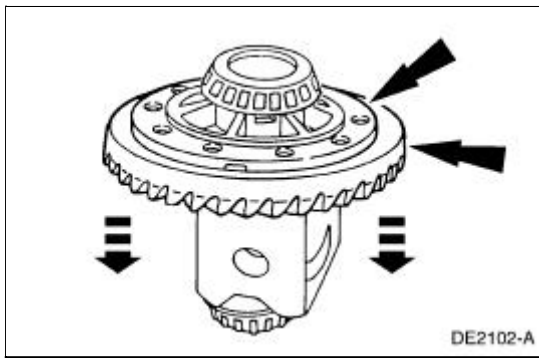
Disassembly

1. Remove the differential assembly from the differential housing. For additional information, refer to [Differential Case](#) in this section.
2. Remove the bolts.

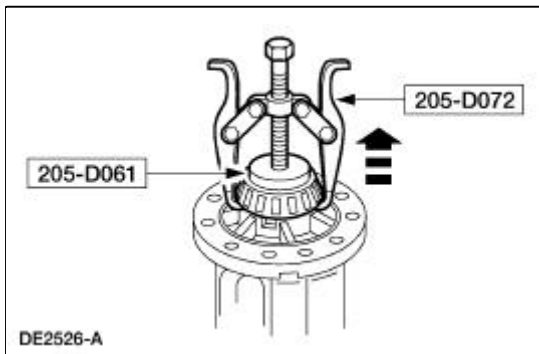


3.  **CAUTION: Do not damage the threads in the bolt holes.**

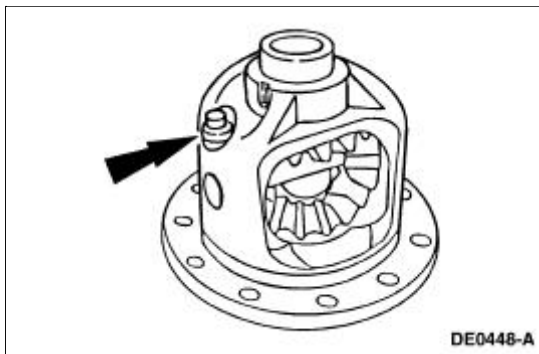
Insert a punch in the bolt holes and drive off the ring gear.



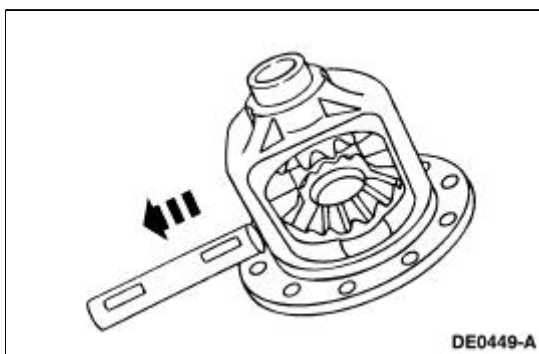
4. Using the special tools, remove the differential bearings (4221), if necessary.



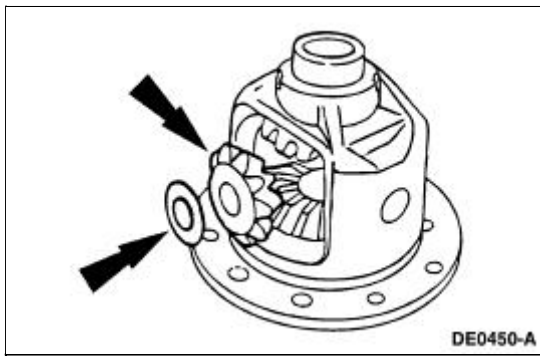
5. Remove the bolt.



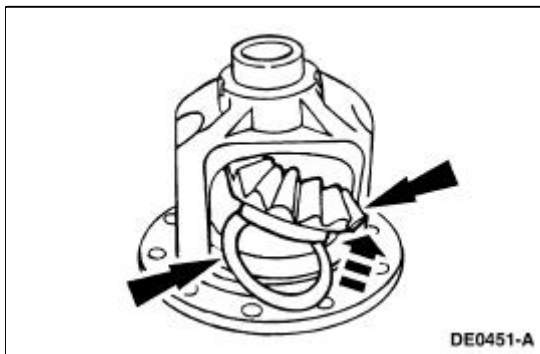
6. Remove the differential pinion shaft (4211).



7. Rotate and remove the differential pinion gears (4215) and differential pinion thrust washers (4230).

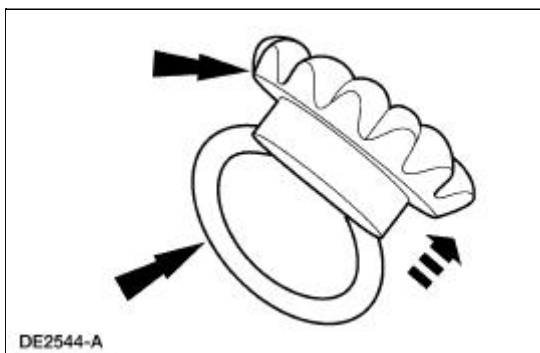


8. Remove the differential side gears (4236) and the differential side gear thrust washers (4228).

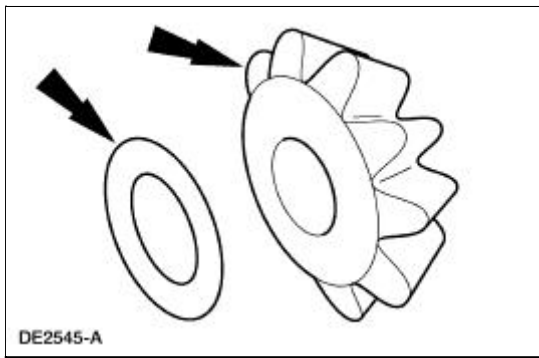


Assembly

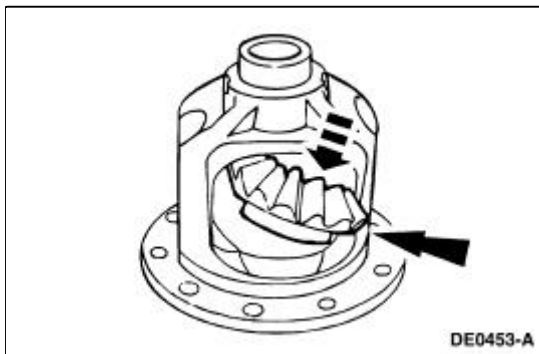
1. Lubricate the differential side gear thrust washers and the differential side gear journals, and assemble the washers to the gears.
 - Use SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A.



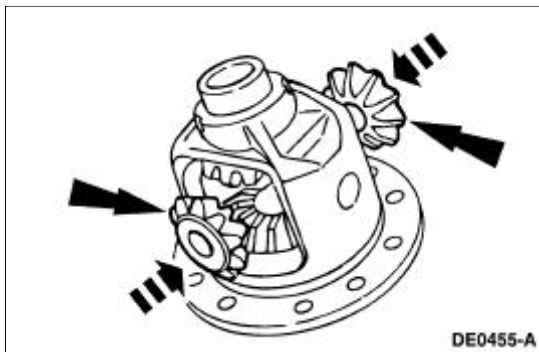
2. Lubricate the differential pinion thrust washers and the differential pinion gears, and assemble the washers to the gears.
 - Use SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A.



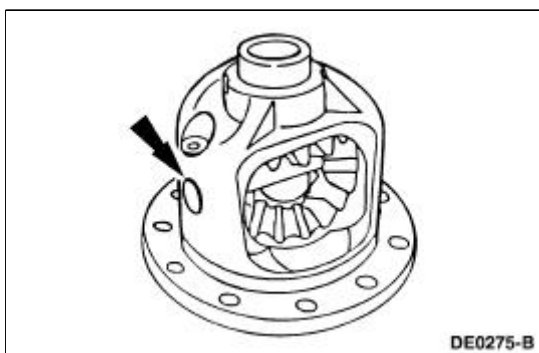
3. Position the differential side gear and thrust washer assemblies in the differential case.



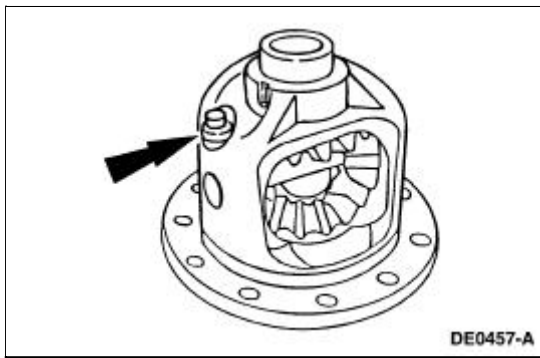
4. Engage the differential pinion gears with the differential side gears and rotate the pinion gears to align with the differential pinion shaft bore.



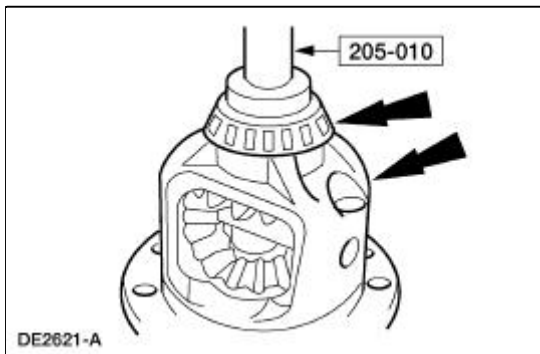
5. Insert the differential pinion shaft.
 - Align the hole in the differential pinion shaft with the hole in the differential case.



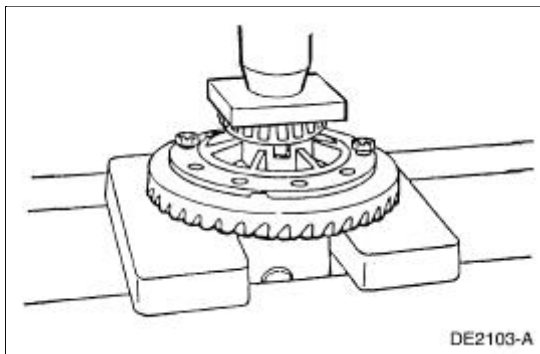
6. Install a new bolt finger-tight.



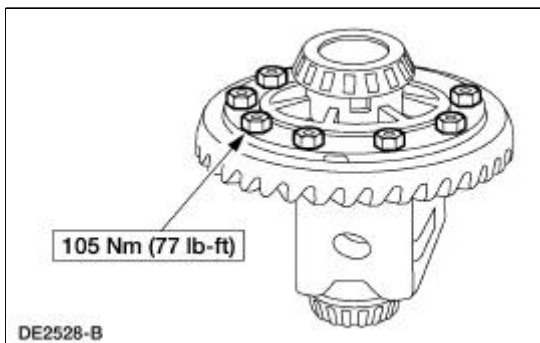
- Using the special tool, install the new differential bearings, if removed.



- Position the ring gear and the differential case. Align the bolt holes by starting two bolts through the holes in the differential case and the ring gear. Press the ring gear on the differential case.



- Install the bolts.
 - Apply Stud and Bearing Mount EOAZ-19554-BA or equivalent meeting Ford specification WSK-M2G349-A1 to the bolt threads.




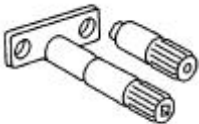

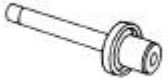

- Install the differential assembly. For additional information, refer to [Differential Case](#) in this

section.



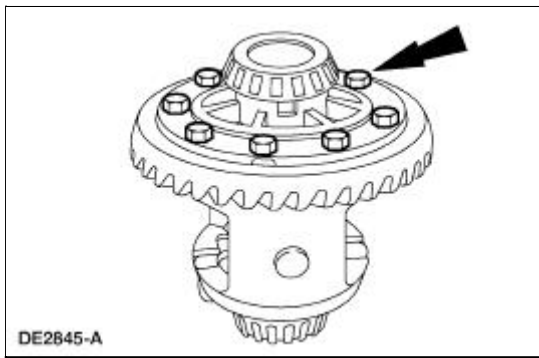
Differential Case and Ring Gear —Traction-Lok®

Special Tool(s)

 ST2026-A	2-Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1265-A	Gauge, Differential Clutch 205-022 (T66L-4204-A)
 ST1374-A	Gauge, Differential Clutch 205-135 (T80P-4946-A)
 ST1375-A	Installer, Differential Side Bearing 205-010 (T57L-4221-A2)
 ST1543-A	Step Plate 205-D061 (D83T-4205-C2) or equivalent

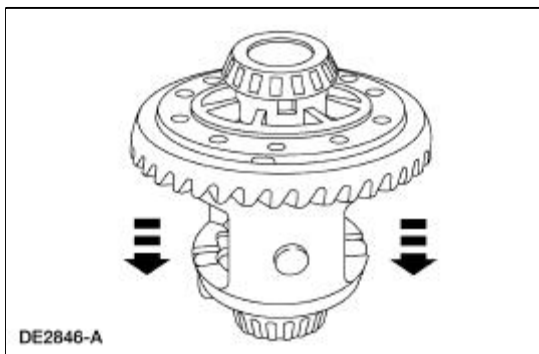
Disassembly

1. Remove the differential assembly from the differential housing. For additional information, refer to [Differential Case](#) in this section.
2. Remove the 10 bolts.

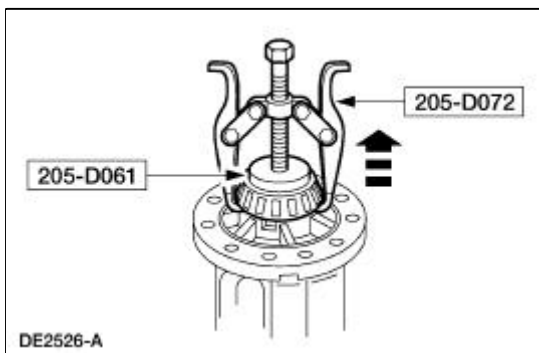


3.  **CAUTION: Do not damage the threads in the bolt holes.**

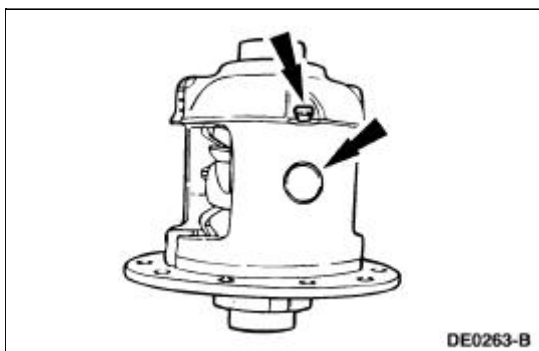
Insert a punch in the bolt holes, and drive off the ring gear.



4. Using the special tools, remove the differential bearings (4221), if necessary.



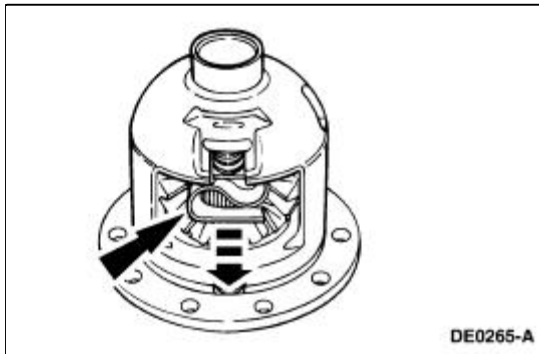
5. Remove the bolt and the differential pinion shaft (4211).



6.  **WARNING: Due to the spring tension, use care when removing the differential**

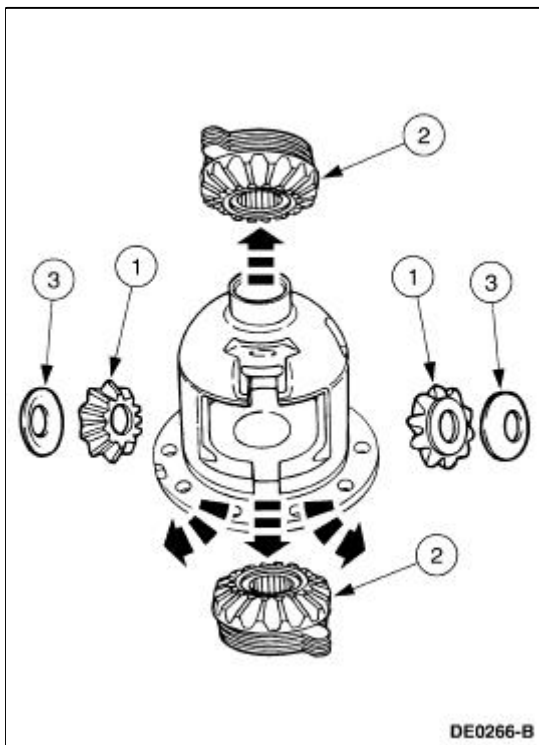
clutch spring (4214). Failure to follow these instructions may result in personal injury.

Remove the differential clutch spring.



7. Remove the differential gears.

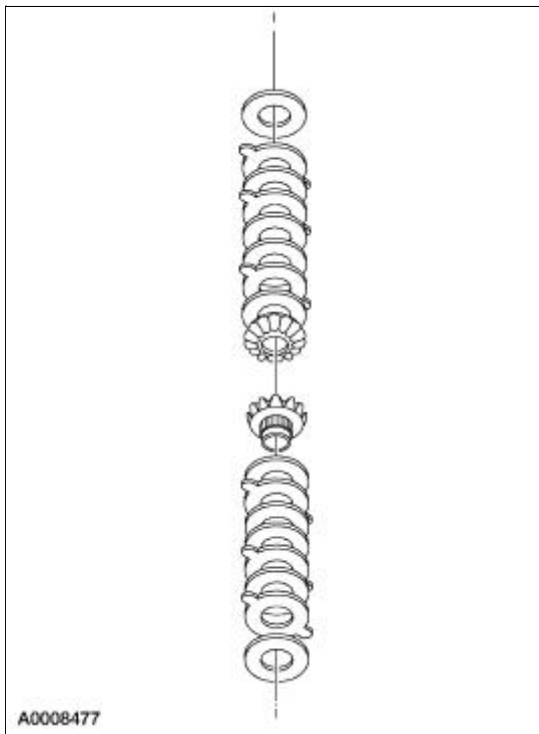
1. Remove the two differential pinion gears (4215).
2. Remove the two differential side gears (4236).
3. Remove the two differential pinion thrust washers (4230).



8.  **CAUTION: Keep the differential clutch packs (4947) in order. Do not mix them. Always reassemble them in the same sequence.**

Separate the differential clutch packs and shims from the differential side gears and tag them "right" and "left".

- Clean and inspect the remaining differential components for wear and damage and install new parts as necessary.



9.  **CAUTION: Do not use acids or solvents when cleaning the differential clutch pack. Wipe components only with a clean, lint-free cloth.**

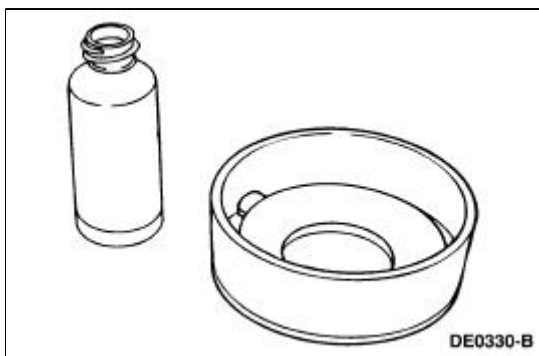
Clean and inspect the differential clutch packs for wear and damage and install new parts as necessary.


Assembly

1.  **CAUTION: 118 ml (4 oz) of the specified Ford Friction Modifier must be used in the axle.**

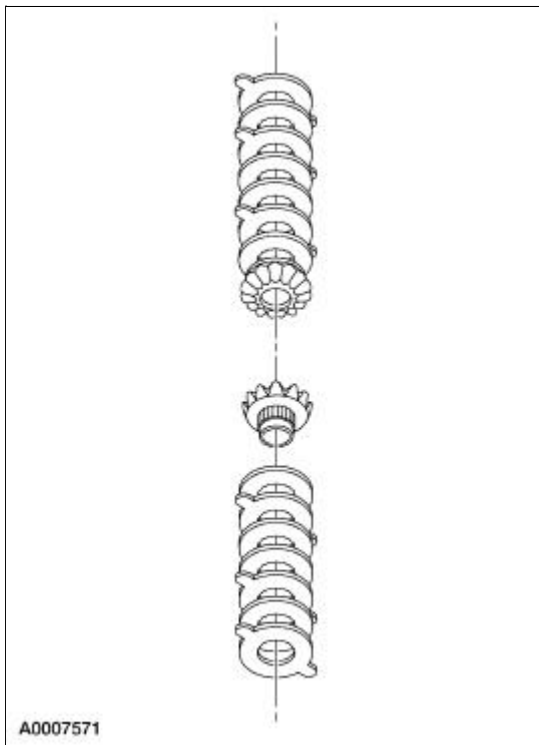
Lubricate each steel clutch plate and soak all friction plates for no less than 15 minutes.

- Use Additive Friction Modifier C8AZ-19B546-A or equivalent meeting Ford specification EST-M2C118-A

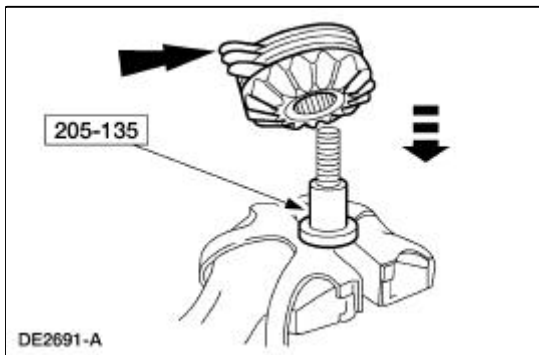


2.  **CAUTION: Do not mix the differential clutch packs or shims from one side with the other.**

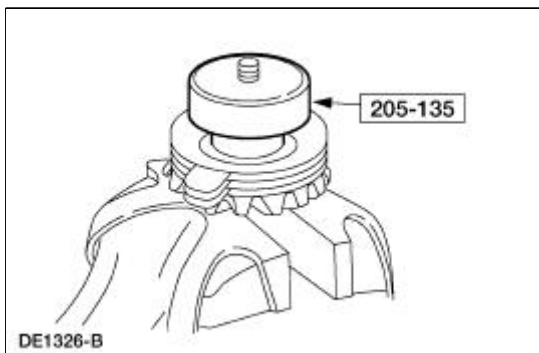
Assemble the differential clutch packs (without the shims) on their respective differential side gears.



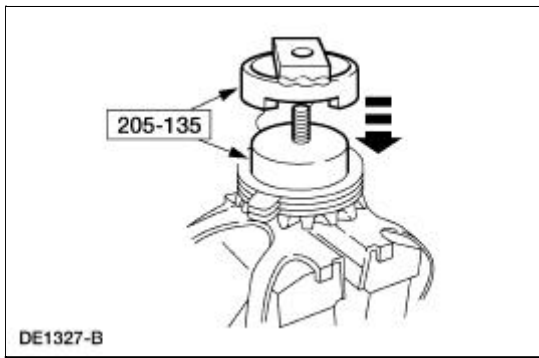
3. Place the base portion of the special tool in a vise. Install the differential differential side gear and differential clutch pack (without the shim) on the tool.



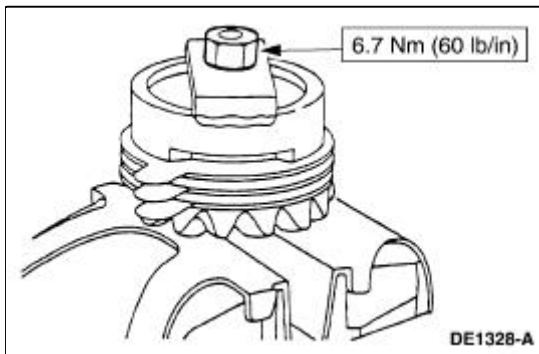
4. Position the special tool hand-tight on top of the differential clutch pack.



5. Install the special tool over the disc and differential clutch pack.



6. Install the nut.

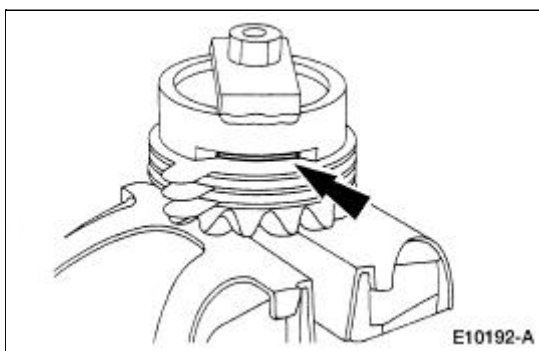


7. **NOTE:** Clutch Pack Rebuild Kit F5AZ-4947-A is available for this application.

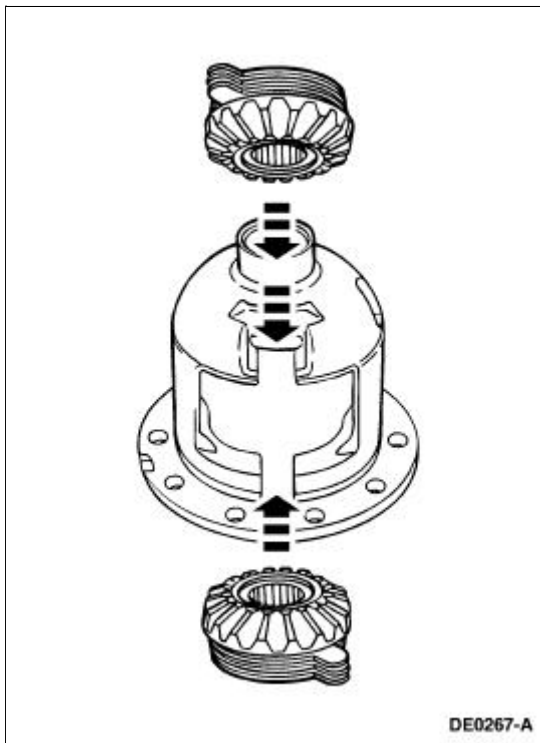
Select and insert the thickest feeler gauge blade that will enter between the tool and the differential clutch pack. The reading will be the thickness of the new clutch shim.

Selective Shims

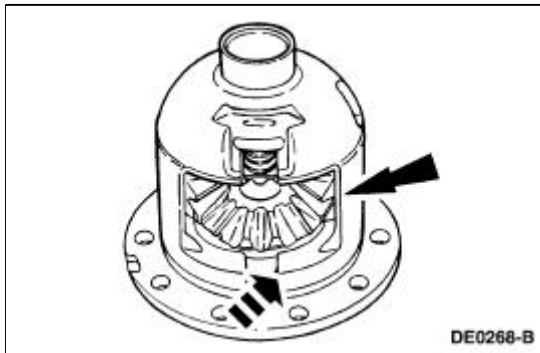
Part Number	Description
EOAZ-4A324-G	0.025 Inch
EOAZ-4A324-H	0.030 Inch
EOAZ-4A324-C	0.035 Inch
EOAZ-4A324-D	0.040 Inch
EOAZ-4A324-F	0.045 Inch



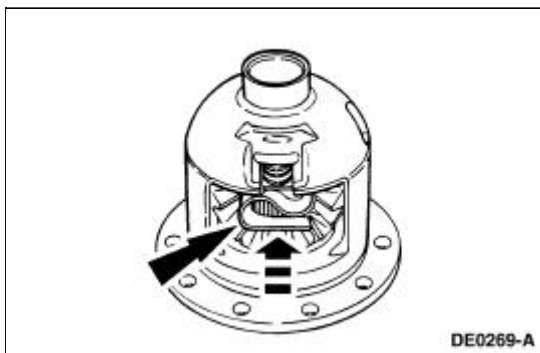
8. Remove the special tools from the differential clutch pack and differential side gear assembly.
9. Install shim(s) on the differential clutch pack and differential side gear assembly.
10. Install the differential side gear assemblies in the differential case.



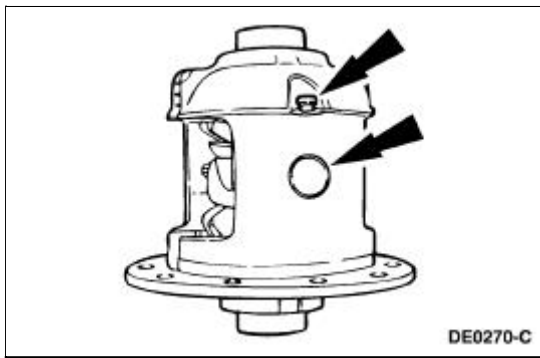
11. Install the differential pinion gear and differential pinion thrust washer assemblies in the differential case.



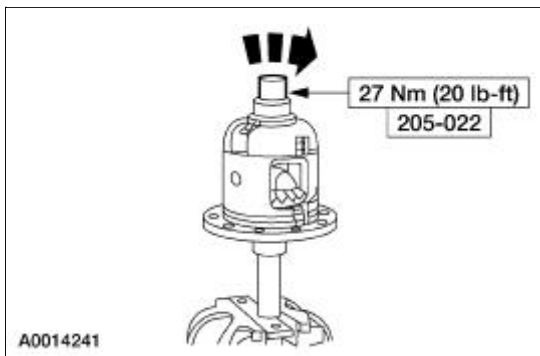
12. Using a soft-faced hammer, install the differential clutch spring.



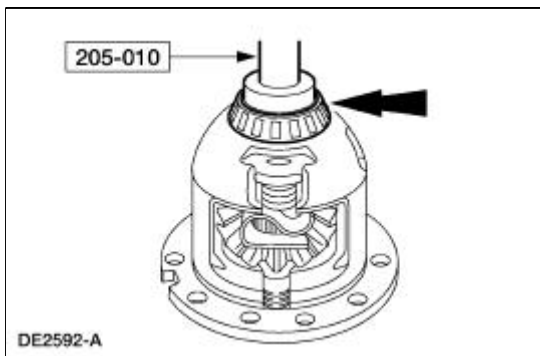
13. Install the differential pinion shaft and install a new bolt finger-tight.



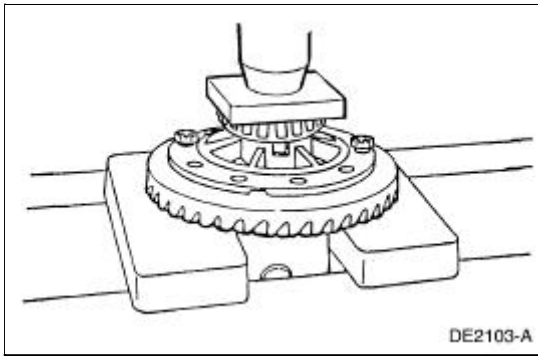
14. Mount the differential case and the special tool in a vise. Using the special tool, check the torque necessary to rotate one differential side gear.
 - If reusing the original clutch plates, the initial minimum break-away torque must be no less than the specification. The minimum rotating torque necessary to keep the differential side gear turning with new clutch plates may vary.



15. Using the special tool, install the differential bearings, if removed.

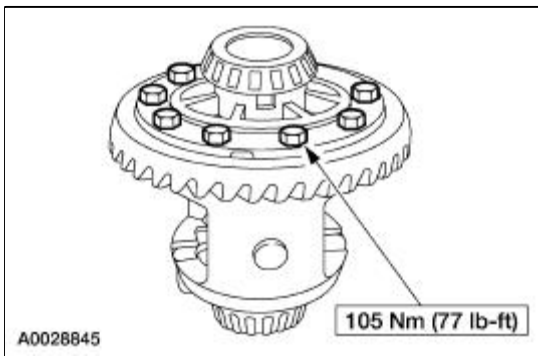


16. Position the differential ring gear and the differential case. Align the bolt holes by starting two bolts through the holes in the differential case and the differential ring gear. Press the differential ring gear on the differential case.



17. Install the bolts.

- Apply Stud and Bearing Mount EOAZ-19554-BA or equivalent meeting Ford specification WSK-M2G349-A1 to the bolt threads.



18. Install the differential assembly in the differential housing. For additional information, refer to [Differential Case](#) in this section.

General Specifications

Item	Specification
Lubricants/Adhesive/Sealants	
Premium Long-Life Grease XG-1-C	ESA-M1C75-B
SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B	WSL-M2C192-A
Additive Friction Modifier C8AZ-19B546-A	EST-M2C118-A
Clear Silicone Rubber F7AZ-19554-CA	ESB-M4G92-A
Stud and Bearing Mount EOAZ-19554-BA	WSK-M2G349-A1
Threadlock and Sealer EOAZ-19554-AA	WSK-M2G351-A5
High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA	ESE-M12A4-A
Capacity	
Additive Friction Modifier	118 ml (4 oz)
Rear axle lubricant	1.23-1.37 liters (2.6-2.9 pints)
Rear axle lubricant level	6.35 mm (1/4 inch) from the bottom of the fill hole
Clearance, Tolerance and Adjustments	
Maximum carrier spread	0.762 mm (0.030 in)
Maximum differential ring gear backface runout	0.076 mm (0.003 in)
Maximum differential case runout	0.076 mm (0.003 in)
Backlash between differential ring gear and pinion teeth	0.203 mm (0.008 in)-0.330 mm (0.013 in)
Preferred backlash	0.254 mm (0.010 in)
Maximum backlash variation between teeth	0.1016 mm (0.004 in)
Maximum radial runout of rear axle pinion flange in assembly TIR	0.254 mm (0.010 in)
Available drive pinion bearing adjustment shim in steps of: 0.0254 mm (0.001 in)	0.254 mm (0.010 in)-0.965 mm (0.038 in)
Lubricant deflector to differential housing cover	5.08 mm (0.200 in)-6.35 mm (0.250 in)

Torque Specifications

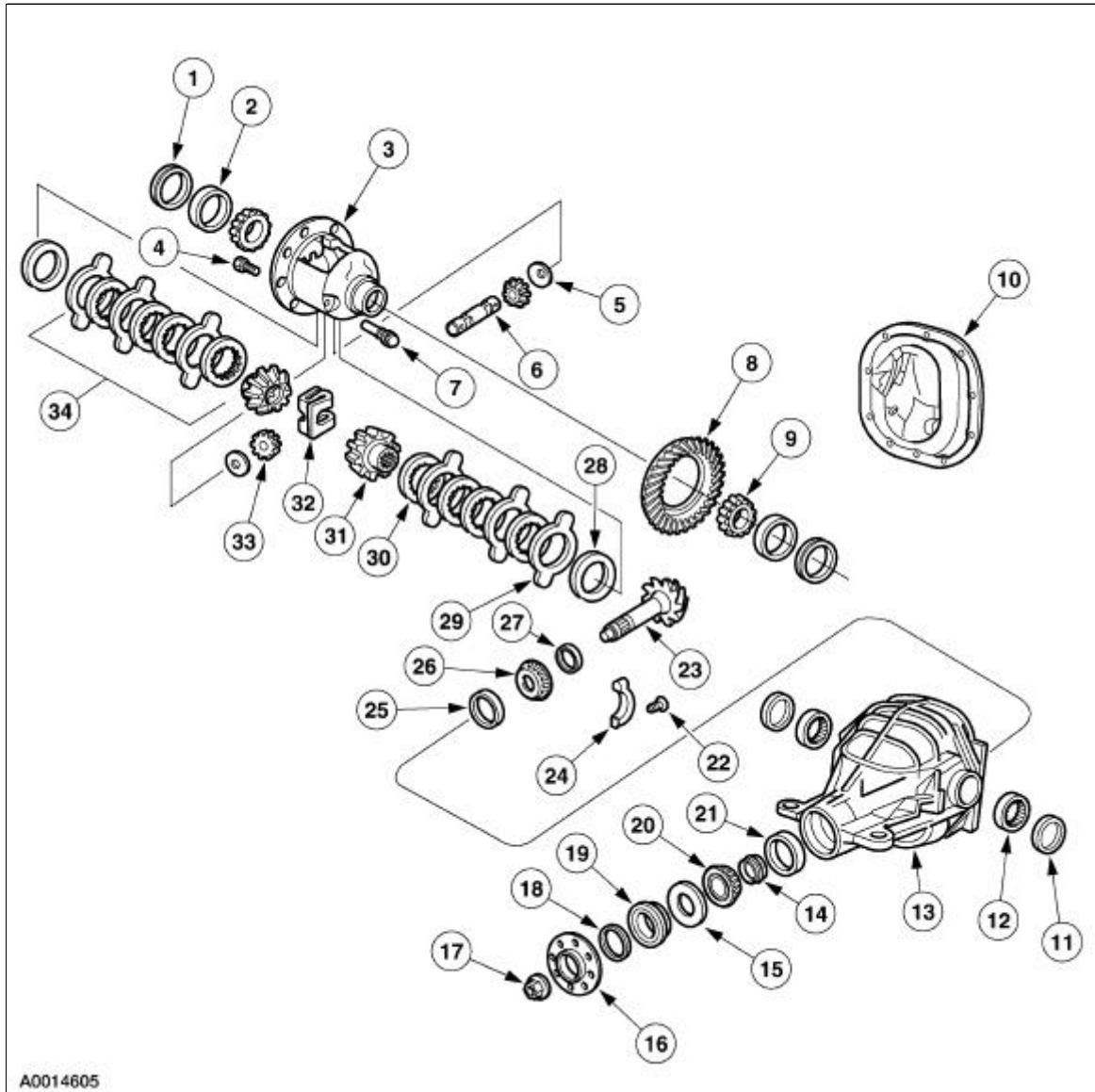
Description	Nm	lb-ft	lb-in
Rear axle wheel hub retainer	340	251	—
Driveshaft to pinion flange bolt	112	83	—
Rear axle differential front lower insulator nut and bolt	70	52	—
Rear axle differential rear insulator bolt	103	76	—

Pinion nose crossmember nut	250	184	—
Toe link nut	47	35	—
Shock absorber to lower suspension arm and bushing	133	98	—
Knuckle to lower suspension arm and bushing	115	85	—
Knuckle to upper suspension arm and bushing	90	66	—
Filler plug	34	25	—
Ring gear bolt ^a	105	77	—
Differential pinion shaft lock bolt	30	22	—
Bearing cap bolt	105	77	—
Differential housing cover bolt	32	24	—
Pinion bearing preload — (drive pinion collapsible spacer) used bearings ^b	0.9-1.16	—	8-14
New pinion bearings	1.8-3.2	—	16-29
Traction-Lok® clutch gauge nut	6.7	—	60
Initial minimum breakaway torque	27	20	—

^a Use Stud and Bearing Mount EOAZ-19554-BA or equivalent meeting Ford specification WSK-M2G349-A1.

^b With pinion flange yoke seal.

Rear Drive Axle and Differential



A0014605

Item	Part Number	Description
1	4067	Differential bearing shim
2	4222	Differential bearing cup
3	4204	Differential case
4	4216	Differential ring gear case bolt
5	4230	Differential pinion thrust washer
6	4211	Differential pinion shaft
7	4241	Differential pinion shaft lock bolt
8	—	Differential ring gear (part of 4209)
9	4221	Differential bearing

10	4033	Differential housing cover
11	4B416	Inboard CV joint stub shaft pilot bearing housing seal
12	4B413	Inboard CV joint stub shaft pilot bearing
13	4010	Differential housing
14	4662	Differential drive pinion collapsible spacer
15	4670	Rear axle drive pinion shaft oil slinger
16	4851	Rear axle pinion flange
17	389546-S100	Pinion nut
18	4859	Drive pinion oil seal deflector
19	4676	Rear axle drive pinion seal
20	4621	Pinion bearing
21	4616	Differential drive pinion bearing cup
22	56187-S	Bolt
23	—	Drive pinion gear (part of 4209)
24	—	Differential bearing cap (part of 4010)
25	4628	Rear axle pinion bearing cup
26	4630	Pinion bearing
27	4663	Drive pinion bearing adjustment shim
28	4A321	Rear axle differential clutch shim
29	—	Clutch plate (part of 4947)
30	—	Clutch disc (part of 4947)
31	4236	Differential side gear
32	4214	Differential clutch spring
33	4215	Differential pinion gear
34	4947	Differential clutch pack

- The differential housing (4010) consists of a cast aluminum housing and a cast aluminum differential housing cover (4033). The differential housing cover uses silicone sealant as a gasket.
- The hypoid-design gearset consists of a 8.8-inch differential ring gear and a drive pinion gear. Two opposed pinion bearings (4621) (4630) support the drive pinion gear in the differential housing.
- A differential drive pinion collapsible spacer (4662), located on the drive pinion gear shaft, maintains pinion bearing preload. The pinion nut adjusts the preload.
- Differential bearing shims (4067), located between the differential bearing cups (4222) and the differential housing, adjust the differential ring gear backlash and the differential bearing preload.
- The differential case (4204) is a one-piece design with two openings to allow for assembly of the internal components and lubricant flow. Two opposed differential bearings (4221) support the differential case in the differential housing. Removable differential bearing caps retain the differential assembly in the differential housing.
- Inside the differential case, the differential pinion shaft (4211) supports two differential pinion gears (4215). The pinion gears engage the differential side gears (4236), to which the halfshafts

are splined. The differential pinion shaft lock bolt retains the differential pinion shaft in the differential case.

- A circlip, located on the inboard CV joint stub shaft, holds the halfshaft in the differential case. When installed, the circlip engages a groove in the differential side gear.
 - The rear axle uses SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A.
 - An embossed metal tag, bolted to the differential housing cover, contains rear axle identification. For additional information, refer to [Section 205-00](#).
-

Stub Shaft Pilot Bearing and Seal

Special Tool(s)

 ST1200-A	Remover, Bearing Cup 308-047 (T77F-1102-A)
 ST2577-A	Protector, Differential Seal (Pair) 205-461
 ST1676-A	Installer, Differential Oil Seal 205-293 (T89P-4850-A)
 ST1326-A	Adapter for 303-224 (Handle) 205-153 (T80T-4000-W)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST1721-A	Installer, Needle Bearing 205-288 (T89P-1244-A)

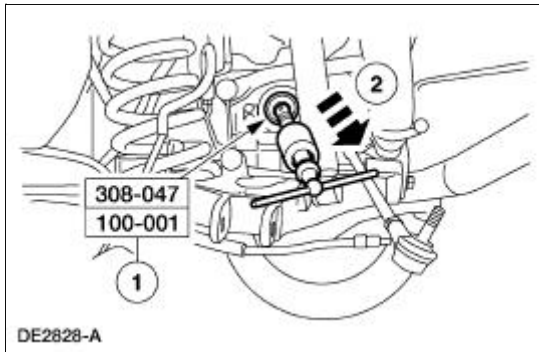
Removal

1. Remove the halfshaft assembly.
 - The knuckle and halfshaft are removable as an assembly. For additional information, refer to [Axle Housing](#) in this section. If it is necessary to remove the halfshaft from the knuckle, refer to [Section 205-05](#).
2. **NOTE:** If only removing the inboard CV joint stub shaft pilot bearing housing seal (4B416),

engage the tangs of the special tool only on the seal.

Using the special tools, remove the inboard CV joint stub shaft pilot bearing housing seal and the inboard CV joint stub shaft pilot bearing (4B413).

1. Firmly engage the tangs of the special tool on the bearing.
2. Remove the bearing and the seal.

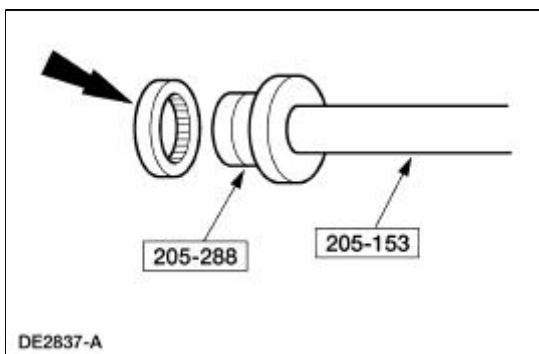


Installation

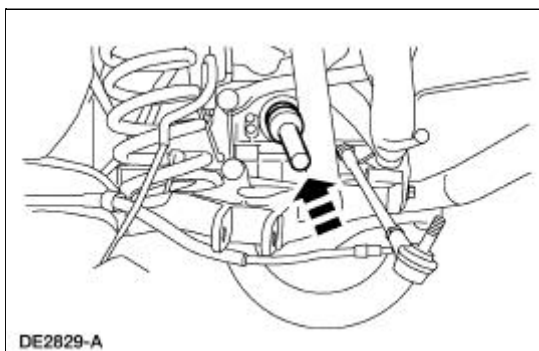
1. Inspect the seal journal for rust, nicks and scratches. Polish the seal journal with fine crocus cloth, if necessary.
2. Lubricate the new inboard CV joint stub shaft pilot bearing.
 - Use SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A.

3.  **CAUTION: Installation without the correct tools can result in early bearing failure.**

Place the inboard CV joint stub shaft pilot bearing onto the special tools.



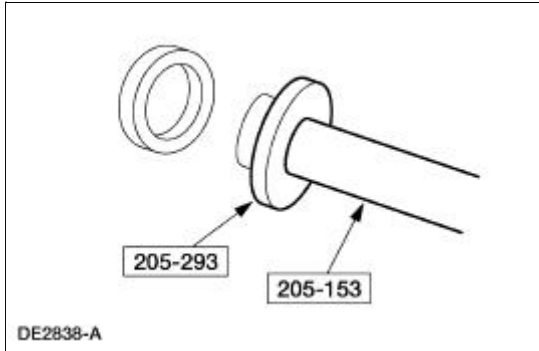
4. Install the inboard CV joint stub shaft pilot bearing.




5. Lubricate the lip of the new inboard CV joint stub shaft pilot bearing housing seal.
 - Use Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B.

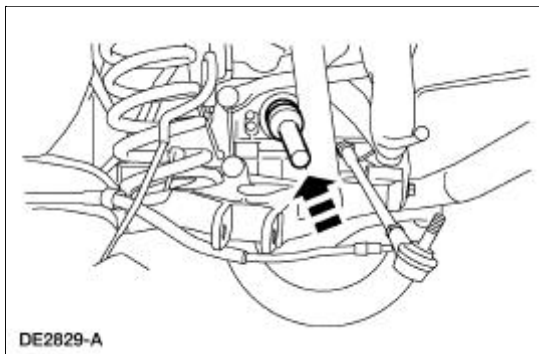
6.  **CAUTION: Installation without the correct tools can result in early seal failure.**


Place the inboard CV joint stub shaft pilot bearing housing seal onto the special tools.



7.  **CAUTION: If the inboard CV joint stub shaft pilot bearing housing seal becomes misaligned in the bore during installation, remove it and install a new one.**

Carefully align the inboard CV joint stub shaft pilot bearing housing seal in the housing bore and install the seal.





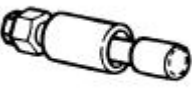
8.  **CAUTION: Use special tool 205-461 to avoid damaging the new inboard CV joint stub shaft pilot bearing housing seal when installing the halfshaft.**

Install the halfshaft.


- If the knuckle and halfshaft were removed as an assembly, refer to [Axle Housing](#) in this section. If the halfshaft was removed from the knuckle, refer to [Section 205-05](#).
-

Drive Pinion Flange

Special Tool(s)

 ST2026-A	2-Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1257-A	Holding Fixture, Drive Pinion Flange 205-126 (T78P-4851-A)
 ST1862-A	Installer, Drive Pinion Flange 205-002 (TOOL-4858-E) or equivalent


Removal

1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Remove the rear wheel and tire assemblies. For additional information, refer to [Section 204-04](#).
3.  **CAUTION: Remove the rear brake calipers to prevent drag during the drive pinion bearing preload adjustment.**

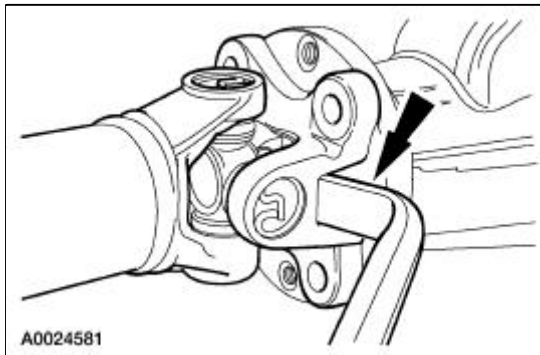
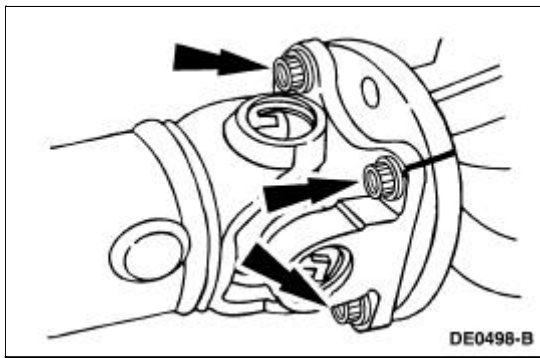
 **CAUTION: Do not allow the calipers to hang from the brake hoses.**

Remove the rear brake caliper and support bracket from the knuckle as an assembly. Wire the caliper and support bracket assembly out of the way. For additional information, refer to [Section 206-04](#).

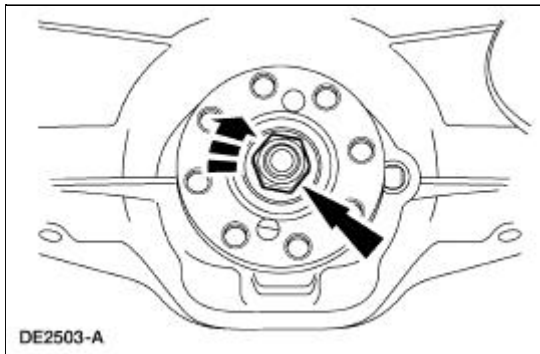
4.  **CAUTION: Index-mark the driveshaft flange and rear axle pinion flange (4851) to maintain initial balance during installation.**

 **CAUTION: The driveshaft centering socket yoke fits tightly on the rear axle pinion flange pilot. Never hammer on the driveshaft (4602) or any of its components to disconnect the yoke from the flange. Pry only in the area shown, with a suitable tool, to disconnect the yoke from the flange.**

Disconnect and position the driveshaft out of the way. For additional information, refer to [Section 205-01](#).

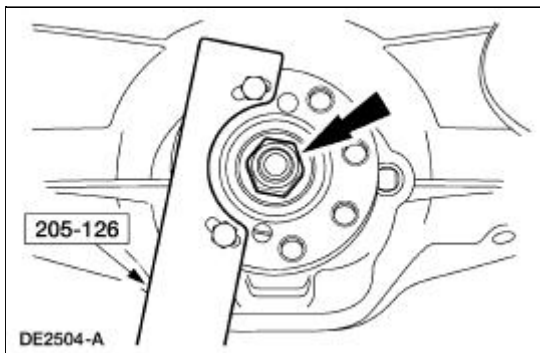


5. Install an Nm (inch/pound) torque wrench on the nut and record the torque necessary to maintain rotation of the drive pinion gear through several revolutions.

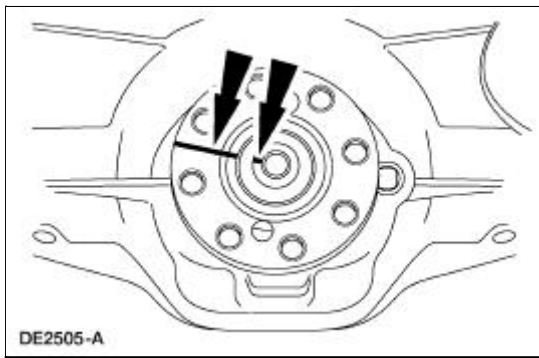


6.  **CAUTION:** After removing the nut, discard it. Use a new nut for installation.

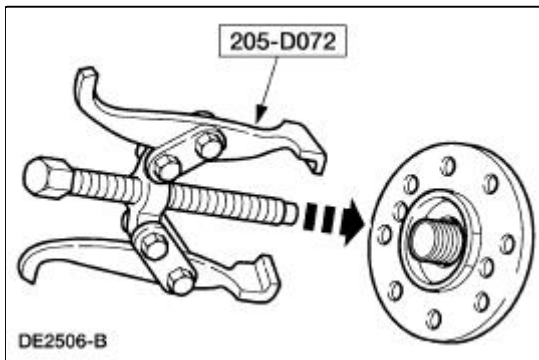
Use the special tool to hold the rear axle pinion flange while removing the nut.



7. Index-mark the rear axle pinion flange and drive pinion gear stem to maintain initial balance during installation.



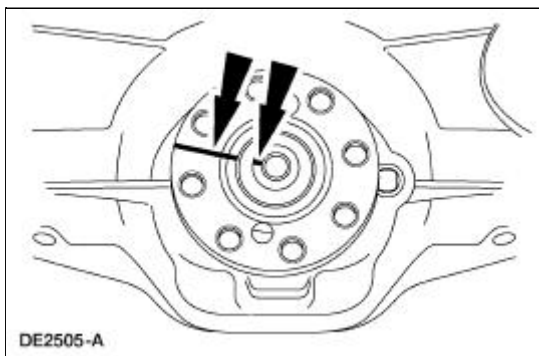
8. Using the special tool, remove the rear axle pinion flange.



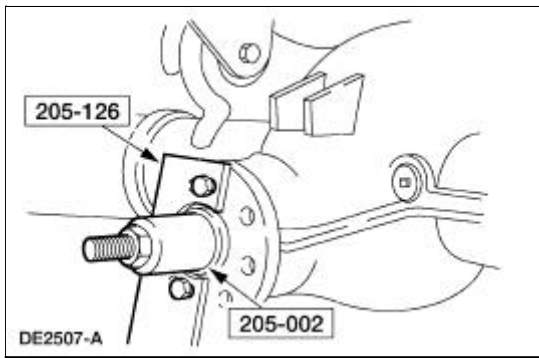
Installation

1. Inspect the rear axle pinion flange seal journal for rust, nicks, and scratches prior to installing the flange. Polish the seal journal with fine crocus cloth, if necessary.
2. Lubricate the rear axle pinion flange splines.
 - Use SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A.
3. **NOTE:** Disregard the index marks if installing a new rear axle pinion flange.

Position the rear axle pinion flange.



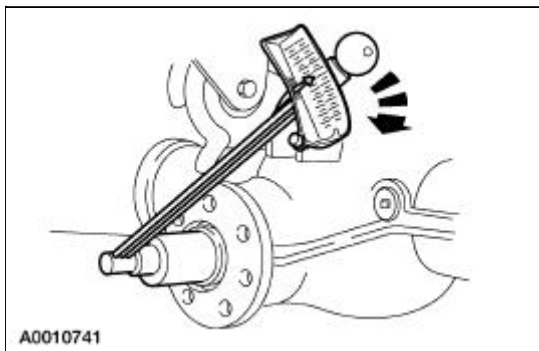
4. Using the special tools, install the rear axle pinion flange.




5.  **CAUTION:** Do not under any circumstance loosen the nut to reduce preload. If it is necessary to reduce preload, install a new differential drive pinion collapsible spacer (4662) and nut.


Tighten the nut to set the preload.

- Rotate the pinion occasionally to make sure the pinion bearings (4630) (4621) seat correctly. Take frequent pinion bearing torque preload readings by rotating the drive pinion gear with a Nm (inch/pound) torque wrench.
- If the preload recorded prior to disassembly is lower than the specification for used bearings, then tighten the nut to specification. If the preload recorded prior to disassembly is higher than the specification for used bearings, then tighten the nut to the original reading as recorded.
- Refer to the torque specification for used pinion bearings in the Specifications portion of this section.

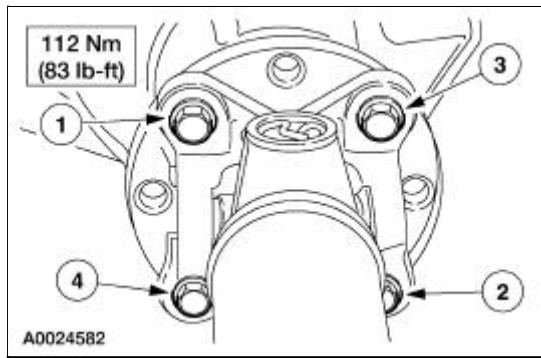


6.  **CAUTION:** Align the index-marks.

 **CAUTION:** Install the driveshaft with new bolts. If new bolts are not available, apply Threadlock and Sealer EOAZ-19554-AA or equivalent meeting Ford specification WSK-M2G351-A5 to the threads of the original bolts.

 **CAUTION:** The driveshaft centering socket yoke fits tightly on the rear axle pinion flange pilot. To make sure that the yoke seats squarely on the flange, tighten the bolts evenly in a cross pattern as shown.

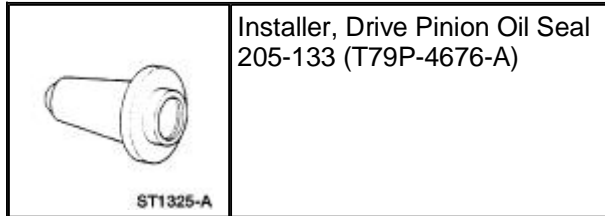
Connect the driveshaft. For additional information, refer to [Section 205-01](#).



7. Install the rear brake calipers. For additional information, refer to [Section 206-04](#).
 8. Install the rear wheel and tire assemblies. For additional information, refer to [Section 204-04](#).
 9. Lower the vehicle.
-

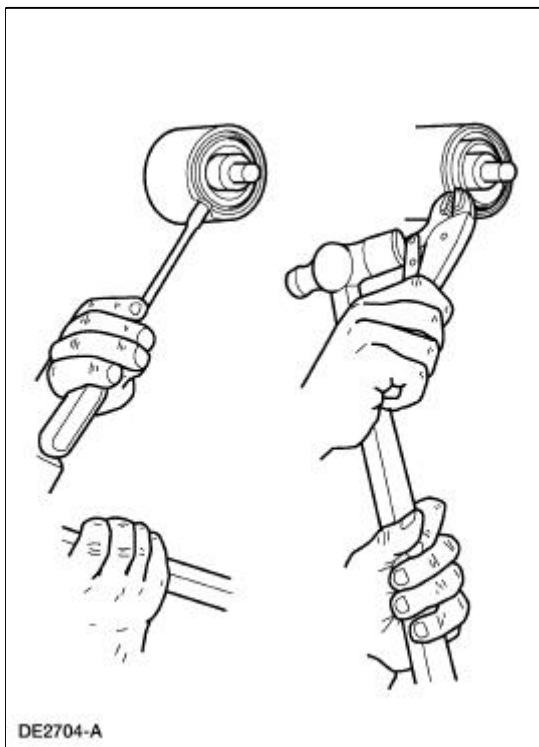
Pinion Seal

Special Tool(s)




Removal

1. Remove the pinion flange (4851). For additional information, refer to [Drive Pinion Flange](#) in this section.
2. Force up the metal flange of the rear axle drive pinion seal (4676).
 - Install gripping pliers and strike with a hammer to remove the seal.

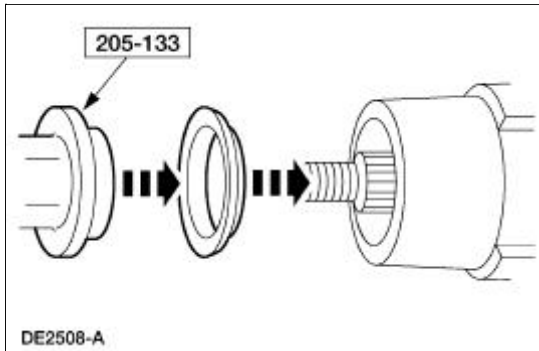


Installation

1. Lubricate the new rear axle drive pinion seal.
 - Use Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B.
2.  **CAUTION: Installation without the proper tool can result in early seal failure.**

 **CAUTION:** If the rear axle drive pinion seal becomes misaligned during installation, remove it and install a new one.

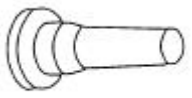


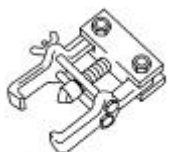
Using the special tool, install the rear axle drive pinion seal.



3. Install the pinion flange. For additional information, refer to [Drive Pinion Flange](#) in this section.
-

Axle Housing

Special Tool(s)

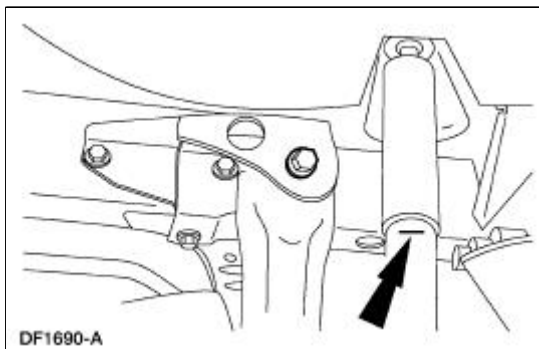
 ST1712-A	Plug Set, Differential 205-294 (T89P-4850-B)
 ST2577-A	Protector, Differential Seal (Pair) 205-461
 ST2309-A	Remover, Halfshaft 205-475
 ST2273-A	Remover, Steering Arm 211-003 (T64P-3590-F)

Removal

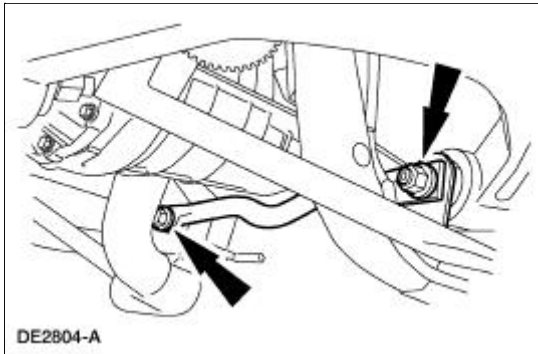
-  **CAUTION:** The vehicle must be on level ground and at curb height.

Mark the rear shock absorbers relative to their protective sleeve.


- During installation, raise the suspension to this reference mark before tightening the suspension component fasteners.



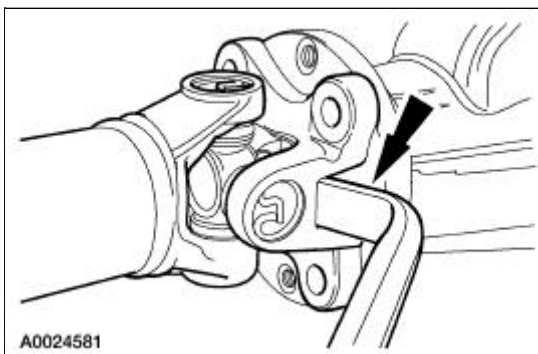
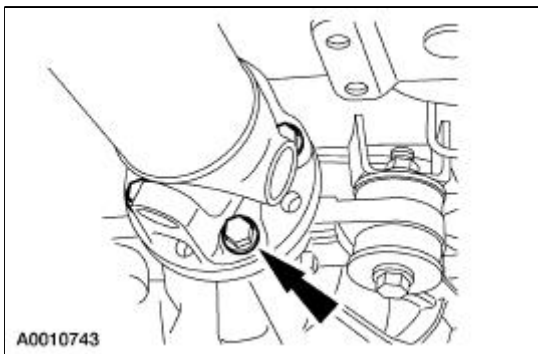
2. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
3. Remove the rear wheel and tire assemblies. For additional information, refer to [Section 204-04](#).
4. Remove the exhaust system. For additional information, refer to [Section 309-00](#).
5. Remove the pinion nose crossmember.



6.  **CAUTION:** Index-mark the driveshaft flange and rear axle pinion flange (4851) to maintain initial balance during installation.

 **CAUTION:** The driveshaft centering socket yoke fits tightly on the rear axle pinion flange pilot. Never hammer on the driveshaft (4602) or any of its components to disconnect the yoke from the flange. Pry only in the area shown, with a suitable tool, to disconnect the yoke from the flange.

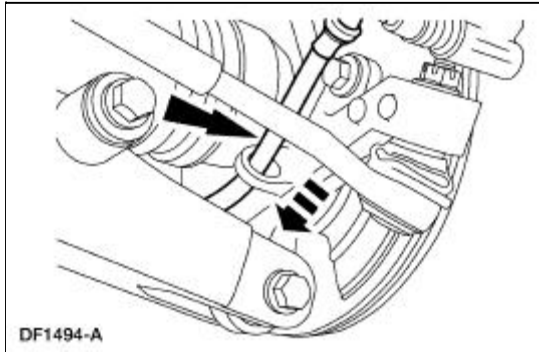
Disconnect and position the driveshaft out of the way.



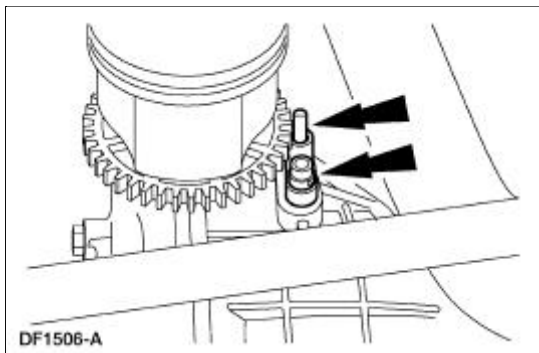
7. **NOTE:** The following halfshaft and knuckle assembly removal steps apply to both sides of the vehicle.

Disconnect the parking brake cable and conduit from the parking brake lever and the caliper. For additional information, refer to [Section 206-05](#) .

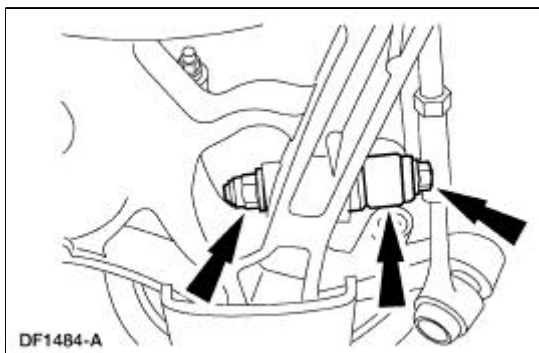
8. Separate the parking brake cable and conduit from the knuckle.



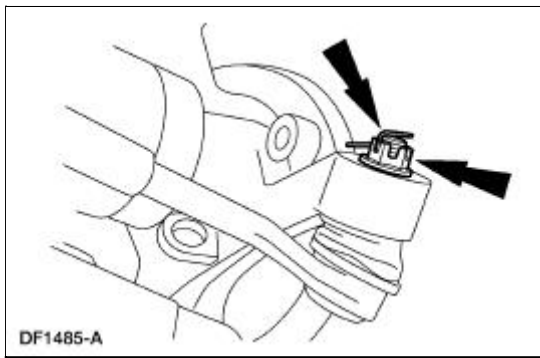
9. Remove the rear brake disc. For additional information, refer to [Section 206-04](#).
 - Remove the rear brake caliper and support bracket from the knuckle as an assembly. Wire the caliper and support bracket assembly out of the way.
10. Remove the rear brake anti-lock sensor and position it aside.



11. Support the lower suspension arm and bushing with a jack stand.
12. Remove and discard the nut and bolt.

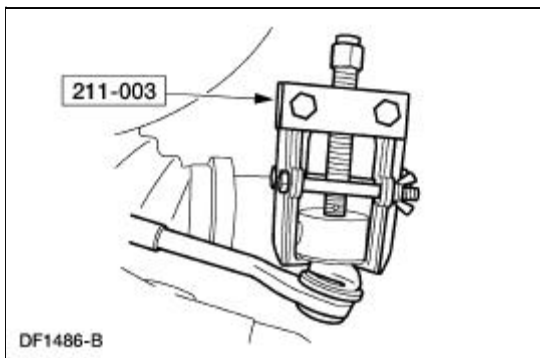


13. Remove and discard the cotter pin and nut.



14.  **CAUTION: Do not strike the toe link or the knuckle to disconnect the toe link from the knuckle.**

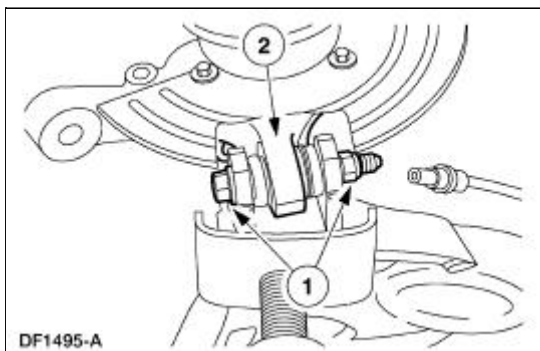
Using the special tool, disconnect the toe link from the knuckle.



15. Mark the cam bolt position relative to the upper suspension arm and bushing.



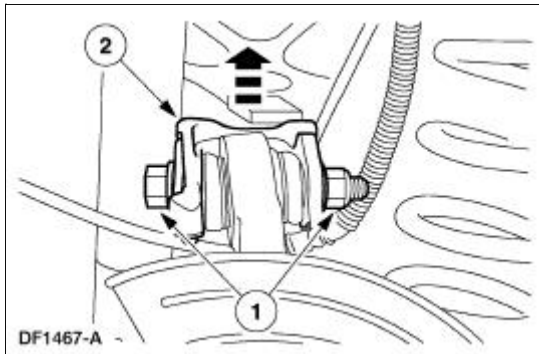
16. Disconnect the knuckle from the lower suspension arm and bushing.
1. Remove and discard the nut and bolt.
 2. Disconnect the knuckle from the lower suspension arm and bushing.




17. **NOTE:** Mark the new cam bolt in the same position as the old one for assembly reference before discarding the old bolt.

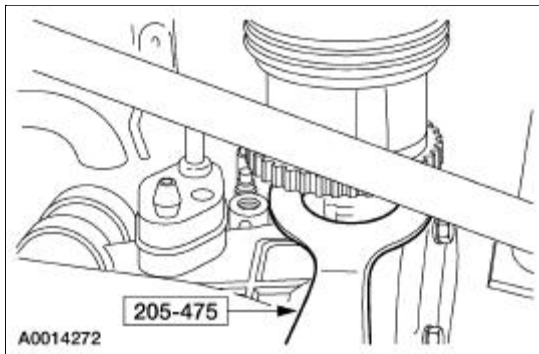
Disconnect the knuckle from upper suspension arm and bushing.

1. Remove and discard the nut and bolt.
2. Disconnect the knuckle from the upper suspension arm and bushing.

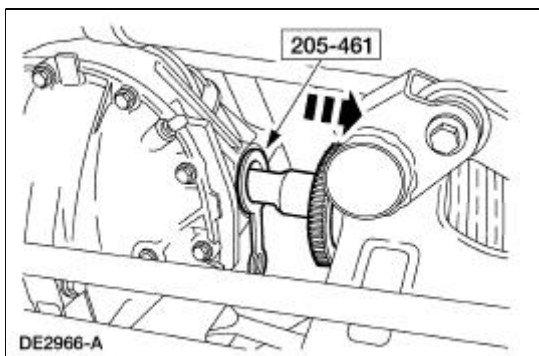


18.  **CAUTION:** The crown on the tool forks must face away from the differential housing. Position the special tool correctly between the CV joint and the differential housing so as not to damage the differential seal.

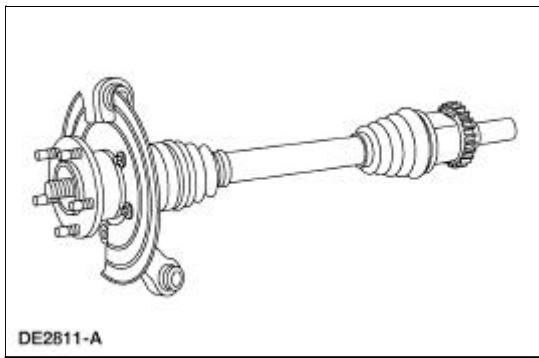
Using the special tool, exert enough pressure to overcome the circlip and separate the CV joint from the differential side gear.



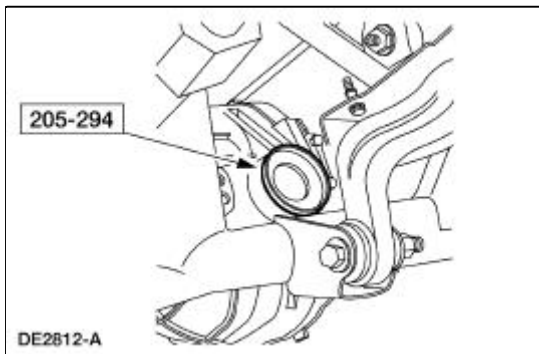
19. Install the special tool.



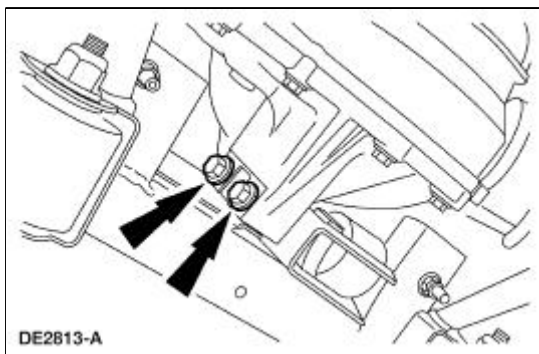
20. Remove the halfshaft and knuckle assembly from the vehicle.



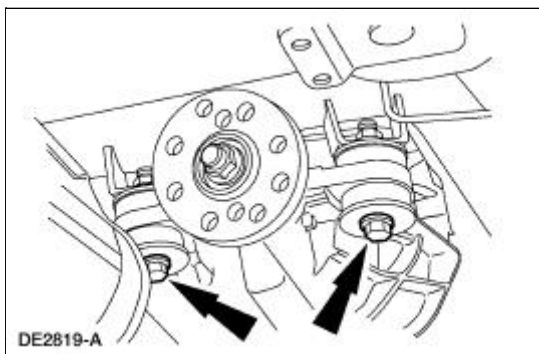
21. Insert the special tool into the housing bore.



22. Remove the other halfshaft and knuckle assembly as described in the previous steps.
23. Support the differential housing (4010) with a transmission jack.
24. Remove the bolts.



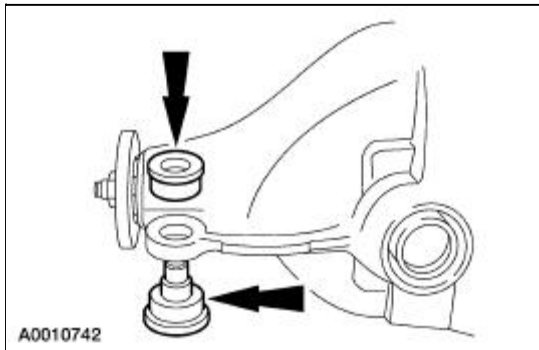
25. Remove the nuts and bolts.



26.  **CAUTION: Do not damage the axle vent hose.**

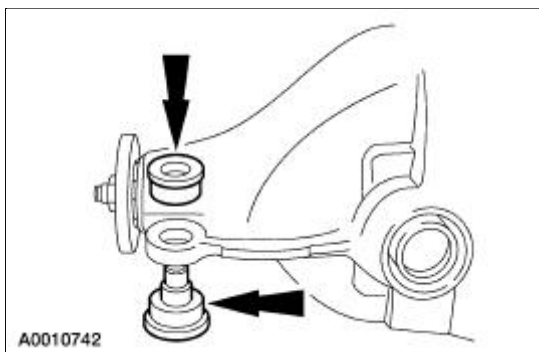
Lower the rear axle assembly from the vehicle.

27. If removal of the mounting bushings is necessary, remove them by hand.

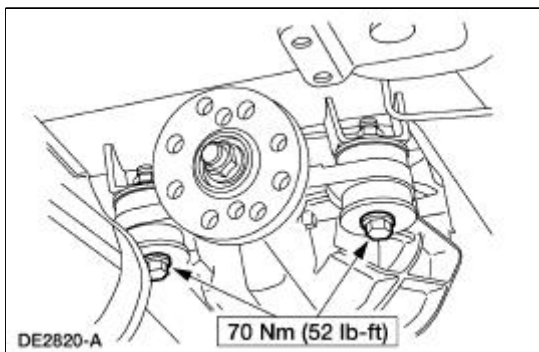


Installation

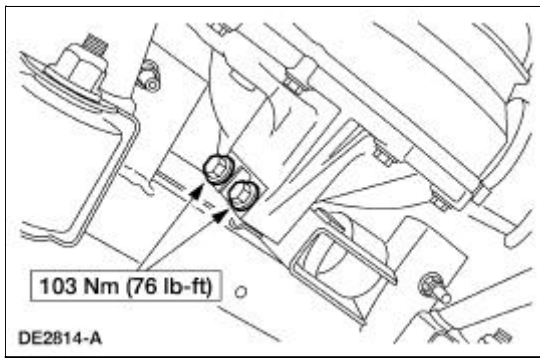
1. Install the bushings, if removed.




2. Using the transmission jack, raise the rear axle assembly into position.
3. Install the bolts and nuts.



4. Install the bolts.

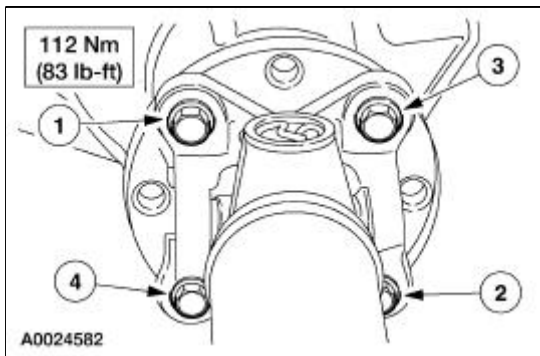


5.  **CAUTION:** Align the index-marks.

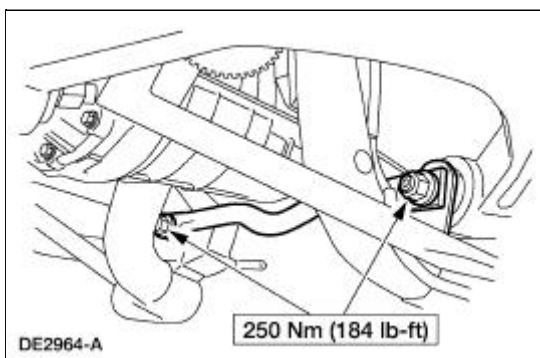
 **CAUTION:** Install the driveshaft with new bolts. If new bolts are not available, apply Threadlock and Sealer EOAZ-19554-AA or equivalent meeting Ford specification WSK-M2G351-A5 to the threads of the original bolts.

 **CAUTION:** The driveshaft centering socket yoke fits tightly on the rear axle pinion flange pilot. To make sure that the yoke seats squarely on the flange, tighten the bolts evenly in a cross pattern as shown.

Connect the driveshaft and install the bolts.

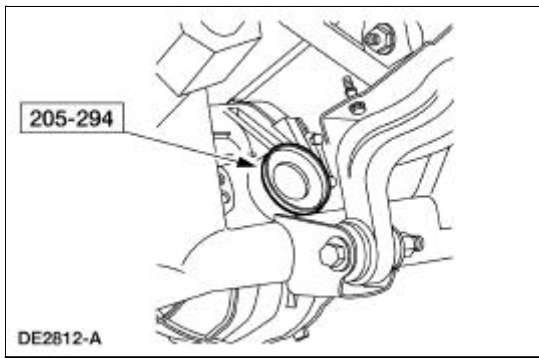



6. Install the pinion nose crossmember.



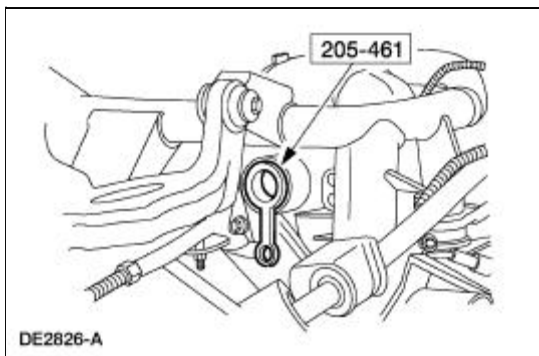
7. **NOTE:** The following halfshaft and knuckle assembly installation steps apply to both sides of the vehicle.

Remove the special tool.

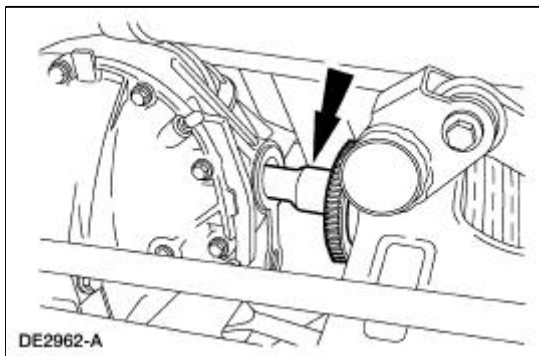


8.  **CAUTION:** Differential seal damage will occur if installing the halfshaft without the special tool.

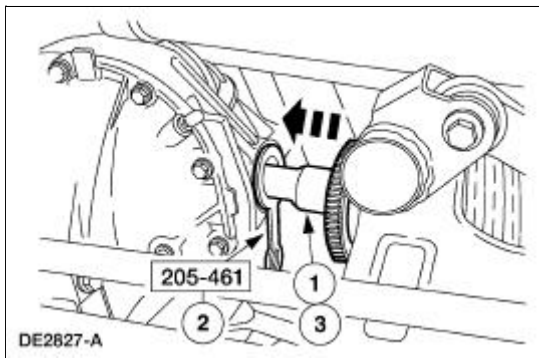
Install the special tool.



9. Position the halfshaft for installation.



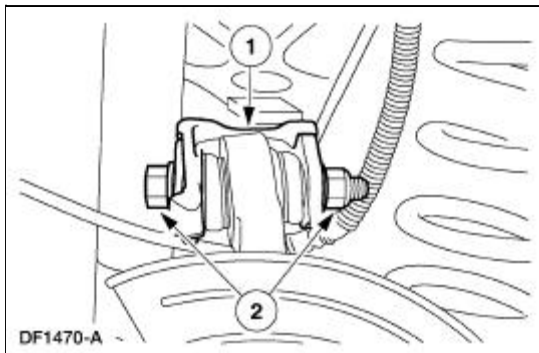
10. Seat the CV joint stub shaft in the differential side gear.
1. Slide the stub shaft into the differential housing until the shaft splines are past the differential seal.
 2. Remove the special tool.
 3. Align the stub shaft splines and the side gear splines, and slide the stub shaft into the gear until it seats.
 - When seated, the axle circlip will lock the stub shaft in the differential side gear. Check the circlip engagement by attempting to pull the inboard CV joint out of the differential side gear. If the circlip has not seated, push the CV joint inward until the circlip is fully engaged in the differential side gear.



11.  **CAUTION: Do not tighten the fastener at this time.**

Connect the knuckle to the upper suspension arm and bushing.

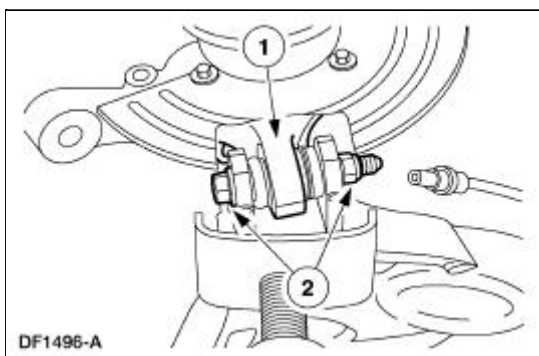
1. Position the knuckle.
2. Install the new cam bolt and nut.



12.  **CAUTION: Do not tighten the fastener at this time.**

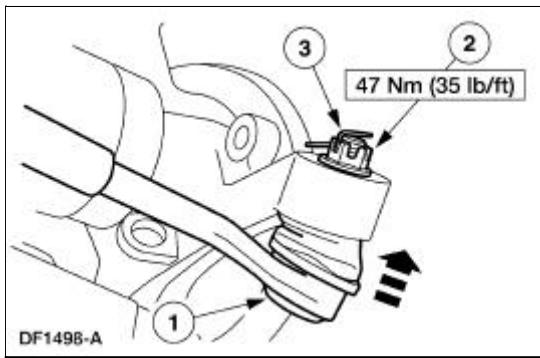
Connect the knuckle to the lower suspension arm and bushing.

1. Position the knuckle.
2. Install the new bolt and nut.



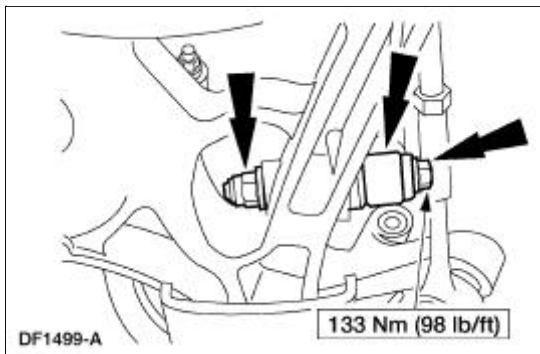
13. Connect the toe link to the knuckle.

1. Position the toe link.
2. Install the new nut.
3. Install the new cotter pin.

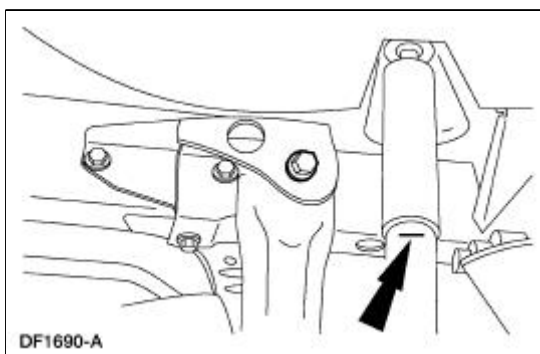


14. **⚠ CAUTION:** Install the hardened washer between the lower suspension arm and bushing and the shock absorber. Failure to do so can result in damage and failure of the lower suspension arm and bushing.

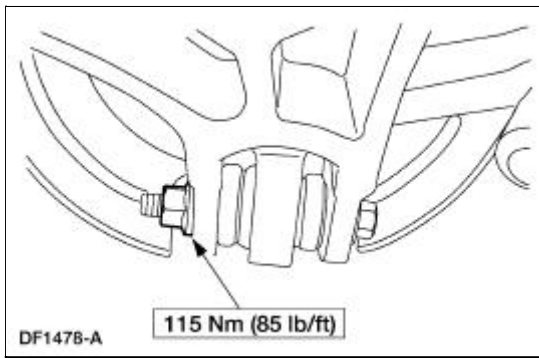
Position the shock absorber, and install the bolt and the new nut.



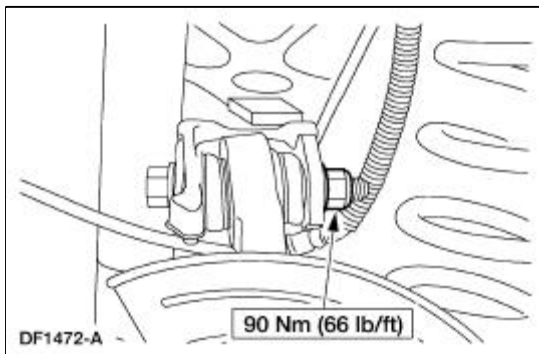
15. Install the other halfshaft and knuckle assembly, toe link, and shock absorber as described in the previous steps.
16. Raise the suspension until the shock absorbers compress to the previously established alignment mark (curb height).



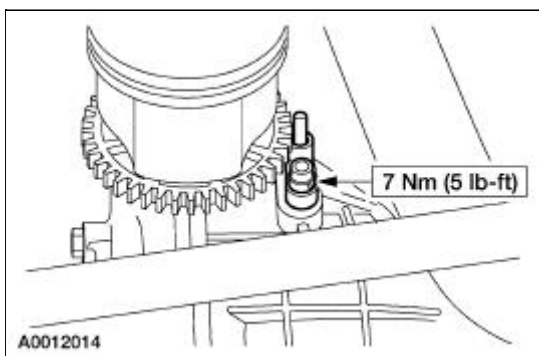
17. Tighten the nut.



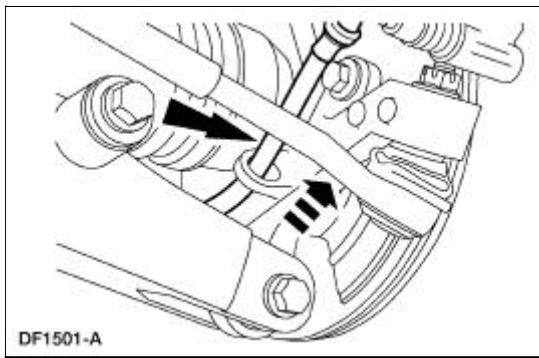
18. Align the marks on the cam bolt and the upper suspension arm and bushing, and tighten the nut.




19. Repeat the two previous steps for the other knuckle.
20. Lower the suspension and remove the jack stands.
21. Apply Anti-Seize Lubricant to the rear brake anti-lock sensors where they contact the axle housing and install the anti-lock sensors.
 - Use High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA or equivalent meeting Ford specification ESE-M12A4-A.



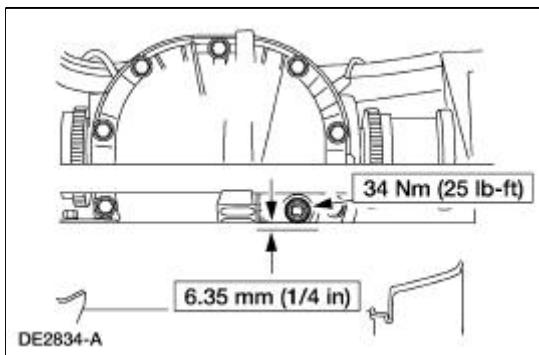
22. Install the brake disc, and the rear disc brake caliper and support bracket assembly. For additional information, refer to [Section 206-04](#).
23. Position the parking brake cable and conduit.



24. Connect the parking brake cable and conduit to the caliper and parking brake lever. For additional information, refer to [Section 206-05](#).
25. Repeat the three previous steps for the brake components on the other side of the vehicle.
26. Install the exhaust system. For additional information, refer to [Section 309-00](#).
27. Install the wheels and tires. For additional information, refer to [Section 204-04](#).
28.  **CAUTION: If refilling the rear axle (4001), first add 118 ml (4 oz) of Additive Friction Modifier C8AZ-19B546-A or equivalent meeting Ford specification EST-M2C118-A.**

Check the lubricant level.


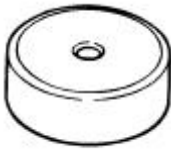


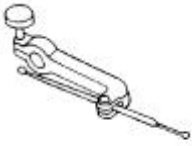


- If necessary, fill the rear axle housing to the level shown with SAE 75W- 140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A. The refill capacity is 1.23-1.37 liters (2.6-2.9 pints).




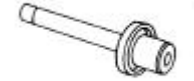

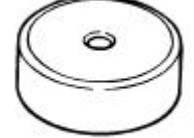





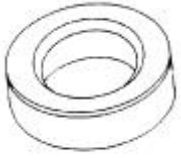

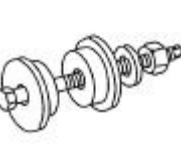


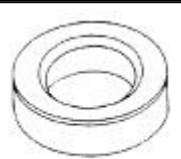
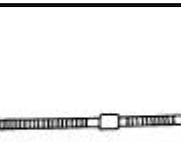
29. Lower the vehicle.
 30. Check, and adjust the wheel alignment as necessary. For additional information, refer to [Section 204-00](#).
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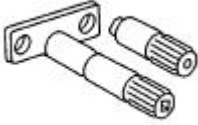
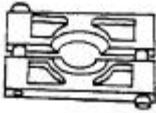

Axle

Special Tool(s)

 <p>ST2026-A</p>	<p>2-Jaw Puller 205-D072 (D97L-4221-A) or equivalent</p>
 <p>ST1743-A</p>	<p>Adapter for 205-S127 205-105 (T76P-4020-A3)</p>
 <p>ST1165-A</p>	<p>Bearing Preload Tool 205-395 (T93P-4220-A)</p>
 <p>ST1254-A</p>	<p>Plate, Bearing/Oil Seal 205-090 (T75L-1165-B)</p>
 <p>ST1348-A</p>	<p>Gauge, Clutch Housing 308-021 (T75L-4201-A)</p>
 <p>ST1257-A</p>	<p>Holding Fixture, Drive Pinion Flange 205-126 (T78P-4851-A)</p>
 <p>ST1724-A</p>	<p>Installer, Drive Pinion Flange 205-002 (TOOL-4858-E) or equivalent</p>
	<p>Dial Indicator Gauge 100-D005 (D78P-4201-G) or equivalent</p>

 <p>ST1183-A</p>	
 <p>ST1214-A</p>	<p>Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent</p>
 <p>ST1259-A</p>	<p>Spreader, Differential Carrier 205-001 (TOOL-4000-E) or equivalent</p>
 <p>ST1375-A</p>	<p>Installer, Differential Side Bearing 205-010 (T57L-4221-A2)</p>
 <p>ST1431-A</p>	<p>Adapter for 205-S127 205-110 (T76P-4020-A10)</p>
 <p>ST1743-A</p>	<p>Adapter for 205-S127 205-129 (T79P-4020-A18)</p>
 <p>ST1434-A</p>	<p>Gauge Tube, Drive Pinion 205-336 (T93P-4020-A)</p>
 <p>ST1432-A</p>	<p>Adapter for 205-S127 205-111 (T76P-4020-A11)</p>
	<p>Spreader, Differential Housing (Plate) 205-335 (T93P-4000-A)</p>

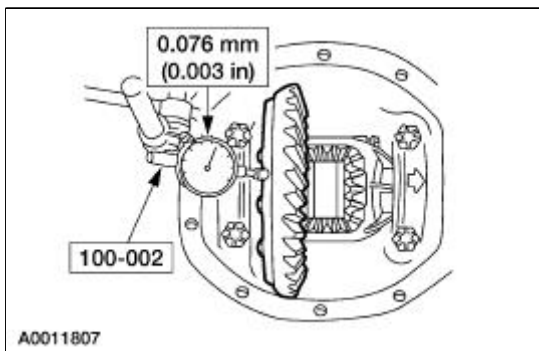
 <p>ST1344-A</p>	
 <p>ST1349-A</p>	<p>Gauge, Differential Bearing 205-338 (T93P-4222-A)</p>
 <p>ST1367-A</p>	<p>Installer, Drive Pinion Bearing Cone 205-005 (T53T-4621-C)</p>
 <p>ST1678-A</p>	<p>Installer, Drive Pinion Bearing Cup 205-024 (T67P-4616-A)</p>
 <p>ST1744-A</p>	<p>Protector, Drive Pinion Thread 205-460</p>
 <p>ST1325-A</p>	<p>Installer, Drive Pinion Oil Seal 205-133 (T79P-4676-A)</p>
 <p>ST1350-A</p>	<p>Gauge, Differential Bearing 205-339 (T93P-4222-B)</p>
 <p>ST1429-A</p>	<p>Adapter for 205-S127 205-109 (T76P-4020-A9)</p>
	<p>Step Plate 205-D061 (D83T-4205-C2) or equivalent</p>

 <p>ST1725-A</p>	
 <p>ST1374-A</p>	<p>Gauge, Differential Clutch 205-135 (T80P-4946-A)</p>
 <p>ST1265-A</p>	<p>Gauge, Differential Clutch Torque 205-013 (T59L-4204-A)</p>
 <p>ST1310-A</p>	<p>Remover, Bearing 205-055 (T71P-4621-B)</p>
 <p>ST1186-A</p>	<p>Holding Fixture, Transmission 307-003 (T57L-500-B)</p>

Disassembly

Initial disassembly

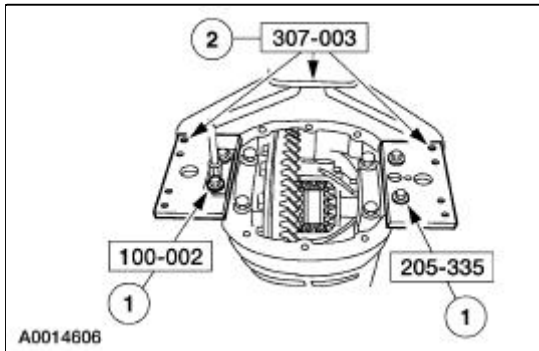
1. Remove the differential housing cover (4033) and drain the lubricant into a suitable container.
2. Wipe the lubricant from the internal working parts and inspect the parts for wear and damage.
3. Using the special tool, measure and note the differential ring gear backface runout.
 - Remove the special tool.



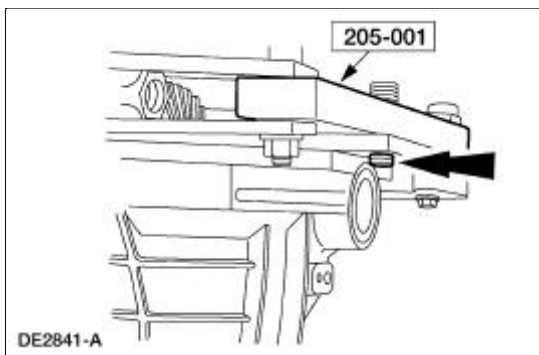
4.  **CAUTION: Do not damage the aluminum differential housing (4010) while carrying out these procedures.**

Using the special tools, mount the differential housing to a work bench.

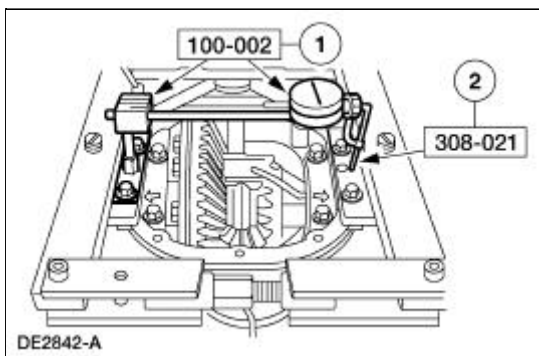
1. Attach the special tools to the differential housing with four bolts that retain the differential housing cover to the differential housing.
2. Attach the special tools together with two 3/8 inch x 1-1/2 inch bolts.




5. Install the special tool by placing the spreader pins in the hole in the Housing Spreader Adapters.



6. Assemble the special tool.
1. Install the special tool.
 2. Attach the special tool and position the tip in the Housing Spreader Adapter hole.

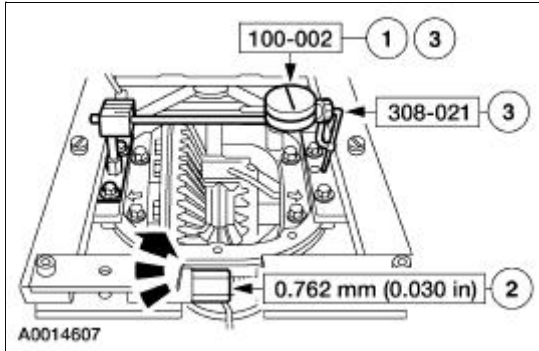


7.  **CAUTION: Overspreading can damage the differential housing.**

NOTE: Tighten and loosen the Differential Carrier Spreader screw to normalize the Housing Spreader Adapters prior to taking the final Dial Indicator reading.

Spread the differential housing to the specification.

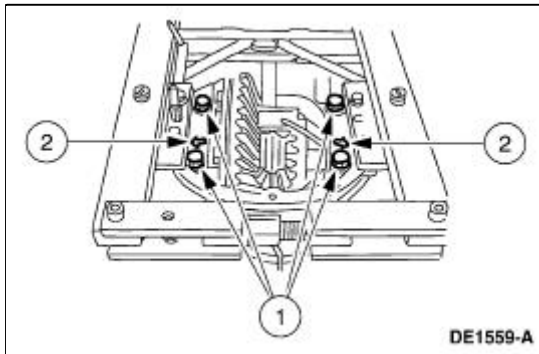
1. Adjust the special tool to zero.
2. Tighten the screw until the differential housing is spread to the specification.
3. Remove the special tools.



8. **⚠ CAUTION:** Mark the position and location of the differential bearing caps as the arrows may not be visible. Always install the differential bearing caps in their identical location and position.

Remove the differential bearing caps.

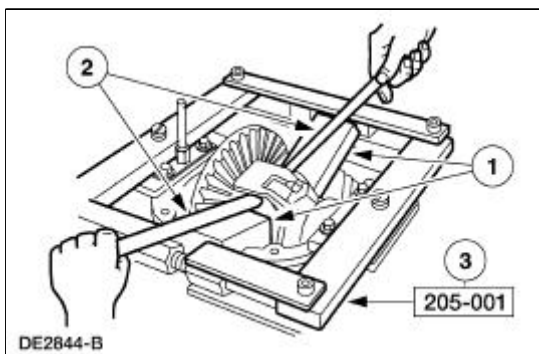
1. Remove the bolts.
2. Remove the differential bearing caps.



9. **⚠ CAUTION:** Use wood blocks to avoid damaging the differential housing.

Remove the differential assembly.

1. Position wood blocks at the top and bottom of the differential case (4204).
2. Pry the differential assembly and the differential bearing shims (4067) out of the differential housing.
3. Remove the special tool.

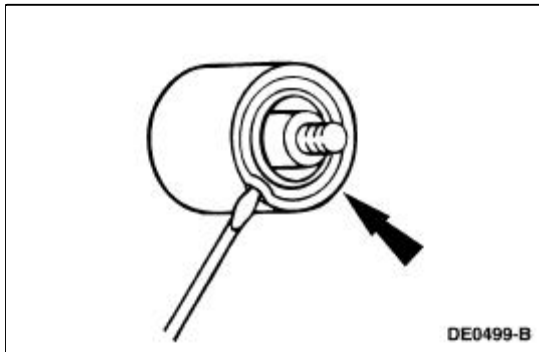


10. **⚠ CAUTION:** Record the torque necessary to maintain rotation of the drive pinion gear

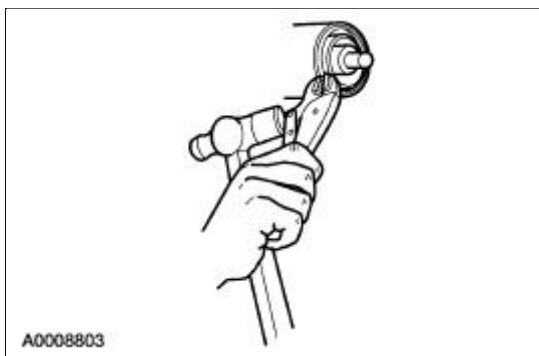
through several revolutions prior to removing the rear axle pinion flange (4851).

Remove the rear axle pinion flange. For additional information, refer to [Drive Pinion Flange](#) in this section.

11. Using a screwdriver, force the rear axle drive pinion seal metal flange up and strike it with a hammer.

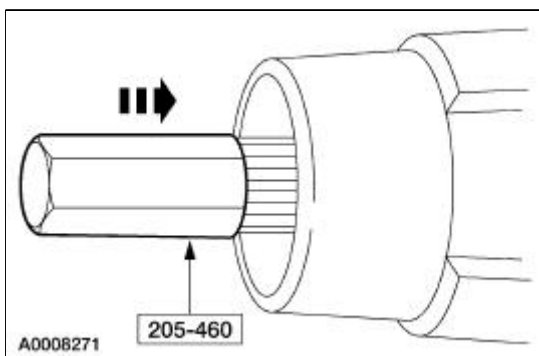


12. Using gripping pliers and a hammer, remove the rear axle drive pinion seal (4676).

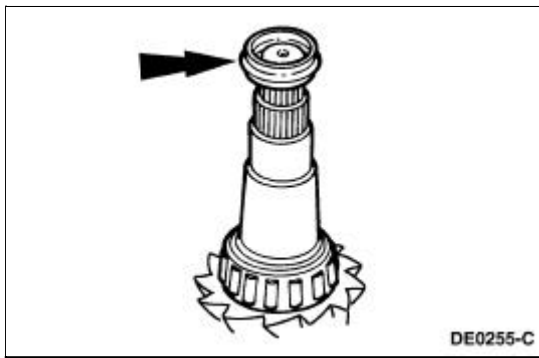


13. Remove the rear axle drive pinion shaft oil slinger (4670).

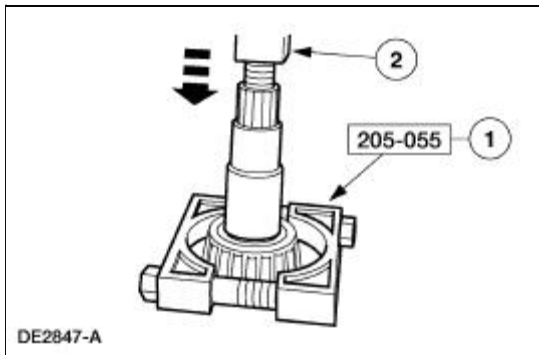
14. Using the special tool and a soft-faced hammer, drive the drive pinion gear out of the front pinion bearing (4621) and remove it through the rear of the differential housing.



15. Remove and discard the differential drive pinion collapsible spacer (4662).

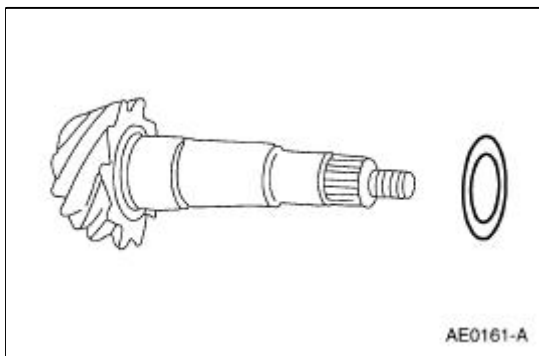


16. Using the special tool and a suitable press, remove the pinion bearing (4630).
1. Position the special tool under the pinion bearing.
 2. Using a press, remove the pinion bearing.

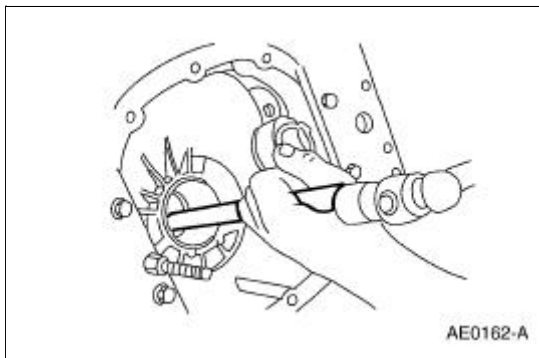


17. **NOTE:** Using a micrometer, measure the drive pinion bearing adjustment shim thickness. Use this measurement as a reference to compare to the shim gauge reading taken prior to installing the pinion bearing.

Remove the drive pinion bearing adjustment shim (4663).



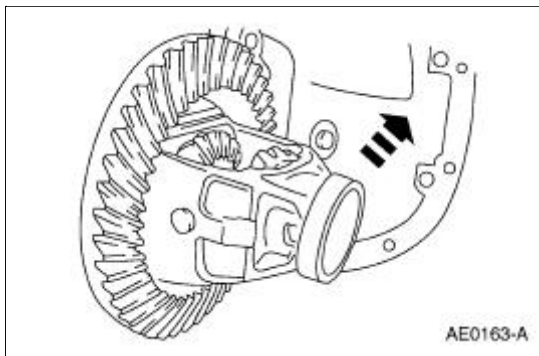
18. Using a brass drift and a hammer, remove any damaged differential drive pinion bearing cup (4616) (4628) from the differential housing. Tap alternately on each side of the cup to prevent it from cocking in the bore.



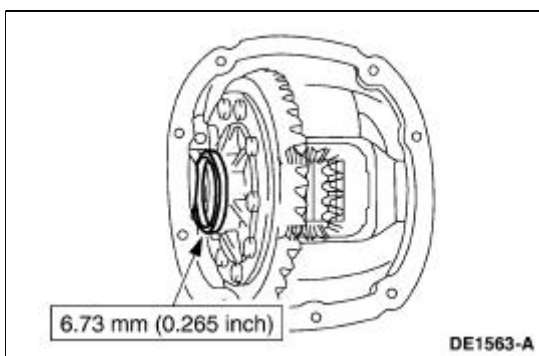
19. If the differential ring gear backface runout measurement, taken at the beginning of this procedure, did not exceed the specification, proceed to Final disassembly in this procedure. If the differential ring gear backface runout measurement, taken at the beginning of this procedure, exceeded the specification, the cause may be a warped differential ring gear, a damaged differential case, or loss of differential bearing preload. Proceed to Excessive differential ring gear backface runout in this procedure to verify the cause of the excessive runout.

Excessive differential ring gear backface runout

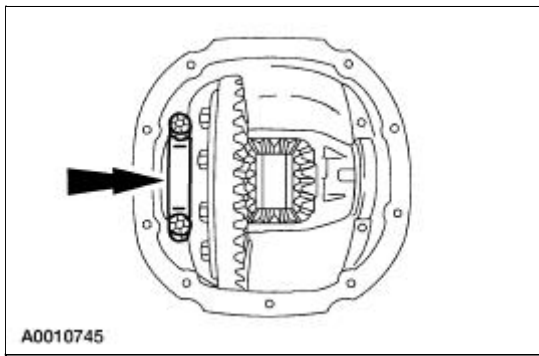
20. Place the differential assembly with the differential bearings (4221) and the differential bearing cups (4222) in the differential housing.



21. Install a differential bearing shim of the thickness shown on the LH side of the differential case.

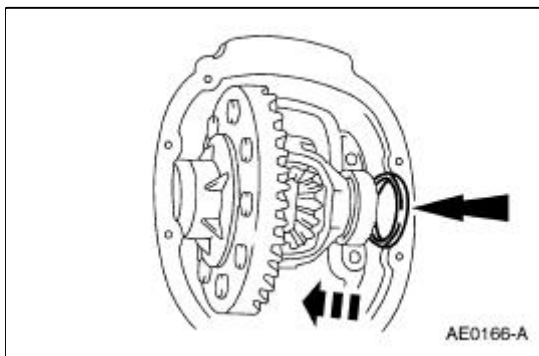


22. Install the LH differential bearing cap finger-tight.

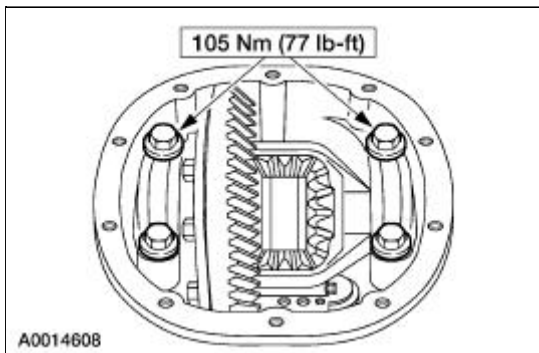


23. **NOTE:** Apply pressure toward the left side to fully seat the differential bearing cup.

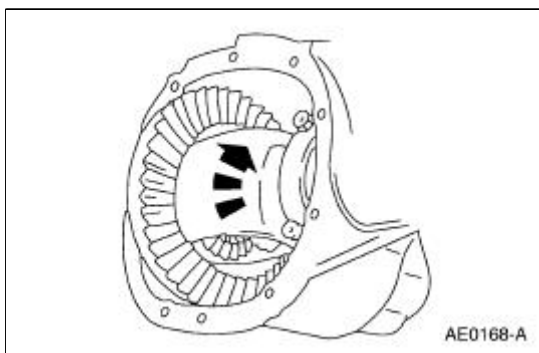
Install progressively larger differential bearing shims on the RH side until the largest differential bearing shim selected can be assembled with a slight drag feel.



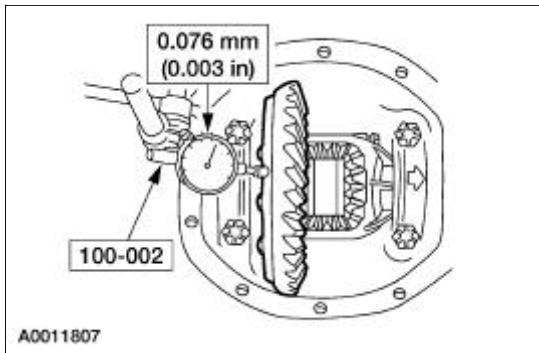
24. Install the RH differential bearing cap.
- Tighten both bearing caps to specification.



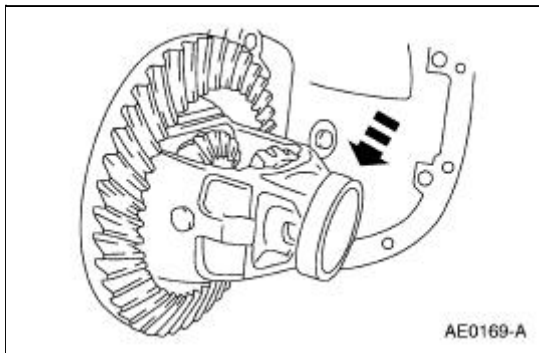
25. Rotate the differential assembly to make sure it turns freely.



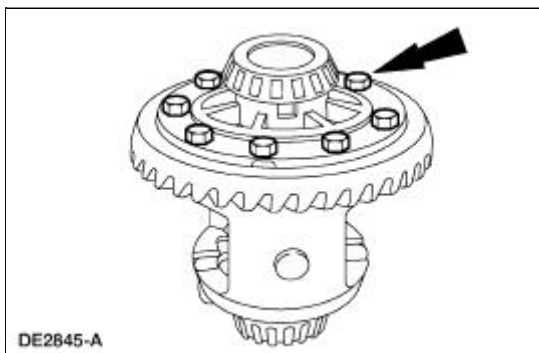
26. Using the special tool, measure and record the differential ring gear backface runout.
- If the runout does not exceed the specification, the cause of the original excessive runout was due to a loss of differential bearing preload. Proceed to Final disassembly in this procedure.
 - If the runout exceeds the specification, proceed as follows.
 - Remove the special tool.



27. Remove the differential assembly.

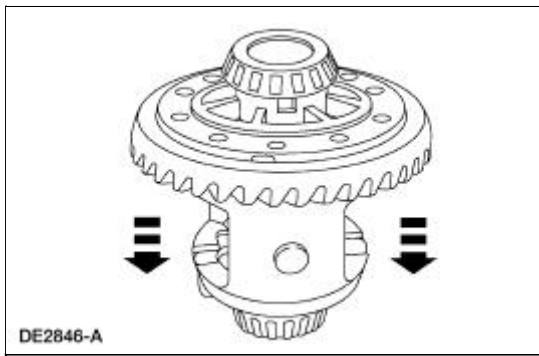


28. Remove the bolts.

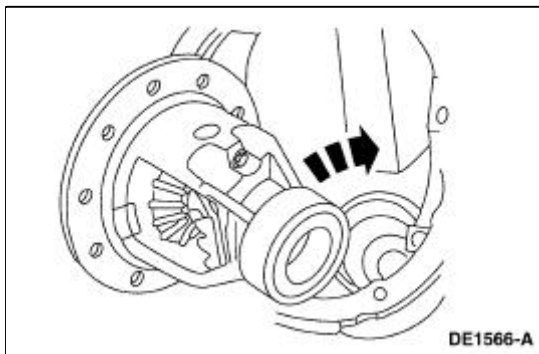


29.  **CAUTION: Do not damage the bolt hole threads.**

Insert a punch in the bolt holes and drive off the differential ring gear.

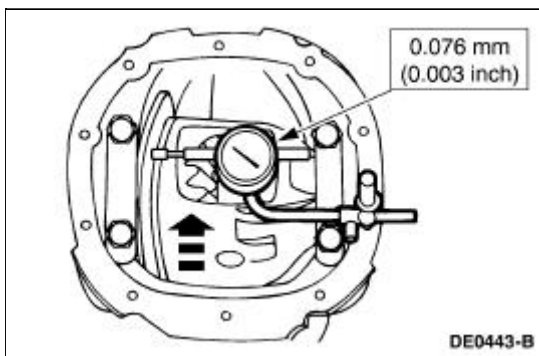


30. Install the differential case. Rotate the differential case to seat the differential bearings.



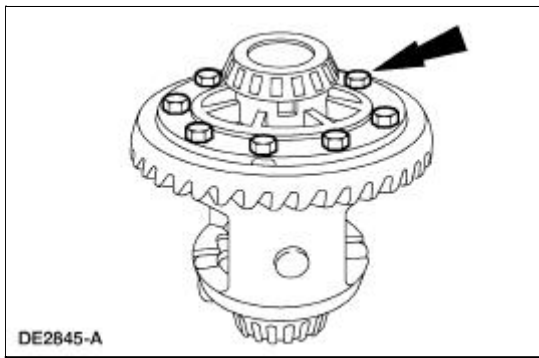
31. Using the special tool, measure the differential case flange runout.

- If the runout does not exceed the specification, the cause of the original excessive runout is the differential ring gear. Remove the differential case. Discard the differential ring gear and the drive pinion gear. Proceed to Final disassembly in this procedure.
- If the runout exceeds the specification, the differential ring gear is true and the concern is due to either differential case/differential bearing damage. Remove the differential case. Discard the differential bearings/differential case. Proceed to Final disassembly in this procedure.
 - Remove the special tool.



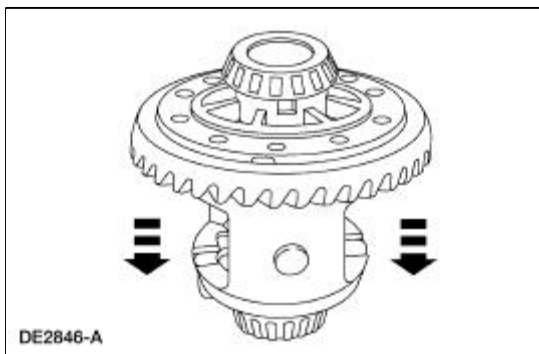
Final disassembly

32. If not done previously, remove the bolts.

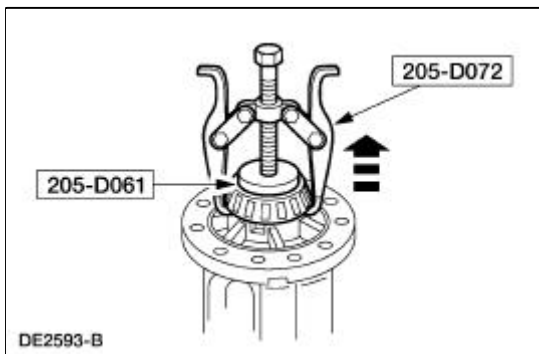


33.  **CAUTION: Do not damage the bolt hole threads.**

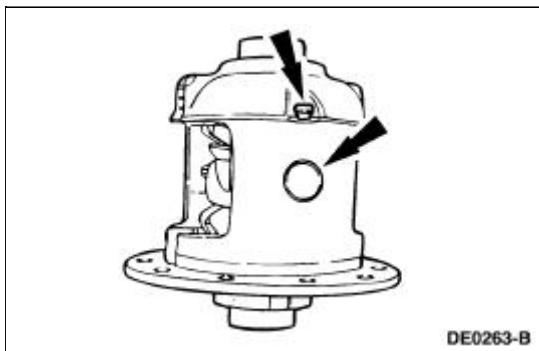
If not done previously, insert a punch in the bolt holes and drive off the differential ring gear.




34. Using the special tools, remove the differential bearing.
- Repeat for the other side.

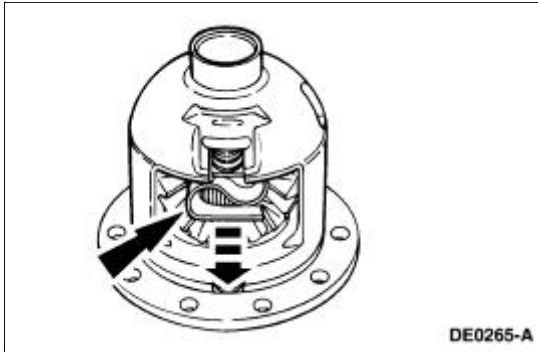


35. Remove the bolt and remove the differential pinion shaft (4211).

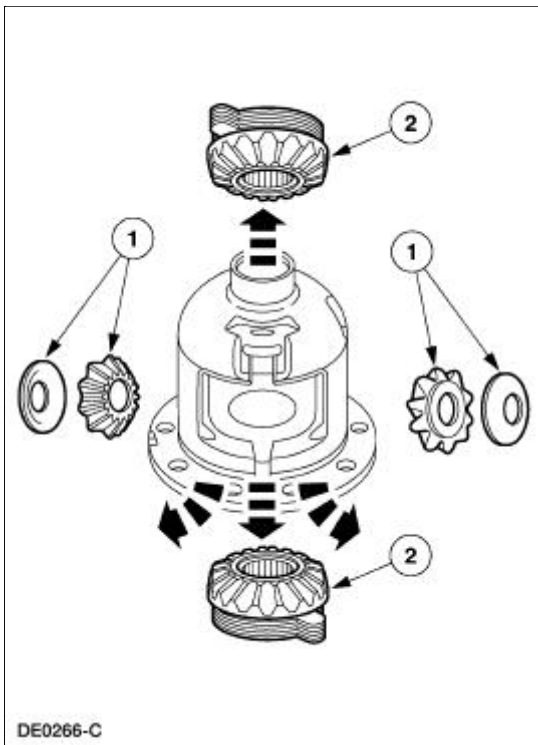


36.  **WARNING: The differential clutch spring (4214) is under tension. Remove the spring carefully. Failure to follow these instructions may result in personal injury.**

Remove the differential clutch spring.



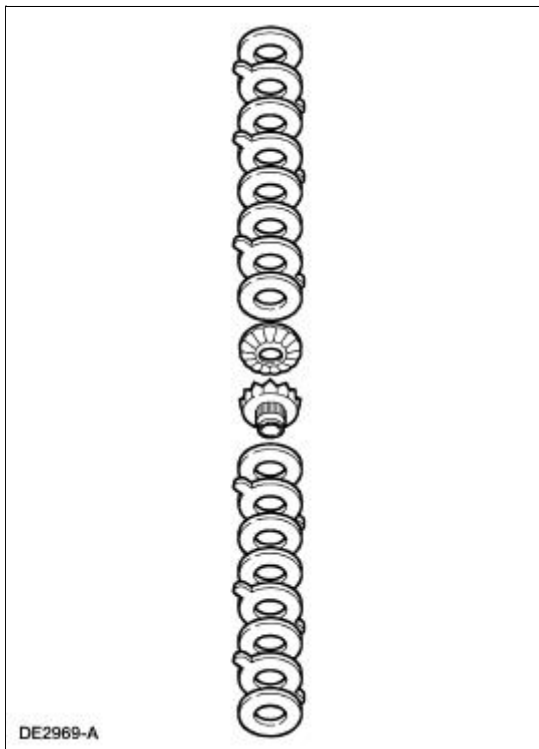
37. Remove the differential gears.
1. Remove the two differential pinion gears (4215) and pinion thrust washers (4230).
 2. Remove the two differential side gears (4236) with the clutch packs (4947) and the shims and tag them "left" and "right."



38.  **CAUTION: Keep the differential clutch packs in order. Do not mix them. Always reassemble them in the same sequence.**

Remove the differential clutch packs and shims from the differential side gears.

- Clean and inspect the remaining differential components for wear and damage. Install new parts as necessary.



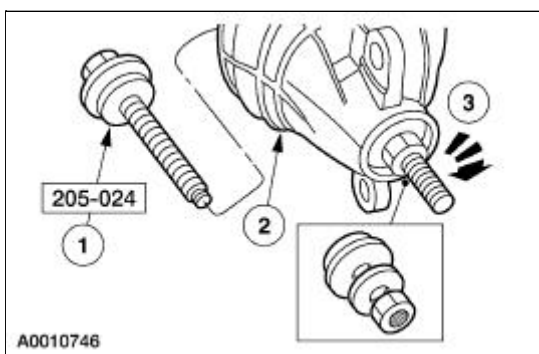
39.  **CAUTION: Do not use acids or solvents when cleaning the differential clutch packs. Wipe the components only with a clean, lint-free cloth.**

Clean and inspect the differential clutch packs for wear and damage. Install new parts as necessary.

Assembly

Initial assembly

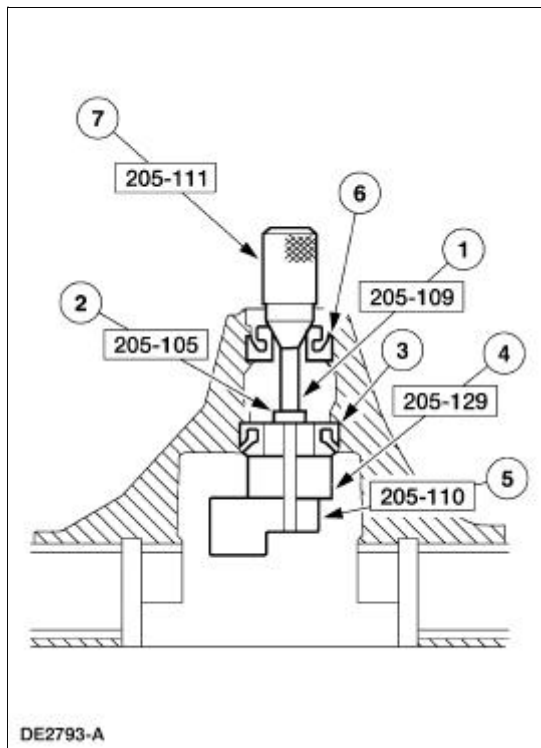
1. Coat the new differential drive pinion bearing cup(s) with lubricant.
 - Use SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A.
2. Using the special tool, install the differential drive pinion bearing cup(s).
 1. Position the bearing cup(s) on the special tool.
 2. Position the special tool and the bearing cup(s) in the differential housing.
 3. Tighten the special tool to fully seat the bearing cup(s) in the bore(s).



3. **NOTE:** Apply a light film of SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A on the front and rear pinion

bearings.

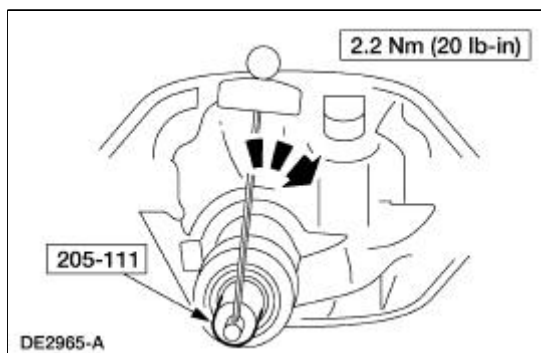
Install the pinion bearings and special tools as shown.



Item	Part Number	Description
1	205-109	Adapter for 205-S127
2	205-105	Adapter for 205-S127
3	4630	Rear (inner) pinion bearing
4	205-129	Adapter for 205-S127
5	205-110	Adapter for 205-S127
6	4621	Front (outer) pinion bearing
7	205-111	Adapter for 205-S127

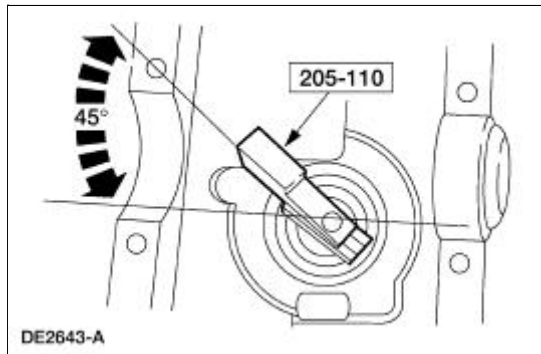
4. **NOTE:** This step duplicates pinion bearing preload.

Thread the special tool onto the Screw and tighten to the specification shown.

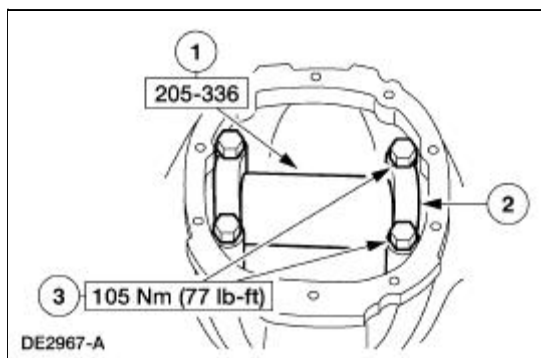


5. **CAUTION:** Offset the special tool to obtain an accurate reading.

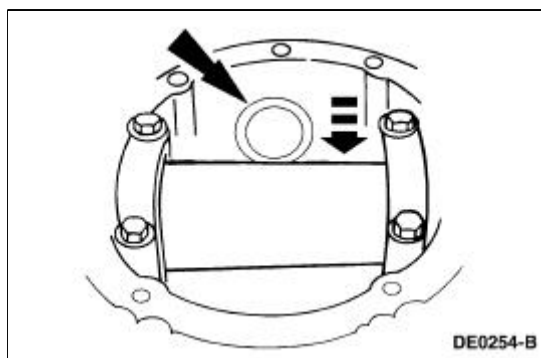
Rotate the special tool several half turns to seat the pinion bearings. Position the special tool as shown.




6. Install the special tool.
 1. Position the special tool on the differential housing differential bearing seat.
 2. Install the differential bearing caps.
 3. Install the bolts.



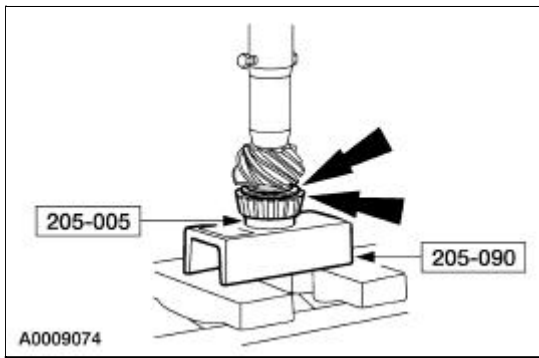
7. Use a drive pinion bearing adjustment shim as a gauge for shim selection. Check the drive pinion bearing adjustment shim thickness between the Gauge Block and the Gauge Tube. A slight drag indicates correct shim selection.




8. Remove all of the special tools.
9.  **CAUTION: Use the same pinion bearings and drive pinion bearing adjustment shim from the drive pinion bearing adjustment shim selection procedure for final assembly.**

Position the drive pinion bearing adjustment shim and the pinion bearing on the drive pinion gear stem.

10. Using the special tools and a suitable press, firmly seat the drive pinion bearing adjustment shim and pinion bearing on the drive pinion gear stem.



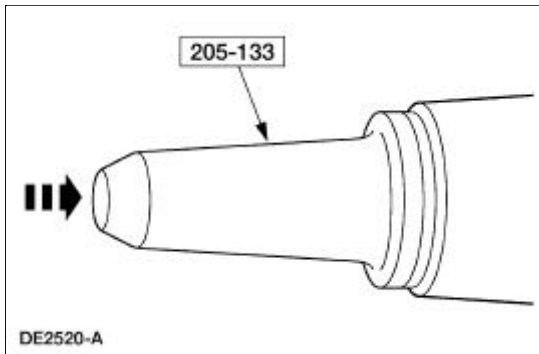
11. Install the front pinion bearing and the rear axle drive pinion shaft oil slinger in the differential housing.


12.  **CAUTION: Installation without the correct tool can result in early seal failure.**

 **CAUTION: If the seal becomes misaligned during installation, remove it and install a new one.**

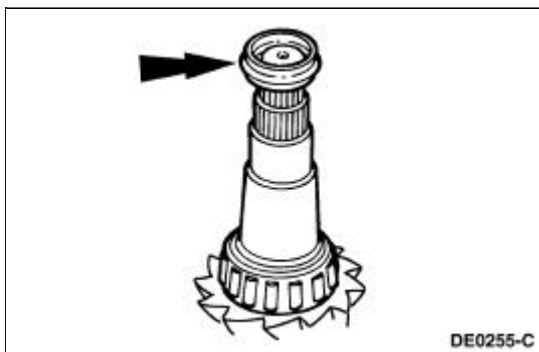
NOTE: Coat the rear axle drive pinion seal lips with Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B.

Using the special tool, install the new rear axle drive pinion seal.



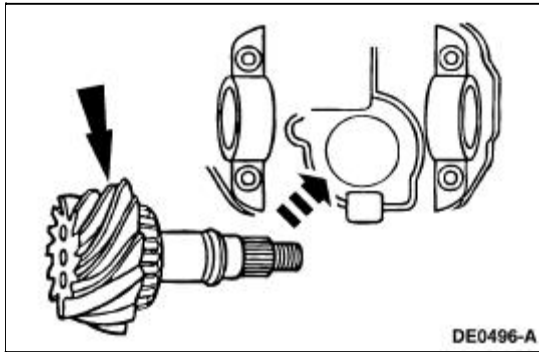
13.  **CAUTION: Make sure the splines on the drive pinion gear stem are free of burrs. If burrs are evident, remove them using a fine crocus cloth, work in a rotational motion.**

Place a new differential drive pinion collapsible spacer on the drive pinion gear stem against the pinion stem shoulder.



14. Install the drive pinion gear with the differential drive pinion collapsible spacer in the differential

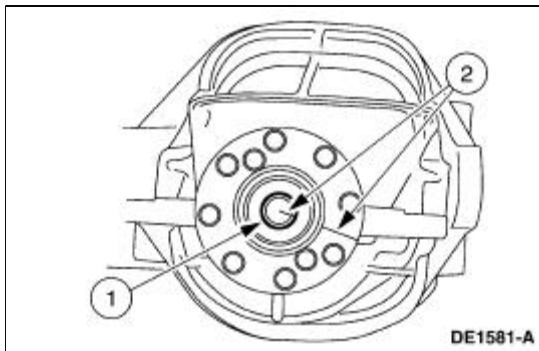
housing.



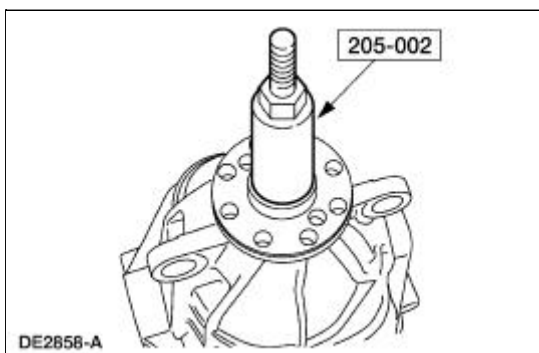
15. **NOTE:** Disregard the index marks if installing a new rear axle pinion flange.

Position the rear axle pinion flange.

1. Lubricate the rear axle pinion flange splines.
 - Use SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A.
2. Position the rear axle pinion flange.



16. Using the special tool, install the rear axle pinion flange.



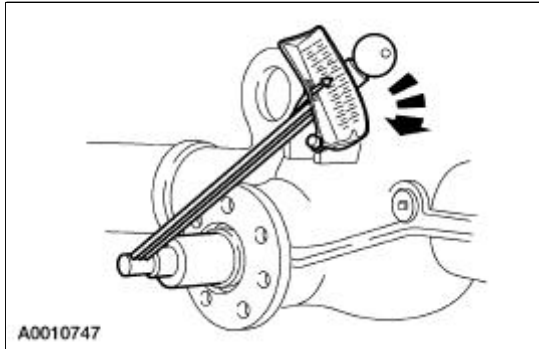
17. **CAUTION:** Do not under any circumstance loosen the nut to reduce preload. If it is necessary to reduce preload, install a new differential drive pinion collapsible spacer and nut.


Tighten the nut to set the preload.

- Rotate the pinion occasionally to make sure the pinion bearings seat correctly. Take frequent pinion bearing torque preload readings by rotating the drive pinion gear with a Nm (inch/pound) torque wrench.
- For new pinion bearings, tighten the nut to specification. Refer to torque specifications for

new pinion bearings in the Specifications portion of this section.

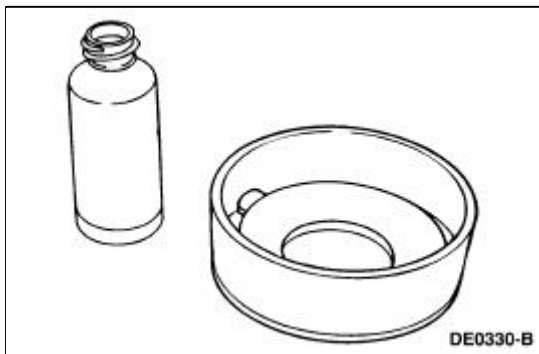
- For used pinion bearings, if the preload recorded prior to disassembly is lower than the specification for used bearings, then tighten the nut to specification. Refer to torque specifications for used pinion bearings in the Specifications portion of this section.
- For used pinion bearings, if the preload recorded prior to disassembly is higher than the specification for used bearings, then tighten the nut to the original reading as recorded.



18.  **CAUTION: 118 ml (4 oz) of Additive Friction Modifier C8AZ-19B546-A or equivalent meeting Ford specification EST-M2C118-A must be used in the axle.**

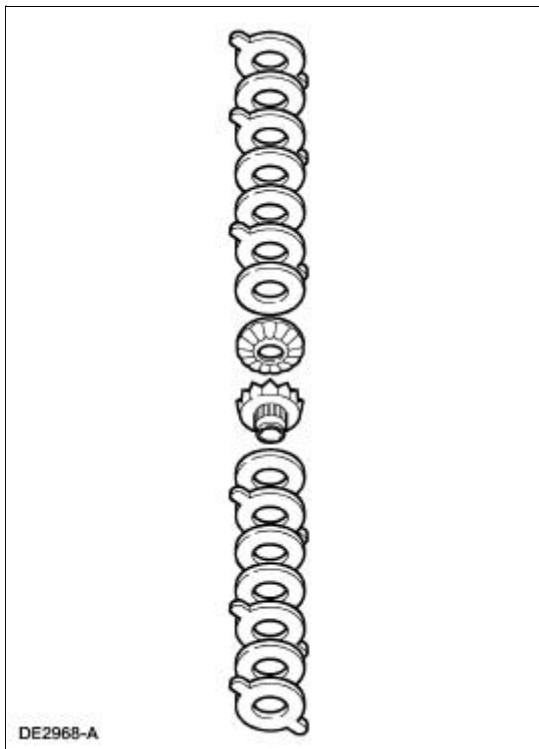
Lubricate each steel clutch plate and soak all friction plates for no less than 15 minutes.

- Use Additive Friction Modifier C8AZ-19B546-A or equivalent meeting Ford specification EST-M2C118-A.

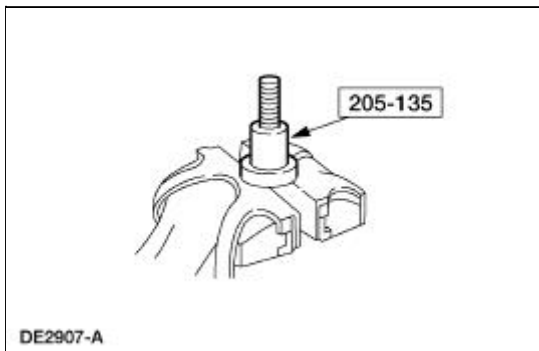


19.  **CAUTION: Do not mix the clutch plates, clutch discs or shim from one side with the other.**

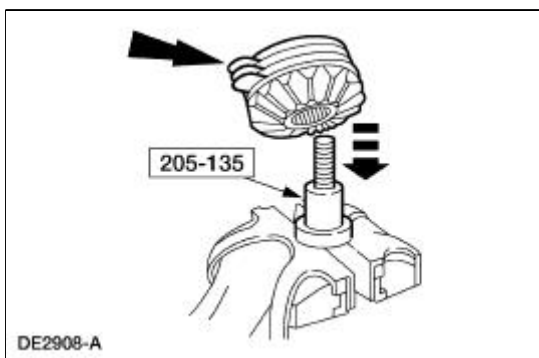
Assemble the differential clutch packs (without the shims) on their respective differential side gear.



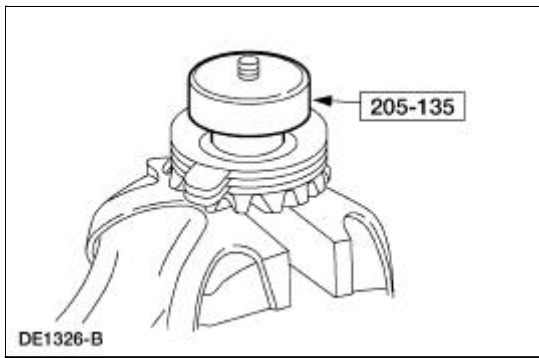
20. Place the base portion of the special tool in a vise.



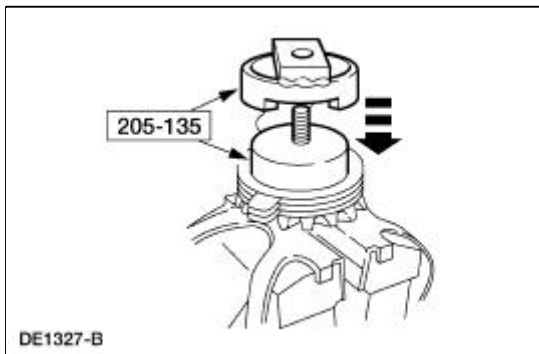
21. Install the differential clutch pack and differential side gear (without the shim) on the special tool.



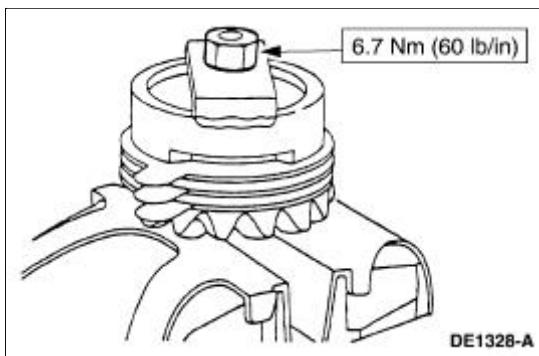
22. Position the special tool hand-tight on top of the differential clutch pack.



23. Install the special tool over the disc and differential clutch pack.



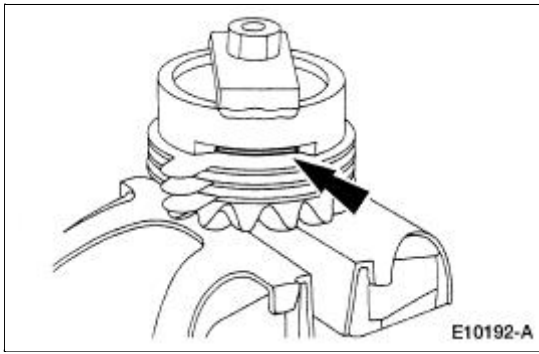
24. Install the nut.



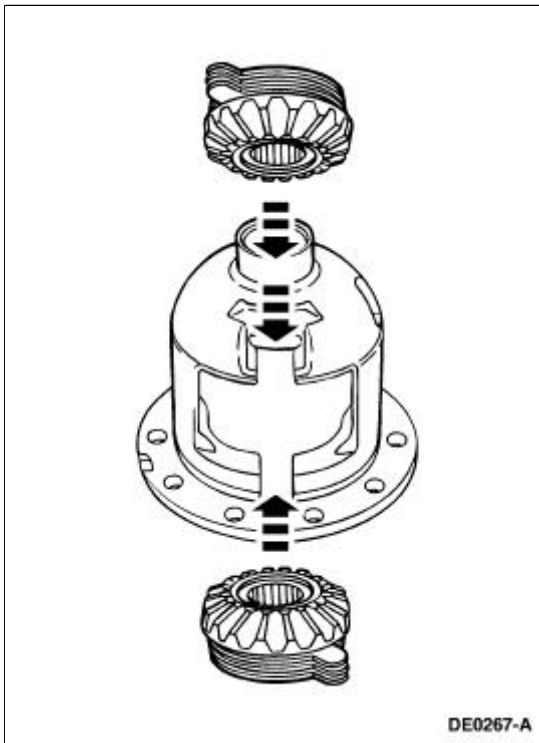
25. Select and insert the thickest feeler gauge blade that will enter between the tool and the differential clutch pack. The reading will be the thickness of the new clutch shim.

Selective Shims

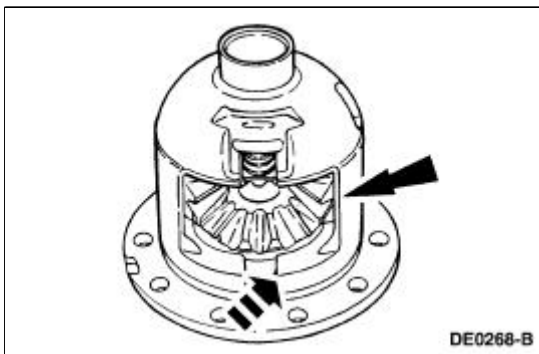
Part Number	Description
EOAZ-4A324-G	0.025 Inch
EOAZ-4A324-H	0.030 Inch
EOAZ-4A324-C	0.035 Inch
EOAZ-4A324-D	0.040 Inch
EOAZ-4A324-F	0.045 Inch



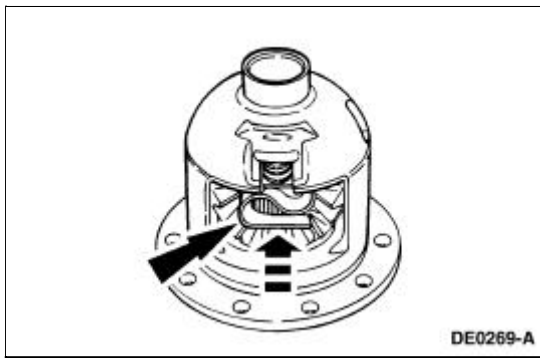
26. Remove the special tool from the differential clutch pack and differential side gear assembly.
27. Install the shim(s) on the differential clutch pack and differential side gear assembly.
28. Install the differential side gear assemblies in the differential case.



29. Install the differential pinion gear and differential pinion thrust washer assemblies in the differential case.

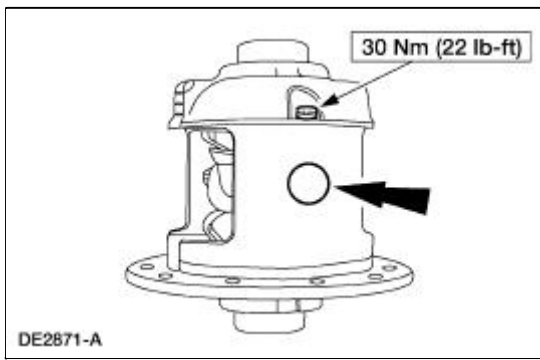


30. Using a soft-faced hammer, install the differential clutch spring.

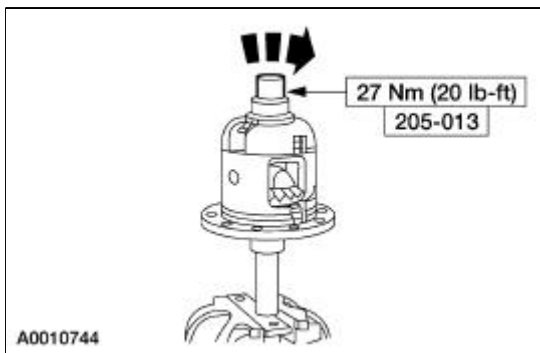


31. **NOTE:** If a new bolt is unavailable, coat the original bolt threads with Threadlock and Sealer EOAZ-19554-AA or equivalent meeting Ford specification WSK-M2G351-A5 prior to final installation.

Install the differential pinion shaft and install a new bolt finger-tight.

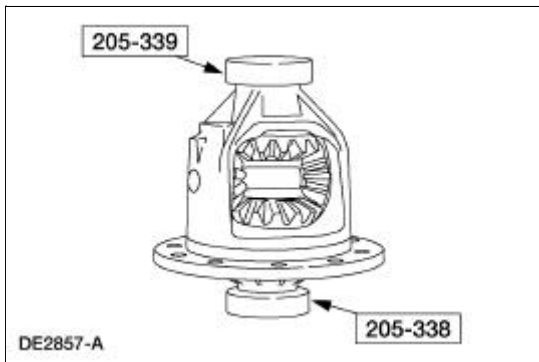


32. Mount the differential case and the special tool in a vise. Using the special tool, check the torque necessary to rotate one differential side gear.
- If reusing the original clutch plates, the initial minimum break-away torque must be no less than the specification. The minimum rotating torque necessary to keep the differential side gear turning with new clutch plates may vary.



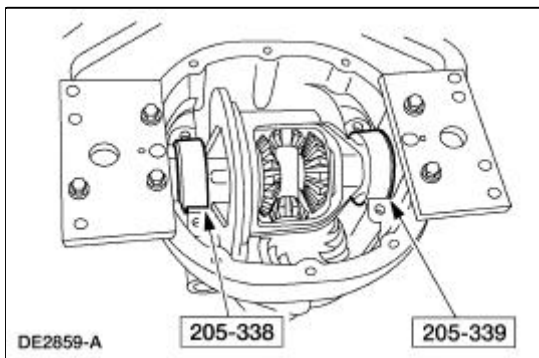
33. **CAUTION:** The Master bearings are marked LH and RH. Install them as shown.

Install the special tools on the differential case.

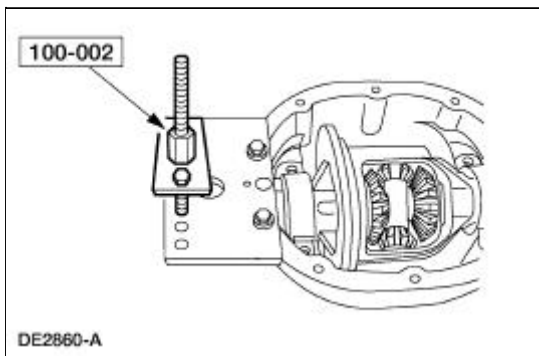


34. **⚠ CAUTION:** Do not damage the aluminum differential housing while carrying out these procedures.

Place the differential case with the special tools in the differential housing.



35. Position the special tool on the outside mounting hole.



36. **NOTE:** Repeat this step until obtaining a consistent reading.

Measure the total end play.

1. Attach the special tool and position the indicator tip on the machined surface of the differential case flange.
2. Move the differential case to the left and the right (as far as possible).
3. Record the reading on the differential bearing shim selection procedure line A.

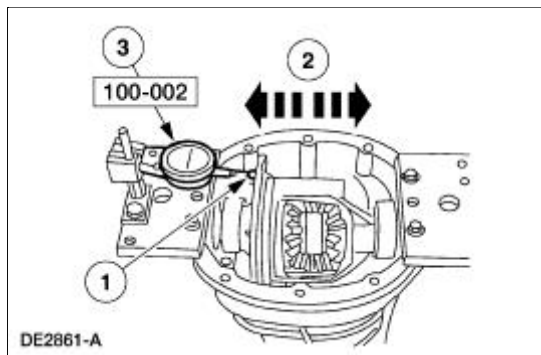
Differential Bearing Shim Selection Chart

8.8-inch Aluminum Axle	Example	Actual
Line-A End play without ring gear	0.498	
Line-B End play with ring gear (ring gear side)	-0.245	Minus (-)
Line-C Subtract Line-B from Line-A, also record on Line C, below	0.253	

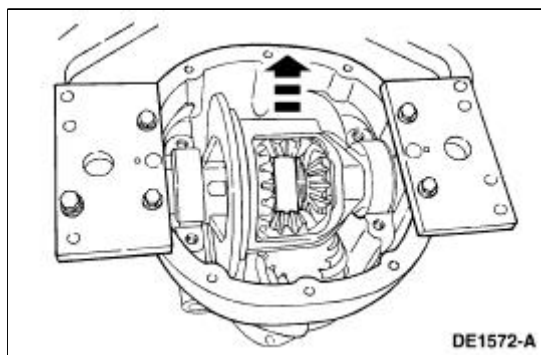
8.8-inch Aluminum Axle	Left Differential Bearing Height		Right Differential Bearing Height	
	Example	Actual	Example	Actual
Master bearing height	0.8695	0.8695	0.8695	0.8695
Line-D Actual bearing height	-0.8478	Minus (-)	-0.8491	Minus (-)
Line-E Difference	0.0217		0.0204	

8.8-inch Aluminum Axle	Left Side		8.8-inch Aluminum Axle	Right Side	
	Example	Actual		Example	Actual
Line-B End play Line-E Bearing height	0.2450 +0.0217	+	Line-C End play Line-E Bearing height	0.2530 +0.0204	+
TOTAL Lines B and E Backlash (subtract)	0.2667 -0.0060	-0.006	TOTAL Lines C and E Backlash/preload (add)	0.2734 +0.020	+0.020
Initial thickness ^a	0.2607		Initial thickness	0.2934	
Final shim thickness — left	0.261		Final shim thickness — right	0.293	

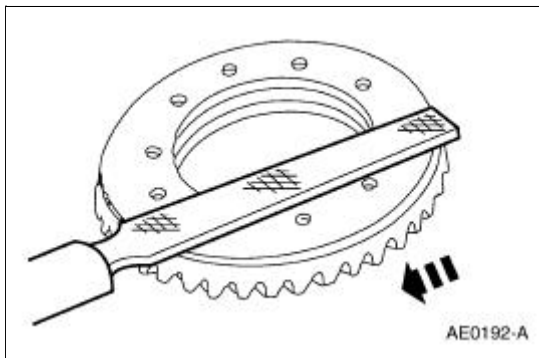
^a Round off initial thickness to the nearest shim thickness as in example for final shim thickness.



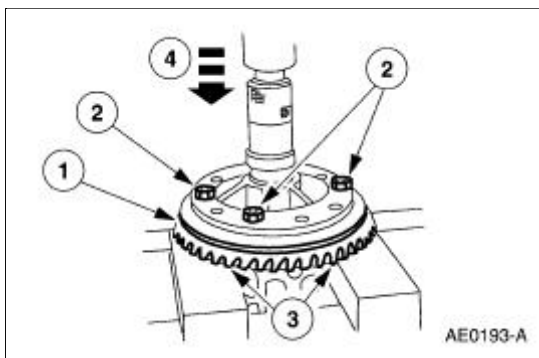
37. Remove the Dial Indicator and the differential case from the differential housing.



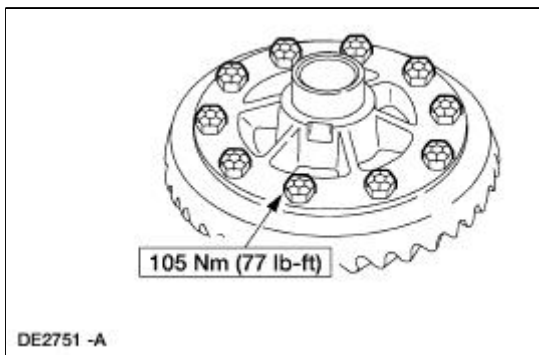
38. Draw-file the differential ring gear mounting surface to remove any nicks or burrs.



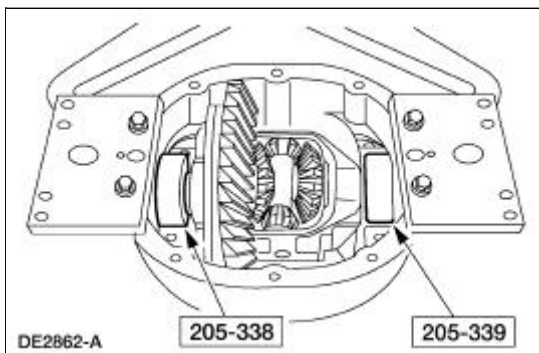
39. Install the differential ring gear.
1. Place the differential ring gear on the differential case.
 2. Hand start three bolts to align the holes in the differential ring gear and the differential case.
 3. Place the differential case and differential ring gear onto the press bed blocks with the differential ring gear teeth facing downward.
 4. Press the differential ring gear into place.



40. Install the remaining bolts.



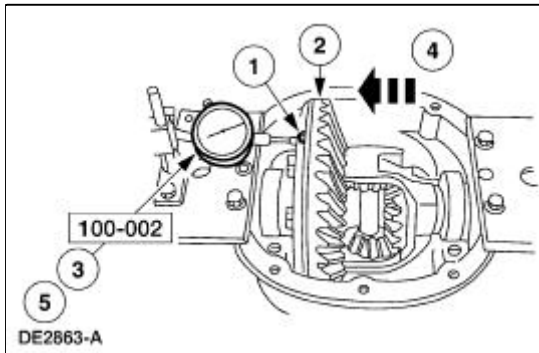
41. Place the differential case with the special tools into the differential housing.



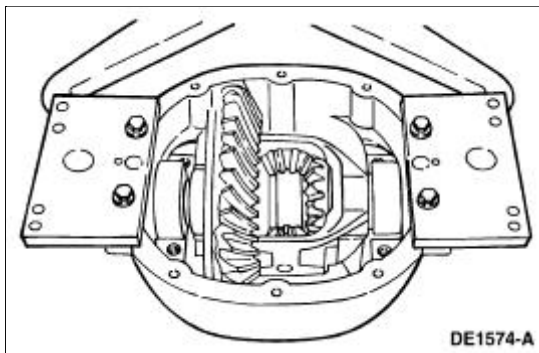
42. **NOTE:** The bolts retaining the differential ring gear to the differential case may interfere while carrying out this procedure. If so, remove three to five bolts to provide clearance.

Measure the end play.

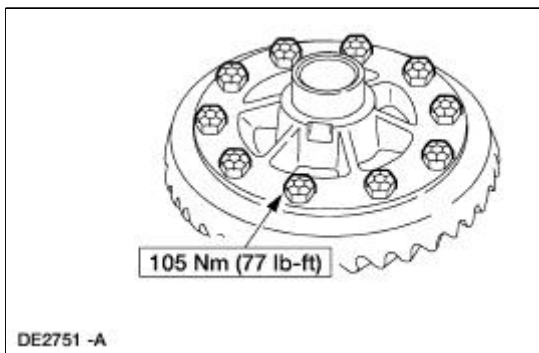
1. Attach the special tool and position the indicator tip on the machined surface of the differential case flange.
 2. Rock the differential ring gear to allow full mesh with the drive pinion gear.
 3. With the gears in full mesh, set the special tool to zero.
 4. Move the differential case as far as possible to the left and note the reading.
 5. Record the reading on the differential bearing shim selection procedure line B.
- Remove the special tool.



43. Remove the differential case from the differential housing.



44. Remove the bolts. Apply Stud and Bearing Mount EOAZ-19554-BA or equivalent meeting Ford specification WSK-M2G349-A1 to the bolt threads, and reinstall the bolts.

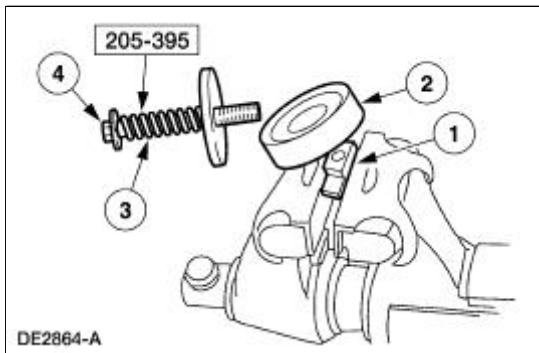


45. **NOTE:** Measure the stand height of both differential bearings prior to installation.

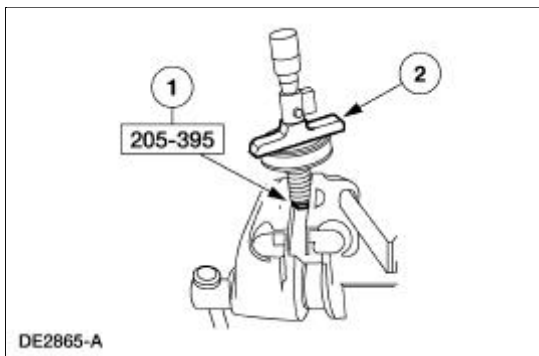
NOTE: Mark the differential bearings left and right before measuring them.

Install the special tool.

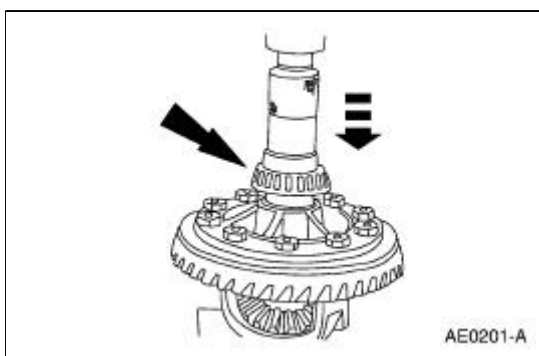
1. Place the special tool base in a soft-jawed vise with the bearing mounting surface above the vise jaws.
2. Position the differential bearing on the special tool base.
3. Attach the bolt, spring, washers and spacer.
4. Tighten the bolt.



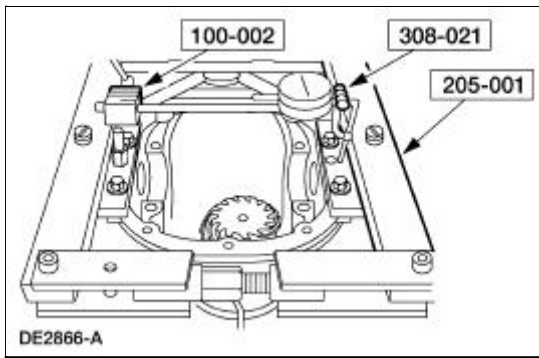
46. Measure the differential bearing stand height.
 1. Invert the special tool and clamp the bolt head in a vise.
 2. Position a depth micrometer flat on the differential bearing.



47. Measure both differential bearings stand height. Record the measurement on the differential bearing shim selection procedure line D.
48. Press the left and right differential bearing on the differential case.



49. Install the special tools.

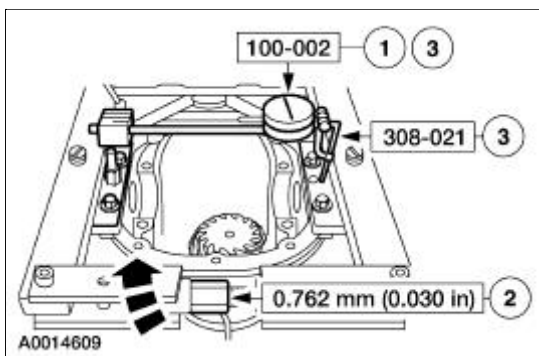


50.  **CAUTION: Overspreading may damage the differential housing.**

NOTE: Tighten and loosen the Differential Carrier Spreader screw to normalize the Housing Spreader Adapters prior to taking the final Dial Indicator reading.

Spread the differential housing to the specification.

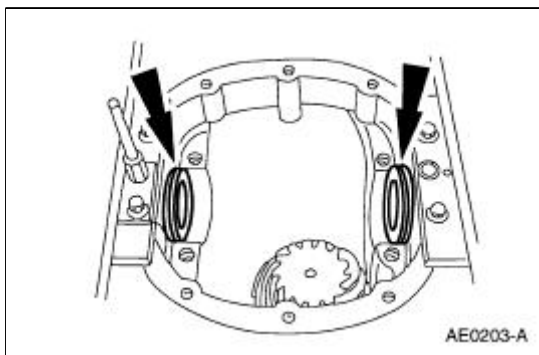
1. Adjust the special tool to zero.
2. Tighten the screw until spreading the differential housing to the specification.
3. Remove the special tools.



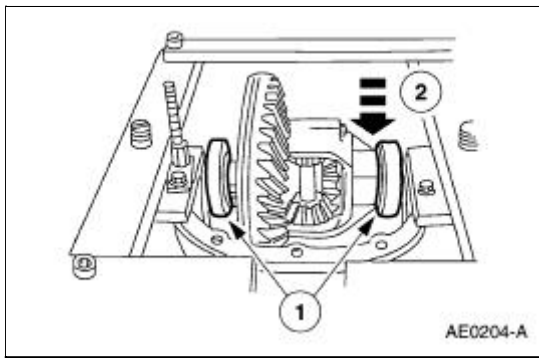
51. **NOTE:** Select the correct size differential bearing shims by completing the differential bearing shim selection chart.

NOTE: Apply a light coating of Premium Long-Life Grease XG-1-C, or equivalent meeting Ford specification ESA-M1C75-B to the differential bearing shim to help hold in place.

Place the differential bearing shims in the differential housing.

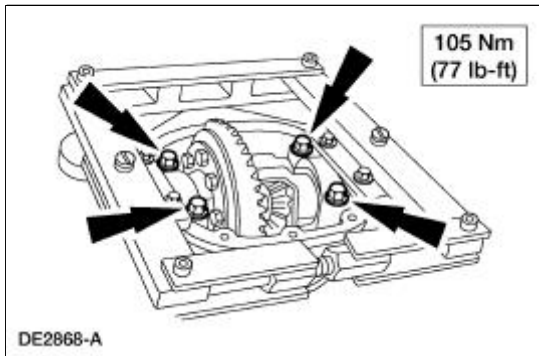


52. Install the differential case.
1. Position the differential bearing cups on the differential bearings.
 2. Lower the differential case in place between the differential bearing shims.

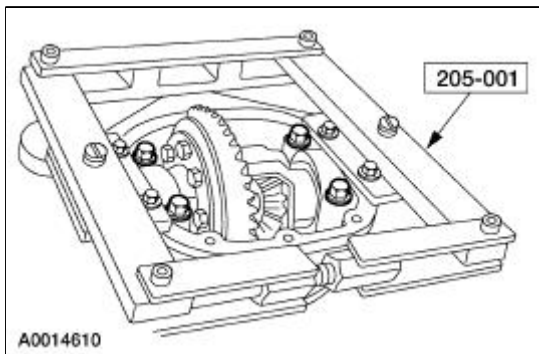


53. **NOTE:** Tighten the bolts prior to releasing the carrier spreader.

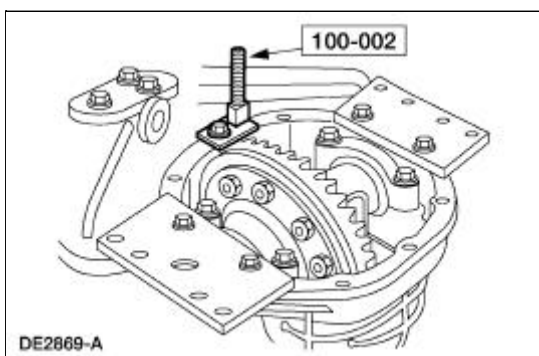
Install the differential bearing caps in their original locations and positions and tighten the bolts.



54. Remove the special tool.

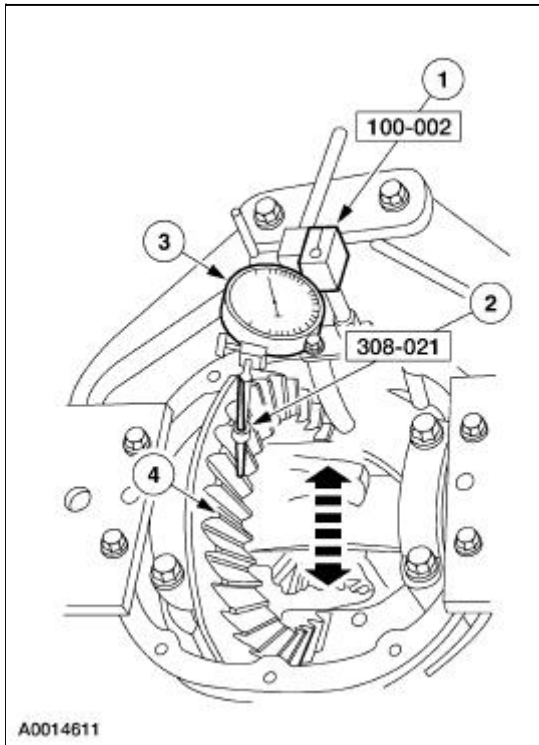


55. Install the special tool at the 12 o'clock position.



56. Using the special tools, measure the differential ring gear backlash at four equally spaced points.

1. Attach the special tool.
2. Position the special tool tip centrally on a drive tooth.
3. Zero the indicator.
4. Turn the differential ring gear without turning the drive pinion gear. Record the indicator reading. The allowable backlash is 0.203 mm (0.008 in) to 0.330 mm (0.013 in) and must not vary more than 0.1016 mm (0.004 in) between points measured. A backlash variation of more than 0.1016 mm (0.004 in) between points checked indicates gear/case runout.
 - If backlash is within specifications, proceed to Final assembly in this procedure.
 - To correct for a high or low backlash proceed as follows.



57. To correct for high or low backlash increase the thickness of one differential bearing shim and decrease the thickness of the other differential bearing shim by the same amount. Refer to the following tables when adjusting the backlash. When the backlash is within specifications, proceed to Final assembly in this procedure.


Backlash Change Required		Thickness Change Required	
mm	Inch	mm	Inch
0.025	0.001	0.050	0.002
0.050	0.002	0.050	0.002
0.076	0.003	0.101	0.004
0.101	0.004	0.152	0.006
0.127	0.005	0.152	0.006
0.152	0.006	0.203	0.008
0.177	0.007	0.254	0.010
0.203	0.008	0.254	0.010
0.228	0.009	0.304	0.012
0.254	0.010	0.355	0.014
0.279	0.011	0.355	0.014

0.304	0.012	0.406	0.016
0.330	0.013	0.457	0.018
0.335	0.014	0.457	0.018
0.381	0.015	0.508	0.020

Differential Shim Size Chart — 4067 —

Numbers of Stripes and Color Code	Dimension A	
	mm	Inch
2—C-COAL	7.7978-7.8105	0.3070-0.3075
1—C-COAL	7.7470-7.7597	0.3050-0.3055
5—BLU	7.6962-7.7089	0.3030-0.3035
4—BLU	7.6454-7.6581	0.3010-0.3015
3—BLU	7.5946-7.6073	0.2990-0.2995
2—BLU	7.5458-7.5565	0.2970-0.2975
5—PINK	7.4422-7.4549	0.2930-0.2935
4—PINK	7.3914-7.4041	0.2910-0.2915
3—PINK	7.3406-7.3533	0.2890-0.2895
2—PINK	7.2898-7.3025	0.2870-0.2875
1—PINK	7.2390-7.2517	0.2850-0.2855
5—GRN	7.1882-7.2009	0.2830-0.2835
4—GRN	7.1374-7.1501	0.2810-0.2815
3—GRN	7.0866-7.0993	0.2790-0.2795
2—GRN	7.0358-7.0485	0.2770-0.2775
1—GRN	6.9850-7.0485	0.2750-0.2755
5—WH	6.9342-6.9469	0.2730-0.2735
4—WH	6.8834-6.8961	0.2710-0.2715
3—WH	6.8326-6.8453	0.2690-0.2695
2—WH	6.7818-6.7945	0.2670-0.2675
1—WH	6.7310-6.7437	0.2650-0.2655
5—YEL	6.6802-6.6929	0.2630-0.2635
4—YEL	6.6294-6.6421	0.2610-0.2615
3—YEL	6.5786-6.5913	0.2590-0.2595
2—YEL	6.5278-6.5405	0.2570-0.2575
1—YEL	6.4770-6.4897	0.2550-0.2555
5—ORNG	6.4262-6.4389	0.2530-0.2535
4—ORNG	6.3754-6.3881	0.2510-0.2515
3—ORNG	6.3246-6.3373	0.2490-0.2495
2—ORNG	6.2738-6.2865	0.2470-0.2475
1—ORNG	6.2223-6.2357	0.2450-0.2455
2—RED	6.1722-6.1849	0.2430-0.2435
1—RED	6.1214-6.1341	0.2410-0.2415

Final assembly

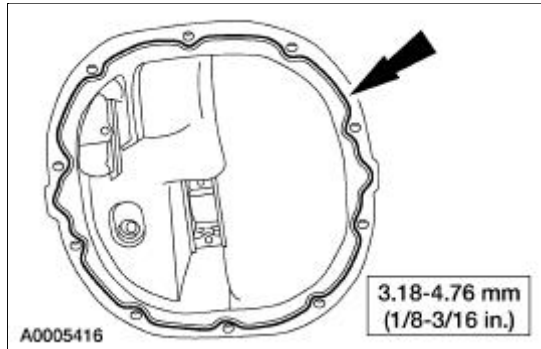
58.  **CAUTION:** The machined surfaces on the differential housing and the differential housing cover must be clean and free of oil before applying the new silicone sealant. Cover the inside of the axle before cleaning the machined surface to prevent contamination.

 **CAUTION:** Install the differential housing cover within 15 minutes of applying the silicone material.


 **CAUTION:** Allow the sealant to cure for one hour before filling the axle with lubricant.

Apply a continuous bead of sealant, of the specified thickness, to the differential housing cover mounting surface.

- Use Clear Silicone Rubber F7AZ-19554-CA or equivalent meeting Ford specification ESB-M4G92-A.



59. Install the differential housing cover.

60.  **CAUTION:** First fill the rear axle (4001) with 118 ml (4 oz) of Additive Friction Modifier C8AZ-19B546-A or equivalent meeting Ford specification EST-M2C118-A.

Install the rear axle assembly in the vehicle. Fill the axle with the specified lubricant. For additional information, refer to [Axle Housing](#) in this section.

General Specifications

Item	Specification
Halfshaft assembled length	817.6 mm (32.19 in)

Torque Specifications

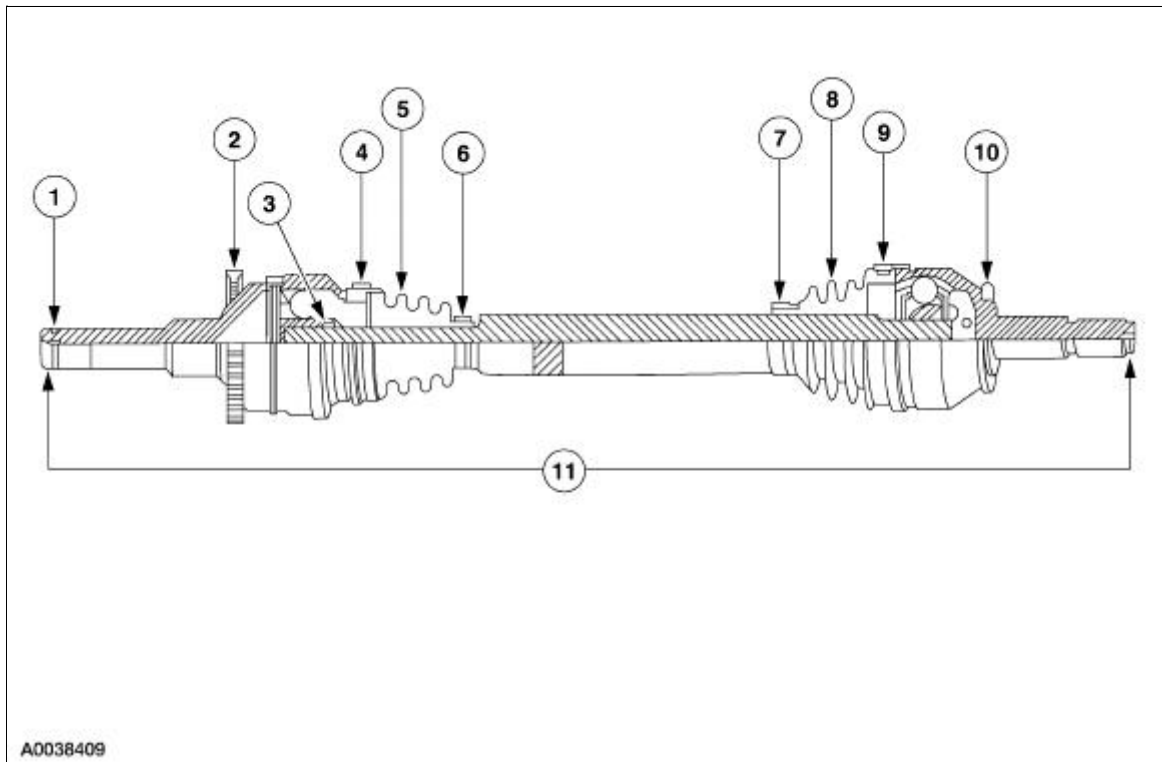
Description	Nm	lb-ft
Tie-rod end to knuckle	47	35
Shock absorber to suspension lower arm	133	98
Suspension upper arm and bushing to knuckle	90	66
Rear brake anti-lock sensor bolt	7	5
Rear axle wheel hub retainer	325	240

Rear Drive Halfshafts

The rear wheel drive halfshaft system consists of and operates as follows:

- Halfshafts (4K138) transmit engine torque from the rear axle housing to the rear wheels.
- Halfshafts rotate at approximately one-third the speed of a driveshaft and do not contribute to rotational vibration disturbances.
- A constant velocity (CV) joint is a mechanism for transmitting uniform torque and rotary motion while operating through a range of angles.
- CV joints at both inboard (differential) and outboard (wheel) ends provide operating smoothness.
- The inboard CV joints are plunge-type joints that provide the axial movement necessary to affect shaft length changes.
- The outboard CV joints have a higher angle capability than the inboard CV joints to accommodate suspension travel.
- Inboard and outboard CV joints connect to a splined shaft.
- A driveshaft bearing retainer circlip retains the splined inboard CV joint to the differential side gear. Install a new circlip every time you remove the halfshaft from the vehicle.
- A rear axle wheel hub retainer secures the interconnecting shaft and outboard CV joint to the rear hub.
- The lubed-for-life CV joints use special CV joint grease. They require no periodic lubrication.

- To separate the halfshaft from the rear hub, press the outboard CV joint from the rear hub.
- To separate the halfshaft from the differential, apply a load to the back face of the inboard CV joint assembly to overcome the circlip.
- The halfshaft assemblies are not repairable. Install a new assembly if worn/damaged.



A0038409

Item	Part Number	Description
1	4B422	Driveshaft bearing retainer circlip
2	2C189	Rear brake anti-lock sensor indicator
3	—	Retaining ring (part of 4B402)
4	4B478	Boot clamp (large inboard)
5	—	Rear axle shaft inner boot (part of 4B402)
6	4B478	Boot clamp (small inboard)
7	4B478	Boot clamp (small outboard)
8	—	Rear axle shaft outer boot (part of 4B402)
9	4B478	Boot clamp (large outboard)
10	2217	Dust seal assembly
11	4B402	Halfshaft assembly

Halfshaft Handling



CAUTION: Never pick up or hold the halfshaft by the outboard joint.

Handle all halfshaft components carefully during removal and installation.

- Do not over-angle the CV joints.
- Damage will occur to an assembled inboard CV joint if it is over-plunged outward from the joint housing.
- Never use a hammer to remove or install the halfshafts.
- Never use the halfshaft assembly as a lever to position other components. Always support the free end of the halfshaft.
- Do not allow the boots to contact sharp edges or hot exhaust components.

- Do not drop assembled halfshafts. The impact will cut the boots from the inside without evidence of external damage.
- Inspect all machined surfaces and splines for damage.

Wheel and Tire Balancing, Rear



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

Hoisting



CAUTION: Use a frame-contact hoist only. Vehicle or component damage can result if other types of hoists are used.

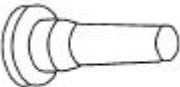



Never raise the vehicle using the halfshafts as lift points.

Undercoating and Rustproofing

During undercoating and rustproofing procedures, protect the boots from the coating materials. Foreign materials on the rubber boots will cause extreme advanced wear.

Halfshaft

Special Tool(s)

 ST1712-A	Differential Plug 205-294 (T89P-4850-B)
 ST2258-A	Differential Seal Protector 205-461
 ST2272-A	Front Hub Remover 205-D070 (D93P-1175-B) or Equivalent
 ST2309-A	Halfshaft Removal Tool 205-475
 ST2273-A	Steering Arm Remover 211-003 (T64P-3590-F)

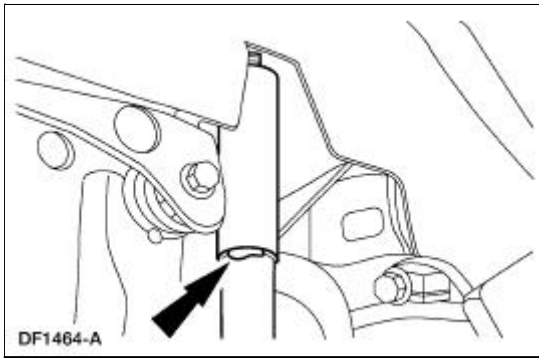
Removal

NOTE: This procedure applies to both the LH and RH halfshafts.

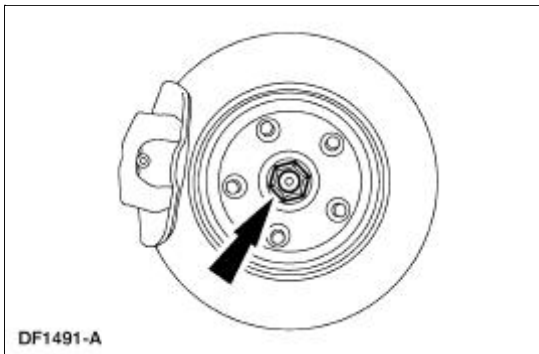
-  **CAUTION:** The vehicle must be on level ground and at curb height.

Mark the rear shock absorber relative to the protective sleeve.

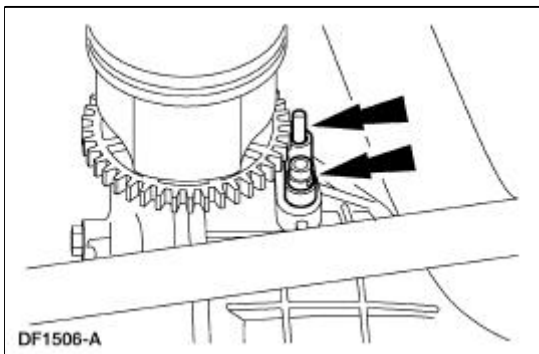
- During installation, raise the suspension to this reference mark before tightening the suspension component fasteners.



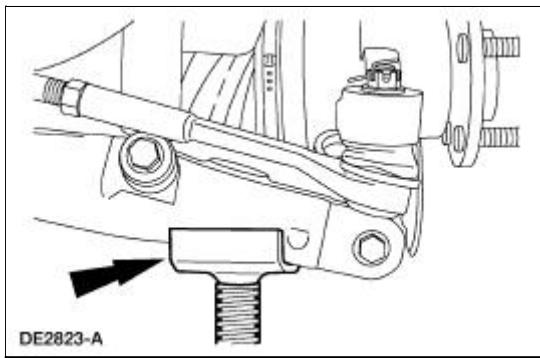
2. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
3. Remove the rear wheel and tire assembly. For additional information, refer to [Section 204-04](#).
4. Remove and discard the rear axle wheel hub retainer.



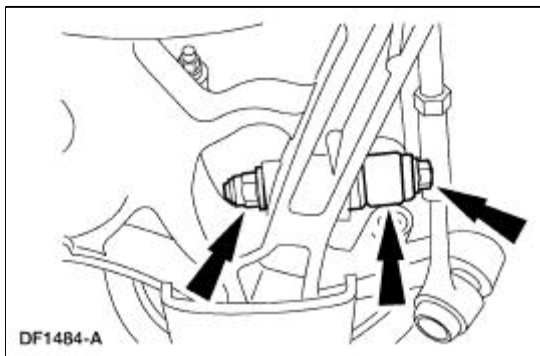
5. Remove the rear brake disc. For additional information, refer to [Section 206-04](#).
6. Remove the rear brake anti-lock sensor and position aside.



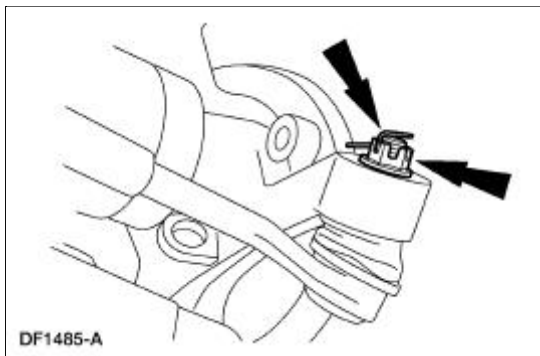
7. Support the suspension lower arm and bushing. This will ease removal of the lower shock absorber mount bolt.



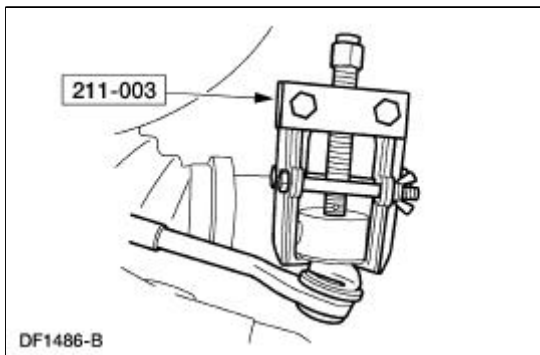
8. Disconnect the shock absorber at the suspension lower arm and bushing. Discard the nut and the bolt.



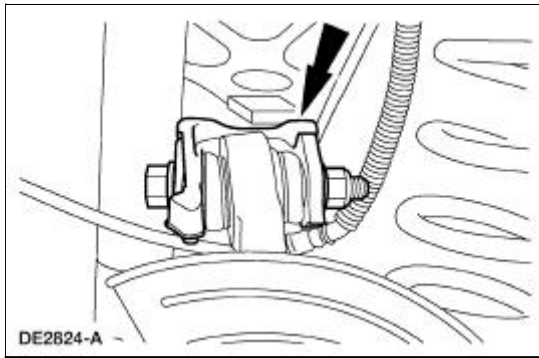
9. Remove and discard the cotter pin and the nut.



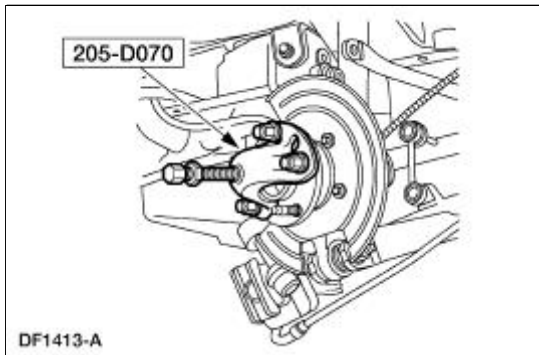
10. Using the special tool, disconnect the tie-rod link at the knuckle.



11. Disconnect the suspension upper arm and bushing at the knuckle. Discard the nut and the bolt.




- Using the special tool, press the outboard CV joint until it is loose in the hub.

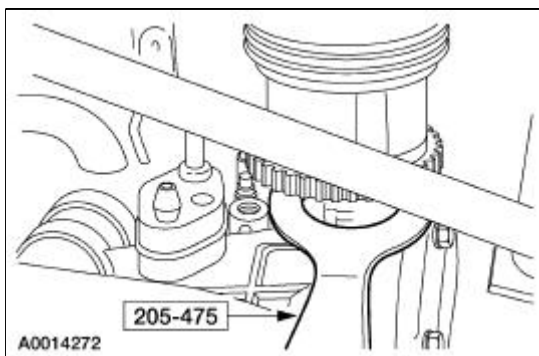


-  **CAUTION: Do not over-angulate the outboard CV joint or damage the boot.**

While lowering the knuckle, remove the CV joint from the hub.

-  **CAUTION: The crown on the tool forks must face away from the axle housing. Position the special tool correctly between the CV joint and the axle housing so as not to damage the differential seal.**

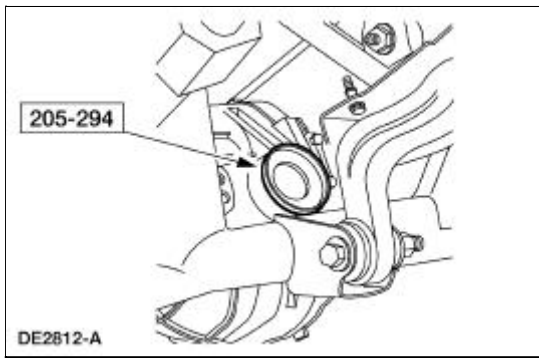
Using the special tool, exert enough pressure to overcome the circlip and separate the CV joint (4K326) from the differential side gear.



-  **CAUTION: Do not damage the differential seal.**

Carefully remove the halfshaft (4K138) with both hands.

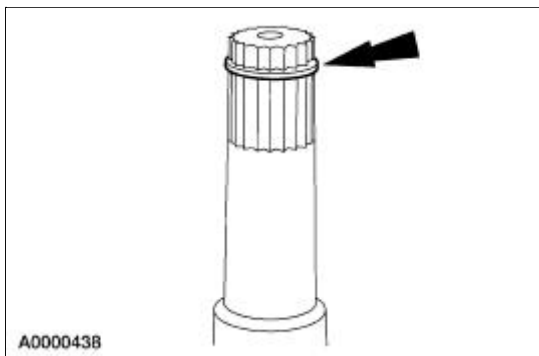
- Install the special tool.



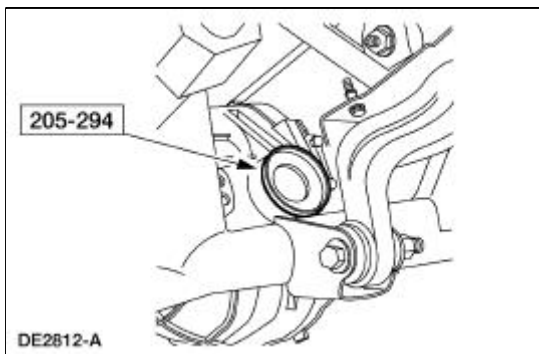
Installation

1. **NOTE:** This procedure applies to both the LH and RH halfshafts.

Install a new driveshaft bearing retainer circlip.

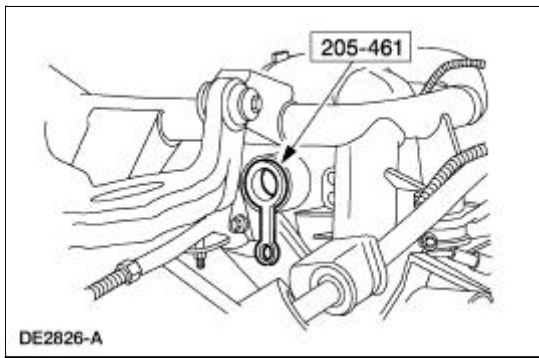


2. Remove the special tool.

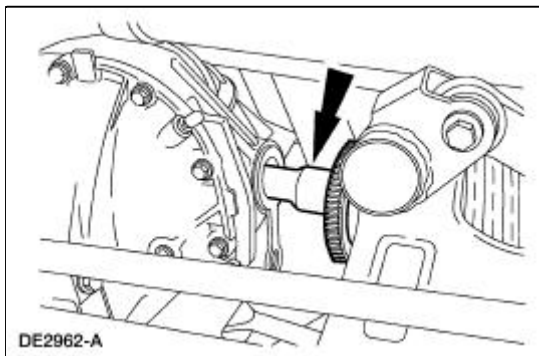


3. **⚠ CAUTION:** Differential seal damage will occur if installing the halfshaft without the special tool installed.

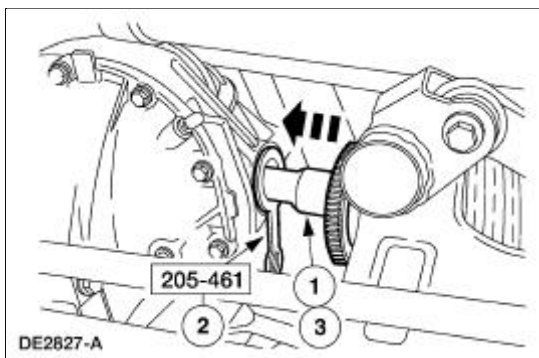
Install the special tool.



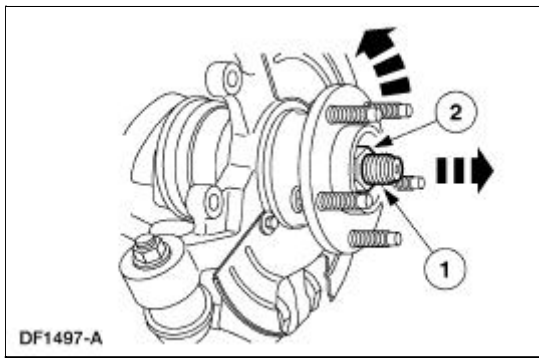
4. Position the halfshaft for installation.



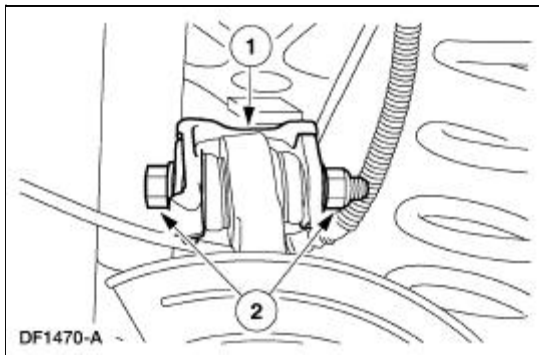
5. Seat the CV joint stub shaft in the differential side gear.
 1. Slide the stub shaft into the axle housing until the shaft splines are past the differential seal.
 2. Remove the special tool.
 3. Align the stub shaft splines and the side gear splines, and slide the stub shaft into the gear until it seats.
 - When seated, the axle circlip will lock the stub shaft in the differential side gear. Check the circlip engagement by attempting to pull the inboard CV joint out of the differential side gear. If the circlip has not seated, push the CV joint inward until the circlip is fully engaged in the differential side gear.



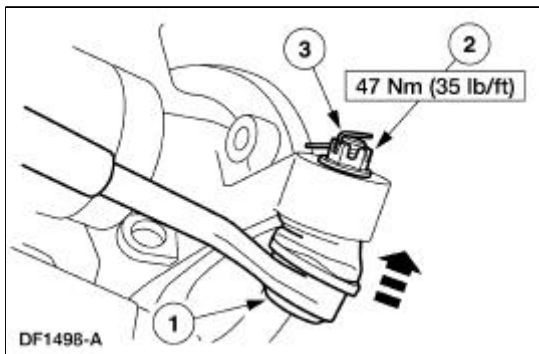
6. Connect the axle shaft to the hub.
 1. Making sure the serrations on the shaft line up with the serrations in the hub, install the axle shaft into the hub.
 2. Install a new retainer. Do not tighten the retainer at this time.



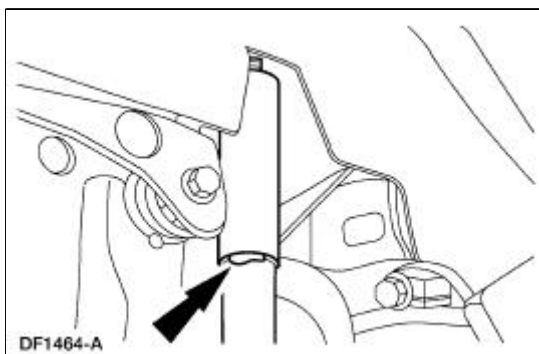
7. Connect the suspension upper arm and bushing to the knuckle.
 1. Position the suspension upper arm and bushing on the knuckle.
 2. Install the new bolt and a new nut. Do not tighten the nut at this time.



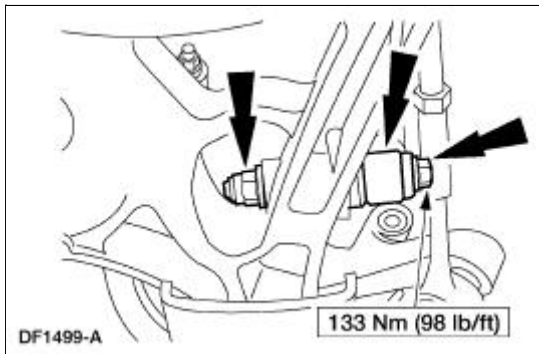
8. Connect the tie-rod end to the knuckle.
 1. Position the tie-rod link in the knuckle.
 2. Install a new nut.
 3. Install a new cotter pin.



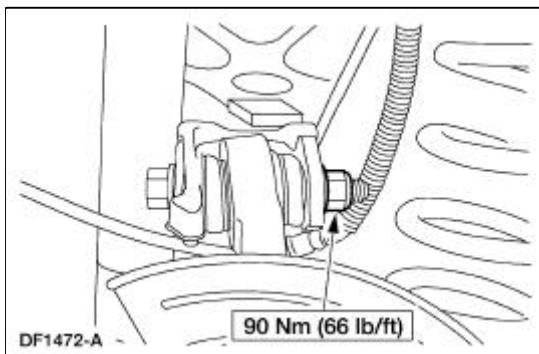
9. Raise the suspension until the shock absorber is compressed to the previously established alignment mark (curb height).



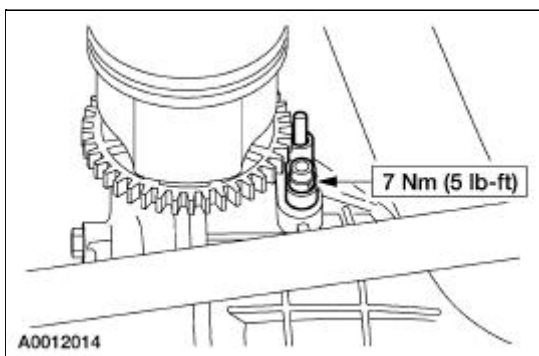
10. Connect the shock absorber to the suspension lower arm and bushing and install the new bolt and a new nut.



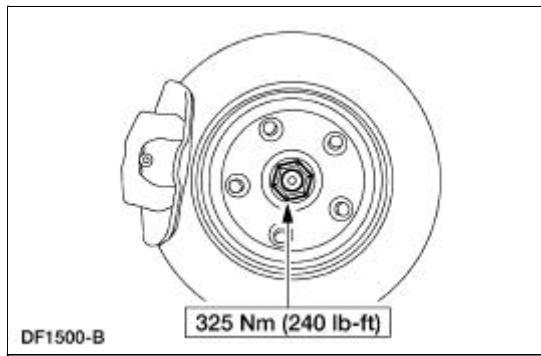
11. Tighten the nut.



12. Lower the suspension and remove the jack stand.
13. Apply Anti-Seize Lubricant to the rear brake anti-lock sensor where it contacts the axle housing and install the anti-lock sensor.
 - Use High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA or equivalent meeting Ford specification ESE-M124A-A.



14. Install the rear brake disc. For additional information, refer to [Section 206-04](#).
15. Tighten the retainer.




16. Install the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
 17. Lower the vehicle.
 18. Check the wheel alignment. Adjust as necessary. For additional information, refer to [Section 204-00](#).
-

Halfshaft Joint

Special Tool(s)

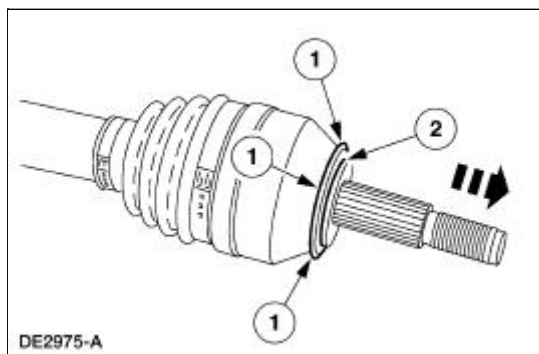
 ST1710-A	Driver 205-199 (T83T-3132-A1)
 ST1359-A	Hub Bearing Cup Replacer 205-147 (T80T-4000-P)
 ST1713-A	Sensing Ring Replacer 206-041 (T89P-20202-A)

Disassembly

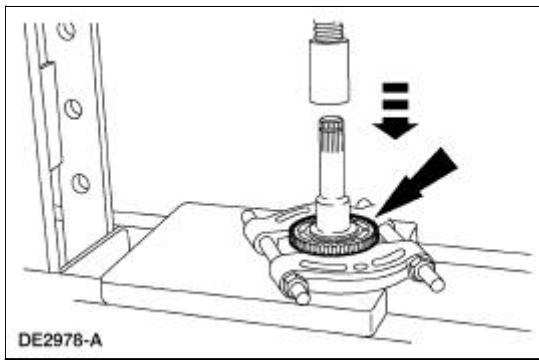
-  **CAUTION: Do not disassemble the halfshaft assembly. Install a new assembly if worn or damaged.**

Remove the halfshaft from the vehicle. For additional information, refer to [Halfshaft](#) in this section.

- If necessary, remove the dust seal assembly (2217).
 - Tap uniformly around the dust seal assembly.
 - Slide the dust seal assembly from the shaft.

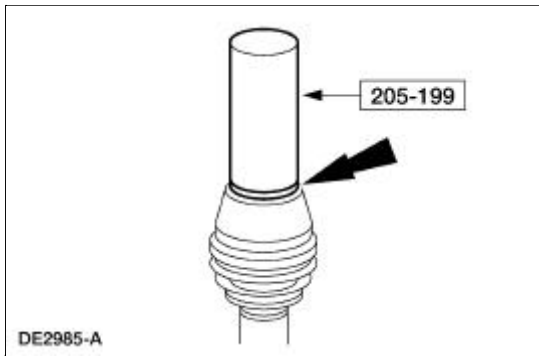



- Using a suitable bearing plate and a press, remove the rear brake anti-lock sensor indicator, if necessary.



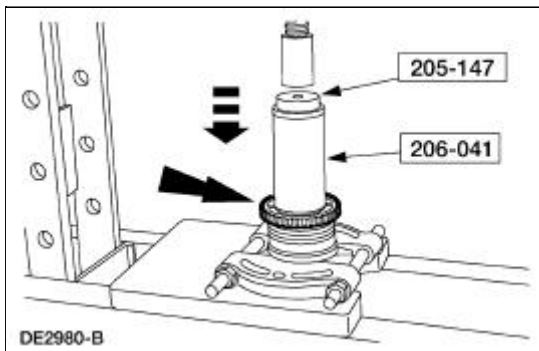
Assembly

1. Using the special tool and a hammer, install the new dust seal assembly, if removed.



2.  **CAUTION:** Place only the inboard CV joint outer race land on the bearing plate. Do not press against any other portion of the outer race or damage will occur.

If removed, using the special tools, the bearing plate and a suitable press, seat the rear brake anti-lock sensor indicator against the inboard CV joint housing.



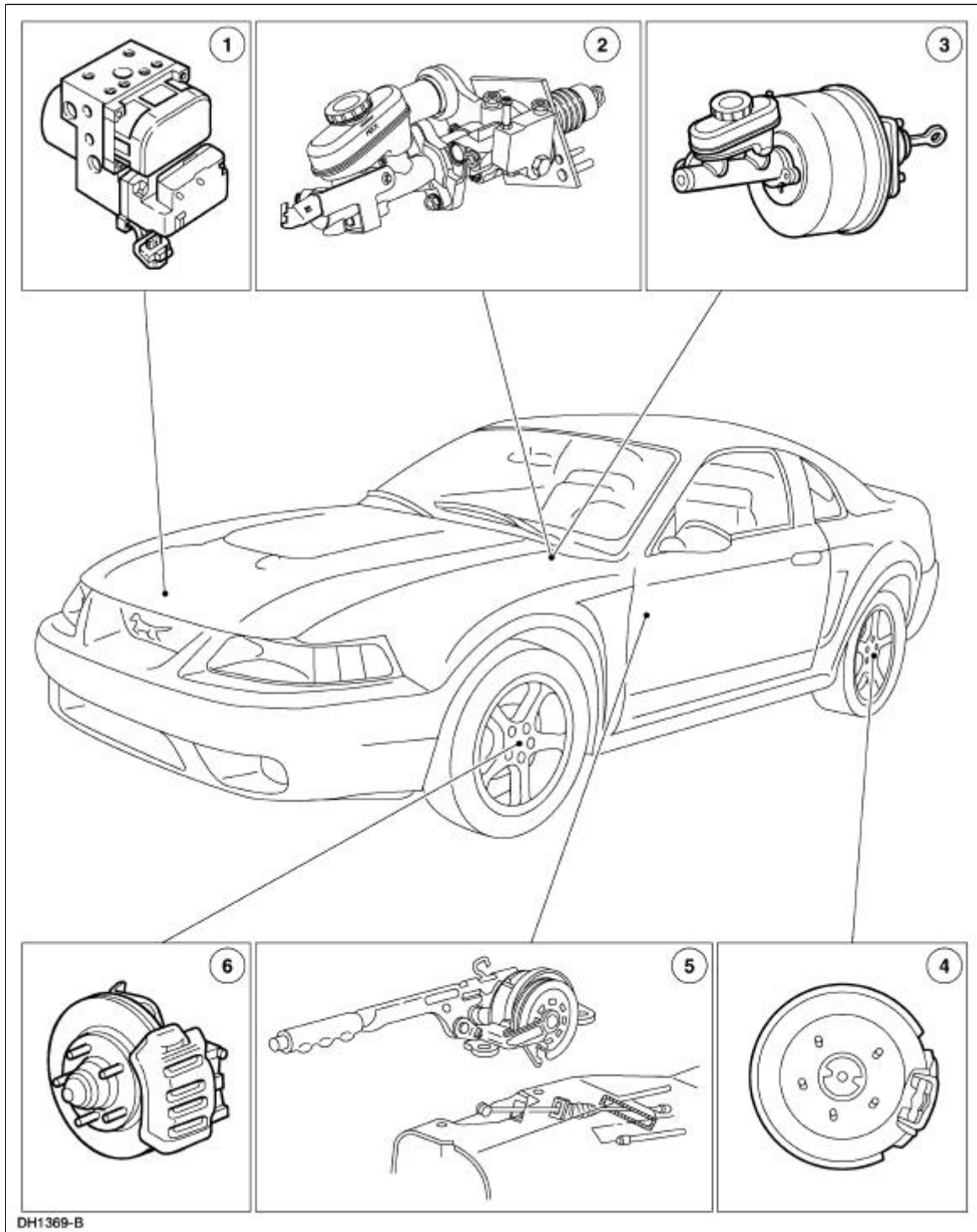
3. Install the halfshaft in the vehicle. For additional information, refer to [Halfshaft](#) in this section.
-

Torque Specifications

Description	Nm	lb-ft	lb-in
Front disc brake caliper bleeder screw	12-18	9-13	—
Front master cylinder brake tube	22-28	17-20	—
Rear bleeder screw	20	15	—
Rear master cylinder brake tube	15-20	11-14	—
Master cylinder bleeder screws	9	—	80

Brake System

Component Locations



DH1369-B

Item	Part Number	Description
1	2C346	Four wheel anti-lock brake system (4WABS)

		hydraulic control unit and control module assy (non-traction)
1	2C353	Four wheel anti-lock brake system (4WABS) hydraulic control unit and control module assy (traction)
2	2B559	Hydro-Boost brake booster and brake master cylinder assy
3	2B195	Vacuum brake booster and brake master cylinder assy
4	2K327	Rear disc brake assy
5	2780	Parking brake control
6	2B119	Front disc brake assy

The vehicle is equipped with a vacuum-assisted or a hydro-boost power braking system. Refer to [Section 206-07](#).

The braking system is a front-to-rear split hydraulic system. Refer to [Section 206-06](#).

The front wheel brakes utilize a dual piston brake caliper and disc brake system. Refer to [Section 206-03](#).

The rear brakes utilize a single piston brake caliper and disc brake system. Refer to [Section 206-04](#).

The parking brake system is a mechanical system that is controlled by an independent hand-operated parking brake control and is self-adjusting. Refer to [Section 206-05](#).




A 4-wheel anti-lock brake system or anti-lock brake system with traction control (4WABS) is optional equipment on all models except Cobra. Cobra has ABS and traction control as standard equipment. Refer to [Section 206-09A](#).

Brake System

Refer to Wiring Diagrams Cell [60](#), Instrument Cluster for schematic and connector information.


Refer to Wiring Diagrams Cell [97](#), Daytime Running Lamps for schematic and connector information.

Special Tool(s)

 ST1137-A	73 Digital Multimeter 105-R0051 or Equivalent
 ST2206-A	ABS Brake and Pressure Test Kit 107-02350 or Equivalent
 ST1687-A	Tire and Wheel Runout Gauge Set 134-00199 or Equivalent

Inspection and Verification

 **WARNING:** Use of any other than the approved DOT 3 brake fluid will cause permanent damage to brake components and will render the brakes inoperative.

 **WARNING:** Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

 **CAUTION:** Do not spill brake fluid onto painted surfaces. If spilled, wipe up immediately.

NOTE: Always check the fluid level in the brake master cylinder reservoir (2K478) before performing the test procedures. If the fluid level is not at the correct level, add High Performance DOT 3 Brake Fluid C6AZ-19542-AB or equivalent DOT 3 fluid meeting Ford specification ESA-M6C25-A.

NOTE: Prior to performing any diagnosis, make sure the brake warning indicator is functional. For additional information, refer to [Section 413-01](#).

The first indication that something may be wrong in the brake system is a change in the feeling through the brake pedal (2455). The brake warning indicator in the instrument cluster and the brake fluid level

in the brake master cylinder reservoir are also indicators of system concerns.

If a wheel is locked and the vehicle must be moved, open a bleeder screw at the locked wheel (1007) to let out enough fluid to relieve the pressure. Close the bleeder screw. This bleeding operation may release the brakes but will not correct the cause of trouble. If this does not relieve the locked wheel condition, repair the locked components before proceeding.

Inspect all hoses and connections. All unused vacuum connectors should be capped. Make sure hoses and their connections are correctly secured and in good condition with no holes, soft or collapsed areas.

Non-Pressure Leaks

The only part of the brake system that could have a brake fluid loss that does not appear when the system is under pressure is the brake master cylinder reservoir area. Brake fluid loss can be caused by a missing or poorly-fitted brake master cylinder filler cap (2162), a punctured or otherwise damaged brake master cylinder reservoir, a missing or damaged brake master cylinder filler cap gasket, or by missing, damaged or poorly-fitted sealing grommets between the brake master cylinder (2140) and the brake master cylinder reservoir.

The brake master cylinder reservoir grommets are not separately serviceable and must be installed new as part of a new brake master cylinder reservoir.

Install a new flexible brake hose if it shows signs of softening, cracking or other damage.

When installing a new brake hose, position the hose to avoid contact with other vehicle components.

Road Test

Perform a road test to compare actual vehicle braking performance with the performance standards expected by the driver. The ability of the test driver to make valid comparisons and detect performance deficiencies will depend on experience.

The driver should have a thorough knowledge of brake system operation and accepted general performance guidelines in order to make good comparisons and detect performance problems.

Select a road that is reasonably smooth and level. Gravel or bumpy roads are not suitable because the surface does not allow the tires to grip the road equally. Avoid crowned roads.

A key factor in evaluating brake concerns is the deceleration rate. This varies from vehicle to vehicle and with changes in operating conditions. It is evident how well the brakes are working after just a few applications.

Avoid locking the brakes. Locked brakes are not an indication of braking efficiency.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none">● Brake master cylinder● Brake caliper piston● Brake discs● Brake pads	<ul style="list-style-type: none">● Parking brake switch● Damaged or corroded wiring harness● Brake master cylinder fluid level switch

- | | |
|--|--|
| <ul style="list-style-type: none">● Power brake booster● Brake pedal linkage● Vacuum booster hose● Tires● Foreign material | |
|--|--|

For low or spongy brake pedal concerns:

- check and, if necessary, refill the brake master cylinder reservoir.
- bleed the brake system and retest the brake pedal feel.
- if the brake pedal is still low or feels spongy, check the brake pedal mounting for looseness and correct installation. Check the power brake booster and the brake master cylinder for loose mounting. Correct as necessary and retest the system for normal operation.

For a slow or incomplete brake pedal return concern:

- inspect for binding, damage, correct installation or interference at the brake pedal.
- check the power brake booster for binding, damage and correct installation.

Vibration When Brakes are Applied

For vibration concerns when brakes are applied, perform the following procedure.

Visually inspect:

- tire condition and pressure.
- suspension bushings and ball joints.

Correct as necessary.

1. Verify and isolate the concern. Brake roughness can be felt in:
 - the steering wheel.
 - the seat.
 - the brake pedal.
2. After verifying the concern, check for related concerns in the:
 - On-Line Automotive Service Information System (OASIS).
 - Technical Service Bulletins.
3. Check wheel bearing end-play and correct as necessary.
4. **NOTE:** Begin at the front of the vehicle unless the vibration has been isolated to the rear.

Remove the tire and wheel.
5. Remove the brake caliper.
6. Measure and record the brake disc thickness. Install a new brake disc if the thickness after machining will be at or below specification. The specification is molded into the brake disc. Do

not machine a new brake disc.

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

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

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

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

9. Using a dial indicator, verify that the brake disc lateral runout is now within vehicle specification.
10. Remove any metal chips.
11. Remove the hub adapter.
12. Remove any remaining metal chips from the machining operation.

13.  **CAUTION: Do not carry out this step on rear drum-in-hat brake discs.**

For vehicles with a two-piece hub and a non drum-in-hat brake disc assembly:

- Remove the brake disc from the hub.
 - Remove any remaining metal chips from hub and brake disc mounting surfaces and from the ABS sensor.
 - Apply High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA to the mounting surfaces.
 - Using the match-marks, mount the brake disc on the hub.
14. Install the caliper and check brake operation.

Symptom Chart

Symptom Chart

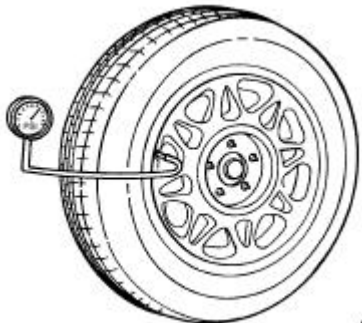
Condition	Possible Sources	Action
<ul style="list-style-type: none">● The Brakes Pull or Drift	<ul style="list-style-type: none">● Tire air pressure.● Wheel alignment.● Brake pads.● Brake components.● Suspension component.	<ul style="list-style-type: none">● Go To Pinpoint Test A .
<ul style="list-style-type: none">● The Red Brake Warning Indicator Is	<ul style="list-style-type: none">● Instrument cluster.● Circuit.	<ul style="list-style-type: none">● Go To Pinpoint Test B .

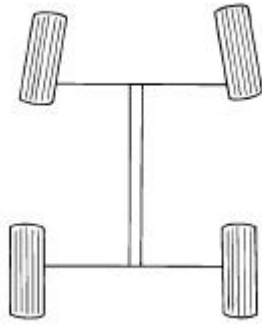
Always On	<ul style="list-style-type: none"> ● Parking brake. ● Brake fluid level. 	
<ul style="list-style-type: none"> ● Vibration When Brakes Are Applied 	<ul style="list-style-type: none"> ● Rear disc brakes. ● Front disc brakes. 	<ul style="list-style-type: none"> ● REFER to Section 100-04.
<ul style="list-style-type: none"> ● Brake Pedal Goes Down Fast 	<ul style="list-style-type: none"> ● Brake fluid level. ● Air in system. ● Brake master cylinder. 	<ul style="list-style-type: none"> ● FILL the brake master cylinder reservoir. BLEED the system. ● BLEED the system. ● PERFORM the brake master cylinder component test in this section.
<ul style="list-style-type: none"> ● The Brake Pedal Eases Down Slowly 	<ul style="list-style-type: none"> ● Air in system. ● Brake master cylinder. 	<ul style="list-style-type: none"> ● BLEED the system. REFER to Bleeding — System in this section. ● PERFORM the brake master cylinder component test in this section.
<ul style="list-style-type: none"> ● Brake Lockup During Light Brake Pedal Force 	<ul style="list-style-type: none"> ● Disc brake component. ● Parking brake component. ● Anti-lock brake control system. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test C.
<ul style="list-style-type: none"> ● Excessive/Erratic Brake Pedal Travel 	<ul style="list-style-type: none"> ● Leak in hydraulic system. ● Air in system. ● Disc brake caliper. ● Brake master cylinder. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test D.
<ul style="list-style-type: none"> ● Brakes Drag 	<ul style="list-style-type: none"> ● Parking brake component. ● Disc brake caliper. ● Brake booster-to-brake master cylinder push rod adjustment. ● Brake master cylinder. 	<ul style="list-style-type: none"> ● REPAIR or INSTALL new components as necessary. REFER to Section 206-05. ● REPAIR or INSTALL a new brake caliper as necessary. REFER to Section 206-03 and Section 206-04. ● ADJUST the push rod. REFER to Section 206-07. ● PERFORM the brake master cylinder component test in this section.
<ul style="list-style-type: none"> ● Excessive Brake Pedal Effort 	<ul style="list-style-type: none"> ● Power brake booster. ● Power brake booster check valve (2365). ● Power brake booster hose. 	<ul style="list-style-type: none"> ● PERFORM the brake booster component test in this section. ● PERFORM the check valve component test in this section. ● REROUTE, REPAIR or INSTALL a new brake

		booster hose as necessary.
<ul style="list-style-type: none"> ● Red Brake Warning Indicator Inoperative 	<ul style="list-style-type: none"> ● Circuit. ● Bulb. 	<ul style="list-style-type: none"> ● REFER to Section 413-01.
<ul style="list-style-type: none"> ● Brake Noise 	<ul style="list-style-type: none"> ● Disc brake component. 	<ul style="list-style-type: none"> ● MACHINE or INSTALL a new brake component as necessary. REFER to Section 206-03 or Section 206-04.
<ul style="list-style-type: none"> ● Hydro-Boost, No Power Assist 	<ul style="list-style-type: none"> ● Power steering pump. ● Linkage. ● Power steering fluid flow. ● Hydro-boost unit. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test E.
<ul style="list-style-type: none"> ● Hydro-Boost Erratic Operation, Sticks, Binds or Grabs 	<ul style="list-style-type: none"> ● Supply hose. ● Hydro-boost unit. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test F.
<ul style="list-style-type: none"> ● Hydro-Boost Brake System Operation Suspect 	<ul style="list-style-type: none"> ● Leakage. ● Hydro-boost unit. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test G.

Pinpoint Tests

PINPOINT TEST A: THE BRAKES PULL OR DRIFT

Test Step	Result / Action to Take
<p>A1 CHECK THE TIRES</p> <p>NOTE: Check tire pressure with the brakes off.</p> <ul style="list-style-type: none"> ● Check tires for uneven and excessive wear and for correct pressure.  <p style="text-align: right;">AH0038-A</p> <ul style="list-style-type: none"> ● Are the tires OK? 	<p>Yes GO to A2.</p> <p>No CORRECT as necessary. RETEST for normal operation.</p>
<p>A2 CHECK THE ALIGNMENT</p> <ul style="list-style-type: none"> ● Check the caster, camber and toe. Refer to Section 204-00. 	<p>Yes GO to A3.</p> <p>No CORRECT alignment as necessary. REFER to Section 204-00. RETEST for correct operation.</p>

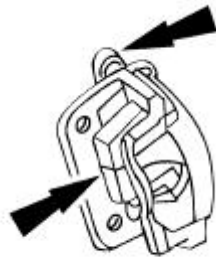


AH0061-A

- Is the alignment OK?

A3 CHECK THE DISC BRAKE COMPONENTS

- Check all disc brake calipers, anchor plate guide pins and brake pads for binding, wear, damage, contamination and correct installation.



AH0041-A

- Are the disc brake calipers, anchor plate guide pins and brake pads OK?

Yes
GO to [A4](#).

No
REPAIR or INSTALL new components as necessary. RETEST for normal operation.

A4 ROAD TEST THE VEHICLE

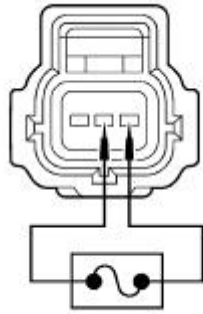
- Road test the vehicle, and observe whether the drift occurs with or without the brakes applied.
- Does the drift or pull occur with the brakes applied?

Yes
REPAIR or INSTALL new front disc brake caliper or anchor plate guide pins on the side opposite to the direction of the drift or pull.

No
REPAIR or INSTALL new front disc brake caliper or anchor plate guide pins on the side of the vehicle in the direction of the drift or pull.

PINPOINT TEST B: THE RED BRAKE WARNING INDICATOR IS ALWAYS ON

Test Step	Result / Action to Take
B1 CHECK THE BRAKE MASTER CYLINDER FLUID LEVEL SWITCH	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Brake Master Cylinder Fluid Level Switch C124. ● Connect a fused jumper from C124-2 circuit 977 (PK/WH) to C124-3 circuit 128 (VT/YE). 	<p>Yes GO to B2.</p> <p>No INSTALL a new brake master</p>



DH1372-A

- Key in ON position.
- Does the brake warning indicator stay on?

cylinder reservoir. TEST the system for normal operation.

B2 CHECK PARKING BRAKE SWITCH

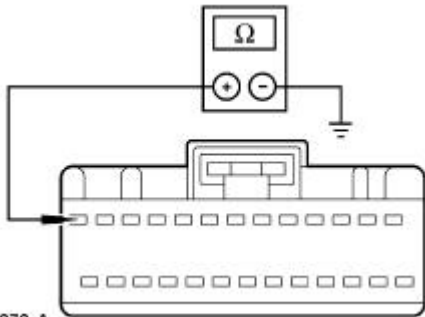
- Key in OFF position.
- Disconnect: Parking Brake Switch.
- Key in ON position.
- Does the brake warning light stay on?

Yes
GO to [B3](#).

No
INSTALL a new parking brake switch. TEST the system for normal operation.

B3 CHECK THE GEM

- Key in OFF position.
- Disconnect: GEM C201e.
- Measure resistance to ground at C201e-13.



DH1373-A

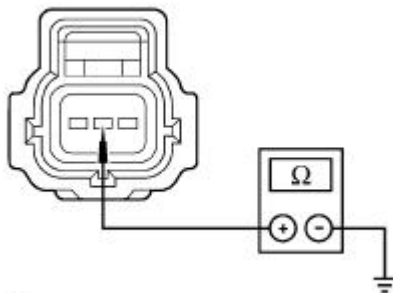
- Is the resistance greater than 10,000 ohms?

Yes
REPAIR the GEM. TEST the system for normal operation.

No
For vehicles without Daytime Running Lights (DRL), GO to [B4](#). For vehicles with DRL, GO to [B5](#).

B4 CHECK CIRCUITS 977 (VT/WH), 22 (LB/BK) AND 128 (VT/YE)

- Remove the fused jumper from C124.
- Measure the resistance to ground at C124-2.



DH1374-A

- Is the resistance greater than 10,000 ohms?

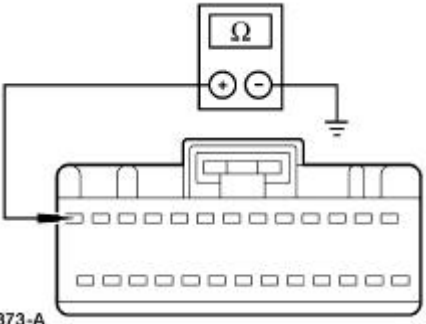
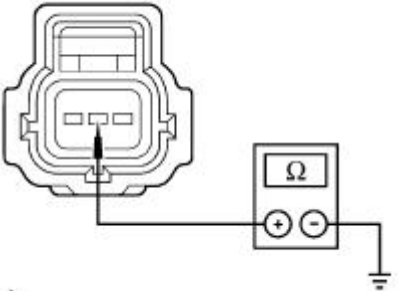
Yes
REPAIR the ground short in circuit 128 (VT/YE). TEST the system for normal operation.

No
REPAIR the ground short in circuit 977 (VT/WH) or circuit 22 (LB/BK). TEST the system for normal operation.

B5 CHECK CIRCUIT 128 (VT/YE)

- Remove the fused jumper from C124.
- Measure the resistance to ground at C201e-13.

Yes
GO to [B6](#).

 <p>DH1373-A</p> <ul style="list-style-type: none"> ● Is the resistance greater than 10,000 ohms? 	<p>No REPAIR the ground short in circuit 128 (VT/YE). TEST the system for normal operation.</p>
B6 CHECK DAYTIME RUNNING LIGHTS (DRL) MODULE	
<ul style="list-style-type: none"> ● Disconnect: DRL Module C1030. ● Measure the resistance to ground at C124-2.  <p>DH1374-A</p> <ul style="list-style-type: none"> ● Is the resistance greater than 10,000 ohms? 	<p>Yes REPAIR the DRL module. TEST the system for normal operation.</p> <p>No REPAIR the ground short in circuit 22 (LB/BK) or 977 (VT/WH). TEST the system for normal operation.</p>

PINPOINT TEST C: BRAKE LOCKUP DURING LIGHT BRAKE PEDAL FORCE

Test Step	Result / Action to Take
<p>C1 INSPECT THE TIRES</p> <ul style="list-style-type: none"> ● Inspect the tires for uneven or excessive wear, correct pressure, correct size and type. ● Are the tires OK? 	<p>Yes GO to C2.</p> <p>No CORRECT as necessary. RETEST for normal operation.</p>
<p>C2 CHECK THE BRAKE CALIPER COMPONENTS</p> <ul style="list-style-type: none"> ● Inspect the brake pads and brake discs for wear, damage, contamination and correct installation. ● Are the brake components OK? 	<p>Yes GO to C3.</p> <p>No CORRECT as necessary. RETEST for normal operation.</p>
<p>C3 CHECK THE PROPORTIONING VALVE</p> <ul style="list-style-type: none"> ● Install the gauges from the ABS brake and pressure test kit on one front and one rear bleeder screw. ● Apply 6895 kPa (1000 psi) to the front brake system. ● Is the pressure in the rear system 3516- 	<p>Yes INSPECT the disc brake calipers and INSTALL new calipers as necessary. RETEST for normal operation.</p> <p>No</p>

4481 kPa (510-650 psi)?	INSTALL a new proportioning valve. RETEST for normal operation.
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PINPOINT TEST D: EXCESSIVE/ERRATIC BRAKE PEDAL TRAVEL

Test Step	Result / Action to Take
D1 CHECK FOR SPONGY PEDAL	
<ul style="list-style-type: none"> ● Key in ON position. ● Operate the brake pedal and note pedal feel. ● Does the pedal feel spongy? 	<p>Yes BLEED the brake system. REFER to Bleeding — System in this section. RETEST for normal operation.</p> <p>No GO to D2.</p>
D2 CHECK THE BRAKE PEDAL	
<ul style="list-style-type: none"> ● Inspect the brake pedal and bracket for binding, obstruction or damage. ● Is the brake pedal OK? 	<p>Yes GO to D3.</p> <p>No REPAIR or INSTALL a new brake pedal as necessary. RETEST for normal operation.</p>
D3 CHECK THE BRAKE COMPONENTS	
<ul style="list-style-type: none"> ● Inspect the calipers bolts, anchor plate bolts and anti-rattle springs for binding, damage, contamination and correct installation. ● Are the bolts and springs OK? 	<p>Yes GO to D4.</p> <p>No REPAIR or INSTALL new components as necessary. RETEST for normal operation.</p>
D4 CHECK THE BOOSTER AND MASTER CYLINDER	
<ul style="list-style-type: none"> ● Check the power brake booster and brake master cylinder for correct installation and correct push rod adjustment. Refer to Section 206-06 and to Section 206-07. ● Are the power brake booster and the brake master cylinder OK? 	<p>Yes INSPECT the front wheel bearings for wear, damage and correct installation and the rear axle end play. CORRECT as necessary. RETEST for normal operation.</p> <p>No CORRECT as necessary. RETEST for normal operation.</p>

PINPOINT TEST E: HYDRO-BOOST, NO POWER ASSIST

Test Step	Result / Action to Take
E1 CHECK FLUID LEVEL IN POWER STEERING PUMP	
<ul style="list-style-type: none"> ● Check fluid level in power steering pump. ● Is level within specification? 	<p>Yes GO to E2.</p> <p>No CHECK for leakage of power steering fluid. ADD fluid as necessary.</p>
E2 CHECK ACCESSORY DRIVE BELT	

<ul style="list-style-type: none"> ● Check accessory drive belt tension and condition. Refer to Section 303-05. ● Is the accessory drive belt OK? 	<p>Yes GO to E3.</p> <p>No INSTALL a new accessory drive belt. REFER to Section 303-05.</p>
E3 CHECK POWER STEERING HOSES	
<ul style="list-style-type: none"> ● Check power steering pressure hoses, power steering gear pressure hoses and power steering return hose for cracks or leaks. ● Do power steering pressure hose, power steering gear hose and power steering return hose check OK? 	<p>Yes GO to E4.</p> <p>No INSTALL new hoses as necessary. REFER to Section 211-00.</p>
E4 CHECK BRAKE PEDAL LINKAGE	
<ul style="list-style-type: none"> ● Check brake pedal linkage for binding or sticking operation. ● Does pedal linkage check OK? 	<p>Yes GO to E5.</p> <p>No INSTALL new pedal linkage as necessary. REFER to Section 206-06.</p>
E5 CHECK POWER STEERING PUMP SPEED	
<ul style="list-style-type: none"> ● Check engine idle speed against specifications. ● Is engine idle speed OK? 	<p>Yes GO to E6.</p> <p>No SET engine idle speed to specification. REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.</p>
E6 CHECK FOR PLUGGED RETURN HOSE	
<ul style="list-style-type: none"> ● NOTE: The return hose from the oil cooler to the power steering reservoir has an in-line filter in the hose. ● Disconnect power steering return hose from power steering fluid cooler and power steering pump reservoir. ● Pass air through hose from the oil cooler end. ● Is hose plugged? 	<p>Yes INSTALL a new power steering return hose.</p> <p>No GO to E7.</p>
E7 CHECK POWER STEERING PUMP FLOW AND RELIEF	
<ul style="list-style-type: none"> ● Test power steering pump for correct flow and relief pressure. Refer to Section 211-00. ● Is power steering pump operating correctly? 	<p>Yes INSTALL a new power brake hydro-boost unit. REFER to Section 206-07.</p> <p>No INSTALL a new power steering pump. REFER to Section 211-02.</p>



PINPOINT TEST F: HYDRO-BOOST ERRATIC OPERATION, STICKS, BINDS OR GRABS

Test Step	Result / Action to Take
F1 CHECK SUPPLY HOSE	
<ul style="list-style-type: none"> ● Check for obstructions in power steering return hose and 	Yes

<p>connections between the power steering pump reservoir and between the power steering pump reservoir and the hydro-boost power brake booster.</p> <ul style="list-style-type: none"> ● Are there any obstructions? 	<p>REMOVE obstructions or INSTALL a new hose.</p> <p>No GO to F2.</p>
F2 CHECK BOOSTER OPERATION	
<ul style="list-style-type: none"> ● Have an assistant check the fluid in the power steering pump reservoir while rapidly applying the brake pedal approximately one inch. ● Does the fluid show any movement or spouting? 	<p>Yes System OK.</p> <p>No INSTALL a new hydro-boost assembly.</p>

PINPOINT TEST G: HYDRO-BOOST BRAKE SYSTEM OPERATION SUSPECT

Test Step	Result / Action to Take
G1 CHECK BASIC OPERATION	
<ul style="list-style-type: none"> ● Key in OFF position. ● Press and release brake pedal several times to deplete all hydraulic pressure from the hydro-boost power brake booster. ● Press and hold brake pedal with light pressure. ● Key in START position. ● Does the brake pedal fall slightly and hold, and is less pressure now required to hold brake pedal at the new position? 	<p>Yes Hydro-boost is OK.</p> <p>No GO to G2.</p>
G2 CHECK FOR HYDRAULIC BRAKE LEAK	
<ul style="list-style-type: none"> ● With engine running, press and release brake pedal several times. ● Hold brake pedal down with medium pressure, 34-47 Nm (25-35 lb-ft). ● Does brake pedal move toward floor? 	<p>Yes GO to G3.</p> <p>No GO to G4.</p>
G3 CHECK FOR LEAKS — BRAKE FLUID LINES	
<ul style="list-style-type: none"> ● Check for leaks at brake lines, including brake master cylinder and brake hose. ● Do components check OK? 	<p>Yes COMPLETE master cylinder By-Pass Condition Test in this section.</p> <p>No INSTALL new hoses and lines as necessary.</p>
G4 CHECK HYDRO-BOOST CONNECTIONS	
<ul style="list-style-type: none"> ● Clean the hydro-boost power brake booster, power steering pressure hose, power steering gear pressure hose and power steering return hose and connection. ● Start engine and run at idle. ● Check hose connections for leakage. ● Do hose connections check OK? 	<p>Yes GO to G5.</p> <p>No REPAIR or INSTALL new hose and connections as necessary.</p>
G5 CHECK FOR HYDRO-BOOST LEAK	

<ul style="list-style-type: none"> ● Engine running at idle speed. ●  CAUTION: Do not hold the brake pedal at 444 Nm (100 lb) force for more than 5 seconds at a time. ● Apply brake pedal with approximately 444 Nm (100 lb) force and hold. ● Check hydro-boost unit input seal, housing seal, accumulator seal, piston seal and spool plug seal for leakage. ● Is hydro-boost unit free of leaks? 	<p>Yes GO to G6.</p> <p>No INSTALL a new hydro-boost unit.</p>
G6 CHECK RESERVE RETENTION	
<ul style="list-style-type: none"> ● Engine running at idle speed. ●  CAUTION: Do not hold the brake pedal at 444 Nm (100 lb) force for more than 5 seconds at a time. ● Charge system to pressure by holding the steering wheel at stop or by pressing the brake pedal with approximately 444 Nm (100 lb) force. ● Key in OFF position. ● Wait five seconds. ● Press brake pedal and observe if there is any power brake reserve. ● Is there any power brake reserve? 	<p>Yes Hydro-boost unit is OK.</p> <p>No INSTALL a new hydro-boost unit.</p>

Component Tests

Brake Booster

1. Check the hydraulic brake system for leaks or insufficient fluid.
2. With the transmission (7003) in NEUTRAL, stop the engine (6007) and apply the parking brake control (2780). Apply the brake pedal several times to exhaust all vacuum in the system.
3. Apply the brake pedal and hold it in the applied position. Start the engine. If the vacuum system is operating, the brake pedal will tend to move downward under constant foot pressure. If no motion is felt, the power brake booster system is not functioning. Continue with the following steps.
4. Remove the vacuum booster hose from the check valve connection. Manifold vacuum must be available at the check valve end of the vacuum booster hose with the engine at idle speed and the transmission in NEUTRAL. If the manifold vacuum is available to the power brake booster, connect the vacuum booster hose to the power brake booster check valve and repeat Steps 2 and 3.
5. If no downward movement of the brake pedal is felt, install a new power brake booster.
6. Operate the engine a minimum of 10 seconds at fast idle. Stop the engine, and let the vehicle stand for 10 minutes. Then apply the brake pedal with approximately 89 N (20 lb) of force. The brake pedal feel should be the same as that noted with the engine operating. If the brake pedal feels hard (no power assist), install a new power brake booster check valve and retest. If the brake pedal feels spongy, bleed the hydraulic system to remove air. For additional information, refer to Bleeding — System in this section.

Check Valve

The function of the power brake booster check valve is to allow manifold vacuum to enter the power brake booster and prevent the escape of vacuum in case manifold vacuum is lost during sustained full throttle operation.

To test the function of the power brake booster check valve :

- Start and run the engine for at least 10 seconds.
- Operate the brake pedal to check for power assist.
- Disconnect the vacuum booster hose from the power brake booster check valve. Do not remove the power brake booster check valve from the power brake booster.
- There should be enough vacuum retained in the brake booster for at least one more power-assisted brake operation.

Brake Master Cylinder — Normal Conditions

The following conditions are considered normal and are not indications that the brake master cylinder is in need of service.

Condition 1: During normal operation of the brake master cylinder, the fluid level in the brake master cylinder reservoir will rise during brake application and fall during release. The net fluid level (i.e., after brake application and release) will remain unchanged.

Condition 2: A trace of brake fluid will exist on the booster shell below the master cylinder mounting flange. This results from the normal lubricating action of the master cylinder bore and seal.

Condition 3: Fluid level will decrease with pad wear.

Brake Master Cylinder — Abnormal Conditions

Changes in brake pedal feel or travel are indicators that something could be wrong in the brake system. GO to [Symptom Chart](#) for abnormal condition diagnosis.

Bypass Condition Test

1. Disconnect the brake lines at the brake master cylinder.
2. Plug the outlet ports of the brake master cylinder.
3. Apply the brakes. If brake pedal height cannot be maintained, the brake master cylinder has an internal leak and must be rebuilt or replaced.

Compensator Port Check



The purpose of the compensator ports in the brake master cylinder is to supply any additional brake fluid required by the system due to brake pad wear and to allow brake fluid returning from the brake lines to the brake master cylinder to enter the brake master cylinder reservoir.

The returning brake fluid will cause a slight turbulence in the brake master cylinder reservoir.


Turbulence seen in the brake master cylinder reservoir upon application or release of the brake pedal is normal and shows that the compensating ports are not plugged.


Bleeding — Components

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool
 ST1270-A	NGS Flash Cable 418-F120 (007-00531) or Equivalent

Master Cylinder Priming — In-Vehicle or Bench

 **WARNING:** Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

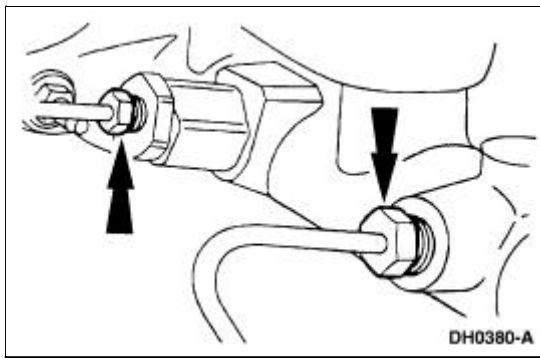
 **CAUTION:** Do not allow the brake master cylinder reservoir to run dry during the bleeding operation. Keep the brake master cylinder reservoir filled with the specified brake fluid. Never reuse the brake fluid that has been drained from the hydraulic system.

 **CAUTION:** Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

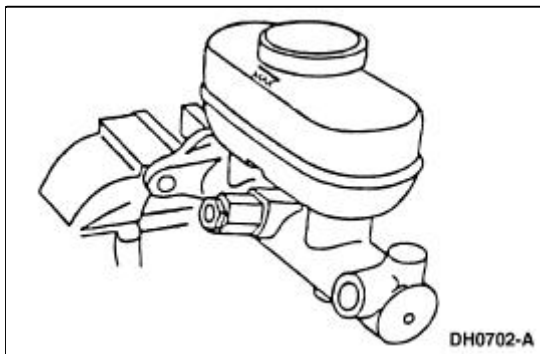
NOTE: When any part of the hydraulic system has been disconnected for repair or installation of new components, air can enter the system and cause spongy brake pedal (2455) action. This requires bleeding of the hydraulic system after it has been correctly connected. The hydraulic system can be bled manually or with pressure bleeding equipment.

NOTE: When a new brake master cylinder (2140) has been installed or the system has been emptied, or partially emptied, it should be primed to prevent air from entering the system.

1. For in-vehicle priming, disconnect the brake lines.



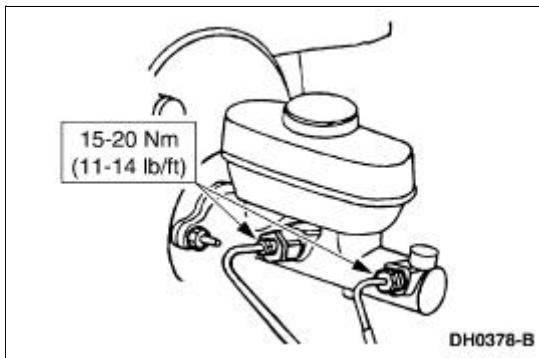
2. For bench priming, mount the brake master cylinder (2140) in a vise.



3. Install short brake tubes with the ends submerged in the brake master cylinder reservoir (2K478), and fill the brake master cylinder reservoir with High Performance DOT 3 Brake Fluid C6AZ-19542-AB or equivalent DOT 3 fluid meeting Ford specification ESA-M6C25-A.




4. Have an assistant pump the brake pedal (2455), or slowly depress the primary piston until clear fluid flows from both brake tubes, without air bubbles.
5. If the brake master cylinder has been primed at the bench, install it in the vehicle. For additional information, refer to [Section 206-06](#).
6. Remove the short brake tubes, and install the brake outlet tubes.

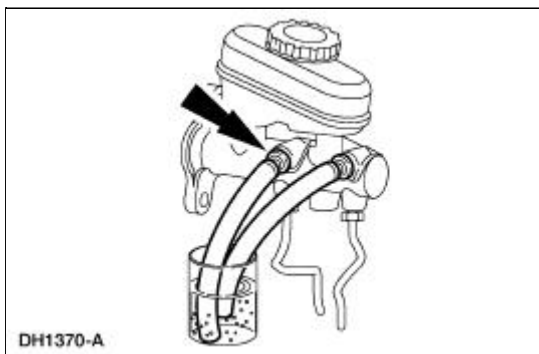


7. Bleed each brake tube at the brake master cylinder as follows:
 1. Have an assistant pump the brake pedal, and then hold firm pressure on the brake pedal.
 2. Loosen the rear most brake tube fittings until a stream of brake fluid comes out. While the assistant maintains pressure on the brake pedal, tighten the brake tube fitting.
 3. Repeat this operation until clear, bubble-free fluid comes out.
 4. Refill the brake master cylinder reservoir as necessary. Repeat the bleeding operation at the front brake tube.

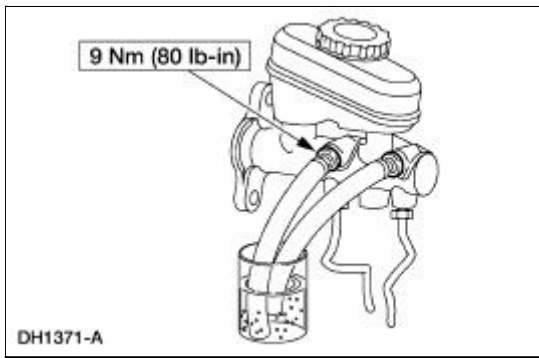
Master Cylinder Priming — 4.6L

1.  **CAUTION:** Use only bleed screws on the engine side of the brake master cylinder (2140). The hydro-boost bleed screw, located near the dash on the hydro-booster casting, is for the booster cavity filled with power steering fluid, not brake fluid.

Connect a clear waste line to the bleed screw closet to the booster first and the other end in a container partially filled with recommended brake fluid.



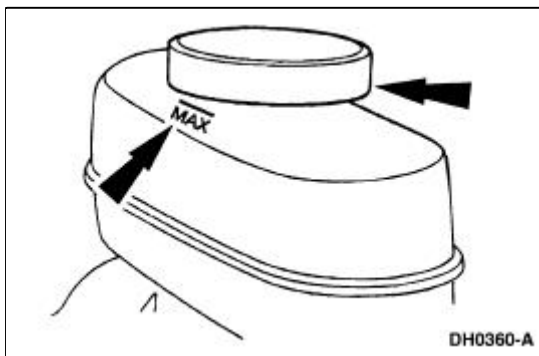
2. Open the bleeder screw, have an assistant push the brake pedal down slowly through full travel, close the bleeder screw, then return brake pedal slowly to full released position. Wait five seconds, then repeat operation until air bubbles cease to appear.
3. Repeat Step 2 for bleeder screw farthest from hydro-booster.



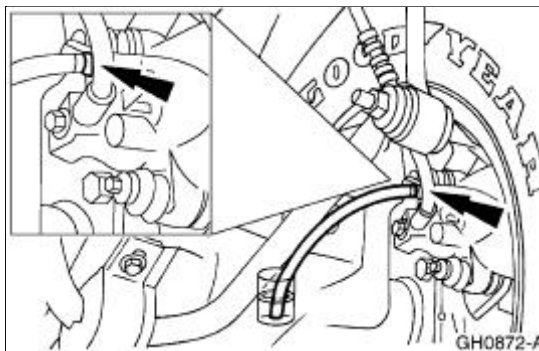
Four Wheel Anti-Lock Brake System (4WABS) Hydraulic Control Unit (HCU)

NOTE: This procedure only needs to be performed if the 4-wheel anti-lock brake (4WABS) hydraulic control unit (HCU) has been installed new or if the HCU lines have been opened.

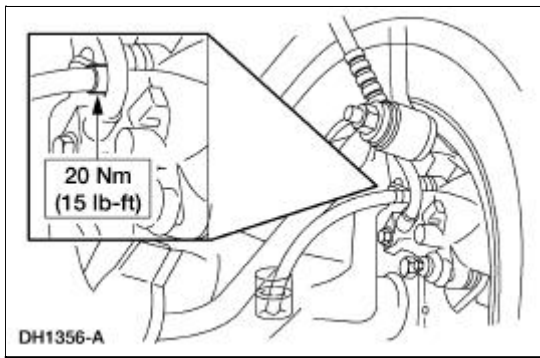
1. Clean all dirt from and remove the brake master cylinder filler cap (2162), and fill the brake master cylinder reservoir (2K478) with the specified brake fluid.



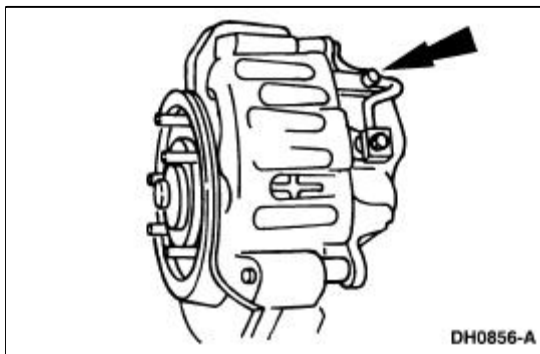
2. Connect a clear waste line to the RH rear bleeder screw (2208) and the other end in a container partially filled with recommended brake fluid.



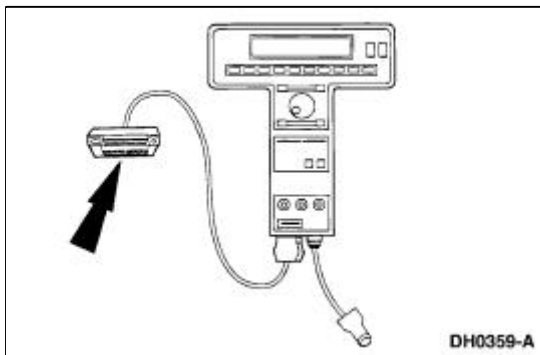
3. Loosen the RH rear bleeder screw until a stream of brake fluid comes out. While the assistant maintains pressure on the brake pedal (2455), tighten the RH rear bleeder screw.
 - Repeat until clear, bubble-free fluid comes out.
 - Refill the brake master cylinder reservoir as necessary.
4. Tighten the RH rear bleeder screw, and disconnect the waste line.



5. Repeat Steps 2, 3 and 4 for the LH rear bleeder screw, the RH front disc brake caliper (2B120) bleeder screw, and the LH front disc brake caliper bleeder screw, in that order.



6. Connect the scan tool DCL cable adapter into the vehicle data link connector (DLC) under the dash, and follow the scan tool instructions.

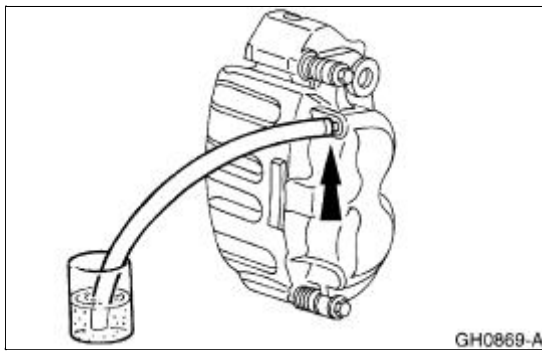


7. Repeat the system bleed procedure as outlined in Steps 1 through 5.

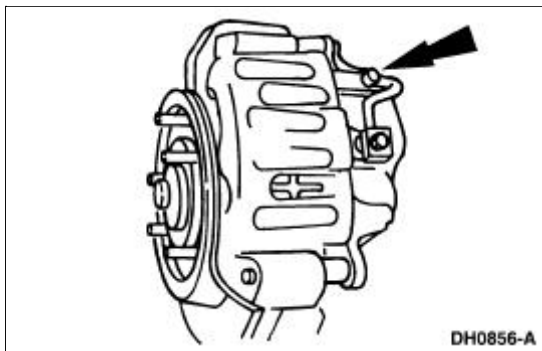
Caliper

1. **NOTE:** It is not necessary to do a complete brake system bleed if only the disc brake caliper (2B120) was disconnected.

Place a box end wrench on the disc brake caliper bleeder screw (2208). Attach a rubber drain tube to the disc brake caliper bleeder screw, and submerge the free end of the tube in a container partially filled with clean brake fluid.



2. Have an assistant pump the brake pedal (BP) (2455) and then hold firm pressure on the brake pedal.
3. Loosen the disc brake caliper bleeder screw until a stream of brake fluid comes out. While the assistant maintains pressure on the brake pedal, tighten the disc brake caliper bleeder screw.
 - Repeat until clear, bubble-free fluid comes out.
 - Refill the brake master cylinder reservoir (2K478) as necessary.
4. Tighten the disc brake caliper bleeder screw. Refer to Specifications.



Bleeding —System

Manual

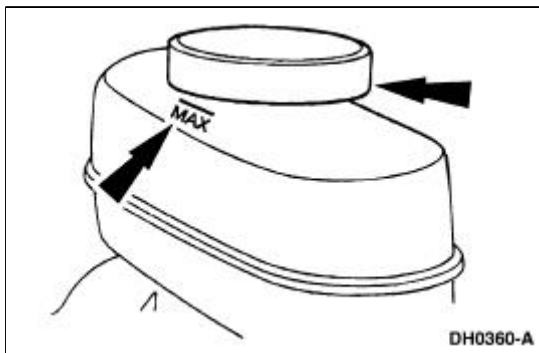
⚠ WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

⚠ CAUTION: Do not allow the brake master cylinder reservoir to run dry during the bleeding operation. Keep the brake master cylinder reservoir filled with the specified brake fluid. Never reuse the brake fluid that has been drained from the hydraulic system.

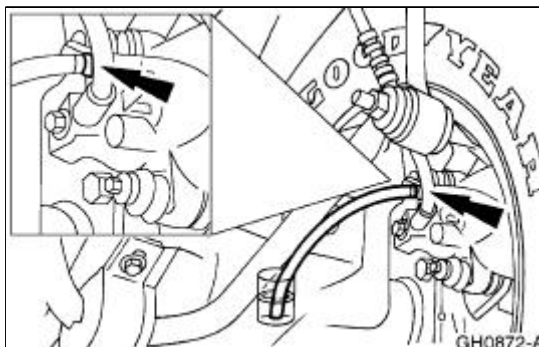
⚠ CAUTION: Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

NOTE: When any part of the hydraulic system has been disconnected for repair or installation of new components, air can get into the system and cause spongy brake pedal action. This requires bleeding of the hydraulic system after it has been correctly connected. The hydraulic system can be bled manually or with pressure bleeding equipment.

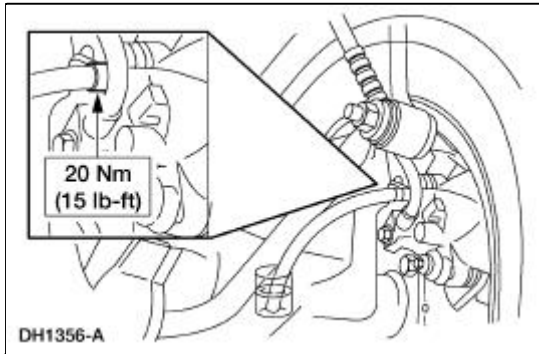
1. Clean all dirt from and remove the brake master cylinder filler cap and fill the brake master cylinder reservoir with the specified brake fluid.



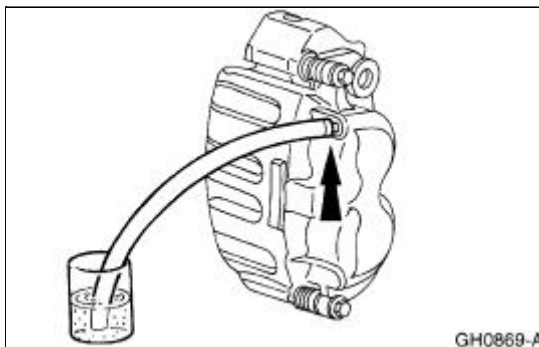
2. Place a box end wrench on the RH rear bleeder screw. Attach a rubber drain tube to the RH rear bleeder screw and submerge the free end of the tube in a container partially filled with clean brake fluid.



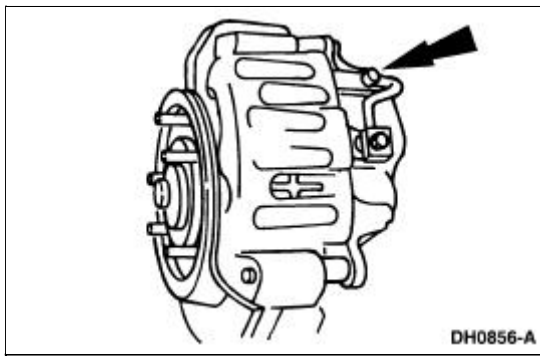
3. Have an assistant pump the brake pedal and then hold firm pressure on the brake pedal.
4. Loosen the RH rear bleeder screw until a stream of brake fluid comes out. While the assistant maintains pressure on the brake pedal, tighten the RH rear bleeder screw.
 - Repeat until clear, bubble-free fluid comes out.
 - Refill the brake master cylinder reservoir as necessary.
5. Tighten the RH rear bleeder screw.



6. Repeat Steps 2, 3, 4 and 5 for the LH rear bleeder screw.
7. Place a box end wrench on the RH front disc brake caliper bleeder screw. Attach a rubber drain tube to the RH front disc brake caliper bleeder screw, and submerge the free end of the tube in a container partially filled with clean brake fluid.



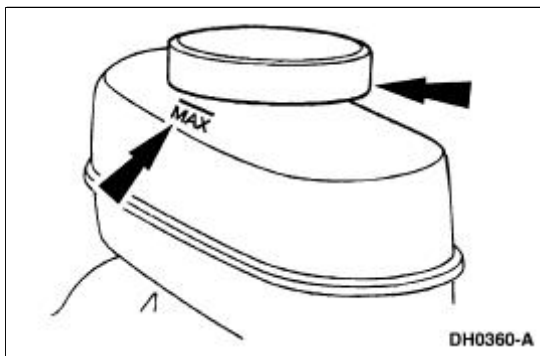
8. Have an assistant pump the brake pedal and then hold firm pressure on the brake pedal.
9. Loosen the RH front disc brake caliper bleeder screw until a stream of brake fluid comes out. While the assistant maintains pressure on the brake pedal, tighten the RH front disc brake caliper bleeder screw.
 - Repeat until clear, bubble-free fluid comes out.
 - Refill the brake master cylinder reservoir as necessary.
10. Tighten the RH front disc brake caliper bleeder screw. For additional information, refer to Specifications in this section.



11. Repeat Steps 7, 8, 9 and 10 for the LH front disc brake caliper bleeder screw.

Pressure

1. Clean all dirt from and remove the brake master cylinder filler cap and fill the brake master cylinder reservoir with the specified brake fluid.

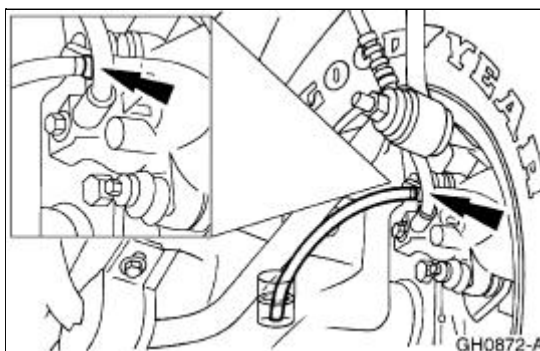


2. **NOTE:** Master cylinder pressure bleeder adapter tools are available from various manufacturers of pressure bleeding equipment. Follow the instructions of the manufacturer when installing the adapter.

Install the bleeder adapter to the brake master cylinder reservoir, and attach the bleeder tank hose to the fitting on the adapter.

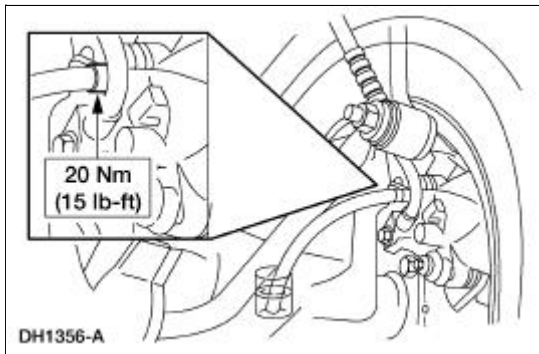
3. **NOTE:** Bleed the longest line first. Make sure the bleeder tank contains enough specified brake fluid to complete the bleeding operation.

Place a box end wrench on the RH rear bleeder screw. Attach a rubber drain tube to the RH rear bleeder screw, and submerge the free end of the tube in a container partially filled with clean brake fluid.



4. Open the valve on the bleeder tank.

5. Loosen the RH rear bleeder screw. Leave open until clear, bubble-free brake fluid flows, then tighten the RH rear bleeder screw and remove the rubber hose.



6. Continue bleeding the rear of the system, going in order from the LH rear bleeder screw to the RH front disc brake caliper bleeder screw ending with the LH front disc brake caliper bleeder screw.
 7. Close the bleeder tank valve. Remove the tank hose from the adapter, and remove the adapter.
-

Hydraulic Leak Check


1. **NOTE:** Brake fluid is water soluble and it is possible that all evidence of fluid leakage has been washed off if the vehicle has been operated in the rain or snow.

Make sure the brake master cylinder reservoir (2K478) is full.

2. Apply the brakes several times and make sure the brake pedal (2455) feel is not spongy. If necessary, bleed the system. For additional information, refer to [Bleeding—System](#) in this section.
 3. If the reservoir level is dropping, inspect the brake components, fittings and lines to locate the source of the leak.
-


Runout Check — Brake Disc and Hub


Special Tool(s)

 ST1687-A	Brake Measurement Kit 134-R0199 or equivalent
---	--

Material

Item	Specification
High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA	ESE-M12A4-A

 **CAUTION:** The brake disc (1126) runout specification must be met to ensure correct brake performance without roughness complaints.

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

NOTE: When installing brake discs, always align the painted match marks on the brake discs with those on the front hub or rear axle.

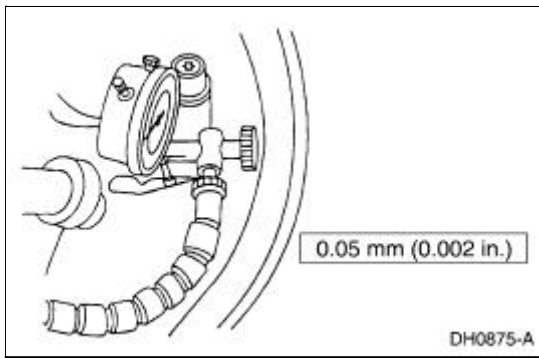
NOTE: When installing brake discs, always apply anti-seize lubricant to the brake disc-to-front hub or to the brake disc-to-rear axle mating surfaces.

1. Do not remove the tire and wheel assembly. Tighten the wheel nuts to specification with a torque stick or torque wrench.
2. Raise and support the vehicle.
3. Assemble the Brake Measurement Kit, using the spherical tip extension.
4. Locate an opening on the inboard side of the dust shield that will allow the dial indicator tip to be positioned at least 5 mm (0.2 inch) from the outer edge of the brake disc.
5. **NOTE:** Do not clamp the gauge set to a vehicle component separated from the brake disc by a flexible joint, such as a ball joint or body mount.

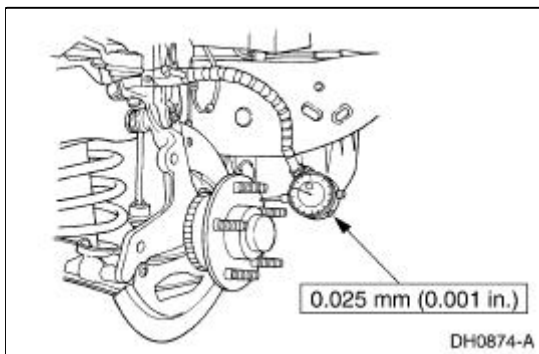
Clamp the Brake Measurement Kit on the vehicle, making sure the flexible indicator arm and probe tip do not touch the dust shield or tire while rotating.

6. **NOTE:** For rear wheel measurement only, have an assistant push in on the wheel cover or axle shaft center while rotating the wheel.

Rotate the wheel for six revolutions, and record the total indicated runout.



7. If the total indicated runout exceeds the maximum specification, remove the brake disc. For additional information, refer to [Section 206-03](#) for front or to [Section 206-04](#) for rear.
8. Clean the brake disc mounting face of dirt, rust and foreign material.
9. For front wheels, measure and record the total indicated runout of the hub face outside the stud circle.



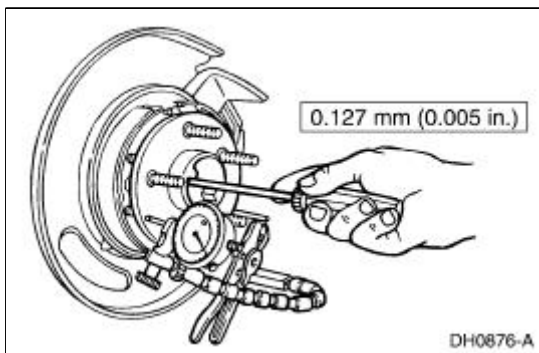
10. Install a new front hub if the total indicated runout exceeds the maximum specification. For additional information, refer to [Section 204-01](#).

- Repeat the hub runout measurement.

11. **NOTE:** Clean the axle flange surface before measuring.

NOTE: For rear wheels, press inward on the axle shaft while measuring the rear axle runout.

For rear wheels, measure and record the total indicated runout at a point on the axle shaft outside the stud circle.



12. If the total indicated runout exceeds the maximum specification, inspect the rear axle. For additional information, refer to [Section 205-00](#). Repair as necessary.

- Repeat the rear brake disc runout measurement.

13. If the brake disc TIR is still out of specification, measure and record the thickness of the brake disc. If thickness is sufficient to machine the brake disc to the runout specification, go to Step 14. If the thickness is not sufficient, install a new brake disc and recheck the TIR.
14. **NOTE:** Brake disc machining must be done with an on-vehicle lathe. Follow the lathe manufacturer's instructions.

Machine the brake disc if final thickness will not be less than the maximum specification.
Recheck the brake disc runout.

General Specifications

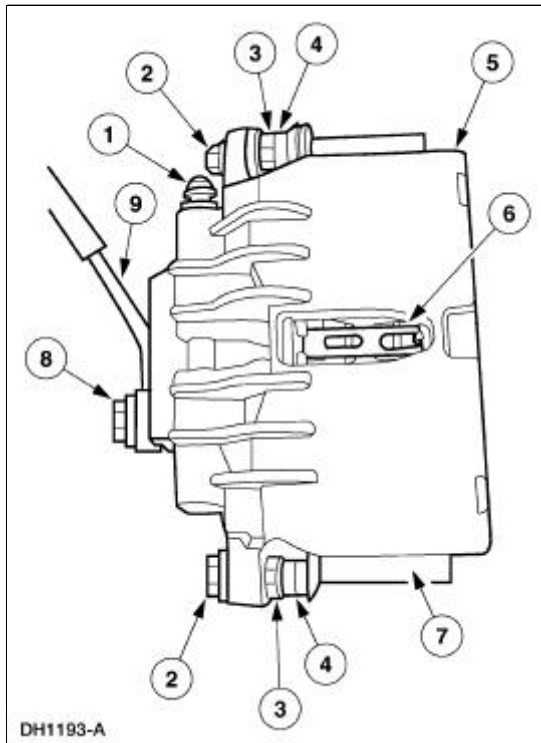
Item	Specification
Disc brake lining wear limit	1.0 mm (0.040 in)
Disc thickness (Mustang/Mustang Cobra)	26 mm (1.02 in)/28 mm (1.10 in)
Disc lateral runout	0.05 mm (0.002 in)
Disc thickness variation	0.009 mm (0.00035 in)
Hub runout	0.025 mm (0.001 in)

Torque Specifications

Description	Nm	lb-ft
Disc brake caliper bolt	31	23
Front brake hose bolt	40	30
Front disc brake caliper anchor plate bolt	115	85
Disc brake caliper bleeder screw	10	7

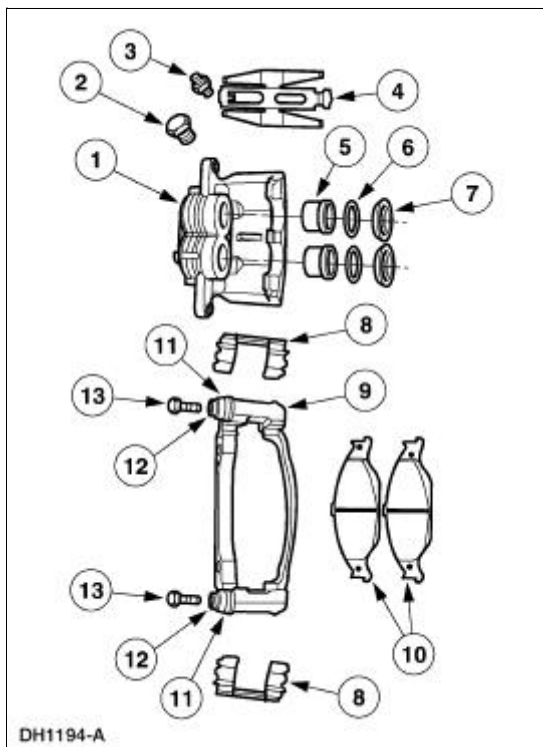
Front Disc Brake

Front Disc Brake Components



Item	Part Number	Description
1	—	Bleeder screw and bleeder screw cap assy
2	2N386	Caliper bolt
3	2B296	Guide pin
4	2A492	Guide pin boot
5	2B120	Disc brake caliper
6	2B164	Anti-rattle spring
7	2B292	Front disc brake caliper anchor plate
8	385116-S2	Flow bolt
9	2078	Front brake hose

Disc Brake Caliper Components



Item	Part Number	Description
1	2B120	Disc brake caliper
2	2L126	Bleeder screw cap
3	2208	Bleeder screw
4	2B164	Anti-rattle spring
5	2196	Caliper piston
6	2B115	Piston seal
7	2207	Piston dust boot
8	2L200	Pad slipper
9	2B292	Front disc brake caliper anchor plate
10	2001	Brake pads
11	2A492	Guide pin boot
12	2B296	Guide pin
13	2N386	Caliper bolt

The front disc brake caliper (2B120):

- bolts to the front disc brake caliper anchor plate (2B292), which bolts to the front wheel spindle (3105).
- is a pin slider, dual piston design.

The front brake discs (1125):

- are of a ventilated full-cast design, with non-directional cooling fins.
- are serviced with the disc brake caliper and front disc brake caliper anchor plate removed.

The front brake disc shield (2K005):


- is riveted to the front wheel spindle.
- protects the front wheel bearings and inboard surface of the front brake disc.

The pads:

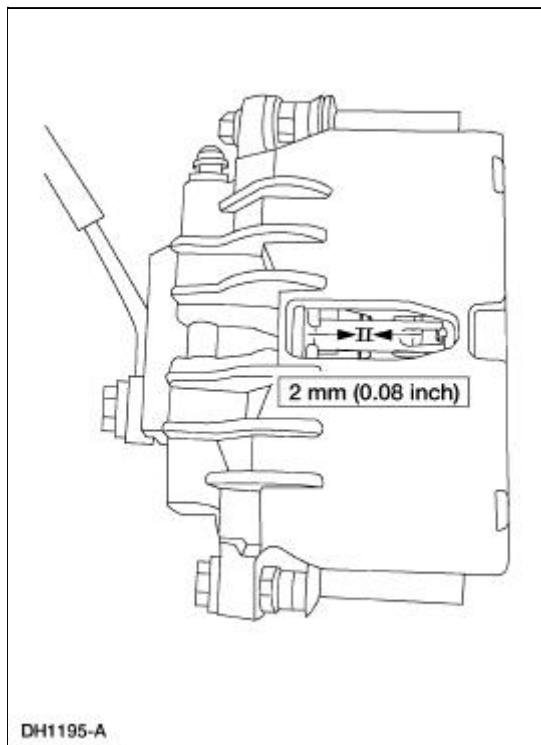
- are housed in the front disc brake caliper anchor plate.
 - are of a non-asbestos, non-metallic composition.
-

Pads

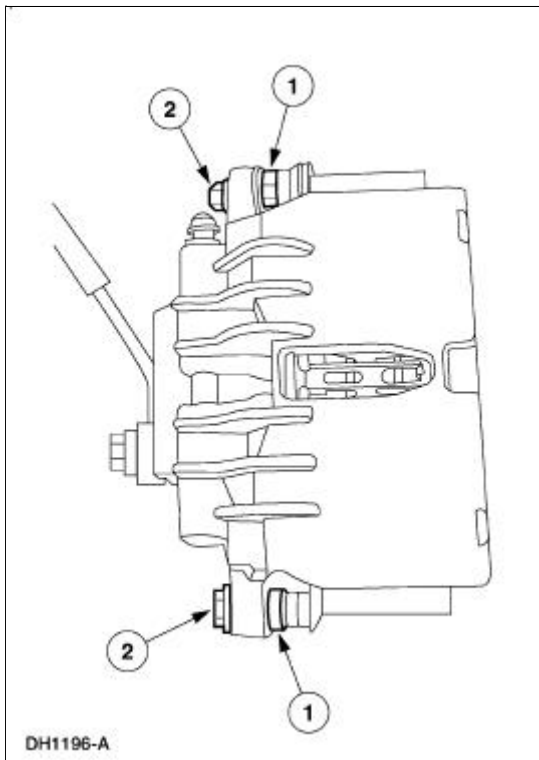
Removal


1. Remove brake master cylinder filler cap (2162). Check brake fluid level in brake master cylinder reservoir (2K478). Remove fluid until brake master cylinder reservoir is half full.
2. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
3. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
4.  **CAUTION: Install new pads if worn to or past the specified thickness above the metal backing plate or rivets. Install pads in complete axle sets.**


Inspect the pads for wear and contamination.



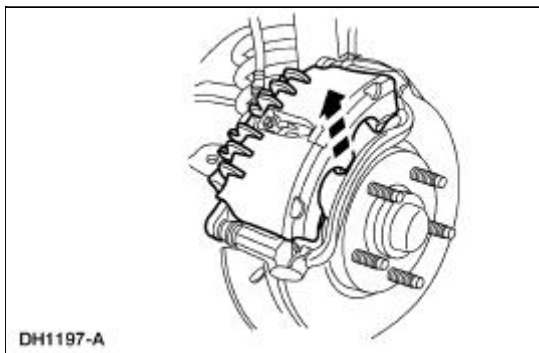
5. Remove the caliper bolts.
 1. Hold the guide pins stationary.
 2. Remove and discard the caliper bolts.



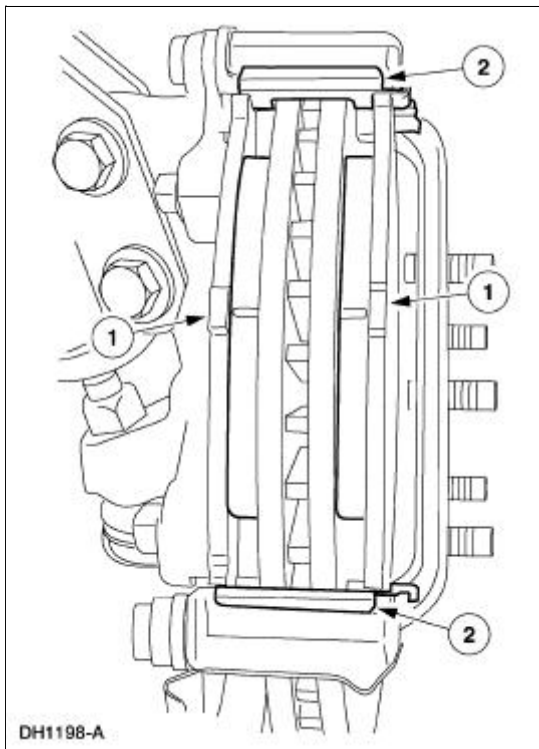
6.  **CAUTION:** Do not pry in caliper sight hole to retract pistons as this can damage the pistons and boots.

 **CAUTION:** When removing the disc brake caliper (2B120), never allow it to hang from the brake hose. Provide a suitable support.

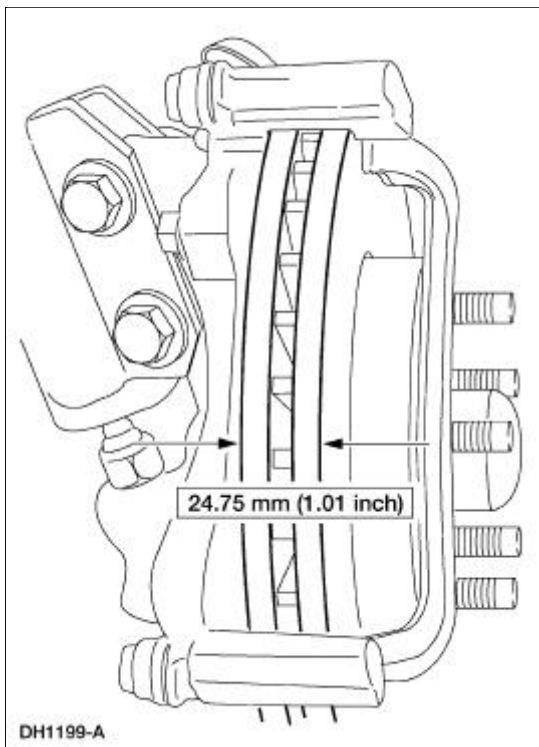
Lift the caliper off the anchor plate (2B292).



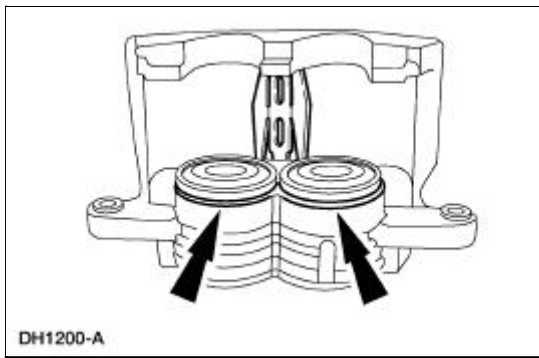
7. Remove the pads and the pad slippers.
1. Remove the pads and verify thickness.
 2. Remove and discard slippers.



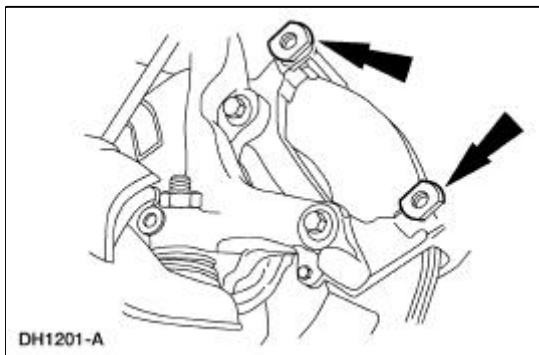
8. Measure the front brake disc thickness.
 - Install a new front brake disc (1125) if not within specification.




9. Inspect the disc brake caliper.
 - If leaks or damaged boots are found, disassembly is required. For additional information, refer to [Caliper](#) in this section.



10. Inspect the front disc brake anchor plate assembly.
 - Check the guide pin boots for damage.
 - Check the guide pins for binding and damage.
 - Worn or damaged pins should be installed new.



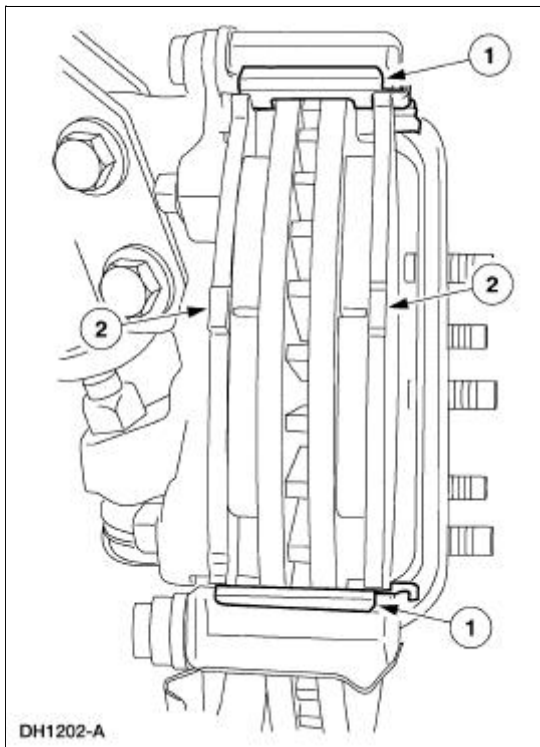
Installation

1.  **CAUTION: Do not allow grease, oil, brake fluid or other contaminants to contact the pad lining material. Do not install contaminated pads.**

NOTE: Install all hardware supplied with pad kits.

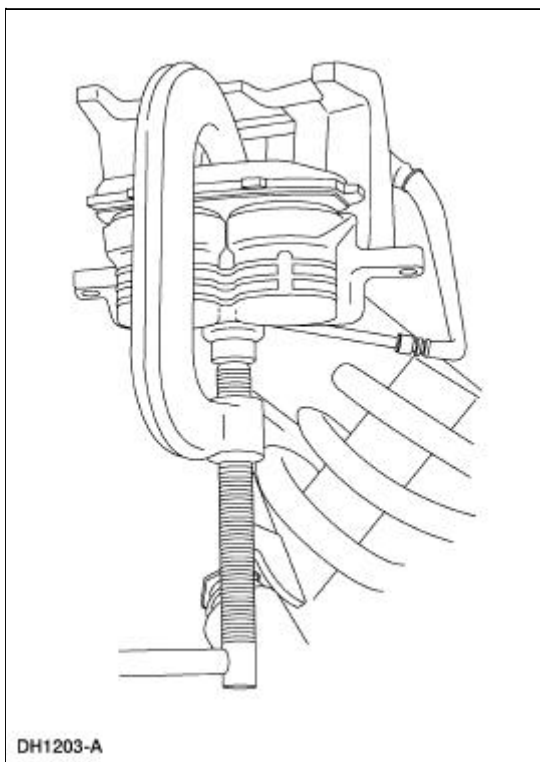
Install the pads.

1. Install the new pad slippers.
2. Install the pads.

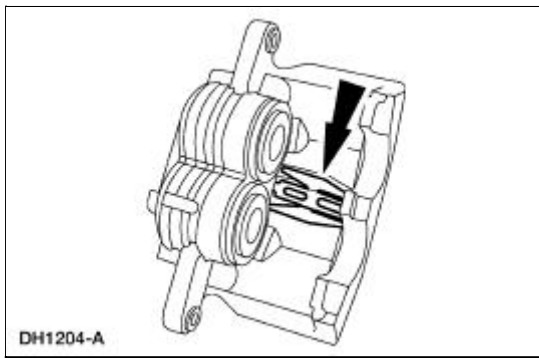


2. **NOTE:** Use a wood block or used pad to protect pistons and boots.

Compress the caliper pistons (2196).



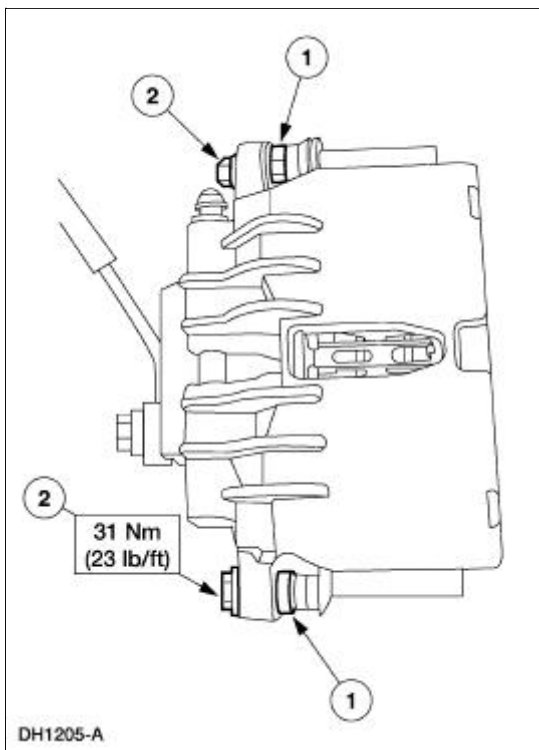
3. Make sure the anti-rattle spring is correctly positioned in the caliper.



4.  **CAUTION:** Use care not to damage the bleeder screw or front brake disc shield.

Install the disc brake caliper.


1. Hold the guide pins stationary.
2. Install the caliper bolts.



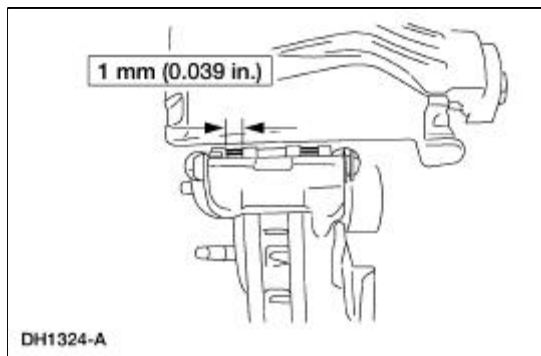
5. Install the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
 6. Lower the vehicle.
 7. Fill the brake master cylinder reservoir with clean High Performance DOT 3 Brake Fluid C6AZ-19542-AB or equivalent DOT 3 fluid meeting Ford specification ESA-M6C25-A. Install brake master cylinder filler cap.
 8. Inspect brake operation.
-

Brake Pads —Cobra

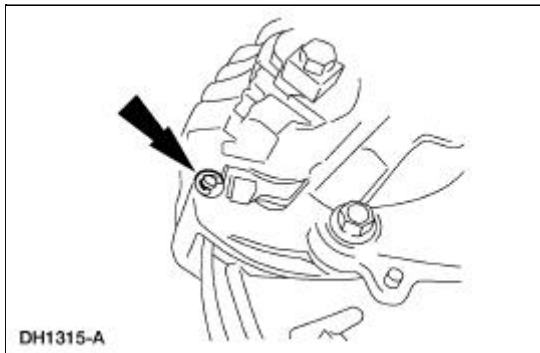
Removal

1. Remove brake fluid in the master cylinder reservoir until the reservoir is half full.
2. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
3. Remove the tire and wheel assembly. For additional information, refer to [Section 204-04](#).
4.  **CAUTION: Install new pads if worn to or past the specified thickness above the metal backing plate or rivets. Install new pads in complete axle sets.**

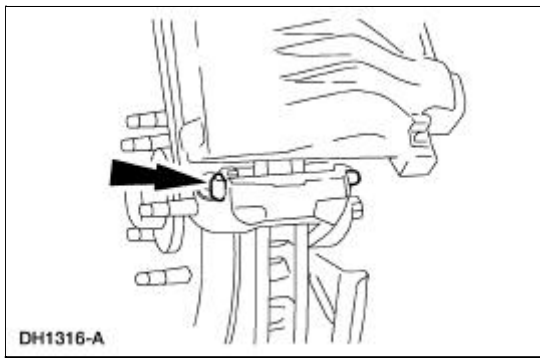
Inspect the pads for wear and contamination.



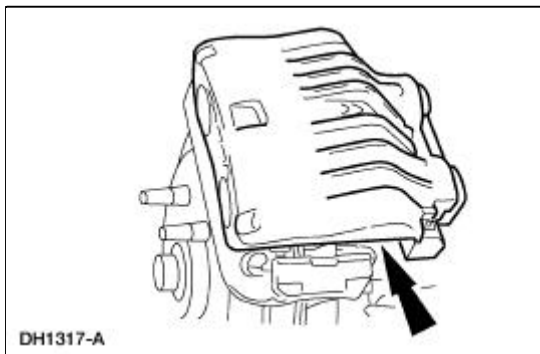
5. Remove the caliper locating pin E-clip.



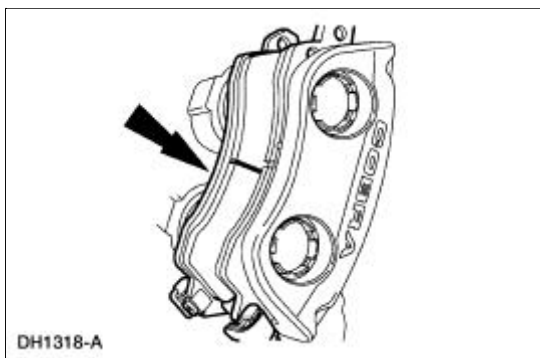
6. Remove the caliper locating pin.



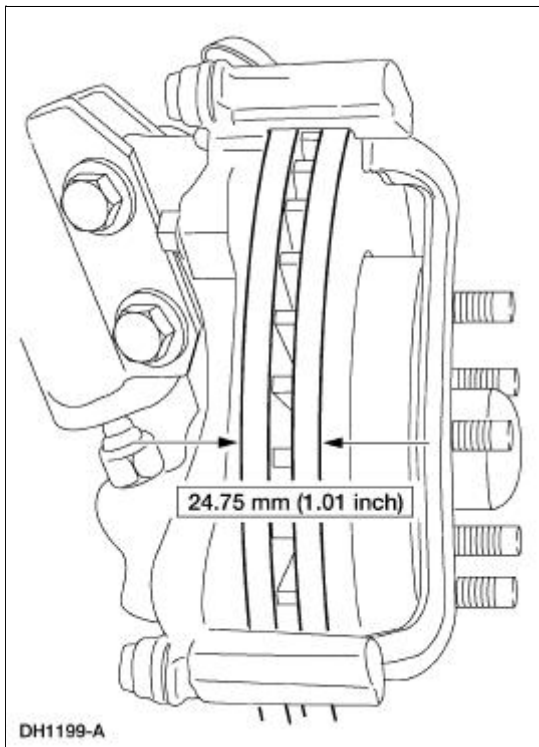
7. Remove the caliper.



8. Remove the brake pads.

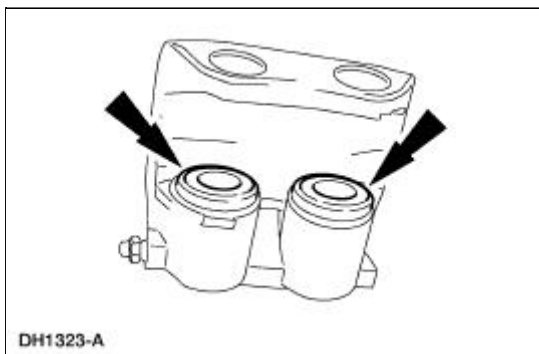


9. Measure the brake disc thickness.
 - Install a new brake disc if not within specification.



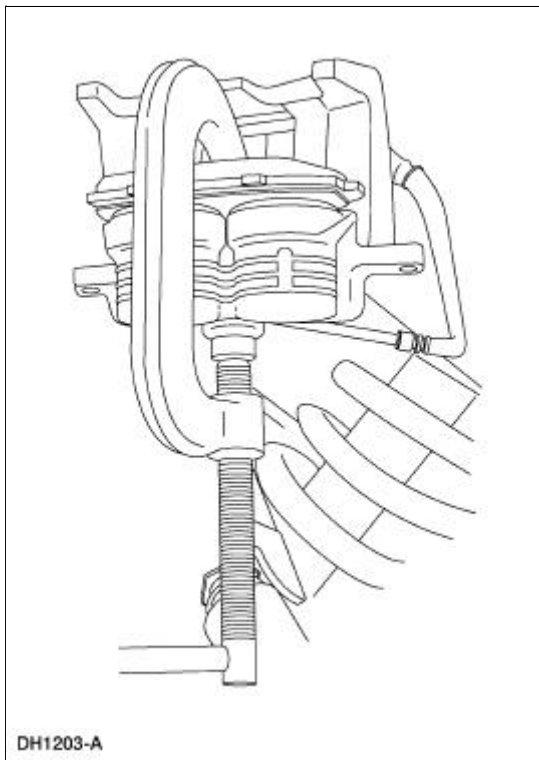
10. Inspect the disc brake caliper.

- If leaks or damaged boots are found, disassembly is required. For additional information, refer to [Caliper](#) in this section.



11. **NOTE:** Use a wood block or used pad to protect pistons and boots.

Compress the caliper pistons (2196).





Installation

1. Follow the removal procedure in reverse order.
-

Caliper

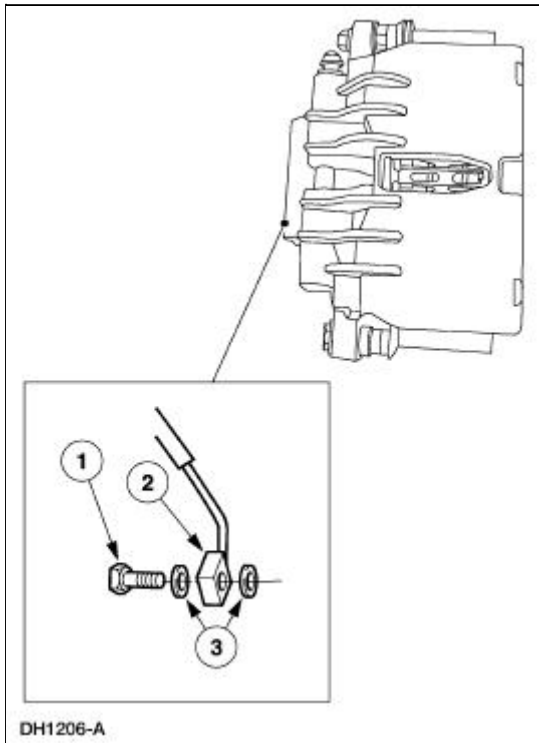
Removal

1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
3.  **WARNING:** Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes, get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

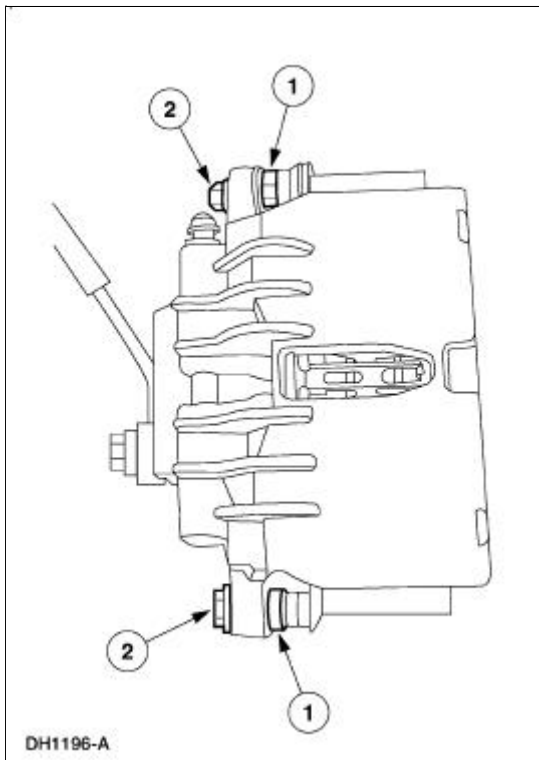
 **CAUTION:** Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, wash it with water immediately.

Disconnect the front brake hose (2078).

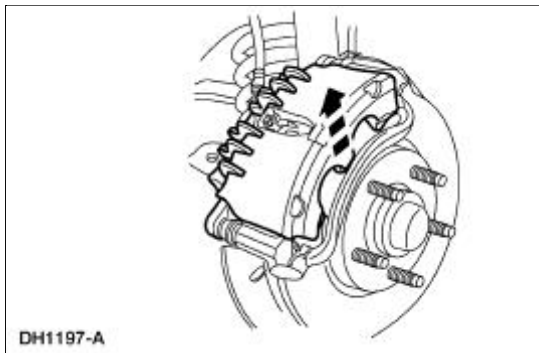
1. Remove the front brake flow bolt.
2. Disconnect the front brake hose.
3. Remove and discard the copper washers. Plug the front brake hose.



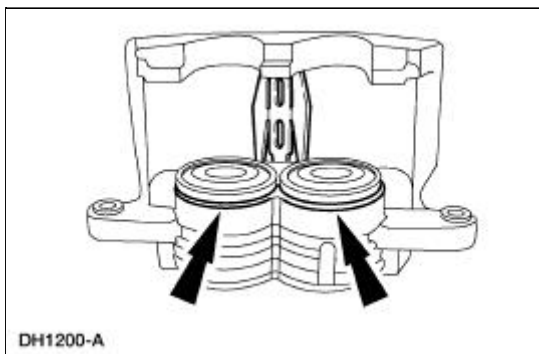
4. Remove the caliper bolts.
 1. Hold the guide pins stationary.
 2. Remove the caliper bolts.



5. Lift the caliper off the anchor plate (2B292).

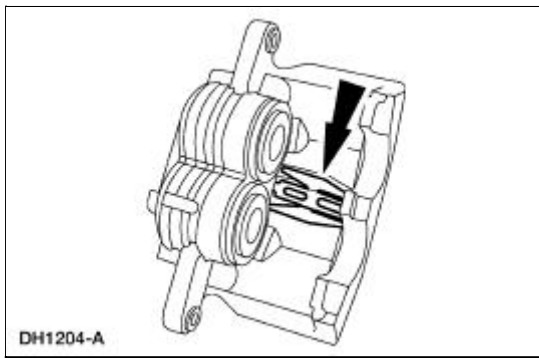


6. Inspect the disc brake caliper.
 - If leaks or damaged boots are found, disassembly is required. For additional information, refer to [Caliper](#) in this section.



Installation

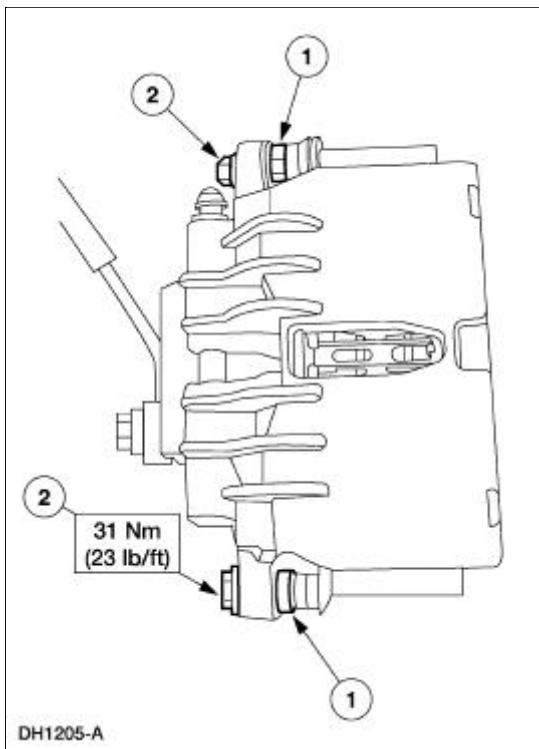
1. Make sure the anti-rattle spring is correctly positioned in the caliper.



2.  **CAUTION:** Make sure guide pin boots are correctly seated or damage to guide pins can occur.

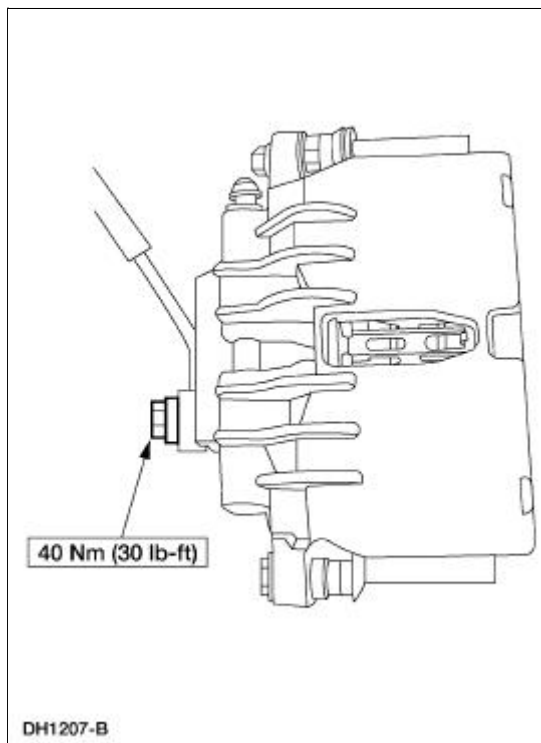
Install the disc brake caliper.

1. Hold the guide pins stationary.
2. Install the caliper bolts.



3. **NOTE:** Use new copper washers.

Install the front brake hose.

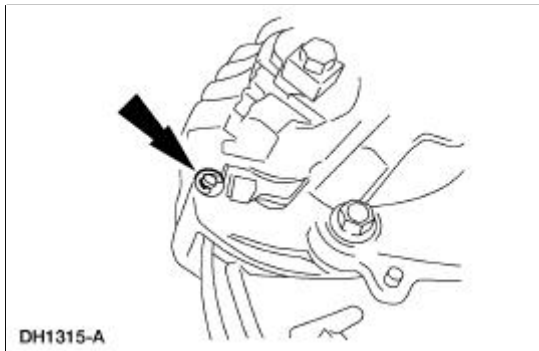


4. Bleed the caliper. For additional information, refer to [Section 206-00](#).
 5. Install the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
 6. Fill the brake master cylinder reservoir (2K478) with clean High Performance DOT 3 Brake Fluid C6AZ-19542-AB or equivalent DOT 3 fluid meeting Ford specification ESA-M6C25-A. Install brake master cylinder filler cap (2162).
 7. Check the brake system operation.
-

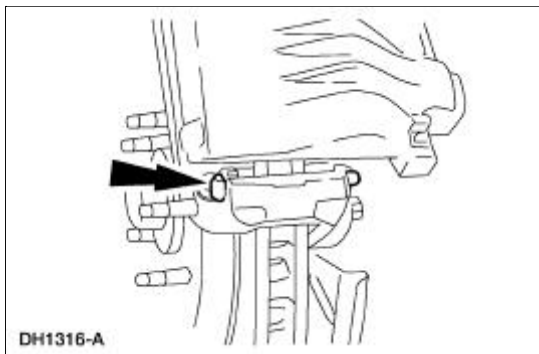
Brake Caliper —Cobra

Removal

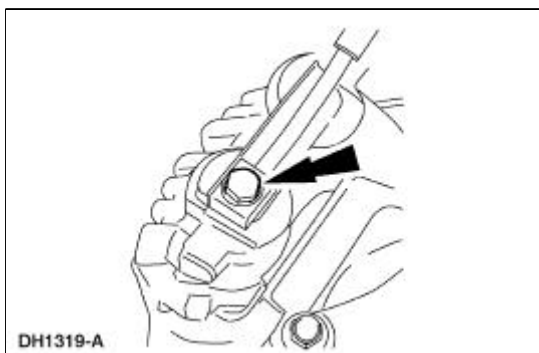
1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Remove the tire and wheel assembly. For additional information, refer to [Section 204-04](#).
3. Remove the caliper locating pin E-clip.



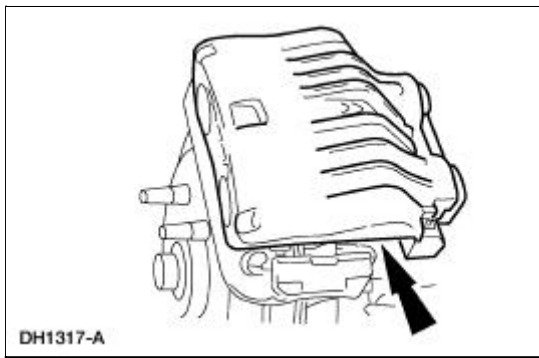
4. Remove the caliper locating pin.



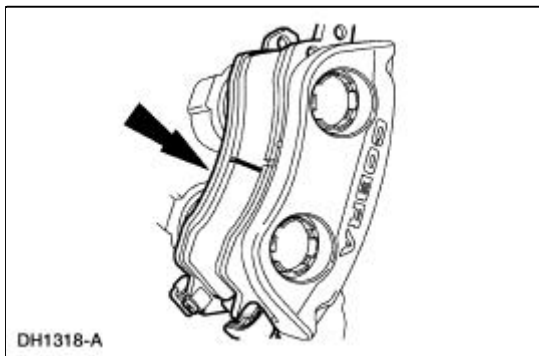
5. Remove the front brake flow bolt.



6. Remove the caliper.



7. Remove the brake pads.

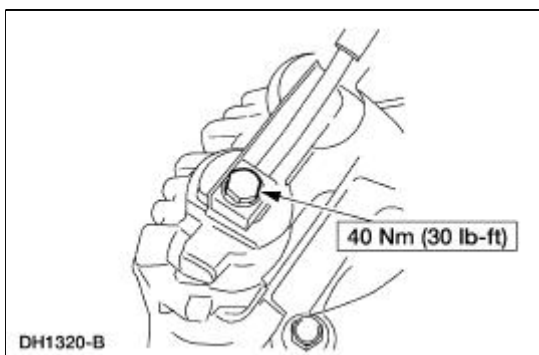


Installation

1. **NOTE:** Use new copper washers on front brake flow bolt.

Follow the removal procedure in reverse order.

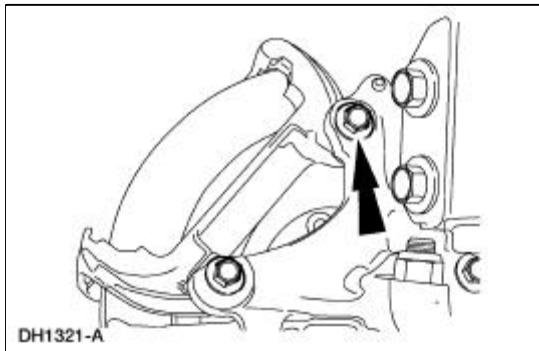
- Bleed the caliper. For additional information, refer to [Section 206-00](#).



Brake Caliper Anchor Plate —Cobra

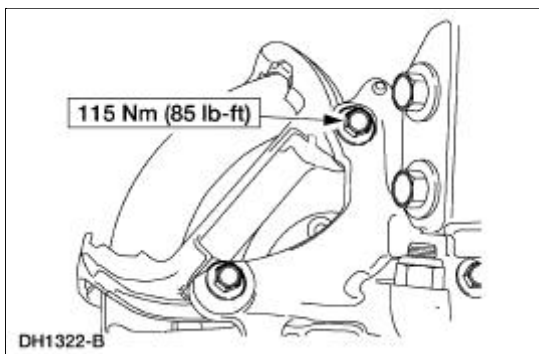
Removal

1. Remove the pads. For additional information, refer to [Brake Pads—Cobra](#) in this section.
2. Remove the anchor plate bolts.



Installation

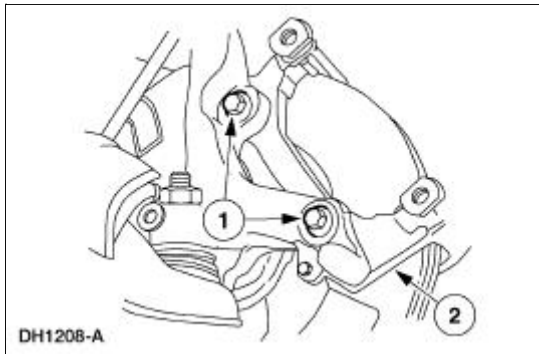
1. Follow the removal procedure in reverse order.




Brake Caliper Anchor Plate

Removal

1. Remove the pads. For additional information, refer to [Pads](#) in this section.
2. Remove the anchor plate (2B292).
 1. Remove and discard the anchor plate bolts.
 2. Remove the anchor plate.

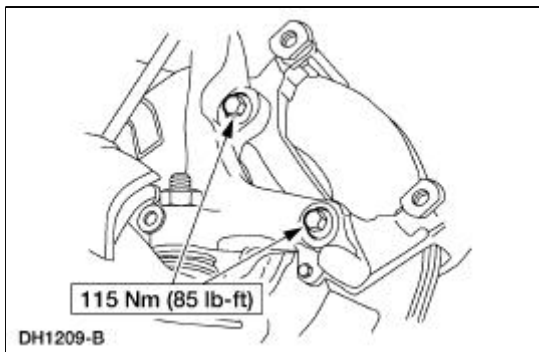


Installation

1.  **CAUTION: Use correct type and length bolts.**

Follow the removal procedure in reverse order.

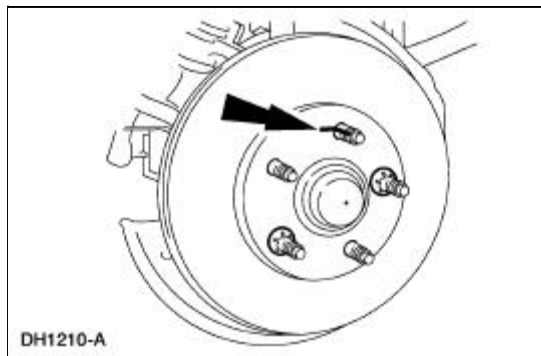
- Install new anchor plate bolts.



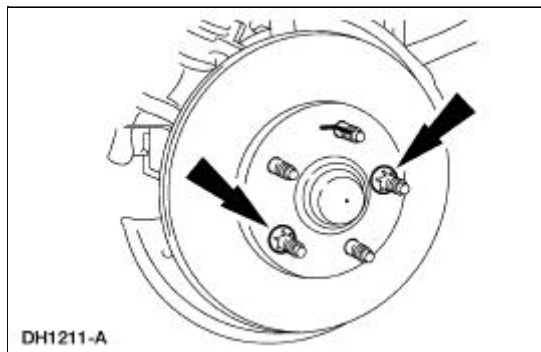
Disc

Removal

1. Remove the front disc brake caliper anchor plate (2B292). For additional information, refer to [Brake Caliper Anchor Plate](#) in this section.
2. Match mark the hub (1104) and the brake disc (1125).



3. If necessary, remove and discard the keeper nuts.

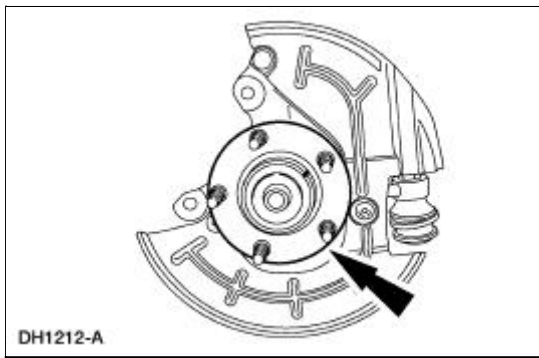


4. **NOTE:** If the brake disc cannot be easily removed, apply Rust Penetrant and Inhibitor F2AZ-19A501-A or equivalent meeting Ford specification ESR-M99C56-A to the mating surfaces.

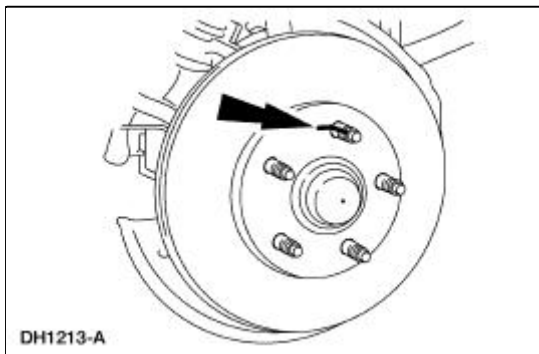
Remove the brake disc from the hub.

Installation

1. Clean rust and foreign material from the mating surfaces of the hub and brake disc.
 - Use Metal Brake Parts Cleaner F3AZ-19579-SA or equivalent to clean the brake disc and hub.
2. Apply High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA or equivalent meeting Ford specification ESE-M12A4-A to the hub flange.



3. Align the match marks and install the brake disc.

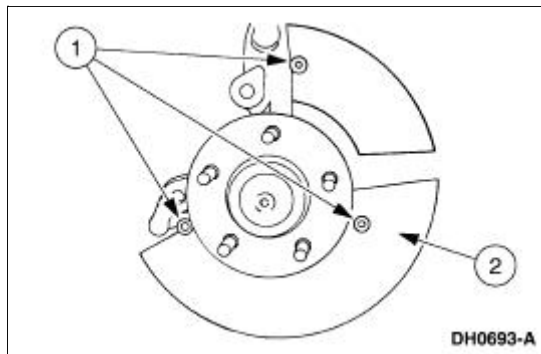


4. Install the anchor plate (2B292). For additional information, refer to [Brake Caliper Anchor Plate](#) in this section.
 5. Check the total indicated runout (TIR). For additional information, refer to [Section 206-00](#).
-

Shield

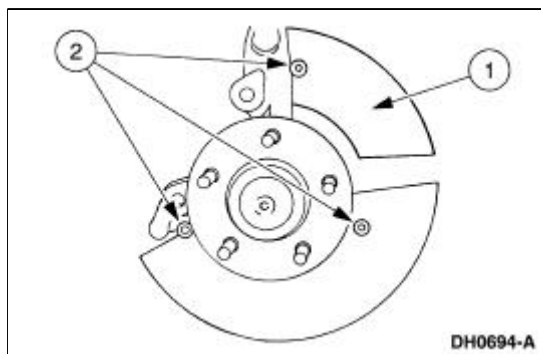
Removal

1. Remove the brake disc (1125). For additional information, refer to [Disc](#) in this section.
2. Remove the brake disc shield (2K004).
 1. Drill out three brake disc shield rivets.
 2. Remove the brake disc shield.



Installation

1. Install the brake disc shield.
 1. Position the shield.
 2. Secure with three rivets.

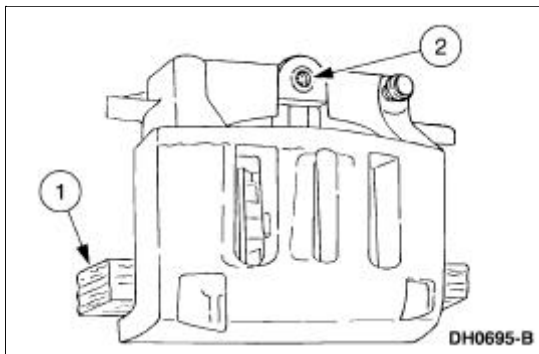


2. Install the brake disc. For additional information, refer to [Disc](#) in this section.

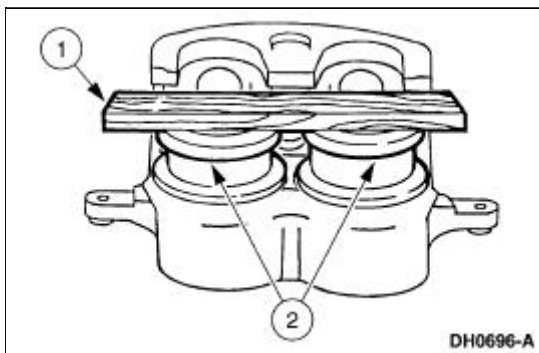
Caliper

Disassembly

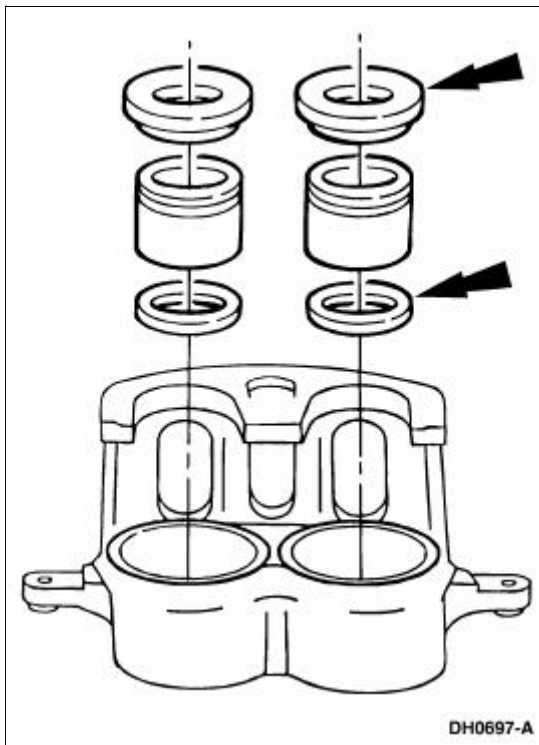
1. Remove the disc brake caliper (2B120). For additional information, refer to [Caliper](#) in this section.
2. Drain the remaining brake fluid from disc brake caliper.
3. Apply low air pressure to the fluid port in the disc brake caliper.
 1. Place a block of wood between the caliper bridge and the caliper pistons (2196).
 2. Apply low air pressure to the fluid port in the disc brake caliper and force out the caliper pistons to the block of wood.



4. Remove the caliper pistons.
 1. Remove the block of wood.
 2. Remove the caliper pistons.




5. Remove and discard the piston seals and boots.



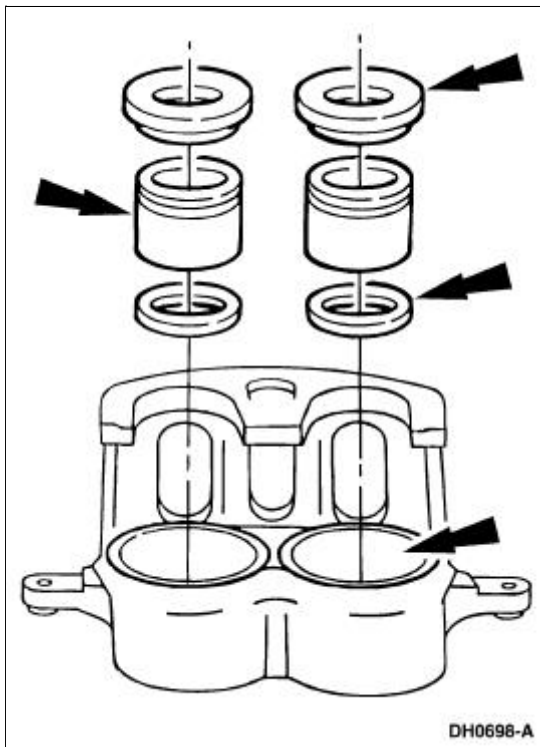
6. Remove and discard the bleed screw and cap.

Assembly

1.  **CAUTION: Do not hone the caliper bores. Caliper pistons are not available for honed caliper bores.**

Clean and inspect the caliper pistons and the disc brake caliper.

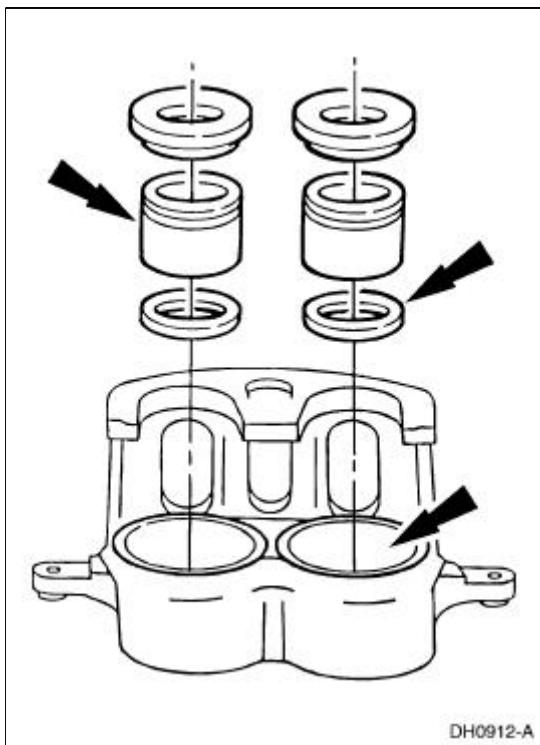
- Remove dirt and debris.
- Examine the caliper pistons for surface irregularities, scoring or wear. Damaged caliper pistons should be installed new.
- Clean the caliper bores with Metal Brake Parts Cleaner F3AZ-19579-SA or equivalent meeting Ford specification.
- If the caliper bores are corroded or excessively scored, install a new disc brake caliper.
- Lubricate the caliper pistons and piston seals before assembly.




2.  **CAUTION: Never reuse piston seals and dust boots.**

NOTE: Never reuse brake fluid that has been drained from the hydraulic system or has been allowed to stand in an open container for an extended period of time.

Lubricate the caliper piston, piston seal and caliper bores with clean High Performance DOT 3 Brake Fluid C6AZ-19542-AB or equivalent DOT 3 fluid meeting Ford specification ESA-M6C25-A.



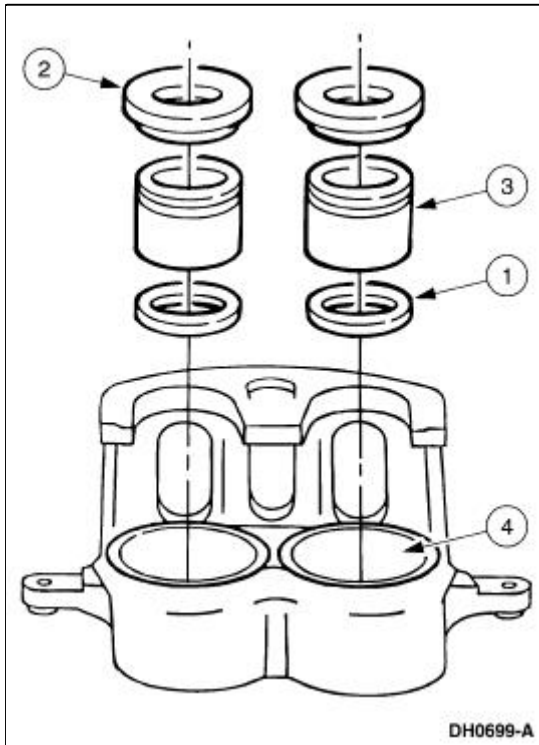
3. Install the caliper piston.

1. Install the piston seal.
2. Install the piston boot on the piston.
3.  **CAUTION: Be careful not to damage or dislodge the piston seal.**

Insert the caliper piston.

4.  **CAUTION: Be careful not to cock the caliper piston.**

Press the caliper piston into the bore.



4. Install a new bleed screw and cap.
 5. Install the disc brake caliper. For additional information, refer to [Caliper](#) in this section.
-

General Specifications

Item	Specification
Disc brake lining wear limit	1.0 mm (0.040 in)
Disc thickness	15 mm (0.59 in)
Disc lateral runout	0.102 mm (0.004 in)
Disc thickness variation	0.01 mm (0.0004 in)
Hub runout	—

Torque Specifications

Description	Nm	lb-ft	lb-in
Rear wheel brake hose-to-rear disc brake caliper retaining bolt	40	30	—
Rear disc brake support bracket bolts	103	76	—
Brake disc shield bolts	9-12	—	80-106
Rear brake pin retainer	33	25	—

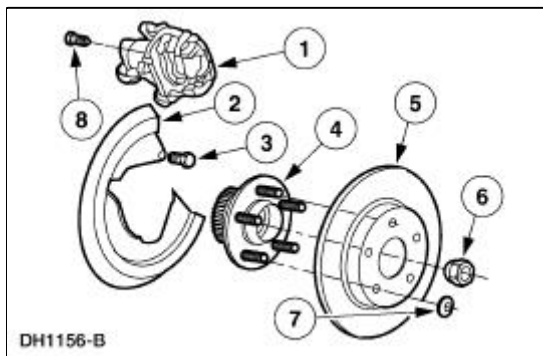
Rear Disc Brake

! **WARNING:** Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

The rear disc brake system consists of:

- solid, full-cast brake disc (2C026).
- hydraulically activated rear disc brake caliper (2552).
- integral mechanically (cable) operated parking brake mechanism that is self-adjusting.

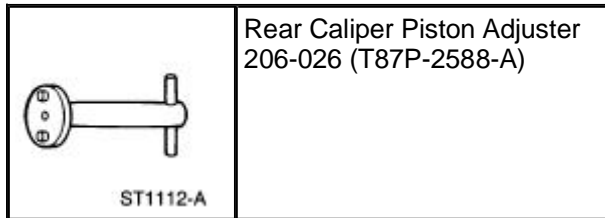
Rear Disc Brake System Components



Item	Part Number	Description
1	2552	Rear disc brake caliper
2	2C028	Brake disc shield
3	N606675-S2	Bolt (3 req'd each side)
4	1104	Wheel hub
5	2C026	Brake disc
6	4B423	Rear wheel hub retainer
7	W623485-S2	Nut (2 req'd each side)
8	N805163-S100	Bolt (4 req'd)

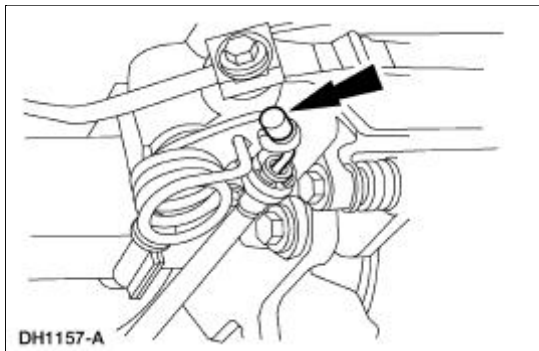
Caliper

Special Tool(s)

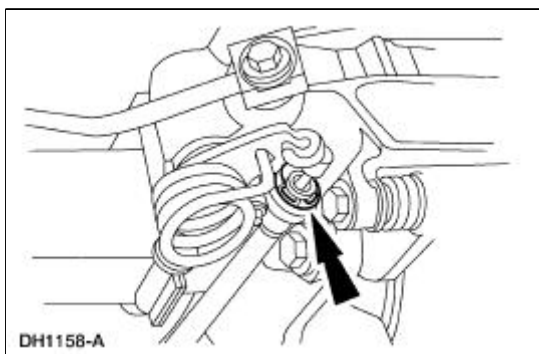


Removal

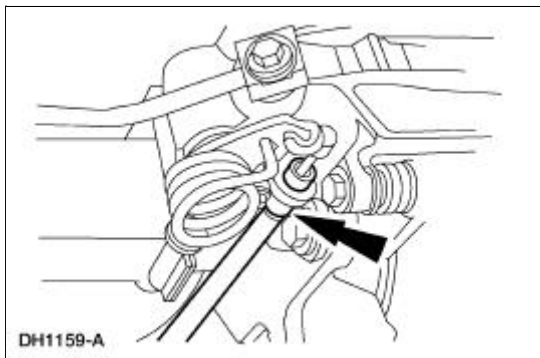
1. Raise the vehicle on a hoist. For additional information, refer to [Section 100-02](#).
2. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
3. Disengage the parking brake cable end from the parking brake lever arm.



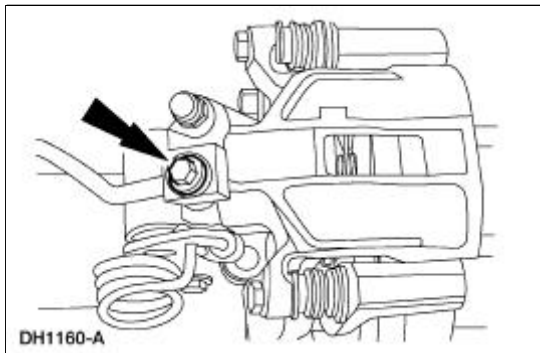
4. Remove the parking brake cable retaining clip.



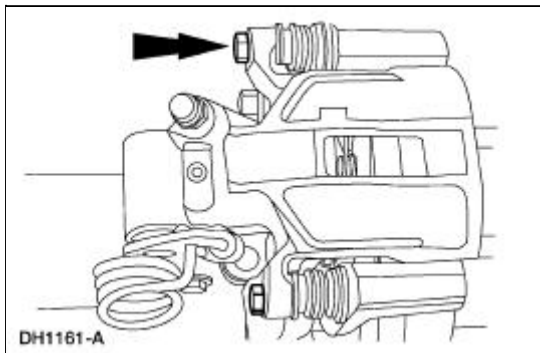
5. Remove the parking brake cable and conduit.



6. Remove the rear disc brake caliper brake hose bolt.



7. Remove the rear brake pin retainers (2N386) and remove the caliper.

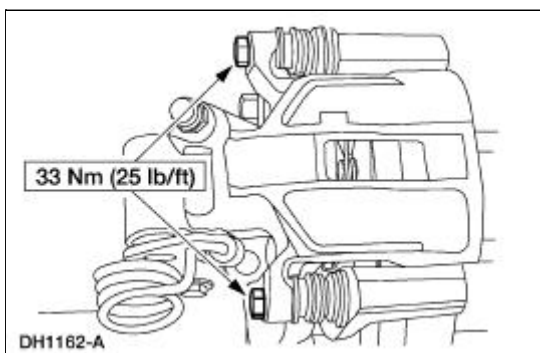


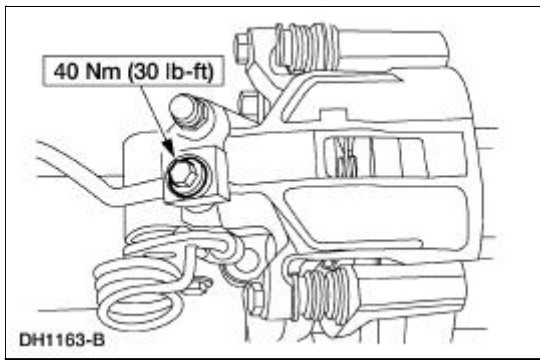
Installation

1. **NOTE:** Use new copper washers.

Follow the removal procedure in reverse order.

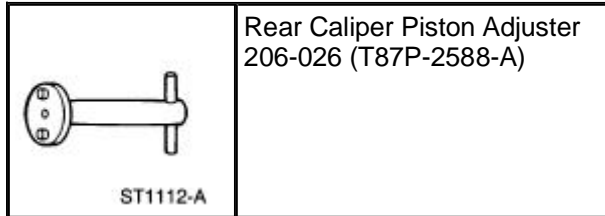
- Bleed the brake system. For additional information, refer to [Section 206-00](#).





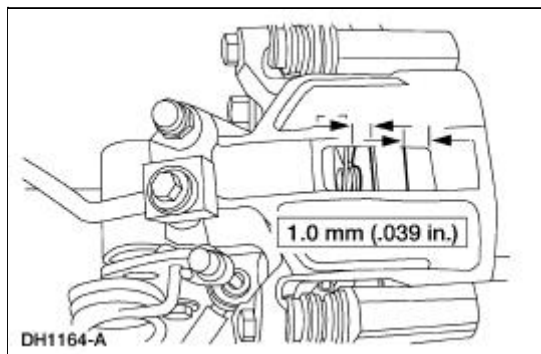
Pads

Special Tool(s)



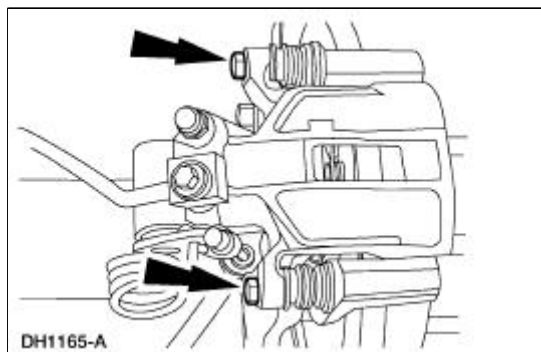
Removal

1. Use a suitable suction device to lower the brake fluid level in the master cylinder reservoir.
2. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
3. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
4. Inspect the pads for wear or contamination, install new if worn to or past specification.

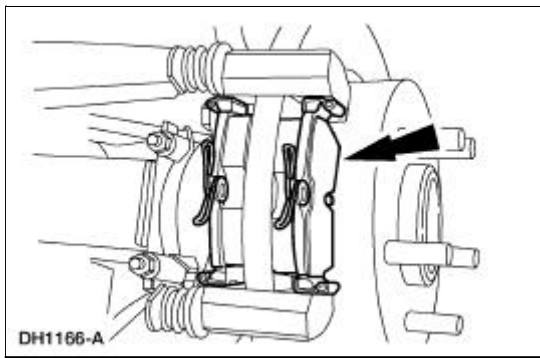


5.  **CAUTION:** Do not allow the rear disc brake caliper (2552) to hang from the rear wheel brake hose (2A442).

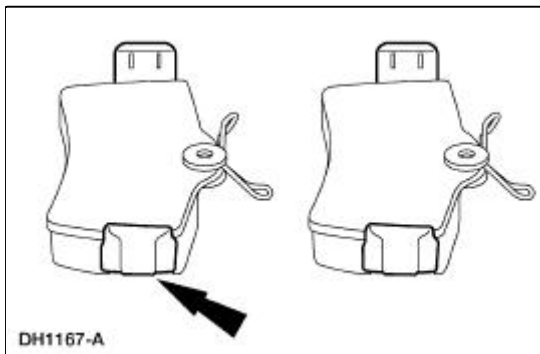
Remove the rear disc brake caliper bolts and position the caliper aside.



6. Remove the brake pads.

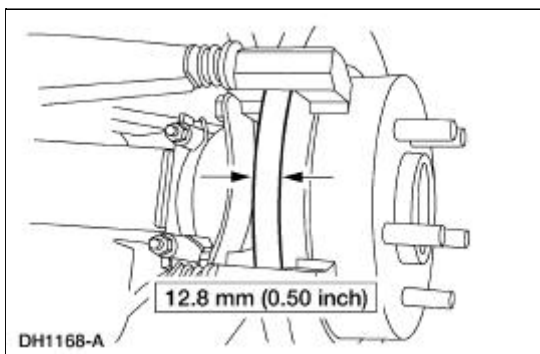


7. Remove the slippers.

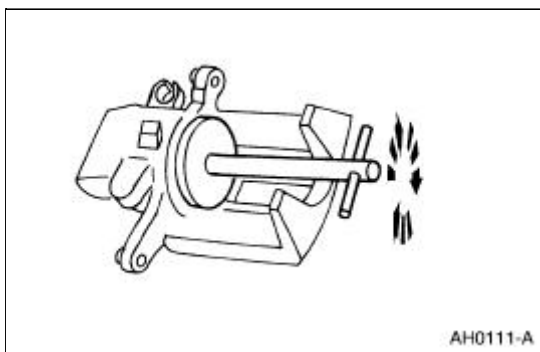


8.  **CAUTION:** Use a hub-mount brake lathe if necessary to machine the brake disc.

Measure the brake disc, resurface and or install new as necessary.



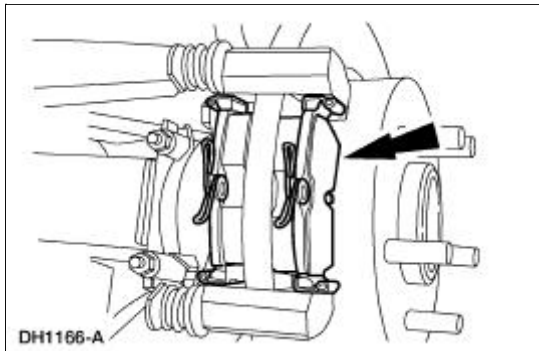
9. Compress the rear disc brake piston and adjuster (2B588) into rear disc brake caliper using Rear Caliper Piston Adjuster.



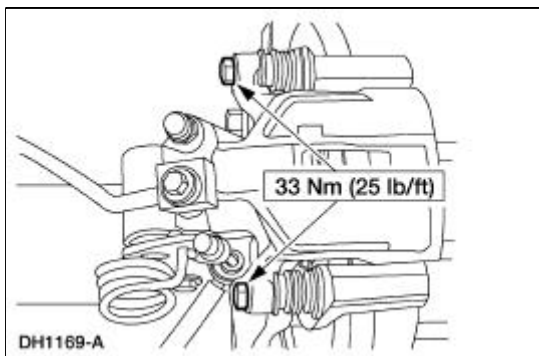
Installation

1.  **CAUTION:** Install the brake pads in full axle sets. Do not install new brake pads on only one side of vehicle.

Install the new slipper and brake pads.





2. Position the caliper on the anchor plate and install the bolts.



3. Install the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
4. Lower the vehicle.

5.  **WARNING:** Use of any other than approved DOT 3 or DOT 4 brake fluid will cause permanent damage to components and will render the brakes inoperative.

 **WARNING:** Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

 **CAUTION:** Brake fluid is harmful to painted or plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

Check the fluid level at the master cylinder. Add fluid if necessary.

6.  **WARNING:** Pump the brake pedal several times to make sure the caliper piston is extended to its operating position. Failure to follow these instructions may result in personal injury.

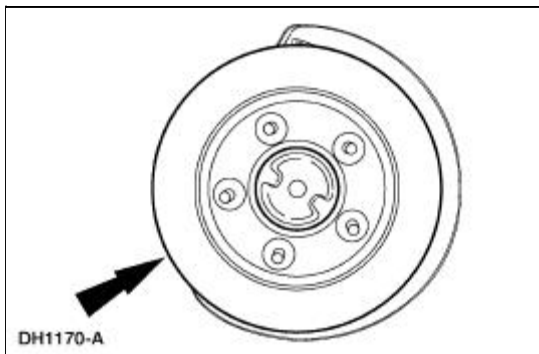
Verify correct brake operation.

7. Recheck the master cylinder fluid level.

Disc

Removal

1. Remove the rear disc support bracket (2B511). For additional information, refer to Support Bracket in this section.
2. Remove the brake disc (2C026).




Installation

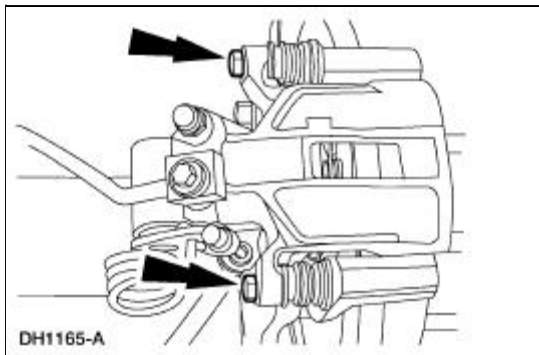
1. Follow the removal procedure in reverse order.
-

Brake Caliper Support Bracket

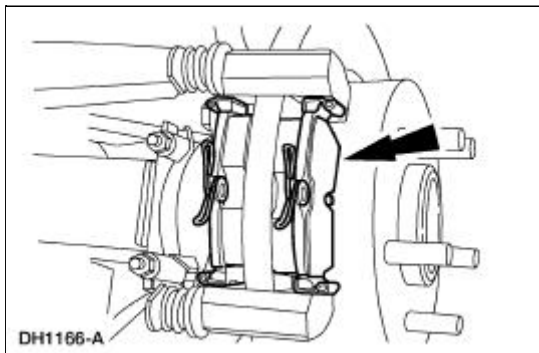
Removal

1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Remove the tire and wheel assembly. For additional information, refer to [Section 204-04](#).
3.  **CAUTION: Do not allow the rear disc brake caliper (2552) to hang from the rear wheel brake hose (2A442)**

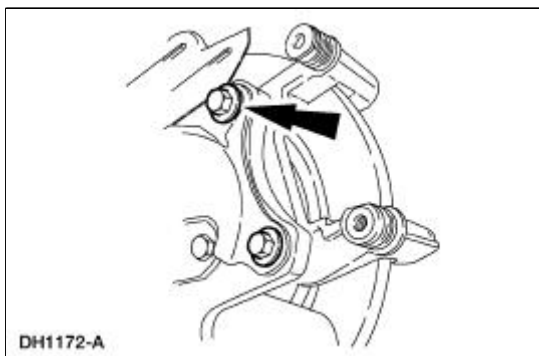
Remove the rear disc brake caliper bolts and position the caliper aside.



4. Remove the brake pads.



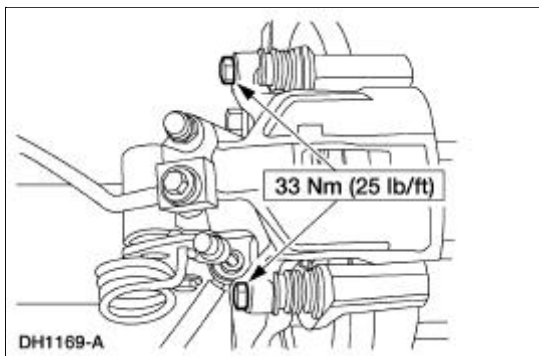
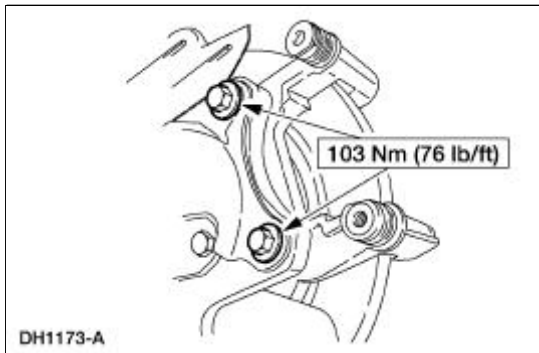
5. Remove the rear disc support bracket (2B511) bolts and bracket.



Installation

1. **NOTE:** New bolts must be used when reinstalling the rear disc support bracket.

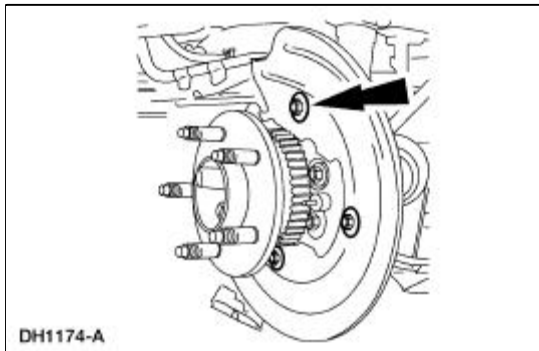
Follow the removal procedure in reverse order.



Shield

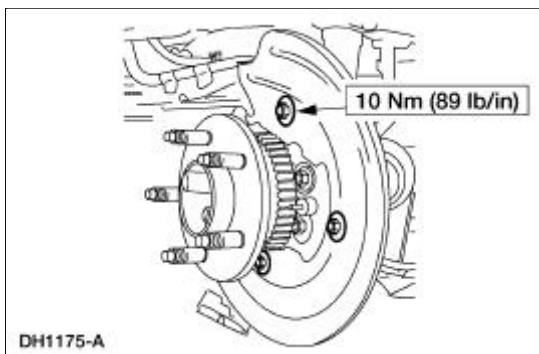
Removal

1. Remove the brake disc (2C026). For additional information, refer to [Disc](#) in this section.
2. Remove the brake disc shield bolts.



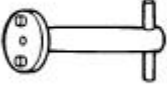

Installation

1. Follow the removal procedure in reverse order.



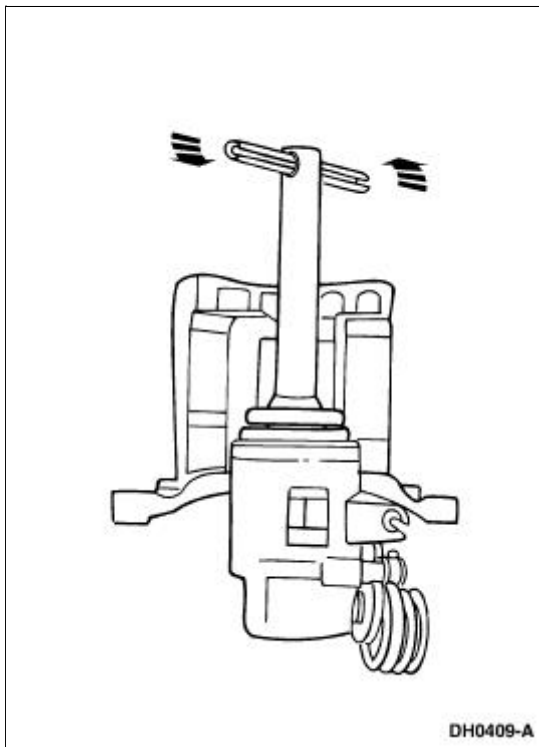
Caliper

Special Tool(s)

 <p>ST1112-A</p>	Rear Caliper Piston Adjuster 206-026 (T87P-2588-A)
 <p>-B1 -B2 -B3 -B4 ST1113-A</p>	Rear Caliper Spring Compressor Set 206-S027 (T87P-2588-B)

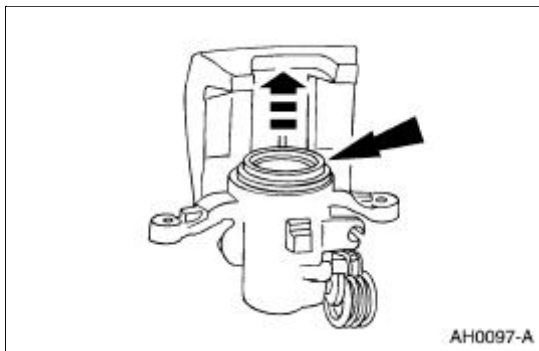
Disassembly

1. Remove the rear disc brake caliper (2552). For additional information, refer to Caliper in the Removal and Installation portion of this section.
2. Drain the brake fluid from the rear disc brake caliper.
3. Secure the rear disc brake caliper in a vise.
4. Turn the rear disc brake piston and adjuster (2B588) counterclockwise with Rear Caliper Piston Adjuster.




DH0409-A

5. Remove the rear disc brake piston and adjuster from the caliper bore.

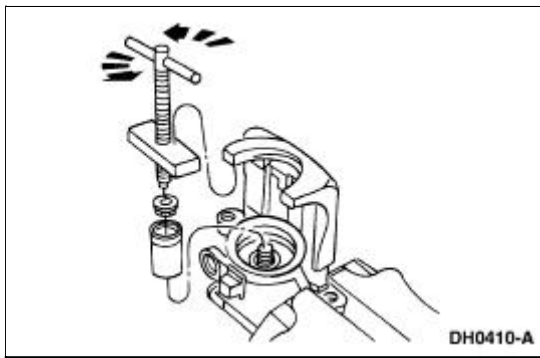


AH0097-A

6. Remove and discard the piston dust boot seal and piston seal from the caliper bore.
7.  **CAUTION: The parking brake lever pin retainer clip (2A746) and spring cover are spring-loaded. Use care when removing the parking brake lever pin retainer clip.**

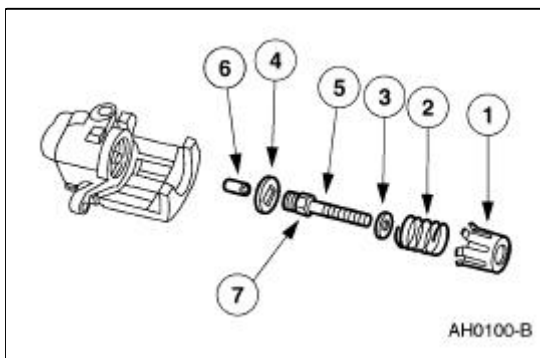
Remove the parking brake lever pin retainer clip.

- Unload the spring tension from the parking brake lever pin retainer clip and spring cover using Screw and Cross Block, a 6-mm washer head nut and a 1/2-inch drive 14-mm socket.
- Remove the parking brake lever pin retainer clip with suitable snap-ring pliers.
- Remove Screw and Cross Block.



8. Remove the following components:

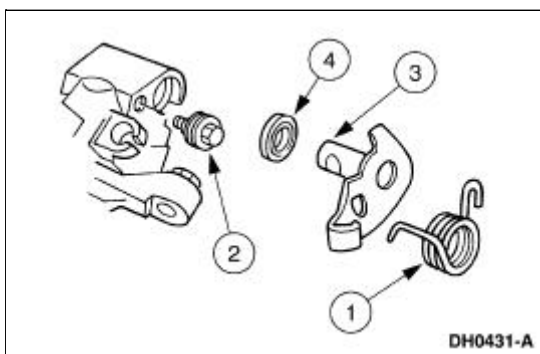
1. spring cover
2. spring
3. washer
4. key plate
5. push rod
6. strut pin
7. push rod O-ring




9. Remove and discard the O-ring seal from the push rod.

10. Remove the parking brake lever (2A637).

1. Remove the parking brake return spring (2456).
2. Remove the limiting bolt (2A795).
3. Remove the parking brake lever.
4. Remove the parking brake lever shaft seal from the caliper bore.



Assembly

1.  **CAUTION:** Do not reuse piston seals or dust boots. Install new seals or dust boots or damage to the vehicle can occur.

NOTE: Use new brake fluid when assembling and bleeding the brake system.

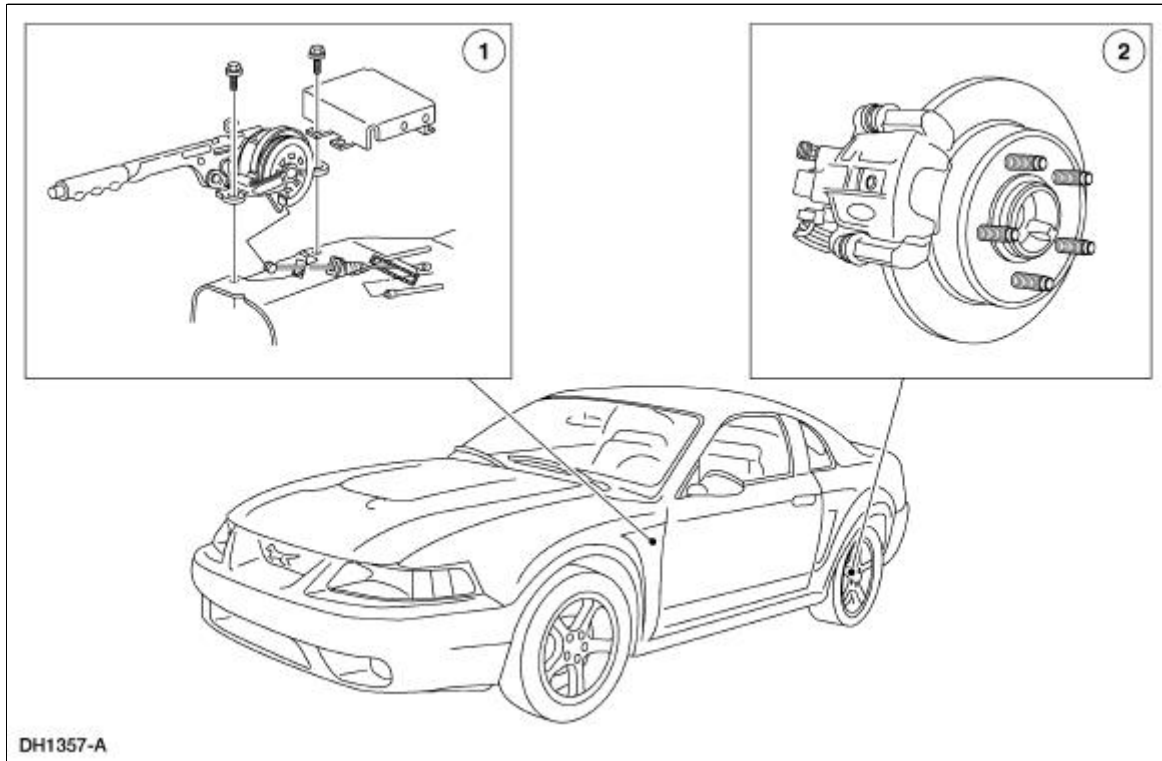
NOTE: Lightly lubricate the parking brake lever bore, limiting bolt, parking brake lever shaft and parking brake shaft recess with Silicone Dielectric Compound D7AZ-19A331-A or equivalent meeting Ford specification ESE-M1C171-A.

Follow the disassembly procedure in reverse order.

Torque Specifications

Description	Nm	Lb/Ft
Parking brake control-to-cowl nut	17	13
Brake hose clip mounting bolt	12	9

Parking Brake



DH1357-A

Item	Part Number	Description
1	2780	Parking brake control
2	2552	Rear disc brake caliper

The parking brake system is cable-actuated and controlled by an independent hand-operated parking brake control (2780). To apply parking brake, pull parking brake control upward as far as possible.

The parking brake system is an AUTO-ADJUST system. The spring in the parking brake control continuously adjusts the cable tension in the system.

Brake Warning System

A parking brake warning indicator:

- is located in the instrument panel.
- illuminates to signal the driver the parking brake is applied or to signal a low fluid condition.
- remains lit when a brake malfunction has occurred.

Parking Brake

Inspection and Verification

1. Verify the customer's concern by operating the parking brake system to duplicate the condition.
2. Inspect to determine if one of the following mechanical or electrical concerns apply:

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> ● Damaged parking brake control ● Binding/damaged parking brake cables 	<ul style="list-style-type: none"> ● Parking brake signal switch

3. If the inspection reveals obvious concern(s) that can be readily identified, service as necessary.
4. If concern(s) remains after the inspection, determine the symptoms. GO to [Symptom Chart](#).

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● Parking Brake Will Not Apply 	<ul style="list-style-type: none"> ● Parking brake control. ● Parking brake cable. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test A.
<ul style="list-style-type: none"> ● Parking Brake Will Not Release 	<ul style="list-style-type: none"> ● Parking brake cable. ● Parking brake control. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test B.

Pinpoint Tests

PINPOINT TEST A: PARKING BRAKE WILL NOT APPLY


Test Step	Result / Action to Take
A1 CHECK THE PARKING BRAKE CABLES	
<ul style="list-style-type: none"> ● Raise and support the vehicle. Refer 	Yes

<p>to Section 100-02 .</p> <ul style="list-style-type: none"> ● Inspect for broken or binding parking brake cables or broken guide clips. ● Is there a parking brake cable concern? 	<p>INSTALL a new parking brake cable as necessary. TEST the system for normal operation.</p> <p>No GO to A2 .</p>
<p>A2 CHECK THE PARKING BRAKE CONTROL</p>	<p>Yes INSTALL a new parking brake lever. RESTORE vehicle and TEST the system for normal operation.</p> <p>No REPAIR the binding condition in the parking brake control. TEST the system for normal operation.</p>
<ul style="list-style-type: none"> ● Operate the parking brake control. ● Does the parking brake control operate smoothly? 	

PINPOINT TEST B: PARKING BRAKE WILL NOT RELEASE

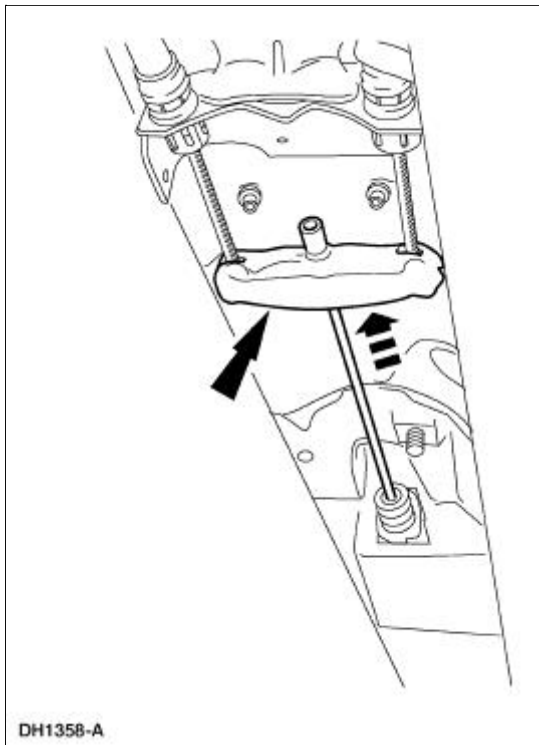
Test Step	Result / Action to Take
<p>B1 CHECK PARKING BRAKE CONTROL</p> <ul style="list-style-type: none"> ● Raise and support the vehicle. Refer to Section 100-02 . ● Release parking brake by pulling upward on hand lever and pushing release button. ● Did parking brake release? 	<p>Yes GO to B2 .</p> <p>No INSTALL a new parking brake control. RESTORE the vehicle and TEST the system for normal operation.</p>
<p>B2 CHECK PARKING BRAKE CABLES</p> <ul style="list-style-type: none"> ● Loosen tensioner. Refer to Parking Brake Cable Tension Release in this section. ● Move the gearshift lever to NEUTRAL position. ● Rotate rear wheels by hand. ● Did rear wheels turn freely? 	<p>Yes GO to B3 .</p> <p>No INSTALL new parking brake cables. RESTORE the vehicle and TEST the system for normal operation.</p>
<p>B3 CHECK REAR PARKING BRAKE LEVERS</p> <ul style="list-style-type: none"> ● Disconnect parking brake levers one at a time. ● Rotate wheel affected by disconnected parking brake lever. ● Did wheel turn freely? 	<p>Yes INSTALL a new parking brake lever. RESTORE vehicle and TEST the system for normal operation.</p> <p>No REPAIR or INSTALL a new rear brake component if worn or damaged. TEST the system for normal operation.</p>


Parking Brake Cable Tension Release

1.  **CAUTION:** If any component in the parking brake system requires repair or if the rear axle housing (4010) is removed, the cable tension must be released.

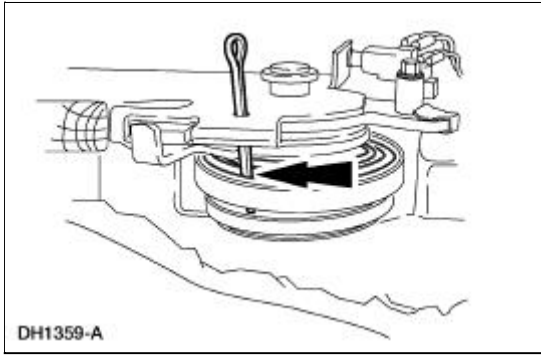
Place the parking brake control (2780) in the released position.

2. Remove the console. For additional information, refer to [Section 501-12](#).
3. With an assistant inside the vehicle, raise and support the vehicle. For additional information, refer to [Section 100-02](#).
4. Pull the parking brake cable and equalizer rearward.



5.  **CAUTION:** Do not remove the steel pin until the parking brake cable and equalizer/rear cable and conduits are connected to the parking brake control. Pin removal releases the tension in the ratchet wheel causing the spring to unwind and release tension.


Insert a steel pin through holes in the lever to the ratchet wheel.



DH1359-A

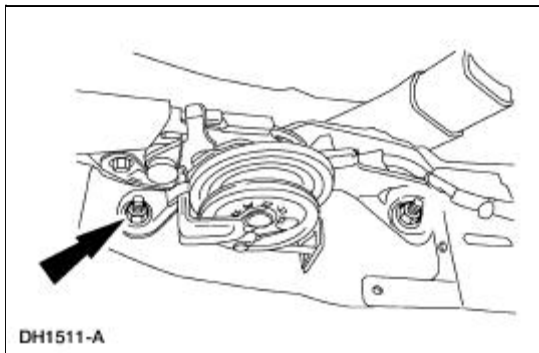
Parking Brake Control

Removal

1.  **CAUTION:** If any component in the parking brake system requires repair or if the rear axle housing (4010) is removed, the cable tension must be released.

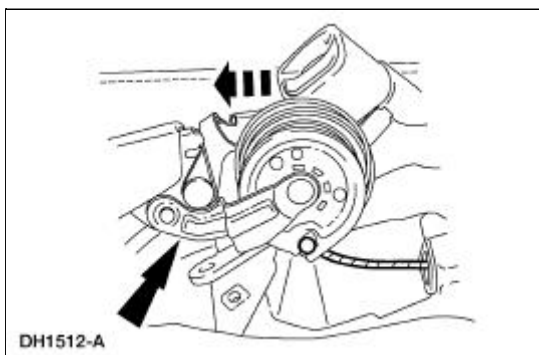
Place the parking brake control (2780) in the released position.

2. Remove the console. For additional information, refer to [Section 501-12](#).
3. Remove the parking brake control studs.

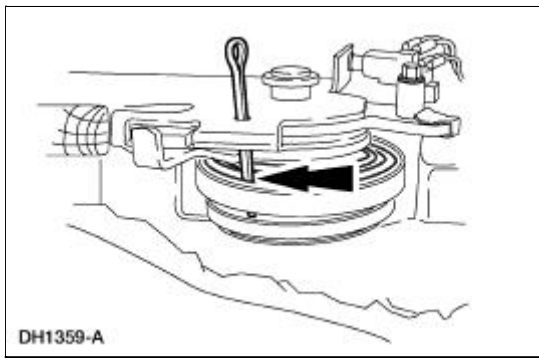


4. **NOTE:** Self adjust pawl must be off to allow wind up.

Place the control handle in the fully downward position, then pull the control handle forward to wind-up the self-adjusting mechanism.

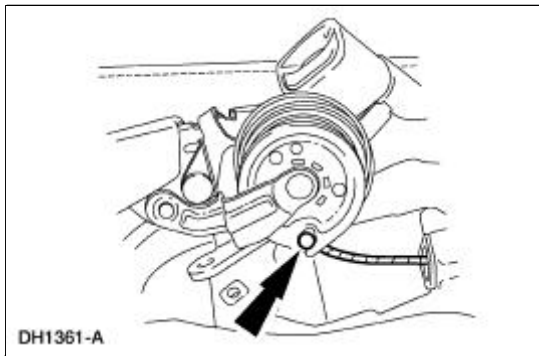


5. Insert a steel pin through hole in the lever to the ratchet wheel, then carefully release the spring tension onto the pin.



6. **NOTE:** Keep tension on the cable so cable end does not fall out of equalizer.

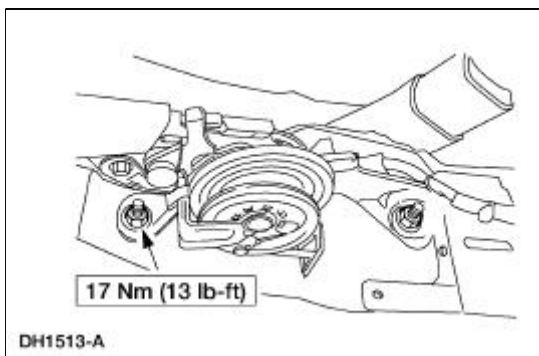
Disconnect the parking brake cable.



Installation


1. **NOTE:** Make sure cable ends are attached to the equalizer.

Follow the removal procedure in reverse order.



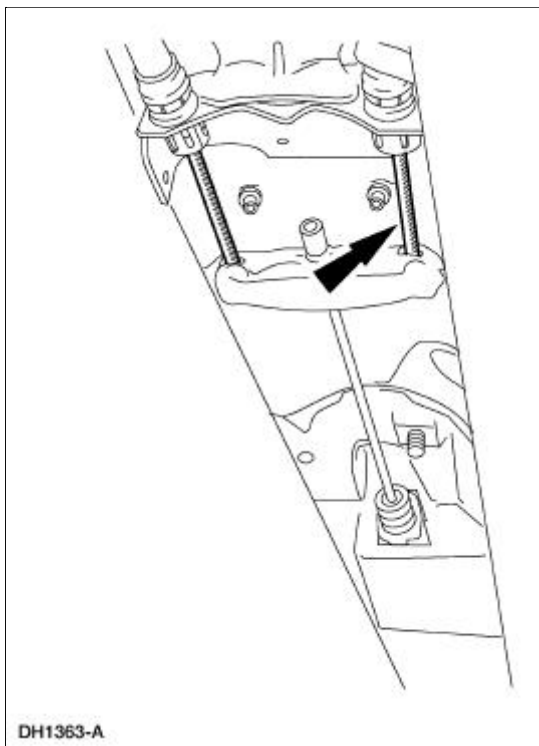
Cable and Conduit —Front

Removal

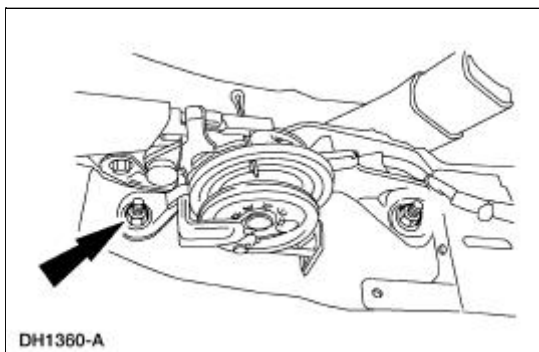
1.  **CAUTION:** If any component in the parking brake system requires repair or if the rear axle housing (4010) is removed, the cable tension must be released.

Release the cable tension. For additional information, refer to [Parking Brake Cable Tension Release](#) in this section.

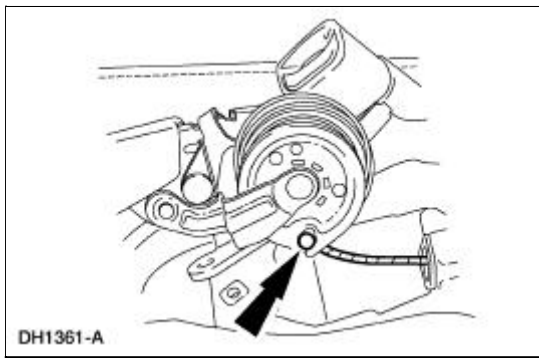
2. Disconnect the parking brake rear cables and conduits.



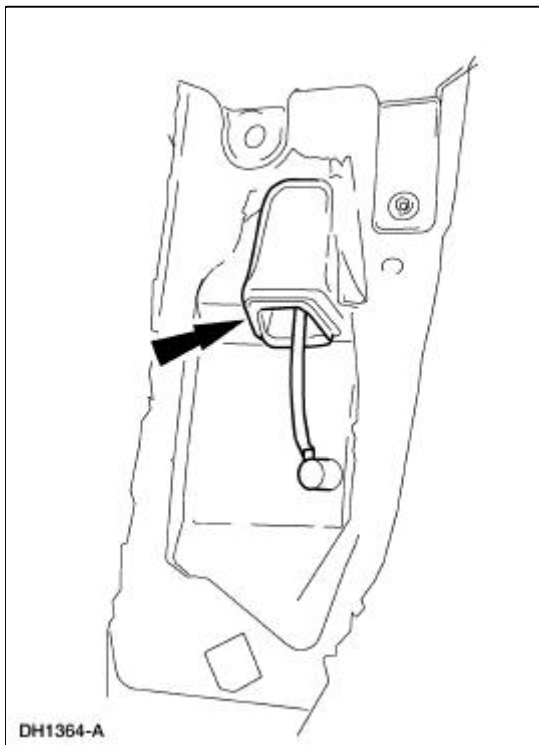
3. Remove the parking brake control nuts.



4. Disconnect the parking brake cable.

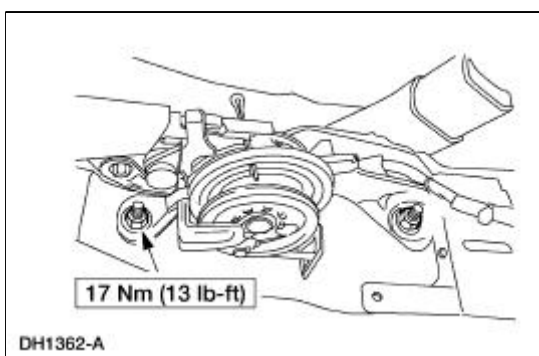


5. Pull the front cable and equalizer through the floorpan from inside the vehicle.



Installation


1. Follow the removal procedure in reverse order.



Cable and Conduit

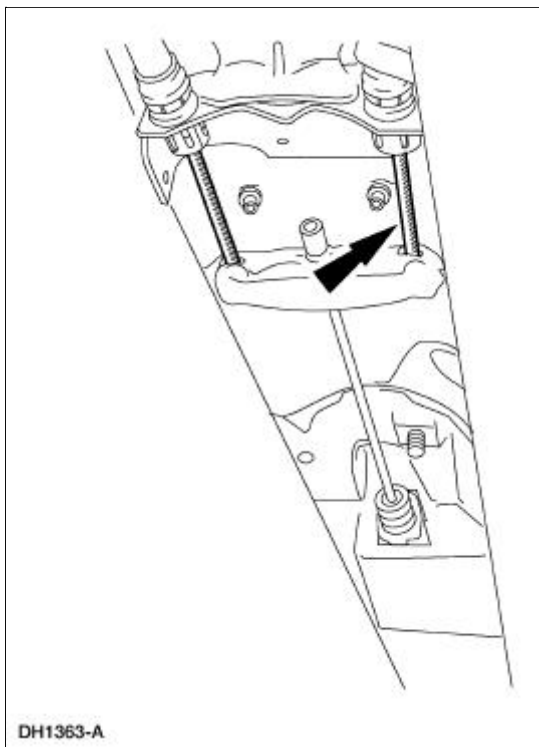
Removal

NOTE: The RH rear is shown, the LH is similar.

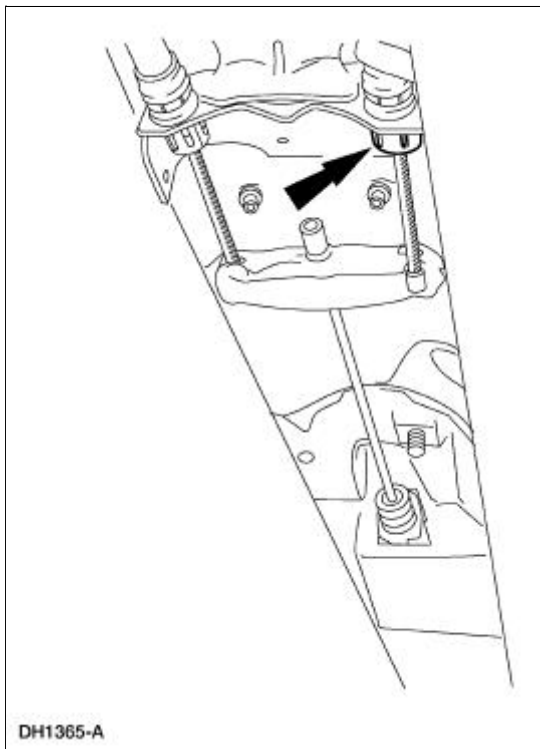
1.  **CAUTION:** If any component in the parking brake system requires repair or if the rear axle housing (4010) is removed, the cable tension must be released.

Release the cable tension. For additional information, refer to [Parking Brake Cable Tension Release](#) in this section.

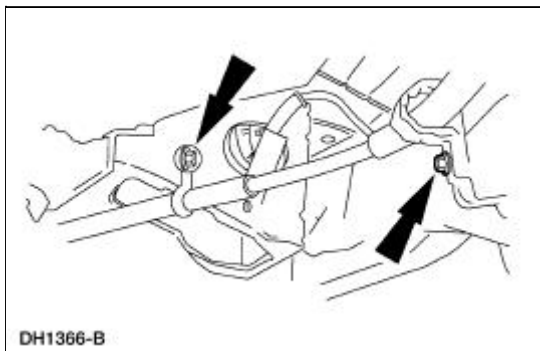
2. Disconnect the parking brake rear cable and conduit.



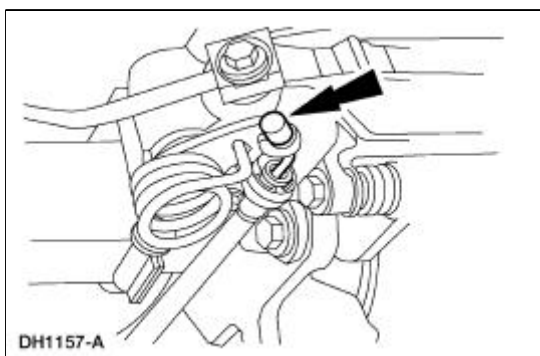
3. Using a 13 mm (0.52 in) box-end wrench, depress the conduit retaining prongs and remove the parking brake rear cable and conduit.



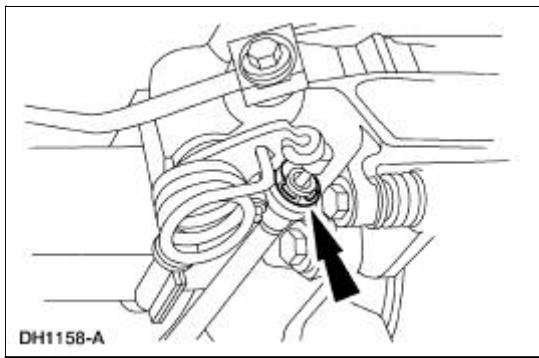
4. Remove the parking brake rear cable and conduit from the routing clip bolts.



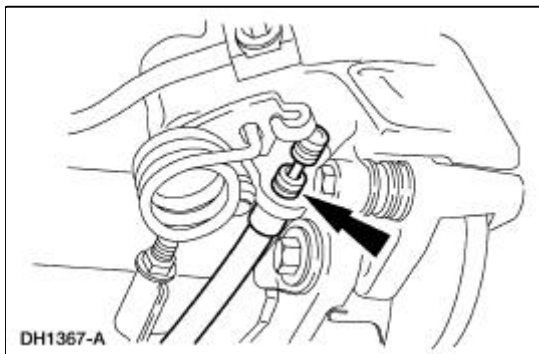
5. Disconnect the parking brake rear cable and conduit from the parking brake lever (2A637).



6. Remove the clip from the rear disc brake caliper (2552).

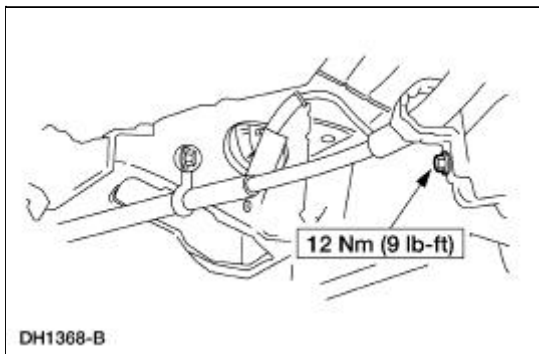


7. Remove the parking brake rear cable and conduit from the rear disc brake caliper.



Installation

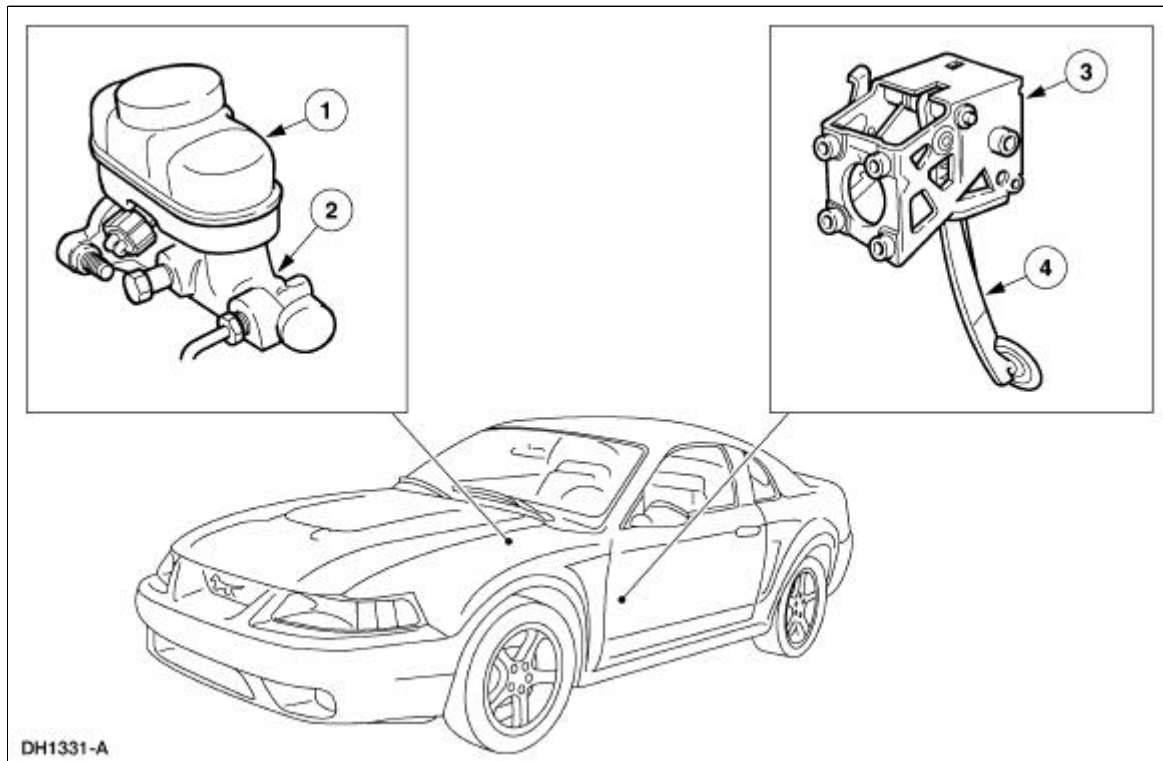
1. Follow the removal procedure in reverse order.



Torque Specifications

Description	Nm	lb-ft
Brake master cylinder nuts	25	19
Brake pedal bracket nuts	25	19
Brake pedal bracket bolt	23	17
Brake fluid control valve	19	15
Hydraulic tube connections	17	13
Brake fluid control valve bracket nut	14	11

Hydraulic Brake Actuation



Item	Part Number	Description
1	2K478	Master cylinder reservoir
2	2140	Master cylinder
3	—	Pedal support bracket (part of 2455)
4	2455	Brake pedal

⚠ CAUTION: Blistering or swelling of rubber brake components may indicate contamination of the brake fluid by a petroleum based substance. New rubber components must be installed in the hydraulic brake system if contaminated and the entire hydraulic brake system must be flushed with clean brake fluid to prevent recontamination.

This vehicle is equipped with a brake pedal actuated dual brake system. The system consists of the following:

- power brake booster (2005)
- brake master cylinder (2140)
- brake pressure control valve (2B091)
- disc brake calipers (2B120)
- rear disc brake calipers (2553)
- brake tubes and hoses
- anti-lock brake system (ABS) components

The dual brake system is split front and rear with the front wheel brakes comprising of one circuit and the rear wheel brakes, the other circuit.

Brake Fluid



WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

Clean, fresh Ford High Performance DOT 3 Brake Fluid C6AZ-19542-AB or equivalent DOT 3 fluid meeting Ford specification ESA-M6C25-A is the only brake fluid that should be used in Ford vehicles.

- Do not reuse brake fluid drained or bled from the system.
- Do not use brake fluid that has been stored in an open container.
- Do not mix different types of brake fluid.

Brake Master Cylinder

The brake master cylinder is a dual piston type. The brake master cylinder operates as follows:

- When the brake pedal (2455) is depressed, pressure is applied by mechanical linkage to the primary and secondary piston.
- Brake master cylinder pistons apply hydraulic pressure to the two hydraulic circuits.
- Brake master cylinder will not be overhauled, a new master cylinder is installed only.

The brake master cylinder consists of:

- brake master cylinder reservoir (2K478)
- brake master cylinder body

Brake Master Cylinder Reservoir

NOTE: Whenever the brake master cylinder reservoir is removed from the brake master cylinder, new grommets must be installed.

The brake master cylinder reservoir :

- is mounted to the brake master cylinder.
- holds fluid supply for each brake master cylinder hydraulic piston.
- provides visual fluid level markings.
- contains the brake master cylinder fluid level sensor.

Brake Pressure Control Valve

The brake pressure control valve proportions the pressure to the rear brakes.

- When the brake pedal is applied, brake fluid pressure passes through the proportioning valves to the rear brake system until the valve split point is reached.
- Above its split point, the proportioning valve begins to reduce the hydraulic pressure to the rear brakes, creating a balanced braking condition between the front and rear brakes.

Brake Tubes and Hoses



CAUTION: Never use copper tubing. It is subject to fatigue, cracking and corrosion which could result in brake tube failure.

Steel tubing is used throughout the brake hydraulic system. All brake tube fittings must be correctly double flared to provide strong leakproof connections. When bending the tubing to fit the underbody or rear axle contours, be careful not to kink or crack the tube.

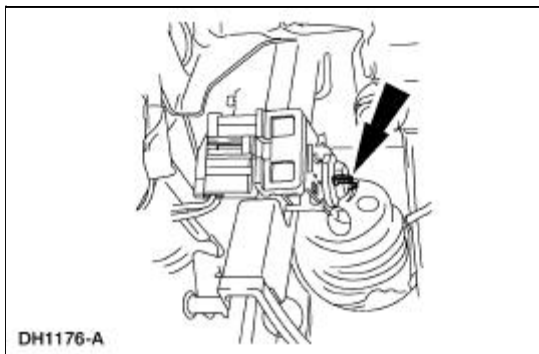
If a section of brake tube is damaged, the entire section must be removed and a new tube of the same type, size, shape and length installed.

When replacing hydraulic brake tubing, hoses, or connectors, tighten all connections securely. After installation, bleed the brake system. For additional information, refer to [Section 206-00](#).

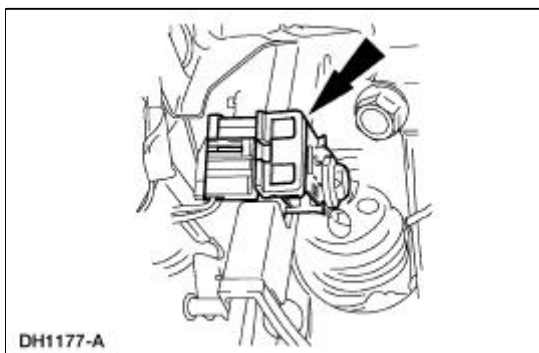
Pedal and Bracket

Removal

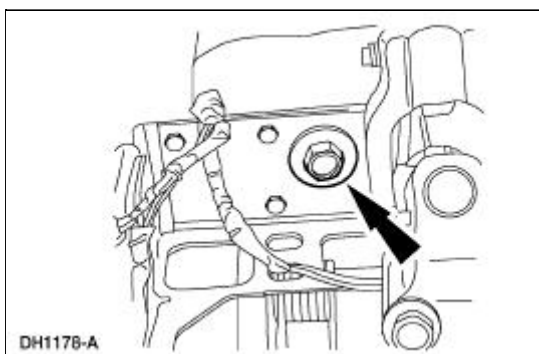
1. Disconnect the battery ground cable (14301). For additional information, refer to [Section 414-01](#).
2. Remove the stoplight switch retaining pin.



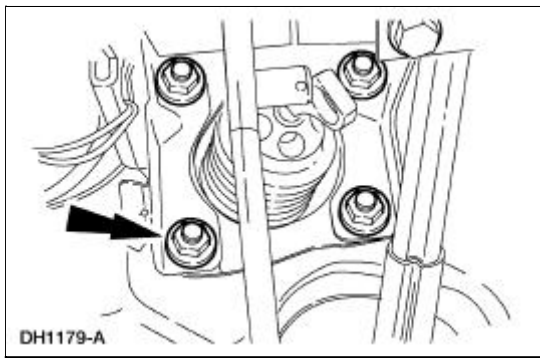
3. Slide the stoplight switch (13480) and booster push rod from the brake pedal pin.



4. Remove the brake pedal bracket retaining bolt.



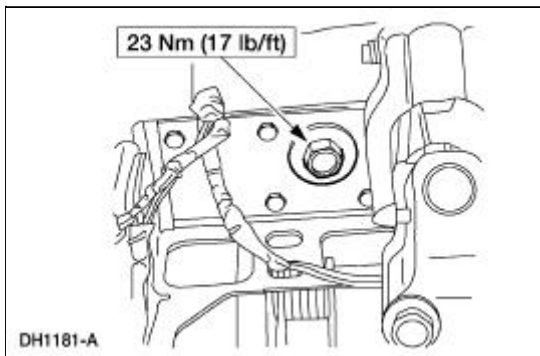
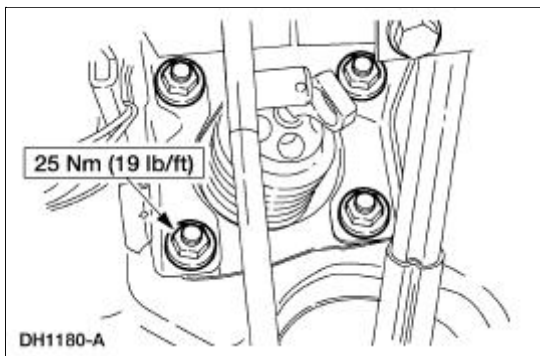
5. Remove the brake pedal bracket retaining nuts.



6. Remove the brake pedal and bracket.

Installation

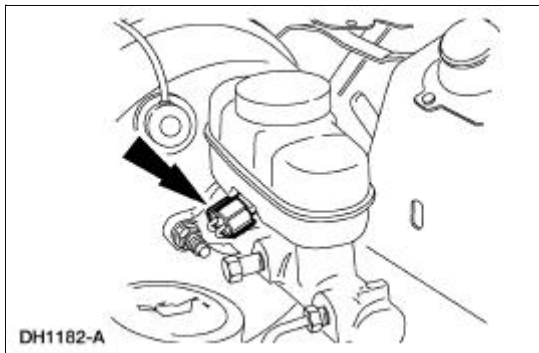
1. To install, reverse the removal procedure.



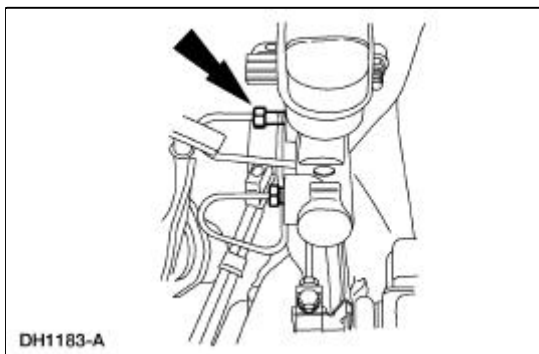
Master Cylinder

Removal

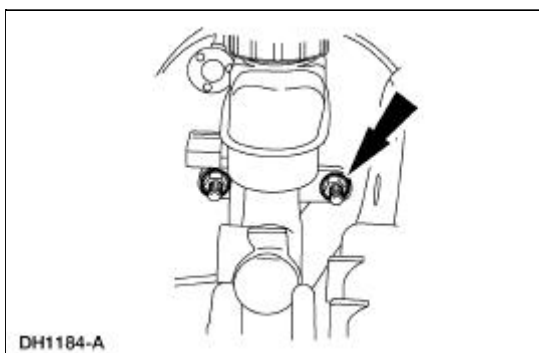
1. Disconnect the fluid level sensor connector.



2. Disconnect the brake tubes.



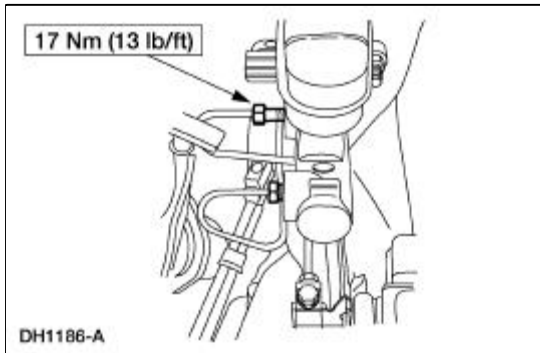
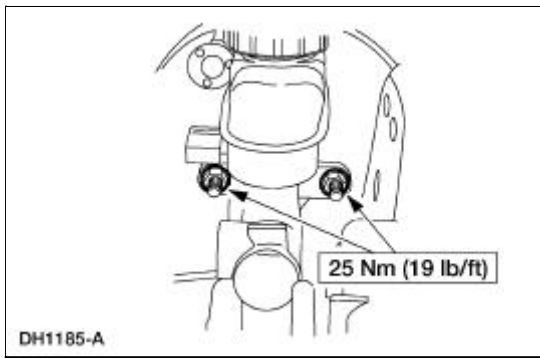
3. Remove the brake master cylinder nuts.



4. Remove the brake master cylinder (2140).

Installation

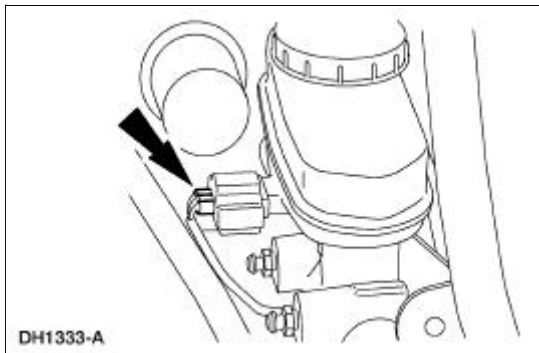
1. To install, reverse the removal procedure.
 - Bleed the brake system. For additional information, refer to [Section 206-00](#).



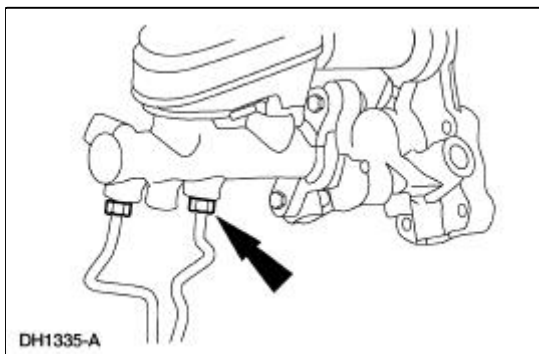
Master Cylinder —Hydro-Boost

Removal

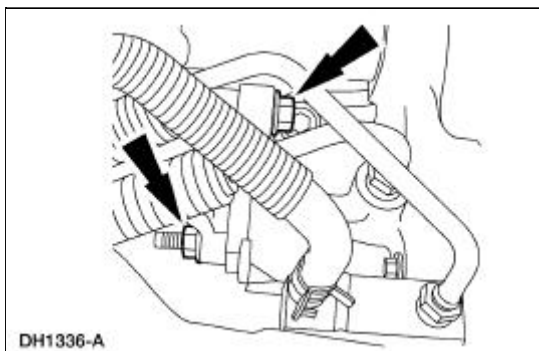
1. Disconnect the fluid level sensor connector.



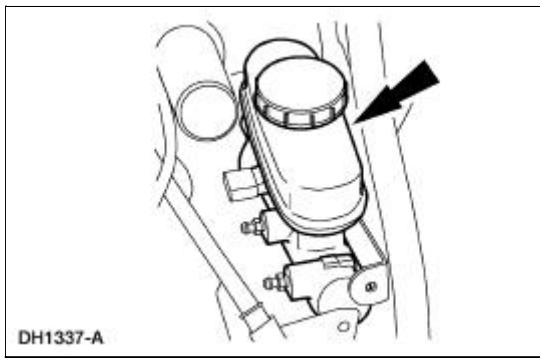
2. Disconnect the brake tubes.



3. Remove the brake master cylinder nuts.

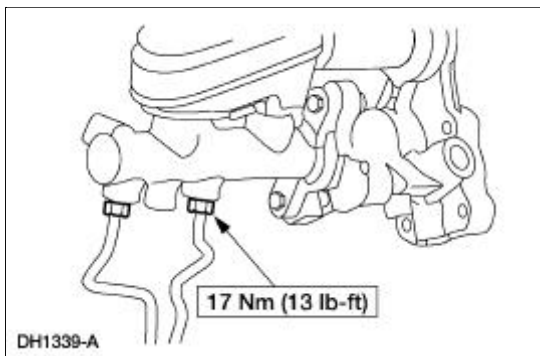
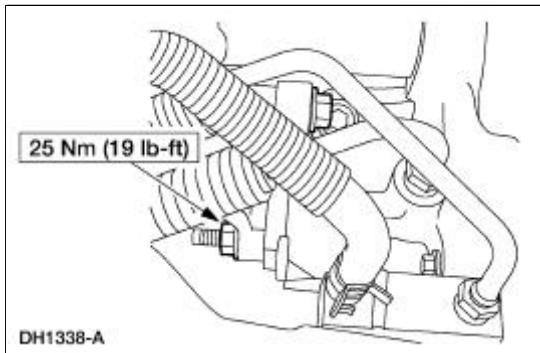


4. Remove the brake master cylinder (2140).




Installation

1. To install, reverse the removal procedure.
 - Bleed the brake system. For additional information, refer to [Section 206-00](#).

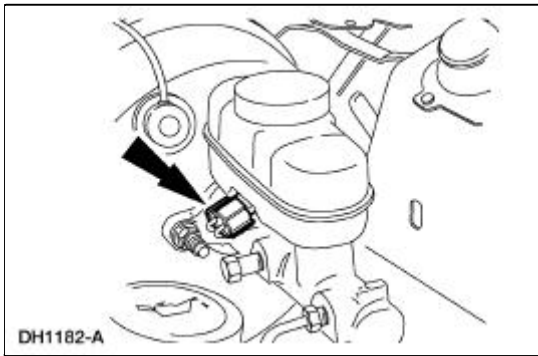


Reservoir

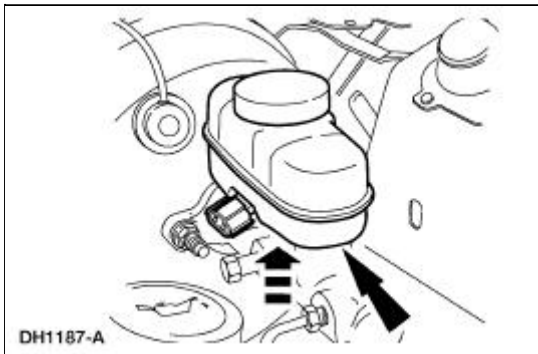
Removal

 **WARNING:** Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

1. Disconnect the brake master cylinder fluid level switch.



2. Use a suitable suction device to drain the brake master cylinder reservoir (2K478).
3. Carefully pry up on the brake master cylinder reservoir and remove.

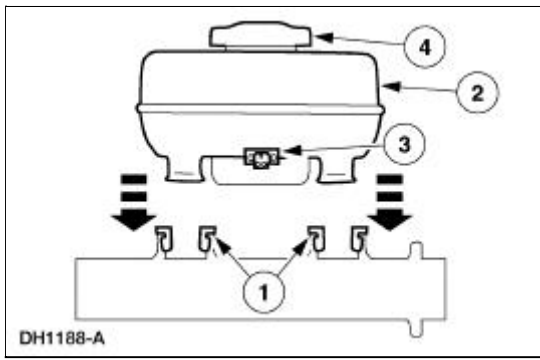


Installation

1. **NOTE:** Whenever installing a new brake master cylinder reservoir, install new grommets.

Install the brake master cylinder reservoir.

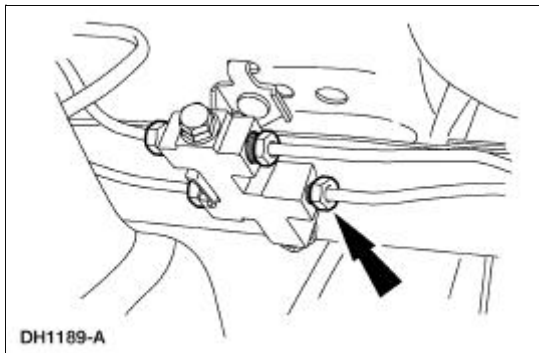
1. Lubricate the two grommets with High Performance DOT 3 Brake Fluid C6AZ-19542-AB or equivalent fluid meeting Ford specification ESA-M6C25-A and insert the grommets into the brake master cylinder (2140).
2. Press the brake master cylinder reservoir into the grommets until it is fully seated.
3. Connect the brake master cylinder fluid level switch.
4. Fill the brake master cylinder reservoir with clean High Performance DOT 3 Brake Fluid C6AZ-19542-AB or equivalent fluid meeting Ford specification ESA-M6C25-A.
5. Bleed the brake master cylinder. For additional information, refer to [Section 206-00](#).



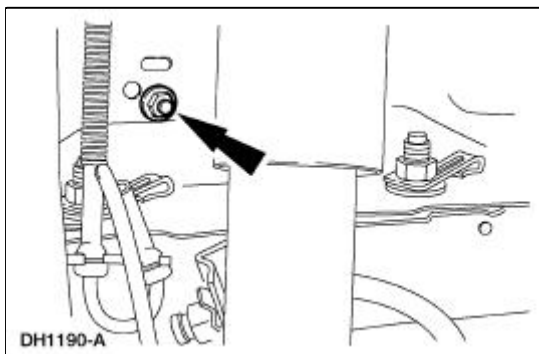
Control Valve

Removal

1. Disconnect the brake tubes.

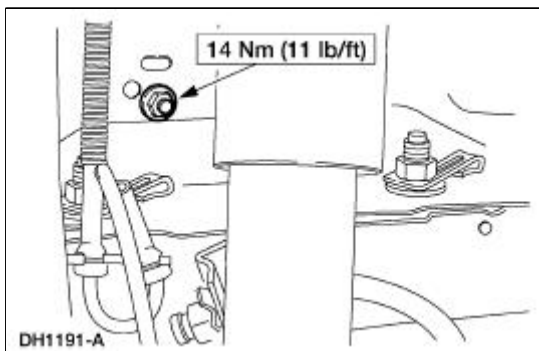


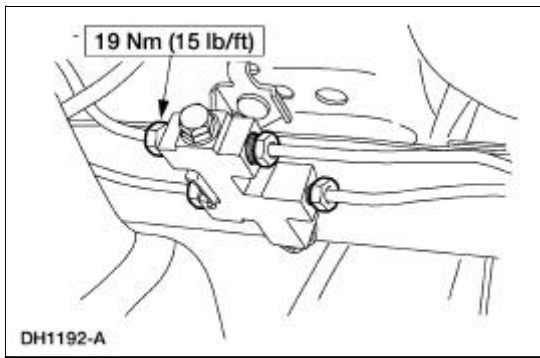
2. Remove the brake fluid control valve bracket nut.



Installation

1. To install, reverse the removal procedure.



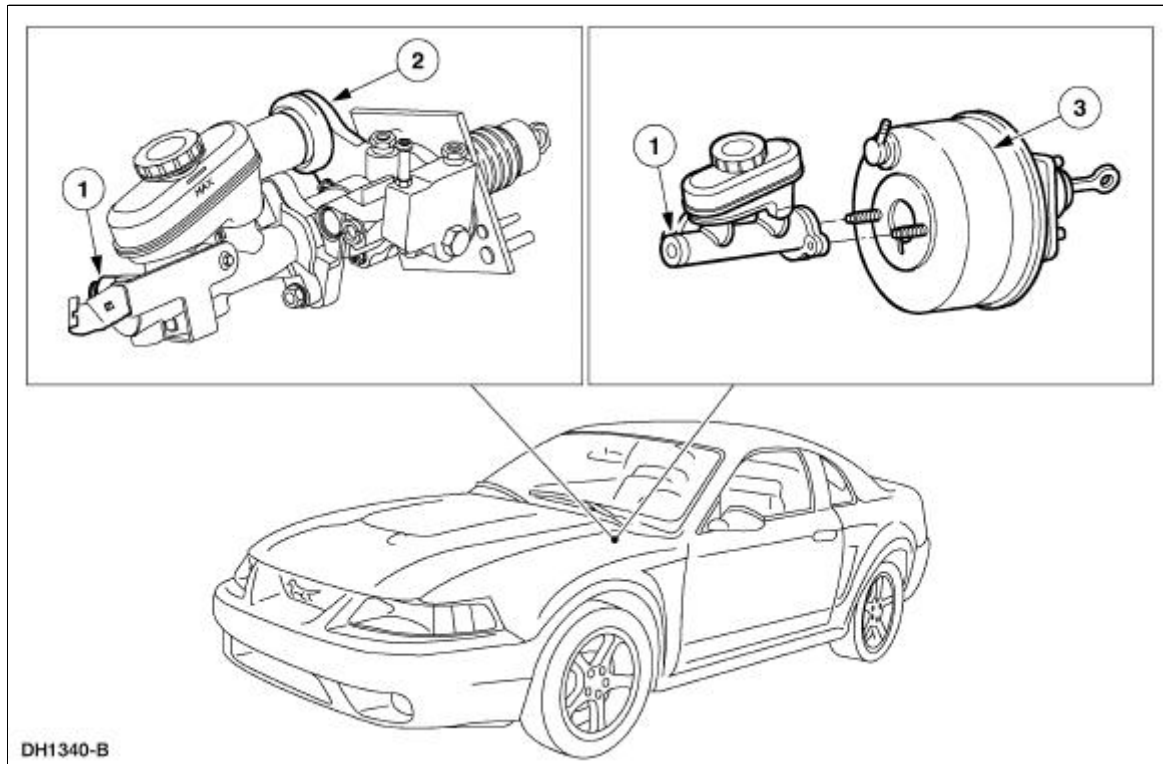


Torque Specifications

Description	Nm	lb-ft
Power brake booster nuts	25	19
Brake master cylinder nuts	25	19
Hydraulic tube connections	17	13
Power steering pressure lines	19	14

Brake Booster — Vacuum

Power Brake Booster



Item	Part Number	Description
1	2140	Master cylinder
2	2B560	Hydro-Boost
3	2005	Power brake booster

The vacuum type power brake booster (2005):

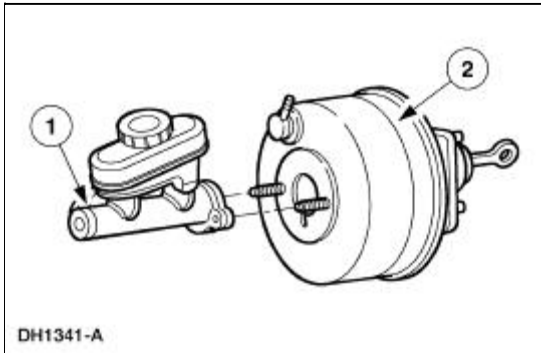
- is a dual diaphragm, vacuum assisted power brake booster
- reduces brake pedal force and travel distance.
- is located on the LH side of the bulkhead in the engine compartment, between the brake pedal (2455) and the brake master cylinder (2140).
- is divided into separate chambers by the diaphragms.
- will not operate if vacuum is restricted or if any of the vacuum related power brake components fail.
- is installed as an assembly.

If the power assist fails, the brake system will continue to operate with increased brake pedal effort.

Hose and Check Valve

The power brake booster check valve (2365):

- is located on the front of the power brake booster.
- is installed separately; (install a new grommet when installing a new check valve).
- is positioned between the power brake booster and the power brake booster hose.
- closes when the engine is turned off.
- in the closed position, traps engine vacuum in the power brake booster
- retains vacuum to provide several power assisted brake applications with the engine off.



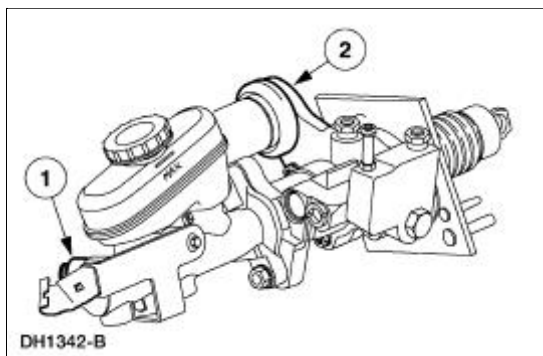
Item	Part Number	Description
1	2140	Master cylinder
2	2005	Power brake booster

Brake Booster —Hydro-Boost

The Hydro-Boost brake booster is a hydraulically operated brake booster powered by the power steering pump (3A674). The power steering pump provides the fluid pressure to operate both the power brake booster and the power steering gear (3504).

A Hydro-Boost reserve system (accumulator) stores sufficient fluid under pressure to provide at least two power-assisted brake applications in the event the power steering pump fluid flow is interrupted.

For low assist concerns on vehicles equipped with the Hydro-Boost system, refer to [Section 211-00](#) to check the power steering pump pressure and flow.



Item	Part Number	Description
1	2140	Master cylinder
2	2B559	Hydro-Boost

The brakes can also be applied manually if the reserve system is depleted.

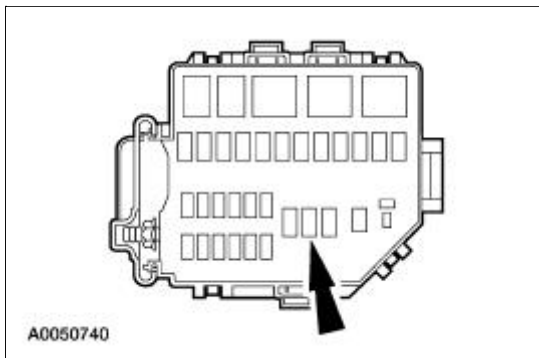
Any leakage goes directly back to the power steering pump reservoir (3E764).

Hydro-Boost Bleeding

1. **NOTE:** The Hydro-Boost power brake booster (2B560) is generally self-bleeding, and the following procedure will normally bleed the air from the power brake booster. Normal operation of the vehicle will further remove any additional trapped air.

Fill the power steering oil reservoir (3A697) with MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent.

2. Remove the powertrain control module (PCM) fuse to prevent the engine from starting.

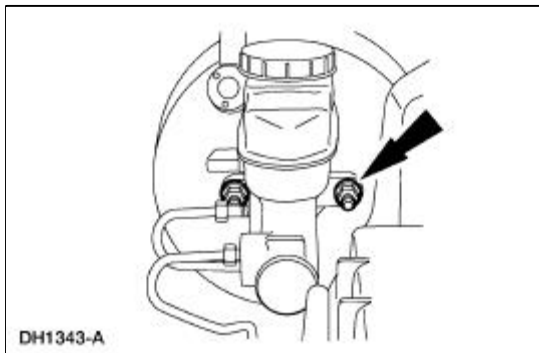


3. Crank the engine for several seconds.
 4. Check the fluid level in the power steering oil reservoir and add if necessary. Install the powertrain control module (PCM) fuse.
 5. Start the engine.
 6. With the engine running, turn the steering wheel (3600) from stop-to-stop twice. Turn the engine off.
 7. Depress the brake pedal (2455) several times to discharge the accumulator.
 8. Repeat Steps 5 and 6.
 9. If foaming occurs, stop the engine and allow the foam to dissipate.
 10. Repeat Steps 5 and 6 as required, until all the air is removed from the system (when the foaming stops).
-

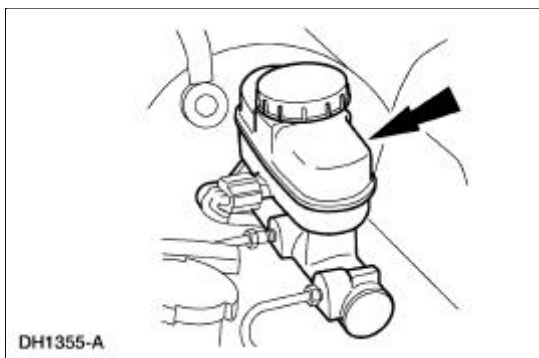
Brake Booster — Vacuum

Removal

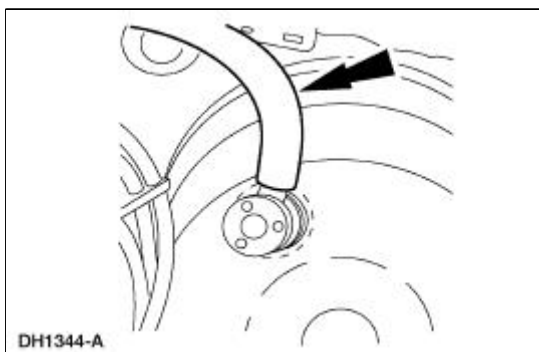
1. Disconnect the battery ground cable (14301). For additional information, refer to [Section 414-01](#).
2. Remove the air cleaner housing. For additional information, refer to [Section 303-12](#).
3. Remove the brake master cylinder nuts.



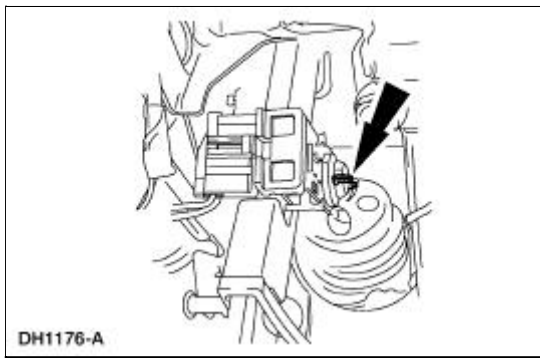
4. Position the brake master cylinder (2140) aside.



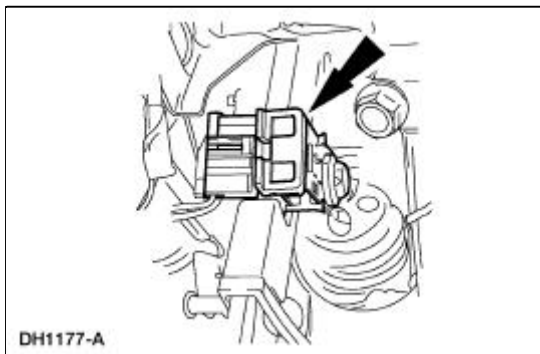
5. With the engine off, depress the brake pedal (2455) several times to discharge the accumulator. Disconnect the booster vacuum hose.



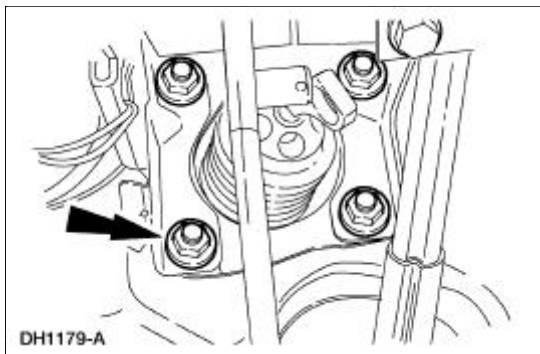
6. Remove the stoplight switch self-locking pin.



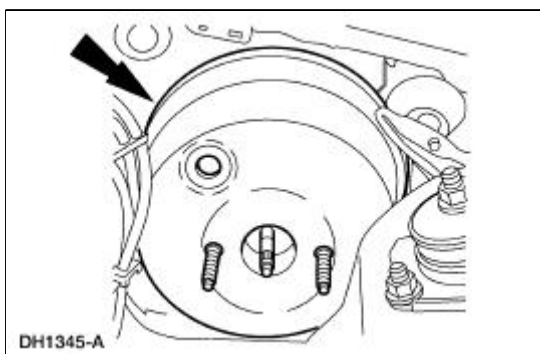
7. Remove the stoplight switch (13480) and the brake booster push rod from the brake pedal pin.



8. Remove the power brake booster nuts.

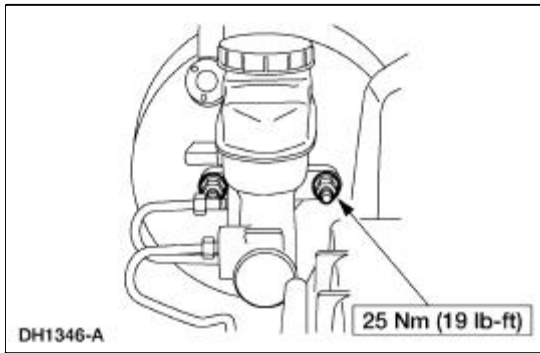
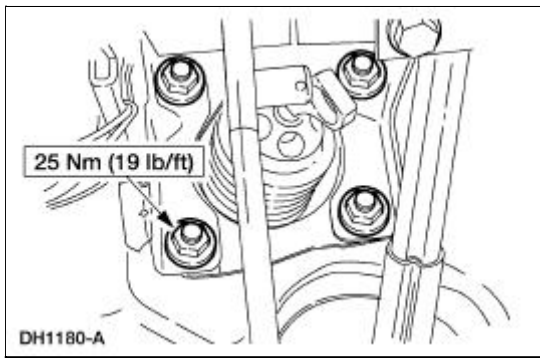


9. Remove the power brake booster (2005).



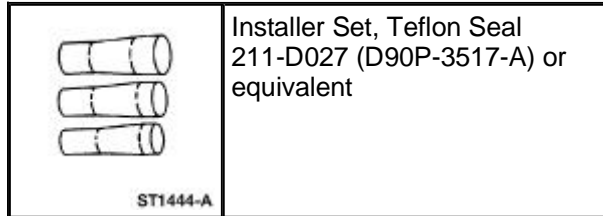
Installation

1. Follow the removal procedure in reverse order.



Brake Booster —Hydro-Boost

Special Tool(s)

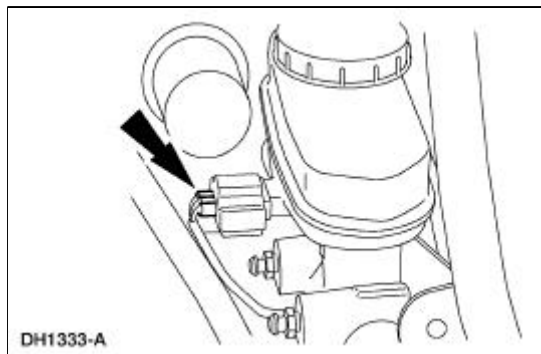


Removal

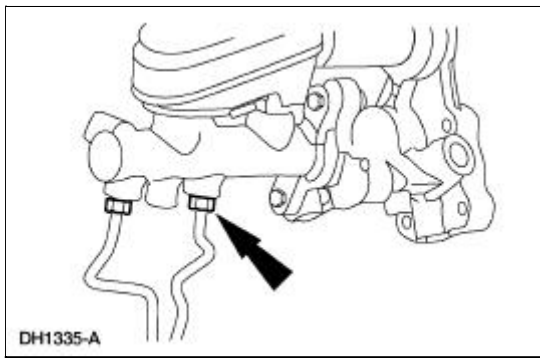
⚠ WARNING: The power brake booster should not be carried by the accumulator, nor should it ever be dropped on the accumulator. Check the snap ring on the accumulator for correct seating before the power brake booster is used. The accumulator contains high-pressure nitrogen gas and can be dangerous if mishandled.

⚠ WARNING: If the accumulator is to be disposed of, it must not be exposed to excessive heat. Before discarding the accumulator, drill a 1.6-mm (1/16-inch) diameter hole in the end of the accumulator can to relieve the gas pressure. Always wear safety glasses when performing this operation.

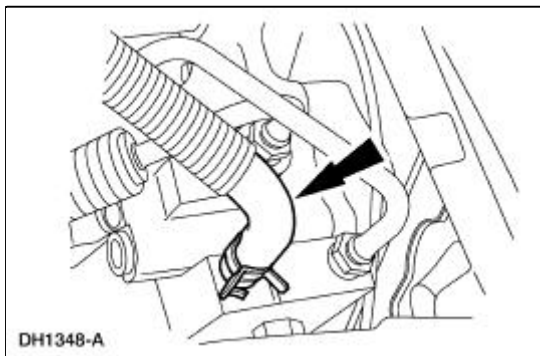
1. With the engine off, depress the brake pedal (2455) several times to discharge the accumulator.
2. Disconnect the battery ground cable (14301). For additional information, refer to [Section 414-01](#).
3. Disconnect the fluid level sensor connector.



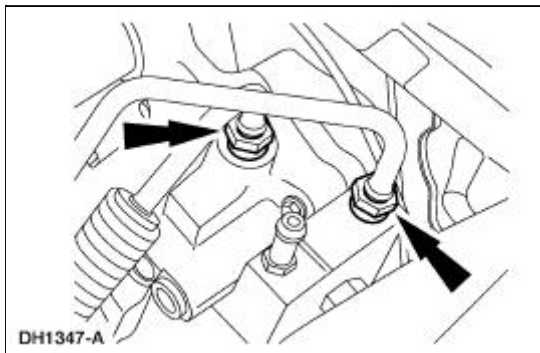
4. Disconnect the brake tubes.



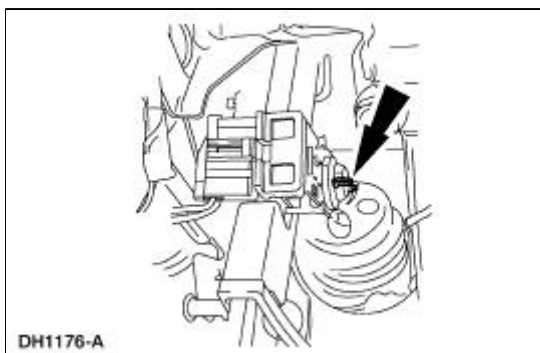
5. Disconnect the power steering return line hose (3A005).



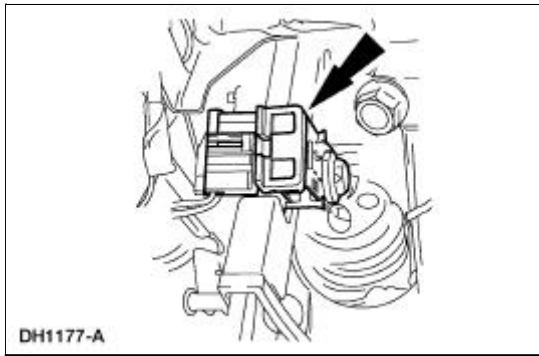
6. Disconnect the power steering pressure lines.



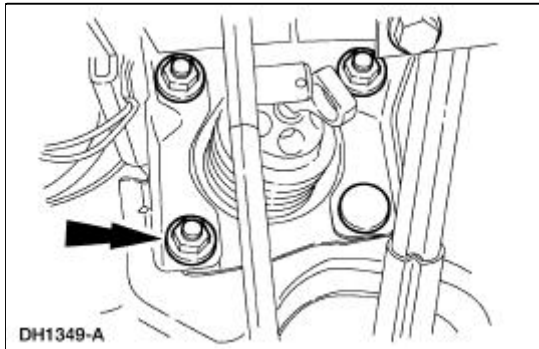
7. Remove the self-locking pin.



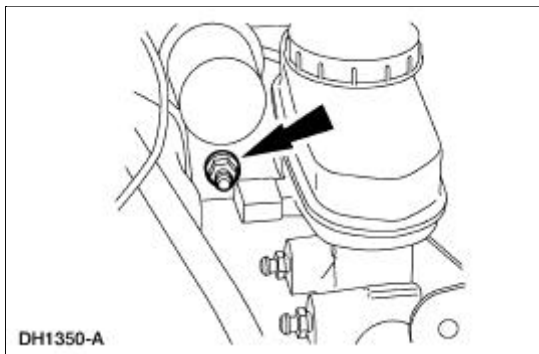
8. Remove the stoplight switch (13480) and the brake booster push rod from the brake pedal pin.



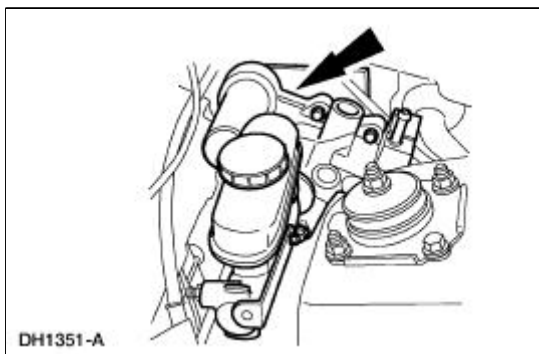
9. Remove the power brake booster nuts.



10. Remove the power brake booster nut.



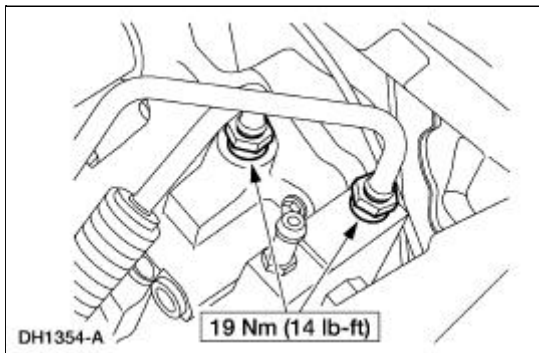
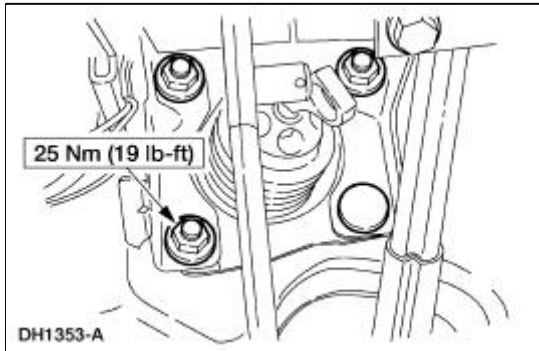
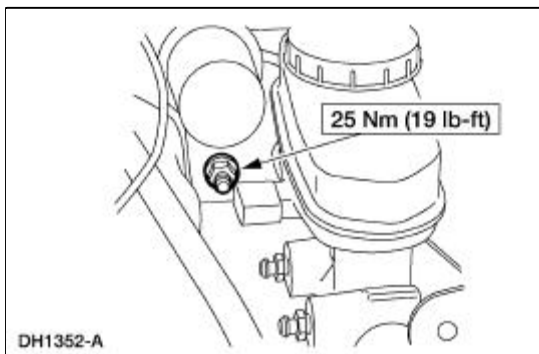
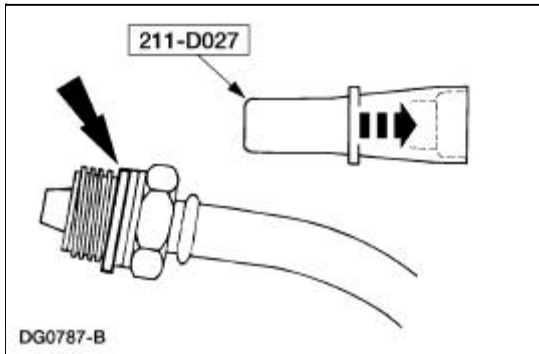
11. Remove the booster.

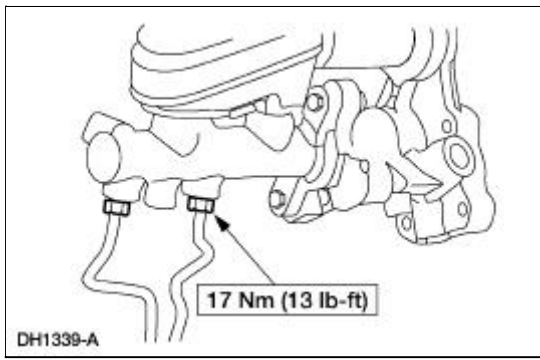


Installation

1. Follow the removal procedure in reverse order.
 - Install new Teflon® seals on the power steering pressure fittings.

- Bleed Hydro-Boost. For additional information, refer to [Hydro-Boost Bleeding](#) in this section.
- Bleed the brake system. For additional information, refer to [Section 206-00](#) .





Torque Specifications

Description	Nm	lb-ft	lb-in
Anti-lock brake control module screws	3	—	26
Brake line fittings to hydraulic control unit	19	14	—
Front anti-lock brake sensor bolt	7	—	62
Hydraulic control unit to mounting bracket nuts	18	13	—
Rear anti-lock brake sensor bolt	7	—	62

Anti-Lock Control



The four wheel anti-lock brake system (4WABS) consists of the following components:

- anti-lock brake control module (2C346)
 - front anti-lock brake sensor (2C205)
 - front anti-lock brake sensor indicator (2C182)
 - hydraulic control unit (2C286)
 - rear anti-lock brake sensor (2C216)
 - rear anti-lock brake sensor indicator (2C189)
 - yellow anti-lock brake system (ABS) warning indicator
-

Anti-Lock Control

Refer to Wiring Diagrams Cell [42](#), Anti-Lock Brake for schematic and connector information.

Special Tool(s)

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

Principles of Operation

The anti-lock brake control module receives wheel speed readings from each anti-lock brake sensor and processes this information to determine if an ABS event is necessary. The anti-lock brake sensor electrically senses each tooth of the anti-lock brake sensor indicators as it passes through the anti-lock brake sensor's magnetic field.

The anti-lock brake control module continuously monitors and compares the rotational speed of each wheel, and when it detects an impending wheel lock, modulates hydraulic brake pressure to the appropriate brake caliper. This is accomplished by the anti-lock brake control module triggering the hydraulic control unit (HCU) to open and close the appropriate solenoid valves. Once the affected wheel returns to normal speed, the anti-lock brake control module returns the solenoid valves to their normal position, and normal (base) braking resumes.

The anti-lock brake control module is self-monitoring. When the ignition switch is turned to the RUN position, the anti-lock brake control module will do a preliminary electrical check, and at approximately 12 km/h (8 mph) the pump motor is turned on for approximately one half-second. Any malfunction of the ABS will cause the ABS to shut off and the yellow ABS warning indicator to illuminate, however, normal power assisted braking remains.

The ABS control module has the ability to store multiple DTCs in memory.

Inspection and Verification

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> ● Low brake fluid ● Anti-lock brake sensor ● Anti-lock brake sensor indicator ● Base brake system 	<ul style="list-style-type: none"> ● Central junction box (CJB)Fuse: <ul style="list-style-type: none"> ■ 15 (10A) ■ 29 (15A) ■ 33 (15A) ■ 35 (15A) ● Battery junction box (BJB) Fuse: <ul style="list-style-type: none"> ■ ABS 1 (50A) ■ ABS 2 (20A) ● Circuitry ● Damaged or corroded connectors ● Yellow ABS warning indicator ● Loose grounds

3. If the concern remains after the inspection, connect the scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If the scan tool does not communicate with the vehicle:
 1. Check that the program card is correctly installed.
 2. Check the connections to the vehicle.
 3. Check the ignition switch position.
4. If the scan tool still does not communicate with the vehicle, refer to the scan tool Manual.
5. Carry out the DATA LINK DIAGNOSTIC TEST. If the scan tool responds with:
 1. CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00.
 2. NO RESP/NOT EQUIP for the anti-lock brake control module, [Go To Pinpoint Test A](#).
 3. SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the anti-lock brake control module.
6. If the DTCs retrieved are related to the concern, go to the Anti-Lock Brake Control Module Diagnostic Trouble Code (DTC) Reference Chart to continue diagnostics.
7. If no DTCs related to the concern are retrieved, GO to [Symptom Chart](#) to continue diagnostics.

Anti-Lock Brake Control Module Diagnostic Trouble Code (DTC) Index

NOTE: If a wheel speed signal fault or a pump motor fault is detected, the yellow ABS warning indicator cannot be reset with the key OFF and key ON method. The vehicle must be driven over 12 km/h (8 mph) for the anti-lock brake control module to carry out a re-check of the system before the yellow ABS warning indicator is turned OFF.

Anti-Lock Brake Control Module Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1318	Battery Voltage Low	ABS	Go To Pinpoint Test C .
B1342	ECU Is Defective	ABS	INSTALL a new anti-lock brake control module; REFER to Module . REPEAT the self-test.
B1484	Brake Pedal Input Open Circuit	ABS	Go To Pinpoint Test D .

B1596	Repair Continuous Codes	ABS	REPAIR the DTCs retrieved.
C1095	ABS Hydraulic Pump Motor Circuit Failure	ABS	Go To Pinpoint Test E.
C1145	RF Anti-Lock Brake Sensor Input Circuit Failure	ABS	Go To Pinpoint Test F.
C1155	LF Anti-Lock Brake Sensor Input Circuit Failure	ABS	Go To Pinpoint Test F.
C1165	RR Anti-Lock Brake Sensor Input Circuit Failure	ABS	Go To Pinpoint Test F.
C1175	LR Anti-Lock Brake Sensor Input Circuit Failure	ABS	Go To Pinpoint Test F.
C1222	Anti-Lock Brake Sensor Mismatch	ABS	Go To Pinpoint Test G.
C1233	LF Anti-Lock Brake Sensor Input Signal Missing	ABS	Go To Pinpoint Test H.
C1234	RF Anti-Lock Brake Sensor Input Signal Missing	ABS	Go To Pinpoint Test H.
C1235	RR Anti-Lock Brake Sensor Input Signal Missing	ABS	Go To Pinpoint Test H.
C1236	LR Anti-Lock Brake Sensor Input Signal Missing	ABS	Go To Pinpoint Test H.
C1266	ABS Valve Power Relay Circuit Failure	ABS	Go To Pinpoint Test I.

Anti-Lock Brake Control Module Parameter Identification (PID) Index

Anti-Lock Brake Control Module Parameter Identification (PID) Index

PID	Description	Expected Value
CCNTABS	Number of Continuous DTCS in the Anti-Lock Brake Control Module	one count per bit
BOO_ABS	Brake Switch Input	OFF, ON
PMP_MTR	ABS Pump Motor	OFF---, OFFO--, OFF-B-, OFF--G, OFFO-G, OFF-BG, OFFOBG, ON---, ONO--, ON-B-, ON--G, ONO-G, ON-BG, ONOBG
VLV_CTR	ABS Valve Control Relay	OFF---, OFFO--, OFF-B-, OFF--G, OFFO-G, OFF-BG, OFFOBG, ON---, ONO--, ON-B-, ON--G, ONO-G, ON-BG, ONOBG
LF_WSPD	LF Wheel Speed	0-255 MPH
RF_WSPD	RF Wheel Speed	0-255 MPH
LR_WSPD	LR Wheel Speed	0-255 MPH
RR_WSPD	RR Wheel Speed	0-255 MPH
ABSLF_I	LF ABS Inlet Valve	OFF---, OFFO--, OFF-B-, OFF--G, OFFO-G, OFF-BG, OFFOBG, ON---, ONO--, ON-B-, ON--G, ONO-G, ON-BG, ONOBG
ABSLF_O	LF ABS Outlet Valve	OFF---, OFFO--, OFF-B-, OFF--G, OFFO-G, OFF-BG, OFFOBG, ON---, ONO--, ON-B-, ON--G, ONO-G, ON-BG, ONOBG

ABSRF_I	RF ABS Inlet Valve	OFF---, OFFO--, OFF-B-, OFF--G, OFFO-G, OFF-BG, OFFOBG, ON---, ONO--, ON-B-, ON--G, ONO-G, ON-BG, ONOBG
ABSRF_O	RF ABS Outlet Valve	OFF---, OFFO--, OFF-B-, OFF--G, OFFO-G, OFF-BG, OFFOBG, ON---, ONO--, ON-B-, ON--G, ONO-G, ON-BG, ONOBG
ABSR_I	Rear ABS Inlet Valve	OFF---, OFFO--, OFF-B-, OFF--G, OFFO-G, OFF-BG, OFFOBG, ON---, ONO--, ON-B-, ON--G, ONO-G, ON-BG, ONOBG
ABSR_O	Rear ABS Outlet Valve	OFF---, OFFO--, OFF-B-, OFF--G, OFFO-G, OFF-BG, OFFOBG, ON---, ONO--, ON-B-, ON--G, ONO-G, ON-BG, ONOBG

Anti-Lock Brake Control Module Active Command Index

Anti-Lock Brake Control Module Active Command Index

Active Command	Display	Action
ABS OUTPUT CONTROL	ABS POWER	OFF, ON
	DSBL TOG	OFF, ON
	LF INLET	OFF, ON
	LF OUTLET	OFF, ON
	RF INLET	OFF, ON
	RF OUTLET	OFF, ON
	R INLET	OFF, ON
	R OUTLET	OFF, ON

Symptom Chart

Symptom Chart

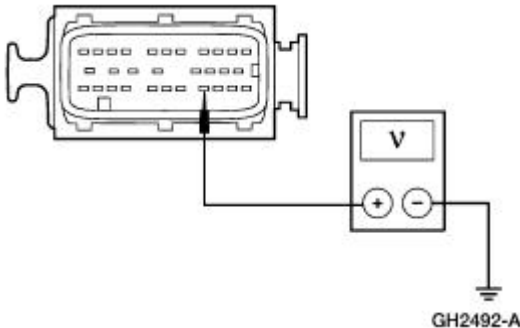
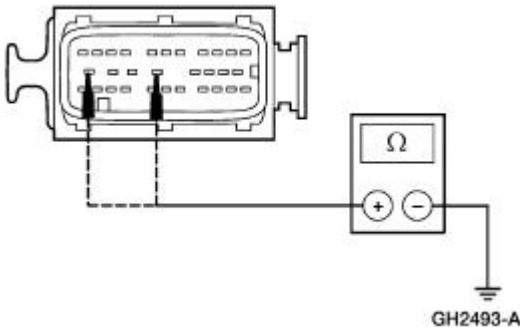
NOTE: Refer to the Wiring Diagrams for connector numbers stated in the Pinpoint tests.

Condition	Possible Sources	Action
<ul style="list-style-type: none"> No communication with the anti-lock brake control module 	<ul style="list-style-type: none"> CJB Fuse 29 (15A). Circuitry. Anti-lock brake control module. 	<ul style="list-style-type: none"> Go To Pinpoint Test A.
<ul style="list-style-type: none"> Unable to enter self-test. 	<ul style="list-style-type: none"> Anti-lock brake control module. 	<ul style="list-style-type: none"> Go To Pinpoint Test B.
<ul style="list-style-type: none"> The yellow ABS warning indicator does not self-check 	<ul style="list-style-type: none"> Circuitry. Anti-lock brake control module. Instrument cluster. 	<ul style="list-style-type: none"> Go To Pinpoint Test J.
<ul style="list-style-type: none"> Spongy brake pedal with no 	<ul style="list-style-type: none"> Air in the brake 	<ul style="list-style-type: none"> Go To Pinpoint

warning indicator	system. ● Base brake system.	Test K. ● REFER to Section 206-00.
● Poor vehicle tracking during anti-lock function	● Air in the brake system. ● Hydraulic control unit (HCU). ● Base brake system.	● Go To Pinpoint Test L. ● REFER to Section 206-00.

Pinpoint Tests

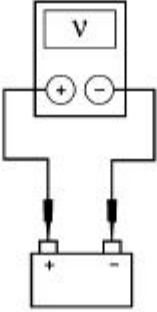
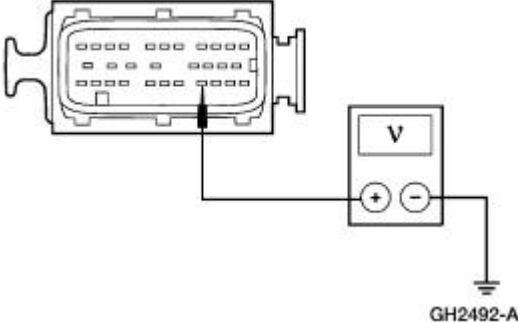
PINPOINT TEST A: NO COMMUNICATION WITH THE ANTI-LOCK BRAKE CONTROL MODULE

Test Step	Result / Action to Take
<p>A1 CHECK CIRCUIT 601 (LB/PK) FOR AN OPEN</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Anti-Lock Brake Control Module C135. ● Key in ON position. ● Measure the voltage between anti-lock brake control module C135 Pin 8, Circuit 601 (LB/PK), harness side and ground.  <p>● Is the voltage greater than 10 volts?</p>	<p>Yes GO to A2.</p> <p>No REPAIR the circuit. REPEAT the self-test.</p>
<p>A2 CHECK THE ANTI-LOCK BRAKE CONTROL MODULE GROUNDS</p> <ul style="list-style-type: none"> ● Measure the resistance between anti-lock brake control module C135 Pin 12, Circuit 1205 (BK), harness side and ground; and between anti-lock brake control module C135 Pin 15, Circuit 397 (BK/WH), harness side and ground.  <p>● Are the resistances less than 5 ohms?</p>	<p>Yes INSTALL a new anti-lock brake control module; REFER to Module. REPEAT the self-test.</p> <p>No REPAIR the circuit in question. REPEAT the self-test.</p>

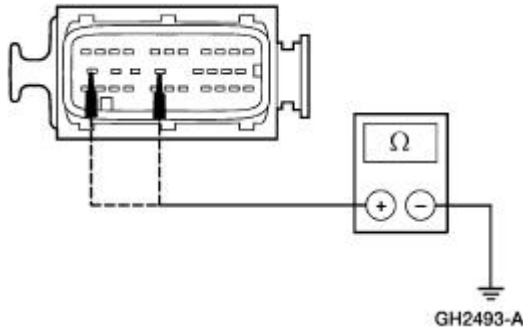
PINPOINT TEST B: UNABLE TO ENTER SELF-TEST

Test Step	Result / Action to Take
B1 CHECK THE COMMUNICATIONS TO THE ANTI-LOCK BRAKE CONTROL MODULE	
<ul style="list-style-type: none"> ● Check the communications to the anti-lock brake control module. ● Does the scan tool communicate with the anti-lock brake control module? 	<p>Yes INSTALL a new anti-lock brake control module; REFER to Module . REPEAT the self-test.</p> <p>No Go To Pinpoint Test A .</p>

PINPOINT TEST C: DTC B1318, BATTERY VOLTAGE LOW

Test Step	Result / Action to Take
C1 CHECK BATTERY VOLTAGE	
<ul style="list-style-type: none"> ● Measure the battery voltage between the positive and negative battery posts with the key ON engine OFF (KOEO), and with the engine running.  <p style="text-align: center;">GL1223-A</p> <ul style="list-style-type: none"> ● Is the battery voltage between 10 and 13 volts with KOEO, and between 11 and 17 volts with the engine running? 	<p>Yes GO to C2 .</p> <p>No REFER to Section 414-00 .</p>
C2 CHECK THE VOLTAGE TO THE ANTI-LOCK BRAKE CONTROL MODULE	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Anti-Lock Brake Control Module C135. ● Key in ON position. ● Measure the voltage between anti-lock brake control module C135 Pin 8, Circuit 601 (LB/PK), harness side and ground.  <p style="text-align: center;">GH2492-A</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to C3 .</p> <p>No REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.</p>
C3 CHECK THE ANTI-LOCK BRAKE CONTROL MODULE GROUNDS	

- Measure the resistance between anti-lock brake control module C135 Pin 12, Circuit 1205 (BK), harness side and ground; and between anti-lock brake control module C135 Pin 15, Circuit 397 (BK/WH), harness side and ground.

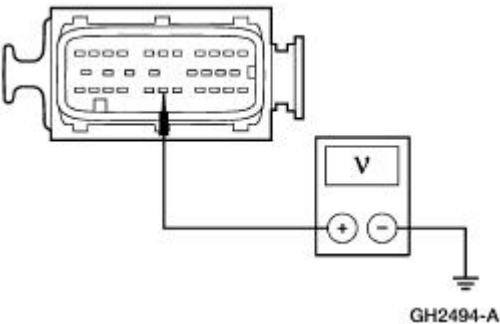


- Are the resistances less than 5 ohms?

Yes
 INSTALL a new anti-lock brake control module;
 REFER to [Module](#) .
 REPEAT the self-test.

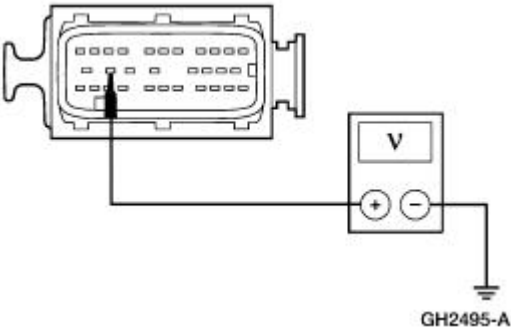
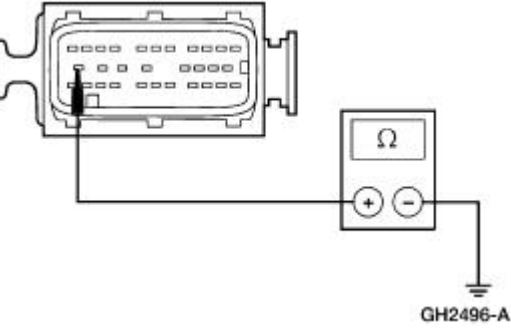
No
 REPAIR the circuit in question.
 CLEAR the DTCs.
 REPEAT the self-test.

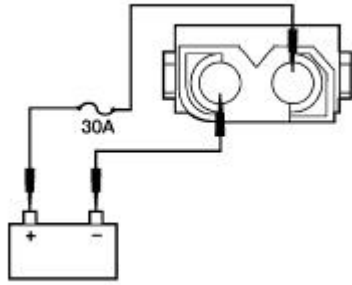
PINPOINT TEST D: DTC B1484, BRAKE PEDAL INPUT OPEN CIRCUIT

Test Step	Result / Action to Take
<p>D1 CHECK THE STOPLAMPS FOR CORRECT OPERATION</p> <ul style="list-style-type: none"> ● Depress the brake pedal while checking the stoplamps. ● Do the stop lamps illuminate? 	<p>Yes GO to D2 .</p> <p>No REFER to Section 417-01 .</p>
<p>D2 CHECK THE BRAKE PEDAL INPUT TO THE ANTI-LOCK BRAKE CONTROL MODULE</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Anti-Lock Brake Control Module C135. ● Measure the voltage between anti-lock brake control module C135 Pin 6, Circuit 511 (LG), harness side and ground, while depressing and releasing the brake pedal.  <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts with the brake pedal depressed and zero volts with the brake pedal released? 	<p>Yes INSTALL a new anti-lock brake control module; REFER to Module . REPEAT the self-test.</p> <p>No REPAIR Circuit 511 (LG) and Circuit 810 (RD/LG) as necessary. CLEAR the DTCs. REPEAT the self-test.</p>

PINPOINT TEST E: DTC C1095, ABS HYDRAULIC PUMP MOTOR FAILURE

Test Step	Result / Action to Take

<p>E1 CHECK THE PUMP MOTOR FOR CONTINUOUS OPERATION</p>	<p>Yes INSTALL a new anti-lock brake control module; REFER to Module. REPEAT the self-test.</p> <p>No GO to E2.</p>
<ul style="list-style-type: none"> ● Check the pump motor for continuous operation. ● Is the pump motor running continuously? 	
<p>E2 CHECK CIRCUIT 534 (YE/LG) FOR AN OPEN</p>	<p>Yes GO to E3.</p> <p>No REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.</p>
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Anti-Lock Brake Control Module C135. ● Measure the voltage between anti-lock brake control module C135 Pin 13, Circuit 534 (YE/LG), harness side, and ground.  <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	
<p>E3 CHECK CIRCUIT 1205 (BK) FOR AN OPEN</p>	<p>Yes GO to E4.</p> <p>No REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.</p>
<ul style="list-style-type: none"> ● Measure the resistance between anti-lock brake control module C135 Pin 12, Circuit 1205 (BK), harness side and ground.  <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	
<p>E4 CHECK THE PUMP MOTOR FOR OPERATION</p>	<p>Yes INSTALL a new anti-lock brake control module; REFER to Module. REPEAT the self-test.</p> <p>No INSTALL a new HCU; REFER to Hydraulic Control Unit. CLEAR the DTCs. REPEAT</p>
<ul style="list-style-type: none"> ● Disconnect: Pump Motor Connector. ● Connect a 30A fused heavy jumper wire between the positive battery post and pump motor connector Pin 1 (component side); and momentarily connect a heavy jumper between negative battery post and pump motor connector Pin 2 (component side). 	

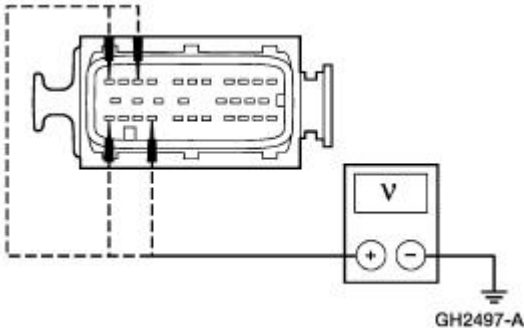


GH1811-A

- Does the pump motor operate?

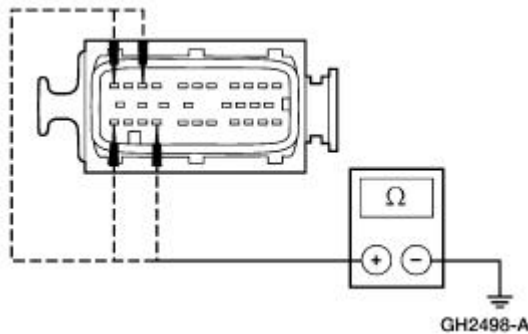
the self-test.

PINPOINT TEST F: DTC C1145 (RF), C1155 (LF), C1165 (RR), C1175 (LR), ANTI-LOCK BRAKE SENSOR INPUT CIRCUIT FAILURE

Test Step	Result / Action to Take															
<p>F1 CHECK THE SUSPECT ANTI-LOCK BRAKE SENSOR CIRCUIT FOR SHORT TO POWER</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Anti-Lock Brake Control Module C135. ● Key in ON position. ● Measure the voltage between anti-lock brake control module C135 Pins, harness side and ground as follows: <table border="1"> <thead> <tr> <th>DTC</th> <th>Anti-Lock Brake Control Module C135 Pin</th> <th>Circuit</th> </tr> </thead> <tbody> <tr> <td>C1145 (RF)</td> <td>4</td> <td>514 (YE/RD)</td> </tr> <tr> <td>C1155 (LF)</td> <td>20</td> <td>521 (TN/OG)</td> </tr> <tr> <td>C1165 (RR)</td> <td>1</td> <td>494 (TN/LG)</td> </tr> <tr> <td>C1175 (LR)</td> <td>22</td> <td>496 (OG)</td> </tr> </tbody> </table>  <ul style="list-style-type: none"> ● Is any voltage present? 	DTC	Anti-Lock Brake Control Module C135 Pin	Circuit	C1145 (RF)	4	514 (YE/RD)	C1155 (LF)	20	521 (TN/OG)	C1165 (RR)	1	494 (TN/LG)	C1175 (LR)	22	496 (OG)	<p>Yes REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.</p> <p>No GO to F2.</p>
DTC	Anti-Lock Brake Control Module C135 Pin	Circuit														
C1145 (RF)	4	514 (YE/RD)														
C1155 (LF)	20	521 (TN/OG)														
C1165 (RR)	1	494 (TN/LG)														
C1175 (LR)	22	496 (OG)														
<p>F2 CHECK THE SUSPECT ANTI-LOCK BRAKE SENSOR CIRCUIT FOR SHORT TO GROUND</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Measure the resistance between anti-lock brake 	<p>Yes GO to F4.</p>															

control module C135 Pins, harness side and ground as follows:

DTC	Anti-Lock Brake Control Module C135 Pin	Circuit
C1145 (RF)	4	514 (YE/RD)
C1155 (LF)	20	521 (TN/OG)
C1165 (RR)	1	494 (TN/LG)
C1175 (LR)	22	496 (OG)

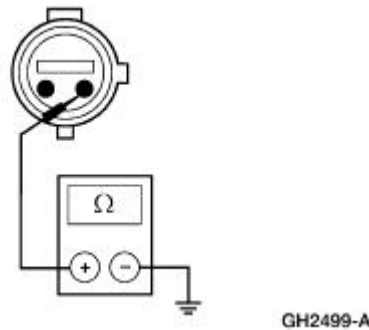


- Is the resistance greater than 10,000 ohms?

No
GO to [F3](#).

F3 CHECK THE SUSPECT ANTI-LOCK BRAKE SENSOR FOR A SHORT TO GROUND

- Disconnect: Suspect Anti-Lock Brake Sensor.
- Measure the resistance between suspect anti-lock brake sensor Pin 1 (component side) and ground.



- Is the resistance greater than 10,000 ohms?

Yes
If RF, REPAIR Circuit 514 (YE/RD) and Circuit 516 (YE/BK), as necessary. CLEAR the DTCs. REPEAT the self-test. If LF, REPAIR Circuit 521 (TN/OG) and Circuit 522 (TN/BK), as necessary. CLEAR the DTCs. REPEAT the self-test. If RR, REPAIR Circuit 494 (TN/LG) and Circuit 492 (BN), as necessary. CLEAR the DTCs. REPEAT the self-test. If LR, REPAIR Circuit 496 (OG) and Circuit 499 (GY/BK), as necessary. CLEAR the DTCs. REPEAT the self-test.

No
INSTALL a new anti-lock brake sensor; REFER to [Sensor—Front](#) or [Sensor—Rear](#). CLEAR the DTCs. REPEAT the self-test.

F4 CHECK THE SUSPECT ANTI-LOCK BRAKE SENSOR CIRCUIT FOR FOR AN OPEN

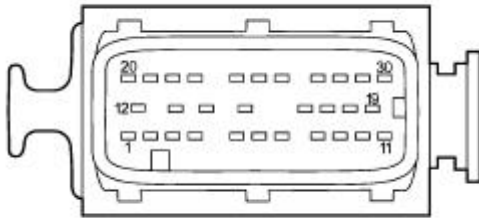
- Key in OFF position.
- Measure the resistance between anti-lock brake control module C135 pins, harness side and suspect anti-lock brake sensor, harness side as follows:

Yes
GO to [F5](#).

No
REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-

DTC	Anti-Lock Brake Control Module	Anti-Lock Brake Sensor	Circuit
C1145 (RF)	C135 Pin 4	C160 Pin 1	514 (YE/RD)
C1145 (RF)	C135 Pin 5	C160 Pin 2	516 (YE/BK)
C1155 (LF)	C135 Pin 20	C150 Pin 1	521 (TN/OG)
C1155 (LF)	C135 Pin 21	C150 Pin 2	522 (TN/BK)
C1165 (RR)	C135 Pin 1	C3117 Pin 2	494 (TN/LG)
C1165 (RR)	C135 Pin 3	C3117 Pin 1	492 (BN)
C1175 (LR)	C135 Pin 22	C3116 Pin 2	496 (OG)
C1175 (LR)	C135 Pin 23	C3116 Pin 1	499 (GY/BK)

test.

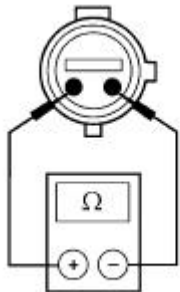


GH2500-A

- Are the resistances less than 5 ohms?

F5 CHECK THE ANTI-LOCK BRAKE SENSOR

- Measure the resistance between suspect anti-lock brake sensor Pin 1 (component side) and suspect anti-lock brake sensor Pin 2 (component side).



GH2501-A

- Is the resistance between 1280 and 1920 (front) or 1830 and 2760 (rear) ohms?

Yes
INSTALL a new anti-lock brake control module; REFER to [Module](#) . REPEAT the self-test.

No
INSTALL a new anti-lock brake sensor; REFER to [Sensor—Front](#) or [Sensor—Rear](#) . CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST G: DTC C1222, ANTI-LOCK BRAKE SENSOR MISMATCH

Test Step	Result / Action to Take
G1 CHECK THE VEHICLE COMPONENTS	
<ul style="list-style-type: none"> ● Check for correct wheel and tire size, front-to-rear and side-to-side. ● Check for excessive bearing end play. ● Check the anti-lock brake sensor indicator for a deformation or missing teeth. ● Are the conditions OK? 	<p>Yes GO to G2.</p> <p>No REPAIR as necessary. CLEAR the DTCs. REPEAT the self-test.</p>
G2 TEST DRIVE THE VEHICLE	
<ul style="list-style-type: none"> ● Enter the following diagnostic mode on the diagnostic tool: CLEAR the DTCs. ● Key in OFF position. ● Key in ON position. ● Test drive the vehicle over 24 kph (15 mph). ● Enter the following diagnostic mode on the diagnostic tool: Retrieve DTCs. ● Is DTC C1222 retrieved? 	<p>Yes INSTALL a new anti-lock brake control module; REFER to Module. REPEAT the self-test.</p> <p>No If another DTC is retrieved, GO to the Anti-Lock Brake Control Module Diagnostic Trouble Code (DTC) index. If no DTCs are retrieved, the system is OK.</p>

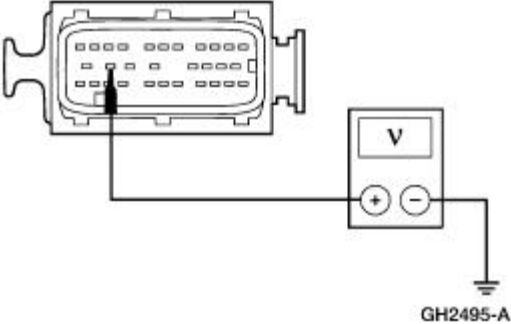
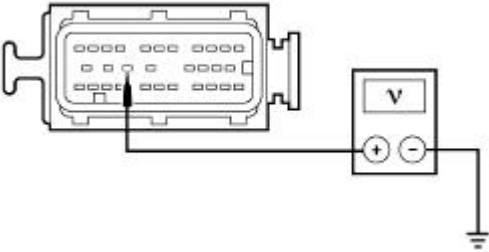
PINPOINT TEST H: DTC C1233 (LF), C1234 (RF), C1235 (RR), C1236 (LR), ANTI-LOCK BRAKE SENSOR INPUT SIGNAL MISSING

Test Step	Result / Action to Take
H1 CHECK THE SUSPECT ANTI-LOCK BRAKE SENSOR	
<ul style="list-style-type: none"> ● Check the suspect anti-lock brake sensor mounting. ● Check the suspect anti-lock brake sensor for excessive dirt build up, obstructions, and damage. ● Is the suspect anti-lock brake sensor and mounting OK? 	<p>Yes GO to H2.</p> <p>No REPAIR as necessary. CLEAR the DTCs. REPEAT the self-test.</p>
H2 CHECK THE SUSPECT ANTI-LOCK BRAKE SENSOR INDICATOR	
<ul style="list-style-type: none"> ● Check the suspect anti-lock brake sensor indicator for corrosion, nicks, bridged teeth, damaged teeth, correct mounting, and alignment with the anti-lock brake sensor. ● Check the air gap and bearing end play. ● Is the suspect anti-lock brake sensor indicator OK? 	<p>Yes GO to H3.</p> <p>No INSTALL a new anti-lock brake sensor indicator; REFER to Sensor—Front or Sensor—Rear. CLEAR the DTCs. REPEAT the self-test.</p>
H3 CHECK THE ANTI-LOCK BRAKE SENSOR OUTPUT	
<ul style="list-style-type: none"> ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: CLEAR the DTCs.. ● Key in OFF position. ● Key in ON position. 	<p>Yes INSTALL a new anti-lock brake control module; REFER to Module. REPEAT the self-test.</p>

- Have an assistant monitor the anti-lock brake control module PIDs LF_WSPD, RF_WSPD, LR_WSPD, and RR_WSPD while driving at various speeds.
- **NOTE:** The vehicle must be driven 16 km/h (10 miles) during this test step.
- Test drive the vehicle for 16 kmh (10 miles).
- **Are the anti-lock brake control module PIDs approximately the same at all times?**

No
 INSTALL a new anti-lock brake sensor; REFER to [Sensor—Front](#) or [Sensor—Rear](#). CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST I: ABS VALVE POWER RELAY CIRCUIT FAILURE

Test Step	Result / Action to Take
<p>I1 CHECK CIRCUIT 534 (YE/LG) FOR AN OPEN</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Anti-Lock Brake Control Module C135. ● Measure the voltage between anti-lock brake control module C135 Pin 13, Circuit 534 (YE/LG), harness side and ground.  <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to I2.</p> <p>No REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.</p>
<p>I2 CHECK CIRCUIT 532 (OG/YE) FOR AN OPEN</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Key in ON position. ● Measure the voltage between anti-lock brake control module C135 Pin 14, Circuit 532 (OG/YE), harness side and ground.  <ul style="list-style-type: none"> ● Is the voltage less than 5 volts? 	<p>Yes REPAIR the open in Circuit 532 (OG/YE). CLEAR the DTCs. REPEAT the self-test.</p> <p>No GO to I3.</p>
<p>I3 CHECK CIRCUIT 1205 (BK) FOR AN OPEN</p> <ul style="list-style-type: none"> ● Measure the resistance between anti-lock brake control module C135 Pin 12, Circuit 1205 (BK), harness side and ground. 	<p>Yes INSTALL a new anti-lock brake control module. REFER to Module in this section. CLEAR the DTCs. REPEAT the self-test.</p>

● Is the resistance less than 5 ohms?

No
REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST J: THE YELLOW ABS WARNING INDICATOR DOES NOT SELF-CHECK

Test Step	Result / Action to Take
J1 CHECK THE ABS WARNING INDICATOR CIRCUITRY	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Anti-Lock Brake Control Module C135. ● Key in ON position. ● Depress and release the shorting bar connector internal to the anti-lock brake control module C135, harness side, while checking the yellow ABS warning indicator in the instrument cluster. ● Does the yellow ABS indicator illuminate with the shorting bar released and turn OFF with the shorting bar depressed? 	<p>Yes INSTALL a new anti-lock brake control module; REFER to Module. TEST the system for normal operation.</p> <p>No REFER to Section 413-01.</p>

PINPOINT TEST K: SPONGY BRAKE PEDAL WITH NO WARNING INDICATOR

Test Step	Result / Action to Take
K1 CHECK THE VEHICLE COMPONENTS	
<ul style="list-style-type: none"> ● Check the brake pedal and power booster/brake master cylinder for correct attachment. ● Are the components OK? 	<p>Yes GO to K2.</p> <p>No REPAIR as necessary. TEST the system for normal operation.</p>
K2 BLEED THE BRAKE SYSTEM	
<ul style="list-style-type: none"> ● Bleed the brake system; Refer to Section 206-00. ● Check for spongy brake pedal. ● Is the brake pedal spongy? 	<p>Yes INSTALL a new HCU; REFER to Hydraulic Control Unit. TEST the system for normal operation.</p> <p>No The brake system is OK. TEST the system for normal operation.</p>

PINPOINT TEST L: POOR VEHICLE TRACKING DURING ANTI-LOCK

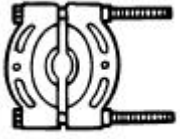
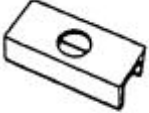

FUNCTION

Test Step	Result / Action to Take
L1 BLEED THE BRAKE SYSTEM	
<ul style="list-style-type: none"> ● Bleed the brake system. Refer to Section 206-00. ● Check for vehicle tracking poorly. ● Does the vehicle track poorly? 	<p>Yes GO to L2.</p> <p>No The brake system is OK. TEST the system for normal operation.</p>
L2 CHECK THE LF ABS VALVE OPERATION	
<ul style="list-style-type: none"> ● Lift the vehicle and rotate all the wheels to make sure they rotate freely (the vehicle must be in neutral). ● NOTE: Trigger must be depressed twice. Each press will run the pump motor for two seconds. ● Trigger the anti-lock brake control module active command PMP MOTOR ON for four seconds. ● Apply moderate brake pedal effort. ● Have an assistant attempt to rotate the LF wheel while the pump motor is running. ● Does the LF wheel rotate? 	<p>Yes INSTALL a new HCU; REFER to Hydraulic Control Unit. TEST the system for normal operation.</p> <p>No GO to L3.</p>
L3 CHECK THE LF ABS VALVE RELEASE	
<ul style="list-style-type: none"> ● Apply moderate brake pedal effort. ● Trigger the anti-lock brake control module active command LF INLET and LF OUTLET. ● NOTE: The scan tool will energize the valves for only two seconds per trigger press. ● Have an assistant rotate the LF wheel immediately after depressing trigger. ● Does the LF wheel rotate? 	<p>Yes GO to L4.</p> <p>No GO to L8.</p>
L4 CHECK THE RF ABS VALVE OPERATION	
<ul style="list-style-type: none"> ● NOTE: Trigger must be depressed twice. Each press will run the pump motor for two seconds. ● Trigger the anti-lock brake control module active command PMP MOTOR ON for four seconds. ● Apply moderate brake pedal effort. ● Have an assistant attempt to rotate the RF wheel while the pump motor is running. ● Does the RF wheel rotate? 	<p>Yes INSTALL a new HCU; REFER to Hydraulic Control Unit. TEST the system for normal operation.</p> <p>No GO to L5.</p>
L5 CHECK THE RF ABS VALVE RELEASE	
<ul style="list-style-type: none"> ● Apply moderate brake pedal effort. ● Trigger the anti-lock brake control module active command RF INLET and RF OUTLET. ● NOTE: The scan tool will energize the valves for only two seconds per trigger press. ● Have an assistant rotate the RF wheel immediately after depressing trigger. ● Does the RF wheel rotate? 	<p>Yes GO to L6.</p> <p>No GO to L8.</p>
L6 CHECK THE REAR ABS VALVE OPERATION	
<ul style="list-style-type: none"> ● NOTE: Trigger must be depressed twice. Each press will run the pump motor for 	<p>Yes INSTALL a new HCU; REFER to</p>

<p>two seconds.</p> <ul style="list-style-type: none"> ● Trigger the anti-lock brake control module active command PMP MOTOR ON for four seconds. ● Apply moderate brake pedal effort. ● Have an assistant attempt to rotate the LR and RR wheels while the pump motor is running. ● Does the LR or RR wheel rotate? 	<p>Hydraulic Control Unit. TEST the system for normal operation.</p> <p>No GO to L7.</p>
L7 CHECK THE REAR ABS VALVE RELEASE	
<ul style="list-style-type: none"> ● Apply moderate brake pedal effort. ● Trigger the anti-lock brake control module active command R INLET and R OUTLET. ● NOTE: The scan tool will energize the valves for only two seconds per trigger press. ● Have an assistant rotate the LR and RR wheels immediately after depressing trigger. ● Does the LR or RR wheel rotate? 	<p>Yes The ABS system is operating correctly.</p> <p>No GO to L8.</p>
L8 CHECK FOR DTCS	
<ul style="list-style-type: none"> ● Carry out the anti-lock brake control module self-test. ● Are any DTCs retrieved? 	<p>Yes GO to the Anti-Lock Brake Control Module Diagnostic Trouble Code (DTC) Index.</p> <p>No INSTALL a new HCU; REFER to Hydraulic Control Unit. TEST the system for normal operation.</p>

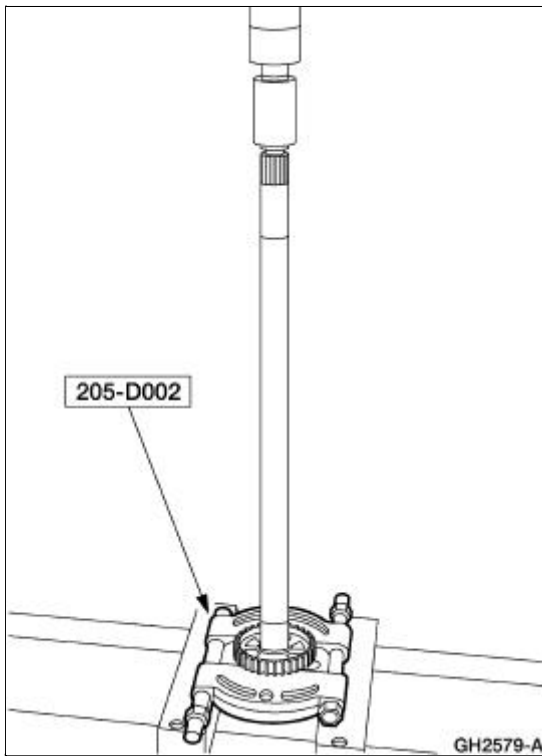
Sensor Indicator —Rear

Special Tool(s)

 ST1895-A	Pinion Bearing Cone Remover 205-D002 (D79P-4621A)
 ST1254-A	Axle Bearing/Seal Plate 205-090 (T75L-1165-B)
 ST1713-A	Sensing Ring Replacer 206-041 (T89P-20202-A)

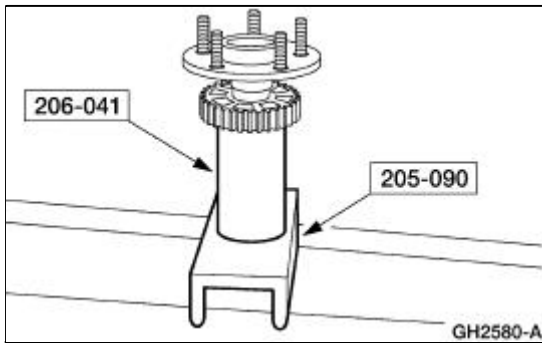
Removal

1. Remove the rear axle shaft bearing, refer to [Section 205-02A](#) or [Section 205-02B](#).
2. Using the special tool, remove the anti-lock brake sensor indicator from the axle shaft.

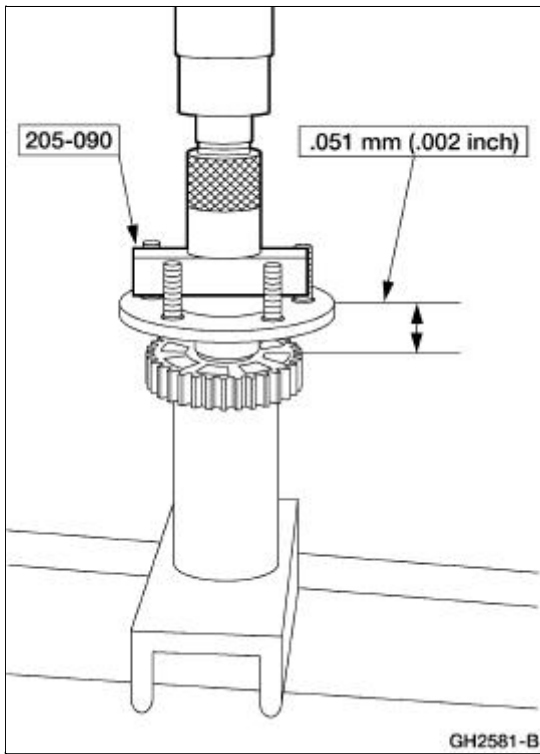


Installation

1. Using the special tools, align the rear anti-lock brake sensor indicator to the rear axle shaft.



2. Using the special tools, press the rear anti-lock brake sensor on the rear axle shaft to specification.

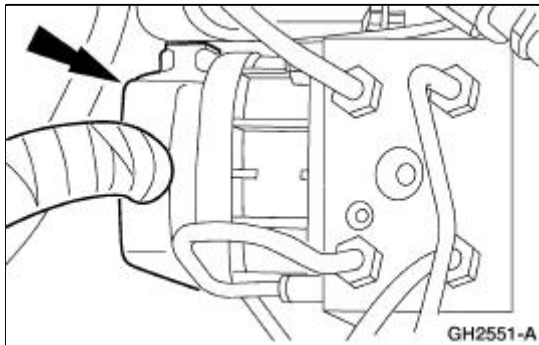


3. Install the rear axle shaft bearing, refer to [Section 205-02A](#).
-

Hydraulic Control Unit

Removal

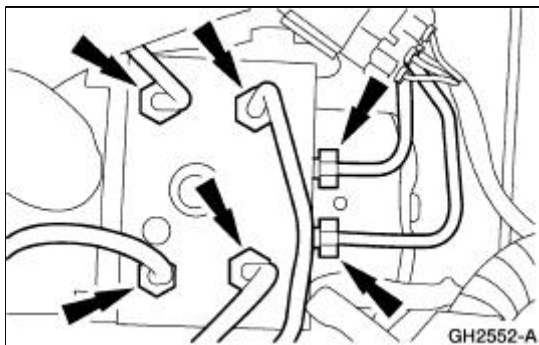
1. Disconnect the battery ground cable(14301).
2. Disconnect the anti-lock-brake control module electrical connector.



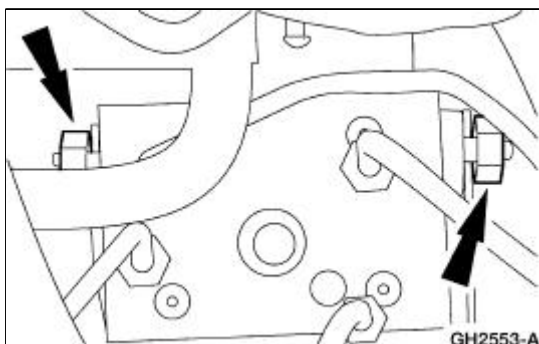
3. **NOTE:** The 4 wheel anti-lock brake system (4WABS) with traction control is shown , the 4WABS without traction control system is similar with one less hydraulic line.

NOTE: Plug brake lines to prevent any brake fluid loss.

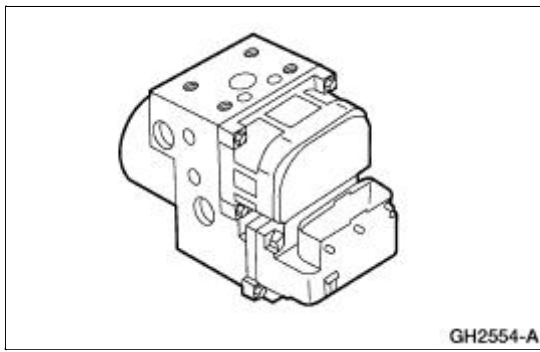
Disconnect the brake lines from the hydraulic control unit (HCU).



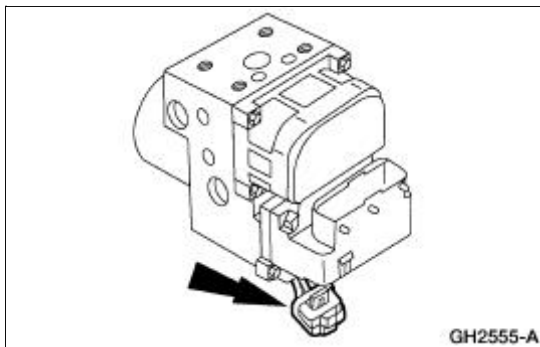
4. Remove the HCU bracket nuts to HCU.



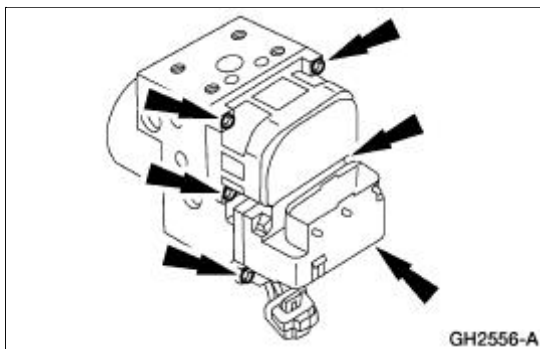
5. Remove the HCU.



6. Remove the pump motor electrical connector.



7. Remove the anti-lock-brake control module screws.

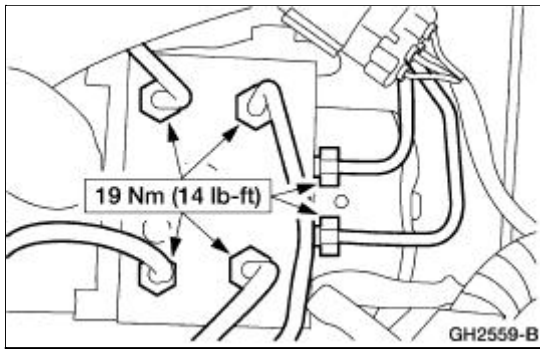
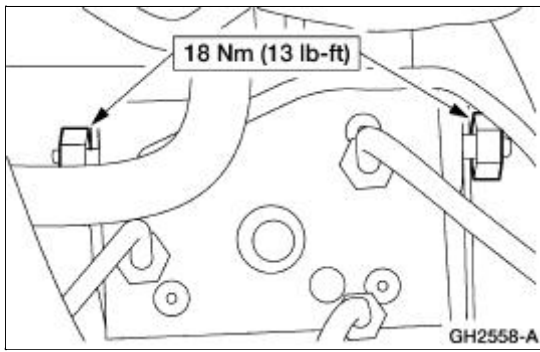


8. Remove the anti-lock-brake control module from the HCU.

Installation

1. **NOTE:** The brake system must be bled after the HCU is installed or replaced. Refer to [Section 206-00](#).

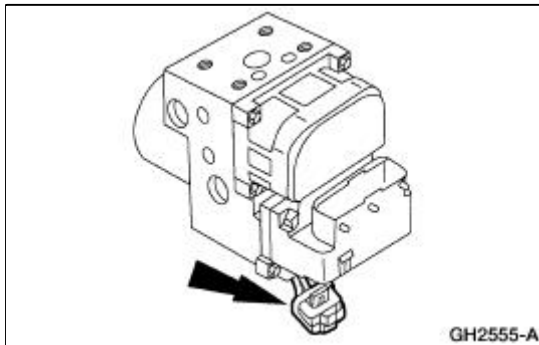
To install, reverse the removal procedure.



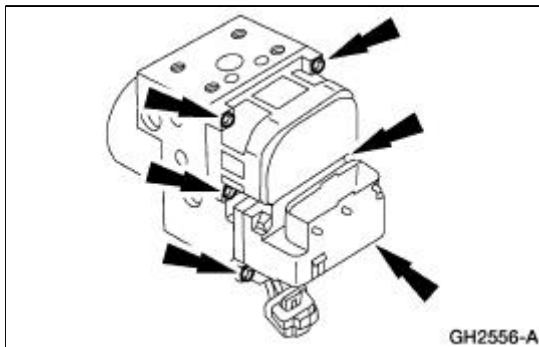
Module

Removal

1. Remove the hydraulic control unit (HCU). Refer to [Hydraulic Control Unit](#).
2. Remove the pump motor electrical connector.



3. Remove the anti-lock-brake control module screws.



4. Remove the anti-lock-brake control module from the HCU.

Installation

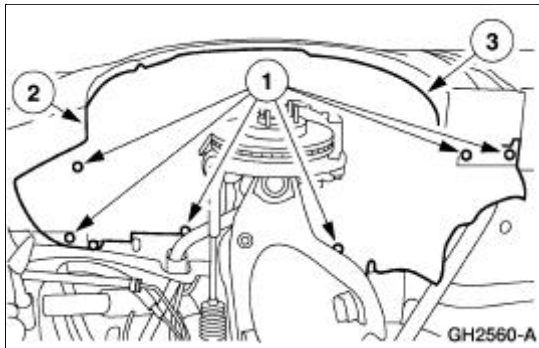
1. **NOTE:** The brake system must be bled after the HCU is installed or replaced. Refer to [Section 206-00](#).

To install, reverse the removal procedure.

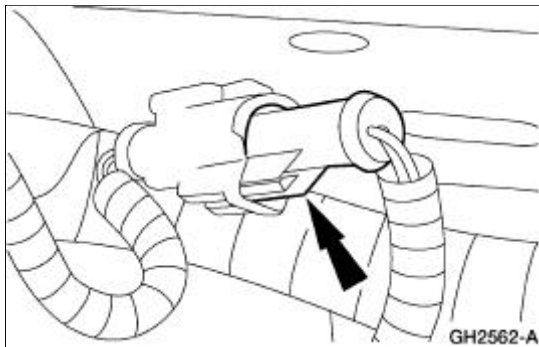
Sensor —Front

Removal

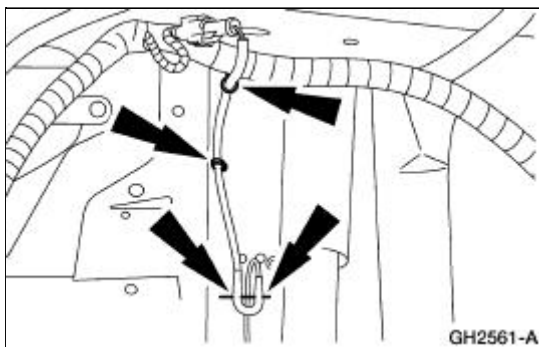
1. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
2. Remove the inner fender splash shield.
 1. Remove the inner fender splash shield push pins.
 2. Remove the inner fender splash shield screw.
 3. Remove the inner fender splash shield.



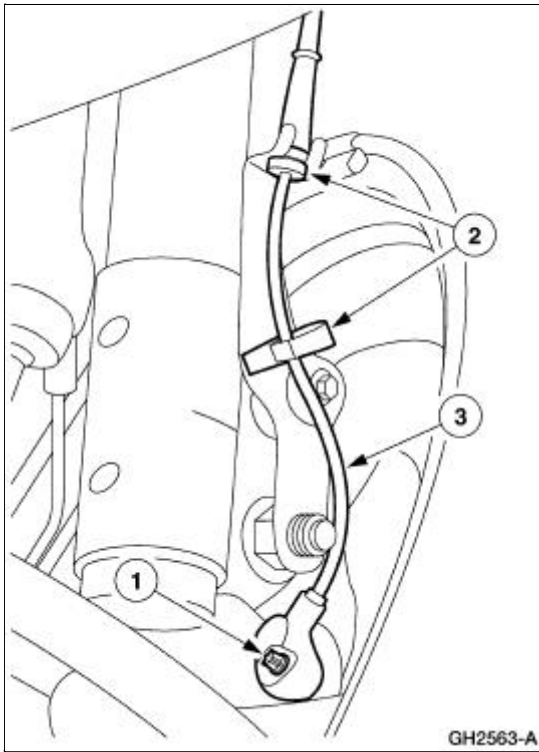
3. Remove the front anti-lock brake sensor electrical connector.



4. Remove the front anti-lock brake sensor harness from the anti-lock brake sensor harness clips.

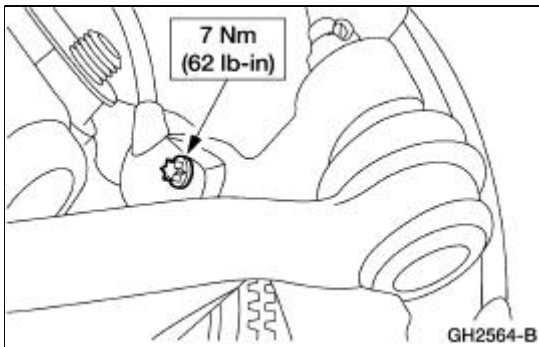


5. Remove the front anti-lock brake sensor.
 1. Remove the front anti-lock brake sensor bolt.
 2. Remove the anti-lock brake sensor harness from the harness clips.
 3. Remove the front anti-lock brake sensor.



Installation

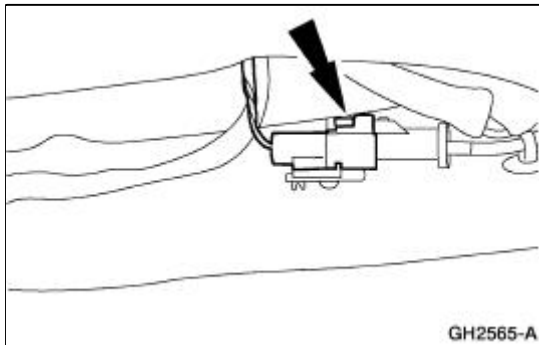
1. To install, reverse the removal procedure.



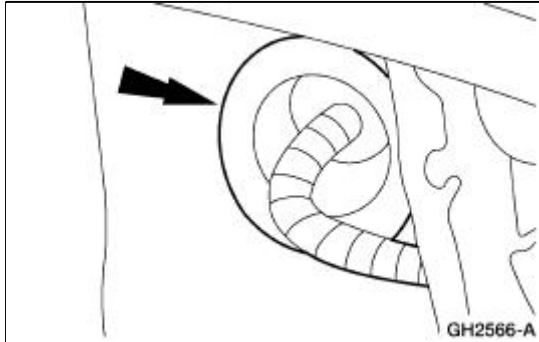
Sensor —Rear

Removal

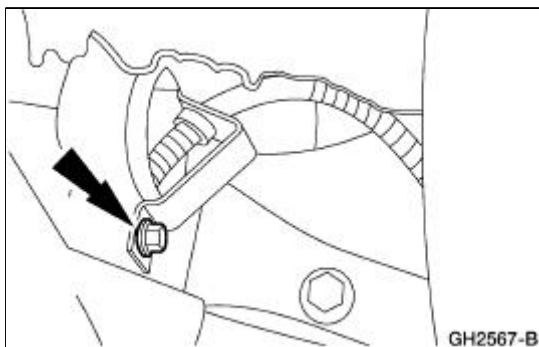
1. Remove the rear passenger seat.
2. Disconnect the rear anti-lock brake sensor electrical connector.



3. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
4. Remove the rear anti-lock brake sensor harness from the floor pan.



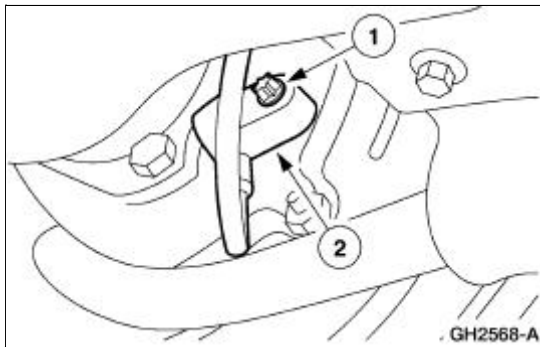
5. Remove the anti-lock brake sensor harness bracket bolt.



6. **NOTE:** The sensor may be seized to the axle. Use Rust Penetrant and Inhibitor F2AZ-19A501-A meeting Ford specification ESR-M99C56-A to loosen the sensor for removal.

Remove the rear anti-lock brake sensor.

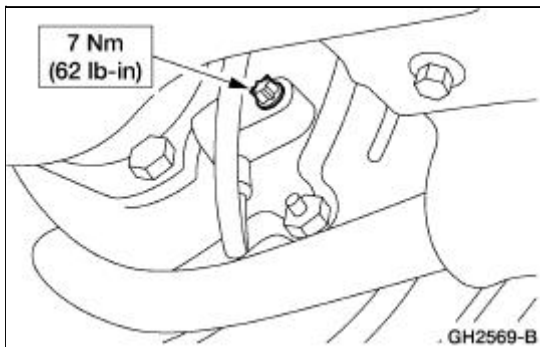
1. Remove the rear anti-lock brake sensor bolt.
2. Remove the rear anti-lock brake sensor.



Installation

1. **NOTE:** Be sure to apply High Temperature Nickel Anti-Sieze Lubricant F6AZ-9L494-AA meeting Ford specification ESE-M124A-A to the sensor body where it will make contact when installed.

To install, reverse the removal procedure.



Torque Specifications

Description	Nm	lb-ft	lb-in
Anti-lock brake control module screws	3	—	26
Brake line fittings to hydraulic control unit	19	14	—
Front anti-lock brake sensor bolt	7	—	62
Hydraulic control unit to mounting bracket nuts	18	13	—
Rear anti-lock brake sensor bolt	7	—	62

Anti-Lock Control —Traction Control



The four wheel anti-lock brake system (4WABS) with traction control consists of the following components:

- anti-lock brake control module (2C346)
 - front anti-lock brake sensor (2C204)/(2C205)
 - front anti-lock brake sensor indicator (2C182)
 - hydraulic control unit (2C286)
 - powertrain control module (12A650)
 - rear anti-lock brake sensor (2C190)/(2C216)
 - rear anti-lock brake sensor indicator (2C189)
 - traction control switch
 - yellow anti-lock brake system (ABS) warning indicator
-

Anti-Lock Control —Traction Control

Refer to Wiring Diagrams Cell [42](#), Anti-Lock Brake System for schematic and connector information.

Special Tool(s)

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

Principles of Operation

The anti-lock-brake control module receives wheel speed readings from each anti-lock brake sensor and processes this information to determine if an ABS event is necessary. The anti-lock brake sensor electrically senses each tooth of the anti-lock brake sensor indicators as it passes through the anti-lock brake sensor's magnetic field.

The anti-lock brake control module continuously monitors and compares the rotational speed of each wheel and, when it detects an impending wheel lock, modulates brake pressure to the appropriate brake caliper. This is accomplished by triggering the hydraulic control unit (HCU) to open and close the appropriate solenoid valves. Once the affected wheel returns to normal speed, the anti-lock brake control module returns the solenoid valves to their normal position, and normal (base) braking resumes.

The anti-lock brake control module is self-monitoring. When the ignition switch is turned to the RUN position, the anti-lock brake control module will do a preliminary electrical check, and at approximately 12 km/h (8 mph) the pump motor is turned on for approximately one half-second. Also during all phases of operation the anti-lock brake control module (after the vehicle is in motion) checks for correct operation of the anti-lock brake sensors. Any malfunction of the ABS will cause the ABS to shut off and ABS warning indicator to illuminate; normal power assisted braking, however, remains.

The ABS control module has the ability to store multiple DTCs in memory.

The traction control system controls wheelspin by modulating the engine torque by communicating to the powertrain control module (PCM) and by applying, then releasing, the appropriate brake to restore traction when one or both drive wheels lose traction and begin to spin during acceleration.

The traction control system can be disabled by depressing the traction control switch. The traction control system will reset and return to normal traction assist when the ignition switch is cycled or when the traction control switch is depressed again.

Inspection and Verification

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none">● Low brake fluid● Anti-lock brake sensor● Anti-lock brake sensor indicator● Base brake system● Wheel bearings	<ul style="list-style-type: none">● Central junction box (CJB) Fuse:<ul style="list-style-type: none">■ 5 (15A)■ 15 (10A)■ 29 (15A)■ 33 (15A)■ 35 (15A)● Battery junction box (BJB) Fuse:<ul style="list-style-type: none">■ ABS 1 (50A)■ ABS 2 (20A)● Circuitry● Damaged or corroded connectors● ABS warning indicator● Loose grounds

3. If the concern remains after the inspection, connect the scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If the scan tool does not communicate with the vehicle:
 1. Check that the program card is correctly installed.
 2. Check the connections to the vehicle.
 3. Check the ignition switch position.
4. If the scan tool still does not communicate with the vehicle, refer to the scan tool manual.
5. Carry out the DATA LINK DIAGNOSTIC TEST. If the scan tool responds with:
 1. CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00.
 2. NO RESP/NOT EQUIP for the anti-lock brake control module, [Go To Pinpoint Test A](#).
 3. SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the anti-lock brake control module.
6. If the DTCs retrieved are related to the concern, go to the Anti-Lock Brake Control Module Diagnostic Trouble Code (DTC) Index to continue diagnostics.
7. If no DTCs related to the concern are retrieved, GO to [Symptom Chart](#) to continue diagnostics.

Anti-Lock Brake Control Module Diagnostic Trouble Code (DTC) Index

NOTE: If a wheel speed signal fault or a pump motor fault is detected, the yellow ABS warning indicator cannot be reset with the key OFF and key ON method. The vehicle must be driven over 12 km/h (8 mph) for the anti-lock brake control module to do a re-check of the system before the yellow ABS warning indicator is turned OFF.

Anti-Lock Brake Control Module Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1318	Battery Voltage Low	ABS/TC	Go To Pinpoint Test C.
B1342	ECU Is Defective	ABS/TC	INSTALL a new anti-lock brake control module; REFER to Module . REPEAT the self-test.
B1484	Brake Pedal Input Open Circuit	ABS/TC	Go To Pinpoint Test D.
B1596	Repair Continuous Codes	ABS/TC	REPAIR the DTCs retrieved.
C1095	ABS Hydraulic Pump Motor Circuit Failure	ABS/TC	Go To Pinpoint Test E.
C1145	RF Anti-Lock Brake Sensor Input Circuit Failure	ABS/TC	Go To Pinpoint Test F.
C1155	LF Anti-Lock Brake Sensor Input Circuit Failure	ABS/TC	Go To Pinpoint Test F.
C1165	RR Anti-Lock Brake Sensor Input Circuit Failure	ABS/TC	Go To Pinpoint Test F.
C1175	LR Anti-Lock Brake Sensor Input Circuit Failure	ABS/TC	Go To Pinpoint Test F.
C1222	Anti-Lock Brake Sensor Mismatch	ABS/TC	Go To Pinpoint Test G.
C1233	LF Anti-Lock Brake Sensor Input Signal Missing	ABS/TC	Go To Pinpoint Test H.
C1234	RF Anti-Lock Brake Sensor Input Signal Missing	ABS/TC	Go To Pinpoint Test H.
C1235	RR Anti-Lock Brake Sensor Input Signal Missing	ABS/TC	Go To Pinpoint Test H.
C1236	LR Anti-Lock Brake Sensor Input Signal Missing	ABS/TC	Go To Pinpoint Test H.
C1266	ABS Valve Power Relay Circuit Failure	ABS/TC	INSTALL a new anti-lock brake control module; REFER to Module . REPEAT the self-test.
C1805	Mismatched PCM and/or Anti-Lock Brake Control Module	ABS/TC	CLEAR the DTCs. RETRIEVE the DTCs. If DTC C1805 is retrieved, check the PCM and Anti-Lock Brake Control Module is for the correct vehicle. INSTALL a new PCM or anti-lock brake control module as necessary. CLEAR the DTCs. REPEAT the self-test.
U1009	SCP (J1850) Invalid or Missing Data for Engine Torque	ABS/TC	CARRY OUT the PCM self-test.
U1027	SCP (J1850) Invalid or Missing Data for Engine RPM	ABS/TC	CARRY OUT the PCM self-test.
U1059	SCP (J1850) Invalid or Missing Data for Transmission/Transaxle/PRNDL	ABS/TC	CARRY OUT the PCM self-test.
U1083	SCP (J1850) Invalid or Missing Data for Engine Systems	ABS/TC	CARRY OUT the PCM self-test.
U1262	SCP (J1850) Communication Bus Fault	ABS/TC	REFER to Section 418-00.

Anti-Lock Brake Control Module Parameter Identification (PID) Index

Anti-Lock Brake Control Module Parameter Identification (PID) Index

PID	Description	Expected Value
CCNTABS	Number of Continuous DTCS in the Anti-Lock Brake Control Module	one count per bit
BOO_ABS	Brake Switch Input	OFF, ON
PMP_MTR	ABS Pump Motor	OFF---, OFFO--, OFF-B-, OFF--G, OFFO-G, OFF-BG, OFFOBG, ON---, ONO--, ON-B-, ON--G, ONO-G, ON-BG, ONOBG
VLV_CTR	ABS Valve Control Relay	OFF---, OFFO--, OFF-B-, OFF--G, OFFO-G, OFF-BG, OFFOBG, ON---, ONO--, ON-B-, ON--G, ONO-G, ON-BG, ONOBG
LF_WSPD	LF Wheel Speed	0-255 MPH
RF_WSPD	RF Wheel Speed	0-255 MPH
LR_WSPD	LR Wheel Speed	0-255 MPH
RR_WSPD	RR Wheel Speed	0-255 MPH
ABSLF_I	LF ABS Inlet Valve	OFF---, OFFO--, OFF-B-, OFF--G, OFFO-G, OFF-BG, OFFOBG, ON---, ONO--, ON-B-, ON--G, ONO-G, ON-BG, ONOBG
ABSLF_O	LF ABS Outlet Valve	OFF---, OFFO--, OFF-B-, OFF--G, OFFO-G, OFF-BG, OFFOBG, ON---, ONO--, ON-B-, ON--G, ONO-G, ON-BG, ONOBG
ABSRF_I	RF ABS Inlet Valve	OFF---, OFFO--, OFF-B-, OFF--G, OFFO-G, OFF-BG, OFFOBG, ON---, ONO--, ON-B-, ON--G, ONO-G, ON-BG, ONOBG
ABSRF_O	RF ABS Outlet Valve	OFF---, OFFO--, OFF-B-, OFF--G, OFFO-G, OFF-BG, OFFOBG, ON---, ONO--, ON-B-, ON--G, ONO-G, ON-BG, ONOBG
ABSLR_I	LR ABS Inlet Valve	OFF---, OFFO--, OFF-B-, OFF--G, OFFO-G, OFF-BG, OFFOBG, ON---, ONO--, ON-B-, ON--G, ONO-G, ON-BG, ONOBG
ABSLR_O	LR ABS Outlet Valve	OFF---, OFFO--, OFF-B-, OFF--G, OFFO-G, OFF-BG, OFFOBG, ON---, ONO--, ON-B-, ON--G, ONO-G, ON-BG, ONOBG
ABSRR_I	RR ABS Inlet Valve	OFF---, OFFO--, OFF-B-, OFF--G, OFFO-G, OFF-BG, OFFOBG, ON---, ONO--, ON-B-, ON--G, ONO-G, ON-BG, ONOBG
ABSRR_O	RR ABS Outlet Valve	OFF---, OFFO--, OFF-B-, OFF--G, OFFO-G, OFF-BG, OFFOBG, ON---, ONO--, ON-B-, ON--G, ONO-G, ON-BG, ONOBG
LF_TC_P	LF Traction Control Priming Valve	OFF, ON
RF_TC_P	RF Traction Control Priming Valve	OFF, ON
LR_TC_P	LR Traction Control Priming Valve	OFF, ON
RR_TC_P	RR Traction Control Priming Valve	OFF, ON
LF_TC_S	LF Traction Control Switching	OFF, ON

	Valve	
RF_TC_S	RF Traction Control Switching Valve	OFF, ON
LR_TC_S	LR Traction Control Switching Valve	OFF, ON
RR_TC_S	RR Traction Control Switching Valve	OFF, ON
T/ALVAL	Left Traction Control Valve Output State	OFF---, OFFO--, OFF-B-, OFF--G, OFFO-G, OFF-BG, OFFOFG, ON---, ONO--, ON-B-, ON--G, ONO-G, ON-BG, ONOFG
T/ARVAL	Right Traction Control Valve Output State	OFF---, OFFO--, OFF-B-, OFF--G, OFFO-G, OFF-BG, OFFOFG, ON---, ONO--, ON-B-, ON--G, ONO-G, ON-BG, ONOFG

Anti-Lock Brake Control Module Active Command Index

Anti-Lock Brake Control Module Active Command Index

Active Command	Display	Action	
ABS OUTPUT CONTROL	ABS POWER	OFF, ON	
	DSBL TOG	OFF, ON	
	LF INLET	OFF, ON	
	LF OUTLET	OFF, ON	
	RF INLET	OFF, ON	
	RF OUTLET	OFF, ON	
	LR INLET	OFF, ON	
	LR OUTLET	OFF, ON	
	RR INLET	OFF, ON	
	RR OUTLET	OFF, ON	
	TRACTION CONTROL PRIMARY AND SWITCHING VALVE CONTROL	LF TC PRV	OFF, ON
		LF TC SWV	OFF, ON
RF TC PRV		OFF, ON	
RF TC SWV		OFF, ON	
LR TC PRV		OFF, ON	
LR TC SWV		OFF, ON	
RR TC PRV		OFF, ON	
RR TC SWV		OFF, ON	

Symptom Chart

Symptom Chart

NOTE: Refer to the wiring diagrams for connector numbers stated in the pinpoint

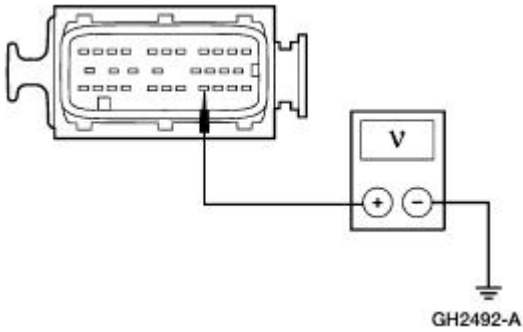
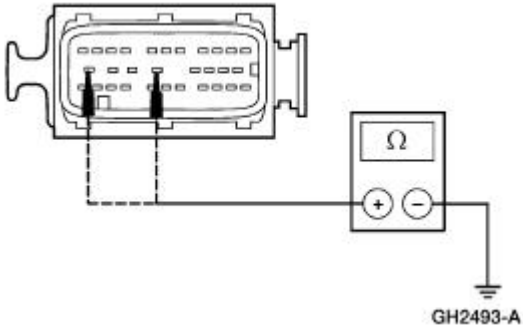
test.

Condition	Possible Sources	Action
<ul style="list-style-type: none"> No communication with the anti-lock brake control module 	<ul style="list-style-type: none"> CJB Fuse 29 (15A). Circuitry. Anti-lock brake control module. 	<ul style="list-style-type: none"> Go To Pinpoint Test A .
<ul style="list-style-type: none"> Unable to enter self-test 	<ul style="list-style-type: none"> Anti-lock brake control module. 	<ul style="list-style-type: none"> Go To Pinpoint Test B .
<ul style="list-style-type: none"> The yellow ABS warning indicator does not self-check 	<ul style="list-style-type: none"> Circuitry. Anti-lock brake control module. Instrument cluster. 	<ul style="list-style-type: none"> Go To Pinpoint Test I .
<ul style="list-style-type: none"> Spongy brake pedal with no warning indicator 	<ul style="list-style-type: none"> Air in the brake system. Base brake system. Hydraulic control unit (HCU). 	<ul style="list-style-type: none"> Go To Pinpoint Test J . REFER to Section 206-00 .
<ul style="list-style-type: none"> Poor vehicle tracking during anti-lock function 	<ul style="list-style-type: none"> Air in the brake system. Hydraulic control unit (HCU). Base brake system. 	<ul style="list-style-type: none"> Go To Pinpoint Test K . REFER to Section 206-00 .
<ul style="list-style-type: none"> The traction control is inoperative—does not operate correctly 	<ul style="list-style-type: none"> CJB 5 (15A). Circuitry. Traction control switch. Instrument cluster. Anti-lock brake control module. 	<ul style="list-style-type: none"> Go To Pinpoint Test L .
<ul style="list-style-type: none"> The traction control indicator is inoperative—traction control switch 	<ul style="list-style-type: none"> Circuitry. Traction control switch. Instrument cluster. 	<ul style="list-style-type: none"> Go To Pinpoint Test M .

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE ANTI-LOCK BRAKE CONTROL MODULE

Test Step	Result / Action to Take
A1 CHECK CIRCUIT 601 (LB/PK) FOR AN OPEN	
<ul style="list-style-type: none"> Key in OFF position. Disconnect: Anti-Lock Brake Control Module C141. Key in ON position. Measure the voltage between anti-lock brake control module C141 Pin 8, Circuit 601 (LB/PK), harness side and ground. 	<p>Yes GO to A2 .</p> <p>No REPAIR the circuit.</p>

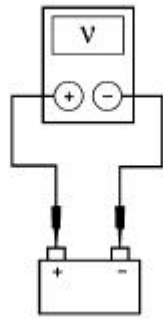
 <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	REPEAT the self-test.
A2 CHECK THE ANTI-LOCK BRAKE CONTROL MODULE GROUNDS	
<ul style="list-style-type: none"> ● Measure the resistance between anti-lock brake control module C141 Pin 12, Circuit 1205 (BK), harness side and ground; and between anti-lock brake control module C141 Pin 15, Circuit 397 (BK/WH), harness side and ground.  <ul style="list-style-type: none"> ● Are the resistances less than 5 ohms? 	<p>Yes INSTALL a new anti-lock brake control module; REFER to Module. REPEAT the self-test.</p> <p>No REPAIR the circuit in question. REPEAT the self-test.</p>

PINPOINT TEST B: UNABLE TO ENTER SELF-TEST

Test Step	Result / Action to Take
B1 CHECK THE COMMUNICATIONS TO THE ANTI-LOCK BRAKE CONTROL MODULE	<p>Yes INSTALL a new anti-lock brake control module; REFER to Module. REPEAT the self-test.</p> <p>No Go To Pinpoint Test A.</p>
<ul style="list-style-type: none"> ● Check the communications to the anti-lock brake control module. ● Does the scan tool communicate with the anti-lock brake control module? 	

PINPOINT TEST C: DTC B1318, BATTERY VOLTAGE LOW

Test Step	Result / Action to Take
C1 CHECK BATTERY VOLTAGE	<p>Yes GO to C2.</p> <p>No REFER to Section</p>
<ul style="list-style-type: none"> ● Measure the battery voltage between the positive and negative battery posts with the key ON engine OFF (KOEO), and with the engine running. 	



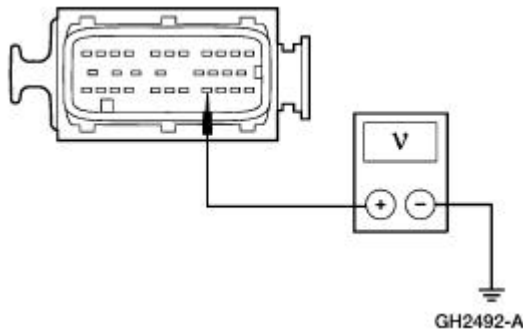
GL1223-A

- Is the battery voltage between 10 and 13 volts with KOEO, and between 11 and 17 volts with the engine running?

[414-00](#).

C2 CHECK THE VOLTAGE TO THE ANTI-LOCK BRAKE CONTROL MODULE

- Key in OFF position.
- Disconnect: Anti-Lock Brake Control Module C141.
- Key in ON position.
- Measure the voltage between anti-lock brake control module C141 Pin 8, Circuit 601 (LB/PK), harness side and ground.



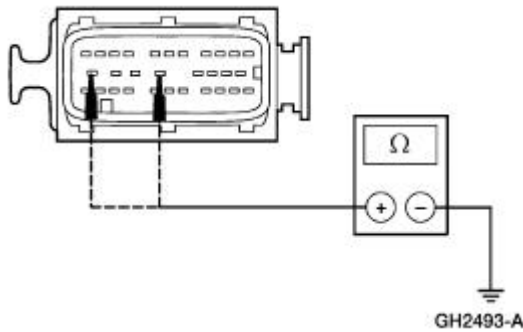
- Is the voltage greater than 10 volts?

Yes
GO to [C3](#).

No
REPAIR the circuit.
CLEAR the DTCs.
REPEAT the self-test.

C3 CHECK THE ANTI-LOCK BRAKE CONTROL MODULE GROUNDS

- Measure the resistance between anti-lock brake control module C141 Pin 12, Circuit 1205 (BK), harness side and ground; and between anti-lock brake control module C141 Pin 15, Circuit 397 (BK/WH), harness side and ground.



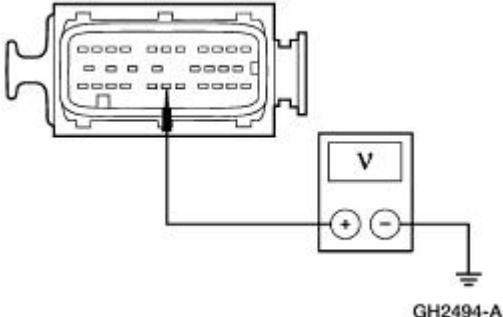
- Are the resistances less than 5 ohms?

Yes
INSTALL a new anti-lock brake control module;
REFER to [Module](#).
REPEAT the self-test.

No
REPAIR the circuit in question.
CLEAR the DTCs.
REPEAT the self-test.

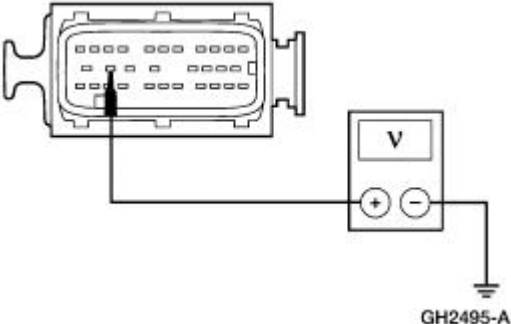
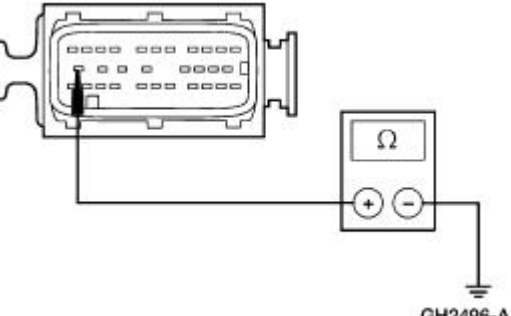
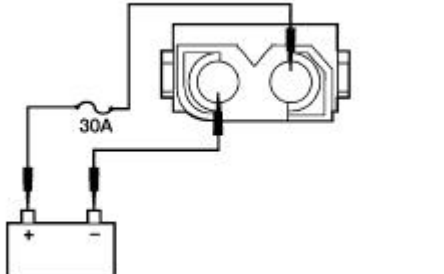
PINPOINT TEST D: DTC B1484, BRAKE PEDAL INPUT OPEN CIRCUIT

Test Step	Result / Action to Take
D1 CHECK THE STOPLAMPS FOR CORRECT OPERATION	

<ul style="list-style-type: none"> ● Depress the brake pedal while checking the stoplamps. ● Do the stop lamps illuminate? 	<p>Yes GO to D2.</p> <p>No REFER to Section 417-01.</p>
<p>D2 CHECK THE BRAKE PEDAL INPUT TO THE ANTI-LOCK BRAKE CONTROL MODULE</p>	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Anti-Lock Brake Control Module C141. ● Measure the voltage between anti-lock brake control module C141 Pin 6, Circuit 511 (LG), harness side and ground, while depressing and releasing the brake pedal.  <p style="text-align: center;">GH2494-A</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts with the brake pedal depressed and zero volts with the brake pedal released? 	<p>Yes INSTALL a new anti-lock brake control module; REFER to Module. REPEAT the self-test.</p> <p>No REPAIR Circuit 511 (LG) and Circuit 810 (RD/LG) as necessary. CLEAR the DTCs. REPEAT the self-test.</p>

PINPOINT TEST E: DTC C1095, ABS HYDRAULIC PUMP MOTOR FAILURE

Test Step	Result / Action to Take
<p>E1 CHECK THE PUMP MOTOR FOR CONTINUOUS OPERATION</p>	
<ul style="list-style-type: none"> ● Check the pump motor for continuous operation. ● Is the pump motor running continuously? 	<p>Yes INSTALL a new anti-lock brake control module; REFER to Module. REPEAT the self-test.</p> <p>No GO to E2.</p>
<p>E2 CHECK CIRCUIT 534 (YE/LG) FOR AN OPEN</p>	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Anti-Lock Brake Control Module C141. ● Measure the voltage between anti-lock brake control module C141 Pin 13, Circuit 534 (YE/LG), harness side, and ground. 	<p>Yes GO to E3.</p> <p>No REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.</p>

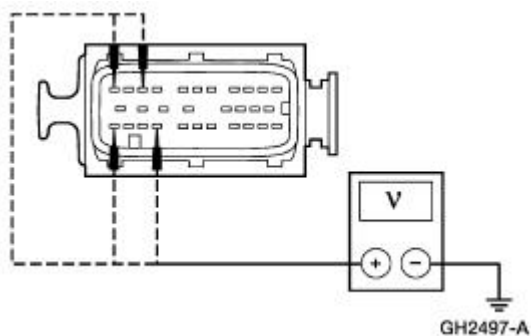
 <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	
<p>E3 CHECK CIRCUIT 1205 (BK) FOR AN OPEN</p>	
<ul style="list-style-type: none"> ● Measure the resistance between anti-lock brake control module C141 Pin 12, Circuit 1205 (BK), harness side and ground.  <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes GO to E4.</p> <p>No REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.</p>
<p>E4 CHECK THE PUMP MOTOR FOR OPERATION</p>	
<ul style="list-style-type: none"> ● Disconnect: Pump Motor Connector. ● Connect a 30A fused heavy jumper wire between the positive battery post and pump motor connector Pin 1 (component side); and momentarily connect a heavy jumper between negative battery post and pump motor connector Pin 2 (component side).  <ul style="list-style-type: none"> ● Does the pump motor operate? 	<p>Yes INSTALL a new anti-lock brake control module; REFER to Module. REPEAT the self-test.</p> <p>No INSTALL a new HCU; REFER to Hydraulic Control Unit. CLEAR the DTCs. REPEAT the self-test.</p>

PINPOINT TEST F: DTC C1145 (RF), C1155 (LF), C1165 (RR), C1175 (LR), ANTI-LOCK BRAKE SENSOR INPUT CIRCUIT FAILURE

Test Step	Result / Action to Take
<p>F1 CHECK THE SUSPECT ANTI-LOCK BRAKE SENSOR CIRCUIT FOR SHORT TO POWER</p>	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Anti-Lock Brake Control Module C141. ● Key in ON position. 	<p>Yes REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-</p>

- Measure the voltage between anti-lock brake control module C141 Pins, harness side and ground as follows:

DTC	Anti-Lock Brake Control Module C141 Pin	Circuit
C1145 (RF)	4	514 (YE/RD)
C1155 (LF)	20	521 (TN/OG)
C1165 (RR)	1	494 (TN/LG)
C1175 (LR)	22	496 (OG)



- Is any voltage present?

test.

No
GO to [F2](#).

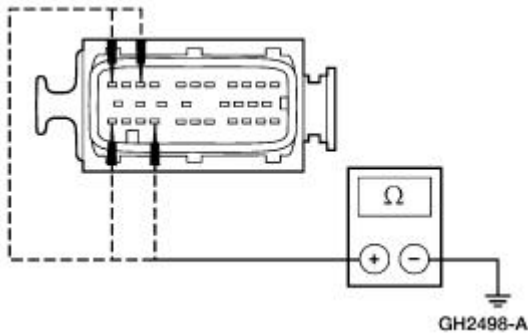
F2 CHECK THE SUSPECT ANTI-LOCK BRAKE SENSOR CIRCUIT FOR SHORT TO GROUND

- Key in OFF position.
- Measure the resistance between anti-lock brake control module C141 Pins, harness side and ground as follows:

DTC	Anti-Lock Brake Control Module C141 Pin	Circuit
C1145 (RF)	4	514 (YE/RD)
C1155 (LF)	20	521 (TN/OG)
C1165 (RR)	1	494 (TN/LG)
C1175 (LR)	22	496 (OG)

Yes
GO to [F4](#).

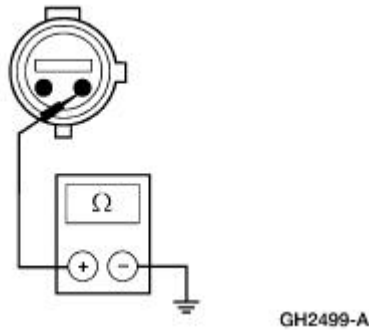
No
GO to [F3](#).



- Is the resistance greater than 10,000 ohms?

F3 CHECK THE SUSPECT ANTI-LOCK BRAKE SENSOR FOR A SHORT TO GROUND

- Disconnect: Suspect Anti-Lock Brake Sensor.
- Measure the resistance between suspect anti-lock brake sensor Pin 1 (component side) and ground.



- Is the resistance greater than 10,000 ohms?

Yes

If RF, REPAIR Circuit 514 (YE/RD) and Circuit 516 (YE/BK), as necessary. CLEAR the DTCs. REPEAT the self-test. If LF, REPAIR Circuit 521 (TN/OG) and Circuit 522 (TN/BK), as necessary. CLEAR the DTCs. REPEAT the self-test. If RR, REPAIR Circuit 494 (TN/LG) and Circuit 492 (BN), as necessary. CLEAR the DTCs. REPEAT the self-test. If LR, REPAIR Circuit 496 (OG) and Circuit 499 (GY/BK), as necessary. CLEAR the DTCs. REPEAT the self-test.

No

INSTALL a new anti-lock brake sensor; REFER to [Sensor—Front](#) or [Sensor—Rear](#). CLEAR the DTCs. REPEAT the self-test.

F4 CHECK THE SUSPECT ANTI-LOCK BRAKE SENSOR CIRCUIT FOR FOR AN OPEN

- Key in OFF position.
- Measure the resistance between anti-lock brake control module C141 Pins, harness side and suspect anti-lock brake sensor, harness side as follows:

DTC	Anti-Lock Brake Control Module	Anti-Lock Brake Sensor	Circuit
C1145 (RF)	C141 Pin 4	C145 Pin 1	514 (YE/RD)
C1145 (RF)	C141 Pin 5	C145 Pin 2	516 (YE/BK)
C1155 (LF)	C141 Pin 20	C144 Pin 1	521 (TN/OG)
C1155 (LF)	C141 Pin 21	C144 Pin 2	522 (TN/BK)
C1165 (RR)	C141 Pin 1	C319 Pin 2	494 (TN/LG)
C1165	C141 Pin 3	C319 Pin 1	492 (BN)

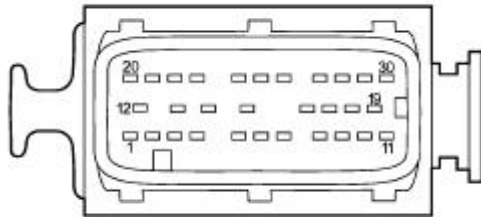
Yes

GO to [F5](#).

No

REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.

(RR)			
C1175 (LR)	C141 Pin 22	C320 Pin 2	496 (OG)
C1175 (LR)	C141 Pin 23	C320 Pin 1	499 (GY/BK)

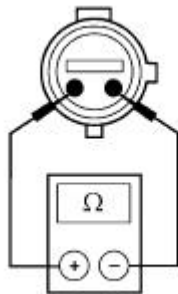


GH2500-A

- Are the resistances less than 5 ohms?

F5 CHECK THE ANTI-LOCK BRAKE SENSOR

- Measure the resistance between suspect anti-lock brake sensor pin 1 (component side) and suspect anti-lock brake sensor pin 2 (component side).



GH2501-A

- Is the resistance between 1280 and 1920 (front) or 1830 and 2760 (rear) ohms?

Yes
INSTALL a new anti-lock brake control module; REFER to [Module](#). REPEAT the self-test.

No
INSTALL a new anti-lock brake sensor; REFER to [Sensor—Front](#) or [Sensor—Rear](#). CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST G: DTC C1222, ANTI-LOCK BRAKE SENSOR MISMATCH

Test Step	Result / Action to Take
G1 CHECK THE VEHICLE COMPONENTS	
<ul style="list-style-type: none"> • Check for correct wheel and tire size, front-to-rear and side-to-side. • Check for excessive bearing end play. • Check the anti-lock brake sensor indicator for a bent sensor ring or missing teeth. • Are the conditions OK? 	<p>Yes GO to G2.</p> <p>No REPAIR as necessary. CLEAR the DTCs. REPEAT the self-test.</p>
G2 TEST DRIVE THE VEHICLE	
<ul style="list-style-type: none"> • Enter the following diagnostic 	Yes

<p>mode on the diagnostic tool: CLEAR the DTCs.</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Key in ON position. ● Test drive the vehicle over 24 km/h (15 mph). ● Enter the following diagnostic mode on the diagnostic tool: Retrieve DTCs. ● Is DTC C1222 retrieved? 	<p>INSTALL a new anti-lock brake control module; REFER to Module. REPEAT the self-test.</p> <p>No If another DTC is retrieved, GO to the Anti-Lock Brake Control Module Diagnostic Trouble Code (DTC) index. If no DTCs are retrieved, system is OK.</p>
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PINPOINT TEST H: DTC C1233 (LF), C1234 (RF), C1235 (RR), C1236 (LR), ANTI-LOCK BRAKE SENSOR INPUT SIGNAL MISSING

Test Step	Result / Action to Take
<p>H1 CHECK THE SUSPECT ANTI-LOCK BRAKE SENSOR</p> <ul style="list-style-type: none"> ● Check the suspect anti-lock brake sensor mounting. ● Check the suspect anti-lock brake sensor for excessive dirt build up, obstructions, and damage. ● Is the suspect anti-lock brake sensor and mounting OK? 	<p>Yes GO to H2.</p> <p>No REPAIR as necessary. CLEAR the DTCs. REPEAT the self-test.</p>
<p>H2 CHECK THE SUSPECT ANTI-LOCK BRAKE SENSOR INDICATOR</p> <ul style="list-style-type: none"> ● Check the suspect anti-lock brake sensor indicator for corrosion, nicks, bridged teeth, damaged teeth, correct mounting, and alignment with the anti-lock brake sensor. ● Check the air gap and bearing end play. ● Is the suspect anti-lock brake sensor indicator OK? 	<p>Yes GO to H3.</p> <p>No INSTALL a new anti-lock brake sensor indicator; REFER to Sensor Indicator—Front or Sensor Indicator—Rear. CLEAR the DTCs. REPEAT the self-test.</p>
<p>H3 CHECK THE ANTI-LOCK BRAKE SENSOR OUTPUT</p> <ul style="list-style-type: none"> ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: CLEAR the DTCs. ● Key in OFF position. ● Key in ON position. ● Have an assistant monitor the anti-lock brake control module PIDs LF_WSPD, RF_WSPD, LR_WSPD, and RR_WSPD while driving at various speeds. ● NOTE: the vehicle must be driven 16 km (10 miles) during this test step. ● Test drive the vehicle for 16 km (10 miles). ● Are the anti-lock brake control module PIDs approximately the same at all times? 	<p>Yes INSTALL a new anti-lock brake control module; REFER to Module. REPEAT the self-test.</p> <p>No INSTALL a new anti-lock brake sensor; REFER to Sensor—Front or Sensor—Rear. CLEAR the DTCs. REPEAT the self-test.</p>

PINPOINT TEST I: THE YELLOW ABS WARNING INDICATOR DOES NOT SELF-CHECK

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Test Step	Result / Action to Take
I1 CHECK THE ABS WARNING INDICATOR CIRCUITRY	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Anti-Lock Brake Control Module C141. ● Key in ON position. ● Depress and release the shorting bar connector internal to the anti-lock brake control module C141, harness side, while checking the yellow ABS warning indicator in the instrument cluster. ● Does the yellow ABS indicator illuminate with the shorting bar released and OFF with the shorting bar depressed? 	<p>Yes INSTALL a new anti-lock brake control module; REFER to Module. TEST the system for normal operation.</p> <p>No REFER to Section 413-01.</p>

PINPOINT TEST J: SPONGY BRAKE PEDAL WITH NO WARNING INDICATOR

Test Step	Result / Action to Take
J1 CHECK THE VEHICLE COMPONENTS	
<ul style="list-style-type: none"> ● Check the brake pedal and power booster/brake master cylinder for correct attachment. ● Are the components OK? 	<p>Yes GO to J2.</p> <p>No REPAIR as necessary. TEST the system for normal operation.</p>
J2 BLEED THE BRAKE SYSTEM	
<ul style="list-style-type: none"> ● Bleed the brake system; REFER to Section 206-00. ● Check for spongy brake pedal. ● Is the brake pedal spongy? 	<p>Yes INSTALL a new HCU; REFER to Hydraulic Control Unit. TEST the system for normal operation.</p> <p>No The brake system is OK. TEST the system for normal operation.</p>

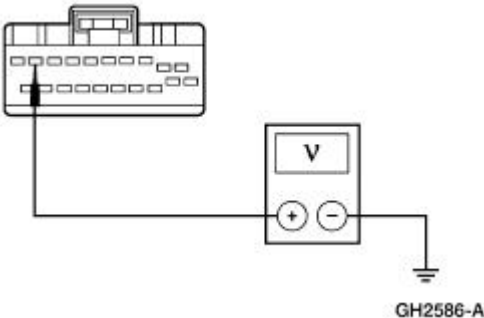
PINPOINT TEST K: POOR VEHICLE TRACKING DURING ANTI-LOCK FUNCTION

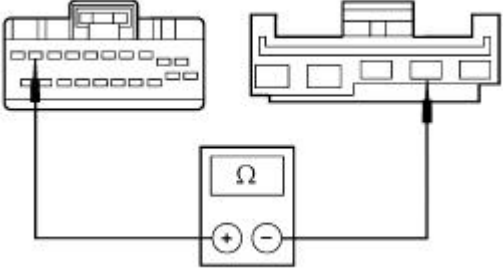
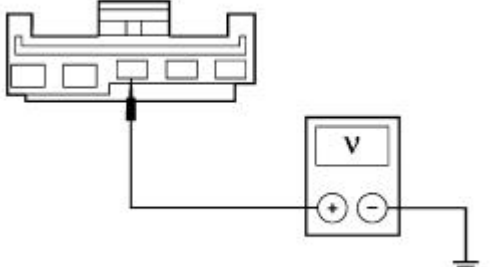
Test Step	Result / Action to Take
K1 BLEED THE BRAKE SYSTEM	
<ul style="list-style-type: none"> ● Bleed the brake system; REFER to Section 206-00. ● Check for vehicle tracking poorly. ● Does the vehicle track poorly? 	<p>Yes GO to K2.</p> <p>No The brake system is OK. TEST the system for normal operation.</p>
K2 CHECK THE LF ABS VALVE OPERATION	
<ul style="list-style-type: none"> ● Lift the vehicle and rotate all the wheels to make sure they rotate freely (the vehicle must be in neutral). ● NOTE: Trigger must be depressed twice. Each depress runs the pump motor for two seconds. 	<p>Yes INSTALL a new HCU; REFER to Hydraulic Control Unit. TEST the system for normal operation.</p> <p>No</p>

<ul style="list-style-type: none"> ● Trigger the anti-lock brake control module active command PMP MOTOR ON for four seconds. ● Apply moderate brake pedal effort. ● Have an assistant attempt to rotate the LF wheel while the pump motor is running. ● Does the LF wheel rotate? 	GO to K3 .
K3 CHECK THE LF ABS VALVE RELEASE	
<ul style="list-style-type: none"> ● Apply moderate brake pedal effort. ● Trigger the anti-lock brake control module active command LF INLET and LF OUTLET. ● NOTE: Trigger must be depressed twice. Each depress runs the pump motor for two seconds. ● Have an assistant rotate the LF wheel immediately after depressing trigger. ● Does the LF wheel rotate? 	Yes GO to K4 . No GO to K10 .
K4 CHECK THE RF ABS VALVE OPERATION	
<ul style="list-style-type: none"> ● NOTE: Trigger must be depressed twice. Each depress runs the pump motor for two seconds. ● Trigger the anti-lock brake control module active command PMP MOTOR ON for four seconds. ● Apply moderate brake pedal effort. ● Have an assistant attempt to rotate the RF wheel while the pump motor is running. ● Does the RF wheel rotate? 	Yes INSTALL a new HCU; REFER to Hydraulic Control Unit . TEST the system for normal operation. No GO to K5 .
K5 CHECK THE RF ABS VALVE RELEASE	
<ul style="list-style-type: none"> ● Apply moderate brake pedal effort. ● Trigger the anti-lock brake control module active command RF INLET and RF OUTLET. ● NOTE: The scan tool will energize the valves for only two seconds per trigger press. ● Have an assistant rotate the RF wheel immediately after depressing trigger. ● Does the RF wheel rotate? 	Yes GO to K6 . No GO to K10 .
K6 CHECK THE LR ABS VALVE OPERATION	
<ul style="list-style-type: none"> ● NOTE: Trigger must be depressed twice. Each depress runs the pump motor for two seconds. ● Trigger the anti-lock brake control module active command PMP MOTOR ON for four seconds. ● Apply moderate brake pedal effort. ● Have an assistant attempt to rotate the LR wheel while the pump motor is running. ● Does the LR wheel rotate? 	Yes INSTALL a new HCU; REFER to Hydraulic Control Unit . TEST the system for normal operation. No GO to K7 .
K7 CHECK THE LR ABS VALVE RELEASE	
<ul style="list-style-type: none"> ● Apply moderate brake pedal effort. ● Trigger the anti-lock brake control module active command LR INLET and LR OUTLET. ● NOTE: The scan tool will energize the valves for only two seconds per trigger press. ● Have an assistant rotate the LR wheel immediately after depressing trigger. ● Does the LR wheel rotate? 	Yes GO to K8 . No GO to K10 .

K8 CHECK THE RR ABS VALVE OPERATION	<p>Yes INSTALL a new HCU; REFER to Hydraulic Control Unit. TEST the system for normal operation.</p> <p>No GO to K9.</p>
K9 CHECK THE RR ABS VALVE RELEASE	<p>Yes The ABS system is operating correctly.</p> <p>No GO to K10.</p>
K10 CHECK FOR DTCS	<p>Yes GO to the Anti-Lock Brake Control Module Diagnostic Trouble Code (DTC) Index.</p> <p>No INSTALL a new HCU; REFER to Hydraulic Control Unit. TEST the system for normal operation.</p>
<ul style="list-style-type: none"> ● NOTE: Trigger must be depressed twice. Each depress runs the pump motor for two seconds. ● Trigger the anti-lock brake control module active command PMP MOTOR ON for four seconds. ● Apply moderate brake pedal effort. ● Have an assistant attempt to rotate the RR wheel while the pump motor is running. ● Does the RR wheel rotate? 	
<ul style="list-style-type: none"> ● Apply moderate brake pedal effort. ● Trigger the anti-lock brake control module active command RF INLET and RF OUTLET. ● NOTE: The scan tool will energize the valves for only two seconds per trigger press. ● Have an assistant rotate the RR wheel immediately after depressing trigger. ● Does the RR wheel rotate? 	
<ul style="list-style-type: none"> ● Carry out the anti-lock brake control module self-test. ● Are any DTCS retrieved? 	

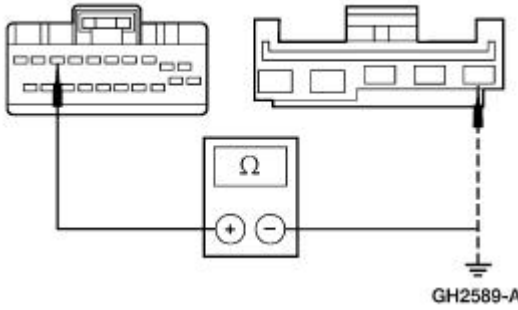
PINPOINT TEST L: THE TRACTION CONTROL IS INOPERATIVE—DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
<p>L1 CHECK THE TRACTION CONTROL SWITCH CIRCUITRY</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Instrument Cluster C251. ● Key in ON position. ● Measure the voltage between instrument cluster C251 Pin 9, Circuit 959 (GY), harness side and ground, while depressing and releasing the traction control switch.  <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts with the traction control switch depressed and zero volts with the traction control switch released? 	<p>Yes INSTALL a new instrument cluster, REFER to Section 413-01. TEST the system for normal operation.</p> <p>No GO to L2.</p>

L2 CHECK CIRCUIT 959 (GY) FOR AN OPEN	<p>Yes GO to L3.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Traction Control Switch C239. ● Measure the resistance between instrument cluster C251 Pin 9, Circuit 959 (GY), harness side and traction control switch C239 Pin 4, Circuit 959 (GY), harness side.  <p style="text-align: center;">GH2587-A</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes INSTALL a new traction control switch. TEST the system for normal operation.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
L3 CHECK CIRCUIT 489 (PK/BK) FOR AN OPEN	<p>Yes INSTALL a new traction control switch. TEST the system for normal operation.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<ul style="list-style-type: none"> ● Key in ON position. ● Measure the voltage between traction control switch C239 Pin 3, Circuit 489 (PK/BK), harness side and ground.  <p style="text-align: center;">GH2588-A</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	

PINPOINT TEST M: THE TRACTION CONTROL INDICATOR IS INOPERATIVE—TRACTION CONTROL SWITCH

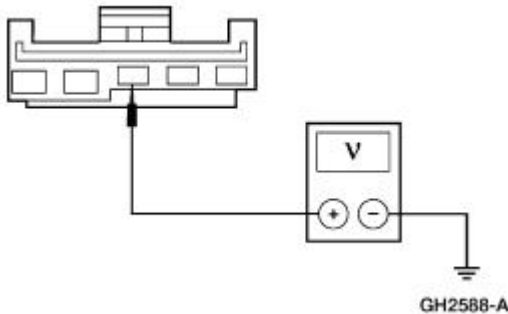
Test Step	Result / Action to Take
M1 CHECK CIRCUIT 960 (BK/LB)	<p>Yes GO to M2.</p> <p>No</p>
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Instrument Cluster C251. ● Disconnect: Traction Control Switch C239. ● Measure the resistance between instrument cluster C251 Pin 8, Circuit 960 (BK/LB), harness side and traction control switch C239 Pin 5, Circuit 960 (BK/LB), harness side; and between instrument cluster C251 Pin 8, Circuit 960 (BK/LB), harness side and ground. 	



- Is the resistance less than 5 ohms between the instrument cluster and traction control switch and greater than 10,000 ohms between instrument cluster and ground?

M2 CHECK CIRCUIT 489 (PK/BK) FOR AN OPEN

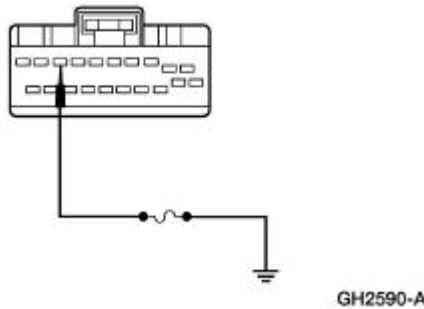
- Key in ON position.
- Measure the voltage between traction control switch C239 Pin 3, Circuit 489 (PK/BK), harness side and ground.



- Is the voltage greater than 10 volts?

M3 CHECK THE TRACTION CONTROL SWITCH INDICATOR

- Key in OFF position.
- Connect: Traction Control Switch C239.
- Key in ON position.
- Momentarily connect a fused (10A) jumper wire between instrument cluster C251 Pin 8, Circuit 960 (BK/LB), harness side and ground, while observing the traction control switch indicator.



- Does the traction control switch indicator illuminate?

Yes
GO to [M3](#).

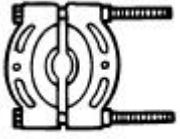
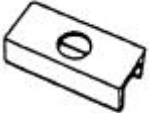

No
REPAIR the circuit.
TEST the system
for normal
operation.

Yes
INSTALL a new
instrument cluster;
REFER to [Section 413-01](#). TEST the
system for normal
operation.

No
INSTALL a new
traction control
switch. TEST the
system for normal
operation.

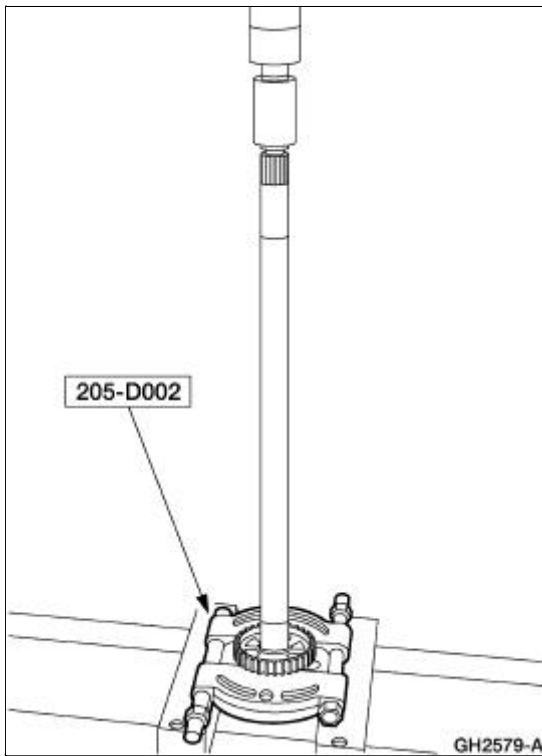
Sensor Indicator —Rear

Special Tool(s)

 ST1895-A	Pinion Bearing Cone Remover 205-D002 (D79P-4621A)
 ST1254-A	Axle Bearing/Seal Plate 205-090 (T75L-1165-B)
 ST1713-A	Sensing Ring Replacer 206-041 (T89P-20202-A)

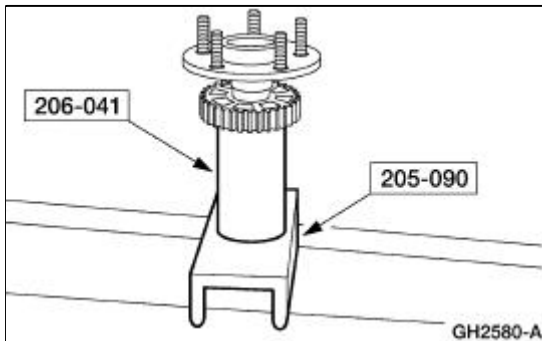
Removal

1. Remove the rear axle shaft bearing, refer to [Section 205-02A](#) or [Section 205-02B](#).
2. Using the special tool, remove the anti-lock brake sensor indicator from the axle shaft.

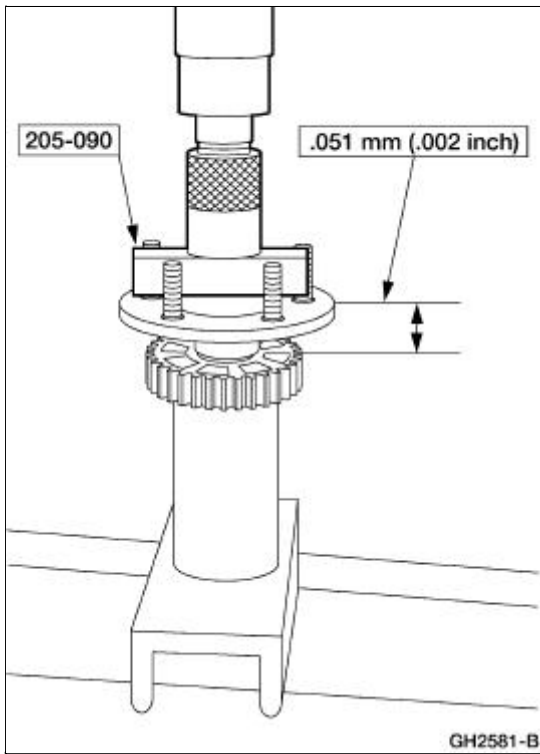


Installation

1. Using the special tools, align the rear anti-lock brake sensor indicator to the rear axle shaft.



2. Using the special tools, press the rear anti-lock brake sensor on the rear axle shaft to specification.

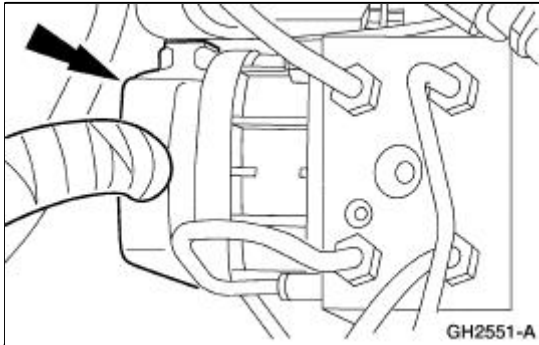


3. Install the rear axle shaft bearing, refer to [Section 205-02A](#).
-

Hydraulic Control Unit

Removal

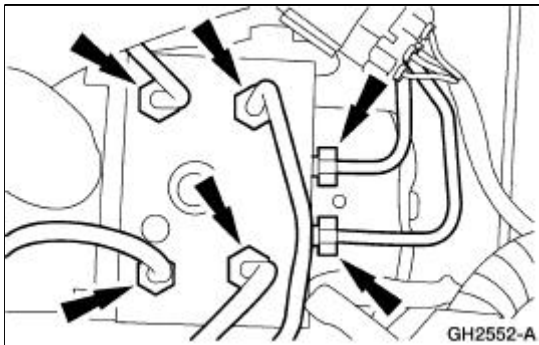
1. Disconnect the battery ground cable(14301).
2. Disconnect the anti-lock-brake control module electrical connector.



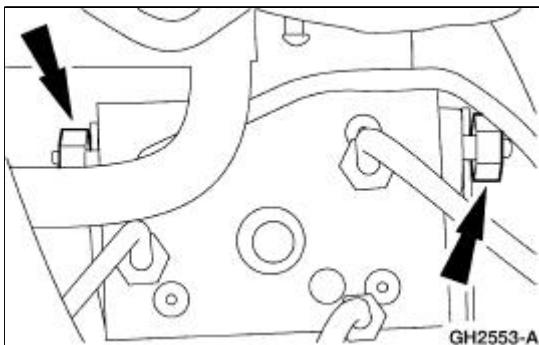
3. **NOTE:** The 4 wheel anti-lock brake system (4WABS) with traction control is shown , the 4WABS without traction control system is similar with one less hydraulic line.

NOTE: Plug brake lines to prevent any brake fluid loss.

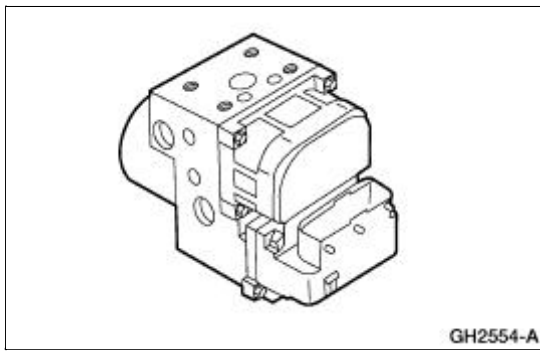
Disconnect the brake lines from the hydraulic control unit (HCU).



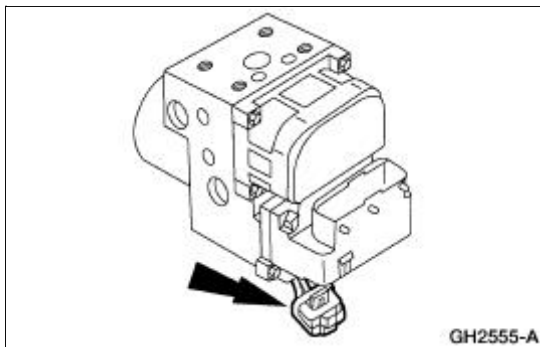
4. Remove the HCU bracket nuts to HCU.



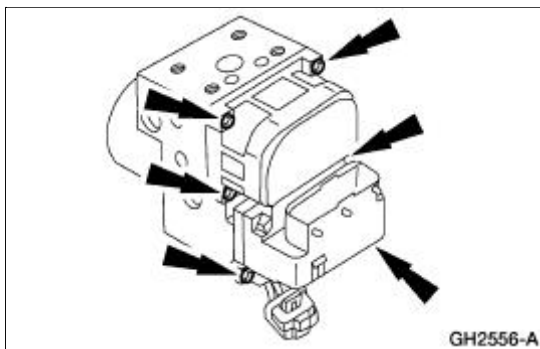
5. Remove the HCU.



6. Remove the pump motor electrical connector.



7. Remove the anti-lock-brake control module screws.

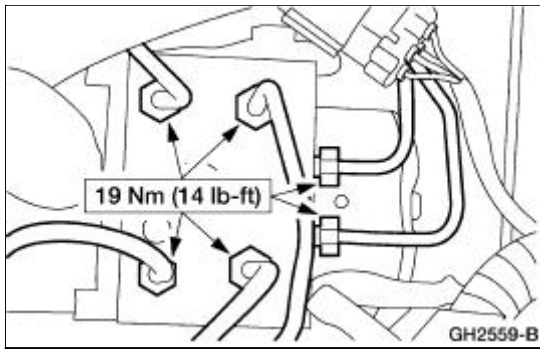
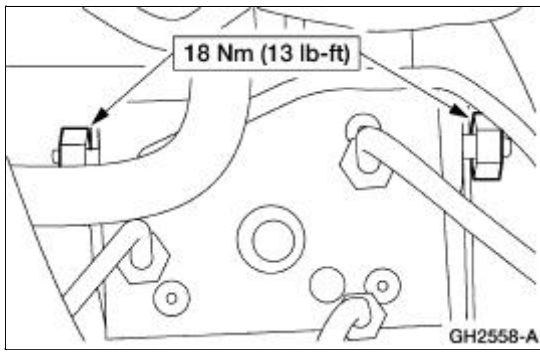


8. Remove the anti-lock-brake control module from the HCU.

Installation

1. **NOTE:** The brake system must be bled after the HCU is installed or replaced. Refer to [Section 206-00](#).

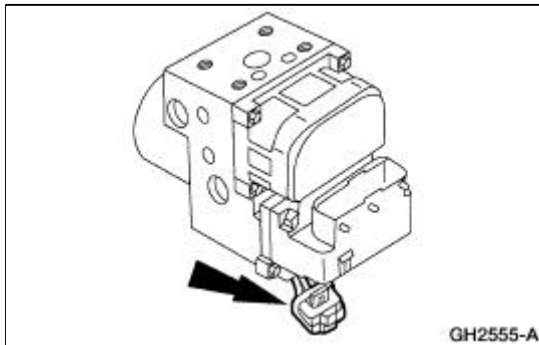
To install, reverse the removal procedure.



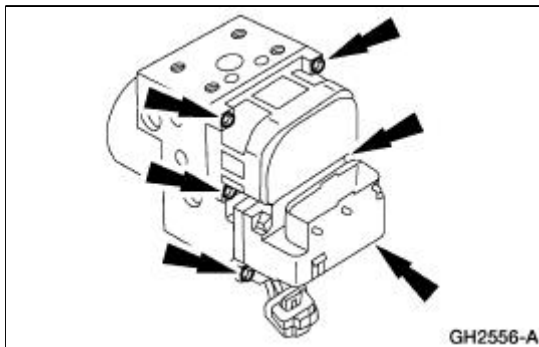
Module

Removal

1. Remove the hydraulic control unit (HCU). Refer to [Hydraulic Control Unit](#).
2. Remove the pump motor electrical connector.



3. Remove the anti-lock-brake control module screws.



4. Remove the anti-lock-brake control module from the HCU.

Installation

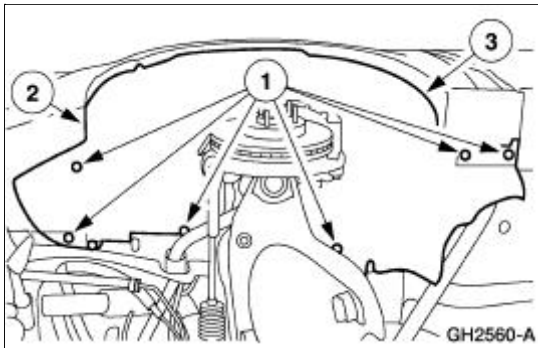
1. **NOTE:** The brake system must be bled after the HCU is installed or replaced. Refer to [Section 206-00](#).

To install, reverse the removal procedure.

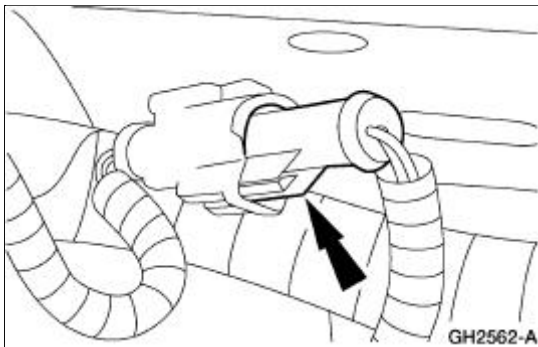
Sensor —Front

Removal

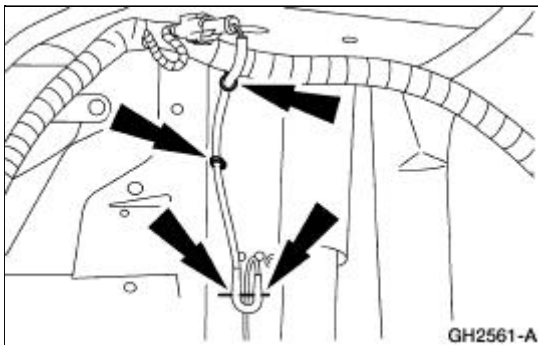
1. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
2. Remove the inner fender splash shield.
 1. Remove the inner fender splash shield push pins.
 2. Remove the inner fender splash shield screw.
 3. Remove the inner fender splash shield.



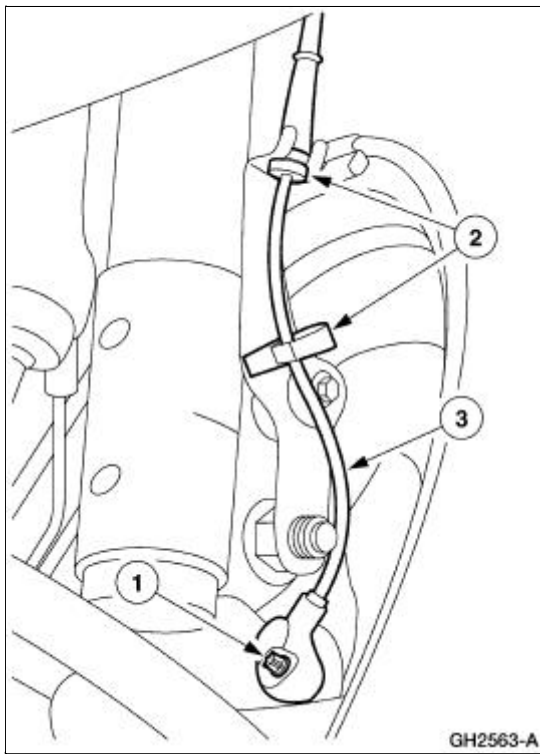
3. Remove the front anti-lock brake sensor electrical connector.



4. Remove the front anti-lock brake sensor harness from the anti-lock brake sensor harness clips.

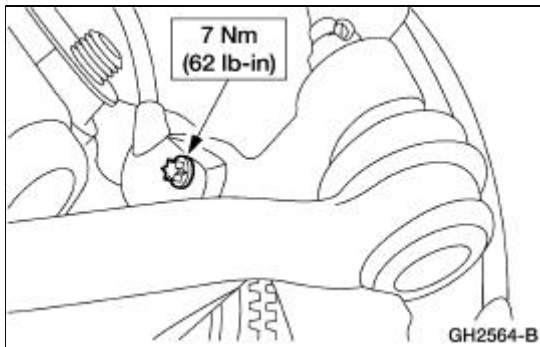


5. Remove the front anti-lock brake sensor.
 1. Remove the front anti-lock brake sensor bolt.
 2. Remove the anti-lock brake sensor harness from the harness clips.
 3. Remove the front anti-lock brake sensor.



Installation

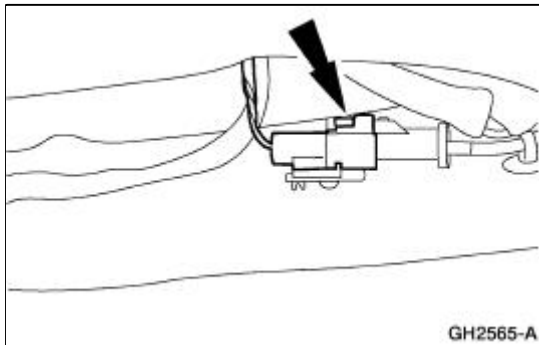
1. To install, reverse the removal procedure.



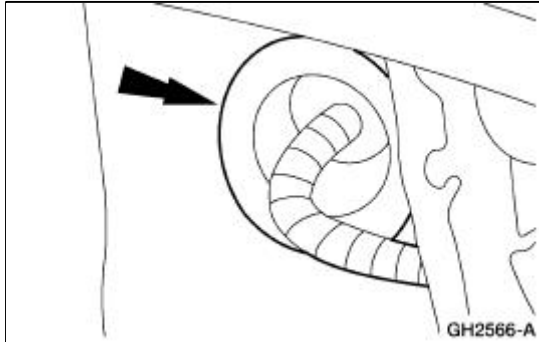
Sensor —Rear

Removal

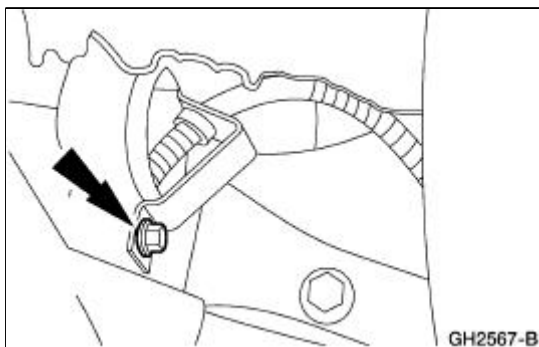
1. Remove the rear passenger seat.
2. Disconnect the rear anti-lock brake sensor electrical connector.



3. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
4. Remove the rear anti-lock brake sensor harness from the floor pan.



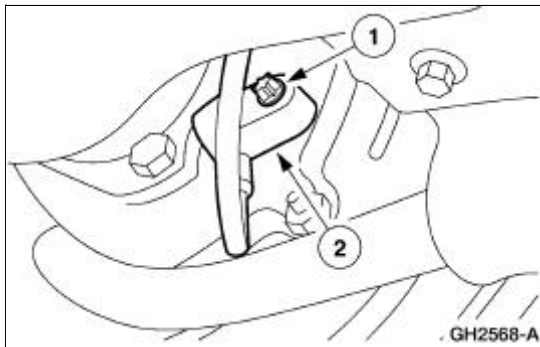
5. Remove the anti-lock brake sensor harness bracket bolt.



6. **NOTE:** The sensor may be seized to the axle. Use Rust Penetrant and Inhibitor F2AZ-19A501-A meeting Ford specification ESR-M99C56-A to loosen the sensor for removal.

Remove the rear anti-lock brake sensor.

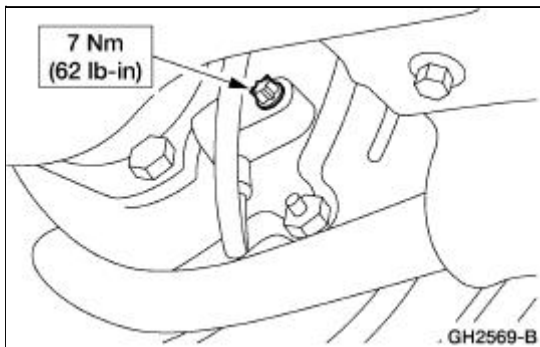
1. Remove the rear anti-lock brake sensor bolt.
2. Remove the rear anti-lock brake sensor.



Installation

1. **NOTE:** Be sure to apply High Temperature Nickel Anti-Sieze Lubricant F6AZ-9L494-AA meeting Ford specification ESE-M124A-A to the sensor body where it will make contact when installed.

To install, reverse the removal procedure.

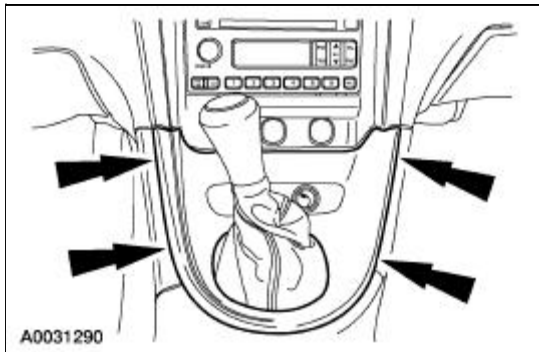


Switch — Traction Control

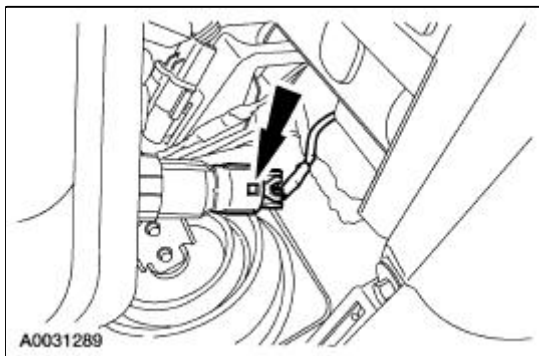
Removal and Installation

1. **NOTE:** If the vehicle is equipped with an automatic transmission, position the shift lever in the 1 position before detaching the floor console finish panel.

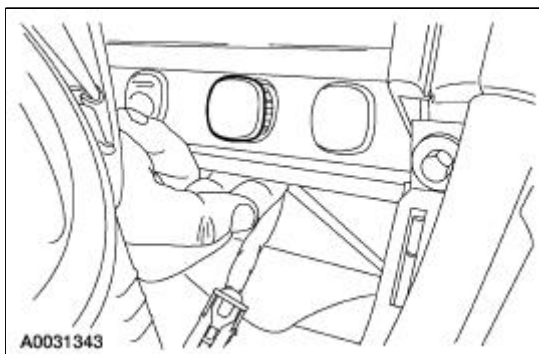
Lifting from both sides, detach the floor console finish panel.



2. Disconnect the electrical connector and position the finish panel out of the way.



3. Reaching behind the center finish panel, push and detach the switch from the finish panel.



4. Disconnect the electrical connector and remove the switch.



5. To install, reverse the removal procedure.
-

General Specifications

Item	Specification
Lubricants	
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®
Power Steering Gear	
Turning effort	2.27 Kg (5.0 lb)
Turns lock-to-lock	2.38
Power Steering Purge Vacuum	
Vacuum	68-85 kPa (20-25 in/hg)
Power Steering Pump — CII	
Flow	9.8 liters/minute (2.6 gpm) Fluid @ 74°-80° C (165°-175° F) Engine at 1,500 rpm
Pressure	1,034 kPa (150 psi) Fluid @ 74°-80° C (165°-175° F) Engine at 1,500 rpm
Minimum capacity	3.4 liters/minute (0.9 gpm) Fluid @ 74°-80° C (165°-175° F) Engine at idle Pressure at 5,102 kPa (750 psi)
Relief pressure	7,240-8,400 kPa (1,050-1,230 psi)
Power Steering Pump — CIII	
Flow	9.8 liters/minute (2.6 gpm) Fluid @ 74°-80° C (165°-175° F) Engine at 1,500 rpm
Pressure	1,034 kPa (150 psi) Fluid @ 74°-80° C (165°-175° F) Engine at 1,500 rpm
Minimum capacity	4.7 liters/minute (1.25 gpm) Fluid @ 74°-80° C (165°-175° F) Engine at idle Pressure at 5,171 kPa (750 psi)

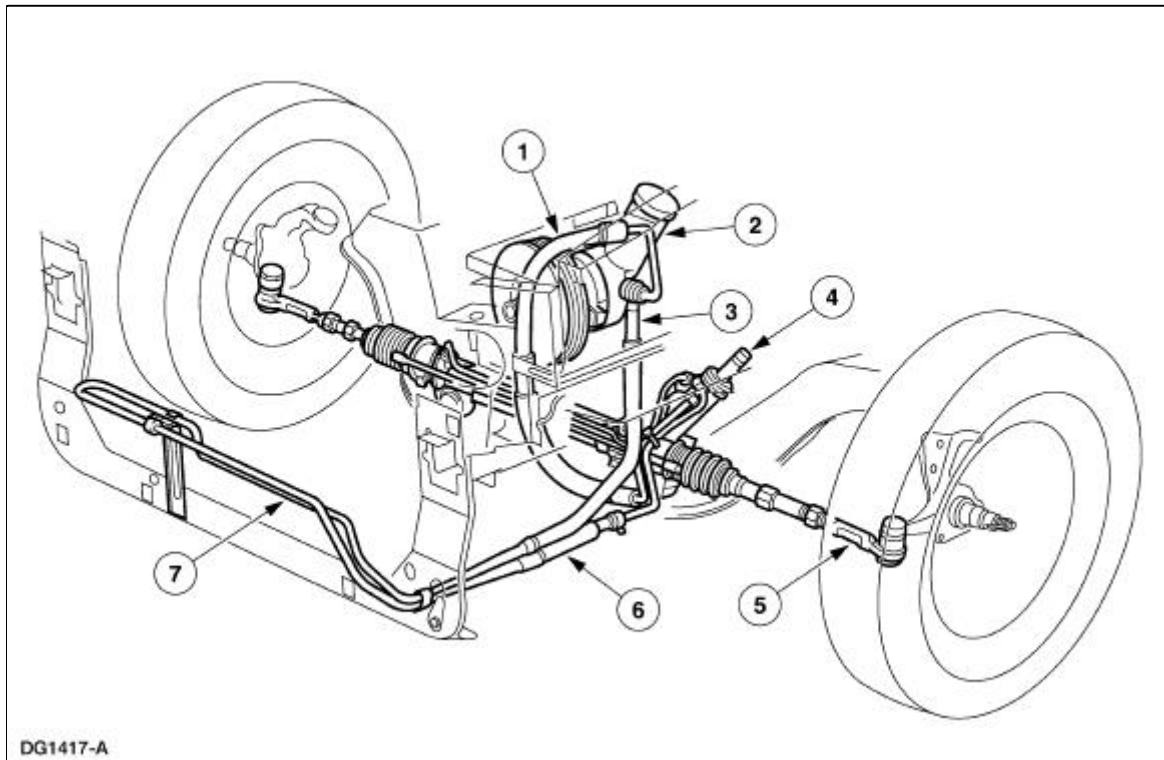
Relief pressure

8,274-9,510 kPa
(1,200-1,380 psi)

Steering System

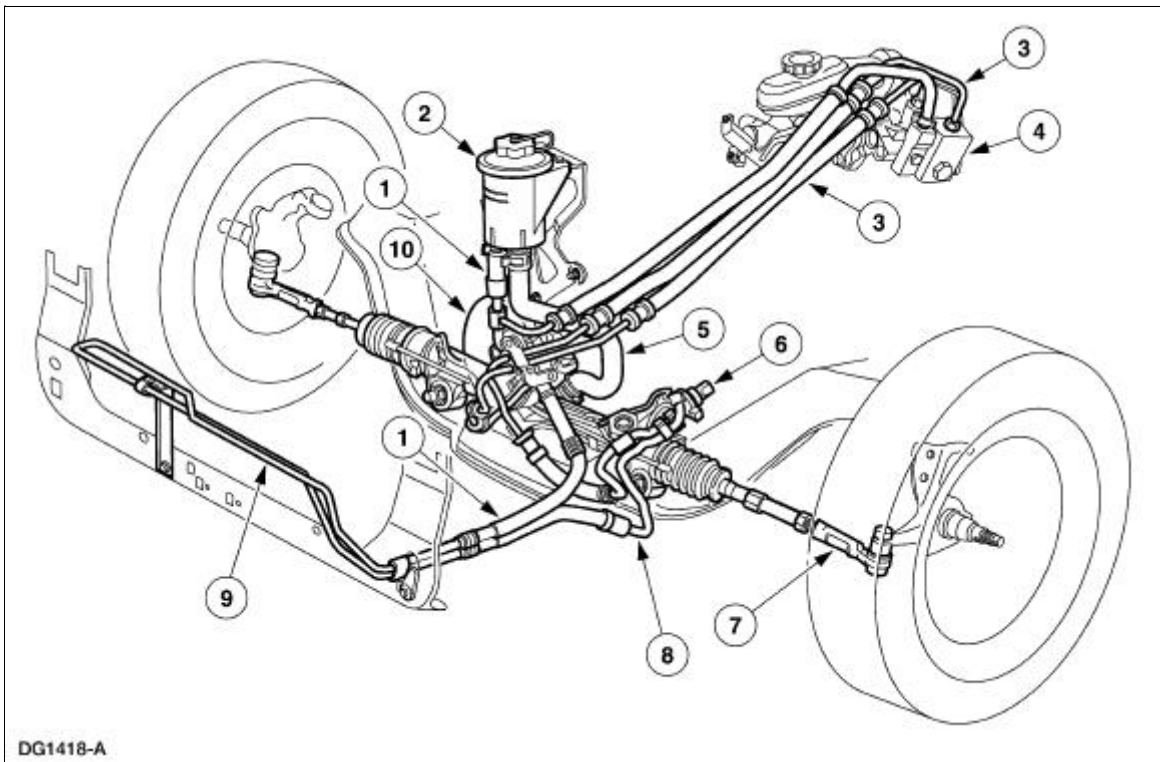
The steering system has a typical rack-and-pinion design consisting of the following:

Steering System Components — 3.8L Engine (CII Power Steering Pump)



Item	Part Number	Description
1	3A714	Power steering hose
2	3A674	Power steering pump
3	3493	Power steering hose
4	3504	Steering gear
5	3A130	Tie-rod end
6	3493	Power steering hose
7	3D746	Power steering fluid cooler

Steering System Components — 4.6L Engine (CIII Power Steering Pump)



DG1418-A

Item	Part Number	Description
1	3A713	Power steering hose
2	3R700	Power steering pump reservoir
3	3A714	Power steering hose
4	2B559	Hydro-boost assy
5	3E525	Power steering hose
6	3504	Steering gear
7	3A130	Tie-rod end
8	3A713	Power steering hose
9	3D746	Power steering fluid cooler
10	3A674	Power steering pump

For information on the power steering oil reservoir (3A697), refer to [Section 211-02](#).

For information on the steering wheel and column assembly, refer to [Section 211-04](#).

For information on the power steering hoses, refer to [Section 211-02](#).

For information on the front wheel spindles, refer to [Section 204-01](#).







For information on the power steering fluid cooler, refer to [Section 211-02](#).

For information on the power steering pump, refer to [Section 211-02](#).


For information on the steering gear, refer to [Section 211-02](#).

Steering System

Special Tool(s)

 ST1396-A	Dial Thermometer 0-220°F 023-R0007 or Equivalent
 ST1177-A	Hand Held Automotive Meter 105-R0053 or Equivalent
 ST1477-A	Power Steering Analyzer 211-F001 (014-00207) or Equivalent
 ST1689-A	Spring Scale 211-034 (T74P-3504-Y)
 ST1398-A	Tach Adapter 418-F102 (007-00061) or Equivalent
 ST1688-A	Tie-Rod End Remover Tool 211-001 (TOOL-3290-D) or Equivalent

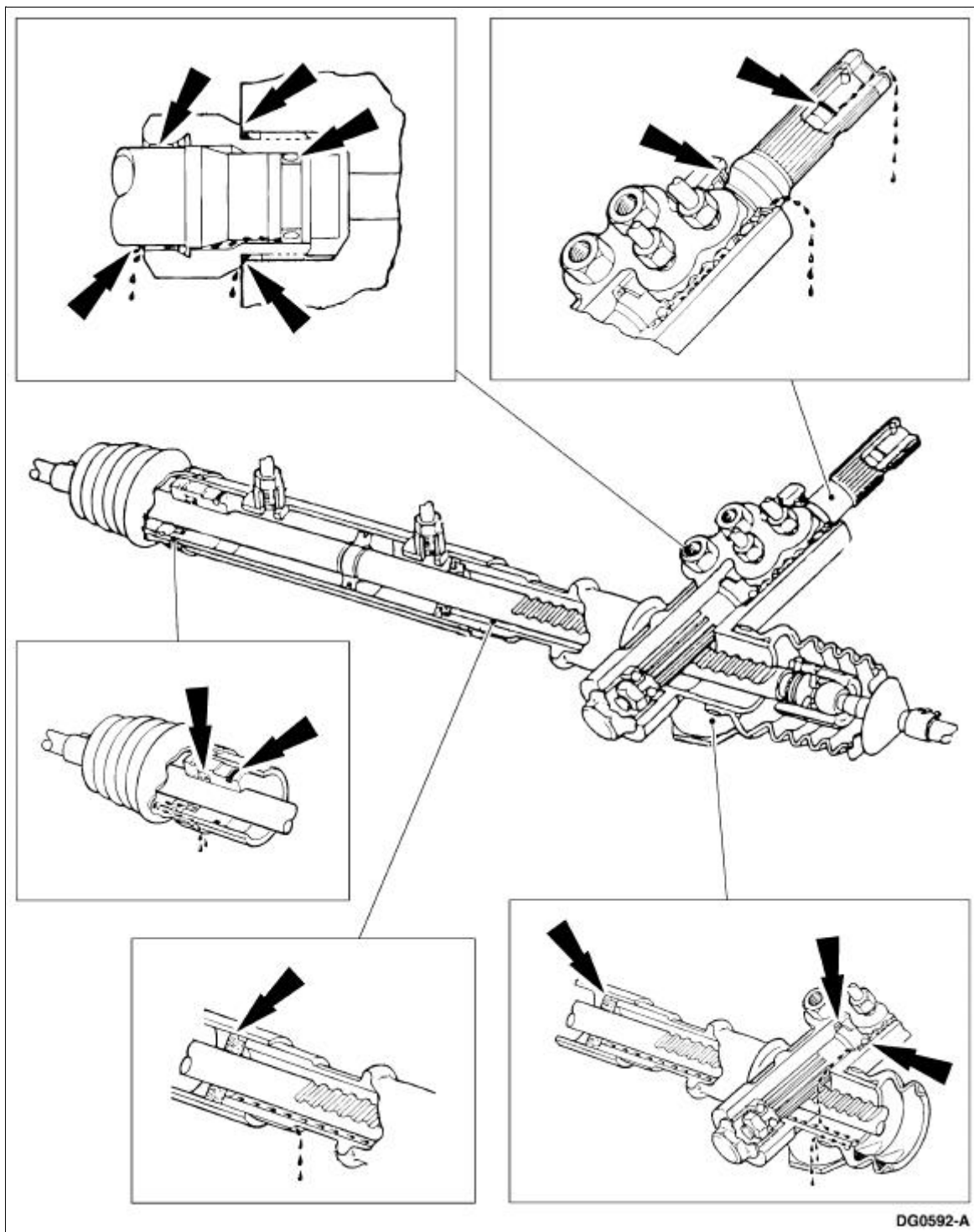
Inspection and Verification

 **CAUTION:** Do not hold the steering wheel (3600) at the stops for an extended amount of time. Damage to the power steering pump (3A674) will result.

NOTE: Make the following preliminary checks before repairing the steering system:

1. Verify the customer concern by operating the steering system.
2. Inspect Tires
 - Check the tire pressure. Refer to the Vehicle Certification (VC) label.
 - Verify that all tires are sized to specification.
 - Check the tires for damage or uneven wear.
3. Belt and Tensioner Check
 - Refer to [Section 303-05](#) for diagnosis and testing of the accessory drive system.
4. Fluid Level Check
 - Verify that the power steering fluid level is within the appropriate indicated range, hot for the 3.8L engine and cold for the 4.6L engine. Add Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent.
5. Air Bleeding
 - Verify that there is no air in the power steering system. Run the engine (6007) until it reaches normal operating temperature. Turn the steering wheel to the left and right several times without hitting the stops. If any air bubbles are present, refer to [Purging—CII Power Steering Pump](#) or [Purging—CIII Power Steering Pump](#) in this section.

External Leak Check — Typical Power Rack-and-Pinion Steering Gear



6. External Leak Check

- With the ignition switch at OFF, wipe off the power steering pump, power steering hoses, power steering fluid cooler (3D746) and steering gear (3504).
- With the engine running, turn the steering wheel from stop-to-stop several times. Do not hold steering wheel at stops. Check for leaks. Repair as necessary if leaks are observed.

7. Turning Effort Check

- Refer to Turning Effort Test under Component Tests in this section.

8. Visually inspect for obvious signs of mechanical damage; refer to the following chart.

Visual Inspection Chart

Mechanical
<ul style="list-style-type: none">● Loose tie-rod ends● Loose suspension components● Loose steering column shaft universal joints● Loose column intermediate shaft bolts● Steering gear● Binding or misaligned steering column● Power steering pump● Bent or pinched power steering hoses

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

Steering System Symptom Definitions

Drift/Pull

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

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

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

Excessive Steering Wheel Play

Excessive steering wheel play is a condition in which there is too much steering wheel movement before the wheels move. A small amount of steering wheel free play is considered normal.

Feedback

Feedback is a roughness felt in the steering wheel when the vehicle is driven over rough pavement.

Hard Steering or Lack of Assist

Hard steering or lack of assist is experienced when the steering wheel effort exceeds specifications. Hard steering can remain constant through the full turn or occur near the end of a turn. It is important to know the difference between hard steering/lack of assist and binding.

Hard steering or lack of assist can result from either hydraulic or mechanical conditions. It is extremely important to know if this concern occurs during driving, during very heavy or static parking maneuvers.

Nibble

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

Poor Returnability/Sticky Steering

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

Shimmy

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

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

Wander

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

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● Hard Steering or Lack of Assist 	<ul style="list-style-type: none"> ● Seized lower steering column shaft U-joints. ● Damaged, fractured steering column bearing(s). ● Power steering pump. ● Suspension components. ● Steering gear internal leakage. 	<ul style="list-style-type: none"> ● INSTALL a new lower steering column shaft. REFER to Section 211-04. ● REPAIR the steering column. REFER to Section 211-04. ● GO to Pump Flow and Pressure Test Component Test in this section. ● REFER to Section 204-00 for suspension system diagnosis and testing. ● GO to Pump Flow and Pressure Test Component Test in this section.
<ul style="list-style-type: none"> ● Excessive Steering Pump Noise 	<ul style="list-style-type: none"> ● Power steering pump. 	<ul style="list-style-type: none"> ● GO to Pump Flow and Pressure Test Component Test in this section.
<ul style="list-style-type: none"> ● Excessive Steering Wheel Play 	<ul style="list-style-type: none"> ● Damaged, loose, or worn tie-rod end (3A130). ● Loose, worn or damaged front wheel spindle tie-rod (3280). ● Damaged/worn steering gear. ● Loose, worn or damaged steering 	<ul style="list-style-type: none"> ● GO to the Steering Linkage Component Test. ● GO to the Tie-Rod Articulation Torque Component Test. ● INSTALL a new steering gear. REFER to Section 211-02. ● INSTALL new steering column

	<p>column bearing(s).</p> <ul style="list-style-type: none"> ● Loose, worn or damaged lower steering column shaft U-joint(s). 	<p>bearing(s). REFER to Section 211-04.</p> <ul style="list-style-type: none"> ● INSTALL a new lower steering column shaft. REFER to Section 211-04.
<ul style="list-style-type: none"> ● Wander 	<ul style="list-style-type: none"> ● Unevenly loaded or overloaded vehicle. ● Loose, worn or damaged front wheel spindle tie-rod. ● Loose, worn or damaged tie-rod ends. ● Loose or damaged steering gear mounting bolts. ● Loose lower steering column shaft U-joint bolts. ● Loose, worn or damaged lower steering column shaft U-joints. ● Loose, worn or damaged steering column bearing(s). ● Suspension components. 	<ul style="list-style-type: none"> ● INFORM the customer of incorrect vehicle loading. ● GO to the Tie-Rod Articulation Torque Component Test. ● GO to the Steering Linkage Component Test. ● INSTALL new or TIGHTEN bolts. REFER to Section 211-02. ● TIGHTEN the bolts. REFER to Section 211-04. ● INSTALL a new lower steering column shaft. REFER to Section 211-04. ● INSTALL new steering column bearings. REFER to Section 211-04. ● REFER to Section 204-00 for suspension system diagnosis and testing.
<ul style="list-style-type: none"> ● Drift/Pull 	<ul style="list-style-type: none"> ● Unevenly loaded or overloaded vehicle. ● Wheel alignment. ● Loose, worn or damaged front wheel spindle tie-rod. ● Loose, worn or damaged tie-rod ends. ● Suspension components. ● The steering gear valve effort out of balance. ● Check the brake system for proper 	<ul style="list-style-type: none"> ● INFORM the customer of incorrect vehicle loading. ● CHECK the wheel alignment. ADJUST as required. REFER to Section 204-00. ● GO to the Tie-Rod Articulation Torque Component Test. ● GO to the Steering Linkage Component Test. ● REFER to Section 204-00 for suspension system diagnosis and testing. ● GO to Steering Gear Valve Component Test in this section. ● REFER to Section 206-00.

	<p>operation.</p> <ul style="list-style-type: none"> ● Incorrect frame/underbody alignment. 	<ul style="list-style-type: none"> ● CORRECT as required. REFER to Frame Dimension Manual.
<ul style="list-style-type: none"> ● Feedback 	<ul style="list-style-type: none"> ● Loose, worn or damaged front wheel spindle tie-rod. ● Loose, worn or damaged tie-rod ends. ● Loose or damaged steering gear insulators or bolts. ● Loose lower steering column shaft U-joint bolts. ● Loose suspension bushings, fasteners or ball joints. ● Worn or damaged steering column bearing(s). 	<ul style="list-style-type: none"> ● GO to the Tie-Rod Articulation Torque Component Test. ● GO to the Steering Linkage Component Test. ● INSTALL new or TIGHTEN the retaining bolts. REFER to Section 211-02. ● TIGHTEN the bolts. REFER to Section 211-04. ● INSTALL new suspension components as necessary. REFER to Section 204-01. ● INSTALL new steering column bearing(s). REFER to Section 211-04.
<ul style="list-style-type: none"> ● Poor Returnability/Sticky Steering 	<ul style="list-style-type: none"> ● Binding lower steering column shaft U-joints. ● Loose, worn or damaged front wheel spindle tie-rod. ● Loose, worn or damaged tie-rod ends. ● Suspension components. ● Binding steering column bearing(s). 	<ul style="list-style-type: none"> ● INSTALL a new lower steering column shaft. REFER to Section 211-04. ● GO to the Tie-Rod Articulation Torque Component Test. ● GO to the Steering Linkage Component Test. ● REFER to Section 204-00 for suspension system diagnosis and testing. ● INSTALL new steering column bearing(s). REFER to Section 211-04.
<ul style="list-style-type: none"> ● Shimmy 	<ul style="list-style-type: none"> ● Loose, worn or damaged tie-rod end. ● Loose, worn or damaged front wheel spindle tie-rod. ● Suspension components. 	<ul style="list-style-type: none"> ● GO to the Steering Linkage Component Test. ● GO to the Tie-Rod Articulation Torque Component Test. ● REFER to Section 204-00 for suspension system diagnosis and testing.

Component Tests

Steering Linkage


1. **NOTE:** Excessive **vertical** motion of the studs relative to the sockets may indicate excessive wear.

With the parking brake applied, perform the following:

- Have an assistant rotate the steering wheel back and forth 360 degrees and watch for relative motion of the studs in the tie-rod end ball sockets.
 - Watch for loose steering gear mounting.
2. Another method is to raise the front wheels (1007) off the ground, grasp the wheel at the front and rear and watch for excessive play or binding in the joints while trying to steer the wheels.
 3. Install new steering components as necessary. For additional information, refer to the appropriate Group 2 steering section.

Turning Effort Test

NOTE: Make sure that the front wheels are properly aligned and the tire pressure is correct before checking the effort.

1. Park the vehicle on dry concrete and set the parking brake.
2. Insert a thermometer into the power steering pump reservoir.
3.  **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump will occur.**

Idle the engine for two to three minutes. Turn the steering wheel from stop-to-stop several times to warm the fluid to 50-60°C (122-140°F).

4. With the engine running, attach special tool 211-034 (T74P-3504-Y) to the rim of the steering wheel.
5. Measure the pull required to turn the steering wheel one complete revolution in each direction. Refer to Steering Wheel Turning Effort under General Specifications in this section.


Pump Flow and Pressure Test




WARNING: Do not touch the flowmeter during the test procedure, or severe burns and serious injury may occur.

1.  **CAUTION: Make sure that the connection point will not interfere with any of the engine accessory drive components or drive belts.**


Install special tool 211-F001 (014-00207) at the high pressure port of the power steering pump. Make sure the power steering analyzer gate valve is fully open.

- On some vehicles, the power steering pump high pressure port is inaccessible and the special tool should then be installed either at the steering gear or at a point in the high pressure line between the power steering pump and the steering gear.
2. Place a dial thermometer in the power steering pump reservoir.
 3. Check the power steering fluid level. If necessary, add power steering fluid.
 - Use Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent.
 4. Install a digital tachometer.
 5.  **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump will occur.**

Start the engine. Place the transmission in neutral. Set the parking brake. Raise the power steering fluid temperature to 74-80°C (165-175°F) by rotating the steering wheel fully to the left and right several times.

6. Set the engine speed to 1500 rpm. Record the flow rate and pressure readings.
 - If the flow rate is below the flow rate specification, a new power steering pump may need to be installed. Continue with the test procedure.
 - If the pressure reading is above the maximum pressure specification, then check power steering hoses for kinks and restrictions.
7. Partially close the gate valve to obtain 750 psi. Set the engine speed at idle. Record the flow rate.
 - If the flow is less than the specified flow rate, then install a new power steering pump. For additional information, refer to [Section 211-02](#).
8.  **CAUTION: Do not allow the gate valve to remain closed for more than 5 seconds.**

Completely close and partially open the gate valve 3 times. Record the pressure relief valve actuation pressure reading.

- If the pressure does not meet the relief pressure specification, install a new power steering pump. For additional information, refer to [Section 211-02](#).
9. Set engine speed to 1500 rpm. Record the flow rate.
 - If the flow rate varies more than 3.785 liters/minute (1 gallon/minute) from the initial flow rate reading, install a new power steering pump. For additional information, refer to [Section 211-02](#).
 10.  **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump will occur.**

Set the engine speed at idle. Turn (or have an assistant turn) the steering wheel to the left and right stops. Record flow rate and pressure readings at the stops.

- The pressure reading at both stops should be nearly the same as the maximum pump relief pressure.
- The flow rate should drop below 1.9 liters/minute (0.5 gallons/minute).
- If the pressure does not reach the maximum pump relief pressure or the flow rate does not drop below the specified value, excessive internal leakage is occurring. Install a new steering gear as necessary. For additional information, refer to [Section 211-02](#).

11. Turn (or have an assistant turn) the steering wheel slightly in both directions and release quickly while watching the pressure gauge.
 - The pressure reading should move from the normal back pressure reading and snap back as the steering wheel is released.
 - If the pressure returns slowly or sticks, the rotary valve in the steering gear is sticking or the steering column is binding. Check the steering column and linkages before servicing the steering gear.

Tie-Rod Articulation Torque

1. **NOTE:** This check may be done with the steering gear on or off the vehicle.

Disconnect the tie-rod end from the front wheel spindle. For additional information, refer to [Section 211-02](#).

2. Move the front wheel spindle tie-rod back and forth three times.
3. Hook the special tool 211-034 (T74P-3504-Y) over the tie-rod end or the threaded portion of the front wheel spindle tie-rod and measure the force required to move the front wheel spindle tie-rod. Refer to Tie-Rod Articulation Torque in General Specifications in this section.
4. If the force required to move the front wheel spindle tie-rod does not meet the specifications, install a new front wheel spindle tie-rod. For additional information, refer to [Section 211-02](#).

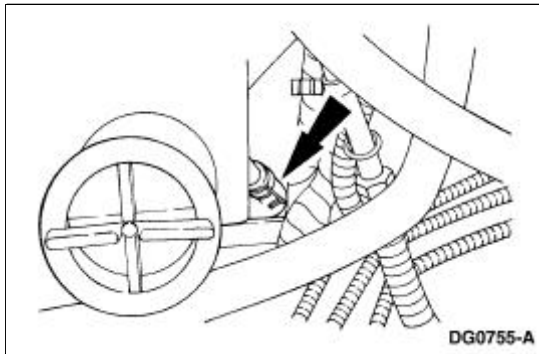
Steering Gear Valve

1. With the vehicle in motion, place the transmission in NEUTRAL and turn the engine OFF.
 - If the vehicle does not pull with the engine OFF, install a new steering gear. For additional information, refer to [Section 211-02](#).
 2. If the vehicle pulls with the engine OFF, cross-switch the front wheels.
 3. If the vehicle pulls to the opposite side, cross-switch the front and rear wheels on the same side.
 4. If the vehicle pull direction does not change, check the front suspension components, wheel alignment and frame alignment. For additional information, refer to [Section 204-00](#) or frame dimensions manual.
-

System Flushing —CII Power Steering Pump

⚠ WARNING: Do not mix oil types. Any mixture or any unapproved oil can lead to seal deterioration and leaks. A leak can ultimately cause loss of fluid, which can result in a loss of power steering assist.

1. Remove the fuel pump fuse from the battery junction box.
2. Disconnect the power steering return hose. Plug the reservoir.



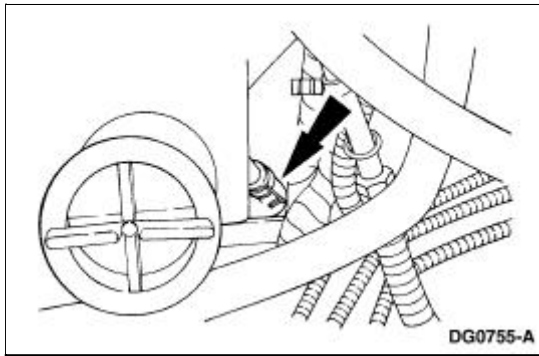
3. Attach an extension hose between the power steering return hose and an empty container.
4. Raise the front wheels off the floor. For additional information, refer to [Section 100-02](#).
5. Check the fluid level. If necessary, fill the reservoir to the correct level.
 - Use Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent.

6. **⚠ CAUTION:** Do not crank the engine for more than 15 seconds at a time. Allow the starter to cool for 1 minute before cranking again. Premature starter failure can occur.

⚠ CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump will occur.

Turn the steering wheel from stop-to-stop while cranking the engine until the fluid exiting the power steering return hose is clear of all contamination and foreign material.

- Add Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent as needed.
7. Lower the vehicle.
 8. Disconnect the extension hose from the power steering return hose. Remove the plug. Attach the power steering return hose to the reservoir.



9.  **CAUTION: Do not overfill the reservoir.**

Check the fluid level. If necessary, fill the reservoir to the correct level.

- Use Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent.

10. Install the fuel pump fuse.

11.  **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump will occur.**

Start the engine and turn the steering wheel from stop-to-stop.

12.  **CAUTION: Do not overfill the reservoir.**

NOTE: If the power steering system is noisy and is accompanied by evidence of aerated fluid it will be necessary to purge the power steering system.

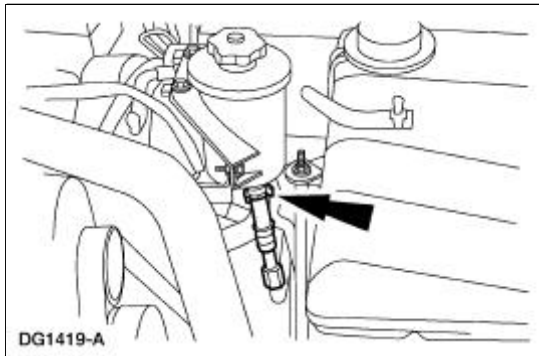
Check the fluid level. If necessary, fill the reservoir to the correct level.

- Use Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent.
-

System Flushing —CIII Power Steering Pump

⚠ WARNING: Do not mix oil types. Any mixture or any unapproved oil can lead to seal deterioration and leaks. A leak can ultimately cause loss of fluid, which can result in a loss of power steering assist.

1. Remove the fuel pump fuse from the battery junction box.
2. Disconnect the power steering return hose. Plug the reservoir.



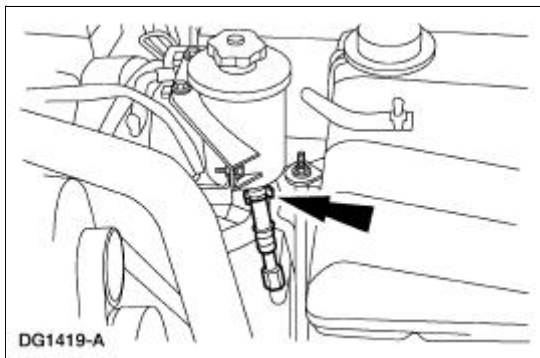
3. Attach an extension hose between the power steering return hose and an empty container.
4. Raise the front wheels off the floor. For additional information, refer to [Section 100-02](#).
5. Check the fluid level. If necessary, fill the reservoir to the correct level.
 - Use Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent.

6. **⚠ CAUTION:** Do not crank the engine for more than 15 seconds at a time. Allow the starter to cool for 1 minute before cranking again. Premature starter failure can occur.

⚠ CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump could occur.

Turn the steering wheel from stop-to-stop while cranking the engine until the fluid exiting the power steering return hose is clear of all contamination and foreign material.

- Add Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent as needed.
7. Lower the vehicle.
 8. Disconnect the extension hose from the power steering return hose. Remove the plug. Attach the power steering return hose to the reservoir.




9.  **CAUTION: Do not overfill the reservoir.**

Check the fluid level. If necessary, fill the reservoir to the correct level.

- Use Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent.

10. Install the fuel pump fuse.

11.  **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump will occur.**

Start the engine and turn the steering wheel from stop-to-stop.

12.  **CAUTION: Do not overfill the reservoir.**

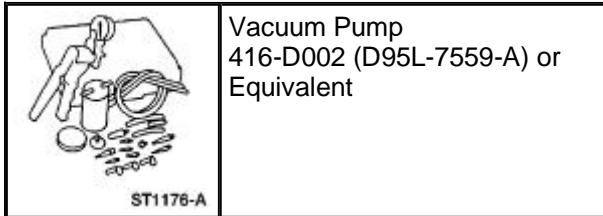
NOTE: If the power steering system is noisy and is accompanied by evidence of aerated fluid it will be necessary to purge the power steering system.

Check the fluid level. If necessary, fill the reservoir to the correct level.

- Use Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent.
-

Purging —CII Power Steering Pump

Special Tool(s)



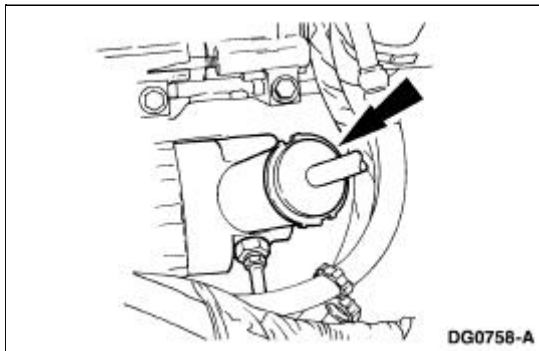
⚠ CAUTION: If the air is not purged from the power steering system correctly, premature power steering pump failure can result. This condition can occur on pre-delivery vehicles with evidence of aerated fluid or on vehicles that have had steering component repairs.

1. **NOTE:** A whine heard from the power steering pump may be caused by air in the system. The power steering purge procedure must be performed prior to any component repair for which power steering noise complaints are accompanied by evidence of aerated fluid.

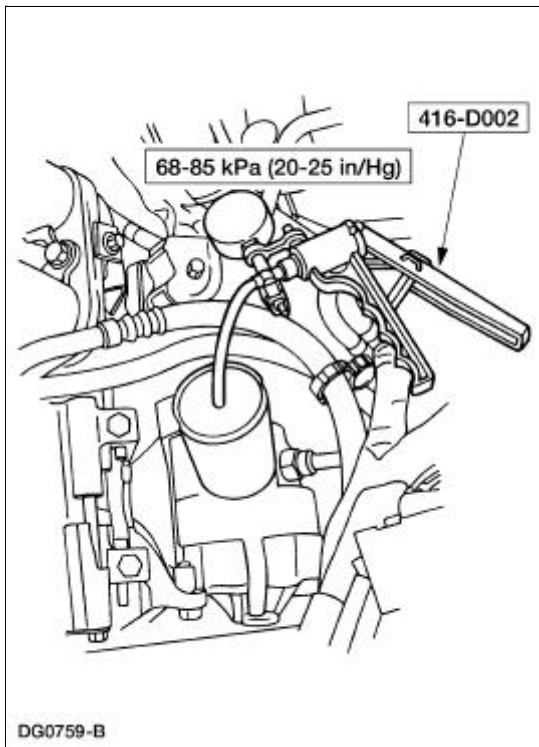
Remove the reservoir cap. Check the fluid level. If necessary, fill the reservoir to the correct level.

- Use Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent.

2. Tightly insert the Vacuum Pump stopper into the reservoir.



3. Start the vehicle.
4. Using the special tool, apply maximum vacuum and maintain it for a minimum of three minutes with the engine speed set at idle.



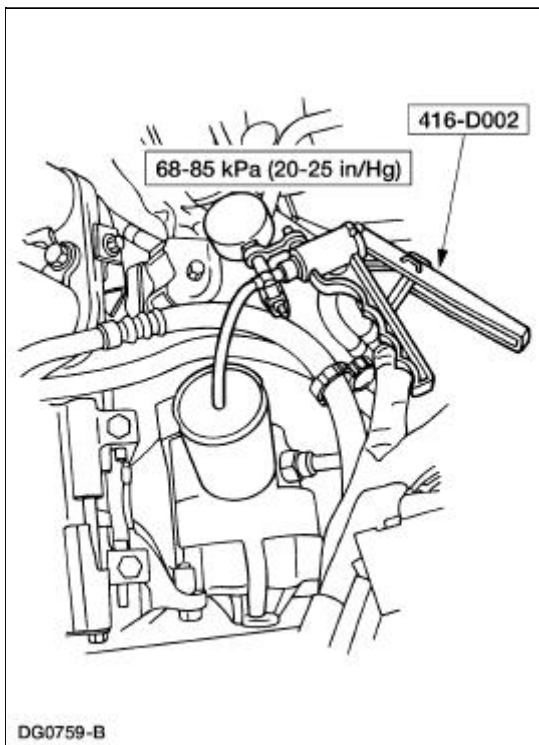
5. Release the vacuum and remove the special tool.


6.  **CAUTION: Do not overfill the reservoir.**

Check the fluid level. If necessary, fill the reservoir to the proper level.

- Use Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent.

7. Reinstall the special tool. Apply and maintain maximum vacuum.



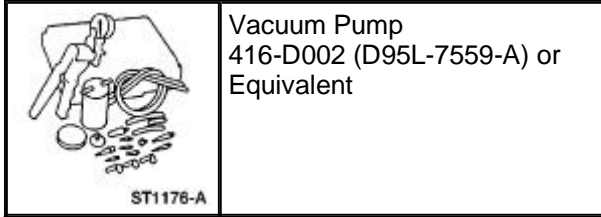
8.  **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump will occur.**

Cycle the steering wheel fully to the left and right every 30 seconds for approximately five minutes.

9. Stop the engine, release the vacuum, and remove the special tool.
 10. Install the reservoir cap.
 11. Check for fluid leaks at all of the connections. If the power steering fluid shows signs of air, repeat this procedure.
-

Purging —CIII Power Steering Pump

Special Tool(s)



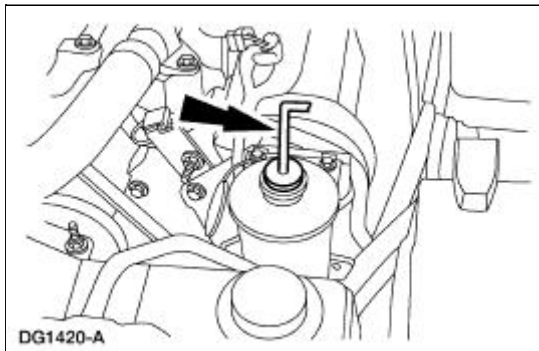
⚠ CAUTION: If the air is not purged from the power steering system correctly, premature power steering pump failure can result. This condition can occur on pre-delivery vehicles with evidence of aerated fluid or on vehicles that have had steering component repairs.

1. **NOTE:** A whine heard from the power steering pump may be caused by air in the system. The power steering purge procedure must be performed prior to any component repair for which power steering noise complaints are accompanied by evidence of aerated fluid.

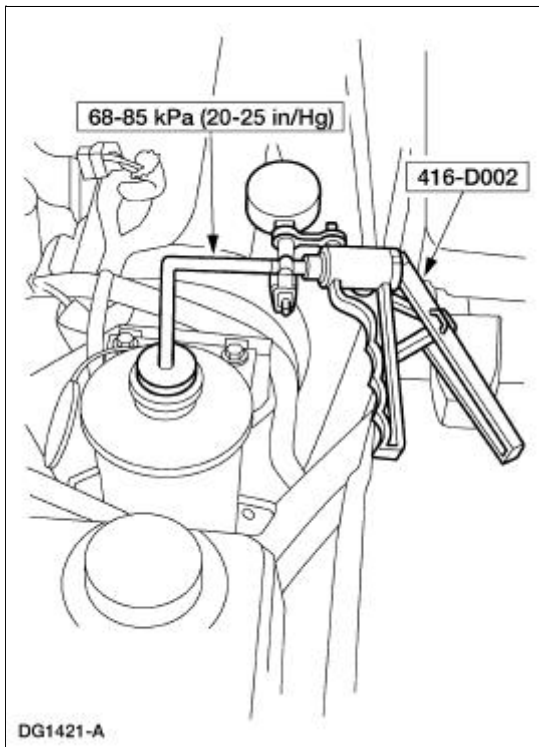
Remove the reservoir cap. Check the fluid level. If necessary, fill the reservoir to the correct level.

- Use Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent.

2. Tightly insert the Vacuum Pump stopper into the reservoir.



3. Start the vehicle.
4. Using the special tool, apply maximum vacuum and maintain it for a minimum of three minutes with the engine speed set at idle.



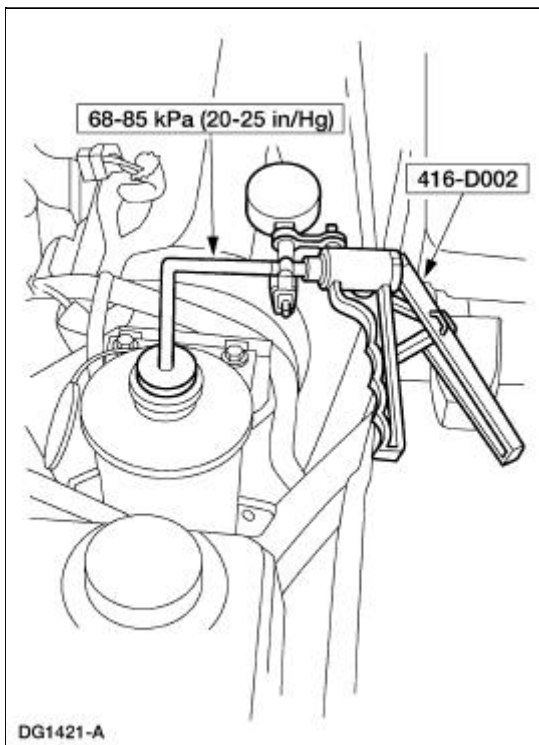
5. Release the vacuum and remove the special tool.


6.  **CAUTION: Do not overfill the reservoir.**

Check the fluid level. If necessary, fill the reservoir to the correct level.

- Use Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent.

7. Reinstall the special tool. Apply and maintain maximum vacuum.




8.  **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump will occur.**

Cycle the steering wheel fully to the left and right every 30 seconds for approximately five minutes.

9. Stop the engine, release the vacuum, and remove the special tool.
 10. Install the reservoir cap.
 11. Check for fluid leaks at all of the connections. If the power steering fluid shows signs of air, repeat this procedure.
-


Fill

1.  **WARNING: Do not mix oil types, any mixture or any unapproved oil can lead to seal deterioration and leaks. A leak can ultimately cause loss of fluid, which can result in a loss of power steering assist.**

Check the fluid level. If necessary, fill the reservoir to the correct level.

- Use Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent.

2. Remove the fuel pump fuse from the battery junction box.
3. Raise the front wheels off the floor. For additional information, refer to [Section 100-02](#).

4.  **CAUTION: Do not crank the engine for more than 15 seconds at a time. Allow the starter to cool for 1 minute before cranking again. Premature starter failure can occur.**

 **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump will occur.**

Turn the steering wheel from stop-to-stop while cranking the engine.

5. Lower the vehicle.

6.  **CAUTION: Do not overfill the reservoir.**

Check the fluid level. If necessary, fill the reservoir to the correct level.

- Use Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent.

7. Install the fuel pump fuse.
-

General Specifications

Item	Specification
Lubricants	
Motorcraft Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®
Silicone Dielectric Compound D7AZ-19A331-A	ESE-M1C171-A
Steering Gear Grease C3AZ-19578-A	ESW-M1C87-A

Torque Specifications

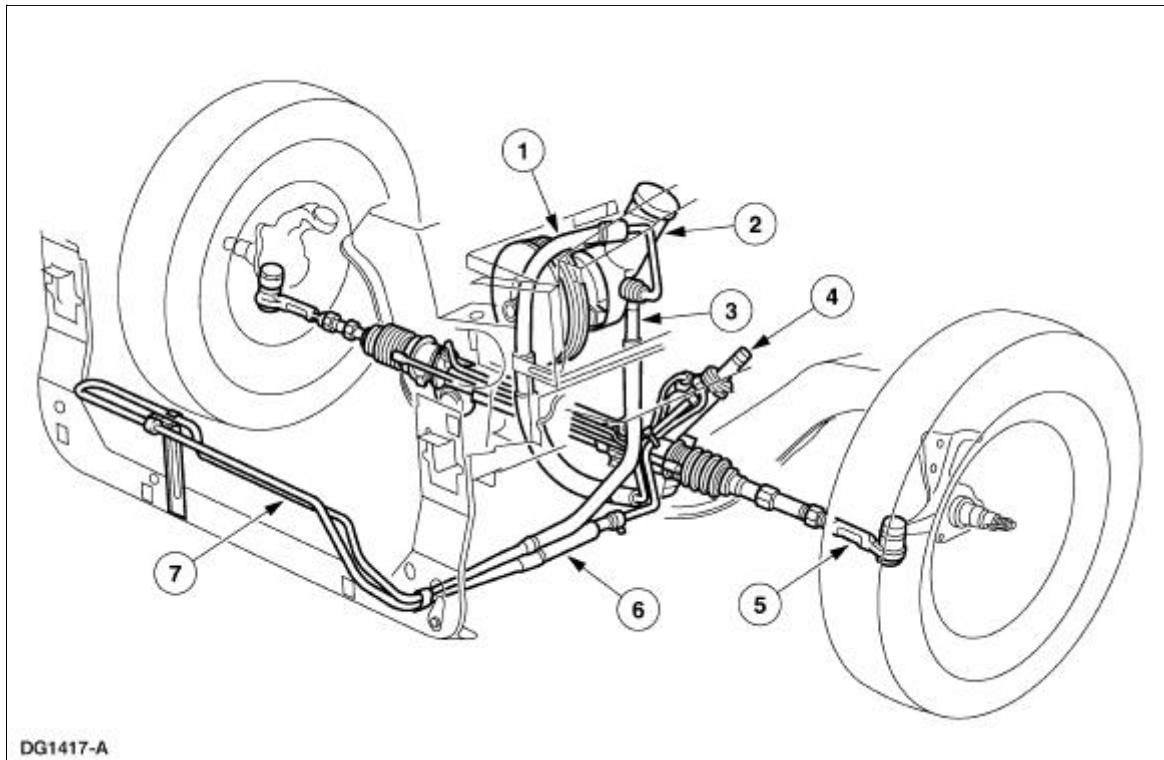
Description	Nm	lb-ft	lb-in
Front wheel spindle tie-rod	100	74	—
Power steering pump mounting bolts (CII pump)	51	38	—
Power steering pump mounting bolts (CIII pump)	25	18	—
Pressure line fitting (CII pump)	40	30	—
Pressure line fitting (CIII pump)	65	48	—
Pressure line fitting	30	22	—
Return line fitting (steering gear)	30	22	—
Steering gear mounting nut	48	35	—
Steering intermediate shaft coupling pinch bolt	34	25	—
Tie-rod end castellated nut	56 ^a	11 ^a	—
Tie-rod end jam nut	55	41	—

^a Once torque is reached, continue turning to align slot in nut with cotter pin hole in tie-rod.

Power Steering

System View

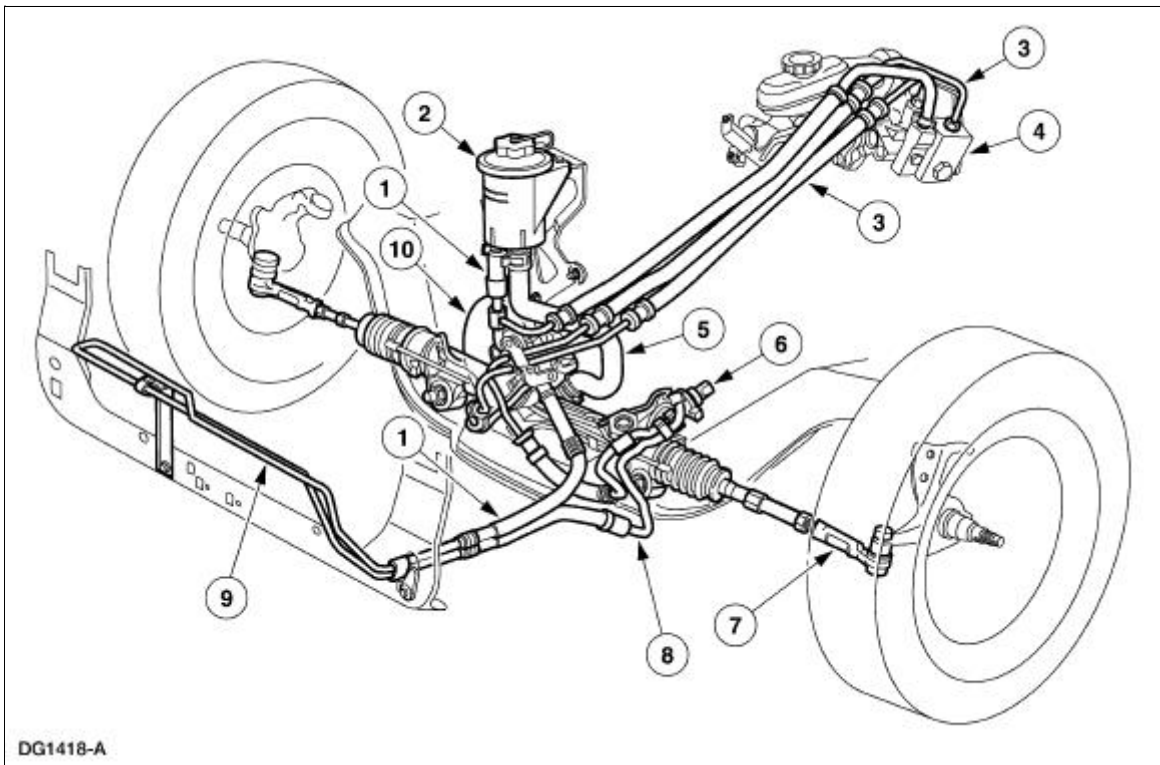
Steering System Components — 3.8L Engine



DG1417-A

Item	Part Number	Description
1	3A714	Power steering hose
2	3A674	Power steering pump
3	3493	Power steering hose
4	3504	Steering gear
5	3A130	Tie-rod end
6	3493	Power steering hose
7	3D746	Power steering fluid cooler

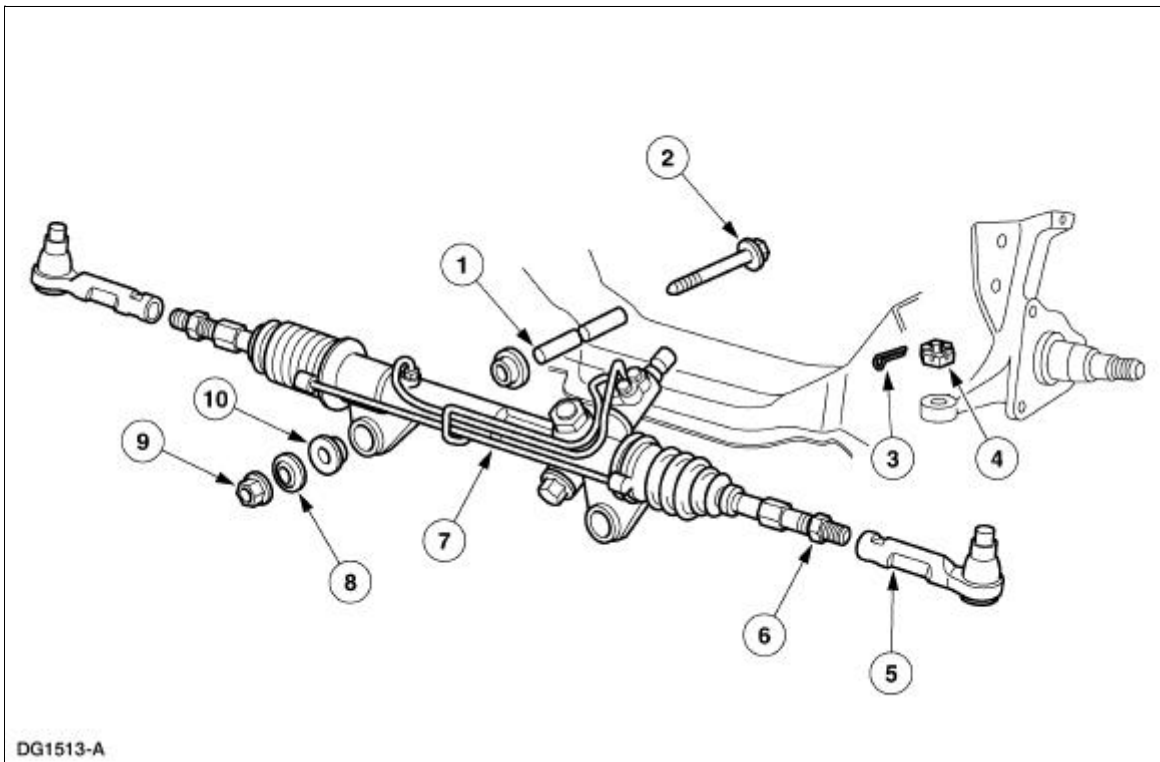
Steering System Components — 4.6L Engine



DG1418-A

Item	Part Number	Description
1	3A713	Power steering return hose
2	3R700	Power steering pump reservoir
3	3A714	Power steering hose
4	—	Hydroboost unit
5	3E525	Power steering reservoir pump hose
6	3504	Steering gear
7	3289	Tie-rod end
8	3A713	Power steering return hose
9	3D746	Power steering fluid cooler
10	3A674	Power steering pump

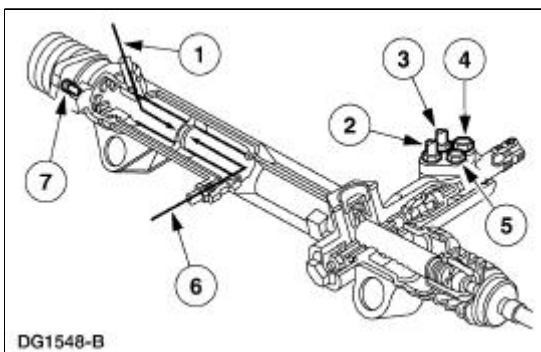
Steering Gear Mounting



DG1513-A

Item	Part Number	Description
1	3E552	Steering gear mounting bracket (2 req'd)
2	N803736-S192	Bolt (2 req'd)
3	72044-S36	Cotter pin (2 req'd)
4	385002-S2	Nut (2 req'd)
5	3289	Tie-rod end (2 req'd)
6	385032-S2	Nut (2 req'd)
7	3504	Steering gear
8	N803734-S2	Washer (2 req'd)
9	N620483-S60	Nut (2 req'd)
10	3F640	Steering gear mounting bracket housing insulator (2 req'd)

Steering Gear

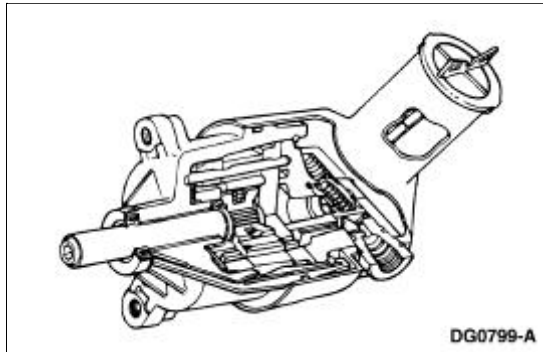


DG1548-B

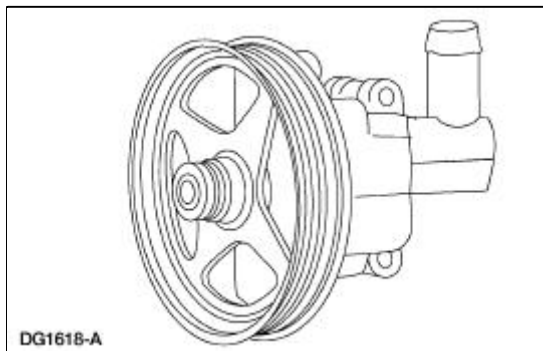
Item	Part Number	Description
1	—	Oil flow — left turn

2	—	To left turn port
3	—	To right turn port
4	—	Return port (out)
5	—	Pressure port (in)
6	—	Oil flow — right turn
7	—	Air transfer tube (between bellows)

Power Steering Pump — CII



Power Steering Pump — CIII

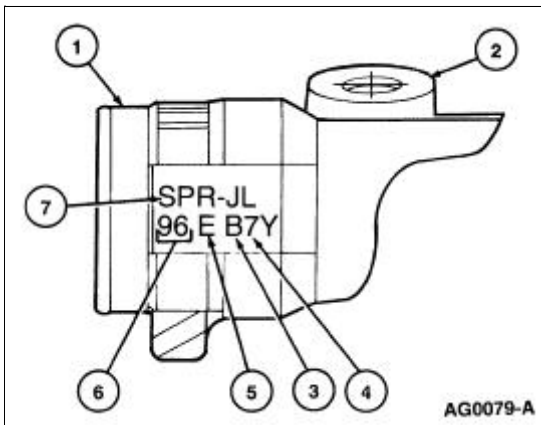


Power Steering Gear Identification



CAUTION: Always use the ID code when ordering service parts.

The steering gear identification code is stamped into the housing.

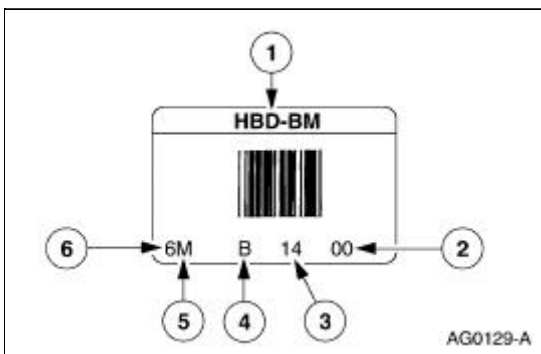


Item	Part Number	Description
1	—	Steering gear housing
2	—	Mounting boss
3	—	Shift code
4	—	Day code
5	—	Month code
6	—	Build year
7	—	Steering gear model code

Power Steering Pump Identification

⚠ CAUTION: Always use the ID code when ordering service parts.

The pump identification code is located on a tag attached to the power steering pump.

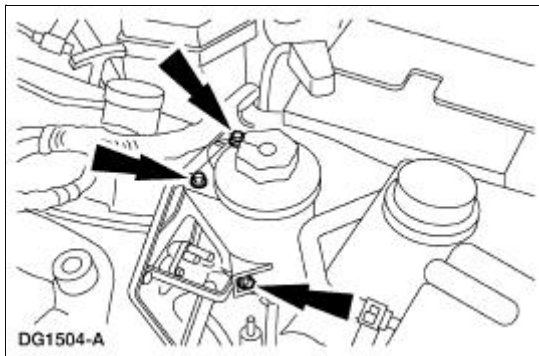


Item	Part Number	Description
1	—	Model code
2	—	For manufacturing purposes only
3	—	Day of the month (A = Jan., B = Feb., etc., I is not used)
4	—	Shift
5	—	Month
6	—	Year

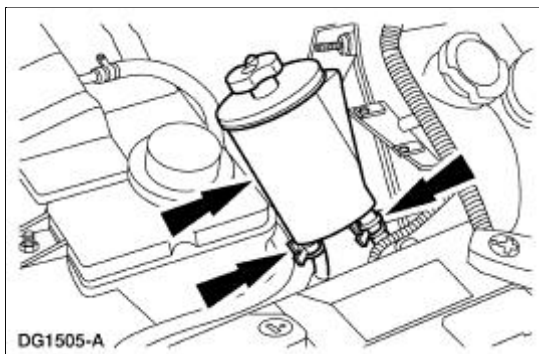
Reservoir —CIII Pump

Removal

1. Remove the bolts.



2. Disconnect the power steering hoses. Remove the reservoir.

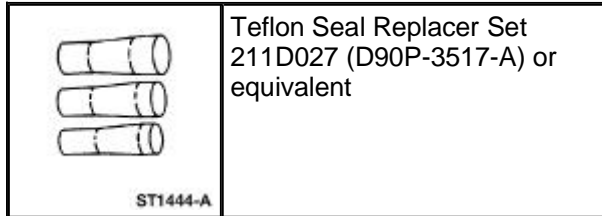


Installation

1. To install, reverse the removal procedure.
 2. Fill and leak check the power steering system. For additional information, refer to [Section 211-00](#).
-

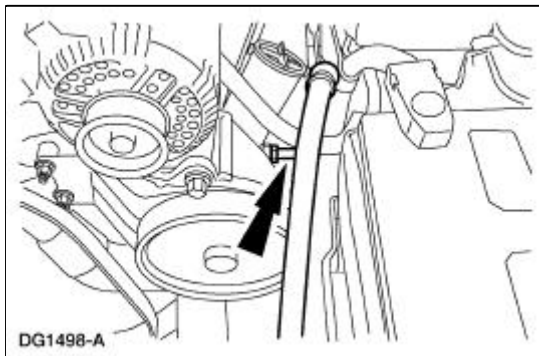
Pump —CII

Special Tool(s)

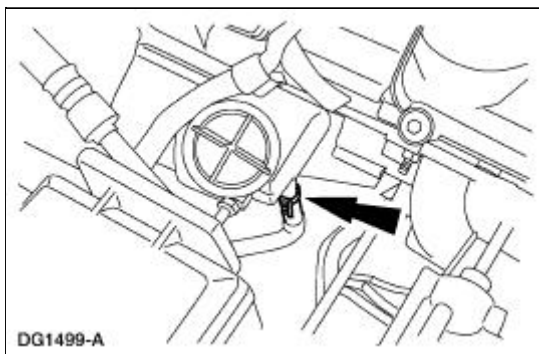


Removal and Installation

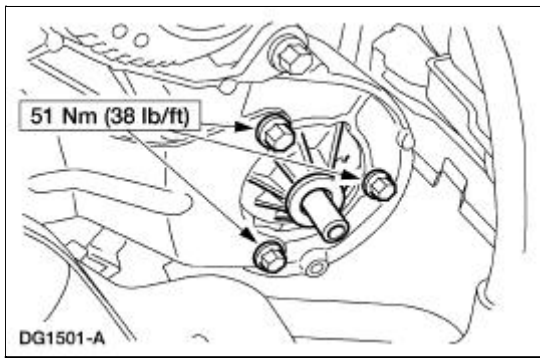
1. Disconnect the power steering hose. Remove and discard the seal ring.



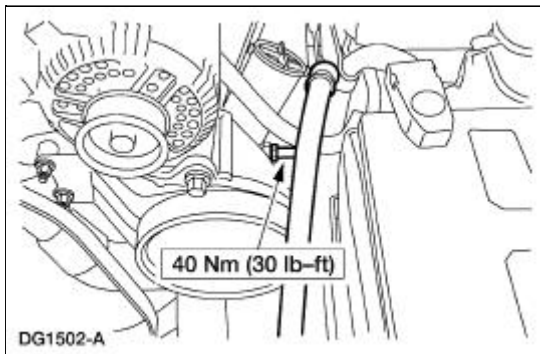
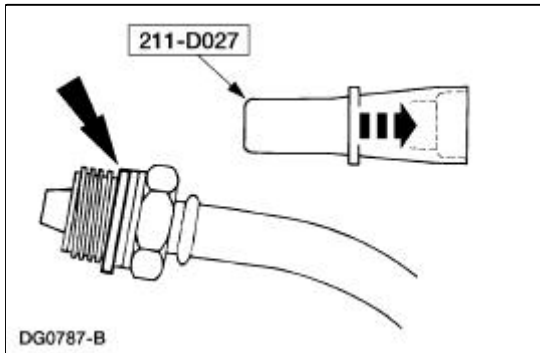
2. Disconnect the power steering hose.



3. Remove the pulley. For additional information, refer to [Pulley—CII Pump](#) in this section.
4. Remove bolts and the power steering pump (3A674).



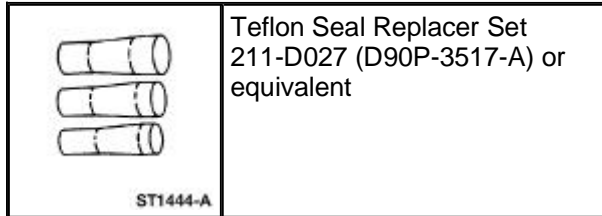
5. To install, reverse the removal procedure.
 - Using the special tool, install a new seal ring.



6. Fill and leak check the power steering system. For additional information, refer to [Section 211-00](#).
-

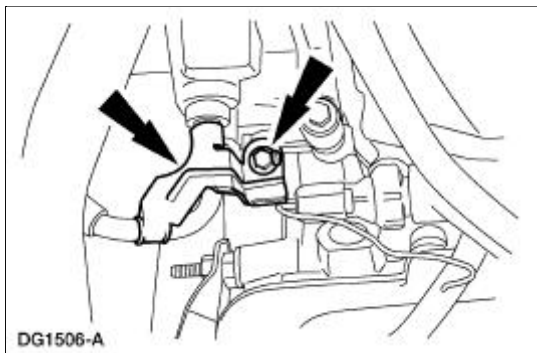
Pump —CIII

Special Tool(s)

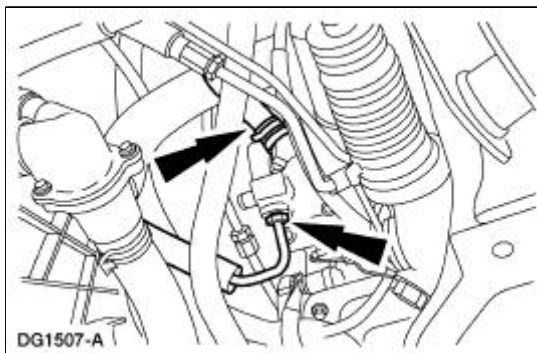


Removal and Installation

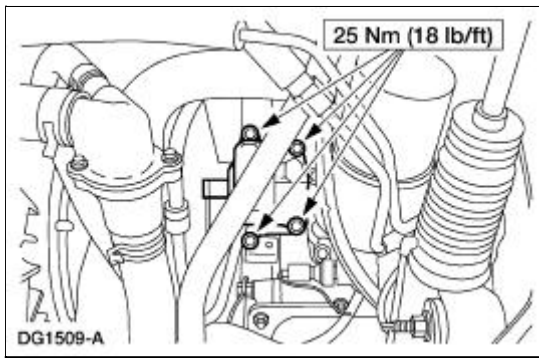
1. Remove the pulley. For additional information, refer to [Pulley—CIII Pump](#) in this section.
2. Remove the bolt and bracket.



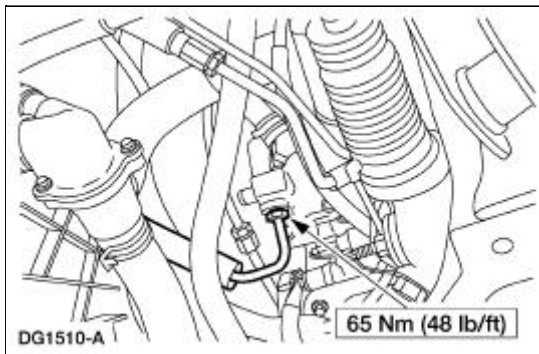
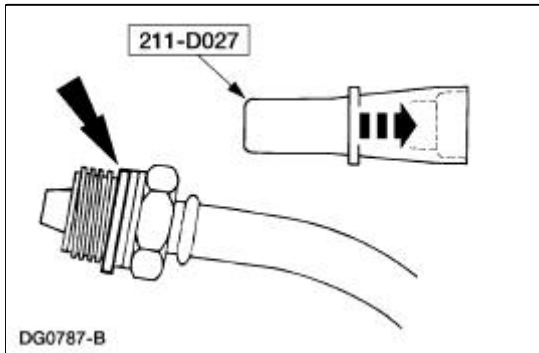
3. Disconnect the power steering hoses. Remove and discard the seal ring.



4. Remove bolts and the power steering pump (3A674).





5. To install, reverse the removal procedure.
 - Using the special tool, install a new seal ring.



6. Fill and leak check the power steering system. For additional information, refer to [Section 211-00](#).
-

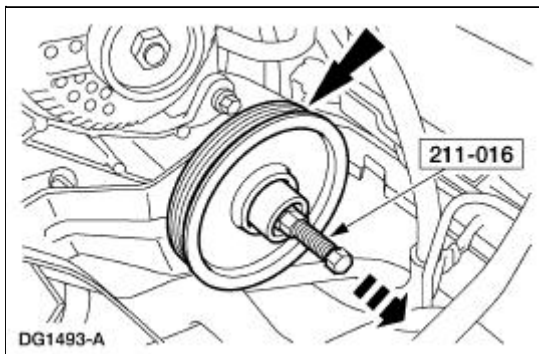
Pulley —CII Pump

Special Tool(s)

	Pump Pulley Installer 211-009 (T65P-3A733-C)
	Pump Pulley Remover 211-016 (T69L-10300-B)

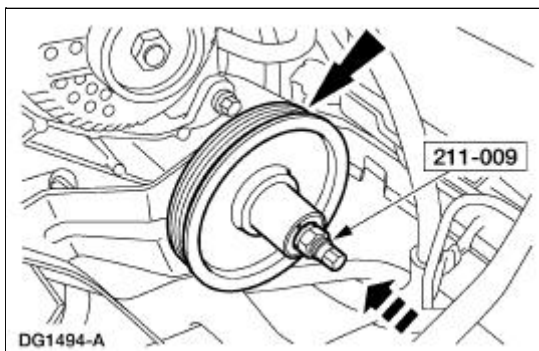
Removal

1. Remove the drive belt. For additional information, refer to [Section 303-05](#).
2. Using the special tool, remove the pulley.



Installation



1. Using the special tool, install the pulley.



2. Install the drive belt. For additional information, refer to [Section 303-05](#).

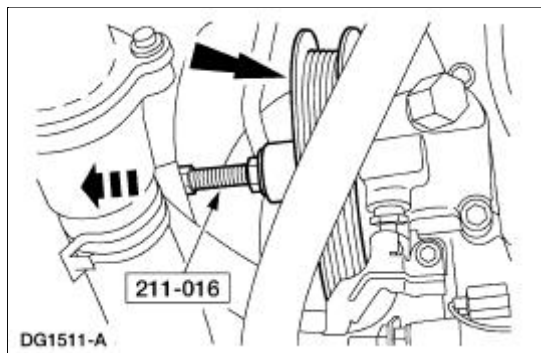
Pulley —CIII Pump

Special Tool(s)

 ST1586-A	Pump Pulley Replacer 211-185 (T91P-3A733-A)
	Pump Pulley Remover 211-016 (T69L-10300-B)

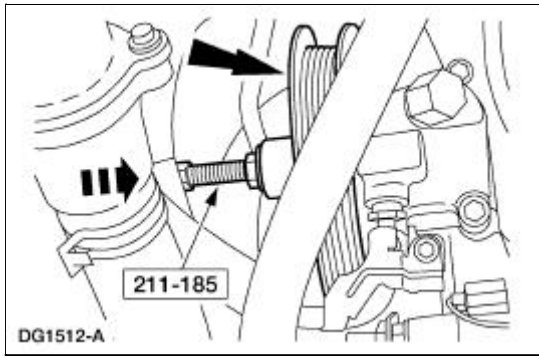
Removal

1. Remove the drive belt. For additional information, refer to [Section 303-05](#).
2. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
3. Using the special tool, remove the pulley.
 - Inspect the pulley for paint marks in the web area near the hub. If there are two paint marks, discard and install a new pulley. If there is no paint or one paint mark, use a paint pencil to mark the web area of the pulley near the hub.



Installation

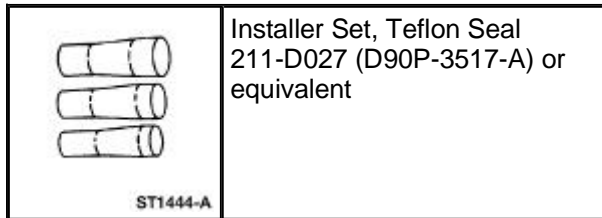
1. Using the special tool, install a new pulley.




2. Install the drive belt. For additional information, refer to [Section 303-05](#).
 3. Lower the vehicle.
-

Hose

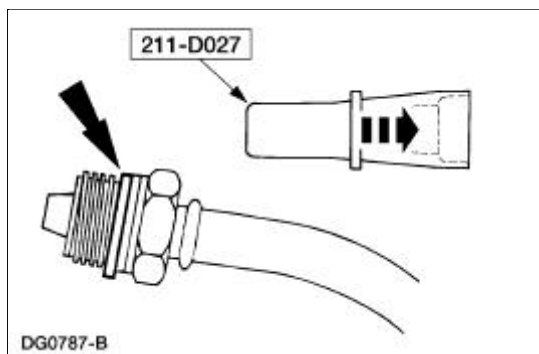
Special Tool(s)



Removal and Installation

 **CAUTION:** While servicing the power steering system, make sure to plug all open hoses, line fittings, and fluid ports to prevent the entry of contaminants or premature failure of the power steering components can result.

1. Refer to the System View illustration in Description and Operation for the hose routing and retention points.
2. When connecting a fitting with a seal ring, a new seal ring must be installed.
 - The special tool is used to install the return line connector seal and the pressure line connector seal.

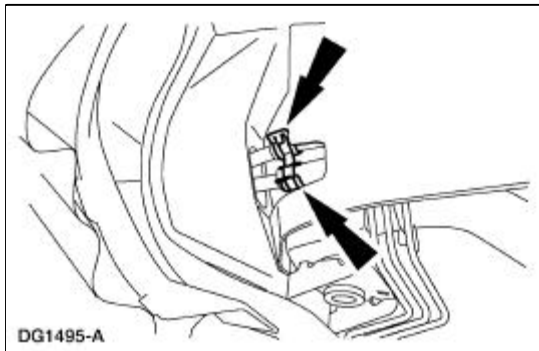


3. Fill, purge and leak check the system. For additional information, refer to [Section 211-00](#).

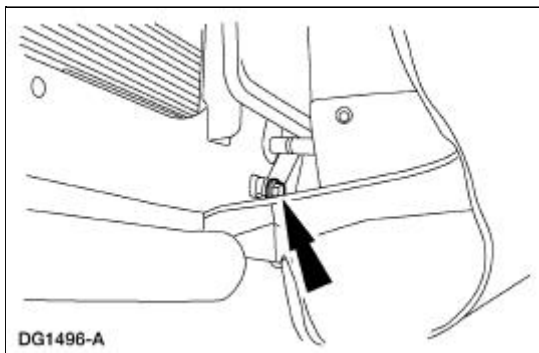
Cooler —Fluid

Removal

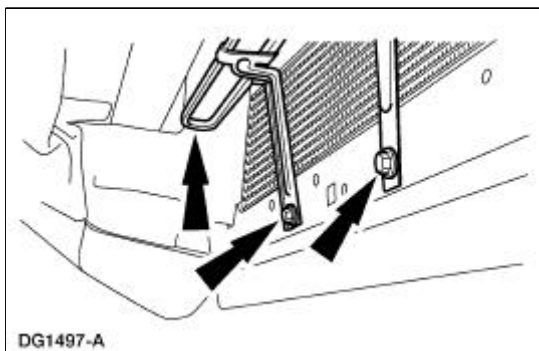
1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Disconnect the power steering hoses.



3. Remove the bolt and routing bracket.



4. Remove the bolts and the power steering fluid cooler.



Installation

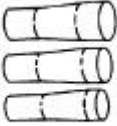

1. To install, reverse the removal procedure.
2. Fill and leak check the power steering system. For additional information, refer to [Section 211-](#)

00.



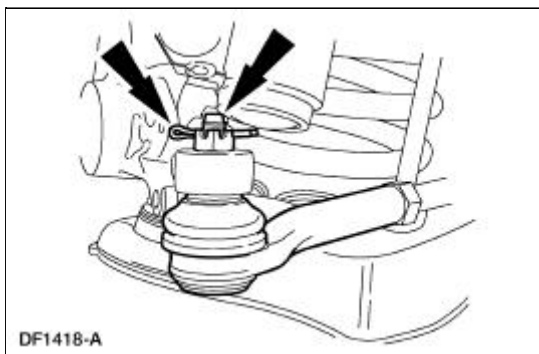
Gear

Special Tool(s)

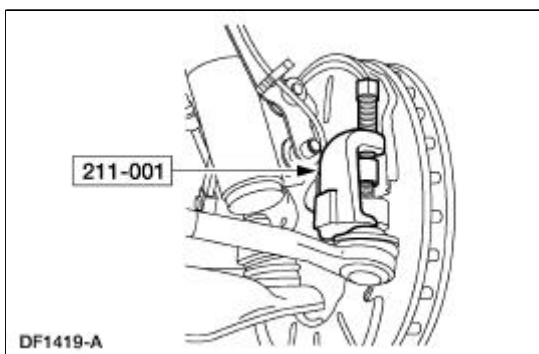
 ST1444-A	Teflon Seal Replacer Set 211-D027 (D90P-3517-A) or Equivalent
 ST1106-A	Tie Rod End Remover 211-001 (TOOL-3290-D)

Removal

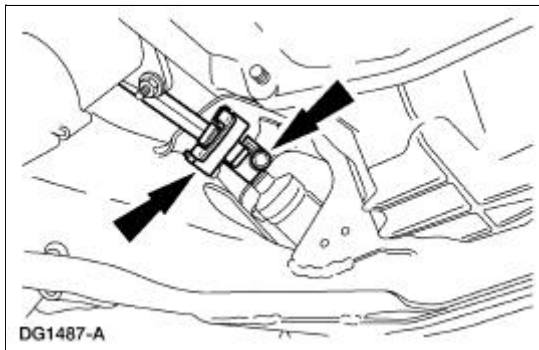
1. Turn the steering wheel as necessary to position the wheels in the straight-ahead position. Do not lock the steering column.
2. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
3. Remove the front wheels and tires. For additional information, refer to [Section 204-04](#).
4. Remove the cotter pin and nut. Discard the cotter pin.




5. Using the special tool, disconnect the tie-rod end.

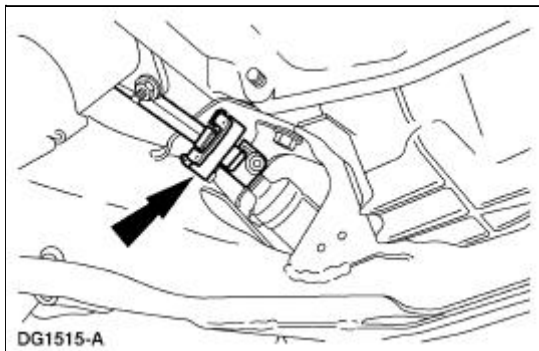


6. Rotate the steering column intermediate shaft as necessary to access the pinch bolt. Remove and discard the pinch bolt.

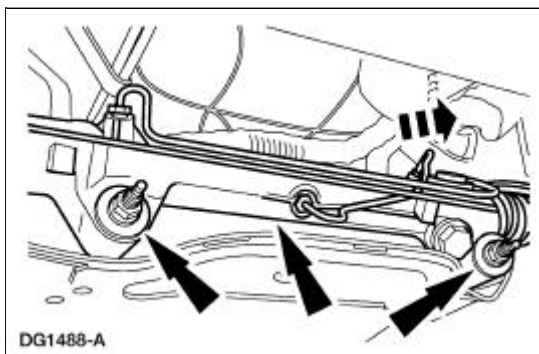


7. Lower the vehicle.
8. Turn the steering wheel back to the straight-ahead position. Turn the ignition key to the locked position.
9.  **CAUTION: Do not rotate the steering wheel when the lower steering column shaft is disconnected, or damage to the air bag sliding contact will result.**

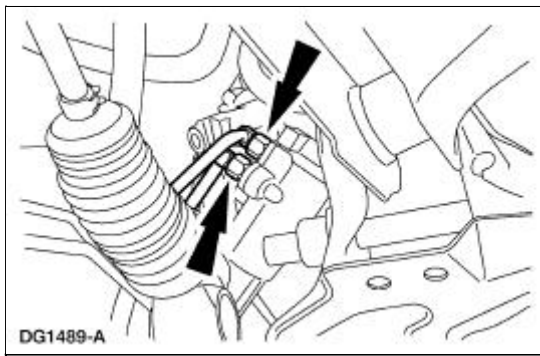
Disconnect the steering column intermediate shaft coupling (3A525).



10. Remove the nuts, washers and bolts. Position the steering gear (3504) forward.



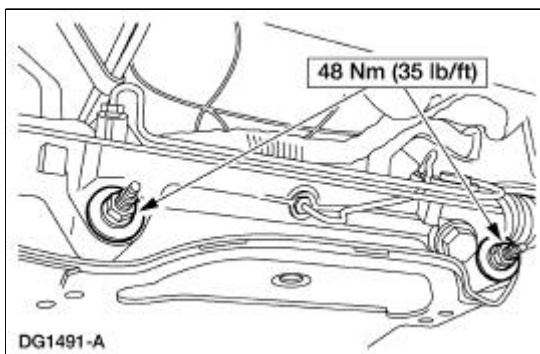
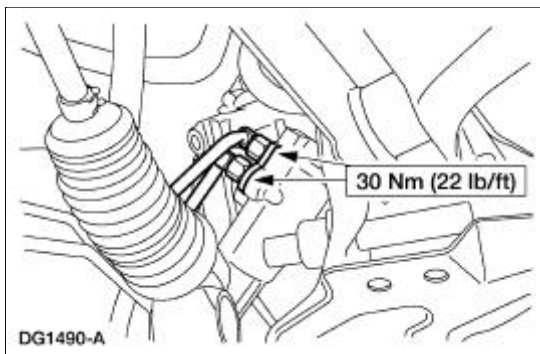
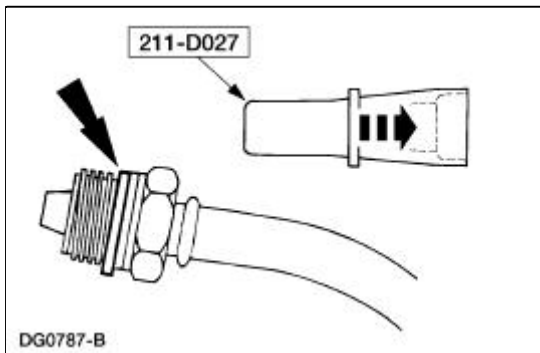
11. Disconnect the power steering hoses. Remove and discard the seal rings.
 - Plug or cap the power steering hoses and steering gear ports to prevent damage and the entry of foreign material.

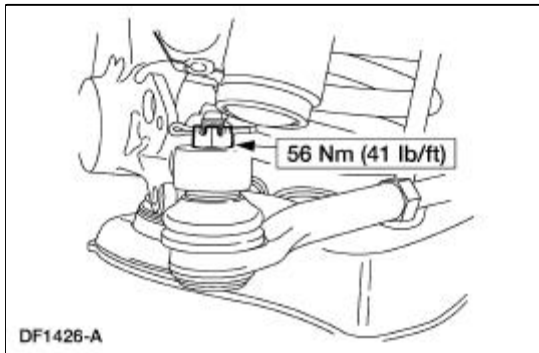
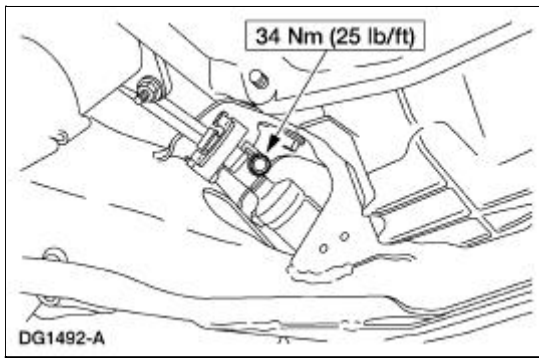


12. Remove the steering gear.

Installation

1. To install, reverse the removal procedure.
 - Using the special tool, install a new seal ring.
 - Install a new pinch bolt.








2. Fill and leak check the power steering system. For additional information, refer to [Section 211-00](#).
-

Gear

Special Tool(s)

 <p>ST2065-A</p>	<p>Head Mounting Fixture 303-D041 (D83L-500-B1) or Equivalent</p>
 <p>ST1427-A</p>	<p>Inner Tie Rod Socket Tool 211-D025 (D90P-3290-A) or Equivalent</p>
 <p>ST1426-A</p>	<p>Steering Gear Holding Fixture 211-D011 (D87P-3504-B) or Equivalent</p>

Material

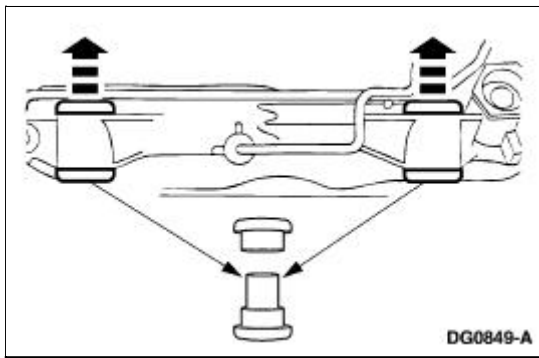
Item	Specification
Multi-Purpose Grease XG-4	ESR-M1C159-A
Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A	ESE-M1C171-A

Disassembly

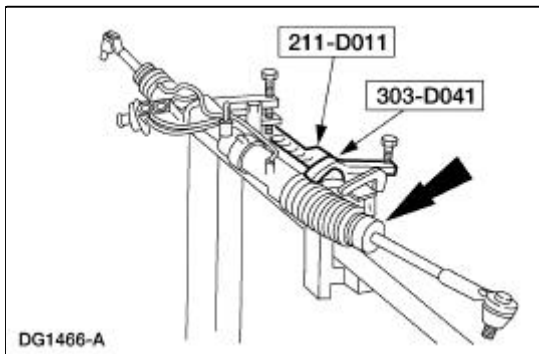
NOTE: The steering gear is serviceable as either a long or short rack assembly. This procedure covers the removal and installation of the components not supplied with a short rack assembly. On short rack assembly only the front wheel spindle tie-rods and front suspension steering ball stud dust seals are serviced separately.

All steering gears

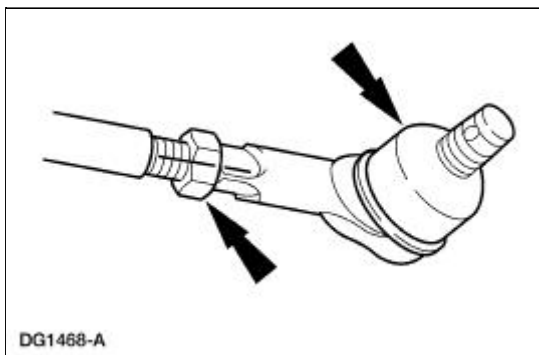
1. Remove the steering gear mounting bracket housing insulators.
 - Discard worn or damaged steering gear mounting bracket housing insulators.



2. Install the steering gear into the special tools.



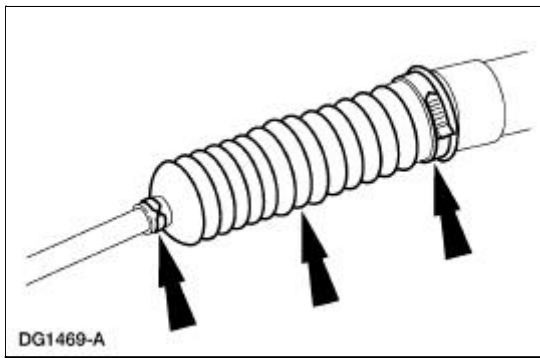
3. Clean the exterior of the steering gear with solvent. If necessary, drain any excess power steering fluid.
4. Inspect the steering gear housing for cracks and other damage. If necessary, install a new steering gear.
5. Verify the power steering gear input shaft bearing rotates freely. If necessary, install a new steering gear.
6. Place an alignment mark on the tie-rod ends, nuts and front wheel spindle tie-rods. Remove the tie-rod ends and nuts.



7. **⚠ CAUTION: Use care not to damage the front suspension steering ball stud dust seals. If the front suspension steering ball stud dust seals are damaged, this will allow contamination into the steering gear and cause leakage.**

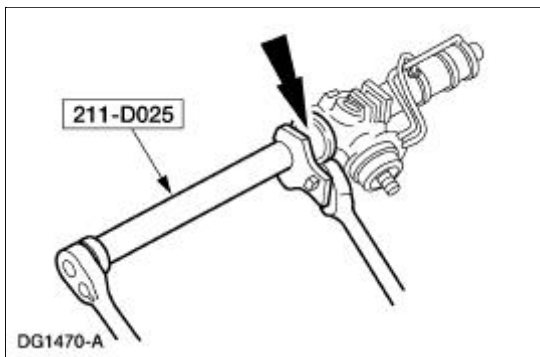
Remove the clamps and the two front suspension steering ball stud dust seals.

- Discard any clamps that are damaged or excessively corroded.
- Discard any front suspension steering ball stud dust seals that are damaged.



8. **⚠ CAUTION:** Place the steering gear at the center position. Use a crowfoot on the flat of the rack gear to resist rotation and prevent damage to the steering gear during removal and installation of the front wheel spindle tie-rods.

Place the steering gear at the center position. Install a crowfoot on the flat of the steering gear. Using the special tool remove the front wheel spindle tie-rods.



Steering gears equipped with travel restrictors

9. **NOTE:** Some steering gears may contain one or two rack travel restrictors on each side of the steering gear. The restrictors are split washers and can be removed if necessary.

Remove the travel restrictors.

- Discard any travel restrictors that are heavily worn.

All steering gears

10. Remove the steering gear from the special tools.

Assembly


All steering gears

1. Install the steering gear in the special tools.

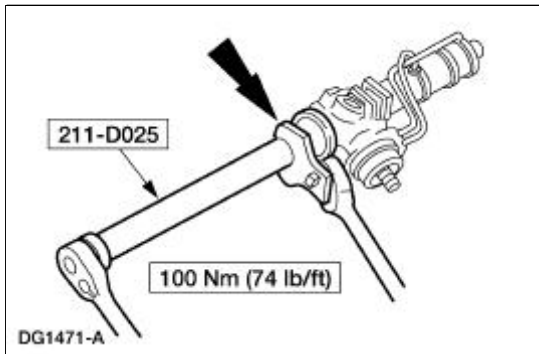
Steering gears equipped with travel restrictors

2. Install the travel restrictors.
- Install new travel restrictors as necessary.


All steering gears

3.  **CAUTION: Place the steering gear at the center position. Use a crowfoot on the flat of the rack gear to resist rotation and prevent damage to the steering gear during removal and installation of the front wheel spindle tie-rods.**

Place the steering gear at the center position. Install a crowfoot on the flat of the steering gear. Using the special tool install the front wheel spindle tie-rods.

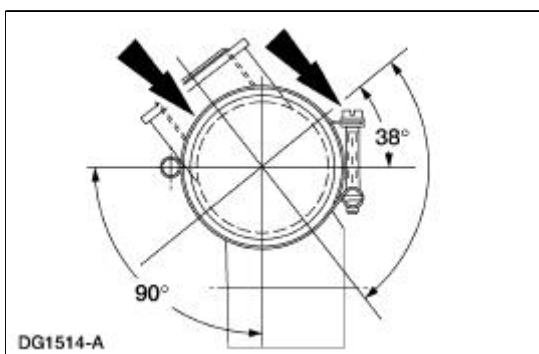
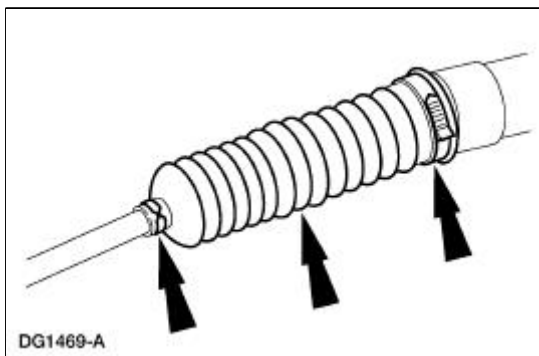


4. Thoroughly clean the steering gear of any foreign material.

5.  **CAUTION: Use care not to damage the front suspension steering ball stud dust seals. If the front suspension steering ball stud dust seals are damaged, this will allow contamination into the steering gear and cause leakage.**

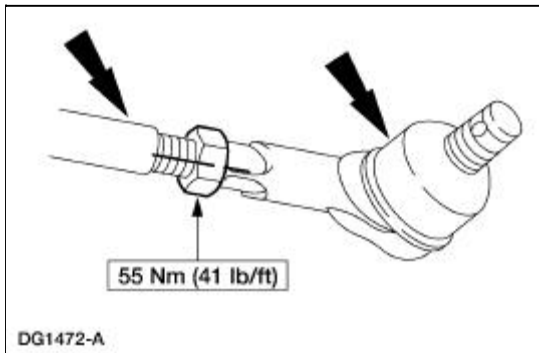
Install the front suspension steering ball stud dust seals and clamps.

- Position the front suspension steering ball stud seals and steering gear rack tubes as shown.
- Install new front suspension steering ball stud dust seals and clamps as necessary.
- To prevent the front suspension steering ball stud dust seals from twisting during toe adjustment, apply grease to the groove in the front wheel spindle tie-rods and uniformly to the inner-diameter of the front suspension steering ball stud dust seals.



6. Install the nut and the tie-rod ends. Align the marks.

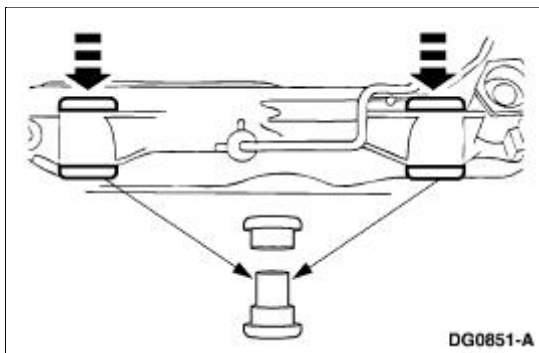
- Apply silicone dielectric compound to the front wheel spindle tie-rod threads.



7. Remove the steering gear from the special tools.

8. Install the steering gear mounting bracket housing insulators.

- Install new steering gear mounting bracket housing insulators as necessary.
- The large end of the metal sleeve must be positioned downward.
- Check that the mounting surfaces are clean and free of foreign material.



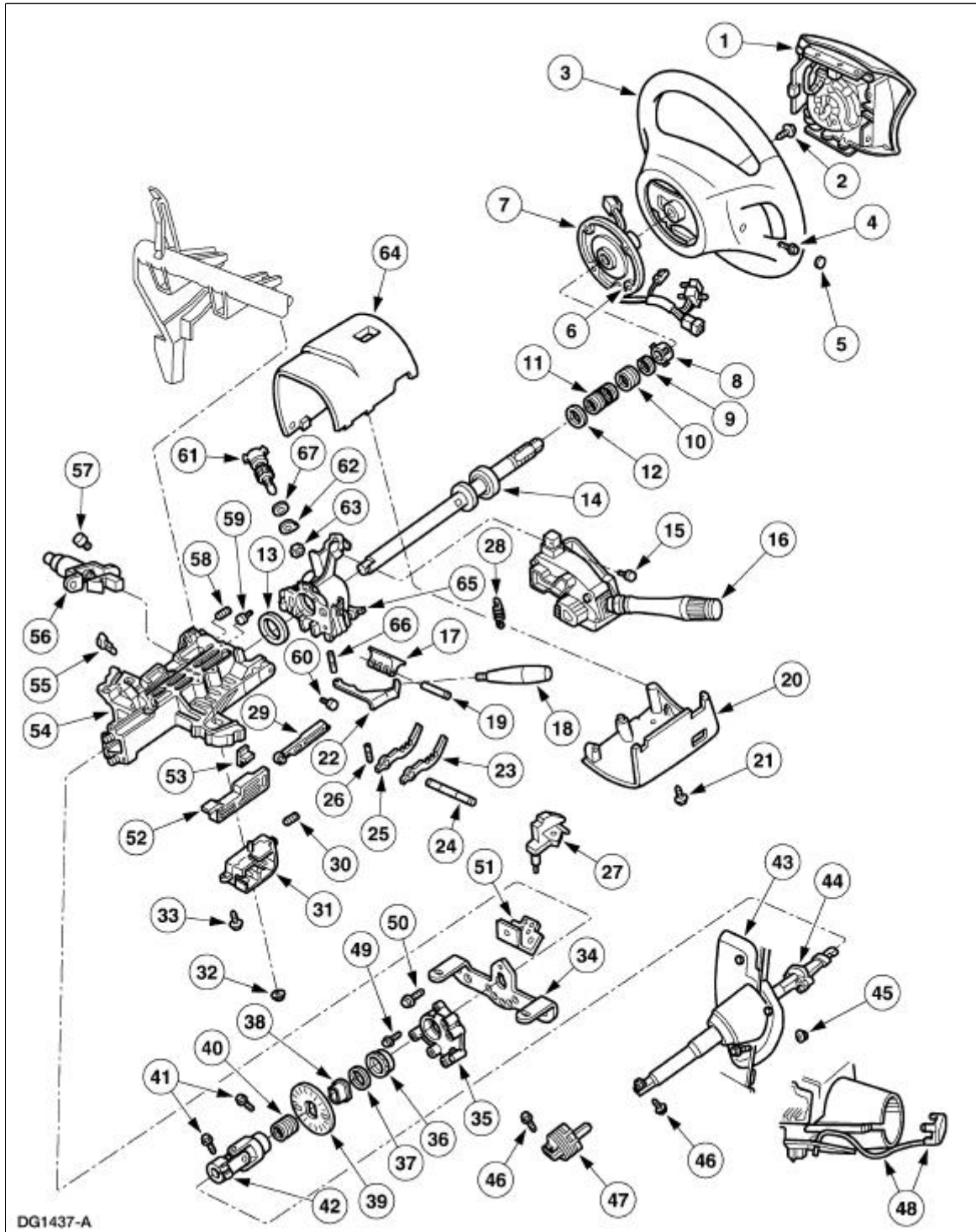
General Specifications

Item	Specification
Lubricant	
Ignition Lock Grease FOAZ-19584-A	ESA-M1C232-A

Torque Specifications

Description	Nm	lb-ft	lb-in
Lock cylinder housing screws	22	17	—
Steering column lower bearing retainer bolts	9	—	80
Ignition switch screws	6	—	53
Multi-function switch screws	3	—	27
Steering wheel bolt	38	28	—
Steering column retaining nuts	15	12	—
Intermediate shaft coupler-to-steering column shaft bolt	25	19	—

Steering Column



Item	Part Number	Description
1	043B13	Driver air bag module
2	N804385-S100	Steering wheel bolt
3	3600	Steering wheel

4	N805572-S36	Air bag module retaining screws (2 req'd)
5	3L518	Steering wheel spoke cover (2 req'd)
6	—	Lock tabs
7	14A664	Clockspring
8	13318	Turn indicator cancel cam
9	3C610	Snap ring
10	3520	Bearing spring
11	3518	Upper bearing sleeve
12	3517	Upper bearing (small)
13	3517	Lower bearing (large)
14	3524	Shaft assembly
15	390345-S36	Screw
16	13K359	Multi-function switch
17	3E695	Lock cam
18	3F609	Tilt wheel handle
19	N806157	Lock cam pivot pin
20	3530	Lower shroud
21	55929	Shroud retaining screws
22	3D544	Release lever
23	3B661	Lock actuator lever (RH)
24	N805856	Lock actuator lever pin
25	3D653	Lock actuator lever (LH)
26	3B664	Lock lever spring (2 req'd)
27	14A099	Wiring shield
28	3D655	Lock lever spring return
29	3E715	Lock lever upper actuator
30	3E696	Lock spring (shaft)
31	11572	Ignition switch
32	N806423-S56	Steering column mounting lower nuts
33	N806584	Screw
34	3E660	Mounting bracket
35	3D681	Bearing retaining
36	3518	Bearing sleeve
37	3517	Lower bearing
38	3L539	Lower bearing tolerance ring
39	3C131	Sensor ring
40	3520	Bearing spring
41	N808349	Bolt — flange yoke
42	3N725	Coupling
43	3C611	Tube boot
44	3B676	Intermediate shaft

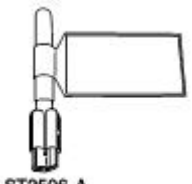
45	N621906	Nut
46	N803942	Bolt
47	3A525	Intermediate shaft coupling
48	11A128	Ignition key warning switch terminal
49	N806583	Bearing housing retaining screw
50	N804865-S58	Screw
51	14A06	Wire connector bracket
52	3E715	Lock lever lower actuator
53	3E691	Lock pawl
54	3F723	Actuator housing
55	3E745	Lock actuator cover
56	3F719	Ignition/shifter interlock cable
57	N808124-58M	Screw
58	3D655	Position spring
59	3D656	Tilt flange bumper
60	N806582	Tilt pivot screws
61	11582	Ignition switch lock cylinder
62	3E700	Lock housing bearing
63	3E717	Lock gear
64	3530	Upper shroud
65	3511	Lock cylinder housing
66	N805857	Lock actuator lever pin
67	3D681	Bearing retainer

NOTE: All fasteners are important because they can affect the performance of vital parts and systems. Incorrect installation of the fasteners can result in major repair expenses. They must be installed new with fasteners of the same part number if installation becomes necessary. Do not install a new part of lesser quality or substitute a design. Torque values must be used as specified during assembly to make sure these parts function correctly.


The body of the steering column (3C529) is made of magnesium die castings. The steering column is attached to a support that is an integral part of the instrument panel. The lower attachments of the steering column are through a bracket that bends during collapse. The upper attachments are through plastic shear modules that separate from the main casting during collapse. A clip and washer are attached to the shear modules to reduce steering column shake and to assist in installation of the steering column.


Supplemental Restraint System (SRS) Deactivation and Reactivation

Special Tool(s)


 ST2506-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-R0012)
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Deactivation


 **WARNING:** Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

 **WARNING:** After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

 **WARNING:** Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

 **WARNING:** Air bag modules with discolored or damaged trim covers must be installed new, not repainted.

 **WARNING:** The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

-  **WARNING:** To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

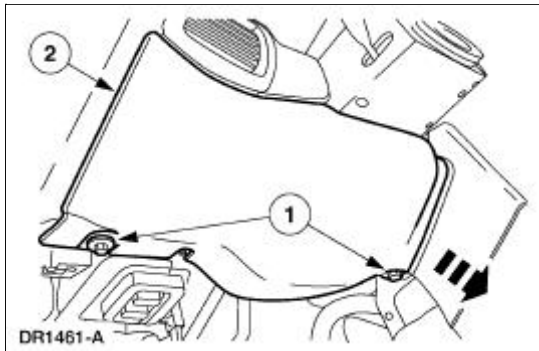
Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

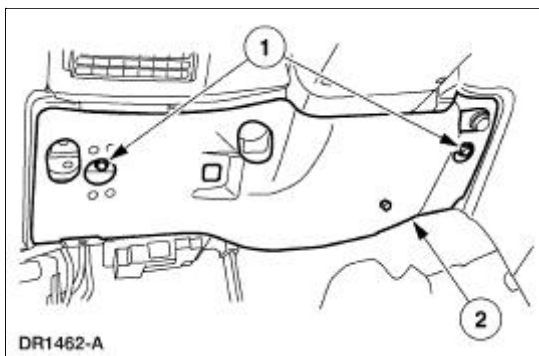
To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable and wait at least one minute. For additional information, refer to [Section 414-01](#) .

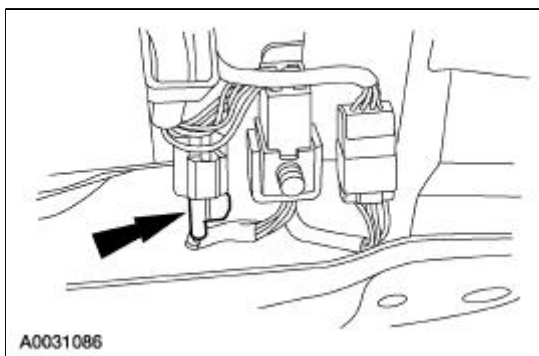
2. Remove the steering column opening lower finish panel.
 1. Remove the screws.
 2. Pull out to release the retaining clips and remove the steering column opening lower finish panel.



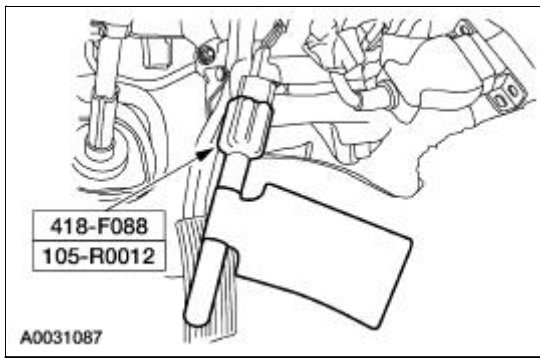
3. Remove the steering column opening lower reinforcement.
 1. Remove the bolts.
 2. Remove the steering column opening lower reinforcement.



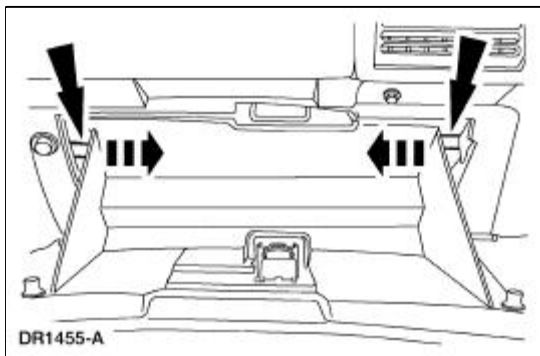
4. Pushing in on the release tab, disconnect the clockspring electrical connector at the base of the steering column.



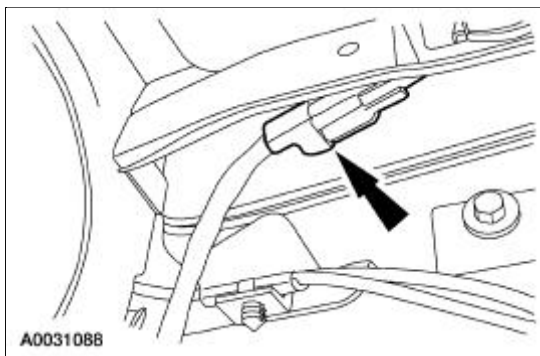
5. Attach the restraint system diagnostic tool to the vehicle harness side of the clockspring electrical connector.



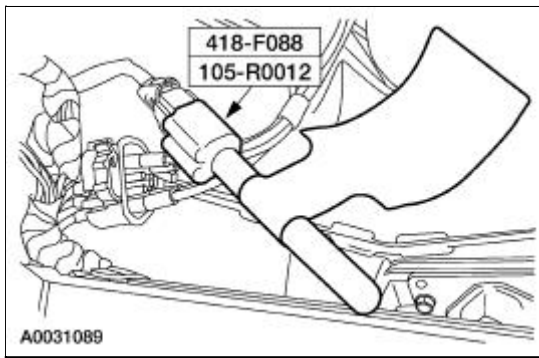
6. Open the glove compartment, push in on the tabs and open the glove compartment door to its fullest extent.



7. Remove the right hand A/C register duct.
 - Remove the two screws retaining the duct to the A/C register.
 - Separate the A/C duct at the air plenum and remove the duct.
8. Disconnect the passenger air bag module.



9. Attach the restraint system diagnostic tool to the vehicle harness side of the passenger air bag electrical connector.



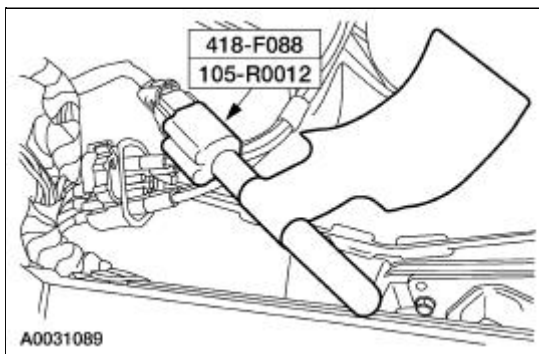
10. Connect the battery ground cable. For additional information, refer to [Section 414-01](#).
11. With the restraint system diagnostic tools installed at all deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to [Section 501-20B](#).
12. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to [Section 414-01](#).

Reactivation

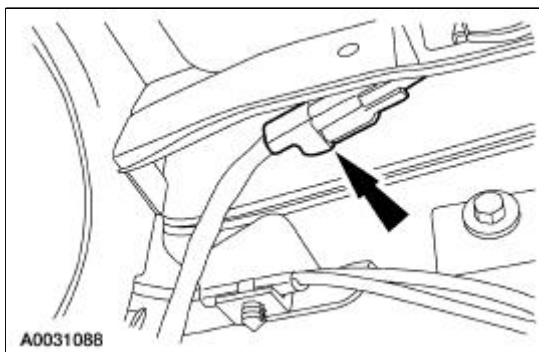


WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the deactivation procedure.

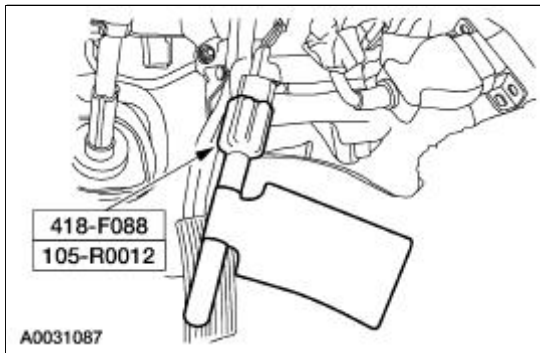
1. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to [Section 414-01](#).
2. Remove the restraint system diagnostic tool from the passenger air bag module electrical connector.



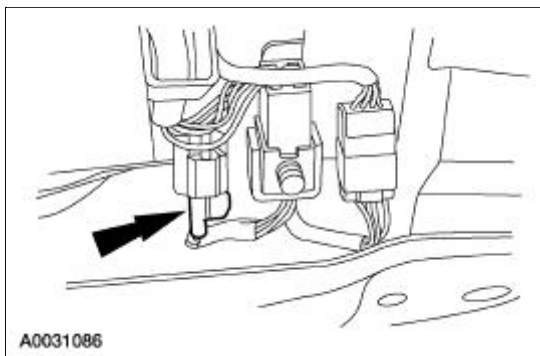
3. Connect the passenger air bag module electrical connector.



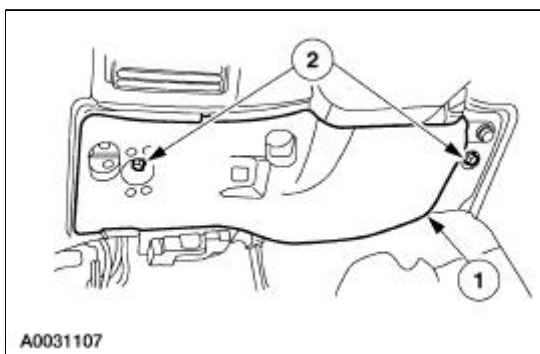
4. Install the right hand A/C register duct.
 - Connect the A/C duct at the air plenum.
 - Install the duct at the A/C register and install the two screws.
5. Close the glove compartment.
6. Remove the restraint system diagnostic tool from the clockspring electrical connector.



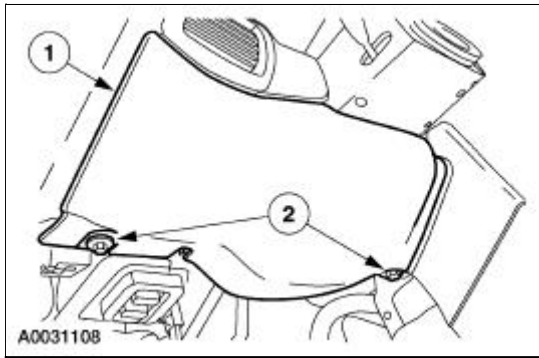
7. Connect the clockspring electrical connector at the base of the steering column.



8. Install the steering column opening lower reinforcement.
 1. Position the steering column opening lower reinforcement.
 2. Install the bolts.



9. Install the steering column opening lower finish panel.
 1. Align the steering column opening lower finish panel and push in, seating the retaining clips.
 2. Install the screws.



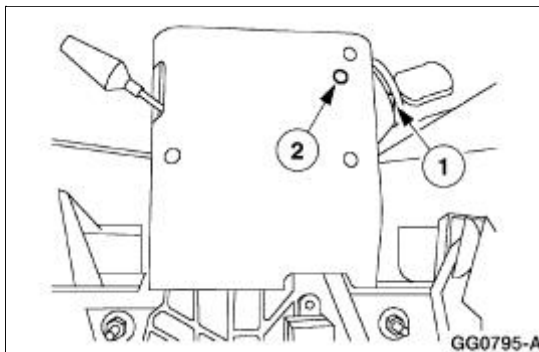
10. Connect the battery ground cable. For additional information, refer to [Section 414-01](#).
11. **⚠ WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to [Section 501-20B](#).

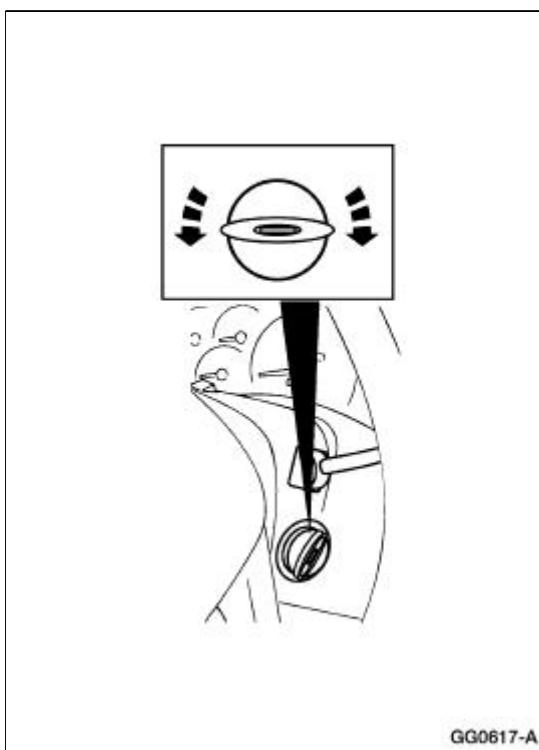
Ignition Switch Lock Cylinder —Functional

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Remove the ignition switch lock cylinder (11582).
 1. Insert the ignition key and turn to the RUN position.
 2. Using a 1/8-inch drift, press the ignition switch lock cylinder release pin through the access hole while pulling out the ignition switch lock cylinder.



3. To install, reverse the removal procedure.
 - Verify ignition switch lock cylinder operation.



Ignition Switch Lock Cylinder —Non-Functional

Removal and Installation

1. **NOTE:** Make sure the front wheels are in the straight-ahead position.

Disconnect the battery ground cable (14301) and wait at least one minute to allow the depletion of the restraint system backup power supply. For additional information, refer to [Section 414-01](#).

2.  **WARNING:** To avoid the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the deactivation procedure.

Deactivate the supplemental restraint system (SRS). For additional information, refer to [Supplemental Restraint System \(SRS\) Deactivation and Reactivation](#) in this section.

3.  **WARNING:** To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the steering wheel removal and installation procedure.

Remove the steering wheel assembly. For additional information, refer to [Wheel](#) in this section.

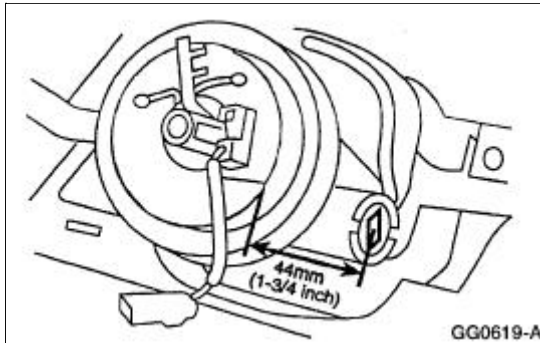
4. Twist off the cap from the ignition switch cylinder.



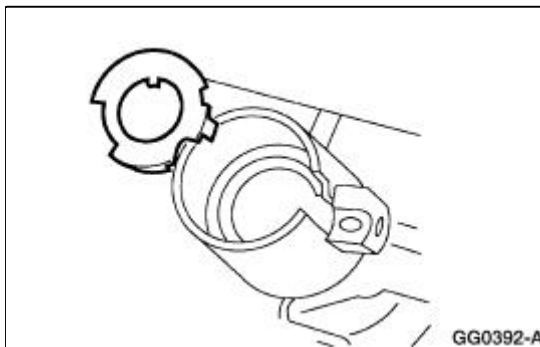
5. **NOTE:** The lock cylinder is repaired by discarding the inoperative lock cylinder and building a new lock cylinder using the appropriate lock repair package (F85Z-11582-AA). The lock repair package includes a detailed instruction sheet to build the new lock cylinder to the current key code of the vehicle.

Remove the ignition switch lock cylinder.

- Use a 1/8-inch diameter drill bit to drill out the lock cylinder retaining pin.
- Use a 3/8-inch drill bit to drill down the middle of the ignition lock key slot until the ignition switch lock cylinder breaks loose.
- Remove and discard the ignition switch lock cylinder and clean the drill shavings from the steering column.



6. Remove the bearing retainer.



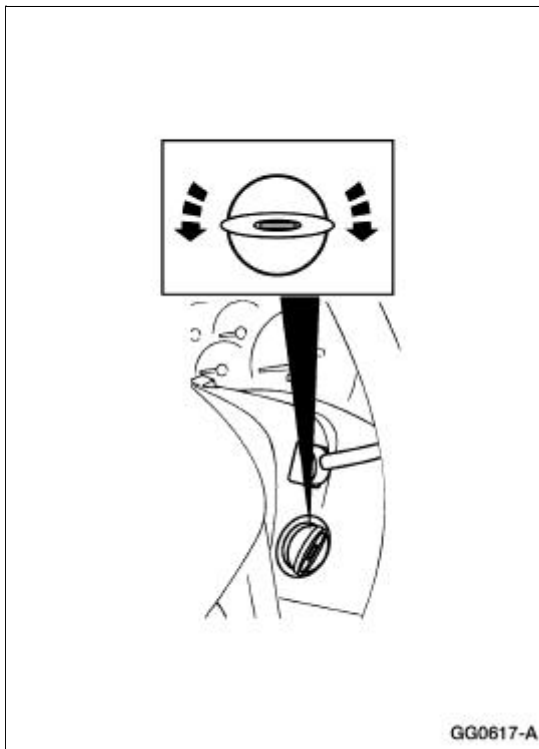
7. Remove the bearing and gear.

- Thoroughly clean all drill shavings from the steering column and inspect it for damage.



8. To install, reverse the removal procedure.

- Install a new ignition switch lock cylinder.
- Verify ignition switch lock cylinder operation.




9.  **WARNING:** To avoid the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the reactivation procedure.

Reactivate the supplemental restraint system (SRS). For additional information, refer to [Supplemental Restraint System \(SRS\) Deactivation and Reactivation](#) in this section.


Wheel

Removal and Installation

1. Disconnect the battery ground cable (14301) and wait at least one minute to allow the depletion of the restraint system backup power supply. For additional information, refer to [Section 414-01](#).
2. Turn the steering wheel to the straight-ahead position and the ignition switch to the OFF position.

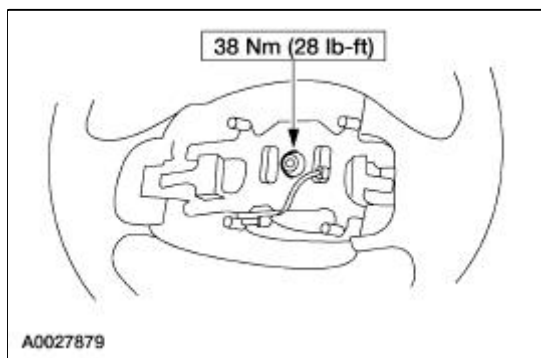
3.  **WARNING: To avoid the risk of serious personal injury, follow all warnings, cautions, notes and instructions in the beginning of the deactivation procedure.**


Deactivate the supplemental restraint system (SRS). For additional information, refer to [Supplemental Restraint System \(SRS\) Deactivation and Reactivation](#) in this section.

4.  **WARNING: To avoid risk of serious personal injury, follow all warnings, cautions, notes and instructions in the driver air bag removal and installation procedure.**

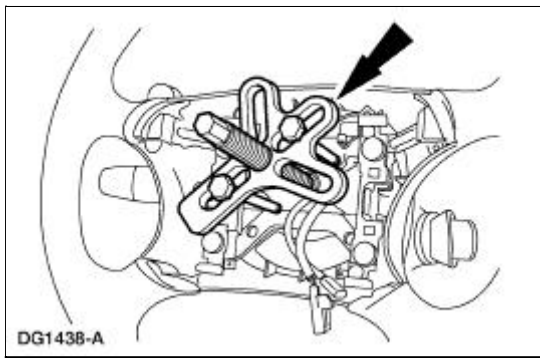
Remove the driver air bag module. For additional information, refer to [Section 501-20B](#).


5. Remove and discard the steering wheel retaining bolt.



6.  **CAUTION: Removing the steering wheel without using a puller can damage the column bearings.**

Use a suitable puller to remove the steering wheel (3600).



7. Remove the steering wheel while routing the wires from the clockspring through the steering wheel.
8. To install, reverse the removal procedure.
9.  **WARNING: To avoid the risk of serious personal injury, follow all warnings, cautions, notes and instructions at the beginning of the reactivation procedure.**


Reactivate the supplemental restraint system (SRS). For additional information, refer to [Supplemental Restraint System \(SRS\) Deactivation and Reactivation](#) in this section.

Column

Removal and Installation

All vehicles

1. Disconnect the battery ground cable and wait at least one minute to allow the depletion of the restraint system backup power supply. For additional information, refer to [Section 414-01](#).

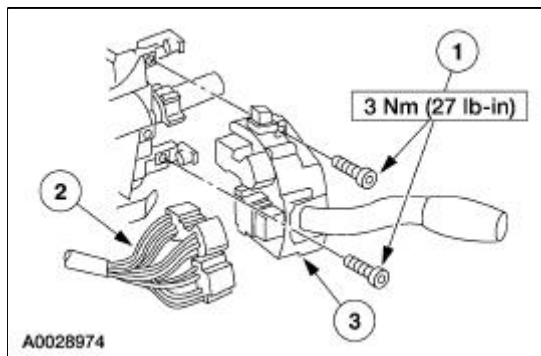
2.  **WARNING: To avoid the risk of serious personal injury, follow all warnings, cautions, notes and instructions at the beginning of the deactivation procedure.**

Deactivate the supplemental restraint system (SRS). For additional information, refer to [Supplemental Restraint System \(SRS\) Deactivation and Reactivation](#) in this section.

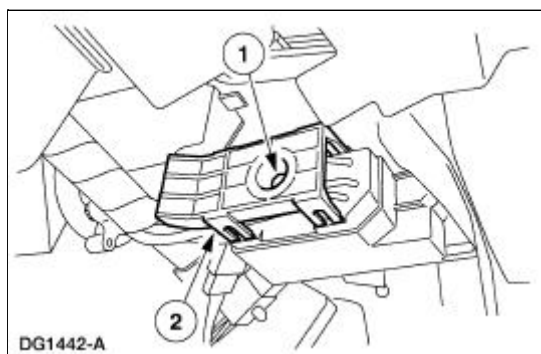
3.  **WARNING: To reduce the risk of serious personal injury, follow all warnings, cautions, notes and instructions in the clockspring removal and installation procedure.**

Remove the clockspring (14A664). For additional information, refer to [Section 501-20B](#).

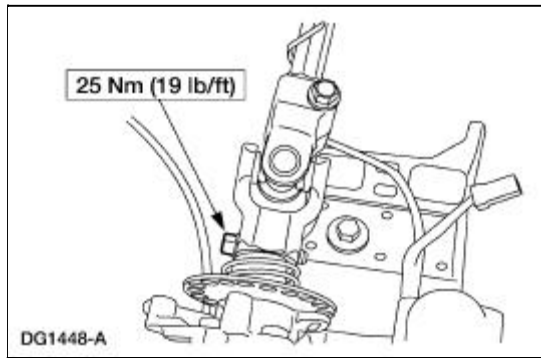
4. Remove the multi-function switch (13K359).
 1. Remove the screws.
 2. Disconnect the electrical connector.
 3. Remove the multi-function switch.



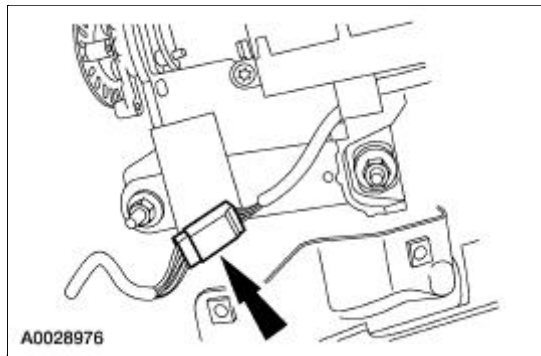
5. Disconnect the ignition switch electrical connector.
 1. Remove the bolt.
 2. Disconnect the electrical connector.



6. Remove the pinch bolt and disconnect the coupling from the steering column.

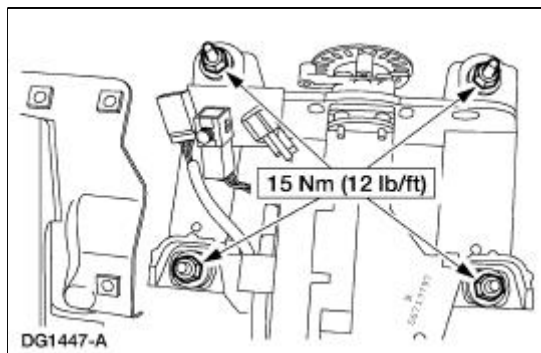


7. Disconnect the electrical connector.



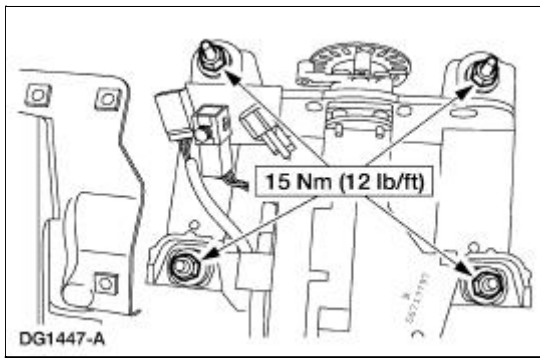
Vehicles with manual transmission

8. Remove the nuts and the steering column.
 - Discard the nuts.

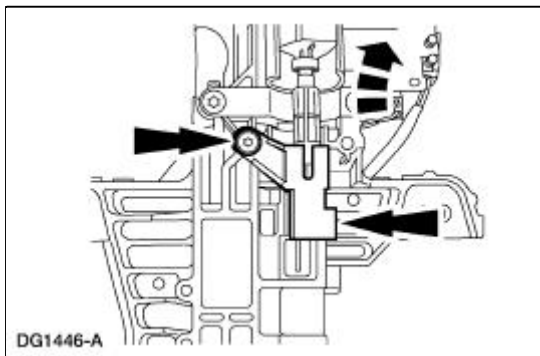


Vehicles with automatic transmission


9. Remove the nuts and lower the steering column.
 - Discard the nuts.



10. Disconnect the ignition/shifter interlock and remove the steering column.




All vehicles

11. To install, reverse the removal procedure.
12.  **WARNING: To avoid the risk of serious personal injury, follow all warnings, cautions, notes and instructions at the beginning of the reactivation procedure.**

Reactivate the supplemental restraint system (SRS). For additional information, refer to [Supplemental Restraint System \(SRS\) Deactivation and Reactivation](#) in this section.

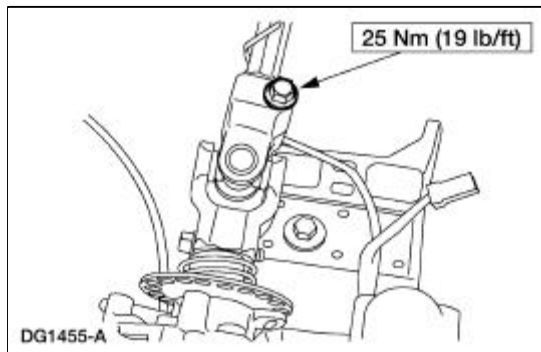
Steering Column Shaft

Removal and Installation

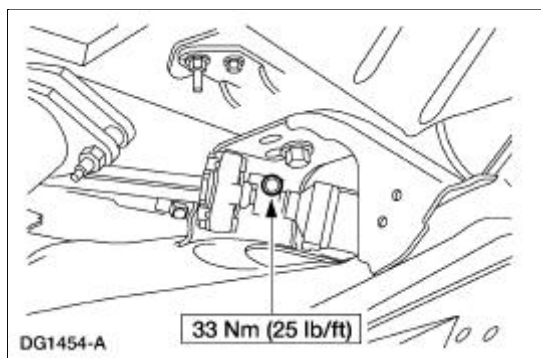
1.  **CAUTION:** Do not allow the steering column shaft to rotate while intermediate shaft is disconnected or damage to the clockspring can result. If there is evidence that the steering column shaft has rotated the clockspring must be removed and recentered. For additional information, refer to [Section 501-20B](#).

NOTE: Discard the steering column shaft pinch bolt and the lower intermediate shaft-to-steering gear pinch bolt. Do not reuse, install new bolts.

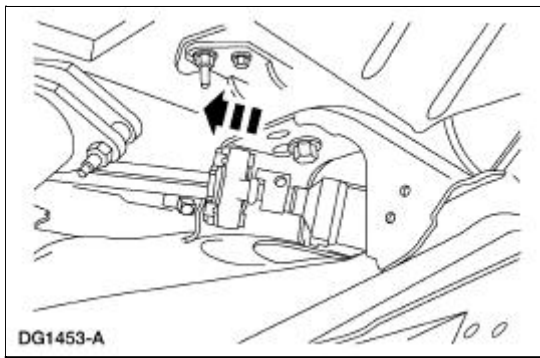
Remove and discard the steering column shaft pinch bolt and disconnect the intermediate from the coupling.



2. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
3. Remove the pinch bolt.




4. Disconnect the intermediate shaft from the gear and remove the intermediate shaft.



5. To install, reverse the removal procedure.
-

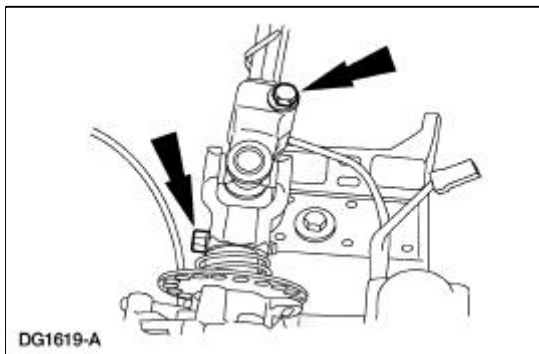
Coupling

Removal and Installation

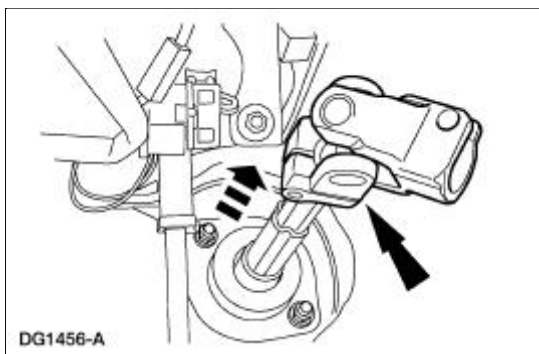
1.  **CAUTION:** Do not allow the steering column shaft to rotate while intermediate shaft is disconnected or damage to the clockspring can result. If there is evidence that the steering column shaft has rotated the clockspring must be removed and recentered. For additional information, refer to [Section 501-20B](#).

NOTE: Discard the steering column shaft pinch bolt and the lower intermediate shaft-to-steering gear pinch bolt upon removal. Do not reuse, install new bolts.

Remove the pinch bolts and disconnect the coupling from the column.



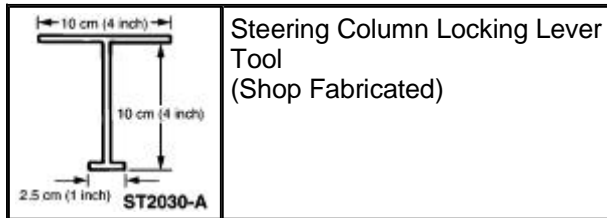
2. Remove the coupling.




3. To install, reverse the removal procedure.

Steering Column

Special Tool(s)

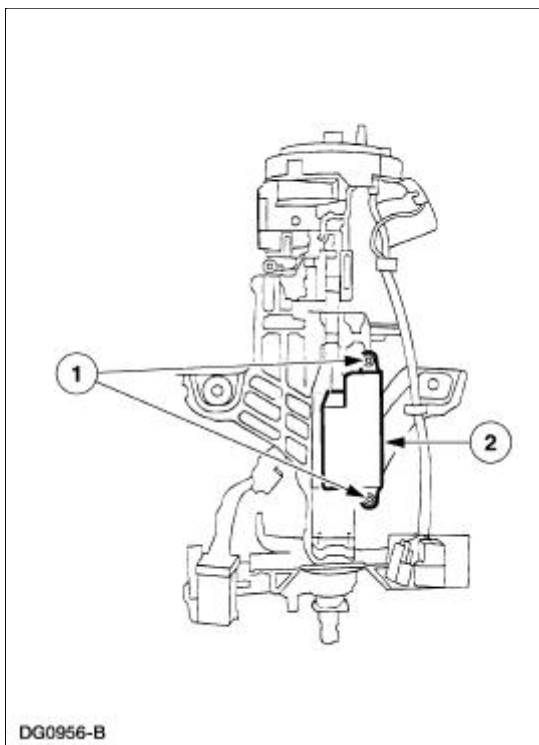


Disassembly

1.  **WARNING:** To avoid risk of serious personal injury, follow all warnings, cautions, notes and instructions in the driver air bag removal and installation procedure.

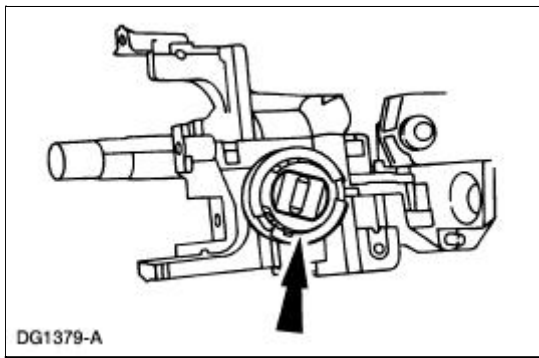
Remove the steering column (3C529). For additional information, refer to [Column](#) in this section.

2. Remove the ignition switch (11572).
 1. Remove the screws.
 2. Remove the ignition switch.

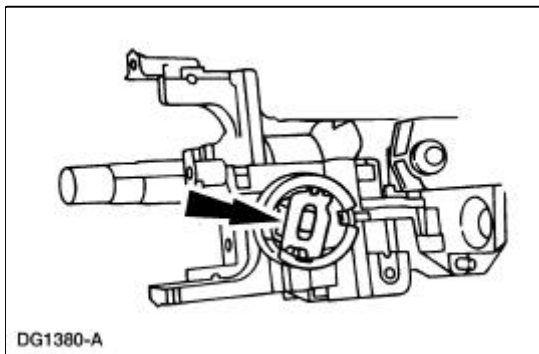


3.  **CAUTION:** Carefully note the position of the steering column lock gear, bearing and retainer prior to removal.

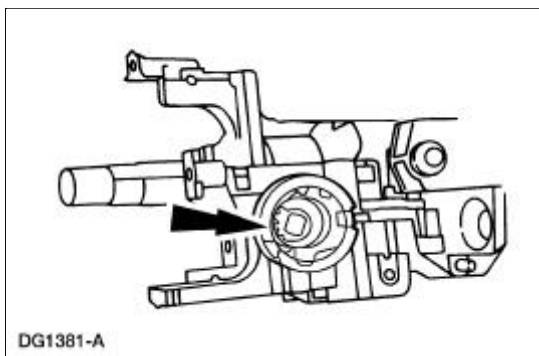
Remove the bearing retainer (3D681).



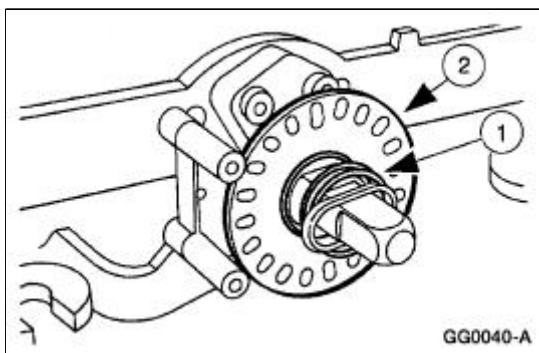
4. Remove the lock housing bearing (3E700).



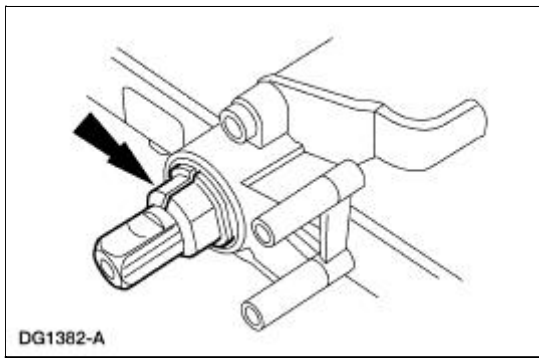
5. Remove the lock gear (3E717).



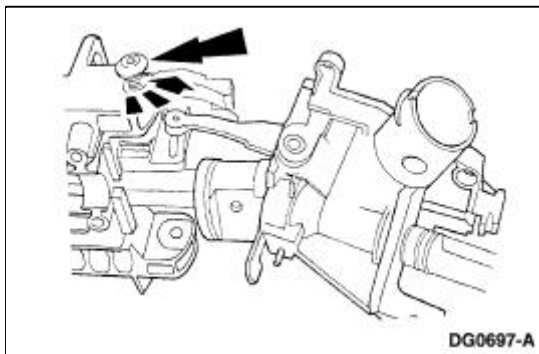
6. Remove the sensor ring.
 1. Remove the lower bearing spring.
 2. Remove the sensor ring.



7. Remove the lower bearing tolerance ring from the shaft.



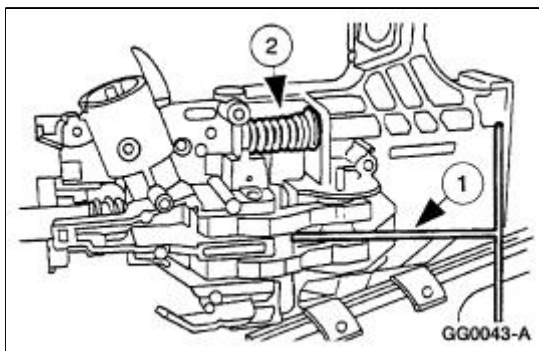
8. Remove the two tilt pivot screws.



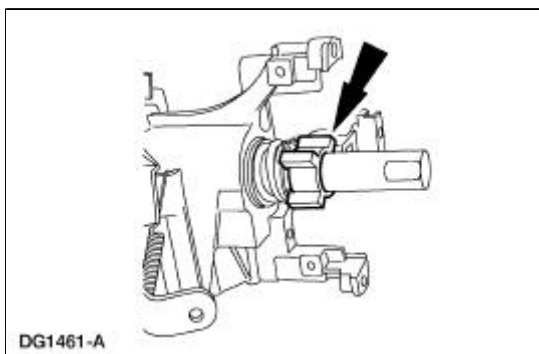
9.  **WARNING: Steering column position spring is under tension and can come out with great force.**

Remove the lock cylinder housing and shaft assembly from the actuator housing (3F723).

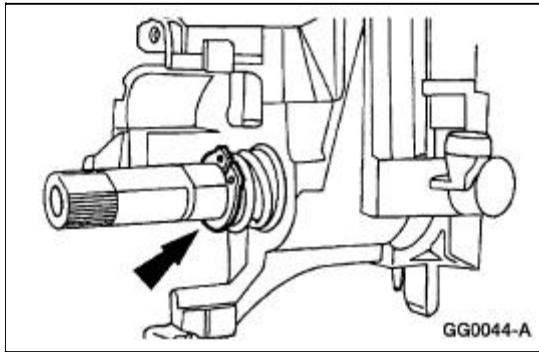
1. Pry up on the lock actuator lever (LH) (3D653) using a shop fabricated tool.
2. Remove the position spring (3D655).



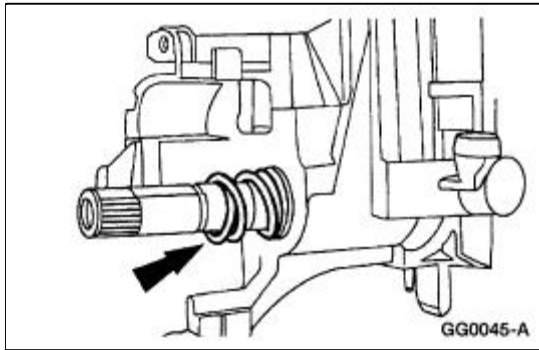
10. Remove the turn indicator cancel cam.



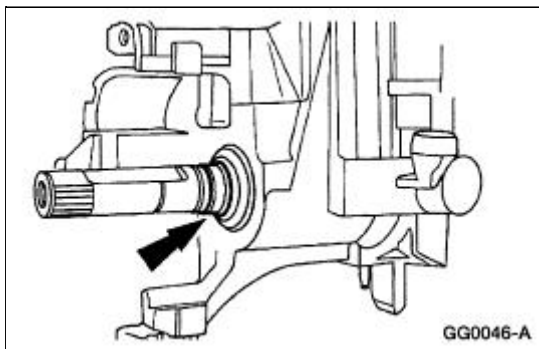
11. Remove the snap ring.



12. Remove the upper bearing spring (3520).

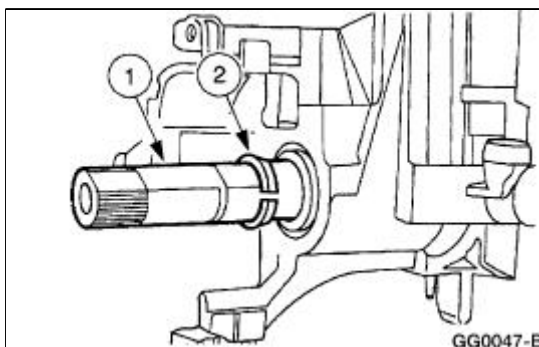


13. Remove the bearing sleeve (3518).

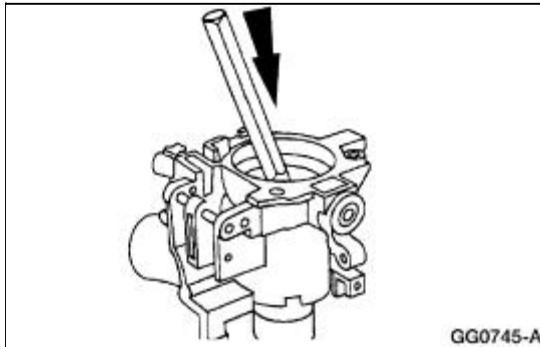


14. Remove the lower bearing tolerance ring (3L539).

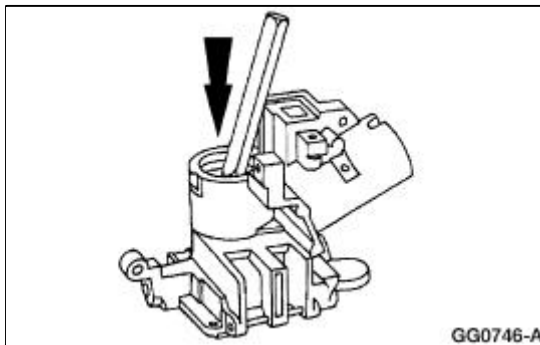
1. Slide the steering column shaft in toward the lock cylinder housing (3511).
2. Slide the steering column bearing tolerance ring from the steering column shaft and remove the shaft.



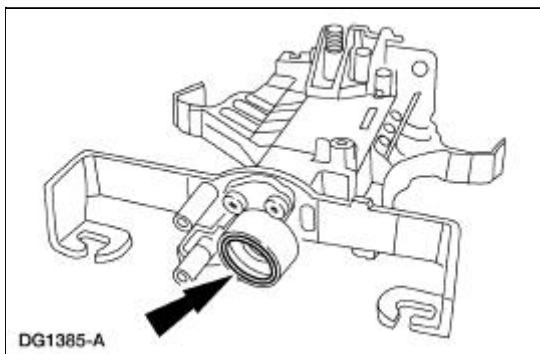
15. Using a suitable punch, remove the lower bearing (3517) from the lock cylinder housing.



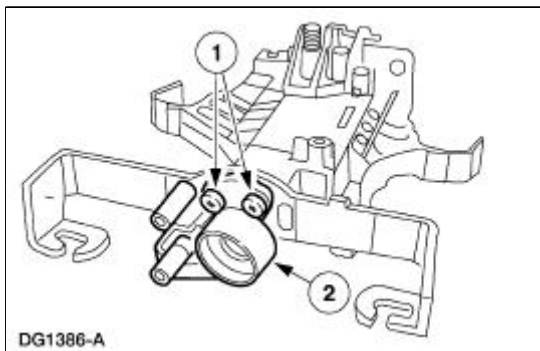
16. Use a suitable punch to remove the bearing from the lock cylinder housing.



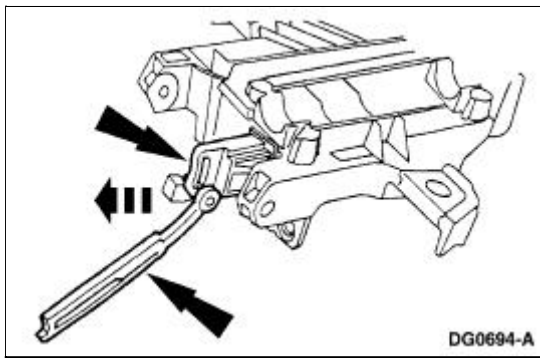
17. Remove the lower bearing and sleeve.



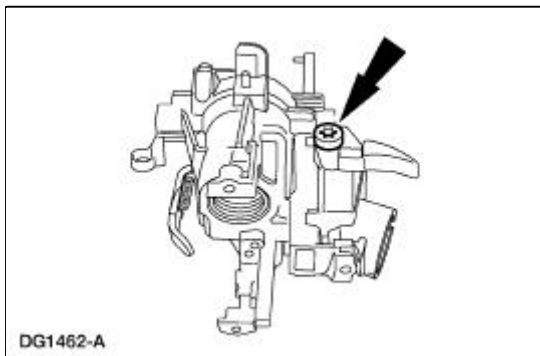
18. Remove the lower bearing retainer (3D681).
1. Remove the three bolts.
2. Remove the lower bearing retainer.



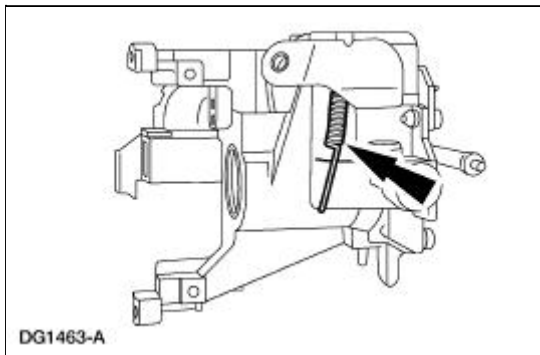
19. Remove the upper lock lever actuator (3E715) and the lower lock lever actuator.



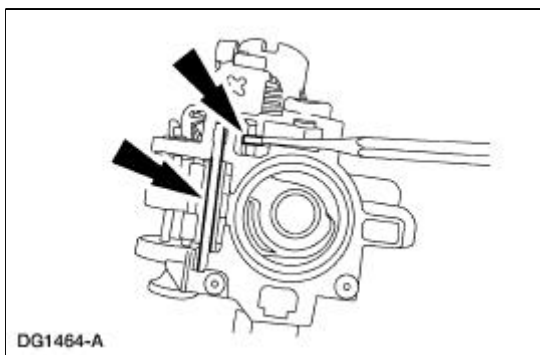
20. Remove the ignition lock cylinder lockout lever.



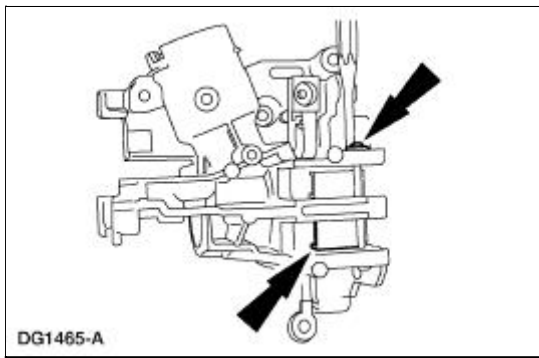
21. Remove the lock actuator lever return spring.



22. Using a pin punch, remove the pin and lock actuator lever.

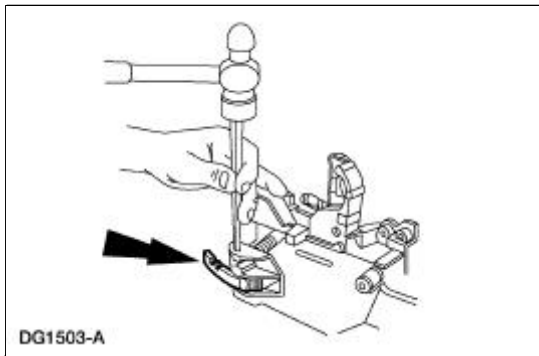


23. Using a pin punch, remove the pin and locking lever cam.



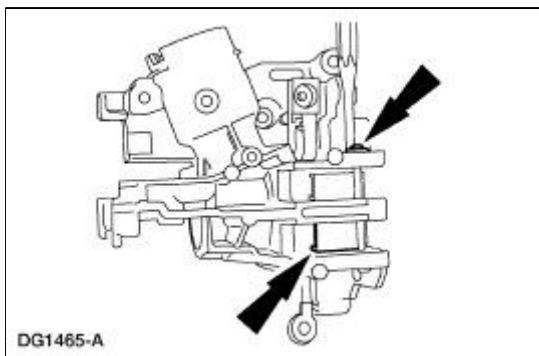
24. **NOTE:** Do not remove the tilt lock levers if not required.

Using a pin punch, remove the pin, tilt locking levers and springs.

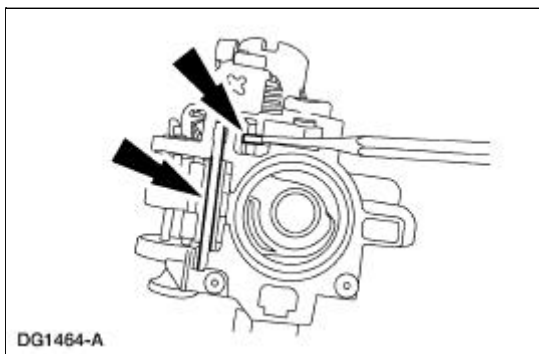


Assembly

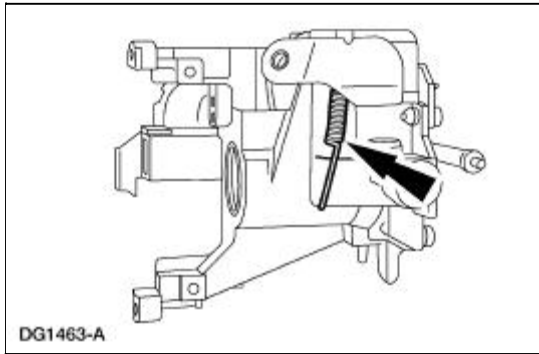
1. Install the locking lever cam and pin.



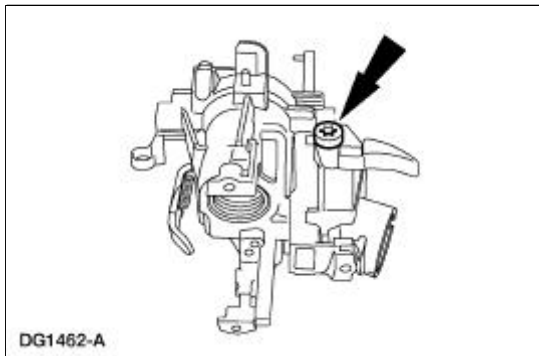
2. Install the lock actuator lever and pin.



3. Install the lock actuator lever return spring.



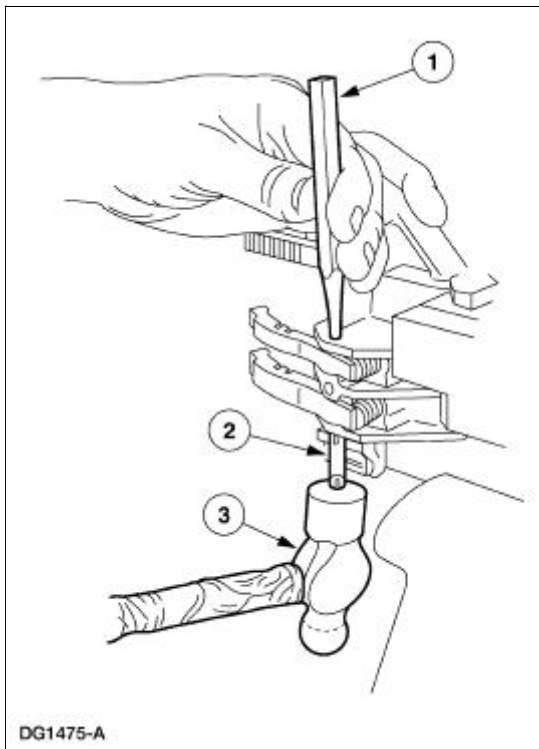
4. Install the ignition lock cylinder lockout lever.



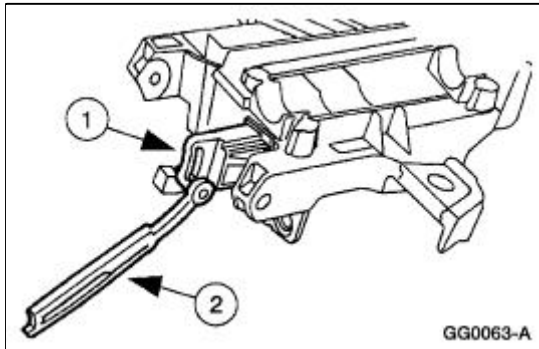
5. **NOTE:** The lock lever with two teeth is installed on the left-hand side.

If necessary, install the springs and lock levers.

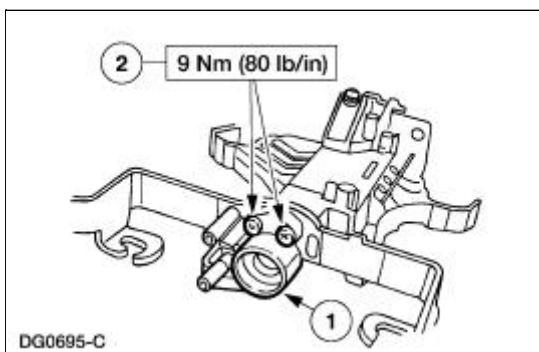
1. Install the spring and lever on the left-hand side. Use a pin punch to hold the compressed spring in position.
2. Install the spring and lever on the right-hand side. Use the pivot pin to hold the compressed spring in position.
3. Tap the pin through the levers, pushing out the pin punch, until flush with the housing.



6. Install the lock lever actuators.
 1. Lubricate the lock lever actuator with Ignition Lock Grease F0AZ-19584-A or equivalent meeting Ford specification ESA-M1C232-A.
 2. Install the lock lever actuators.

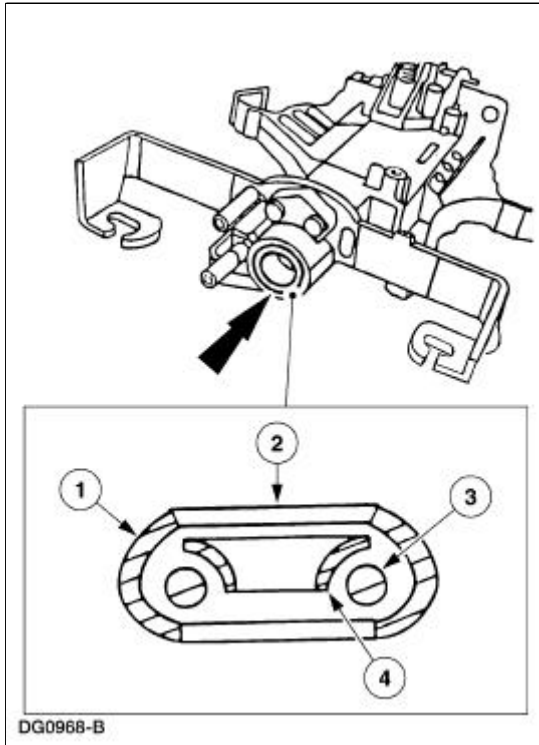


7. Install the lower bearing retainer.
 1. Position the lower bearing retainer.
 2. Install the three bolts.




8. **NOTE:** The "UP" position of the bearing must be facing forward.

Install the lower bearing and sleeve.

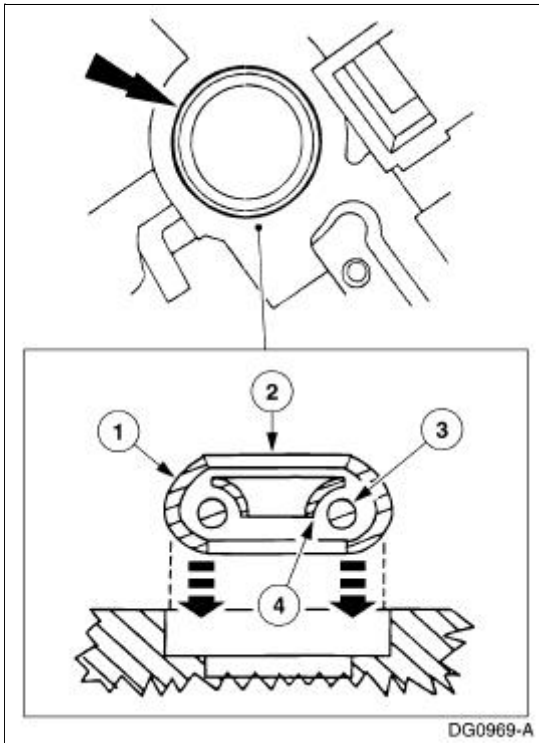


Item	Part Number	Description
1	—	Outer race
2	3517	Bearing (in the "UP" position)
3	—	Ball
4	—	Inner race

9.  **CAUTION:** Install the steering column bearing so that the inner race is visible when installed.

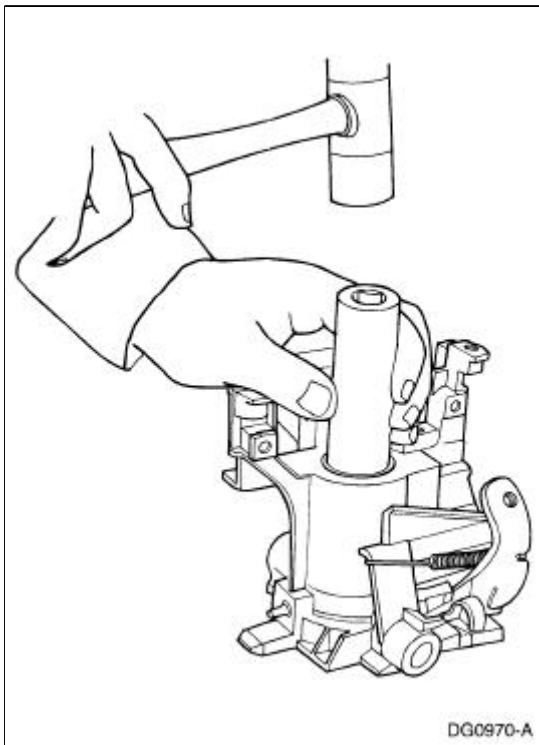
NOTE: Use an appropriate bearing installer or socket.

Install the bearing in the lock cylinder housing.




DG0969-A

Item	Part Number	Description
1	—	Outer race
2	—	Bearing (in the "UP" position)
3	—	Ball
4	—	Inner race

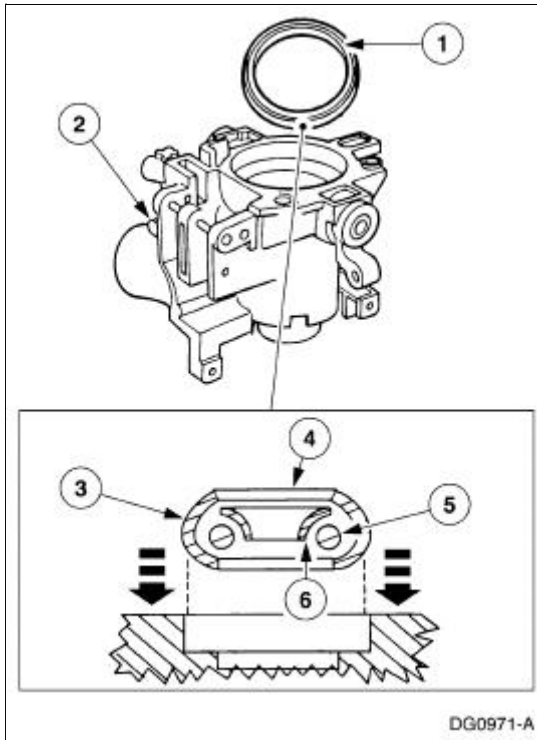


DG0970-A

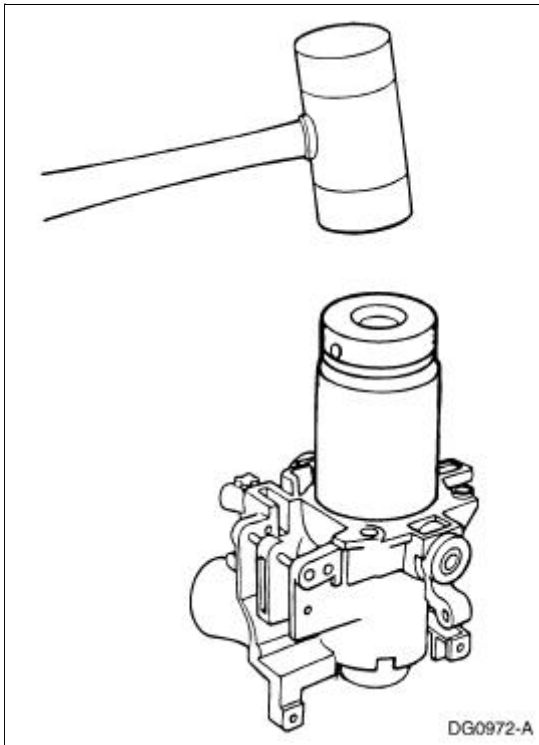
- 
CAUTION: Install the steering column bearing so that the inner race is visible when installed.

NOTE: Use an appropriate bearing installer or socket.

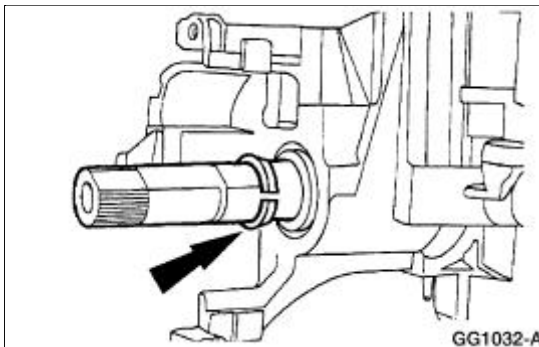
Install the bearing in the lock cylinder housing.



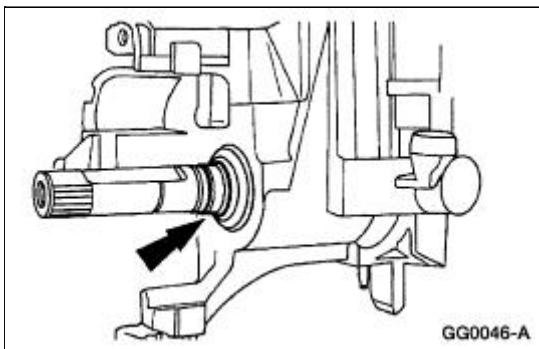
Item	Part Number	Description
1	—	Bearing slot
2	3511	Lock cylinder housing
3	—	Outer race
4	—	Bearing (in the "UP" position)
5	—	Ball
6	—	Inner race



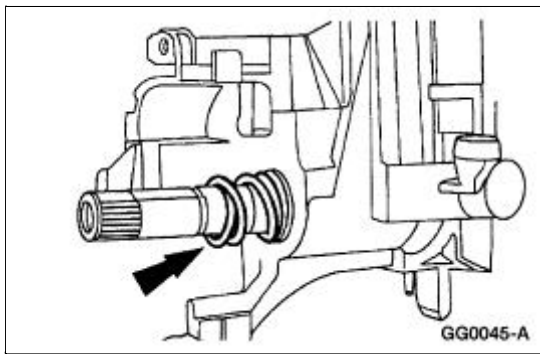
11. Position the shaft in the steering column lock cylinder housing.
 - Install the bearing tolerance ring on the steering column shaft.



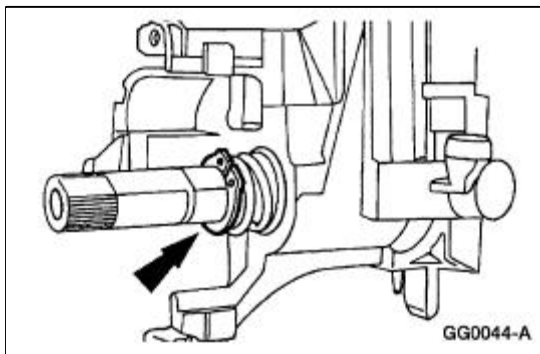
12. Install the bearing sleeve.



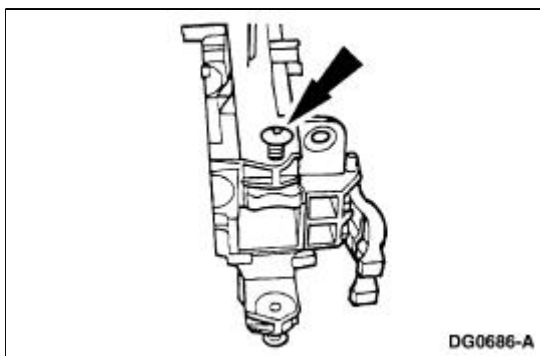
13. Install the upper bearing spring.



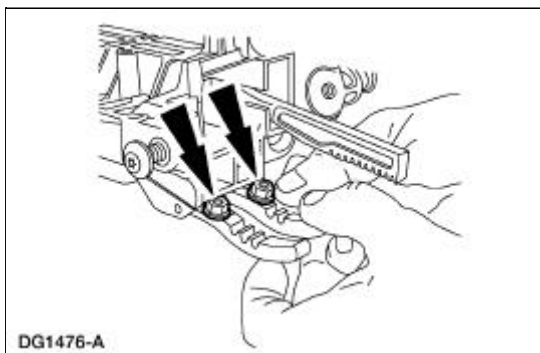
14. Install the snap ring.



15. Install the tilt pivot screws loosely and position the actuator housing in a vise.
 - Lubricate the pivot screws with Ignition Lock Grease F0AZ-19584-A or equivalent meeting Ford specification ESA-M1C232-A.



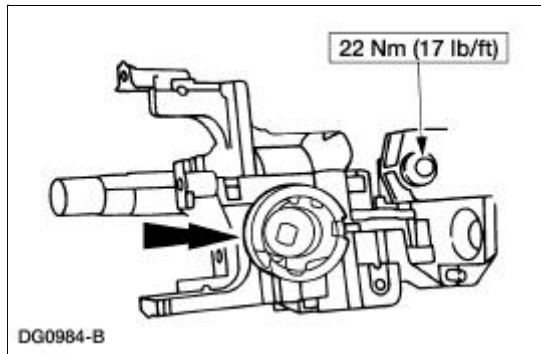
16. Place two nuts or spacers to hold the lock levers away from the actuator housing.



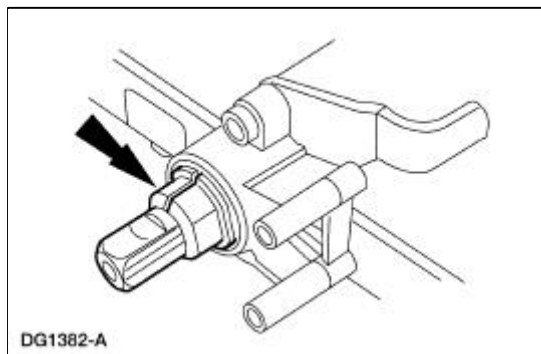
17. **NOTE:** Lubricate the lock cylinder housing pivot bushings with Ignition Lock Grease F0AZ-19584-A or equivalent meeting Ford specification ESA-M1C232-A.

Install the lock cylinder housing.

- Position the lock cylinder housing and the shaft assembly on the actuator housing.
- Make sure the upper and lower lock actuators are aligned.
- Install and compress the steering column position spring.
- Align the lock cylinder housing bushings with the pivot screws and tighten the screws.
- Using a long thin screwdriver, remove the nuts installed under the lock levers.

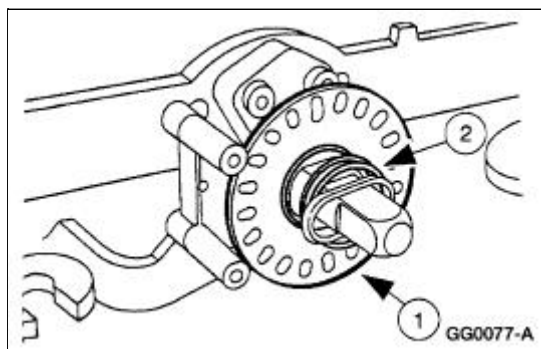


18. Install the bearing tolerance ring.



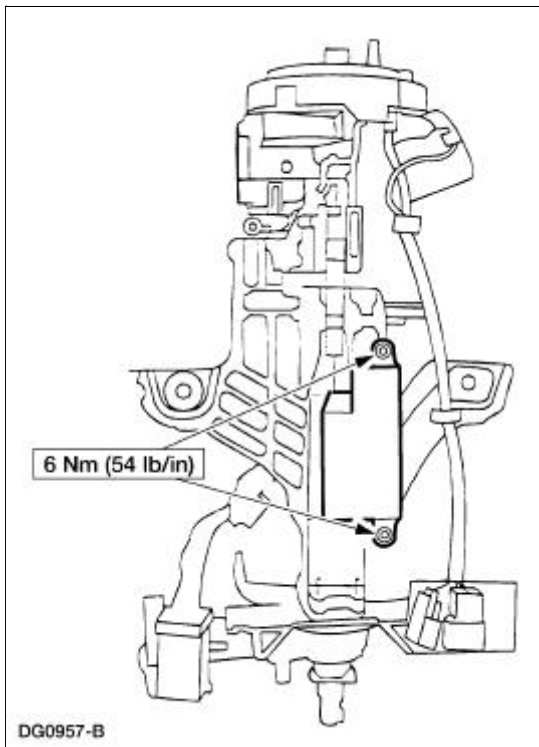
19. Install the sensor ring.

1. Install the sensor ring.
2. Install the lower bearing spring.



20. Install the ignition switch. Align the ignition switch with the slot and index-mark on the actuator housing.

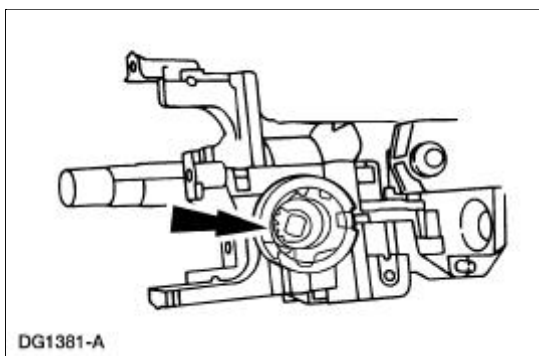
- Install the screws.



21. **NOTE:** The narrow section of the keyhole in the lock gear should be in the one o'clock position.

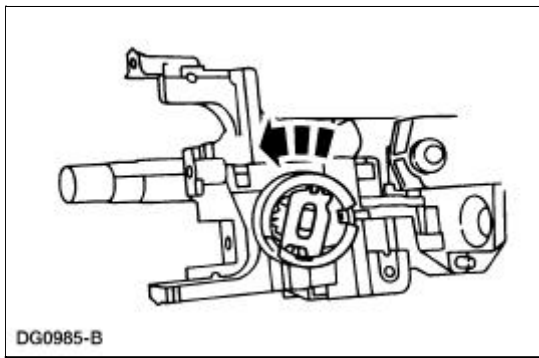
Install the lock gear.

- Use Ignition Lock Grease F0AZ-19584-A or equivalent meeting Ford specification ESA-M1C232-A to coat the lock gear.

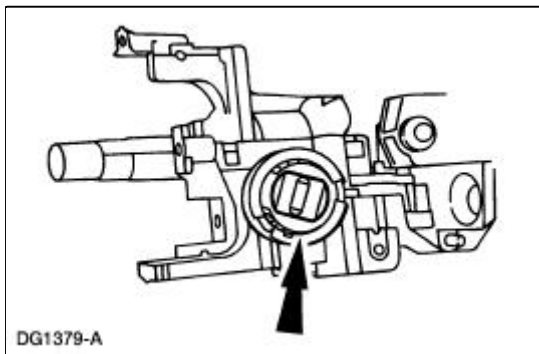


22. Install the lock housing bearing.

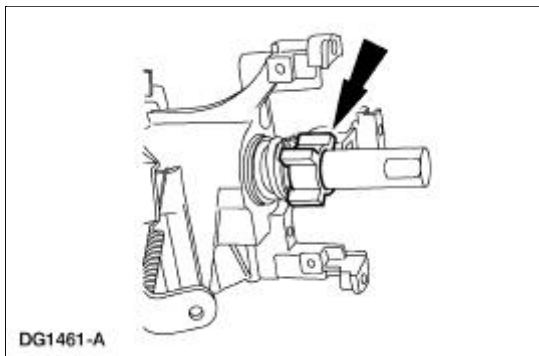
- The narrow section of the keyhole should be in the one o'clock position, with the tab inboard at the three o'clock position, and rotate it counterclockwise.
- Lubricate the lock housing bearing with Ignition Lock Grease F0AZ-19584-A or equivalent meeting Ford specification ESA-M1C232-A.




23. Install the upper bearing retainer firmly to engage the four retention tabs into the lock housing.



24. Install the turn indicator cancel cam.



25.  **WARNING:** To avoid risk of serious personal injury, follow all warnings, cautions, notes and instructions in the steering column removal and installation procedure.

Install the steering column. For additional information, refer to [Column](#) in this section.

Torque Specifications

Description	Nm	lb-ft	lb-in
Ignition switch screws	6	—	53
Instrument panel reinforcement screws	9	—	80
Instrument panel steering column cover screws	9	—	80
Key release button bolt	5	—	44

Steering Column Switches

The steering column switches system consists of the following components:

- multifunction switch (13K359)
- key release button (manual transmission only) (3F527)
- ignition switch (11572)

The integrated multifunction switch is mounted to the LH side of the steering column and controls the turn signals, hazard flasher, windshield wiper/washer control, and headlamp dimmer/flash-to-pass.

The key release button is equipped with manual transmissions only.

The ignition switch is mounted below the steering column and is activated by rotating the key lock cylinder on the steering column.

Steering Column Switches



Refer to Wiring Diagrams Cell [13](#), Power Distribution for schematic and connector information.

Refer to Wiring Diagrams Cell [81](#), Interval Wiper/Washer for schematic and connector information.

Refer to Wiring Diagrams Cell [85](#), Headlamps for schematic and connector information.

Refer to Wiring Diagrams Cell [90](#), Turn/Stop/Hazard Lamps for schematic and connector information.

Special Tool(s)

 <p>ST2332-A</p>	<p>Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool</p>
 <p>ST1137-A</p>	<p>73 Digital Multimeter 105-R0051 or equivalent</p>

Inspection and Verification

1. Verify the customer concern by operating the multifunction or ignition switch.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> ● Ignition key ● Ignition switch ● Multifunction switch ● Turn signal switch ● Hazard/flasher switch 	<ul style="list-style-type: none"> ● Battery junction box (BJB) Fuses: <ul style="list-style-type: none"> ■ (3) IGN (40A) ● Central junction box (CJB) Fuses: <ul style="list-style-type: none"> ■ 6 (25A) ■ 39 (5A) ● Damaged wiring harness ● Loose or corroded connections

3. If the concern remains after the inspection, connect the scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If the scan tool does not communicate with the vehicle:
 - check that the program card is correctly installed.

- check the connections to the vehicle.
 - check the ignition switch position.
4. If the scan tool still does not communicate with the vehicle, refer to the scan tool manual.
 5. Carry out the DATA LINK DIAGNOSTIC TEST. If the scan tool responds with:
 - CKT914, CKT915 or CKT70 =ALL ECUS NO RESP/NOT EQUIP, refer to [Section 418-00](#).
 - NO RESP/NOT EQUIP for GEM, go to Pinpoint Test A.
 - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the GEM.
 6. If the DTCs retrieved are related to the concern, go to the GEM Diagnostic Trouble Code (DTC) Index to continue diagnostics.
 7. If no DTCs related to the concern are retrieved, proceed to the Symptom Chart to continue diagnostics.

GEM Diagnostic Trouble Code (DTC) Index

GEM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1217	Horn Relay Coil Circuit Failure	GEM	REFER to Section 413-06 .
B1218	Horn Relay Coil Circuit Short to Vbatt	GEM	REFER to Section 413-06 .
B1312	Lamp Headlamp Input Circuit Short to Battery	GEM	REFER to Section 417-01 .
B1317	Battery Voltage High	GEM	REFER to Section 414-00 .
B1318	Battery Voltage Low	GEM	REFER to Section 414-00 .
B1322	Driver Door Ajar Circuit Short to Ground	GEM	REFER to Section 417-02 .
B1330	Passenger Door Ajar Circuit Short to Ground	GEM	REFER to Section 417-02 .
B1334	Decklid Ajar Rear Door Circuit Short to Ground	GEM	REFER to Section 417-02 .
B1339	Chime Input Request Circuit Short to Battery	GEM	REFER to Section 413-09 .
B1340	Chime Input Request Circuit Short to Ground	GEM	REFER to Section 413-09 .
B1342	ECU Is Defective	GEM	CLEAR the DTC. Retrieve the DTCs. If DTC B1342 is retrieved, INSTALL a new GEM. REFER to Section 419-10 .
B1353	Ignition Key-In Circuit Open	GEM	REFER to Section 413-09 .
B1359	Ignition Run/Acc Circuit Failure	GEM	GO to Pinpoint Test E .
B1396	Power Door Lock Circuit Short to Battery	GEM	REFER to Section 501-14B .
B1397	Power Door Unlock Circuit Short to Battery	GEM	REFER to Section 501-14B .

B1405	Driver Power Window Down Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1408	Driver Power Window Up Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1410	Driver Power Window Motor Circuit Failure	GEM	REFER to Section 501-11 .
B1426	Lamp Safety Belt Circuit Short to Battery	GEM	REFER to Section 413-01 .
B1428	Lamp Safety Belt Circuit Failure	GEM	REFER to Section 413-01 .
B1431	Wiper Brake/Run Relay Circuit Failure	GEM	REFER to Section 501-16 .
B1432	Wiper Brake/Run Relay Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1434	Wiper Hi/Low Speed Relay Coil Circuit Failure	GEM	REFER to Section 501-16 .
B1436	Wiper Hi/Low Speed Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1438	Wiper Mode Select Switch Circuit Failure	GEM	REFER to Section 501-16 .
B1441	Wiper Mode Select Switch Circuit Short to Ground	GEM	REFER to Section 501-16 .
B1446	Wiper Park Sense Circuit Failure	GEM	REFER to Section 501-16 .
B1448	Wiper Park Sense Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1450	Wiper Wash/Delay Switch Circuit Failure	GEM	REFER to Section 501-16 .
B1453	Wiper Wash/Delay Switch Circuit Short to Ground	GEM	REFER to Section 501-16 .
B1458	Wiper Washer Pump Motor Relay Circuit Failure	GEM	REFER to Section 501-16 .
B1460	Wiper Washer Pump Motor Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1462	Safety Belt Switch Circuit Failure	GEM	REFER to Section 413-09 .
B1466	Wiper Hi/Low Speed Not Switching	GEM	REFER to Section 501-16 .
B1473	Wiper Low Speed Circuit Motor Failure	GEM	REFER to Section 501-16 .
B1476	Wiper High Speed Circuit Motor Failure	GEM	REFER to Section 501-16 .
B1551	Decklid Release Circuit Failure	GEM	REFER to Section 501-14B .
B1553	Decklid Release Circuit Short to Battery	GEM	REFER to Section 501-14B .
B1555	Ignition Run/Start Circuit Failure	GEM	GO to Pinpoint Test D .
B1687	Lamp Dome Input Circuit Short to Battery	GEM	REFER to Section 417-02 .
B2486	LF Side Repeater Lamp Output	GEM	REFER to Section 417-01 .

	Circuit Failure		
B2488	RF Side Repeater Lamp Output Circuit Failure	GEM	REFER to Section 417-01 .
C1189	Brake Fluid Level Sensor Input Short Circuit to Ground	GEM	REFER to Section 413-01 .
C1223	Lamp Brake Warning Output Circuit Failure	GEM	REFER to Section 413-01 .
C1225	Lamp Brake Warning Output Circuit Short to Battery	GEM	REFER to Section 413-01 .


Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none"> No communication with the generic electronic module 	<ul style="list-style-type: none"> CJB Fuse 39 (5A). Circuitry. GEM. 	<ul style="list-style-type: none"> Go To Pinpoint Test A.
<ul style="list-style-type: none"> The ignition switch is inoperative 	<ul style="list-style-type: none"> BJB Fuse IGN SW (40A). Ignition switch. Circuitry. 	<ul style="list-style-type: none"> Go To Pinpoint Test B.
<ul style="list-style-type: none"> No power in ACC 	<ul style="list-style-type: none"> Ignition switch. Circuitry. 	<ul style="list-style-type: none"> Go To Pinpoint Test C.
<ul style="list-style-type: none"> No power in RUN 	<ul style="list-style-type: none"> Ignition switch. Circuitry. 	<ul style="list-style-type: none"> Go To Pinpoint Test D.
<ul style="list-style-type: none"> No power in START 	<ul style="list-style-type: none"> Ignition switch. Circuitry. 	<ul style="list-style-type: none"> Go To Pinpoint Test E.
<ul style="list-style-type: none"> The multifunction switch/hazard switch does not operate correctly 	<ul style="list-style-type: none"> Multifunction switch. 	<ul style="list-style-type: none"> Carry out the multifunction switch component test. REFER to Wiring Diagrams, Cell 149, Component Testing.

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE GENERIC ELECTRONIC MODULE

Test Step	Result / Action to Take
 CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.	
A1 CHECK THE GENERIC ELECTRONIC MODULE (GEM) POWER SUPPLY	Yes GO to A2 .
<ul style="list-style-type: none"> Key in OFF position. Disconnect: Generic Electronic Module (GEM) C201a. 	

- Disconnect: GEM C201b.
- Key in ON position.
- Using the following table. measure the voltage between the GEM, harness side and ground.

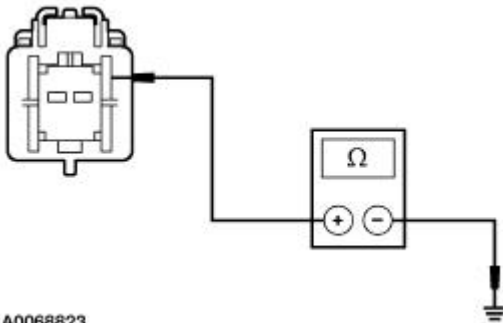
Connector	Pin	Circuit
C201a	2	400 (LB/BK)
C201a	3	1006 (DG/WH)
C201b	1	1001 (WH/YE)
C201b	4	193 (YE/LG)

- Are the voltages greater than 10 volts?

No
REPAIR the circuit(s) in question. TEST the system for normal operation.

A2 CHECK THE GEM GROUND CIRCUIT 397 (BK/WH) FOR OPEN

- Key in OFF position.
- Measure the resistance between the GEM C201b pin 2, circuit 397 (BK/WH), harness side and ground.



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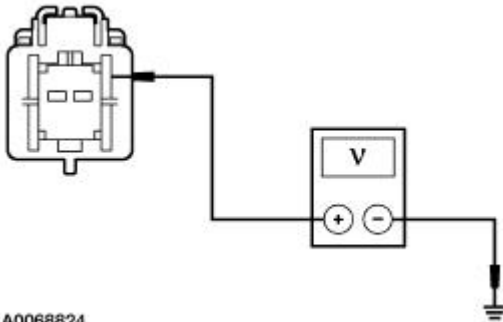
- Is the resistance less than 5 ohms?

Yes
GO to [A3](#).

No
REPAIR the circuit(s) in question. TEST the system for normal operation.

A3 CHECK CIRCUIT 397 (BK/WH) FOR SHORT TO POWER

- Measure the voltage between GEM C201b pin 2, circuit 397 (BK/WH), harness side and ground.



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- Is any voltage present?

Yes
REPAIR the circuit. TEST the system for normal operation.

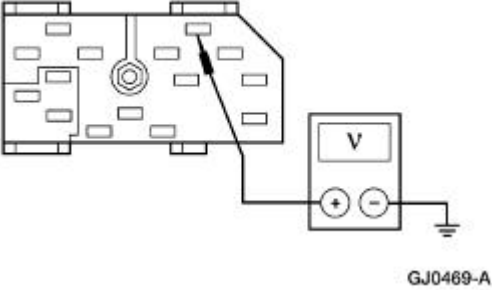
No
REFER to [Section 418-00](#).

PINPOINT TEST B: THE IGNITION SWITCH IS INOPERATIVE

Test Step	Result / Action to Take
B1 CHECK THE IGNITION SWITCH	
<ul style="list-style-type: none"> ● Carry out the ignition switch component test. REFER to Wiring Diagrams Cell 149, Component Testing. ● Is the ignition switch OK ? 	<p>Yes INSTALL a new BJB. TEST the system for normal operation.</p>

No
 INSTALL a new ignition switch. REFER to [Ignition Switch](#). TEST the system for normal operation.

PINPOINT TEST C: NO POWER IN ACC

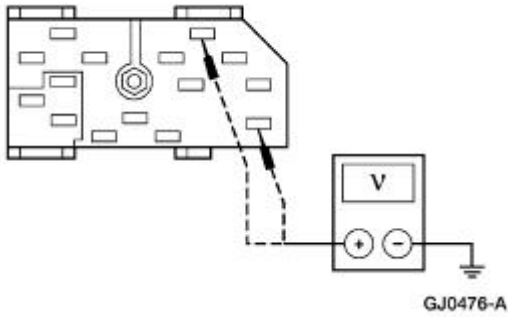
Test Step	Result / Action to Take
C1 CHECK THE RADIO FOR NORMAL OPERATION	<p>Yes GO to C2.</p> <p>No Go To Pinpoint Test D.</p>
<ul style="list-style-type: none"> ● Key in ON position. ● Check the radio for normal operation. ● Does the radio operate correctly? 	
C2 CHECK THE VOLTAGE AT THE IGNITION SWITCH	<p>Yes INSTALL a new ignition switch. REFER to Ignition Switch. TEST the system for normal operation.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<ul style="list-style-type: none"> ● Disconnect: Ignition Switch C250 . ● Measure the voltage between ignition switch C250 Pin B5, Circuit 1050 (LG/VT), harness side and ground.  <p style="text-align: center;">GJ0469-A</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	

PINPOINT TEST D: NO POWER IN RUN

Test Step	Result / Action to Take
D1 CHECK THE IGNITION SWITCH	<p>Yes INSTALL a new BJB. TEST the system for normal operation.</p> <p>No INSTALL a new ignition switch. REFER to Ignition Switch. TEST the system for normal operation.</p>
<ul style="list-style-type: none"> ● Carry out the ignition switch component test. REFER to Wiring Diagrams Cell 149, Component Testing. ● Is the ignition switch OK ? 	

PINPOINT TEST E: NO POWER IN START

Test Step	Result / Action to Take
E1 CHECK THE VOLTAGE TO THE IGNITION SWITCH	<p>Yes GO to E2.</p>
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Ignition Switch C250 . 	

<ul style="list-style-type: none"> ● Measure the voltage between ignition switch C250 Pin B4, Circuit 1050 (LG/VT), harness side and ground; and between ignition switch C250 Pin B5, Circuit 1050 (LG/VT), harness side and ground.  <ul style="list-style-type: none"> ● Are the voltages greater than 10 volts? 	<p>No REPAIR the circuit in question. TEST system for normal operation.</p>
E2 CHECK THE CONTINUITY OF THE IGNITION SWITCH	
<ul style="list-style-type: none"> ● Carry out the ignition switch continuity test. REFER to Wiring Diagrams, Cell 149, Component Testing. ● Does the ignition switch test OK? 	<p>Yes GO to E3.</p> <p>No INSTALL a new ignition switch. REFER to Ignition Switch. TEST the system for normal operation.</p>
E3 CHECK CIRCUIT 16 (RD/LB), AND CIRCUIT 33 (WH/PK)	
<ul style="list-style-type: none"> ● Connect: Ignition Switch C250. ● Turn ignition switch to START. ● Does the starter engage? 	<p>Yes REPAIR Circuit 16 (RD/LB). TEST the system for normal operation.</p> <p>No REPAIR Circuit 33 (WH/PK). TEST the system for normal operation.</p>

Component Test

Ignition Switch Continuity Check

Refer to Wiring Diagrams Cell 149, Component Testing.

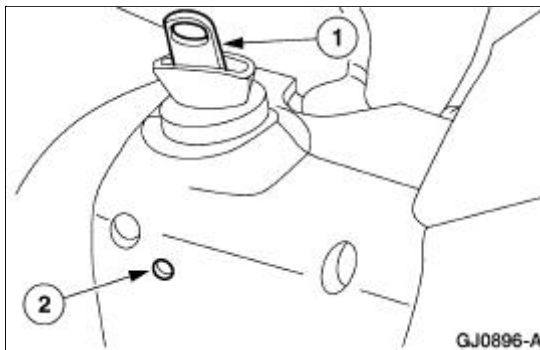
Multifunction Switch

Refer to Wiring Diagrams Cell 149, Component Testing.

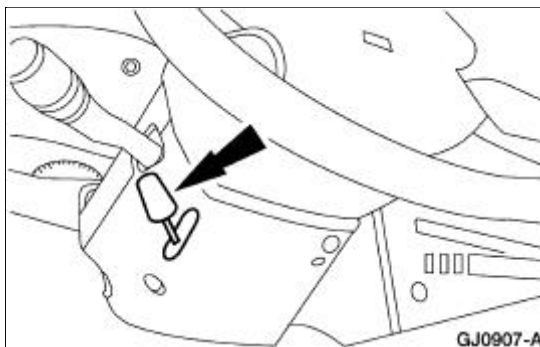
Multifunction Switch

Removal

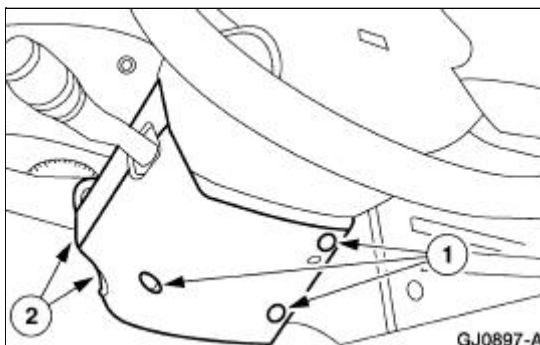
1. Disconnect the battery ground cable.
2. Remove the ignition switch lock cylinder.
 1. Insert the ignition key into the ignition switch lock cylinder and turn to RUN position.
 2. Push the ignition switch lock cylinder release tab with a punch while pulling out the ignition switch lock cylinder.



3. Remove the tilt wheel handle.

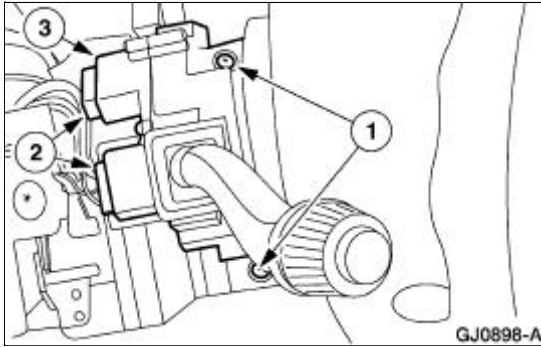


4. Remove the upper and lower steering column shrouds.
 1. Remove the screws.
 2. Remove the upper and lower steering column shrouds.



5. Remove the multifunction switch.
 1. Remove the screws.

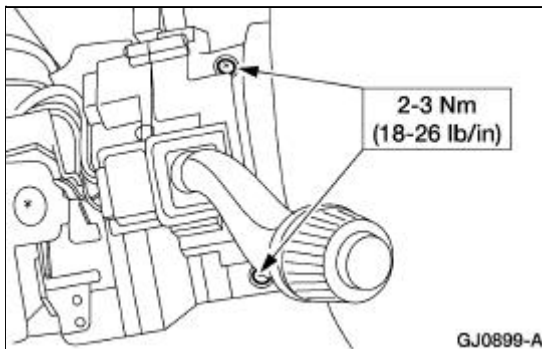
2. Disconnect the electrical connectors.
3. Remove the multifunction switch.



Installation

1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

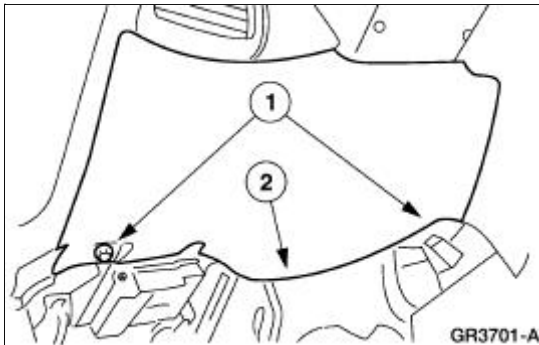
To install, reverse the removal procedure.



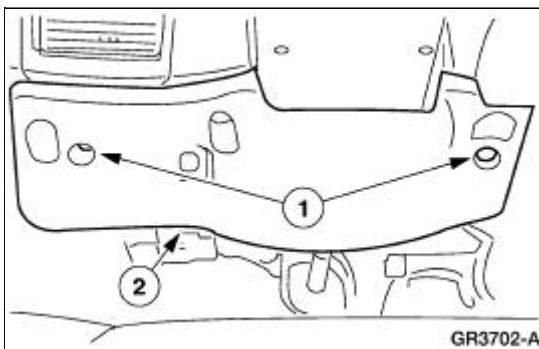
Ignition Switch

Removal

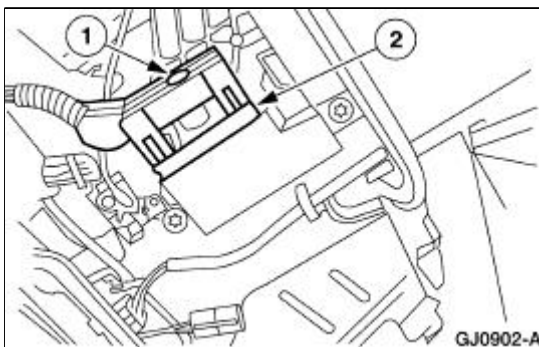
1. Disconnect the battery ground cable.
2. Remove the lower instrument panel steering column cover.
 1. Remove the screws.
 2. Remove the lower instrument panel steering column cover.



3. Remove the instrument panel reinforcement.
 1. Remove the screws.
 2. Remove the instrument panel reinforcement.



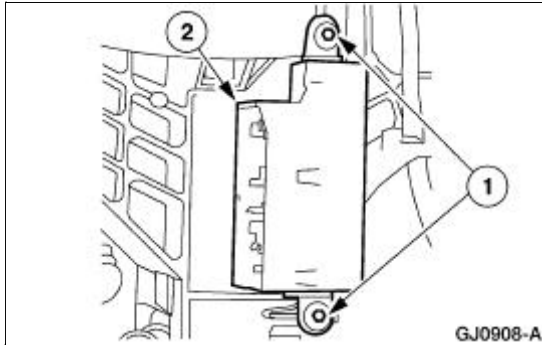
4. Disconnect the ignition switch electrical connector.
 1. Loosen the bolt.
 2. Disconnect the ignition switch electrical connector.



5. **NOTE:** Ignition switch should be in the OFF position.

Remove the ignition switch.

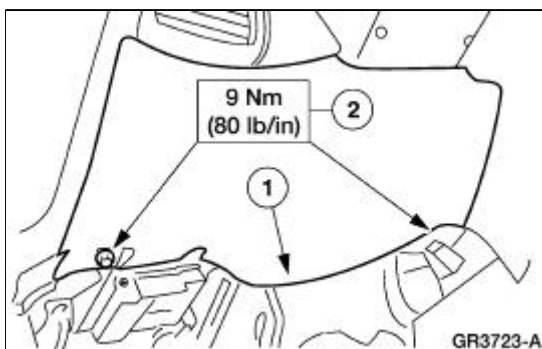
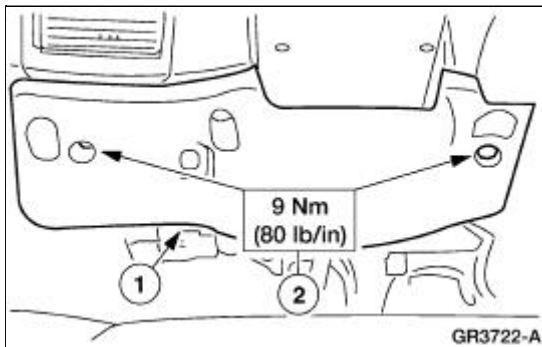
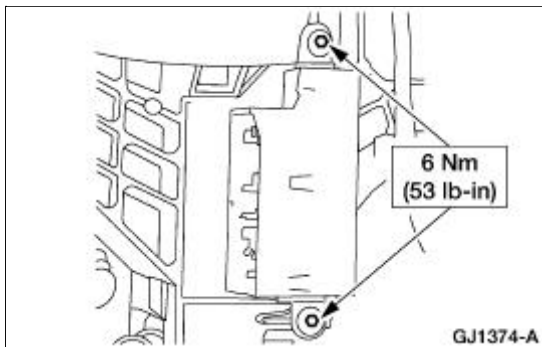
1. Remove the screws.
2. Remove the ignition switch.



Installation

1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

To install, reverse the removal procedure.

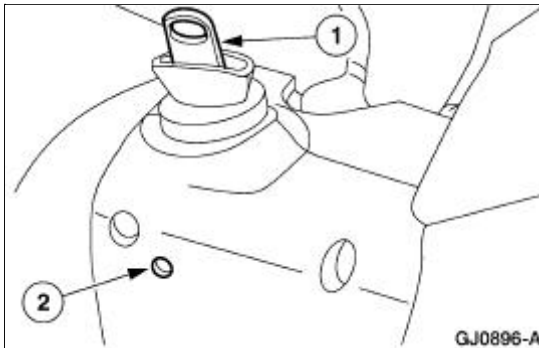




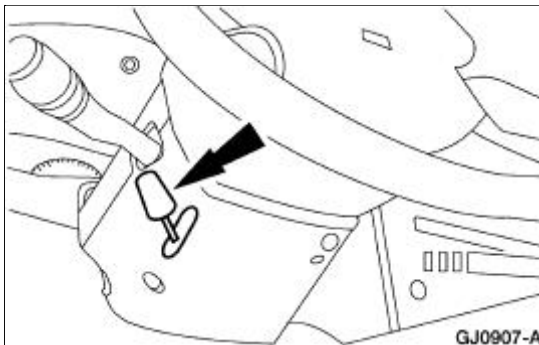
Key Release Button

Removal

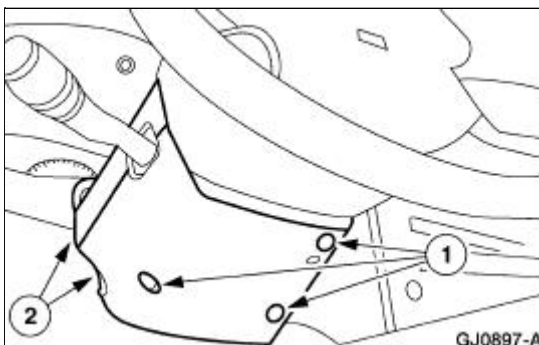
1. Disconnect the battery ground cable.
2. Remove the ignition switch lock cylinder.
 1. Insert the ignition key into the ignition switch lock cylinder and turn to RUN position.
 2. Push the ignition switch lock cylinder release tab with a punch while pulling out the ignition switch lock cylinder.



3. Remove the tilt wheel handle.

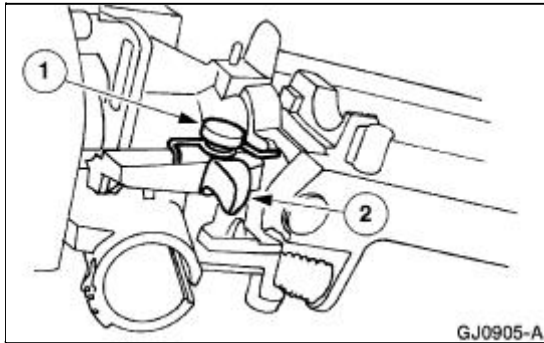


4. Remove the upper and lower steering column shrouds.
 1. Remove the screws.
 2. Remove the upper and lower steering column shrouds.



5. Remove the key release button.
 1. Remove the key release button bolt.

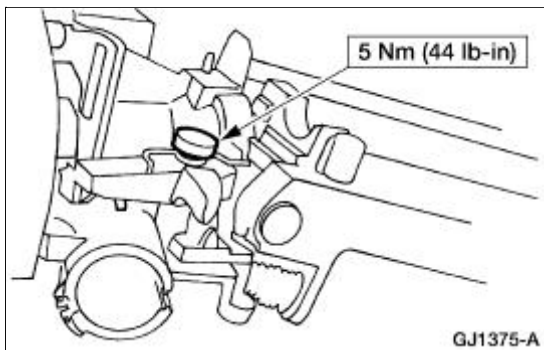
2. Remove the release button handle and the spring.



Installation

1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

To install, reverse the removal procedure.



General Specifications

Item	Specification
Lubricants and Sealants	
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP	WSS-M2C153-H
Diesel engine oil	Refer to owner literature
Gasoline Engine Oil Dye 164-R3705	ESE-M99C103-B1
Threadlock® 262 E2FZ-19554-B	WSK-M2G351-A6

Engine

NOTE: This section contains information, steps and procedures that may not be specific to your engine.

This section covers general procedures and diagnosis and testing of the engine system, except for exhaust emission control devices, which are covered in the Powertrain Control/Emissions Diagnosis Manual.

The engine incorporates the following features:

- a closed positive crankcase ventilation (PCV) system. For additional information, refer to [Section 303-08](#).
- an exhaust emission control system. For additional information, refer to [Section 303-08](#).
- an evaporative emission control system. For additional information, refer to [Section 303-13](#).

Some engines incorporate a fail-safe cooling system. Refer to the appropriate section in Group [303](#) for the procedure.

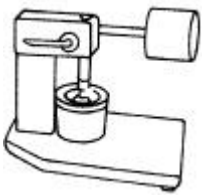






The engine, fuel system, ignition system, emissions system and exhaust system all affect exhaust emission levels and must be maintained according to the maintenance schedule. Refer to the scheduled Maintenance Guide.

Correct engine identification is required to order parts. Refer to the appropriate section in Group [303](#) for the procedure.

For complete vehicle and engine identification codes, refer to [Section 100-01](#).

Engine

Special Tool(s)

	Commercially Available Leakdown Tester —
 <p>ST1299-A</p>	Quick Disconnect Compression Tester 134-R0212 or equivalent
 <p>ST1272-A</p>	Dial Indicator Gauge Adapter 303-007 (TOOL-6565-AB) or equivalent
 <p>ST1214-A</p>	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
 <p>ST1298-A</p>	Engine Cylinder Leak Detection/Air Pressurization Kit 014-00708 or equivalent
 <p>ST1296-A</p>	Oil Pressure Gauge 303-088 (T73L-6600-A)
 <p>ST1300-A</p>	UV Leak Detector Kit 164-R0756 or equivalent
	Vacuum/Pressure Tester 164-R0253 or equivalent



Material

Item	Specification
Gasoline Engine Oil Dye 164-R3705 or equivalent	ESE-M99C103-B1
Engine Oil	Refer to owner literature

Inspection and Verification

1. Verify the customer concern by operating the engine to duplicate the condition.
2. Visually inspect for obvious signs of mechanical damage. Refer to the following chart.

Visual Inspection Chart

Mechanical
<ul style="list-style-type: none"> ● Engine coolant leaks ● Engine oil leaks ● Fuel leaks ● Damaged or severely worn parts ● Loose mounting bolts, studs and nuts

3. If the inspection reveals obvious concerns that can be readily identified, repair as necessary.
4. If the concerns remain after the inspection, determine the symptoms. GO to [Symptom Chart](#).

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● Difficult starting 	<ul style="list-style-type: none"> ● Damaged ignition system. ● Damaged fuel system. ● Damaged starting system. 	<ul style="list-style-type: none"> ● Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. ● Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. ● Refer to the appropriate section in Group 303 for the procedure.

	<ul style="list-style-type: none"> ● Damaged charging system/battery. ● Burnt valve. ● Worn piston. ● Worn piston rings. ● Worn cylinder. ● Damaged head gasket. ● Damaged cooling system. 	<p>REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.</p> <ul style="list-style-type: none"> ● REFER to Section 414-00 . ● INSTALL a new valve. ● INSTALL a new piston. ● INSTALL new piston rings. ● REPAIR or INSTALL a new cylinder block. ● INSTALL a new head gasket. ● Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
<ul style="list-style-type: none"> ● Poor idling 	<ul style="list-style-type: none"> ● Vacuum leaks. ● Malfunctioning or damaged ignition system. ● Malfunctioning or damaged fuel system. ● Damaged valve tappet or lash adjuster. ● Damaged valve tappet guide or lash adjuster. ● Incorrect valve-to-valve seat contact. ● Damaged head gasket. 	<ul style="list-style-type: none"> ● Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. ● Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. ● Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. ● INSTALL a new valve tappet or lash adjuster. ● INSTALL a new valve tappet guide or valve tappet. ● REPAIR or INSTALL a new valve or valve seat. ● INSTALL a new head gasket.
<ul style="list-style-type: none"> ● Abnormal combustion 	<ul style="list-style-type: none"> ● Malfunctioning or damaged fuel system. ● Malfunctioning or damaged ignition system. ● Malfunctioning or damaged air intake system. 	<ul style="list-style-type: none"> ● Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. ● Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. ● Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis

	<ul style="list-style-type: none"> ● Damaged valve tappet or lash adjuster. ● Damaged valve tappet guide or valve tappet. ● Burnt or sticking valve. ● Weak or broken valve spring. ● Carbon accumulation in combustion chamber. 	<p>(PC/ED) manual.</p> <ul style="list-style-type: none"> ● INSTALL a new valve tappet or lash adjuster. ● INSTALL a new valve tappet guide or valve tappet. ● REPAIR or INSTALL a new valve. ● INSTALL a new valve spring. ● ELIMINATE carbon buildup.
<ul style="list-style-type: none"> ● Excessive oil consumption 	<ul style="list-style-type: none"> ● Leaking oil. ● Malfunctioning PCV system. ● Worn valve stem seal. ● Worn valve stem or valve guide. ● Sticking piston rings. ● Worn piston ring groove. ● Worn piston or cylinder. 	<ul style="list-style-type: none"> ● REPAIR oil leakage. ● REPAIR or INSTALL new necessary components. ● INSTALL a new valve stem seal. ● INSTALL a new valve and valve guide. ● REPAIR or INSTALL new piston rings. ● INSTALL a new piston and piston pin. ● REPAIR or INSTALL a new piston or cylinder block.
<ul style="list-style-type: none"> ● Engine noise 	<ul style="list-style-type: none"> ● Leaking exhaust system. ● Incorrect drive belt tension. ● Malfunctioning generator bearing. ● Malfunctioning water pump bearing. ● Malfunctioning or damaged cooling system. ● Malfunctioning or damaged fuel system. ● Loose timing chain/belt (6268). ● Damaged timing chain tensioner (6L266). ● Excessive main bearing clearance. 	<ul style="list-style-type: none"> ● REPAIR exhaust leakage. ● REFER to Section 303-05. ● Refer to the appropriate section in Group 414 for the procedure. ● REFER to Section 303-03A. ● REFER to Section 303-03A. ● Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. ● ADJUST or INSTALL a new timing chain/belt. ● INSTALL a new timing chain tensioner. ● ADJUST clearance or INSTALL a new crankshaft main bearing (6333).

	<ul style="list-style-type: none"> ● Seized or heat damaged crankshaft main bearing. ● Excessive crankshaft end play. ● Excessive connecting rod bearing clearance. ● Heat damaged connecting rod bearing (6211). ● Damaged connecting rod bushing (6207). ● Worn cylinder. ● Worn piston (6108) or piston pin (6135). ● Damaged piston rings. ● Bent connecting rod. ● Malfunctioning valve tappet (6500) or lash adjuster. ● Excessive valve tappet or lash adjuster clearance. ● Broken valve spring (6513). ● Excessive valve guide clearance. 	<ul style="list-style-type: none"> ● INSTALL a new crankshaft main bearing. ● INSTALL a new thrust bearing or crankshaft (6303). ● INSTALL a new connecting rod bearing or connecting rod (6200). ● INSTALL a new connecting rod bearing. ● INSTALL a new connecting rod bushing. ● REPAIR or INSTALL a new cylinder block (6010). ● INSTALL a new piston or piston pin. ● INSTALL new piston rings. ● INSTALL a new connecting rod. ● INSTALL a new valve tappet or lash adjuster. ● ADJUST clearance or INSTALL a new valve tappet guide or valve tappet. ● INSTALL a new valve spring. ● ADJUST clearance or INSTALL a new valve guide (6510) or valve.
<ul style="list-style-type: none"> ● Insufficient power 	<ul style="list-style-type: none"> ● Malfunctioning or damaged ignition system. ● Malfunctioning or damaged fuel system. ● Malfunctioning or damaged air intake system. ● Damaged or plugged exhaust system. ● Incorrect tire size. ● Dragging brakes. 	<ul style="list-style-type: none"> ● Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. ● Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. ● Refer to the appropriate section in Group 303 for the procedure. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. ● INSPECT exhaust system. ● REFER to Section 204-04 . ● REFER to Section 206-00 .

	<ul style="list-style-type: none"> ● Slipping transmission. ● Malfunctioning valve tappet or lash adjuster. ● Damaged valve tappet guide or valve tappet. ● Compression leakage at valve seat. ● Seized valve stem. ● Weak or broken valve spring. ● Worn or damaged camshaft. ● Damaged head gasket (6051). ● Cracked or distorted cylinder head. ● Damaged, worn or sticking piston ring (s). ● Worn or damaged piston. 	<ul style="list-style-type: none"> ● Refer to the appropriate section in Group 307 for the procedure. ● INSTALL a new valve tappet or lash adjuster. ● INSTALL a new valve tappet guide or valve tappet. ● REPAIR or INSTALL a new valve, valve seat or cylinder head (6049). ● INSTALL a new valve. ● INSTALL a new valve spring. ● INSTALL a new camshaft. ● INSTALL a new head gasket. ● INSTALL a new cylinder head. ● REPAIR or INSTALL a new piston ring(s). ● INSTALL a new piston and piston pin.
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Component Tests

Engine Oil Leaks

NOTE: When diagnosing engine oil leaks, the source and location of the leak must be positively identified prior to repair.

Prior to carrying out this procedure, clean all sealing surface areas with a suitable solvent to remove all traces of oil.

Engine Oil Leaks—Fluorescent Oil Additive Method

Use the UV Leak Detector Kit to carry out the following procedure for oil leak diagnosis.

1. Add gasoline engine oil dye. Use a minimum 14.8 ml (0.5 ounce) to a maximum 29.6 ml (1 ounce) of fluorescent additive to all engines. If the oil is not premixed, fluorescent additive must first be added to crankcase.
2. Run the engine for 15 minutes. Stop the engine and inspect all seal and gasket areas for leaks using the UV Leak Detector Kit. A clear bright yellow or orange area will identify the leak. For extremely small leaks, several hours may be required for the leak to appear.

Leakage Points—Underhood

Examine the following areas for oil leakage:

- valve cover gaskets

- intake manifold gaskets
- cylinder head gaskets
- oil bypass filter
- oil filter adapter
- engine front cover
- oil filter adapter and filter body
- oil level indicator tube connection
- oil pressure sensor

Leakage Points—Under Engine—With Vehicle on Hoist

- oil pan gaskets (6710)
- oil pan sealer
- oil pan rear seal (6723)
- engine front cover gasket
- crankshaft front seal (6700)
- crankshaft rear oil seal (6701)
- crankshaft main bearing cap side bolts
- oil filter adapter and filter body
- oil cooler, if equipped

Leakage Points—With Transmission and Flywheel Removed

- crankshaft rear oil seal
- rear main bearing cap parting line
- rear main bearing cap and seals
- flywheel mounting bolt holes (with flywheel [6375] installed)
- camshaft rear bearing covers (6266) or pipe plugs at the end of oil passages

Oil leaks at crimped seams in sheet metal parts and cracks in cast or stamped parts can be detected when using the dye method.

Compression Test—Compression Gauge Check

1. Make sure the oil in the crankcase is of the correct viscosity and at the correct level and that the battery (10655) is correctly charged. Operate the vehicle until the engine is at normal operating temperature. Turn the ignition switch to the OFF position, then remove all the spark plugs (12405).
2. Set the throttle plates in the wide-open position.
3. Install a compression gauge such as the Compression Tester in the No. 1 cylinder.
4. Install an auxiliary starter switch in the starting circuit. With the ignition switch in the OFF position, and using the auxiliary starter switch, crank the engine a minimum of five compression strokes and record the highest reading. Note the approximate number of compression strokes

required to obtain the highest reading.

- Repeat the test on each cylinder, cranking the engine approximately the same number of compression strokes.

Compression Test—Test Results

The indicated compression pressures are considered within specification if the lowest reading cylinder is at least 75 percent of the highest reading. Refer to the Compression Pressure Limit Chart.

Compression Pressure Limit Chart

Maximum Pressure	Minimum Pressure	Maximum Pressure	Minimum Pressure	Maximum Pressure	Minimum Pressure	Maximum Pressure	Minimum Pressure
924 kPa (134 psi)	696 kPa (101 psi)	1131 kPa (164 psi)	848 kPa (123 psi)	1338 kPa (194 psi)	1000 kPa (146 psi)	1544 kPa (224 psi)	1158 kPa (168 psi)
938 kPa (136 psi)	703 kPa (102 psi)	1145 kPa (166 psi)	855 kPa (124 psi)	1351 kPa (196 psi)	1014 kPa (147 psi)	1558 kPa (226 psi)	1165 kPa (169 psi)
952 kPa (138 psi)	717 kPa (104 psi)	1158 kPa (168 psi)	869 kPa (126 psi)	1365 kPa (198 psi)	1020 kPa (148 psi)	1572 kPa (228 psi)	1179 kPa (171 psi)
965 kPa (140 psi)	724 kPa (106 psi)	1172 kPa (170 psi)	876 kPa (127 psi)	1379 kPa (200 psi)	1034 kPa (150 psi)	1586 kPa (230 psi)	1186 kPa (172 psi)
979 kPa (142 psi)	738 kPa (107 psi)	1186 kPa (172 psi)	889 kPa (129 psi)	1303 kPa (202 psi)	1041 kPa (151 psi)	1600 kPa (232 psi)	1200 kPa (174 psi)
933 kPa (144 psi)	745 kPa (109 psi)	1200 kPa (174 psi)	903 kPa (131 psi)	1407 kPa (204 psi)	1055 kPa (153 psi)	1055 kPa (153 psi)	1207 kPa (175 psi)
1007 kPa (146 psi)	758 kPa (110 psi)	1214 kPa (176 psi)	910 kPa (132 psi)	1420 kPa (206 psi)	1062 kPa (154 psi)	1627 kPa (154 psi)	1220 kPa (177 psi)
1020 kPa (148 psi)	765 kPa (111 psi)	1227 kPa (178 psi)	917 kPa (133 psi)	1434 kPa (208 psi)	1075 kPa (156 psi)	1641 kPa (238 psi)	1227 kPa (178 psi)
1034 kPa (150 psi)	779 kPa (113 psi)	1241 kPa (180 psi)	931 kPa (135 psi)	1448 kPa (210 psi)	1083 kPa (157 psi)	1655 kPa (240 psi)	1241 kPa (180 psi)
1048 kPa (152 psi)	786 kPa (114 psi)	1255 kPa (182 psi)	936 kPa (136 psi)	1462 kPa (212 psi)	1089 kPa (158 psi)	1669 kPa (242 psi)	1248 kPa (181 psi)
1062 kPa (154 psi)	793 kPa (115 psi)	1269 kPa (184 psi)	952 kPa (138 psi)	1476 kPa (214 psi)	1103 kPa (160 psi)	1682 kPa (244 psi)	1262 kPa (183 psi)
1076 kPa (156 psi)	807 kPa (117 psi)	1282 kPa (186 psi)	965 kPa (140 psi)	1489 kPa (216 psi)	1117 kPa (162 psi)	1696 kPa (246 psi)	1269 kPa (184 psi)
1089 kPa (158 psi)	814 kPa (118 psi)	1296 kPa (188 psi)	972 kPa (141 psi)	1503 kPa (218 psi)	1124 kPa (163 psi)	1710 kPa (248 psi)	1202 kPa (186 psi)
1103 kPa (160 psi)	827 kPa (120 psi)	1310 kPa (190 psi)	979 kPa (142 psi)	1517 kPa (220 psi)	1138 kPa (165 psi)	1724 kPa (250 psi)	1289 kPa (187 psi)
1110 kPa (161 psi)	834 kPa (121 psi)	1324 kPa (192 psi)	993 kPa (144 psi)	1631 kPa (222 psi)	1145 kPa (166 psi)	—	—

If one or more cylinders reads low, squirt approximately one tablespoon of engine oil on top of the pistons in the low-reading cylinders. Repeat the compression pressure check on these cylinders.

Compression Test—Interpreting Compression Readings

1. If compression improves considerably, piston rings are faulty.
2. If compression does not improve, valves are sticking or seating incorrectly.
3. If two adjacent cylinders indicate low compression pressures and squirting oil on each piston does not increase compression, the head gasket may be leaking between cylinders. Engine oil or coolant in cylinders could result from this condition.
Use the Compression Pressure Limit Chart when checking cylinder compression so that the lowest reading is within 75 percent of the highest reading.

Cylinder Leakage Detection

When a cylinder produces a low reading, use of the Engine Cylinder Leak Detection/Air Pressurization Kit will be helpful in pinpointing the exact cause.

The leakage detector is inserted in the spark plug hole, the piston is brought up to dead center on the compression stroke, and compressed air is admitted.

Once the combustion chamber is pressurized, a special gauge included in the kit will read the percentage of leakage. Leakage exceeding 20 percent is excessive.

While the air pressure is retained in the cylinder, listen for the hiss of escaping air. A leak at the intake valve (6507) will be heard in the throttle body (9E926). A leak at the exhaust valve (6505) can be heard at the tail pipe. Leakage past the piston rings will be audible at the positive crankcase ventilation (PCV) connection. If air is passing through a blown head gasket to an adjacent cylinder, the noise will be evident at the spark plug hole of the cylinder into which the air is leaking. Cracks in the cylinder block or gasket leakage into the cooling system may be detected by a stream of bubbles in the radiator (8005).

Oil Consumption Test

The following diagnostic procedure is used to determine the source of excessive internal oil consumption.

1. **NOTE:** Oil use is normally greater during the first 16,100 km (10,000 miles) of service. As mileage increases, oil use generally decreases. Vehicles in normal service should get at least 1,450 km per liter (900 miles per quart) after 16,000 km (10,000 miles) of service. High speed driving, towing, high ambient temperature and other factors may result in greater oil use.

Define excessive oil consumption, such as the number of miles driven per liter (quart) of oil used. Also determine customer's driving habits, such as sustained high speed operation, towing, extended idle and other considerations.

2. Verify that the engine has no external oil leak as described under Engine Oil Leaks in the Diagnosis and Testing portion of this section.
3. Verify that the engine has the correct oil level dipstick (6750).
4. Verify that the engine is not being run in an overfilled condition. Check the oil level at least five minutes after a hot shutdown with the vehicle parked on a level surface. In no case should the level be above MAX or the letter F in FULL. If significantly overfilled, carry out Steps 6a through 6d.
5. Verify the spark plugs are not oil saturated. If the spark plugs are oil saturated and compression is good it can be assumed the valve seals or valve guides are at fault.

6. Carry out an oil consumption test:
 - a. Drain the engine oil, remove the oil bypass filter (6714) and refill with one liter (quart) less than the recommended amount.
 - b. Run the engine for three minutes (10 minutes if cold), and allow the oil to drain back for at least five minutes with the vehicle on a level surface.
 - c. Remove oil level dipstick and wipe clean. (Do not wipe with anything contaminated with silicone compounds.) Reinstall the oil level dipstick, being sure to seat it firmly in the oil level indicator tube (6754). Remove the oil level dipstick and draw a mark on the back (unmarked) surface at the indicated oil level. This level should be about the same as the MIN or ADD mark on the face of the oil level dipstick.
 - d. Add one liter (quart) of oil. Restart the engine and allow to idle for at least two minutes. Shut off the engine and allow the oil to drain back for at least five minutes. Mark the oil level dipstick, using the procedure above.
 - e. Record the vehicle mileage.
 - f. Instruct the customer to drive the vehicle as usual and perform the following:
 - Check the oil level regularly at intervals of 160 to 240 km (100-150 miles).
 - Return to the service point when the oil level drops below the lower (MIN or ADD) mark on the oil level dipstick.
 - Add only full liters (quarts) of the same oil in an emergency. Note the mileage at which the oil is added.
 - g. Check the oil level under the same conditions and at the same location as in Steps 6c and 6d.
 - Measure the distance from the oil level to the UPPER mark on the oil level dipstick and record.
 - Measure the distance between the two scribe marks and record.
 - Divide the first measurement by the second.
 - Divide the distance driven during the oil test by the result. This quantity is the approximate oil consumption rate in kilometers per liter or in miles per quart.
 - h. If the oil consumption rate is unacceptable, go to Step 7.
7. Check the positive crankcase ventilation (PCV) system. Make sure the system is not plugged.
8. Check for plugged oil drain-back holes in the cylinder heads and cylinder block.
9. If the condition still exists after performing the above steps, go to Step 10.
10. Perform a cylinder compression test or perform a cylinder leak detection test with Engine Cylinder Leak Detection/Air Pressurization Kit. This can help determine the source of oil consumption such as valves, piston rings or other areas.
11. **NOTE:** After determining if new parts should be installed, make sure correct parts are used.

Check valve guides for excessive guide clearance. Install new all valve stem seals (6571) after verifying valve guide clearance.
12. Worn or damaged internal engine components can cause excessive oil consumption. Small deposits of oil on the tips of spark plugs can be a clue to internal oil consumption. If internal oil consumption still persists, proceed as follows:
 - a. Remove the engine from the vehicle and place it on an engine work stand. Remove the intake manifolds (9424), cylinder heads, oil pan (6675) and oil pump (6600).
 - b. Check piston ring clearance, ring gap and ring orientation. Repair as necessary.
 - c. Check for excessive bearing clearance. Repair as necessary.
13. Repeat the oil consumption test (Step 6) to confirm the oil consumption concern has been resolved.

Intake Manifold Vacuum Test

Bring the engine to normal operating temperature. Connect the Vacuum/Pressure Tester to the intake manifold. Run the engine at the specified idle speed.

The vacuum gauge should read between 51-74 kPa (15-22 in-Hg) depending upon the engine condition and the altitude at which the test is performed. Subtract 4.0193 kPa (1 in-Hg) from the specified reading for every 304.8 m (1,000 feet) of elevation above sea level.

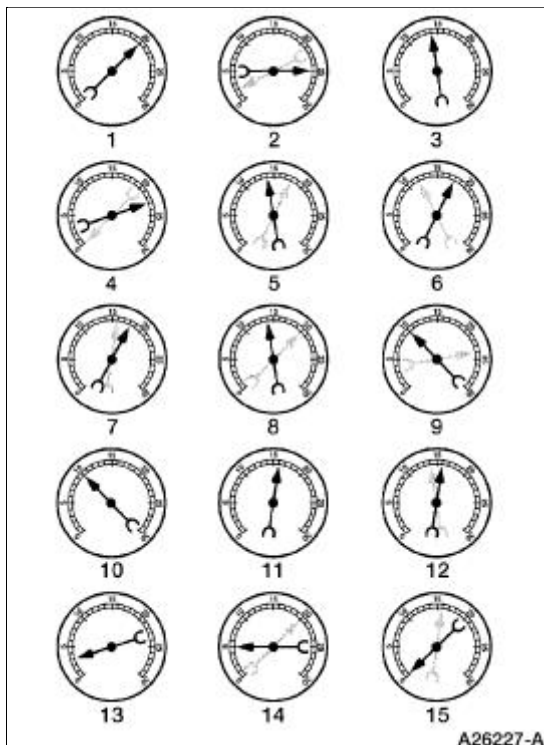
The reading should be steady. If necessary, adjust the gauge damper control (where used) if the needle is fluttering rapidly. Adjust the damper until the needle moves easily without excessive flutter.

Intake Manifold Vacuum Test—Interpreting Vacuum Gauge Readings

A careful study of the vacuum gauge reading while the engine is idling will help pinpoint trouble areas. Always conduct other appropriate tests before arriving at a final diagnostic decision. Vacuum gauge readings, although helpful, must be interpreted carefully.

Most vacuum gauges have a normal band indicated on the gauge face.

The following are potential gauge readings. Some are normal; others should be investigated further.



1. **NORMAL READING:** Needle between 51-74 kPa (15-22 in-Hg) and holding steady.
2. **NORMAL READING DURING RAPID ACCELERATION AND DECELERATION:** When the engine is rapidly accelerated (dotted needle), the needle will drop to a low reading (not to zero). When the throttle is suddenly released, the needle will snap back up to a higher than normal figure.
3. **NORMAL FOR HIGH-LIFT CAMSHAFT WITH LARGE OVERLAP:** The needle will register as low as 51 kPa (15 in-Hg) but will be relatively steady. Some oscillation is normal.

4. **WORN RINGS OR DILUTED OIL:** When the engine is accelerated (dotted needle), the needle drops to 0 kPa (0 in-Hg). Upon deceleration, the needle runs slightly above 74 kPa (22 in-Hg).
5. **STICKING VALVES:** When the needle (dotted) remains steady at a normal vacuum but occasionally flicks (sharp, fast movement) down and back about 13 kPa (4 in-Hg), one or more valves may be sticking.
6. **BURNED OR WARPED VALVES:** A regular, evenly-spaced, downscale flicking of the needle indicates one or more burned or warped valves. Insufficient hydraulic lash adjuster or hydraulic lash adjuster (HLA) clearance will also cause this reaction.
7. **POOR VALVE SEATING:** A small but regular downscale flicking can mean one or more valves are not seating.
8. **WORN VALVE GUIDES:** When the needle oscillates over about a 13 kPa (4 in-Hg) range at idle speed, the valve guides could be worn. As engine speed increases, the needle will become steady if guides are responsible.
9. **WEAK VALVE SPRINGS:** When the needle oscillation becomes more violent as engine rpm is increased, weak valve springs are indicated. The reading at idle could be relatively steady.
10. **LATE VALVE TIMING:** A steady but low reading could be caused by late valve timing.
11. **IGNITION TIMING RETARDING:** Retarded ignition timing will produce a steady but somewhat low reading.
12. **INSUFFICIENT SPARK PLUG GAP:** When spark plugs are gapped too close, a regular, small pulsation of the needle can occur.
13. **INTAKE LEAK:** A low, steady reading can be caused by an intake manifold or throttle body gasket leak.
14. **BLOWN HEAD GASKET:** A regular drop of fair magnitude can be caused by a blown head gasket or warped cylinder head-to-cylinder block surface.
15. **RESTRICTED EXHAUST SYSTEM:** When the engine is first started and is idled, the reading may be normal, but as the engine rpm is increased, the back pressure caused by a clogged muffler (5230), kinked tail pipe or other concerns will cause the needle to slowly drop to 0 kPa (0 in-Hg). The needle then may slowly rise. Excessive exhaust clogging will cause the needle to drop to a low point even if the engine is only idling.
16. When vacuum leaks are indicated, search out and correct the cause. Excess air leaking into the system will upset the fuel mixture and cause concerns such as rough idle, missing on acceleration or burned valves. If the leak exists in an accessory unit such as the power brake booster (2005), the unit will not function correctly. Always fix vacuum leaks.

Excessive Engine Oil Consumption

The amount of oil an engine uses will vary with the way the vehicle is driven in addition to normal engine-to-engine variation. This is especially true during the first 16,100 km (10,000 miles) when a new engine is being broken in or until certain internal engine components become conditioned. Vehicles used in heavy-duty operation may use more oil. The following are examples of heavy-duty operation:

- trailer towing applications
- severe loading applications
- sustained high speed operation

Engines need oil to lubricate the following internal components:

- cylinder block cylinder walls
- pistons and piston, pin and rings (6102)
- intake and exhaust valve stems
- intake and exhaust valve guides
- all internal engine components

When the pistons move downward, a thin film of oil is left on the cylinder walls. As the vehicle is operated, some oil is also drawn into the combustion chambers past the intake and exhaust valve stem seals and burned.

The following is a partial list of conditions that can affect oil consumption rates:

- engine duty cycle
- operator driving habits
- ambient temperature
- quality and viscosity of the oil

Operation under varying conditions can frequently be misleading. A vehicle that has been run for several thousand miles on short trips or in below-freezing ambient temperatures may have consumed a "normal" amount of oil. However, when checking the engine oil level, it may measure up to the FULL or MAX on the oil level dipstick due to dilution (condensation and fuel) in the engine crankcase. The vehicle might then be driven at high speeds on the highway where the condensation and fuel boil off. The next time the engine oil is checked, it may appear that a liter (quart) of oil was used in about 160 km (100 miles). This perceived 160 km (100 miles) per liter (quart) oil consumption rate causes customer concern even though the actual overall oil consumption rate is about 2,400 km (1,500 miles) per liter (quart).

Make sure the selected engine oil meets the current recommended API performance category with SAE viscosity grade as shown in the vehicle Owner's Guide. It is also important that the engine oil is changed at the intervals specified. Refer to the vehicle Owner's Guide.

Oil Pressure Test

1. Disconnect and remove the oil pressure sensor (9278) from the engine.
2. Connect the Oil Pressure Gauge to the oil pressure sender oil galley port.
3. Run the engine until normal operating temperature is reached.
4. Run the engine at the specified rpm and record the gauge reading.
5. The oil pressure should be within specifications; refer to the specification chart in the appropriate engine section.
6. If the pressure is not within specification, check the following possible sources:
 - insufficient oil
 - oil leakage
 - worn or damaged oil pump
 - oil pump screen cover and tube (6622)
 - excessive main bearing clearance

- excessive connecting rod bearing clearance

Valve Train Analysis—Engine Off—Valve Cover Removed

Check for damaged or severely worn parts and correct assembly. Make sure correct parts are used with the static engine analysis as follows.

Valve Train Analysis—Engine Off, Rocker Arm

- Check for loose mounting bolts, studs and nuts.
- Check for plugged oil feed in the rocker arms (6564) or cylinder head.

Valve Train Analysis—Engine Off, Camshaft Roller Followers and Hydraulic Lash Adjusters, Overhead Camshaft

- Check for loose mounting bolts on camshaft carriers.
- Check for plugged oil feed in the camshaft roller followers, lash adjusters or cylinder heads.

Valve Train Analysis—Engine Off, Camshaft—Engines

- Check for broken or damaged parts.

Valve Train Analysis—Engine Off, Push Rods

- Check for bent push rods (6565) and restricted oil passage.

Valve Train Analysis—Valve Springs

- Check for broken or damaged parts.

Valve Train Analysis—Engine Off, Valve Spring Retainer and Valve Spring Retainer Keys

- Check for correct seating of the valve spring retainer key (6518) on the valve stem and in valve spring retainer (6514).
- Check for correct seating on the valve stem.

Valve Train Analysis—Engine Off, Valves and Cylinder Head

- Check for plugged oil drain back holes.
- Check for worn or damaged valve tips.
- Check for missing or damaged guide-mounted valve stem seal.
- Check collapsed valve tappet gap.
- Check installed valve spring height.
- Check for missing or worn valve spring seats.
- Check for plugged oil metering orifice in cylinder head oil reservoir (if equipped).

Static checks (engine off) are to be made on the engine prior to the dynamic procedure.

Valve Train Analysis—Engine Running

- Start the engine and, while idling, check for correct operation of all parts. Check the following:

Valve Train Analysis—Engine Running, Valves and Cylinder Head

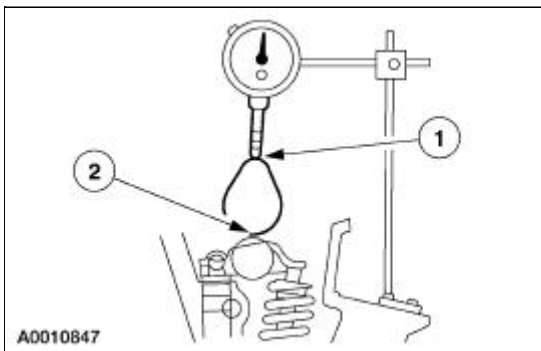
- Check for plugged oil drain back holes.
- Check for missing or damaged valve stem seals or guide mounted valve stem seals.
- Check for a plugged oil metering orifice in the cylinder head oil reservoir (4.6L engine only).

If insufficient oiling is suspected, check oil passages for blockage, then accelerate the engine to 1,200 rpm with the transmission in NEUTRAL and the engine at normal operating temperature. Oil should spurt from the rocker arm oil holes such that valve tips and camshaft roller followers are well oiled. With the valve covers (6582) off, some oil splash may overshoot camshaft roller followers.

Valve Train Analysis—Engine Running, Camshaft Lobe Lift—OHC Engines

Check the lift of each camshaft lobe in consecutive order and make a note of the readings.

1. Remove the valve covers.
2. Remove the spark plugs.
3. Install the Dial Indicator Gauge with Holding Fixture so the rounded tip of indicator is on top of the camshaft lobe and on the same plane as the valve tappet.
4. Rotate the crankshaft using a breaker bar and socket attached to the crankshaft pulley retainer bolt. Rotate the crankshaft until the base circle of the camshaft lobe is reached.



5. Zero the dial indicator. Continue to rotate the crankshaft until the (1) high-lift point of the camshaft lobe is in the fully-raised position (highest indicator reading).
6. To check the accuracy of the original indicator reading, continue to rotate crankshaft until the (2) base circle is reached. The indicator reading should be zero. If zero reading is not obtained, repeat Steps 1 through 6.
7. **NOTE:** If the lift on any lobe is below specified service limits, install a new camshaft, and new camshaft roller followers.

Remove the Dial Indicator Gauge with Holding Fixture.

8. Install the spark plugs.

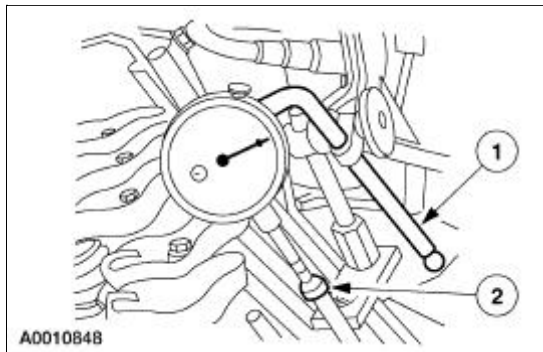
9. Install the valve covers.

Valve Train Analysis—Engine Running, Camshaft Lobe Lift—Push Rod Engine

Check the lift of each lobe in consecutive order and make a note of the readings.

1. Remove the valve covers.
2. Remove the rocker arm seat bolts, rocker arm seat (6A528) and rocker arms.

Typical Engine With Push Rods



3. Make sure the valve tappet is seated against camshaft (6250). Install (1) Dial Indicator Gauge with Holding Fixture so the ball socket adapter of the indicator is on top of the valve tappet or (2) Dial Indicator Gauge Adapter is on top of push rod and in same plane as valve tappet push rod movement.
4. Remove the spark plugs.
5. Connect an auxiliary starter switch in the starting circuit. Crank the engine with ignition switch in OFF position. Bump crankshaft over until valve tappet is on base circle of camshaft lobe. At this point, valve tappet will be in its lowest position. If checking during engine assembly, turn crankshaft using a socket or ratchet.
6. Zero the dial indicator. Continue to rotate crankshaft slowly until valve tappet is in fully-raised position (highest indicator reading).
7. **NOTE:** If lift on any lobe is below specified service limits, install a new camshaft, and new valve tappets.

Remove the Dial Indicator with Holding Fixture, Dial Indicator Gauge Adapter, and auxiliary starter switch.

8. Install rocker arm seats, rocker arms and rocker arm seat bolts.
9. Install valve covers.
10. Install spark plugs.

Valve Train Analysis—Engine Running, Valve Tappet

Valve tappet noise can be caused by any of the following:

- excessive valve tappet gap (collapsed)

- incorrectly functioning valve tappet
- air in lubrication system
- excessive valve guide wear
- low oil pressure


Excessive collapsed valve tappet gap can be caused by loose rocker arm seat bolts/nuts, incorrect initial adjustment or wear of valve tappet face, or worn roller valve tappets, push rod (6565), rocker arm (6564), rocker arm seat or valve tip. With valve tappet collapsed, check gap between the valve tip and the rocker arm to determine if any other valve train parts are damaged, worn or out of adjustment.

An incorrectly functioning valve tappet can be sticking, caused by contaminants or varnish inside the tappet. The tappet can have a check valve that is not functioning correctly, which can be caused by an obstruction, such as dirt or chips that prevent the check valve from closing, or a broken check valve spring. A tappet with a leakdown time out of specification can cause tappet noise. If no other cause for noisy valve tappets can be found, the leakdown rate should be checked and new valve tappets installed if found to be out of specification.

Assembled valve tappets can be tested with Hydraulic Tappet Leakdown Tester to check the leakdown rate. The leakdown rate specification is the time in seconds for the plunger to move a specified distance while under a 22.7 kg (50 lb) load.

Air bubbles in the lubrication system will prevent the valve tappet from supporting the valve spring load. This can be caused by too high or too low an oil level in the oil pan or by air being drawn into the system through a hole, crack or leaking gasket on the oil pump screen cover and tube.

Sprockets

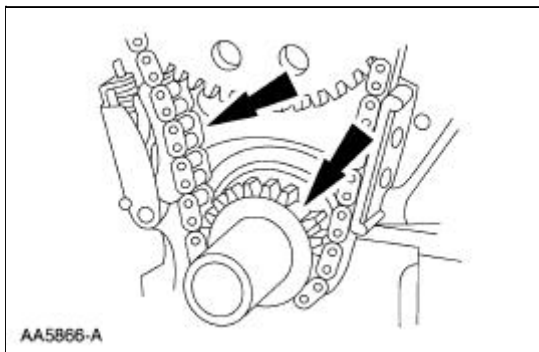
1.  **WARNING:** To avoid the possibility of personal injury or damage to the vehicle, do not operate the engine with the hood open until the fan blade has been examined for possible cracks and separation.

NOTE: Specifications show the expected minimum or maximum condition. Refer to the appropriate section in Group [303](#) for the procedure.

NOTE: If a component fails to meet the specifications, it is necessary to install a new component or refinish. If the component can be refinished, wear limits are provided as an aid to making a decision. A new component must be installed for any component that fails to meet specifications and cannot be refinished.

Inspect the timing chain/belt and the sprockets.

- Install new components as necessary. Refer to the appropriate section in Group [303](#) for the procedure.



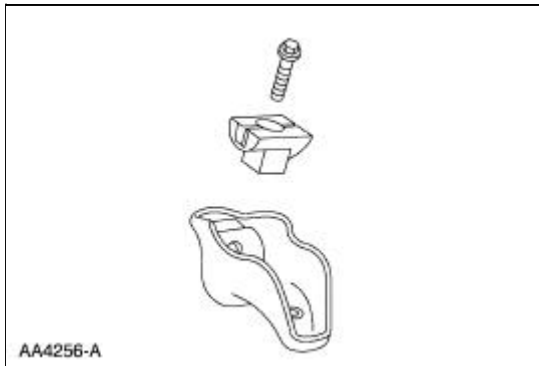
Rocker Arms —Cleaning

1. Clean all parts thoroughly. Make sure all oil passages are open.
 2. Make sure oil passage in the push rod/valve tappet end of the rocker arm (6564) is open.
-

Rocker Arms —Inspection

⚠ CAUTION: Do not attempt to true surfaces by grinding. Check the rocker arm pad, side rails and seat for excessive wear, cracks, nicks or burrs. Check the rocker arm seat bolt for stripped or broken threads. Install new components as necessary or possible damage may occur.

1. Inspect the rocker arm push rod bore for nicks, scratches, scores or scuffs. Install new components as necessary. Refer to the appropriate section in Group [303](#) for the procedure.



2. Inspect the pad at the valve end of the rocker arm for indications of scuffing or abnormal wear. If the pad is grooved, install a new rocker arm. Refer to the appropriate section in Group [303](#) for the procedure.
-

Push Rods —Cleaning

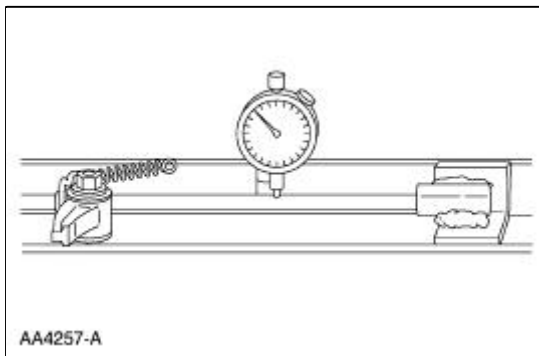
1. Clean the push rods (6565) in a suitable solvent. Blow out the oil passage in the push rods with compressed air.
-

Push Rods —Inspection

1.  **CAUTION: Do not attempt to straighten push rods.**

Check the ends of the push rods for nicks, grooves, roughness or excessive wear. Install new push rods as necessary. Refer to the appropriate section in Group [303](#) for the procedure.

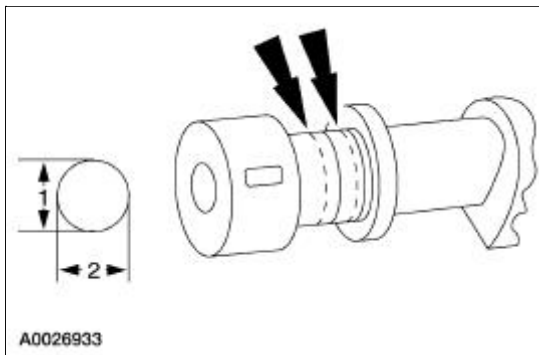
- The push rods can be checked for straightness while they are installed in the engine by rotating them with the valve closed.
- They also can be checked using a Dial Indicator with Bracketry.



2. If the push rod is bent beyond specifications, install a new push rod. Refer to the appropriate section in Group [303](#) for the procedure.

Camshaft Journal — Diameter

1. Measure each camshaft journal diameter in two directions.
 - If out of specification, install new components as necessary. Refer to the appropriate section in Group [303](#) for the procedure.

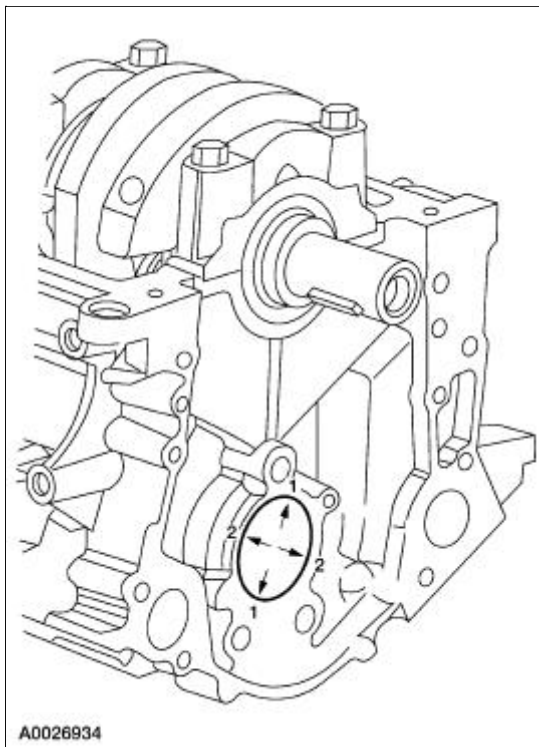


Camshaft Journal — Clearance, Push Rod Engines, Micrometer Method

1. **NOTE:** The camshaft journals must meet specifications before checking camshaft journal clearance.

Measure each camshaft bearing (6261) in two directions.

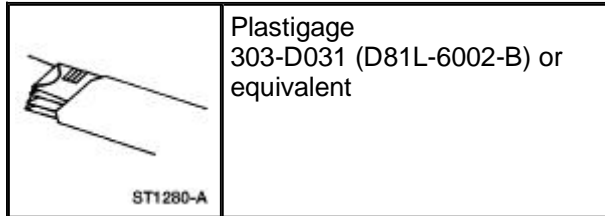
- Subtract the camshaft journal diameter from the camshaft bearing diameter.



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Camshaft Journal — Clearance, Plastigage Method

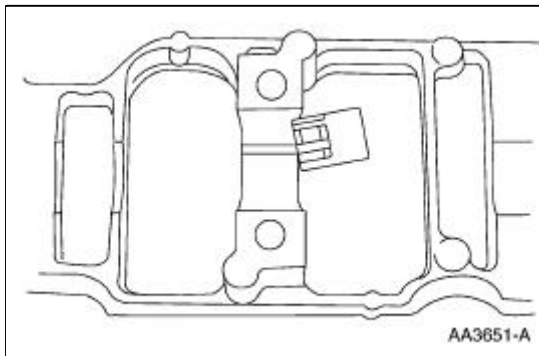
Special Tool(s)



NOTE: The camshaft journals must meet specifications before checking camshaft journal clearance.

1. Remove the camshaft bearing cap and lay Plastigage across the surface. Refer to the appropriate section in Group [303](#) for the procedure.
2. **NOTE:** Do not turn the camshaft while carrying out this procedure.

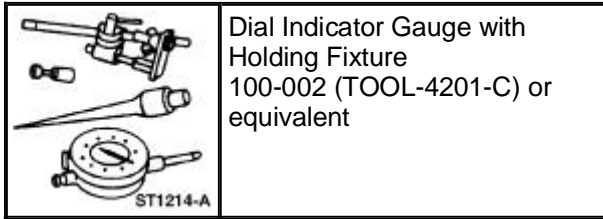
Position the camshaft bearing cap and install the bolts. Refer to the appropriate section in Group [303](#) for the procedure.



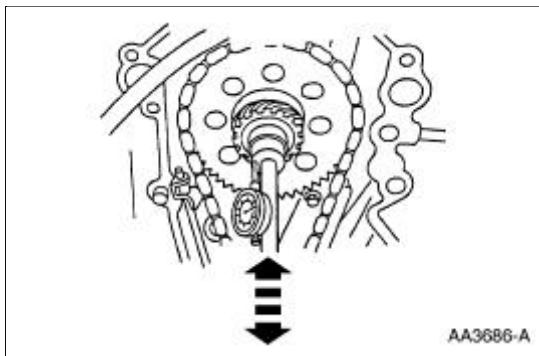
3. Use Plastigage to verify the camshaft journal clearance.
 - If out of specification, install new components as necessary. Refer to the appropriate section in Group [303](#) for the procedure.

Camshaft End Play —Push Rod Engines

Special Tool(s)

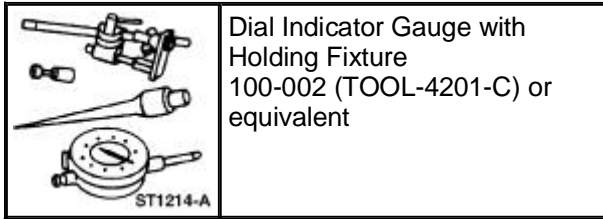


1. Remove the valve tappets. Refer to the appropriate section in Group [303](#) for the procedure.
2. Use a Dial Indicator Gauge with Holding Fixture to measure camshaft end play.
3. Position the camshaft to the rear of the cylinder block.
4. Zero the indicator.
5. Move the camshaft to the front of the cylinder block. Note and record the camshaft end play.
 - If the camshaft end play exceeds specifications, install a new camshaft thrust plate. Refer to the appropriate section in Group [303](#) for the procedure.

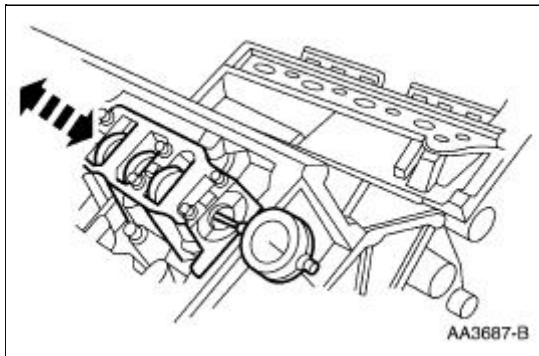


Camshaft End Play —OHC Engines

Special Tool(s)

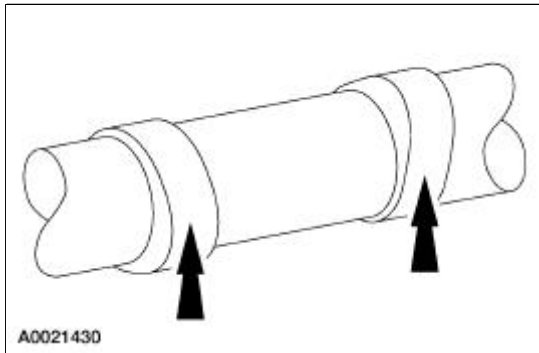


1. Remove the roller followers. Refer to the appropriate section in Group [303](#) for the procedure.
2. Use a Dial Indicator Gauge with Holding Fixture to measure camshaft end play.
3. Position the camshaft to the rear of the cylinder head.
4. Zero the indicator.
5. Move the camshaft to the front of the cylinder head. Note and record the camshaft end play.
 - If camshaft end play exceeds specifications, install new camshaft and recheck end play. Refer to the appropriate section in Group [303](#) for the procedure.
 - If camshaft end play exceeds specification after camshaft installation, install a new cylinder head. Refer to the appropriate section in Group [303](#) for the procedure.



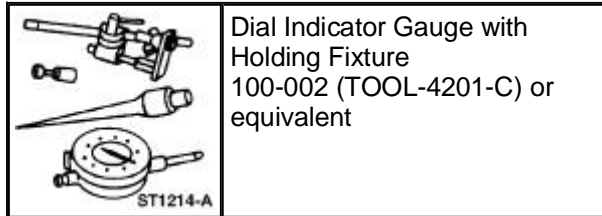
Camshaft —Lobe Surface

1. Inspect camshaft lobes for pitting or damage in the contact area. Minor pitting is acceptable outside the contact area.
 - If excessive pitting or damage is present, install new components as necessary. Refer to the appropriate section in Group [303](#) for the procedure.

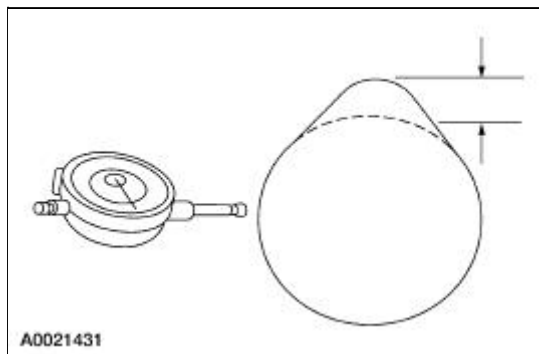


Camshaft Lobe Lift

Special Tool(s)

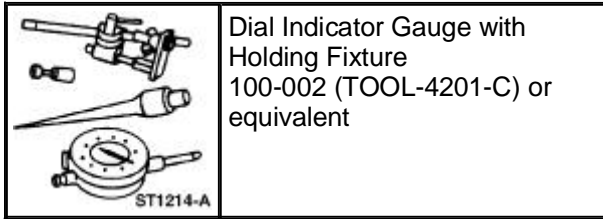


1. Use a Dial Indicator Gauge with Holding Fixture to measure camshaft intake/exhaust lobe lift.
 - Rotate the camshaft and subtract the lowest indicator reading from the highest indicator reading to figure the camshaft lobe lift.
 - Refer to the appropriate section in Group [303](#) for the procedure.



Camshaft Runout

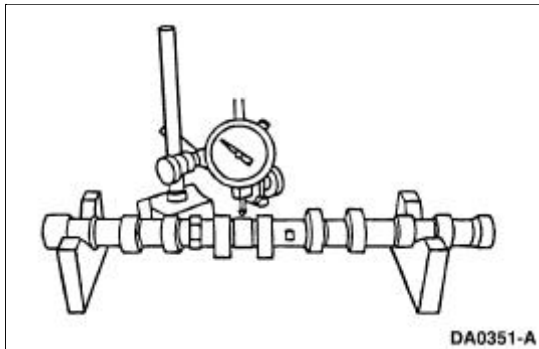
Special Tool(s)



1. **NOTE:** Camshaft journals must be within specifications before checking runout.

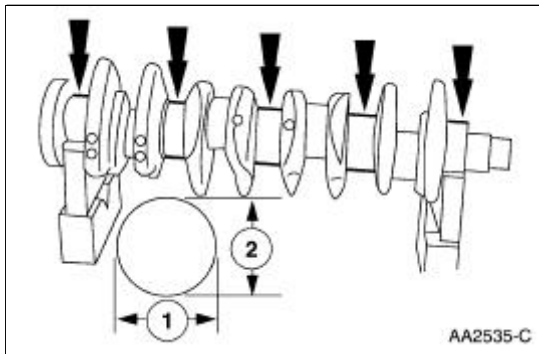
Use a Dial Indicator Gauge with Holding Fixture to measure the camshaft runout.

- Rotate the camshaft and subtract the lowest indicator reading from the highest indicator reading.
- For additional information, refer to the specification chart in the appropriate engine section.
- If out of specification, install new components as necessary. Refer to the appropriate section in Group [303](#) for the procedure.



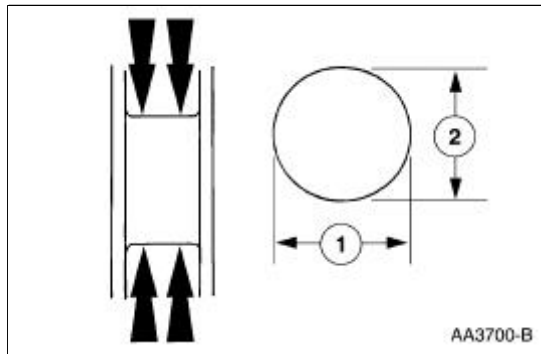
Crankshaft Main Bearing Journal —Diameter

1. Measure each of the crankshaft main bearing journal diameters in at least two directions.
 - Refer to the appropriate section in Group [303](#) for the procedure.
 - If out of specification, install new components as necessary. Refer to the appropriate section in Group [303](#) for the procedure.



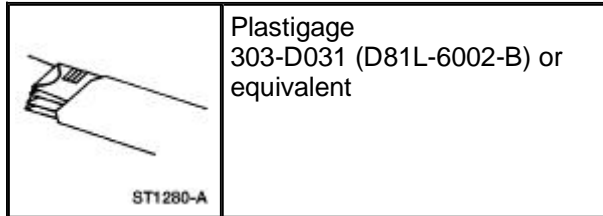
Crankshaft Main Bearing Journal —Taper

1. Measure each of the crankshaft main bearing journal diameters in at least two directions at each end of the main bearing journal.
 - Refer to the appropriate section in Group [303](#) for the procedure.
 - If out of specification, install new components as necessary. Refer to the appropriate section in Group [303](#) for the procedure.



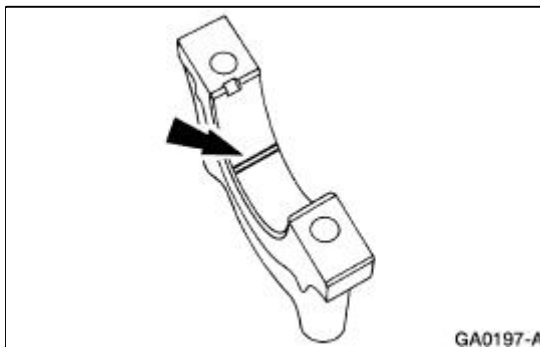
Crankshaft Main Bearing Journal — Clearance

Special Tool(s)



NOTE: Crankshaft main bearing journals must be within specifications before checking journal clearance.

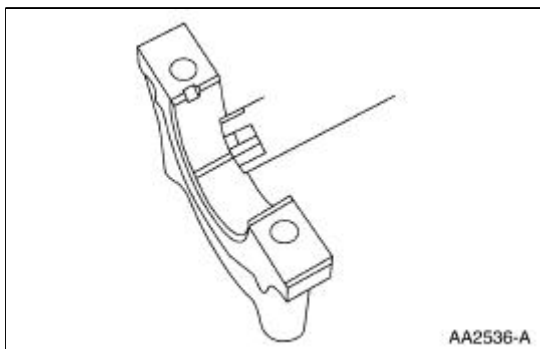
1. Remove the crankshaft main bearing caps and crankshaft main bearing.
2. Lay a piece of Plastigage across the face of each crankshaft main bearing surface.



3. **NOTE:** Do not turn the crankshaft while carrying out this procedure.

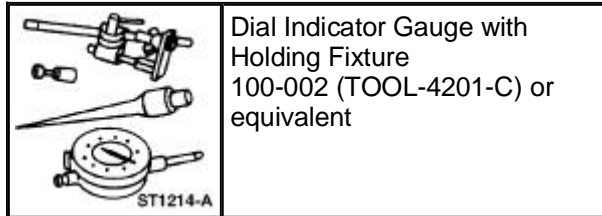
Install and remove the crankshaft main bearing cap.

4. Verify the crankshaft journal clearance.
 - Refer to the appropriate section in Group [303](#) for the procedure.
 - If out of specification, install new components as necessary. Refer to the appropriate section in Group [303](#) for the procedure.

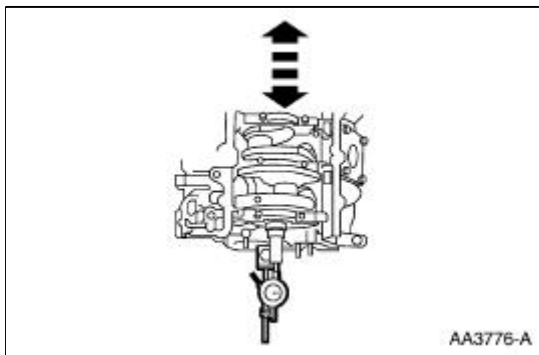


Crankshaft End Play

Special Tool(s)

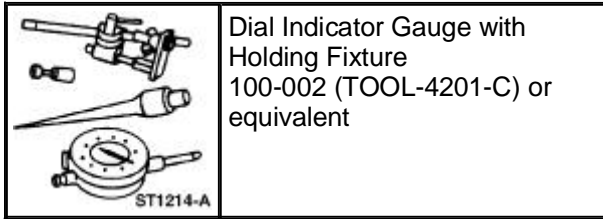


1. Measure the crankshaft end play. Use a Dial Indicator Gauge with Holding Fixture to measure crankshaft end play.
2. Position the crankshaft to the rear of the cylinder block.
3. Zero the indicator.
4. Move the crankshaft to the front of the cylinder block. Note and record the crankshaft end play.
 - If crankshaft end play exceeds specifications, install a new crankshaft thrust washer (6334) or crankshaft thrust main bearing (6337). Refer to the appropriate section in Group [303](#) for the procedure.



Crankshaft Runout

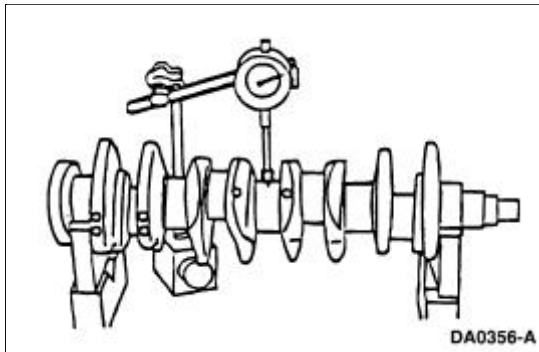
Special Tool(s)



1. **NOTE:** Crankshaft main bearing journals must be within specifications before checking runout.

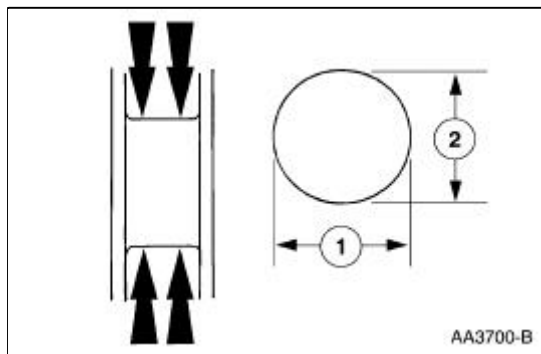
Use the Dial Indicator Gauge with Holding Fixture to measure the crankshaft runout.

- Refer to the appropriate section in Group [303](#) for the procedure.
- Rotate the crankshaft and subtract the lowest dial indicator reading from the highest dial indicator reading to figure the crankshaft runout. If it is out of specification, install new components as necessary. Refer to the appropriate section in Group [303](#) for the procedure.



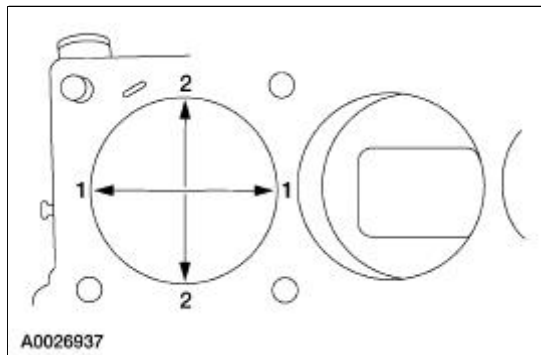
Crankshaft —Connecting Rod Journal Taper, Out of Round

1. Measure the crankshaft connecting rod journal diameters in two directions perpendicular to one another at each end of the connecting rod journal. The difference in the measurements from one end to the other is the taper. Verify measurement is within the wear limit.
 - Refer to the appropriate section in Group [303](#) for the procedure.
 - If out of specification, install new components as necessary. Refer to the appropriate section in Group [303](#) for the procedure.



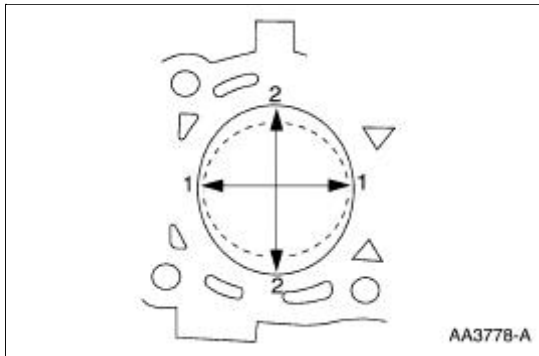
Cylinder Bore —Taper

1. Measure the cylinder bore at the top, middle, and bottom of piston ring travel in two directions as indicated. Verify the cylinder bore is within the wear limit. The difference indicates the cylinder bore taper. Bore the cylinder to the next oversize.
 - Refer to the appropriate section in Group [303](#) for the procedure.



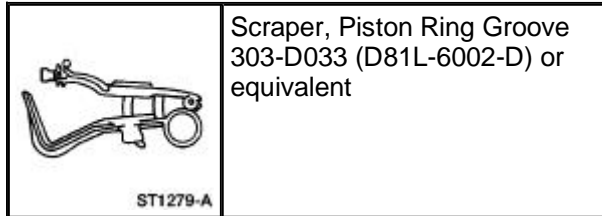
Cylinder Bore — Out-of-Round


1. Measure the cylinder bore in two directions. The difference is the out-of-round. Verify the out-of-round is within the wear limit and bore the cylinder to the next oversize limit.
 - Refer to the appropriate section in Group [303](#) for the procedure.



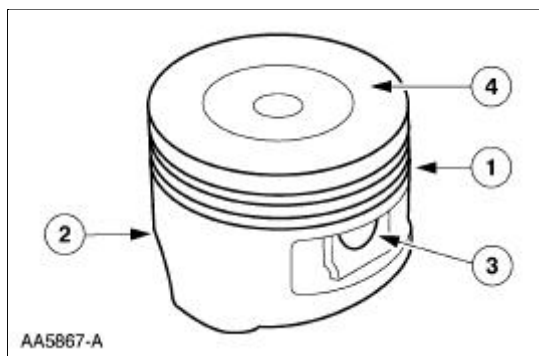
Piston Inspection

Special Tool(s)

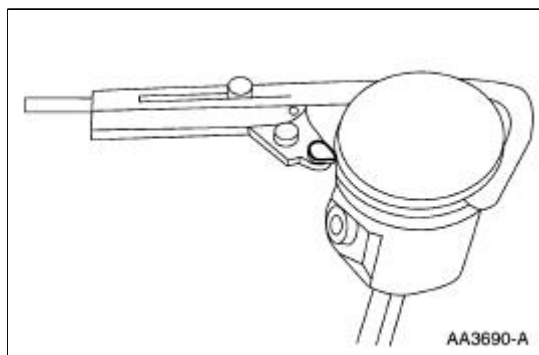


 **CAUTION:** Do not use a caustic cleaning solution or a wire brush to clean the pistons or damage can occur.

1. Clean and inspect the (1) ring lands, (2) skirts, (3) pin bosses, and the (4) tops of the pistons. If wear marks, scores or glazing is found on the piston skirt, check for a bent or twisted connecting rod.



2. Use the Piston Ring Groove Scraper to clean the piston ring grooves.
 - Make sure the oil ring holes are clean.



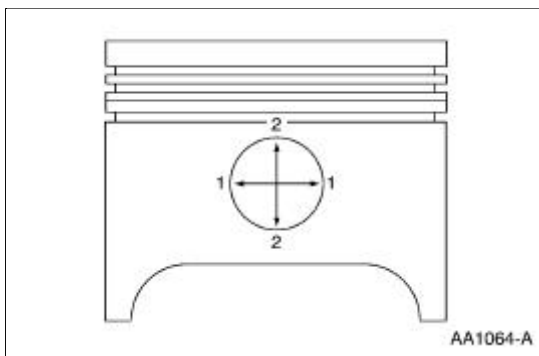
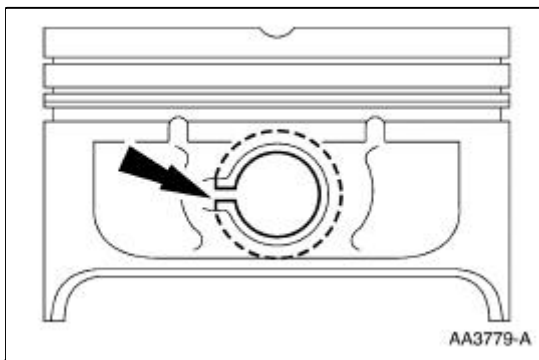
Piston — Pin to Bore Diameter

1.  **WARNING:** Cover the end of the pin bore with a hand or shop rag when removing the retainer ring, since it has a tendency to spring out. Wear eye protection.

NOTE: Piston and piston pins are a matched set and should not be interchanged.

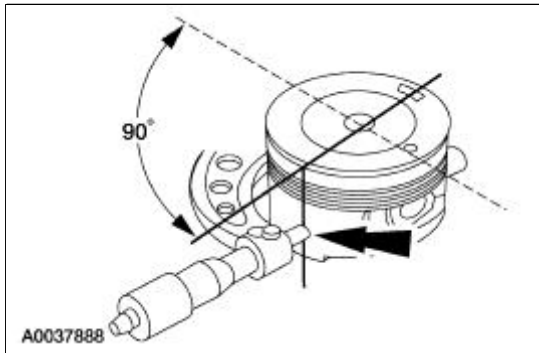
Measure the piston pin bore diameter in two directions on each side. Verify the diameter is within specification.

- If out of specification, install new components as necessary. Refer to the appropriate section in Group [303](#) for the procedure.



Piston — Diameter

1. Measure the piston diameter 90 degrees from the piston pin at the point indicated. Refer to the appropriate section in Group [303](#) for the procedure.
 - If out of specification, install new components as necessary. Refer to the appropriate section in Group [303](#) for the procedure.



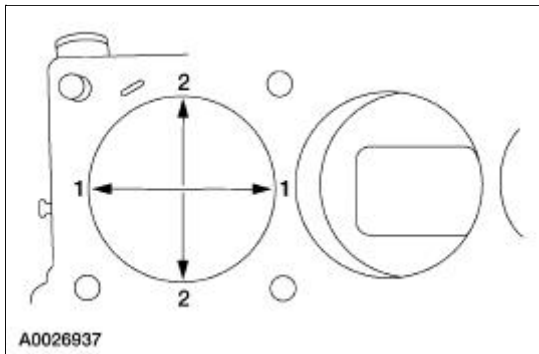
Piston —to Cylinder Bore Clearance

1. Subtract the piston diameter from the cylinder bore diameter to find the piston-to-cylinder bore clearance.
-

Piston — Selection

NOTE: The cylinder bore must be within the specifications for taper and out-of-round before fitting a piston.

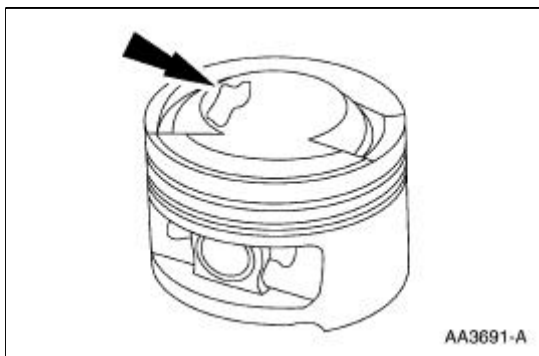
1. Select a piston size based on the cylinder bore.



2. **NOTE:** For precision fit, new pistons are divided into three categories within each size range based on their relative position within the range. A paint spot on the new pistons indicates the position within the size range.


Choose the piston with the correct paint color.

- Refer to the appropriate section in Group [303](#) for the procedure.



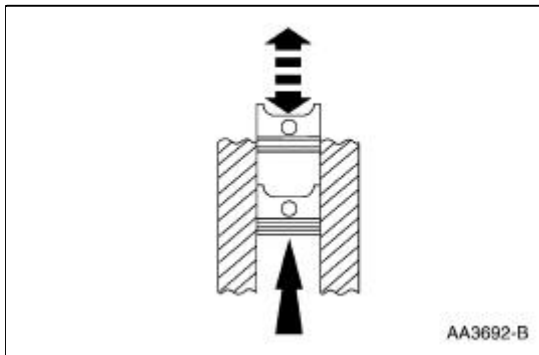
Piston — Ring End Gap

 **CAUTION:** Use care when fitting piston rings to avoid possible damage to the piston ring or the cylinder bore.

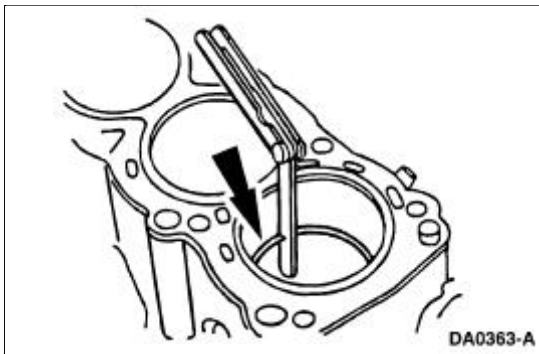
 **CAUTION:** Piston rings should not be transferred from one piston to another.

NOTE: Cylinder bore must be within specification for taper and out-of-round.

1. Use a piston without rings to push a piston ring in a cylinder to the bottom of ring travel.

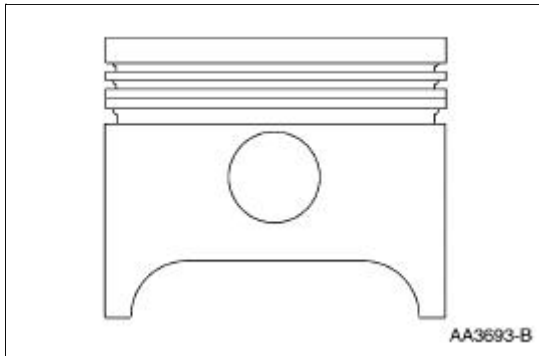


2. Use a feeler gauge to measure the top piston ring end gap and the second piston ring end gap.
 - Refer to the appropriate section in Group [303](#) for the procedure.

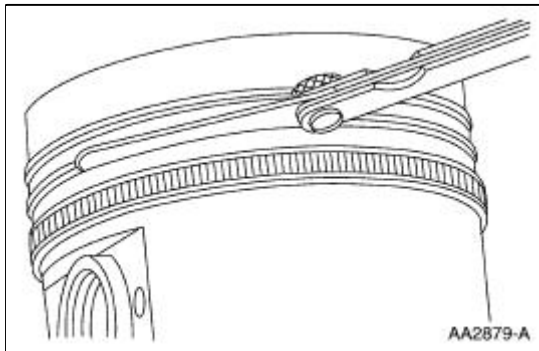


Piston — Ring-to-Groove Clearance

1. Inspect the piston for ring land damage or accelerated wear.

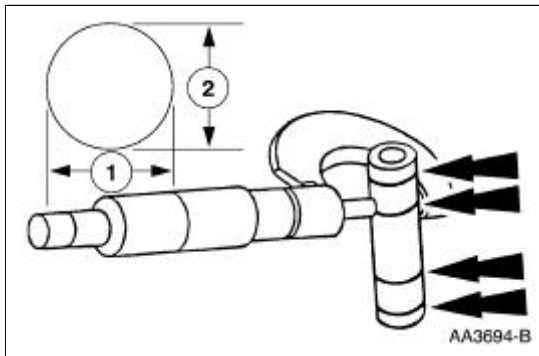


2. Measure the piston ring-to-groove clearance.
 - Refer to the appropriate section in Group [303](#) for the procedure.
 - If out of specification, install new components as necessary. Refer to the appropriate section in Group [303](#) for the procedure.



Piston — Pin Diameter

1. Measure the piston pin diameter in two directions at the points shown. Verify the diameter is within specification.
 - Refer to the appropriate section in Group [303](#) for the procedure.
 - If out of specification, install new components as necessary. Refer to the appropriate section in Group [303](#) for the procedure.

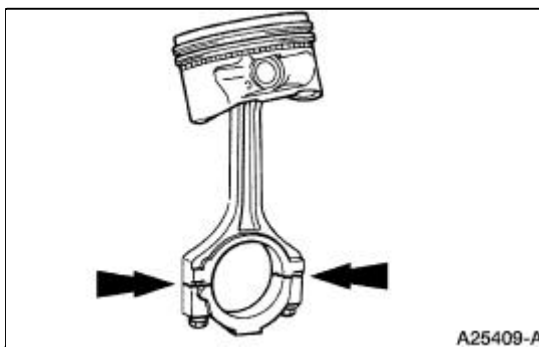


Connecting Rod —Cleaning

 **CAUTION:** Do not use a caustic cleaning solution or damage to connecting rods can occur.

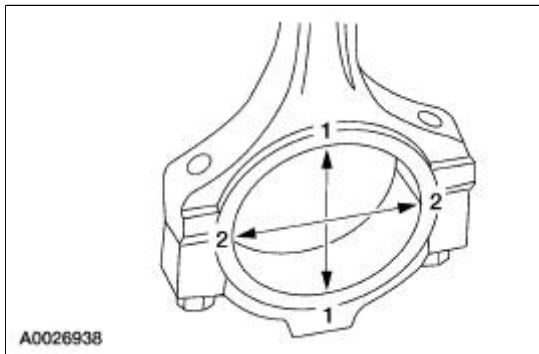
1. **NOTE:** The connecting rod large end is a matched set. The connecting rod cap must be installed on the original connecting rod in the original position. Do not reverse the cap. Parts are not interchangeable.

Mark and separate the parts and clean with solvent. Clean the oil passages.



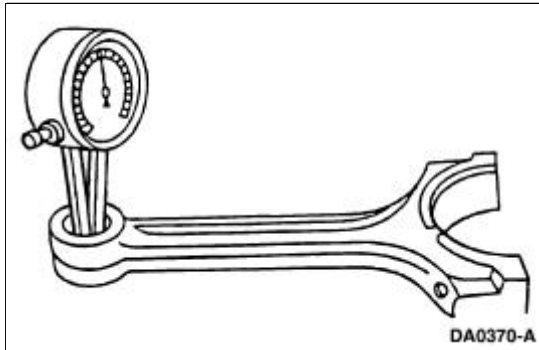
Connecting Rod —Large End Bore

1. Tighten the bolts to specification, then measure the bore in two directions. The difference is the connecting rod bore out-of-round. Verify the out-of-round is within specification.
 - Refer to the appropriate section in Group [303](#) for the procedure.
 - If out of specification, install new components as necessary. Refer to the appropriate section in Group [303](#) for the procedure.



Connecting Rod — Bushing Diameter

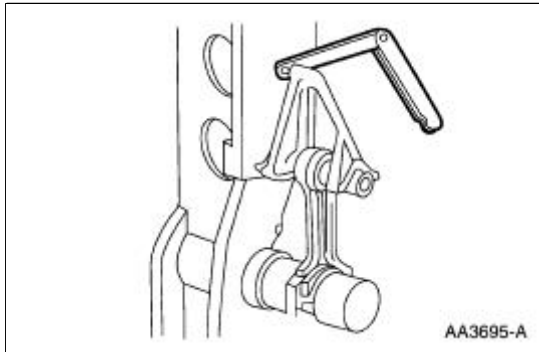
1. Measure the inner diameter of the connecting rod bushing, if equipped. Verify the diameter is within specification.
 - Refer to the appropriate section in Group [303](#) for the procedure.
 - If out of specification, install new components as necessary. Refer to the appropriate section in Group [303](#) for the procedure.



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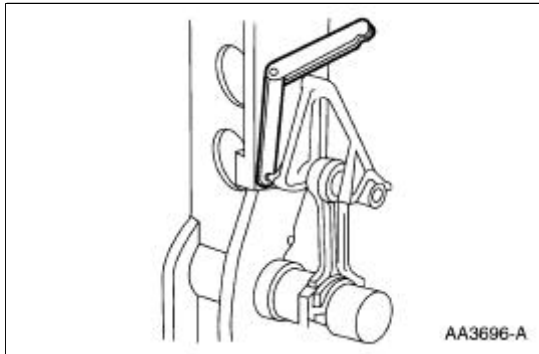
Connecting Rod — Bend

1. Measure the connecting rod bend on a suitable alignment fixture. Follow the instructions of the fixture manufacturer. Verify the bend measurement is within specification.
 - Refer to the appropriate section in Group [303](#) for the procedure.
 - If out of specification, install new components as necessary. Refer to the appropriate section in Group [303](#) for the procedure.



Connecting Rod —Twist

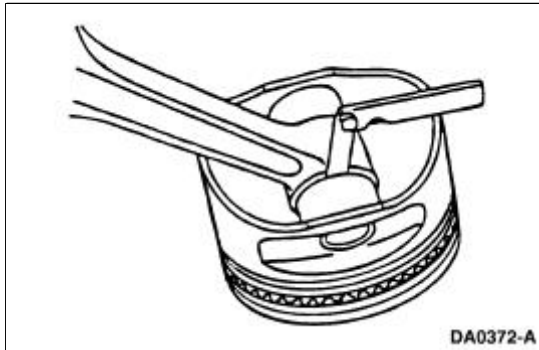
1. Measure the connecting rod twist on a suitable alignment fixture. Follow the instructions of the fixture manufacturer. Verify the measurement is within specification.
 - Refer to the appropriate section in Group [303](#) for the procedure.
 - If out of specification, install new components as necessary. Refer to the appropriate section in Group [303](#) for the procedure.



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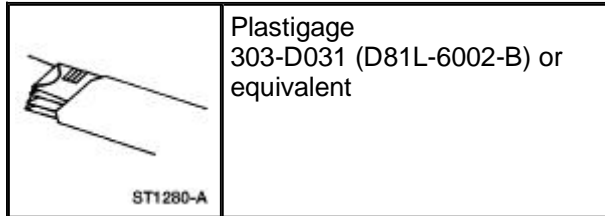
Connecting Rod —Piston Pin Side Clearance

1. Measure the clearance between the connecting rod and the piston. Verify the measurement is within specification.
 - Refer to the appropriate section in Group [303](#) for the procedure.
 - If out of specification, install new components as necessary. Refer to the appropriate section in Group [303](#) for the procedure.



Connecting Rod — Bearing Journal Clearance

Special Tool(s)



NOTE: The crankshaft connecting rod journals must be within specifications to check the connecting rod bearing journal clearance.

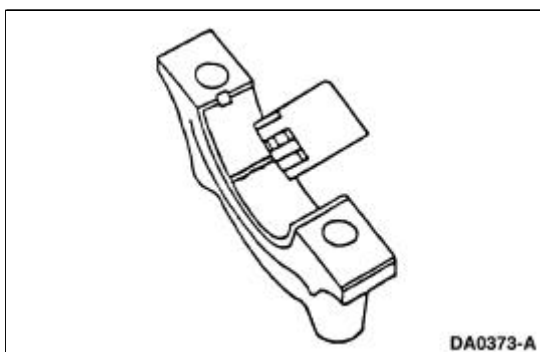
1. Remove the connecting rod bearing cap.
2. Position a piece of Plastigage across the bearing surface.



3. **NOTE:** Do not turn the crankshaft during this step.

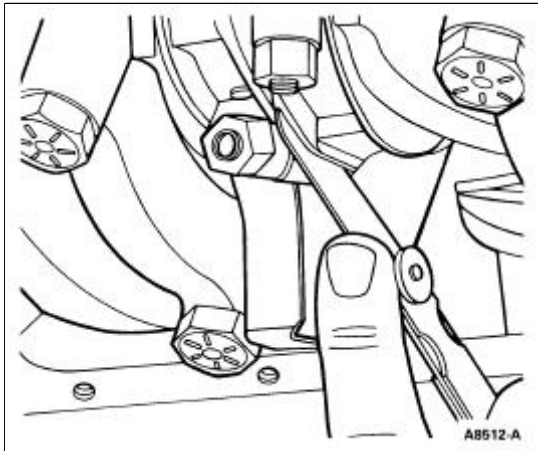
Install and tighten to specifications, then remove the connecting rod bearing cap.

4. Measure the Plastigage to get the connecting rod bearing journal clearance. The Plastigage should be smooth and flat. A changing width indicates a tapered or damaged connecting rod or connecting rod bearing.
 - Refer to the appropriate section in Group [303](#) for the procedure.
 - If out of specification, install new components as necessary. Refer to the appropriate section in Group [303](#) for the procedure.



Connecting Rod — Side Clearance

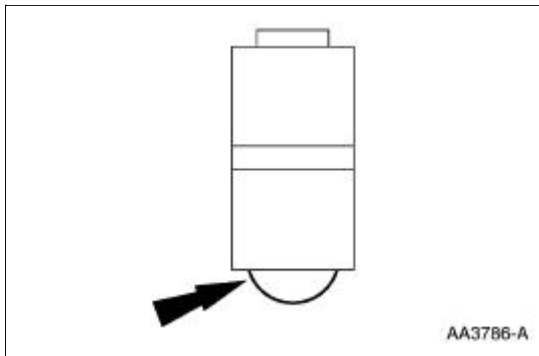
1. Measure the clearance between the connecting rod and the crankshaft. Verify the measurement is within specification.
 - Refer to the appropriate section in Group [303](#) for the procedure.
 - If out of specification, install new components as necessary. Refer to the appropriate section in Group [303](#) for the procedure.



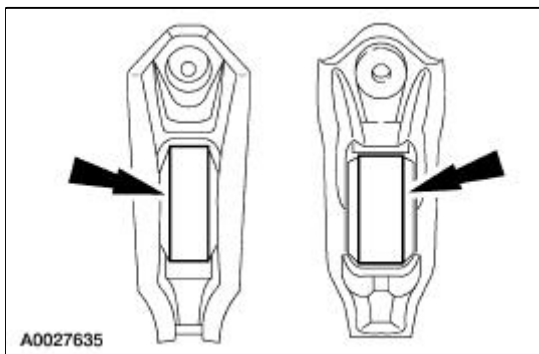
Roller Follower — Inspection

Push rod engines

1. Inspect the roller for flat spots or scoring. If any damage is found, inspect the camshaft lobes and valve tappet for damage.



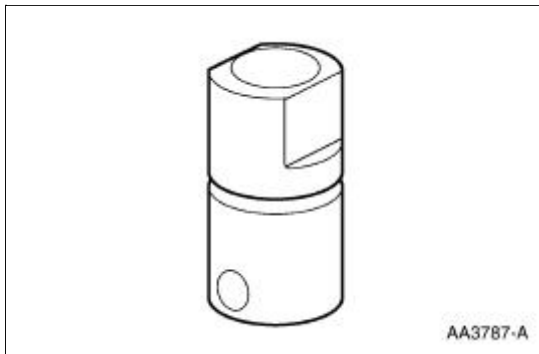
OHC engines



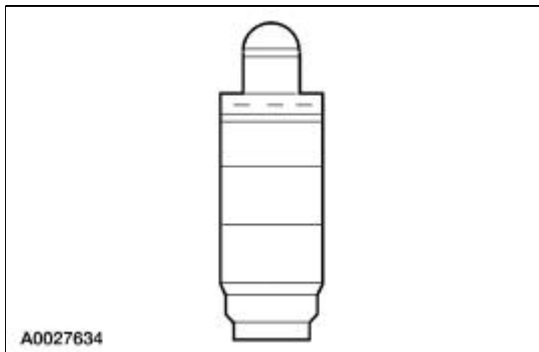
Valve Tappet — Inspection

Push rod engines

1. Inspect the hydraulic valve tappet and roller for damage. If any damage is found, inspect the camshaft lobes and valves for damage.

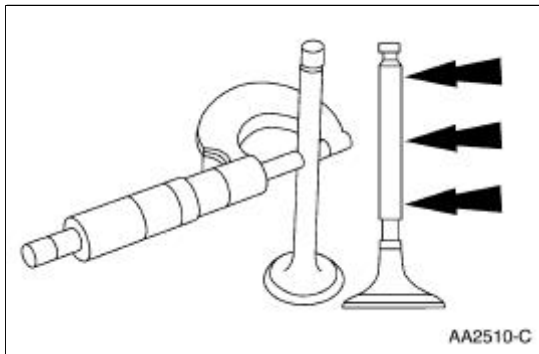


OHC engines



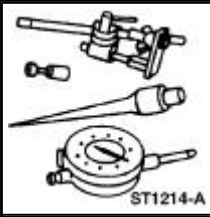
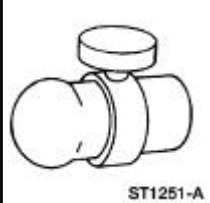
Valve — Stem Diameter

1. Measure the diameter of each intake and exhaust valve stem at the points shown. Verify the diameter is within specification.
 - Refer to the appropriate section in Group [303](#) for the procedure.
 - If out of specification, install new components as necessary. Refer to the appropriate section in Group [303](#) for the procedure.



Valve Stem to Valve Guide Clearance

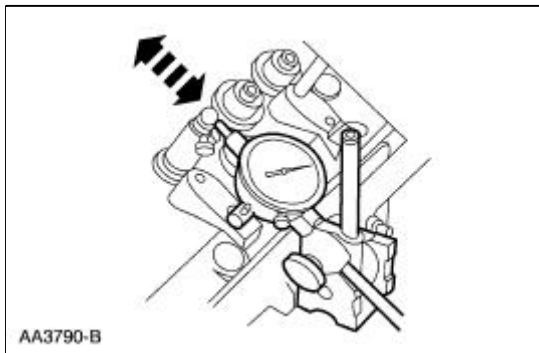
Special Tool(s)

	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
	Clearance Gauge, Valve Guide 303-004 (TOOL-6505-E) or equivalent

NOTE: Valve stem diameter must be within specifications before checking valve stem to valve guide clearance.

1. **NOTE:** If necessary, use a magnetic base.

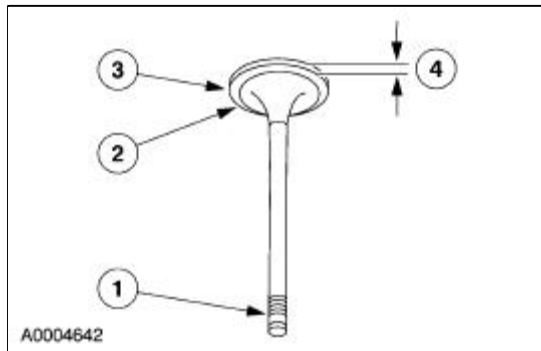
Install a Valve Guide Clearance Gauge on the valve stem and install a Dial Indicator Gauge with Holding Fixture. Lower the valve until the Valve Guide Clearance Gauge contacts the upper surface of the valve guide.



2. Move the Valve Guide Clearance Gauge toward the indicator and zero the indicator. Move the Valve Guide Clearance Gauge away from the indicator and note the reading. The reading will be **DOUBLE** the valve stem-to-valve guide clearance. Valves with oversize stems will need to be installed if out of specification.

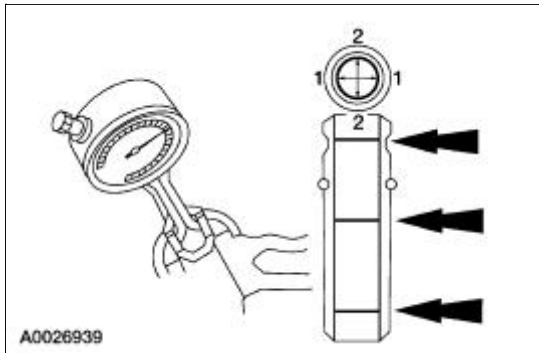
Valve — Inspection

1. Inspect the following valve areas:
 1. the end of the stem for grooves or scoring
 2. the valve face and the edge for pits, grooves or scores
 3. the valve head for signs of burning, erosion, warpage and cracking
 4. the valve margin for wear



Valve — Guide Inner Diameter

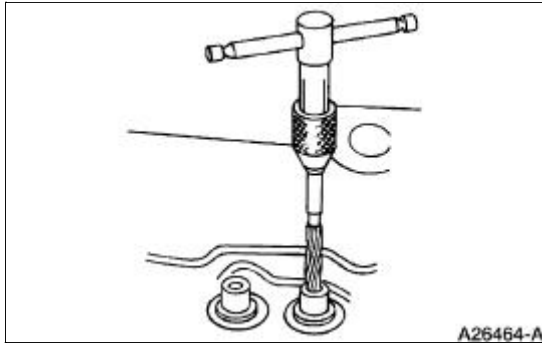
1. Measure the inner diameter of the valve guides in two directions where indicated.
 - Refer to the appropriate section in Group [303](#) for the procedure.



2. If the valve guide is not within specifications, ream the valve guide and install a valve with an oversize stem or remove the valve guide and install a new valve guide.

Valve —Guide Reaming

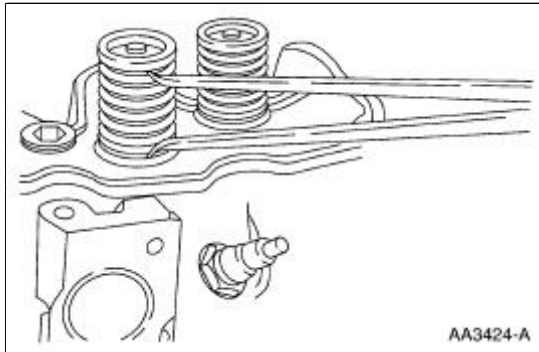
1. Use a hand-reaming kit to ream the valve guide.



2. Reface the valve seat.
 3. Clean the sharp edges left by reaming.
-

Valve — Spring Installed Length

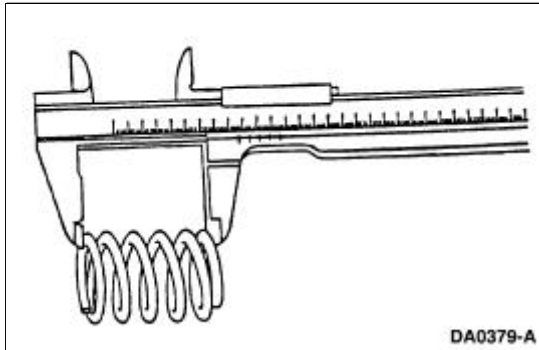
1. Measure the installed length of each valve spring.
 - Refer to the appropriate section in Group [303](#) for the procedure.
 - If out of specification, install new components. Refer to the appropriate section in Group [303](#) for the procedure.



AA3424-A

Valve — Spring Free Length

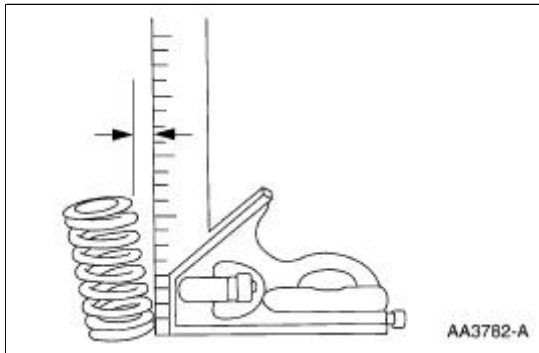
1. Measure the free length of each valve spring.
 - Refer to the appropriate section in Group [303](#) for the procedure.
 - If out of specification, install new components as necessary. Refer to the appropriate section in Group [303](#) for the procedure.



DA0379-A

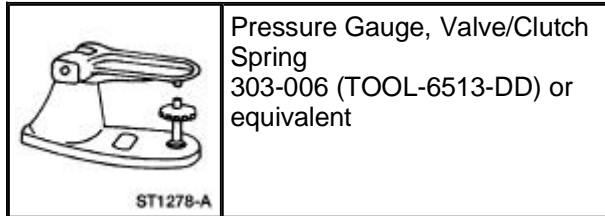
Valve —Spring Squareness

1. Measure the out-of-square on each valve spring.
 - Turn the valve spring and observe the space between the top of the valve spring and the square. Install a new valve spring if out of square. Refer to the appropriate section in Group [303](#) for the procedure.

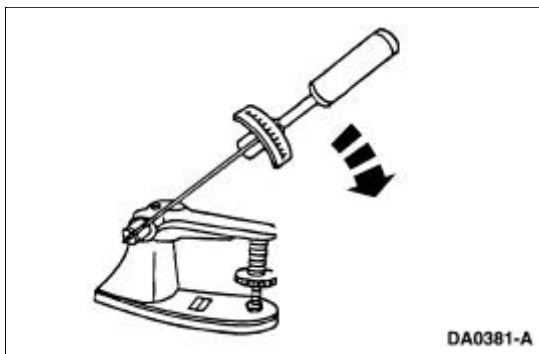


Valve Spring Strength

Special Tool(s)



1. Use a Valve/Clutch Spring Pressure Gauge to check the valve spring for correct strength at the specified valve spring length.
 - Refer to the appropriate section in Group [303](#) for the procedure.
 - If out of specification, install new components as necessary. Refer to the appropriate section in Group [303](#) for the procedure.



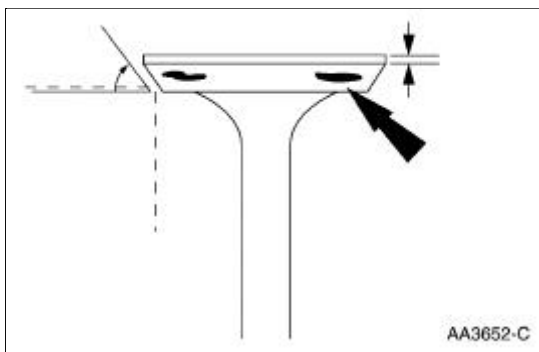
Valve —Seat Inspection

Valve and Seat Refacing Measurements



CAUTION: After grinding valves or valve seats, check valve clearance.

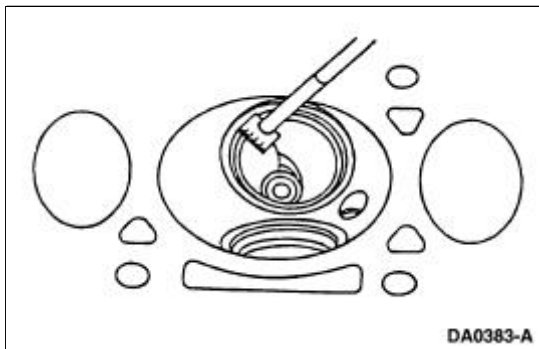
1. Check the valve head and seat.
 - Check valve angles.
 - Check margin width.
 - Refer to the appropriate section in Group [303](#) for the procedure.
 - Be sure margin width is within specification.



2. Inspect for abnormalities on the valve face and seat.

Valve — Seat Width

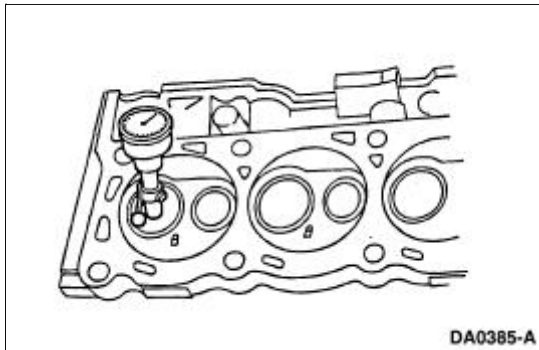
1. Measure the valve seat width. If necessary, grind the valve seat to specification.
 - Measure the intake valve seat width.
 - Measure the exhaust valve seat width.
 - Recheck the valve spring installed length after the seats have been ground, and shim the valve springs as necessary to achieve the correct installed spring length.
 - Refer to the appropriate section in Group [303](#) for the procedure.



DA0383-A


Valve —Seat Runout

1. Use the Valve Seat Runout Gauge to check valve seat runout.

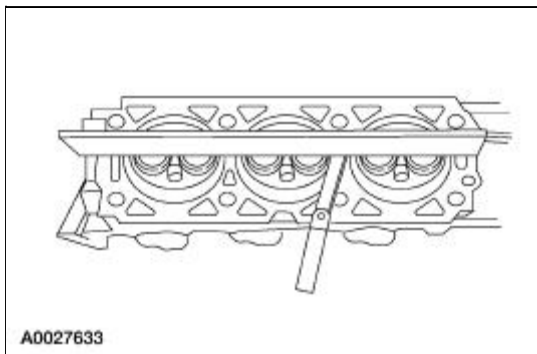


Cylinder Head —Distortion


Special Tool(s)

 <p>ST1246-A</p>	<p>Straight Edge 303-D039 (D83L-4201-A) or equivalent</p>
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1. Use a straight edge and a feeler gauge to inspect the cylinder head for flatness. If the cylinder head is distorted, install a new cylinder head.



Cylinder Bore —Cleaning


1.  **CAUTION:** If these procedures are not followed, rusting of the cylinder bores may occur.

Clean the cylinder bores with soap or detergent and water.

2. Thoroughly rinse with clean water and wipe dry with a clean, lint-free cloth.
 3. Use a clean, lint-free cloth and lubricate the cylinder bores.
 - Use clean engine oil meeting Ford specification.
-

Cylinder Block Core Plug Replacement

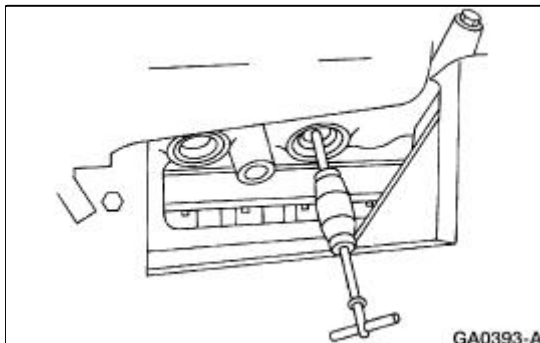
Special Tool(s)

 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
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Material

Item	Specification
Threadlock® 262 E2FZ-19554-B or equivalent	WSK-M2G351-A6

1. Use a slide hammer or tools suitable to remove the cylinder block core plug.



2. Inspect the cylinder block plug bore for any damage that would interfere with the correct sealing of the plug. If the cylinder block plug bore is damaged, bore for the next oversize plug.
3. **NOTE:** Oversize plugs are identified by the OS stamped in the flat located on the cup side of the plug.

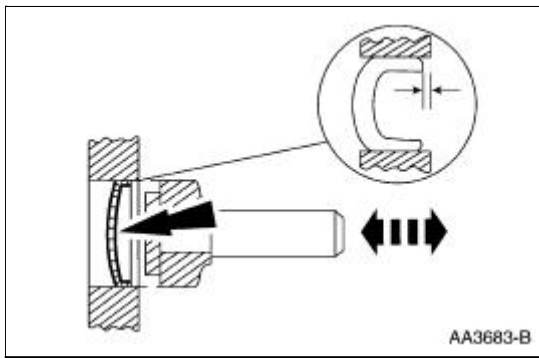
Coat the cylinder block core plug and bore lightly with Threadlock® 262 and install the cylinder block core plug.

Cup-Type

4.  **CAUTION:** Use care during this procedure so as not to disturb or distort the cup sealing surface.

 **CAUTION:** When installed, the flanged edge must be below the chamfered edge of the bore to effectively seal the bore.

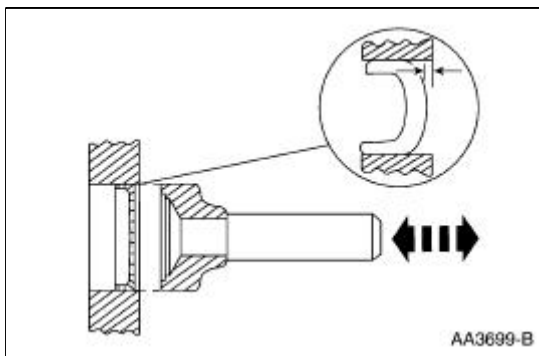
Use a tool suitable to seat the cup-type cylinder block core plug.



Expansion-Type

1.  **CAUTION:** Do not contact the crown when installing an expansion-type cylinder block core plug. This could expand the plug before seating and result in leakage.

Use tool suitable to seat the expansion-type cylinder block core plug.

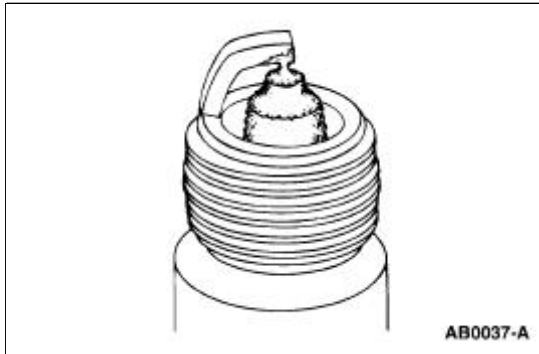


Spark Plug Hole Thread Repair

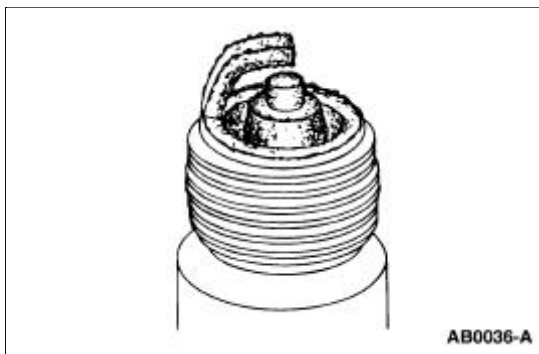
1. There is no authorized repair for spark plug hole threads. If the threads are damaged, install a new cylinder head.
-

Spark Plug — Inspection

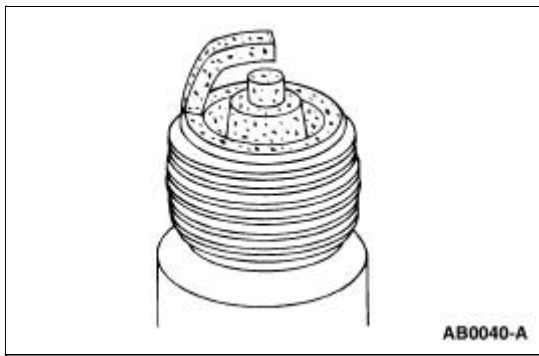
1. Inspect the spark plug for a bridged gap.
 - Check for deposit build-up closing the gap between the electrodes. Deposits are caused by oil or carbon fouling.
 - Clean the spark plug.



2. Check for oil fouling.
 - Check for wet, black deposits on the insulator shell bore electrodes, caused by excessive oil entering the combustion chamber through worn rings and pistons, excessive valve-to-guide clearance or worn or loose bearings.
 - Correct the oil leak concern.
 - Install a new spark plug.

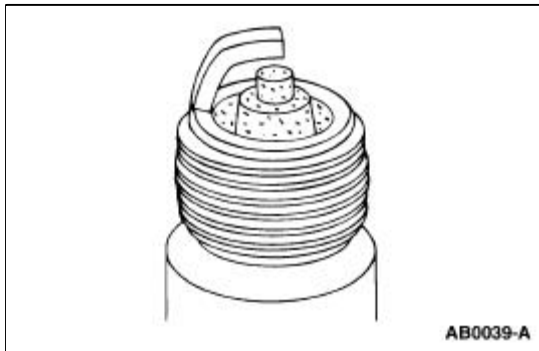


3. Inspect for carbon fouling. Look for black, dry, fluffy carbon deposits on the insulator tips, exposed shell surfaces and electrodes, caused by a spark plug with an incorrect heat range, dirty air cleaner, too rich a fuel mixture or excessive idling.
 - Clean the spark plug.



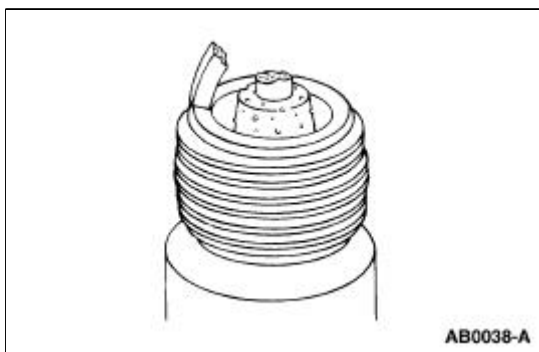
4. Inspect for normal burning.

- Check for light tan or gray deposits on the firing tip.



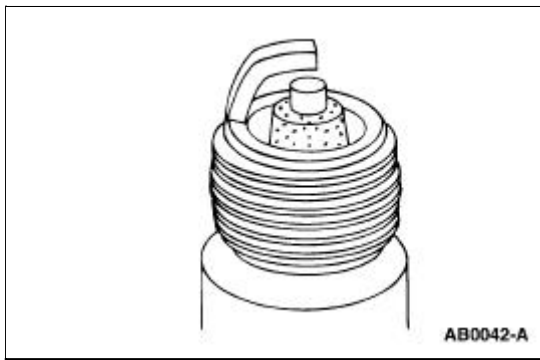
5. Inspect for pre-ignition, identified by melted electrodes and a possibly damaged insulator. Metallic deposits on the insulator indicate engine damage. This may be caused by incorrect ignition timing, wrong type of fuel or the unauthorized installation of a heli-coil insert in place of the spark plug threads.

- Install a new spark plug.



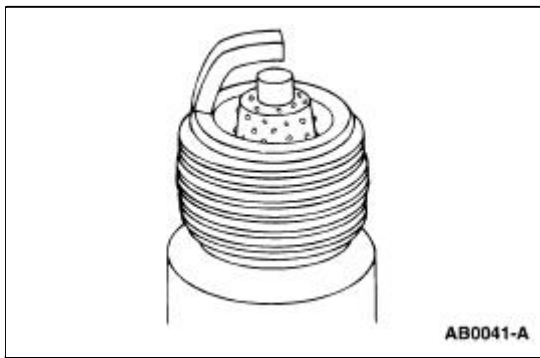
6. Inspect for overheating, identified by a white or light gray spots and with bluish-burnt appearance of electrodes. This is caused by engine overheating, wrong type of fuel, loose spark plugs, spark plugs with an incorrect heat range, low fuel pump pressure or incorrect ignition timing.

- Install a new spark plug.



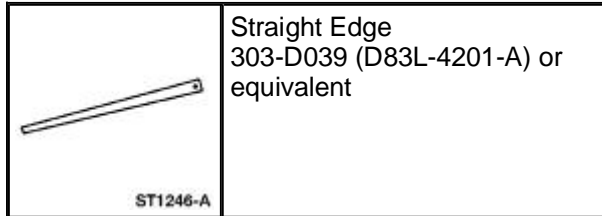
7. Inspect for fused deposits, identified by melted or spotty deposits resembling bubbles or blisters. These are caused by sudden acceleration.

- Clean the spark plug.

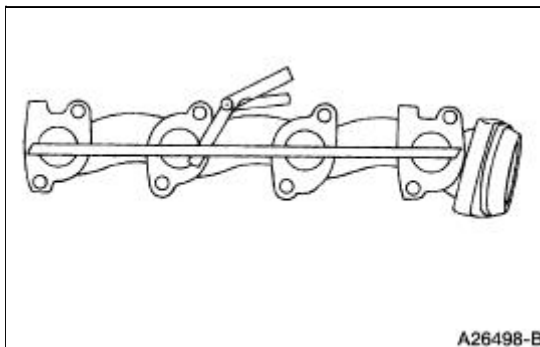


Exhaust Manifold — Inspection

Special Tool(s)

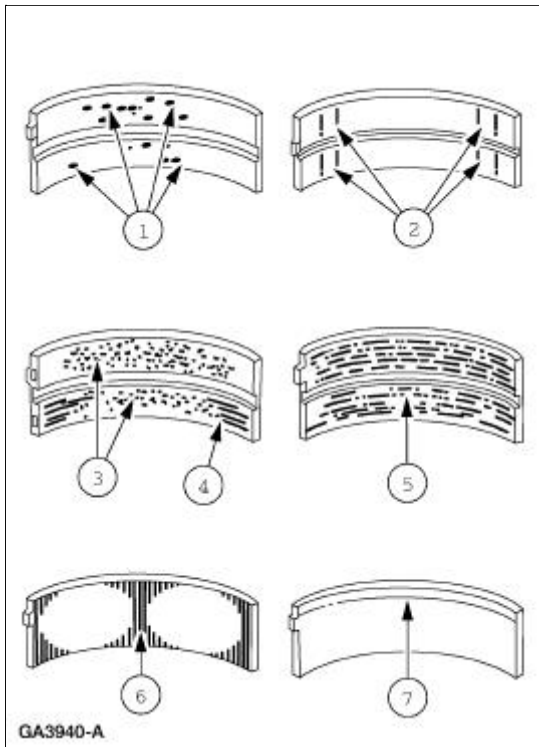


1. Place a straight edge across the exhaust manifold flanges and check for warping with a feeler gauge.



Bearing — Inspection

1. Inspect bearings for the following defects. Possible causes are shown:
 1. Cratering — fatigue failure.
 2. Spot polishing — incorrect seating.
 3. Imbedded dirt engine oil.
 4. Scratching — dirty engine oil.
 5. Base exposed — poor lubrication.
 6. Both edges worn — journal damaged.
 7. One edge worn — journal tapered or bearing not seated.



General Specifications

Item	Specification
Lubricants and Sealants	
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP	WSS-M2C153-H
Gasket and Trim Adhesive F3AZ-19B508-AA	ESE-M2G52-A
Pipe Sealant with Teflon® D8AZ-19554-A	WSK-M2G350-A2
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4
Metal Surface Cleaner F4AZ-19A536-RA	WSE-M5B392-A
Engine	
Displacement	3.8L
Number of cylinders	6
Bore	96.8325 mm (3.81 in)
Stroke	86.0 mm (3.39 in)
Firing order	1-4-2-5-3-6
Oil pressure (hot 2,500 rpm)	40-125 psi
Oil capacity	5 quarts w/filter change
Compression ratio	—
Cylinder Head and Valve Train	
Cylinder head gasket surface flatness	0.18 mm (0.007 in)
Combustion chamber volume	61.5-64.5 cc
Valve arrangement (front to rear)	—
Valve guide bore diameter	7.015-7.044 mm (0.276-0.277 in)
Valve stem diameter — intake	6.955-6.988 mm (0.2738-0.2751 in)
Valve stem diameter — exhaust	6.929-6.962 mm (0.2728-0.2741 in)
Valve stem diameter — oversize (intake)	9.075-9.055 mm (0.3573-0.3565 in)
Valve stem diameter — oversize (exhaust)	9.063-9.043 mm (0.3568-0.3560 in)
Valve stem diameter — oversize (intake)	9.456-9.436 mm (0.3723-0.3715 in)
Valve stem diameter — oversize (exhaust)	9.444-9.424 mm (0.3718-0.3710 in)
Valve stem-to-guide clearance — intake	0.020-0.069 mm (0.045-0.090 in)
Valve stem-to-guide clearance — exhaust	0.038-0.083 mm (0.0015-0.0033 in)
Valve head diameter — intake	47.27 mm (1.86 in)
Valve head diameter — exhaust	37.1 mm (1.46 in)
Valve face runout	0.05 mm (0.002 in)
Valve face angle	45.675 degrees
Valve seat width	1.5-2.0 mm (0.06-0.08 in)
Valve seat runout (T.I.R.)	0.076 mm (0.003 in)

Valve seat angle	44.75 degrees
Valve spring free length	—
Valve spring squareness	—
Valve spring compression pressure — valve open (without damper)	1000 N (224 lbs) @ 29.2 mm (1.16 in)
Valve spring compression pressure — valve closed (without damper)	350 N (79 lbs) @ 40.7 mm (1.62 in)
Valve spring installed height	40.7 mm (1.62 in)
Valve spring installed pressure	—
Rocker arm ratio	1.73
Hydraulic Lash Adjuster	
Diameter	22.195-22.212 mm (0.8738-0.8745 in)
Clearance-to-bore	0.018-0.068 mm (0.0007-0.0027 in)
Service limit	0.127 mm (0.005 in)
Hydraulic leakdown rate	a
Collapsed lash adjuster gap	—
Camshaft	
Theoretical valve lift @ 0 lash — intake	11.30 mm (0.45 in)
Theoretical valve lift @ 0 lash — exhaust	11.47 mm (0.45 in)
Lobe lift — intake	6.53 mm (0.257 in)
Lobe lift — exhaust	6.57 mm (0.259 in)
Allowable lobe lift loss	0.127 mm (0.005 in)
Journal diameter	52.082-52.108 mm (2.0505-2.0515 in)
Camshaft journal bore inside diameter — No. 1	55.689-55.664 mm (2.192-2.191 in)
Camshaft journal bore inside diameter — No. 2 and No. 3	55.308-55.283 mm (2.177-2.176 in)
Camshaft journal bore inside diameter — No. 4	55.684-55.664 mm (2.192-2.191 in)
Camshaft journal-to-bearing clearance	0.025-0.076 mm (0.001-0.003 in)
Runout	0.05 mm (0.002 in) runout of No. 2 or No. 3 relative to No. 1 and No. 4
End play	0.025-0.150 mm (0.001-0.006 in)
Cylinder Block	
Cylinder bore diameter	96.813 mm (3.81 in)
Cylinder bore maximum taper	0.050 mm (0.002 in)
Cylinder bore maximum out-of-round	0.050 mm (0.002 in)
Main bearing bore inside diameter	68.905 mm (2.713 in) 68.885 mm (2.712 in)
Camshaft bearing bore inside diameter — intake	47.097 mm (1.8542 in) max. 47.072 mm (1.8532 in) min.
Camshaft bearing bore inside diameter — exhaust	39.739 mm (1.5645 in) max. 39.714 mm (1.5635 in) min.
Head gasket surface flatness	0.08 mm (0.003 in) in 152.0 mm (6.00 in)
Crankshaft	
Main bearing journal diameter	63.983-64.003 mm (2.5190-2.5198 in)

Main bearing journal maximum taper	0.008 mm (0.0003 in) per 25 mm (1.0 in)
Main bearing journal maximum out-of-round	0.008 mm (0.0003 in) max. in 45 degrees, 0.015 mm (0.006 in) total
Main bearing journal-to-cylinder block clearance — desired	0.025-0.035 mm (0.001-0.0014 in)
Main bearing journal-to-cylinder block clearance — allowable	0.013-0.058 mm (0.0005-0.0023 in)
Connecting rod journal diameter	58.682-58.702 mm (2.3103-2.3111 in)
Connecting rod journal maximum taper	0.008 mm per 25 mm (0.0003 in per in)
Connecting rod journal maximum out-of-round	0.008 mm (0.0003 in) max. in 45 degrees, 0.015 mm (0.0006 in) total
Crankshaft maximum end play	0.10-0.20 mm (0.004-0.008 in)
Piston and Connecting Rod	
Piston diameter — code red	96.795-96.782 mm (3.8108-3.8103 in)
Piston diameter — code blue	96.808-96.795 mm (3.8113-3.8108 in)
Piston diameter — code yellow	96.821-96.808 mm (3.8118-3.8113 in)
Piston-to-cylinder bore clearance (undercoated clearance)	0.018-0.044 mm (0.0007-0.0017 in)
Piston ring end gap — compression (top, in gauge)	0.17-0.33 mm (0.0067-0.013 in)
Piston ring end gap — compression (bottom, in gauge)	0.3-0.55 mm (0.0118-0.0217 in)
Piston ring end gap — oil ring (steel rail, in gauge)	0.15-0.65 mm (0.0059-0.0256 in)
Piston ring groove width — compression (top)	1.54-1.52 mm (0.0606-0.0598 in)
Piston ring groove width — compression (bottom)	1.54-1.52 mm (0.0606-0.0598 in)
Piston ring groove width — compression (oil)	3.05-3.03 mm (0.1200-0.1193 in)
Piston ring width — compression (top and bottom)	1.460-1.490 mm (0.0575-0.0587 in)
Piston ring width — compression (oil)	Side seal — snug fit
Piston ring-to-groove clearance (1st and 2nd ring)	0.030-0.080 mm (0.0012-0.0032 in)
Piston pin bore diameter	22.94-22.98 mm (0.9032-0.9047 in)
Piston pin diameter	23.000-23.003 mm (0.9055-0.9056 in)
Piston pin length	63.55-63.05 mm (2.5096-2.4823 in)
Piston pin-to-piston fit	0.011-0.018 mm (0.0004-0.0007 in)
Piston-to-connecting rod clearance	—
Connecting rod-to-pin clearance	Press fit 8 kilonewtons (1,800 lbs)
Connecting rod pin bore diameter	—
Connecting rod length (center-to-center)	154.66-154.74 mm (6.0890-6.0921 in)
Connecting rod maximum allowed bend	0.04 per 25 mm (0.0016 per in)
Connecting rod maximum allowed twist	0.059 per 25 mm (0.002 per in)
Connecting rod bearing bore diameter	61.635-61.655 mm (2.4266-2.4274 in)
Connecting rod bearing-to-crankshaft clearance	0.025-0.035 mm (0.001-0.0014 in)

— desired	
Connecting rod bearing-to-crankshaft clearance — allowable	0.022-0.069 mm (0.00086-0.0027 in)
Connecting rod side clearance	0.11-0.49 mm (0.0047-0.0193 in)
Balance Shaft	
Journal diameter	52.108-52.082 mm (2.0515-2.0505 in)
Bore inside diameter	55.689-55.664 mm (2.192-2.191 in)
Maximum runout	0.025 mm (0.001 in)
End play	0.075-0.200 mm (0.003-0.008 in)

^a 20-200 seconds to leakdown 3.18 mm (0.125 in) with 225 Newtons (50 pounds) load and tappet filled with leak-down fluid.

Torque Specifications

Description	Nm	lb-ft	lb-in
EGR transducer bracket-to-intake manifold bolts	10	—	89
Ignition coil-to-intake manifold bolts	6	—	53
Water outlet tube-to-intake manifold stud bolt	10	—	89
EGR tube-to-EGR valve nut	40	30	—
Water outlet tube-to-front water pump bolt	10	—	89
Fuel supply manifold bolts	10	—	89
LH valve cover-to-cylinder head bolts	10	—	89
LH valve cover-to-cylinder head stud bolts	10	—	89
EGR tube-to-exhaust manifold nut	40	30	—
RH valve cover-to-cylinder head bolts	10	—	89
RH valve cover-to-cylinder head stud bolts	10	—	89
Coolant recovery reservoir-to-cylinder head stud bolts	10	—	89
Coolant recovery reservoir-to-bracket bolts	5	—	44
Crankshaft pulley bolt	160	118	—
Camshaft position sensor bolts	3	—	27
Camshaft synchronizer-to-front cover bolt	25	18	—
Front cover-to-cylinder block bolts	25	18	—
Radiator fan shroud-to-radiator bolts	9	—	80
Camshaft thrust plate-to-cylinder block bolts	12	9	—
Camshaft synchronizer drive gear-to-camshaft bolt	45	33	—
Timing chain tensioner-to-cylinder block bolts	12	9	—
Exhaust manifold-to-cylinder head nuts	33	24	—
Power steering pump bracket-to-water pump nuts	20	15	—
Power steering pump bracket-to-generator bracket bolts	20	15	—
Generator bracket-to-cylinder head bolts	40	30	—
Exhaust manifold studs	8	—	71
A/C compressor bracket-to-cylinder head bolts	48	35	—
A/C compressor bracket-to-cylinder head nut	48	35	—

A/C compressor bracket-to-cylinder head stud bolt	25	18	—
Oil level indicator tube-to-cylinder head bolt	10	—	89
Coolant recovery reservoir bracket-to-GOP bolts	9	—	80
Motor mount-to-subframe nuts	115	85	—
Oil pan drain plug	26	19	—
Wire harness bracket to motor mount nut	27	20	—
Steering column pinch bolt	47	35	—
Front subframe-to-body bolts	90	66	—
Front subframe-to-shock tower bolts	115	85	—
Oil pan-to-cylinder block bolts ^a	—	—	—
Oil pan-to-transmission bell housing	45	33	—
Main bearing bridge nuts	32	24	—
Oil pump cover-to-engine front cover bolts	25	18	—
Oil pump cover-to-engine front cover bolt	10	89	—
Oil pickup tube-to-cylinder block bolts	25	18	—
Oil pickup tube-to-oil pan baffle nut	48	35	—
Flywheel-to-crankshaft bolts	80	59	—
Wire harness bracket-to-motor mount stud-nut	27	20	—
Engine ground strap-to-motor mount nut	27	20	—
Motor mount-to-motor mount bracket bolts	70	52	—
RH motor mount-to-motor mount bracket nut	70	52	—
Hood ground strap-to-hood hinge bolt	12	9	—
Hood hinge nuts	12	9	—
Generator mounting bracket	25	18	—
Power steering pump bracket nuts	8	—	71
Power steering pump bolts	25	18	—
Valve tappet guide plate bolts	12	9	—
Generator positive cable nut	10	—	89
Power steering pressure tube to pump nut	40	30	—
Accelerator cable bracket-to-intake manifold bolts	10	—	89
42-pin connector bolt	10	—	89
Transmission oil cooler tube bracket-to-motor mount bracket nut	27	20	—
Torque converter-to-flywheel nuts	36	27	—
Engine-to-transmission bolts	40	30	—
Engine mount bracket-to-engine bolts	70	52	—
Engine mount bracket-to-engine nuts	70	52	—
Water pump pulley bolts	25	18	—
Oil filter ^b	—	—	—
Upper intake manifold-to-lower intake manifold bolts ^a	—	—	—
Lower intake manifold-to-cylinder head bolts ^a	—	—	—
Rocker arm pivot-to-cylinder head bolts ^a	—	—	—

Cylinder head bolts ^a	—	—	—
Crankshaft main bearing bolts and studs ^a	—	—	—
Connecting rod cap bolts ^a	—	—	—

^a Refer to the procedure in this section

^b Advance one-half turn after gasket contacts the sealing surface.

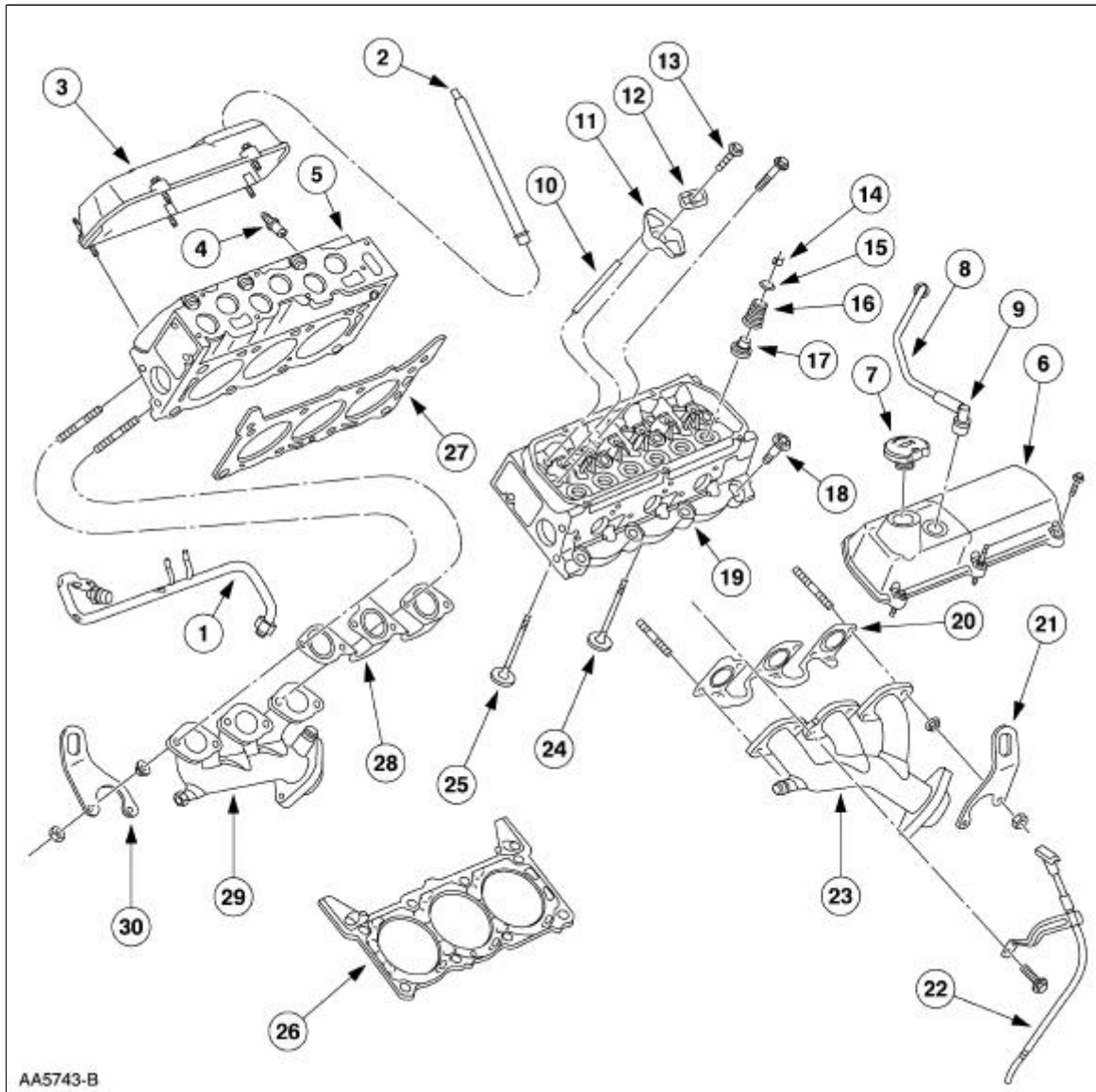
Engine

The 3.8L engine has:

- a V-block with six cylinders and splayed crankpins.
 - a distributorless ignition system.
 - a multiport, sequential fuel injection (SFI) system.
 - overhead valves.
 - hydraulic valve tappets for automatic lash adjustment.
 - connecting rod parting faces that are unique with an interference fit.
 - an engine dynamic balance shaft.
-

Engine Component View

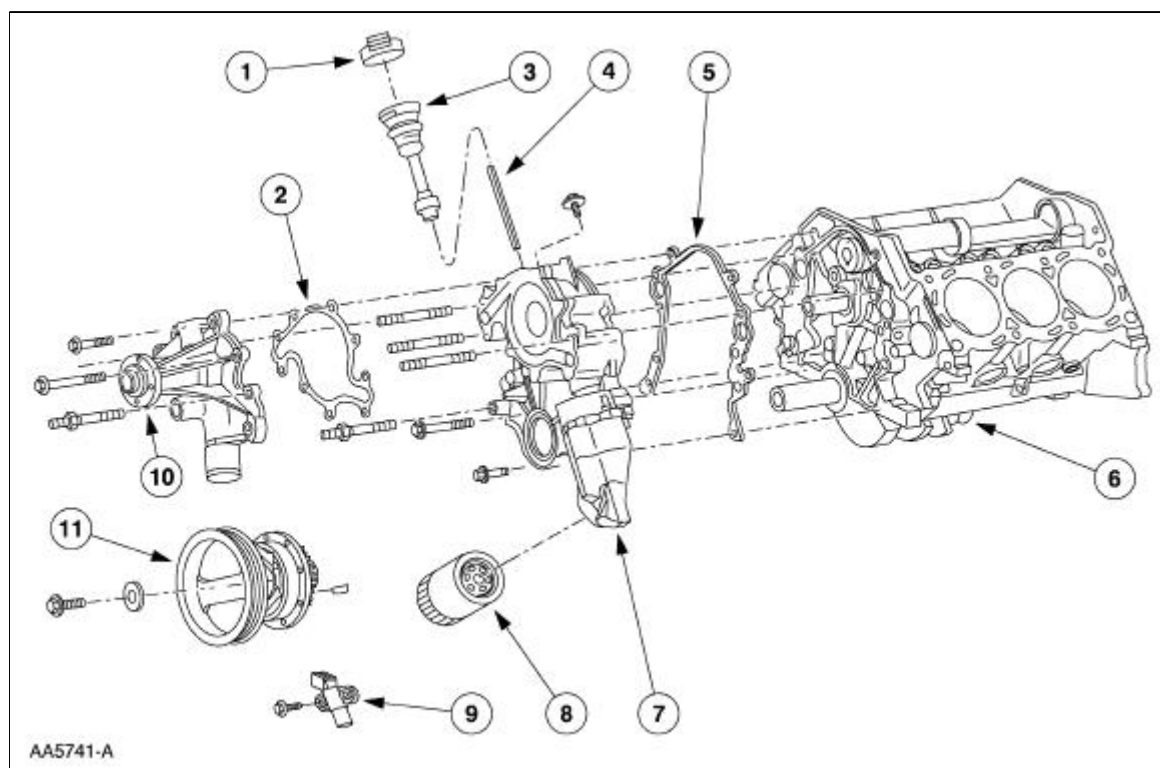
Cylinder Heads and Valve Train Components



Item	Part Number	Description
1	9D477	EGR valve-to-exhaust manifold tube
2	6C342	Crankcase ventilation hose
3	6582	Valve cover — RH
4	12405	Spark plug
5	6049	Cylinder head — RH
6	6582	Valve cover — LH
7	6766	Oil fill cap
8	6758	Crankcase ventilation tube

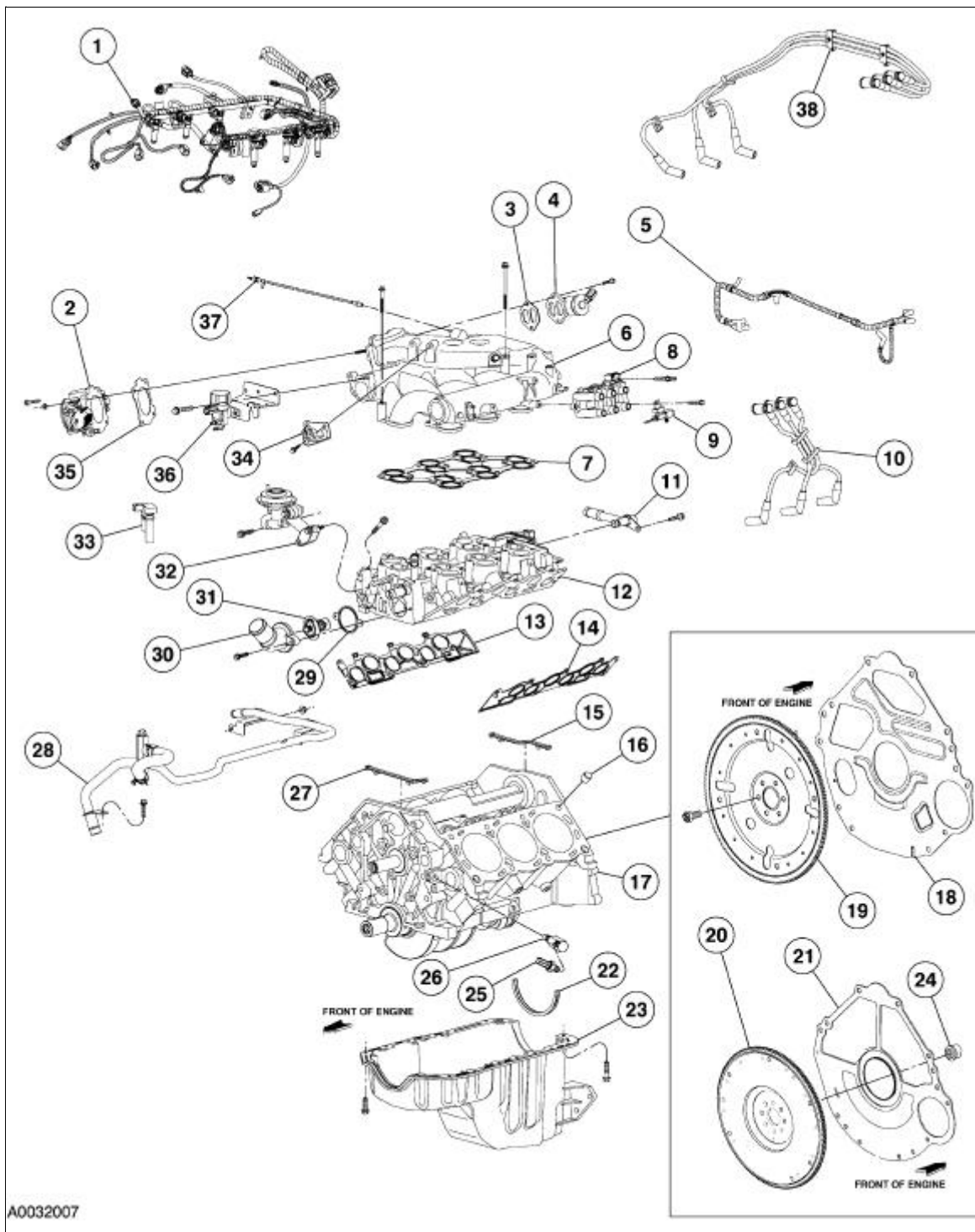
9	6A666	Positive crankcase ventilation valve
10	6565	Push rod
11	6564	Rocker arm
12	6A528	Rocker arm seat
13	N807699	Bolt
14	6518	Valve spring retainer key
15	6514	Valve spring retainer
16	6513	Valve spring
17	6A517	Valve stem seal
18	611497	Bolt
19	6049	Cylinder head — LH
20	9448	Exhaust manifold gasket — LH
21	17A084	Engine lifting eye
22	6754	Oil level indicator tube
23	9430	Exhaust manifold — LH
24	6507	Intake valve
25	6505	Exhaust valve
26	6051	Head gasket — LH
27	6051	Head gasket — RH
28	9448	Exhaust manifold gasket — RH
29	9430	Exhaust manifold — RH
30	17A084	Engine lifting eye

Engine Front Cover Components



Item	Part Number	Description
1	6B288	Camshaft position sensor
2	8507	Water pump housing gasket
3	12A362	Camshaft synchronizer
4	6A618	Oil pump intermediate shaft
5	6020	Engine front cover gasket
6	6010	Cylinder block
7	6019	Engine front cover
8	6714	Oil bypass filter
9	6C315	Crankshaft position sensor
10	8501	Water pump
11	6312	Crankshaft pulley

Engine Components

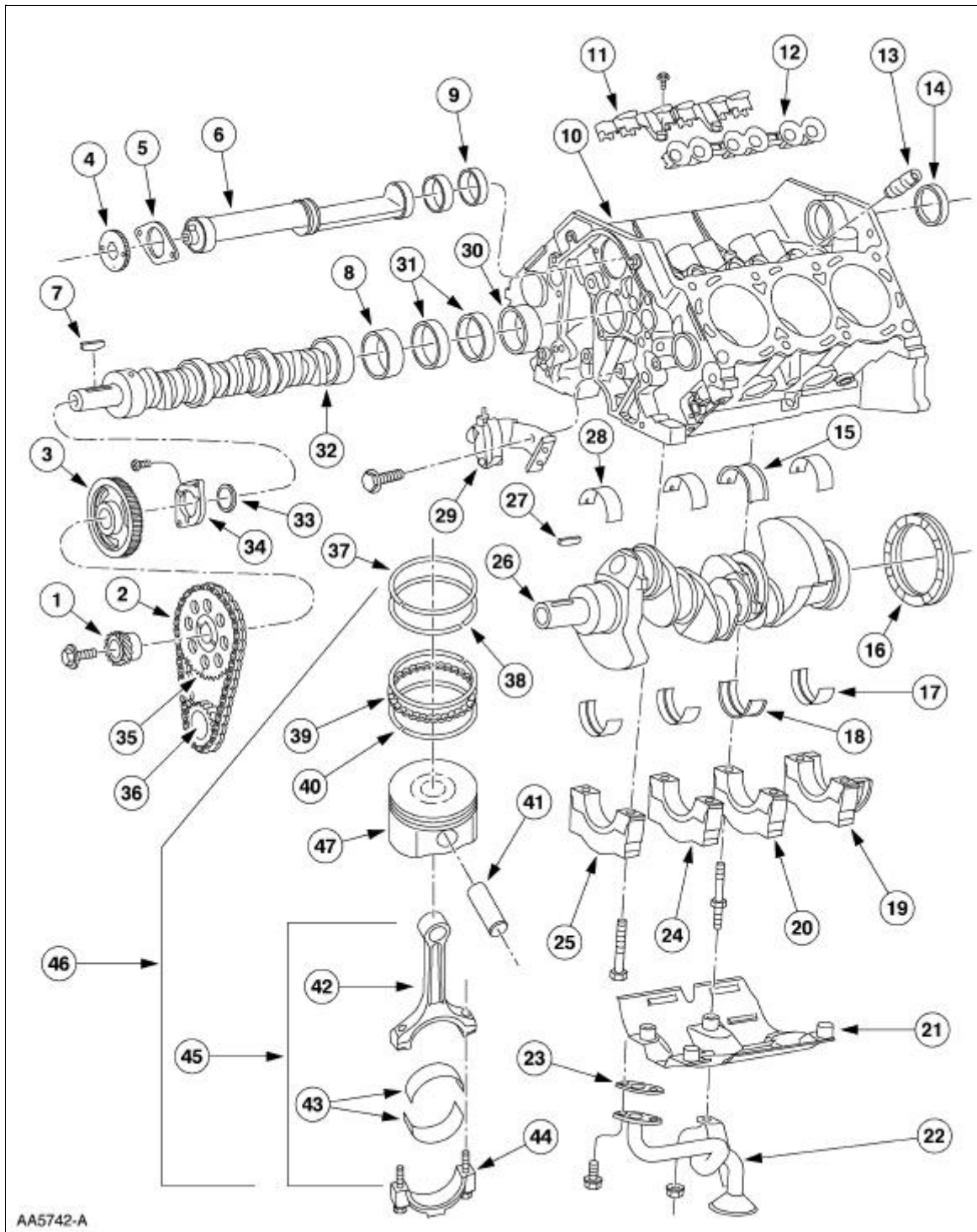


A0032007

Item	Part Number	Description
1	9F797	Engine wire harness
2	9E926	Throttle body
3	9F670	Idle air control gasket
4	9F715	Idle air control valve
5	9E498	Emissions vacuum harness
6	9424	Intake manifold (upper)
7	9H486	Intake manifold gasket (upper)
8	12029	Ignition coil

9	18801	Radio ignition interference capacitor
10	12281	Ignition wire set — LH
11	18696	Tube assembly
12	9424	Intake manifold (lower)
13	9439	Intake manifold gasket — RH
14	9439	Intake manifold gasket — LH
15	9A424	Intake manifold seal (rear)
16	6A008	Cylinder head-to-block dowel
17	6010	Cylinder block
18	6A373	Engine rear plate (automatic transmission)
19	6375	Flywheel (automatic transmission)
20	6375	Flywheel (manual transmission)
21	6A372	Engine rear plate (manual transmission)
22	6723	Oil pan rear seal
23	6675	Oil pan
24	7120	Pilot bushing
25	9278	Oil pressure sensor
26	9B339	Oil pressure sensor fitting
27	9A424	Intake manifold seal (front)
28	18663	Heater water outlet tube
29	8255	Thermostat housing-to-intake manifold gasket
30	8592	Water outlet connection
31	9875	Water thermostat
32	9D475	EGR valve
33	9H465	Vacuum control solenoid
34	9723	Accelerator cable bracket
35	9E936	Throttle body gasket
36	9J433	EGR transducer
37	9E498	Vacuum hose
38	12280	Ignition wire set — RH

Cylinder Block and Lower End Components



Item	Part Number	Description
1	6255	Distributor drive gear
2	6268	Timing chain
3	6A303	Engine balance shaft drive gear
4	6A304	Engine balance shaft driven gear
5	6C341	Balance shaft thrust plate
6	6A311	Engine dynamic balance shaft
7	W705934	Woodruff key
8	6261	Camshaft bearing

9	6A333	Balance shaft front and rear bearing
10	6010	Cylinder block
11	6K564	Tappet guide plate and retainer — RH
12	6K564	Tappet guide plate and retainer — LH
13	6500	Valve tappet
14	376958	Balance shaft cover plug
15	6337	Crankshaft thrust main bearing
16	6701	Crankshaft rear oil seal
17	6A338	Crankshaft main bearing (lower)
18	6A339	Crankshaft thrust main bearing
19	6325	Rear main bearing cap
20	6327	Main bearing cap
21	6687	Oil pan baffle
22	6622	Oil pump screen cover and tube
23	6625	Oil pump inlet tube gasket
24	6334	Main bearing cap
25	6329	Main bearing cap
26	6303	Crankshaft
27	388907	Woodruff key
28	6333	Crankshaft main bearing (upper)
29	6284	Timing chain vibration damper
30	6263	Camshaft rear bearing
31	6262	Camshaft center bearing
32	6250	Camshaft
33	6265	Camshaft sprocket spacer
34	6269	Camshaft thrust plate
35	6256	Camshaft sprocket
36	6303	Crankshaft sprocket
37	6150	Piston ring
38	6152	Piston ring
39	6161	Piston ring
40	6159	Piston ring
41	6135	Piston pin
42	6200	Connecting rod
43	6211	Connecting rod bearing
44	6210	Connecting rod cap
45	6200	Connecting rod assembly
46	6100	Piston and connecting rod assembly
47	6108	Piston

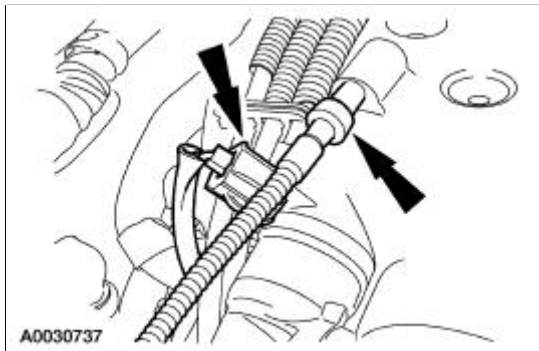
Engine

Refer to [Section 303-00](#) for basic mechanical concerns or refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for driveability concerns.

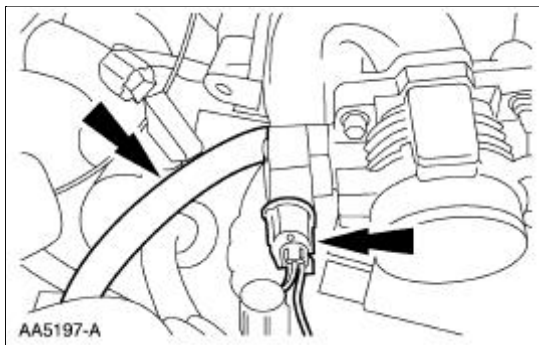
Upper Intake Manifold

Removal

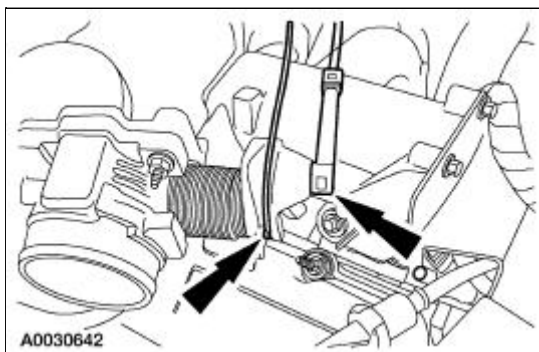
1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Remove the engine air cleaner outlet pipe. For additional information, refer to [Section 303-12](#).
3. Disconnect the vacuum hose and the idle air control (IAC) valve electrical connector.



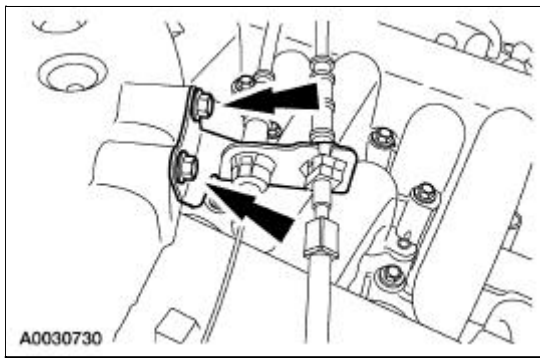
4. Disconnect the throttle position (TP) sensor electrical connector and the evaporative emissions (EVAP) return tube.



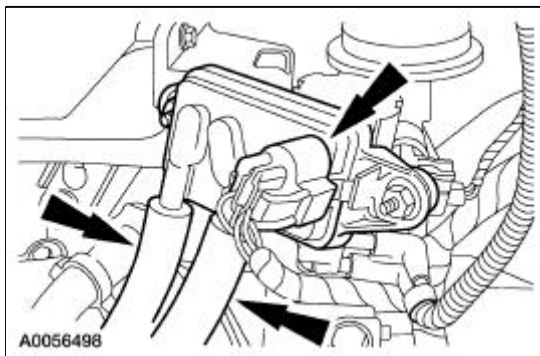
5. Disconnect the accelerator and the speed control cables from the throttle body cam.



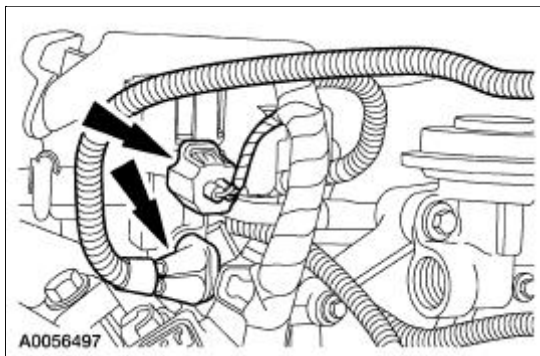
6. Remove the bolts and position the accelerator cable bracket assembly aside.



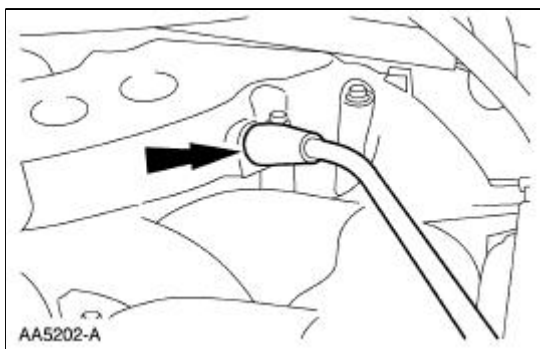
7. Disconnect the differential pressure feedback exhaust gas recirculation (EGR) system electrical and vacuum connections.



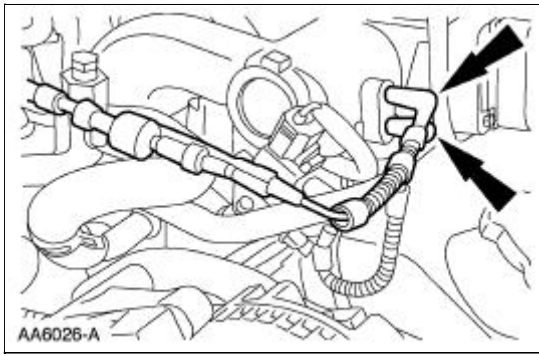
8. Disconnect the EGR vacuum regulator solenoid electrical and vacuum connections.



9. Disconnect the positive crankcase ventilation (PCV) tube.

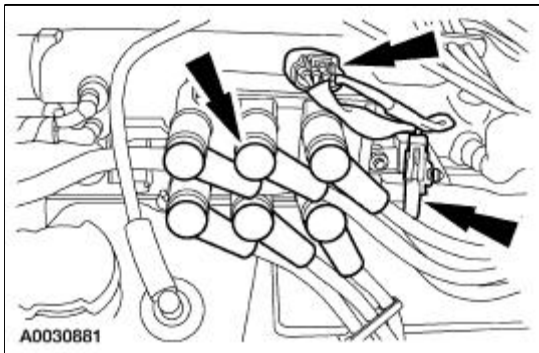


10. Disconnect the vacuum hoses.

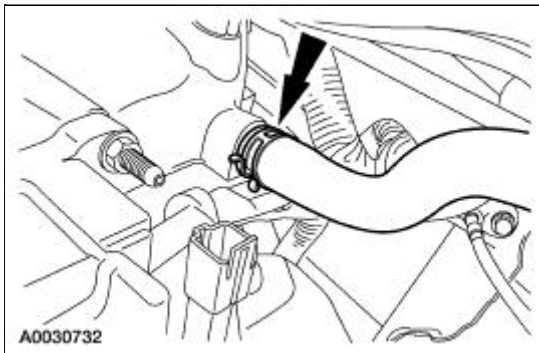


11. Disconnect the following:

- Ignition coil electrical connector.
- Radio interference capacitor electrical connector.
- Spark plug wires.



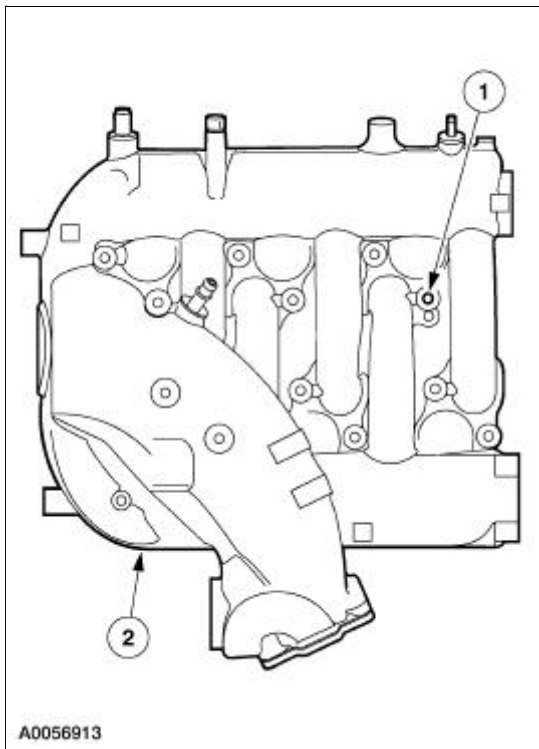
12. Disconnect the vacuum hose.



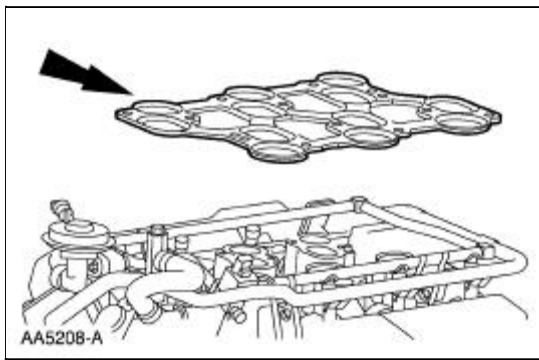
13. **NOTE:** For ease in installation, record the location of the long bolts and the short bolts.

Remove the upper intake manifold.

1. Remove the 12 bolts.
2. Remove the upper intake manifold.

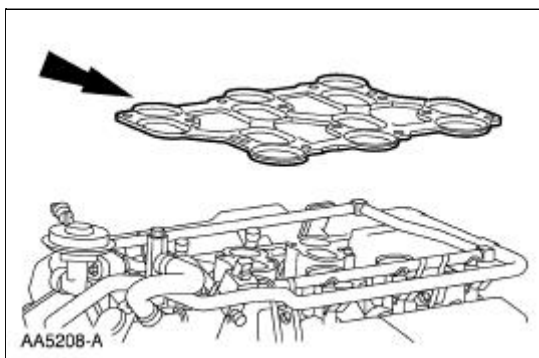


14. Remove and discard the upper intake manifold gasket.



Installation

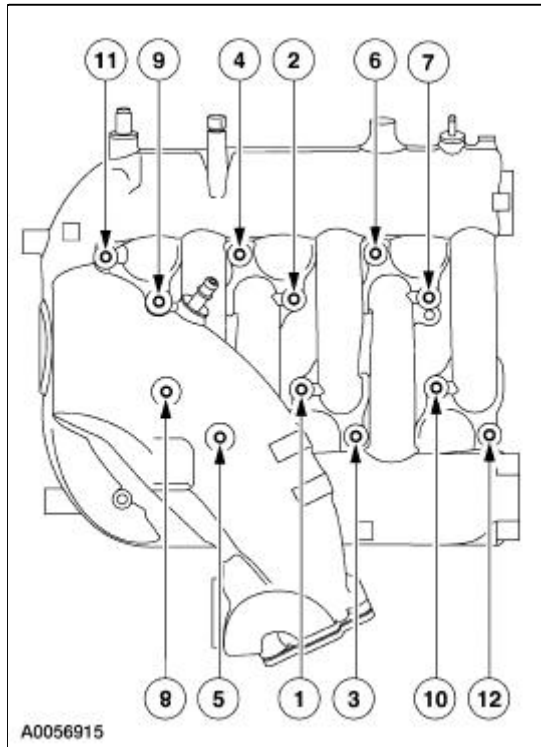
1. Install a new upper intake manifold gasket.



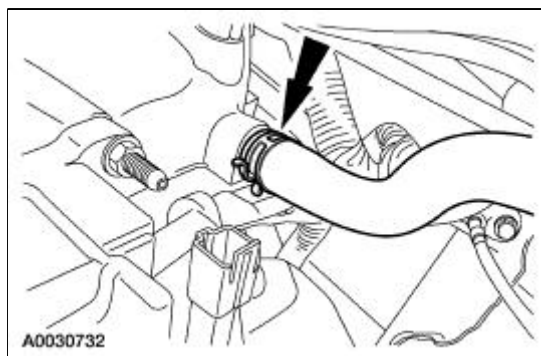
2. **NOTE:** Refer to the location note made during removal and make sure the bolts are installed in the correct locations.

Install the upper intake manifold. Tighten the bolts in two stages in the sequence shown.

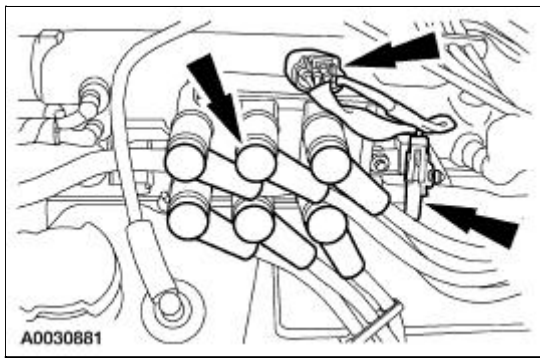
- Stage 1: Tighten to 10 Nm (89 lb-in).
- Stage 2: Rotate an additional 90 degrees (1/4 turn).



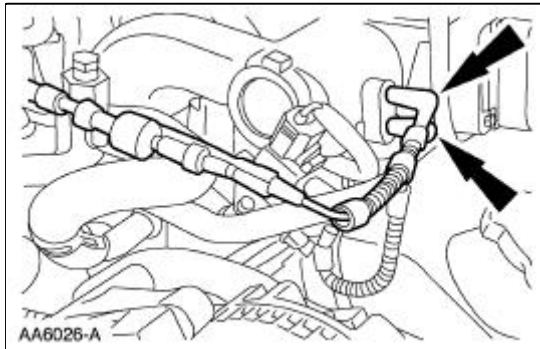
3. Connect the vacuum hose.



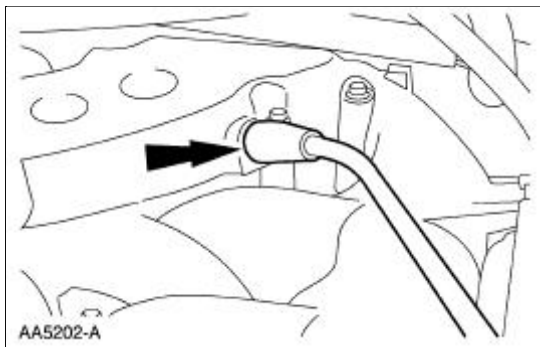
4. Connect the following:
 - Ignition coil electrical connector.
 - Radio interference capacitor electrical connector.
 - Spark plug wires.



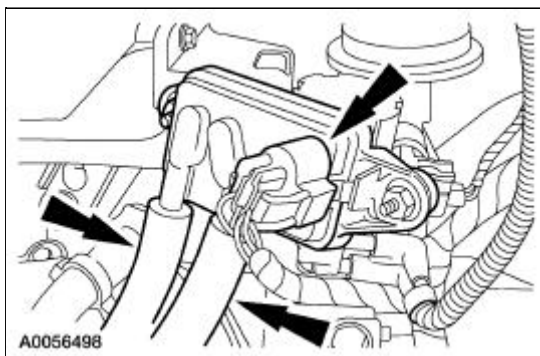
5. Connect the vacuum hoses.



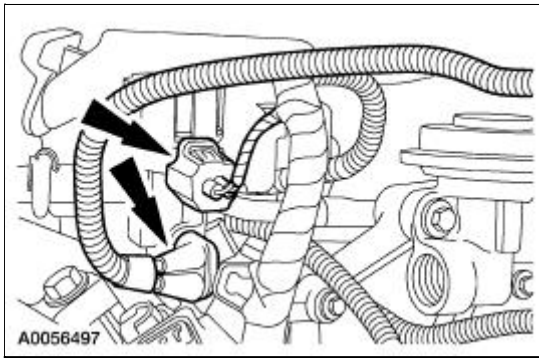
6. Connect the PCV tube.



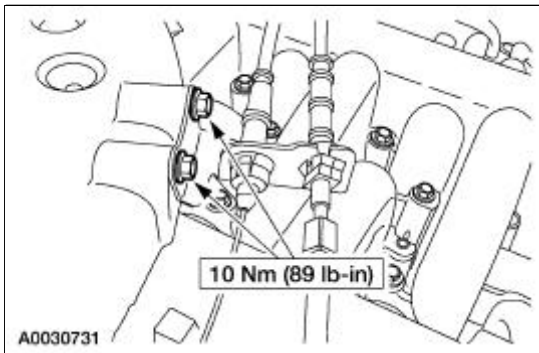
7. Connect the differential pressure feedback EGR system electrical and vacuum connections.



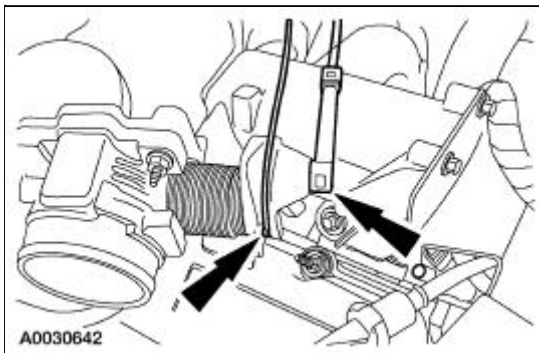
8. Connect the EGR vacuum regulator solenoid electrical and vacuum connections.



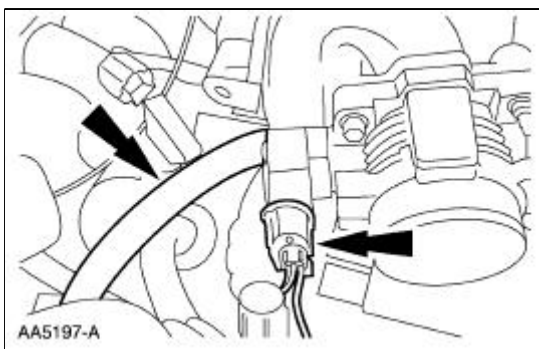
9. Position the accelerator cable bracket and install the bolts.



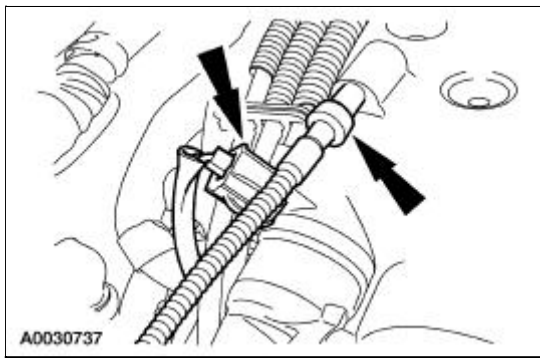
10. Connect the accelerator and speed control cables to the throttle body cam.



11. Connect the EVAP return tube and the TP sensor electrical connector.



12. Connect the vacuum hose and the IAC valve electrical connector.



13. Install the engine air cleaner outlet pipe. For additional information, refer to [Section 303-12](#).
 14. Connect the battery ground cable. For additional information, refer to [Section 414-01](#).
-

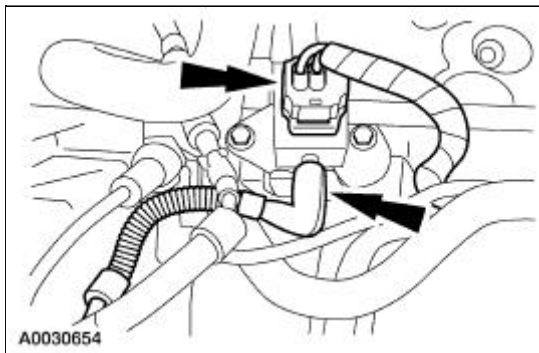
Lower Intake Manifold

Material

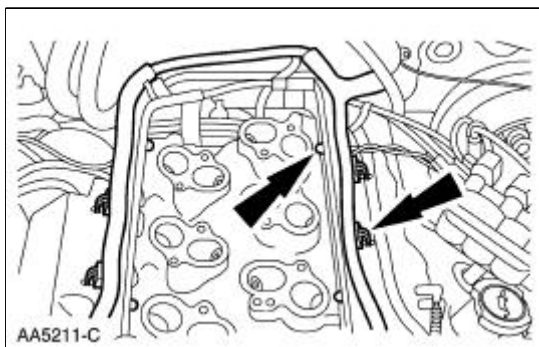
Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A

Removal

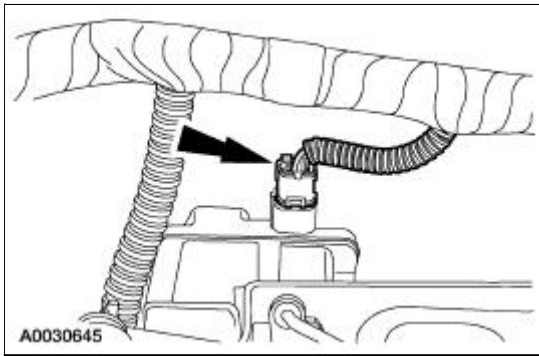
1. Remove the upper intake manifold. For additional information, refer to [Upper Intake Manifold](#) in this section.
2. Partially drain the cooling system. For additional information, refer to [Section 303-03A](#).
3. Relieve the fuel system pressure. For additional information, refer to [Section 310-00](#).
4. Disconnect the fuel rail pressure (FRP) sensor electrical connector and vacuum hose.



5. Disconnect the fuel supply tube spring lock coupling. For additional information, refer to [Section 310-00](#).
6. Disconnect and position the engine wire harness aside.

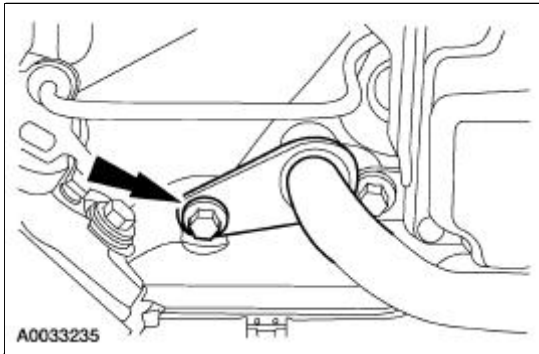


7. Disconnect the intake manifold runner control (IMRC) electrical connector.

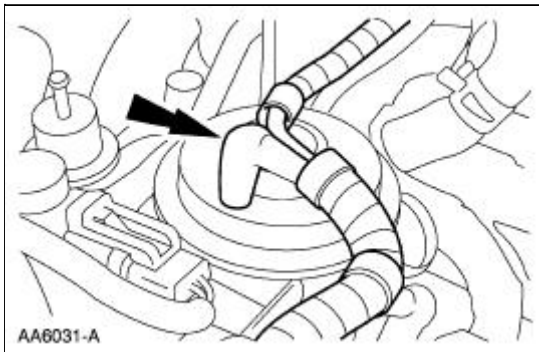


8. Remove the heater bypass tube. For additional information, refer to [Section 303-03A](#).

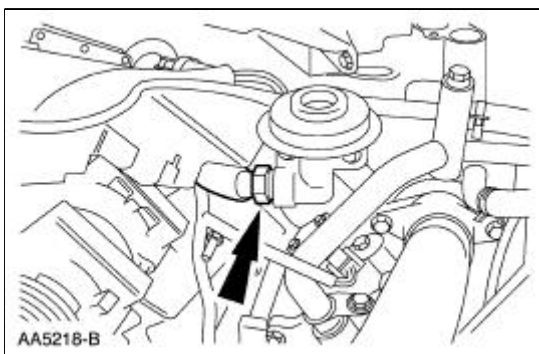
9. Disconnect the heater hose.



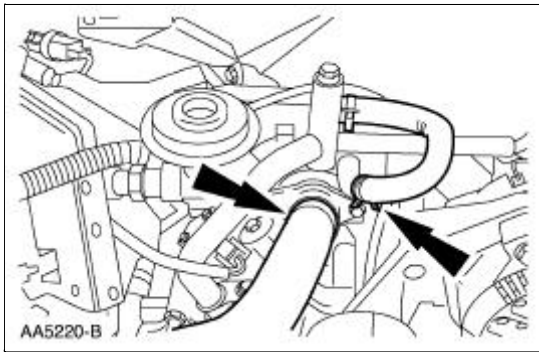
10. Disconnect the exhaust gas recirculation (EGR) vacuum tube.



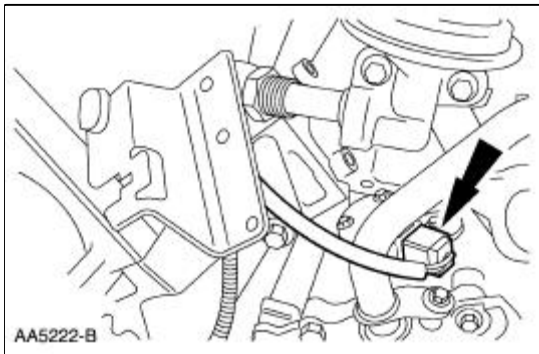
11. Disconnect the EGR tube from the EGR valve.



12. Disconnect the radiator upper hose and coolant bypass hose.

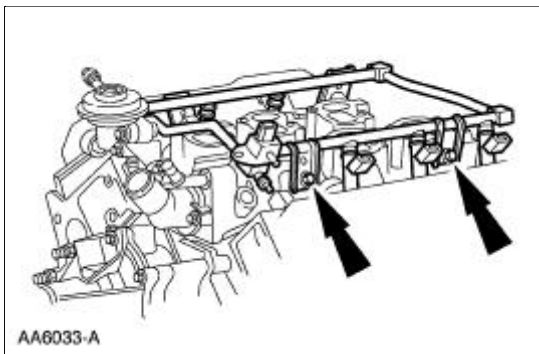


13. Disconnect the electrical connector.



14. **NOTE:** Remove the fuel injection supply manifold and fuel injectors as an assembly.

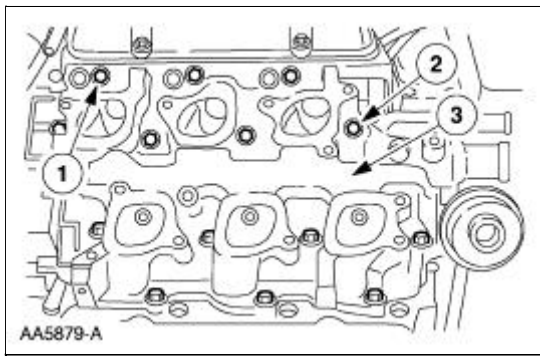
Remove the bolts and the fuel injection supply manifold.



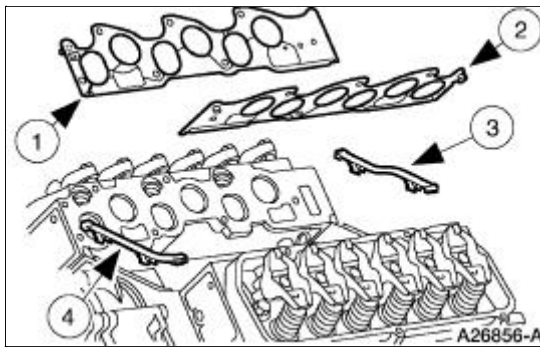
15. **NOTE:** For ease in installation, record the location of the short bolts and the long bolts.

Remove the lower intake manifold.

1. Remove the eight short bolts.
2. Remove the six long bolts.
3. Remove the lower intake manifold.



16. Remove and discard the intake manifold gaskets.



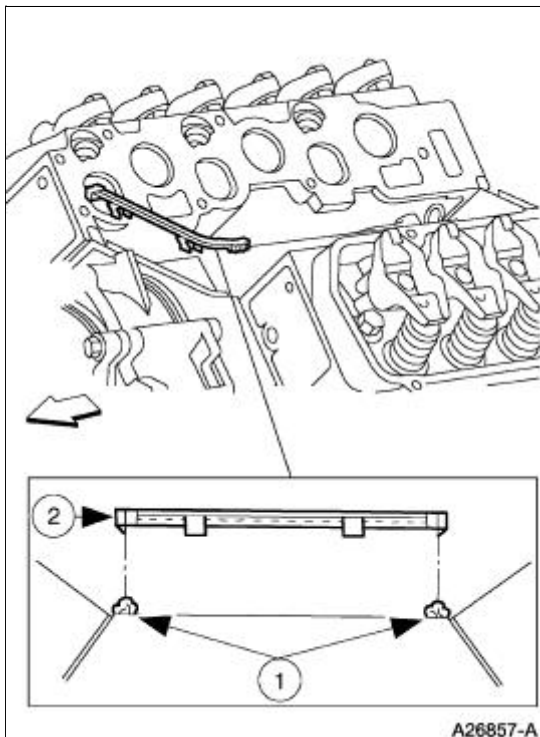
Item	Part Number	Description
1	9439	Intake manifold gasket—RH
2	9441	Intake manifold gasket—LH
3	9A424	Intake manifold rear end seal (part of 9439)
4	9A425	Intake manifold front end seal (part of 9439)

Installation

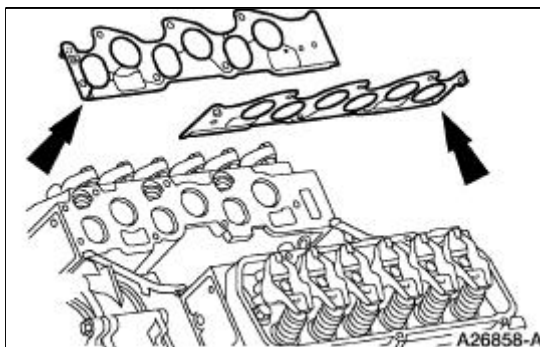
1. **NOTE:** If the lower intake manifold is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

Install the lower intake manifold front and rear end seals.

1. Apply a bead of silicone gasket and sealant to the intake manifold front and rear end seal mounting points as indicated.
2. Install the lower intake manifold front and rear end seals.



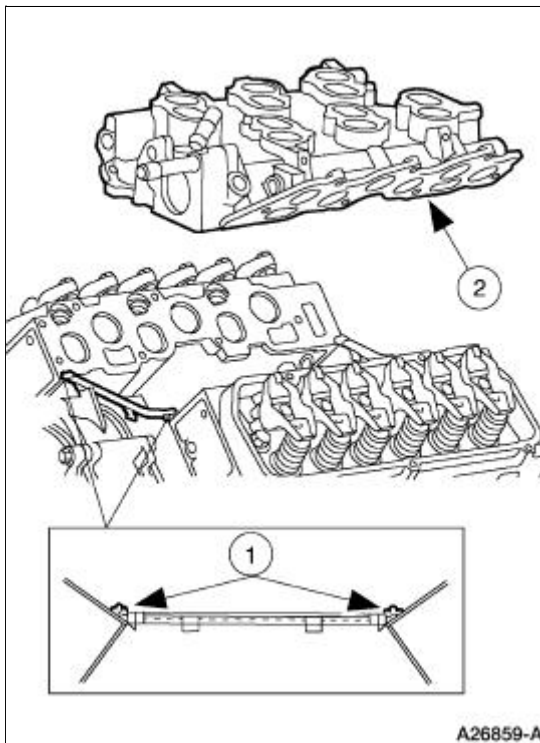
2. Install the intake manifold gaskets.



3. **NOTE:** If the lower intake manifold is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

Position the lower intake manifold.

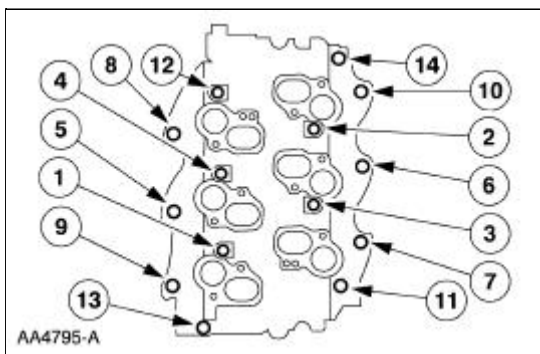
1. Apply a bead of silicone gasket and sealant to the lower intake manifold mounting at the points indicated.
2. Position the lower intake manifold.



4. **NOTE:** Refer to the location note made during removal and make sure the bolts are installed in the correct location.

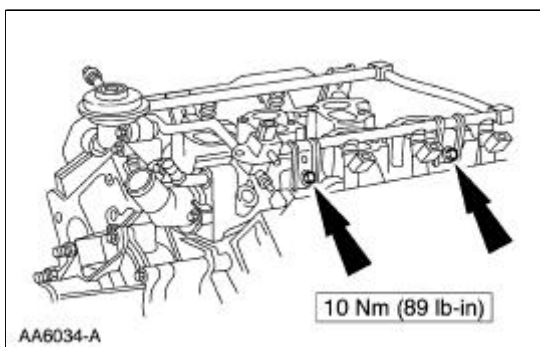
Tighten the bolts in two stages in the sequence shown:

- Stage 1: Tighten the bolts to 5 Nm (44 lb-in).
- Stage 2: Tighten the bolts to 10 Nm (89 lb-in).

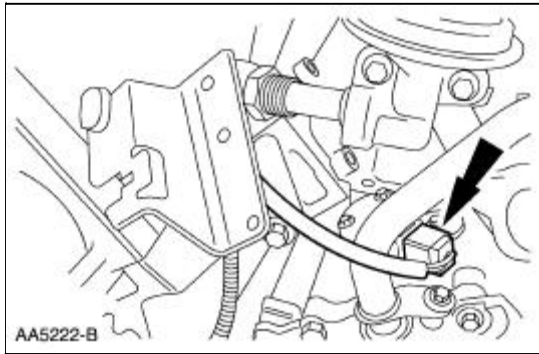


5. **NOTE:** Install the fuel injection supply manifold and fuel injectors as an assembly.

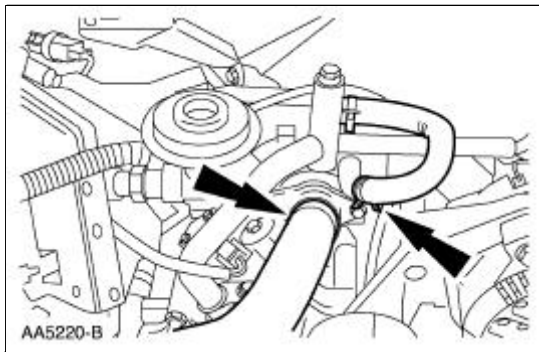
Install the fuel injector supply manifold and bolts.



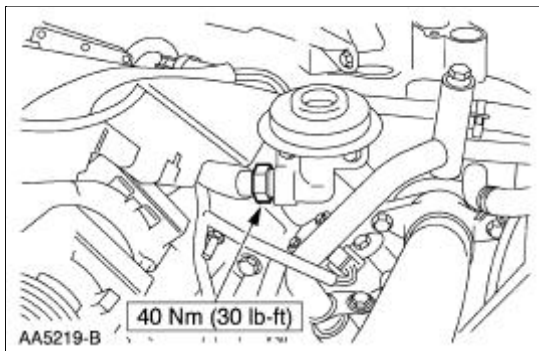
6. Connect the electrical connector.



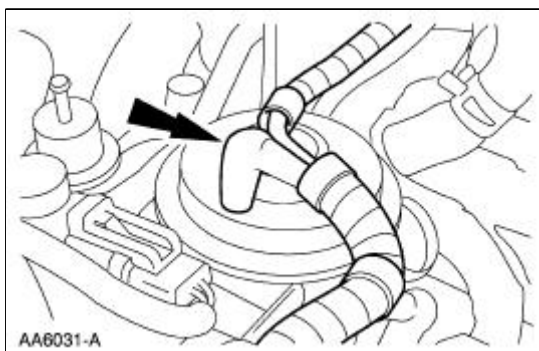
7. Connect the coolant hoses.



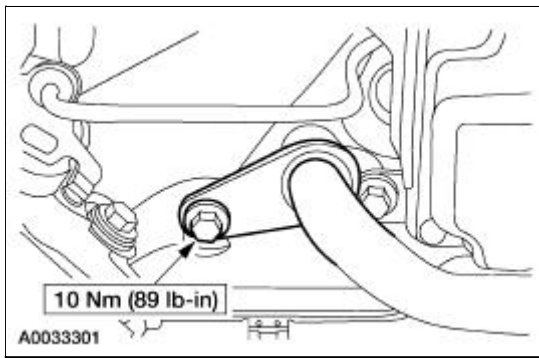
8. Connect the EGR tube.



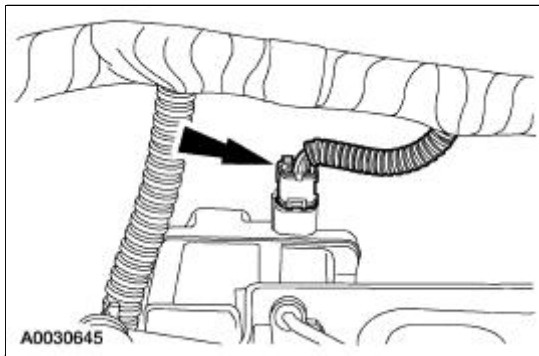
9. Connect the EGR vacuum tube.



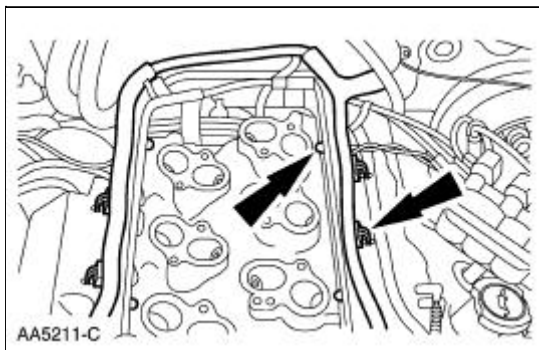
10. Lubricate the O-ring with water and install the heater hose.



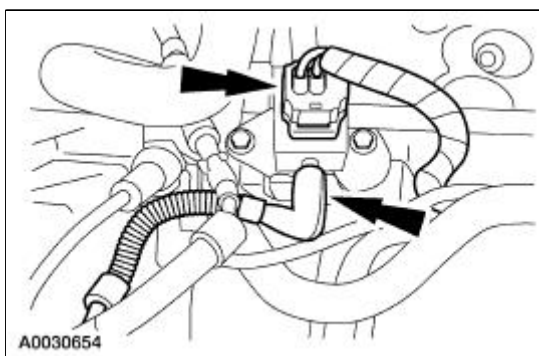
11. Install the heater bypass tube. For additional information, refer to [Section 303-03A](#).
12. Connect the IMRC electrical connector.



13. Position and connect the engine wire harness. Install the pin-type retainers.



14. Connect the fuel supply tube spring lock coupling. For additional information, refer to [Section 310-00](#).
15. Connect the FRP sensor electrical connector and the vacuum hose.



16. Install the upper intake manifold. For additional information, refer to [Upper Intake Manifold](#) in this section.

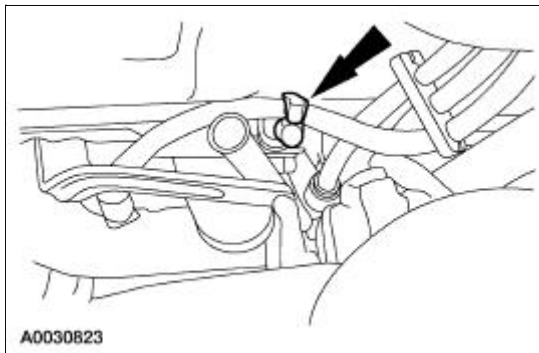
17.  **CAUTION: Correct cooling system bleeding is critical for correct engine cooling.**

Fill and bleed the cooling system. For additional information, refer to [Section 303-03A](#) .

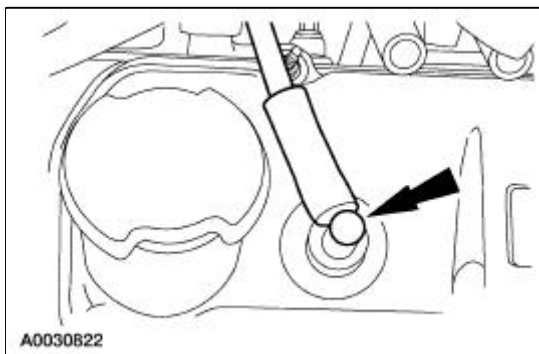
Valve Cover —LH

Removal and Installation

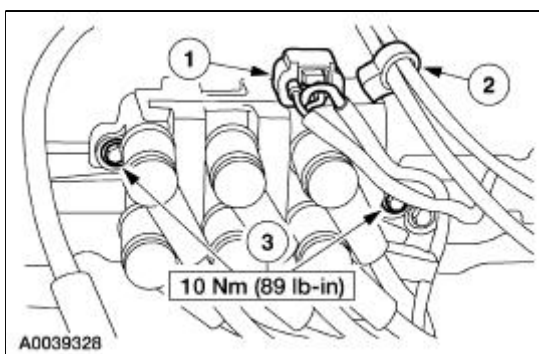
1. Position the ignition wires (12281) aside.



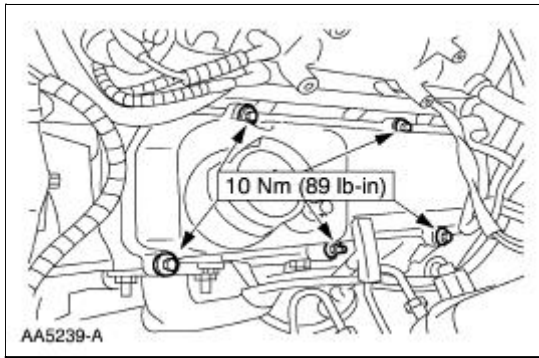
2. Disconnect the positive crankcase ventilation (PCV) valve (6758).



3. Remove the ignition coil and position aside.
 1. Disconnect the electrical connector.
 2. Disconnect the accelerator control cable retainer.
 3. Remove the bolts.



4. Remove the LH valve cover (6A565).
 - Inspect the gasket (6584) and install a new gasket if necessary.

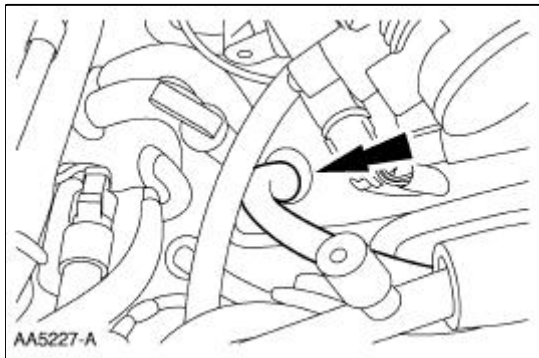


5. To install, reverse the removal procedure.
-

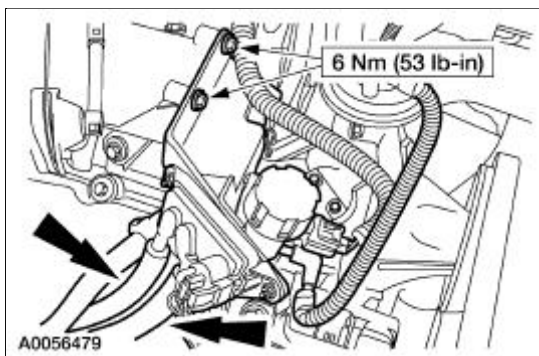
Valve Cover RH

Removal and Installation

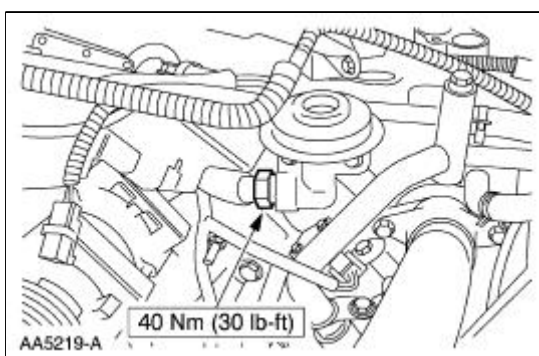
1. Remove the throttle body. For additional information, refer to [Section 303-04A](#).
2. Disconnect the crankcase vent hose.



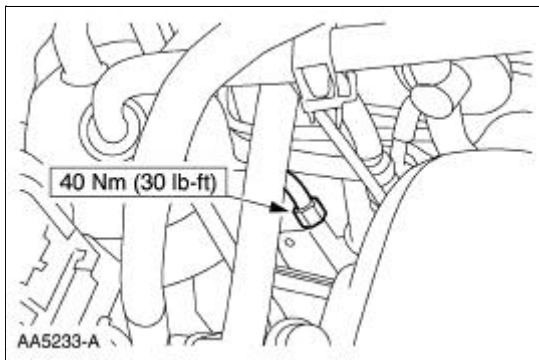
3. Remove the differential feedback exhaust gas recirculation (EGR) system vacuum hoses and the bracket bolts. Position the bracket assembly aside.



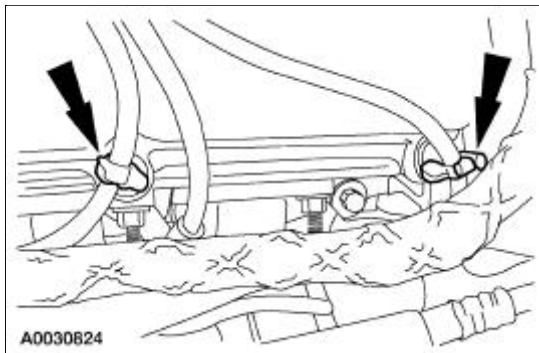
4. Disconnect the EGR tube.



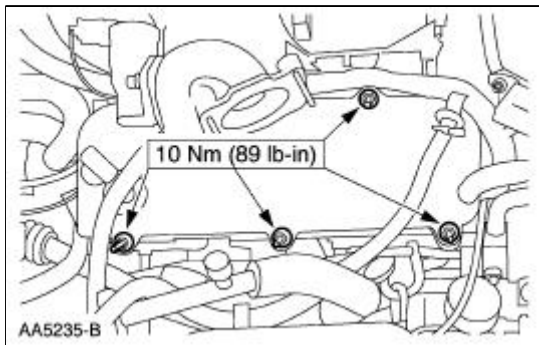
5. Remove the EGR tube.



6. Position the spark plug wires aside.






7. Remove the RH valve cover.



8. To install, reverse the removal procedure.
 - Install a new valve cover gasket as necessary.
-

Crankshaft Pulley

Special Tool(s)

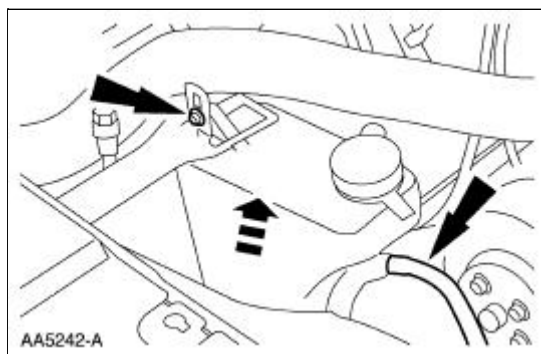
 <p>ST1286-A</p>	<p>Remover, Crankshaft Vibration Damper 303-009 (T58P-6316-D)</p>
 <p>ST1378-A</p>	<p>Remover, Crankshaft Vibration Damper 303-176 (T82L-6316-B)</p>
 <p>ST1387-A</p>	<p>Installer, Crankshaft Damper/Crankshaft Front Oil Seal 303-175 (T82L-6316-A)</p>

Material

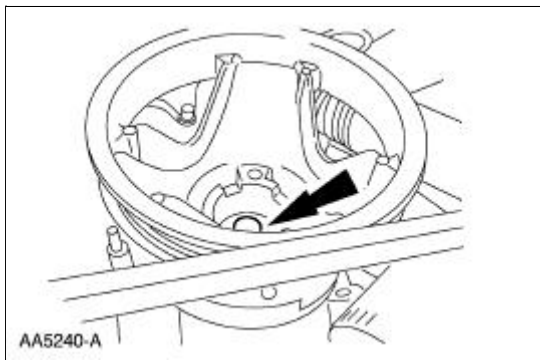
Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4

Removal

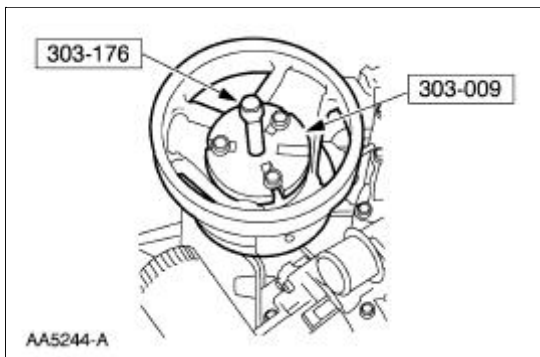
1. Remove the drive belt (8620). For additional information, refer to [Section 303-05](#).
2. Remove the radiator coolant recovery reservoir (8A080).



3. Raise the vehicle on a hoist. For additional information, refer to [Section 100-02](#).
4. Remove the crankshaft pulley bolt.

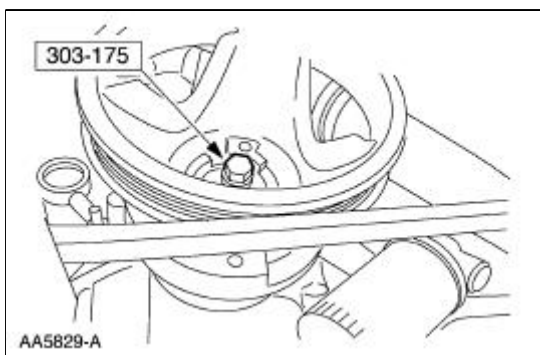


5. Using the special tool, remove the crankshaft pulley (6B321).

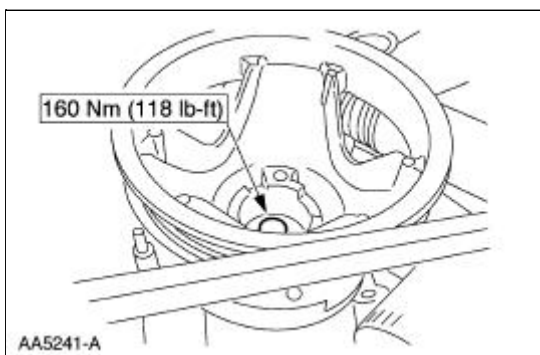


Installation

1. Apply a bead of silicone gasket and sealant to the keyway in the crankshaft damper and use the special tool to install the crankshaft pulley.

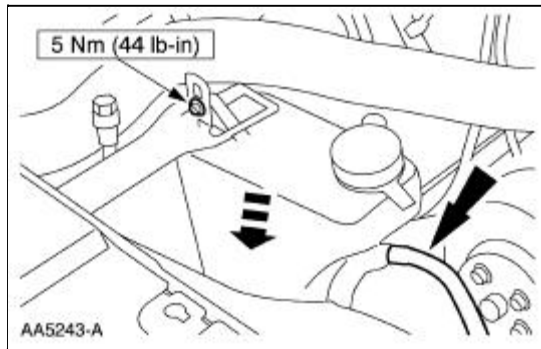


2. Install the crankshaft bolt.



3. Lower the vehicle.

4. Install the radiator coolant recovery reservoir.



5. Install the drive belt. For additional information, refer to [Section 303-05](#).
-

Crankshaft Front Seal

Special Tool(s)

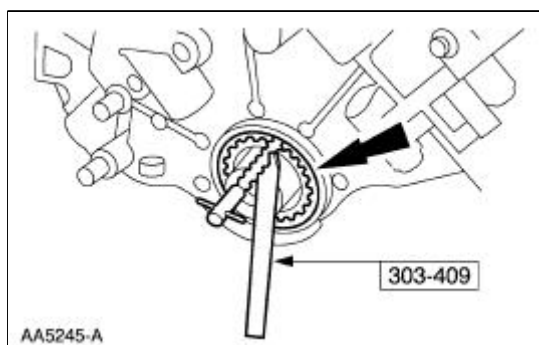
 ST1328-A	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A)
 ST1379-A	Installer, Crankshaft Front Oil Seal 303-474 (T94P-6701-AH)
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700-CH)

Material

Item	Specification
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

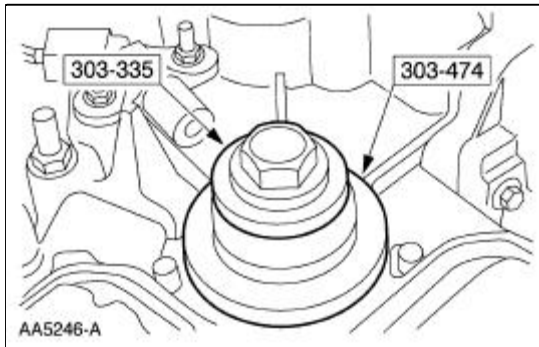
1. Remove the crankshaft pulley. For additional information, refer to [Crankshaft Pulley](#) in this section.
2. Using the special tool, remove and discard the crankshaft front seal.



Installation

1. **NOTE:** Lubricate the crankshaft front seal with clean engine oil before assembly.

Using the special tool, install the crankshaft front seal.



2. Install the crankshaft pulley. For additional information, refer to [Crankshaft Pulley](#) in this section.
-

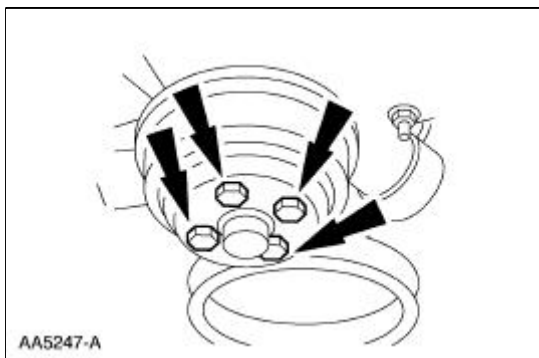
Engine Front Cover

Material

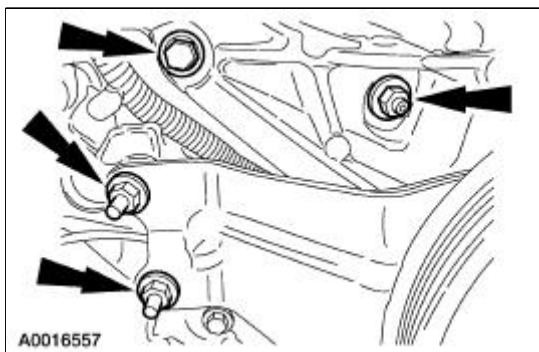
Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

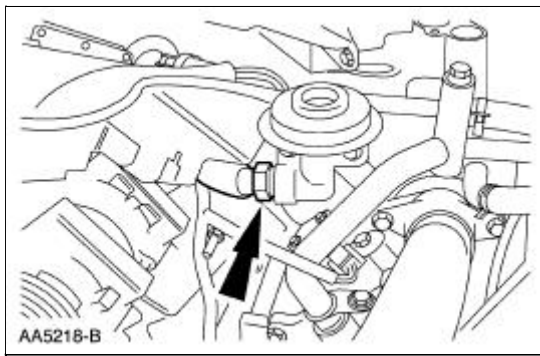
1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Drain the engine cooling system. For additional information, refer to [Section 303-03A](#).
3. Remove the crankshaft pulley. For additional information, refer to [Crankshaft Pulley](#) in this section.
4. Remove the water pump pulley.



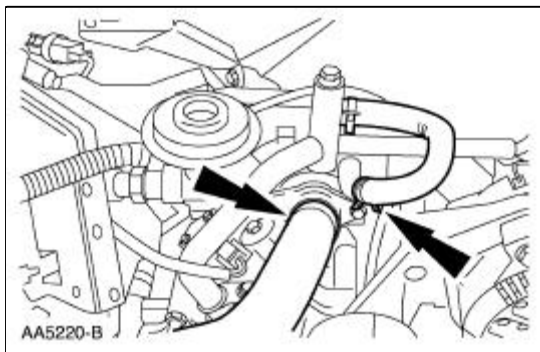
5. Remove the retainers and position the power steering pump aside.



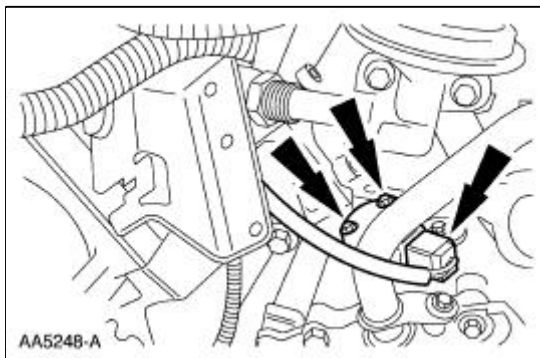
6. Disconnect the exhaust gas recirculation (EGR) tube.



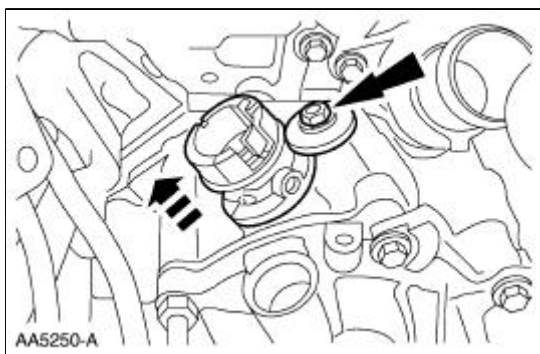
7. Disconnect the upper radiator hose and the bypass hose.



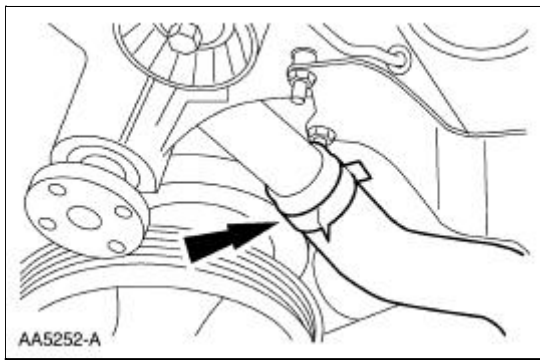
8. Remove the camshaft position (CMP) sensor.



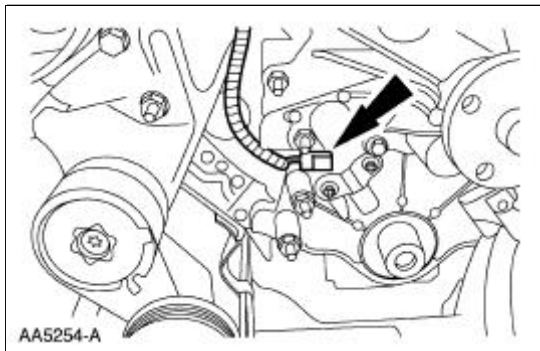
9. Remove the heater water outlet tube. For additional information, refer to [Section 303-03A](#).
10. Remove the camshaft synchronizer assembly.



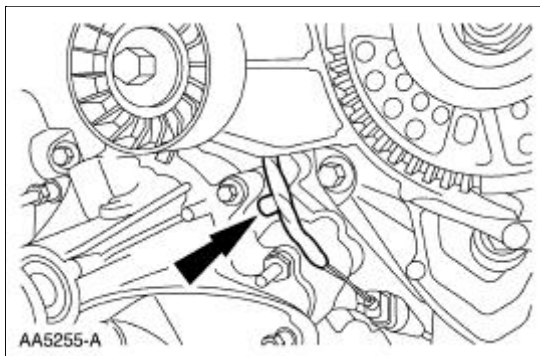
11. Disconnect the lower radiator hose.



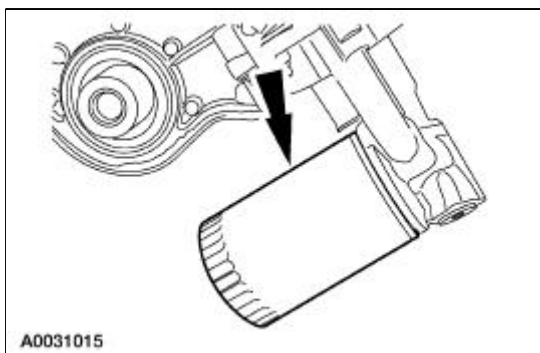
12. Disconnect the crankshaft position sensor electrical connector.



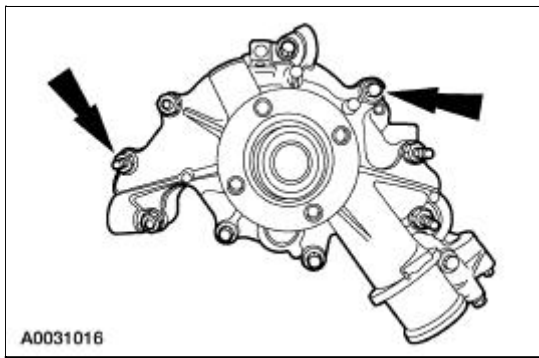
13. Remove the wiring harness pin-type retainer.



14. Remove the oil filter.



15. Remove the retainers and the water pump.

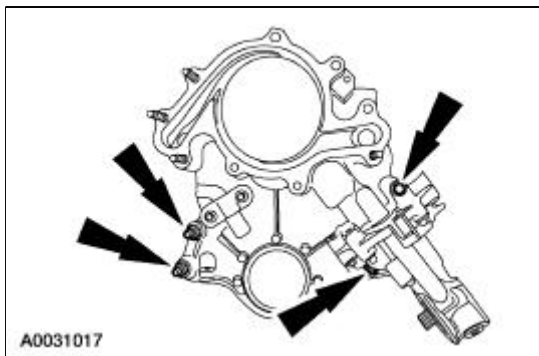


16.  **CAUTION:** The cap screw is hidden; make sure to remove it or the engine front cover will be damaged.


NOTE: Record the location, type and size of the fasteners.


Remove the engine front cover.

- Slide the engine front cover off the two dowels.
- Remove and discard the engine front cover gasket.



Installation

1.  **CAUTION:** In order to prevent foreign material from contaminating the engine block or the engine front cover it is necessary to seal the coolant and oil passages of both components. Failure to follow these directions will result in engine damage.

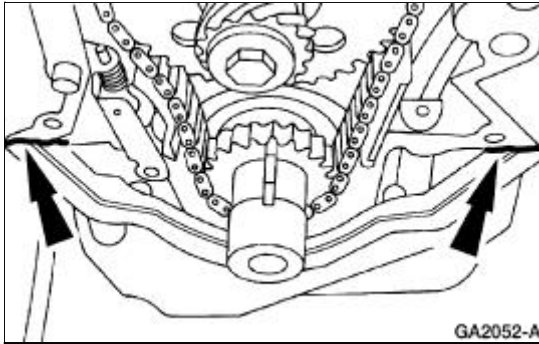
 **CAUTION:** Do not use a surface conditioning pad or any other type of fibrous abrasive disc to clean the gasket surfaces. Failure to follow these directions will result in engine damage.

Clean and inspect the engine block and front cover as follows:

- Pack the exposed portion of the oil pan with clean shop towels.
- Plug the oil and coolant passages.
- Clean the gasket surfaces.
- Clean all surfaces requiring gasket sealant with metal surface cleaner.
- Using compressed air, remove any remaining foreign material from the engine block and engine front cover.
- Remove the shop towels from the oil pan.
- Remove the plugs or seals from the engine block and engine front cover.

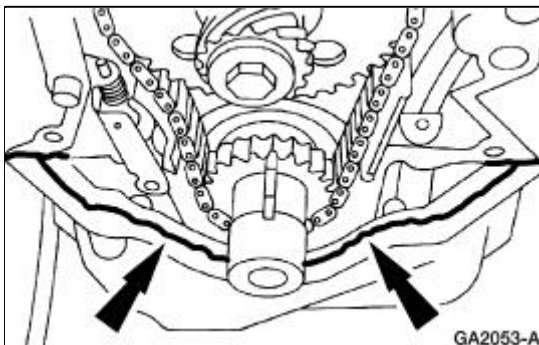
2. **NOTE:** If the engine front cover is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

Apply a small amount of silicone gasket and sealant as shown.

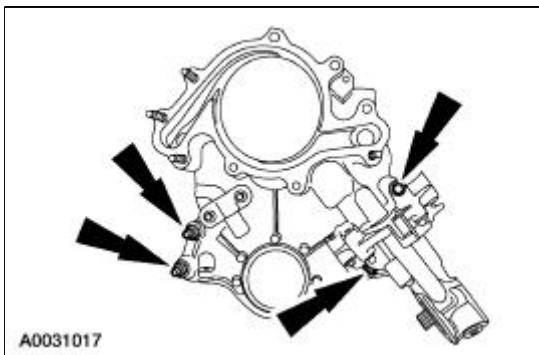


3. **NOTE:** If the engine front cover is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

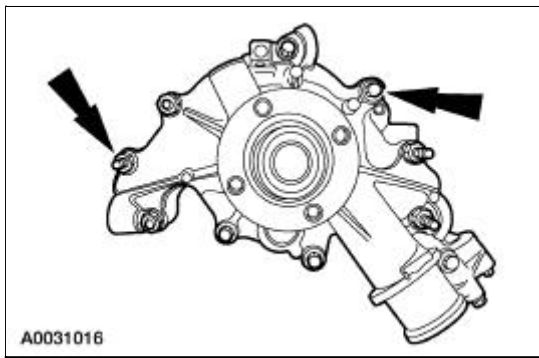
Install the engine front cover gasket and apply silicone gasket and sealant as shown.



4. Install the engine front cover and bolts.

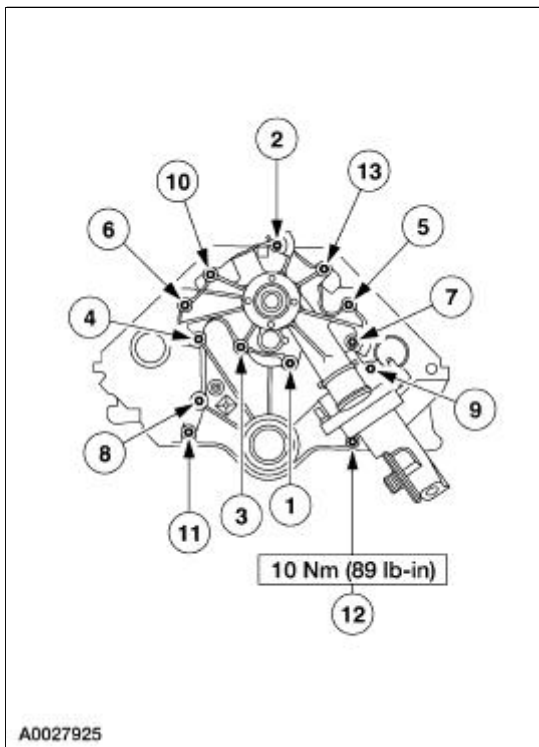


5. Install the water pump. Install the nuts and bolts.

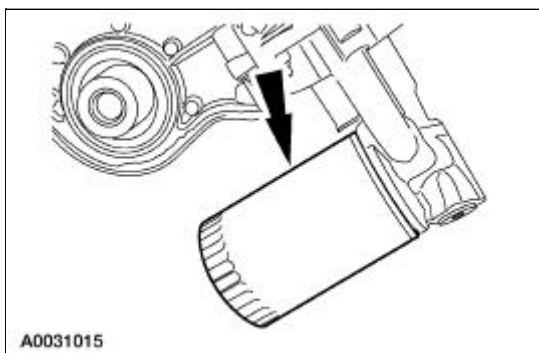


6. **NOTE:** The number 12 bolt is not part of the tightening sequence.

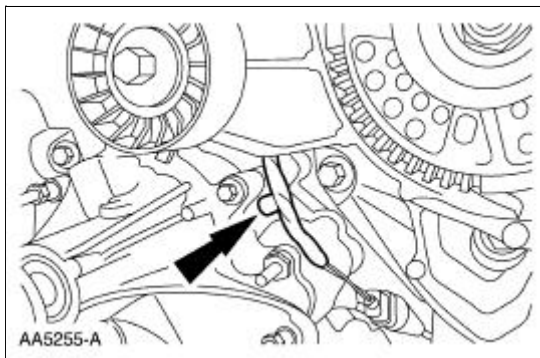
Tighten the fasteners to 26 Nm (19 lb-ft) in the sequence shown.



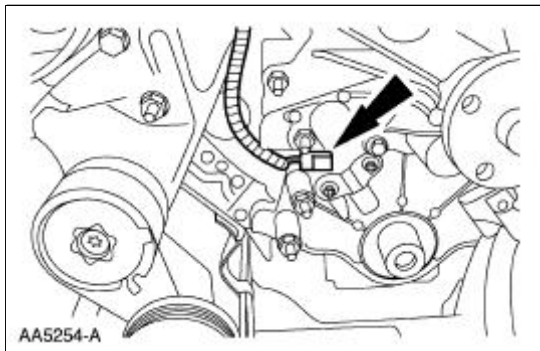
7. Install a new oil filter.



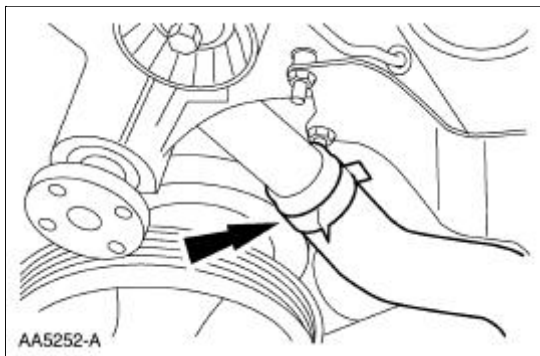
8. Install the wiring harness pin-type retainer.



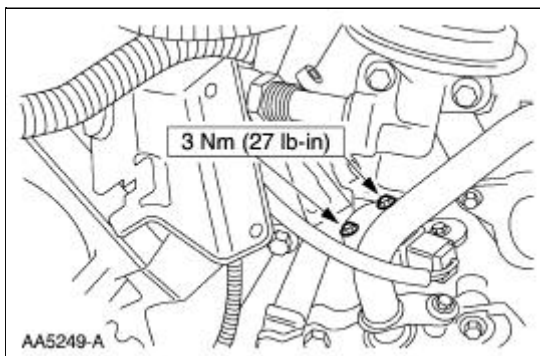
9. Connect the crankshaft position sensor electrical connector.



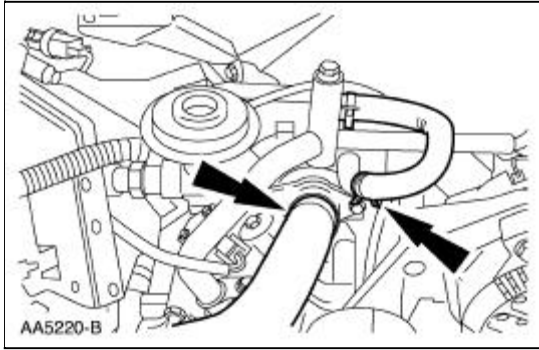
10. Connect the lower radiator hose.



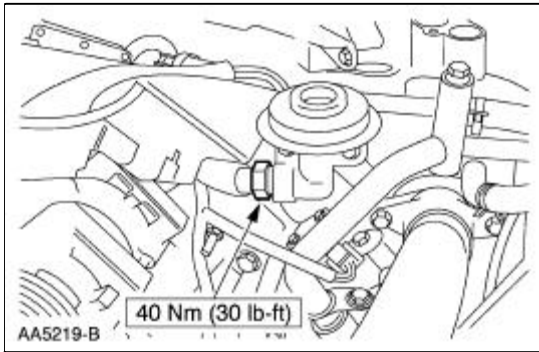
11. Install the camshaft synchronizer assembly. For additional information, refer to [Section 303-14](#).
12. Install the heater water outlet tube. For additional information, refer to [Section 303-13](#).
13. Install the camshaft position (CMP) sensor, and connect the electrical connector.



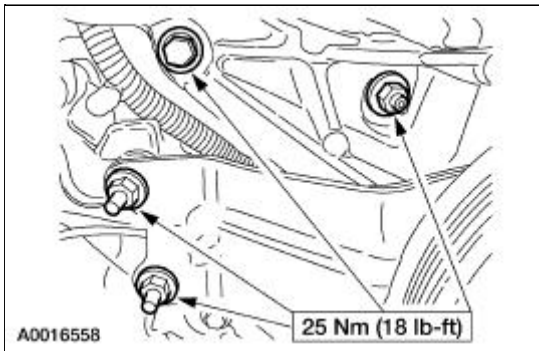
14. Connect the bypass hose and the upper radiator hose.



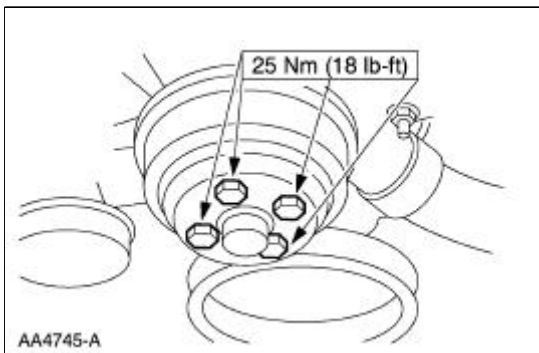
15. Connect the EGR tube.



16. Install the power steering pump.



17. Install the water pump pulley.



18. Install the crankshaft pulley. For additional information, refer to [Crankshaft Pulley](#) in this section.

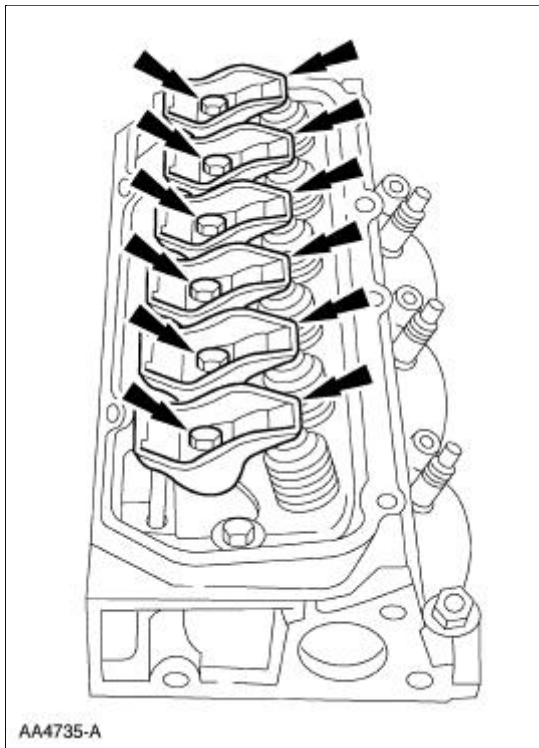
19. Drain the engine oil and fill with clean engine oil.
 20. Fill the engine cooling system. For additional information, refer to [Section 303-03A](#).
 21. Connect the battery ground cable. For additional information, refer to [Section 414-01](#).
-

Rocker Arm

Removal

 **CAUTION:** If removing more than one rocker arm (6564), mark the components removed for correct location.

1. Remove the valve covers. For additional information, refer to [Valve Cover—LH](#) and [Valve Cover RH](#) in this section.
2. Remove the rocker arm assembly.
 - Remove the bolt.



Installation

1. Install the rocker arms, tighten the bolts in two stages.
 - Stage 1: tighten to 5 Nm (44-lb-in).
 - Stage 2: tighten to 35 Nm (26 lb-ft).
2. Install the valve covers. For additional information, refer to [Valve Cover—LH](#) and [Valve Cover RH](#) in this section.

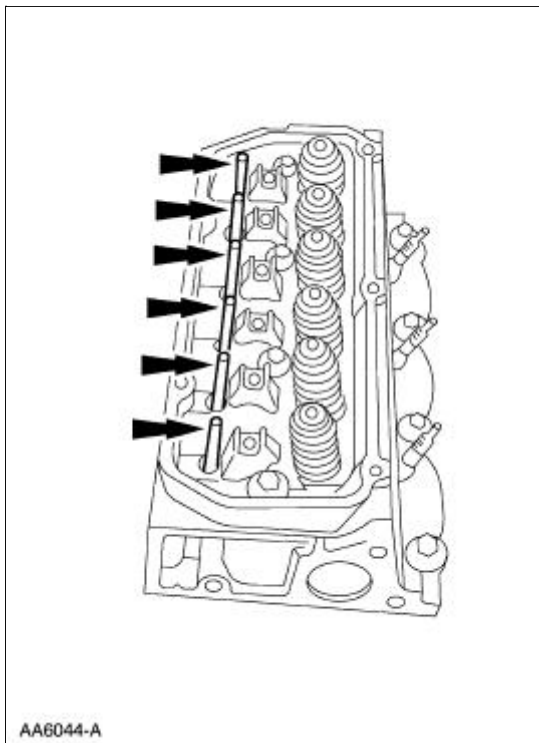
Push Rod

Removal



CAUTION: Mark the components removed for correct location.

1. Remove the rocker arms (6564). For additional information, refer to [Rocker Arm](#) in this section.
2. Remove the push rods (6565).



3. Inspect the components. For additional information, refer to [Section 303-00](#).

Installation

1. To install, reverse the removal procedure.

Valve Springs


Special Tool(s)

 ST1383-A	Compressor, Valve Spring 303-163 (T81P-6513-A)
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Material

Item	Specification
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

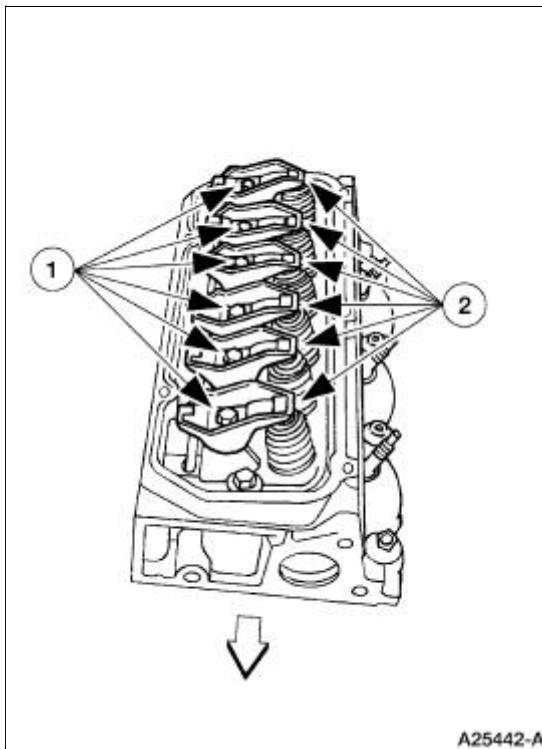
Removal

1. Remove the LH and the RH valve covers. For additional information, refer to [Valve Cover—LH](#) and [Valve Cover RH](#) in this section.
2. Rotate the crankshaft until the piston for the valve being worked on is at the top of its stroke with both the intake valve and the exhaust valve closed.
3. Hold the valve in the cylinder head.
 - Remove the spark plug. For additional information, refer to [Section 303-07A](#).
 - Apply a minimum of 965 kPa (140 psi) of compressed air into the cylinder.
4.  **CAUTION: If the components are to be reinstalled, they must be installed in the same position. Mark the components for location.**

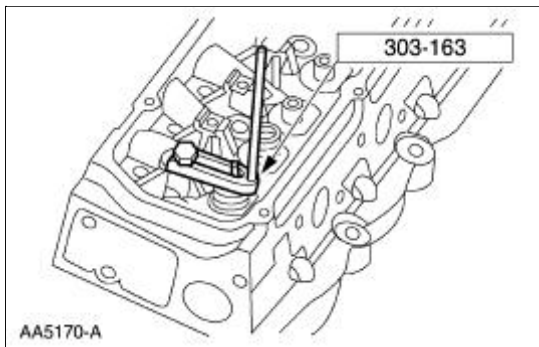
NOTE: If a valve drops into the cylinder, remove the cylinder head. For additional information, refer to [Cylinder Head LH](#) or [Cylinder Head RH](#) in this section.

Remove the rocker arms.

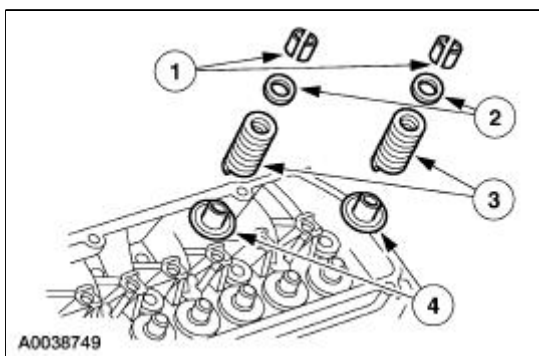
1. Remove the bolts.
2. Remove the rocker arms.



5. Using the special tool, compress the valve springs.



6. Remove the valve spring assembly.
 1. Remove the valve spring retainer key.
 2. Remove the valve spring retainer.
 3. Remove the valve spring.
 4. Remove and discard the valve stem seal and spring seat assembly.



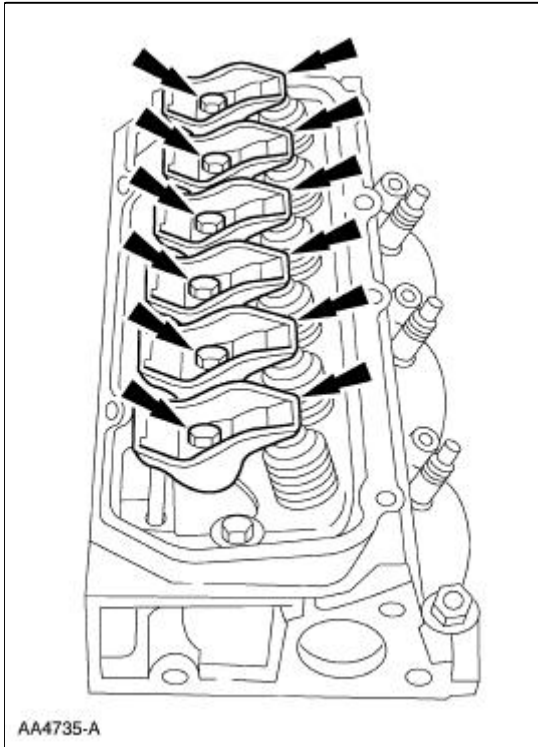
7. Inspect the components. For additional information, refer to [Section 303-00](#).

Installation

1. **NOTE:** Lubricate the parts with clean engine oil.

To install, reverse the removal procedure. Tighten the rocker arm bolts in two stages.

- Stage 1: Tighten to 5 Nm (44 lb-in).
- Stage 2: Tighten to 35 Nm (26 lb-ft).



Valve Tappets

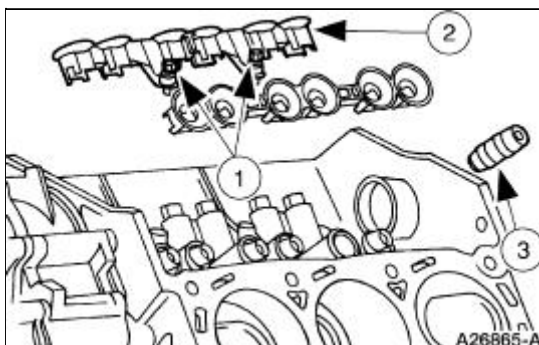
Material

Item	Specification
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

 **CAUTION:** If removing more than one valve tappet, mark the components removed for correct location.

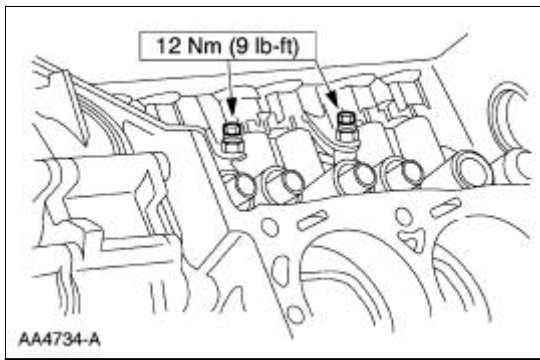
1. Remove the lower intake manifold. For additional information, refer to [Lower Intake Manifold](#) in this section.
2. Remove the push rods. For additional information, refer to [Push Rod](#).
3. Remove the eight valve tappets.
 1. Remove the bolts.
 2. Remove the tappet guide plate and retainer.
 3. Remove the valve tappets.



Installation

1. **NOTE:** Lubricate the valve tappet with clean engine oil before installing.

To install, reverse the removal procedure.



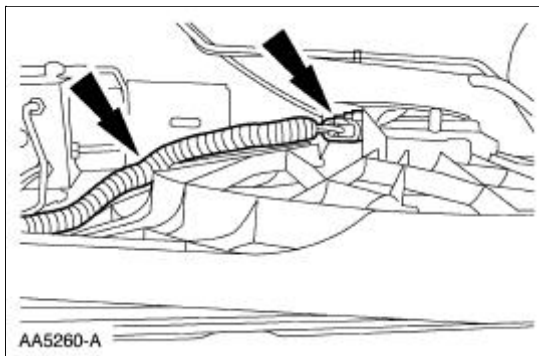
Camshaft

Material

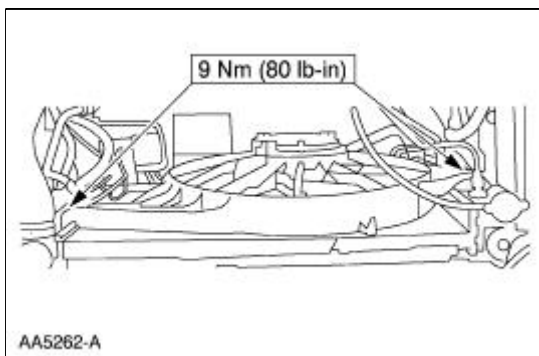
Item	Specification
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

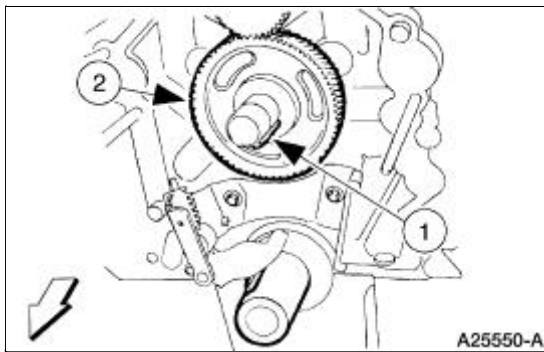
1. Remove the valve tappets. For additional information, refer to [Valve Tappets](#) in this section.
2. Remove the timing chain. For additional information, refer to [Timing Chain](#) in this section.
3. Position the wire harness aside.



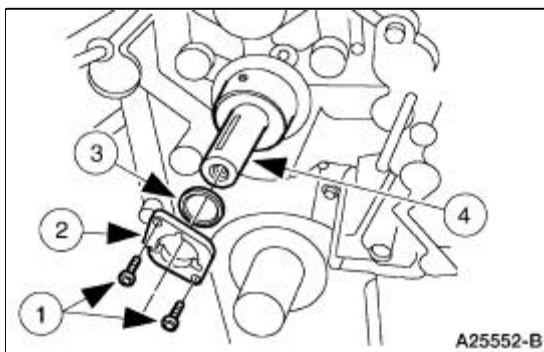
4. Remove the radiator fan and shroud assembly.



5. Remove the engine balance shaft drive gear from the camshaft.
 1. Remove the camshaft key.
 2. Remove the engine balance shaft drive gear.



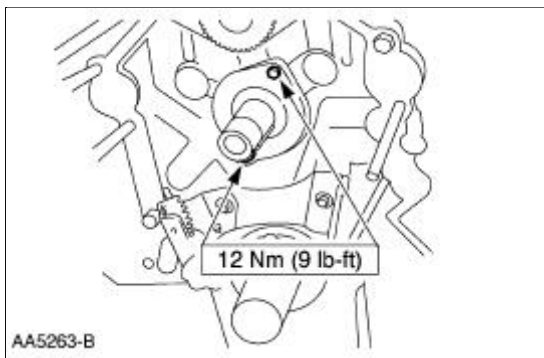
6. Remove the camshaft.
 1. Remove the bolts.
 2. Remove the camshaft thrust plate.
 3. Remove the spacer.
 4. Remove the camshaft.



Installation

1. **NOTE:** Lubricate the camshaft with clean engine oil prior to installation.

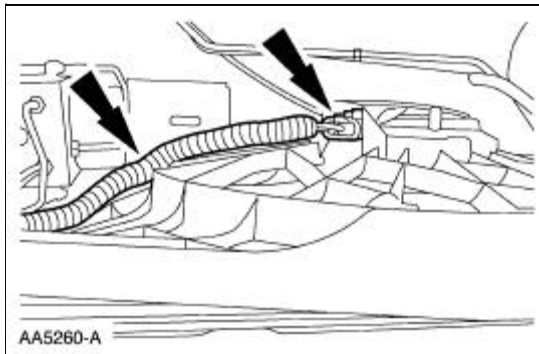
To install, reverse the removal procedure.



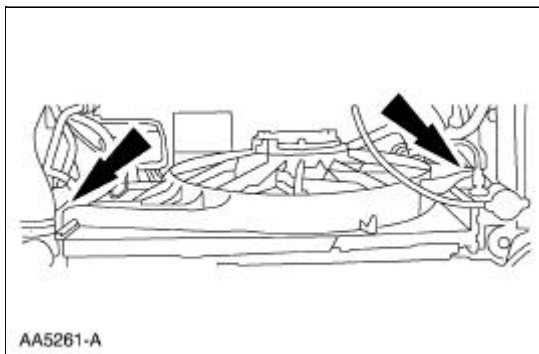
Engine Dynamic Balance Shaft

Removal

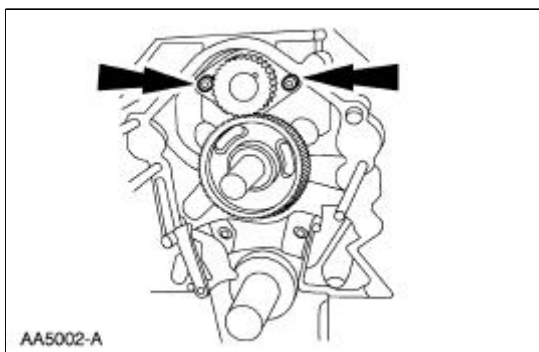
1. Remove the timing chain (6268). For additional information, refer to [Timing Chain](#) in this section.
2. Disconnect and position the wire harness aside.



3. Remove the radiator fan and shroud assembly (8146).

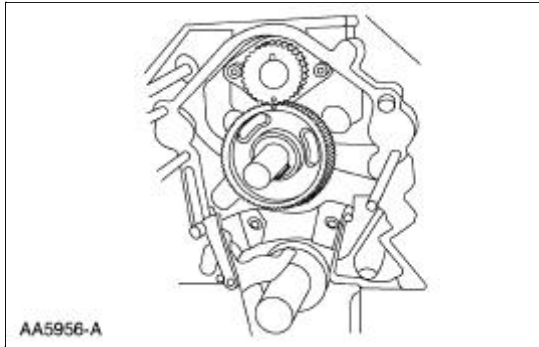


4. Remove the engine dynamic balance shaft (6A311).
 - Remove the bolts.
 - Remove the balance shaft driver gear, thrust plate and engine dynamic balance shaft as an assembly.



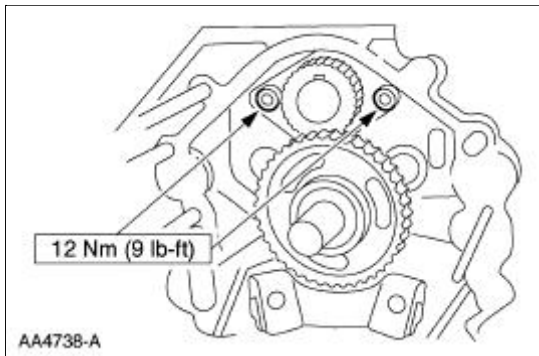
Installation

1. Turn the camshaft so that the timing mark is at 12 o'clock and install the engine dynamic balance shaft assembly into the cylinder block (6010). Turn the engine balance shaft driven gear so that the timing mark lines up with the timing mark on the engine balance shaft drive gear (6A303).

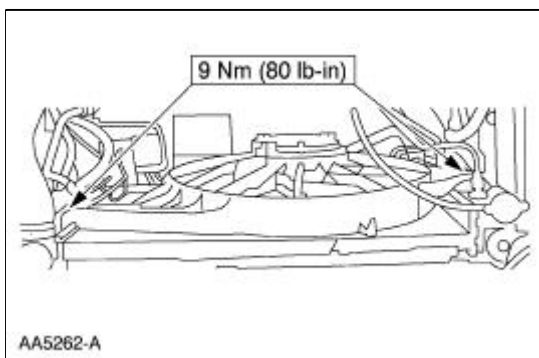


2. **NOTE:** If correctly aligned, the engine dynamic balance shaft keyway will be at 12 o'clock and the camshaft keyway will be at 6 o'clock on the camshaft.

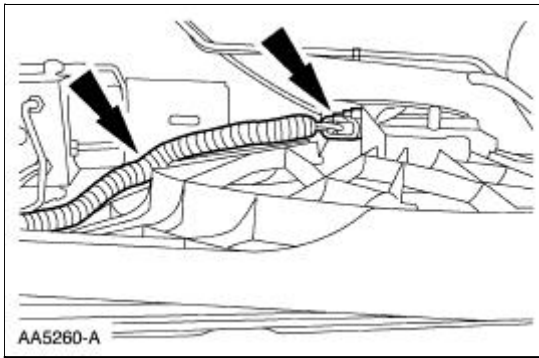
Install the bolts.



3. Install the radiator fan and shroud assembly.



4. Connect the connector and install the pin-type retainer.

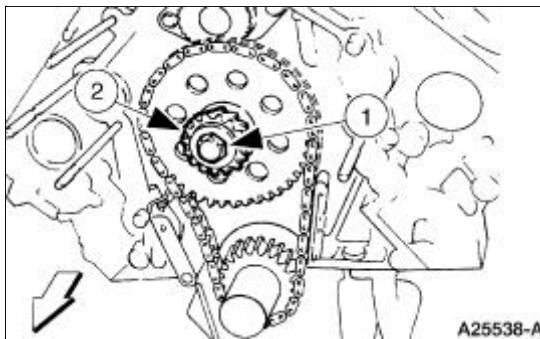


5. Install the timing chain. For additional information, refer to [Timing Chain](#) in this section.
-

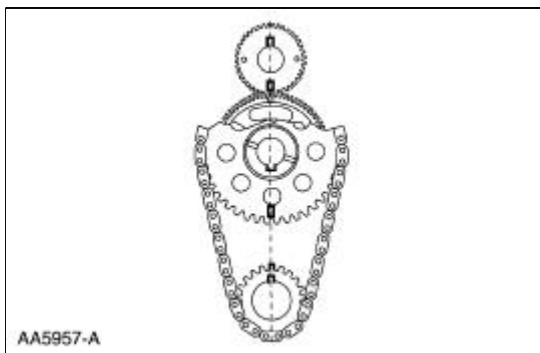
Timing Chain

Removal

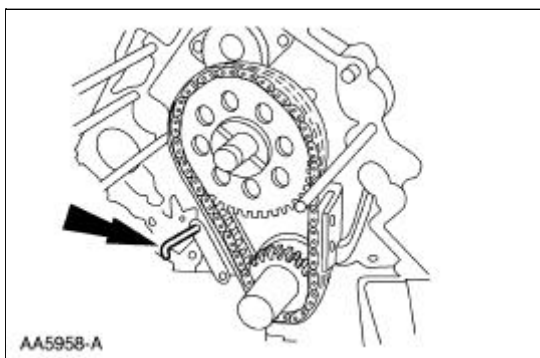
1. Remove the timing cover. For additional information, refer to [Engine Front Cover](#) in this section.
2. Remove the camshaft position sensor drive gear.
 1. Remove the bolt.
 2. Remove the camshaft position sensor drive gear.



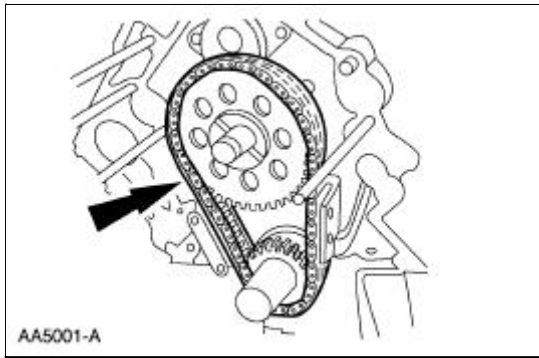
3. Rotate the crankshaft (6303) until the timing marks and keyways align.



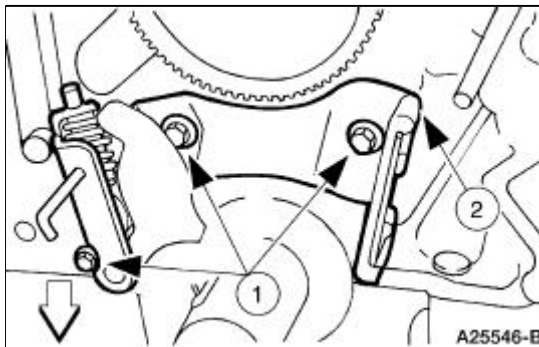
4. Compress and install a retaining pin to hold the timing chain tensioner (6L266).



5. Remove the camshaft sprocket (6256), the crankshaft sprocket (6306) and the timing chain/belt (6268) as an assembly.

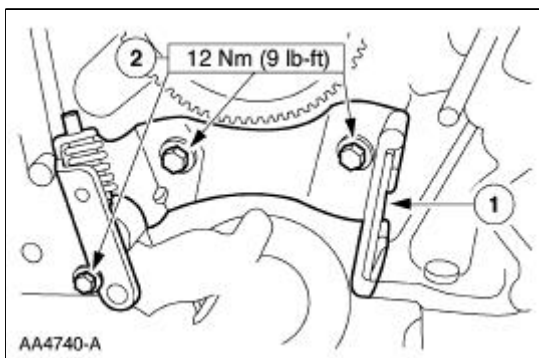


6. Remove the timing chain tensioner.
 1. Remove the bolts.
 2. Remove the timing chain tensioner.

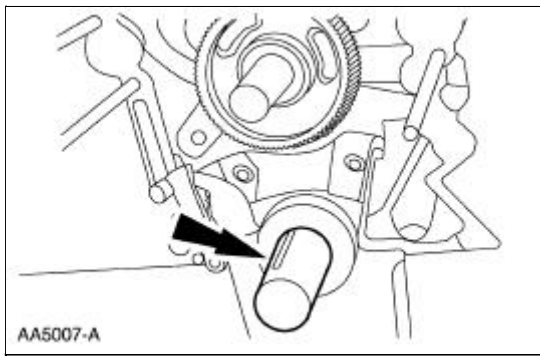


Installation

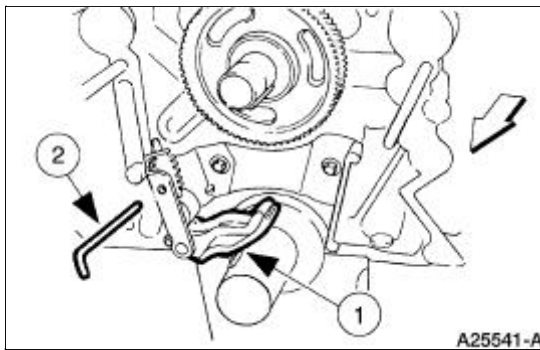
1. Install the timing chain tensioner.
 1. Position the timing chain tensioner.
 2. Install the bolts.



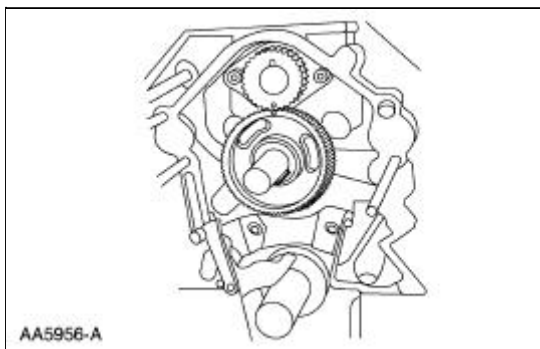
2. Rotate the crankshaft so the number one piston (6108) is at top dead center (TDC) and the key is at the 12 o'clock position.



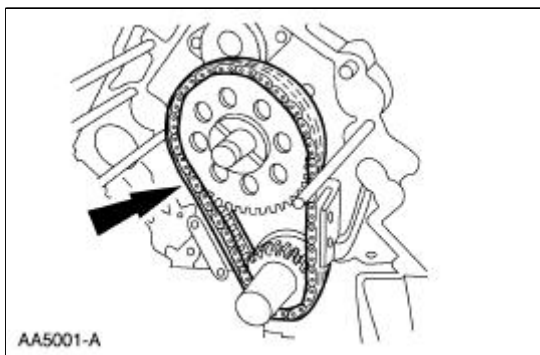
3. If necessary, retract the tensioner pad retracting mechanism.
 1. Compress the tensioner pad retracting mechanism.
 2. Insert a retaining pin.



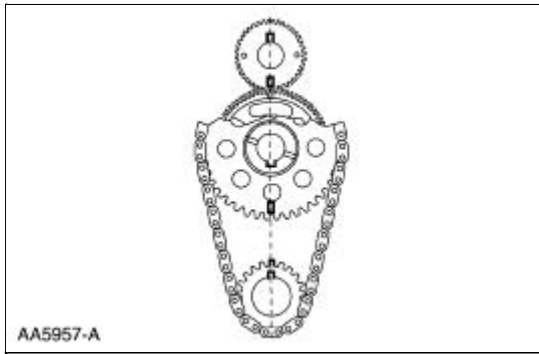
4. Turn the camshaft sprocket so that the timing mark is on the bottom of the balance shaft (6250).



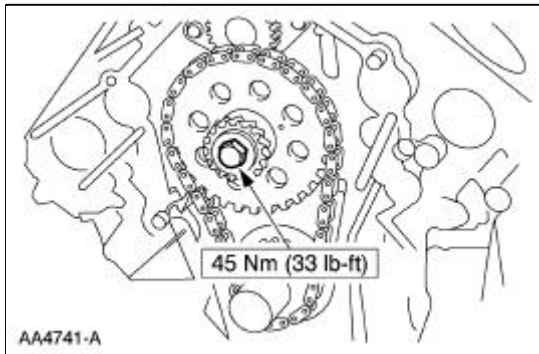
5. Install the timing chain, the camshaft sprocket and the crankshaft sprocket.



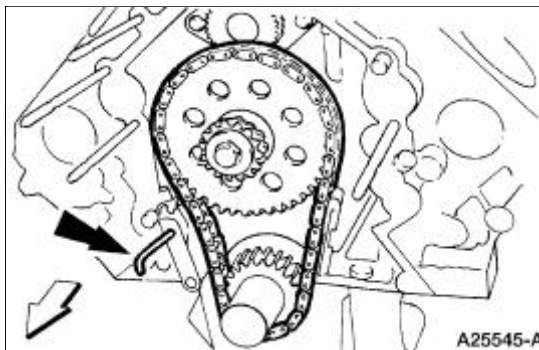
6. Make sure that the timing marks and the keyways are aligned.



7. Install the camshaft position sensor drive gear.



8. Remove the retaining pin.

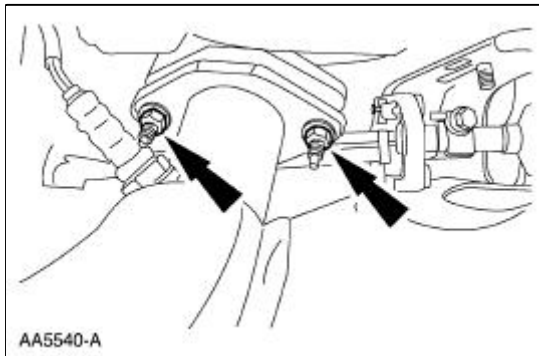


9. Install the engine front cover. For additional information, refer to [Engine Front Cover](#) in this section.
-

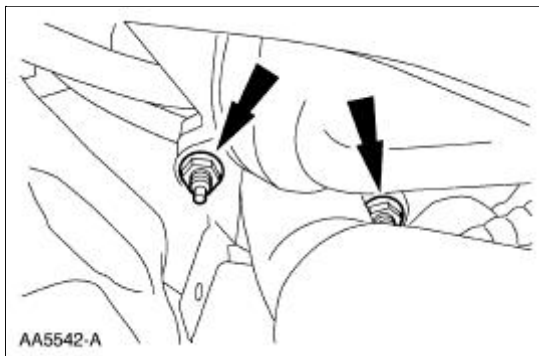
Exhaust Manifold —LH

Removal

1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Remove the LH exhaust manifold flange nuts.



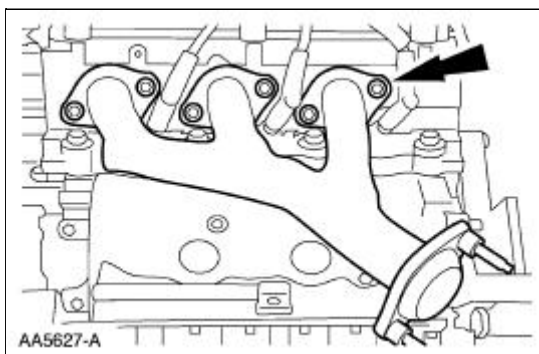
3. Remove the RH exhaust manifold flange nuts.



4. Lower the vehicle.
5. **NOTE:** Discard the exhaust manifold gasket.

Remove the LH exhaust manifold (9431).

- Remove the nuts.

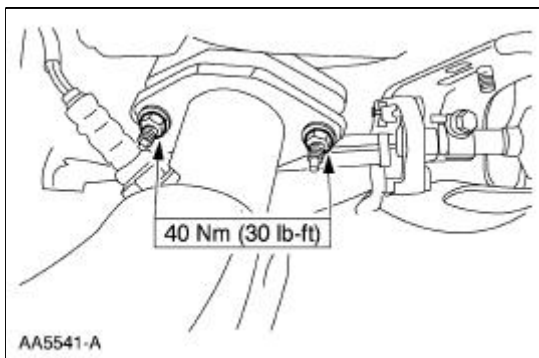
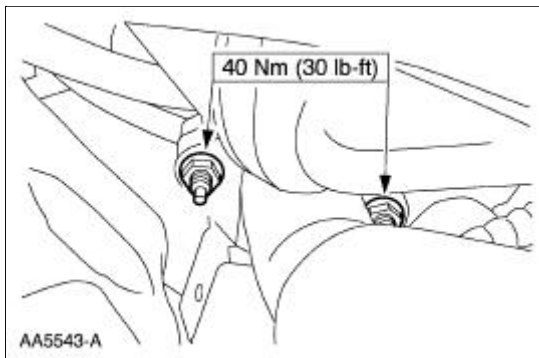
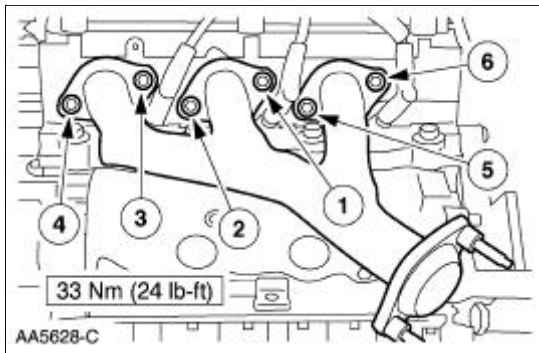


Installation

1. **NOTE:** Install a new gasket.

NOTE: Tighten the nuts in the sequence shown.

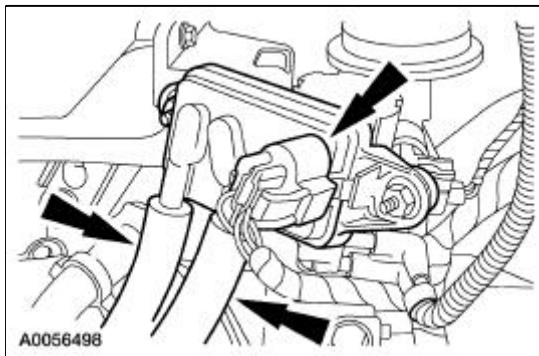
To install, reverse the removal procedure.



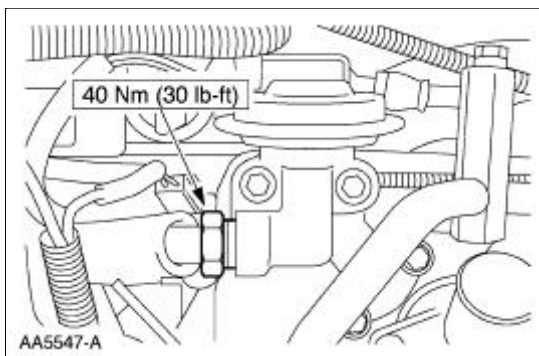
Exhaust Manifold RH

Removal and Installation

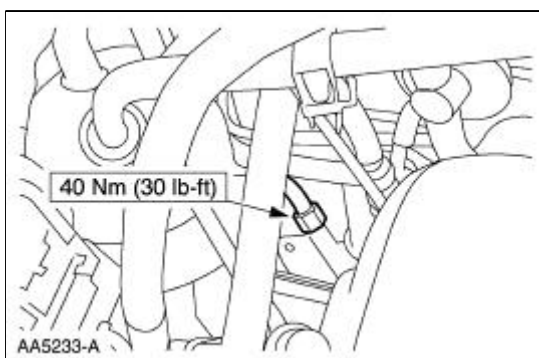
1. Disconnect the battery negative cable. For additional information, refer to [Section 414-01](#).
2. Remove the air cleaner outlet pipe. For additional information, refer to [Section 303-12](#).
3. Disconnect the differential pressure feedback exhaust gas recirculation (EGR) system electrical and vacuum connections.



4. Disconnect the EGR tube.

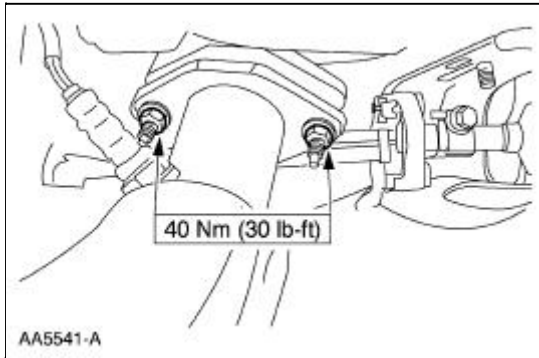


5. Remove the EGR tube.

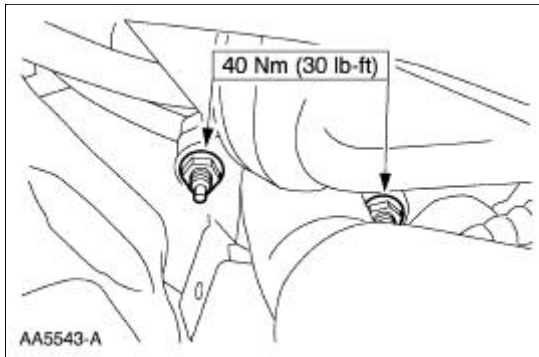


6. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).

7. Remove the LH exhaust manifold flange nuts.

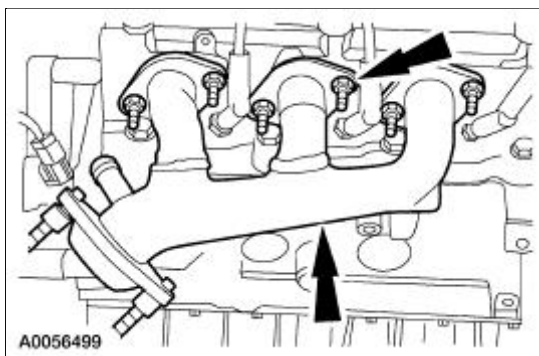


8. Remove the RH exhaust manifold flange nuts.

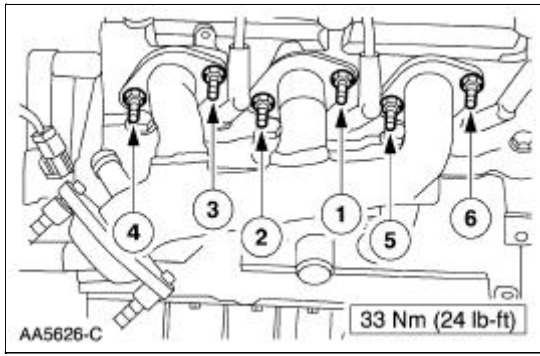


9. Lower the vehicle.
10. **NOTE:** Discard the exhaust manifold gasket.

Remove the RH exhaust manifold retaining nuts and the RH exhaust manifold.





11. To install, reverse the removal procedure. Tighten the exhaust manifold nuts in the sequence shown.



Cylinder Head LH

Special Tool(s)

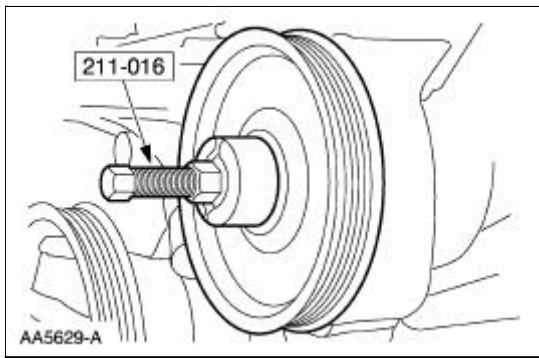
 ST1290-B	Remover, Power Steering Pump Pulley 211-016 (T69L-10300-B)
	Installer, Power Steering Pump Pulley 211-009

Material

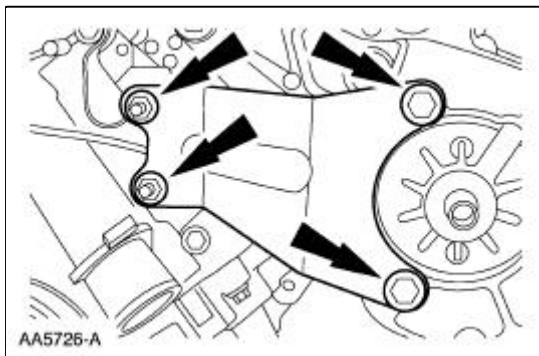
Item	Specification
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

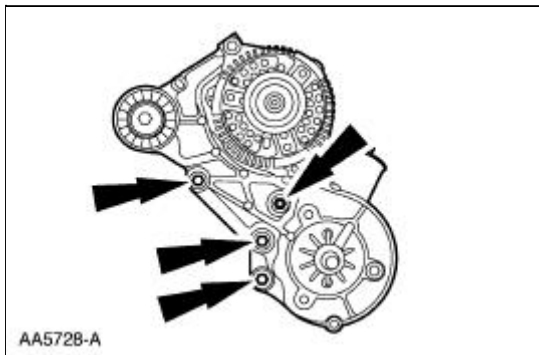
1. Disconnect the battery negative cable. For additional information, refer to [Section 414-01](#).
2. Drain the engine cooling system. For additional information, refer to [Section 303-03A](#).
3. Remove the LH exhaust manifold. For additional information, refer to [Exhaust Manifold—LH](#) in this section.
4. Remove the lower intake manifold. For additional information, refer to [Lower Intake Manifold](#) in this section.
5. Remove the push rods. For additional information, refer to [Push Rod](#) in this section.
6. Remove the drive belt. For additional information, refer to [Section 303-05](#).
7. Using the special tool, remove the power steering pump pulley.



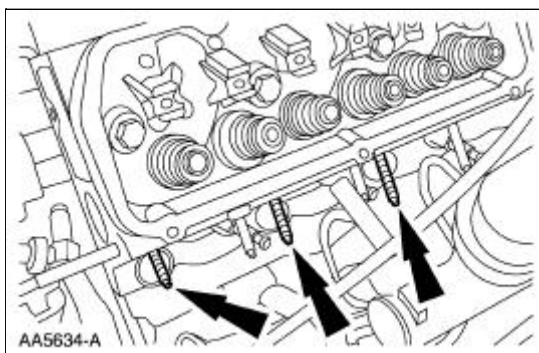
8. Remove the power steering pump bracket.



9. Remove the generator bracket.



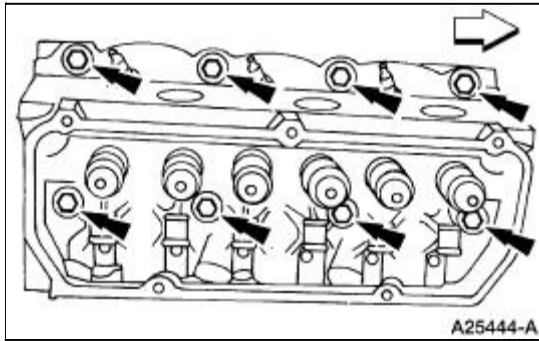
10. Remove the three exhaust manifold studs.



11. **NOTE:** Discard the cylinder head gasket.

NOTE: Record the location of the long bolts and the short bolts.

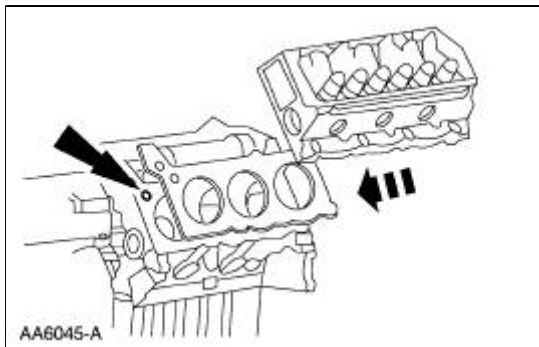
Remove the cylinder head. Discard the cylinder head bolts.



Installation

NOTE: Do not use a fiber disc to clean the surfaces. Fibers from the disc can get into the oil pan and oil and clog the oil bypass valve.

1. Clean and inspect the cylinder head for flatness. For additional information, refer to [Section 303-00](#).
2. Install a new head gasket on the cylinder block with the small hole to the front of the engine.
3. Position the cylinder head.

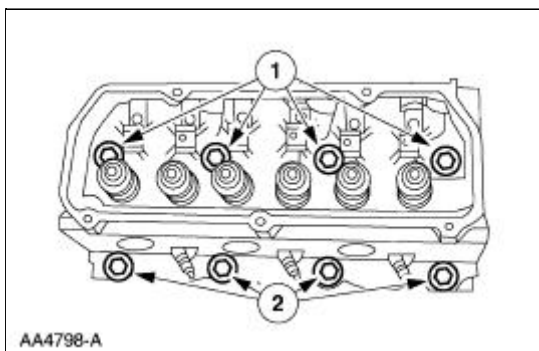


4.  **CAUTION: Always use new bolts.**

NOTE: Lubricate the bolts with clean engine oil.

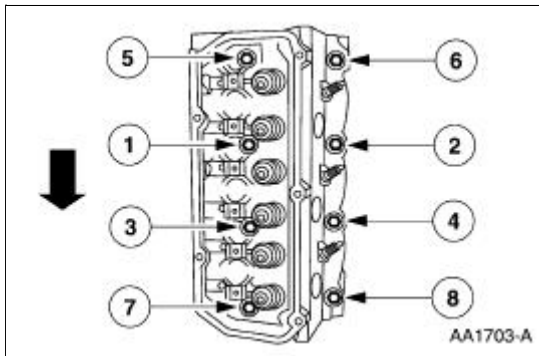
Install new bolts. Refer to the location note made during removal and make sure the bolts are installed the correct location.


1. Install the new long bolts.
2. Install the new short bolts.



5. Tighten the bolts in three stages in the sequence shown.

- Stage 1: Tighten the bolts to 20 Nm (15 lb-ft).
- Stage 2: Tighten the bolts to 40 Nm (30 lb-ft).
- Stage 3: Tighten the bolts to 50 Nm (37 lb-ft).

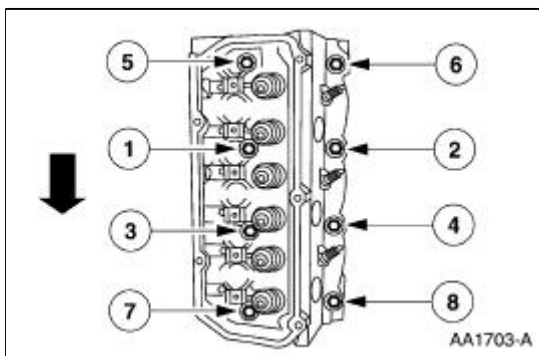


6.  **CAUTION: Do not loosen all of the bolts at one time. Each bolt must be loosened and final-tightened prior to working on the next bolt in the sequence.**

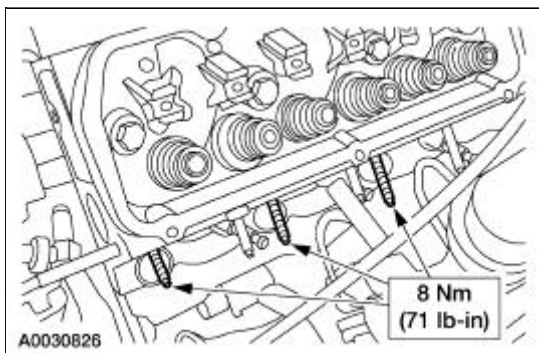
NOTE: The short bolts are numbered 2, 4, 6 and 8 and the long bolts numbered 1, 3, 5 and 7.

Loosen, then tighten the bolts in two stages in the sequence shown.

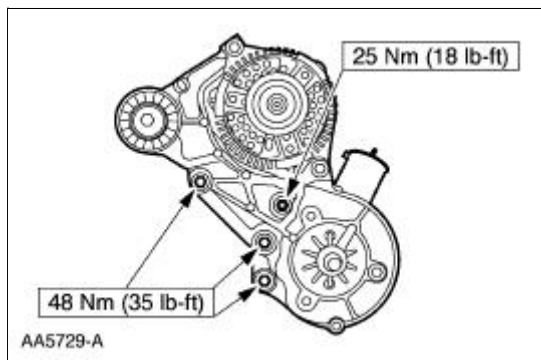
- Stage 1: Tighten short bolts to 25 Nm (18 lb-ft), then tighten an additional 180 degrees.
- Stage 2: Tighten long bolts to 45 Nm (33 lb-ft), then tighten an additional 180 degrees.



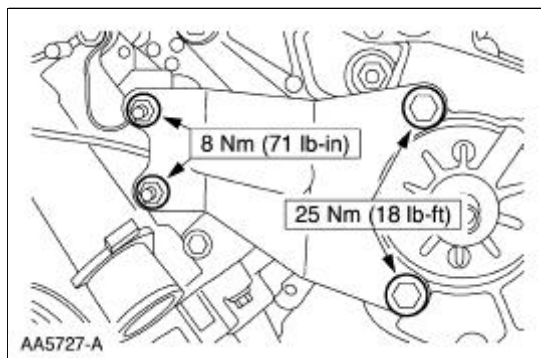
7. Install the exhaust manifold studs.



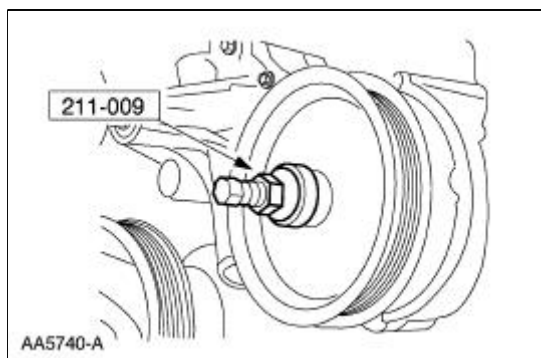
8. Install the bracket and bolts.




9. Install the support bracket.



10. Using the special tool, install the power steering pump pulley.



11. Install the drive belt. For additional information, refer to [Section 303-05](#).
12. Install the push rods. For additional information, refer to [Push Rod](#) in this section.
13. Install the lower intake manifold. For additional information, refer to [Lower Intake Manifold](#) in this section.
14. Install the LH exhaust manifold. For additional information, refer to [Exhaust Manifold—LH](#) in this section.
15. Connect the battery ground cable. For additional information, refer to [Section 414-01](#).
16.  **CAUTION: Correct cooling system bleeding is critical for correct engine cooling.**
Fill and bleed the engine cooling system. For additional information, refer to [Section 303-03A](#).

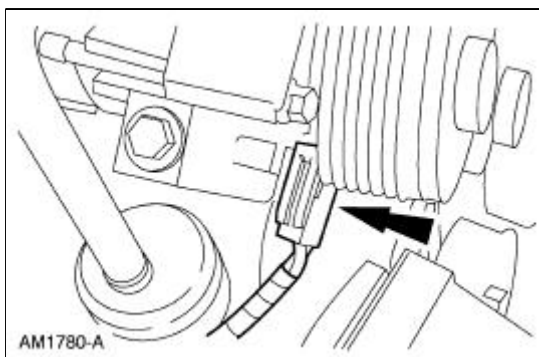
Cylinder Head RH

Material

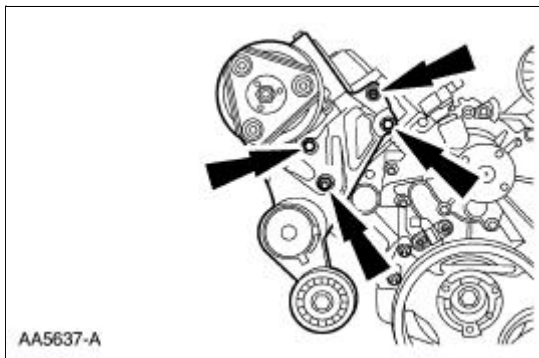
Item	Specification
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

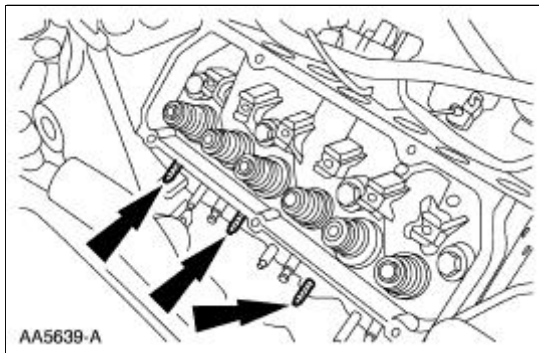
1. Disconnect the battery negative cable. For additional information, refer to [Section 414-01](#).
2. Drain the engine cooling system. For additional information, refer to [Section 303-03A](#).
3. Remove the RH exhaust manifold. For additional information, refer to [Exhaust Manifold RH](#) in this section.
4. Remove the lower intake manifold. For additional information, refer to [Lower Intake Manifold](#) in this section.
5. Remove the push rods. For additional information, refer to [Push Rod](#) in this section.
6. Remove the drive belt. For additional information, refer to [Section 303-05](#).
7. Disconnect the A/C manifold and tube assembly. For additional information, refer to [Section 412-03](#).
8. Disconnect the A/C compressor clutch electrical connector.



9. Remove the A/C compressor bracket.



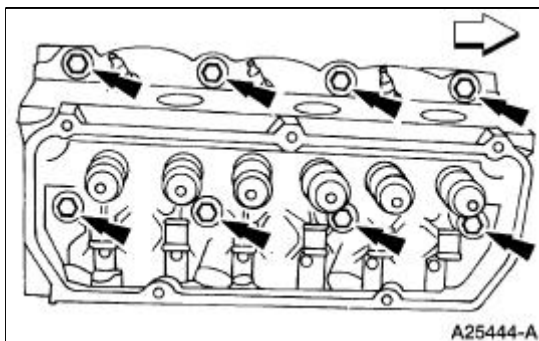
10. Remove the three exhaust manifold studs.



11. **NOTE:** Discard the cylinder head gasket.

NOTE: Record the location of the long bolts and the short bolts.

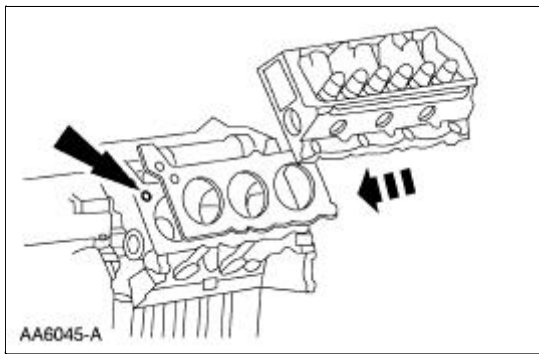
Remove the cylinder head. Discard the cylinder head bolts.



Installation

NOTE: Do not use a fiber disc to clean the surfaces. Fibers from the disc can get into the oil pan and oil and clog the oil bypass valve.

1. Clean and inspect the cylinder head for flatness. For additional information, refer to [Section 303-00](#).
2. Install a new head gasket on the cylinder block with the small hole to the front of the engine and position the cylinder head.

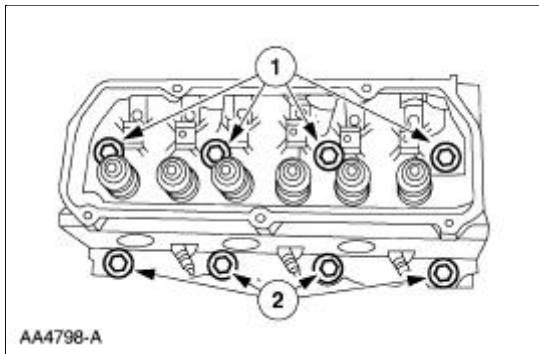


3.  **CAUTION: Always use new bolts.**

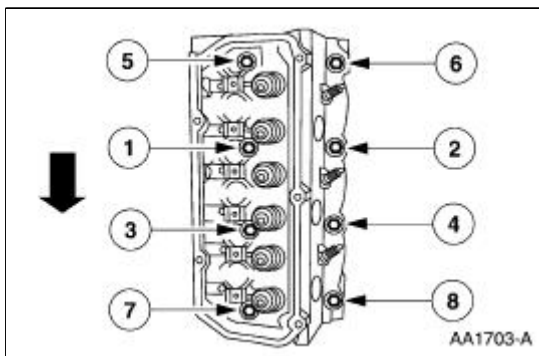
NOTE: Lubricate the bolts with clean engine oil.

Install new bolts. Refer to the location note made during removal and make sure the bolts are installed the correct location.

1. Install the new long bolts.
2. Install the new short bolts.



4. Tighten the bolts in three stages in the sequence shown.
- Stage 1: Tighten to 20 Nm (15 lb-ft).
 - Stage 2: Tighten to 40 Nm (30 lb-ft).
 - Stage 3: Tighten to 50 Nm (37 lb-ft).

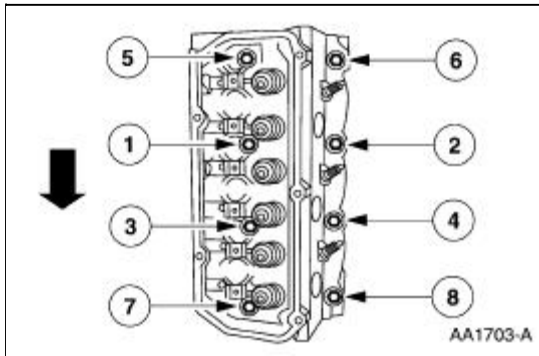


5.  **CAUTION: Do not loosen all of the bolts at one time. Each bolt must be loosened and final-tightened prior to working on the next bolt in the sequence.**

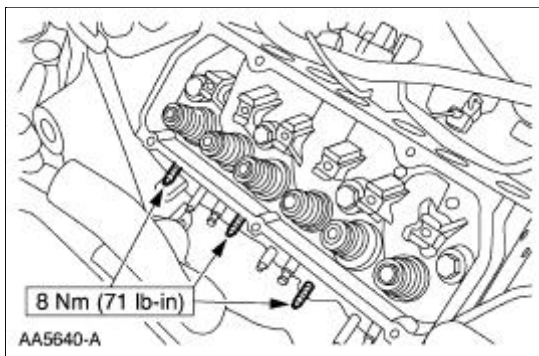
NOTE: The short bolts are numbered 2, 4, 6 and 8 and the long bolts are numbered 1, 3, 5 and 7.

Loosen, then tighten the bolts in the sequence shown:

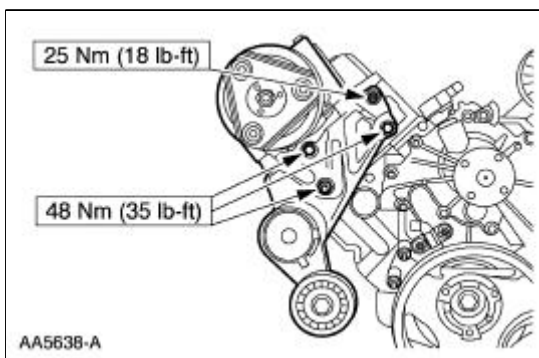
- Tighten short bolts to 25 Nm (18 lb-ft), then tighten an additional 180 degrees.
- Tighten long bolts to 45 Nm (33 lb-ft), then tighten an additional 180 degrees.



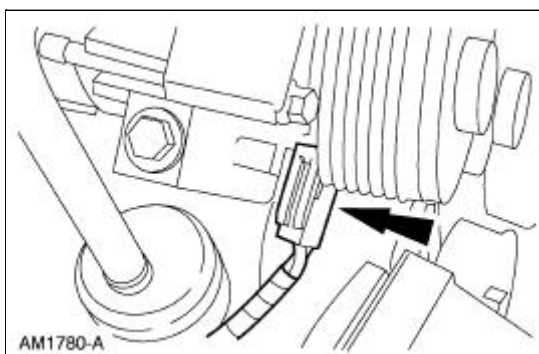
6. Install the three studs.




7. Install the bracket and bolts.



8. Connect the A/C compressor clutch electrical connector.

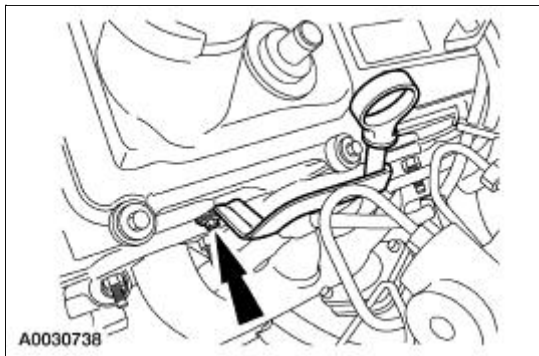


9. Connect the A/C manifold and tube assembly. For additional information, refer to [Section 412-03](#).
 10. Install the accessory drive belt. For additional information, refer to [Section 303-05](#).
 11. Install the push rods. For additional information, refer to [Push Rod](#) in this section.
 12. Install the lower intake manifold. For additional information, refer to [Lower Intake Manifold](#) in this section.
 13. Install the RH exhaust manifold. For additional information, refer to [Exhaust Manifold RH](#) in this section.
 14. Connect the battery ground cable. For additional information, refer to [Section 414-01](#).
 15.  **CAUTION: Correct cooling system bleeding is critical for correct engine cooling.**
Fill and bleed the engine cooling system. For additional information, refer to [Section 303-03A](#).
 16. Recharge the A/C refrigerant system. For additional information, refer to [Section 412-00](#).
-

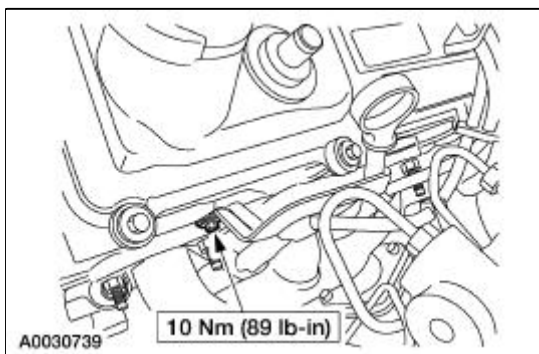
Oil Level Indicator and Tube

Removal and Installation

1. Remove the oil level indicator tube (6754).
 - Remove the bolt.
 - Remove the oil level indicator tube.
 - Remove and discard the oil level indicator tube O-ring.





2. To install, reverse the removal procedure.



Oil Pan

Special Tool(s)

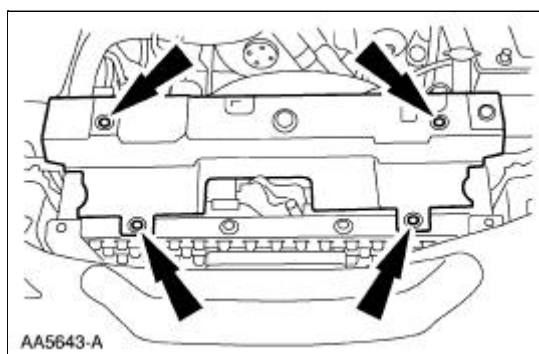
 <p>ST2333-A</p>	<p>3 Bar Engine Support Kit 303-F072</p>
 <p>ST2375-A</p>	<p>Lifting Bracket Set, Engine 303-D095 (D94L-6001-A) or equivalent</p>

Material

Item	Specification
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4

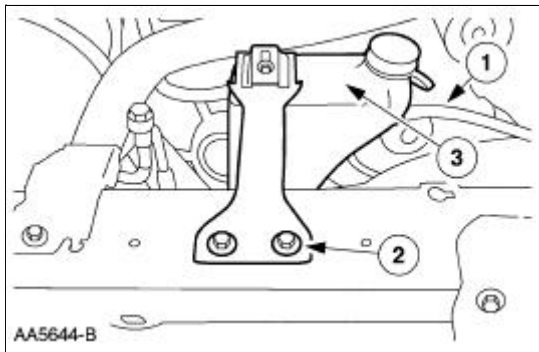
Removal

1. Disconnect the battery ground cable.
2. Remove the air cleaner outlet pipe. For additional information, refer to [Section 303-12](#).
3. Remove the radiator sight shield.

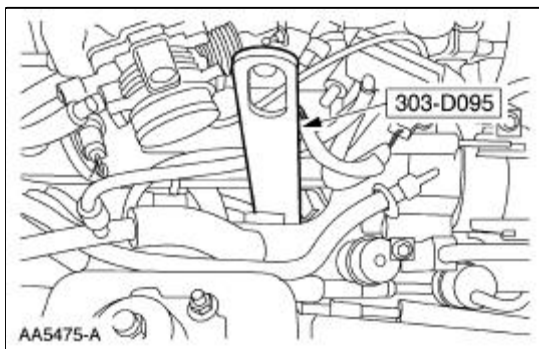


4. Remove the coolant recovery reservoir.
 1. Disconnect the hose.

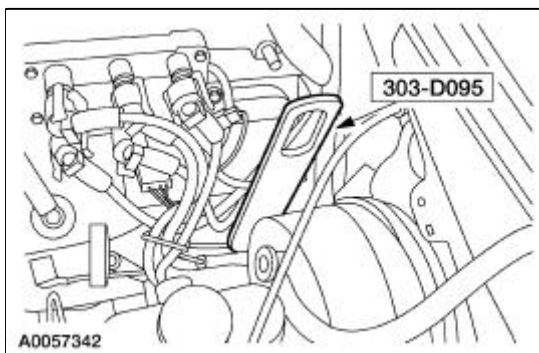
2. Remove the bolts.
3. Remove the coolant recovery reservoir.



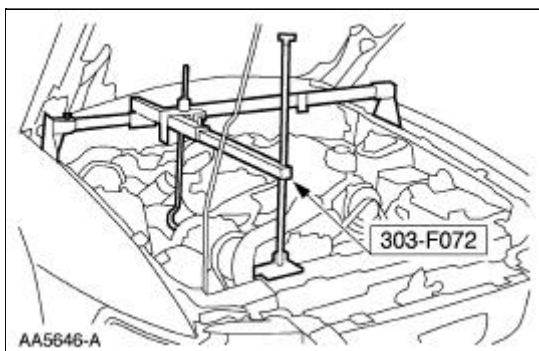
5. Install the special tool.



6. Install the special tool.

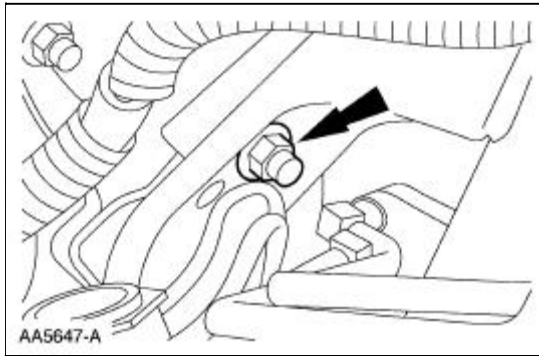


7. Install the special tool.

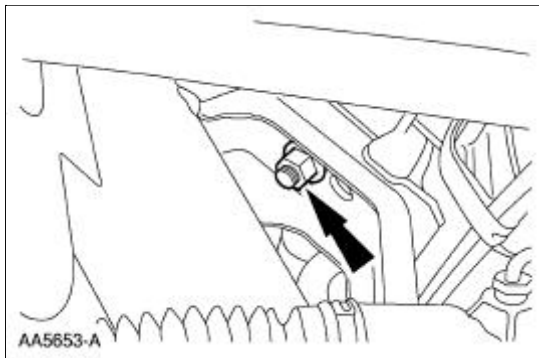


8. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).

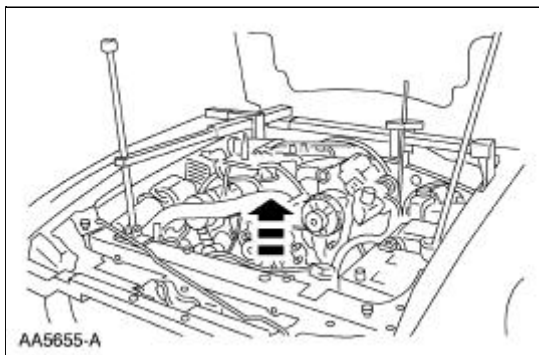
9. Remove the LH engine mount nut.



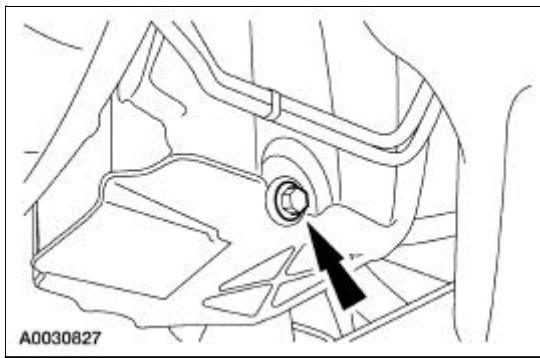
10. Remove the RH engine mount nut.



11. Lower the vehicle.
12. Raise the engine.

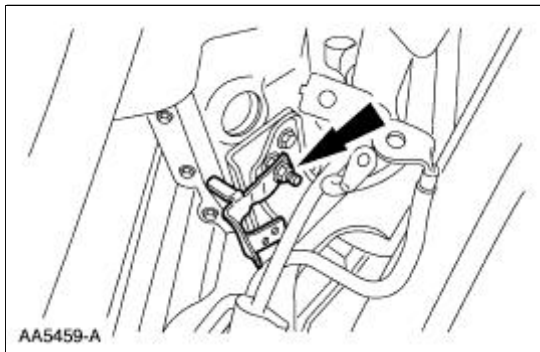


13. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
14. Remove the oil pan drain plug and drain the engine oil.

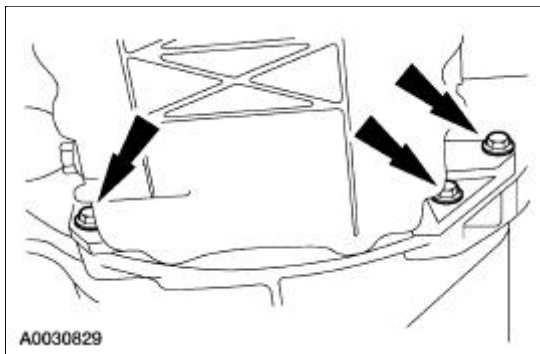


15. Remove the starter motor. For additional information, refer to [Section 303-06](#).

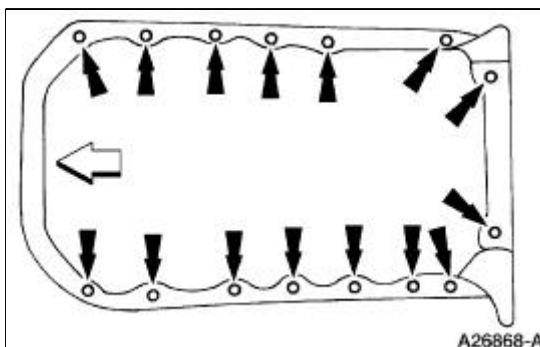
16. Position the wiring harness bracket aside.



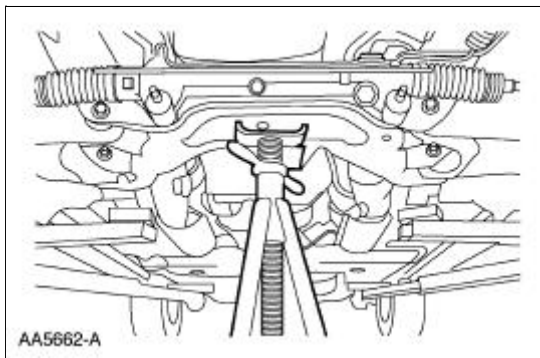
17. Remove the transmission lower bolts.



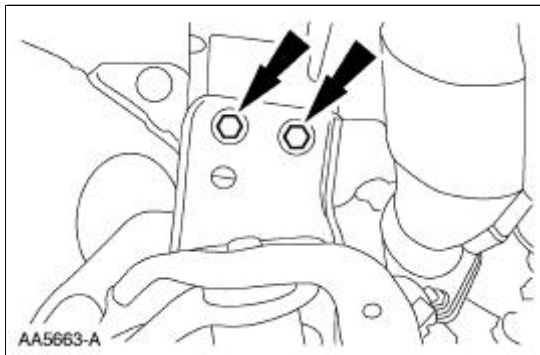
18. Remove the oil pan bolts.



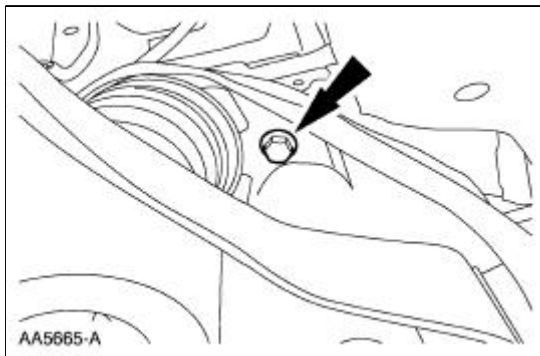
19. Position a safety stand under the subframe crossmember.



20. Remove the four subframe lower bolts.

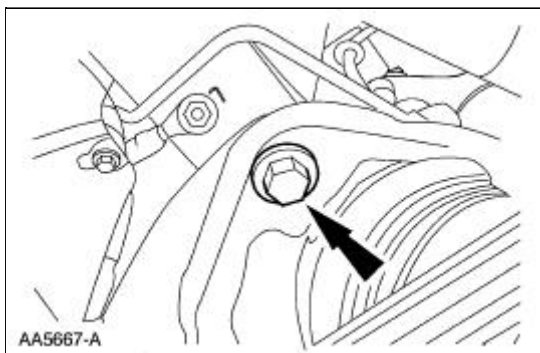


21. Remove the two subframe upper bolts.

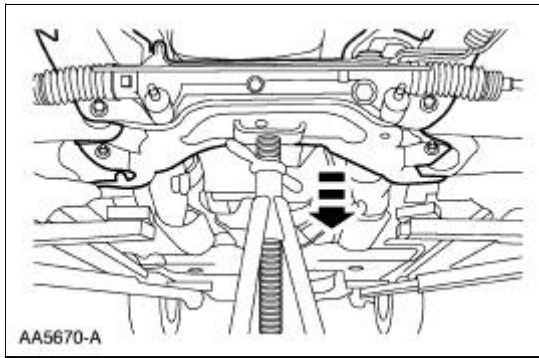


22. **NOTE:** Do not completely remove these bolts.

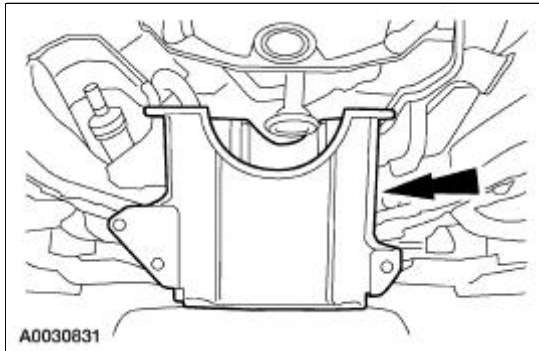
Loosen the two bolts.



23. Lower the front subframe.



24. Remove the oil pan.

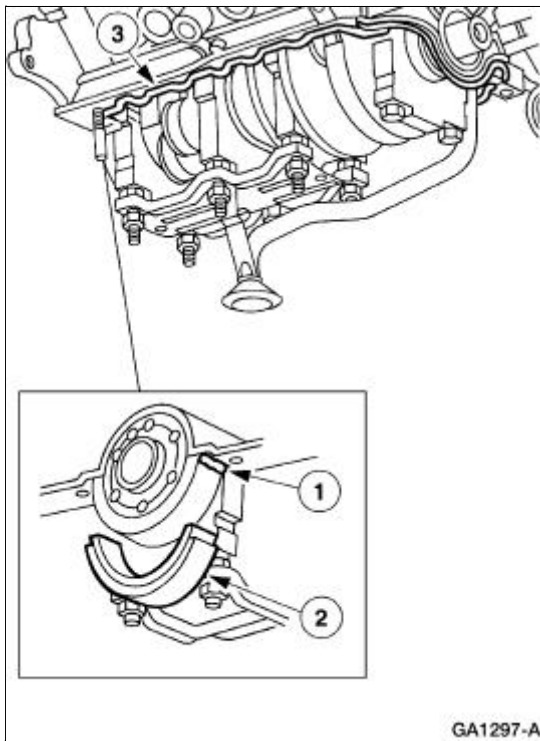


Installation

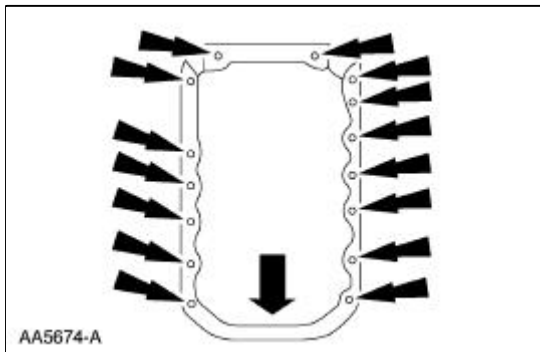
1. **NOTE:** If the oil pan is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

Clean and apply sealant to the oil pan sealing areas shown and install the oil pan rear seal.

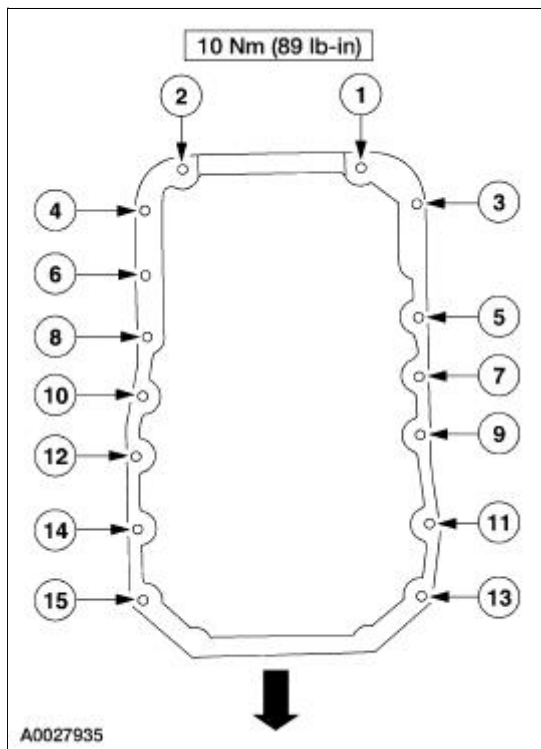
1. Apply silicone gasket and sealant to the rear main bearing cap.
2. Install the oil pan rear seal.
3. Clean the oil pan mating surfaces with metal surface cleaner and apply silicone gasket and sealant to the oil pan mating surface.



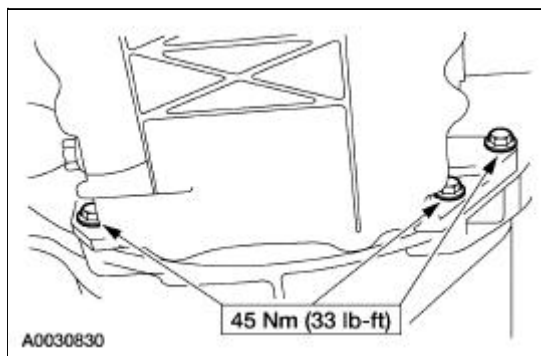
2. Position the oil pan and start the bolts.



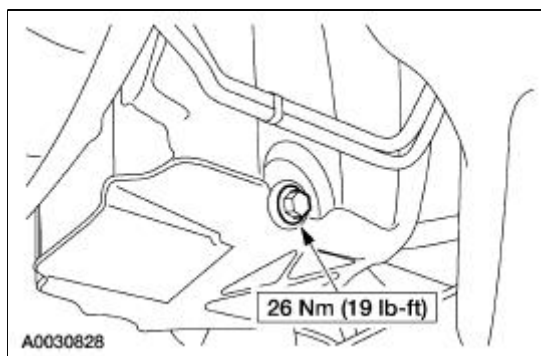
3. Tighten the bolts in two stages in the sequence shown.
 - Stage 1: Tighten to 5 Nm (44 lb-in).
 - Stage 2: Tighten to 10 Nm (89 lb-in).



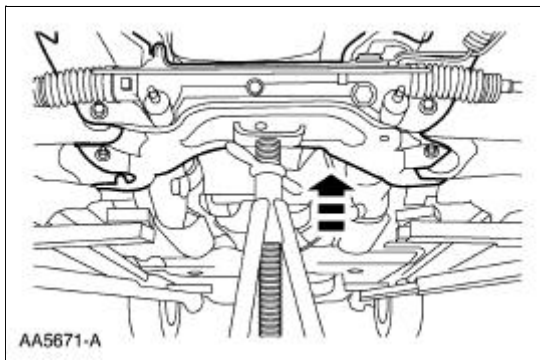
4. Install the transmission lower bolts.



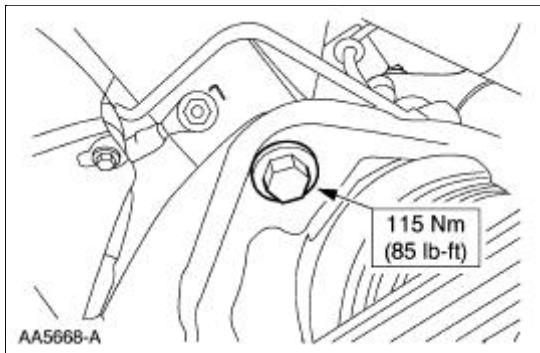
5. Install the oil pan drain plug.



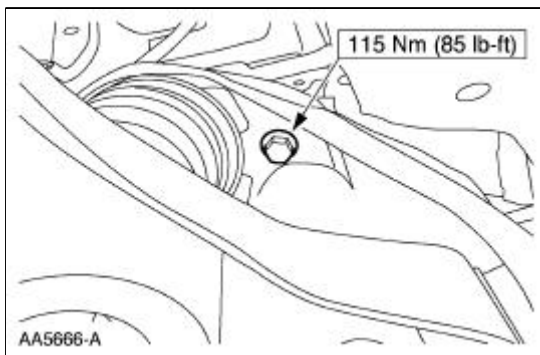
6. Raise the front subframe into position.



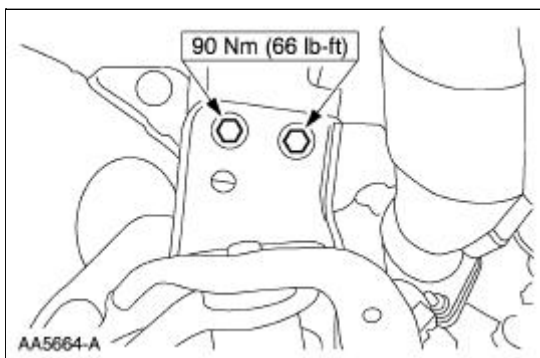
7. Tighten the two bolts.



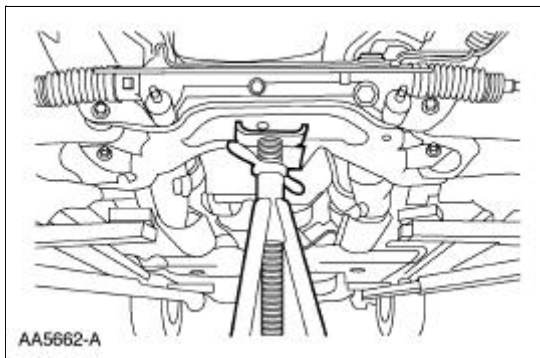
8. Install the two bolts.



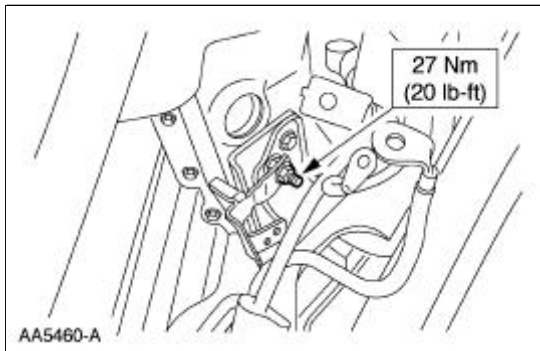
9. Install the four subframe lower bolts.



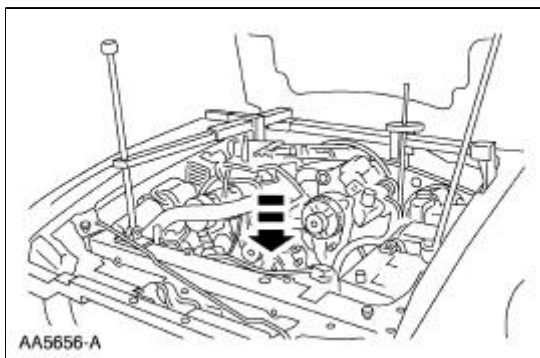
10. Remove the safety stand.



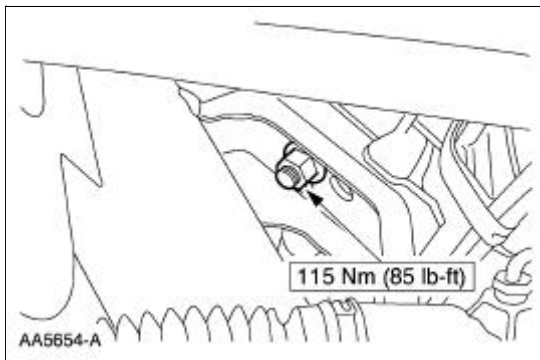
11. Install the bracket.



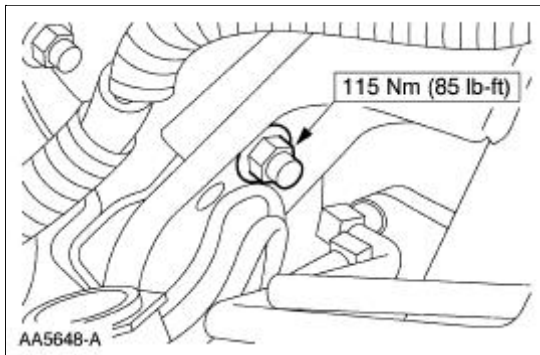
12. Install the starter motor. For additional information, refer to [Section 303-06](#).
13. Lower the vehicle.
14. Lower the engine.



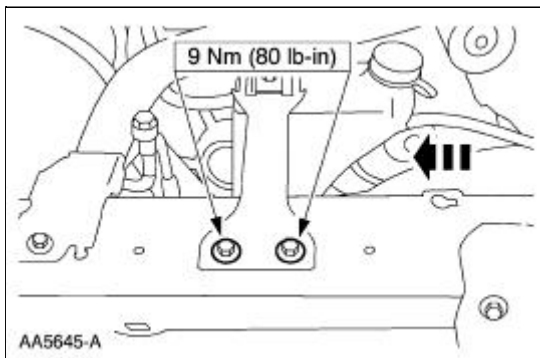
15. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
16. Install the RH engine mount nut.



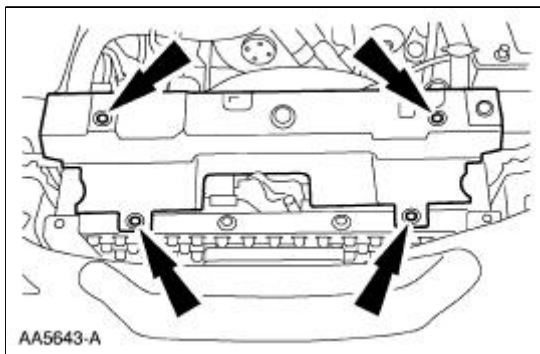
17. Install the LH engine mount nut.




18. Lower the vehicle.
19. Remove the special tools.
20. Install the coolant recovery reservoir.



21. Install the radiator sight shield.



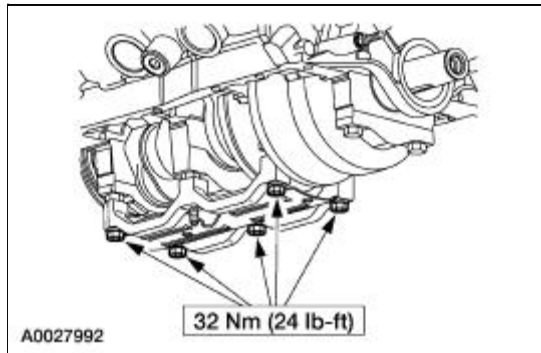
22. Install the air cleaner outlet pipe. For additional information, refer to [Section 303-12](#).
23. Connect the battery ground cable. For additional information, refer to [Section 414-01](#).
24. Fill the engine with clean engine oil.
25.  **CAUTION: Correct coolant bleeding is critical for correct engine cooling.**

Fill and bleed the engine cooling system. For additional information, refer to [Section 303-03A](#).

Oil Pan Baffle

Removal and Installation

1. Remove the oil pump screen cover and tube (6622). For additional information, refer to [Oil Pump Screen and Pickup Tube](#) in this section.
2. Remove the oil pan baffle (6687).
 - Remove the nuts.

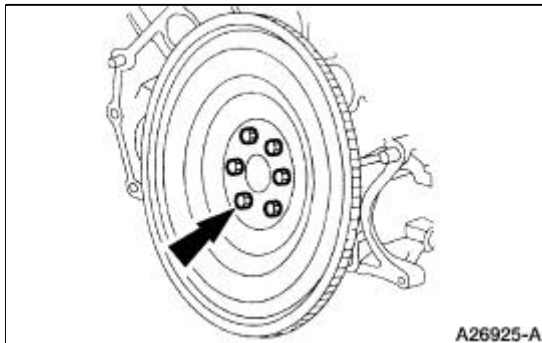


3. To install, reverse the removal procedure.
-

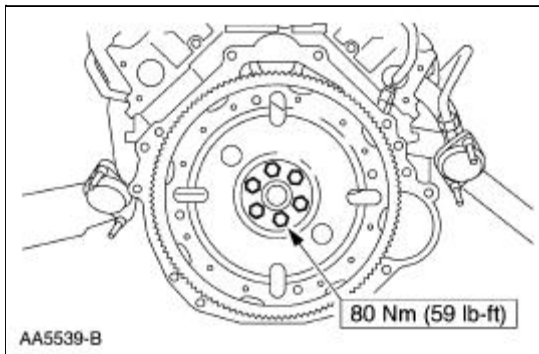
Flywheel

Removal and Installation

1. Remove the clutch. For additional information, refer to [Section 308-01](#).
2. Remove the flywheel bolts.



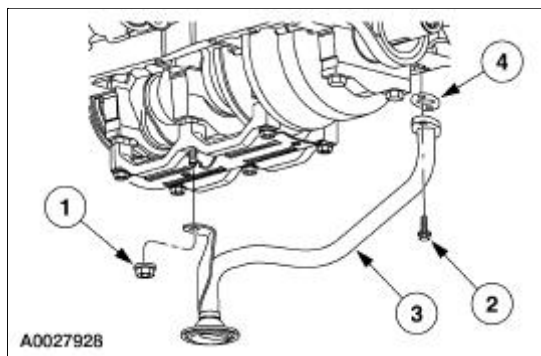
3. To install, reverse the removal procedure.



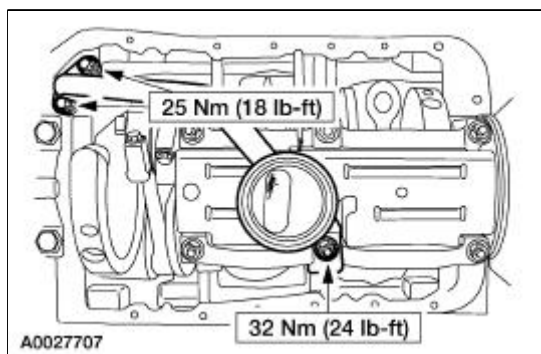
Oil Pump Screen and Pickup Tube

Removal and Installation

1. Remove the oil pan (6675). For additional information, refer to [Oil Pan](#) in this section.
2. Remove the oil pump screen cover and tube (6622) and discard the gasket.
 1. Remove the nut.
 2. Remove the two bolts.
 3. Remove the oil pump screen cover and tube.
 4. Remove and discard the gasket.



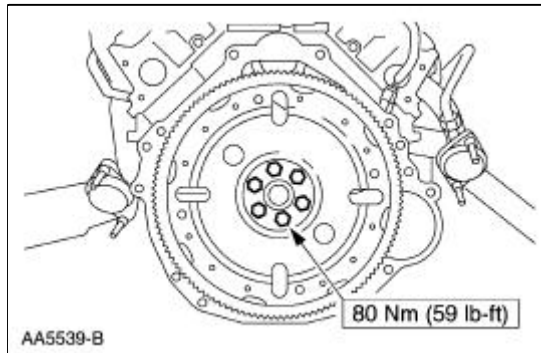
3. To install, reverse the removal procedure.



Flexplate

Removal and Installation







1. Remove the transmission. For additional information, refer to [Section 307-01](#).
2. Remove the six bolts retaining the flexplate to crankshaft, and remove the flexplate.



3. To install, reverse the removal procedure.
-

Crankshaft Rear Seal

Special Tool(s)

 ST1185-A	Impact Slide Hammer 100-001 (T50T-100-A)
 ST1382-A	Remover, Crankshaft Rear Seal 303-519 (T95P-6701-EH)
 T95P-6701-BH ST1089-A	Replacer, Rear Crankshaft Seal 303-516 (T95P-6701-BH)
 T96T-6701-B ST1068-A	Spacer, Rear Crank Seal Replacer 303-561 (T96T-6701-B)
 T95P-6701-DH ST1060-A	Adapter, Crankshaft Rear Seal (Use only the adapter retaining bolts) 303-518 (T95P-6701-DH)
 ST1593-A	Adapter, Crankshaft Rear Seal (Use only the adapter and the center jack screw) 303-S560 (T96T-6701-A)

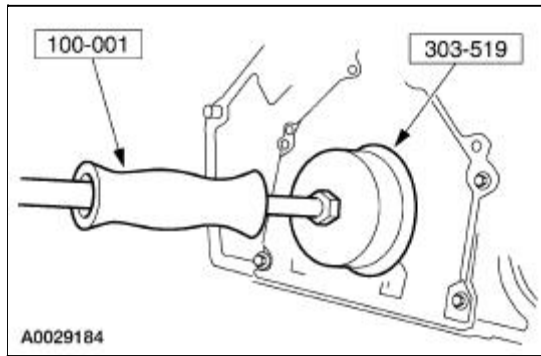
Material

Item	Specification
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

1. Remove the flywheel or the flexplate. For additional information, refer to [Flexplate](#) in this section.

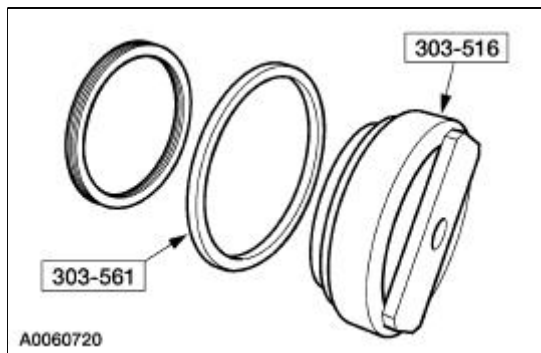
- Using the special tools, remove the crankshaft rear seal.



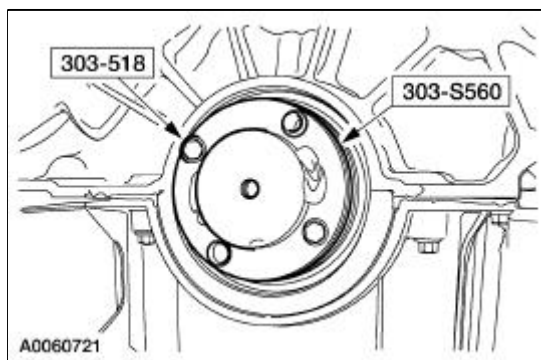
Installation

- Clean and inspect the mating surface.
- NOTE:** Lubricate the crankshaft rear seal lips with clean engine oil prior to installation.

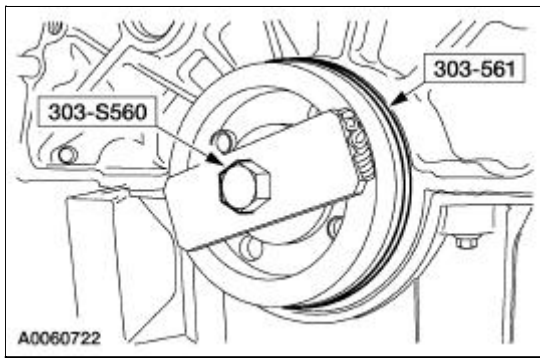
Assemble the special tools and the crankshaft rear seal.



- Install the special tools on the rear of the crankshaft.





- Install the crankshaft rear seal. Tighten the center jack screw (303-S560) until the spacer (303-561) contacts the engine block.



5. Install the flywheel or the flexplate. For additional information, refer to [Flexplate](#) in this section.
-

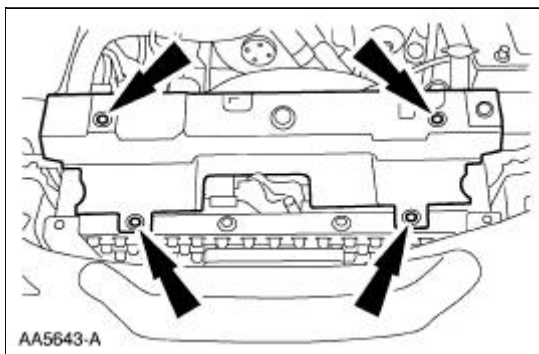
Engine Support Insulators

Special Tool(s)

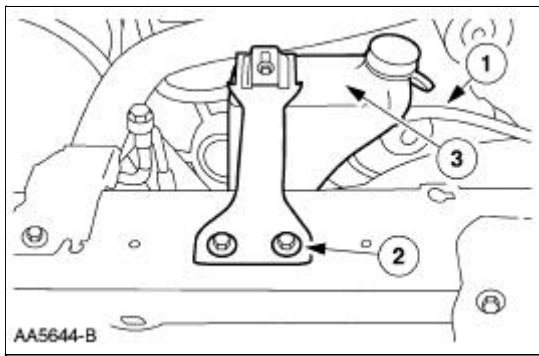
 <p>ST2333-A</p>	<p>3 Bar Engine Support Kit 303-F072</p>
 <p>ST2375-A</p>	<p>Engine Lift Bracket Set 303-D095 (D94L-6001-A) or equivalent</p>

Removal

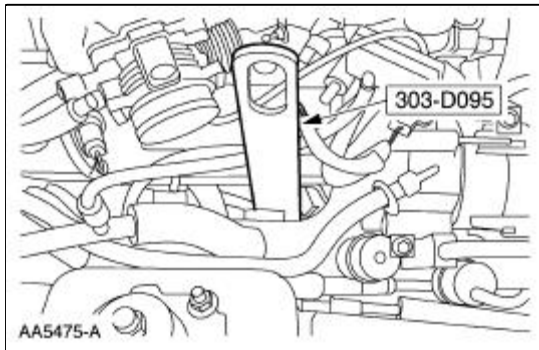
1. Disconnect the battery ground cable (14301). For additional information, refer to [Section 414-01](#).
2. Remove the air cleaner outlet tube (9B659). For additional information, refer to [Section 303-12](#).
3. Remove the radiator sight shield (8C291).



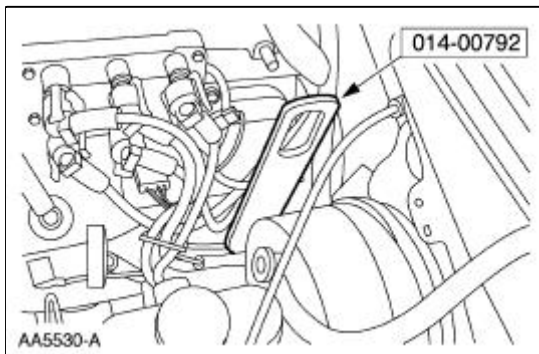
4. Remove the coolant recovery reservoir (8A080).
 1. Disconnect the hose.
 2. Remove the bolts.
 3. Remove the coolant recovery reservoir.



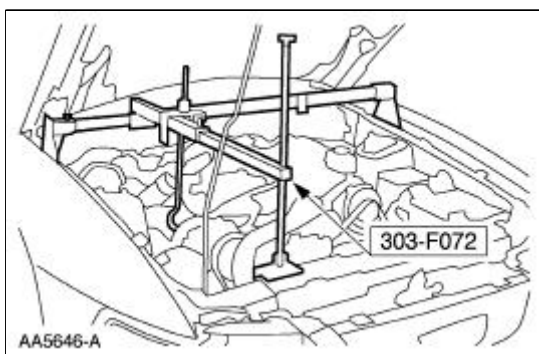
5. Install the special tool.



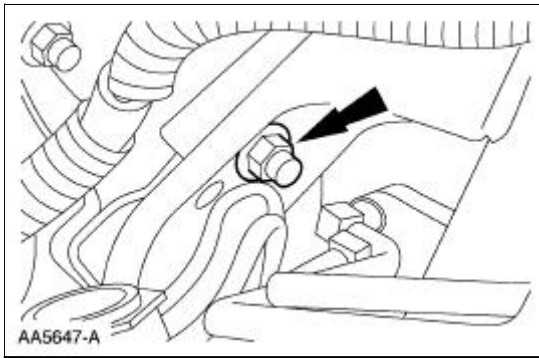
6. Install the special tool.



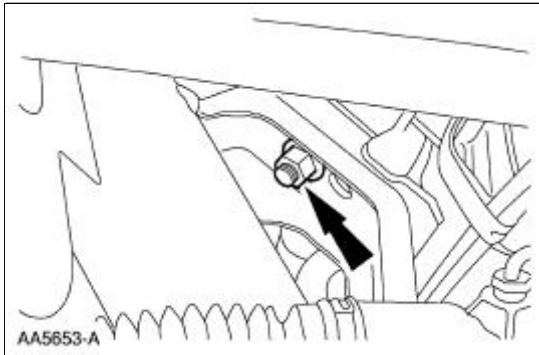
7. Install the special tool.



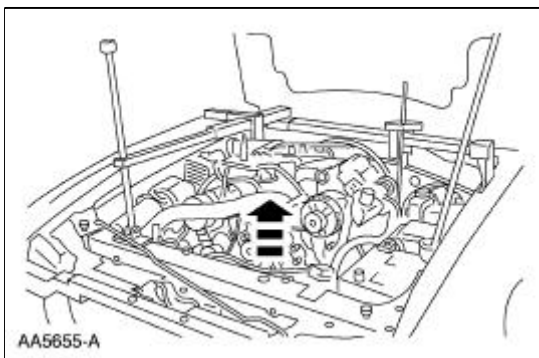
8. Raise the vehicle on a hoist. For additional information, refer to [Section 100-02](#).
9. Remove the LH engine mount nut.



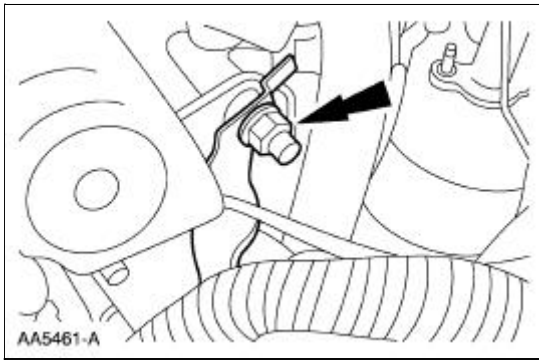
10. Remove the RH engine mount nut.



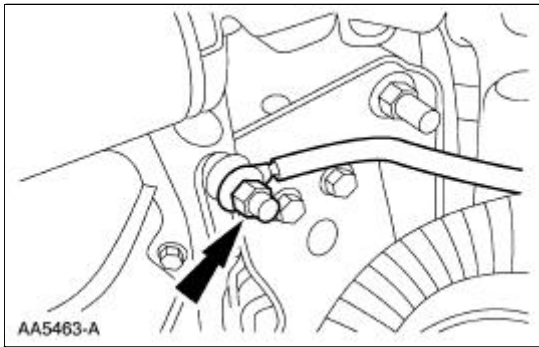
11. Lower the vehicle.
12. Raise the engine.



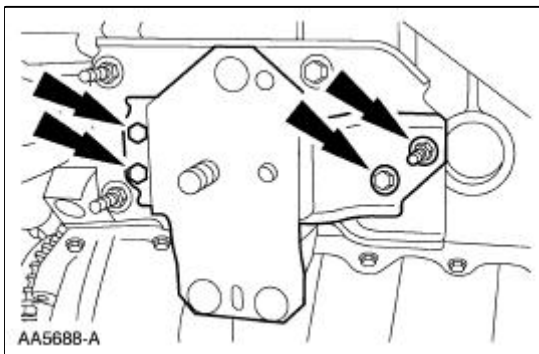
13. Raise the vehicle on a hoist.
14. Position the bracket aside.
 - Remove the nut.



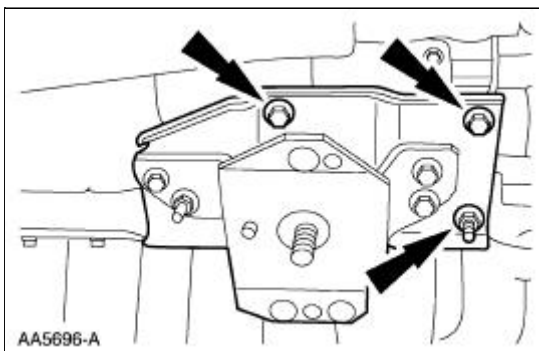
15. Disconnect the engine ground strap.
- Remove the nut.



16. Remove the LH engine insulator (6038).
- Remove the bolts.

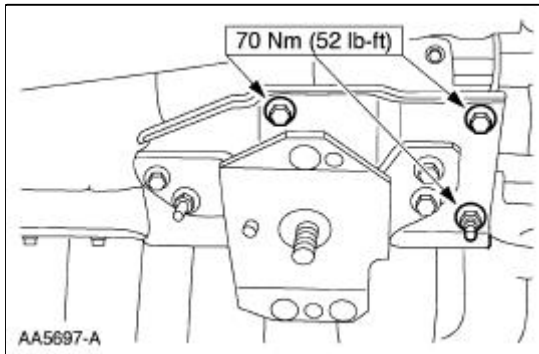


17. Remove the RH engine insulator.
- Remove the bolts.
 - Remove the nuts.

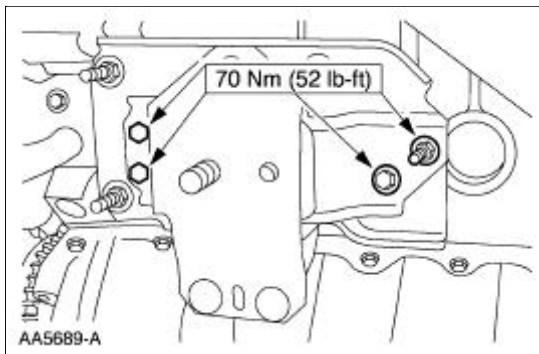


Installation

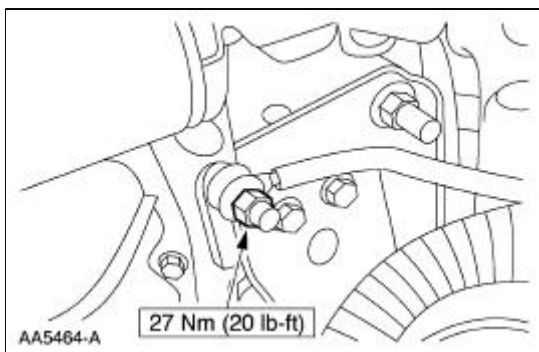
1. Install the RH engine insulator.
 - Install the nuts.
 - Install the bolts.



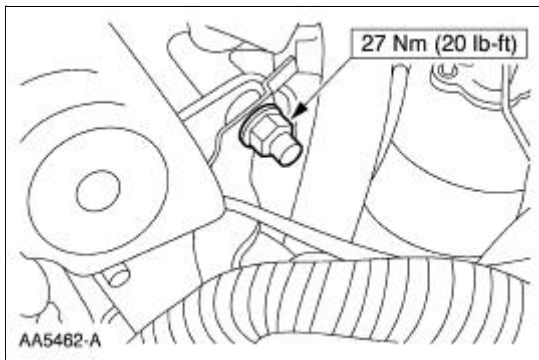
2. Install the LH engine insulator.



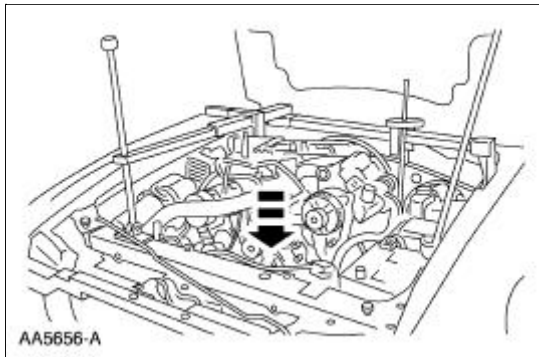
3. Connect the engine ground strap.



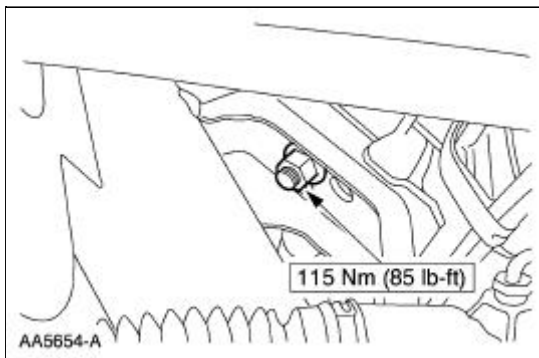
4. Install the bracket.



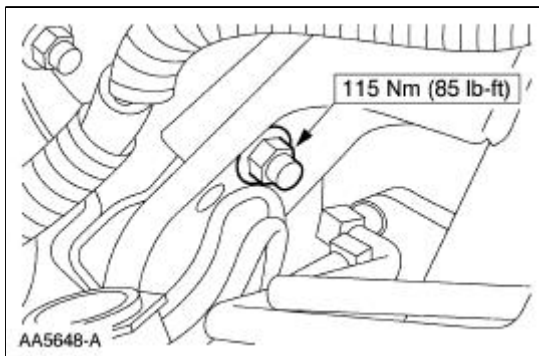
5. Lower the vehicle.
6. Lower the engine.



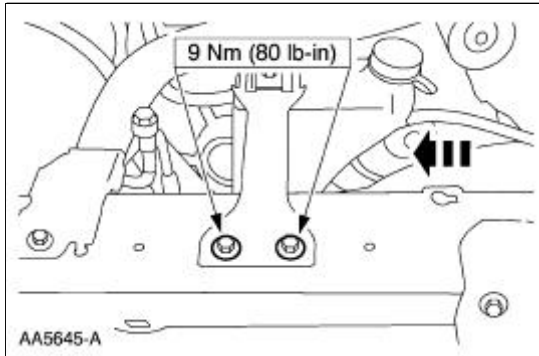
7. Raise the vehicle.
8. Install the RH engine mount nut.



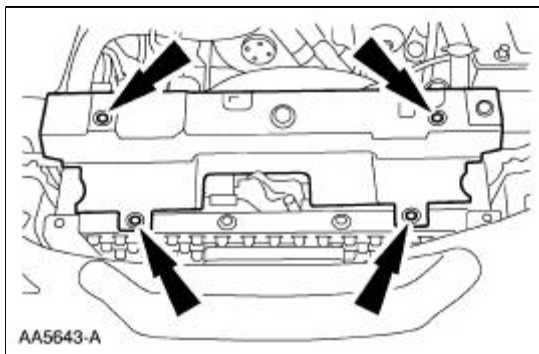
9. Install the LH engine mount nut.



10. Lower the vehicle.
11. Remove the special tools.
12. Install the coolant recovery reservoir.




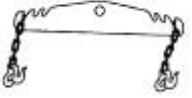

13. Install the radiator sight shield.




14. Install the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).
 15. Connect the battery ground cable. For additional information, refer to [Section 414-01](#).
-

Engine

Special Tool(s)

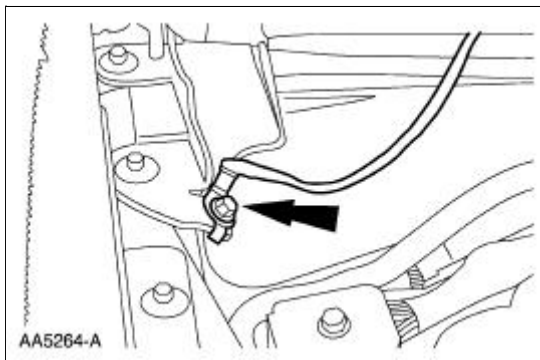
 ST2375-A	Lifting Bracket Set, Engine 303-D095 (D94L-6001-A) or equivalent
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent
 ST1341-A	Heavy Duty Floor Crane 014-00071 or equivalent

Removal

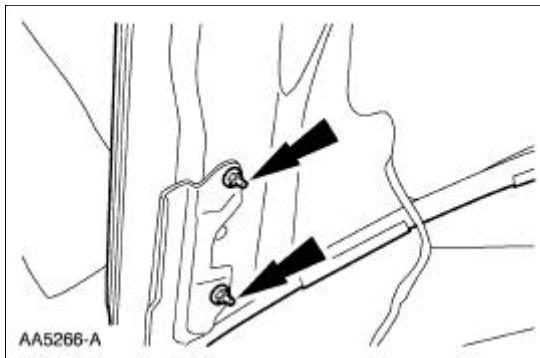
 **WARNING:** Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

All vehicles

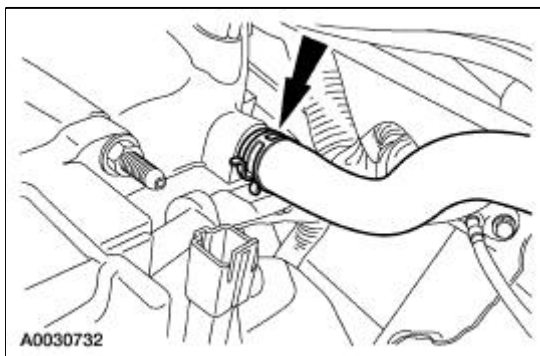
1. Drain the engine cooling system. For additional information, refer to [Section 303-03A](#).
2. Recover the A/C refrigerant. For additional information, refer to [Section 412-00](#).
3. Disconnect the battery negative cable (14301). For additional information, refer to [Section 414-01](#).
4. Relieve the fuel pressure. For additional information, refer to [Section 310-00](#).
5. Disconnect the hood ground strap.



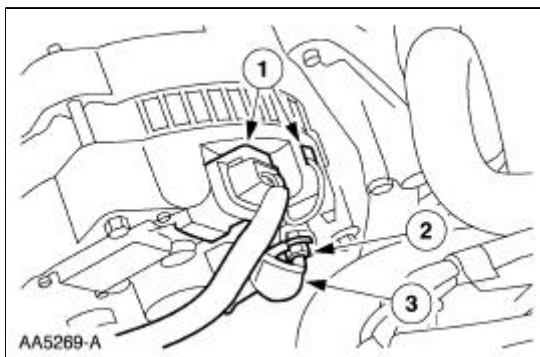
6. Remove the hood (16612).



7. Disconnect the vacuum hose.

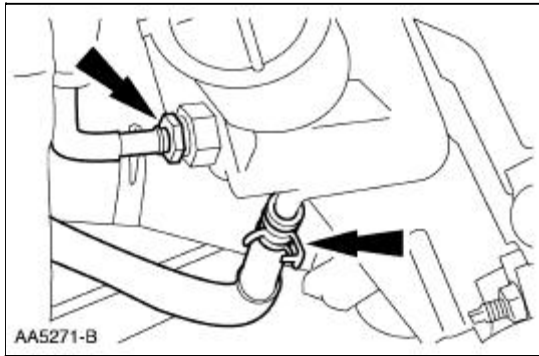


8. Disconnect the generator (10346).
 1. Disconnect the connectors.
 2. Remove the nut.
 3. Remove the battery positive cable.

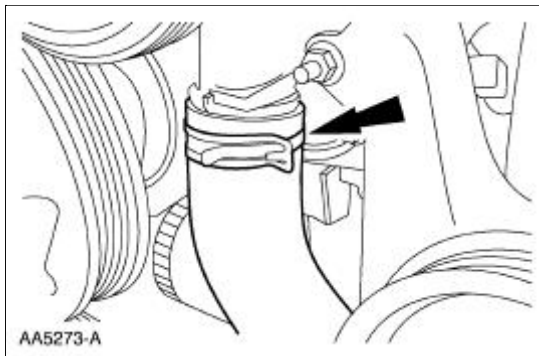


9. **NOTE:** Place a suitable container under the pump.

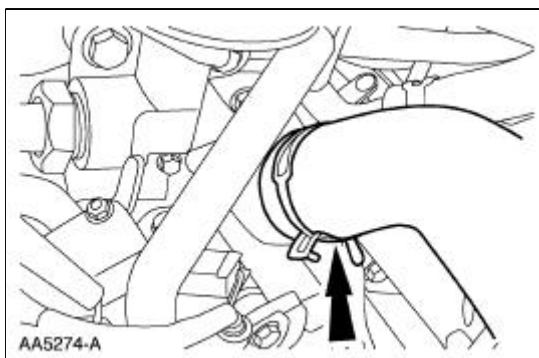
Disconnect the power steering pump (3A674).



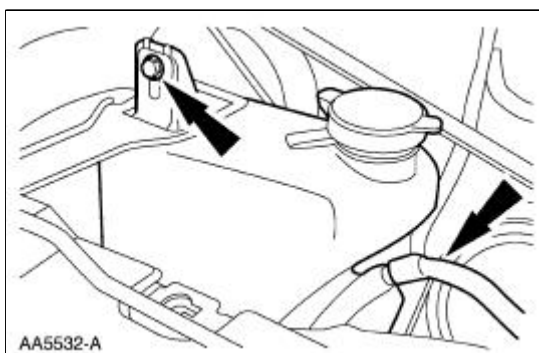
10. Disconnect the lower radiator hose (8286).



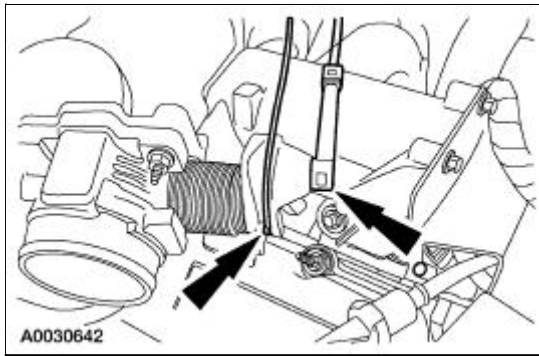
11. Disconnect the upper radiator hose (8620).



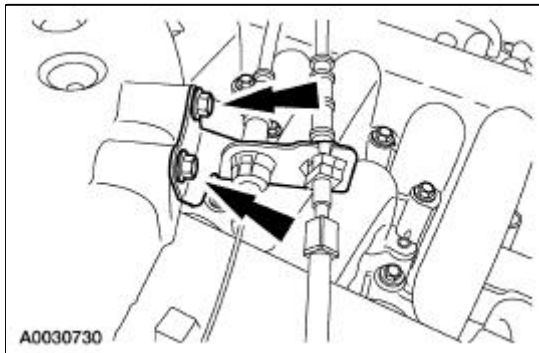
12. Remove the radiator coolant recovery reservoir (8A080).



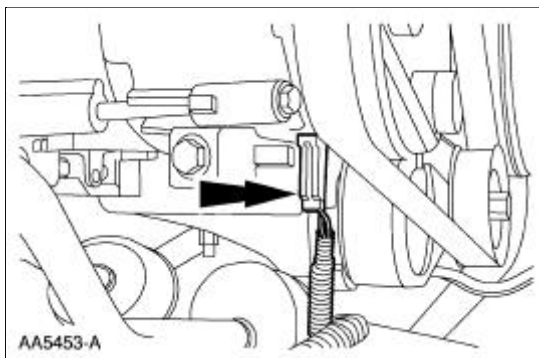
13. Disconnect the accelerator cable and, if equipped, the speed control cable.



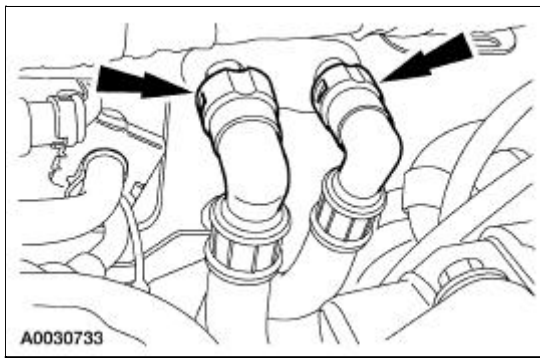
14. Position the accelerator cable bracket (9723) aside.
 - Remove the bolts.



15. Remove the air cleaner outlet tube (9B659) and the air cleaner assembly. For additional information, refer to [Section 303-12](#).
16. Disconnect the A/C manifold and tube (19D734). For additional information, refer to [Section 412-03](#).
17. Disconnect the A/C compressor electrical connector.

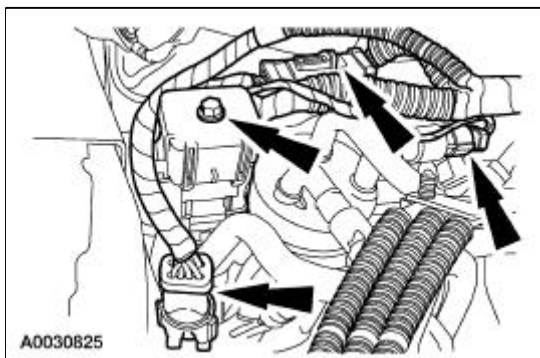


18. Disconnect the fuel supply line (9J337). For additional information, refer to [Section 310-00](#).
19. Disconnect the heater hoses (12270).

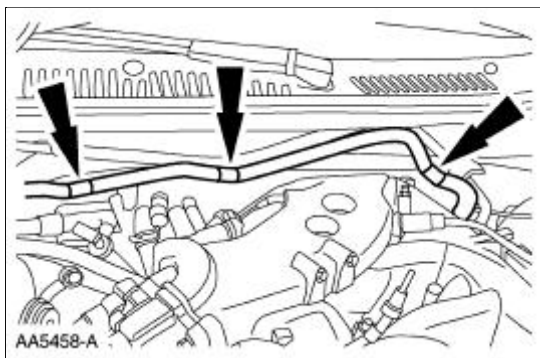


20. Disconnect the following connectors:

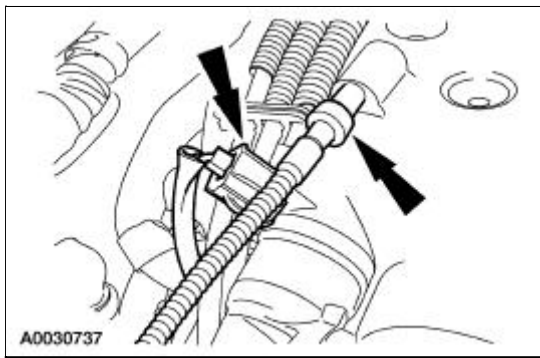
- 42-pin electrical connector
- 16-pin electrical connector
- 8-pin electrical connector
- A/C pressure switch



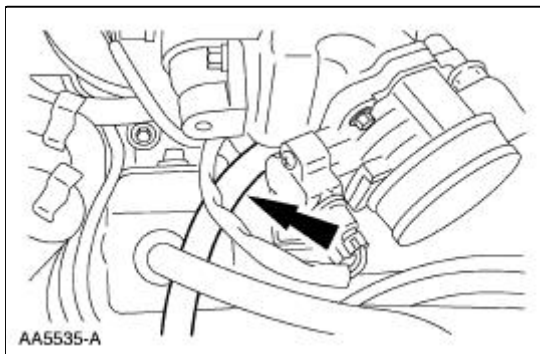
21. Position the wire harness aside.



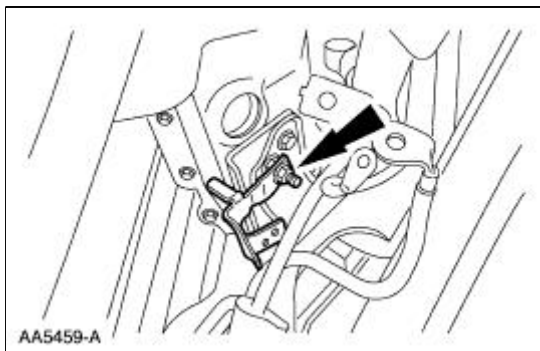
22. Disconnect the connector and the vacuum tube.



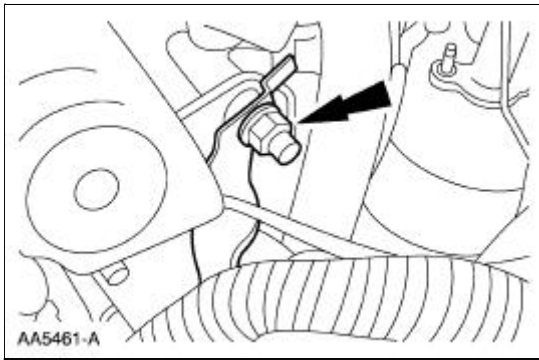
23. Disconnect the evaporative emissions (EVAP) return tube (9G271).



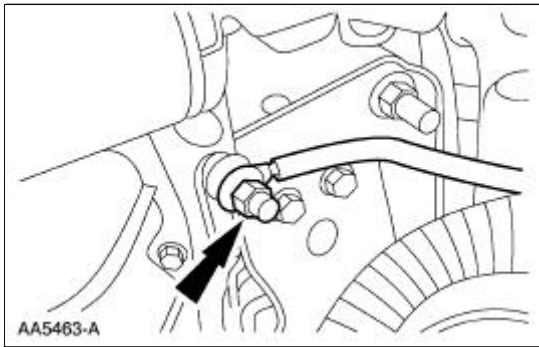
24. Raise the vehicle on a hoist. For additional information, refer to [Section 100-02](#) .
25. Remove the starter motor (11002). For additional information, refer to [Section 303-06](#) .
26. Remove the dual converter Y-pipe (5F250). For additional information, refer to [Section 309-00](#) .
27. Remove the bracket.



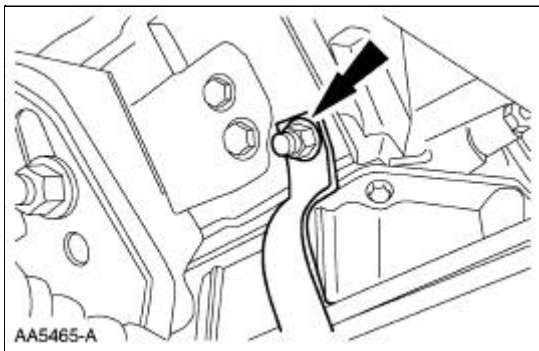
28. Remove the bracket.
 - Remove the nut.



29. Disconnect the engine ground strap.
 - Remove the nut.

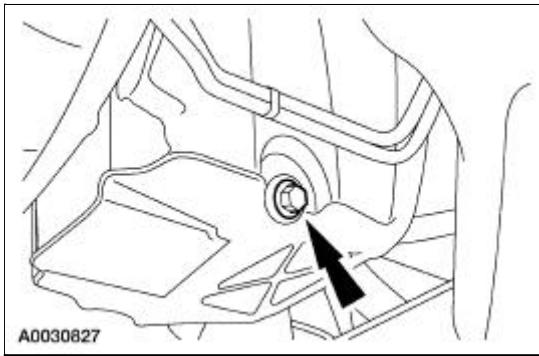


30. Remove the bracket.



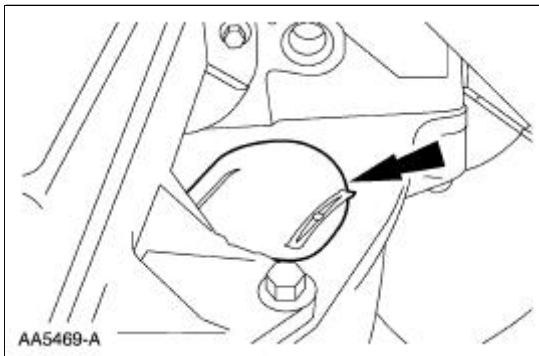
Vehicles equipped with manual transmission

31. Remove the transmission. For additional information refer to [Section 308-03A](#).
32. Drain the engine oil.
 - Remove the oil drain plug.



Vehicle equipped with automatic transmission

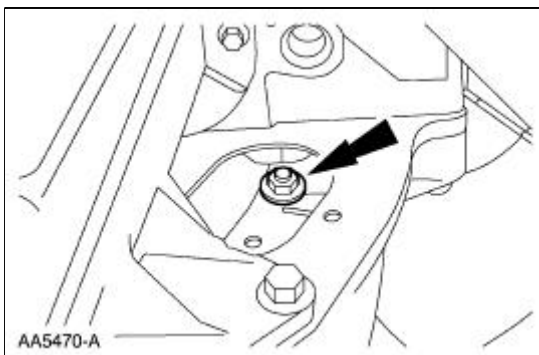
33. Remove the access cover.



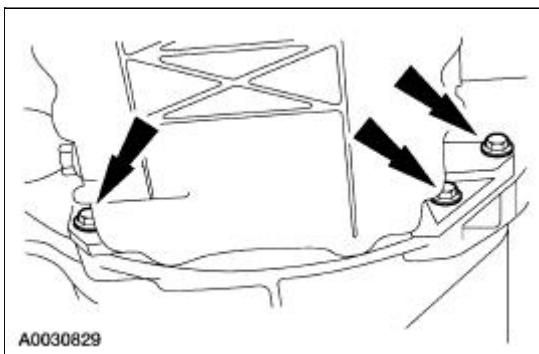
34. **NOTE:** Discard the torque converter nuts.

Disconnect the torque converter (7902).

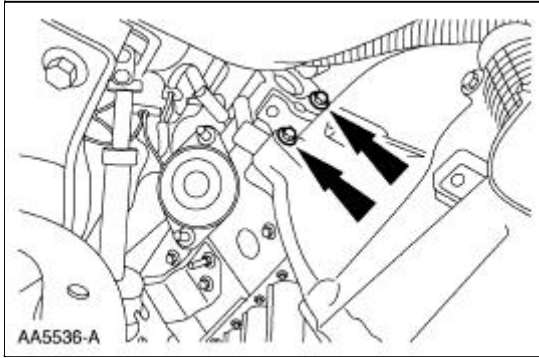
- Remove the four nuts.



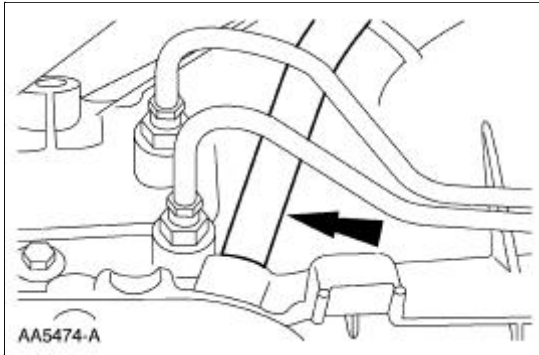
35. Remove the oil pan-to-transmission bolts.



36. Remove the upper bell housing bolts.

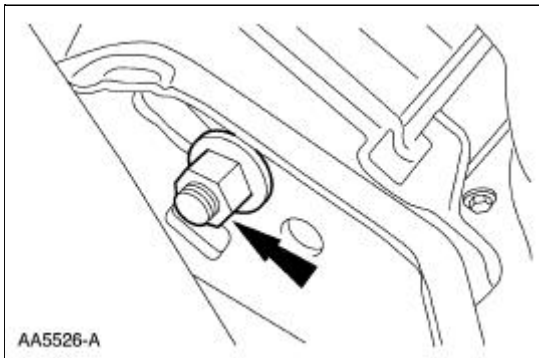


37. Remove the transmission oil filler tube (7A228).

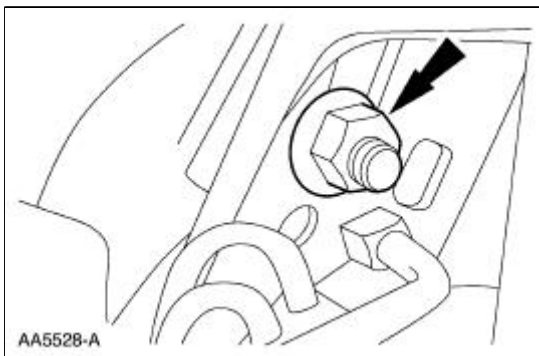


All vehicles

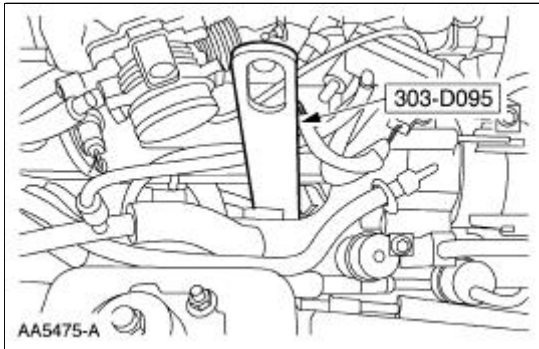
38. Remove the RH engine mount nut.



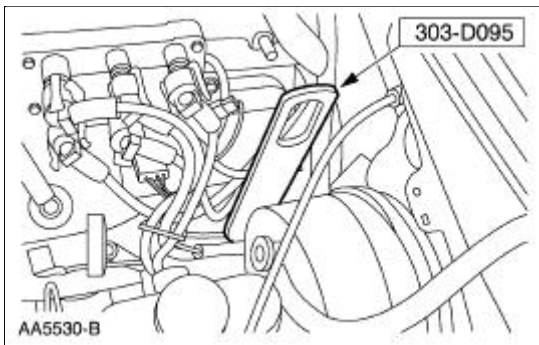
39. Remove the LH engine mount nut.



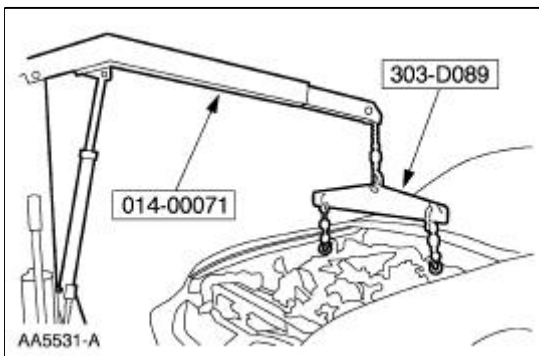
40. Lower the vehicle.
41. Support the transmission.
42. Install the special tool.



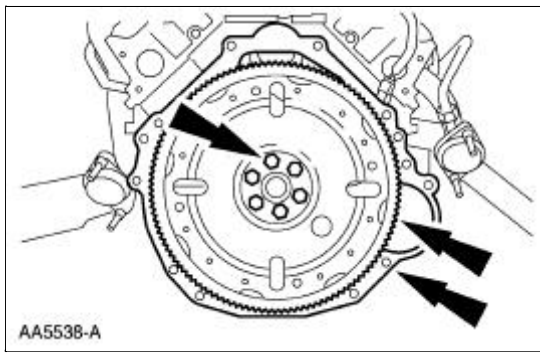
43. Install the special tools.



44. Using the special tool, remove the engine.



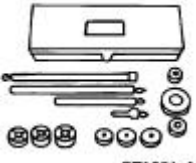





45. If necessary, remove the flywheel (6375) and the separator plate (6A372).
 - Remove the bolts.



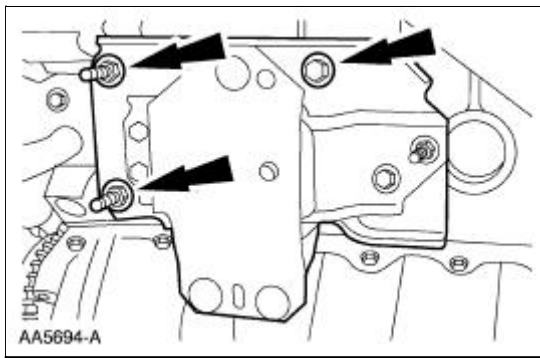
46. Mount the engine on a suitable engine stand.

Engine

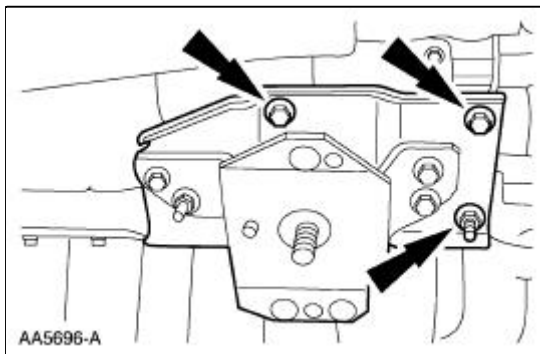
Special Tool(s)

 <p>ST1381-A</p>	Service Set, Camshaft 303-017 (T65L-6250-A)
 <p>ST1286-A</p>	Remover, Crankshaft Vibration Damper 303-009 (T58P-6316-D)
 <p>ST2375-A</p>	Lifting Bracket Set, Engine 303-D095 (D94L-6001-A) or equivalent
 <p>ST1385-A</p>	Remover, Power Steering Pump Pulley 211-016 (T69L-10300-B)
 <p>ST1385-A</p>	Remover, Oil Seal 303-409 (T92C-6700-CH)
 <p>ST1378-A</p>	Remover, Crankshaft Vibration Damper 303-176 (T82L-6316-B)

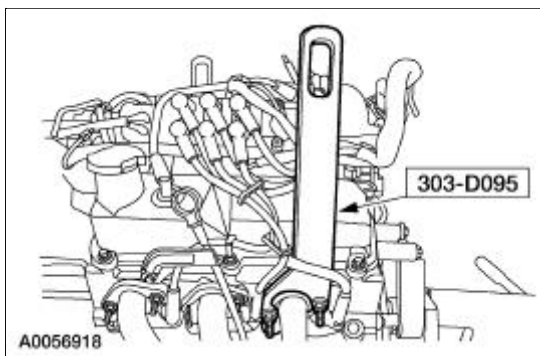
1. Remove the bolts and the LH engine support insulator.



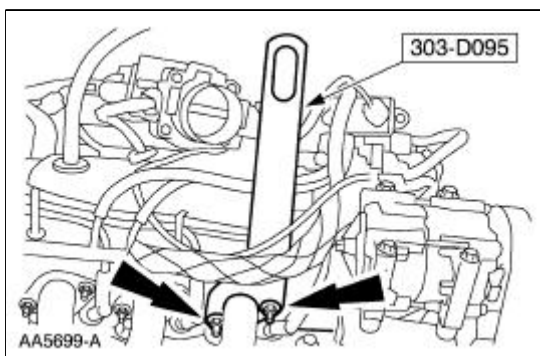
2. Remove the bolts and the RH engine support insulator.



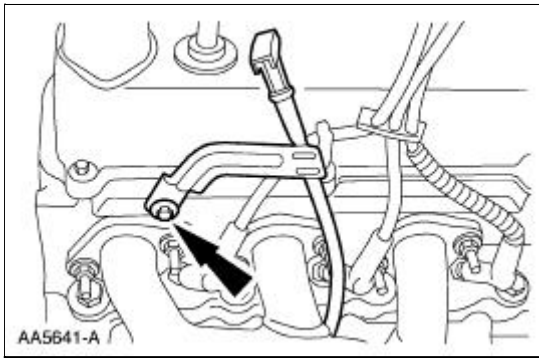
3. Remove the special tool.



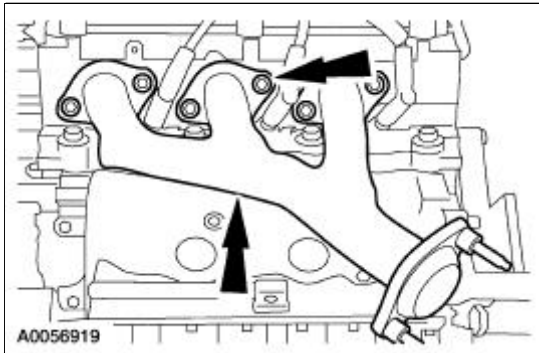
4. Remove the special tool.



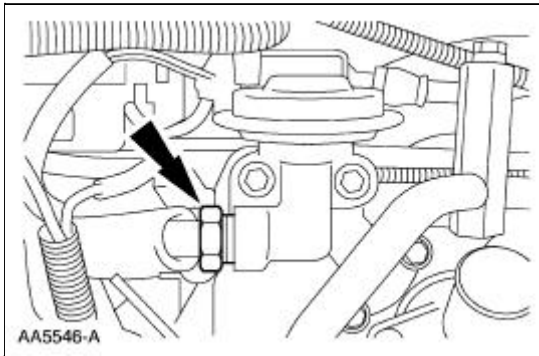
5. Remove the bolt and the oil level indicator and tube. Discard the O-ring.



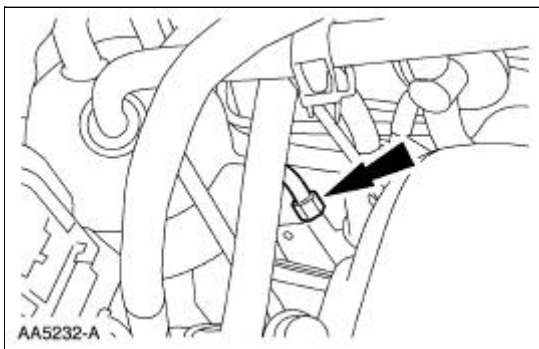
6. Remove the bolts and the LH exhaust manifold. Discard the gasket.



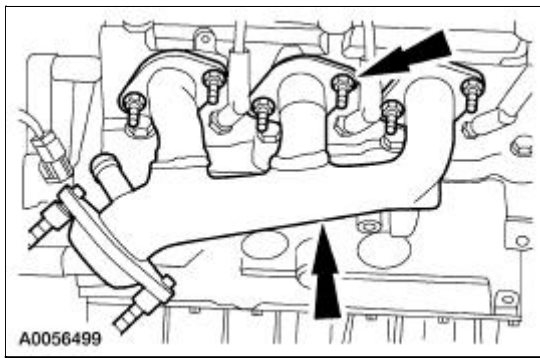
7. Disconnect the exhaust gas recirculation (EGR) tube.



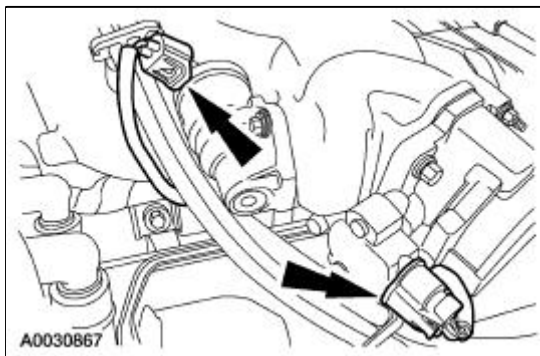
8. Remove the EGR tube.



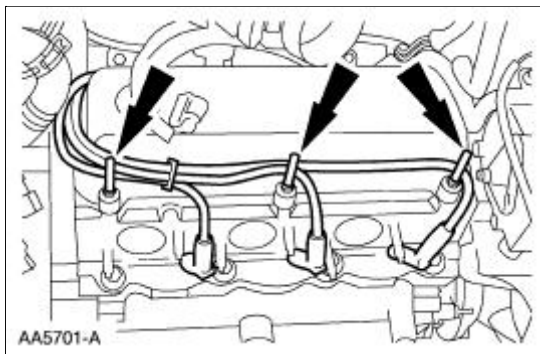
9. Remove the nuts and the RH exhaust manifold. Discard the gasket.



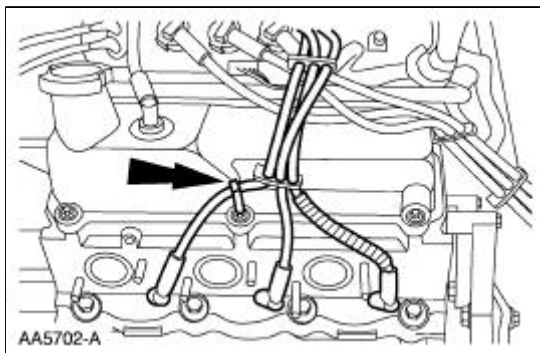
10. Disconnect the idle air control (IAC) valve and throttle position (TP) sensor electrical connectors.



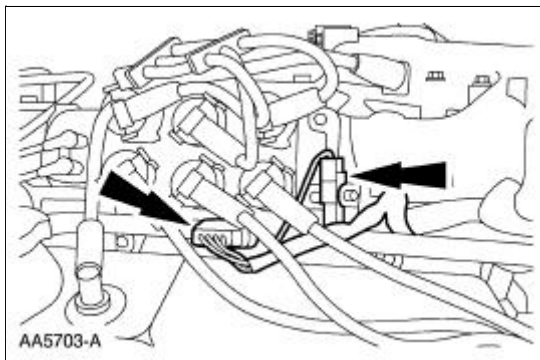
11. Position the RH spark plug wires aside.



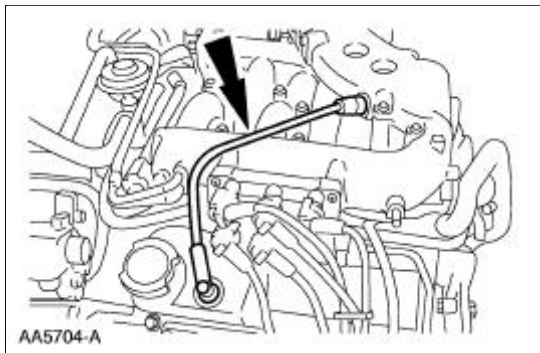
12. Position the LH spark plug wires aside.



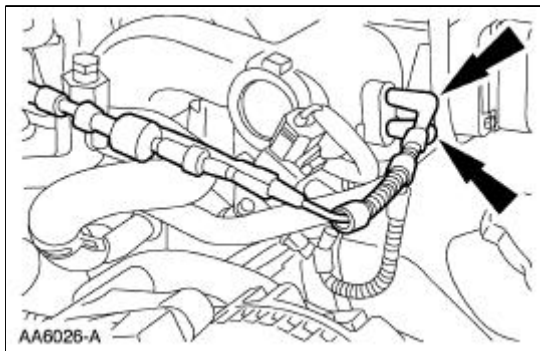
13. Disconnect the ignition coil and the radio interference capacitor electrical connectors.



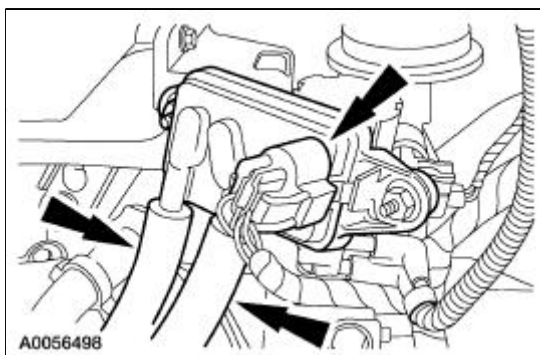
14. Remove the positive crankcase ventilation (PCV) tube.



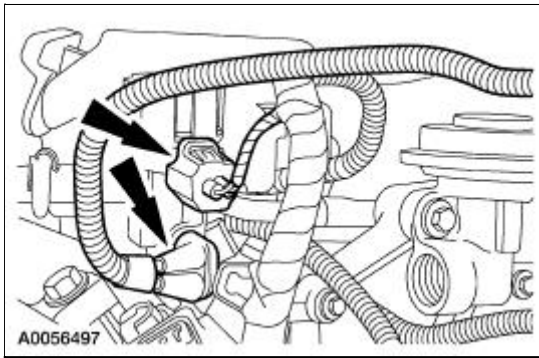
15. Disconnect the vacuum hoses.



16. Disconnect the differential pressure feedback EGR system electrical and vacuum connections.

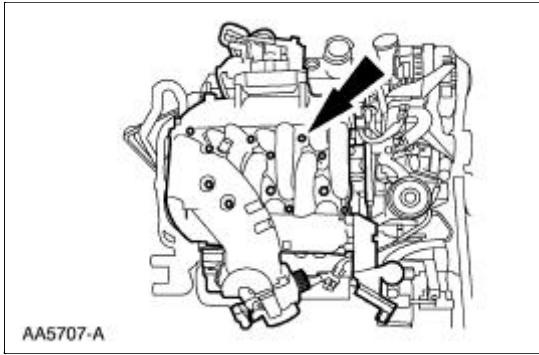


17. Disconnect the EGR vacuum regulator solenoid electrical and vacuum connections.



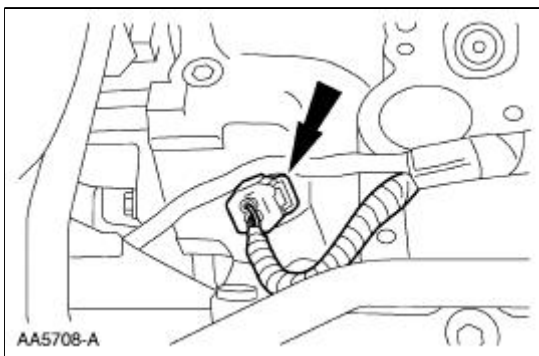
18. **NOTE:** Record the location of the long bolts and the short bolts.

Remove the upper intake manifold and the upper intake manifold gasket.

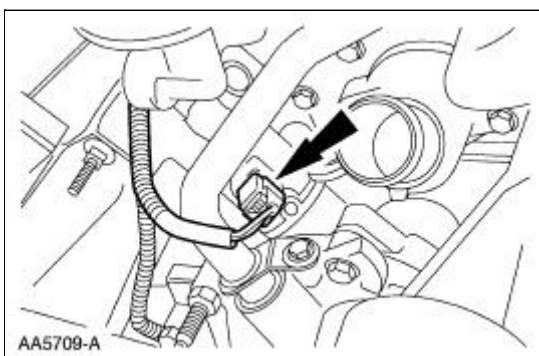


19. Remove the fuel injection supply manifold and the fuel injectors. For additional information, refer to [Section 303-04A](#).

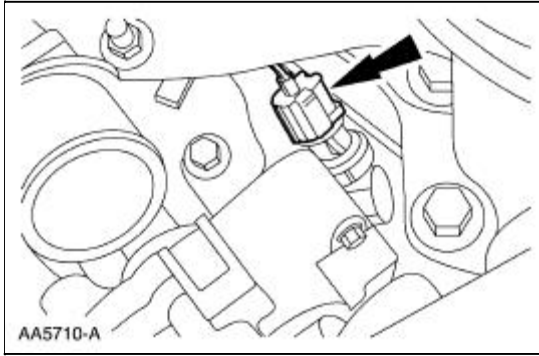
20. Disconnect the cylinder head temperature (CHT) sensor.



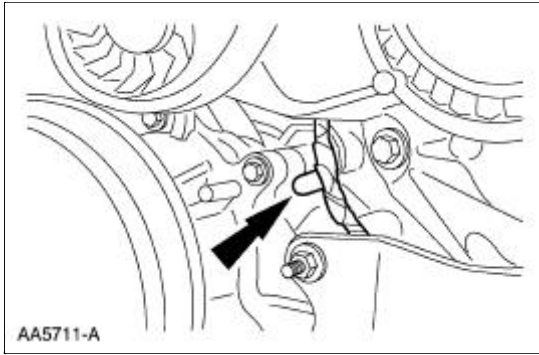
21. Disconnect the camshaft position (CMP) sensor electrical connector.



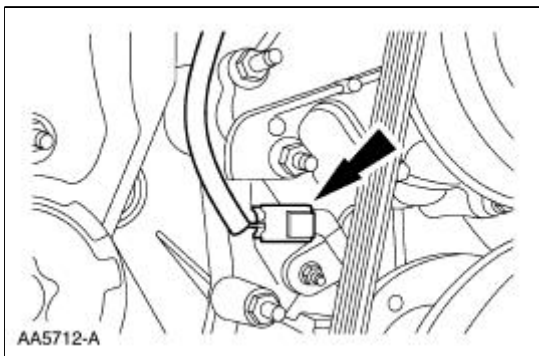
22. Disconnect the engine oil pressure sender electrical connector.



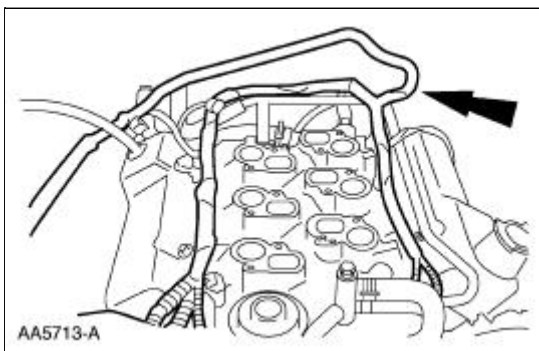
23. Remove the pin-type retainer.



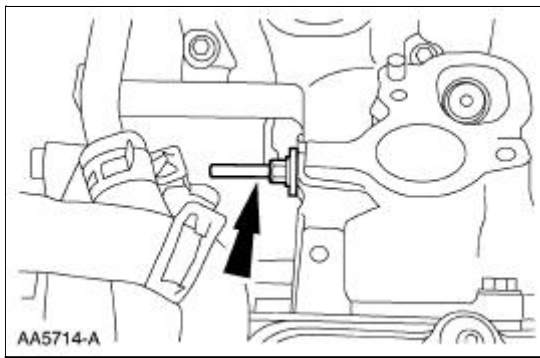
24. Disconnect the crankshaft position (CKP) sensor electrical connector.



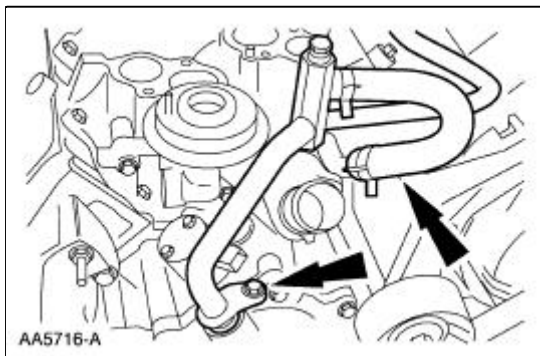
25. Remove the engine wiring harness.



26. Remove the stud bolt.

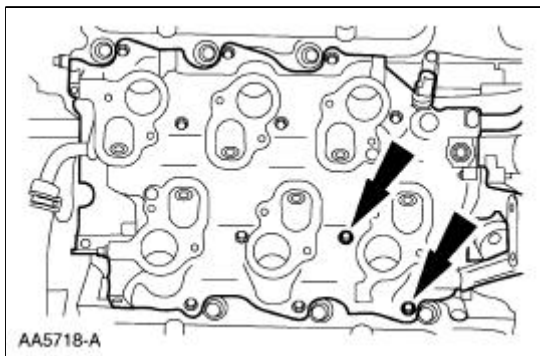


27. Remove the heater water outlet tube.

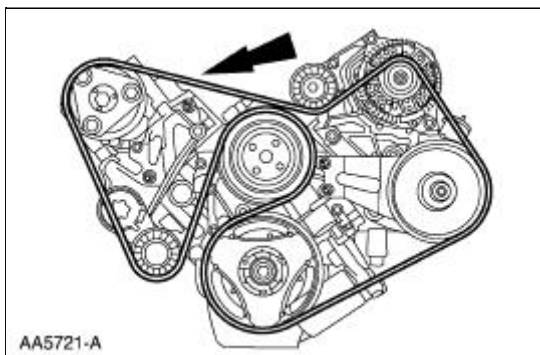


28. **NOTE:** Record the location of the long bolts and the short bolts.

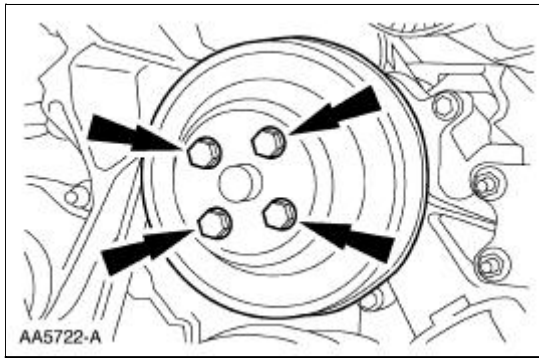
Remove the lower intake manifold and the intake manifold gasket.



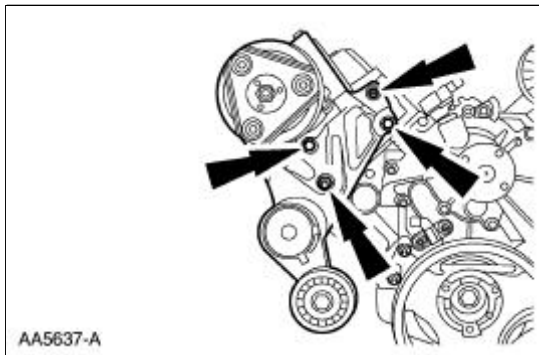
29. Remove the accessory drive belt.



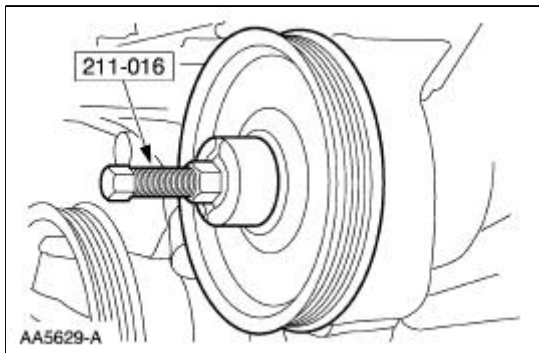
30. Remove the water pump pulley.



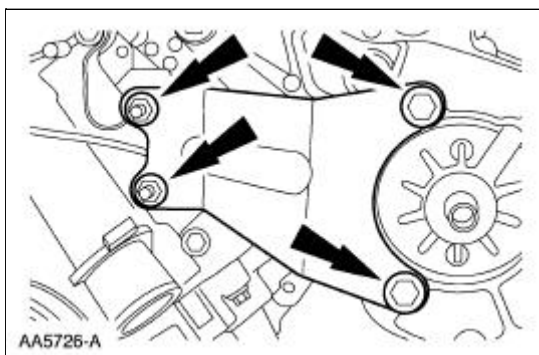
31. Remove the A/C compressor bracket.



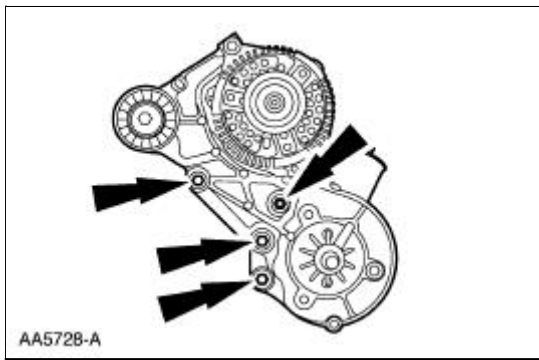
32. Using the special tool, remove the power steering pump pulley.



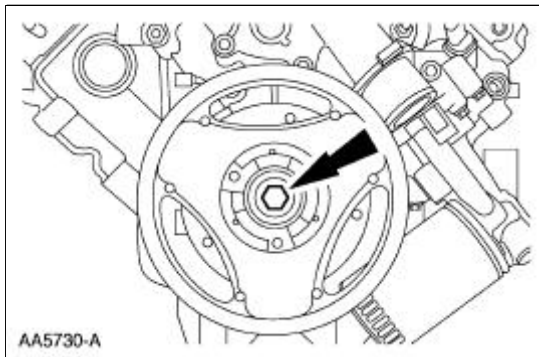
33. Remove the power steering pump bracket.



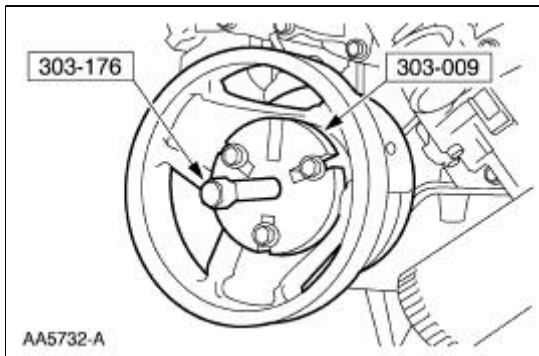
34. Remove the bolts and the generator mounting bracket.



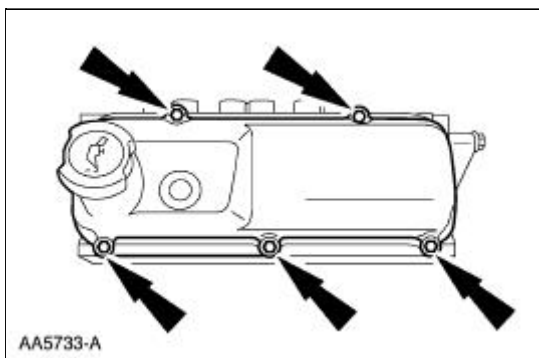
35. Remove the crankshaft pulley bolt.



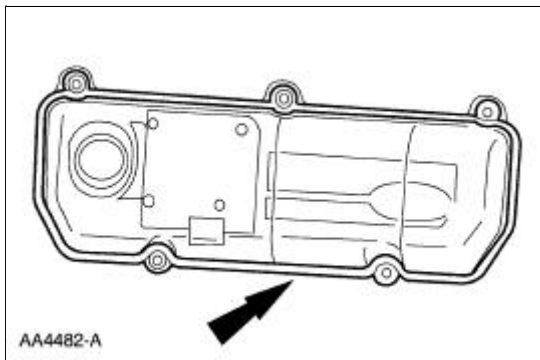
36. Using the special tool, remove the crankshaft pulley.



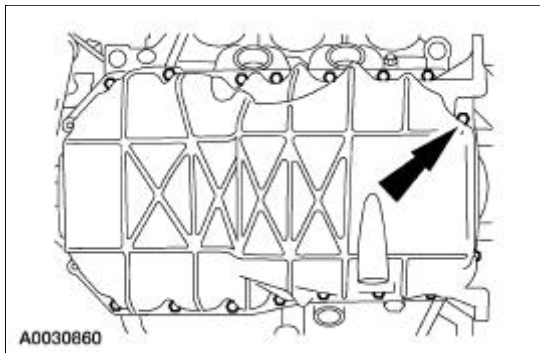
37. Remove the RH and the LH valve covers.




38. Inspect the valve cover gaskets. Install new gaskets if necessary.



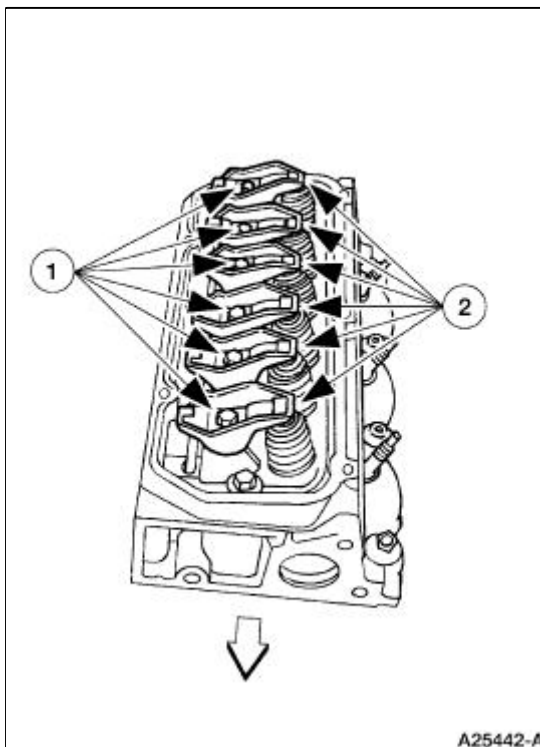
39. Remove the bolts and the oil pan.



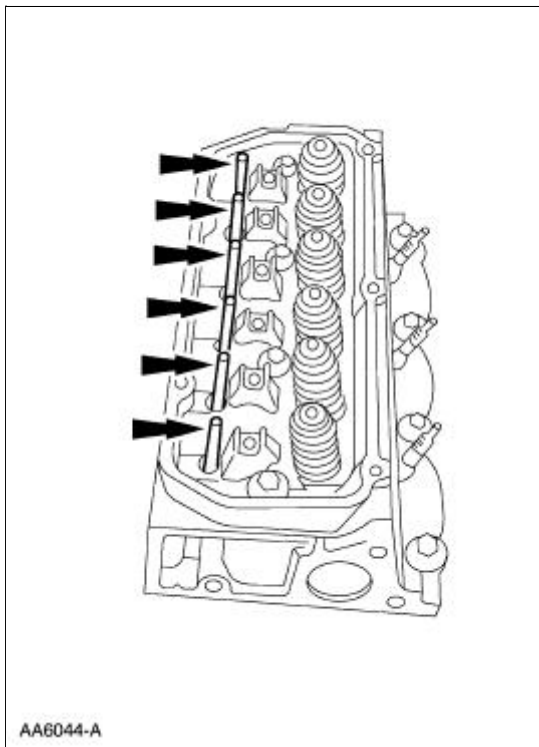
40.  **CAUTION:** If the components are to be reinstalled, they must be installed into the same position. Mark the components for location.

Remove the LH rocker arms.

1. Remove the bolts.
2. Remove the rocker arms.

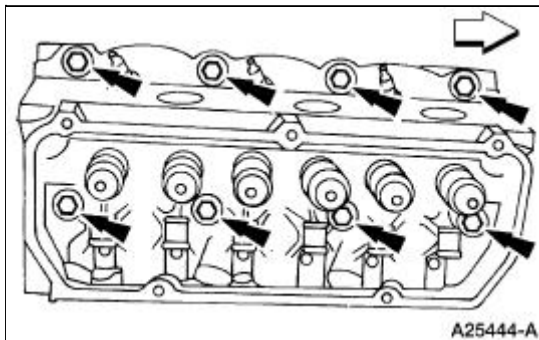


41. Remove the LH push rods.

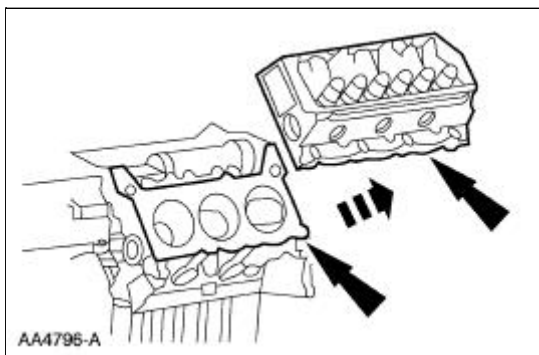


42. **NOTE:** Record the location of the long bolts and the short bolts.

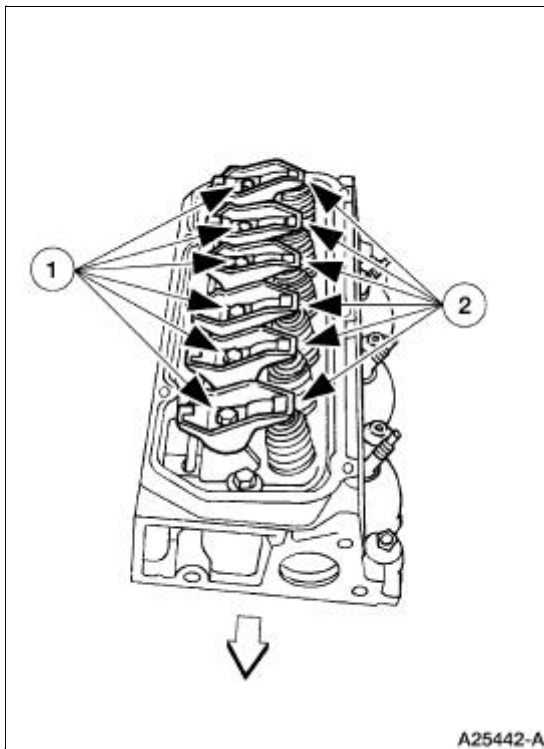
Remove and discard the LH cylinder head bolts.



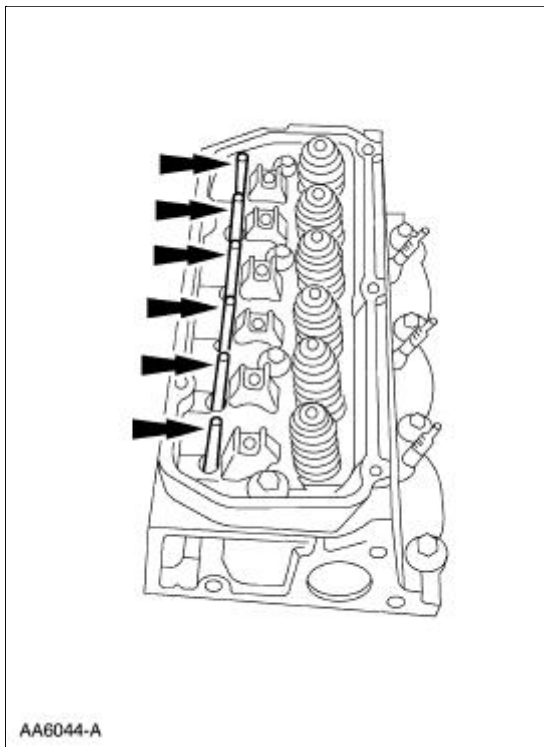
43. Remove the LH cylinder head and gasket. Discard the gasket.



44. Remove the RH rocker arms.
1. Remove the bolts.
2. Remove the rocker arms.

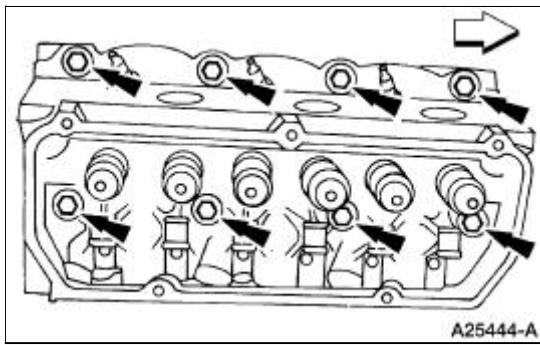


45. Remove the RH push rods.

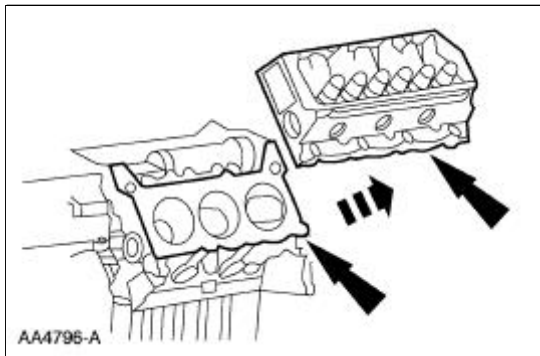


46. **NOTE:** Record the location of the long bolts and the short bolts.

Remove and discard the RH cylinder head bolts.

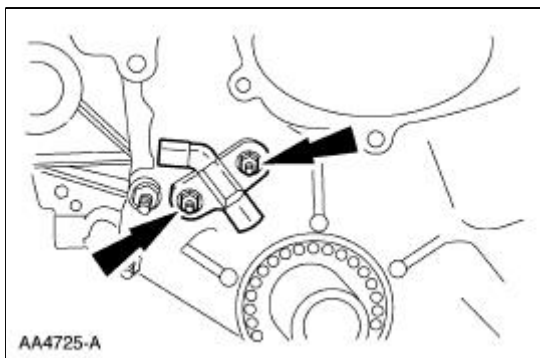


47. Remove the RH cylinder head and gasket. Discard the gasket.

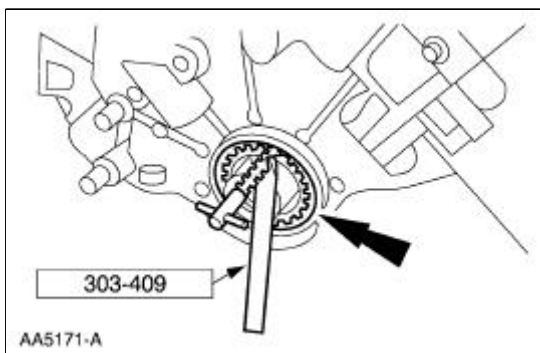


48. Remove the camshaft synchronizer. For additional information, refer to [Section 303-14](#).

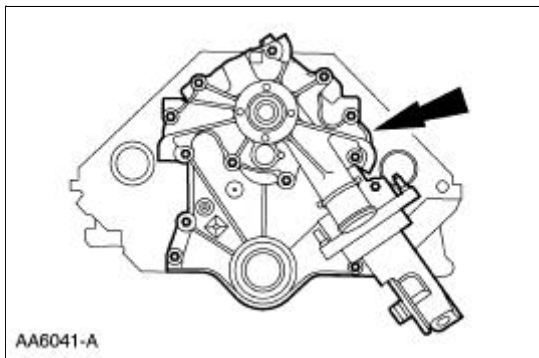
49. Remove the bolts and the crankshaft position sensor.



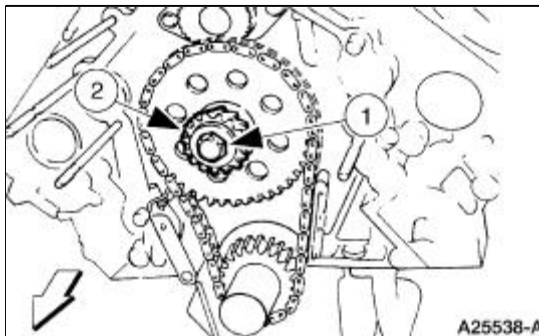
50. Using the special tool, remove the crankshaft front seal.



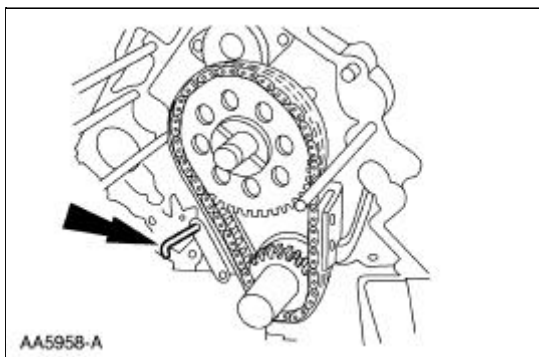
51. Remove the bolts and the front cover assembly and gasket.



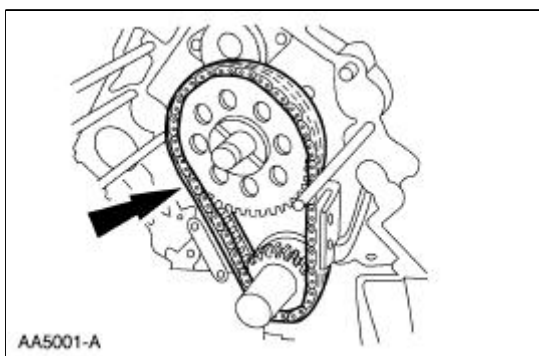
52. Remove the camshaft position sensor drive gear.
1. Remove the bolt.
 2. Remove the camshaft position sensor drive gear.



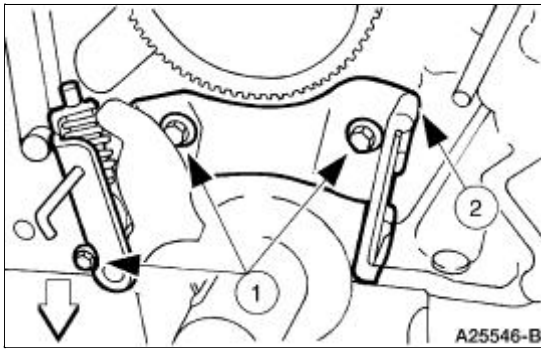
53. Compress and install a retaining pin to hold the timing chain tensioner.



54. Remove the camshaft sprocket, the crankshaft sprocket and the timing chain as an assembly.

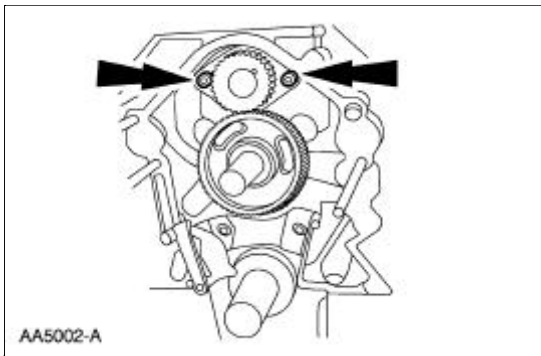


55. Remove the timing chain tensioner.
1. Remove the bolts.
 2. Remove the timing chain tensioner.



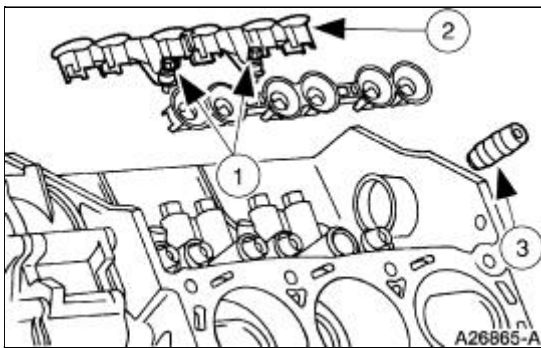
56. Remove the engine dynamic balance shaft.

- Remove the bolts.
- Remove the balance shaft driven gear, thrust plate and engine dynamic balance shaft as an assembly.



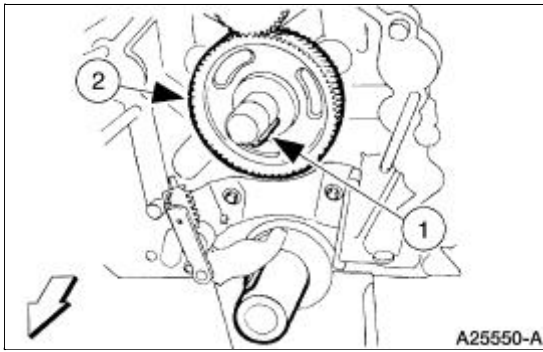
57. Remove the valve tappets.

1. Remove the bolts.
2. Remove the tappet guide plates and retainers.
3. Remove the valve tappets.

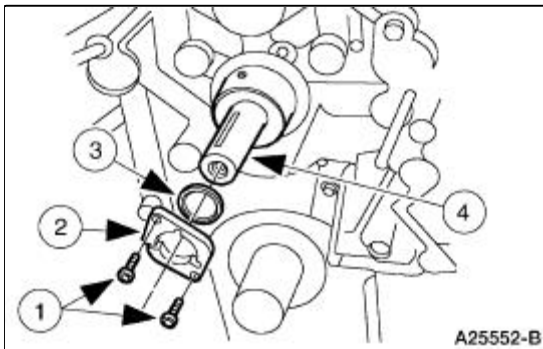


58. Remove the engine balance shaft drive gear.

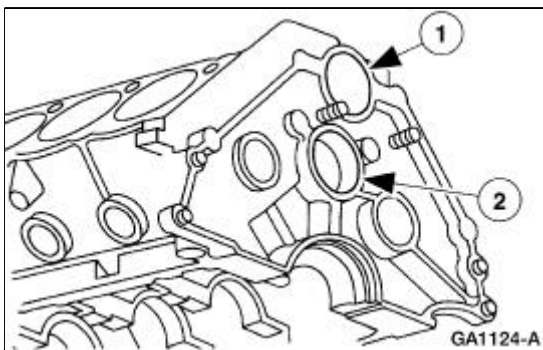
1. Remove the camshaft keyway.
2. Remove the gear.



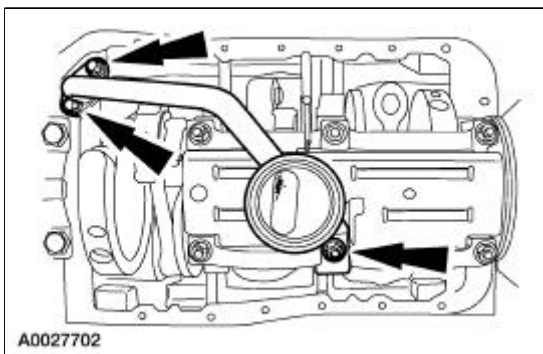
59. Remove the camshaft.
1. Remove the bolts.
 2. Remove the camshaft thrust plate.
 3. Remove the spacer.
 4. Remove the camshaft.



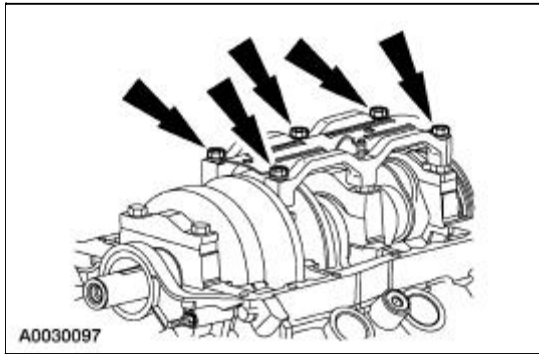
60. Remove the bearing covers.
1. Remove the engine dynamic balance shaft bearing cover.
 2. Remove the camshaft bearing cover.





61. Remove the oil pump screen cover and tube.




62. Remove the oil pan bridge and baffle assembly.




63.  **CAUTION:** The connecting rods and bearings are matched to the crankshaft journals. Make sure the components are marked and installed in the correct location.

 **CAUTION:** Each connecting rod and connecting rod cap are matched sets. They will fit together only one way. Mark them before removing.

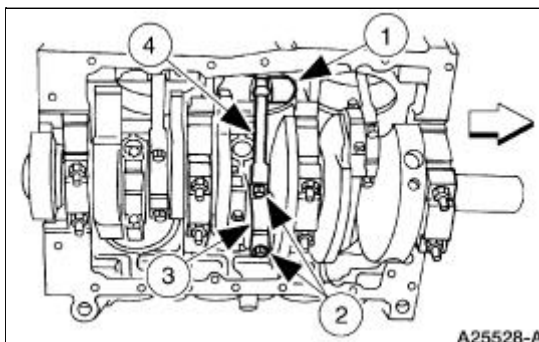
 **CAUTION:** Care should be taken not to damage the connecting rod and the connecting rod cap fractured joint face surface or engine damage may occur.

NOTE: Before removing the pistons, inspect the top of the cylinder bores. If necessary, remove the ridge or carbon deposits from each cylinder, using a cylinder ridge reamer and following the manufacturer's instructions.


Remove the pistons.

1. Make sure the piston being removed is at the bottom of the cylinder bore.
2. Remove the bolts.
3. Remove the connecting rod cap and the lower connecting rod bearing.
4.  **CAUTION:** Be careful to avoid damage to the cylinder wall when removing the piston.

Push the piston and the connecting rod out of the cylinder.



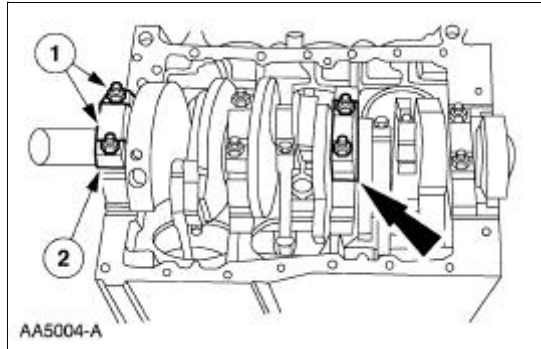
64. Repeat the removal steps for the remaining pistons.

65.  **CAUTION:** The crankshaft main bearings and the main bearing caps are matched to the crankshaft journals. Make sure the components are marked for position.

NOTE: The crankshaft main bearing located at the rear main bearing cap is the thrust bearing.

Remove the four main bearing caps and lower crankshaft main bearings.

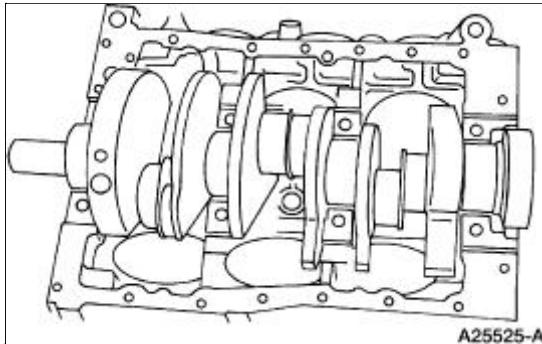
1. Remove the stud bolts.
2. Remove the main bearing cap and the lower crankshaft main bearing.



66. Repeat the main bearing cap and the lower bearing removal steps for the remaining main bearing caps and the crankshaft lower main bearings.

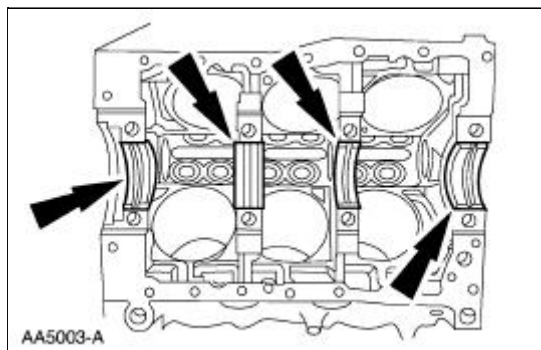
67.  **CAUTION: The crankshaft journals must be protected from damage when the crankshaft is removed.**

Remove the crankshaft and the crankshaft rear seal.

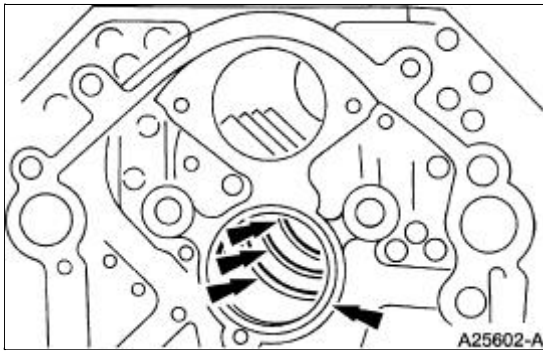


68. **NOTE:** For ease in assembly, record the location of the crankshaft upper thrust bearing.

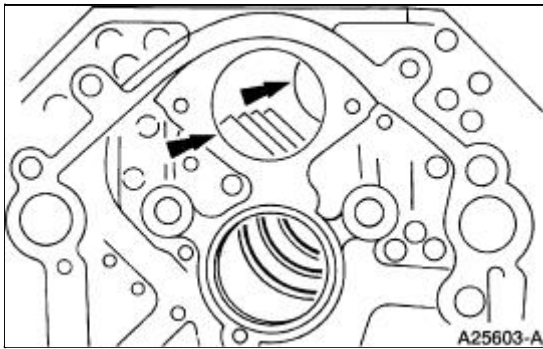
Remove the crankshaft upper main bearings and the crankshaft upper thrust bearing.



69. Using the camshaft bearing service set, remove the camshaft bearings.



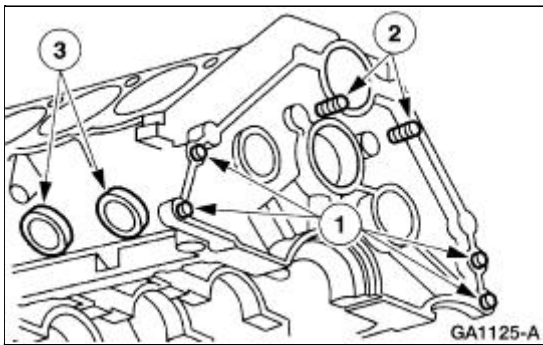
70. Using the camshaft bearing service set, remove the engine dynamic balance shaft bearings.



71. If equipped, remove the engine block heater. For additional information, refer to [Section 303-03A](#).
72. **NOTE:** For cleaning purposes, the plugs should be removed.

If necessary, remove the following:

1. the cylinder block dowels.
2. the oil gallery plugs.
3. the water jacket plugs.



Cylinder Head


Special Tool(s)

 ST1383-A	Compressor, Valve Spring 303-163 (T81P-6513-A)
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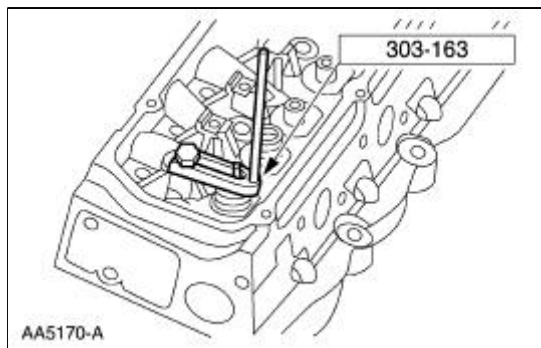
Material

Item	Specification
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

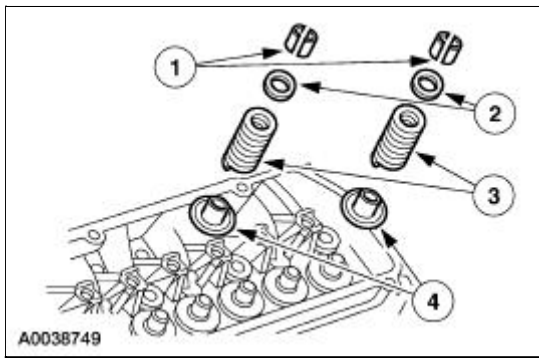
Disassembly and Assembly

 **CAUTION:** If the components are to be reinstalled, they must be installed in the same position. Mark the components removed for location.

1. Remove the spark plugs (12405) if necessary.
2. Using the special tool, compress the valve springs (6513).



3. Remove the following:
 1. The valve spring retainer key (6518).
 2. The valve spring retainers (6514).
 3. The valve springs (6513).
 4. The valve stem seals and seats (6A517).




4. Inspect the components. For additional information, refer to [Section 303-00](#).

5.  **CAUTION: Lubricate the parts with clean engine oil before installing.**

To assemble, reverse the disassembly procedure.

Piston

Special Tool(s)

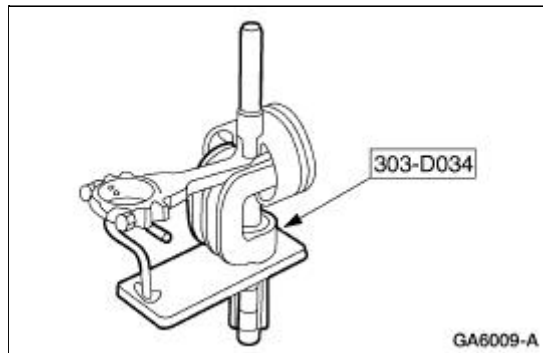
 ST1336-A	Piston Pin Tool or equivalent 303-D034 (D81L-6135-A)
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Material

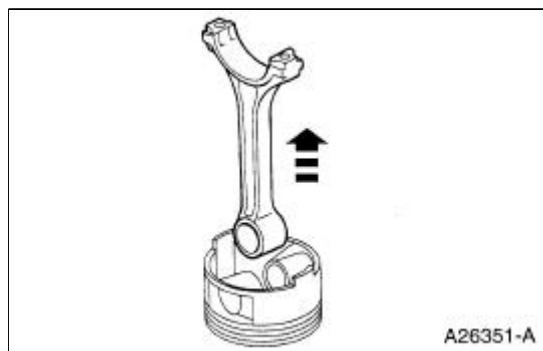
Item	Specification
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Disassembly

1. Using the special tool, press the piston pin out from the connecting rod and piston assembly.



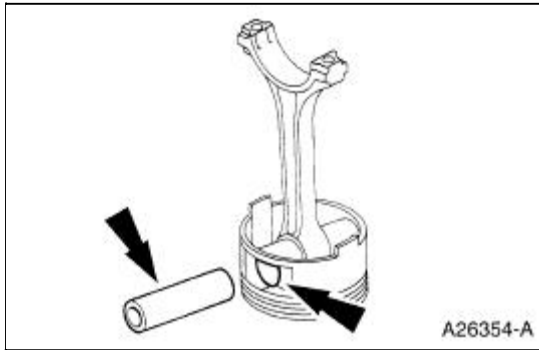
2. Remove the connecting rod from the piston.



3. Clean and inspect the connecting rod and piston. For additional information, refer to [Section 303-00](#).

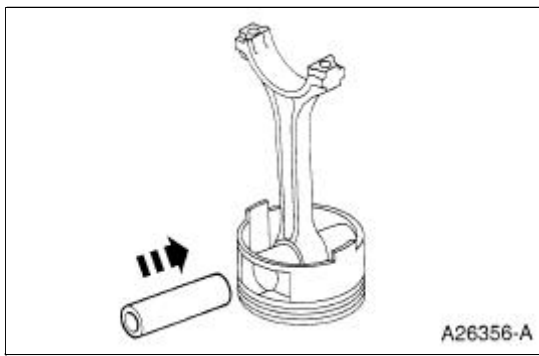
Assembly

1. Lubricate the piston pin and piston pin bore with clean engine oil.

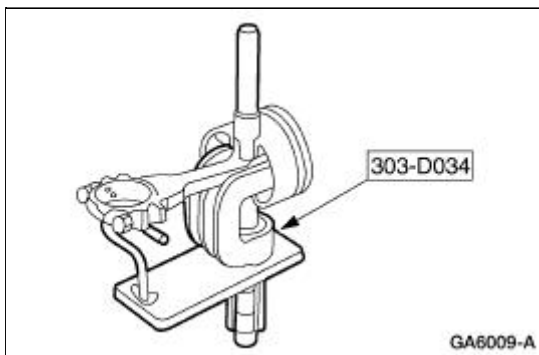


2. **NOTE:** The connecting rod can be installed in either direction.

Position the piston pin in the bore aligned with the connecting rod bore.











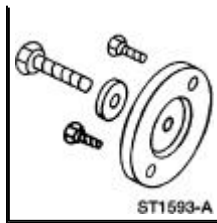
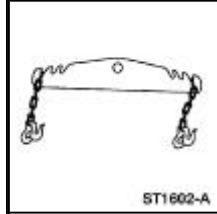
3. Using the special tool, press the piston pin into the piston and rod assembly.



Engine


Special Tool(s)


 <p>ST1185-A</p>	<p>Slide Hammer 307-005 (T59L-100-B)</p>
 <p>ST1378-A</p>	<p>Remover Adapter, Vibration Damper 303-176 (T82L-6316-B)</p>
 <p>ST1379-A</p>	<p>Installer, Crankshaft Front Seal 303-474 (T94P-6701-AH)</p>
	<p>Replacer, Steering Pump Pulley 211-009 (T65P-3A733-C)</p>
 <p>ST2337-A</p>	<p>Engine Lift Bracket Set 303-D095 (D94L-6001-A)</p>
 <p>T95P-6701-BH ST1059-A</p>	<p>Replacer, Rear Crankshaft Seal 303-516 (T95P-6701-BH)</p>
 <p>T96T-6701-B ST1058-A</p>	<p>Spacer, Rear Crank Seal Replacer 303-561 (T96T-6701-B)</p>
 <p>T95P-6701-DH ST1060-A</p>	<p>Adapter, Crankshaft Rear Seal (Use only the adapter retaining bolts) 303-518 (T95P-6701-DH)</p>

 <p>ST1593-A</p>	<p>Adapter, Crankshaft Rear Seal (Use only the adapter and the center jack screw) 303-S560 (T96T-6701-A)</p>
 <p>ST1602-A</p>	<p>Spreader Bar 303-D089 (D93P-6001-A3)</p>

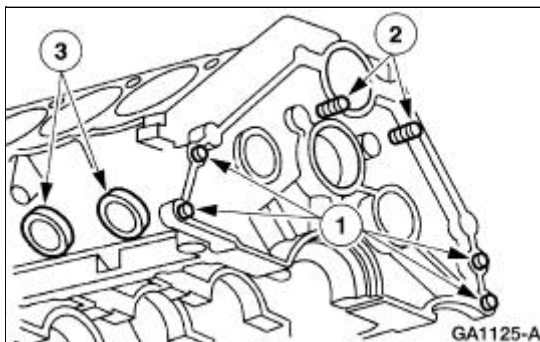
Material

Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H
Pipe Sealant with Teflon® XW7Z-19554-AA	WSK-M2G350-A2

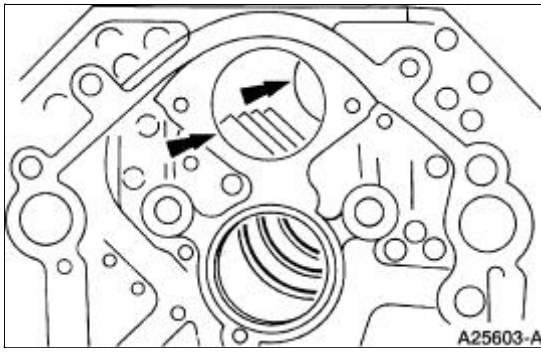
 **CAUTION:** The moving components must be lubricated with clean engine oil before assembly.

 **CAUTION:** The components with oil holes must be correctly aligned with the oil feed holes.

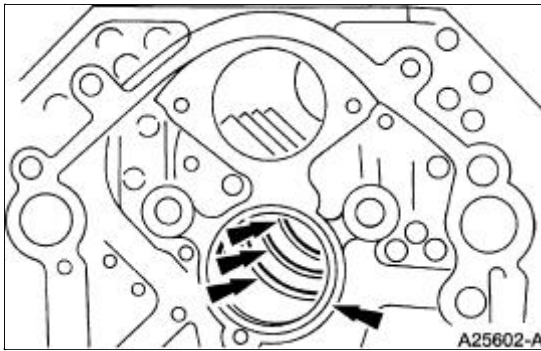
1. If necessary, install the following:
 1. the cylinder block dowels.
 2. the oil gallery plugs.
 3. the water jacket plugs.



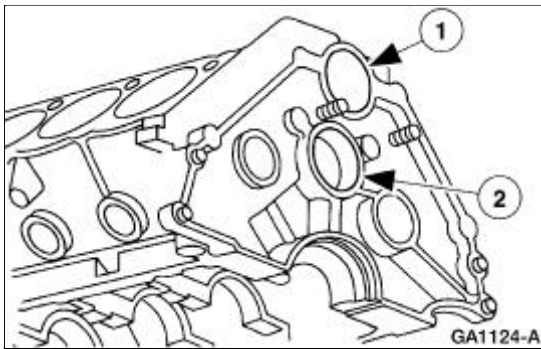
2. If equipped, install the engine coolant heater. For additional information refer to [Section 303-03A](#).
3. Using the camshaft bearing service set, install the engine dynamic balance shaft bearings.



4. Using the camshaft bearing service set, install the camshaft bearings.

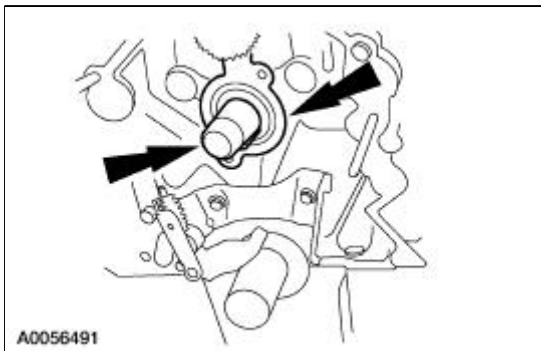


5. Install the following:
1. the engine dynamic balance shaft bearing cover.
 2. the camshaft bearing cover.

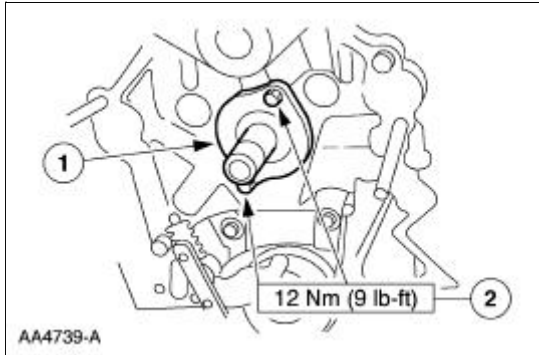


6.  **CAUTION: Do not damage the camshaft lobes when installing the camshaft.**

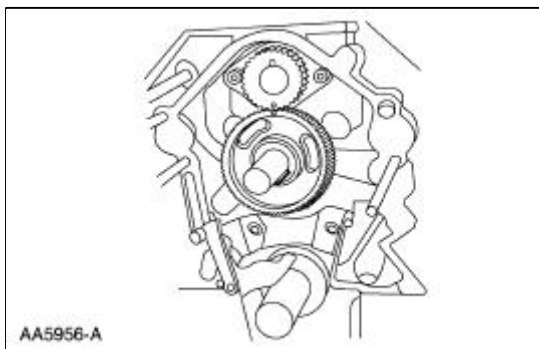
Install the camshaft and the camshaft spacer.



7. Install the camshaft thrust plate.
 1. Position the camshaft thrust plate.
 2. Install the bolts.

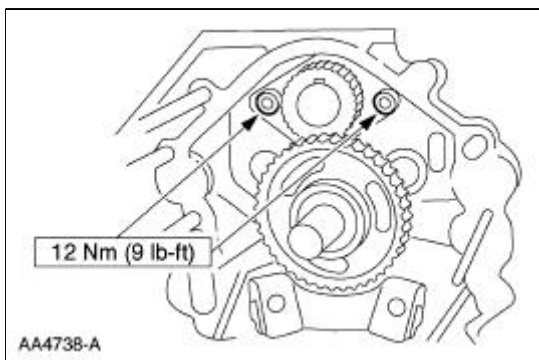


8. Turn the camshaft so that the timing mark is at 12 o'clock and install the engine dynamic balance shaft assembly into the cylinder block. Turn the engine balance shaft driven gear so that the timing mark aligns up with the timing mark on the engine balance shaft drive gear.



9. **NOTE:** If correctly aligned, the engine dynamic balance shaft keyway will be at 12 o'clock and the camshaft keyway will be at 6 o'clock on the camshaft.

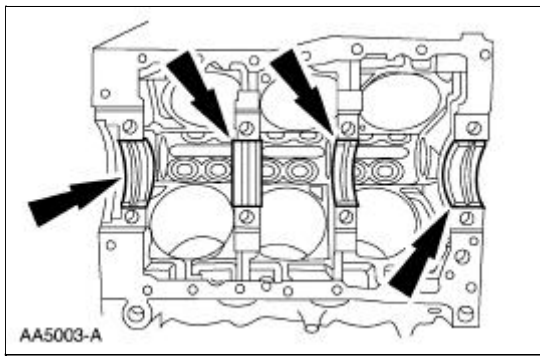
Install the bolts.



10.  **CAUTION: Make sure the components are installed in the correct location.**

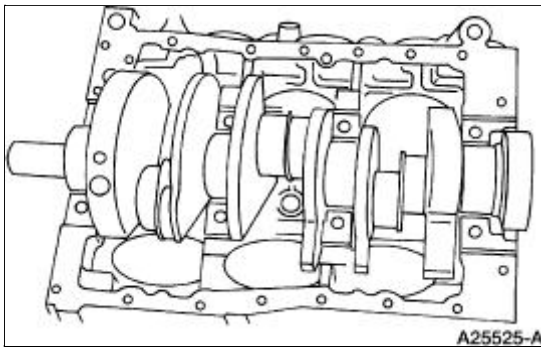
NOTE: Lubricate the crankshaft main bearings prior to installation.

Install the crankshaft upper main bearings and the crankshaft upper thrust main bearing.



11.  **CAUTION:** The crankshaft journals must be protected from damage when installing the crankshaft.

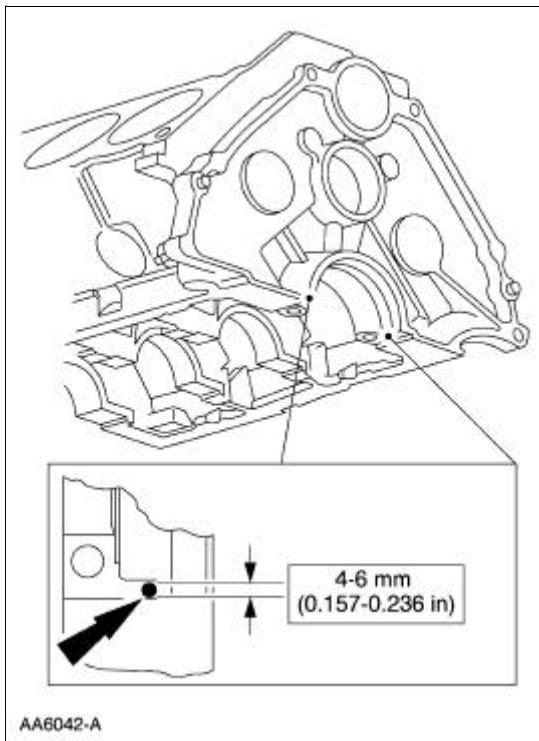
Position the crankshaft.



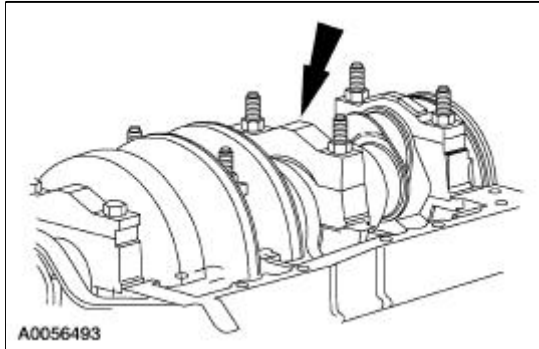
-  **CAUTION:** The main bearings are precision selective fit. Inspect the bearing clearance. For additional information, refer to [Section 303-00](#).

12. **NOTE:** If the rear main bearing cap is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

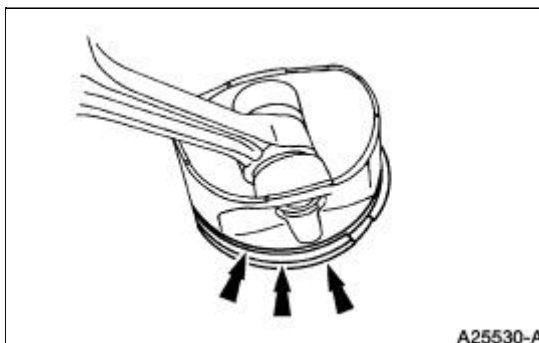
Clean the rear main bearing cap sealing area with metal surface cleaner. Apply silicone gasket and sealant to the rear main bearing cap-to-cylinder block parting line.




13. Install the main bearing caps. Tighten the bolts in two stages:
- Stage 1: Tighten to 50 Nm (37 lb-ft).
 - Stage 2: Rotate an additional 120 degrees.



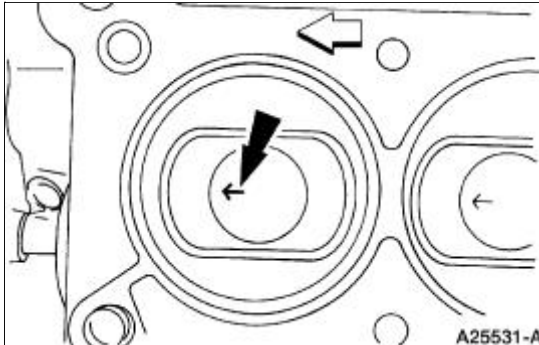
14. Compress the piston rings.



15.  **CAUTION:** Inspect the piston clearance. For additional information, refer to [Section 303-00](#).

 **CAUTION:** Do not damage the cylinder wall with the sharp edges of the connecting rod.

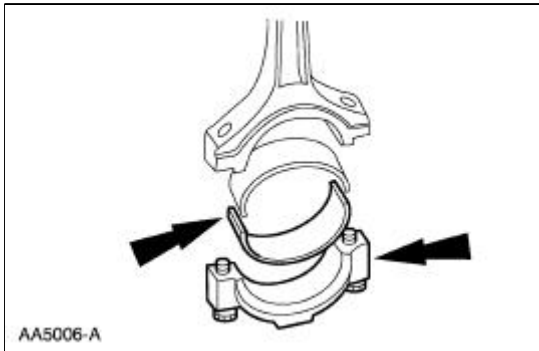
Install the piston with the arrow on the piston face pointing toward the front of the engine.



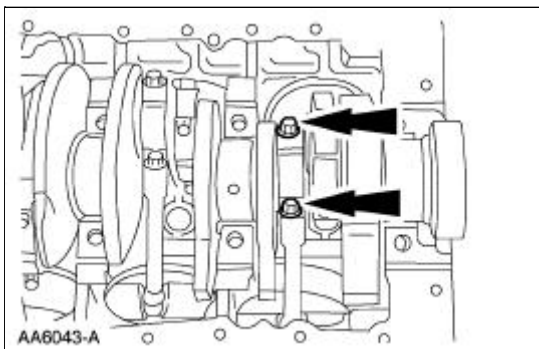
16.  **CAUTION:** Inspect the connecting rod bearing clearance. For additional information, refer to [Section 303-00](#).

 **CAUTION:** The connecting rod cap will fit only one way.

Position the connecting lower rod bearing and the connecting rod cap on the connecting rod and the crankshaft journal.

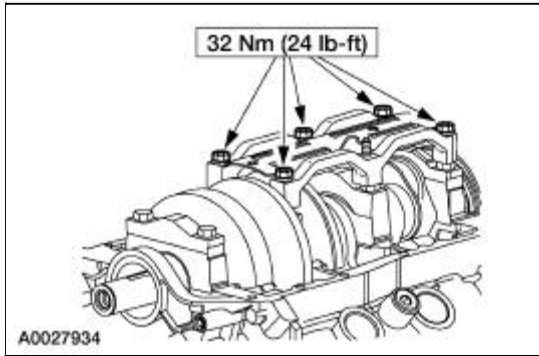


17. Install the rod caps. Tighten the bolts in three stages:
- Stage 1: Tighten to 25 Nm (18 lb-ft).
 - Stage 2: Tighten to 45 Nm (33 lb-ft).
 - Stage 3: Tighten an additional 105 degrees.

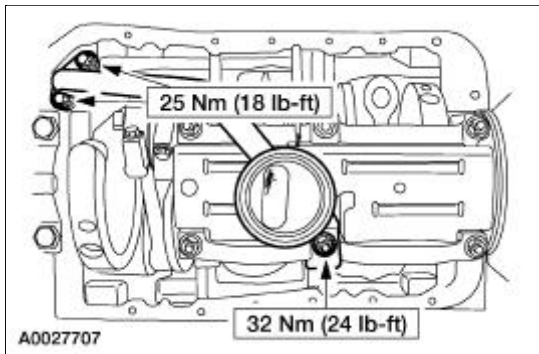


18. Install the remaining pistons and the connecting rods.

19. Install the oil pan bridge and baffle assembly.

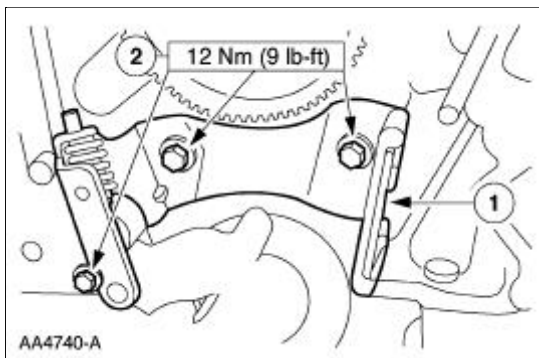


20. Using a new gasket, install the oil pump screen cover and tube.



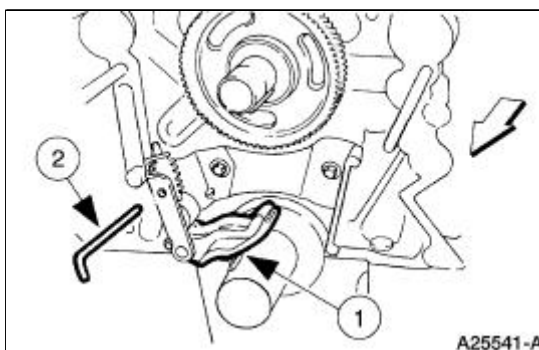
21. Install the timing chain tensioner.

1. Position the timing chain tensioner.
2. Install the bolts.

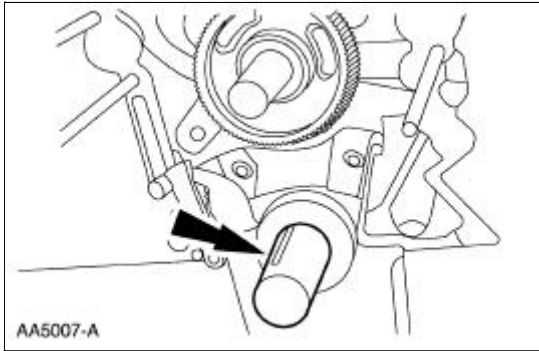


22. Retract the tensioner pad retracting mechanism.

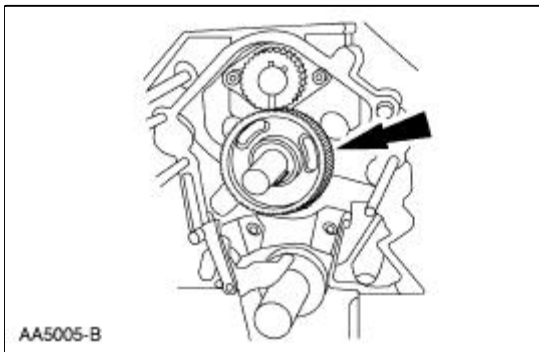
1. Compress the tensioner pad retracting mechanism.
2. Insert a retaining pin.



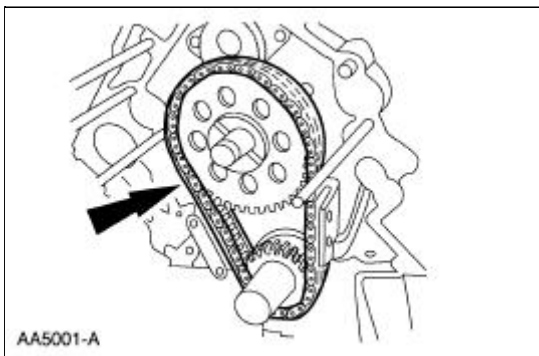
23. Rotate the crankshaft so the number one piston is at top dead center (TDC) and the key is at the 12 o'clock position.



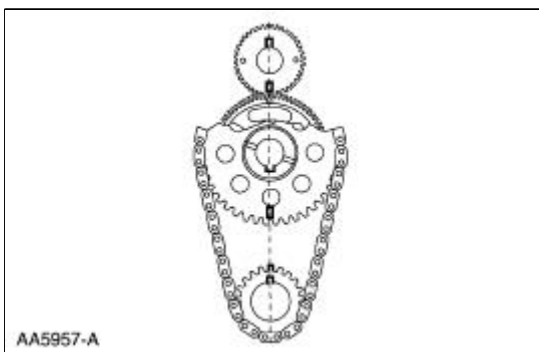
24. Turn the camshaft sprocket so that the keyway is on the bottom of the camshaft.



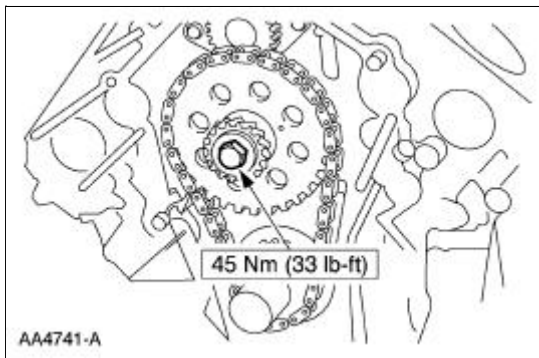
25. Install the timing chain, the camshaft sprocket and the crankshaft sprocket as an assembly.



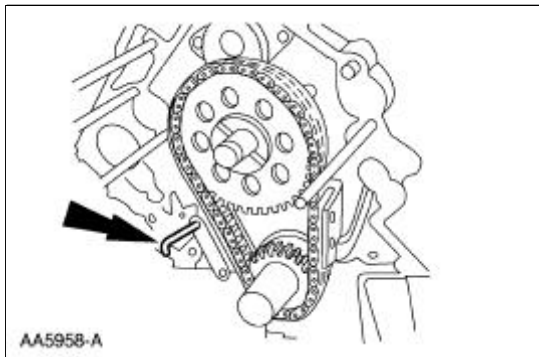
26. Make sure the timing marks and the keyways are aligned.



27. Install the camshaft position sensor drive gear and retaining bolt.



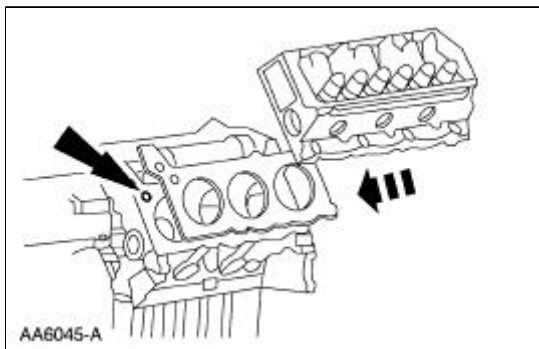
28. Remove the retaining pin.



⚠ CAUTION: The components removed should be marked for location. Make sure the used parts are installed in the correct location.

29. **NOTE:** Install the new cylinder head gaskets with the small hole to the front of the engine.

Using new gaskets, install the RH and the LH cylinder heads.

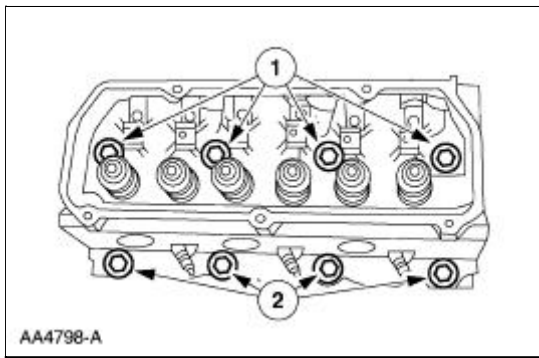


30. **⚠ CAUTION:** Always use new bolts.

NOTE: Lubricate the bolts with clean engine oil prior to installation.

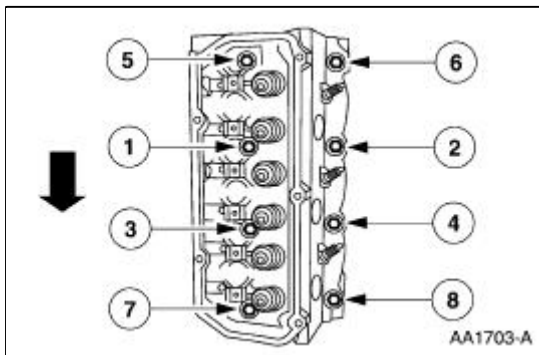
Position the new bolts.

1. Position the new long bolts.
2. Position the new short bolts.



31. Tighten the bolts in three stages in the sequence shown:

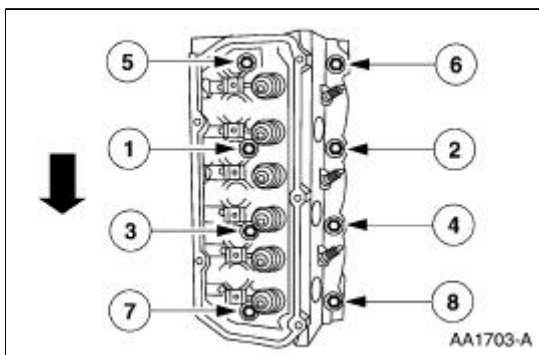
- Stage 1: Tighten to 20 Nm (15 lb-ft).
- Stage 2: Tighten to 40 Nm (30 lb-ft).
- Stage 3: Tighten to 50 Nm (37 lb-ft).



32.  **CAUTION: Do not loosen all of the bolts at one time. Each bolt must be loosened and tightened prior to working on the next bolt in the sequence.**

Tighten the bolts in four stages in the sequence shown: short bolts numbered 2, 4, 6 and 8:

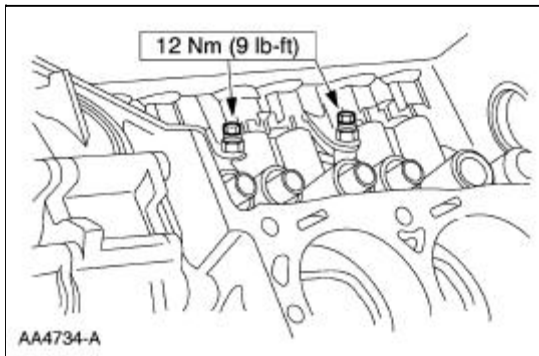
- Stage 1: Tighten to 25 Nm (18 lb-ft).
- Stage 2: Tighten an additional 180 degrees.
Long bolts numbered 1, 3, 5 and 7:
- Stage 3: Tighten to 45 Nm (33 lb-ft).
- Stage 4: Tighten an additional 180 degrees.



33. **NOTE:** Lubricate the valve tappets with clean engine oil prior to installing.

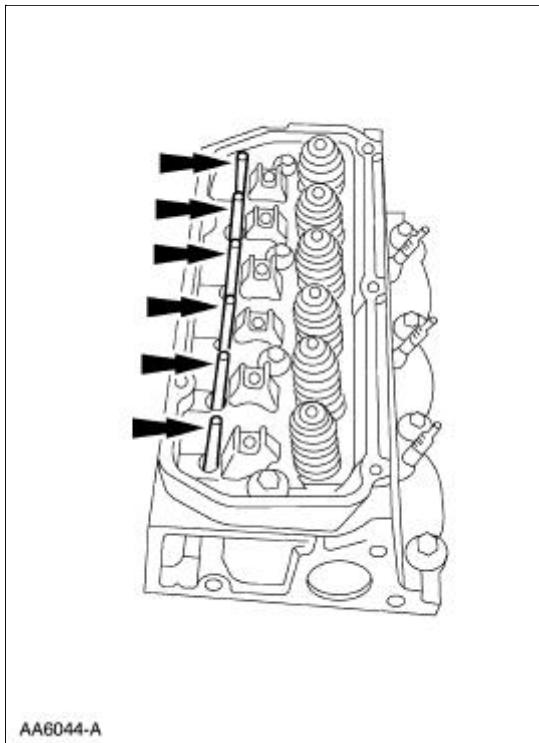
Install the valve tappets.

- Install the valve tappets.
- Install the tappet guide plates and retainers.
- Install the bolts.



34. **NOTE:** Lubricate the push rods with clean engine oil prior to installation.

Install the 12 push rods.



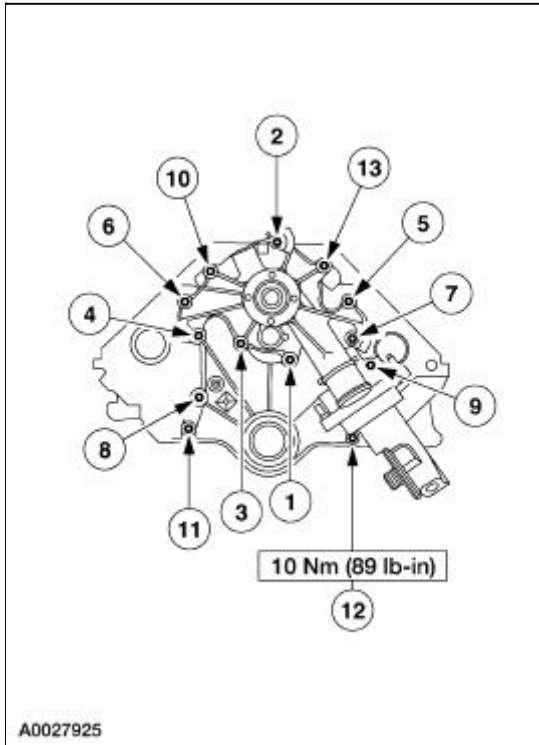
35. Install the 12 rocker arms. For additional information, refer to [Rocker Arm](#) in this section.

36. **NOTE:** Use pipe sealant with Teflon® on studs No. 4 and 6, and bolt No. 12.

Using a new gasket, install the engine front cover. Tighten the nuts and the bolts in the sequence shown.

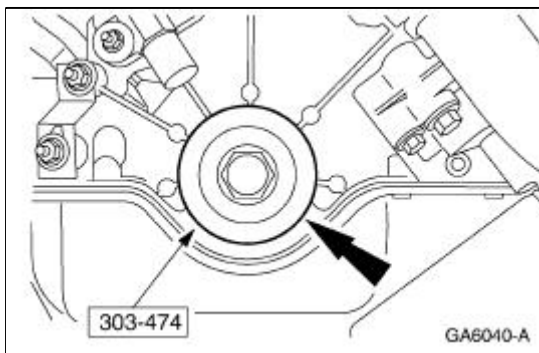
- Install a 135.5 mm (5.42 in) stud at location No. 5 and tighten to 7 Nm (62 lb-in).
- Install a 137 mm (5.48 in) stud at locations No. 4, 6, 7 and 10, and tighten to 7 Nm (62 lb-in).
- Using a new gasket, install the water pump.
- Tighten bolt No. 12 to 10 Nm (89 lb-in). All other nuts and bolts are to be tightened to 28

Nm (21 lb-ft).

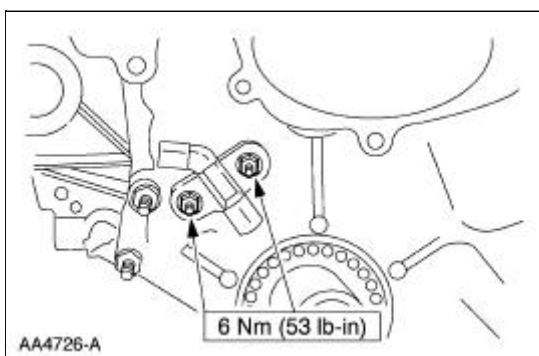


37. **NOTE:** Lubricate the parts with clean engine oil before assembly.

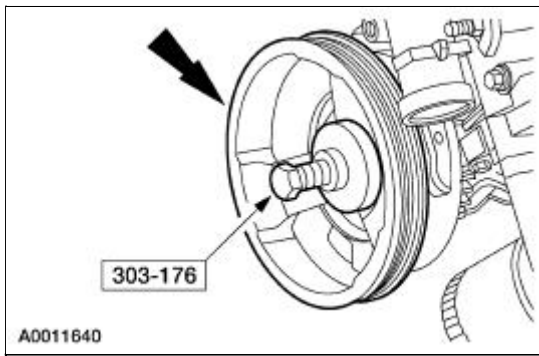
Using the special tool, install the front crankshaft seal.



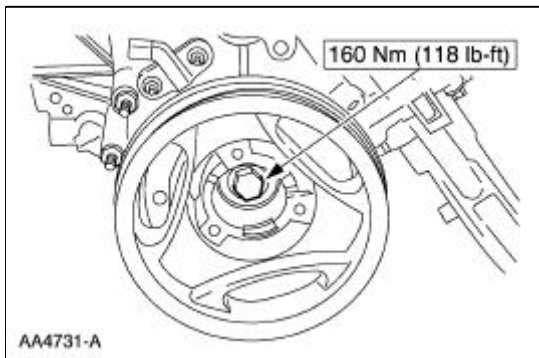
38. Install the crankshaft position sensor.



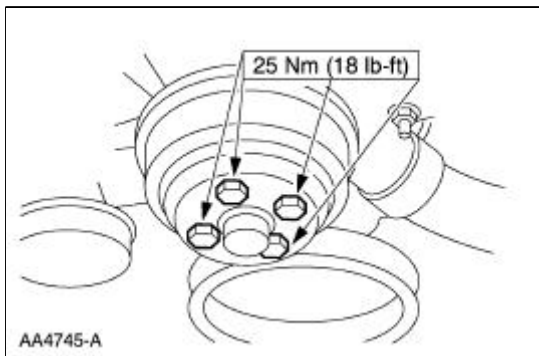
39. Apply a bead of silicone gasket and sealant to the keyway in the crankshaft damper. Using the special tool, position and install the crankshaft damper.



40. Install the crankshaft pulley bolt.



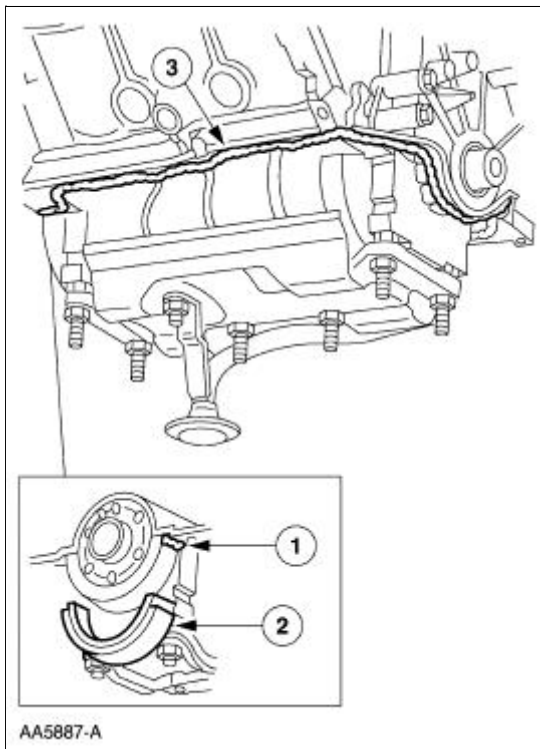
41. Install the camshaft synchronizer. For additional information, refer to [Section 303-14](#) .
42. Install the water pump pulley and the retaining bolts.



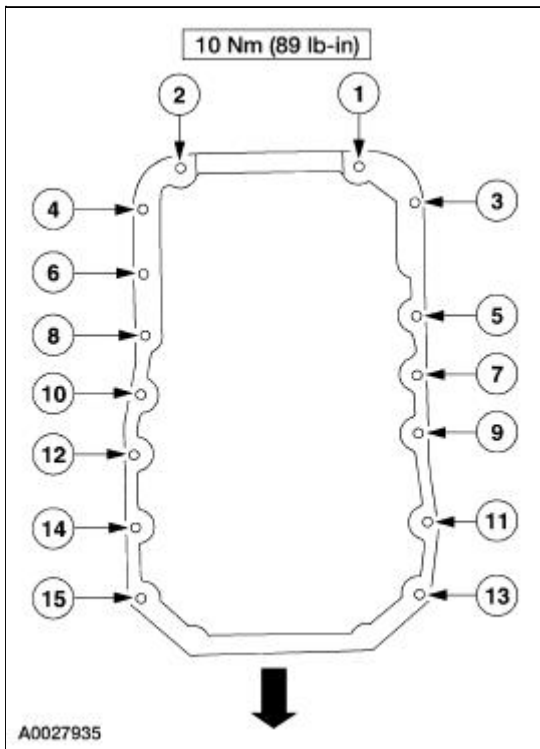
43. **NOTE:** If the oil pan is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

Clean and apply the sealant to the oil pan sealing areas shown and install the oil pan rear seal.

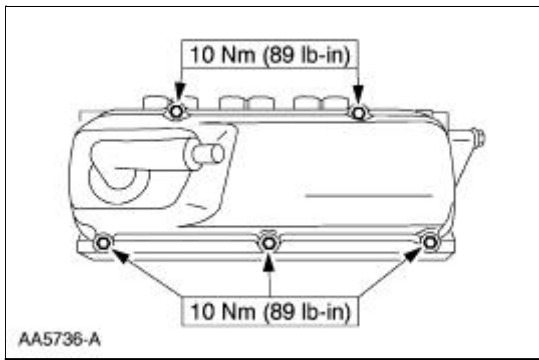
1. Apply silicone gasket and sealant to the rear main bearing cap.
2. Install the oil pan rear seal.
3. Clean the oil pan mating surfaces with metal surface cleaner and apply silicone gasket and sealant to the oil pan mating surface.



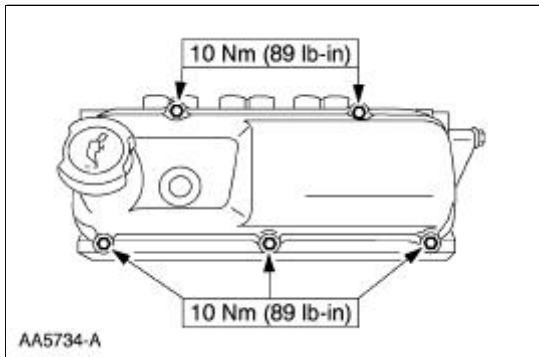
44. Tighten the oil pan bolts in the sequence shown.



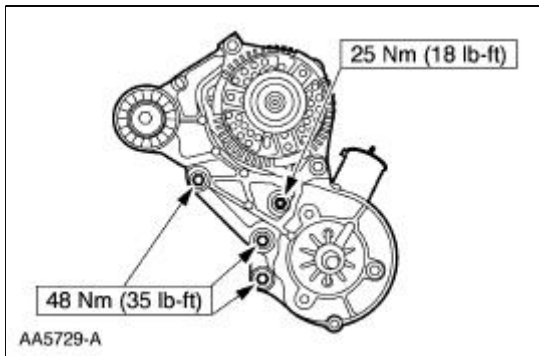
45. Install the RH valve cover.



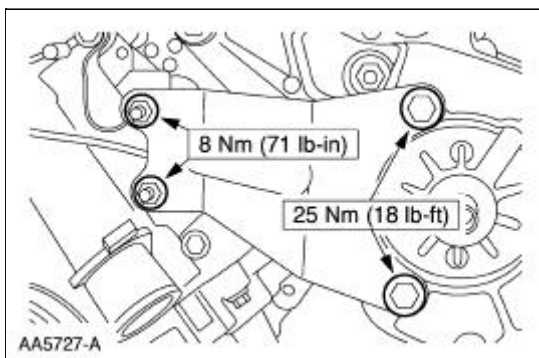
46. Install the LH valve cover.



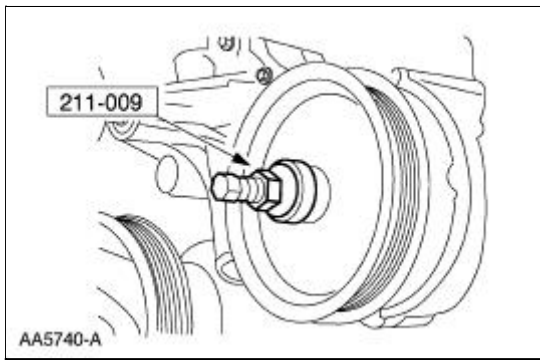
47. Install the generator mounting bracket.



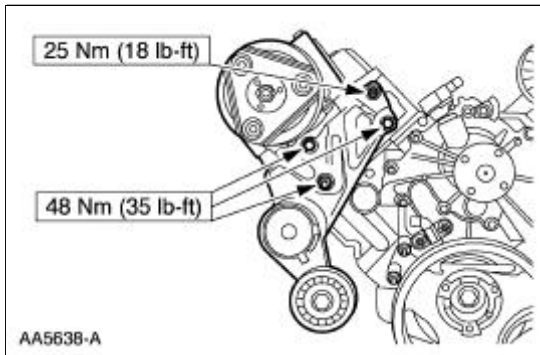
48. Install the power steering pump bracket.



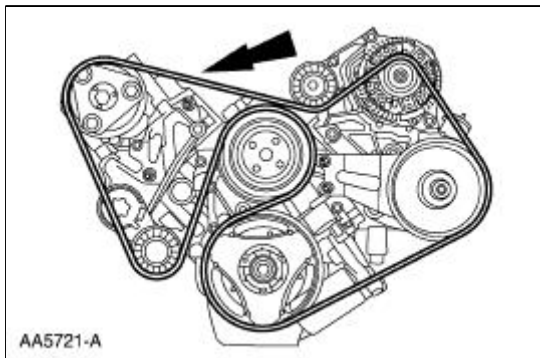
49. Using the special tool, install the power steering pump pulley.



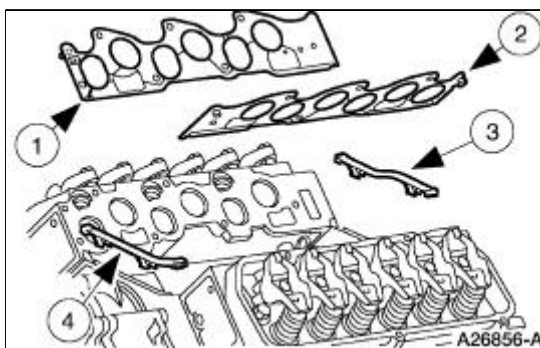
50. Install the A/C compressor bracket and the bolts.



51. Install the accessory drive belt.



52. Refer to the illustration for intake manifold sealing components.

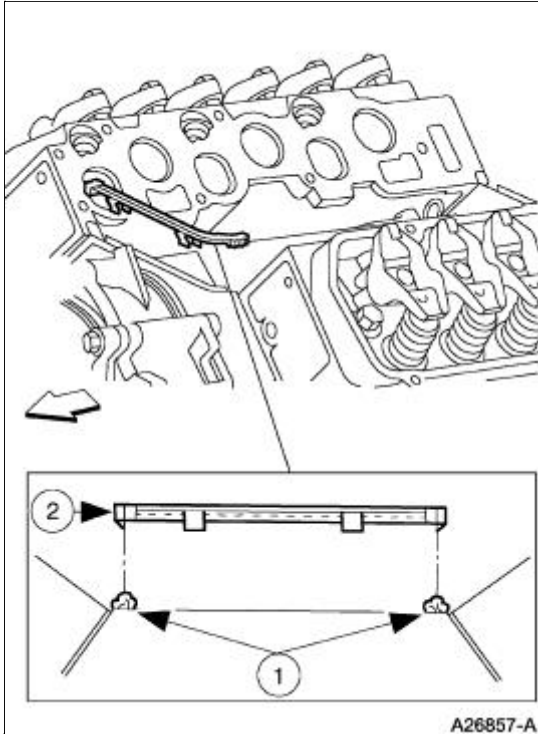


Item	Part Number	Description
1	9439	Intake manifold gasket, RH
2	9441	Intake manifold gasket, LH
3	9A424	Intake manifold rear end seal (part of 9439)

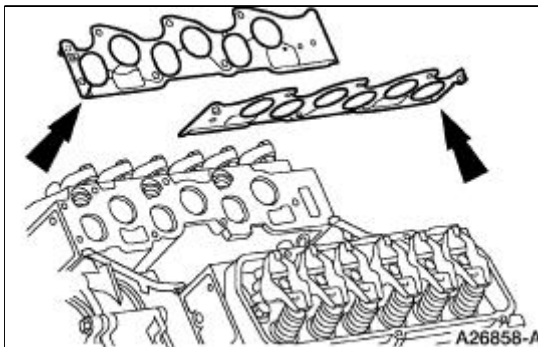
53. **NOTE:** If the lower intake manifold is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

Install the lower intake manifold front and rear end seals.

1. Apply a bead of silicone gasket and sealant to the intake manifold front and rear end seal mounting points as indicated.
2. Install the lower intake manifold front and rear end seals.



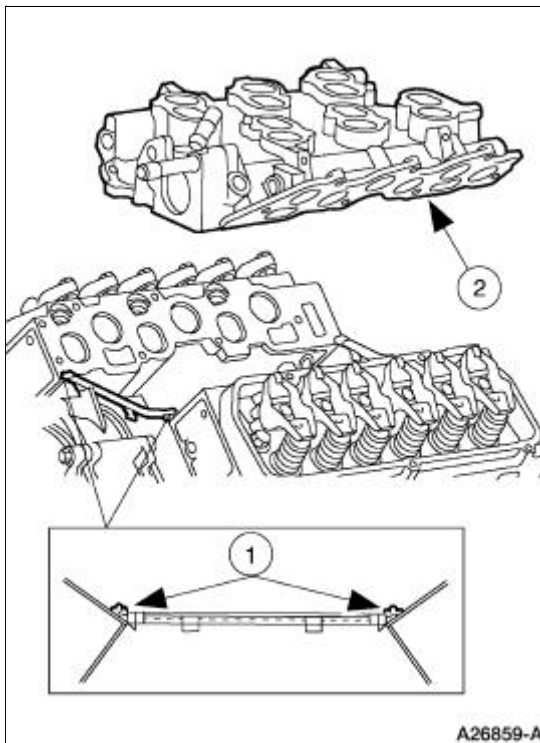
54. Install the intake manifold gaskets.



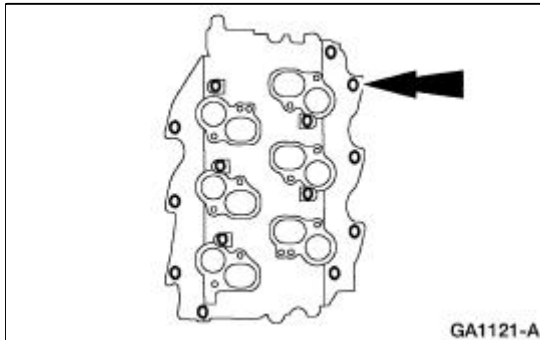
55. **NOTE:** If the lower intake manifold is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

Position the lower intake manifold.

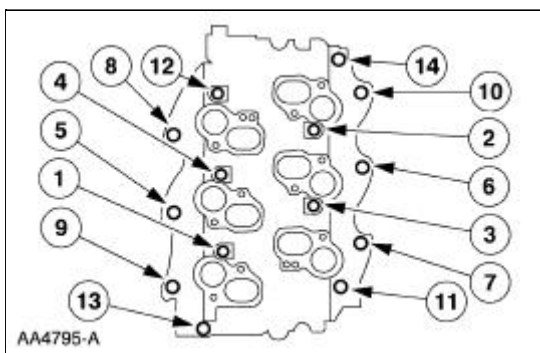
1. Apply a bead of silicone gasket and sealant to the lower intake manifold mounting at the points indicated.
2. Position the lower intake manifold.



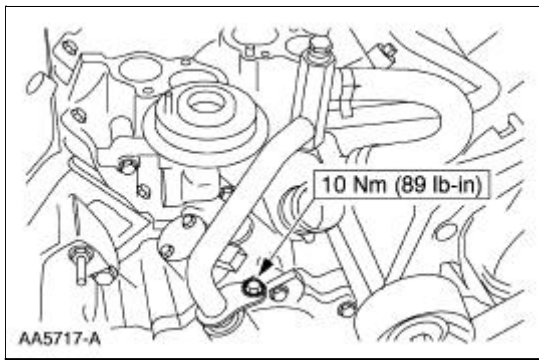
56. Install the lower intake manifold bolts.
- Install the six long bolts.
 - Install the eight short bolts.



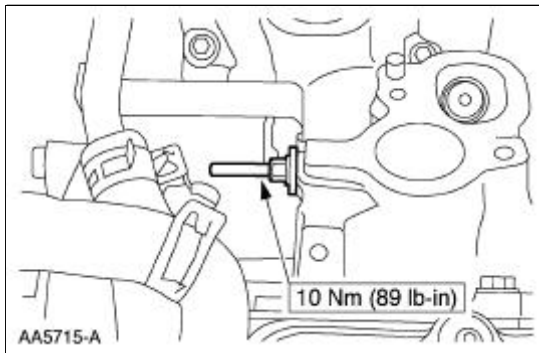
57. Tighten the bolts in two stages in the sequence shown.
1. Stage 1: Tighten to 5 Nm (44 lb-in).
 2. Stage 2: Tighten to 10 Nm (89 lb-in).



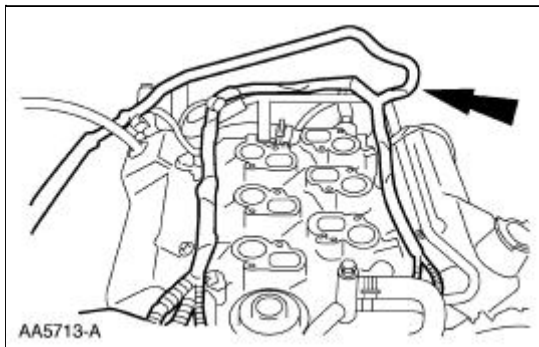
58. Install the heater water outlet tube.



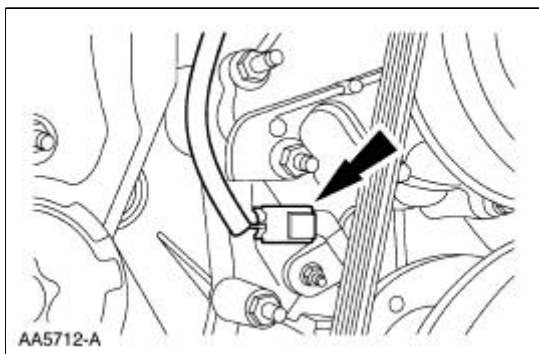
59. Install the stud bolt.



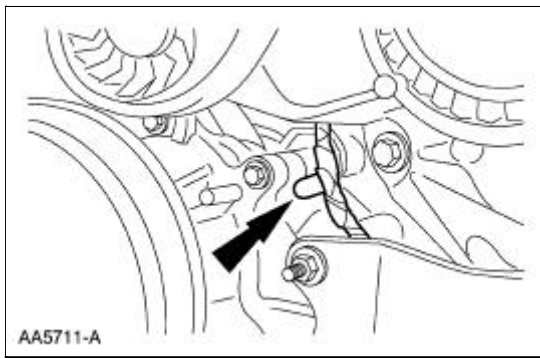
60. Position the engine wire harness.



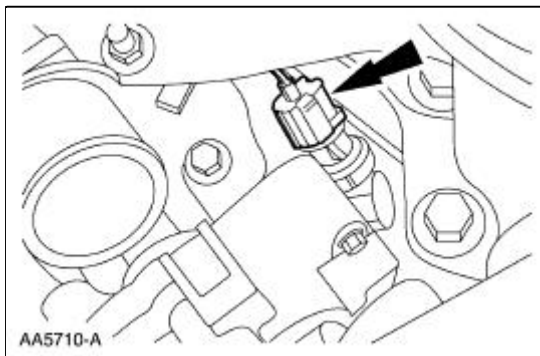
61. Connect the crankshaft position sensor electrical connector.



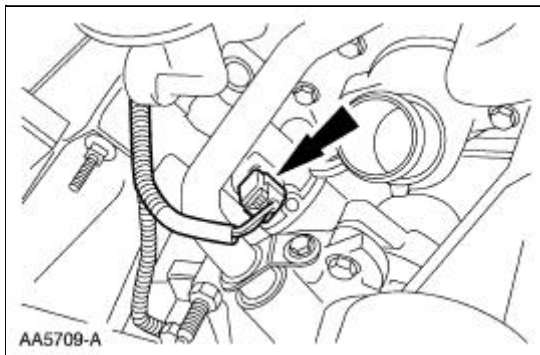
62. Install the pin-type retainer.



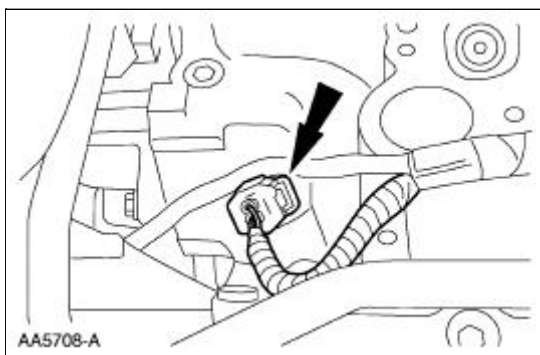
63. Connect the engine oil pressure sender electrical connector.



64. Connect the camshaft position (CMP) sensor electrical connector.

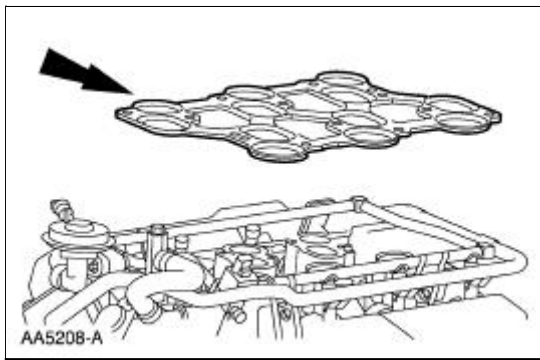


65. Connect the cylinder head temperature (CHT) sensor.



66. Install the fuel injectors and the fuel injection supply manifold as an assembly. For additional information, refer to [Section 303-04A](#).

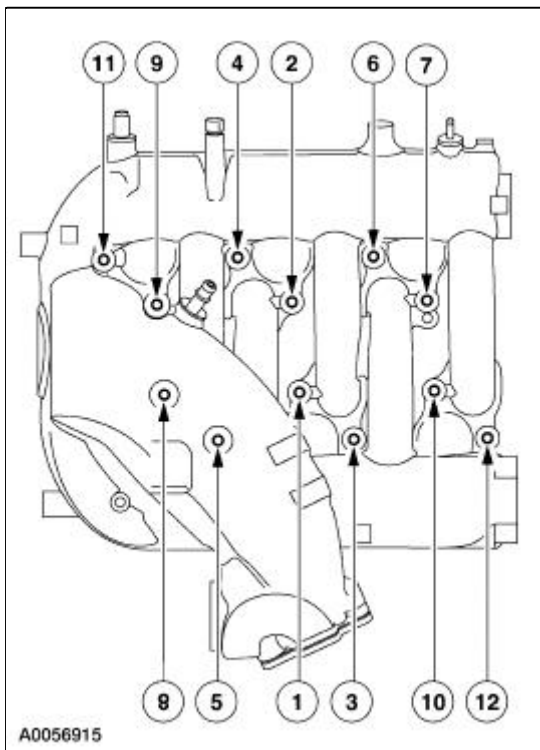
67. Install a new upper intake manifold gasket.



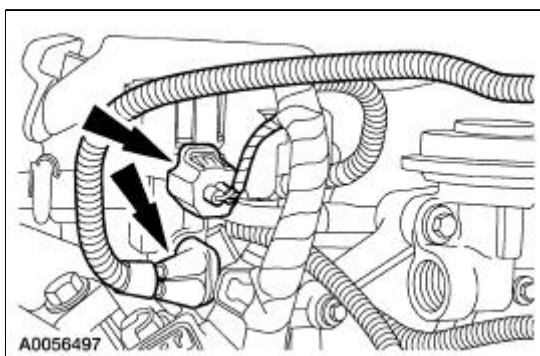
68. **NOTE:** Refer to the location note made during removal and make sure the bolts are installed in the correct location.

Install the upper intake manifold. Tighten the bolts in two stages in the sequence shown.

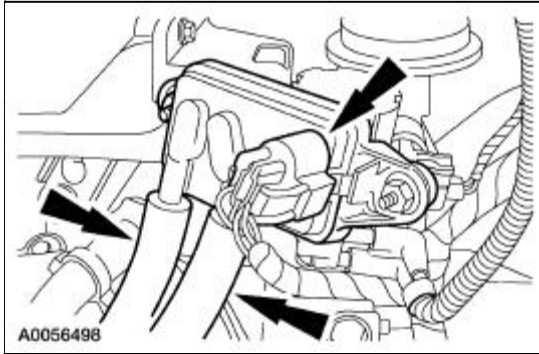
- Stage 1: Tighten to 10 Nm (89 lb-in).
- Stage 2: Rotate an additional 90 degrees.



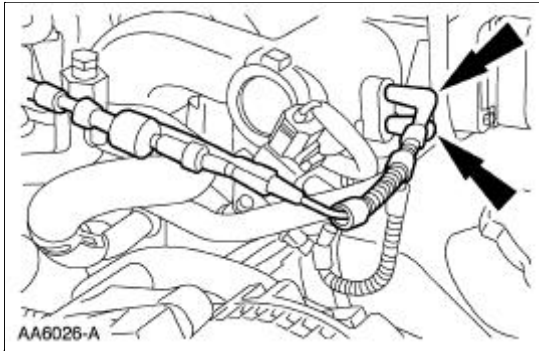
69. Connect the exhaust gas recirculation (EGR) vacuum regulator solenoid electrical and vacuum connections.



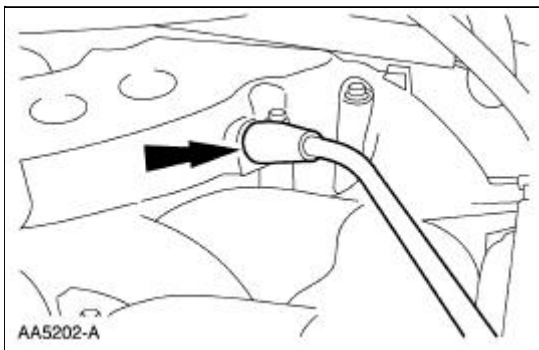
70. Connect the differential pressure feedback EGR system electrical and vacuum connections.



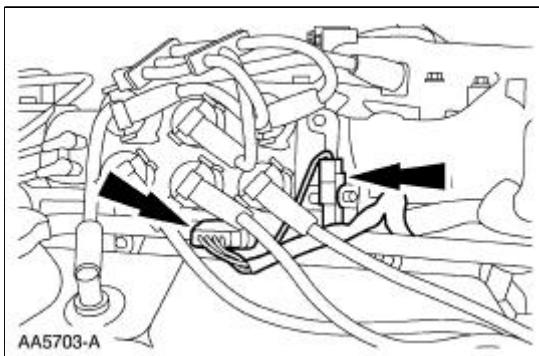
71. Connect the vacuum hoses.



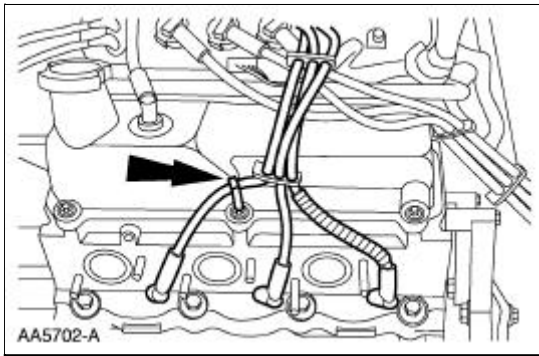
72. Install the positive crankcase ventilation (PCV) tube.



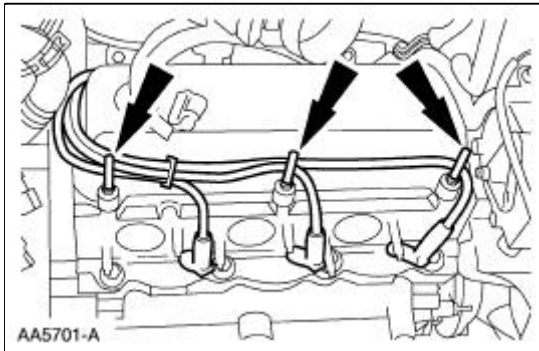
73. Connect the ignition coil and the radio interference capacitor electrical connectors.



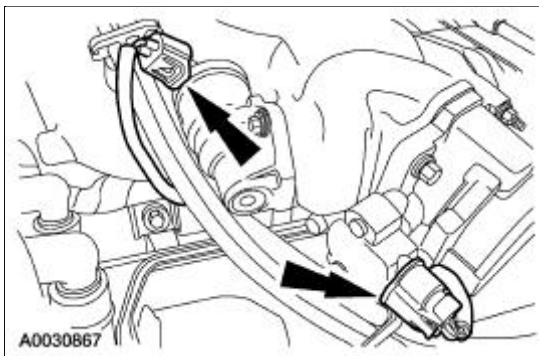
74. Position and connect the LH spark plug wires.



75. Position and connect the RH spark plug wires.

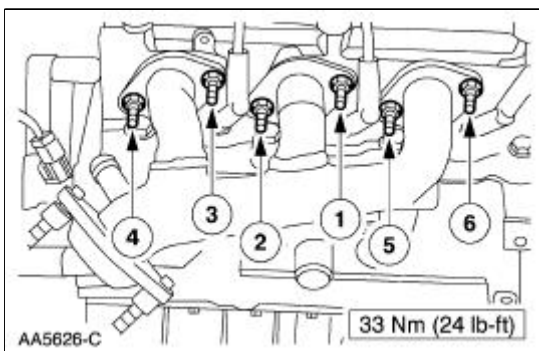


76. Connect the idle air control (IAC) valve and the throttle position (TP) sensor electrical connectors.

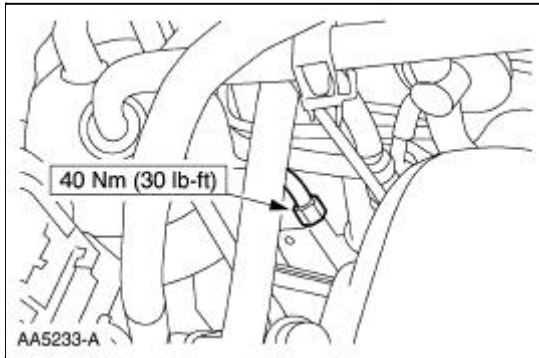


77. Install the RH exhaust manifold.

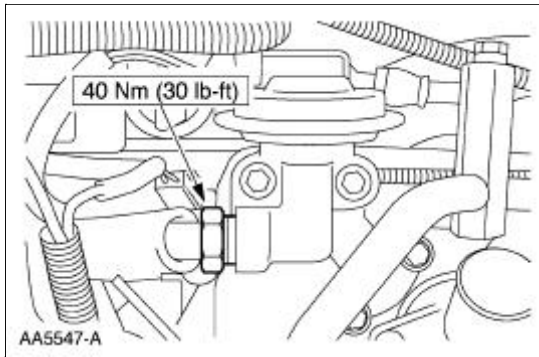
- Install a new exhaust manifold gasket.
- Install the exhaust manifold.
- Tighten the nuts in the sequence shown.



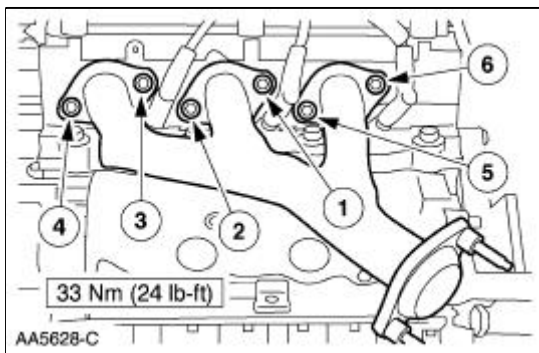
78. Install the exhaust gas recirculation (EGR) tube.



79. Connect the EGR valve nut.

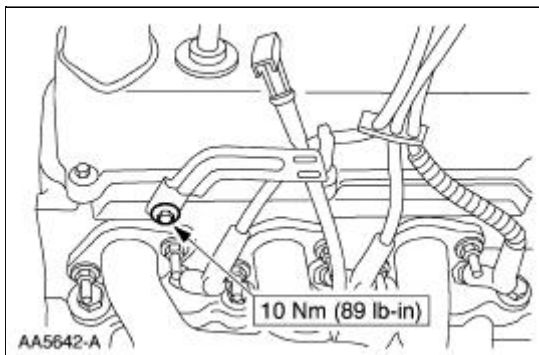


80. Using a new gasket, install the LH exhaust manifold. Tighten the nuts in the sequence shown.

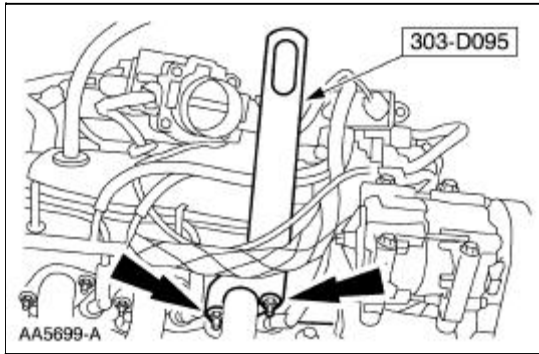


81. **NOTE:** Install a new O-ring seal.

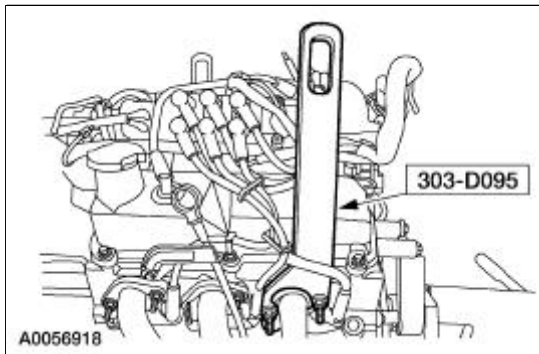
Install the oil level indicator and tube and retaining bolt.



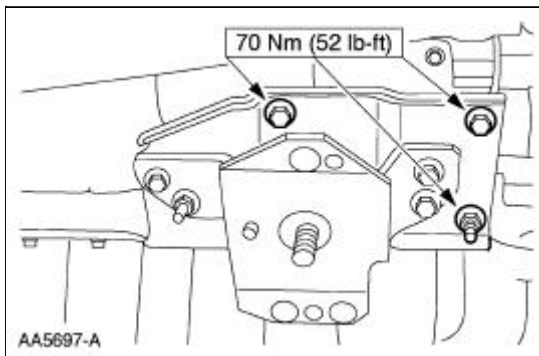
82. Install the special tool.



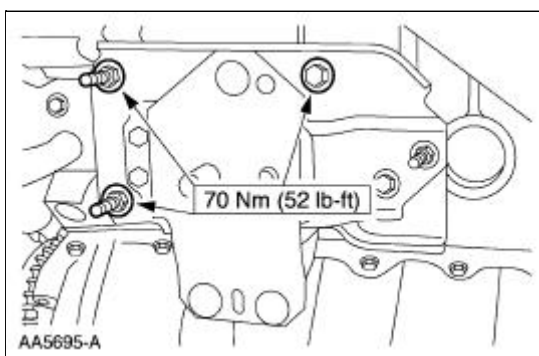
83. Install the special tool.



84. Install the RH engine support insulator.



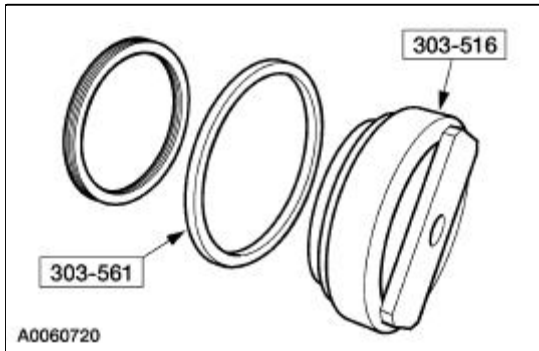
85. Install the LH engine support insulator.



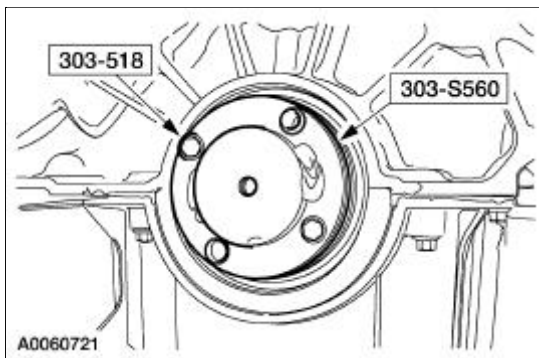
86. Remove the engine from the stand.

87. **NOTE:** Lubricate the crankshaft rear seal lips with clean engine oil prior to installation.

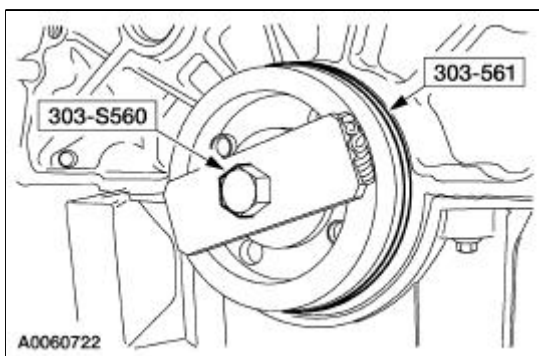
Assemble the special tools and the crankshaft rear seal.



88. Install the special tools on the rear of the crankshaft.


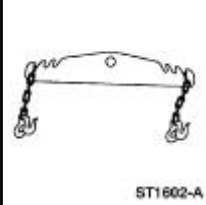


89. Install the crankshaft rear seal. Tighten the center jack screw (303-S560) until the spacer (303-561) contacts the engine block.



Engine

Special Tool(s)

 <p>ST1341-A</p>	Heavy Duty Floor Crane 014-00071 or equivalent
 <p>ST1602-A</p>	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent

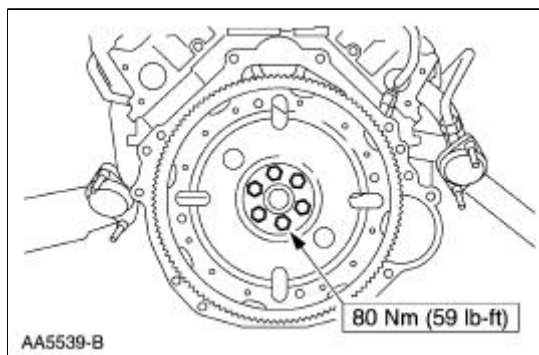
Material

Item	Specification
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

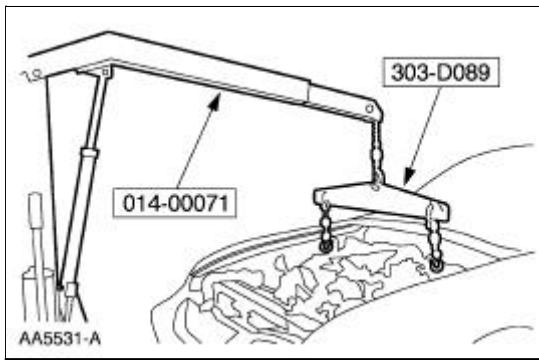
Installation

All vehicles

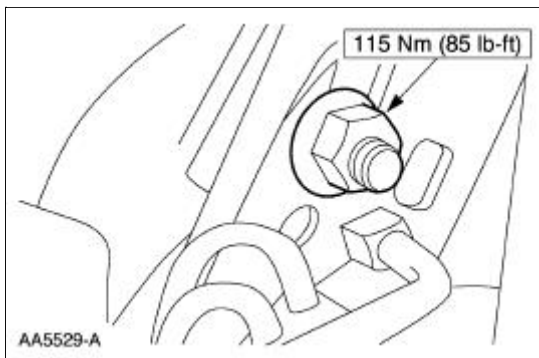
1. Install the separator plate and the flywheel.



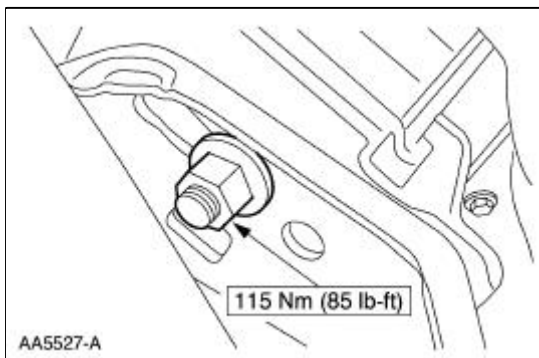
2. Using the special tools, position the engine in the vehicle.



3. Remove the special tools.
4. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
5. Install the LH engine mount nut.

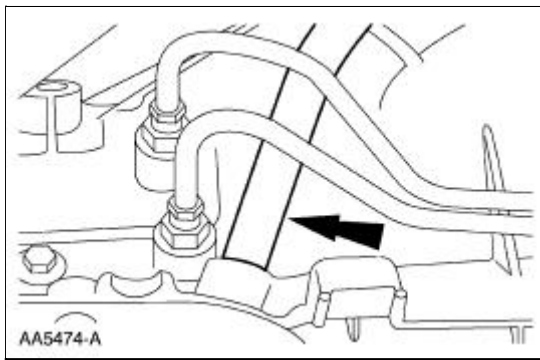


6. Install the RH engine mount nut.



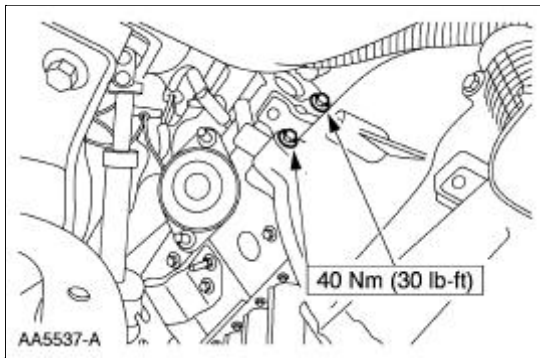
Vehicles equipped with manual transmission

7. Install the transmission. For additional information, refer to [Section 308-03A](#).
8. Install the transmission oil filler tube.

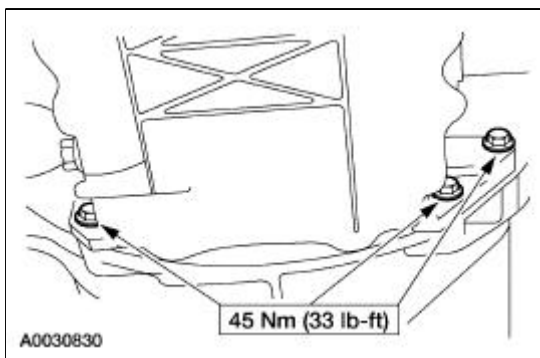


Vehicles equipped with automatic transmission

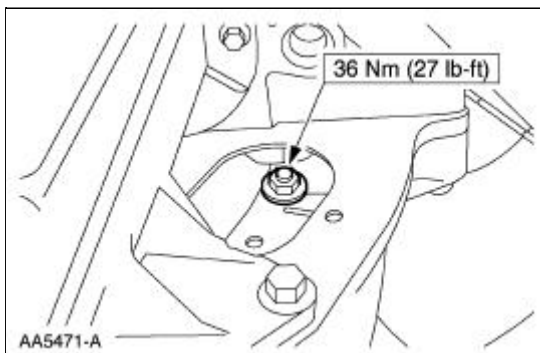
9. Install the five bellhousing upper bolts.



10. Install the bolts.

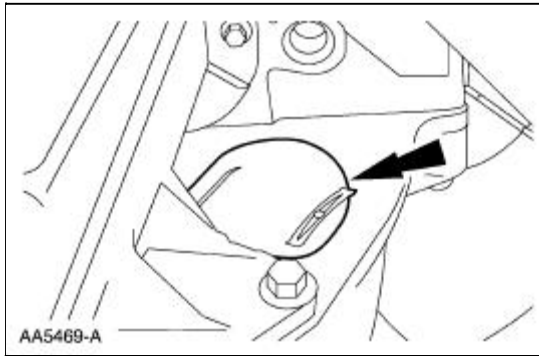


11. Install the four torque converter nuts.

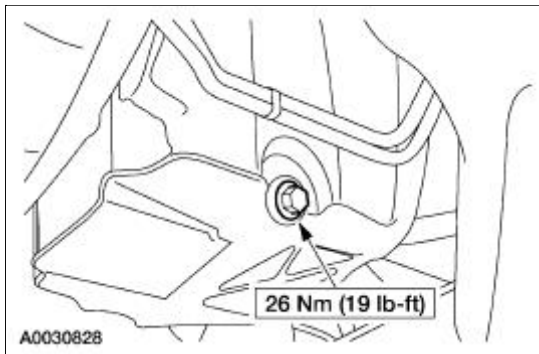


All vehicles

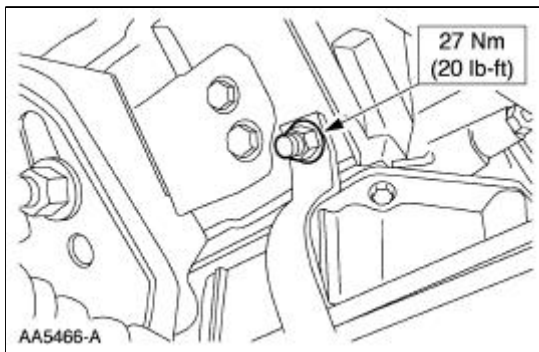
12. Install the access cover.



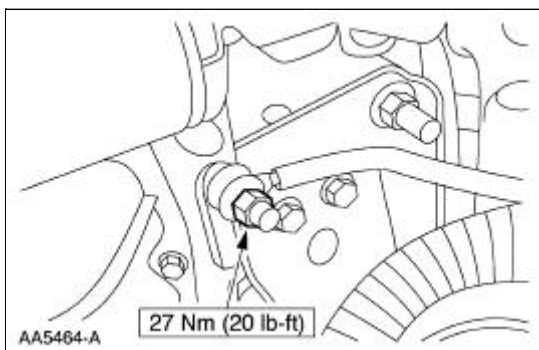
13. Install the oil pan drain plug.



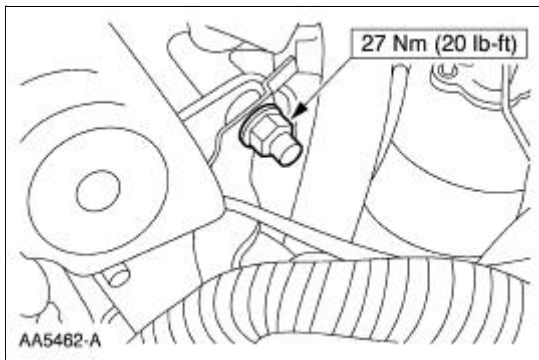
14. Install the bracket.



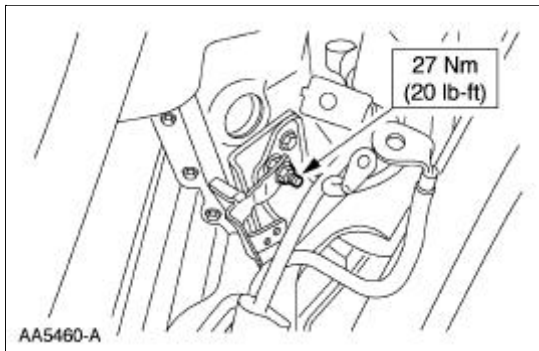
15. Connect the engine ground strap.



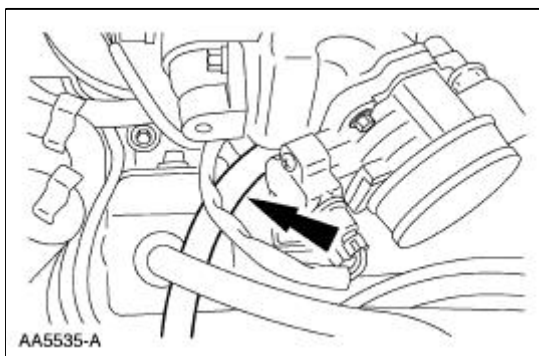
16. Install the bracket.



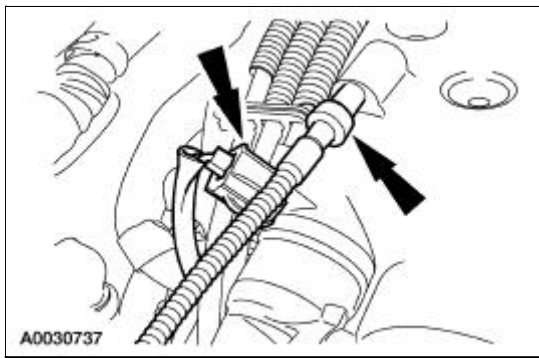
17. Install the bracket.



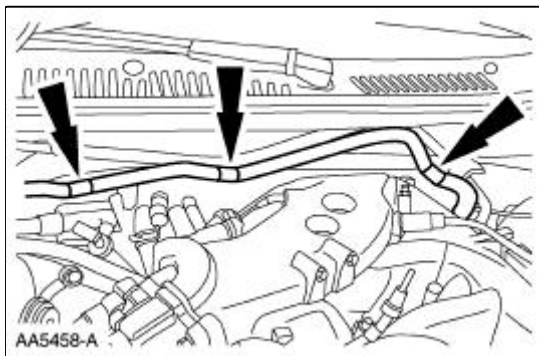
18. Install the dual converter Y-pipe. For additional information, refer to [Section 309-00](#).
19. Install the starter motor. For additional information, refer to [Section 303-06](#).
20. Lower the vehicle.
21. Connect the evaporative emissions (EVAP) return tube.



22. Connect the connector and vacuum tube.

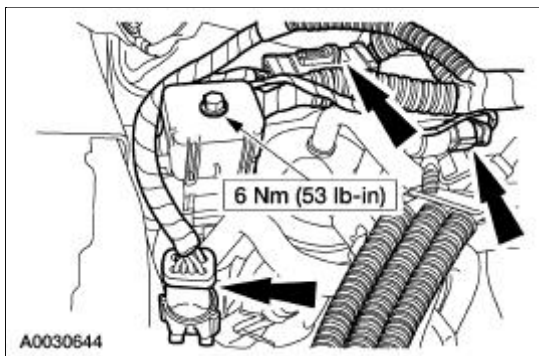


23. Position the wiring harness.

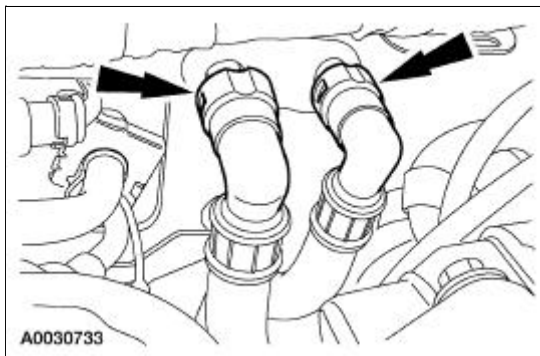


24. Connect the following connectors:

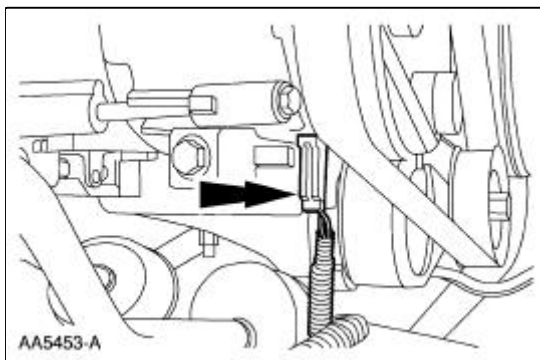
- 42-pin electrical connector
- 16-pin electrical connector
- 8-pin electrical connector
- A/C pressure switch



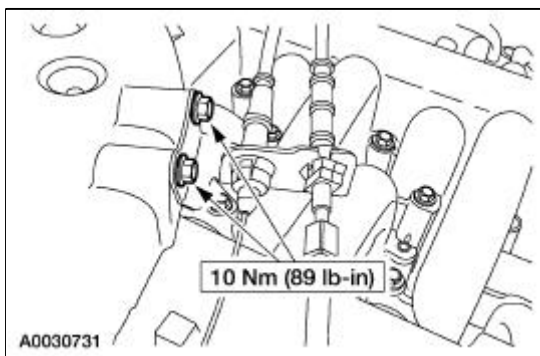
25. Connect the heater hoses.



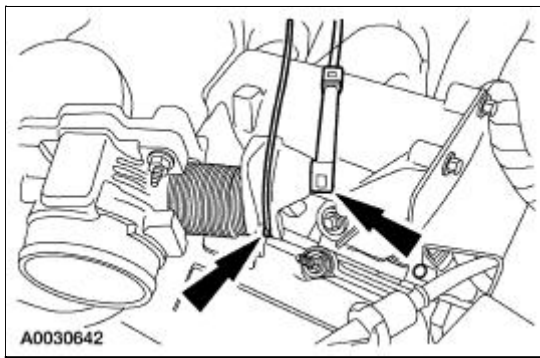
26. Connect the fuel supply tube spring lock coupling. For additional information, refer to [Section 310-00](#).
27. Connect the A/C compressor electrical connector.



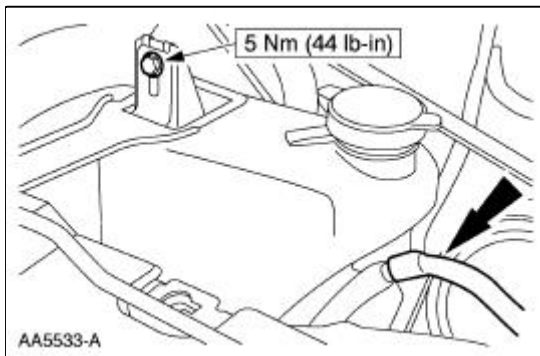
28. Connect the A/C manifold and tube. For additional information, refer to [Section 412-03](#).
29. Install the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).
30. Install the accelerator cable bracket.



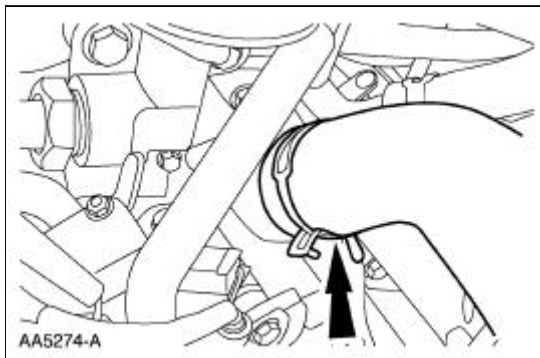
31. Connect the accelerator cable.



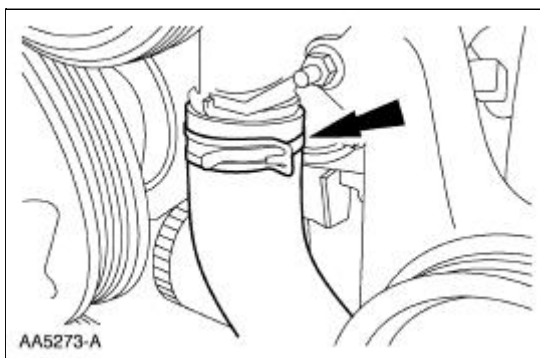
32. Install the radiator coolant recovery reservoir.



33. Connect the upper radiator hose.



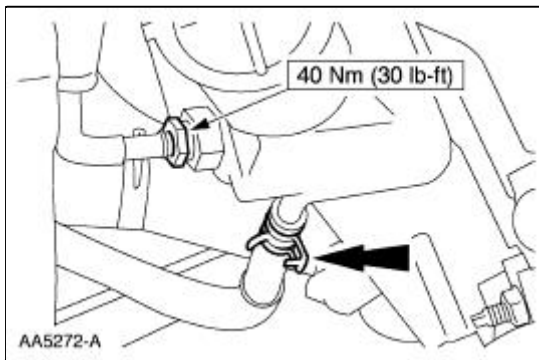
34. Connect the lower radiator hose.



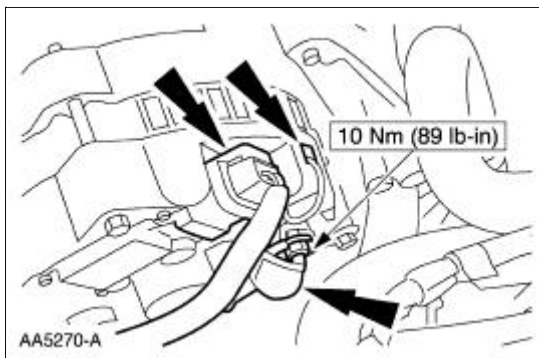
35. Connect the power steering pump.

- Connect the power steering return hose.
- Position the clamp.

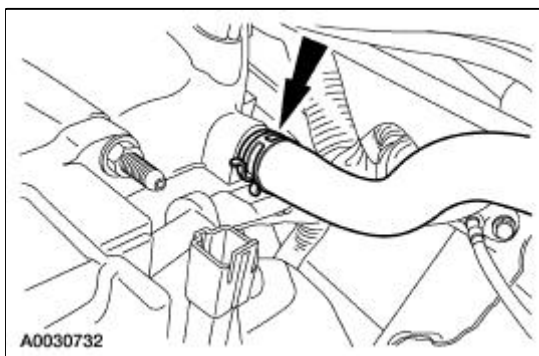
- Connect the power steering pressure tube.



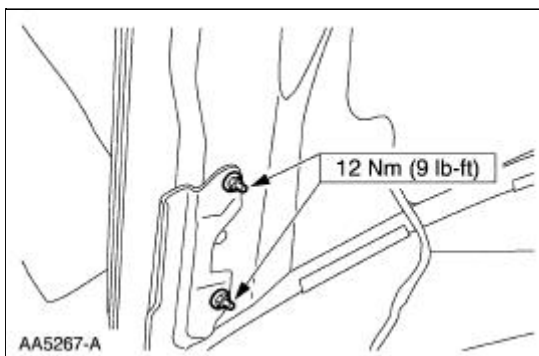
36. Connect the generator electrical connections.



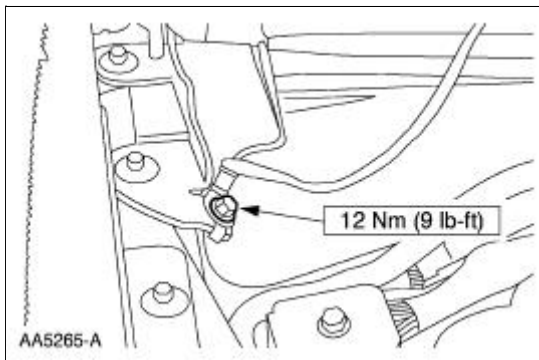
37. Connect the vacuum hose.



38. Install the hood.



39. Connect the hood ground strap.



40. Connect the battery negative cable. For additional information, refer to [Section 414-01](#).
 41. Fill the engine with clean engine oil.
 42. Fill the engine cooling system. For additional information, refer to [Section 303-03A](#).
 43. Recharge the A/C refrigerant system. For additional information, refer to [Section 412-00](#).
 44. Fill and bleed the power steering system. For additional information, refer to [Section 211-00](#).
-

General Specifications

Item	Specification
Lubricants and Sealants	
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4
Premium Engine Coolant VC-4A, VC-5 in Oregon, CXC-10 in Canada	ESE-M97B44-A
Super Premium 5W-20 Motor Oil XO-5W20-QSP	WSS-M2C153-H
Threadlock 262 E2FZ-19554-B	WSK-M2G351-A6
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Engine	
Displacement	4.6L (2V) (281 CID)
Number of cylinders	8
Bore	90.2 mm (3.55 in)
Stroke	90.0 mm (3.54 in)
Firing order	1-3-7-2-6-5-4-8
Oil pressure (hot 1,500 rpm)	138-310 kPa (20-45 psi)
Oil capacity	6.25 ± 0.25 quarts ^a
Compression ratio	9.37:1 (+0.61/-0.46)
Cylinder Head and Valve Train	
Combustion chamber volume	43.9 ± 1.5 cm ³
Valve arrangement (front to rear) — LH ^b	E-I-E-I-E-I-E-I
Valve arrangement (front to rear) — RH ^b	I-E-I-E-I-E-I-E
Valve guide bore diameter	7.015-7.044 mm (0.2762-0.2773 in)
Valve stem diameter	6.975-6.995 mm (0.2754-0.2746 in)
Valve stem-to-guide clearance — intake	0.020-0.069 mm (0.00078-0.00272 in)
Valve stem-to-guide clearance — exhaust	0.046-0.095 mm (0.0018-0.0037 in)
Valve head diameter — intake	44.37-44.63 mm (1.75-1.76 in)
Valve head diameter — exhaust	35.88-36.14 mm (1.41-1.43 in)
Valve face runout	0.05 mm (0.002 in)
Valve face angle	45.5 degrees
Valve seat width	1.3-1.5 mm (0.051-0.060 in)
Valve seat runout (T.I.R.)	Recommended 0.025 mm (0.001 in) max. 0.050 mm (0.002 in)
Valve seat angle	45 degrees
Valve spring free length (approx.)	51.77-54.97 mm (2.04-2.16 in)
Valve spring squareness	2 degrees
Valve spring compression pressure	720.0-800.0 N @ 28.80 mm (161.9 lb @ 1.13 in)

Valve spring installed height	42.3-42.9 mm (1.67-1.69 in)
Valve spring installed pressure	283.0-321.0 N @ 42.56 mm (63.61 lb @ 1.68 in)
Roller follower ratio — intake	2.02:1
Roller follower ratio — exhaust	2.03:1
Hydraulic Lash Adjuster	
Diameter	16.000-15.988 mm (0.6299-0.6294 in)
Clearance-to-bore	0.018-0.069 mm (0.0007-0.0027 in)
Service limit	15.988 mm
Hydraulic leakdown rate ^c	5-25 seconds
Collapsed lash adjuster gap — desired	0.45-0.85 mm (0.02-0.03 in)
Camshaft	
Theoretical valve lift @ 0 lash — intake	13.00 mm (0.51 in)
Theoretical valve lift @ 0 lash — exhaust	13.75 mm (0.54 in)
Lobe lift — intake	7.11038 mm (0.28 in)
Lobe lift — exhaust	7.4794 mm (0.30 in)
Allowable lobe lift loss	0 mm (0.0 in)
Journal diameter	26.962-26.936 mm (1.0615-1.0605 in)
Camshaft journal bore inside diameter	27.012-26.987 mm (1.0635-1.0625 in)
Camshaft journal-to-bearing clearance	0.025-0.076 mm (0.00098-0.002992 in)
Camshaft journal-to-bearing clearance — service limit	0.100 mm (0.003937 in) max.
Runout — Front and rear journals	0.03 mm (0.001 in)
Runout — four inner journals	0.09 mm (0.003 in)
End play	0.027-0.190 mm (0.001-0.007 in)
End play — service limit	0.190 mm (0.007480 in)
Cylinder Block	
Cylinder bore diameter	31 mm (1.24 in) from top of block red — 90.200-90.210 blue — 90.210-90.220 yellow — 90.220-90.230
Cylinder bore maximum taper	0.70 mm (0.027559 in)
Cylinder bore maximum out-of-round — limit	0.20 mm (0.007874 in)
Cylinder bore maximum out-of-round — service limit	0.70 mm (0.027559 in)
Main bearing bore inside diameter	72.400-72.424 mm (2.8504-2.8513 in)
Crankshaft	
Main bearing journal diameter	67.482-67.504 mm (2.66-21.661 in)
Main bearing journal maximum taper	0.004 mm (0.0002 in)
Main bearing journal maximum out-of-round	0.05 mm (0.002 in)
Main bearing journal-to-cylinder block clearance — desired	0.025-0.044 mm (0.001-0.002 in)
Main bearing journal-to-cylinder block clearance — allowable	0.025-0.050 mm (0.00098-0.00197 in)
Connecting rod journal diameter	52.983-53.003 mm (2.085941-2.086728 in)

Connecting rod journal maximum taper	0.004 mm (0.0002 in)
Connecting rod journal maximum out-of-round	0.05 mm (0.002 in)
Crankshaft maximum end play	0.075-0.377 mm (0.003-0.015 in)
Piston and Connecting Rod	
Piston diameter — code red 1 ^d	90.185-90.205 mm (3.55-3.551 in)
Piston diameter — code blue 2 ^d	90.195-90.215 mm (3.55-3.551 in)
Piston diameter — code yellow 3 ^d	90.205-90.225 mm (3.551-3.552 in)
Piston-to-cylinder bore clearance	-0.005-0.025 mm (-0.002/+0.001 in)
Piston ring end gap — compression (top) ^e	0.130-0.280 mm (0.005-0.011 in)
Piston ring end gap — compression (bottom) ^e	0.300-0.550 mm (0.0018-0.0022 in)
Piston ring end gap — oil ring (steel rail) ^e	0.150-0.650 mm (0.006-0.0256 in)
Piston ring groove width — compression (top)	1.530-1.550 mm (0.06-0.061 in)
Piston ring groove width — compression (bottom)	1.520-1.540 mm (0.06-0.061 in)
Piston ring groove width — oil ring	3.030-3.050 mm (0.12-0.12 in)
Piston ring width — compression (top)	1.480-1.500 mm (0.058-0.059 in)
Piston ring width — compression (bottom)	1.470-1.490 mm (0.0587-0.0586 in)
Piston ring-to-groove clearance — compression (top)	0.050-0.090 mm (0.002-0.004 in)
Piston ring-to-groove clearance — compression (bottom)	0.030-0.080 mm (0.00118-0.00315 in)
Piston ring-to-groove clearance — oil ring	Snug fit
Piston pin bore diameter ^f	21.008-22.014 mm (0.866-0.867 in)
Piston pin diameter	22.0010-22.0030 mm (0.87-0.871 in)
Piston pin length	61.601-62.030 mm (2.42523-2.44212 in)
Piston pin-to-piston fit	-0.005/+0.0135 mm (-0.0002/+0.0005 in)
Piston-to-connecting rod clearance — standard	0.009-0.0235 mm (0.0004-0.00092 in)
Piston-to-connecting rod clearance — service limit	0.035 mm (0.001378 in)
Connecting rod-to-pin clearance	0.009-0.023 mm (0.0004-0.0009 in)
Connecting rod pin bore diameter	22.012-22.024 mm (0.86661-0.86708 in)
Connecting rod length (center-to-center)	150.7 mm (5.933 in)
Connecting rod maximum allowed bend ^g	0.038 per 25 mm (0.00150 per 0.9843 in)
Connecting rod maximum allowed twist ^c	0.050 per 25 mm (0.00197 per 0.9843 in)
Connecting rod bearing bore diameter	56.866-56.886 mm (2.23881-2.23960 in)
Connecting rod bearing-to-crankshaft clearance	0.027-0.069 mm (0.0010629-0.0027165 in)
Connecting rod side clearance — standard	0.125-0.475 mm (0.005-0.019 in)
Connecting rod side clearance — service limit	0.50 mm (0.01969 in) max.

^a With installation of a new filter.

^b Distance front edge of bearing is installed below front face of cylinder block.

^c Time necessary for plunger to leak down 1.6 mm of travel with 222 N force and leak down fluid in tappet.

^d Measured at 31.5 mm from top of block. Measured at 43 mm from top of piston, at 90 degrees to the piston pin.

^e Specification in 90.200 mm diameter gauge.

^f If applicable, measured vertically, +0.030-0.050 mm (0.001-0.002 inch) measured horizontally (oval pin bore).

^g Pin bore and crank bearing bore must be parallel and in same vertical plane within the specified total difference when measured at the ends of a 203 mm bar, 101.5 mm on each side of rod centerline.

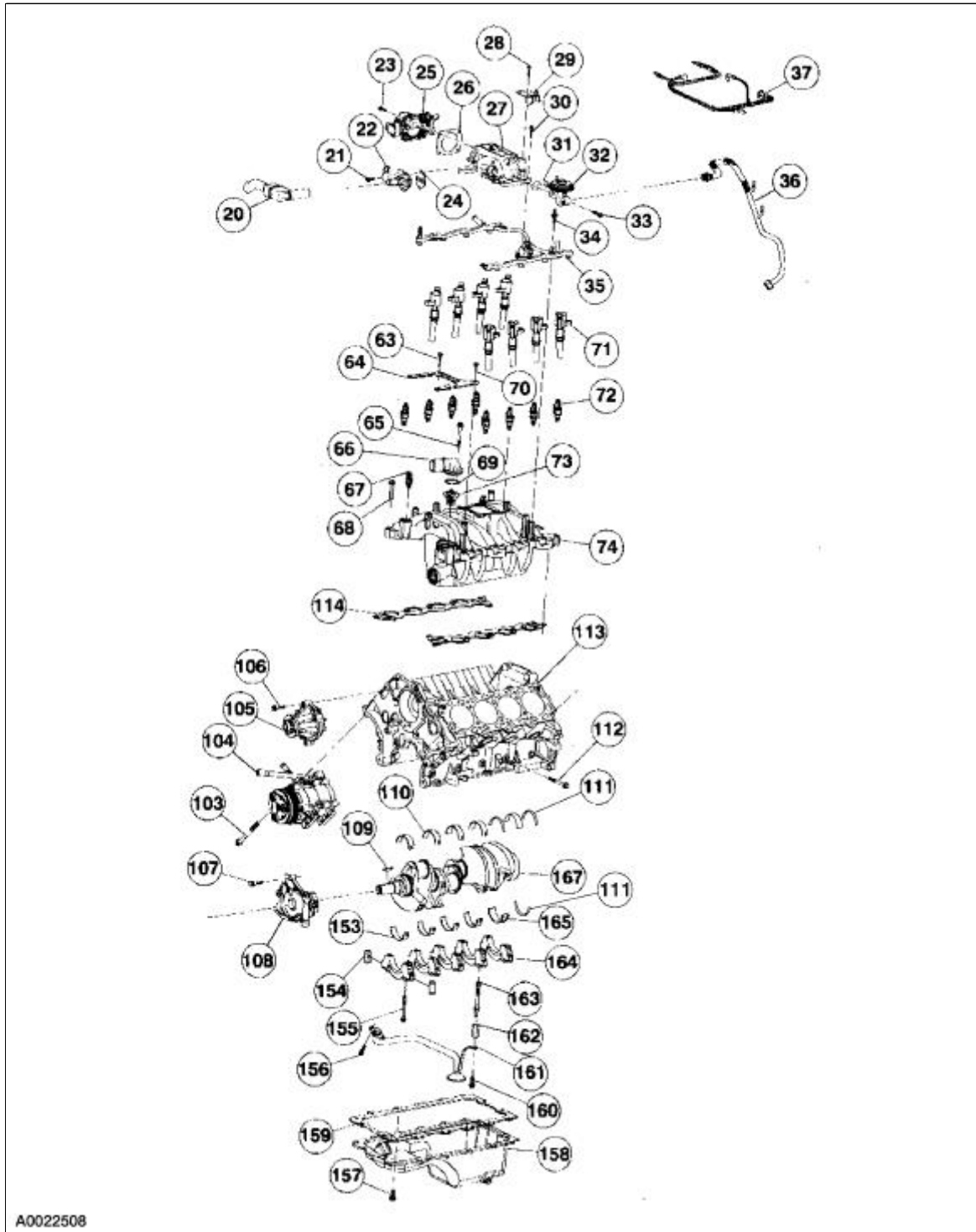
Torque Specifications

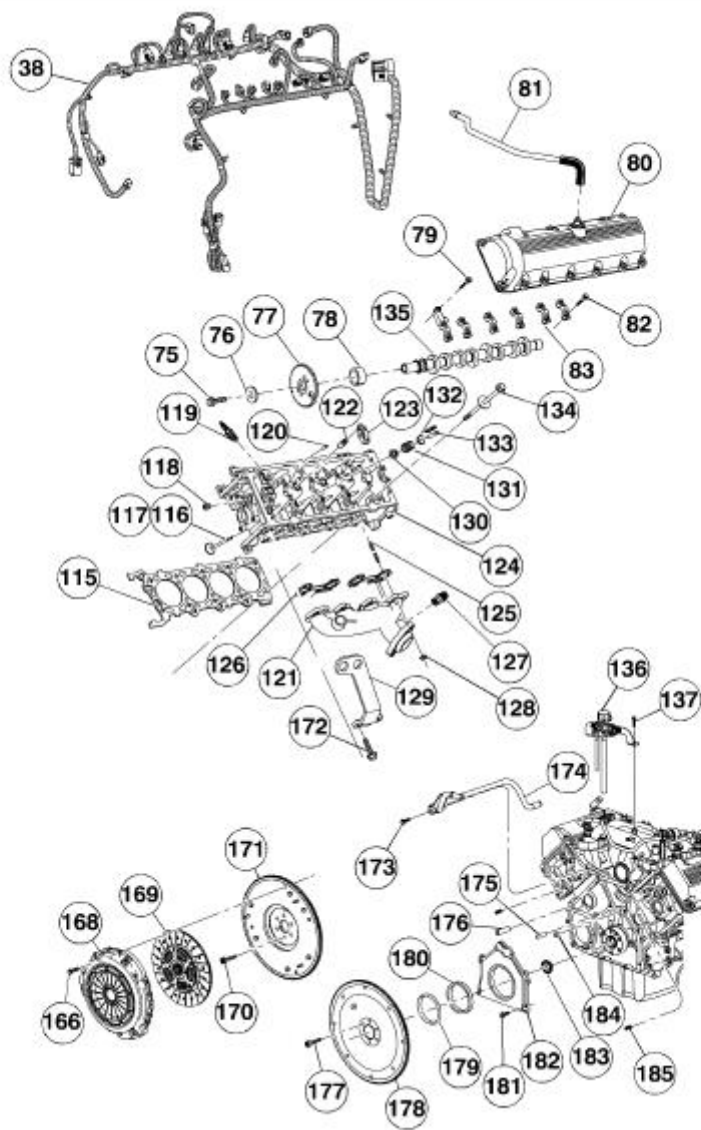
Description	Nm	lb-ft	lb-in
Main bearing cap adjusting bolts ^a	—	—	—
EGR sensor bracket	10	—	89
Belt idler pulley	25	18	—
Oil filter	15	11	—
Oil filter adapter insert	58	43	—
Camshaft sprocket bolt ^a	—	—	—
Connecting rod bolt ^a	—	—	—
Engine mount nuts	150	111	—
Engine mount-to-cylinder block bolts	70	52	—
Exhaust manifolds ^a	—	—	—
Engine front cover bolts ^a	—	—	—
Drive belt tensioner bolts	25	18	—
A/C muffler	20	15	—
Battery cable support brackets	20	15	—
Cylinder head bolt ^a	—	—	—
Pulley-to-crankshaft bolt ^a	—	—	—
EGR valve to intake manifold	25	18	—
EGR valve tube to exhaust manifold fittings	40	30	—
Intake manifold-to-cylinder head bolt	25	18	—
Main bearing cap bolt ^a	—	—	—
Oil filter adapter bolts	25	18	—
Oil level indicator tube bolt	10	—	89
Oil pump screen cover and tube-to-oil pump bolt	10	—	89
Oil pan-to-cylinder block bolt ^a	—	—	—
Flywheel	80	59	—
Oil pan-to-engine front cover bolts ^a	—	—	—
Oil pump-to-cylinder block bolt	10	—	89
Oil pump screen cover and tube-to-main bearing cap stud spacer bolt	25	18	—
Water pump pulley bolts	25	18	—
Cam cover bolt ^a	—	—	—
Water pump-to-cylinder block bolt	25	18	—
Water bypass tube	25	18	—
EGR tube nuts (2 req'd)	40	30	—
Power steering pump to engine	25	18	—

Power steering reservoir bolts	10	—	89
Water outlet connector bolts	25	18	—
Camshaft cap cluster to cylinder head bolts	10	—	89
Torque converter nuts	25	18	—
Timing chain tensioner bolts	25	18	—
Transmission filler tube bolt	47	35	—
A/C compressor bolts	25	18	—
Ignition coil bolts	6	—	53
Generator brace bolts	10	—	89
Primary timing chain guide-to-engine bolts	10	—	89
Accelerator cable bracket bolts	10	—	89
Rear seal retainer bolts	10	—	89
Pressure plate bolts	2	—	47
Spark plugs	18	13	—
Crankshaft timing bolt sensor assembly	10	—	89
Camshaft timing bolt sensor assembly	10	—	89
Fuel rail studs	10	—	89
Engine coolant sensor	15	11	—
Exhaust manifold—stud to cylinder head	10-13	7-10	—
Throttle body adaptor bolts ^a	—	—	—
Throttle body bolts	10	—	89
Idle air control valve	10	—	89
RFI capacitor nut	10	—	89
Generator bolts	25	18	—
Oil pan drain plug	14	10	—
Water bypass tube bracket bolt	25	18	—
Subframe bolts	115	85	—
Battery lead to generator	10	—	89
EGR vacuum regulator solenoid bracket	10	—	89
Pipe plug—water drain	20	15	—
Screen and cover assembly to main bearing cap stud spacer	25	18	—
Wiring harness retainer nut	10	—	89
Oil pressure switch ^a	—	—	—
A/C muffler stud to cylinder head	10	—	89
EGR tube to exhaust manifold connector	50	37	—

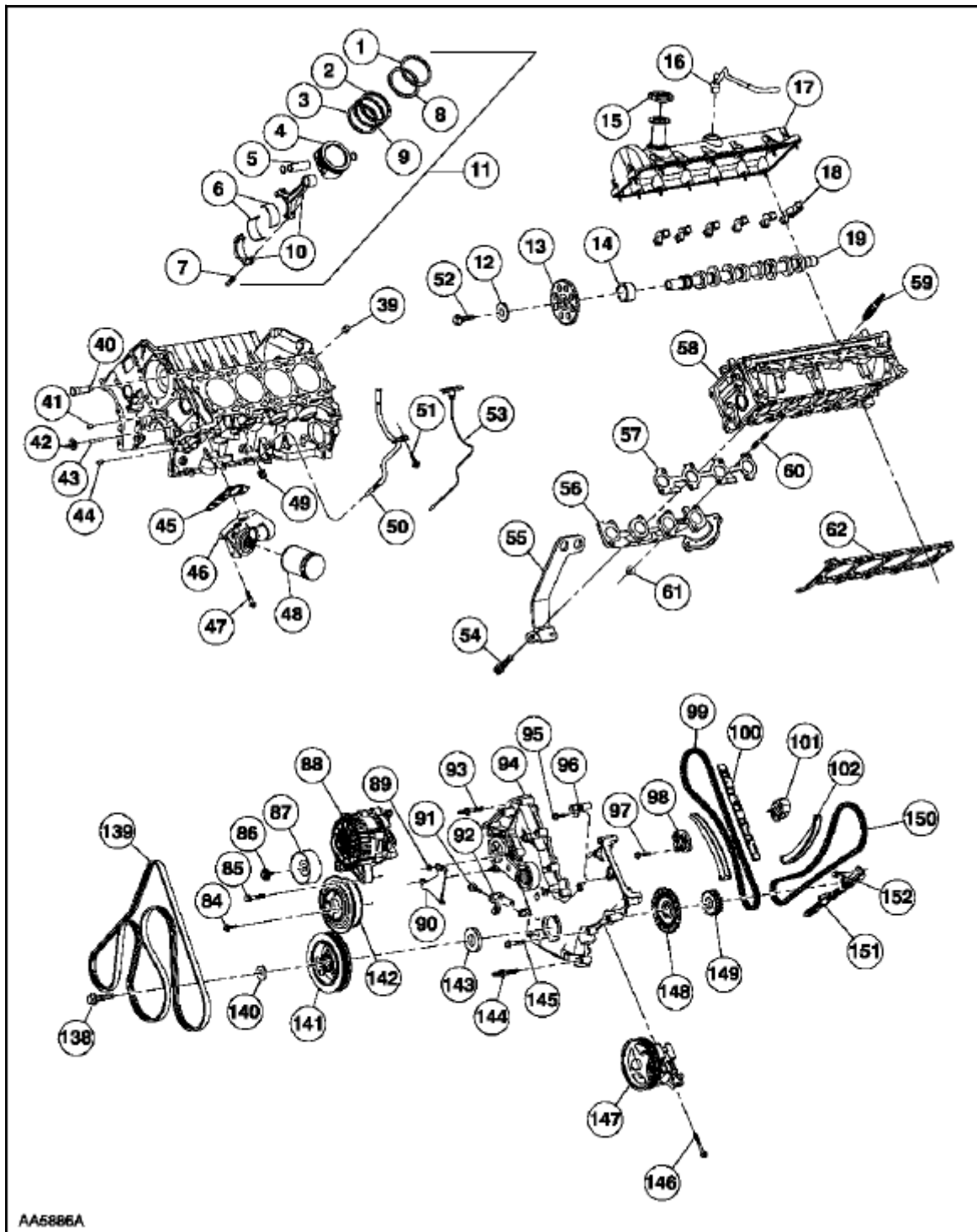
^a Refer to the procedure in this section.

Engine





AA5885A



AA5886A

Item	Part Number	Description
1	6150	Piston ring
2	6159	Piston ring
3	6159	Piston ring
4	6110	Piston
5	6135	Piston pin
6	6211	Connecting rod bearing
7	6214	Connecting rod bolt
8	6152	Piston ring

9	6161	Piston ring
10	6200	Connecting rod assy.
11	6100	Piston and rod assy (8 req'd)
12	N806164	Washer
13	6256	Camshaft sprocket
14	6265	Camshaft sprocket spacer
15	6766	Oil filler cap
16	6C324	Crankcase vent connector and hose
17	6582	Valve cover
18	6B280	Camshaft bearing cap
19	6250	Camshaft
20	9H308	Idle air control valve inlet tube
21	N806155	Bolt (2 req'd)
22	9F715	Idle air control valve
23	N806154	Bolt (4 req'd)
24	9F670	Idle air control gasket
25	9E926	Throttle body
26	9E936	Throttle body gasket
27	9A589	Throttle body gasket
28	N807309	Bolt (3 req'd)
29	9728	Bracket
30	N806154	Bolt (5 req'd)
31	9D476	EGR valve gasket
32	9D460	EGR valve
33	W701625	Bolt (2 req'd)
34	N811017	Stud bolt (4 req'd)
35	9F792	Fuel injection supply manifold
36	9D477	EGR valve to exhaust manifold tube
37	9E498	Main emission vacuum control connector
38	12A522	Engine control sensor extension wire
39	N806459	Dowel (4 req'd)
40	8555	Water bypass tube
41	N646419	Dowel (2 req'd)
42	W623454	Washer (2 req'd)
43	N806040	Dowel (2 req'd)
44	N806007	Dowel (2 req'd)
45	6A636	Oil filter adapter gasket
46	6881	Oil filter adapter (manual transmission)
47	N806156	Bolt (4 req'd)
48	6714	Oil bypass filter
49	N87838	Dowel
50		

	6754	Oil level indicator tube
51	N806155	Bolt
52	N806139	Bolt
53	6750	Oil level dipstick
54	N811363	Bolt (2 req'd)
55	18198A	Engine lifting eye
56	9430	Exhaust manifold
57	9448	Exhaust manifold gasket
58	6049	Cylinder head, RH
59	12405	Spark plug
60	W701681	Stud (8 req'd)
61	W701706	Nut (8 req'd)
62	6051	Head gasket
63	N807071	Bolt
64	10153	Generator mounting bracket
65	N811011	Bolt (2 req'd)
66	8549	Water outlet connector
67	10884	Water temperature indicator sender unit
68	N808130	Bolt (9 req'd)
69	N806807	O-ring
70	N807309	Bolt (2 req'd)
71	12A366	Coil on plug (8 req'd)
72	9F593	Fuel injector
73	8575	Water thermostat
74	9424	Intake manifold
75	N806139	Bolt
76	N806164	Washer
77	6256	Camshaft sprocket
78	6265	Camshaft sprocket spacer
79	N807352	Bolt (4 req'd)
80	6A505	Valve cover
81	6758	Crankcase ventilation tube
82	N806070	Bolt (24 req'd)
83	6B280	Camshaft bearing cap
84	N806282	Bolt (4 req'd)
85	N807173	Bolt (2 req'd)
86	N808102	Bolt
87	19A216	Belt idler pulley
88	10300	Generator
89	N804178	Nut (2 req'd)
90	19A439	Bracket
91		

	N806155	Bolt (2 req'd)
92	6C315	Crankshaft position sensor
93	N806300	Stud bolt (5 req'd)
94	6C086	Engine front cover
95	N806155	Bolt
96	6B288	Camshaft position sensor
97	N606543	Bolt (4 req'd)
98	6L266	Timing chain tensioner
99	6268	Timing chain belt
100	6K297	Timing chain cover
101	6M269	Timing chain tensioner
102	6L253	Timing chain tensioner arm
103	N806184	Bolt (3 req'd)
104	19D629	A/C compressor
105	8501	Water pump
106	N806177	Bolt (4 req'd)
107	N806183	Bolt (4 req'd)
108	6621	Oil pump
109	N806201	Woodruff key
110	6333	Crankshaft main bearing (5 req'd)
111	6A341	Crankshaft thrust washer (3 req'd)
112	6C357	Crankshaft main bearing side bolt (10 req'd)
113	6010	Cylinder block
114	9439	Intake manifold gasket (2 req'd)
115	6083	Head gasket
116	6505	Exhaust valve (8 req'd)
117	6507	Intake valve (8 req'd)
118	87838	Pipe plug (8 req'd)
119	12405	Spark plug (8 req'd)
120	6F087	Dowel
121	9431	Exhaust manifold
122	6C501	Valve tappet (16 req'd)
123	6529	Rocker arm (16 req'd)
124	6049	Cylinder head, RH
125	W701681	Stud (8 req'd)
126	9Y431	Exhaust manifold gasket
127	9F485	EGR valve tube to manifold connector
128	W701706	Nut (8 req'd)
129	181198A	Engine lifting eye
130	6A517	Valve stem seal (16 req'd)
131	6513	Valve spring (16 req'd)
132		

	6514	Valve spring retainer (16 req'd)
133	6518	Valve spring retainer key (32 req'd)
134	6065	Cylinder head bolt (20 req'd)
135	6C255	Camshaft
136	9J434	EGR transducer
137	N807309	Bolt (2 req'd)
138	N806139	Bolt
139	8620	Drive belt
140	N806165	Washer
141	6316	Crankshaft pulley
142	8A528	Water pump pulley
143	6700	Crankshaft front seal
144	N808793	Stud bolt (2 req'd)
145	N806177	Bolt (6 req'd)
146	N806176	Bolt (3 req'd)
147	3A674	Power steering pump
148	12A227	Ignition pulse ring
149	6306	Crankshaft sprocket (2 req'd)
150	6268	Timing chain/belt
151	6K297	Timing chain guide
152	N804958	Bolt (4 req'd)
153	6A338	Crankshaft main bearing (4 req'd)
154	6A346	Crankshaft main bearing cap dowel pin (10 req'd)
155	6345	Crankshaft main bearing cap bolt (9 req'd)
156	N806155	Bolt (2 req'd)
157	W701240	Bolt (16 req'd)
158	6675	Oil pan
159	6710	Oil pan gasket
160	N605904	Bolt
161	6622	Oil pump screen cover and tube
162	N806180	Spacer
163	6K258	Crankshaft main bearing cap stud
164	6325	Main bearing cap (5 req'd)
165	6A339	Crankshaft thrust main bearing
166	N602549	Bolt
167	6303	Crankshaft
168	7563	Clutch pressure plate
169	7550	Clutch disc
170	N808139	Bolt (6 req'd)
171	6375	Flywheel (manual transmission)
172	N811363	Bolt (2 req'd)
173		

	N605919	Bolt
174	18663	Heater water tube
175	N806007	Dowel (2 req'd)
176	N807198	Dowel (2 req'd)
177	N806168	Bolt (6 req'd)
178	6375	Flywheel (automatic transmission)
179	6310	Crankshaft oil slinger
180	6701	Crankshaft rear oil seal
181	N806155	Bolt (6 req'd)
182	6K318	Crankshaft rear oil seal and retainer
183	7120	Transmission input shaft pilot bearing
184	N806435	Pipe plug
185	N87836	Dowel (2 req'd)

A modular engine is built around four modules:

- the intake module
- the cylinder head module (RH)
- the cylinder head module (LH)
- the lower engine module

While not all repairs can take advantage of the modular concept, most out-of-vehicle repairs benefit due to the reduction of necessary time and labor.

The basic engine components consist of the following:

- single overhead camshafts
 - two valves per cylinder
 - sequential multiport fuel injection (SFI)
 - aluminum cylinder heads (6049)
 - cast iron, 90-degree V-shaped cylinder block
 - individual ignition coils for each spark plug
 - composite-material intake manifold
 - large-bore throttle body
-

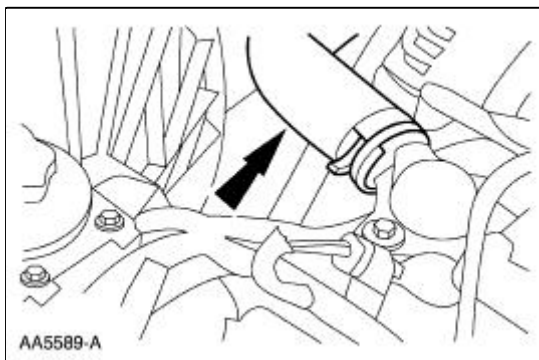
Engine

For basic mechanical concerns, refer to [Section 303-00](#) . Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

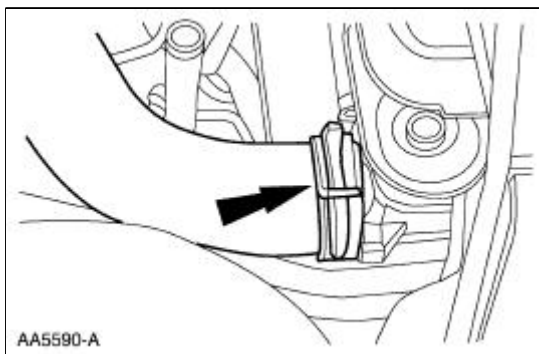
Intake Manifold

Removal

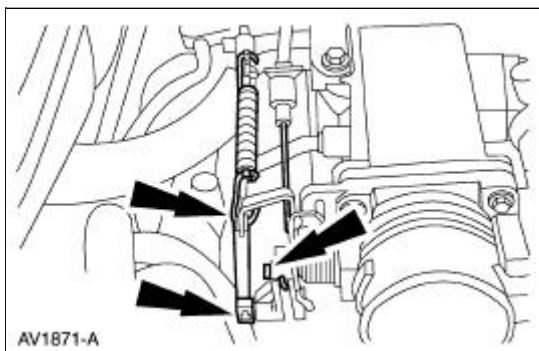
1. Drain the engine cooling system. For additional information, refer to [Section 303-03A](#) or [Section 303-03B](#).
2. Remove the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).
3. Disconnect the fuel line. For additional information, refer to [Section 310-00](#).
4. Disconnect the upper radiator hose from the water outlet connector.



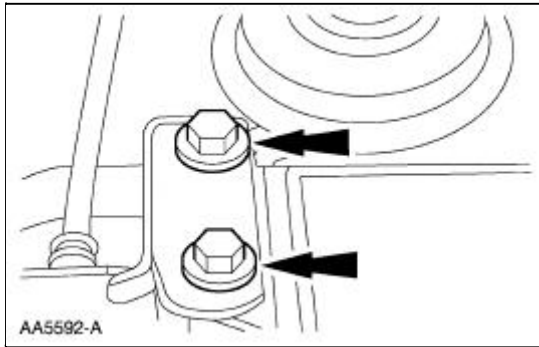
5. Disconnect and remove the upper radiator hose.



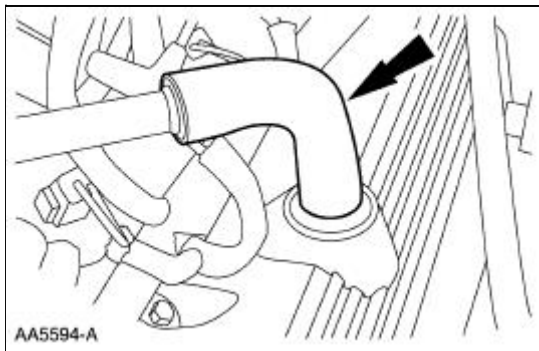
6. Disconnect the accelerator cable, speed control actuator cable and return spring.



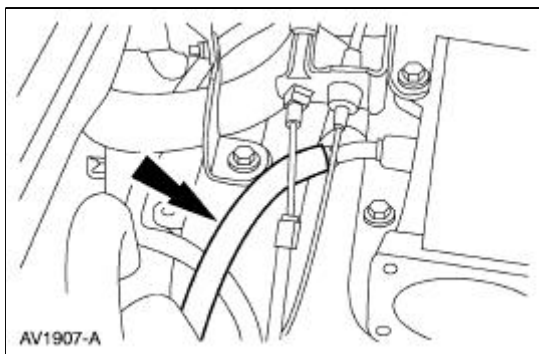
7. Remove the bolts and position the cables and bracket out of the way.



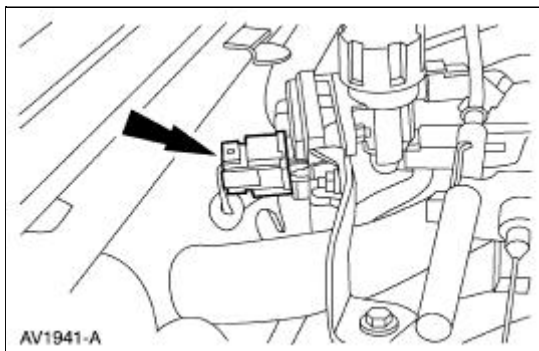
8. Remove the breather tube.



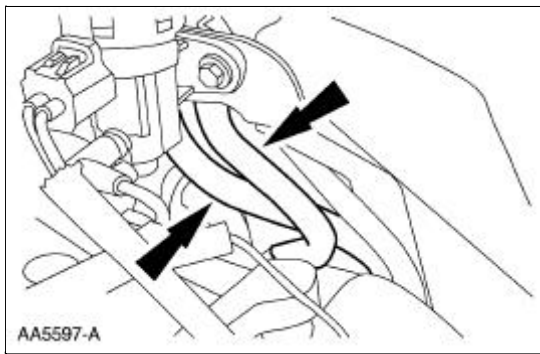
9. Disconnect the evaporative emissions return line.



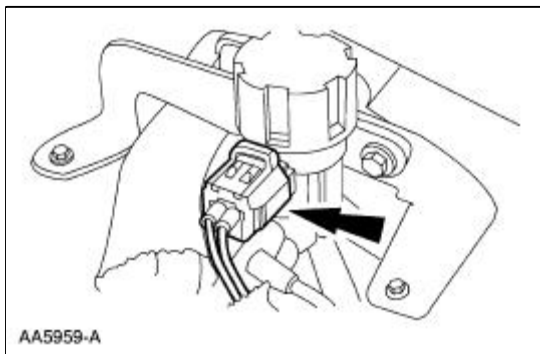
10. Disconnect the differential pressure feedback EGR electrical connector.



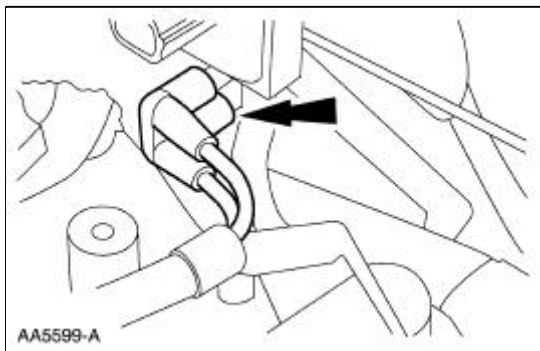
11. Disconnect the hoses from the differential pressure feedback EGR transducer.



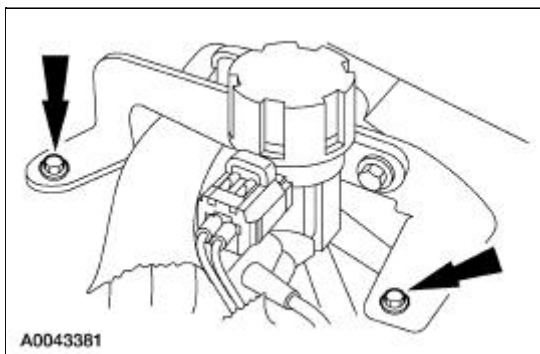
12. Disconnect the EGR vacuum regulator solenoid electrical connector.



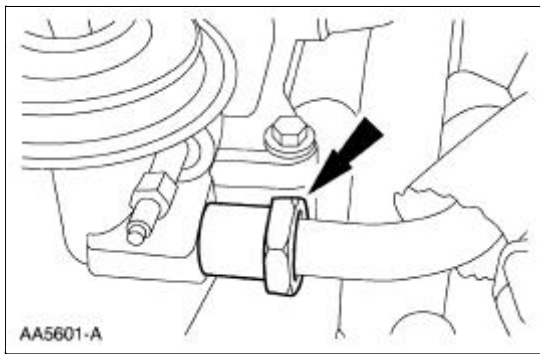
13. Disconnect the EGR vacuum regulator solenoid vacuum supply.



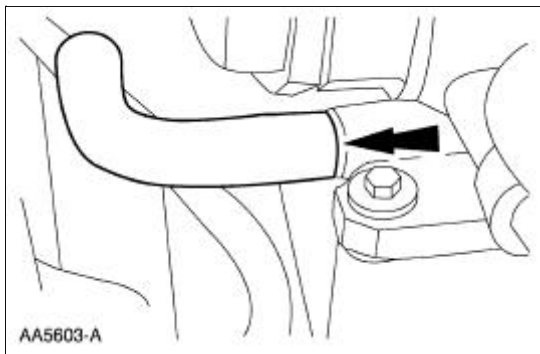
14. Remove the bolts retaining the EGR vacuum regulator solenoid bracket to the intake manifold.



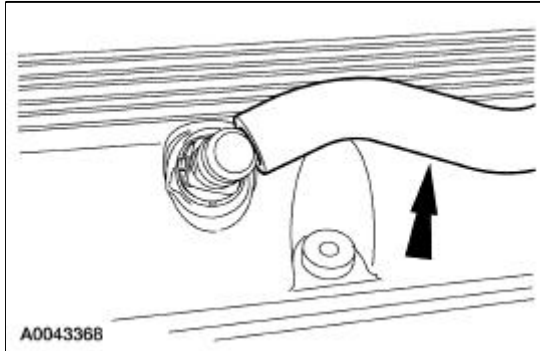
15. Disconnect the exhaust gas recirculation (EGR) tube from the EGR valve.



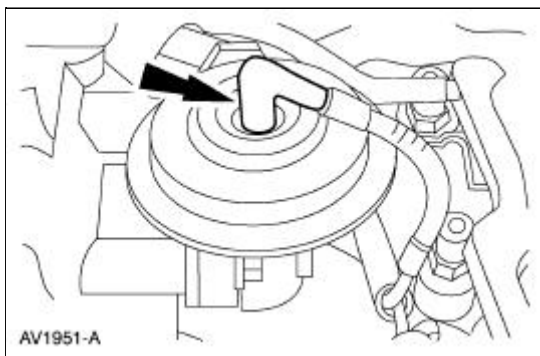
16. Disconnect the positive crankcase ventilation (PCV) hose from the base of the throttle body and spacer assembly.



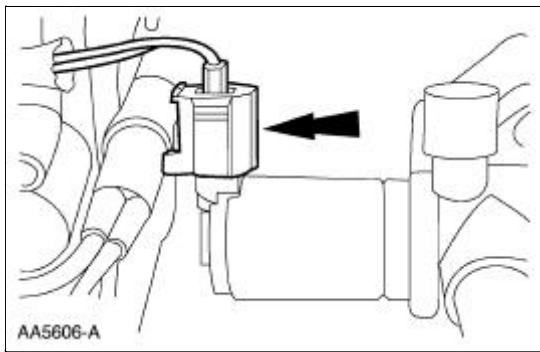
17. Disconnect the hose from the PCV valve.



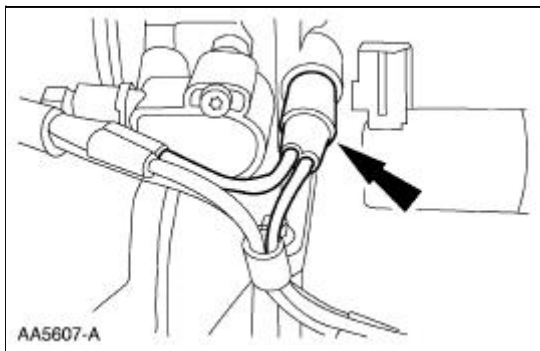
18. Disconnect the vacuum hose from the EGR valve.



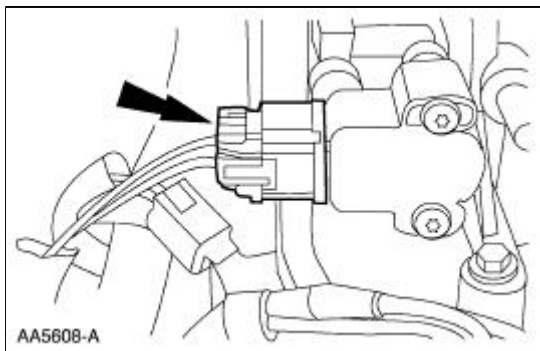
19. Disconnect the idle air control (IAC) valve electrical connector.



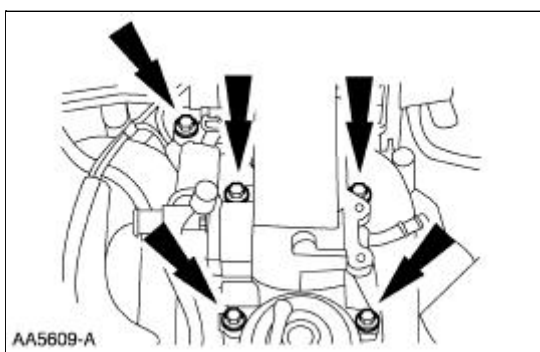
20. Disconnect the main vacuum supply from the base of the throttle body adapter.



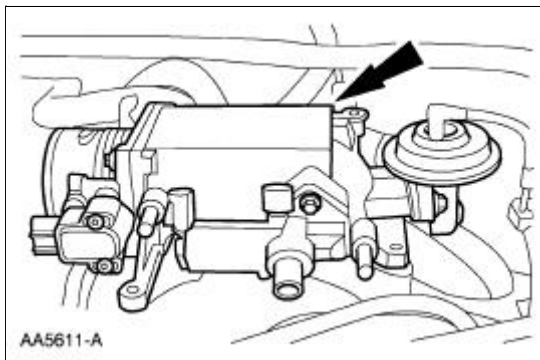
21. Disconnect the throttle position sensor (TPS) electrical connector.



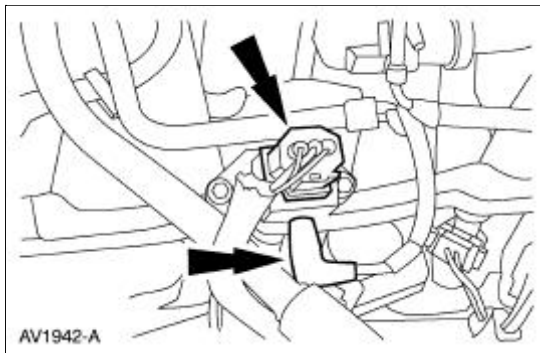
22. Remove the bolts.



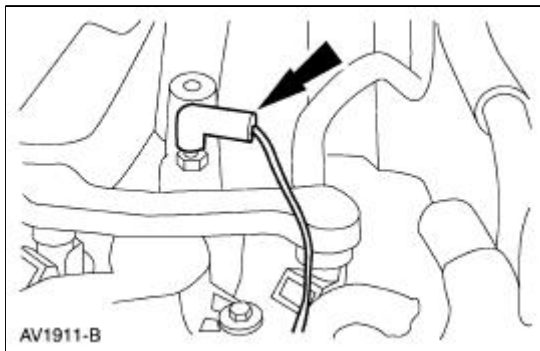
23. Remove the throttle body and adapter as an assembly.
- Inspect and clean the sealing surfaces.
 - The gasket is reusable if not damaged.



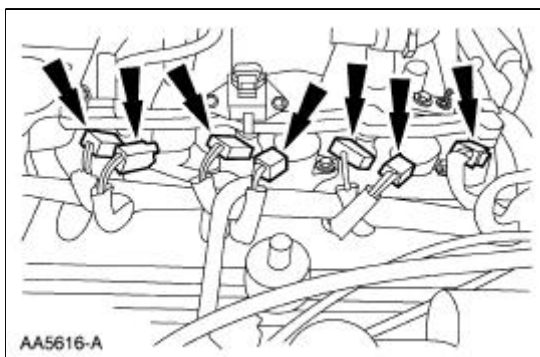
24. Disconnect the fuel pressure sensor electrical connector and the vacuum hose.



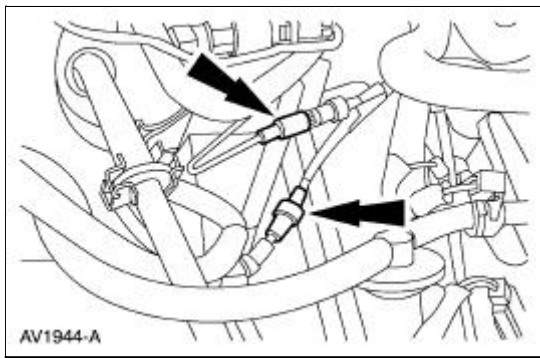
25. Disconnect the fuel charging ground wire.



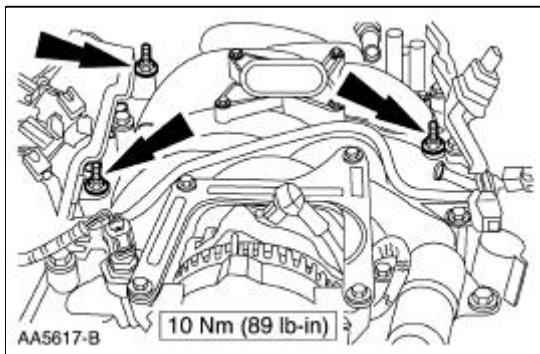
26. Disconnect the ignition coils and the fuel injectors.



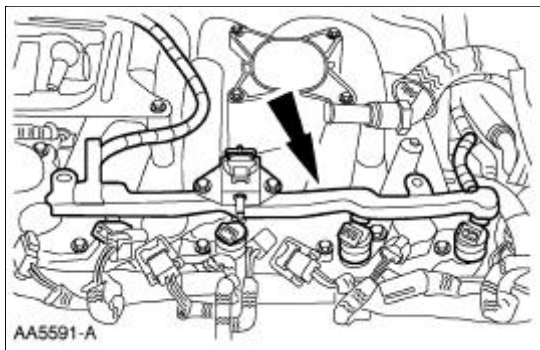
27. Disconnect the climate control vacuum supply hoses and remove the vacuum harness.



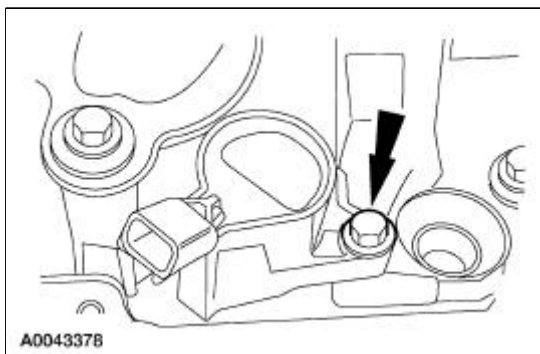
28. Remove the four studs.



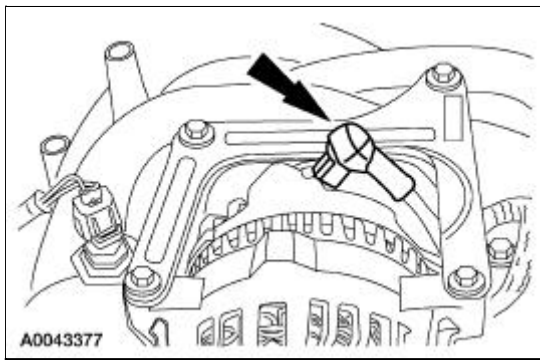
29. Remove the injectors and fuel injection supply manifold as an assembly.



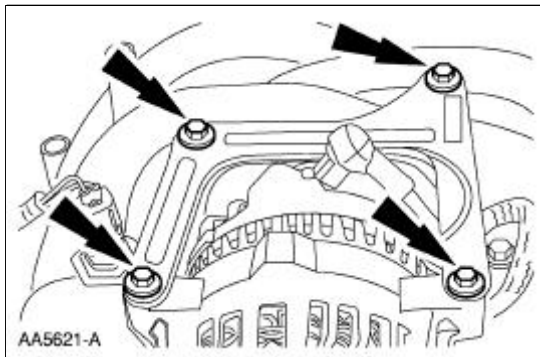
30. Remove the ignition coils.



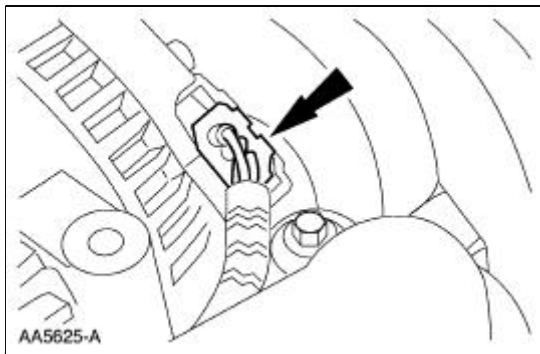
31. Disconnect the battery terminal.



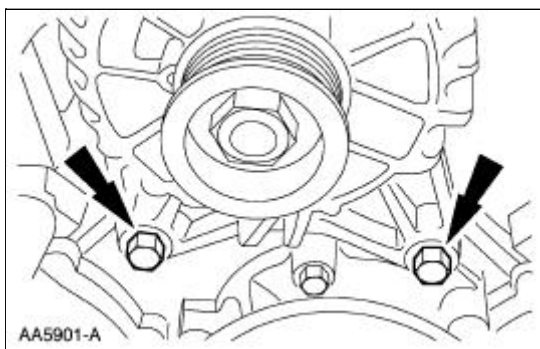
32. Remove the generator support brace.



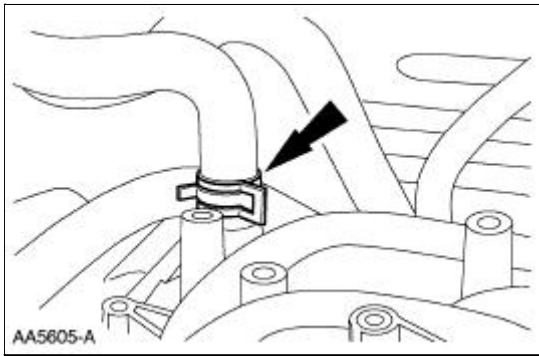
33. Disconnect the electrical connector.



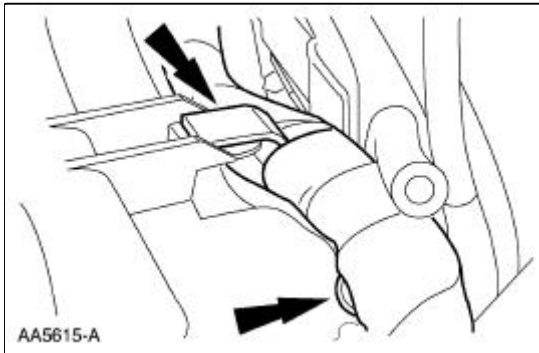
34. Remove the generator.



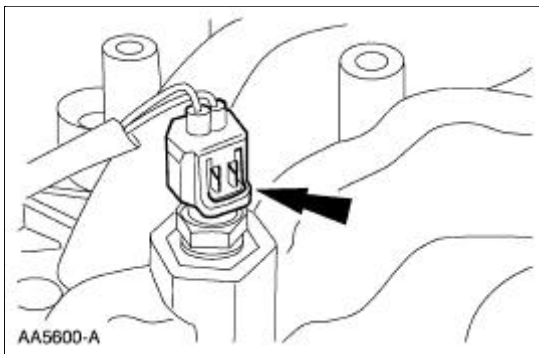
35. Disconnect the heater hose.



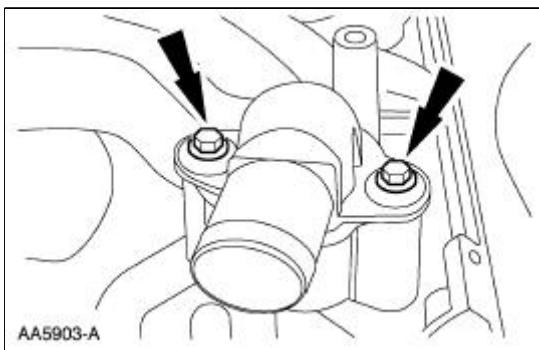
36. Separate the engine harness and position it out of the way.



37. Disconnect the water temperature indicator sender.

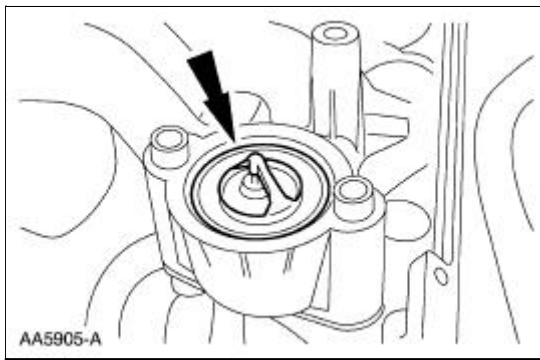


38. Remove the water outlet connector.



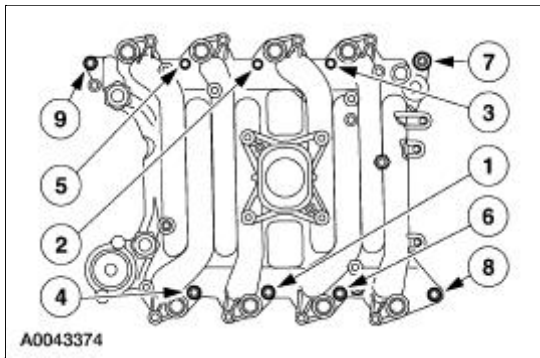
39. Remove the water thermostat and the O-ring.

- Inspect the O-ring and discard if necessary.



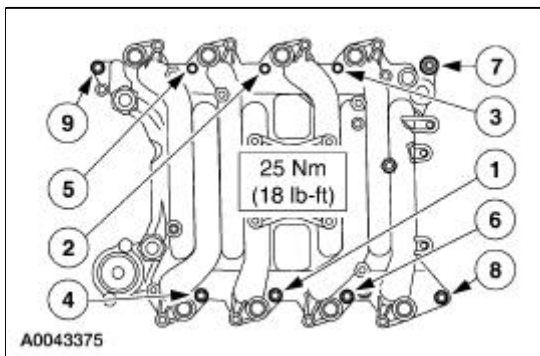
40. **NOTE:** The gaskets are reusable if not damaged.

Remove the bolts in the sequence shown, remove the intake manifold and gaskets.



Installation

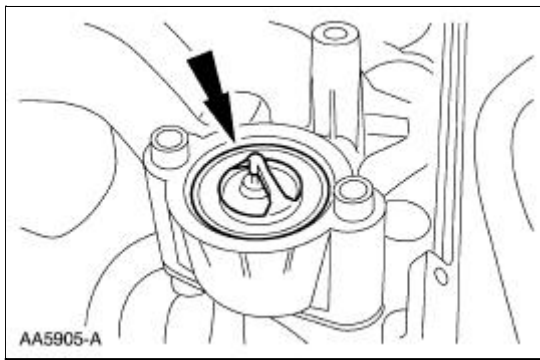
1. Install the intake manifold and gaskets, tighten the bolts in the sequence shown.



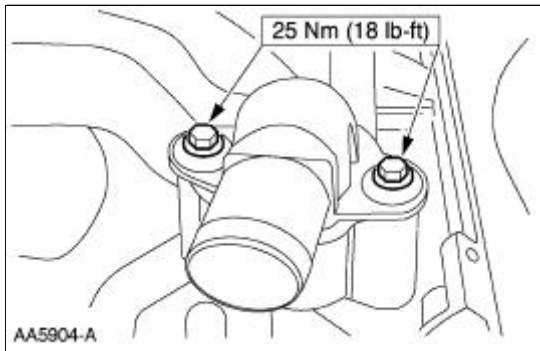
2. **NOTE:** The O-ring is to be installed on the top of the thermostat.

Install the water thermostat and the O-ring.

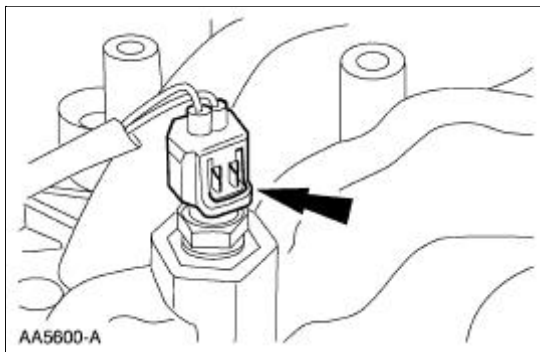
- Install a new O-ring as necessary.



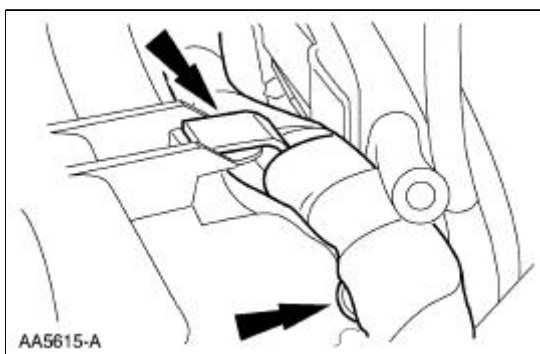
3. Install the water outlet adapter.



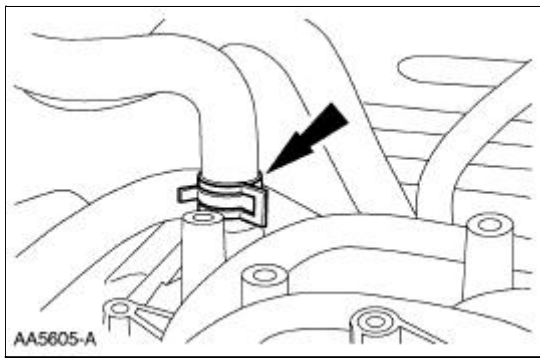
4. Connect the water temperature indicator sender.



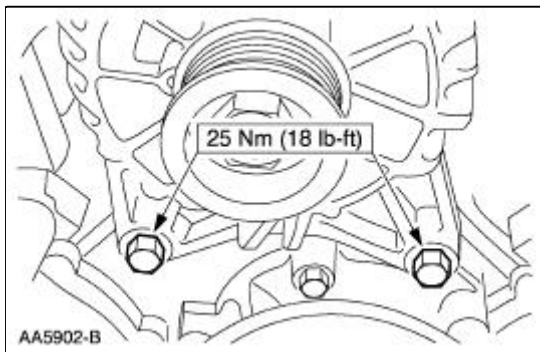
5. Position the engine harness and attach to the intake manifold in two locations.



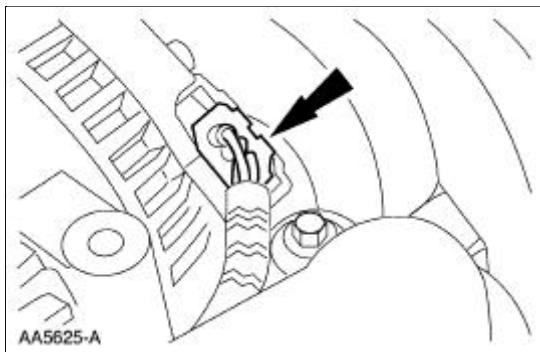
6. Connect the heater hose.



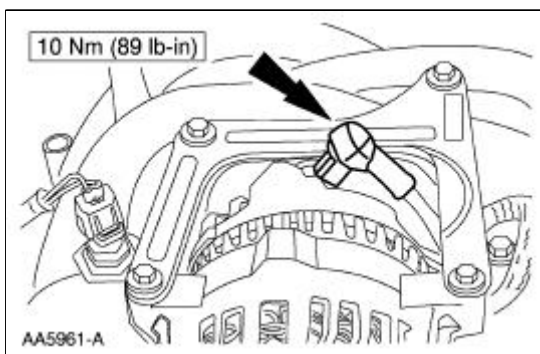
7. Install the generator.



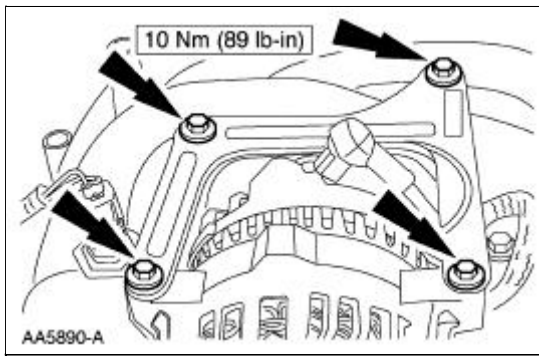
8. Connect the electrical connector.



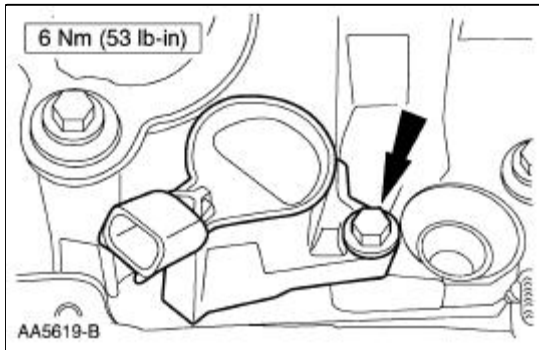
9. Connect the battery lead.



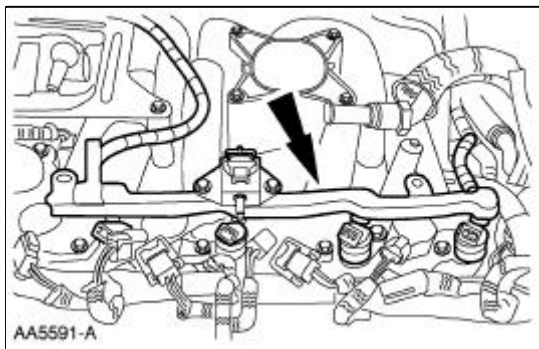
10. Install the generator support brace.



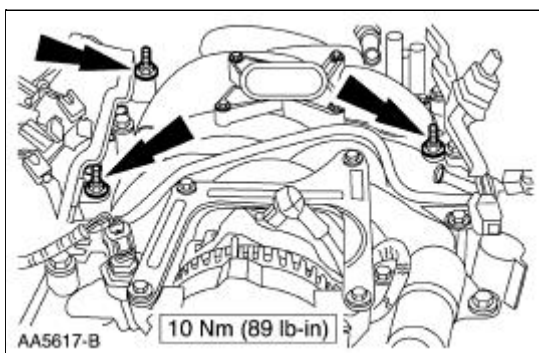
11. Install the ignition coils.



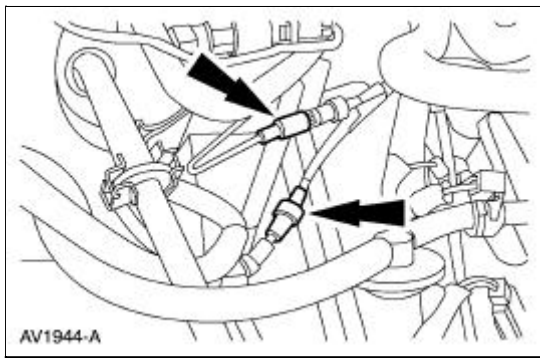
12. Install the fuel injection supply manifold and fuel injectors as an assembly.



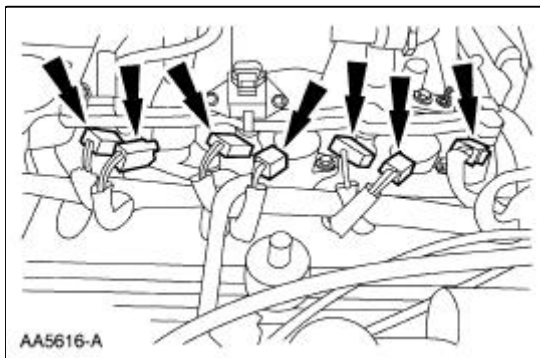
13. Install four studs.



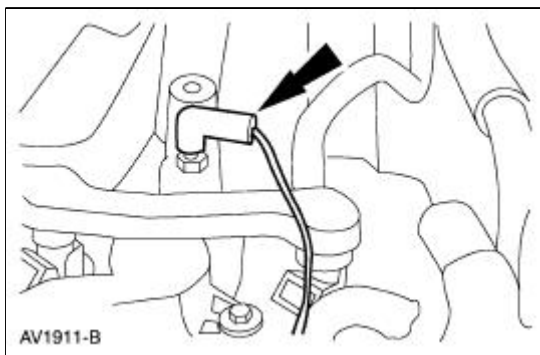
14. Position the vacuum harness and connect to the climate control vacuum supply hoses.



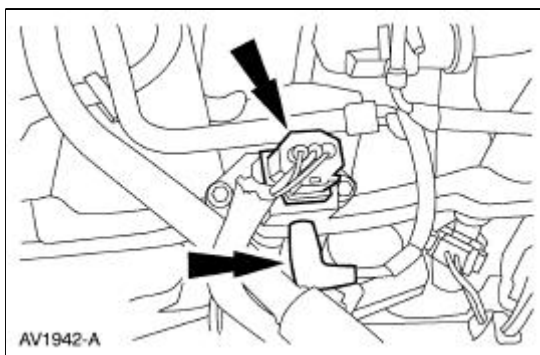
15. Connect the ignition coils and the fuel injectors.



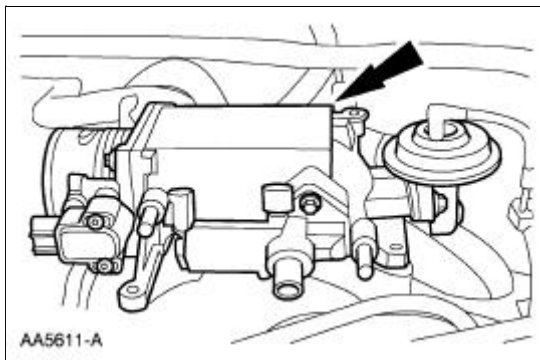
16. Connect the fuel charging ground wire.



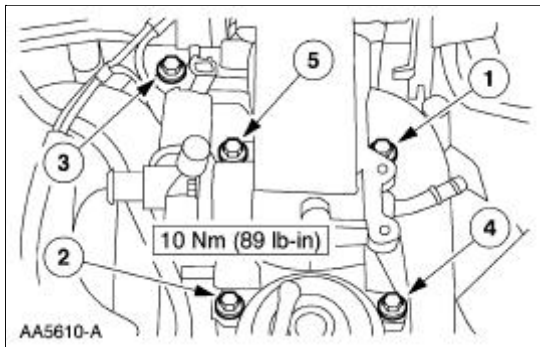
17. Connect the fuel pressure sensor electrical connector and the vacuum hose.



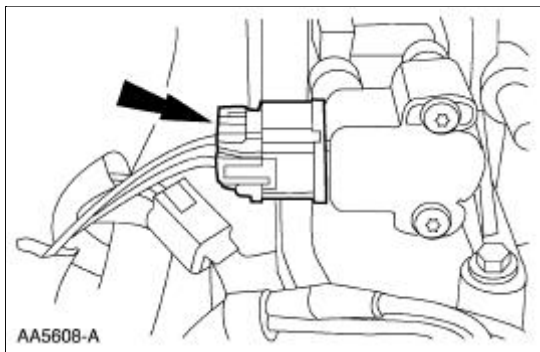
18. Install the throttle body and adapter as an assembly.



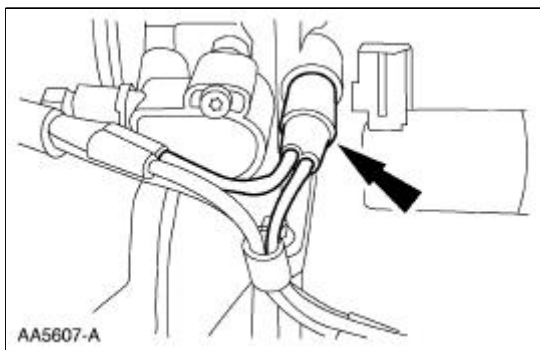
19. Tighten the bolts in the sequence shown.



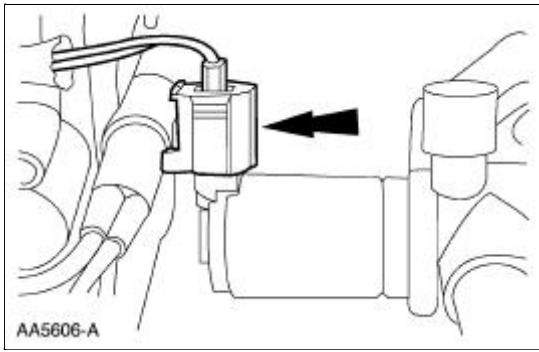
20. Connect the throttle position sensor (TPS) electrical connector.



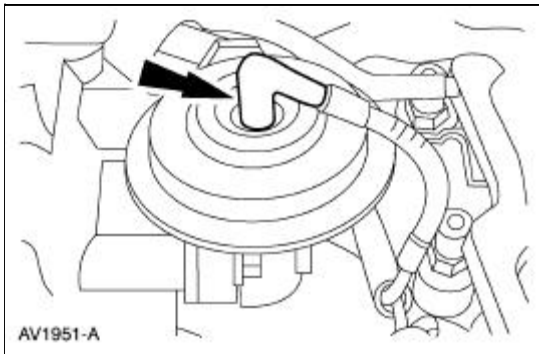
21. Connect the main vacuum supply to the base of the throttle body adapter.



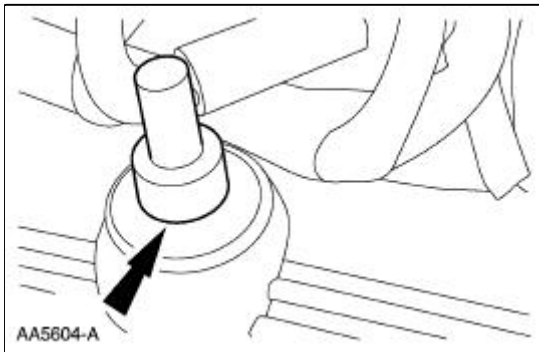
22. Connect the idle air control (IAC) valve electrical connector.



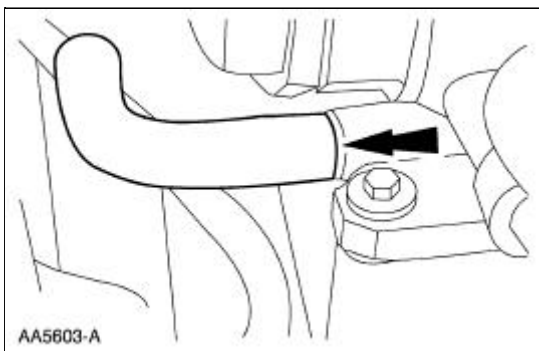
23. Connect the vacuum hose to the EGR valve.



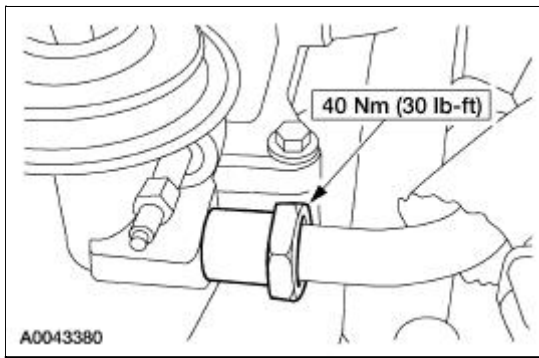
24. Connect the hose to the PCV valve.



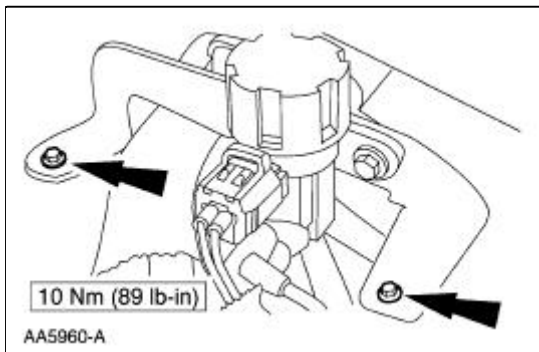
25. Connect the PCV hose to the base of the throttle body assembly.



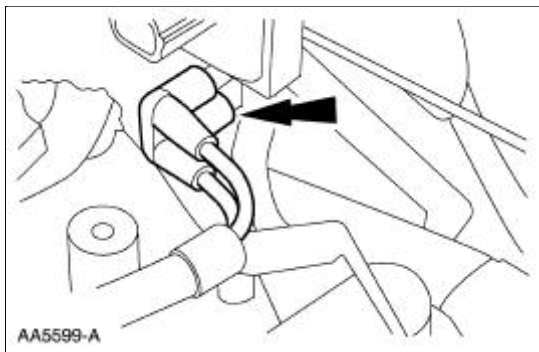
26. Connect the EGR tube to the EGR valve.



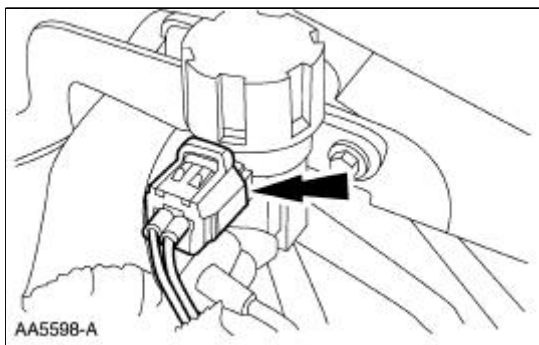
27. Install the EGR vacuum regulator solenoid bracket.



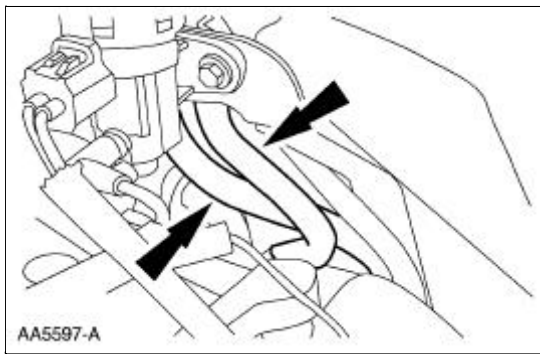
28. Connect the EGR vacuum regulator solenoid vacuum supply.



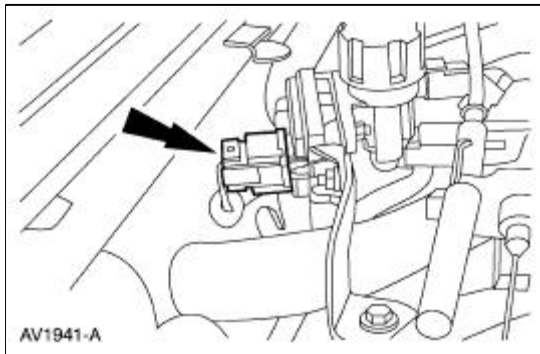
29. Connect the EGR vacuum regulator solenoid electrical connector.



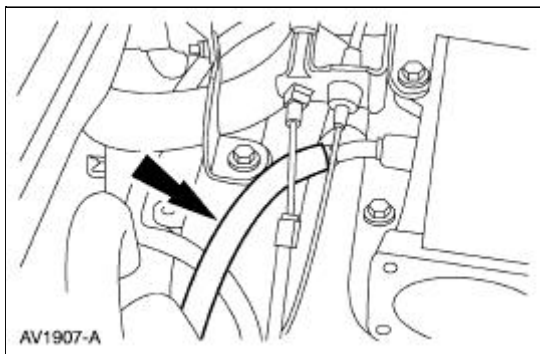
30. Connect the hoses to the differential pressure feedback EGR transducer.



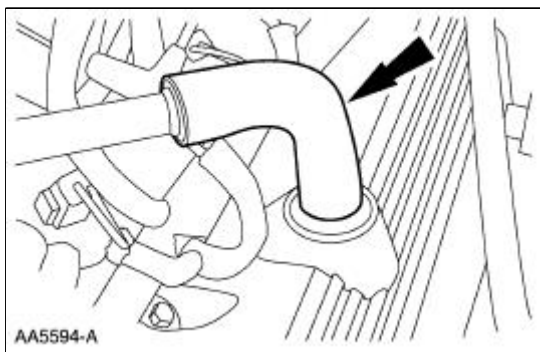
31. Connect the differential pressure feedback EGR electrical connector.



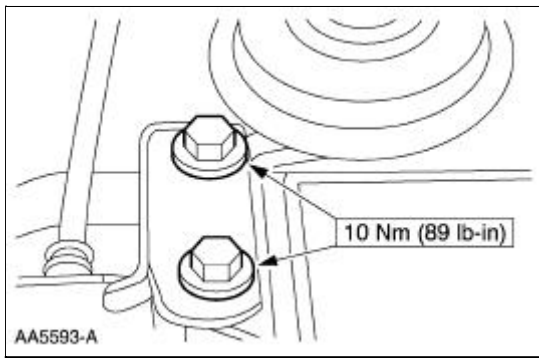
32. Connect the evaporative emissions return line.



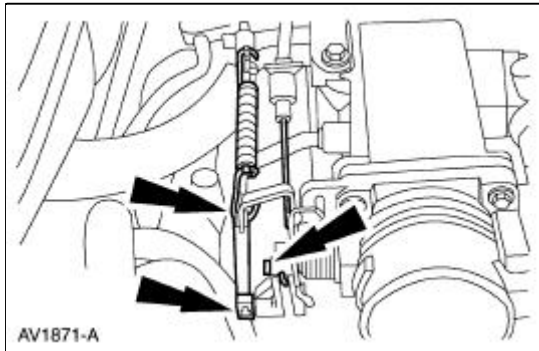
33. Install the breather tube.



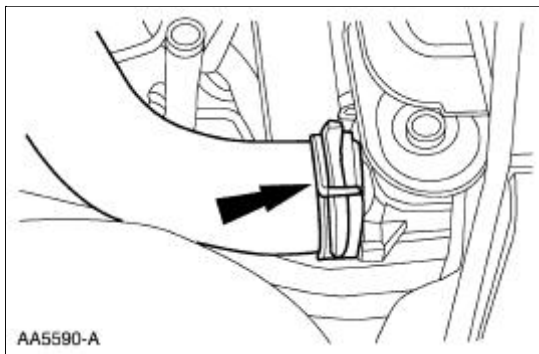
34. Position the cables and install the bracket.



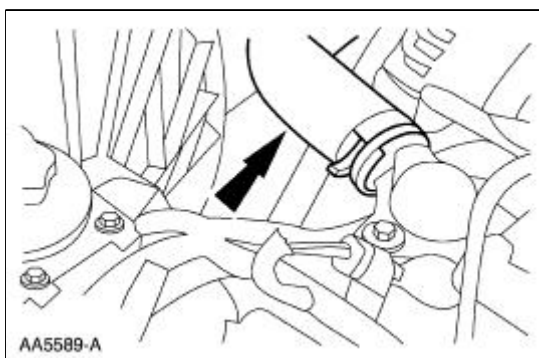
35. Connect the accelerator cable, speed control actuator cable and the return spring.



36. Connect the upper radiator hose.



37. Connect the upper radiator hose to the water outlet adapter.



38. Connect the fuel line. For additional information, refer to [Section 310-00](#).

39. Install the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).

40. Refill the engine cooling system. For additional information, refer to [Section 303-03A](#) or [Section 303-03B](#).
-

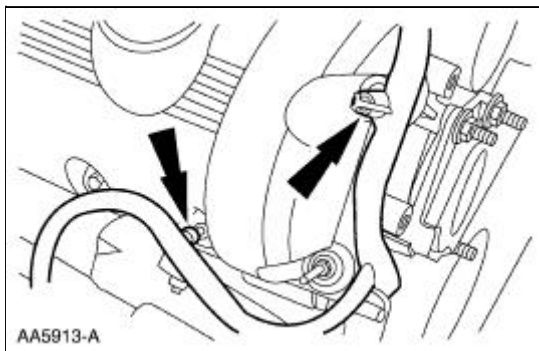
Valve Cover RH

Material

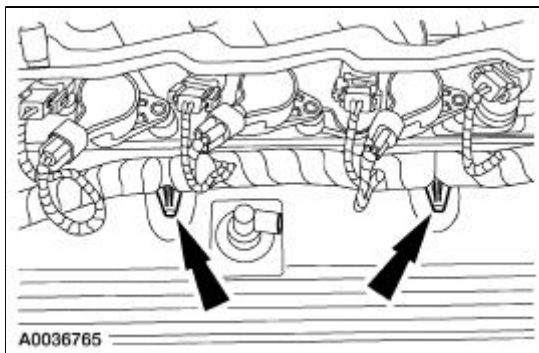
Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4

Removal and Installation

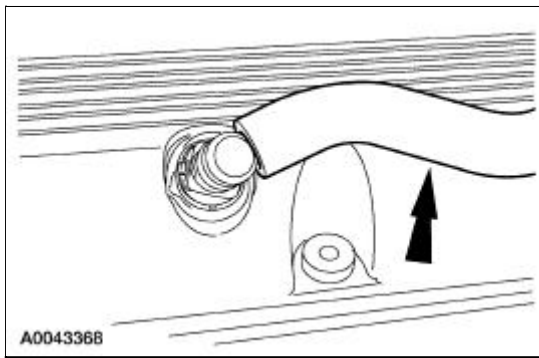
1. Remove the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).
2. Disconnect the fuel line. For additional information, refer to [Section 310-00](#).
3. Separate the engine wiring harness from the valve cover studs.



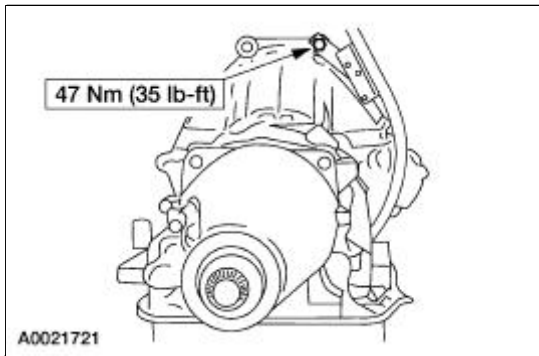
4. Separate the engine wiring harness from the valve cover studs.



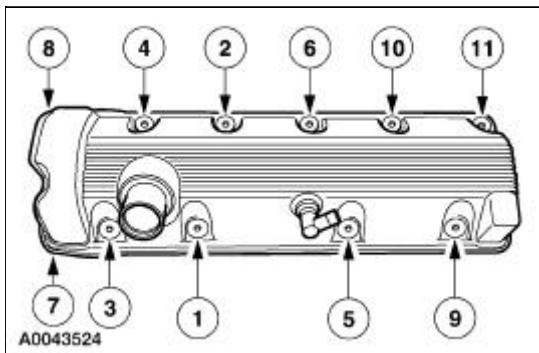
5. Remove the positive crankcase ventilation (PCV) hose from the valve cover and position aside.



6. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
7. Remove the bolt and position the transmission filler tube aside.

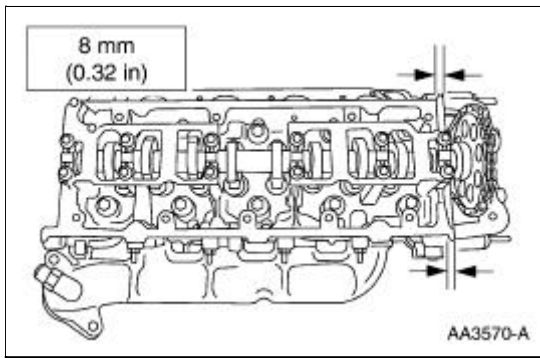


8. Remove the bolts, studs and the valve cover in the sequence shown.
 - Clean and inspect the sealing surfaces.



9. **NOTE:** Apply an eight millimeter bead of silicone gasket and sealant at the intersection of the engine front cover and the cylinder head.

To install, reverse the removal procedure.



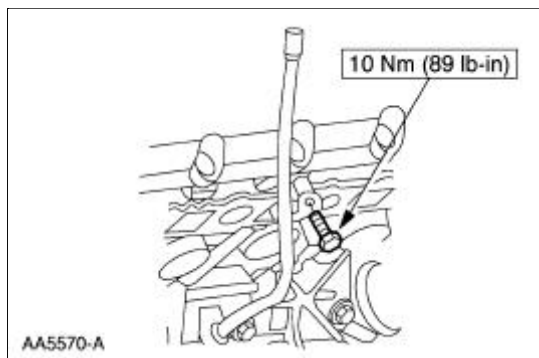
Valve Cover LH

Material

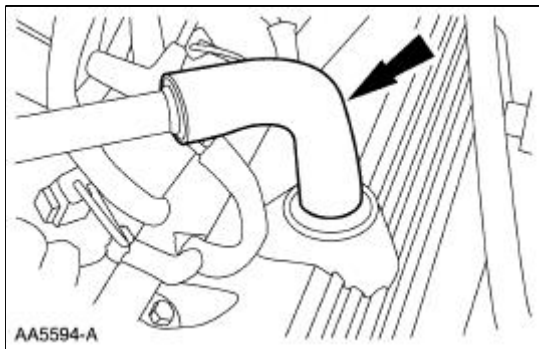
Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4

Removal and Installation

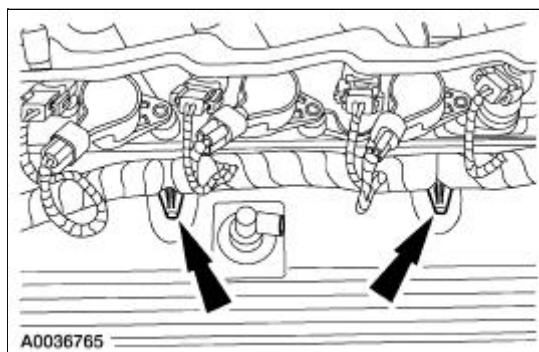
1. Position the oil level tube (6754) out of the way.



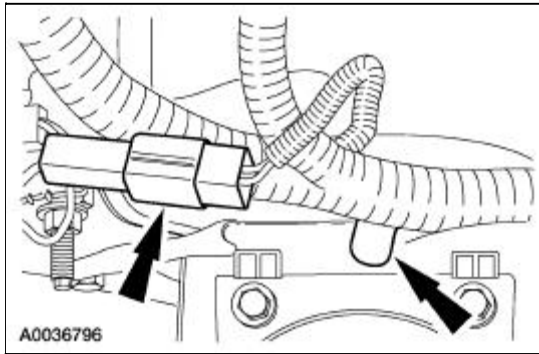
2. Disconnect the breather tube.



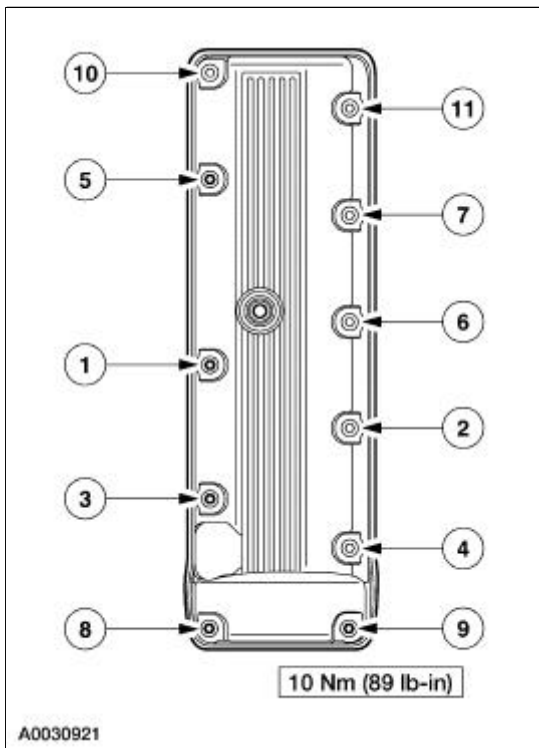
3. Separate the engine wiring harness in the locations shown.



4. Disconnect the engine wiring harness retainer and position it aside.

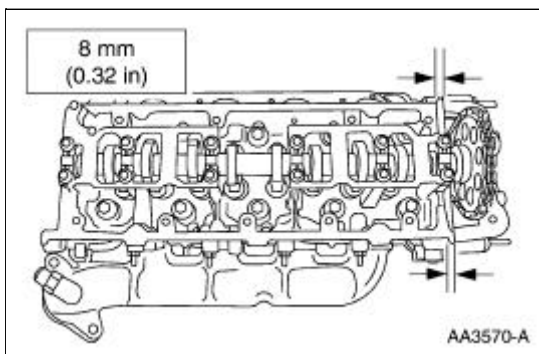


5. Remove the bolts, studs and the valve cover in the sequence shown.
- Inspect and clean the sealing surfaces.





6. **NOTE:** Apply an eight millimeter bead of silicone gasket and sealant at the intersection of the engine front cover and the cylinder head.

To install, reverse the removal procedure.



Crankshaft Pulley

Special Tool(s)

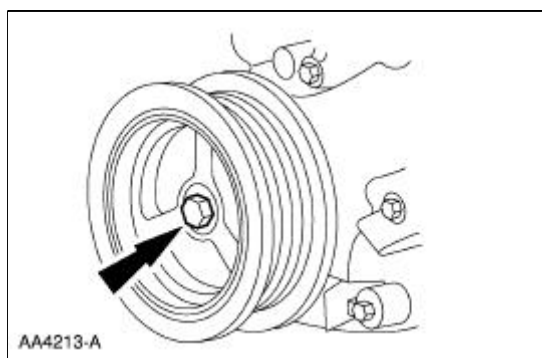
 ST1286-A	Remover, Crankshaft Vibration Damper 303-009 (T58P-6316-D)
 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)

Material

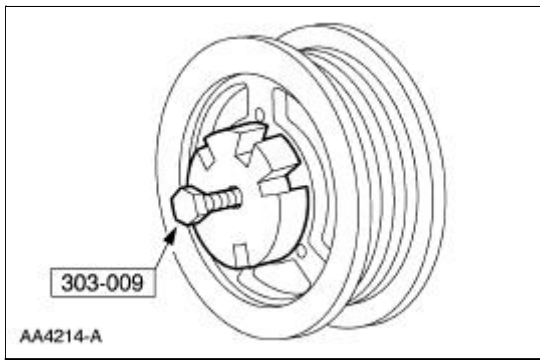
Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4

Removal

1. Remove the drive belt. For additional information, refer to [Section 303-05](#).
2. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
3. Remove the bolt.



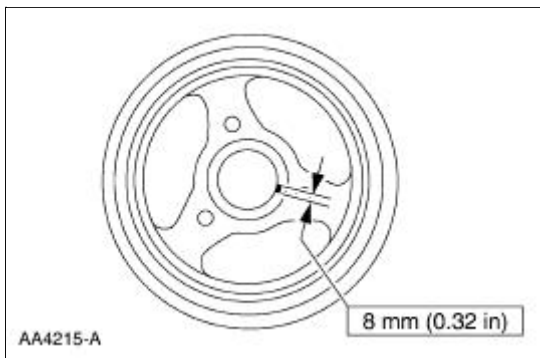
4. Using the special tool, remove the crankshaft pulley (6312).



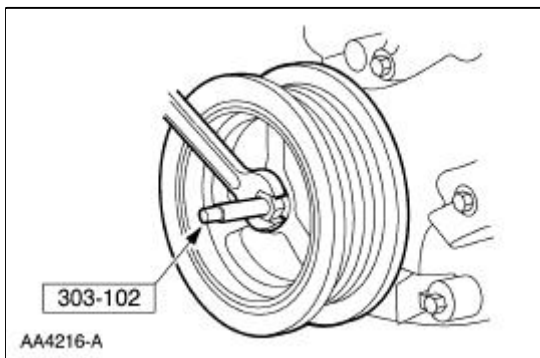
Installation

1. **NOTE:** The crankshaft pulley must be installed within four minutes of applying the sealant.

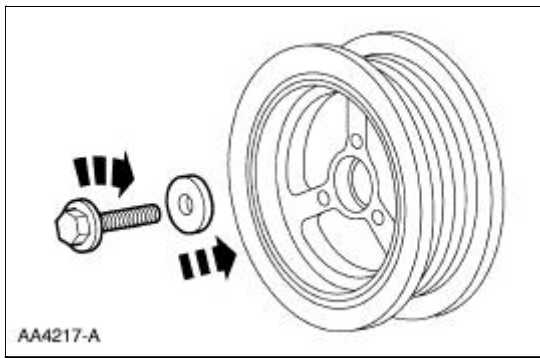
Apply sealant to the woodruff key slot on the crankshaft pulley.



2. Using the special tool, install the crankshaft pulley.



3. Install the washer and the bolt. Tighten the bolt in four stages.
 - Stage 1: Tighten the bolt to 90 Nm (66 lb-ft).
 - Stage 2: Loosen the bolt one full turn.
 - Stage 3: Tighten the bolt to 50 Nm (37 lb-ft).
 - Stage 4: Tighten the bolt an additional 90 degrees.



4. Lower the vehicle.
 5. Install the drive belt. For additional information, refer to [Section 303-05](#).
-

Crankshaft Front Oil Seal

Special Tool(s)

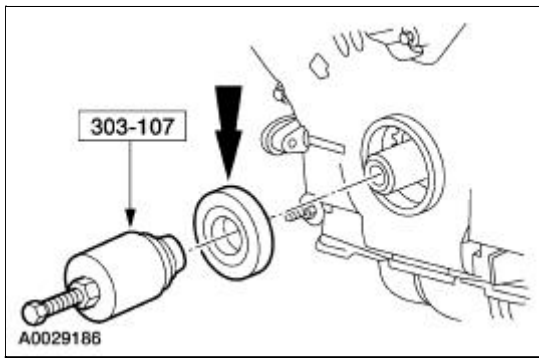
<p>ST1328-A</p>	<p>Crankshaft Seal Installer/Aligner 303-335 (T88T-6701-A)</p>
<p>ST1288-A</p>	<p>Front Cover Seal Remover 303-107 (T74P-6700-A)</p>
<p>ST2197-A</p>	<p>Crankshaft Seal Installer 303-635</p>
<p>ST1287-A</p>	<p>Crankshaft Damper Replacer 303-102 (T74P-6316-B)</p>

Material

Item	Specification
<p>Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent</p>	<p>WSS-M2C153- H</p>

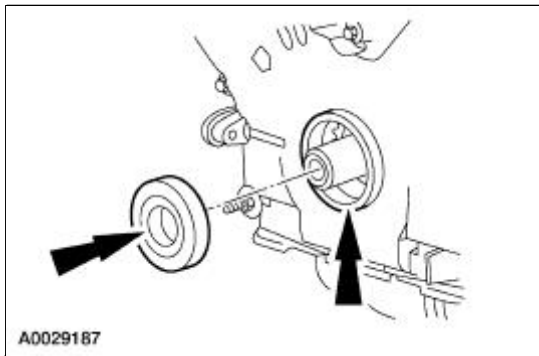
Removal

1. Remove the crankshaft pulley. For additional information, refer to [Crankshaft Pulley](#) in this section.
2. Using the special tool, remove the crankshaft front oil seal.

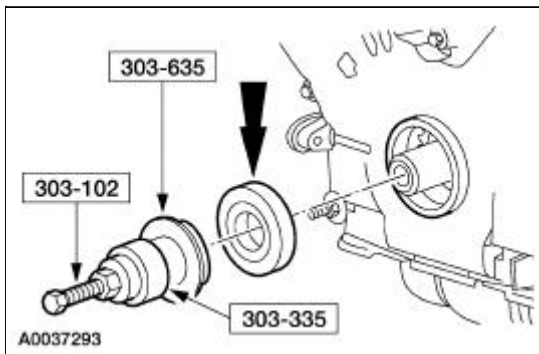


Installation

1. Lubricate the engine front cover and the crankshaft front oil seal inner lip with clean engine oil.



2. Using the special tools, install the crankshaft front oil seal into the engine front cover.



3. Install the crankshaft pulley. For additional information, refer to [Crankshaft Pulley](#).
-

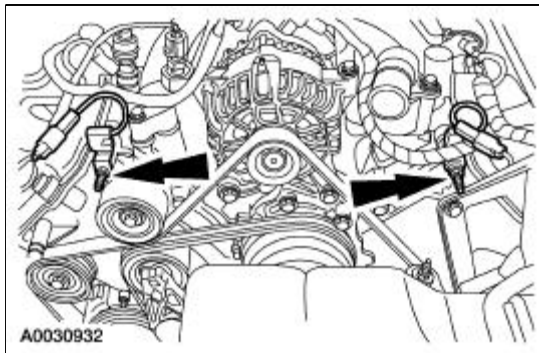
Engine Front Cover

Material

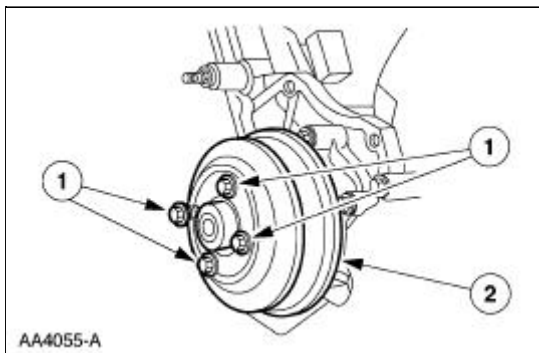
Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323- A4
Super Premium SAE 5W-20 Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

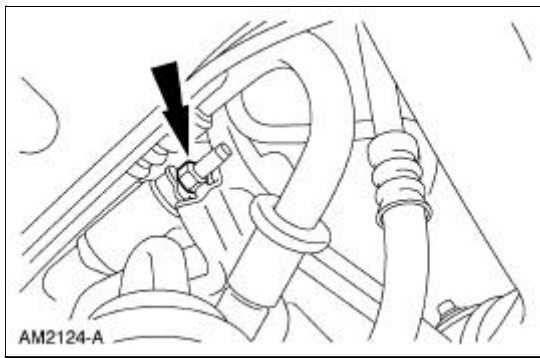
1. Remove the nuts and position the radio ignition interference capacitors aside.



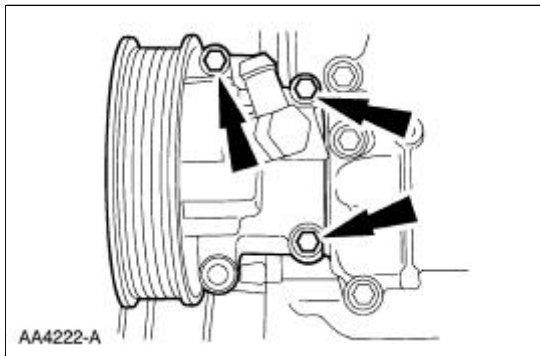
2. Remove the valve covers. For additional information, refer to [Valve Cover RH](#) and [Valve Cover LH](#) in this section.
3. Remove the cooling fan. For additional information, refer to [Section 303-03A](#) or [Section 303-03B](#).
4. Remove the accessory drive belt. For additional information, refer to [Section 303-05](#).
5. Remove bolts (1) and the water pump pulley (2).



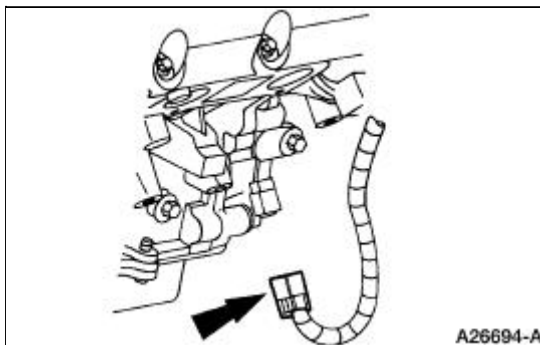
6. Remove the nut and position the A/C muffler aside.



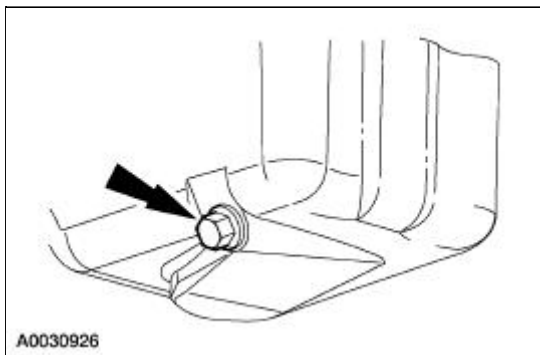
7. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
8. Remove the bolts and position the power steering pump aside.



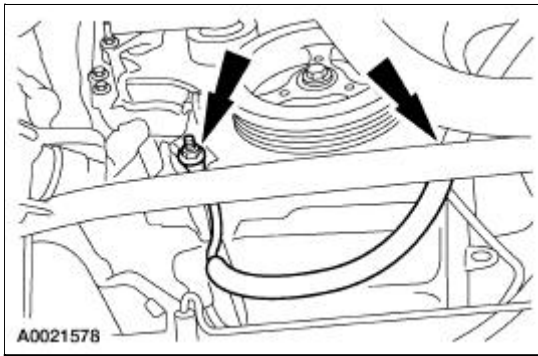
9. Disconnect the crankshaft position (CKP) sensor electrical connector.



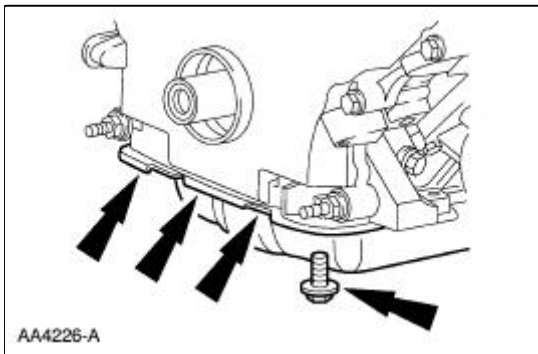
10. Drain the engine oil.



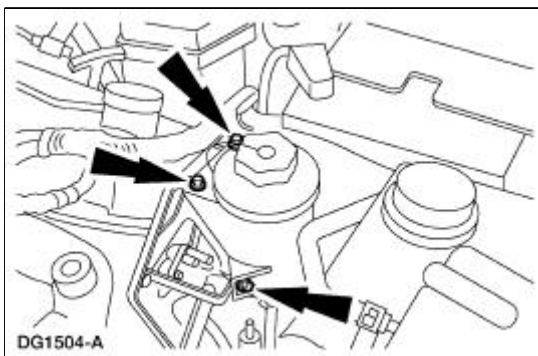
11. Remove the two support nuts and position the battery cable aside.



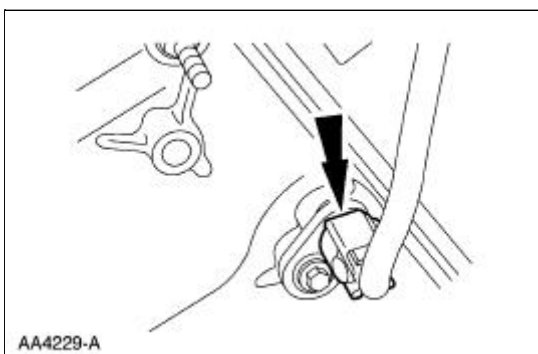
12. Remove the crankshaft front oil seal. For additional information, refer to [Crankshaft Front Oil Seal](#) in this section.
13. Remove the front oil pan bolts.



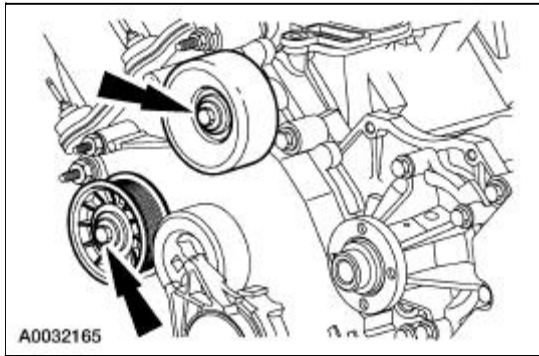
14. Lower the vehicle.
15. Remove the bolts and position the power steering reservoir aside.



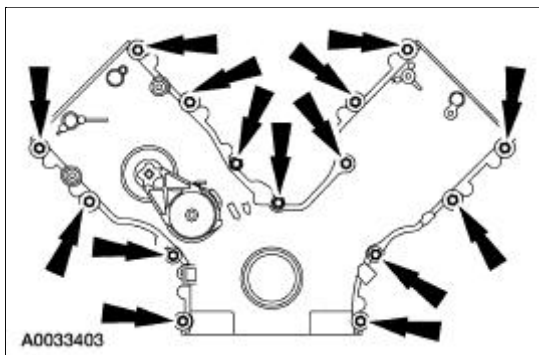
16. Disconnect the camshaft position (CMP) sensor electrical connector.



17. Remove the bolts and the belt idler pulleys.

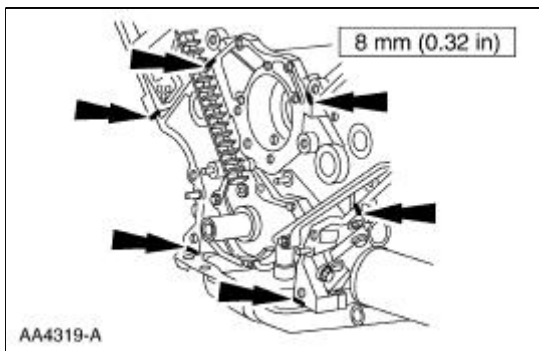


18. Remove the engine front cover bolts and the studs.
 - Discard the gaskets. Clean and inspect the sealing surfaces.

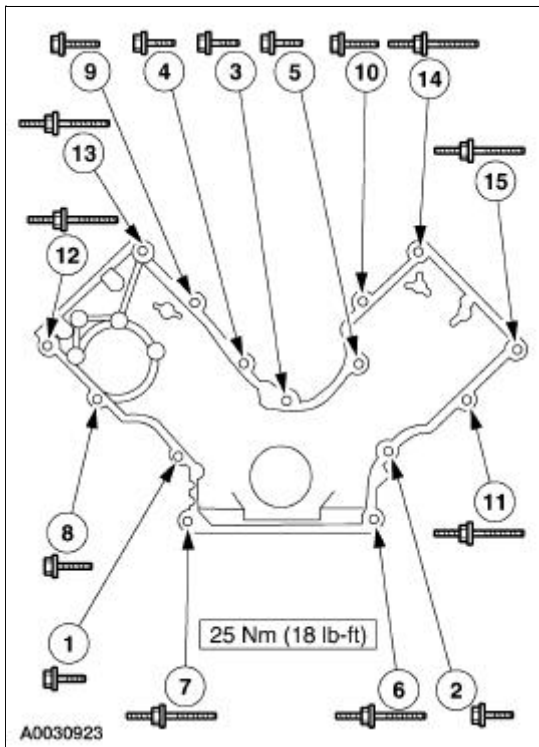


Installation

1. Apply silicone gasket and sealant in the locations shown.

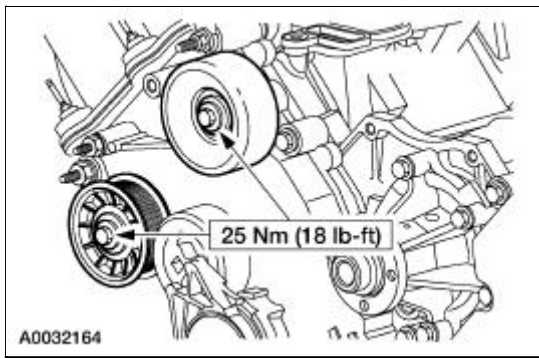


2. Install the engine front cover.

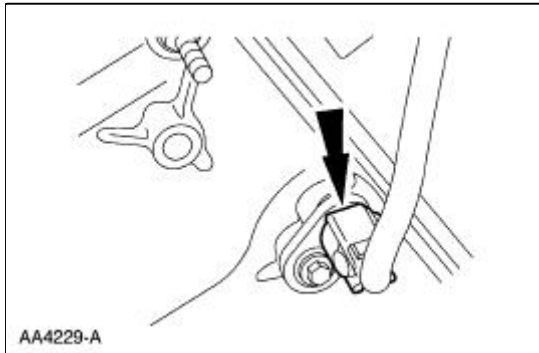


Item	Part Number	Description
1	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
2	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
3	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
4	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
5	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
6	W706508	Stud, Hex Shldr Pilot, M8 x 1.25 x 50 — M6 x 1 x 10
7	N808586	Stud and Washer, Hex Head Pilot, M8 x 1.25 x 60 — M6 x 1 x 26
8	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
9	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
10	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
11	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
12	W706560	Stud, Hex Head Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 16
13	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
14	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
15	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26

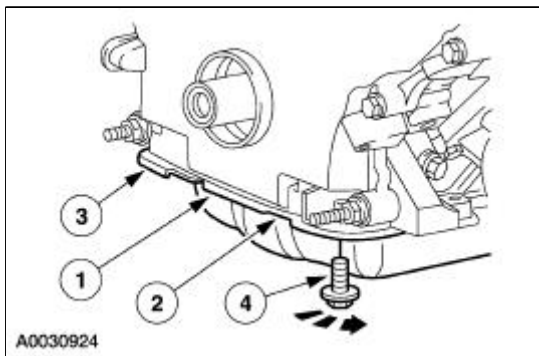
3. Install the belt idler pulleys and the bolts.



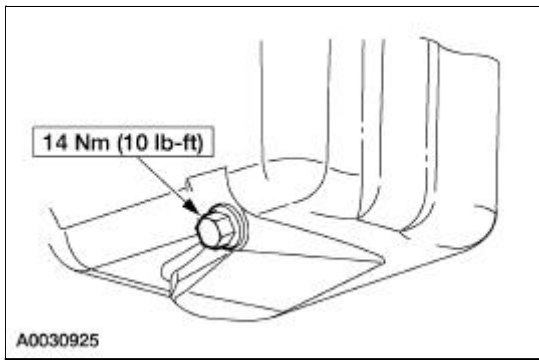
4. Connect the CMP sensor electrical connector.



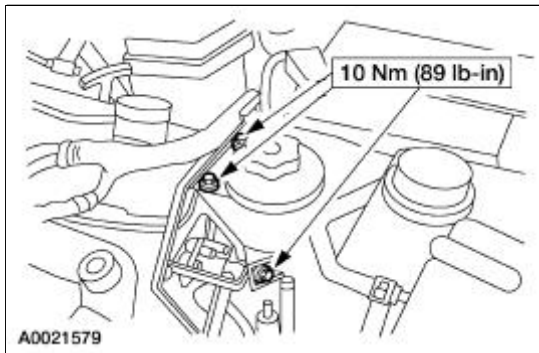
5. Raise the vehicle.
6. Install the crankshaft front oil seal. For additional information, refer to [Crankshaft Front Oil Seal](#) in this section.
7. Tighten the four oil pan bolts in the sequence shown.
 - Stage 1: Tighten to 2 Nm (18 lb-in).
 - Stage 2: Tighten to 20 Nm (15 lb-ft).
 - Stage 3: Tighten an additional 60 degrees.



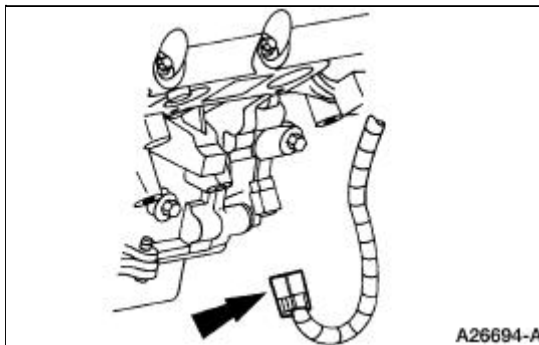
8. Install the drain plug.



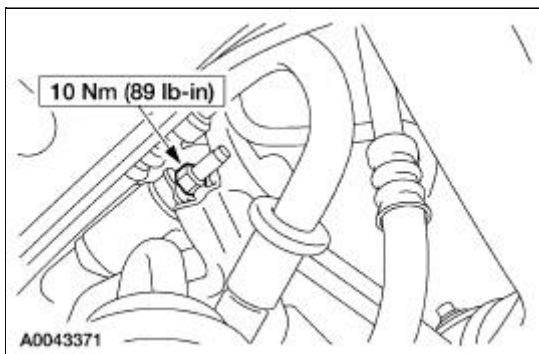
9. Position the power steering reservoir and install the bolts.



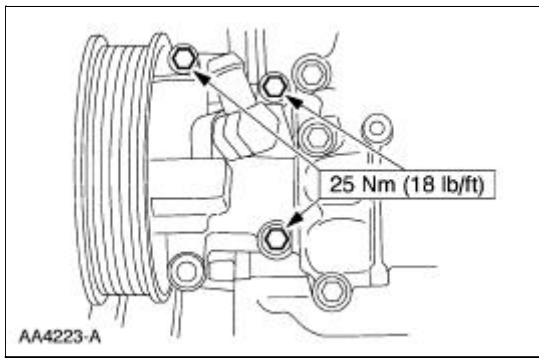
10. Connect the CKP sensor electrical connector.



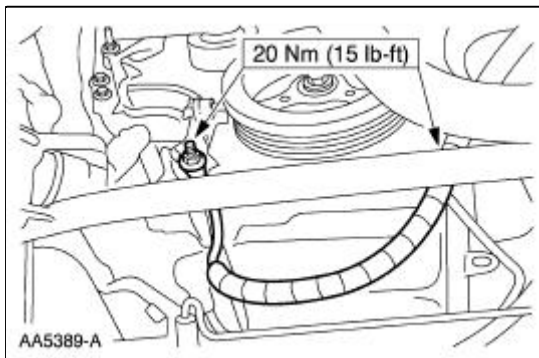
11. Position the A/C muffler and tighten the nut.



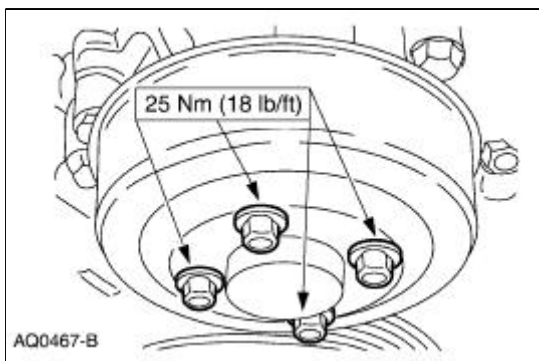
12. Install the power steering pump and the bolts.



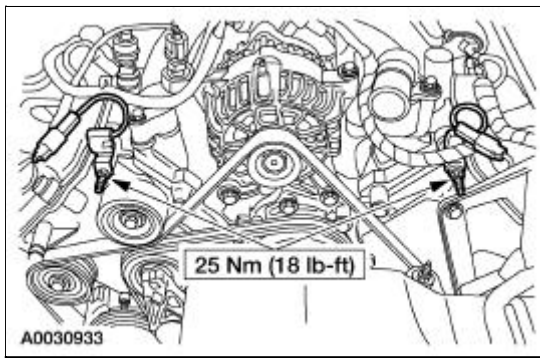
13. Position the battery cable and install the two nuts.



14. Install the crankshaft pulley. For additional information, refer to [Crankshaft Pulley](#) in this section.
15. Install the water pump pulley and the bolts.



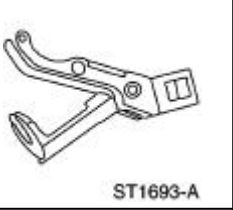

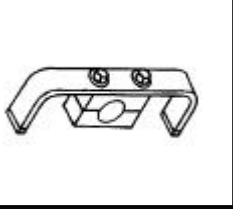
16. Install the cooling fan. For additional information, refer to [Section 303-03A](#) or [Section 303-03B](#).
17. Install the accessory drive belt. For additional information, refer to [Section 303-05](#).
18. Install the valve covers. For additional information, refer to [Valve Cover RH](#) and [Valve Cover LH](#) in this section.
19. Position the radio ignition interference capacitors and install the nuts.




20. Fill the crankcase with clean engine oil.
-

Timing Drive Components

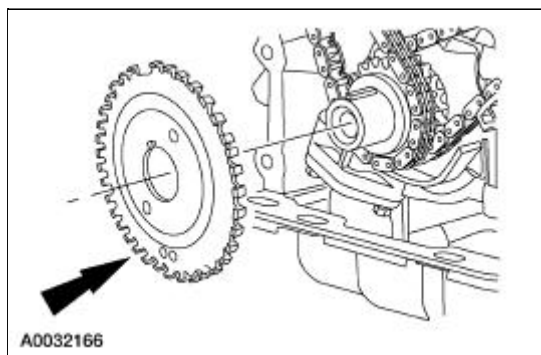
Special Tool(s)

 <p>ST1693-A</p>	Compressor, Valve Spring 303-567 (T97P-6565-AH)
 <p>ST1335-A</p>	Holding Tool, Crankshaft 303-448 (T93P-6303-A)
 <p>303-557 (T96T-6256-B)</p>	Aligner, Camshaft Position 303-557 (T96T-6256-B)

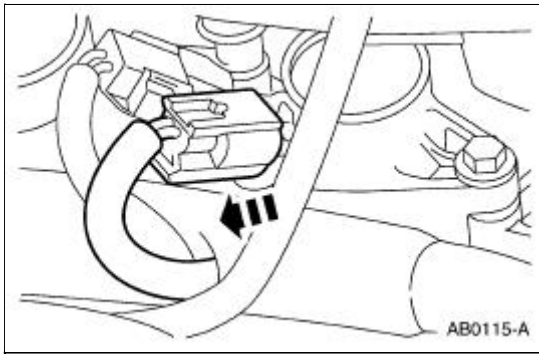
Removal

 **CAUTION:** Since the engine is not free-wheeling, timing procedures must be followed exactly or piston and valve damage can occur.

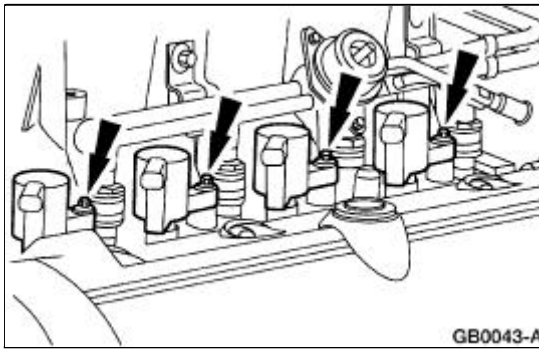
1. Remove the engine front cover. For additional information, refer to [Engine Front Cover](#) in this section.
2. Remove the crankshaft sensor ring from the crankshaft.



3. Disconnect the eight ignition coil electrical connectors.

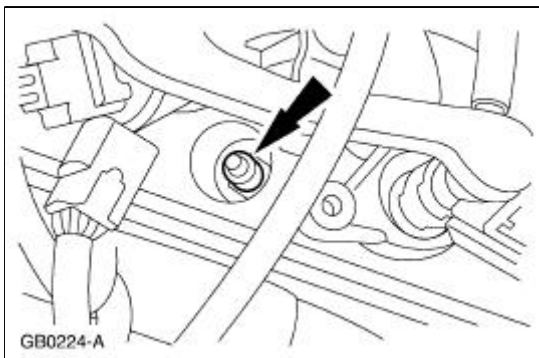


4. Remove the bolts and the eight ignition coils.



5. **NOTE:** Use compressed air to remove any foreign material from the spark plug wells before removing the spark plugs.

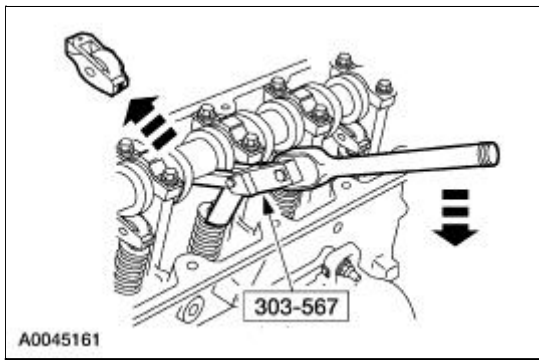
Remove the spark plugs.



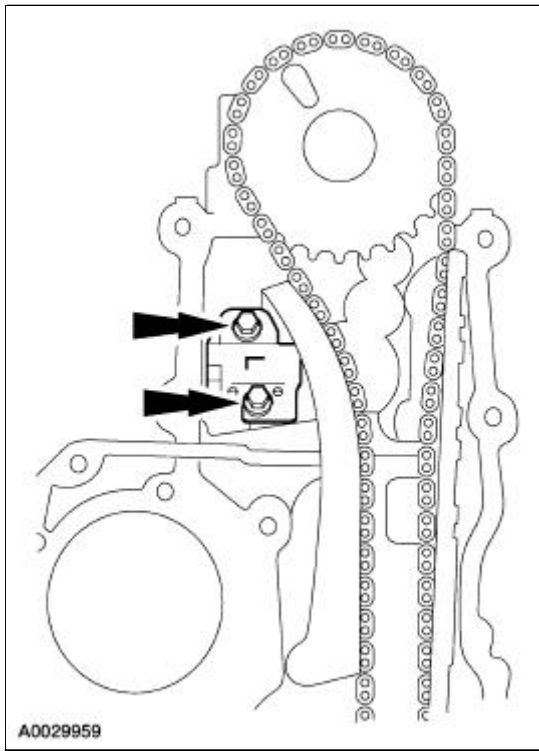
6. **NOTE:** Rotate the camshaft to the base circle of the camshaft lobe before removing the followers. Keep the roller followers in order when removing.

Using the special tool, remove the 16 roller followers.

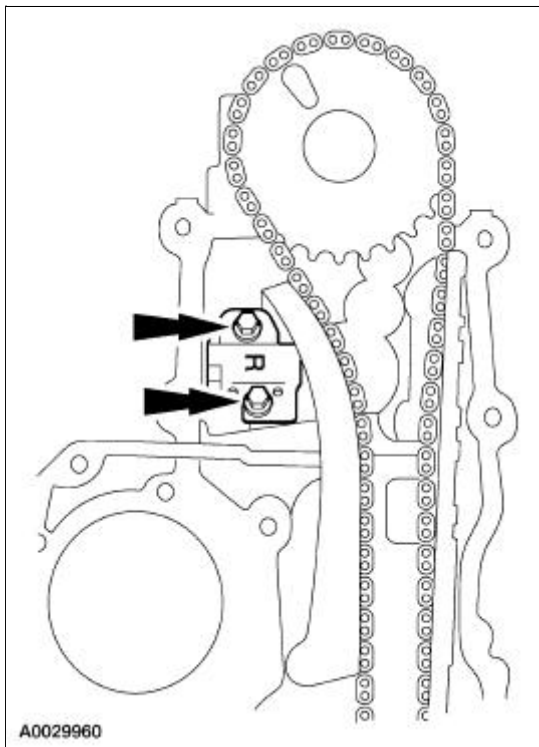
- Rotate the crankshaft and camshaft as necessary.



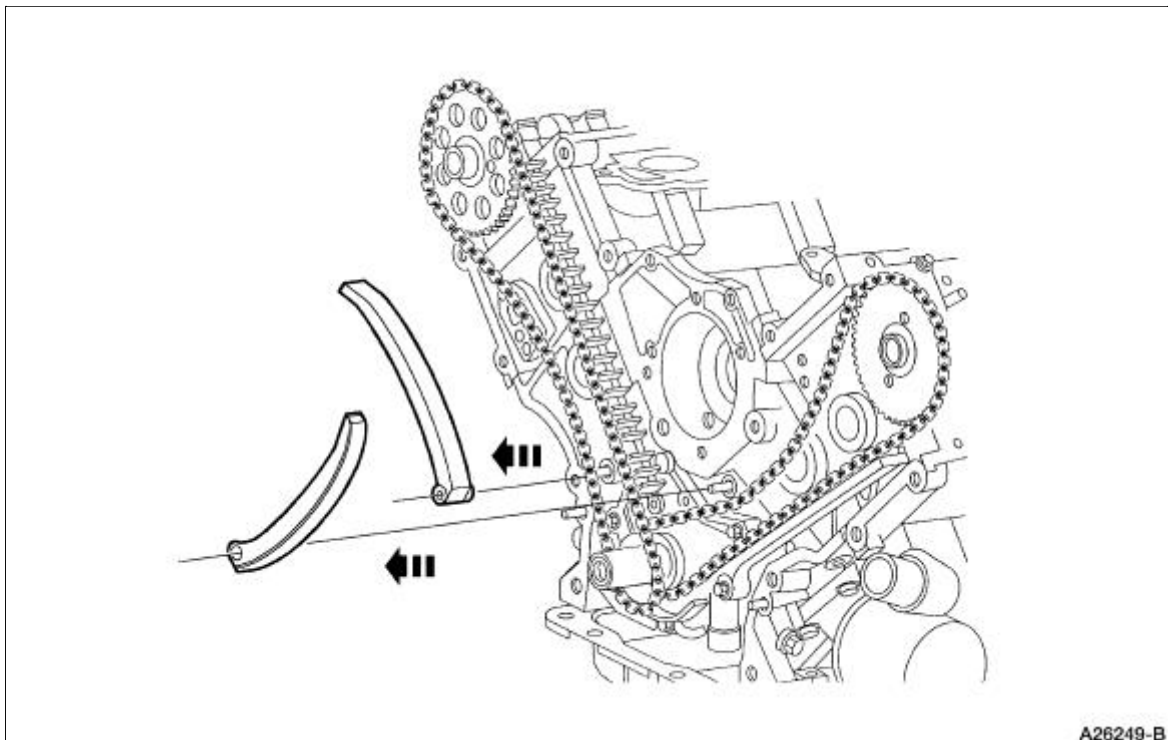
7. Remove the bolts and the LH timing chain tensioner.



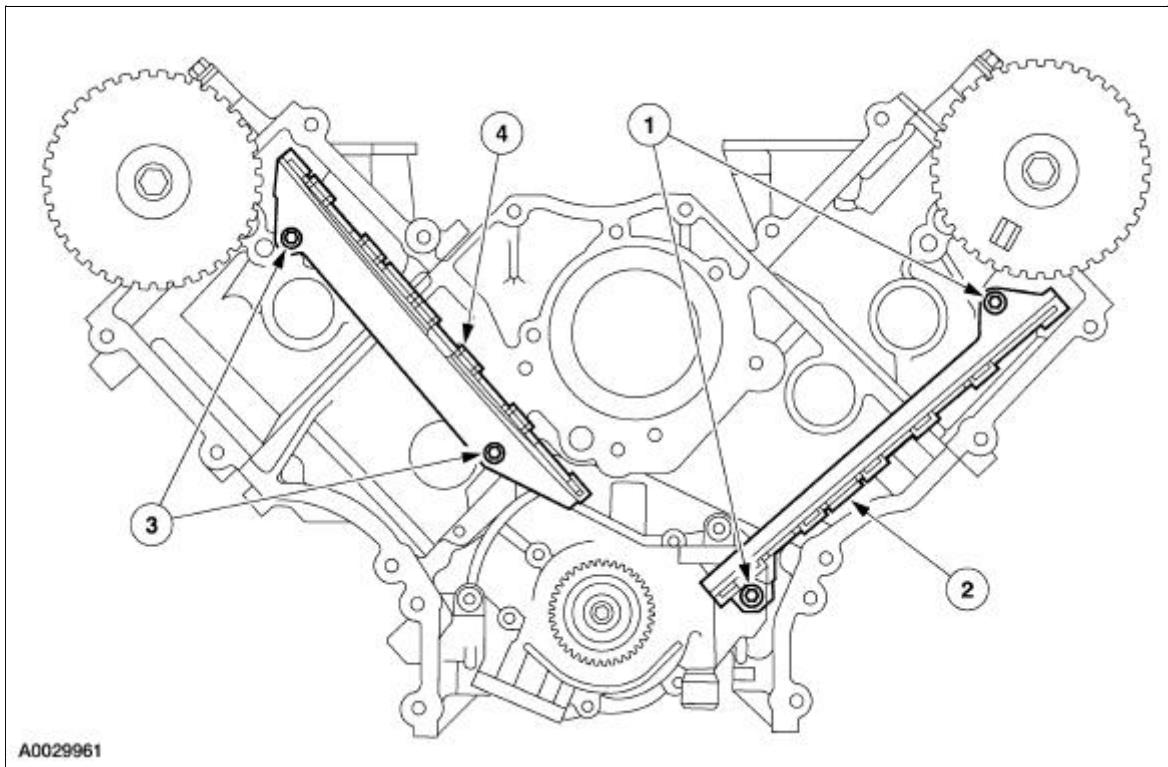
8. Remove the bolts and the RH timing chain tensioner.



9. Remove the LH and the RH timing chain tensioner arm from the dowel pins.

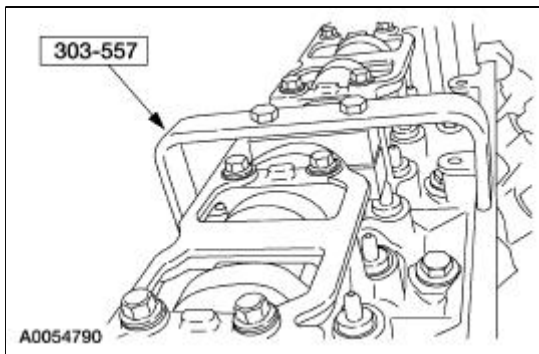


10. Remove the timing chains and the crankshaft sprocket.
11. Remove the timing chain guides.
 1. Remove the bolts.
 2. Remove the LH timing chain guide.
 3. Remove the bolts.
 4. Remove the RH timing chain guide.



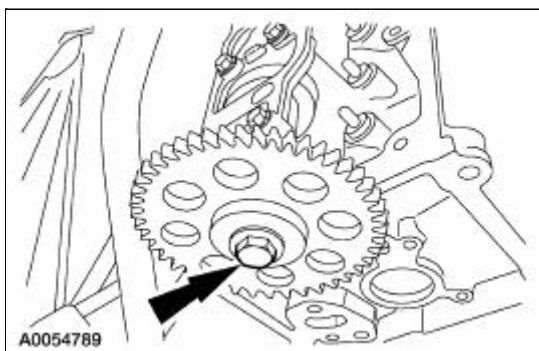
12. **NOTE:** RH shown, LH similar.

Install the special tool.



13. **NOTE:** RH shown, LH similar.

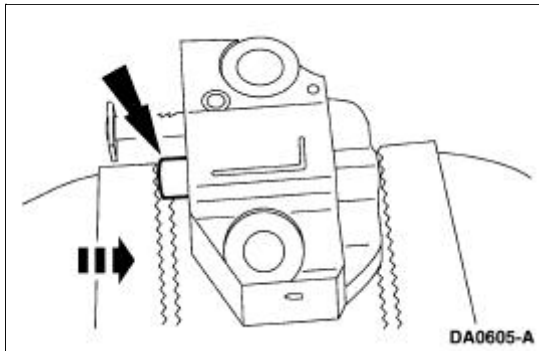
Remove the bolt and the camshaft gear.



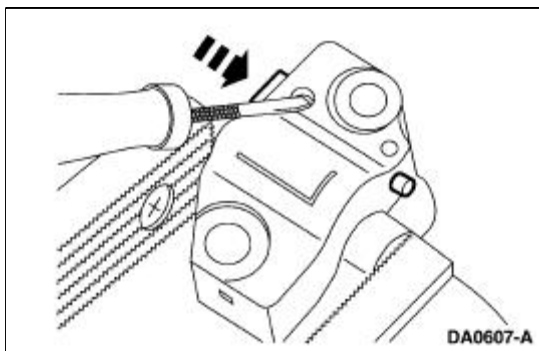
Installation

1.  **CAUTION: The timing chain procedures must be followed exactly or damage to the valve and pistons will result.**

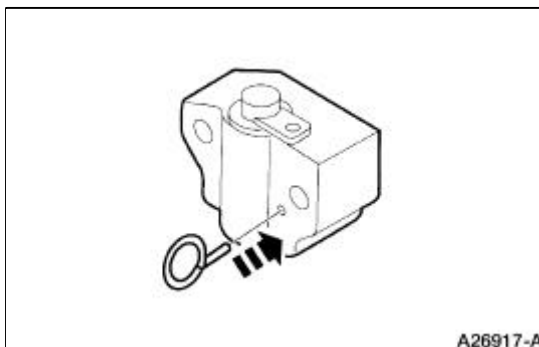
Compress the tensioner plunger, using an edge of a vise.



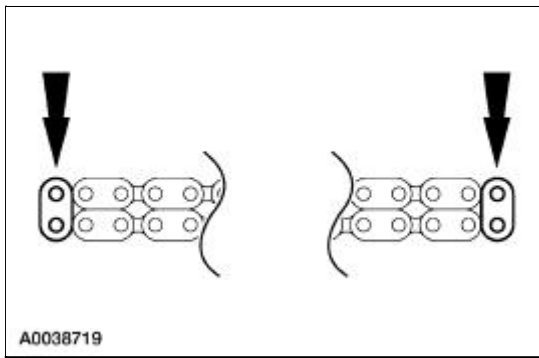
2. While holding the ratchet mechanism, push the ratchet arm back into the tensioner housing.



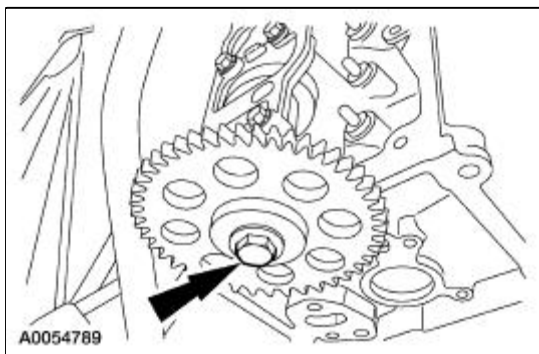
3. Install a paper clip into the hole in the tensioner housing to hold the ratchet assembly and plunger in during installation.



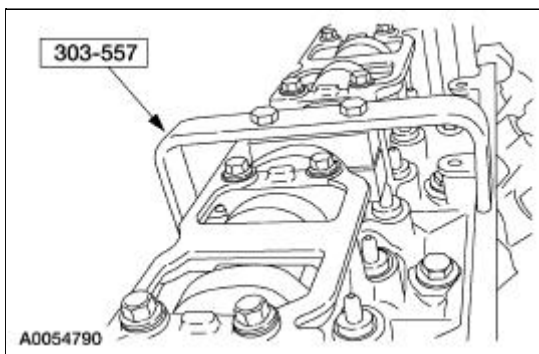
4. If the copper links are not visible, mark one link on one end and one link on the other end, and use as timing marks.



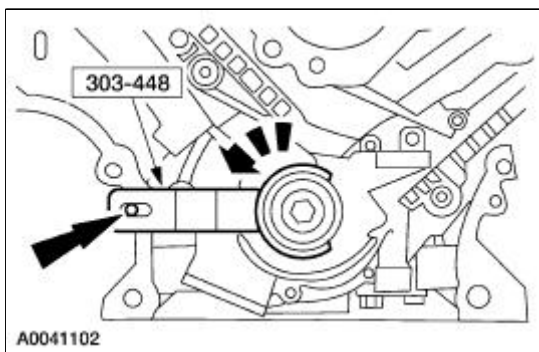
5. Install the camshaft sprockets and new bolts. Tighten the bolts in two stages.
 - Stage 1: Tighten the bolt to 40 Nm (30 lb-ft).
 - Stage 2: Tighten the bolt an additional 90 degrees (1/4 turn).



6. Remove the special tool.

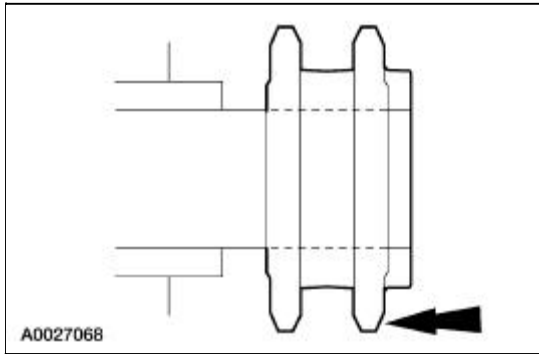


7. Using the special tool, position the crankshaft so the number one cylinder is at TDC.

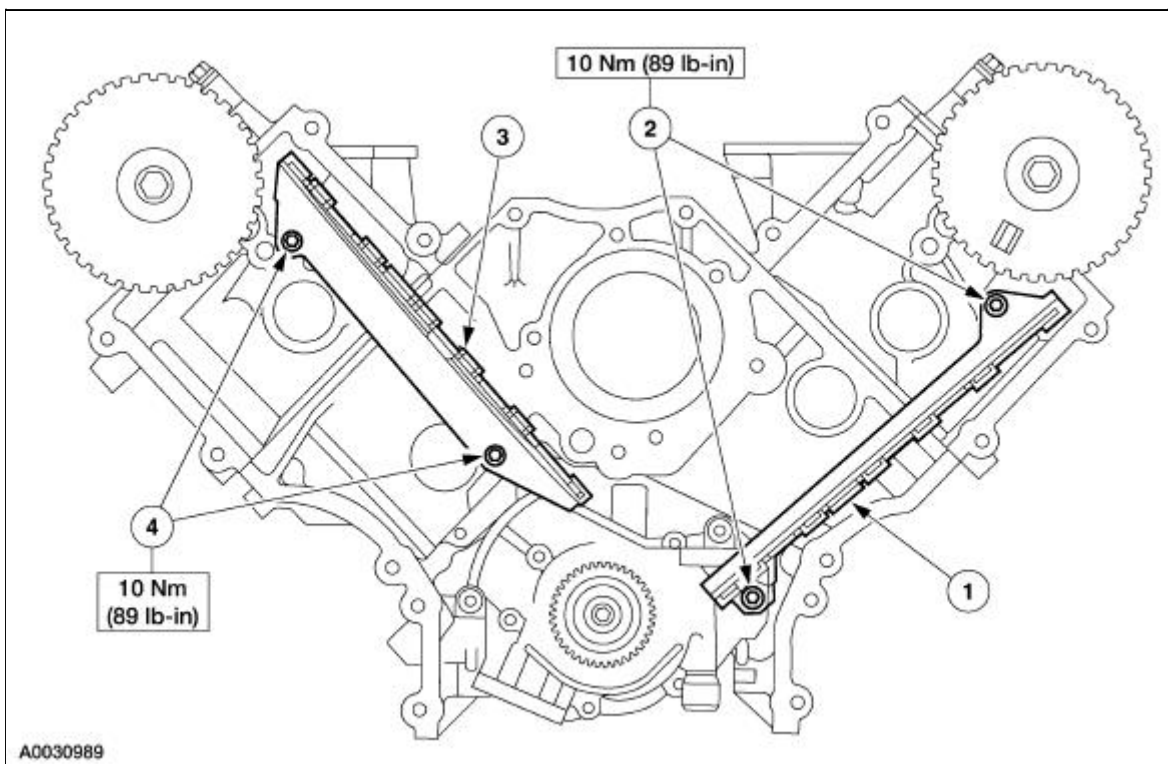


8. Remove the special tool.

9. Install the crankshaft sprocket, making sure the flange faces forward.

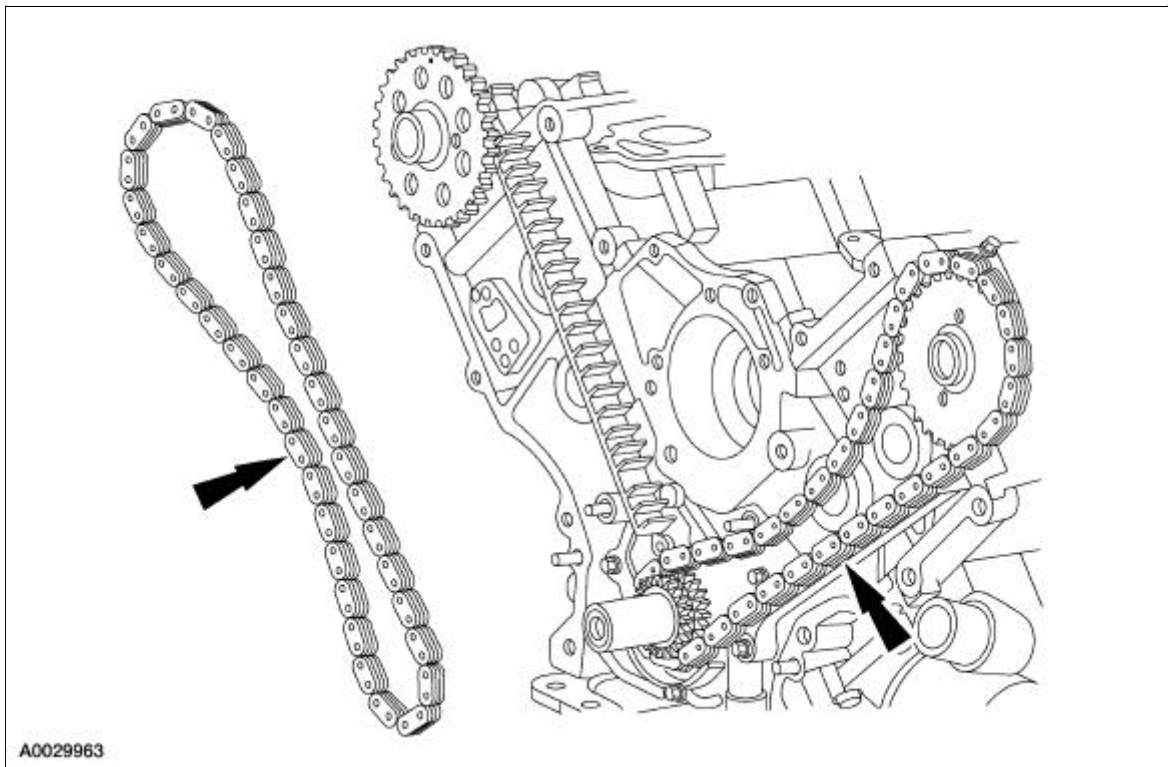


10. Install the timing chain guide.
1. Position the LH timing chain guide.
 2. Install and tighten the LH bolts.
 3. Position the RH timing chain guide.
 4. Install and tighten the RH bolts.

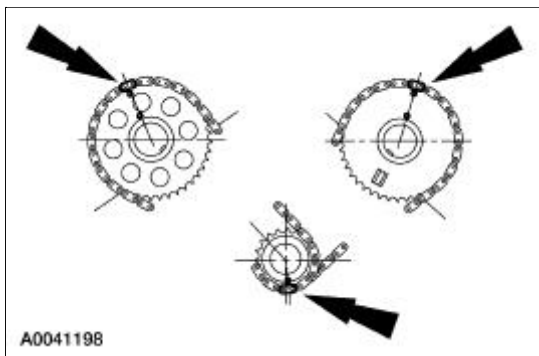


11. Install the timing chains.

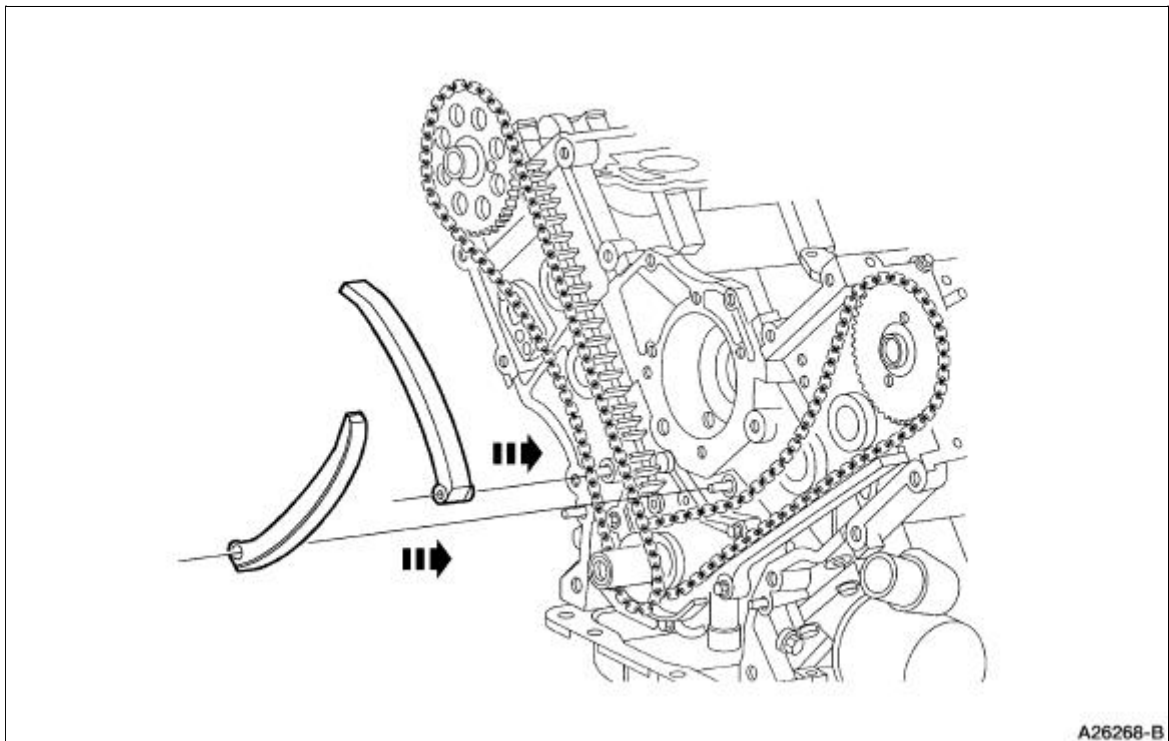
- Install the LH (inner) timing chain on the crankshaft sprocket, aligning the copper link with the dot on the crankshaft sprocket.
- Install the LH (inner) timing chain on the camshaft sprocket, aligning the copper link with the dot on the camshaft sprocket.
- Install the RH (outer) timing chain on the crankshaft sprocket, aligning the copper link with the dot on the crankshaft sprocket.
- Install the RH (outer) timing chain on the camshaft sprocket, aligning the copper link with the dot on the camshaft sprocket.



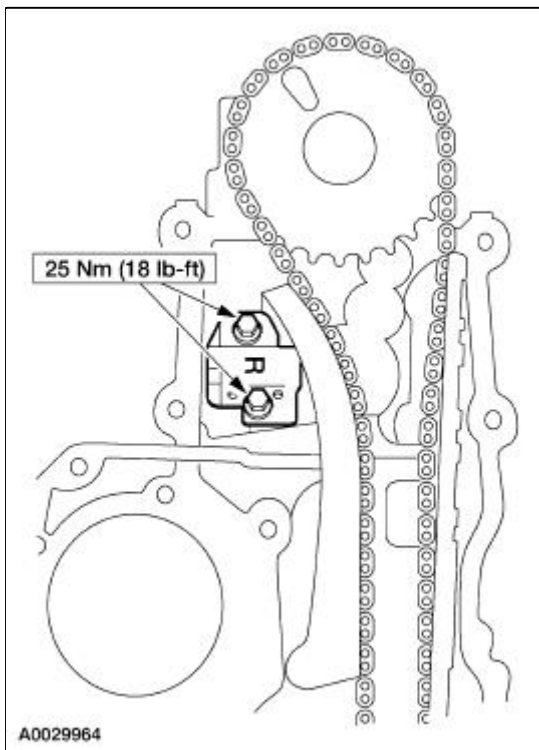
12. Make sure that the copper (marked) chain links are lined up with the dots on the crankshaft sprocket and the camshaft sprockets.



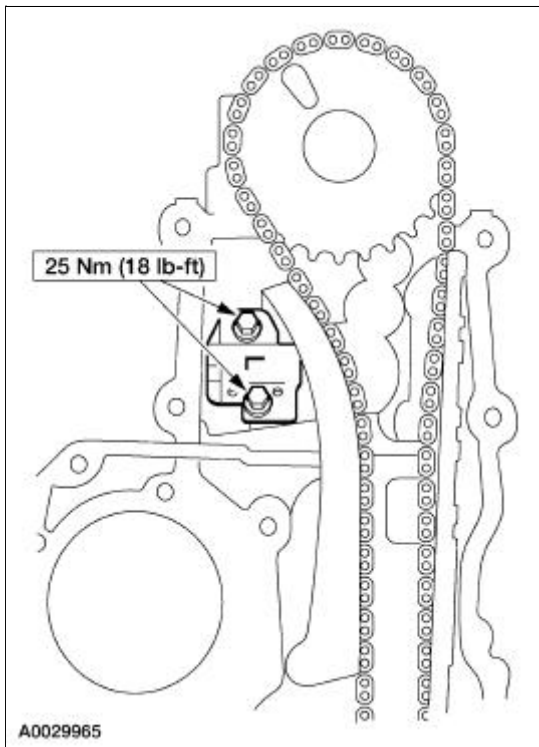
13. **NOTE:** The LH timing chain tensioner arm has a bump near the dowel hole, for identification.
Position the LH and the RH timing chain tensioner arm on the dowel pins.



14. Position the RH timing chain tensioner and install the bolts.



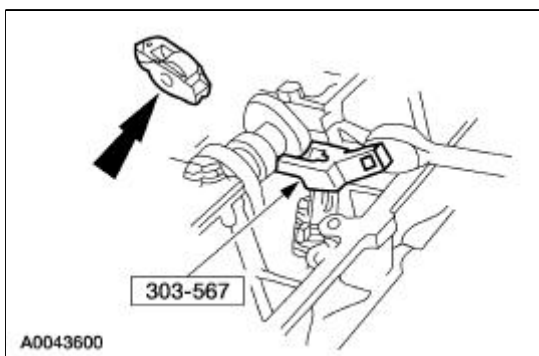
15. Position the LH timing chain tensioner and install the bolts.



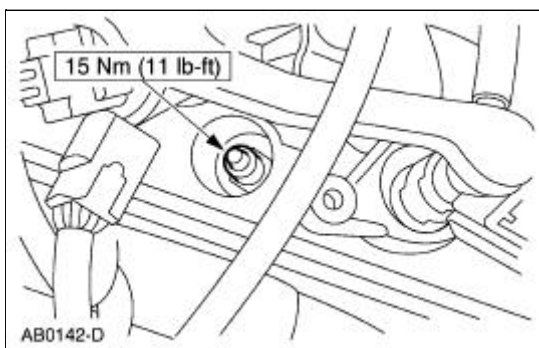
16. Remove the paper clip from the RH and the LH timing chain tensioners.
17. **NOTE:** Rotate the camshaft to the base circle of the camshaft lobe before installing the roller followers.

NOTE: Keep all the roller followers in order when installing.

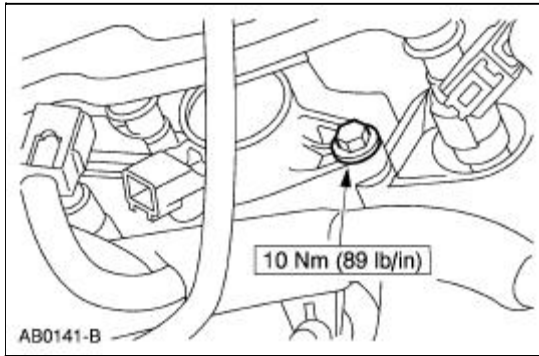
Using the special tool, install the 16 roller followers.



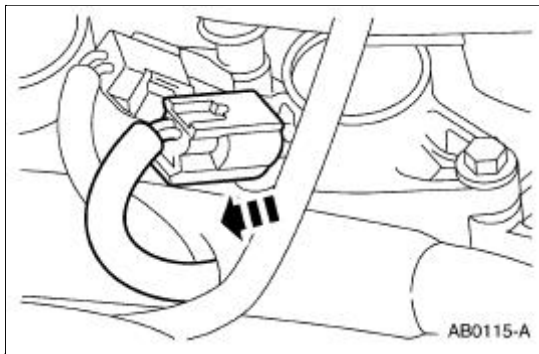
18. Install the eight spark plugs.



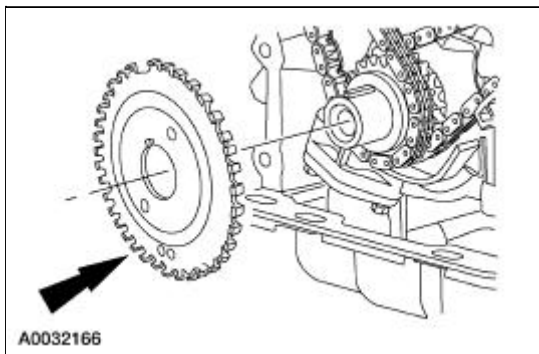
19. Install the eight ignition coils and bolts.



20. Connect the eight ignition coil electrical connectors.





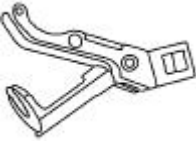
21. Install the crankshaft sensor ring on the crankshaft.



22. Install the engine front cover. For additional information, refer to [Engine Front Cover](#) in this section.
-

Valve Seals


Special Tool(s)

 <p>ST1718-A</p>	Valve Spring Compressor 303-452 (T93P-6565-AR)
 <p>ST1332-A</p>	Valve Stem Seal Replacer 303-383 (T91P-6571-A)
 <p>ST1693-A</p>	Compressor, Valve Spring (Exhaust) 303-567 (T97P- 6565-AH)

Material

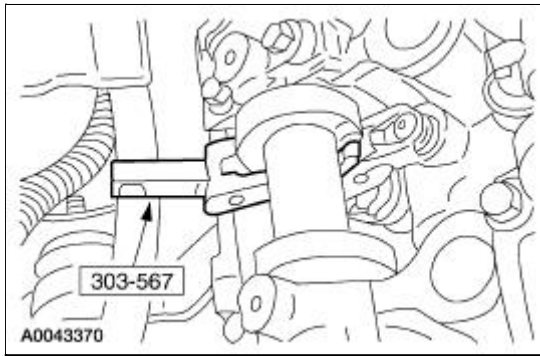
Item	Specification
Super Premium SAE 5W-20 Motor Oil XO-5W20-QSP	WSS-M2C153- H

Removal and Installation

1. Remove the roller followers. For additional information, refer to [Camshaft Roller Follower](#) in this section.
2. Remove the spark plug (12405) from the applicable cylinder.
3. Position the piston (6102) of the cylinder being serviced at the bottom of the stroke.
4.  **CAUTION:** If air pressure has forced the piston to the bottom of the cylinder, any loss of air pressure will allow the valve to fall into the cylinder. If air pressure must be removed, support the valve prior to removal.

Use compressed air in the cylinder to hold both valves in position.

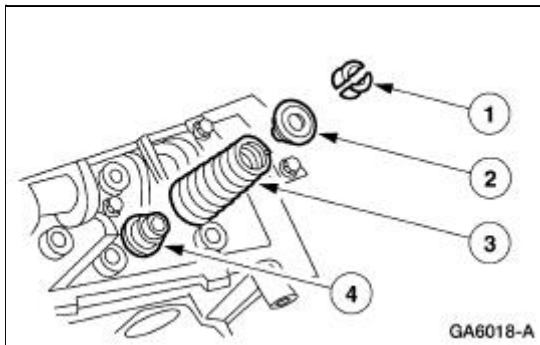
5. Using the special tool, compress the valve spring (6513).



6. **NOTE:** Valve stem seals should be visually inspected if not installing new seals.

Remove the valve stem seals.

1. Remove the valve spring retainer keys.
2. Remove the valve spring retainers.
3. Remove the valve springs.
4. Remove the valve stem seals.



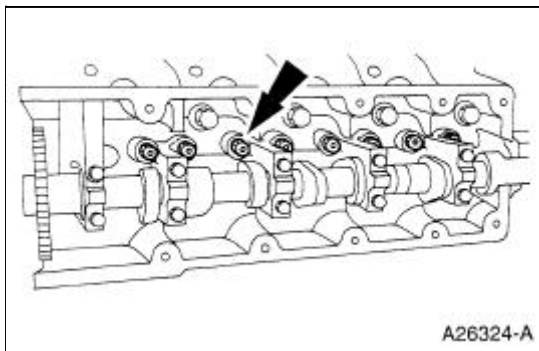
7. **NOTE:** Lubricate the lip of the new seal with clean engine oil prior to installation.

To install, reverse the removal procedure.

Hydraulic Lash Adjuster

Removal and Installation


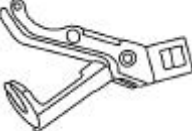
1. Remove the roller followers. For additional information, refer to [Camshaft Roller Follower](#) in this section.
2. Remove the eight hydraulic lash adjusters.



3. Inspect the lash adjusters. For additional information, refer to [Section 303-00](#).
 4. To install, reverse the removal procedure.
-

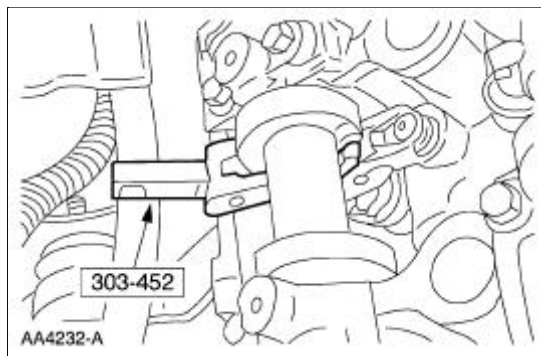
Camshaft Roller Follower

Special Tool(s)

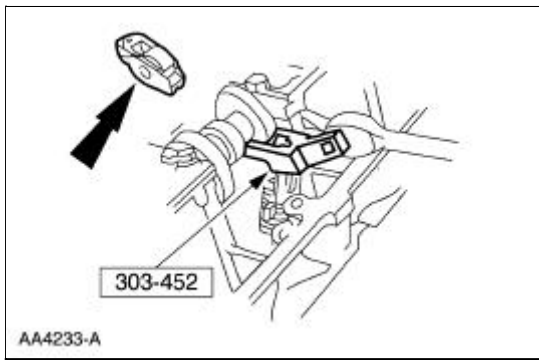
 ST1718-A	Compressor, Valve Spring (Intake) 303-452 (T93P-6565-AR)
 ST1693-A	Compressor, Valve Spring (Exhaust) 303-567 (T97P-6565-AH)

Removal

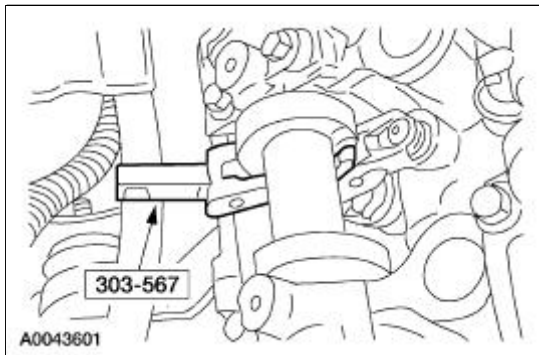
1. Remove the valve cover. For additional information, refer to [Valve Cover LH](#) or [Valve Cover RH](#) in this section.
2. Position the piston of the cylinder being serviced at the bottom of the stroke and the camshaft lobe at base circle.
3. Using the special tool compress the intake valve spring.



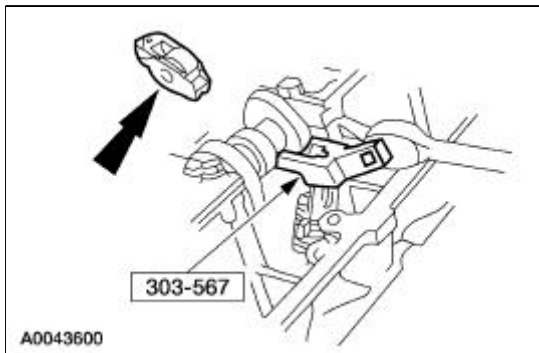
4. Remove the roller follower from the intake valve.



5. Using the special tool compress the exhaust valve spring.



6. Remove the camshaft roller follower from the exhaust valve.



7. Repeat Steps 2, 3 and 4 to remove all the necessary roller followers. Inspect roller finger followers and camshafts. For additional information, refer to [Section 303-00](#).

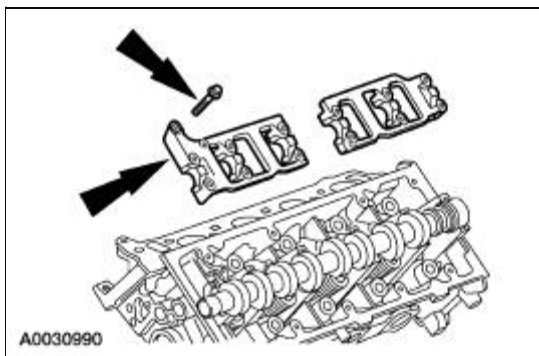
Installation

1. To install, reverse the removal procedure.
-

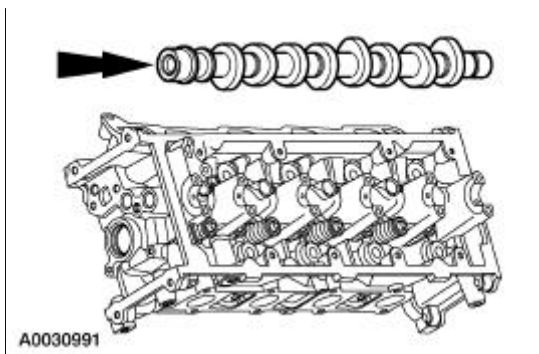
Camshaft

Removal and Installation

1. Remove the timing chains. For additional information, refer to [Timing Drive Components](#) in this section.
2. Remove the roller followers. For additional information, refer to [Camshaft Roller Follower](#) in this section.
3. Remove the bolts and camshaft bearing caps.

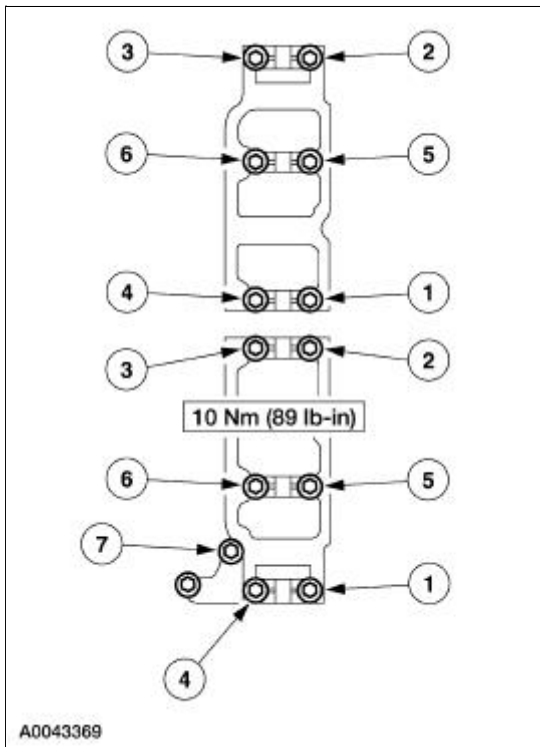


4. Remove the camshaft.





5. **NOTE:** Tighten the camshaft bearing cap bolts in the sequence shown.

To install, reverse the removal procedure.



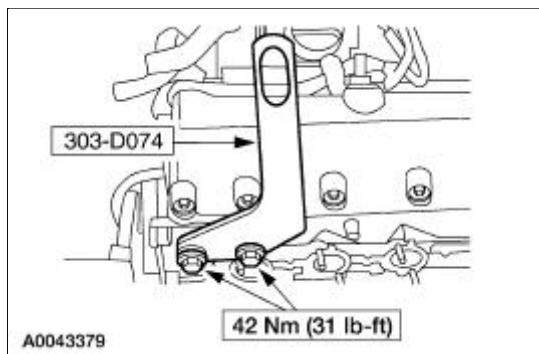
Exhaust Manifold RH

Special Tool(s)

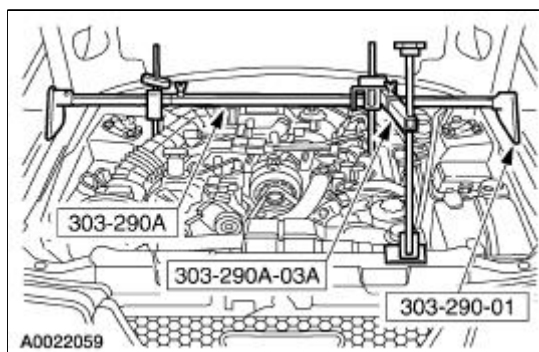
 <p>ST1603-A</p>	Lifting Bracket, Engine 303-D088 (D93P-6001-A2)
 <p>ST2363-A</p>	Support Bar, Engine 303-290-A

Removal and Installation

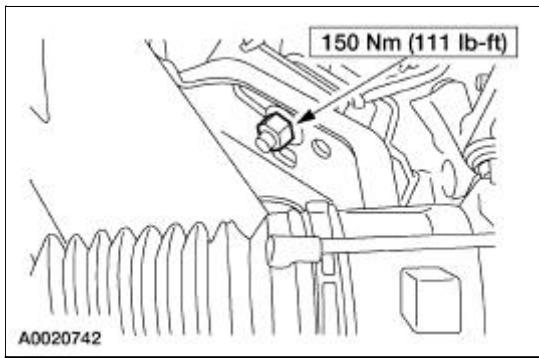
1. Install the special tool.



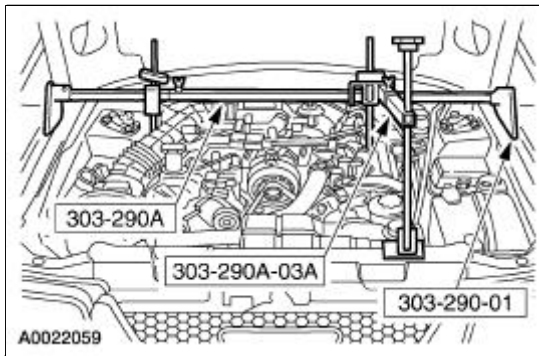
2. Install the special tools.



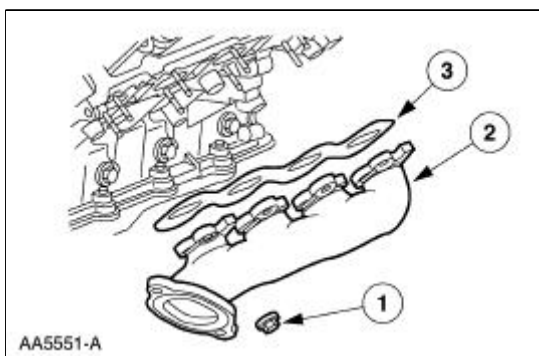
3. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
4. Remove the LH and RH side engine mount nuts.



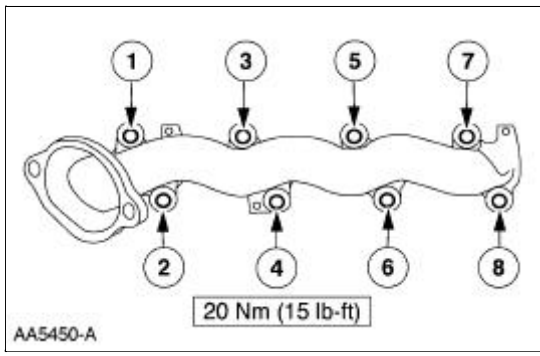
5. Lower the vehicle.
6. Using the special tools, raise the engine.



7. Remove the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).
8. Raise and support the vehicle.
9. Remove the starter motor. For additional information, refer to [Section 303-06](#).
10. Separate the exhaust at the exhaust manifold. For additional information, refer to [Section 309-00](#).
11. Remove the exhaust manifold.
 1. Remove the exhaust manifold nuts.
 2. Remove the exhaust manifold.
 3. Remove the exhaust manifold gasket and discard.


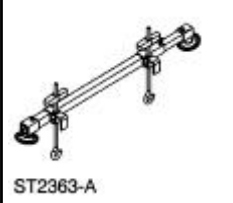


12. **NOTE:** Tighten the exhaust manifold nuts in the sequence shown.
To install, reverse the removal procedure.



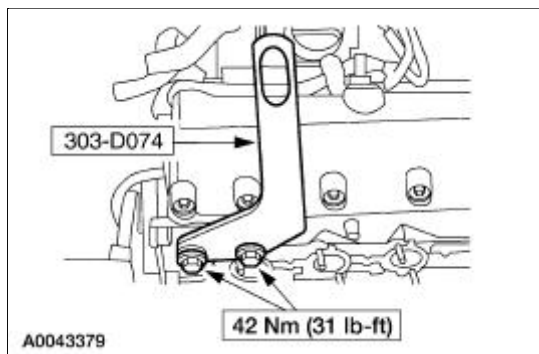
Exhaust Manifold LH

Special Tool(s)

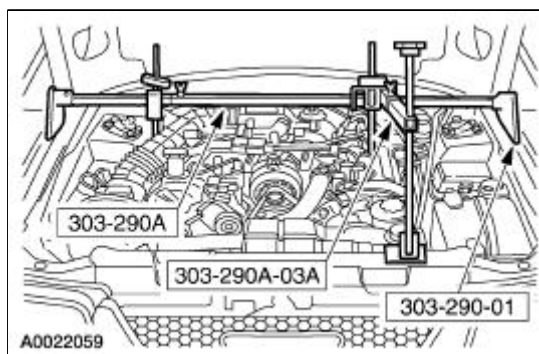
 <p>ST1603-A</p>	Lifting Bracket, Engine 303-D088 (D93P-6001-A2)
 <p>ST2363-A</p>	Support Bar, Engine 303-290-A

Removal and Installation

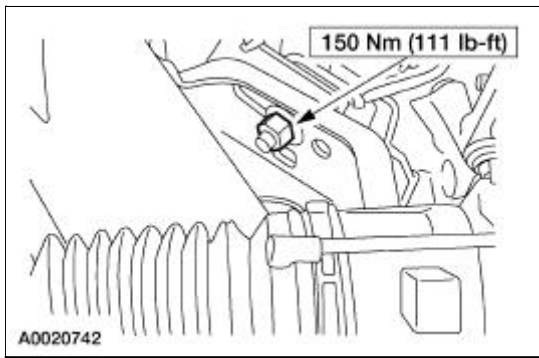
1. Install the special tool.



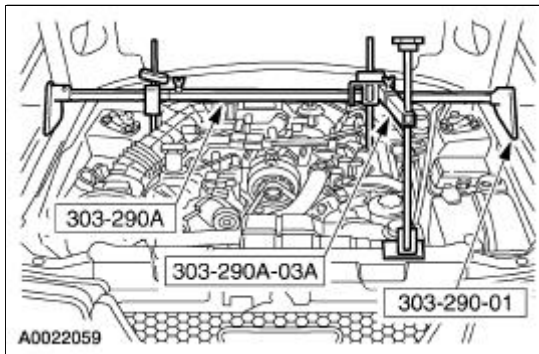
2. Install the special tools.



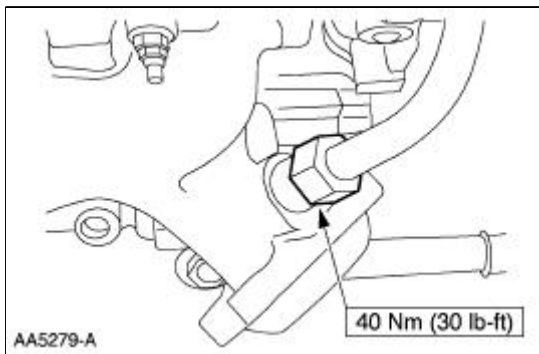
3. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
4. Remove the LH and RH side engine mount nuts.



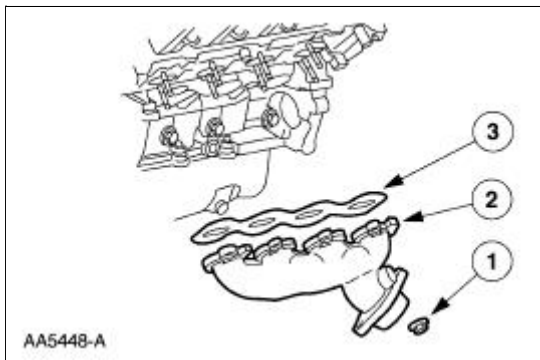
5. Lower the vehicle.
6. Using the special tools, raise the engine.



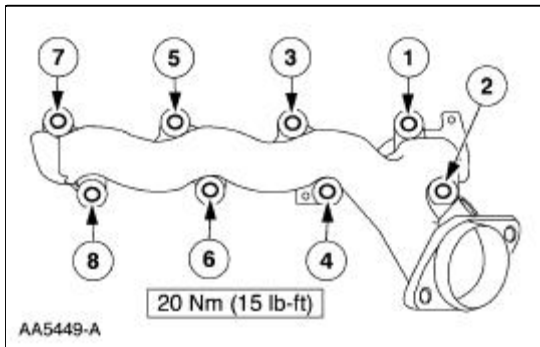
7. Raise the vehicle.
8. Separate the exhaust at the exhaust manifold. For additional information, refer to [Section 309-00](#).
9. Disconnect the exhaust gas recirculation (EGR) tube at the exhaust manifold.



10. Remove the exhaust manifold.
 1. Remove the exhaust manifold nuts.
 2. Remove the exhaust manifold.
 3. Remove the exhaust manifold gasket.



11. To install, reverse the removal procedure.
 1. Tighten the exhaust manifold nuts in the sequence shown.



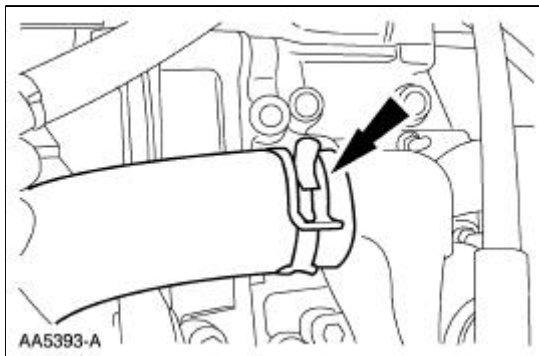
Oil Filter Adapter

Material

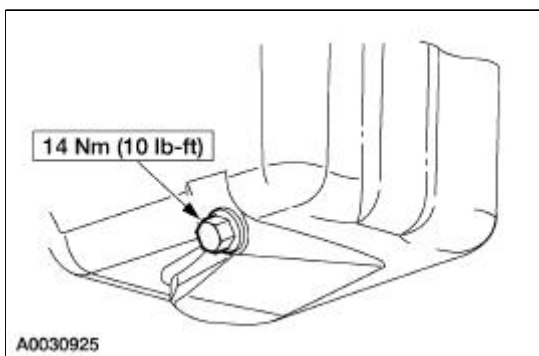
Item	Specification
Super Premium SAE 5W-20 Motor Oil XO-5W20 QSP or equivalent	WSS-M2C153-H
Premium Engine Coolant VC-4A (In Canada CXC-10; In Oregon VC-5) or equivalent	ESE-M97B44-A

Removal and Installation

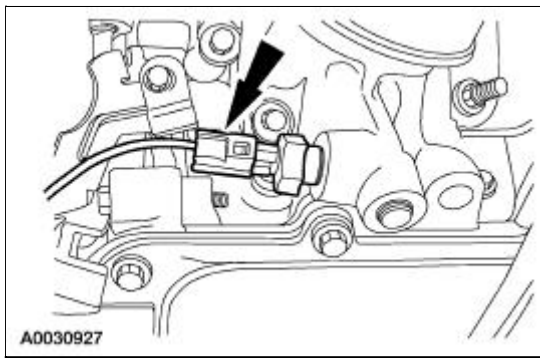
1. Drain the cooling system. For additional information, refer to [Section 303-03A](#) or [Section 303-03B](#).
2. Disconnect the lower radiator hose.



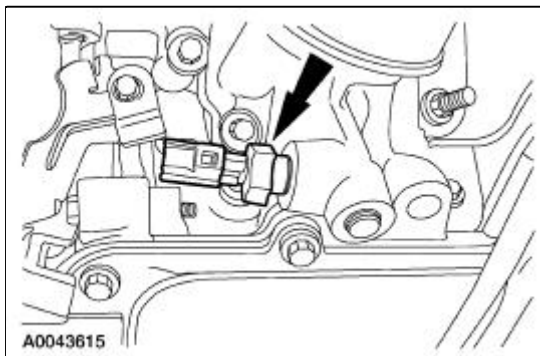
3. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
4. Drain the engine oil.



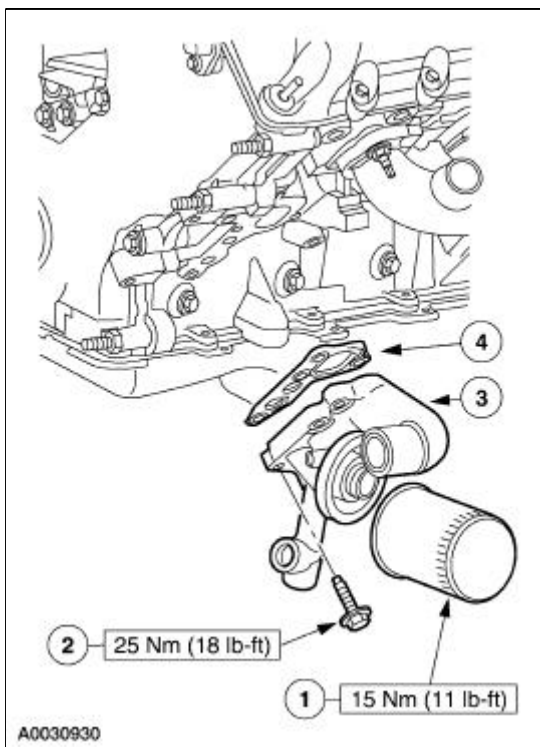
5. Disconnect the oil pressure sensor electrical connector.



6. Remove the oil pressure sensor.

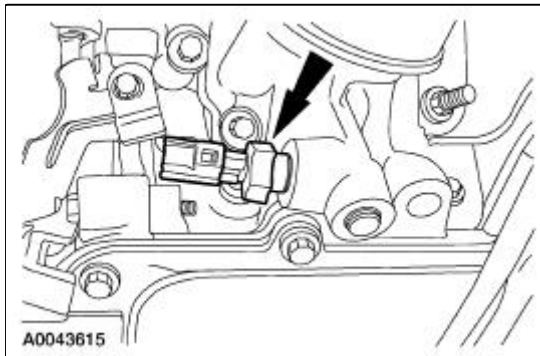


7. Remove the oil filter adapter (6881).
1. Remove the oil bypass filter.
 2. Remove the bolts.
 3. Remove the oil filter adapter.
 4. Clean and inspect the sealing surfaces.



8. To install, reverse the removal procedure.
9. Tighten the oil pressure sensor in two stages.

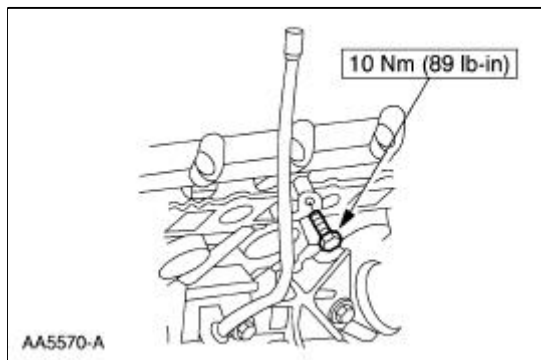
- Tighten to 14Nm(10 lb-ft).
- Tighten an additional 180°



Oil Level Indicator and Tube

Removal and Installation

1. Remove the oil level indicator.
2. Remove the LH exhaust manifold. For additional information, refer to [Exhaust Manifold LH](#) in this section.
3. Remove the bolt.







4. Remove the oil level indicator tube.



5. To install, reverse the removal procedure.
 - Install a new oil level indicator tube seal.

Oil Pan

Special Tool(s)

 <p>ST1352-A</p>	<p>Compressor, Coil Spring 204-D001 (D78P-5310-A)</p>
 <p>ST2363-A</p>	<p>Support Bar, Engine 303-290-A</p>
 <p>ST1604-A</p>	<p>Lifting Bracket, Engine 303-D087 (D93P-6001-A1)</p>
 <p>ST1603-A</p>	<p>Lifting Bracket, Engine 303-D088 (D93P-6001-A2)</p>

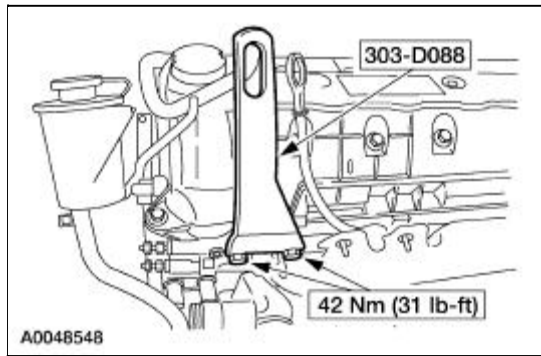
Material

Item	Specification
<p>Metal Surface Cleaner F4ZA-19A536-RA or equivalent</p>	<p>WSE-M5B392-A</p>
<p>Silicone Gasket and Sealant F7AZ-19554-EA or equivalent</p>	<p>WSE-M4G323- A4</p>
<p>Super Premium SAE 5W-20 Motor Oil XO-5W20-QSP or equivalent</p>	<p>WSS-M2C153-H</p>

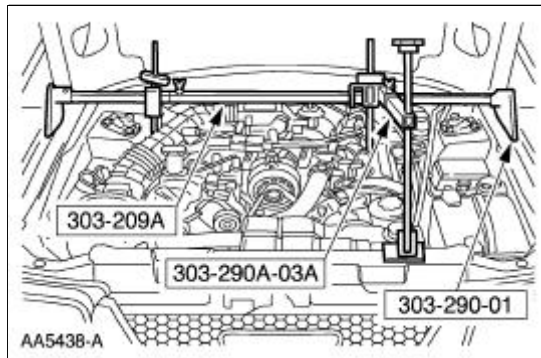
Removal

1. Disconnect the battery ground cable.
2. Remove the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).
3. Remove the radiator sight shield.

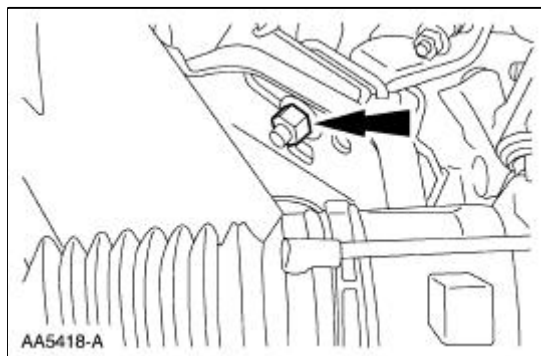
4. Install the special tool.



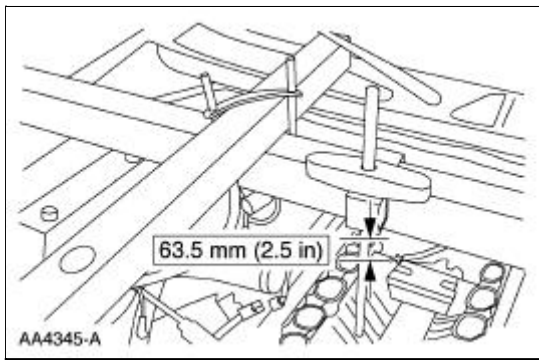
5. Using the special tools, support the engine.



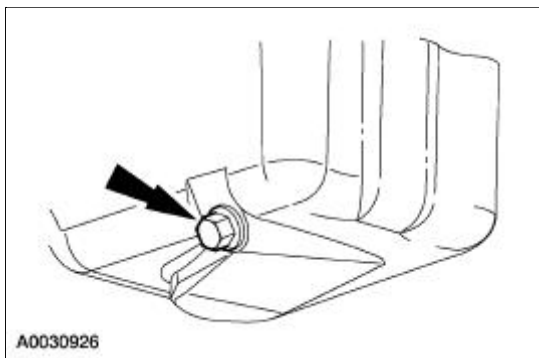
6. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
7. Remove the two engine mount nuts.



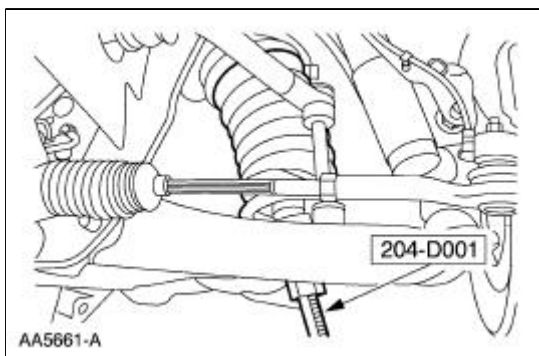
8. Lower the vehicle.
9. Using the special tool, raise the engine.



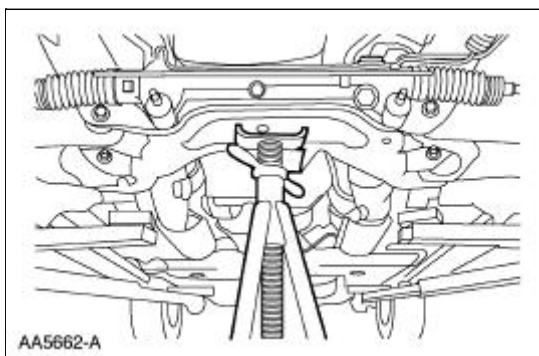
10. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
11. Drain the engine oil.
 - Remove the oil pan drain plug.



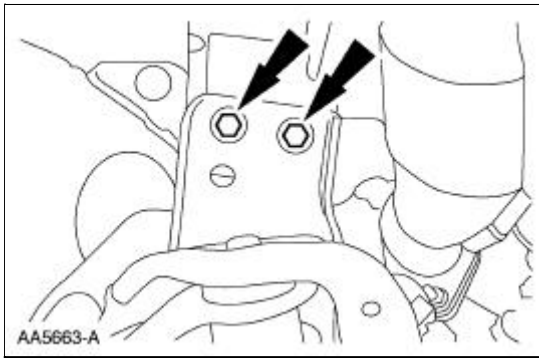
12. Using the special tool, compress the front coil springs.



13. Position a safety stand.

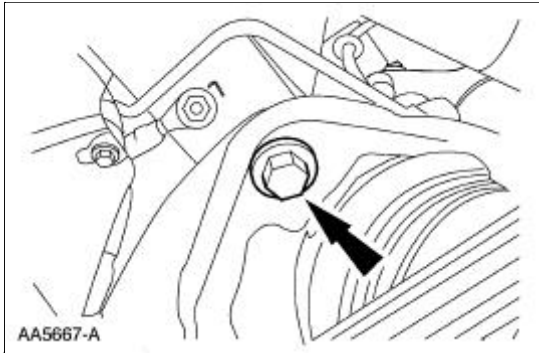


14. Remove the four engine mount bolts.

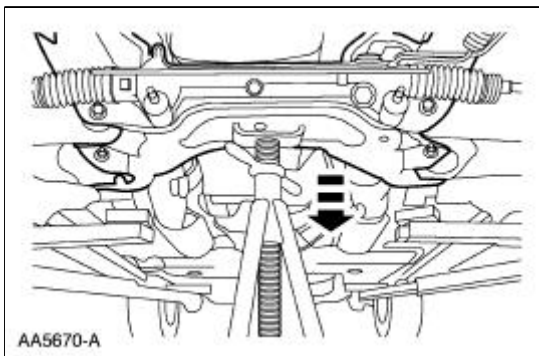


15. **NOTE:** Do not completely remove the bolts.

Loosen the front subframe bolts.

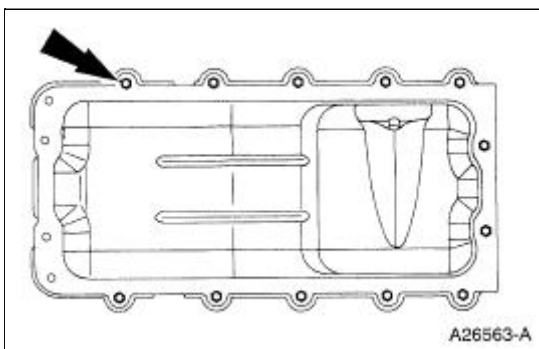


16. Lower the front subframe.




17. **NOTE:** Be careful when removing the oil pan gasket. It may be reusable. Inspect the oil pan gasket for damage.

Remove the oil pan and gasket.



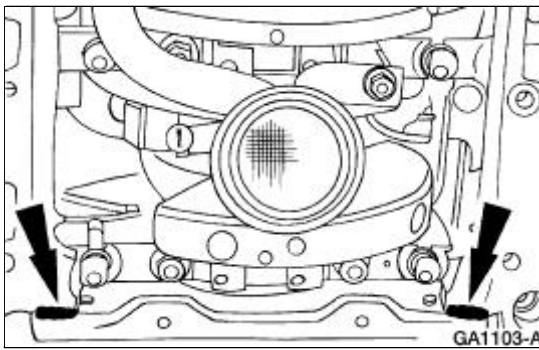
Installation

1.  **CAUTION:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

Clean and inspect the mating surfaces.

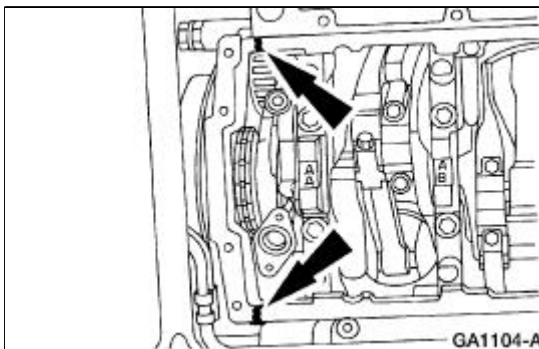
2. **NOTE:** If the oil pan is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

Apply the silicone gasket and sealant at the rear oil seal retainer-to-cylinder block sealing surface.

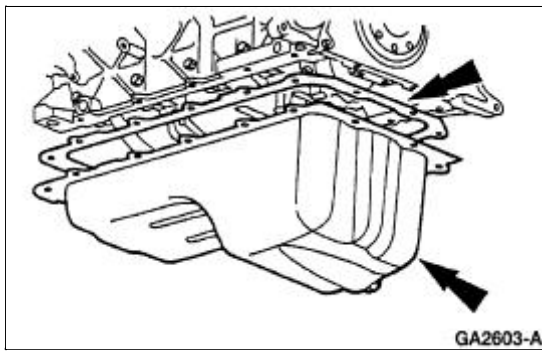


3. **NOTE:** If the oil pan is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

Apply the silicone gasket and sealant at the engine front cover-to-cylinder block mating surface.

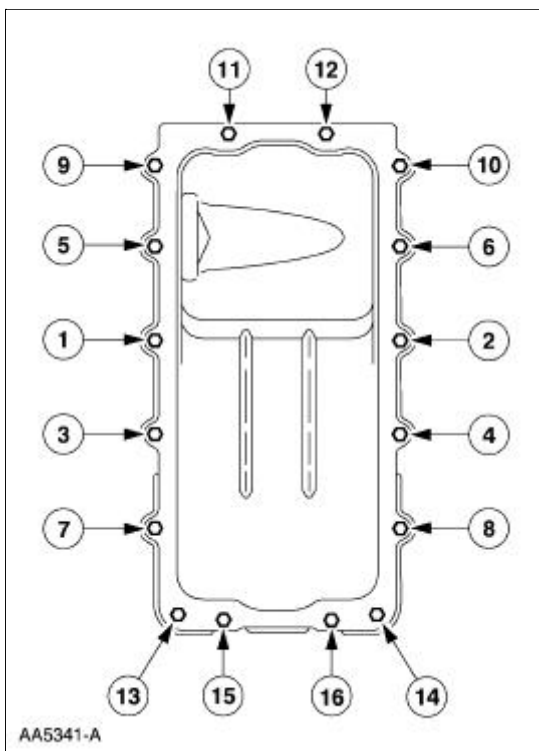


4. Install the oil pan and gasket and loosely install the bolts.

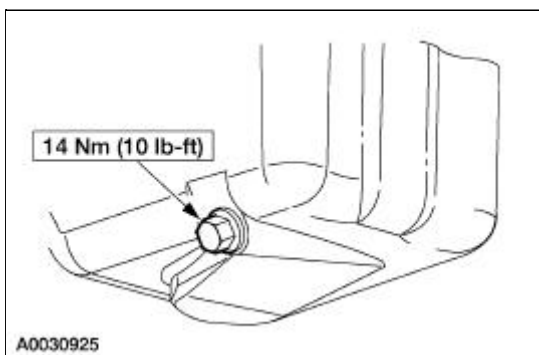


5. Tighten the bolts in the sequence shown in three stages.

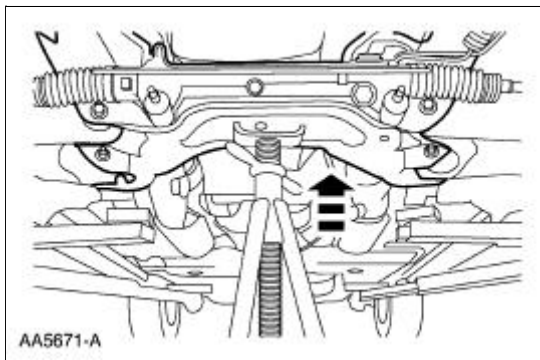
- Stage 1: Tighten to 2 Nm (18 lb-in).
- Stage 2: Tighten to 20 Nm (15 lb-ft).
- Stage 3: Tighten an additional 60 degrees.



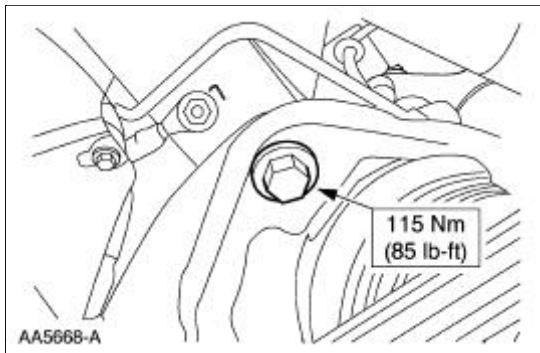
6. Install the oil pan drain plug.



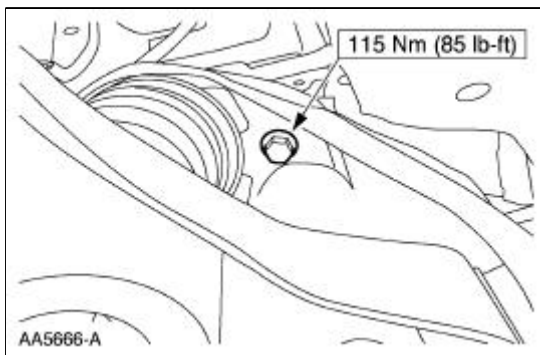
7. Raise the front subframe into position.



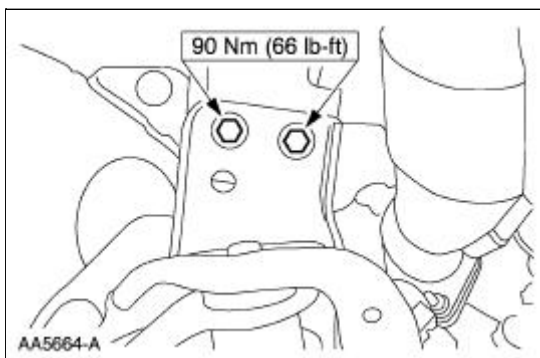
8. Install the two upper subframe bolts.



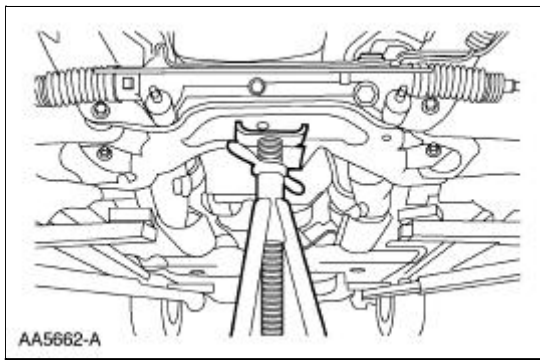
9. Install the two lower subframe bolts.



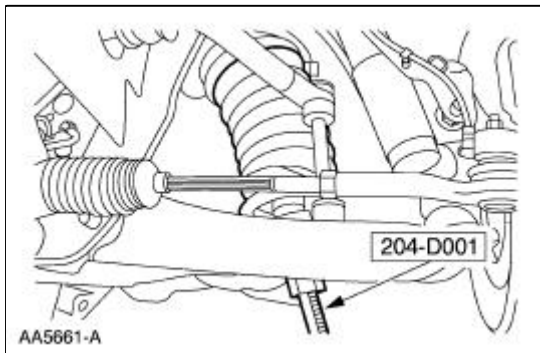
10. Install the engine mount bolts.



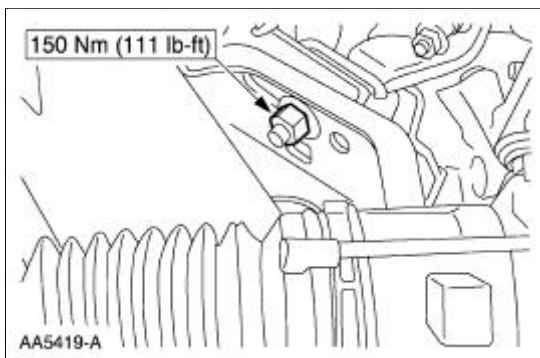
11. Position the safety stand aside.



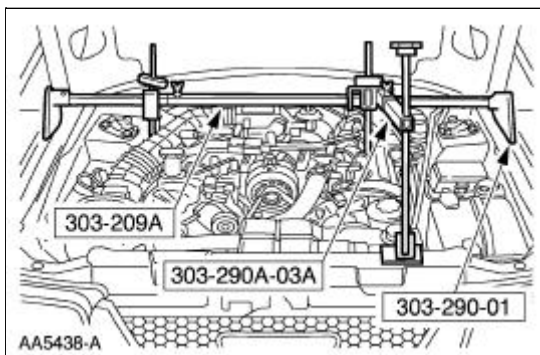
- Using the special tool, release the tension from the front coil springs and remove the special tool.



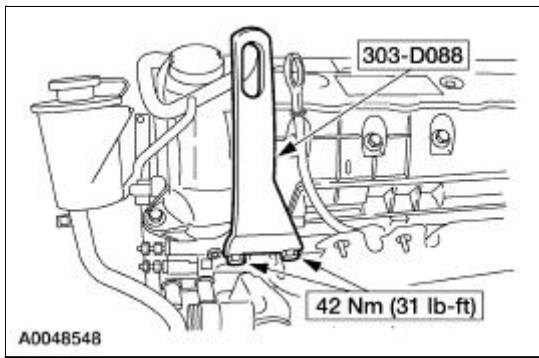
- Install the engine mount nuts.



- Lower the vehicle.
- Using the special tools, lower the engine and remove the special tool.



- Remove the special tool.

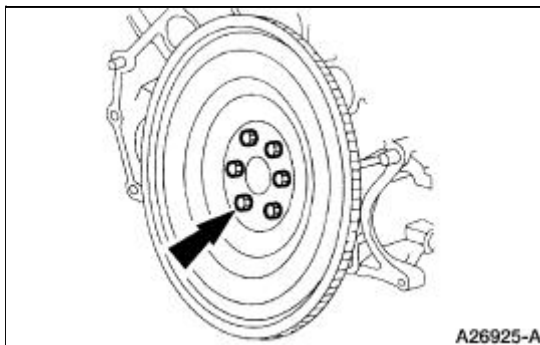


17. Fill the engine crankcase with clean engine oil.
-

Flywheel

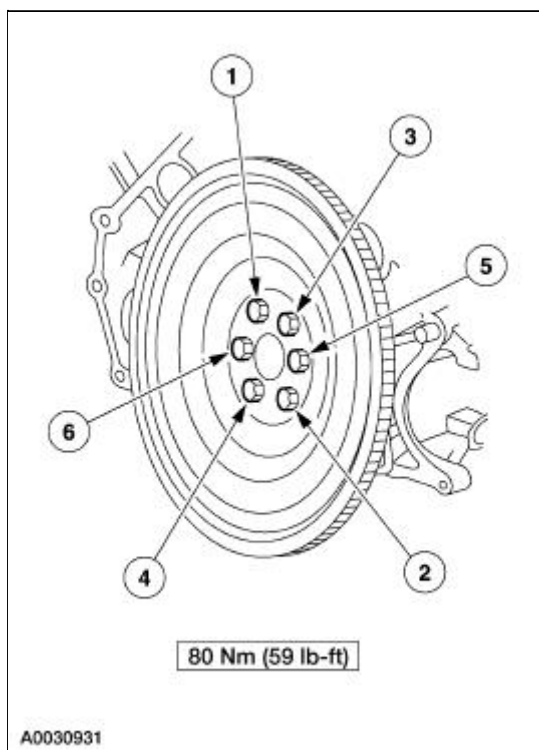
Removal

1. Remove the clutch components. For additional information, refer to [Section 308-03A](#) or [Section 308-03B](#).
2. Remove the bolts and the flywheel.



Installation

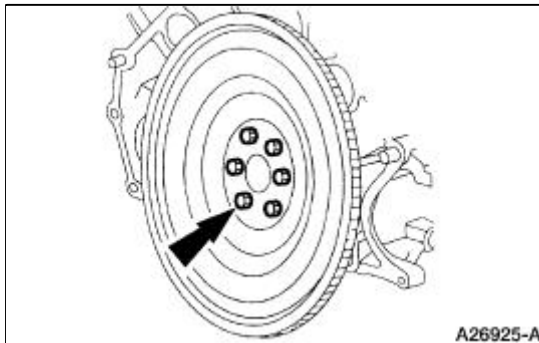
1. To install, reverse the removal procedure.
 - Tighten the bolts in the sequence shown.



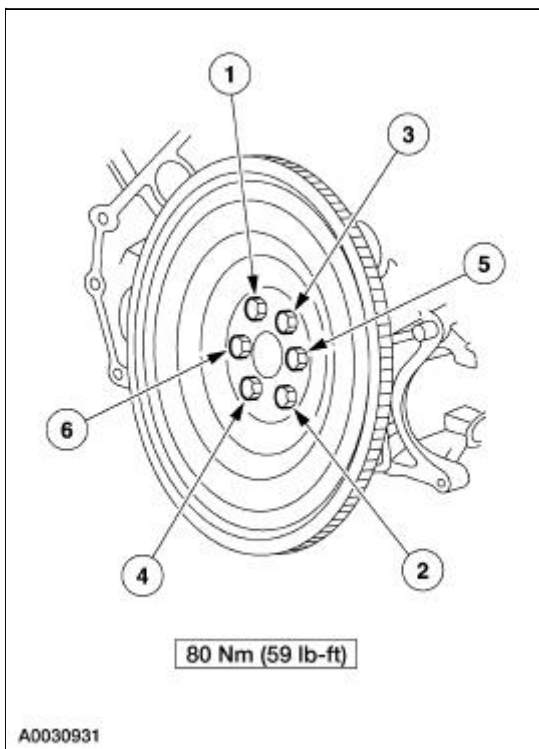
Flexplate

Removal and Installation

1. Remove the transmission. For additional information, refer to [Section 307-01](#).
2. Remove the six bolts retaining the flexplate to crankshaft, and remove the flexplate.

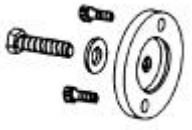

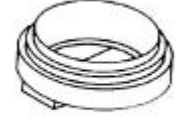
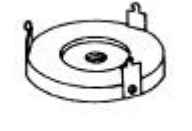




3. To install, reverse the removal procedure.
 - Tighten the bolts in the sequence shown



Crankshaft Rear Oil Seal

Special Tool(s)

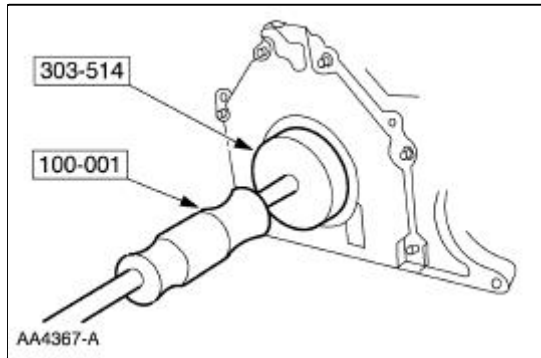
 <p>ST1480-A</p>	<p>Installer, Crankshaft Rear Oil Seal 303-518 (T95P-6701-DH)</p>
 <p>ST1382-A</p>	<p>Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)</p>
 <p>ST1479-A</p>	<p>Installer, Crankshaft Rear Oil Seal 303-516 (T95P-6701-BH)</p>
 <p>ST1481-A</p>	<p>Remover, Crankshaft Rear Oil Slinger 303-514 (T95P-6701-AH)</p>
 <p>ST1482-A</p>	<p>Installer, Crankshaft Rear Oil Slinger 303-517 (T95P-6701-CH)</p>
 <p>ST1185-A</p>	<p>Impact Slide Hammer 100-001 (T50T-100-A)</p>

Material

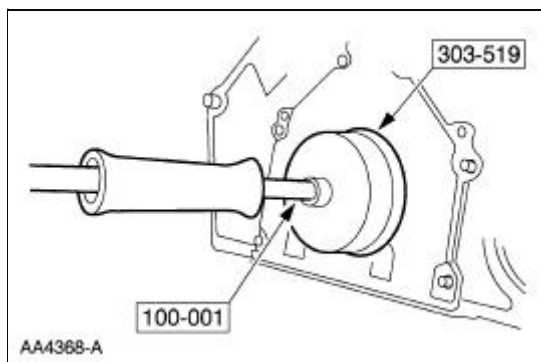
Item	Specification
<p>Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent</p>	<p>WSS-M2C153-H</p>

Removal

1. Remove the flywheel. For additional information, refer to [Flywheel](#) in this section.
2. Using the special tools, remove the crankshaft oil slinger.

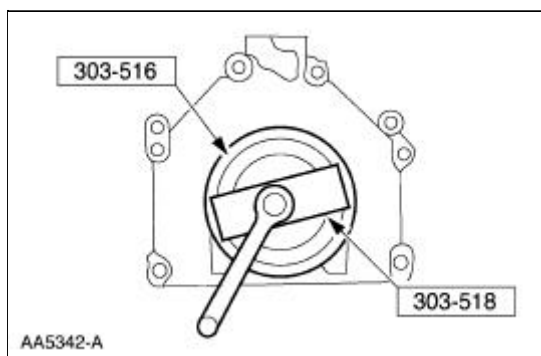


3. Using the special tools, remove the crankshaft rear oil seal (6701).

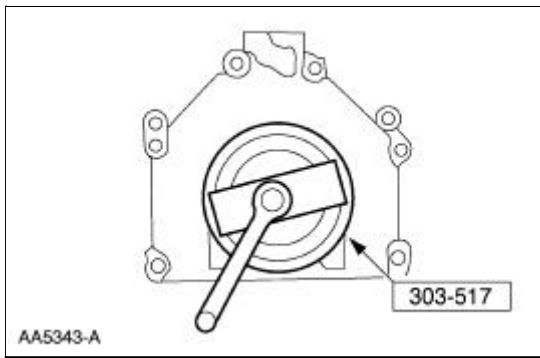


Installation

1. Using the special tools, install the crankshaft rear oil seal.
 - Lubricate the oil seal using clean engine oil.



2. Using the special tool, install the crankshaft oil slinger.



3. Install the flywheel. For additional information, refer to [Flywheel](#) in this section.
-

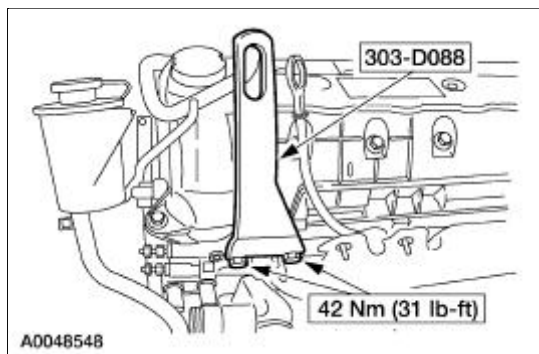
Engine Mount RH

Special Tool(s)

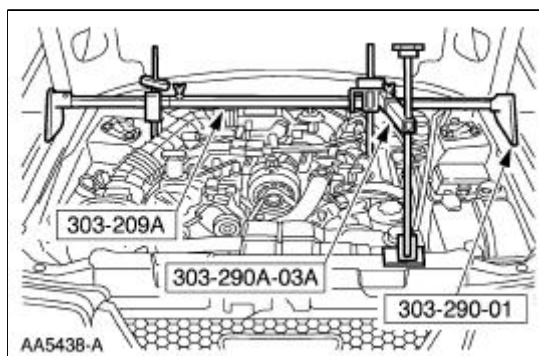
 ST1603-A	Lifting Bracket, Engine 303-D088 (D93P-6001-A2)
 ST2363-A	Support Bar, Engine 303-290-A

Removal

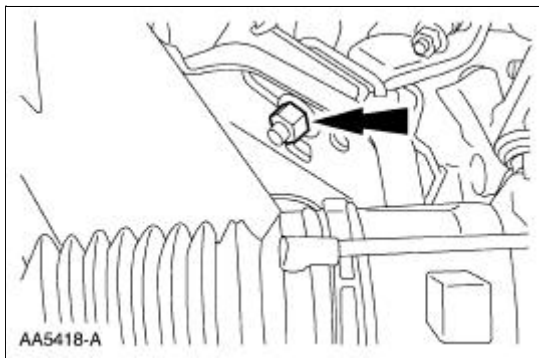
1. Install the special tool.



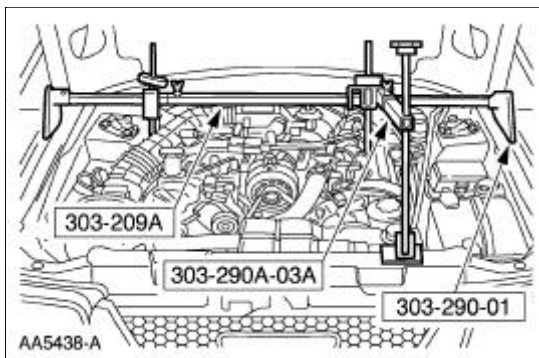
2. Install the special tools.



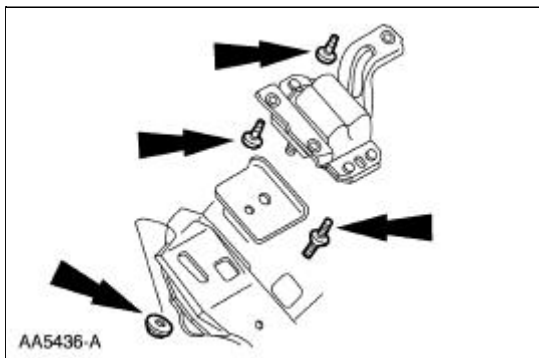
3. Remove the starter. For additional information, refer to [Section 303-06](#).
4. Remove the two engine mount nuts.



5. Lower the vehicle.
6. Using the special tools, raise the engine.

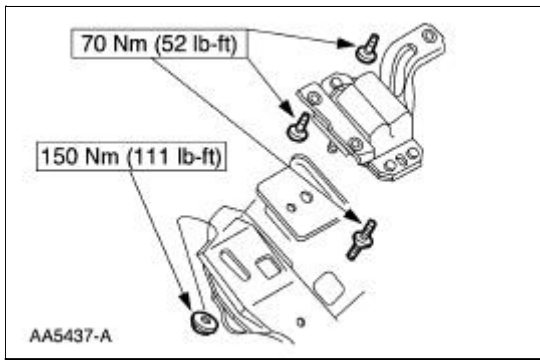


7. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
8. Remove the engine mount.





Installation

1. To install, reverse the removal procedure.



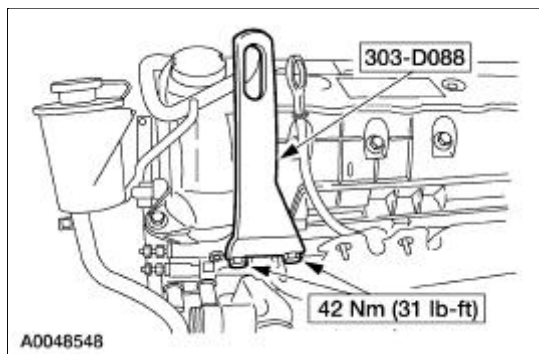
Engine Mount LH

Special Tool(s)

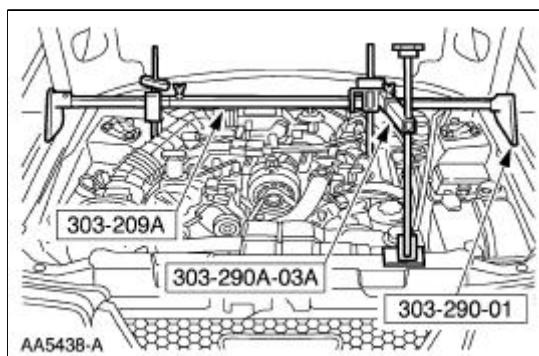
 <p>ST1603-A</p>	Lifting Bracket, Engine 303-D088 (D93P-6001-A2)
 <p>ST2363-A</p>	Support Bar, Engine 303-290-A

Removal

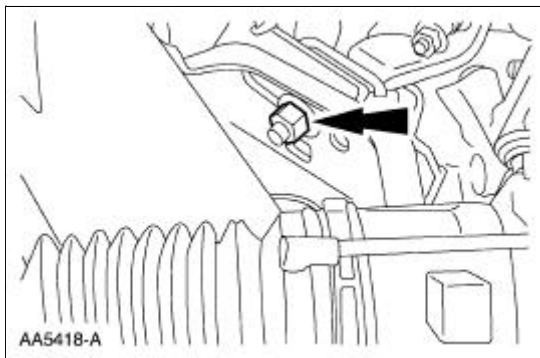
1. Install the special tool.



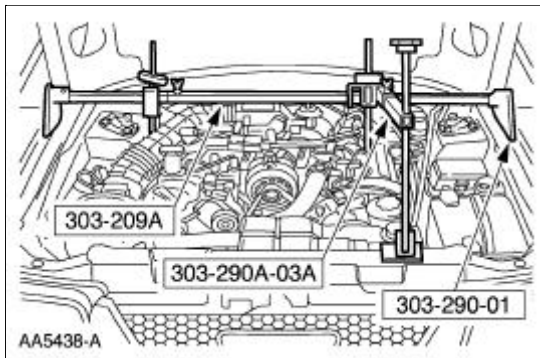
2. Install the special tools.



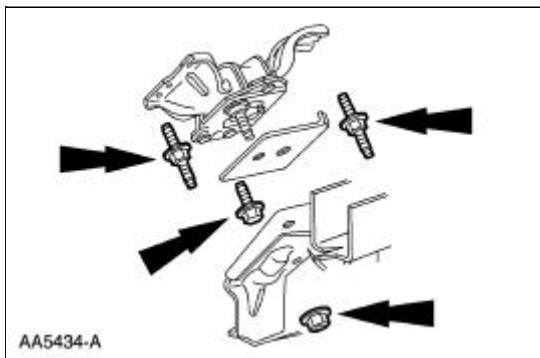
3. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
4. Remove the two engine mount nuts.



5. Lower the vehicle.
6. Using the special tools, raise the engine.

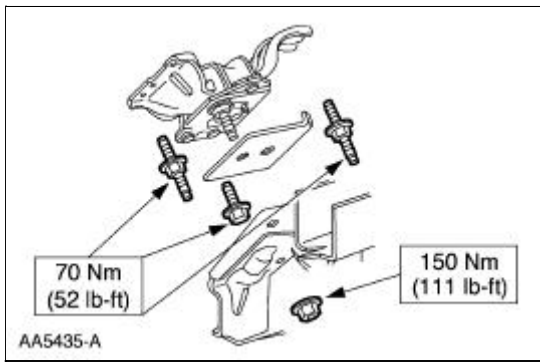


7. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
8. Remove the engine mount.





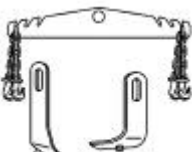

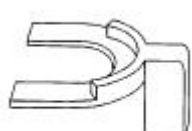
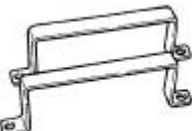
Installation

1. To install, reverse the removal procedure.



Cylinder Heads

Special Tool(s)

 <p>ST1286-A</p>	<p>Remover, Crankshaft Vibration Damper 303-009 (T58P-6316-D)</p>
 <p>ST1730-A</p>	<p>Remover, Crankshaft Front Oil Seal 303-107 (T74P-6700-A)</p>
 <p>ST2443-A</p>	<p>Engine Lift Bracket Set 303-DS086 (D93P-6001-A)</p>
 <p>ST1693-A</p>	<p>Compressor, Valve Spring (Exhaust) 303-567 (T97P-6565-AH)</p>
 <p>ST1331-A</p>	<p>Compressor Spacer, Valve Spring 303-382 (T91P-6565-AH)</p>
 <p>ST1668-A</p>	<p>Remover/Installer, Cylinder Head 303-572 (T97T-6000-A)</p>

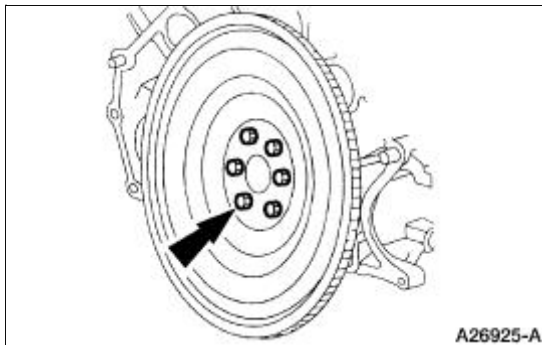
Material

Item	Specification
<p>Motorcraft Silicone Gasket Remover ZC-30</p>	<p>—</p>
<p>Motorcraft Metal Surface Prep</p>	<p>—</p>

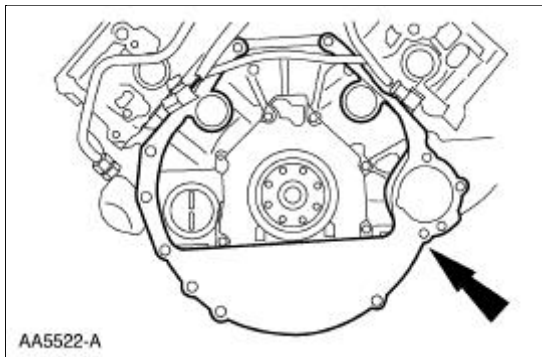
Removal

Both cylinder heads

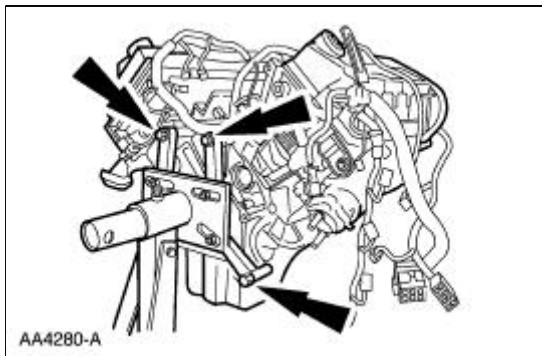
1. Remove the engine. For additional information, refer to [Engine](#) in the Removal portion of this section.
2. Remove the flywheel.



3. Remove the separator plate.

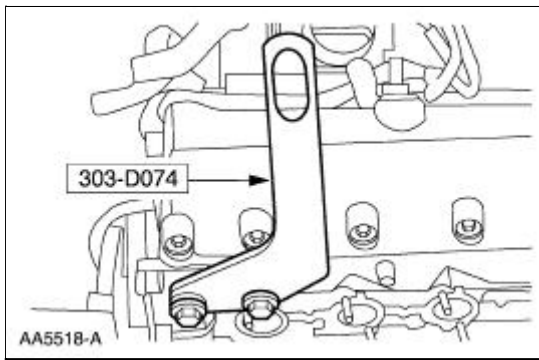


4. Mount the engine on a suitable engine stand.

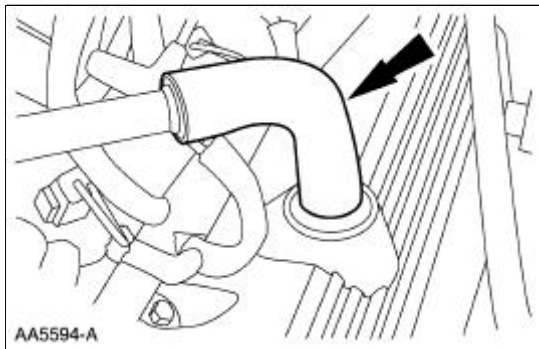


5. **NOTE:** RH shown, LH similar.

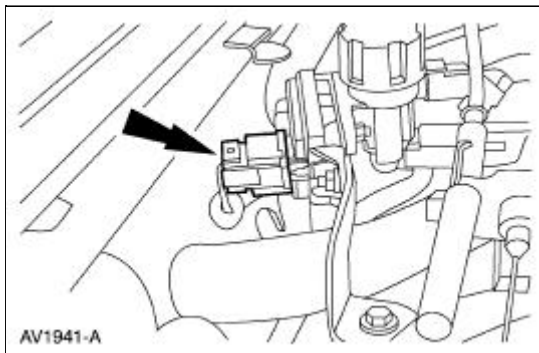
Remove the RH and LH lifting eyes.



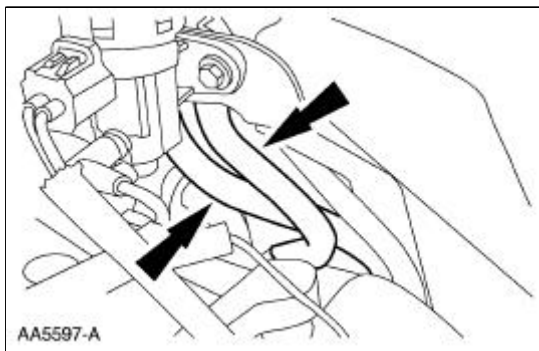
6. Remove the breather tube.



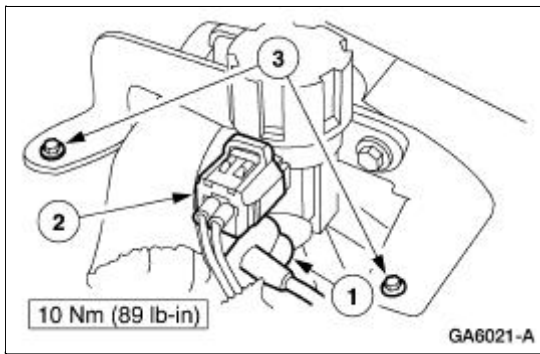
7. Disconnect the differential pressure feedback exhaust gas recirculation (EGR) electrical connector.



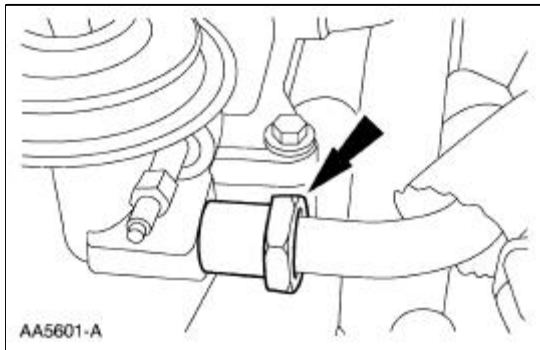
8. Disconnect the hoses from the differential pressure feedback EGR transducer.



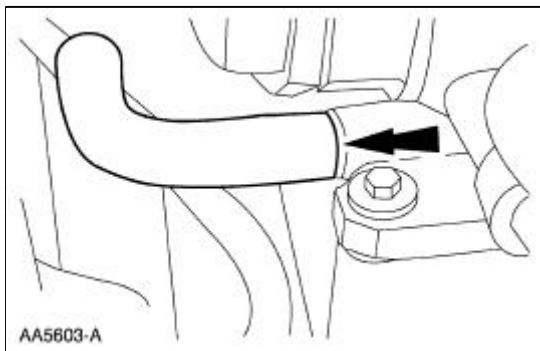
9. Remove the EGR vacuum regulator solenoid.
 1. Remove the vacuum lines.
 2. Remove the electrical connector.
 3. Remove the bolts.



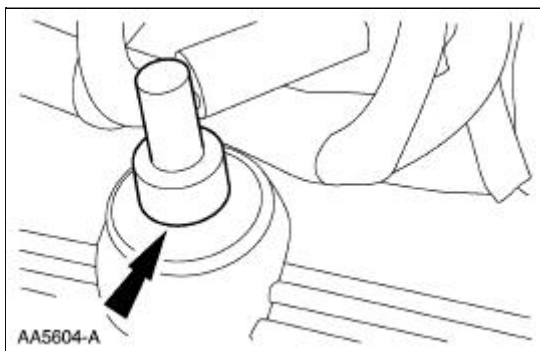
10. Disconnect the EGR tube from the EGR valve.



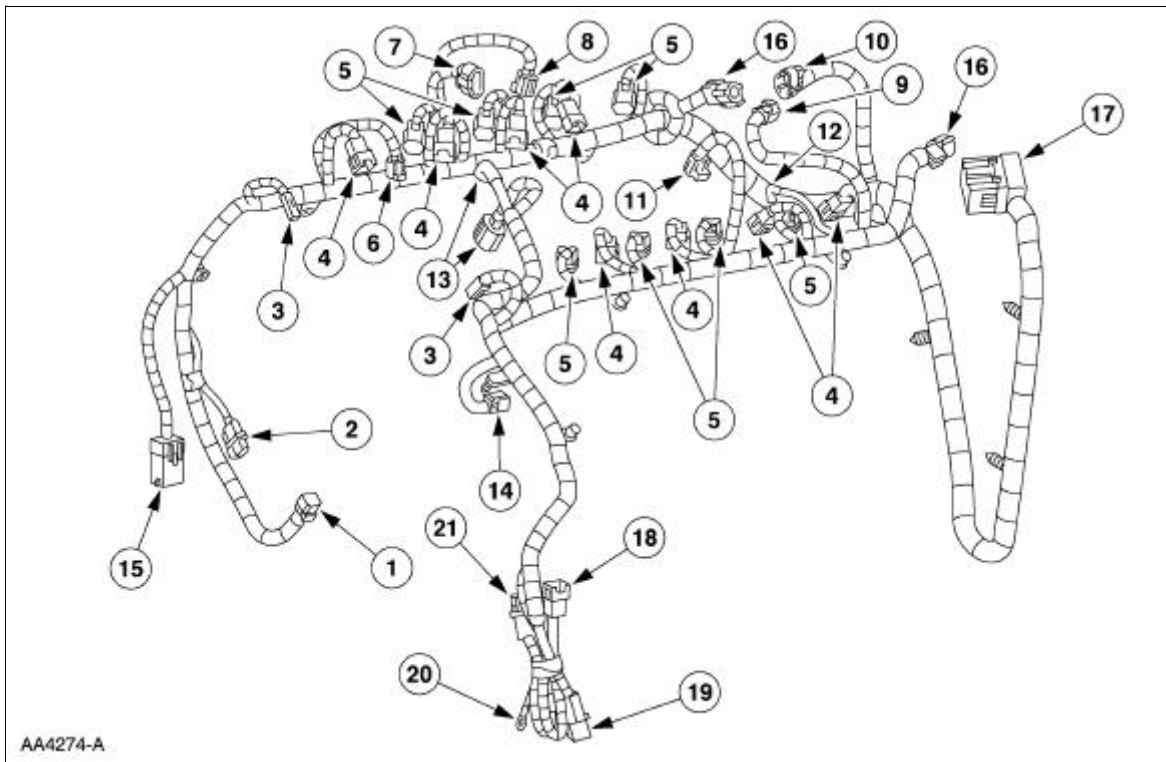
11. Disconnect the positive crankcase ventilation (PCV) hose from the base of the throttle body.



12. Remove the PCV valve and hose as an assembly.

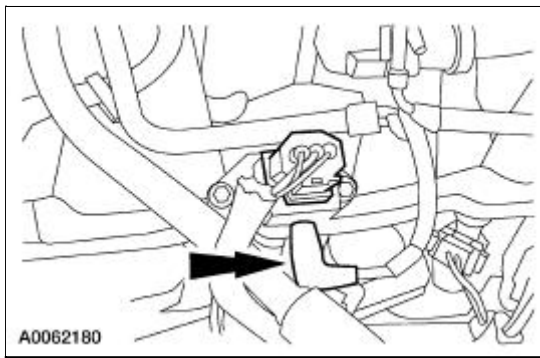


13. Remove the engine wiring harness.

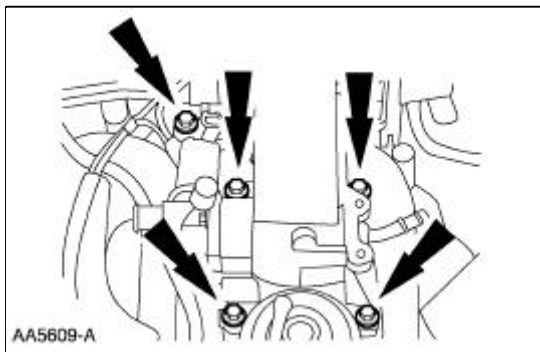


Item	Part Number	Description
1	—	To crankshaft position sensor
2	—	To A/C compressor
3	—	To radio ignition interference capacitor (2)
4	—	To fuel injectors (8)
5	—	To ignition coils (8)
6	—	To engine coolant temperature sensor
7	—	To throttle position sensor
8	—	To idle air control valve
9	—	To EGR vacuum regulator
10	—	To differential pressure feedback EGR
11	—	To fuel pressure regulator
12	—	Fuel injection ground
13	—	To generator
14	—	To camshaft position sensor
15	—	To body
16	—	To heated oxygen sensor (2)
17	—	Engine bulkhead connector
18	—	To low coolant sensor
19	—	To body
20	—	To power distribution box
21	—	To body

14. Disconnect the vacuum line from the fuel pressure sensor.



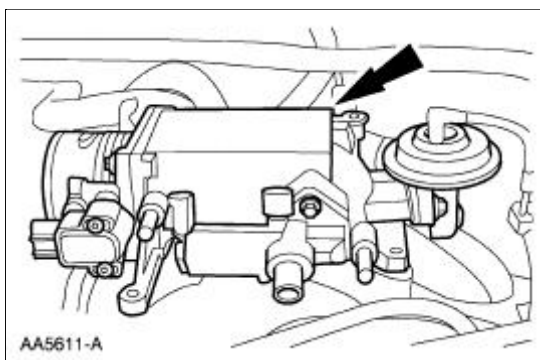
15. Remove the throttle body bolts.



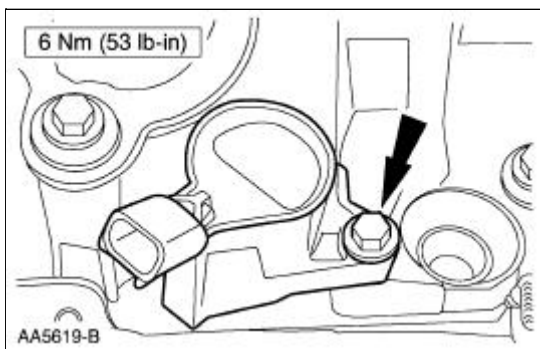
16. **NOTE:** The gasket is reusable if not damaged.

Remove the throttle body and adapter as an assembly.

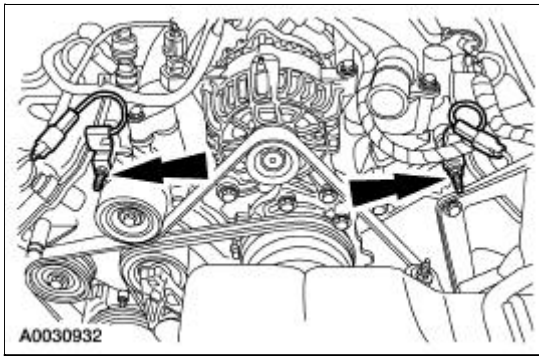
- Inspect and clean the sealing surfaces.



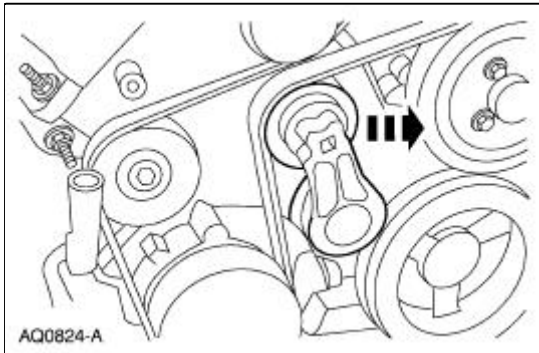
17. Remove the ignition coils.



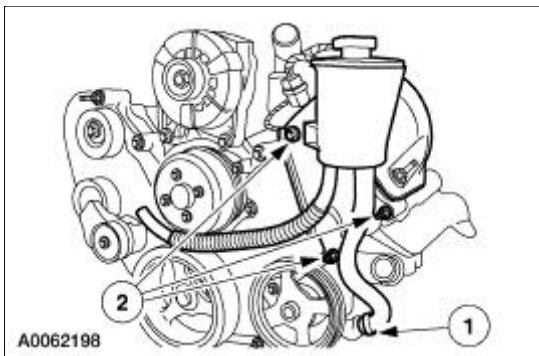
18. Remove the radio interference capacitors.



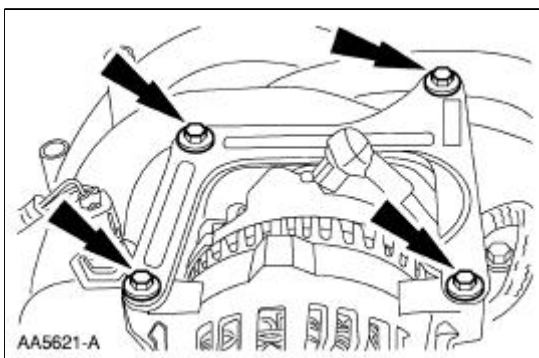
19. Remove the accessory drive belt.



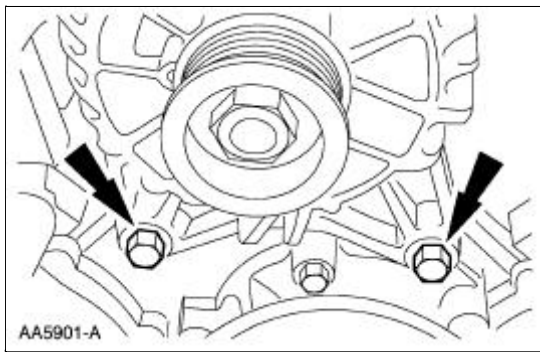
20. Remove the power steering reservoir and bracket as an assembly.
1. Disconnect the supply line from the pump.
2. Remove the (3) bolts and the reservoir and bracket.



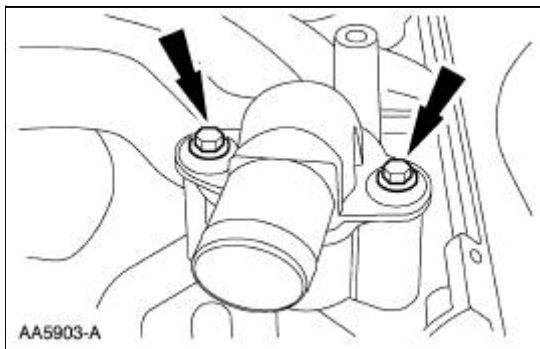
21. Remove the upper generator support bracket.



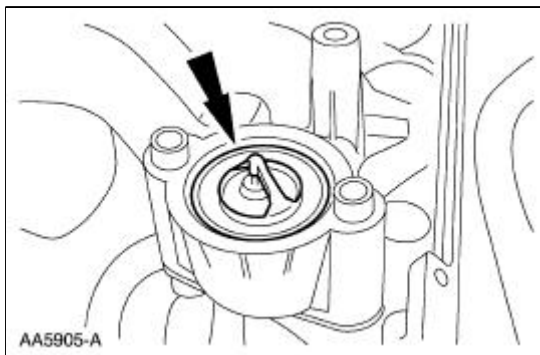
22. Remove the bolts and the generator.



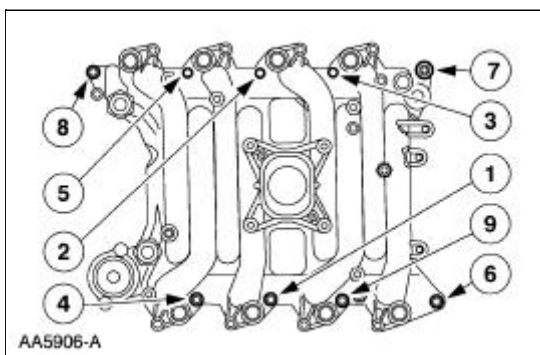
23. Remove the coolant outlet adapter.



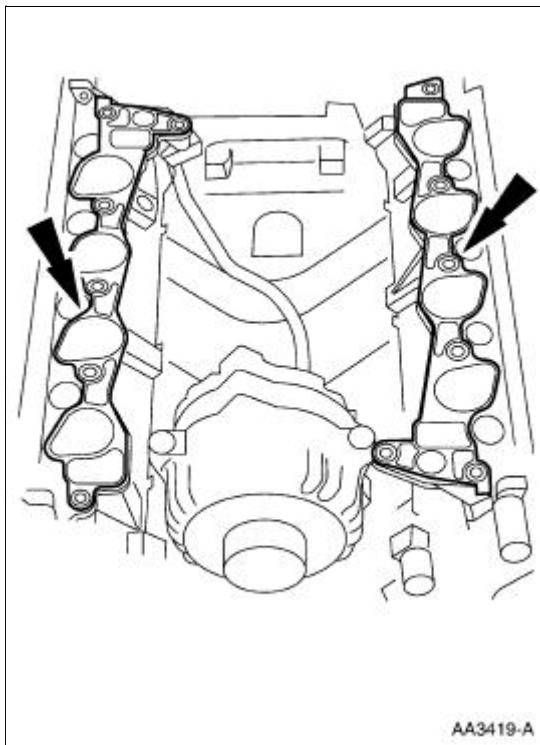
24. Remove the thermostat and O-ring.




25. Remove the bolts in the sequence shown, and remove the intake manifold.



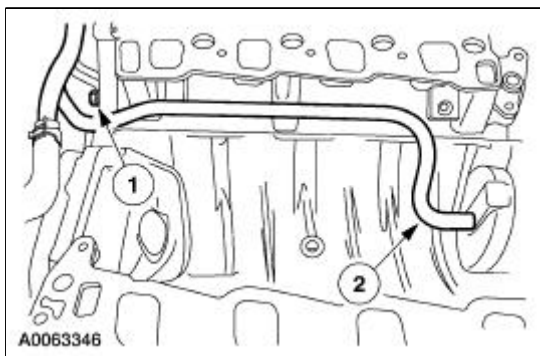
26. Remove the intake manifold gaskets.



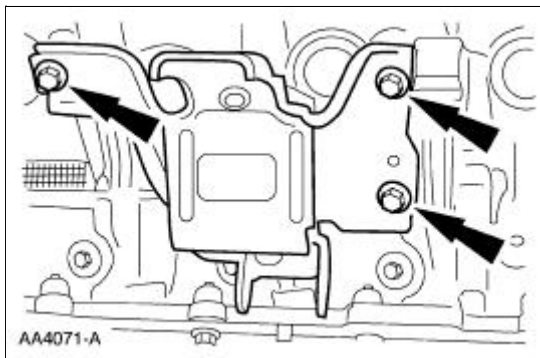
27.  **CAUTION:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean sealing surfaces. These tools will cause scratches and gouges which make leak paths.

Clean the sealing surfaces.

28. Remove the coolant bypass tube.
1. Remove the nut.
2. Remove the coolant bypass tube.



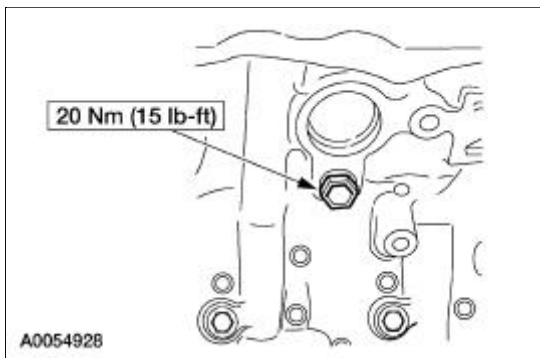
29. Remove the RH engine mount.



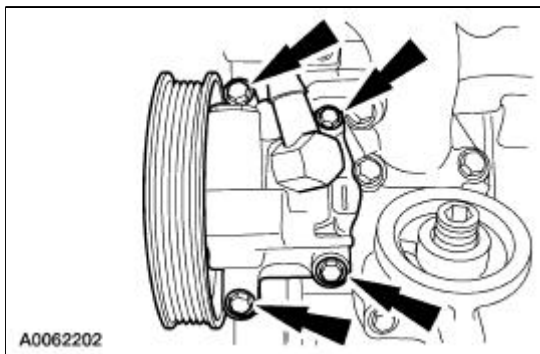
30. **NOTE:** LH shown; RH similar.

Using a suitable container, drain coolant from the engine block.

- Install the drain plugs when finished.

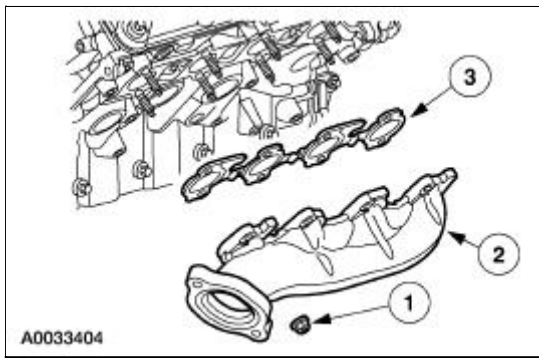


31. Remove the four bolts and the power steering pump.



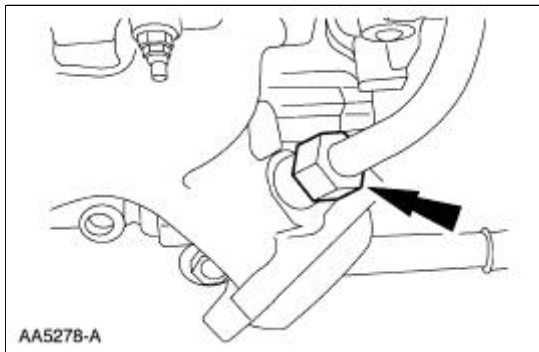
RH cylinder head

32. Remove the RH exhaust manifold.
1. Remove the RH exhaust manifold nuts.
 2. Remove the RH exhaust manifold.
 3. Remove the RH exhaust manifold gasket and discard.

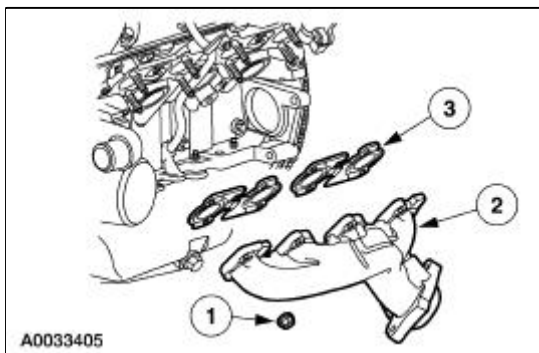


LH cylinder head

33. Disconnect the EGR tube at the exhaust manifold.



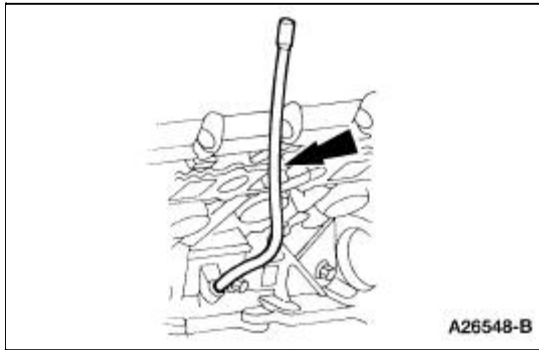
34. Remove the LH exhaust manifold.
 1. Remove the LH exhaust manifold nuts.
 2. Remove the LH exhaust manifold.
 3. Remove the LH exhaust manifold gasket and discard.



35. Remove the oil level indicator tube bolt.




36. Remove the oil level indicator tube.



Both cylinder heads

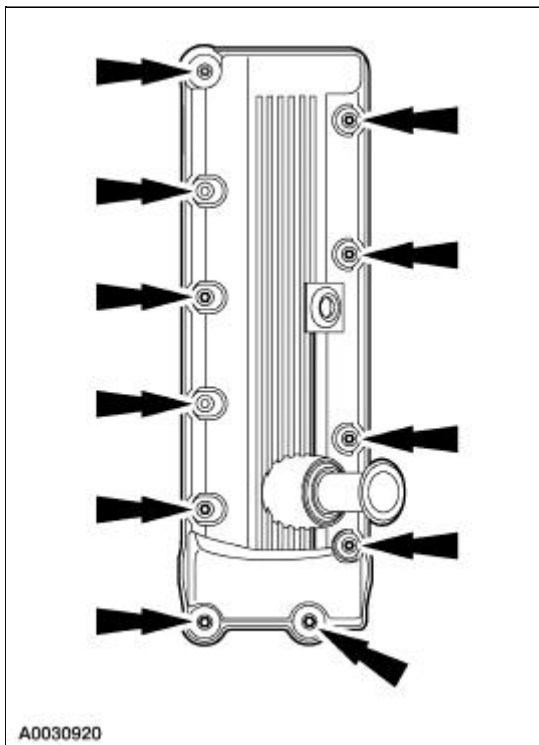
37. Clean and inspect the exhaust manifolds. For additional information, refer to [Section 303-00](#).

38.  **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

NOTE: The bolts are part of the valve cover and should not be removed. RH valve cover shown, LH valve cover similar.

Remove the RH and LH valve covers.

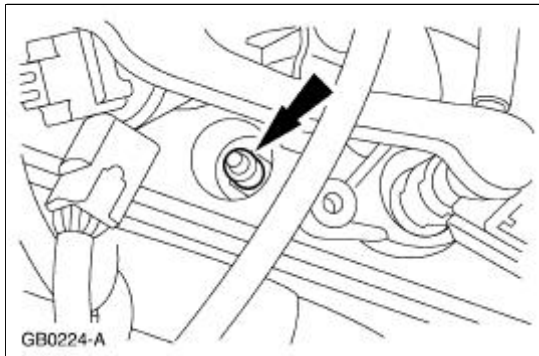
- Fully loosen the bolts and remove the valve covers.
- Clean the valve cover mating surface of the cylinder heads with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
- Inspect the valve cover gasket(s). If the gasket(s) is damaged, remove and discard the gasket(s). Clean the valve cover gasket groove(s) with soap and water or a suitable solvent.



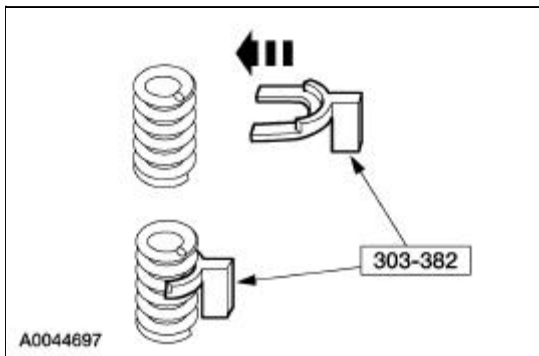
39. **NOTE:** Use compressed air to remove any foreign material from the spark plug well before removing the spark plugs.

NOTE: One spark plug shown, others are similar.

Remove the spark plugs.

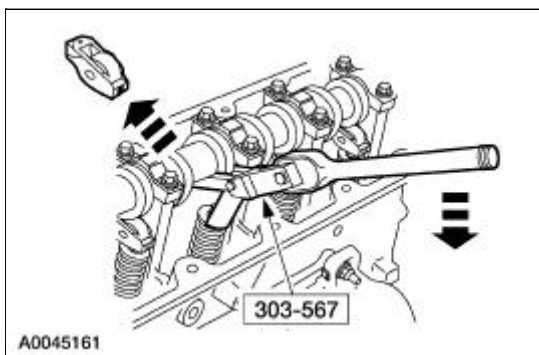


40. Install the special tool between the valve spring coils to prevent valve stem seal damage.

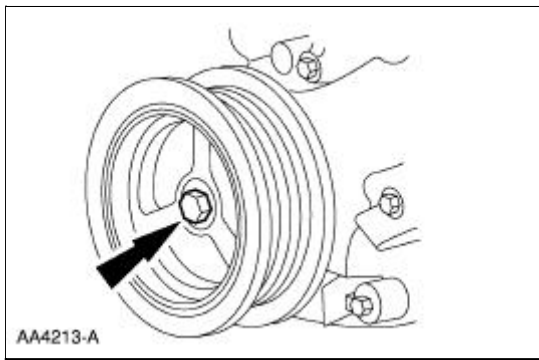


41. **NOTE:** Rotate the camshaft to see the base circle of the camshaft's lobe before removing the followers. Keep roller followers in order when removing.

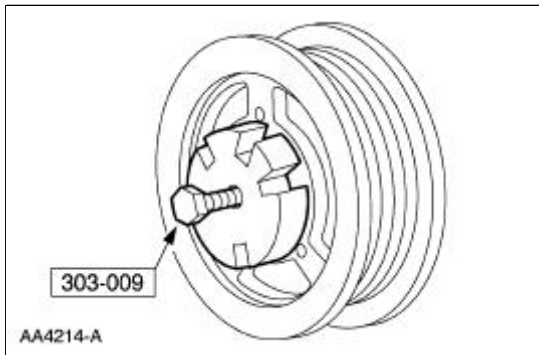
Use the special tool to compress the valve springs and remove the 16 camshaft roller followers. Rotate the camshaft and crankshaft as necessary.



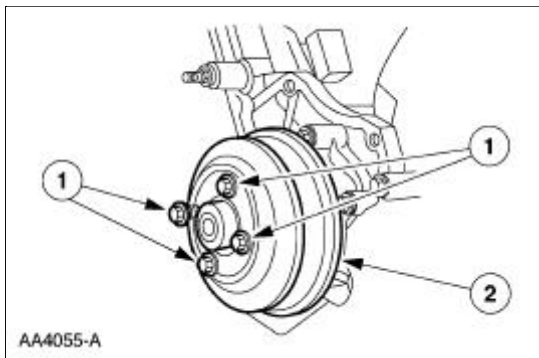
42. Remove the crankshaft pulley bolt.



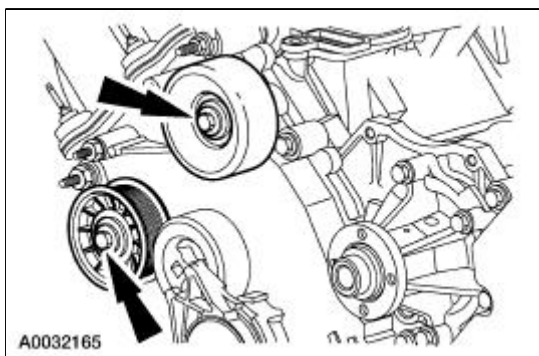
43. Using the special tool, remove the crankshaft pulley.



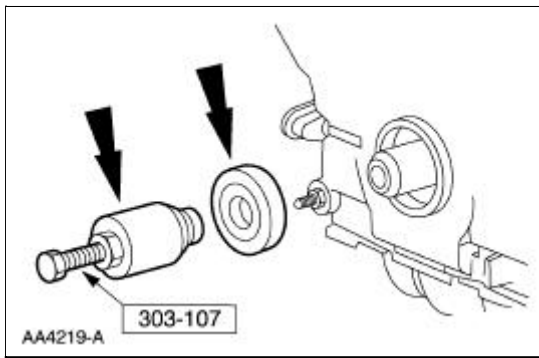
44. Remove the coolant pump pulley.
1. Remove the coolant pump pulley bolts.
 2. Remove the coolant pump pulley.



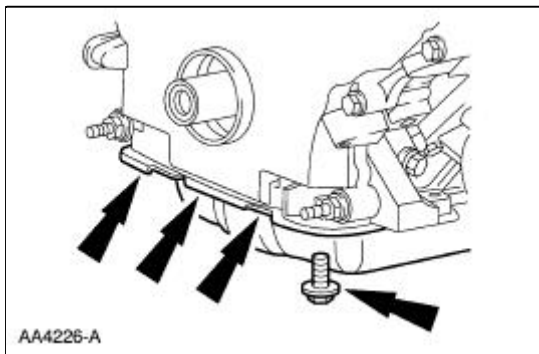
45. Remove the bolts and belt idler pulleys.



46. Using the special tool, remove the engine front cover seal.

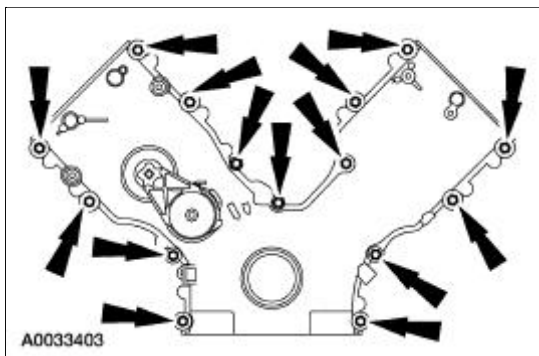


47. Remove the bolts.



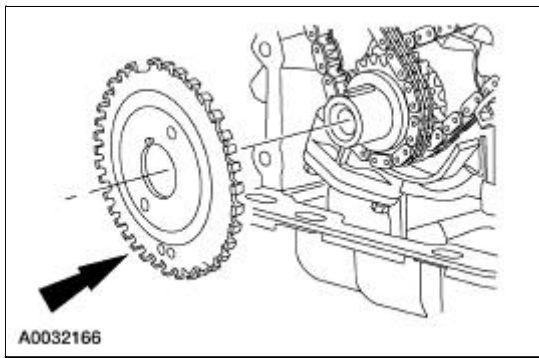
48. Remove the bolts, the studs, and the engine front cover.

- Discard the gaskets, clean and inspect the sealing surfaces.

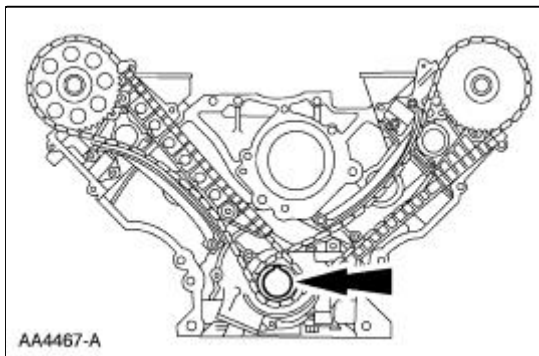


⚠ CAUTION: Since the engine is not free-wheeling, if the crankshaft or the camshafts are moved in any manner during removal and installation, the crankshaft and the camshafts must be re-synchronized.

49. Remove the crankshaft sensor ring from the crankshaft.

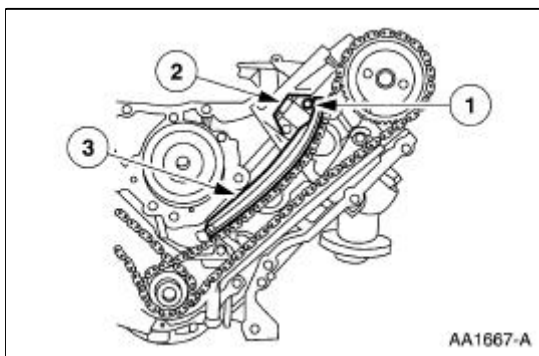


50. Position the crankshaft with the keyway at the 12 o'clock position.



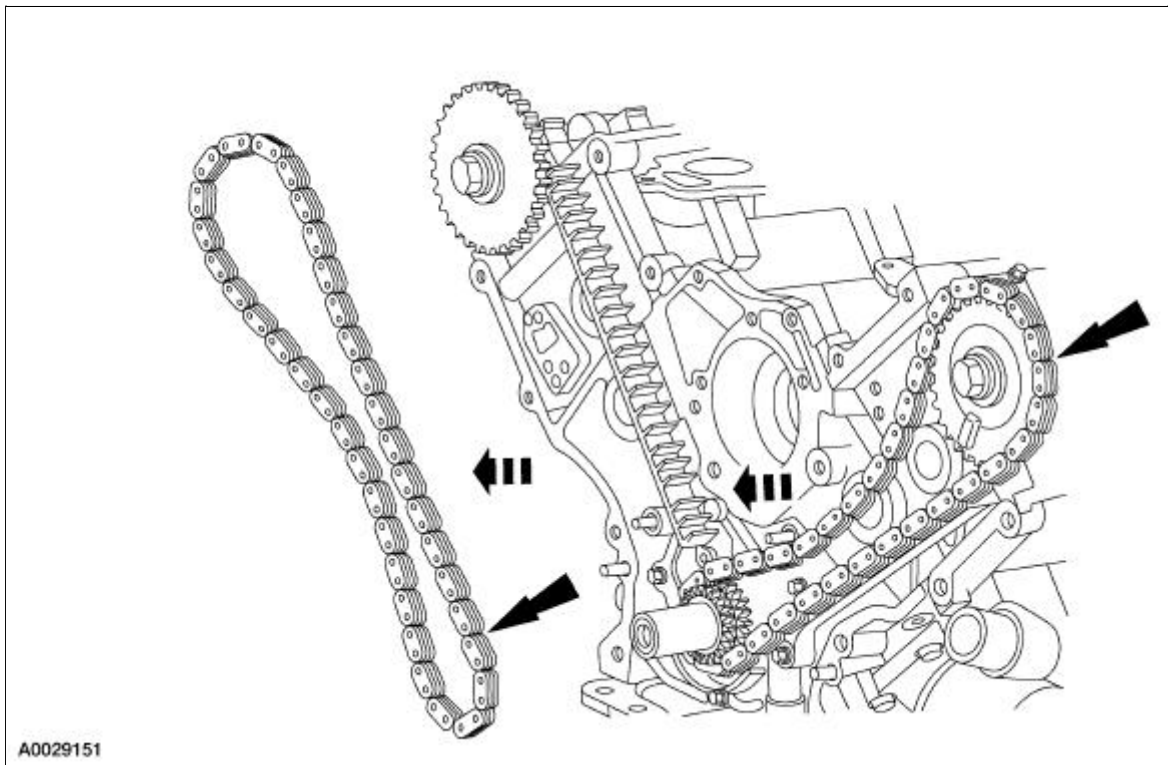
51. Remove the RH and LH timing chain tensioning system from both timing chains.

1. Remove the bolts.
2. Remove the timing chain tensioners.
3. Remove the timing chain tensioner arms.



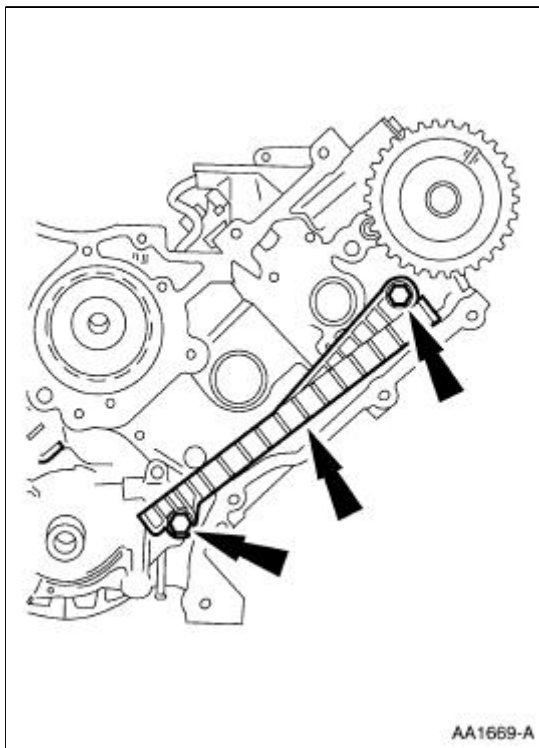
52. Remove the LH and RH timing chains and the crankshaft sprocket.

- Remove the RH timing chain from camshaft sprocket.
- Remove the RH timing chain from the crankshaft sprocket.
- Remove the LH timing chain from the camshaft sprocket.
- Remove the LH timing chain and crankshaft sprocket.



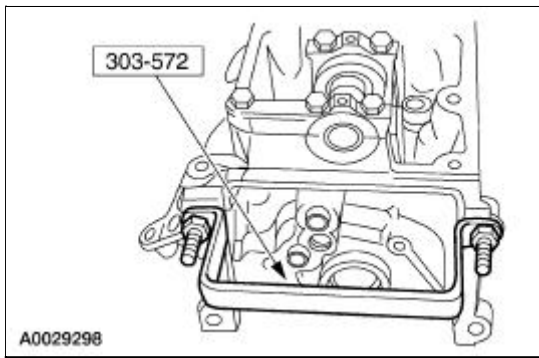
53. **NOTE:** LH shown; RH similar.

Remove the bolts and the timing chain guides.



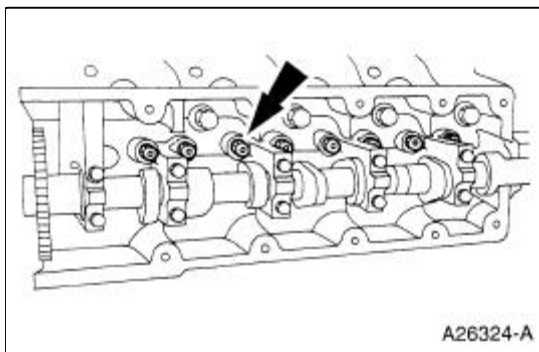
54. **NOTE:** LH shown; RH similar.

Install the lifting handles to the RH and LH cylinder heads.



55. **NOTE:** The hydraulic lash adjusters must be reinstalled in their original locations. Record the hydraulic lash adjuster locations.

Remove the hydraulic lash adjusters.



RH cylinder head

56. **!** **CAUTION:** The cylinder head must be cool before removing it from the engine. Cylinder head warpage can result if a warm or hot cylinder head is removed.

! **CAUTION:** Place clean shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine.

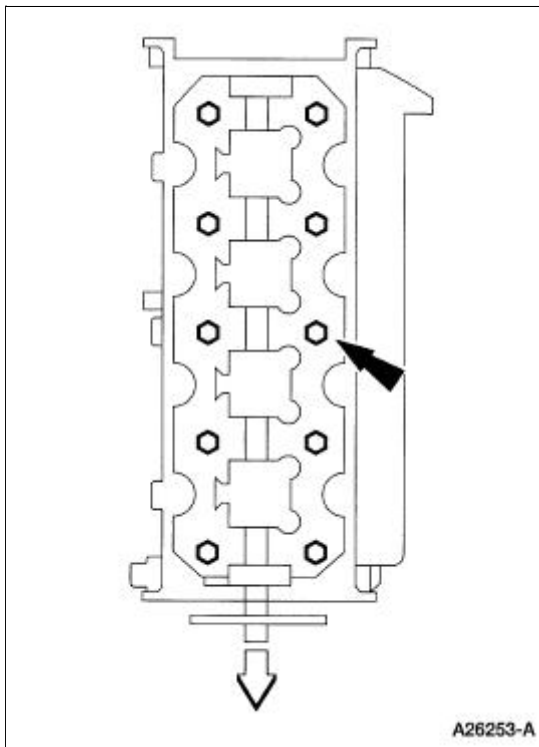
! **CAUTION:** The cylinder head bolts must be discarded and new bolts installed. They are tighten-to-yield designed and cannot be reused.

! **CAUTION:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.


! **CAUTION:** Aluminum surfaces are soft and can be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface.

Remove the bolts and the RH cylinder head.


- Discard the cylinder head gasket.
- Discard the cylinder head bolts.





LH cylinder head

57.  **CAUTION:** The cylinder head must be cool before removing it from the engine. Cylinder head warpage can result if a warm or hot cylinder head is removed.

 **CAUTION:** Place clean shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine.

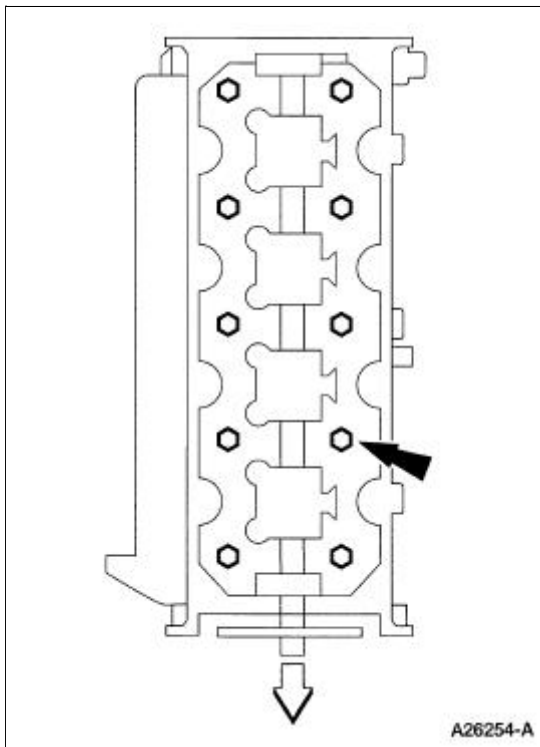
 **CAUTION:** The cylinder head bolts must be discarded and new bolts installed. They are tighten-to-yield designed and cannot be reused.

 **CAUTION:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.


 **CAUTION:** Aluminum surfaces are soft and can be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface.


Remove the bolts and the LH cylinder head.

- Discard the cylinder head gasket.
- Discard the cylinder head bolts.



Both cylinder heads

58.  **CAUTION:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.

 **CAUTION:** Observe all warnings or cautions and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.


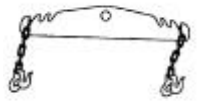
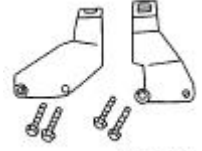
Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder head and the cylinder block.

1. Remove any large deposits of silicone or gasket material with a plastic scraper.
 2. Apply silicone gasket remover, following package directions, and allow to set for several minutes.
 3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
 4. Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant, and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.
59. **NOTE:** The straightedge used must be flat within 0.0051 mm (0.0002 in) per foot of tool length.

Support the cylinder head on a bench with the head gasket side up. Inspect all areas of the deck face with a straightedge, paying particular attention to the oil pressure feed area. The cylinder head must not have depressions deeper than 0.0254 mm (0.001 in) across a 38.1 mm (1.5 in) square area, or scratches more than 0.0254 mm (0.001 in) .

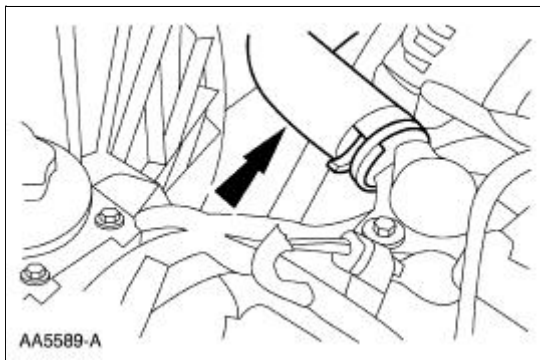
Engine

Special Tool(s)

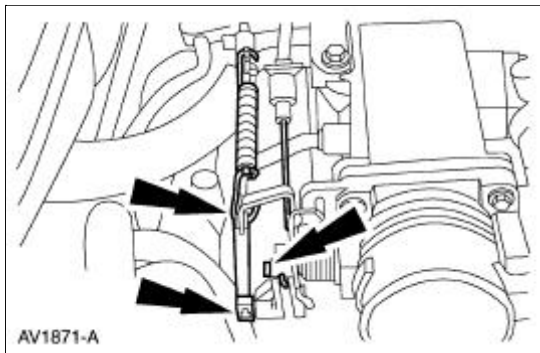
 ST2334-A	Support Bracket, Engine 303-639
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3)
 ST1701-A	Lifting Bracket Set, Engine 303-D074 (D91P-6001-A)

Removal

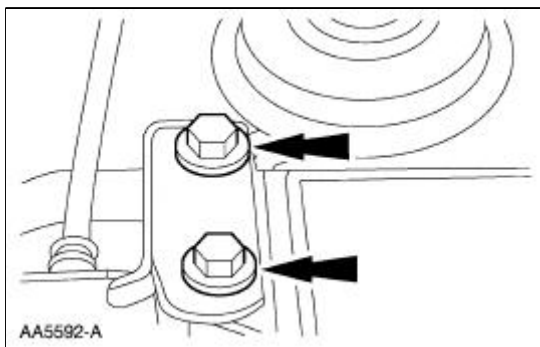
1. Remove the hood.
2. Remove the battery. For additional information, refer to [Section 414-01](#).
3. Remove the air cleaner and outlet tube. For additional information, refer to [Section 303-12](#).
4. Drain the engine cooling system. For additional information, refer to [Section 303-03A](#) or [Section 303-03B](#).
5. Remove the degas bottle. For additional information, refer to [Section 303-03A](#) or [Section 303-03B](#).
6. Recover the A/C system. For additional information, refer to [Section 412-00](#).
7. Disconnect the fuel lines. For additional information, refer to [Section 310-00](#).
8. Disconnect the upper radiator hose from the water outlet connector.



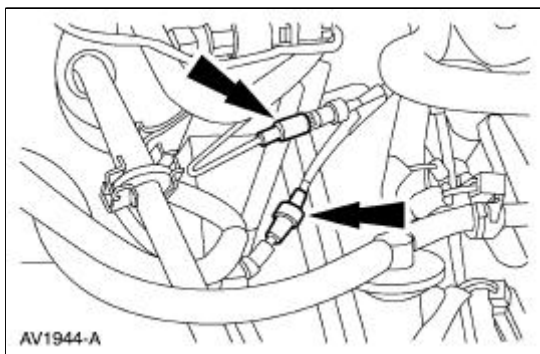
9. Disconnect the throttle cable, speed control actuator cable and the return spring.



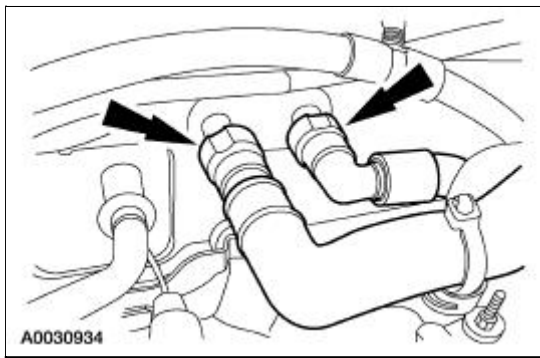
10. Remove the bolts and position the cables and bracket out of the way.



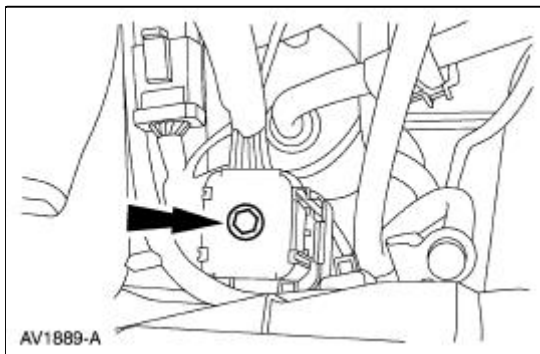
11. Disconnect the climate control vacuum supply hoses.



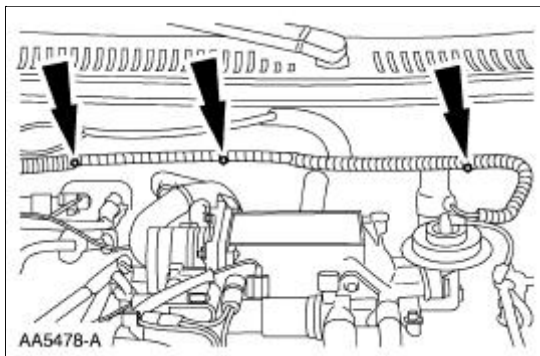
12. Disconnect the two heater water hoses.



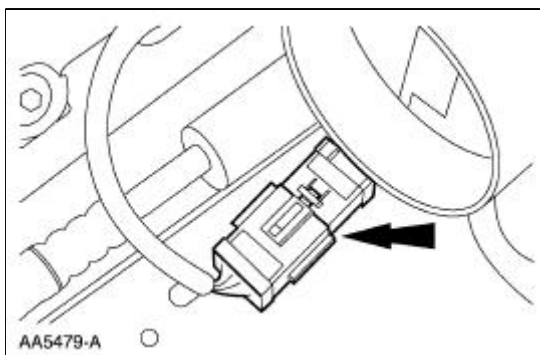
13. Disconnect the engine bulkhead connector.



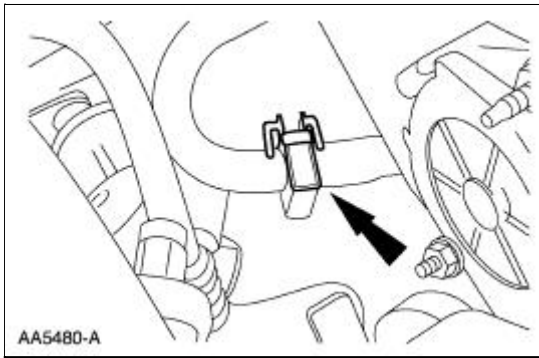
14. Separate the harness in three locations.



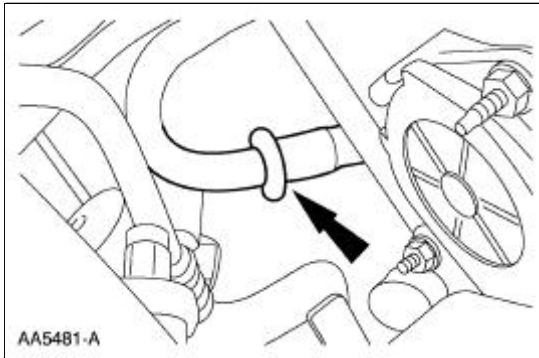
15. Disconnect the electrical connector.



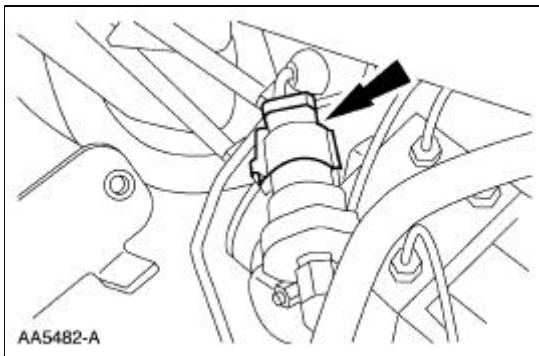
16. Remove the safety clip from the manifold suction tube.



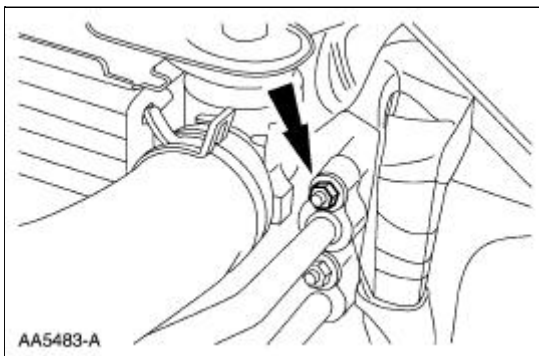
17. Disconnect the A/C manifold suction tube.



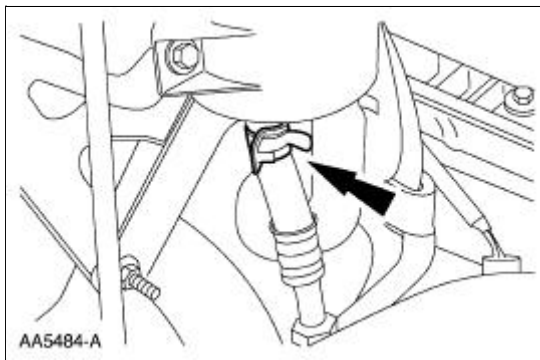
18. Disconnect the A/C pressure cycle switch.



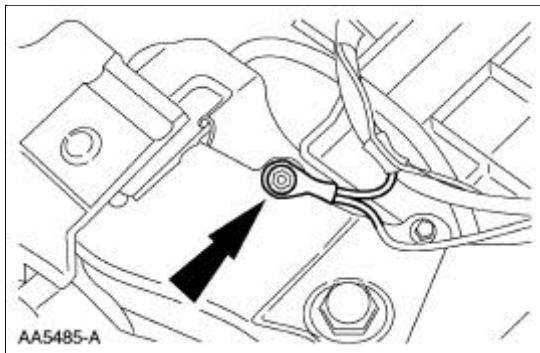
19. Remove the nut and separate the liquid tube from the A/C condenser.



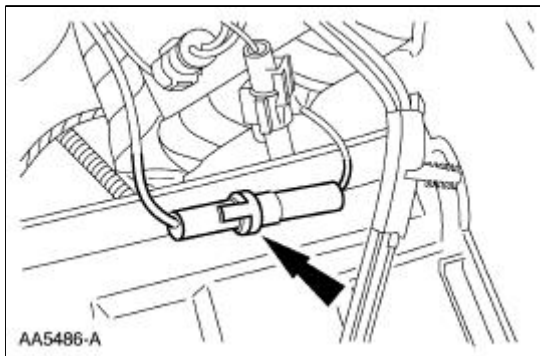
20. Disconnect the power steering hose from the reservoir.



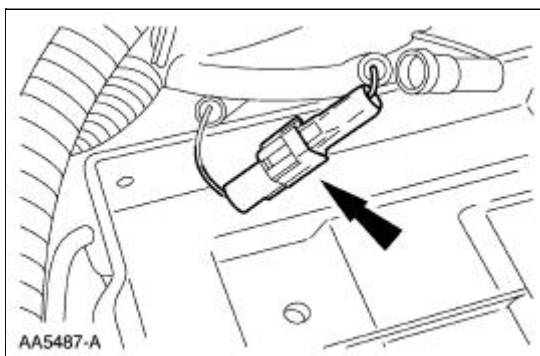
21. Remove the bolt and the body ground.



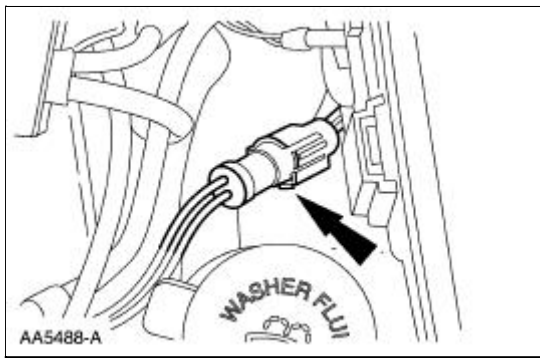
22. Separate the fuse link.



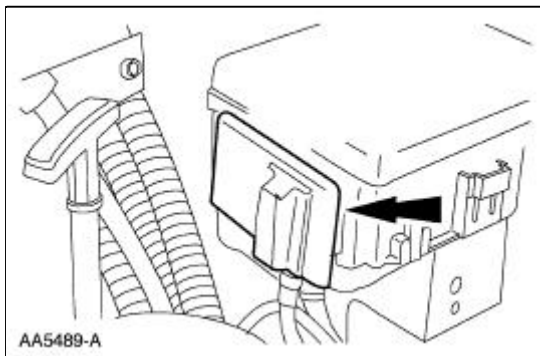
23. Disconnect the connector.



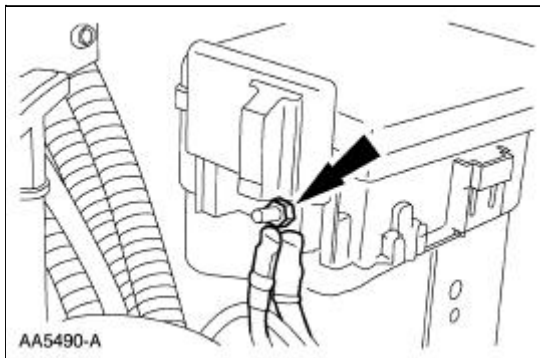
24. Disconnect the ground connector.



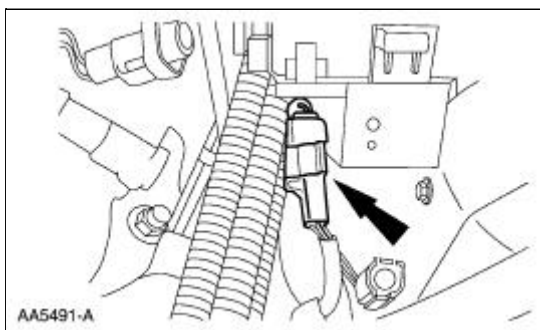
25. Slide the access cover up.



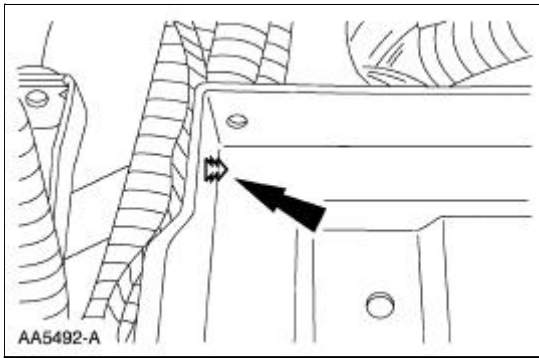
26. Remove the nut and the battery leads.



27. Disconnect the connector.

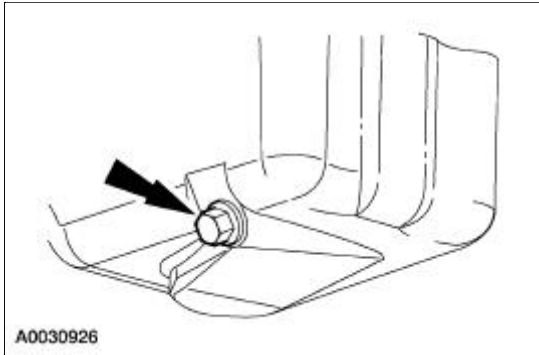


28. Separate the degas sensor lead from the battery tray.

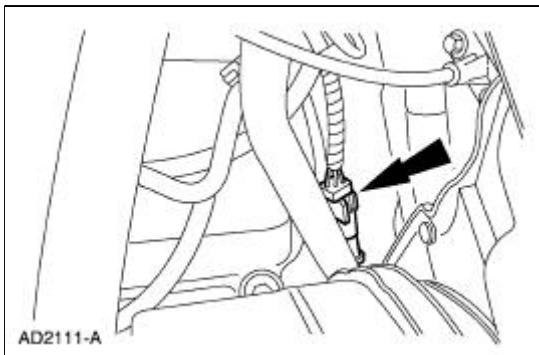


29. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).

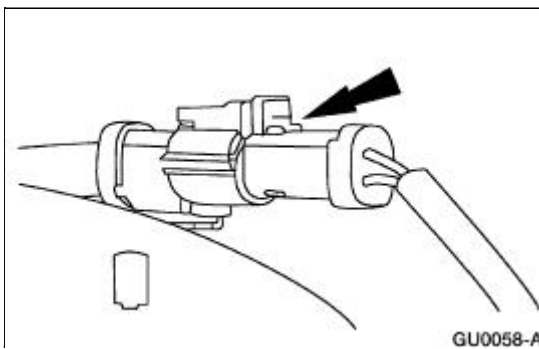
30. Drain the engine oil.



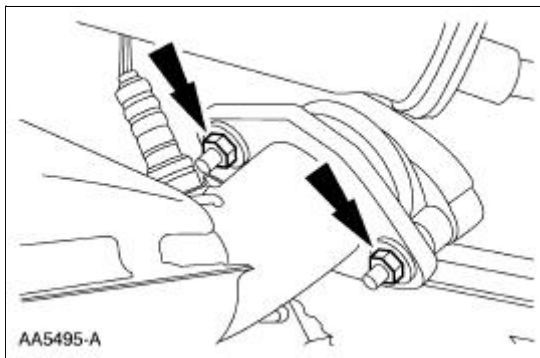
31. Disconnect the RH heated oxygen sensor connector.



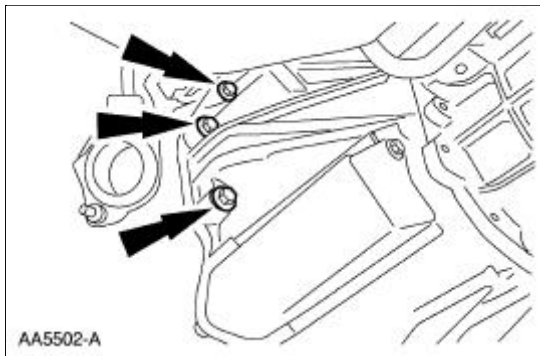
32. Disconnect the LH heated oxygen sensor connector.



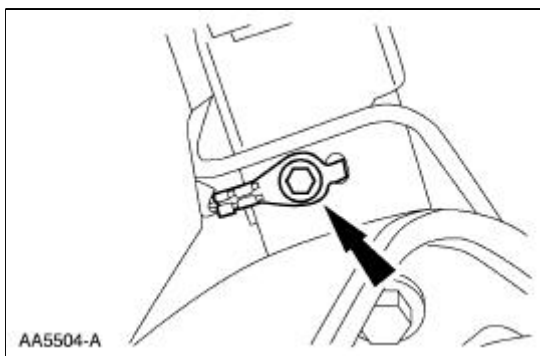
33. Remove the four exhaust manifold flange nuts.



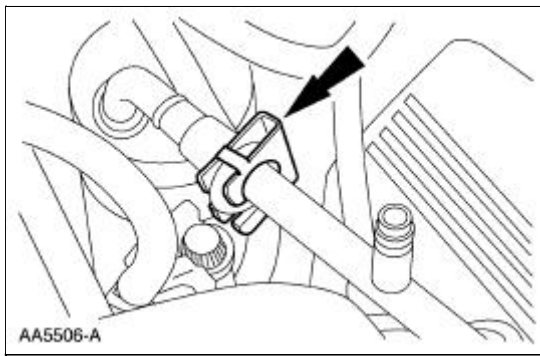
34. Remove the starter. For additional information, refer to [Section 303-06](#).
35. Remove the nine bell housing bolts.



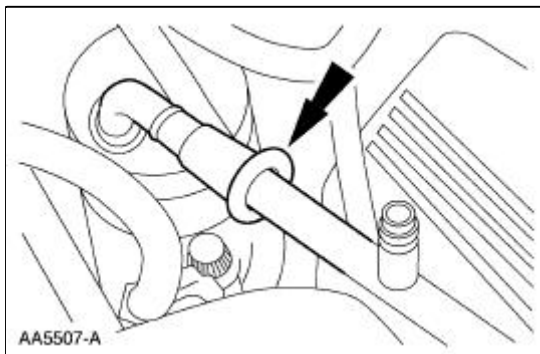
36. Remove the bolt and the body ground.



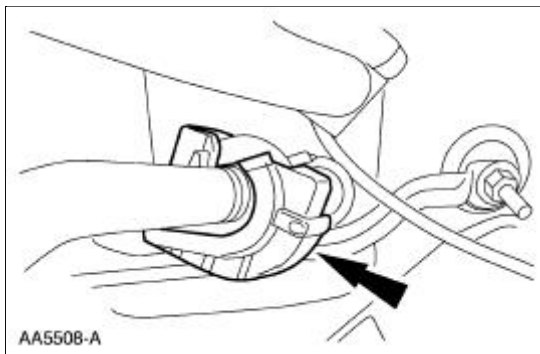
37. Remove the power steering pump. For additional information, refer to [Section 211-02](#).
38. Lower the vehicle.
39. Remove the safety clip from the suction tube.



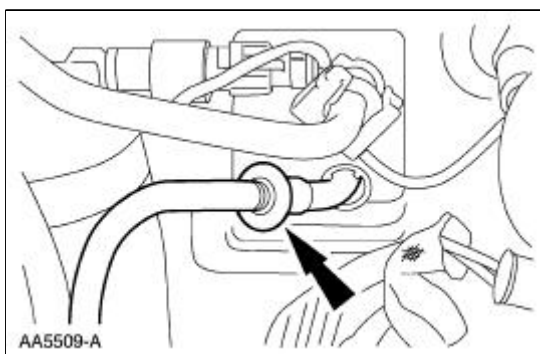
40. Disconnect the suction tube at the receiver/drier and remove the tube.



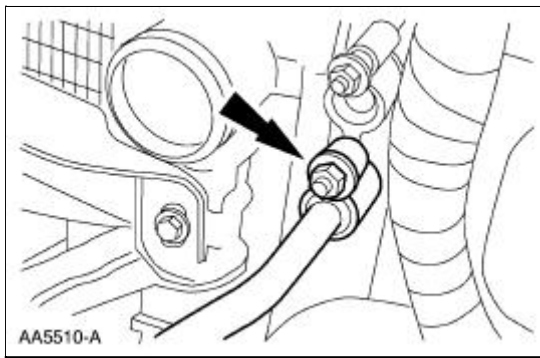
41. Remove the safety clip from the line at the evaporator core.



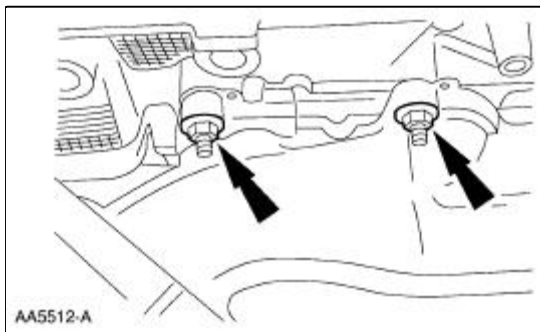
42. Disconnect the tube from the evaporator core.



43. Remove the nut and remove the tube from the vehicle.



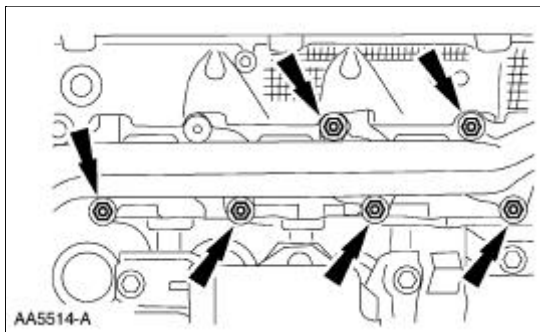
44. Remove the two nuts from the RH exhaust manifold.



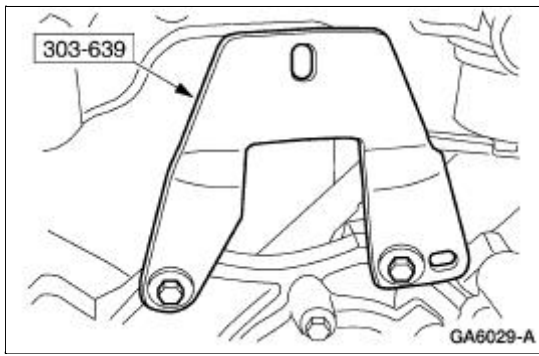
45. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).

46. **NOTE:** The manifold will not be removed from the vehicle in this step.

Remove the six exhaust manifold nuts.

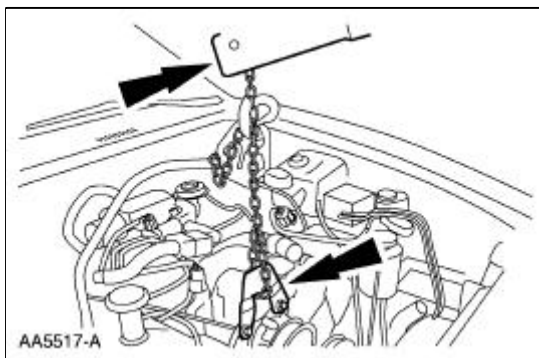


47. Lower the vehicle.
48. Remove the generator. For additional information, refer to [Section 414-02](#).
49. Install the special tool.

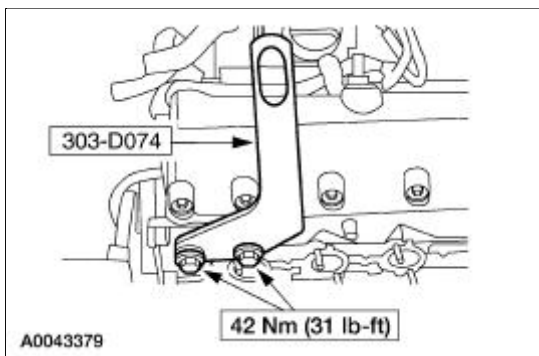


50. **NOTE:** This step will allow removal of the exhaust manifold through the bottom and access for the installation of the engine lift brackets.

Using a suitable floor crane, raise the engine to remove the exhaust manifold.

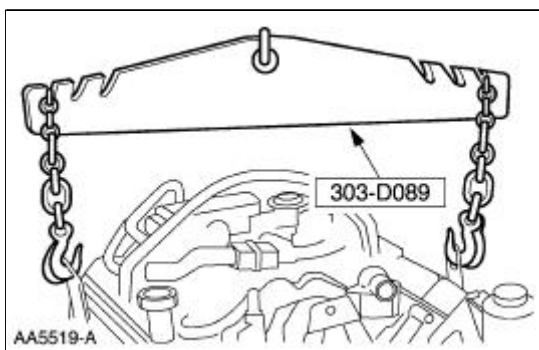


51. Install the RH and LH special tool.



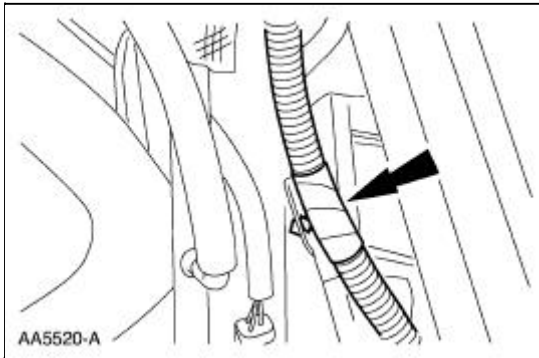
52. **NOTE:** Before carrying out this step it will be necessary to support the transmission with a floor jack and a block of wood.

Install the special tool.



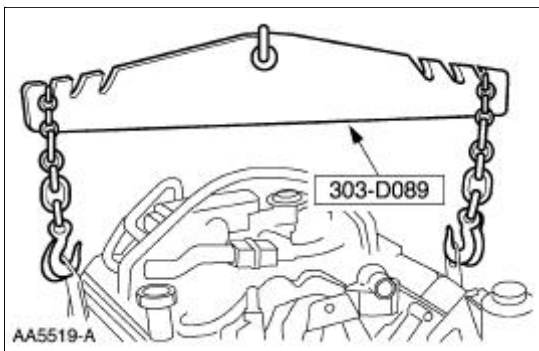
53. Separate the harness from the bracket.

- Raise the engine slightly to gain access to the transmission wiring support bracket.





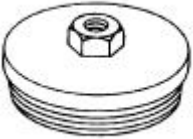

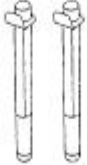

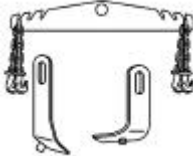
54. **NOTE:** Adjust the transmission support jack as necessary to aid in the removal of the engine.



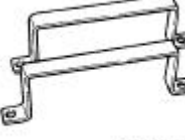
Using the special tool, remove the engine from the vehicle.



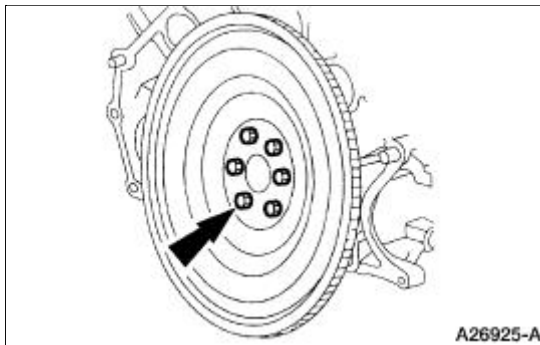
Engine

Special Tool(s)

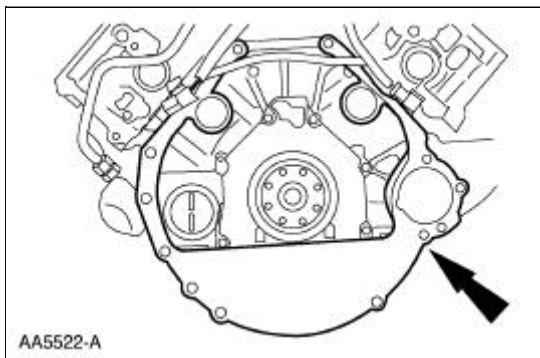
 ST1185-A	Impact Slide Hammer 100-001 (T50T-100-A)
 ST1481-A	Remover, Crankshaft Rear Oil Slinger 303-514 (T95P-6701-AH)
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
 ST1286-A	Remover, Crankshaft Vibration Damper 303-009 (T58P-6316-D)
 ST1337-A	Installer, Connecting Rod 303-442 (T93P-6136-A)
 ST1730-A	Remover, Crankshaft Front Oil Seal 303-107 (T74P-6700-A)
 ST2443-A	Engine Lift Bracket Set 303-DS086- (D93P-6001-EA)
	Cylinder Ridge Reamer 303-016 (T64L-6011-EA)

 <p>ST1276-A</p>	
 <p>ST1693-A</p>	<p>Compressor, Valve Spring (Exhaust) 303-567 (T97L-6565-AH)</p>
 <p>ST1668-A</p>	<p>Remover/Installer, Cylinder Head 303-572 (T97T-6000-A)</p>

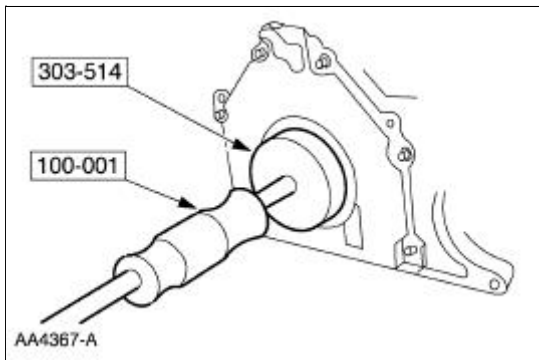
1. Remove the flywheel.



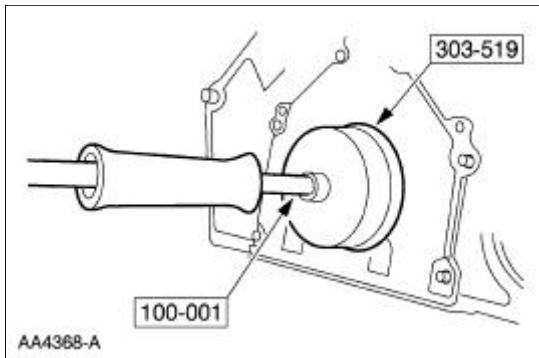
2. Remove the separator plate.



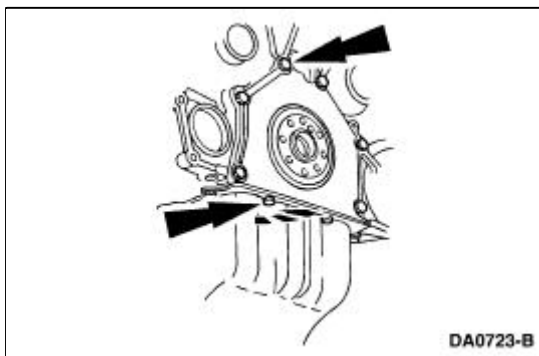
3. Using the special tools, remove the crankshaft rear oil slinger.



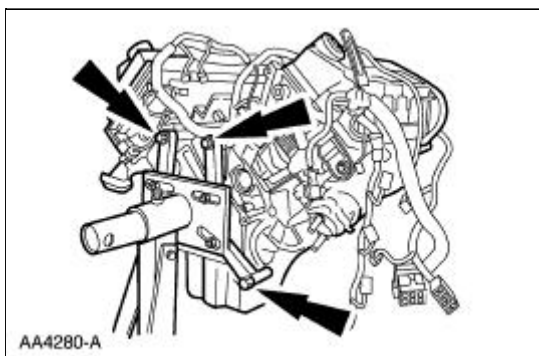
4. Using the special tools, remove the rear main seal.



5. Remove the rear seal retainer plate.

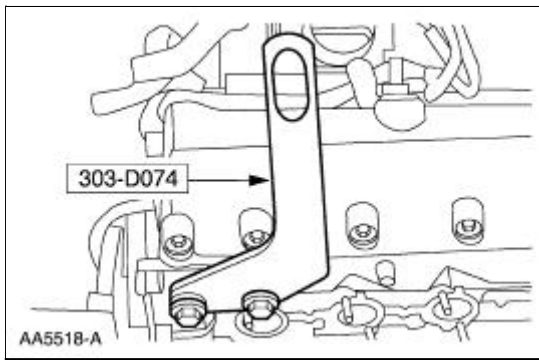


6. Mount the engine on a work stand.

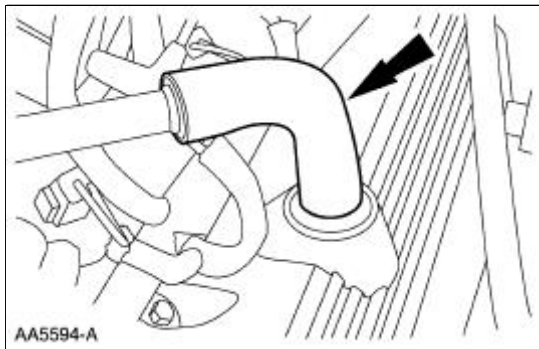


7. **NOTE:** RH shown, LH similar.

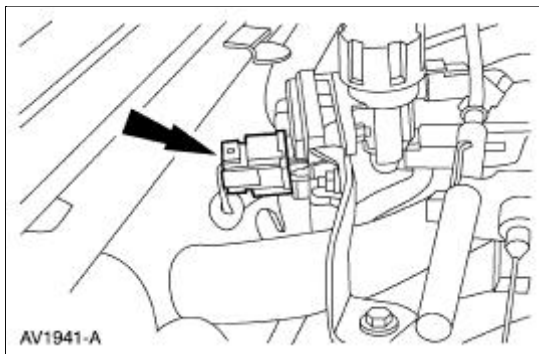
Remove the RH and LH lifting eyes.



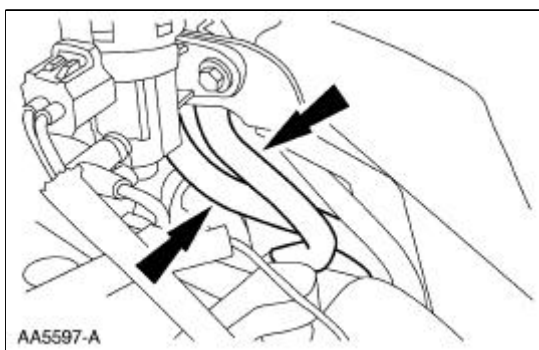
8. Remove the breather tube.



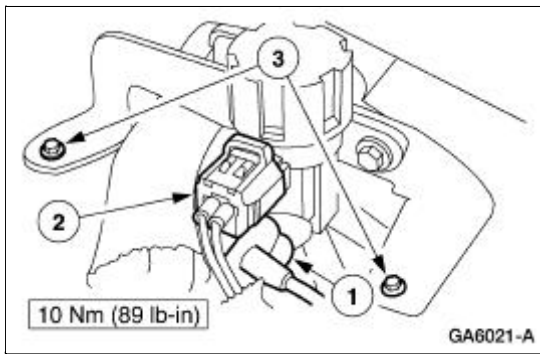
9. Disconnect the differential pressure feedback EGR electrical connector.



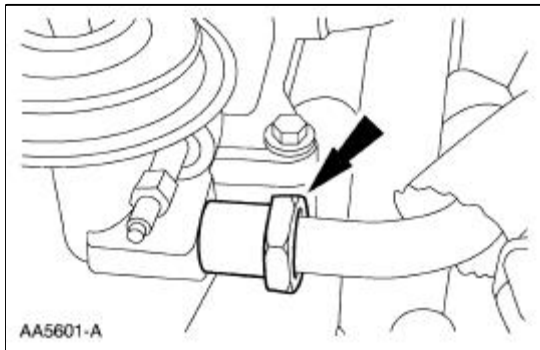
10. Disconnect the hoses from the differential pressure feedback EGR transducer (9J434).



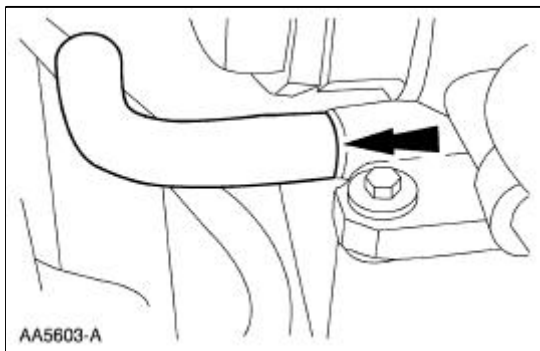
11. Remove the EGR vacuum regulator solenoid.
 1. Remove the vacuum hoses.
 2. Remove the electrical connector.
 3. Remove the bolts.



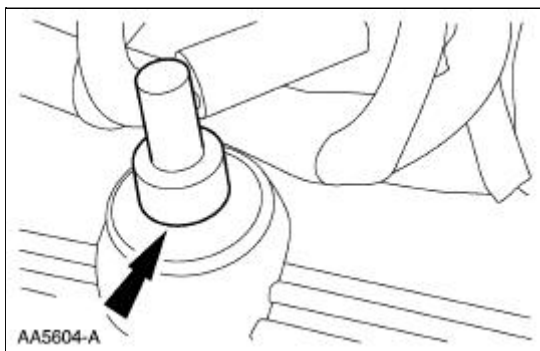
12. Disconnect the exhaust gas recirculation (EGR) tube from the EGR valve.



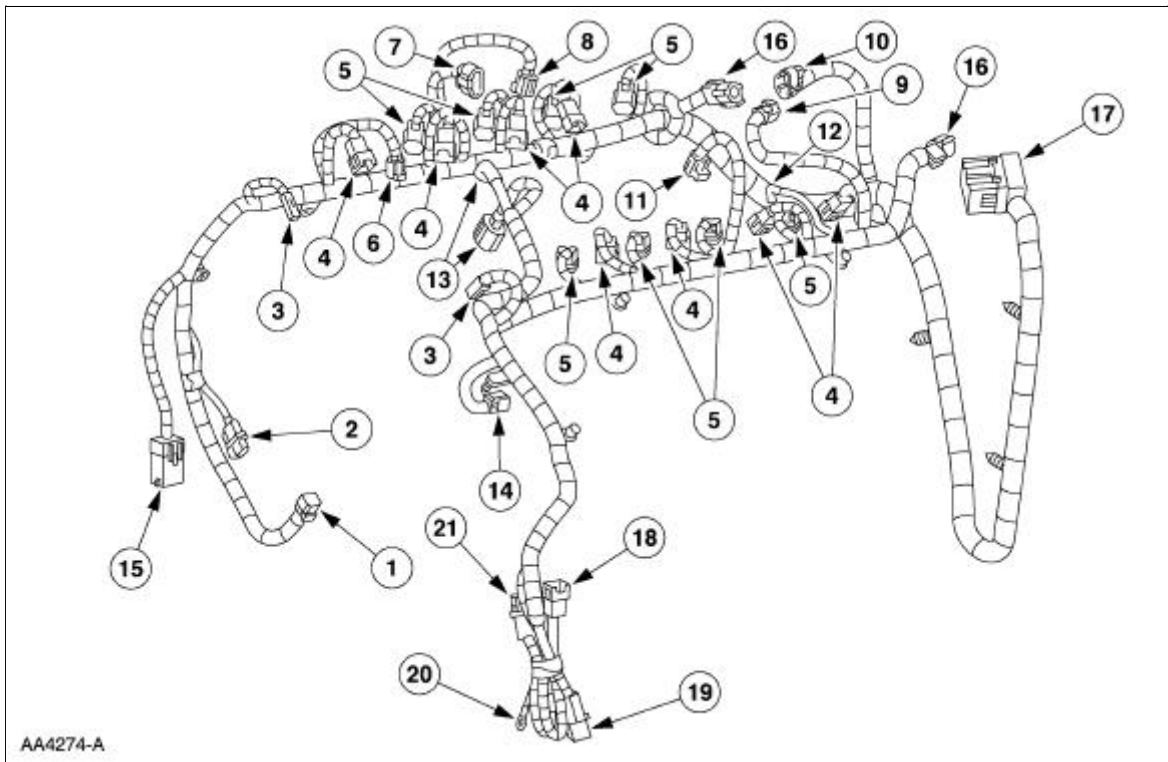
13. Disconnect the positive crankcase ventilation (PCV) hose from the base of the throttle body.



14. Disconnect the PCV valve hose.



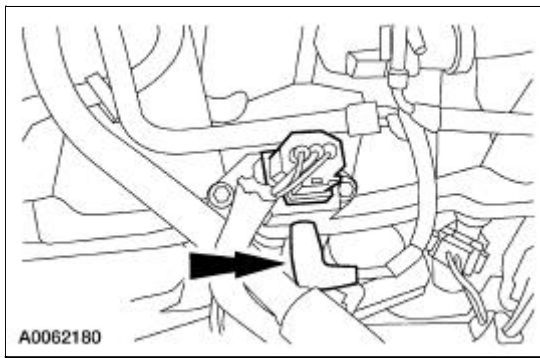
15. Remove the engine wiring harness.



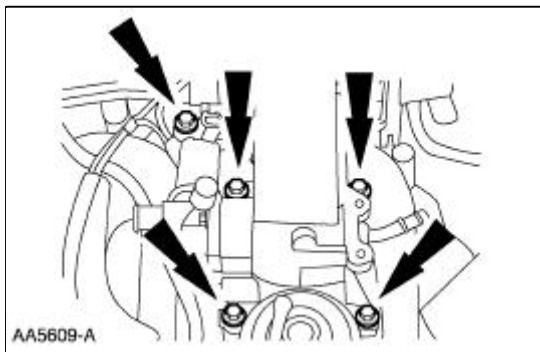
AA4274-A

Item	Part Number	Description
1	—	To crankshaft position sensor
2	—	To A/C compressor
3	—	To radio ignition interference capacitor (2)
4	—	To fuel injectors (8)
5	—	To ignition coils (8)
6	—	To engine coolant temperature sensor
7	—	To throttle position sensor
8	—	To idle air control valve
9	—	To EGR vacuum regulator
10	—	To differential pressure feedback EGR
11	—	To fuel pressure regulator
12	—	Fuel injection ground
13	—	To generator
14	—	To camshaft position sensor
15	—	To body
16	—	To heated oxygen sensor (2)
17	—	Engine bulkhead connector
18	—	To low coolant sensor
19	—	To body
20	—	To power distribution box
21	—	To body

16. Disconnect the vacuum line to the fuel pressure sensor.



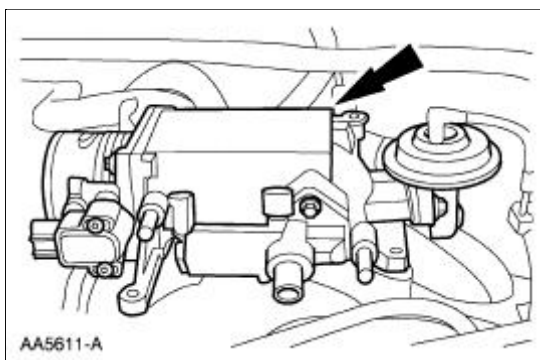
17. Remove the throttle body bolts.



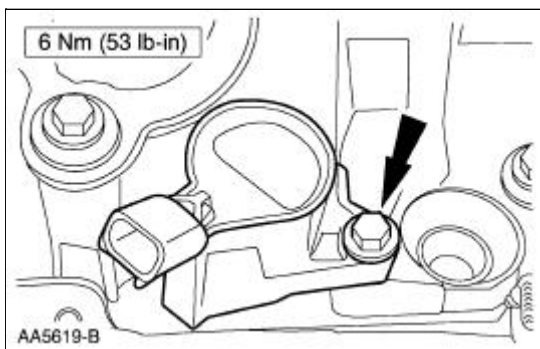
18. **NOTE:** The gasket is reusable if not damaged.

Remove the throttle body and adapter as an assembly.

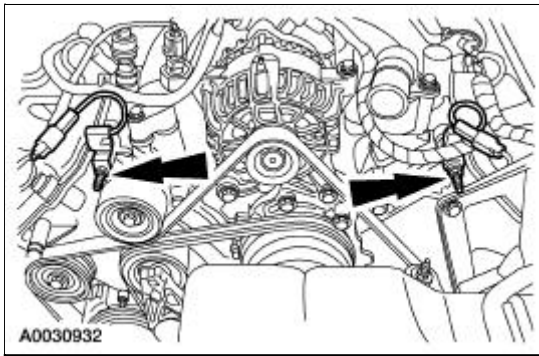
- Inspect and clean the sealing surfaces.



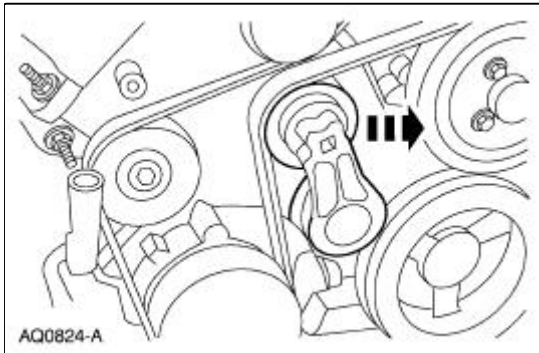
19. Remove the ignition coils.



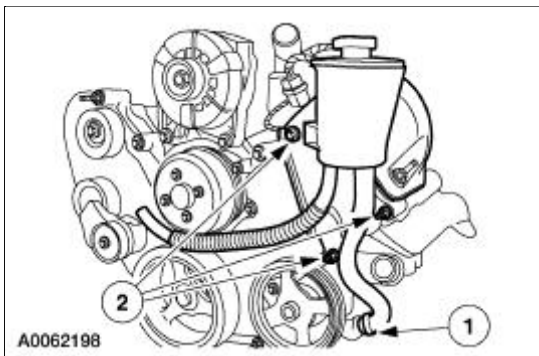
20. Remove the radio interference capacitors.



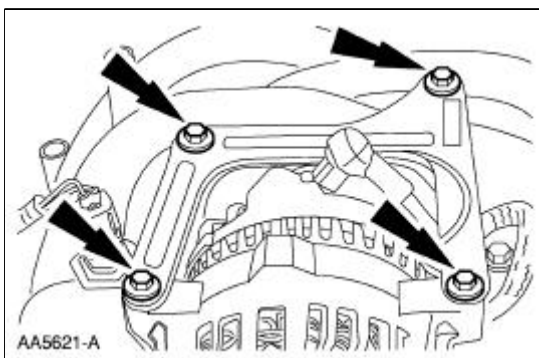
21. Rotate the belt tensioner and remove the accessory drive belt.



22. Remove the power steering reservoir bracket as an assembly.
 1. Disconnect the supply line from the pump.
 2. Remove the three bolts and reservoir.

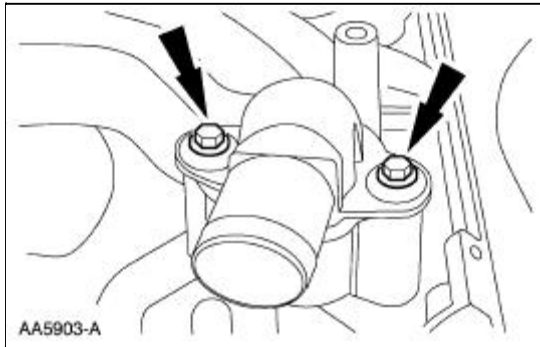


23. Remove the upper generator support bracket.

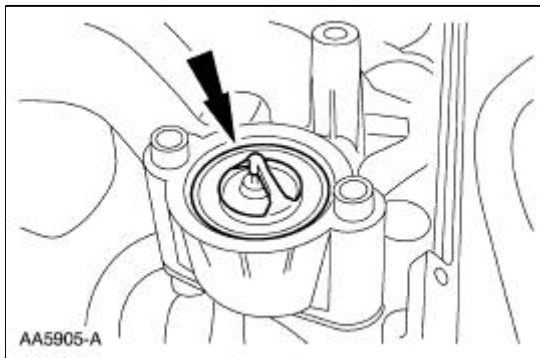


24. Remove the bolts and the generator.

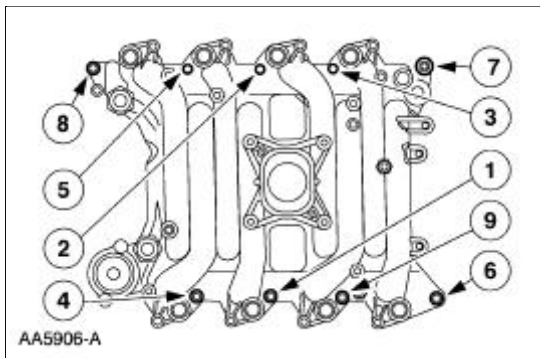
25. Remove the water outlet connector.



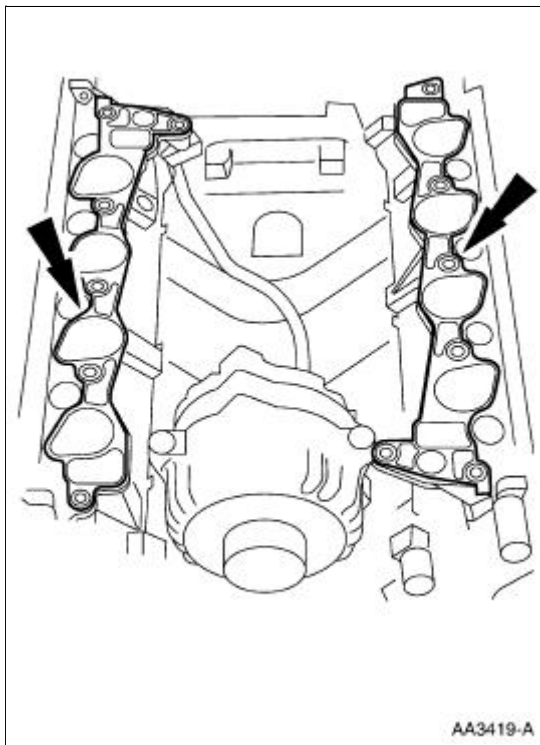
26. Remove the water thermostat and O-ring.




27. Remove the bolts in the sequence shown, and remove the intake manifold.



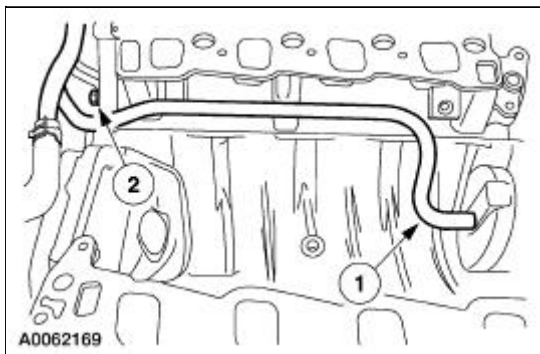
28. Remove the intake manifold gaskets.



29.  **CAUTION:** Do not use metal scrapers, wire brushes, power abrasive discs or other means to clean sealing surfaces. These tools cause scratches and gouges which make leak paths.

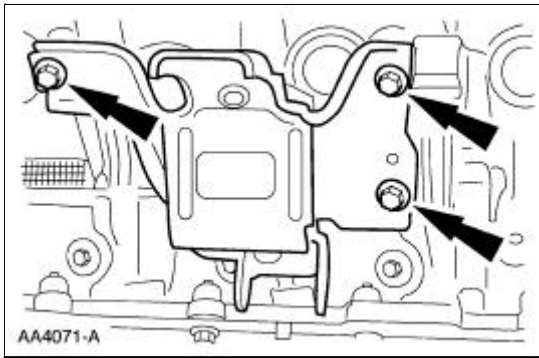
Remove the water bypass tube.

1. Remove the nut.
2. Remove the water bypass tube.



30. **NOTE:** RH shown, LH similar.

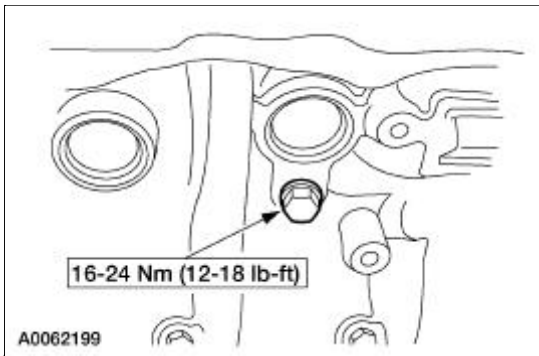
Remove the RH and the LH engine mount.



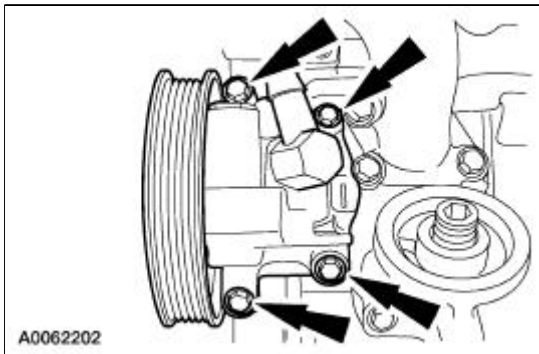
31. **NOTE:** One side shown, other side similar.

Using a suitable container, drain coolant from the engine block.

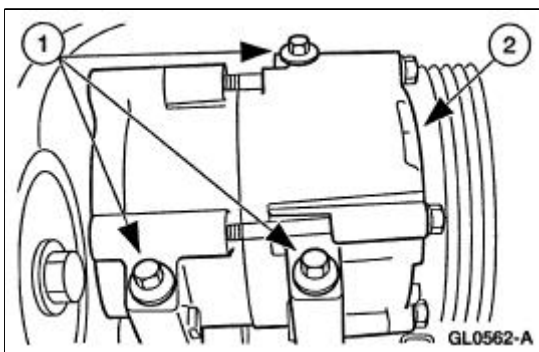
- Install the drain plugs when finished.



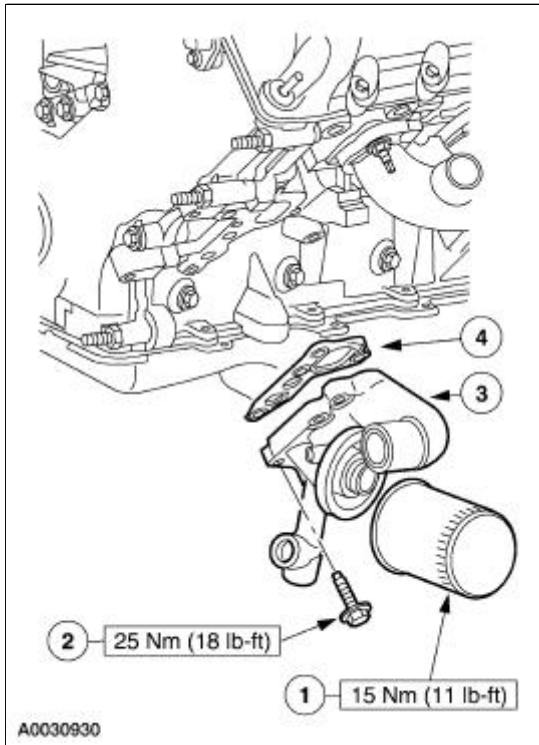
32. Remove the four bolts and the power steering pump.



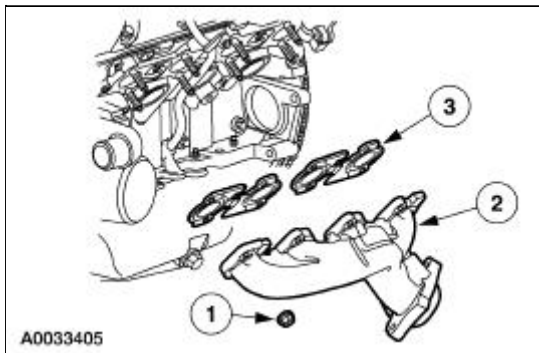
33. Remove the compressor.
 1. Remove the bolts.
 2. Remove the compressor.



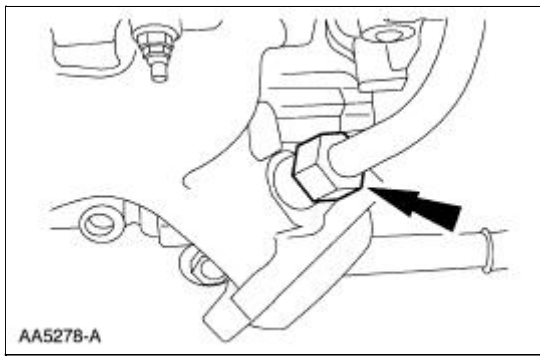
34. Remove the oil filter adapter.
 1. Remove the oil bypass filter.
 2. Remove the bolts.
 3. Remove the oil filter adapter.
 4. Clean and inspect the sealing surfaces.



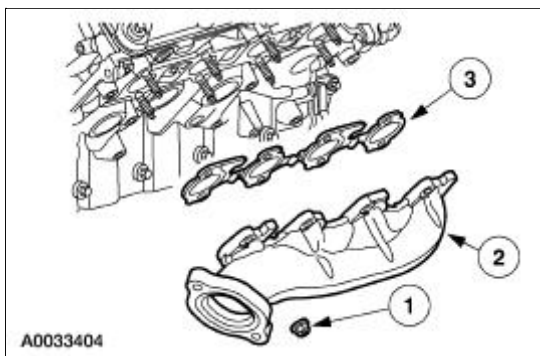
35. Remove the LH exhaust manifold.
 1. Remove the exhaust manifold nuts.
 2. Remove the exhaust manifold.
 3. Remove the exhaust manifold gasket and discard.



36. Disconnect the exhaust recirculation (EGR) tube (9D477) at the exhaust manifold.



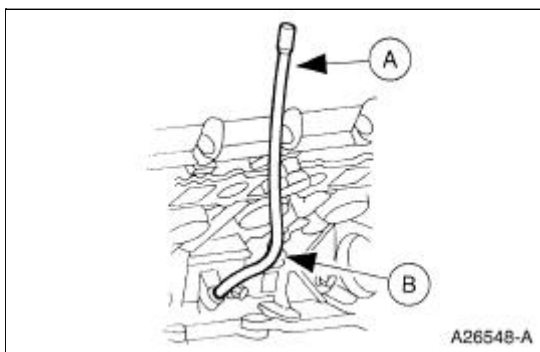
37. Remove the RH exhaust manifold.
 1. Remove the exhaust manifold nuts.
 2. Remove the exhaust manifold.
 3. Remove the exhaust manifold gasket and discard.



38. Clean and inspect the exhaust manifolds. For additional information, refer to [Section 303-00](#).
39. Remove the oil level indicator tube bolt.

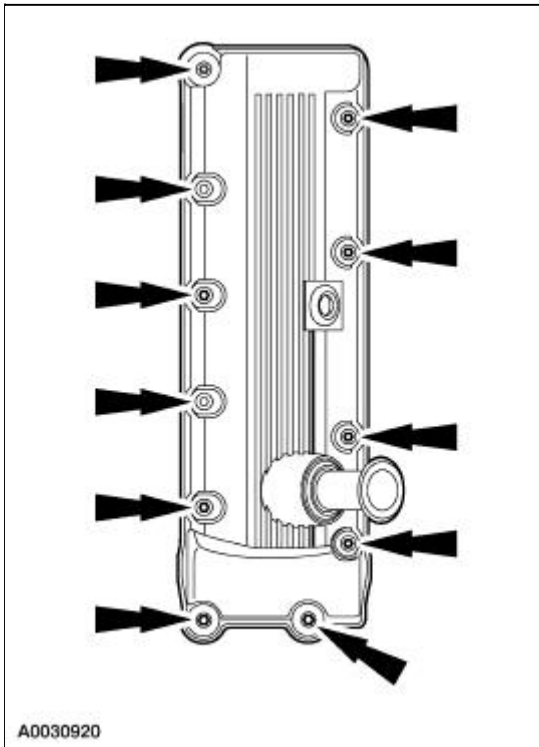


40. Remove the bolt and the oil level indicator tube.



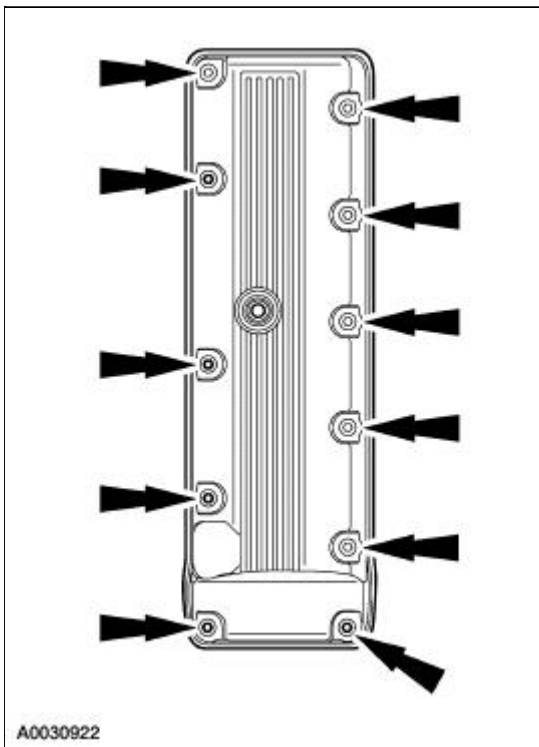
41. Remove valve cover.

- Remove the fasteners.
- Remove the valve cover.



42. Remove valve cover.

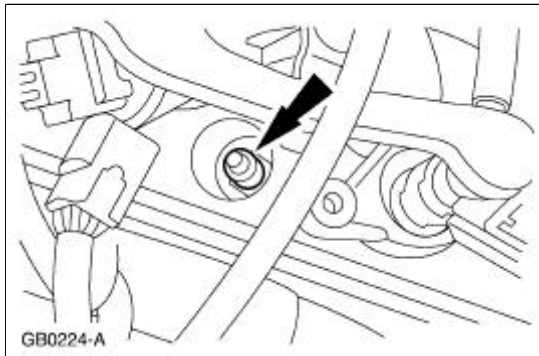
- Remove the fasteners.
- Remove the valve cover.



43. **NOTE:** Use compressed air to remove any foreign material from the spark plug well before removing the spark plugs (12405).

NOTE: One spark plug is shown; others are similar.

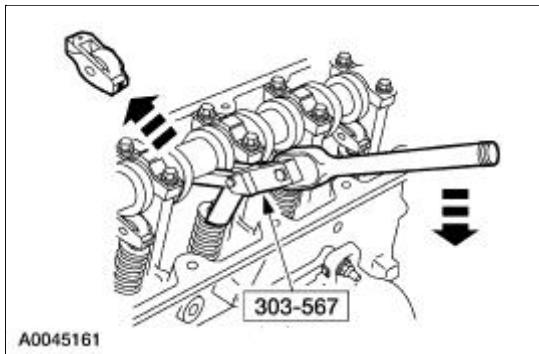
Remove the spark plugs.



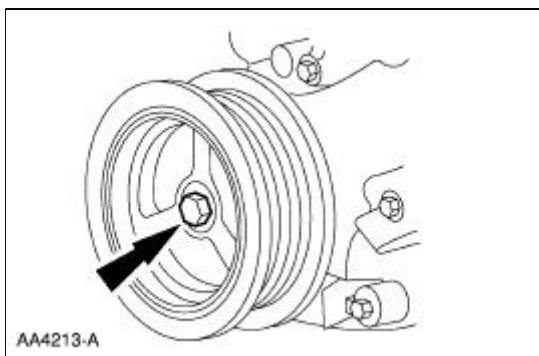
44. **NOTE:** Rotate the camshaft to the base circle of the camshaft lobe before removing followers. Keep roller followers in order when removing.

Use special tool to compress the valve springs (6513) and remove the 16 camshaft roller followers.

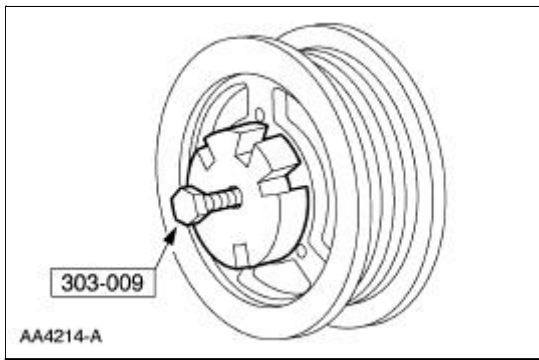
- Rotate the camshaft and the crankshaft as necessary.



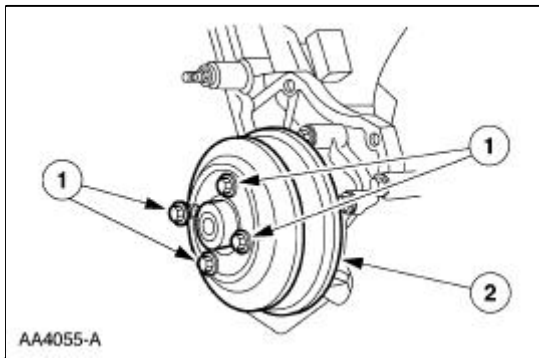
45. Remove the crankshaft pulley bolt.



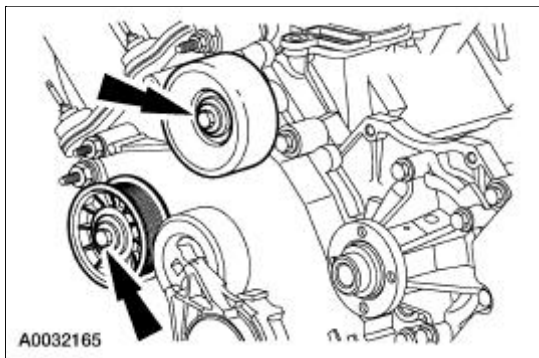
46. Using the special tool, remove the crankshaft pulley.



47. Remove the water pump pulley.
1. Remove the water pump pulley bolts.
 2. Remove the water pump pulley.



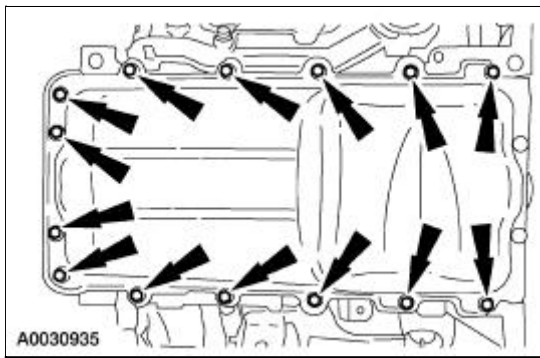
48. Remove the bolts and belt idler pulleys.



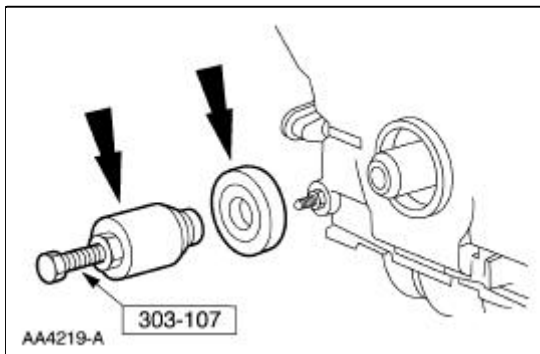
49. **NOTE:** The gasket can be reused if not damaged.

Remove the oil pan.

- Remove the bolts.
- Remove the oil pan.

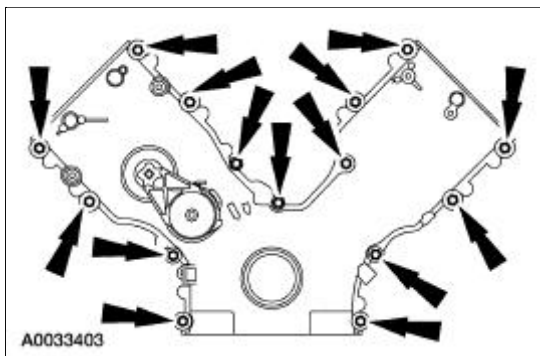


50. Using the special tool, remove the front cover seal.



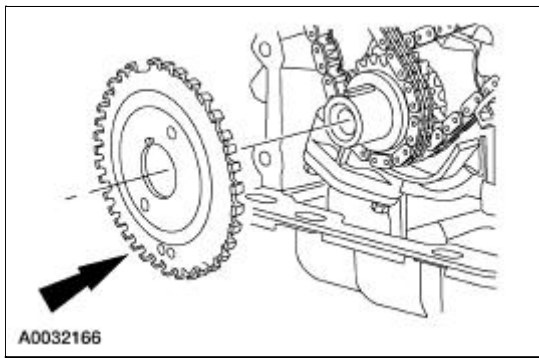
51. Remove the bolts, the studs, and the engine front cover.

- Discard the gaskets. Clean and inspect the sealing surfaces.

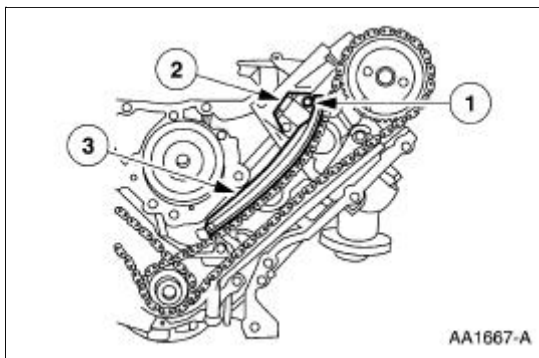


⚠ CAUTION: Since the engine is not free-wheeling, if the crankshaft or the camshafts are moved in any manner during removal and installation, the crankshaft and the camshafts must be re-synchronized.

52. Remove the crankshaft sensor ring from the crankshaft.



53. Remove the RH and LH timing chain tensioner (RH shown, LH similar).
1. Remove the bolts.
 2. Remove the timing chain tensioners.
 3. Remove the timing chain tensioner arms.

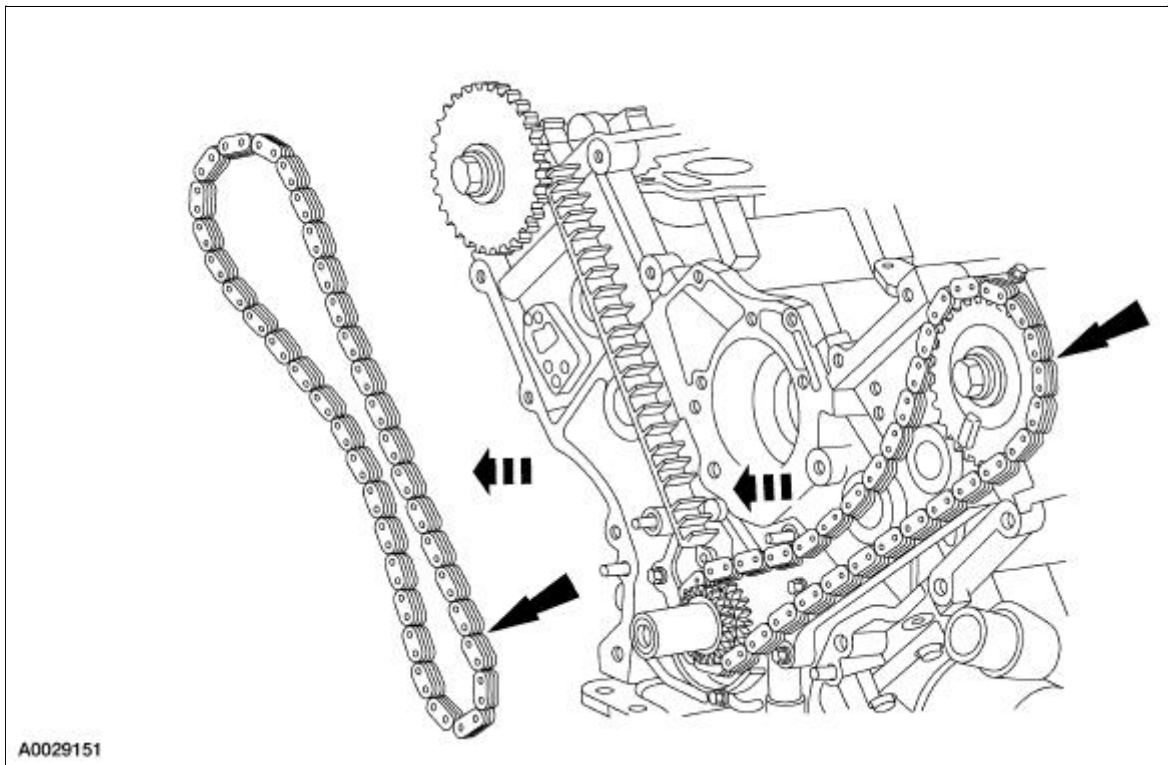


54. **⚠ CAUTION: Unless otherwise instructed, at no time when the timing chains are removed and the cylinder heads are installed is the crankshaft or the camshaft to be rotated. Severe piston and valve damage can occur.**

⚠ CAUTION: Do not remove the special tool from the camshafts.

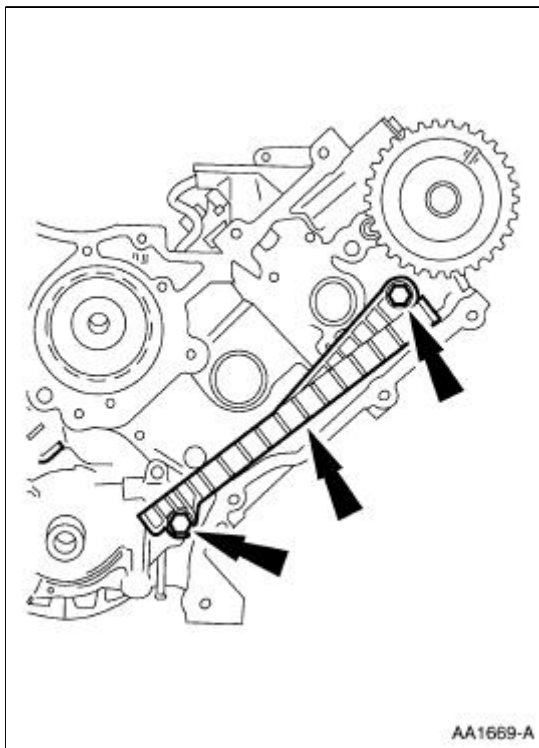
Remove the LH and RH timing chains and the crankshaft sprocket.

- Remove the RH timing chain from the camshaft sprocket.
- Remove the RH timing chain from the crankshaft sprocket.
- Remove the LH timing chain from the camshaft sprocket.
- Remove the LH timing chain from the crankshaft sprocket.



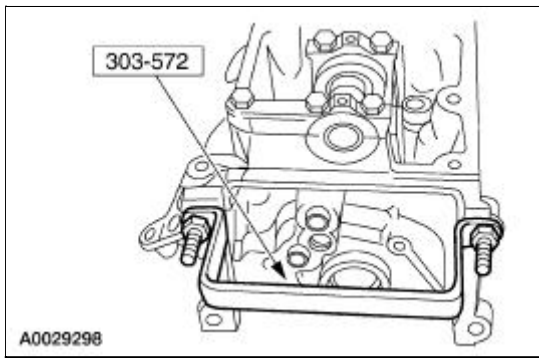
55. **NOTE:** The LH is shown and the RH is similar.

Remove the bolts and the timing chain guides.



56. **NOTE:** One side shown, other side similar.

Install the lifting handles to the RH and LH cylinder heads.

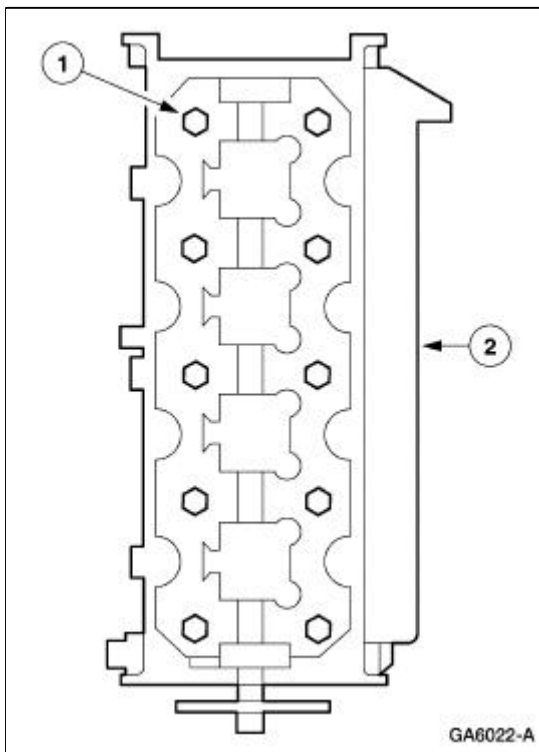


57. **⚠ CAUTION: New cylinder head bolts must be installed. They are tighten-to-yield designed and cannot be reused.**

⚠ CAUTION: Place cylinder head on cardboard or wood surface to prevent damage to the joint face.

Remove the RH and LH cylinder heads.

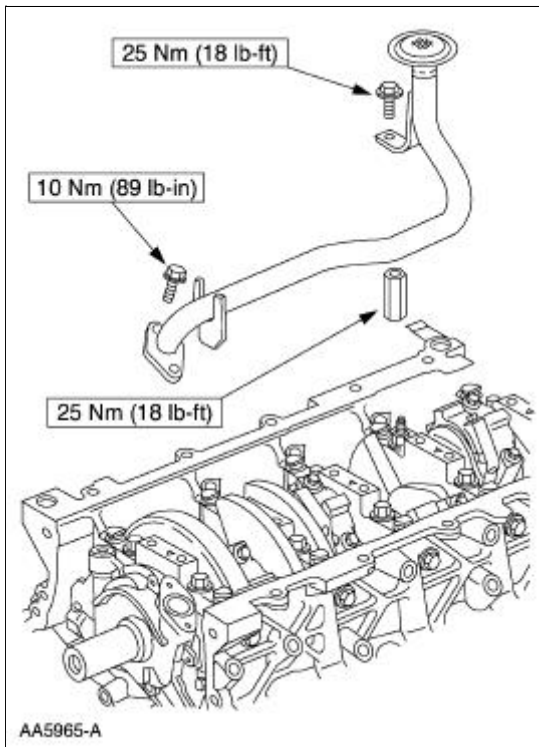
1. Remove the bolts.
2. Remove the cylinder heads.



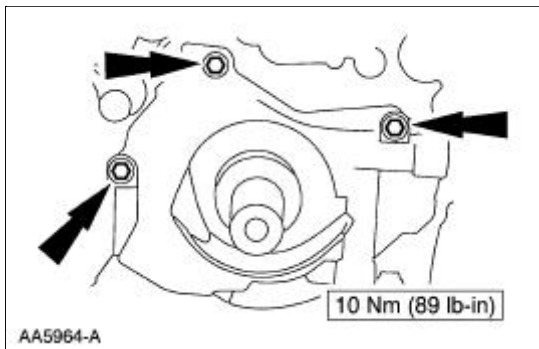
58. **⚠ CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean gasket surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket (6051).**

Clean and inspect all of the sealing surfaces. For additional information, refer to [Section 303-00](#).

59. Remove the oil pump screen cover and tube, and the spacer.



60. Remove the oil pump.

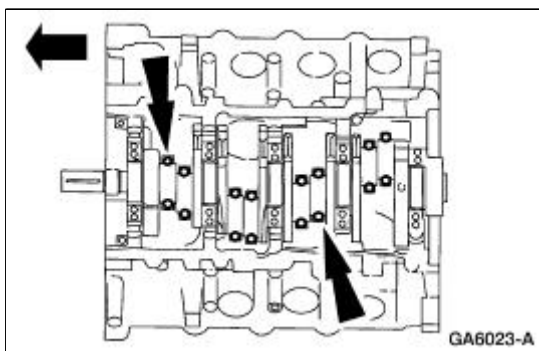


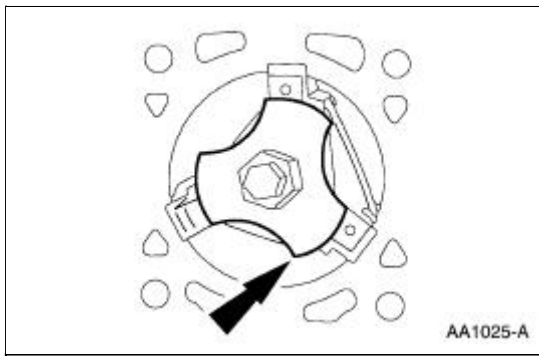
61.  **CAUTION:** Do not stamp the top of pistons, as ring land damage can occur.

NOTE: Connecting rods and rod caps should be numbered to retain correct orientation.

Remove the connecting rod caps for piston numbers 1 and 6.

- Discard the bolts.

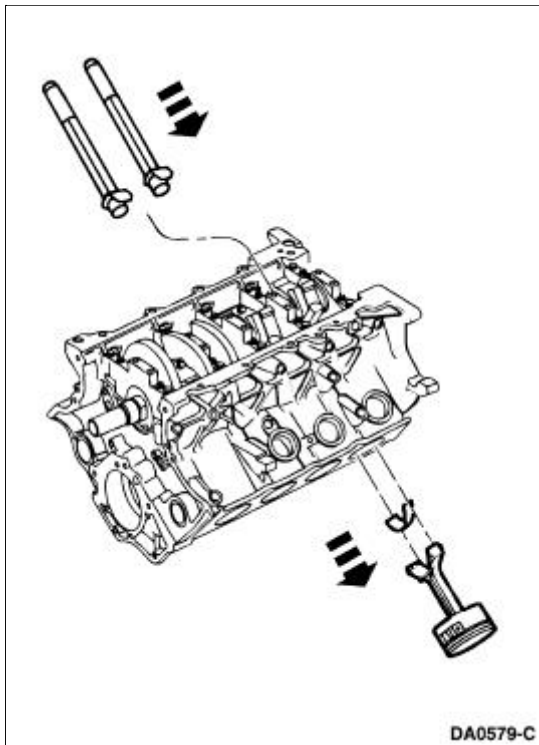




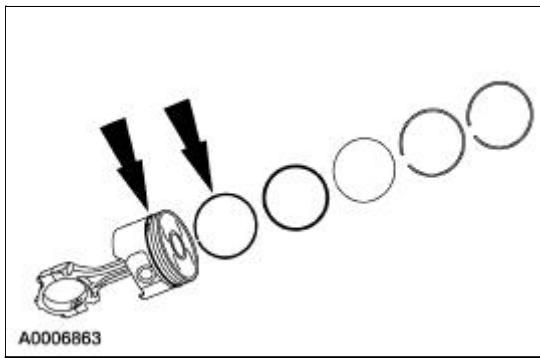
62.  **CAUTION: Do not scratch cylinder walls or crankshaft journals with the connecting rod.**

NOTE: Before removing pistons, inspect the top of the cylinder bores. If necessary, remove the ridge or carbon deposits from each cylinder using a cylinder ridge reamer following the manufacturer's instructions.

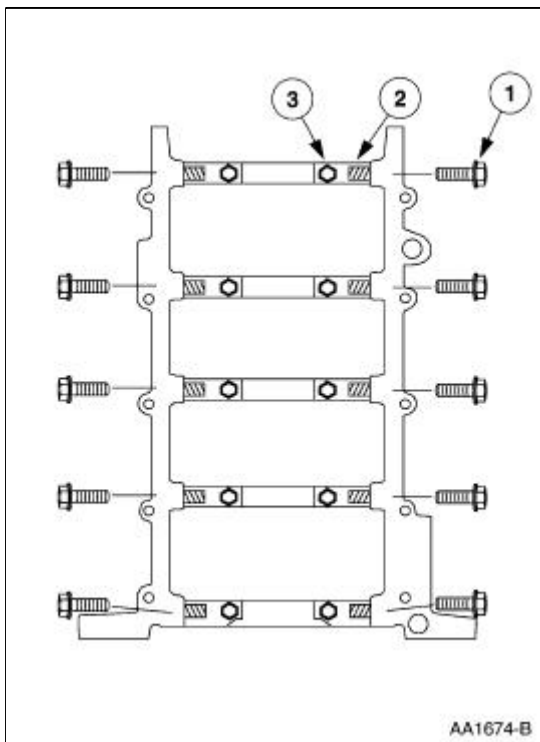
Remove the piston removing pistons number 1 and 6 through the top of the cylinder block.



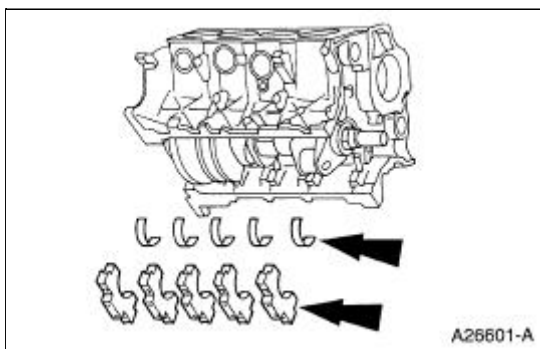
63. Repeat the previous two steps to remove the remaining pistons, rotating the crankshaft 90 degrees between piston pairs 3 and 5, 4 and 7, 2 and 8.
64. Remove the piston rings.



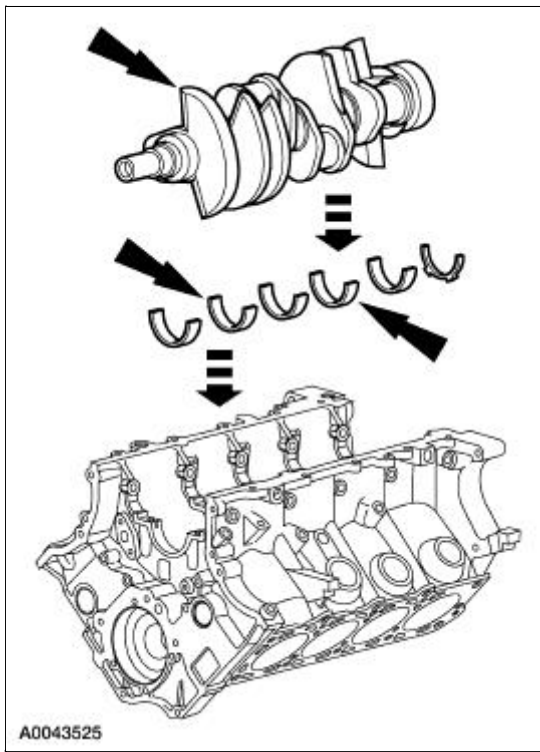
65. Clean and inspect pistons. For additional information, refer to [Section 303-00](#).
66. Remove the crankshaft bearing cap fasteners.
 1. Remove and discard the cross-mounted main cap bolts.
 2. Loosen the jackscrews.
 3. Remove and discard the main cap bolts.



67. Remove the main bearing cap and the crankshaft main bearings from the cylinder block.




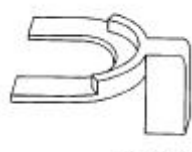
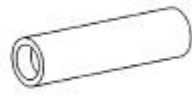
68. Remove the crankshaft, crankshaft main bearings and the thrust washer.



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Cylinder Head

Special Tool(s)

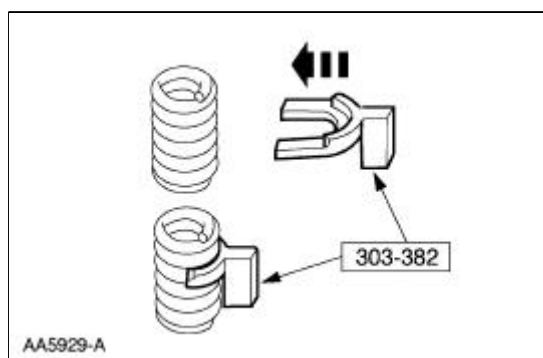
 <p>ST1330-A</p>	<p>Compressor, Valve Spring 303-381(T91P-6565-A)</p>
 <p>ST1331-A</p>	<p>Compressor Spacer, Valve Spring 303-382 (T91P-6565-AH)</p>
 <p>ST1332-A</p>	<p>Installer, Valve Stem Oil Seal 303-383 (T91P-6571-A)</p>

Material

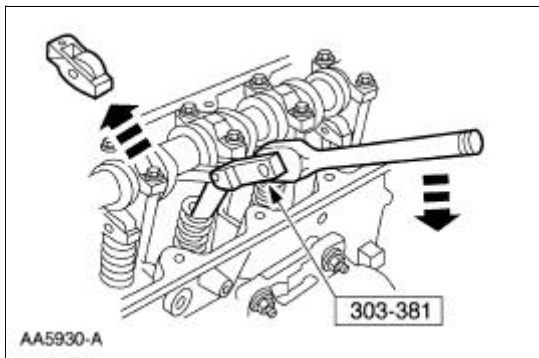
Item	Specification
<p>Super Premium SAE 5W-20 Motor Oil 5W20-QSP or equivalent</p>	<p>WSS-M2C153- H</p>

Disassembly

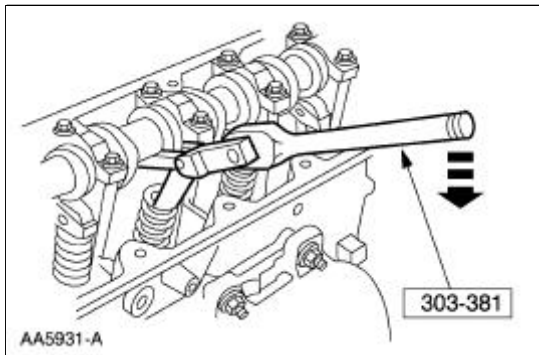
1. Install the special tool.



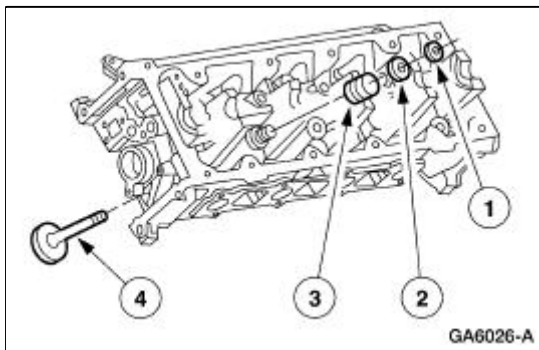
2. Using the special tool, remove the roller followers.



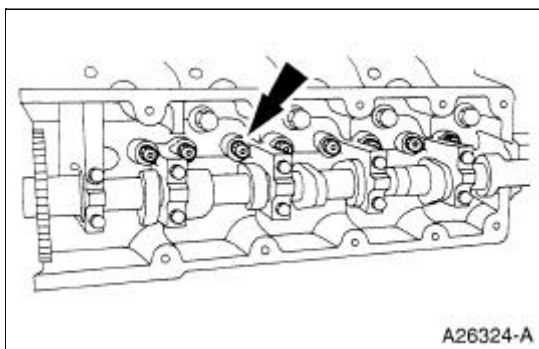
3. Using the special tool, compress the valve spring.



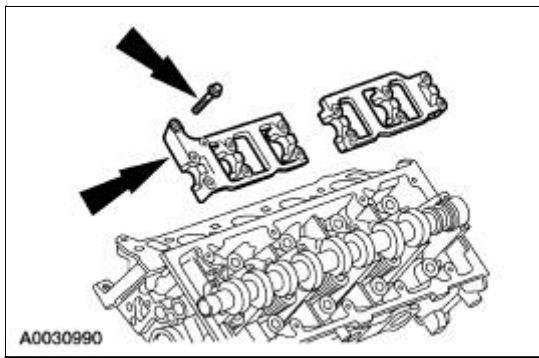
4. Remove the valves.
 1. Remove the valve spring retainer keys.
 2. Remove the valve spring retainers.
 3. Remove the valve spring.
 4. Remove the valves.



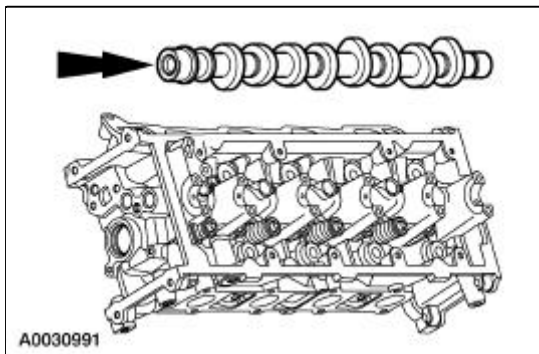
5. Remove the hydraulic lash adjusters.



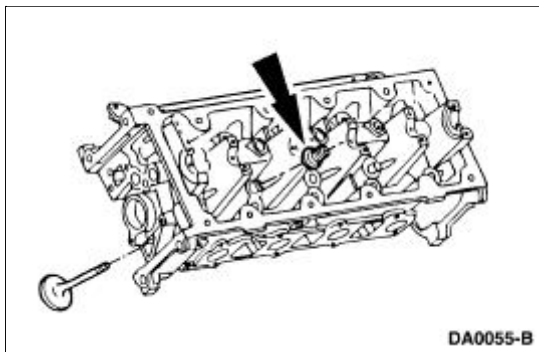
6. Remove the bolts and the camshaft bearing caps.



7. Remove the camshaft (6250).



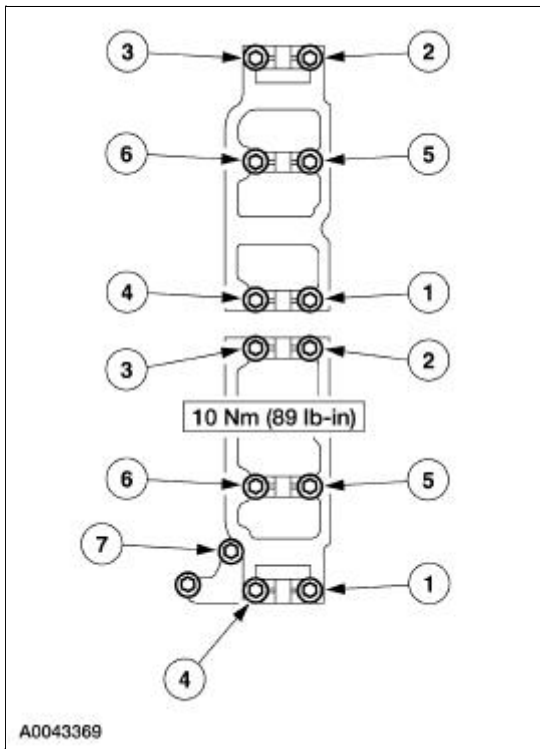
8. Remove the valve stem seals.



Assembly

1. **NOTE:** Lubricate all moving parts with clean engine oil prior to assembly.

To install, reverse the removal procedure.



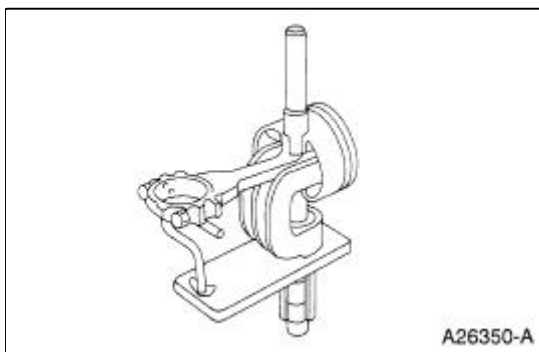
Piston

Material

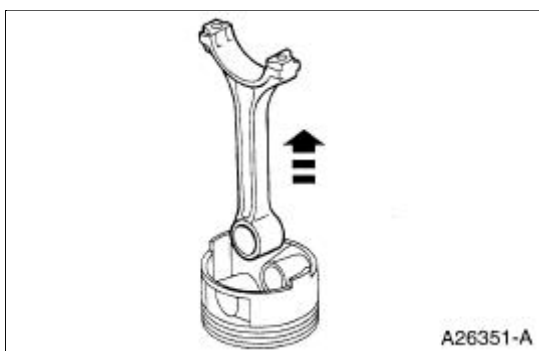
Item	Specification
Super Premium SAE 5W-20 Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Disassembly

1. Press the piston pin out of the connecting rod and piston assembly.



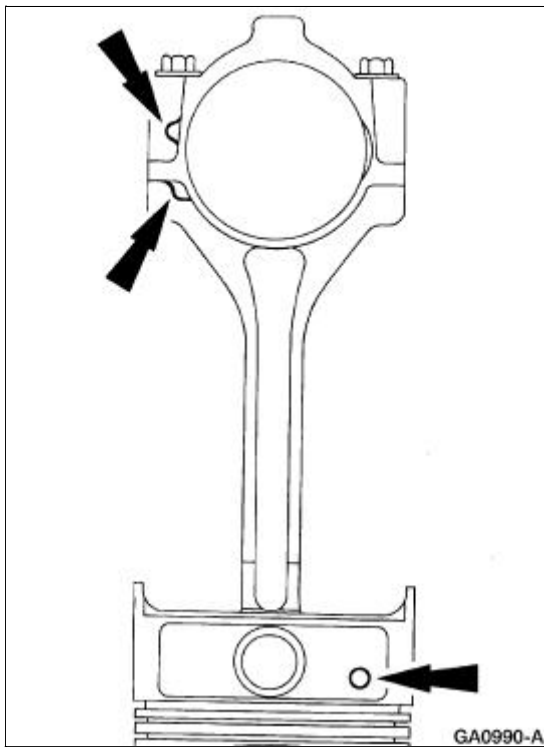
2. Remove the connecting rod from the piston.



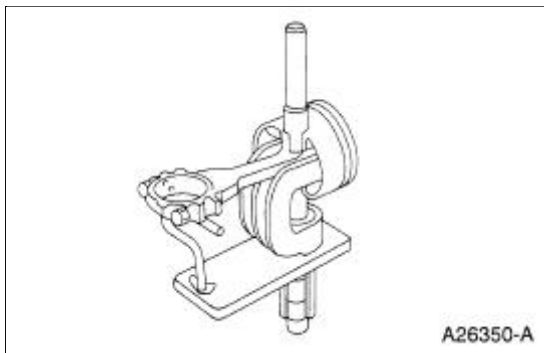
3. Clean and inspect the piston and connecting rod. For additional information, refer to [Section 303-00](#).

Assembly

1. **NOTE:** Connecting rod must be installed into piston with identification markings toward front.
Position the connecting rod in the piston.



2. Press the piston into the piston and connecting rod assembly.



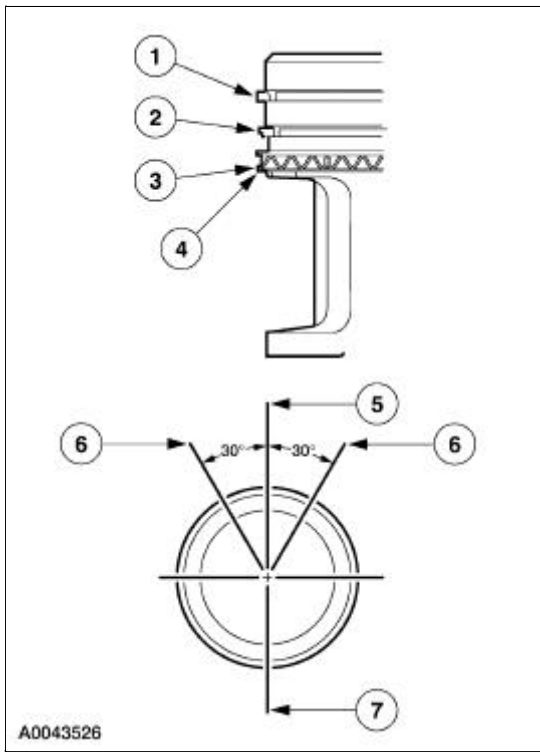
3. Install the piston rings.
 1. Using a suitable ring expander tool install the upper compression ring with the top side identification mark towards the dome.
 2. Using a suitable ring expander tool install the lower compression ring with the top side identification mark towards the dome.
 3. **NOTE:** Assemble with end gaps up.

Using a suitable tool install the piston oil control segment ring spacer.

 4. **NOTE:** Install one segment ring above and one segment ring below the spacer.

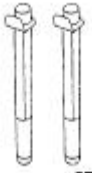

Using a suitable tool install the piston oil control segment rings.


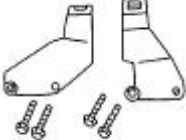

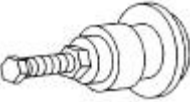
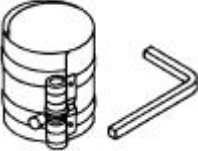

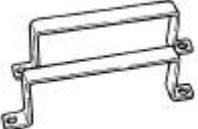

 5. Orient the upper compression ring gap to the center line at the rear of the piston, parallel to the wrist pin bore.
 6. Orient the oil control ring gaps as shown.
 7. Orient the expander ring gap and lower compression ring gap as shown.



Engine

Special Tool(s)

 <p>ST1337-A</p>	<p>Guides, Connecting Rod 303-442 (T93P-6136-A)</p>
 <p>ST1480-A</p>	<p>Installer, Crankshaft Rear Oil Seal 303-518 (T95P-6701-DH)</p>
 <p>ST1479-A</p>	<p>Installer, Crankshaft Rear Oil Seal 303-516 (T95P-6701-BH)</p>
 <p>ST1482-A</p>	<p>Installer, Crankshaft Rear Oil Slinger 303-517 (T95P-6701-CH)</p>
 <p>ST1185-A</p>	<p>Impact Slide Hammer 100-001 (T50T-100-A)</p>
 <p>ST1602-A</p>	<p>Spreader Bar 303-D089 (D93P-6001-A3)</p>
 <p>ST1604-A</p>	<p>Lifting Bracket, Engine 303-D087 (D93P-6001-A1)</p>
	<p>Lifting Bracket, Engine 303-D088 (D93P-6001-A2)</p>

 <p>ST1603-A</p>	
 <p>ST1701-A</p>	<p>Lifting Bracket Set, Engine 303-D074 (D91P-6001-A)</p>
 <p>ST1287-A</p>	<p>Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)</p>
 <p>ST1328-A</p>	<p>Installer, Front Cover Oil Seal 303-335 (T88T-6701-A)</p>
	<p>Compressor, Piston Ring 303-D032 (D81L-6002-C) or equivalent</p>
 <p>ST1335-A</p>	<p>Holding Tool, Crankshaft 303-448 (T93P-6303-A)</p>
 <p>ST1668-A</p>	<p>Remover/Installer, Cylinder Head 303-572 (T97T-6000-A)</p>
 <p>ST1330-A</p>	<p>Compressor, Valve Spring 303-576 (T97P-6565-AH)</p>
	<p>Strap Wrench 303-D055 (D85L-6000-A) or equivalent</p>

 <p>ST1438-A</p>	
 <p>ST2197-A</p>	<p>Crankshaft Seal Installer 303-635</p>

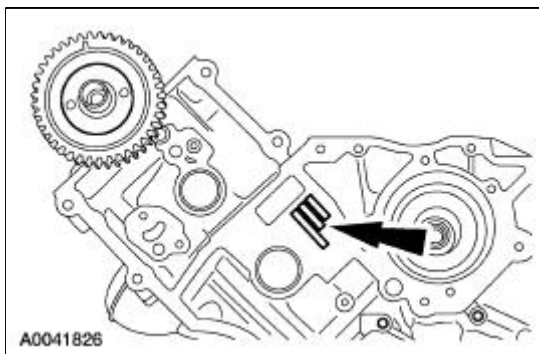
Material

Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
Super Premium SAE 5W-20 Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

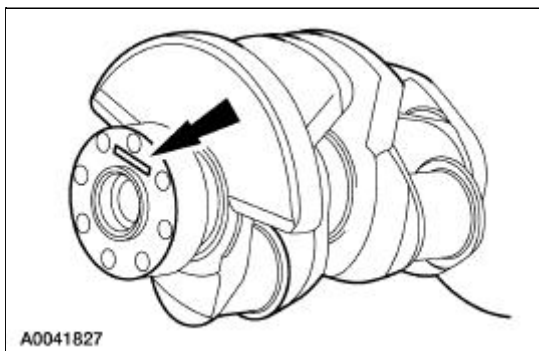
Assembly

NOTE: During engine assembly, it may be necessary to check bearing clearances and end play. For additional information, refer to [Section 303-00](#).

1. Record the main bearing code found on the front of the engine block.



2. Record the main bearing code found on the back of the crankshaft.



3. Using the data recorded earlier and the Bearing Select Fit Chart, Standard Bearings Chart

determine the required bearing grade for each main bearing.

- Read the first letter of the engine block main bearing code and the first letter of the crankshaft main bearing code.
- Read down the column below the engine block main bearing code letter, and across the row next to the crankshaft main bearing code letter, until the two intersect. This is the required bearing grade for the number one crankshaft main bearing.
- As an example, if the engine block code letter is "F" and the crankshaft code letter is "D," the correct bearing grade for this main bearing is "2."
- Repeat this process for the remaining four main bearings.

		MINIMUM BLOCK DIA																															
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X								
		72.400	.401	.402	.403	.404	.405	.406	.407	.408	.409	.410	.411	.412	.413	.414	.415	.416	.417	.418	.419	.420	.421	.422	.423	.424							
MAXIMUM CRANKSHAFT DIA	X	67.504	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	
	W	67.503	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	V	67.502	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	U	67.501	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	T	67.500	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	S	67.499	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	R	67.498	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	Q	67.497	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	P	67.496	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	O	67.495	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	N	67.494	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	M	67.493	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	L	67.492	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	K	67.491	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	J	67.490	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	I	67.489	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	H	67.488	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	G	67.487	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	F	67.486	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	E	67.485	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	D	67.484	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	C	67.483	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	B	67.482	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	A	67.481	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

4. If oversize bearings are being used, use the procedure in the previous step and the Bearing Select Fit Chart, Oversize Bearing Chart to determine the required grade for each main bearing.

		MINIMUM BLOCK DIA																							
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
72.400		.401	.402	.403	.404	.405	.406	.407	.408	.409	.410	.411	.412	.413	.414	.415	.416	.417	.418	.419	.420	.421	.422	.423	.424
MAXIMUM CRANKSHAFT DIA	X 67.254	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	W 67.253	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	V 67.252	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	U 67.251	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	T 67.250	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	S 67.249	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	R 67.248	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	Q 67.247	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	P 67.246	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	O 67.245	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	N 67.244	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	M 67.243	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	L 67.242	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	K 67.241	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	J 67.240	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	I 67.239	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	H 67.238	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	G 67.237	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
	F 67.236	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
	E 67.235	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
D 67.234	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		
C 67.233	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		
B 67.232	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		
A 67.231	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		

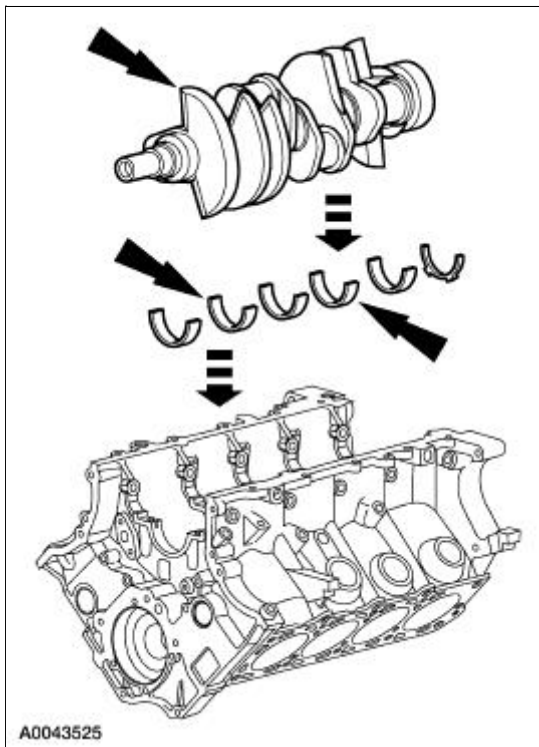
A0041840

NOTE: Before assembling the cylinder block, all sealing surfaces must be free from chips, dirt, paint and foreign material. Also, make sure the coolant and oil passages are clear.

5. Install the crankshaft upper main bearings into the cylinder block and lubricate them with clean engine oil.
6. **NOTE:** Do not install the upper thrust washer until the crankshaft is installed. Refer to Step 3.

NOTE: Do not install the upper thrust washer until the crankshaft (6303) is installed. Refer to Step 3.

Install the crankshaft onto the upper main bearings.



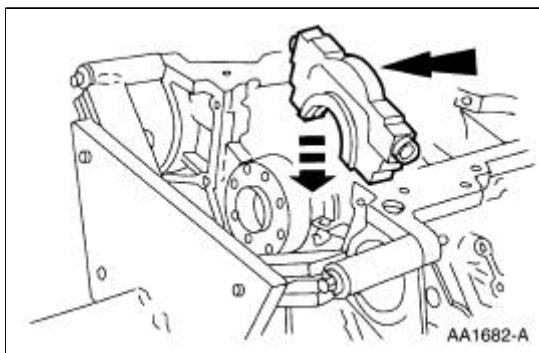
7. **NOTE:** The oil groove on the thrust washer must face toward the rear of the engine (against the crankshaft surface).

Push the crankshaft rearward and install the crankshaft upper thrust washer at the rear of the No. 5 main boss.

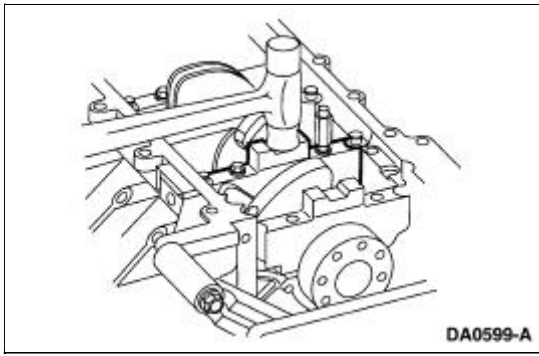
8. **NOTE:** Rotate the jackscrews into the bearing caps enough to provide clearance to the cylinder block prior to installing the bearing caps.

Install the lower main bearings into the main bearing caps and lubricate them with clean engine oil.

9. Install the rear main bearing cap.

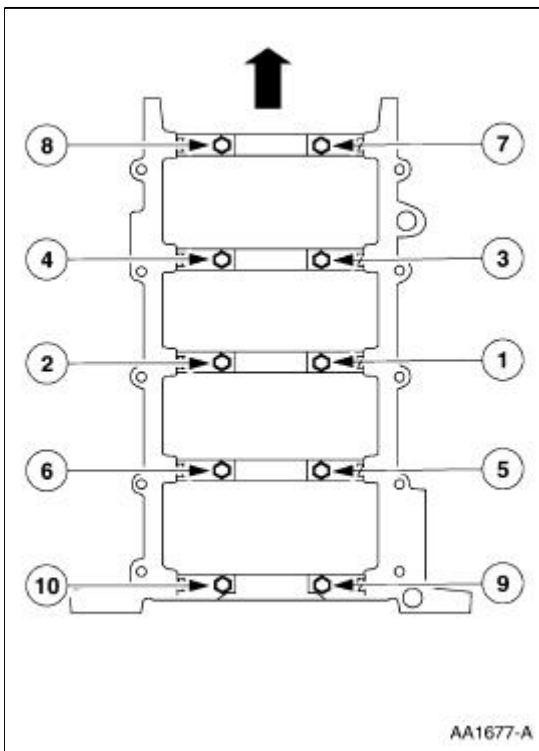


10. Install the remaining main bearing caps on the cylinder block and tap into place using a plastic or dead-blow hammer.



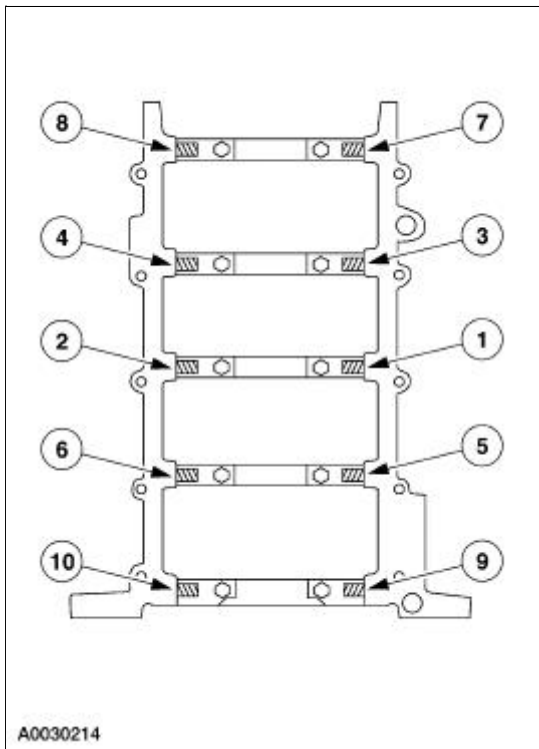
11. Install the vertical main bearing cap fasteners and tighten in the sequence shown.

- Tighten to 40 Nm (30 lb-ft).
- Tighten an additional 85-95 degrees.

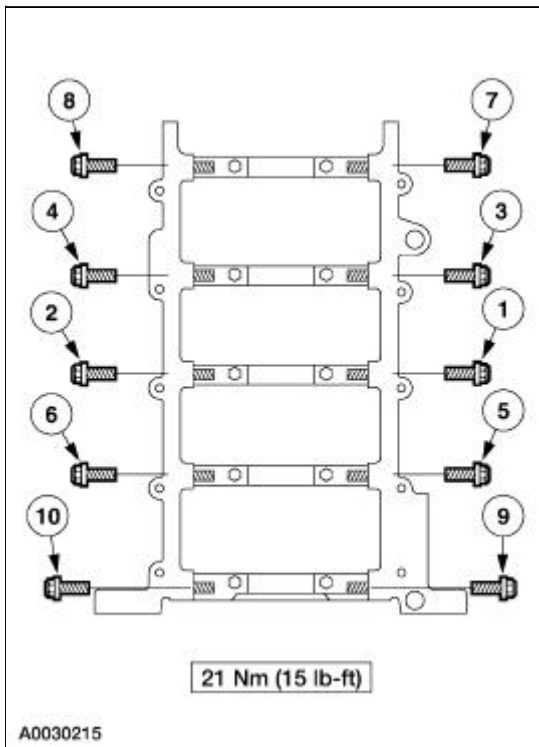


12. Back out the jackscrews against the cylinder block in sequence shown.

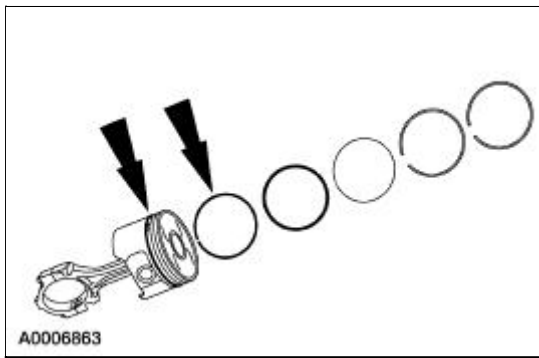
- Tighten to 5 Nm (44 lb-in).
- Tighten to 10 Nm (89 lb-in).



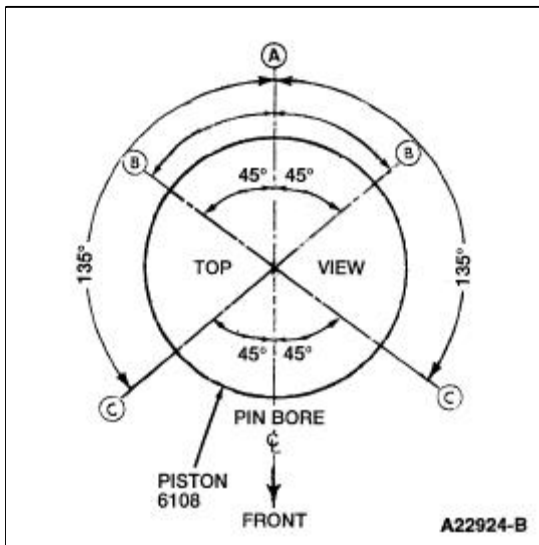
13. Install the side bolts and tighten them in the sequence shown.



14. Check the crankshaft end play. For additional information, refer to [Section 303-00](#).
15. Check the piston to cylinder block and piston ring clearances. For additional information, refer to [Section 303-00](#).
16. Install the piston rings.



17. Make sure the ring gaps (oil spacer [A], oil ring [B], and compression ring [C]) are properly spaced around the circumference of the piston.



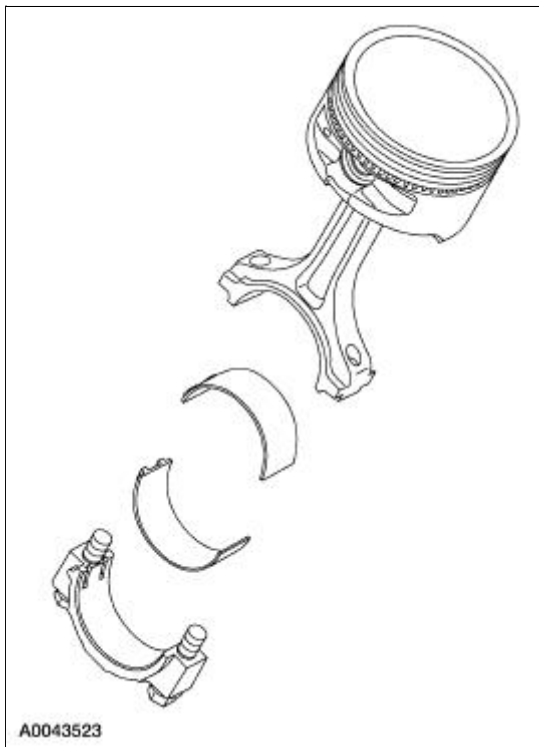
18.  **CAUTION: Do not scratch the cylinder walls or the crankshaft journals with the connecting rod.**

NOTE: Only one piston and connecting rod shown, others similar.

NOTE: Make sure the crankshaft is facing forward.

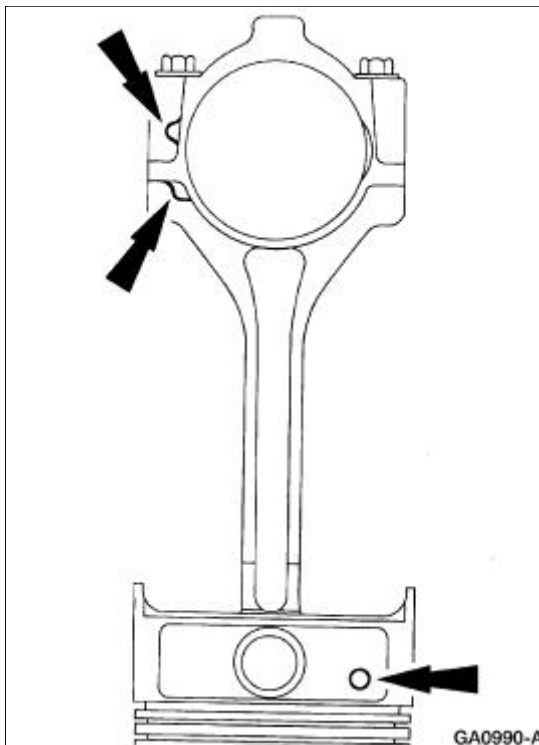
NOTE: Lubricate the piston rings, cylinder walls and connecting rod bearings with clean engine oil.

Install the upper bearings in the connecting rod as shown.



19. **NOTE:** The piston grade number will face the rear of the engine.

Check that the piston/connecting rod assembly is oriented with the identification marks facing the front of the engine.

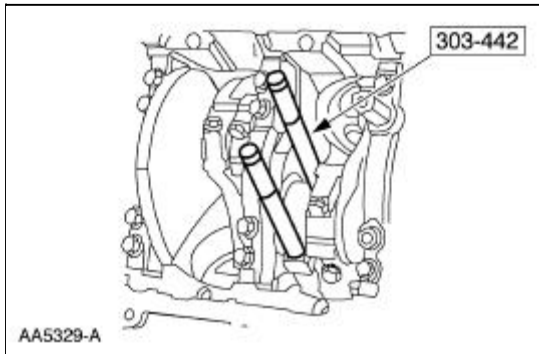


20.  **CAUTION:** Do not scratch the cylinder walls or the crankshaft journals with the connecting rod.

NOTE: Make sure the crankshaft is at TDC.

NOTE: Only one connecting rod assembly shown, others similar.

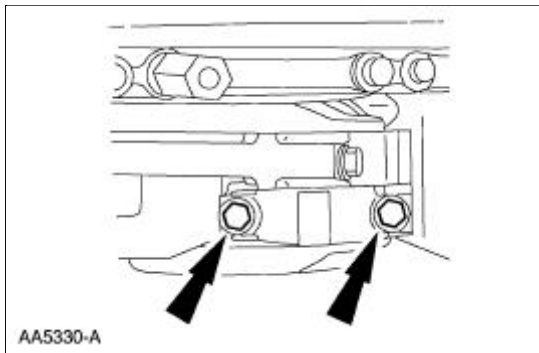
Using the special tool install the piston and connecting rod assembly by pushing the pistons through the top of the cylinder block.



21. **NOTE:** These bolts are torque-to-yield. Install new bolts each time they are serviced.

Install the connecting rod bearing caps and bolts and tighten in three stages.

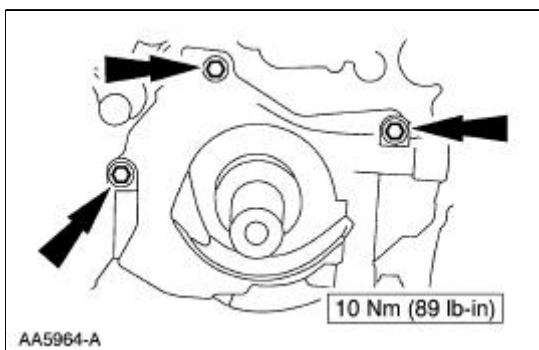
- Stage 1: Tighten to 25Nm (18 lb-ft).
- Stage 2: Tighten to 40Nm (30 lb-ft).
- Stage 3: Tighten an additional 90 degrees.



22. Rotate the crankshaft and install the remaining piston and connecting rod assemblies.

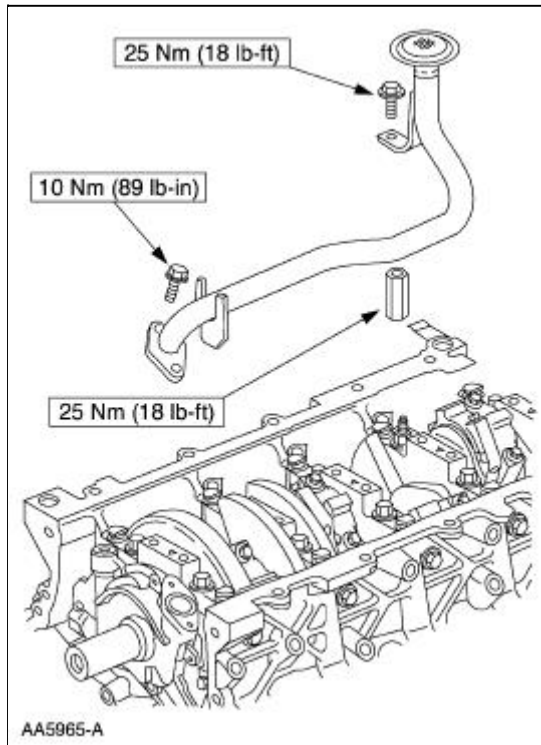
23. Check the connecting rod bearing clearance. For additional information, refer to [Section 303-00](#).

24. Install the oil pump and tighten the bolts.



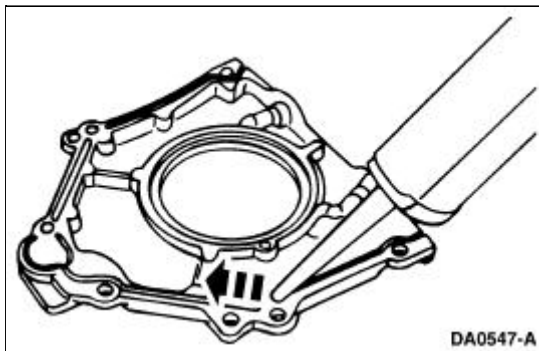
25. **NOTE:** Install a new O-ring if necessary.

Install the oil pump screen cover and tube.

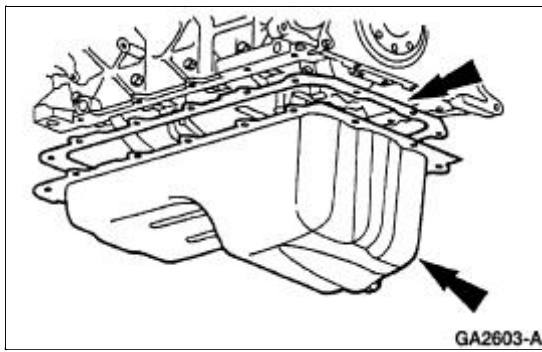


26. **NOTE:** If not secured within four minutes, sealant must be removed and sealing area cleaned with metal surface cleaner. Allow to dry until there are no signs of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

If the retainer plate was removed, apply a 4 mm (0.16 in) bead of silicone gasket and sealant around the rear oil seal retainer sealing surface.

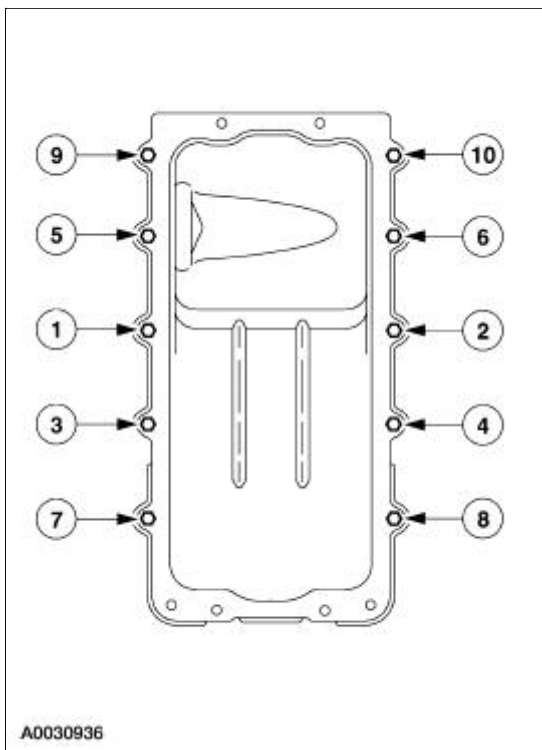


27. Install the rear main seal retainer plate. Tighten the bolts in the sequence shown.
- Tighten bolts 1-6 to 10 Nm (89 lb-in).
 - Hand-tighten bolts 7 and 8.
 - Tighten bolts 7 and 8 to 20 Nm (15 lb-ft).
 - Tighten bolts 7 and 8 an additional 60 degrees.
28. Install the oil pan and gasket and loosely install the bolts.

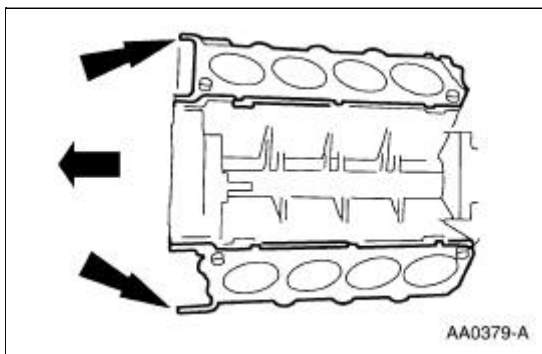



29. Tighten the bolts in the sequence shown.

- Tighten to 20 Nm (15 lb-ft).
- Rotate an additional 60 degrees.



30. Install the cylinder head gaskets.



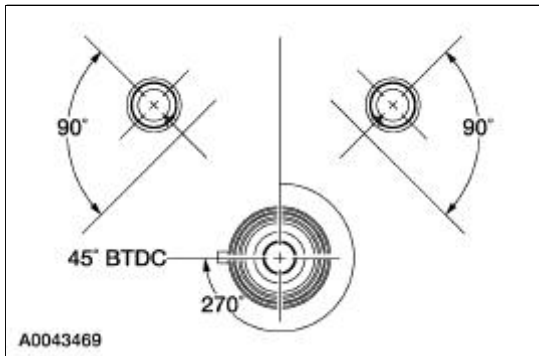
31.  **CAUTION:** Cylinder head to cylinder block pre-assembly must be followed exactly or damage to valves and pistons can result.

⚠ CAUTION: Camshaft keyways must maintain a 90 degree clocked position relative to the valve cover rail.

⚠ CAUTION: To prevent piston crown and valve damage the crankshaft keyway must be clocked at 270° (45° BTDC) before the installation of the cylinder head assembly.

NOTE: Crankshaft must be rotated clockwise only.

Align the keyways as shown.

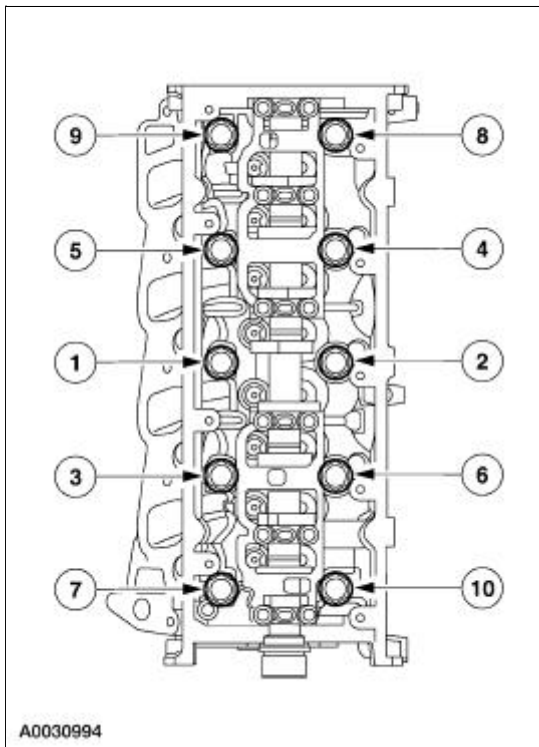



32. **NOTE:** Position the RH and the LH cylinder heads over the dowels on the cylinder head gaskets.

NOTE: The LH is shown the RH is similar.

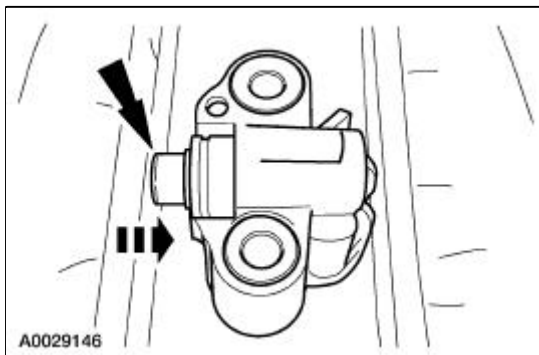
Tighten the bolts in six stages in the sequence shown.

- Stage 1: Tighten to 40 Nm (30 lb-ft).
- Stage 2: Tighten an additional 90 degrees.
- Stage 3: Loosen the bolts a minimum of one full turn.
- Stage 4: Tighten to 40 Nm (30 lb-ft).
- Stage 5: Tighten an additional 90 degrees.
- Stage 6: Tighten an additional 90 degrees.

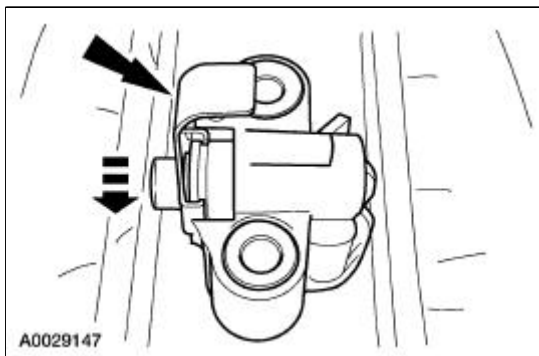


33.  **CAUTION:** Timing chain procedures must be followed exactly or damage to valves and pistons will result.

Using a vise, compress the tensioner plunger.



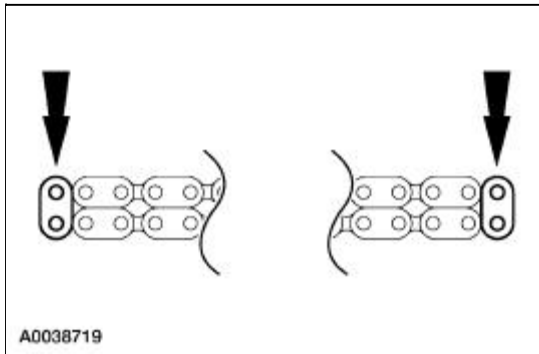
34. Install a retaining clip on the tensioner to hold the plunger in during installation.



35. Remove the tensioner from the vise.

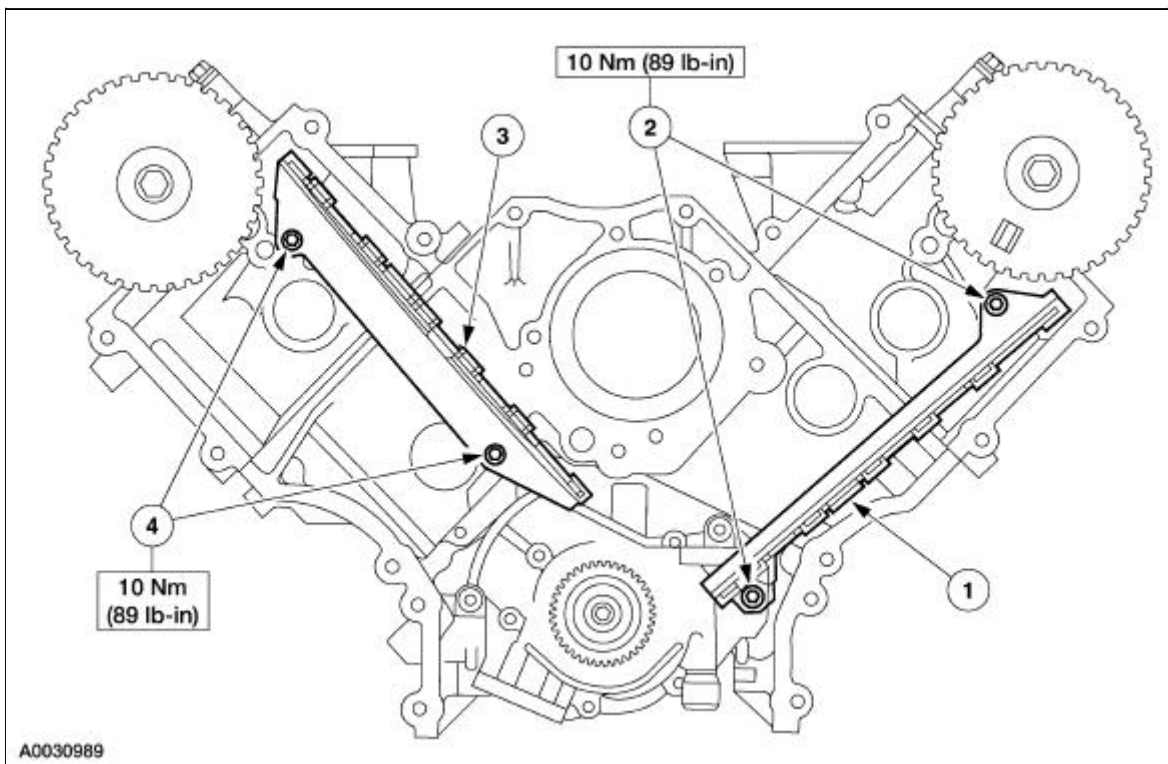
36. **NOTE:** There are 58 links in each timing chain.

If the copper links are not visible, mark one link on one end and one link on the other end to use as timing marks.

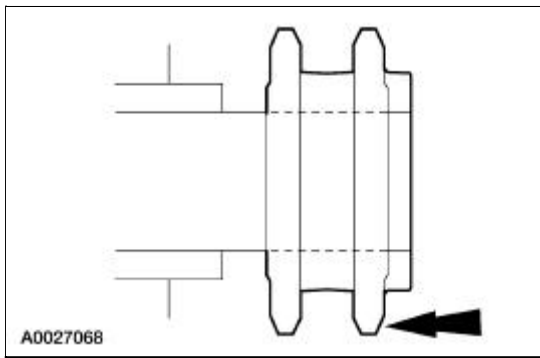


37. Install the timing chain guides.

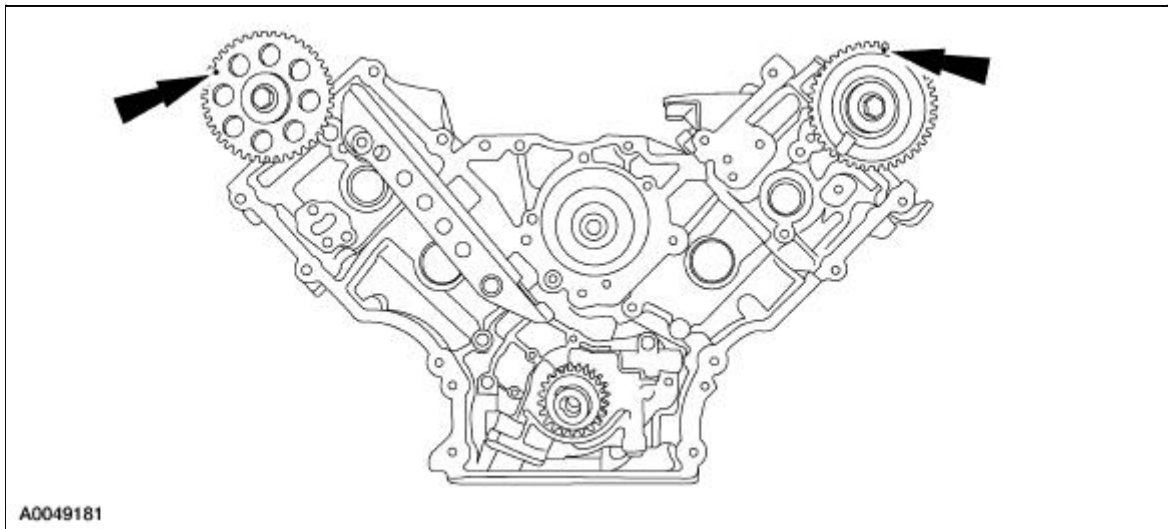
1. Position the LH timing chain guide.
2. Install and tighten the LH bolts.
3. Position the RH timing chain guide.
4. Install and tighten the RH bolts.



38. Install the crankshaft sprocket, making sure the flange faces forward.



39. Rotate the RH camshaft sprocket until the timing mark is approximately at the 11 o'clock position. Rotate the LH camshaft sprocket until the timing mark is approximately at the 12 o'clock position.

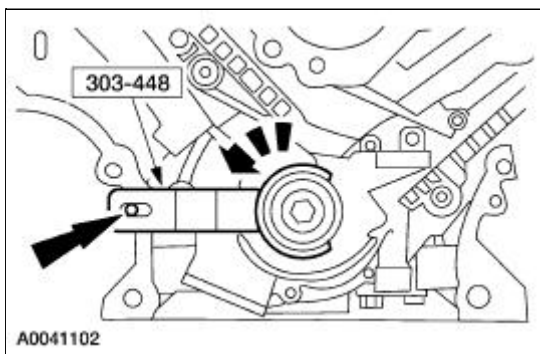


40. **⚠ CAUTION:** Unless otherwise instructed, do not rotate either the crankshaft or the camshafts, when the timing chains are removed and the cylinder heads are installed. Severe piston and valve damage will occur.

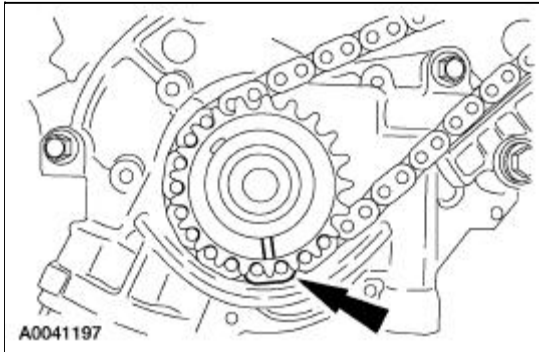
⚠ CAUTION: When instructed to do so, rotate the crankshaft counterclockwise only. Do not rotate past the position shown or severe piston and valve damage can occur.

NOTE: The number one cylinder is at top dead center (TDC) when the stud on the engine block fits into the slot in the handle of the special tool.

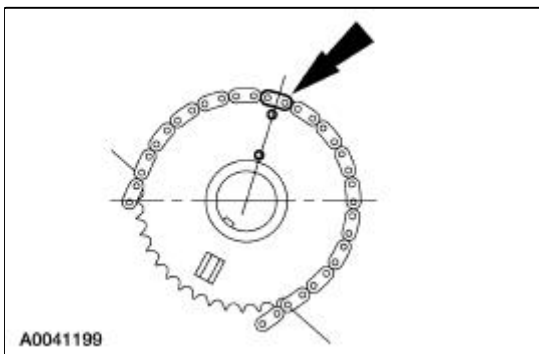
Using the special tool, position the crankshaft so the number one cylinder is at TDC.



41. Remove the special tool.
42. Position the LH (inner) timing chain on the crankshaft sprocket, aligning the copper (marked) link with the timing mark on the sprocket.

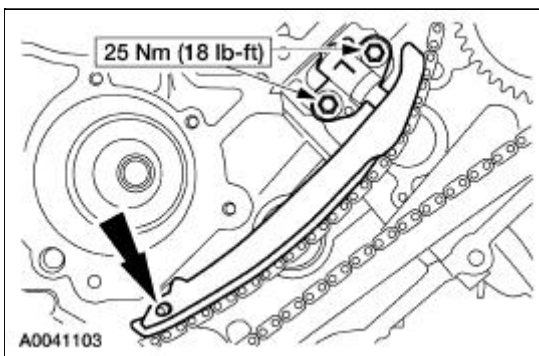


43. Install the LH timing chain on the camshaft sprocket, aligning the copper (marked) link with the timing marks on the sprocket.

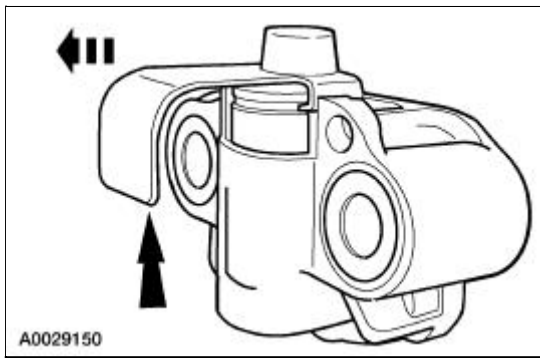


44. **NOTE:** The LH timing chain tensioner arm has a bump near the dowel hole for identification.

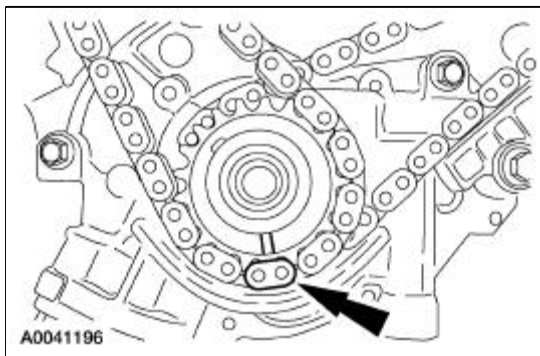
Position the LH timing chain tensioner arm on the dowel pin and install the LH timing chain tensioner.



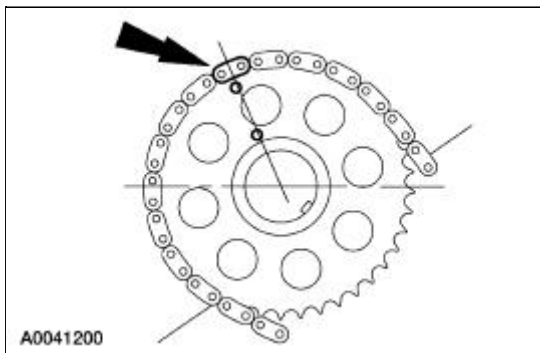
45. Remove the retaining clip from the LH timing chain tensioner.



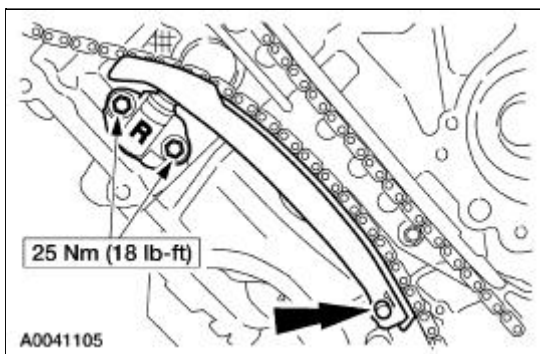
46. Position the RH (outer) timing chain on the crankshaft sprocket, aligning the copper (marked) link with the timing mark on the sprocket.



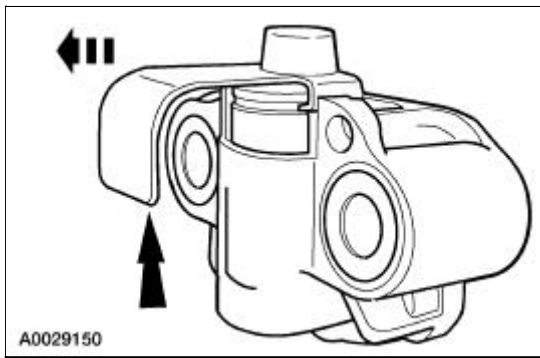
47. Install the RH timing chain on the camshaft sprocket, aligning the copper (marked) link with the timing marks on the sprocket.



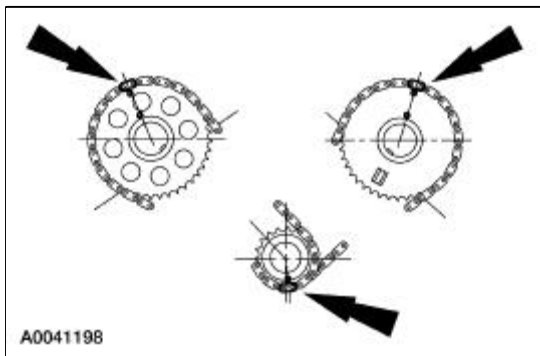
48. Position the RH timing chain tensioner arm on the dowel pin and install the RH timing chain tensioner.



49. Remove the retaining clip from the RH timing chain tensioner.

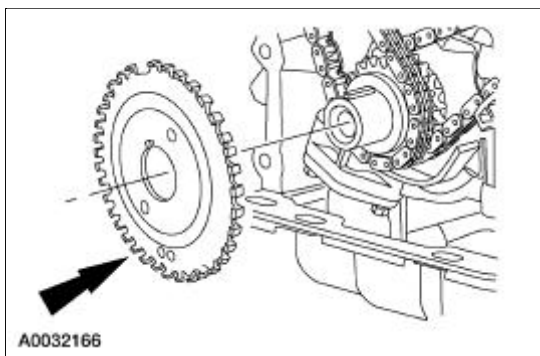


50. Make sure that the copper (marked) chain links are lined up with the dots on the crankshaft sprockets and the camshaft sprocket.



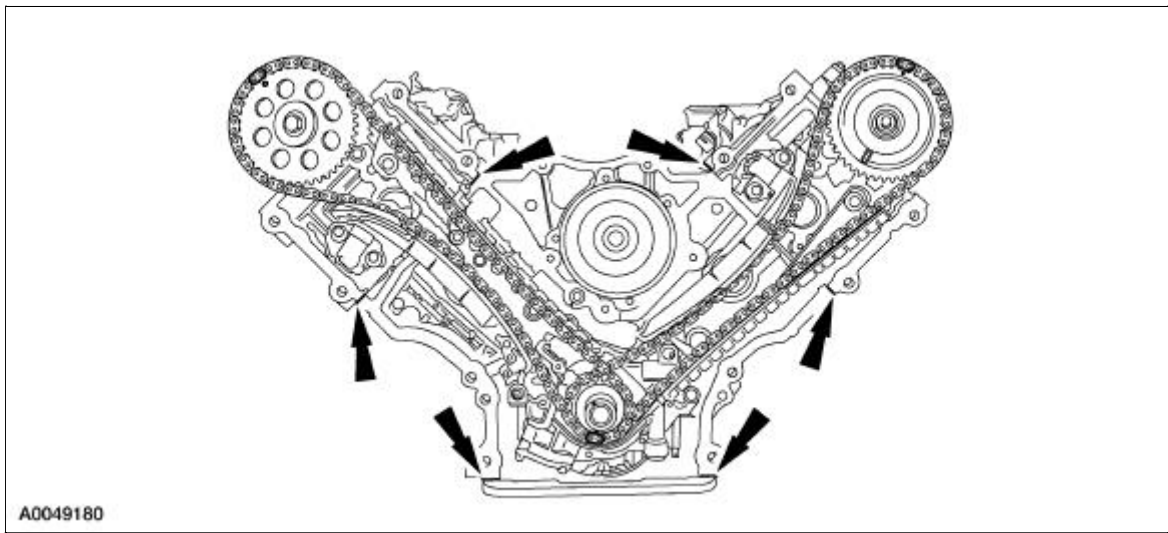
51. **NOTE:** Sensor ring teeth must face forward.

Position the crankshaft sensor ring on the crankshaft.

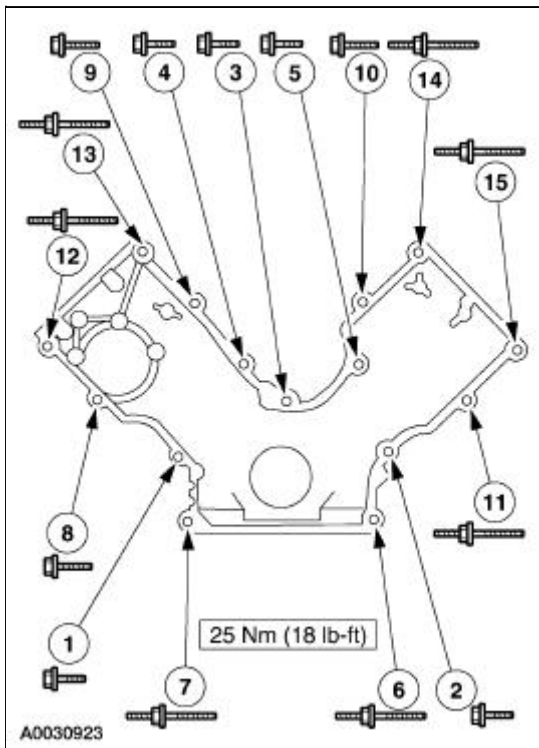


52. **NOTE:** The front cover must be installed within four minutes of applying sealant.

Apply silicone gasket and sealant in the locations shown.



53. Install a new engine front cover gasket on the engine front cover.
54. Install the engine front cover.

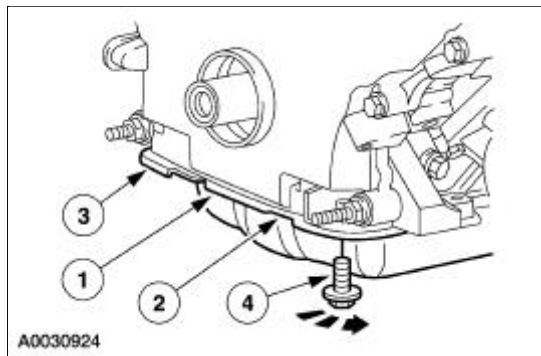


Item	Part Number	Description
1	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
2	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
3	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
4	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
5	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
6	W706508	Stud, Hex Shldr Pilot, M8 x 1.25 x 50 — M6 x 1 x 10
7	N808586	Stud and Washer, Hex Head Pilot, M8 x 1.25 x 60 — M6 x 1 x 26

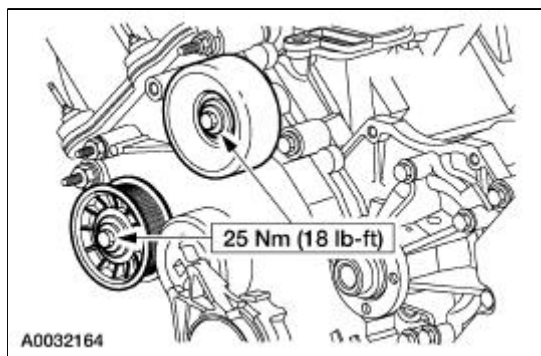
8	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
9	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
10	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
11	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
12	W706560	Stud and Washer, Hex-Head Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 16
13	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
14	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
15	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26

55. Tighten the four oil pan bolts in the sequence shown in three stages.

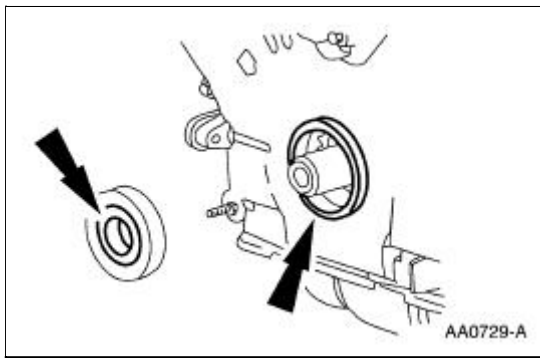
- Stage 1: Tighten to 2 Nm (18 lb-in).
- Stage 2: Tighten to 20 Nm (15 lb-ft).
- Stage 3: Tighten an additional 60 degrees.



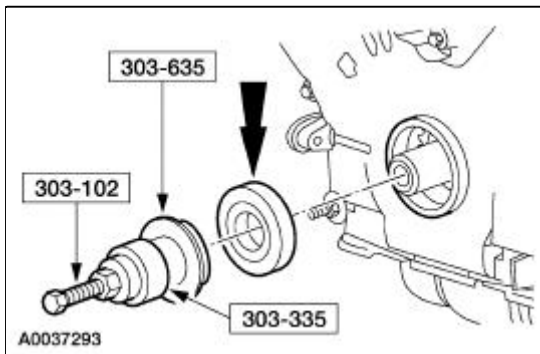
56. Install the belt idler pulleys.



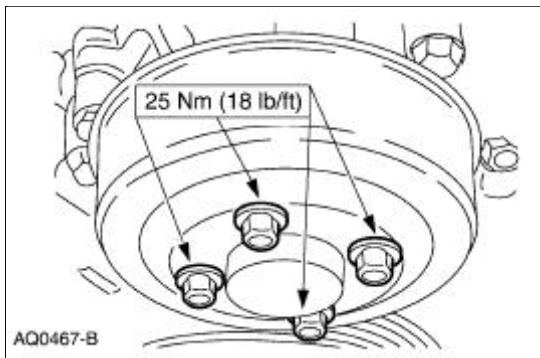
57. Lubricate the engine front cover and the front oil seal inner lip with clean engine oil.



58. Using the special tool, install the front oil seal.

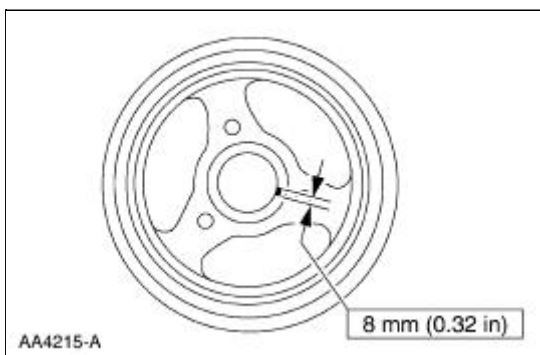


59. Install the water pump pulley and bolts.

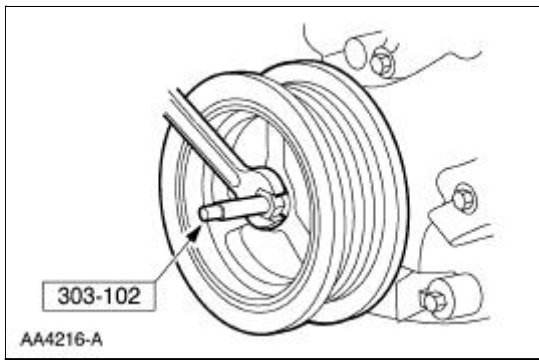


60. **NOTE:** The crankshaft pulley must be installed within four minutes of applying sealant.

Apply silicone gasket and sealant to the Woodruff key slot on the crankshaft pulley.



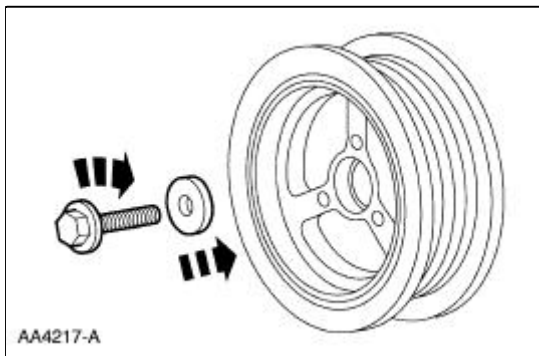
61. Using the special tool, install the crankshaft pulley.



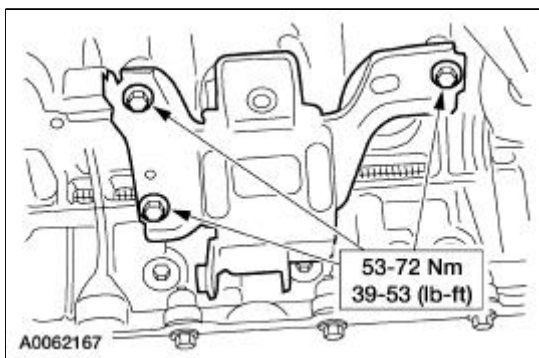
62. **NOTE:** Use special tool 303-009 or a suitable strap wrench to hold the crankshaft pulley.

Install the washer and the bolt. Tighten the bolt in four stages.

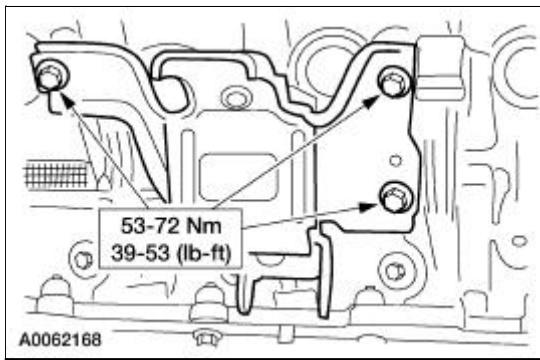
- Stage 1: Tighten to 90 Nm (66 lb-ft).
- Stage 2: Loosen one full turn.
- Stage 3: Tighten to 50 Nm (37 lb-ft).
- Stage 4: Tighten an additional 90 degrees.



63. Install the LH engine mount.



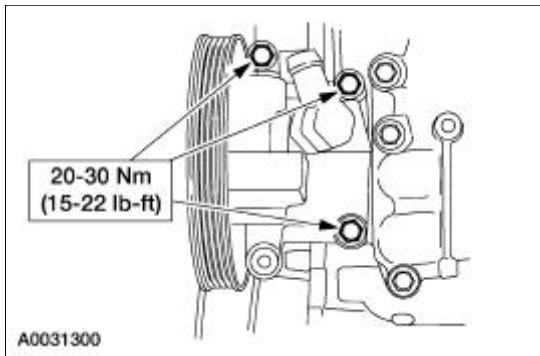
64. Install the RH engine mount.



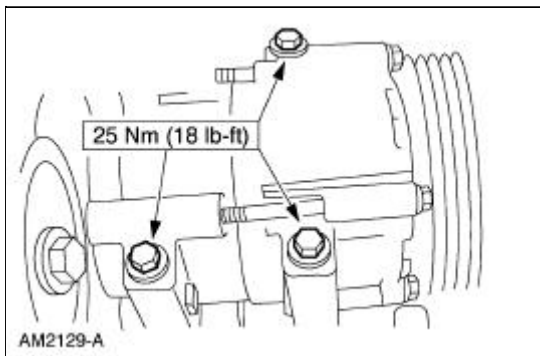
65. **NOTE:** Only three bolts are required for installation.

Install the power steering pump.

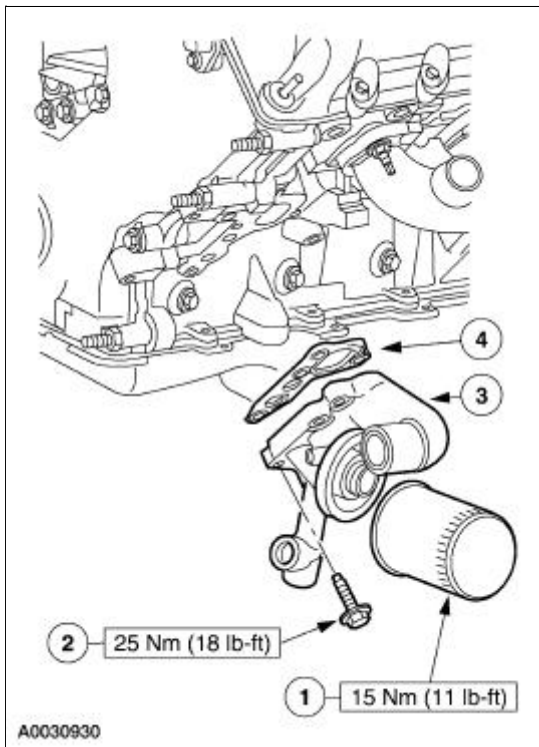
- Position the power steering pump.
- Install the bolts.



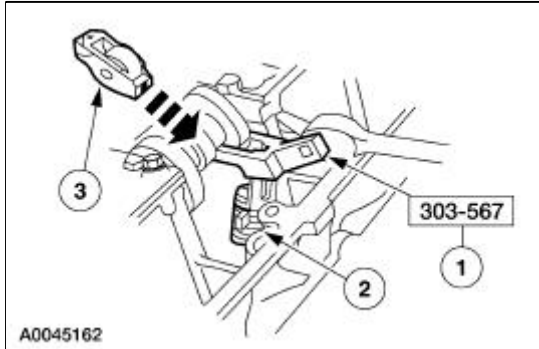
66. Lubricate the O-ring seal with PAG compressor oil, YN-12C, F7AZ-19589-DA or equivalent meeting Ford specification WSH-M1C231-B. Install the A/C compressor.



67. Install the oil filter adapter.

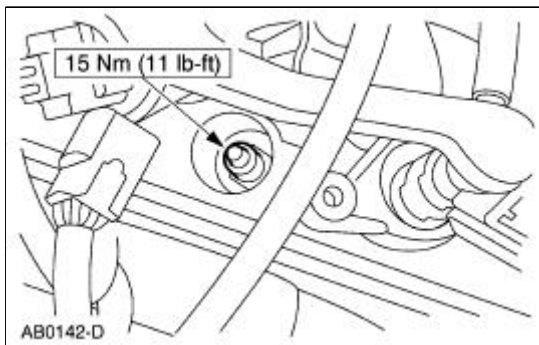


68. Install the camshaft roller followers.
1. Install the special tool.
 2. Compress the valve spring.
 3. Install the camshaft follower.



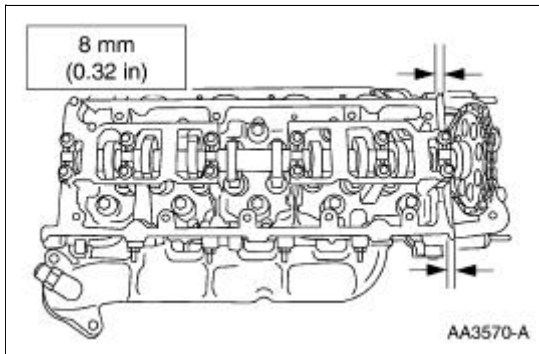
69. **NOTE:** One spark plug shown, others similar.

Install spark plugs.



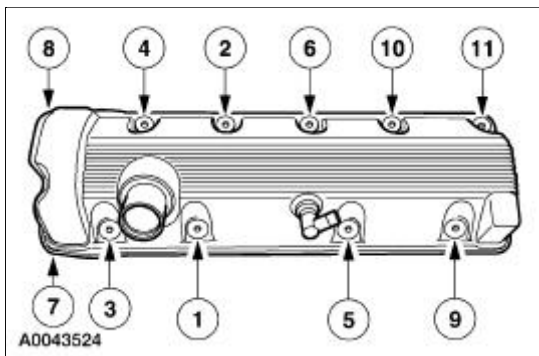
70. **NOTE:** The RH side is shown, the LH side is similar.

Apply an eight millimeter bead of silicone gasket and sealant at the intersection of the engine front cover and the cylinder head.



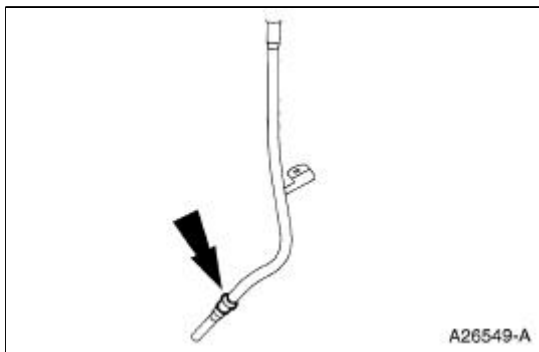
71. **NOTE:** RH valve cover shown, LH similar.

Install the valve covers.

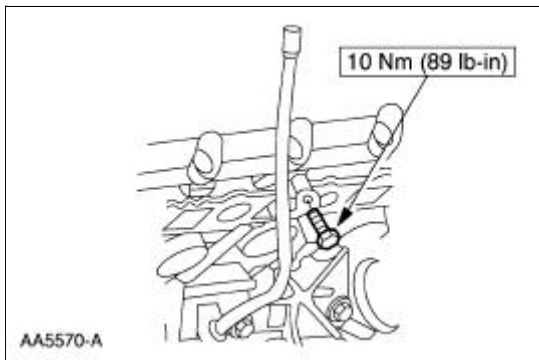


72. **NOTE:** Lubricate the O-ring seal with clean engine oil.

Install a new O-ring.

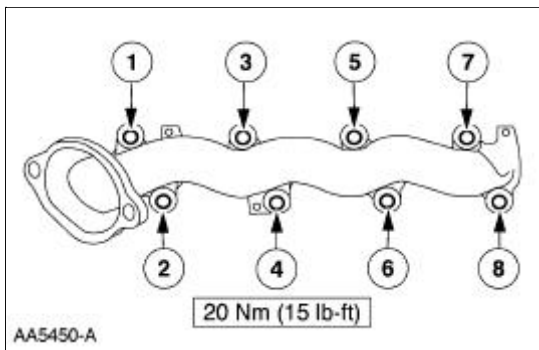


73. Install the tube.

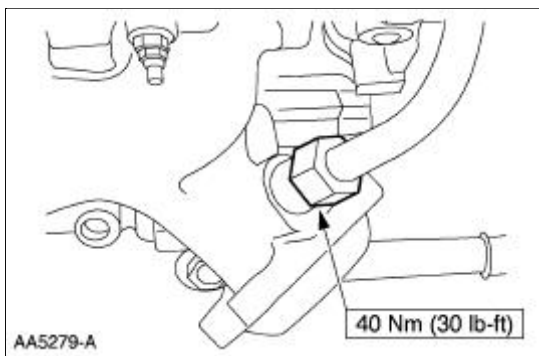


74. **NOTE:** RH exhaust manifold shown, LH similar. Tighten the bolts in the sequence shown.

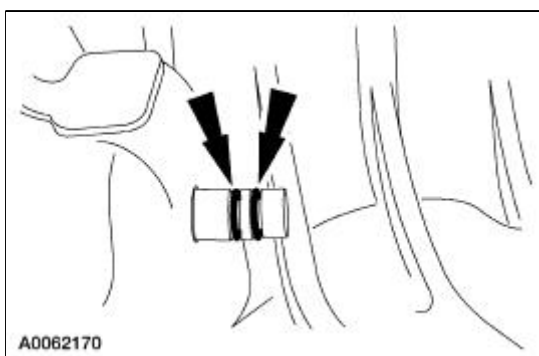
Install the LH exhaust manifold.



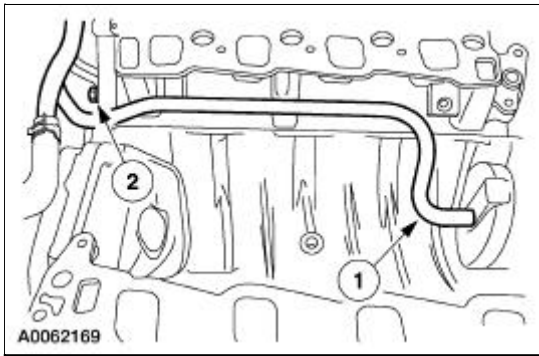
75. Connect the lower end of the EGR tube to the LH exhaust manifold.



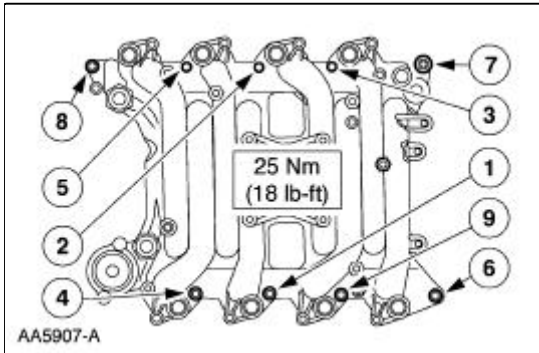
76. Inspect the O-ring seals and install new O-ring seals as necessary.



77. Install the water bypass tube.
 1. Install the bypass tube.
 2. Install the nut.



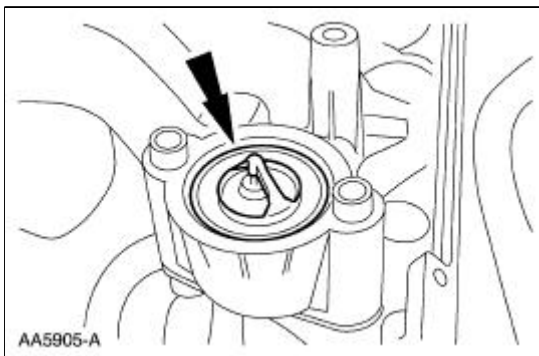
78. Install the intake manifold and gaskets. Tighten the bolts in the sequence shown.



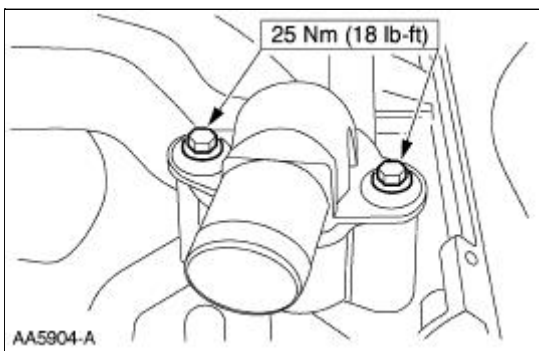
79. **NOTE:** The O-ring is to be installed on top of the thermostat.

Install the water thermostat and O-ring.

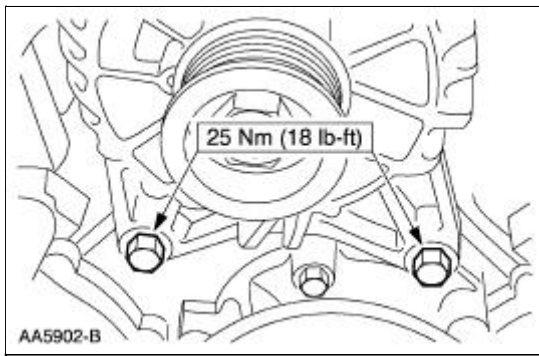
- Install a new O-ring as necessary.



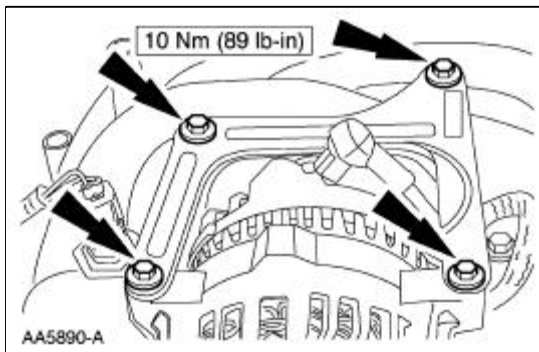
80. Install the water outlet connector.



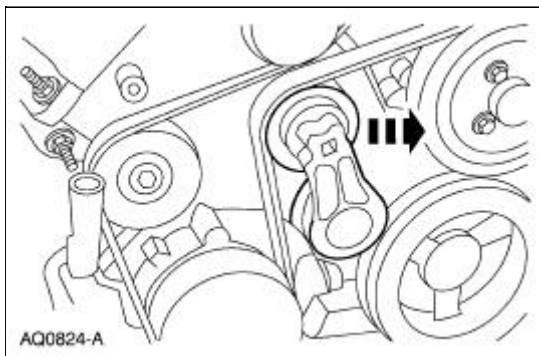
81. Install the bolts and the generator.



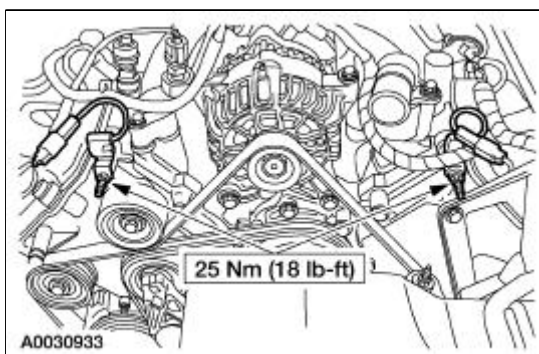
82. Install the generator support brace.



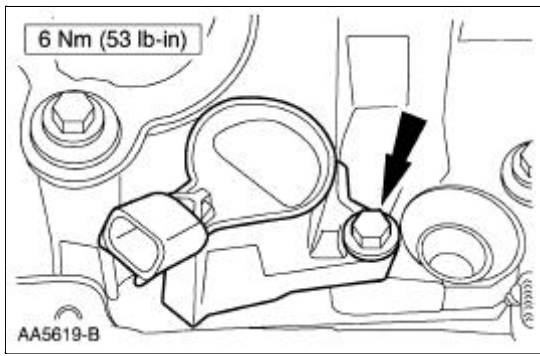
83. Install the accessory drive belt. For additional information, refer to [Section 303-05](#).



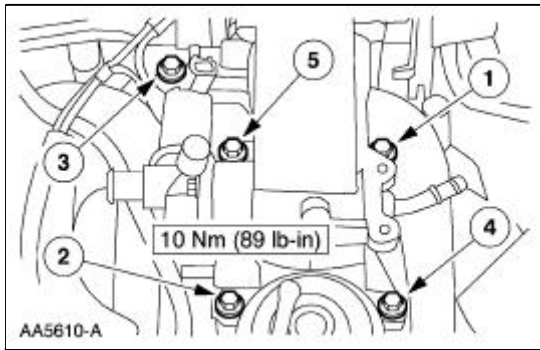
84. Install the radio interference capacitors.



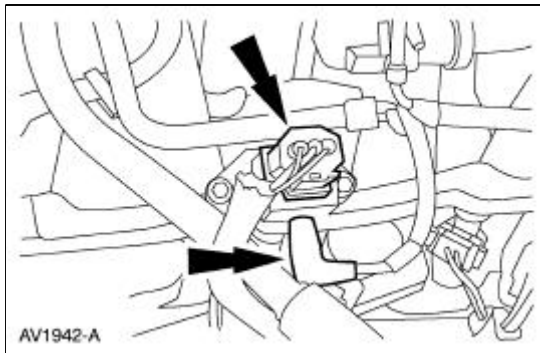
85. Install the ignition coils and bolts.



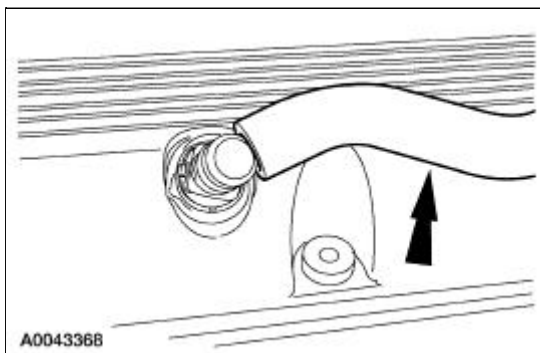
86. Position the throttle body and install the bolts, tighten in the sequence shown.



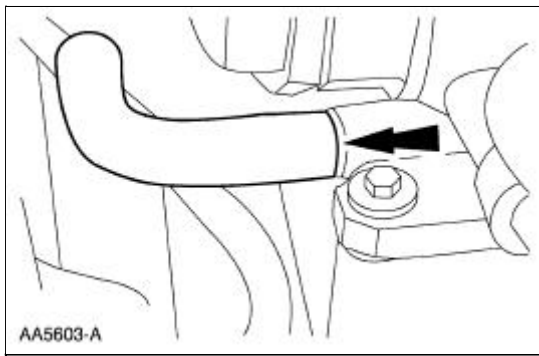
87. Connect the vacuum line to the fuel pressure sensor.



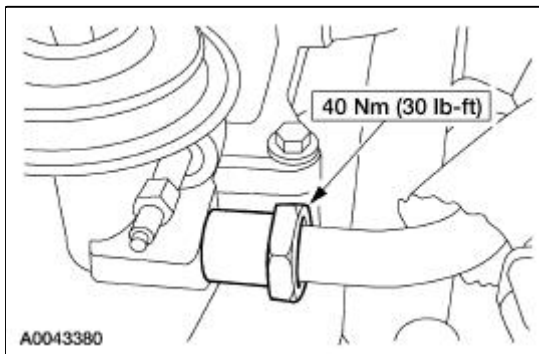
88. Connect the PCV hose.



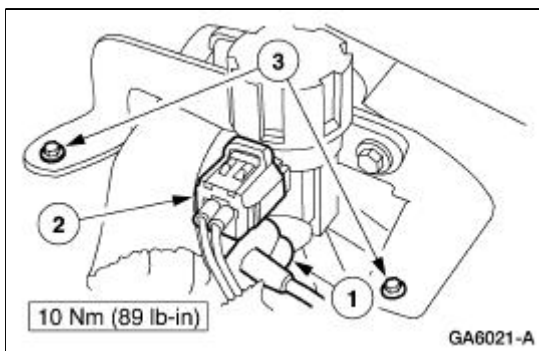
89. Connect the PCV hose to the base of the throttle body.



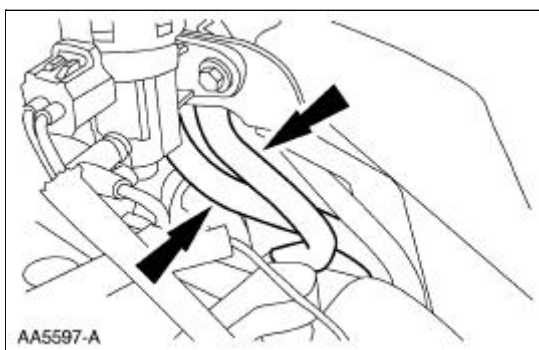
90. Connect the EGR tube to the EGR valve.



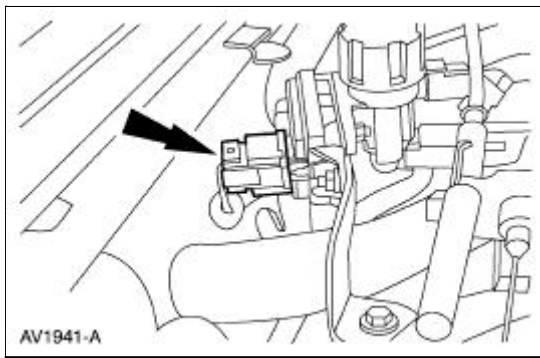
91. Install the EGR vacuum regulator solenoid.
1. Install the vacuum hoses.
 2. Install the electrical connector.
 3. Install the bolts.



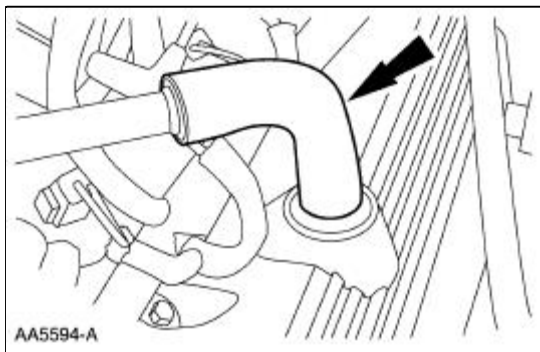
92. Connect the hoses from the differential pressure feedback EGR transducer.



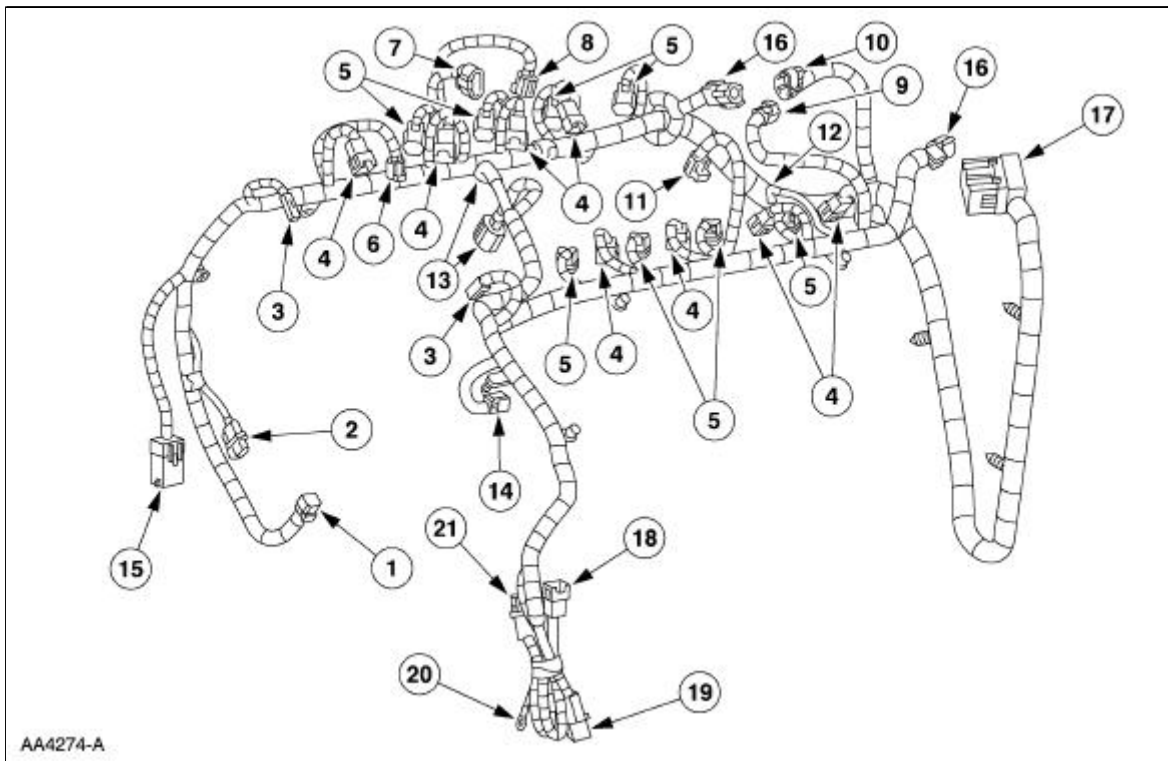
93. Connect the differential pressure feedback EGR electrical connector.



94. Install the breather tube.



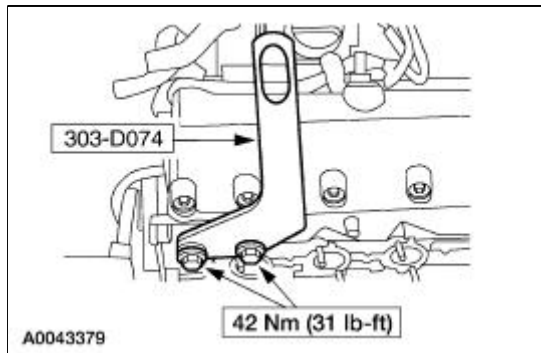
95. Install the engine control sensor wiring.



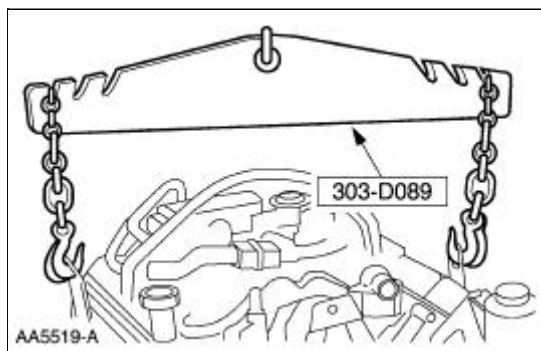
Item	Part Number	Description
1	—	To crankshaft position sensor
2	—	To A/C compressor
3	—	To radio ignition interference capacitor (2)
4	—	To fuel injectors (8)

5	—	To ignition coils (8)
6	—	To engine coolant temperature sensor
7	—	To throttle position sensor
8	—	To idle air control valve
9	—	To EGR vacuum regulator
10	—	To differential pressure feedback EGR
11	—	To fuel pressure regulator
12	—	Fuel injection ground
13	—	To generator
14	—	To camshaft position sensor
15	—	To body
16	—	To heated oxygen sensor (2)
17	—	Engine bulkhead connector
18	—	To low coolant sensor
19	—	To body
20	—	To power distribution box
21	—	To body

96. Install the RH and LH special tools.

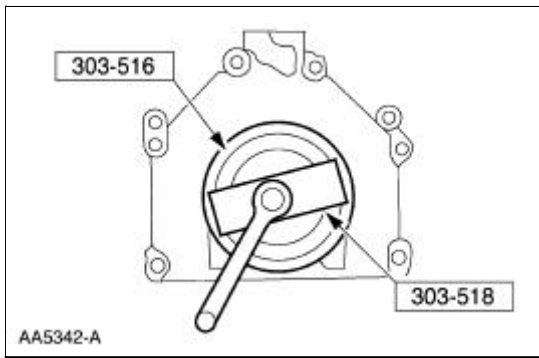


97. Using the special tool, remove the engine from the stand.

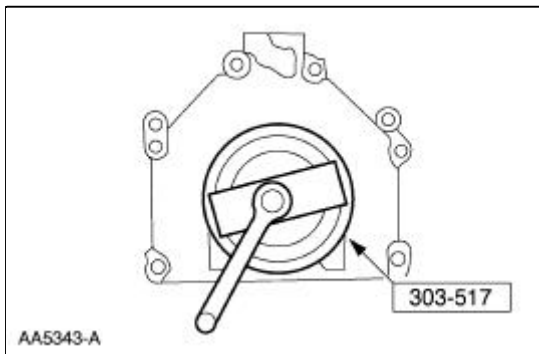


98. Using the special tool, install the crankshaft rear main seal.

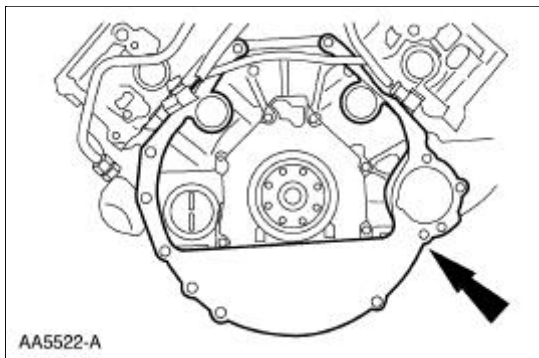
- Lubricate the oil seal using clean engine oil.



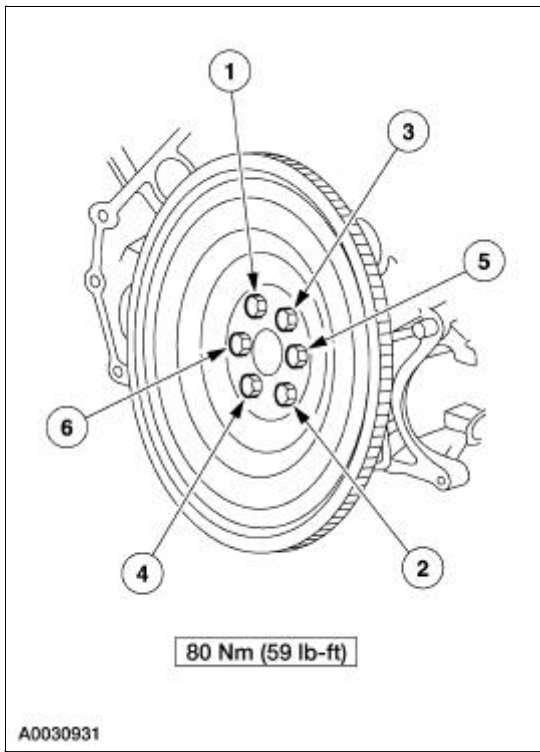
99. Using the special tools, install the crankshaft rear oil slinger.



100. Install the separator plate.




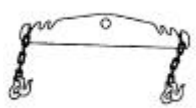
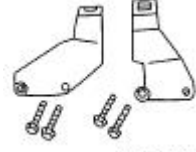




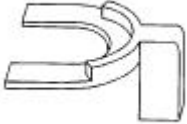
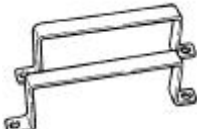
101. Install the flywheel.



Cylinder Heads

Special Tool(s)


 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)
 ST1328-A	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A)
 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3)
 ST1701-A	Lifting Bracket Set, Engine 303-D074 (D91P-6001-A)
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A) or equivalent
 ST1330-A	Compressor, Valve Spring 303-567 (T97P-6565-AH)
	Compressor Spacer, Valve Spring

 <p>ST1331-A</p>	303-382 (T91P-6565-AH)
 <p>ST1668-A</p>	Remover/Installer, Cylinder Head 303-572 (T97T-6000-A)


Material

Item	Specification
Motorcraft Silicone Gasket Remover ZC-30	—
Motorcraft Metal Surface Prep ZC-31	—
Hydraulic Chain Tensioner Retaining Clip 1L3Z-6P250-AA	—
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Both cylinder heads

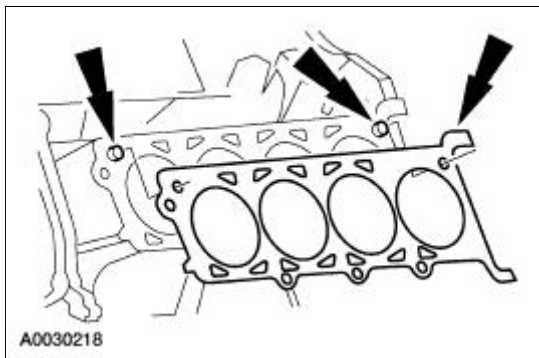
- 
CAUTION: The gasket sealing surfaces on the cylinder head and cylinder block must be clean. For additional information, refer to [Cylinder Heads](#) in the Removal portion of this section.


CAUTION: The use of sealing aids (aviation cement, copper spray and glue) is not permitted. The gasket must be installed dry.


CAUTION: The new gasket has a film coating which is crucial to the gasket's ability to seal correctly. Do not scratch the gasket.

NOTE: RH head gasket shown; LH head gasket similar.

Install the head gasket over the dowel pins.



2. **⚠ CAUTION:** Cylinder head machining or milling is not authorized by the Ford Motor Company. Cylinder head flatness must be within 0.0254 mm (0.001 in) across a 38.1 mm (1.5 in) square area.

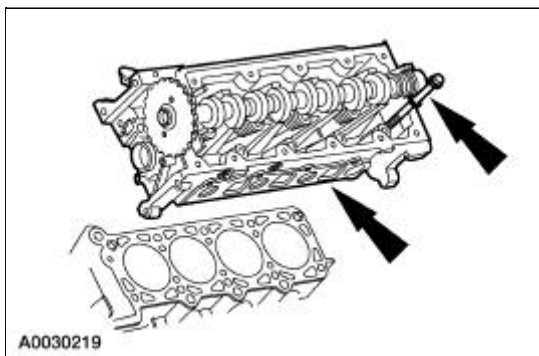
⚠ CAUTION: The use of sealing aids (aviation cement, copper spray and glue) is not permitted. The gasket must be installed dry.

⚠ CAUTION: Do not allow the dowels to scratch the sealing surface of the cylinder head during cylinder head installation.

NOTE: The new cylinder head bolts must be lightly oiled with a rag, and allowed to drain for a few minutes prior to installation.

NOTE: RH head gasket shown; LH head gasket similar.

Install the cylinder head on the dowels and the head gasket. Loosely install new bolts.

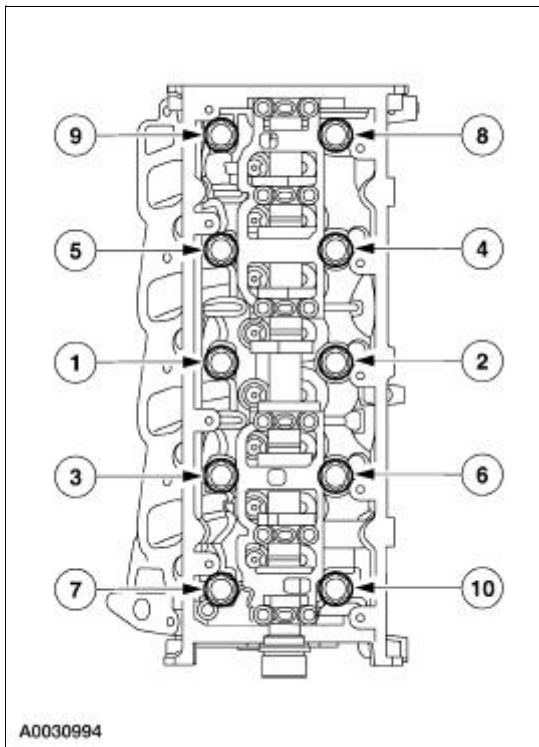


NOTE: Position the cylinder head(s) over the dowels on the head gasket(s).

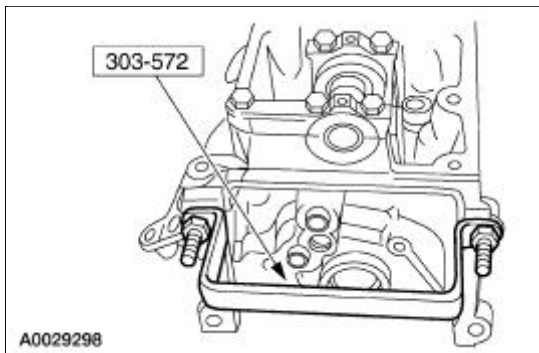
3. **NOTE:** LH shown, RH similar.

Tighten the bolts in six stages in the sequence shown.

- Stage 1: Tighten to 40 Nm (30 lb-ft).
- Stage 2: Tighten an additional 90 degrees.
- Stage 3: Loosen the bolts a minimum of one full turn.
- Stage 4: Tighten to 40 Nm (30 lb-ft).
- Stage 5: Tighten an additional 90 degrees.
- Stage 6: Tighten an additional 90 degrees.

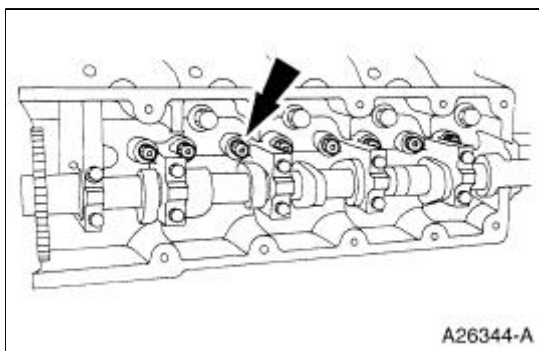



4. Remove the special tools from both ends of the cylinder head.



NOTE: Lubricate the hydraulic lash adjusters with clean engine oil.

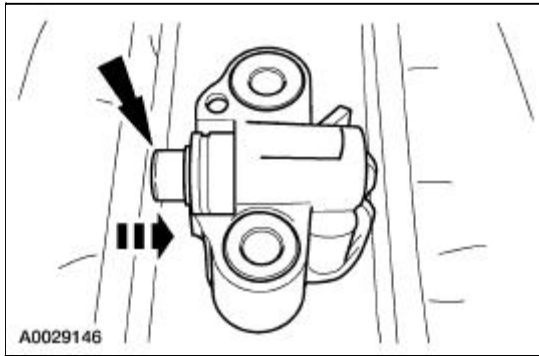
5. Install the hydraulic lash adjusters in their original locations.



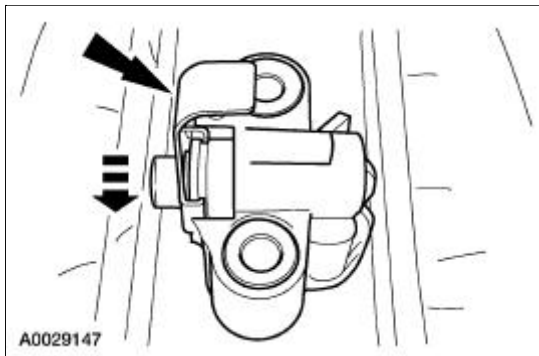
6.  **CAUTION:** Timing chain procedures must be followed exactly or damage to the valves and pistons will result.

NOTE: LH shown, RH similar.

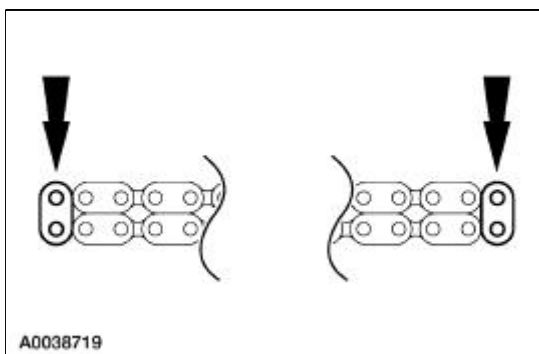
Compress each tensioner plunger, using a vise.



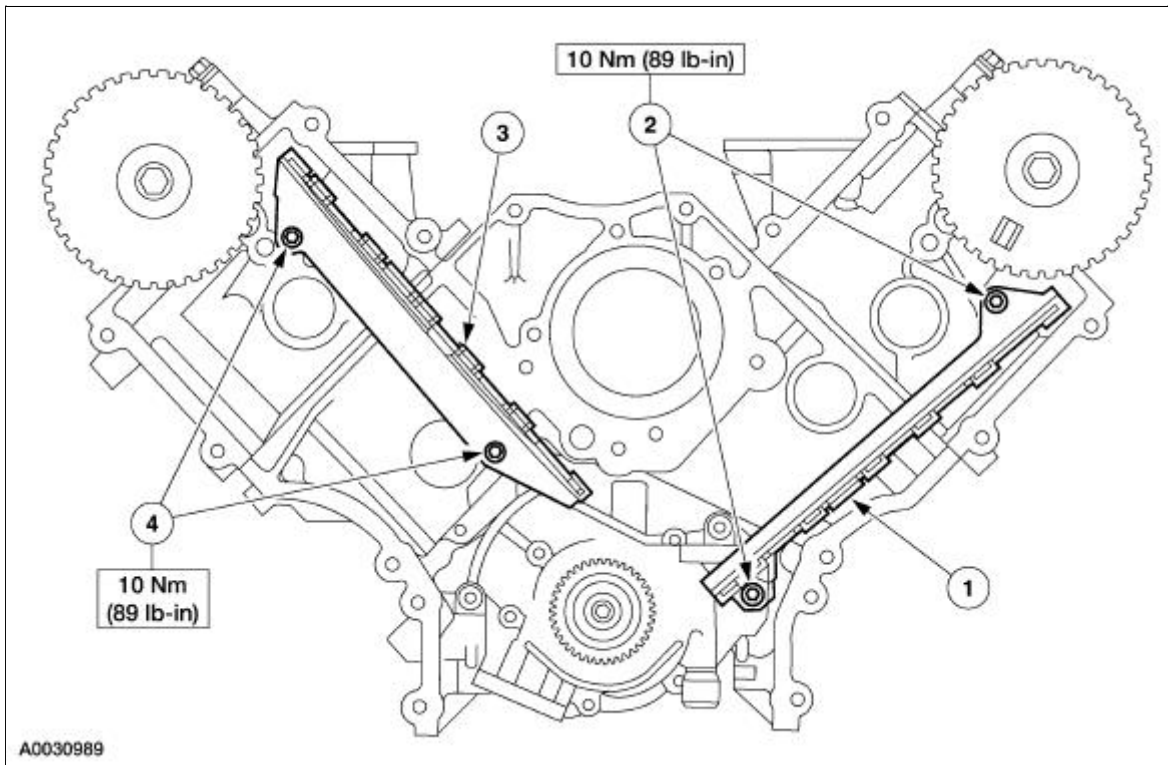
7. Install a retaining clip on each tensioner to hold the plunger in during installation.



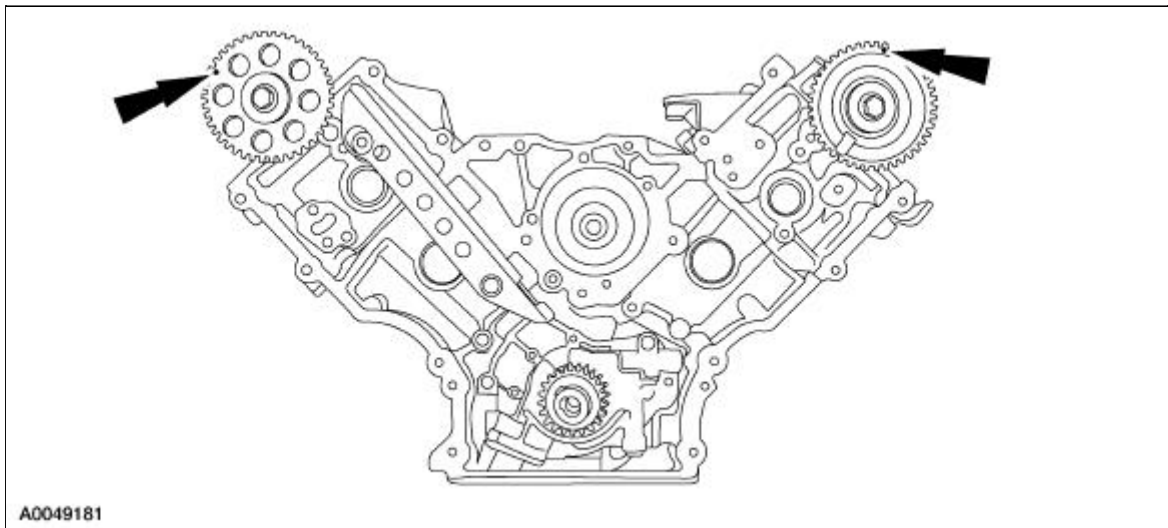
8. Remove the tensioner from the vise.
9. If the copper links are not visible, mark one link on one end and one link on the other end, and use as timing marks.



10. Install the timing chain guides.
 1. Position LH timing chain guide.
 2. Install and tighten the bolts.
 3. Position the RH timing chain guide.
 4. Install and tighten the RH bolts.



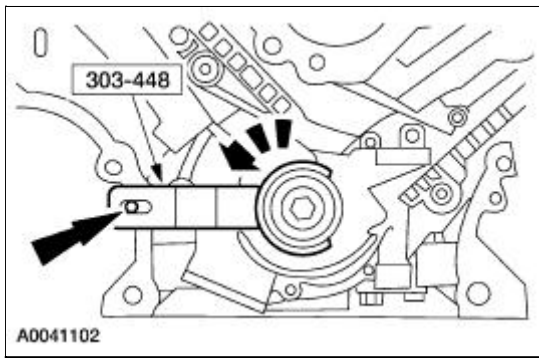
11. Rotate the RH camshaft sprocket until the timing mark is approximately at the 11 o'clock position. Rotate the LH camshaft sprocket until the timing mark is approximately at the 12 o'clock position.



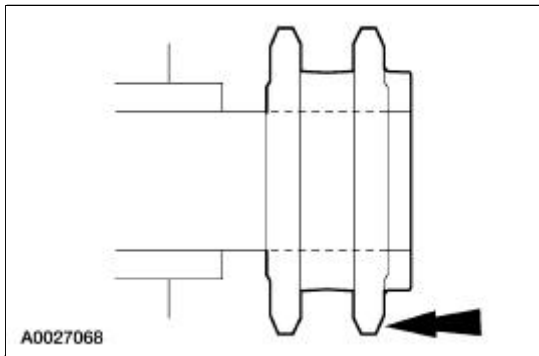
12. **⚠ CAUTION: When instructed to do so, rotate the crankshaft counterclockwise only. Do not rotate past the position shown or severe piston and valve damage can occur.**

NOTE: The number one cylinder is at top dead center (TDC) when the stud on the engine block fits into the slot in the handle of the special tool.

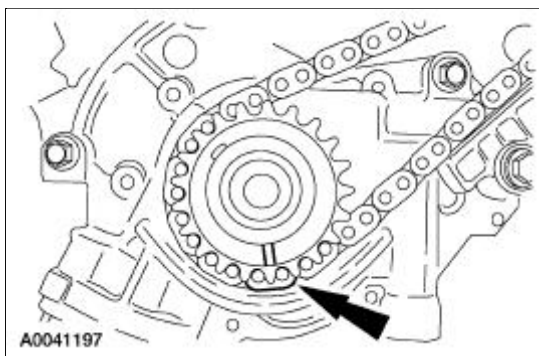
Using the special tool, position the crankshaft so the number one cylinder is at TDC.



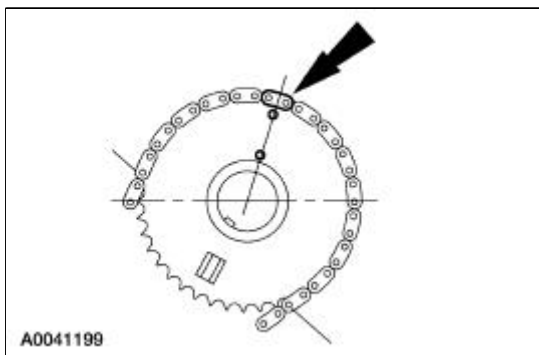
13. Remove the special tool.
14. Install the crankshaft sprocket, making sure the flange faces forward.



15. Position the LH (inner) timing chain on the crankshaft sprocket, aligning the copper (marked) link with the timing mark on the sprocket.

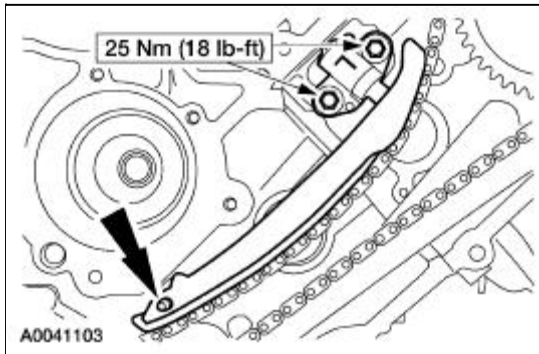


16. Install the LH timing chain on the camshaft sprocket, aligning the copper (marked) link with the timing marks on the sprocket.

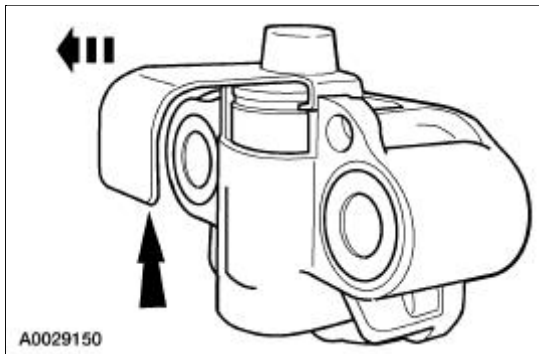


17. **NOTE:** The LH timing chain tensioner arm has a bump near the dowel hole for identification.

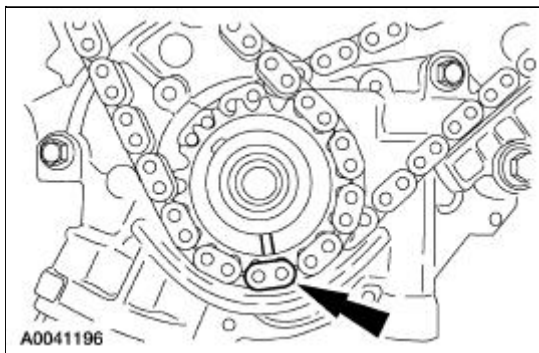
Position the LH timing chain tensioner arm on the dowel pin and install the LH timing chain tensioner.



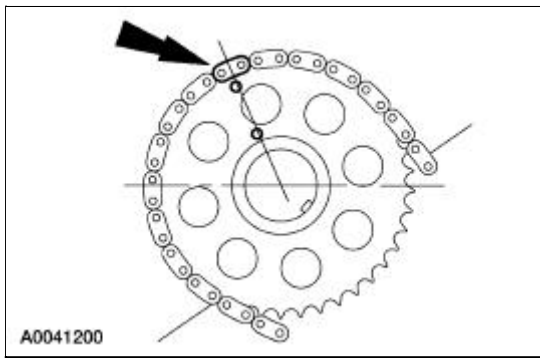
18. Remove the retaining clip from the LH timing chain tensioner.



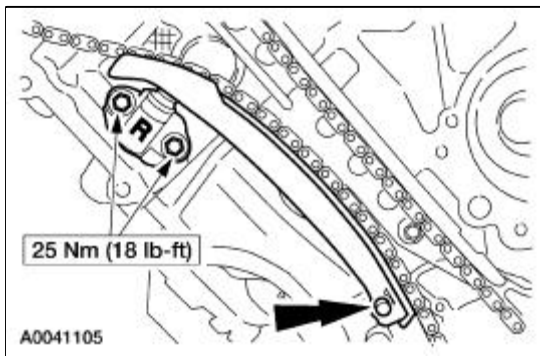
19. Position the RH (outer) timing chain on the crankshaft sprocket, aligning the copper (marked) link with the timing mark on the sprocket.



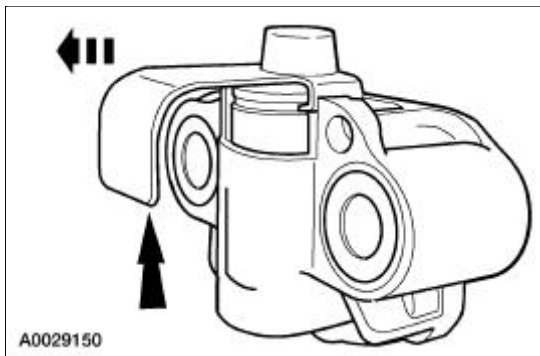
20. Install the RH timing chain on the camshaft sprocket, aligning the copper (marked) link with the timing marks on the sprocket.



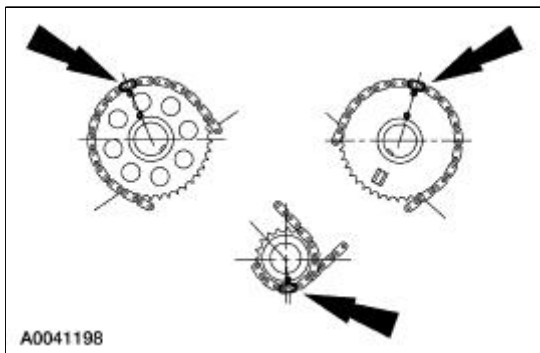
21. Position the RH timing chain tensioner arm on the dowel pin and install the RH timing chain tensioner.



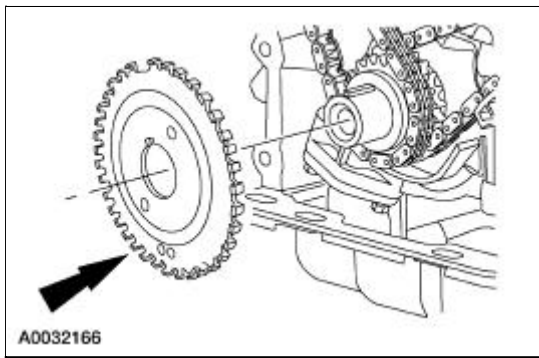
22. Remove the retaining clip from the RH timing chain tensioner.



23. Make sure that the copper (marked) chain links are lined up with the dots on the crankshaft sprockets and the camshaft sprocket.

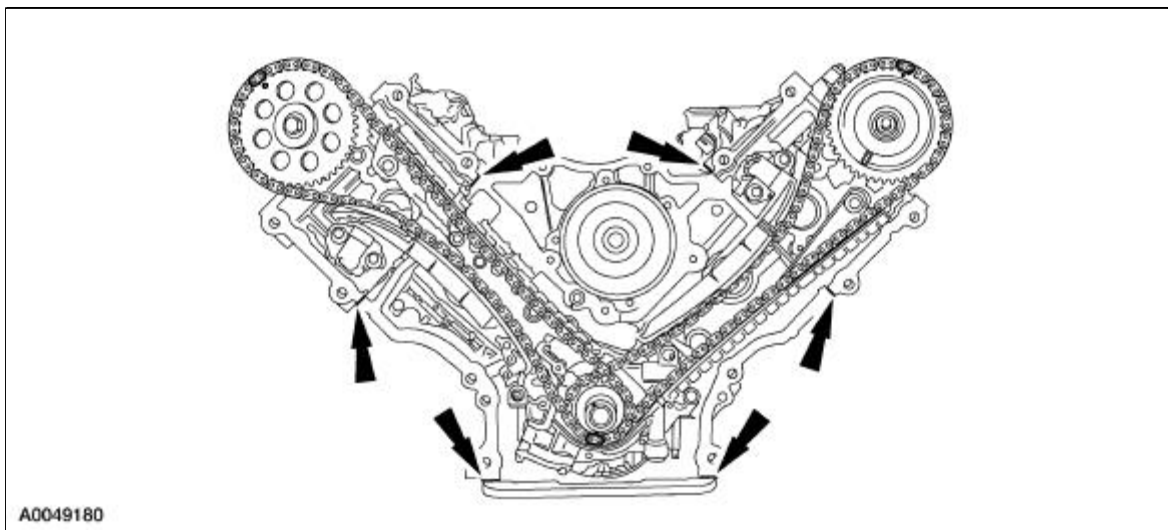


24. Install the crankshaft sensor ring on the crankshaft.

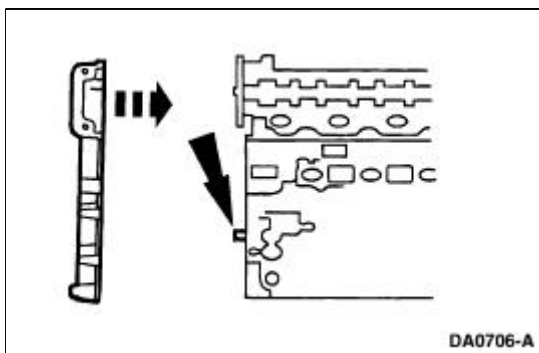


25. **NOTE:** If the engine front cover is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

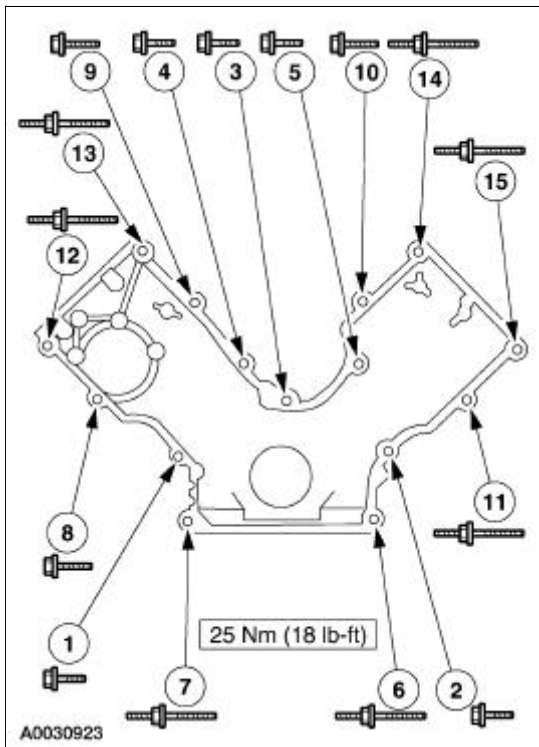
Apply a bead of sealant along the head-to-block surface as shown.



26. Install a new engine front cover gasket on the engine front cover. Position the engine front cover. Install the fasteners finger-tight.



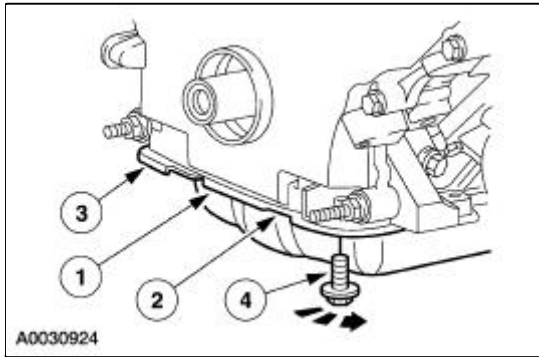
27. Tighten the front cover fasteners in the sequence shown.



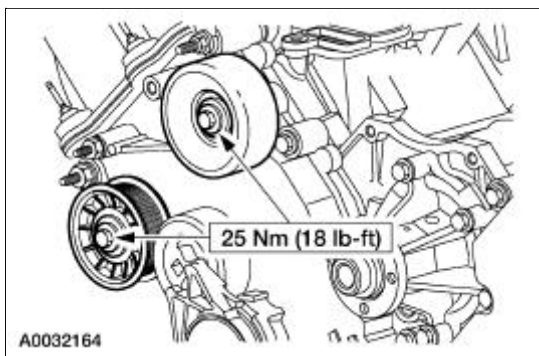
Item	Part Number	Description
1	N806177	Bolt, hex flange head pilot, M8 x 1.25 x 53
2	N806177	Bolt, hex flange head pilot, M8 x 1.25 x 53
3	N806177	Bolt, hex flange head pilot, M8 x 1.25 x 53
4	N806177	Bolt, hex flange head pilot, M8 x 1.25 x 53
5	N806177	Bolt, hex flange head pilot, M8 x 1.25 x 53
6	W706508	Stud, hex shldr pilot, M8 x 1.25 x 50 — m6 x 1 x 10
7	N808586	Stud and washer, hex head pilot, M8 x 1.25 x 60 — m6 x 1 x 26
8	N806177	Bolt, hex flange head pilot, M8 x 1.25 x 53
9	N806177	Bolt, hex flange head pilot, M8 x 1.25 x 53
10	N806177	Bolt, hex flange head pilot, M8 x 1.25 x 53
11	N806300	Stud, hex shldr pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
12	W706560	Stud and washer, hex-head pilot, M8 x 1.25 x 65 — M8 x 1.25 x 16
13	N806300	Stud, hex shldr pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
14	N806300	Stud, hex shldr pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
15	N806300	Stud, hex shldr pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26

28. Loosely install the bolts, then tighten the bolts in three stages in the sequence shown.
- Stage 1: Tighten to 2 Nm (18 lb-in).
 - Stage 2: Tighten to 20 Nm (15 lb-ft).

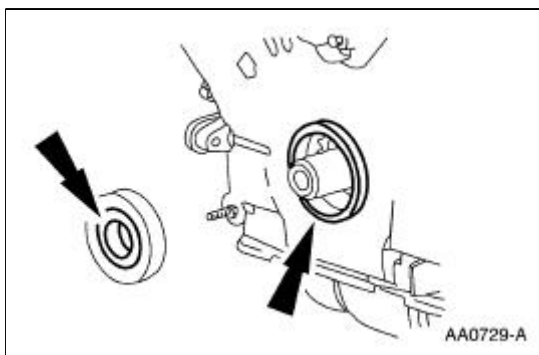
- Stage 3: Tighten an additional 60 degrees.



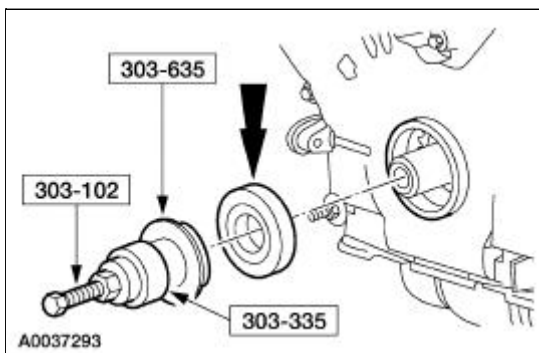
29. Install the belt idler pulleys.



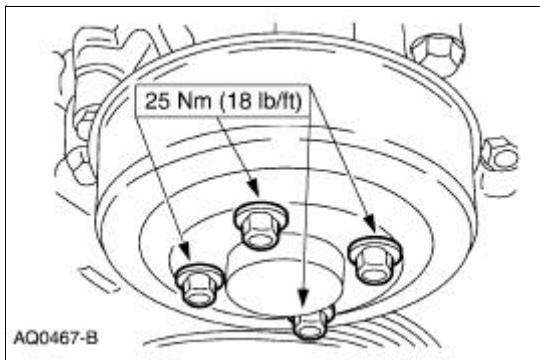
30. Lubricate the engine front cover and the front oil seal inner lip with clean engine oil.



31. Using the special tool, install the front oil seal.

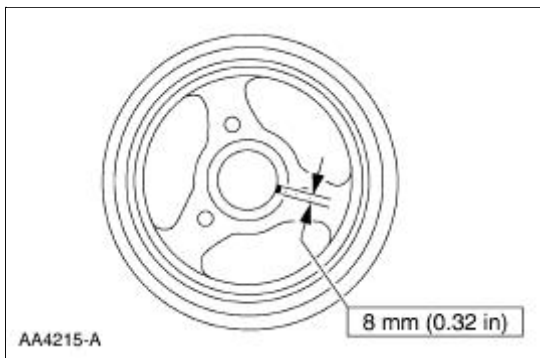


32. Install the coolant pump pulley and bolts.

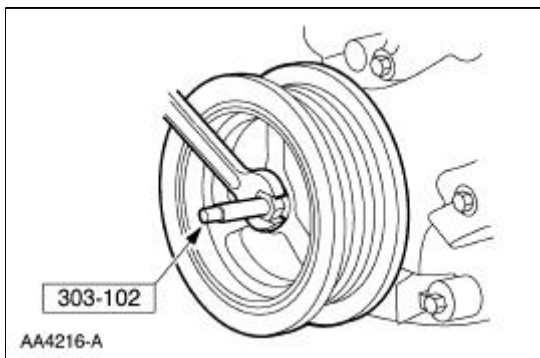


33. **NOTE:** The crankshaft pulley must be installed within four minutes of applying the sealant.

Apply silicone gasket and sealant to the Woodruff key slot on the crankshaft pulley.



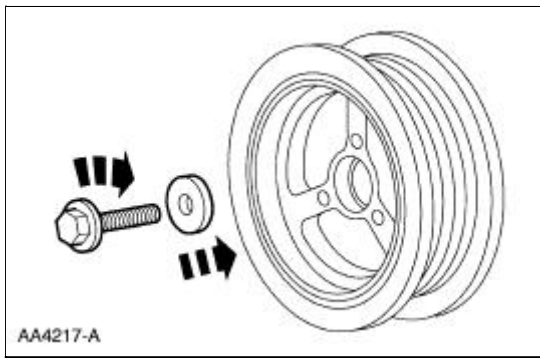
34. Using the special tool, install the crankshaft pulley.



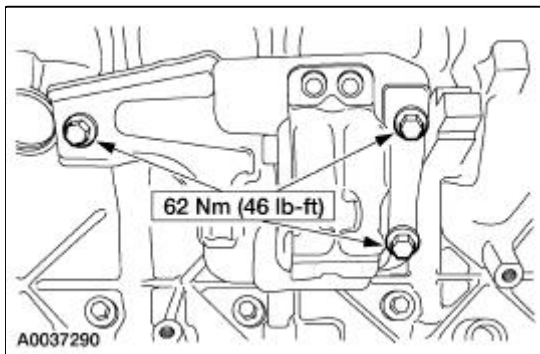
35. **NOTE:** Use special tool 303-009 or a suitable strap wrench to hold the crankshaft pulley.

Install the washer and the bolt. Tighten the bolt in four stages.

- Stage 1: Tighten to 90 Nm (66 lb-ft).
- Stage 2: Loosen one full turn.
- Stage 3: Tighten to 50 Nm (37 lb-ft).
- Stage 4: Tighten an additional 90 degrees.



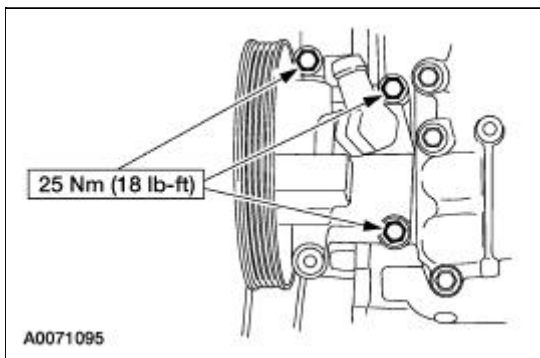
36. Install the RH engine mount.



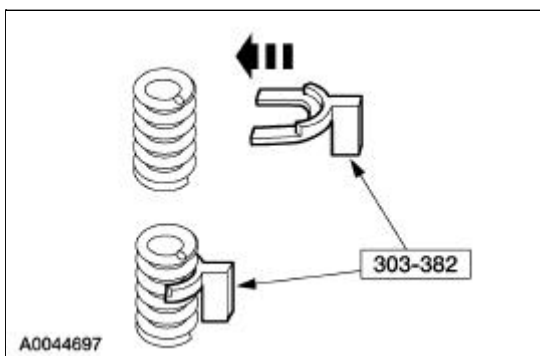
37. **NOTE:** Only three bolts are required for installation.

Install the power steering pump bolts.

- Position the power steering pump.
- Install the bolts.



38. Install the special tool between the valve spring coils to prevent valve stem seal damage.

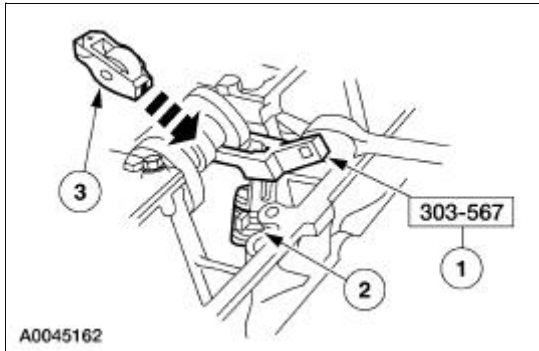


39. **NOTE:** Lubricate the camshaft roller followers using clean engine oil.

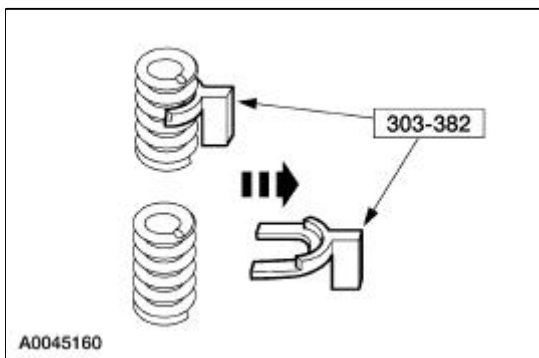
NOTE: Position the cam lobe away from the camshaft roller follower location prior to installing each camshaft roller follower.

Install the camshaft roller followers.

1. Install the special tool.
2. Compress the valve spring.
3. Install the camshaft roller followers in their original locations.

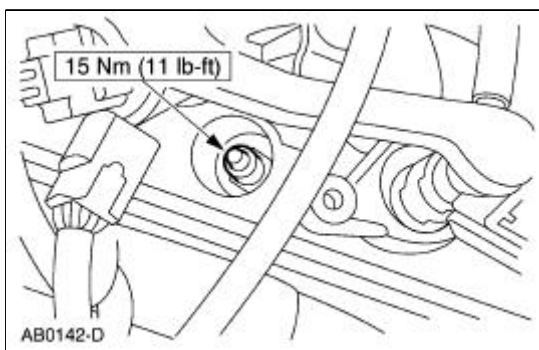


40. Remove the special tool.



41. **NOTE:** One spark plug shown, others similar.

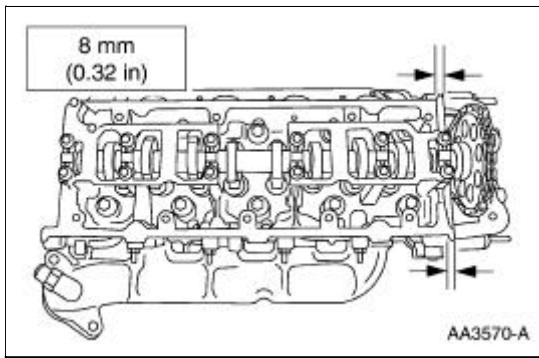
Install the spark plugs.



42. **NOTE:** RH side shown, LH side similar.

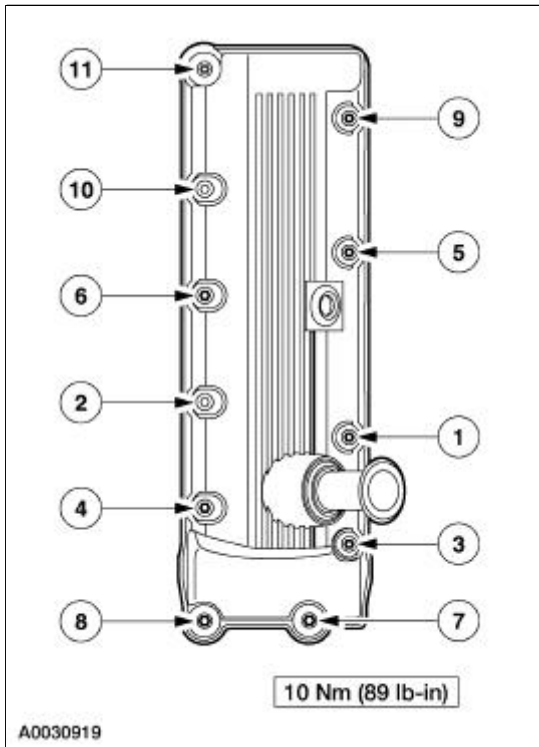
NOTE: If not secured within four minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

Apply silicone gasket and sealant in the locations shown.



43. **NOTE:** RH valve cover shown, LH similar.

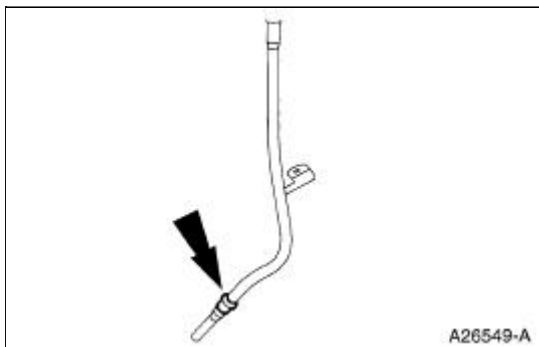
Install the valve covers.



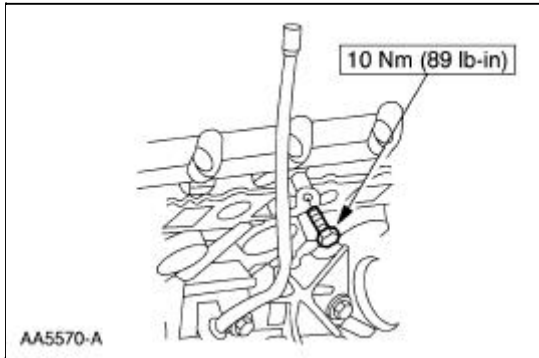
LH cylinder head

44. **NOTE:** Lubricate the O-ring seal with clean engine oil.

Install a new O-ring.

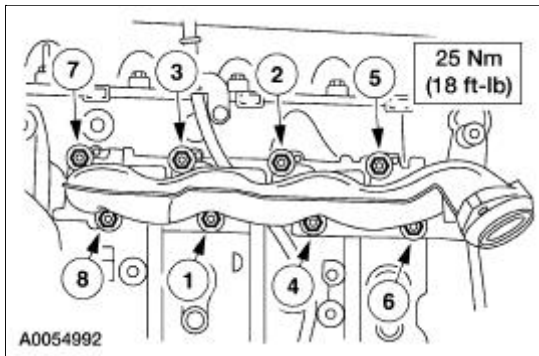


45. Install the oil level indicator tube.

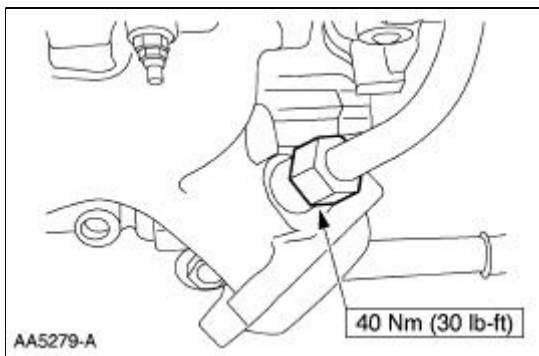


46. Install the LH exhaust manifold.

- Install a new manifold gasket.
- Install the LH exhaust manifold.
- Tighten the nuts in the sequence shown.



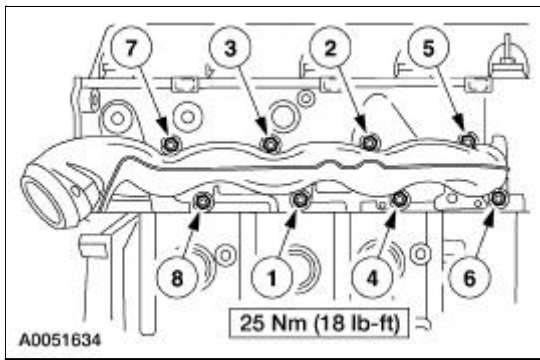
47. Connect the lower end of the exhaust gas recirculation (EGR) tube to the LH exhaust manifold.



RH cylinder head

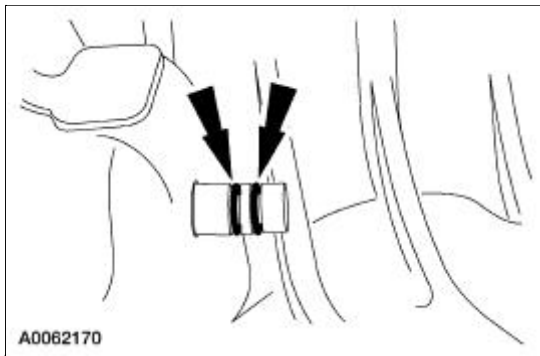
48. Install the RH exhaust manifold.

- Install a new exhaust manifold gasket.
- Install the RH exhaust manifold.
- Tighten the nuts in the sequence shown.

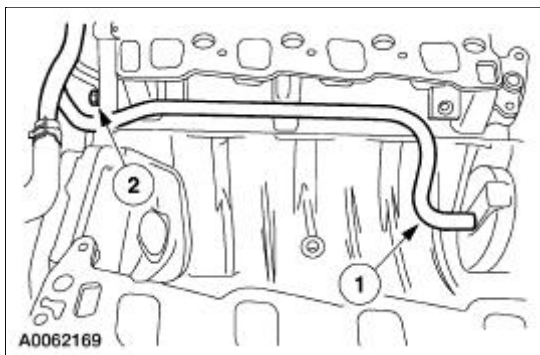


Both cylinder heads

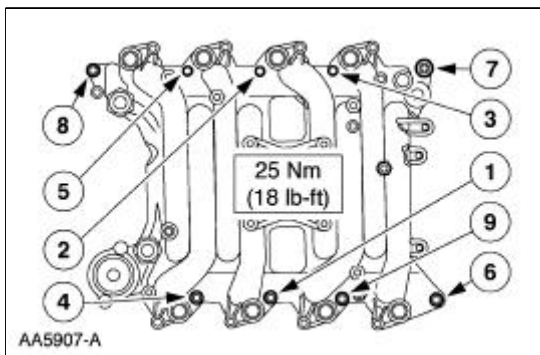
49. Inspect O-ring seals and install new O-ring seals as necessary.



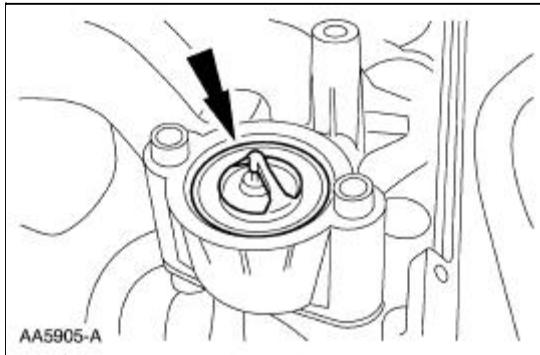
50. Install the coolant bypass tube.
 1. Install the bypass tube.
 2. Install the nut.



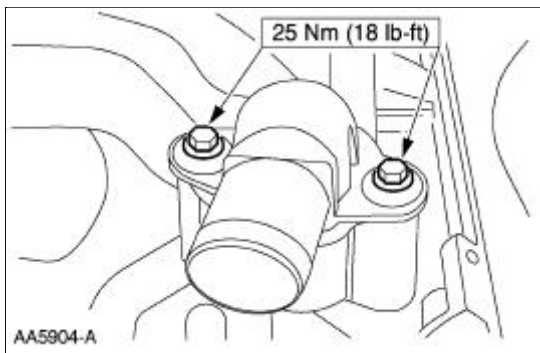
51. Install the intake manifold and gaskets. Tighten the bolts in the sequence shown.



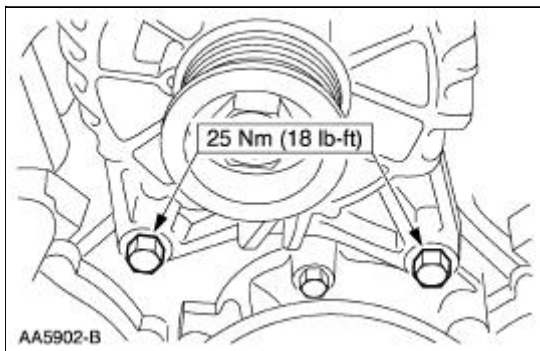
52. Install the thermostat and O-ring.
- Install a new O-ring as necessary.



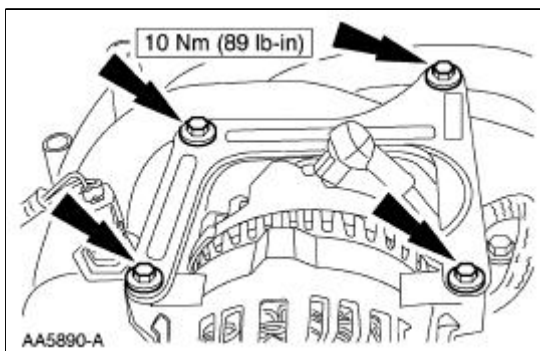
53. Install the coolant outlet adapter.



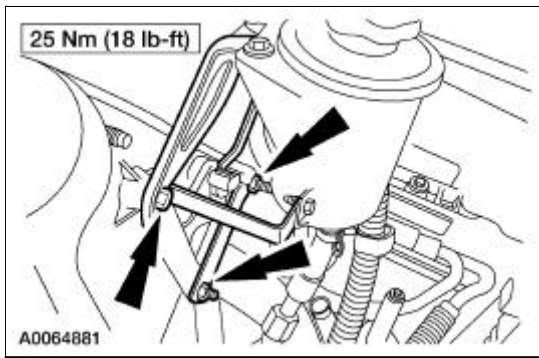
54. Install the bolts and the generator.



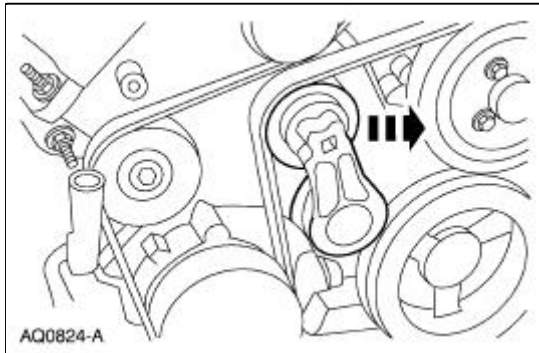
55. Install the upper generator support bracket.



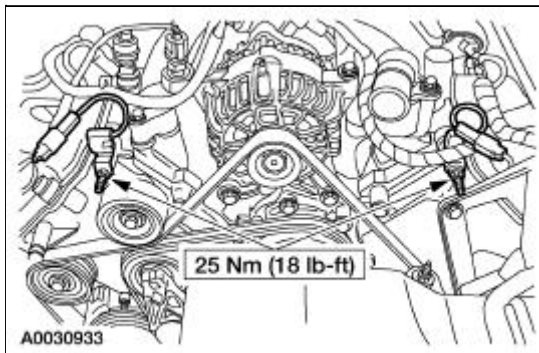
56. Position the power steering reservoir and bracket, then install the bolts.



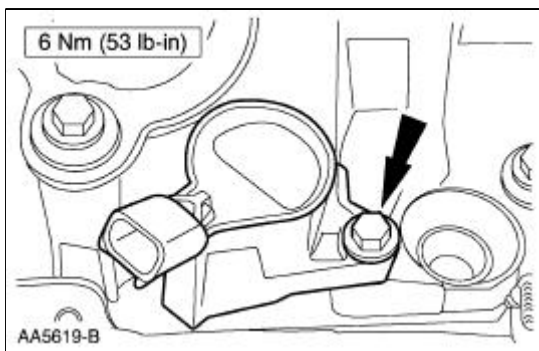
57. Install the accessory drive belt.



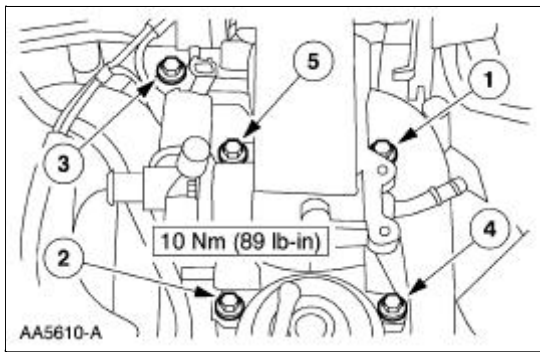
58. Install the radio interference capacitors.



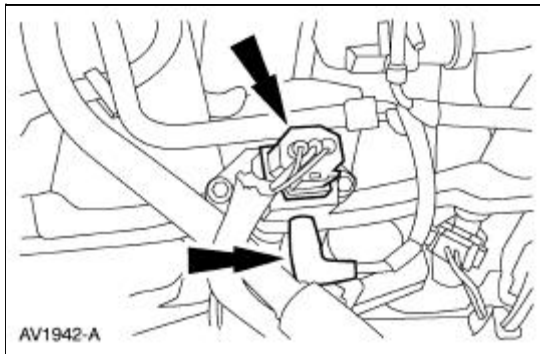
59. Install the ignition coils and bolts.



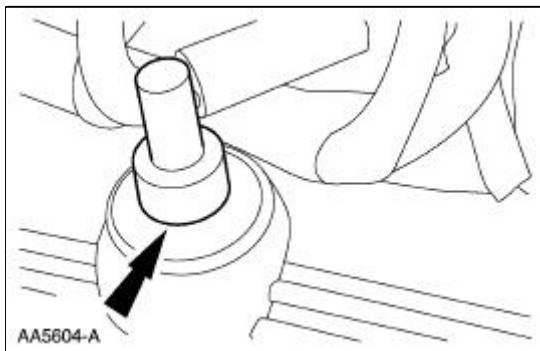
60. Position the throttle body and install the bolts, tightening in the sequence shown.



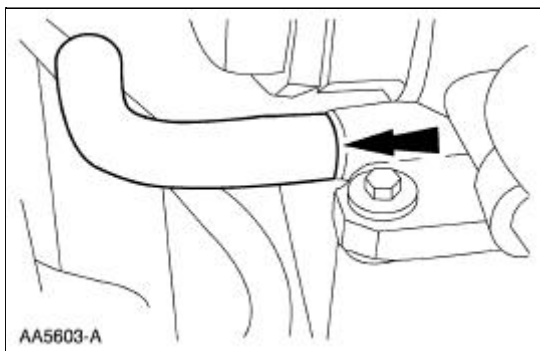
61. Connect the vacuum line to the fuel pressure sensor.



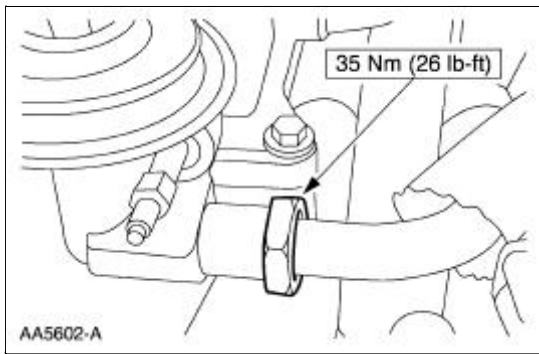
62. Install the positive crankcase ventilation (PCV) valve and hose as an assembly.



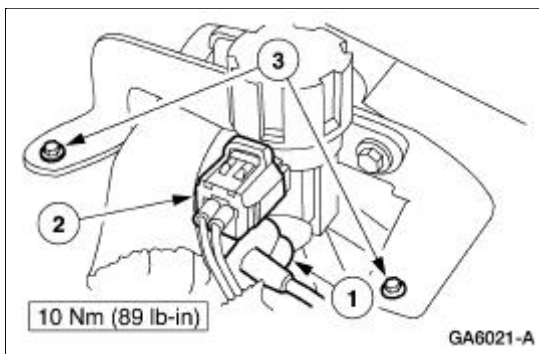
63. Connect the PCV hose to the base of the throttle body.



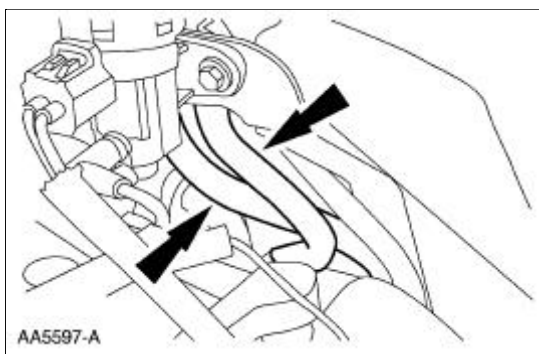
64. Connect the EGR tube to the EGR valve.



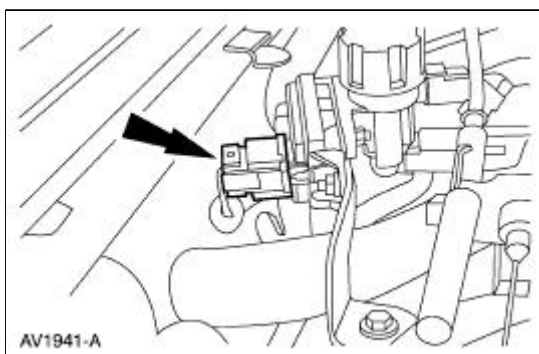
65. Install the EGR vacuum regulator solenoid.
1. Install the vacuum lines.
 2. Install the electrical connector.
 3. Install the bolts.



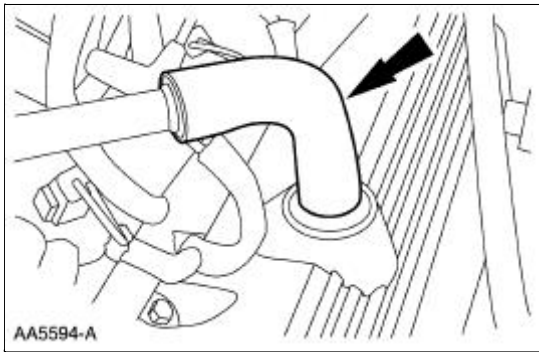
66. Connect the hoses from the differential pressure feedback EGR transducer.



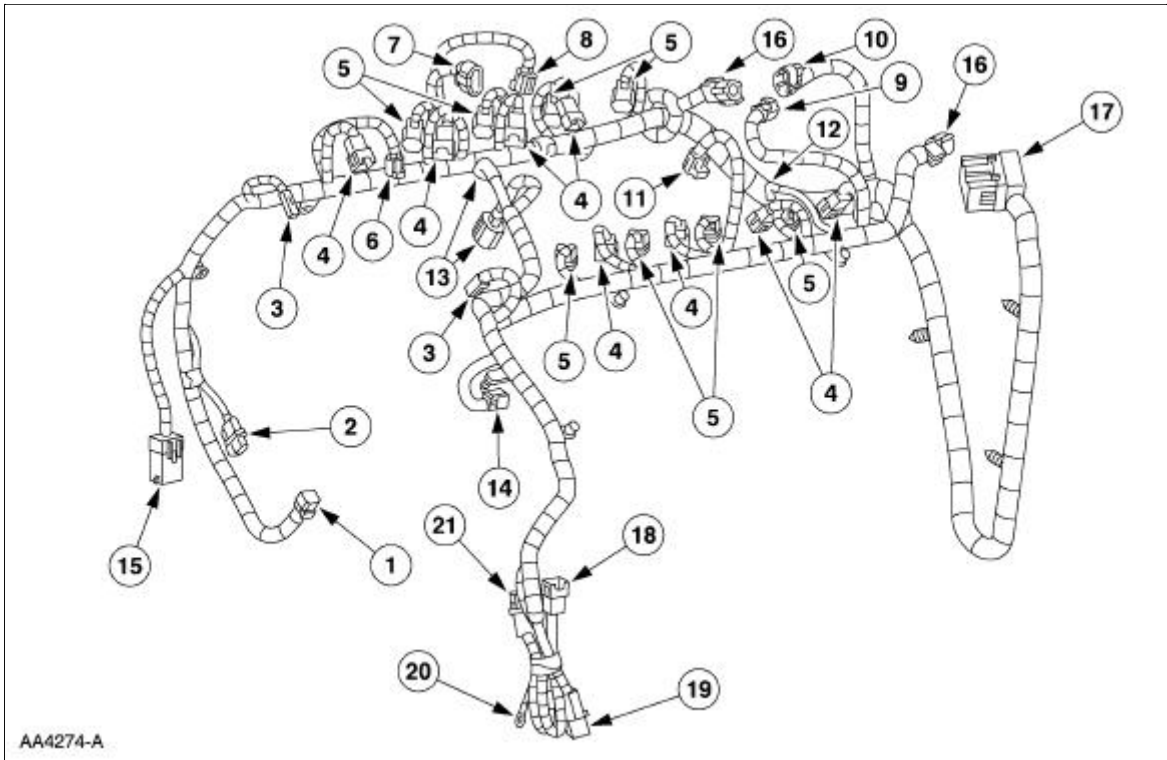
67. Connect the differential pressure feedback EGR electrical connector.



68. Install the breather tube.



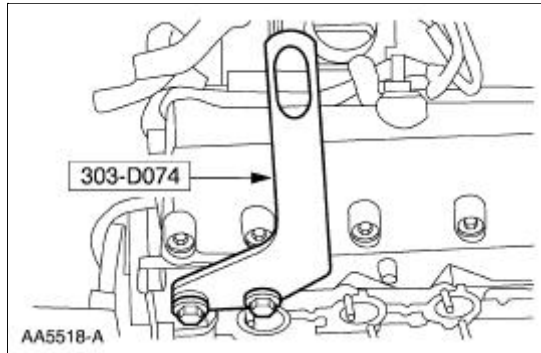
69. Install the engine control sensor wiring.



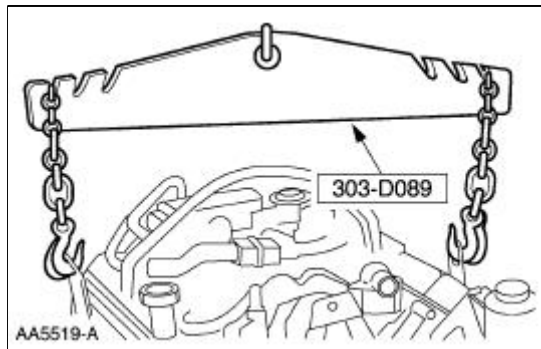
Item	Part Number	Description
1	—	To crankshaft position sensor
2	—	To A/C compressor
3	—	To radio ignition interference capacitor (2)
4	—	To fuel injectors (8)
5	—	To ignition coils (8)
6	—	To engine coolant temperature sensor
7	—	To throttle position sensor
8	—	To idle air control valve
9	—	To EGR vacuum regulator
10	—	To differential pressure feedback EGR
11	—	To fuel pressure regulator
12	—	Fuel injection ground
13	—	To generator
14	—	To camshaft position sensor

15	—	To body
16	—	To heated oxygen sensor (2)
17	—	Engine bulkhead connector
18	—	To low coolant sensor
19	—	To body
20	—	To power distribution box
21	—	To body

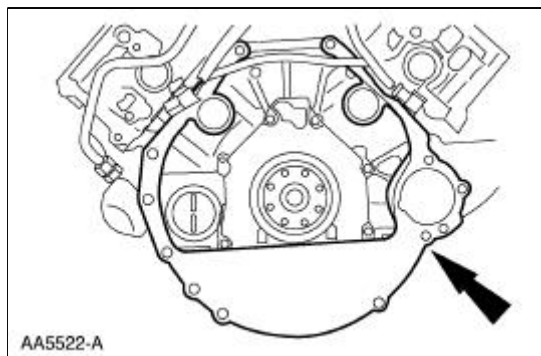
70. Install the RH and LH special tool.



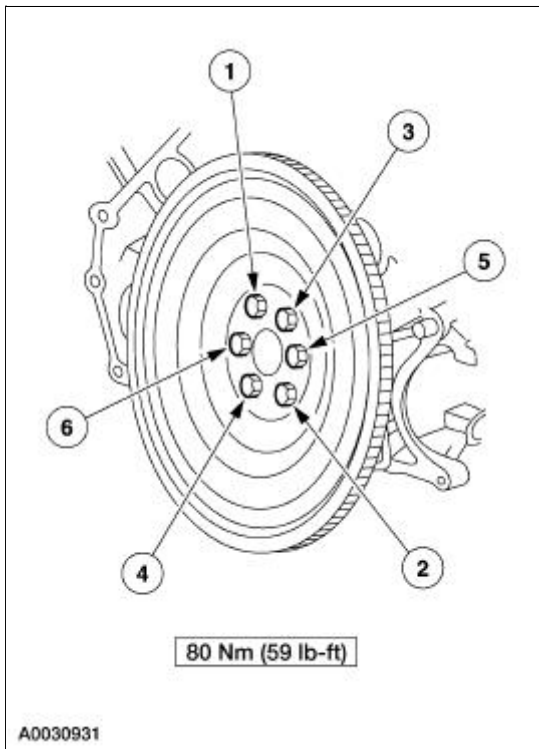
71. Using the special tool, remove the engine from the stand.



72. Install the separator plate.



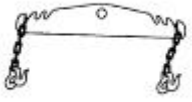



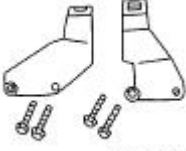
73. Install the flywheel.



74. Install the engine. For additional information, refer to [Engine](#) in the Installation portion of this section.
-

Engine

Special Tool(s)

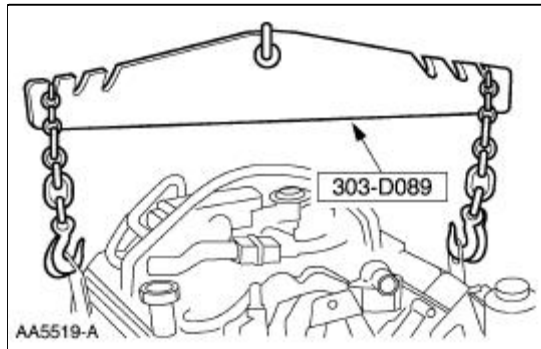
 <p>ST1602-A</p>	<p>Spreader Bar 303-D089 (D93P-6001-A3)</p>
 <p>ST2334-A</p>	<p>Support Bracket, Engine 303-639</p>
 <p>ST1604-A</p>	<p>Lifting Bracket, Engine 303-D087 (D93P-6001-A1)</p>
 <p>ST1603-A</p>	<p>Lifting Bracket, Engine 303-D088 (D93P-6001-A2)</p>
 <p>ST1701-A</p>	<p>Lifting Bracket Set, Engine 303-D074 (D91P-6001-A)</p>

Material

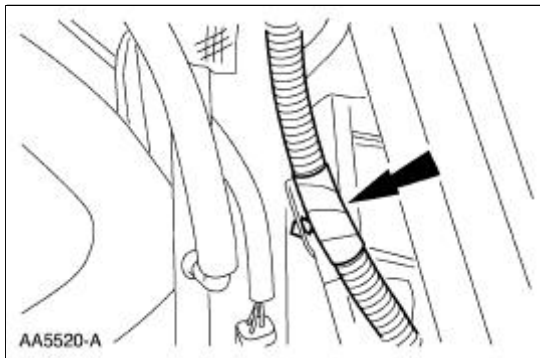
Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H
Premium Engine Coolant E2FZ-19549-AA (In Canada CXC-10; In Oregon F5FZ- 19549-CC) or equivalent	ESE-M97B44-A

1. **NOTE:** Adjust the transmission support jack as necessary to aid in the installation of the engine.

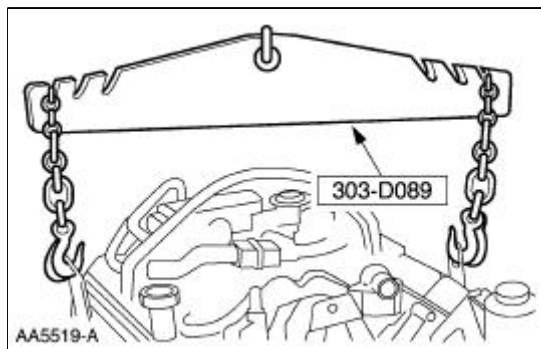
Using the special tool, install the engine.



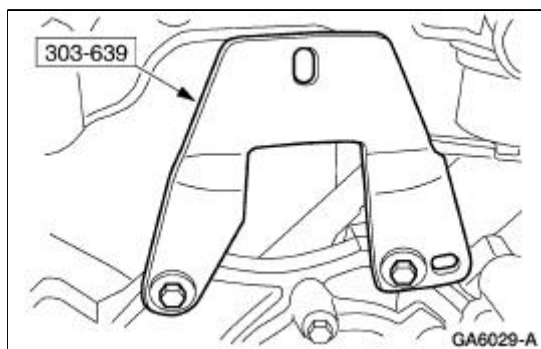
2. Connect the transmission wiring to the bracket during installation.



3. Remove the special tool.

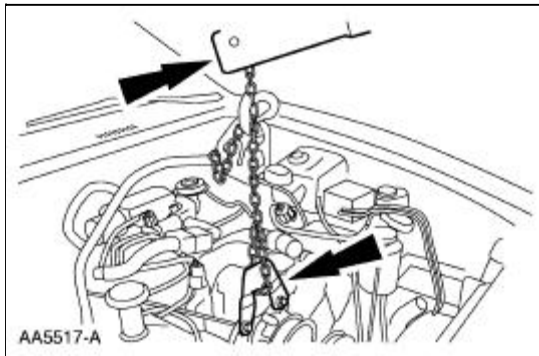


4. Install the special tool.

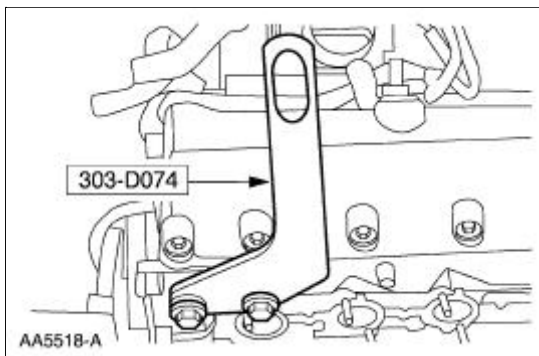


5. **NOTE:** This step will allow the installation of the exhaust manifold through the bottom and access for the removal of the engine lift brackets.

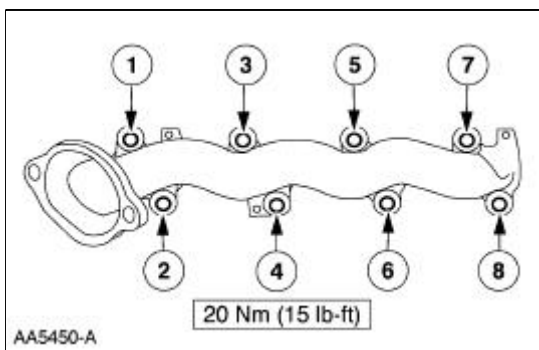
Using a suitable floor crane raise the engine.



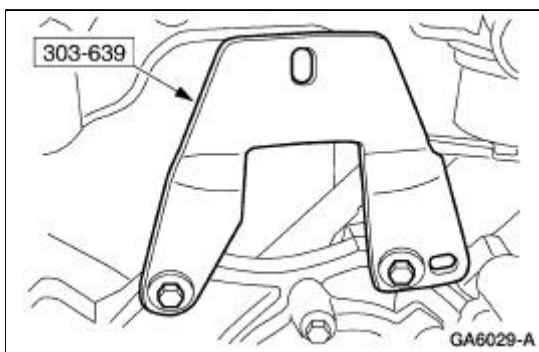
6. Remove the RH and LH special tool.



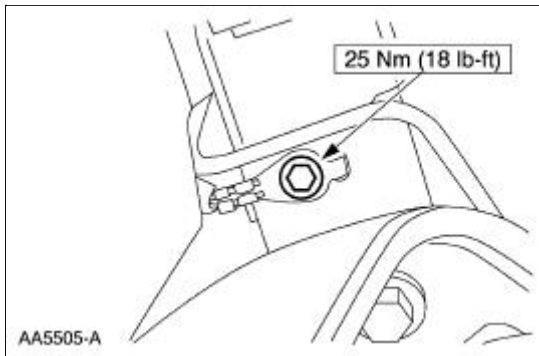
7. Install new gaskets and the exhaust manifolds, tighten the nuts in the sequence shown.



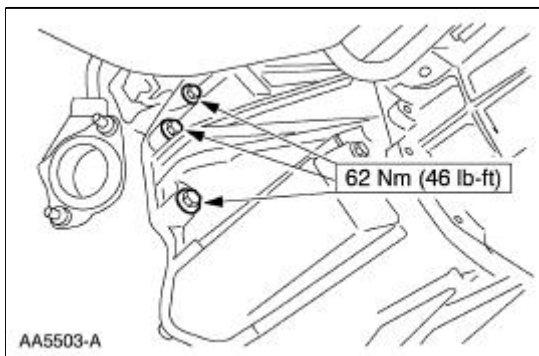
8. Lower the engine, remove the special tool.



9. Install the generator. For additional information, refer to [Section 414-02](#).
10. Raise the vehicle. for additional information, refer to [Section 100-02](#).
11. Install the power steering pump. For additional information, refer to [Section 211-02](#).
12. Install the bolt and the body ground.

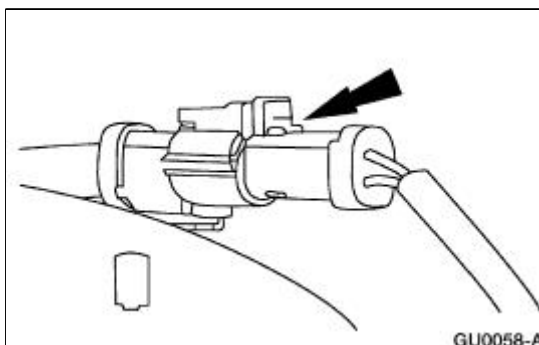


13. Install the nine bell housing bolts.



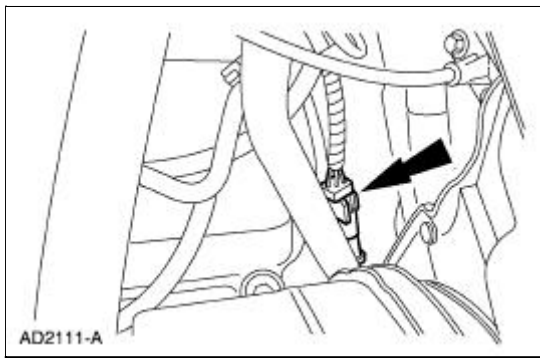
14. Install the starter. For additional information, refer to [Section 303-06](#).
15. **NOTE:** This will need to be done as the H-pipe is being positioned.

Connect the LH heated oxygen sensor.

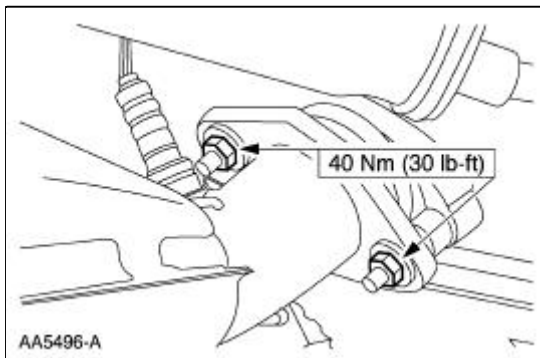


16. **NOTE:** This will need to be done as the H-pipe is being positioned.

Connect the RH heated oxygen sensor.

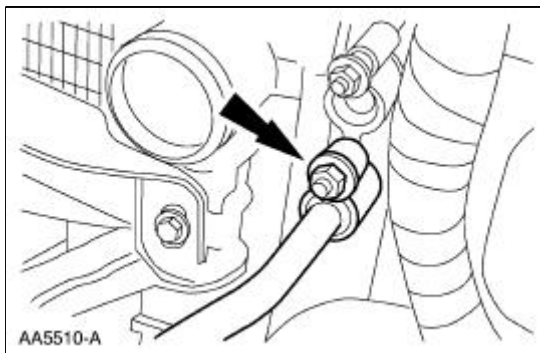


17. Re-position the H-pipe and install the four exhaust flange to manifold nuts.



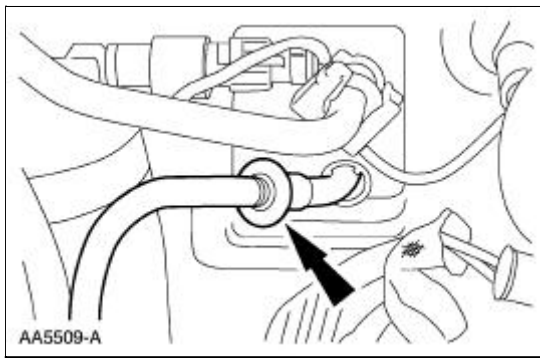
18. Lower the vehicle.
19. **NOTE:** The O-ring seal must be inspected and cleaned before installation. For additional information, refer to [Section 412-00](#).

Install the A/C line and tighten the nut.

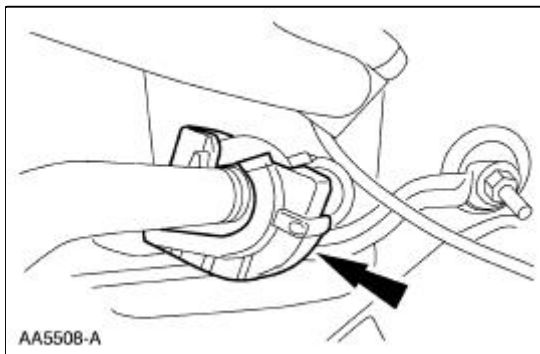


20. **NOTE:** The O-ring seal must be inspected and cleaned before installation. For additional information, refer to [Section 412-00](#).

Connect the line to the evaporator core.

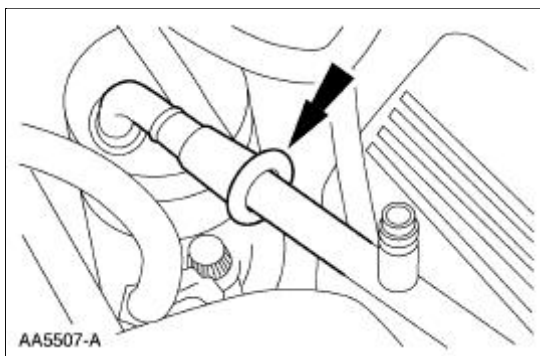


21. Install the safety clip.

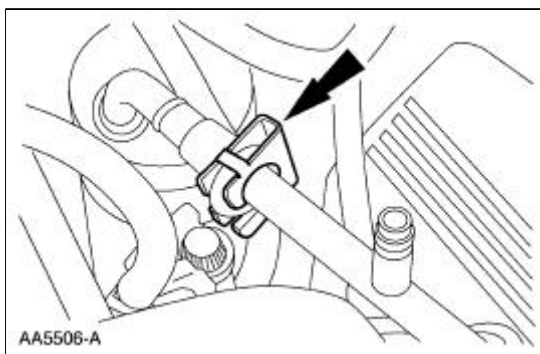


22. **NOTE:** The O-ring seal must be inspected and cleaned before installation. For additional information, refer to [Section 412-00](#).

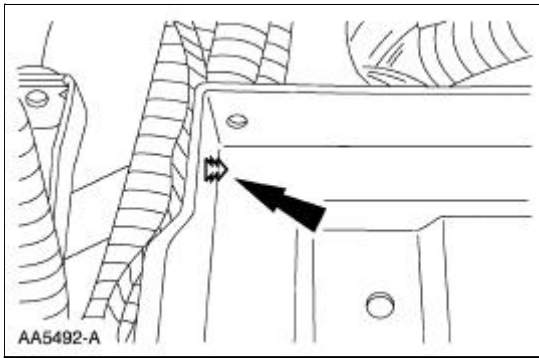
Connect the line to the receiver drier.



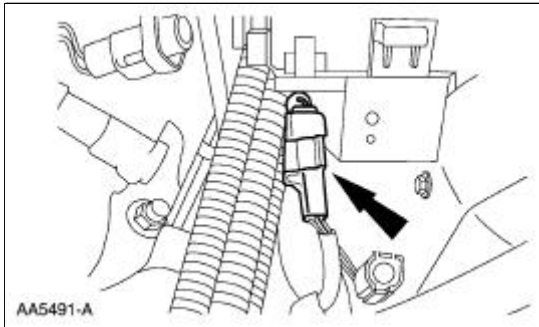
23. Install the safety clip.



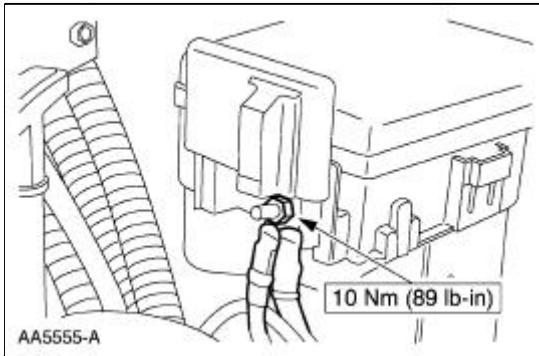
24. Connect the degas sensor lead to the battery tray.



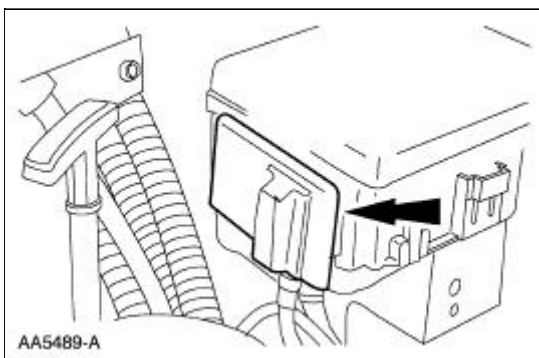
25. Connect the connector.



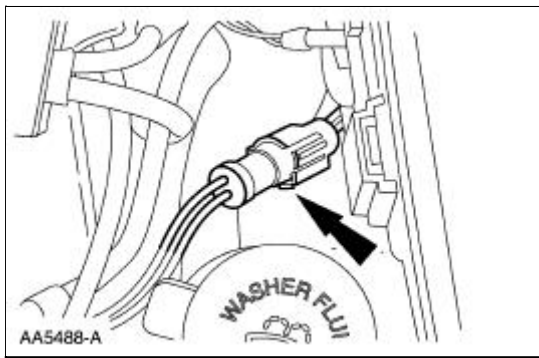
26. Install the battery leads.



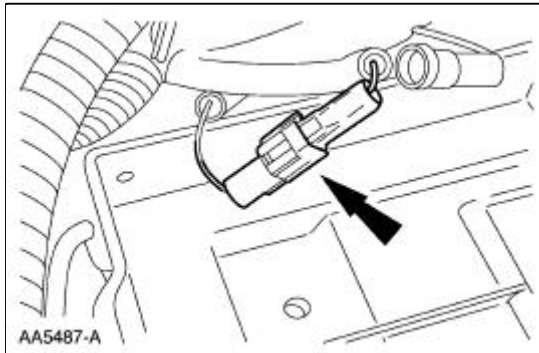
27. Position the access cover.



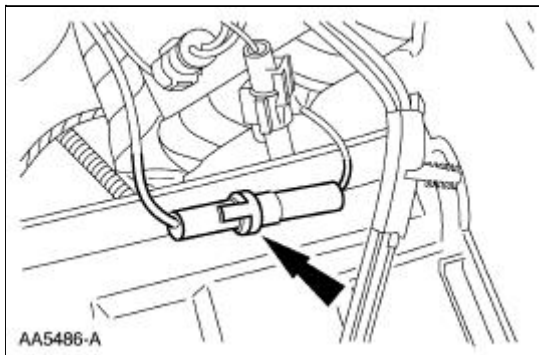
28. Connect the ground connector.



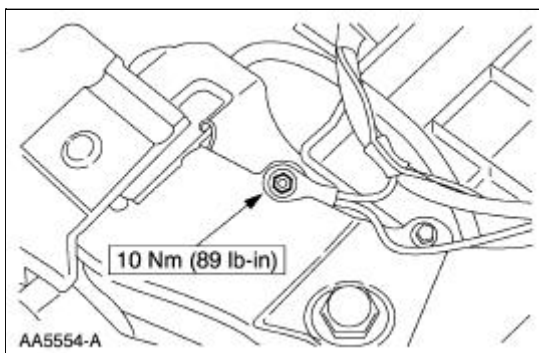
29. Connect the connector.



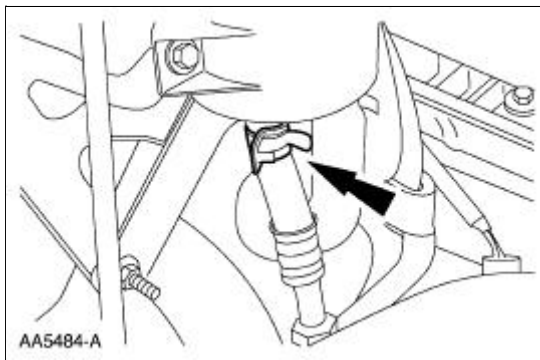
30. Connect the fuse link.



31. Install and tighten the body ground.

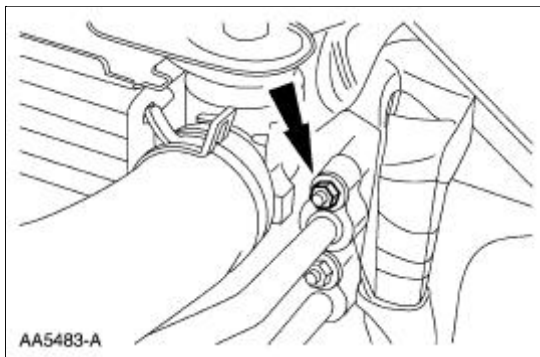


32. Connect the power steering line.

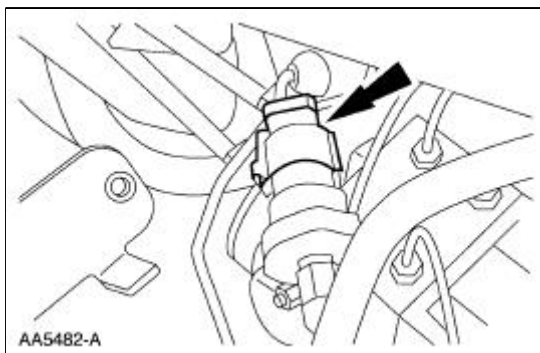


33. **NOTE:** The O-ring seal must be inspected and cleaned before installation. For additional information, refer to [Section 412-00](#).

Install the A/C line.

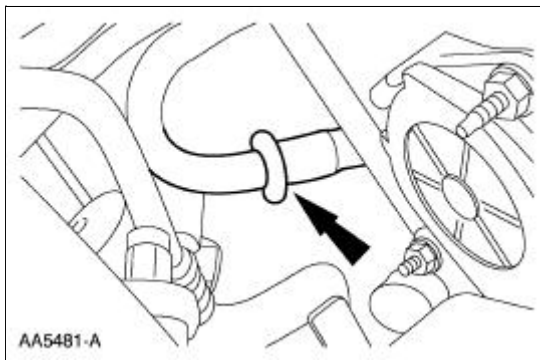


34. Connect the A/C pressure cycle switch.

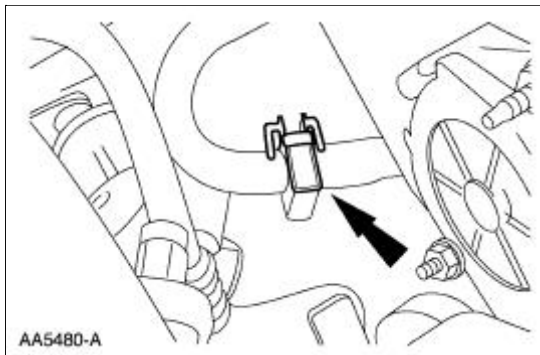


35. **NOTE:** The O-ring seal must be inspected and cleaned before installation. For additional information, refer to [Section 412-00](#).

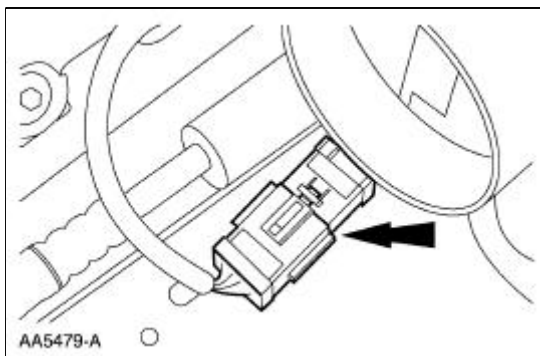
Connect the A/C manifold suction line.



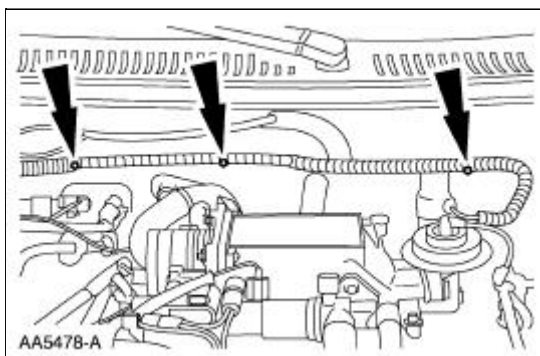
36. Install the safety clip to the manifold suction line.



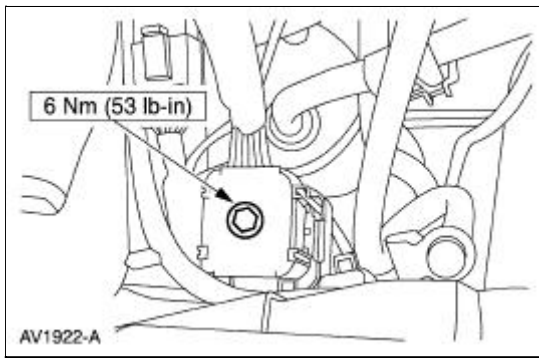
37. Connect the electrical connector.



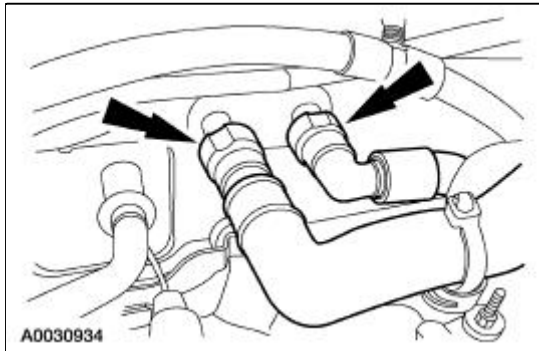
38. Connect the harness in three locations.



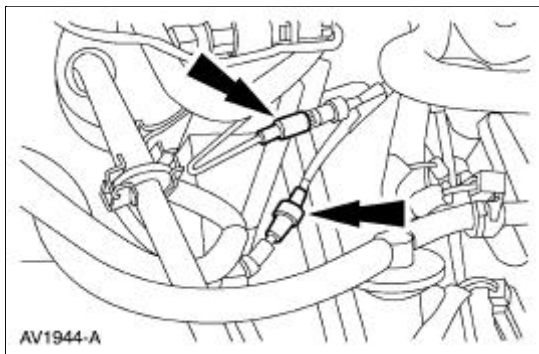
39. Connect the engine bulkhead connector.



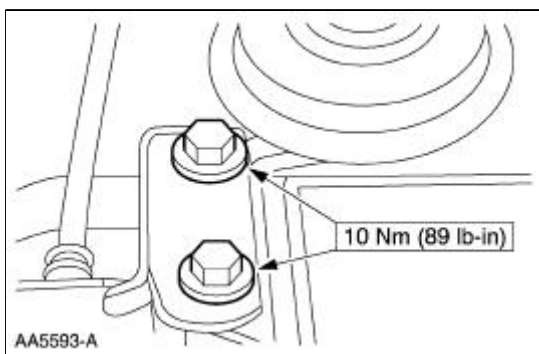
40. Connect the heater water hoses.



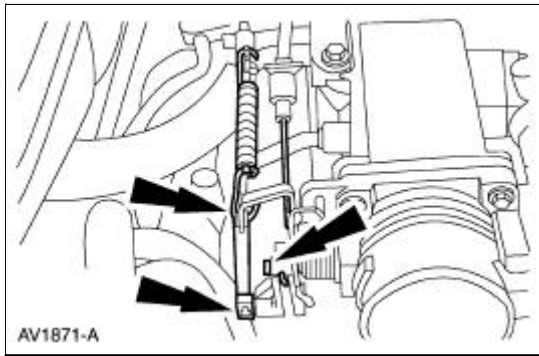
41. Connect the climate control vacuum supply lines.



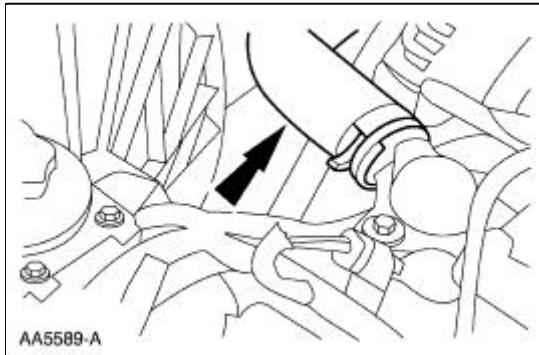
42. Position the cables and install the bracket.



43. Connect the throttle cable, speed control actuator cable and the return spring.



44. Connect the upper radiator hose from the water outlet adapter.



45. Connect the fuel lines. For additional information, refer to [Section 310-00](#).
 46. Install the battery. For additional information, refer to [Section 414-01](#).
 47. Install the air cleaner and outlet tube. For additional information, refer to [Section 303-12](#).
 48. Install the degas bottle. For additional information, refer to [Section 303-03A](#) or [Section 303-03B](#).
 49. Fill the fluids to the correct levels.
 50. Start the engine and check for leaks. Stop the engine and recheck the fluid levels.
 51. Recharge the A/C system. For additional information, refer to [Section 412-00](#).
 52. Install the hood.
-

General Specifications

Item	Specification
Lubricants and Sealants	
Motorcraft Premium Engine Coolant VC-4-A (In Oregon VC-5, In Canada CXC-10)	ESE-M97B44-A
Motorcraft Premium Gold Engine Coolant VC-7-A (In Oregon VC-7-B)	WSS-M97B51-A1
SAE 5W-20 Engine Premium Synthetic Blend Engine Oil XO-5W20-QSP	WSS-M2C153-H
Metal Surface Cleaner F4AZ-19A536-RA	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4
Pipe Sealant with Teflon® D8AZ-19554-A	WSK-M2G350-A2
Threadlock 262 E2FZ-19554-B	WSK-M2G351-A6
Engine	
Displacement	4.6L (4V) (281 CID)
Number of cylinders	8
Bore	90.2 mm (3.55 in)
Stroke	90.0 mm (3.54 in)
Firing order	1-3-7-2-6-5-4-8
Oil pressure	138-310 kPa
Oil capacity	6 ± 0.25 ^a
Compression ratio	8.5:1
Cylinder Head and Valve Train	
Cylinder head gasket surface flatness	0.10 mm (0.004 inch) max. overall
Combustion chamber volume	52.6 ± 0.5 cm
Valve arrangement (front to rear) ^b Intake (left hand):	S-P-S-P-S-P-S-P
Valve arrangement (front to rear) Exhaust (left hand):	E-E-E-E-E-E-E-E
Valve arrangement (front to rear) Intake (right hand):	P-S-P-S-P-S-P-S
Valve arrangement (front to rear) Exhaust (right hand):	E-E-E-E-E-E-E-E
Valve guide bore diameter	7.015-7.044 mm (0.2762-0.2773 in)
Valve stem diameter—intake	6.975-6.995 mm (0.2754-0.2746 inch)
Valve stem diameter—exhaust	6.949-6.970 mm (0.2744-0.2736 inch)
Valve stem-to-guide clearance—intake	0.020-0.069 mm (0.00078-0.00272 inch)
Valve stem-to-guide clearance—exhaust	0.046-0.094 mm (0.0018-0.0037 in)
Valve head diameter—intake	37 mm (1.46 inch)

Valve head diameter—exhaust	30 mm (1.18 inch)
Valve face runout	0.05 mm (0.002 in)
Valve face angle	45.5 degrees
Valve seat width—intake	1.8-2.2 mm (0.071-0.086 inch)
Valve seat width—exhaust	1.8-2.2 mm (0.071-0.086 inch)
Valve seat runout	0.05 mm (0.002 inch)
Valve seat angle	45 degrees
Valve spring free length—intake	42.16 mm (1.6598 inch)
Valve spring free length—exhaust	42.16 mm (1.6598 inch)
Valve spring squareness	2 degrees
Valve spring compression pressure—intake	711.47 N @ 26.19 mm (159.9 lb-ft @ 1.031 inch)
Valve spring compression pressure—exhaust	711.47 N @ 26.19 mm (159.9 lb-ft @ 1.031 inch)
Valve spring installed height	36.14 mm (1.4228 in)
Valve spring installed pressure—intake	289.1 N @ 36.14 mm (64.99 lb-ft @ 1.4228 inch)
Valve spring installed pressure—exhaust	289.1 N @ 36.14 mm (64.99 lb-ft @ 1.4228 inch)
Roller follower ratio	1.8:1
Hydraulic Lash Adjuster	
Diameter	16.000-15.988 mm (0.6299-0.6294 inch)
Clearance-to-bore	0.018-0.069 mm (0.000709-0.002717 inch)
Service limit	0.016 mm (1.0006299 inch)
Hydraulic leakdown rate °	5-25 seconds
Collapsed lash adjuster gap	0.80-1.20 mm (0.0315-0.0472 inch)
Camshaft	
Theoretical valve lift @ 0 lash—intake (primary and secondary)	10.0 mm (0.3937 inch)
Theoretical valve lift @ 0 lash—exhaust	10.0 mm (0.3937 inch)
Lobe lift	5.54 mm (0.218 in)
Allowable lobe lift loss	0.130 mm (0.0051 in)
Journal diameter	26.962-26.936 mm (1.0615-1.0605 inch)
Camshaft journal bore inside diameter	27.012-26.987 mm (1.0635-1.0625 in)
Camshaft journal-to bearing clearance	0.025-0.076 mm (0.00098-0.002992 inch)
Runout	0.025 mm (0.0010 in)
End play	0.025-0.165 mm (0.00098-0.00649 inch)
Cylinder Block	
Cylinder bore diameter	90.2-90.239 mm
Cylinder bore maximum taper	0.016 mm
Cylinder bore maximum out-of-round	0.016 mm
Main bearing bore diameter	72.402-72.422 mm

Head gasket surface flatness	0.15 mm (0.006 in) max. overall
Crankshaft	
Main bearing journal diameter	67.493 mm
Main bearing journal maximum taper	0.05 mm
Main bearing journal maximum out-of round	0.05 mm
Main bearing journal-to-cylinder block clearance	0.023-0.055 mm
Connecting rod journal diameter	56.866-56.886 mm
Connecting rod journal maximum taper	0.004 mm (0.0002 in)
Connecting rod journal maximum out-of-round	0.004 mm (0.0002 in)
Crankshaft maximum end play	0.130-0.301 mm
Thrust bearing journal diameter	67.493 mm
Thrust bearing journal maximum out-of round	0.05 mm
Thrust bearing journal maximum taper	0.05 mm
Thrust bearing journal length	17.725-17.775 mm
Piston and Connecting Rod	
Piston diameter	90.180-90.191 mm
Piston-to-cylinder bore clearance	-0.010/+0.026 mm
Piston ring end gap — compression (top)	0.30 mm
Piston ring end gap — compression (bottom)	0.50 mm
Piston ring end gap — compression (oil ring)	0.65 mm
Piston ring groove width — compression (top)	1.53-1.549 mm
Piston ring groove width — compression (bottom)	1.519-1.539 mm
Piston ring groove width — oil ring	3.031-3.055 mm
Piston ring width — compression (top)	1.47-1.49 mm
Piston ring width — compression (bottom)	1.47-1.49 mm
Piston ring width — oil ring	2.854-2.984 mm
Piston ring-to groove clearance — compression (top)	0.04-0.079 mm
Piston ring-to groove clearance — compression (bottom)	0.029-0.069 mm
Piston ring-to groove clearance — oil ring	0.047-0.201 mm
Piston pin bore diameter	22.0042-21.998 mm
Piston pin diameter	21.991-29.994 mm
Piston pin length	61.60-62.03 mm
Piston pin-to-piston fit	0.0058-0.0132 mm
Connecting rod-to-pin clearance	0.018-0.033 mm
Connecting rod pin bore diameter	22.012-22.024 mm
Connecting rod length	150.7 mm
Connecting rod maximum allowed bend	0.038 mm per 25 mm
Connecting rod maximum allowed twist	0.050 mm per 25 mm
Connecting rod bearing bore diameter	56.866-56.886 mm
Connecting rod bearing-to-crankshaft clearance	0.027-0.069 mm
Connecting rod side clearance	0.15-0.45 mm

^a With installation of a new filter.

^b P=Primary, S=Secondary, E=Exhaust

^c Time necessary for plunger to leak down 1.6 mm of travel with 222 N force and leak down fluid in tappet.

Torque Specifications

Description	Nm	lb-ft	lb-in
A/C compressor bolts	25	18	—
A/C peanut fittings	8	—	71
A/C muffler nut	25	18	—
Accelerator bracket bolts	10	—	89
Battery tray bolts	11	8	—
Belt idler support bracket assembly fasteners	25	18	—
Camshaft sprocket bolt	115	85	—
Coolant bypass tube studs	25	18	—
Coolant bypass tube bolts	25	18	—
Coolant hose and tube assembly bolt	25	18	—
Cooling fan motor and shroud bolts	10	—	89
Connecting rod bolt ^a	—	—	—
Engine front cover bolt	a	a	a
Drive belt tensioner bolts	25	18	—
Cylinder head bolt ^a	—	—	—
Idler pulley bracket	25	18	—
Power steering pump bolts	25	18	—
Power steering hose fitting	65	48	—
Power steering hose bracket bolt	10	—	89
Pulley to crankshaft bolt ^a	—	—	—
EGR valve to intake manifold ^a	—	—	—
Engine coolant degas bottle bolts	10	—	89
Exhaust manifold studs	25	18	—
Generator bolts	25	18	—
Generator support bracket bolts	25	18	—
Hood prop bolt	10	—	89
Hood mounting nuts	12	9	—
Heater water inlet tube	10	—	89
Heater water outlet tube	24	18	—
Lower intake manifold-to-cylinder head bolt ^a	—	—	—
Main bearing cap bolt ^a	—	—	—
Oil filter adapter bolt	25	18	—
Oil bypass filter to adapter	50	37	—
Oil pump screen cover and tube-to-oil pump bolt	10	—	89
Oil pan-to-cylinder block bolt ^a	—	—	—

Oil pan-to-engine front cover bolts ^a	—	—	—
Oil pump-to-cylinder block bolt	10	—	89
Radio ignition interference capacitor bolts	25	18	—
Oil pump screen and pickup tube-to-main bearing cap stud spacer bolt	25	18	—
Water pump pulley bolts	25	18	—
Throttle body spacer nuts	25	18	—
Vacuum accessory bracket fasteners	10	—	89
Valve cover bolt	10	—	89
Wiring harness support bracket	25	18	—
Water pump-to-cylinder block bolt	25	18	—
EGR valve to exhaust manifold tube nuts	40	30	—
Power steering pump to engine	25	18	—
Power steering hose bracket nut	25	18	—
Power steering reservoir bracket fasteners	10	—	89
Supercharger degas bottle bolts	10	—	89
Camshaft cap cluster to cylinder head	10	—	89
Timing chain tensioner bolts—primary	25	18	—
Timing chain tensioner bolts—secondary	10	—	89
Ignition coil cover bolts	10	—	89
Generator mounting bracket retainers	10	—	89
Oil level indicator tube retainer	10	—	89
Primary timing chain guide-to-engine bolts	10	—	89
Oil pump screen and pickup tube spacer to main bearing stud	25	18	—
Belt idler pulley bolt	25	18	—
Subframe brace nuts	41	30	—

^a Refer to the procedure.

Engine



WARNING: Do not operate the engine with the hood open until the fan blade has been first examined for possible cracks and separation.

The 4.6L (4V) (281 CID) Cobra engine is a V-8 with the following features:

- intercooled supercharger
- dual overhead camshafts
- four valves per cylinder
- sequential multiport fuel injection (SFI)
- an aluminum intake manifold
- aluminum cylinder heads
- a cast aluminum, 90-degree V- cylinder block
- individually chain-driven camshafts with a hydraulic timing chain tensioner on each timing chain
- the electronic ignition system with eight ignition coils

Identification

Always refer to these labels when replacement parts are necessary or when checking engine calibrations. The engine parts often differ within a CID family. Verification of the identification codes will ensure that the correct parts are obtained. These codes contain all the pertinent information relating to the dates, optional equipment and revisions. The Ford Master Parts Catalog contains a complete listing of the codes and their application.

Code Information

The engine code information label, located on the side of the valve cover and the front side of the valve cover, contains the following:

- engine build date
- engine plant code
- engine code

Exhaust Emission Control System

Operation and necessary maintenance of the exhaust emission control devices used on this engine is covered in the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Induction System

The sequential multiport fuel injection (SFI) provides the fuel/air mixture needed for combustion in the cylinders. The eight solenoid-operated fuel injectors:

- are mounted in the lower intake manifold.
- meter fuel into the air intake stream in accordance with engine demand.

- are positioned so that their tips direct fuel just ahead of the engine intake valves.
- are connected in series with the fuel pressure sensor.
- supply fuel from the fuel tank with a fuel pump mounted in the fuel tank.

A constant fuel pressure drop is maintained across the fuel injectors by the fuel pressure sensor. The fuel pressure sensor:

- is positioned upstream from the fuel injectors on the fuel injection supply manifold.

Valve Train

The valve train operates as follows:

- ball-tip hydraulic lash adjusters provide automatic lash adjustment.
- roller followers ride on the camshaft lobes, transferring the up-and-down motion of the camshafts to the valves in the cylinder heads.

Positive Crankcase Ventilation System

All engines are equipped with a closed-type positive crankcase ventilation system recycling the crankcase vapors to the upper intake manifold.

Lubrication System

The engine lubrication system operates as follows:

- oil is drawn into the oil pump through the oil pump screen cover and tube in the sump of the oil pan.
- oil is pumped through the oil bypass filter on the left front side of the cylinder block.
- oil enters the main oil gallery where it is distributed to the crankshaft main journals and to both cylinder heads.
- From the main journals, the oil is routed through cross-drilled passages in the crankshaft to lubricate the connecting rod bearings. Controlled leakage through the crankshaft main bearings and connecting rod bearings is slung radially outward to cool and lubricate the cylinder walls as well as the entire connecting rod, piston and piston rings assembly.
- The left cylinder head is fed from a drilling into the supply passage feeding the main gallery at the front of the cylinder block. The right cylinder head is fed from a drilling into the rear of the main gallery. Main gallery pressure is reduced as it enters the cylinder head galleries through fixed serviceable orifices located at the upper part of the feed passages. It is this reduced pressure in the cylinder head galleries which feeds the camshaft journals, the hydraulic lash adjusters and the primary and secondary timing chain tensioners.
- The camshaft lobe and roller followers are lubricated by splash created through valve train operation.

Oil Pump

The lubrication system of the 4.6L (4V) engine is designed to provide optimum oil flow to critical components of the engine through its entire operating range. The heart of the system is a positive displacement internal gear oil pump using top seal rotors. Generically this design is known as a gerotor pump, which operates as follows.

- The oil pump is mounted on the front face of the cylinder block.

- The inner rotor is piloted on the crankshaft post and is driven through flats on the crankshaft.
- System pressure is limited by an integral, internally-vented relief valve which directs the bypassed oil back to the inlet side of the oil pump.
- Oil pump displacement has been selected to provide adequate volume to ensure correct oil pressure both at hot idle and maximum speed.
- The relief valve calibration protects the system from excessive pressure during high viscosity conditions.
- The relief valve is designed to provide adequate connecting rod bearing lubrication under high-temperature and high-speed conditions.

Cooling System

The engine cooling system includes the following:

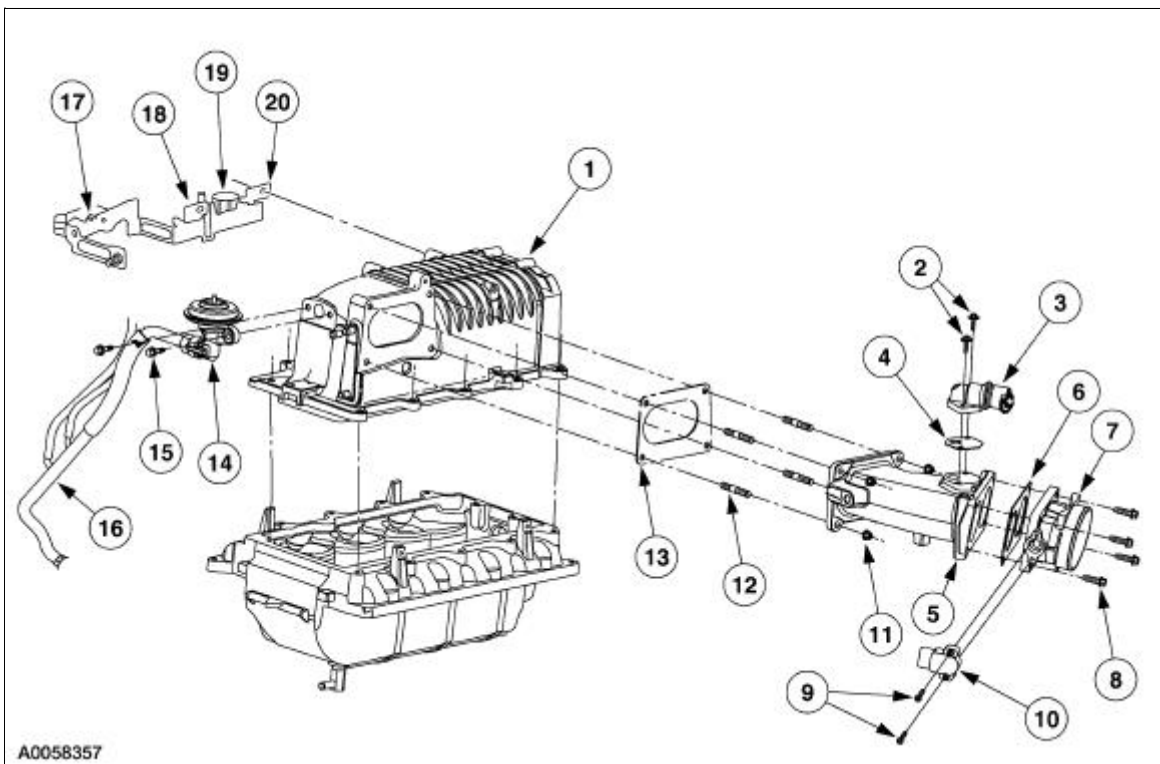
- radiator
- water pump
- the electric cooling fan motor and fan blade, activated by the variable control module
- the degas bottle, which aids in maintaining the correct volume of engine coolant
- water thermostat
- upper radiator hose
- lower radiator hose
- heater water hoses

Drive Belt System

The 4.6L (4V) DOHC engine is equipped with a serpentine drive belt. To ensure maximum life, a replacement drive belt should be of the same type as originally installed.

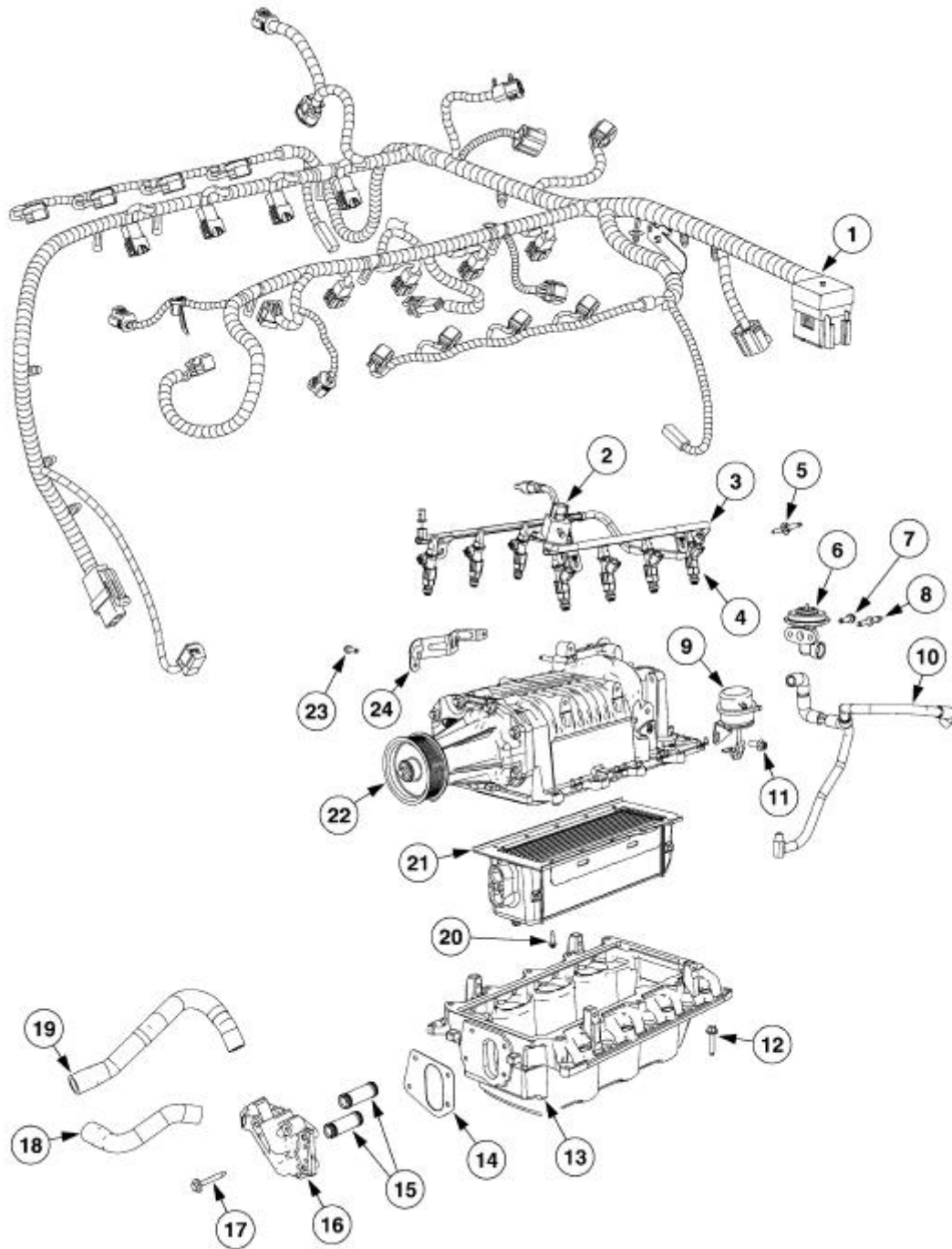
- The accessories mounted on the front of the engine are belt-driven by the crankshaft.
- The serpentine drive belt is routed over each accessory pulley, driven by the crankshaft pulley bolted to the crankshaft.

For service procedures, including tensioning, refer to [Section 303-05](#).



A0058357

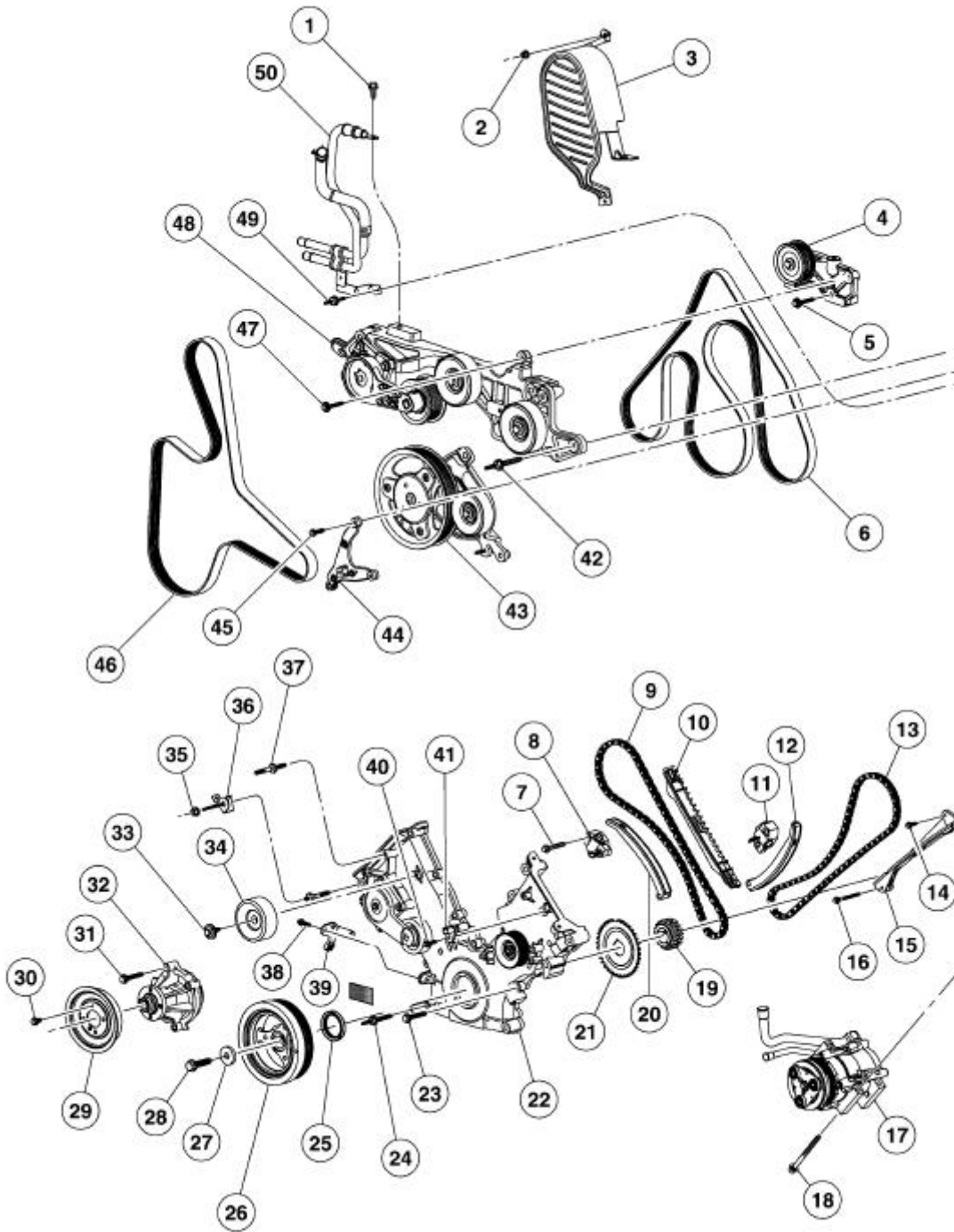
Item	Part Number	Description
1	6F066	Supercharger assembly
2	N806154	Screws (2 req'd)
3	9F715	Idle air control valve
4	—	Idle air control valve gasket
5	9P697	Spacer assembly
6	9E936	Throttle body gasket
7	9E926	Throttle body
8	—	Bolts (4 req'd)
9	—	Bolts (2 req'd)
10	9E926	Throttle position sensor
11	N804178	Nuts (4 req'd)
12	—	Studs (4 req'd)
13	—	Spacer assembly gasket
14	9D475	Exhaust gas recirculation valve
15	—	Stud
16	9D477	Exhaust gas recirculation tube
17	—	Manifold absolute pressure sensor
18	9J460	Differential pressure feedback EGR system
19	9J459	Exhaust gas recirculation vacuum regulator
20	9J472	Vacuum accessory bracket



A0058355

Item	Part Number	Description
1	12B637	Wiring harness
2	9C986	Fuel pulse damper
3	9F792	Fuel injection supply manifold
4	9F593	Fuel injector
5	—	Stud
6	9D475	Exhaust gas recirculation valve
7	W701232	Bolt
8	N806979	Stud

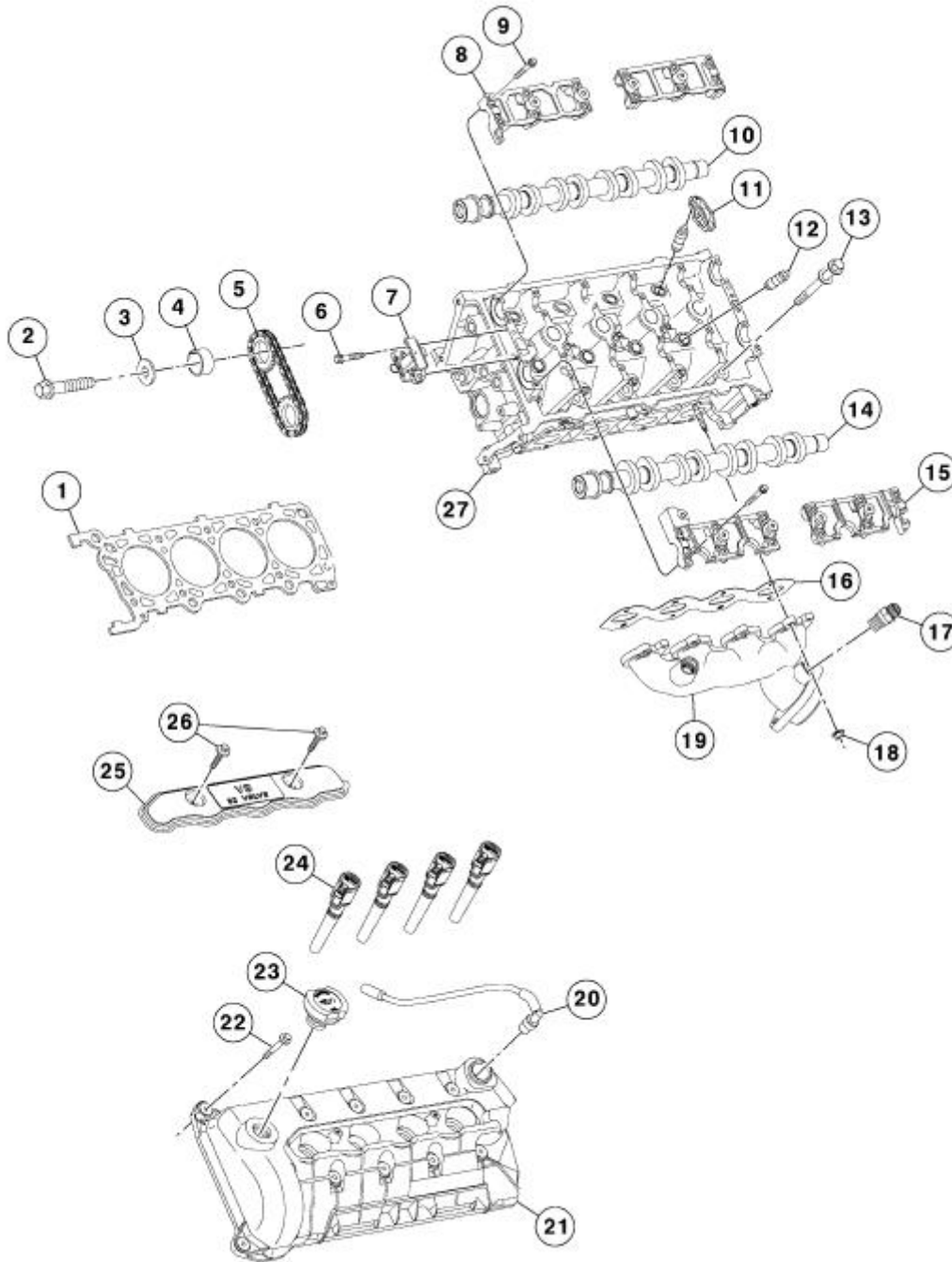
9	—	EGR vacuum hoses
10	6F089	Vacuum actuator valve
11	N605892	Bolts (2 req'd)
12	—	Bolts (10 req'd)
13	9J447	Lower intake manifold
14	9L438	Coolant intake manifold gasket
15	—	Coolant tubes
16	9N491	Coolant intake manifold
17	W701592	Bolt
18	NL443	Inter cooler hose
19	NL443	Inter cooler hose
20	W506404	Bolts (10 req'd)
21	6K755	Charge air cooler
22	6F066	Supercharger assembly
23	N605892	Bolt
24	9726	Accelerator cable bracket



A0058356

Item	Part Number	Description
1	N605904	Bolt
2	N620480	Nut
3	6A946	Cover
4	17K814	Alternator bracket assembly
5	N811268	Bolts (2 req'd)
6	8620	Accessory drive belt
7	N606543	Bolt (4 req'd)
8	6L266	Timing chain tensioner

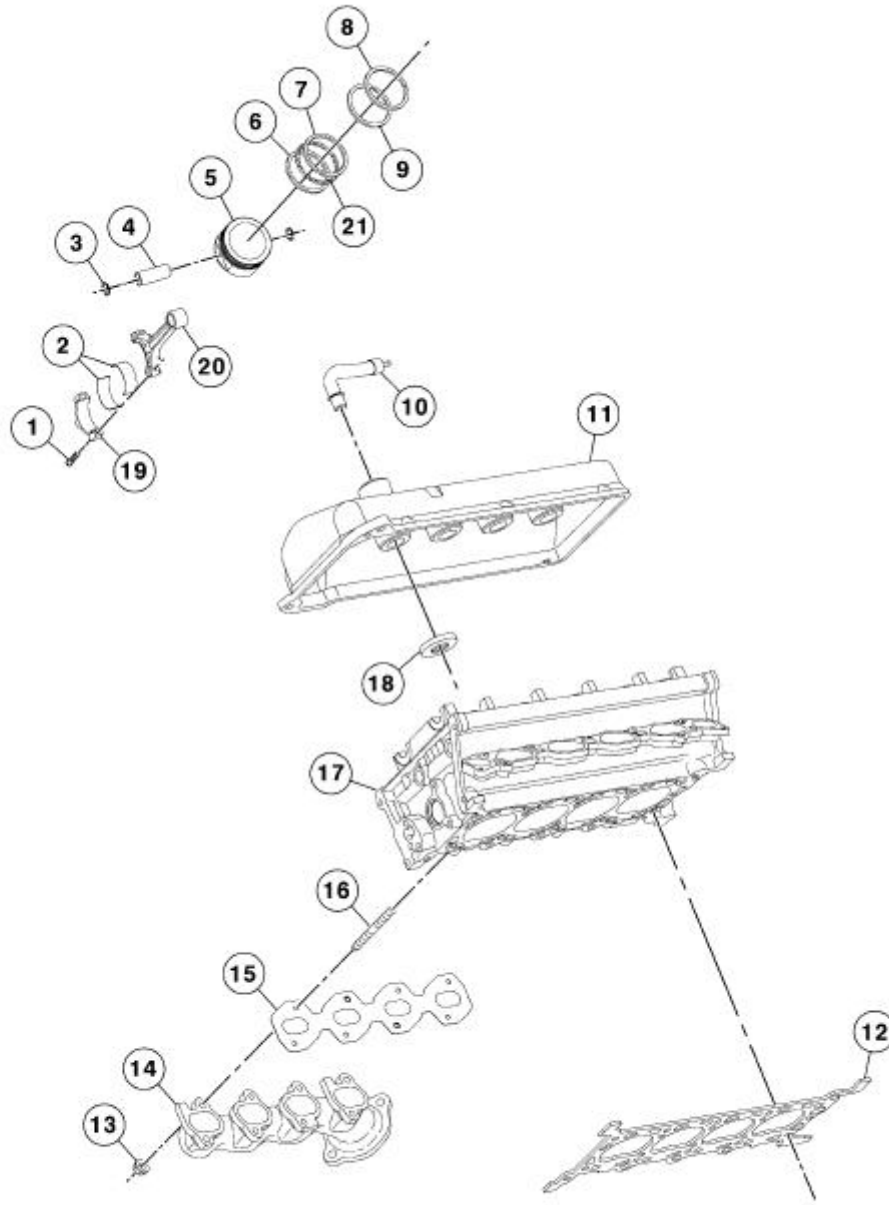
9	6268	Timing chain (2 req'd)
10	6M256	Timing chain guide
11	6L266	Timing chain tensioner
12	6L253	Timing chain tensioner arm
13	6268	Timing chain (2 req'd)
14	N804958	Bolt (2 req'd)
15	6B274	Timing chain guide
16	N606527	Bolt
17	19D269	A/C compressor
18	N806184	Bolts (3 req'd)
19	6306	Crankshaft sprocket
20	6L253	Timing chain tensioner arm
21	12A227	Ignition pulse ring
22	6C086	Engine front cover
23	N806177	Bolts (8 req'd)
24	N806300	Studs (5 req'd)
25	6700	Crankshaft front seal
26	6316	Crankshaft pulley
27	N806165	Washer
28	W701512	Stud
29	8A528	Water pump pulley
30	N806282	Bolts (4 req'd)
31	N806177	Bolts (4 req'd)
32	8501	Water pump
33	N808102	Bolt
34	19A216	Belt idler pulley
35	N804178	Nut
36	N806300	Harness support bracket
37	N806300	Stud
38	N806155	Bolt
39	6C315	Crankshaft position sensor
40	N806155	Bolt
41	6B288	Camshaft position sensor
42	N808920	Bolts (3 req'd)
43	6C254	Crankshaft extension support pulley
44	10153	Lower support bracket
45	N605909	Bolts (2 req'd)
46	8620	Accessory drive belt
47	N811268	Bolt
48	8B603	Belt idler bracket support
49	N808198	Stud
50		



A0032159

Item	Part Number	Description
1	6083	Cylinder head gasket
2	—	Bolt (2 req'd)
3	—	Washer (2 req'd)
4	6255	Spacer
5	—	Secondary timing chain (2 req'd)
6	—	Screw and washer
7	6C271	Timing chain vibration damper

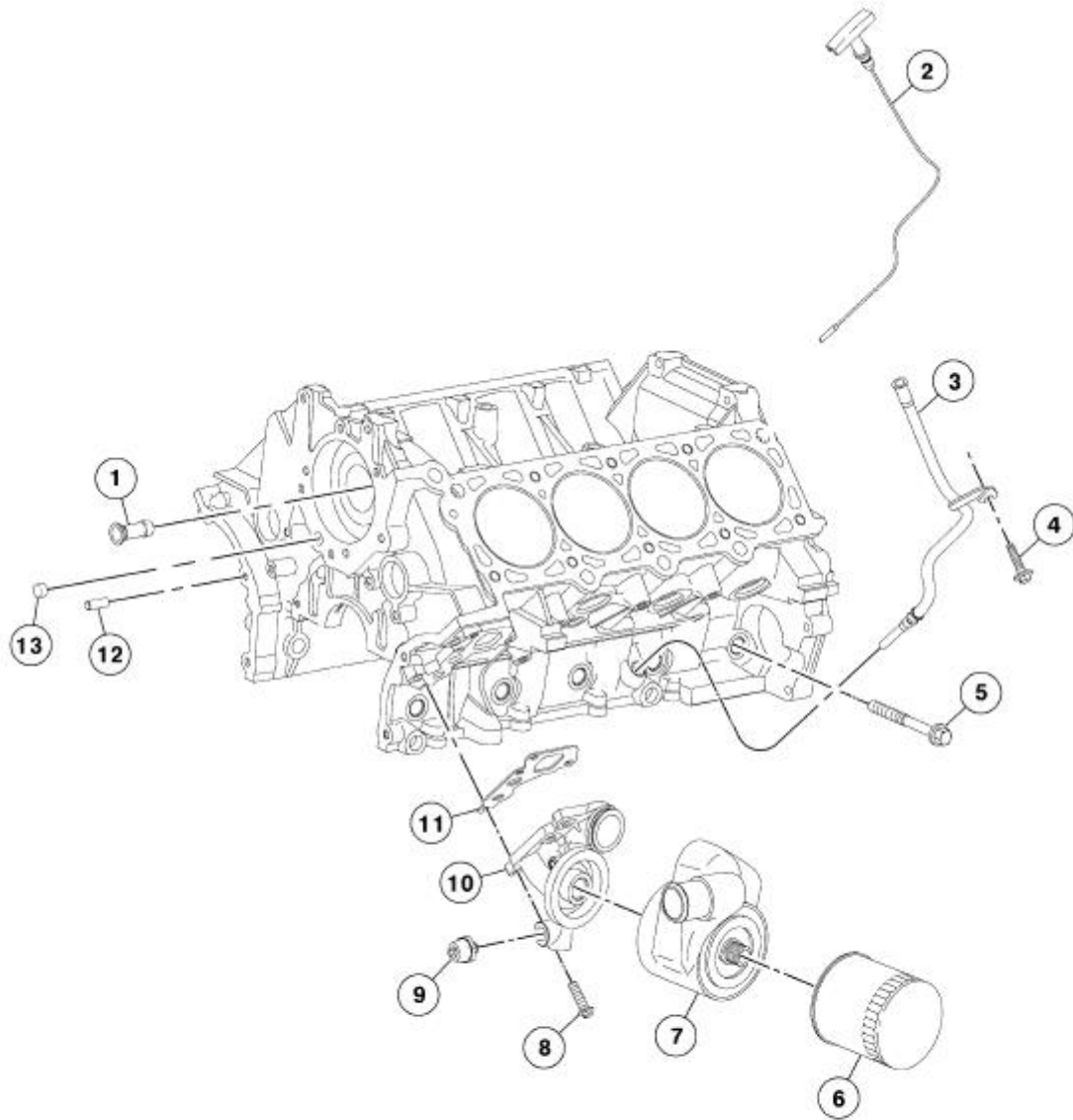
8	6B277	Camshaft bearing cap
9	—	Bolt (24 req'd)
10	6A271	Camshaft
11	6529	Roller follower (8 req'd)
12	6C501	Hydraulic lash adjuster
13	6065	Bolt (20 req'd)
14	6A273	Camshaft
15	6B278	Camshaft bearing cap (2 req'd)
16	9448	Exhaust manifold gasket
17	9F485	EGR valve tube to manifold connector
18	W701706	Nut (8 req'd)
19	9431	Exhaust manifold
20	6C324	PCV tube
21	6A505	Valve cover
22	N808199	Bolt (20 req'd)
23	6766	Oil filler cap
24	12A366	Ignition coils
25	6P068	Ignition coil cover
26	N807309	Bolt (4 req'd)
27	6050	Cylinder head



A0032161

Item	Part Number	Description
1	6214	Bolt (2 req'd)
2	6211	Connecting rod bearing (16 req'd)
3	6140	Piston pin retainer (16 req'd)
4	6135	Piston pin (8 req'd)
5	6110	Piston (8 req'd)
6	6159	Piston ring (8 req'd)
7	6159	Piston ring (8 req'd) (part of 6100)
8	6150	Piston ring (8 req'd) (part of 6100)

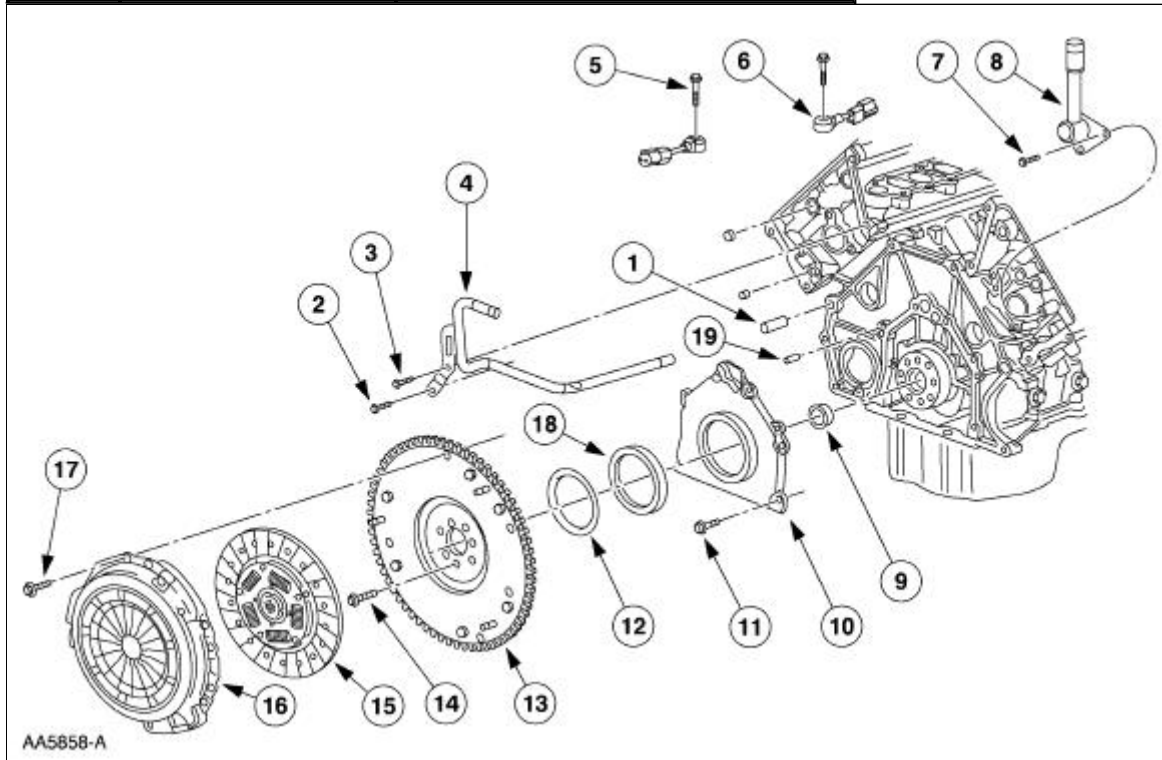
9	6152	Piston ring (8 req'd)
10	6758	Crankcase vent tube and connector
11	6582	Valve cover
12	6051	Cylinder head gasket
13	W701706	Nut (8 req'd)
14	9430	Exhaust manifold
15	9448	Exhaust manifold gasket
16	W701681	Stud (8 req'd)
17	6049	Cylinder head
18	6C527	Spark plug gasket (8 req'd)
19	6200	Connecting rod (8 req'd)
20	6200	Connecting rod (8 req'd)
21	6161	Piston ring (8 req'd)



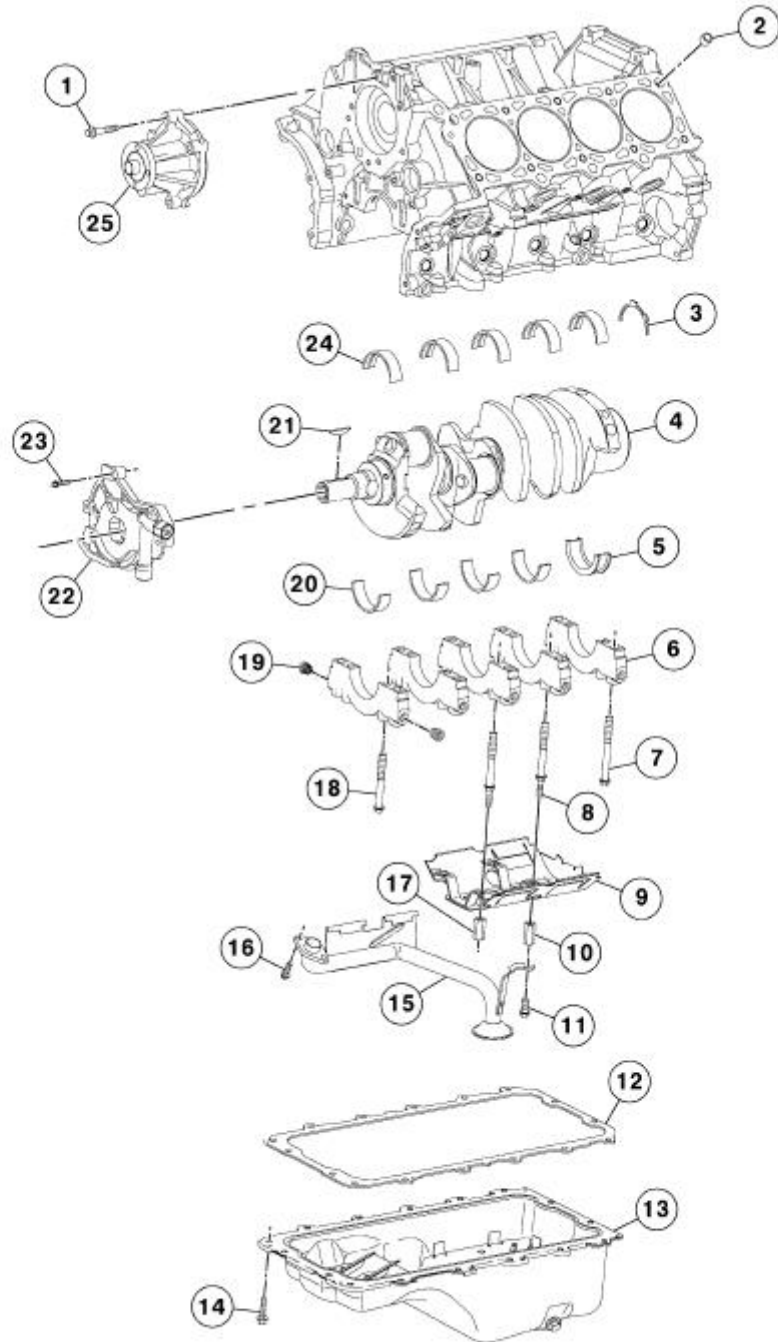
A0032162

Item	Part Number	Description
1	8555	Water bypass tube
2	6750	Oil level indicator
3	6754	Oil level indicator tube
4	N806155	Bolt
5	6C358	Bolt (10 req'd)
6	6714	Oil bypass filter
7	6A642	Oil cooler
8	N806156	Bolt (4 req'd)

9	9278	Oil pressure sender
10	6884	Oil filter adapter
11	6A636	Oil filter adapter gasket
12	N620482	Dowel
13	87836	Plug



Item	Part Number	Description
1	N807198	Dowel pin (2 req'd)
2	N807309	Bolt
3	N807959	Bolt
4	18663	Heater water hose
5	W500110	Bolt (2 req'd)
6	12A699	Knock sensor (2 req'd)
7	N807309	Bolt (2 req'd)
8	18696	Heater water hose
9	7120	Pilot bearing
10	6K318	Crankshaft rear retainer
11	N806155	Bolt (6 req'd)
12	6310	Crankshaft oil slinger
13	6375	Flywheel
14	N808139	Bolt (8 req'd)
15	7550	Clutch disc
16	7563	Clutch pressure plate
17	N808969	Bolt (6 req'd)
18	6701	Crankshaft rear oil seal



A0032163

Item	Part Number	Description
1	N806177	Bolt (4 req'd)
2	N806459	Dowel (4 req'd)
3	6A341	Thrust washer
4	6303	Crankshaft
5	6A339	Thrust bearing
6	6325	Main bearing cap (5 req'd)
7	6345	Bolt (10 req'd)

8	6K258	Stud (4 req'd)
9	6687	Oil pan baffle
10	N806180	Spacer
11	N605904	Bolt
12	6710	Oil pan gasket
13	6675	Oil pan
14	W701240	Bolt (16 req'd)
15	6622	Oil pump screen pickup and tube
16	N806155	Bolt (2 req'd)
17	N811280	Spacer (3 req'd)
18	6345	Bolt (6 req'd)
19	6C360	Main bearing cap adjusting screw (10 req'd)
20	6A338	Crankshaft main bearing (4 req'd)
21	N806201	Woodruff key
22	6621	Oil pump
23	N806183	Bolt (4 req'd)
24	6333	Crankshaft main bearing
25	8501	Water pump

Engine

Refer to [Section 303-00](#) for basic mechanical concerns or refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for driveability concerns.

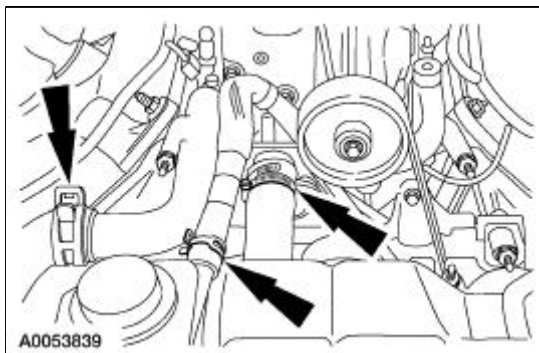
Lower Intake Manifold

Material

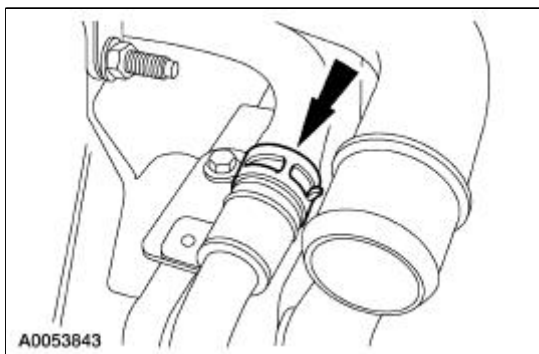
Item	Specification
Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10) (green color)	ESE-M97B44- A
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) (yellow color)	WSS-M97B51- A1

Removal and Installation

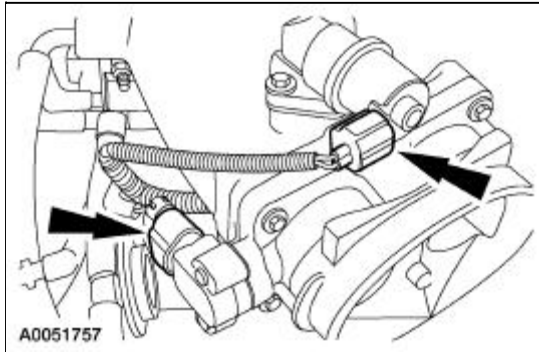
1. Drain the engine coolant. For additional information, refer to [Section 303-03A](#) in this section.
2. Drain the supercharger coolant. For additional information, refer to [Section 303-03B](#).
3. Release the fuel system pressure. For additional information, refer to [Section 310-00](#).
4. Disconnect the radiator upper hose, radiator lower hose and the supercharger degas hose.



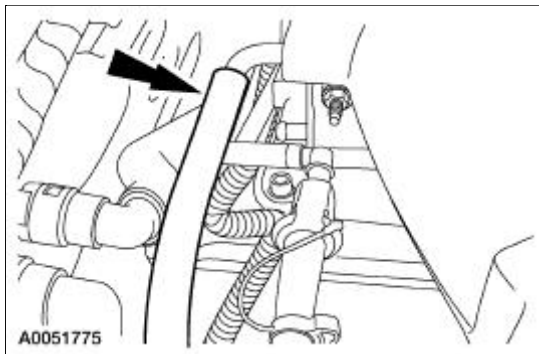
5. Remove the supercharger belt. For additional information, refer to [Section 303-05](#).
6. Disconnect the coolant hose.



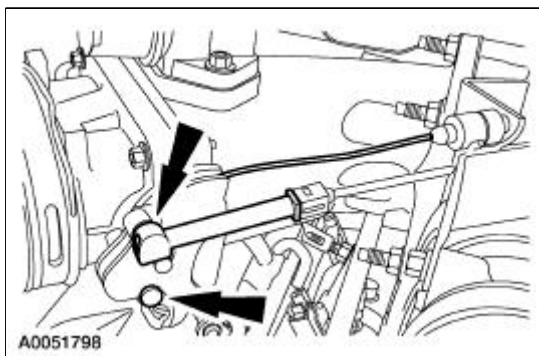
7. Remove the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).
8. Disconnect the throttle position (TP) sensor and the idle air control (IAC) valve electrical connectors.



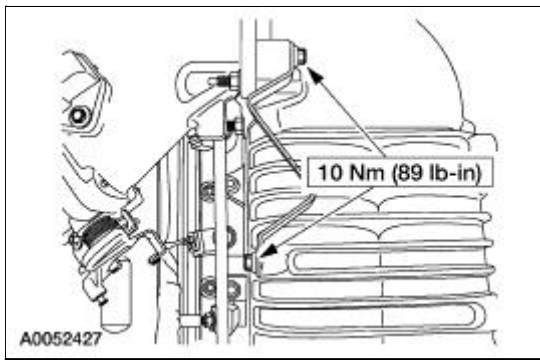
9. Disconnect the vacuum hose.



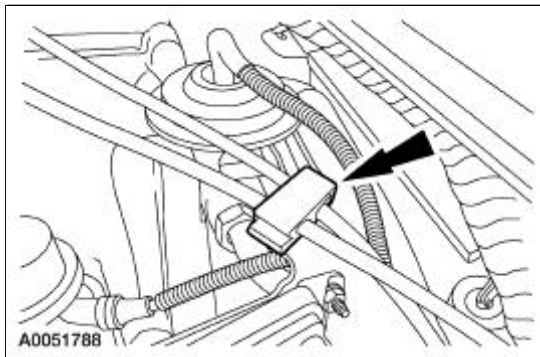
10. Disconnect the fuel hose spring lock coupling. For additional information, refer to [Section 310-00](#).
11. Disconnect the accelerator controls.
 - Disconnect the accelerator cable.
 - If equipped, disconnect the speed control cable.



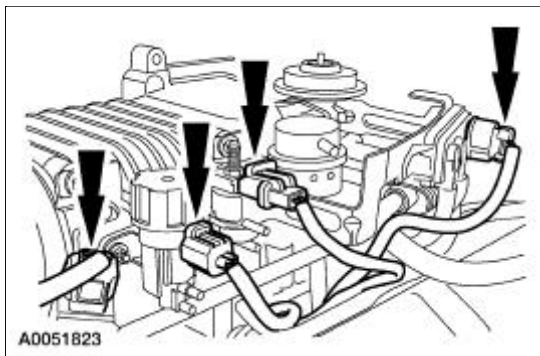
12. Remove the accelerator cable bracket bolts.



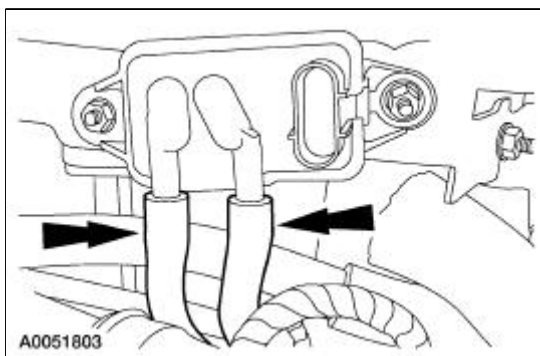
13. Release the clip and position the accelerator cable bracket and the cables aside.



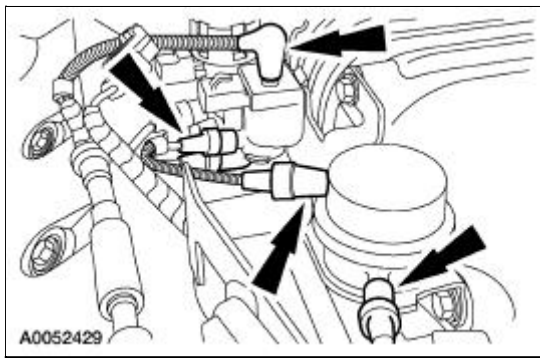
14. Disconnect the electrical connectors from the fuel pulse damper, exhaust gas recirculation (EGR) vacuum regulator solenoid, supercharger bypass vacuum solenoid, and the differential pressure feedback EGR system.



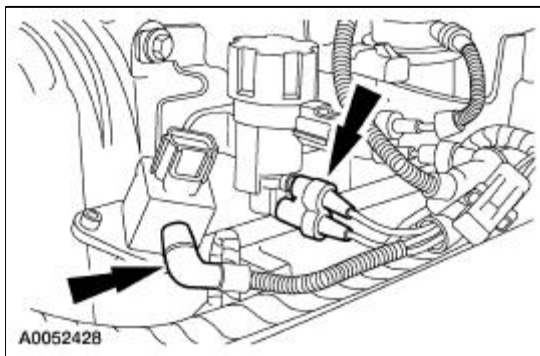
15. Disconnect the vacuum hoses from the differential pressure feedback EGR system.



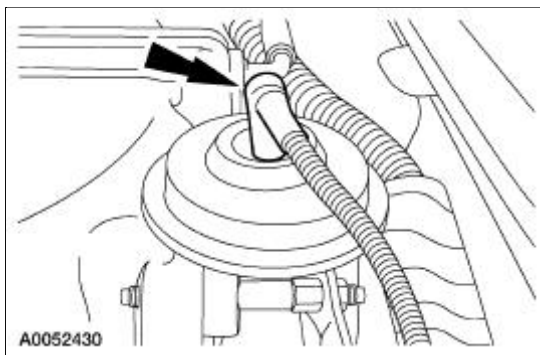
16. Disconnect the vacuum hoses from the supercharger bypass vacuum solenoid and the actuator.



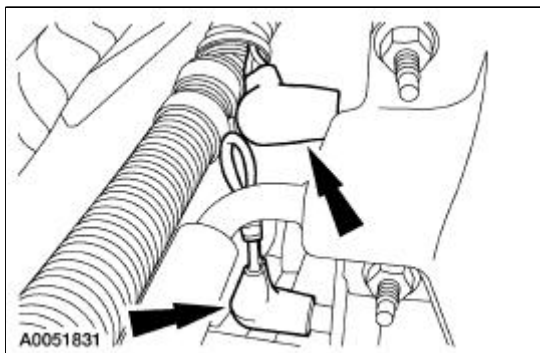
17. Disconnect the vacuum hoses from the fuel pulse damper and the EGR vacuum regulator solenoid.



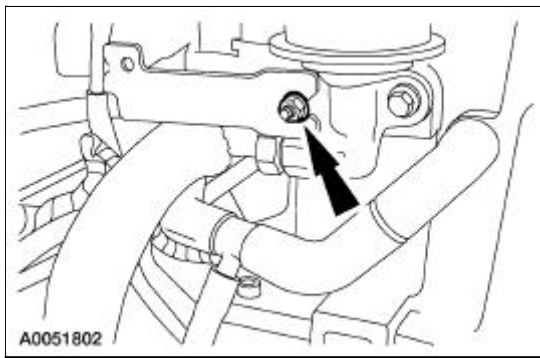
18. Disconnect the vacuum hose from the EGR valve.



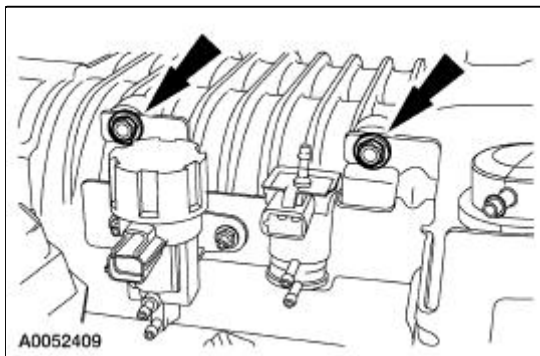
19. Disconnect the vacuum hoses at the back of the supercharger and position the vacuum harness aside.



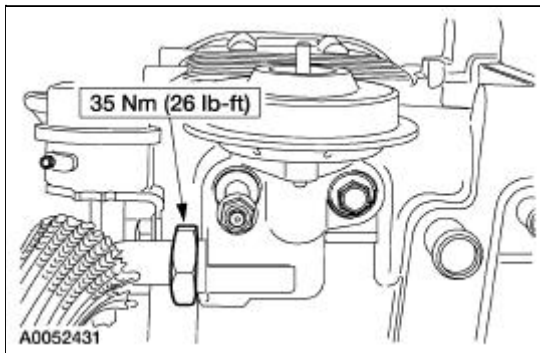
20. Remove the vacuum accessory bracket mounting nut.



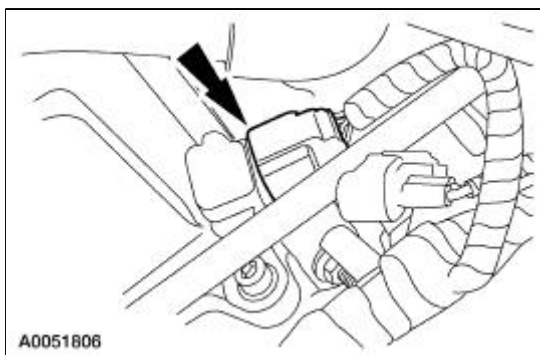
21. Remove the mounting bolts and the vacuum accessory bracket.



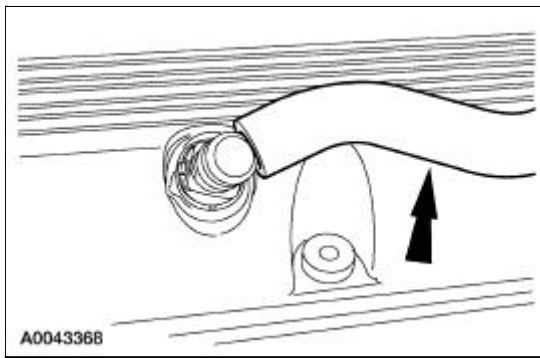
22. Disconnect the exhaust manifold to EGR valve tube.



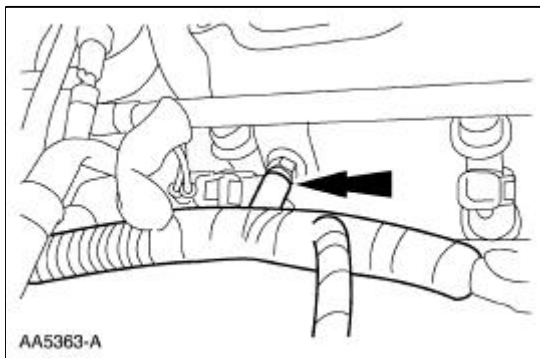
23. Disconnect the barometric pressure (BARO) sensor electrical connector.



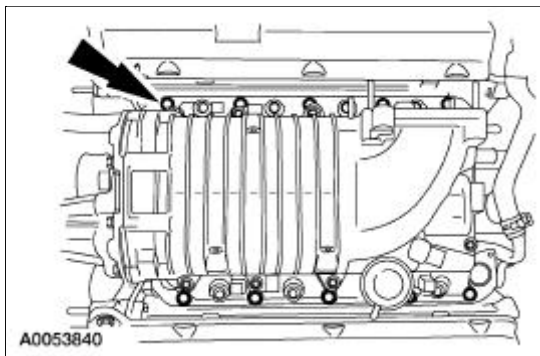
24. Disconnect the positive crankcase ventilation hose.



25. Separate the fuel charging wiring harness from the fuel injection supply manifold in four places and position the harness aside.



26. Remove the ten bolts and the intake manifold, and the supercharger and fuel supply manifold as an assembly.

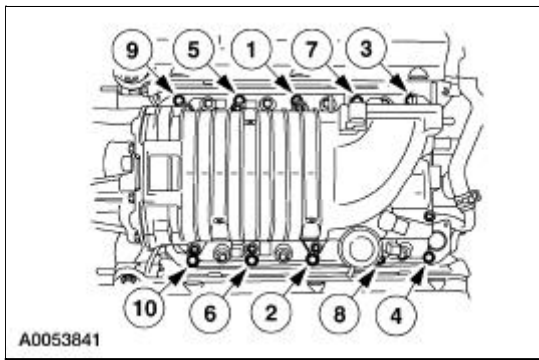


27. **NOTE:** Inspect the intake manifold gaskets and install new gaskets, if necessary.

NOTE: Install new bypass tube O-rings and lubricate them, using premium engine coolant.

To install, reverse the removal procedure.

- Tighten the intake manifold bolts in the sequence shown.



28. Fill and bleed the engine cooling system. For additional information, refer to [Section 303-03A](#) in this section.
 29. Fill and bleed the supercharger cooling system. For additional information, refer to [Section 303-03B](#).
-

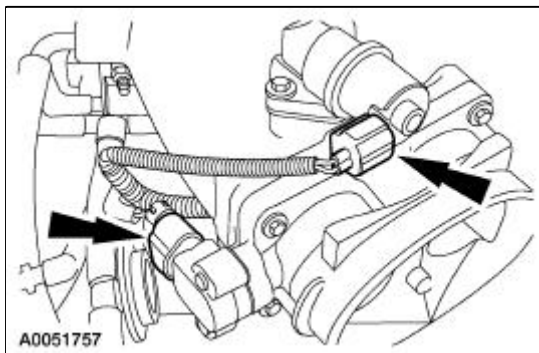
Valve Cover RH

Material

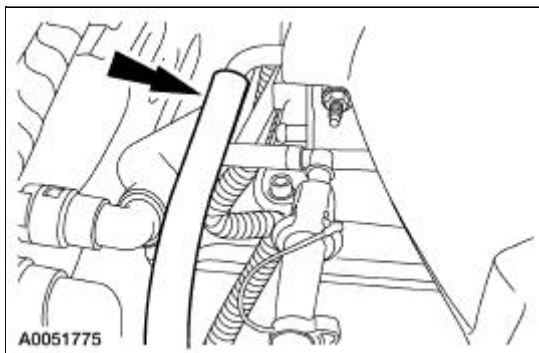
Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4
Metal Surface Cleaner F4AZ-19A536-RA	WSE-M5B392-A

Removal and Installation

1. Remove the RH ignition coils. For additional information, refer to [Section 303-07C](#).
2. Remove the A/C condenser to evaporator tube. For additional information, refer to [Section 412-03](#).
3. Remove the A/C manifold and tube assembly. For additional information, refer to [Section 412-03](#).
4. Disconnect the throttle position (TP) sensor and the idle air control (IAC) valve electrical connectors.

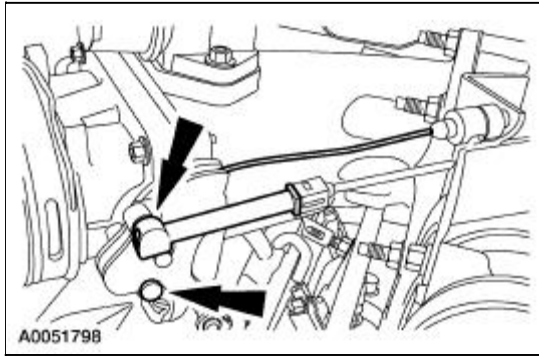


5. Disconnect the vacuum hose.

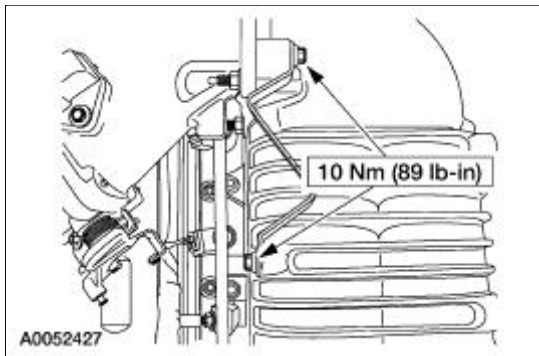


6. Disconnect the fuel hose spring lock coupling. For additional information, refer to [Section 310-00](#).

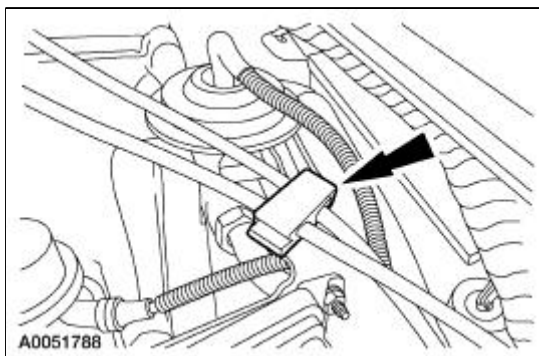
7. Disconnect the accelerator controls.
 - Disconnect the accelerator cable.
 - If equipped, disconnect the speed control cable.



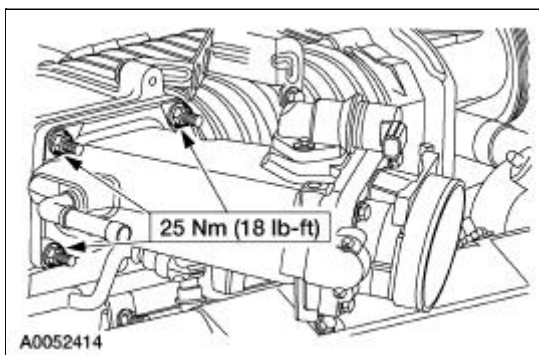
8. Remove the accelerator cable bracket bolts.




9. Release the clip and position the accelerator cable bracket and the cables aside.



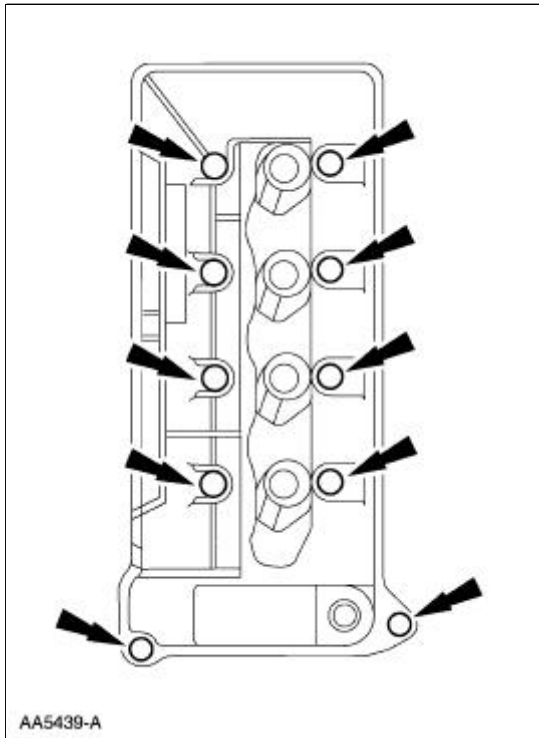
10. Remove the throttle body and spacer assembly.



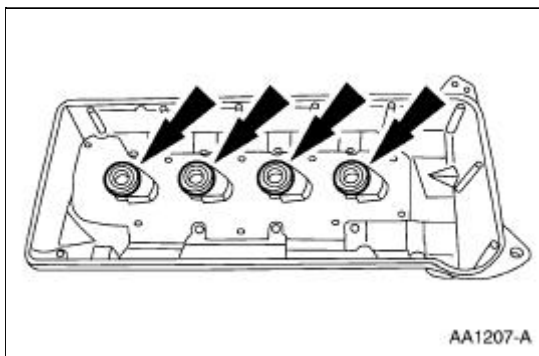
11. Remove the RH valve cover.

-  **CAUTION:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

Remove and discard the gasket, clean and inspect the sealing surfaces.

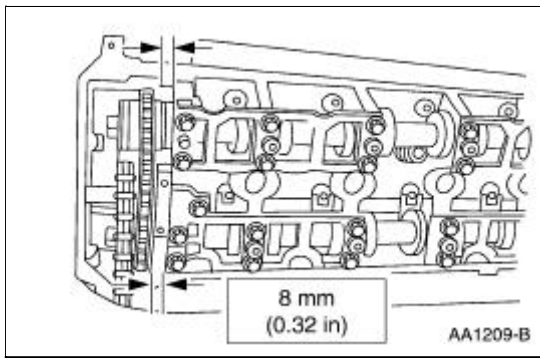


12. Inspect the valve cover spark plug hole gaskets. Install new gaskets, if necessary. Make sure the gaskets are correctly seated on the valve cover.



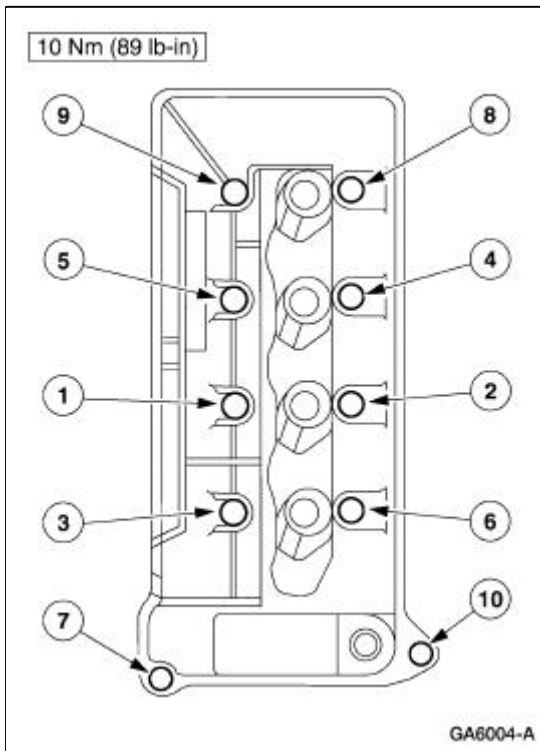
13. **NOTE:** If the valve cover is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

Apply a bead of silicone gasket and sealant in two places where indicated.



14. To install, reverse the removal procedure.

- Tighten the valve cover bolts in the sequence shown.



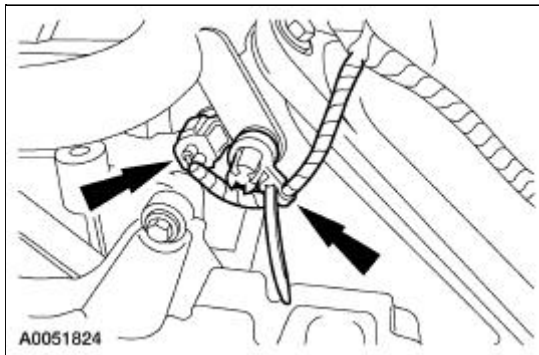
Valve Cover LH

Material

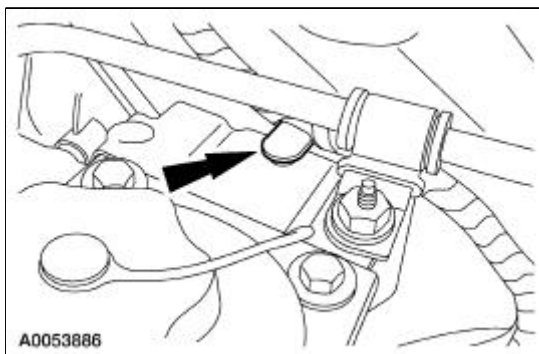
Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4
Metal Surface Cleaner F4AZ-19A536-RA	WSE-M5B392-A

Removal and Installation

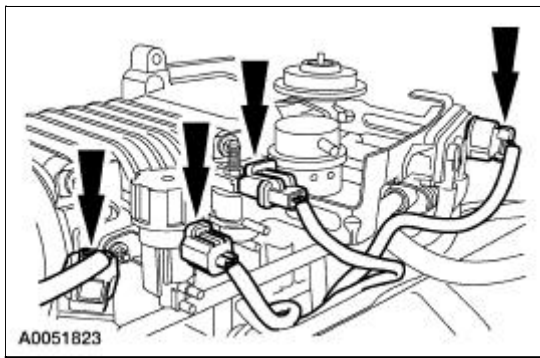
1. Remove the Hydro Boost brake booster. For additional information, refer to [Section 206-07](#).
2. Remove the LH ignition coils. For additional information, refer to [Section 303-07C](#).
3. Disconnect the engine coolant temperature (ECT) sensor and unclip the wiring harness from the stud.



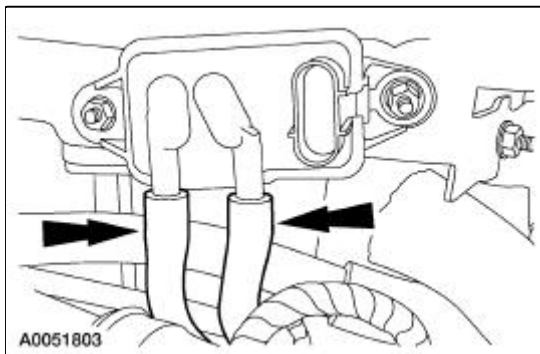
4. Unclip the wiring harness from the power steering bracket.



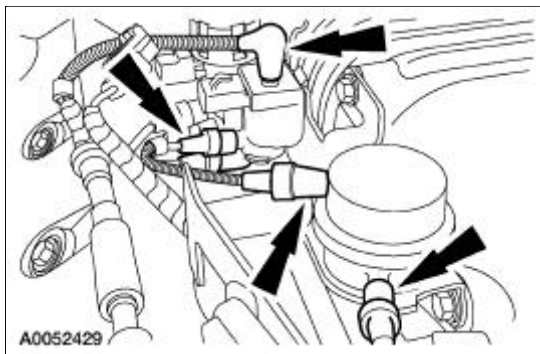
5. Disconnect the electrical connectors from the fuel pulse damper, EGR vacuum regulator solenoid, supercharger bypass vacuum solenoid, and the differential pressure feedback EGR system.



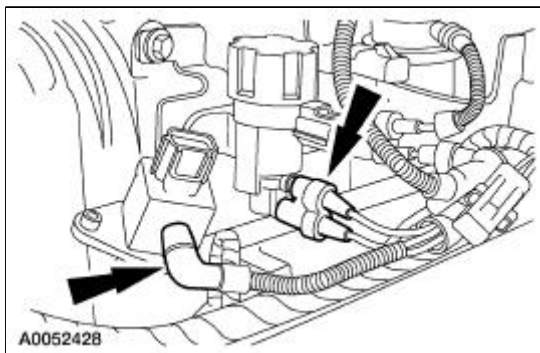
6. Disconnect the vacuum hoses from the differential pressure feedback EGR system.



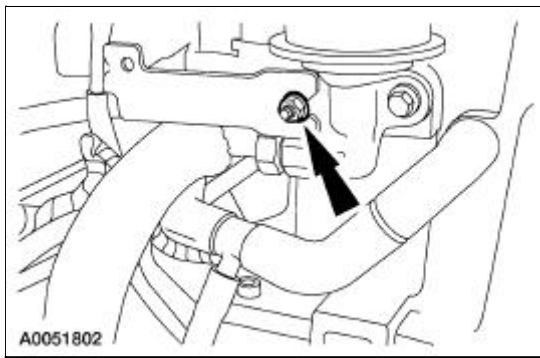
7. Disconnect the vacuum hoses from the supercharger bypass vacuum solenoid and the actuator.



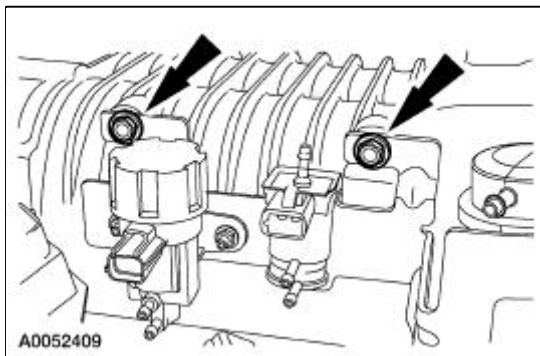
8. Disconnect the vacuum hoses from the fuel pulse damper and the EGR vacuum regulator solenoid, and position the vacuum harness aside.



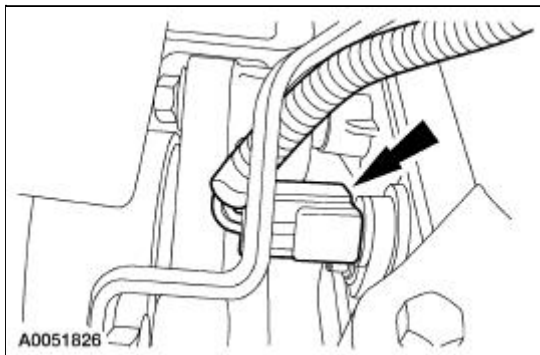
9. Remove the vacuum accessory bracket mounting nut.



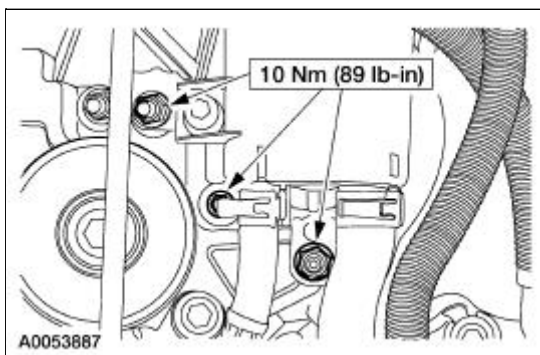
10. Remove the mounting bolts and the vacuum accessory bracket.



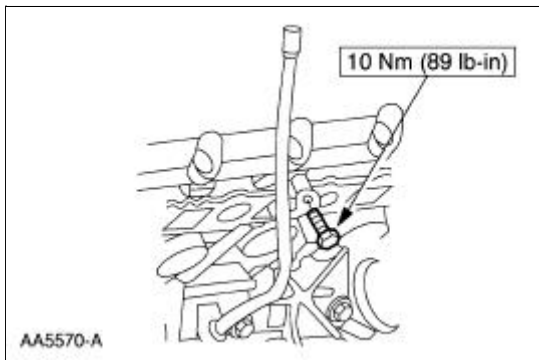
11. Disconnect the camshaft position (CMP) sensor electrical connector.



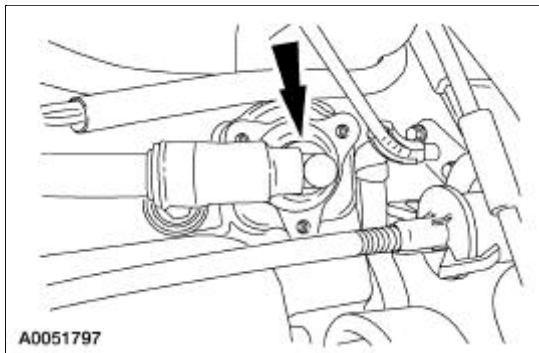
12. Remove the fasteners and position the power steering reservoir aside.



13. Remove the bolt and position the oil level indicator tube aside.



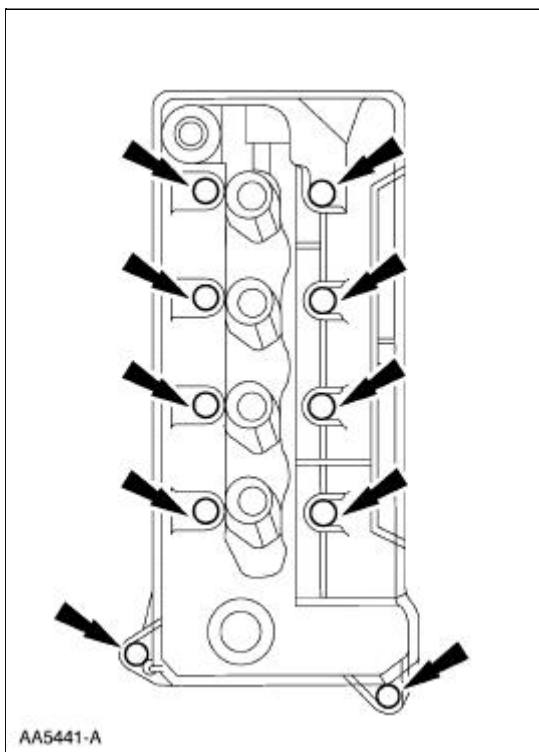
14. Disconnect the positive crankcase ventilation (PCV) valve and position it aside.



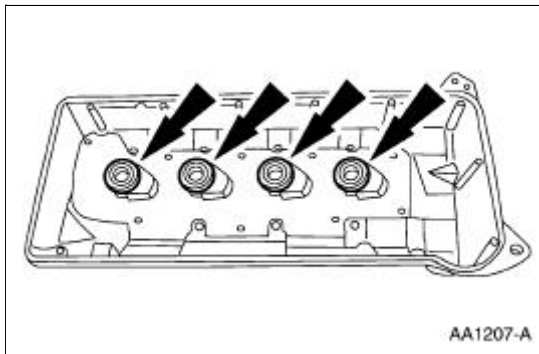
15. **⚠ CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

Remove the valve cover.

- Remove and discard the gasket, clean and inspect the sealing surfaces.

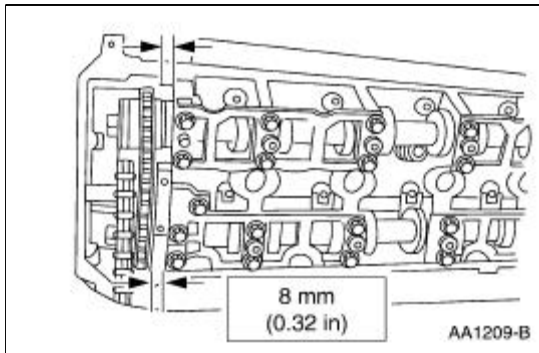


16. Inspect the valve cover spark plug hole gaskets. Install new gaskets, if necessary. Make sure the gaskets are correctly seated on the valve cover.



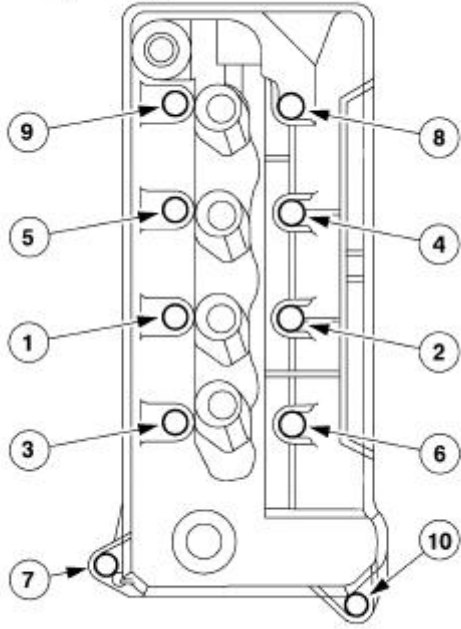
17. **NOTE:** If the valve cover is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

Apply a bead of silicone gasket and sealant in two places where indicated.



18. To install, reverse the removal procedure.
- Tighten the valve cover in the sequence shown.



10 Nm (89 lb-in)



AA5442-B

Crankshaft Pulley

Special Tool(s)

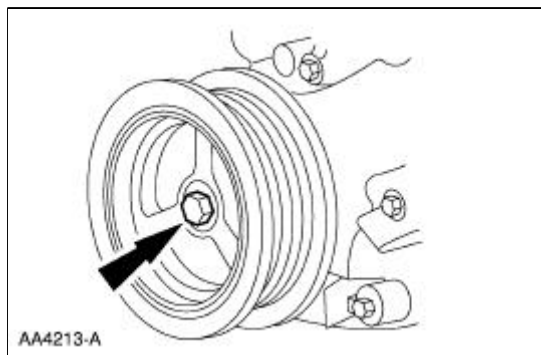
 ST1286-A	Remover, Crankshaft Vibration Damper 303-009 (T58P-6316-D)
 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)

Material

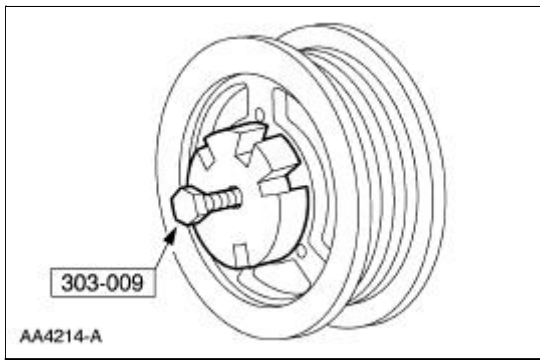
Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4

Removal

1. Remove the auxiliary crankshaft pulley. For additional information, refer to [Crankshaft Pulley—Auxiliary](#) in this section.
2. Remove the accessory drive belt. For additional information, refer to [Section 303-05](#).
3. Remove the bolt.

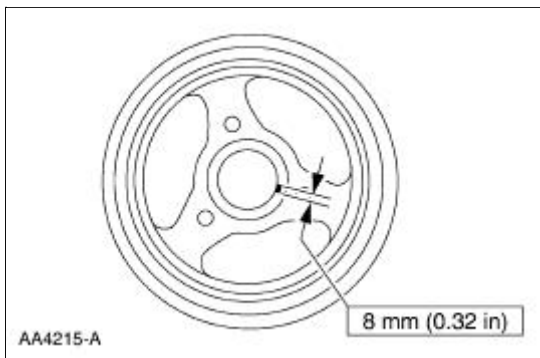


4. Using the special tool, remove the crankshaft pulley.

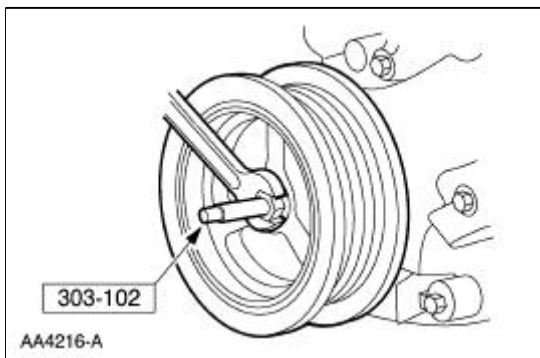


Installation

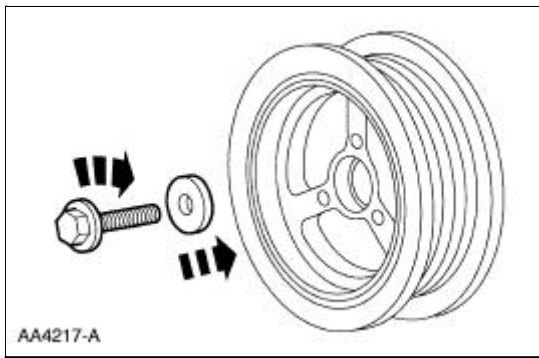
1. **NOTE:** The crankshaft pulley must be installed within four minutes after applying the silicone.
Apply silicone gasket and sealant to the Woodruff key slot on the crankshaft pulley.



2. Using the special tool, install the crankshaft pulley.



3. Install the bolt and washer. Tighten the bolt in four stages.
 - Stage 1: Tighten the bolt to 90 Nm (66 lb-ft).
 - Stage 2: Loosen the bolt one full turn.
 - Stage 3: Tighten the bolt to 50 Nm (37 lb-ft).
 - Stage 4: Tighten the bolt an additional 85 to 95 degrees.



4. Install the accessory drive belt. For additional information, refer to [Section 303-05](#).
 5. Install the auxiliary crankshaft pulley. For additional information, refer to [Crankshaft Pulley—Auxiliary](#) in this section.
-

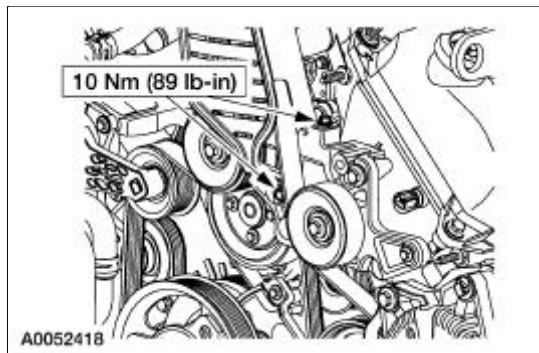
Crankshaft Pulley —Auxiliary

Special Tool(s)

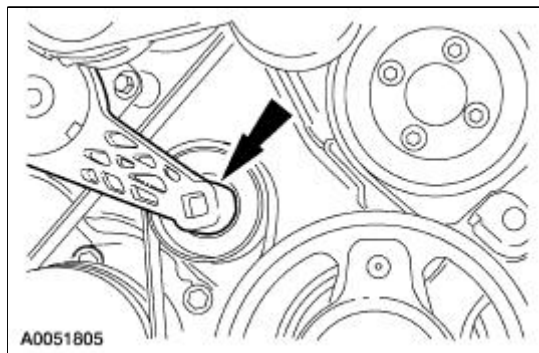
 ST2422-A	Locking Tool, Flywheel 303-673
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Removal and Installation

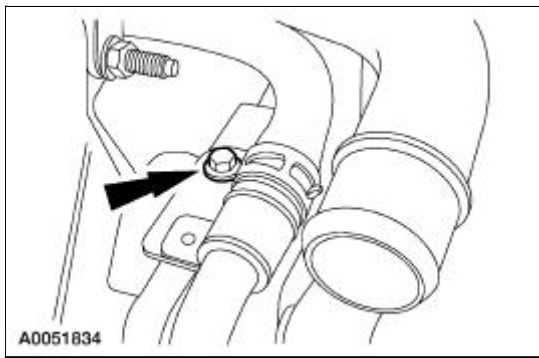
1. Remove the cooling fan. For additional information, refer to [Section 303-03A](#).
2. Remove the supercharger drive belt cover.



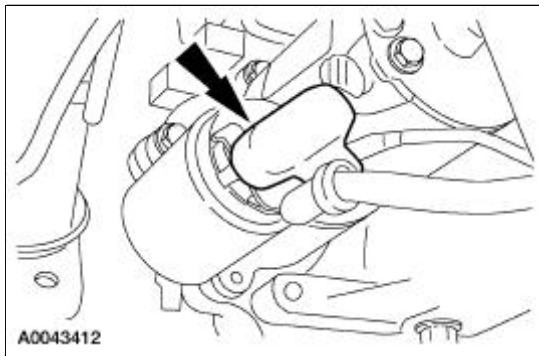
3. Rotate the supercharger belt tensioner clockwise and remove the supercharger belt.



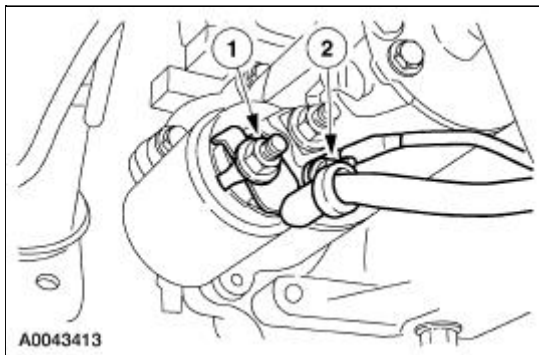
4. Remove the coolant hose assembly bolt.



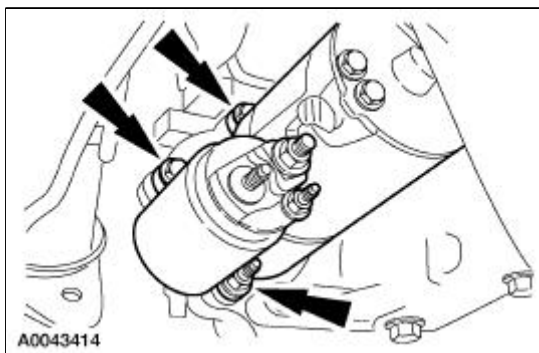
5. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
6. Remove the starter motor terminal cover.



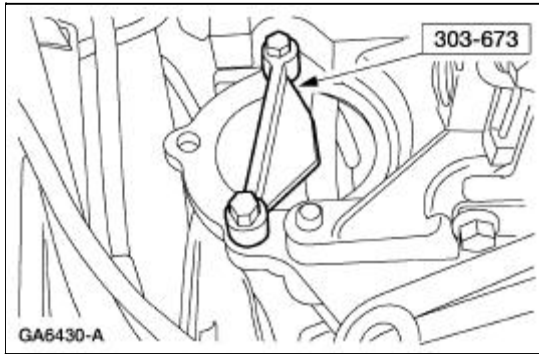
7. Disconnect the starter wiring.
 1. Remove the nut and disconnect the battery positive cable.
 2. Remove the nut and disconnect the starter solenoid wire.



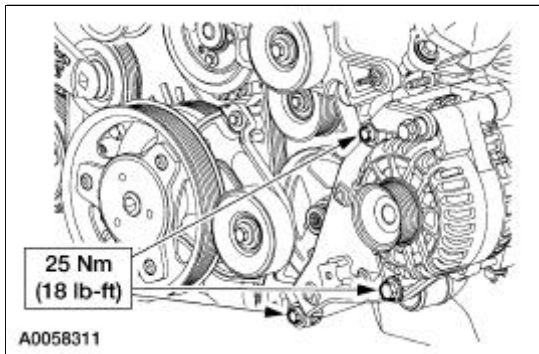
8. Remove the three bolts and the starter.



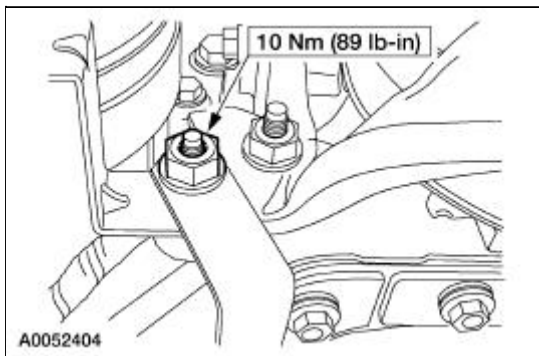
9. Install the special tool.



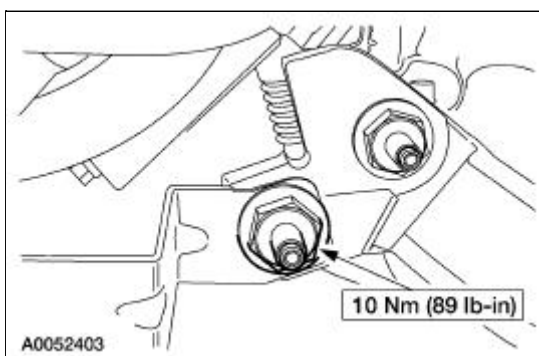
10. Remove the bolts and the alternator support bracket.



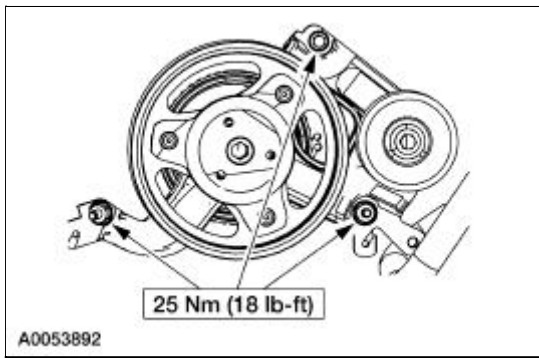
11. Remove the nut and position the wiring harness aside.



12. Remove the stud and position the coolant hose assembly aside.

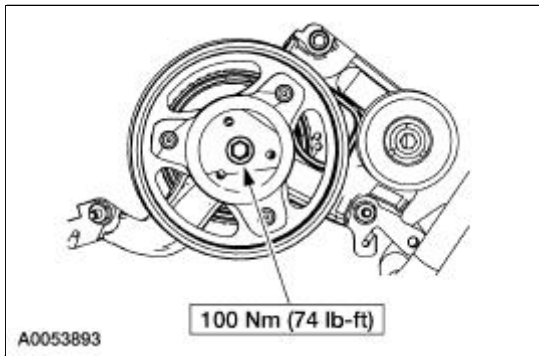


13. Remove the auxiliary crankshaft pulley brace fasteners.



14. **NOTE:** The auxiliary crankshaft pulley is left-hand threaded.

Remove the auxiliary crankshaft pulley and brace assembly.



15. To install, reverse the removal procedure.

Crankshaft Front Seal

Special Tool(s)

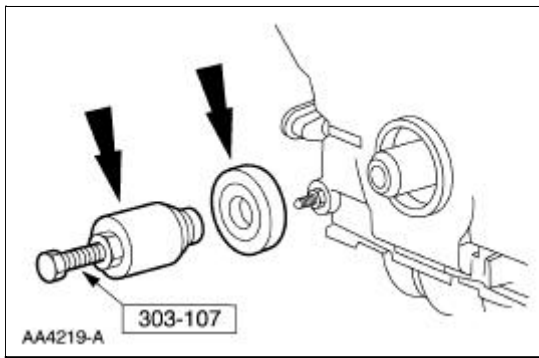
 <p>ST1328-A</p>	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A)
 <p>ST1288-A</p>	Remover, Crankshaft Front Oil Seal 303-107 (T74P-6700-A)
 <p>ST2197-A</p>	Installer, Crankshaft Front Oil Seal 303-635
 <p>ST1287-A</p>	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)

Material

Item	Specification
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

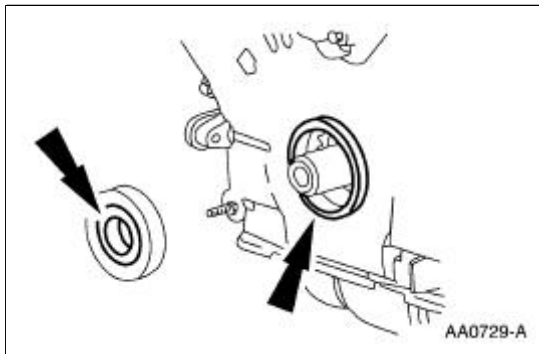
Removal

1. Remove the crankshaft pulley. For additional information, refer to [Crankshaft Pulley](#) in this section.
2. Using the special tool, remove the crankshaft front seal.

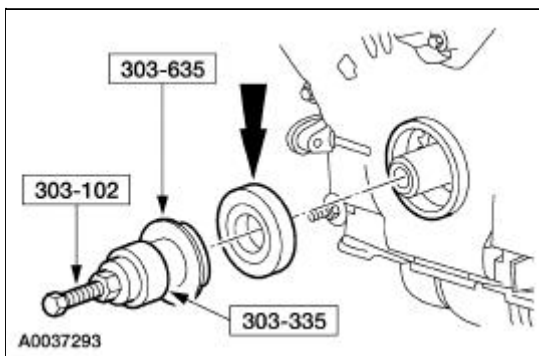


Installation

1. Lubricate the engine front cover and the crankshaft front seal inner lip with clean engine oil.



2. Using the special tool, install the crankshaft front seal.



3. Install the crankshaft pulley. For additional information, refer to [Crankshaft Pulley](#) in this section.
 4. Install the auxiliary crankshaft pulley. For additional information, refer to [Crankshaft Pulley—Auxiliary](#) in this section.
-

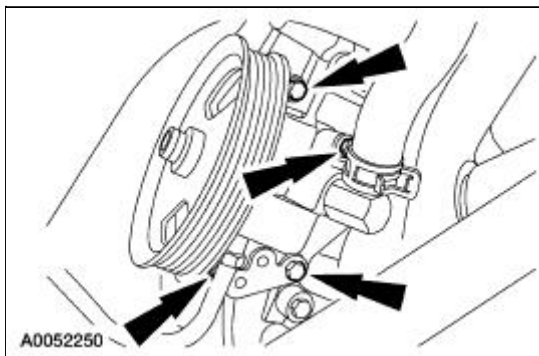
Engine Front Cover

Material

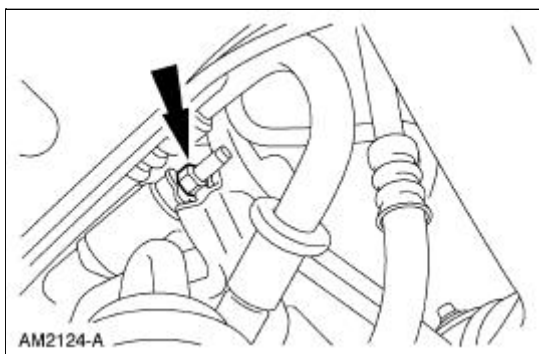
Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
SAE 5W-20 Premium Synthetic Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

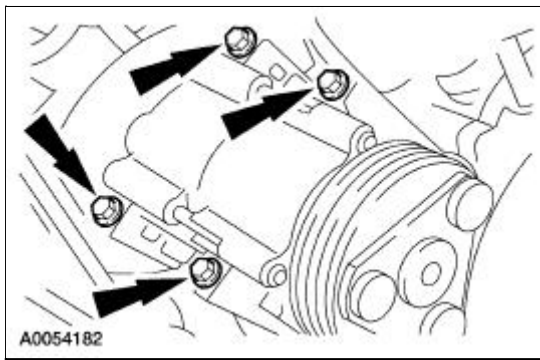
1. Remove the crankshaft front seal. For additional information, refer to [Crankshaft Front Seal](#) in this section.
2. Remove the oil filter adapter. For additional information, refer to [Oil Filter Adapter](#) in this section.
3. Remove the three bolts shown. Loosen the fourth bolt (hidden below the power steering tube) and position the power steering pump aside.



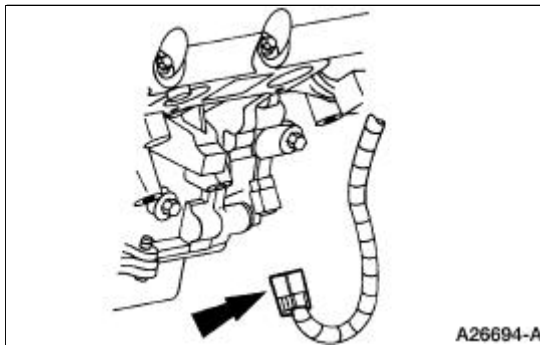
4. Remove the A/C muffler bracket nut.



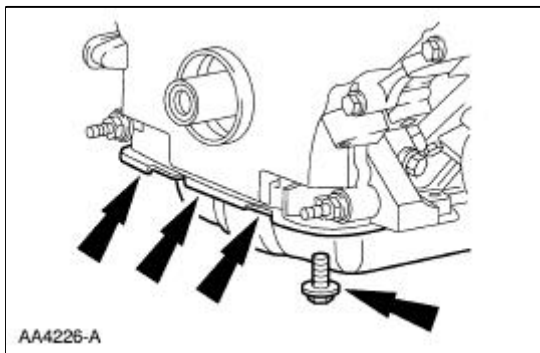
5. Remove the bolts and position the A/C compressor aside.



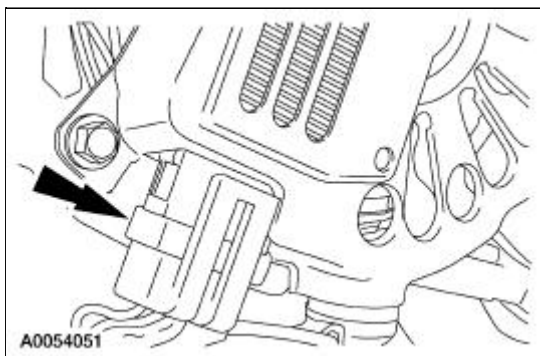
6. Disconnect the crankshaft position sensor.



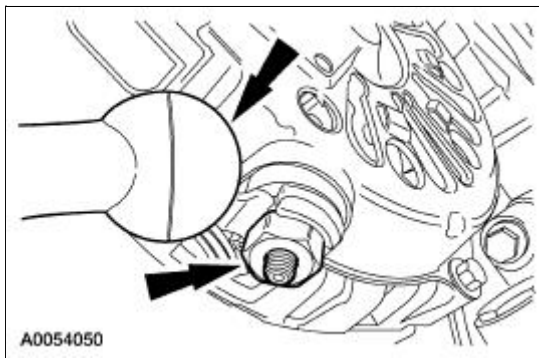
7. Remove the four front bolts.



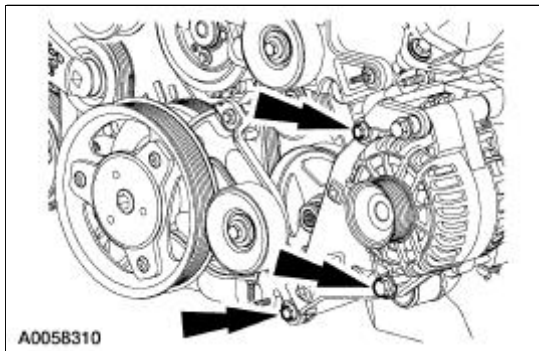
8. Disconnect the generator electrical connector.



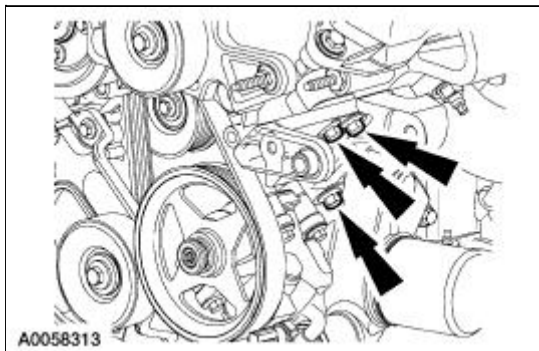
9. Remove the generator B+ terminal nut and detach the B+ cable.



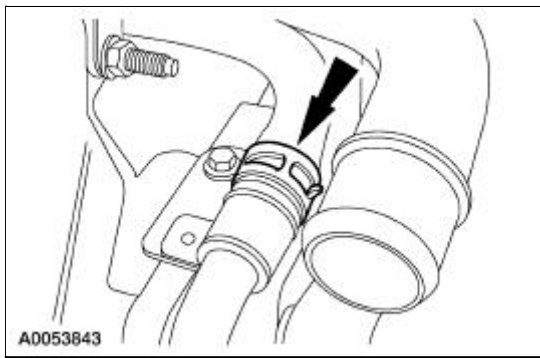
10. Remove the bolts and the generator.



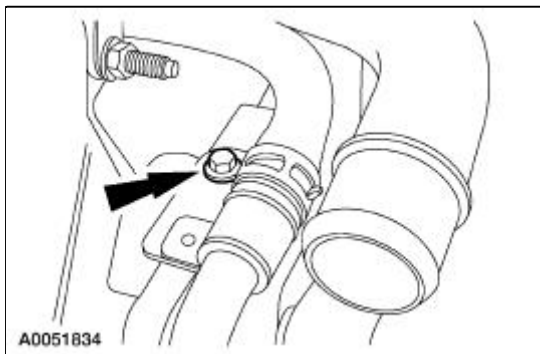
11. Remove the generator support bracket.



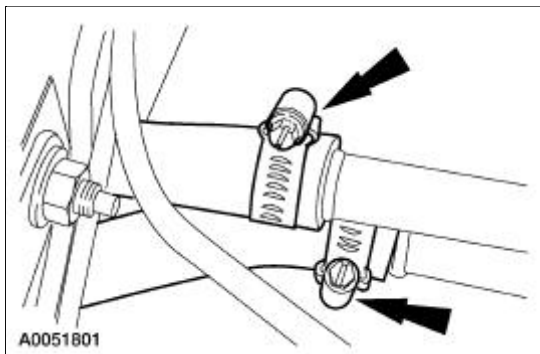
12. Drain the engine coolant and the supercharger coolant. For additional information, refer to [Section 303-03A](#) and [Section 303-03B](#).
13. Lower the vehicle.
14. Remove the coolant bypass tube. For additional information, refer to [Section 303-03A](#).
15. Remove the left and right valve covers. For additional information, refer to [Valve Cover LH](#) and [Valve Cover RH](#) in this section.
16. Disconnect the supercharger coolant hose.



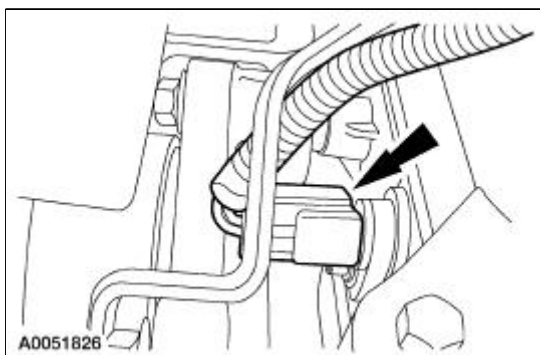
17. Remove the coolant hose mounting bolt.



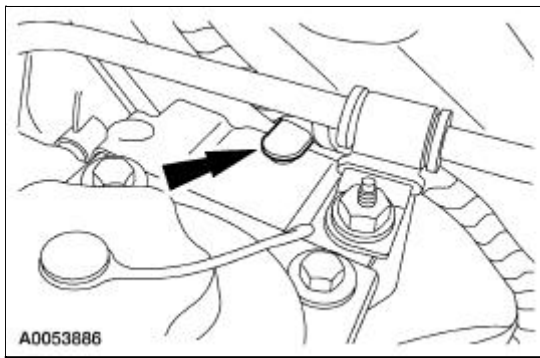
18. Disconnect the supercharger coolant hoses and remove the supercharger hose and tube assembly.



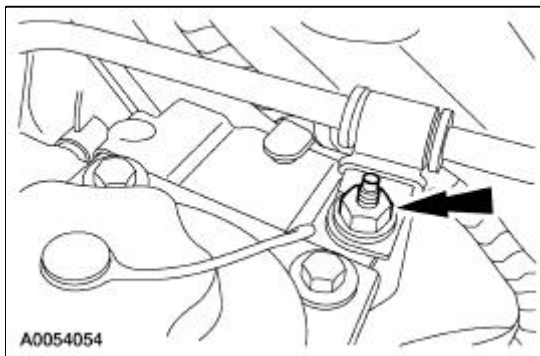
19. Disconnect the camshaft position (CMP) sensor electrical connector.



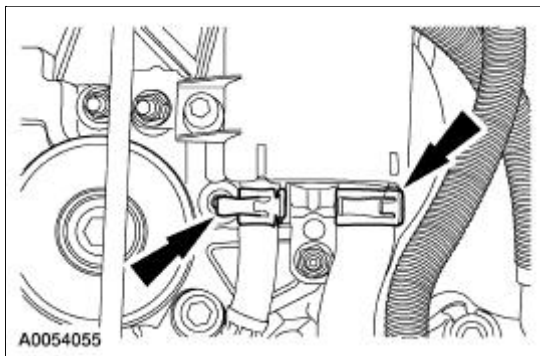
20. Unclip the wiring harness from the power steering bracket.



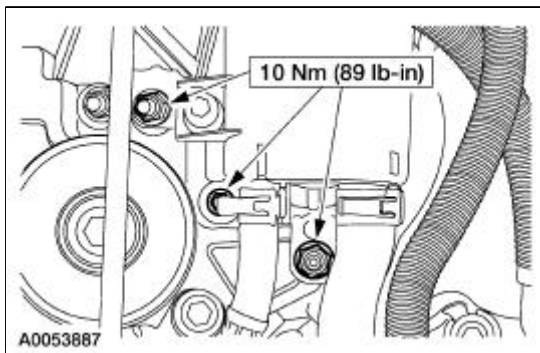
21. Remove the nut.



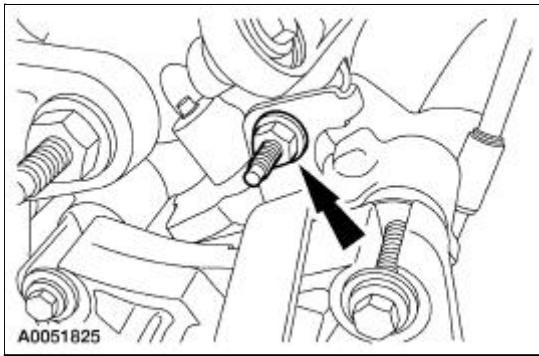
22. Disconnect the power steering hoses and drain the power steering fluid into a suitable container.



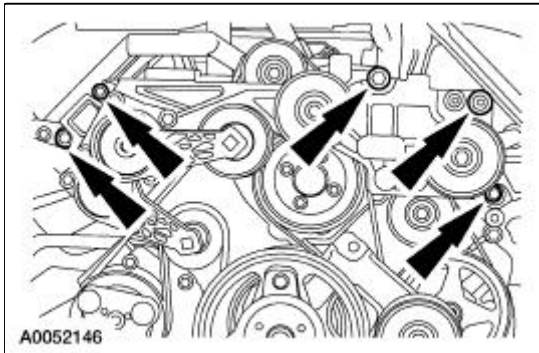
23. Remove the fasteners and the power steering reservoir.



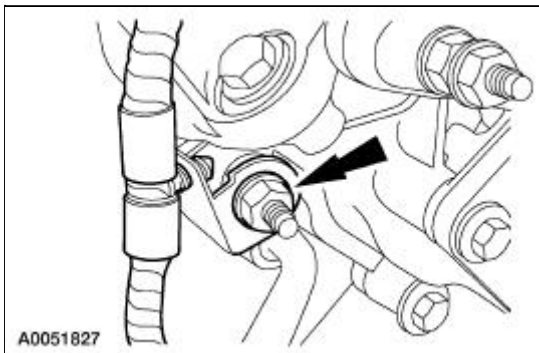
24. Remove the nut and the position the power steering hose aside.



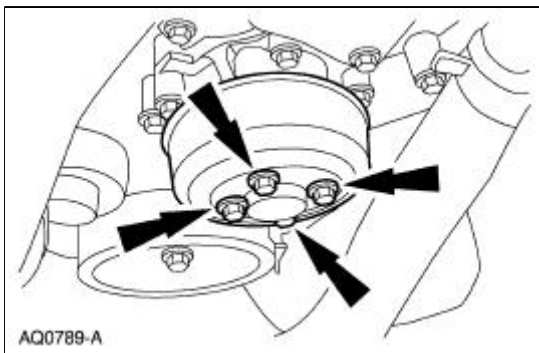
25. Remove the fasteners and the supercharger belt idler support bracket assembly.



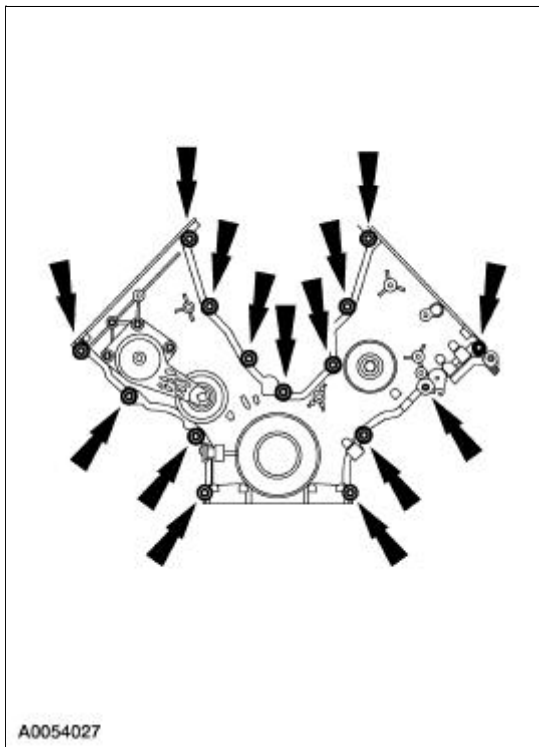
26. Remove the wiring harness bracket.




27. Remove the water pump pulley.



28. Remove the bolts, the studs and the engine front cover.



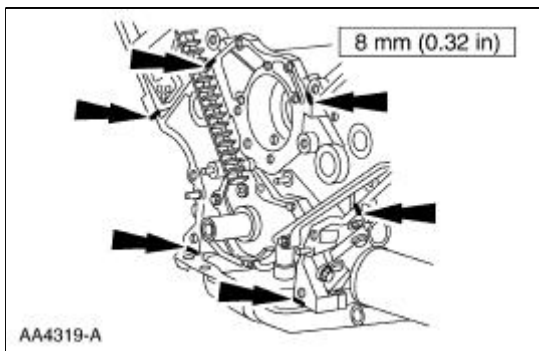
29.  **CAUTION:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

Remove and discard the gasket, clean and inspect the sealing surfaces.

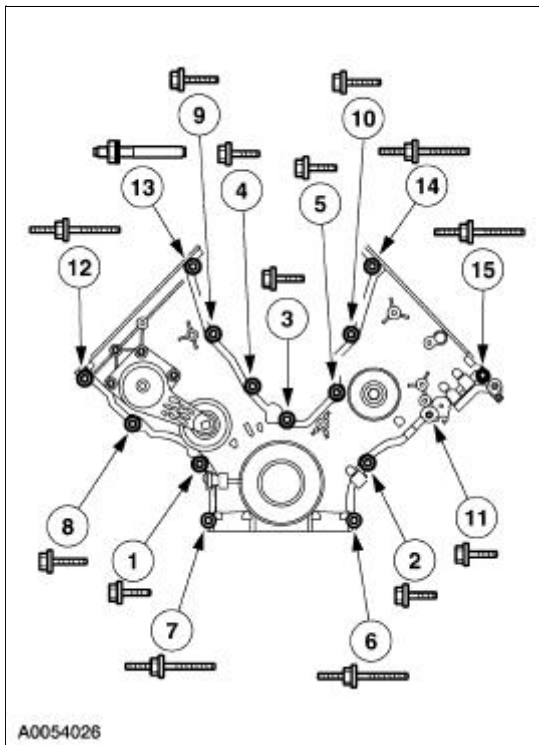
Installation

1. **NOTE:** If the valve cover is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

Apply silicone gasket and sealant in the locations shown.



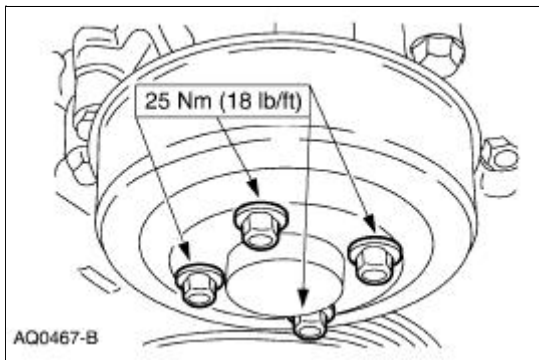
2. Install the engine front cover and tighten the fasteners in the sequence shown, to 25 Nm (18 lb-in).



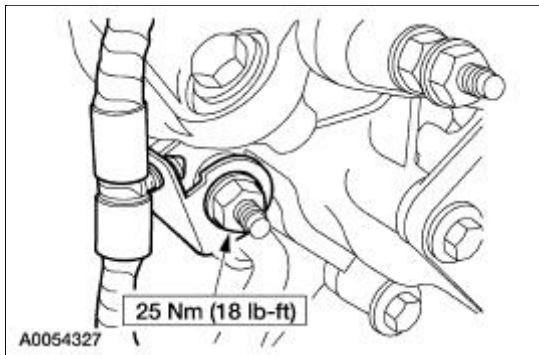
A0054026

Item	Part Number	Description
1	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
2	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
3	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
4	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
5	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
6	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 1.25 x 91.1
7	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 1.25 x 91.1
8	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
9	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
10	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
11	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
12	W706560	Stud, Hex Head Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 16
13	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 1.25 x 91.1
14	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 1.25 x 91.1
15	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 1.25 x 91.1

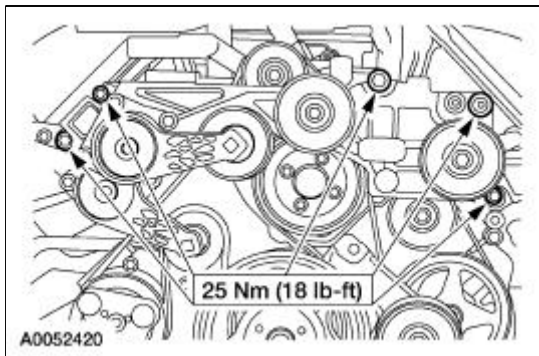
3. Install the water pump pulley.



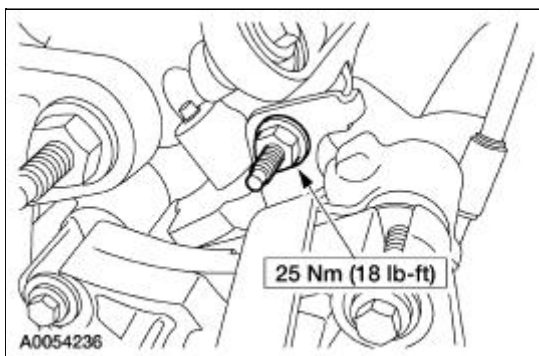
4. Install the wiring harness bracket and the nut.



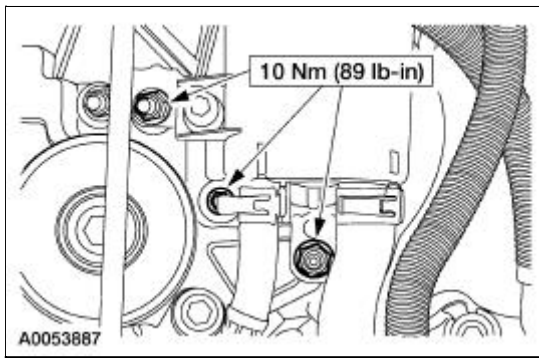
5. Install the supercharger belt idler support bracket assembly and fasteners.



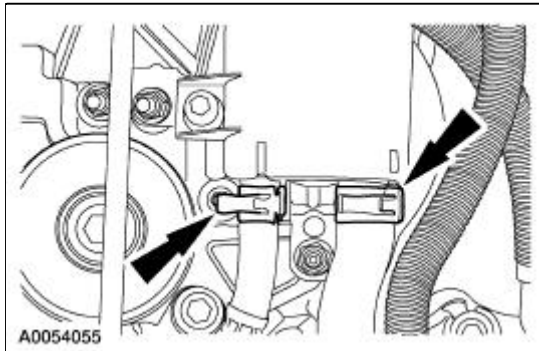
6. Install the power steering hose bracket nut.



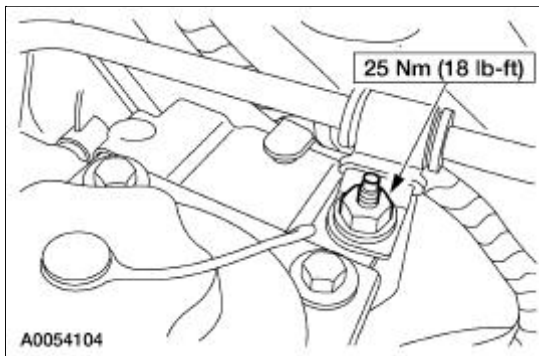
7. Install the power steering reservoir and the fasteners.



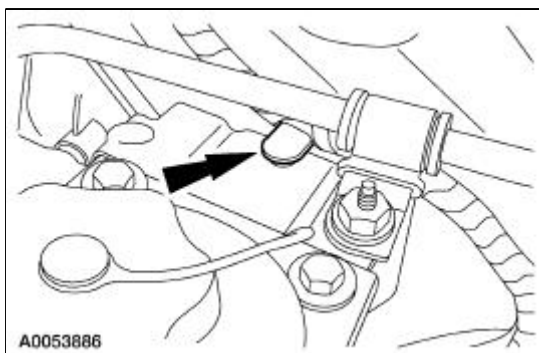
8. Connect the power steering hoses.



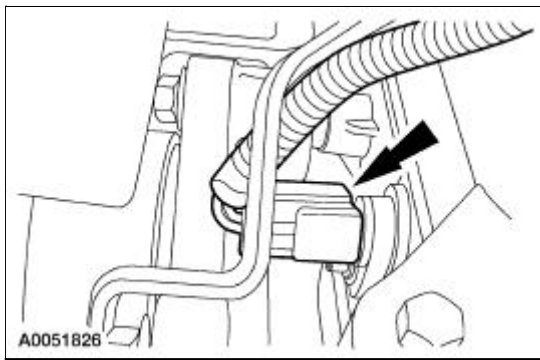
9. Install the power steering hose nut.



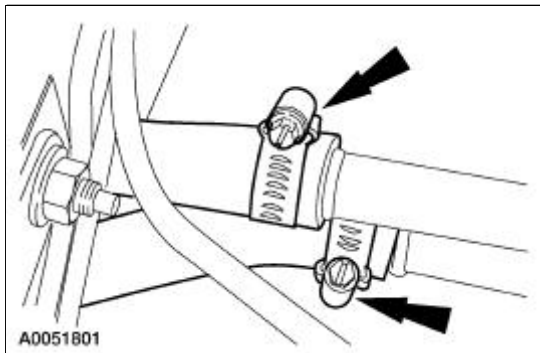
10. Attach the wiring harness to the power steering bracket.



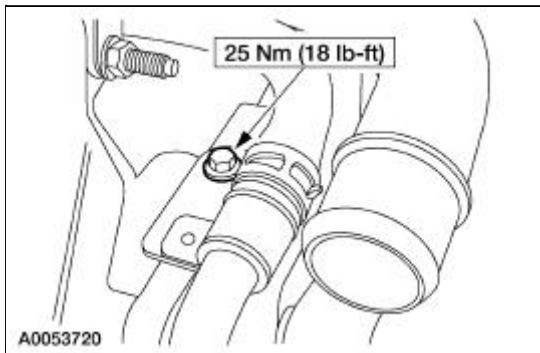
11. Connect the camshaft position (CMP) sensor electrical connector.



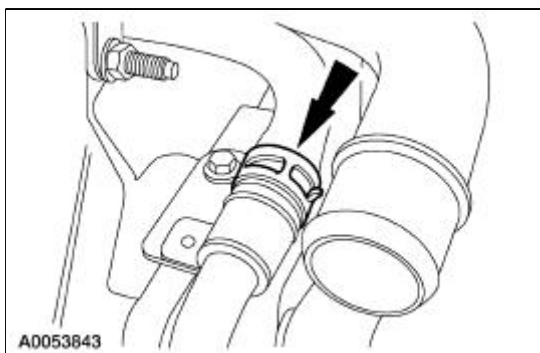
12. Install the supercharger hose and tube assembly, and connect the coolant hoses.



13. Install the coolant hose mounting bolt.

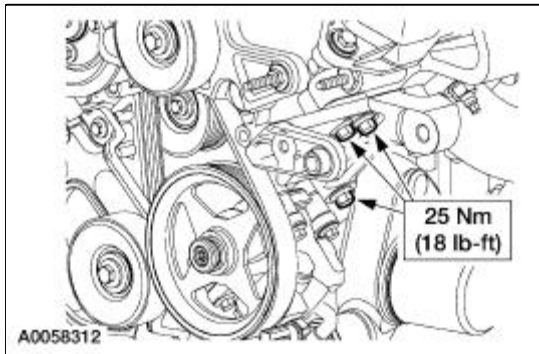


14. Connect the supercharger coolant hose.

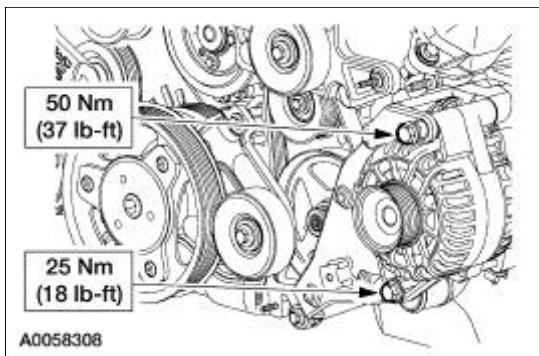


15. Install the left and right valve covers. For additional information, refer to [Valve Cover LH](#) and [Valve Cover RH](#) in this section.
16. Install the coolant bypass tube. For additional information, refer to [Section 303-03A](#).

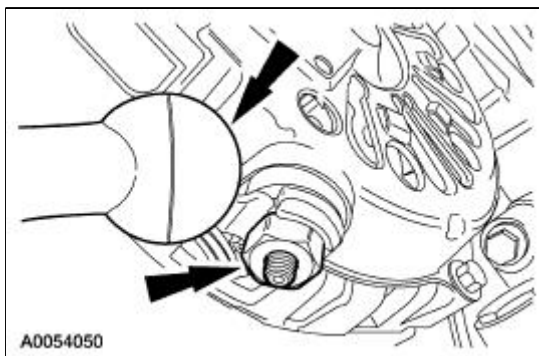
17. Raise the vehicle.
18. Install the generator support bracket.



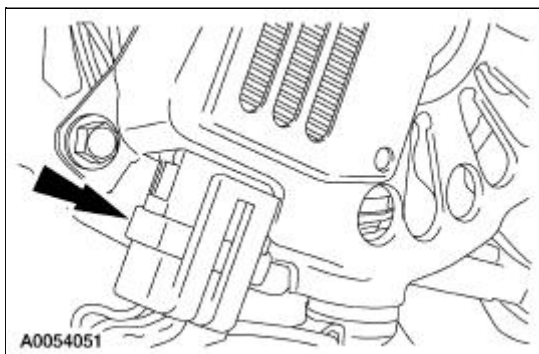
19. Install the generator and the bolts.



20. Attach the B + cable and install the generator B + terminal nut.

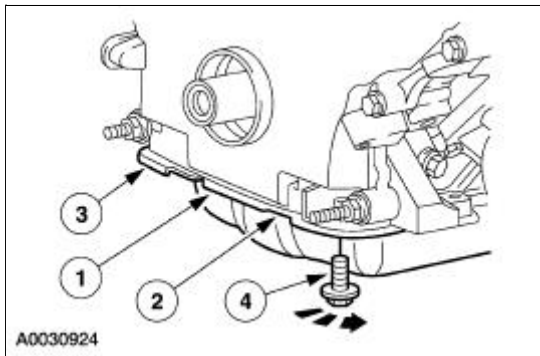


21. Connect the generator electrical connector.

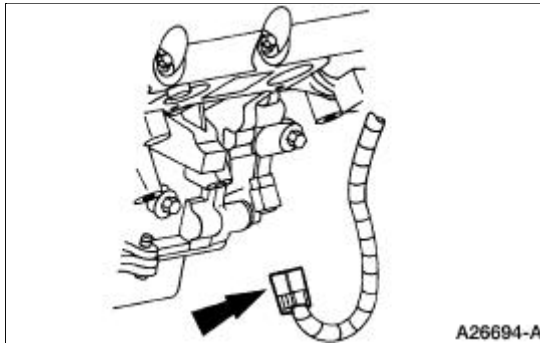


22. Tighten the bolts in three stages, in the sequence shown.

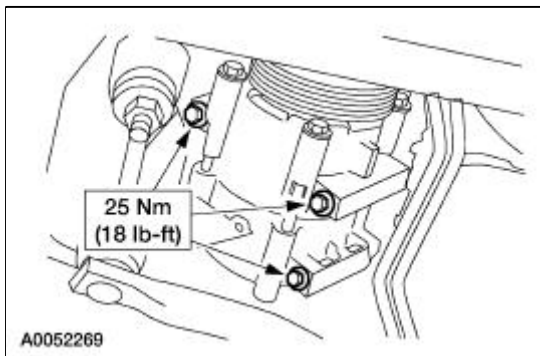
- Stage 1: Tighten to 2 Nm (18 lb-in).
- Stage 2: Tighten to 20 Nm (15 lb-ft).
- Stage 3: Tighten an additional 60 degrees.



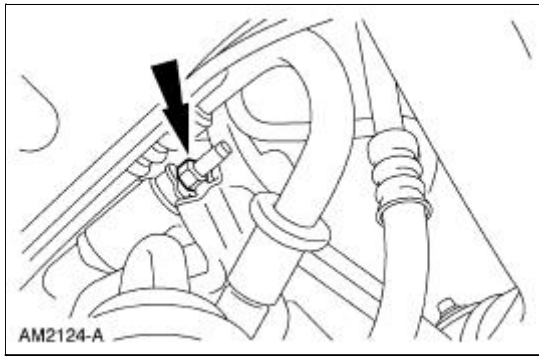
23. Connect the crankshaft position sensor electrical connector.



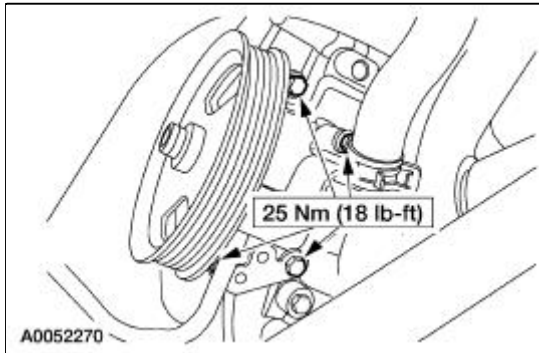
24. Position the A/C compressor and install the bolts.



25. Install the A/C muffler bracket nut.



26. Position the power steering pump and install the bolts.



27. Install the oil filter adapter. For additional information, refer to [Oil Filter Adapter](#) in this section.
 28. Install the crankshaft front seal. For additional information, refer to [Crankshaft Front Seal](#) in this section.
 29. Fill and bleed the engine coolant and the supercharger coolant. For additional information, refer to [Section 303-03A](#) and [Section 303-03B](#).
 30. Fill the crankcase with clean engine oil.
-

Timing Drive Components

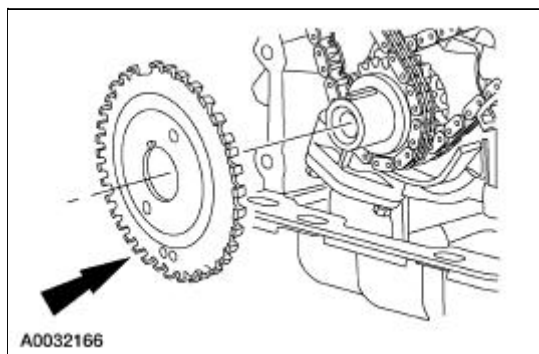
Special Tool(s)



Removal

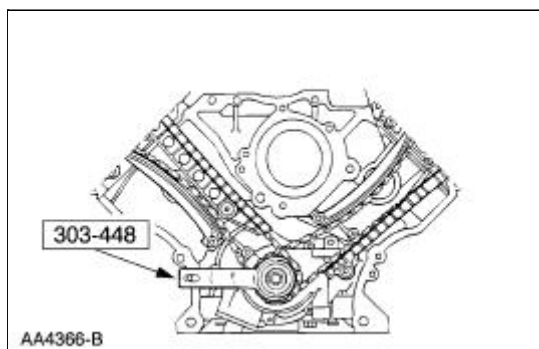
⚠ CAUTION: Since the engine is not free-wheeling, if the crankshaft (6303) or the camshafts (6250) are moved in any manner during removal and installation, the crankshaft and the camshafts must be resynchronized.


1. Remove the engine front cover (6019). For additional information, refer to [Engine Front Cover](#) in this section.
2. Remove the crankshaft sensor ring from the crankshaft.



3. **⚠ CAUTION:** Unless otherwise instructed, at no time when the timing chains (6268) are removed and the cylinder heads (6049) are installed is the crankshaft (6303) or the camshaft (6250) to be rotated. Severe piston (6108) and valve damage will occur.

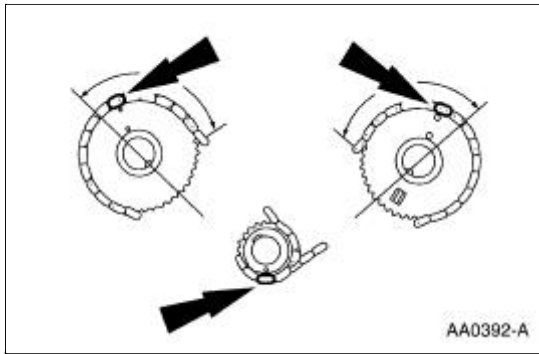
Using the special tool, position the crankshaft as shown.



4.  **CAUTION: The camshaft timing marks must be correctly lined up or damage to the valves and pistons can occur.**

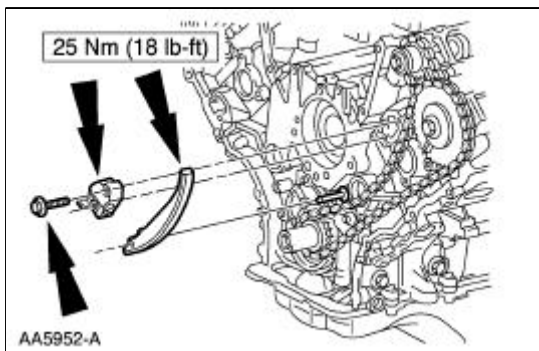
NOTE: The copper links on the timing chain may not line up with the timing marks on the sprockets.


Make sure the timing marks on the camshaft sprockets are correctly positioned. If necessary, turn the crankshaft one full turn clockwise to correctly position the sprockets.



5. **NOTE:** LH shown; RH similar.

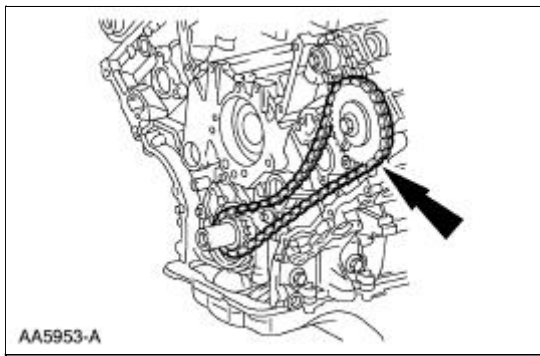
Remove the two bolts, the timing chain tensioner (6L266) and tensioner arm (6L253).



6.  **CAUTION: Unless otherwise instructed, at no time when the timing chains are removed and the cylinder heads are installed is the crankshaft or the camshaft to be rotated. Severe piston and valve damage will occur.**

Remove the LH and RH timing chains and the crankshaft sprocket (6306).

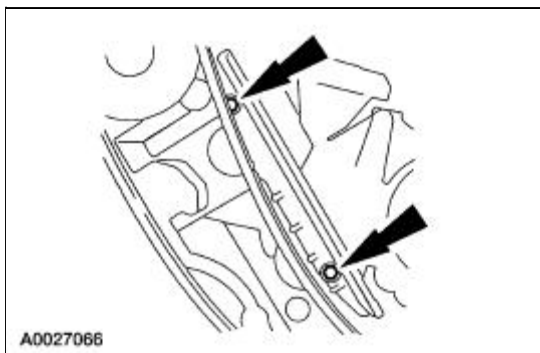
- Remove the special tool from the crankshaft.
- Remove the RH timing chain from camshaft sprocket.
- Remove the RH timing chain from the crankshaft sprocket.
- Remove the LH timing chain from the camshaft sprocket.
- Remove the LH timing chain and crankshaft sprocket.




7.  **CAUTION:** The bolts are different lengths and must be returned to their original location.

NOTE: RH shown; LH similar.

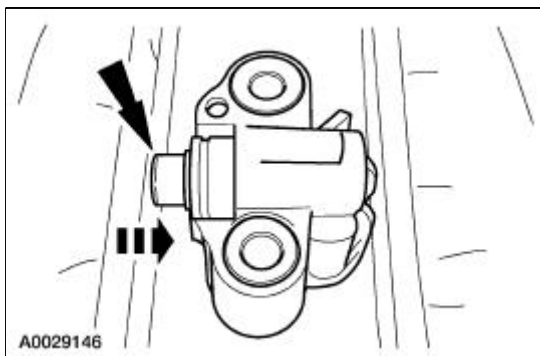
Remove the bolts and the timing chain guides (6K297).



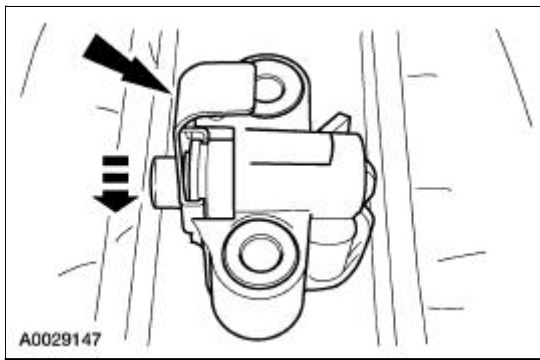
Installation

1.  **CAUTION:** Timing chain procedures must be followed exactly or damage to the pistons or valves will result.

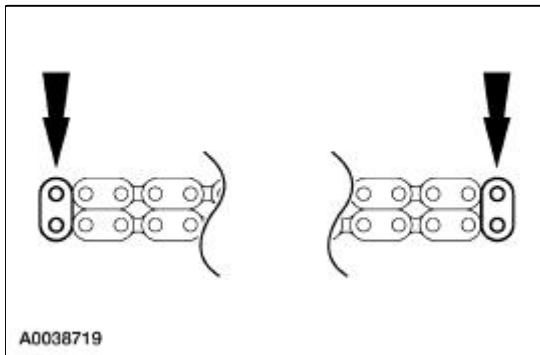
Compress the tensioner plunger, using a soft-jawed vise.



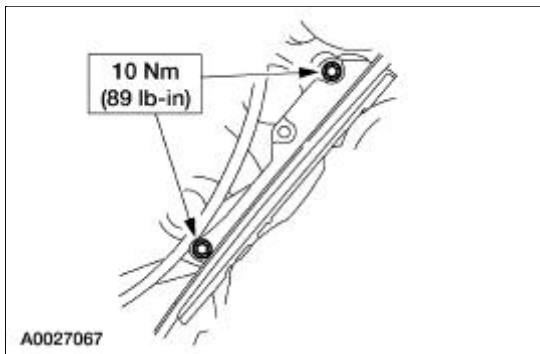
2. Install a retaining clip on the tensioner to hold the plunger in during installation.
- Remove the tensioner from the vise.



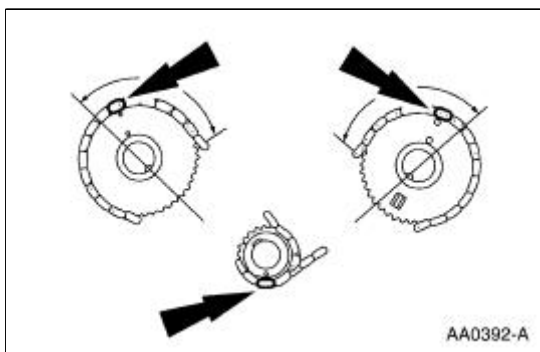
3. If the copper links are not visible, mark one link on one end and one link on the other end, and use as timing marks.



4. Install the timing chain guides.




5. Rotate the LH camshaft sprocket until the timing mark is approximately at the 12 o' clock position. Rotate the RH camshaft timing sprocket until the timing mark is approximately in the 11 o' clock position.

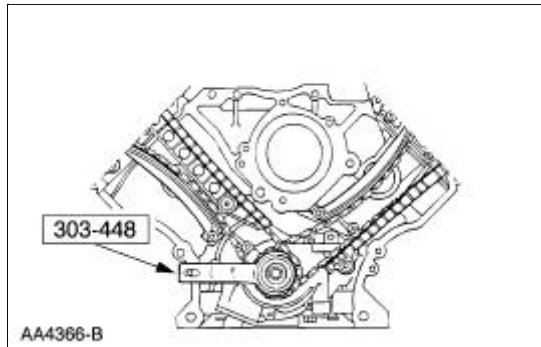


6.  **CAUTION:** Unless otherwise instructed, at no time when the timing chains are

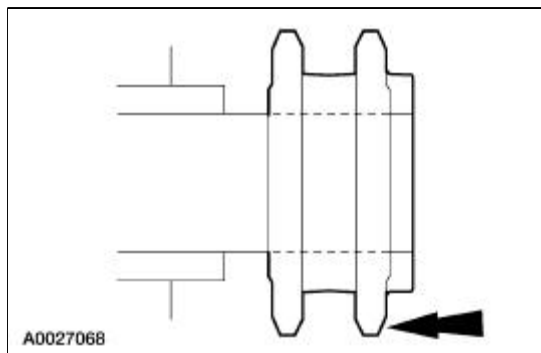
removed and the cylinder heads are installed is the crankshaft or the camshaft to be rotated. Severe piston and valve damage will occur.

 **CAUTION:** Rotate the crankshaft counterclockwise only. Do not rotate past position shown or severe piston or valve damage will occur.

Using the special tool, position the crankshaft.

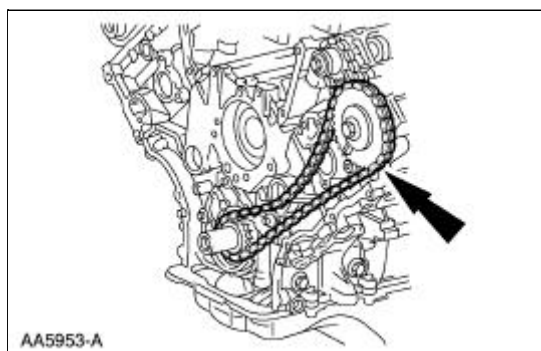


7. Remove the special tool.
8. Install the crankshaft sprocket with the flange facing forward.

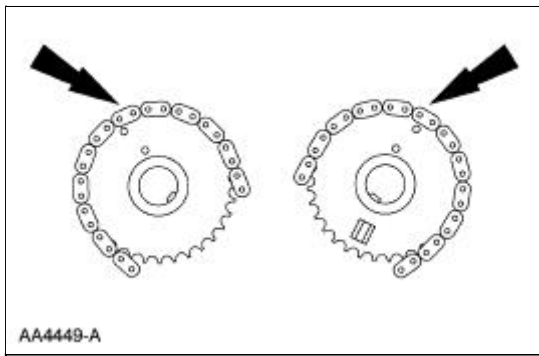


9. **NOTE:** LH timing chain shown; RH similar.

Install the LH timing chain onto the crankshaft sprocket, aligning the one copper link on the timing chain (6268) with the slot on the crankshaft sprocket.

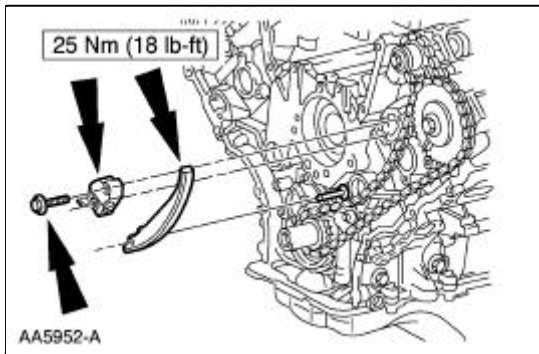


10. Verify the camshaft sprocket to copper link alignment.

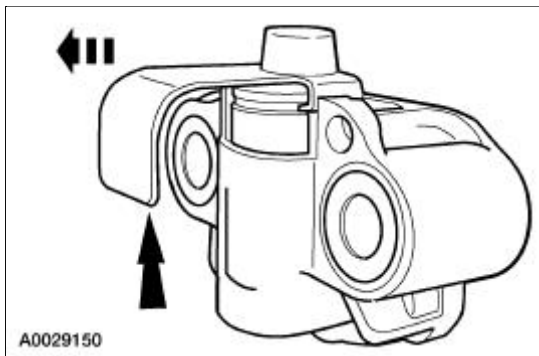


11. **NOTE:** LH shown; RH similar.

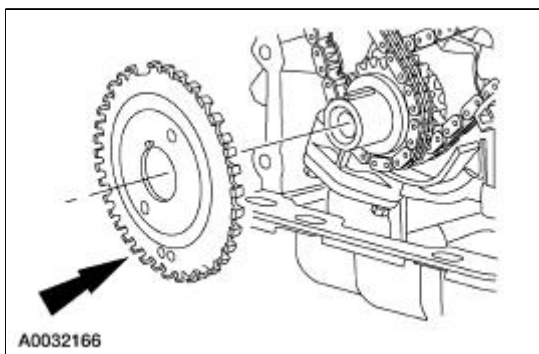
Position the tensioner arms and tensioners, and install the bolts.



12. Remove the retaining clips from the timing chain tensioners.



13. Position the crankshaft sensor ring on the crankshaft.

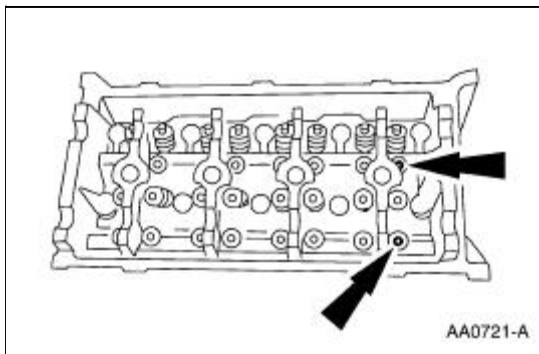


14. Install the engine front cover. For additional information, refer to [Engine Front Cover](#) in this section.

Hydraulic Lash Adjusters

Removal

1. Remove the roller followers. For additional information, refer to [Camshaft Roller Follower](#) in this section.
2. Remove the 16 hydraulic lash adjusters.



3. Inspect the roller followers. For additional information, refer to [Section 303-00](#).

Installation

1. To install, reverse the removal procedure.
-

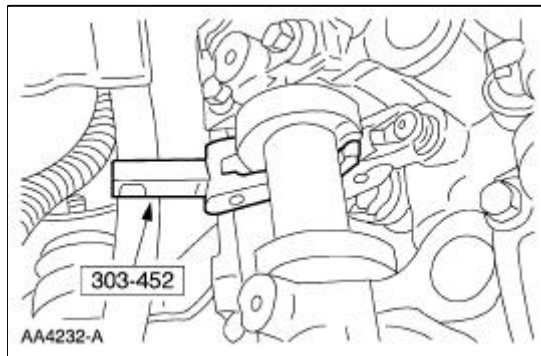
Camshaft Roller Follower

Special Tool(s)

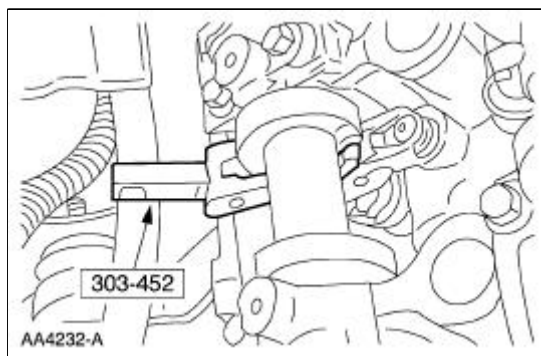


Removal and Installation

1. Remove the left and right valve cover (6582). For additional information, refer to [Valve Cover LH](#) and [Valve Cover RH](#) in this section.
2. Position the piston of the cylinder being repaired at the bottom of the stroke and camshaft lobe at base circle.
3. Using the special tool, compress the intake valve spring and remove the roller follower.



4. Using the special tool, compress the exhaust valve spring and remove the roller follower.



5. Repeat Steps 2, 3 and 4 to remove all the necessary roller followers. Inspect roller finger followers and camshafts. For additional information, refer to [Section 303-00](#).
6. To install, reverse the removal procedure.

Camshaft

Special Tool(s)

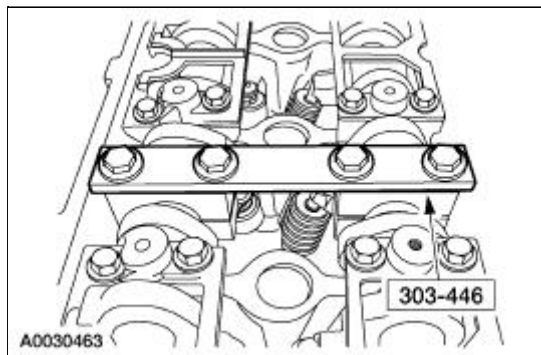
 ST1715-A	Holding Tool, Camshaft 303-446 (T93P-6256-AHR)
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Material

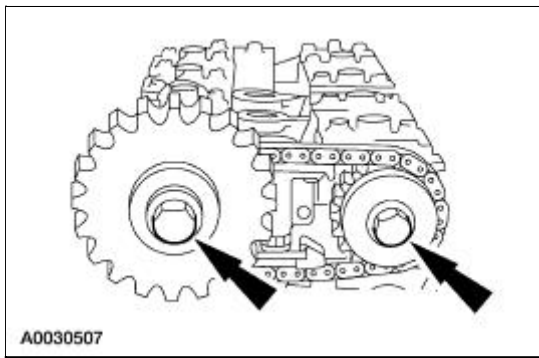
Item	Specification
Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153- H

Removal

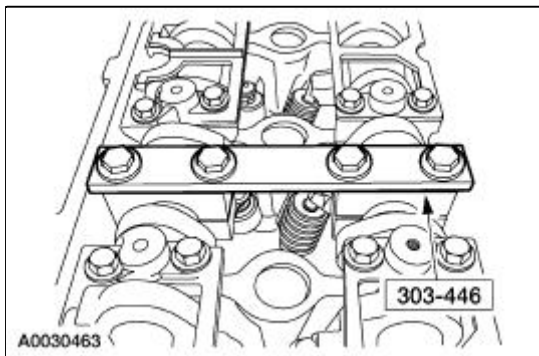
1. Remove the roller followers. For additional information, refer to [Camshaft Roller Follower](#) in this section.
2. Remove the LH timing chain (6268) for the LH side and both timing chains for the RH side. For additional information, refer to [Timing Drive Components](#) in this section.
3. Install the special tool.



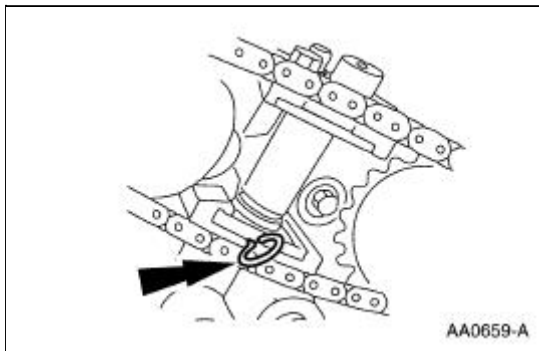
4. Remove the exhaust camshaft sprocket (6250) and the intake camshaft bolt, washer and spacer.



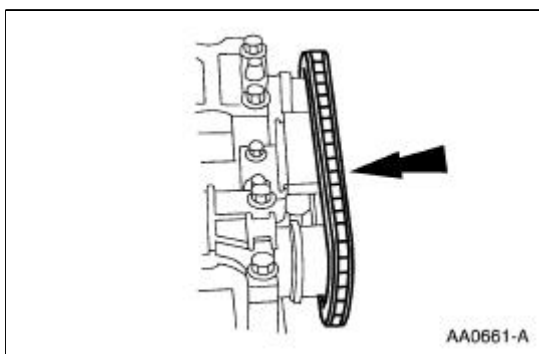
5. Remove the special tool.



6. Compress the tensioner (6L266) and install a lock pin.

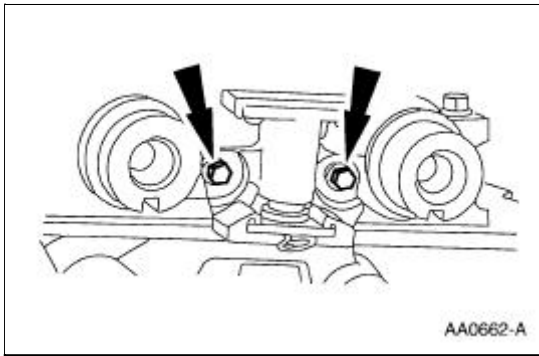



7. Remove the timing chain, the sprocket, and intake camshaft sprocket spacer.



8. **NOTE:** LH shown; RH similar.

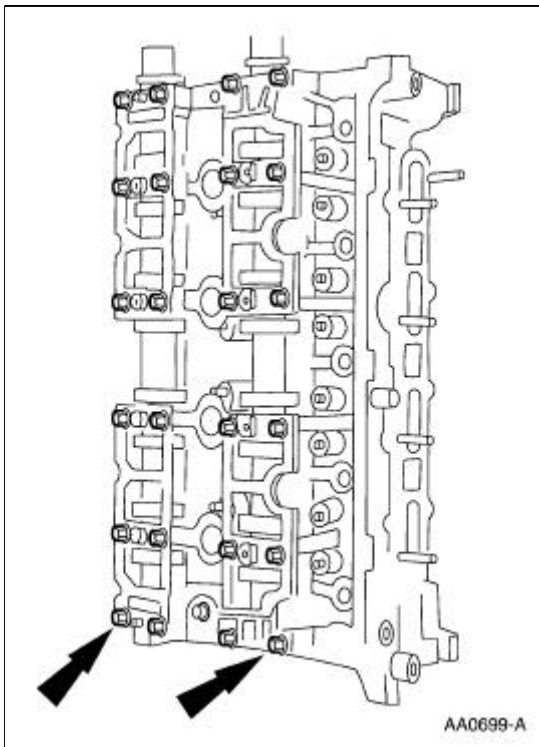
Remove the bolts.



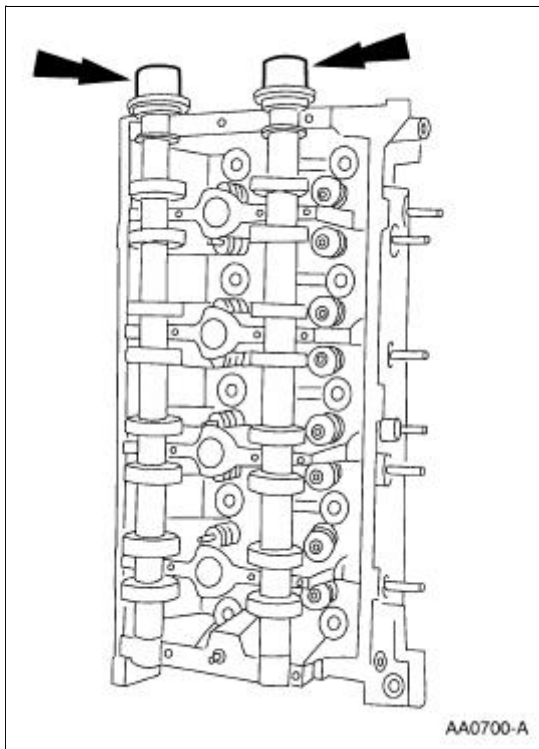
9.  **CAUTION:** The outer bolts on the outer cam bearing cap (exhaust) are longer and must be returned to the same location or engine damage may occur.

NOTE: Identify the camshaft to cylinder head location. Caps are not interchangeable.

Remove the bolts and the camshaft bearing cap assemblies.



10. Remove the camshafts (6250).

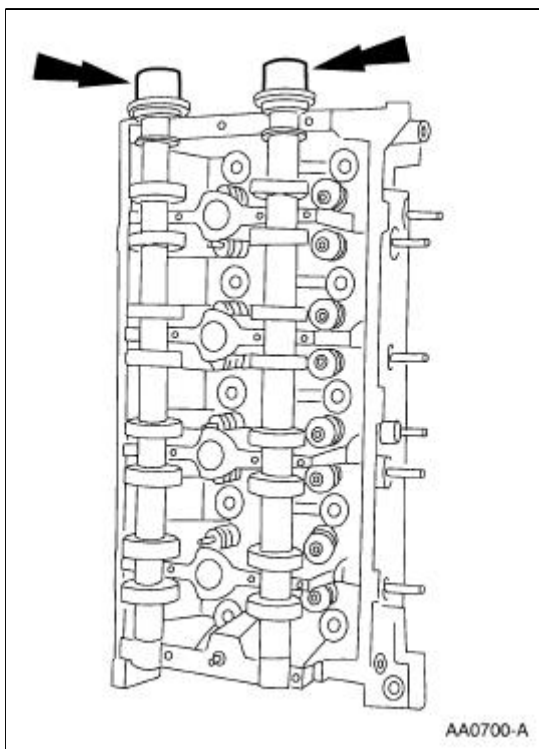


Installation

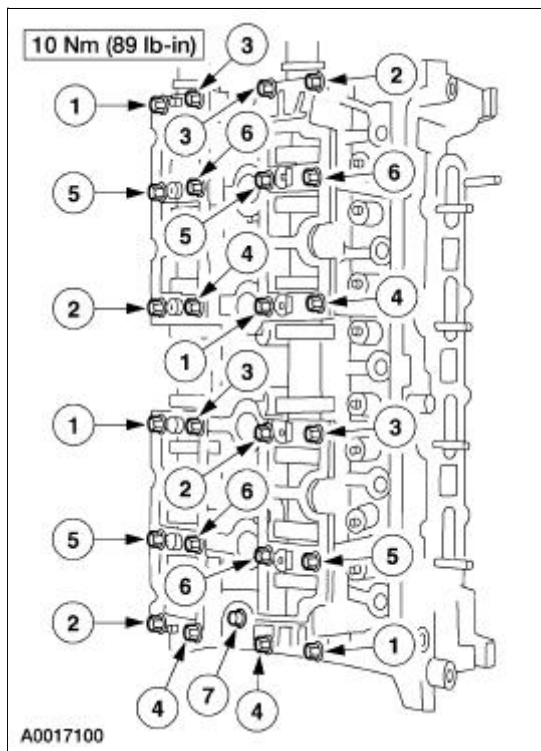
1. **NOTE:** LH shown; RH similar.

Install the camshafts.

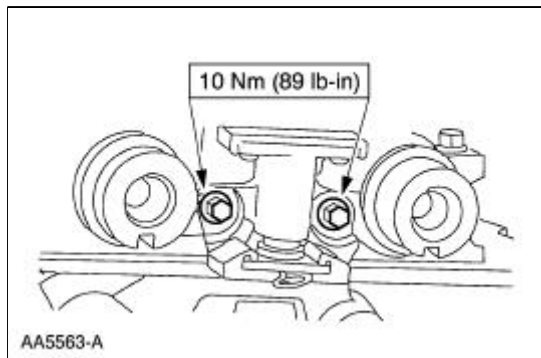
- Lubricate the camshafts with clean engine oil.



2. Install the camshaft bearing cap assemblies and tighten the bolts in the sequence shown.

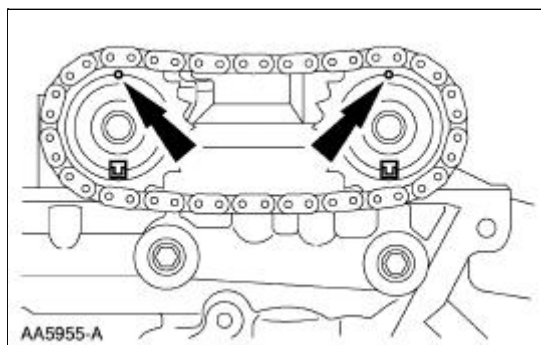


3. Install the bolts.

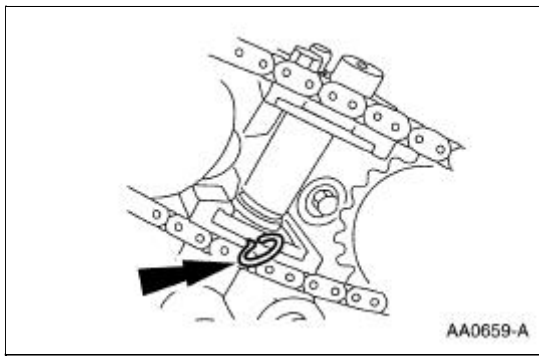


4.  **CAUTION: Timing marks must be at 12 o'clock and indexed at 6 o'clock.**

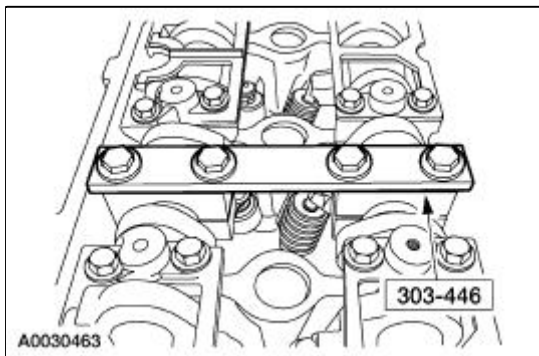
Install the camshaft sprockets and the chain as an assembly.



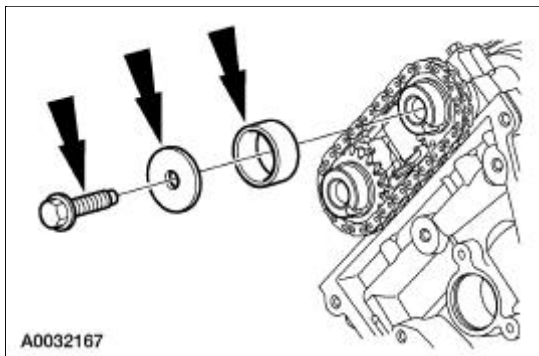
5. Remove the lockpin from the chain tensioner.



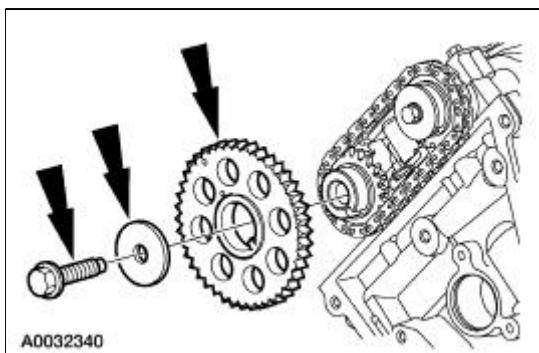
6. Install the special tool.



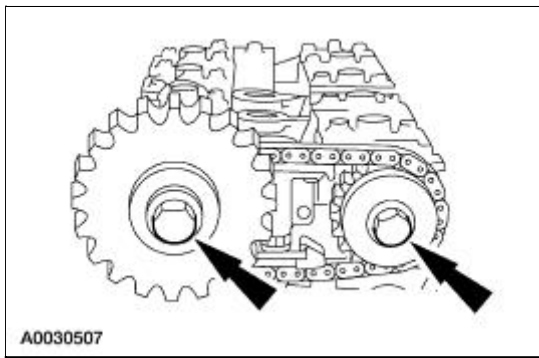
7. Install the camshaft spacer, washer and bolt and hand-tighten the bolt.



8. Install the camshaft sprocket, washer and bolt, and hand-tighten the bolt.



9. Tighten the bolts in two stages:
 - Stage 1: Tighten to 40 Nm (30 lb-ft).
 - Tighten an additional 90 degrees.

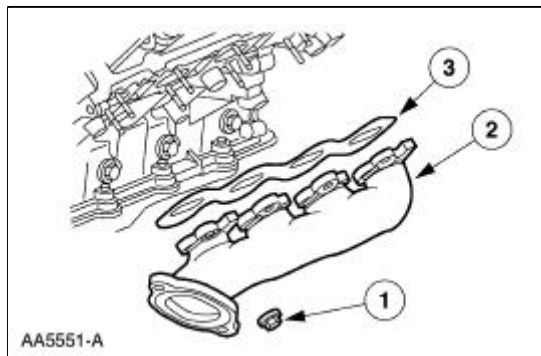


10. Remove the special tool.
 11. Install the left timing chain for the left side or both timing chains for the right side. For additional information, refer to [Timing Drive Components](#) in this section.
 12. Install the roller followers. For additional information, refer to [Camshaft Roller Follower](#) in this section.
-

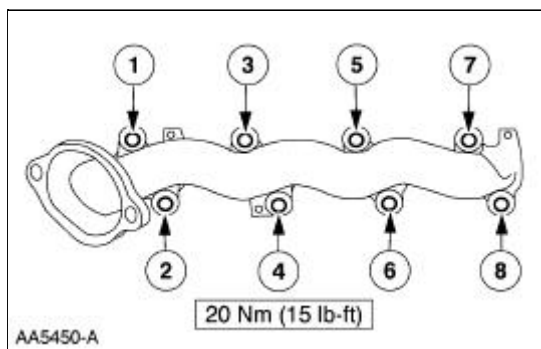
Exhaust Manifold RH

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Raise the vehicle. For additional information, refer to [Section 100-02](#).
3. Remove the dual converter Y-pipe. For additional information, refer to [Section 309-00](#).
4. Remove the starter. For additional information, refer to [Section 303-06](#).
5. Remove the exhaust manifold.
 1. Remove the nuts.
 2. Remove the exhaust manifold.
 3. Remove and discard the gasket.



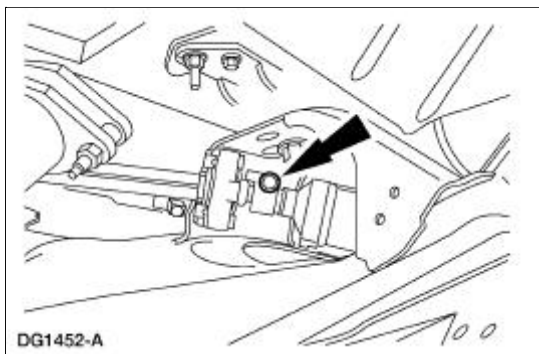
6. To install, reverse the removal procedure.
 - Use a new exhaust manifold gasket.
 - Tighten the exhaust manifold nuts in the sequence shown.



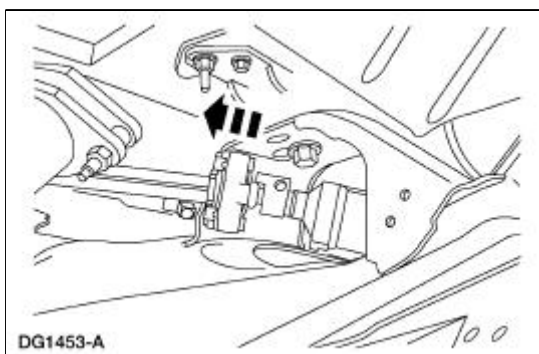
Exhaust Manifold LH

Removal and Installation

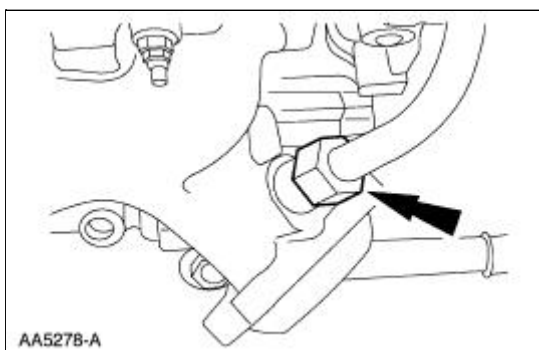
1. Position the steering wheel straight ahead and lock the column.
2. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
3. Raise the vehicle. For additional information, refer to [Section 100-02](#).
4. Remove the dual converter Y-pipe. For additional information, refer to [Section 309-00](#).
5. Remove and discard the pinch bolt.



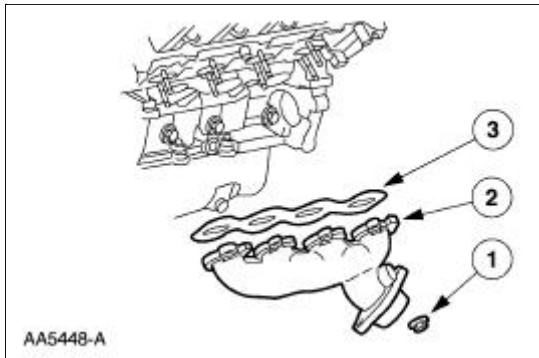
6. Separate the steering coupler.



7. Disconnect the exhaust gas recirculation (EGR) tube at the exhaust manifold.



8. Remove the exhaust manifold.
 1. Remove the nuts.
 2. Remove the exhaust manifold.
 3. Remove and discard the gasket.

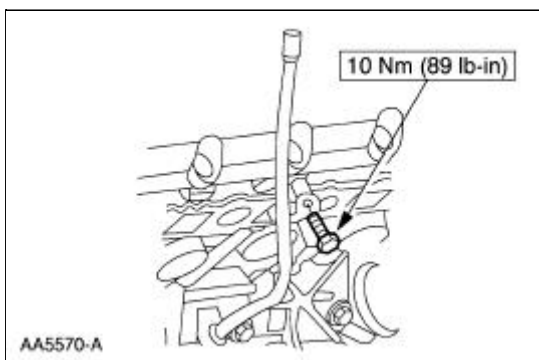


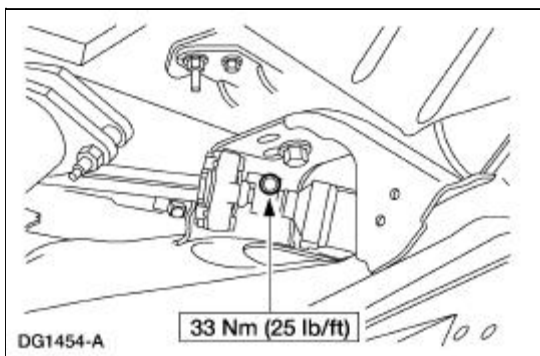
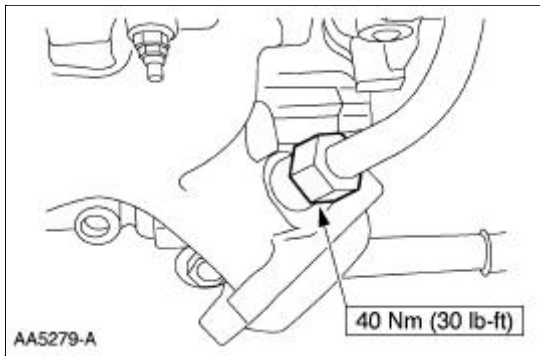
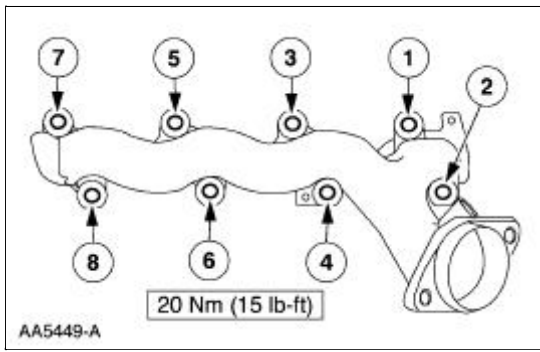
9. Remove the oil level indicator tube.



10. Remove and discard the exhaust manifold gasket.

11. To install, reverse the removal procedure.
 - Use a new exhaust manifold gasket.

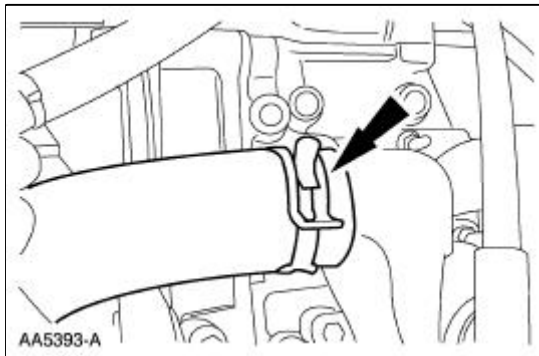




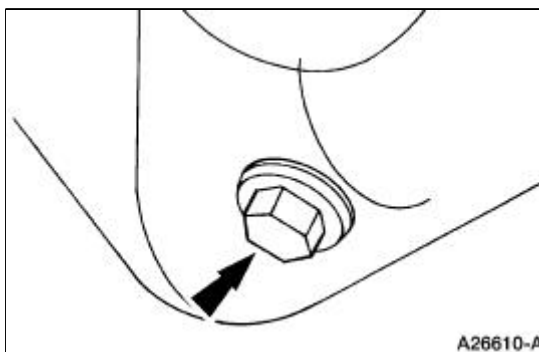
Oil Filter Adapter

Removal and Installation

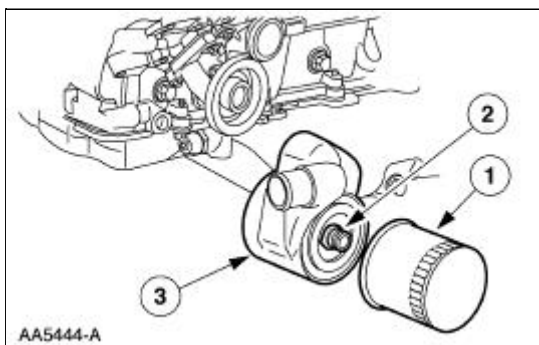
1. Drain the cooling system. For additional information, refer to [Section 303-03A](#)
2. Disconnect the lower radiator hose.



3. Raise the vehicle. For additional information, refer to [Section 100-02](#).
4. Drain the engine oil.



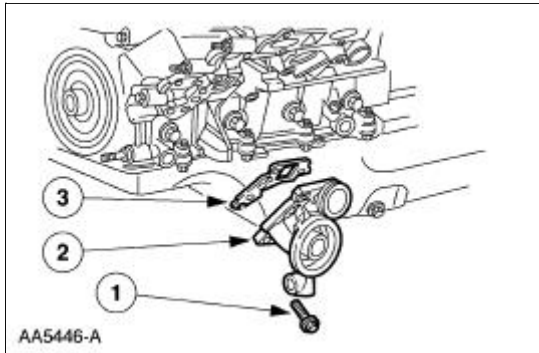
5. Remove the oil cooler.
 1. Remove the oil bypass filter.
 2. Remove the insert and the oil cooler.
 3. Inspect the O-ring and clean the sealing surface.



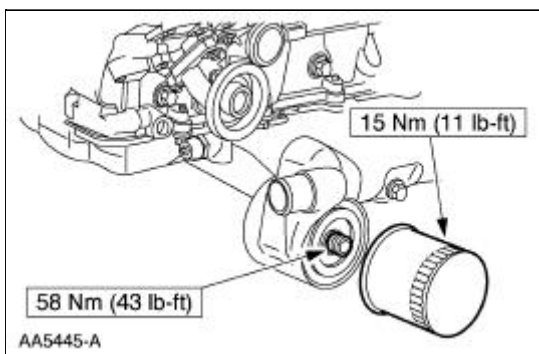
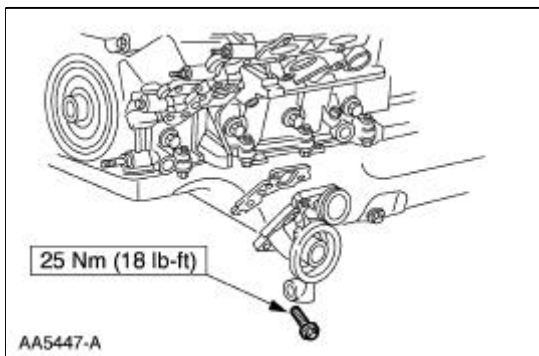
6. Clean and inspect the oil cooler.

- Plug the coolant connections.
- Flush the oil passages with parts cleaner. If metal particles are present in the oil cooler, install a new cooler.

7. Remove the oil filter adapter.
 1. Remove the bolts.
 2. Remove the oil filter adapter.
 3. Remove the gasket.



8. Clean and inspect the oil filter adapter.
 - Flush the oil filter adapter with parts cleaner. If metal particles are present in the adapter, install a new adapter.
9. To install, reverse the removal procedure.



Oil Level Indicator and Tube

Removal

1. Remove the oil level dipstick (6750).
2. Remove the LH exhaust manifold (9430). For additional information, refer to [Exhaust Manifold LH](#) in this section.
3. Remove the bolt.

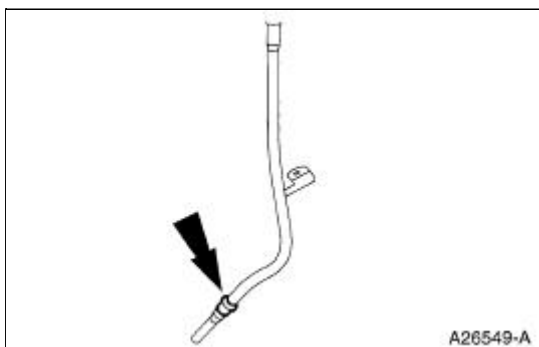


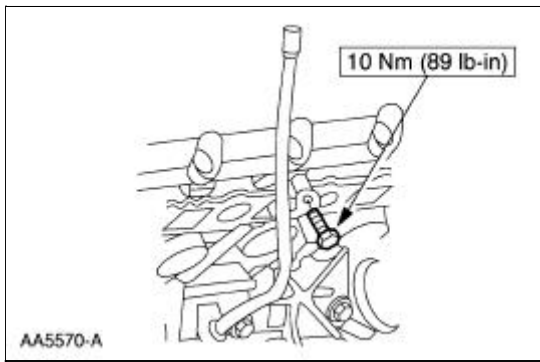
4. Remove the oil level indicator tube (6754).



Installation

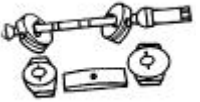

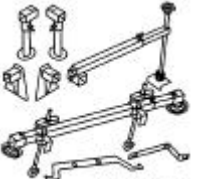
1. To install, follow the removal procedure in reverse.





Oil Pan

Special Tool(s)

 <p>ST1352-A</p>	<p>Compressor, Coil Spring 204-D001 (D78P-5310-A)</p>
 <p>ST1604-A</p>	<p>Lifting Bracket, Engine 303-D088 (D93P-6001-A2)</p>
 <p>ST2333-A</p>	<p>3-Bar Engine Support Kit 303-F072</p>

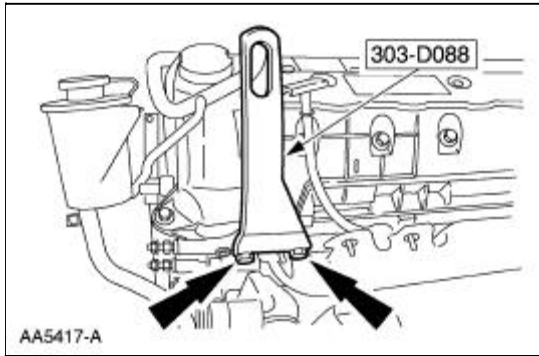
Material

Item	Specification
<p>Metal Surface Cleaner F4AZ-19A536-RA or equivalent</p>	<p>WSE-M5B392-A</p>
<p>Silicone Gasket and Sealant F7AZ-19554-EA or equivalent</p>	<p>WSE-M4G323- A4</p>
<p>Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent</p>	<p>WSS-M2C153-H</p>

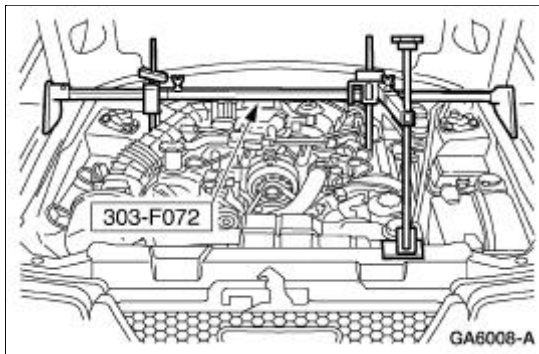
Removal

1. Disconnect the battery ground cable (14301). For additional information, refer to [Section 414-01](#).
2. Remove the transmission. For additional information, refer to [Section 308-03B](#).
3. Remove the air cleaner outlet tube (9B659). For additional information, refer to [Section 303-12](#).
4. Remove the radiator sight shield (8C251).
5. Remove the manifold and tube assembly—accumulator to compressor, 4.6L. For additional information, refer to [Section 412-03](#).
6. Remove the A/C line. For additional information, refer to [Section 412-03](#).

7. Install the special tools.

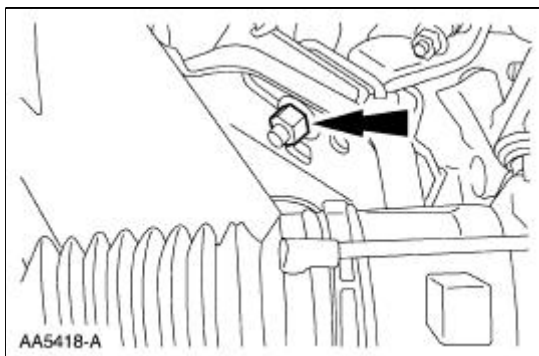


8. Install the special tool.

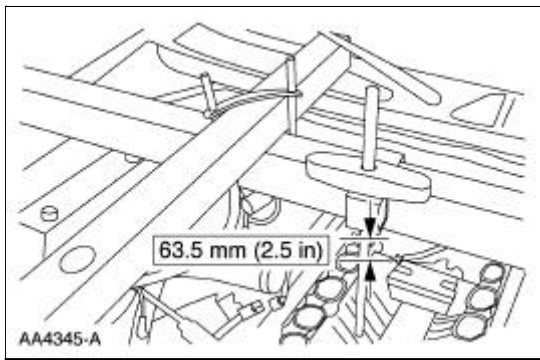


9. Raise the vehicle on a hoist. For additional information, refer to [Section 100-02](#).

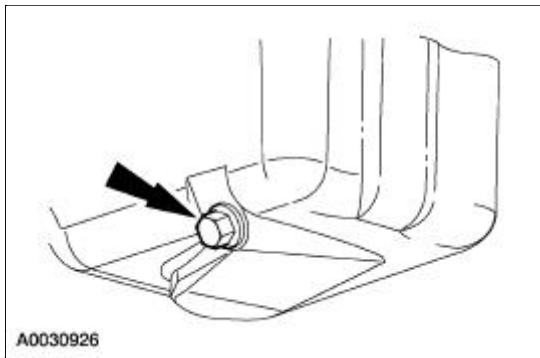
10. Remove the two nuts.



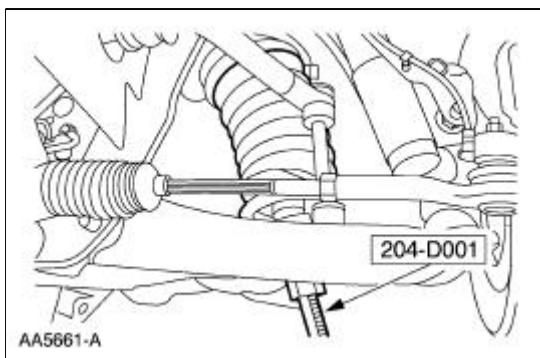
11. Lower the vehicle.
12. Using the special tool, raise the engine.



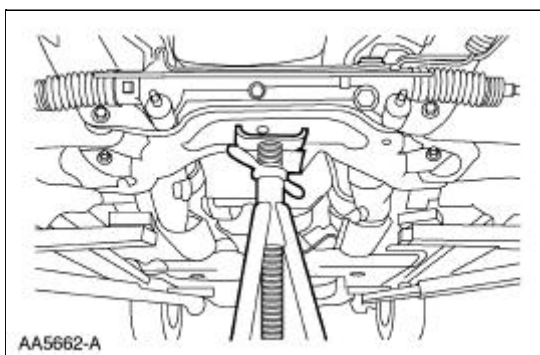
13. Raise the vehicle on a hoist.
14. Remove the oil pan drain plug (6730) and drain the engine oil.



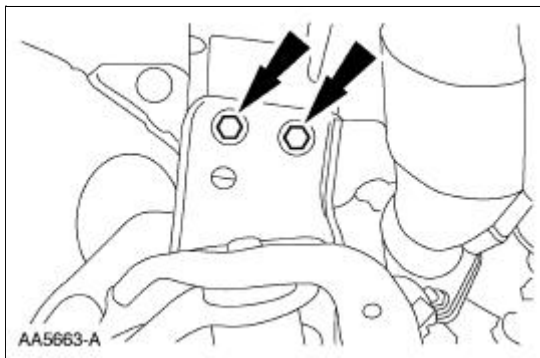
15. Using the special tool, compress the front coil springs (5310).



16. Position a safety stand.

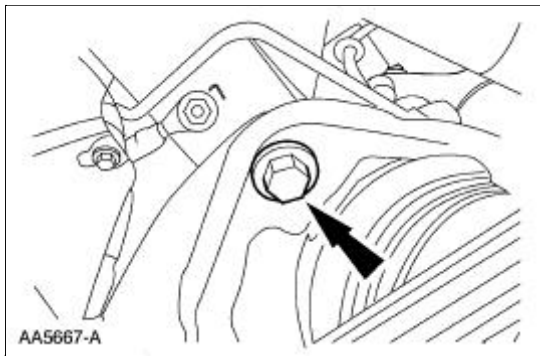


17. Remove the four bolts.

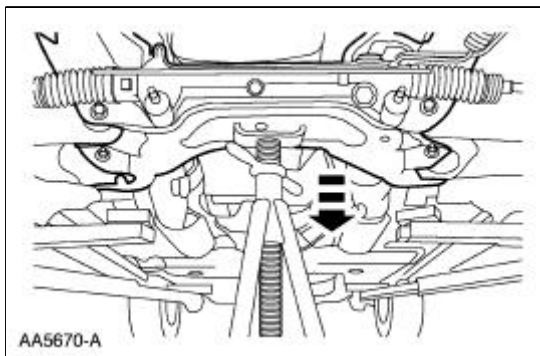


18. **NOTE:** Do not completely remove the bolts.

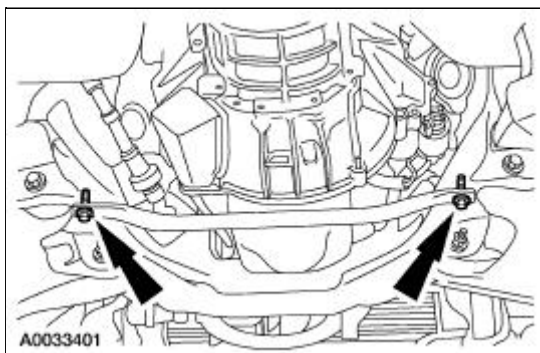
Loosen the bolts.



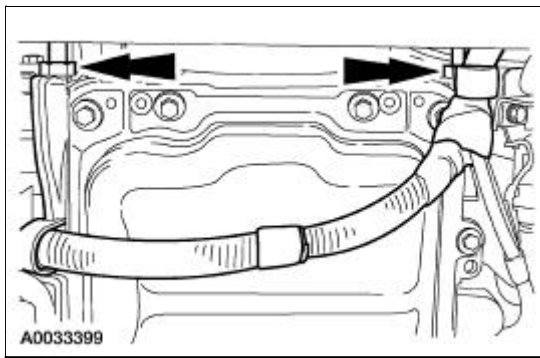
19. Lower the front sub-frame (5C145).



20. Remove the sub-frame brace.



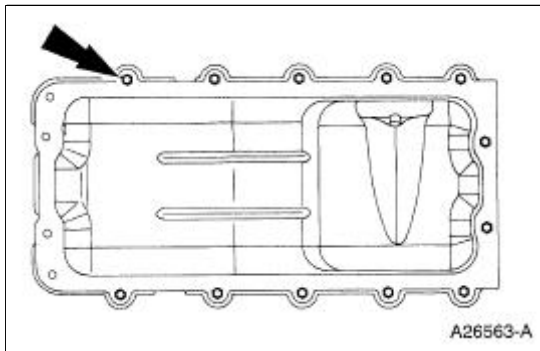
21. Remove the starter wiring harness nuts and position the wiring harness out of the way.




22. **NOTE:** Be careful when removing the oil pan gasket. It is reusable.

Remove the oil pan and gasket.

- Inspect the oil pan gasket for damage.



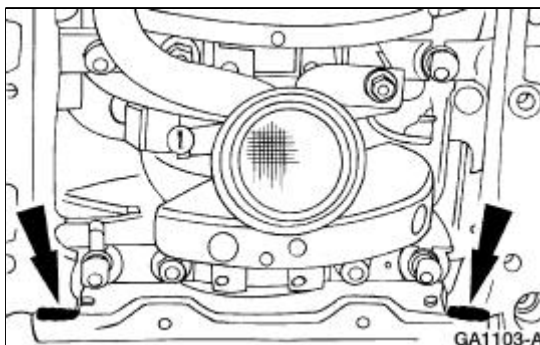
Installation

1.  **CAUTION:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

Clean and inspect the mating surfaces.

2. **NOTE:** If the oil pan is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure may result in future oil leakage.

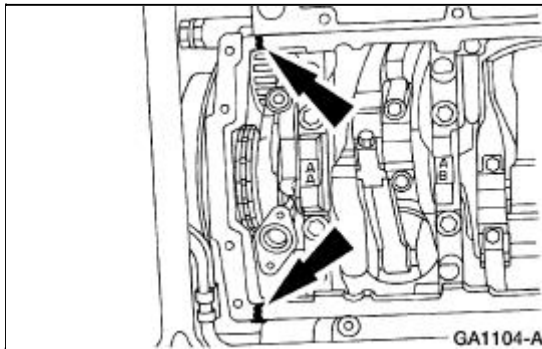
Apply silicone gasket and sealant at the engine front cover-to-cylinder block mating surface.



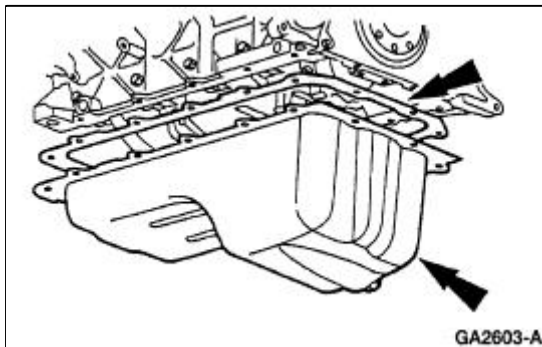
3. **NOTE:** If the oil pan is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness,

or four minutes, whichever is longer. Failure to follow this procedure may result in future oil leakage.

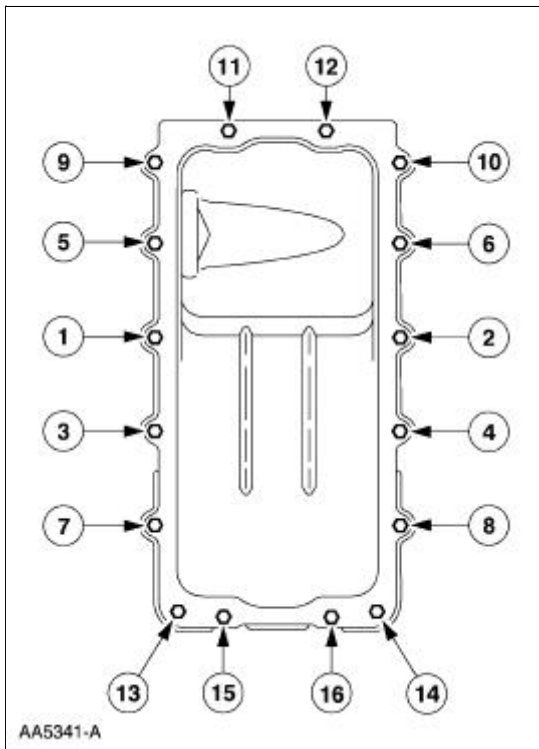
Apply silicone gasket and sealant at the rear oil seal retainer-to-cylinder block sealing surface.



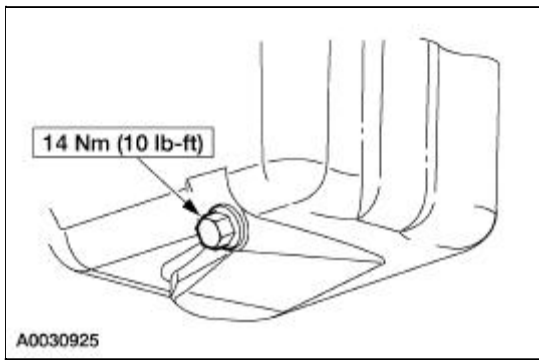
4. Install the oil pan and gasket and loosely install the bolts.



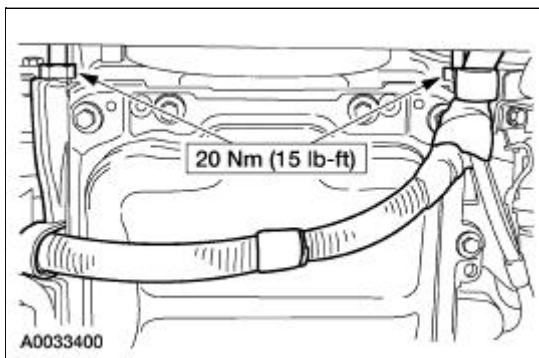
5. Tighten the bolts in the sequence shown in three stages.
 - Stage 1: Tighten to 2 Nm (18 lb-in).
 - Stage 2: Tighten to 20 Nm (15 lb-ft).
 - Stage 3: Tighten an additional 60 degrees.



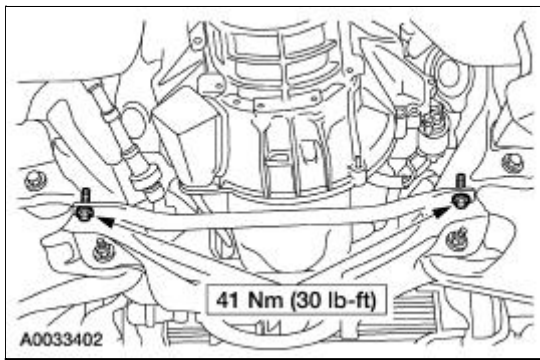
6. Install the oil pan drain plug.



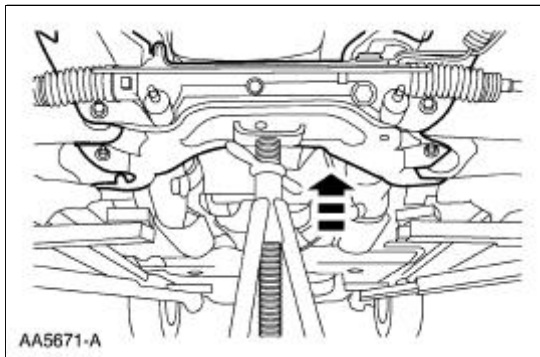
7. Position the starter wiring harness and install the wiring harness nuts.



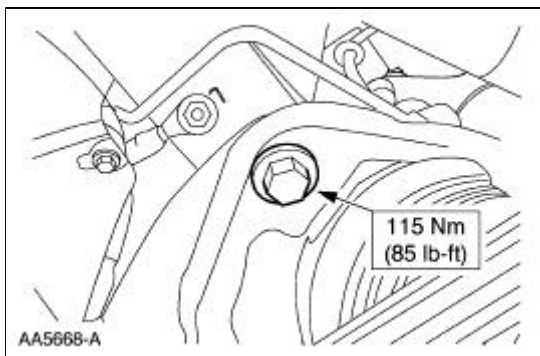
8. Install the sub-frame brace.



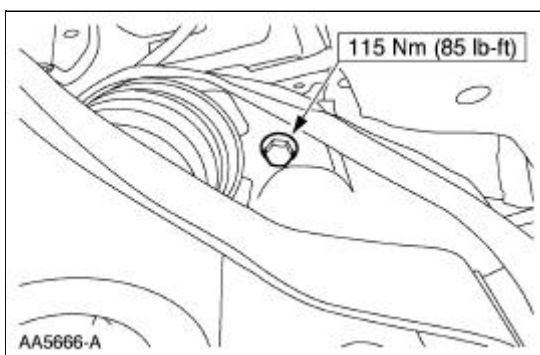
9. Raise the front sub-frame into position.



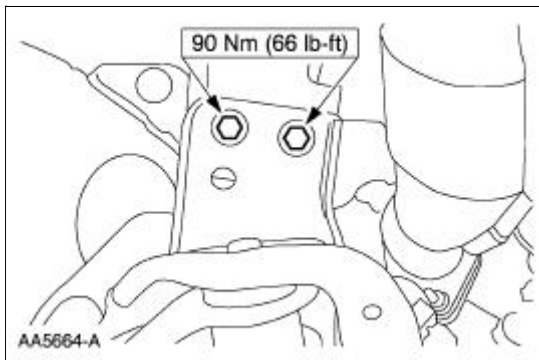
10. Install the two bolts.



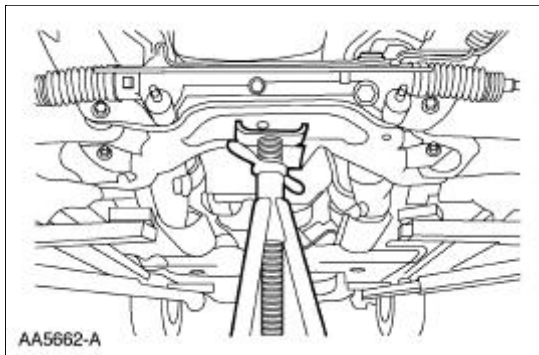
11. Install the two bolts.



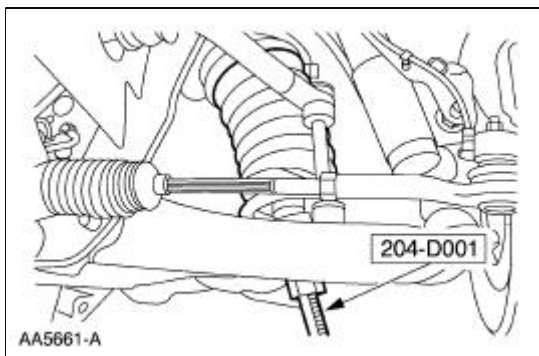
12. Install the four bolts.



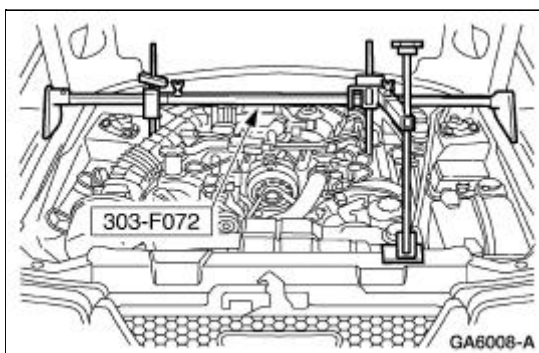
13. Position the safety stand aside.



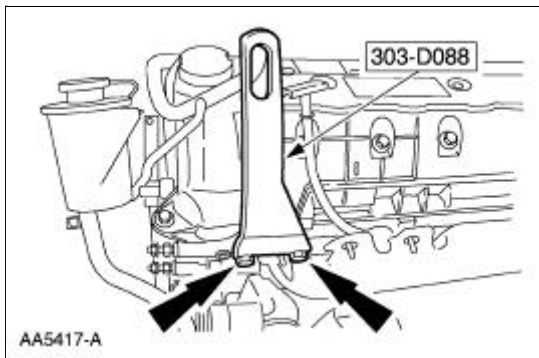
14. Release the tension from the front coil springs and remove the special tool.



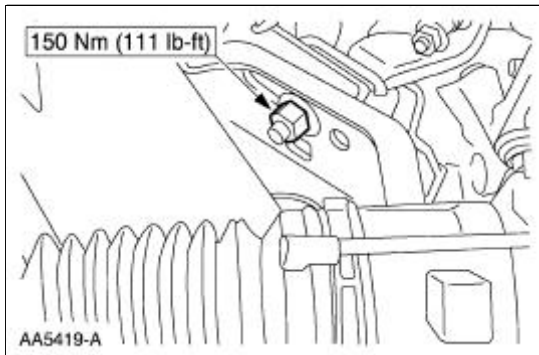
15. Raise the vehicle.
16. Using the special tool, lower the engine and remove the special tool.



17. Remove the special tools.



18. Install the two nuts.

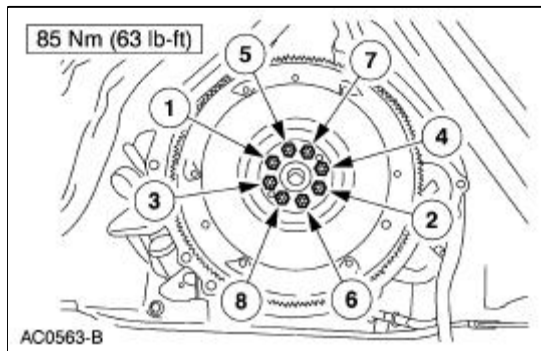


19. Install the transmission. For additional information, refer to [Section 308-03B](#).
 20. Lower the vehicle.
 21. Fill the engine crankcase with clean engine oil.
 22. Install the A/C line. For additional information, refer to [Section 412-03](#).
 23. Install the manifold and tube assembly—accumulator to compressor, 4.6L. For additional information, refer to [Section 412-03](#).
 24. Install the radiator sight shield.
 25. Install the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).
 26. Install the battery ground cable. For additional information, refer to [Section 414-01](#).
 27. Start the engine and check for leaks.
-

Flywheel

Removal

1. Remove the clutch components. For additional information, refer to [Section 308-01](#).
2. Remove the bolts and the flywheel.

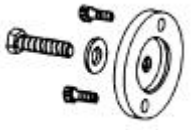

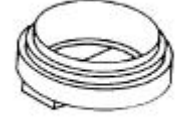
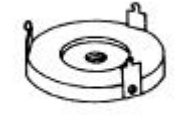




Installation

1. To install, reverse the removal procedure.
-

Crankshaft Rear Seal with Retainer Plate

Special Tool(s)

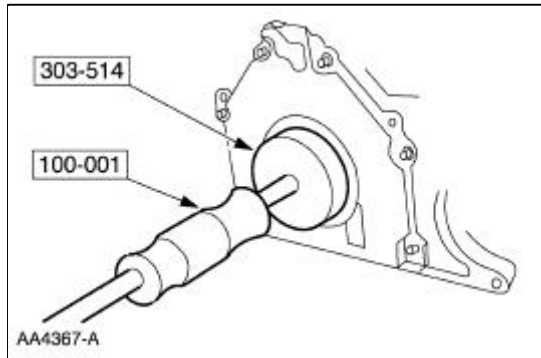
 <p>ST1480-A</p>	<p>Installer, Crankshaft Rear Oil Seal 303-518 (T95P-6701-DH)</p>
 <p>ST1382-A</p>	<p>Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)</p>
 <p>ST1479-A</p>	<p>Installer, Crankshaft Rear Oil Seal 303-516 (T95P-6701-BH)</p>
 <p>ST1481-A</p>	<p>Remover, Crankshaft Rear Oil Slinger 303-514 (T95P-6701-AH)</p>
 <p>ST1482-A</p>	<p>Installer, Crankshaft Rear Oil Slinger 303-517 (T95P-6701-CH)</p>
 <p>ST1185-A</p>	<p>Slide Hammer 100-001 (T50T-100-A)</p>

Material

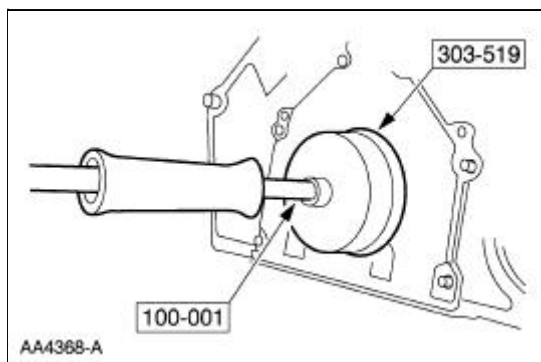
Item	Specification
<p>Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent</p>	<p>WSS-M2C153-H</p>

Removal

1. Remove the flywheel. For additional information, refer to [Flywheel](#) in this section.
2. Using the special tools, remove the crankshaft oil slinger.

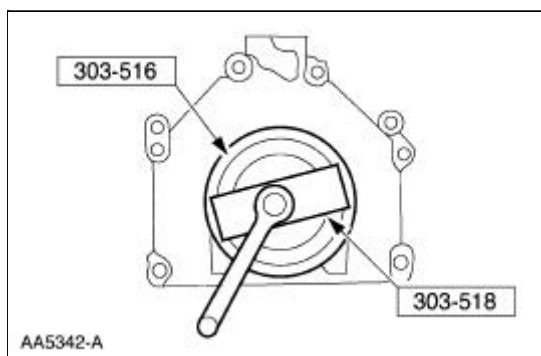


3. Using the special tools, remove the crankshaft rear oil seal (6701).

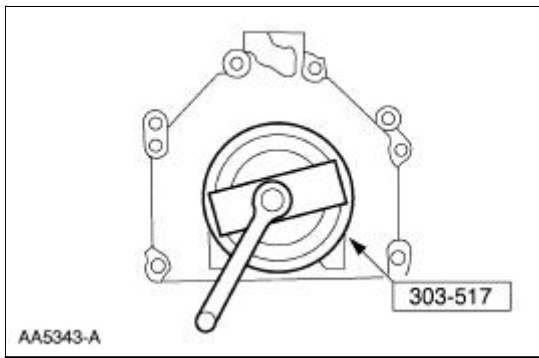


Installation

1. Using the special tools, install the crankshaft rear oil seal.
 - Lubricate the oil seal using clean engine oil.




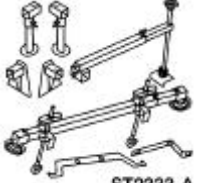
2. Using the special tool, install the crankshaft oil slinger.



3. Install the flywheel. For additional information, refer to [Flywheel](#) in this section.
-

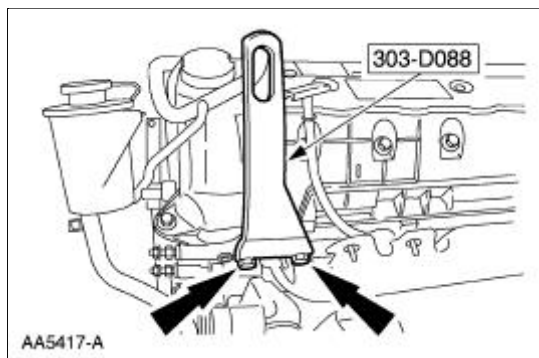
Engine Mount RH

Special Tool(s)

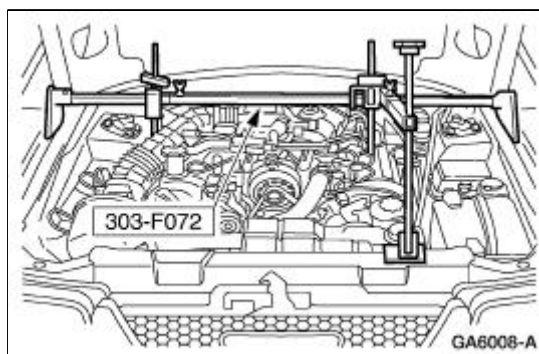
 <p>ST1604-A</p>	Lifting Bracket, Engine 303-D088 (D93P-6001-A2)
 <p>ST2333-A</p>	3-Bar Engine Support Kit 303-F072

Removal

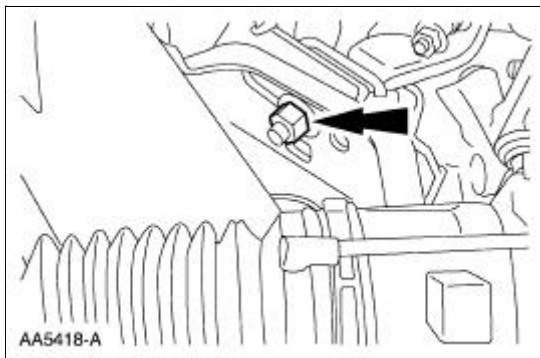
1. Install the special tools.



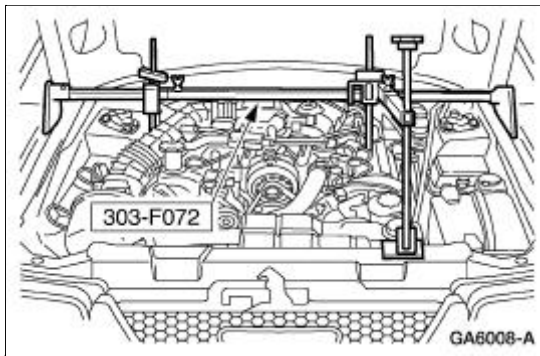
2. Install the special tool.



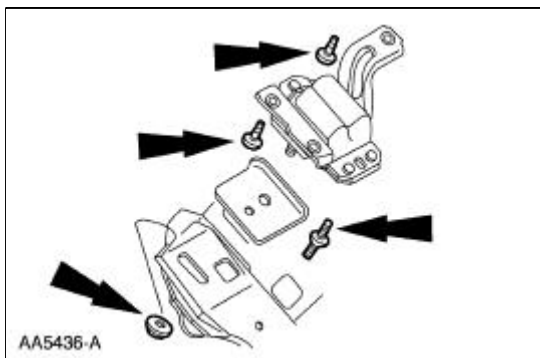
3. Raise the vehicle. For additional information, refer to [Section 100-02](#).
4. Remove the two nuts.



5. Lower the vehicle.
6. Using the special tool, raise the engine.

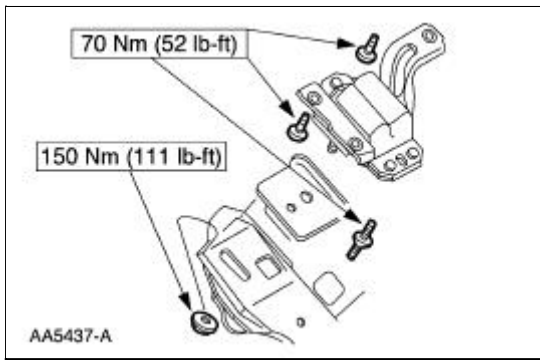


7. Raise the vehicle.
8. Remove the engine mount.




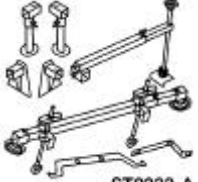
Installation

1. To install, reverse the removal procedure.



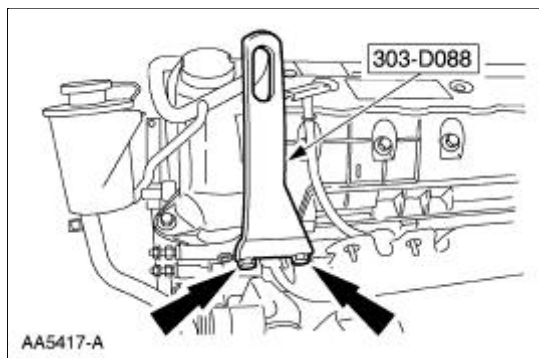
Engine Mount LH

Special Tool(s)

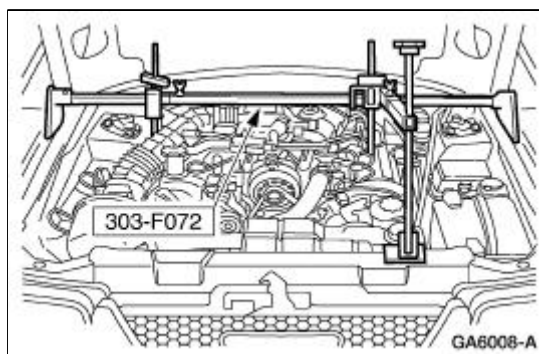
 <p>ST1604-A</p>	Lifting Bracket, Engine 303-D088 (D93P-6001-A2)
 <p>ST2333-A</p>	3-Bar Engine Support Kit 303-F072

Removal

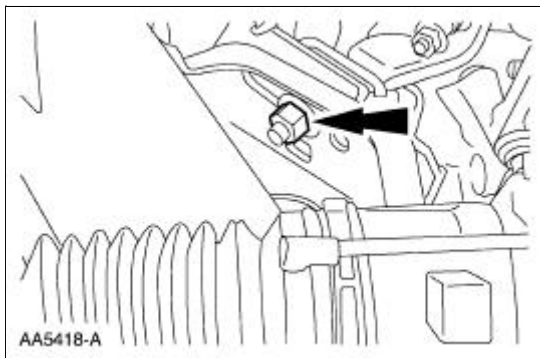
1. Install the special tools.



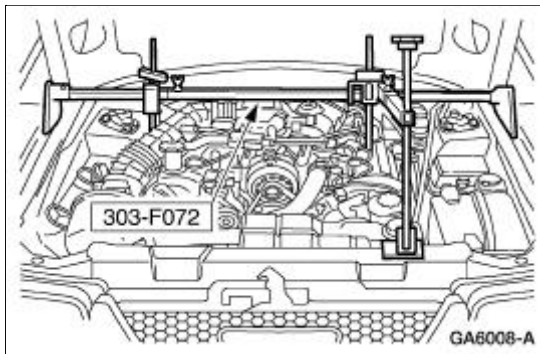
2. Install the special tool.



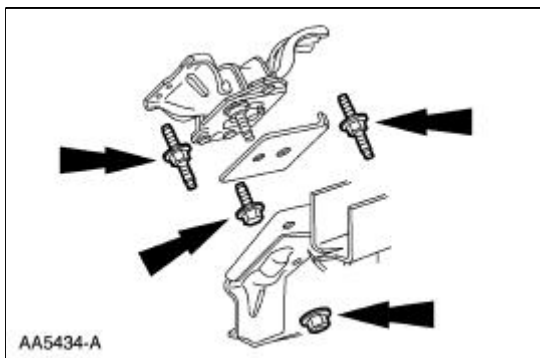
3. Raise the vehicle. For additional information, refer to [Section 100-02](#).
4. Remove the two nuts.



5. Lower the vehicle.
6. Using the special tool, raise the engine.

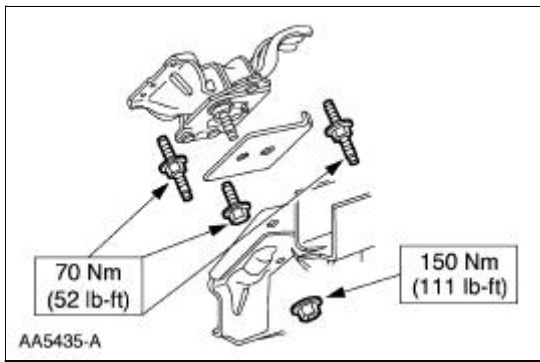


7. Raise the vehicle on a hoist.
8. Remove the engine mount.



Installation

1. To install, follow the removal procedure in reverse.



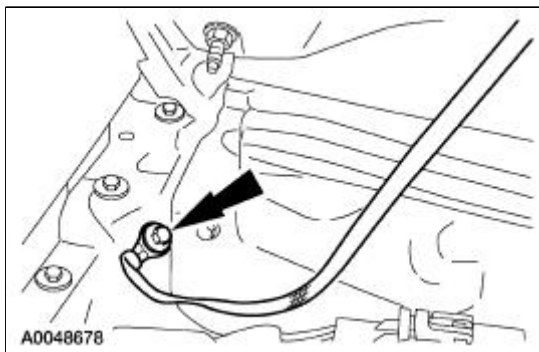
Engine

Special Tool(s)

 ST1603-A	Lifting Bracket, Engine 303-D087 (D93P-6001-A1)
 ST1604-A	Lifting Bracket, Engine 303-D088 (D93P-6001-A2)
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3)

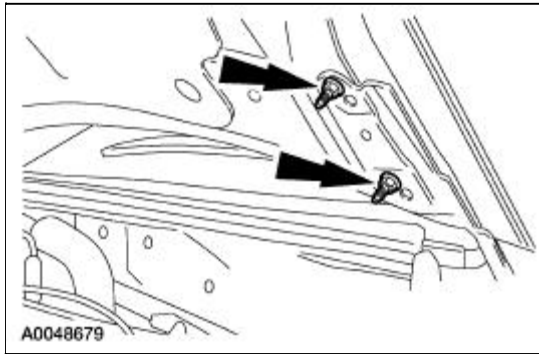
Removal

1. Remove the battery. For additional information, refer to [Section 414-01](#).
2. Release the fuel pressure. For additional information, refer to [Section 310-00](#).
3. Drain the engine cooling system. For additional information, refer to [Section 303-03A](#).
4. Drain the supercharger cooling system. For additional information, refer to [Section 303-03B](#).
5. Recover the A/C system refrigerant. For additional information, refer to [Section 412-00](#).
6. Remove the hood-to-body ground strap.

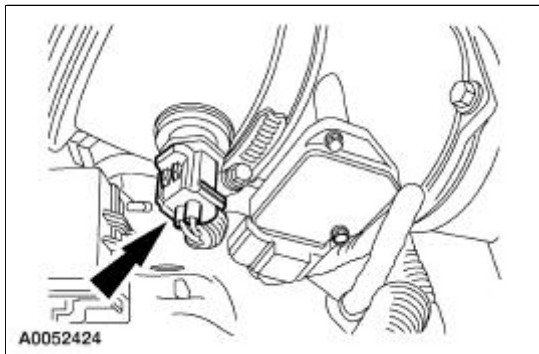


7. **NOTE:** Mark the hood hinge locations to aid in hood installation.

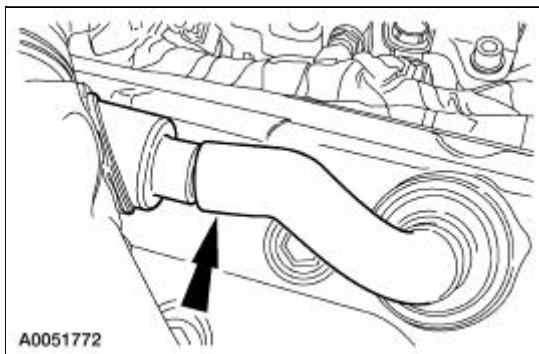
Remove the four nuts and the hood.



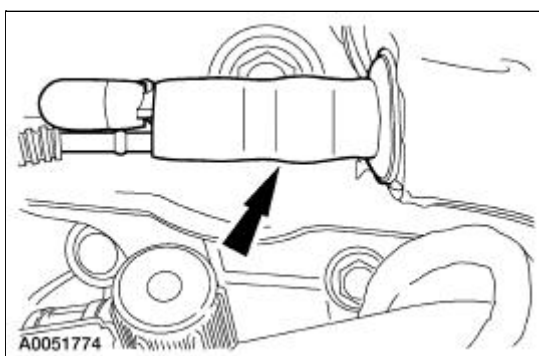
8. Disconnect the intake air temperature (IAT) sensor.



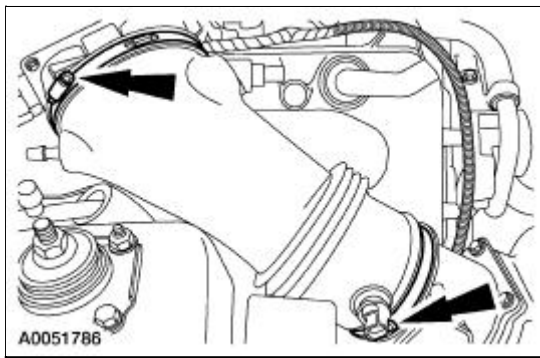
9. Disconnect the breather hose.



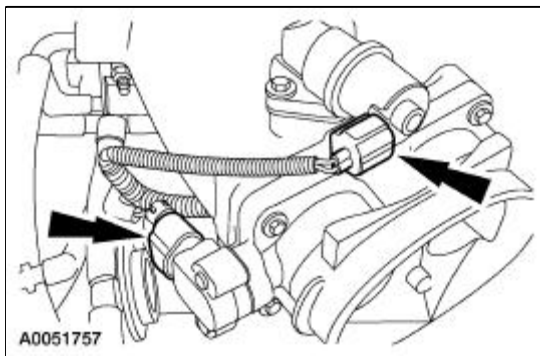
10. Disconnect the vacuum hose.



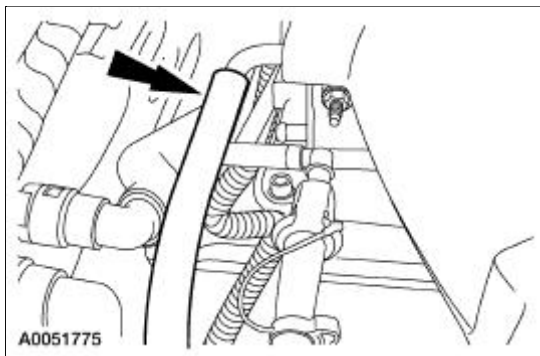
11. Loosen the clamps and remove the air cleaner outlet pipe.



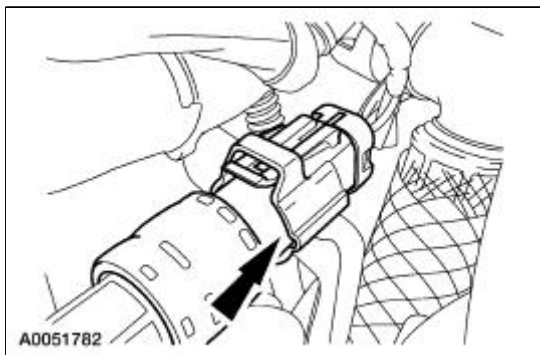
12. Disconnect the throttle position (TP) sensor and the idle air control (IAC) valve electrical connectors.



13. Disconnect the vacuum hose.

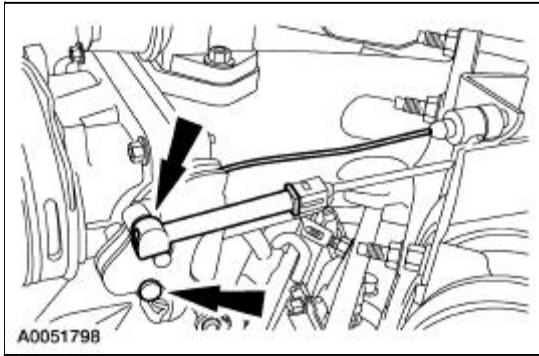


14. Disconnect the A/C pressure switch electrical connector.

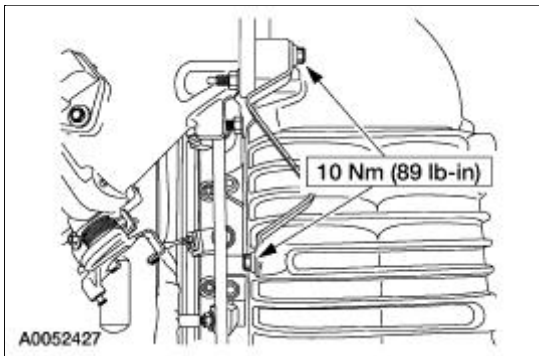


15. Disconnect the fuel tube spring lock coupling. For additional information, refer to [Section 310-00](#).

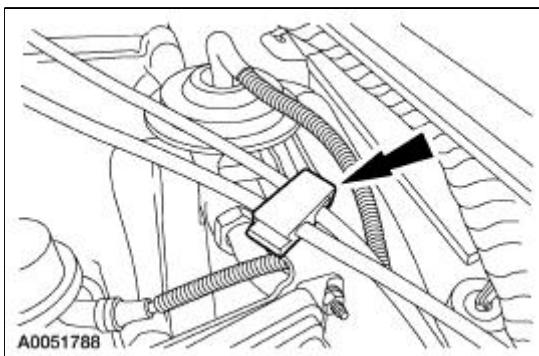
16. Disconnect the accelerator controls.
- Disconnect the accelerator cable.
 - If equipped, disconnect the speed control cable.



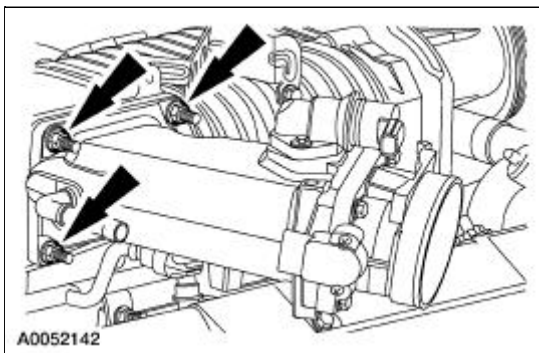
17. Remove the accelerator cable bracket bolts.



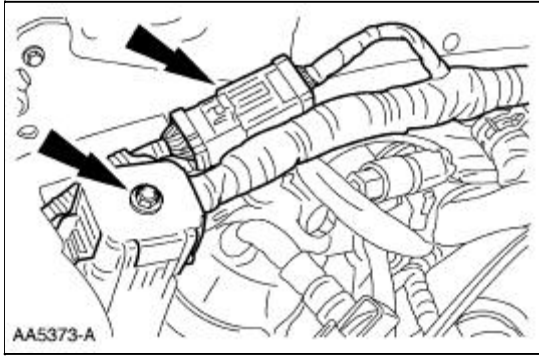
18. Release the clip and position the accelerator cable bracket and the cables aside.



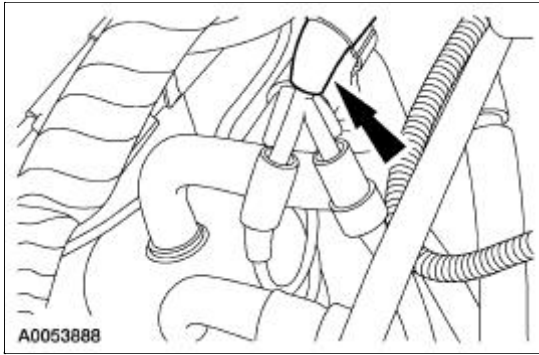
19. Remove the four nuts and the throttle body and spacer assembly.



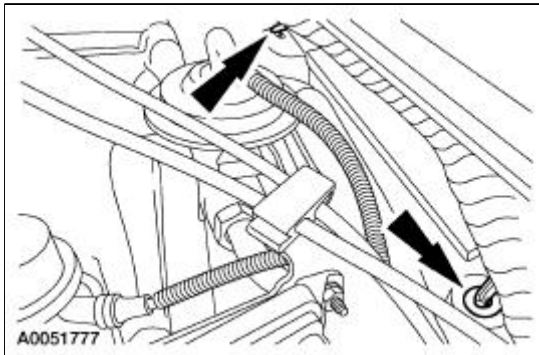
20. Disconnect the 16-pin and the 42-pin connectors.



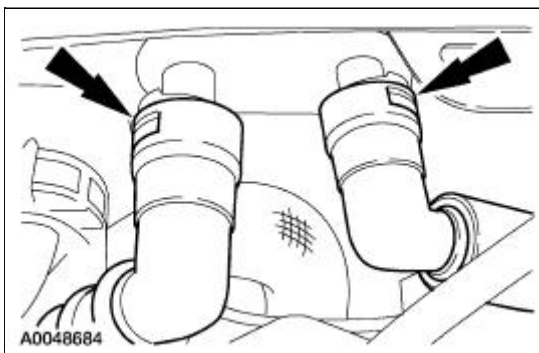
21. Disconnect the vacuum hoses.



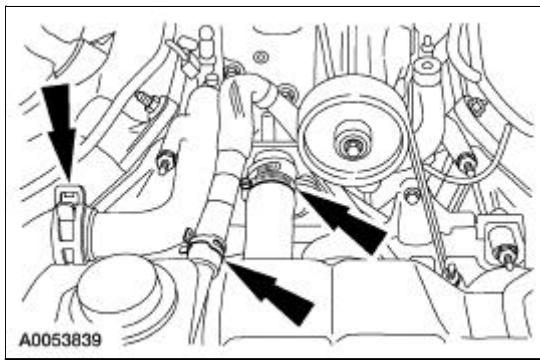
22. Separate the wiring harness from the dash panel.



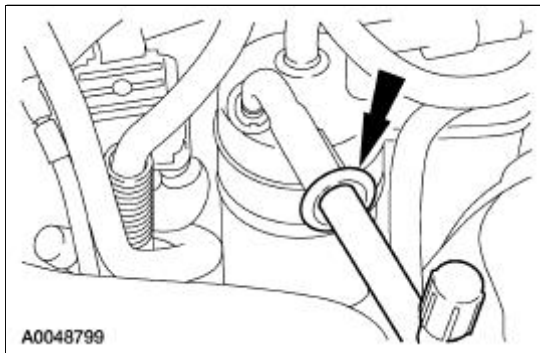
23. Disconnect the heater hoses.



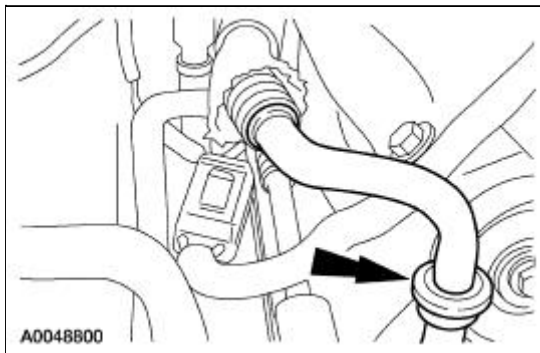
24. Disconnect the radiator upper hose, radiator lower hose and the supercharger degas hose.



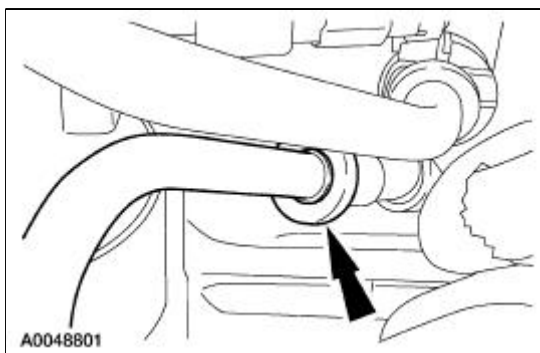
25. Disconnect the A/C suction tube from the accumulator.



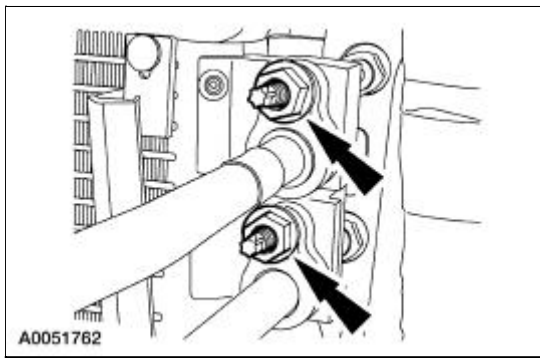
26. Disconnect and remove the A/C suction tube.



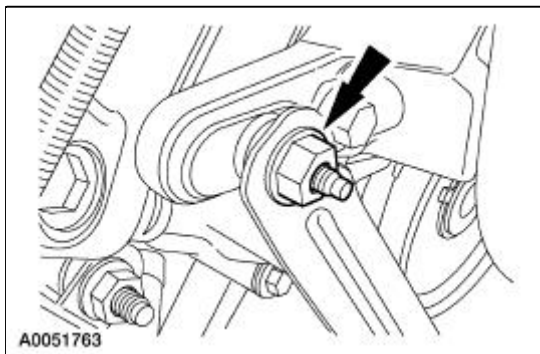
27. Disconnect the A/C tube.



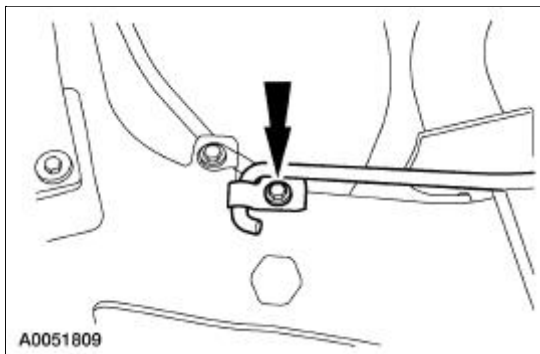
28. Remove the nuts and disconnect the A/C tubes.



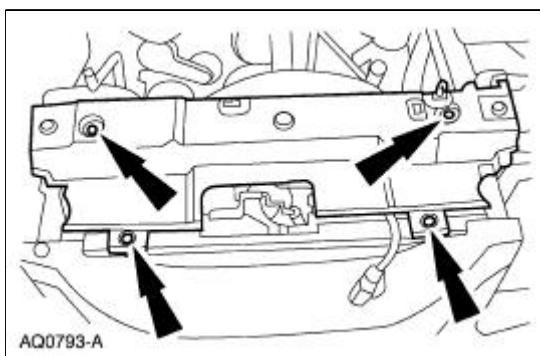
29. Remove the nut and the A/C manifold tube.



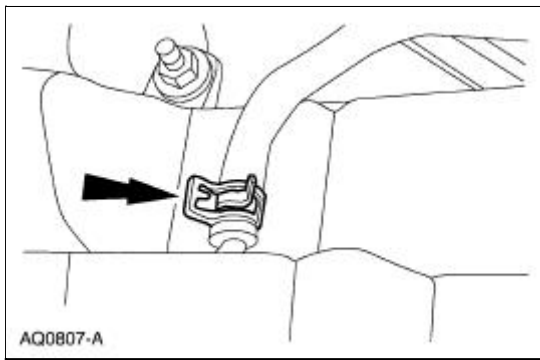
30. Remove the hood prop.



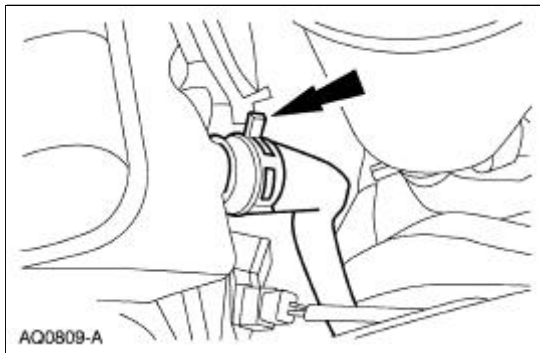
31. Remove the push pins and the radiator sight shield.



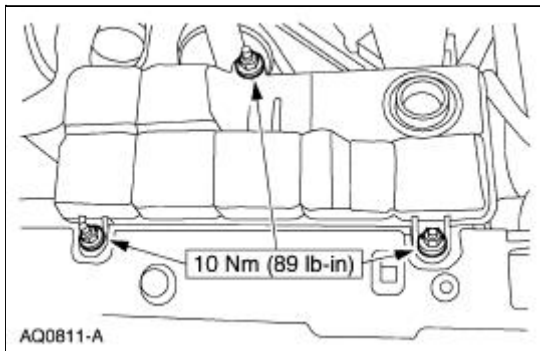
32. Disconnect the radiator vent hose from the degas bottle.



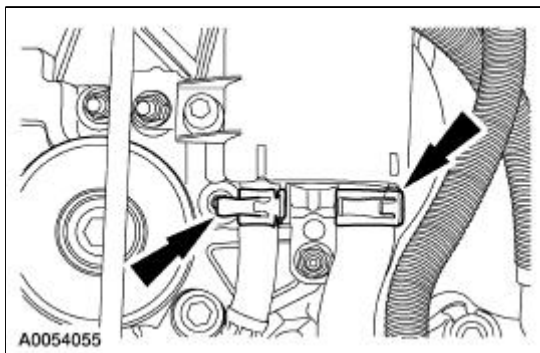
33. Remove the degas bottle return hose.



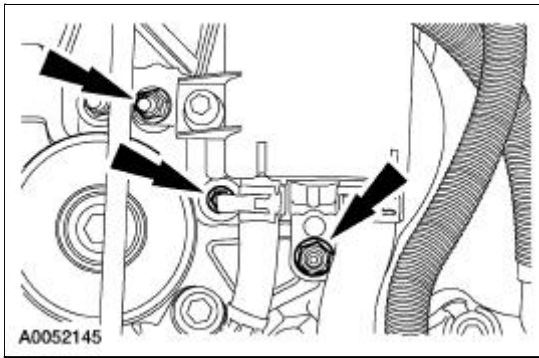
34. Remove the nuts and the degas bottle.



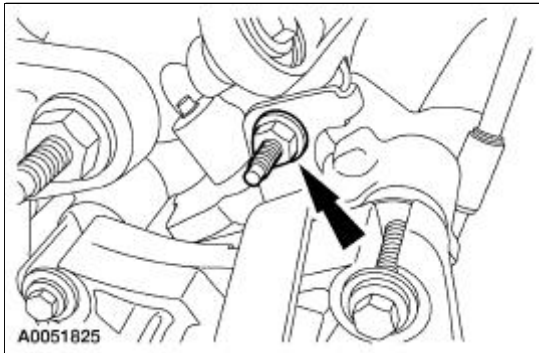
35. Disconnect the power steering hoses.



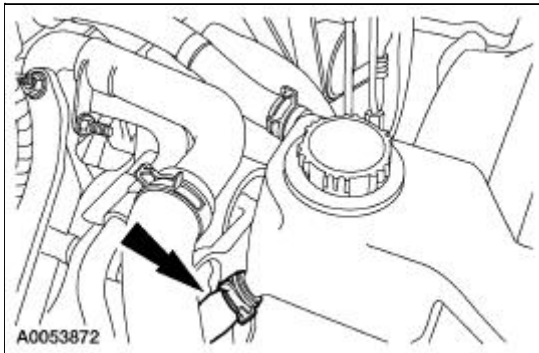
36. Remove the fasteners, and the power steering reservoir and bracket.



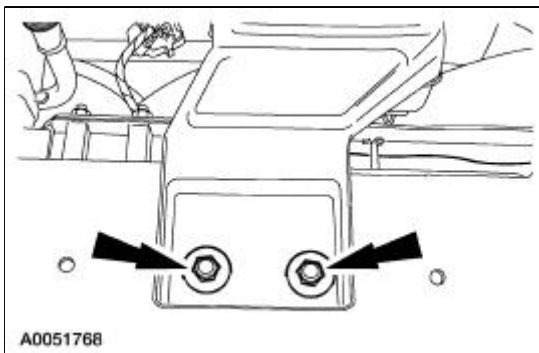
37. Remove the power steering hose bracket.



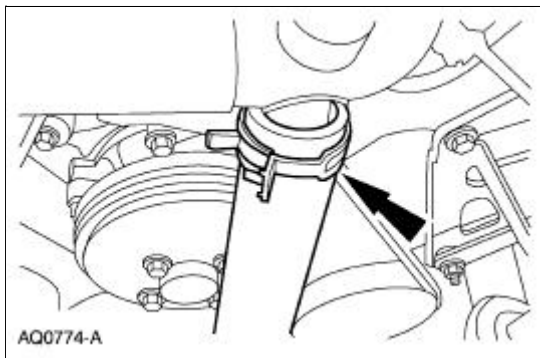
38. Disconnect the supercharger degas hose.



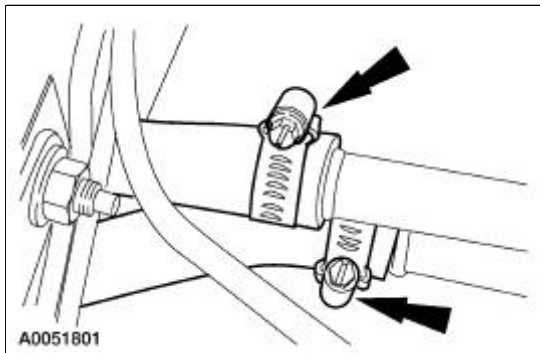
39. Remove the bolts and the supercharger degas bottle.



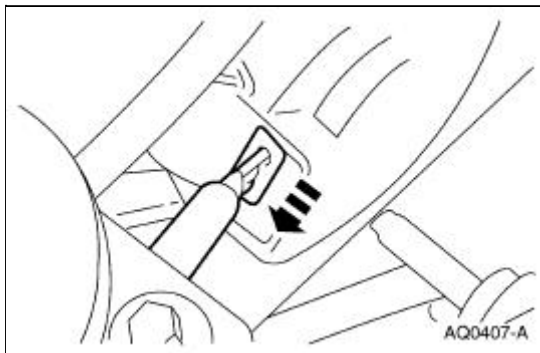
40. Disconnect the radiator lower hose.



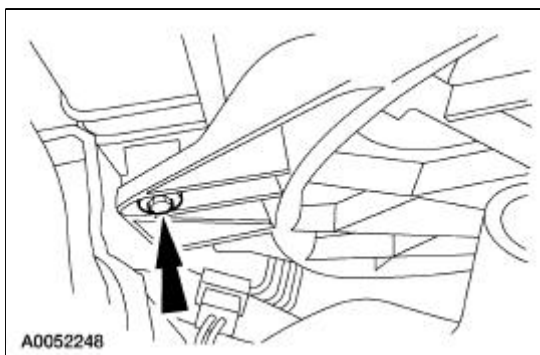
41. Disconnect the supercharger coolant hoses.



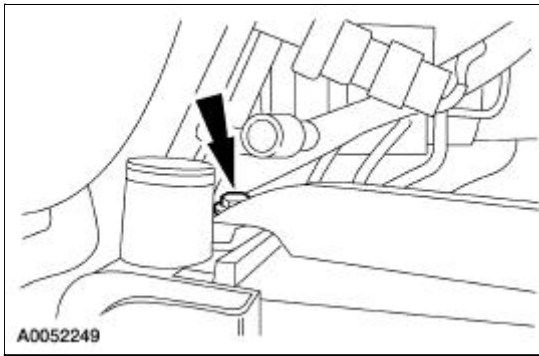
42. Disconnect the cooling fan electrical connector.



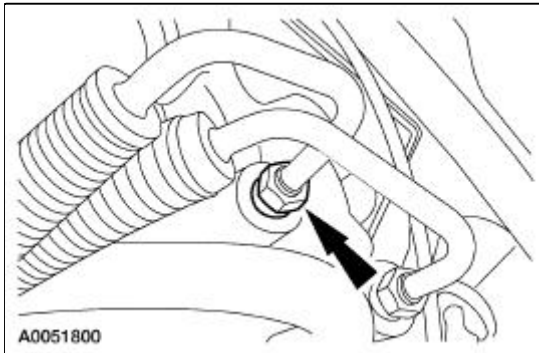
43. Remove the LH cooling fan shroud bolt.



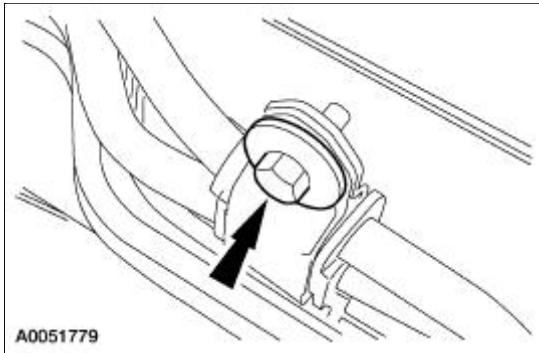
44. Remove the RH cooling fan shroud bolt, and remove the fan, motor and shroud as an assembly.



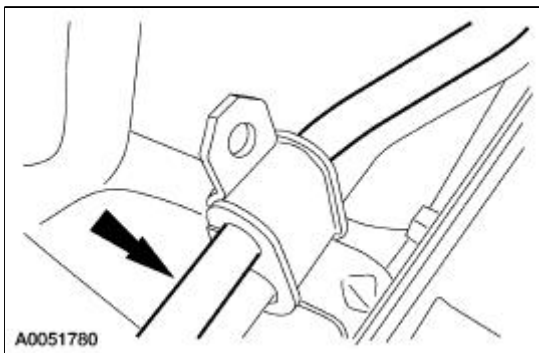
45. Disconnect the power steering hose.



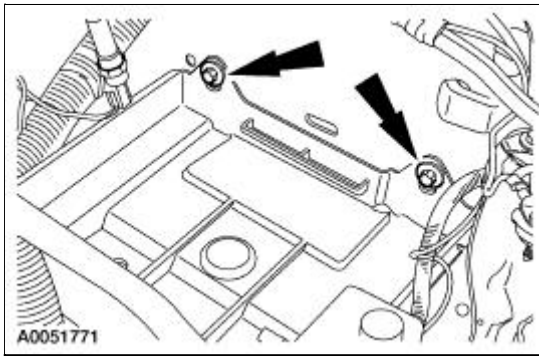
46. Remove the power steering bracket bolt.



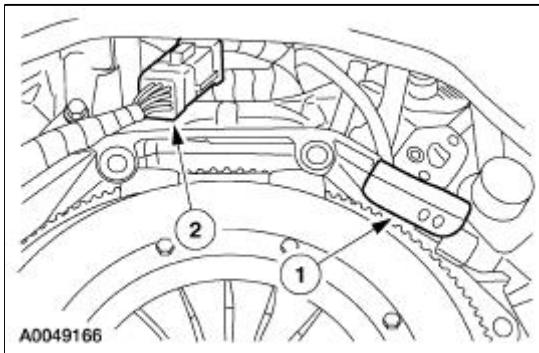
47. Remove the power steering hose from the grommet.



48. Remove the bolts and the battery tray.

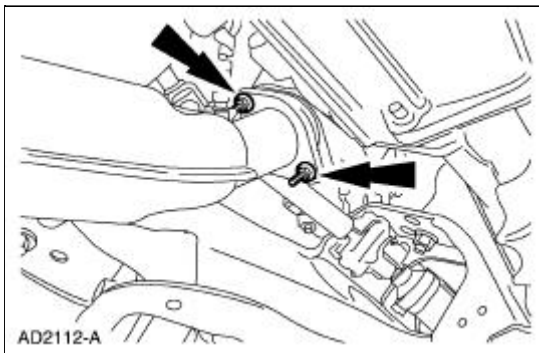


49. Remove the auxiliary crankshaft pulley. For additional information, refer to [Crankshaft Pulley—Auxiliary](#) in this section.
50. Remove the clutch. For additional information, refer to [Section 308-01](#).
51. Remove the transmission wiring harness.
 1. Remove the RH oxygen sensor connector from the bracket.
 2. Disconnect the transmission wiring connector and remove the harness.

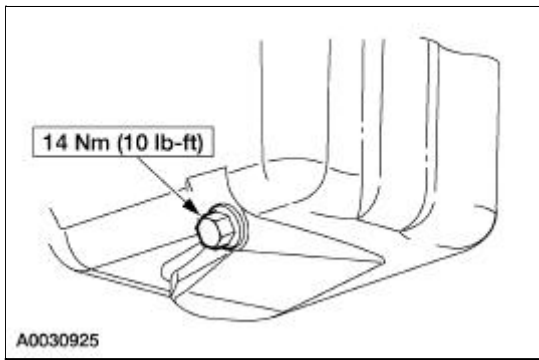


52. **NOTE:** LH is shown, RH is similar.

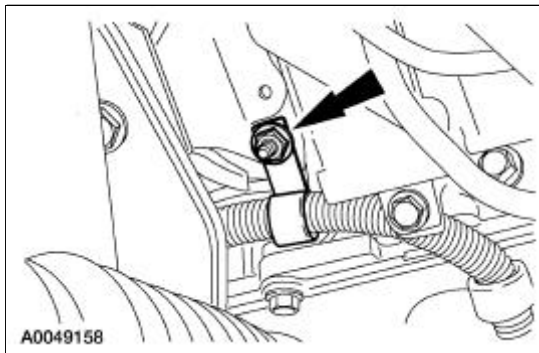
Remove the right and left exhaust manifold flange nuts, and position the exhaust manifold aside.



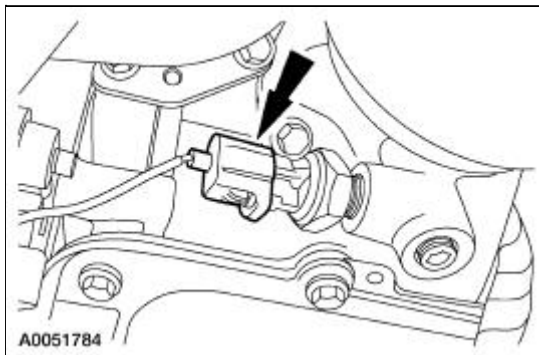
53. Drain the engine oil.
 - Install the drain plug when finished.



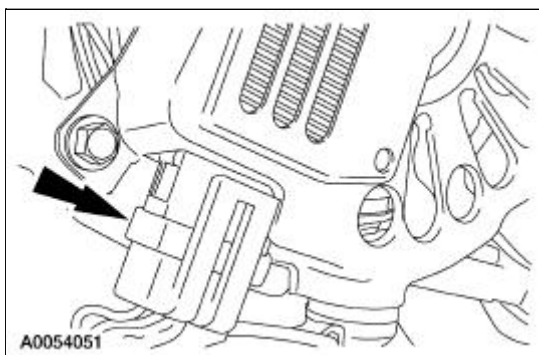
54. Remove the nut and the wiring harness bracket.



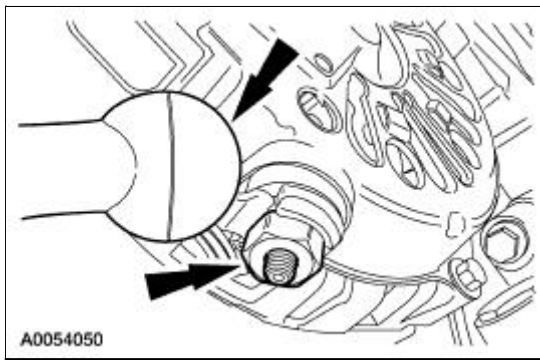
55. Disconnect the oil pressure sender electrical connector.



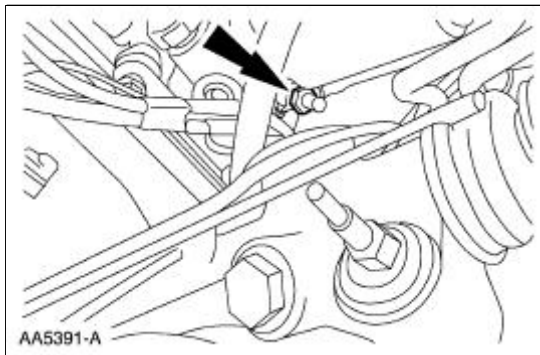
56. Disconnect the generator electrical connector.



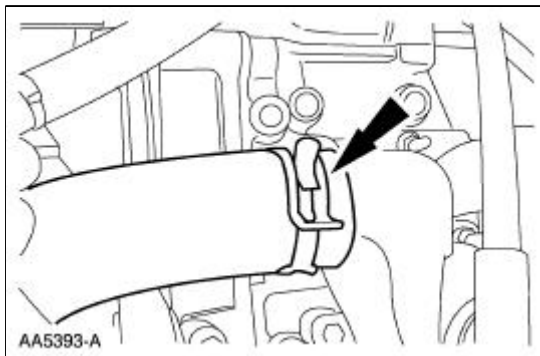
57. Remove the generator B + nut and disconnect the B + cable.



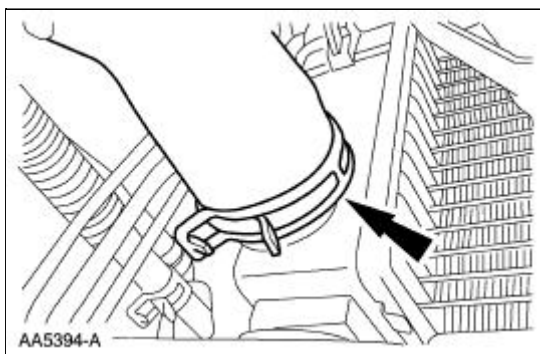
58. Remove the nut and the engine ground cable.



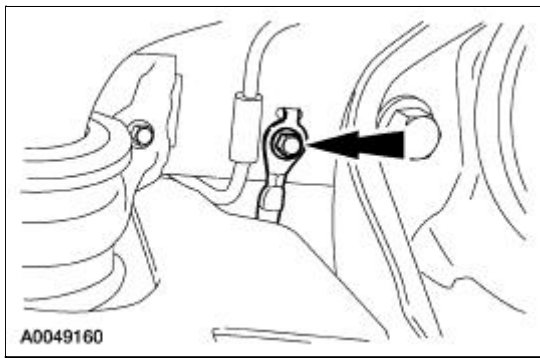
59. Disconnect the hose from the oil filter adapter.



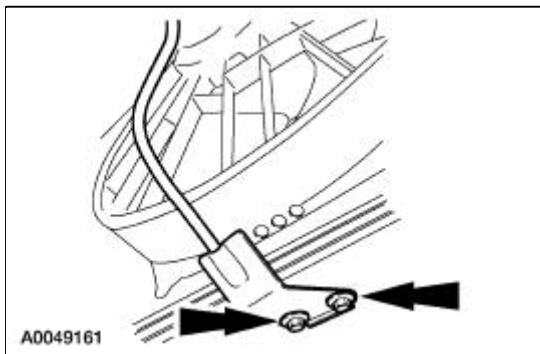
60. Disconnect and remove the lower hose from the radiator.



61. Remove the ground strap bolt.

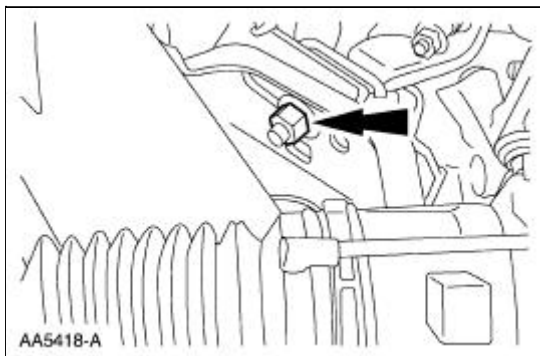


62. Remove the degas bottle support bracket.



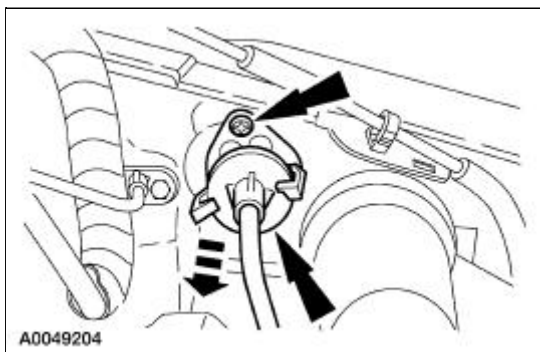
63. **NOTE:** RH side shown, LH side similar.

Remove the two engine mount nuts.



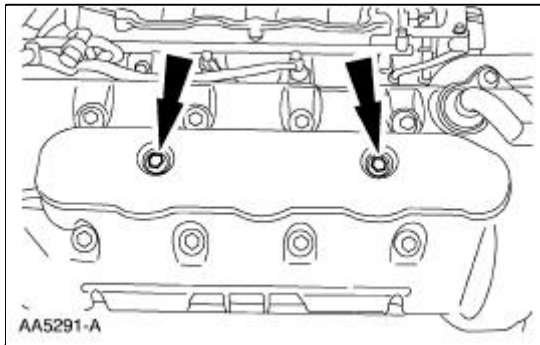
64. Lower the vehicle.

65. Remove the two screws and position the clutch cable aside.

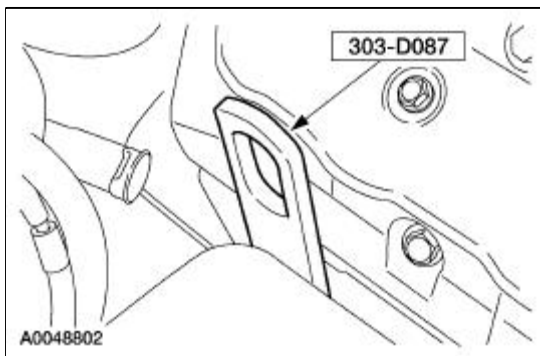


66. **NOTE:** RH is shown LH is similar.

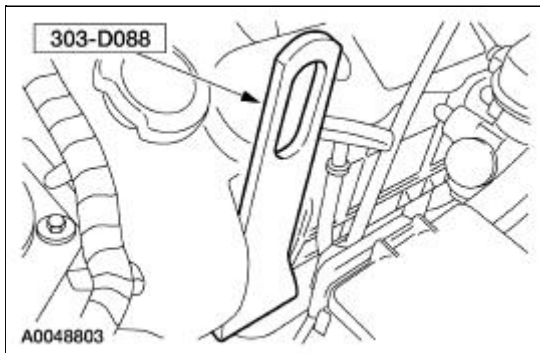
Remove the right and left ignition coil covers.



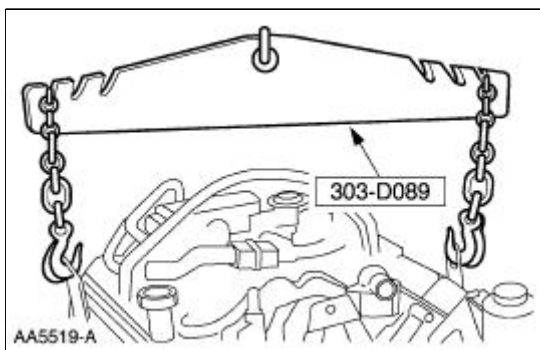
67. Install the special tool.



68. Install the special tool.






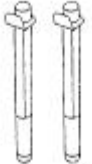



69. Attach the special tool to a floor crane and the engine, and remove the engine from the vehicle.

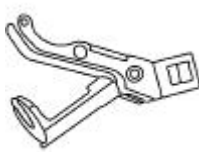





Engine

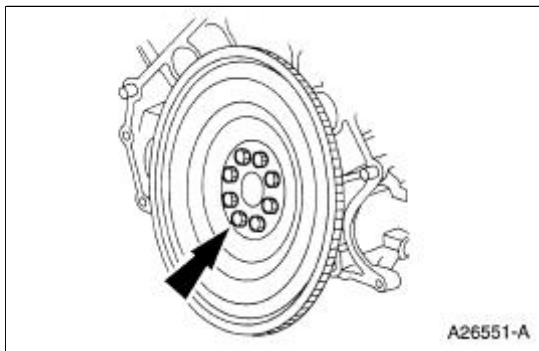
Special Tool(s)

 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST1286-A	Remover, Crankshaft Vibration Damper 303-009 (T58P-6316-D)
 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)
 ST1337-A	Installer, Connecting Rod 303-442 (T93P-6136-A)
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
 ST1481-A	Remover, Crankshaft Rear Oil Slinger 303-514 (T95P-6701-AH)
 ST1718-A	Compressor, Valve Spring (Intake) 303-452 (T93P-6565-AR)
	Compressor, Valve Spring (Exhaust)

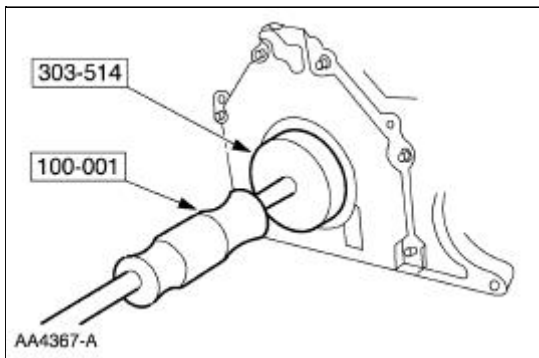
 <p>ST1693-A</p>	<p>303-567 (T97P-6565-AH)</p>
 <p>ST1730-A</p>	<p>Remover, Crankshaft Front Oil Seal 303-107 (T74P-6700-A)</p>

Disassembly

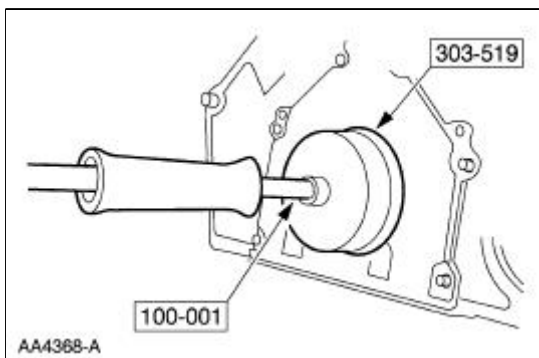
1. Remove the bolts and the flywheel.



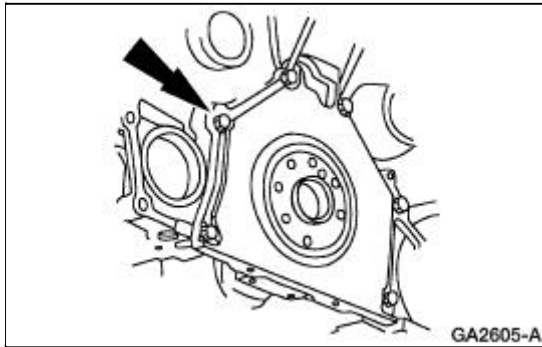
2. Using the special tool, remove the rear oil slinger.



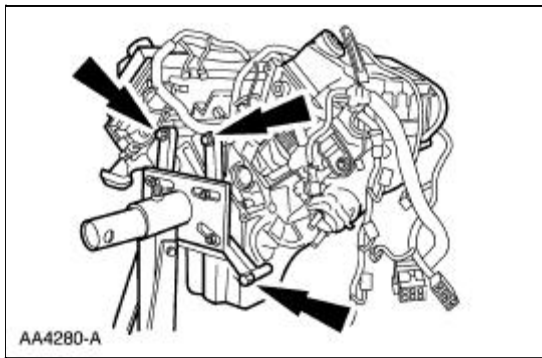
3. Using the special tool, remove the rear main seal.



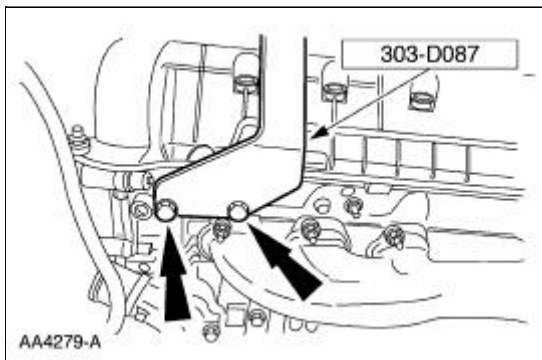
4. Remove the bolts and the rear seal retainer plate.



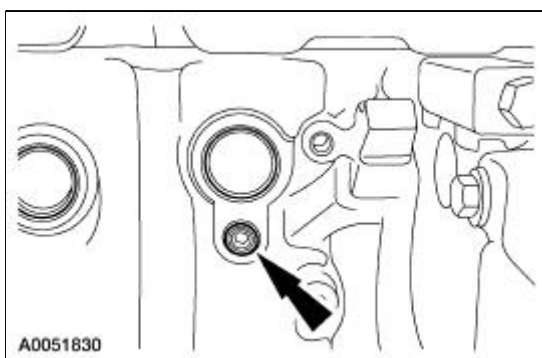
5. Mount the engine on a workstand.



6. Remove the special tools.

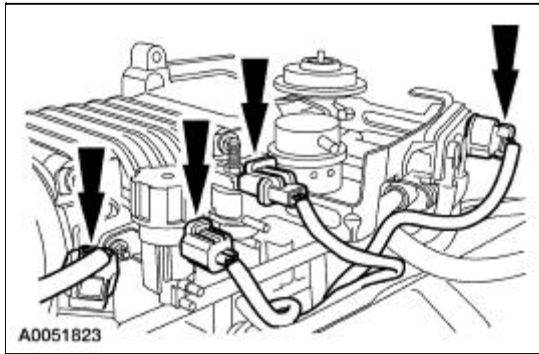


7. Remove the drain plug and drain the engine coolant.

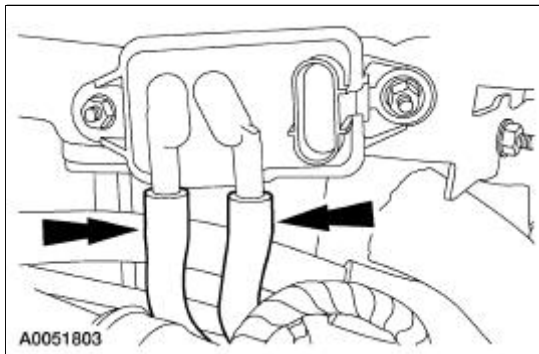


8. Disconnect the electrical connectors from the fuel pulse damper, exhaust gas recirculation (EGR) vacuum regulator solenoid, supercharger bypass vacuum solenoid, and the differential

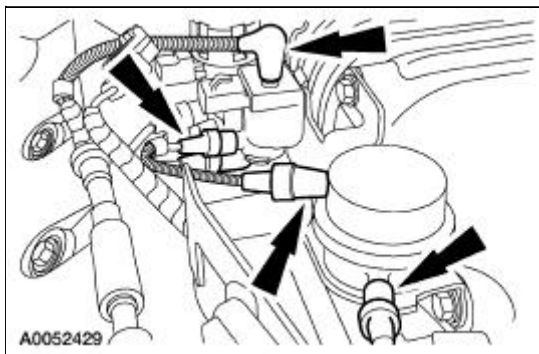
pressure feedback EGR system.



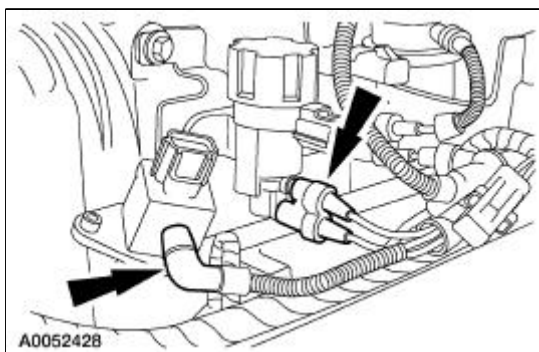
9. Disconnect the vacuum hoses from the differential pressure feedback EGR system.



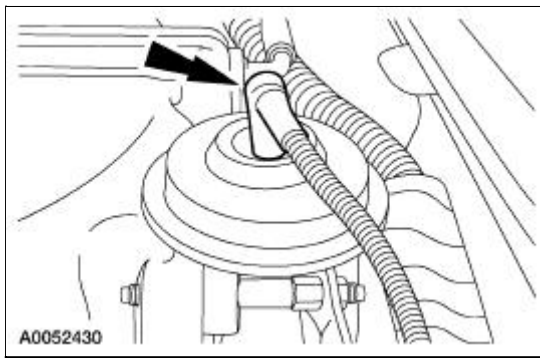
10. Disconnect the vacuum hoses from the supercharger bypass vacuum solenoid and the actuator.



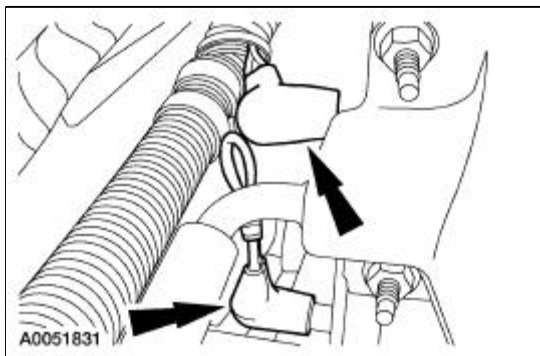
11. Disconnect the vacuum hoses from the fuel pulse damper and the EGR vacuum regulator solenoid.



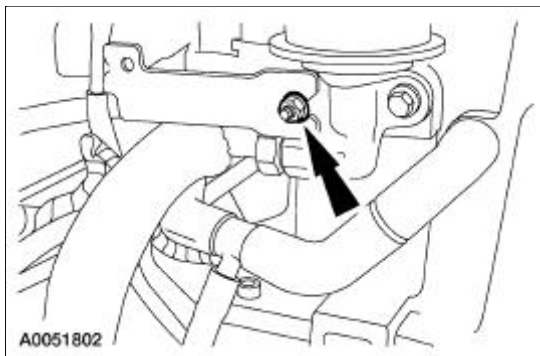
12. Disconnect the vacuum hose from the EGR valve.



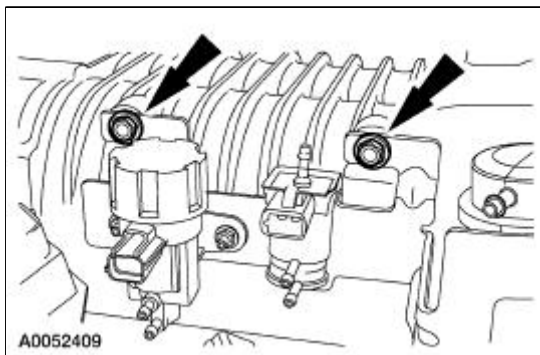
13. Disconnect the vacuum hoses at the back of the supercharger and remove the vacuum harness.



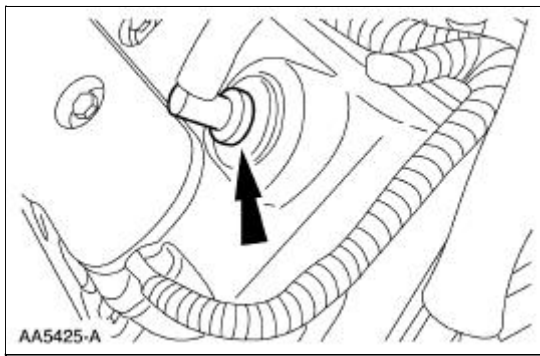
14. Remove the vacuum accessory bracket mounting nut.



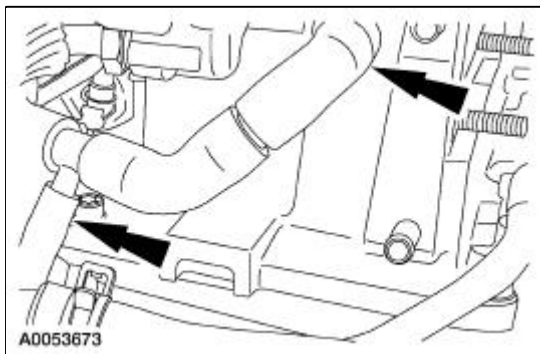
15. Remove the mounting bolts and the vacuum accessory bracket.



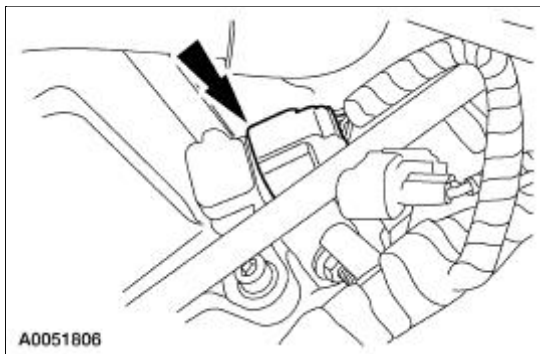
16. Remove the positive crankcase ventilation (PCV) valve.



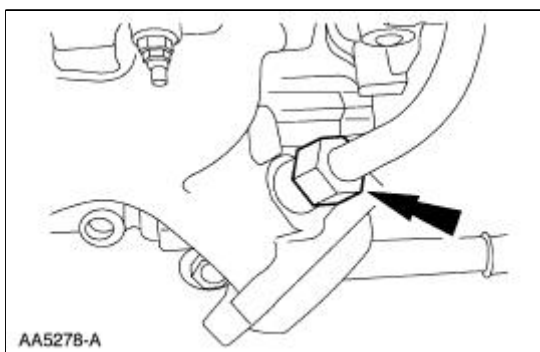
17. Disconnect and remove the PCV hose.



18. Disconnect the barometric pressure (BARO) sensor electrical connector.

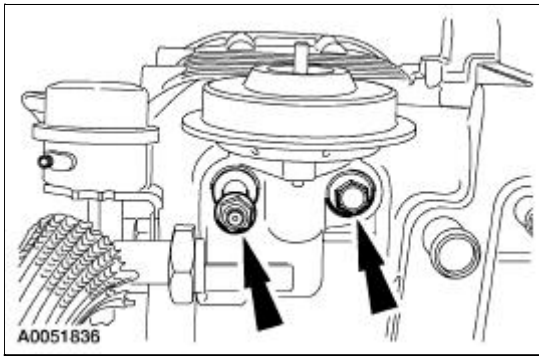


19. Disconnect the EGR tube from the exhaust manifold.

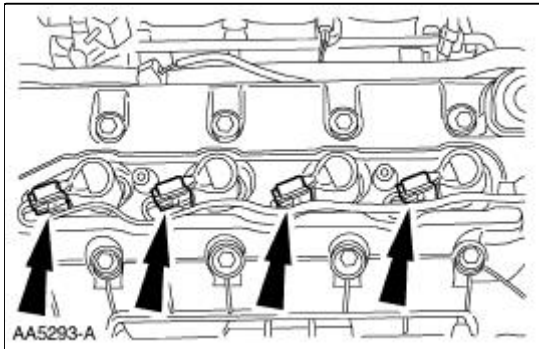


20. **NOTE:** Discard the EGR valve gasket.

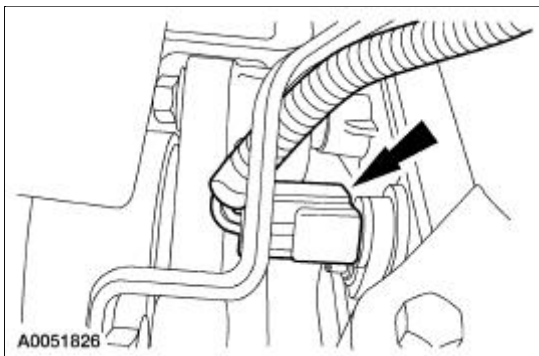
Remove the EGR valve and tube as an assembly.



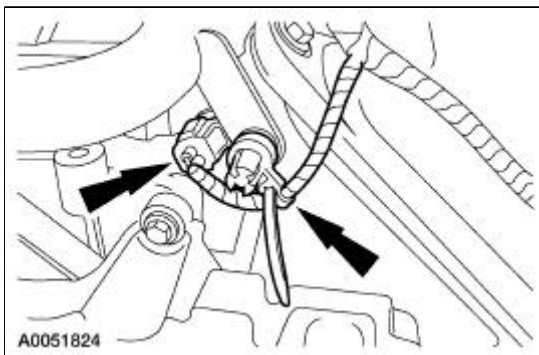
21. Disconnect the electrical connectors and remove the LH ignition coils.



22. Disconnect the camshaft position (CMP) sensor electrical connector.

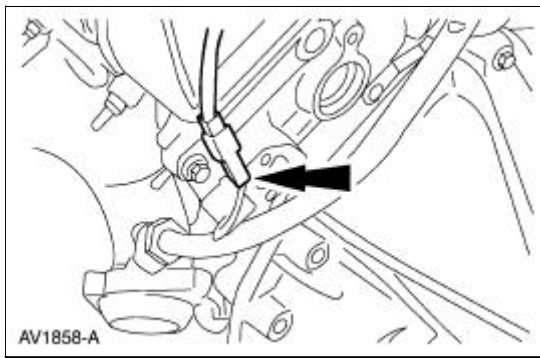


23. Disconnect the engine coolant temperature (ECT) sensor electrical connector and unclip the harness from the stud.

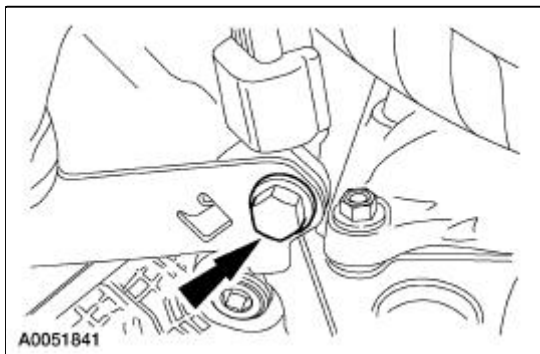


24. **NOTE:** LH is shown, RH is similar.

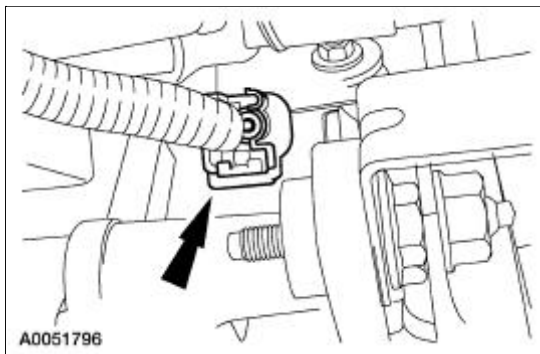
Disconnect the two radio ignition interference capacitor electrical connectors.



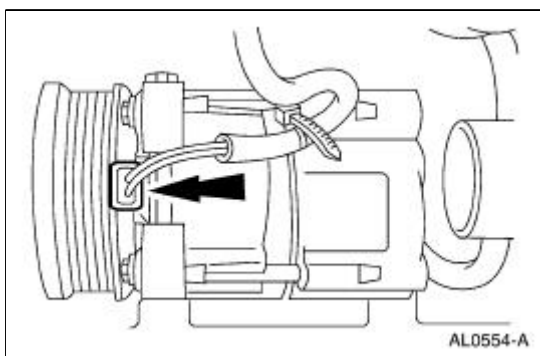
25. Remove the fuel charging wiring harness bracket bolt.



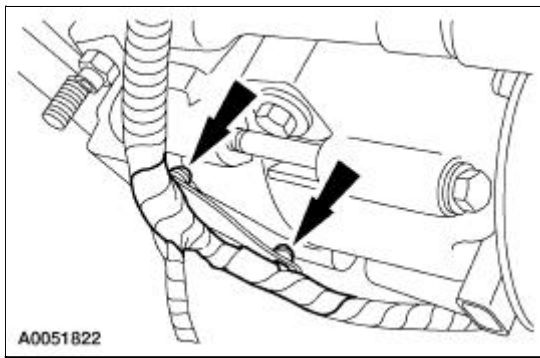
26. Disconnect the crankshaft position (CKP) sensor electrical connector.



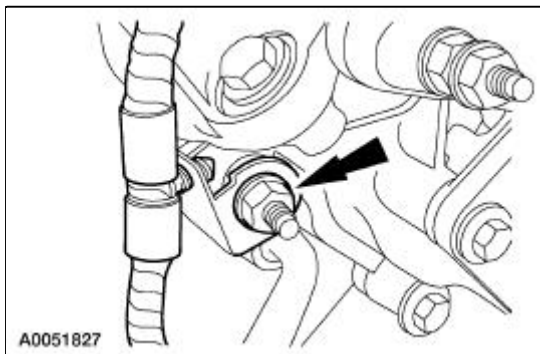
27. Disconnect the A/C compressor electrical connector.



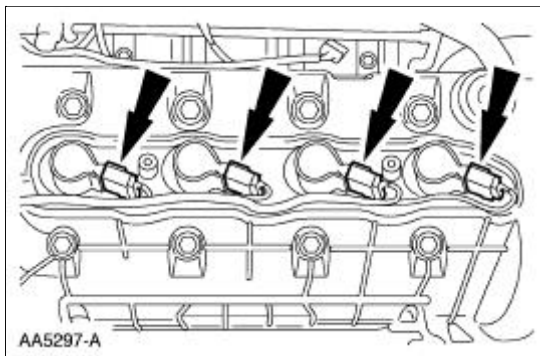
28. Unclip the harness from the bracket.



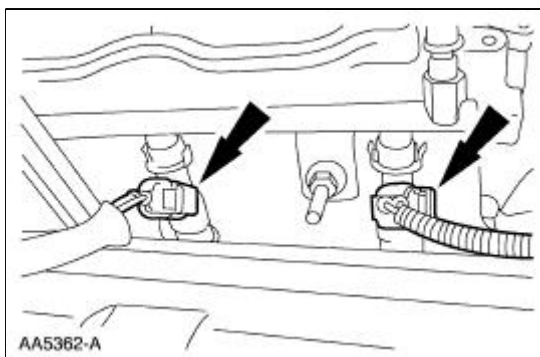
29. Remove the harness support bracket.



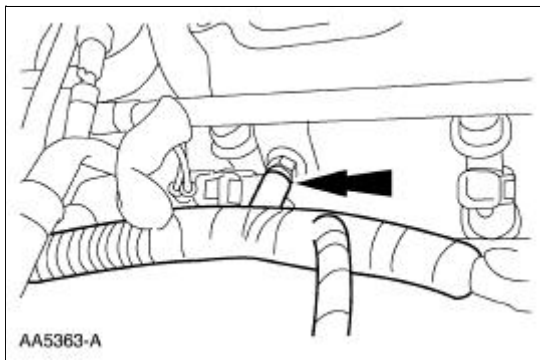
30. Disconnect the electrical connectors and remove the RH ignition coils.



31. Disconnect the eight fuel injectors.

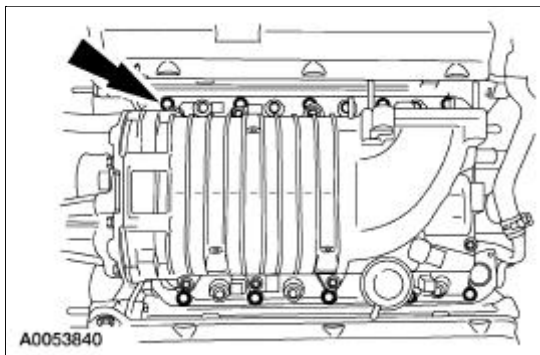


32. Separate the harness from the fuel supply manifold studs in four places and remove the fuel charging wiring harness.

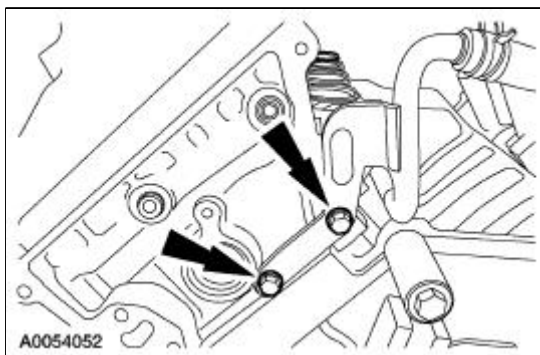


33. **NOTE:** The intake manifold gaskets are reusable if undamaged.

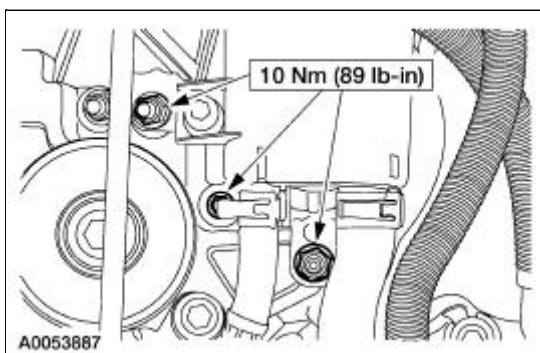
Remove the ten bolts and the intake manifold, and the supercharger and fuel supply manifold as an assembly.



34. Remove the bolts and the heater water outlet tube.

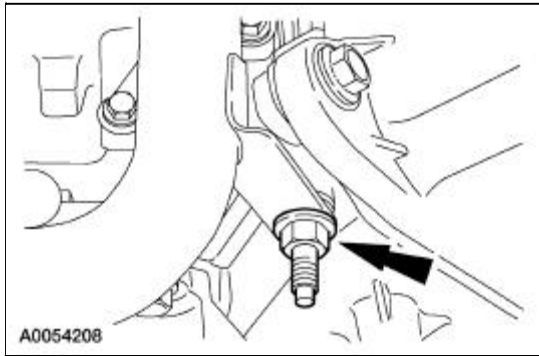


35. Remove the bolts and the heater water inlet tube.



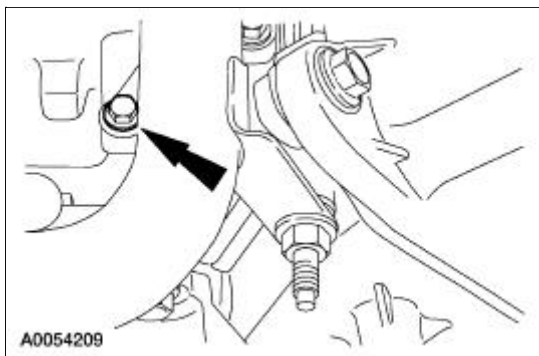
36. **NOTE:** LH is shown, RH is similar.

Remove the coolant bypass studs.

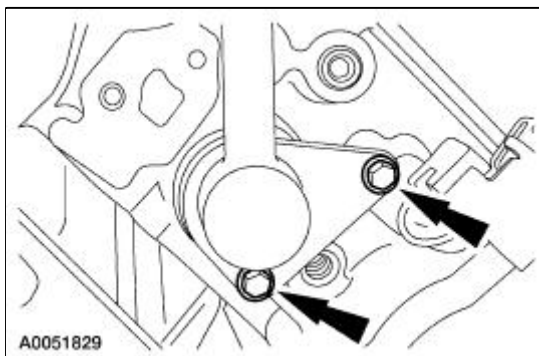


37. **NOTE:** LH is shown, RH is similar.

Remove the bolts and the coolant bypass tube.



38. Remove the bolts and the heater water inlet tube.

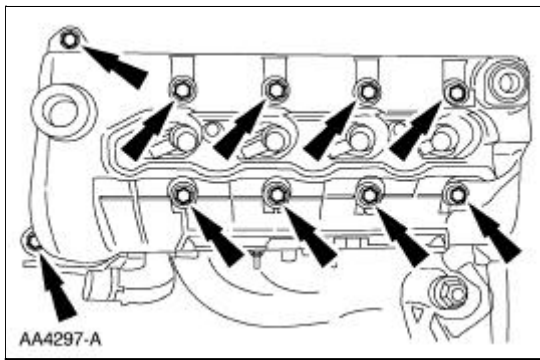


39. **⚠ CAUTION:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

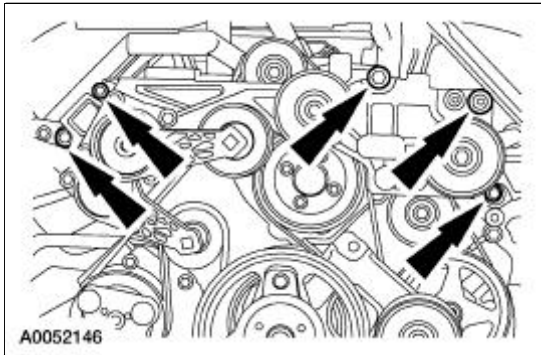
NOTE: LH is shown, RH is similar.

Remove the fasteners and the LH and RH valve covers.

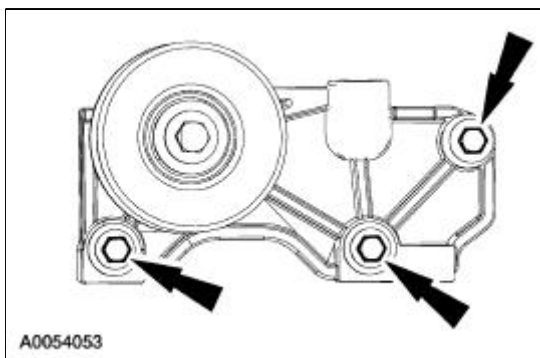
- Remove and discard the gasket, clean and inspect the sealing surfaces.



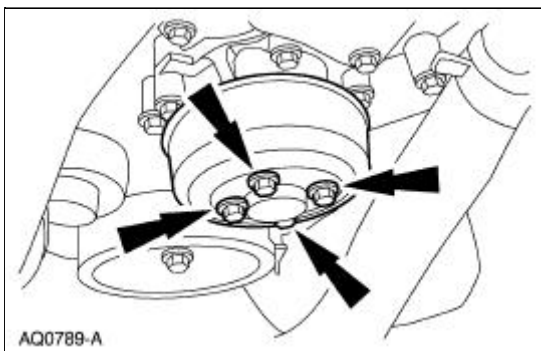
40. Remove the supercharger belt idler support bracket assembly.



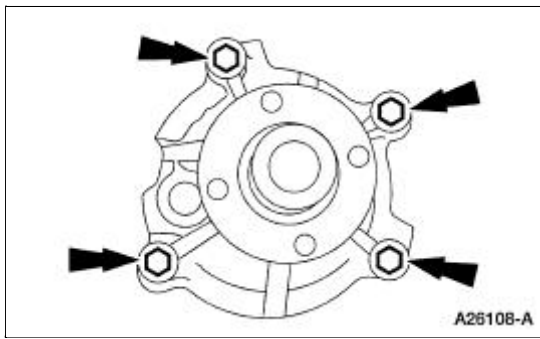
41. Remove the accessory drive belt.
42. Remove the bolts and belt idler bracket.



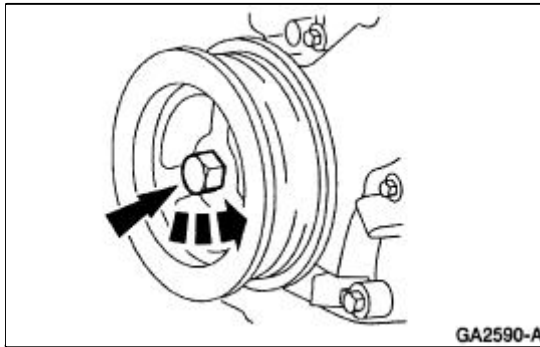
43. Remove the bolts and the water pump pulley.



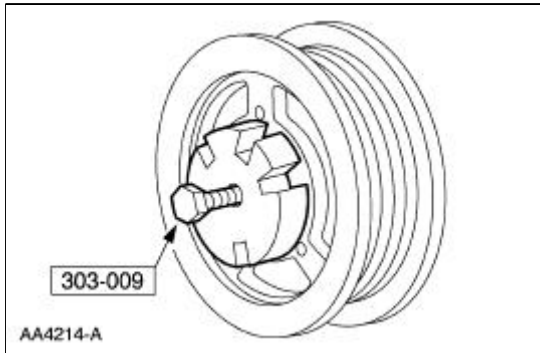
44. Remove the water pump from the cylinder block.
 - Inspect and clean the sealing surfaces.



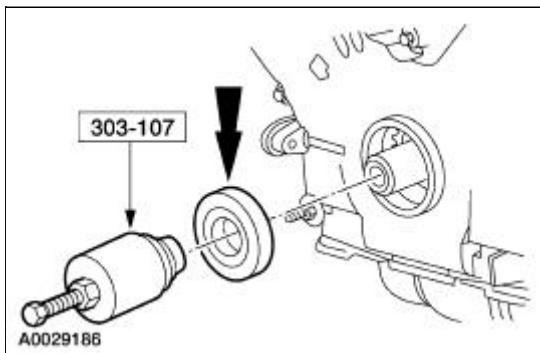
45. Remove the bolt.



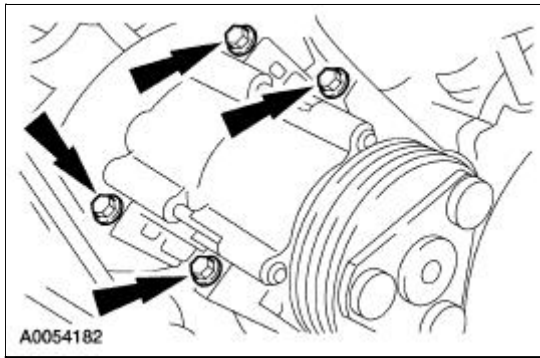
46. Using the special tool, remove the crankshaft pulley.



47. Using the special tools, remove the crankshaft front seal.



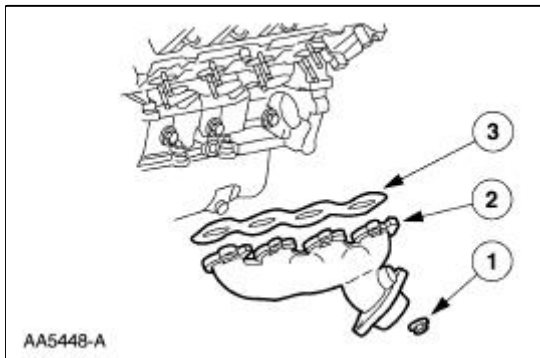
48. Remove the bolts and the A/C compressor.



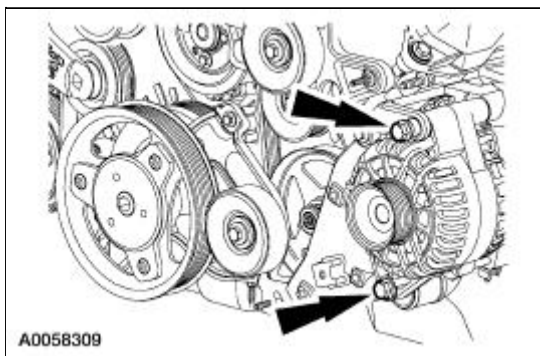
49. **NOTE:** LH is shown; RH is similar.

Remove the exhaust manifold.

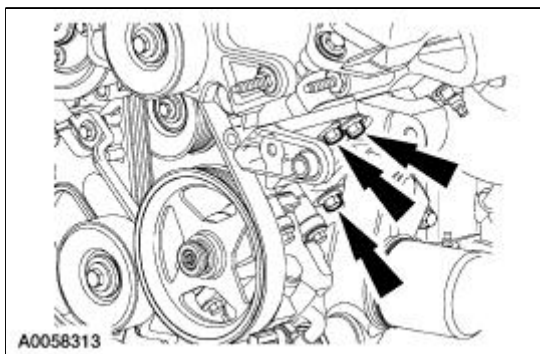
1. Remove the nuts.
2. Remove the exhaust manifold.
3. Remove and discard the exhaust manifold gasket.



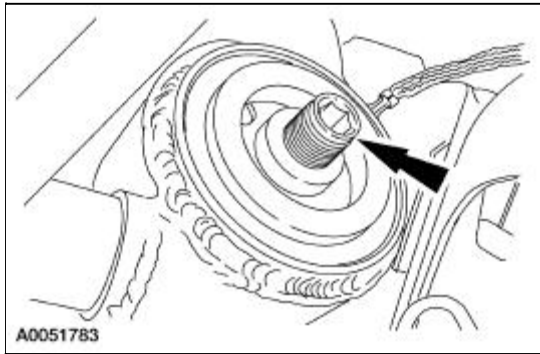
50. Remove the bolts and the generator.



51. Remove the bolts and the generator support bracket.

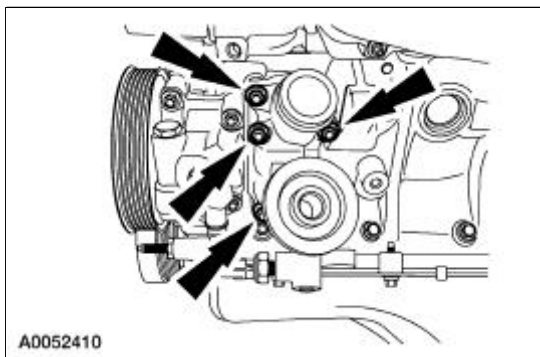


52. Remove the oil cooler.



53. Remove the bolts, the oil filter adapter and the gasket.

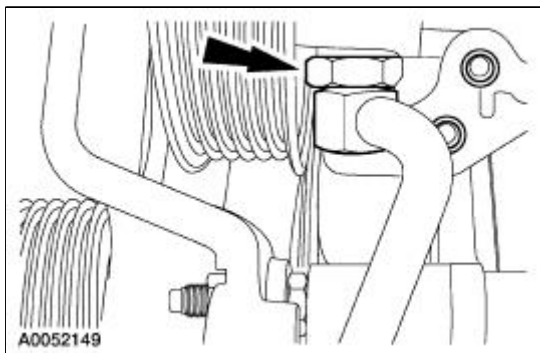
- Discard the gasket.



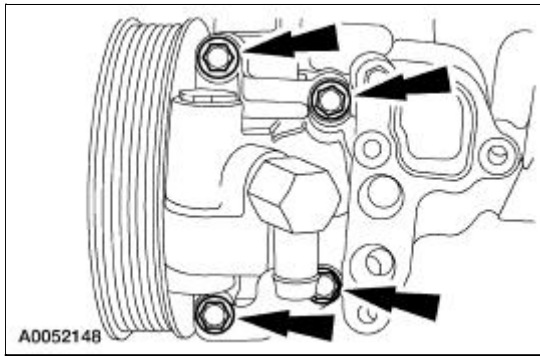
54. Clean and inspect the oil filter adapter and the oil cooler.

- Plug the oil cooler coolant lines.
- Flush the adapter and cooler with parts cleaner. If metal particles are present, install a new oil filter adapter and oil cooler.

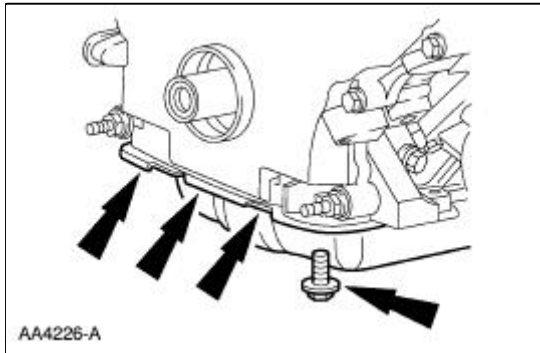
55. Remove the power steering pressure hose.



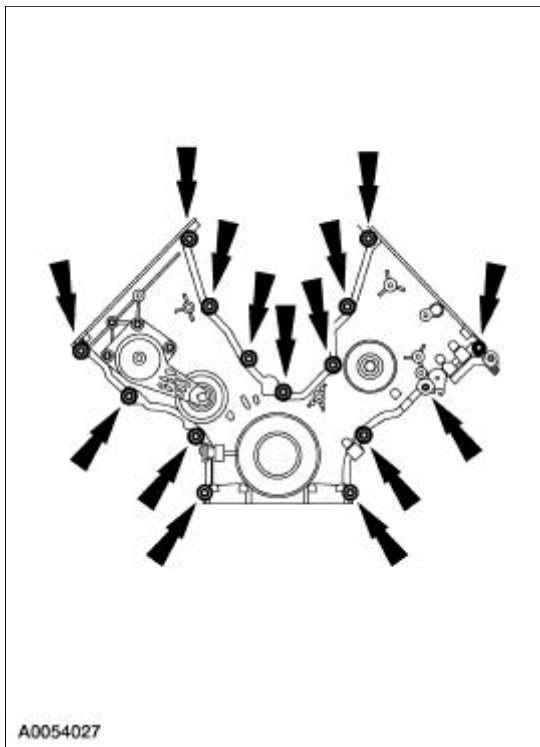
56. Remove the bolts and the power steering pump.



57. Remove the four bolts.

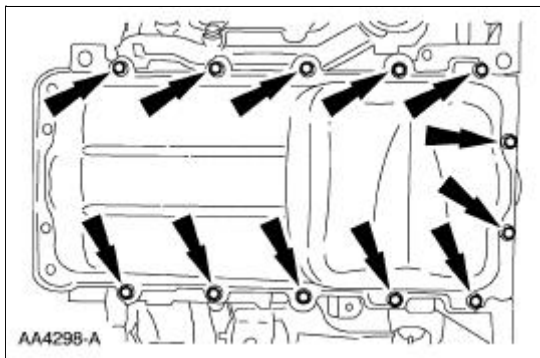


58. Remove the bolts, the studs, and the engine front cover.

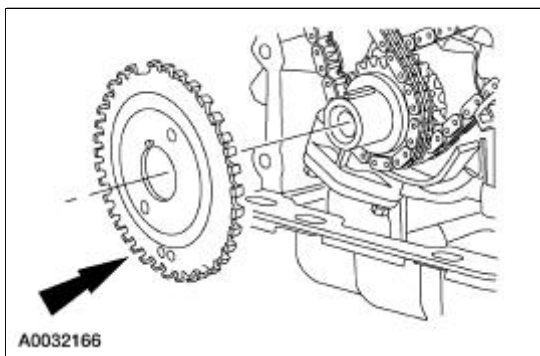


59. **NOTE:** The oil pan gasket is reusable if not damaged. Inspect the gasket and install new if necessary.

Remove the bolts, the oil pan, and the gasket.

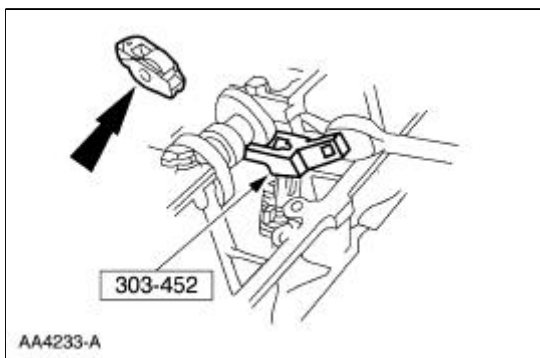


60. Remove the crankshaft position sensor pulse wheel.

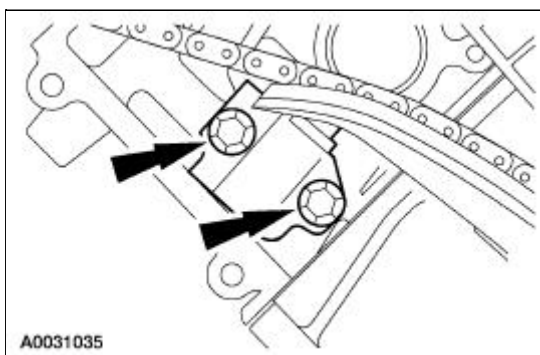


61. **NOTE:** Make sure the base circle of the camshaft is facing the roller follower being removed.

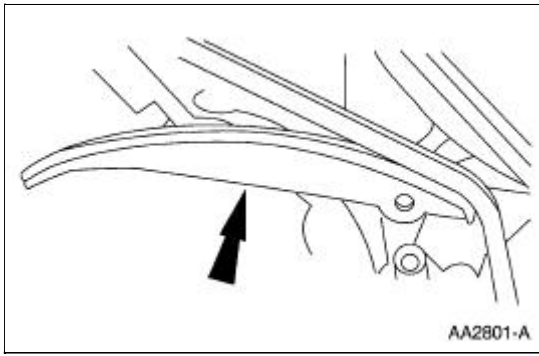
Using the special tool, remove the 32 roller followers.



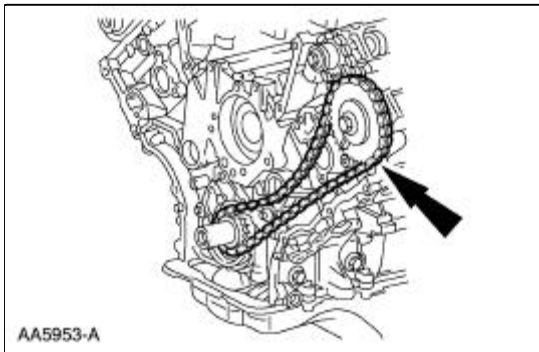
62. Remove the bolts and the RH and LH timing chain tensioners.



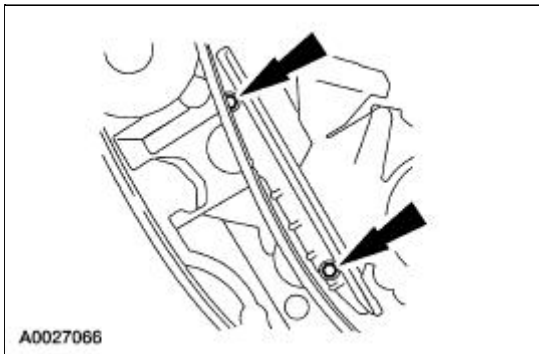
63. Remove the RH and LH timing chain tensioner arms.



64. Remove the RH and the LH timing chains and the crankshaft sprocket.

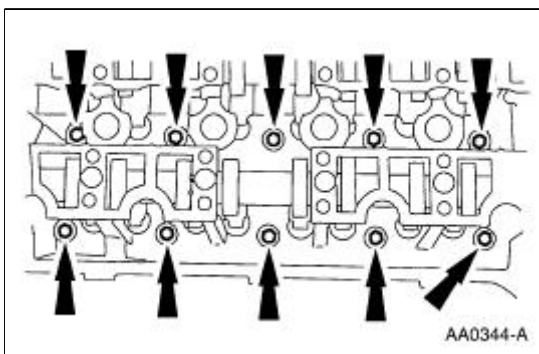


65. Remove the bolts and the RH and LH timing chain guides.

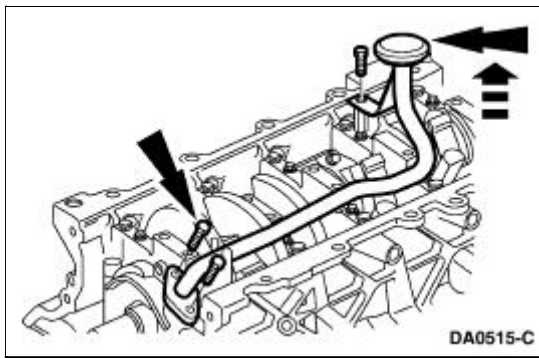


66. **NOTE:** Cylinder head bolts are not to be reused. Discard the bolts.

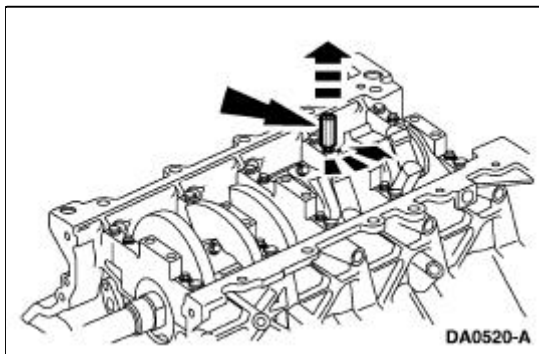
Remove the bolts and the RH and LH cylinder heads.



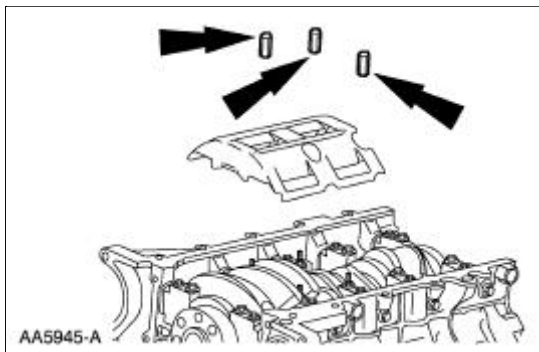
67. Remove the bolts and the oil pump screen and pickup tube (6622).



68. Remove the oil pump screen and pickup tube spacer.

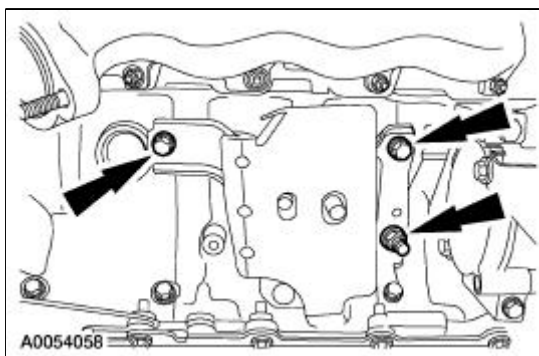


69. Remove the spacers and the windage tray.

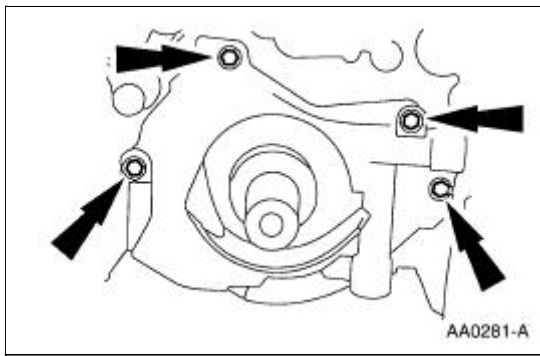


70. **NOTE:** RH is shown, LH is similar.

Remove the RH and LH engine mounts.



71. Remove the bolts and remove the oil pump.

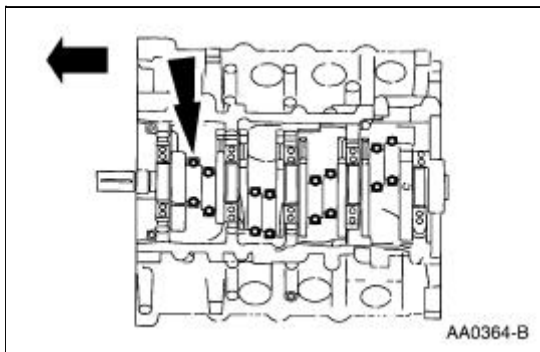


72.  **CAUTION: Do not stamp the top of pistons, as ring land damage can occur.**

NOTE: Connecting rods and rod caps should be numbered to keep the correct orientation in the following sequence.

Remove the connecting rod caps for pistons number 1 and 6.

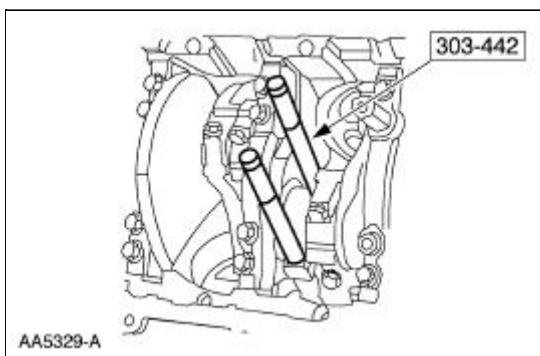
- Discard the bolts.



73.  **CAUTION: Do not scratch the cylinder walls or crankshaft journals with the connecting rod.**

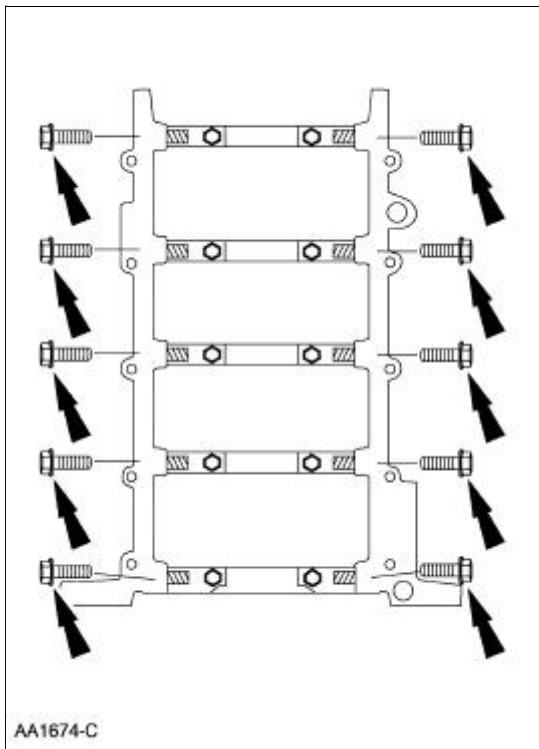
NOTE: Before removing pistons, inspect the top of the cylinder bores. If necessary, remove the ridge or carbon deposits from each cylinder using a cylinder ridge reamer. Follow manufacturer's instructions.

Using the special tool, push pistons number 1 and 6 through the top of the cylinder block.

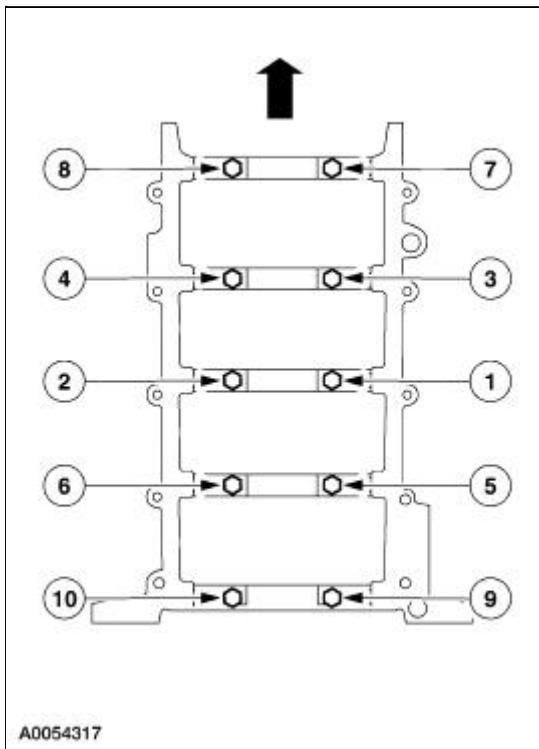


74. To remove pistons number 3 and 5, 4 and 7, 2 and 8, turn the crankshaft 90 degrees and repeat the previous two steps.

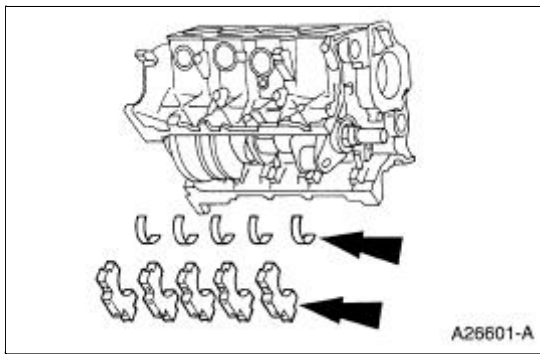
75. Remove the side bolts.



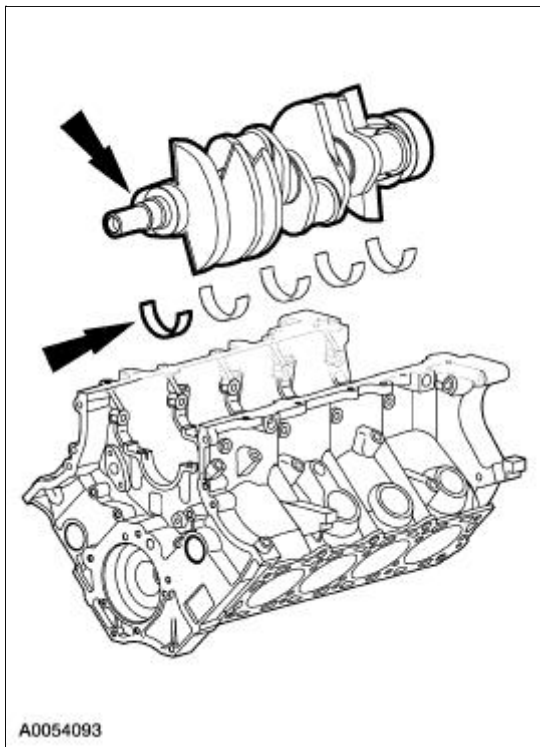
76. Remove and discard the bolts.



77. Remove the main bearing caps and the crankshaft lower main bearings from the cylinder block.





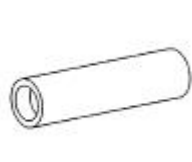


78. Remove the crankshaft, the crankshaft thrust washer, and the crankshaft upper main bearings from the cylinder block.



Cylinder Head


Special Tool(s)

 <p>ST2373-A</p>	<p>Compressor, Valve Spring (Exhaust Side) 303-567 (T97P-6565-AH)</p>
 <p>ST1718-A</p>	<p>Compressor, Valve Spring (Intake Side) 303-452 (T93P-6565-AR)</p>
 <p>ST1715-A</p>	<p>Holding Tool, Camshaft 303-446 (T93P-6256-AHR)</p>
 <p>ST1716-A</p>	<p>Air Operated Valve Spring Holder 134-R0207 or equivalent</p>
 <p>ST1332-A</p>	<p>Installer, Valve Stem Oil Seal 303-383 (T91P-6571-A)</p>

Material

Item	Specification
<p>Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent</p>	<p>WSS-M2C153- H</p>

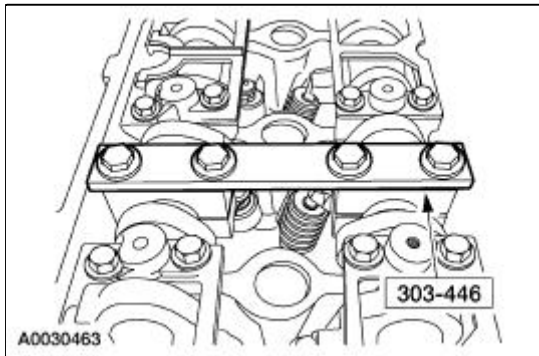
Disassembly

-  **CAUTION:** Do not place the cylinder head (6049) flat on the bench; the valves will bend.

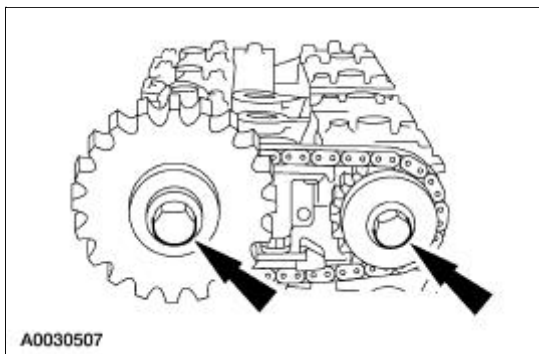
 **CAUTION:** Before disassembly begins, mark the valve position on the face of each

valve being removed. The valves must be re-installed into the same positions.

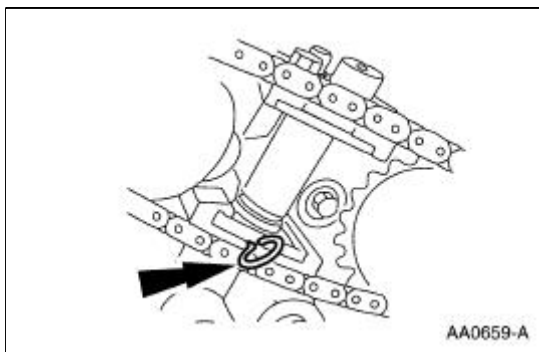
Install the special tool.



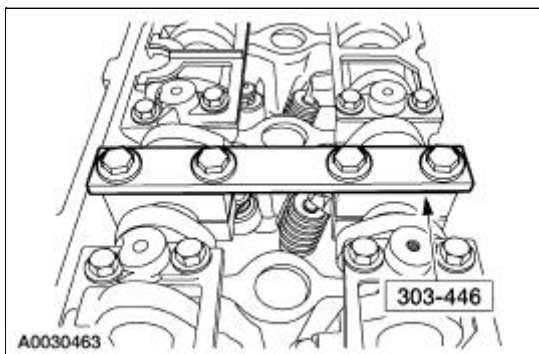
2. Remove the exhaust camshaft sprocket and the intake camshaft bolt, washer and spacer.



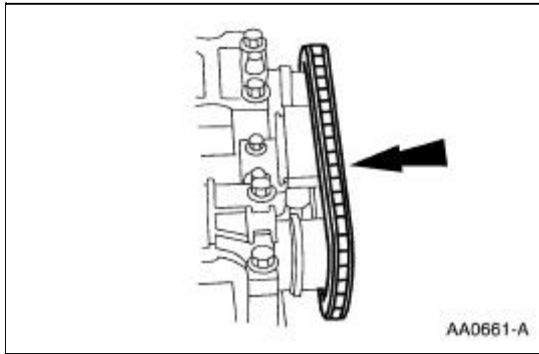
3. Compress the tensioner (6L266) and install a lock pin.



4. Remove the special tool.

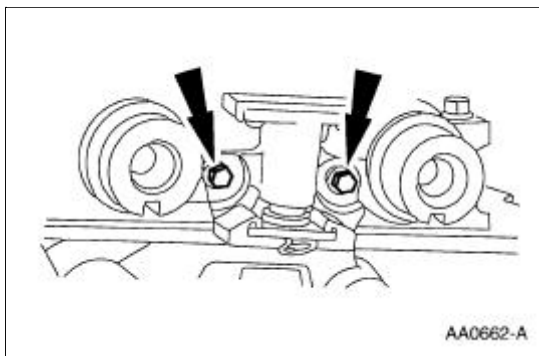


5. Remove the timing chain (6268) and the camshaft sprocket (6256).

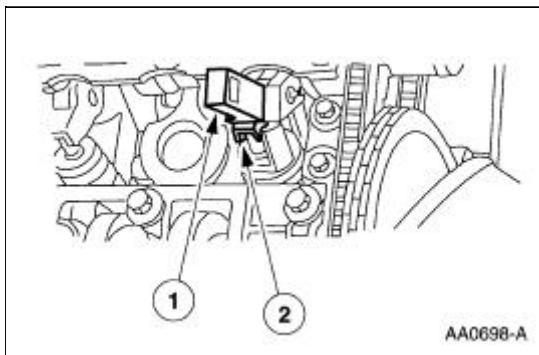


6. **NOTE:** LH tensioner is shown, RH tensioner is similar.

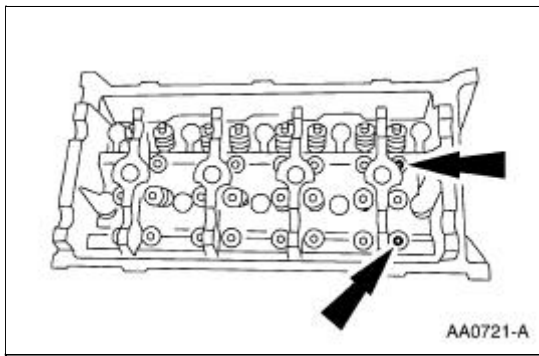
Remove the tensioner.




7. Remove the roller followers on the base circle.
1. Install the special tool on the valve spring.
2. Compress the tool and remove the roller follower.

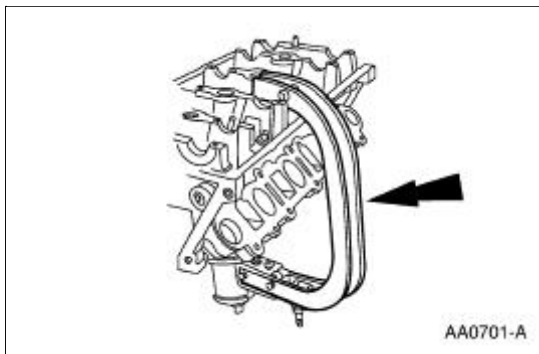


8. Repeat the previous step for the remaining roller followers.
9. Remove the hydraulic lash adjusters.

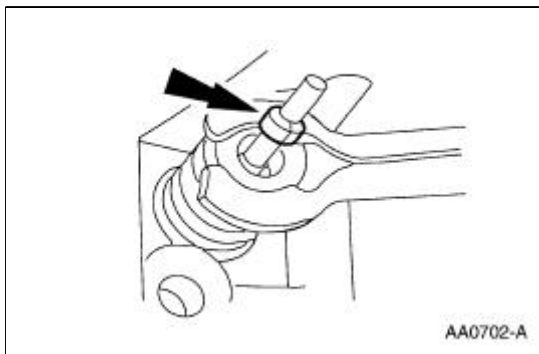


10.  **CAUTION:** Make sure the tool is seated correctly on the valve spring. Apply a small amount of air at a time. This will prevent the tool from shifting and causing damage to the cylinder head.

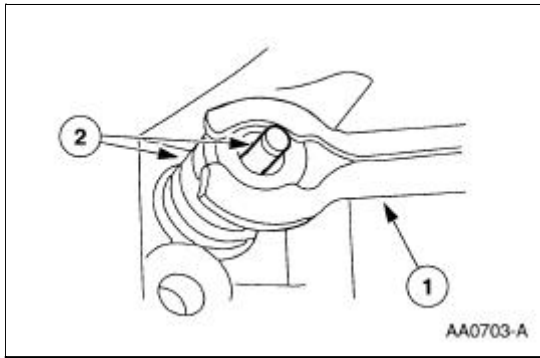
Install the air-operated spring compressor on the cylinder head.



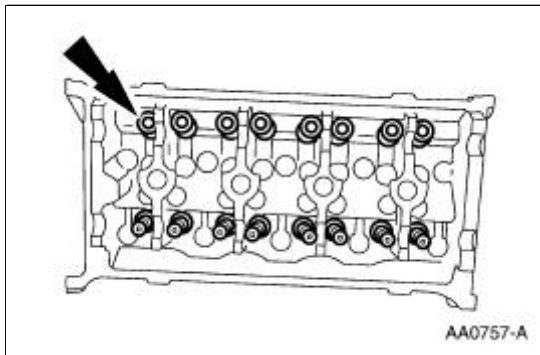
11. Compress the valve spring compressor and remove the key from the valves.




12. Remove the intake valves and the valve springs.
1. Release the pressure and remove the valve spring compressor.
 2. Remove the intake valves and the valve springs from the cylinder head.



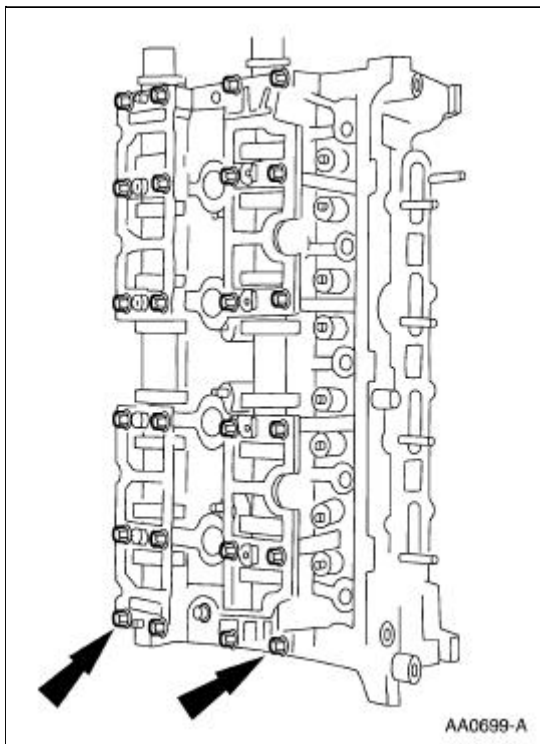
13. Remove the valve stem seals.



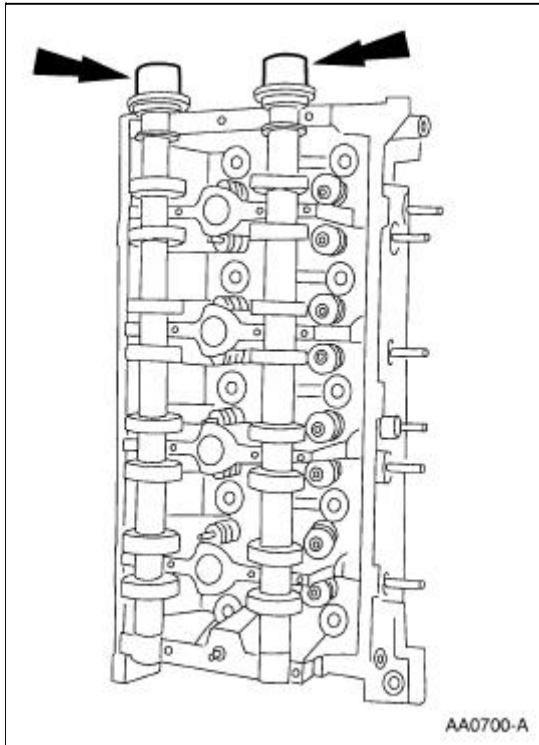
14.  **CAUTION:** The outer bolts on the outer cam bearing cap (exhaust) are longer and must be returned to the same location or engine damage may occur.

NOTE: Identify the camshaft-to-cylinder head location. Caps are not interchangeable.

Remove the bolts and the camshaft bearing cap assemblies.

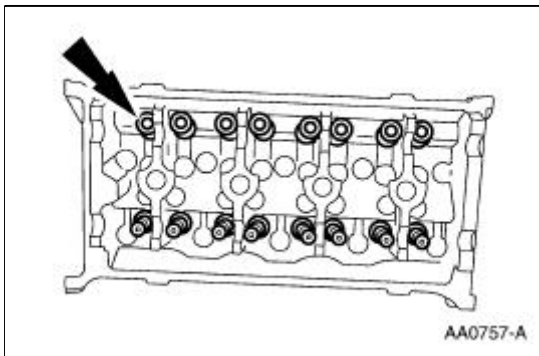



15. Remove the camshafts (6250).



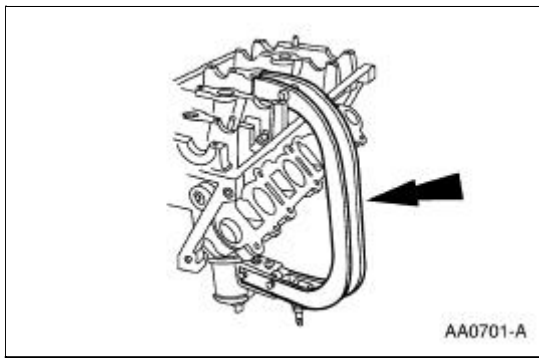
Assembly

1. Install the valve stem seals.

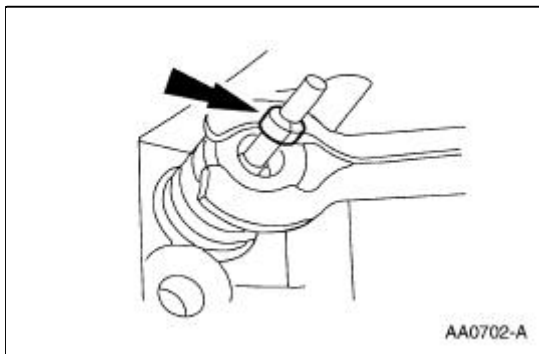


2. Install the valves and the valve springs.
3.  **CAUTION: Make sure the tool is seated correctly on the valve spring. Apply a small amount of air at a time. This will prevent the tool from shifting and causing damage to the cylinder head.**

Install the air-operated spring compressor on the cylinder head.



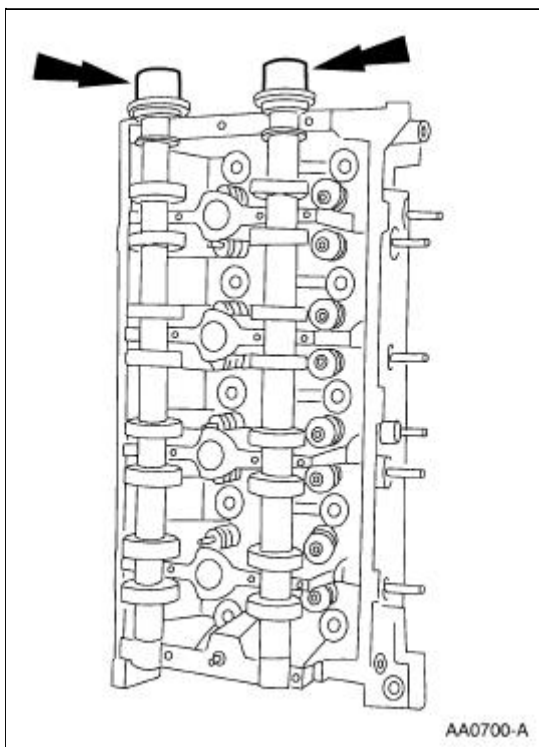
4. Compress the valve spring compressor and install the key on the valves.



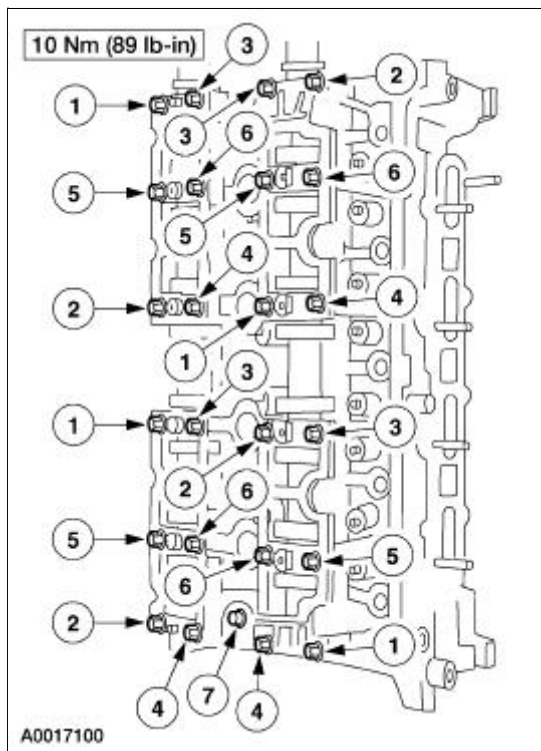
5. **NOTE:** LH is shown, RH is similar.

Install the camshafts.

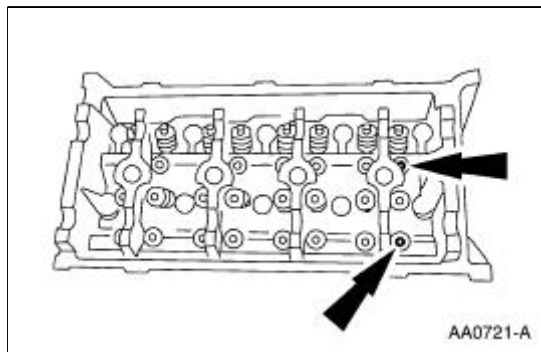
- Lubricate the camshafts with clean engine oil.



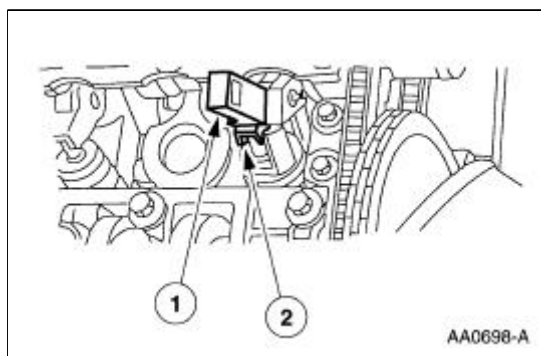
6. Install the camshaft bearing cap assemblies.



7. Install the hydraulic lash adjusters.

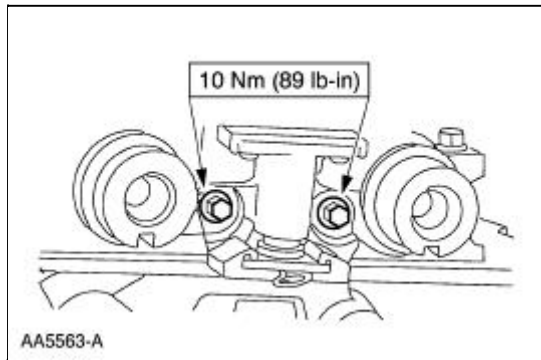


8. Install the roller followers.
 1. Install the special tool on the valve spring.
 2. Compress the spring and install the roller follower.



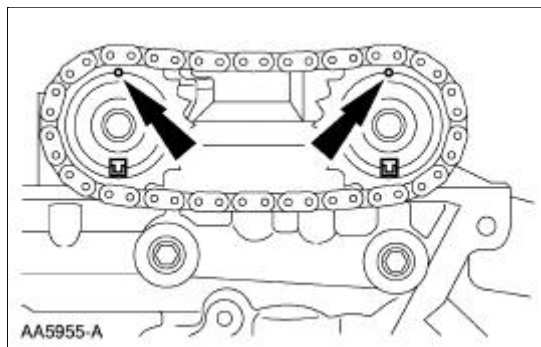
9. Repeat the previous step for the remaining roller followers.
10. **NOTE:** LH tensioner is shown, RH tensioner is similar.

Install the tensioner.

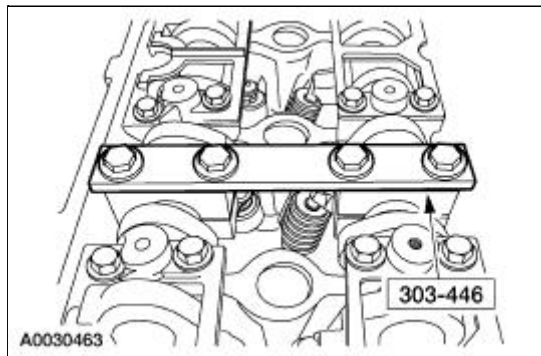


11.  **CAUTION: Timing marks must be at 12 o'clock and indexed at 6 o'clock.**

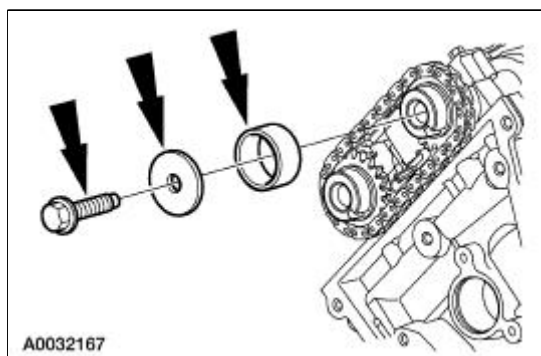
Install the camshaft sprockets and the chain as an assembly.



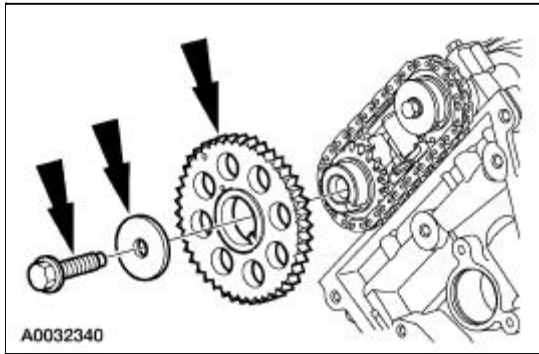
12. Install the special tool.



13. Install the camshaft spacer, washer and bolt, and hand-tighten the bolt.

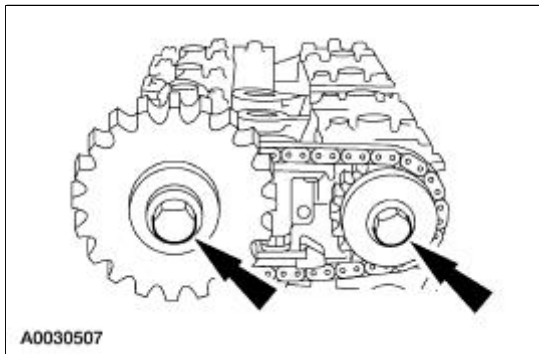


14. Install the camshaft sprocket, washer and bolt, and hand-tighten the bolt.

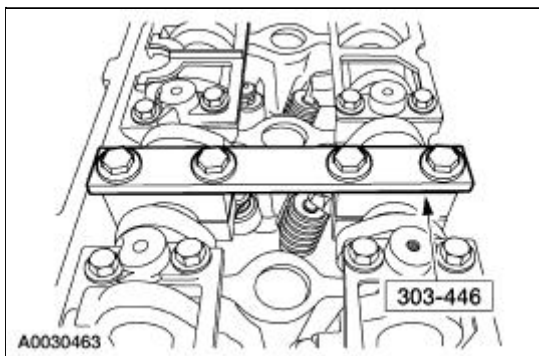


15. Tighten the bolts in two stages:

- Stage 1: Tighten to 40 Nm (30 lb-ft).
- Stage 2: Tighten and additional 90 degrees.



16. Remove the special tool.



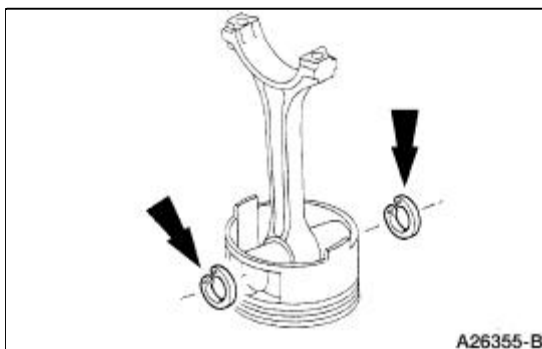
Piston

Material

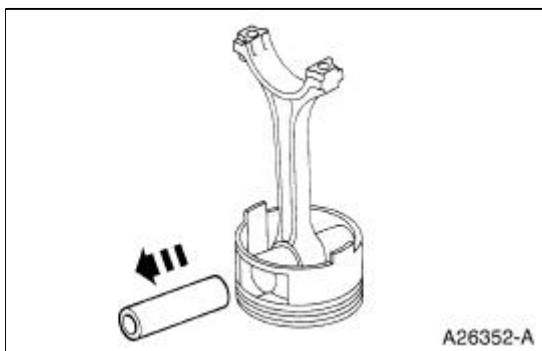
Item	Specification
Super Premium SAE 5W-20 Motor Oil XO-5W20-QSP	WSS-M2C153- H

Disassembly

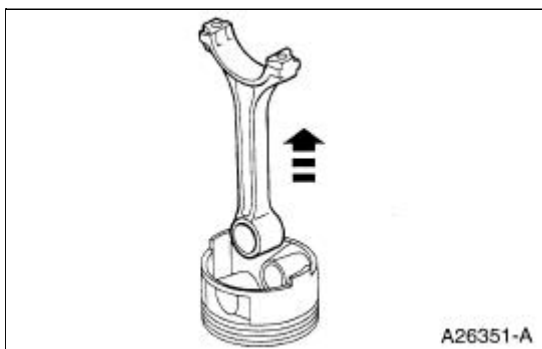
1. Remove the clips.



2. Remove the piston pin (6135) from the piston (6108) and connecting rod assembly.



3. Remove the connecting rod (6200) from the piston.

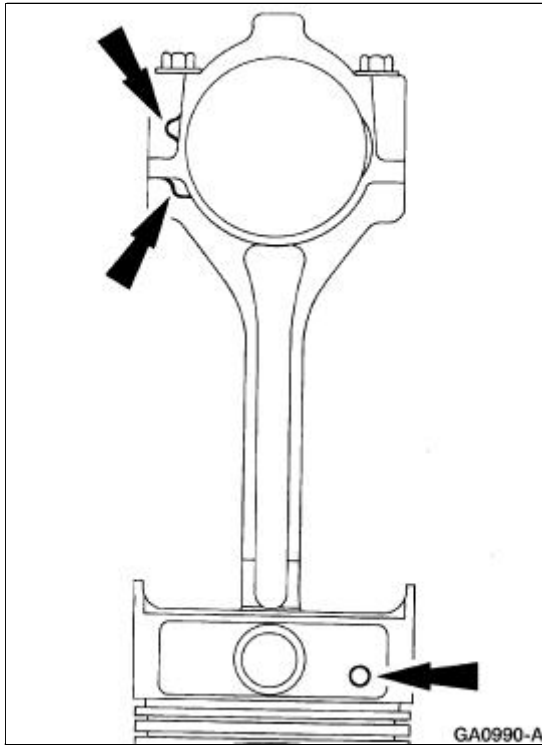


4. Clean and inspect the piston and connecting rod. For additional information, refer to [Section 303-00](#).

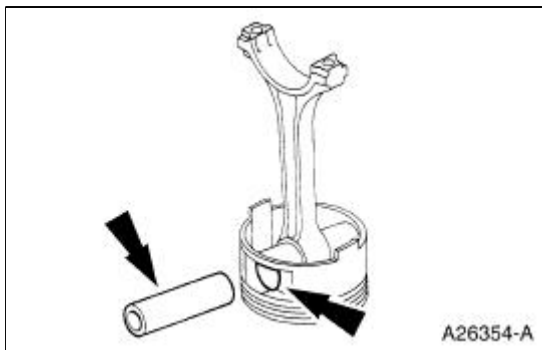
Assembly

1. **NOTE:** Connecting rod must be installed into piston with identification markings toward front.

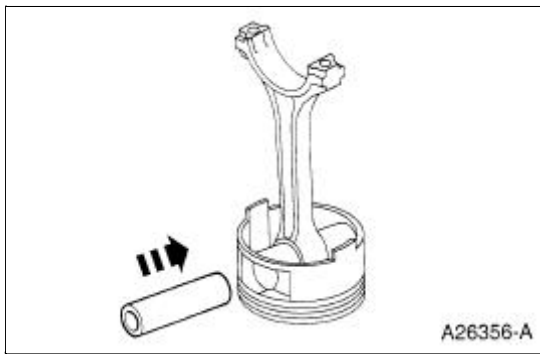
Position the connecting rod in the piston.



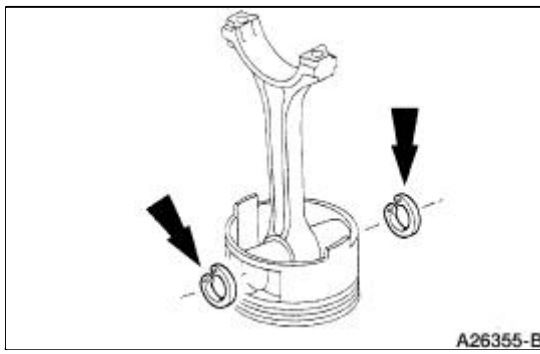
2. Lubricate the piston pin and pin bore with clean engine oil.



3. Install the piston pin in the piston and connecting rod assembly.



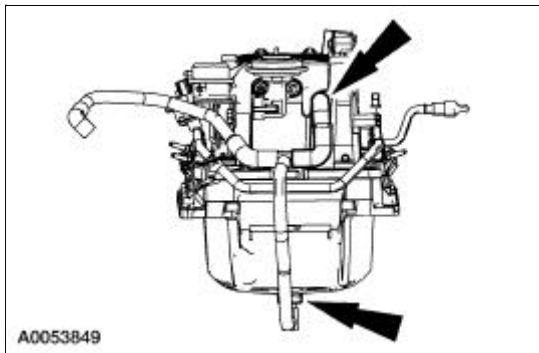
4. Install the piston pin retaining clips in the piston.



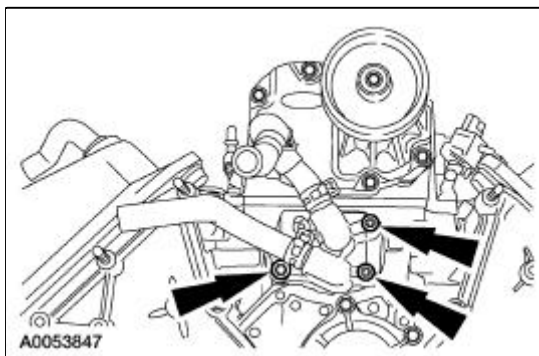
Intake Manifold Assembly

Disassembly and Assembly

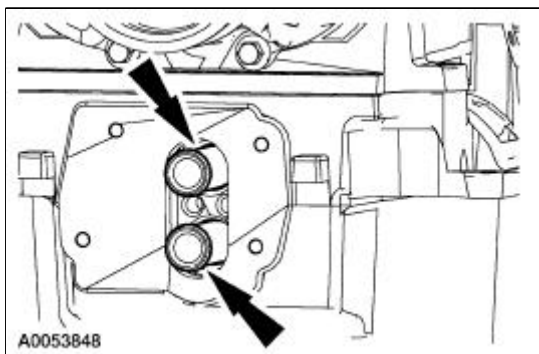
1. Disconnect and remove the PCV hoses.



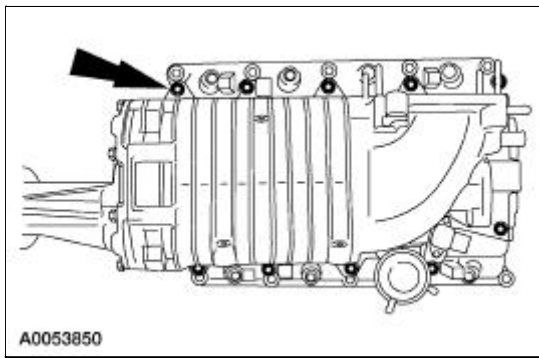
2. Remove the coolant supply and return manifold.



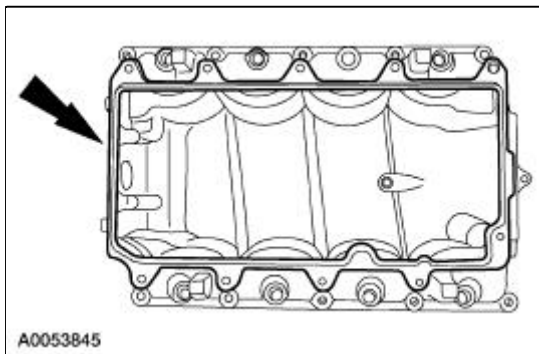
3. Remove the coolant supply and return tubes and seals.



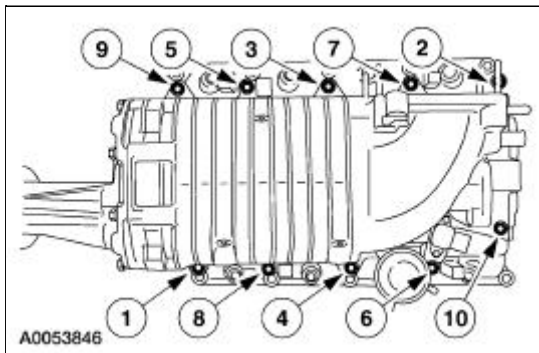
4. Remove the bolts, the supercharger and the charge air cooler (CAC) assembly.



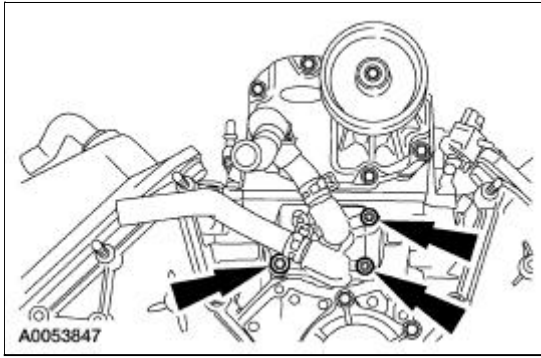
5. Inspect the CAC plenum gasket and install a new gasket if necessary.



6. To assemble, reverse the disassembly procedure
7. Tighten the supercharger and CAC cooler assembly-to-lower intake manifold bolts, in the sequence shown, in two stages.
 1. Stage 1: Tighten to 2 Nm (18 lb-in).
 2. Stage 2: Tighten to 25 Nm (18 lb-ft).

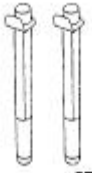

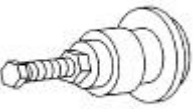






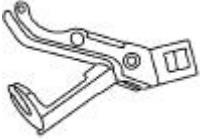
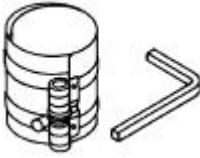

8. Tighten the coolant supply and return manifold in two stages.
 1. Stage 1: Tighten to 10 Nm (89 lb-ft).
 2. Stage 2: Tighten an additional 90 degrees.



Engine

Special Tool(s)

 <p>ST1337-A</p>	<p>Installer, Connecting Rod 303-442 (T93P-6136-A)</p>
 <p>ST1287-A</p>	<p>Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)</p>
 <p>ST1328-A</p>	<p>Installer, Front Cover Oil Seal 303-335 (T88T-6701-A)</p>
 <p>ST2197-A</p>	<p>Installer, Crankshaft Front Oil Seal 303-635</p>
 <p>ST1480-A</p>	<p>Installer, Crankshaft Rear Oil Seal 303-518 (T95P-6701-DH)</p>
 <p>ST1482-A</p>	<p>Installer, Crankshaft Rear Oil Slinger 303-517 (T95P-6701-CH)</p>
 <p>ST1718-A</p>	<p>Compressor, Valve Spring (Intake) 303-452 (T93P-6565-AR)</p>
	<p>Compressor, Valve Spring (Exhaust) 303-567 (T97P-6565-AH)</p>

 <p>ST1693-A</p>	
 <p>ST1479-A</p>	<p>Installer, Crankshaft Rear Oil Seal 303-516 (T95P-6701-BH)</p>
 <p>ST1335-A</p>	<p>Compressor, Piston Ring 303-D032 (D81L-6002-C) or equivalent</p>
 <p>ST1335-A</p>	<p>Holding Tool, Crankshaft 303-448 (T93P-6303-A)</p>

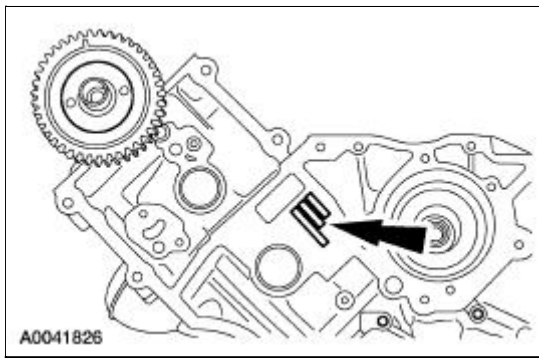
Material

Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H
Motorcraft Premium Engine Coolant VC-4-A (in Canada CXC-10; in Oregon VC-5) or equivalent	ESE-M97B44-A
Motorcraft Premium Gold Engine Coolant VC-7-A (in Canada VC-7-B) or equivalent	WSS-M97B51-A1

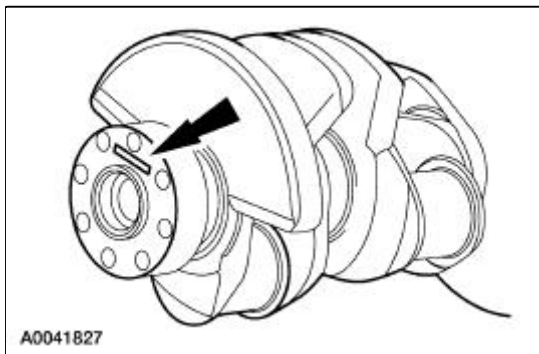
Assembly

NOTE: Before assembling the cylinder block, all sealing surfaces must be free from chips, dirt, paint and foreign material. Also, make sure the coolant and oil passages are clear.

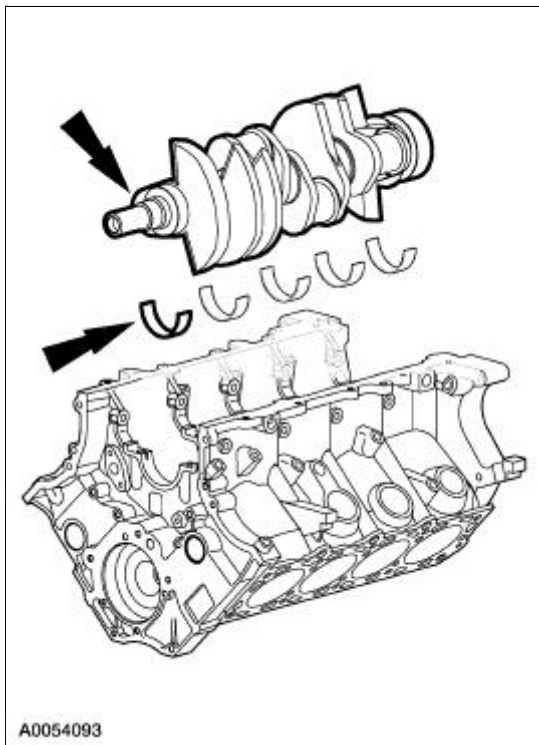
1. Record the main bearing code found on the front of the engine block.



2. Record the main bearing code found on the back of the crankshaft.

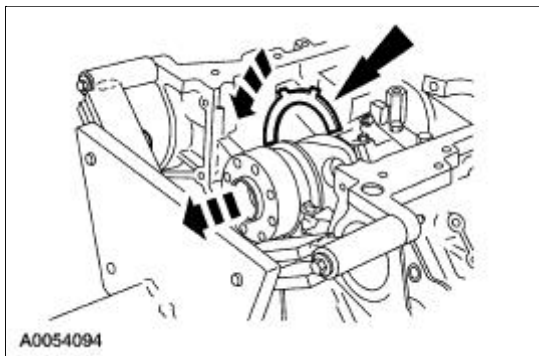


3. Using the data recorded earlier and the Bearing Select Fit Chart, Standard Bearings determine the required bearing grade for each main bearing.
 - Read the first letter of the engine block main bearing code and the first letter of the crankshaft main bearing code.
 - Read down the column below the engine block main bearing code letter, and across the row next to the crankshaft main bearing code letter, until the two intersect. This is the required bearing grade for the number one crankshaft main bearing.
 - As an example, if the engine block code letter is "F" and the crankshaft code letter is "D", the correct bearing grade for this main bearing is a "2".
 - Repeat this process for the remaining four main bearings.



7. **NOTE:** The oil groove on the thrust washer must face toward the front of the engine (against the crankshaft thrust surface).

Install the thrust washer to the rear of the No. 5 upper main bearing.



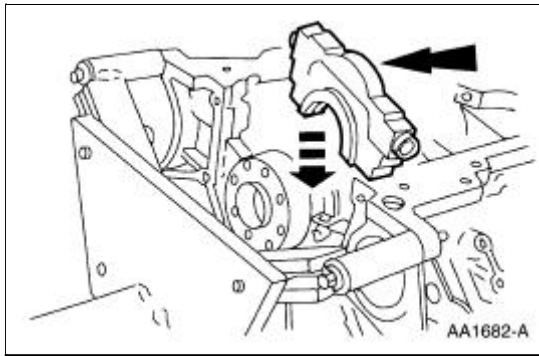
8. **NOTE:** Rotate the jack screws into the bearing caps enough to provide clearance to the cylinder block, prior to installing the bearing caps

NOTE: Install the thrust bearing to the rear main bearing cap and lubricate it with clean engine oil.

NOTE: Install the crankshaft lower main bearings into the main bearing caps and lubricate them with clean engine oil.

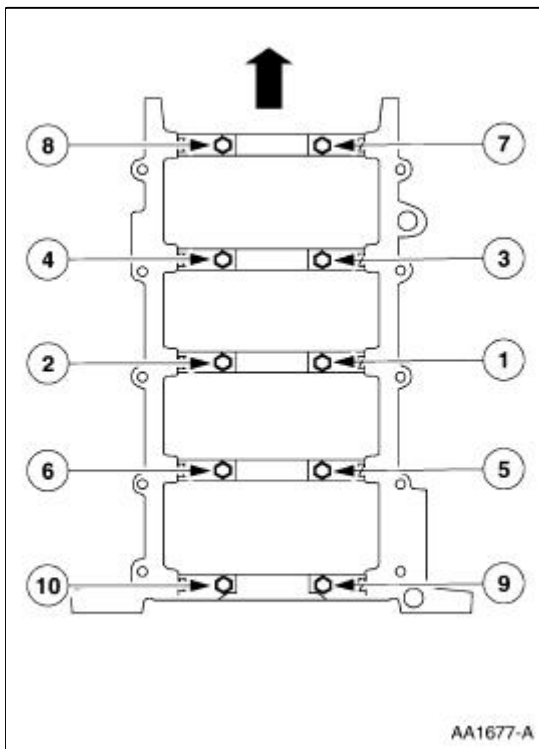
Apply forward force to the crankshaft, so that the crankshaft thrust face is against the No. 5 bulkhead. With the crankshaft in this position, locate the No. 5 main bearing cap on the cylinder block and tap into place using a plastic or dead blow hammer.

- Install the four remaining main bearing caps.



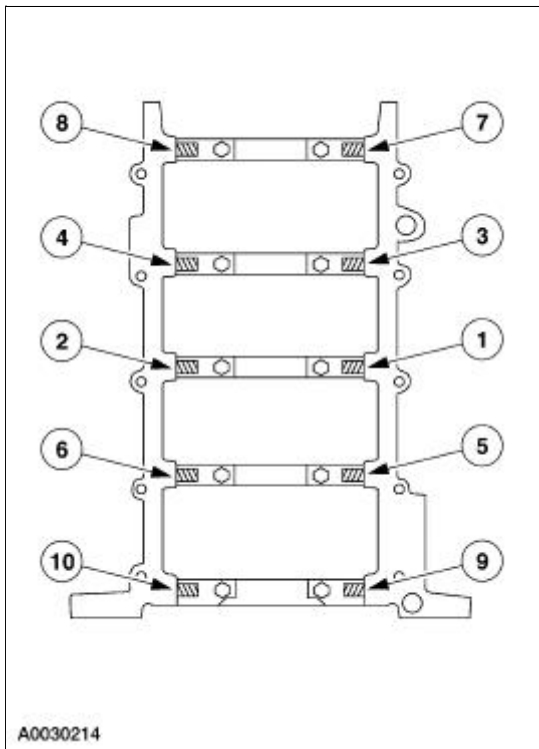
9. Install the vertical main bearing cap fasteners and tighten in the sequence shown, in two stages.

- Stage 1: Tighten to 40 Nm (30 lb-ft).
- Stage 2: Tighten an additional 90 degrees.

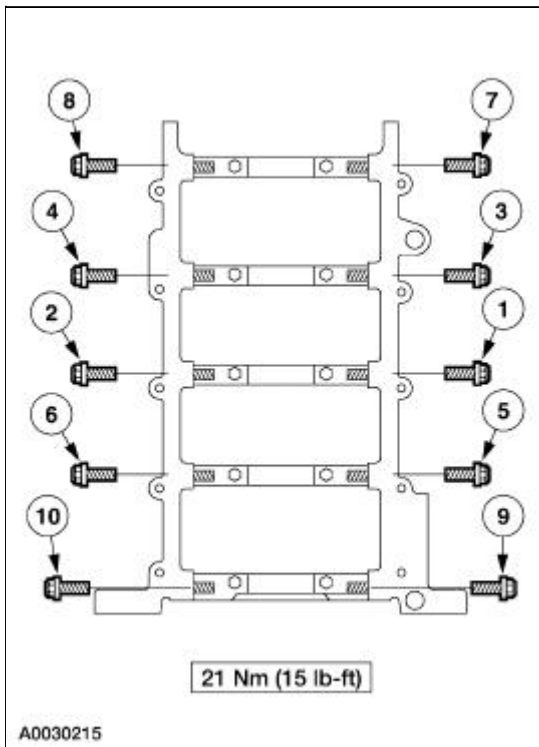


10. Tighten the jack screws against the cylinder block in the sequence shown, in two stages.

- Stage 1: Tighten to 5 Nm (44 lb-in).
- Stage 2: Tighten to 10 Nm (89 lb-in).



11. Install the side bolts and tighten them in the sequence shown.



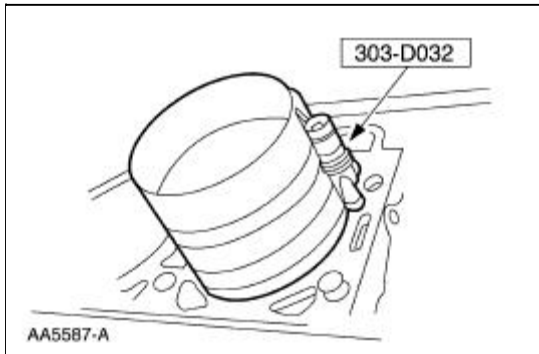
12. Check the crankshaft end play. For additional information, refer to [Section 303-00](#).

13.  **CAUTION: Do not scratch the cylinder walls or crankshaft journals with the connecting rod.**

NOTE: Make sure that the piston arrow is facing forward.

NOTE: Lubricate the piston rings, cylinder walls and connecting rod bearings with clean engine oil.

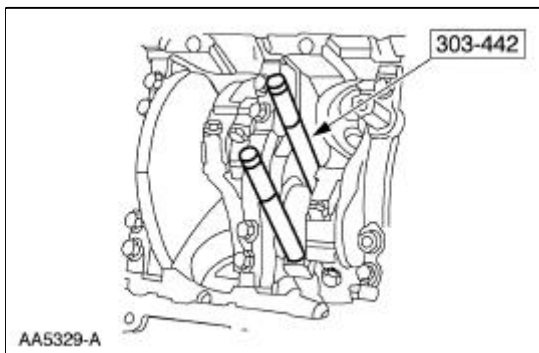
Using the special tool push the pistons through the top of the cylinder block.



14.  **CAUTION:** Do not scratch the cylinder walls or the crankshaft journals with the connecting rod.

NOTE: Make sure the crankshaft is at top dead center (TDC).

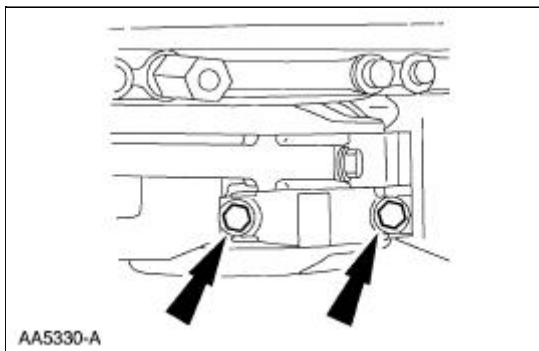
Using the special tool, install the connecting rod assemblies.



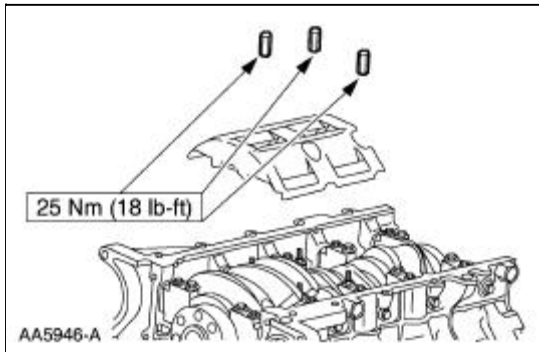
15. **NOTE:** The rod bearing cap bolts are torque-to-yield. Install new bolts, each time they are serviced.

Install the connecting rod bearing caps and bolts. and tighten in three stages.

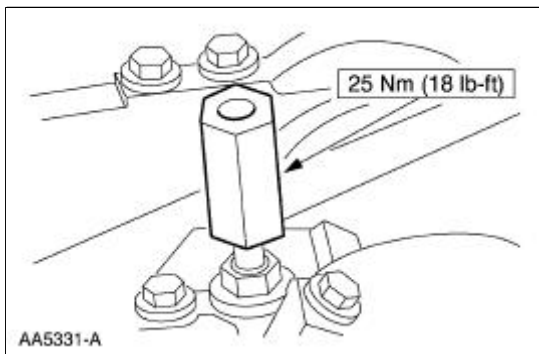
- Stage 1: Tighten to 25 Nm (18 lb-ft).
- Stage 2: Tighten to 45 Nm (33 lb-ft).
- Stage 3: Tighten an additional 90 degrees.



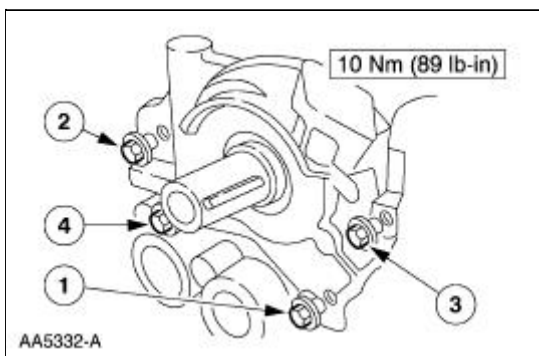
16. Check the connecting rod bearing clearance. For additional information, refer to [Section 303-00](#).
17. Install the windage tray.



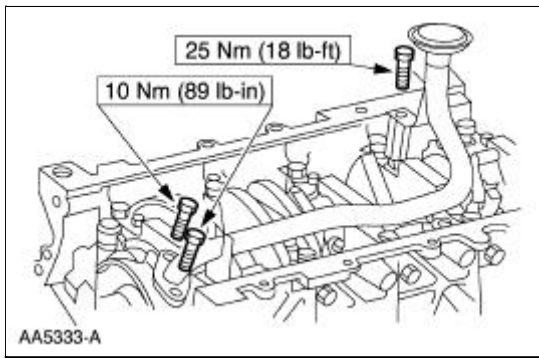
18. Install and tighten the oil pump screen spacer.



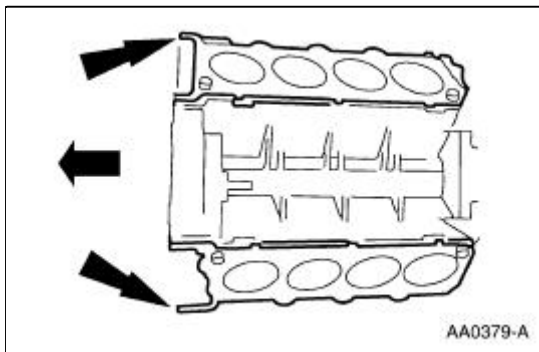
19. Position the oil pump; tighten the bolts in the sequence shown.



20. **NOTE:** Install a new O-ring if necessary.
Install the oil pump screen cover and tube.



21. Install the cylinder head gaskets.



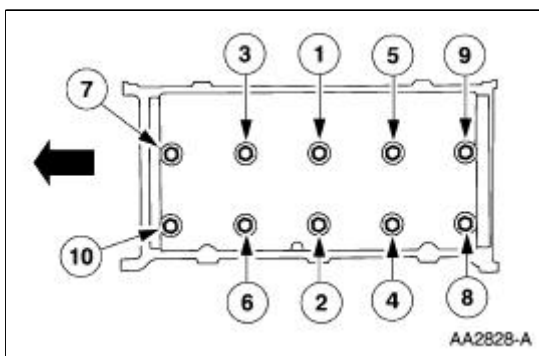
22. **NOTE:** Install new cylinder head bolts.


NOTE: LH is shown, RH is similar.

NOTE: Lubricate the bolt heads and threads. Use clean engine oil.

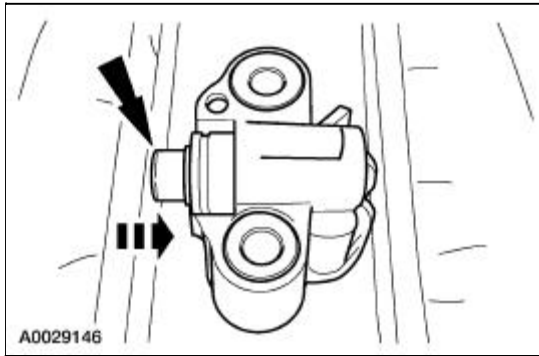
Install the LH and RH cylinder heads and tighten the bolts in six stages, in the sequence shown.

- Stage 1: Tighten to 40 Nm (30 lb-ft).
- Stage 2: Tighten an additional 90 degrees.
- Stage 3: Loosen the bolts a minimum of one full turn.
- Stage 4: Tighten to 40 Nm (30 lb-ft).
- Stage 5: Tighten an additional 90 degrees.
- Stage 6: Tighten an additional 90 degrees.

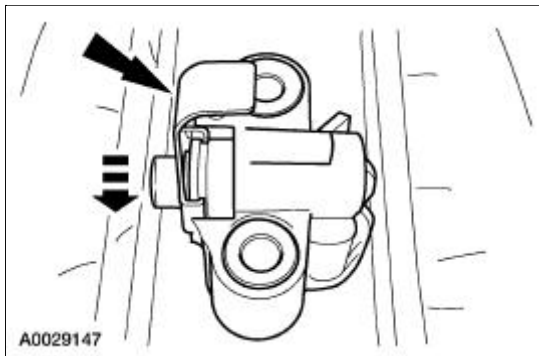


23.  **CAUTION:** Timing chain procedures must be followed exactly or damage to valves and pistons will result.

Compress the tensioner plunger, using a vise.

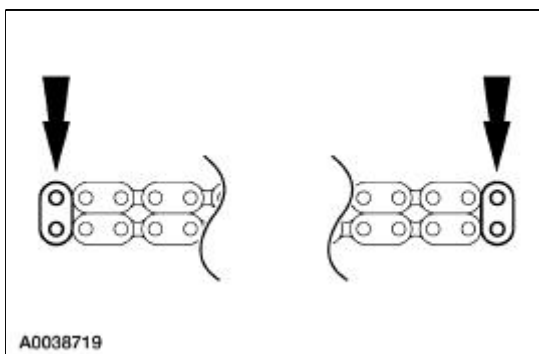


24. Install a retaining clip on the tensioner to hold the plunger in during installation.

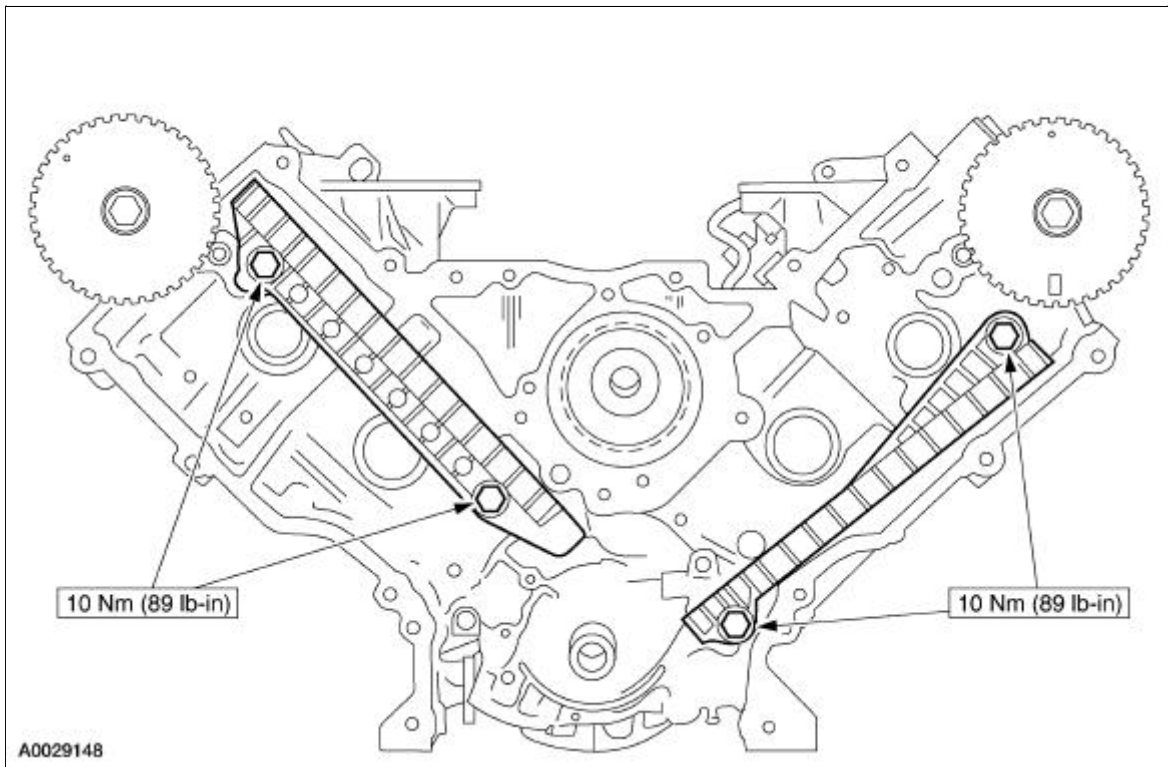


25. Remove the tensioner from the vise.

26. If the copper links are not visible, mark two links on one end and one link on the other end, and use as timing marks.

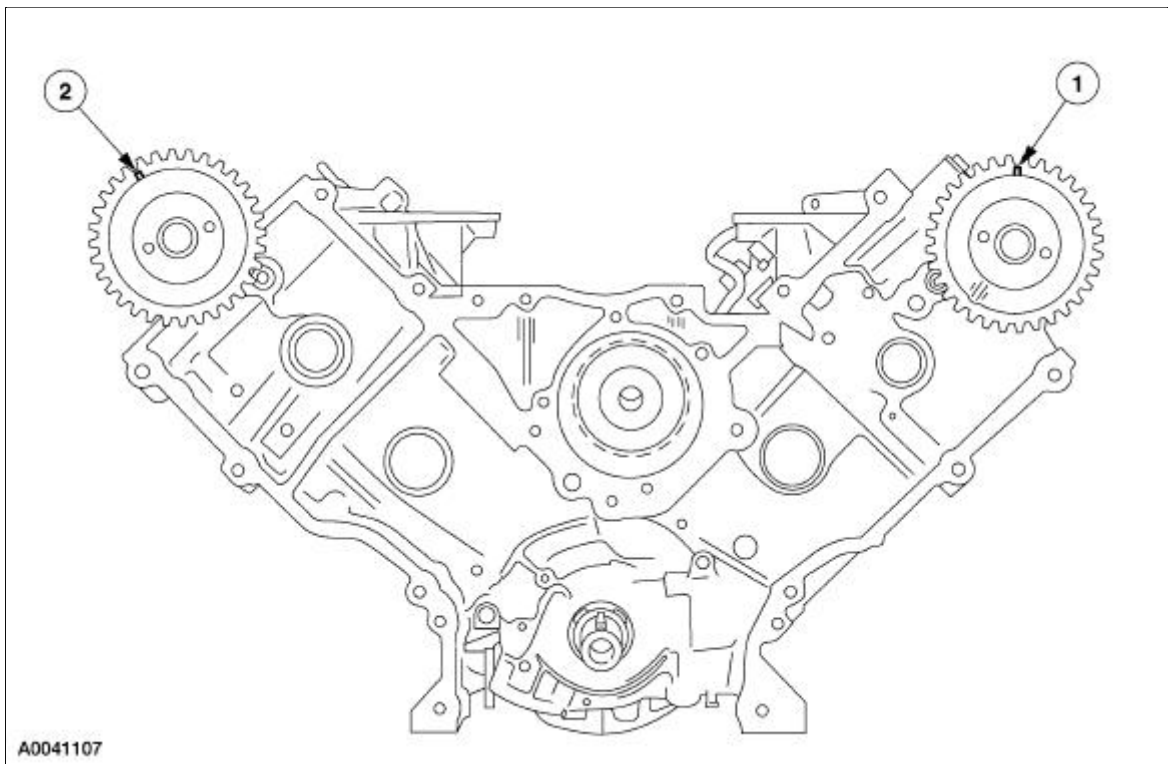


27. Install the timing chain guides.

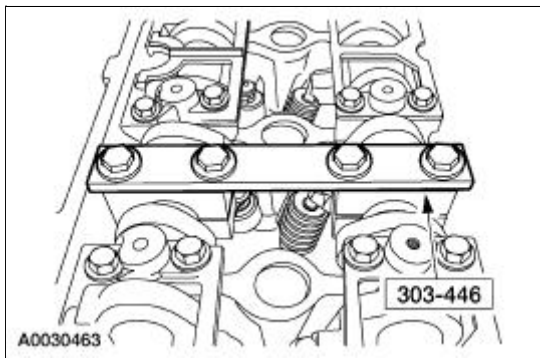


28. Pre-position the camshafts.

1. Rotate the LH camshaft until the timing mark is approximately at 12 o'clock.
2. Rotate the RH camshaft until the timing mark is approximately at 11 o'clock.



29. Install the special tool.

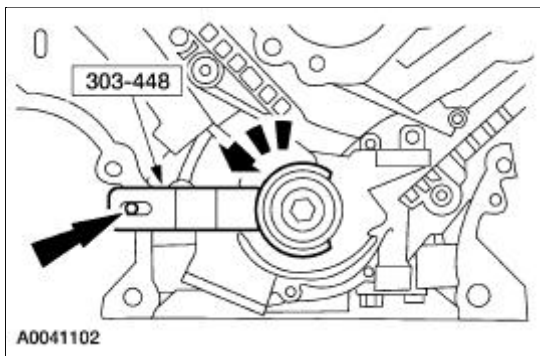


30. **⚠ CAUTION:** Unless otherwise instructed, at no time when the timing chains are removed and the cylinder heads are installed is the crankshaft or camshaft to be rotated. Severe piston and valve damage will occur.

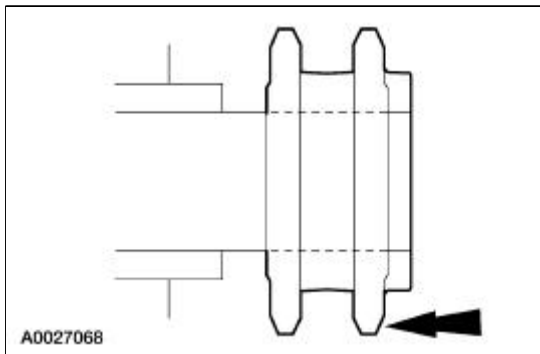
⚠ CAUTION: Rotate the crankshaft counterclockwise only. Do not rotate past position shown or severe piston and/or valve damage will occur.

Using the special tool, position the crankshaft.

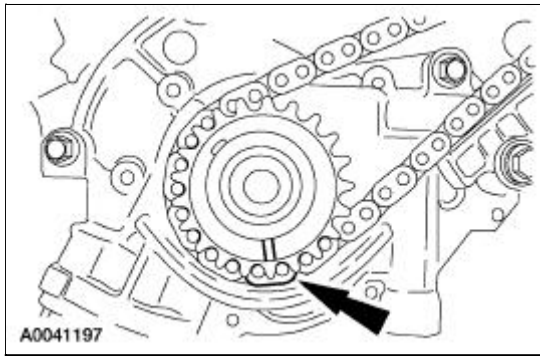
- Remove the special tool.



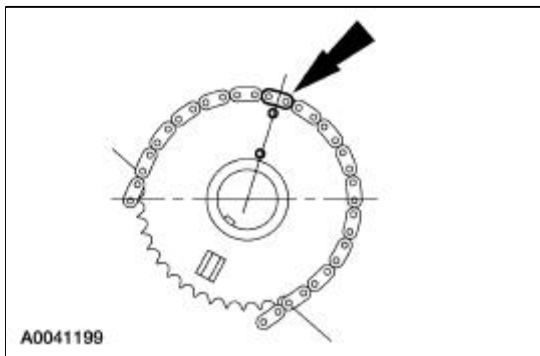
31. Install the crankshaft sprocket with the flange facing forward.



32. Position the LH (inner) timing chain onto the crankshaft sprocket, aligning the one copper link on the timing chain with the slot on the crankshaft sprocket.

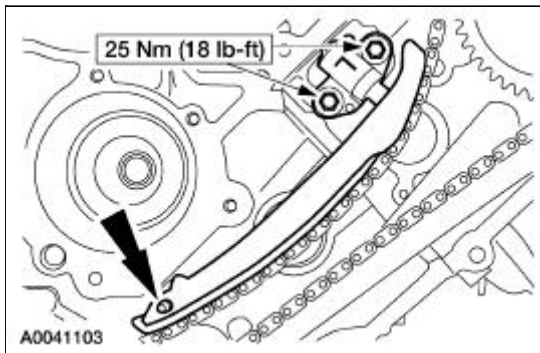


33. Install the LH timing chain on the camshaft sprocket, aligning the copper (marked) link with the timing marks on the sprocket.

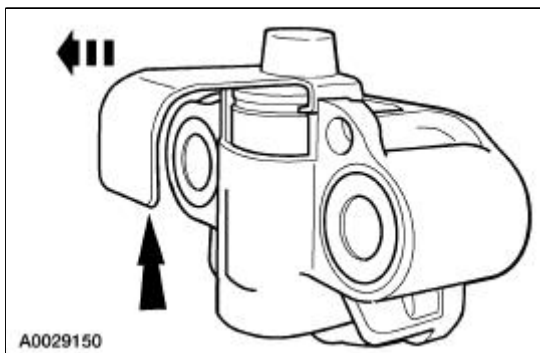


34. **NOTE:** The LH timing chain tensioner arm has a bump near the dowel hole for identification.

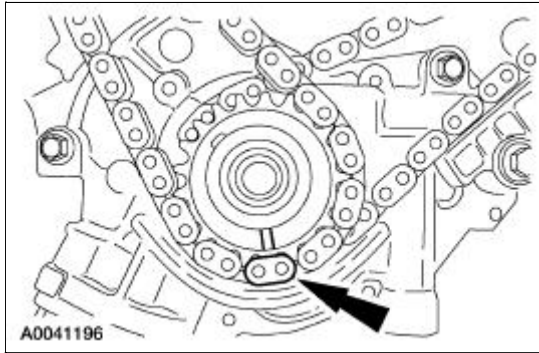
Position the LH timing chain tensioner arm on the dowel pin and install the LH timing chain tensioner.



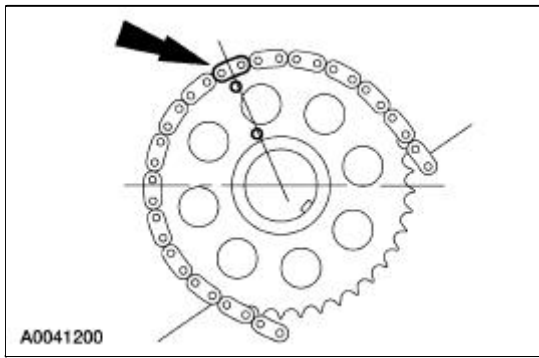
35. Remove the retaining clip from the LH timing chain tensioner.



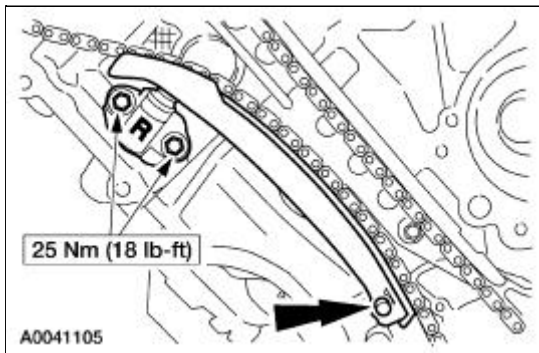
36. Position the RH (outer) timing chain on the crankshaft sprocket, aligning the copper (marked) link with the timing marks on the sprocket.



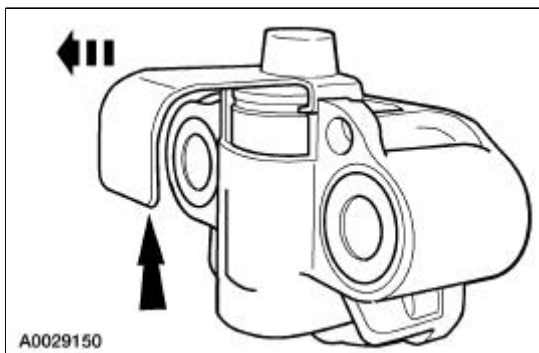
37. Install the RH timing chain on the camshaft sprocket, aligning the copper (marked) link with the timing marks on the sprocket.



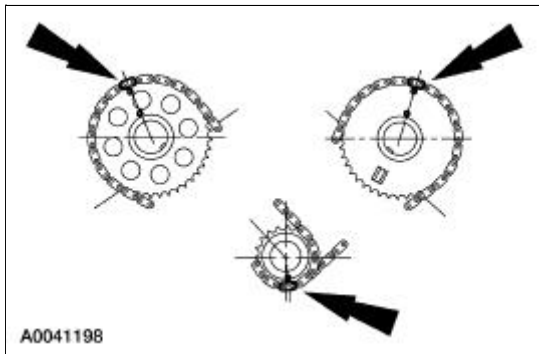
38. Position the RH timing chain tensioner arm on the dowel pin and install the RH timing chain tensioner.



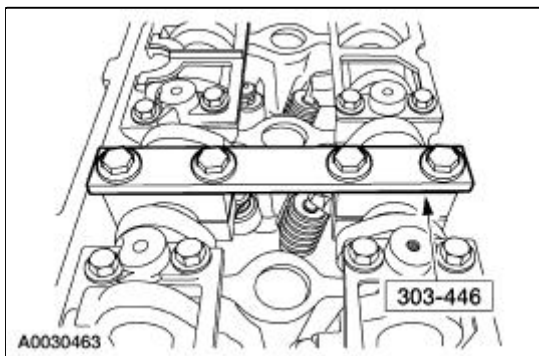
39. Remove the retaining clip from the RH timing chain tensioner.



40. As a post-check, make sure that the copper (marked) chain links are lined up with the dots on the crankshaft sprockets and the camshaft sprockets.

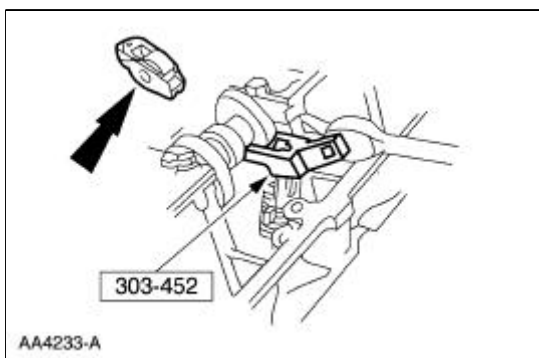


41. Remove the special tool.

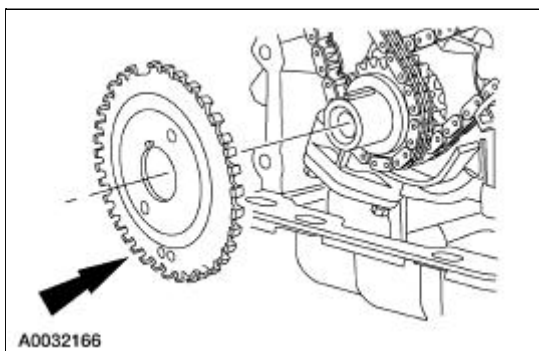


42. **NOTE:** Make sure the base circle of the camshaft is facing the roller follower being installed.

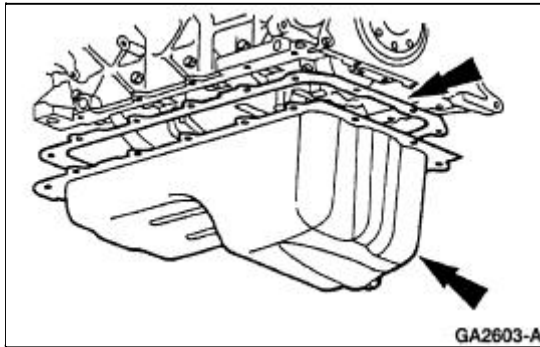
Using the special tool, install the 32 roller followers.



43. Position the crankshaft sensor ring on the crankshaft.

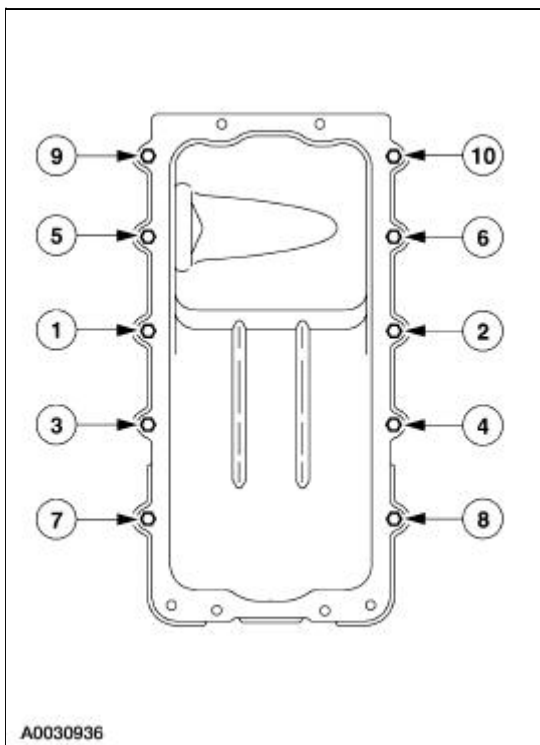


44. Install the oil pan and gasket, and loosely install the bolts.



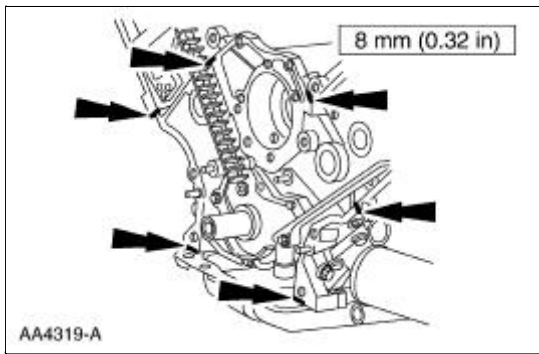
45. Tighten the bolts in the sequence shown, in two stages.

- Stage 1: Tighten to 20 Nm (15 lb-ft).
- Stage 2: Rotate an additional 60 degrees.

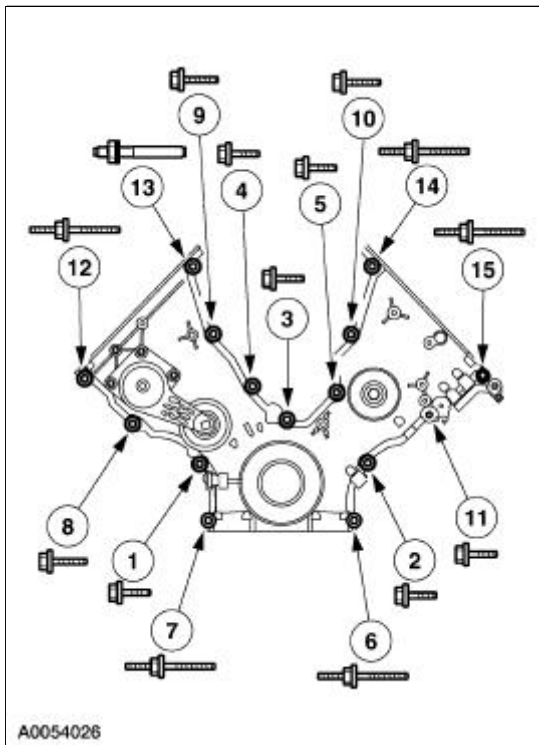


46. **NOTE:** If the engine front cover is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

Apply silicone gasket and sealant in the locations shown.



47. Install the engine front cover, the bolts and the studs, and tighten the fasteners in the sequence shown to 25 Nm (18 lb-ft).

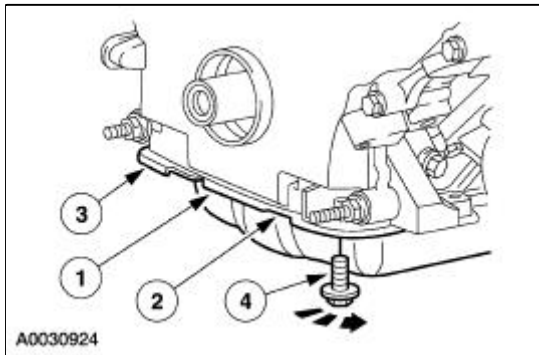


Item	Part Number	Description
1	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
2	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
3	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
4	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
5	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
6	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 1.25 x 91.1
7	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 1.25 x 91.1
8	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
9	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
10	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
11	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
12	W706560	Stud, Hex Head Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 16

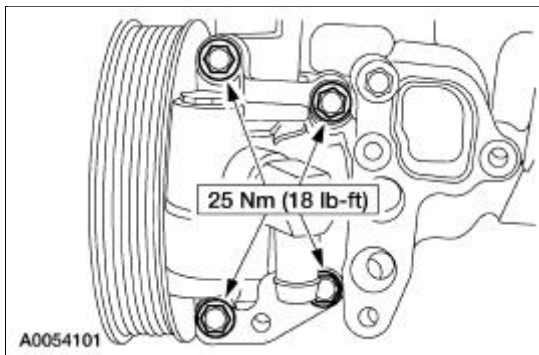
13	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 1.25 x 91.1
14	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 1.25 x 91.1
15	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 1.25 x 91.1

48. Tighten the four oil pan bolts in the sequence shown, in three stages.

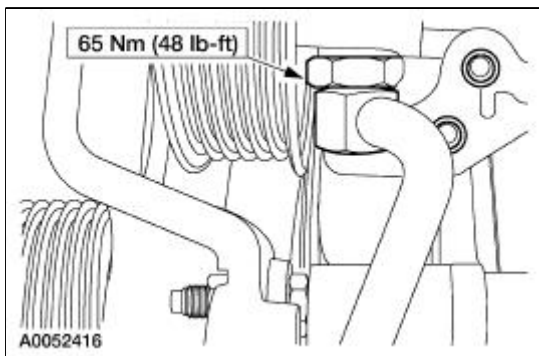
- Stage 1: Tighten to 2 Nm (18 lb-in).
- Stage 2: Tighten to 20 Nm (15 lb-ft).
- Stage 3: Tighten an additional 60 degrees.



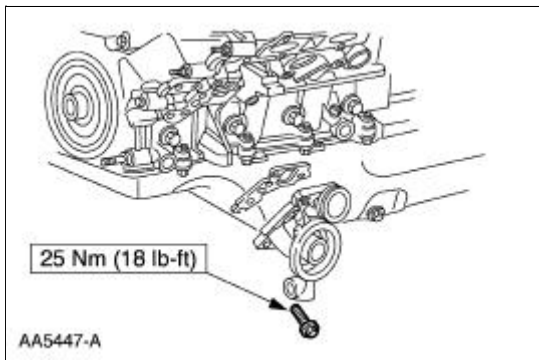
49. Install the power steering pump and the bolts.



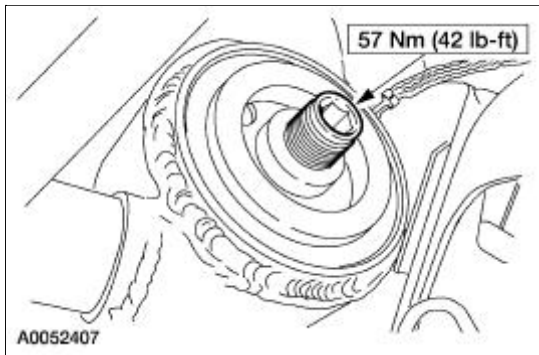
50. Install the power steering hose.



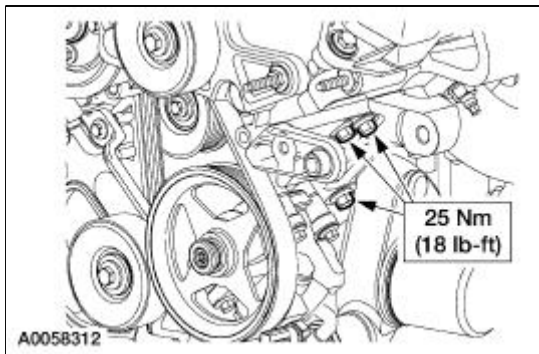
51. Install a new gasket and the oil filter adapter.



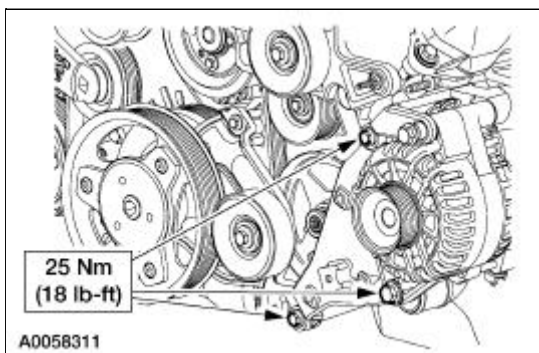
52. Install a new O-ring seal and the oil cooler.



53. Install the generator support bracket.



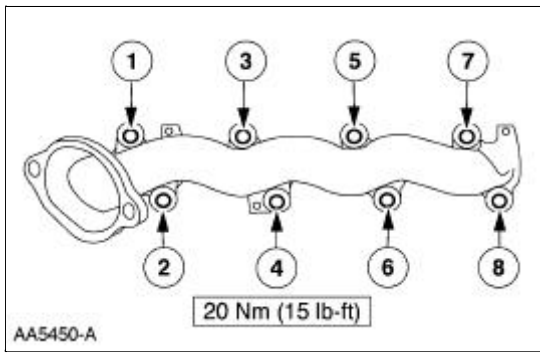
54. Install the generator.



55. **NOTE:** RH is shown, LH is similar. Use new gaskets when installing the exhaust manifolds.

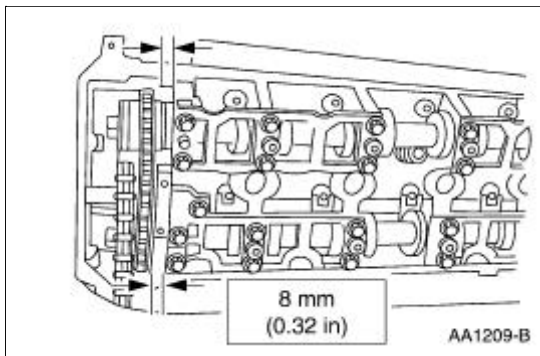
Install the exhaust manifolds.

- Tighten the nuts in the sequence shown.



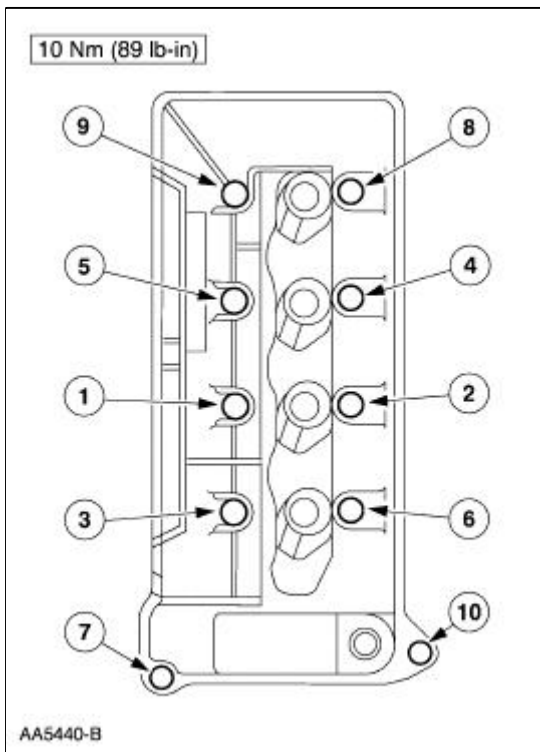
56. **NOTE:** If the valve cover is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

Apply silicone gasket and sealant in the locations shown.

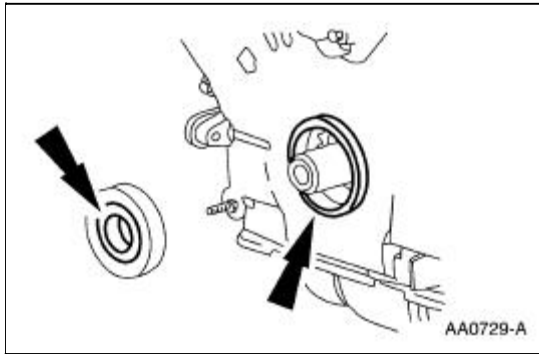


57. **NOTE:** RH is shown, LH is similar. Inspect and install new O-ring seals if necessary.

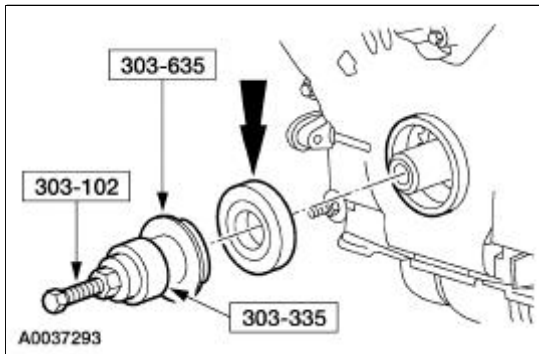
Install the valve covers and tighten the bolts in the sequence shown.



58. Lubricate the front oil seal and the engine front cover with clean engine oil.

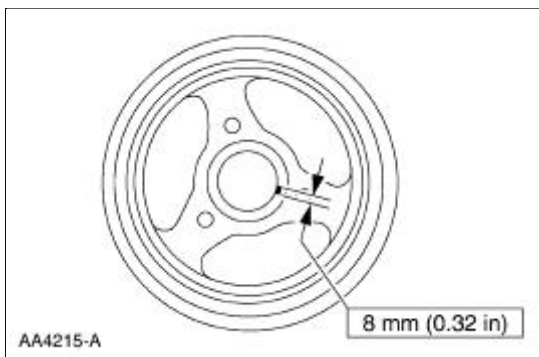


59. Using the special tools, install the front oil seal.

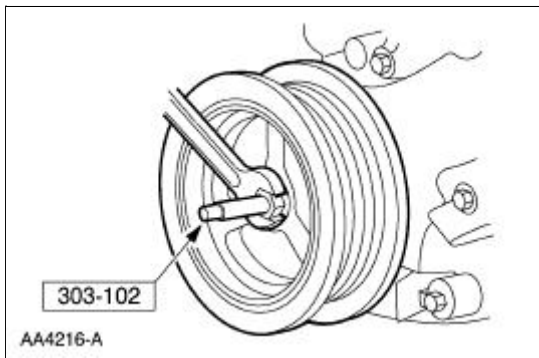


60. **NOTE:** If the crankshaft pulley is not installed within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

Apply silicone gasket and sealant to the Woodruff key on the crankshaft pulley.

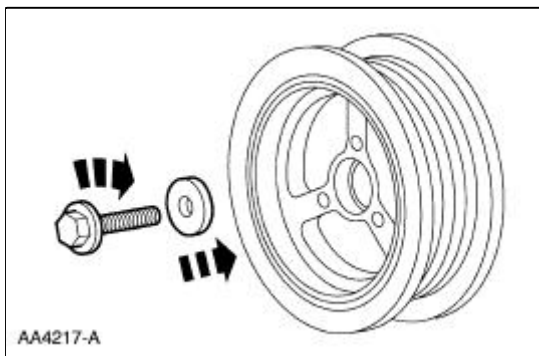


61. Using the special tool, install the crankshaft pulley.



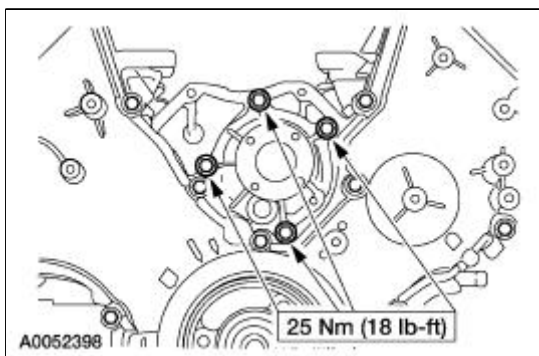
62. Install the crankshaft pulley and tighten the bolt in four stages.

- Stage 1: Tighten to 90 Nm (66 lb-ft).
- Stage 2: Loosen the bolt one full turn.
- Stage 3: Tighten to 50 Nm (37 lb-ft).
- Stage 4: Tighten an additional 90 degrees.

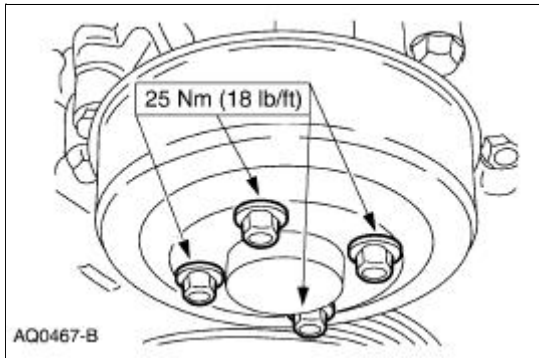


63. **NOTE:** Lubricate the O-ring seal with clean engine coolant.

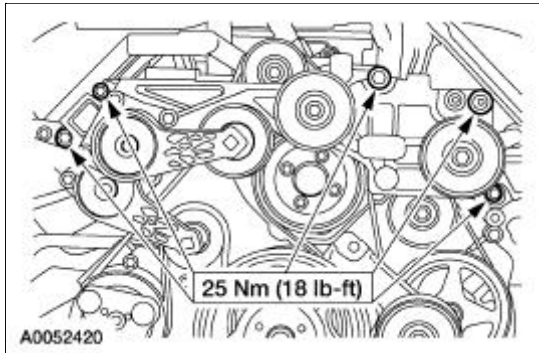
Install the water pump.



64. Install the water pump pulley and the bolts.



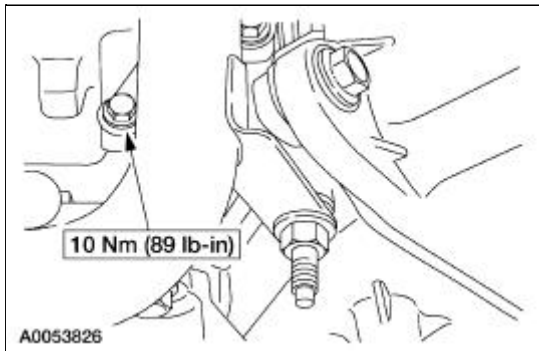
65. Install the supercharger belt idler support bracket assembly.



66. **NOTE:** Lubricate the O-rings with clean engine coolant.

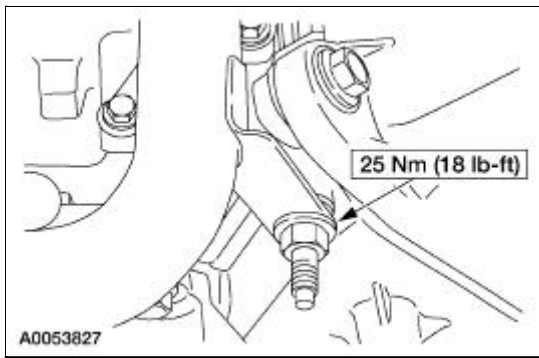
NOTE: LH is shown, RH is similar.

Install the coolant bypass tube and mounting bolts.



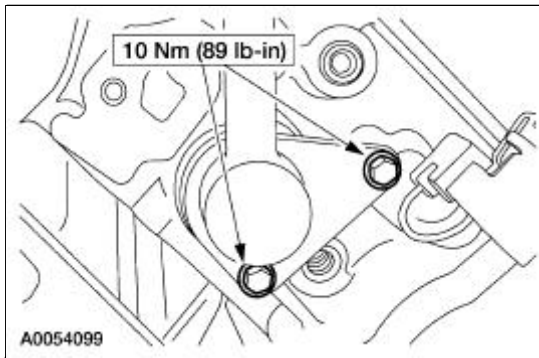
67. **NOTE:** LH is shown, RH is similar.

Install the coolant bypass tube studs.



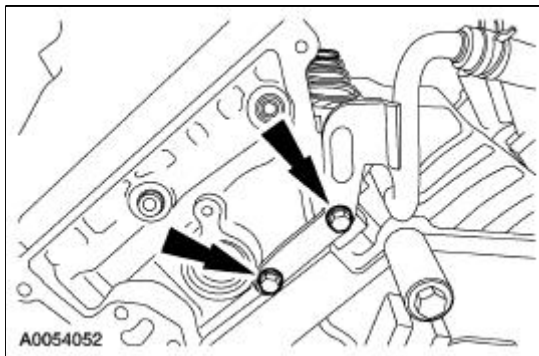
68. **NOTE:** Lubricate the O-ring with clean engine coolant.

Install the heater water inlet tube.



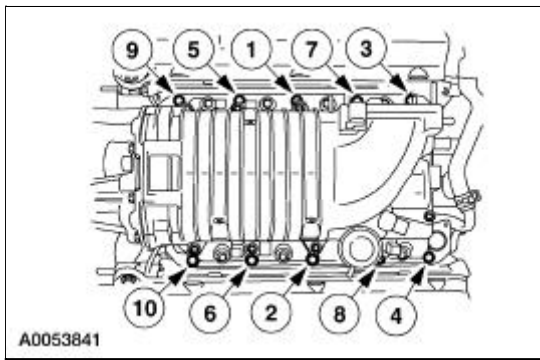
69. **NOTE:** Lubricate the O-rings with clean engine coolant.

Install the heater water outlet tube and the mounting bolts.

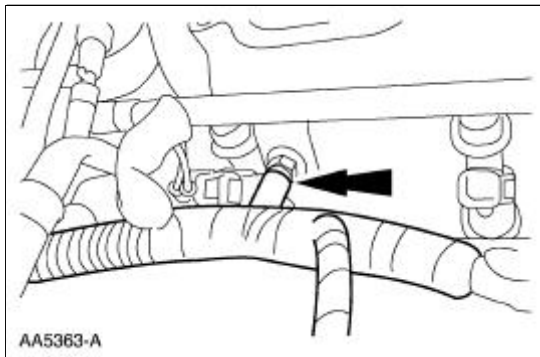


70. **NOTE:** Inspect the intake manifold gaskets and install new gaskets, if necessary.

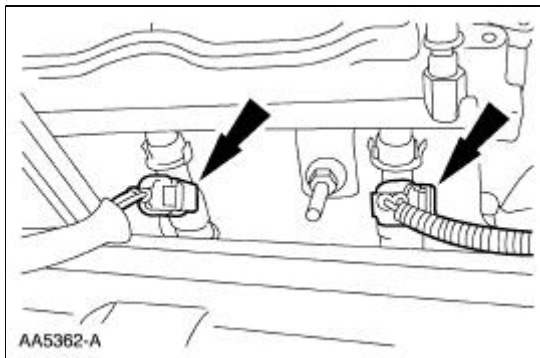
Install the intake manifold, supercharger and fuel supply manifold as an assembly, and tighten the bolts to 10 Nm (89 lb-in) in the sequence shown.



71. Position the wiring harness onto the engine and attach it to the four fuel supply manifold studs.

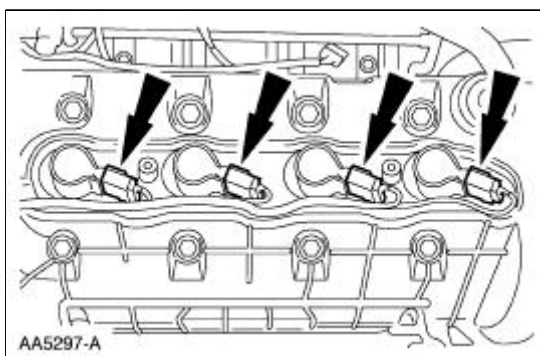


72. Connect the eight fuel injector electrical connectors.

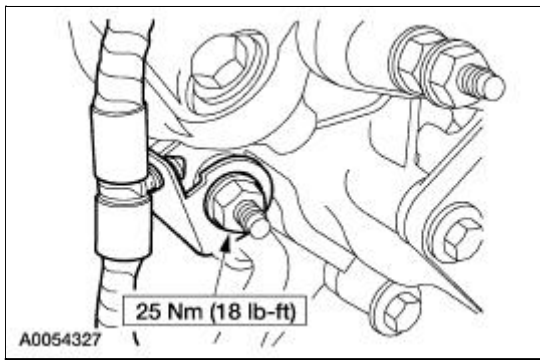


73. **NOTE:** RH is shown, LH is similar.

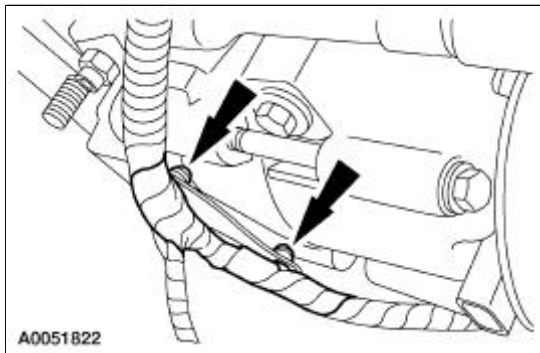
Install the RH and LH ignition coils and connect the electrical connectors.



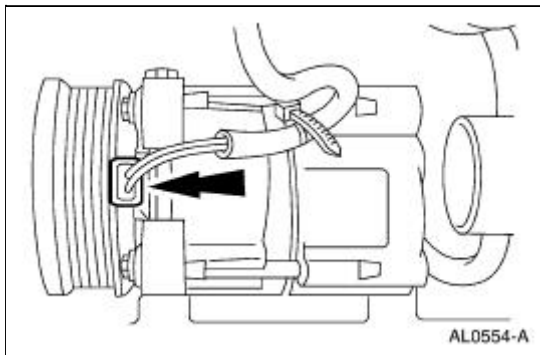
74. Install the harness support bracket.



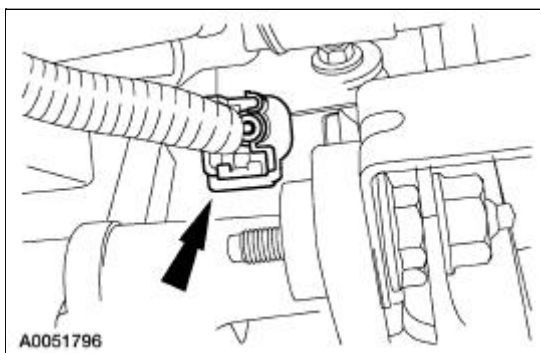
75. Clip the harness to the bracket.



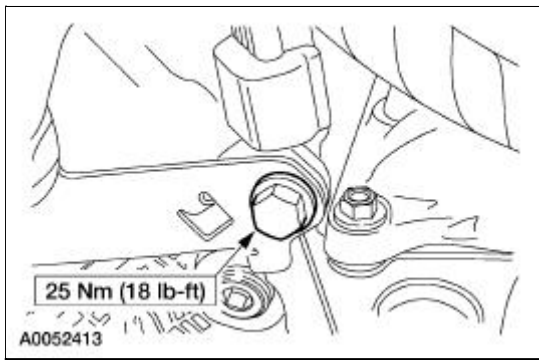
76. Connect the A/C compressor electrical connector.



77. Connect the crankshaft position (CKP) sensor electrical connector.

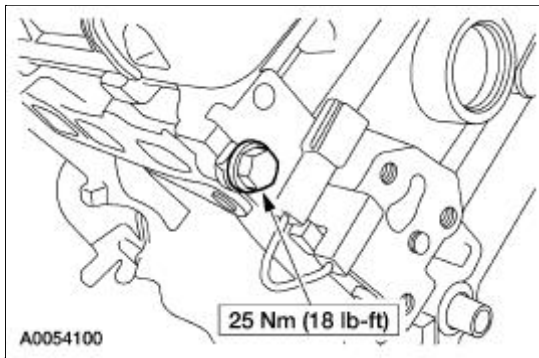


78. Install the fuel charging wiring harness bracket bolt.



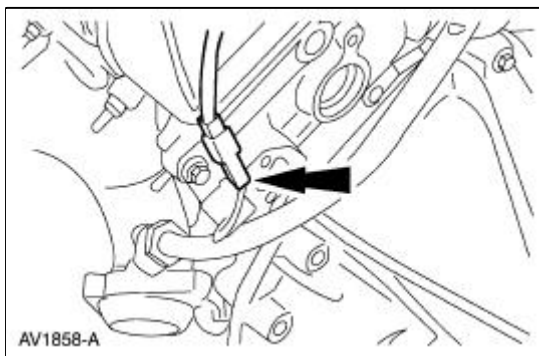
79. **NOTE:** LH is shown, RH is similar.

Install the RH and LH radio ignition interference capacitors.

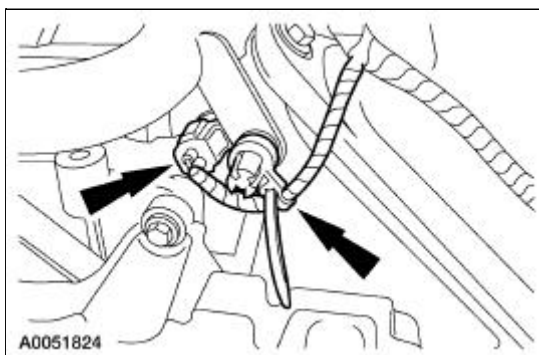


80. **NOTE:** LH is shown, RH is similar.

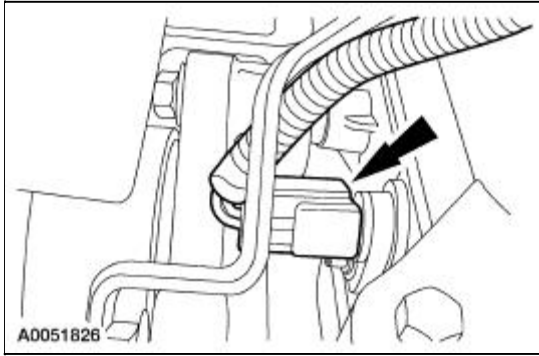
Connect the two radio ignition interference capacitor electrical connectors.



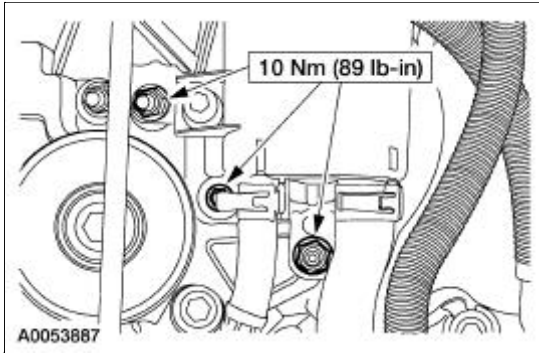
81. Connect the engine coolant temperature (ECT) sensor electrical connector, and attach the harness to the stud.



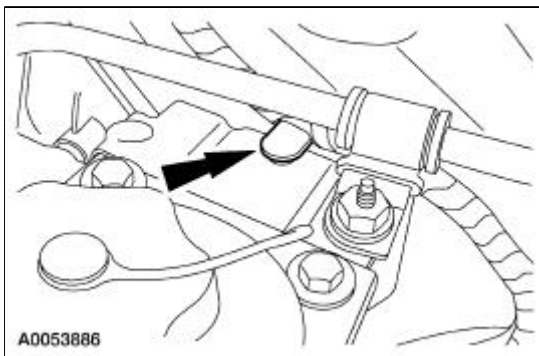
82. Connect the camshaft position (CMP) sensor electrical connector.



83. Install the power steering reservoir and mounting bolts.

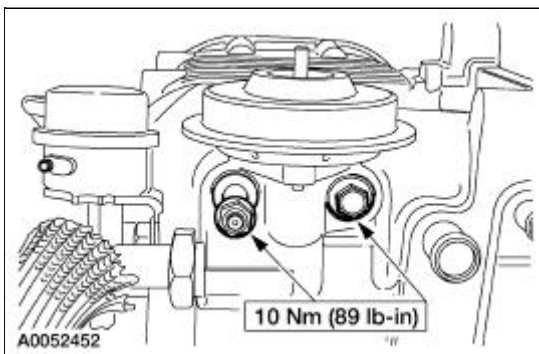


84. Attach the wiring harness to the power steering support bracket.

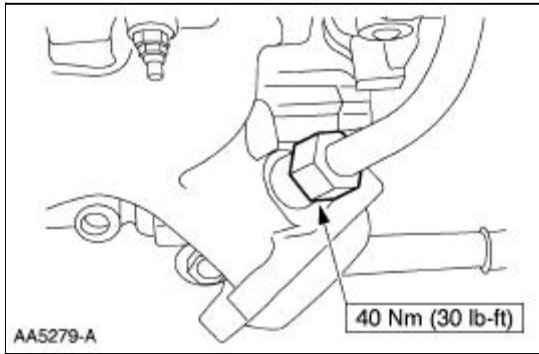


85. **NOTE:** Install a new exhaust gas recirculation (EGR) valve gasket.

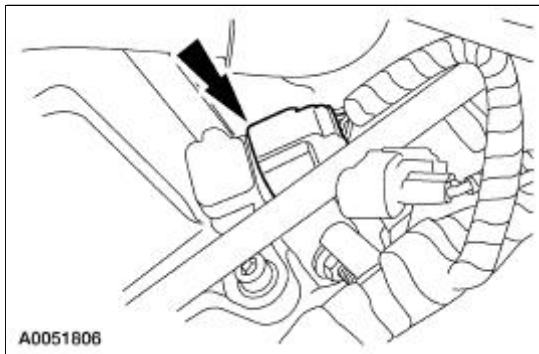
Install the EGR valve and tube as an assembly.



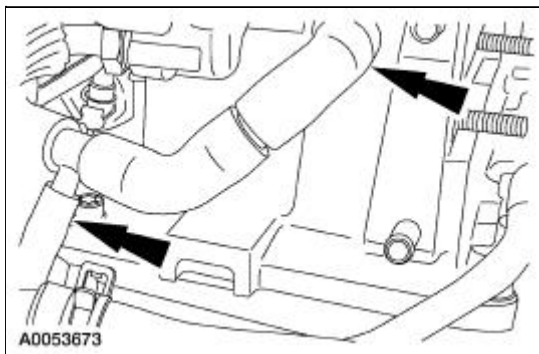
86. Tighten the EGR tube to the exhaust manifold.



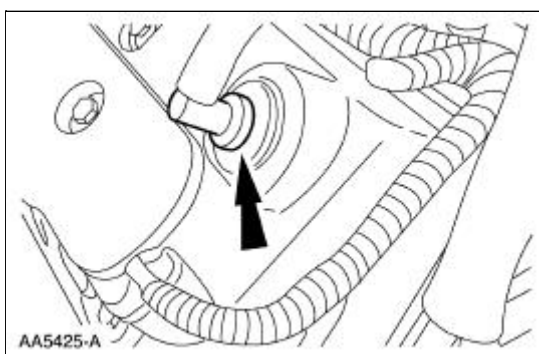
87. Connect the barometric pressure (BARO) sensor electrical connector.



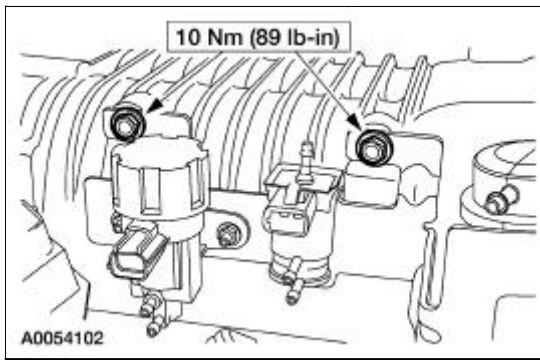
88. Install and connect the positive crankcase ventilation (PCV) hose.



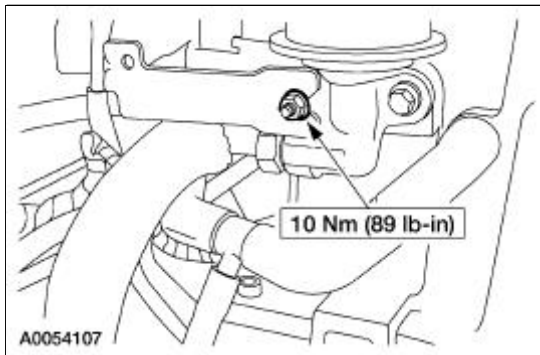
89. Install the PCV valve.



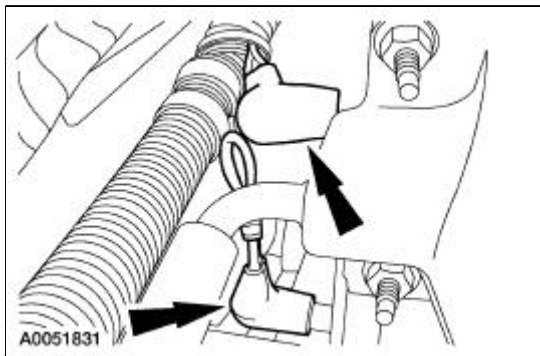
90. Install the vacuum accessory bracket and the mounting bolts.



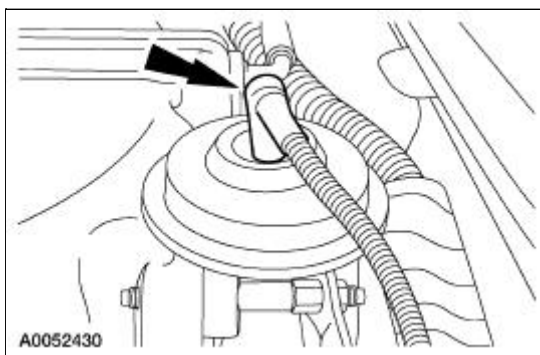
91. Install the vacuum accessory bracket mounting nut.



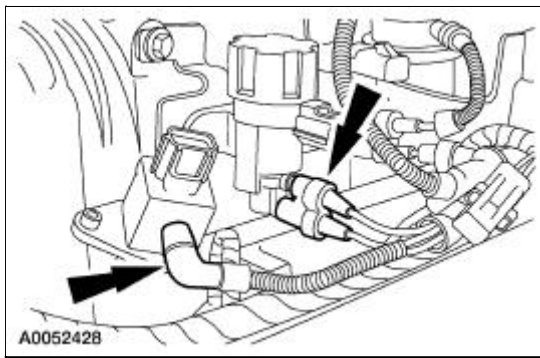
92. Position the vacuum harness and connect the vacuum hoses to the back of the supercharger.



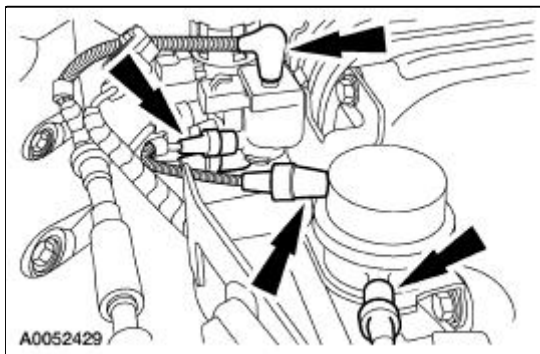
93. Connect the vacuum hose to the EGR valve.



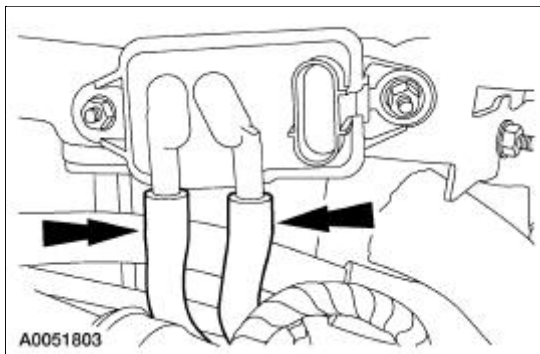
94. Connect the vacuum hoses to the fuel pulse damper and the EGR vacuum regulator solenoid.



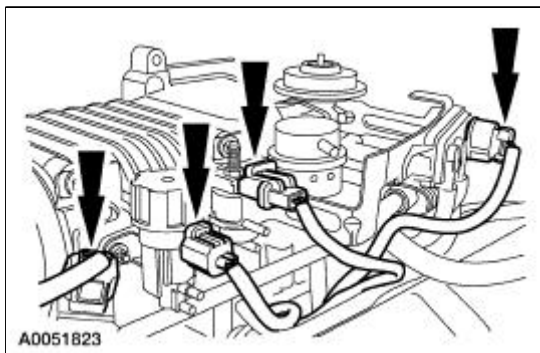
95. Connect the vacuum hoses to the supercharger bypass vacuum solenoid and the actuator.



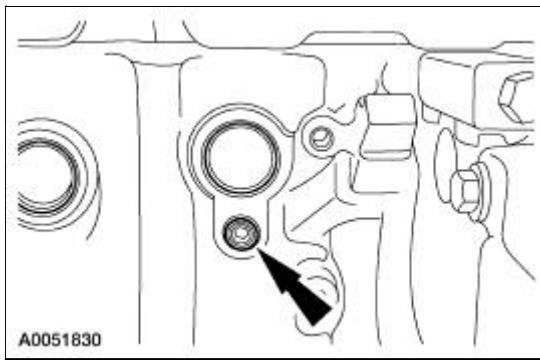
96. Connect the vacuum hoses to the differential pressure feedback EGR system.



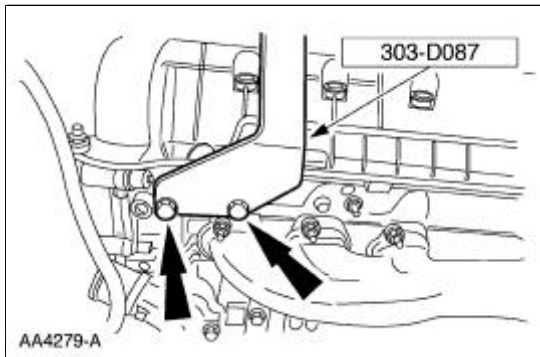
97. Connect the electrical connectors to the fuel pulse damper, EGR vacuum regulator solenoid, supercharger bypass vacuum solenoid, and the differential pressure feedback EGR system.



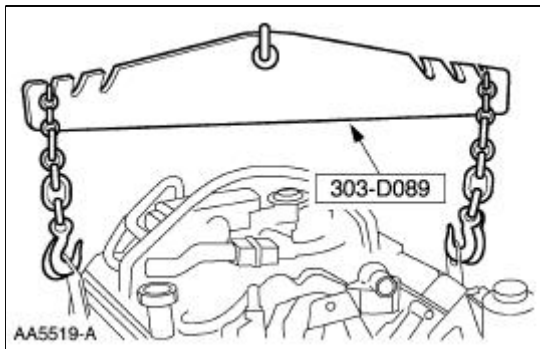
98. Install the drain plug.



99. Install the special tools.

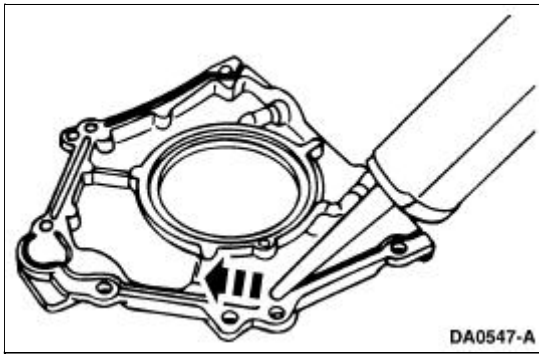


100. Attach the special tool to a floor crane and the engine, and remove the engine from the stand.



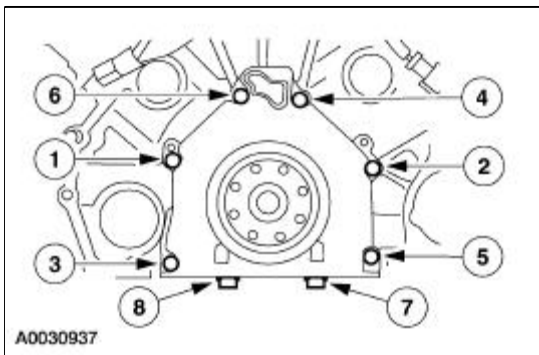
101. **NOTE:** If not secured within four minutes, the sealant must be removed and the sealing surface must be cleaned with metal surface cleaner. Allow the surface to dry until there is no sign of wetness or four minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

Apply a 4 mm (0.16 in) bead of silicone gasket and sealant around the rear oil seal retainer plate sealing surface. Also apply a bead of silicone gasket and sealant at the junction where the cylinder block, oil pan and rear oil seal retainer plate meet.

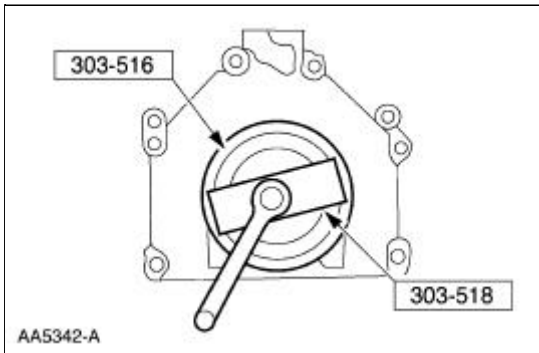


102. Install the rear oil seal retainer plate and tighten the bolts in the sequence shown.

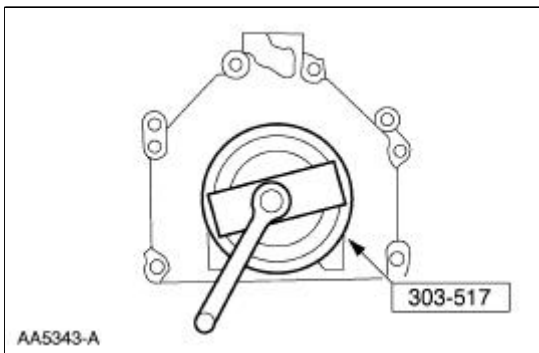
- Tighten bolts No. 1-6 to 10 Nm (89 lb-in).
- Tighten bolts No. 7 and 8 to 20 Nm (15 lb-ft)
- Tighten bolts No. 7 and 8 an additional 60 degrees.



103. Using the special tools, install the crankshaft rear main seal.

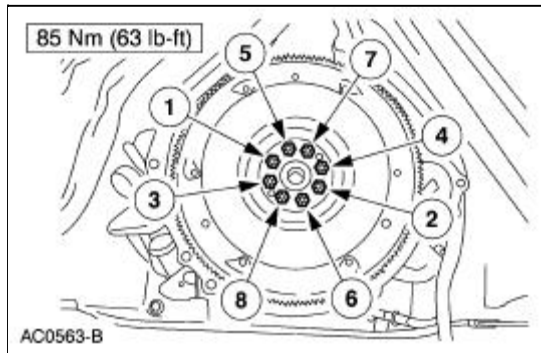


104. Using the special tool, install the crankshaft oil slinger.





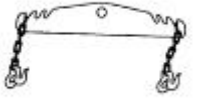
105. Install the flywheel and the bolts.

- Tighten the bolts in the sequence shown.



Engine

Special Tool(s)

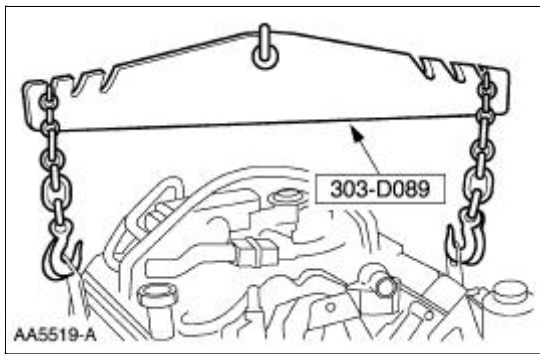
 <p>ST1603-A</p>	Lifting Bracket, Engine 303-D087 (D93P-6001-A1)
 <p>ST1604-A</p>	Lifting Bracket, Engine 303-D088 (D93P-6001-A2)
 <p>ST1602-A</p>	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent

Material

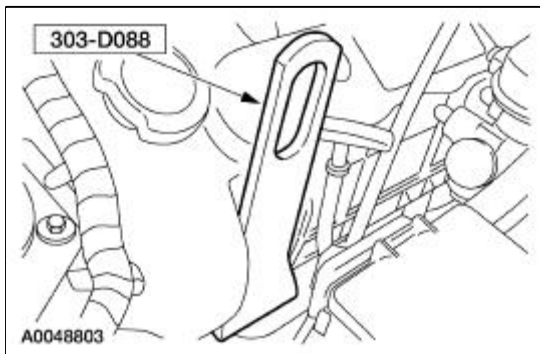
Item	Specification
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153- H
Motorcraft Premium Engine Coolant VC-4-A (in Canada CXC-10; in Oregon VC-5) or equivalent	ESE-M97B44- A
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) or equivalent	WSS-M97B51- A1
Threadlock and Sealer E0AZ-19554-AA	WSK-M2G351- A5
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (MC YN-12-C)	WSH-M1C231- B

Installation

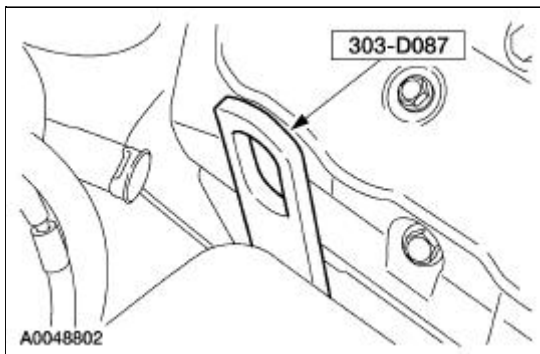
1. Install the engine in the vehicle and remove the floor crane and the special tool.



2. Remove the special tool.

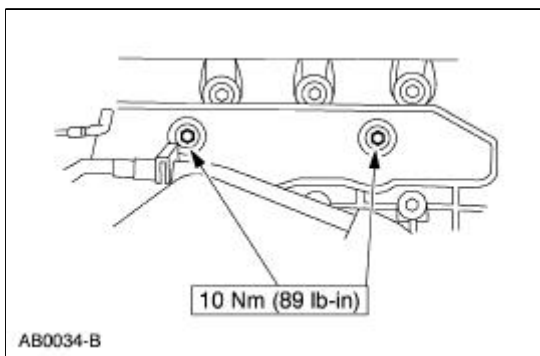


3. Remove the special tool.

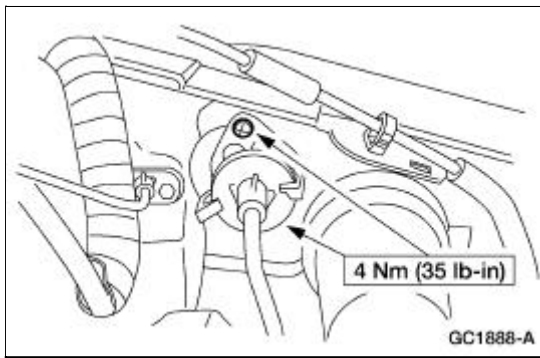


4. **NOTE:** RH is shown, LH is similar.

Install the RH and LH ignition coil covers.



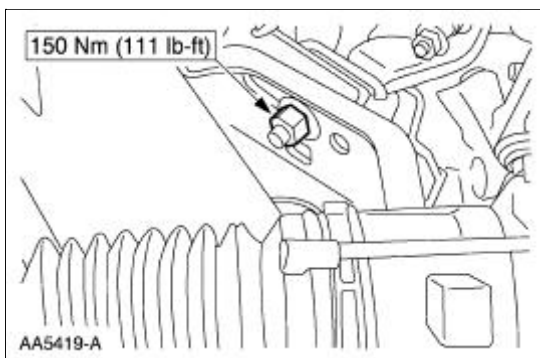
5. Install the clutch cable and retaining screws.



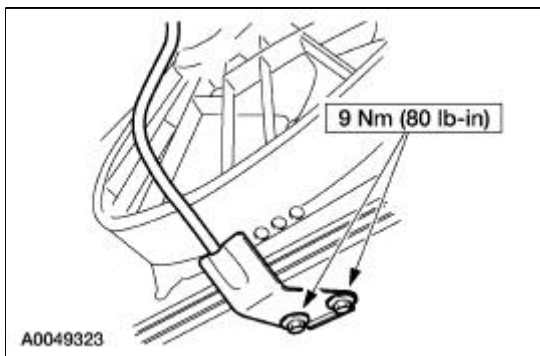
6. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).

7. **NOTE:** RH is shown, LH is similar.

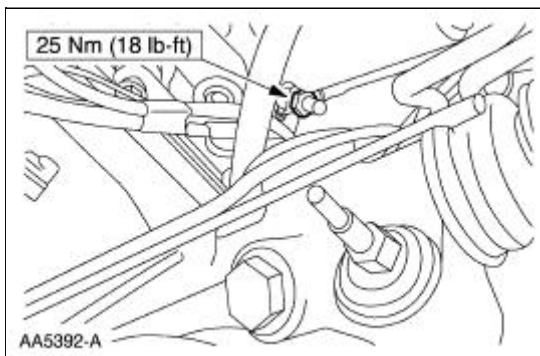
Install the two engine mount nuts.



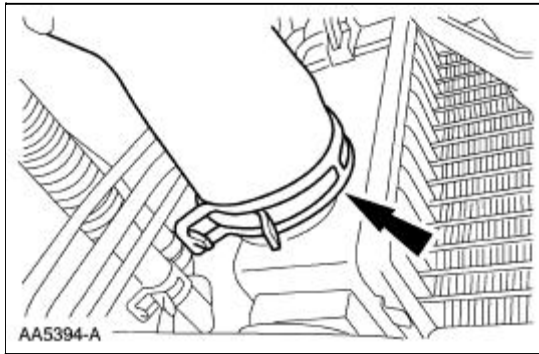
8. Install the degas bottle support bracket and the bolts.



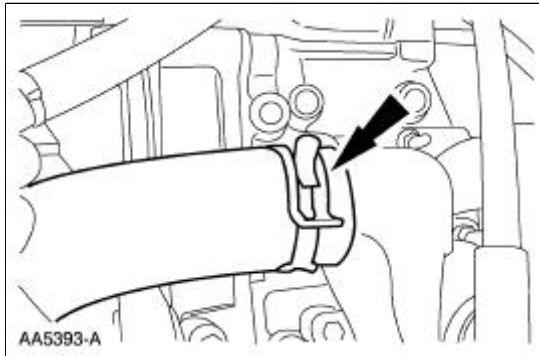
9. Install the ground strap and the bolt.



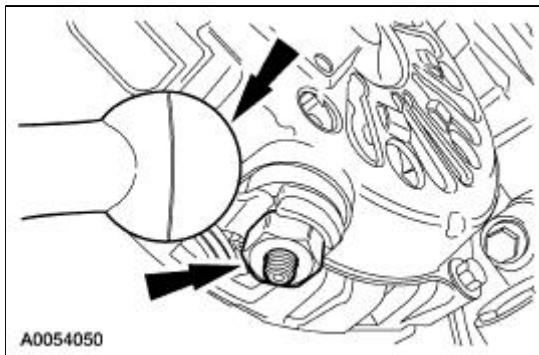
10. Connect the lower radiator hose.



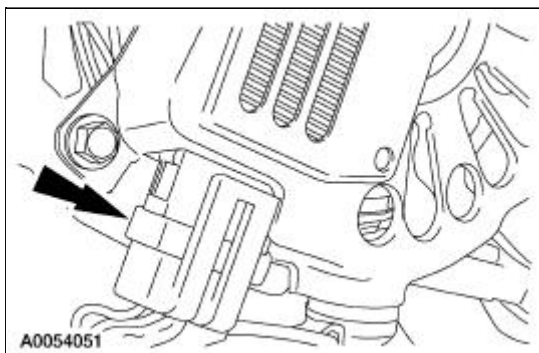
11. Connect the hose to the oil filter adapter.



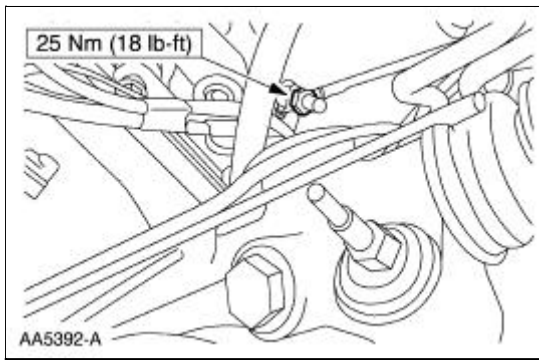
12. Attach the B + terminal cable and install the nut.



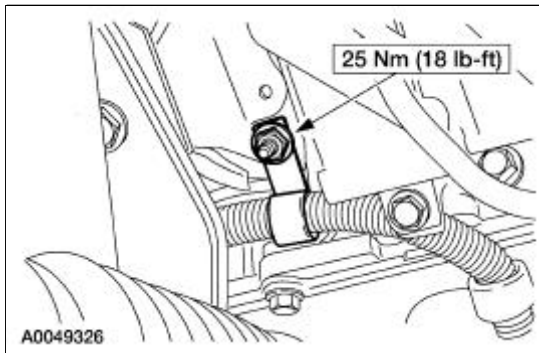
13. Connect the generator electrical connector.



14. Install the ground cable and the nut.

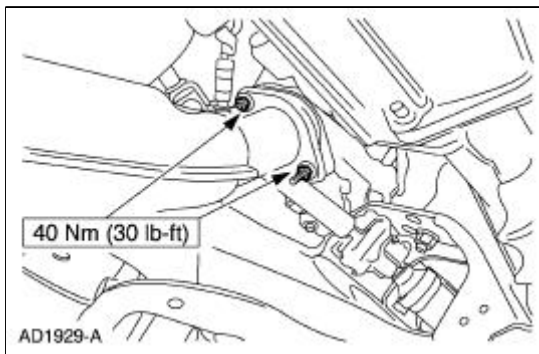


15. Position the wiring harness bracket and install the nut.

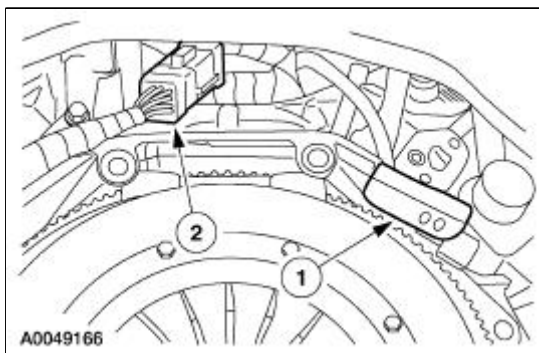


16. **NOTE:** RH is shown, LH is similar.

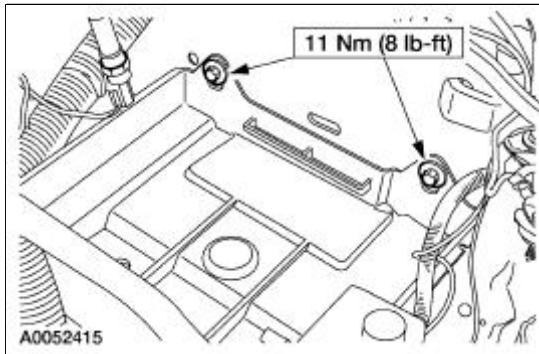
Position the exhaust and install the manifold flange nuts.



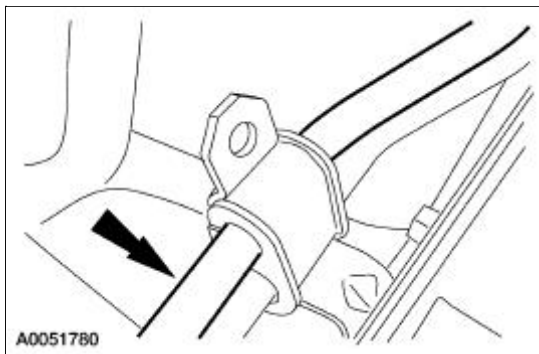
17. Connect the transmission wiring harness.
1. Connect the RH oxygen sensor connector retainer.
 2. Connect the transmission harness electrical connector.



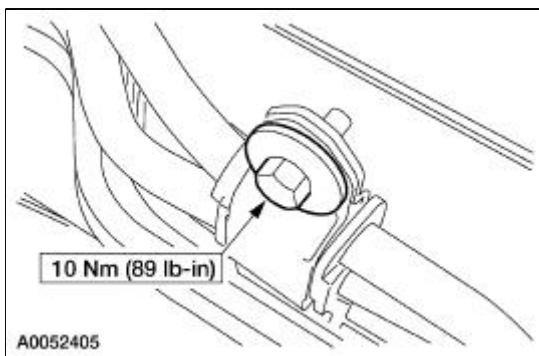
18. Install the clutch. For additional information, refer to [Section 308-01](#).
19. Install the auxiliary crankshaft pulley. For additional information, refer to [Crankshaft Pulley—Auxiliary](#) in this section.
20. Install the battery tray and the mounting bolts.



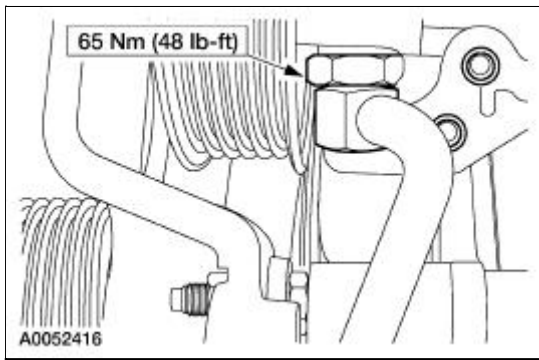
21. Position the power steering hose into the grommet.



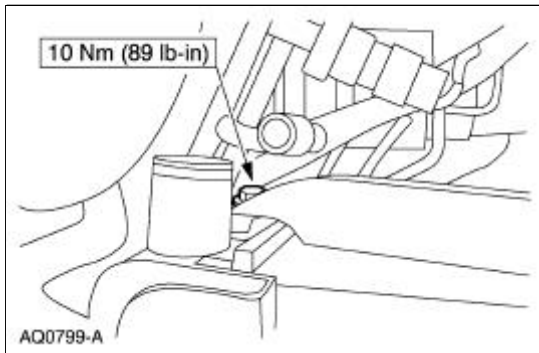
22. Install the bracket mounting bolt.



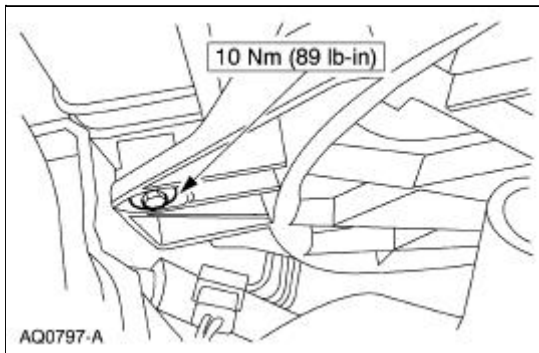
23. Position the power steering hose and tighten the fitting.



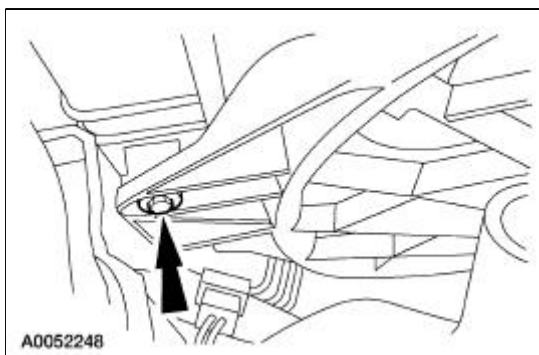
24. Install the cooling fan, motor and shroud as an assembly, and install the RH mounting bolt.



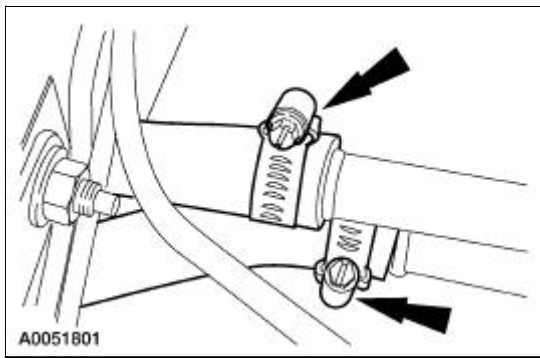
25. Install the LH cooling fan mounting bolt.



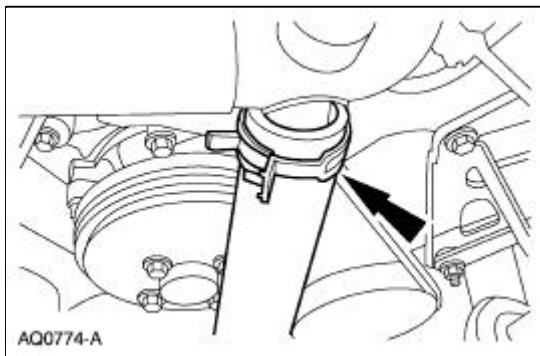
26. Connect the cooling fan electrical connector.



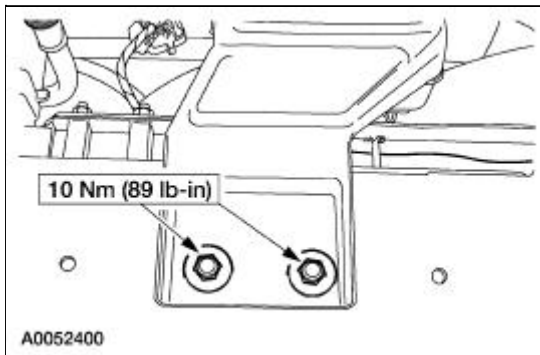
27. Install the supercharger cooling hose assembly and tighten the clamps.



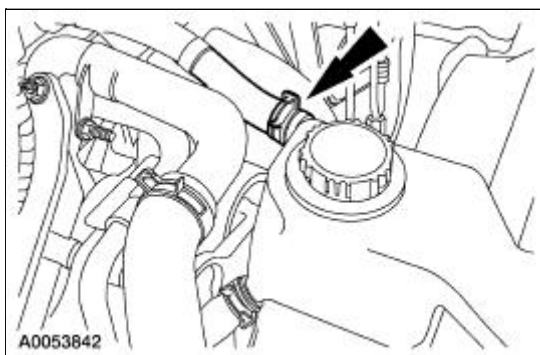
28. Connect the lower radiator hose to the coolant bypass tube.



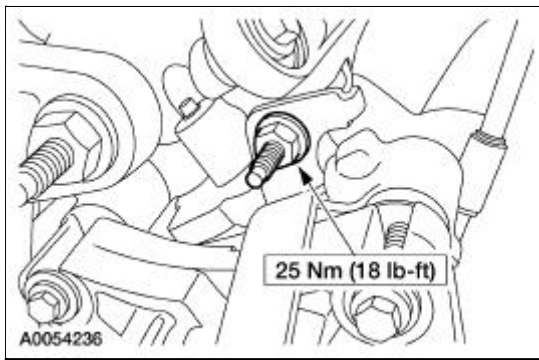
29. Install the supercharger degas bottle and the mounting bolts.



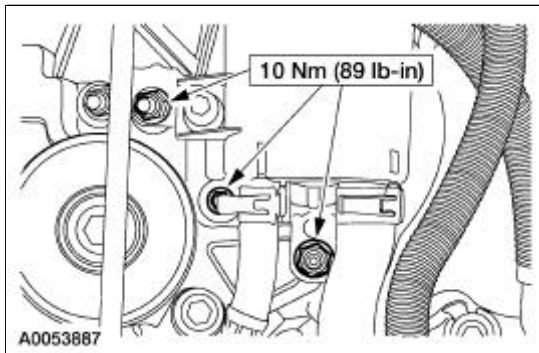
30. Connect the supercharger degas hose.



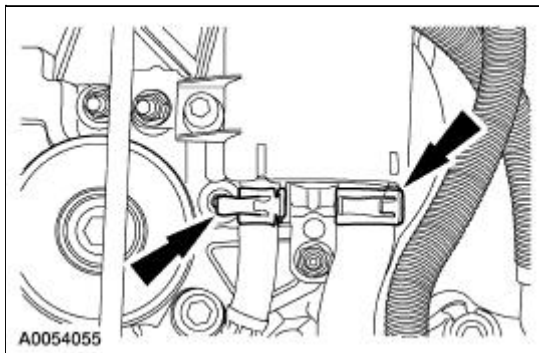
31. Install the power steering hose bracket and mounting nut.



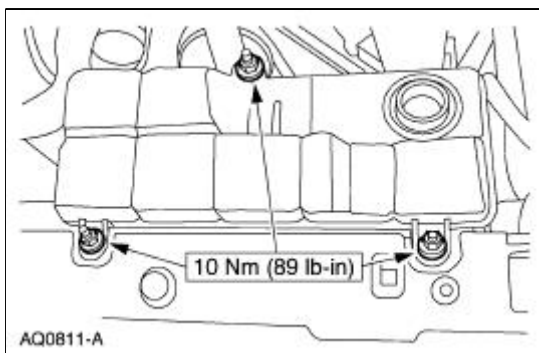
32. Install the power steering reservoir and the fasteners.



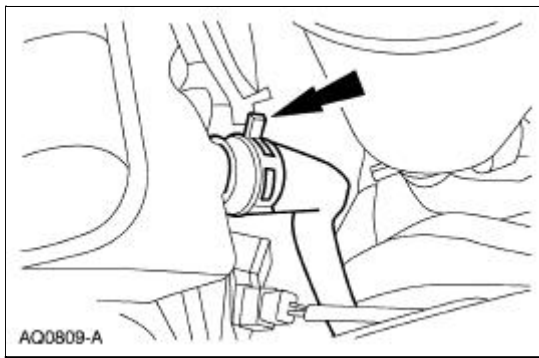
33. Connect the power steering hoses.



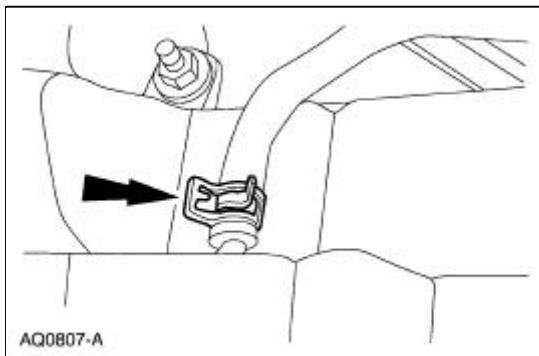
34. Install the engine coolant degas bottle and the fasteners.



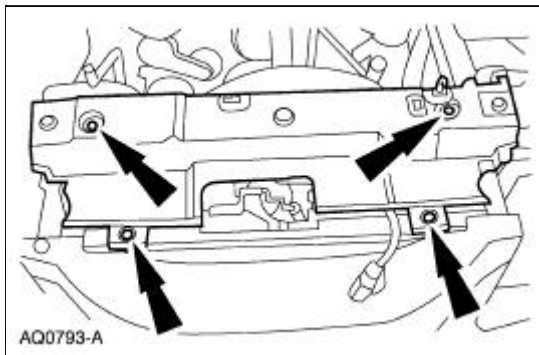
35. Install the degas bottle return hose.



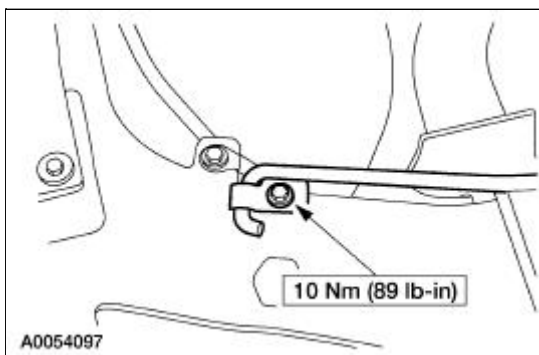
36. Connect the radiator vent hose at the degas bottle.



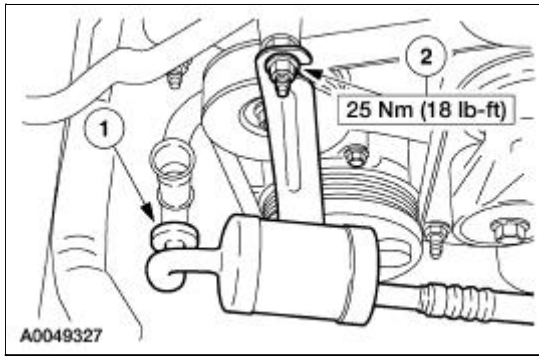
37. Install the radiator sight shield and the push pins.



38. Install the hood prop.



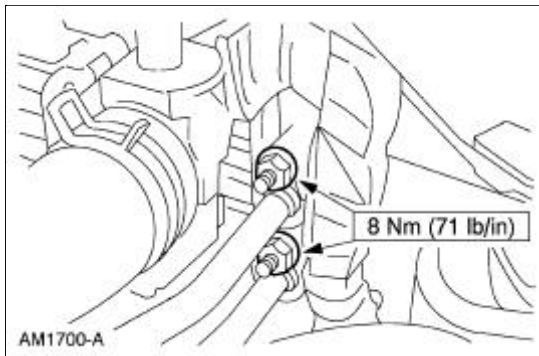
39. Install the A/C muffler.
1. Connect the A/C tube and position the A/C muffler.
 2. Install the bracket nut.



40. **NOTE:** Inspect the O-rings and install new O-rings, if necessary.

NOTE: Lubricate the O-rings with refrigerant oil.

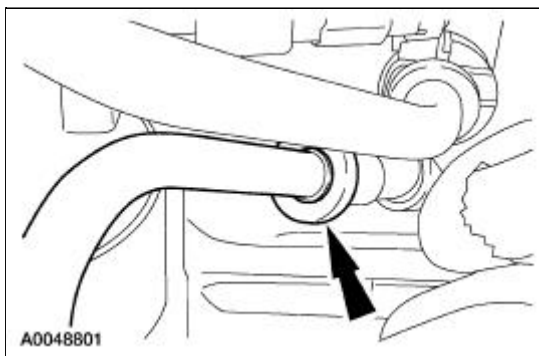
Connect the A/C tube peanut fittings at the condenser.



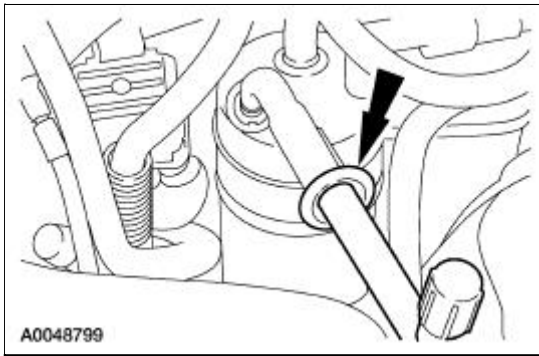
41. **NOTE:** Inspect the O-rings and install new O-rings, if necessary.

NOTE: Lubricate the O-rings with refrigerant oil.

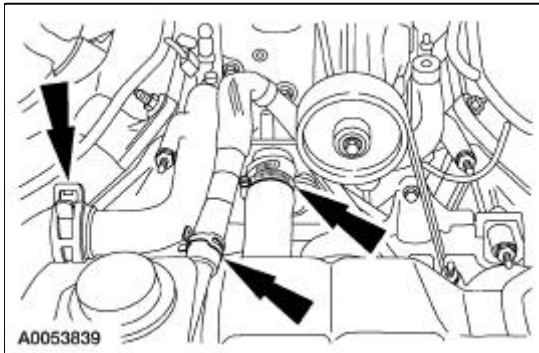
Connect the A/C tube.



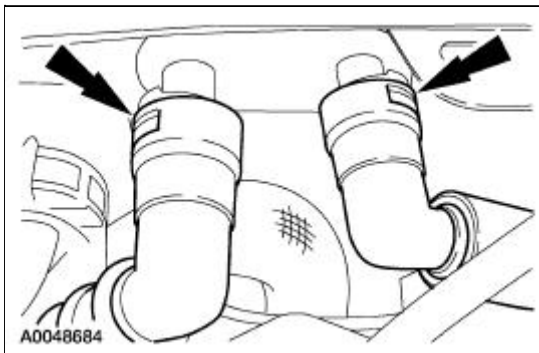
42. Connect the A/C tube at the accumulator.



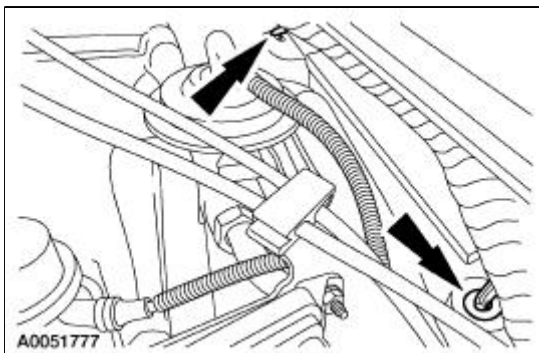
43. Connect the radiator upper hose, the radiator lower hose and the supercharger degas hose.



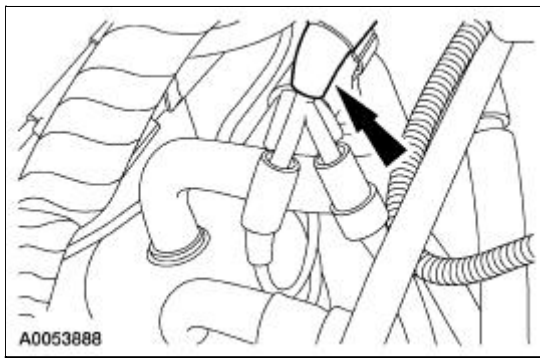
44. Connect the heater hoses.



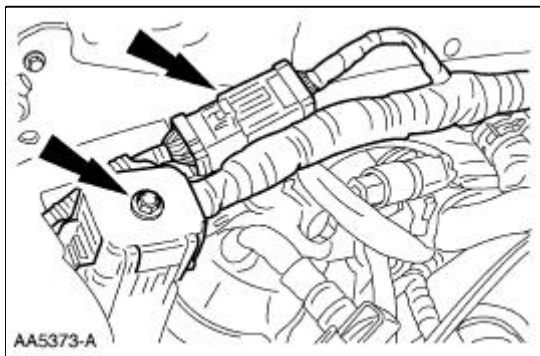
45. Install the wiring harness to the dash panel.



46. Connect the vacuum hoses.

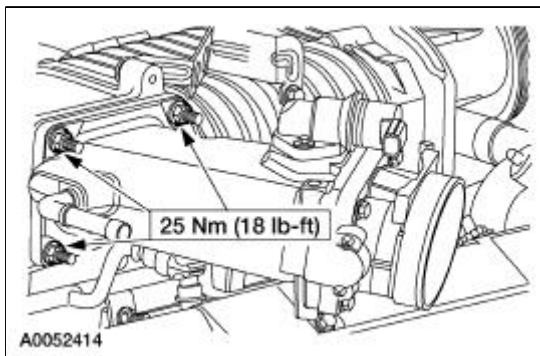


47. Connect the 16-pin and the 42-pin electrical connectors.

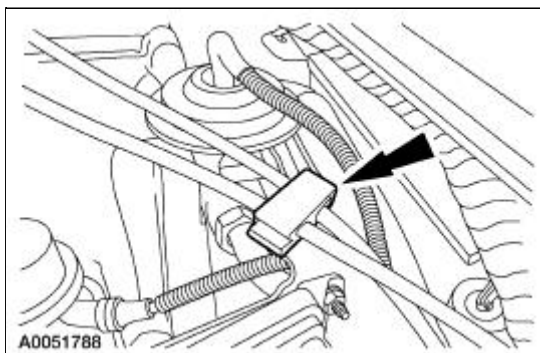


48. **NOTE:** Install a new gasket, if necessary.

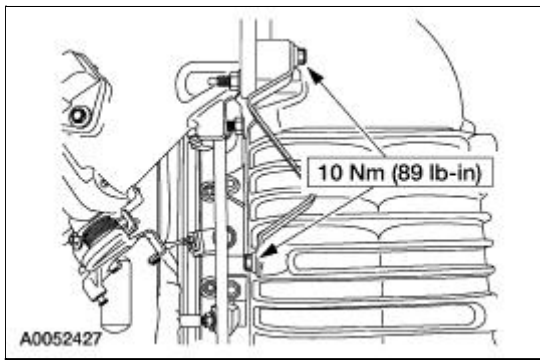
Install the throttle body and spacer assembly and the mounting nuts.



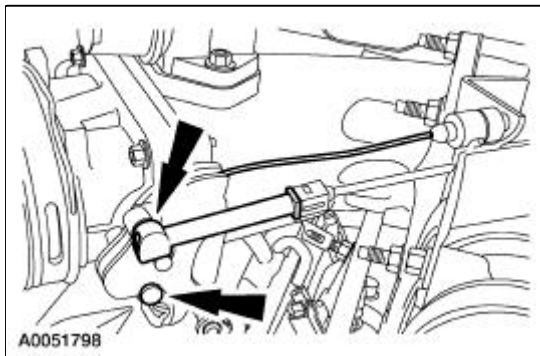
49. Position the accelerator and speed control cables.



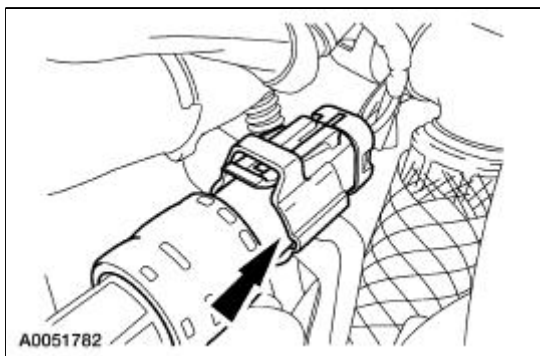
50. Install the accelerator cable bracket bolts.



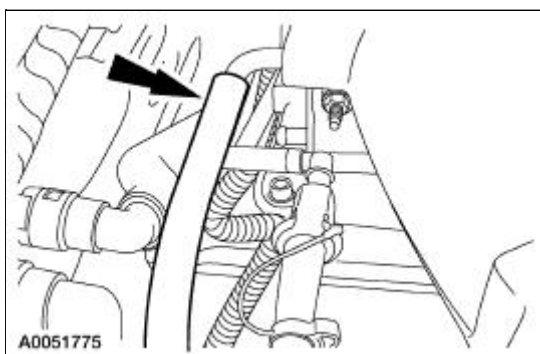
51. Connect the accelerator controls.
 - Connect the accelerator cable.
 - If equipped, connect the speed control cable.



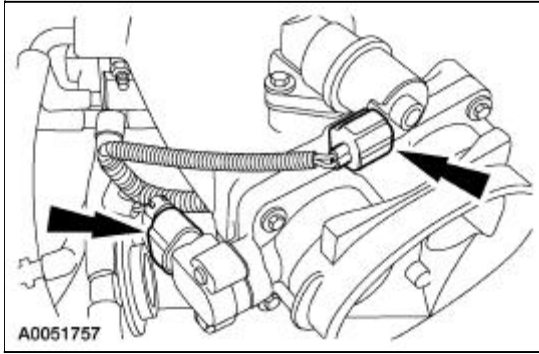
52. Connect the fuel tube spring lock coupling. For additional information, refer to [Section 310-00](#).
53. Connect the A/C pressure switch electrical connector.



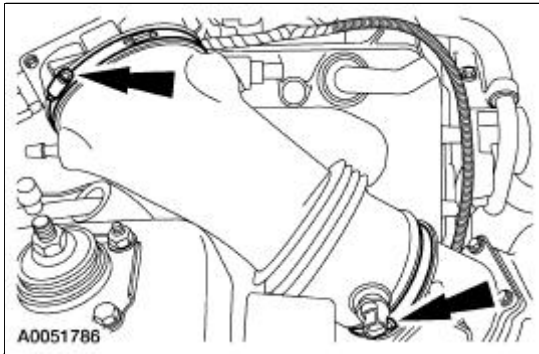
54. Connect the vacuum hose.



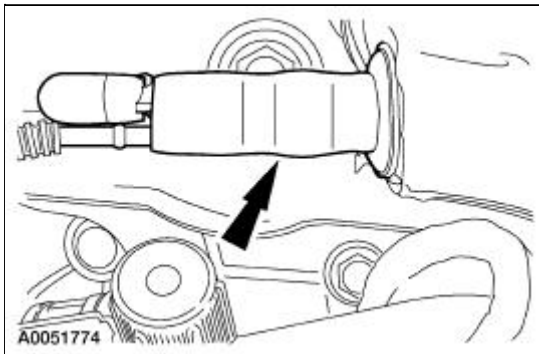
55. Connect the idle air control (IAC) and the throttle position (TP) electrical connectors.



56. Install the air cleaner outlet pipe and tighten the clamps.



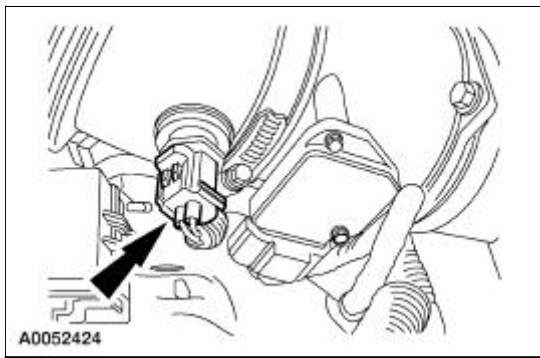
57. Connect the vacuum hose.



58. Connect the breather hose.

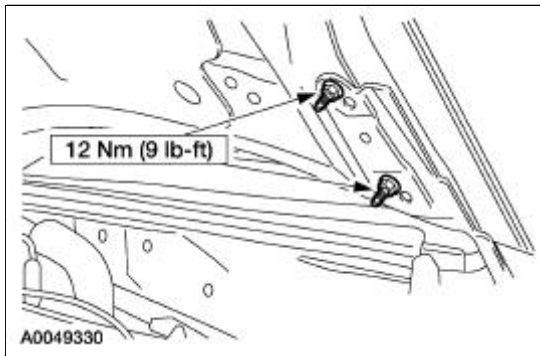


59. Connect the intake air temperature (IAT) sensor electrical connector.

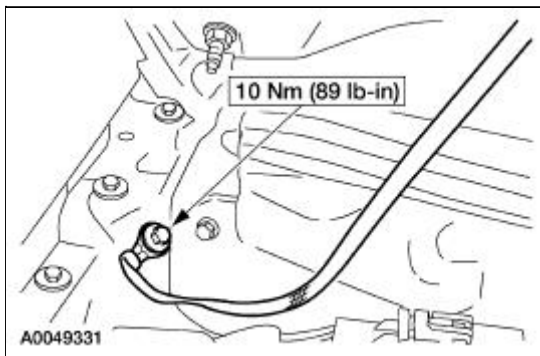


60. **NOTE:** Use reference marks made during removal to aid in the installation.

Install the hood and the four nuts.



61. Install the hood-to-body ground strap.



62. Connect the battery ground cable. For additional information, refer to [Section 414-01](#).

63. Fill the crankcase with clean engine oil and check that all other fluids are at the correct levels.

64. Fill and bleed the engine cooling system. For additional information, refer to [Section 303-03A](#).

65. Fill and purge the power steering system. For additional information, refer to [Section 211-00](#).

66. Start the engine and check for leaks. Stop the engine and recheck the fluid levels.

67. Charge the A/C system. For additional information, refer to [Section 412-00](#).

General Specifications

Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) (Yellow Color)	WSS-M97B51-A1
Pipe Sealant with Teflon® D8AZ-19554-A	WSK-M2G350-A2
Motorcraft MERCON® Super Premium 5W-20 Motor Oil XO-5W20-QSP	WSS-M2C153-H
Threadlock 262 E2FZ-19554-B	WSK-M2G351-A6

Engine Specifications

Description	Specification
GENERAL SPECIFICATIONS	
Displacement	4.6L (4V) (281 CID)
Number of Cylinders	8
Bore and Stroke	90.2 x 90.0 mm (3.55 x 3.54 inch)
Firing Order	1-3-7-2-6-5-4-8
Oil Pressure (HOT 1500 RPM)	138-310 kPa
Drive Belt Tension	a
Combustion Chamber Volume (cc)	52.6±0.5 cm ^c
Valve Seats	
• Width—Intake	1.8-2.2 mm (0.071-0.086 inch)
• Width—Exhaust	1.8-2.2 mm (0.071-0.086 inch)
• Angle	45 degrees
• Runout (T.I.R.) Max	0.05 mm (0.002 inch)
Valve Arrangement (Front-to-Rear)^c	
• (Left Hand) Intake:	S-P-S-P-S-P-S-P
• Exhaust:	E-E-E-E-E-E-E-E
• (Right Hand) Intake:	P-S-P-S-P-S-P-S
• Exhaust: (C)	E-E-E-E-E-E-E-E
Valve Stem to Guide Clearance	
• Intake	0.020-0.069 mm (0.00078-0.00272 inch)
• Exhaust	0.046-0.095 mm (0.0018-0.0037 inch)

Valve Head Diameter	
· Intake	37 mm (1.46 inch)
· Exhaust	30 mm (1.18 inch)
· Gauge Diameters	35.0 and 28.0 mm (1.378-1.102 inch)
Valve Face Runout Limit	0.05 mm (0.002 inch)
Valve Face Angle	45.5 degrees
Valve Stem Diameter (Std)	
· Intake	6.975-6.995 mm (0.2754-0.2746 inch)
· Exhaust	6.949-6.970 mm (0.2744-0.2736 inch)
Valve Springs	
· Compression Pressure (N (Lb) @ Spec Length)	
· Intake	711.47 N @ 26.19 mm (159.9 Lb-Ft @ 1.031 inch)
· Exhaust	711.47 N @ 26.19 mm (159.9 Lb-Ft @ 1.031 inch)
· Free Length (Approximate)	
· Intake	42.16 mm (1.6598 inch)
· Exhaust	42.16 mm (1.6598 inch)
· Installed Pressure (N (Lb-Ft) @ Spec. Length)	
· Intake	289.1 N @ 36.14 mm (64.99 Lb-Ft @ 1.4228 inch)
· Exhaust	289.1 N @ 36.14 mm (64.99 Lb-Ft @ 1.4228 inch)
· Service Limit	10% Pressure Loss @ 28.02 mm (1.103 inch)
Roller Follower	
· Ratio	1.8:1
Hydraulic Lash Adjuster	
· Diameter (Std)	16.000-15.988 mm (0.6299-0.6294 inch)
· Clearance to Bore	0.018-0.069 mm (0.000709-0.002717 inch)
· Service Limit	0.016 mm (1.0006299 inch)
· Hydraulic Leakdown Rate ^d	5-25 seconds
· Collapsed Lash Adjuster Gap—Desired	0.80-1.20 mm (0.0315-0.0472 inch)
CAMSHAFT	
Theoretical Valve Lift @ Zero Lash	
· Intake (Primary)	10.0 mm (0.3937 inch)
· Intake (Secondary)	10.0 mm (0.3937 inch)
· Exhaust	10.0 mm (0.3937 inch)
End Play	0.025-0.165 mm (0.00098-0.00649 inch)
· Service Limit	0.190 mm (0.007480 inch)
Journal to Bearing Clearance	0.025-0.076 mm (0.00098-0.002992 inch)
· Service Limit	0.100 mm (0.003937 inch) MAX
Journal Diameter (All)	26.962-26.936 mm (1.0615-1.0605 inch)

Bearing Inside Diameter (All)	27.012-26.987 mm (1.0635-1.0625 inch)
Front Bearing Location	e
CYLINDER BLOCK	
· Head Gasket Face Flatness	0.15 mm (0.006 in) MAX overall
· Head Gasket Surface Finish ^b	
Main Bearing Bore Diameter	72.400-72.424 mm (2.8504-2.8513 inch)
CRANKSHAFT	
Main Bearing Journal Diameter	67.481-67.505 mm (2.6567269-2.6576718 inch)
Connecting Rod Journal	
· Diameter	52.983-53.003 mm (2.085941-2.086728 inch)
Crankshaft Free End Play	0.130-0.301 mm (0.005118-0.011850 inch)
Crankshaft Runout to Rear Face of Block	0.050 mm (0.01969 inch) MAX
Connecting Rod Bearings	
Clearance to Crankshaft	
· Desired	0.027-0.069 mm (0.0010629-0.0027165 inch)
· Allowable	0.027-0.069 mm (0.0010629-0.0027165 inch)
Bearing Wall Thickness (Std) ^f	1.920-1.928 mm (0.075591-0.075905 inch)
Main Bearings	
Clearance to Crankshaft	
· Desired	0.025-0.045 mm (0.00098-0.00177 inch)
· Allowable	0.025-0.050 mm (0.00098-0.00197 inch)
Bearing Wall Thickness (Std) ^f	2.451 mm (0.0965 inch)
Connecting Rod	
· Pin Bore Diameter	22.012-22.024 mm (0.86661-0.86708 inch)
· Crankshaft Bearing Bore Diameter	56.866-56.886 mm (2.23881-2.23960 inch)
· Length (Center-to-Center)	150.7 mm (5.933 inch)
Alignment (Bore-To-Bore Max. Diff.) ^g	
· Twist	0.050 per 25 mm (0.00197 per 0.9843 inch)
· Bend	0.038 per 25 mm (0.00150 per 0.9843 inch)
Side Clearance (Assembled to Crank)	
· Standard	0.15-0.45 mm (0.00591-0.01772 inch)
· Service Limit	0.50 mm (0.01969 inch) MAX
CYLINDER BORE AND PISTON	
Cylinder Bore	
Diameter ^h	
· Surface Finish (RMS)	0.2-0.6 Microns
· Out-of-Round Limit	0.015 mm
· Out-of-Round Service Limit	0.020 mm
· Taper Service Limit	0.006 mm
Piston	
· Diameter ⁱ	.028 mm (.0010 inch)

· Coded Red 1	90.167-90.188 mm (3.299-3.5505 inch)
· Coded Blue 2	90.180-90.195 mm (3.5504-3.5510 inch)
· Coded Yellow 3	90.198-90.208 mm
Coated Piston-to-Bore Clearance	-0.010/+0.026 mm (-0.0003937/+0.0010236 inch)
Pin Bore Diameter	21.9985-22.0025 mm (0.866081-0.866238 inch)
Ring Groove Width	
· Compression (Top)	1.230-1.250 mm (0.484-0.0492 inch)
· Compression (Bottom)	1.520-1.540 mm (0.05984-0.06062 inch)
· Oil Ring	3.030-3.055mm
Piston Pin	
· Length	61.601-62.030 mm (2.42523-2.44212 inch)
· Diameter	22.0005-22.0030 mm (0.8661596-0.8662581 inch)
Pin to Piston Fit^j	-0.0045/+0.002 mm (-0.000177/+0.0000787 inch)
Pin to Rod Clearance	
· Standard	0.004-0.0175 mm (0.000157-0.00689 inch)
· Service Limit	0.035 mm (0.001378 inch)
Oil Ring	1.15 mm (0.04528 inch) MAX
· Side Clearance	.075-.1000 mm (.0030-.0040 inch)
· Compression (Top)	0.0090-0.0235 mm (0.000354-0.000925 inch)
· Compression (Bottom)	0.030-0.080 mm (0.00118-0.00315 inch)
· Oil Ring	Snug Fit
Ring Gap^k	
· Compression (Top)	.150-.300 mm (.006-0.0018 inch)
· Compression (Bottom)	0.300-0.550 mm (0.0018-0.0022 inch)
· Oil Ring (Steel Rail)	0.15-0.66 mm (0.00591-0.02598 inch)
Piston Rings	
· Ring Gap	
· Compression (Top)	1.00 mm (0.03937 inch) MAX
· Compression (Bottom)	1.00 mm (0.03937 inch) MAX
· Service Limit	1.15 mm (0.04528 inch) MAX
LUBRICATION SYSTEM	
Oil Capacity (Quarts U.S.)	6 ± 0.25 ^l

^a Newly Installed—Refers to the condition of the "NEW" drive belt before the engine has made no more than one rotation and before the belt has had a chance to stretch or seat into the pulley grooves.

^c P=Primary, S=Secondary, E=Exhaust

^d Time necessary for plunger to leak down 1.6 mm of travel with 222 N force and leak down fluid in tappet.

^e Distance front edge of bearing is installed below front face of cylinder block.

^f 0.050 Undersize—add 0.025 to standard thickness.

^g Pin bore and crank bearing bore must be parallel and in same vertical plane within the specified total difference when measured at the ends of a 203 mm bar, 101.5 mm on each side of rod centerline.

^h Cylinder Bore Diameter

Red—90.200-90.213

Blue—90.213-90.226

Yellow—90.226-90.239

ⁱ Measured at 42 mm from piston dome, at 90 degrees to the piston pin.

^j Piston pin outer diameter is larger than piston pin bore, providing a possible interference fit.

^k Specification in 90.200 mm diameter gauge.

^l With installation of a new filter.

Drive Belt Tension

Belt Type	Belt Tension
6 Rib (Fixed) ^a	110-120 Lbs

^a "Fixed" refers to systems with manually-adjusted centers which are bolted in place and considered fixed.

Torque Specifications

Description	Nm	lb-ft	lb-in
Camshaft sprocket bolt	115	85	—
Connecting rod bolt	a	a	a
Engine front cover bolt	a	a	a
Drive belt tensioner bolts	25	18	—
Cylinder head bolt	a	a	a
Pulley to crankshaft bolt	a	a	a
EGR valve to intake manifold	a	a	a
Exhaust manifold studs	25	18	—
Lower intake manifold-to-cylinder head bolt	a	a	a
Main bearing cap bolt	a	a	a
Oil filter adapter bolt	25	18	—
Oil bypass filter to adapter	50	37	—
Oil pump screen cover and tube-to-oil pump bolt	10	—	89
Oil pan-to-cylinder block bolt	a	a	a
Oil pan-to-engine front cover bolts	a	a	a
Oil pump-to-cylinder block bolt	10	—	89
Oil pump screen and pickup tube-to-main bearing cap stud spacer bolt	25	18	—
Coolant pump pulley bolts	25	18	—
Valve cover bolt	10	—	89
Coolant pump-to-cylinder block bolt	25	18	—
EGR valve to exhaust manifold tube nuts	40	30	—
Power steering pump to engine	25	18	—
Outlet heater hose stud bolts	25	18	—
Camshaft cap cluster to cylinder head	10	—	89
Timing chain tensioner bolts—primary	25	18	—
Timing chain tensioner bolts—secondary	10	—	89
A/C compressor bolts	25	18	—
Ignition coil cover bolts	10	—	89
Generator mounting bracket retainers	10	—	89

Flexplate bolts	80	59	—
Flywheel bolts	85	63	—
Torque converter nuts	36	27	—
Oil level indicator tube retainer	10	—	89
Primary timing chain guide-to-engine bolts	10	—	89
Oil pump screen and pickup tube spacer to main bearing stud	25	18	—
Accelerator cable bracket	10	—	89
Belt idler pulley bolt	25	18	—
Sub-frame brace nuts	41	30	—
Air intake scoop bolts	25	18	—
Air intake scoop bracket bolt	25	18	—
Air intake scoop bracket nuts	25	18	—
Air intake scoop bracket throttle body nut	9	—	80
Exhaust gas recirculation (EGR) vacuum regulator solenoid bolts	10	—	89

^a Refer to the procedure.

Engine



WARNING: Do not operate the engine with the hood open until the fan blade has been first examined for possible cracks and separation.

The 4.6L (4V) (281 CID) is a V-8 engine with the following features:

- dual overhead camshafts
- four valves per cylinder
- sequential multiport fuel injection (SFI)
- an aluminum intake manifold
- aluminum cylinder heads
- a cast aluminum, 90-degree V- cylinder block
- individually chain-driven camshafts with a hydraulic timing chain tensioner on each timing chain
- the electronic ignition system with eight ignition coils

Identification

Always refer to these labels when replacement parts are necessary or when checking engine calibrations. The engine parts often differ within a CID family. Verification of the identification codes will ensure that the correct parts are obtained. These codes contain all the pertinent information relating to the dates, optional equipment and revisions. The Ford Master Parts Catalog contains a complete listing of the codes and their application.

Code Information

The engine code information label, located on the side of the valve cover and the front side of the valve cover, contains the following:

- engine build date
- engine plant code
- engine code

Exhaust Emission Control System

Operation and necessary maintenance of the exhaust emission control devices used on this engine is covered in the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Induction System

The sequential multiport fuel injection (SFI) provides the fuel/air mixture needed for combustion in the cylinders. The eight solenoid-operated fuel injectors:

- are mounted in the lower intake manifold.
- meter fuel into the air intake stream in accordance with engine demand.
- are positioned so that their tips direct fuel just ahead of the engine intake valves.

- are connected in series with the fuel pressure sensor.
- supply fuel from the fuel tank with a fuel pump mounted in the fuel tank.

A constant fuel pressure drop is maintained across the fuel injectors by the fuel pressure sensor. The fuel pressure sensor:

- is positioned upstream from the fuel injectors on the fuel injection supply manifold.

Valve Train

The valve train operates as follows:

- ball-tip hydraulic lash adjusters provide automatic lash adjustment.
- roller followers ride on the camshaft lobes, transferring the up-and-down motion of the camshafts to the valves in the cylinder heads.

Positive Crankcase Ventilation System

All engines are equipped with a closed-type positive crankcase ventilation system recycling the crankcase vapors to the upper intake manifold.

Lubrication System

The engine lubrication system operates as follows:

- oil is drawn into the oil pump through the oil pump screen cover and tube in the sump of the oil pan.
- oil is pumped through the oil bypass filter on the left front side of the cylinder block.
- oil enters the main oil gallery where it is distributed to the crankshaft main journals and to both cylinder heads.
- From the main journals, the oil is routed through cross-drilled passages in the crankshaft to lubricate the connecting rod bearings. Controlled leakage through the crankshaft main bearings and connecting rod bearings is slung radially outward to cool and lubricate the cylinder walls as well as the entire connecting rod, piston and piston rings assembly.
- The left cylinder head is fed from a drilling into the supply passage feeding the main gallery at the front of the cylinder block. The right cylinder head is fed from a drilling into the rear of the main gallery. Main gallery pressure is reduced as it enters the cylinder head galleries through fixed serviceable orifices located at the upper part of the feed passages. It is this reduced pressure in the cylinder head galleries which feeds the camshaft journals, the hydraulic lash adjusters and the primary and secondary timing chain tensioners.
- The camshaft lobe and roller followers are lubricated by splash created through valve train operation.

Oil Pump

The lubrication system of the 4.6L (4V) engine is designed to provide optimum oil flow to critical components of the engine through its entire operating range. The heart of the system is a positive displacement internal gear oil pump using top seal rotors. Generically this design is known as a gerotor pump, which operates as follows.

- The oil pump is mounted on the front face of the cylinder block.
- The inner rotor is piloted on the crankshaft post and is driven through flats on the crankshaft.

- System pressure is limited by an integral, internally-vented relief valve which directs the bypassed oil back to the inlet side of the oil pump.
- Oil pump displacement has been selected to provide adequate volume to ensure correct oil pressure both at hot idle and maximum speed.
- The relief valve calibration protects the system from excessive pressure during high viscosity conditions.
- The relief valve is designed to provide adequate connecting rod bearing lubrication under high-temperature and high-speed conditions.

Cooling System

The engine cooling system includes the following:

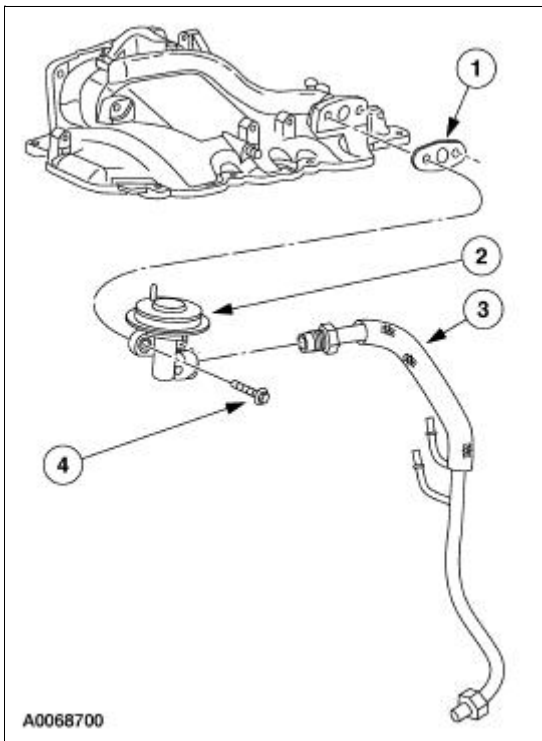
- radiator
- coolant pump
- the electric cooling fan motor and fan blade, activated by the variable control module
- the degas bottle, which aids in maintaining the correct volume of engine coolant
- thermostat
- upper radiator hose
- lower radiator hose
- heater coolant hoses

Drive Belt System

The 4.6L (4V) DOHC engine is equipped with a serpentine drive belt. To ensure maximum life, a replacement drive belt should be of the same type as originally installed.

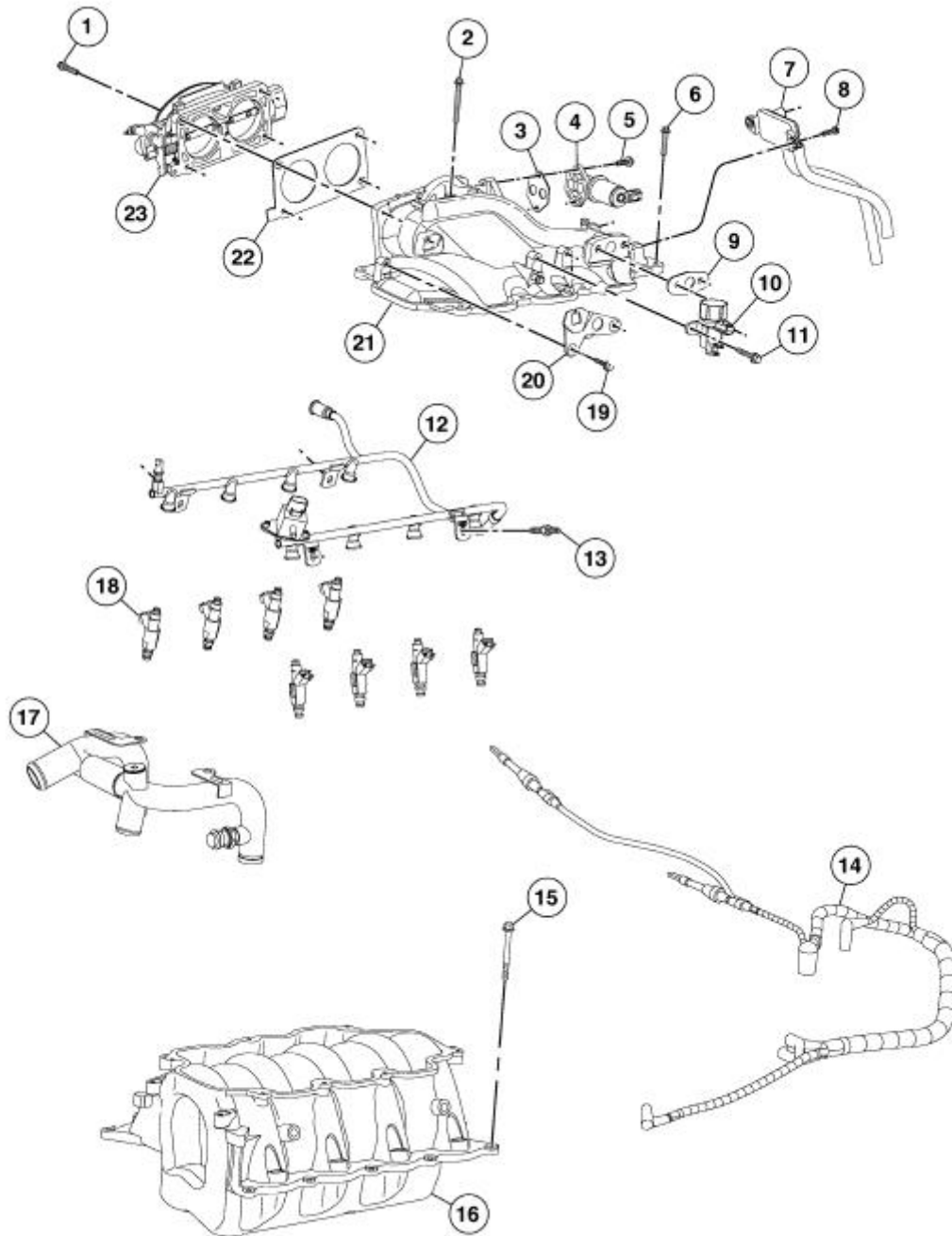
- The accessories mounted on the front of the engine are belt-driven by the crankshaft.
- The serpentine drive belt is routed over each accessory pulley, driven by the crankshaft pulley bolted to the crankshaft.

For service procedures, including tensioning, refer to [Section 303-05](#).



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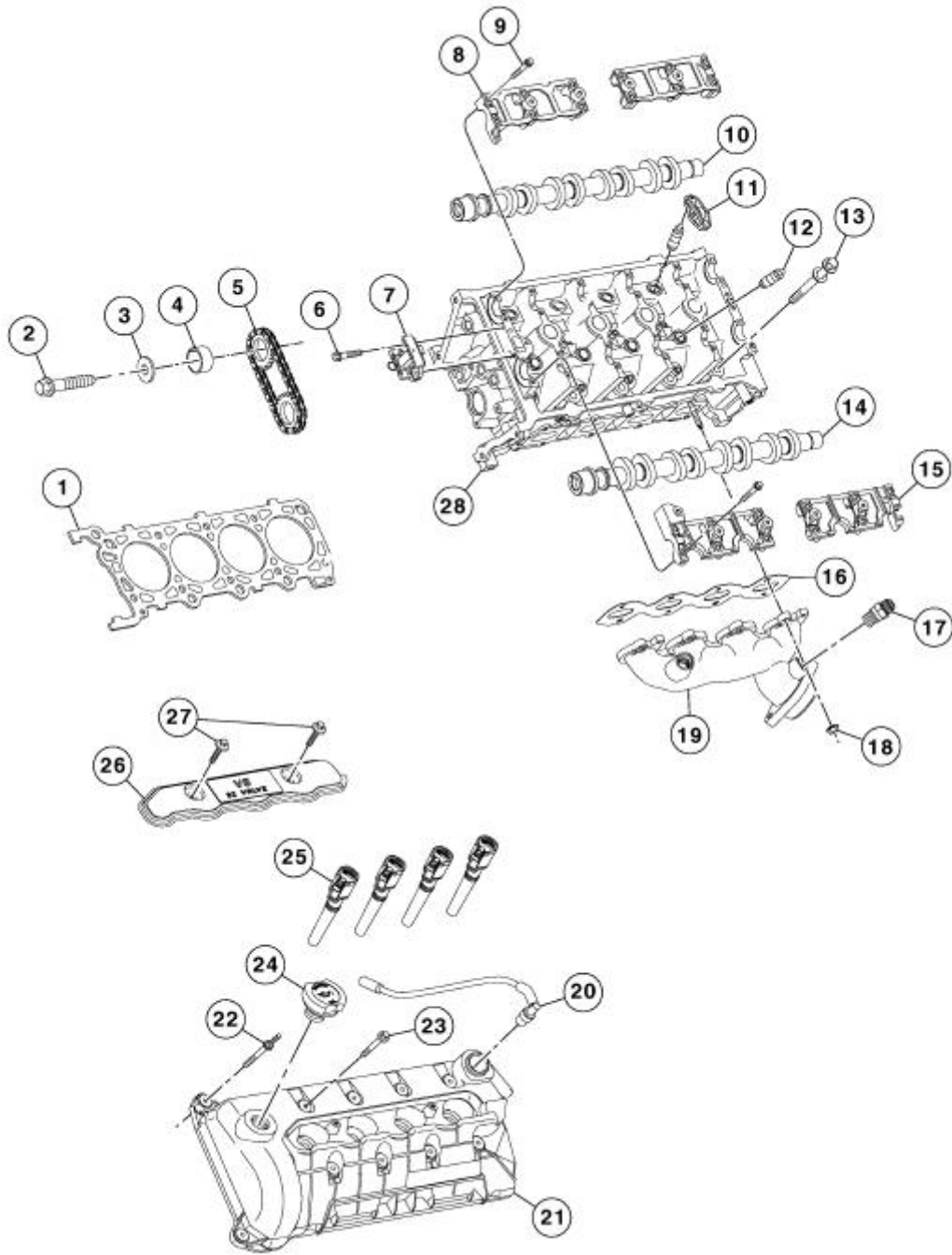
Item	Part Number	Description
1	9D476	EGR valve gasket
2	9D460	EGR valve
3	9D477	EGR valve-to-exhaust manifold tube
4	W701625	Bolt (2 req'd)



A0071294

Item	Part Number	Description
1	N806154	Bolt (4 req'd)
2	N705654	Bolt
3	9F670	Idle air control valve gasket
4	9F715	Idle air control valve
5	N806154	Bolt (2 req'd)
6	N806154	Bolt (5 req'd)
7	9J433	Differential pressure feedback EGR
8	W701557	Screw (2 req'd)

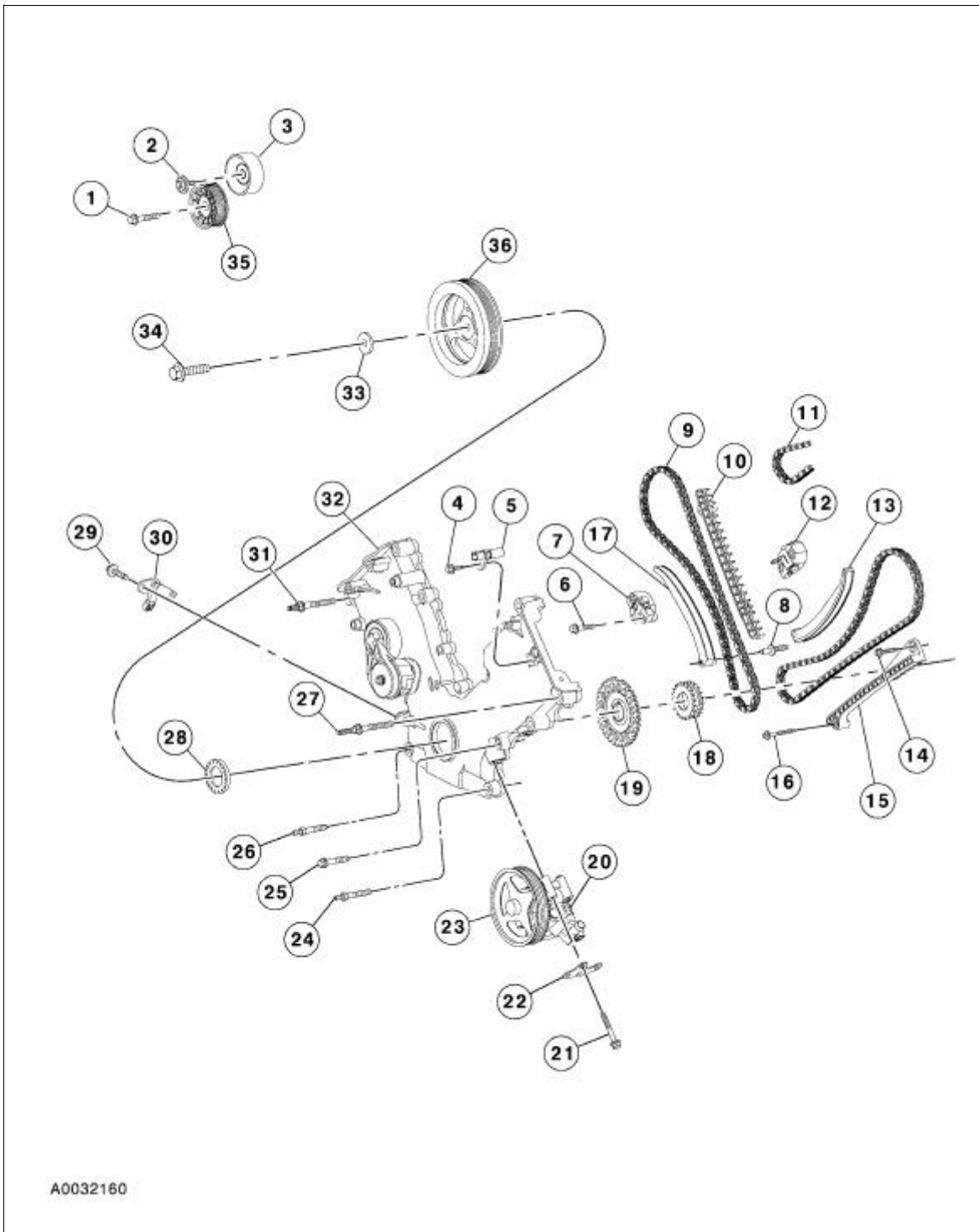
9	9D476	EGR valve gasket
10	9J459	EGR vacuum regulator solenoid
11	W701557	Bolt (2 req'd)
12	9F792	Fuel injection supply manifold
13	N811449	Stud (4 req'd)
14	9E498	Vacuum harness
15	W704682	Bolt (10 req'd)
16	9J447	Intake manifold (lower)
17	8548	Coolant crossover
18	9F593	Fuel Injector (8 req'd)
19	N605892	Bolt (2 req'd)
20	9728	Bracket
21	9424	Intake manifold (upper)
22	9E936	Throttle body gasket
23	9E926	Throttle body



A0071288

Item	Part Number	Description
1	6083	Cylinder head gasket
2	—	Bolt (2 req'd)
3	—	Washer (2 req'd)
4	6255	Spacer
5	—	Secondary timing chain (2 req'd)
6	—	Screw and washer
7	6C271	Timing chain vibration damper
8	6B277	Camshaft bearing cap

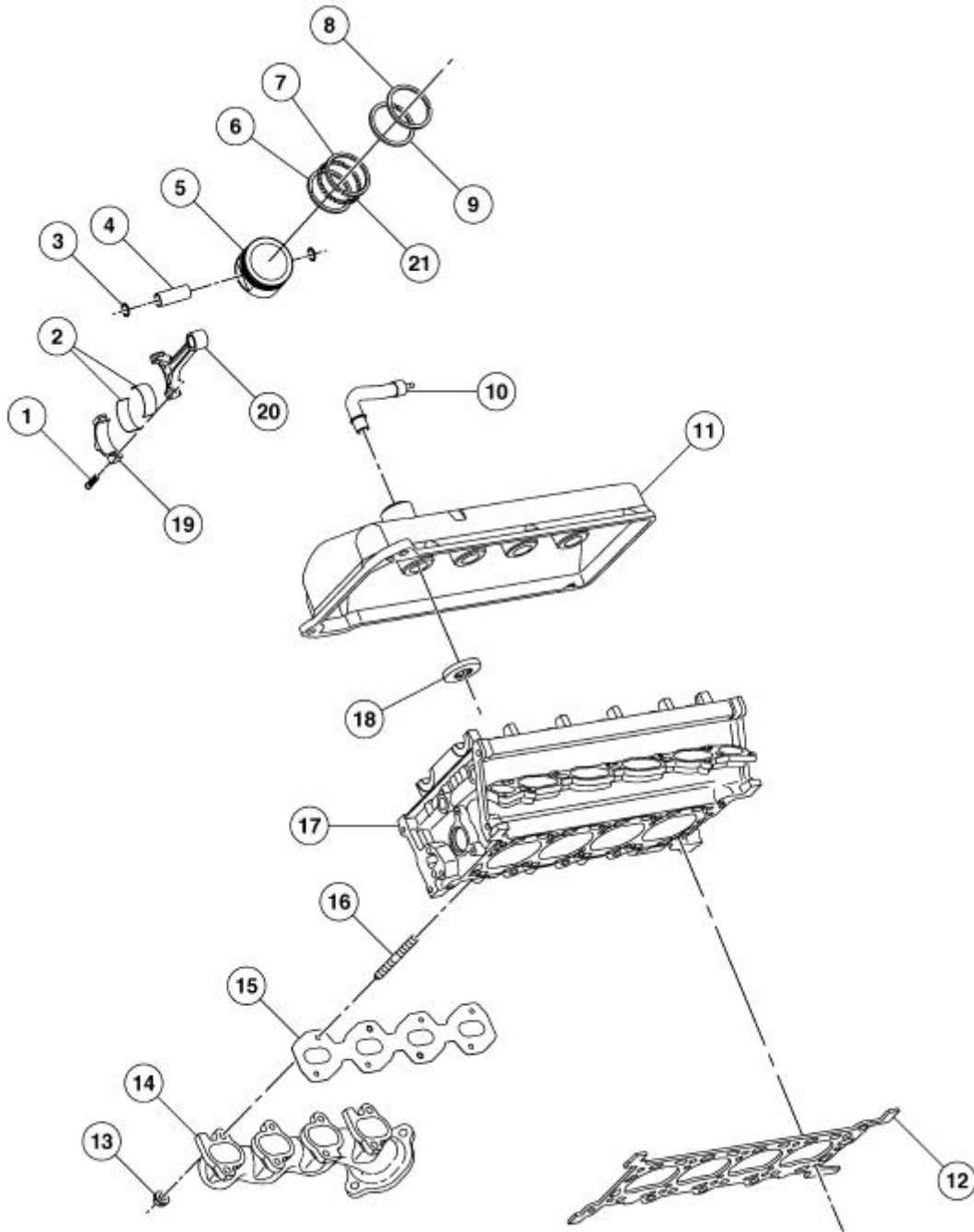
9	—	Bolt (24 req'd)
10	6A271	Camshaft
11	6529	Roller follower (8 req'd)
12	6C501	Hydraulic lash adjuster
13	6065	Bolt (20 req'd)
14	6A273	Camshaft
15	6B278	Camshaft bearing cap (2 req'd)
16	9448	Exhaust manifold gasket
17	9F485	EGR valve tube to manifold connector
18	W701706	Nut (8 req'd)
19	9431	Exhaust manifold
20	6C324	PCV tube
21	6A505	Valve cover
22	W708442	Stud bolt (4 req'd)
23	N808199	Bolt (16 req'd)
24	6766	Oil filler cap
25	12A366	Ignition coils
26	6P068	Ignition coil cover
27	N807309	Bolt (4 req'd)
28	6050	Cylinder head



A0032160

Item	Part Number	Description
1	N808102	Bolt
2	N808102	Bolt
3	19A216	Belt idler pulley
4	N806155	Bolt
5	6B288	Camshaft position sensor
6	N606543	Bolt (4 req'd)
7	6L266	Timing chain tensioner
8	W705803	Stud

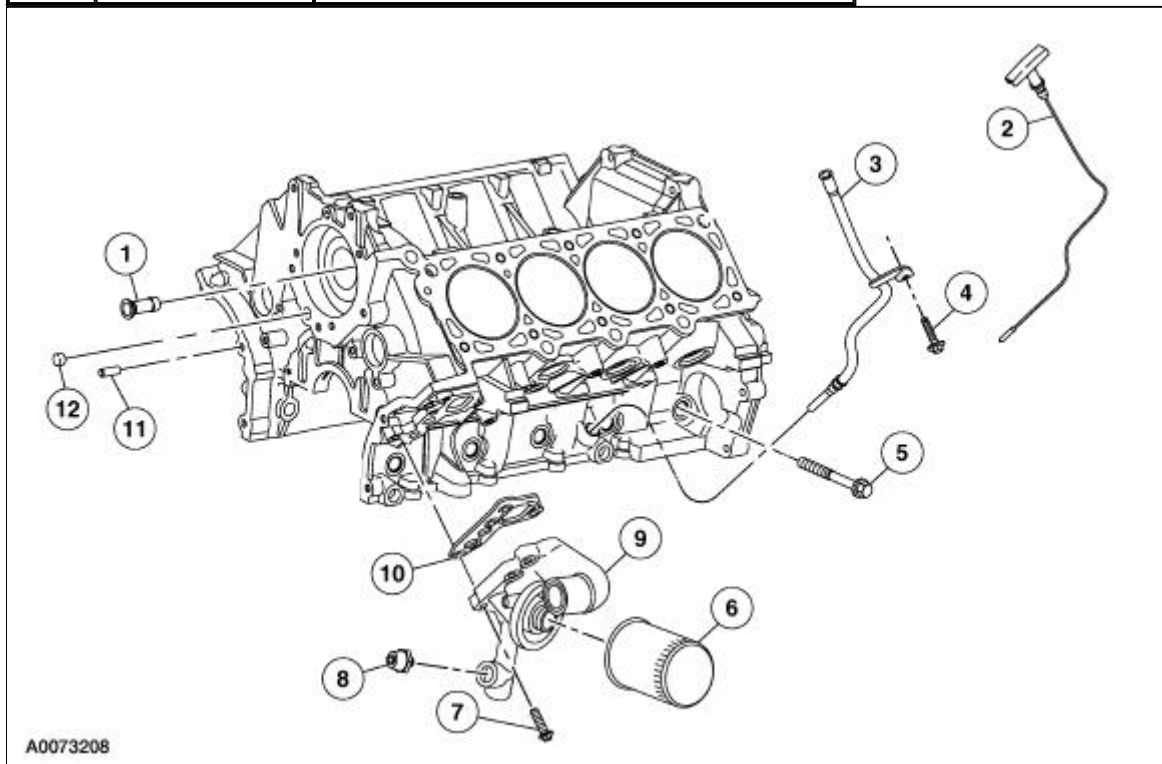
9	6268	Timing chain (2 req'd)
10	6K297	Timing chain guide
11	6268	Timing chain (2 req'd)
12	6M269	Timing chain tensioner
13	6L253	Timing chain tensioner arm
14	N605893	Bolt (4 req'd)
15	6K297	Timing chain guide
16	N804958	Bolt (2 req'd)
17	6L253	Timing chain tensioner arm
18	6306	Crankshaft sprocket
19	12A227	Ignition pulse ring
20	3A696	Power steering pump
21	N806176	Bolt (4 req'd)
22	3R801	Gasket
23	3A696	Power steering pump pulley
24	W706508	Stud
25	N806177	Bolt (8 req'd)
26	N808586	Stud
27	N806300	Stud (4 req'd)
28	6700	Crankshaft front seal
29	N806155	Bolt
30	6C315	Crankshaft position sensor
31	W706560	Stud
32	6C086	Engine front cover
33	N806165	Washer
34	N806139	Bolt
35	19A216	Belt Idler Pulley
36	6316	Crankshaft pulley



A0073234

Item	Part Number	Description
1	6214	Bolt (2 req'd)
2	6211	Connecting rod bearing (16 req'd)
3	6140	Piston pin retainer (16 req'd)
4	6135	Piston pin (8 req'd)
5	6110	Piston (8 req'd)
6	6159	Piston ring (8 req'd)
7	6159	Piston ring (8 req'd) (part of 6100)
8	6150	Piston ring (8 req'd) (part of 6100)

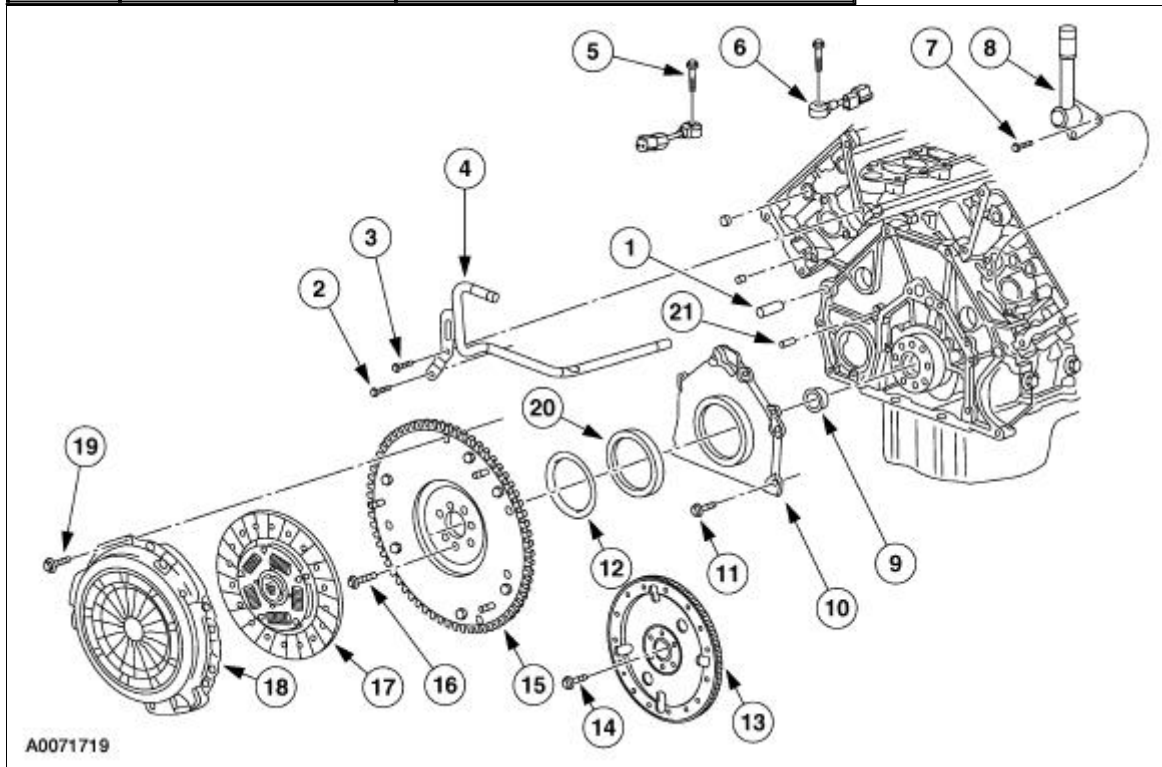
9	6152	Piston ring (8 req'd)
10	6758	Crankcase vent tube and connector
11	6582	Valve cover
12	6051	Cylinder head gasket
13	W701706	Nut (8 req'd)
14	9430	Exhaust manifold
15	9448	Exhaust manifold gasket
16	W701681	Stud (8 req'd)
17	6049	Cylinder head
18	6C527	Spark plug gasket (8 req'd)
19	6200	Connecting rod (8 req'd)
20	6200	Connecting rod (8 req'd)
21	6161	Piston ring (8 req'd)



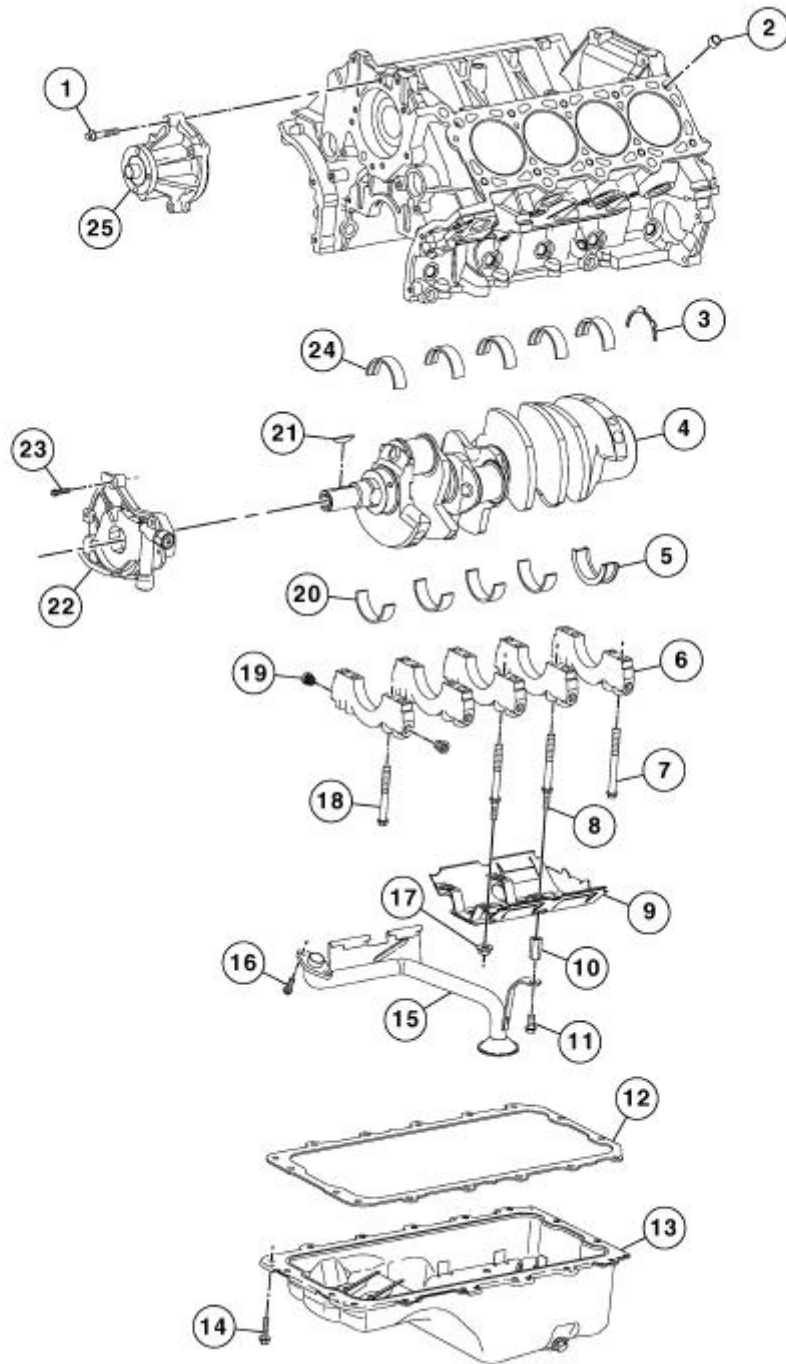
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Item	Part Number	Description
1	8555	Coolant bypass tube
2	6750	Oil level indicator
3	6754	Oil level indicator tube
4	N806155	Bolt
5	6C358	Bolt (10 req'd)
6	6714	Oil bypass filter
7	N806156	Bolt (4 req'd)
8	9278	Oil pressure sender
9	6881	Oil filter adapter
10	6A636	Oil filter adapter gasket

11	N620482	Dowel
12	87836	Plug



Item	Part Number	Description
1	N807198	Dowel pin (2 req'd)
2	N807309	Bolt
3	N807959	Bolt
4	18663	Heater water hose
5	W500110	Bolt (2 req'd)
6	12A699	Knock sensor (2 req'd)
7	N807309	Bolt (2 req'd)
8	18696	Heater water hose
9	7120	Pilot bearing
10	6K318	Crankshaft rear retainer
11	N806155	Bolt (6 req'd)
12	6310	Crankshaft oil slinger
13	6375	Flexplate
14	N806168	Bolt (6 req'd)
15	—	Flywheel
16	N808139	Bolt (8 req'd)
17	7550	Clutch disc
18	7563	Clutch pressure plate
19	N808969	Bolt (6 req'd)
20	6701	Crankshaft rear oil seal
21	N806007	Dowel pin (2 req'd)



A0071291

Item	Part Number	Description
1	N806177	Bolt (4 req'd)
2	N806459	Dowel (4 req'd)
3	6A341	Thrust washer
4	6303	Crankshaft
5	6A339	Thrust bearing
6	6325	Main bearing cap (5 req'd)
7	6345	Bolt (10 req'd)
8	6K258	Stud (4 req'd)

9	6687	Oil pan baffle
10	N806180	Spacer
11	N605904	Bolt
12	6710	Oil pan gasket
13	6675	Oil pan
14	W701240	Bolt (16 req'd)
15	6622	Oil pump screen pickup and tube
16	N806155	Bolt (2 req'd)
17	N806180	Nut (2 req'd)
18	6345	Bolt (6 req'd)
19	6C360	Main bearing cap adjusting screw (10 req'd)
20	6A338	Crankshaft main bearing (4 req'd)
21	N806201	Woodruff key
22	6621	Oil pump
23	N806183	Bolt (4 req'd)
24	6333	Crankshaft main bearing
25	8501	Coolant pump

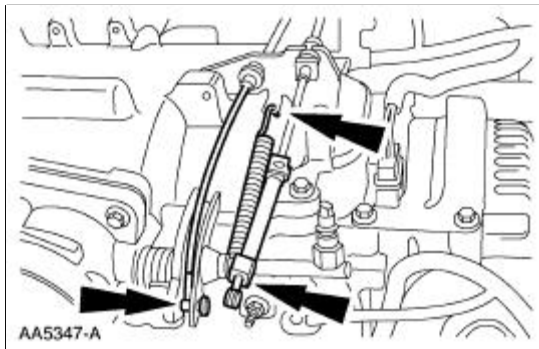
Engine

Refer to [Section 303-00](#) for basic mechanical concerns or refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for driveability concerns.

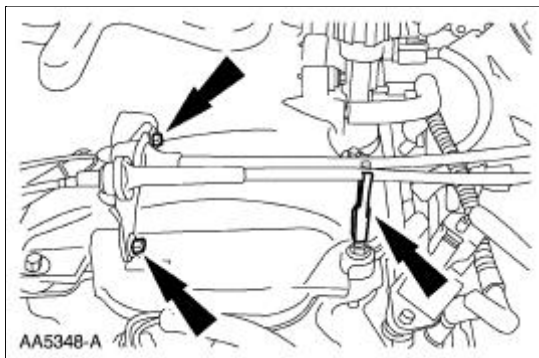
Intake Manifold —Upper

Removal

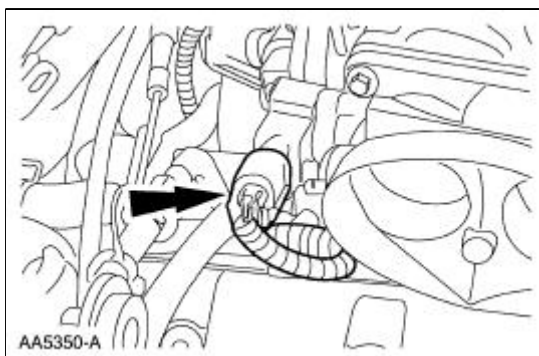
1. Remove the air intake scoop bracket. For additional information, refer to [Section 303-12](#).
2. Remove the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).
3. Disconnect the accelerator cable, the speed control actuator cable and the return spring.



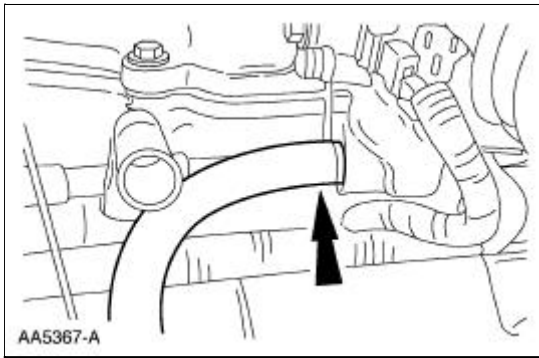
4. Remove the bolts, disconnect the clip and position the cables out of the way.



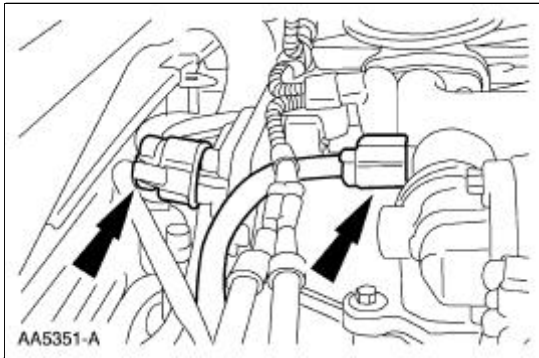
5. Disconnect the throttle position (TP) sensor.



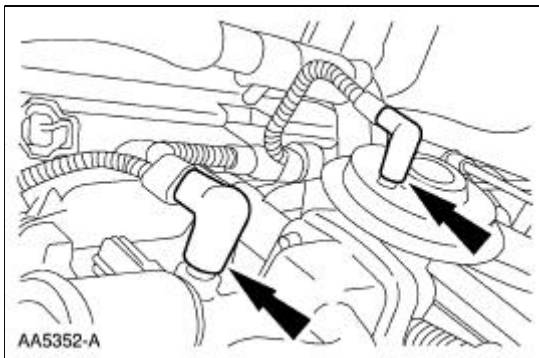
6. Disconnect the evaporative emissions (EVAP) return hose.



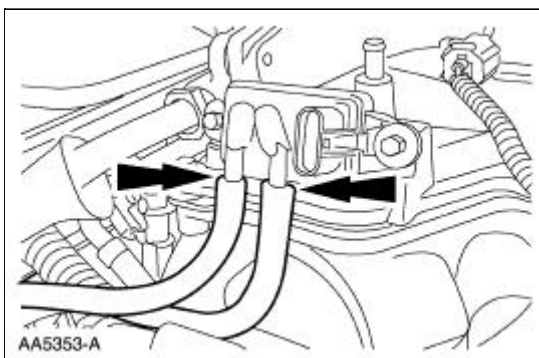
7. Disconnect the idle air control valve and the differential pressure feedback EGR.



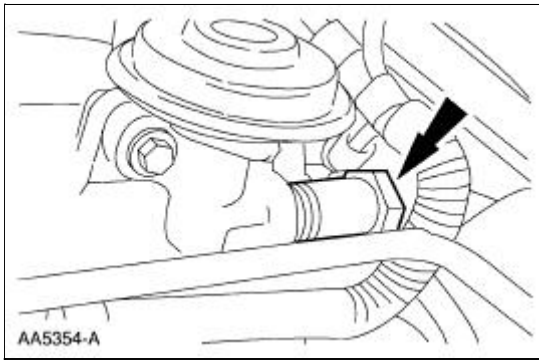
8. Disconnect the main chassis vacuum supply line and the EGR valve vacuum line.



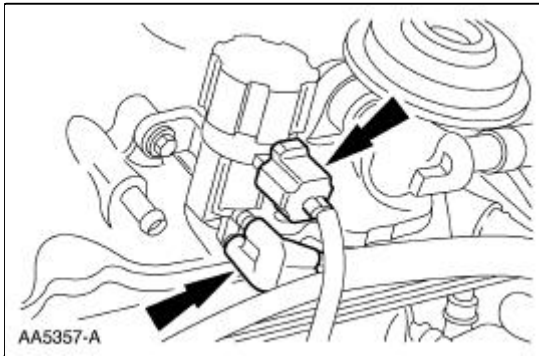
9. Disconnect the differential pressure feedback EGR hoses.



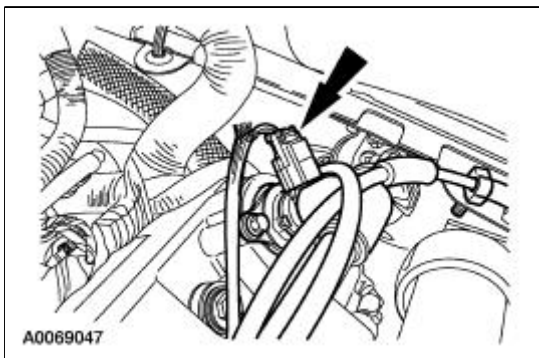
10. Disconnect the EGR valve to exhaust manifold tube from the EGR valve.



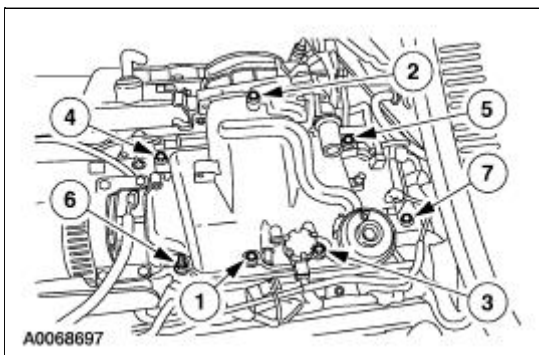
11. Disconnect the electrical connector and the vacuum lines from the EGR vacuum regulator solenoid.



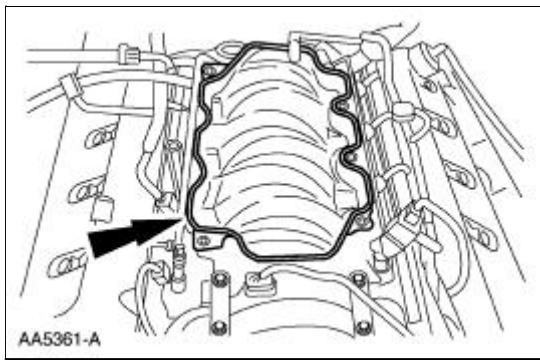
12. Remove the PCV valve-to-intake manifold tube.



13. Remove the upper intake manifold bolts in the sequence shown and remove the intake manifold assembly.

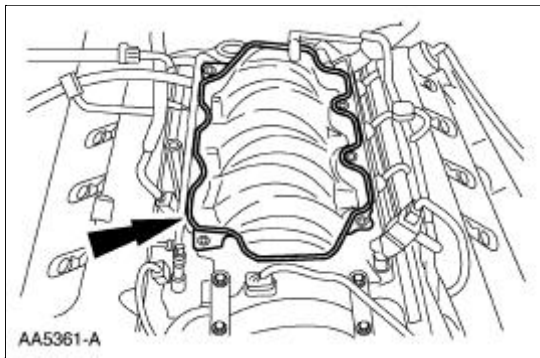


14. Inspect and clean the sealing surfaces.

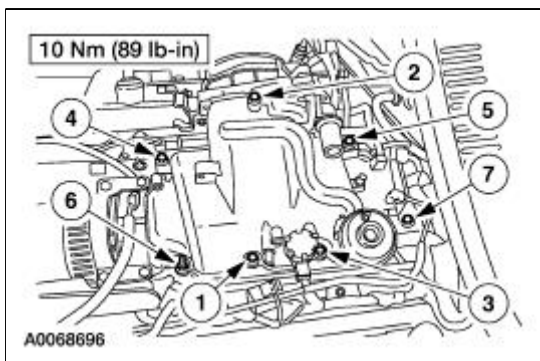


Installation

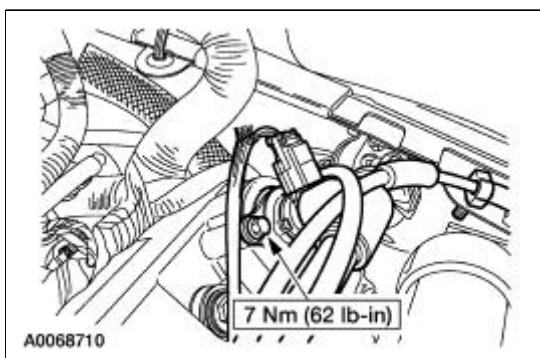
1. Install the upper intake manifold gasket.



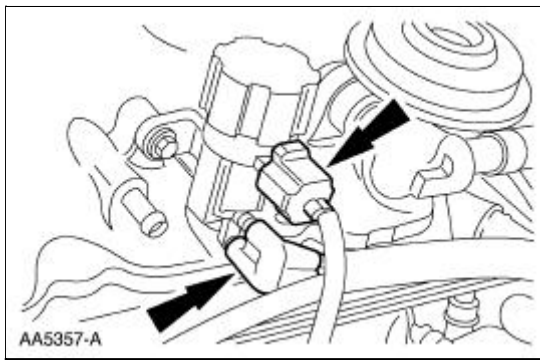
2. Install the intake manifold and bolts in the sequence shown.



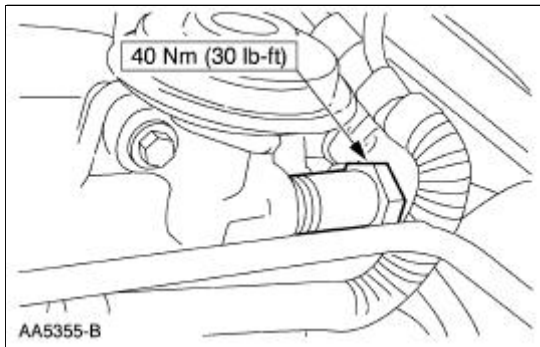
3. Install the PCV valve-to-intake manifold tube.



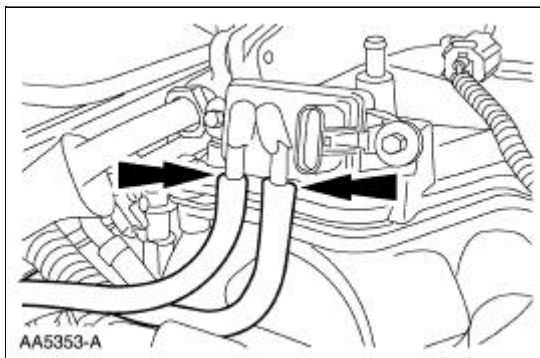
4. Connect the vacuum hoses and the electrical connector to the EGR vacuum regulator solenoid.



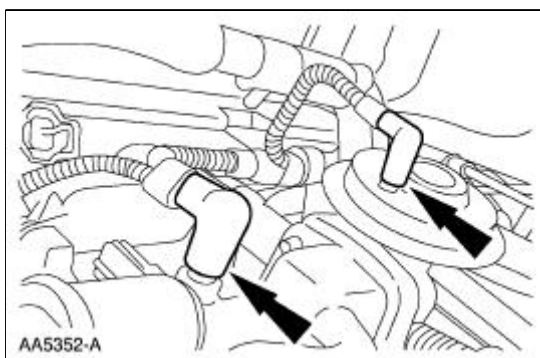
5. Connect the EGR tube to the EGR valve.



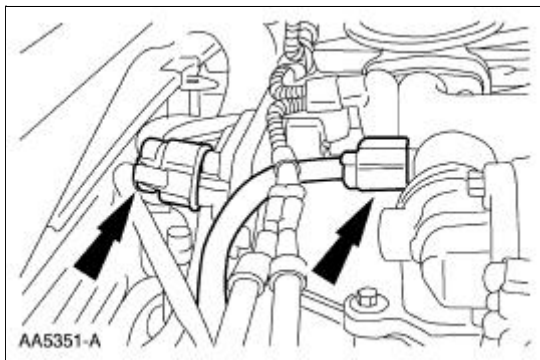
6. Connect the hoses to the differential pressure feedback EGR.



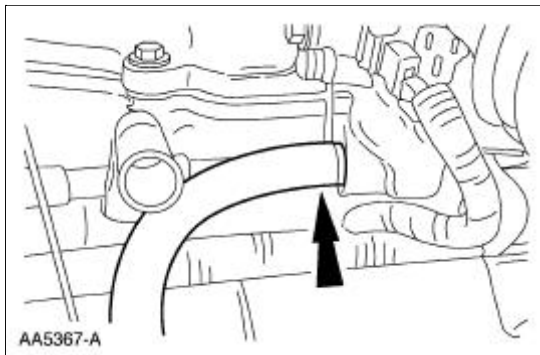
7. Connect the main chassis vacuum supply line and the EGR valve vacuum line.



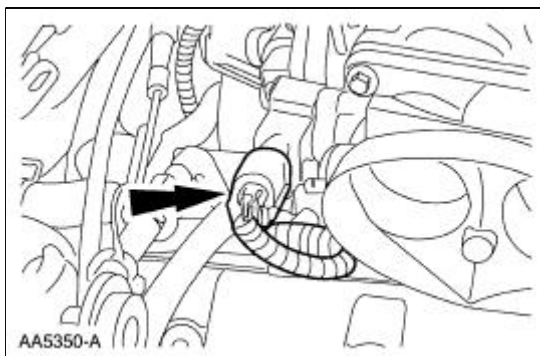
8. Connect the IAC valve and the differential pressure feedback EGR electrical connectors.



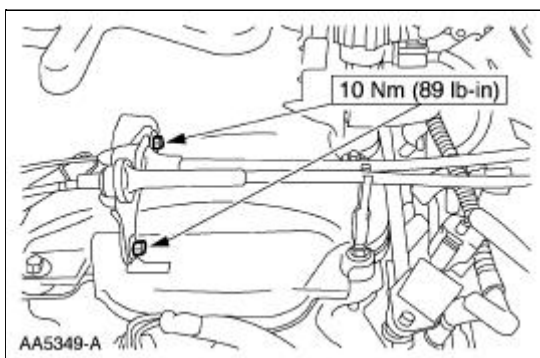
9. Connect the EVAP return hose.



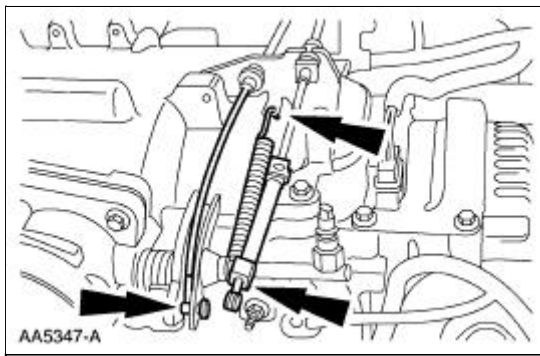
10. Connect the TP sensor.



11. Position the cables and bracket.
 - Install the bolts, connect the clip.



12. Connect the throttle cable, the speed control actuator cable and throttle return spring.



13. Install the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).
 14. Install the air intake scoop bracket. For additional information, refer to [Section 303-12](#).
-

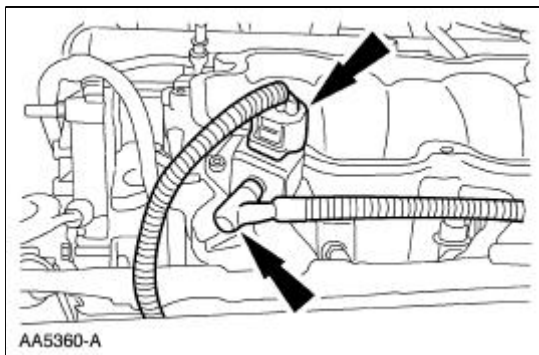
Intake Manifold —Lower

Material

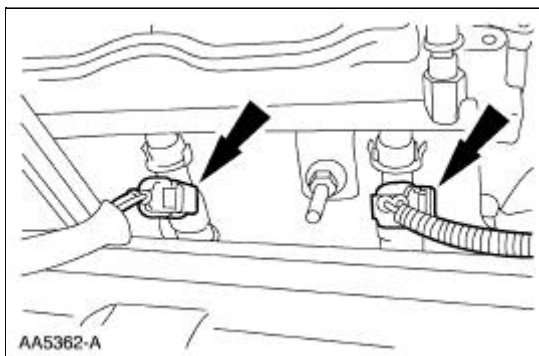
Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A

Removal

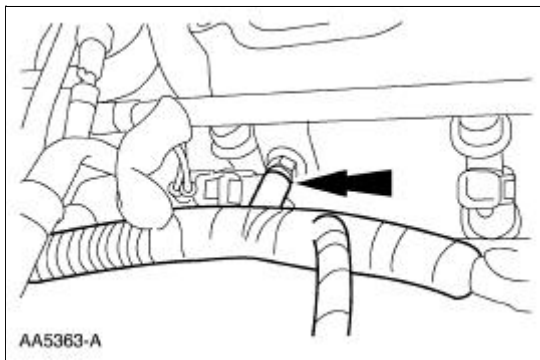
1. Remove the upper intake manifold. For additional information, refer to [Intake Manifold—Upper](#) in this section.
2. Disconnect the fuel line. For additional information, refer to [Section 310-00](#).
3. Remove the coolant by-pass tube. For additional information, refer to [Section 303-03A](#).
4. Remove the generator. For additional information, refer to [Section 414-02](#).
5. Disconnect the electrical connector and the vacuum line from the fuel pressure sensor.



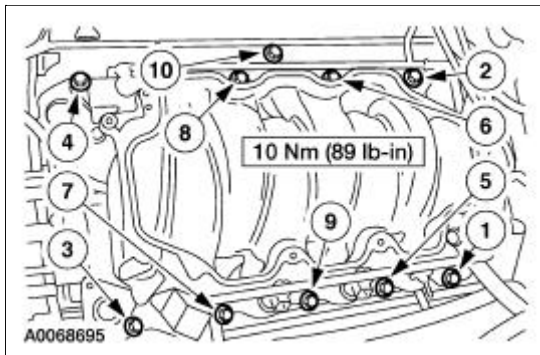
6. Disconnect the eight fuel injector electrical connectors.



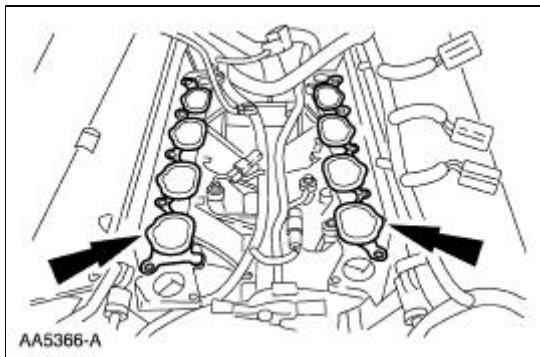
7. Separate the fuel charging wiring harness from the fuel injection supply manifold studs in three places.



8. Remove the ten bolts in the sequence shown and raise the lower intake manifold slightly.

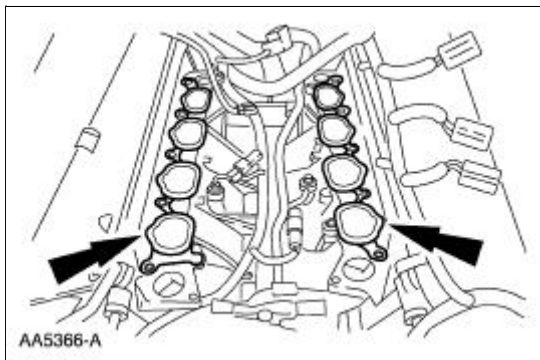


9. Disconnect the fuel charging wiring harness from the rear of the lower intake manifold and remove the manifold.
10. Remove the intake manifold gaskets.
 - Clean and inspect the sealing surfaces.

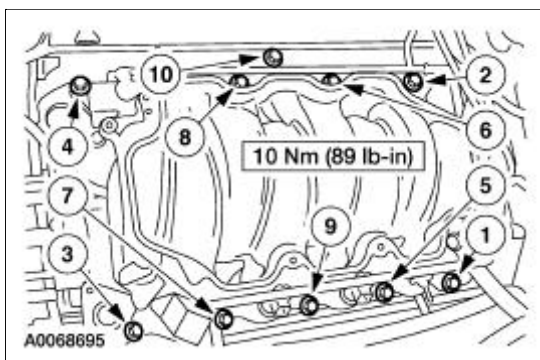


Installation

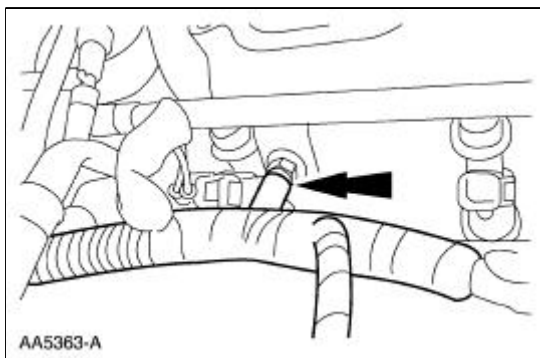
1. Install the lower intake manifold gaskets.



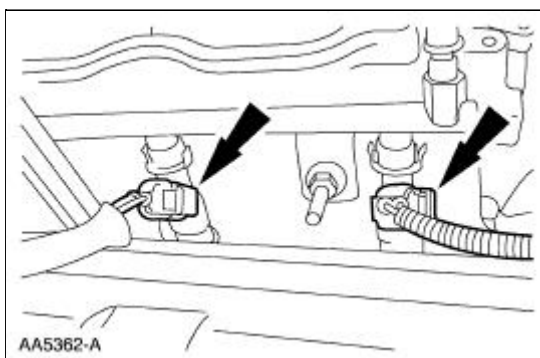
2. Connect the fuel charging wiring harness to the rear of the lower intake manifold and install the manifold.
3. Install the intake manifold fasteners and tighten in the sequence shown.



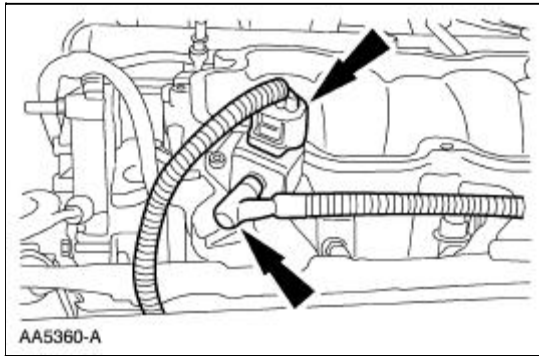
4. Position the fuel charging wiring harness and connect it to the fuel injection supply manifold in three places.



5. Connect the eight fuel injector electrical connectors.



6. Connect the electrical connector and the vacuum line to the fuel pressure sensor.



7. Install the generator. For additional information, refer to [Section 414-02](#).
 8. Install the coolant bypass tube. For additional information, refer to [Section 303-03A](#).
 9. Connect the fuel line. For additional information, refer to [Section 310-00](#).
 10. Install the upper intake manifold. For additional information, refer to [Intake Manifold—Upper](#) in this section.
-

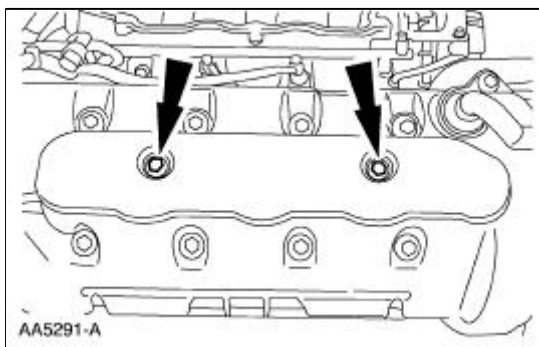
Valve Cover RH

Material

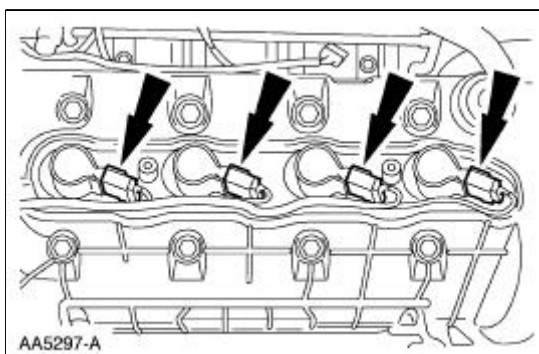
Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
PAG Refrigerant Compressor Oil F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent	WSH-M1C231-B

Removal

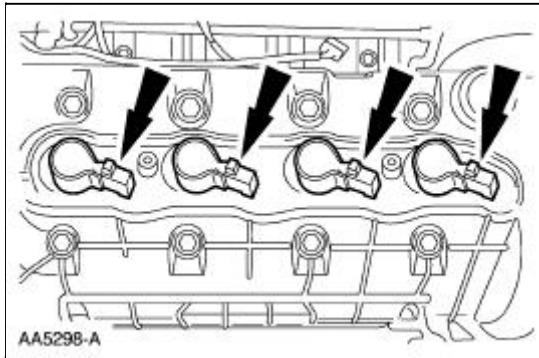
1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Drain the cooling system. For additional information, refer to [Section 303-03A](#).
3. Recover the refrigerant. For additional information, refer to [Section 412-00](#).
4. Remove the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).
5. Remove the RH ignition coil cover bolts and the cover.



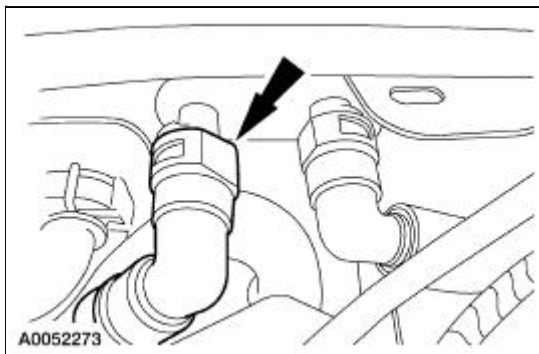
6. Disconnect the ignition coil electrical connectors.



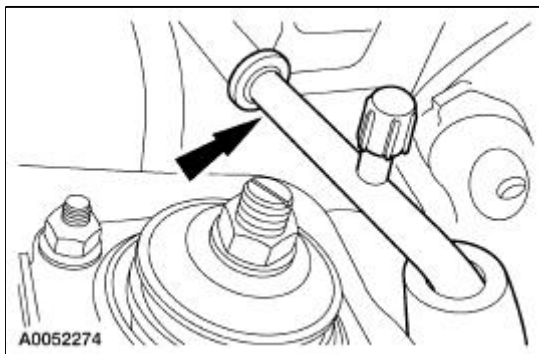
7. Remove the ignition coils.



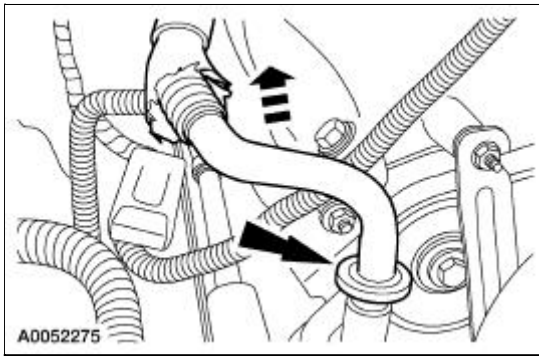
8. Remove the throttle body. For additional information, refer to [Section 303-04D](#).
9. Disconnect the fuel tube spring lock coupling. For additional information, refer to [Section 310-00](#).
10. Disconnect the heater hose.



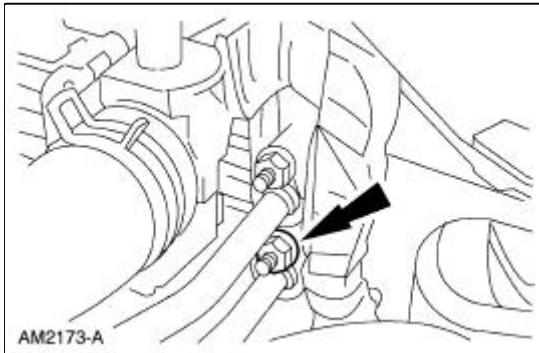
11. Disconnect the A/C suction tube at the accumulator.



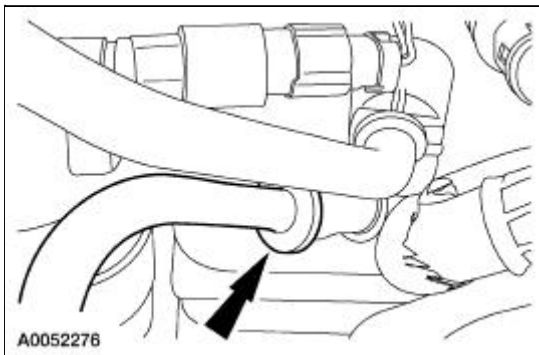
12. Disconnect and remove the A/C suction tube.



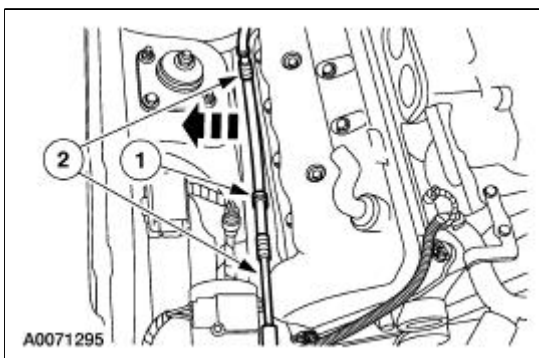
13. Remove the nut and separate the A/C tube from the condenser.



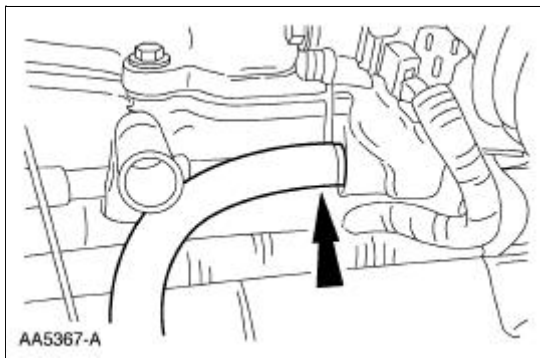
14. Disconnect the A/C tube at the evaporator.



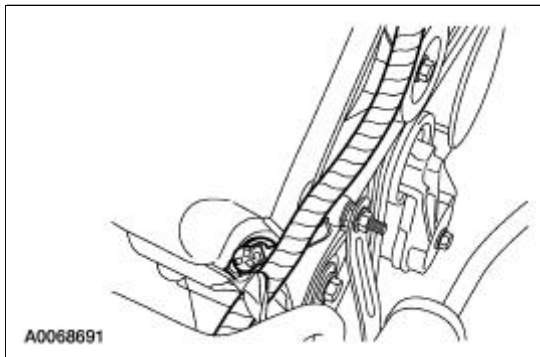
15. Remove the A/C tube.
1. Disconnect the pin-type retainer.
2. Remove the A/C tube.



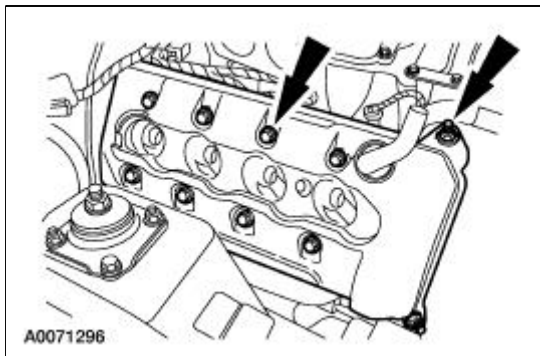
16. Disconnect the evaporative emissions (EVAP) return tube.




17. Disconnect the wiring harness from the valve cover stud bolt.

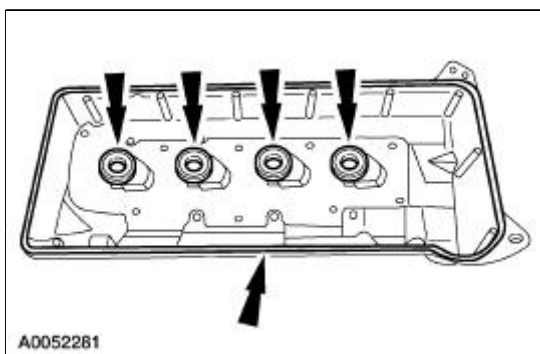


18. Remove the bolts and the RH valve cover.



19.  **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

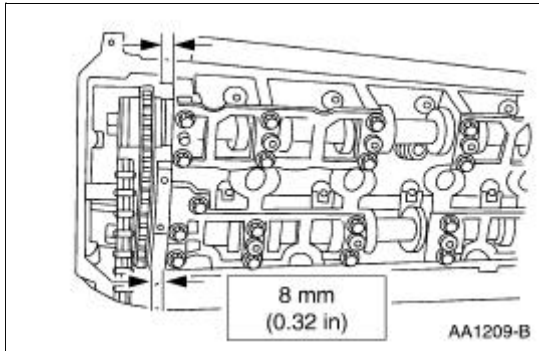
Clean and inspect the sealing surfaces and inspect the valve cover gaskets. If necessary, install new gaskets. Make sure the gaskets are correctly seated on the valve cover.



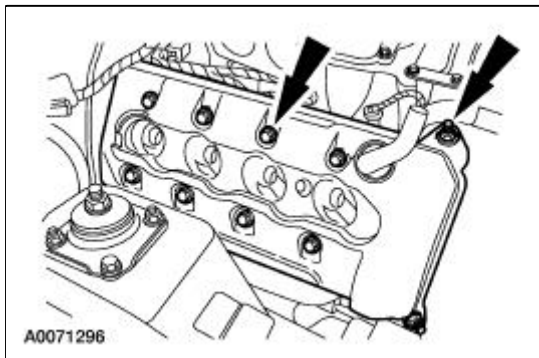
Installation

1. **NOTE:** If the valve cover is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

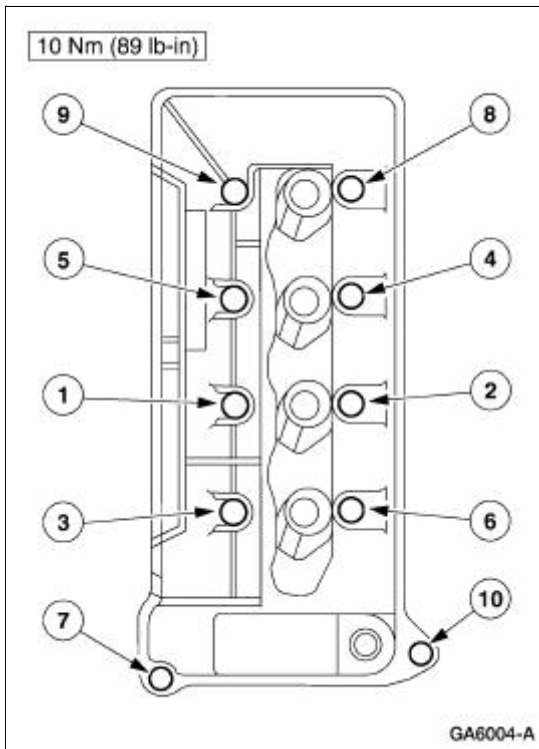
Apply a bead of silicone gasket and sealant in two places where the engine front cover meets the cylinder head.



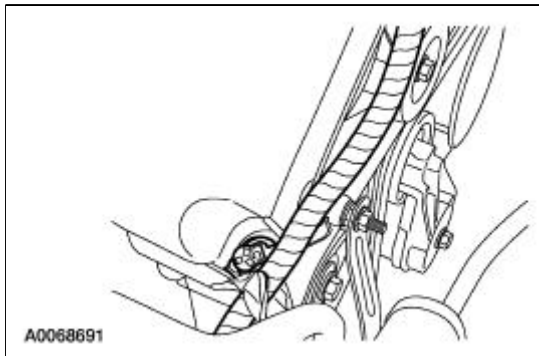
2. Install the RH valve cover and finger tighten the bolts.



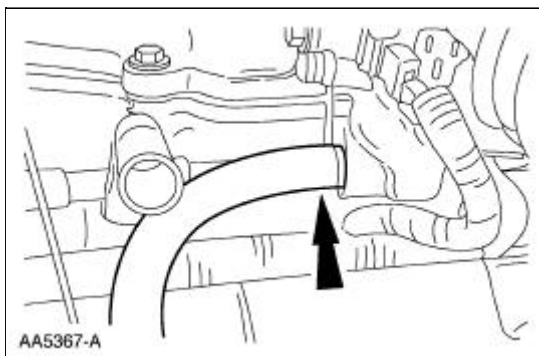
3. Tighten the RH valve cover bolts in the sequence shown.



4. Connect the wiring harness to the valve cover stud bolt.



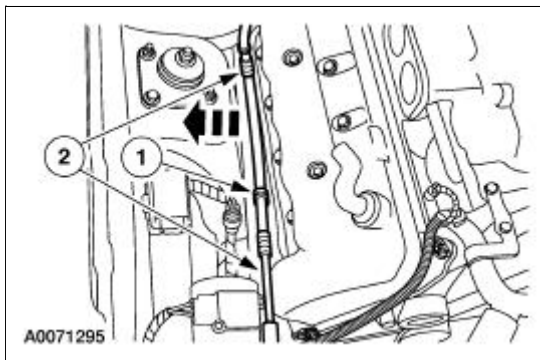
5. Connect the evaporative emissions (EVAP) return tube.



6. **NOTE:** Lubricate O-ring with clean PAG oil or equivalent.

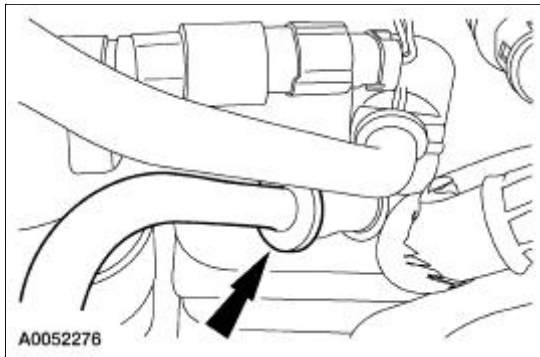
Install the A/C tube.

1. Install the A/C tube.
2. Connect the pin-type retainer.

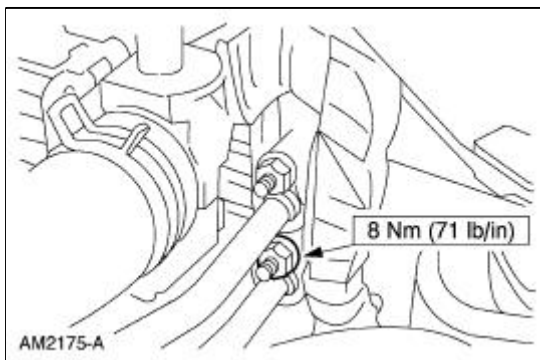


7. **NOTE:** Lubricate O-ring with clean PAG oil or equivalent.

Connect the A/C tube to the evaporator.

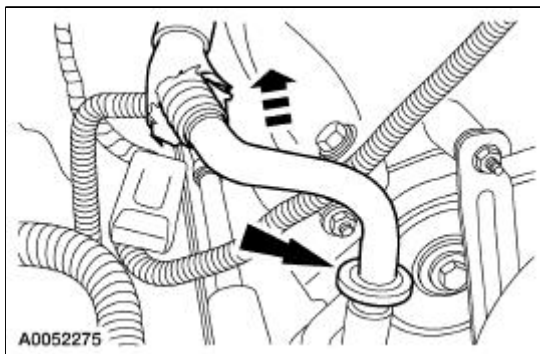


8. Connect the A/C tube and install the nut.



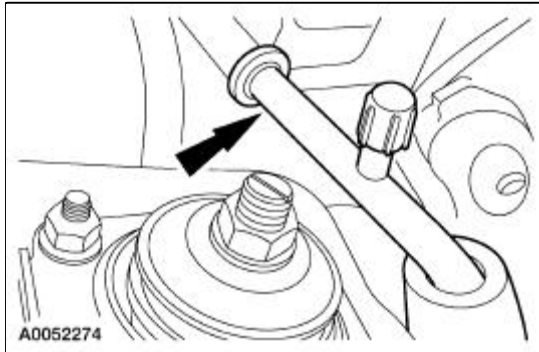
9. **NOTE:** Lubricate O-ring with clean PAG oil or equivalent.

Install the A/C suction tube.

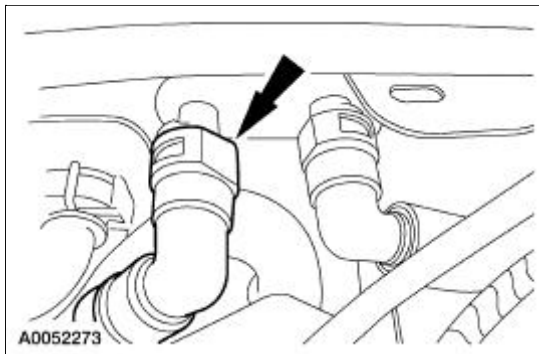


10. **NOTE:** Lubricate O-ring with clean PAG oil or equivalent.

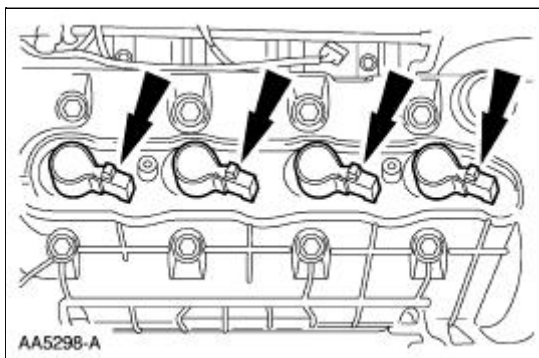
Connect the A/C suction tube to the accumulator.



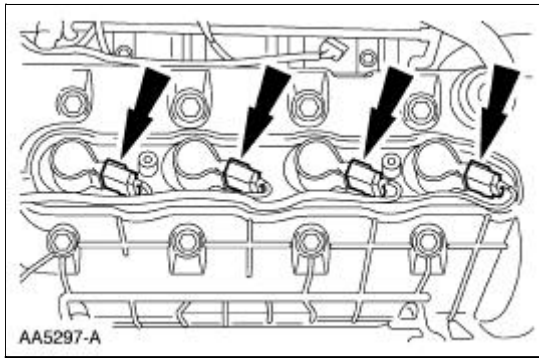
11. Connect the heater hose.



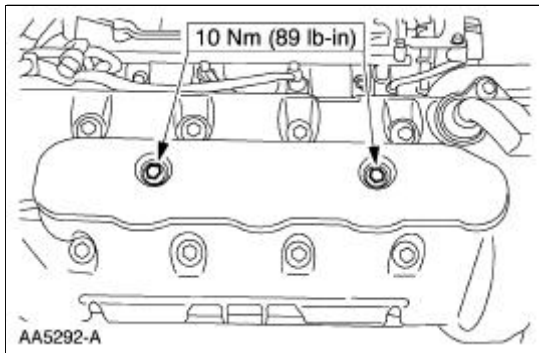
12. Install the throttle body. For additional information, refer to [Section 303-04D](#).
13. Connect the fuel tube spring lock coupling. For additional information, refer to [Section 310-00](#).
14. Install the RH ignition coils.



15. Connect the RH ignition coil electrical connectors.



16. Install the RH ignition coil cover and the two bolts.



17. Install the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).
 18. Connect the battery ground cable. For additional information, refer to [Section 414-01](#).
 19. Fill the cooling system. For additional information, refer to [Section 303-03A](#).
 20. Recharge the A/C system. For additional information, refer to [Section 412-00](#).
-

Valve Cover LH

Material

Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323- A4

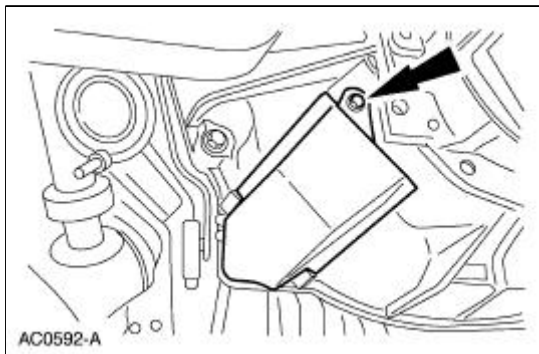
Removal

All vehicles

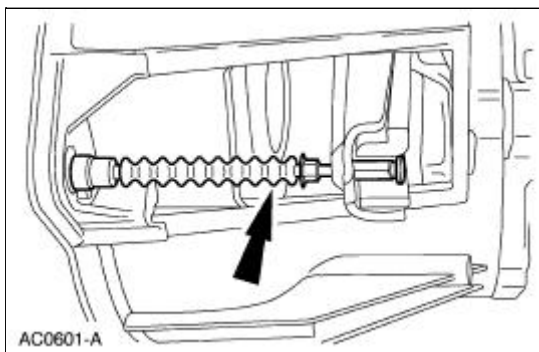
1. Remove the air intake scoop. For additional information, refer to [Section 303-12](#).
2. Remove the Hydro-Boost brake booster. For additional information, refer to [Section 206-07](#).
3. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).

Manual transmission vehicles

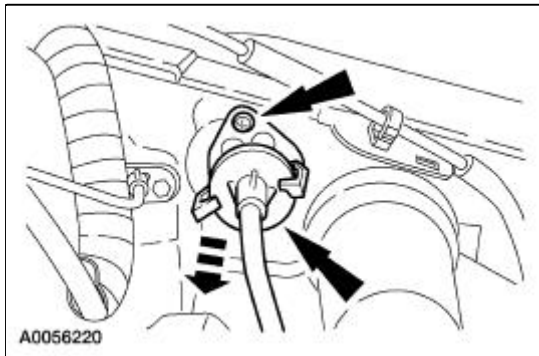
4. Remove the screw and the dust shield.



5. Disengage the clutch release cable from the clutch release fork.

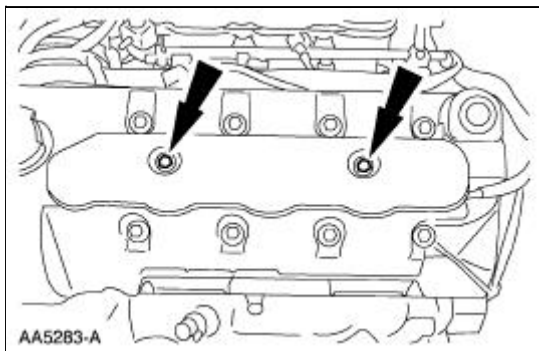


6. Lower the vehicle.
7. Remove the two screws and position the clutch release cable aside.

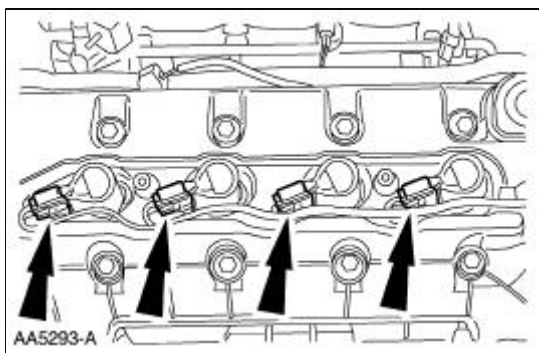


All vehicles

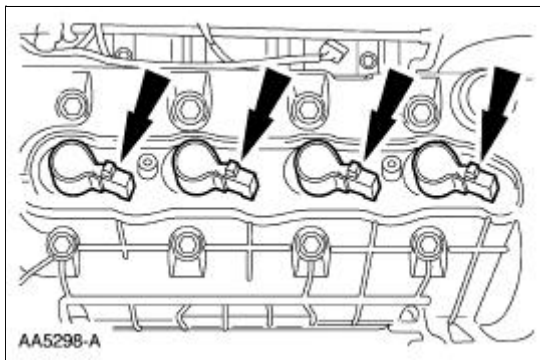
8. Remove the LH ignition coil cover bolts and the cover.



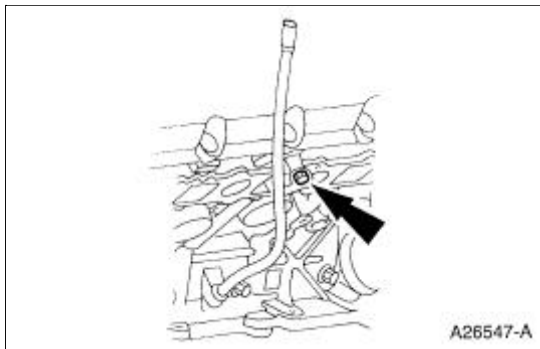
9. Disconnect the ignition coil electrical connectors.



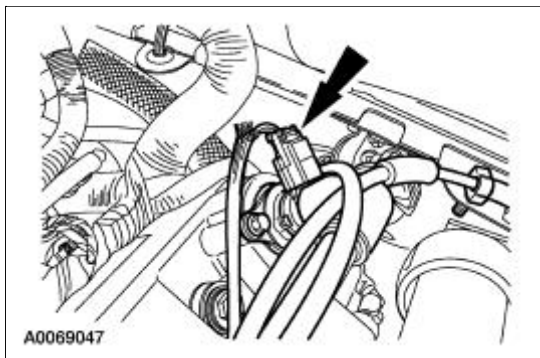
10. Remove the ignition coils.



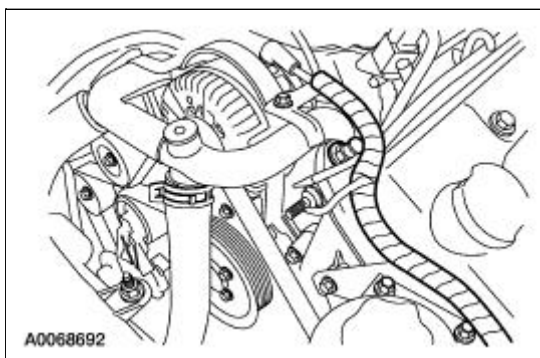
11. Remove the bolt and position the oil level indicator tube aside.



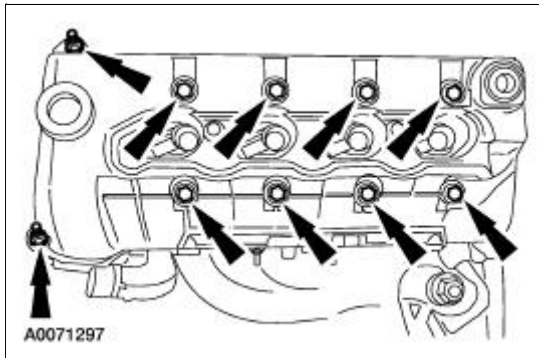
12. Disconnect the positive crankcase ventilation (PCV) valve hose and the electrical connector.



13. Disconnect the wiring harness anchor from the valve cover.

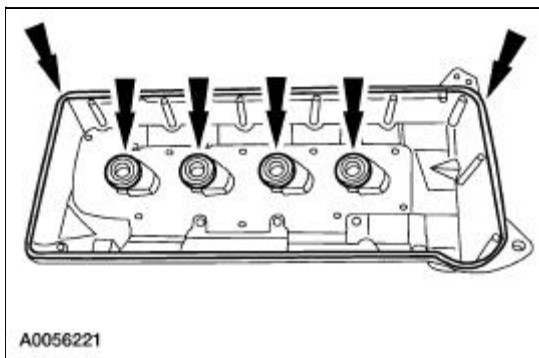


14. Remove the LH valve cover.



15. **⚠ CAUTION:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

Clean and inspect the sealing surfaces and the valve cover gaskets. If necessary, install new gaskets. Make sure the gaskets are correctly seated on the valve cover.

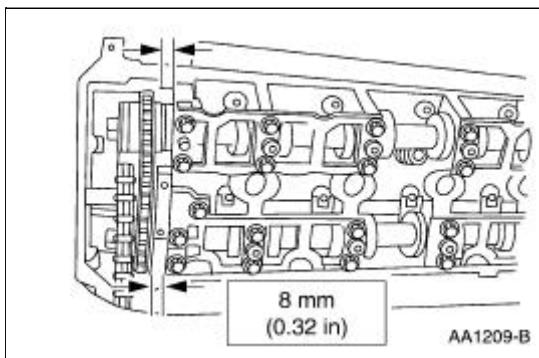


Installation

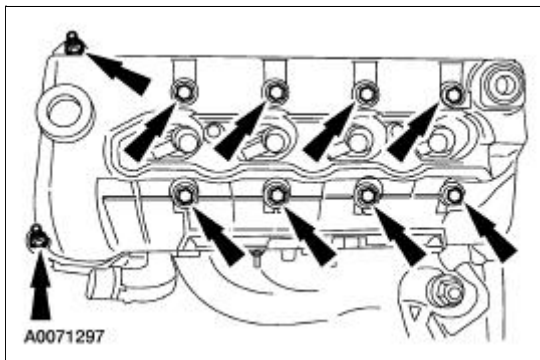
All vehicles

1. **NOTE:** If the valve cover is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

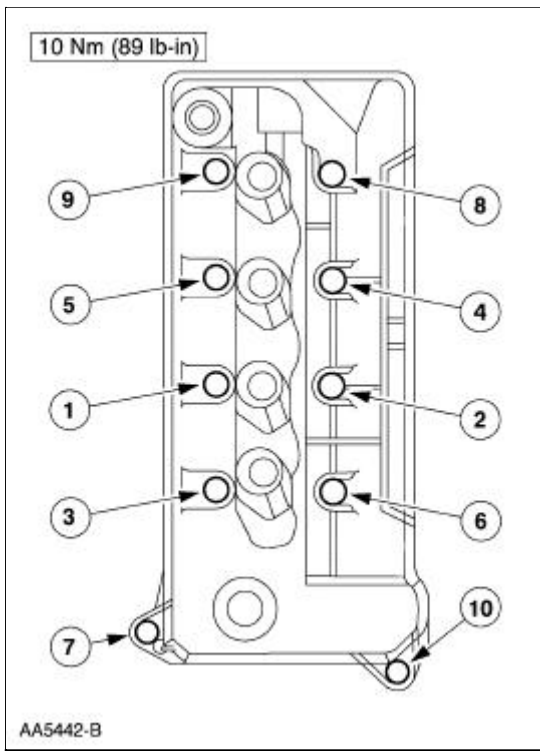
Apply silicone gasket and sealant to areas shown.



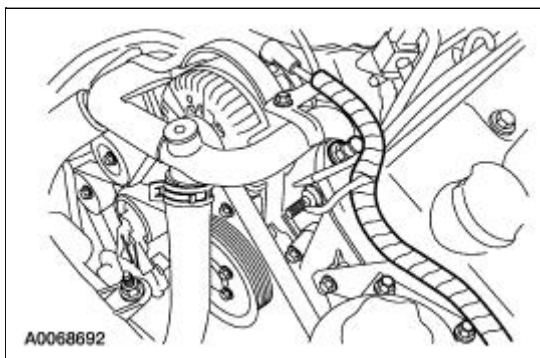
2. Install the LH valve cover and loosely install the bolts.



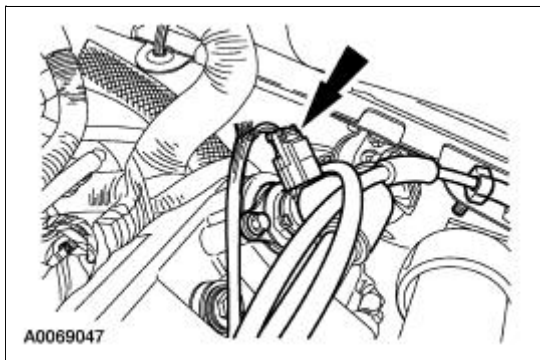
3. Tighten the LH valve cover bolts in the sequence shown.



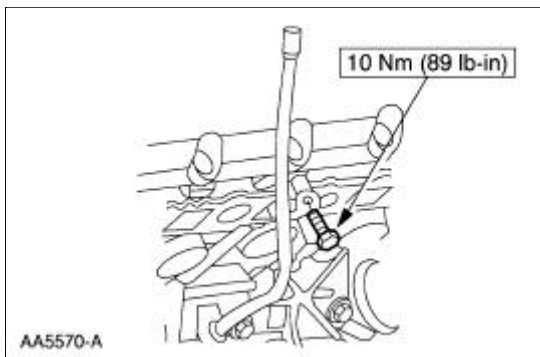
4. Connect the wiring harness anchor to the valve cover stud bolt.



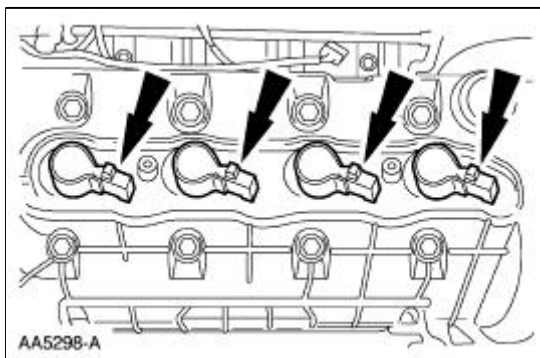
5. Connect the positive crankcase ventilation (PCV) valve hose and electrical connector.



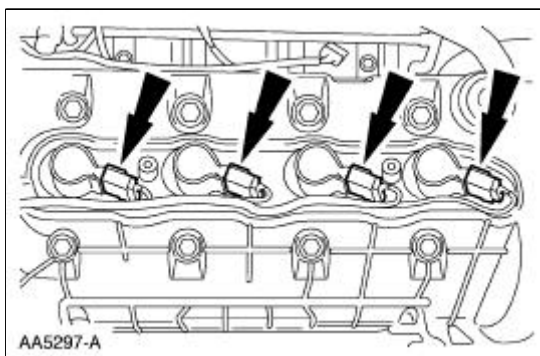
6. Position the oil level indicator tube and install the bolt.



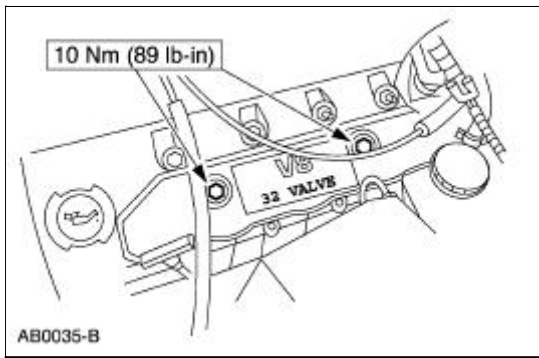
7. Install the LH ignition coils.



8. Connect the ignition coil electrical connectors.

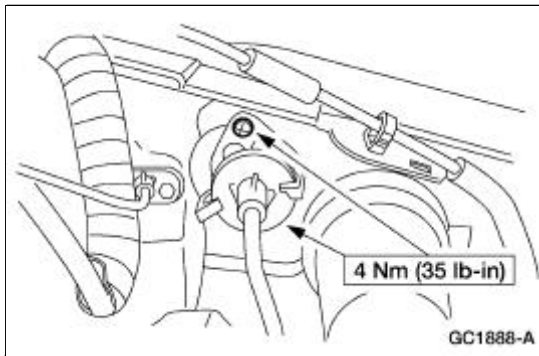


9. Install the LH ignition coil cover and the bolts.

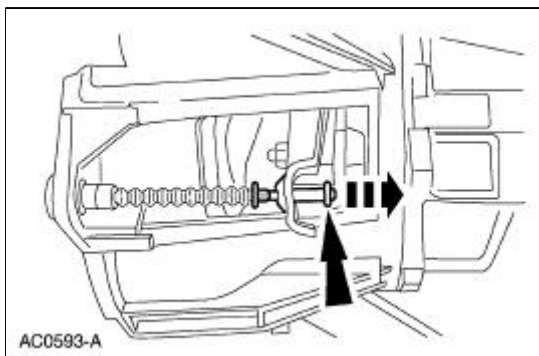


Manual transmission vehicles

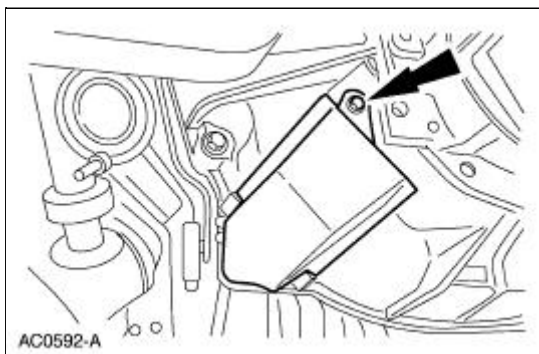
10. Install the clutch release cable and install the two screws.



11. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
12. Connect the clutch release cable to the clutch release fork.



13. Install the dust shield and the screw.



14. Lower the vehicle.



All vehicles

15. Install the Hydro-Boost brake booster. For additional information, refer to [Section 206-07](#).

16. Install the air intake scoop. For additional information, refer to [Section 303-12](#).

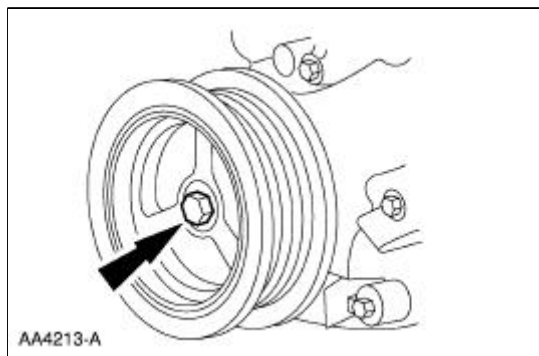
Crankshaft Pulley

Special Tool(s)

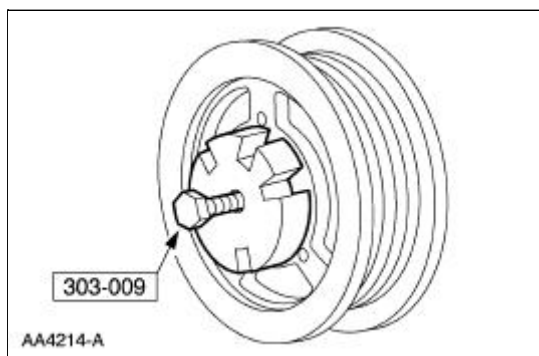
 ST1286-A	Remover, Crankshaft Vibration Damper 303-009 (T58P-6316-D)
 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)

Removal

1. Remove the accessory drive belt. For additional information, refer to [Section 303-05](#).
2. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
3. Remove the bolt.



4. Using the special tool, remove the crankshaft pulley.

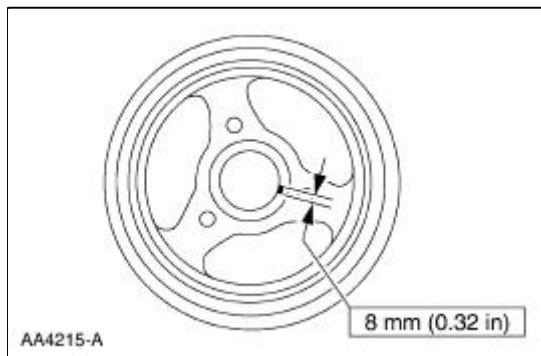


Installation

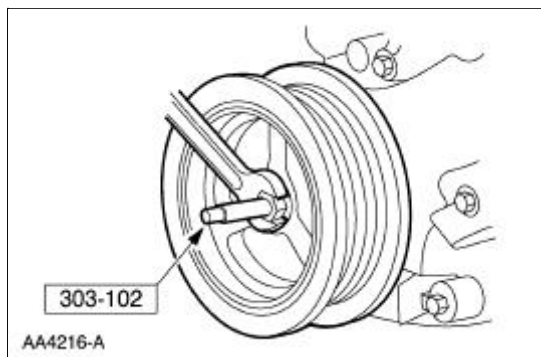
1. **NOTE:** The crankshaft pulley must be installed within four minutes after applying the silicone.

Apply silicone to the Woodruff key slot on the crankshaft pulley.

- Use Silicone Gasket and Sealant F7AZ-19554-EA or equivalent meeting Ford specification WSE-M4G323-A4.

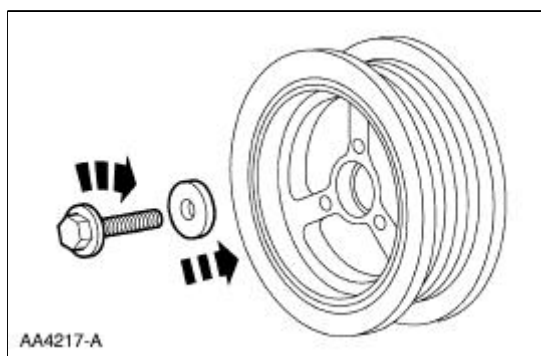


2. Using the special tool, install the crankshaft pulley.



3. Install the bolt and washer. Tighten the bolt in four stages.

- Stage 1: Tighten the bolt to 90 Nm (66 lb-ft).
- Stage 2: Loosen the bolt one full turn.
- Stage 3: Tighten the bolt to 50 Nm (37 lb-ft).
- Stage 4: Tighten the bolt an additional 90 degrees.



4. Lower the vehicle.
5. Install the accessory drive belt. For additional information, refer to [Section 303-05](#).



Crankshaft Front Oil Seal

Special Tool(s)

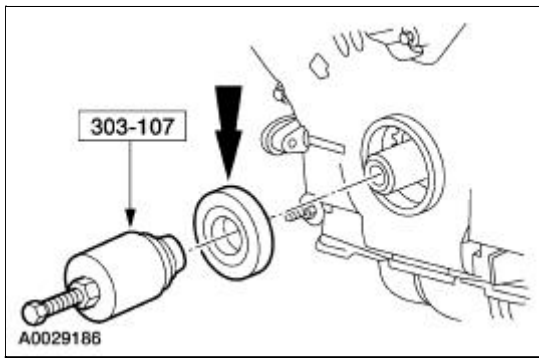
 <p>ST1328-A</p>	<p>Crankshaft Seal Installer/Aligner 303-335 (T88T-6701-A)</p>
 <p>ST1288-A</p>	<p>Front Cover Seal Remover 303-107 (T74P-6700-A)</p>
 <p>ST2197-A</p>	<p>Crankshaft Seal Installer 303-635</p>
 <p>ST1287-A</p>	<p>Crankshaft Damper Replacer 303-102 (T74P-6316-B)</p>

Material

Item	Specification
Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153- H

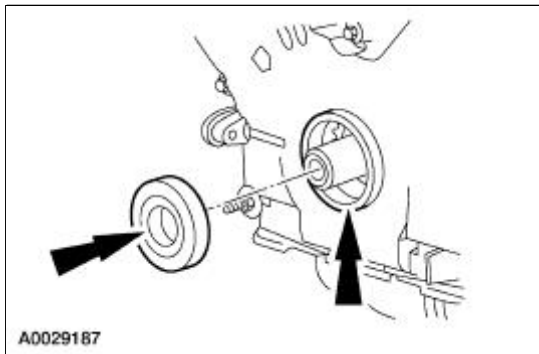
Removal

1. Remove the crankshaft pulley. For additional information, refer to [Crankshaft Pulley](#) in this section.
2. Using the special tool, remove the crankshaft front oil seal.

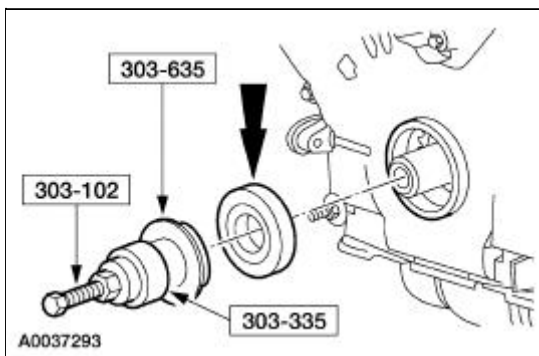


Installation

1. Lubricate the engine front cover and the crankshaft front oil seal inner lip with clean engine oil.



2. Using the special tools, install the crankshaft front oil seal into the engine front cover.



3. Install the crankshaft pulley. For additional information, refer to [Crankshaft Pulley](#).
-

Engine Front Cover

Material

Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
SAE 5W-30 Premium Synthetic Blend Motor Oil XO-5W30-QSP or equivalent	WSS-M2C153-G

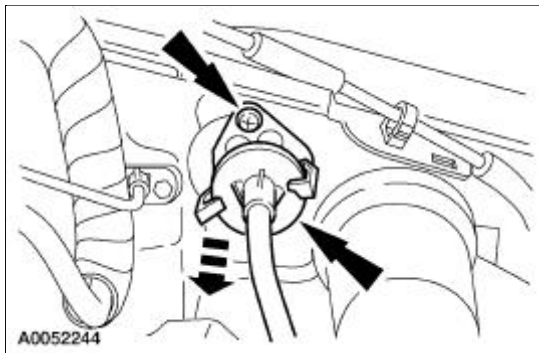
Removal

All vehicles

1. Remove the air intake scoop bracket. For additional information, refer to [Section 303-12](#).
2. Remove the RH valve cover. For additional information, refer to [Valve Cover RH](#) in this section.
3. Remove the Hydro-Boost brake booster. For additional information, refer to [Section 206-07](#).

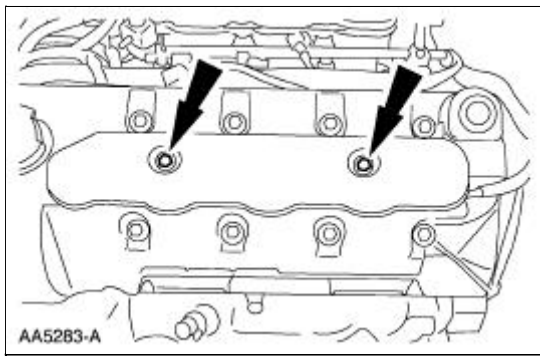
Manual transmission vehicles

4. Remove the two clutch release cable retaining screws.

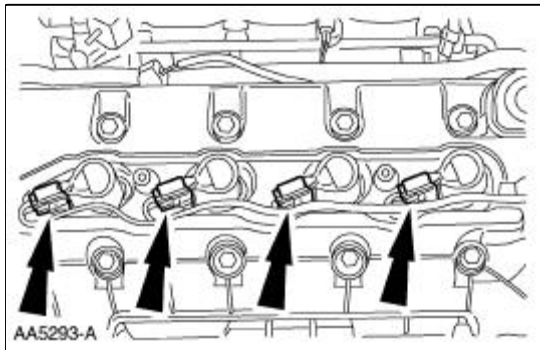


All vehicles

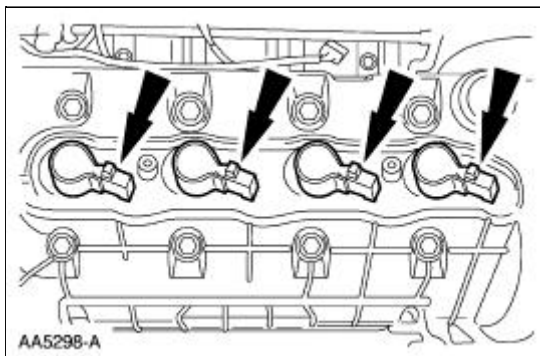
5. Remove the LH ignition coil cover bolts and the cover.



6. Disconnect the ignition coil electrical connectors.



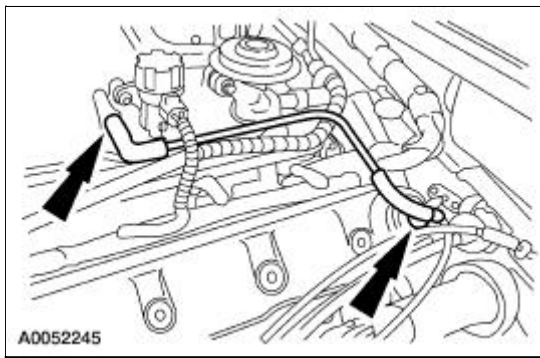
7. Remove the ignition coils.



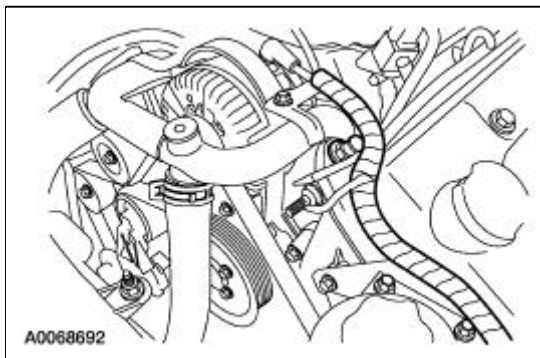
8. Remove the bolt and position the oil level indicator tube aside.



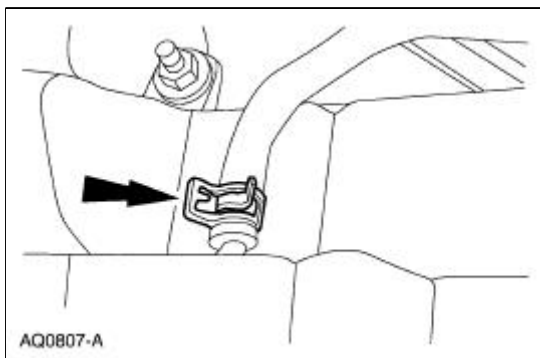
9. Remove the positive crankcase ventilation (PCV) valve hose and disconnect the electrical connector.



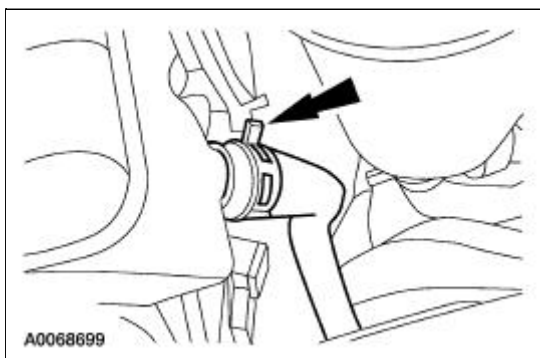
10. Disconnect the wiring harness anchor from the valve cover.



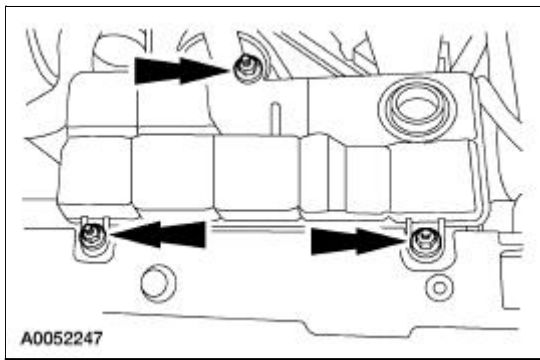
11. Remove the degas bottle vent hose.



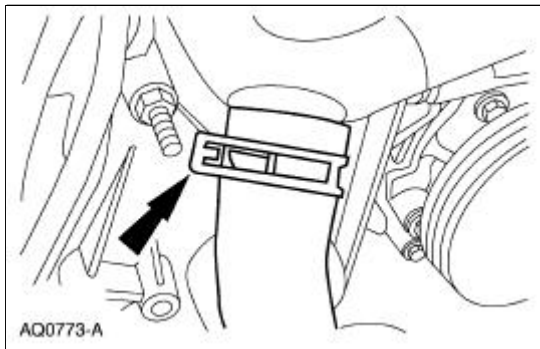
12. Remove the degas bottle return hose.



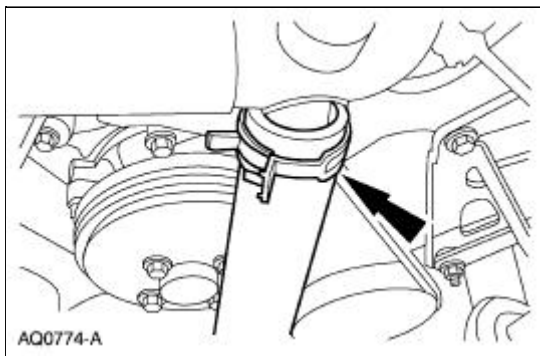
13. Remove the nuts and the degas bottle.



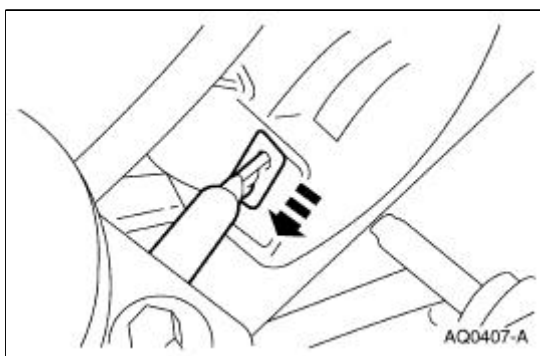
14. Disconnect the upper radiator hose from the bypass tube.



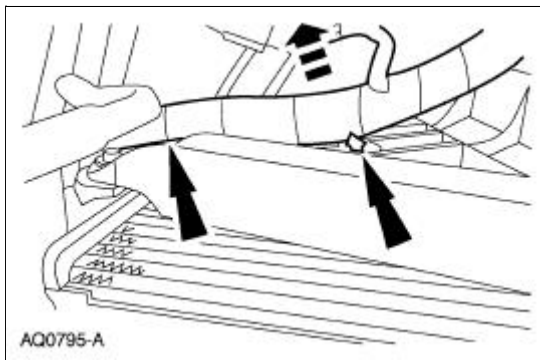
15. Disconnect the lower radiator hose from the bypass tube.



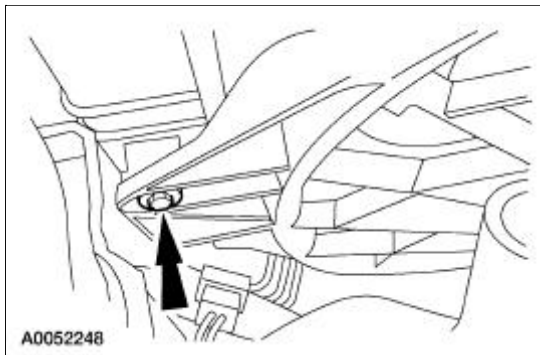
16. Disconnect the cooling fan electrical connector.



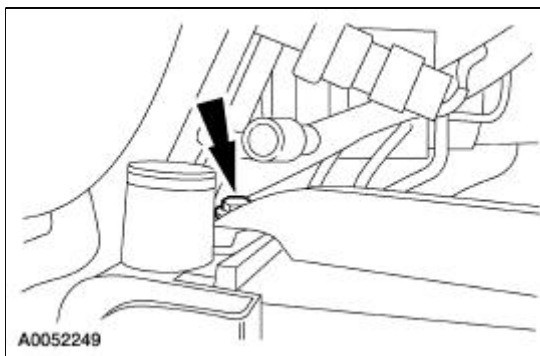
17. Separate the cooling fan wiring harness from the fan shroud.



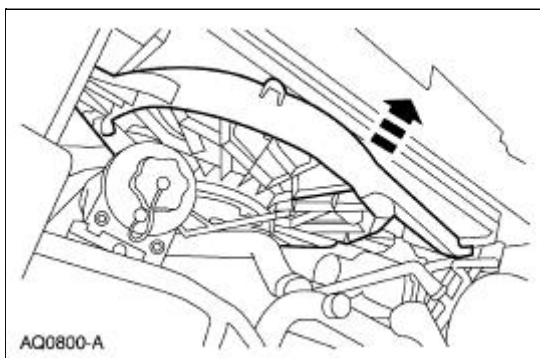
18. Remove the LH cooling fan shroud bolt.



19. Remove the RH cooling fan shroud bolt.

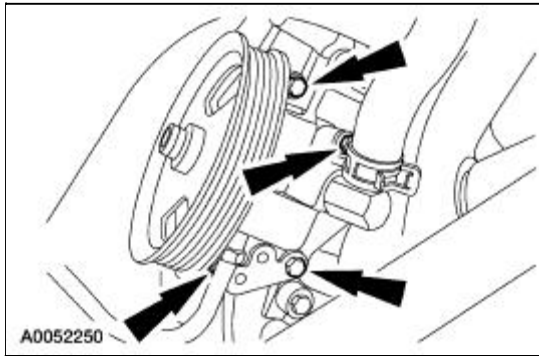


20. Remove the cooling fan and shroud as an assembly.

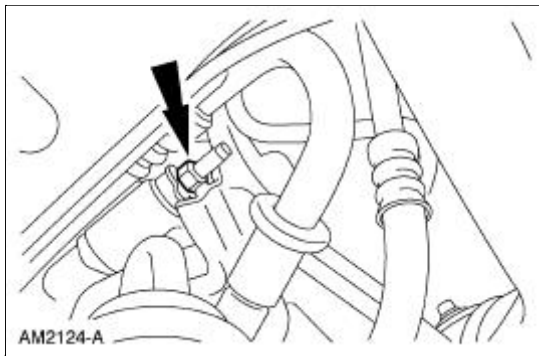


21. Remove the crankshaft front oil seal. For additional information, refer to [Crankshaft Front Oil Seal](#).
22. Remove the three bolts shown. Loosen the fourth bolt (hidden behind the p/s tube). Position the

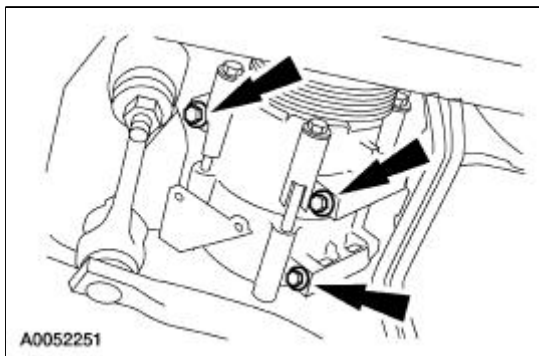
power steering pump aside.



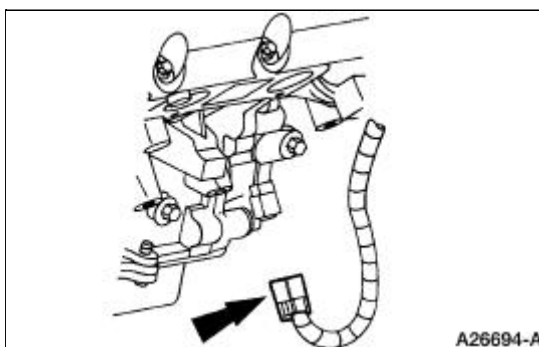
23. Remove the A/C muffler bracket nut.



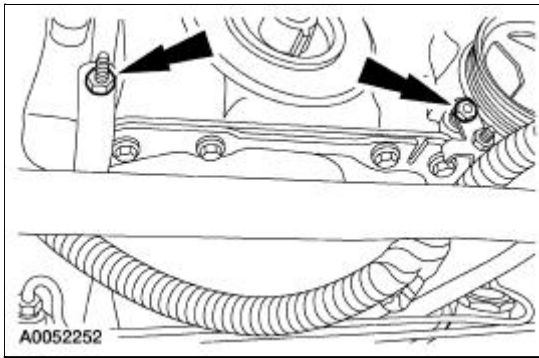
24. Remove the bolts and position the A/C compressor aside.



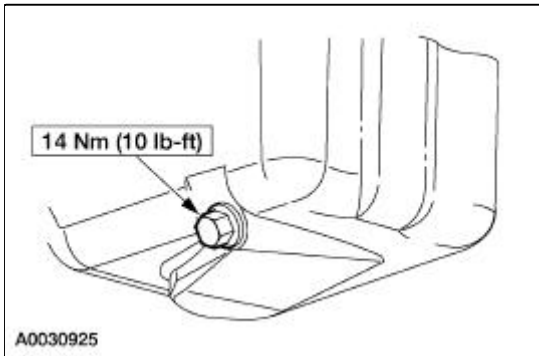
25. Disconnect the crankshaft position (CKP) sensor electrical connector.



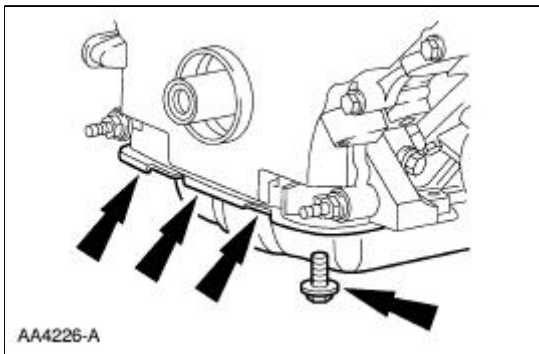
26. Remove the wiring harness nuts and position the wiring harness aside.



27. Remove the drain plug and drain the oil.
- Install the drain plug when finished.

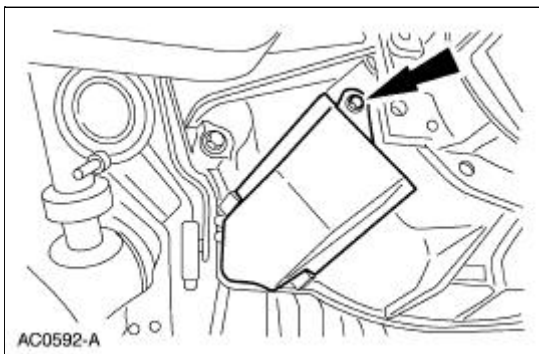


28. Remove the front four oil pan bolts.

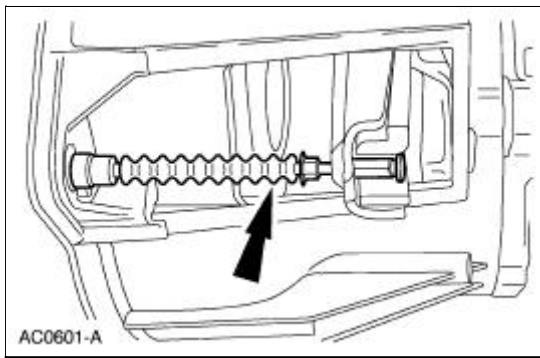


Manual transmission vehicles

29. Remove the bolt and the clutch release cable shield.



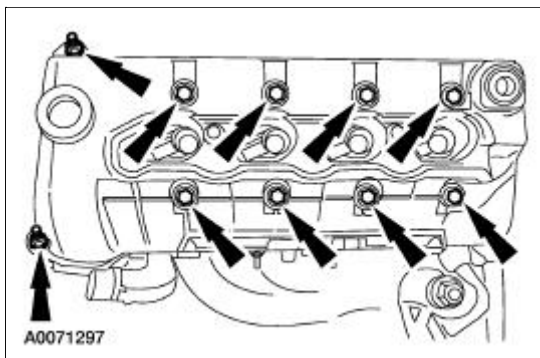
30. Disengage the clutch release cable from the clutch release fork.




31. Lower the vehicle.

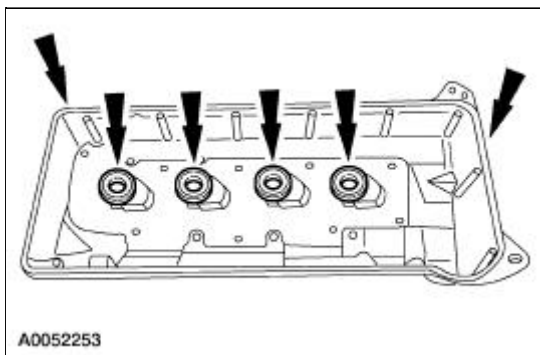
All vehicles

32. Remove the LH valve cover.

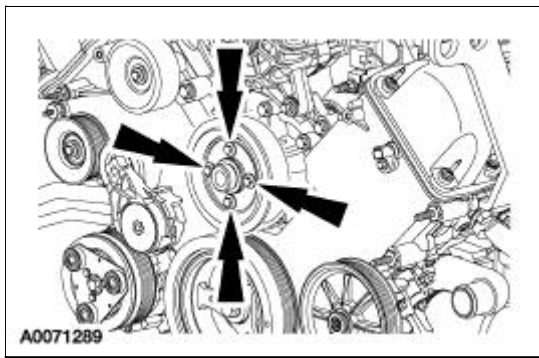


33.  **CAUTION: Do not use metal scraper, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

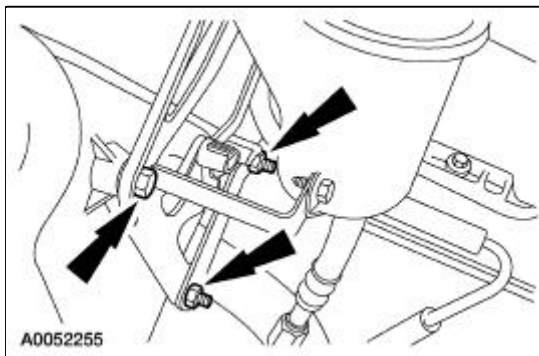
Clean and inspect sealing surfaces and valve cover gaskets. If necessary, install new gaskets. Make sure the gaskets are correctly seated on the valve cover.



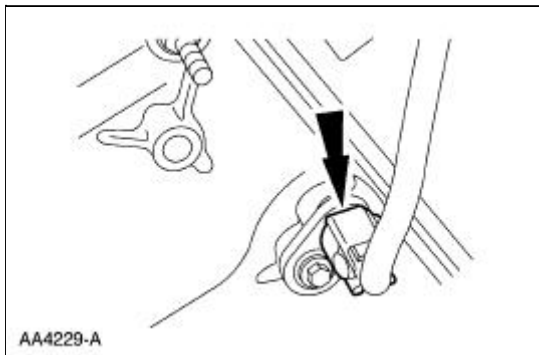
34. Remove the four bolts and the coolant pump pulley.



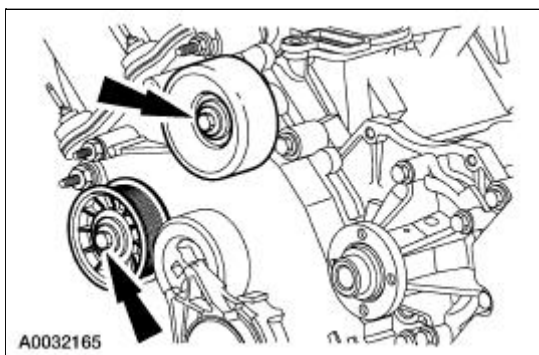
35. Remove the three bolts and position the power steering reservoir and bracket assembly aside.



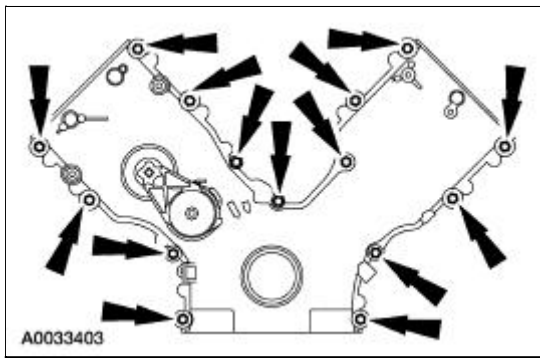
36. Disconnect the camshaft position (CMP) sensor electrical connector.




37. Remove the idler pulleys.

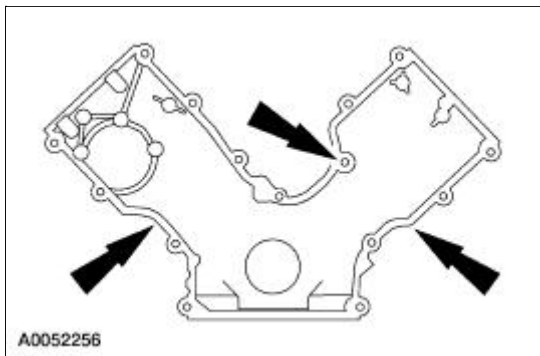


38. Remove the bolts and the studs and remove the engine front cover.



39.  **CAUTION:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

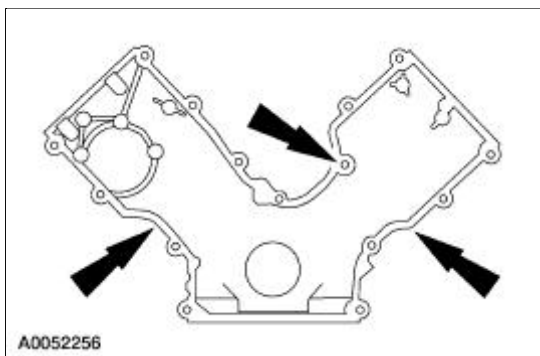
Remove and discard the gasket. Clean and inspect the sealing surfaces.



Installation

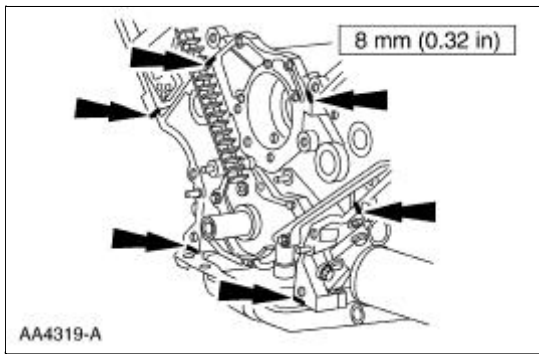
All vehicles

1. Position the engine front cover gasket on the engine front cover.

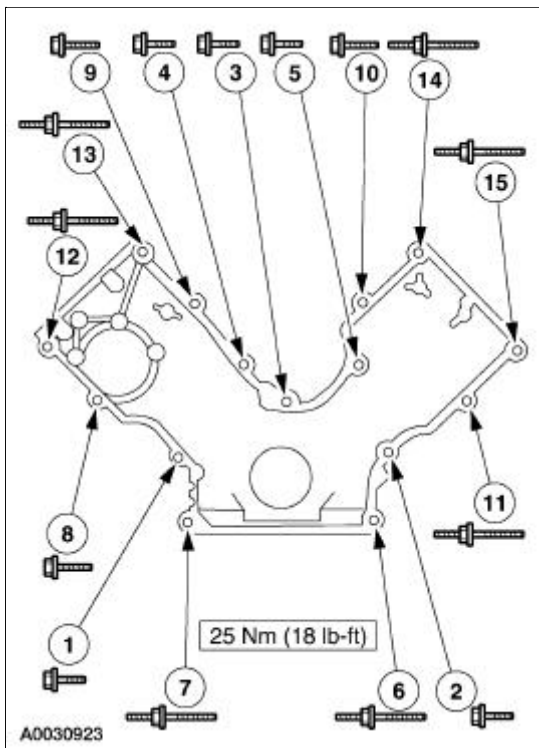


2. **NOTE:** If the engine front cover is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

Apply the silicone gasket and sealant along the cylinder head-to-cylinder block surface and the oil pan-to-cylinder block surface.



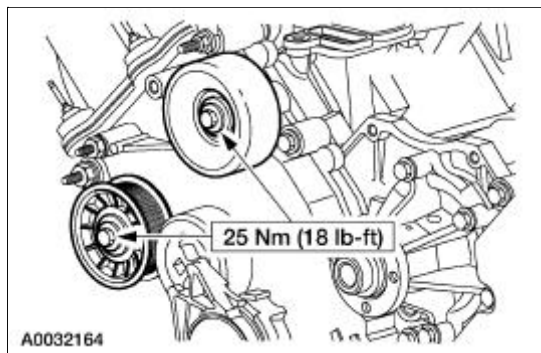
3. Install the engine front cover and tighten the bolts and studs in sequence shown.



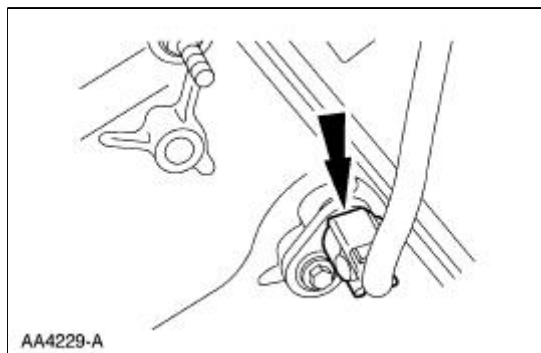
Item	Part Number	Description
1	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
2	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
3	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
4	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
5	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
6	W706508	Stud, Hex Shldr Pilot, M8 x 1.25 x 50 — M6 x 1 x 10
7	N808586	Stud and Washer, Hex-Head Pilot, M8 x 1.25 x 60 — M6 x 1 x 26
8	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
9	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
10	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
11	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
12	W706560	Stud, Hex Head Pilot, M8 x 1.25 x 65 — M8 x

		1.25 x 16
13	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
14	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
15	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26

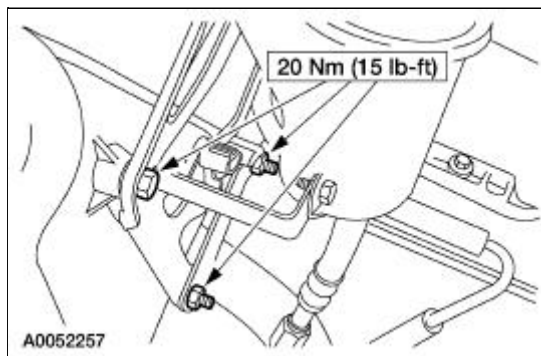
4. Install the idler pulleys.



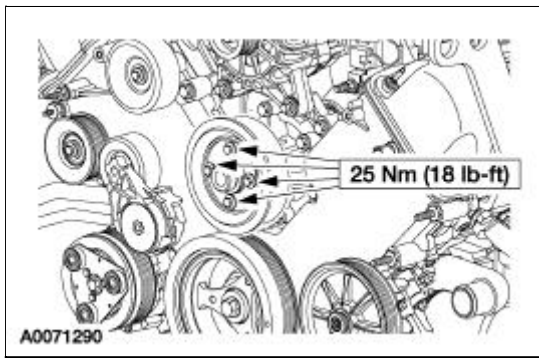
5. Connect the camshaft position (CMP) sensor electrical connector.



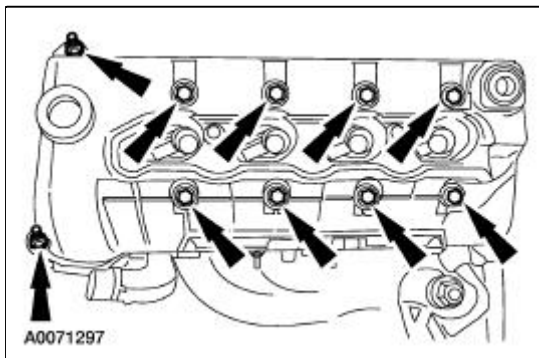
6. Position the power steering reservoir and bracket assembly and install the bolts.



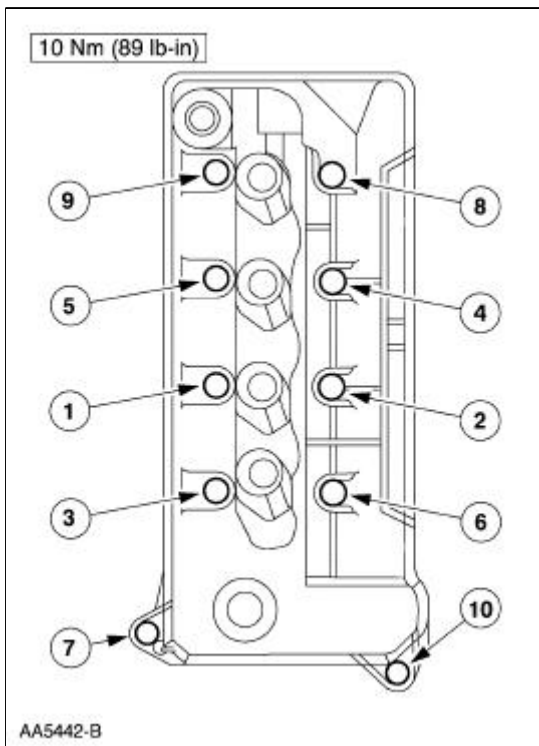
7. Install the coolant pump pulley and the bolts.



8. Install the LH valve cover and loosely install the bolts.



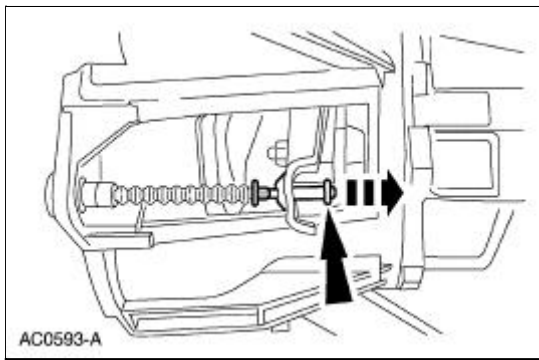
9. Tighten the LH valve cover bolts in the sequence shown.



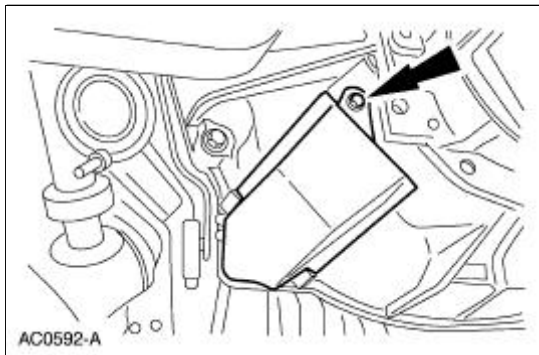
10. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).

Manual transmission vehicles

11. Connect the clutch release cable to the clutch release fork.

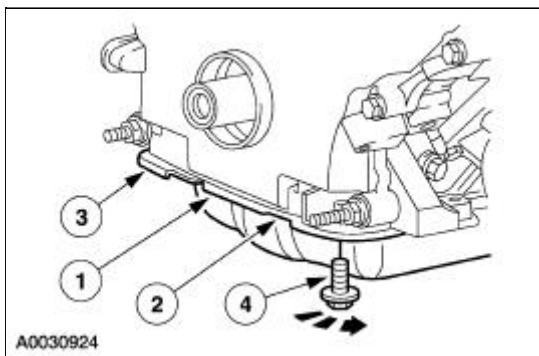


12. Install the clutch release cable shield and the bolt.

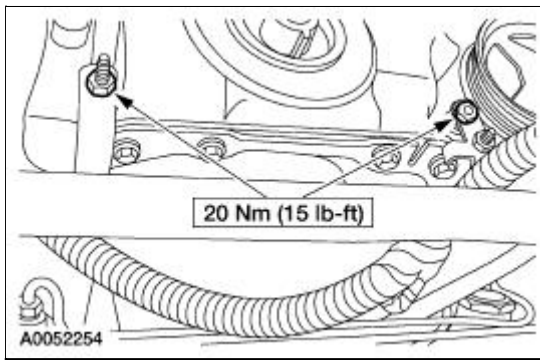


All vehicles

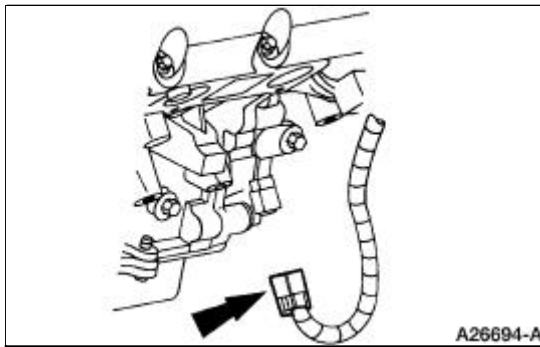
13. Loosely install the four oil pan bolts. Tighten the bolts in three stages, and in the sequence shown.
1. Stage 1: Tighten the bolts to 2 Nm (18 lb-in).
 2. Stage 2: Tighten the bolts to 20 Nm (15 lb-ft).
 3. Stage 3: Tighten the bolts an additional 90 degrees (1/4 turn).



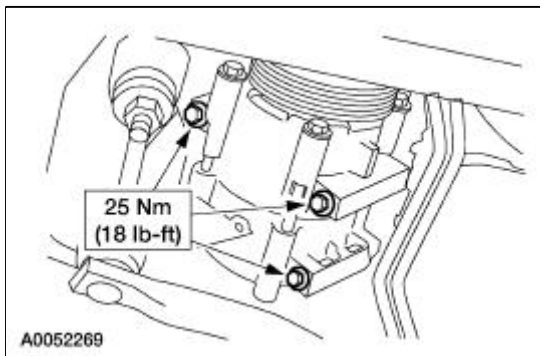
14. Position the wiring harness and install the nuts.



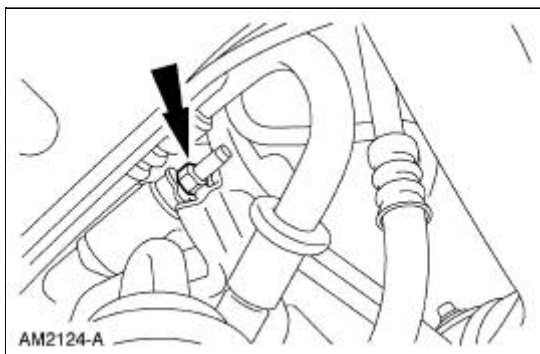
15. Connect the crankshaft position (CKP) sensor electrical connector.



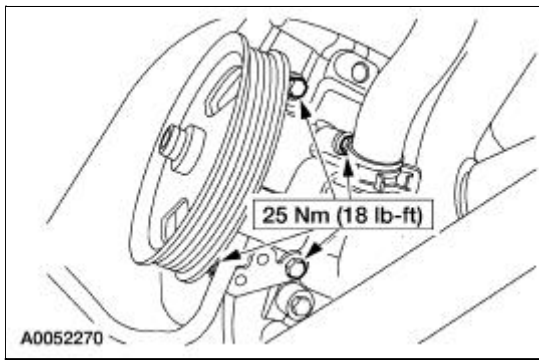
16. Position the A/C compressor, A/C muffler, and the hose. Install the bolts.



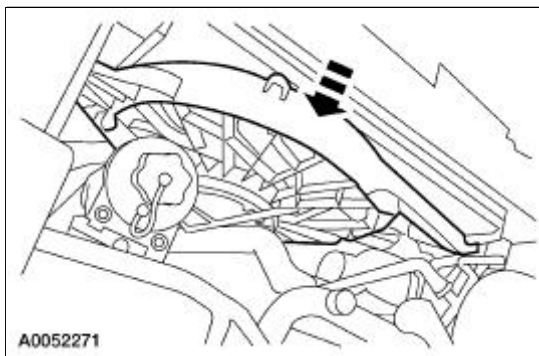
17. Install the A/C muffler bracket nut.



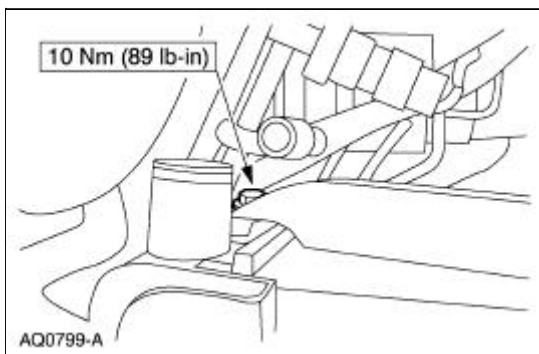
18. Position the power steering pump and install the bolts.



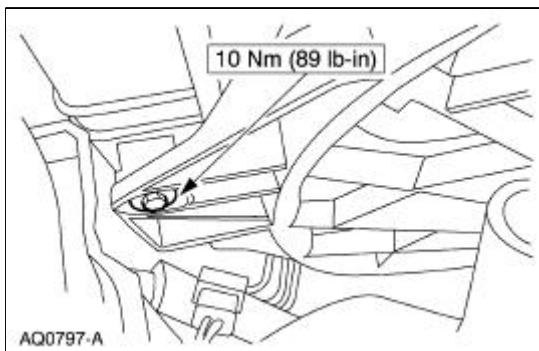
19. Install the crankshaft front oil seal. For additional information, refer to [Crankshaft Front Oil Seal](#) in this section.
20. Position the cooling fan and shroud in the installed position.



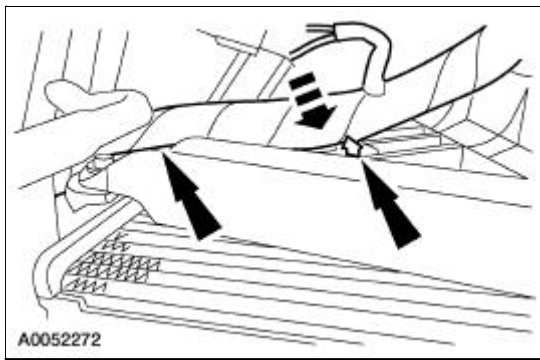
21. Install the RH cooling fan bolt.



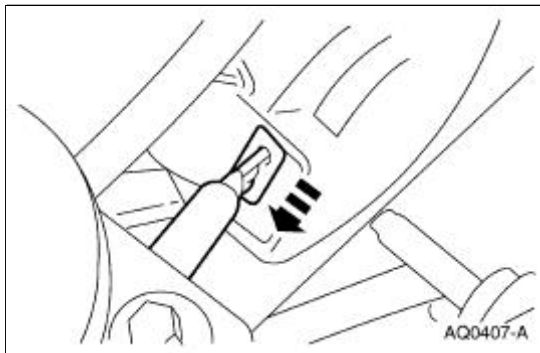
22. Install the LH cooling fan bolt.



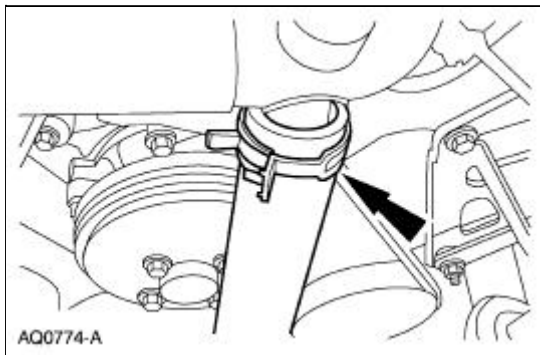
23. Attach the cooling fan wiring harness to the fan shroud.



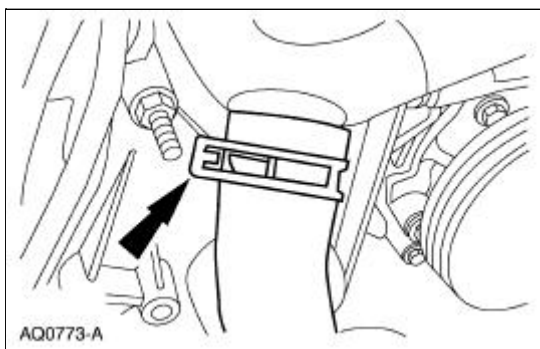
24. Connect the cooling fan electrical connector.



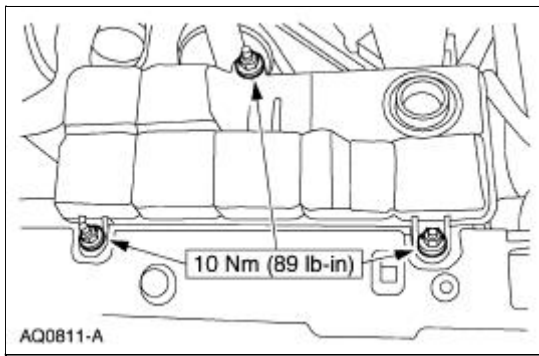
25. Connect the lower radiator hose to the bypass tube.



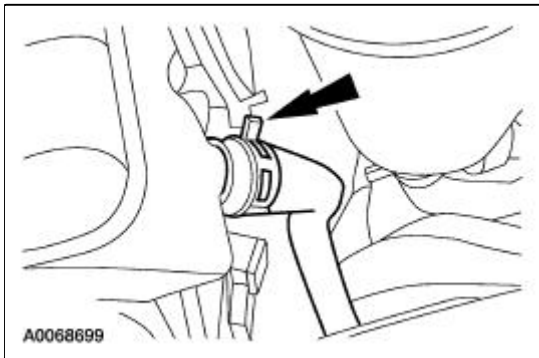
26. Connect the upper radiator hose to the bypass tube.



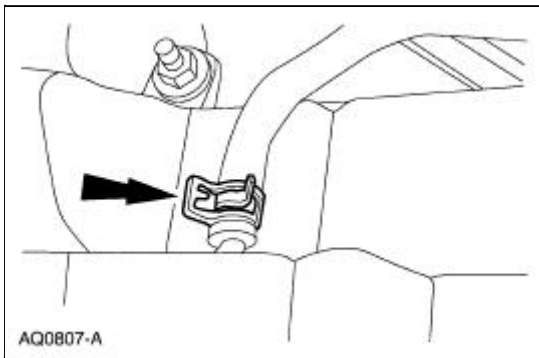
27. Install the degas bottle and the nuts.



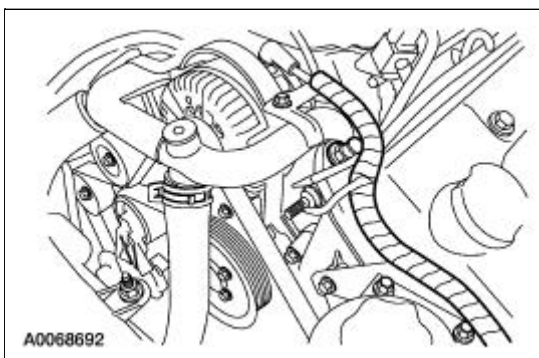
28. Connect the degas bottle return hose.



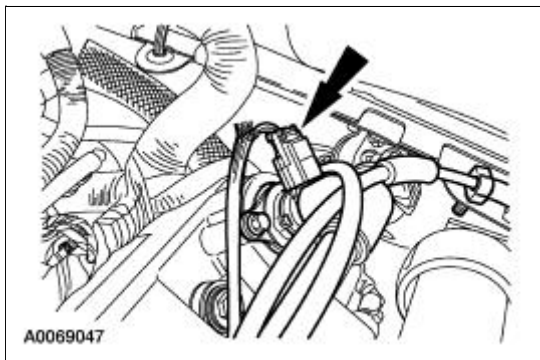
29. Connect the degas bottle vent hose.



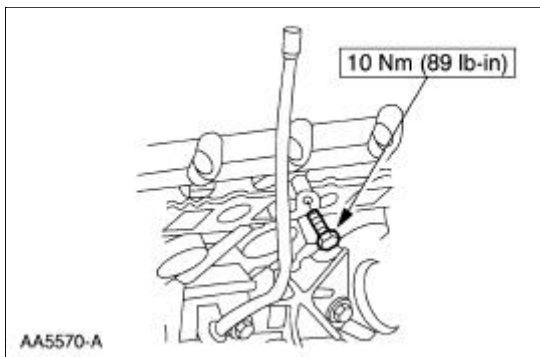
30. Connect the wiring harness anchor to the valve cover.



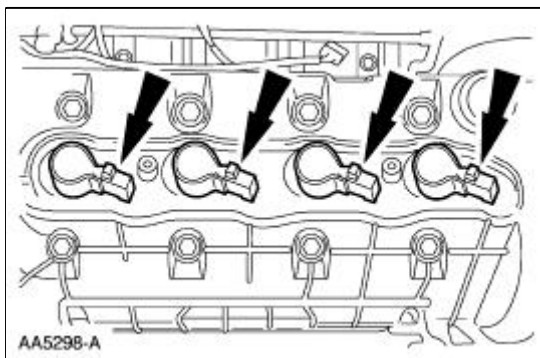
31. Install the positive crankcase ventilation (PCV) valve hose and connect the electrical connector.



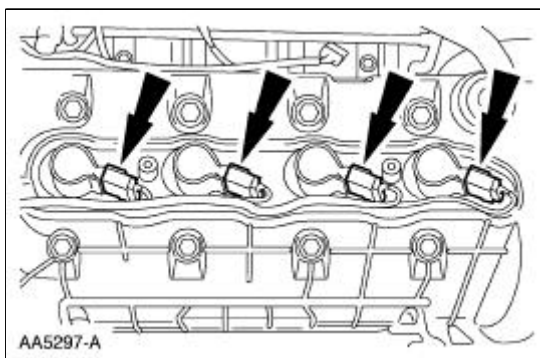
32. Position the oil level indicator tube and install the bolt.



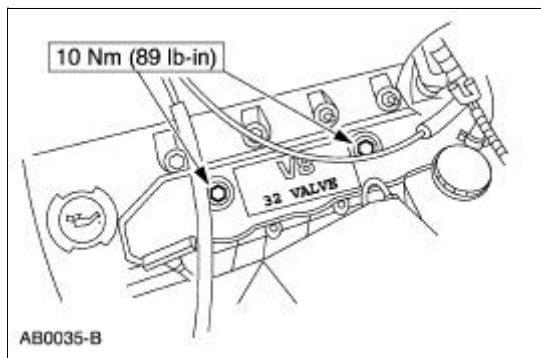
33. Install the LH ignition coils.



34. Connect the LH ignition coil electrical connectors.

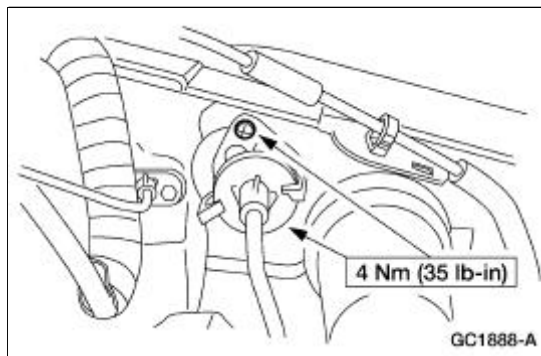


35. Install the LH coil cover and install the bolts.



Manual transmission vehicles

36. Install the clutch release cable screws.



All vehicles

37. Install the RH valve cover. For additional information, refer to [Valve Cover RH](#) in this section.
 38. Install the Hydro-Boost brake booster. For additional information, refer to [Section 206-07](#).
 39. Install the air intake scoop bracket. For additional information, refer to [Section 303-12](#).
 40. Fill the crankcase with clean engine oil.
-

Timing Drive Components

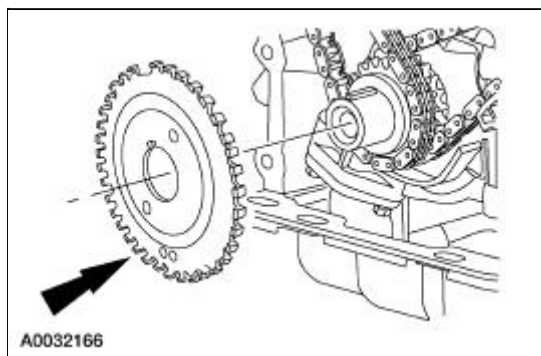
Special Tool(s)



Removal

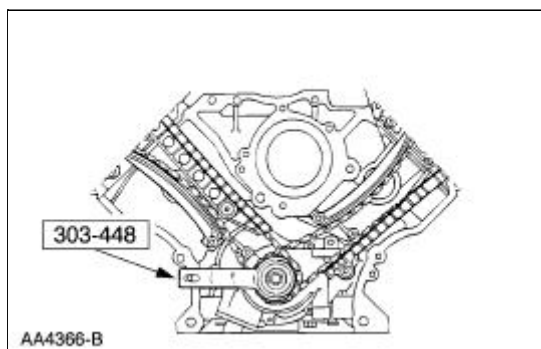
⚠ CAUTION: Since the engine is not free-wheeling, if the crankshaft or the camshafts are moved in any manner during removal and installation, the crankshaft and the camshafts must be re-synchronized.


1. Remove the engine front cover. For additional information, refer to [Engine Front Cover](#) in this section.
2. Remove the crankshaft sensor ring from the crankshaft.



3. **⚠ CAUTION:** Unless otherwise instructed, at no time when the timing chains are removed and the cylinder heads are installed is the crankshaft or the camshaft to be rotated. Severe piston and valve damage will occur.

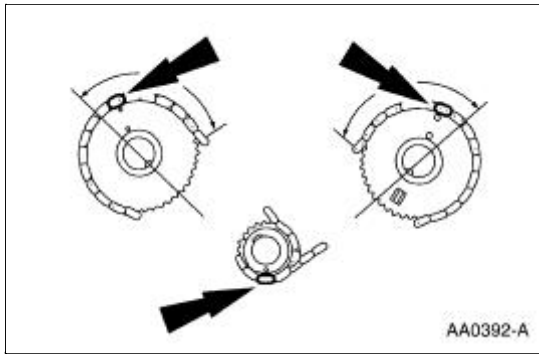
Using the special tool, position the crankshaft as shown.



4.  **CAUTION: The camshaft timing marks must be correctly lined up or damage to the valves and pistons can occur.**

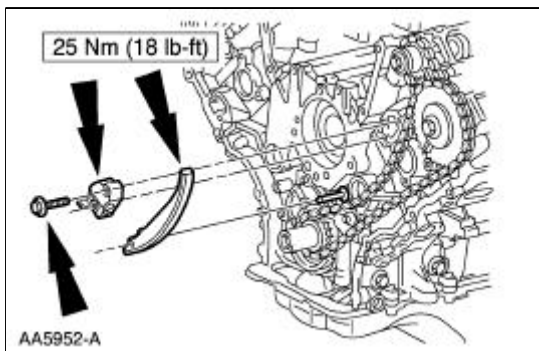
NOTE: The copper links on the timing chain may not line up with the timing marks on the sprockets.


Make sure the timing marks on the camshaft sprockets are correctly positioned. If necessary, turn the crankshaft one full turn clockwise to correctly position the sprockets.



5. **NOTE:** LH shown; RH similar.

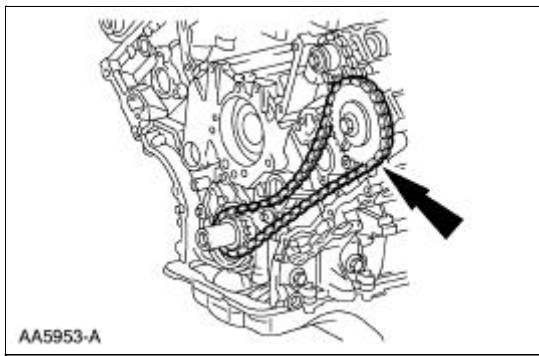
Remove the two bolts, the timing chain tensioner and tensioner arm.



6.  **CAUTION: Unless otherwise instructed, at no time when the timing chains are removed and the cylinder heads are installed is the crankshaft or the camshaft to be rotated. Severe piston and valve damage will occur.**

Remove the LH and RH timing chains and the crankshaft sprocket.

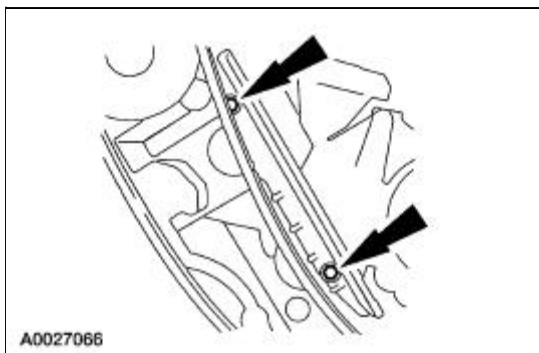
- Remove the special tool from the crankshaft.
- Remove the RH timing chain from camshaft sprocket.
- Remove the RH timing chain from the crankshaft sprocket.
- Remove the LH timing chain from the camshaft sprocket.
- Remove the LH timing chain and the crankshaft sprocket.




7.  **CAUTION:** The bolts are different lengths and must be returned to their original location.

NOTE: RH shown; LH similar.

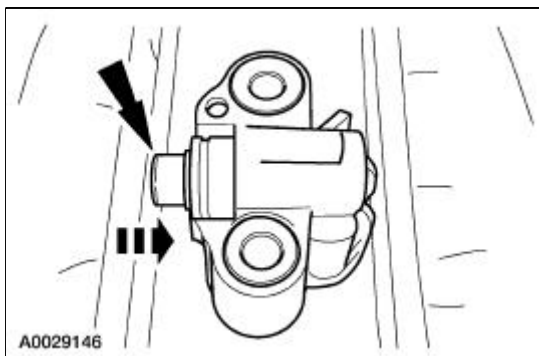
Remove the bolts and the timing chain guides.



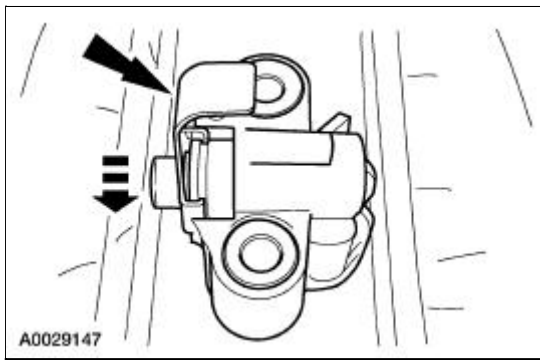
Installation

1.  **CAUTION:** Timing chain procedures must be followed exactly or damage to the pistons or valves will result.

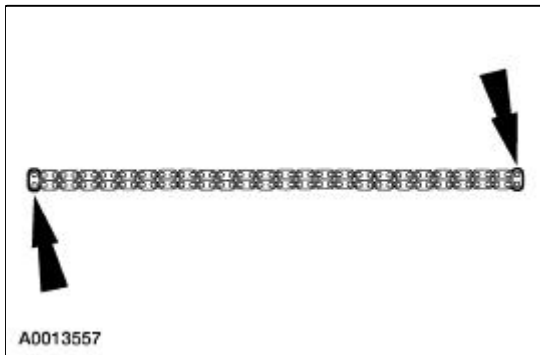
Compress the tensioner plunger, using a soft-jawed vise.



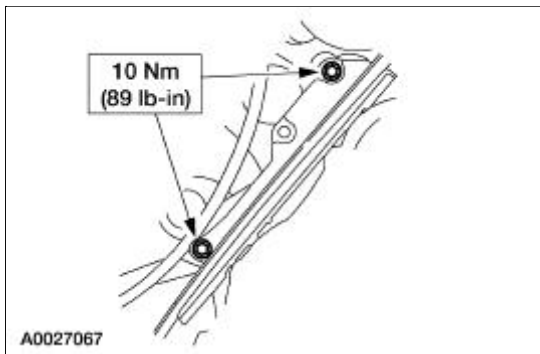
2. Install a retaining clip on the tensioner to hold the plunger in during installation.
- Remove the tensioner from the vise.



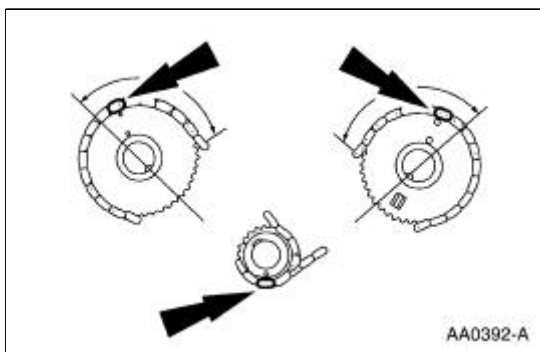
3. If the copper links are not visible, mark one link on one end and one link on the other end, and use as timing marks.



4. Install the timing chain guides.




5. Rotate the LH camshaft sprocket until the timing mark is approximately at the 12 o' clock position. Rotate the RH camshaft timing sprocket until the timing mark is approximately in the 11 o' clock position.

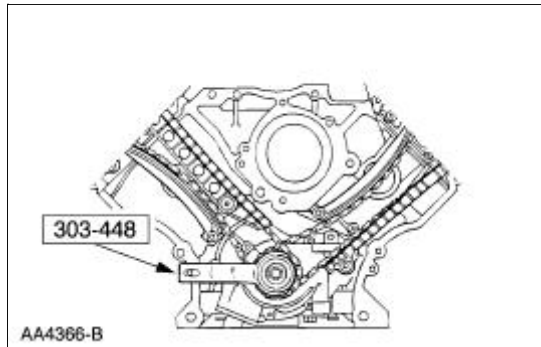


6.  **CAUTION:** Unless otherwise instructed, at no time when the timing chains are

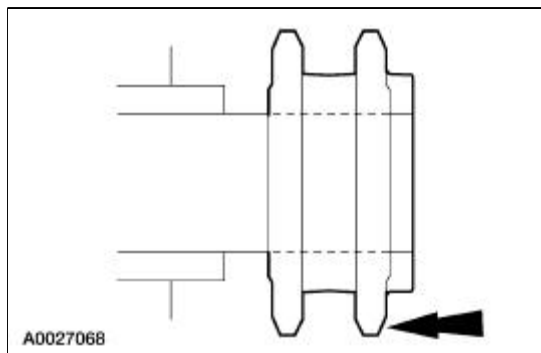
removed and the cylinder heads are installed is the crankshaft or the camshaft to be rotated. Severe piston and valve damage will occur.

 **CAUTION:** Rotate the crankshaft counterclockwise only. Do not rotate past position shown or severe piston or valve damage will occur.

Using the special tool, position the crankshaft.

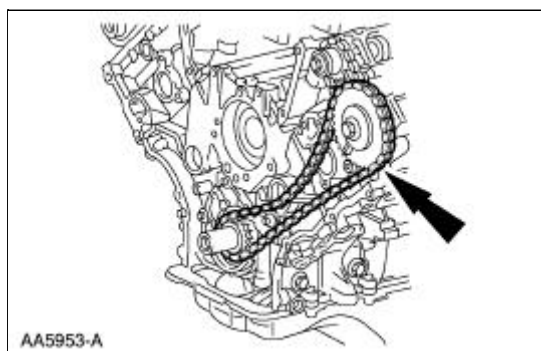


7. Remove the special tool.
8. Install the crankshaft sprocket with the flange facing forward.

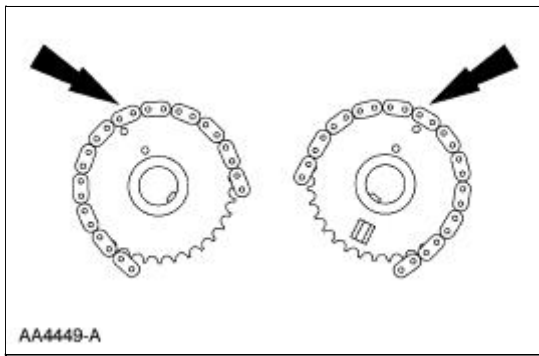


9. **NOTE:** LH timing chain shown; RH similar.

Install the LH timing chain onto the crankshaft sprocket, aligning the one copper link on the timing chain with the slot on the crankshaft sprocket.

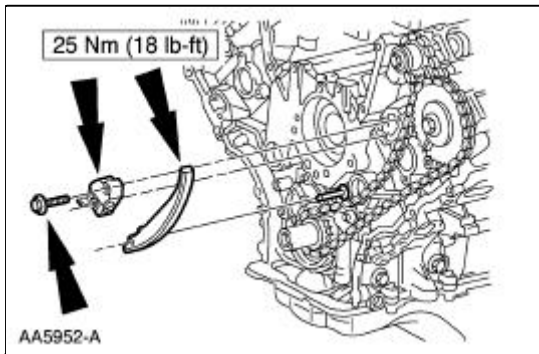


10. Verify the camshaft sprocket to copper link alignment.

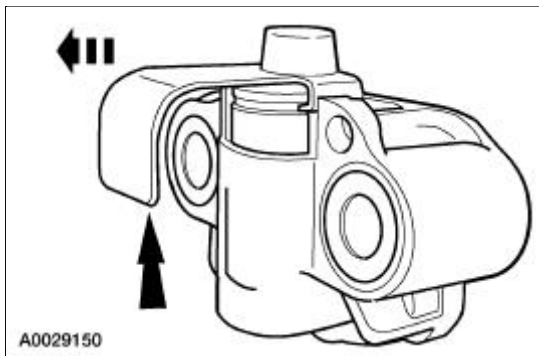


11. **NOTE:** LH shown; RH similar.

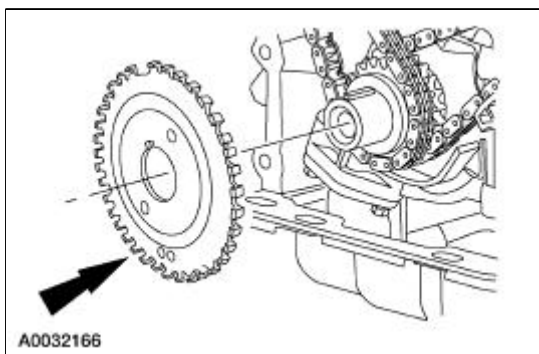
Position the tensioner arms and tensioners, and install the bolts.



12. Remove the retaining clips from the timing chain tensioners.





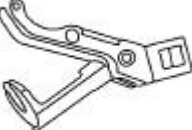
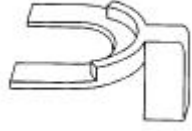
13. Position the crankshaft sensor ring on the crankshaft.




14. Install the engine front cover. For additional information, refer to [Engine Front Cover](#) in this section.

Valve — Springs, Retainer and Valve Stem Seal

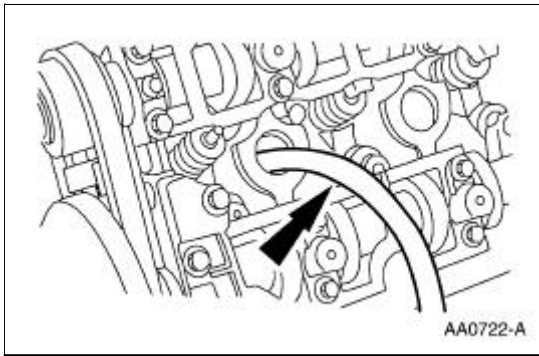
Special Tool(s)

 ST1718-A	Compressor, Valve Spring 303-452 (T93P-6565-AR)
 ST1332-A	Installer, Valve Stem Oil Seal 303-383 (T91P-6571-A)
 ST1693-A	Compressor, Valve Spring 303-567 (T97P-6565-AH)
 ST1331-A	Spacer, Valve Spring Compressor 303-382 (T91P-6565-AH)

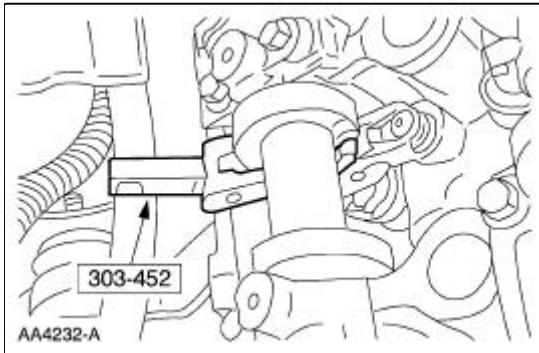
Removal

1. Remove the roller followers. For additional information, refer to [Roller Followers](#) in this section.
2. Remove the spark plugs. For additional information, refer to [Section 303-07C](#).
3. Position the piston of the cylinder being serviced at the bottom of the stroke.
4.  **CAUTION:** If air pressure has forced the piston to the bottom of the cylinder any loss of air pressure will allow the valve to fall into the cylinder. If air pressure must be removed support the valve prior to removal.

Use compressed air in the cylinder to hold both valves in position.

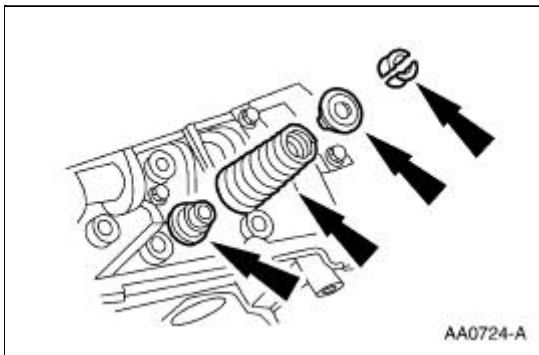


5. Using the special tool, compress the intake valve spring.

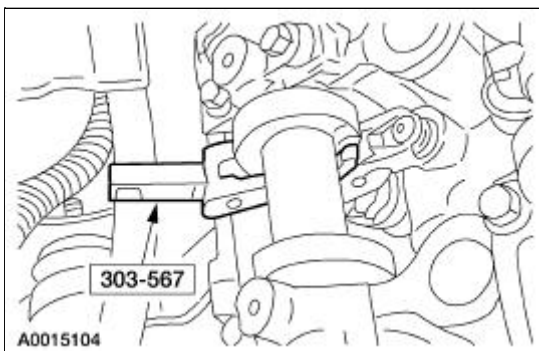


6. **NOTE:** Valve stem seals should be visually inspected if new seals are not installed.

Remove the valve spring retainer keys, the valve spring retainer, the valve spring and the valve stem seal.

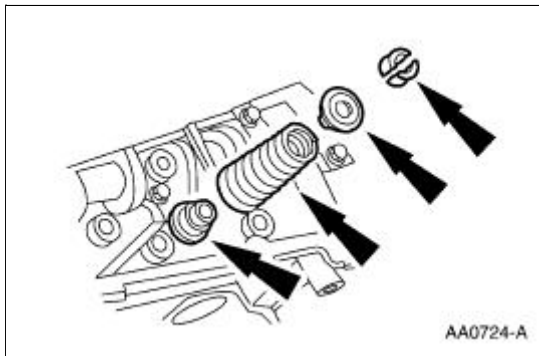


7. Using the special tool, compress the exhaust valve spring.



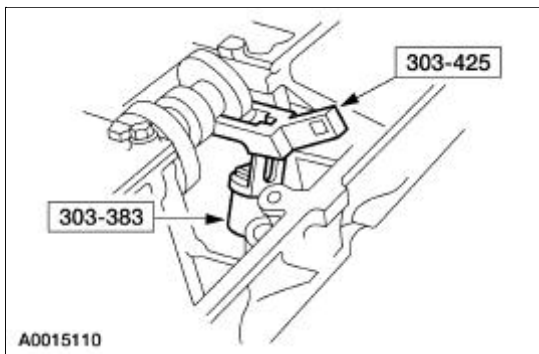
8. **NOTE:** Valve stem seals should be visually inspected if new seals are not installed.

Remove the valve spring retainer keys, the valve spring retainer, the valve spring and the valve stem seal.

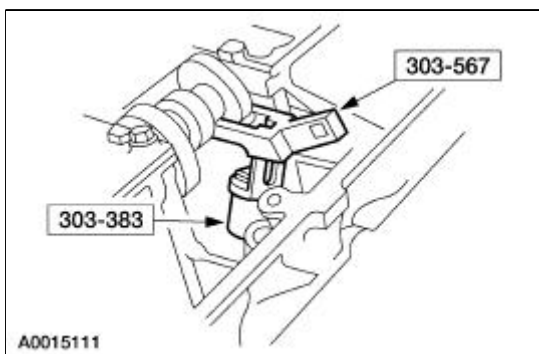


Installation

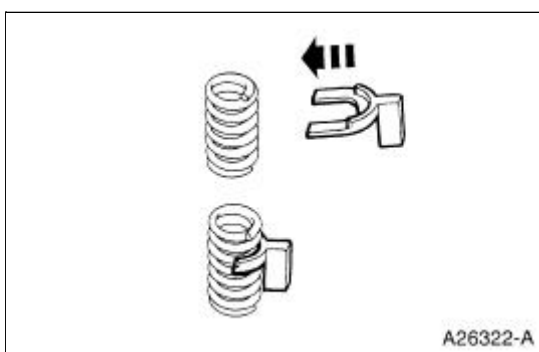
1. Using the special tools, install the new intake valve stem seals.



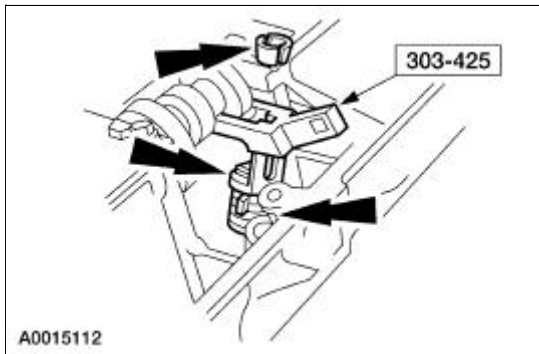
2. Using the special tools, install the new exhaust valve stem seals.



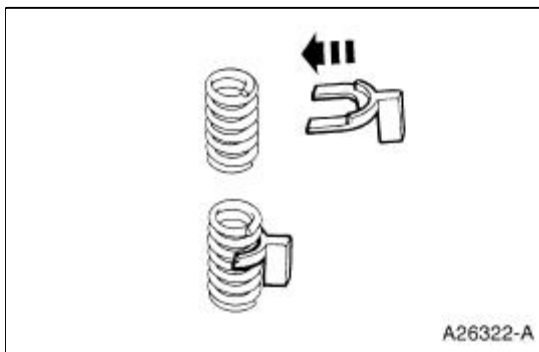
3. Install the Valve Spring Compressor Spacer between the valve spring coils to protect the intake valve stem seal from damage.



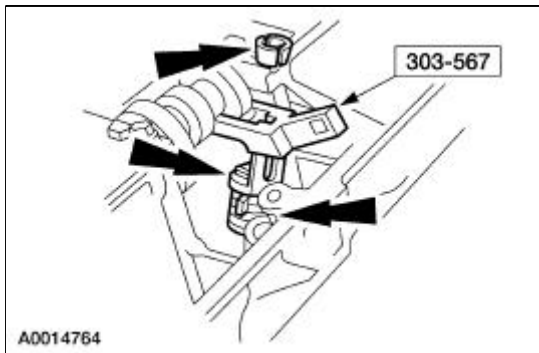
- Using the special tool, install the intake valve spring, the spring retainer and the valve spring retainer keys.



- Install the Valve Spring Compressor Spacer between the valve spring coils to protect the intake valve stem seal from damage.



- Using the special tool, install the exhaust valve spring, the spring retainer and the valve spring retainer keys.

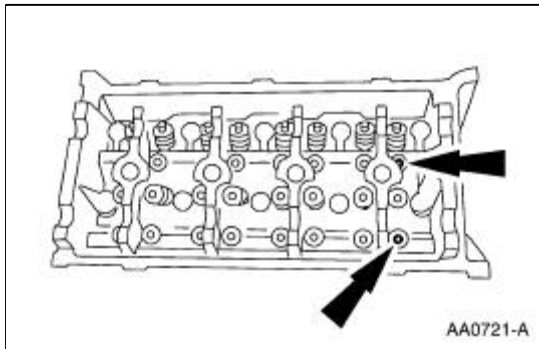


- Remove the compressed air hose from the cylinder.
 - Install the spark plugs. For additional information, refer to [Section 303-07C](#).
 - Install the roller followers. For additional information, refer to [Roller Followers](#) in this section.
-

Hydraulic Lash Adjusters

Removal

1. Remove the roller followers. For additional information, refer to [Roller Followers](#) in this section.
2. Remove the 16 hydraulic lash adjusters.



3. Inspect the roller followers. For additional information, refer to [Section 303-00](#).

Installation

1. To install, reverse the removal procedure.
-

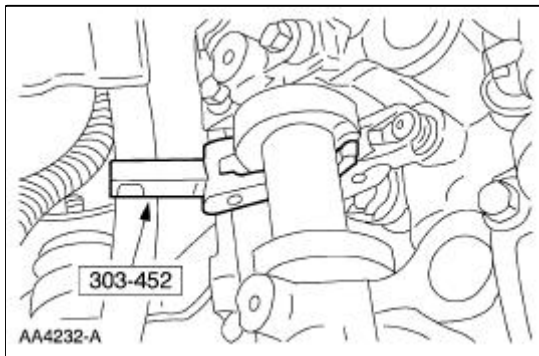
Roller Followers

Special Tool(s)

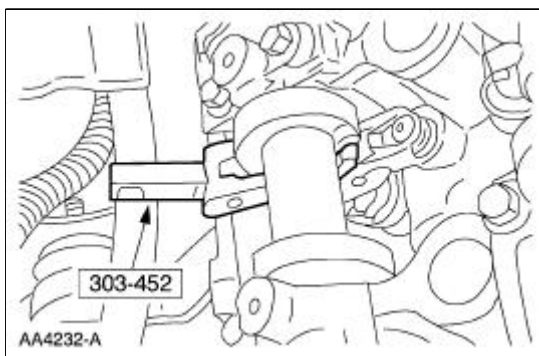


Removal and Installation

1. Remove the LH and RH valve cover. For additional information, refer to [Valve Cover LH](#) and [Valve Cover RH](#) in this section.
2. Position the piston of the cylinder being repaired at the bottom of the stroke and camshaft lobe at base circle.
3. Using the special tool, compress the intake valve spring and remove the roller follower.



4. Using the special tool, compress the exhaust valve spring and remove the roller follower.



5. Repeat Steps 2, 3 and 4 to remove all the necessary roller followers. Inspect roller finger followers and camshafts. For additional information, refer to [Section 303-00](#).
6. To install, reverse the removal procedure.

Camshaft

Special Tool(s)

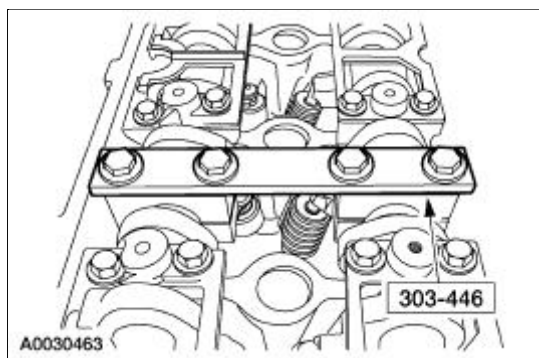
 ST1715-A	Holding Tool, Camshaft 303-446 (T93P-6256-AHR)
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Material

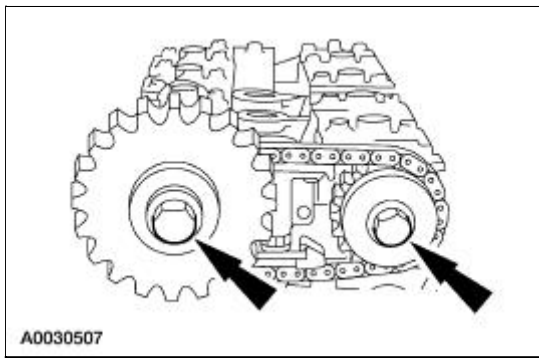
Item	Specification
Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153- H

Removal

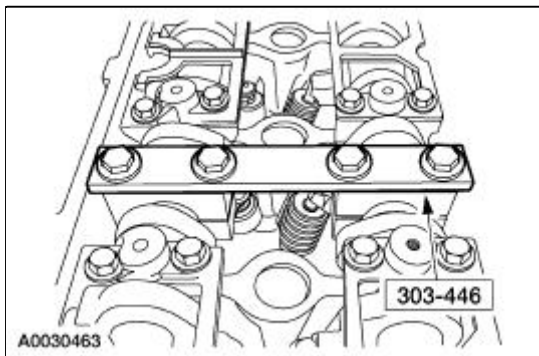
1. Remove the roller followers. For additional information, refer to [Roller Followers](#) in this section.
2. Remove the LH timing chain for the LH side and both timing chains for the RH side. For additional information, refer to [Timing Drive Components](#) in this section.
3. Install the special tool.



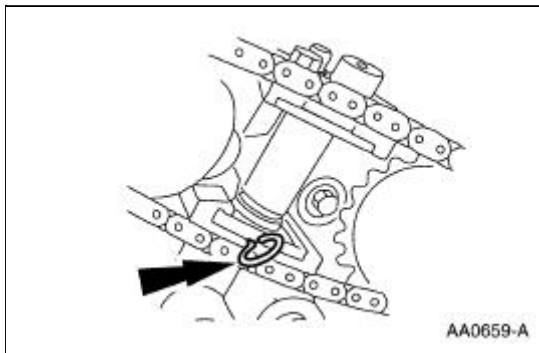
4. Remove the exhaust camshaft sprocket and the intake camshaft bolt, washer and spacer.



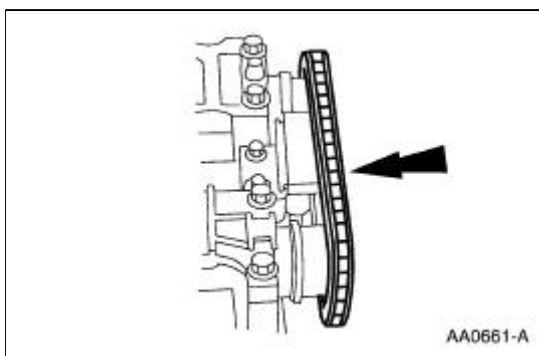
5. Remove the special tool.



6. Compress the tensioner and install a lock pin.

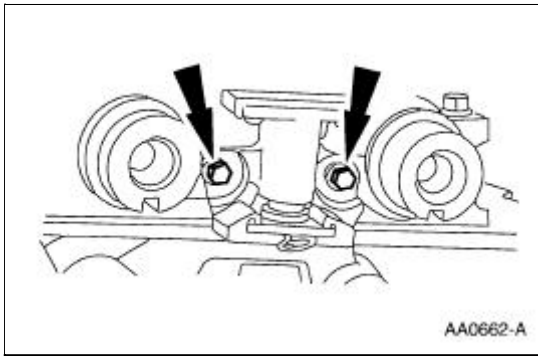



7. Remove the timing chain, the sprocket, and intake camshaft sprocket spacer.



8. **NOTE:** LH shown; RH similar.

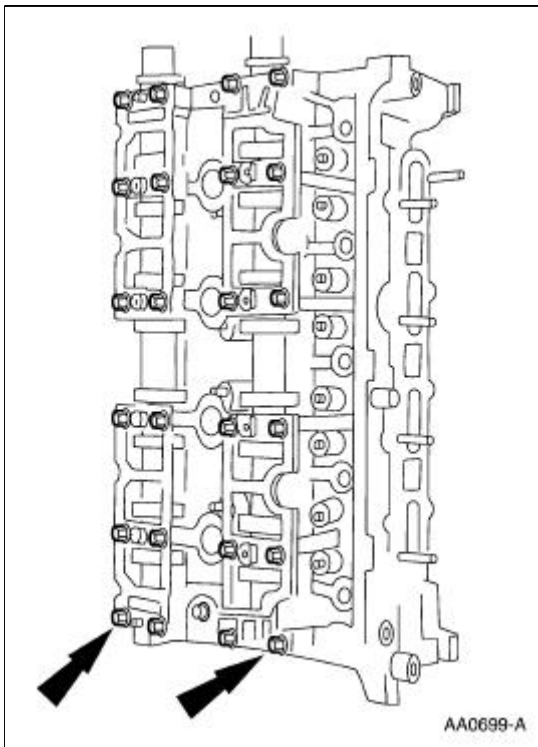
Remove the bolts.



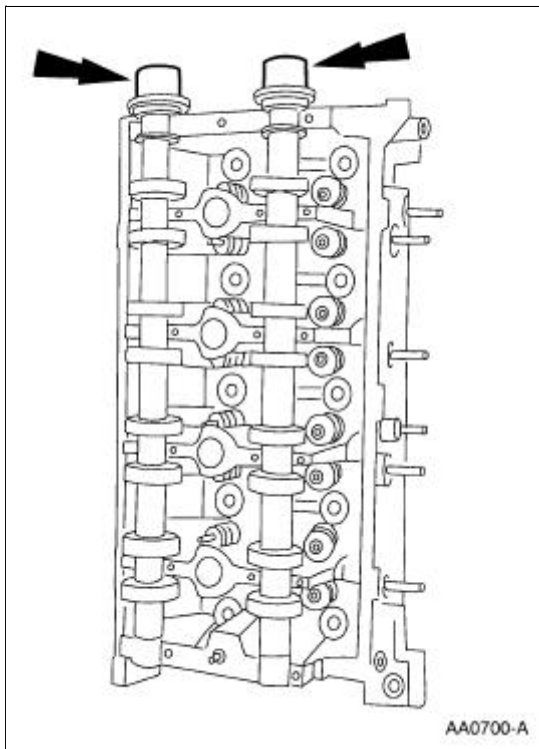
9.  **CAUTION:** The outer bolts on the outer cam bearing cap (exhaust) are longer and must be returned to the same location or engine damage may occur.

NOTE: Identify the camshaft to cylinder head location. Caps are not interchangeable.

Remove the bolts and the camshaft bearing cap assemblies.



10. Remove the camshafts.

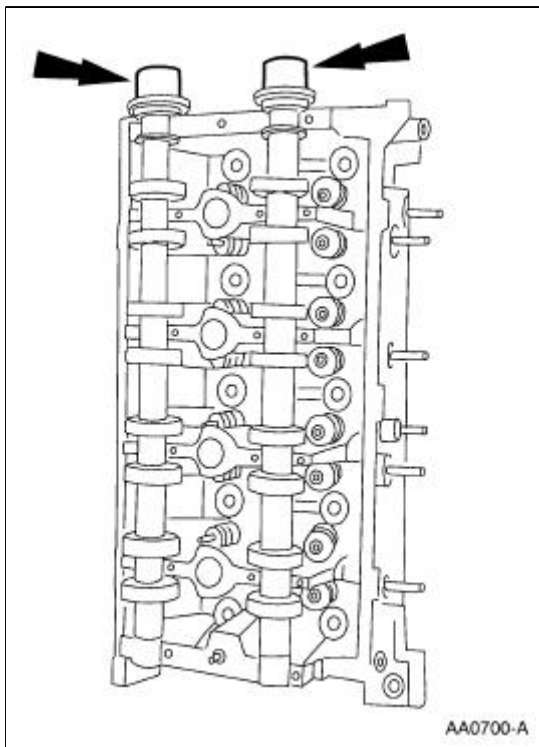


Installation

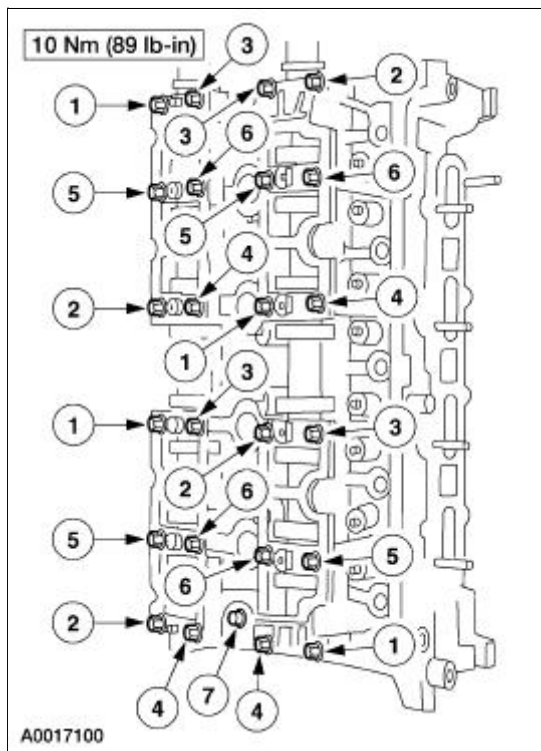
1. **NOTE:** LH shown; RH similar.

Install the camshafts.

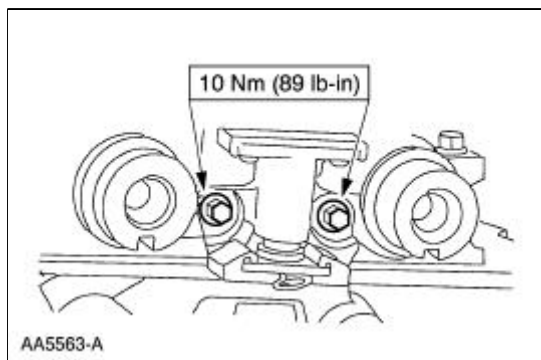
- Lubricate the camshafts with clean engine oil.



2. Install the camshaft bearing cap assemblies and tighten the bolts in the sequence shown.

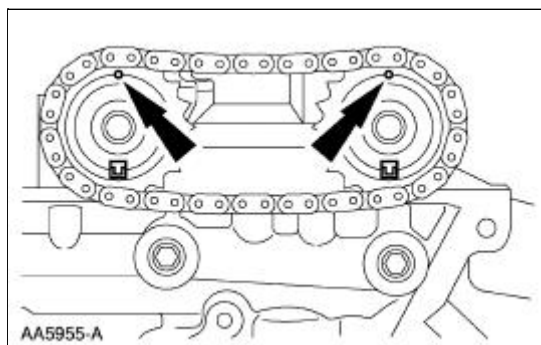


3. Install the bolts.

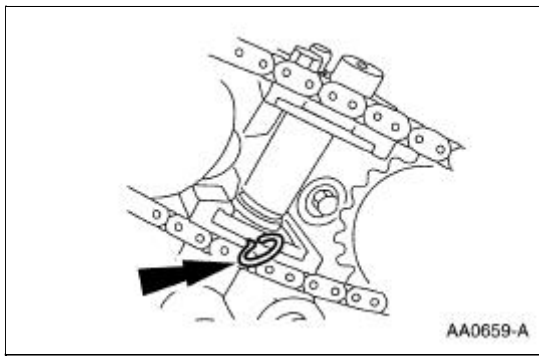


4.  **CAUTION: Timing marks must be at 12 o'clock and indexed at 6 o'clock.**

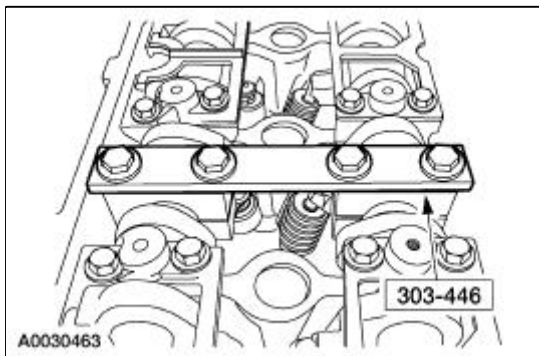
Install the camshaft sprockets and the chain as an assembly.



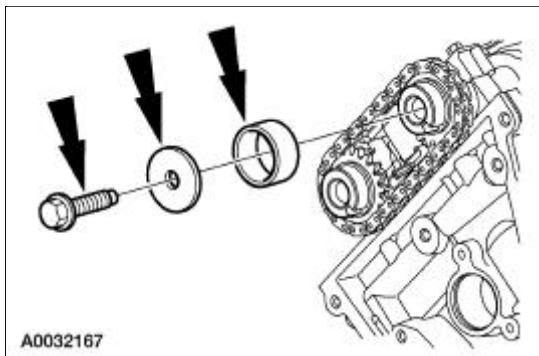
5. Remove the lockpin from the chain tensioner.



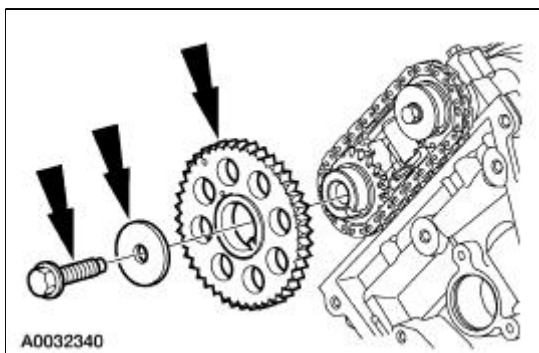
6. Install the special tool.



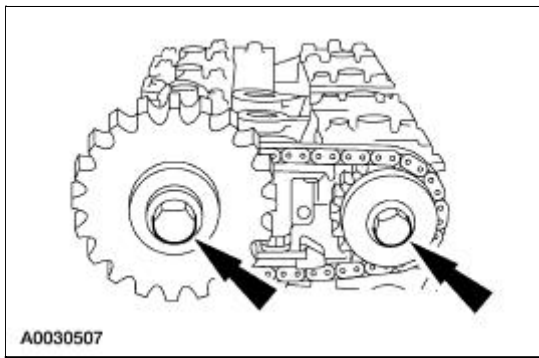
7. Install the camshaft spacer, washer and bolt and hand-tighten the bolt.



8. Install the camshaft sprocket, washer and bolt, and hand-tighten the bolt.



9. Tighten the bolts in two stages:
 - Stage 1: Tighten to 40 Nm (30 lb-ft).
 - Tighten an additional 90 degrees.

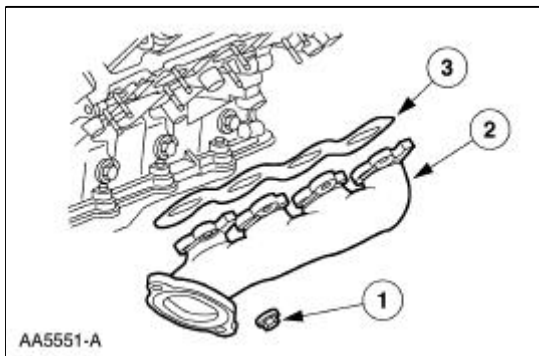


10. Remove the special tool.
 11. Install the left timing chain for the left side or both timing chains for the right side. For additional information, refer to [Timing Drive Components](#) in this section.
 12. Install the roller followers. For additional information, refer to [Roller Followers](#) in this section.
-

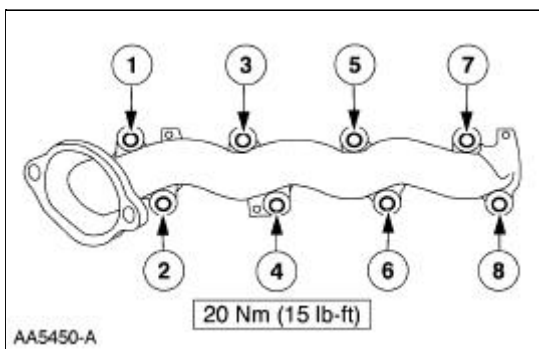
Exhaust Manifold RH

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Raise the vehicle. For additional information, refer to [Section 100-02](#).
3. Remove the dual converter Y-pipe. For additional information, refer to [Section 309-00](#).
4. Remove the starter. For additional information, refer to [Section 303-06](#).
5. Remove the exhaust manifold.
 1. Remove the nuts.
 2. Remove the exhaust manifold.
 3. Remove and discard the gasket.



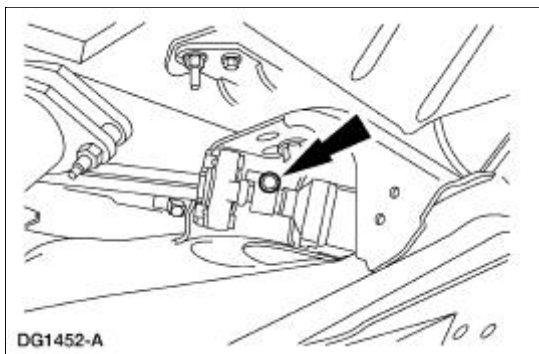
6. To install, reverse the removal procedure.
 - Use a new exhaust manifold gasket.
 - Tighten the exhaust manifold nuts in the sequence shown.



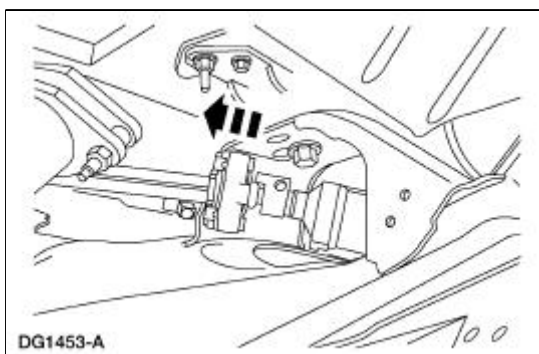
Exhaust Manifold LH

Removal and Installation

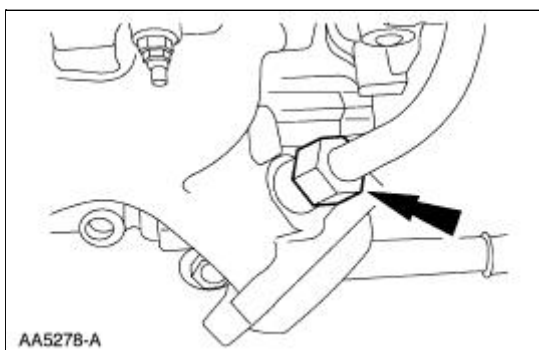
1. Position the steering wheel straight ahead and lock the column.
2. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
3. Raise the vehicle. For additional information, refer to [Section 100-02](#).
4. Remove the dual converter Y-pipe. For additional information, refer to [Section 309-00](#).
5. Remove and discard the pinch bolt.



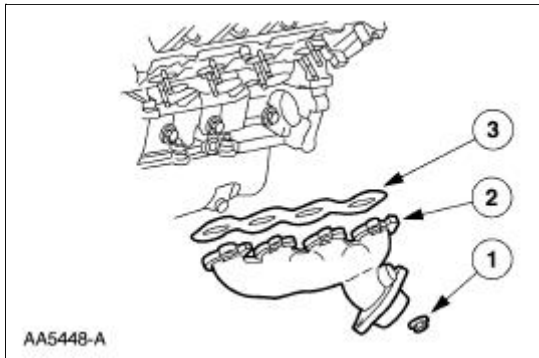
6. Separate the steering coupler.



7. Disconnect the exhaust gas recirculation (EGR) tube at the exhaust manifold.



8. Remove the exhaust manifold.
 1. Remove the nuts.
 2. Remove the exhaust manifold.
 3. Remove and discard the gasket.

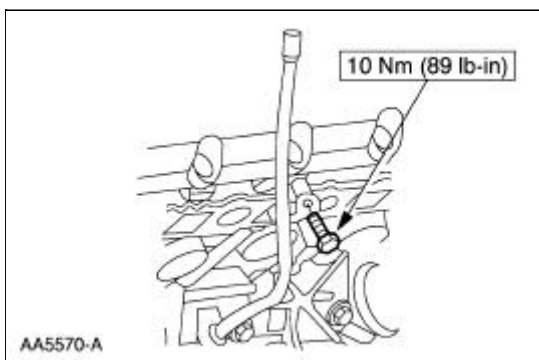


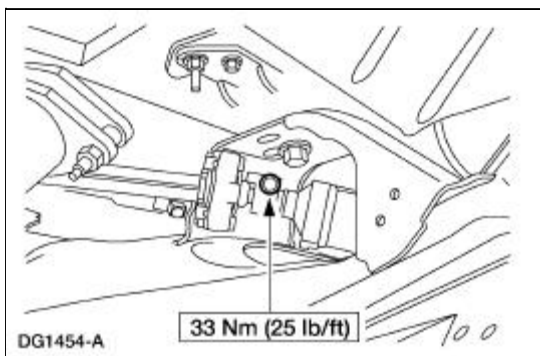
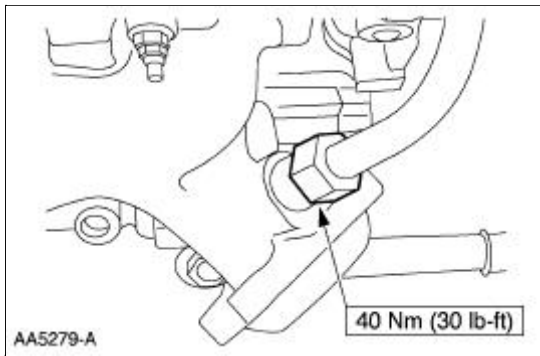
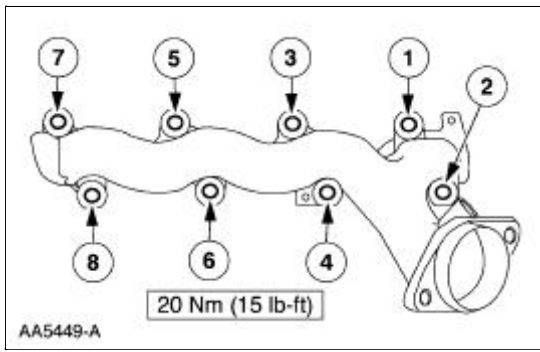
9. Remove the oil level indicator tube.



10. Remove and discard the exhaust manifold gasket.

11. To install, reverse the removal procedure.
 - Use a new exhaust manifold gasket.

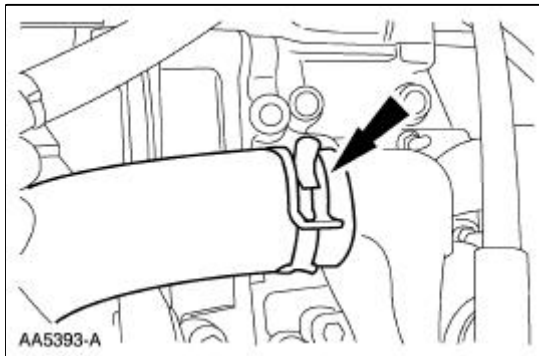




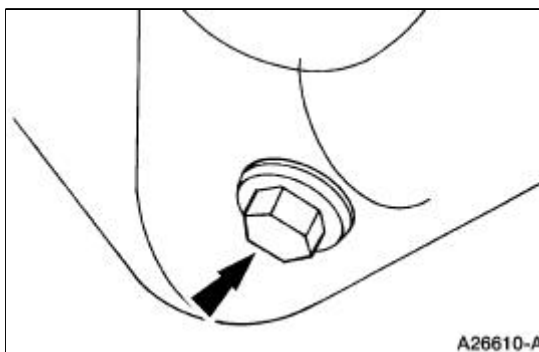
Oil Filter Adapter

Removal

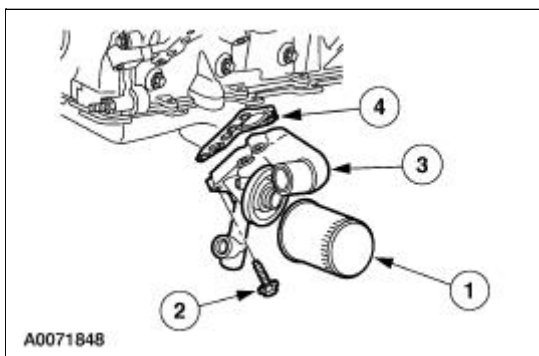
1. Drain the cooling system. For additional information, refer to [Section 303-03A](#).
2. Disconnect the lower radiator hose.



3. Raise the vehicle. For additional information, refer to [Section 100-02](#).
4. Drain the engine oil.



5. Remove the oil filter adapter.
 1. Remove the oil filter.
 2. Remove the bolts.
 3. Remove the oil filter adapter.
 4. Remove the gasket.

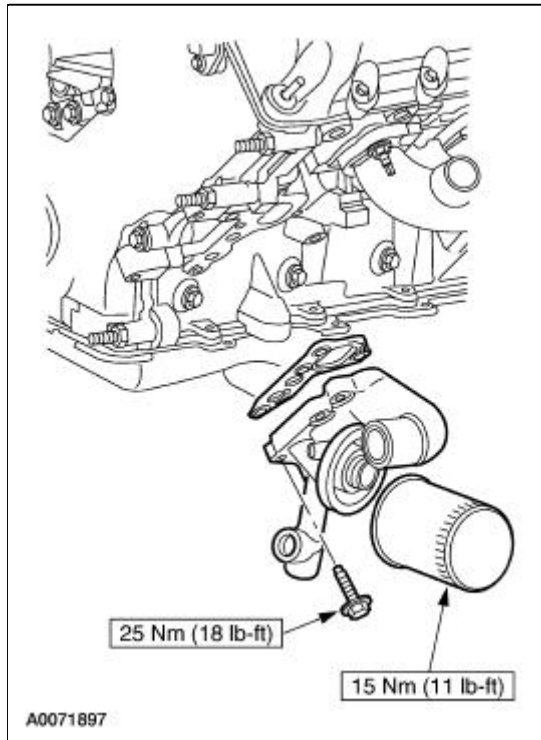


6. Clean and inspect the oil filter adapter.

- Flush the oil filter adapter with parts cleaner. If metal particles are present in the adapter, install a new adapter.

Installation

1. To install, reverse the removal procedure.



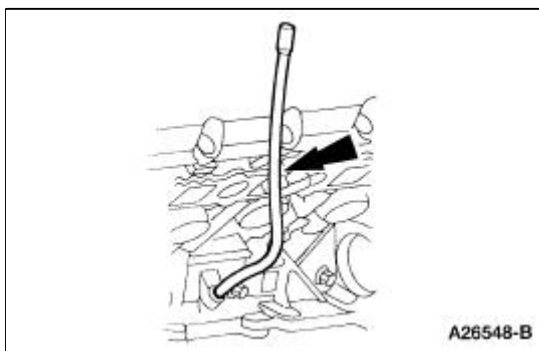
Oil Level Indicator and Tube

Removal

1. Remove the oil level indicator.
2. Remove the LH exhaust manifold. For additional information, refer to [Exhaust Manifold LH](#) in this section.
3. Remove the bolt.

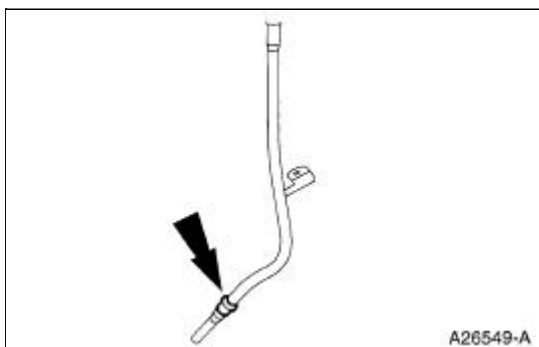


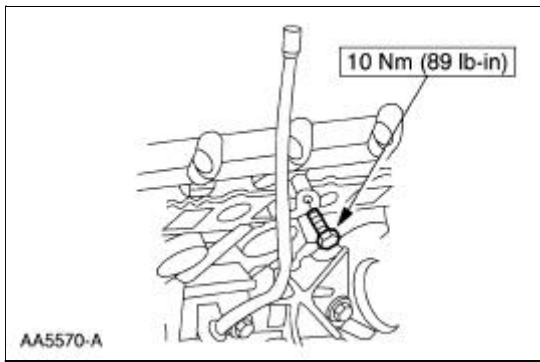
4. Remove the oil level indicator tube.



Installation

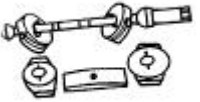

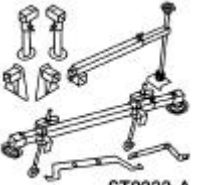
1. To install, reverse the removal procedure.





Oil Pan

Special Tool(s)

 <p>ST1352-A</p>	<p>Compressor, Coil Spring 204-D001 (D78P-5310-A)</p>
 <p>ST1604-A</p>	<p>Lifting Bracket, Engine 303-D088 (D93P-6001-A2)</p>
 <p>ST2333-A</p>	<p>3-Bar Engine Support Kit 303-F072</p>

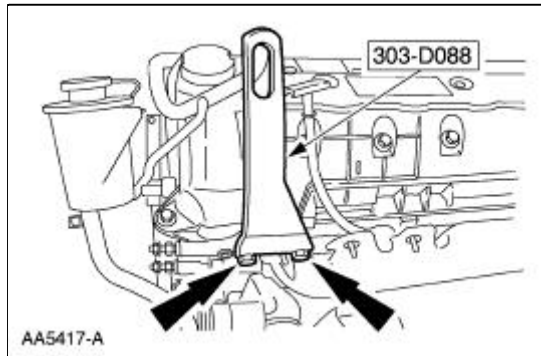
Material

Item	Specification
<p>Metal Surface Cleaner F4AZ-19A536-RA or equivalent</p>	<p>WSE-M5B392-A</p>
<p>Silicone Gasket and Sealant F7AZ-19554-EA or equivalent</p>	<p>WSE-M4G323- A4</p>
<p>Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent</p>	<p>WSS-M2C153-H</p>

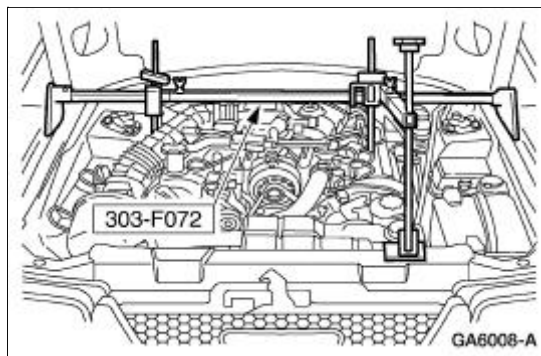
Removal

1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Remove the transmission. For additional information, refer to [Section 307-01](#) or [Section 308-03B](#).
3. Remove the air intake scoop. For additional information, refer to [Section 303-12](#).
4. Remove the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).
5. Remove the radiator sight shield.
6. Remove the manifold and tube assembly—accumulator to compressor, 4.6L. For additional information, refer to [Section 412-03](#).

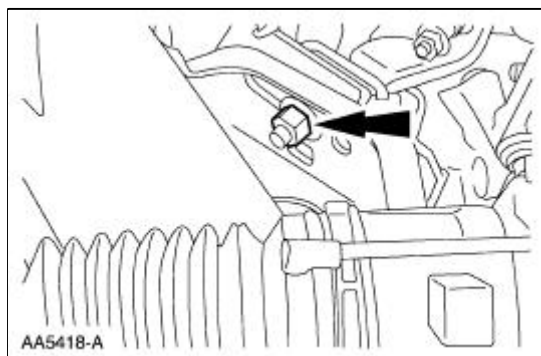
7. Remove the A/C line. For additional information, refer to [Section 412-03](#).
8. Install the special tools.



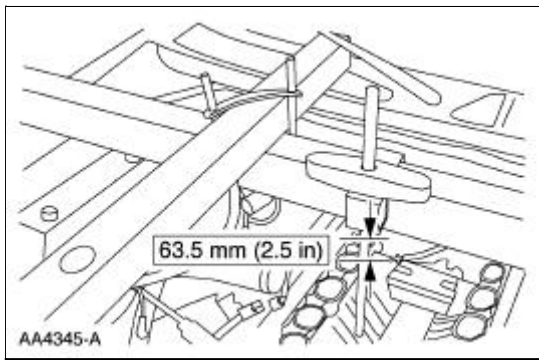
9. Install the special tool.



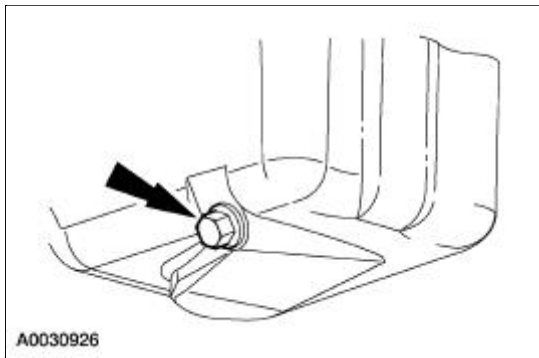
10. Raise the vehicle on a hoist. For additional information, refer to [Section 100-02](#).
11. Remove the two engine mount nuts.



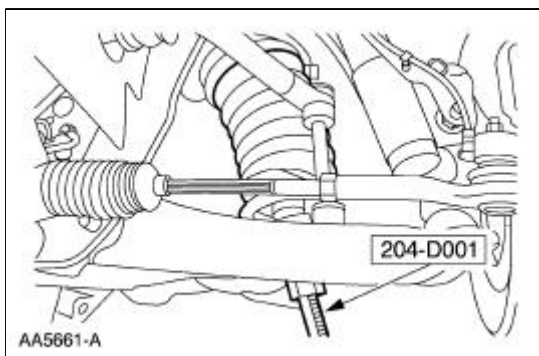
12. Lower the vehicle.
13. Using the special tool, raise the engine.



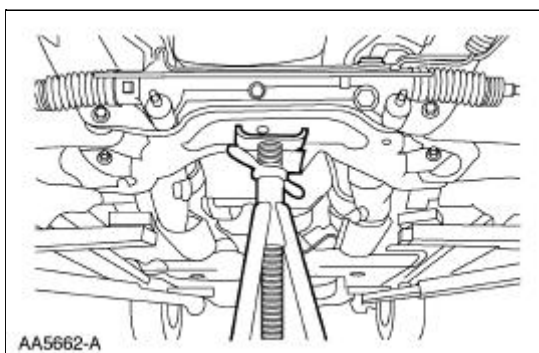
14. Raise the vehicle on a hoist.
15. Remove the oil pan drain plug and drain the engine oil.



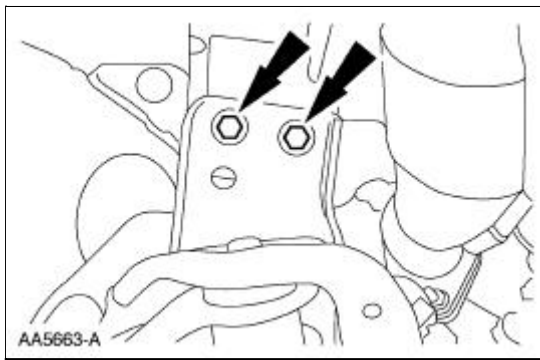
16. Using the special tool, compress the front coil springs.



17. Position a safety stand.

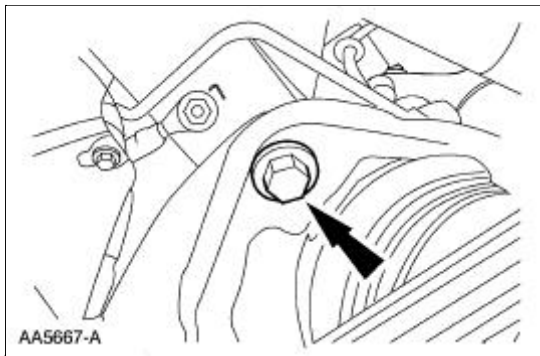


18. Remove the four bolts.

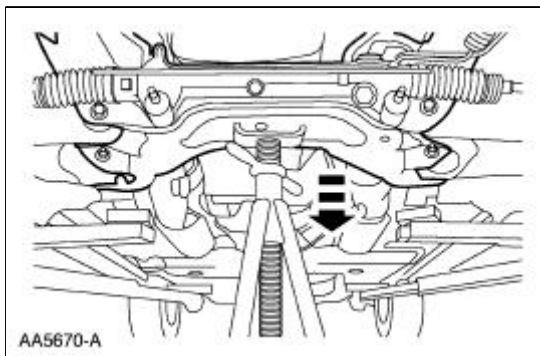


19. **NOTE:** Do not completely remove the bolts.

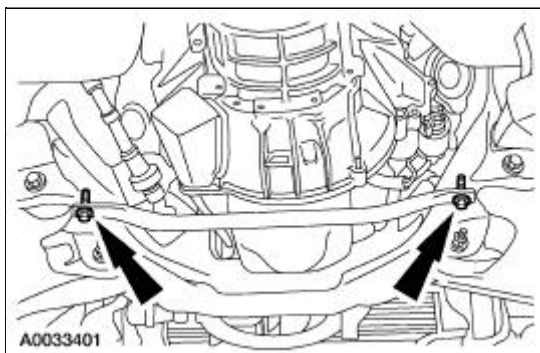
Loosen the bolts.



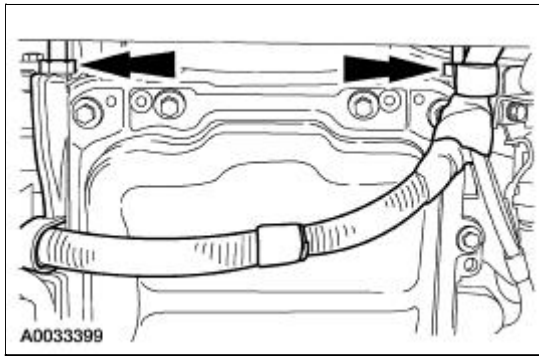
20. Lower the front sub-frame.



21. Remove the sub-frame brace.



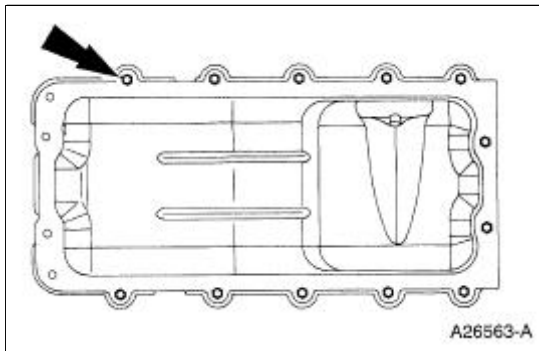
22. Remove the starter wiring harness nuts and position the wiring harness out of the way.




23. **NOTE:** Be careful when removing the oil pan gasket. It is reusable.

Remove the oil pan and gasket.

- Inspect the oil pan gasket for damage.



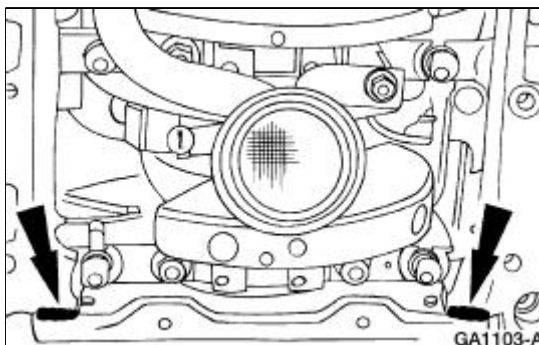
Installation

1.  **CAUTION:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

Clean and inspect the mating surfaces.

2. **NOTE:** If the oil pan is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure may result in future oil leakage.

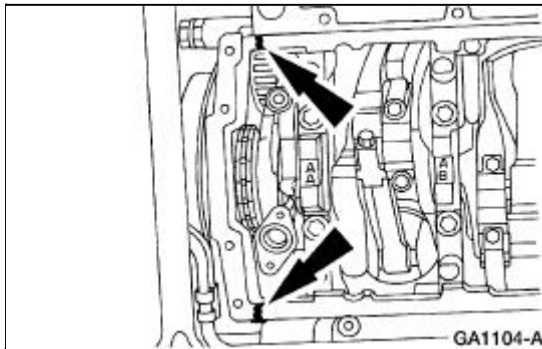
Apply silicone gasket and sealant at the engine front cover-to-cylinder block mating surface.



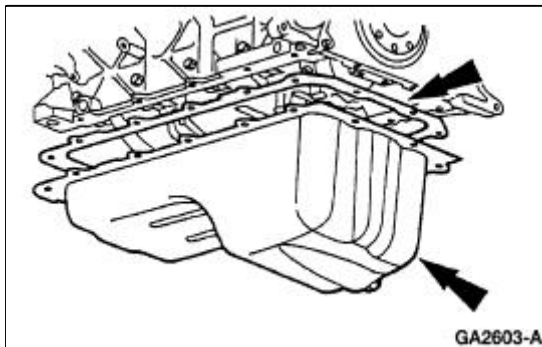
3. **NOTE:** If the if the oil pan is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of

wetness, or four minutes, whichever is longer. Failure to follow this procedure may result in future oil leakage.

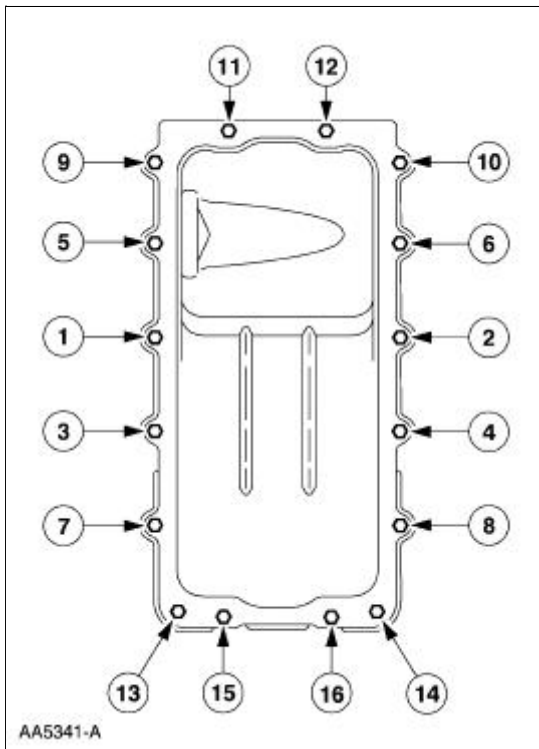
Apply silicone gasket and sealant at the rear oil seal retainer-to-cylinder block sealing surface.



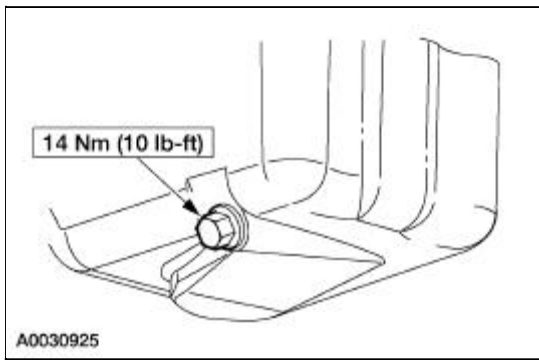
4. Install the oil pan and gasket and loosely install the bolts.



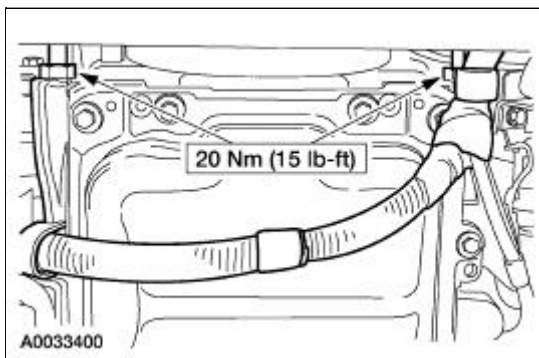
5. Tighten the bolts in the sequence shown in three stages.
 - Stage 1: Tighten to 2 Nm (18 lb-in).
 - Stage 2: Tighten to 20 Nm (15 lb-ft).
 - Stage 3: Tighten an additional 60 degrees.



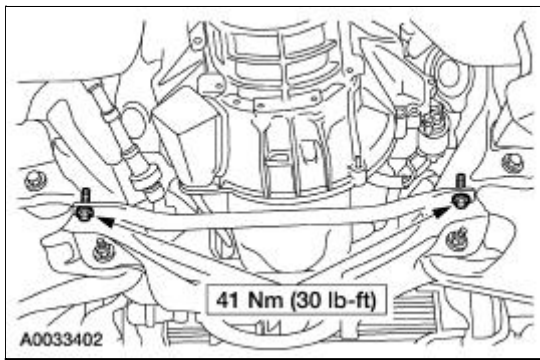
6. Install the oil pan drain plug.



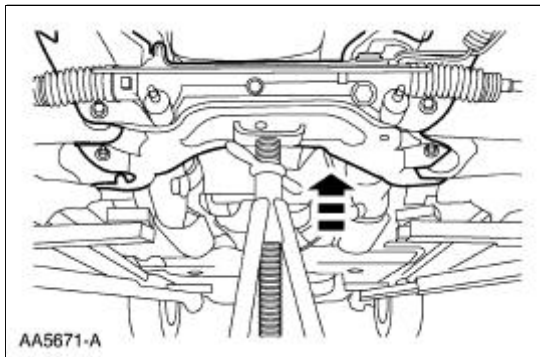
7. Position the starter wiring harness and install the wiring harness nuts.



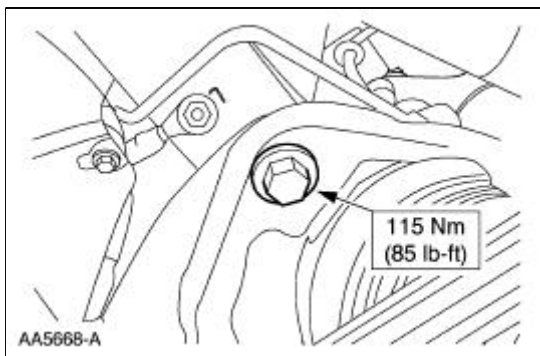
8. Install the sub-frame brace.



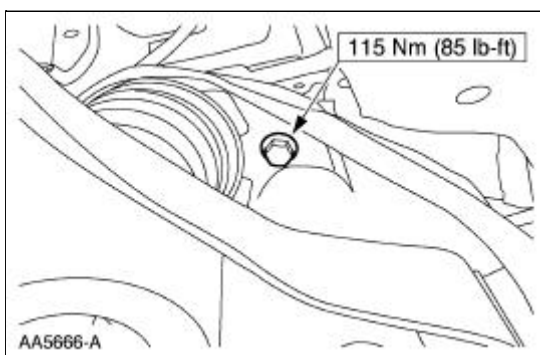
9. Raise the front sub-frame into position.



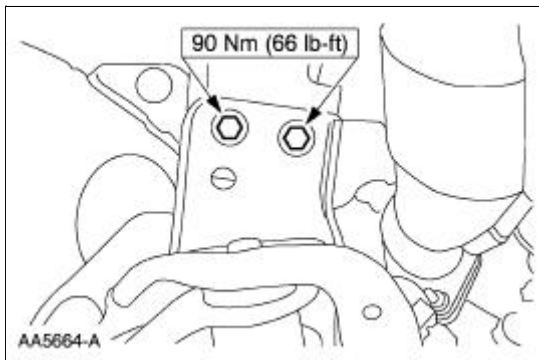
10. Install the two bolts.



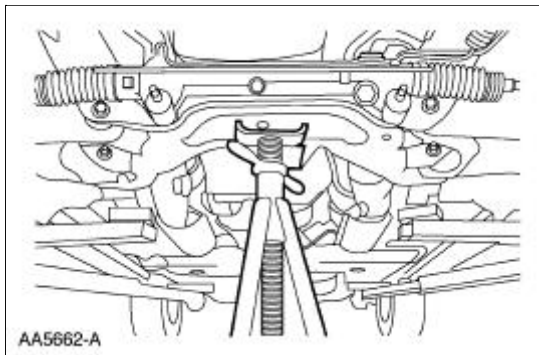
11. Install the two bolts.



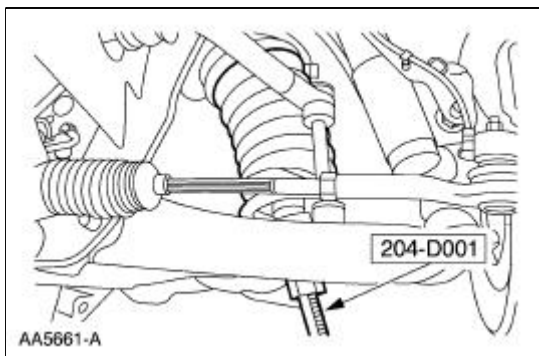
12. Install the four bolts.



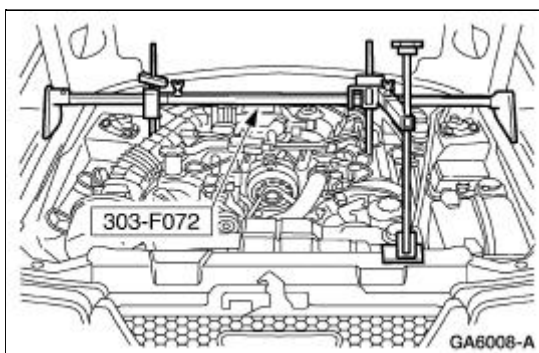
13. Position the safety stand aside.



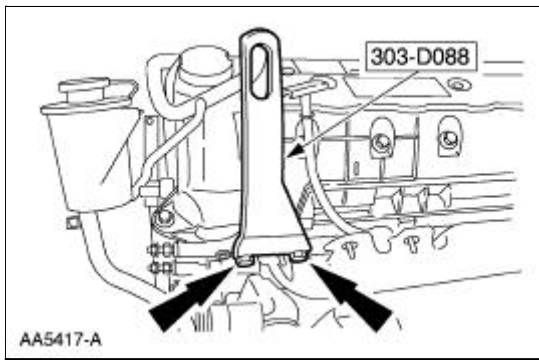
14. Release the tension from the front coil springs and remove the special tool.



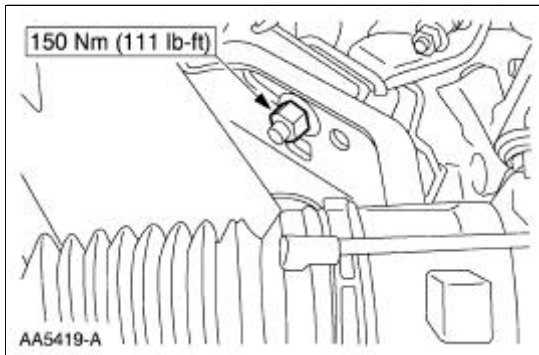
15. Raise the vehicle.
16. Using the special tool, lower the engine and remove the special tool.



17. Remove the special tools.



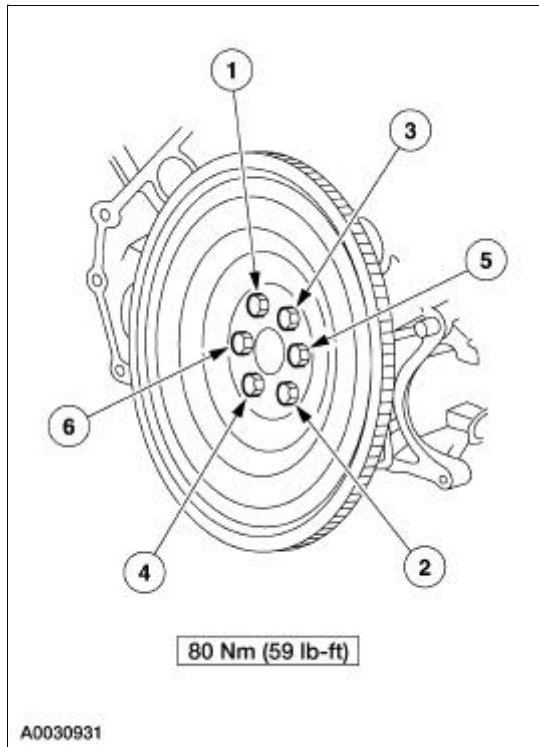
18. Install the two engine mount nuts.



19. Install the transmission. For additional information, refer to [Section 307-01](#) or [Section 308-03B](#).
 20. Lower the vehicle.
 21. Fill the engine crankcase with clean engine oil.
 22. Install the A/C line. For additional information, refer to [Section 412-03](#).
 23. Install the manifold and tube assembly—accumulator to compressor, 4.6L. For additional information, refer to [Section 412-03](#).
 24. Install the radiator sight shield.
 25. Install the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).
 26. Install the air intake scoop. For additional information, refer to [Section 303-12](#).
 27. Install the battery ground cable. For additional information, refer to [Section 414-01](#).
 28. Start the engine and check for leaks.
-

Flexplate

1. Remove the transmission. For additional information, refer to [Section 307-01](#).
2. Remove the bolts in the sequence shown, and remove the flexplate.

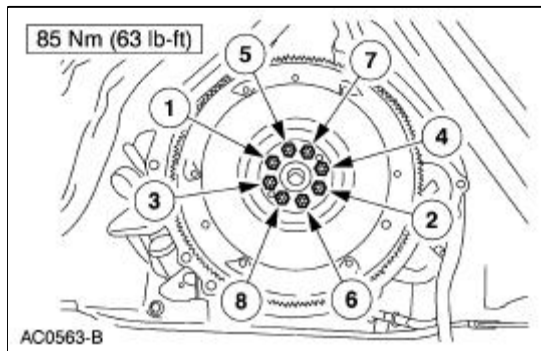


3. To install, reverse the removal procedure.

Flywheel

Removal

1. Remove the clutch components. For additional information, refer to [Section 308-01](#).
2. Remove the bolts and the flywheel.

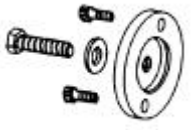

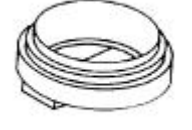
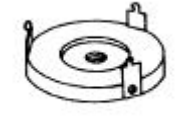




Installation

1. To install, reverse the removal procedure.
-

Crankshaft Rear Oil Seal

Special Tool(s)

 <p>ST1480-A</p>	<p>Installer, Crankshaft Rear Oil Seal 303-518 (T95P-6701-DH)</p>
 <p>ST1382-A</p>	<p>Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)</p>
 <p>ST1479-A</p>	<p>Installer, Crankshaft Rear Oil Seal 303-516 (T95P-6701-BH)</p>
 <p>ST1481-A</p>	<p>Remover, Crankshaft Rear Oil Slinger 303-514 (T95P-6701-AH)</p>
 <p>ST1482-A</p>	<p>Installer, Crankshaft Rear Oil Slinger 303-517 (T95P-6701-CH)</p>
 <p>ST1185-A</p>	<p>Impact Slide Hammer 100-001 (T50T-100-A)</p>

Material

Item	Specification
Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

Automatic transmission vehicles

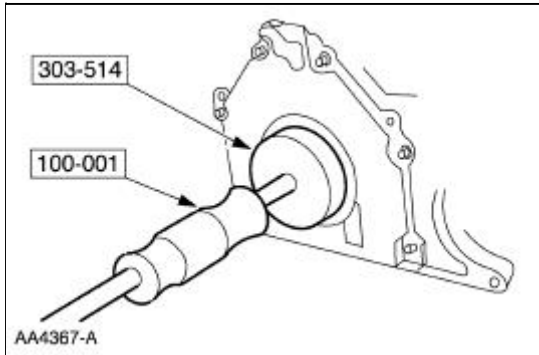
1. Remove the flexplate. For additional information, refer to [Flexplate](#) in this section.

Manual transmission vehicles

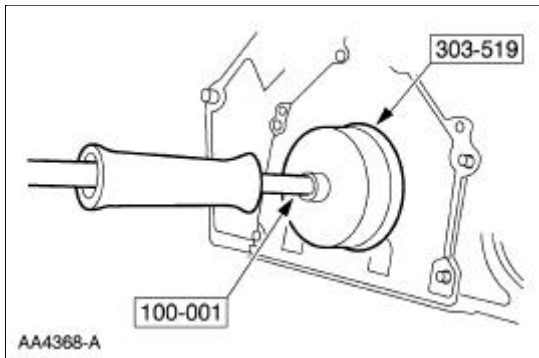
2. Remove the flywheel. For additional information, refer to [Flywheel](#) in this section.

All vehicles

3. Using the special tools, remove the crankshaft oil slinger.



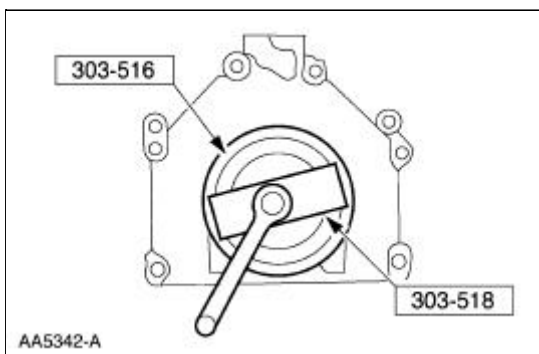
4. Using the special tools, remove the crankshaft rear oil seal.



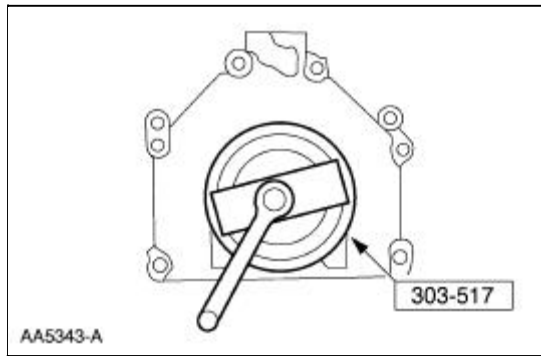
Installation

All vehicles

1. Using the special tools, install the crankshaft rear oil seal.
 - Lubricate the oil seal using clean engine oil.



2. Using the special tool, install the crankshaft oil slinger.



Manual transmission vehicles


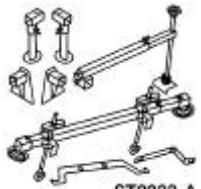

3. Install the flywheel. For additional information, refer to [Flywheel](#) in this section.

Automatic transmission vehicles

4. Install the flexplate. For additional information, refer to [Flexplate](#) in this section.
-

Engine Mount

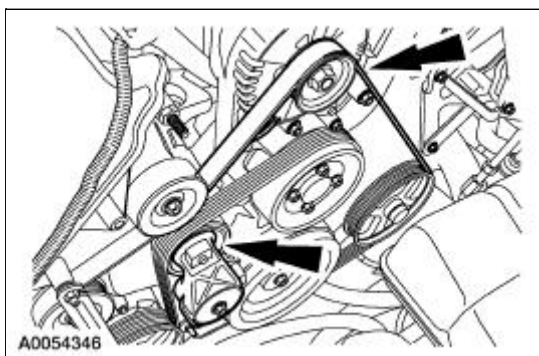
Special Tool(s)

 ST2334-A	Support Bracket, Engine 303-639
 ST2333-A	3-Bar Engine Support Kit 303-F072
 ST2430-A	Alignment Tool, Subframe 502-004

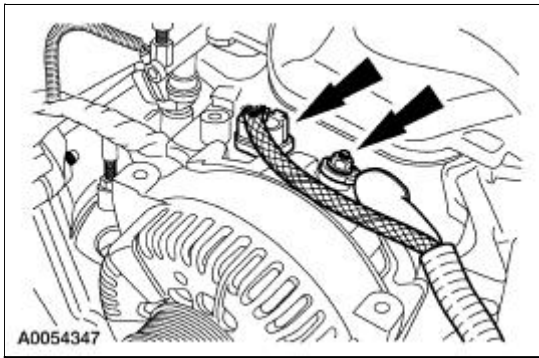
Removal

Both mounts

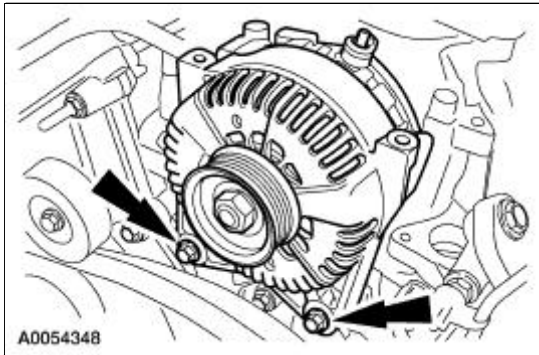
1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Remove the coolant bypass tube. For additional information, refer to [Section 303-03A](#).
3. Rotate the drive belt tensioner clockwise and detach the drive belt from the generator pulley.



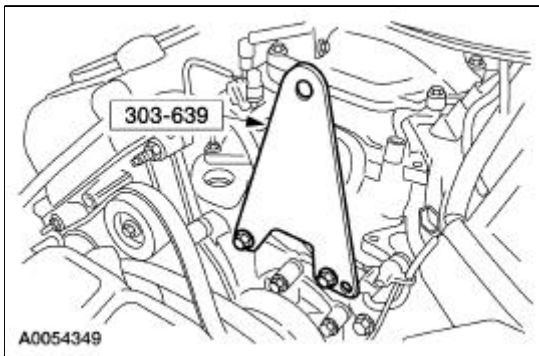
4. Disconnect the generator electrical connections.



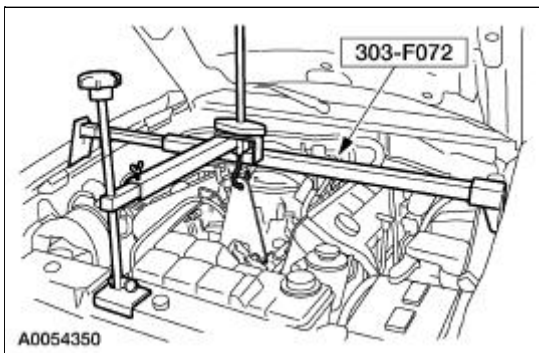
5. Remove the bolts and the generator.



6. Install the special tool.

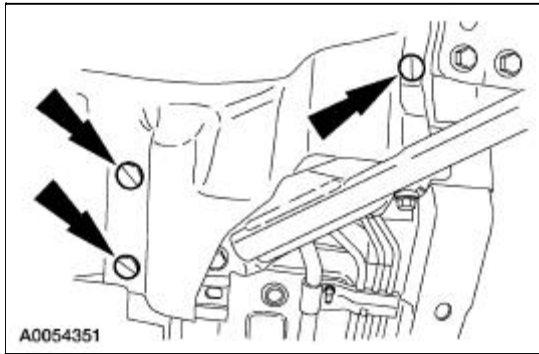


7. Using the special tool, support the engine.

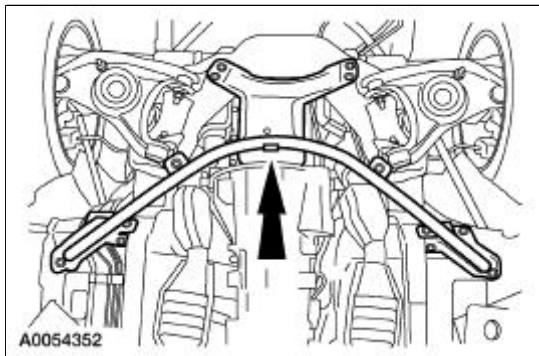


8. Remove the front springs. For additional information, refer to [Section 204-01](#).
9. **NOTE:** RH shown, LH similar.

Remove the six splash-shield pushpins.

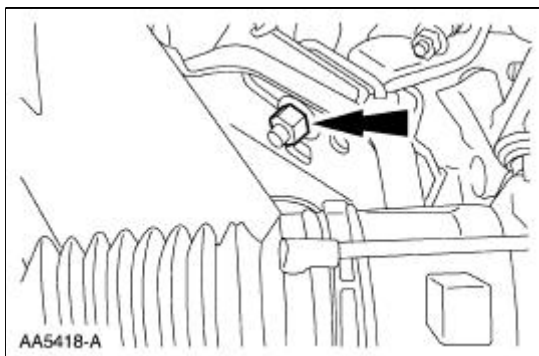


10. Remove the 13 bolts and the cross-brace support.

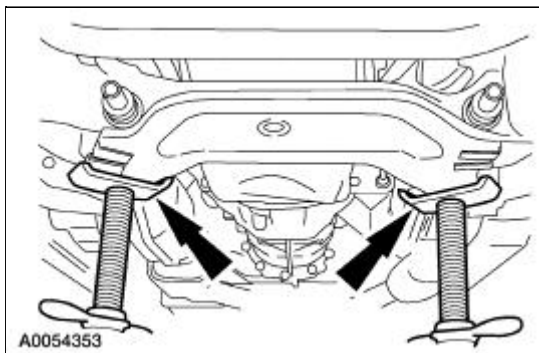


11. **NOTE:** RH shown, LH similar.

Remove the two engine mount nuts.



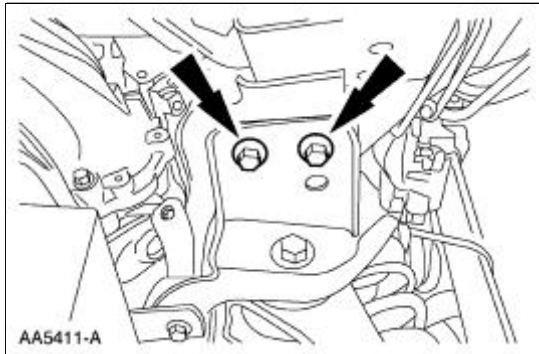
12. Using two jackstands, support the subframe.



13. **NOTE:** Mark the bolts and the crossmember location for assembly reference.

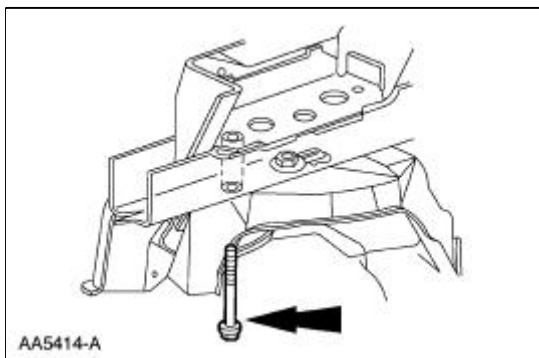
NOTE: RH shown, LH similar.

Remove the four bolts.



14. **NOTE:** RH shown, LH similar.

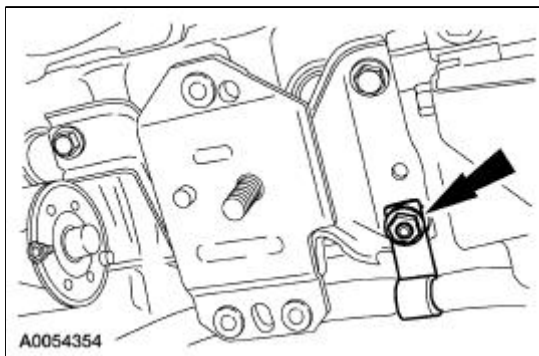
Remove the four bolts.



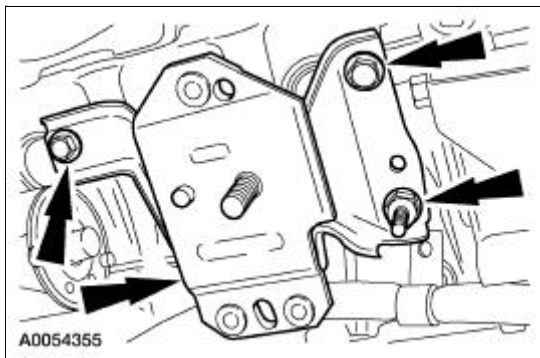
15. Using the jackstands, lower the front subframe.

RH mount

16. Remove the nut and detach the wiring harness.

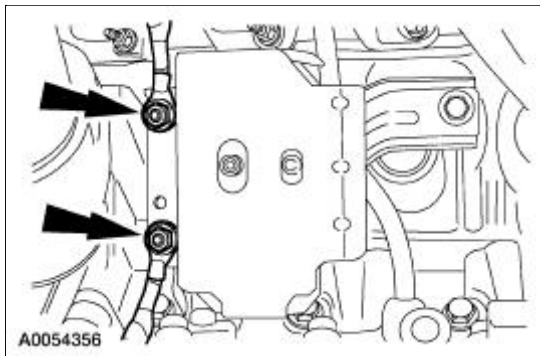


17. Remove the bolts, the studbolt and the engine mount.

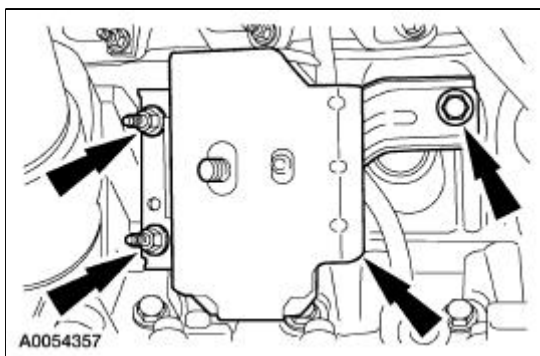


LH mount

18. Remove the nuts and detach the ground cables.



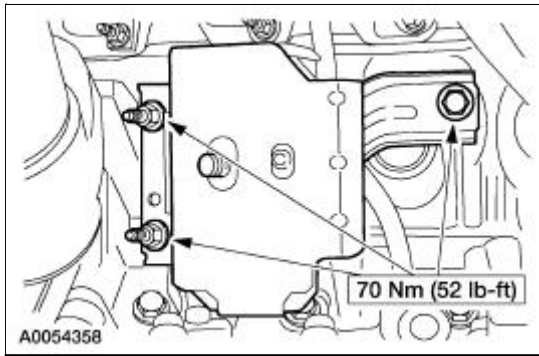
19. Remove the bolt, the studbolts and the engine mount.



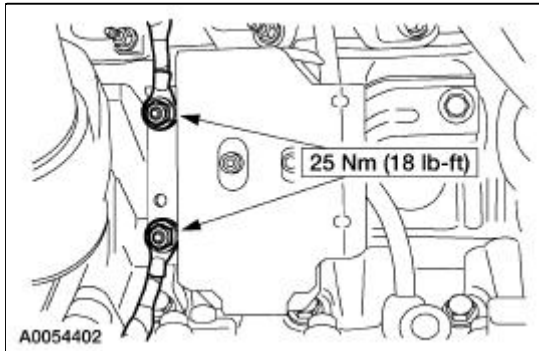
Installation

LH mount

1. Position the engine mount and install the bolt and studbolts.

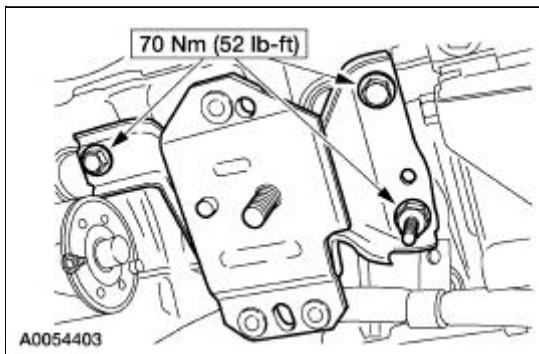


2. Attach the ground cables and install the nuts.

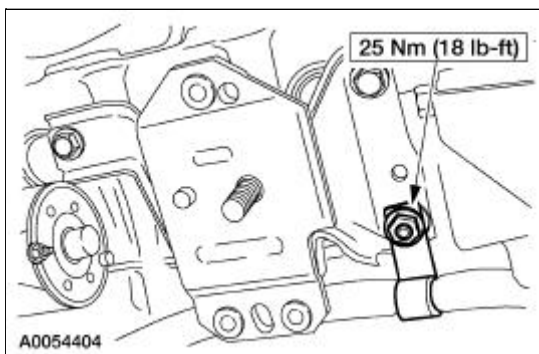


RH mount

3. Position the engine mount and install the bolts and studbolt.



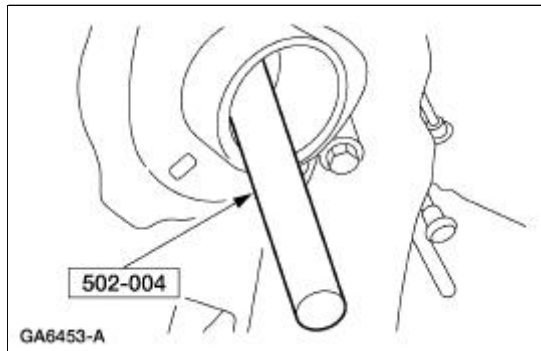
4. Attach the wiring harness and install the nut.



Both mounts

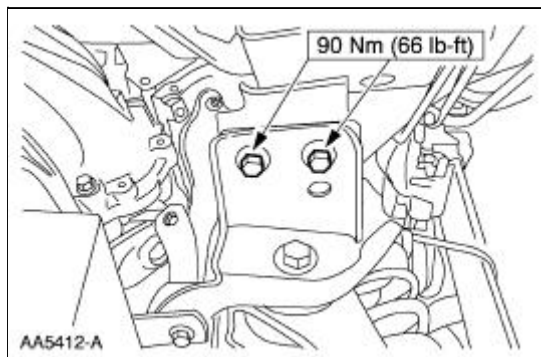
- Using the jackstands, raise the subframe into position.
- NOTE:** RH shown, LH similar.

Using the special tool, align the subframe.



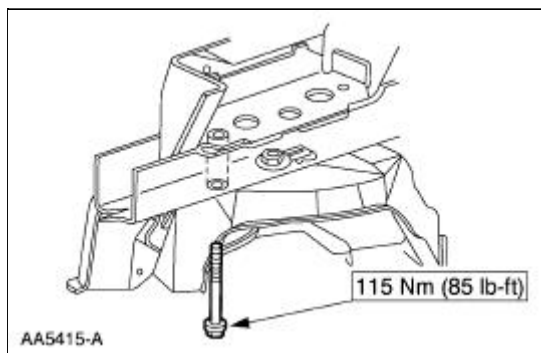
- NOTE:** RH shown, LH similar.

Install the four bolts.

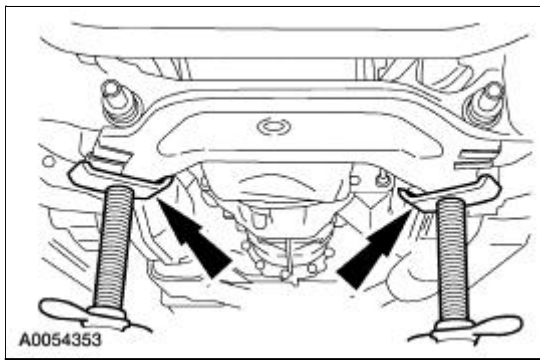


- NOTE:** RH shown, LH similar.

Install the four bolts.

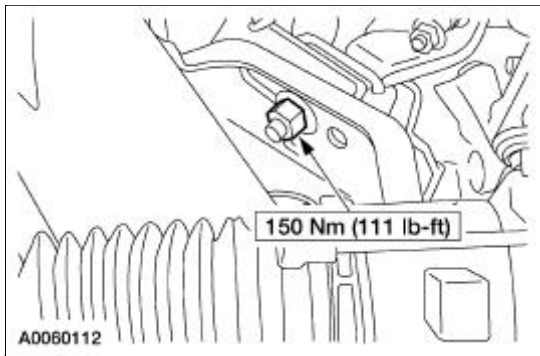


- Remove the jackstands.

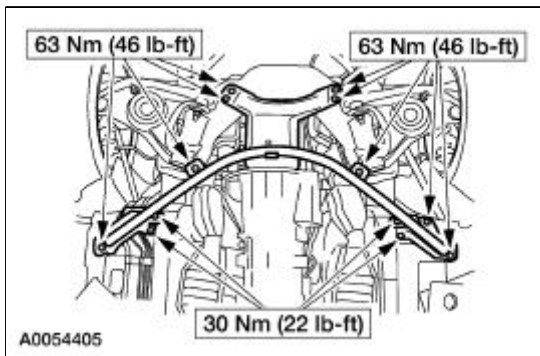


10. **NOTE:** RH shown, LH similar.

Install the two engine mount nuts.

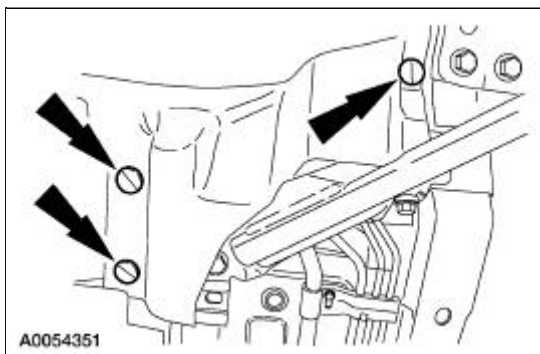


11. Position the cross-brace support and install the 13 bolts.

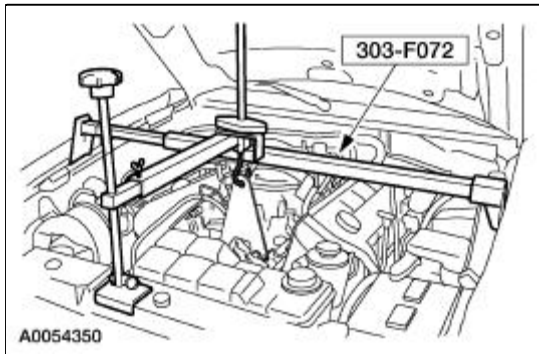


12. **NOTE:** RH shown, LH similar

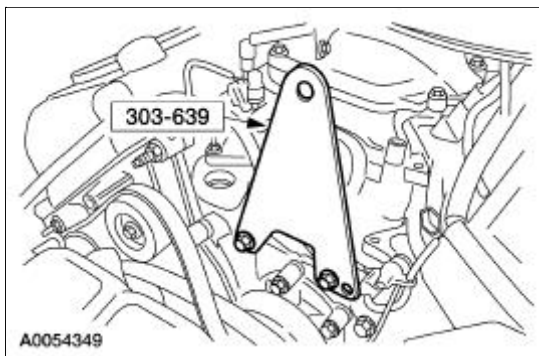
Install the six splash-shield pushpins.



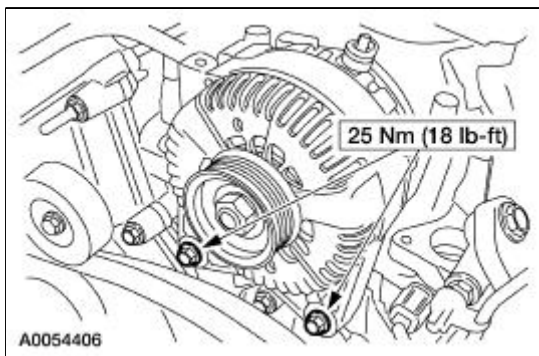
13. Install the front springs. For additional information, refer to [Section 204-01](#).
14. Remove the special tool.



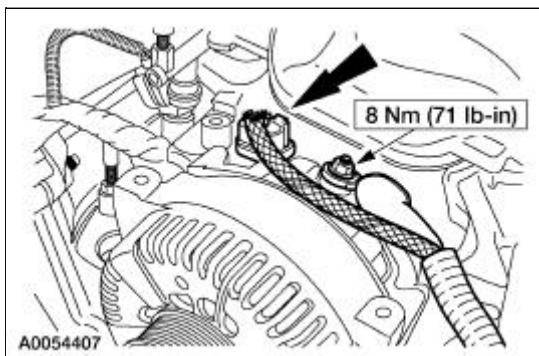
15. Remove the special tool.



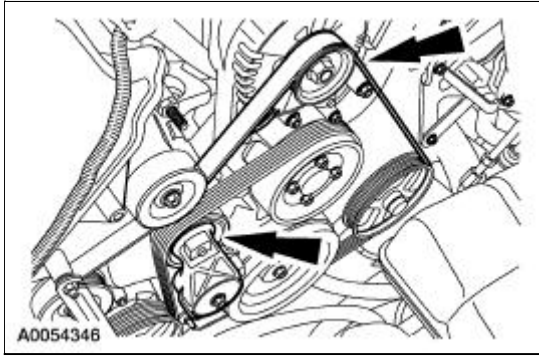
16. Position the generator and install the bolts.



17. Connect the generator electrical connections.



18. Rotate the drive belt tensioner clockwise and attach the drive belt to the generator pulley.
 - Make sure the drive belt is routed correctly and is aligned correctly installed on each pulley.



19. Connect the battery ground cable. For additional information, refer to [Section 414-01](#).
 20. Install the coolant bypass tube. For additional information, refer to [Section 303-03A](#).
-

Engine

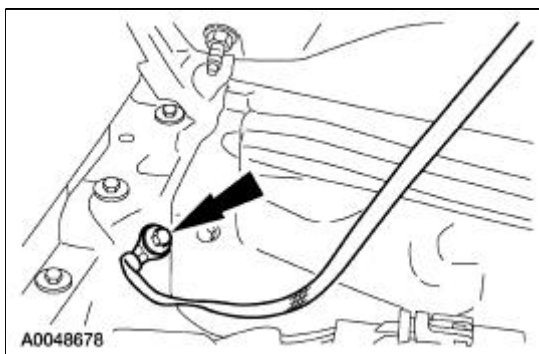
Special Tool(s)

 ST1603-A	Lifting Bracket, Engine 303-D087 (D93P-6001-A1)
 ST1604-A	Lifting Bracket, Engine 303-D088 (D93P-6001-A2)
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3)

Removal

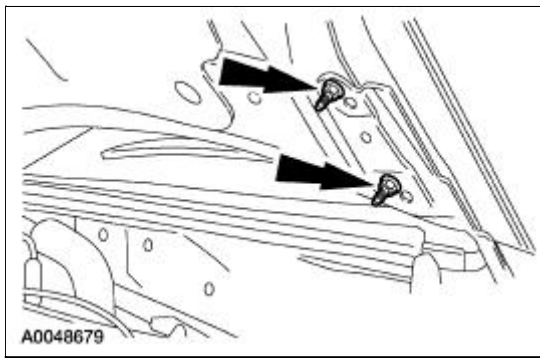
All vehicles

1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Remove the hood-to-body ground strap.

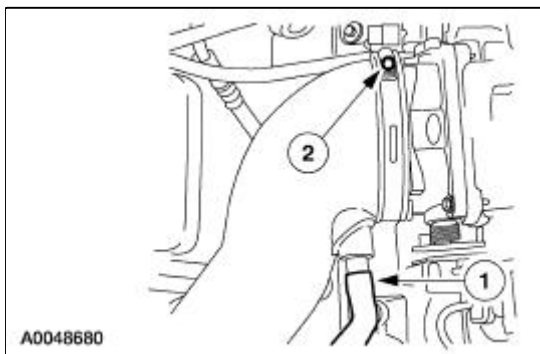


3. **NOTE:** Mark the hood hinge locations to aid in hood installation.

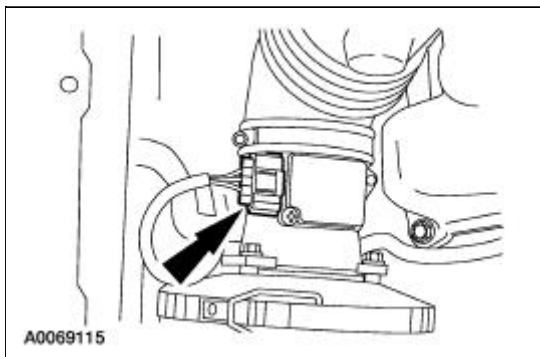
Remove the four nuts and the hood.



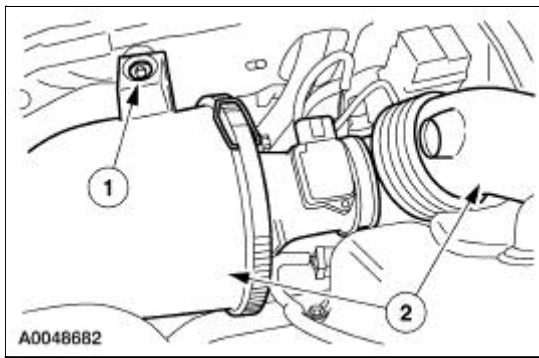
4. Recover the A/C system. For additional information, refer to [Section 412-00](#).
5. Remove the air intake scoop bracket. For additional information, refer to [Section 303-12](#).
6. Disconnect the air cleaner outlet pipe at the throttle body.
 1. Disconnect the positive crankcase ventilation (PCV) inlet tube.
 2. Loosen the clamp and disconnect the outlet pipe.



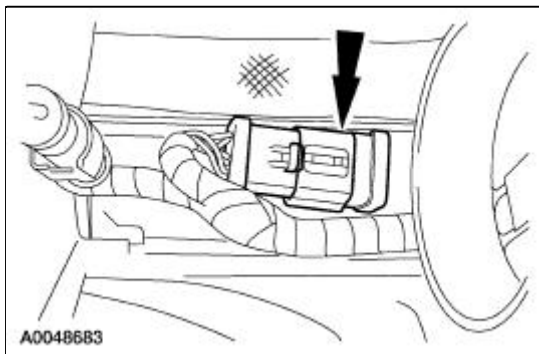
7. Disconnect the mass airflow sensor electrical connector.



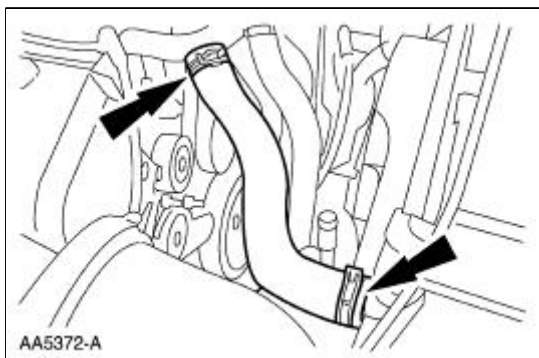
8. Remove the air cleaner.
 1. Remove the bolt.
 2. Remove the air cleaner and the outlet pipe as an assembly.



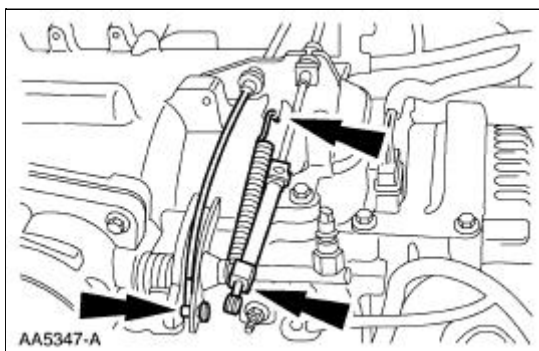
9. Disconnect the electrical connector.



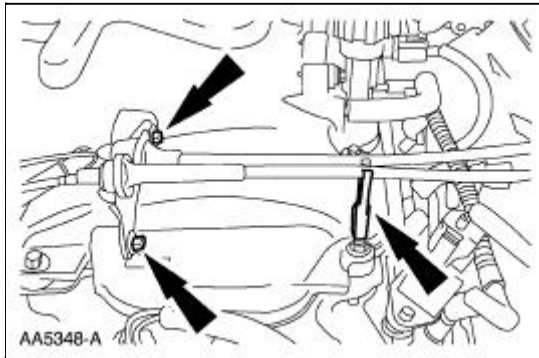
10. Drain the engine cooling system. For additional information, refer to [Section 303-03A](#).
11. Disconnect the fuel tube spring lock coupling. For additional information, refer to [Section 310-00](#).
12. Remove the upper radiator hose (8260).



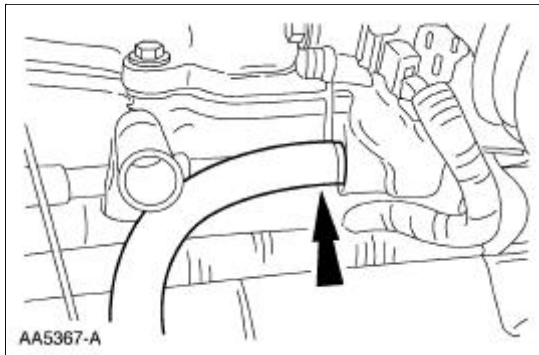
13. Disconnect the throttle cable, and the speed control cable, and remove the throttle return spring.



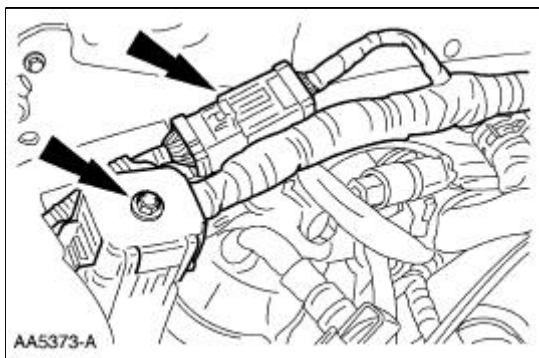
14. Remove the bolts and detach the retainer. Position the cables and the bracket aside.



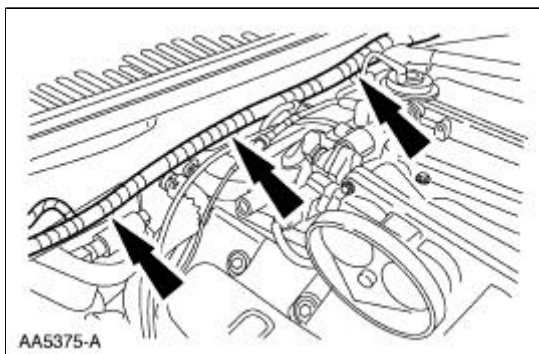
15. Disconnect the evaporative emissions return line.



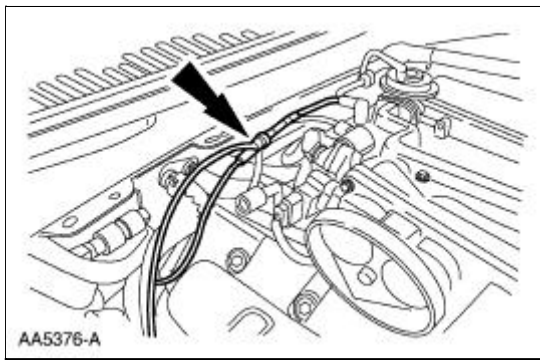
16. Disconnect the 16-pin and the 42-pin connectors.



17. Separate the engine control sensor wiring in three locations and position onto the engine.



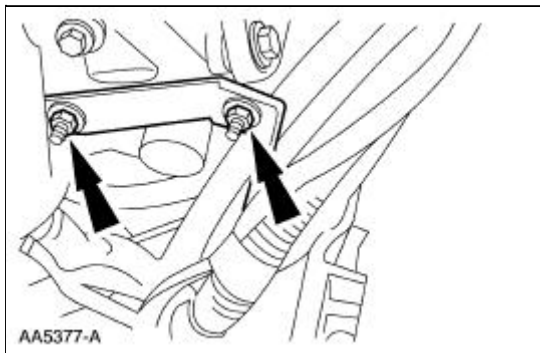
18. Disconnect the vacuum hoses.



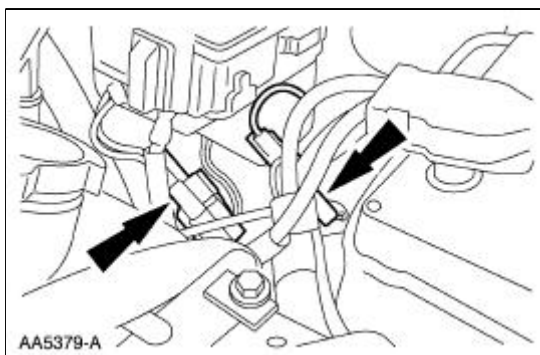
19. Disconnect the heater hoses.



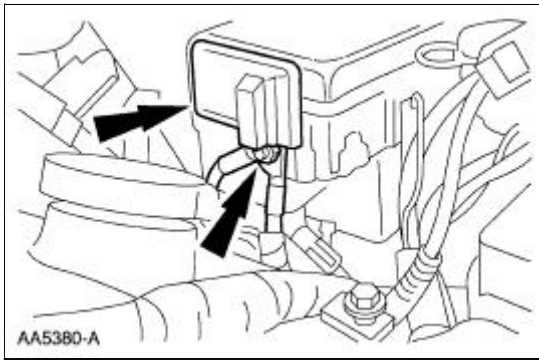
20. Remove the wiring support bracket.



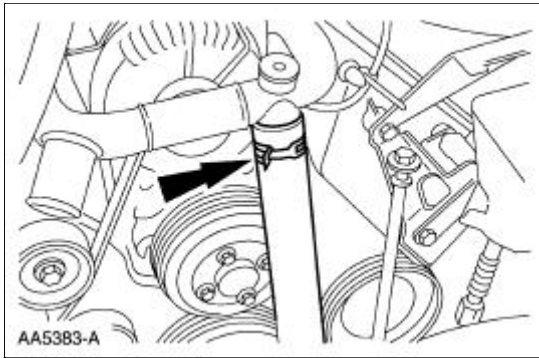
21. Disconnect the connectors.



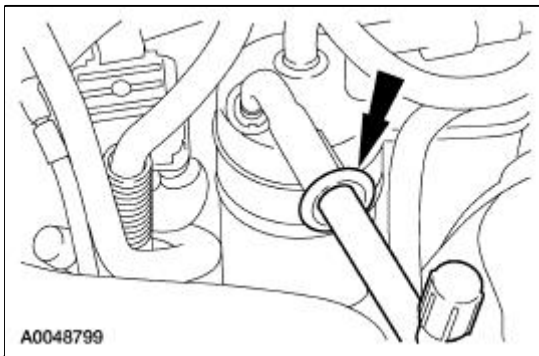
22. Raise the cover and remove the nut and cables.



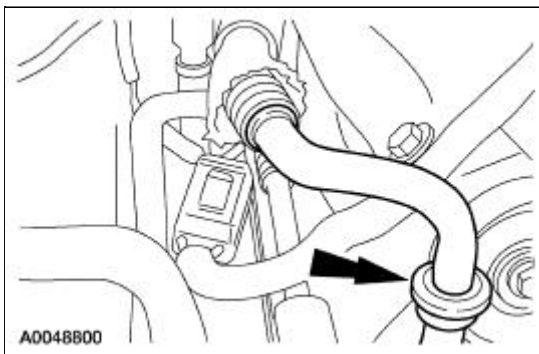
23. Disconnect the hose from the coolant bypass tube.



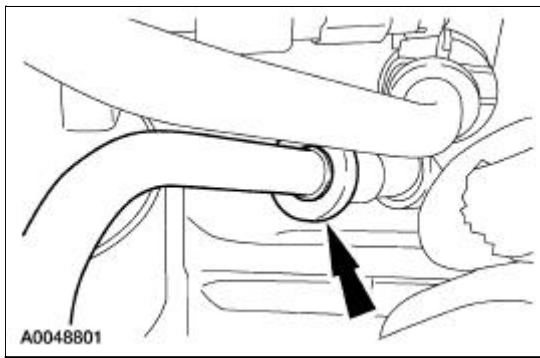
24. Disconnect the A/C suction tube from the accumulator.



25. Disconnect and remove the A/C suction tube.

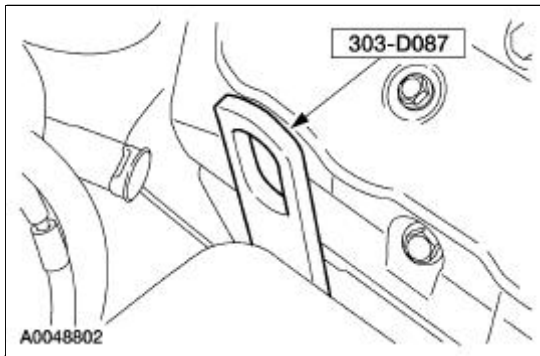


26. Disconnect the A/C tube. Position A/C tube aside.

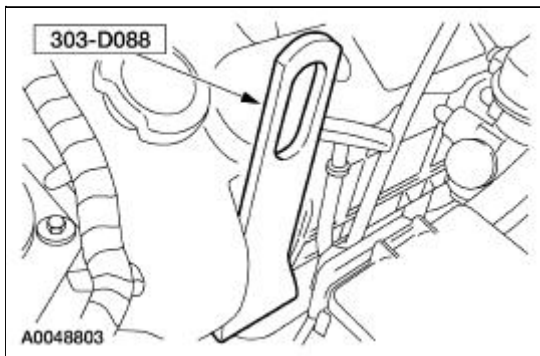


27. **NOTE:** The lifting bracket bolts will be installed when the vehicle is raised.

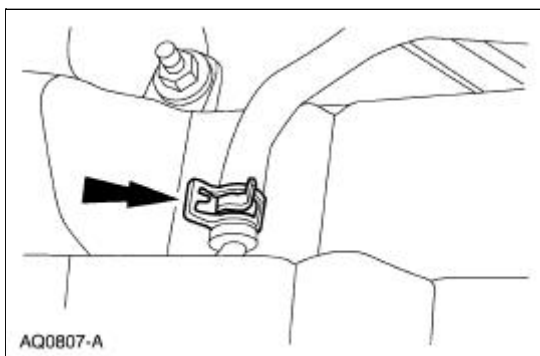
Position the RH lifting bracket.



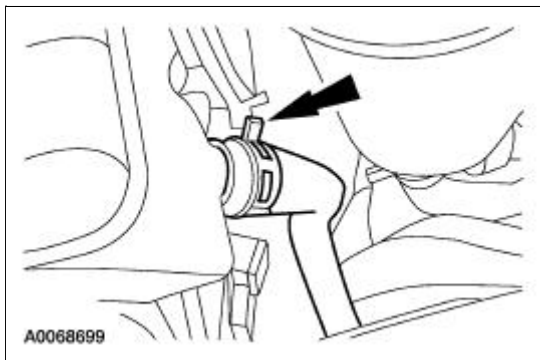
28. Install the LH lifting bracket.



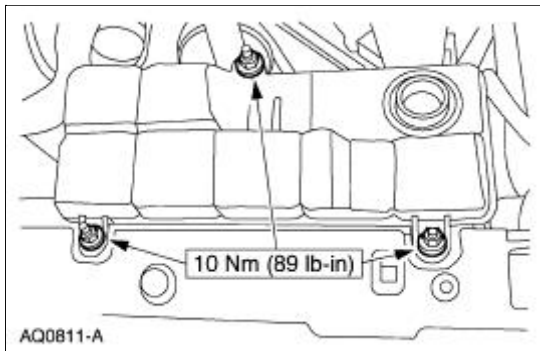
29. Disconnect the radiator vent hose from the degas bottle.



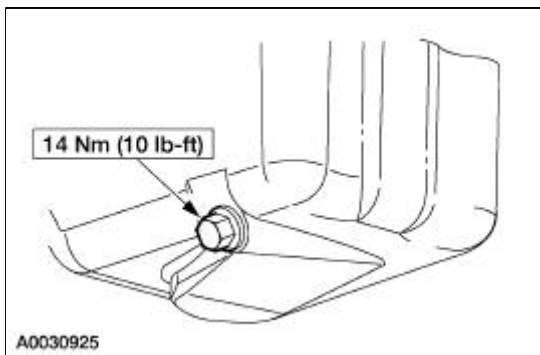
30. Remove the degas bottle return hose.



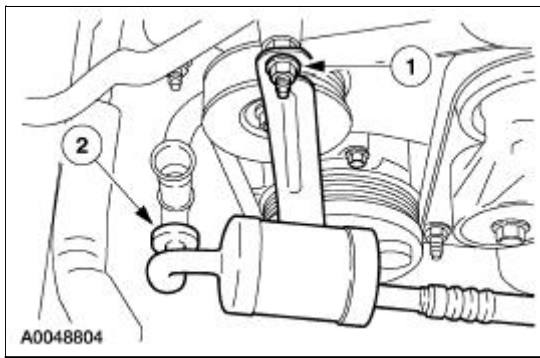
31. Remove the nuts and the degas bottle



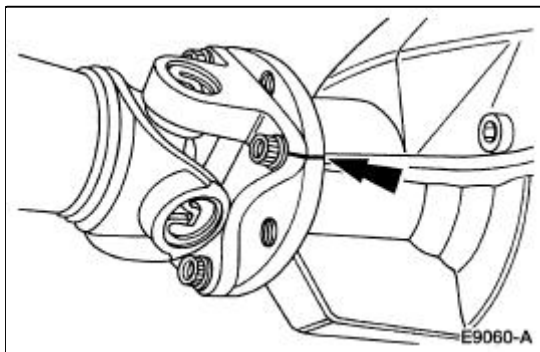
32. Remove the shifter. For additional information, refer to [Section 307-01](#) or [Section 308-03B](#).
33. Remove the dual converter H-pipe. For additional information, refer to [Section 309-00](#).
34. Drain the engine oil.
 - Install the drain plug when finished.



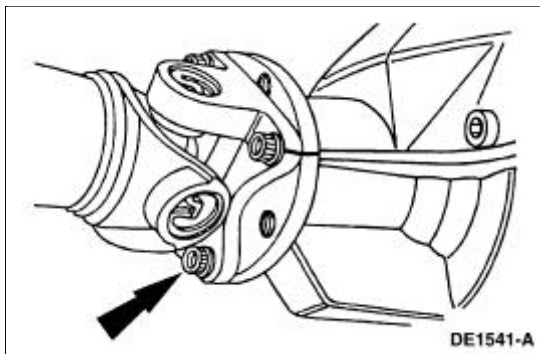
35. Position the A/C muffler aside.
 1. Remove the bracket retainer.
 2. Disconnect the A/C tube and position the A/C muffler aside.



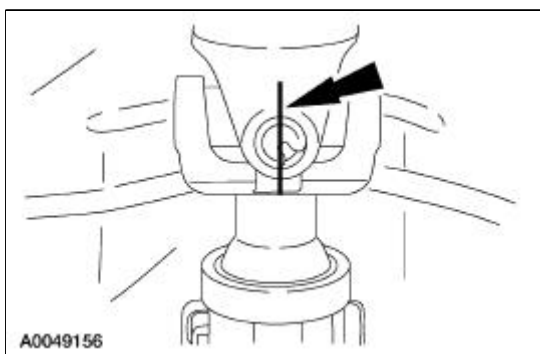
36. Index-mark the driveshaft flange and the rear axle pinion flange.




37. Remove the four bolts



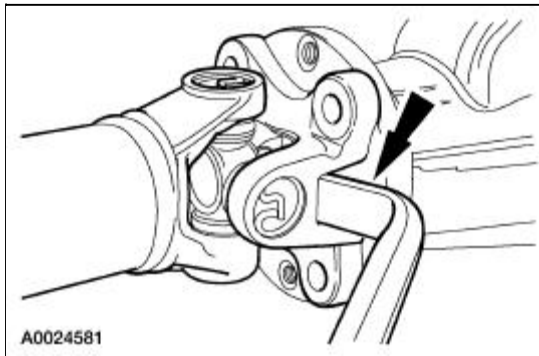
38. Index-mark the driveshaft at the six o'clock position.



39.  **CAUTION:** the driveshaft flange fits tightly on the rear axle pinion flange pilot. Never hammer on the driveshaft or any of its components to disconnect the driveshaft flange from the pinion flange. Pry only in the area shown, with a suitable tool, to disconnect the driveshaft flange from the pinion flange.

NOTE: Do not rotate the driveshaft.

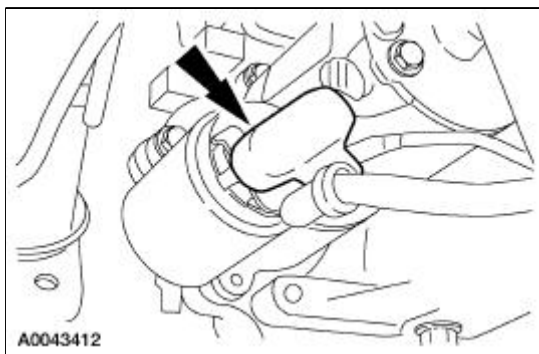
Using a suitable tool, disconnect the driveshaft flange from the rear axle flange and remove the driveshaft.



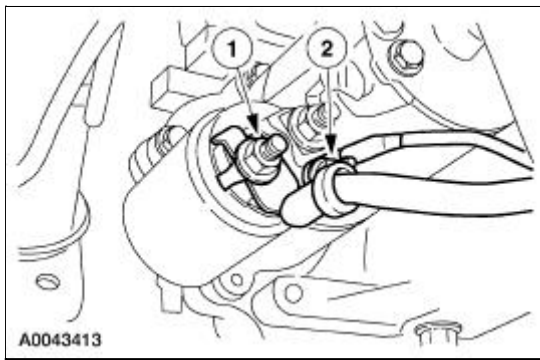
40. Index-mark the transmission output shaft at the six o'clock position.



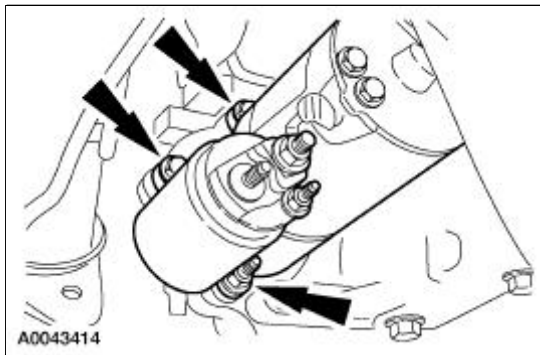
41. Remove the starter motor terminal cover.



42. Disconnect the starter wiring.
1. Remove the nut and disconnect the battery positive cable.
 2. Remove the nut and disconnect the starter solenoid wire.

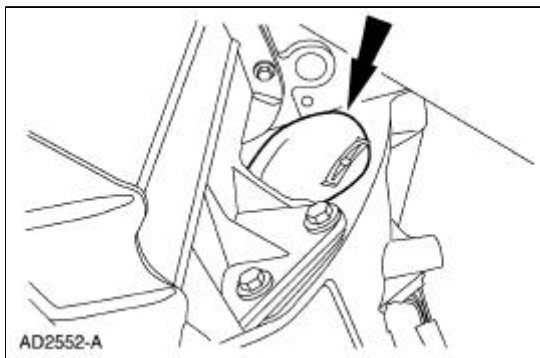


43. Remove the three bolts and the starter.

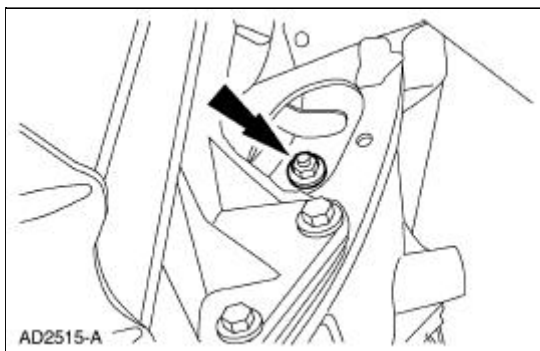


Automatic transmission vehicles

44. Remove the flywheel inspection cover.

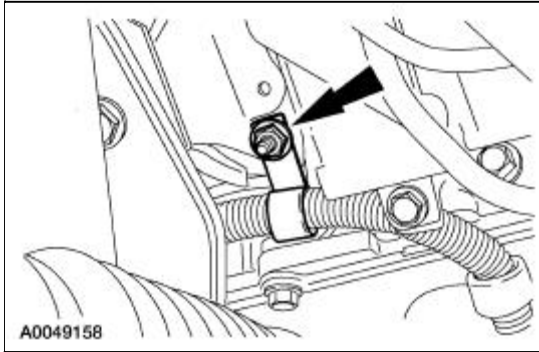


45. Remove the torque converter nuts.

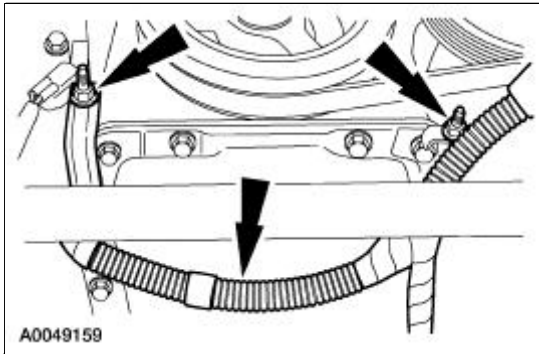


All vehicles

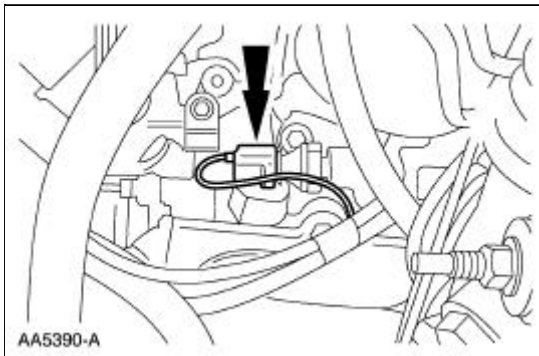
46. Remove the nut and the wiring harness bracket.



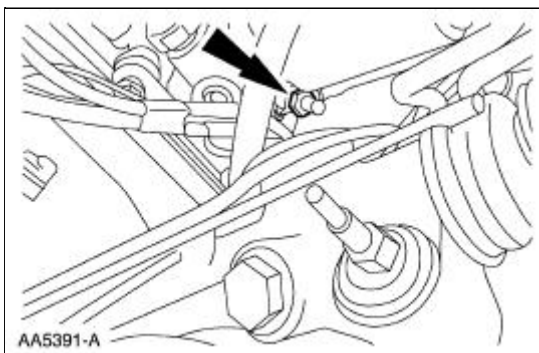
47. Remove the nuts and position the wiring harness aside.



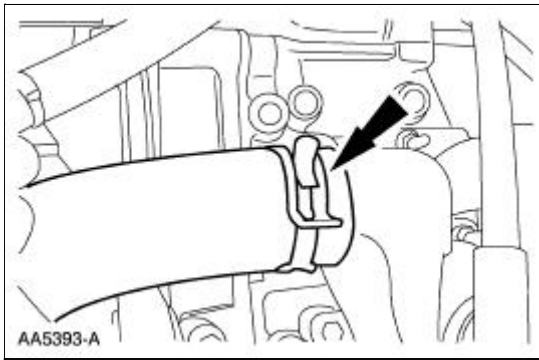
48. Disconnect the oil pressure sensor.



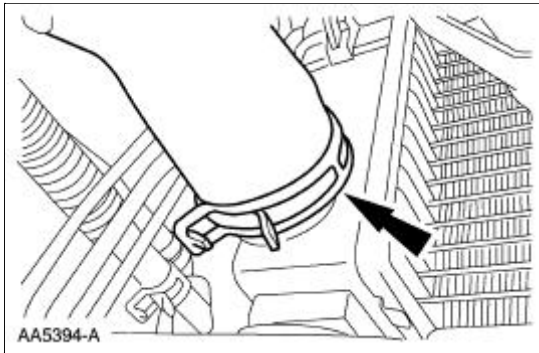
49. Remove the nut and the engine ground cable.



50. Disconnect the hose from the oil filter adapter.

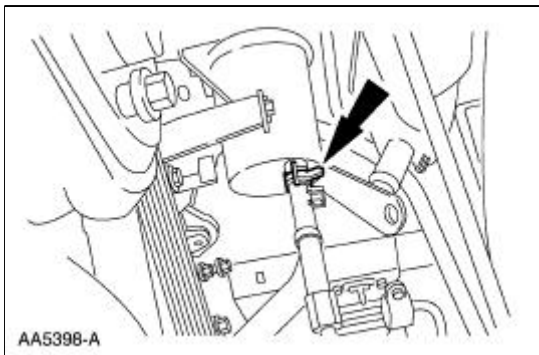


51. Disconnect and remove the lower hose from the radiator.

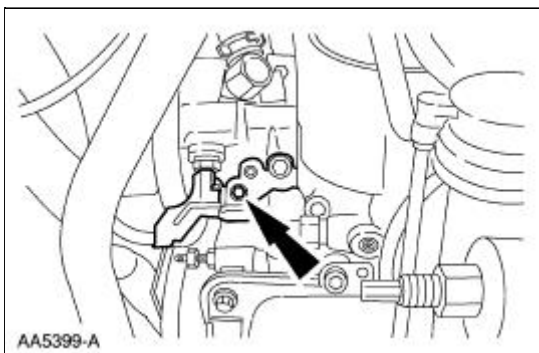


52. **NOTE:** Drain the power steering fluid into a suitable container.

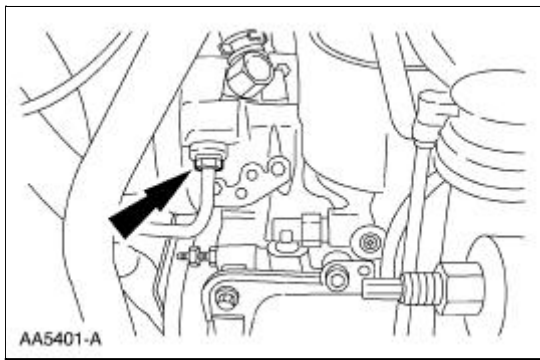
Disconnect the hose from the power steering reservoir.



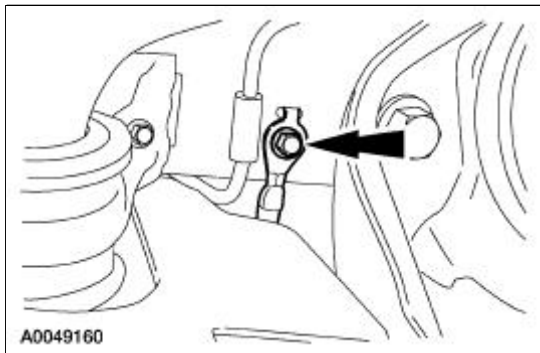
53. Remove the bolt and the anti-rotation clip.



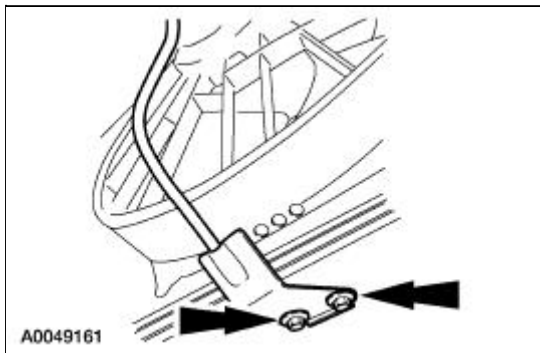
54. Loosen the fitting and disconnect the high pressure hose from the power steering pump.



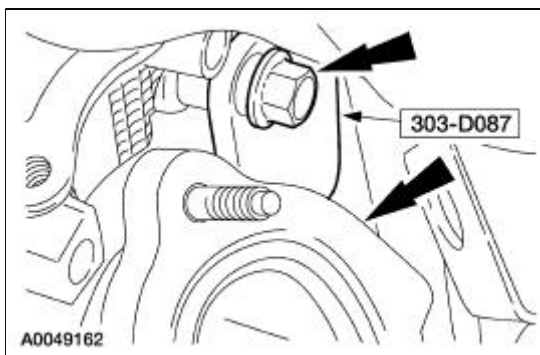
55. Remove the ground strap bolt.



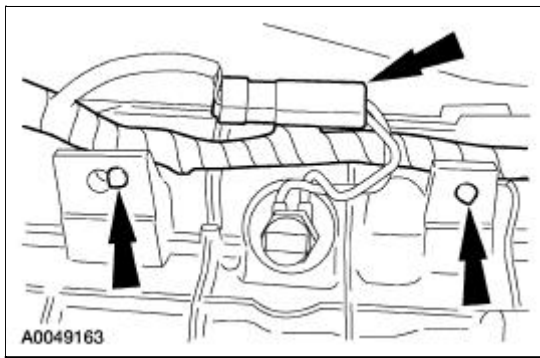
56. Remove the degas bottle support bracket.



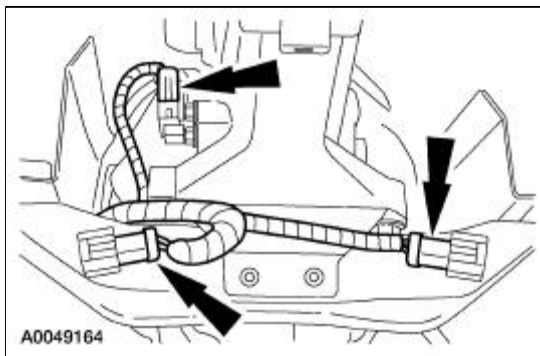
57. Install the two bolts from the RH lifting bracket.



58. Disconnect the reversing lamp switch electrical connector, and the wiring harness from the transmission.

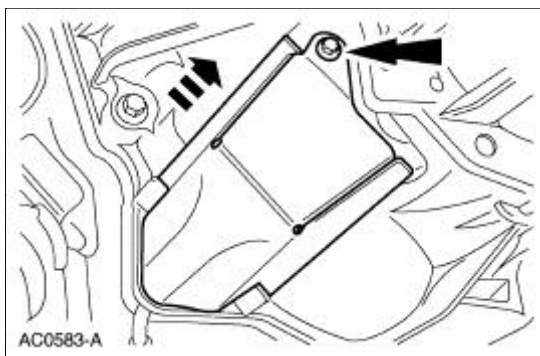



59. Disconnect the output shaft speed (OSS) sensor electrical connector and detach the left and right oxygen sensor electrical connectors from the crossmember.



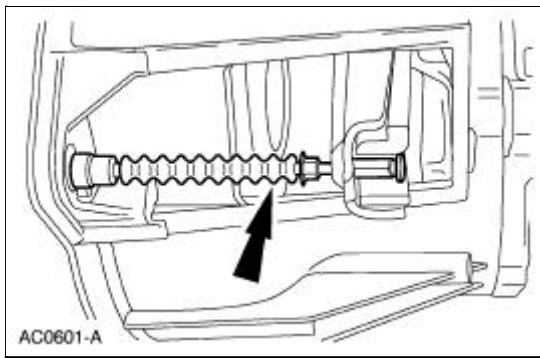
Manual transmission vehicles

60. Remove the bolt and the clutch release lever cover.

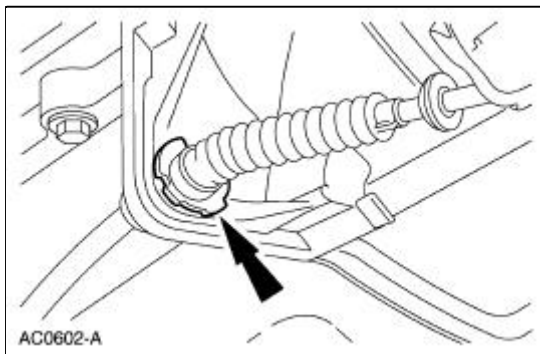


61.  **CAUTION:** To prevent component damage, do not depress the clutch pedal with the transmission removed.

Detach the clutch release cable from the clutch release fork.

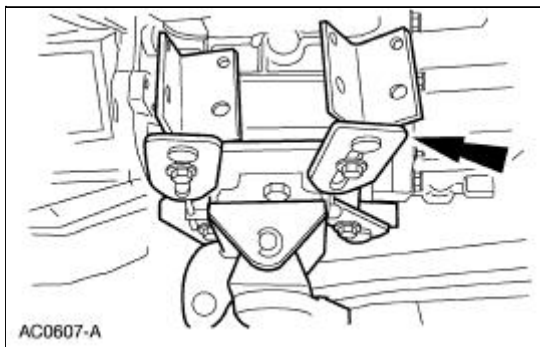


62. Remove the clutch cable retainer and remove the clutch cable from the transmission.

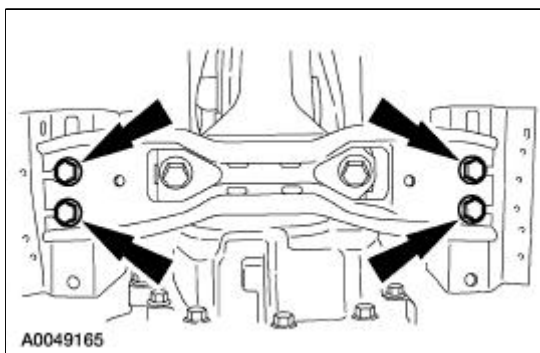


All vehicles

63. Position a transmission jack and support the transmission.

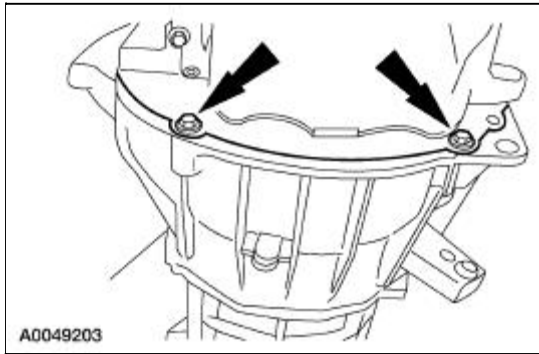


64. Remove the transmission crossmember bolts.



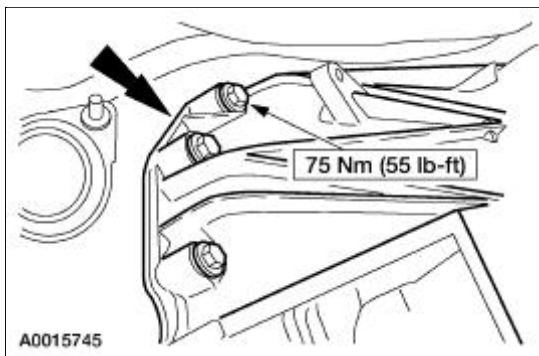
Automatic transmission vehicles

65. Remove the bolts.



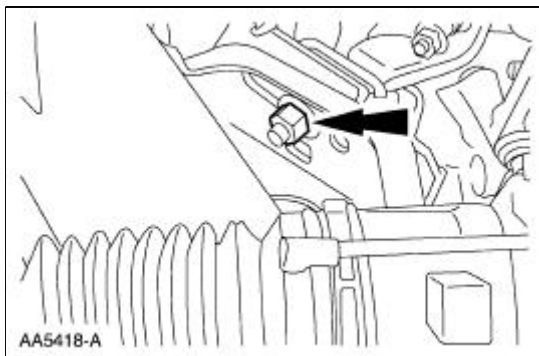
All vehicles

66. Lower the transmission, remove the seven bolts, and remove the transmission.



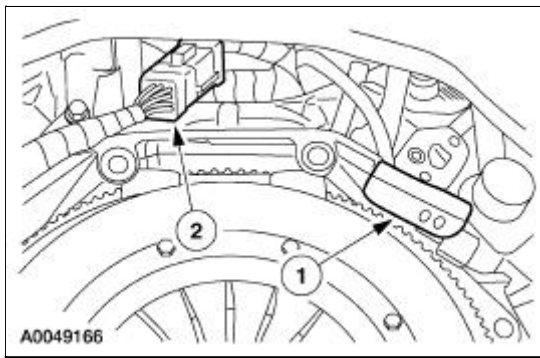
67. **NOTE:** RH side shown, LH side similar.

Remove the two engine mount nuts.



68. Remove the transmission wiring harness.

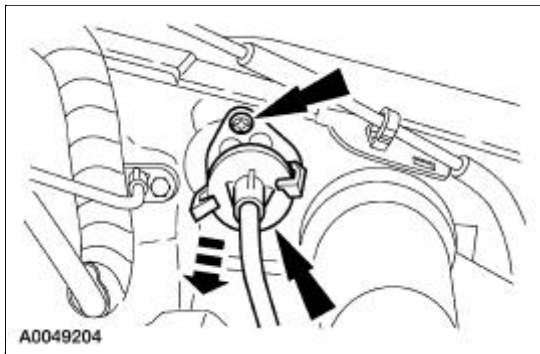
1. Remove the RH oxygen sensor connector from the bracket.
2. Disconnect the transmission wiring connector and remove the harness.



69. Lower the vehicle.

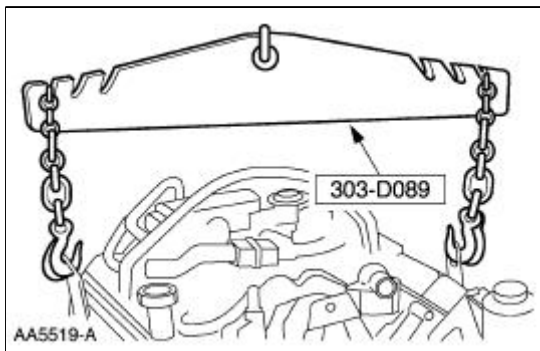
Manual transmission vehicles

70. Remove the two screws and position the clutch cable aside.






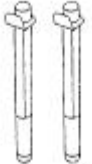



All vehicles

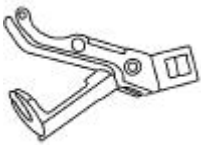

71. Attach the special tool to a floor crane and the engine, and remove the engine from the vehicle.



Engine

Special Tool(s)

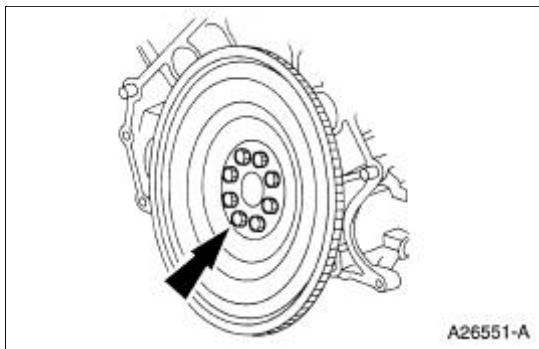
 <p>ST1185-A</p>	<p>Impact Slide Hammer 100-001 (T50T-100-A)</p>
 <p>ST1286-A</p>	<p>Remover, Crankshaft Vibration Damper 303-009 (T58P-6316-D)</p>
 <p>ST1335-A</p>	<p>Holding Tool, Crankshaft 303-448 (T93P-6303-A)</p>
 <p>ST1337-A</p>	<p>Guides, Connecting Rod 303-442 (T93P-6136-A)</p>
 <p>ST1382-A</p>	<p>Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)</p>
 <p>ST1481-A</p>	<p>Remover, Crankshaft Rear Oil Slinger 303-514 (T95P-6701-AH)</p>
 <p>ST1718-A</p>	<p>Compressor, Valve Spring (Intake) 303-452 (T93P-6565-AR)</p>
	<p>Compressor, Valve Spring (Exhaust)</p>

 <p>ST1693-A</p>	<p>303-567 (T97P-6565-AH)</p>
 <p>ST1730-A</p>	<p>Remover, Crankshaft Front Oil Seal 303-107 (T74P-6700-A)</p>

Disassembly

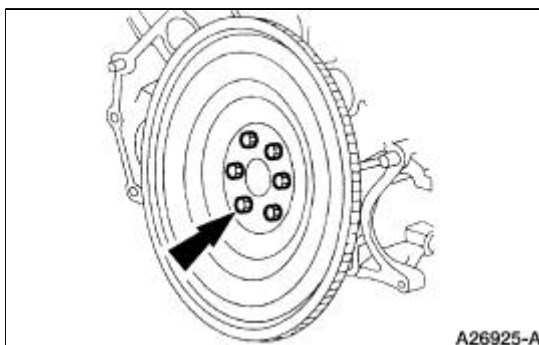
Manual transmission vehicles

1. Remove the clutch and pressure plate. For additional information, refer to [Section 308-02](#).
2. Remove the flywheel.



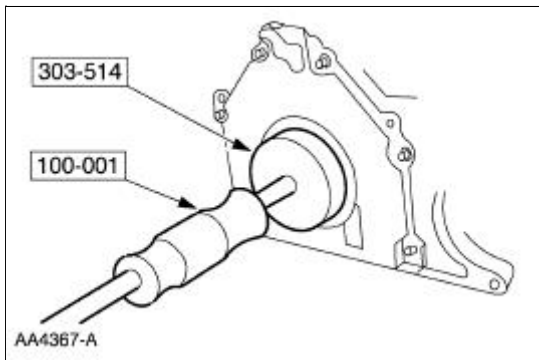
Automatic transmission vehicles

3. Remove the flexplate. For additional information, refer to [Flexplate](#) in this section.

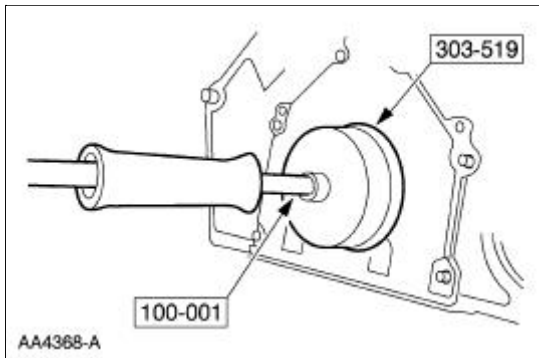


All vehicles

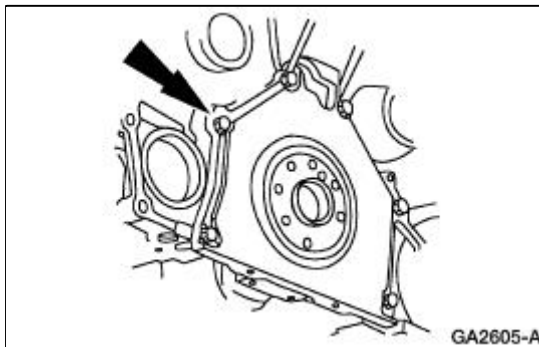
4. Using the special tool, remove the rear oil slinger.



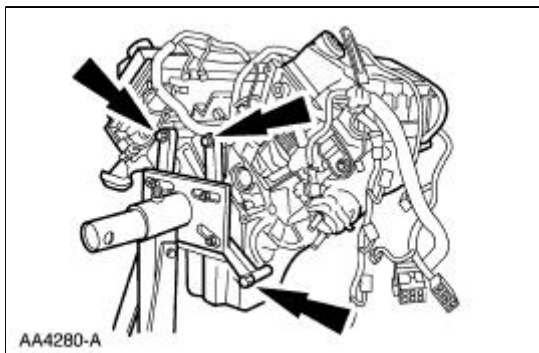
5. Using the special tool, remove the rear main seal.



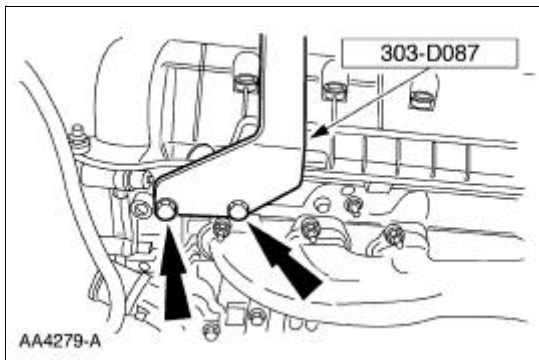
6. Remove the rear seal retainer plate.



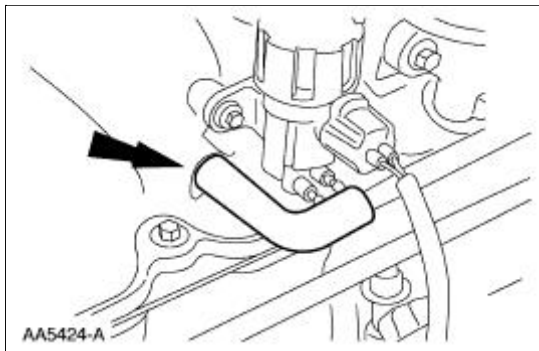
7. Mount the engine on a work stand.



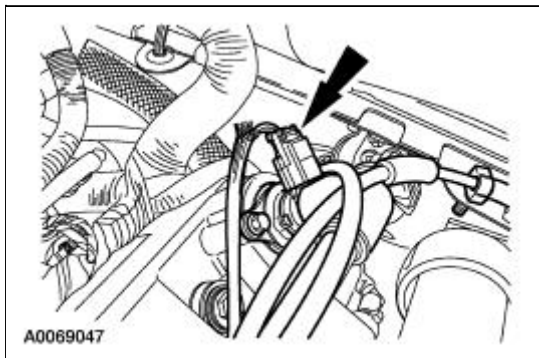
8. Remove the special tools.



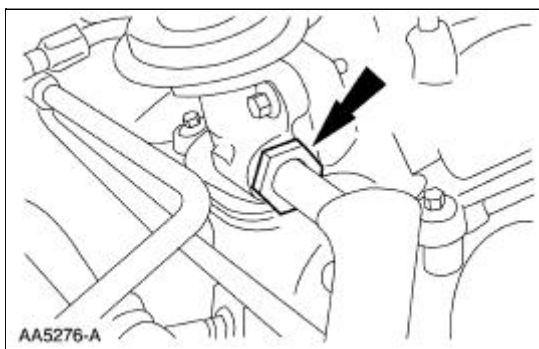
9. Disconnect the positive crankcase ventilation (PCV) tube.



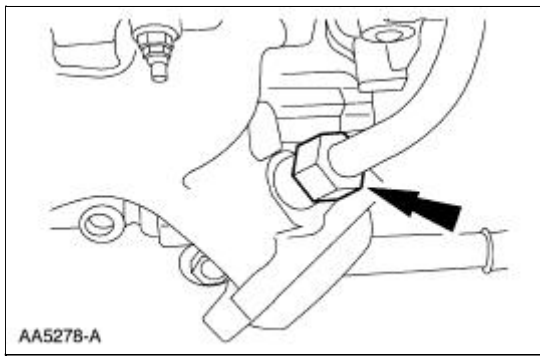
10. Remove the PCV valve tube and electrical connector.



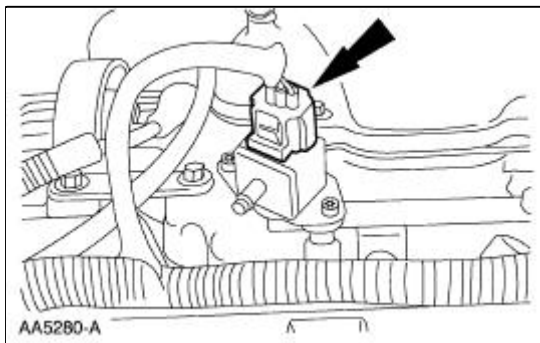
11. Disconnect the exhaust gas recirculation (EGR) tube from the EGR valve.



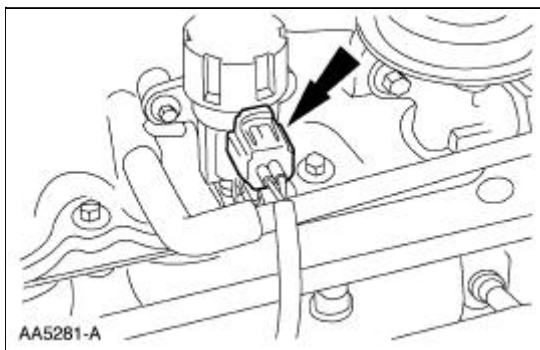
12. Disconnect the EGR tube from the exhaust manifold.



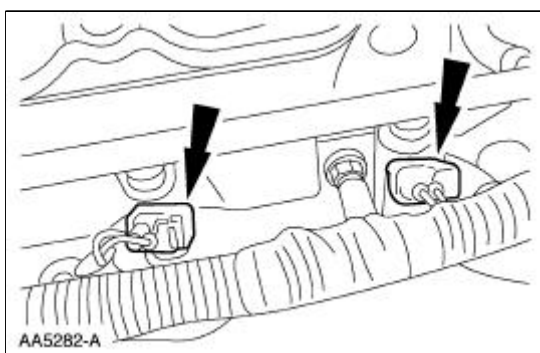
13. Disconnect the fuel pressure damper electrical connector.



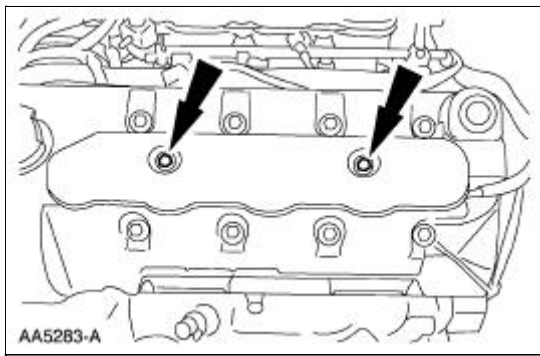
14. Disconnect the EGR vacuum regulator electrical connector.



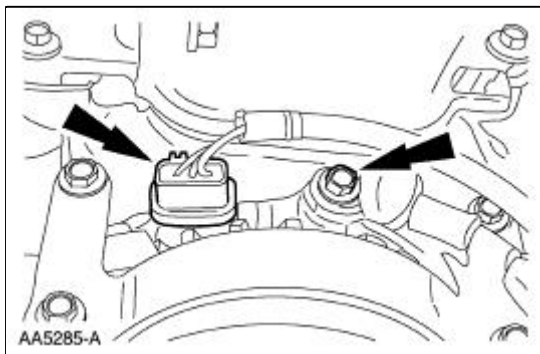
15. Disconnect the four LH fuel injector electrical connectors.



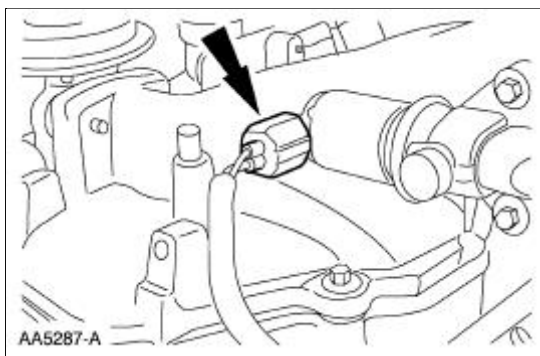
16. Remove the LH coil cover.



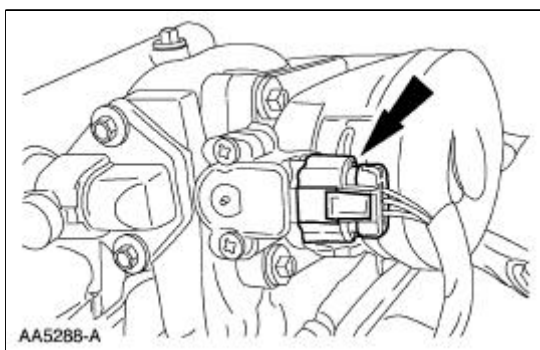
17. Disconnect the generator.



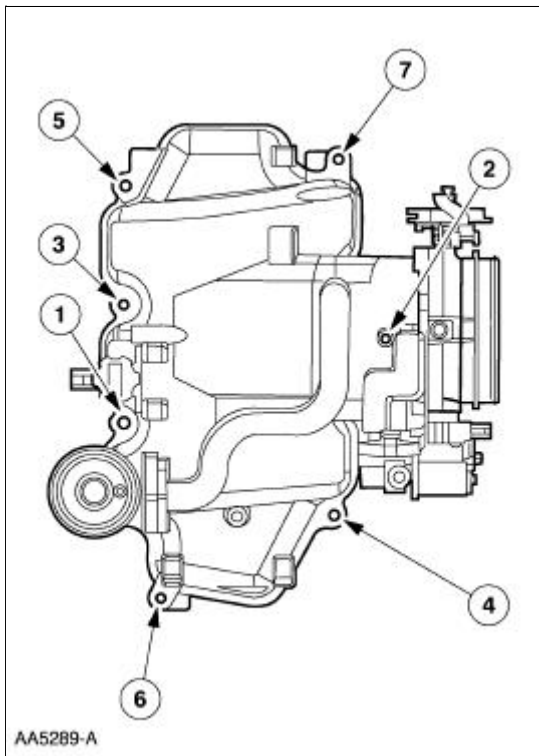
18. Disconnect the idle air control (IAC) valve electrical connector.



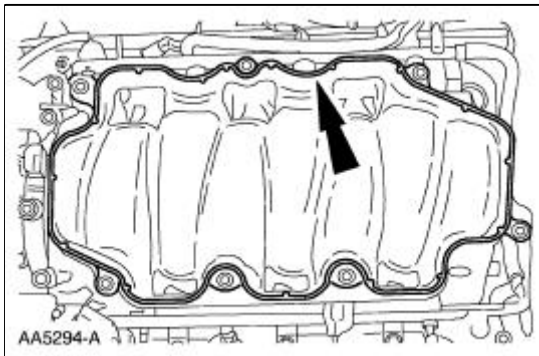
19. Disconnect the throttle position (TP) sensor electrical connector.



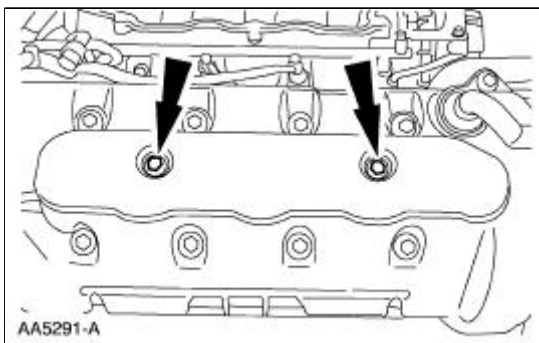
20. Remove the bolts and the upper intake manifold.



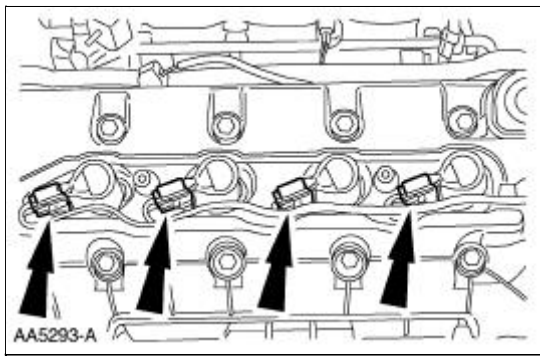
21. Remove the upper intake manifold gasket.
 - Clean and inspect the sealing surfaces.



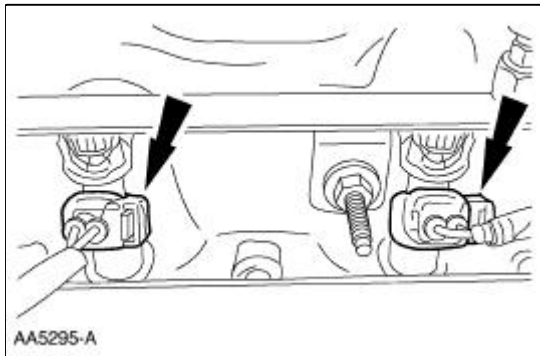
22. Remove the RH coil cover.



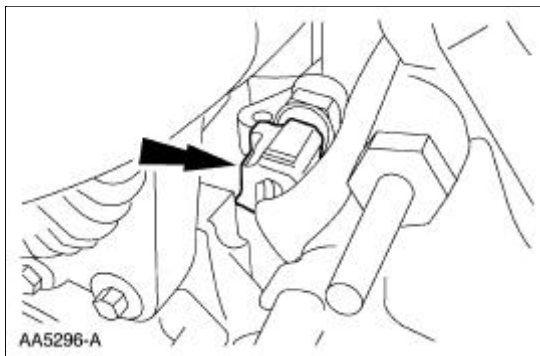
23. Disconnect the LH ignition coils.



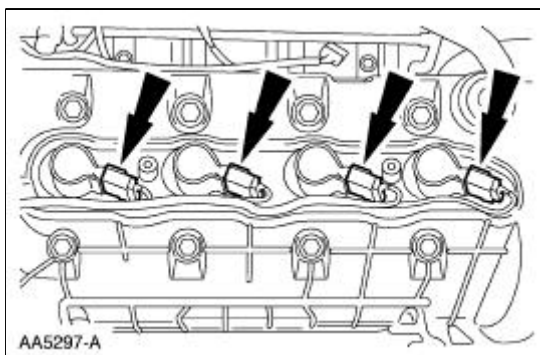
24. Disconnect the four RH fuel injector electrical connectors.



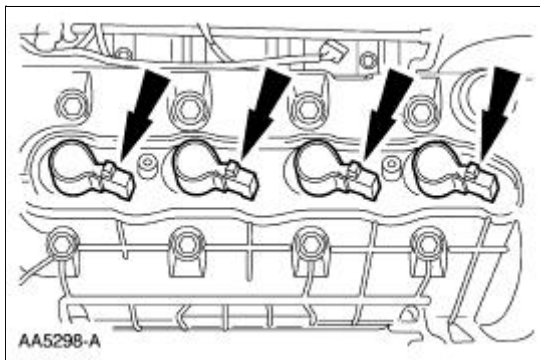
25. Disconnect the engine coolant temperature (ECT) sensor.



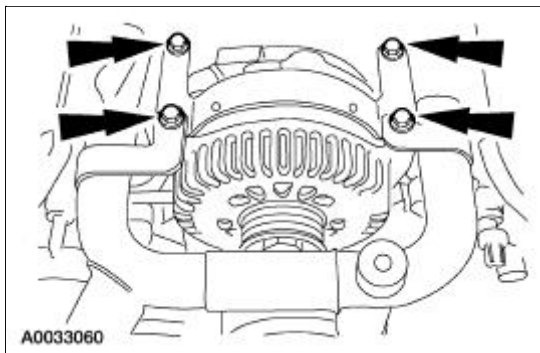
26. Disconnect the RH ignition coils.



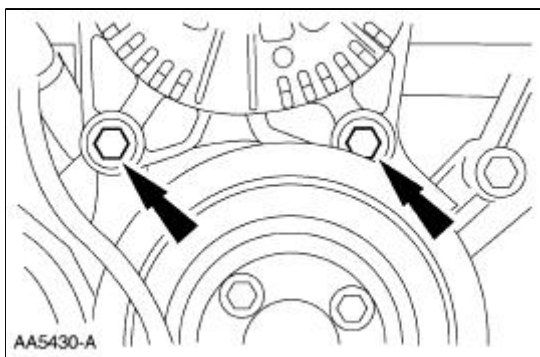
27. Remove the eight ignition coils.



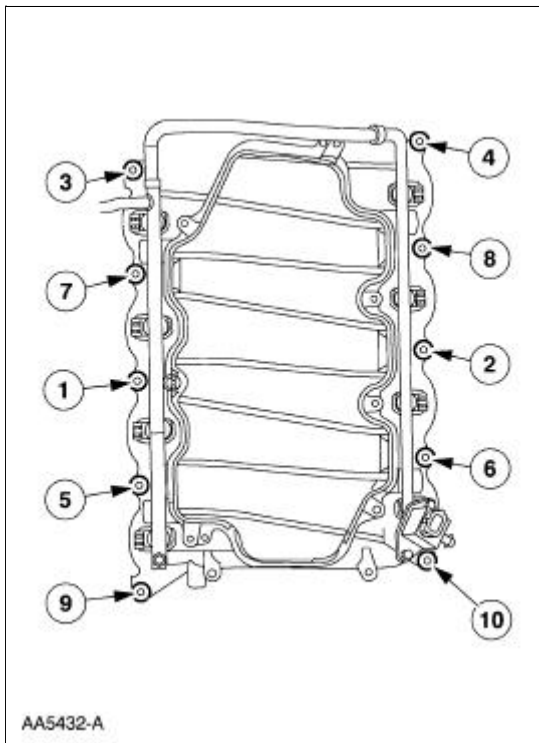
28. Remove the bracket from the accessory drive belt tensioner.
29. Remove the accessory drive belt.
30. Remove the coolant bypass tube and upper generator support bracket.
 - Remove the bolts.
 - Remove the coolant bypass tube.
 - Remove the upper generator support bracket.



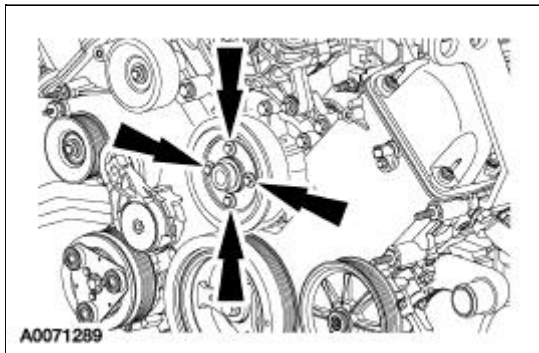
31. Remove the generator.



32. Remove the eight bolts and the two studs in the sequence shown. Remove the lower intake manifold.

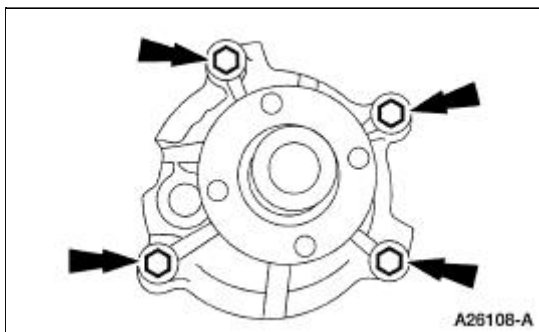


33. Remove the bolts and the coolant pump pulley.

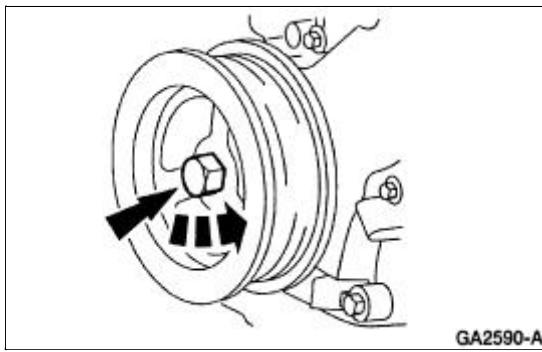


34. Remove the coolant pump from the cylinder block.

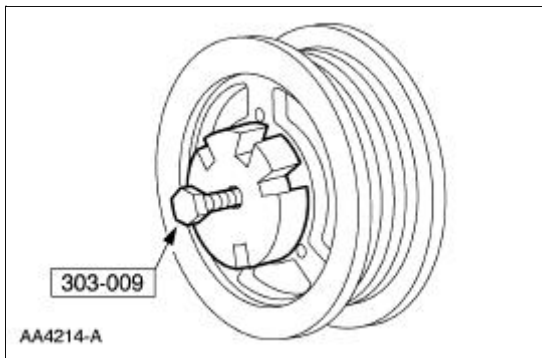
- Remove the bolts.
- Inspect and clean the sealing surfaces.



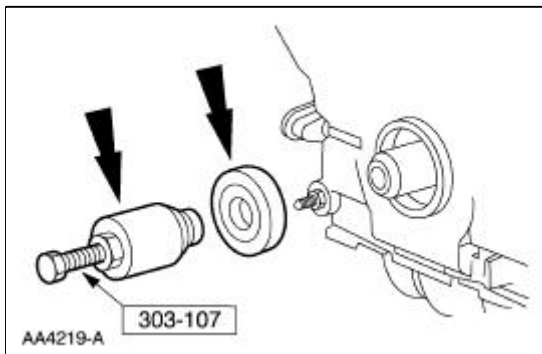
35. Remove the bolt.



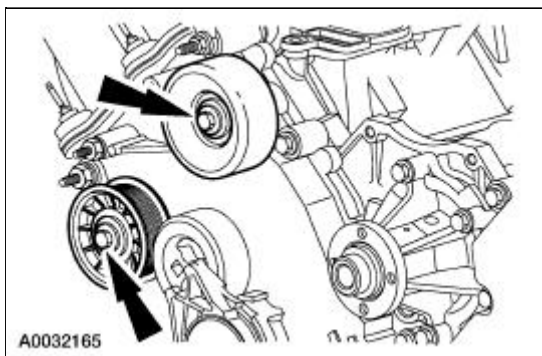
36. Using the special tool, remove the crankshaft pulley.



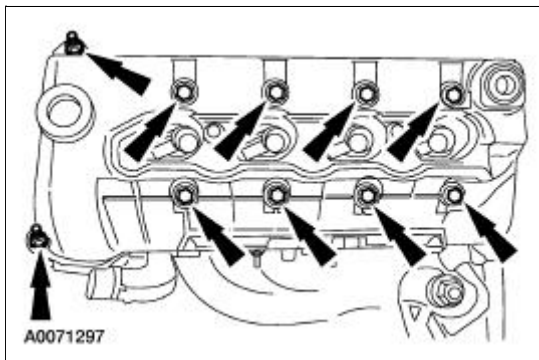
37. Using the special tool, remove the crankshaft front seal.



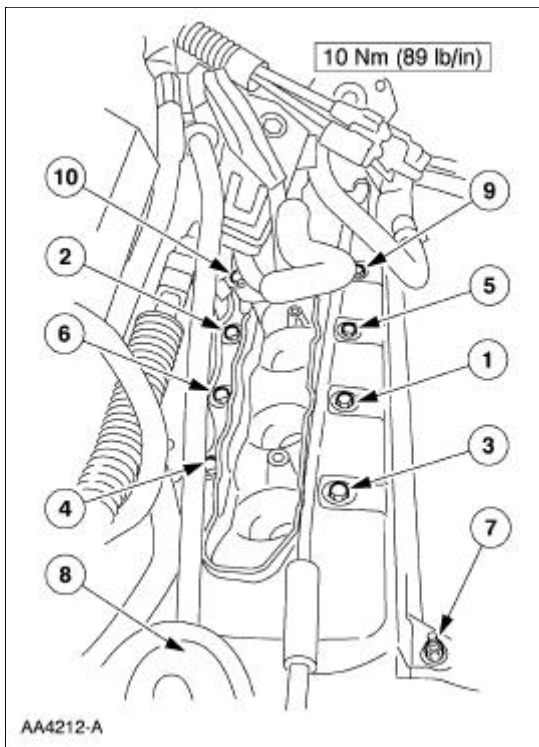
38. Remove the belt idler pulleys.



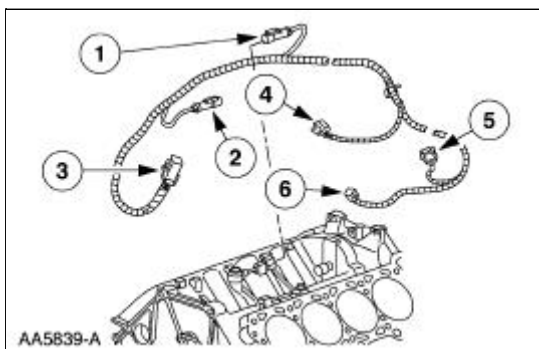
39. Remove the bolts and the LH valve cover.



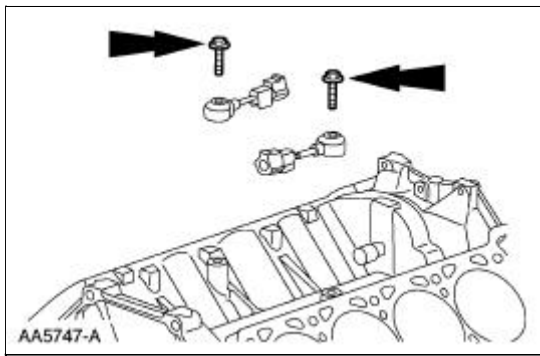
40. Remove the bolts and the RH valve cover.



41. Remove the knock sensor wiring harness.
1. LH knock sensor electrical connector.
 2. RH knock sensor electrical connector.
 3. Engine control sensor electrical connector.
 4. Fuel injector electrical connector.
 5. A/C compressor electrical connector.
 6. Crankshaft position sensor (CKP) electrical connector.



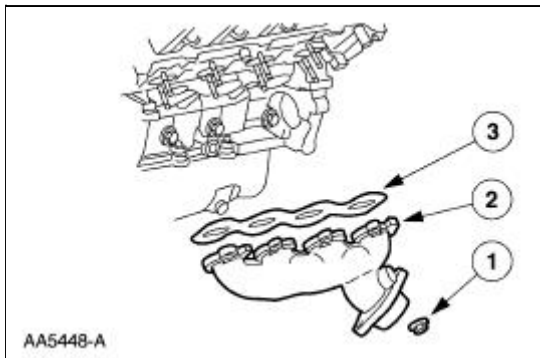
42. Remove the knock sensors.



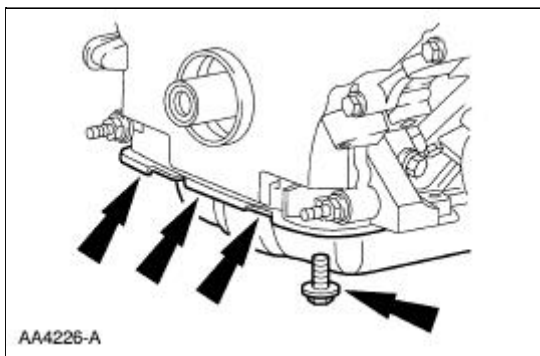
43. **NOTE:** LH side is shown; RH side is similar.

Remove the exhaust manifolds.

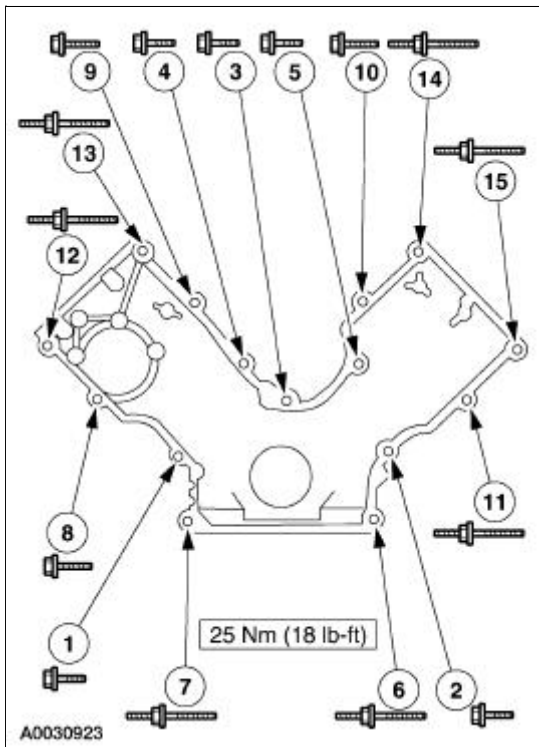
1. Remove the nuts.
2. Remove the LH and RH exhaust manifolds.
3. Remove the exhaust manifold gaskets.



44. Remove the four bolts.



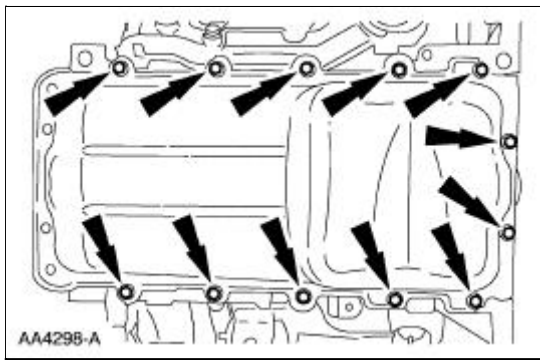
45. Remove the engine front cover.



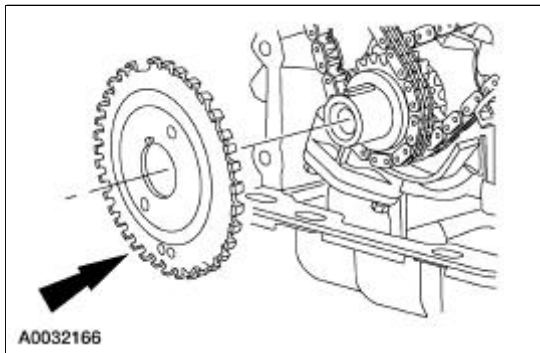
Item	Part Number	Description
1	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
2	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
3	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
4	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
5	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
6	W706508	Stud, Hex Shldr Pilot, M8 x 1.25 x 50 — M6 x 1 x 10
7	N808586	Stud and Washer, Hex-Head Pilot, M8 x 1.25 x 60 — M6 x 1 x 26
8	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
9	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
10	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
11	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
12	W706560	Stud, Hex-Head Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 16
13	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
14	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
15	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26

46. **NOTE:** Be careful when removing the gasket. It is reusable if not damaged.

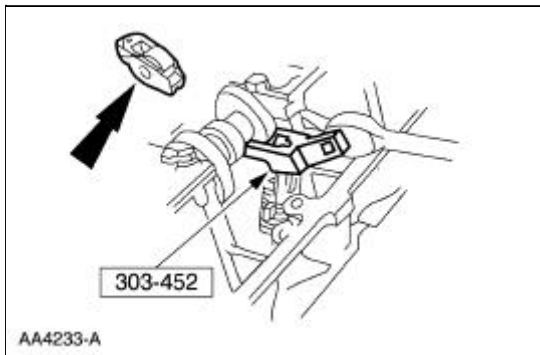
Remove the oil pan and the gasket.



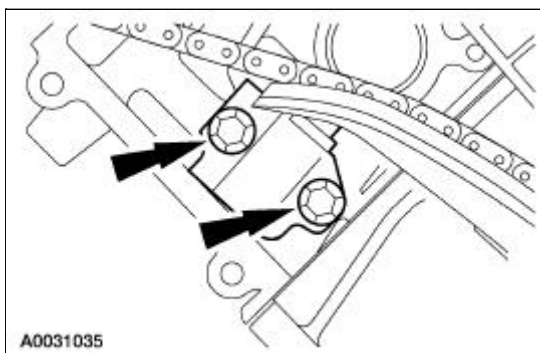
47. Remove the CKP sensor pulse wheel.



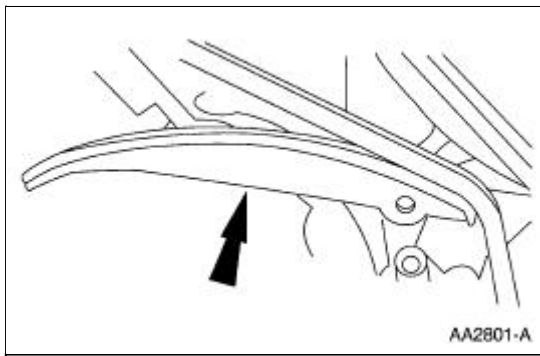
48. Using the special tool, remove the 32 roller followers.



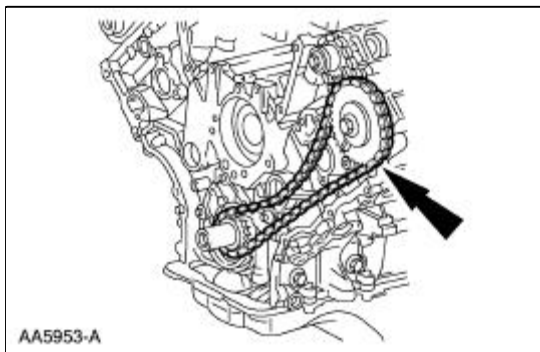
49. Remove the bolts and the RH and LH timing chain tensioners.



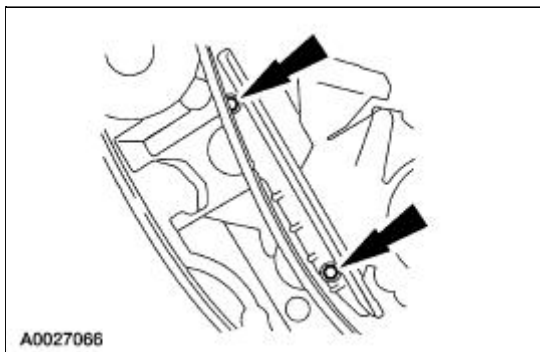
50. Remove the RH and LH timing chain tensioner arms.



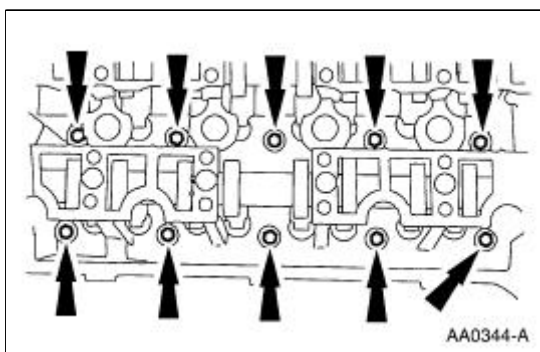
51. Remove the RH and the LH timing chains and crankshaft sprocket.



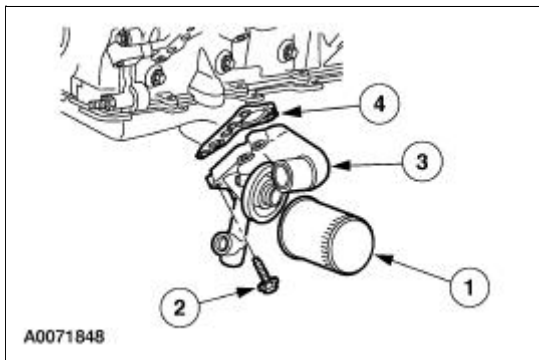
52. Remove the RH and LH timing chain guides.



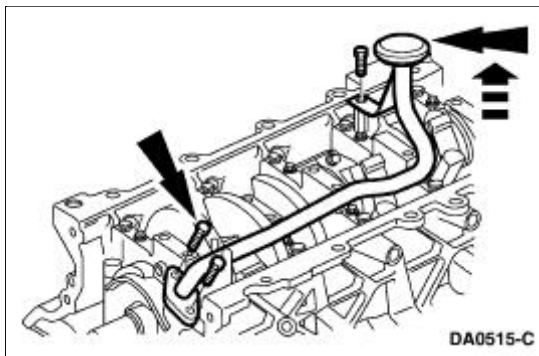
53. Remove the RH and LH cylinder heads.



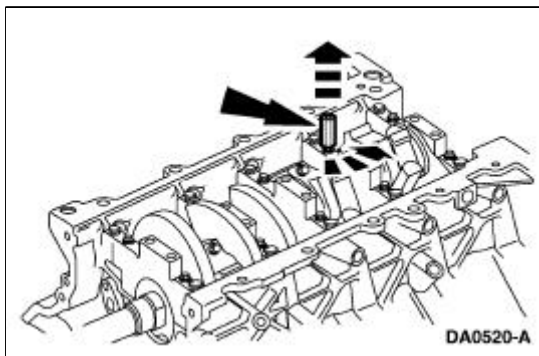
54. Remove the oil filter adapter.
1. Remove the oil filter.
2. Remove the bolts.
3. Remove the oil filter adapter.
4. Remove the gasket.



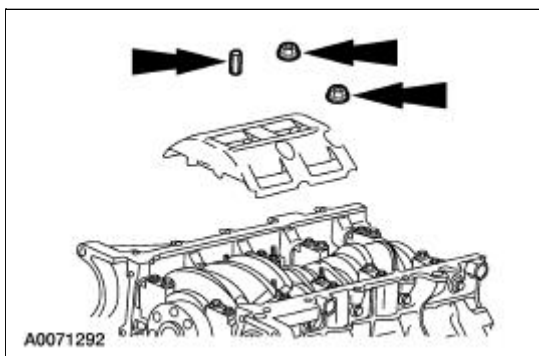
55. Clean and inspect the oil filter adapter.
 - Flush the adapter with parts cleaner. If metal particles are present, install a new oil filter adapter.
56. Remove the bolts and the oil pump screen and pickup tube.



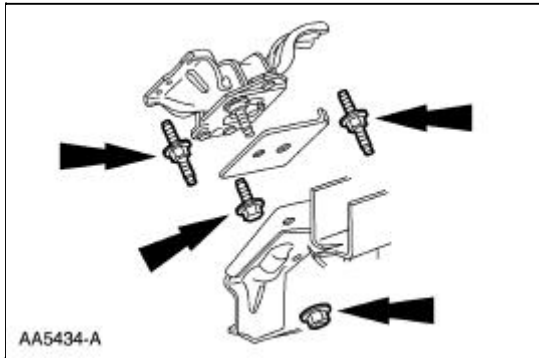
57. Remove the oil pump screen and pickup tube spacer.



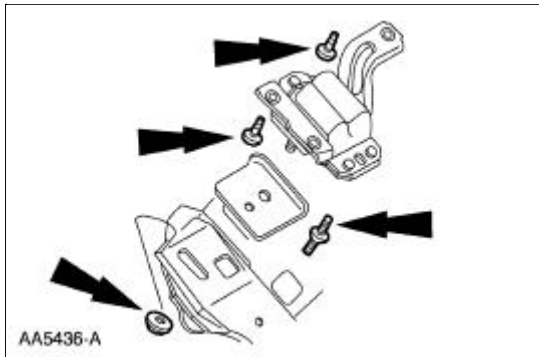
58. Remove the nuts and the windage tray.



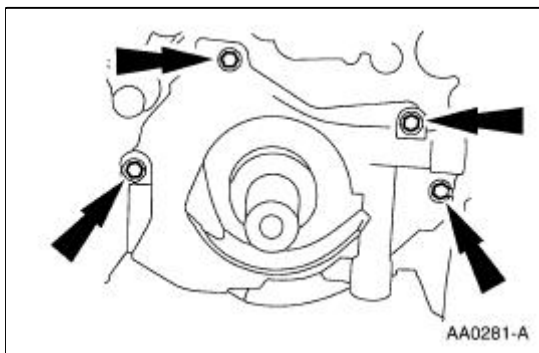
59. Remove the LH engine mount.



60. Remove the RH engine mount.



61. Remove the bolts and the oil pump.

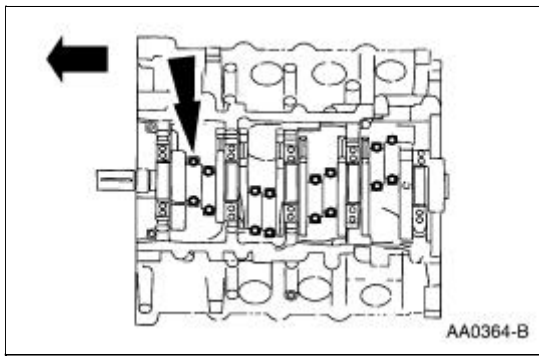


62.  **CAUTION: Do not stamp the top of pistons, as ring land damage can occur.**

NOTE: Connecting rods and rod caps should be numbered to keep the correct orientation in the following sequence.

Remove the connecting rod caps for piston number 1 and 6.

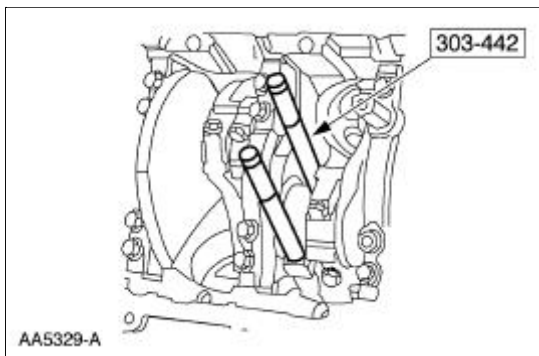
- Discard the bolts.



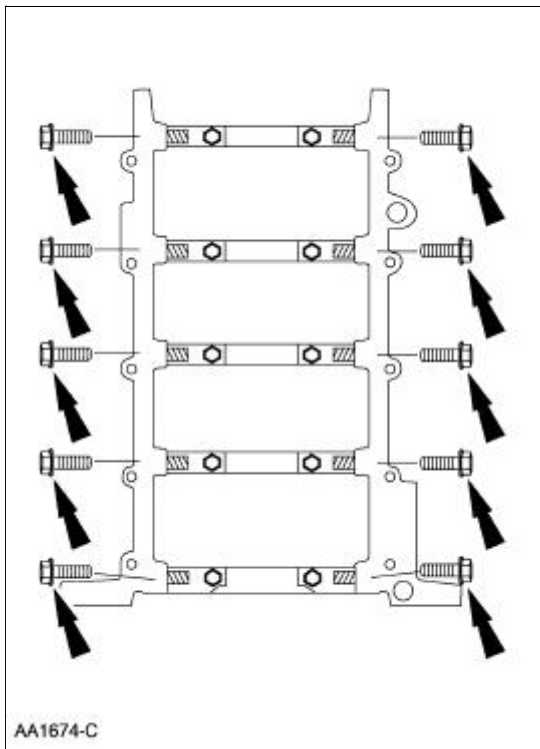
63.  **CAUTION: Do not scratch the cylinder walls or crankshaft journals with the connecting rod.**

NOTE: Before removing pistons, inspect the top of the cylinder bores. If necessary, remove the ridge or carbon deposits from each cylinder using a cylinder ridge reamer following manufacturer's instructions.

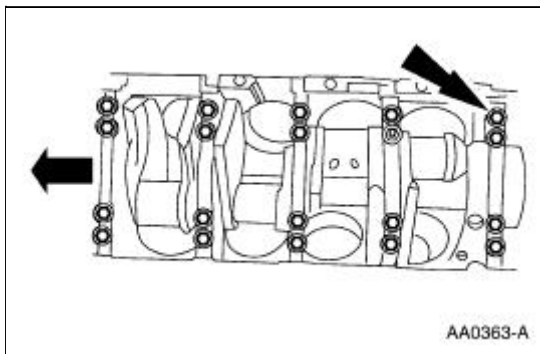
Using the special tool, push pistons number 1 and 6 through the top of the cylinder block.



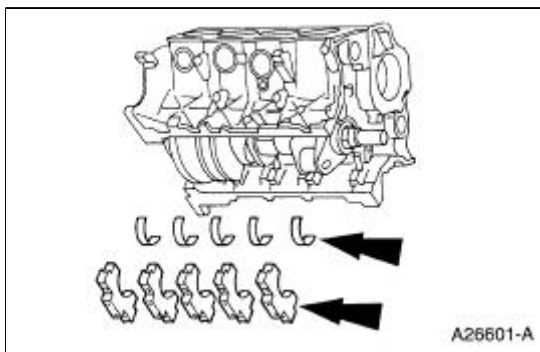
64. To remove pistons 3 and 5, 4 and 7, 2 and 8, turn crankshaft 90 degrees and repeat the previous two steps.
65. Remove the side main bearing cap bolts.



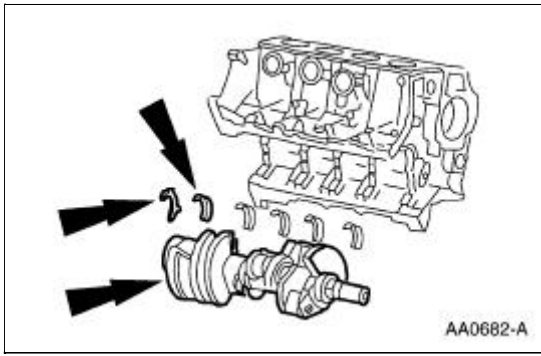
66. Remove and discard the main bearing cap bolts.



67. Remove the main bearing caps and the crankshaft lower main bearings from the cylinder block.





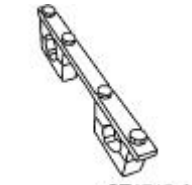

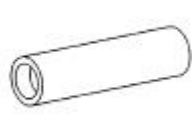
68. Remove the crankshaft, the crankshaft thrust washer, and the crankshaft upper main bearings from the cylinder block.



AA0682-A

Cylinder Head

Special Tool(s)


 <p>ST2373-A</p>	<p>Compressor, Valve Spring (Exhaust Side) 303-567 (T97P-6565-AH)</p>
 <p>ST1718-A</p>	<p>Compressor, Valve Spring (Intake Side) 303-452 (T93P-6565-AR)</p>
 <p>ST1715-A</p>	<p>Holding Tool, Camshaft 303-446 (T93P-6256-AHR)</p>
 <p>ST1716-A</p>	<p>Compressor, Valve Spring, Air Operated 134-R0207 or equivalent</p>
 <p>ST1332-A</p>	<p>Installer, Valve Stem Oil Seal 303-383 (T91P-6571-A)</p>

Material

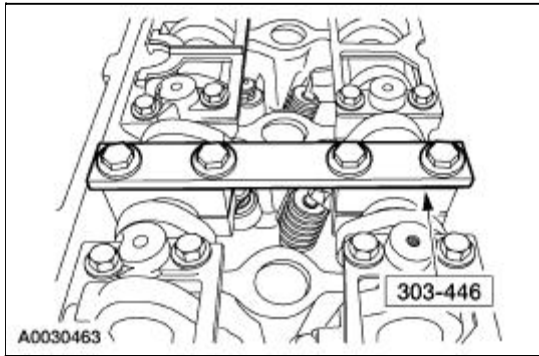
Item	Specification
<p>Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent</p>	<p>WSS-M2C153- H</p>

Disassembly

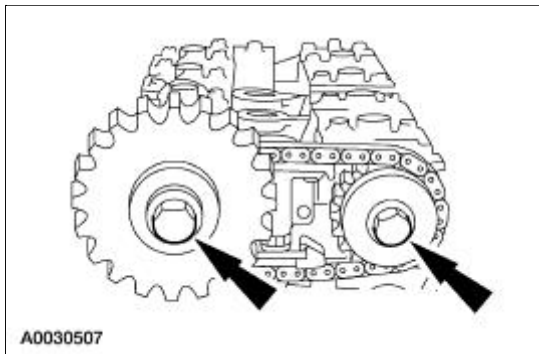
-  **CAUTION:** Do not place the cylinder head flat on the bench; the valves will bend.

 **CAUTION:** Before disassembly begins, mark the valve position on the face of each valve being removed. The valves must be re-installed into the same positions.

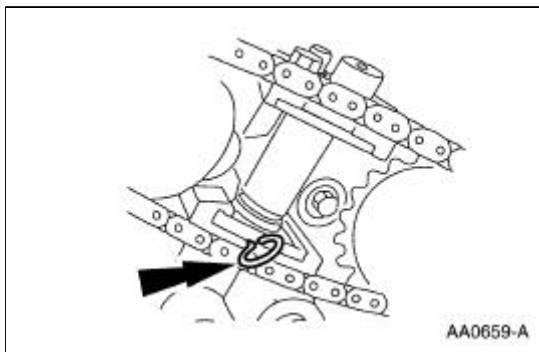
Install the special tool.



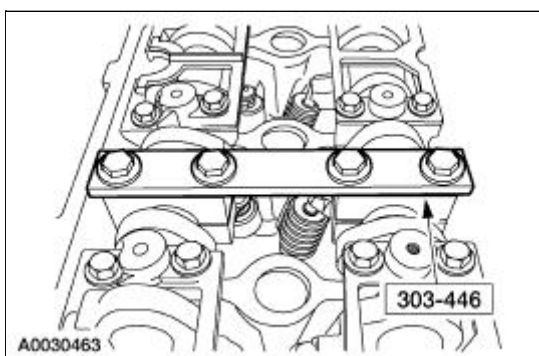
2. Remove the exhaust camshaft sprocket and the intake camshaft bolt, washer and spacer.



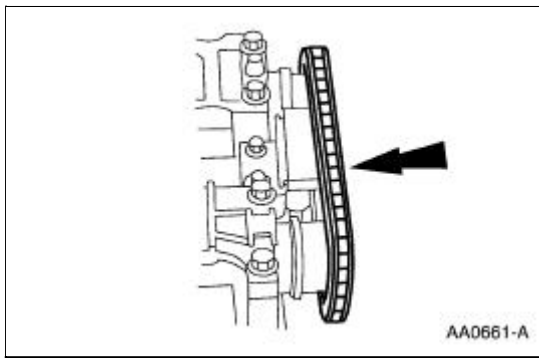
3. Compress the tensioner and install a lock pin.



4. Remove the special tool.

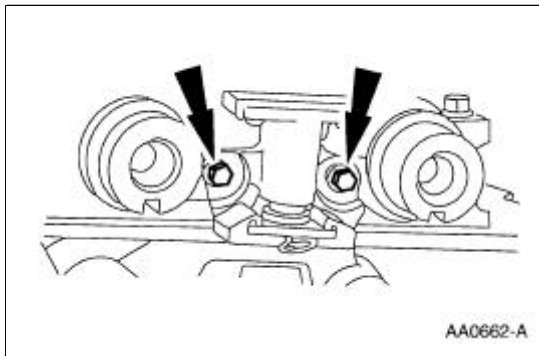


5. Remove the timing chain and the camshaft sprocket.

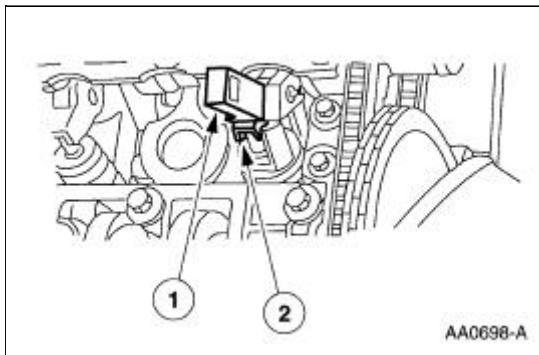


6. **NOTE:** LH tensioner is shown, RH tensioner is similar.

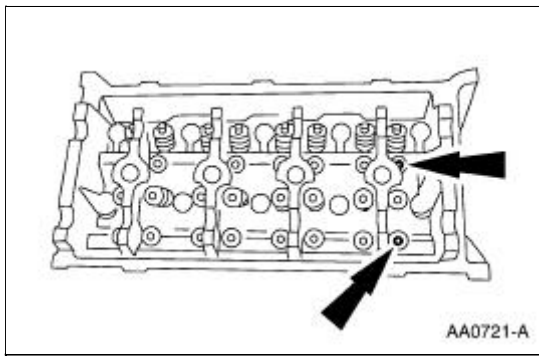
Remove the tensioner.




7. Remove the roller followers on the base circle.
1. Install the special tool on the valve spring.
 2. Compress the tool and remove the roller follower.

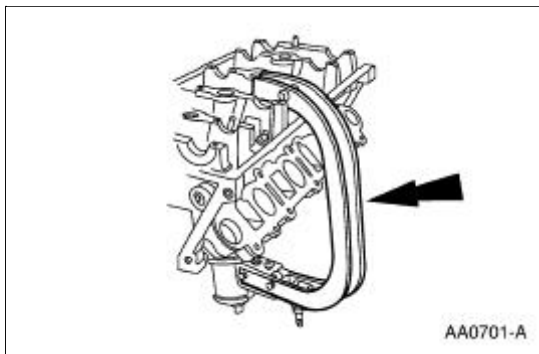


8. Repeat the previous step for the remaining roller followers.
9. Remove the hydraulic lash adjusters.

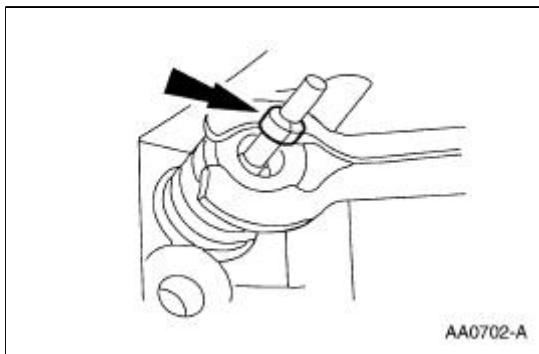


10.  **CAUTION:** Make sure the tool is seated correctly on the valve spring. Apply a small amount of air at a time. This will prevent the tool from shifting and causing damage to the cylinder head.

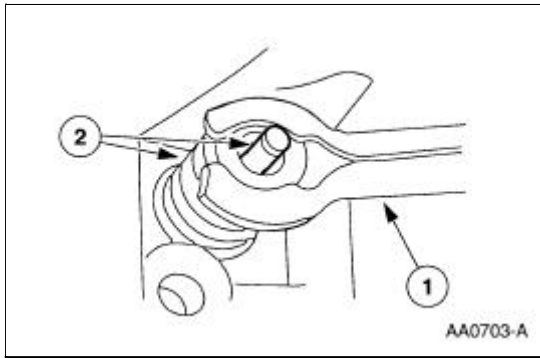
Install the air-operated spring compressor on the cylinder head.



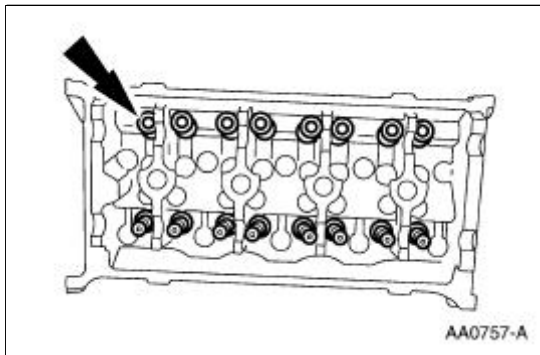
11. Compress the valve spring compressor and remove the key from the valves.




12. Remove the intake valves and the valve springs.
1. Release the pressure and remove the valve spring compressor.
 2. Remove the intake valves and the valve springs from the cylinder head.



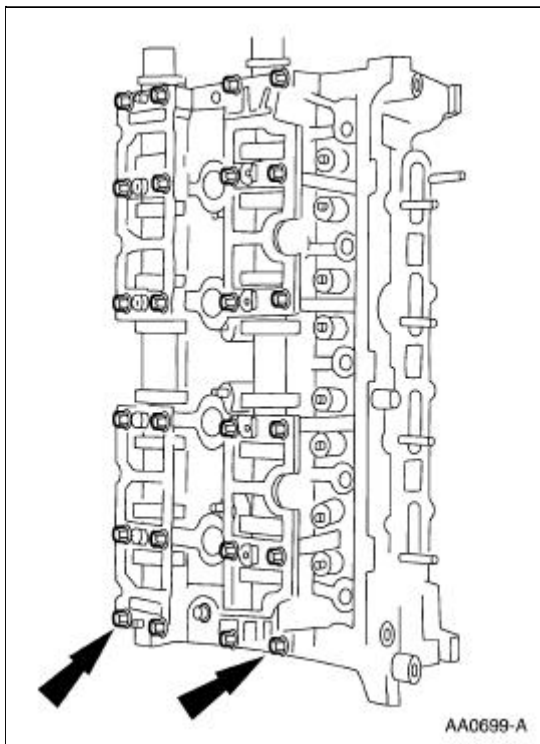
13. Remove the valve stem seals.



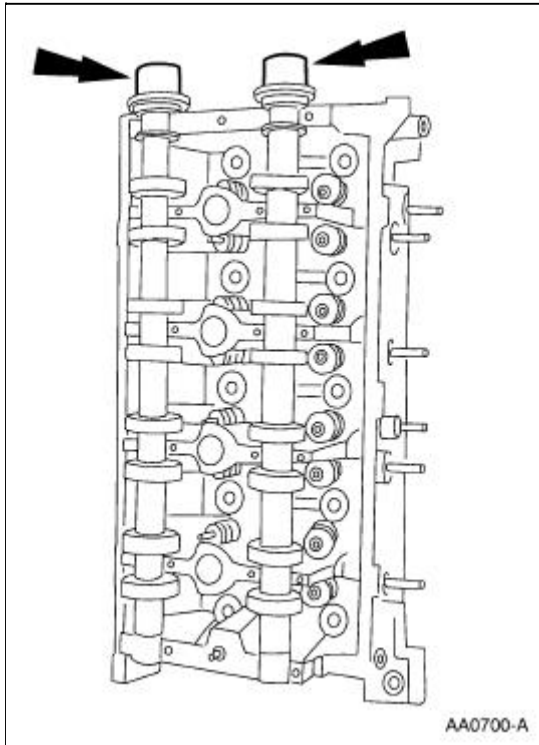
14.  **CAUTION:** The outer bolts on the outer cam bearing cap (exhaust) are longer and must be returned to the same location or engine damage may occur.

NOTE: Identify the camshaft-to-cylinder head location. Caps are not interchangeable.

Remove the bolts and the camshaft bearing cap assemblies.

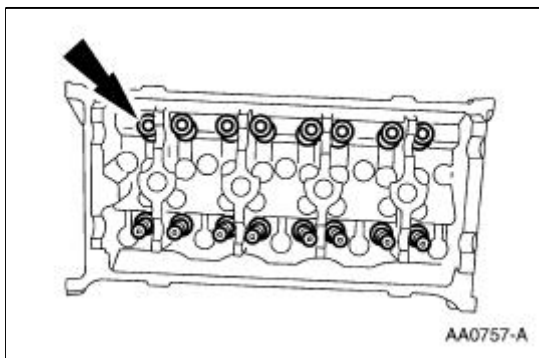



15. Remove the camshafts.



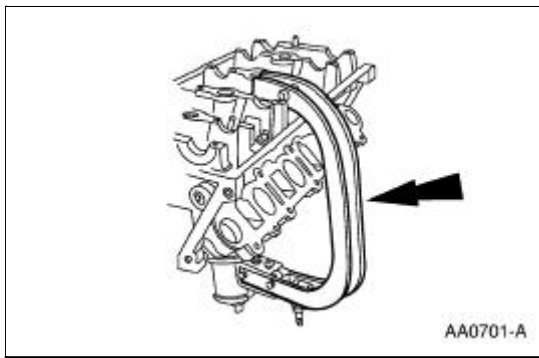
Assembly

1. Install the valve stem seals.

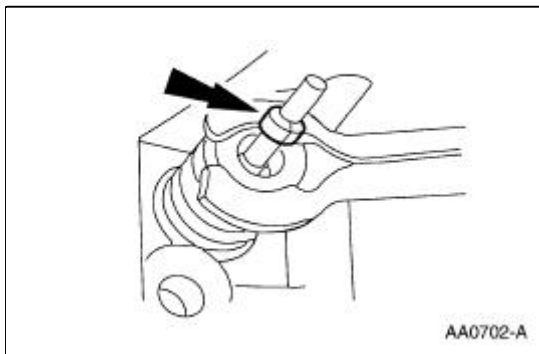


2. Install the valves and the valve springs.
3.  **CAUTION: Make sure the tool is seated correctly on the valve spring. Apply a small amount of air at a time. This will prevent the tool from shifting and causing damage to the cylinder head.**

Install the air-operated spring compressor on the cylinder head.



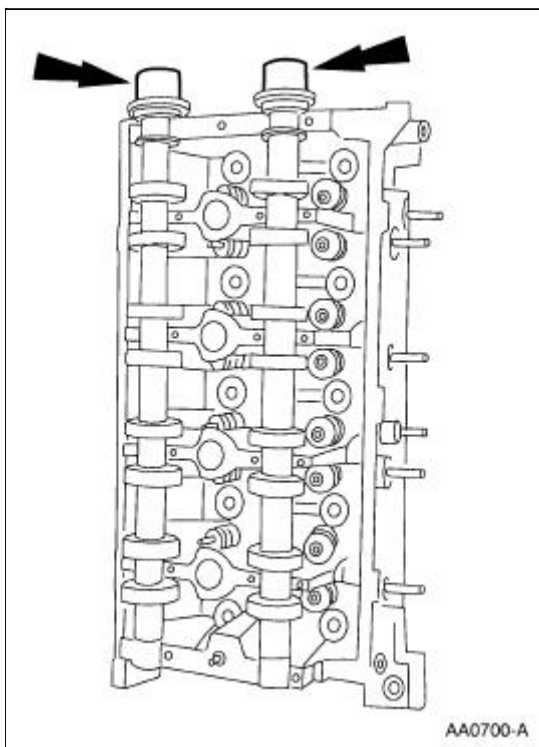
4. Compress the valve spring compressor and install the key on the valves.



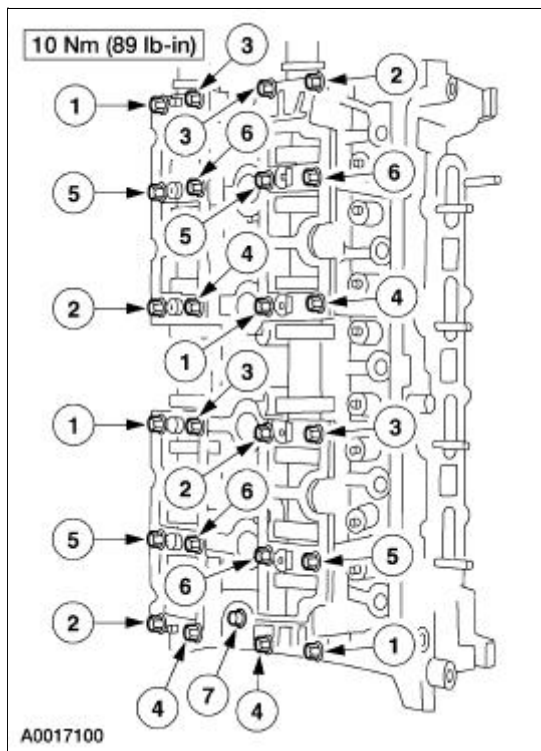
5. **NOTE:** LH is shown, RH is similar.

Install the camshafts.

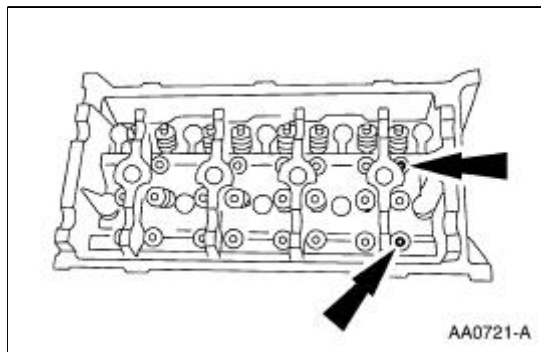
- Lubricate the camshafts with clean engine oil.



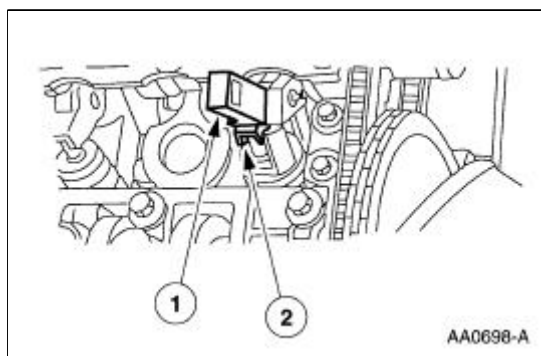
6. Install the camshaft bearing cap assemblies.



7. Install the hydraulic lash adjusters.

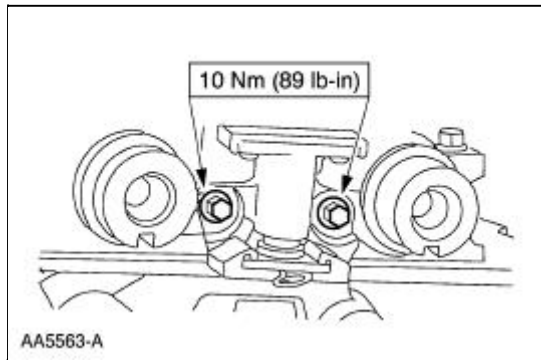


8. Install the roller followers.
 1. Install the special tool on the valve spring.
 2. Compress the spring and install the roller follower.



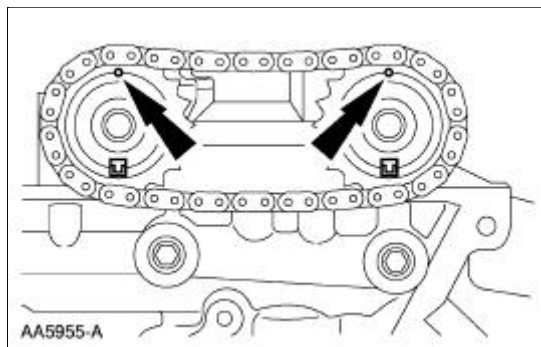
9. Repeat the previous step for the remaining roller followers.
10. **NOTE:** LH tensioner is shown, RH tensioner is similar.

Install the tensioner.

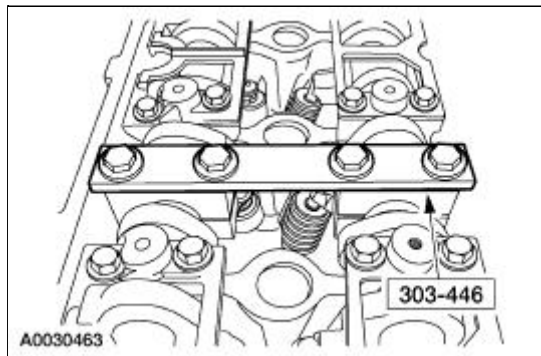


11.  **CAUTION:** Timing marks must be at 12 o'clock and indexed at 6 o'clock.

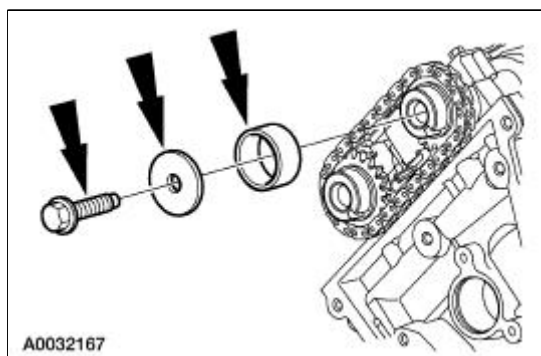
Install the camshaft sprockets and the chain as an assembly.



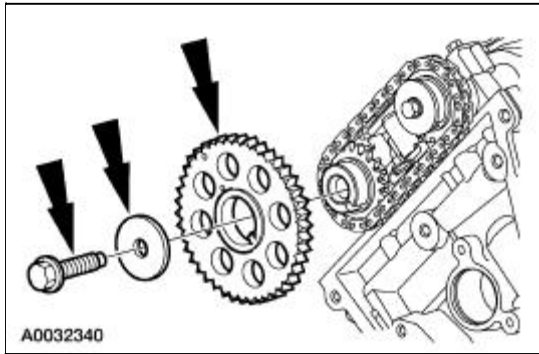
12. Install the special tool.



13. Install the camshaft spacer, washer and bolt, and hand-tighten the bolt.

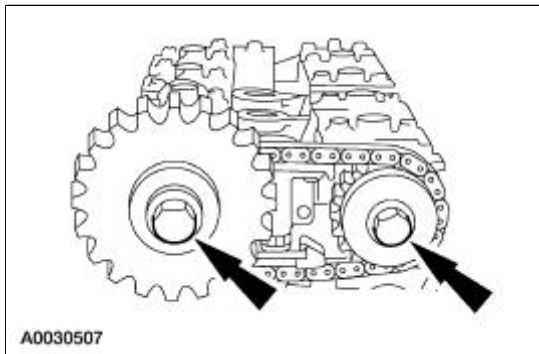


14. Install the camshaft sprocket, washer and bolt, and hand-tighten the bolt.

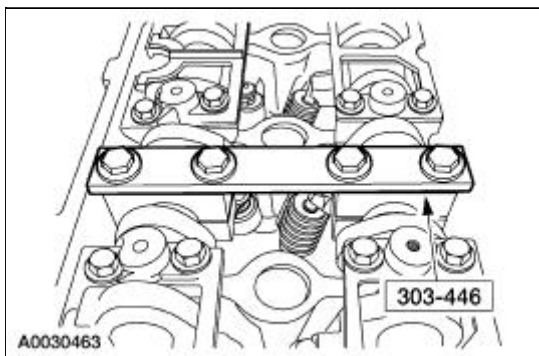


15. Tighten the bolts in two stages:

- Stage 1: Tighten to 40 Nm (30 lb-ft).
- Stage 2: Tighten and additional 90 degrees.



16. Remove the special tool.



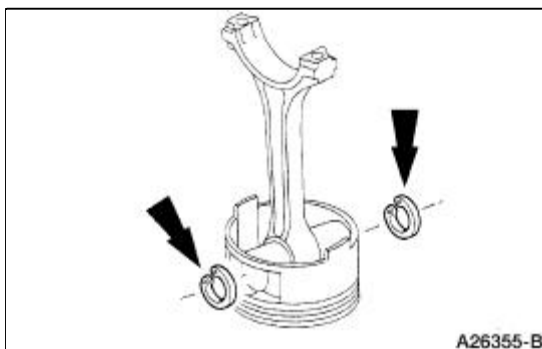
Piston —Pin Connecting Rod, Floating Pin

Material

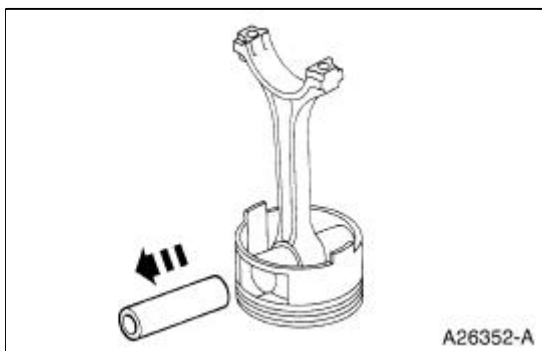
Item	Specification
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP	WSS-M2C153-H

Disassembly

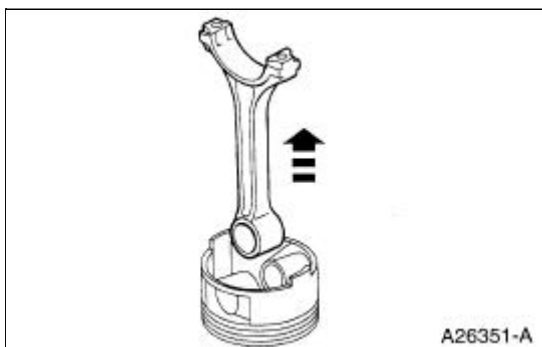
1. Remove the clips.



2. Remove the piston pin from the piston and connecting rod assembly.



3. Remove the connecting rod from the piston.

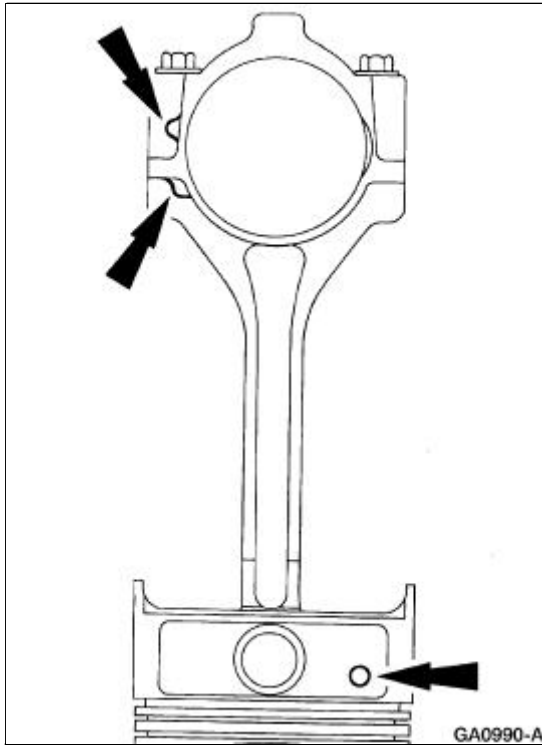


4. Clean and inspect the piston and connecting rod. For additional information, refer to [Section 303-00](#).

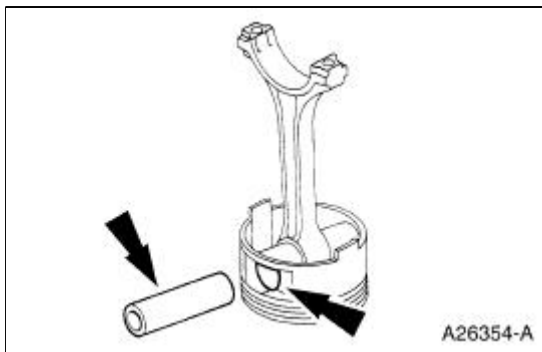
Assembly

1. **NOTE:** Connecting rod must be installed into piston with identification markings toward front.

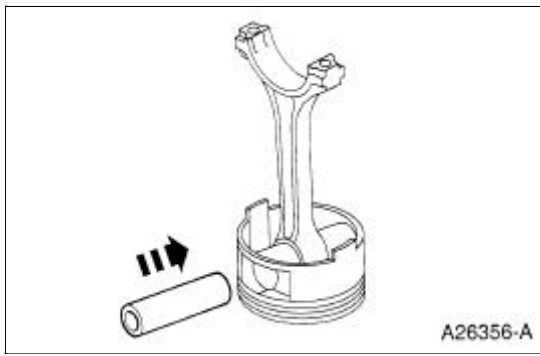
Position the connecting rod in the piston.



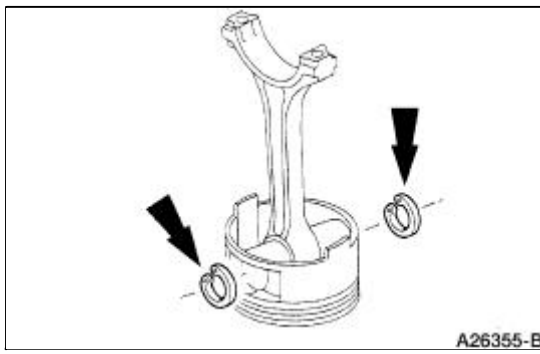
2. Lubricate the piston pin and pin bore with clean engine oil.



3. Install the piston pin in the piston and connecting rod assembly.

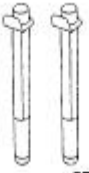





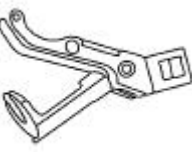


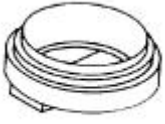
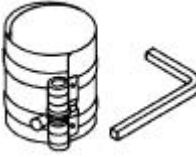

4. Install the piston pin retaining clips in the piston.



Engine

Special Tool(s)

 <p>ST1337-A</p>	<p>Guides, Connecting Rod 303-442 (T93P-6136-A)</p>
 <p>ST1287-A</p>	<p>Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)</p>
 <p>ST1328-A</p>	<p>Installer, Front Cover Oil Seal 303-335 (T88T-6701-A)</p>
 <p>ST1480-A</p>	<p>Installer, Crankshaft Rear Oil Seal 303-518 (T95P-6701-DH)</p>
 <p>ST1482-A</p>	<p>Installer, Crankshaft Rear Oil Slinger 303-517 (T95P-6701-CH)</p>
 <p>ST1718-A</p>	<p>Compressor, Valve Spring (Intake) 303-452 (T93P-6565-AR)</p>
 <p>ST1693-A</p>	<p>Compressor, Valve Spring (Exhaust) 303-567 (T97P-6565-AH)</p>
	<p>Installer, Crankshaft Rear Oil Seal</p>

 <p>ST1479-A</p>	303-516 (T95P-6701-BH)
	Compressor, Piston Ring 303-D032 (D81L-6002-C) or equivalent
 <p>ST1335-A</p>	Holding Tool, Crankshaft 303-448 (T93P-6303-A)

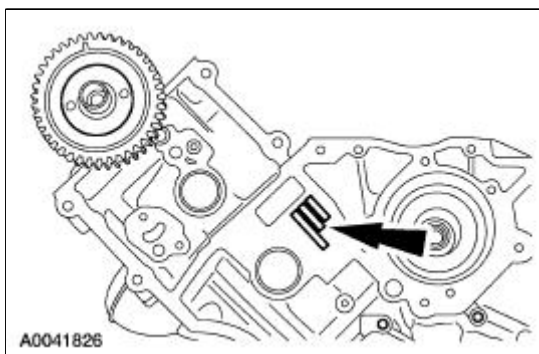
Material

Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392- A
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323- A4
Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153- H
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) (yellow color)	WSS-M97B51- A1

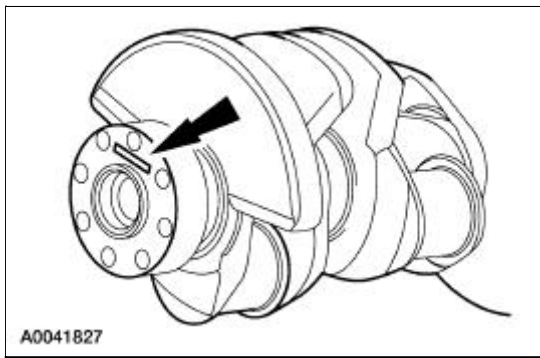
Assembly

All vehicles

1. Record the main bearing code found on the front of the engine block.



2. Record the main bearing code found on the back of the crankshaft.



3. Using the data recorded earlier and the Bearing Select Fit Chart, Standard Bearings Chart determine the required bearing grade for each main bearing.
 - Read the first letter of the engine block main bearing code and the first letter of the crankshaft main bearing code.
 - Read down the column below the engine block main bearing code letter, and across the row next to the crankshaft main bearing code letter, until the two intersect. This is the required bearing grade for the number one crankshaft main bearing.
 - As an example, if the engine block code letter is "F" and the crankshaft code letter is "D," the correct bearing grade for this main bearing is "2."
 - Repeat this process for the remaining four main bearings.

		MINIMUM BLOCK DIA																									
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X		
		72.400	.401	.402	.403	.404	.405	.406	.407	.408	.409	.410	.411	.412	.413	.414	.415	.416	.417	.418	.419	.420	.421	.422	.423	.424	
MAXIMUM CRANKSHAFT DIA	X	67.504	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	W	67.503	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	V	67.502	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	U	67.501	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	T	67.500	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	S	67.499	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	R	67.498	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Q	67.497	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	P	67.496	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	O	67.495	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	N	67.494	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	M	67.493	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	L	67.492	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	K	67.491	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	J	67.490	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	I	67.489	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	H	67.488	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	G	67.487	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	F	67.486	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	E	67.485	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	D	67.484	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	C	67.483	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	B	67.482	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	A	67.481	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

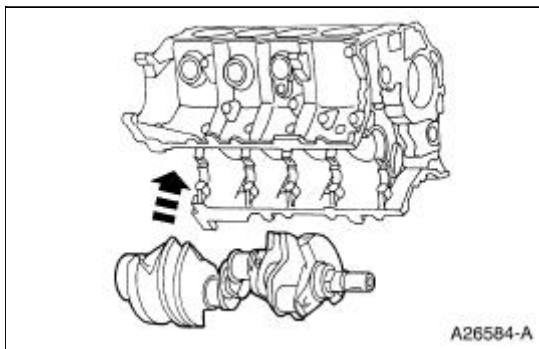
4. If oversize bearings are being used, use the procedure in the previous step and the Bearing Select Fit Chart, Oversize Bearing Chart to determine the required grade for each main bearing.


		MINIMUM BLOCK DIA																								
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	
72.400		.401	.402	.403	.404	.405	.406	.407	.408	.409	.410	.411	.412	.413	.414	.415	.416	.417	.418	.419	.420	.421	.422	.423	.424	
MAXIMUM CRANKSHAFT DIA	X 67.254	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	W 67.253	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	V 67.252	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	U 67.251	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	T 67.250	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	S 67.249	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	R 67.248	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	Q 67.247	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	P 67.246	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	O 67.245	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	N 67.244	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	M 67.243	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	L 67.242	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	K 67.241	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	J 67.240	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	I 67.239	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	H 67.238	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	G 67.237	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	F 67.236	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	E 67.235	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
D 67.234	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
C 67.233	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
B 67.232	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
A 67.231	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	

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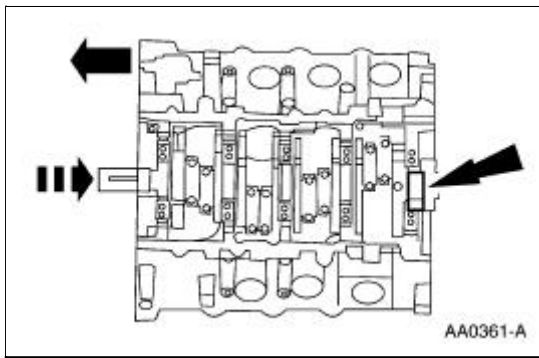
NOTE: Before assembling the cylinder block, all sealing surfaces must be free from chips, dirt, paint and foreign material. Also, make sure the coolant and oil passages are clear.

5. Install the upper main bearings into the cylinder block and the lower main bearing into the crankshaft main bearing caps. Lubricate the main bearings with clean engine oil.
6. Install the crankshaft into the cylinder block.

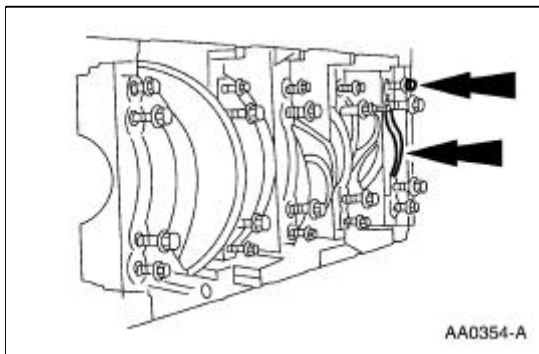


7.  **CAUTION:** Make sure the coated side of the thrust washer with the 5-mm wide oil grooves faces the crankshaft thrust surface.

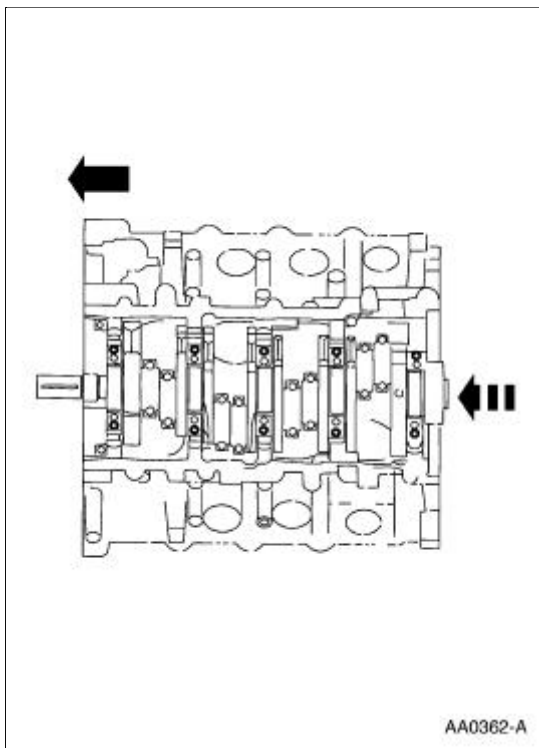
Push the crankshaft rearward and install the crankshaft thrust washer at the back of the No. 5 main boss.



8. Loosely install the main bearing caps and the bolts.



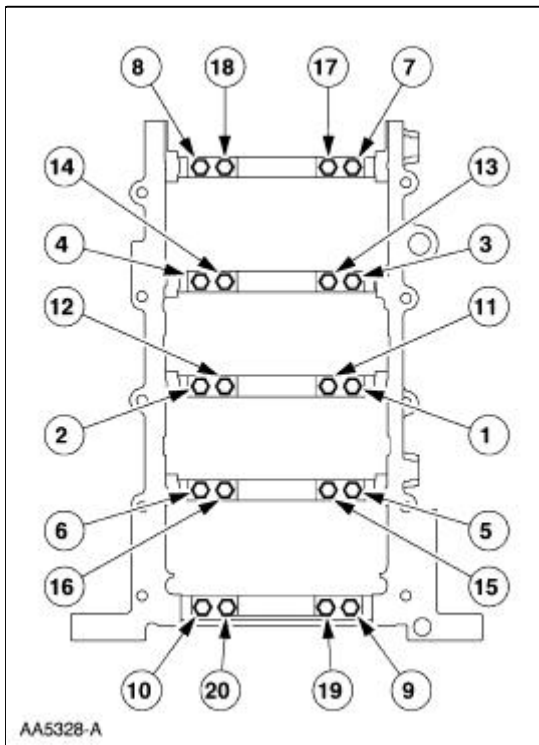
9. Push the crankshaft forward to seat the crankshaft thrust washer and hold the crankshaft in the forward position.



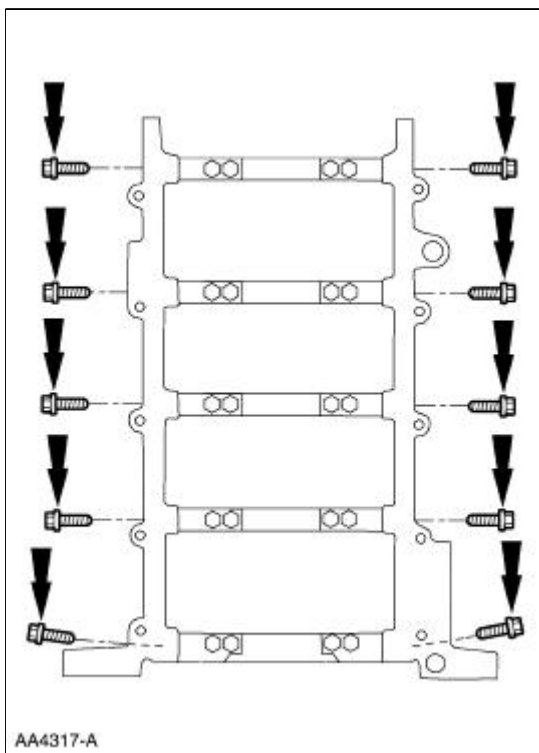
10. Tighten bolts 1-20 in sequence shown in four stages.

- Stage 1: tighten to 10 Nm (89 lb-in).
- Stage 2: tighten to 25 Nm (18 lb-ft).
- Stage 3: tighten to 40 Nm (30 lb-ft).

- Stage 4: tighten an additional 90 degrees.



11. Install and tighten the cross-mounted bolts in two stages.
 - Stage 1: tighten to 40 Nm (30 lb-ft).
 - Stage 2: tighten an additional 90 degrees.



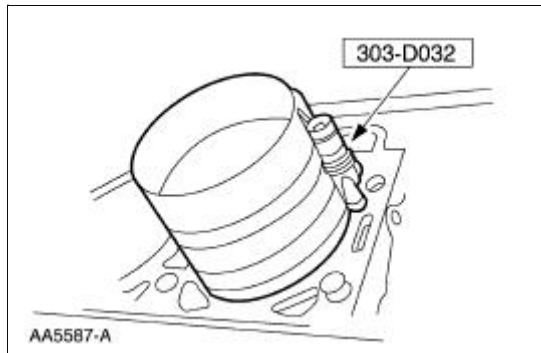
12. Check the crankshaft end play. For additional information, refer to [Section 303-00](#).

13.  **CAUTION: Do not scratch the cylinder walls or crankshaft journals with the connecting rod.**

NOTE: Make sure that the piston arrow is facing forward.

NOTE: Lubricate the piston rings, cylinder walls and connecting rod bearings with clean engine oil.

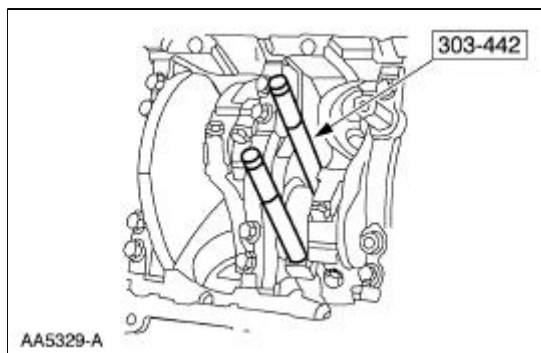
Using the special tool push the pistons through the top of the cylinder block.



14.  **CAUTION: Do not scratch the cylinder walls or the crankshaft journals with the connecting rod.**

NOTE: Make sure the crankshaft is at T.D.C.

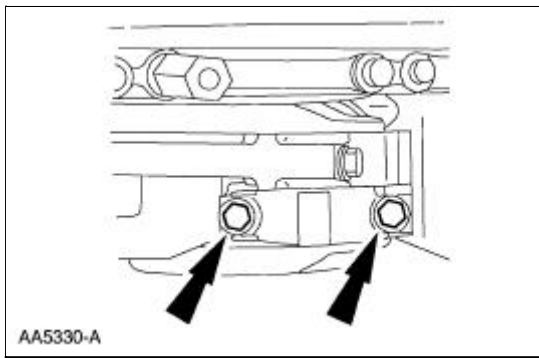
Using the special tool, install the connecting rod assemblies.



15. **NOTE:** The rod bearing cap bolts are torque-to-yield. Install new bolts each time they are serviced.

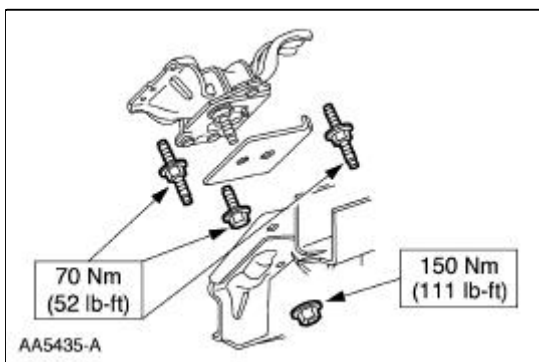
Install the connecting rod bearing caps and bolts and tighten in three stages.

- Stage 1: tighten to 25 Nm (18 lb-ft).
- Stage 2: tighten to 45 Nm (33 lb-ft).
- Stage 3: tighten an additional 90 degrees.

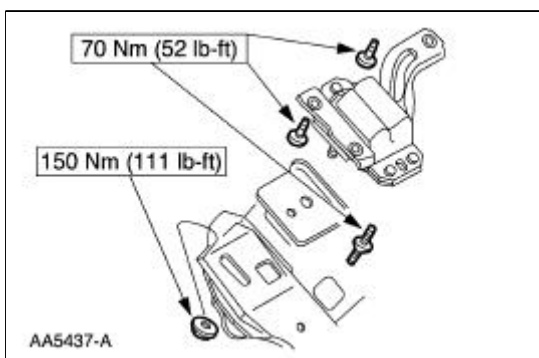


16. Check the connecting rod bearing clearance. For additional information, refer to [Section 303-00](#).

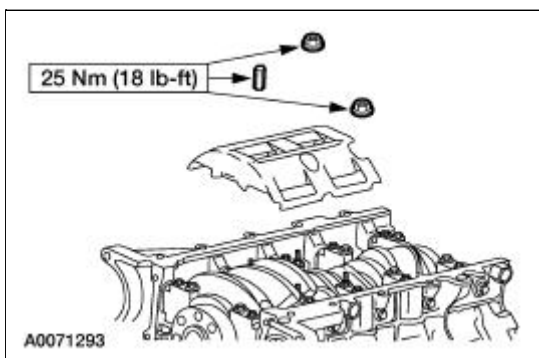
17. Install the LH engine mount.



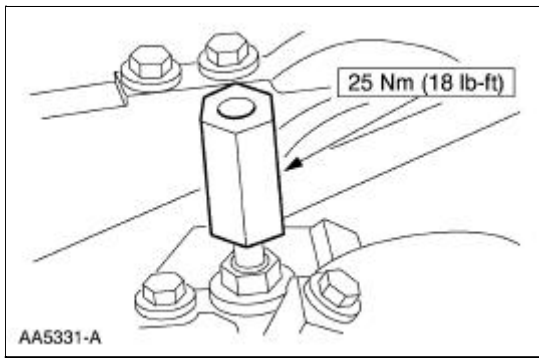
18. Install the RH engine mount.



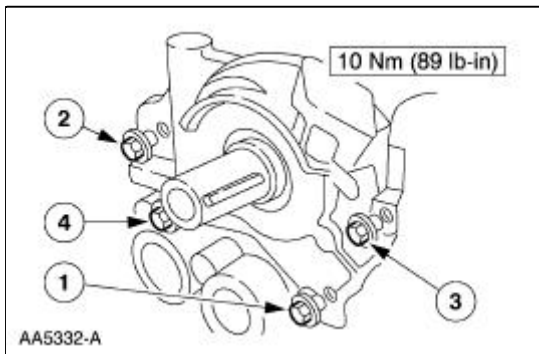
19. Install the nuts and the windage tray.



20. Install and tighten the oil pump screen spacer.

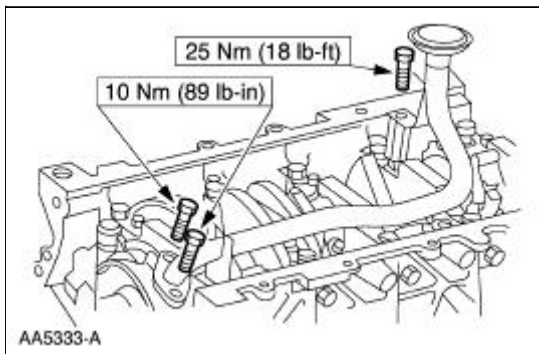


21. Position the oil pump and tighten the bolts in the sequence shown.

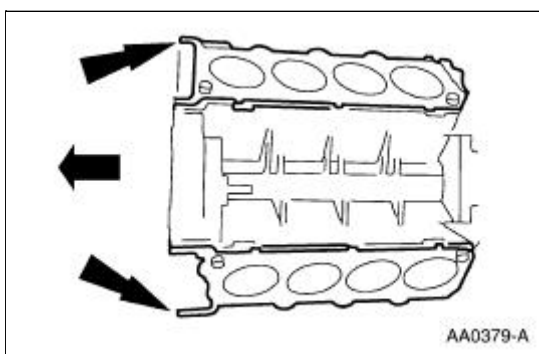


22. **NOTE:** Install a new O-ring if necessary.

Install the oil pump screen cover and tube.



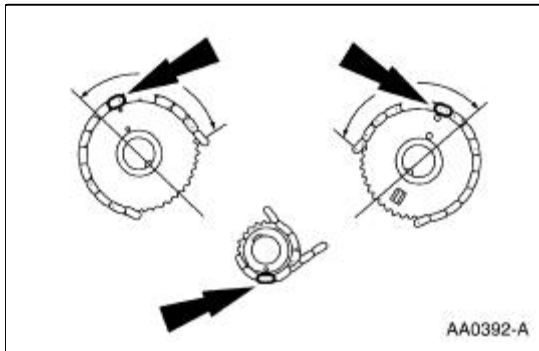
23. Install the cylinder head gaskets.



24. **CAUTION:** The camshafts must be positioned so the camshaft keyway is 90 degrees from the valve cover gasket surface to avoid damage to valves and pistons during timing

procedures.

Make sure the camshaft timing sprockets are positioned correctly.

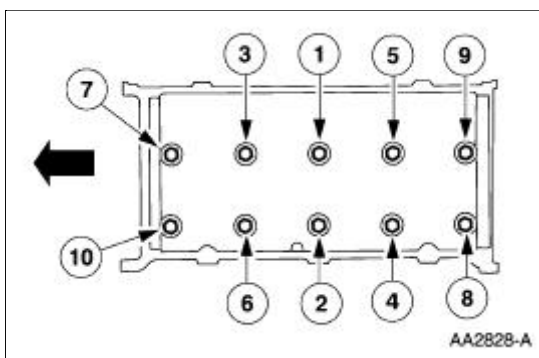



25. **NOTE:** The LH is shown; the RH is similar.

NOTE: Lubricate the bolt heads and threads. Use clean engine oil.

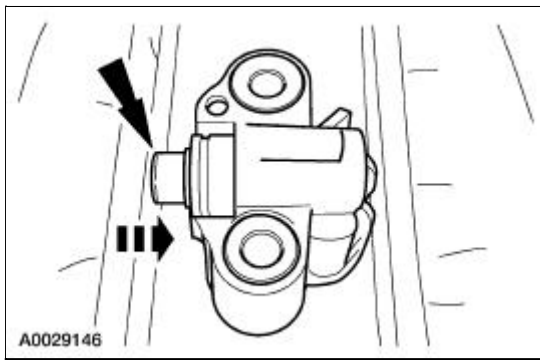
Install the LH and RH cylinder heads and tighten the bolts in six stages in the sequence shown.

- Stage 1: tighten to 40 Nm (30 lb-ft).
- Stage 2: tighten an additional 90 degrees.
- Stage 3: loosen the bolts a minimum of one full turn.
- Stage 4: tighten to 40 Nm (30 lb-ft).
- Stage 5: tighten an additional 90 degrees.
- Stage 6: tighten an additional 90 degrees.

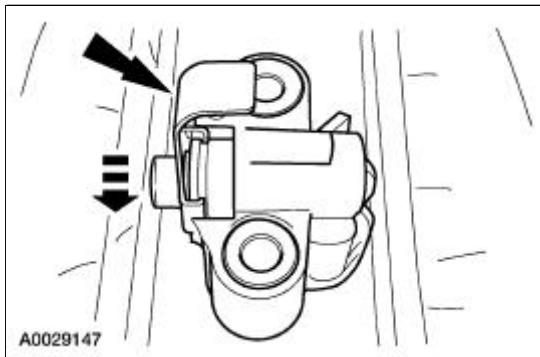


26.  **CAUTION: Timing chain procedures must be followed exactly or damage to valves and pistons will result.**

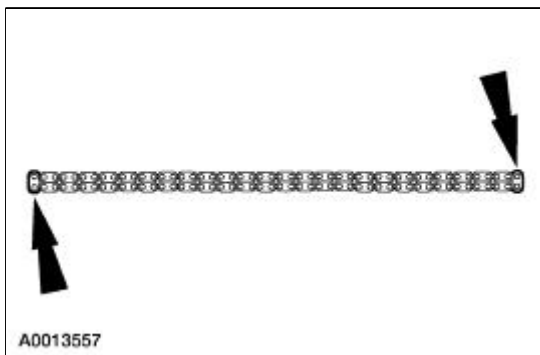
Compress the tensioner plunger, using a vise.



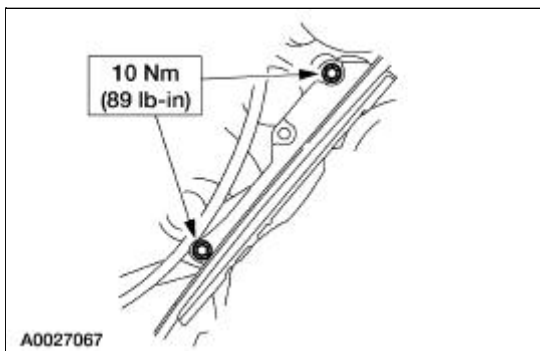
27. Install a retaining clip on the tensioner to hold the plunger in during installation.



28. Remove the tensioner from the vise.
29. If the copper links are not visible, mark two links on one end and one link on the other end, and use as timing marks.

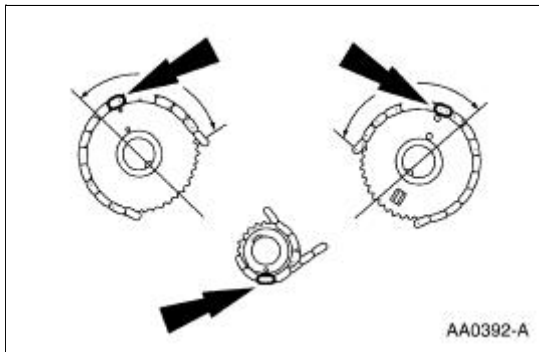



30. Install the timing chain guides.




31. Rotate the LH camshaft timing sprocket until the timing mark is approximately at the 12 o'clock

position. Rotate the RH camshaft timing sprocket until the timing mark is at approximately 11 o'clock position.

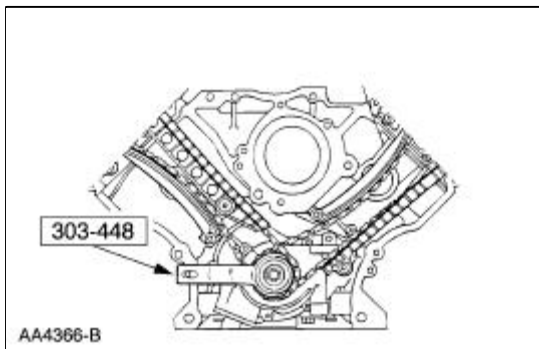


32.  **CAUTION:** Unless otherwise instructed, at no time when the timing chains are removed and the cylinder heads are installed is the crankshaft or camshaft to be rotated. Severe piston and valve damage will occur.

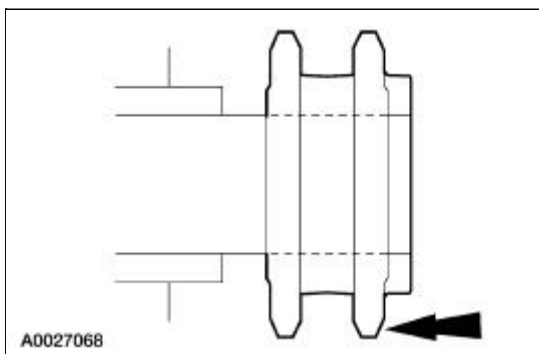
 **CAUTION:** Rotate the crankshaft counterclockwise only. Do not rotate past position shown or severe piston and/or valve damage will occur.

Using the special tool, position the crankshaft.

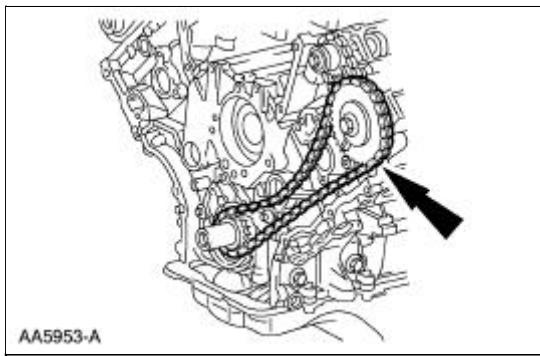
- Remove the special tool.



33. Install the crankshaft sprocket with the flange facing forward.



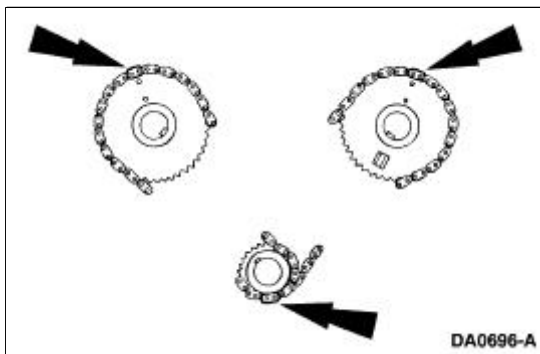
34. Install the LH and RH timing chain onto the crankshaft sprocket, aligning the one copper (or marked) link on the timing chain with the slot on the crankshaft sprocket.



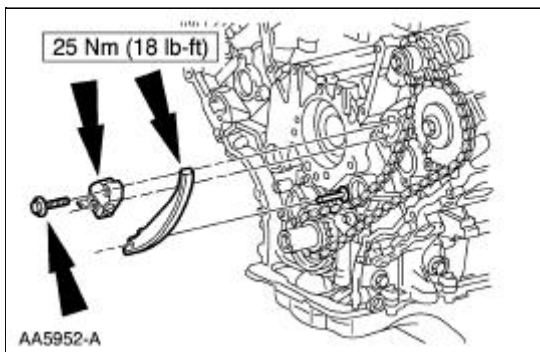
35. **NOTE:** If necessary, adjust the camshaft sprocket slightly to obtain timing mark alignment.

Position the RH timing chain on the camshaft sprocket. Make sure the two copper-colored links align with the camshaft sprocket timing mark.

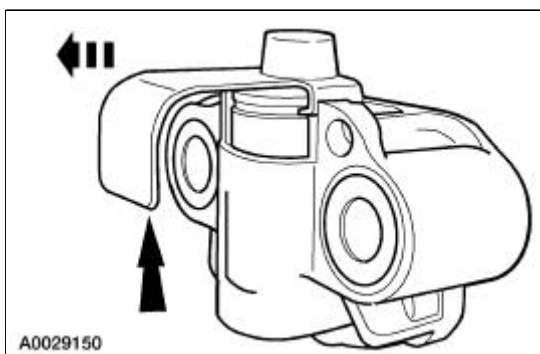
36. As a post-check, verify correct alignment of all timing marks.



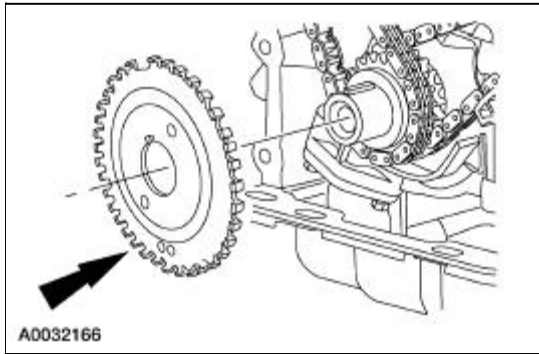
37. Position the LH and RH timing chain tensioner arms on the dowel pins. Position the timing chain tensioner assemblies, and install the bolts.



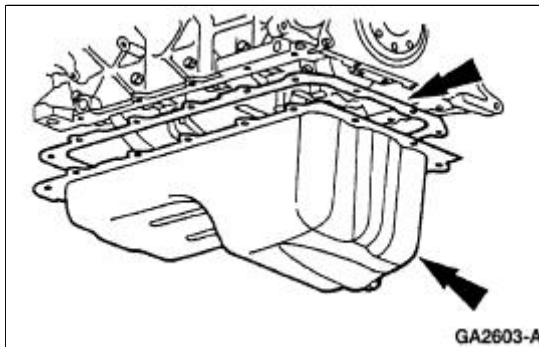
38. Remove the retaining clips from the timing chain tensioners.



39. Position the crankshaft sensor ring on the crankshaft.

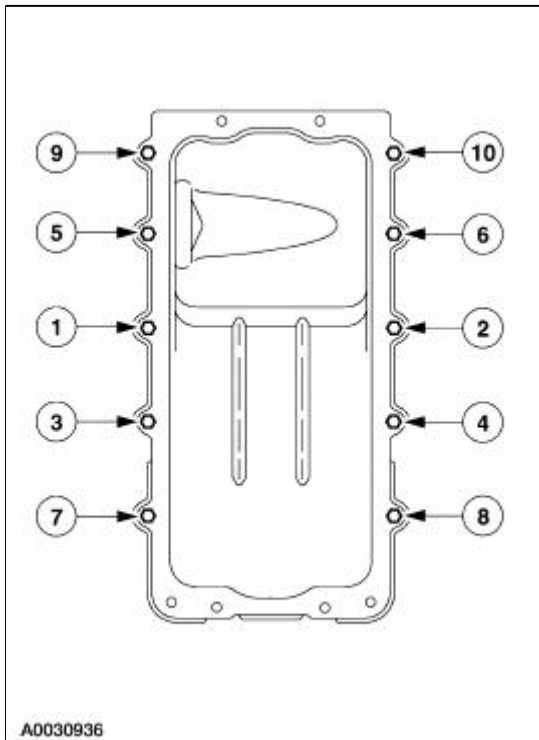


40. Install the oil pan and gasket and loosely install the bolts.

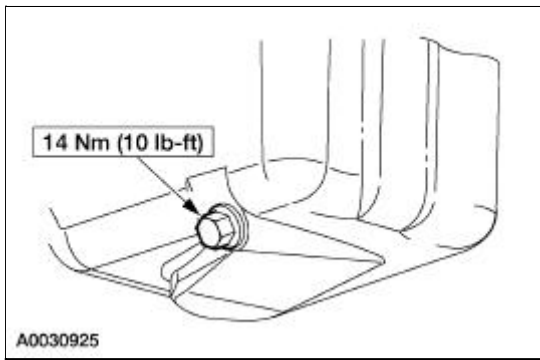


41. Tighten the bolts in the sequence shown.

- Tighten to 20 Nm (15 lb-ft).
- Rotate an additional 60 degrees.

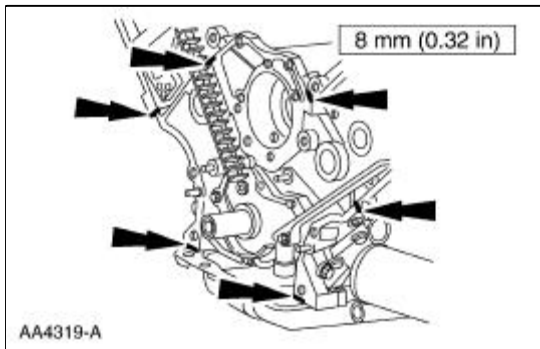


42. Install the drain plugs

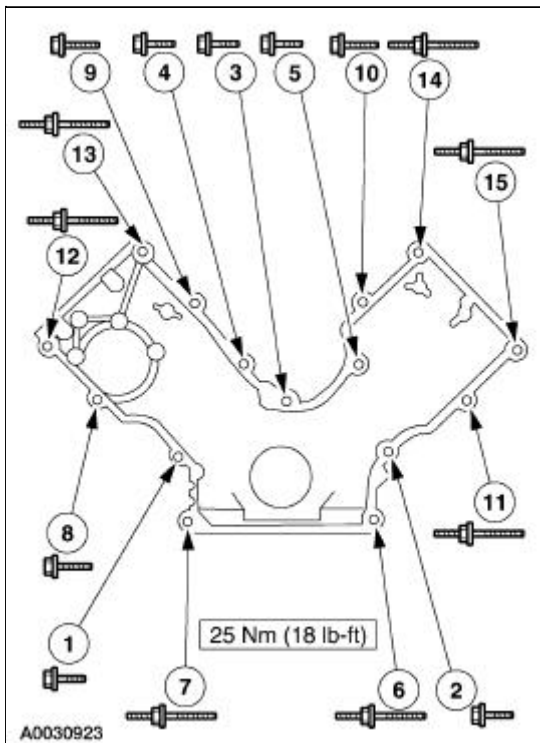


43. **NOTE:** If the engine front cover is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

Apply silicone gasket and sealant in the locations shown.



44. Install the engine front cover.

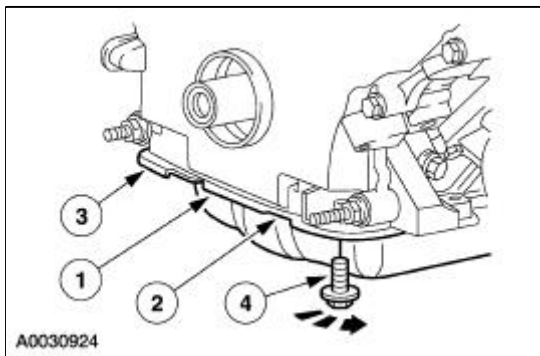


Item	Part Number	Description

1	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
2	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
3	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
4	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
5	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
6	W706508	Stud, Hex Shldr Pilot, M8 x 1.25 x 50 — M6 x 1 x 10
7	N808586	Stud and Washer, Hex-Head Pilot, M8 x 1.25 x 60 — M6 x 1 x 26
8	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
9	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
10	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
11	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
12	W706560	Stud, Hex-Head Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 16
13	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
14	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
15	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26

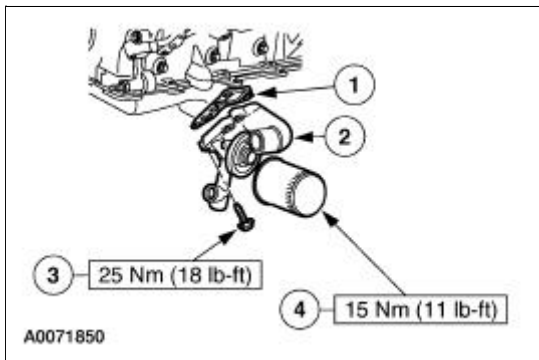
45. Tighten the four oil pan bolts in the sequence shown.

- Stage 1: Tighten to 2 Nm (18 lb-in).
- Stage 2: Tighten to 20 Nm (15 lb-ft).
- Stage 3: Tighten an additional 60 degrees.

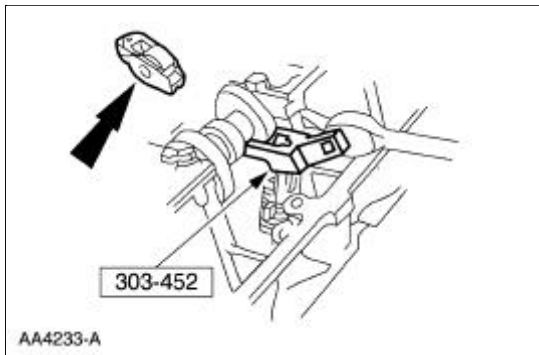


46. Install oil filter adapter.

1. Position the gasket.
2. Position the oil filter adapter.
3. Tighten the bolts.
4. Install a new oil filter.

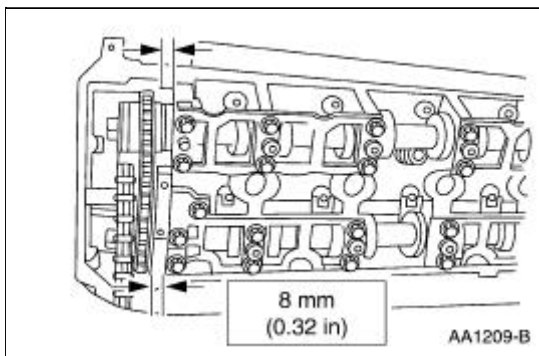


47. Using the special tool, install the 32 roller followers.



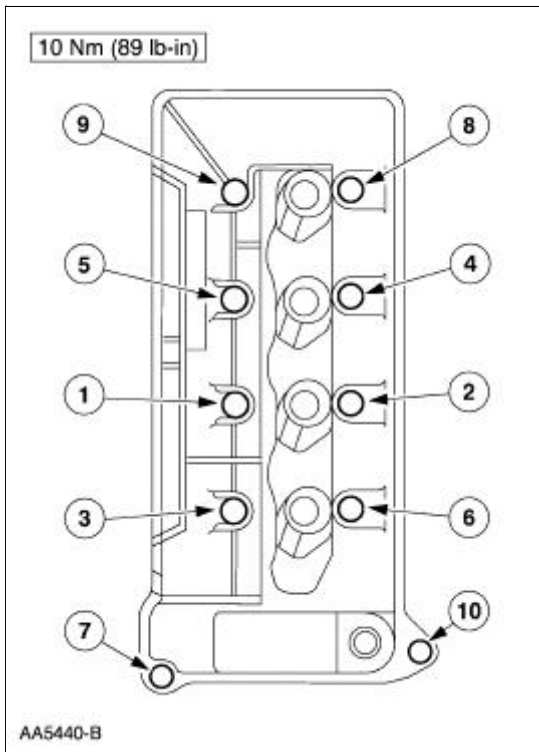
48. **NOTE:** If the valve cover is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

Apply silicone gasket and sealant in the locations shown.

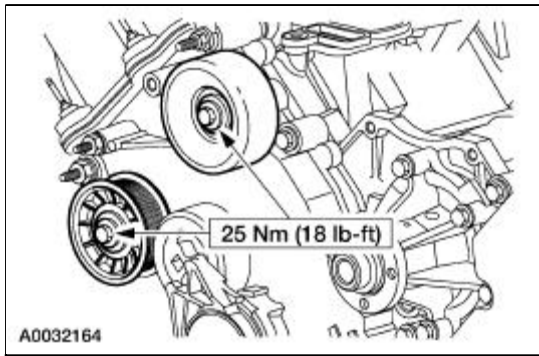


49. **NOTE:** The RH is shown; the LH is similar.

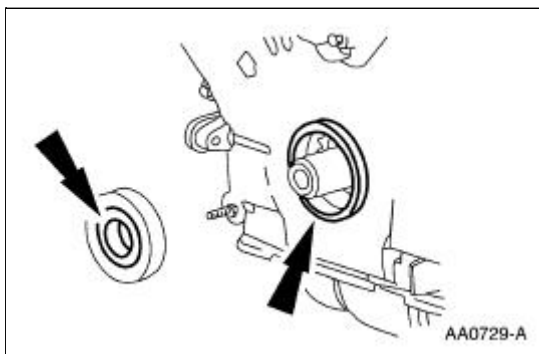
Install the valve covers and tighten the bolts in the sequence shown.



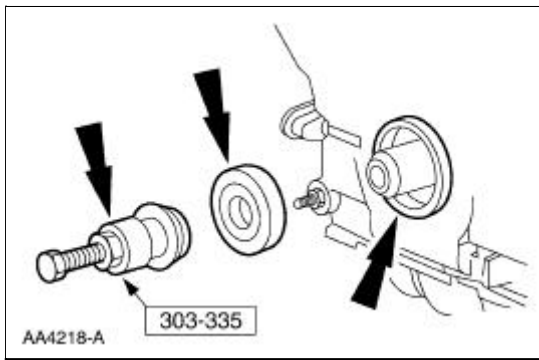
50. Install the belt idler pulleys.



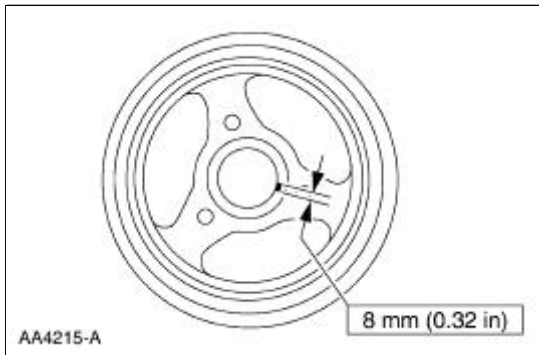
51. Lubricate the front oil seal and the engine front cover with clean engine oil.



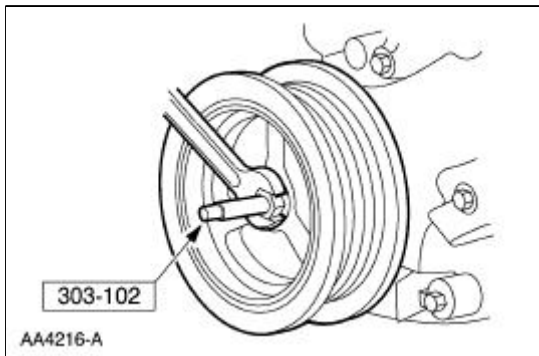
52. Using the special tool, install the front oil seal.



53. Apply silicone gasket and sealant to the woodruff key on the crankshaft pulley.

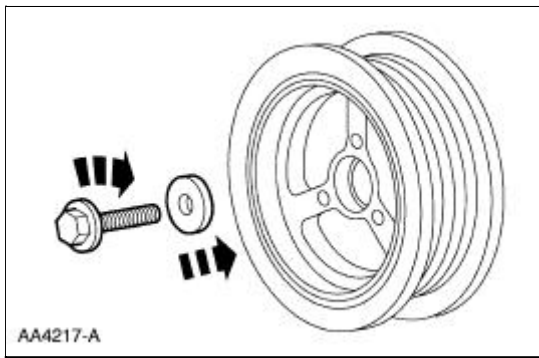


54. Using the special tool, install the crankshaft pulley.



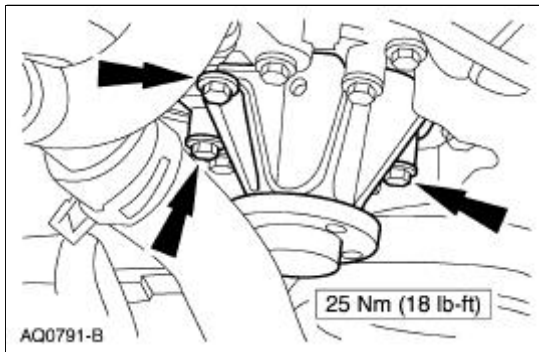
55. Install the crankshaft pulley and tighten the bolt in four stages.

- Stage 1: tighten to 90 Nm (66 lb-ft).
- Stage 2: loosen the bolt one full turn.
- Stage 3: tighten to 50 Nm (37 lb-ft).
- Stage 4: tighten an additional 90 degrees.



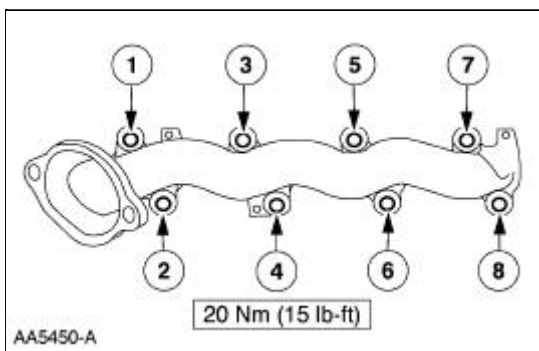
56. **NOTE:** Lubricate the O-ring seal with clean engine oil.

Install the coolant pump.

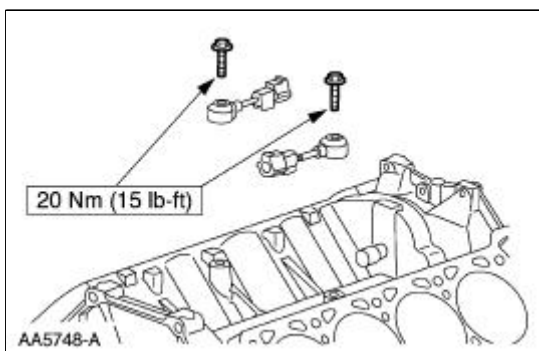


57. **NOTE:** The RH is shown; the LH is similar. Use new gaskets when installing the exhaust manifolds.

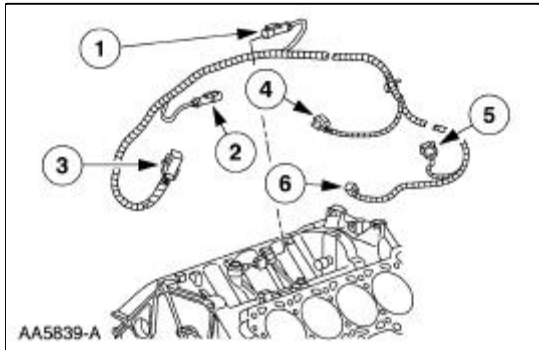
Install the exhaust manifold.



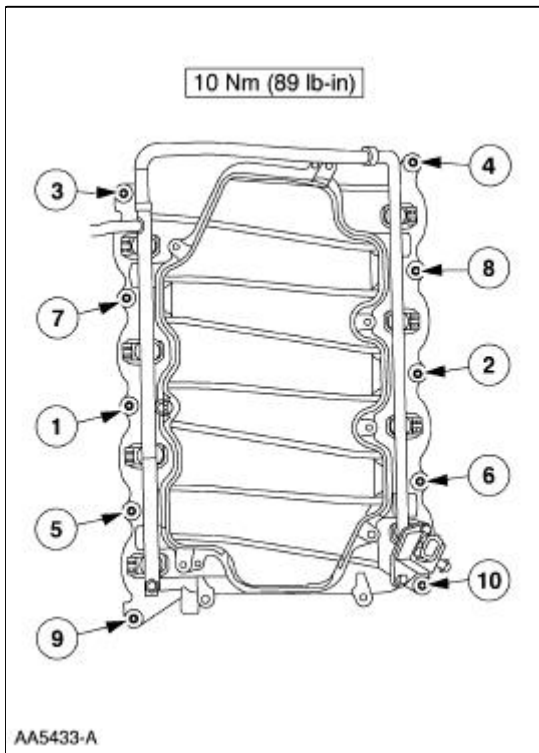
58. Install the knock sensors.



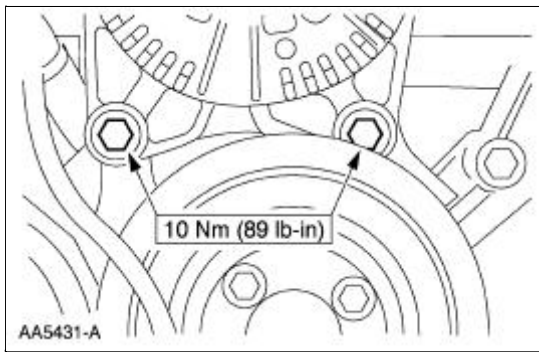
59. Install the knock sensor wiring harness.
1. LH knock sensor electrical connector
 2. RH knock sensor electrical connector
 3. Engine control sensor electrical connector
 4. Fuel injector electrical connector
 5. A/C compressor electrical connector
 6. CKP sensor electrical connector



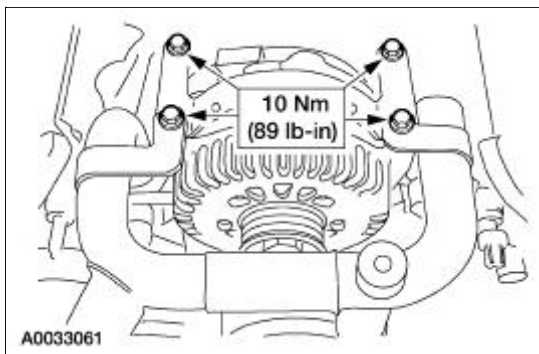
60. Install the lower intake manifold.
- Position the gaskets.
 - Install the intake manifold and tighten the bolts in the sequence shown.



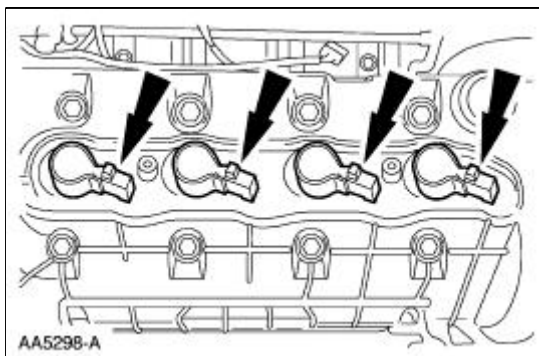
61. Install the generator.



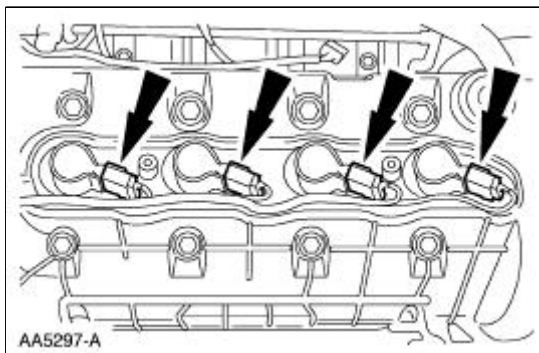
62. Install the upper generator support bracket and coolant bypass tube.
- Install the upper generator support bracket.
 - Install the coolant bypass tube.
 - Install the bolts.



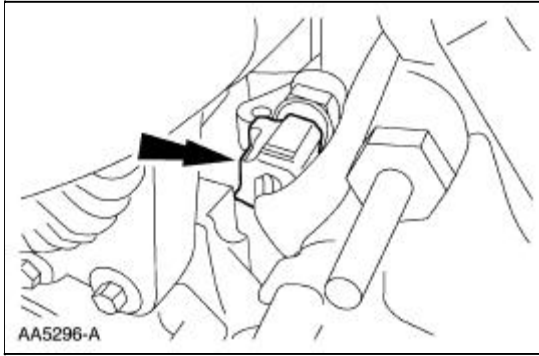
63. Install the eight ignition coils.



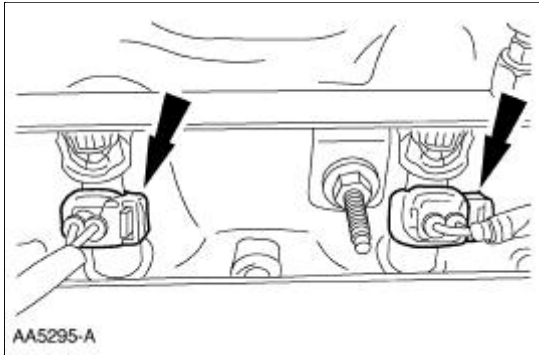
64. Connect the eight ignition coils.



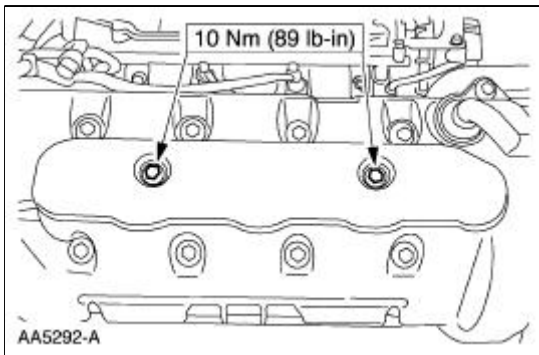
65. Connect the engine coolant temperature (ECT) sensor.



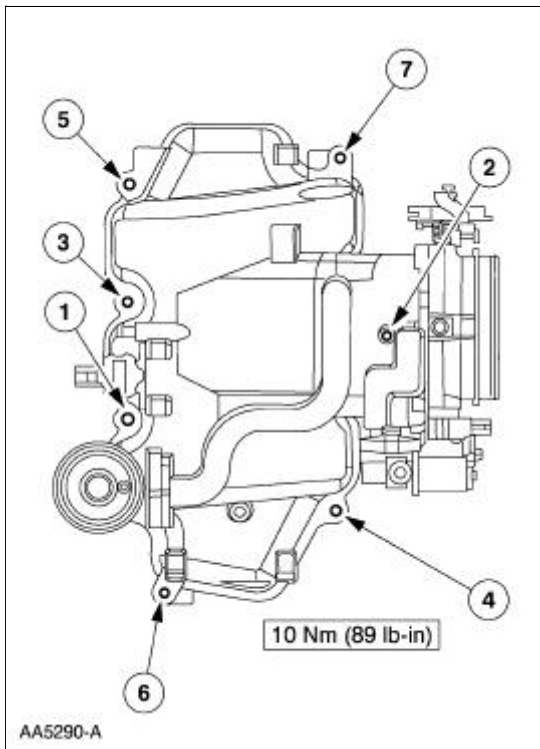
66. Connect the eight fuel injectors.



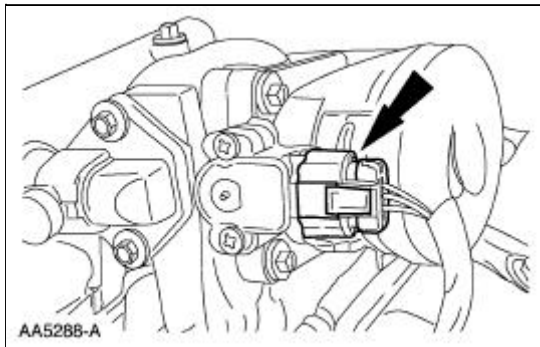
67. Install the RH ignition coil cover.



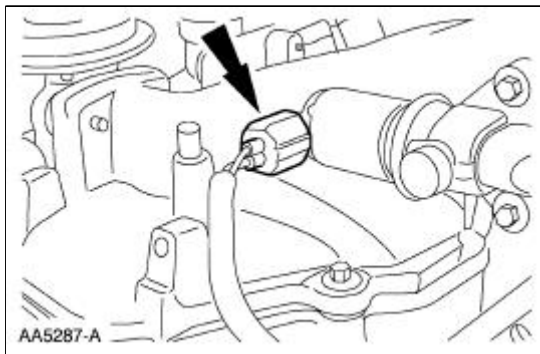
68. **NOTE:** The fastener at location five is a stud.
Install the gasket and the upper intake.



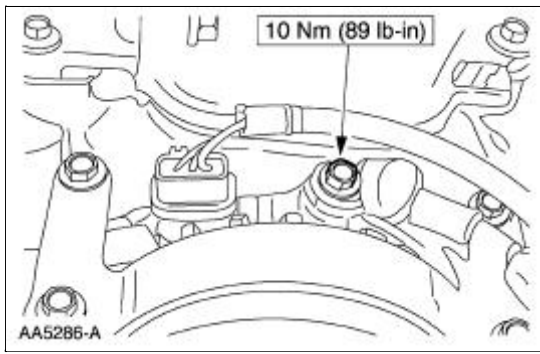
69. Connect the throttle position (TP) sensor electrical connector.



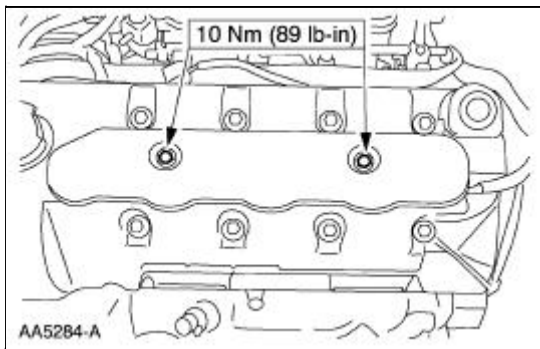
70. Connect the idle air control (IAC) valve electrical connector.



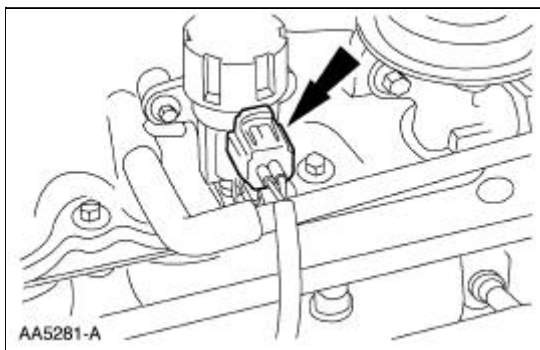
71. Connect the generator wiring.



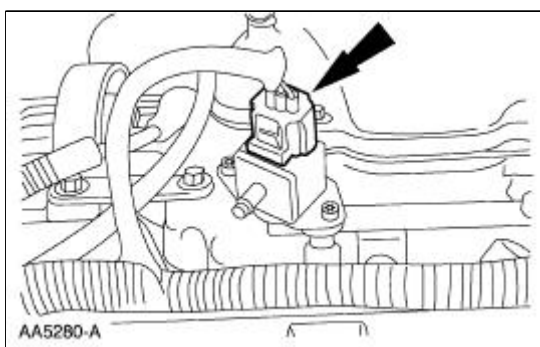
72. Install the LH coil cover.



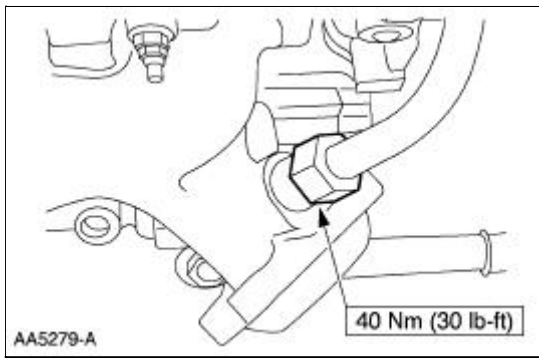
73. Connect the EGR vacuum regulator (EVR) electrical connector.



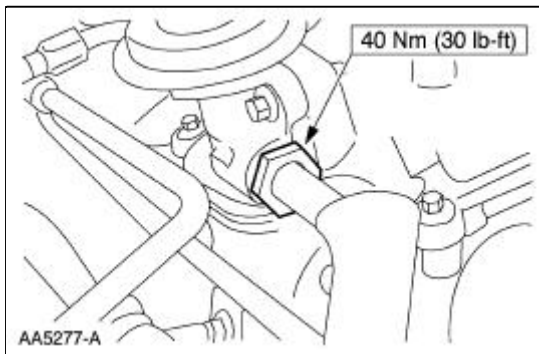
74. Connect the fuel pressure sensor electrical connector.



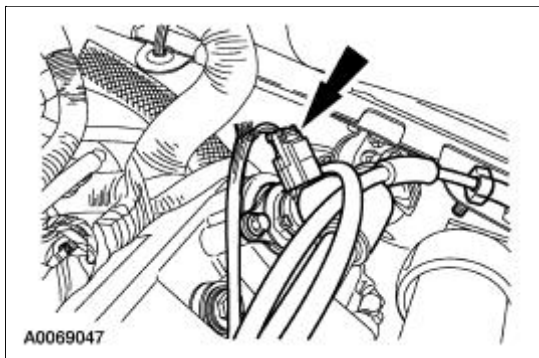
75. Connect the EGR tube to the exhaust manifold.



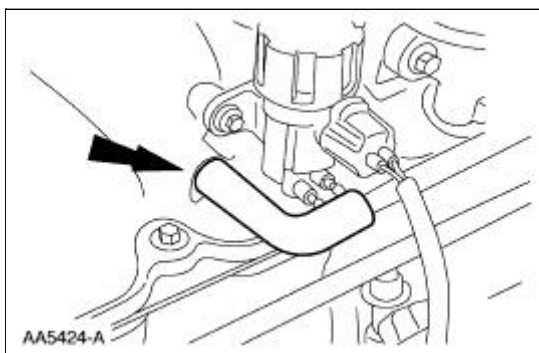
76. Connect the EGR tube to the EGR valve.



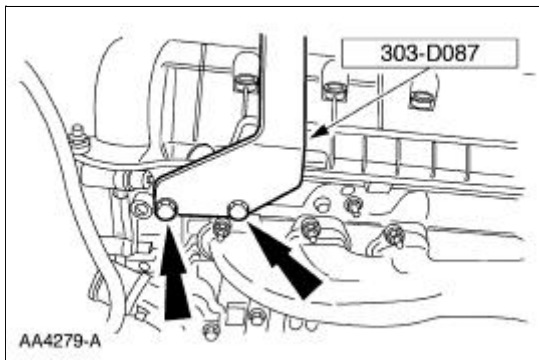
77. Install the PCV valve hose and connect the electrical connector.



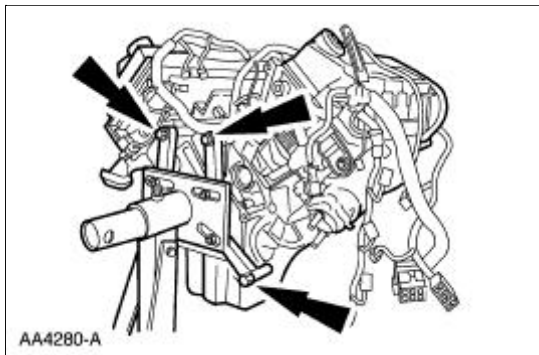
78. Connect the PCV valve tube to the upper intake manifold.



79. Install the special tool.

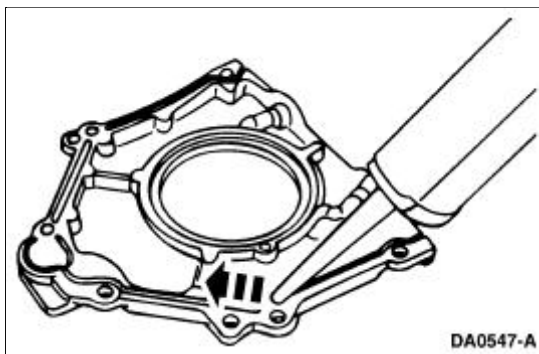


80. Remove the engine from the stand.



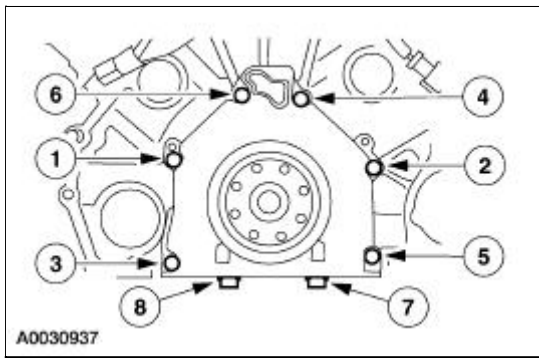
81. **NOTE:** If not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

Apply a 4 mm (0.16 in) bead of silicone gasket and sealant around the rear oil seal retainer plate sealing surface. Also apply a bead of silicone gasket and sealant at the junction where the cylinder block, oil pan and rear oil seal retainer plate meet.

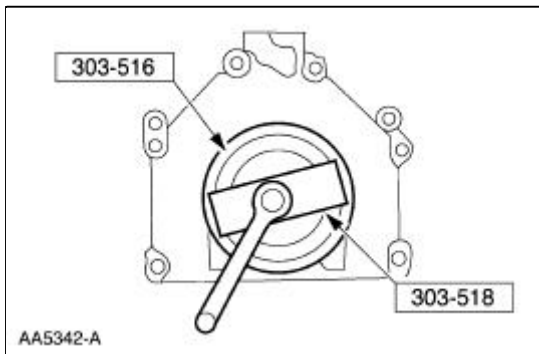


82. Install the rear oil seal retainer plate. Tighten the bolts in the sequence shown.

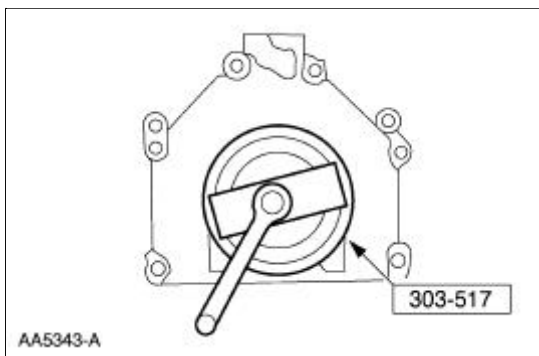
- Tighten the bolts to 1-6 to 10 Nm (89 lb-in).
- Hand-tighten bolts 7 and 8.
- Tighten bolts 7 and 8 to 20 Nm (15 lb-ft).
- Tighten bolts 7 and 8 an additional 60 degrees.



83. Using the special tool, install the crankshaft rear main seal.

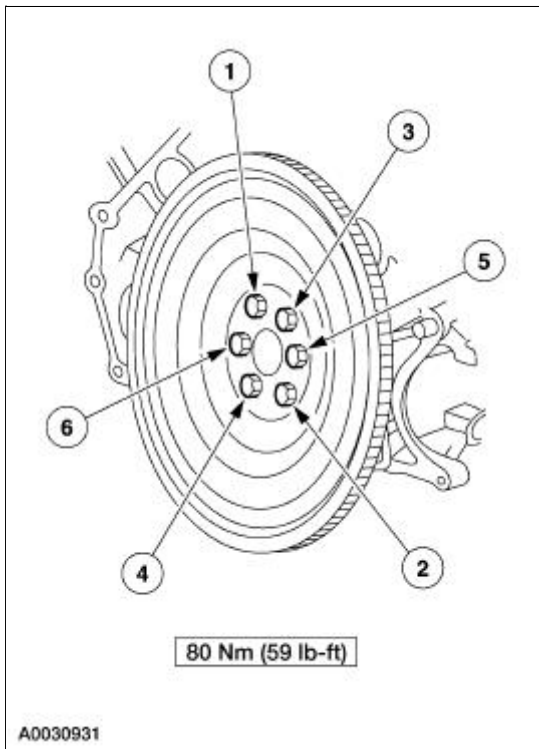


84. Using the special tools, install the crankshaft oil slinger.



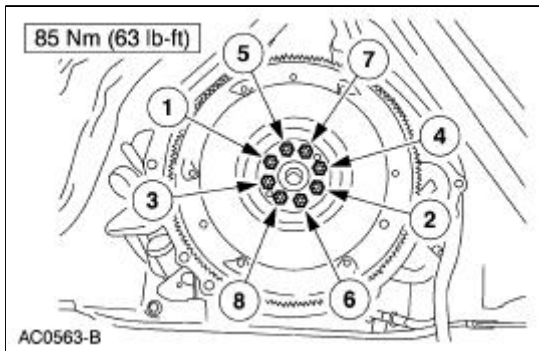
Automatic transmission vehicles

85. Install the flexplate and install the bolts in the sequence shown.



Manual transmission vehicles



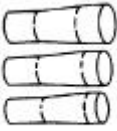
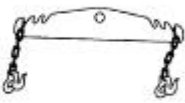
86. Install the flywheel and the bolts in the sequence shown.



87. Install the clutch and pressure plate. For additional information, refer to [Section 308-02](#).
-

Engine

Special Tool(s)

 <p>ST1603-A</p>	<p>Lifting Bracket, Engine 303-D087 (D93P-6001-A1)</p>
 <p>ST1604-A</p>	<p>Lifting Bracket, Engine 303-D088 (D93P-6001-A2)</p>
 <p>ST1444-A</p>	<p>Installer Set, Teflon Seal 211-D027 (D90P-3517A) or equivalent</p>
 <p>ST1602-A</p>	<p>Spreader Bar 303-D089 (D93P-6001-A3) or equivalent</p>

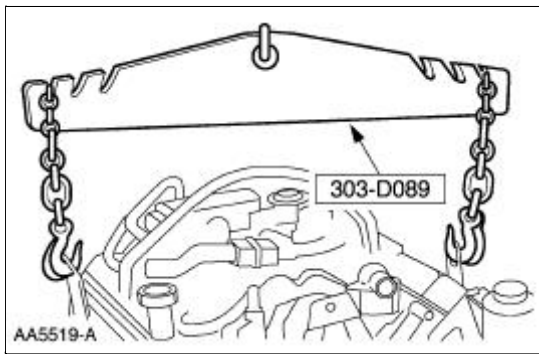
Material

Item	Specification
<p>Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent</p>	<p>WSS-M2C153- H</p>
<p>Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) (yellow color)</p>	<p>WSS-M97B51- A1</p>
<p>Threadlock and Sealer E0AZ-19554-AA</p>	<p>WSK-M2G351- A5</p>

Installation

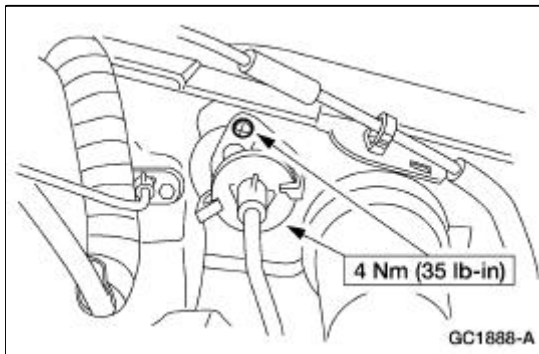
All vehicles

1. Install the engine in the vehicle and remove the floor crane and the spreader bar.



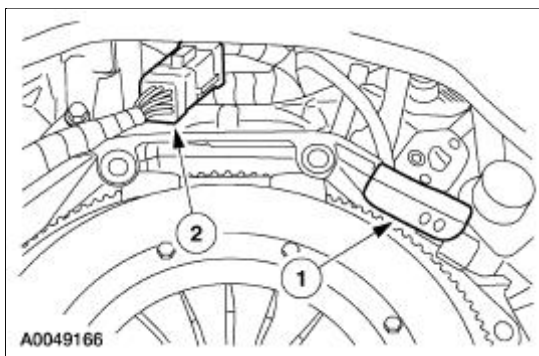
Manual transmission vehicles

2. Install the clutch cable and retaining screws.



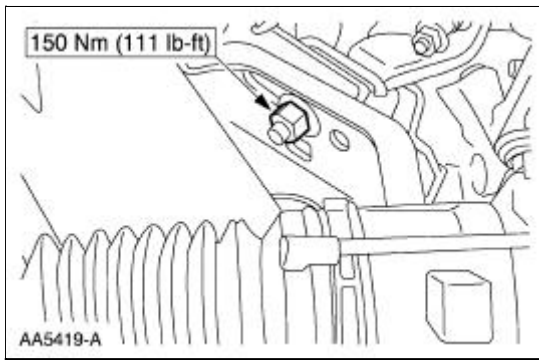
All vehicles

3. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
4. Connect the transmission wiring harness.
 1. Connect the RH oxygen sensor connector retainer.
 2. Connect the transmission harness electrical connector.



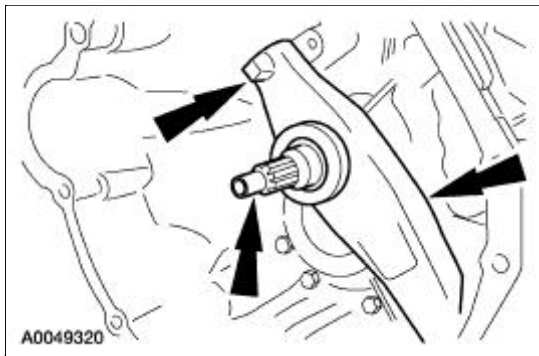
5. **NOTE:** RH side shown, LH side similar.

Install the LH and RH engine mount nuts.



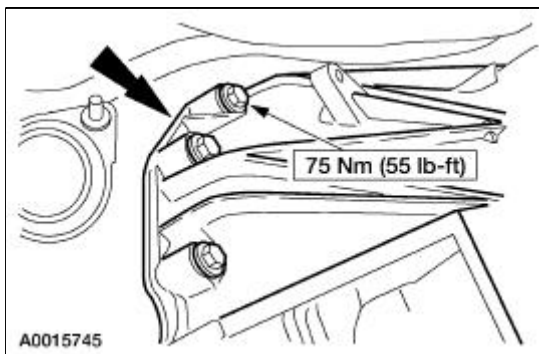
Manual transmission vehicles

6. Lubricate the ball stud, clutch release lever and the input shaft with clean engine oil.

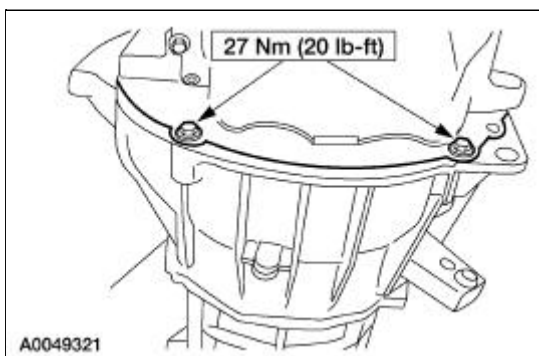


All vehicles

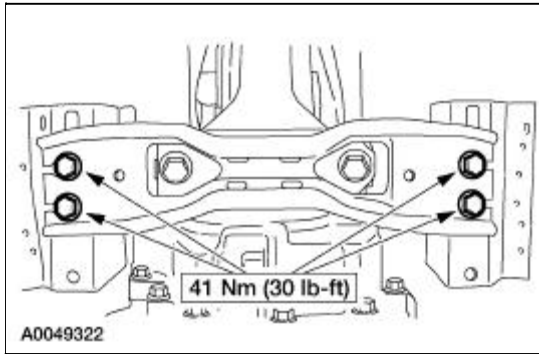
7. Raise the transmission and install the seven bolts.



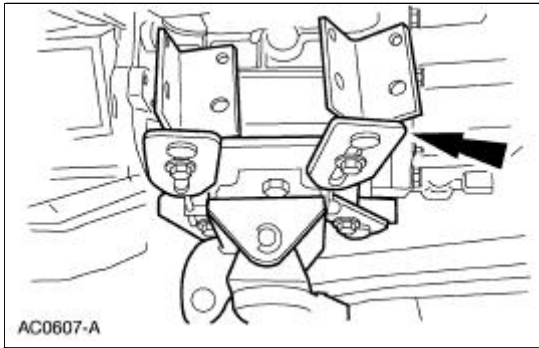
8. Install the bolts.



9. Install the transmission crossmember and the bolts.

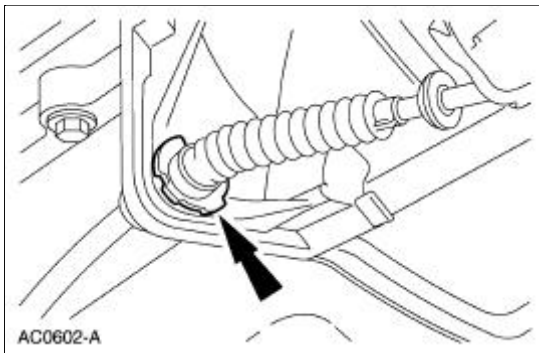


10. Remove the transmission jack.

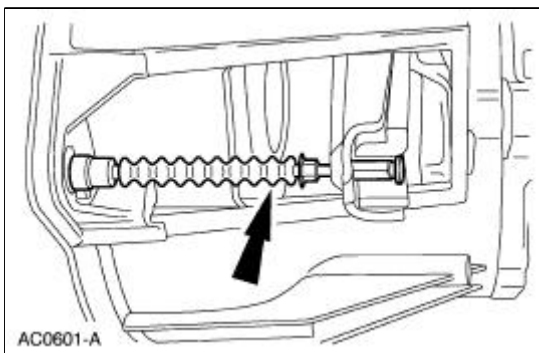


Manual transmission vehicles

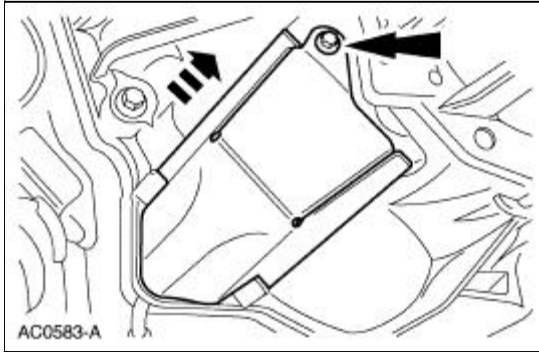
11. Install the clutch cable and the clutch cable retainer.



12. Attach the clutch release cable to the clutch release fork.

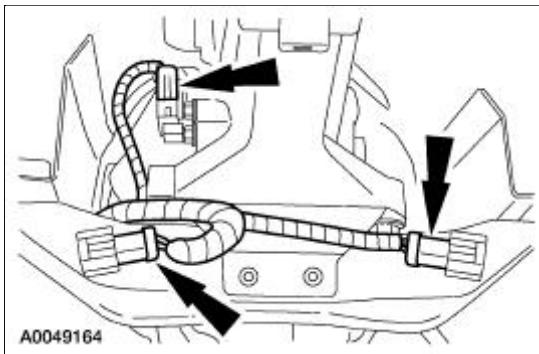


13. Install the clutch release lever cover and bolt.

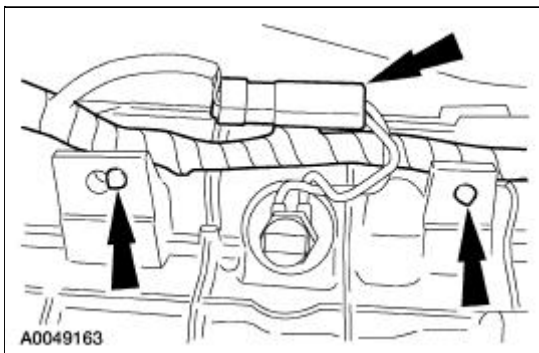


All vehicles

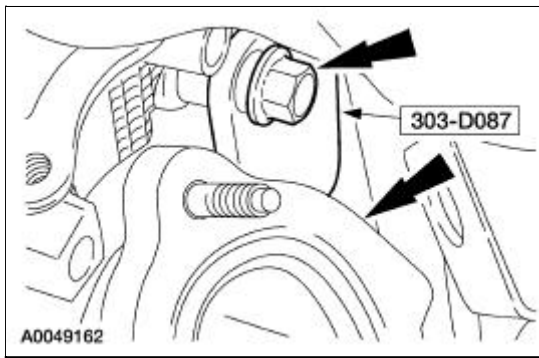
14. Connect the output shaft speed (OSS) sensor electrical connector and attach the left and right oxygen sensor electrical connectors to the crossmember.



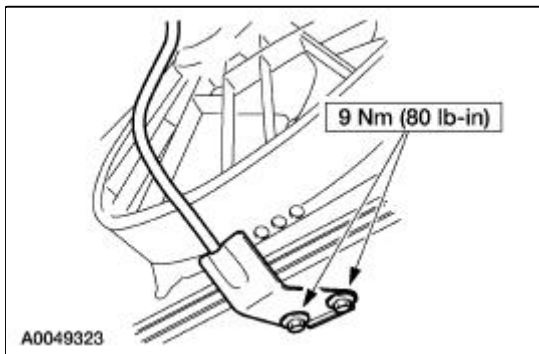
15. Connect the reversing lamp switch electrical connector and the wiring harness to the transmission.



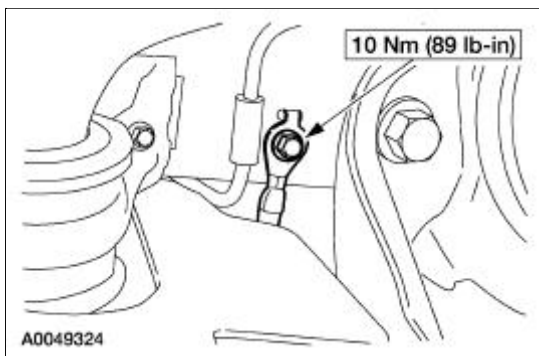
16. Remove the two bolts from the RH lifting bracket.



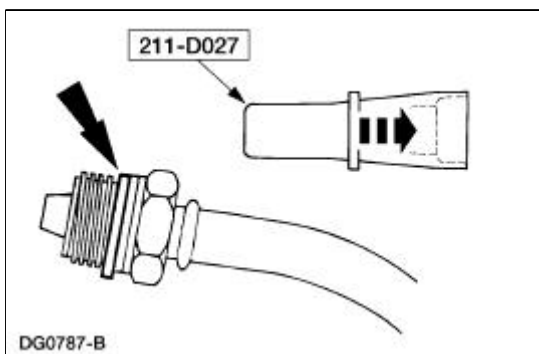
17. Install the degas bottle support bracket.



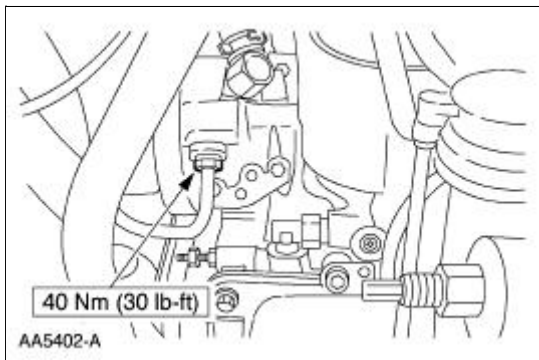
18. Connect the engine ground strap to the frame.



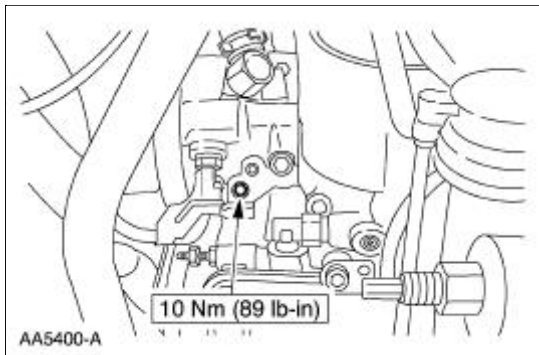
19. Using the special tool, install a new seal ring.



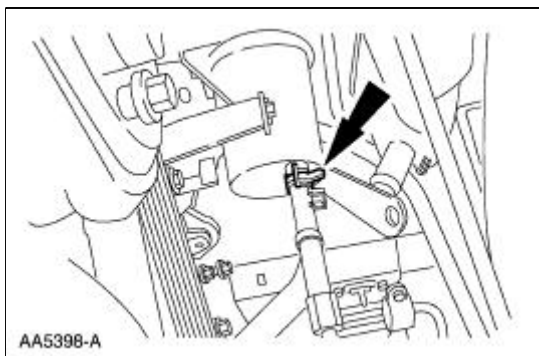
20. Install the high pressure power steering hose to the pump.



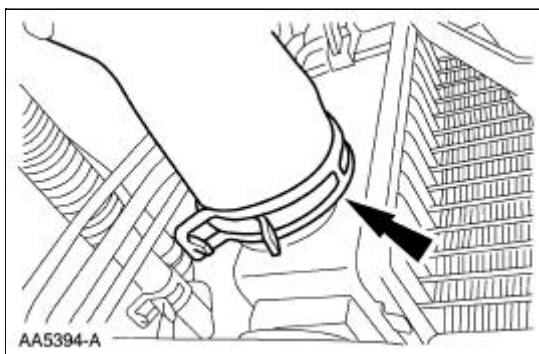
21. Position the clip and install the bolt.



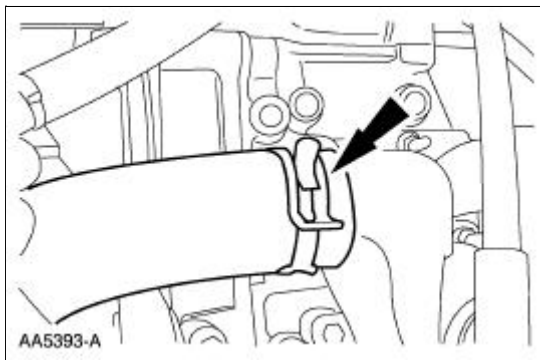
22. Connect the hose to the power steering reservoir.



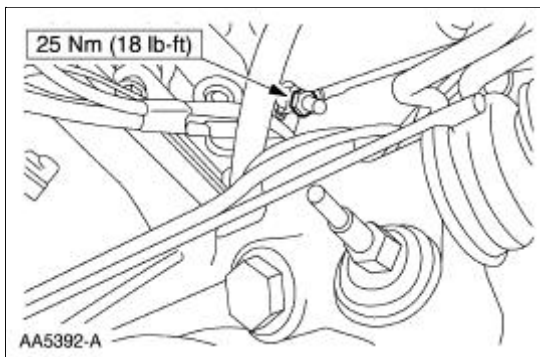
23. Connect the lower radiator hose.



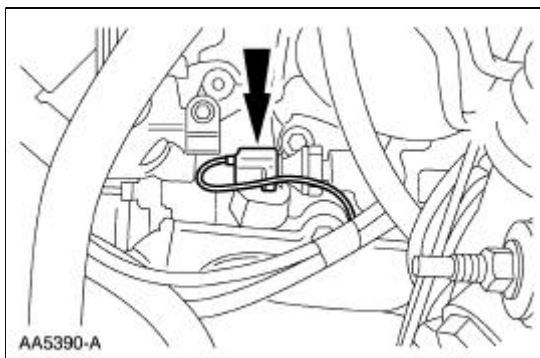
24. Connect the hose to the oil filter adapter.



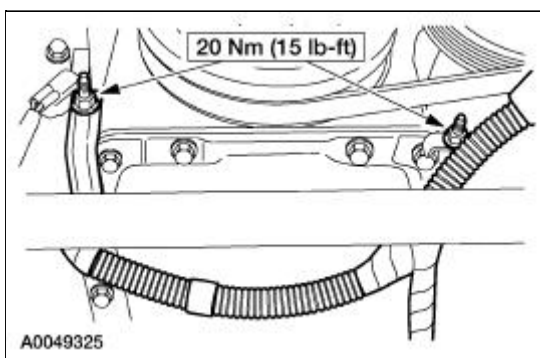
25. Install the ground cable.



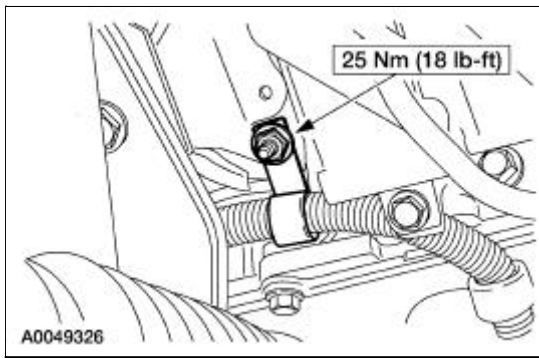
26. Connect the oil pressure sender.



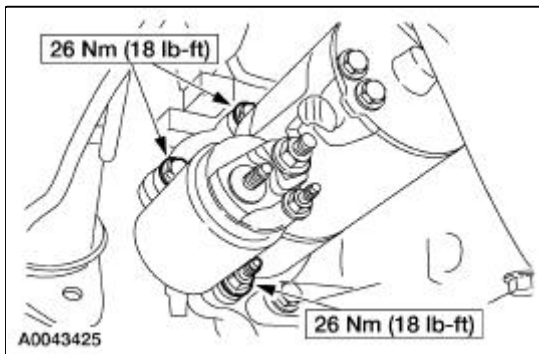
27. Position the wiring harness and install the two nuts.



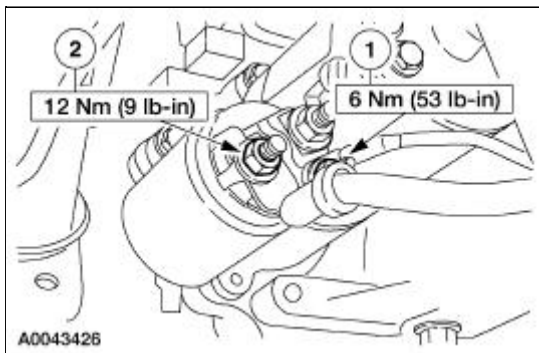
28. Position the wiring harness bracket and install the nut.



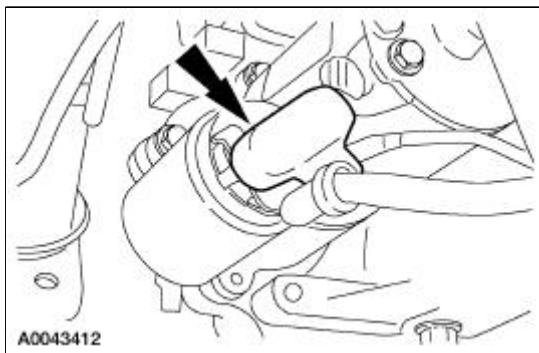
29. Position the starter and install the bolts.



30. Install the starter wires.
1. Position the solenoid wire and install the nut.
 2. Position the battery cable and install the nut.

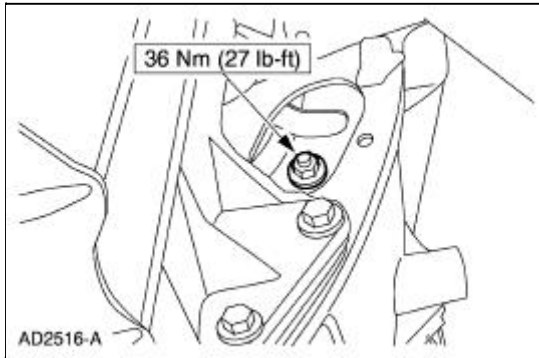


31. Install the cap.

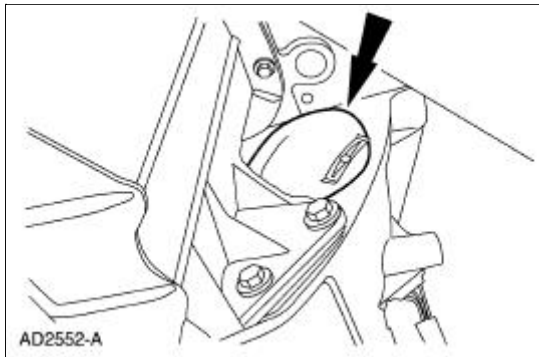


Automatic transmission vehicles

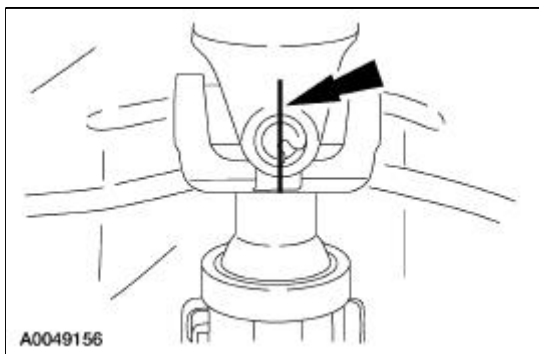
32. Install the torque converter nuts.




33. Install the flywheel inspection cover.



34. Install the driveshaft onto the transmission output shaft, aligning the index-mark in the six o'clock position.

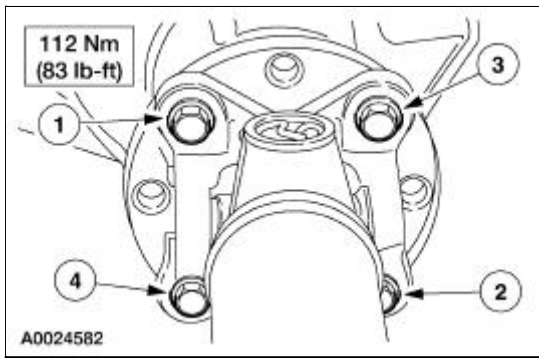


35.  **CAUTION:** Use new bolts to install the driveshaft. If new bolts are not available, apply threadlock to the threads of the original bolts.

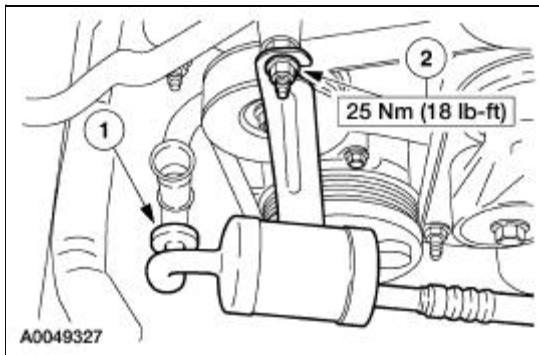
 **CAUTION:** The driveshaft centering socket yoke fits tightly on the rear axle pinion flange pilot. To make sure the yoke seats squarely on the flange, tighten the bolts evenly in the sequence shown.

NOTE: Align the marks made on the flange and driveshaft during removal.

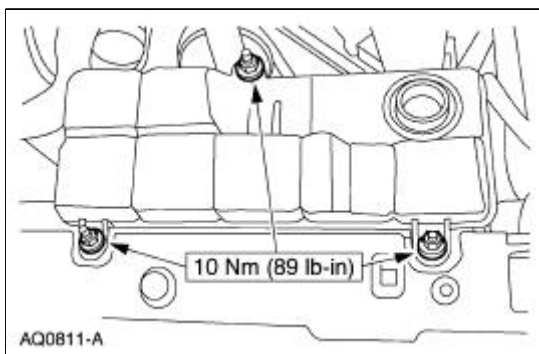
Position the driveshaft and install the driveshaft-to-pinion flange bolts in the sequence shown.



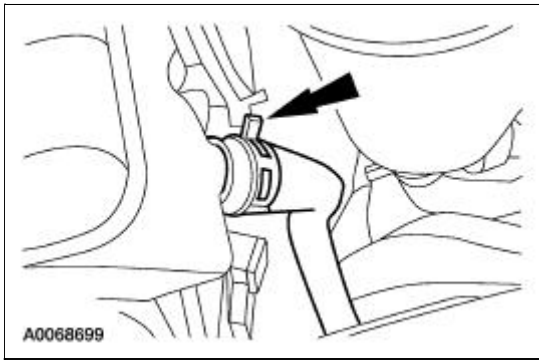
36. Install the A/C muffler.
 1. Connect the A/C tube and position the A/C muffler.
 2. Install the bracket nut.



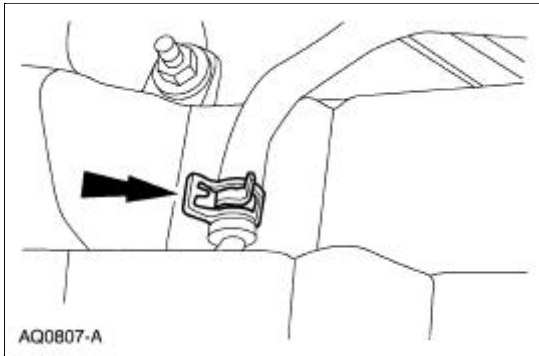
37. Install the dual converter H-pipe. For additional information, refer to [Section 309-00](#).
38. Lower the vehicle.
39. Install the shifter. For additional information, refer to [Section 307-01](#) or [Section 308-03B](#).
40. Install the degas bottle.



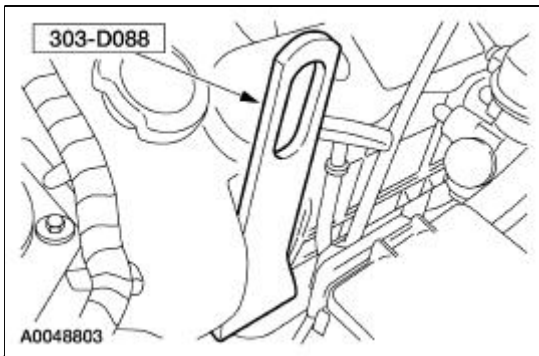
41. Connect the degas bottle return hose.



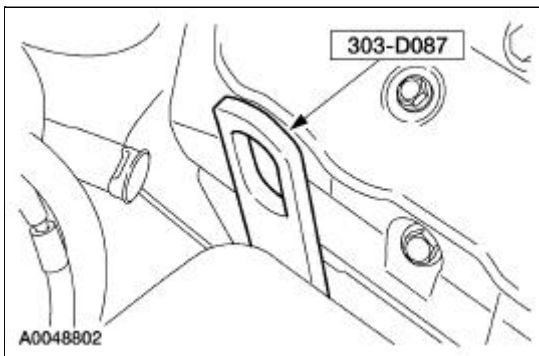
42. Connect the radiator vent hose to the degas bottle.



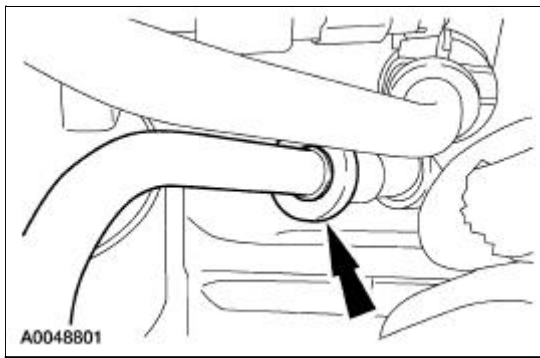
43. Remove the LH lifting bracket.



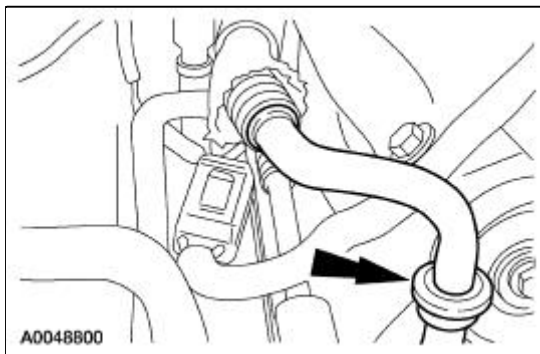
44. Remove the RH lifting bracket.



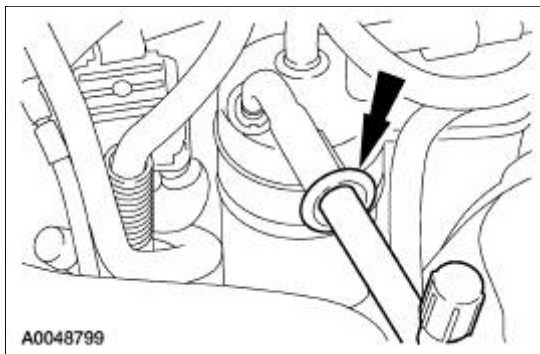
45. Connect the A/C tube.



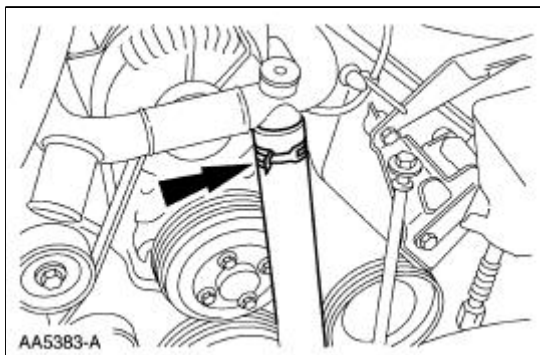
46. Connect the A/C suction tube to the manifold tube.



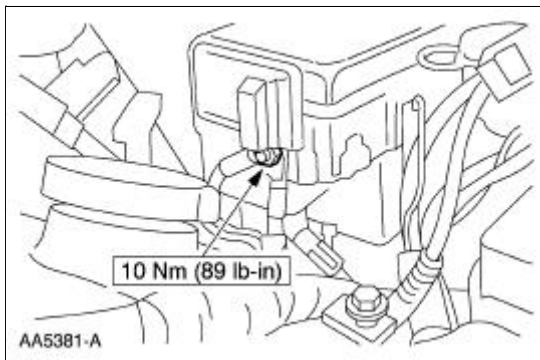
47. Connect the A/C suction tube to the accumulator.



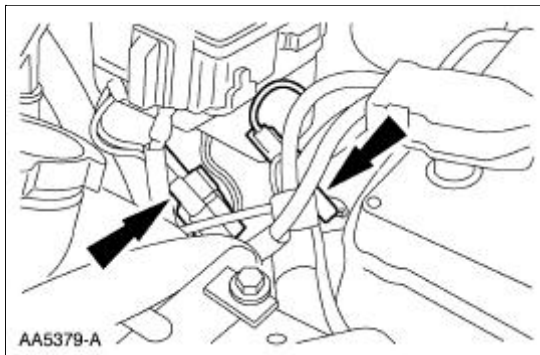
48. Connect the hose to the bypass tube.



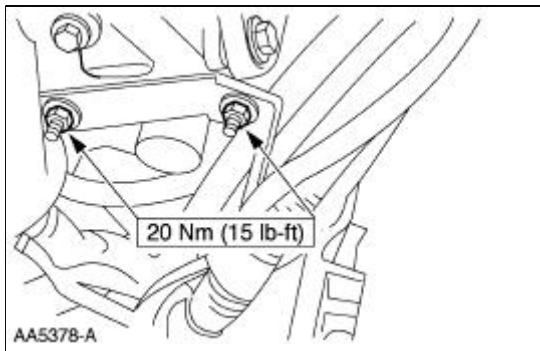
49. Connect the cables.



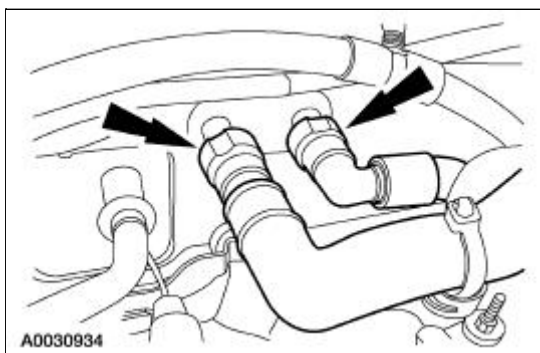
50. Connect the connectors.



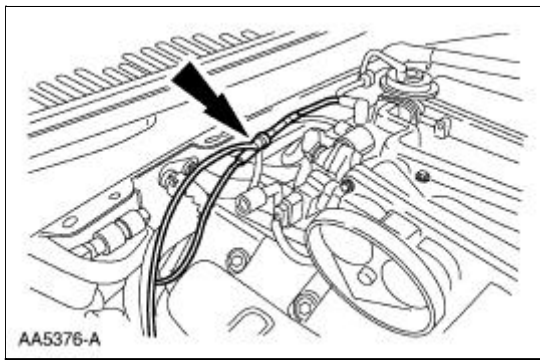
51. Position the wiring support bracket and install the nuts.



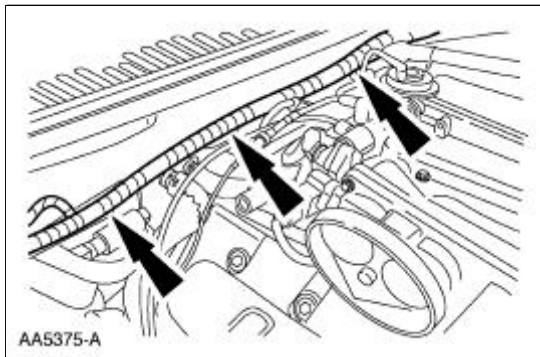
52. Connect the heater hoses.



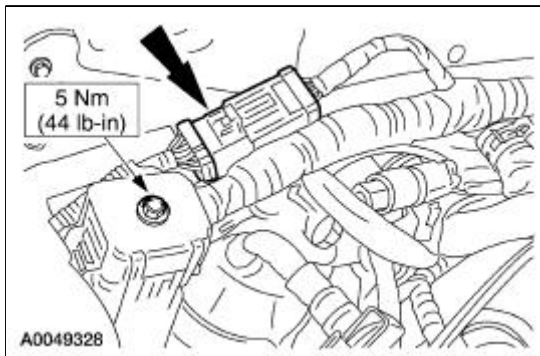
53. Connect the vacuum hoses.



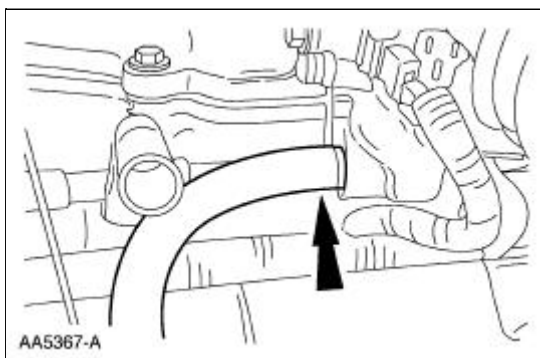
54. Connect the fuel charging wiring harness.



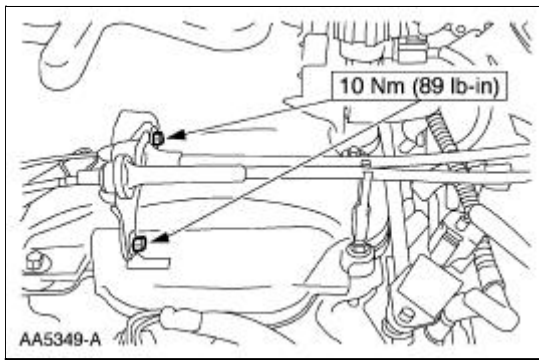
55. Connect the 16-pin and the 42-pin connectors.



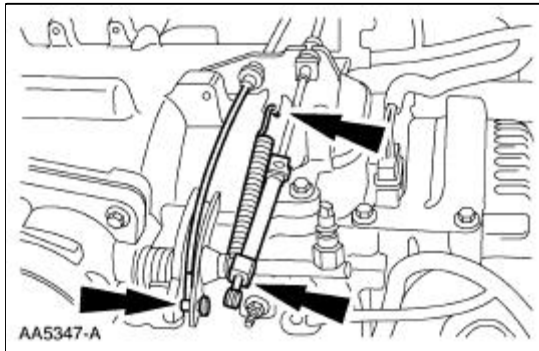
56. Connect the evaporative emissions return tube.



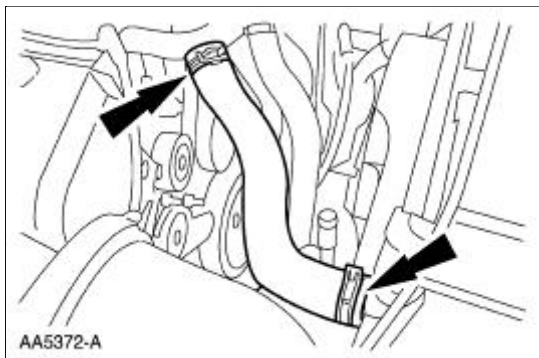
57. Position the cables, and install the bolts.



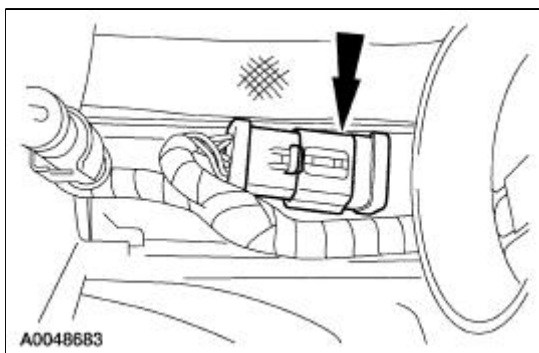
58. Connect the throttle cable and the speed control actuator cable, and install the throttle return spring.



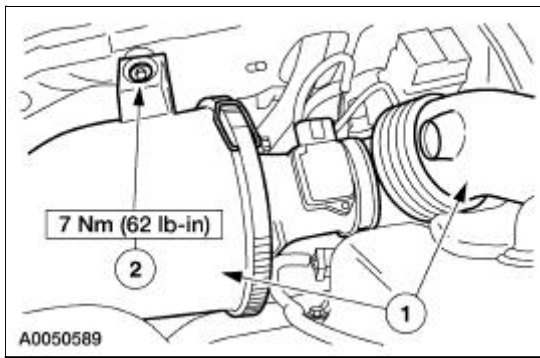
59. Install the upper radiator hose.



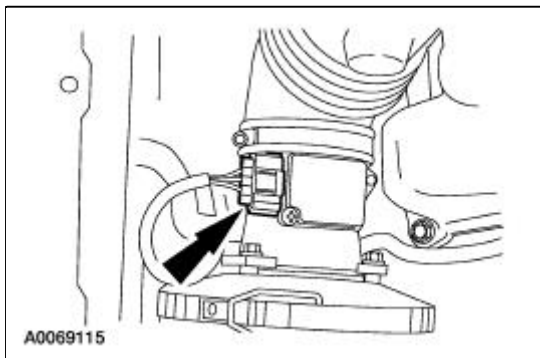
60. Connect the wiring connector.



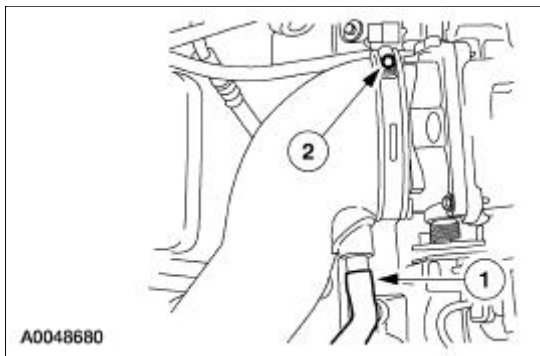
61. Install the air cleaner assembly.
1. Install the air cleaner and the outlet tube as an assembly
 2. Install the bolt.



62. Connect the mass air flow (MAF) sensor electrical connector.

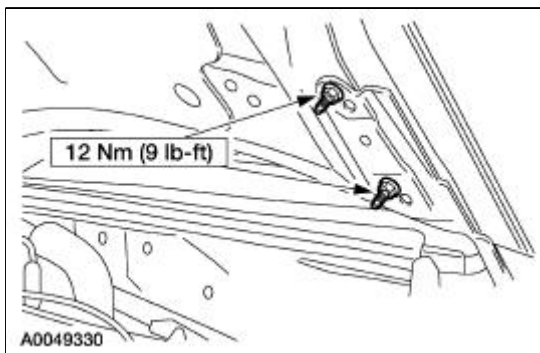


63. Connect the air cleaner outlet pipe at the throttle body.
1. Connect the positive crankcase ventilation (PCV) inlet tube.
2. Tighten the clamp.

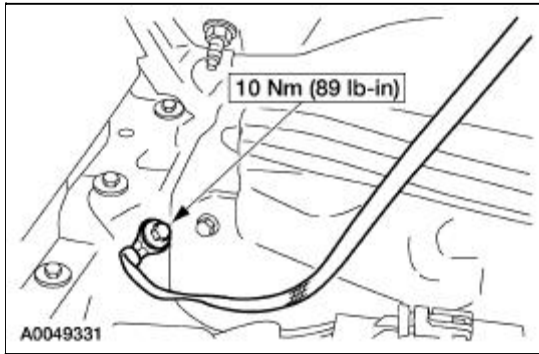


64. **NOTE:** Use reference marks made during removal to aid in the installation.

Install the hood and the four nuts.



65. Install the hood-to-body ground strap.



66. Connect the fuel spring lock coupling. For additional information, refer to [Section 310-00](#).

67. Install the air intake scoop bracket. For additional information, refer to [Section 303-12](#).

68. Connect the battery ground cable. For additional information, refer to [Section 414-01](#).

69. Fill the crankcase with clean engine oil and check that all other fluids are at the correct levels.

70. Fill and bleed the engine cooling system. For additional information, refer to [Section 303-03A](#).

71. Fill and purge the power steering system. For additional information, refer to [Section 211-00](#).

72. Start the engine and check for leaks. Stop the engine and recheck the fluid levels.

73. Charge the A/C system. For additional information, refer to [Section 412-00](#).

General Specifications

Item	Specification
Cooling System Capacity	15.2 L (4.0 gal)
Coolant Type	
Motorcraft Premium Gold Engine Coolant VC-7-A in (Oregon VC-7-B) (yellow color)	WSS-M97B51-A1
Other Chemicals	
Motorcraft Premium Cooling System Flush VC-1	ESR-M14P7-A
Premium Long Life Grease XG-1-C	ESA-M1C75-B
Cooling System Stop Leak Pellets VC-6	ESE-M99B37-B5 except as noted in ES-F65E-19A511-AA
Gasket Adhesive TA-6	WSS-M2G408-A
Cooling System Pressure Test Specifications	138 kPa (20 psi)
Radiator Cap Pressure Test Specifications	110 kPa (16 psi)
Thermostat Opening Temperatures	
Starts to open (4.6L 2V)	87-93°C (192-199°F)
Starts to open (3.8L)	86.7-90.6°C (189-196°F)
Starts to open (Cobra)	80-83°C (175-182°F)
Fully open	104°C (219°F)

Torque Specifications

Description	Nm	lb-ft	lb-in
Accelerator cable bracket bolts	10	—	89
Cylinder block drain plug	20	15	—
Exhaust manifold to EGR valve tube nut	35	26	—
Fan shroud bolts	10	—	89
Fan motor bolts	10	—	89
Degas bottle nuts	10	—	89
Coolant expansion tank bracket bolts	10	—	89
Radiator support bracket bolts	30	22	—
Transmission fluid cooler fittings	30	22	—
Coolant outlet connection bolts (3.8L)	10	—	89
Bypass tube bracket bolts (3.8L)	10	—	89
Bypass tube bolts (4.6L)	10	—	89
Bypass tube nuts (Supercharged engine)	25	18	—
Coolant hose mounting bolt	25	18	—

Intake manifold bolts	10	—	89
Supercharger drive belt cover	10	—	89
Thermostat housing bolts	10	—	89
Vacuum accessory bracket fasteners	10	—	89
Coolant outlet connection bolts (4.6L 2V)	25	18	—
Coolant outlet connection bolts (4.6L 4V)	10	—	89
Coolant pump bolts (3.8L)	28	21	—
Coolant pump bolts (4.6L)	25	18	—
Coolant pump pulley bolts	25	18	—
Air intake scoop bolts	25	18	—
Air intake scoop bracket bolt	25	18	—
Air intake scoop bracket nuts	25	18	—
Air intake scoop bracket throttle body nut	9	—	80
Exhaust gas recirculation (EGR) vacuum regulator solenoid bolts	10	—	89

Engine Cooling



CAUTION: Vehicle cooling systems are filled with Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Always fill the cooling system with the same coolant that is present in the system. Do not mix coolant types.

NOTE: The addition of Motorcraft Cooling System Stop Leak Pellets, VC-6, darkens Motorcraft Premium Gold Engine Coolant from yellow to golden tan.

The 4.6L cooling system components include the:

- block heater
- engine coolant temperature (ECT) sensor
- fan blade, fan motor and fan shroud assembly
- radiator
- pressure relief cap
- radiator draincock
- coolant pump
- coolant thermostat
- oil filter adapter
- radiator overflow hose
- upper radiator hose
- lower radiator hose

The radiator overflow hose circulates the coolant.

The coolant thermostat:

- controls the engine coolant temperature.
- allows for quicker engine warm-up.

The degas bottle/coolant expansion tank:

- provides a location for service fill.
- contains coolant expansion and system pressurization.
- provides air separation during operation.
- replenishes the engine coolant to the system.

The engine coolant flows:

- from the lower radiator hose to the coolant pump.
- from the coolant pump to the engine block and the cylinder heads.

The 3.8L cooling system components include the:

- block heater
- engine coolant temperature (ECT) sensor
- fan blade, fan motor and fan shroud assembly
- radiator
- radiator cap
- radiator draincock
- coolant pump
- coolant thermostat
- oil filter adapter
- radiator overflow hose
- coolant expansion tank
- upper radiator hose
- lower radiator hose

The fan blade draws air through the radiator to help cool the engine coolant.

The fan motor:

- operates only when the ignition switch is in the RUN position.
- will not operate with the switch in the OFF position.

The engine coolant:

- flows through the radiator tubes and is cooled by passing air over the cooling fins.
- is then circulated from the radiator outlet tank through the coolant pump and into the cylinder block to complete the circuit.

A closed coolant thermostat returns the engine coolant to the coolant pump. An open coolant thermostat allows the engine coolant to flow to the radiator.



CAUTION: Engine coolant provides freeze protection, boil protection, cooling efficiency, and corrosion protection to the engine and cooling components. In order to obtain these protections, the engine coolant must be maintained at the correct concentration and fluid level in the degas bottle (4.6L) or coolant expansion tank (3.8L).

When adding engine coolant, use a 50/50 mixture of engine coolant and deionized water.

To maintain the integrity of the coolant and the cooling system:

- **NOTE:** The addition of Motorcraft Cooling System Stop Leak Pellets, VC-6, darkens Motorcraft Premium Gold Engine Coolant from yellow to golden tan.

Add Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Use the same coolant that is present in the cooling system. Do not mix coolant types.

- Do not add/mix orange-colored Motorcraft Speciality Orange Engine Coolant VC-2 or equivalent

meeting Ford specification WSS-M97B44-D. Mixing coolants may degrade the coolant's corrosion protection.

- Do not add alcohol, methanol, or brine, or any engine coolants mixed with alcohol or methanol antifreeze. These can cause engine damage from overheating or freezing.
- Do not mix with recycled coolant unless it meets the requirements of Ford specification WSS-M97B51-A1. Not all coolant recycling processes meet these Ford specifications. Use of such coolants can harm the engine and cooling system components.





The coolant temperature sensor (4.6L) or cylinder head temperature sensor (3.8L) provides a signal to the temperature gauge.

The optional block heater:


- electrical heating element is installed in the core plug opening.
 - uses a standard 110V electrical supply
 - keeps the engine coolant warm during cold weather.
-


Engine Cooling

Special Tool(s)

 <p>ST1474-A</p>	Pressure Tester 014-R1072 or equivalent
 <p>ST1137-A</p>	73III Automotive Meter 105-R0057 or equivalent
 <p>ST2332-A</p>	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool
 <p>ST1720-A</p>	Battery/Anti-Freeze Tester 014-R1060 or equivalent

Inspection and Verification

 **WARNING:** Never remove the pressure relief cap while the engine is operating or when the cooling system is hot. Failure to follow these instructions can result in damage to the cooling system or engine or personal injury. To avoid having scalding hot coolant or steam blow out of the degas bottle when removing the pressure relief cap, wait until the engine is cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released, turn and remove the pressure relief cap (still with a cloth).


 **CAUTION:** Check the coolant level, engine oil and transmission fluid, top off the coolant if needed. If there is engine coolant in the engine oil or transmission fluid, the cause must be corrected and oil/fluid changed or major component damage may occur.

1. Verify the customer's concern by operating the engine to duplicate the condition.
2. Inspect to determine if any of the following mechanical or electrical concerns apply.

Visual Inspection Chart

Mechanical
<ul style="list-style-type: none">● Leaks● Hoses● Hose clamps● Water gasket● Head gaskets● Intake manifold gasket● Coolant pump● Radiator● Degas bottle/coolant expansion tank● Heater core● Fan/fan clutch● Engine coolant temperature sensor (4.6L)● Cylinder head temperature sensor (3.8L)● Circuitry

3. If the inspection reveals an obvious concern that can be readily identified, repair as necessary.

4.  **CAUTION: Some vehicle cooling systems are filled with Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Always fill the cooling system with the same coolant that is present in the system. Do not mix coolant types.**

NOTE: The addition of Motorcraft Cooling System Stop Leak Pellets, VC-6, darkens Motorcraft Premium Gold Engine Coolant from yellow to golden tan.

Inspect the coolant condition.

1. Inspect the coolant color.

- If Motorcraft Premium Gold Engine Coolant (yellow color) VC-7-A (in Oregon VC-7-B) or equivalent meeting Ford specification WSS-M97B51-A1 has a clear or pale yellow color, this indicates higher water content than required.
- Dark brown can indicate unauthorized stop leak may have been used. Use Motorcraft Cooling System Stop Leak Pellets VC-6 or equivalent meeting Ford specification ESE-M99B37-5 except as noted in ES-F6SE-19A511-AA only.
- A light or reddish brown color indicates that rust may be present in the cooling system. Flush the system and refill with the correct mixture of water and engine coolant.
- An iridescent sheen on top of the coolant can indicate a trace of oil is entering the system. For additional information on engine diagnosis, refer to [Section 303-00](#).
- A milky brown color may indicate that either engine oil or transmission fluid is entering the cooling system. If transmission fluid is suspected, the cause may be a leaky radiator. Pressure test the cooling system. For additional information, refer to component tests in this section. If engine oil is suspected the cause of the leak may be internal to the engine. For additional information, refer to [Section 303-00](#).

2. If the engine coolant appearance is acceptable, test the engine coolant freezing point range with the battery and anti-freeze tester. The freezing point should be in the range -40°C to -20°C (-50°F to -10°F). If the vehicle is driven in cold climates less than -32°C (-34°F), it may be necessary to increase the coolant concentration to get adequate freeze protection.

- Maximum coolant concentration is 60% coolant/40% water.
- Minimum coolant concentration is 40% coolant/60% water.

3. Adjust coolant range and level, if necessary:

- If coolant is low, add specified coolant mixture only.
 - If the engine coolant tests too weak, add straight engine coolant until the readings are within acceptable levels.
 - If the engine coolant tests strong, remove some of the engine coolant and add water until the readings are within acceptable levels.
5. If the concern remains after the inspection, determine the symptom(s) and GO to [Symptom Chart](#)


Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● Loss of coolant 	<ul style="list-style-type: none"> ● Radiator. ● Coolant pump seal. ● Radiator hoses. ● Heater hoses. ● Heater core. ● Engine gaskets. ● Degas bottle or coolant expansion tank. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test A.
<ul style="list-style-type: none"> ● The engine overheats 	<ul style="list-style-type: none"> ● Thermostat. ● Coolant pump. ● Internal engine coolant leak. ● Radiator. ● Cooling fan. ● Pressure relief cap or radiator cap. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test B.
<ul style="list-style-type: none"> ● The engine does not reach normal operating temperature 	<ul style="list-style-type: none"> ● Thermostat. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test C.


Pinpoint Tests

PINPOINT TEST A: LOSS OF COOLANT

Test Step	Result / Action to Take
A1 CHECK THE ENGINE COOLANT LEVEL	
 WARNING: Never remove the pressure relief cap while the engine is operating or when the cooling system is hot. Failure to follow these instructions can result in damage to the cooling system or engine or personal injury. To avoid having scalding hot coolant or steam blow out of the degas bottle when removing the pressure relief cap, wait until the engine is cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly. Step back	Yes GO to A2 . No REFILL the engine coolant as necessary. GO to A2 .

<p>while the pressure is released from the cooling system. When you are sure all the pressure has been released, turn and remove the pressure relief cap (still with a cloth). NOTE: Allow the engine to cool before checking the engine coolant level.</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Visually check the engine coolant level at the degas bottle or coolant expansion tank. ● Is the engine coolant level within specification? 	
<p>A2 CHECK THE PRESSURE RELIEF CAP</p>	
<ul style="list-style-type: none"> ● Carry out the Cap—3.8L or Cap—4.6L test. Go to Component Tests in this section. ● Is pressure relief cap/radiator cap OK? 	<p>Yes GO to A3.</p> <p>No INSTALL a new pressure relief cap/radiator cap. TEST the system for normal operation.</p>
<p>A3 CHECK THE ENGINE COOLANT FOR INTERNAL LEAK</p>	
<ul style="list-style-type: none"> ● Key in OFF position. ● Inspect the engine coolant in degas bottle/coolant expansion tank for signs of transmission fluid or engine oil. ● Is oil or transmission fluid evident in the coolant? 	<p>Yes If engine oil is evident, REFER to Section 303-00. If transmission fluid is evident, REPAIR or INSTALL a new radiator as necessary.</p> <p>No GO to A4.</p>
<p>A4 CHECK THE ENGINE AND THE TRANSMISSION FOR COOLANT</p>	
<ul style="list-style-type: none"> ● Remove the oil level dipstick from the engine and the transmission. ● Is coolant evident in the oil or transmission fluid? 	<p>Yes If coolant is in engine, REFER to Section 303-00. If coolant is in transmission, REPAIR or INSTALL a new radiator as necessary. To repair the automatic transmission, REFER to Section 307-01.</p> <p>No GO to A5.</p>
<p>A5 PRESSURE TEST THE ENGINE COOLING SYSTEM</p>	
<ul style="list-style-type: none"> ● Pressure test the engine cooling system. Go to Component Tests in this section. ● Does the engine cooling system leak? 	<p>Yes REPAIR or install new components. TEST the system for normal operation.</p> <p>No The cooling system is operational. GO to Symptom Chart.</p>

PINPOINT TEST B: THE ENGINE OVERHEATS

Test Step	Result / Action to Take
B1 CHECK THE ENGINE COOLANT LEVEL	<p>Yes GO to B2.</p> <p>No REFILL the engine coolant at the degas bottle/coolant expansion tank. Go To Pinpoint Test A.</p>
<p> WARNING: Never remove the pressure relief cap while the engine is operating or when the cooling system is hot. Failure to follow these instructions can result in damage to the cooling system or engine or personal injury. To avoid having scalding hot coolant or steam blow out of the degas bottle when removing the pressure relief cap, wait until the engine is cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released, turn and remove the pressure relief cap (still with a cloth). NOTE: If the engine is hot, allow the engine to cool before proceeding.</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Check the engine coolant level at the degas bottle/coolant expansion tank. ● Is the engine coolant OK? 	
B2 CHECK THE COOLANT CONDITION	<p>Yes GO to B3.</p> <p>No FLUSH the engine cooling system. REFER to Engine and Radiator Flushing in this section. TEST the system for normal operation.</p>
<ul style="list-style-type: none"> ● Check the coolant for dirt, rust or contamination. ● Is the coolant condition OK? 	
B3 CHECK FOR AN AIRFLOW OBSTRUCTION	<p>Yes REMOVE the obstruction. CLEAN the A/C condenser core and radiator. TEST the system for normal operation.</p> <p>No GO to B4.</p>
<ul style="list-style-type: none"> ● Inspect the A/C condenser core and radiator for obstructions such as leaves or dirt. ● Is there an obstruction? 	
B4 CHECK THE WATER THERMOSTAT OPERATION	<p>Yes INSTALL a new water thermostat. REFER to Thermostat—3.8L, Thermostat—4.6L(2V) or Thermostat—4.6L(4V) in this section. TEST the system for normal operation.</p> <p>No GO to B5.</p>
<ul style="list-style-type: none"> ● Start the engine and allow the engine to run for ten minutes. ● Feel the inlet and outlet heater water hoses and the underside of the upper radiator hose. ● Are the upper radiator hose and the heater water hoses cold? 	

B5 CHECK THE COOLING FAN OPERATION	
<ul style="list-style-type: none"> ● Carry out the cooling fan component tests. Go to Component Tests. ● Is the cooling fan operation OK? 	<p>Yes For diagnosis and testing of the engine, REFER to Section 303-00.</p> <p>No INSTALL a new fan component as necessary. TEST the system for normal operation.</p>

PINPOINT TEST C: THE ENGINE DOES NOT REACH NORMAL OPERATING TEMPERATURE

Test Step	Result / Action to Take
C1 CHECK THE ENGINE TEMPERATURE	
<ul style="list-style-type: none"> ● Start the engine and allow the engine to idle for ten minutes. ● Feel the inlet and heater water hoses and the underside of the upper radiator hose. ● Are the upper radiator hose and the heater water hoses cold? 	<p>Yes INSTALL a new water thermostat. REFER to Thermostat—3.8L, Thermostat—4.6L(2V) or Thermostat—4.6L(4V) in this section. TEST the system for normal operation.</p> <p>No For diagnosis and testing of the engine coolant temperature gauge, REFER to Section 413-01.</p>

Component Tests

Pressure Test — 3.8L



WARNING: Never remove the pressure relief cap while the engine is operating or when the cooling system is hot. Failure to follow these instructions can result in damage to the cooling system or engine or personal injury. To avoid having scalding hot coolant or steam blow out of the degas bottle when removing the pressure relief cap, wait until the engine is cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released, turn and remove the pressure relief cap (still with a cloth).


1. Remove the radiator cap. Fill the radiator as needed. Fit the pressure tester to the radiator neck, using an aftermarket adapter.

2.  **CAUTION:** Do not pressurize the cooling system beyond 110 kPa (16 psi).

Pump the cooling system to a maximum of 102 kPa (14.9 psi) and hold for 2 minutes. If the pressure drops within this time, inspect for leaks and repair as necessary.

Pressure Test — 4.6L

1. Turn the engine OFF.

2.  **WARNING:** Never remove the pressure relief cap while the engine is operating or when the cooling system is hot. Failure to follow these instructions can result in damage to the cooling system or engine or personal injury. To avoid having scalding hot coolant or steam blow out of the degas bottle when removing the pressure relief cap, wait until the engine is cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released, turn and remove the pressure relief cap (still with a cloth).

Check the engine coolant level; refer to [Cooling System Draining, Filling and Bleeding](#) in this section.


3. Connect Radiator Heater Core Pressure Tester to the degas bottle nipple and vent hose. Install a pressure test pump to the quick-connect fitting of the test adapter.

4.  **CAUTION:** Do not pressurize the cooling system beyond 152 kPa (22 psi).

NOTE: If the plunger of the pump is depressed too quickly, an erroneous pressure reading will result.

Slowly depress the plunger of the pressure test pump until the pressure gauge reading stops increasing and note the highest pressure reading obtained.

5. If the pressure relief cap does not hold pressure, remove and wash the pressure relief cap in clean water to dislodge all foreign particles from the gaskets. Check the sealing surface in the filler neck.
6. If 110 kPa (16 psi) cannot be reached, install a new pressure relief cap. If more than 124 kPa (18 psi) shows on gauge, install a new pressure relief cap.

7.  **CAUTION:** If the pressure drops, check for leaks at the engine-to-heater core hoses, engine-to-radiator hoses, water valve hose (if applicable), oil cooler return tube gasket (6N789), radiator and heater core or other system components and connections. Any leaks which are found must be corrected and the system rechecked.

Pressurize the engine cooling system as described in Step 4 (using a pressure relief cap that operates within the specified upper and lower pressure limits). Observe the gauge reading for approximately two minutes; refer to General Specifications. Pressure should not drop during this time.

8. Release the system pressure by loosening the pressure relief cap. Check the engine coolant level and replenish, if necessary, with the correct engine coolant mixture; refer to [Cooling System Draining, Filling and Bleeding](#) in this section.

Cap — 3.8L

1. Inspect the radiator cap and seals for damage or deterioration. Install a new radiator cap if necessary.
2. Fit the radiator cap to Radiator/Heater Core Pressure Tester Kit, using the aftermarket adapter.
3. **NOTE:** If the plunger of the pressure tester is depressed too fast, an incorrect pressure reading will result.

Slowly pump the pressure tester until the pressure gauge stops increasing and note the highest

pressure reading. Release pressure and repeat the test. Install a new radiator cap if the pressure is not 99.3-121.4 kPa (14.4-17.6 psi).

Cap — 4.6L



WARNING: Never remove the pressure relief cap while the engine is operating or when the cooling system is hot. Failure to follow these instructions can result in damage to the cooling system or engine or personal injury. To avoid having scalding hot coolant or steam blow out of the degas bottle when removing the pressure relief cap, wait until the engine is cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released, turn and remove the pressure relief cap (still with a cloth).

1. Remove the pressure relief cap from the degas bottle.
2. Follow the instructions from the pressure tester.
3. **NOTE:** If the plunger of the pump is depressed too quickly, an erroneous pressure reading will result.

Slowly depress the plunger of the pressure test pump until the pressure gauge reading stops increasing and note the highest pressure reading obtained.

4. If the pressure test gauge readings are not within specifications, install a new pressure relief cap. If the pressure test gauge readings are within specifications, carry out the cooling system Pressure Test.

Thermostat — Water

A new water thermostat should be installed only after the following electrical and mechanical tests have been carried out.

Thermostat — Electrical Test



CAUTION: Always vent the exhaust to the outside when carrying out this test.

NOTE: The electrical thermostat test is most accurate if carried out at less than 37.8°C (100°F) ambient air. This test may be carried out with or without the hood open and with the engine warm or cold.

1. Check the engine coolant level. Fill as needed.
2. With the ignition OFF, remove the engine coolant temperature (ECT) (4.6L) or cylinder head temperature (CHT) (3.8L) sensor harness connector and attach ECT (4.6L) or CHT (3.8L) Sensor "T" Cable as a jumper between the powertrain control module (PCM) (12A650) and the ECT (4.6L) or CHT (3.8L) sensor. Attach the 73III Automotive Meter to the ECT (4.6L) or CHT (3.8L) Sensor "T" Cable. Voltage values (0-5 V) may now be monitored while the sensor retains its connection to the wiring harness.
An appropriate diagnostic tool may be used to monitor the ECT on vehicles equipped with data link connector (DLC).

3. **NOTE:** Running this test with the vehicle in gear or with the A/C compressor clutch engaged (running) will cause incorrect diagnosis.

Place the transmission in PARK (P) or NEUTRAL (N).

4. Start the engine and allow the engine to idle throughout this test. Allow the engine to run for 2 minutes, then record the ECT (4.6L) or CHT (3.8L) voltage. Record the ECT (4.6L) or CHT (3.8L) voltage every 60 seconds. When the ECT (4.6L) or CHT (3.8L) voltage trend changes direction or only changes slightly (0.03 volts or less) from the previous reading, record this as the thermostat opening voltage. Use the voltage and corresponding coolant temperature chart listed below for 4.6L engines only.

Coolant Temperature °C (°F)	ECT (Volts)
22 (71)	3.00
43 (109)	2.01
71 (159)	1.01
82 (180)	0.75
91 (195)	0.059
97 (206)	0.050
105 (221)	0.040

5. If the thermostat opening voltage is greater than 0.75 volts and less than 82°C (180°F), install a new water thermostat.
6. If the thermostat opening voltage is less than 0.75 volts and greater than 82°C (180°F), the water thermostat is good and a new water thermostat should not be installed. GO to [Symptom Chart](#) for further instructions.

Thermostat — Mechanical Test

1. Remove the water thermostat.
2. Check the water thermostat for seating. Hold the water thermostat up to a lighted background. Leakage of light around the thermostat valve at room temperature indicates that a new water thermostat should be installed. Some water thermostats have a small leakage notch at one location on the perimeter of the thermostat valve, which is considered normal.
3. Immerse the water thermostat in a boiling coolant and water mixture.
4. See the General Specifications chart for water thermostat opening temperatures.

Radiator Leak Test, Removed From the Vehicle



CAUTION: Never leak test an aluminum radiator in the same water that copper/brass radiators are tested in. Flux and caustic cleaners may be present in the cleaning tank and they will damage aluminum radiators.

NOTE: Always install plugs in the oil cooler fittings before leak-testing or cleaning any radiator.

NOTE: Clean the radiator before leak-testing to avoid contamination of tank.

1. Leak-test the radiator in clean water with 138 kPa (20 psi) air pressure.

Fan — Electric Test


Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.


Cooling System Draining, Filling and Bleeding

Material

Item	Specification
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) (yellow color)	WSS-M97B51-A1

Draining


 **WARNING:** Never remove the pressure relief cap while the engine is operating or when the cooling system is hot. Failure to follow these instructions can result in damage to the cooling system or engine or personal injury. To avoid having scalding hot coolant or steam blow out of the degas bottle when removing the pressure relief cap, wait until the engine is cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released, turn and remove the pressure relief cap (still with a cloth).


 **CAUTION:** The coolant must be recovered in a suitable, clean container for reuse. If the coolant is contaminated, it must be recycled or disposed of correctly.

NOTE: Less than 80% of coolant capacity can be recovered with the engine in the vehicle. Dirty, rusty or contaminated coolant should be drained and filled with new coolant.

1. Release the pressure in the cooling system by slowly turning the pressure relief cap one half turn counterclockwise or the radiator cap counterclockwise to the first stop. When the pressure is released, remove the pressure relief cap/radiator cap.
2. Place a suitable container below the radiator draincock. If equipped, disconnect the coolant return hose at the fluid cooler. Open the draincock and drain the engine coolant.
 - Close the radiator draincock.

Filling — 3.8L

 **CAUTION:** Vehicle cooling systems are filled with Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Always fill the cooling system with the same coolant that is present in the system. Do not mix coolant types.

 **CAUTION:** Engine coolant provides freeze protection, boil protection, cooling efficiency, and corrosion protection to the engine and cooling components. In order to obtain these protections, the engine coolant must be maintained at the correct concentration and fluid level in the degas bottle.

When adding engine coolant, use a 50/50 mixture of engine coolant and deionized water.

To maintain the integrity of the coolant and the cooling system:

- Add Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Use the same coolant that was drained from the cooling system. Do not mix coolant types.
- Do not add/mix orange-colored Motorcraft Speciality Orange Engine Coolant VC-2 or equivalent meeting Ford specification WSS-M97B44-D. Mixing coolants may degrade the coolant's corrosion protection.
- Do not add alcohol, methanol, or brine, or any engine coolants mixed with alcohol or methanol antifreeze. These can cause engine damage from overheating or freezing.
- Do not mix with recycled coolant unless it meets the requirements of Ford specification WSS-M97B51-A1. Not all coolant recycling processes meet these Ford specifications. Use of such coolants can harm the engine and cooling system components.

NOTE: The addition of Motorcraft Cooling System Stop Leak Pellets, VC-6, darkens Motorcraft Premium Gold Engine Coolant from yellow to golden tan.

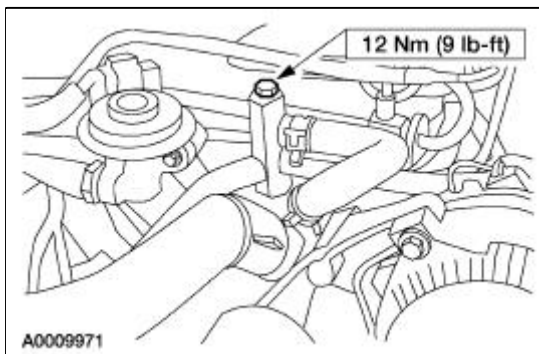
1. Place the heater temperature selector in the maximum cool position.

2.  **CAUTION:** On 3.8L engines, the vent plug must be removed before radiator fill or the engine may not fill completely.

NOTE: It is important to maintain engine coolant concentrate between 40 percent or -24°C (-11°F) and 60 percent or -52°C (-62°F).

Fill the engine cooling system with 50/50 mixture of water and engine coolant.

3. After filling the engine cooling system, add coolant to the vent until full. Install the vent plug.



4. Leave the pressure relief cap off and run the engine until it reaches normal operating temperature.
5. Stop the engine and add the correct engine coolant mixture to the degas bottle/coolant expansion tank until the coolant level is between the COOLANT FILL LEVEL marks.
6. Turn the engine off and allow the cooling system to cool. Check the level in the degas bottle/coolant expansion tank, and add a 50/50 mix as needed.

Filling — 4.6L (2V)

⚠ CAUTION: Vehicle cooling systems are filled with Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Always fill the cooling system with the same coolant that is present in the system. Do not mix coolant types.

⚠ CAUTION: Engine coolant provides freeze protection, boil protection, cooling efficiency, and corrosion protection to the engine and cooling components. In order to obtain these protections, the engine coolant must be maintained at the correct concentration and fluid level in the degas bottle.

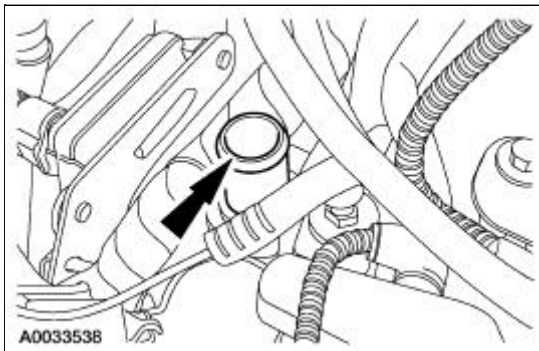
When adding engine coolant, use a 50/50 mixture of engine coolant and deionized water.

To maintain the integrity of the coolant and the cooling system:

- Add Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Use the same coolant that was drained from the cooling system. Do not mix coolant types.
- Do not add/mix orange-colored Motorcraft Speciality Orange Engine Coolant VC-2 or equivalent meeting Ford specification WSS-M97B44-D. Mixing coolants may degrade the coolant's corrosion protection.
- Do not add alcohol, methanol, or brine, or any engine coolants mixed with alcohol or methanol antifreeze. These can cause engine damage from overheating or freezing.
- Do not mix with recycled coolant unless it meets the requirements of Ford specification WSS-M97B51-A1. Not all coolant recycling processes meet these Ford specifications. Use of such coolants can harm the engine and cooling system components.


NOTE: The addition of Motorcraft Cooling System Stop Leak Pellets, VC-6, darkens Motorcraft Premium Gold Engine Coolant from yellow to golden tan.

1. Remove the thermostat. For additional information, refer to [Thermostat—4.6L\(2V\)](#) in this section.
2. Disconnect the heater core coolant supply hose from the fitting at the rear of the manifold.
3. Add the coolant/water mixture through the thermostat opening until coolant appears at the heater core coolant supply outlet fitting at the rear of the manifold.



4. Install the heater hose, using an appropriately sized worm style clamp in place of the constant tension clamp.
5. Reinstall the thermostat gasket (O-ring) and the thermostat. For additional information, refer to [Thermostat—4.6L\(2V\)](#) in this section.
6. Add the correct engine coolant mixture to the degas bottle until the coolant level is between the


"COOLANT FILL LEVEL" marks and replace the pressure cap.


7. Select the maximum cool temperature setting.
8. Run the engine until it reaches operating temperature.
9.  **CAUTION: If the engine coolant temperature gauge does not move, the engine coolant level in the engine is low and must be filled. Stop the engine, allow it to cool and fill the cooling system.**

Add the correct engine coolant mixture to the degas bottle until the coolant level is between the "COOLANT FILL LEVEL" marks.

10. Repeat the two previous steps until the engine coolant mixture is between the "COOLANT FILL LEVEL" marks on the degas bottle. Turn off the engine and allow it to cool.
11. Check the freeze protection of the engine coolant mixture with the Battery/Anti-freeze Tester 014-R1060 or equivalent. Adjust freezing point range if necessary.

Filling — Cobra

 **CAUTION: Vehicle cooling systems are filled with Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Always fill the cooling system with the same coolant that is present in the system. Do not mix coolant types.**

 **CAUTION: Engine coolant provides freeze protection, boil protection, cooling efficiency, and corrosion protection to the engine and cooling components. In order to obtain these protections, the engine coolant must be maintained at the correct concentration and fluid level in the degas bottle.**


When adding engine coolant, use a 50/50 mixture of engine coolant and deionized water.

To maintain the integrity of the coolant and the cooling system:

- Add Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Use the same coolant that was drained from the cooling system. Do not mix coolant types.
- Do not add/mix orange-colored Motorcraft Speciality Orange Engine Coolant VC-2 or equivalent meeting Ford specification WSS-M97B44-D. Mixing coolants may degrade the coolant's corrosion protection.
- Do not add alcohol, methanol, or brine, or any engine coolants mixed with alcohol or methanol antifreeze. These can cause engine damage from overheating or freezing.
- Do not mix with recycled coolant unless it meets the requirements of Ford specification WSS-M97B51-A1. Not all coolant recycling processes meet these Ford specifications. Use of such coolants can harm the engine and cooling system components.


NOTE: The addition of Motorcraft Cooling System Stop Leak Pellets, VC-6, darkens Motorcraft Premium Gold Engine Coolant from yellow to golden tan.


1. Check all hose clamps for correct tightness. Make sure the radiator draincock is closed.
2. Place the heater temperature selector in maximum cool position.

3. Remove the pressure cap from the cooling system reservoir and the fill plug from the engine crossover tube.
4.  **CAUTION: Do not fill the cooling system through the reservoir only. Coolant will not enter the engine. Only the reservoir and the radiator will be filled and engine overheating will occur.**

Add coolant into the fill neck on the engine crossover tube until coolant reaches the top of the fill neck on the cooling system reservoir.

5. Install the cooling system pressure cap on the reservoir.
6. Continue to fill the cooling system at the engine crossover fill neck until full.
7. Install the engine crossover tube fill plug.


8.  **WARNING: To avoid the possibility of personal injury or damage to the vehicle, do not operate the engine with the hood open until the fan has been first examined for possible cracks and separation.**


 **CAUTION: If the engine temperature gauge does not move, coolant level is low in the engine and must be filled. Stop the engine, allow to cool, and fill the cooling system as outlined.**

Run the engine until the thermostat opens (coolant flowing through the radiator lower hose becomes hot).

9. Stop the engine and allow to cool.
10. Add coolant to the engine crossover tube fill neck until the cooling system is full.
11. Install the fill plug.
12. Repeat the fill procedure if necessary.

Filling — Mach I

 **CAUTION: Vehicle cooling systems are filled with Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Always fill the cooling system with the same coolant that is present in the system. Do not mix coolant types.**

 **CAUTION: Engine coolant provides freeze protection, boil protection, cooling efficiency, and corrosion protection to the engine and cooling components. In order to obtain these protections, the engine coolant must be maintained at the correct concentration and fluid level in the degas bottle.**

When adding engine coolant, use a 50/50 mixture of engine coolant and deionized water.

To maintain the integrity of the coolant and the cooling system:


- Add Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Use the same coolant that

was drained from the cooling system. Do not mix coolant types.

- Do not add/mix orange-colored Motorcraft Speciality Orange Engine Coolant VC-2 or equivalent meeting Ford specification WSS-M97B44-D. Mixing coolants may degrade the coolant's corrosion protection.
- Do not add alcohol, methanol, or brine, or any engine coolants mixed with alcohol or methanol antifreeze. These can cause engine damage from overheating or freezing.
- Do not mix with recycled coolant unless it meets the requirements of Ford specification WSS-M97B51-A1. Not all coolant recycling processes meet these Ford specifications. Use of such coolants can harm the engine and cooling system components. Do not mix coolant types


NOTE: The addition of Motorcraft Cooling System Stop Leak Pellets, VC-6, darkens Motorcraft Premium Gold Engine Coolant from yellow to golden tan.


1. Remove the air intake scoop. For additional information, refer to [Section 303-12](#).
2. Check all hose clamps for correct tightness. Make sure the radiator draincock is closed.
3. Place the heater temperature selector in maximum cool position.
4. Remove the pressure cap from the cooling system reservoir and the fill plug from the engine crossover tube.

5.  **CAUTION: Do not fill the cooling system through the reservoir only. Coolant will not enter the engine. Only the reservoir and the radiator will be filled and engine overheating will occur.**

Add coolant into the fill neck on the engine crossover tube until coolant reaches the top of the fill neck on the cooling system reservoir.

6. Install the cooling system pressure cap on the reservoir.
7. Continue to fill the cooling system at the engine crossover fill neck until full.
8. Install the engine crossover tube fill plug.

9.  **WARNING: To avoid the possibility of personal injury or damage to the vehicle, do not operate the engine with the hood open until the fan has been first examined for possible cracks and separation.**


 **CAUTION: If the engine temperature gauge does not move, coolant level is low in the engine and must be filled. Stop the engine, allow to cool, and fill the cooling system as outlined.**

Run the engine until the thermostat opens (coolant flowing through the radiator lower hose becomes hot).

10. Stop the engine and allow to cool.
11. Add coolant to the engine crossover tube fill neck until the cooling system is full.
12. Install the fill plug.
13. Repeat the fill procedure if necessary.

14. Install the air intake scoop. For additional information, refer to [Section 303-12](#).

Bleeding

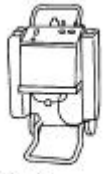


1. Select the maximum heater temperature and blower motor speed settings. Position the control to discharge air at A/C vents in instrument panel.
2. Start the engine and allow to idle. While engine is idling, feel for hot air at A/C vents.
3.  **CAUTION: If the air discharge remains cool and the engine coolant temperature gauge does not move, the engine coolant level is low and must be filled. Stop the engine, allow the engine to cool and fill cooling system.**

Start the engine and allow it to idle until normal operating temperature is reached. Hot air should discharge from A/C vents. The engine coolant temperature gauge should maintain a stabilized reading in the middle of the NORMAL range. The upper radiator hose should feel hot to the touch.

4. Shut the engine off and allow the engine to cool.
 5. Check the engine for coolant leaks.
 6. Check the engine coolant level in the degas bottle/coolant expansion tank and fill as necessary.
-


Engine and Radiator Flushing

Special Tool(s)

 <p>ST2421-A</p>	<p>Coolant System Drain/Flush/Fill 164-R3673 or equivalent</p>
 <p>ST1168-A</p>	<p>Flush Kit 164-R3658 or equivalent</p>
 <p>ST1167-A</p>	<p>Drain Kit 164-R3662 or equivalent</p>

Material

Item	Specification
<p>Motorcraft Premium Cooling System Flush VC-1 or equivalent</p>	<p>ESR-M14P7-A</p>
<p>Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) (yellow color)</p>	<p>WSS-M97B51- A1</p>

-  **WARNING:** Never remove the pressure relief cap while the engine is operating or when the cooling system is hot. Failure to follow these instructions can result in damage to the cooling system or engine or personal injury. To avoid having scalding hot coolant or steam blow out of the degas bottle when removing the pressure relief cap, wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released, turn and remove the pressure relief cap (still with a cloth).

Once pressure is released, remove the pressure relief cap/radiator cap.

- Drain the cooling system. For additional information, refer to [Cooling System Draining, Filling and Bleeding](#) in this section.
- Remove the coolant thermostat. For additional information, refer to [Thermostat—3.8L](#), [Thermostat—4.6L\(2V\)](#) or [Thermostat—4.6L\(4V\)](#) in this section.

4. Install the coolant hose connection without the thermostat.
5. **NOTE:** Refer to the cooling system flusher manufacturer's operating instructions for specific vehicle hook-up.



NOTE: The addition of Motorcraft Cooling System Stop Leak Pellets, VC-6, darkens Motorcraft Premium Gold Engine Coolant from yellow to golden tan.

Using an appropriate cooling system flusher, flush the engine and radiator. Use Ford Premium Cooling System Flush VC-1 or equivalent meeting Ford specification ESR-M14P7-A. Always flush the cooling system with water thoroughly after using the VC-1 flush and prior to filling the cooling system with the same coolant that was present in the system. Do not mix coolant types.

6. Install the thermostat.
 7. Backflush the heater core. For additional information, refer to [Heater Core Backflushing](#) in this section.
 8. Fill the cooling system. For additional information, refer to [Cooling System Draining, Filling and Bleeding](#) in this section.
-


Heater Core Backflushing

Special Tool(s)

 ST1168-A	Flush Kit 164-R3658 or equivalent
 ST1167-A	Drain Kit 164-R3662 or equivalent

Material

Item	Specification
Motorcraft Premium Cooling System Flush VC-1 or equivalent	ESR-M14P7-A
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) (yellow color)	WSS-M97B51-A1

-  **WARNING:** Never remove the pressure relief cap while the engine is operating or when the cooling system is hot. Failure to follow these instructions can result in damage to the cooling system or engine or personal injury. To avoid having scalding hot coolant or steam blow out of the degas bottle when removing the pressure relief cap, wait until the engine is cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released, turn and remove the pressure relief cap (still with a cloth).

Once pressure is released, remove the pressure relief cap.

- Partially drain the cooling system. For additional information, refer to [Cooling System Draining, Filling and Bleeding](#) in this section.
- NOTE:** For additional information, refer to the cooling system flusher manufacturer's operating instructions for particular vehicle hook-up.

Use an appropriate cooling system flusher to backflush the heater core. Use Motorcraft Cooling System Flush VC-1 or equivalent meeting Ford specification ESR-M14P7-A. Flush with water thoroughly after using VC-1 or equivalent prior to refilling the cooling system

- Fill the cooling system. For additional information, refer to [Cooling System Draining, Filling and Bleeding](#) in this section.

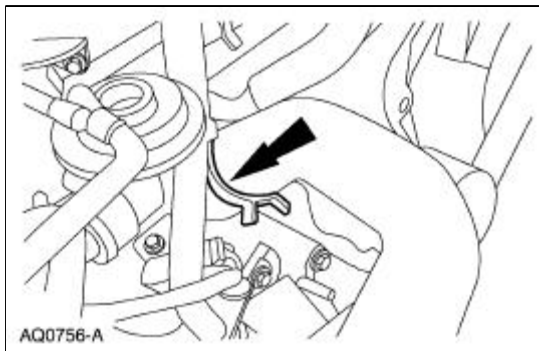
Thermostat —3.8L

Material

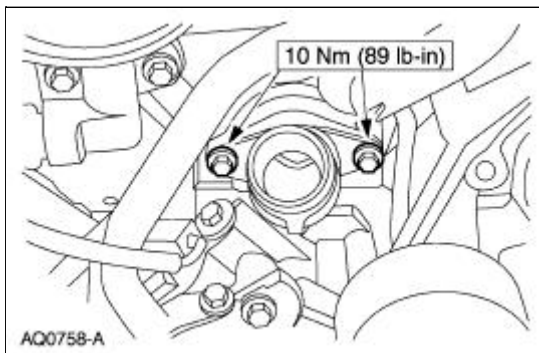
Item	Specification
Gasket Adhesive TA-6 or equivalent	WSS-M2G408- A
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) (yellow color)	WSS-M97B51- A1

Removal and Installation

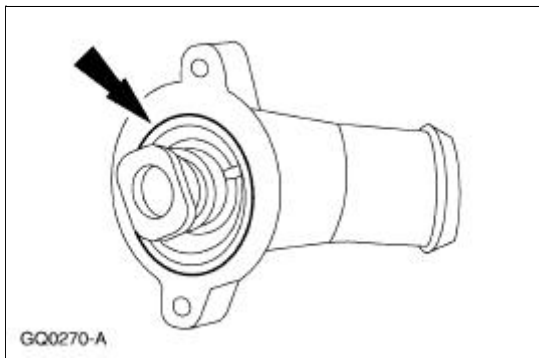
1. Drain the engine coolant. For additional information, refer to [Cooling System Draining, Filling and Bleeding](#) in this section.
2. Disconnect the upper radiator hose from the coolant hose connection.



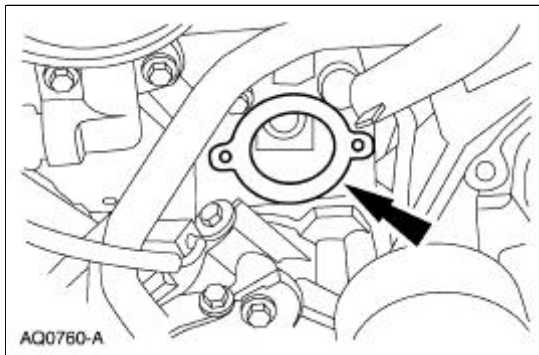
3. Remove the thermostat housing.
 - Remove the bolts.



4. Remove the thermostat.
 - Clean and inspect the water outlet connection.
 - Discard the thermostat gasket, and clean and inspect the mating surface.



5. Clean and inspect the thermostat mating surface at the engine.



6. **NOTE:** The thermostat is indexed and must be returned to the original location.

NOTE: Coat the new thermostat gasket with gasket adhesive.

NOTE: Make sure the new O-ring gasket is secure around the thermostat.

To install, reverse the removal procedure.

7. Fill the cooling system. For additional information, refer to [Cooling System Draining, Filling and Bleeding](#) in this section.
-

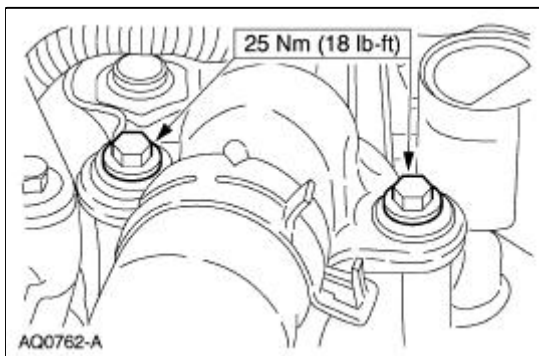
Thermostat —4.6L(2V)

Material

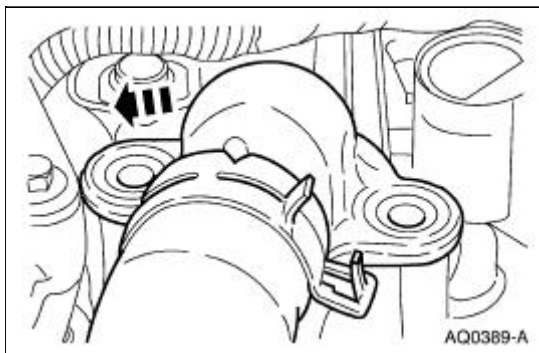
Item	Specification
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) (yellow color)	WSS-M97B51-A1

Removal and Installation

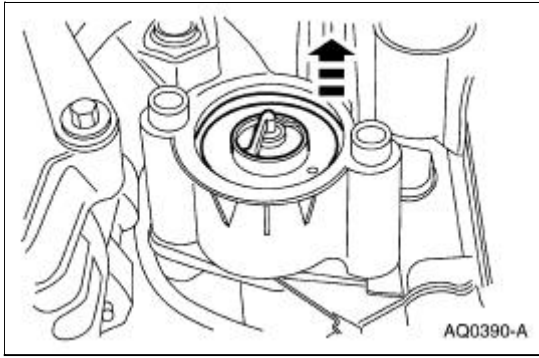
1. Drain the engine coolant. For additional information, refer to [Cooling System Draining, Filling and Bleeding](#) in this section.
2. Remove the bolts and coolant outlet connection.



3. Position aside the coolant outlet connection and the upper radiator hose.



4. Remove the thermostat and O-ring seal from the upper intake manifold.
 - Inspect the O-ring seal. Install a new seal if necessary.



5. To install, reverse the removal procedure.

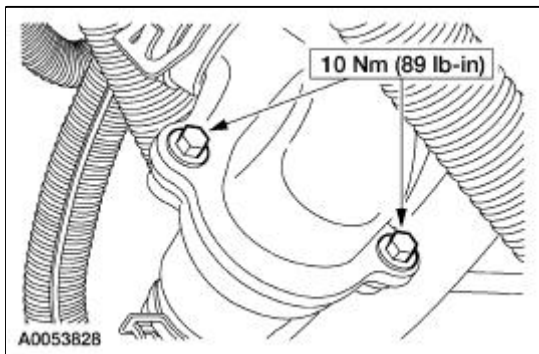
Thermostat —4.6L(4V)

Material

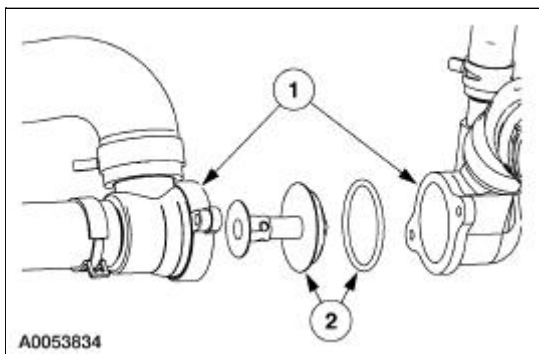
Item	Specification
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) (yellow color)	WSS-M97B51-A1

Removal and Installation

1. With the vehicle in neutral, position it on a hoist. For additional information, refer to [Section 100-02](#).
2. Drain the engine coolant. For additional information, refer to [Cooling System Draining, Filling and Bleeding](#) in this section.
3. Remove the thermostat housing bolts.



4. Remove the coolant thermostat.
 1. Separate the thermostat housing.
 2. Remove the coolant thermostat and the O-ring seal.
 - Inspect the O-ring seal. Install a new seal, if necessary.



5. **NOTE:** The thermostat is indexed and must be returned to the original location.

NOTE: Make sure the new O-ring seal is secure around the thermostat.

To install, reverse the removal procedure.

6. Fill the cooling system. For additional information, refer to [Cooling System Draining, Filling and Bleeding](#) in this section.
-

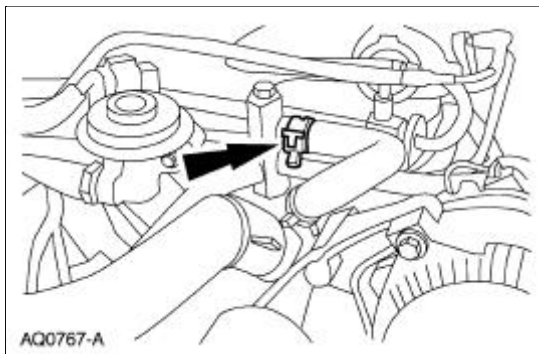
Bypass Tube —3.8L

Material

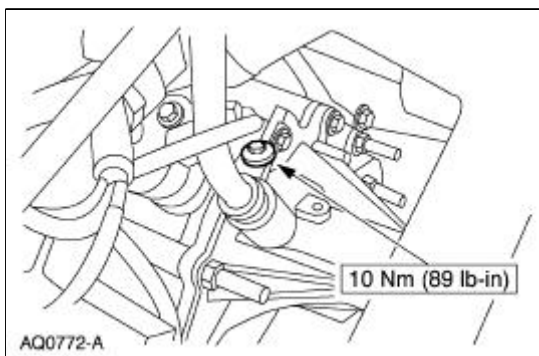
Item	Specification
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) (yellow color)	WSS-M97B51-A1

Removal and Installation

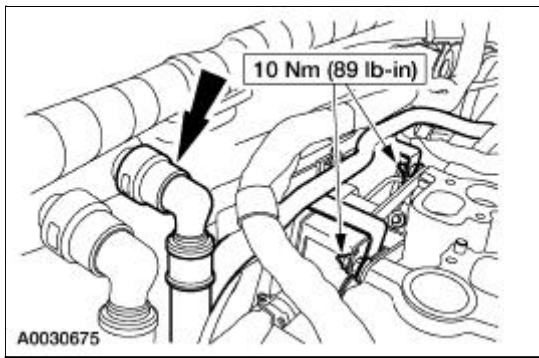
1. Drain the engine coolant. For additional information, refer to [Cooling System Draining, Filling and Bleeding](#) in this section.
2. Remove the upper intake manifold. For additional information, refer to [Section 303-01A](#).
3. Remove the bypass hose from the bypass tube.



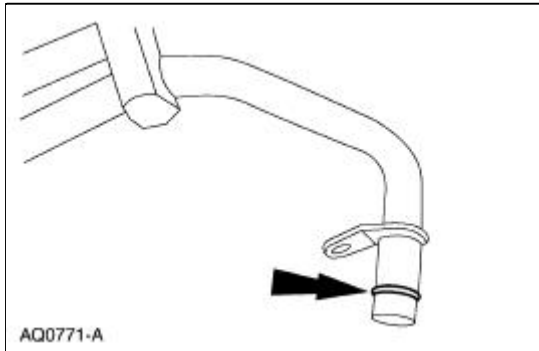
4. Remove the bolt and remove the bypass tube from the coolant pump.



5. Disconnect the quick connect fitting and remove the bracket bolts and the bypass tube.



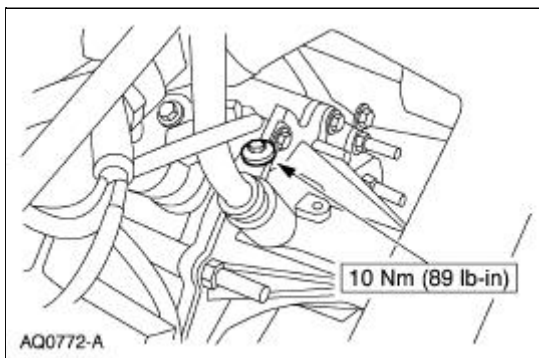
6. Install a new O-ring seal on the coolant bypass tube.



7.  **CAUTION: Do not cut the O-ring seal during tube installation or engine coolant leakage may occur.**

Clean the O-ring sealing surface on the cylinder heads and lubricate the O-ring seal. Use premium engine coolant.

8. To install, reverse the removal procedure.



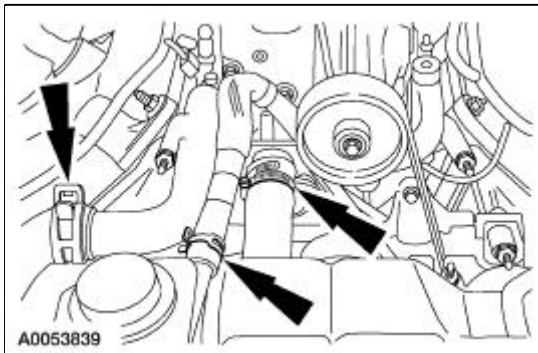
Bypass Tube —Cobra

Material

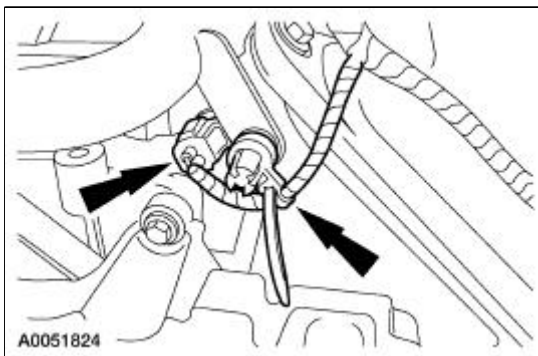
Item	Specification
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) (yellow color)	WSS-M97B51-A1

Removal and Installation

1. Drain the engine coolant. For additional information, refer to [Cooling System Draining, Filling and Bleeding](#) in this section.
2. Disconnect the radiator upper hose and the radiator lower hose.

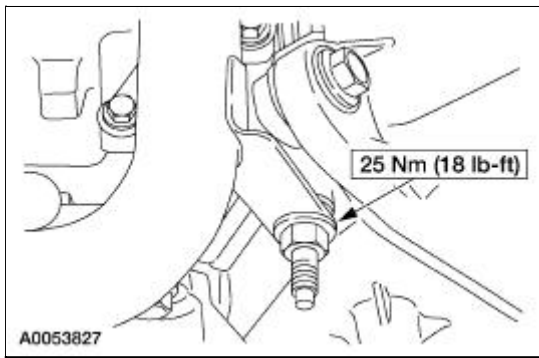


3. Remove the supercharger belt. For additional information, refer to [Section 303-05](#).
4. Disconnect the engine coolant temperature sensor electrical connector and unclip the wiring harness from the stud.



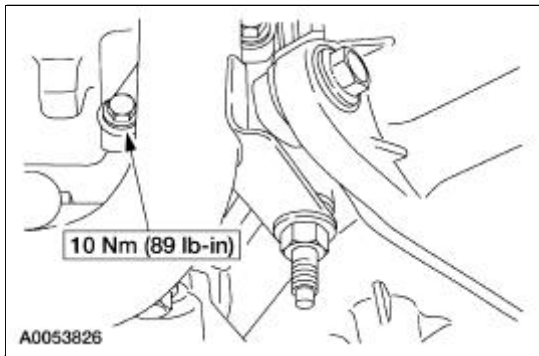
5. **NOTE:** LH is shown, RH is similar.

Remove the coolant bypass nuts.



6. **NOTE:** LH is shown, RH is similar.

Remove the bolts and the coolant bypass tube.



7. **NOTE:** Install new bypass tube O-rings and lubricate them, using premium engine coolant.

To install, reverse the removal procedure.

8. Fill and bleed the engine cooling system. For additional information, refer to [Cooling System Draining, Filling and Bleeding](#) in this section.
-

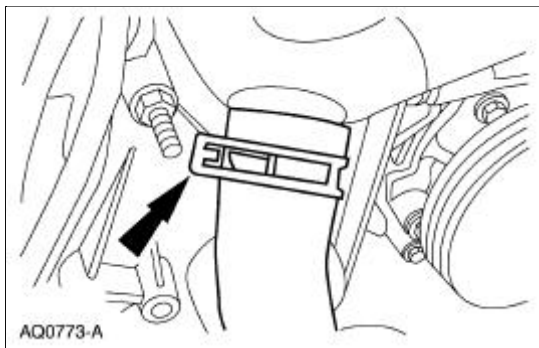
Bypass Tube —Mach I

Material

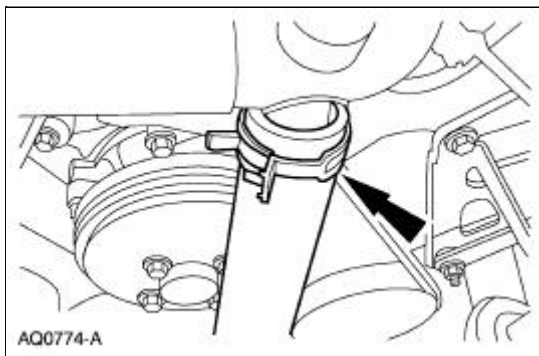
Item	Specification
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) (yellow color)	WSS-M97B51-A1

Removal and Installation

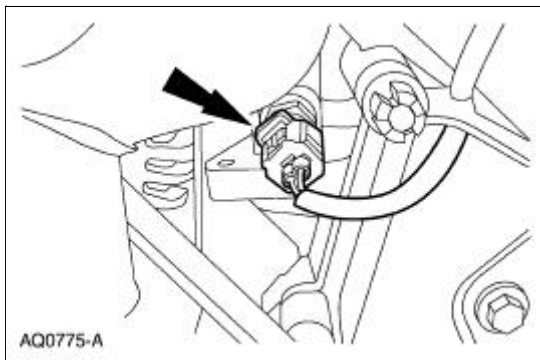
1. Remove the air intake scoop and bracket. For additional information, refer to [Section 303-12](#).
2. Drain the engine coolant. For additional information, refer to [Cooling System Draining, Filling and Bleeding](#) in this section.
3. Disconnect the upper radiator hose from the bypass tube.



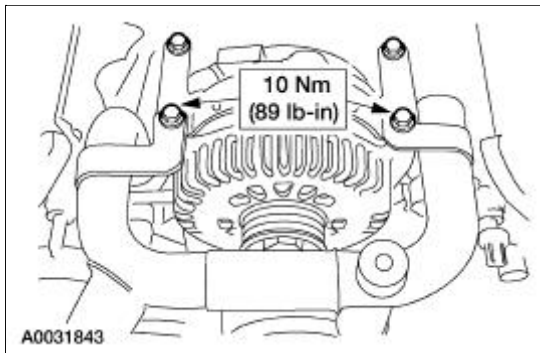
4. Disconnect the lower radiator hose.



5. Disconnect the engine temperature control (ECT) sensor electrical connector.



6. Remove the bolts and the bypass tube.



7. **NOTE:** Do not cut the O-ring seal during tube installation into cylinder heads or engine coolant leakage may occur.

NOTE: Wipe the O-ring sealing surface on the cylinder heads with a soft cloth, if necessary and lubricate the O-ring seal. Use premium engine coolant.

To install, reverse the removal procedure

8. Fill the cooling system. For additional information, refer to [Cooling System Draining, Filling and Bleeding](#) in this section.
-

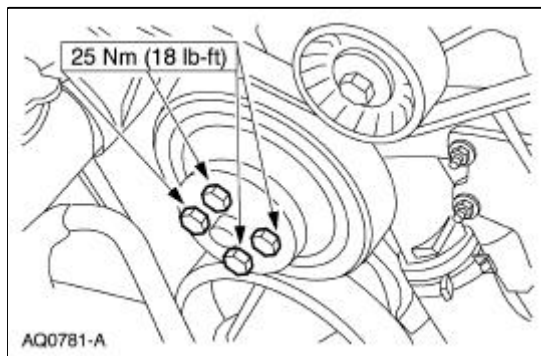
Water Pump —3.8L

Material

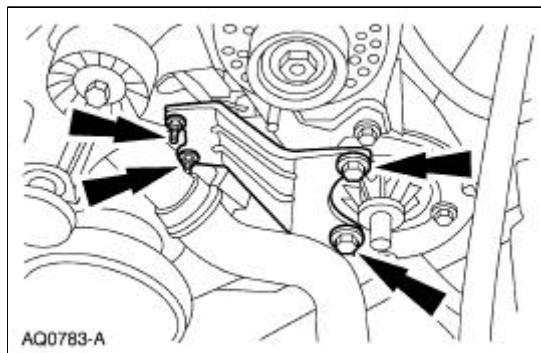
Item	Specification
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) (yellow color)	WSS-M97B51-A1

Removal and Installation

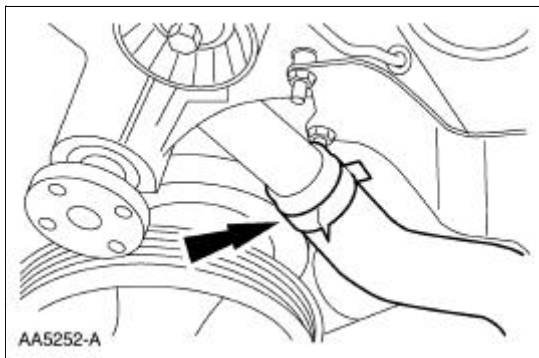
1. Drain the engine coolant. For additional information, refer to [Cooling System Draining, Filling and Bleeding](#) in this section.
2. Loosen the coolant pump pulley bolts.



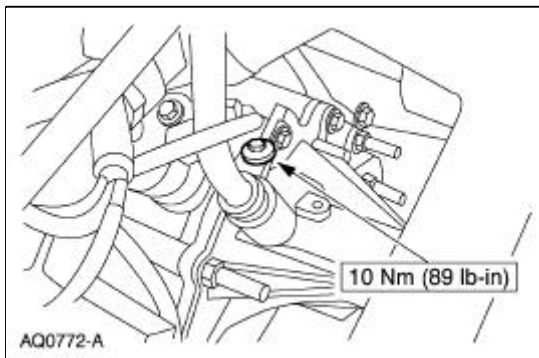
3. Remove the power steering (PS) pump pulley. For additional information, refer to [Section 211-02](#).
4. Remove the bolts and the coolant pump pulley.
5. Remove the PS bracket.
 - Remove the bolts.
 - Remove the nuts.



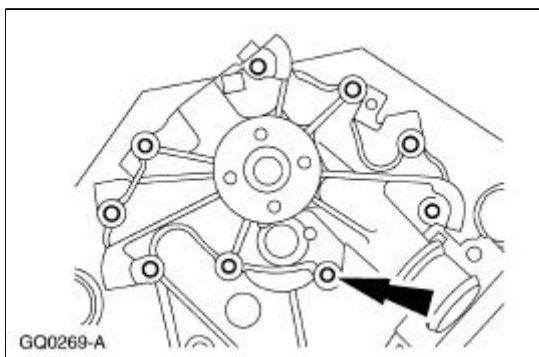
6. Disconnect the lower radiator hose from the coolant pump.



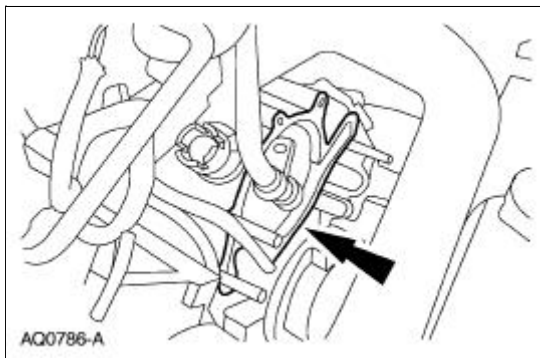
7. Position aside the coolant heater outlet tube assembly.
 - Remove the bolt.



8. Remove the coolant pump.
 - Remove the stud.
 - Remove the four bolts.
 - Remove the four nuts.

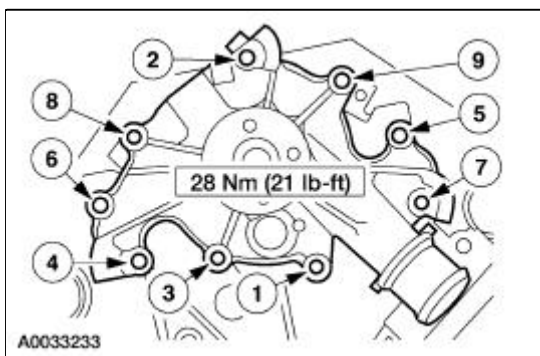


9. Clean and inspect the gasket sealing surfaces.



10. To install, reverse the removal procedure.

- Install a new gasket.
- Tighten the coolant pump stud, bolts and nuts in the sequence shown.



11. Fill and bleed the cooling system. For additional information, refer to [Cooling System Draining, Filling and Bleeding](#) in this section.

Water Pump —4.6L(2V) and 4.6L(4V)

Material

Item	Specification
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) (yellow color)	WSS-M97B51-A1

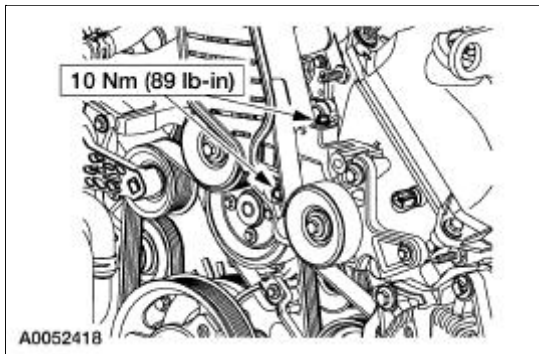
Removal and Installation

Mach I

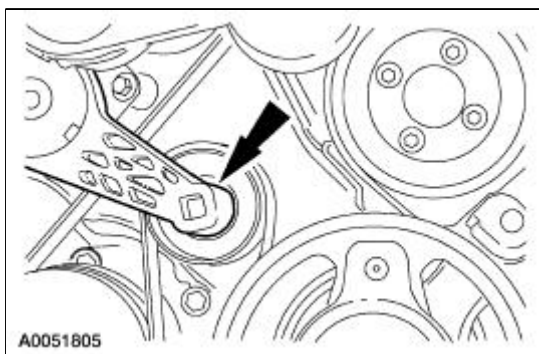
1. Remove the air intake scoop. For additional information, refer to [Section 303-12](#).

Cobra

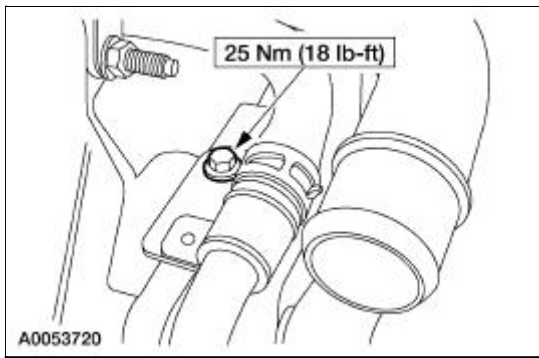
2. Remove the supercharger drive belt cover.



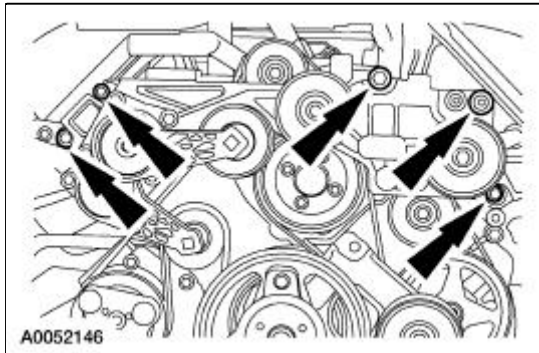
3. Rotate the supercharger belt tensioner clockwise and remove the supercharger drive belt.



4. Remove the coolant hose mounting bolt.

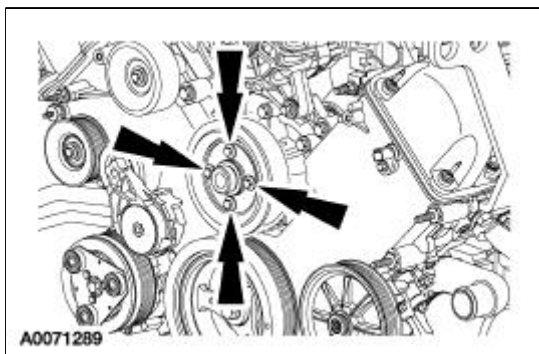


5. Remove the belt idler bracket support assembly.

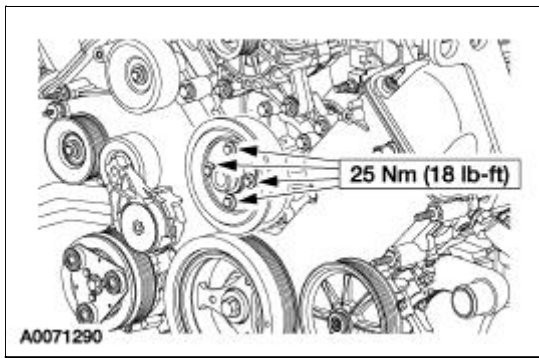


All vehicles

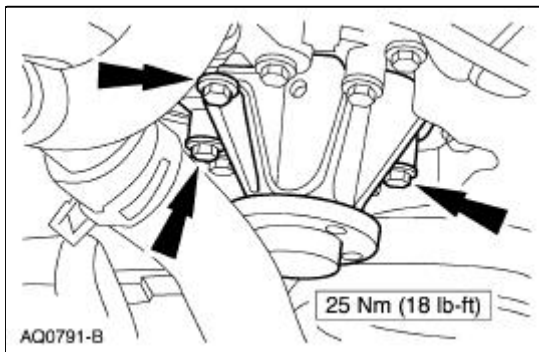
6. Drain the engine coolant. For additional information, refer to [Cooling System Draining, Filling and Bleeding](#) in this section.
7. Loosen the coolant pump pulley bolts.




8. Remove the accessory drive belt. For additional information, refer to [Section 303-05](#).
9. Remove the bolts and the coolant pump pulley.



10. Remove the four bolts and the coolant pump.



11. If necessary, wipe the coolant pump mounting surface with a soft cloth.
12.  **CAUTION: Do not rotate the coolant pump housing once installed in the engine. Damage to the O-ring seal can occur, causing the coolant pump to leak.**

NOTE: Install a new O-ring seal and lubricate with the same clean engine coolant that is present in the system. Do not mix coolant types.

To install, reverse the removal procedure.

Radiator

Material

Item	Specification
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) (yellow color)	WSS-M97B51-A1

Removal and Installation

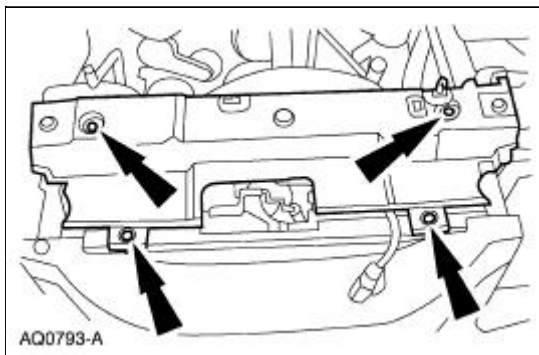
NOTE: Radiator removal and installation is similar for both 3.8L and 4.6L vehicles. The art shown in the procedure is the 4.6L engine.

Mach I

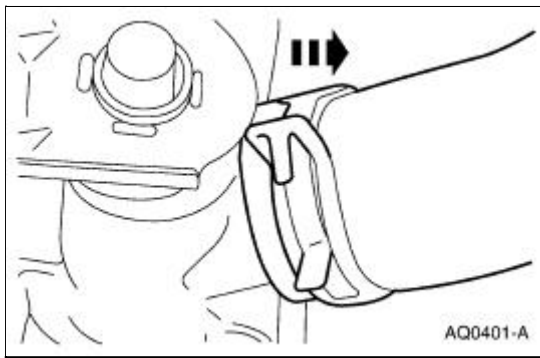
1. Remove the air intake scoop. For additional information, refer to [Section 303-12](#).

All vehicles

2. Drain the engine cooling system. For additional information, refer to [Cooling System Draining, Filling and Bleeding](#) in this section.
3. Remove the radiator sight shield.
 - Release the clips.

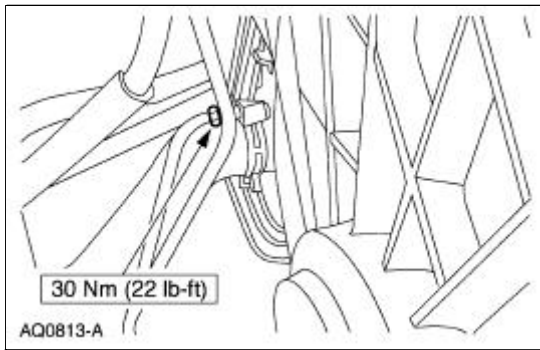


4. Remove the fan blade, fan motor and fan shroud assembly. For additional information, refer to [Cooling Fan Motor and Shroud](#) in this section.
5. Remove the upper radiator hose from the radiator.



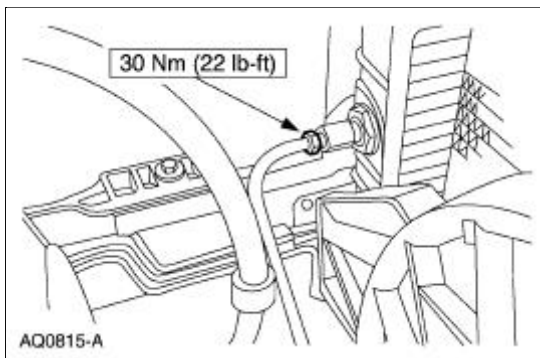
6. **NOTE:** To avoid disturbing the transmission oil cooler fittings, use a backup wrench.

If equipped, remove the transmission lower cooler tube fitting.

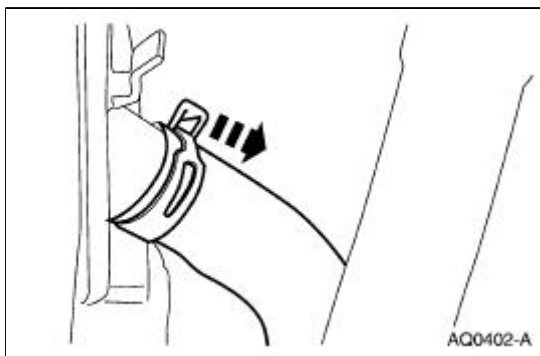


7. **NOTE:** To avoid disturbing the transmission oil cooler fittings, use a backup wrench.

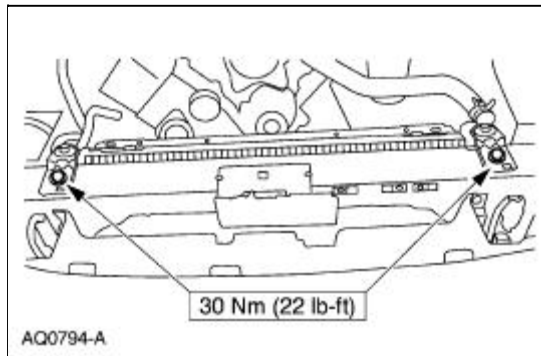
If equipped, remove the upper transmission cooler tube fitting.



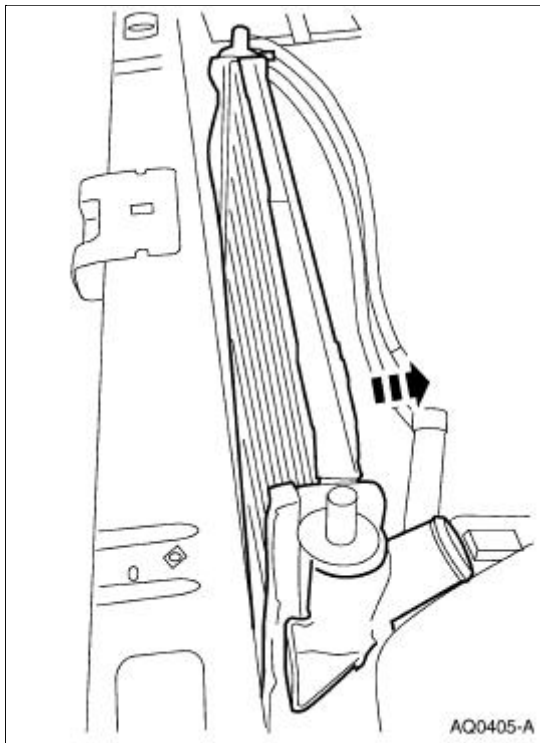
8. Remove the lower radiator hose from the radiator.



9. Remove the radiator supports.



10. Remove the radiator.



11. To install, reverse the removal procedure.
12. Fill and bleed the cooling system. For additional information, refer to [Cooling System Draining, Filling and Bleeding](#) in this section.

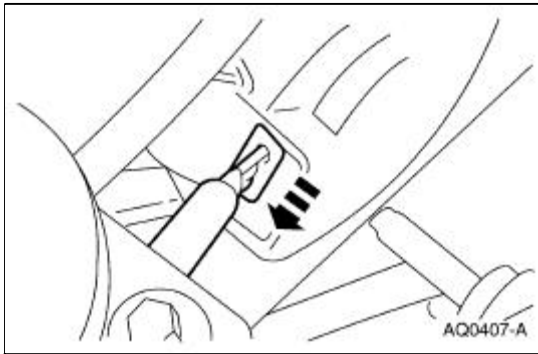
Mach I

13. Install the air intake scoop. For additional information, refer to [Section 303-12](#).
-

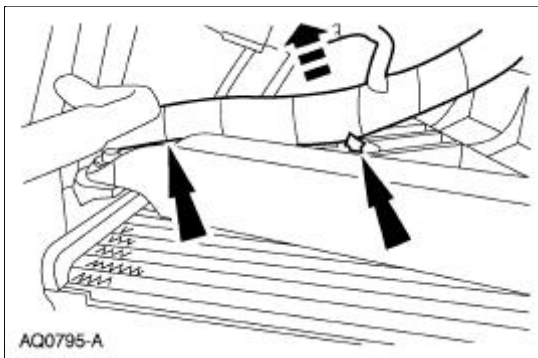
Cooling Fan Motor and Shroud

Removal and Installation

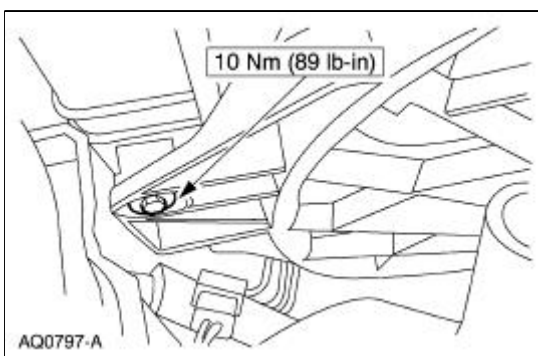
1. Disconnect the battery ground cable.
2. Remove the degas bottle or coolant expansion tank. For additional information, refer to [Degas Bottle—4.6L\(2V\) and 4.6L\(4V\)](#) in this section.
3. Disconnect the cooling fan electrical connector.



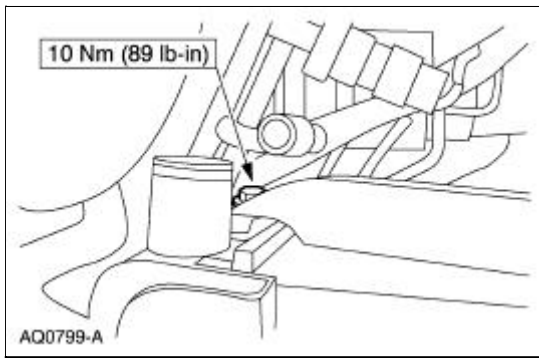
4. Separate the fan harness from the shroud.



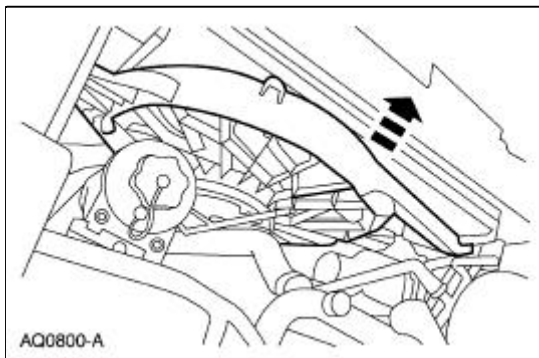
5. Remove the LH bolt.



6. Remove the RH bolt.



7. Remove the fan, motor and shroud.

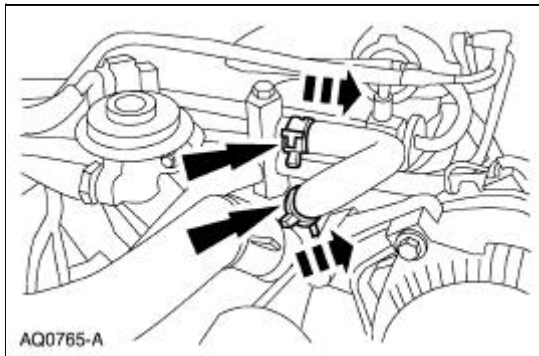


8. To install, reverse the removal procedure.
-

Water Bypass Hose —3.8L

Removal and Installation

1. Drain the engine coolant. For additional information, refer to [Cooling System Draining, Filling and Bleeding](#) in this section.
2. Remove the bypass hose.

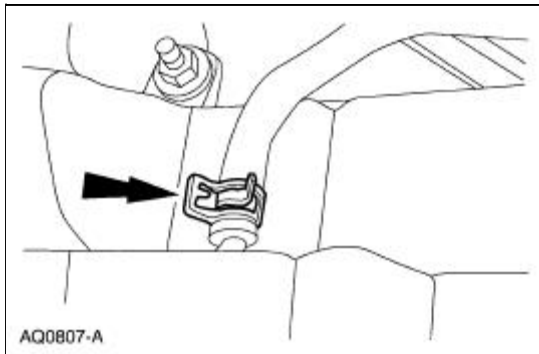


3. To install, reverse the removal procedure.
 4. Fill and bleed the cooling system. For additional information, refer to [Cooling System Draining, Filling and Bleeding](#) in this section.
-

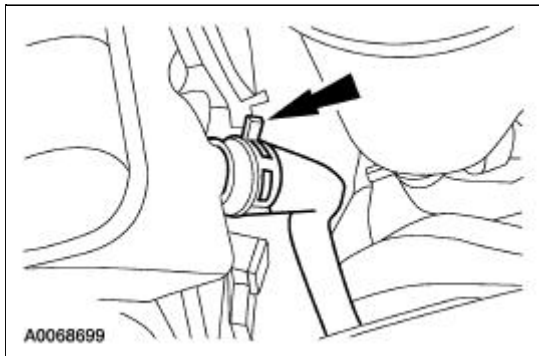
Degas Bottle —4.6L(2V) and 4.6L(4V)

Removal and Installation

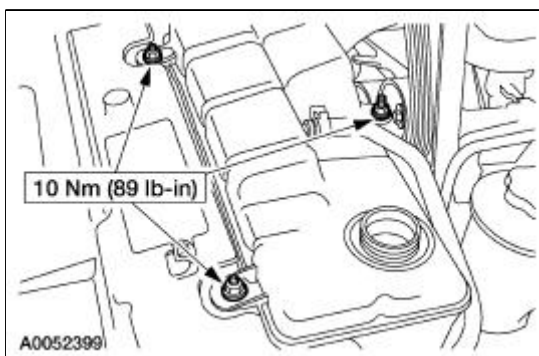
1. Drain the engine coolant from the degas bottle only. For additional information, refer to [Cooling System Draining, Filling and Bleeding](#) in this section.
2. Disconnect the radiator vent hose.



3. Remove the degas bottle return hose.



4. Remove the nuts and the degas bottle.



5. To install, reverse the removal procedure.
6. Fill and bleed the cooling system. For additional information, refer to [Cooling System Draining, Filling and Bleeding](#) in this section.



General Specifications

Item	Specification
Cooling System Capacity	
System capacity L (qts)	3.75 (4.0)
Coolant Type	
Motorcraft Premium Engine Coolant VC-4-A (CXC-10 in Canada, VC-5 in Oregon) ^a	ESE-M97B44-A
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) ^a ^b	WSS-M97B51-A1
Other Chemicals	
Premium Cooling System Flush VC-1	ESR-M14P7-A
Premium Long Life Grease XG-1-C	ESA-M1C75-B
Cooling System Stop Leak Pellets VC-6	ESE-M99B37-5 except as noted in ES-F65E-19A511-AA
Cooling System Pressure Test Specifications	
System (radiator) kPa (psi)	138 (20)
System (intercooler) kPa (psi)	138 (20)
Cap (relief opening pressure) kPa (psi)	69 (10)

^a Use the same type coolant that was drained from the cooling system. Do not mix coolant types.

^b The addition of Motorcraft Cooling System Stop Leak Pellets, VC-6, darkens Motorcraft Premium Gold Engine Coolant from yellow to golden tan.

Torque Specifications

Description	Nm	lb-ft	lb-in
Water pump bolts	20	—	15
Dropping resistor screw	6	53	—
Degas bottle bolt	10	89	—
Intercooler radiator support bracket-to-bumper bolts	12	—	9
Intercooler radiator support bracket bolts	10	89	—

Supercharger Cooling



CAUTION: Some vehicle cooling systems are filled with Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10) or equivalent meeting Ford specification ESE-M97B44-A (green color). Others are filled with Motorcraft Premium Gold Engine Coolant VC-7-A or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Always fill the cooling system with the same coolant that is present in the system. Do not mix coolant types.

NOTE: The addition of Motorcraft Cooling System Stop Leak Pellets, VC-6, darkens Motorcraft Premium Gold Engine Coolant from yellow to golden tan.

NOTE: The air that is produced from the supercharger is cooled by the intercooler.

Walter C. Avrea, the owner of patents 3,601,181 and RE 27,965, has granted Ford Motor Company rights with respect to cooling systems covered by these patents.

The cooling system components include the:

- intercooler
- intercooler radiator (8K226)
- pressure relief cap
- degas bottle
- electric water pump (8501)

The degas bottle:

- provides a location for system fill.
- contains coolant expansion and system pressurization.
- provides air separation during operation.
- replenishes the intercooler coolant to the system.

The intercooler coolant flows:

- from the intercooler to the degas bottle.
- from the degas bottle to the water pump.
- from the water pump to the intercooler radiator.
- from the intercooler radiator to the intercooler.

Engine coolant provides freeze protection, boil protection, cooling efficiency and corrosion protection to the engine and cooling components. In order to obtain these protections, the engine coolant must be maintained at the correct concentration and fluid level in the degas bottle.

When adding engine coolant, use a 50/50 mixture of engine coolant and clean, drinkable water.


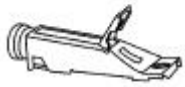
To maintain the integrity of the coolant and the cooling system:

NOTE: The addition of Motorcraft Cooling System Stop Leak Pellets, VC-6, darkens Motorcraft Premium Gold Engine Coolant from yellow to golden tan.

- Add Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10) or equivalent meeting Ford specification ESE-M97B44-A (green color), or Motorcraft Premium Gold Engine Coolant VC-7-A or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Use the same coolant that was drained from the cooling system. Do not mix coolant types.
 - Do not add/mix orange-colored Motorcraft Speciality Orange Engine Coolant VC-2 or equivalent meeting Ford specification WSS-M97B44-D. Mixing coolants may degrade the coolant's corrosion protection.
 - Do not add alcohol, methanol, brine, or any engine coolants mixed with alcohol or methanol antifreeze. These can cause engine damage from overheating or freezing.
 - Do not mix with recycled coolant unless it meets the requirements of Ford specification ESE-M97B44-A or WSS-M97B51-A1. Not all coolant recycling processes meet these Ford specifications. Use of such coolants can harm the engine and cooling system components.
-

Supercharger Cooling


Special Tool(s)


 <p>ST1474-A</p>	<p>Pressure Test Kit 014-R1072 or equivalent</p>
 <p>ST1720-A</p>	<p>Battery/Antifreeze Tester 014-R1060 or equivalent</p>

Material

Item	Specification
<p>Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10)</p>	<p>ESE-M97B44-A</p>
<p>Motorcraft Premium Gold Engine Coolant VC-7-A</p>	<p>WSS-M97B51-A1</p>
<p>Motorcraft Cooling System Stop Leak Pellets VC-6 or equivalent</p>	<p>ESE-M99B37-5 except as noted in ES-F65E-19A511-AA</p>

Inspection and Verification

 **WARNING:** Never remove the pressure relief cap while the engine is operating or when the cooling system is hot. Failure to follow these instructions can result in damage to the cooling system or engine or personal injury. To avoid having scalding hot coolant or steam blow out of the degas bottle when removing the pressure relief cap, wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released, (still with a cloth) turn and remove the pressure relief cap.

 **CAUTION:** Check the coolant and engine oil levels. Top off the coolant level if needed. If there is engine coolant in the engine oil, the cause must be corrected and the oil changed or major component damage can occur.



CAUTION: Some vehicle cooling systems are filled with Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10) or equivalent meeting Ford specification ESE-M97B44-A (green color). Others are filled with Motorcraft Premium Gold Engine Coolant VC-7-A or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Always fill the cooling system with the same coolant that is present in the system. Do not mix coolant types.


NOTE: The addition of Motorcraft Cooling System Stop Leak Pellets, VC-6, darkens Motorcraft Premium Gold Engine Coolant from yellow to golden tan.

1. Verify the customer's concern by operating the engine to duplicate the condition.
2. Inspect to determine if any of the following mechanical or electrical concerns apply.


Visual Inspection Chart


Mechanical	Electrical
<ul style="list-style-type: none"> ● Radiator brackets ● Leaks ● Damaged hoses ● Hose clamps ● Water pump ● Radiator ● Degas bottle ● Water pump bracket 	<ul style="list-style-type: none"> ● Damaged water pump wiring

3. If the inspection reveals an obvious concern that can be readily identified, repair it as necessary.
4. Inspect the coolant condition.

1.  **WARNING:** Never remove the pressure relief cap while the engine is operating or when the cooling system is hot. Failure to follow these instructions can result in damage to the cooling system or engine or personal injury. To avoid having scalding hot coolant or steam blow out of the degas bottle when removing the pressure relief cap, wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released, (still with a cloth) turn and remove the pressure relief cap.

Allow the engine to cool. Once pressure is released, remove the pressure relief cap.

2.  **CAUTION:** Check the coolant and engine oil level and top off the coolant if needed. If there is engine coolant in the engine oil the cause must be corrected and oil/fluid changed or major component damage can occur.

 **CAUTION:** Some vehicle cooling systems are filled with Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10) or equivalent meeting Ford specification ESE-M97B44-A (green color). Others are filled with Motorcraft Premium Gold Engine Coolant VC-7-A or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Always fill the cooling system with the same coolant that is present in the system. Do not mix coolant types.

Inspect the coolant color:

- If Motorcraft Premium Engine Coolant (green color) VC-4-A or equivalent meeting Ford specification ESE-M97B44-A has a clear, light green or blue color, this

indicates higher water content than required.

- **NOTE:** The addition of Motorcraft Cooling System Stop Leak Pellets, VC-6, darkens Motorcraft Premium Gold Engine Coolant from yellow to golden tan.

If Motorcraft Premium Gold Engine Coolant (yellow color) VC-7-A or equivalent meeting Ford specification WSS-M97B51-A1 has a clear or pale yellow color, this indicates higher water content than required.

- Dark brown can indicate unauthorized stop leak may have been used. Use Motorcraft Cooling System Stop Leak Pellets VC-6 or equivalent meeting Ford specification ESE-M99B37-5 except as noted in ES-F65E-19A511-AA only.
 - A light or reddish brown color indicates that rust may be present in the cooling system. Flush the system and refill with the correct mixture of water and engine coolant.
 - An iridescent sheen on top of the coolant or a milky brown color can indicate a trace of oil is entering the system. For additional information on engine diagnosis, refer to [Section 303-00](#).
3. If the engine coolant appearance is acceptable, test the engine coolant freezing point range with the special tool. The freezing point should be in the range -50°F to -10°F. If the vehicle is driven in cold climates less than -34°F, it may be necessary to increase the coolant concentration to get adequate freeze protection.
 - Maximum coolant concentration is 60/40.
 - Minimum coolant concentration is 40/60.
 4. Check the coolant system conditions:
 - If the intercooler fluid is low, add the specified coolant mixture only.
 - If the intercooler coolant fluid tests weak, add straight engine coolant until the readings are within acceptable levels.
 - If the engine coolant tests strong, remove some of the engine coolant and add water until readings are within acceptable levels.
 5. If the concern remains after the inspection, determine the symptom(s). GO to [Symptom Chart](#).
 6. Verify the cooling system is correctly filled and bled. Refer to [Supercharger Cooling System Draining, Filling and Bleeding](#) in this section.




Symptom Chart

SYMPTOM CHART


Condition	Possible Sources	Action
<ul style="list-style-type: none">● Loss of intercooler coolant	<ul style="list-style-type: none">● Intercooler.● Intercooler radiator.● Water pump.● Coolant hoses.● Degas bottle.	<ul style="list-style-type: none">● Go To Pinpoint Test A.

Pinpoint Tests

PINPOINT TEST A: LOSS OF COOLANT

Test Step	Result / Action to Take
<p>A1 CHECK THE INTERCOOLER COOLANT LEVEL</p> <p> WARNING: Never remove the pressure relief cap under any conditions while the engine is operating. Failure to follow these instructions could result in damage to the cooling system or engine and/or personal injury. To avoid having scalding hot coolant or steam blow out of the cooling system, use extreme care when removing the pressure relief cap from a hot degas bottle. Wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly one turn (counterclockwise). Step back while the pressure is released from the cooling system. When certain all the pressure has been released, remove the pressure relief cap (still with a cloth). NOTE: Allow the engine to cool before checking the engine coolant level. The engine must be off to check the coolant.</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Visually check the intercooler coolant level at the degas bottle. ● Is the coolant level within specification? 	<p>Yes GO to A2.</p> <p>No REFILL the coolant as necessary. GO to A2.</p>
<p>A2 CHECK THE DEGAS BOTTLE PRESSURE RELIEF CAP</p> <p> WARNING: Never remove the pressure relief cap under any conditions while the engine is operating. Failure to follow these instructions could result in damage to the cooling system or engine and/or personal injury. To avoid having scalding hot coolant or steam blow out of the cooling system, use extreme care when removing the pressure relief cap from a hot degas bottle. Wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly one turn (counterclockwise). Step back while the pressure is released from the cooling system. When certain all the pressure has been released, remove the pressure relief cap (still with a cloth).</p> <ul style="list-style-type: none"> ● Remove the pressure relief cap. ● Inspect the pressure relief cap for foreign material between the sealing gasket and the diaphragm. ● Is the pressure relief cap OK? 	<p>Yes GO to A3.</p> <p>No CLEAN or INSTALL a new pressure relief cap. TEST the system for normal operation.</p>
<p>A3 CHECK THE DEGAS BOTTLE</p> <p> WARNING: Never remove the pressure relief cap under any conditions while the engine is operating. Failure to follow these instructions could result in damage to the cooling system or engine and/or personal injury. To avoid having scalding hot coolant or steam blow out of the cooling system, use extreme care when removing the pressure relief cap from a hot degas bottle. Wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly one turn (counterclockwise). Step back while the pressure is released from the cooling system. When certain all the pressure has been released, remove the pressure relief cap (still with a cloth).</p> <ul style="list-style-type: none"> ● NOTE: The engine must be cool when coolant is added to the degas bottle. ● Add coolant to the degas bottle until fluid is between the coolant fill level marks. ● Does the degas bottle leak? 	<p>Yes INSTALL a new degas bottle. TEST the system for normal operation.</p> <p>No CARRY OUT the cooling system pressure test. REFER to the Component Tests in this section. REPAIR as necessary. TEST the system for normal operation.</p>


Pressure Test

1. Turn the engine OFF.
2.  **WARNING:** Never remove the pressure relief cap under any conditions while the engine is operating. Failure to follow these instructions could result in damage to the cooling system or engine and/or personal injury. To avoid having scalding hot coolant or steam blow out of the cooling system, never remove the pressure relief cap from a hot degas bottle. Wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly one turn (counterclockwise). Step back while the pressure is released from the cooling system. When certain all the pressure has been released, remove the pressure relief cap (still with a cloth).

Check the intercooler coolant level. For additional information, refer to [Supercharger Cooling System Draining, Filling and Bleeding](#) in this section.

3. Connect the Radiator/Heater Core Pressure Tester to the degas bottle nipple. Install a pressure test pump to the quick-connect fitting of the test adapter.
4. **NOTE:** If the plunger of the pump is depressed too fast, an erroneous pressure reading will result.

Slowly depress the plunger of the pressure test pump until the pressure gauge reading stops increasing and note the highest pressure reading obtained.

5. If the pressure relief cap does not hold pressure, remove and wash the pressure relief cap in clean water to dislodge all foreign particles from the gaskets. Check the sealing surface in the filler neck.
6. If 69 kPa (10 psi) cannot be reached, install a new pressure relief cap. If more than 12 kPa (18 psi) shows on the gauge, install a new pressure relief cap.
7.  **CAUTION:** If the pressure drops, check for leaks at the intercooler hoses or other system components and connections. Any leaks which are found must be corrected and the system rechecked.

NOTE: Intercooler system is not connected to the main engine cooling system.

Pressurize the intercooler cooling system as described in Step 4 (using a pressure relief cap that operates within the specified upper and lower pressure limits). Observe the gauge reading for approximately two minutes; refer to General Specifications. Pressure should not drop during this time.

- If the pressure drops and no external leak is found, the intercooler may be the cause. Remove and inspect the intercooler. Install a new intercooler if necessary.

8. Release the system pressure by loosening the pressure relief cap. Check the coolant level and replenish, if necessary, with the correct coolant mixture. For additional information, refer to [Supercharger Cooling System Draining, Filling and Bleeding](#) in this section.

Cap



WARNING: Never remove the pressure relief cap under any conditions while the engine is

operating. Failure to follow these instructions could result in damage to the cooling system or engine and/or personal injury. To avoid having scalding hot coolant or steam blow out of the cooling system, use extreme care when removing the pressure relief cap from a hot degas bottle. Wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly one turn (counterclockwise). Step back while the pressure is released from the cooling system. When certain all the pressure has been released, remove pressure relief cap (still with a cloth).

1. Immerse the pressure relief cap in water and install it on the shallow filler neck of Radiator/Heater Core Pressure Tester and Radiator Cap Adapter, part of Radiator/Heater Core Pressure Tester.
2. Immerse the filler neck seal in water and install it in the filler neck adapter.
3. Install the filler neck adapter with the filler neck seal to the Radiator Cap Adapter.
4. Connect the female quick-connect fitting of the pressure test pump to the male quick-connect fitting of the filler neck adapter.
5. **NOTE:** If the plunger of the pump is depressed too fast, an erroneous pressure reading will result.

Slowly depress the plunger of the pressure test pump until the pressure gauge reading stops increasing and note the highest pressure reading obtained.

6. Release the pressure by turning the relief screw counterclockwise. Then tighten the pressure relief screw and repeat Step 6 (at least twice) to make sure the reading is repeatable within the specifications of the pressure relief cap.
7. If the pressure test gauge readings are not within specifications, install a new pressure relief cap. If the pressure test gauge readings are within specifications, carry out the cooling system pressure test.

Radiator Leak Test, Removed From the Vehicle



CAUTION: Never leak test an aluminum radiator or intercooler in the same water that copper/brass radiators are tested in. Flux and caustic cleaners may be present in the cleaning tank and they will damage aluminum radiators and intercoolers.

NOTE: Clean the radiator or intercooler before leak testing to avoid contamination of tank.

1. Leak test the radiator or intercooler in clean water with 138 kPa (20 psi) air pressure.
-

Supercharger Cooling System Draining, Filling and Bleeding

Draining



WARNING: Never remove the pressure relief cap while the engine is operating or when the cooling system is hot. Failure to follow these instructions can result in damage to the cooling system or engine or personal injury. To avoid having scalding hot coolant or steam blow out of the degas bottle when removing the pressure relief cap, wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly. Step back while the pressure is released from the cooling system. When certain all the pressure has been released, (still with a cloth) turn and remove the pressure relief cap.



CAUTION: The coolant must be recovered in a suitable, clean container for reuse. If the coolant is contaminated, it must be recycled or disposed of correctly and replaced.



CAUTION: Some vehicle cooling systems are filled with Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10) or equivalent meeting Ford specification ESE-M97B44-A (green color). Others are filled with Motorcraft Premium Gold Engine Coolant VC-7-A or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Always fill the cooling system with the same coolant that is present in the system. Do not mix coolant types.

NOTE: The addition of Motorcraft Cooling System Stop Leak Pellets, VC-6, darkens Motorcraft Premium Gold Engine Coolant from yellow to golden tan.

NOTE: Less than 80% of coolant capacity can be recovered with the engine in the vehicle. Dirty, rusty or contaminated coolant requires replacement.

1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Remove the lower hose from the intercooler radiator and allow the coolant to drain.

Filling and Bleeding



CAUTION: Engine coolant provides freeze protection, boil protection, cooling efficiency and corrosion protection to the engine and cooling components. In order to obtain these protections, the engine coolant must be maintained at the correct concentration and fluid level in the degas bottle.




CAUTION: Some vehicle cooling systems are filled with Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10) or equivalent meeting Ford specification ESE-M97B44-A (green color). Others are filled with Motorcraft Premium Gold Engine Coolant VC-7-A or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Always fill the cooling system with the same coolant that is present in the system. Do not mix coolant types.

NOTE: The addition of Motorcraft Cooling System Stop Leak Pellets, VC-6, darkens Motorcraft Premium Gold Engine Coolant from yellow to golden tan.

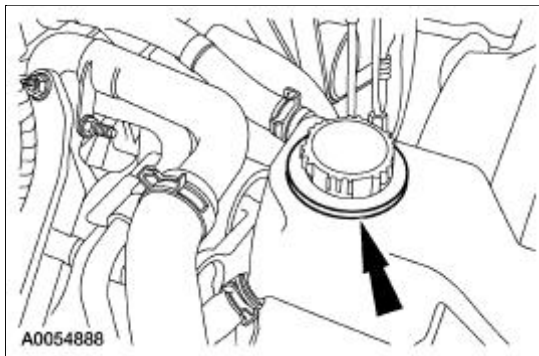
NOTE: When adding engine coolant, use a 50/50 mixture of engine coolant and clean, drinkable water.

1. To maintain the integrity of the coolant and the cooling system:
 1. Add Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10) or equivalent meeting Ford specification ESE-M97B44-A (green color), or Motorcraft Premium Gold Engine Coolant VC-7-A or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Use the same coolant that was drained from the cooling system. Do not mix coolant types.
 2. Do not add/mix orange-colored Motorcraft Speciality Orange Engine Coolant VC-2 or equivalent meeting Ford specification WSS-M97B44-D. Mixing coolants may degrade the coolant's corrosion protection.
 3. Do not add alcohol, methanol, brine, or any engine coolants mixed with alcohol or methanol antifreeze. These can cause engine damage from overheating or freezing.
 4. Do not mix with recycled coolant unless it meets the requirements of Ford specification ESE-M97B44-A or WSS-M97B51-A1. Not all coolant recycling processes meet these Ford specifications. Use of such coolants can harm the engine and cooling system components.
 2. Fill the degas bottle. Use Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10) or equivalent meeting Ford specification ESE-M97B44-A (green color), or Motorcraft Premium Gold Engine Coolant VC-7-A or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Use the same coolant that was drained from the cooling system. Do not mix coolant types.
 3. Start the engine and allow to run until coolant circulation is observed in the intercooler degas bottle. Absence of circulation indicates air is trapped in the system.
 - Turn the engine off.
 4. Add coolant as needed. Use Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10) or equivalent meeting Ford specification ESE-M97B44-A (green color), or Motorcraft Premium Gold Engine Coolant VC-7-A or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Use the same coolant that was drained from the cooling system. Do not mix coolant types.
 5. Repeat the above procedure to make sure all entrapped air is released.
-

Supercharger Cooling System Flushing

1.  **WARNING:** Never remove the pressure relief cap while the engine is operating or when the cooling system is hot. Failure to follow these instructions can result in damage to the cooling system or engine or personal injury. To avoid having scalding hot coolant or steam blow out of the degas bottle when removing the pressure relief cap, wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released, (still with a cloth) turn and remove the pressure relief cap.

Once pressure is released, remove the pressure relief cap.



2. Drain the cooling system. For additional information, refer to [Supercharger Cooling System Draining, Filling and Bleeding](#) in this section.
3. **NOTE:** Refer to the cooling system flusher manufacturer's operating instructions for specific vehicle hook-up.

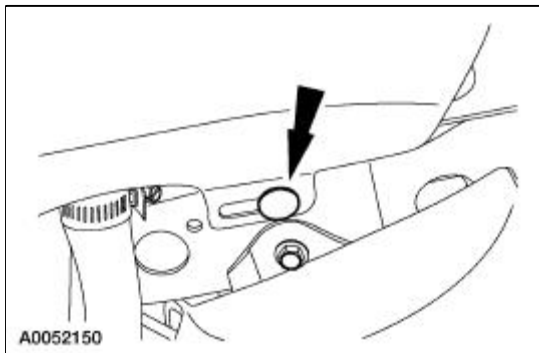
Using an appropriate cooling system flusher, flush the intercooler cooling system. Use Premium Cooling System Flush VC-1 meeting Ford specification ESR-M14P7-A.

4. Fill the cooling system. For additional information, refer to [Supercharger Cooling System Draining, Filling and Bleeding](#) in this section.

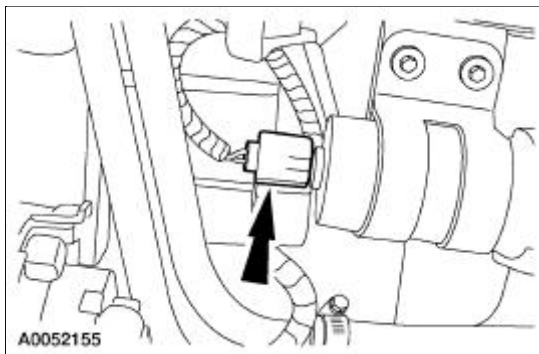
Water Pump

Removal and Installation

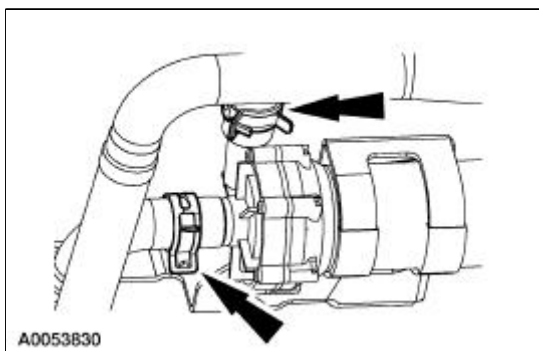
1. Disconnect the battery ground cable.
2. Drain the coolant. For additional information, refer to [Supercharger Cooling System Draining, Filling and Bleeding](#) in this section.
3. Remove the retainer and position the inner fender well aside.



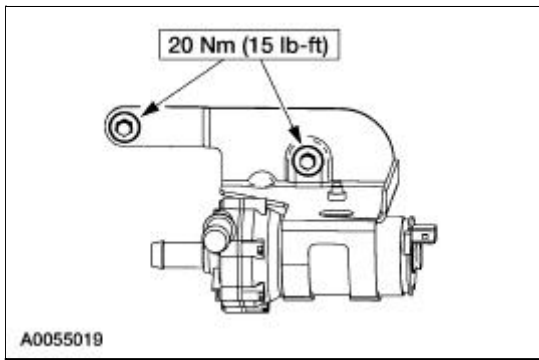
4. Disconnect the water pump electrical connector.



5. Disconnect the coolant hoses.



6. Remove the bolts and the water pump.



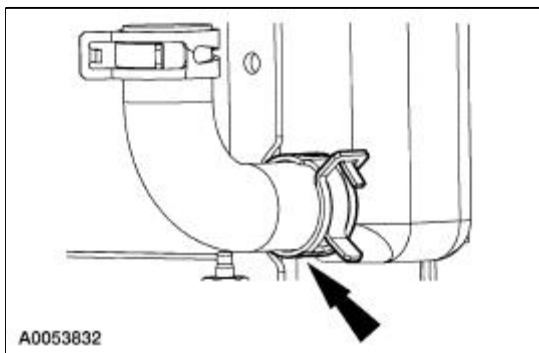
7. To install, reverse the removal procedure.
-

Radiator

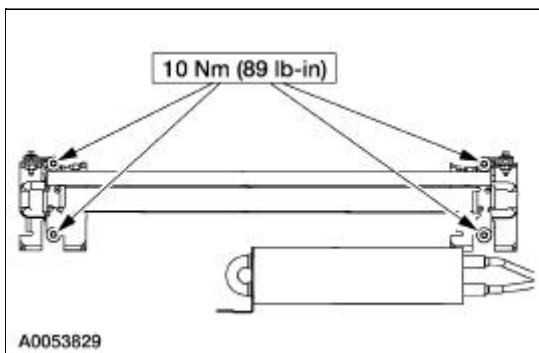
Removal and Installation

1. Drain the coolant. For additional information, refer to [Supercharger Cooling System Draining, Filling and Bleeding](#) in this section.
2. **NOTE:** RH is shown LH is similar.

Disconnect the two coolant hoses.



3. Remove the bolts and the radiator.

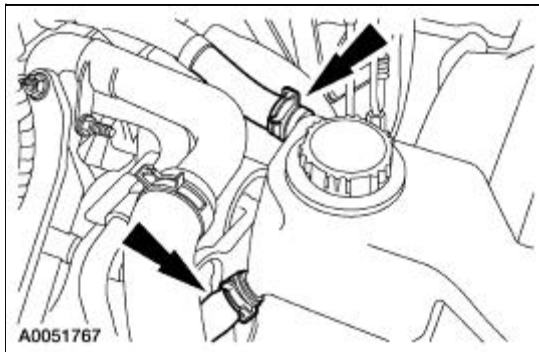


4. To install, reverse the removal procedure.

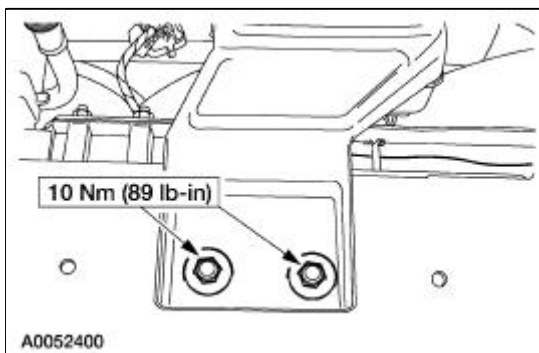
Degas Bottle

Removal and Installation

1. Drain the coolant. For additional information, refer to [Supercharger Cooling System Draining, Filling and Bleeding](#) in this section.
2. Disconnect the coolant hoses.



3. Remove the bolts and the degas bottle.



4. To install, reverse the removal procedure.
-

General Specifications

Item	Specification
Lubricants and Chemicals	
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP	WSS-M2C153-H

Torque Specifications

Description	Nm	lb-in
Throttle body nuts and bolts	9	80
Fuel injection supply manifold bolts	10	89
42-pin engine bulkhead electrical connector bolt	6	53

Fuel Charging And Controls

The fuel injection supply manifold (9F792):

- delivers fuel to the fuel injector.
- receives fuel from the fuel supply line.

The throttle body (9E926):

- controls air supply to the upper intake manifold (9424) by positioning the throttle plate.
- connects the accelerator cable (9A758) and, if equipped, the speed control actuator cable (9A825) to the throttle lever.
- is not adjustable.
- cannot be cleaned.

The fuel injector (9F593):

- is electrically operated by the powertrain control module (PCM) (12A650).
- has an internal solenoid that opens a needle valve to inject fuel into the lower intake manifold.
- atomizes the fuel as the fuel is delivered.
- is deposit-resistant. Do not clean.

The fuel pressure relief valve (9H321):

- is used to inspect and relieve fuel pressure.
-

Fuel Charging And Controls


Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Idle Speed Adjustment

Powertrain Control/Emissions Diagnosis (PC/ED) manual

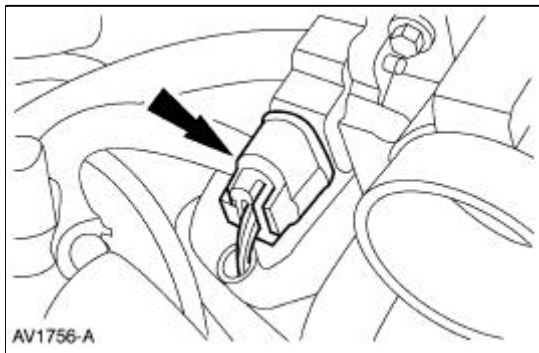
Throttle Body

Removal and Installation

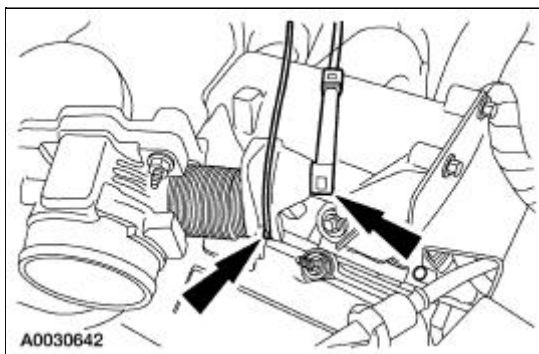
 **WARNING:** Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and may ignite. Failure to follow these instructions may result in personal injury.

 **CAUTION:** The throttle body bore and plate area have a special coating and cannot be cleaned.

1. Remove the air cleaner outlet tube (9B659). For additional information, refer to [Section 303-12](#).
2. Disconnect the throttle position (TP) sensor electrical connector.



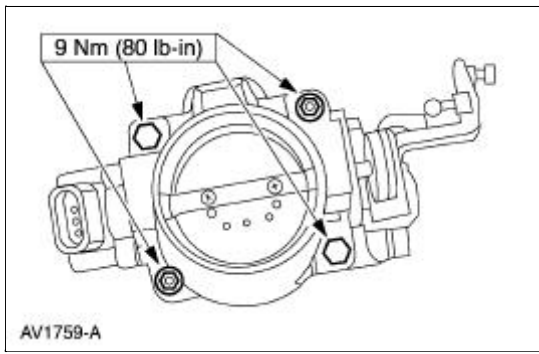
3. Disconnect the accelerator cable (9A758) and (if equipped) the speed control actuator cable (9A825).



4. **NOTE:** Discard the throttle body gasket after removing the throttle body.

Remove the throttle body.

- Remove the nuts.
- Remove the bolts.




5. To install, reverse the removal procedure.
-


Fuel Injectors

Material

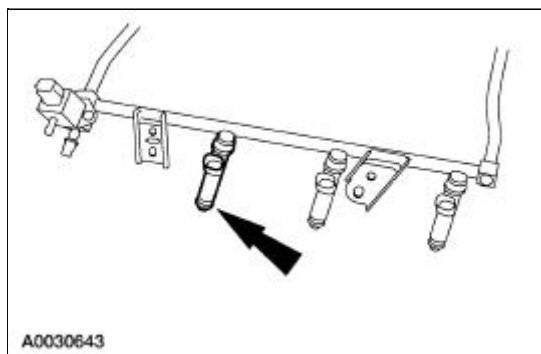
Item	Specification
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal and Installation

 **WARNING:** Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and may ignite. Failure to follow these instructions may result in personal injury.

 **WARNING:** Fuel in the fuel system remains under high pressure even when the engine is not running. Before working on or disconnecting any of the fuel lines or fuel system components, the fuel pressure must be relieved. Failure to follow these instructions may result in personal injury

1. Remove the supply manifold. For additional information, refer to [Supply Manifold](#) in this section.
2. Remove the six fuel injectors from the supply manifold.

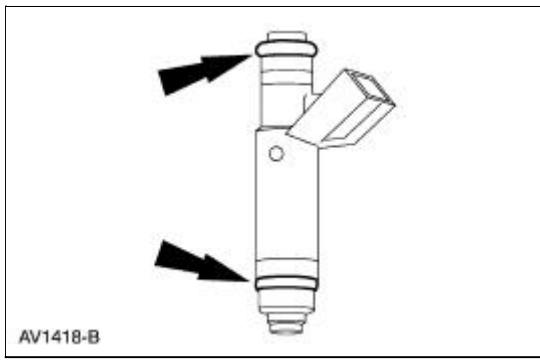


3.  **CAUTION:** The retaining clip must be in the upper groove on the injector or the injector may become loose.

NOTE: Inspect the two O-rings from each fuel injector. Install new O-rings as needed.


NOTE: Lubricate the new O-rings with clean engine oil to aid installation.

To install, reverse the removal procedure.

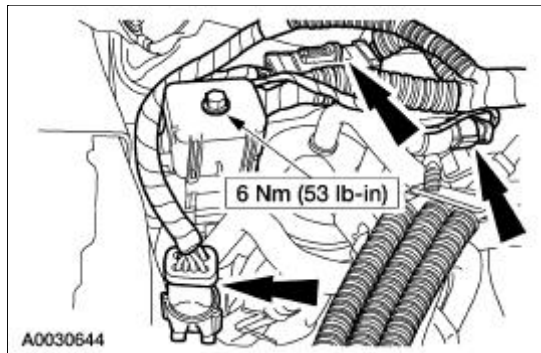


Fuel Charging Wiring Harness

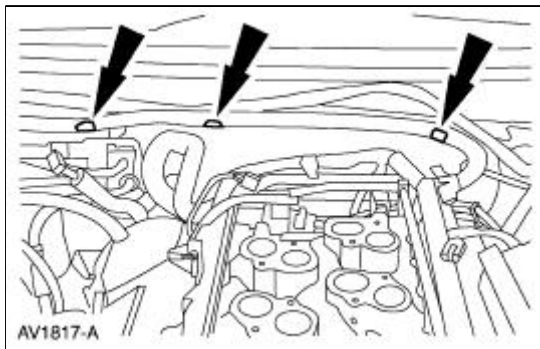
Removal and Installation

 **WARNING:** Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and may ignite. Failure to follow these instructions may result in personal injury.

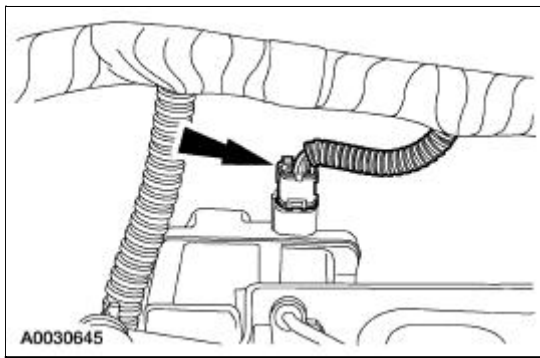
1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Remove the upper intake manifold. For additional information, refer to [Section 303-01A](#).
3. Disconnect the following electrical connectors.
 - 42-pin engine bulkhead connector
 - 16-pin connector
 - 8-pin connector
 - A/C pressure switch



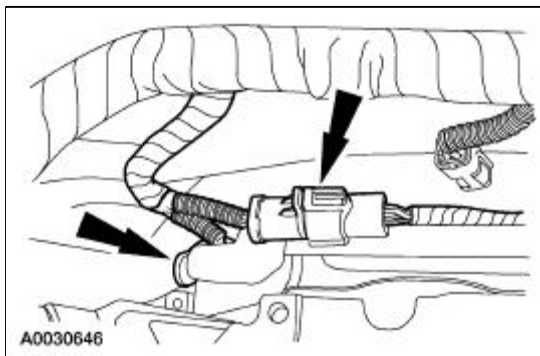
4. Separate the wiring harness from the dash panel.



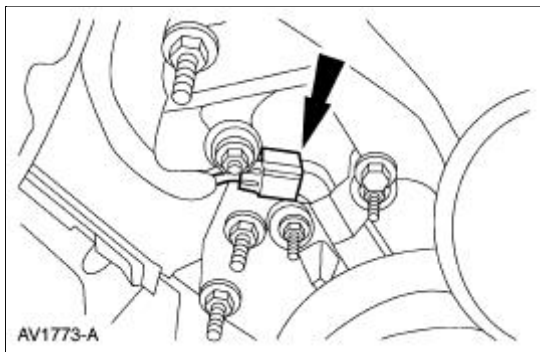
5. Disconnect the intake manifold runner control (IMRC) actuator electrical connector.



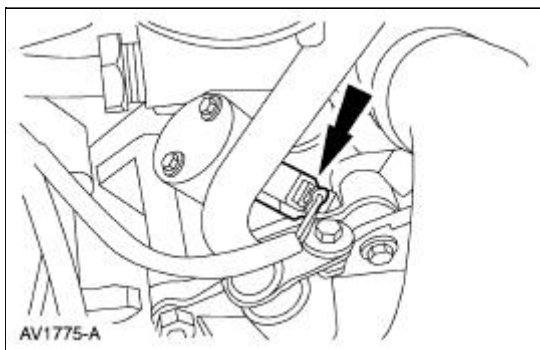
6. Disconnect the RH heated oxygen sensor (HO2S) electrical connector and the 16-pin electrical connector.



7. Disconnect the crankshaft position (CKP) sensor electrical connector.

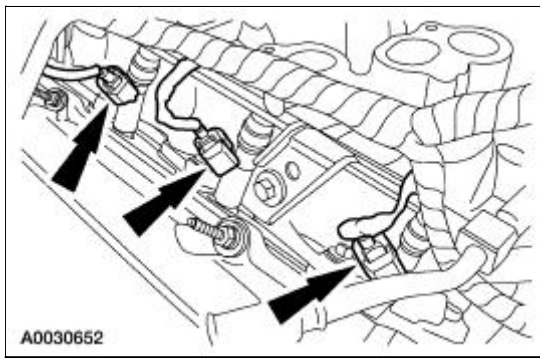


8. Disconnect the camshaft position (CMP) sensor electrical connector.

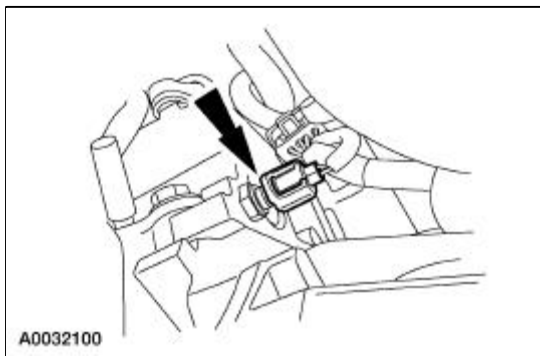


9. **NOTE:** Right side shown, left side similar.

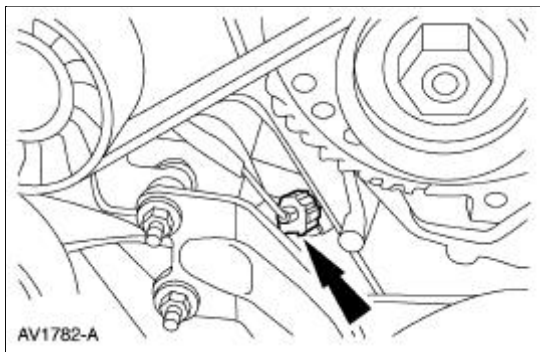
Disconnect the six fuel injector electrical connectors.



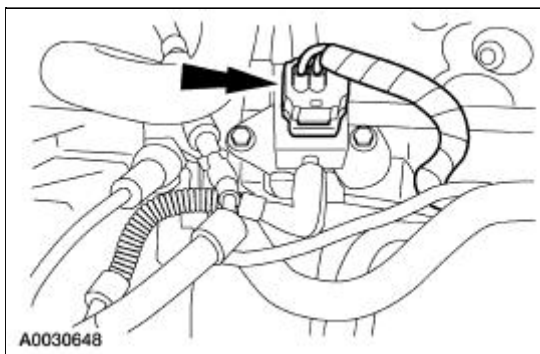
10. Disconnect the cylinder head temperature (CHT) sensor electrical connector on the back of the left cylinder head.



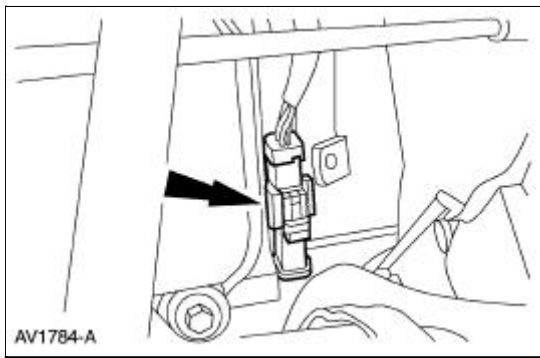
11. Disconnect the engine oil pressure sender electrical connector.



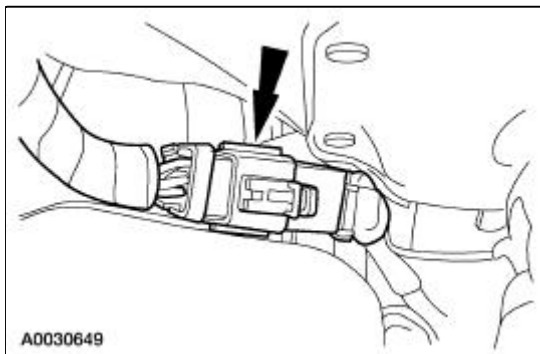
12. Disconnect the fuel pressure sensor electrical connector.



13. Disconnect the LH heated oxygen sensor (HO2S) electrical connector.




14. Disconnect the 16-pin electrical connector on the back of the left cylinder head.




15. Remove the wiring harness:
 - Separate the wiring harness from the fuel supply manifold.
 16. To install, reverse the removal procedure.
-

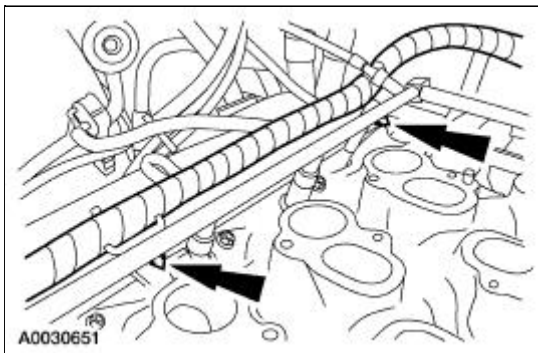
Supply Manifold

Removal and Installation

 **WARNING:** Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and may ignite. Failure to follow these instructions may result in personal injury.

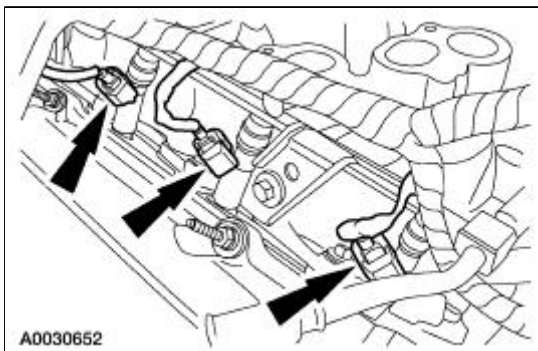
 **WARNING:** Fuel in the fuel system remains under high pressure even when the engine is not running. Before working on or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved. Failure to follow these instructions may result in personal injury.

1. Disconnect the battery ground cable.
2. Remove the upper intake manifold. For additional information, refer to [Section 303-01A](#).
3. Relieve the fuel pressure. For additional information, refer to [Section 310-00](#).
4. Disconnect the fuel line. For additional information, refer to [Section 310-00](#).
5. Separate the wiring harness from the supply manifold.



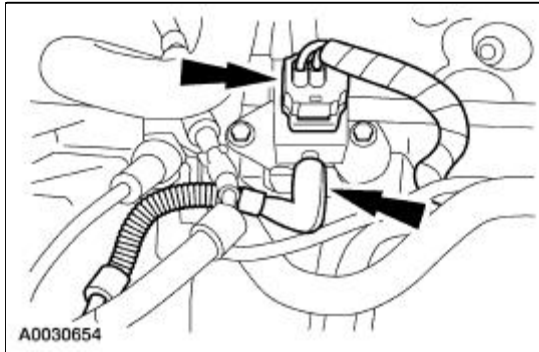
6. **NOTE:** Right side shown, left side similar.

Disconnect the six fuel injector electrical connectors.



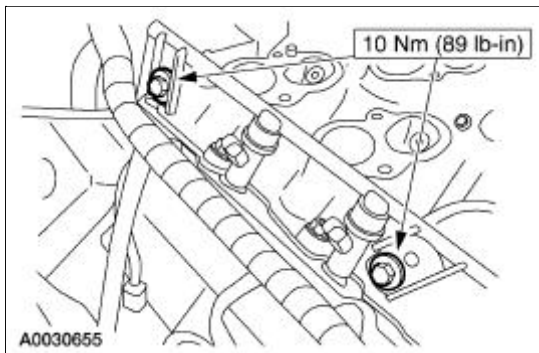
7. Disconnect the fuel pressure sensor.

- Disconnect the connector.
- Disconnect the vacuum hose.



8. **NOTE:** The right side is shown. The left side is similar.

Remove the four supply manifold bolts and remove the fuel supply manifold with the injectors.



9. **NOTE:** When the battery (10655) is disconnect and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

To install, reverse the removal procedure.

General Specifications

Item	Specification
Lubricants and Chemicals	
Super Premium SAE 10W-30, XO-10W30-DSP	WSS-M2C153-G

Torque Specifications

Description	Nm	lb-ft	lb-in
Throttle body bolts	10	—	89
Fuel injection supply manifold bolts	10	—	89
Fuel charging wiring 42 pin connector bolt	6	—	53
Battery supply wire nut	8	—	71
EGR pressure transducer bracket bolts	25	18	—
Generator battery supply nut	8	—	71

Fuel Charging And Controls

The fuel injection supply manifold (9F792):

- delivers fuel to the fuel injector.
- receives fuel from the fuel supply line.

The throttle body (9E926):

- controls air supply to the upper intake manifold (9424) by positioning the throttle plate.
- connects the accelerator cable (9A758) and the speed control actuator cable (9A825) (if equipped) to the throttle lever.
- is not adjustable.
- cannot be cleaned.

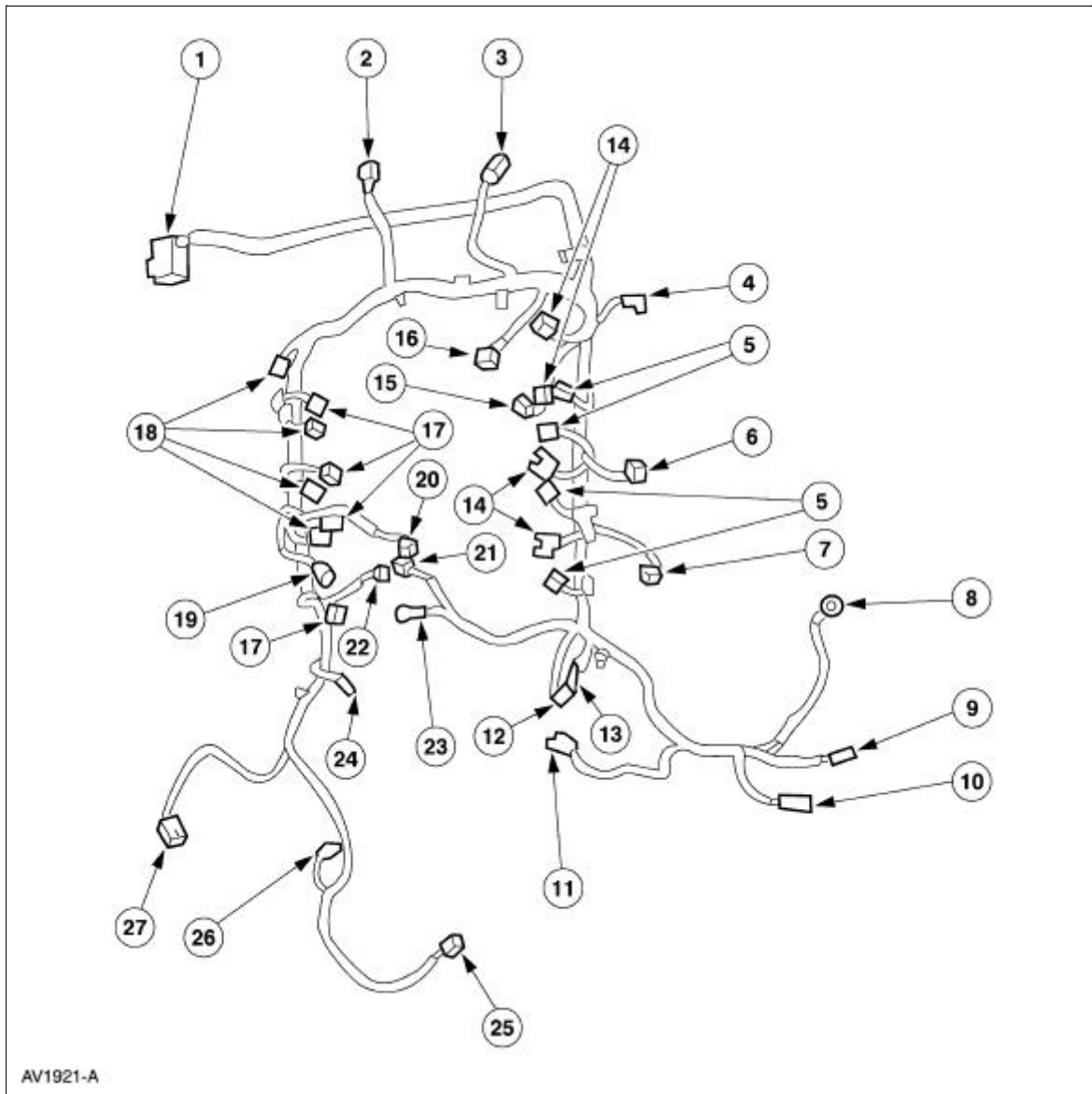
The fuel injector (9F593):

- is electrically operated by the powertrain control module (PCM) (12A650).
- has an internal solenoid that opens a needle valve to inject fuel into the lower intake manifold.
- atomizes the fuel as the fuel is delivered.
- is deposit-resistant. Do not clean.

The fuel pressure relief valve (9H321):

- is used to inspect and relieve fuel pressure.

Fuel Charging Wiring Connections



AV1921-A

Item	Part Number	Description
1	—	Engine control sensor wiring — 42 pin electrical connector
2	—	RH heated oxygen sensor (HO2S) electrical connector
3	—	LH heated oxygen sensor (HO2S) electrical connector
4	—	Ground wire electrical connector
5	—	LH ignition coil electrical connectors
6	—	Fuel pressure sensor electrical connector
7	—	Fuel temperature sensor electrical connector
8	—	Power distribution box battery feed electrical wire
9	—	2 pin electrical connector
10	—	4 pin electrical connector
11	—	Camshaft position sensor (CMP) electrical connector

12	—	Coolant reservoir bottle electrical connector
13	—	Radio ignition interference capacitor electrical connector
14	—	Fuel injector electrical connectors
15	—	Exhaust vacuum regulator (EVR) electrical connector
16	—	Differential pressure feedback EGR electrical connector
17	—	RH ignition coil electrical connectors
18	—	Ignition coil electrical connectors
19	—	Throttle position (TP) sensor electrical connector
20	—	Idle air control (IAC) solenoid electrical connector
21	—	Voltage regulator electrical connector
22	—	Engine coolant temperature (ECT) electrical connector
23	—	Generator battery electrical connector
24	—	Radio ignition interference capacitor electrical connector
25	—	Crankshaft position (CKP) sensor electrical connector
26	—	Air conditioning compressor clutch electrical connector
27	—	16 pin electrical connector

Fuel Charging And Controls


Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Idle Speed Adjustment

Powertrain Control/Emissions Diagnosis (PC/ED) manual

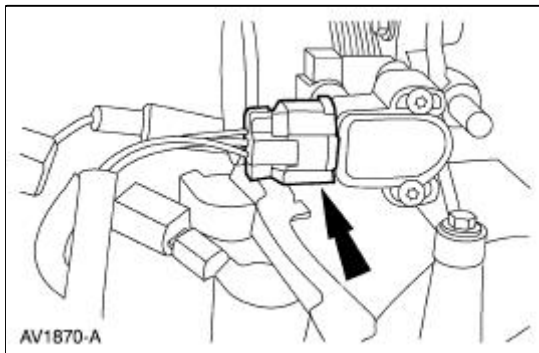
Throttle Body

Removal

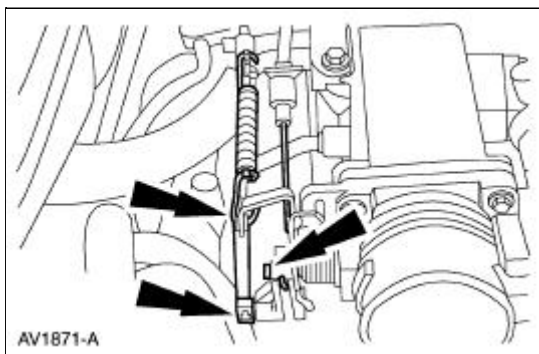
 **WARNING:** Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

 **CAUTION:** The throttle body bore and plate area have a special coating and cannot be cleaned.

1. Remove the air cleaner outlet tube (9B659). For additional information, refer to [Section 303-12](#).
2. Disconnect the throttle position (TP) sensor electrical connector.



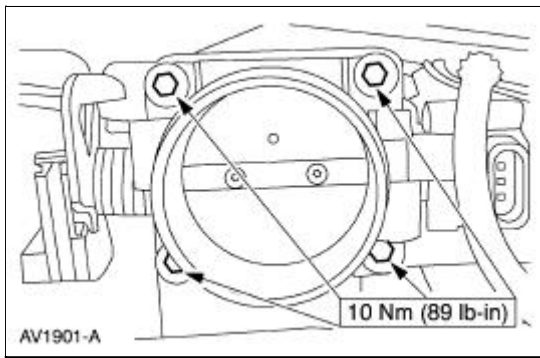
3. Disconnect the accelerator controls.
 - Disconnect the accelerator cable (9E926).
 - Disconnect the speed control cable (9A825).
 - Disconnect the return spring.



4. **NOTE:** Discard the throttle body gasket.

Remove the throttle body.

- Remove the bolts.
- Remove the throttle body.





Installation

1. To install, reverse the removal procedure.
-

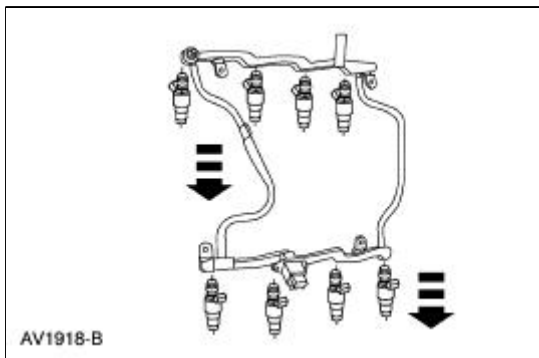
Fuel Injectors

Removal

 **WARNING:** Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

 **WARNING:** Fuel in the fuel system remains under high pressure even when the engine is not running. Before working on or disconnecting any of the fuel lines or fuel system components, the fuel pressure must be relieved. Failure to follow these instructions may result in personal injury.

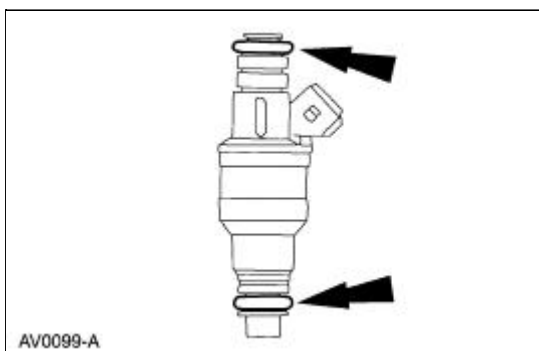
1. Relieve the fuel pressure. For additional information, refer to [Section 310-00](#).
2. Remove the supply manifold. For additional information, refer to [Fuel Injection Supply Manifold](#) in this section.
3. Remove the fuel injectors from the supply manifold.



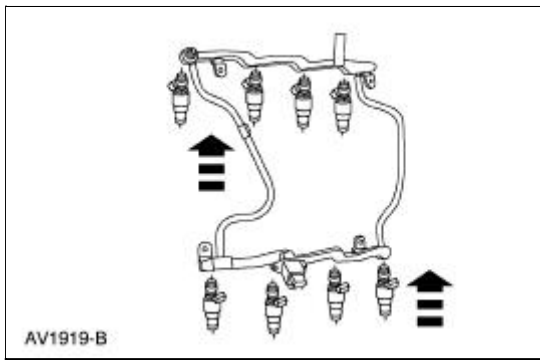
Installation

1. **NOTE:** Lubricate the new O-rings with Super Premium SAE 10W-30, XO-10W30-DSP or equivalent meeting Ford specification WSS-M2C153-G, to aid installation.

Inspect the two O-rings on each fuel injector. Install new O-rings if necessary.




2. Install the fuel injectors onto the supply manifold.



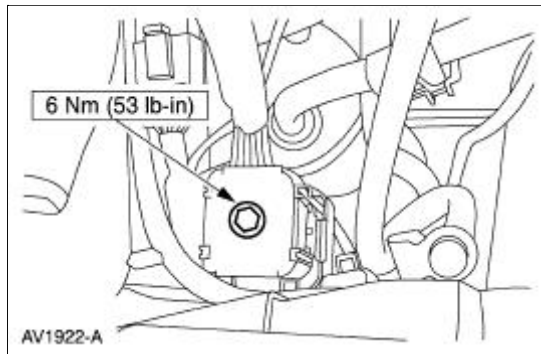
3. Install the fuel supply manifold.
-

Fuel Charging Wiring Harness

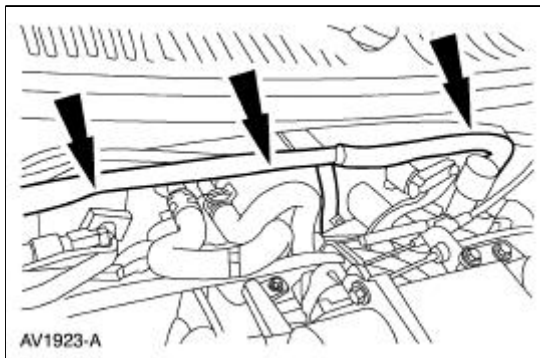
Removal

 **WARNING:** Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

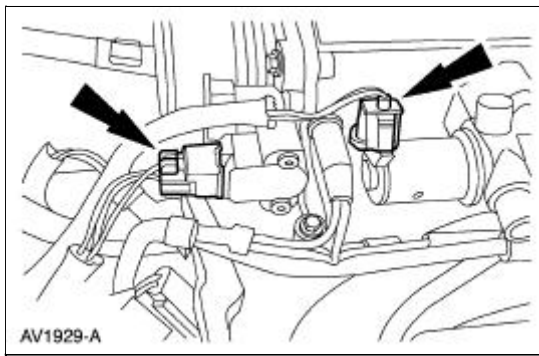
1. Disconnect the battery ground cable (14301). For additional information, refer to [Section 414-01](#).
2. Disconnect the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).
3. Disconnect the 42 pin connector.



4. Separate the wiring harness retainers from the dash panel.

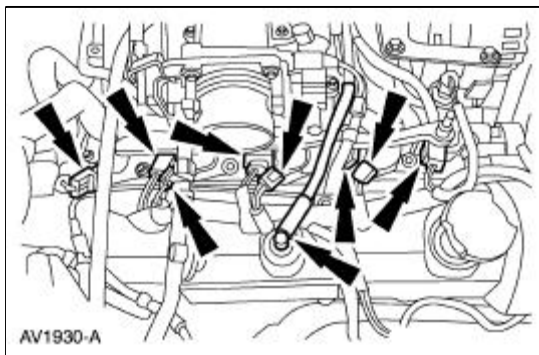


5. Disconnect the following connectors:
 - Throttle position (TP) sensor
 - Idle air control (IAC) valve



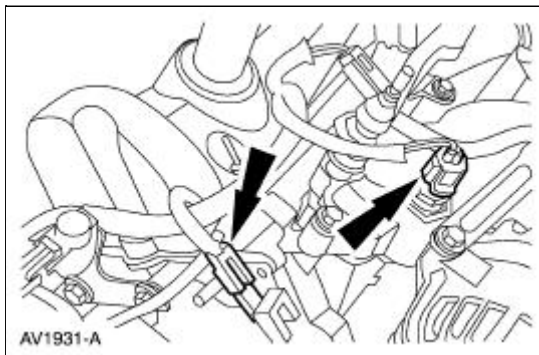
6. Disconnect the following connections:

- Four ignition coils
- Four fuel injectors
- Positive crankcase ventilation (PCV) hose from valve cover.

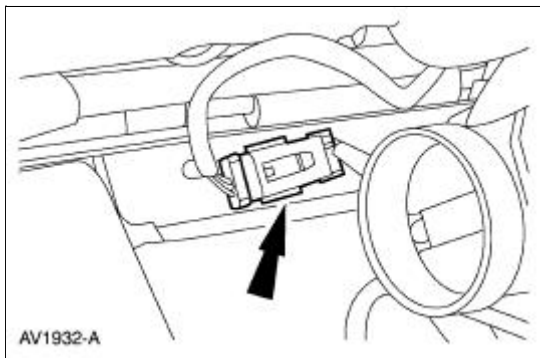


7. Disconnect the following connectors:

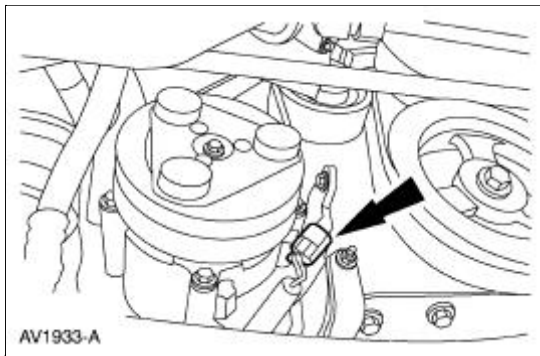
- RH radio ignition interference capacitor
- Engine coolant temperature (ECT) sensor



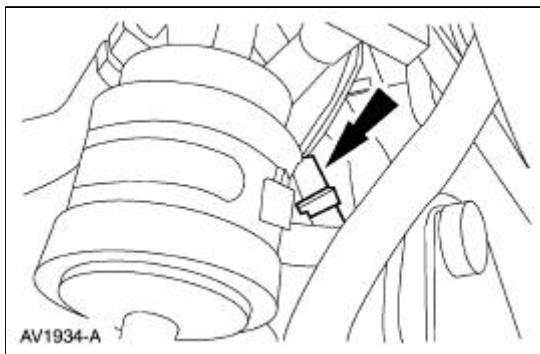
8. Disconnect the 16 pin connector



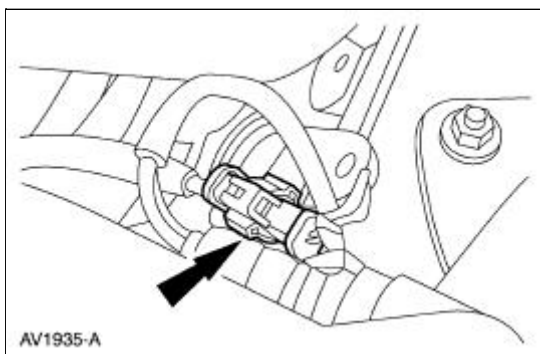
9. Raise the vehicle. For additional information, refer to [Section 100-02](#).
10. Disconnect the crankshaft position (CKP) sensor electrical connector.



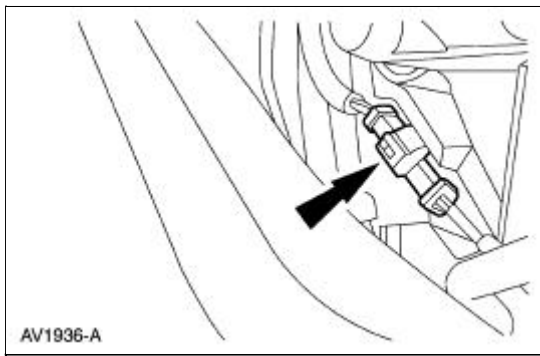
11. Disconnect the A/C compressor clutch electrical connector.



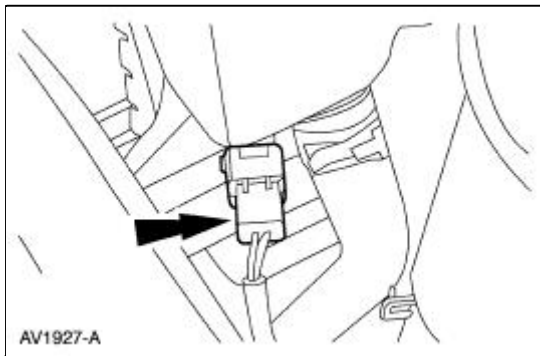
12. Disconnect the RH heated oxygen sensor (HO2S) electrical connector.



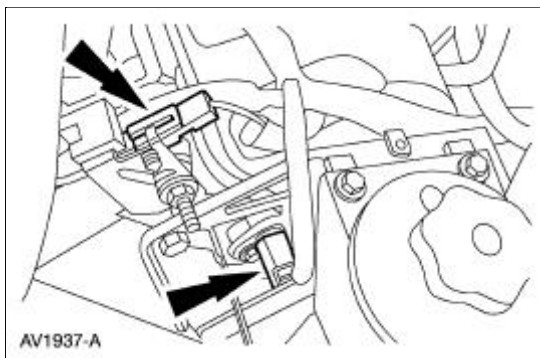
13. Disconnect the LH heated oxygen sensor (HO2S) electrical connector.



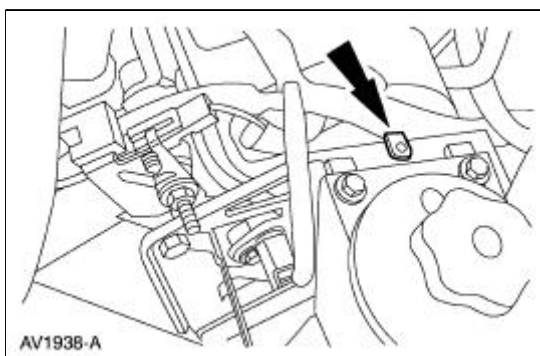
14. Lower the vehicle.
15. Disconnect the coolant reservoir electrical connector.



16. Disconnect the following connectors:
 - Camshaft position (CMP) sensor
 - LH radio ignition interference capacitor

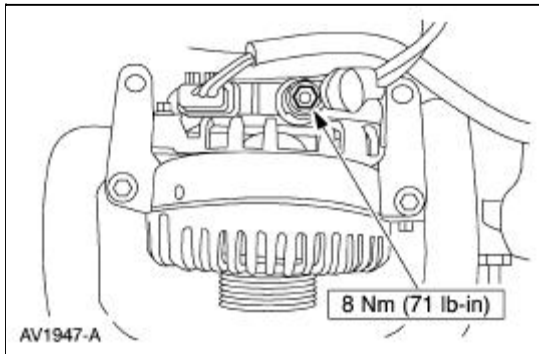


17. Separate the wiring harness from the power steering reservoir bracket.



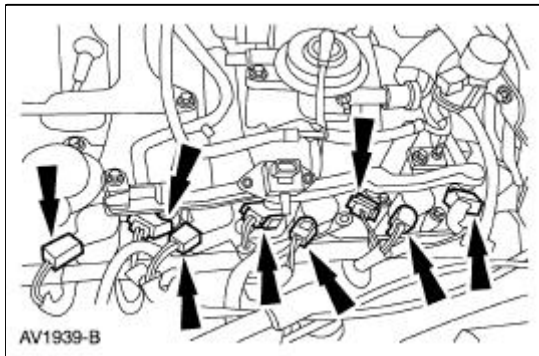
18. Disconnect the generator connectors:

- Battery power supply wire
- Voltage regulator



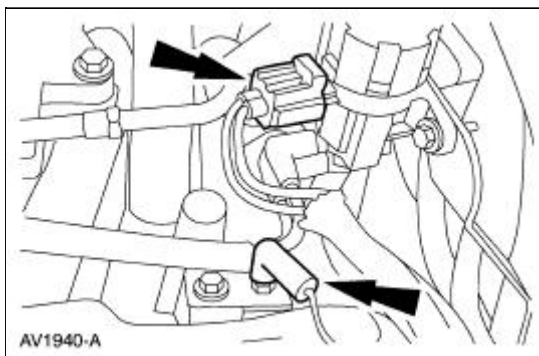
19. Disconnect the following connectors:

- LH fuel injectors
- LH ignition coils

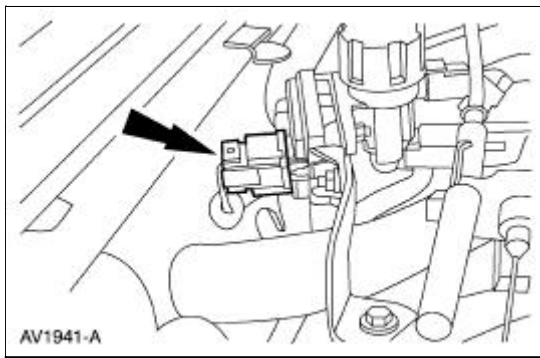


20. Disconnect the following connectors:

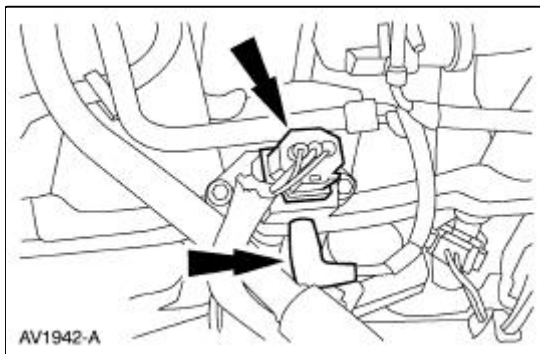
- Exhaust vacuum regulator (EVR)
- Ground wire



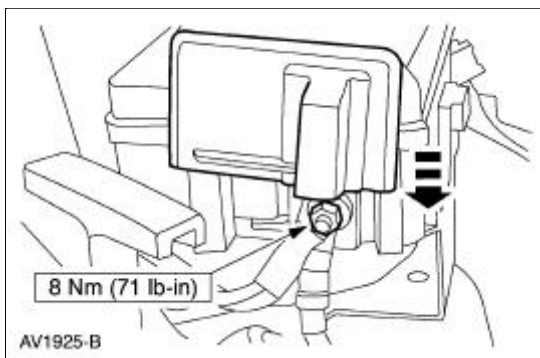
21. Disconnect the EGR pressure transducer electrical connector.



22. Disconnect the fuel pressure sensor electrical connector and the vacuum hose.

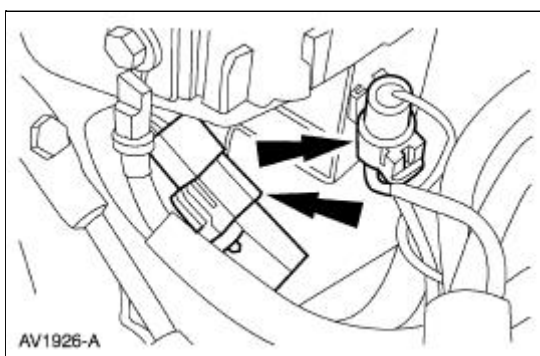


23. Slide cover up and remove the nut and the power distribution box battery supply wire.

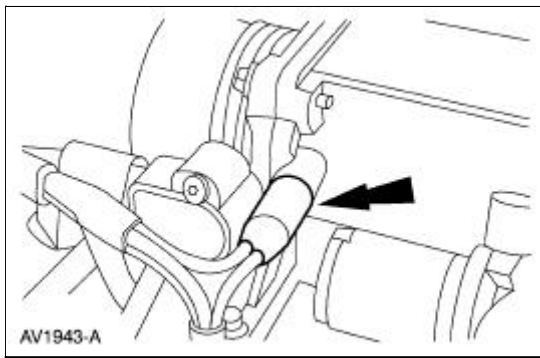


24. **NOTE:** These two connectors are located under the power distribution box.

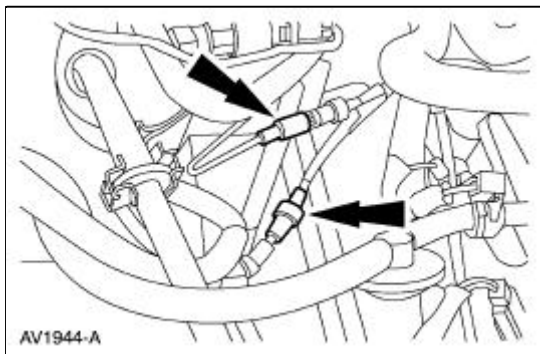
Disconnect the two connectors.



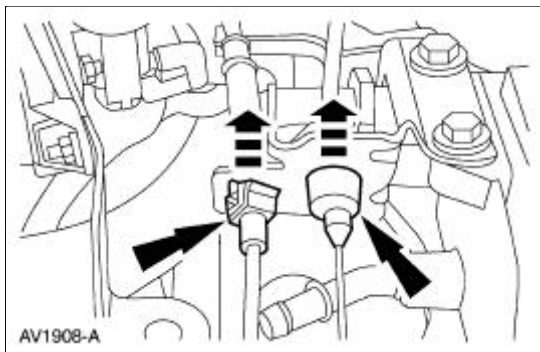
25. Disconnect the main vacuum hose.



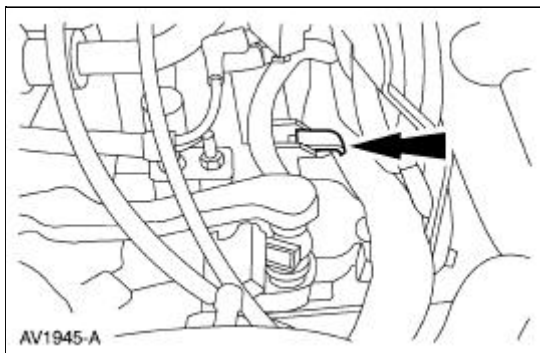
26. Disconnect the vacuum lines



27. Squeeze the two locking tabs, and remove the accelerator cable and the speed control cable (if equipped) from the bracket and position aside.

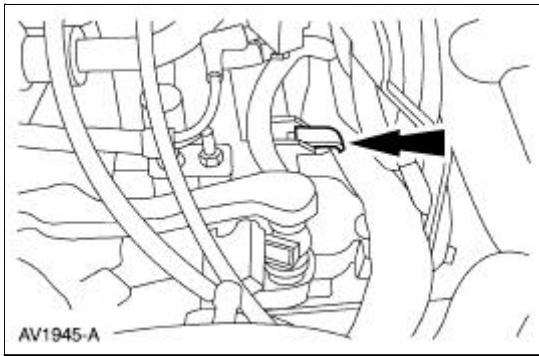


28. Separate the fuel charging wiring (9D930) from the rear of the intake manifold (9424) and remove from the vehicle.



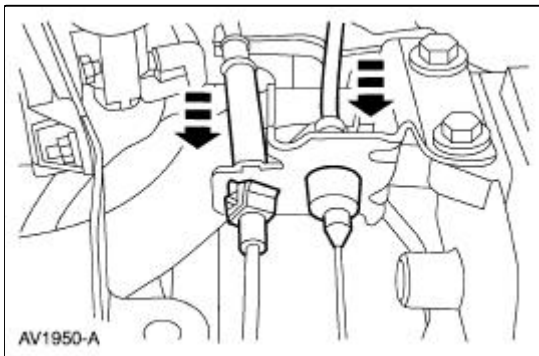
Installation

1. Position the fuel charging wiring in the vehicle and attach to the rear of the intake manifold.

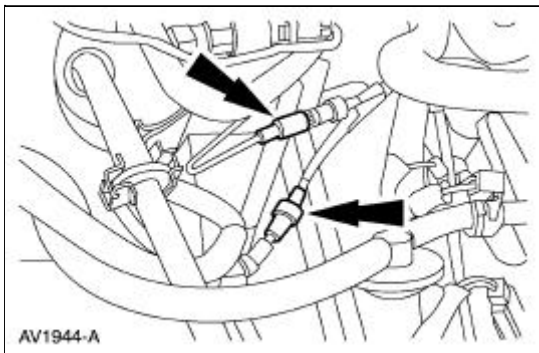


2. **NOTE:** Make sure the locking clips are fully engaged into the bracket.

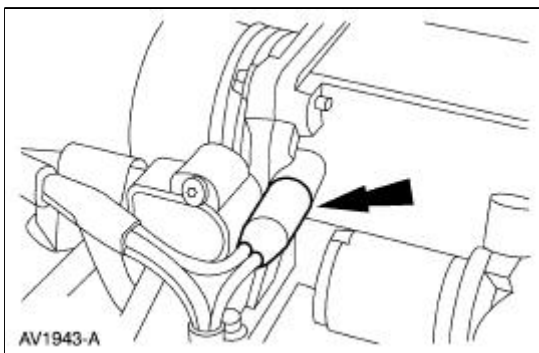
Reposition the accelerator cable and the speed control cable (if equipped) and install the cables into the bracket.



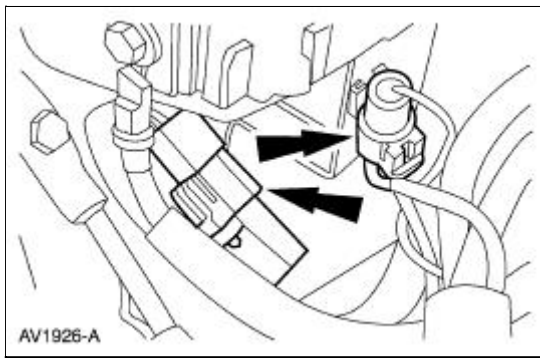
3. Connect the vacuum lines.



4. Connect the main vacuum hose.

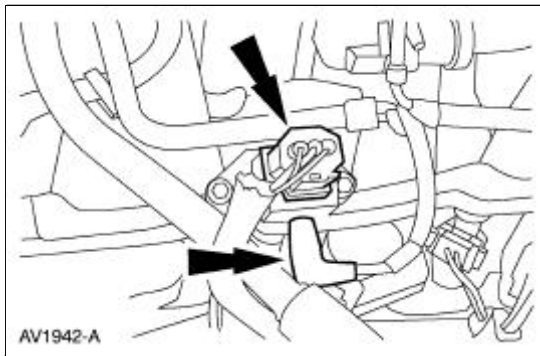


5. Connect the two connectors.

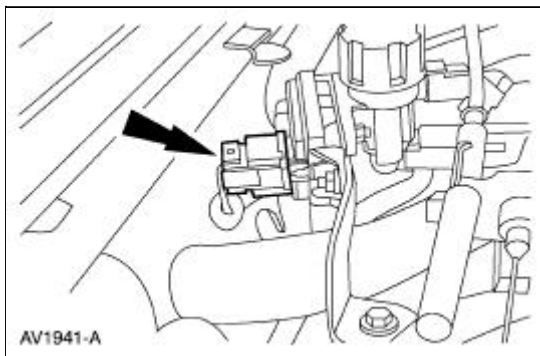


6. Install the battery supply wire, tighten the nut and close the cover.

7. Connect the fuel pressure sensor and the vacuum hose.

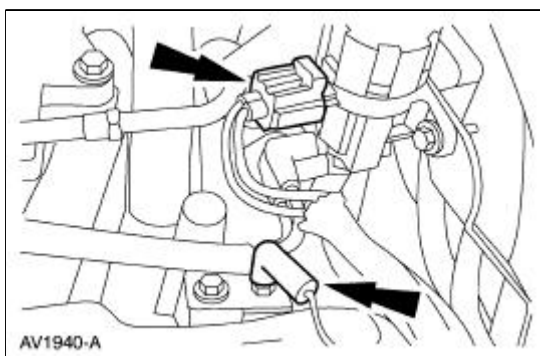


8. Connect the EGR pressure transducer electrical connector.



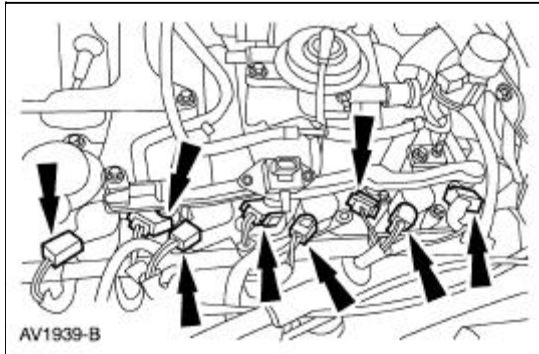
9. Connect the following connectors:

- Ground wire
- Exhaust vacuum regulator (EVR)



10. Connect the following connectors:

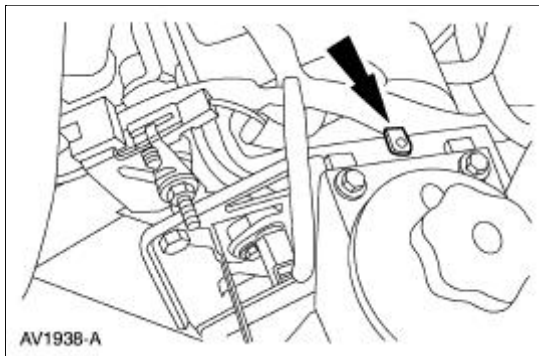
- LH fuel injectors
- LH ignition coils



11. Connect the following generator connectors:

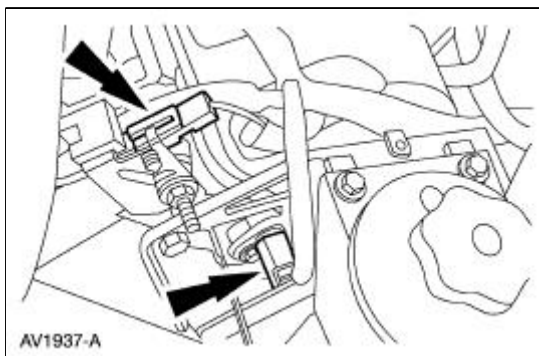
- Voltage regulator
- Battery supply

12. Install the wiring harness retainers to the power steering reservoir bracket.

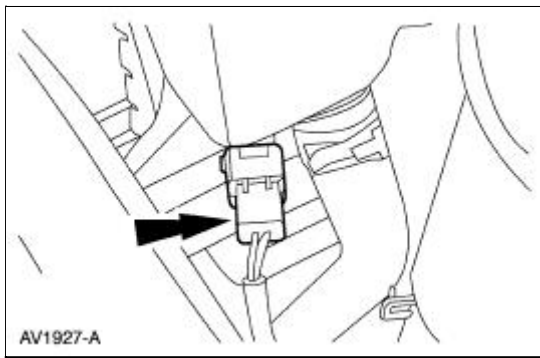


13. Connect the following connectors:

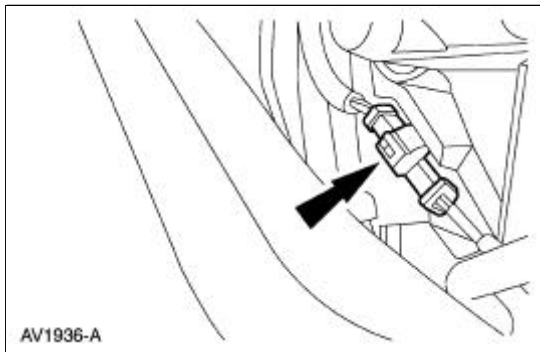
- LH radio ignition interference capacitor
- CMP sensor



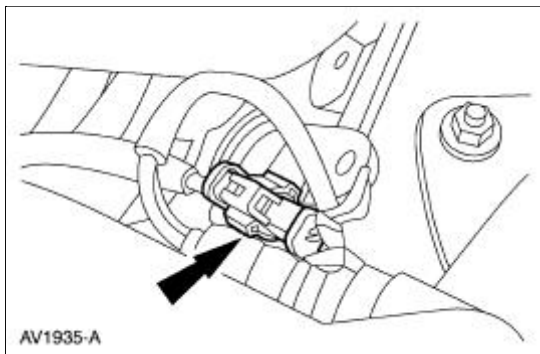
14. Connect the coolant reservoir electrical connector.



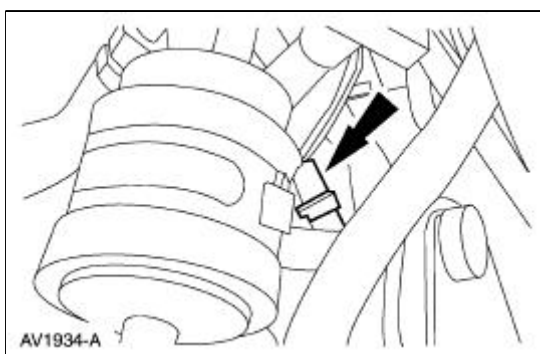
15. Raise the vehicle.
16. Connect the LH (HO2S) electrical connector.



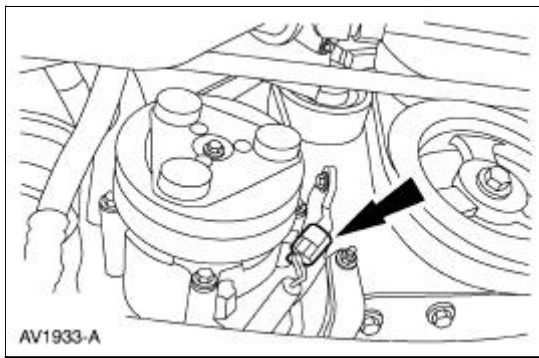
17. Connect the RH (HO2S) electrical connector.



18. Connect the A/C compressor clutch electrical connector.

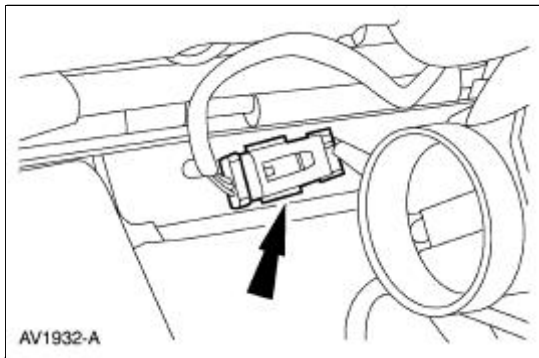


19. Connect the CKP electrical connector.



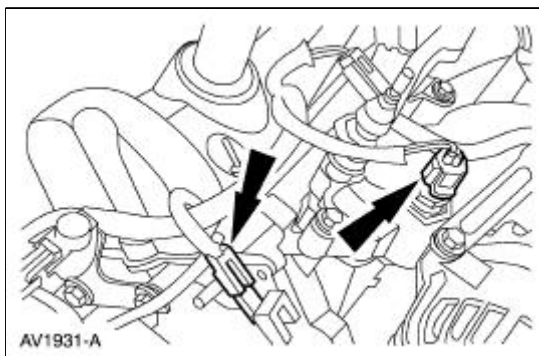
20. Lower the vehicle.

21. Connect the 16 pin connector.



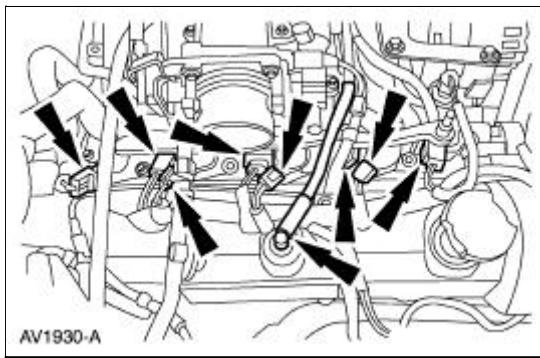
22. Connect the following connectors:

- ECT sensor
- RH radio ignition interference capacitor



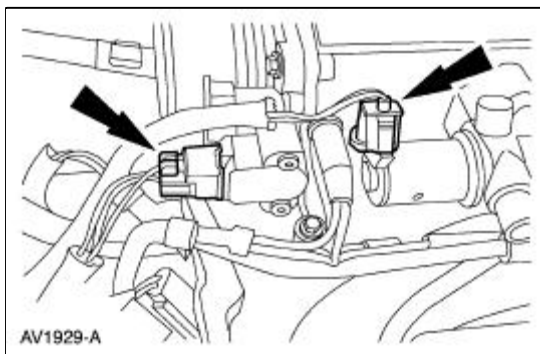
23. Connect the following connectors:

- PCV hose
- Four fuel injectors
- Four ignition coils

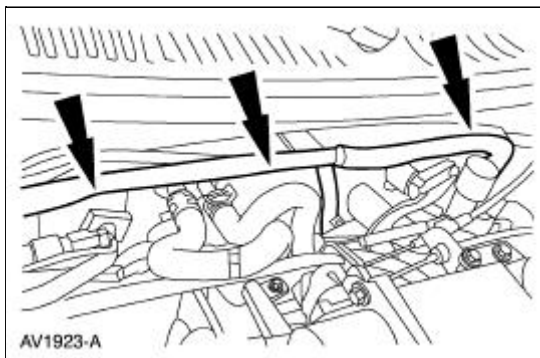


24. Connect the following connectors:

- IAC valve
- TP sensor




25. Install the wiring harness retainers to the dash panel.




26. Connect the 42 pin connector.
27. Connect the air cleaner outlet tube.
28. Connect the battery ground cable.
-

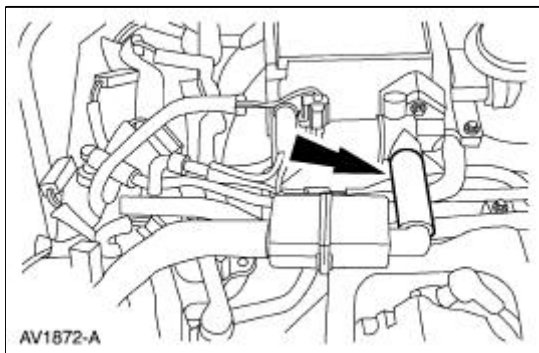
Fuel Injection Supply Manifold

Removal

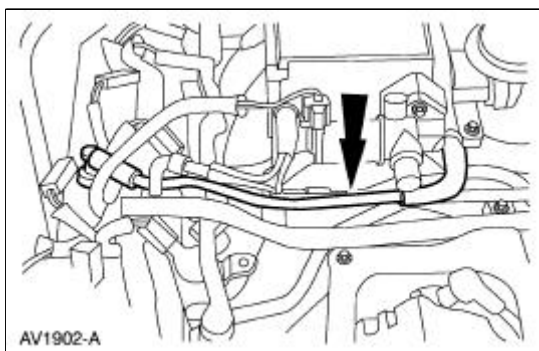
 **WARNING:** Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

 **WARNING:** Fuel in the fuel system remains under high pressure even when the engine is not running. Before working on or disconnecting any of the fuel lines or fuel system components, the fuel pressure must be relieved. Failure to follow these instructions may result in personal injury.

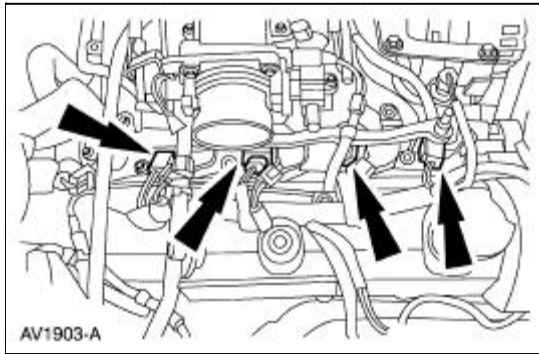
1. Disconnect the battery ground cable (14301). For additional information, refer to [Section 414-01](#).
2. Disconnect the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).
3. Relieve the fuel pressure. For additional information, refer to [Section 310-00](#).
4. Disconnect the fuel line. For additional information, refer to [Section 310-00](#).
5. Remove the throttle body (9E926). For additional information, refer to [Throttle Body](#) in this section.
6. Remove the idle air control (IAC) hose and position it out of the way.



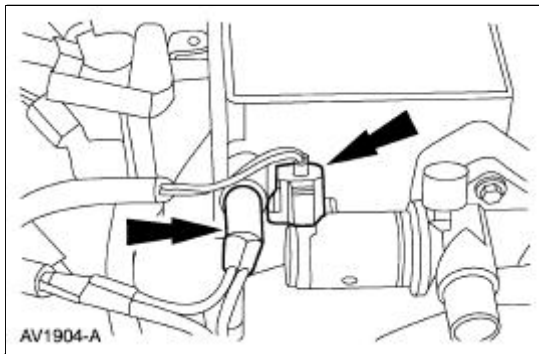
7. Remove the positive crankshaft ventilation (PCV) hose.



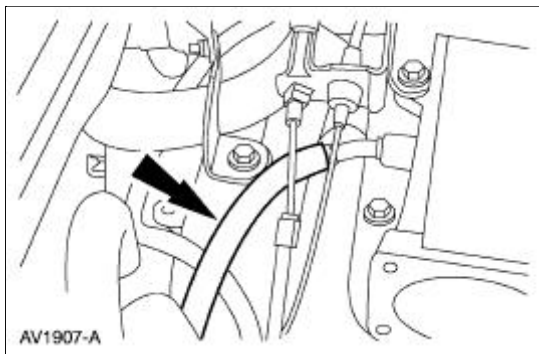
8. Disconnect the four RH fuel injector electrical connectors.



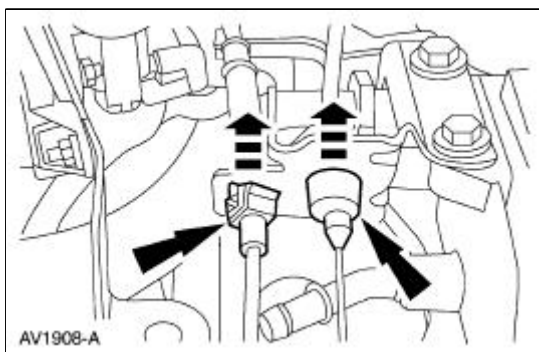
9. Disconnect the IAC electrical connector and the main chassis vacuum hose.



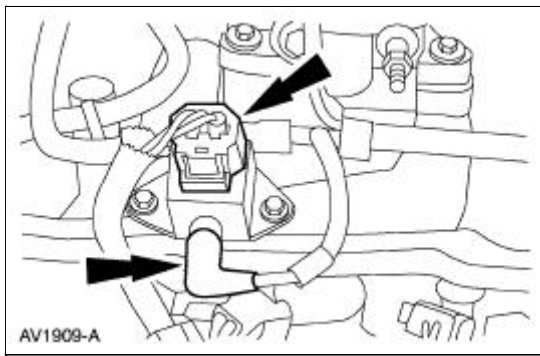
10. Remove the hose.



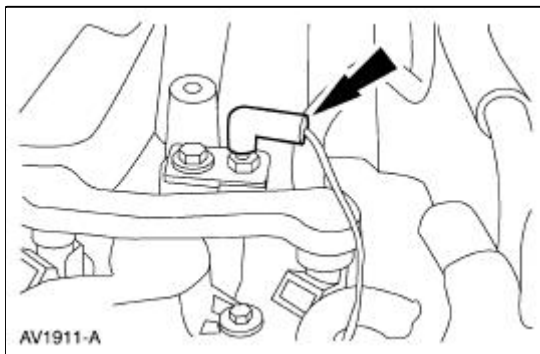
11. Squeeze the two locking tabs, and remove the accelerator cable and the speed control cable (if equipped) and position aside.



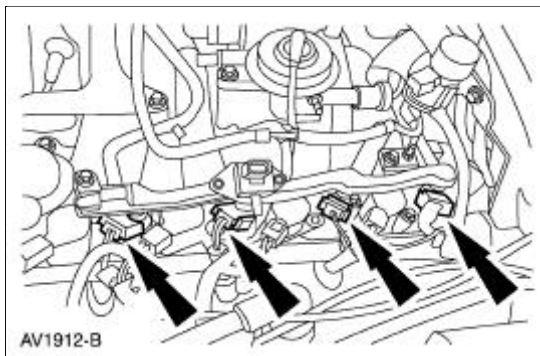
12. Disconnect the fuel pressure sensor electrical connector and the vacuum hose.



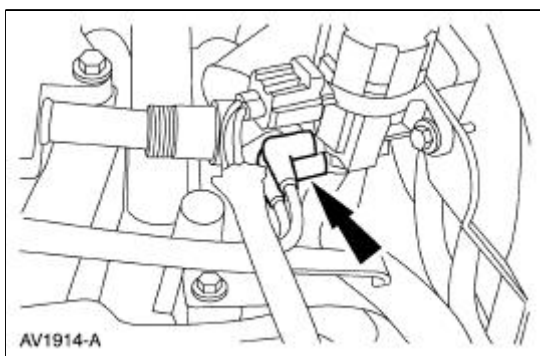
13. Disconnect the ground wire.



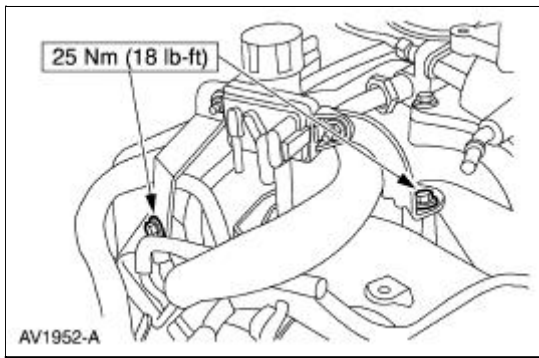
14. Disconnect the LH fuel injector electrical connectors.



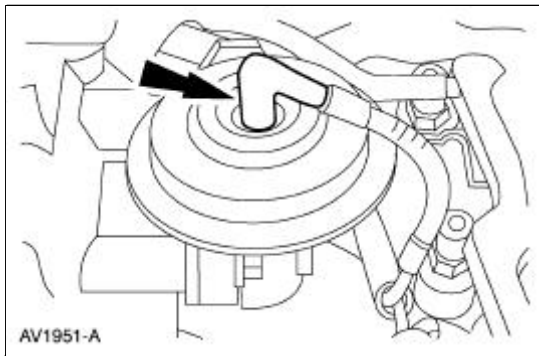
15. Remove the exhaust vacuum regulator (EVR) solenoid vacuum lines.



16. Remove the bolts from the EGR pressure transducer bracket and position aside.

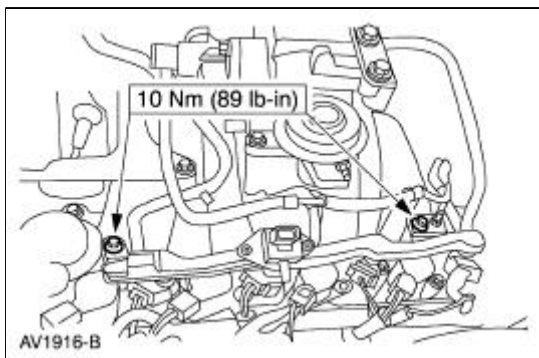


17. Remove the EGR to exhaust manifold tube. For additional information, refer to [Section 303-08](#).
18. Disconnect the exhaust valve recirculation (EGR) vacuum line.



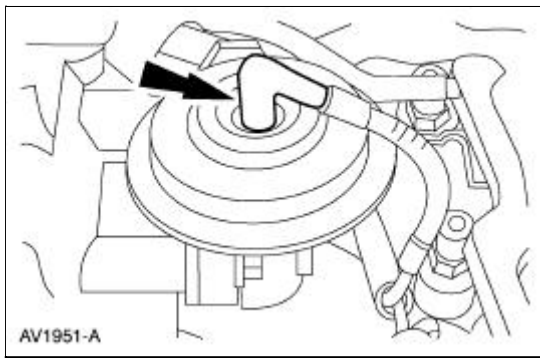
19. **NOTE:** The LH side is shown, the RH is similar.

Remove the four bolts and remove the supply manifold with the fuel injectors attached.



Installation

1. **NOTE:** The LH side is shown, and the RH is similar.
Install the supply manifold and tighten the four bolts.
2. Connect the EGR vacuum line.

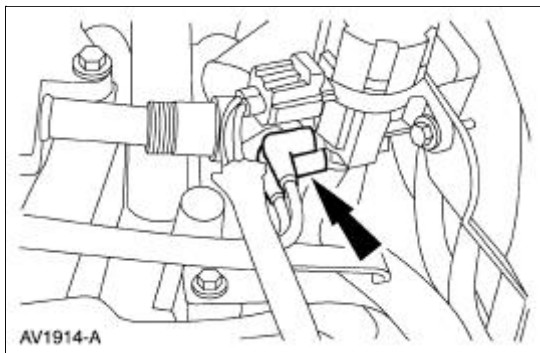


3. Install the EGR to exhaust manifold tube. For additional information, refer to [Section 303-08](#).

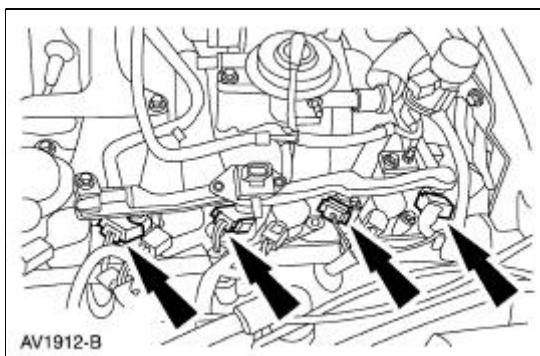
4. **NOTE:** The engine is removed for clarity.

Position the EVR bracket and tighten the bolts.

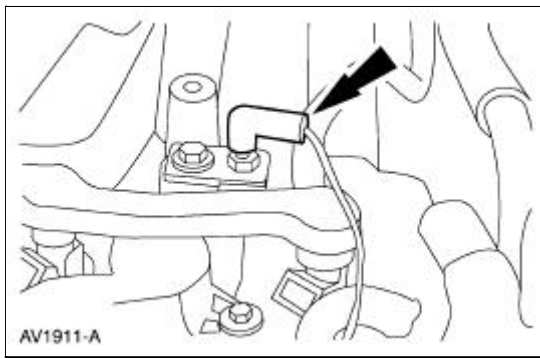
5. Connect the EVR solenoid vacuum lines.



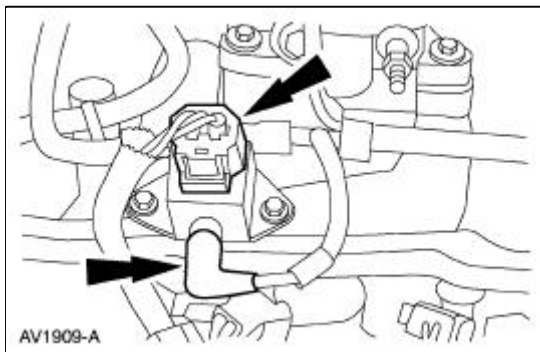
6. Connect the LH fuel injector electrical connectors.



7. Connect the ground wire.

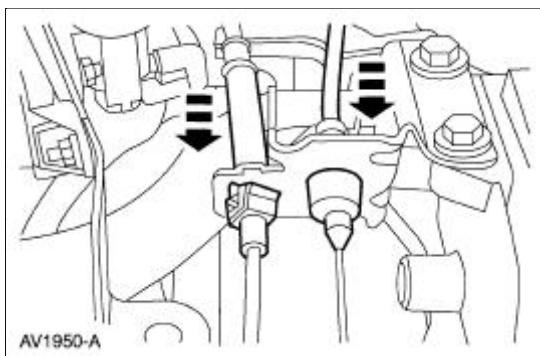


8. Connect the fuel pressure sensor electrical connector and the vacuum hose.

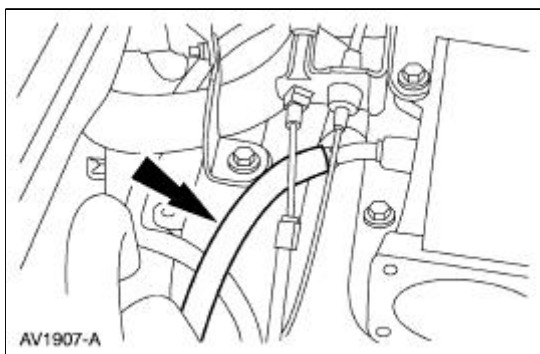


9. **NOTE:** Make sure the locking clips are fully engaged into the bracket.

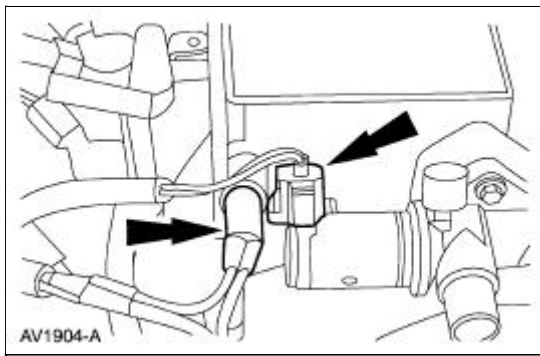
Reposition the accelerator cable and the speed control cable (if equipped) and install the cables into the bracket.



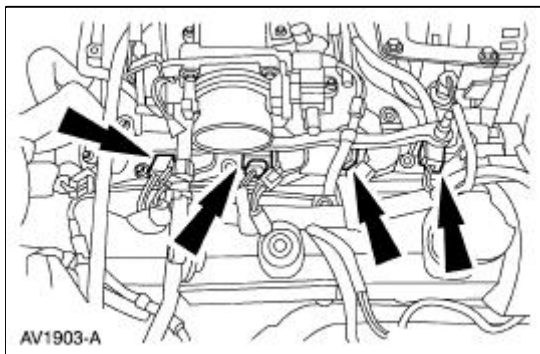
10. Connect the hose.



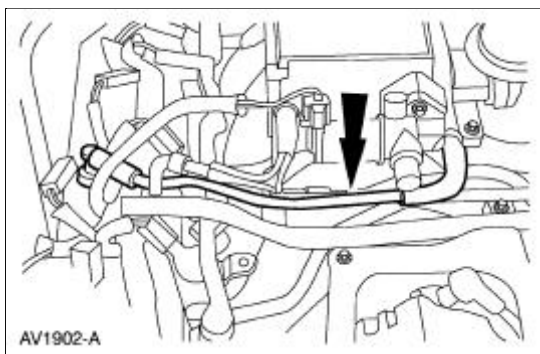
11. Connect the IAC electrical connector and install the main chassis vacuum hose.



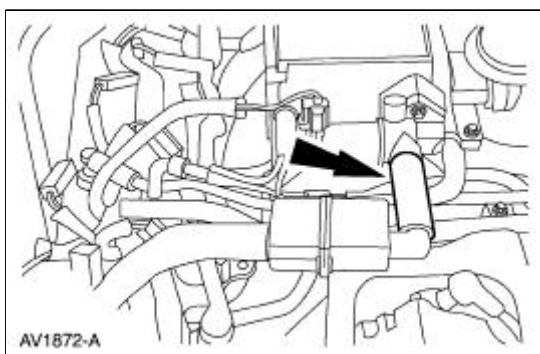
12. Connect the four RH fuel injector electrical connectors.



13. Connect the PCV hose.



14. Position the IAC hose and connect the hose.



15. Install the throttle body.

16. Connect the fuel line.

17. Connect the air cleaner outlet tube.

18. Connect the battery ground cable.

General Specifications

Item	Specification
Lubricants and Chemicals	
SAE 5W-20 Premium Synthetic Blend Motor Oil, XO-5W20-QSP	WSS-M2C153-H

Torque Specifications

Description	Nm	lb-in
Battery ground bolt	10	89
Throttle body bolts	9	80
Fuel injection supply manifold bolts	10	89
42-pin engine bulkhead electrical connector bolt	6	53
Ignition coil cover bolts	10	89
Battery supply wire nut to power distribution box	8	71
Battery supply wire nut to generator	8	71

Fuel Charging and Controls

The fuel injection supply manifold:

- receives fuel from the fuel supply line.
- delivers fuel to the fuel injector.

The throttle body:

- controls air supply to the intake manifold by positioning the throttle plate.
- connects the accelerator cable and, if equipped, the speed control actuator cable to the throttle lever.
- is not adjustable.
- cannot be cleaned.

The fuel injector:

- is electrically operated by the powertrain control module (PCM).
- has an internal solenoid that opens a needle valve to inject fuel into the lower intake manifold.
- atomizes the fuel as the fuel is delivered.
- is deposit-resistant. Do not clean.

The fuel pressure relief valve:


- is used to inspect and relieve fuel pressure.
-

Fuel Charging and Controls

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

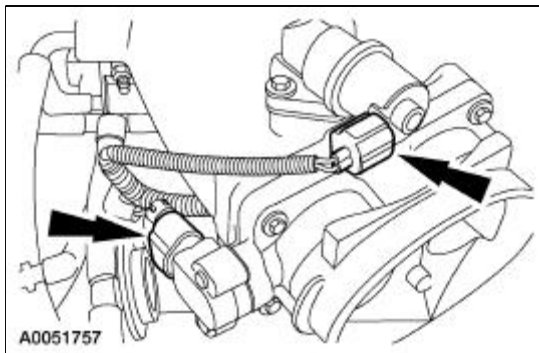
Throttle Body

Removal and Installation

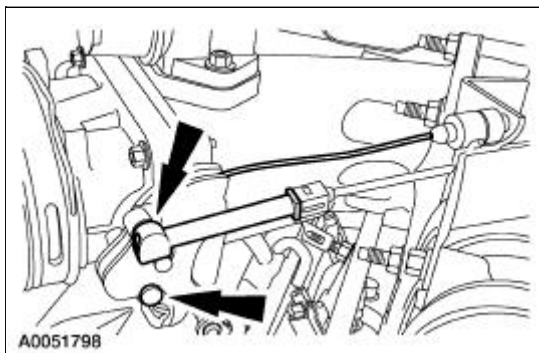
 **WARNING:** Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and can ignite. Failure to follow these instructions can result in personal injury.

 **CAUTION:** The throttle body bore and plate area have a special coating and cannot be cleaned.

1. Remove the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).
2. Disconnect the throttle position (TP) sensor and the idle air control (IAC) valve electrical connectors.

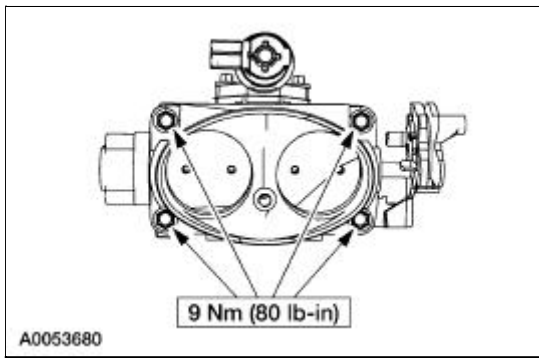


3. Disconnect the accelerator controls.
 - Disconnect the accelerator cable.
 - If equipped, disconnect the speed control cable.



4. **NOTE:** Discard the throttle body gasket after removing the throttle body.

Remove the bolts and the throttle body.




5. **NOTE:** Install a new throttle body gasket.

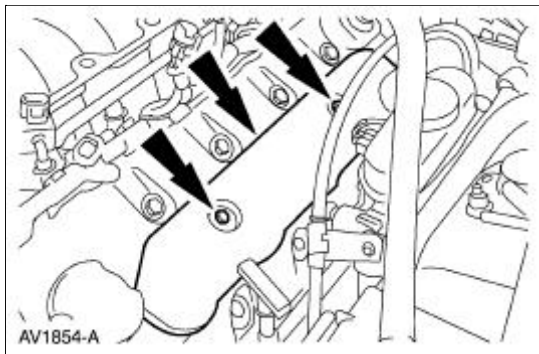
To install, reverse the removal procedure.

Fuel Charging Wiring Harness

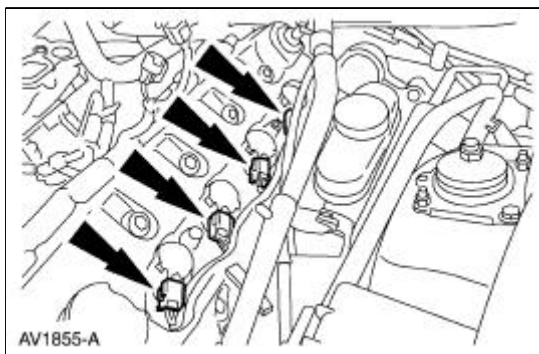
Removal and Installation

 **WARNING:** Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and can ignite. Failure to follow these instructions can result in personal injury.

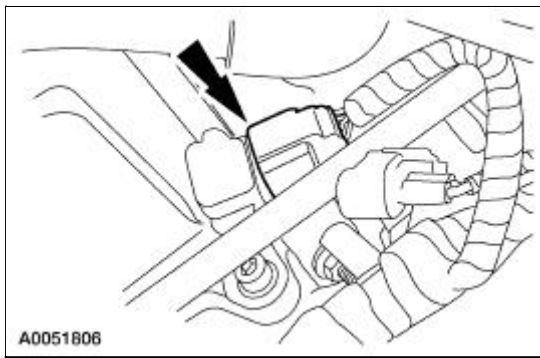
1. Disconnect the battery ground cable.
2. Remove the exhaust gas recirculation (EGR) valve and the exhaust manifold to EGR valve tube. For additional information, refer to [Section 303-08](#).
3. Remove the bolts and the LH ignition coil cover.



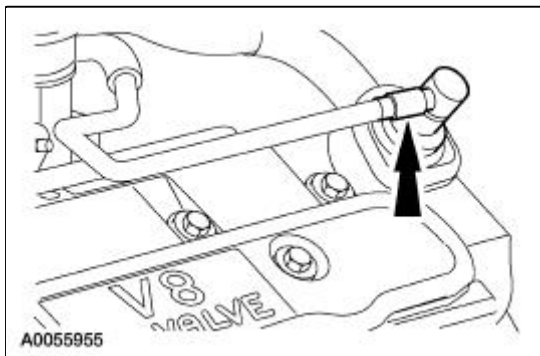
4. Disconnect the LH ignition coil electrical connectors.



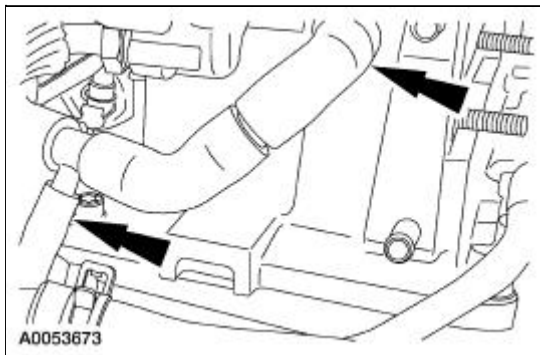
5. Disconnect the barometric pressure (BARO) sensor electrical connector.



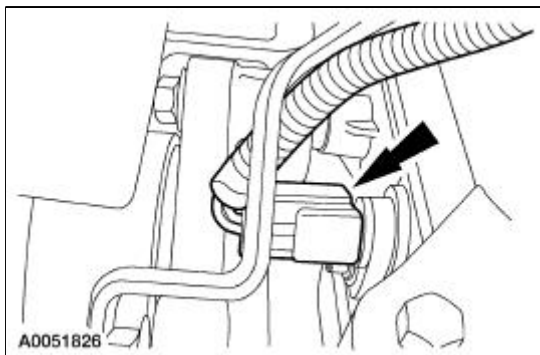
6. Remove the PCV valve.



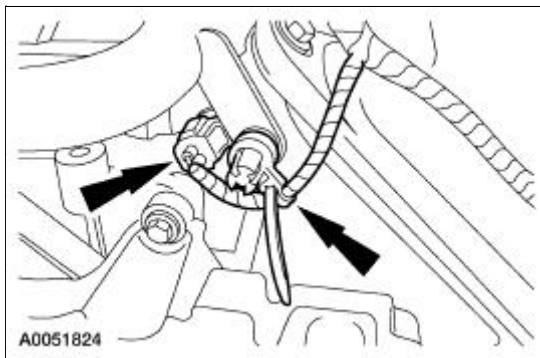
7. Disconnect and remove the PCV hose.



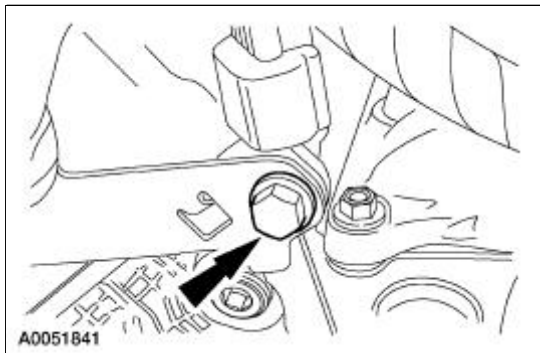
8. Disconnect the camshaft position (CMP) sensor electrical connector.



9. Disconnect the engine coolant temperature (ECT) sensor electrical connector and unclip the harness from the stud.

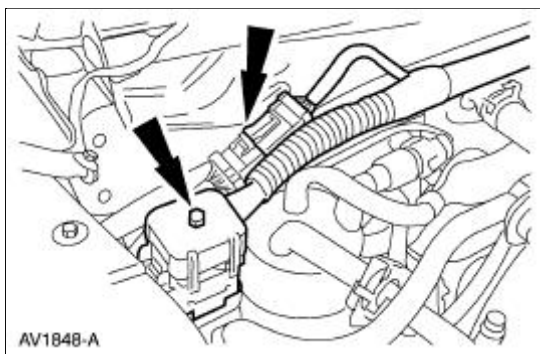


10. Remove the fuel charging wiring harness bracket bolt.

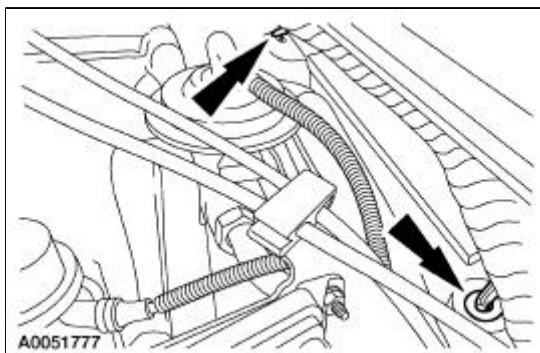


11. Disconnect the following:

- The 42-pin engine bulkhead electrical connector.
- The 16-pin electrical connector.

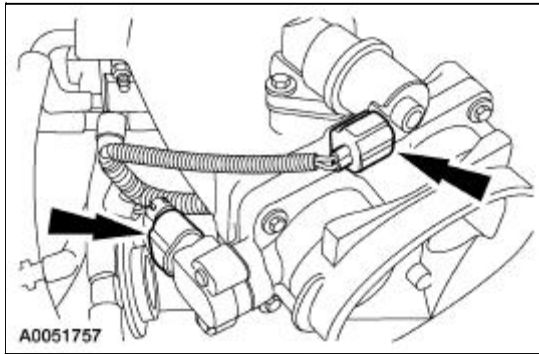


12. Separate the wiring harness from the dash panel.

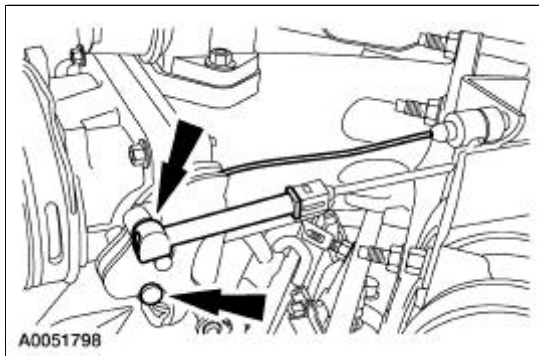


13. Remove the air cleaner outlet pipe. For additional information, refer to [Section 303-12](#).

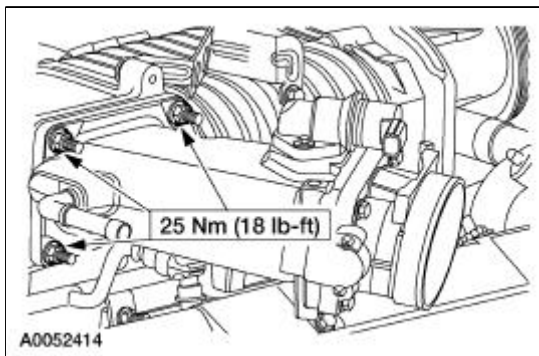
14. Disconnect the throttle position (TP) and the idle air control (IAC) valve electrical connectors.



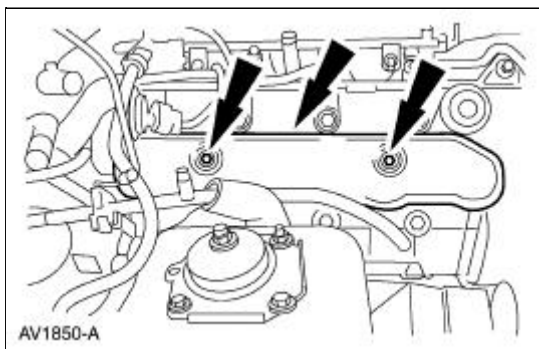
15. Disconnect the accelerator cable, and if equipped, the speed control cable.



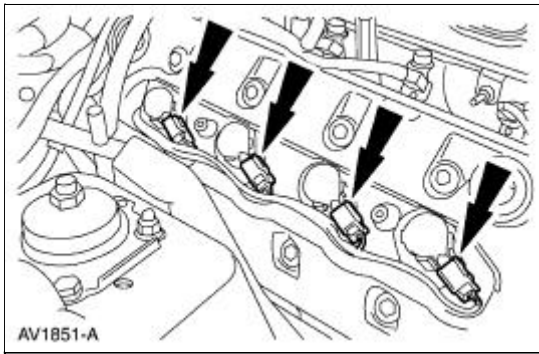
16. Remove the nuts and the throttle body spacer assembly.



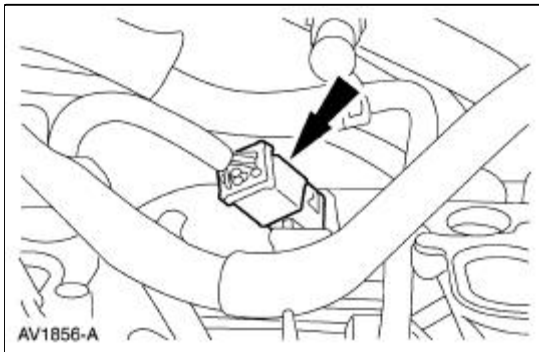
17. Remove the bolts and the RH ignition coil cover.



18. Disconnect the RH ignition coil electrical connectors.

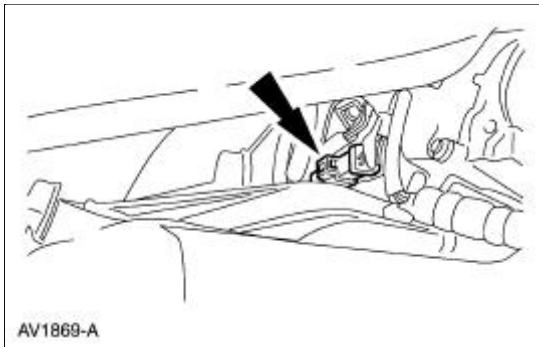


19. Disconnect the transmission main control harness electrical connector.

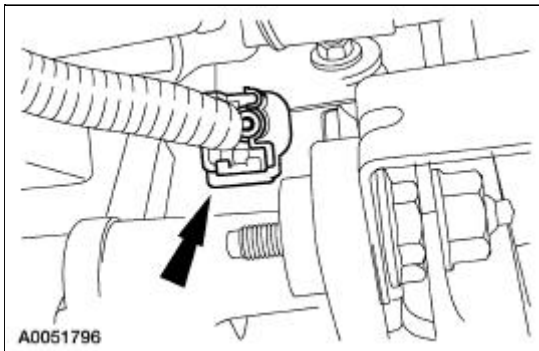


20. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).

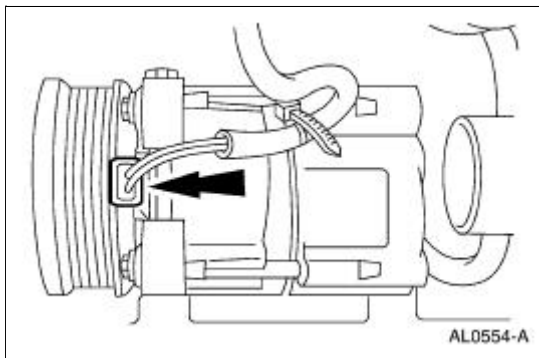
21. Disconnect the RH heated oxygen sensor (HO2S) electrical connector.



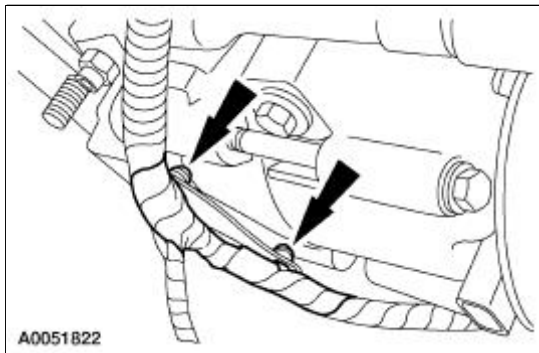
22. Disconnect the crankshaft position (CKP) sensor electrical connector.



23. Disconnect the air conditioning compressor electrical connector.



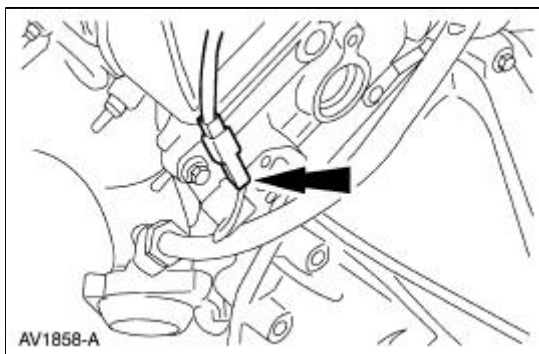
24. Unclip the harness from the bracket.



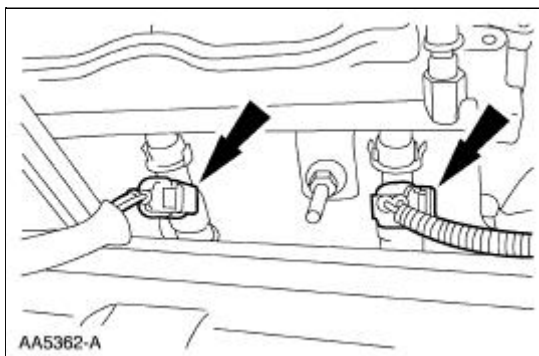
25. Lower the vehicle.

26. **NOTE:** LH side shown, RH side similar.

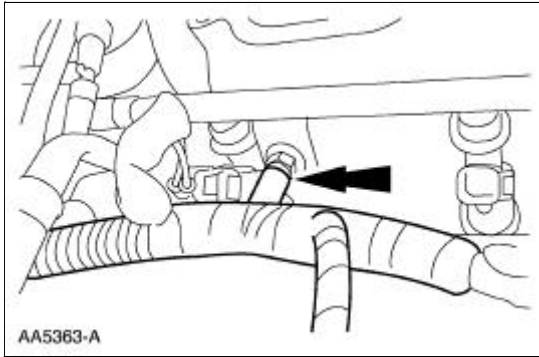
Disconnect the two radio ignition interference capacitor electrical connectors.



27. Disconnect the eight fuel injectors.



28. Separate the harness from the fuel supply manifold studs in four places and remove the fuel charging wiring harness from the vehicle.



29. To install, reverse the removal procedure.
-

Fuel Injection Supply Manifold and Fuel Injector

Material

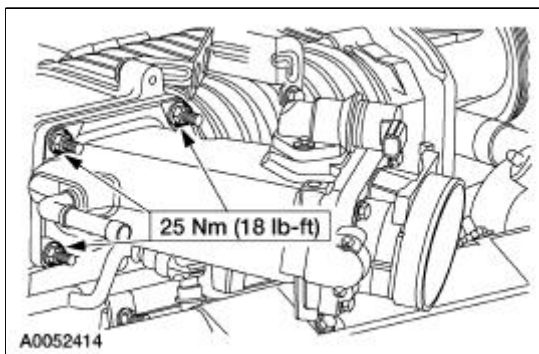
Item	Specification
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP	WSS-M2C153-H

Removal and Installation

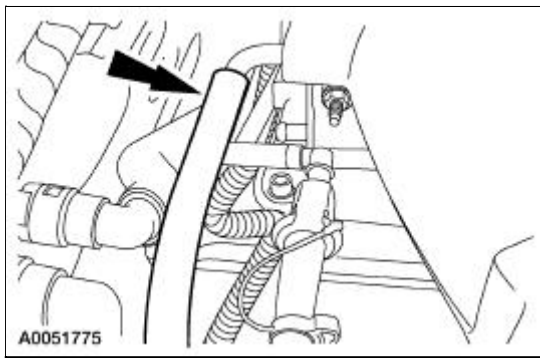
⚠ WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and can ignite. Failure to follow these instructions can result in personal injury.

⚠ WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before working on or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved. Failure to follow these instructions can result in personal injury.

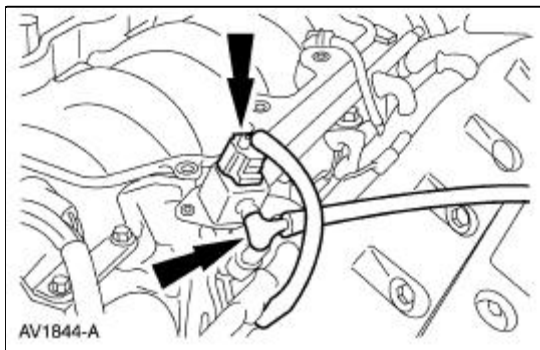
1. Disconnect the battery ground cable.
2. Remove the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).
3. Release the fuel pressure. For additional information, refer to [Section 310-00](#).
4. Disconnect the fuel supply hose spring lock coupling. For additional information, refer to [Section 310-00](#).
5. Remove the exhaust gas recirculation (EGR) valve and the exhaust manifold-to-EGR valve tube. For additional information, refer to [Section 303-08](#).
6. Remove the throttle body and spacer assembly.



7. Disconnect the vacuum hose.

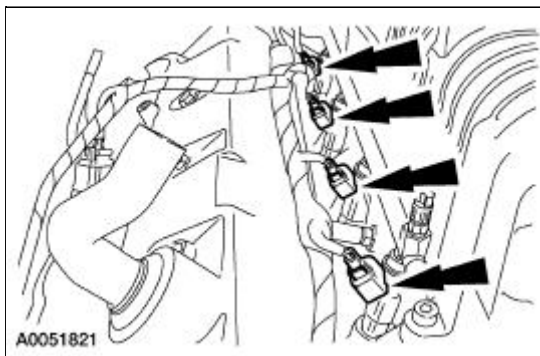


8. Disconnect the fuel pulse damper electrical connector and the vacuum hose.

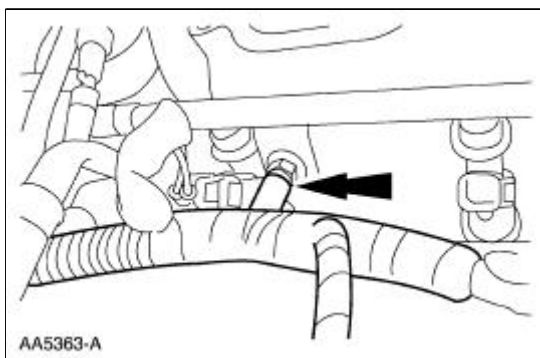


9. **NOTE:** RH shown, LH similar.

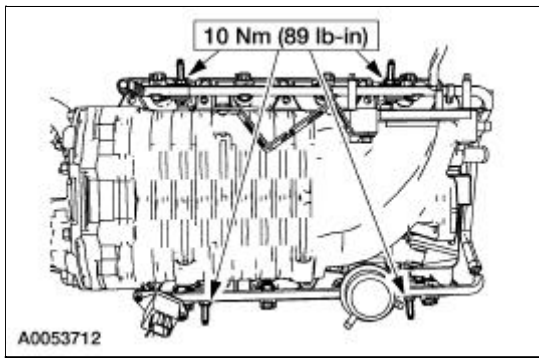
Disconnect the eight fuel injector electrical connectors.



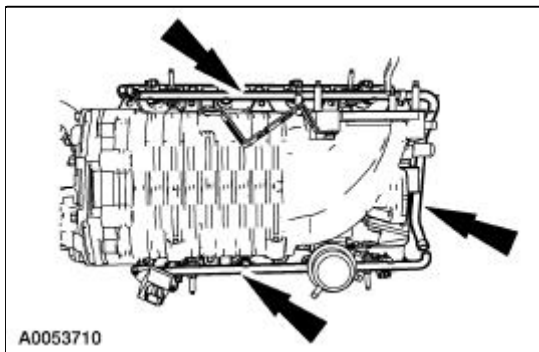
10. Separate the fuel charging wiring harness from the fuel injection supply manifold in four places.



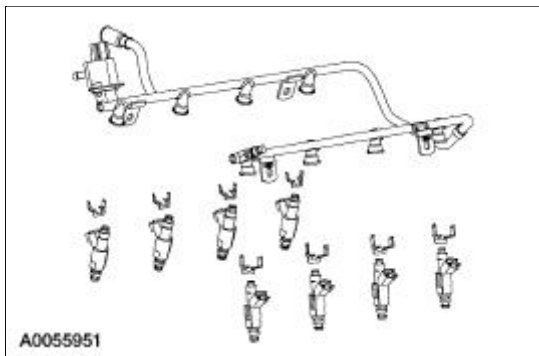
11. Remove the fuel supply manifold mounting studs.



12. Remove the fuel supply manifold and fuel injectors as an assembly.



13. Remove the anti-rotation clips and the fuel injectors from the fuel supply manifold.

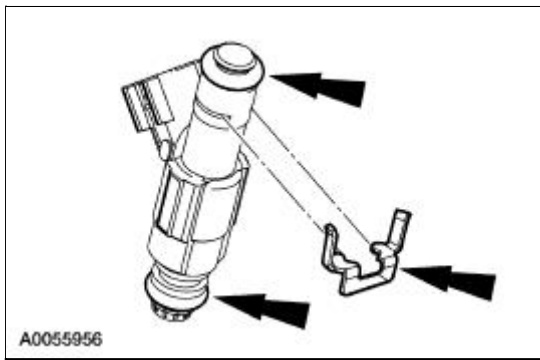


14. **NOTE:** Always install new O-rings.

NOTE: Lubricate the O-rings with clean engine oil to aid installation.

NOTE: Make sure the anti-rotation clips are installed.

To install, reverse the removal procedure.



General Specifications

Item	Specification
Fluid/Lubricant Specification	
Super Premium SAE 5W-30, XO-5W30-QSP	WSS-M2C153-G

Torque Specifications

Description	Nm	lb-ft	lb-in
Battery ground bolt	10	—	89
Throttle body bolts	9	—	80
Fuel injection supply manifold bolts	10	—	89
42 pin engine bulkhead electrical connector bolt	6	—	53
Ignition coil cover bolts	10	—	89
Battery supply wire nut to power distribution box	8	—	71
Battery supply wire nut to generator	8	—	71
Air intake scoop bolts	25	18	—
Air intake scoop bracket bolt	25	18	—
Air intake scoop bracket nuts	25	18	—
Air intake scoop bracket throttle body nut	9	—	80
Exhaust gas recirculation (EGR) vacuum regulator solenoid bolts	10	—	89
Wiring harness bracket bolt	20	15	—

Fuel Charging and Controls

The fuel injection supply manifold (9F792):

- delivers fuel to the fuel injector.
- receives fuel from the fuel supply line.

The throttle body:

- controls air supply to the upper intake manifold by positioning the throttle plate.
- connects the accelerator cable and, if equipped, the speed control actuator cable to the throttle lever.
- is not adjustable.
- cannot be cleaned.

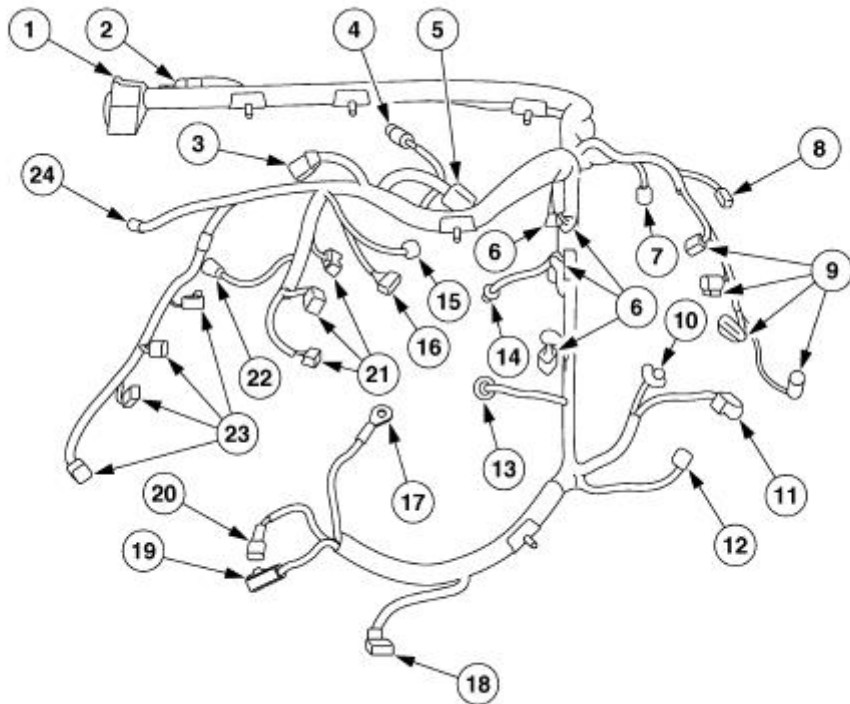
The fuel injector:

- is electrically operated by the powertrain control module (PCM).
- has an internal solenoid that opens a needle valve to inject fuel into the lower intake manifold.
- atomizes the fuel as the fuel is delivered.
- is deposit-resistant. Do not clean.

The fuel pressure relief valve:

- is used to inspect and relieve fuel pressure.

Fuel Charging Wiring Connections



A0069046

Item	Part Number	Description
1	—	Engine control sensor wiring 42 pin electrical connector
2	—	16 pin electrical connector
3	—	Engine control jumper harness electrical connector
4	—	RH heated oxygen sensor (HO2S) electrical connector
5	—	Transmission main control harness electrical connector.
6	—	Fuel injector electrical connectors
7	—	Heated positive crankcase ventilation (PCV) valve electrical connector.
8	—	Radio ignition interference capacitor electrical connector
9	—	Ignition coil electrical connectors
10	—	Generator battery electrical connector
11	—	Generator field electrical connector
12	—	Engine coolant temperature (ECT) sensor electrical connector
13	—	Fuel pressure sensor electrical connector
14	—	Exhaust vacuum regulator (EVR) electrical connector
15	—	Idle air control (IAC) electrical connector
16	—	EGR backpressure transducer electrical connector
17	—	Power distribution box battery feed electrical wire
18	—	Camshaft position (CMP) sensor electrical connector

19	—	16 pin electrical connector
20	—	16 pin electrical connector
21	—	Fuel injector electrical connectors
22	—	Throttle position (TP) sensor electrical connector
23	—	Ignition coil electrical connectors
24	—	Radio ignition interference capacitor electrical connector

Fuel Charging and Controls


Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Idle Speed Adjustment

Powertrain Control/Emissions Diagnosis (PC/ED) manual

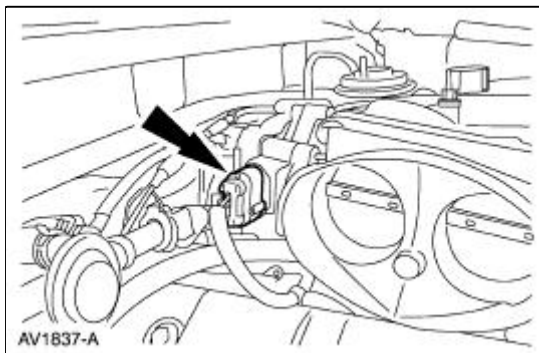
Throttle Body

Removal

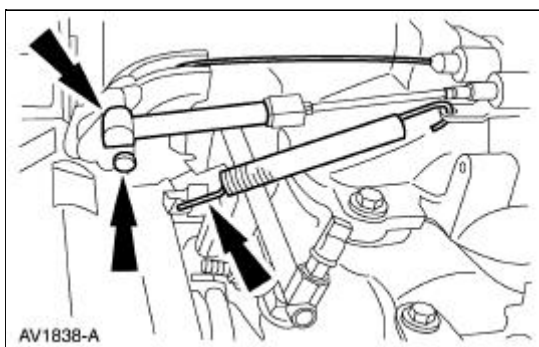
 **WARNING:** Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and can ignite. Failure to follow these instructions can result in personal injury.

 **CAUTION:** The throttle body bore and plate area have a special coating and cannot be cleaned.

1. Remove the air intake scoop bracket. For additional information, refer to [Section 303-12](#).
2. Remove the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).
3. Disconnect the throttle position (TP) sensor electrical connector.



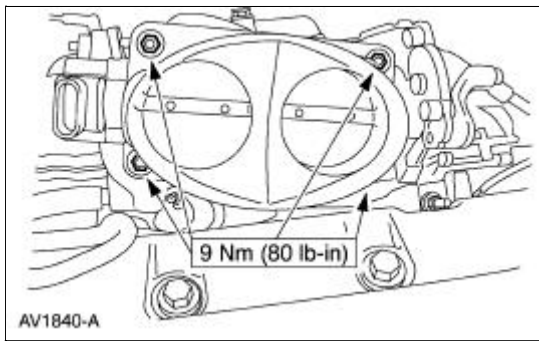
4. Disconnect the accelerator controls.
 - Disconnect the accelerator cable.
 - Disconnect the speed control cable.
 - Disconnect the return spring.



5. **NOTE:** Discard the throttle body gasket after removing the throttle body.

Remove the throttle body.

- Remove the four bolts.



Installation

1. **NOTE:** Install a new throttle body gasket.

To install, reverse the removal procedure.

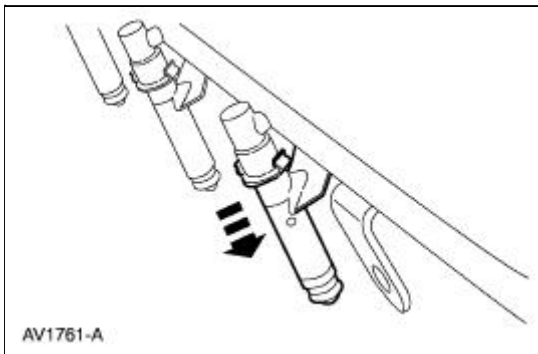
Fuel Injectors

Removal

⚠ WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and can ignite. Failure to follow these instructions can result in personal injury.

⚠ WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before working on or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved. Failure to follow these instructions can result in personal injury.

1. Remove the supply manifold. For additional information, refer to [Supply Manifold](#) in this section.
2. Remove the eight fuel injectors from the supply manifold.



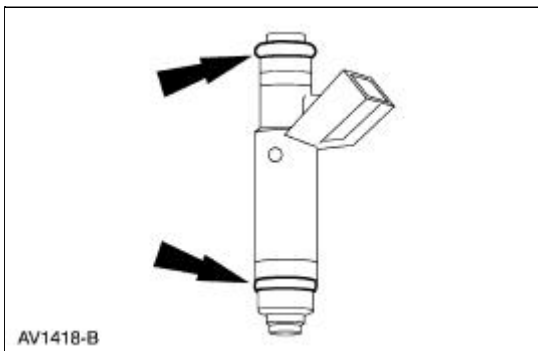
Installation

⚠ CAUTION: The retaining clip must be in the upper groove on the injector or the injector can become loose.

1. **NOTE:** Inspect the two O-rings from each fuel injector. Install new O-rings as needed.


NOTE: Lubricate the new O-rings with clean engine oil.

To install, reverse the removal procedure.

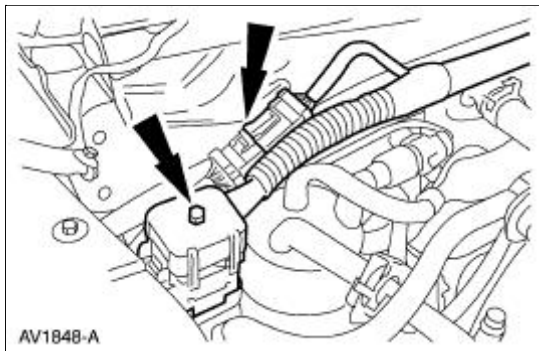


Wiring Harness

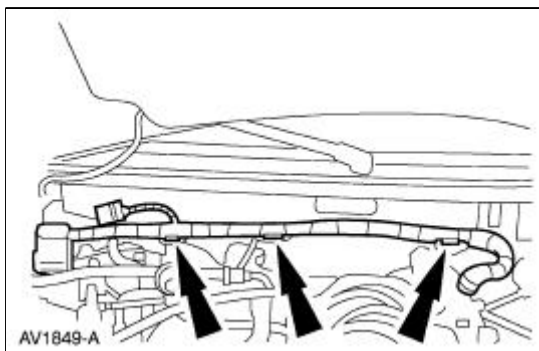
Removal

 **WARNING:** Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and can ignite. Failure to follow these instructions can result in personal injury.

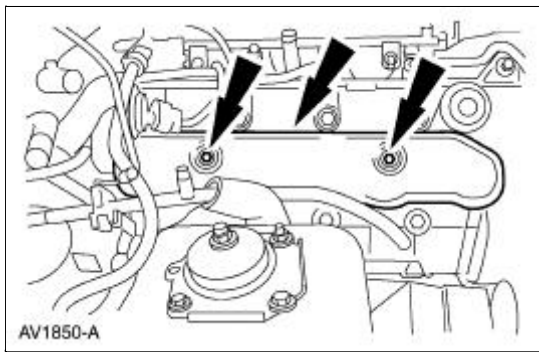
1. With the vehicle in neutral, position it on a hoist. For additional information, refer to [Section 100-02](#).
2. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
3. Remove the upper intake manifold. For additional information, refer to [Section 303-01D](#).
4. Disconnect the following connectors:
 - The 42 pin engine bulkhead electrical connector.
 - The 16 pin electrical connector.



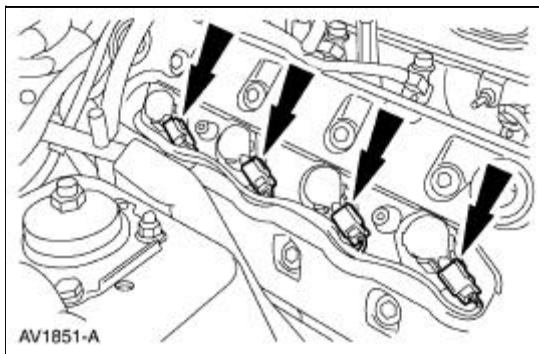
5. Separate the wiring harness from the dash panel.



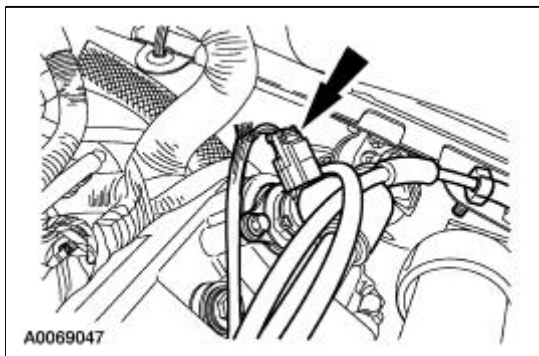
6. Remove the RH ignition coil cover.
 - Remove the bolts.
 - Remove the coil cover.



7. Disconnect the RH ignition coil electrical connectors.

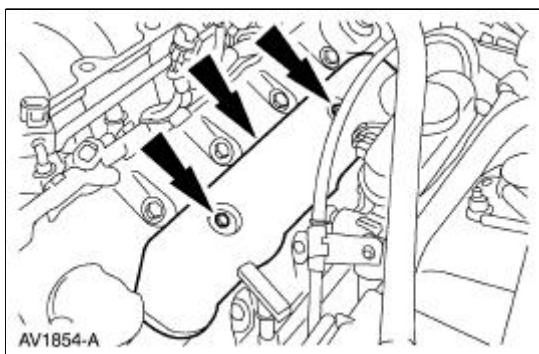


8. Disconnect the heated positive crankcase ventilation (PCV) valve electrical connector.

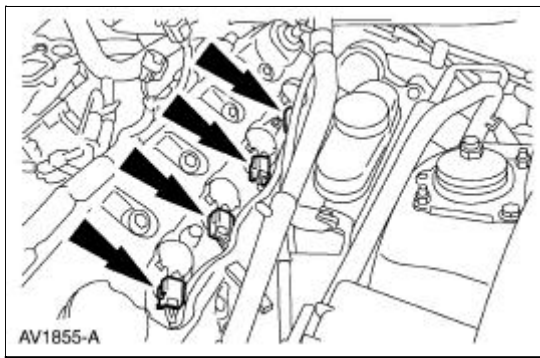


9. Remove the LH ignition coil cover.

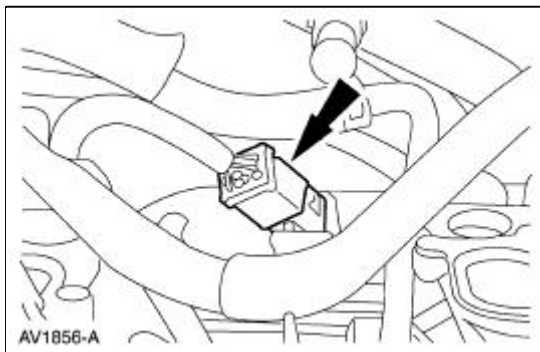
- Remove the bolts.
- Remove the coil cover.



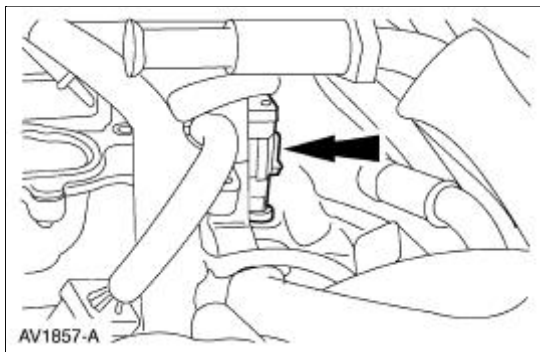
10. Disconnect the LH ignition coil electrical connectors.



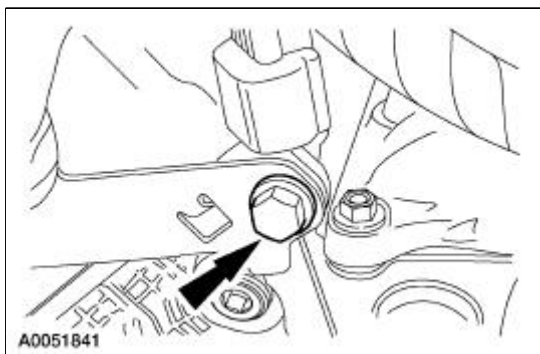
11. Disconnect the transmission main control harness electrical connector.



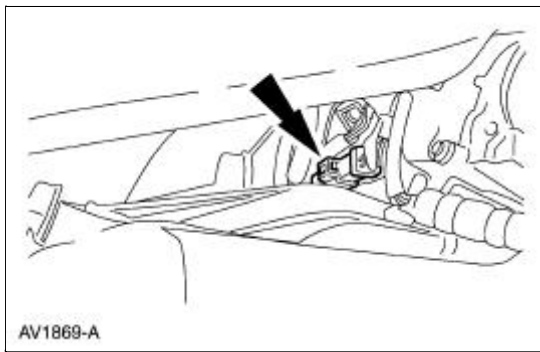
12. Disconnect the engine control jumper harness electrical connector.



13. Remove the wiring harness bracket bolt.

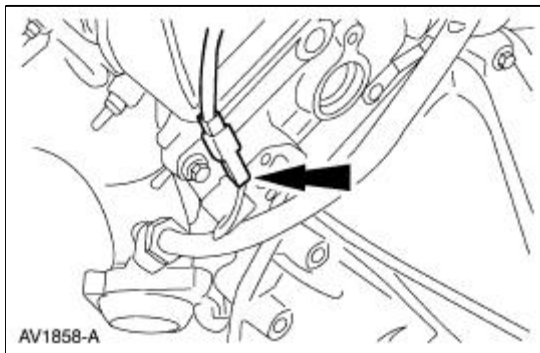


14. Disconnect the RH heated oxygen sensor (HO2S) electrical connector.

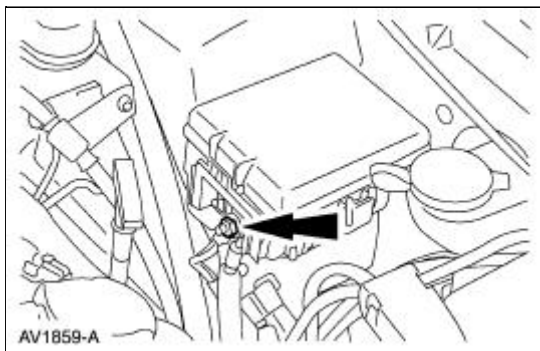


15. **NOTE:** LH side is shown, RH side is similar.

Disconnect the two radio ignition interference capacitor electrical connectors.

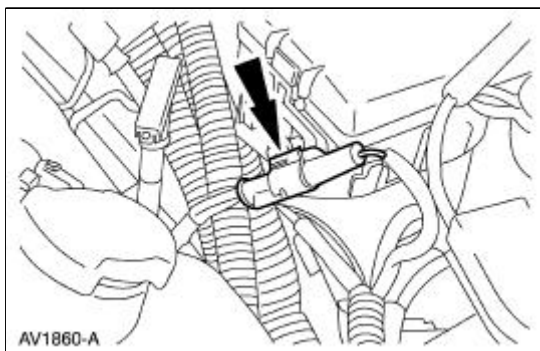


16. Disconnect the battery supply wire from the power distribution box stud.

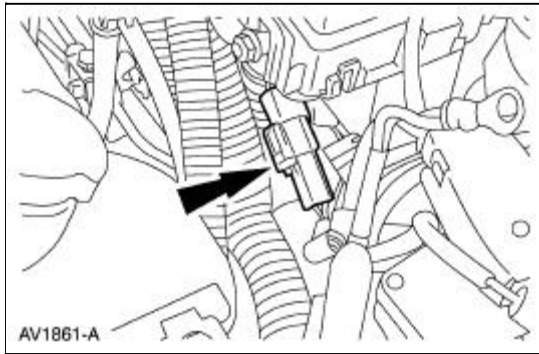


17. **NOTE:** The electrical connector is located under the power distribution box.

Disconnect the electrical connector.

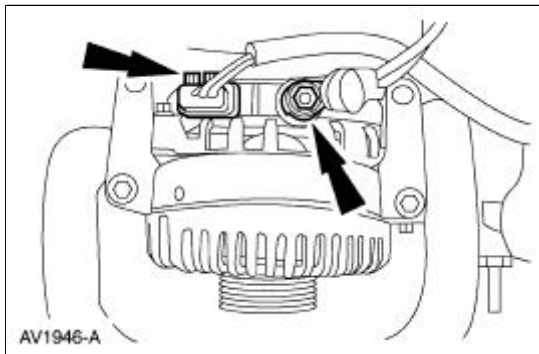


18. Disconnect the electrical connector.

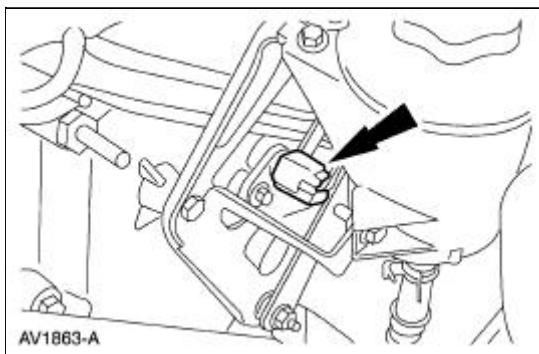


19. Disconnect the following generator electrical connectors:

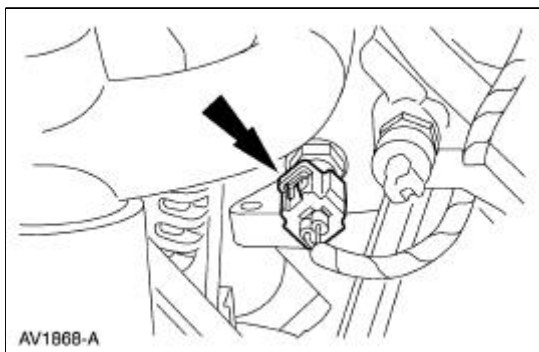
- Battery power supply wire.
- Voltage regulator.



20. Disconnect the camshaft position (CMP) sensor electrical connector.

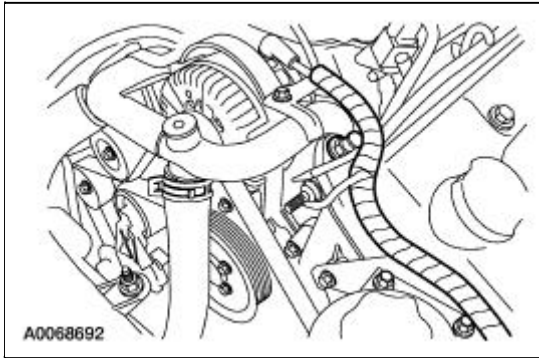


21. Disconnect the engine coolant temperature (ECT) sensor electrical connector.



22. Remove the wiring harness.

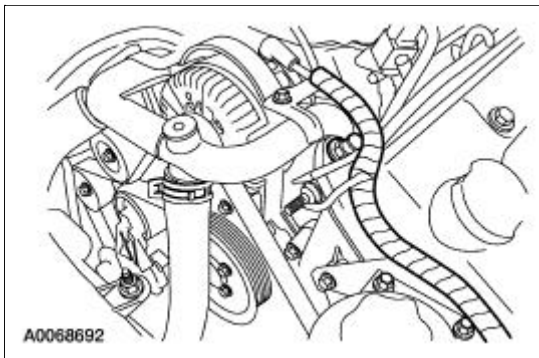
- Separate the wiring harness from the LH valve cover stud bolt.
- Separate the wiring harness from the power steering reservoir bracket.



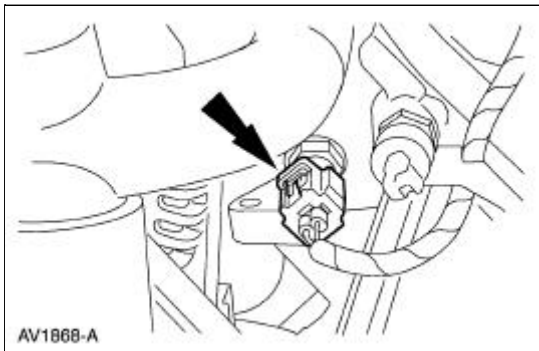
Installation

1. Position the wiring harness:

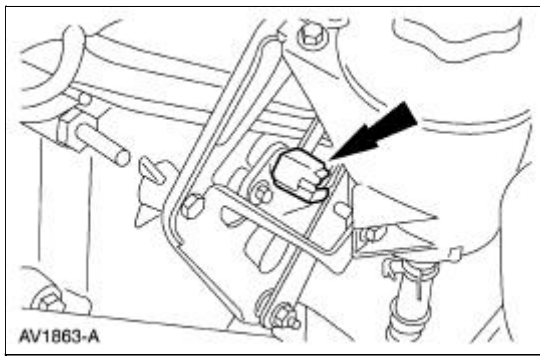
- Install the wiring harness retainer onto the LH valve cover stud bolt.
- Install the wiring harness retainer into the power steering reservoir.



2. Connect the ECT sensor electrical connector.

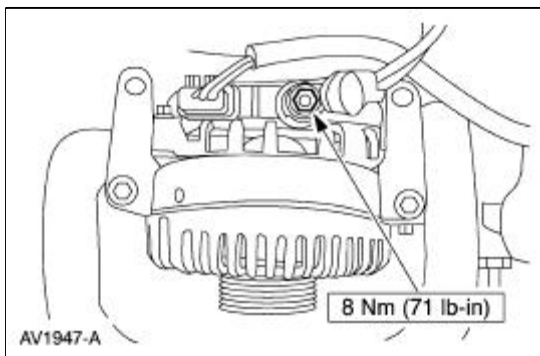


3. Connect the CMP sensor electrical connector.

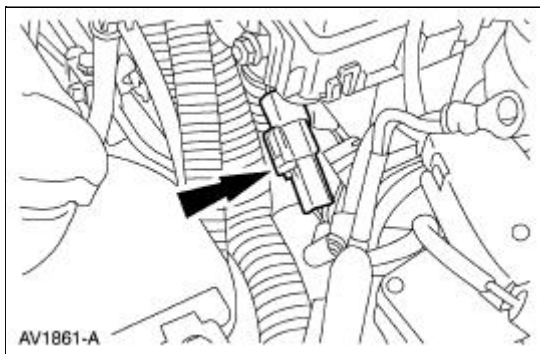


4. Connect the following generator electrical connectors:

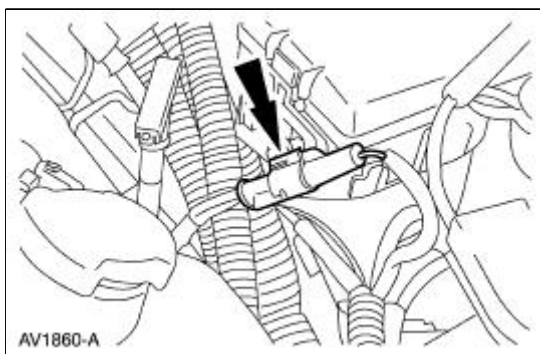
- Battery power supply wire.
- Voltage regulator.



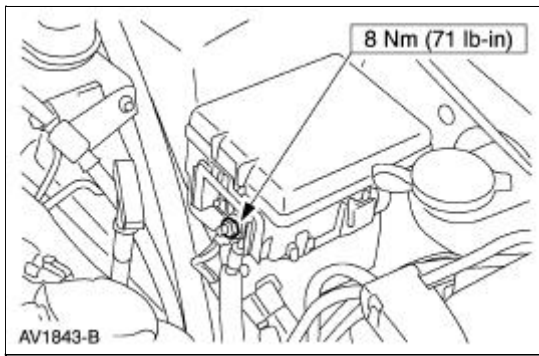
5. Connect the electrical connector.



6. Connect the electrical connector.

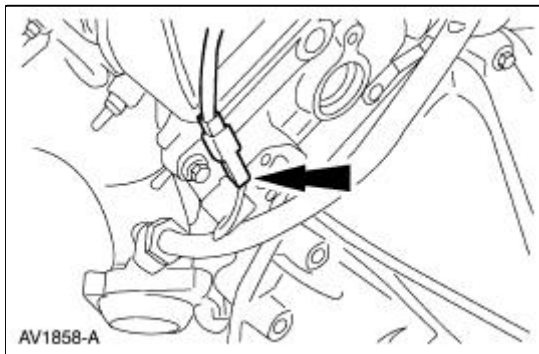


7. Install the battery supply wire to the power distribution box stud.

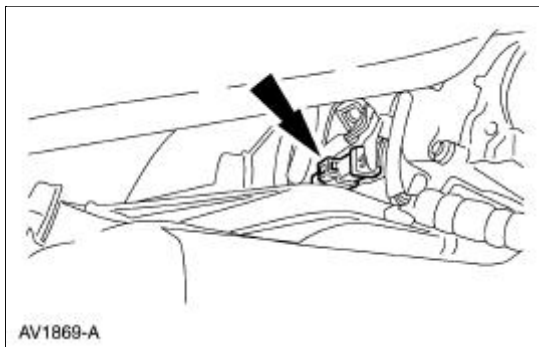


8. **NOTE:** LH side is shown, RH side is similar.

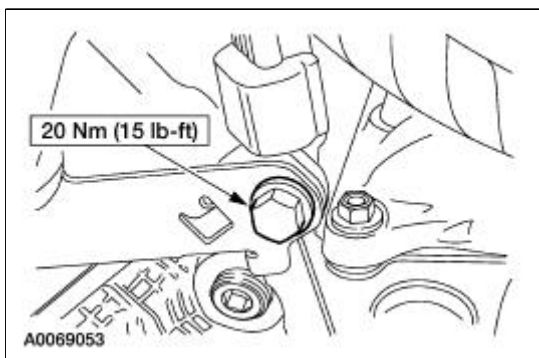
Connect the two radio ignition interference capacitor electrical connectors.



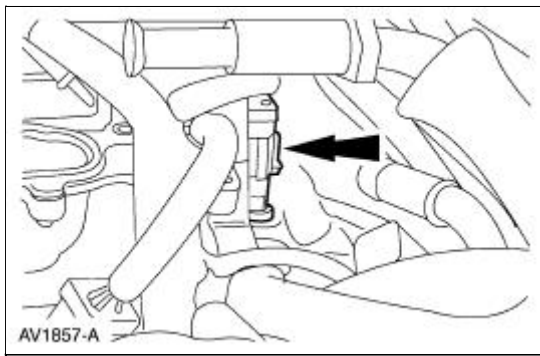
9. Connect the RH HO2S electrical connector.



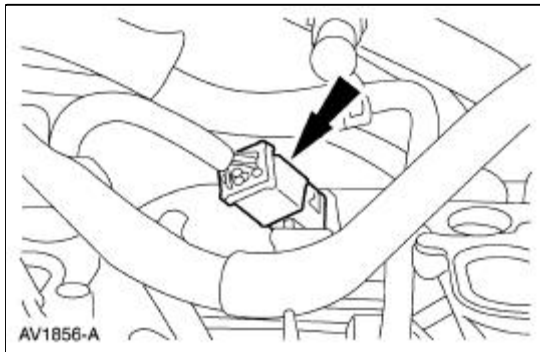
10. Install the wiring harness bracket bolt.



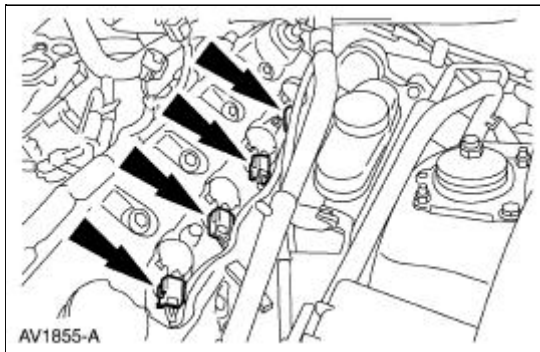
11. Connect the engine control jumper harness electrical connector.



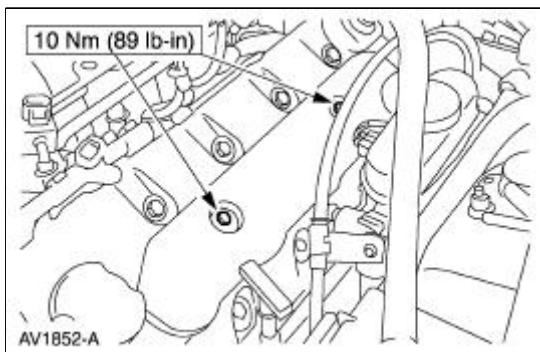
12. Connect the transmission main control harness electrical connector.



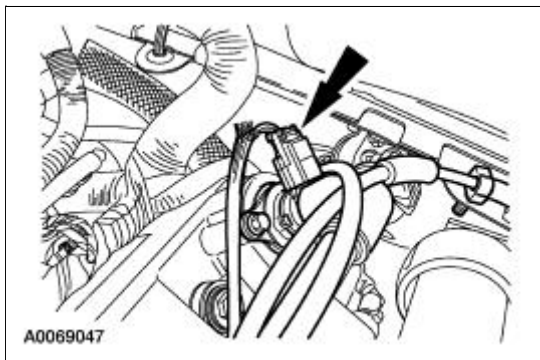
13. Connect the LH ignition coil electrical connectors.



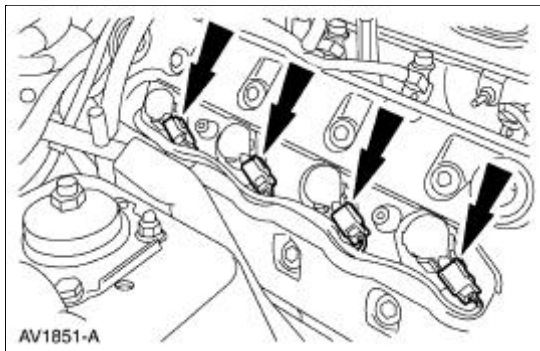
14. Install the LH ignition coil cover and bolts.



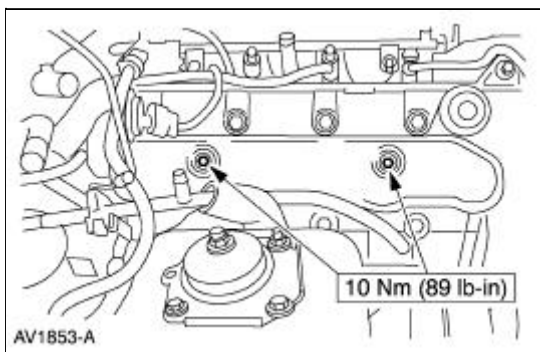
15. Connect the heated positive crankcase ventilation (PCV) valve electrical connector.



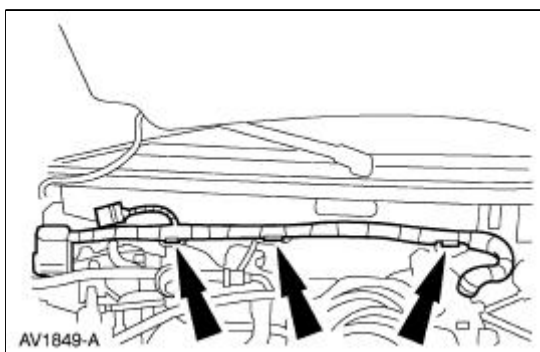
16. Connect the RH ignition coil electrical connectors.



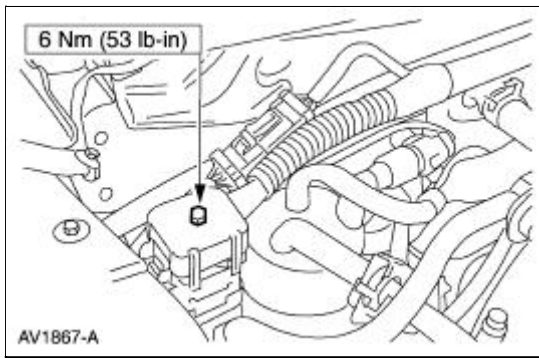
17. Install the RH ignition coil cover and bolts.



18. Install the wiring harness retainers into the dash panel.



19. Connect the following connectors:
- The 42 pin engine bulkhead electrical connector.
 - The 16 pin electrical connector.





20. Install the upper intake manifold. For additional information, refer to [Section 303-01D](#).
21. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

Connect the battery ground cable. For additional information, refer to [Section 414-01](#).

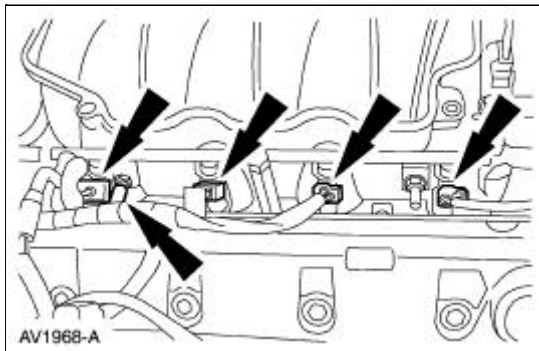
Supply Manifold

Removal

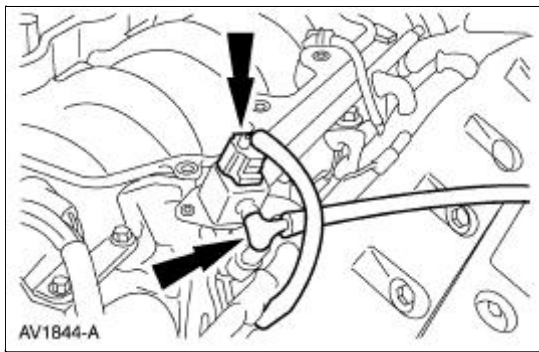
 **WARNING:** Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and can ignite. Failure to follow these instructions can result in personal injury.

 **WARNING:** Fuel in the fuel system remains under high pressure even when the engine is not running. Before working on or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved. Failure to follow these instructions can result in personal injury.

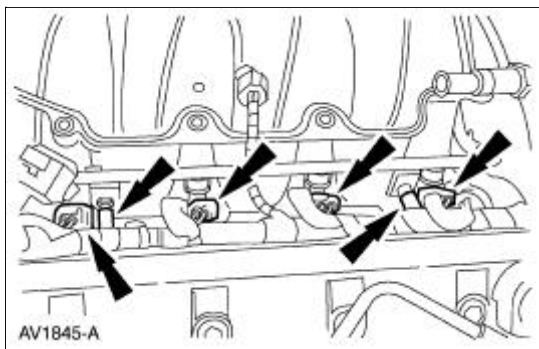
1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#) .
2. Remove the upper intake manifold. For additional information, refer to [Section 303-01D](#) .
3. Relieve the fuel pressure. For additional information, refer to [Section 310-00](#) .
4. Disconnect the fuel line. For additional information, refer to [Section 310-00](#) .
5. Position the wiring harness aside.
 - Disconnect the RH fuel injector electrical connectors.
 - Separate the harness from the RH fuel supply manifold stud bolt.



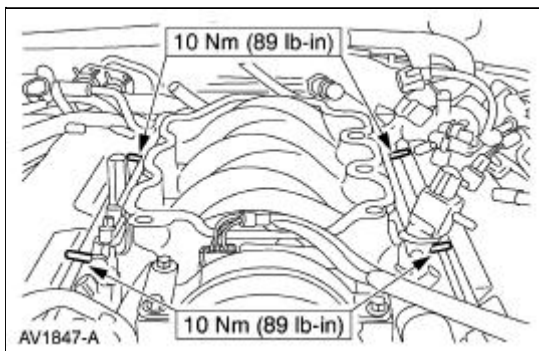
6. Disconnect the fuel pressure sensor.
 - Disconnect the electrical connector.
 - Disconnect the vacuum hose.



7. Position the wiring harness aside.
 - Disconnect the LH fuel injector electrical connectors.
 - Separate the harness from the LH fuel supply manifold stud bolt.



8. Remove the fuel supply manifold.
 - Remove the four bolts.



Installation

1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

To install, reverse the removal procedure.

General Specifications

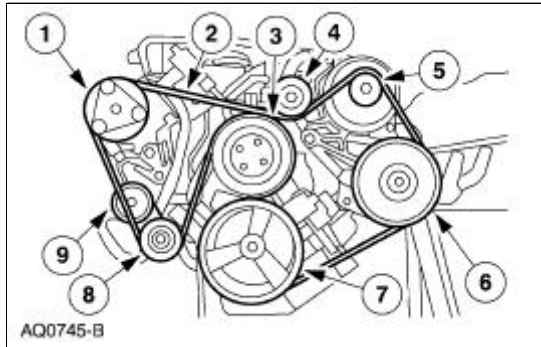
Item	Specification
Accessory drive belt	6 ribs
Supercharger drive belt	8 ribs

Torque Specifications

Description	Nm	lb-ft	lb-in
Belt idler pulley bolt	25	18	—
Drive belt tensioner bolt — 3.8L	82	60	—
Drive belt tensioner bolt — 4.6L	10	—	89
Drive belt tensioner bolt — Supercharged engine	25	18	—
Cooling hose mounting bolt	25	18	—
Belt idler support assembly bracket bolts	25	18	—
Air intake scoop bolts	25	18	—
Air intake scoop bracket bolt	25	18	—
Air intake scoop bracket nuts	25	18	—
Air intake scoop bracket throttle body nut	9	—	80
Exhaust gas recirculation (EGR) vacuum regulator solenoid bolts	10	—	89

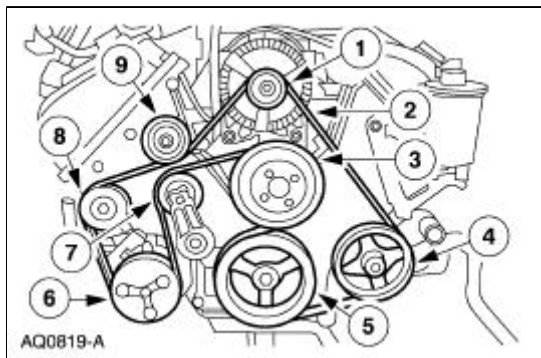
Accessory Drive

Component Locations— 3.8L



Item	Part Number	Description
1	19D784	A/C clutch pulley
2	8620	Drive belt
3	8509	Coolant pump pulley
4	8678	Belt idler pulley
5	10344	Generator pulley
6	10344	Power steering pump pulley
7	63126	Crankshaft vibration damper
8	6B209	Drive belt tensioner
9	—	Drive belt tensioner (part of 6B209)

Component Locations—4.6L

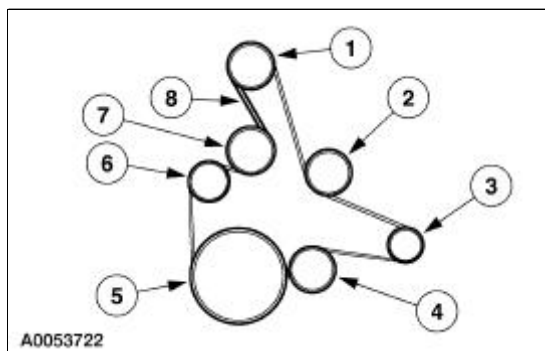


Item	Part Number	Description
1	10344	Generator pulley
2	8620	Drive belt
3	8A528	Coolant pump pulley
4	3D673	Power steering pump pulley
5	6316	Crankshaft vibration damper
6	19D784	A/C clutch pulley

7	6B209	Drive belt tensioner
8	19A216	Belt idler pulley
9	19A216	Belt idler pulley

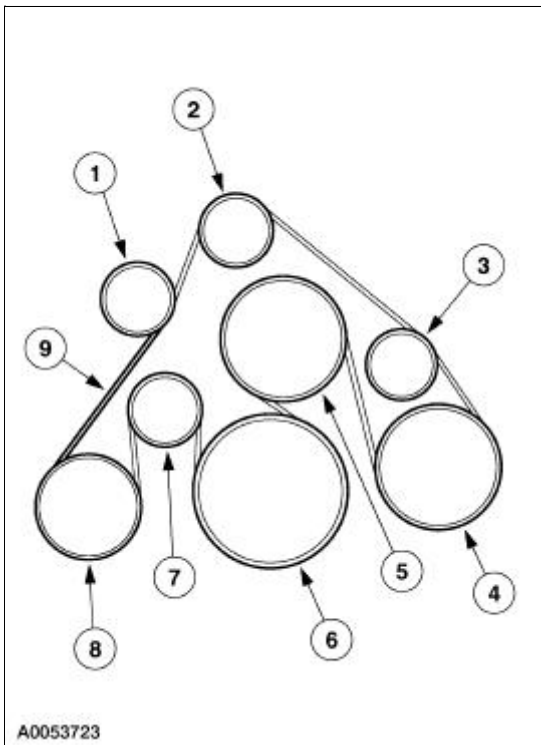
Accessory Drive —Cobra

Component Locations —Supercharger Accessory Drive



Item	Part Number	Description
1	—	Supercharger pulley
2	8678	Belt idler pulley
3	10344	Generator pulley
4	8678	Belt idler pulley
5	6C254	Crankshaft extension pulley
6	6B209	Belt tensioner
7	8678	Belt idler pulley
8	8620	Drive belt

Component Location —Accessory Drive



A0053723

Item	Part Number	Description
1	8678	Belt idler pulley
2	8678	Belt idler pulley
3	8678	Belt idler pulley
4	3A733	Power steering pulley
5	10344	Coolant pump pulley
6	6C254	Crankshaft pulley
7	6B209	Belt tensioner
8	19D784	A/C clutch pulley
9	8620	Drive belt

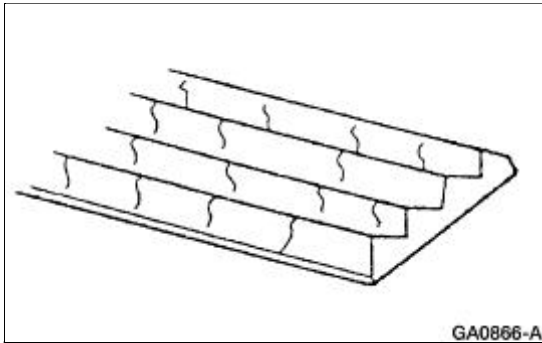
Accessory Drive

Inspection and Verification

1. Verify customer concern by running the engine.
2. Inspect the drive belt for chunking, fraying and wear.
3. Check the drive belt for correct routing.

Drive Belt Cracking/Chunking/Wear

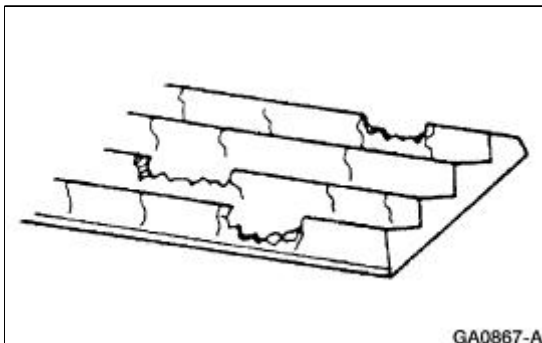
V Ribbed Serpentine Drive Belt With Cracks Across Ribs



The accessory drive:

- has a single serpentine drive belt.
- has an automatic drive belt tensioner.
- does not require adjustment.

V Ribbed Belt With Chunks of Rib Missing



Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● Drive belt noise, chirping, flutter 	<ul style="list-style-type: none"> ● Defective/worn drive belt. ● Misaligned pulley. ● Pulley runout. ● Damaged accessories. ● Fluid contamination of drive belt. ● Damaged or worn drive belt tensioner. 	<ul style="list-style-type: none"> ● GO to Component Tests, Drive Belt, Noise/Flutter. ● GO to Component Tests, Belt Tensioner, Automatic.
<ul style="list-style-type: none"> ● Premature drive belt wear 	<ul style="list-style-type: none"> ● Defective drive belt. ● Misaligned pulley. ● Pulley runout. ● Damaged accessories. ● Incorrectly installed drive belt. 	<ul style="list-style-type: none"> ● GO to Component Tests, Drive Belt Noise/Flutter and Drive Belt Misalignment diagnosis.

Component Tests

Drive Belt Noise/Flutter

Drive belt chirp occurs due to pulley misalignment or excessive pulley runout. It can be the result of a damaged pulley or an incorrectly aligned pulley.

To correct, determine the area where the noise comes from. Check each of the pulleys in that area with a straightedge to the crankshaft pulley, looking for accessory pulleys out of position in the fore/aft direction or at an angle to the straightedge.

Drive belt squeal is an intermittent noise that occurs when the drive belt slips on a pulley during certain conditions, such as: engine start up, rapid engine acceleration, or A/C clutch engagement.

Drive belt squeal can occur:

- if any of the accessories are damaged, have a worn or damaged bearing, internal torsional resistance above normal. All accessories should be rotatable by hand in the unloaded condition. If not, inspect the accessory.
- if fluid gets on the drive belt. This includes power steering fluid, engine coolant, engine oil or air conditioning system lubricant. If fluid does get on the drive belt during service, clean the drive belt with soap and water and thoroughly rinse with clean water.
- **NOTE:** The drive belt tensioner arm should rotate freely without binding.

if the drive belt is too long. A drive belt that is too long will allow the drive belt tensioner arm to go all the way to the arm travel stop under certain load conditions, which will release tension to the drive belt. If the drive belt tensioner indicator is outside the installation wear range window, install a new drive belt.

- if the drive belt tensioner is worn or damaged.

Belt Tension

NOTE: Drive belt tension is not adjustable.

The drive belt tensioner automatically adjusts drive belt tension.

Belt Tensioner, Automatic

Check the automatic drive belt tensioner:

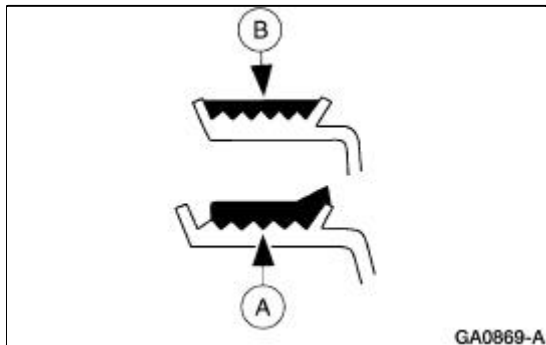
1. With the engine off, check for correct drive belt routing; refer to [Accessory Drive](#). Repair as necessary.
2. Rotate the drive belt tensioner and check for a binding or frozen condition. Install new components as necessary.

Drive Belt Misalignment



CAUTION: Incorrect drive belt installation will cause excessive drive belt wear and may cause the drive belt to come off the drive pulleys.

Non-standard drive belts may track differently or incorrectly. If a drive belt tracks incorrectly, install it with an original equipment drive belt to avoid performance failure or loss of drive belt.



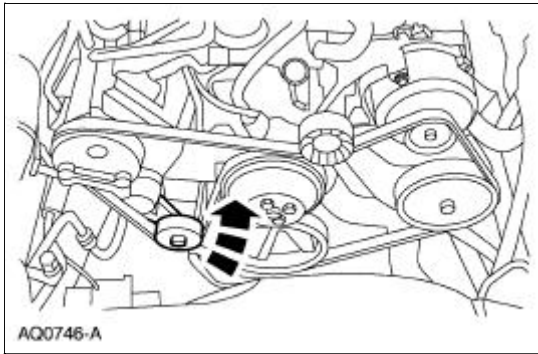
With the engine running, check drive belt tracking. If the (A) edge of the drive belt rides beyond the edge of the pulleys, noise and premature wear may occur. Make sure the (B) drive belt rides correctly on the pulley. If a drive belt tracking condition exists, proceed with the following:

- Visually check the drive belt tensioner for damage, especially the mounting pad surface. If the drive belt tensioner is not installed correctly, the mounting surface pad will be out of position. This will result in chirp and squeal noises.
 - With the engine running, visually observe the grooves in the pulleys (not the pulley flanges or the pulley forward faces) for excessive wobble. Install new components as necessary.
 - Check all accessories, mounting brackets and the drive belt tensioner for any interference that would prevent the component from mounting correctly. Correct any interference condition and recheck the drive belt tracking.
 - Tighten all accessories, mounting brackets, and drive belt tensioner retaining hardware to specification. Recheck the drive belt tracking.
-

Accessory Drive Belt —3.8L

Removal and Installation

1. Rotate the drive belt tensioner counterclockwise and remove the drive belt.



2. **NOTE:** Make sure the drive belt is correctly installed on each pulley.

To install, reverse the removal procedure.

- Refer to [Accessory Drive](#) for drive belt routing.
-

Accessory Drive Belt —4.6L (2V) and (4V)

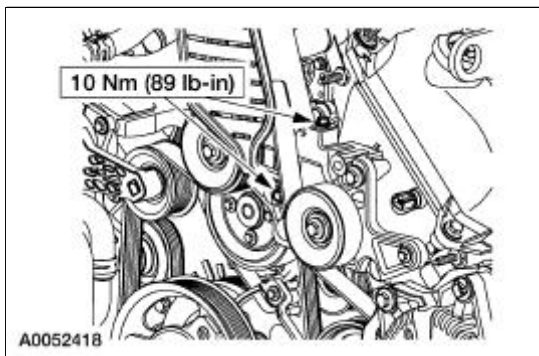
Removal and Installation

Mach I

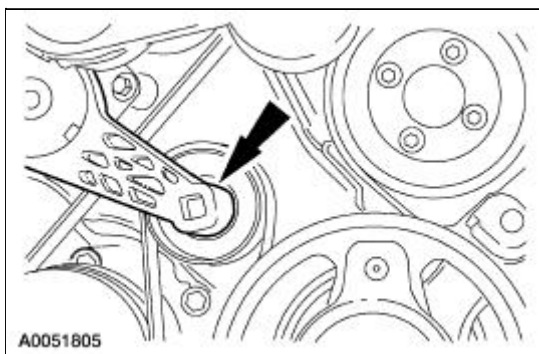
1. Remove the air intake scoop. For additional information, refer to [Section 303-12](#).

Cobra

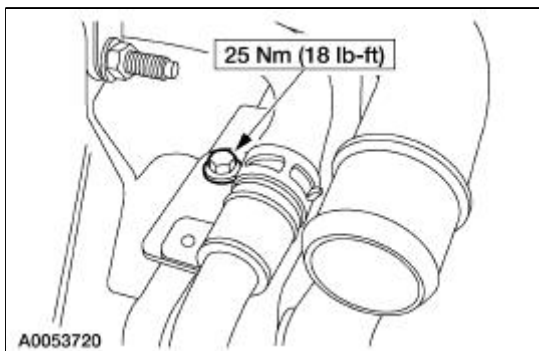
2. Remove the supercharger drive belt cover.



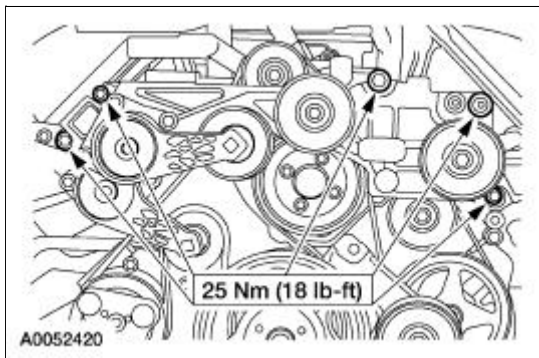
3. Rotate the supercharger belt tensioner clockwise and remove the supercharger belt.



4. Remove the coolant hose mounting bolt.



5. Remove the belt idler support bracket assembly.



6. Remove auxiliary crankshaft pulley. For additional information, refer to [Section 303-01C](#).

All engines

7. Rotate the belt tensioner and remove the accessory drive belt.
8. **NOTE:** Make sure the accessory drive belt is correctly installed on each pulley.

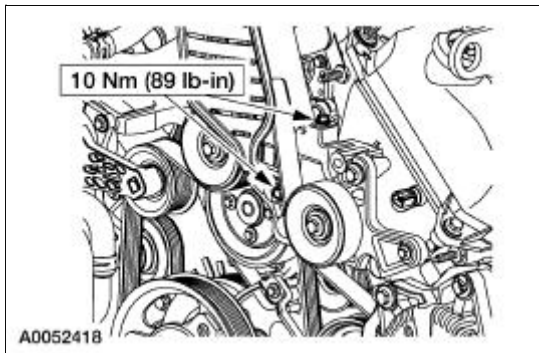
To install, reverse the removal procedure.

- Refer to [Accessory Drive](#) and [Accessory Drive—Cobra](#) for accessory drive belt routing.
-

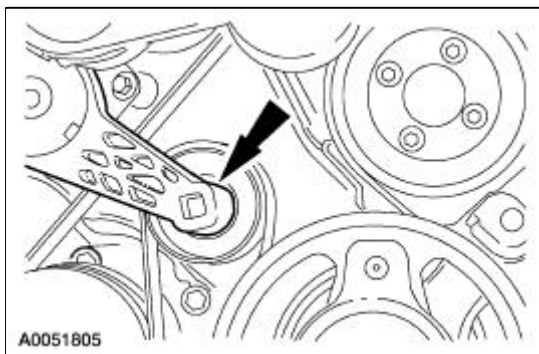
Supercharger Belt

Removal and Installation

1. Remove the supercharger drive belt cover.



2. Rotate the supercharger belt tensioner clockwise and remove the supercharger belt.

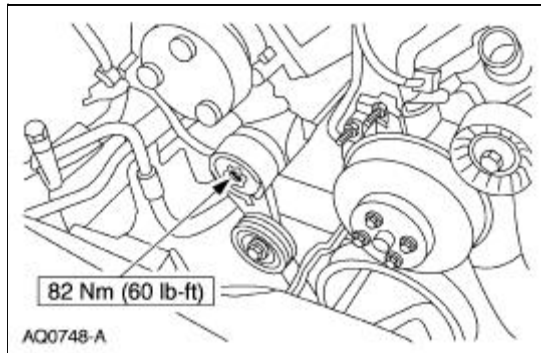


3. To install, reverse the removal procedure.
-

Accessory Drive Belt Tensioner —3.8L

Removal and Installation

1. Remove the drive belt. For additional information, refer to [Accessory Drive Belt—3.8L](#) in this section.
2. Remove the belt tensioner.
 - Remove the bolt.



3. To install, reverse the removal procedure.
-

Accessory Drive Belt Tensioner —4.6L (2V) and (4V)

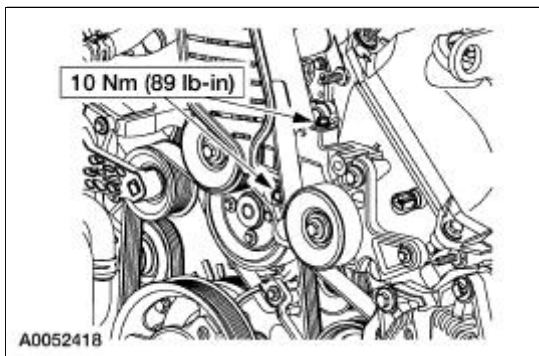
Removal and Installation

Mach I

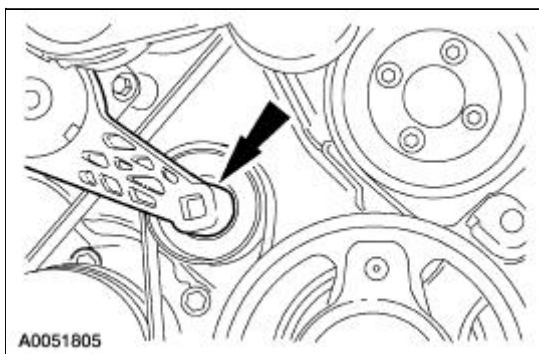
1. Remove the air intake scoop. For additional information, refer to [Section 303-12](#).

Cobra

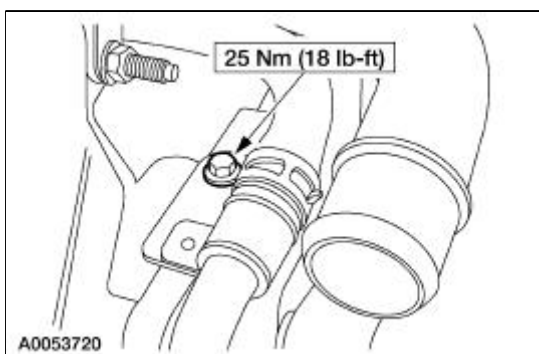
2. Remove the supercharger drive belt cover.



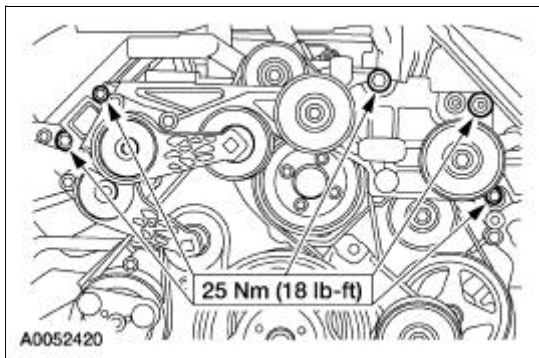
3. Rotate the supercharger belt tensioner clockwise and remove the supercharger belt.



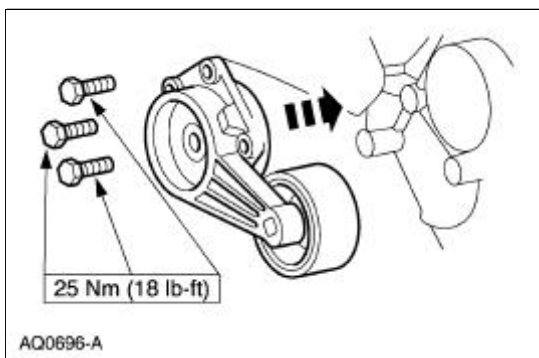
4. Remove the cooling hose and tube assembly mounting bolt.



5. Remove the belt idler support bracket assembly.

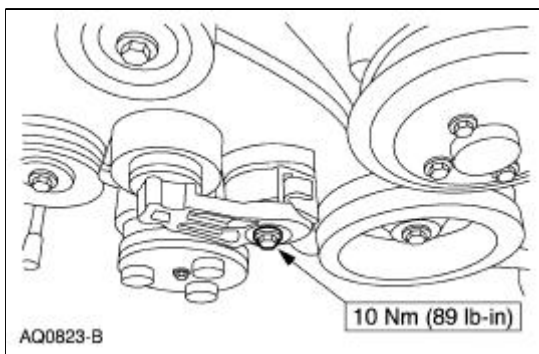


6. Remove the accessory drive belt. For additional information, refer to [Accessory Drive Belt—4.6L \(2V\) and \(4V\)](#) in this section.
7. Remove the accessory drive belt tensioner.



All engines

8. Remove the accessory drive belt. For additional information, refer to [Accessory Drive Belt Tensioner—4.6L \(2V\) and \(4V\)](#) in this section.
9. Remove the belt tensioner.
 - Remove the bolt and the tensioner.

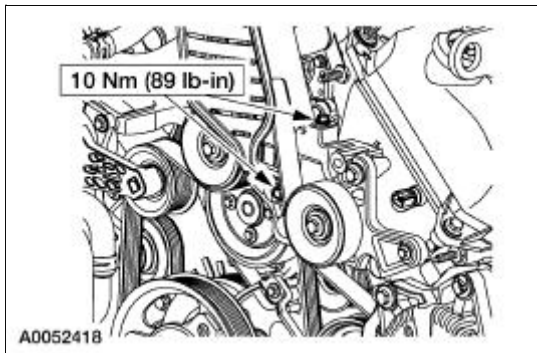


10. To install, reverse the removal procedure. Refer to [Accessory Drive](#) and [Accessory Drive—Cobra](#) for accessory drive belt routing.
-

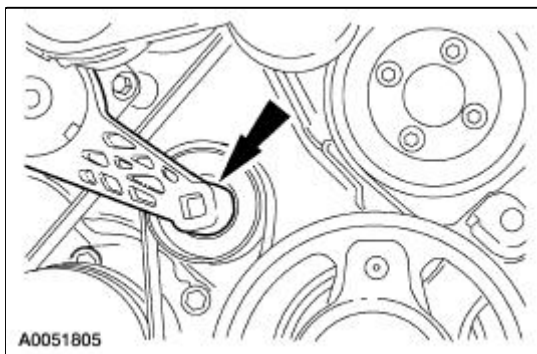
Supercharger Belt Tensioner

Removal and Installation

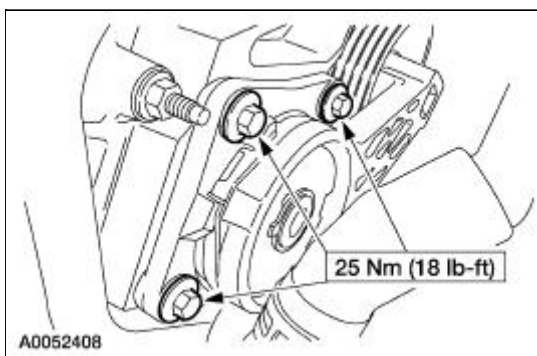
1. Remove the supercharger drive belt cover.



2. Rotate the supercharger belt tensioner clockwise and remove the supercharger belt.



3. Remove the bolts and the supercharger belt tensioner.

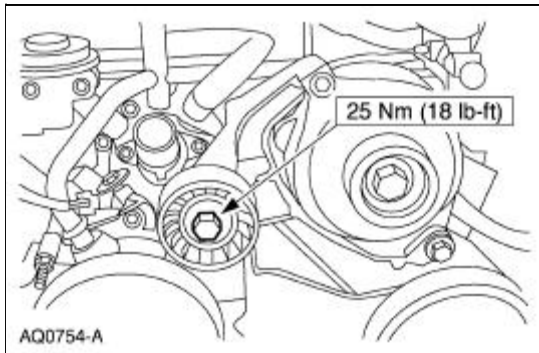


4. To install, reverse the removal procedure.

Accessory Drive Belt Idler Pulley —3.8L

Removal and Installation

1. Remove the drive belt. For additional information, refer to [Accessory Drive Belt—3.8L](#) in this section.
2. Remove the belt idler pulley.
 - Remove the bolt.



3. To install, reverse the removal procedure.
-

Accessory Drive Belt Idler Pulley —4.6L (2V) and (4V)

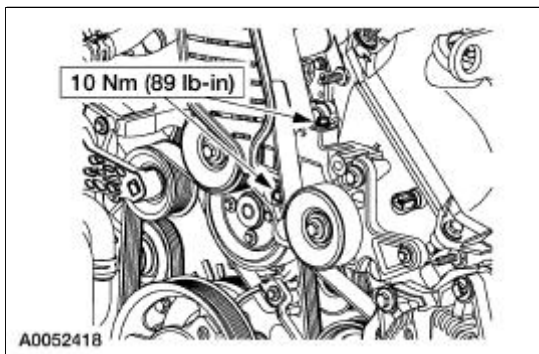
Removal and Installation

Mach I

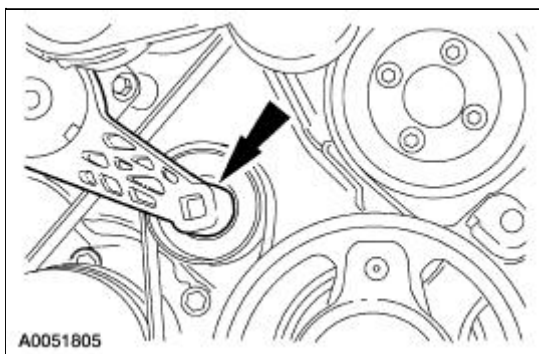
1. Remove the air intake scoop. For additional information, refer to [Section 303-12](#).

Cobra

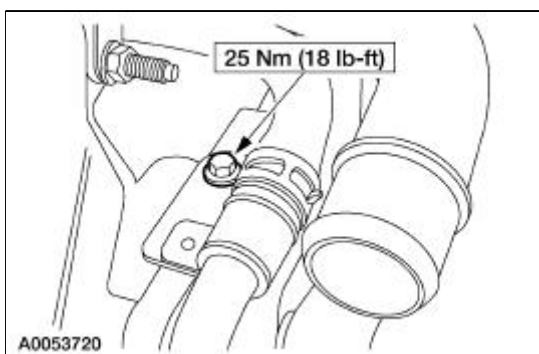
2. Remove the supercharger drive belt cover.



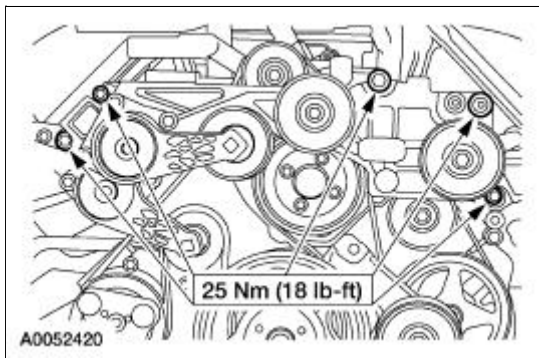
3. Rotate the supercharger belt tensioner clockwise and remove the supercharger belt.



4. Remove the coolant hose mounting bolt.



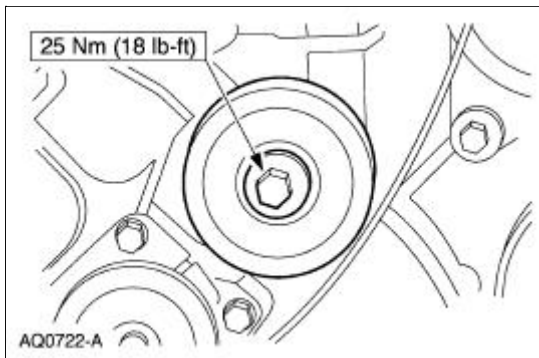
5. Remove the belt idler support bracket assembly.



All engines

6. Rotate the belt tensioner and position the accessory drive belt aside.
7. **NOTE:** The procedure listed below can be carried out on any of the 4.6L engine accessory drive belt idler pulleys.

Remove the bolt and the belt idler pulley.

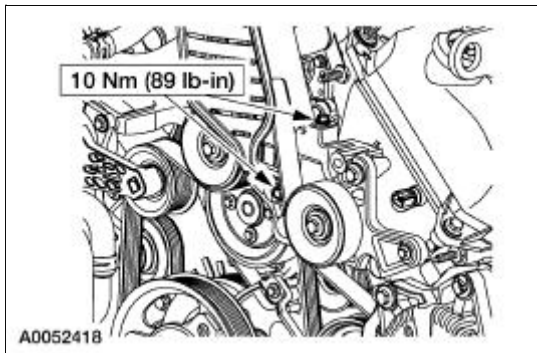


8. To install, reverse the removal procedure. Refer to [Accessory Drive](#) or [Accessory Drive—Cobra](#) in this section, for accessory belt routing.
-

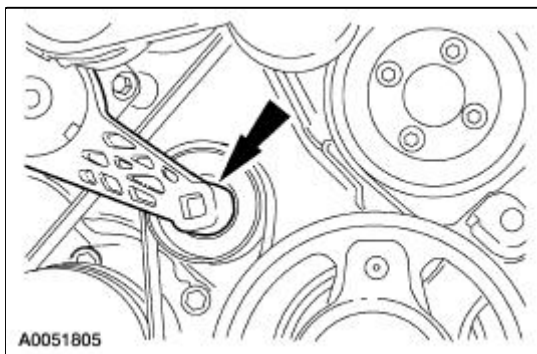
Supercharger Belt Idler Pulley

Removal and Installation

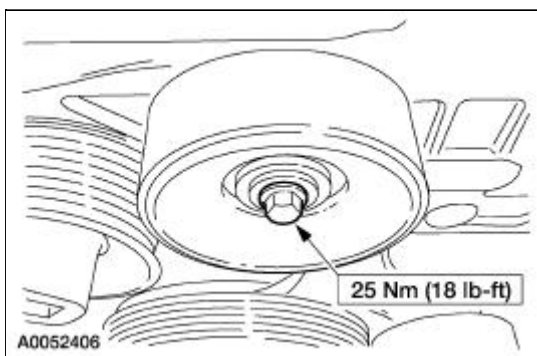
1. Remove the supercharger drive belt cover.



2. Rotate the supercharger belt tensioner clockwise and remove the supercharger belt.



3. Remove the bolt and the supercharger belt idler pulley.



4. To install, reverse the removal procedure.

General Specifications

Item	Specification
Normal engine cranking speed rpm	100-140 rpm
Starter motor no load current draw amperes	60-80 amps
Starter motor normal load current draw	130 amps
Starter motor maximum load current draw amperes	400 amps
Maximum starting circuit voltage drop (engine at normal engine temperature)	0.5 volt

Torque Specifications

Description	Nm	lb-ft	lb-in
Starter motor bolts	25	18	—
Starter motor ground cable nut	25	18	—
Starter motor solenoid S terminal nut	6	—	53
Starter motor solenoid B terminal nut	12	9	—

Starting System

Starter Motor

The starter motor is a 12-volt unit that has the starter solenoid mounted on the drive end housing and functions as follows:

- The current flows through the solenoid energizing coil until the solenoid plunger is at the end of its travel.
- The plunger closes a set of contacts that bypass the energizing coil, letting the holding coil keep the starter drive engaged and passing starting current to the starter motor.
- The motor is energized when the starter solenoid contacts are closed.
- The starter drive engages the flywheel ring gear and starts the engine.
- An overrunning clutch in the starter drive protects the starter motor from excessive speed when the engine starts.

Starter Relay

The starter interrupt relay consists of:

- pull in coil and contacts

When the ignition switch is in the START position:

- the pull-in coil is activated and pulls the contacts together.
- current passes through the starter relay from the engine compartment power distribution box to the starter solenoid.

Clutch Pedal Position (CPP) Switch

The CPP switch for:

- a manual transmission closes when the clutch pedal is depressed, completing the starting circuit.
- an automatic transmission is a jumper inserted in place of the CPP switch to complete the circuit.

Starter System — Operation


When the ignition switch is turned to the START position the starter relay switches power to the starter solenoid causing the starter motor to engage as long as:

- the clutch pedal is depressed (manual transmission only).
- the digital transmission range (TR) sensor is in PARK or NEUTRAL (automatic transmission only).

Starting System

Refer to Wiring Diagrams Cell [20](#), Starting System for schematic and connector information.

Special Tool(s)

 <p>ST1137-A</p>	<p>Digital Multimeter 105-R0051 or equivalent</p>
---	---

Inspection and Verification



WARNING: When servicing starter motor or carrying out other underhood work in the vicinity of the starter motor, be aware that the heavy gauge battery input lead at the starter solenoid is "electrically hot" at all times. A protective cap or boot is provided over this terminal that must be installed after servicing. Be sure to disconnect the battery negative cable before servicing the starter. Failure to follow these instructions may result in personal injury.



WARNING: When working in area of the starter motor, be careful to avoid touching hot exhaust components. Failure to follow these instructions may result in personal injury.



WARNING: When using a remote starter switch or jumper wire, be sure the ignition switch is in the OFF position and the transmission is in PARK (A/T) or Neutral (M/T) with the parking brake control fully applied.

1. Verify the customers concern by operating the starting system to duplicate the conditions.
2. Inspect to determine if any of the following mechanical or electrical concerns apply.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> ● Starter motor ● Brackets 	<ul style="list-style-type: none"> ● Battery ● Battery junction box (BJB) fuse ignition switch (40A) ● Central junction box (CJB) Fuse 6 (20A) ● Fuse 24 (10A) ● Damaged wiring harness ● Starter Relay ● Loose or corroded connections

3. If the inspection reveals an obvious concern that can be readily identified, repair as necessary.
4. If the concern remains after the inspection, determine the symptom. GO to [Symptom Chart](#).

Symptom Chart

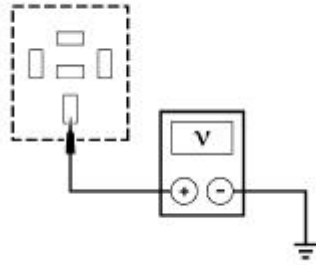
SYMPTOM CHART

Condition	Possible Sources	Action
<ul style="list-style-type: none"> The engine does not crank and the relay does click 	<ul style="list-style-type: none"> Battery. Fuse. Starter motor/solenoid. Ignition switch. Circuit. 	<ul style="list-style-type: none"> Go To Pinpoint Test A.
<ul style="list-style-type: none"> The engine does not crank and the relay does not click 	<ul style="list-style-type: none"> Fuse. Battery. Starter relay. Ignition switch. Digital transmission range (TR) sensor. Starter solenoid. Clutch pedal position (CPP) switch. Circuit. 	<ul style="list-style-type: none"> Go To Pinpoint Test B.
<ul style="list-style-type: none"> The engine cranks slowly 	<ul style="list-style-type: none"> Battery. Starter motor/solenoid. Circuit. 	<ul style="list-style-type: none"> Go To Pinpoint Test C.
<ul style="list-style-type: none"> Unusual starter noise 	<ul style="list-style-type: none"> Starter motor mounting. Starter motor. Incorrect starter drive engagement. 	<ul style="list-style-type: none"> Go To Pinpoint Test D.
<ul style="list-style-type: none"> The starter spins but the engine does not crank 	<ul style="list-style-type: none"> Starter Motor Damaged flywheel/ring gear teeth. 	<ul style="list-style-type: none"> INSPECT the starter motor mounting and engagement. REPAIR as necessary. INSPECT the flywheel/ring gear for damaged, missing or worn teeth. REPAIR as necessary.

Pinpoint Tests

PINPOINT TEST A: THE ENGINE DOES NOT CRANK AND THE RELAY DOES CLICK

Test Step	Result / Action to Take
A1 CHECK THE VOLTAGE TO THE STARTER RELAY	
<ul style="list-style-type: none"> Measure the voltage between the starter relay pin 30, circuit 1050 (LG/VT) and ground. 	<p>Yes GO to A2.</p> <p>No REPAIR circuit 1050 (LG/VT)</p>



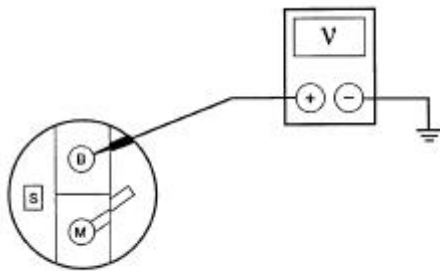
A0032573

- Is the voltage greater than 12.5 volts?

for an open. TEST the system for normal operation.

A2 CHECK THE VOLTAGE TO THE STARTER MOTOR SOLENOID

- Measure the voltage between the starter motor solenoid positive terminal and ground.



J6079-A

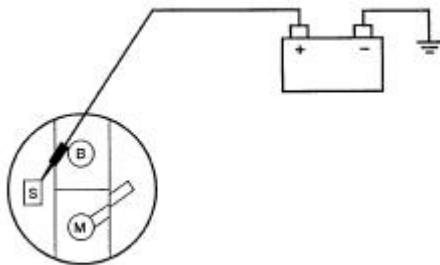
- Is the voltage 12.5 volts or greater?

Yes
GO to [A3](#).

No
REPAIR circuit 2037 (RD) for an open. TEST the system for normal operation.

A3 MANUALLY JUMP THE STARTER MOTOR

- Connect one end of a fused (15A) jumper wire to the positive terminal of the battery and touch the other end to the starter solenoid S-terminal.



J6080-A

- Does the starter solenoid engage?

Yes
GO to [A4](#).

No
INSTALL a new starter motor. REFER to [Starter Motor—3.8L](#) or [Starter Motor—4.6L](#). TEST the system for normal operation.

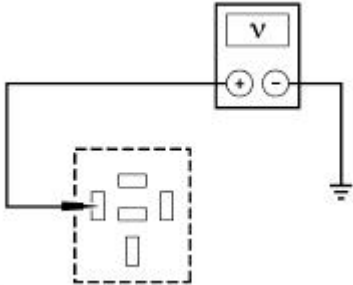
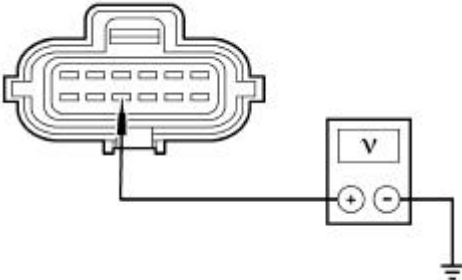
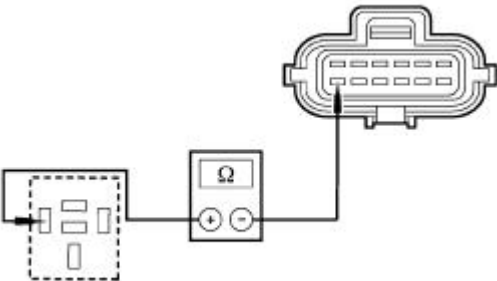
A4 TEST THE STARTER MOTOR RELAY

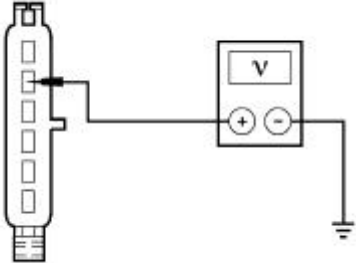
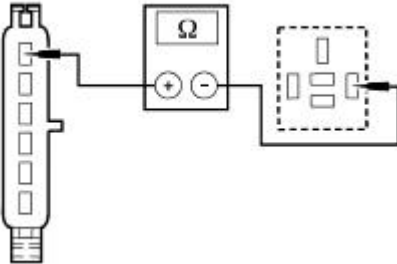
- Carry out the relay component test on the starter motor relay. Refer to the relay component test in this section.
- Does the starter motor relay test good?

Yes
REPAIR circuit 33 (WH/PK)/262 (BN/PK) for an open. TEST the system for normal operation.

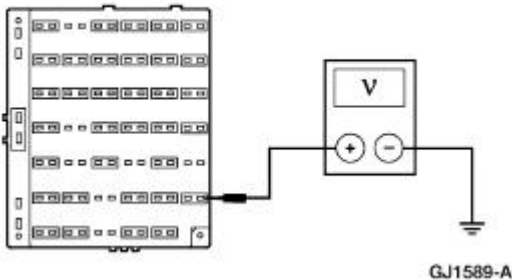
No
INSTALL a new starter motor relay. TEST the system for normal operation.

PINPOINT TEST B: THE ENGINE DOES NOT CRANK AND THE RELAY DOES NOT CLICK

Test Step	Result / Action to Take
<p>B1 CHECK CIRCUIT 33 (WH/PK) FOR VOLTAGE</p> <ul style="list-style-type: none"> ● Disconnect: Starter Motor Relay. ● Key in START position. ● Measure the voltage between the starter motor relay pin 85, circuit 33 (WH/PK) and ground while holding the key in the START position. <div style="text-align: center;">  <p>A0013862</p> </div> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to B10.</p> <p>No For automatic transmissions, GO to B2. For manual transmissions, GO to B5.</p>
<p>B2 CHECK CIRCUIT 32 (RD/LB) FOR VOLTAGE AT THE DIGITAL TR SENSOR</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Digital TR Sensor C110. ● Key in START position. ● Measure the voltage between the digital TR sensor C110 pin 10, circuit 32 (RD/LB) and ground while holding the key in the START position. <div style="text-align: center;">  <p>A0065013</p> </div> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to B3.</p> <p>No GO to B7.</p>
<p>B3 CHECK CIRCUIT 33 (WH/PK) FOR OPEN</p> <ul style="list-style-type: none"> ● Key in OFF position. <div style="text-align: center;">  <p>A0067319</p> </div> <ul style="list-style-type: none"> ● Measure the resistance between the digital TR sensor C110 pin 	<p>Yes GO to B4.</p> <p>No REPAIR circuit 33 (WH/PK). TEST the system for normal operation.</p>

<p>12, circuit 33 (WH/PK) and the starter motor relay pin 86, circuit 33 (WH/PK).</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	
<p>B4 CHECK DIGITAL TRANSMISSION RANGE (TR) SENSOR ADJUSTMENT</p>	
<ul style="list-style-type: none"> ● Carry out the digital TR sensor adjustment. Refer to Section 307-01. ● Is the digital TR sensor adjusted correctly? 	<p>Yes INSTALL a new digital TR sensor. TEST the system for normal operation.</p> <p>No ADJUST the digital TR as necessary. TEST the system for normal operation.</p>
<p>B5 CHECK CIRCUIT 32 (RD/LB) FOR VOLTAGE AT THE CLUTCH SWITCH OR JUMPER</p>	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Clutch Pedal Switch C255. ● Key in START position. ● Measure the voltage between the clutch pedal switch C255 pin 2, circuit 32 (RD/LB) and ground while holding the key in the START position.  <p>A0067320</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to B6.</p> <p>No GO to B7.</p>
<p>B6 CHECK CIRCUIT 33 (WH/PK)/32 (RD/LB) FOR OPEN</p>	
<ul style="list-style-type: none"> ● Key in OFF position. ● Measure the resistance between the clutch pedal switch C255 pin 1, circuit 33 (WH/PK)/32 (RD/LB) and the starter motor relay pin 86, circuit 33 (WH/PK)/32 (RD/LB).  <p>A0067321</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes INSTALL a new clutch pedal switch. TEST the system for normal operation.</p> <p>No REPAIR circuit 33 (WH/PK)/32 (RD/LB). TEST the system for normal operation.</p>
<p>B7 CHECK FOR VOLTAGE AT FUSE 6</p>	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Fuse #6. ● Key in START position. 	<p>Yes REPAIR circuit 32 (RD/LB). TEST the</p>

- Measure the voltage between the central junction box fuse 6, circuit 33 (WH/PK) and ground while holding the key in the START position.



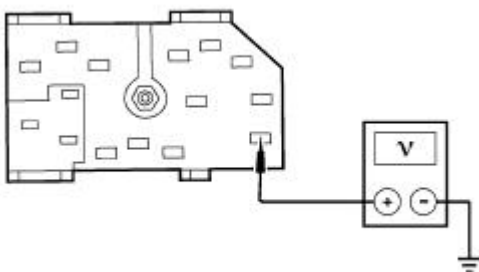
- Is the voltage greater than 10 volts?

system for normal operation.

No
GO to [B8](#).

B8 CHECK CIRCUIT 1050 (LG/VT) FOR VOLTAGE

- Key in OFF position.
- Disconnect: Ignition Switch C209.
- Key in ON position.
- Measure the voltage between the ignition switch connector C209 pin B4, circuit 1050 (LG/VT) and ground.



- Is the voltage greater than 10 volts?

Yes
GO to [B9](#).

No
REPAIR circuit 1050 (LG/VT). TEST the system for normal operation.

B9 CHECK THE IGNITION SWITCH

- Carry out the ignition switch component test. Refer to Refer to Wiring Diagrams Cell [149](#) for schematic and connector information.
- Does the ignition switch test good?

Yes
REPAIR circuit 33 (WH/PK). TEST the system for normal operation.

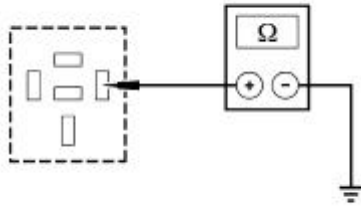
No
INSTALL a new ignition switch. TEST the system for normal operation.

B10 CHECK CIRCUIT 1205 (BK) FOR OPEN

- Key in OFF position.

Yes
INSTALL a new starter motor relay. TEST the system for normal operation.

No
REPAIR circuit 1205 (BK). TEST the system for normal operation.



A0013858

- Measure the resistance between the starter motor relay pin 86, circuit 1205 (BK) and ground.
- **Is the resistance less than 5 ohms?**

PINPOINT TEST C: THE ENGINE CRANKS SLOWLY

Test Step	Result / Action to Take
NOTE: Before beginning this test, be sure that the battery is tested and fully charged.	
C1 CHECK THE VOLTAGE TO THE STARTER	
<ul style="list-style-type: none"> ● Key in OFF position. ● Measure the voltage between the starter motor solenoid positive terminal and ground. <p style="text-align: right;">J6079-A</p> <ul style="list-style-type: none"> ● Is the voltage 12.5 volts or greater? 	<p>Yes GO to C2.</p> <p>No REPAIR the circuit between the battery and the starter solenoid. CLEAN and TIGHTEN the connections at the battery terminals. TEST the system for normal operation.</p>
C2 CHECK MOTOR GROUND CIRCUIT	
<ul style="list-style-type: none"> ● Carry out the Motor Ground Circuit test; refer to Component Tests in this section. ● Is the ground OK? 	<p>Yes INSTALL a new starter motor. REFER to Starter Motor—3.8L or Starter Motor—4.6L. TEST the system for normal operation.</p> <p>No REPAIR the ground circuit as necessary. TEST the system for normal operation.</p>

PINPOINT TEST D: UNUSUAL STARTER NOISE

Test Step	Result / Action to Take
D1 CHECK THE STARTER MOTOR MOUNTING	
<ul style="list-style-type: none"> ● Inspect the starter motor mounting 	Yes

<p>brackets for cracks.</p> <ul style="list-style-type: none"> ● Check the starter motor mounting bolts for looseness. ● Is the starter motor mounted correctly? 	<p>GO to D2.</p> <p>No REINSTALL the starter motor correctly. REFER to Starter Motor—3.8L or Starter Motor—4.6L in this section.</p>
D2 INSPECT THE STARTER MOTOR	
<ul style="list-style-type: none"> ● Remove the starter motor; refer to Starter Motor—3.8L or Starter Motor—4.6L in this section. ● Inspect the starter motor for damage. ● Is the starter motor damaged? 	<p>Yes INSTALL a new starter motor. REFER to Starter Motor—3.8L or Starter Motor—4.6L in this section. TEST the system for normal operation.</p> <p>No CHECK the starter drive. REFER to Component Tests, Starter Drive Test in this section. INSTALL a new starter motor. TEST the system for normal operation.</p>

Component Tests

Starter Motor —Voltage Drop Test



WARNING: When servicing starter motor or carrying out other underhood work in the vicinity of the starter motor, be aware that the heavy gauge battery input lead at the starter solenoid is "electrically hot" at all times. A protective cap or boot is provided over this terminal that must be installed after servicing. Be sure to disconnect the battery negative cable before servicing the starter. Failure to follow these instructions may result in personal injury.

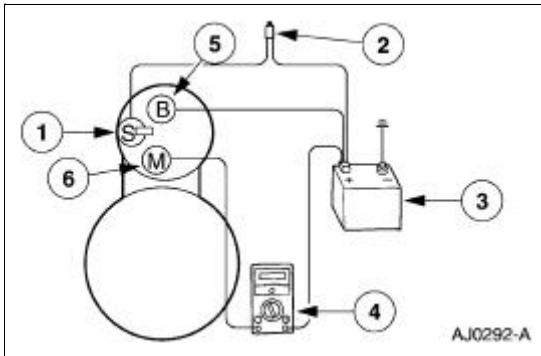


WARNING: When using a remote starter switch or jumper wire, be sure the ignition switch is in the OFF position and the transmission is in PARK (A/T) or Neutral (M/T) with the parking brake control fully applied.

Always make the Digital Multimeter connections at the component terminal rather than at the wiring end connector. Making a connection at the wiring end connector could result in false readings because the meter will not pick up a high resistance between the wiring connector and the component.

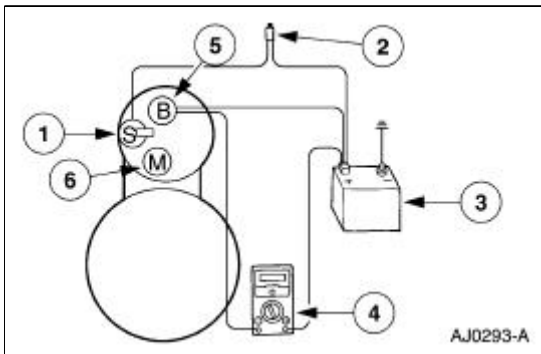
Starter Motor—Motor Feed Circuit

1. Make sure the battery is fully charged. Perform a battery load test. For additional information, refer to [Section 414-00](#).
2. Disconnect the inertia fuel shut off (IFS) switch.
3. Connect a remote starter switch between the starter solenoid S-terminal and the battery positive (+) terminal.
4. Connect the Digital Multimeter positive lead to the battery positive (+) post. Connect negative lead to the starter solenoid M-terminal.



Item	Part Number	Description
1	—	S-terminal
2	—	Remote starter switch
3	10653	Battery
4	—	Digital multimeter
5	—	B-terminal
6	—	M-terminal

- Engage the remote starter switch. Read and record the voltage. The voltage reading should be 0.5 volt or less.
- If the voltage reading is less than 0.5 volts, go to the Starter Motor-Ground Circuit Component Test.
- If the voltage reading is greater than 0.5 volts, this an indication of excessive resistance in the connections, the positive battery cable or in the starter solenoid. Move the Digital Multimeter negative lead to the starter solenoid B-terminal and repeat the test. If the voltage reading at the B-terminal is less than 0.5 volts, the concern is either in the connections at the starter solenoid or in the solenoid contacts. Go to Step 8. If the voltage reading is greater than 0.5 volts at the B-terminal, the concern is either the positive battery cable or connections. Go to Step 9.



Item	Part Number	Description
1	—	S-terminal
2	—	Remote starter switch
3	10653	Battery
4	—	Digital multimeter
5	—	B-terminal
6	—	M-terminal

- Remove the cables from solenoid B-, S- and M-terminals. Clean the cables and connections and reinstall the cables to the correct terminals. Repeat Steps 3 through 6. If the voltage drop

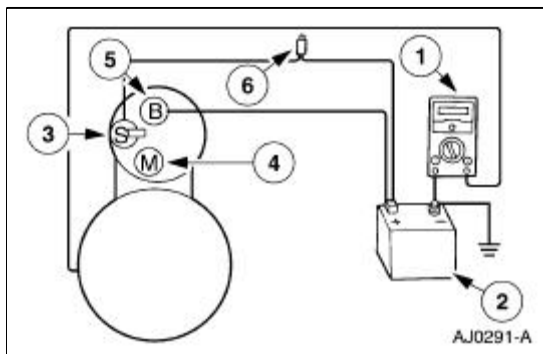
reading is still greater than 0.5 volts when checked at the M-terminal and less than 0.5 volts when checked at the B-terminal, the concern is in the solenoid contacts. Install a new starter motor. Refer to [Starter Motor—3.8L](#) or [Starter Motor—4.6L](#) .

9. Clean the positive (+) battery cable connections. Repeat the test at the starter solenoid B terminal. If the voltage is greater than 0.5 volts, install a new positive battery cable.

Starter Motor—Ground Circuit

A slow cranking condition can be caused by resistance in the ground or return portion of the cranking circuit. Check the voltage drop in the ground circuit as follows:

1. Connect the Digital Multimeter positive lead to the starter motor housing (the connection must be clean and free of rust or grease). Connect the negative lead to the negative (-) battery terminal.

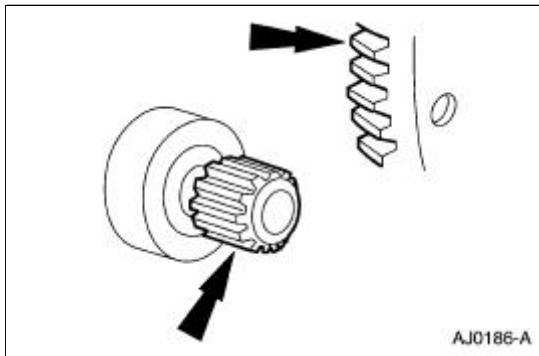


Item	Part Number	Description
1	105-R0057	Digital multimeter
2	10653	Battery
3	—	S-terminal
4	—	M-terminal
5	—	B-terminal
6	—	Remote starter switch

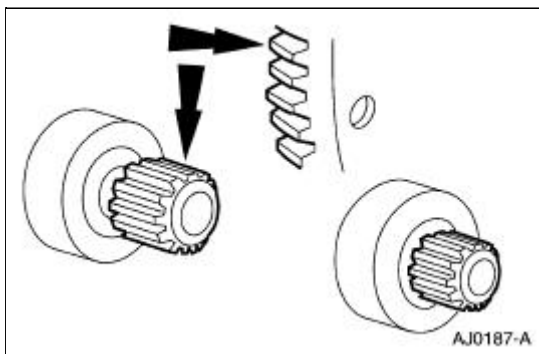
2. Engage the remote starter switch. Read and record the voltage. The voltage reading should be less than 0.3 volts.
3. If the voltage is greater than 0.3 volts, clean the negative cable connections at the battery, body ground connections, and the starter ground connections. Retest.
4. If the voltage is greater than 0.3 volts, install a new cable. If the voltage reading is less than 0.2 volts and the engine still cranks slowly, install a new starter motor. Refer to [Starter Motor—3.8L](#) or [Starter Motor—4.6L](#) .

Starter Drive and Flywheel Ring Gear Inspection

1. Remove the starter motor. For additional information, refer to [Starter Motor—3.8L](#) or [Starter Motor—4.6L](#) in this section.
2. Check the wear patterns on the starter drive gear and the flywheel ring gear . If the wear pattern is normal, install the starter motor. For additional information, refer to [Starter Motor—3.8L](#) or [Starter Motor—4.6L](#) in this section.

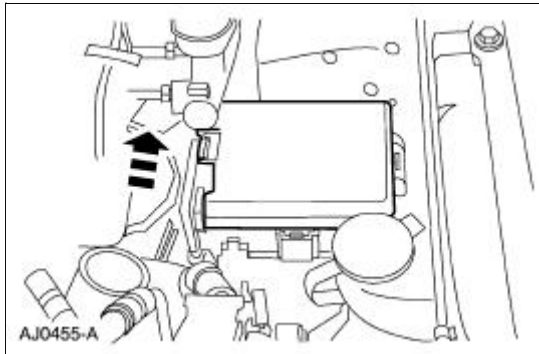


3. If the starter drive gear and the flywheel ring gear are not fully meshing and both of the gears are scored or damaged, install a new starter motor. For additional information refer to [Starter Motor—3.8L](#) or [Starter Motor—4.6L](#) in this section. If necessary, install a new flywheel. For additional information, refer to [Section 303-01A](#) or section [Section 303-01B](#).

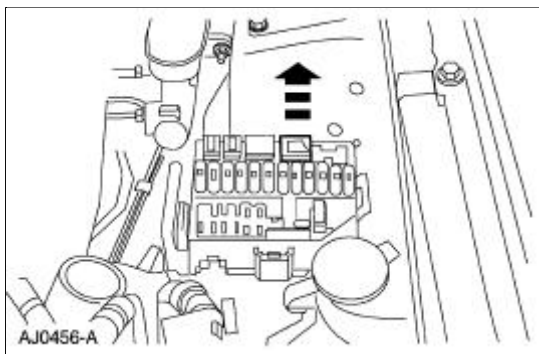


Relay Switch

1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#) .
2. Remove the power distribution box cover.



3. Remove the starter relay from the power distribution box.





Installation

1. To install, reverse the removal procedure.
-

Starter Motor —3.8L

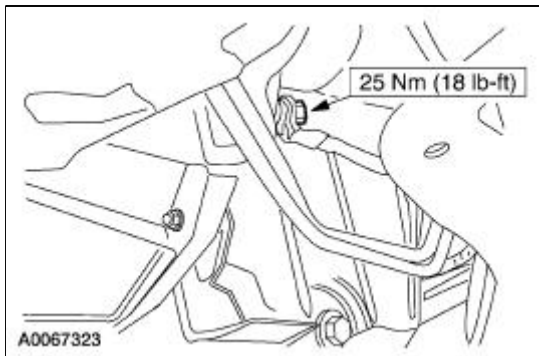
Removal

 **WARNING:** When servicing starter motor (11002) or carrying out other underhood work in the vicinity of the starter motor, be aware that the heavy gauge battery input lead at the starter solenoid (11390) is "electrically hot" at all times. A protective cap or boot is provided over this terminal that must be installed after servicing. Be sure to disconnect the battery negative cable before servicing the starter. Failure to follow these instructions may result in personal injury.

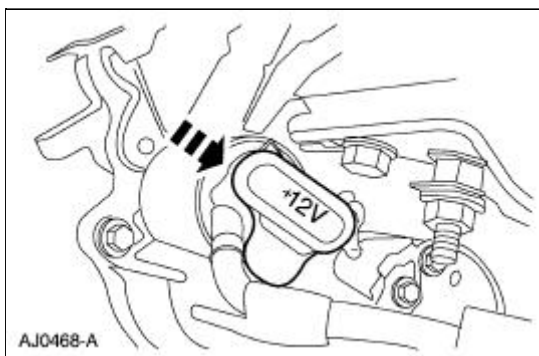
 **WARNING:** When working in area of the starter motor, be careful to avoid touching hot exhaust components. Failure to follow these instructions may result in personal injury.

NOTE: When working on the starter system, make sure the anti-theft system is deactivated (if equipped.)

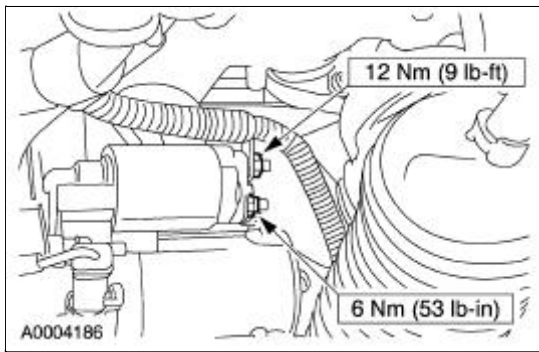
1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
3. Remove the ground cable nut.



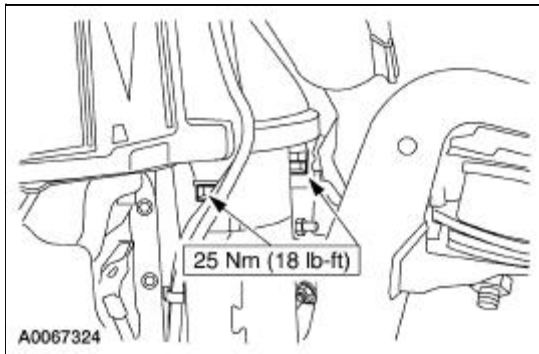
4. Remove the cap.



5. Remove the nuts and position aside the wires.



6. Remove the bolts and the starter motor.



Installation

1. To install, reverse the removal procedure.
-

Starter Motor —4.6L

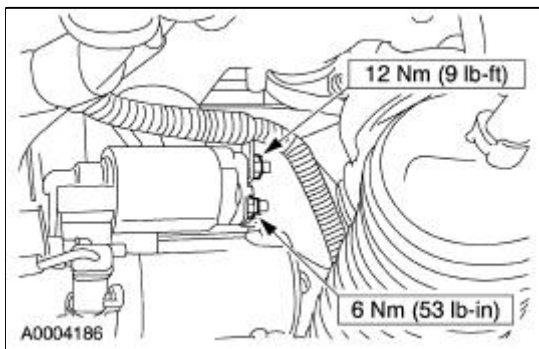
Removal

⚠ WARNING: When servicing starter motor (11002) or carrying out other underhood work in the vicinity of the starter motor, be aware that the heavy gauge battery input lead at the starter solenoid (11390) is "electrically hot" at all times. A protective cap or boot is provided over this terminal that must be installed after servicing. Be sure to disconnect the battery negative cable before servicing the starter. Failure to follow these instructions can result in personal injury.

⚠ WARNING: When working in area of the starter motor, be careful to avoid touching hot exhaust components. Failure to follow these instructions can result in personal injury.

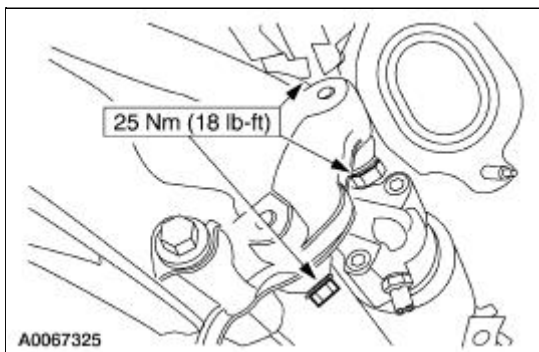
NOTE: When working on the starter system, make sure the anti-theft system is deactivated (if equipped.)

1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
3. Remove the red starter solenoid safety cap.
4. Remove the starter solenoid nuts and position aside the wires.



5. **NOTE:** To ease removal, remove the upper, concealed bolt first.

Remove the three starter motor bolts.

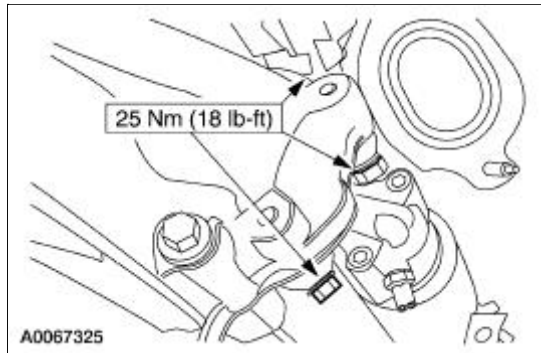


6. Remove the starter motor.

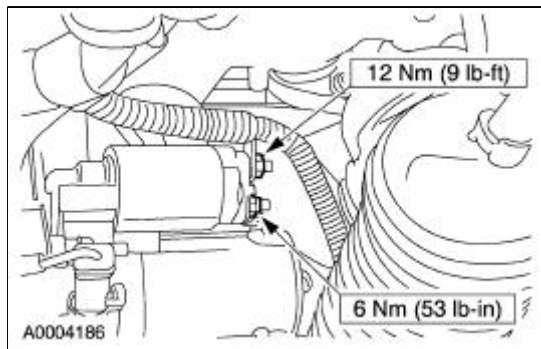
Installation

1. Position the starter motor to the engine.
2. **NOTE:** To ease installation, first install the two lower bolts finger tight, then install the upper, concealed bolt. Tighten all three bolts to specification.

Install the three starter motor bolts.



3. Connect the starter motor solenoid and starter motor cable connections.



4. Install the red starter solenoid safety cap.
 5. Lower the vehicle.
 6. Connect the battery ground cable.
-

General Specifications

Item	Specification
Base ignition timing	TBD
Firing order	1-4-2-5-3-6
Spark plug gap mm (in)	1.32-1.42 (0.052-0.056)
Spark plug type production LH	AWSF-42E
Spark plug type production RH	AWSF-42EG
Spark plug type service	AWSF-42EE
Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A	ESE-M1C171-A

Torque Specifications

Description	Nm	lb-ft	lb-in
Spark plugs	15	11	—
Ignition coil bolts	7	—	52

Engine Ignition

The ignition coil (12029), which is mounted on the upper intake manifold, can be described as a coil pack containing three separate coil units. Each coil unit is individually controlled by the powertrain control module (PCM) (12A650) through separate wire leads. Each coil unit activates two spark plugs wired in a series by the spark plug wires (12286).

- One spark plug activates on the compression stroke and uses the majority of the ignition coil's stored energy.
- The other spark plug activates on the exhaust stroke and uses very little of the ignition coil's stored energy.
- Because the pairs of spark plugs are connected in a series, one spark will travel from ground to the electrode while the other spark will travel from the electrode to ground.

The spark plug (12405):

- changes the high voltage pulse into a spark which ignites the fuel and air mixture.
- originally equipped on the vehicle has a platinum-enhanced active electrode for long life.

The crankshaft position (CKP) sensor (6C315):

NOTE: Initial engine ignition timing is set at 10 degrees \pm 2 degrees before top dead center (BTDC) and is not adjustable.

- is a variable reluctance sensor triggered by a 36-minus-1 tooth trigger pulse wheel located on the crankshaft (6303) inside the engine front cover (6019).

The sine wave type signal generated from the crankshaft position sensor provides two types of information:

- position of the crankshaft in 10 degree increments
- the crankshaft speed (rpm)

The powertrain control module (PCM) (12A650) uses this information to determine ignition coil turn ON and turn OFF times and misfire detection.

For additional information, refer to [Section 303-14](#).

Engine Ignition

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

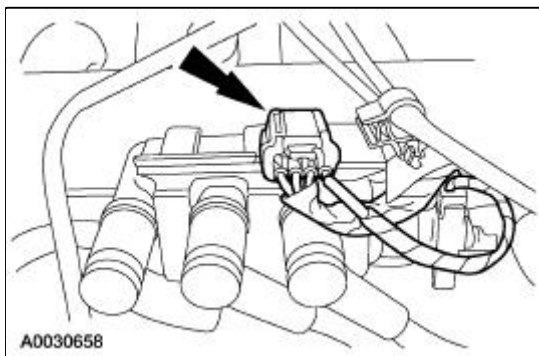
Ignition Coil


Material

Item	Specification
Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A or equivalent	ESE-M1C171-A

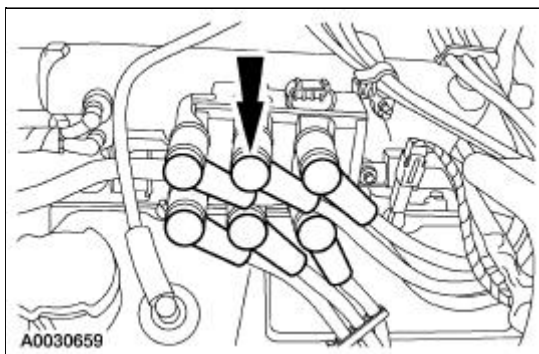
Removal and Installation

1. Disconnect the battery ground cable (14301). For additional information, refer to [Section 414-01](#).
2. Disconnect the ignition coil electrical connector.

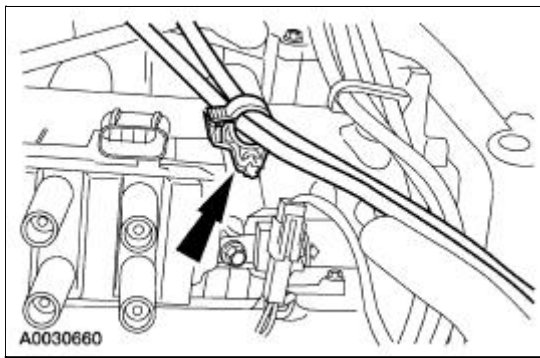


3.  **CAUTION:** Spark plug wires (12286) must be connected to the correct ignition coil terminal. Mark spark plug wire locations before removing them.

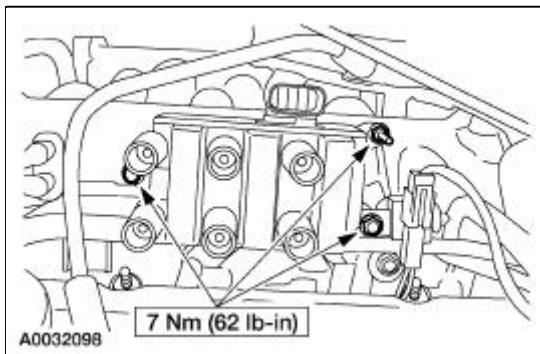
Twist while pulling upward to disconnect the spark plug wires.



4. Disconnect the accelerator cable retaining clamp from the ignition coil stud bolt.



5. Remove the bolts and the ignition coil (12029).



6. **NOTE:** Apply silicone brake caliper grease and dielectric compound to the inside of the spark plug wire coil boot.

NOTE: Be sure to reinstall the radio ignition interference capacitor (18801) under the correct mounting bolt.

To install, reverse the removal procedure.

Spark Plug Wire

Special Tool(s)

 ST1394-A	Remover, Spark Plug Wire 303-106 (T74P-6666A)
---	--

Material

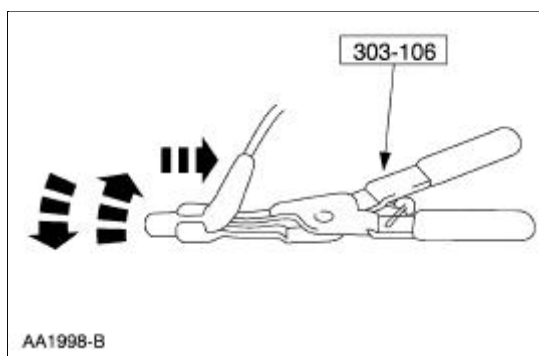
Item	Specification
Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A or equivalent	ESE-M1C171-A

Removal and Installation

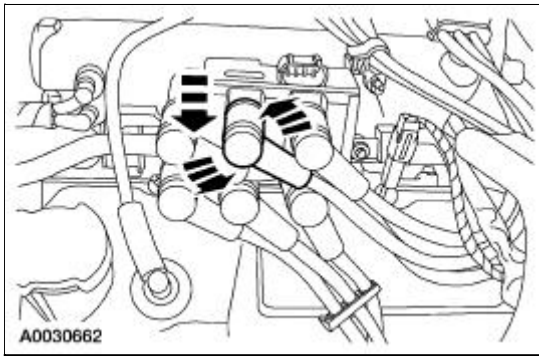
 **CAUTION:** It is important to twist the spark plug wire boots while pulling upward to avoid possible damage to the spark plug wire.

 **CAUTION:** Spark plug wires must be connected to the correct ignition coil terminal. Mark spark plug wire (12286) locations before removing them.

1. Using the special tool, remove the spark plug wire from the spark plug using a twisting motion.



2. Twist while pulling upward to disconnect the spark plug wires from the ignition coil (12029).



3.  **CAUTION:** Be sure to orient the spark plug boots so the spark plug wires do not contact the exhaust manifold.

NOTE: Apply silicone brake caliper grease and dielectric compound to the inside of spark plug and ignition coil boots of the spark plug wire.

To install, reverse the removal procedure.

Spark Plugs

Special Tool(s)

 ST1394-A	Remover, Spark Plug Wire 303-106 (T74P-6666A)
---	--

Material

Item	Specification
Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A or equivalent	ESE-M1C171-A

Removal and Installation



CAUTION: It is important to twist the spark plug wire boots while pulling upward to avoid possible damage to the spark plug wire.



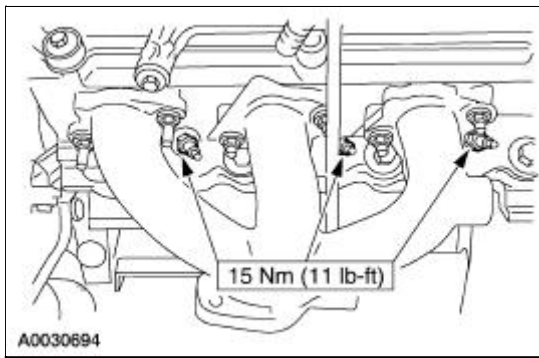
CAUTION: Spark plug wires must be connected to the correct ignition coil terminal. Mark spark plug wire (12286) locations before removing them.

1. Remove the air cleaner outlet pipe. For additional information, refer to [Section 303-12](#).
2. Using the special tool, remove the spark plug wires from the spark plugs using a twisting motion.
3. **NOTE:** Use compressed air to remove any foreign material from the spark plug well before removing the spark plugs.

NOTE: If an original spark plug is reused, make sure it is installed in the same cylinder from which it was taken. New spark plugs can be used in any cylinder.

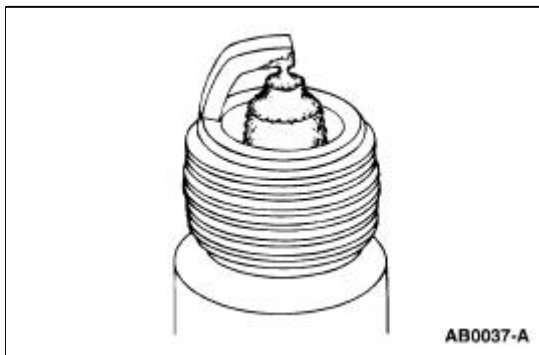
NOTE: Left side shown, right side similar.

Remove the spark plugs.



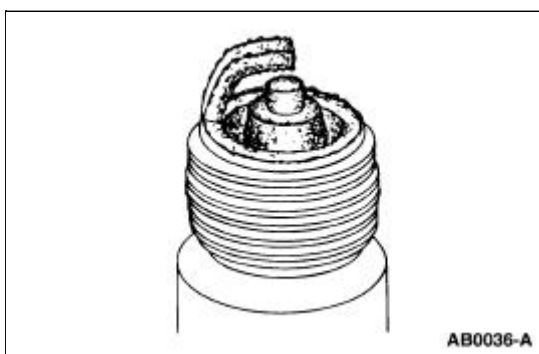
4. Inspect for gap bridged.

- This can be identified by deposit build up closing the gap between electrodes.
- This may be caused by oil or carbon fouling.
- Clean the spark plug.



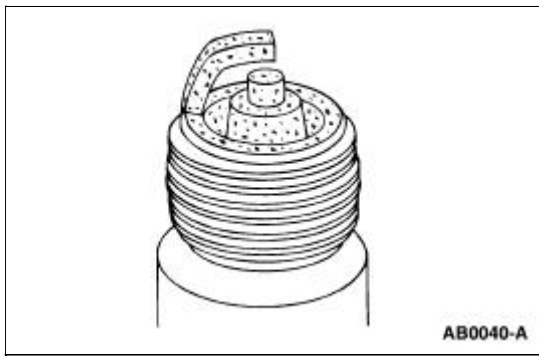
5. Inspect for oil fouling.

- This can be identified by wet black deposits on the insulator shell bore electrodes.
- This may be caused by excessive oil entering the combustion chamber through worn rings and pistons, excessive clearance between valve guides and stems, or worn or loose bearings. Correct the oil problem.
- Install a new spark plug.



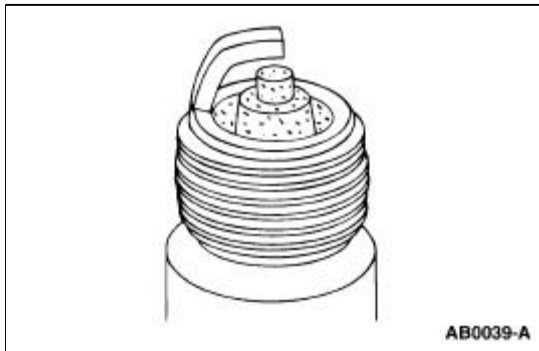
6. Inspect for carbon fouling.

- This can be identified by black, dry, fluffy carbon deposits on the insulator tips, exposed shell surfaces and electrodes.
- This may be caused by too cold a plug, dirty air cleaner, damaged fuel pump, too rich a fuel mixture or excessive idling.
- Clean the spark plug.



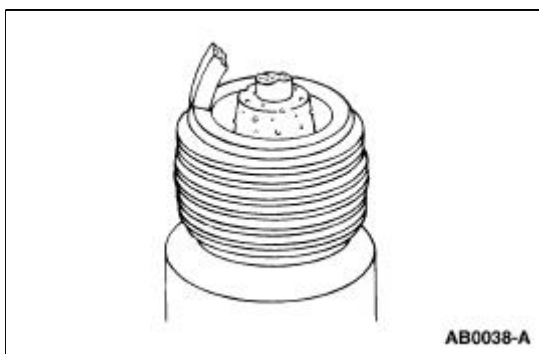
7. Inspect for normal burning.

- This can be identified by light tan or gray deposits on the firing tip.



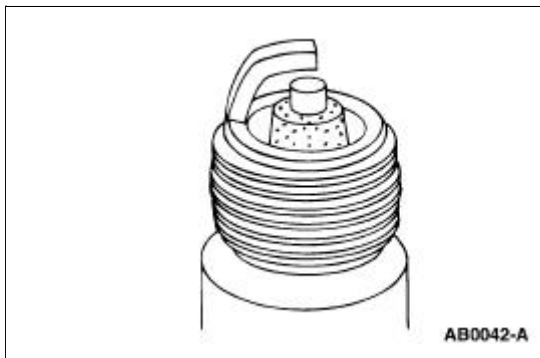
8. Inspect for pre-ignition.

- This can be identified by melted electrodes and possibly a blistered insulator. Metallic deposits on the insulator indicate engine damage.
- Install a new spark plug.



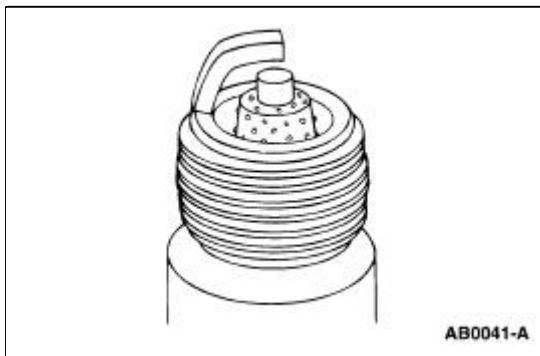
9. Inspect for overheating.


- This can be identified by a white or light gray insulator with small black or gray brown spots and a bluish-burnt appearance of the electrodes.
- This may be caused by engine overheating, the wrong type of fuel, loose spark plugs, too hot a plug, low fuel pump pressure or incorrect ignition timing.
- Install a new spark plug.



10. Inspect for fused spot deposits.

- This can be identified by melted or spotty deposits resembling bubbles or blisters.
- This can be caused by sudden acceleration.
- Clean the spark plug.

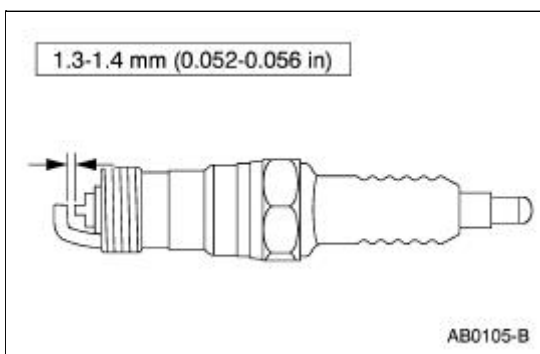


11.  **CAUTION: Be sure to orient the spark plug boots so the spark plug wires do not contact the exhaust manifold.**

NOTE: Apply silicone brake caliper grease and dielectric compound to the inside of the spark plug wire boots.

To install, reverse the removal procedure.

- Adjust the spark plug gap as necessary.



General Specifications

Item	Specification
Base ignition timing	10 degrees \pm 2 degrees non-adjustable
Firing order	1-3-7-2-6-5-4-8
Spark plug gap mm (in)	1.32-1.42 (0.052-0.056)
Spark plug type	AWSF-32PP

Torque Specifications

Description	Nm	lb-ft	lb-in
Spark plugs	15	11	—
Coil on plug bolts	10	—	89

Engine Ignition

Eight separate ignition coils (12029):

- are mounted directly above each spark plug (12405).
- are controlled by the powertrain control module (PCM) for correct firing sequence.

The spark plug:

- changes the high voltage pulse into a spark which ignites the fuel and air mixture.
- originally equipped on the vehicle has a platinum-enhanced active electrode for long life.

Crankshaft position (CKP) sensor (6C315):

NOTE: Initial engine ignition timing is set at 10 degrees \pm 2 degrees before top dead center (BTDC) and is not adjustable. For additional information, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

- is a variable reluctance sensor triggered by a 36-minus-1 tooth trigger pulse wheel located on the crankshaft (6303) inside the engine front cover (6019).

The sine wave type signal generated from the crankshaft position sensor provides two types of information:

- position of the crankshaft in 10 degree increments
- the crankshaft speed (rpm)

The powertrain control module (PCM) (12A650) uses this information to determine ignition coil turn ON and turn OFF times and misfire detection.

For additional information, refer to [Section 303-14](#).

Engine Ignition

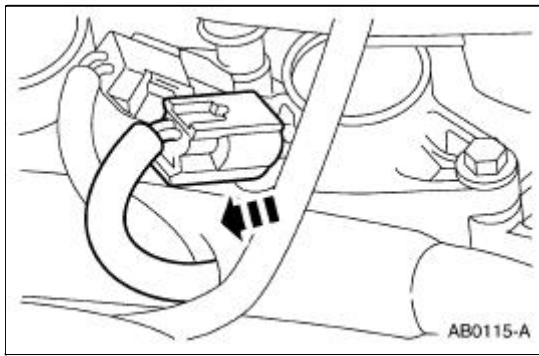
Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Ignition Coil —Coil On Plug

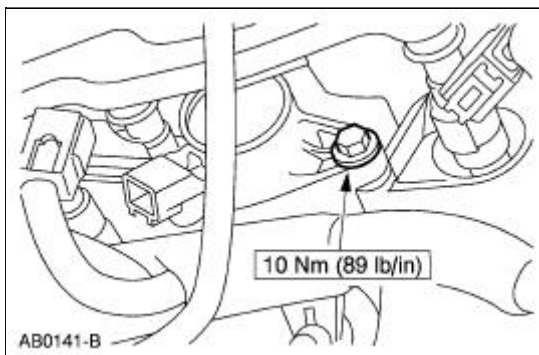
Removal

1. Disconnect the battery ground cable (14301). For additional information, refer to [Section 414-01](#).
2. Remove the air cleaner outlet tube (9B659). For additional information, refer to [Section 303-12](#).
3. **NOTE:** One ignition coil is shown, and the others are similar.

Disconnect the connector from the ignition coil (12029).



4. Remove the bolt and the ignition coil.



Installation

1. **NOTE:** Verify the ignition coil spring is correctly located inside the ignition coil boot and there is no damage to the tip of the boot.

To install, reverse the removal procedure.

Spark Plug

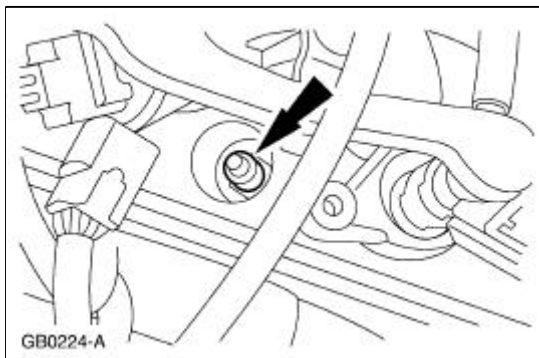
Removal

1. Remove the ignition coil on plug. For additional information, refer to [Ignition Coil—Coil On Plug](#) in this section.
2. **NOTE:** Use compressed air to remove any foreign material from the spark plug well before removing the spark plugs (12405).

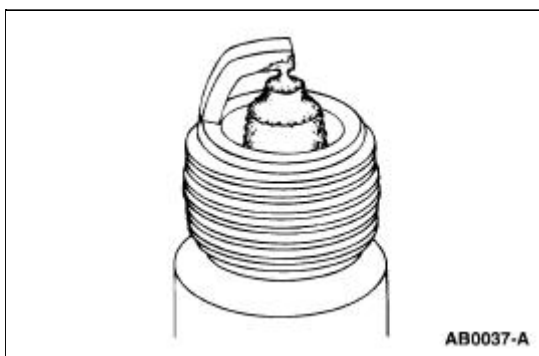
NOTE: If an original spark plug is used, make sure it is installed in the same cylinder from which it was taken. New spark plugs can be used in any cylinder.

NOTE: One spark plug is shown; others are similar.

Remove the spark plugs

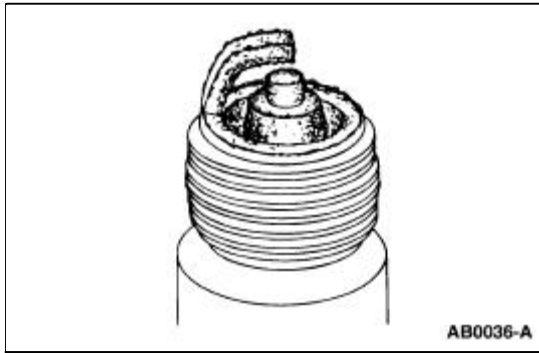


3. Inspect for gap bridged.
 - This can be identified by a deposit build up closing the gap between electrodes.
 - This can be caused by oil or carbon fouling.
 - Clean the spark plug.



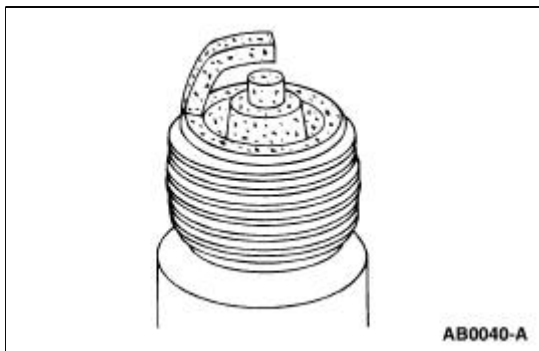
4. Inspect for oil fouling.
 - This can be identified by wet black deposits on the insulator shell bore electrodes.
 - This can be caused by excessive oil entering the combustion chamber through worn rings and pistons, excessive clearance between valve guides and stems, or worn or loose bearings. Correct the oil problem.

- Install a new spark plug.



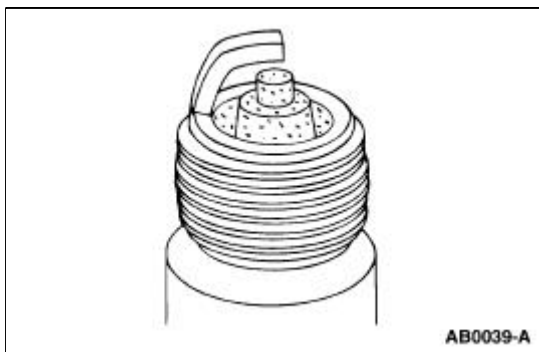
5. Inspect for carbon fouling.

- This can be identified by black, dry fluffy carbon deposits on insulator tips, exposed shell surfaces and electrodes.
- This may be caused by too cold a plug, dirty air cleaner, damaged fuel pump, too rich a fuel mixture or excessive idling.
- Clean the spark plug.



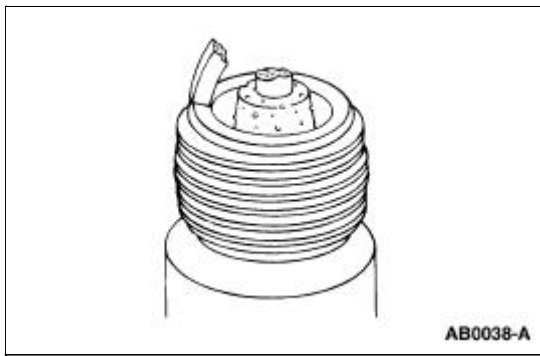
6. Inspect for normal burning.

- This can be identified by light tan or gray deposits on the firing tip.



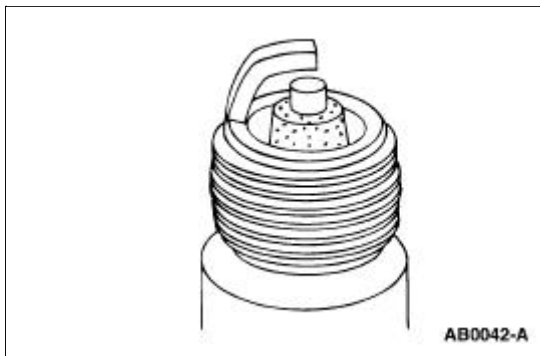
7. Inspect for pre-ignition.

- This can be identified by melted electrodes and possibly a blistered insulator. Metallic deposits on insulator indicate engine damage.
- Install a new spark plug.



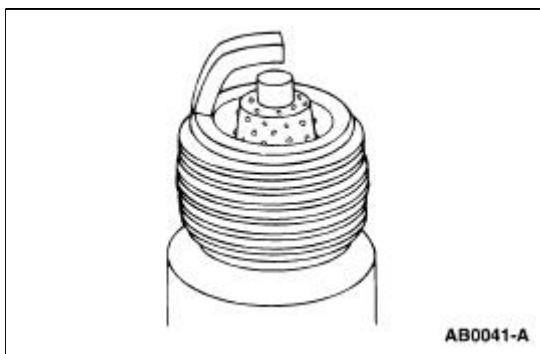
8. Inspect for overheating.

- This can be identified by a white or light gray insulator with small black or gray brown spots and with bluish-burnt appearance of the electrodes.
- This may be caused by engine overheating, wrong type of fuel, loose spark plugs, too hot a plug, low fuel pump pressure or incorrect ignition timing.
- Install a new spark plug.



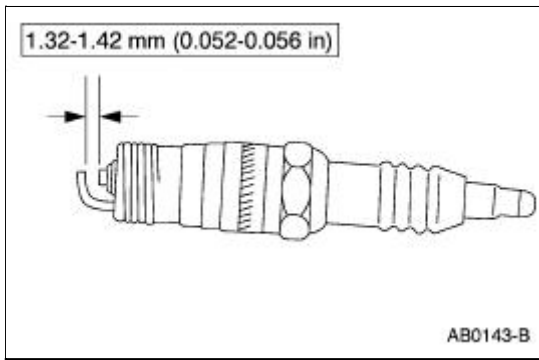
9. Inspect for fused spot deposits.

- This can be identified by melted or spotty deposits resembling bubbles or blisters.
- This may be caused by sudden acceleration.
- Clean the spark plug.

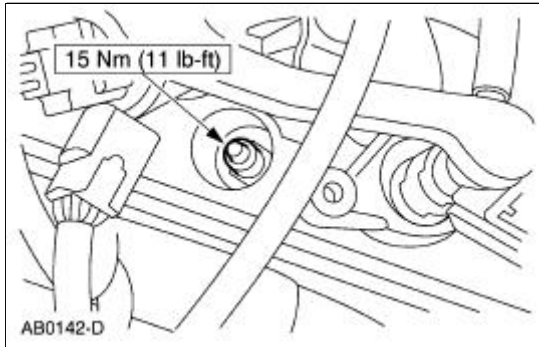


Installation

1. Adjust the spark plug gap as necessary.



2. To install, reverse the removal procedure.



General Specifications

Item	Specification
Ignition timing	10 degrees BTDC \pm 2 degrees non-adjustable
Firing order	1-3-7-2-6-5-4-8
Spark plug gap mm (in)	1.32-1.42 (0.052-0.056)
Spark plug type	AWSF-32EM

Torque Specifications

Description	Nm	lb-ft	lb-in
Spark plugs	15	11	—
Ignition coil cover bolts	10	—	89

Engine Ignition

Eight separate ignition coils:

- are controlled by the powertrain control module (PCM).
- are mounted directly above each spark plug.
- are controlled by the powertrain control module for correct firing sequence.

The spark plug:

- changes the high voltage pulse into a spark which ignites the fuel and air mixture.
- originally equipped on the vehicle has a platinum-enhanced active electrode for long life.

The crankshaft position (CKP) sensor:

NOTE: Initial engine ignition timing is set at 10 degrees \pm 2 degrees before top dead center (BTDC) and is not adjustable. For additional information, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

- is a variable reluctance sensor, triggered by a 36-minus-1 tooth trigger pulse wheel located on the crankshaft, inside the engine front cover.

The sine wave type signal generated from the crankshaft position sensor provides two types of information:

- position of the crankshaft in 10 degree increments
- the crankshaft speed (rpm)

For additional information, refer to [Section 303-14](#).

Engine Ignition

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

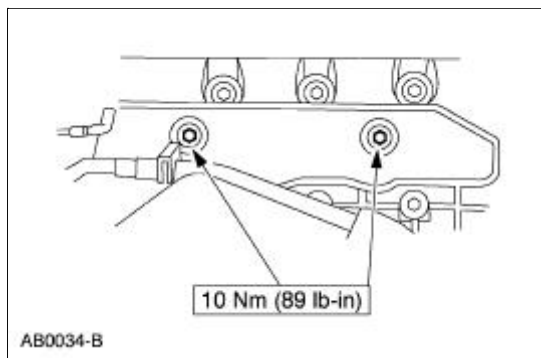
Ignition Coil-On-Plug

Material

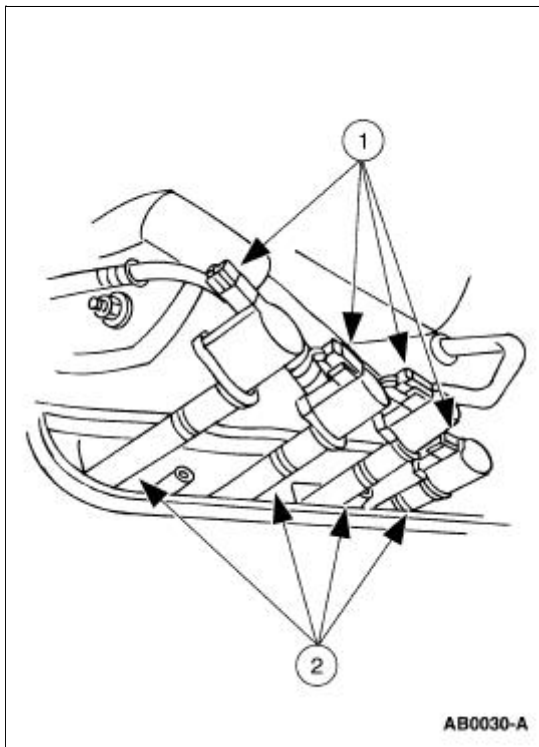
Item	Specification
Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A or equivalent	ESE-M1C171-A

Removal and Installation

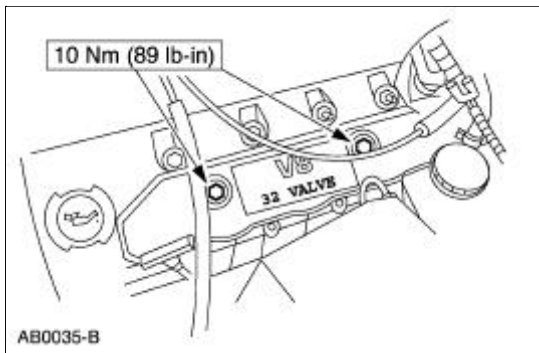
1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Remove the air cleaner outlet pipe. For additional information, refer to [Section 303-12](#).
3. Remove the RH ignition coil cover bolts and the cover.



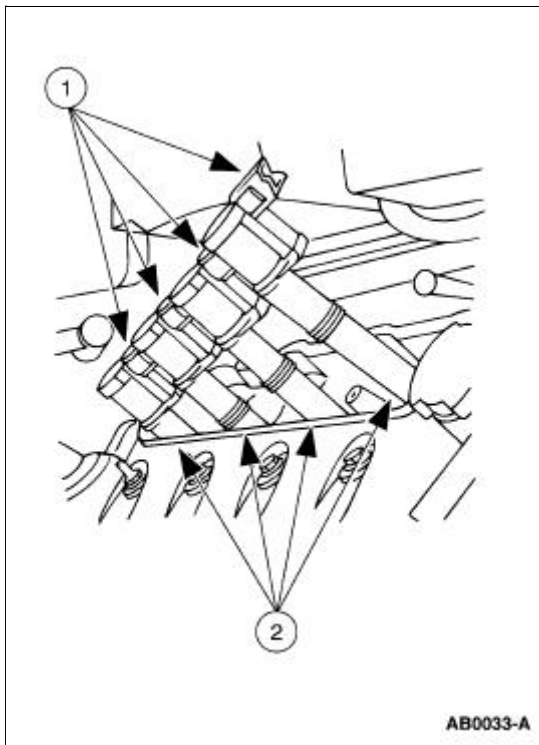
4. Remove the ignition coils.
 1. Disconnect the electrical connectors.
 2. Remove the ignition coils.



5. Remove the LH ignition coil cover bolts and the cover.



6. Remove the ignition coils.
 1. Disconnect the connectors.
 2. Remove the ignition coils.



7. **NOTE:** Verify that the ignition coil spring is correctly located inside the ignition coil boot and that there is no damage to the tip of the boot.

To install, reverse the removal procedure.

- Apply a light coat of dielectric grease to the inside of the ignition coil boots.
-

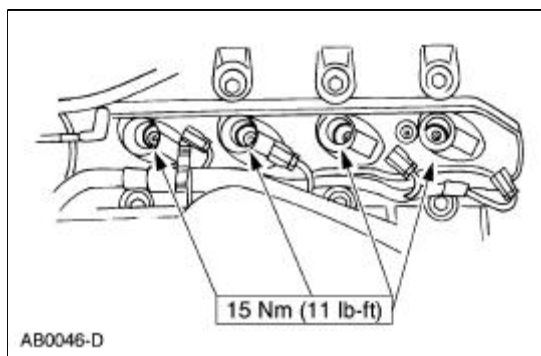
Spark Plugs

Removal and Installation

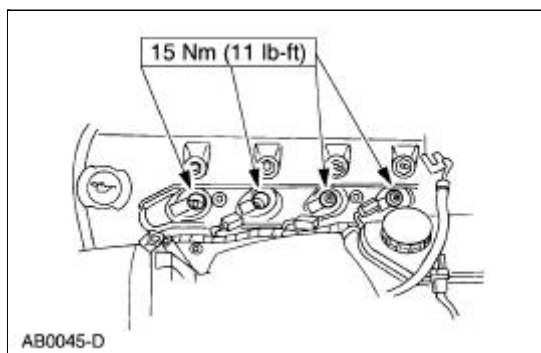
1. Remove the ignition coil-on-plug. For additional information, refer to [Ignition Coil-On-Plug](#) in this section.
2. **NOTE:** Use compressed air to remove any foreign material from the spark plug well before removing the spark plugs.

NOTE: If an original spark plug is used, make sure it is installed in the same cylinder from which it was taken. New spark plugs can be used in any cylinder.

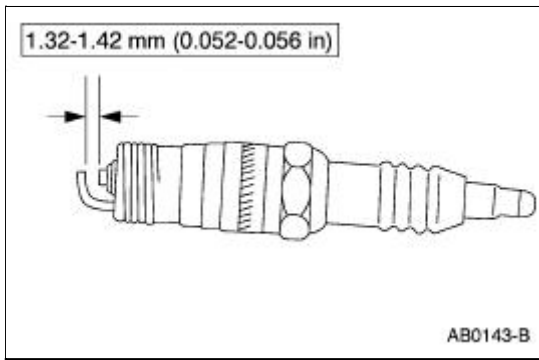
Remove the RH spark plugs.



3. Remove the LH spark plugs.



4. Inspect the spark plugs. Install new spark plugs as necessary. For additional information, refer to [Section 303-00](#)
5. Adjust the spark plug gap as necessary.



6. To install, reverse the removal procedure.
-

Torque Specifications

Description	Nm	lb-ft	lb-in
EGR vacuum regulator solenoid nuts	7	—	62
Differential pressure feedback EGR	7	—	62
Differential pressure feedback EGR — Bullitt	10	—	89
EGR valve bolts	10	—	89
EGR valve-to-exhaust manifold tube fitting	35	26	—
EGR tube-to-exhaust manifold fitting (except Bullitt)	40	30	—
EGR tube-to-exhaust manifold fitting	35	26	—
Vacuum accessory bracket fasteners	10	—	89
Air intake scoop bolts	25	18	—
Air intake scoop bracket bolt	25	18	—
Air intake scoop bracket nuts	25	18	—
Air intake scoop bracket throttle body nut	9	—	80
Exhaust gas recirculation (EGR) vacuum regulator solenoid bolts	10	—	89

Engine Emission Control

⚠ CAUTION: Do not remove any part of the engine emission control system. Operating the engine without the engine emission control system will reduce fuel economy and engine ventilation. This will weaken engine performance and shorten engine life.

The engine emission control consists of the:

- positive crankcase ventilation (PCV) system.
- exhaust gas recirculation (EGR) system.

Typical Vehicle Emission Control Information (VECI) Decal

**FORD MOTOR COMPANY
IMPORTANT VEHICLE INFORMATION**

THIS VEHICLE IS EQUIPPED WITH EEC II MFI SYSTEMS. IDLE SPEEDS AND IDLE MIXTURES ARE NOT ADJUSTABLE. SEE SHOP MANUAL FOR ADDITIONAL INFORMATION. ADJUST IGNITION TIMING WITH THE TRANSMISSION IN NEUTRAL, PARKING BRAKE SET AND THE WHEELS BLOCKED. ENGINE MUST BE AT NORMAL OPERATING TEMPERATURE.

(1) TURN OFF ENGINE.
(2) DISCONNECT THE IN-LINE IN-POUT CONNECTOR (□□ OR □□).
(3) RE-START PREVIOUSLY WARMED-UP ENGINE.
(4) ADJUST IGNITION TIMING TO 10° BTDC.
(5) TURN OFF ENGINE AND RESTORE ELECTRICAL CONNECTION.

FIRING ORDER - 15426378

THIS VEHICLE CONFORMS TO U.S. EPA REGULATIONS APPLICABLE TO 1993 MODEL YEAR NEW LIGHT-DUTY TRUCKS. COMPLIANCE DEMONSTRATED AND DESIGNED FOR PRINCIPAL USE BELOW 4000 FEET, FOR NEW VEHICLE COMPLIANCE ABOVE 4000 FEET. SEE SERVICE PUBLICATIONS.

ETAE-9C485
CCR **CATALYST** SPARK PLUG : ASF-42C
5.0L - 7MM HFM .075HAGX - A SR/EGS/TWCF GAP - .042-0.46

VACUUM HOSE ROUTING

FRONT OF VEHICLE

GA1472-A

Item	Part Number	Description
1	—	Adjustment procedure notes
2	—	Ignition timing specification
3	—	Engine vacuum hose routing (typical)
4	—	Spark plug gap specification
5	—	Engine type

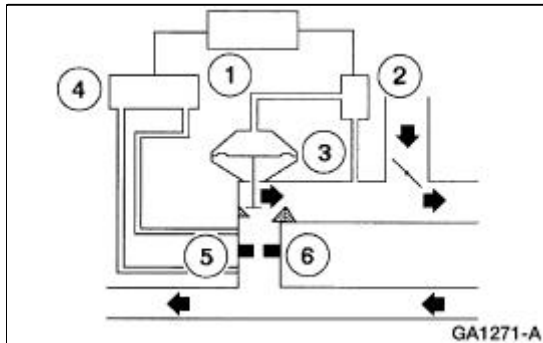
The Vehicle Emission Control Information (VECI) decal shows:

- the components of the emission control system.
- the correct vacuum hose routing.

- the color stripe of the vacuum hoses.

The PCV system uses the intake manifold vacuum to ventilate the crankcase and return the fumes to the intake manifold for combustion.

EGR System Components



Item	Part Number	Description
1	12A65	Powertrain control module
2	9J459	EGR vacuum regulator solenoid
3	9D475	EGR valve
4	9J433	EGR transducer
5	—	Metering orifice
6	9D477	EGR valve to exhaust manifold tube

The EGR system returns a portion of the exhaust gas to the intake manifold to reduce the combustion temperature. This results in lower nitrous oxide formation.

The powertrain control module (PCM) controls the EGR vacuum regulator solenoid . The EGR vacuum regulator solenoid controls the vacuum to the EGR valve. When the EGR valve opens, exhaust gas flows to the intake manifold. The EGR transducer measures the flow through the EGR valve to exhaust manifold tube and sends a signal to the powertrain control module. A metering orifice in the EGR valve to exhaust manifold tube restricts the flow rate when the EGR valve is open.

The PCV valve:

- controls the amount of ventilating air and blow-by gases going to the intake manifold.
- prevents a backfire from reaching the crankcase.

The EGR valve to exhaust manifold tube:

- connects the exhaust manifold to the EGR valve.
- has two tubes connecting to the EGR transducer for EGR flow monitoring.

The EGR transducer:

- monitors the EGR flow rate through the EGR valve to exhaust manifold tube.
- sends an EGR flow rate signal to the powertrain control module.

The EGR vacuum regulator solenoid uses input from the powertrain control module to change the EGR valve operation.

Engine Emission Control

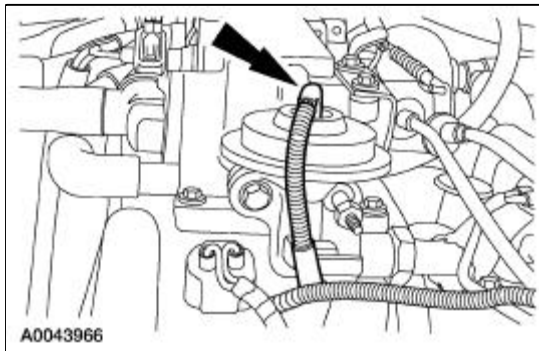
Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Exhaust Gas Recirculation (EGR) Valve

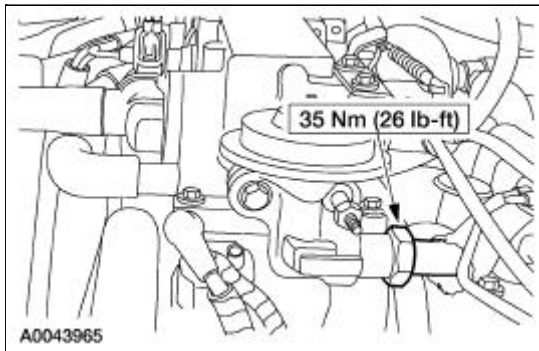
Removal and Installation

NOTE: The 4.6L, 2V is shown. The 3.8L is similar.

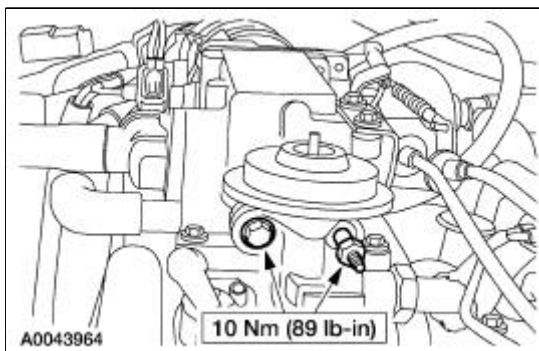
1. Disconnect the vacuum hose.



2. Disconnect the EGR tube from the EGR valve.



3. Remove the two bolts, the EGR valve and the gasket.



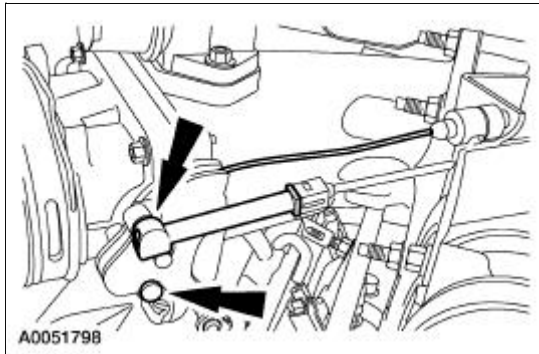
4. **NOTE:** Install a new gasket.

To install, reverse the removal procedure.

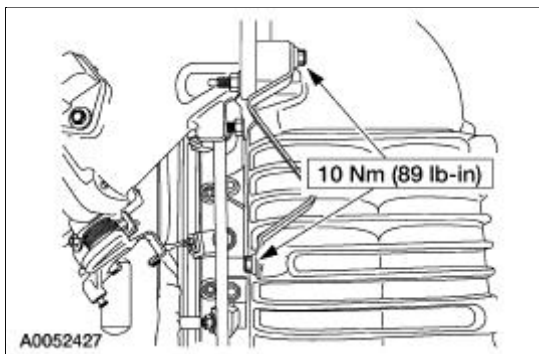
Exhaust Gas Recirculation (EGR) Valve —Cobra

Removal and Installation

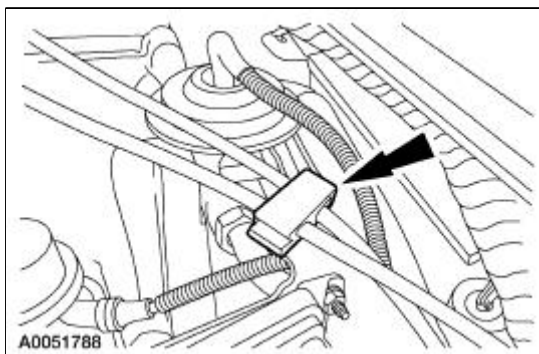
1. Disconnect the accelerator cable and the speed control cable.



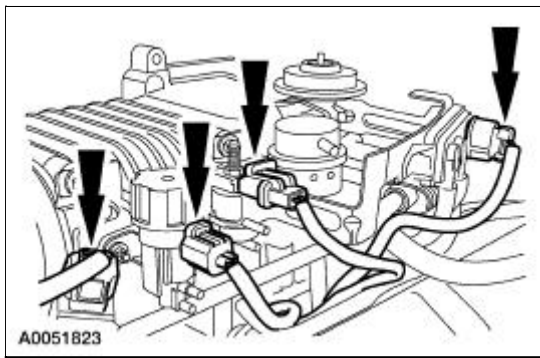
2. Remove the accelerator cable bracket bolts.



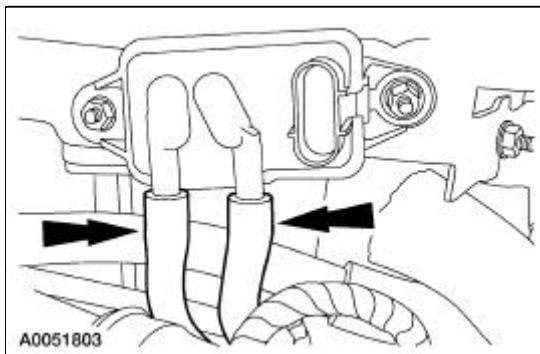
3. Release the clip and position the accelerator cable bracket and the cables aside.



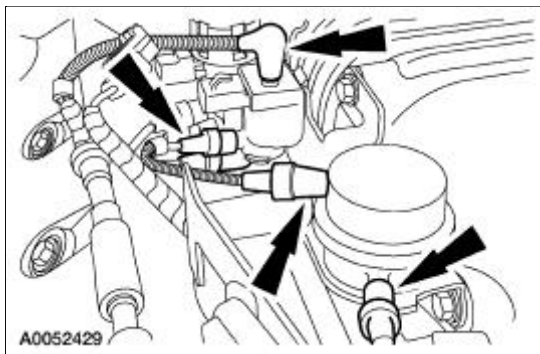
4. Disconnect the electrical connectors from the fuel pulse damper, EGR vacuum regulator solenoid, supercharger bypass vacuum solenoid, and the differential pressure feedback EGR system.



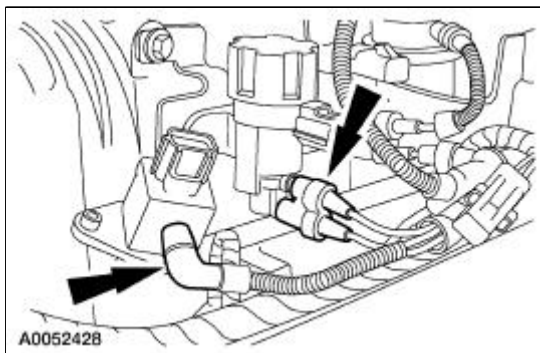
5. Disconnect the vacuum hoses from the differential pressure feedback EGR system.



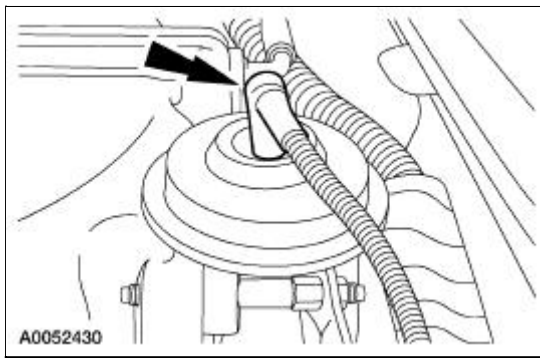
6. Disconnect the vacuum hoses from the supercharger bypass vacuum solenoid, and the actuator.



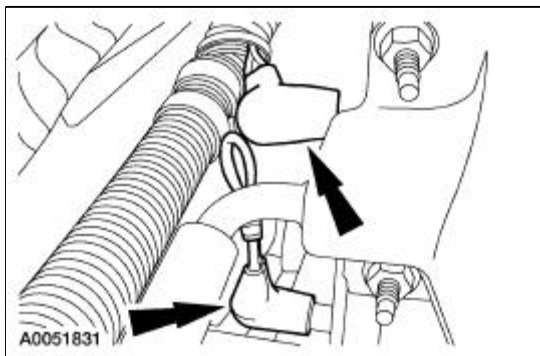
7. Disconnect the vacuum hoses from the fuel pulse damper and the EGR vacuum regulator solenoid.



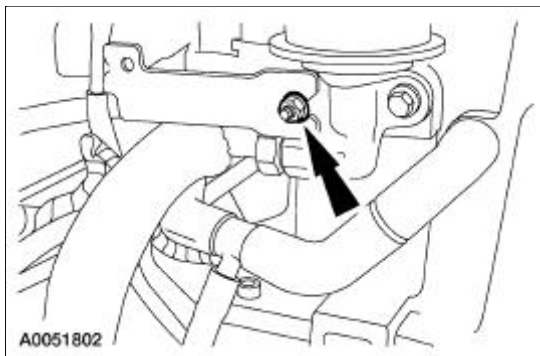
8. Disconnect the vacuum hose from the EGR valve.



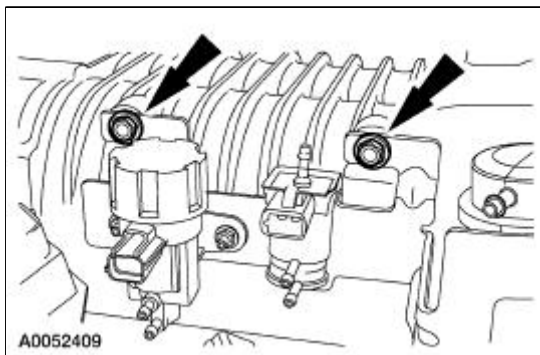
9. Disconnect the vacuum hoses at the back of the supercharger and position the vacuum harness aside.



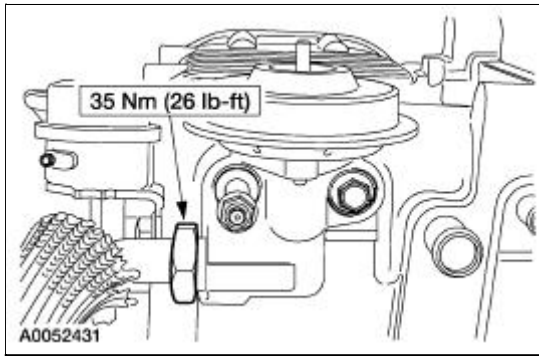
10. Remove the vacuum accessory bracket mounting nut.



11. Remove the mounting bolts, and the vacuum accessory bracket.

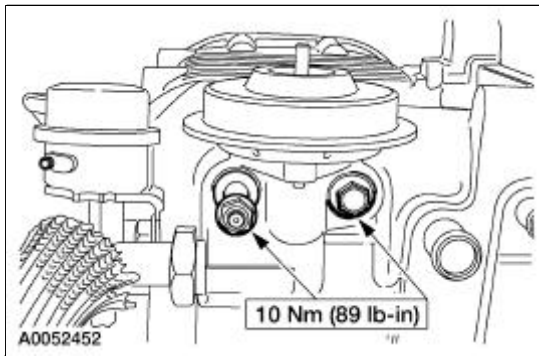


12. Disconnect the exhaust manifold to EGR valve tube.



13. **NOTE:** Discard the EGR valve gasket.

Remove the mounting bolts and the EGR valve.



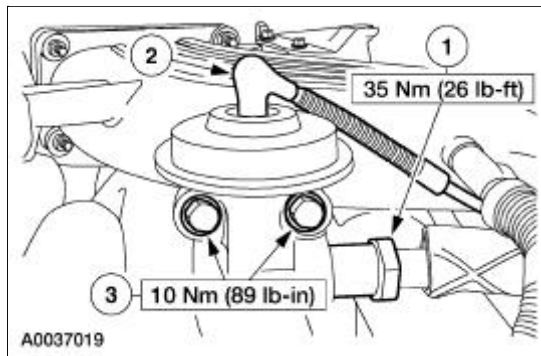
14. **NOTE:** Install a new EGR valve gasket.

To install, reverse the removal procedure.

Exhaust Gas Recirculation (EGR) Valve —Mach I

Removal and Installation

1. Remove the air intake scoop. For additional information, refer to [Section 303-12](#).
2. Remove the exhaust gas recirculation (EGR) valve.
 1. Disconnect the EGR tube upper fitting.
 2. Disconnect the vacuum hose.
 3. Remove the two bolts and remove the EGR valve and gasket.



3. **⚠ CAUTION: Do not use metal scrapers, wire brushes, power abrasive disks or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

Clean and inspect the mating surfaces.

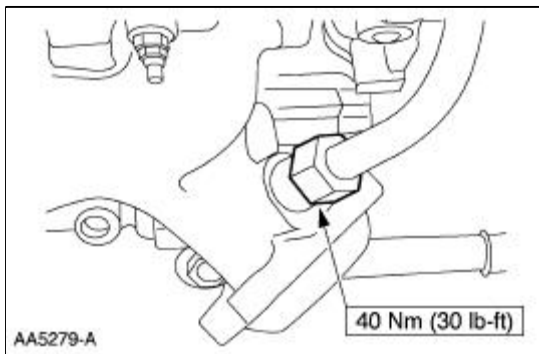
4. To install, reverse the removal procedure.
 - Install a new gasket.

Exhaust Manifold to Exhaust Gas Recirculation (EGR) Valve Tube

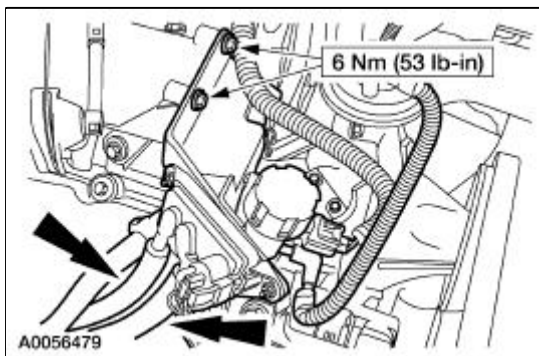
Removal and Installation

NOTE: 3.8L shown, 4.6L (2V) similar.

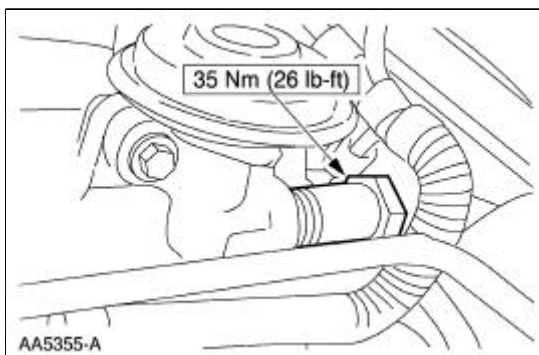
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).
2. Disconnect the exhaust gas recirculation (EGR) valve tube from the exhaust manifold.



3. Remove the differential feedback exhaust gas recirculation (EGR) system vacuum hoses and the bracket bolts. Position the bracket assembly aside.



4. Disconnect the EGR tube from the EGR valve.

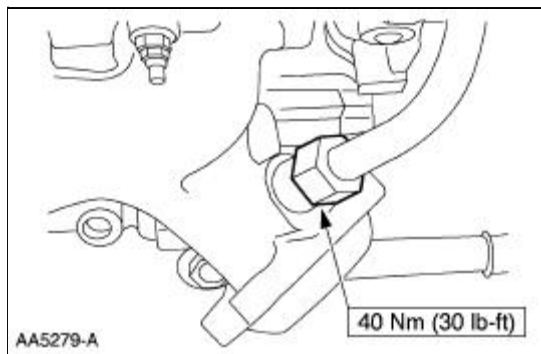


5. Remove the exhaust manifold-to-EGR valve tube.
 6. To install, reverse the removal procedure.
-

Exhaust Manifold to Exhaust Gas Recirculation (EGR) Valve Tube —Cobra

Removal and Installation

1. Remove the EGR valve. For additional information, refer to [Exhaust Gas Recirculation \(EGR\) Valve—Cobra](#) in this section.
2. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).
3. Disconnect the exhaust manifold to EGR valve tube.

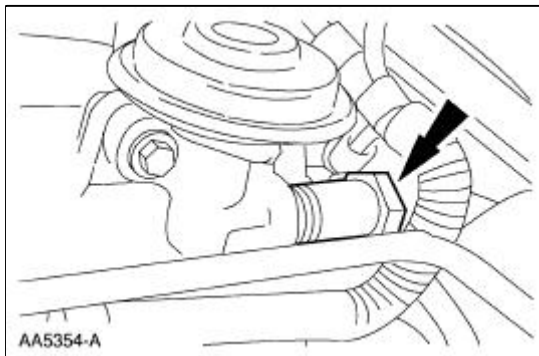


4. Remove the exhaust manifold to EGR tube from the engine compartment.
 5. To install, reverse the removal procedure.
-

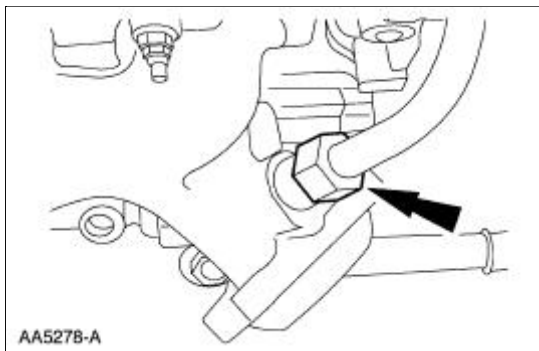
Exhaust Manifold to Exhaust Gas Recirculation (EGR) Valve Tube —Mach I

Removal

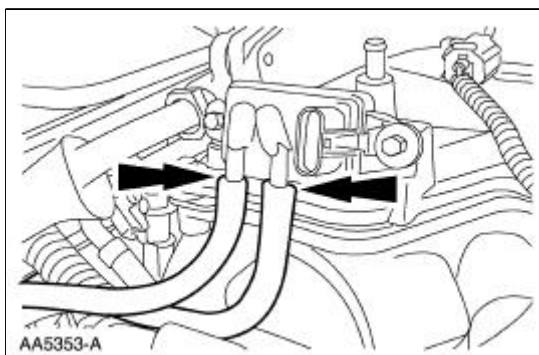
1. Remove the air intake scoop. For additional information, refer to [Section 303-12](#).
2. Disconnect the exhaust gas recirculation (EGR) tube from the EGR valve.



3. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).
4. Disconnect the EGR tube from the exhaust manifold.

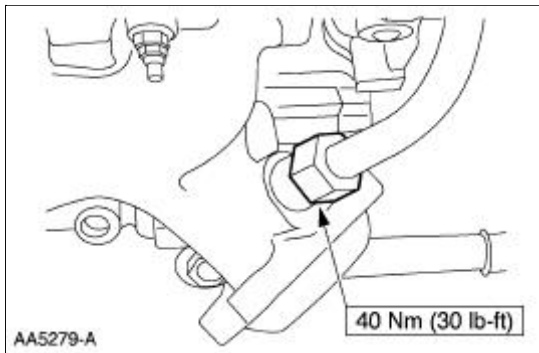
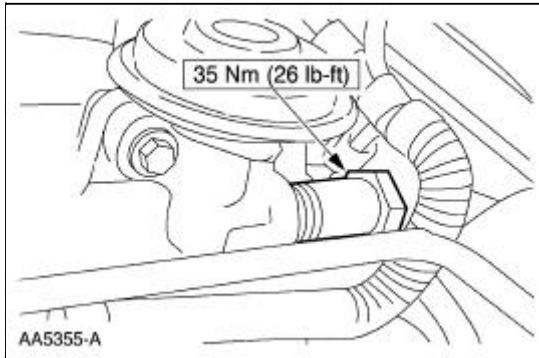


5. Disconnect the hoses and remove the tube from the vehicle.



Installation

1. To install, reverse the removal procedure.



Differential Pressure Feedback Exhaust Gas Recirculation (EGR) System

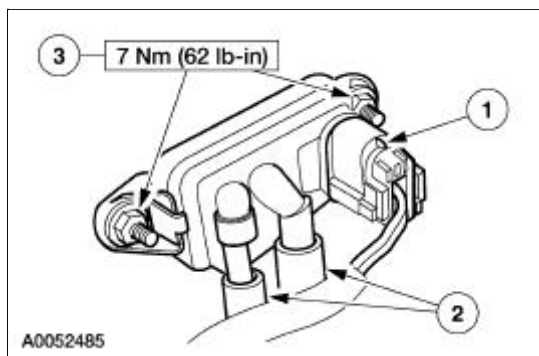
Removal and Installation

1. **NOTE:** The 4.6L (2V) is shown. The 4.6L (4V) and 3.8L are similar.

NOTE: Bolts may be used in place of nuts on some applications.

Remove the differential pressure feedback EGR.

1. Disconnect the connector.
2. Remove the hoses.
3. Remove the nuts and the differential pressure feedback EGR.

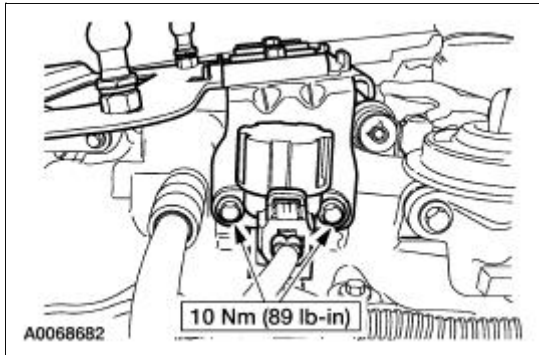


2. To install, reverse the removal procedure.
-

Exhaust Gas Recirculation (EGR) Vacuum Regulator Solenoid

Mach I vehicles

1. Remove the air intake scoop. For additional information, refer to [Section 303-12](#).



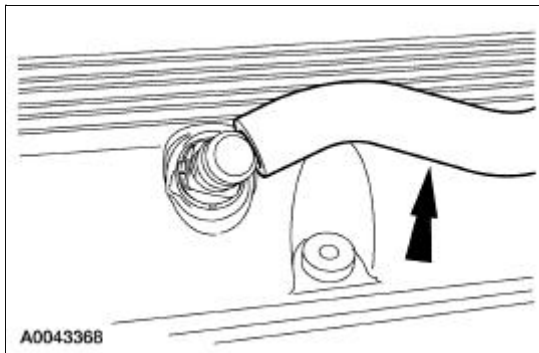
All vehicles

2. Remove the exhaust gas recirculation (EGR) vacuum regulator solenoid.
 - Disconnect the electrical connector.
 - Remove the bolts.
 3. To install, reverse the removal procedure.
-

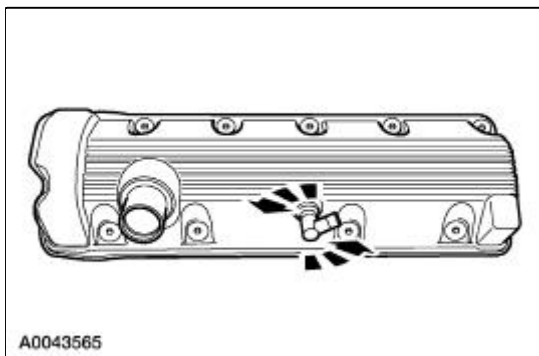
Positive Crankcase Ventilation (PCV) Hose

Removal and Installation

1. Disconnect the hose on the PCV valve.



2. Twist and remove the PCV valve.



3. To install, reverse the removal procedure.
-

Torque Specifications

Description	Nm	lb-ft	lb-in
Air cleaner and duct assembly bolt	7	62	—
Coolant supply and return manifold ^a	—	—	—
Charge air cooler bolts ^a	—	—	—
Supercharger mounting bolts ^a	—	—	—
Air intake scoop bolts	25	18	—
Air intake scoop bracket bolt	25	18	—
Air intake scoop bracket nuts	25	18	—
Air intake scoop bracket throttle body nut	9	—	80
Exhaust gas recirculation (EGR) vacuum regulator solenoid bolts	10	—	89

^a Refer to the procedure

Intake Air Distribution and Filtering

The air intake system consists of the:

- air intake scoop (Mach I)
- air cleaner (ACL).
- air cleaner (ACL) element.
- mass air flow (MAF) sensor.
- air cleaner outlet tube.
- air cleaner and duct assembly.

The air intake system:

- cleans intake air with an air cleaner element.
 - measures air flow with a MAF sensor. For additional information, refer to [Section 303-14](#).
-

Intake Air Distribution and Filtering —Supercharger, Charge Air Cooler

The supercharger (SC) is a positive displacement pump. Its purpose is to supply an excess volume of intake air to the engine by increasing air pressure and density in the intake manifold. The supercharger is matched to the engine by its displacement and belt ratio, and can provide excess airflow at any engine speed.

NOTE: The supercharger is repaired only as an assembly. Disassembly of the supercharger unit may void the warranty.

NOTE: The supercharger is not a bolt-on option. It is part of an integrated engine system. Many components of the supercharged engine are not interchangeable with similar parts from a non-supercharged engine.

The supercharger contains two three-lobed rotors. The helical shape and specialized porting provide a smooth discharge flow and low level of noise during operation. The rotors are supported by ball bearings in front and needle bearings at the rear. The drive gears are pressed into place, therefore the supercharger is installed new as a unit, and is not repairable.

The supercharger system is a blow-through type with the fuel injected directly into the intake ports. The supercharger is belt driven off the crankshaft through an idler pulley. The throttle body controls the amount of intake air to the supercharger through the intake plenum. Air from the supercharger is routed through the charge air cooler (CAC), then to the intake manifold. The resulting denser air charge in the combustion chamber provides for a higher power output of the engine over a non-supercharged engine of the same displacement.

NOTE: It is not possible to increase manifold pressure or engine power output by altering the bypass valve or the actuator.

At partial-throttle opening or when vacuum is present in the intake system, a vacuum-controlled bypass valve reroutes some discharged air from the supercharger back through the intake plenum. This prevents the supercharger from cavitating, causing reduced performance, increased temperatures, and poor fuel economy.

The supercharger has a self-contained oiling system that does not require a fluid change for the life of the vehicle. However, at every 30,000 mile interval, the supercharger fluid level should be checked. The vehicle should be parked on a level surface, the engine cool, and not running. To check the oil, remove the Allen head plug located at the front of the supercharger. The oil level should be at the bottom of the fill plug threads when cold. If the fluid level is low, add Synthetic Supercharger Fluid E9SZ-19577-A or equivalent meeting Ford specification ESE-M99C115-A

Supercharged vehicles are equipped with a charge air cooler (CAC). The CAC cools the pressurized air from the supercharger, increasing the air density, which improves combustion efficiency, engine horsepower and torque.

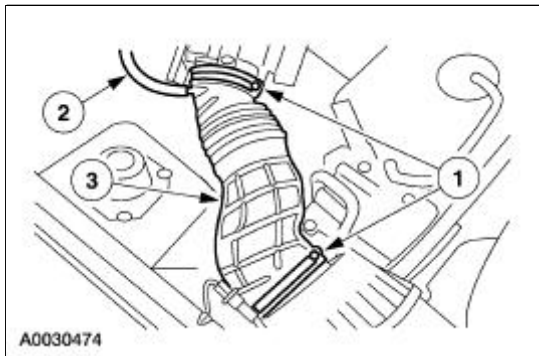
Intake Air Distribution and Filtering

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Air Cleaner Outlet Pipe —3.8L

Removal and Installation

1. Remove the air cleaner outlet tube.
 1. Loosen the clamps.
 2. Disconnect the hose.
 3. Remove the tube.

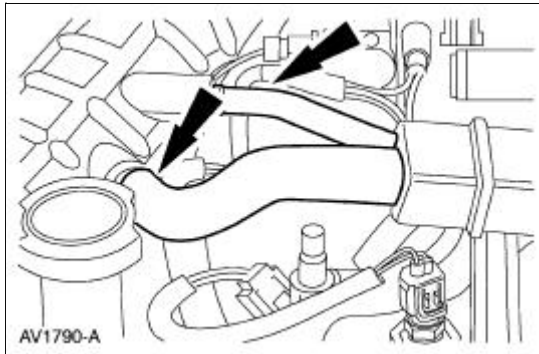


2. To install, reverse the removal procedure.
-

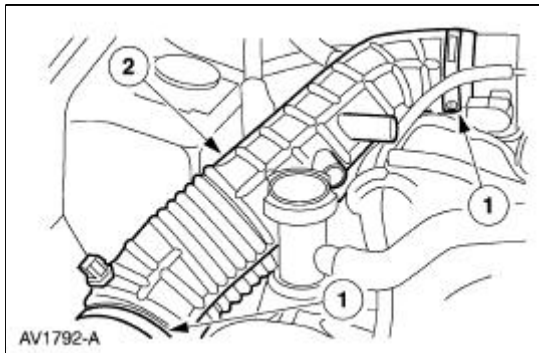
Air Cleaner Outlet Pipe —4.6L (2V)

Removal and Installation

1. Disconnect the hoses.



2. Remove the air cleaner outlet tube.
 1. Loosen the clamps.
 2. Remove the tube.



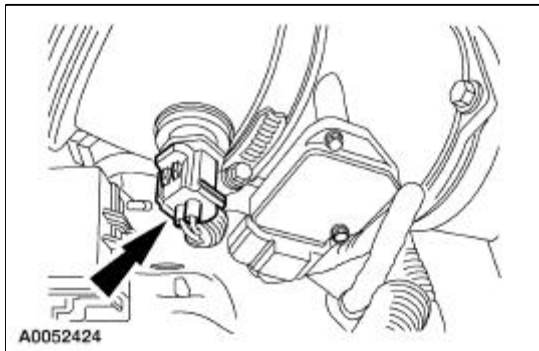
3. To install, reverse the removal procedure.
-

Air Cleaner Outlet Pipe —4.6L (4V)

Removal and Installation

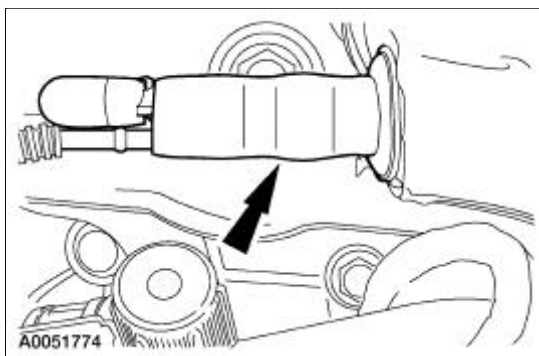
Cobra

1. Disconnect the intake air temperature (IAT) sensor.

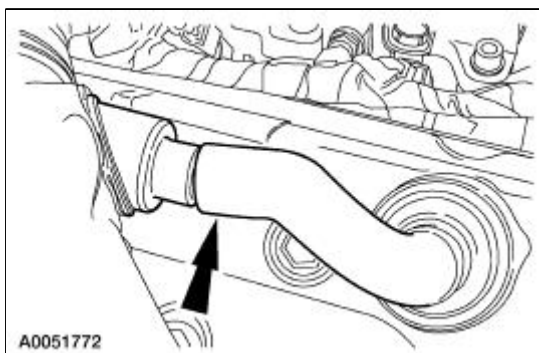


All vehicles

2. Disconnect the vacuum hose.

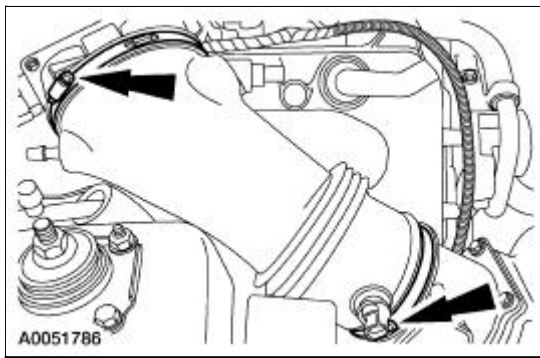


3. Disconnect the breather hose.



NOTE: Cobra shown, Mach I similar.

4. Loosen the clamps and remove the air cleaner outlet pipe.

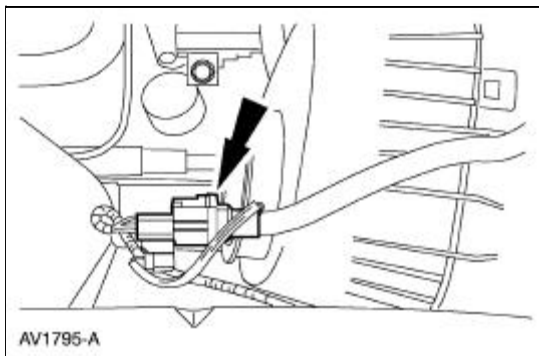


5. To install, reverse the removal procedure.
-

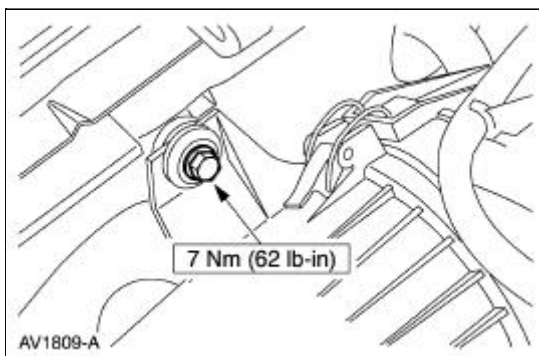
Air Cleaner —3.8L

Removal and Installation

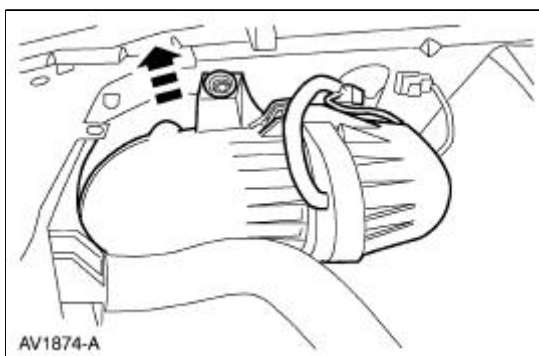
1. Remove the air cleaner outlet tube from the throttle body. For additional information, refer to [Air Cleaner Outlet Pipe—3.8L](#) in this section.
2. Disconnect the connector.



3. Remove the bolt.



4. Remove the air cleaner and duct assembly.



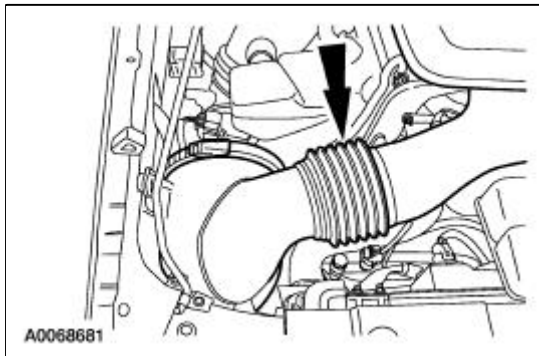
5. To install, reverse the removal procedure.

Air Cleaner —4.6L (2V) and 4.6L (4V)

Removal and Installation

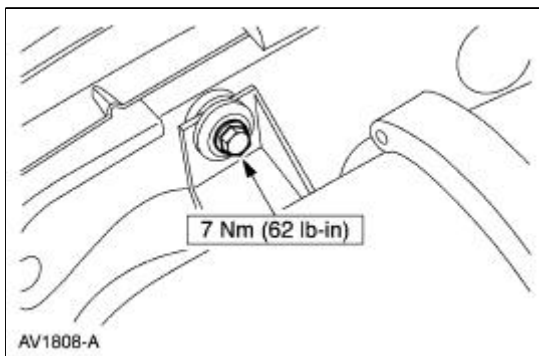
Mach I

1. Disconnect the air intake scoop outlet tube.

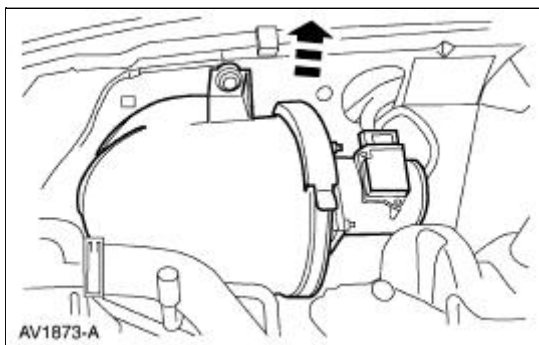


All vehicles

2. Remove the air cleaner outlet tube from the throttle body. For additional information, refer to [Air Cleaner Outlet Pipe—4.6L \(2V\)](#) or [Air Cleaner Outlet Pipe—4.6L \(4V\)](#) in this section.
3. Remove the bolt.



4. Remove the air cleaner and duct assembly.

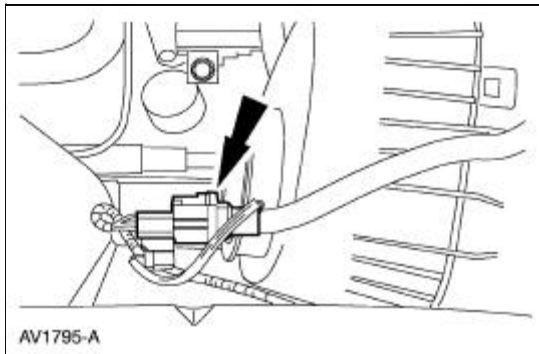


5. To install, reverse the removal procedure.

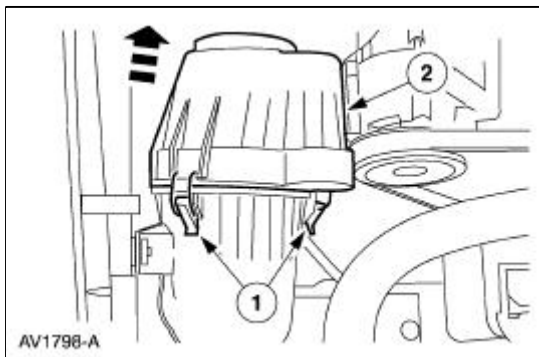
Air Cleaner Element —3.8L

Removal and Installation

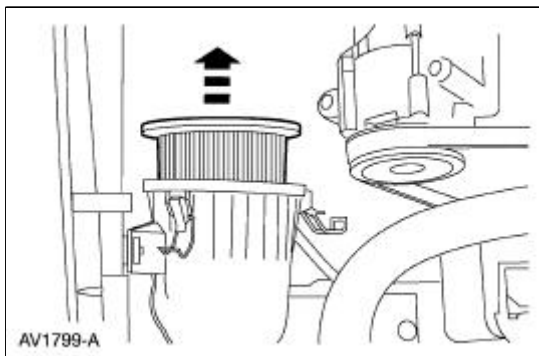
1. Remove the air cleaner outlet tube. For additional information, refer to [Air Cleaner Outlet Pipe—3.8L](#) in this section
2. Disconnect the connector.



3. Remove the mass air flow (MAF) sensor.
 1. Release the clips.
 2. Remove the MAF sensor assembly.



4. Remove the air cleaner element.

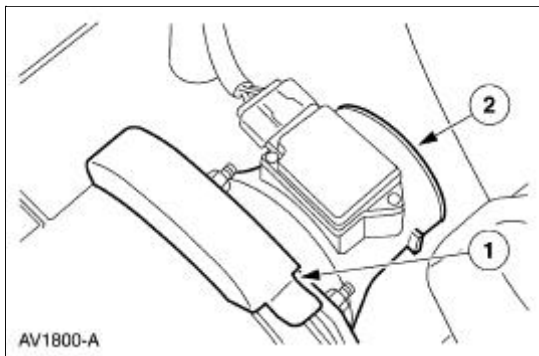


5. To install, reverse the removal procedure.

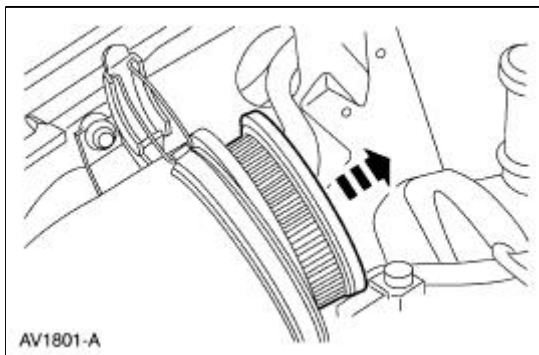
Air Cleaner Element —4.6L (2V)

Removal and Installation

1. Remove the air cleaner outlet tube (9B659). For additional information, refer to [Air Cleaner Outlet Pipe—4.6L \(2V\)](#) in this section.
2. Remove the mass air flow (MAF) assembly.
 1. Release the clip.
 2. Remove the MAF sensor assembly and position aside.



3. Remove the air cleaner element.



4. To install, reverse the removal procedure.

Air Cleaner Element —4.6L (4V)

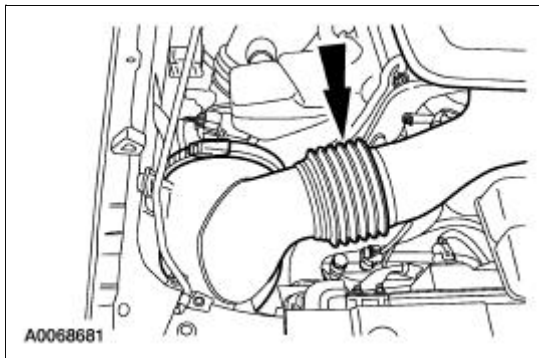
Removal and Installation

1. Open the air cleaner housing.
 2. Remove the element.
 3. To install, reverse the removal procedure.
-

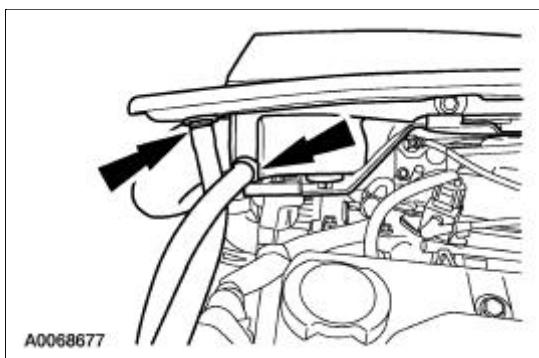
Air Intake Scoop

Removal and Installation

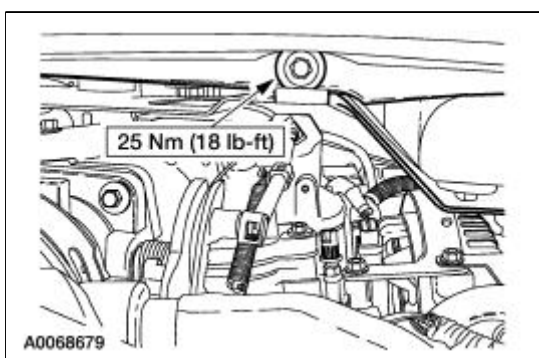
1. Disconnect the air intake scoop outlet from the air cleaner.



2. Disconnect the air intake scoop water drain hoses.



3. Remove the air intake scoop from the air intake scoop bracket.
 - Remove the two air intake scoop bolts.
 - Lift the air intake scoop from the air intake bracket studs.

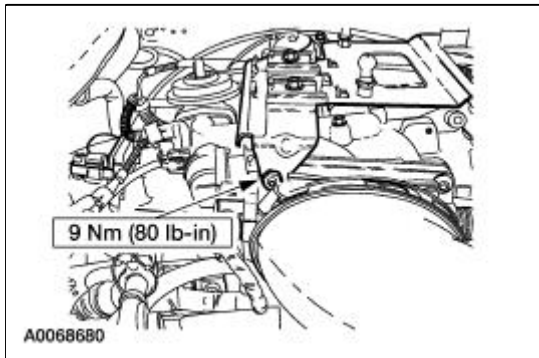


4. To install, reverse the removal procedure.

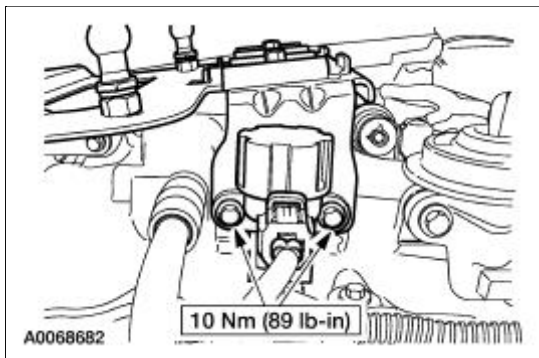
Air Intake Scoop Bracket

Removal and Installation

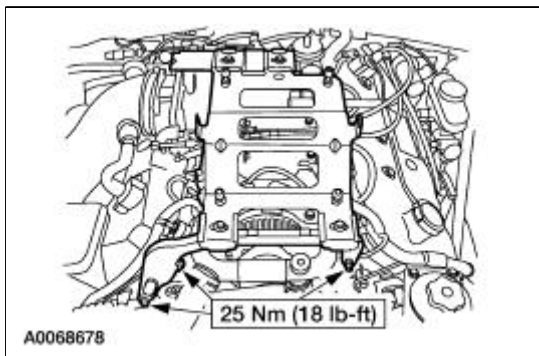
1. Remove the air intake scoop. For additional information, refer to [Air Intake Scoop](#) in this section.
2. Remove the air intake scoop bracket nut at the throttle body.



3. Remove the exhaust gas recirculation (EGR) vacuum regulator solenoid bolts and position the EGR vacuum regulator solenoid aside.



4. Remove the air intake scoop bracket nuts and the air intake scoop bracket bolt and remove the air intake scoop bracket from the engine.



5. To install, reverse the removal procedure.

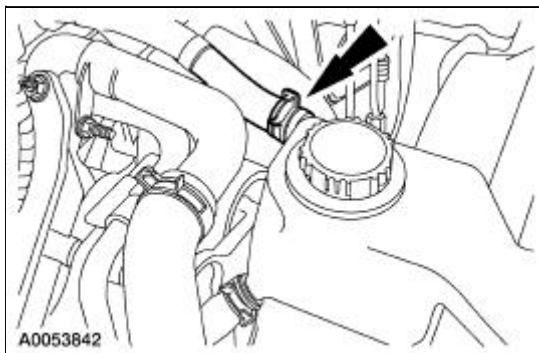
Charge Air Cooler

Material

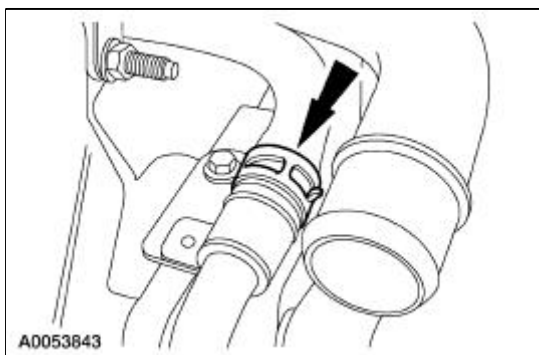
Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-EA

Removal and Installation

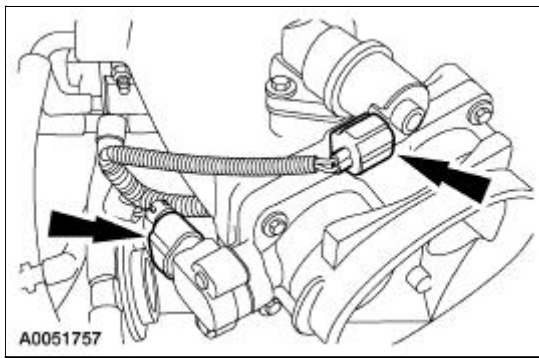
1. Drain the supercharger coolant. For additional information, refer to [Section 303-03B](#).
2. Release the fuel pressure. For additional information, refer to [Section 310-00](#).
3. Disconnect the supercharger degas hose.



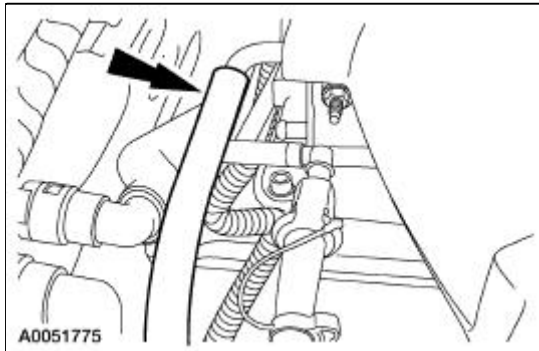
4. Disconnect the coolant hose.



5. Remove the supercharger belt. For additional information, refer to [Section 303-05](#).
6. Remove the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).
7. Disconnect the throttle position (TP) sensor and the idle air control (IAC) valve electrical connectors.

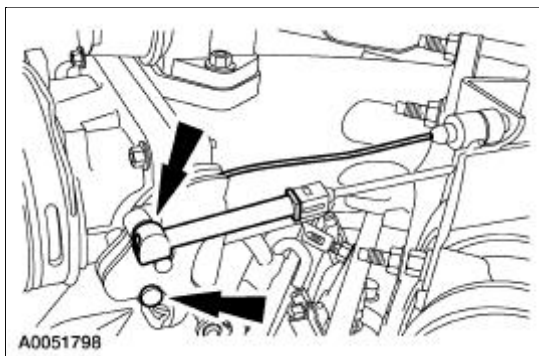


8. Disconnect the vacuum hose.

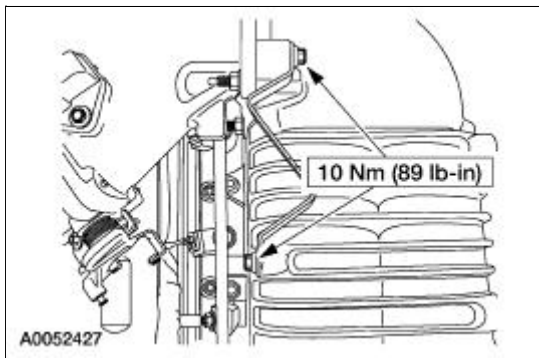


9. Disconnect the fuel supply spring lock coupler. For additional information, refer to [Section 310-00](#).

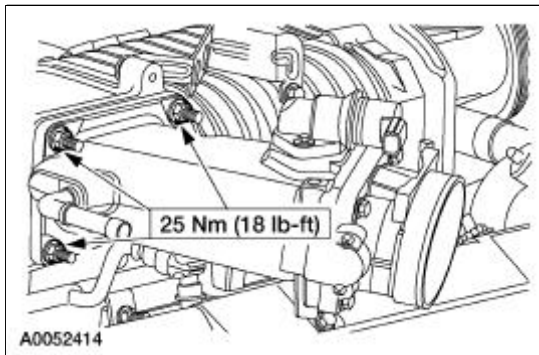
10. Disconnect the accelerator controls.
 - Disconnect the accelerator cable.
 - If equipped, disconnect the speed control cable.



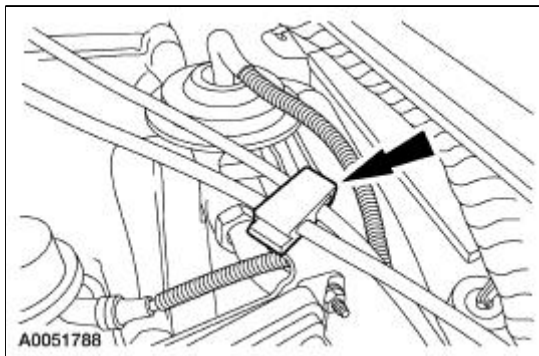
11. Remove the accelerator cable bracket bolts.



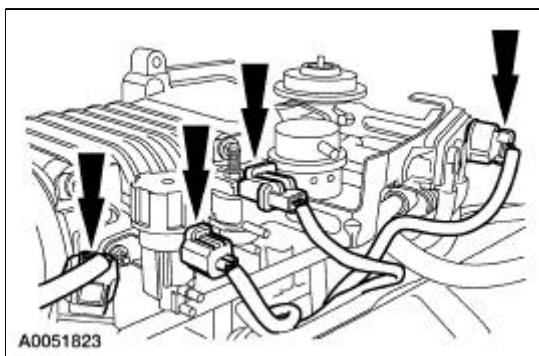
12. Remove the throttle body and spacer assembly.



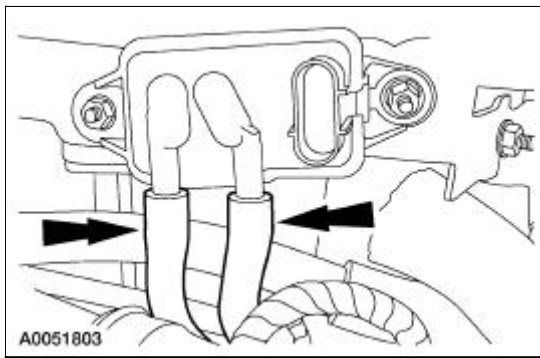
13. Release the clip and position the accelerator cable bracket and the cables aside.



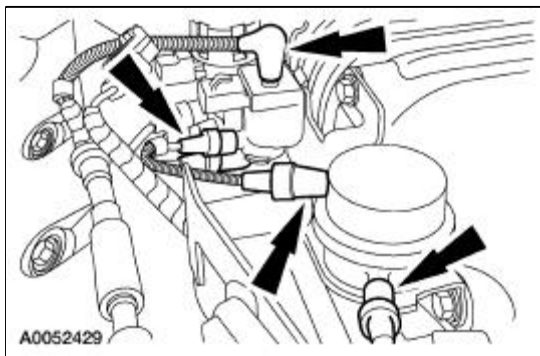
14. Disconnect the electrical connectors from the fuel pulse damper, EGR vacuum regulator solenoid, supercharger bypass vacuum solenoid, and the differential pressure feedback EGR system.



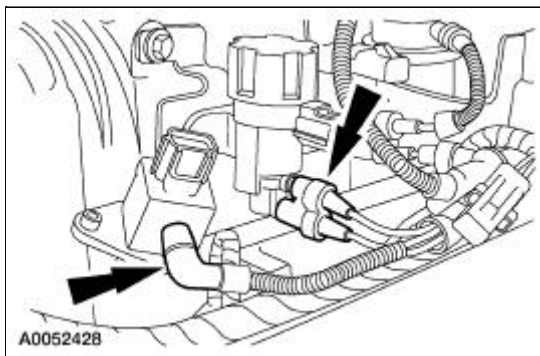
15. Disconnect the vacuum hoses from the differential pressure feedback EGR system.



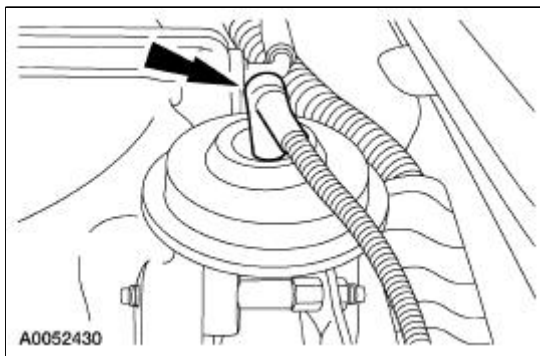
16. Disconnect the vacuum hoses from the supercharger bypass vacuum solenoid, and the actuator.



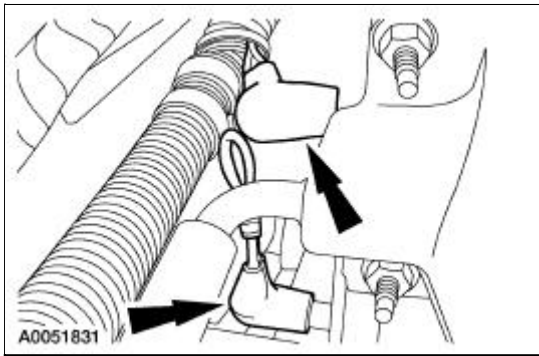
17. Disconnect the vacuum hoses from the fuel pulse damper and the EGR vacuum regulator solenoid.



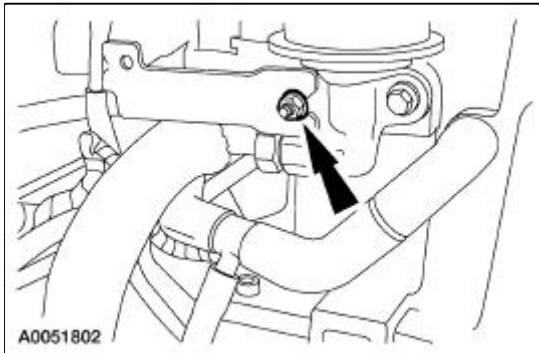
18. Disconnect the vacuum hose from the EGR valve.



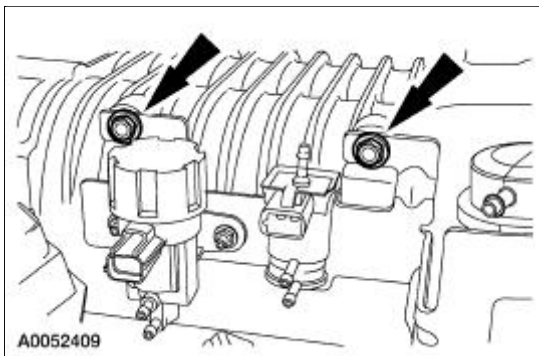
19. Disconnect the vacuum hoses at the back of the supercharger and position the vacuum harness aside.



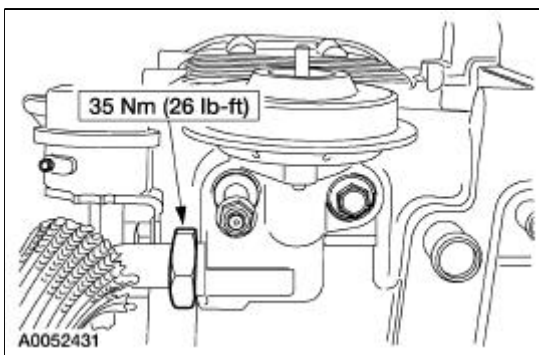
20. Remove the vacuum accessory bracket mounting nut.



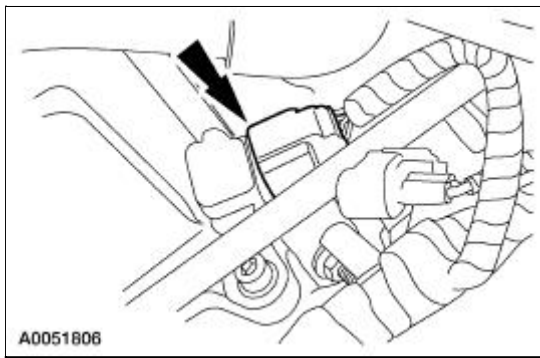
21. Remove the mounting bolts, and the vacuum accessory bracket.



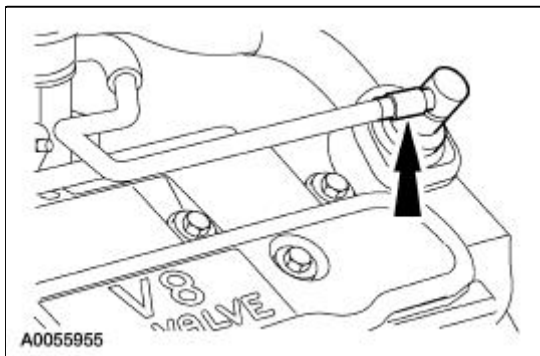
22. Disconnect the exhaust manifold to EGR valve tube.



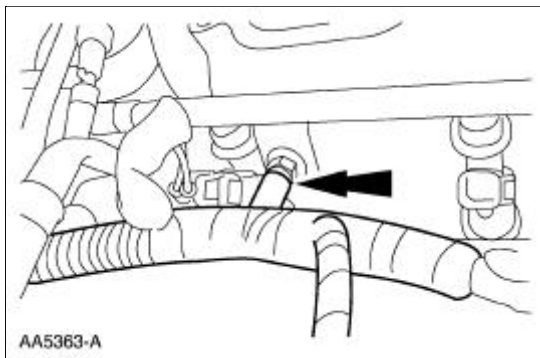
23. Disconnect the barometric pressure (BARO) sensor electrical connector.



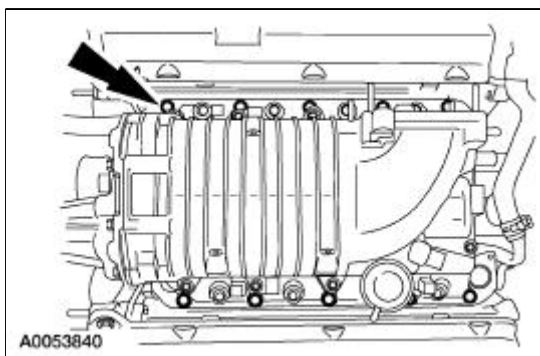
24. Disconnect the positive crankcase ventilation (PCV) hose.



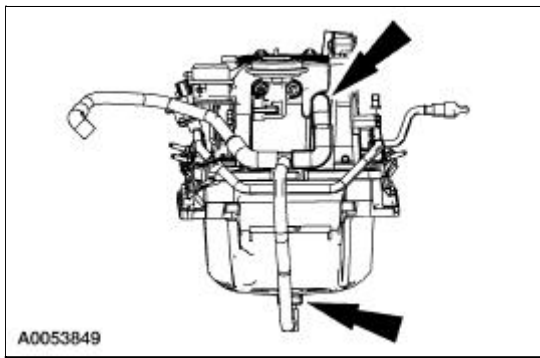
25. Separate the fuel charging wiring harness from the fuel injection supply manifold in four places and position the harness aside.



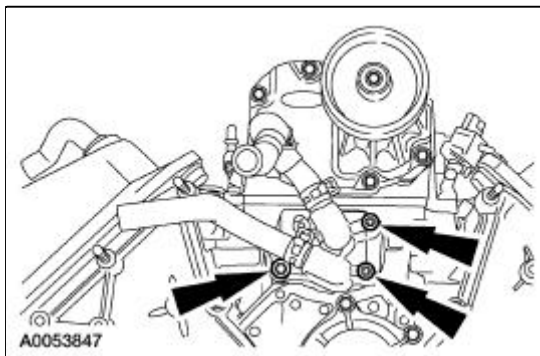
26. Remove the ten bolts, the intake manifold, supercharger and fuel supply manifold as an assembly.



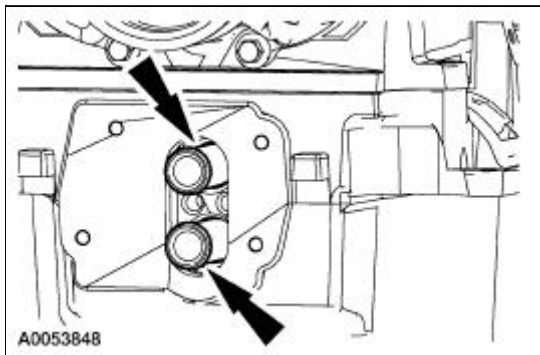
27. Disconnect and remove the PCV hoses.



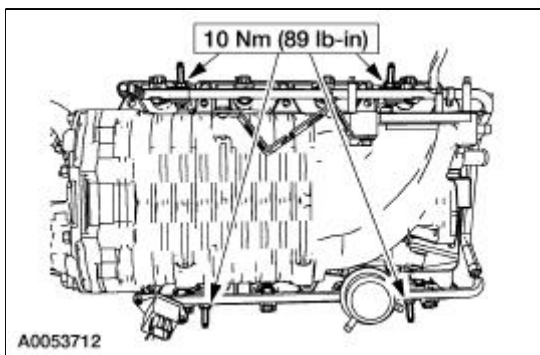
28. Remove the coolant supply and return manifold.



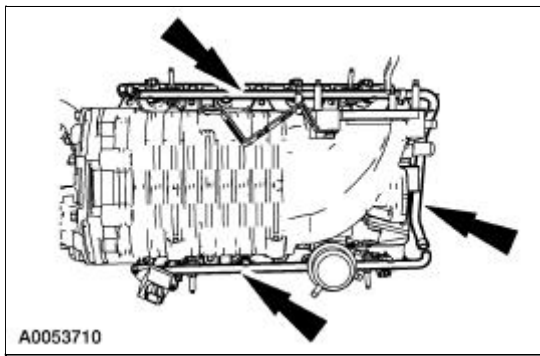
29. Remove the coolant supply and return tubes and seals.



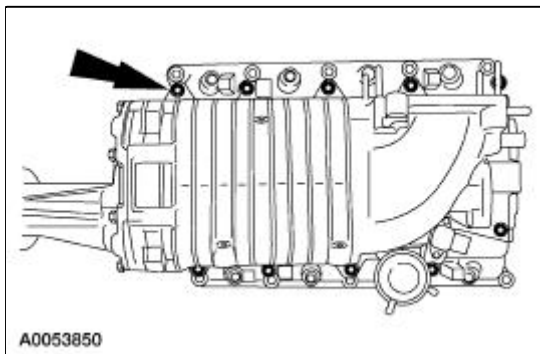
30. Remove the fuel supply manifold mounting studs.



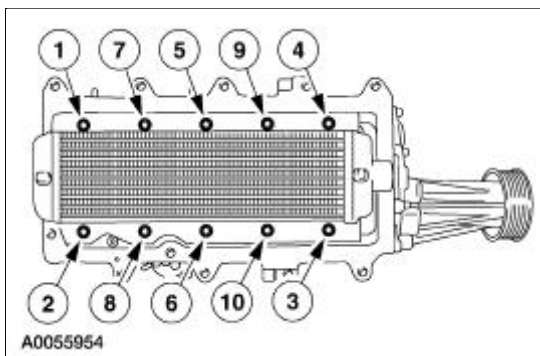
31. Remove the fuel supply manifold and fuel injectors as an assembly.



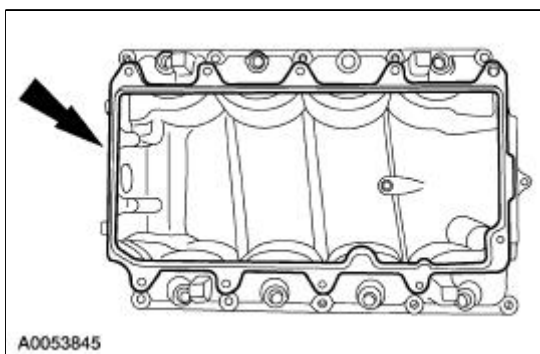
32. Remove the bolts, the supercharger and charge air cooler (CAC) assembly.



33. Remove the bolts and the CAC in the sequence shown.

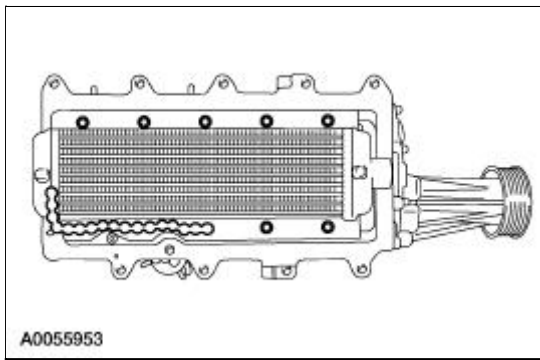


34. Inspect the CAC plenum gasket and install a new gasket if necessary.



35. To install, reverse the removal procedure

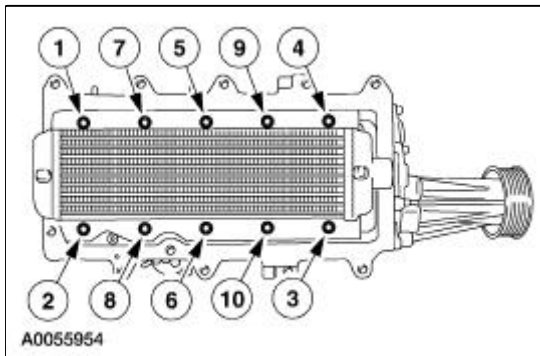
36. Apply a bead of sealant in the areas shown on the supercharger flange between the CAC and the supercharger.



37. **NOTE:** Once the torque procedure has been started, final tightening must be finished within five minutes maximum.

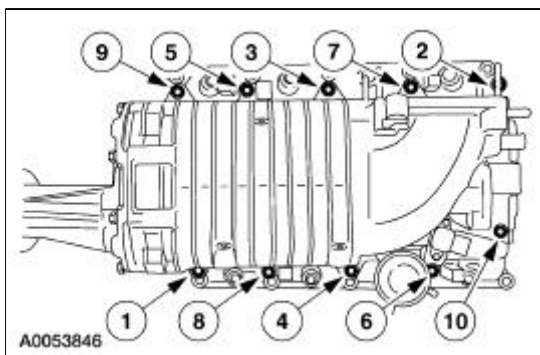
Tighten the CAC bolts in the sequence shown in two stages.

1. Tighten to 2 Nm (18 lb-in).
2. Tighten to 6 Nm (53 lb-in).



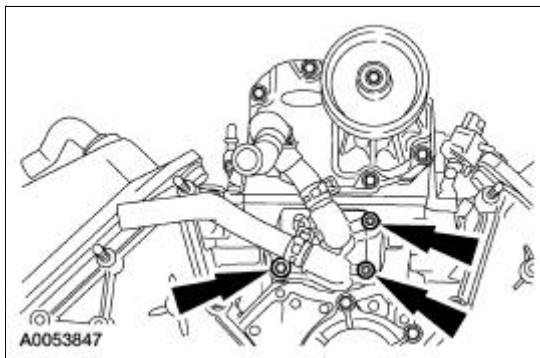
38. Tighten the supercharger and CAC cooler assembly-to-lower intake manifold bolts in the sequence shown in three stages.

1. Tighten to 2 Nm (18 lb-in).
2. Tighten to 25 Nm (18 lb-ft).
3. Tighten an additional 90 degrees.



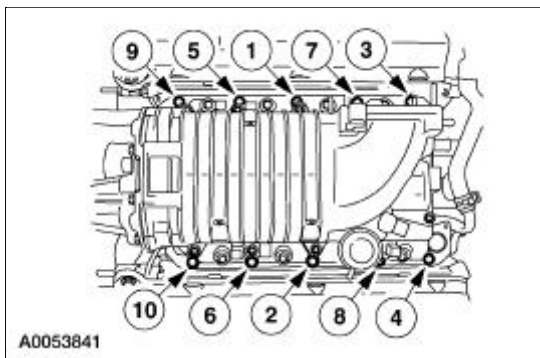
39. Tighten the coolant supply and return manifold in two stages.

1. Tighten to 10 Nm (89 lb-ft).
2. Tighten an additional 90 degrees.



40. **NOTE:** Inspect the intake manifold gaskets and install new gaskets, if necessary.

Tighten the lower intake manifold bolts in the sequence shown.



41. Fill and bleed the supercharger cooling system. For additional information, refer to [Section 303-03B](#).

General Specifications

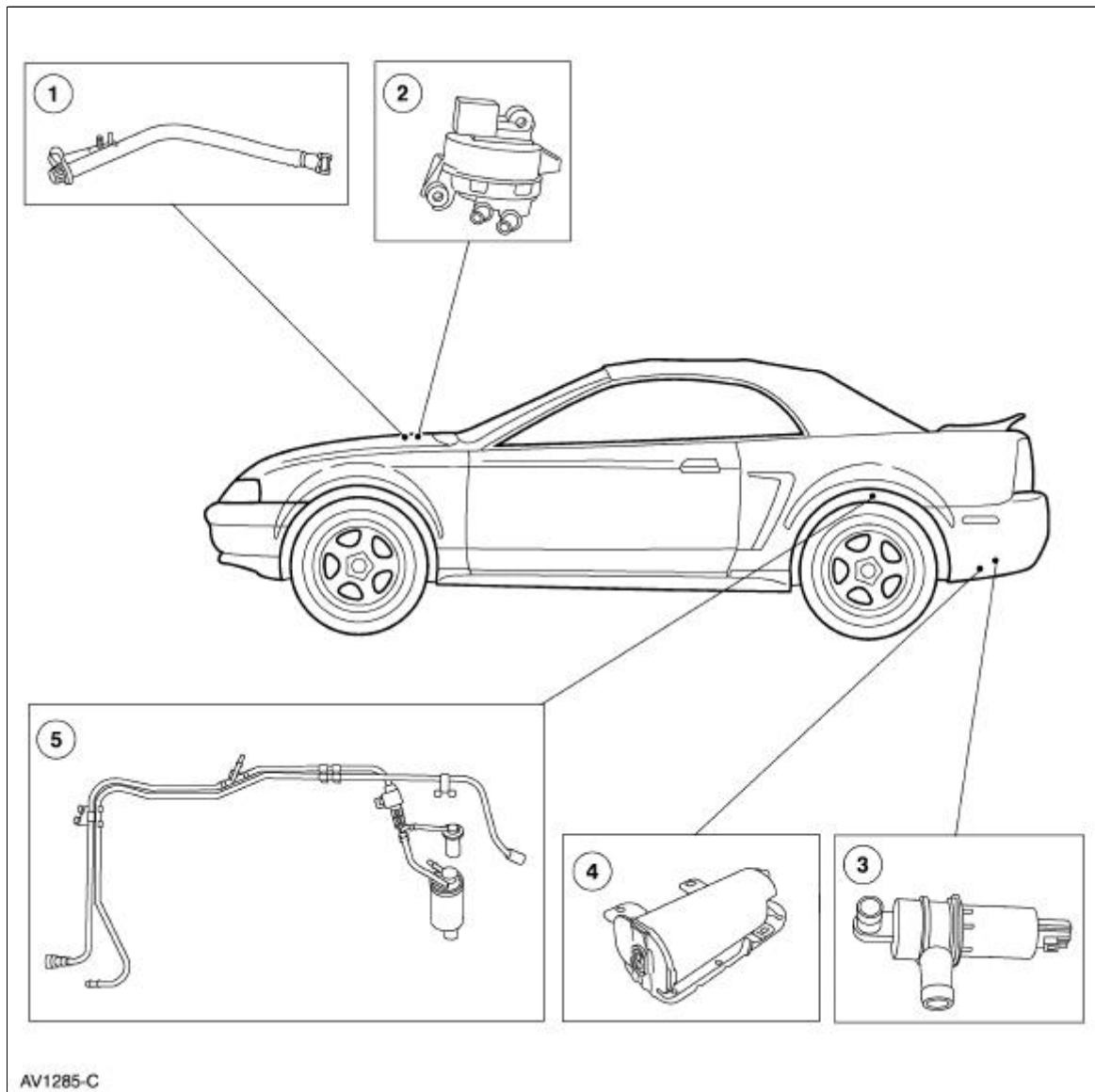
Item	Specification
MERPOL® O-ring Seal Lubricant	ESE-M99B144-B

Torque Specifications

Description	Nm	lb-ft	lb-in
Evaporative emissions canister and bracket assembly bolts	25	18	—
Evaporative emission canister purge valve nuts	7	—	62

Evaporative Emissions

Component Location



Item	Part Number	Description
1	9F980	Evaporative emission test port
2	9C915	Evaporative emission canister purge valve
3	9F945	Canister vent solenoid
4	9D653	Evaporative emission canister
5	9C047	Fuel vapor control valve tube assembly

The evaporative emission system:

- is equipped with an on-board refueling vapor recovery (ORVR) system.

- prevents hydrocarbon emissions from reaching the atmosphere.
- stores fuel vapors in the evaporative emission (EVAP) canister that are generated during vehicle operation or hot soak, or vehicle refueling, until they can be consumed by the engine.
- routes the stored fuel vapors to the engine during engine operation.
- is controlled by the powertrain control module (PCM) which uses various sensor inputs to calculate the desired amount of purge flow. The PCM regulates the purge flow, induced by the application of intake manifold vacuum, by varying the duty cycle applied to the EVAP canister purge valve.
- has an evaporative emission test port for test purposes.

The fuel vapors are routed:

- from the fuel tank through the fuel vapor control valve and fuel vapor vent valve.
- to the EVAP canister through a vapor line.
- to the engine when the EVAP canister purge valve is opened by the PCM.

The fuel tank pressure (FTP) sensor:

- monitors the pressure levels in the fuel tank.
- communicates the pressure reading to the PCM during the OBDII leak test.
- is located in-line above the fuel tank and is serviced as part of the fuel vapor control valve tube assembly.

The evaporative emission canister:

- is located in the left rear quarter panel.
- contains activated carbon.
- stores fuel vapor.

The fuel tank filler cap:

- relieves system pressure above 14 kPa (56.21 inches H₂O).
- relieves system vacuum below 3.8 kPa (15.26 inches H₂O).

The canister vent solenoid:

- is normally open.
- seals the EVAP system for the inspection and maintenance (I/M 240) test and OBDII leak and pressure tests.
- is mounted to the evaporative emission canister.
- is repaired as a separate item.

The evaporative emission (EVAP) canister purge valve:

- is normally closed.
- regulates purging of the EVAP canister.
- is controlled by the PCM.

- is located in the right front inner fender well.

The fuel vapor control valve tube assembly:

- consists of the fuel vapor control valve, fuel vapor vent valve and an in-line fuel tank pressure sensor.
- prevents suspended liquid fuel from being drawn into the evaporative emission canister along with the fuel vapors.
- returns the liquid to the fuel tank.
- includes a fresh air transfer tube routing fresh air between the canister vent solenoid hose and the fuel tank filler pipe assembly.
- requires two grommets to seal the fuel vapor control valve and fuel vapor vent valve to the fuel tank.

The evaporative emission (EVAP) system monitor:



- is a self-test strategy within the PCM, which tests the integrity of the EVAP system.
- monitors the EVAP system for leaks.
- monitors electronic EVAP components for irrationally high or low voltages.
- monitors for correct EVAP system operation.
- utilizes intake manifold vacuum to test the EVAP system and involves several stages.

The evaporative emission (EVAP) test port:

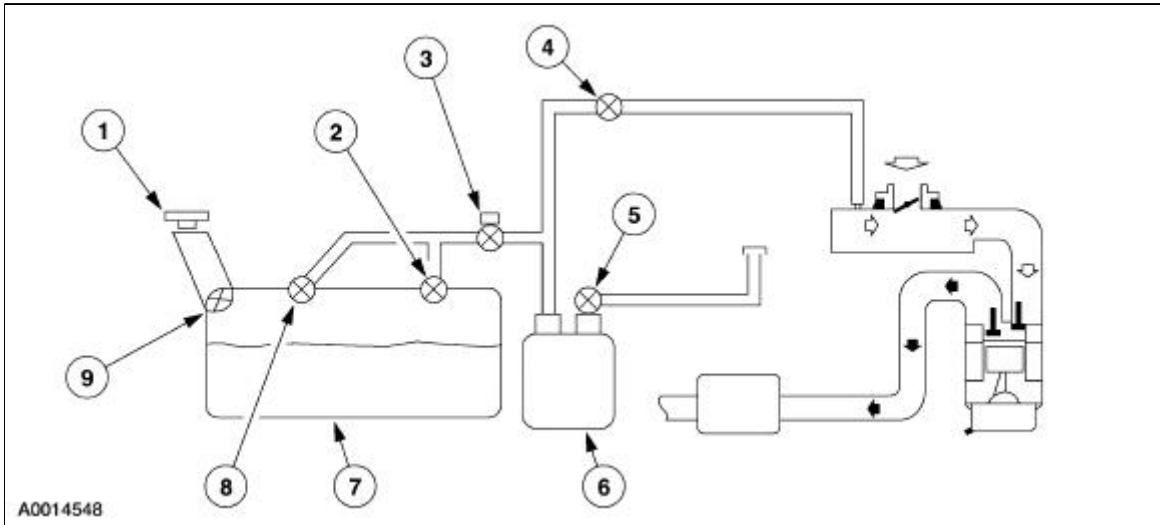
- is used to connect the Evaporative Emission System Leak Tester to the EVAP system.
 - is located on the EVAP canister purge outlet tube near the EVAP canister purge valve.
-

Evaporative Emissions

Special Tool(s)

 <p>ST2116-A</p>	<p>Evaporative Emission System Leak Tester 310-F007 (134-00056) or equivalent</p>
 <p>ST2332-A</p>	<p>Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool</p>

Evaporative Emission System



Item	Part Number	Description
1	9030	Fuel filler cap
2	9B593	Fuel vapor vent valve
3	9C052	Fuel tank pressure sensor
4	9C915	Evaporative emission canister purge valve
5	9F945	Canister vent solenoid
6	9D653	Evaporative emission canister
7	9002	Fuel tank
8	9B190	Fuel vapor control valve
9	9189	Fuel filler pipe check valve

Principles of Operation

Evaporative Emission (EVAP) Canister Purge Valve

The EVAP canister purge valve is controlled by the powertrain control module (PCM). The EVAP canister purge valve controls the flow of fuel vapors from the EVAP canister to the engine intake manifold during various engine operating modes. The EVAP canister purge valve is normally closed.

Evaporative Emission (EVAP) Canister

Fuel vapors from the fuel tank are stored in the EVAP canister. When the engine is running, the vapors are purged from the EVAP canister for combustion.

Canister Vent Solenoid

During the Evaporative Emission (EVAP) System Test Monitor, Evaporative Emissions Repair Verification Drive Cycle, and the Evaporative Emission System Leak Test, the canister vent solenoid is closed to allow a vacuum to be drawn on the fuel tank at a specific level. The canister vent solenoid is normally open.

Fuel Tank Pressure (FTP) Sensor

The fuel tank pressure sensor is used to measure the fuel tank pressure during the Evaporative Emissions Monitor Test. The fuel tank pressure sensor is mounted in the fuel vapor control valve tube as it crosses over the fuel tank.

Fuel Vapor Control Valve

The fuel vapor control valve is normally between the EVAP canister and the fuel vapor vent valve. Its function is to prevent the flow of liquid fuel into the EVAP canister or up to the canister purge valve during refueling, and to prevent the collection of liquid fuel in the fuel vapor hoses by overfilling the fuel tank.

Fuel Vapor Vent Valve (FVV) Assembly

The fuel vapor vent valve (FVV) assembly is mounted on the top of the fuel tank. It is used to control the flow of fuel vapors entering the EVAP system. The head portion of the assembly prevents the fuel tank from overfilling during refueling. The assembly also has a spring float, which prevents liquid fuel from entering the vapor delivery system under severe handling or vehicle rollover conditions. In the upright position, the open bottom of the float will lift and shut off the orifice. Under severe handling conditions, the spring will push the float closed when angles allow liquid fuel to reach the orifice. In a rollover condition, the weight of the open bottom float and spring pressure will close the orifice.

Fuel Filler Pipe Check Valve

The fuel filler pipe check valve is an intricate part of the fuel filler pipe. It is intended to prevent liquid fuel from re-entering the fuel filler pipe from the fuel tank on refueling or roll over conditions.

Fuel Filler Cap

The fuel filler cap is used to prevent fuel spill and to close the EVAP system to the atmosphere.

Evaporative Emission System Monitor

When a fault occurs, the EVAP system monitor is reset to NO and a diagnostic trouble code (DTC) is set in the PCM memory. After the DTC is repaired, the vehicle drive cycle must be completed to reset the monitor in preparation for inspection and maintenance testing.

EVAP Emission System Leak Test

To start the testing, conditions of stable purging and vehicle speed must be satisfied. During the first stage, the canister vent solenoid is closed, while the EVAP canister purge valve remains open, applying and building vacuum in the system as indicated by the FTP sensor. This phase checks for major leaks in the EVAP system.

In the second stage, the EVAP canister purge valve closes and the system looks for minimal decay rate in the EVAP vacuum, indicating the absence of any small EVAP system leaks.

The last stage is entered only if stage two of the leak test has failed and checks whether the failed test was due to excess vapor generation. It monitors fuel vapor generation rate. Initially, the canister vent solenoid is opened to equalize EVAP system pressure to atmosphere. Then the canister vent solenoid is closed, allowing pressure to build if vapor generation is present in sufficient quantity. If the rate of generation is found to be too high, the EVAP running loss system leak test is aborted. If not, then a small leak is diagnosed.

On-Board Refueling Vapor Recovery (ORVR) Evaporative Emission (EVAP) System

The basic elements forming the ORVR system are as follows:

- The fuel filler pipe forms a seal to prevent vapors from escaping the fuel tank while liquid is entering the fuel tank. Liquid in the one inch diameter tube blocks vapors from rushing back up the fuel filler pipe.
- A fuel vapor control valve controls the flow of vapors out of the fuel tank. The valve closes when the liquid level reaches a height associated with fuel tank usable capacity. The valve accomplishes the following:
 - limits the total amount of fuel that can be dispensed into the fuel tank
 - prevents liquid gasoline from exiting the fuel tank when submerged (as well as when tipped well beyond a horizontal plane as part of the vehicle rollover protection in road accidents)
 - minimizes vapor flow resistance during anticipated refueling conditions
- Fuel vapor tubing connects the fuel vapor control valve to the EVAP canister. This routes the fuel tank vapors, displaced by the incoming liquid, to the EVAP canister.
- A check valve in the fuel filling system prevents liquid from rushing back up the fuel filler pipe during the liquid flow variations associated with the filler nozzle shut-off.

Between refueling events, the EVAP canister is purged with fresh air so that it may be used again to store vapors accumulated during engine soaks or subsequent refueling events. The vapors drawn off of the carbon in the EVAP canister are consumed by the engine.

Inspection and Verification

1. Verify the customer concern is with the evaporative emission (EVAP) system.
2. Visually inspect for the following obvious signs of mechanical damage.

Visual Inspection Chart

Mechanical
<ul style="list-style-type: none">● Fuel filler cap● EVAP test port● EVAP canister or canister vent solenoid

- EVAP lines or hoses
- Vacuum lines or hoses

- If the concern remains after the inspection, connect the scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If the scan tool does not communicate with the vehicle:
 - check that the program card is correctly installed.
 - check the connections to the vehicle.
 - check the ignition switch position.
- If the scan tool still does not communicate with the vehicle, refer to the scan tool manual.
- Carry out the DATA LINK DIAGNOSTICS test. If the scan tool responds with:
 - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to [Section 418-00](#).
 - NO RESP/NOT EQUIP for PCM, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
 - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out the PCM KOEO self-test.
- If the DTCs retrieved are related to the concern, go to the PCM Diagnostic Trouble Code (DTC) Index to continue diagnostics.
- If the concern remains after the inspection, determine the symptom. GO to [Symptom Chart](#).

PCM Diagnostics Trouble Code (DTC) Index

DTC	Description	Source	Action
P0442	Small leak detected in EVAP system (As small as 1.02 mm [0.040 inch])	PCM	Go To Pinpoint Test A .
P0455	Major leak or no flow detected	PCM	Go To Pinpoint Test B .
P0457	Check for missing or leaking fuel filter cap	PCM	Go To Pinpoint Test A .
P1443	Very small or no purge flow detected	PCM	Go To Pinpoint Test B .
P1450	Excessive vacuum detected in the fuel tank	PCM	Go To Pinpoint Test C .
—	Any other PCM DTC	PCM	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Symptom Chart

SYMPTOM CHART

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● Hissing sound when removing fuel cap 	<ul style="list-style-type: none"> ● Canister vent solenoid. ● Evaporative emissions canister. ● Fuel vapor control valve 	<ul style="list-style-type: none"> ● Go To Pinpoint Test D.

	<ul style="list-style-type: none"> tube assembly. ● EVAP canister tube. ● EVAP canister purge outlet tube. 	
<ul style="list-style-type: none"> ● Excessive fuel odor 	<ul style="list-style-type: none"> ● Canister vent solenoid. ● Evaporative emissions canister. ● Fuel vapor control valve tube assembly. ● Evaporative emissions test port. ● EVAP canister purge outlet tube. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test E.
<ul style="list-style-type: none"> ● Unable to refuel vehicle 	<ul style="list-style-type: none"> ● Fuel filler pipe. ● Canister vent solenoid. ● Fuel vapor control valve tube assembly. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test D.

Pinpoint Tests

NOTE: Reinstall or install new evaporative emission hose clamps removed or damaged during testing procedures.

PINPOINT TEST A: DTC P0442 SMALL LEAK IN EVAP SYSTEM

Test Step	Result / Action to Take
<p>NOTE: Condition P0442 DTC set: less than 0.625 kPa (2.5 inches H₂O) bleed-up over 15 seconds at 75% fuel fill. Vapor generation limit: more than 0.625 kPa (2.5 inches H₂O) over 120 seconds.</p>	
<p>A1 VISUALLY INSPECT THE COMPONENTS FOR SMALL LEAKS</p> <ul style="list-style-type: none"> ● Check for the presence of a fuel filler cap. Do not tighten or check for correct installation at this time. ● Verify the canister vent solenoid is correctly seated on the EVAP canister. ● Check for cut or loose connections to fuel vapor hoses, tubes and connections in the following locations: <ul style="list-style-type: none"> ■ EVAP canister to EVAP canister purge valve ■ EVAP canister to fuel vapor vent valve assembly ■ fuel vapor control valve tube assembly to fuel tank ● Check the fuel filler pipe for damage. ● Is a concern with a hose, tube, connection or valve visually evident? 	<p>Yes REPAIR or INSTALL new components as necessary. GO to A2.</p> <p>No GO to A2.</p>
<p>A2 CHECK AT THE EVAP TEST PORT FOR SMALL SYSTEM LEAKS</p> <ul style="list-style-type: none"> ● Disconnect and plug the evaporative emission return tube at the intake 	<p>Yes GO to A3.</p>

<p>manifold.</p> <ul style="list-style-type: none"> ● Complete the evaporative emission system leak test. Refer to Evaporative Emission System Leak Test in this section. ● Does the system pass the leak test? 	<p>No GO to A4.</p>
<p>A3 VISUALLY INSPECT THE FUEL FILLER CAP</p>	
<ul style="list-style-type: none"> ● Visually inspect the fuel filler cap for damage. ● Is the fuel filler cap damaged? 	<p>Yes INSTALL a new fuel filler cap. GO to A4.</p> <p>No GO to A4.</p>
<p>A4 CHECK FOR SMALL LEAKS AT THE FUEL FILLER CAP AND EVAP TEST PORT</p>	
<ul style="list-style-type: none"> ● Connect the Evaporative Emission System Leak Tester to the fuel filler pipe. ● Key in ON position. ● Close the canister vent solenoid. Refer to Canister Vent Solenoid Closing Procedure in this section. ● Pressurize the EVAP system to 3.48 kPa (14 inches H₂O). ● Using the ultrasonic leak detector, check the fuel filler cap and EVAP test port for leaks. ● Is a leak detected? 	<p>Yes REPAIR or INSTALL new components as necessary. GO to A5.</p> <p>No INSTALL the fuel filler cap. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emissions repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.</p>
<p>A5 CHECK FOR CONCERN OTHER THAN THE FUEL FILLER CAP</p>	
<ul style="list-style-type: none"> ● Refer to previous test results. ● Did the system pass the evaporative emission system leak test carried out in pinpoint test Step A2? 	<p>Yes CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.</p> <p>No INSTALL the fuel filler cap. GO to A6.</p>
<p>A6 CHECK FOR SMALL LEAK WITH TESTER SET AT FILL POSITION</p>	
<ul style="list-style-type: none"> ● Connect the Evaporative Emission System Leak Tester to the EVAP test port. ● Key in ON position. ● Close the canister vent solenoid. Refer to Canister Vent Solenoid Closing Procedure in this section. ● Turn the selector on the Evaporative Emission System Leak Tester to the FILL position. ● Pressurize the EVAP system to 3.48 kPa (14 inches H₂O). ● Does the pressure on the EVAP system hold between 3.43 kPa and 3.53 kPa (13.80 inches and 14.20 	<p>Yes GO to A7.</p> <p>No DISCONTINUE pressurizing the system. GO to A8.</p>

<p>inches H₂O)?</p>	
<p>A7 CHECK FOR LEAKS IN THE COMPLETE EVAP SYSTEM</p>	
<ul style="list-style-type: none"> ● Connect the Evaporative Emission System Leak Tester to the EVAP test port. ● Key in ON position. ● Close the canister vent solenoid. Refer to Canister Vent Solenoid Closing Procedure in this section. ● Pressurize the EVAP system to 3.48 kPa (14 inches H₂O). ● Using the ultrasonic leak detector, check the following EVAP system locations: <ul style="list-style-type: none"> ■ EVAP return tube to EVAP canister purge valve ■ EVAP canister purge valve to EVAP canister— canister vent solenoid assembly ■ EVAP canister — canister vent solenoid assembly to fuel tank ■ fuel filler cap and fuel filler tube ● Is a leak detected at EVAP return tube, EVAP canister purge outlet tube or EVAP canister tube or associated hose? 	<p>Yes REPAIR or INSTALL new components as necessary. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emissions repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.</p> <p>No DISCONTINUE pressurizing the system. GO to A8.</p>
<p>A8 CHECK FOR SMALL LEAK FROM THE EVAP RETURN TUBE TO THE FUEL VAPOR TEE</p>	
<ul style="list-style-type: none"> ● Disconnect the EVAP canister purge outlet tube at the fuel vapor tee. Plug the opening in the EVAP canister purge outlet tube. ● Connect the Evaporative Emission System Leak Tester to the EVAP test port. ● Pressurize the EVAP system to 3.48 kPa (14 inches H₂O). ● Using the ultrasonic leak detector, check the EVAP system from the intake manifold to the EVAP canister purge outlet tube. ● Is a leak detected? 	<p>Yes REPAIR or INSTALL new components as necessary. REPEAT Step A6 to verify the repair. GO to A9.</p> <p>No GO to A9.</p>
<p>A9 CHECK FOR SMALL LEAK BETWEEN EVAP CANISTER AND FUEL TANK FILLER PIPE</p>	
<ul style="list-style-type: none"> ● Connect the Evaporative Emission System Leak Tester to the fuel filler pipe. ● Transfer the plug from the EVAP canister purge outlet tube to the fuel vapor tee. ● Turn the Evaporative Emission System Leak Tester selector to the FILL position. ● Key in ON position. ● Close the canister vent solenoid. Refer to Canister Vent Solenoid Closing 	<p>Yes REPAIR or INSTALL new components as necessary.</p> <p>GO to A10.</p> <p>No GO to A10.</p>

<p>Procedure in this section.</p> <ul style="list-style-type: none"> ● Pressurize the EVAP system to 3.48 kPa (14 inches H₂O). ● Using the ultrasonic leak detector, check the fuel vapor control valve tube to the fuel tank for leaks. Check the fuel tank pressure sensor, fuel vapor control valve tube and the fuel filler pipe. Check fuel tank to EVAP canister - canister vent solenoid. ● Is a leak detected? 	
<p>A10 CHECK EVAP SYSTEM AT FUEL FILLER PIPE</p>	<p>Yes RESTORE the system to normal operation. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emissions repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.</p> <p>No GO to A6.</p>
<ul style="list-style-type: none"> ● Reconnect the EVAP canister purge outlet tube to the fuel vapor tee. ● Complete the evaporative emission system leak test. Refer to Evaporative Emission System Leak Test in this section. ● Does the EVAP system pass the leak test? 	

PINPOINT TEST B: DTC P0455 MAJOR LEAK OR NO FLOW DETECTED OR DTC P1443 VERY SMALL OR NO PURGE FLOW DETECTED IN SYSTEM

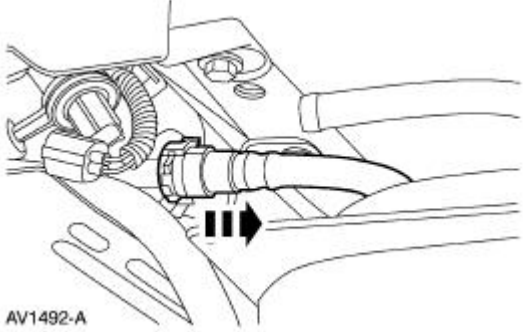
Test Step	Result / Action to Take
<p>NOTE: Condition DTC P0455 set: -1.74 kPa (-7.0 inches H₂O) over 30 seconds.</p>	
<p>NOTE: Condition DTC P1443 set: -1.74 kPa (-7.0 inches H₂O) over 30 seconds with more than 0.02 lb/min vapor flow.</p>	
<p>B1 CHECK FOR DIAGNOSTIC TROUBLE CODE P0455 OR P1443</p>	<p>Yes GO to B2.</p> <p>No GO to B3.</p>
<ul style="list-style-type: none"> ● Use the recorded results from the PCM DTCs. ● Is DTC P0455 present? 	
<p>B2 VISUALLY CHECK FOR GROSS EVAP SYSTEM LEAKS</p>	<p>Yes REPAIR or INSTALL new EVAP components as necessary. GO to B3.</p> <p>No GO to B3.</p>
<ul style="list-style-type: none"> ● Check for the presence of a fuel filler cap. Do not tighten or check for correct installation at this time. ● Check the input port vacuum and EVAP return tube are connected to the EVAP canister purge valve. ● Check that the canister vent solenoid is correctly attached to the EVAP 	

<p>canister.</p> <ul style="list-style-type: none"> ● Check for disconnected or cracked fuel vapor hoses or tubes between the intake manifold and following components: <ul style="list-style-type: none"> ■ EVAP canister purge valve ■ EVAP canister ■ fuel vapor vent valve assembly ■ fuel vapor control valve tube assembly ● Check for damaged fuel tank or fuel filler pipe. ● Is a concern with a hose, tube, connection or valve visually evident? 	
<p>B3 CHECK FOR EVAP SYSTEM LEAKS</p>	<p>Yes GO to B4.</p> <p>No VERIFY that the fuel filler cap is installed correctly. REPAIR or INSTALL new components as necessary. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.</p>
<ul style="list-style-type: none"> ● Disconnect the EVAP return tube from the intake manifold and plug the EVAP return tube. ● Connect the Evaporative Emissions System Leak Tester to the EVAP test port. ● Carry out the evaporative emissions system leak test. Refer to Evaporative Emission System Leak Test in this section. ● Does the system pressure stay above 1.99 kPa (8 inches H₂O)? 	<p>B4 CHECK FOR BLOCKAGE BETWEEN THE EVAP CANISTER PURGE VALVE AND FUEL VAPOR TEE</p> <p>Yes GO to B5.</p> <p>No INSTALL a new vapor line between the EVAP canister purge valve and the fuel vapor tee. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.</p>
<ul style="list-style-type: none"> ● Key in ON position. ● Close the canister vent solenoid. Refer to Canister Vent Solenoid Closing Procedure in this section. ● Pressurize the EVAP system to 3.48 kPa (14 inches H₂O). ● Open the canister vent solenoid. Refer to Canister Vent Solenoid Closing Procedure in this section. ● Does the pressure drop immediately? 	<p>B5 CHECK FOR BLOCKAGE BETWEEN FUEL FILLER PIPE AND THE FUEL VAPOR TEE</p>
<ul style="list-style-type: none"> ● Connect the Evaporative Emissions System Leak 	<p>Yes GO to B6.</p>

<p>Tester to the fuel filler pipe.</p> <ul style="list-style-type: none"> ● Pressurize the EVAP system to 6.47 to 6.97 kPa (26 to 28 inches H₂O). ● Does the pressure drop immediately? 	<p>No INSTALL new fuel tank vapor line(s). REPEAT pinpoint test Step B5 to verify the repair. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.</p>
<p>B6 CHECK FOR FAILED EVAP CANISTER PURGE VALVE OR FUEL TANK PRESSURE SENSOR</p>	
<ul style="list-style-type: none"> ● Use the recorded results from the PCM DTCs. ● Are DTC codes P0455 and P1443 present? 	<p>Yes INSTALL a new EVAP canister purge valve. REFER to Evaporative Emission Canister Purge Valve in this section. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If no leak is detected, CARRY OUT the evaporative emissions repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.</p> <p>No INSTALL a new fuel tank pressure sensor. REFER to Fuel Tank Pressure Sensor in this section. CARRY OUT the evaporative emission system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY out the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.</p>

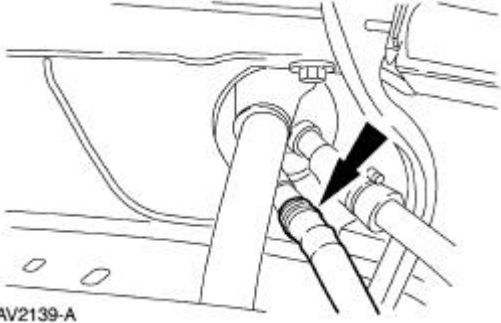
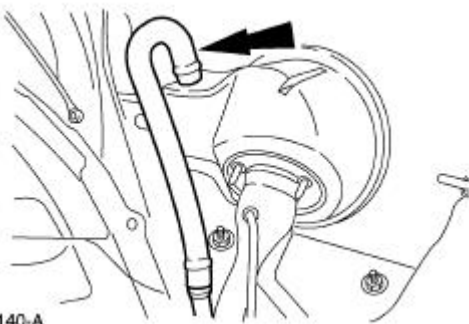
PINPOINT TEST C: DTC P1450 EXCESSIVE VACUUM DETECTED IN THE FUEL TANK

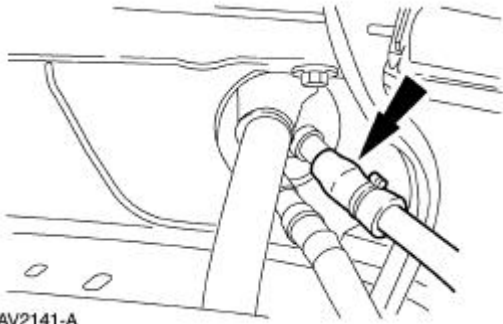
Test Step	Result / Action to Take
<p>NOTE: Condition P1450 DTC set: more than -1.79 kPa (-7.2 inches H₂O) over 30 seconds.</p>	
<p>C1 CHECK FOR VISUAL CAUSES OF EXCESSIVE FUEL TANK VACUUM</p> <ul style="list-style-type: none"> ● Check for kinks or bends in the fuel vapor hoses and tubes. ● Visually check the EVAP canister inlet port, canister vent solenoid filter or outlet hose for contamination or foreign material. ● Check the canister vent solenoid for blockage or contamination. ● Is a concern with a hose, tube, connection or component visually evident? 	<p>Yes REMOVE any contamination or foreign material around fuel vapor hoses and tubes. REPAIR the hoses, tubes or components as necessary. After all visual concerns are repaired, GO to C2.</p> <p>No GO to C2.</p>
<p>C2 CHECK FOR BLOCKAGE BETWEEN EVAP TEST PORT AND CANISTER VENT SOLENOID</p> <ul style="list-style-type: none"> ● Disconnect and plug the EVAP return tube at the intake manifold. ● Connect the Evaporative Emissions System Leak Tester to the EVAP test port. 	<p>Yes GO to C3.</p> <p>No</p>

<ul style="list-style-type: none"> ● Pressurize the EVAP system to 3.48 kPa (14 inches H₂O). ● Does the pressure drop immediately? 	GO to Pinpoint Test D .
C3 CHECK FOR BLOCKAGE BETWEEN THE FUEL FILLER PIPE AND THE FUEL VAPOR TEE	
<ul style="list-style-type: none"> ● Connect the Evaporative Emission System Leak Tester to the fuel filler pipe. ● Pressurize the EVAP system to 3.48 kPa (14 inches H₂O). ● Does the pressure drop immediately? 	Yes GO to C4 . No GO to Pinpoint Test D .
C4 CHECK FOR FUEL TANK PRESSURE SENSOR PID WITHOUT PRESSURE APPLIED	
<ul style="list-style-type: none"> ● Disconnect the EVAP canister outlet tube at the EVAP canister.  <p style="text-align: center;">AV1492-A</p> <ul style="list-style-type: none"> ● Key in ON position. ● Access PCM PID FTP V. ● Record the reading. ● Is PID FTP V reading between 2.40 and 2.80 volts? 	Yes GO to C5 . No REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual to continue diagnosis.
C5 CHECK FOR STUCK OPEN EVAP CANISTER PURGE VALVE CONDITION AT IDLE	
<ul style="list-style-type: none"> ● Connect the EVAP canister outlet tube. ● Remove the plug from the EVAP return tube and reconnect the tube to the intake manifold. ● Verify that the fuel filler cap is correctly installed. ● Key in ON position. ● Access PCM PIDs FTP V and EVAPPDC. ● Start the engine and allow to idle. ● Monitor the FTP V and EVAPPDC PIDs. ● When PID EVAPPDC is zero, is PID FTP V reading below 2.40 volts? 	Yes INSTALL a new EVAP canister purge valve. REFER to Evaporative Emission Canister Purge Valve in this section. CARRY OUT an EVAP system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT an evaporative emissions repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section. No CARRY OUT the EVAP system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emissions repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.

PINPOINT TEST D: HISSING SOUND WHEN REMOVING FUEL CAP

Test Step	Result / Action to Take
D1 TEST FOR FUEL TANK PRESSURE SENSOR OPERATION	
<ul style="list-style-type: none"> ● Key in OFF position. ● Connect the Evaporative Emission System Leak Tester to the fuel filler pipe. ● Close the canister vent solenoid. Refer to Canister Vent Solenoid Closing Procedure in this section. ● Pressurize the EVAP system to 3.48 kPa (14 inches H₂O). ● Is the FTP (FTP V) PID reading 3.11 kPa to 3.86 kPa (12.5 to 15.5 inches H₂O) (4.22 to 4.90 volts)? 	<p>Yes GO to D2.</p> <p>No GO to D3.</p>
D2 TEST FOR BLOCKAGE IN VENTING PORTION OF EVAP SYSTEM	
<ul style="list-style-type: none"> ● Open the canister vent solenoid by selecting the STOP button on the scan tool. ● Does the pressure drop immediately? 	<p>Yes CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.</p> <p>No GO to D7.</p>
D3 TEST FOR FUEL TANK PRESSURE SENSOR OPERATION	
<ul style="list-style-type: none"> ● Connect the Evaporative Emission System Leak Tester to the evaporative emission test port. ● Close the canister vent solenoid. Refer to Canister Vent Solenoid Closing Procedure in this section. ● Pressurize the EVAP system to 3.48 kPa (14 inches H₂O). ● Is the FTP (FTP V) PID reading 3.11 kPa to 3.86 kPa (12.5 to 15.5 inches H₂O) (4.22 to 4.90 volts)? 	<p>Yes GO to D4.</p> <p>No REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.</p>
D4 TEST TO DETERMINE BLOCKAGE LOCATION	
<ul style="list-style-type: none"> ● Open the canister vent solenoid. ● Does the pressure drop immediately? 	<p>Yes GO to D5.</p> <p>No GO to D7.</p>
D5 TEST FOR PINCHED FUEL VAPOR CONTROL VALVE TUBE	
<ul style="list-style-type: none"> ● Lower the fuel tank 19.05 mm (3/4 inch). ● Connect the Evaporative Emission System Leak Tester to the fuel filler pipe. ● Close the canister vent solenoid. Refer to Canister Vent Solenoid Closing Procedure in this section. ● Pressurize the EVAP system to 3.48 kPa (14 inches H₂O). ● Is the FTP (FTP V) PID reading 3.11 kPa to 3.86 kPa (12.5 to 15.5 inches H₂O) (4.22 to 4.90 volts)? 	<p>Yes INSTALL a new fuel vapor control valve tube assembly. REFER to Fuel Vapor Control Tube Assembly Valve in this section. CARRY OUT a leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.</p>

	<p>No GO to D6.</p>
<p>D6 TEST FOR BLOCKAGE IN FUEL FILLER TUBE ASSEMBLY</p> <ul style="list-style-type: none"> ● Disconnect the tank vapor recirculation tube from the fuel filler pipe and plug both openings.  <p>AV2139-A</p> <ul style="list-style-type: none"> ● Pressurize the EVAP system to 3.48 kPa (14 inches H₂O). ● Remove the plug from the vapor recirculation tube. ● Does the pressure drop immediately? 	<p>Yes INSTALL a new fuel vapor control valve tube assembly. REFER to Fuel Vapor Control Tube Assembly Valve in this section. CARRY OUT a leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.</p> <p>No INSTALL a new fuel filler pipe assembly. REFER to Section 310-01. CARRY OUT a leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.</p>
<p>D7 TEST FOR BLOCKAGE IN FRESH AIR VENT HOSE</p> <ul style="list-style-type: none"> ● Disconnect the fresh air vent hose from the fuel filler pipe inside the luggage compartment.  <p>AV2140-A</p> <ul style="list-style-type: none"> ● Pressurize the EVAP system to 3.48 kPa (14 inches H₂O). ● Does the pressure drop immediately? 	<p>Yes INSTALL a new fresh air vent hose. CARRY OUT a leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.</p> <p>No GO to D8.</p>
<p>D8 TEST FOR BLOCKAGE IN THE FRESH AIR TUBE ON THE FUEL FILLER PIPE ASSEMBLY</p> <ul style="list-style-type: none"> ● Disconnect the fresh air tube from the fuel filler pipe assembly. 	<p>Yes INSTALL a new fuel filler pipe assembly. REFER to Section 310-01. CARRY OUT a leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to</p>



AV2141-A

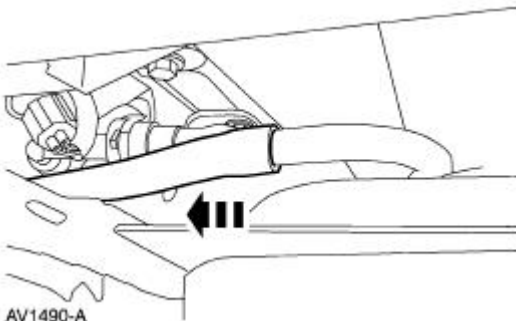
- Pressurize the EVAP system to 3.48 kPa (14 inches H₂O).
- Does the pressure drop immediately?

[Evaporative Emission Repair Verification Drive Cycle](#) in this section.

No
GO to [D9](#).

D9 TEST FOR BLOCKAGE IN THE TANK VAPOR VALVE ASSEMBLY—FRESH AIR TUBE

- Disconnect the tank vapor valve assembly—fresh air tube from the canister vent solenoid vent hose.



AV1490-A

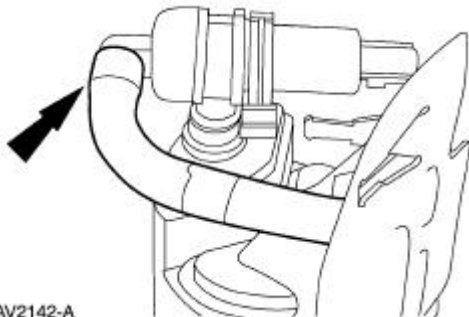
- Pressurize the EVAP system to 3.48 kPa (14 inches H₂O).
- Does the pressure drop immediately?

Yes
INSTALL a new tank vapor valve assembly—fresh air tube. CARRY OUT a leak test. REFER to [Evaporative Emission System Leak Test](#) in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to [Evaporative Emission Repair Verification Drive Cycle](#) in this section.

No
GO to [D10](#).

D10 TEST FOR BLOCKAGE IN CANISTER VENT SOLENOID HOSE

- Disconnect the canister vent solenoid hose from the canister vent solenoid.



AV2142-A

- Pressurize the EVAP system to 3.48 kPa (14 inches H₂O).
- Does the pressure drop immediately?

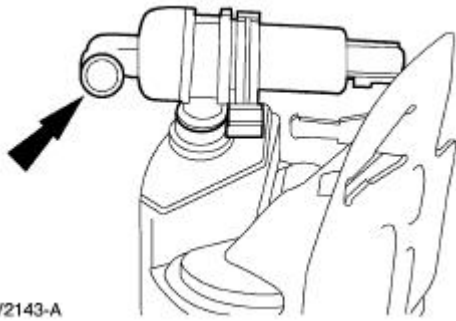
Yes
INSTALL a new canister vent solenoid hose. CARRY OUT a leak test. REFER to [Evaporative Emission System Leak Test](#) in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to [Evaporative Emission Repair Verification Drive Cycle](#) in this section.

No
GO to [D11](#).

D11 TEST FOR BLOCKAGE IN CANISTER VENT SOLENOID

- Disconnect the canister vent solenoid from the evaporative emissions canister. Refer to [Evaporative Emission Canister Vent Solenoid](#) in this section.

Yes
INSTALL a new canister vent solenoid. REFER to [Evaporative Emission Canister Vent Solenoid](#) in



AV2143-A

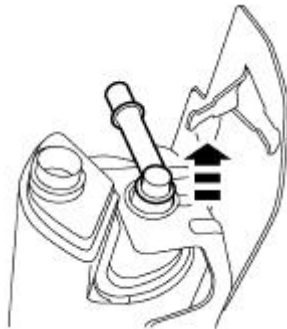
- Pressurize the EVAP system to 3.48 kPa (14 inches H₂O).
- **Does the pressure drop immediately?**

this section. CARRY OUT a leak test. REFER [Evaporative Emission System Leak Test](#) in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to [Evaporative Emission Repair Verification Drive Cycle](#) in this section.

No
GO to [D12](#).

D12 TEST FOR BLOCKAGE IN EVAPORATIVE EMISSIONS CANISTER

- Disconnect the evaporative emissions canister inlet elbow from the evaporative emissions canister.



AV1497-A

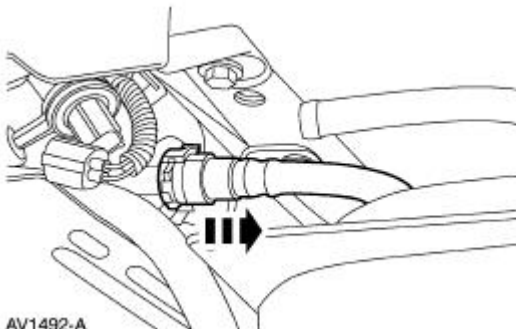
- Pressurize the EVAP system to 3.48 kPa (14 inches H₂O).
- **Does the pressure drop immediately?**

Yes
INSTALL a new evaporative emissions canister. REFER to [Evaporative Emission Canister](#) in this section. CARRY OUT a leak test. REFER to [Evaporative Emission System Leak Test](#) in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to [Evaporative Emission Repair Verification Drive Cycle](#) in this section.

No
GO to [D13](#).

D13 TEST FOR BLOCKAGE IN CANISTER INLET ELBOW

- Disconnect the fuel vapor control valve tube assembly from the evaporative emissions canister inlet elbow.



AV1492-A

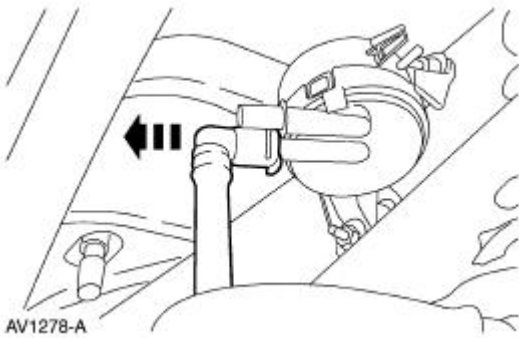
- Pressurize the EVAP system to 3.48 kPa (14 inches H₂O).
- **Does the pressure drop immediately?**

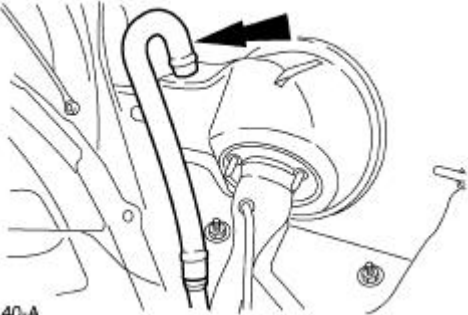
Yes
INSTALL a new evaporative emissions canister inlet elbow. CARRY OUT a leak test. REFER to [Evaporative Emission System Leak Test](#) in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to [Evaporative Emission Repair Verification Drive Cycle](#) in this section.

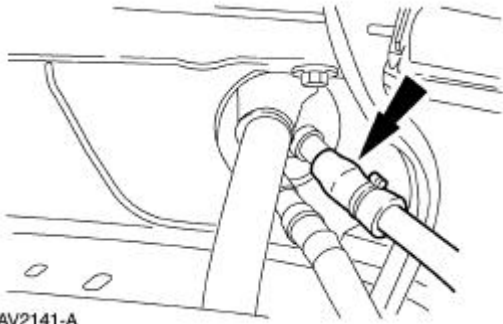
No
INSTALL a new fuel vapor control valve tube assembly. REFER to [Fuel Vapor Control Tube Assembly Valve](#) in this section. CARRY OUT a leak test. REFER to [Evaporative Emission System Leak Test](#) in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to [Evaporative](#)

PINPOINT TEST E: EXCESSIVE FUEL ODOR

Test Step	Result / Action to Take
E1 EVAPORATIVE EMISSION SYSTEM LEAK TEST	
<ul style="list-style-type: none"> ● Carry out the Evaporative Emission System Leak Test procedure. Refer to Evaporative Emission System Leak Test in this section. ● Does the EVAP system pass the leak test? 	<p>Yes GO to E2.</p> <p>No GO to E3.</p>
E2 CARRY OUT THE EVAPORATIVE EMISSION SYSTEM RUNNING LOSS MONITOR REPAIR VERIFICATION DRIVE CYCLE	
<ul style="list-style-type: none"> ● Carry out the Evaporative Emission Running Loss Monitor Repair Verification Drive Cycle; refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. ● Are the powertrain control module DTCs retrieved? 	<p>Yes For DTCs P0442, P0455, P1443, and P1450 REFER to the Diagnostic Trouble Code (DTC) Index in this section. For all other DTCs, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of the DTCs.</p> <p>No EVAP system diagnosis complete. REFER to Symptom Chart.</p>
E3 ISOLATE SYSTEM LEAK FROM FRONT TO REAR	
<ul style="list-style-type: none"> ● Disconnect EVAP canister purge outlet tube from fuel vapor control valve tube assembly and plug both ends. ● Connect the Evaporative Emission System Leak Tester to the evaporative emissions test port. ● Pressurize the EVAP system to 3.48 kPa (14 inches H₂O). ● Does the pressure drop immediately? 	<p>Yes GO to E4.</p> <p>No GO to E9.</p>
E4 TEST FUEL VAPOR HOSE FROM FUEL TANK TO TUBE ASSEMBLY FUEL SUPPLY-RETURN AND VAPOR	
<ul style="list-style-type: none"> ● Disconnect the fuel vapor return hose from the tube assembly fuel supply-return and vapor under vehicle, and plug the fuel supply-return and vapor tube assembly. ● Pressurize the EVAP system to 3.48 kPa (14 inches H₂O). ● Does the pressure drop immediately? 	<p>Yes GO to E5.</p> <p>No INSTALL a new fuel vapor return hose. CARRY OUT a leak test. REFER to Evaporative Emission System Leak Test on this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.</p>
E5 TEST THE FUEL SUPPLY-RETURN AND VAPOR TUBE ASSEMBLY	

<ul style="list-style-type: none"> ● Disconnect the fuel supply-return and vapor tube assembly from the EVAP canister purge outlet tube, and plug the EVAP canister purge outlet tube. ● Pressurize the EVAP system to 3.48 kPa (14 inches H₂O). ● Does the pressure drop immediately? 	<p>Yes GO to E6.</p> <p>No INSTALL a new fuel supply-return and vapor tube assembly. CARRY OUT a leak test. REFER to Evaporative Emission System Leak Test on this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.</p>
E6 TEST FOR EVAPORATIVE EMISSIONS TEST PORT LEAK	
<ul style="list-style-type: none"> ● Disconnect the evaporative emissions test port tube from the EVAP canister purge outlet tube and plug the evaporative emissions test port tube. ● Pressurize the EVAP system to 3.48 kPa (14 inches H₂O). ● Does the pressure drop immediately? 	<p>Yes INSTALL a new evaporative emissions test port. REFER to Evaporative Emission Test Port. CARRY OUT a leak test. REFER to Evaporative Emission System Leak Test on this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.</p> <p>No RECONNECT the evaporative emissions test port tube to the EVAP canister purge outlet tube. GO to E7.</p>
E7 TEST FOR EVAP CANISTER PURGE OUTLET TUBE LEAK	
<ul style="list-style-type: none"> ● Disconnect the EVAP canister purge outlet tube from the evaporative emissions canister purge valve and plug the EVAP canister purge outlet tube.  <p style="text-align: center;">AV1278-A</p> <ul style="list-style-type: none"> ● Pressurize the EVAP system to 3.48 kPa (14 inches H₂O). ● Does the pressure drop immediately? 	<p>Yes INSTALL a new EVAP canister purge outlet tube. CARRY OUT a leak test. REFER to Evaporative Emission System Leak Test on this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.</p> <p>No RECONNECT the EVAP canister purge outlet tube. GO to E8.</p>
E8 TEST FOR LEAK AT EVAPORATIVE EMISSIONS PURGE VALVE	
<ul style="list-style-type: none"> ● Disconnect the evaporative emissions return tube from the evaporative emissions canister purge 	<p>Yes INSTALL a new evaporative</p>

<p>valve and plug the evaporative emissions canister purge valve.</p> <ul style="list-style-type: none"> ● Pressurize the EVAP system to 3.48 kPa (14 inches H₂O). ● Does the pressure drop immediately? 	<p>emissions canister purge valve. REFER to Evaporative Emission Canister Purge Valve in this section. CARRY OUT a leak test. REFER to Evaporative Emission System Leak Test on this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.</p> <p>No INSTALL a new evaporative emissions return tube. CARRY OUT a leak test. REFER to Evaporative Emission System Leak Test on this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.</p>
<p>E9 TEST FOR BLOCKAGE IN VENTING PORTION OF EVAP SYSTEM</p>	
<ul style="list-style-type: none"> ● Reconnect all components. ● Connect the Evaporative Emission System Leak Tester to the fuel filler pipe. ● Close the canister vent solenoid. Refer to Canister Vent Solenoid Closing Procedure in this section. ● Pressurize the EVAP system to 3.48 kPa (14 inches H₂O). ● Open the canister vent solenoid. ● Does the pressure drop immediately? 	<p>Yes GO to E14.</p> <p>No GO to E10.</p>
<p>E10 TEST FOR BLOCKAGE IN THE FRESH AIR VENT HOSE</p>	
<ul style="list-style-type: none"> ● Disconnect the fresh air vent hose from the fuel filler pipe inside the luggage compartment.  <p>AV2140-A</p> <ul style="list-style-type: none"> ● Pressurize the EVAP system to 3.48 kPa (14 inches H₂O). ● Does the pressure drop immediately? 	<p>Yes INSTALL a new fresh air vent hose. CARRY OUT a leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.</p> <p>No GO to E11.</p>
<p>E11 TEST FOR BLOCKAGE IN THE FRESH AIR TUBE ON THE FUEL FILLER PIPE ASSEMBLY</p>	
<ul style="list-style-type: none"> ● Disconnect the fresh air tube from the fuel filler pipe assembly. 	<p>Yes INSTALL a new fuel filler pipe</p>



AV2141-A

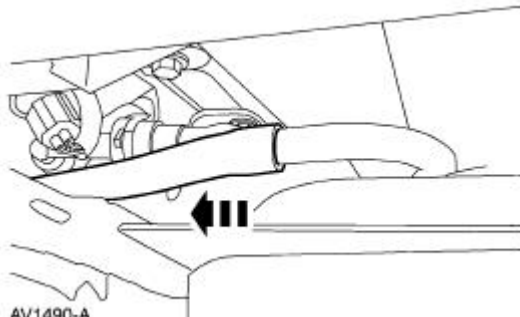
- Pressurize the EVAP system to 3.48 kPa (14 inches H₂O).
- **Does the pressure drop immediately?**

assembly. REFER to [Section 310-01](#) . CARRY OUT a leak test. REFER to [Evaporative Emission System Leak Test](#) in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to [Evaporative Emission Repair Verification Drive Cycle](#) in this section.

No
GO to [E12](#) .

E12 TEST FOR BLOCKAGE IN THE FUEL VAPOR CONTROL VALVE TUBE ASSEMBLY—FRESH AIR TUBE

- Disconnect the fuel vapor control valve tube assembly—fresh air tube from the canister vent solenoid vent hose.



AV1490-A

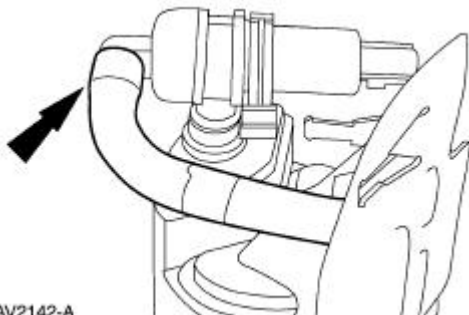
- Pressurize the EVAP system to 3.48 kPa (14 inches H₂O).
- **Does the pressure drop immediately?**

Yes
INSTALL a new fuel vapor control valve tube assembly—fresh air tube. CARRY OUT a leak test. REFER to [Evaporative Emission System Leak Test](#) in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to [Evaporative Emission Repair Verification Drive Cycle](#) in this section.

No
GO to [E13](#) .

E13 TEST FOR BLOCKAGE IN CANISTER VENT SOLENOID HOSE

- Disconnect the canister vent solenoid hose from the canister vent solenoid.

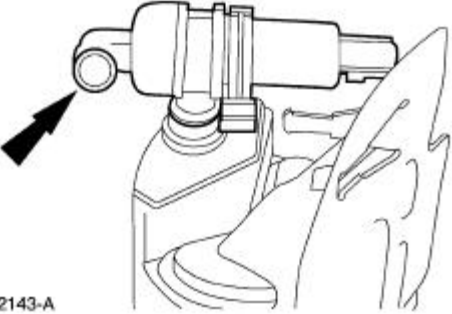
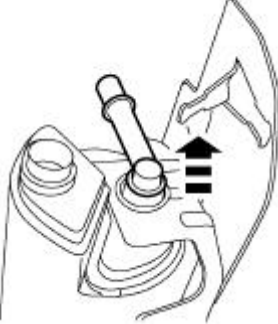


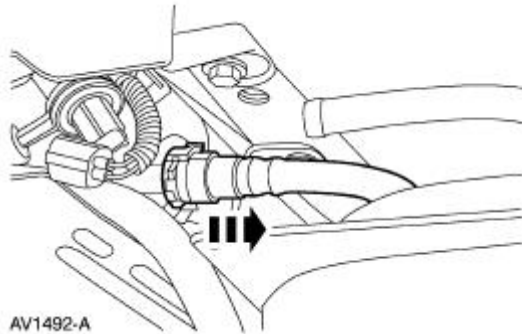
AV2142-A

- Pressurize the EVAP system to 3.48 kPa (14 inches H₂O).
- **Does the pressure drop immediately?**

Yes
INSTALL a new canister vent solenoid hose. CARRY OUT a leak test. REFER to [Evaporative Emission System Leak Test](#) in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to [Evaporative Emission Repair Verification Drive Cycle](#) in this section.

No
INSTALL a new canister vent solenoid. REFER to [Evaporative Emission Canister Vent Solenoid](#) in this section. CARRY OUT a leak test. REFER to [Evaporative Emission System Leak Test](#) in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to [Evaporative](#)

	Emission Repair Verification Drive Cycle in this section.
E14 TEST FOR LEAK IN EVAPORATIVE EMISSIONS CANISTER	
<ul style="list-style-type: none"> ● Carry out the Evaporative Emission Canister and Bracket Assembly Leak Test. Refer to Evaporative Emission System Leak Test in this section. ● Does the EVAP system pass the leak test? 	<p>Yes EVAP system diagnosis complete. GO to E18.</p> <p>No GO to E15.</p>
E15 TEST FOR CANISTER VENT SOLENOID LEAK	
<ul style="list-style-type: none"> ● Disconnect the canister vent solenoid from the evaporative emissions canister and plug the canister.  <p>AV2143-A</p> <ul style="list-style-type: none"> ● Carry out the evaporative emission system leak test. Refer to Evaporative Emission System Leak Test in this section. ● Does the EVAP system pass the leak test? 	<p>Yes INSTALL a new canister vent solenoid. REFER to Evaporative Emission Canister Vent Solenoid in this section. CARRY OUT a leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.</p> <p>No GO to E16.</p>
E16 TEST FOR CANISTER LEAK	
<ul style="list-style-type: none"> ● Disconnect the EVAP canister inlet elbow from the evaporative emissions canister and plug the EVAP canister inlet elbow.  <p>AV1497-A</p> <ul style="list-style-type: none"> ● Carry out the evaporative emission system leak test. Refer to Evaporative Emission System Leak Test in this section. ● Does the EVAP system pass the leak test? 	<p>Yes INSTALL a new EVAP canister assembly. REFER to Evaporative Emission Canister in this section. CARRY OUT a leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.</p> <p>No GO to E17.</p>
E17 TEST FOR CANISTER INLET ELBOW LEAK	
<ul style="list-style-type: none"> ● Disconnect the fuel vapor control valve tube assembly from the EVAP canister inlet elbow and plug the fuel vapor control valve tube assembly. 	<p>Yes INSTALL a new evaporative emissions canister inlet elbow. CARRY OUT a leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair</p>



AV1492-A

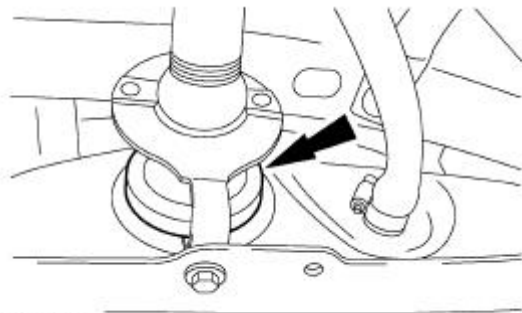
- Carry out the evaporative emissions system leak test. Refer to [Evaporative Emission System Leak Test](#) in this section.
- Does the EVAP system pass the leak test?

verification drive cycle. REFER to [Evaporative Emission Repair Verification Drive Cycle](#) in this section.

No
 INSTALL a new fuel vapor control valve tube assembly. REFER to [Fuel Vapor Control Tube Assembly Valve](#) in this section. CARRY OUT a leak test. REFER to [Evaporative Emission System Leak Test](#) in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to [Evaporative Emission Repair Verification Drive Cycle](#) in this section.

E18 TEST FOR LEAKAGE IN FUEL FILLER PIPE GROMMET

- Reconnect all components.
- Connect the Evaporative Emission System Leak Tester to the fuel filler pipe.
- Close the canister vent solenoid. Refer to [Canister Vent Solenoid Closing Procedure](#) in this section.
- Pressurize the system.



AV2148-A

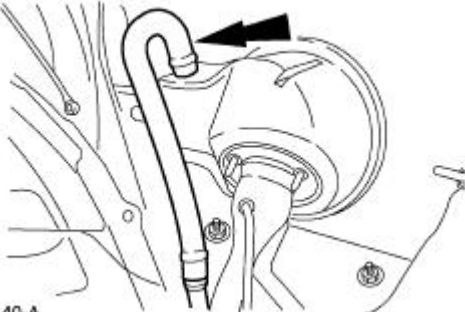
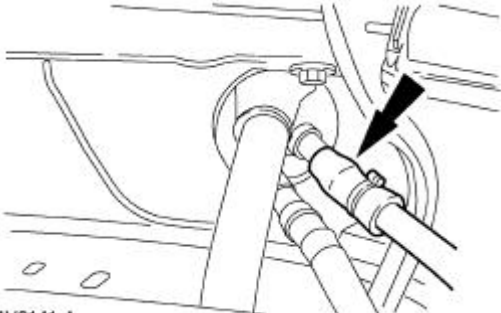
- Does the pressure drop?

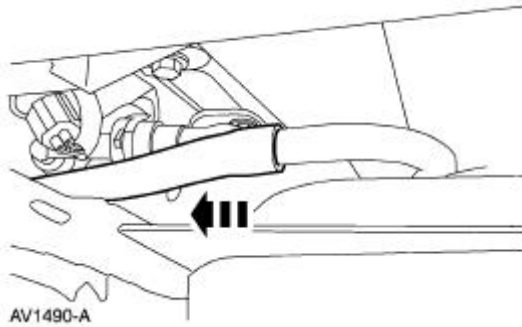
Yes
 INSPECT fuel filler pipe to tank grommet for cuts, abrasions or leaks. REFER to [Section 310-00](#) for repair procedures.

No
 CARRY OUT a leak test. REFER to [Evaporative Emission System Leak Test](#) in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to [Evaporative Emission Repair Verification Drive Cycle](#) in this section.

PINPOINT TEST F: UNABLE TO REFUEL VEHICLE (ORVR)

Test Step	Result / Action to Take
F1 TEST THE FUEL FILLER PIPE AND THE FUEL FILLER PIPE CHECK VALVE <ul style="list-style-type: none"> ● Remove the fuel filler cap. ● Connect the Evaporative Emission System Leak Tester to the fuel filler pipe. ● Close the canister vent solenoid. Refer to Canister Vent Solenoid Closing Procedure in this section. ● Access PCM PID FTP V. ● Pressurize the EVAP System to 3.48 kPa (14 inches H₂O). ● Is PID FTP V reading 3.11 kPa to 3.86 kPa (12.5 to 15.5 inches H₂O) (4.22 to 4.90 volts)? 	<p>Yes GO to F2.</p> <p>No GO to F10.</p>
F2 TEST THE EVAP SYSTEM FOR RESTRICTION <ul style="list-style-type: none"> ● Connect the Evaporative Emission System Leak 	<p>Yes</p>

<p>Tester to the fuel filler pipe.</p> <ul style="list-style-type: none"> ● Attempt to pressurize the EVAP System to 3.48 kPa (14 inches H₂O). ● Does the system pressurize? 	<p>GO to F3.</p> <p>No CARRY OUT the evaporative emissions system leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emissions repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.</p>
<p>F3 TEST FOR BLOCKAGE IN FRESH AIR VENT HOSE</p>	
<ul style="list-style-type: none"> ● Disconnect the fresh air vent hose from the fuel filler pipe inside the luggage compartment.  <p>AV2140-A</p> <ul style="list-style-type: none"> ● Pressurize the EVAP system to 3.48 kPa (14 inches H₂O). ● Does the pressure drop immediately? 	<p>Yes INSTALL a new fresh air vent hose. CARRY OUT a leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.</p> <p>No GO to F4.</p>
<p>F4 TEST FOR BLOCKAGE IN THE FRESH AIR TUBE ON THE FUEL FILLER PIPE ASSEMBLY</p>	
<ul style="list-style-type: none"> ● Disconnect the fresh air tube from the fuel filler pipe assembly.  <p>AV2141-A</p> <ul style="list-style-type: none"> ● Pressurize the EVAP system to 3.48 kPa (14 inches H₂O). ● Does the pressure drop immediately? 	<p>Yes INSTALL a new fuel filler pipe assembly. REFER to Section 310-01. CARRY OUT a leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to Evaporative Emission Repair Verification Drive Cycle in this section.</p> <p>No GO to F5.</p>
<p>F5 TEST FOR BLOCKAGE IN THE TANK VAPOR VALVE ASSEMBLY—FRESH AIR TUBE</p>	
<ul style="list-style-type: none"> ● Disconnect the tank vapor valve assembly—fresh air tube from the canister vent solenoid vent hose. 	<p>Yes INSTALL a new tank vapor valve assembly—fresh air tube. CARRY OUT a leak test. REFER to Evaporative Emission System Leak Test in this section. If the system passes the leak test, CARRY OUT</p>



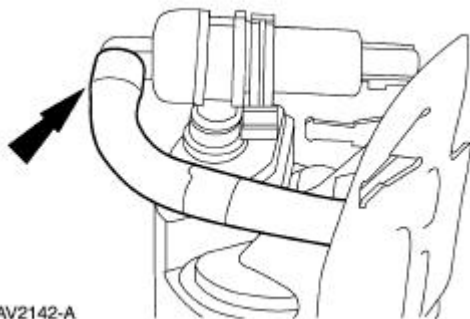
- Pressurize the EVAP system to 3.48 kPa (14 inches H₂O).
- Does the pressure drop immediately?

the evaporative emission repair verification drive cycle. REFER to [Evaporative Emission Repair Verification Drive Cycle](#) in this section.

No
GO to [F6](#).

F6 TEST FOR BLOCKAGE IN CANISTER VENT SOLENOID HOSE

- Disconnect the canister vent solenoid hose from the canister vent solenoid.



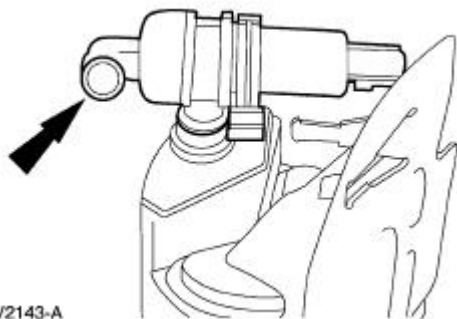
- Pressurize the EVAP system to 3.48 kPa (14 inches H₂O).
- Does the pressure drop immediately?

Yes
INSTALL a new canister vent solenoid hose. CARRY OUT a leak test. REFER to [Evaporative Emission System Leak Test](#) in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to [Evaporative Emission Repair Verification Drive Cycle](#) in this section.

No
GO to [F7](#).

F7 TEST FOR BLOCKAGE IN CANISTER VENT SOLENOID

- Disconnect the canister vent solenoid from the evaporative emissions canister. Refer to [Evaporative Emission Canister Vent Solenoid](#) in this section.



- Pressurize the EVAP system to 3.48 kPa (14 inches H₂O).
- Does the pressure drop immediately?

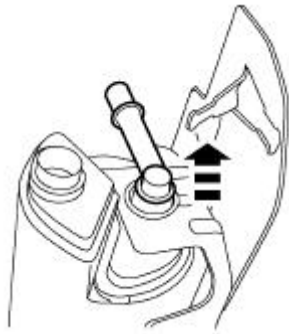
Yes
INSTALL a new canister vent solenoid. REFER to [Evaporative Emission Canister Vent Solenoid](#) in this section. CARRY OUT a leak test. REFER to [Evaporative Emission System Leak Test](#) in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to [Evaporative Emission Repair Verification Drive Cycle](#) in this section.

No
GO to [F8](#).

F8 TEST FOR BLOCKAGE IN EVAPORATIVE EMISSIONS CANISTER

- Disconnect the evaporative emissions canister inlet elbow from the evaporative emissions canister.

Yes
INSTALL a new evaporative emissions canister. REFER to



AV1497-A

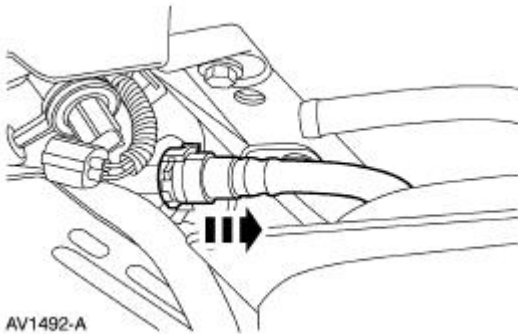
- Pressurize the EVAP system to 3.48 kPa (14 inches H₂O).
- **Does the pressure drop immediately?**

[Evaporative Emission Canister](#) in this section. CARRY OUT a leak test. REFER to [Evaporative Emission System Leak Test](#) in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to [Evaporative Emission Repair Verification Drive Cycle](#) in this section.

No
GO to [F9](#).

F9 TEST FOR BLOCKAGE IN CANISTER INLET ELBOW

- Disconnect the fuel vapor control valve tube assembly from the evaporative emissions canister inlet elbow.



AV1492-A

- Pressurize the EVAP system to 3.48 kPa (14 inches H₂O).
- **Does the pressure drop immediately?**

Yes
INSTALL a new evaporative emissions canister inlet elbow. CARRY OUT a leak test. REFER to [Evaporative Emission System Leak Test](#) in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to [Evaporative Emission Repair Verification Drive Cycle](#) in this section.

No
GO to [F10](#).

F10 TEST FOR PINCHED FUEL VAPOR CONTROL VALVE TUBE

- Lower the fuel tank 19.05 mm (3/4 inch).
- Connect the Evaporative Emission System Leak Tester to the fuel filler pipe.
- Close the canister vent solenoid. Refer to [Canister Vent Solenoid Closing Procedure](#) in this section.
- Pressurize the EVAP system to 3.48 kPa (14 inches H₂O).
- **Is the FTP (FTP V) PID reading 3.11 kPa to 3.86 kPa (12.5 to 15.5 inches H₂O) (4.22 to 4.90 volts)?**

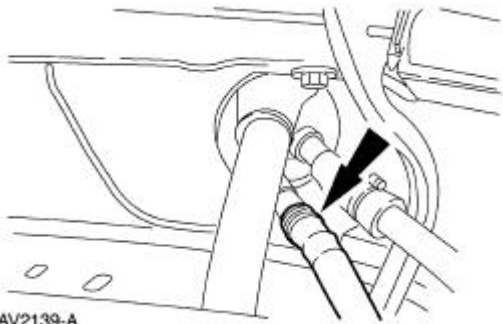
Yes
INSTALL a new fuel vapor control valve tube assembly. REFER to [Fuel Vapor Control Tube Assembly Valve](#) in this section. CARRY OUT a leak test. REFER to [Evaporative Emission System Leak Test](#) in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to [Evaporative Emission Repair Verification Drive Cycle](#) in this section.

No
GO to [F11](#).

F11 TEST FOR BLOCKAGE IN FUEL FILLER TUBE ASSEMBLY

- Disconnect the tank vapor recirculation tube from the fuel filler pipe and plug both openings.

Yes
INSTALL a new fuel vapor control valve tube assembly. REFER to




- Pressurize the EVAP system to 3.48 kPa (14 inches H₂O).
- Remove the plug from the vapor recirculation tube.
- **Does the pressure drop immediately?**

[Fuel Vapor Control Tube Assembly Valve](#) in this section. CARRY OUT a leak test. REFER to [Evaporative Emission System Leak Test](#) in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to [Evaporative Emission Repair Verification Drive Cycle](#) in this section.

No
INSTALL a new fuel filler pipe assembly. REFER to [Section 310-01](#). CARRY OUT a leak test. REFER to [Evaporative Emission System Leak Test](#) in this section. If the system passes the leak test, CARRY OUT the evaporative emission repair verification drive cycle. REFER to [Evaporative Emission Repair Verification Drive Cycle](#) in this section.

Canister Vent Solenoid Closing Procedure

Special Tool(s)



 <p>ST2332-A</p>	<p>Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool</p>
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! **CAUTION:** The canister vent solenoid must not be energized for more than nine minutes at one time. Once the canister vent solenoid is energized and de-energized, adequate time must be allowed for the component to cool adequately. Failure to allow the component to cool may create a false failure in the diagnostics, causing unnecessary repairs.

1. Connect the scan tool and select the output test mode.
 2. If PID monitors are not active, select PIDs.
 3. Select the fuel tank pressure (FTP) and the volts (V) parameter identification (PID) for monitoring.
 4. Select the ALL OFF mode.
 5. Close the canister vent solenoid by pushing the START button on the scan tool.
-

Evaporative Emission System Leak Test

Special Tool(s)


 ST2116-A	Evaporative Emission System Tester 310-F007 (134-00056) or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

 **CAUTION:** The evaporative emission system must not be pressurized to more than 3.48 kPa (14 inches H₂O) or damage to the evaporative emission system may occur.

1. Connect the Evaporative Emission System Leak Tester to the evaporative emission test port.
2. Close the canister vent solenoid. For additional information, refer to [Canister Vent Solenoid Closing Procedure](#) in this section.
3. Pressurize the evaporative emission system to 3.48 kPa (14 inches H₂O).
4. Monitor the system for two minutes. The system fails the leak test if the pressure falls below 2.0 kPa (8 inches H₂O).
5. Repair any leaks as necessary.
6. Repeat the leak test until the system remains above 2.0 kPa (8 inches H₂O) after the two-minute test period.

Evaporative Emission Repair Verification Drive Cycle

Special Tool(s)

	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool
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Drive Cycle Recommendations

NOTE: The following procedure is designed to execute and complete the evaporative emission repair verification drive cycle and to clear the Ford P1000, inspection and maintenance (I/M) readiness code. When the ambient air temperature is below 4.4°C (40°F) or above 37.8°C (100°F), or the altitude is above 2,438 meters (8,000 feet), the EVAP monitor will not run. If the P1000 must be cleared in these conditions, the powertrain control module (PCM) must detect them once (twice on some applications) before the EVAP monitor can be bypassed and the P1000 cleared. The EVAP bypassing procedure is described in the following drive cycle.

1. Most OBD II monitors will complete more readily using a steady foot driving style during cruise or acceleration modes. Operating the throttle in a smooth fashion will minimize the time necessary for monitor completion.
2. Fuel tank level should be between one-half and three-quarters full with three-quarters full being the most desirable.
3. The evaporative monitor can only operate during the first 30 minutes of engine operation. When executing the procedure for this monitor, stay in part throttle mode and drive in a smooth fashion to minimize fuel slosh.

Drive Cycle Preparation

NOTE: For best results, follow each of the following steps as accurately as possible.

4. **NOTE:** This step bypasses the engine soak timer and resets OBD II monitor status.

Install the scan tool. Turn the key ON with the engine OFF. Cycle the key off, then on. Select the appropriate vehicle and engine qualifier. Clear all diagnostic trouble codes (DTCs) and carry out a PCM reset.

5. Begin to monitor the following PIDs: ECT, EVAPDC, FLI (if available) and TP MODE. Press Diagnostic Data Link, PCM, PID/Data monitor and record, press trigger to select each PID, then start.
6. Start the engine without returning the key to the OFF position.

Preparation for Monitor Entry



WARNING: Strict observance of posted speed limits and attention to driving conditions

are mandatory when proceeding through the following drive cycle.

7. **NOTE:** This step allows engine warm-up and provides intake air temperature (IAT) input to the PCM.

Idle the vehicle for 15 seconds. Drive at 64 km/h (40 mph) until the ECT is at least 76.7°C (170°F).

8. Is IAT above 4.4°C (40°F) and below 37.8°C (100°F)? If not, continue with the following steps but note that the EVAP Monitor Bypass portion of the drive cycle (Step 13) will be required to bypass the EVAP monitor and clear the P1000.

9. **NOTE:** This step executes the heated oxygen sensor (HO2S) monitor.

Cruise at 64 km/h (40 mph) for 60 seconds.

10. **NOTE:** This executes the EVAP monitor if IAT is above 4.4°C (40°F) and below 37.8°C (100°F).

NOTE: To initiate the monitor, TP MODE should equal PT, EVAPDC must be greater than 75%, and FLI must be between 15 and 85%.

NOTE: Avoid sharp turns and hills.

Cruise at 72 to 104 km/h (45 to 65 mph) for 10 minutes.

11. **NOTE:** This step executes the ISC portion of the Secondary Air/CCM.

Bring the vehicle to a stop. Idle with the transmission in DRIVE (for automatic transmission) or NEUTRAL (for manual transmission) for two minutes.

Pending Code and EVAP Monitor Bypass Check

12. **NOTE:** This determines if a pending code is preventing the clearing of P1000.

NOTE: If the EVAP monitor is not complete and IAT was below 4.4°C (40°F) or above 37.8°C (100°F) temperature range in Step 8, or the altitude is above 2,438 meters (8,000 feet), the EVAP Monitor Bypass (Step 13) must be carried out.

Using the scan tool, check for pending codes. Conduct normal repair procedures for any pending code concerns. Rerun any incomplete monitor.

EVAP Monitor Bypass


13. **NOTE:** This allows the bypass counter to increment to two.

NOTE: Do not repeat Step 4.

Park the vehicle for a minimum of eight hours. Repeat Steps 5 through 12.


Evaporative Emission Canister

Removal and Installation

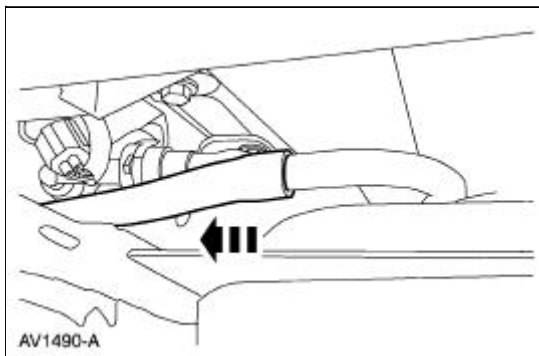
1.  **WARNING:** The evaporative emission system contains fuel vapor and condensed fuel vapor. Although not in large quantities, it still presents the danger of explosion or fire. Disconnect the battery ground cable from the battery to minimize the possibility of an electrical spark occurring, possibly causing a fire or explosion if fuel vapor or liquid fuel is present in the area. Failure to follow these instructions may result in personal injury.

Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).

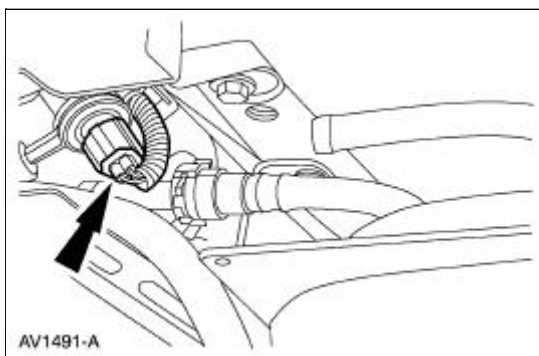
2. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
3. Remove the left rear wheel. For additional information, refer to [Section 204-04](#).

4.  **WARNING:** Do not smoke or carry lighted tobacco or open flame of any type when working on or around any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

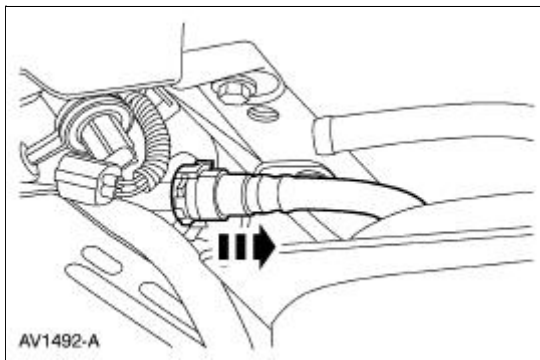
Disconnect the canister vent solenoid hose assembly.



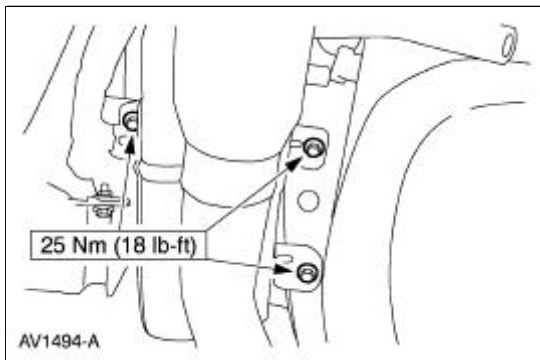
5. Disconnect the connector.



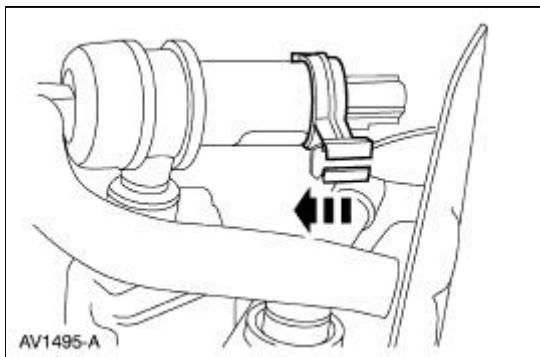
6. Disconnect the evaporative emission (EVAP) canister purge outlet tube.



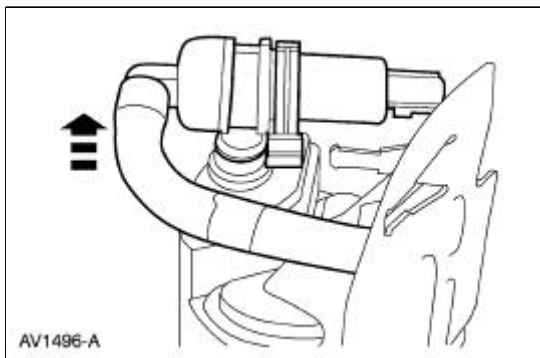
7. Remove the EVAP canister with bracket assembly from the vehicle.
 - Remove the bolts.



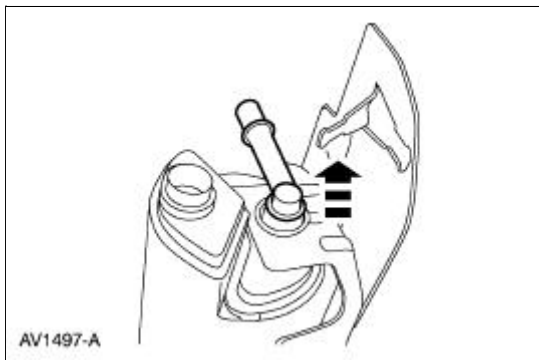
8. Disconnect the brace.



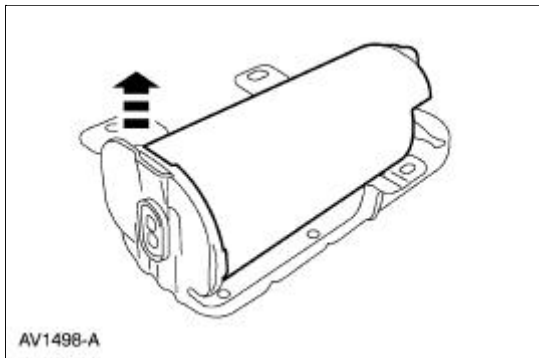
9. Remove the canister vent solenoid and canister vent solenoid hose assembly.



10. Remove the EVAP canister purge outlet tube elbow.




11. Remove the EVAP canister from the canister bracket.



12. To install, reverse the removal procedure.
- Carry out a leak test. For additional information, refer to [Evaporative Emission System Leak Test](#) in this section.
 - Carry out the evaporative emission repair verification drive cycle. For additional information, refer to [Evaporative Emission Repair Verification Drive Cycle](#) in this section.
-

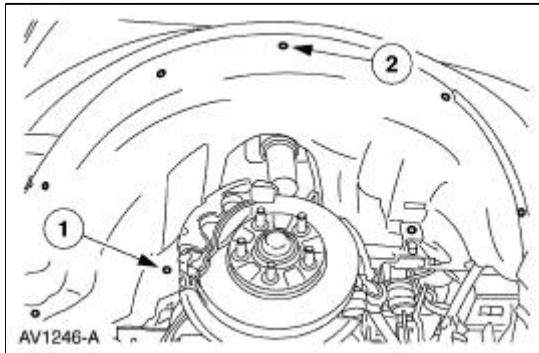
Evaporative Emission Canister Purge Valve

Removal and Installation

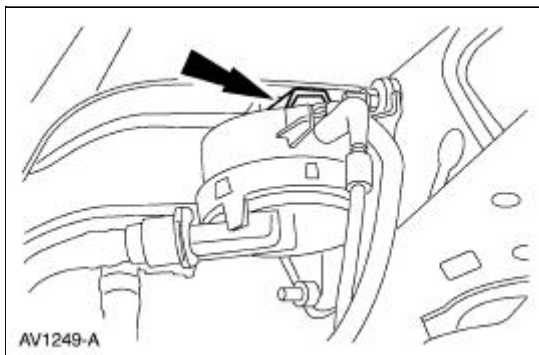
1.  **WARNING:** The evaporative emission system contains fuel vapor and condensed fuel vapor. Although not in large quantities, it still presents the danger of explosion or fire. Disconnect the battery ground cable from the battery to minimize the possibility of an electrical spark occurring, possibly causing a fire or explosion if fuel vapor or fuel liquid is present in the area. Failure to follow these instructions may result in personal injury.

Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).

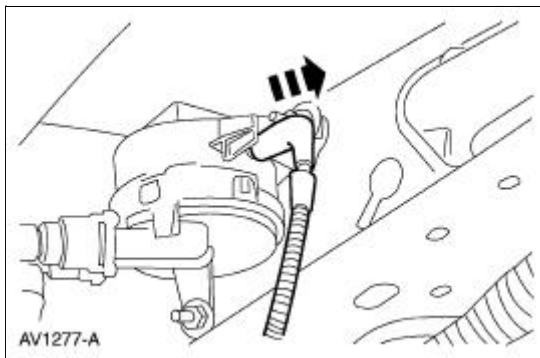
2. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
3. Remove the RH front wheel. For additional information, refer to [Section 204-04](#).
4. Remove the right front splash shield.
 1. Remove the three screws.
 2. Remove the five pin-type retainers.




5. Disconnect the connector.

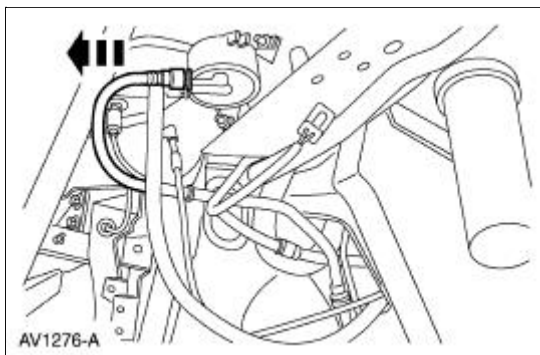


6. Disconnect the main emission vacuum control connector.

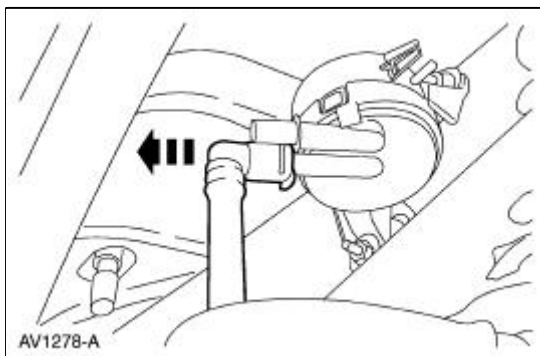


7.  **WARNING:** Do not smoke or carry lighted tobacco or open flame of any type when working on or around any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

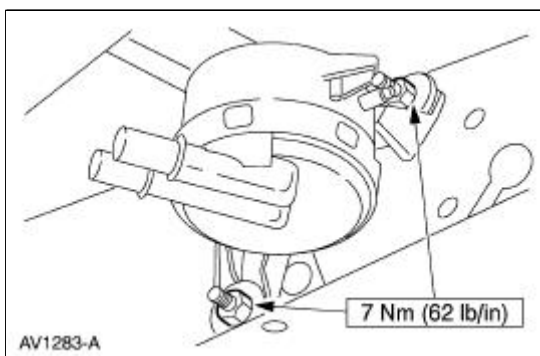
Disconnect the evaporative emission (EVAP) canister purge outlet tube.



8. Disconnect the EVAP return tube.



9. Remove the nuts and the EVAP canister purge valve.



10. To install, reverse the removal procedure.

- Leak test the system. For additional information, refer to [Evaporative Emission System Leak Test](#) in this section.
 - Carry out the evaporative emission repair verification drive cycle. For additional information, refer to [Evaporative Emission Repair Verification Drive Cycle](#) in this section.
-

Fuel Vapor Vent Valve

Removal and Installation

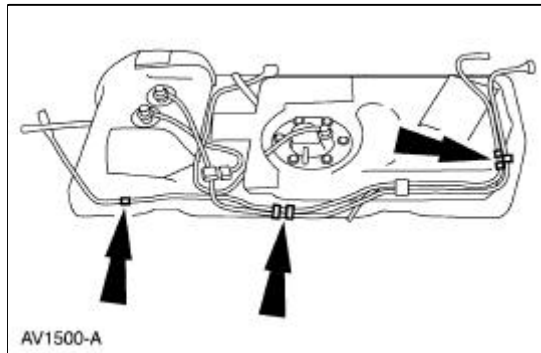
1. **NOTE:** The fuel vapor vent valve is repaired along with the fuel vapor control valve and the in-line fuel tank pressure sensor as a fuel vapor control valve tube assembly.

For removal and installation of the fuel vapor vent valve, refer to [Fuel Vapor Control Tube Assembly Valve](#) in this section.

Fuel Vapor Control Tube Assembly Valve

Removal and Installation

1. Remove the fuel tank. For additional information, refer to [Section 310-01](#).
2. Remove the retainers.

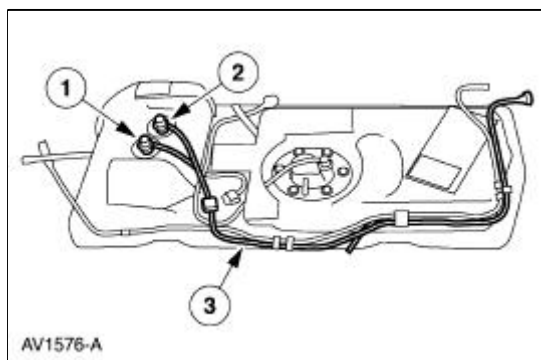


3. **NOTE:** The fuel vapor vent valve, fuel vapor control valve and the in-line fuel tank pressure sensor are repaired as a fuel vapor control valve tube assembly.

NOTE: It may be necessary to lubricate the fuel vapor control valve tube assembly grommets with ESE-M00B144-B Merpol® or equivalent to assist in the removal procedure.

Remove the fuel vapor control valve tube assembly.

1. Loosen the fuel vapor vent valve.
2. Loosen the fuel vapor control valve.
3. Remove the fuel vapor control valve tube assembly.



4. **NOTE:** Lubricate all O-ring seals with MERPOL® O-Ring Seal Lubricant or equivalent meeting Ford specification ESE-M99B144-B.

NOTE: New grommets are necessary when the fuel vapor control valve tube assembly is removed.

To install, reverse the removal procedure.

- Leak test the system. For additional information, refer to [Evaporative Emission System Leak Test](#) in this section.
- Carry out the evaporative emission repair verification drive cycle. For additional

information, refer to [Evaporative Emission Repair Verification Drive Cycle](#) in this section.

Fuel Tank Pressure Sensor

Removal and Installation

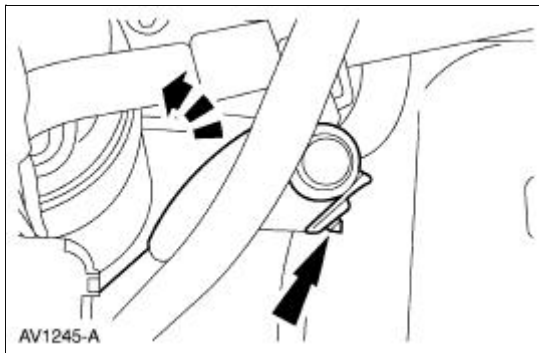
1. **NOTE:** The in-line fuel tank pressure sensor is repaired along with the fuel vapor vent valve and the fuel vapor control valve as a fuel vapor control valve tube assembly.

For removal and installation of the fuel vapor control valve, refer to [Fuel Vapor Control Tube Assembly Valve](#) in this section.

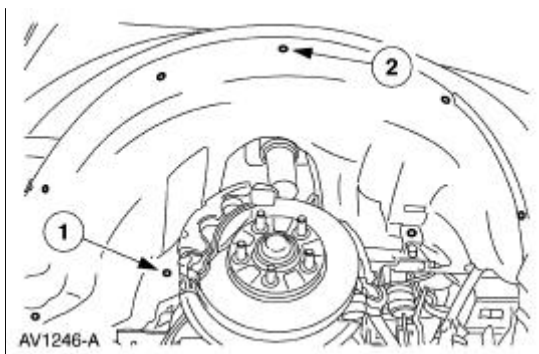
Evaporative Emission Test Port

Removal and Installation

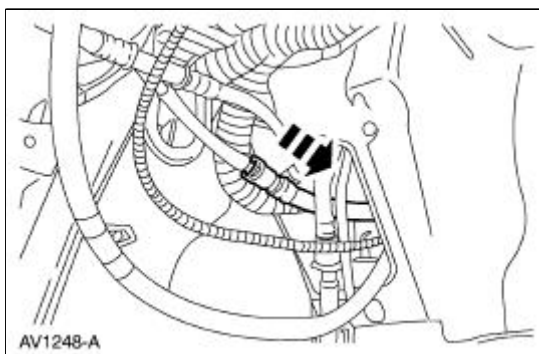
1. Disconnect the pin-type retainer.



2. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
3. Remove the RH front wheel. For additional information, refer to [Section 204-04](#).
4. Remove the RH front splash shield.
 1. Remove the three screws.
 2. Remove the five pin-type retainers.



5. Remove the evaporative emission test port by disconnecting at the EVAP canister purge outlet tube junction.



6. To install, reverse the removal procedure.

- Leak test the system. For additional information, refer to [Evaporative Emission System Leak Test](#) in this section.
 - Carry out the evaporative emission repair verification drive cycle. For additional information, refer to [Evaporative Emission Repair Verification Drive Cycle](#) in this section.
-

Evaporative Emission Canister Vent Solenoid

Removal and Installation

1. Remove the canister vent solenoid. For additional information, refer to [Evaporative Emission Canister](#) in this section.
-

General Specifications

Item	Specification
Lubricants	
Super premium SAE 5W-20 Engine Oil XO-5W20-DSP	WSS-M2C914-A
Penetrating and Lock Lubricant E8AZ-19A501-B	N/A
Pipe Sealant with Teflon D8AZ-19554-A	WSK-M26350-A2

Torque Specifications

Description	Nm	lb-ft	lb-in
Cylinder head temperature (CHT) sensor — 3.8L	10	—	89
Engine coolant temperature (ECT) sensor — 4.6L (2V)	20	—	15
Engine coolant temperature (ECT) sensor — 4.6L (4V)	24	18	—
Heated oxygen sensors (HO2S)	41	30	—
Catalyst monitor sensors	41	30	—
Crankshaft position (CKP) sensor bolts — 3.8L	6	—	53
Crankshaft position (CKP) sensor bolts — 4.6L	10	—	89
Power steering reservoir bolts	10	—	89
Camshaft position (CMP) sensor bolt — 4.6L	10	—	89
PCM connector to module bolt	6	—	53
Idle air control (IAC) valve bolts	10	—	89
Camshaft synchronizer housing bolt	25	18	—
Throttle position (TP) sensor screws	3	—	27
Fuel pressure sensor bolts	4	—	35
Air intake scoop bolts	25	18	—
Air intake scoop bracket bolt	25	18	—
Air intake scoop bracket nuts	25	18	—
Air intake scoop bracket throttle body nut	9	—	80
Exhaust gas recirculation (EGR) vacuum regulator solenoid bolts	10	—	89

Electronic Engine Controls

The electronic engine controls consist of the following:

- powertrain control module (PCM)
- throttle position (TP) sensor
- idle air control (IAC) valve
- engine coolant temperature (ECT) sensor
- cylinder head temperature sensor
- camshaft position (CMP) sensor
- crankshaft position (CKP) sensor
- mass air flow (MAF) sensor
- intake air temperature (IAT) sensor
- heated oxygen sensor (HO2S) — front
- catalyst monitor sensor — rear
- wheel speed sensor

The powertrain control module needs the following inputs to calibrate the engine correctly:

- crankshaft position
- engine rpm
- engine load (manifold pressure)
- atmospheric (barometric) pressure
- engine coolant temperature

The throttle position sensor:

- sends the powertrain control module a signal indicating the throttle plate angle.
- is the main input to the powertrain control module from the driver.

The idle air control valve:

- controls bypass air around the throttle plate at low speeds.
- is controlled by the powertrain control module.

The cylinder head temperature sensor:

- provides a gauge signal for coolant temperature.
- is mounted on rear of LH cylinder head.
- sends the powertrain control module a signal indicating engine temperature.
- resistance decreases as coolant temperature increases.

The camshaft position sensor:

- sends the powertrain control module a signal indicating camshaft position, used for fuel synchronization.

The crankshaft position sensor:

- sends the powertrain control module a signal indicating crankshaft position.
- is essential for calculating spark timing.

The mass air flow sensor:

- sends the powertrain control module a signal indicating mass air flow rate of air entering the engine.

The intake air temperature sensor:

- sends the powertrain control module a signal indicating the temperature of the air entering the engine.

The heated oxygen sensor:

- has the ability to create a voltage signal depending on exhaust oxygen content.
- provides feedback information to the powertrain control module used to calculate fuel delivery.

The rear catalyst monitor sensor:

- monitors oxygen content after the oxygen flows through the catalytic converter.
- provides a voltage to the powertrain control module used to calculate catalytic converter integrity.

The wheel speed sensor:

- sends a signal to the powertrain control module indicating wheel speed.
-

Electronic Engine Controls —Cobra

Most of the Cobra engine electronic controls are similar to that of the non-supercharged 4.6L (2V) engine. These components are as follows:

- Crankshaft position (CKP) sensor
- Throttle position (TP) sensor
- Idle air control (IAC) valve
- Mass air flow (MAF) sensor
- Heated oxygen sensors (HO2S)
- Engine coolant temperature (ECT) sensor

There are also three controls that are unique to the Cobra engine. These are as follows:

- Integrated temperature and manifold absolute pressure (T-MAP) sensor
- Supercharger bypass vacuum solenoid
- Supercharger bypass vacuum solenoid — actuator

Supercharger Bypass Vacuum Solenoid and Actuator

The Supercharger bypass vacuum solenoid will bleed off boost under the following conditions:

- heavy engine misfire
- engine coolant over-temperature
- loss of intercooler fluid
- pump failure

This prevents damage that can occur if boost were allowed under these conditions. The solenoid is located on the upper LH side of the engine. The solenoid uses engine vacuum to operate a actuator and linkage that connects to the pressure bleed off valve. The actuator is located near the solenoid and is connected to it by a vacuum line.

Integrated Temperature and Manifold Absolute Pressure (TMAP) Sensor

The TMAP sensor is located on the upper LH side of the engine and is used to measure current manifold absolute pressure and manifold air charge temperature.

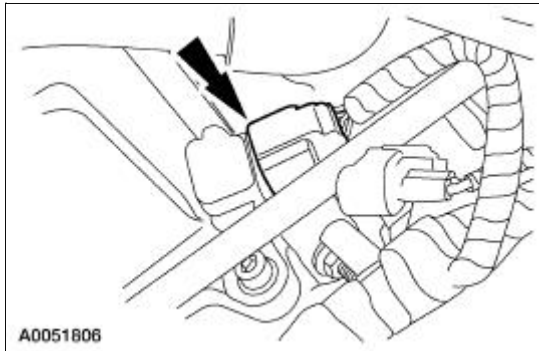
Electronic Engine Controls

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

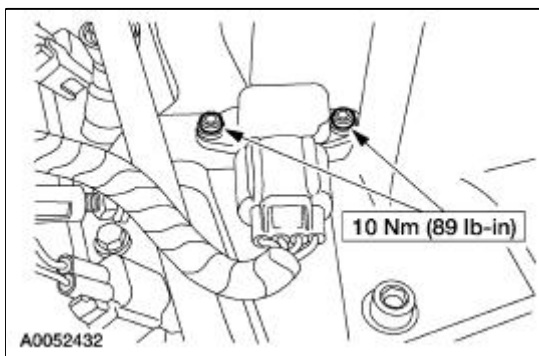
Temperature and Manifold Absolute Pressure (T-MAP) Sensor —Cobra

Removal and Installation

1. Disconnect the temperature manifold absolute pressure (T-MAP) sensor electrical connector.



2. Remove the bolts and the T-MAP sensor.

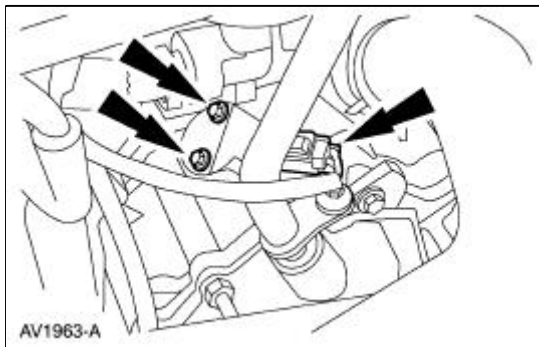


3. To install, reverse the removal procedure.
-

Camshaft Position (CMP) Sensor —3.8L

Removal

1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Remove the camshaft position (CMP) sensor.
 - Disconnect the connector.
 - Remove the bolts and the sensor.



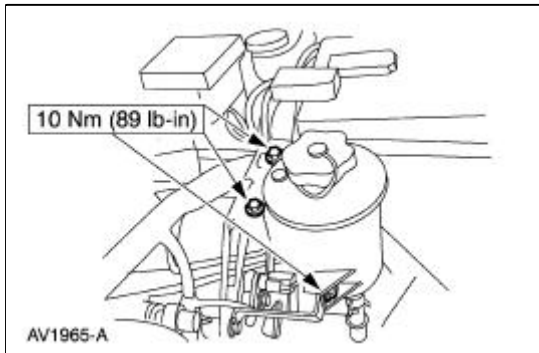
Installation

1. To install, reverse the removal procedure.
-

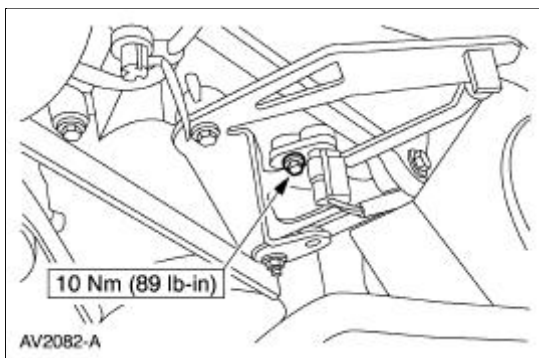
Camshaft Position (CMP) Sensor —4.6L

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Remove the bolts and position aside the power steering pump reservoir.



3. Remove the camshaft position (CMP) sensor.
 - Disconnect the connector.
 - Remove the bolt and the sensor.

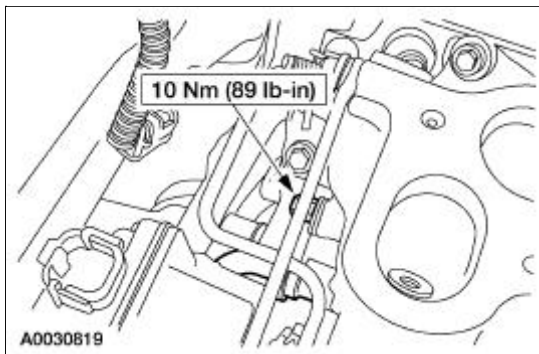


4. To install, reverse the removal procedure.

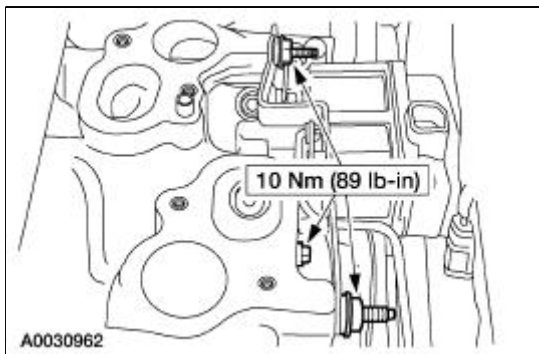
Intake Manifold Runner Control (IMRC) Actuator —3.8L

Removal and Installation

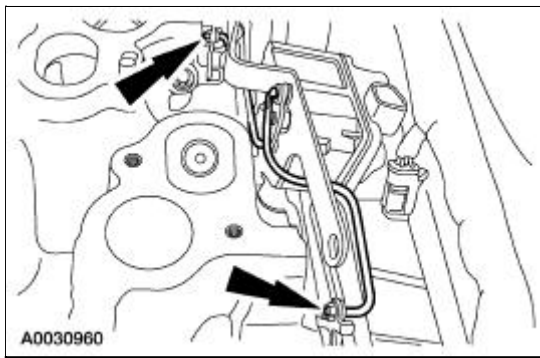
1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Drain the cooling system. For additional information, refer to [Section 303-03A](#).
3. Remove the upper intake manifold. For additional information, refer to [Section 303-01A](#).
4. Remove the fuel injector supply manifold. For additional information, refer to [Section 303-04A](#).
5. Remove the coolant bypass tube. For additional information, refer to [Section 303-03A](#).
6. Remove the bolt and heater water inlet tube at the back of the lower intake.



7. Remove the two stud bolts and one bolt. Position the actuator aside.



8. Disconnect the linkage and remove the actuator.



9. **NOTE:** New plastic IMRC retainers must be installed any time an IMRC rod is removed.

NOTE: Before installing the IMRC actuator, be sure to rotate the motor driver plate until the levers make contact with the set screws, then rotate the motor until the motor bracket bolt holes line up with the tapped holes in the lower intake manifold.

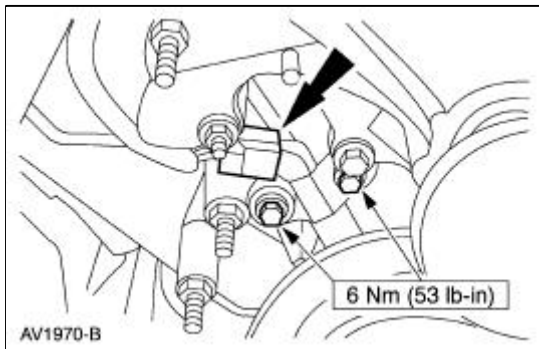
NOTE: Discard O-ring and install a new O-ring on the heater inlet tube. Lubricate the O-ring with engine coolant prior to installation.

To install, reverse the removal procedure.

Crankshaft Position (CKP) Sensor —3.8L

Removal

1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Remove the crankshaft position (CKP) sensor.
 - Disconnect the connector.
 - Remove the bolts and the sensor.



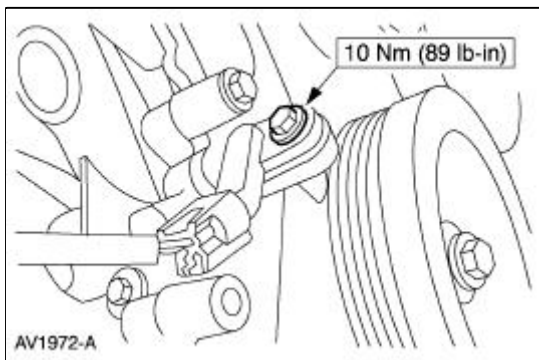
Installation

1. To install, reverse the removal procedure.
-

Crankshaft Position (CKP) Sensor —4.6L

Removal

1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Remove the A/C compressor. For additional information, refer to [Section 412-03](#).
3. Remove the crankshaft position (CKP) sensor.
 - Disconnect the connector.
 - Remove the bolt and remove the sensor.



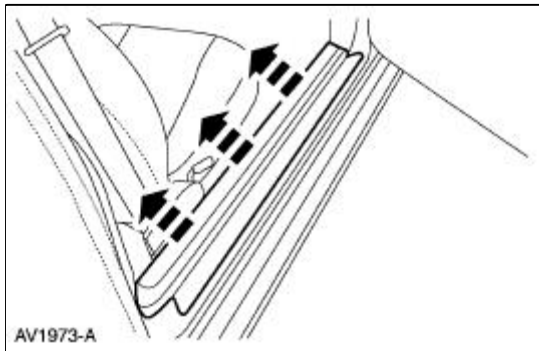
Installation

1. To install, reverse the removal procedure.
-

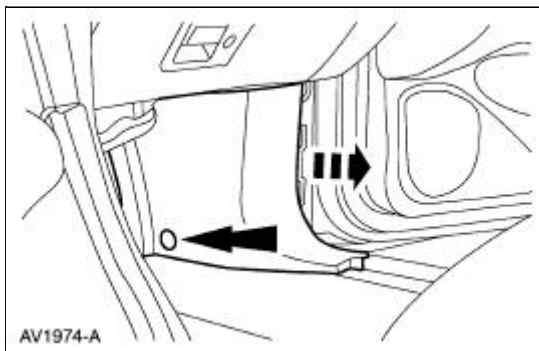
Powertrain Control Module (PCM)

Removal

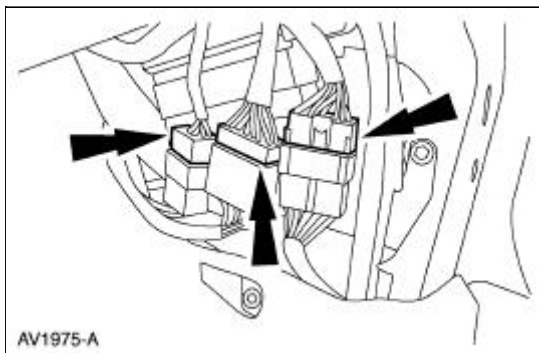
1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Remove the RH front door scuff plate.



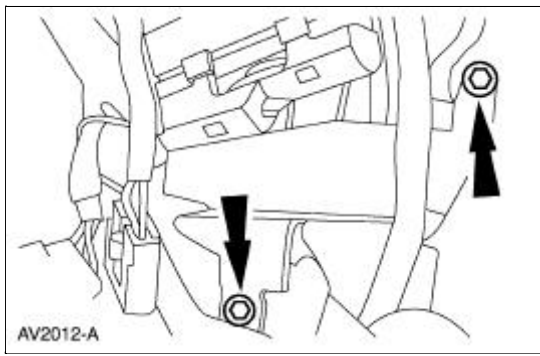
3. Remove the RH cowl side trim panel.
 - Remove the pin-type retainer.
 - Remove the panel.



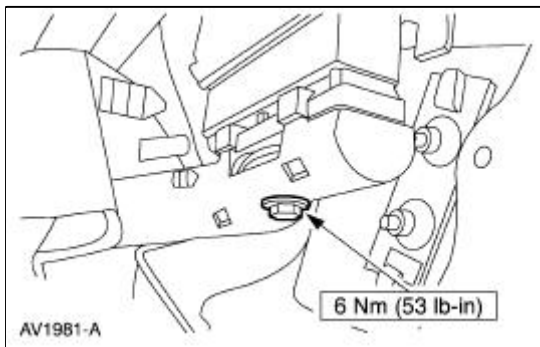
4. Disconnect the connectors and position them aside.



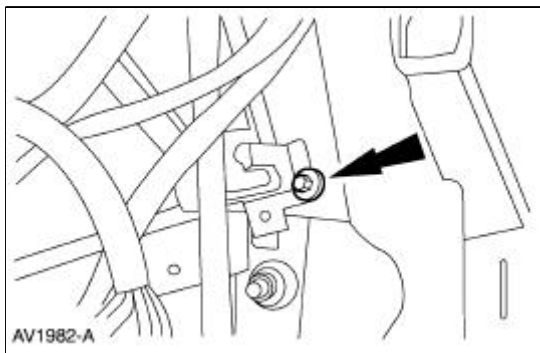
5. Remove the bolts and the bracket.



6. Loosen the bolt and remove the connector.



7. Remove the bolt and the powertrain control module (PCM).



Installation

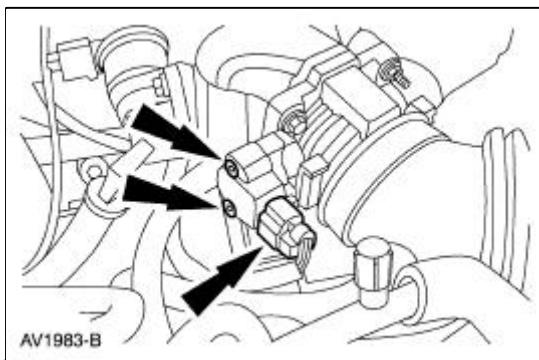
1. To install, reverse the removal procedure.
-

Throttle Position (TP) Sensor

Removal

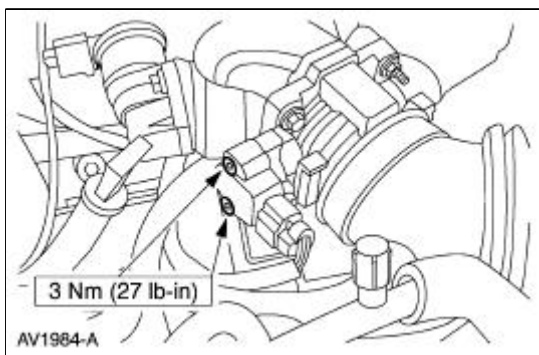
NOTE: The 3.8L engine is shown; the 4.6L (2V) is similar.

1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Remove the throttle position (TP) sensor.
 - Disconnect the connector.
 - Remove the screws, and remove the sensor.



Installation

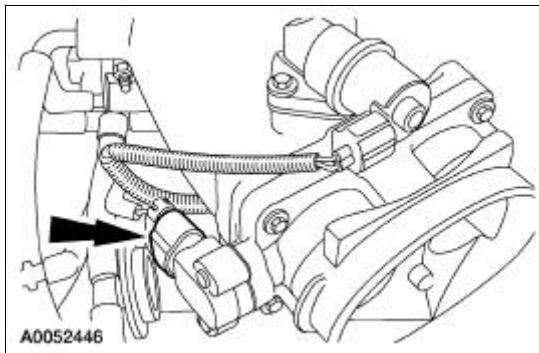
1. To install, reverse the removal procedure.



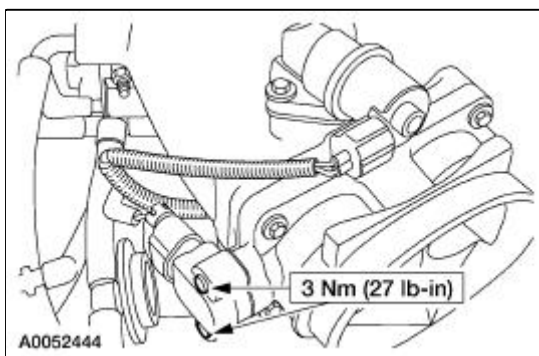
Throttle Position (TP) Sensor —Cobra

Removal and Installation

1. Disconnect the throttle position (TP) sensor electrical connector.



2. Remove the bolts and the TP sensor.

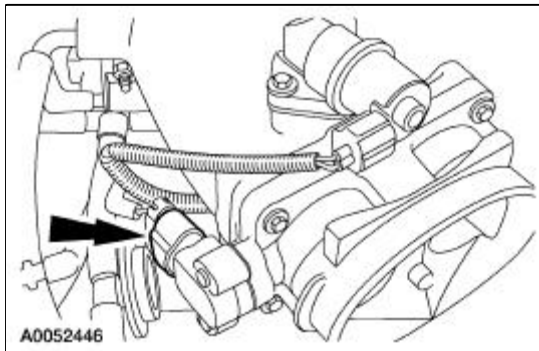


3. To install, reverse the removal procedure.
-

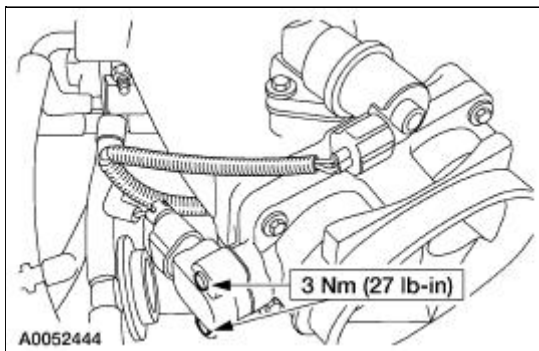
Throttle Position (TP) Sensor —Mach I

Removal and Installation

1. Remove the air intake scoop bracket. For additional information, refer to [Section 303-12](#).
2. Disconnect the throttle position (TP) sensor electrical connector.



3. Remove the bolts and the TP sensor.



4. To install, reverse the removal procedure.

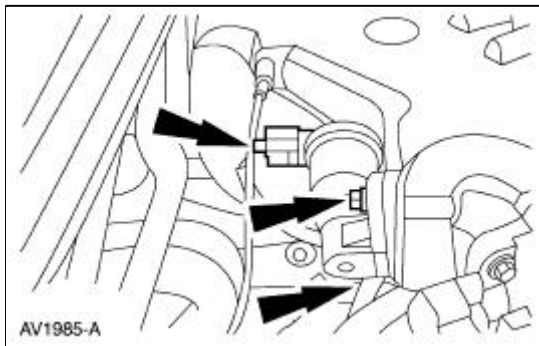
Idle Air Control (IAC) Valve —3.8L

Removal

1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. **NOTE:** Discard the idle air control (IAC) valve gasket.

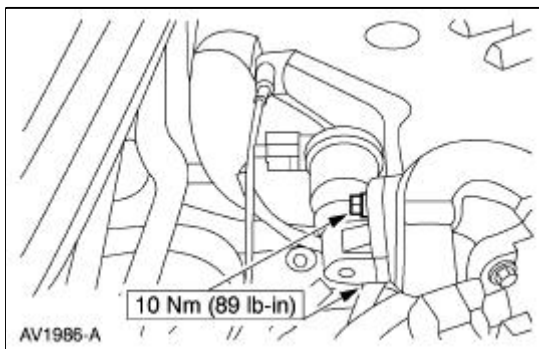
Remove the IAC valve.

- Disconnect the connector.
- Remove the two bolts, the IAC valve and the gasket.



Installation

1. To install, reverse the removal procedure.



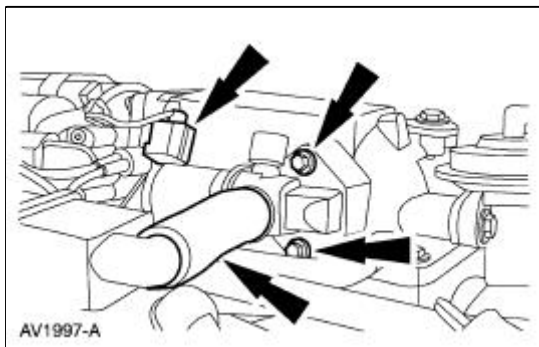
Idle Air Control (IAC) Valve —4.6L (2V)

Removal

1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. **NOTE:** Discard the idle air control (IAC) valve gasket.

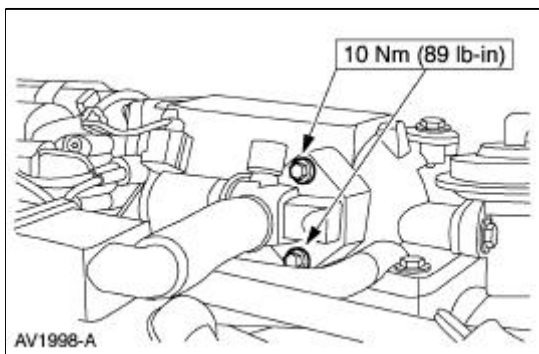
Remove the IAC valve.

- Disconnect the connector.
- Disconnect the hose.
- Remove the bolts, the IAC valve and the gasket.



Installation

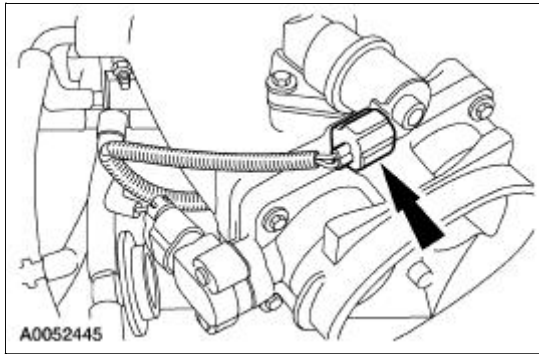
1. To install, reverse the removal procedure.



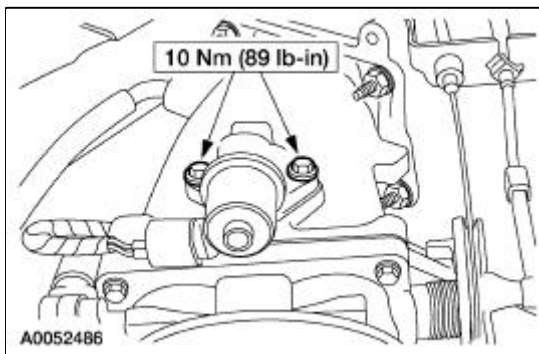
Idle Air Control (IAC) Valve —Cobra

Removal and Installation

1. Disconnect the idle air control (IAC) valve electrical connector.



2. Remove the bolts, the IAC valve and the gasket.



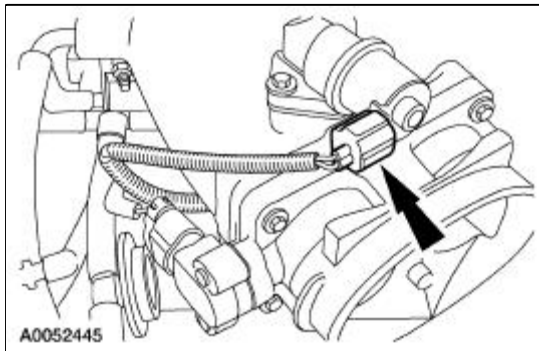
3. **NOTE:** Install a new gasket if necessary.

To install, reverse the removal procedure.

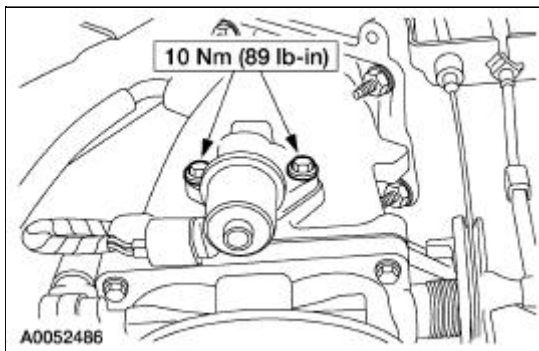
Idle Air Control (IAC) Valve —Mach I

Removal and Installation

1. Remove the air intake scoop. For additional information, refer to [Section 303-12](#).
2. Disconnect the idle air control (IAC) valve electrical connector.



3. Remove the bolts, the IAC valve and the gasket.



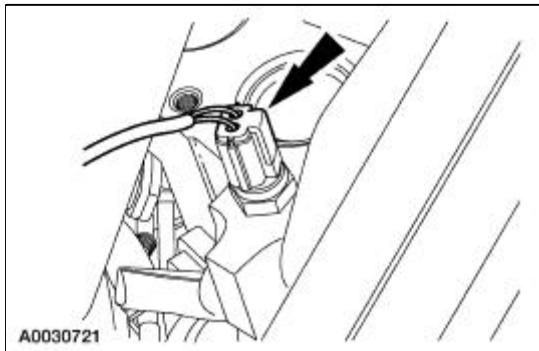
4. **NOTE:** Install a new gasket if necessary.

To install, reverse the removal procedure.

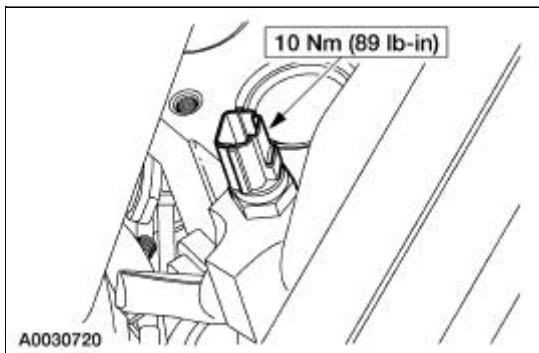
Cylinder Head Temperature (CHT) Sensor —3.8L

Removal

1. Disconnect the battery ground cable. For additional information refer to [Section 414-01](#).
2. Disconnect the cylinder head temperature sensor connector.



3. Remove the CHT sensor.



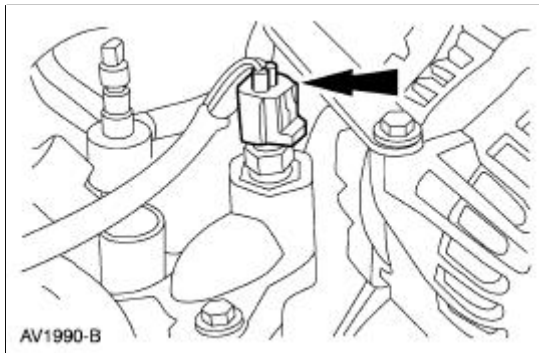
Installation

1. To install, reverse the removal procedure.
-

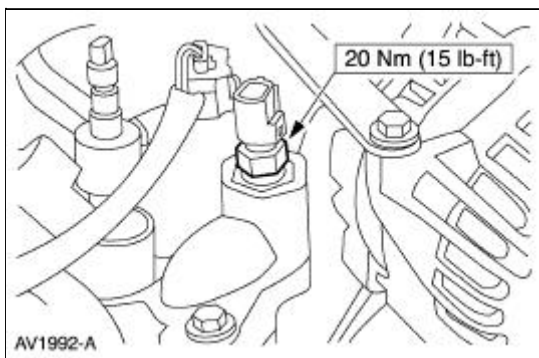
Engine Coolant Temperature (ECT) Sensor —4.6L (2V)

Removal

1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Partially drain the cooling system. For additional information, refer to [Section 303-03A](#).
3. Disconnect the engine coolant temperature (ECT) sensor (12A648) connector.



4. Remove the ECT sensor.



Installation

1. To install, reverse the removal procedure.
-

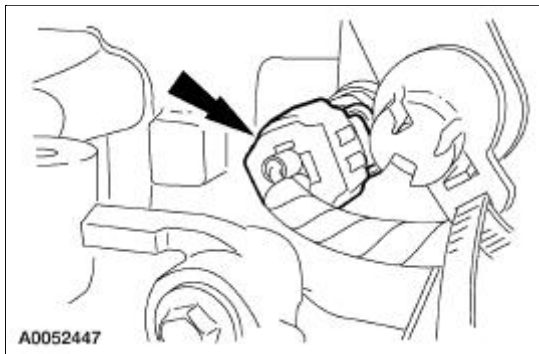
Engine Coolant Temperature (ECT) Sensor —Cobra

Material

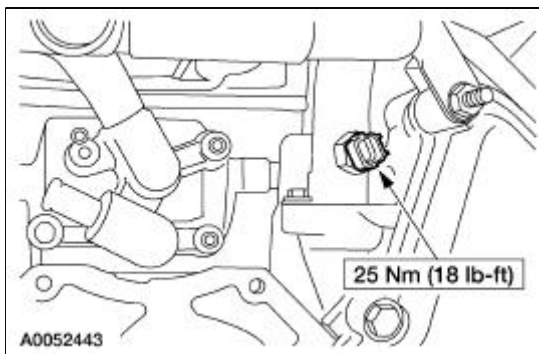
Item	Specification
Pipe Sealant with Teflon D8AZ-19554-A	WSK-M2G350-A2

Removal and Installation

1. Partially drain the engine cooling system. For additional information, refer to [Section 303-03A](#).
2. Disconnect the engine coolant temperature (ECT) sensor electrical connector.



3. Remove the ECT sensor.



4. To install, reverse the removal procedure.
 - Apply sealant to the ECT sensor threads.

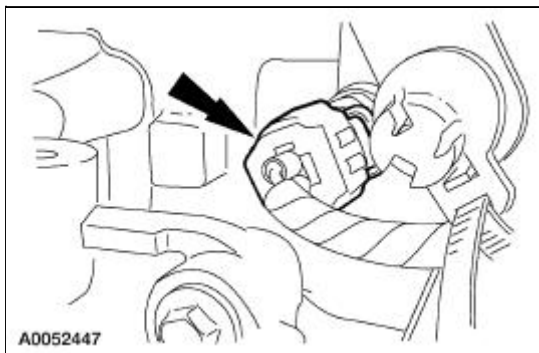
Engine Coolant Temperature (ECT) Sensor —Mach I

Material

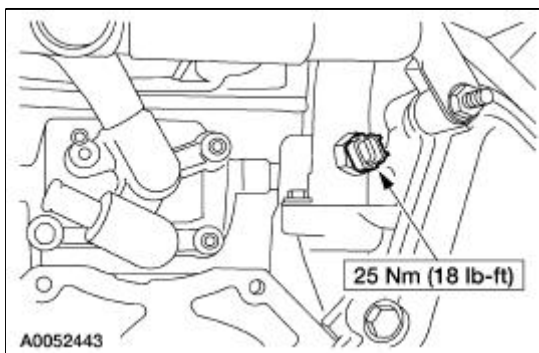
Item	Specification
Pipe Sealant with Teflon D8AZ-19554-A	WSK-M2G350-A2

Removal and Installation

1. Remove the air intake scoop. For additional information, refer to [Section 303-12](#).
2. Partially drain the engine cooling system. For additional information, refer to [Section 303-03A](#).
3. Disconnect the engine coolant temperature (ECT) sensor electrical connector.




4. Remove the ECT sensor.



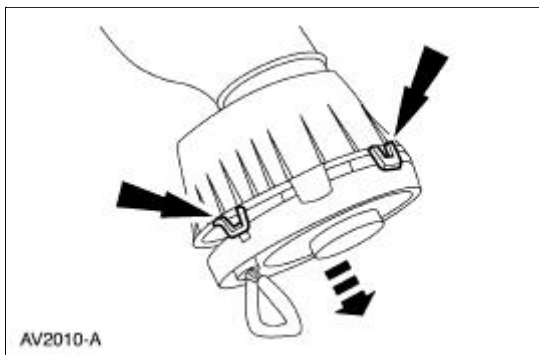
5. To install, reverse the removal procedure.
 - Apply sealant to the ECT sensor threads.

Mass Air Flow (MAF) Sensor —3.8L

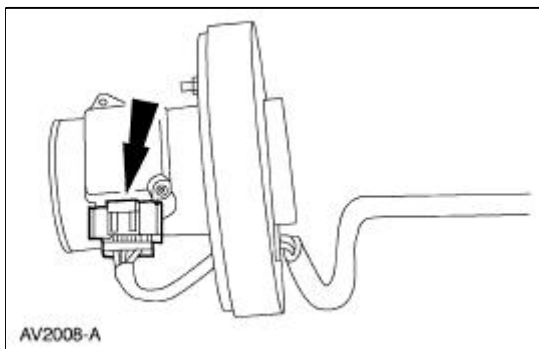
Removal

 **CAUTION:** The mass air flow (MAF) sensor hot wire sensing element and housing are calibrated as a unit and must be repaired as a complete assembly. Do not damage the sensing element (internal to housing) or possible failure to the mass air flow sensor may occur.

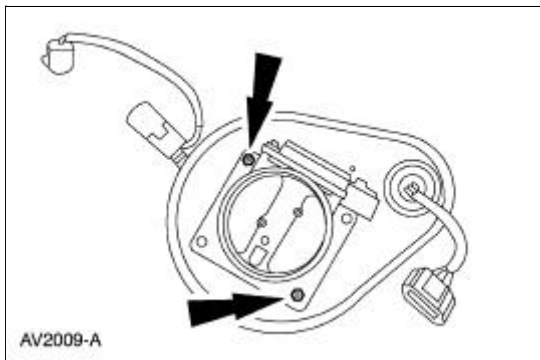
1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Remove the air cleaner and duct assembly. For additional information, refer to [Section 303-12](#).
3. Release the four tabs and remove the mass air flow (MAF) sensor.



4. Disconnect the connector.



5. Remove the mass air flow sensor (MAF).
 - Remove the nuts and the MAF sensor.




Installation

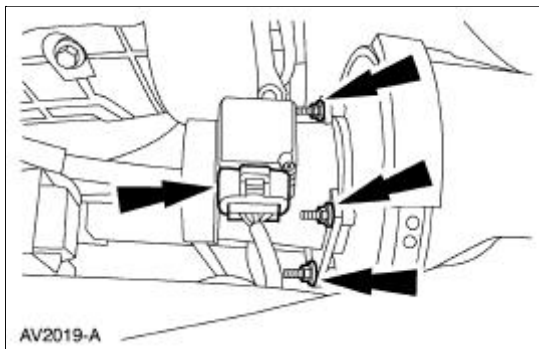
1. To install, reverse the removal procedure.
-

Mass Air Flow (MAF) Sensor —4.6L (2V)

Removal

 **CAUTION:** The mass air flow (MAF) sensor hot wire sensing element and housing are calibrated as a unit and must be repaired as a complete assembly. Do not damage the sensing element (internal to housing) or possible failure to the mass air flow sensor may occur

1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Remove the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).
3. Remove the mass air flow sensor (MAF).
 - Disconnect the connector.
 - Remove the four nuts and the MAF sensor.



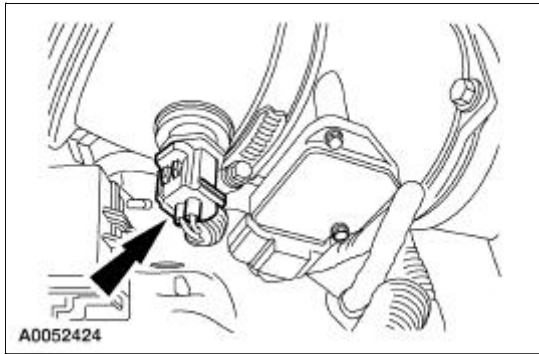
Installation

1. To install, reverse the removal procedure.

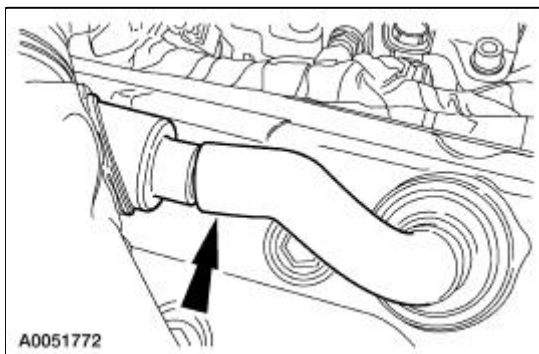
Mass Air Flow (MAF) Sensor —Cobra

Removal and Installation

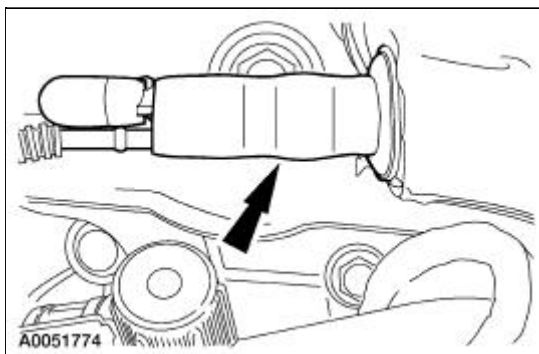
1. Disconnect the intake air temperature (IAT) sensor.



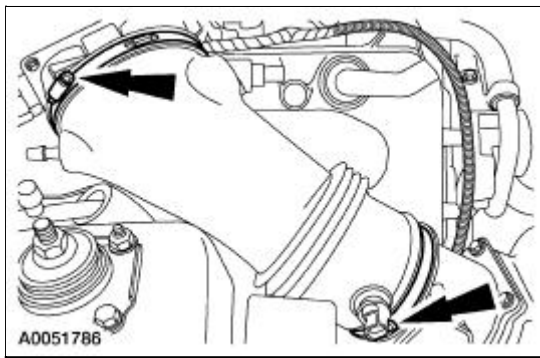
2. Disconnect the breather hose.




3. Disconnect the vacuum hose.



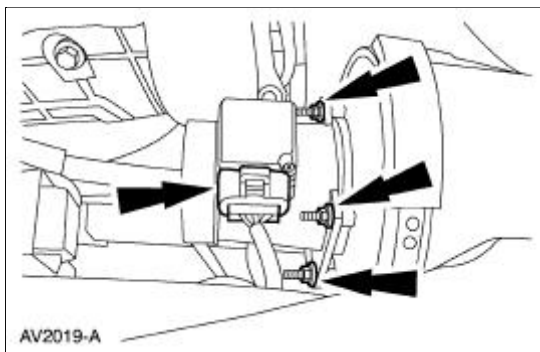
4. Loosen the clamps and remove the air cleaner outlet pipe.



5.  **CAUTION:** The mass air flow (MAF) sensor hot wire sensing element and housing are calibrated as a unit and must be repaired as a complete assembly. Do not damage the sensing element (internal to housing) or possible failure to the mass air flow sensor can occur.

Remove the mass air flow sensor.


- Disconnect the MAF sensor electrical connector.
- Remove the bolts and the MAF sensor.



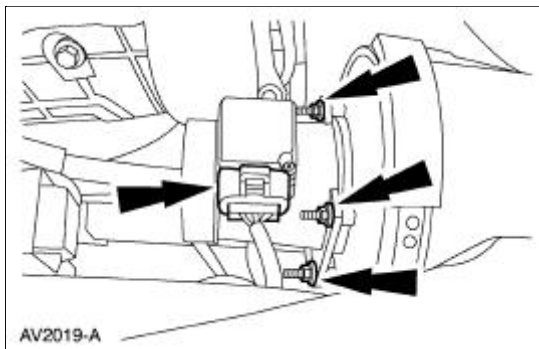
6. To install, reverse the removal procedure.
-

Mass Air Flow (MAF) Sensor —Mach I

Removal

 **CAUTION:** The mass air flow (MAF) sensor hot wire sensing element and housing are calibrated as a unit and must be repaired as a complete assembly. Do not damage the sensing element (internal to housing) or possible failure to the mass air flow sensor may occur

1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Remove the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).
3. Remove the mass air flow sensor (MAF).
 - Disconnect the connector.
 - Remove the four nuts and the MAF sensor.

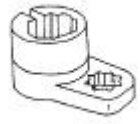


Installation

1. To install, reverse the removal procedure.

Heated Oxygen Sensor (HO2S)

Special Tool(s)

 ST1447-A	Socket, Exhaust Gas Oxygen Sensor 303-476 (T94P-9472-A)
---	--

Material

Item	Specification
Penetrating and Lock Lubricant or equivalent	E8AZ-19A501-B

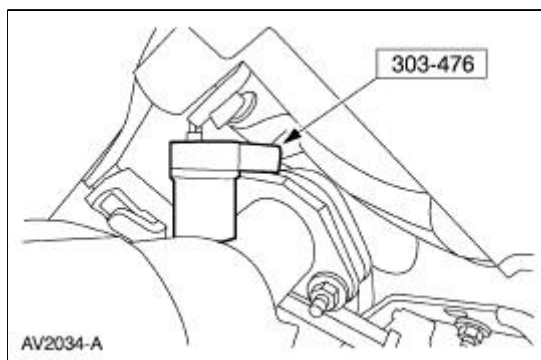
Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
3. **NOTE:** Two heated oxygen sensors (HO2S) are used for the engine control system. They are located in the dual converter Y pipe. The left side (HO2S) is shown, the right side is similar.

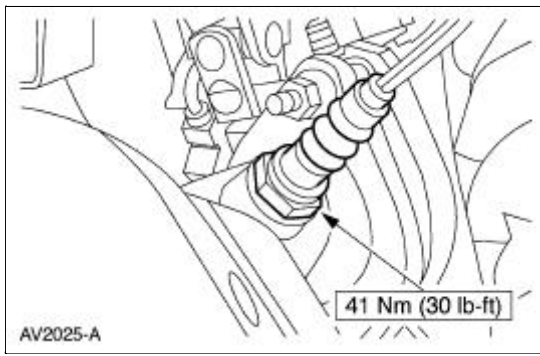
Disconnect the HO2S electrical connector.

4. **NOTE:** If necessary, lubricate the heated oxygen sensors with penetrating and lock lubricant to assist in removal.

Using the special tool, remove the HO2S from the dual converter Y pipe.

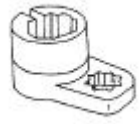


5. To install, reverse the removal procedure.



Catalyst Monitor Sensor

Special Tool(s)

 ST1447-A	Socket, Exhaust Gas Oxygen Sensor 303-476 (T94P-9472-A)
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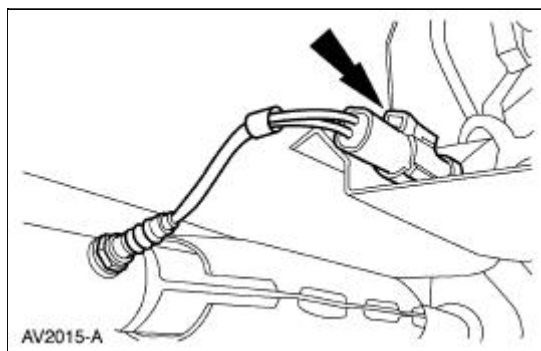
Material

Item	Specification
Penetrating and Lock Lubricant or equivalent	E8AZ-19A501-B

Removal and Installation

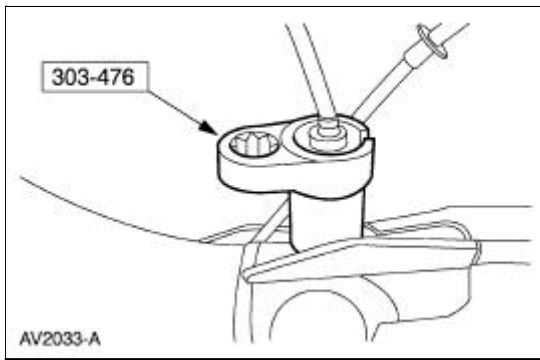
1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
3. **NOTE:** Two catalyst monitor sensors are used for the engine control system. They are located in the dual converter Y pipe downstream from the catalyst. The left side catalyst monitor sensor is shown, the right side is similar.

Disconnect the connector.

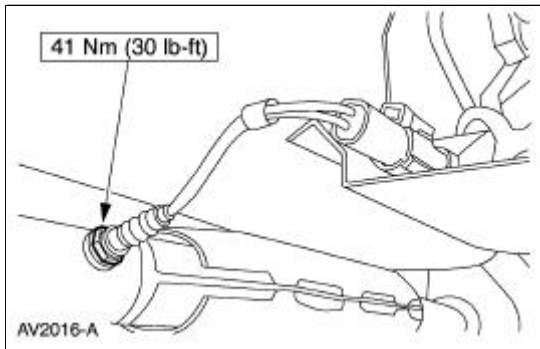


4. **NOTE:** If necessary, lubricate the sensors with penetrating and lock lubricant to assist in removal.

Using the special tool, remove the catalyst monitor sensors from the dual converter Y pipe.



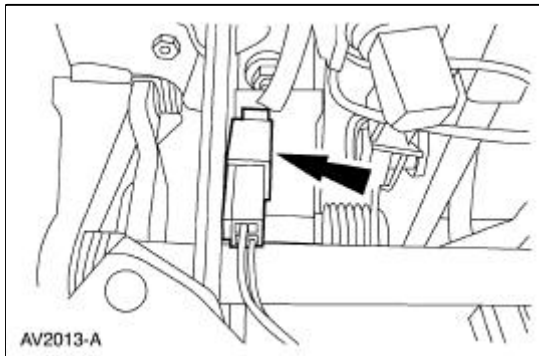
5. To install, reverse the removal procedure.



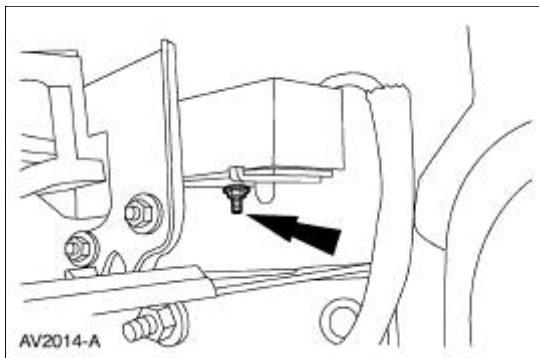
Clutch Pedal Position (CPP) Switch

Removal

1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Disconnect the connector.



3. Remove the bolt and the clutch pedal position (CPP) switch.



Installation

1. To install, reverse the removal procedure.
-

Fuel Pressure Sensor

Material

Item	Specification
Super Premium SAE 5W-20 Motor Oil XO-5W20-DSP or equivalent	WSS-M2C914-A

Removal

⚠ WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

⚠ WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before working on or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved. Failure to follow these instructions may result in personal injury.

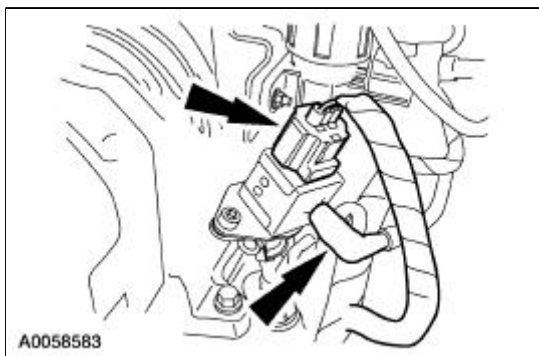
Mach I

1. Remove the air intake scoop. For additional information, refer to [Section 303-12](#).

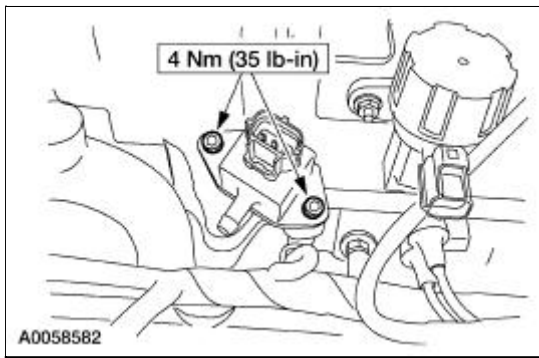
All engines

2. Relieve the fuel pressure. For additional information, refer to [Section 310-00](#).
3. **NOTE:** The 4.6L (4V) Cobra engine is shown, the other engines are similar.

Disconnect the connector and the vacuum line.

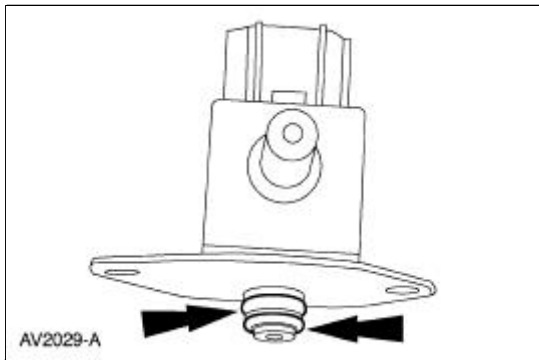


4. Remove the bolts and the sensor.



Installation

1. Inspect the O-rings, and install new O-rings if necessary.



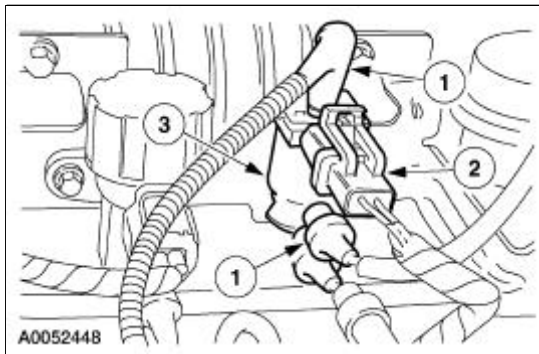
2. **NOTE:** Lubricate the new O-rings with clean engine oil to aid installation.

To install, reverse the removal procedure.

Supercharger Bypass Vacuum Solenoid

Removal and Installation

1. Remove the supercharger bypass vacuum solenoid.
 1. Disconnect the vacuum hoses.
 2. Disconnect the electrical connector.
 3. Unclip the supercharger bypass vacuum solenoid from the vacuum accessory bracket.

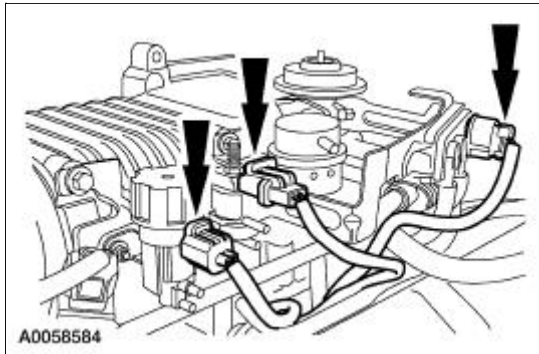


2. To install, reverse the removal procedure.
-

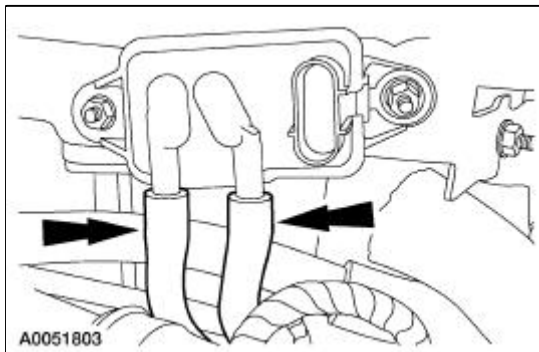
Supercharger Bypass Vacuum Solenoid —Actuator

Removal

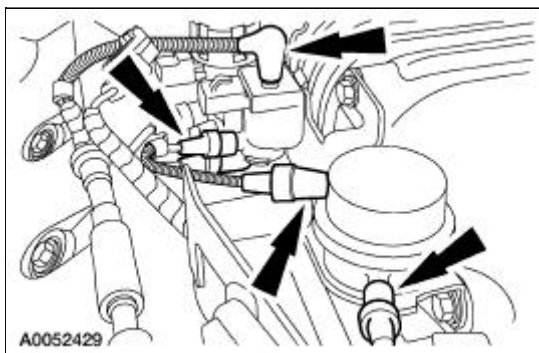
1. Disconnect the electrical connectors from the EGR vacuum regulator solenoid, the supercharger bypass vacuum solenoid, and the differential pressure feedback EGR system.



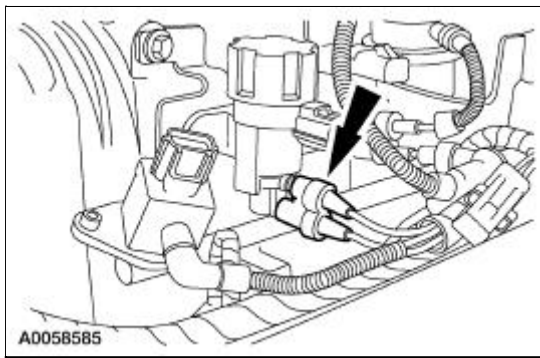
2. Disconnect the vacuum hoses from the differential pressure feedback EGR system.



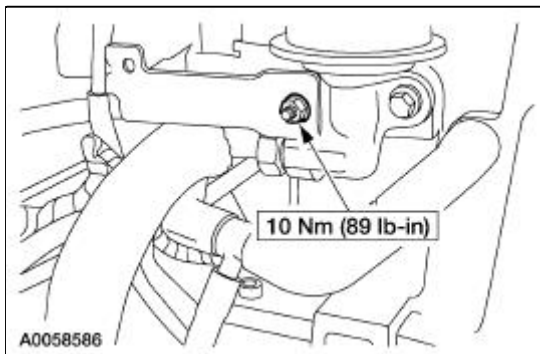
3. Disconnect the vacuum hoses from the supercharger bypass vacuum solenoid, and the actuator.



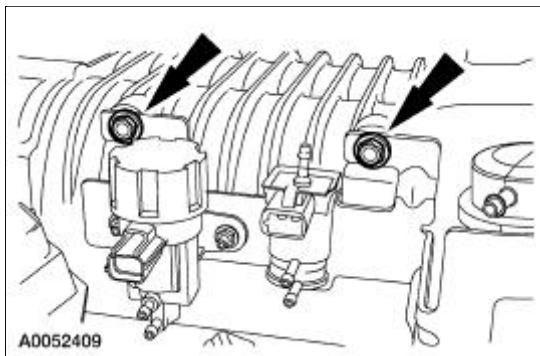
4. Disconnect the vacuum hoses from the EGR vacuum regulator solenoid.



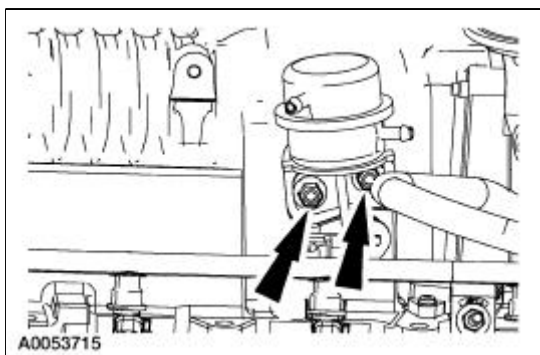
5. Remove the vacuum accessory bracket mounting nut.



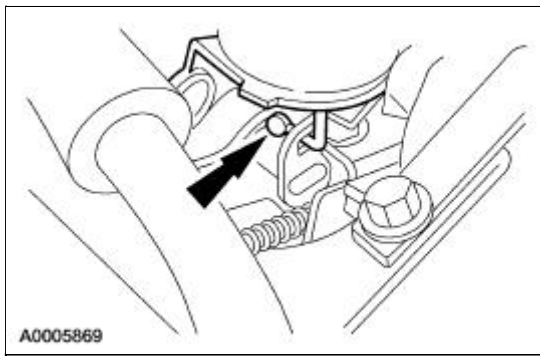
6. Remove the mounting bolts and the vacuum accessory bracket.



7. Remove the actuator mounting bolts.



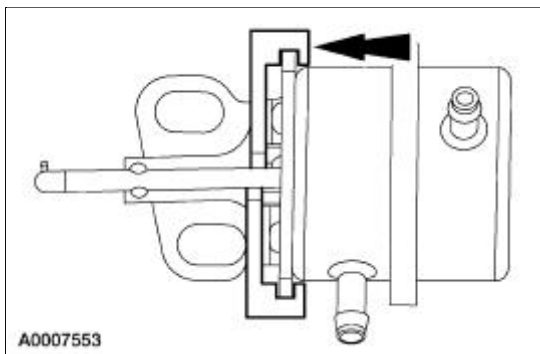
8. Align the actuator rod with the slot in the actuator linkage, and remove the actuator.



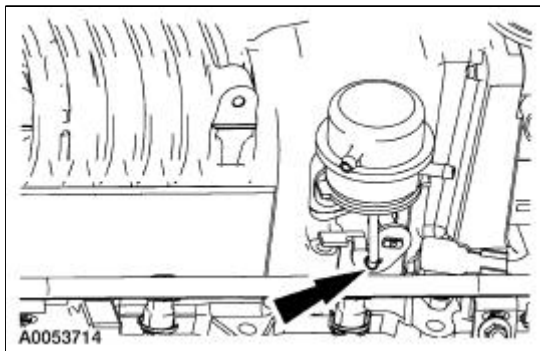
Installation

1.  **CAUTION:** The actuator adjustment tool included with the replacement actuator kit must be used when installing the supercharger bypass vacuum actuator. Failure to correctly adjust the actuator will result in incorrect operation of the supercharger assembly.

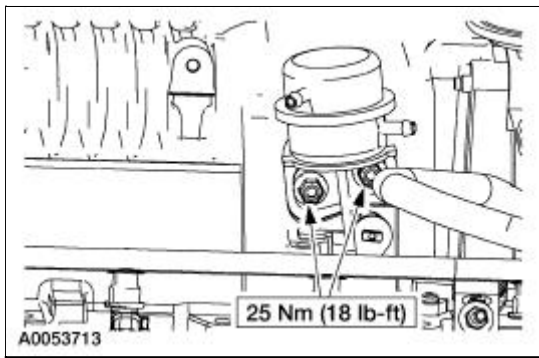
Install the actuator adjustment tool onto the actuator, making sure the tool is correctly attached to the actuator rod. rotate the actuator into position until the rod engages the lever.



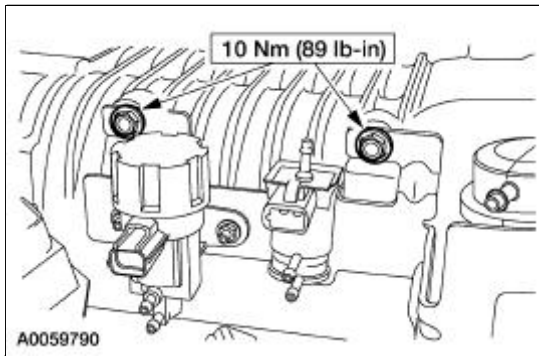
2. Install the actuator.
 - Align the actuator rod with the slot in the linkage.



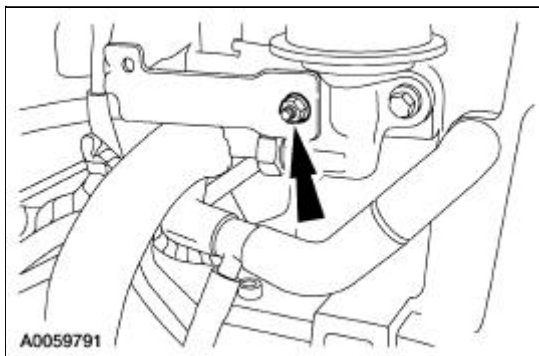
3. Install the actuator bolts.



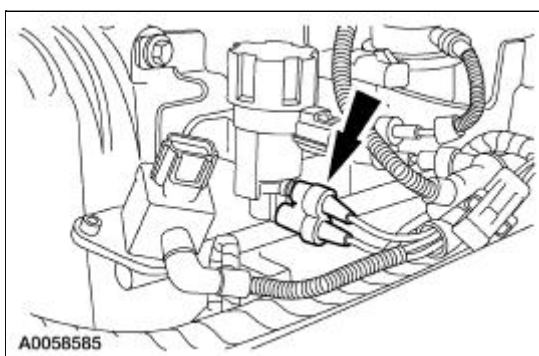
4. Remove the actuator adjustment tool.
5. Install the vacuum accessory bracket, and the mounting bolts.



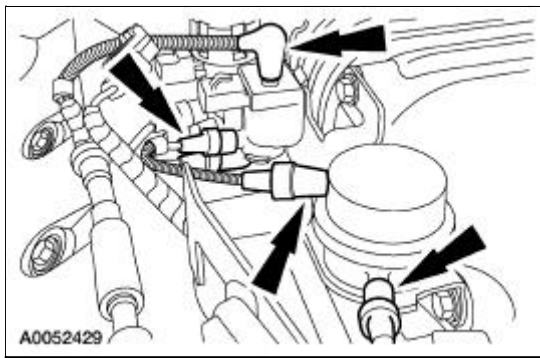
6. Install the vacuum accessory bracket mounting nut.



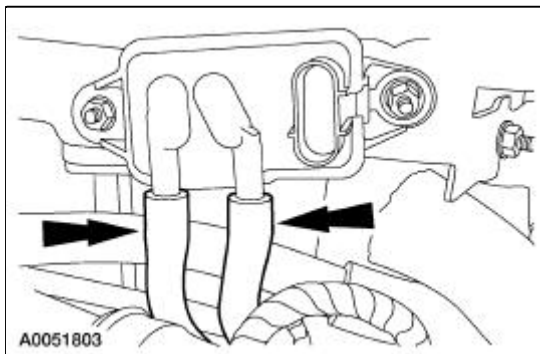
7. Connect the vacuum hoses to the EGR vacuum regulator solenoid.



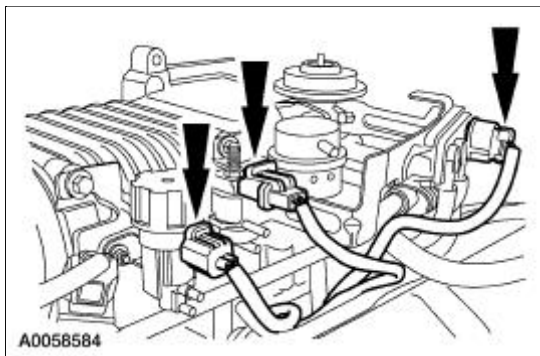
8. Connect the vacuum hoses to the supercharger bypass vacuum solenoid, and the actuator.



9. Connect the vacuum hoses to the differential pressure feedback EGR system.



10. Connect the electrical connectors to the EGR vacuum regulator solenoid, the supercharger bypass vacuum solenoid, and the differential pressure feedback EGR system.



General Specifications

Item	Specification
Fluid ^a	
Motorcraft MERCON® V Transmission Fluid XT-5-QM	MERCON®V
Fluid Capacities	
3.8L engine	13.2L (13.9 quarts)
4.6L engine	12.0L (12.8 quarts)
Fluid Filter	
Inline Transmission Fluid Filter Kit	XC3Z-7B155-AA
Inline Transmission Fluid Filter	XC3Z-7B155-BA
Lubricant	
Ford Multi-Purpose Grease D0AZ-19584-AA	ESB-M1C93-B

^a MERCON® V is not interchangeable at this time with the current MERCON® fluids. Check the transmission fluid level indicator to determine the correct fluid and refer to the Workshop/Owner publication to determine the correct service interval for the specific vehicle.

Torque Converter End Play

Item	Specification
New or remanufactured	0.355-1.04 mm (0.014-0.074 in)
Used	0.355-1.87 mm (0.014-0.074 in)

Band and Clutch Application Chart

Gear	Overdrive Band	Low Reverse Band	Forward Clutch	Direct Clutch	Interm Friction Clutch	Reverse Clutch	Interm One-Way Clutch	Planetary One-Way Clutch
1st Gear Manual Low		A	A					H
2nd Gear Manual Low	A		A		A		H	
1st Gear — (D) (Overdrive)			A					H
2nd Gear — (D) (Overdrive)			A		A		H	
3rd Gear — (D) (Overdrive)			A	A	A		O/R	
4th Gear — (D)	A			A	A		O/R	

(Overdrive)								
Reverse (R)		A				A		
Park Engine Running		A						

A = Applied

H = Holding

O/R = Overrunning

Stall Speed

Application	Min.	Max.
3.8L engine	2,240	2,619
4.6L 2V engine	2,339	2,738
4.6L 4V MACH 1 engine	2,375	2,767

Shift Speeds 4.6L 4V MACH 1 (3.55:1 Axle Ratio)

Throttle Position	Shift	MPH	Km/H
Light throttle	1-2	10-14	16-23
TP voltage 1.25 volts	2-3	18-22	29-35
	3-4	34-37	55-60
Closed throttle	4-3	22-25	35-40
	3-2	12-16	19-26
	2-1	11-7	18-11
Wide open throttle	1-2	36-44	58-71
	2-3	75-83	121-134
	3-2	70	113
	2-1	33	53

Shift Speeds 4.6L 2V HO (3:27:1 Axle Ratio)

Throttle Position	Shift	MPH	Km/H
Light throttle	1-2	9-12	14-19
TP voltage 1.25 volts	2-3	14-18	23-29
	3-4	36-38	58-61
Closed throttle	4-3	26-22	42-35
	3-2	15-11	24-18
	2-1	12-8	19-13
Wide open throttle	1-2	29-44	47-71

	2-3	74-80	119-129
	3-2	73	117
	2-1	32	51

Shift Speeds 3.8L (3:27:1 Axle Ratio)

Throttle Position	Shift	MPH	Km/H
Light throttle	1-2	6-10	10-16
TP voltage 1.25 volts	2-3	18-22	29-35
	3-4	28-30	45-48
Closed throttle	4-3	24-22	39-35
	3-2	14-12	22-19
	2-1	6-8	10-13
Wide open throttle	1-2	36-40	58-64
	2-3	74-70	119-112
	3-2	67	108
	2-1	28	45

Shift Speeds 3.8L (3:08:1 Axle Ratio)

Throttle Position	Shift	MPH	Km/H
Light throttle	1-2	6-10	10-16
TP voltage 1.25 volts	2-3	16-20	26-32
	3-4	38-42	61-68
Closed throttle	4-3	34-28	55-45
	3-2	16-13	26-21
	2-1	9-7	14-11
Wide open throttle	1-2	38-45	61-72
	2-3	72-76	116-122
	3-2	71	114
	2-1	31	50

Sensor Resistance Readings

Component	Resistance (ohms)
SSA	20-30
SSB	20-30
EPC	2.48-5.66
TCC	10-16
OSS	1,026-1,194

Item	Specification	
	mm	inch
Green thickness	1.217-1.371	0.050-0.054
Yellow thickness	1.727-1.828	0.068-0.072
Natural thickness	2.159-2.260	0.085-0.089
Red thickness	2.590-2.692	0.102-0.106
Blue thickness	3.022-3.124	0.119-0.123

Forward Clutch Pack

Item	Specification	
	mm	inch
Clearance	1.17-1.63	0.046-0.068
Snap ring thickness	1.524-1.625	0.060-0.064
	1.880-1.981	0.074-0.078
	2.235-2.337	0.088-0.092
	2.591-2.692	0.102-0.106

Reverse Clutch Pack

Item	Specification	
	mm	inch
Clearance	1.27-1.94 mm	(0.050-0.076 in)
Snap ring thickness	1.524-1.625	0.060-0.064
	1.880-1.981	0.074-0.078
	2.235-2.337	0.088-0.092
	2.591-2.692	0.102-0.106

Direct Clutch Pack

Item	Specification	
	mm	inch
Clearance	1.5748-21.59	0.062-0.85
Snap ring thickness	1.270-1.372	0.050-0.054
	1.625-1.727	0.064-0.068
	1.98,1-2.083	0.078-0.082
	2.337-2.438	0.092-0.096

Intermediate Clutch Pack

Item	Specification	
	mm	inch

Clearance	41.7322-42.5958	1.643-1.677
Selective steel plate	1.702-1.803	0.067-0.071
	1.956-2.057	0.077-0.081
	2.210-2.311	0.087-0.091
	2.464-2.565	0.097-0.101

Torque Specifications

Description	Nm	lb-ft	lb-in
Rear transmission support crossmember bolts	55	40	—
Rear insulator bolts	80	59	—
Extension housing bolts	28	21	—
Transmission fluid pan bolts	14	10	—
Front pump bolts	27	20	—
Front pump support bolts	23	17	—
Harness electrical connector bolt	5	—	44
Inspection cover bolts	35	26	—
Main control valve body bolts	10	—	89
Main control valve body cover plate bolts	10	—	89
Main control valve body separator plate bolts	10	—	89
Manual lever shaft nut	33	24	—
Manual lever shaft outer nut	33	24	—
Fluid cooler line case fittings	21	15	—
Pressure tap plugs	12	9	—
Rear driveshaft bolts	112	83	—
Starter bolts	25	18	—
TCC solenoid bolt	10	—	89
Torque converter drain plug	12	9	—
Torque converter nuts	37	27	—
Digital transmission range (TR) sensor bolts	9	—	80
Transmission bell housing bolts	47	35	—
Vehicle speed sensor (VSS) plug bolt	9	—	80
Output shaft speed (OSS) sensor bolt	12	9	—
Starter B+ cable	11	8	—
Exhaust manifold bolts	40	30	—
Exhaust pipe bolts	40	30	—
Transmission vent tube	12	9	—
Manual control valve detent lever spring bolt	10	—	89
Cooler tube nut to case fitting	18	13	—
Rear differential retaining nuts (front)	90	66	—
Rear differential retaining bolts and nuts (rear)	70	52	—

Transmission linkage	23	17	—
Shift cable bracket	14	10	—
Transmission test plate bolts	10	—	89

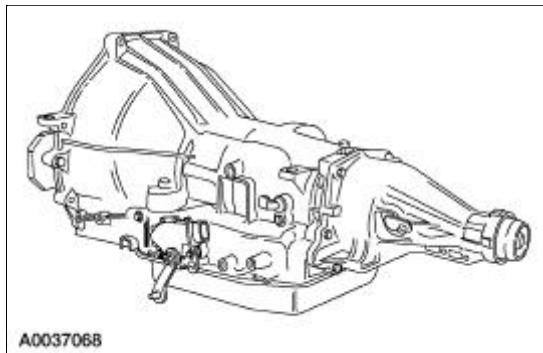
Transmission Description

The 4R70W has the following features:

- Wide ratio gears
- Four speeds
- Rear wheel drive
- Automatic
- Electronic shift
- Torque converter clutch control
- Line pressure controls

The transmission uses Ravigneaux-style double-pinion gearset with two bands, one one-way roller clutch, one mechanical diode and four friction clutches to produce four forward gears and Reverse.

4R70W Automatic Transmission

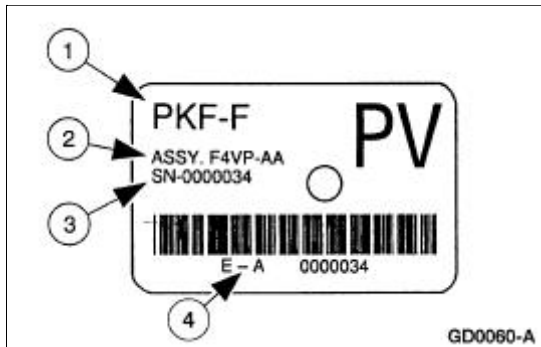


Identification Tags

All vehicles are equipped with a Vehicle Certification Label, located on the driver side door lock post. For correct transmission identification, refer to the code in the space marked TR.

For model, service ID level or build date information, refer to the transmission service ID tag located on the transmission case.

Identification Tag



Item	Part Number	Description
1	—	Model number
2	—	Assembly number
3	—	Serial number
4	—	Model and serial number

Range Selection

The transmission has six range positions: P, R, N, (D), 2 and 1.



Park

In the PARK position:

- there is no powerflow through the transmission.
- the parking pawl locks the output shaft to the case.
- the engine can be started.
- the ignition key can be removed.

Reverse

In the REVERSE position:

- the vehicle can be operated in a rearward direction, at a reduced gear ratio.
- engine braking will occur.

Neutral

In the NEUTRAL position:

- there is no powerflow through the transmission.
- the output shaft is not held and is free to turn.
- the engine can be started.

Overdrive

Overdrive is the normal position for most forward driving.

The OVERDRIVE position provides:

- Automatic shifts.

- Apply and release of the torque converter clutch.
- Maximum fuel economy during normal operation.

Second Position

This position provides:

- Second gear start and hold.
- The torque converter clutch can apply and release.
- Improved traction and engine braking on slippery roads.
- Engine braking for descending steep grades.

First Position

If this position is selected at normal road speeds, the transmission will shift into second gear, then into first when the vehicle reaches a speed below approximately 45 km/h (28 mph).

This position provides:

- First gear operation only.
 - Engine braking for descending steep grades.
-

Shift Patterns

Upshifts

Transmission upshifting is controlled by the powertrain control module (PCM). The PCM receives inputs from various engine or vehicle sensors and driver demands to control shift scheduling, shift feel and torque converter clutch (TCC) operation.

Downshifts

Under certain conditions the transmission will downshift automatically to a lower gear range (without moving the gearshift lever). There are three categories of automatic downshifts; Coastdown, Torque Demand and Forced or Kickdown shifts.

Coastdown

The coastdown downshift occurs when the vehicle is coasting down to a stop.

Torque Demand

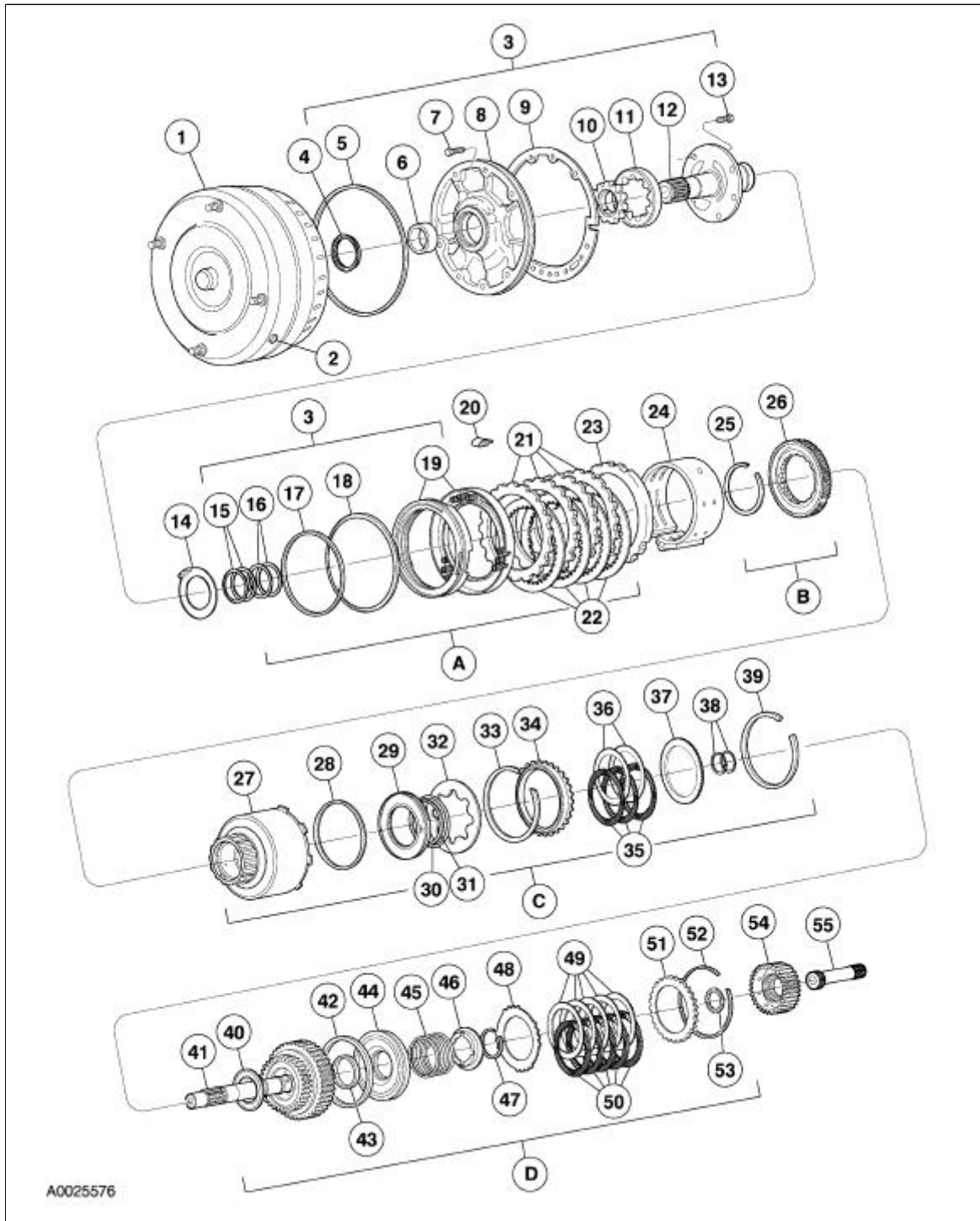
The torque demand downshift occurs (automatically) during part throttle acceleration when the demand for torque is greater than the engine can provide at that gear ratio. If applied, the transmission will disengage the TCC to provide added acceleration.

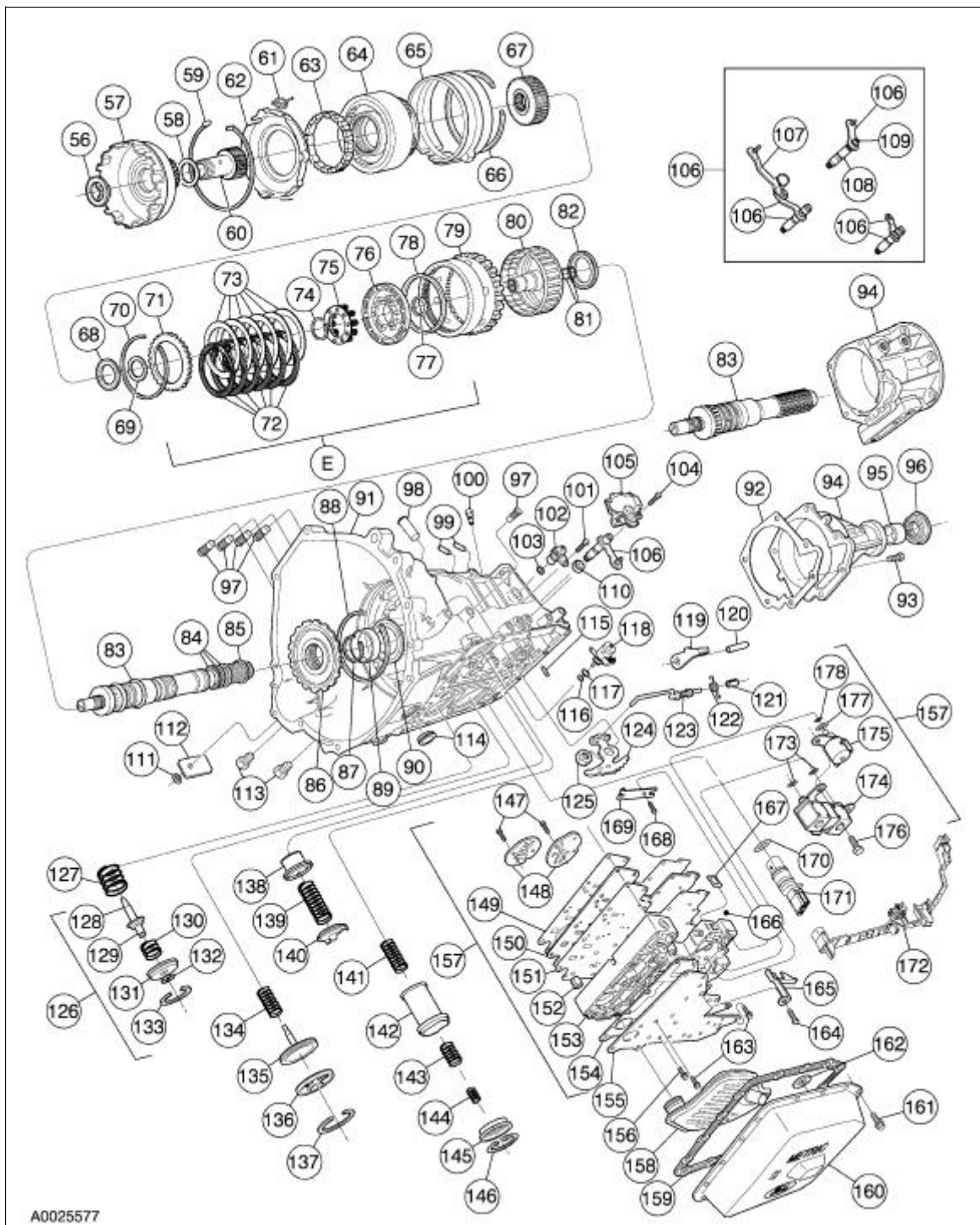
Kickdown

For maximum acceleration, the driver can force a downshift by pressing the accelerator pedal to the floor. A forced downshift into a lower gear is possible below calibrated speeds. Specifications for downshift speeds are subject to variations due to tire size, engine and transmission calibration requirements.

Disassembled Views

4R70W Automatic Transmission — Disassembled View





A0025577

Item	Part Number	Description
1	7902	Converter assembly (model dependent)
2	391855-S100	Plug — converter drain — 1/8-27 Dryseal (model dependent)
3	7A103	Pump assembly — front
4	7A248	Seal assembly — front pump
5	7A248	Seal — front pump
6	7B258	Bushing — front pump
7	N605789-S100	Bolt — M8-1.25 x 35 hex head (7-attaches 7A103 to 7005)

8	7A106	Body assembly — front pump (part of 7A103)
9	7A136	Gasket — front pump
10	7H169	Gear — pump inner gerotor (part of 7A103)
11	7H169	Gear — pump outer gerotor (part of 7A103)
12	7A108	Support assembly — front pump
13	N605787-S	Bolt — M8-1.25 x 25 hex flange head (5-attaches 7A108 to 7A103)
14	7D014	Washer — front pump support thrust — select fit No. 1
15	7D020	Seals — reverse clutch cylinder (2 req'd)
16	7D019	Seals — forward clutch cylinder (2 req'd)
17	7F225	Seal — intermediate clutch piston inner
18	7F224	Seal — intermediate clutch piston outer
19	7E005	Piston kit — intermediate clutch
20	7A609	Intermediate clutch anti-rattle clip (model dependent)
21	7B442	Plate — intermediate clutch external spline (select fit) (steel)
22	7B164	Plate assembly — intermediate clutch internal spline (friction)
23	7B066	Plate — intermediate clutch pressure
24	7F196	Band assembly — overdrive
25	391267-S	Ring — 3-21/64 retains type SU external (retains 7F262 to 7F215)
26	7F271	Clutch assembly — intermediate one-way clutch
27	7D044	Drum assembly — reverse clutch
28	7D403	Seal — reverse clutch piston outer
29	7D402	Piston assembly — reverse clutch
30	7D404	Seal reverse clutch piston inner
31	7D256	Ring — reverse clutch piston pressure
32	7B070	Spring — reverse clutch piston return
33	7A577	Spring — reverse clutch piston spring
34	7B066	Plate — reverse clutch front pressure
35	7B164	Plate — reverse clutch internal spline (friction)
36	7B442	Plate — reverse clutch external spline (steel)
37	7B066	Plate — reverse clutch rear pressure
38	7B497	Seals — input shaft (2 req'd)
39	7D483	Retainer — reverse clutch pressure plate — (select fit)
40	7A166	Bearing and race assembly — forward clutch No. 2
41	7F207	Cylinder and input shaft assembly — forward clutch
42	7A548	Seal — forward clutch piston outer

43	7C099	Seal — forward clutch piston inner
44	7A262	Piston — forward clutch
45	7A480	Spring — forward clutch piston return
46	7A527	Retainer return spring — forward clutch
47	388099-S	Snap ring — retaining — 1-59/64 (retains 7A529 in 7F207)
48	7E085	Spring — rear clutch pressure plate (model dependent)
49	7B442	Plate — forward clutch external spline (steel)
50	7B164	Plate — forward clutch internal spline (friction)
51	7B066	Plate — forward clutch pressure
52	7D483	Snap ring — retaining (select fit)
53	7F231	Bearing and race assembly — forward clutch front No. 3
54	7B067	Hub — forward clutch
55	7F351	Shaft — intermediate stub
56	7C096	Bearing and race assembly — forward clutch hub No. 4
57	7A019	Gear assembly — reverse sun
58	7F244	Bearing and race assembly — forward clutch sun gear No. 5
59	388501-S	Retaining ring — center support — 7-7/92
60	7A399	Gear assembly — forward clutch sun
61	7F277	Spring — case to planet support
62	7A130	Support assembly — planetary gear
63	7A089	OWC cage spring and roller assembly — planetary
64	7A398	Planetary assembly (model dependent)
65	7D095	Band assembly — reverse
66	377437-S	Retaining ring — 0.58 thick (locates reverse band during assembly)
67	7F236	Hub — direct clutch
68	7F243	Bearing and race assembly — direct clutch inner No. 7
69	7F237	Support — direct clutch inner bearing
70	7D483	Retaining ring — direct clutch pressure plate (select fit)
71	7B066	Plate — direct clutch pressure
72	7B164	Plate — direct clutch internal spline (friction)
73	7B442	Plate — direct clutch external spline (steel)
74	388104-S	Retainer ring — 1-19/32 (retains 7F235 to 7F283)
75	7F235	Retainer and spring assembly — direct clutch
76	7A262	Piston assembly — direct clutch
77	7C099	Seal — direct clutch piston inner

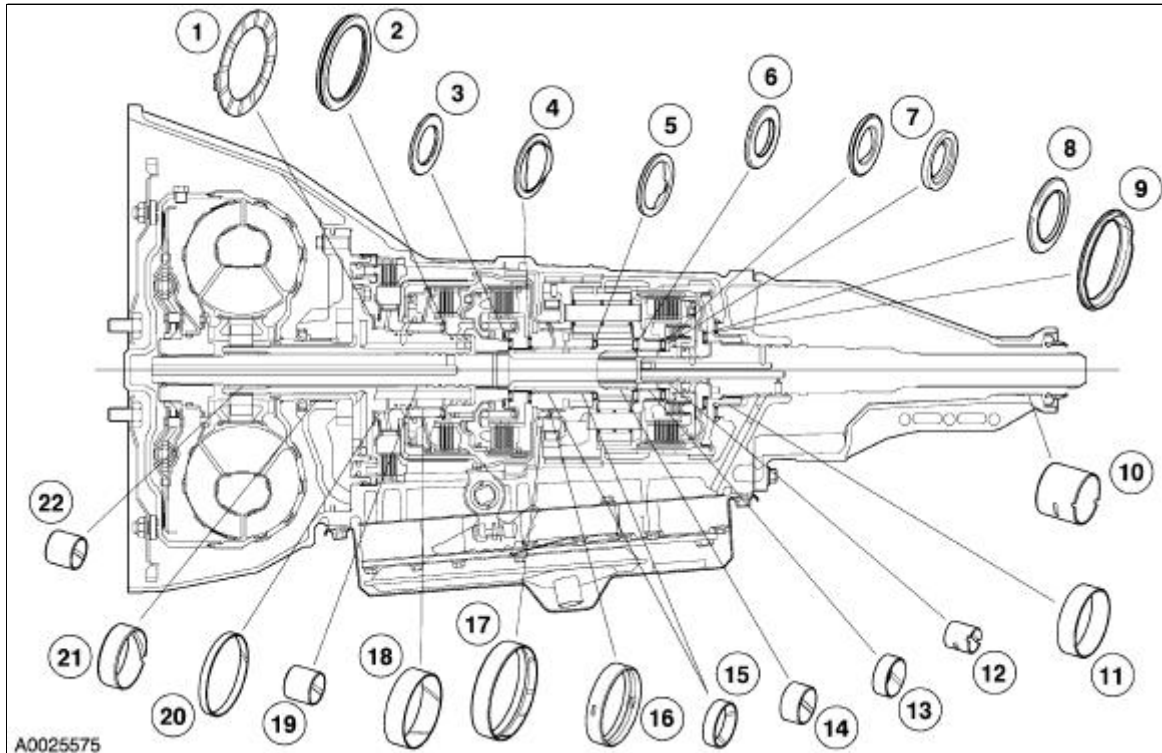
78	7A233	Seal — direct clutch piston outer
79	7A153	Gear — output shaft ring
80	7F283	Cylinder assembly — direct clutch
81	7F274	Seals — output shaft small — direct clutch (2 req'd)
82	7F240	Bearing and race assembly — direct clutch outer No. 8
83	7060	Shaft assembly — output (model dependent)
84	7F273	Seal — output to case shaft large (3 req'd)
85	87054-S94	Seal — O-ring (piloted output shaft only) (model dependent)
86	7D164	Hub — output shaft
87	97713-S	Snap ring — 1-13/16 retaining (retains 7D164 to 7060)
88	7C122	Snap ring — retaining (retains 7D164 to 7A153)
89	7025	Bushing — rear case
90	7F242	Bearing and race assembly — case rear No. 9
91	7005	Case assembly
92	7086	Gasket — extension (model dependent)
93	N803747-S1101	Bolt — M8-1.25 x 30 (6-attaches 7A039 to 7005) (model dependent)
94	7A039	Extension housing assembly (model dependent)
95	—	Bushing — extension housing (part of 7A039)
96	7052	Seal assembly — extension housing (model dependent)
97	390318-S100	Pipe plug — 1/8-27 Dryseal tapered (5 req'd)
98	7F295	Pin — overdrive band anchor
99	388142-S	Pin — reverse band anchor (part of 7005)
100	7034	Vent assembly — case
101	N605771-S427	Bolt — M6-1.0 x 14 hex head (attaches output shaft speed sensor to case)
102	7H103	Sensor assembly — transmission output shaft speed
103	N811757-S100	Seal — 14.0 x 1.78 O-ring (2 req'd)
104	N806933-S102	Bolt and washer assembly — M6-1.0 x 25 mm (1 in) (2-attaches 7F293 to 7005) (model dependent)
105	7F293	Sensor — transmission range
106	7A256	Lever assembly — manual control (model dependent)
107	7H296	Link assembly — manual control (model dependent)
108	7C493	Shaft — transmission manual control lever (model dependent)
109	N808737-	Nut — M10-1.5 (attaches 7A256 to 7C493)

	S427	
110	7B498	Seal assembly — manual control lever
111	373907-S2	Nut — 1/4 spring (retains identification tag to 7000)
112	7B148	Tag — identification (part of 7005)
113	7D273	Connector assembly — fluid tube (2 req'd)
114	7N171	Plug — converter housing access
115	7B210	Pin — manual lever shaft retainer
116	391131	Seal — 0.426 x 0.070 O-ring
117	N805862-S	Seal — 14.0 x 1.78 O-ring
118	7G383	Solenoid valve — transmission pressure control
119	7A441	Pawl — parking pawl
120	7D071	Shaft — parking pawl
121	7D419	Cup — park rod guide (part of 7A039)
122	7D070	Spring — parking pawl return
123	7A232	Rod assembly — park pawl actuating
124	7A115	Lever assembly — manual valve detent lever
125	N800287-S536	Nut — M14 x 1.5 hex intermediate detent lever (attaches 7A115 to 7A256)
126	7H188	Piston assembly — overdrive servo
127	7F201	Spring — overdrive servo piston
128	7F203	Rod — overdrive servo actuating (part of 7H188)
129	7H179	Washer — backup overdrive servo (part of 7H188)
130	7G277	Spring — overdrive cushion spring (part of 7H188)
131	7F200	Piston assembly — overdrive servo (part of 7H188)
132	97411-S	Ring — retaining (part of 7H188)
133	7384	Ring — 2.85 retaining type TVP "H" internal (retains 7H188 to 7005)
134	7D031	Spring — reverse band servo piston
135	7D189	Piston assembly — reverse band servo
136	7D036	Cover assembly — reverse band servo piston
137	388215-S100	Retaining ring internal — 3-13/16
138	7H292	Piston — 2-3 accumulator (bonded seals)
139	7F285	Spring — 2-3 shift accumulator piston (model dependent)
140	7B264	Retainer — 2-3 shift accumulator spring
141	7F284	Spring — 1-2 shift accumulator (model dependent)
142	7F251	Piston — 1-2 shift accumulator (bonded seals)
143	7F284	Spring — 1-2 shift accumulator

144	7G326	Nested spring — 1-2 (inner spring) (vehicle dependent)
145	7F247	Cover and seal assembly — 1-2 accumulator
146	7384	Ring — 2-1/16 retaining type HU internal (retains 7H300 to 7005)
147	N807178-S1000	Bolt — M6-1.0 x 18 hex head (12-attaches reinforcing plate to valve body)
148	7F282	Plate — valve body reinforcing (part of 7A100)
149	7C155	Gasket — valve body separator upper
150	7A008	Plate — control valve body separator (part of 7A100)
151	7D100	Gasket — valve body separator lower
152	7D174	Valve — converter drainback
153	7A091	Body assembly — main control
154	7H173	Gasket — valve body cover plate
155	7C034	Plate — valve body cover (part of 7A100)
156	N807178-S1000	Bolt — M6-1.0 x 18 hex head (11-attaches 7C034 to 7A100 (part of 7A100)
157	7A100	Control assembly — main (model dependent)
158	7A098	Filter and seal assembly — fluid
159	7A191	Gasket — transmission pan
160	7A194	Pan — transmission
161	N605785-S1036	Bolt — M8-1.25 x 18 hex flange head (14-attaches 7A194 to 7005)
162	7L027	Magnet — ceramic case (part of 7A194)
163	N808947-S1300	Bolt — M8-1.25 x 46 hex shoulder pilot (2-attaches 7C034 to 7A100)
164	N807179-S1000	Bolt — M6-1.0 x 52 hex flange head (12-attaches 7A100 to 7005)
165	7H111	Retainer — solenoid
166	7E195	Ball — 1/4 diameter coast booster valve shuttle (8 req'd)
167	7H187	Screen — solenoid pressure supply
168	N800670-S1000	Bolt — M6-1.0 x 40 hex flange head (13-attaches 7A100 to 7005)
169	7E332	Spring assembly — manual valve detent
170	7Z276	Seal — 0.864 x 0.070 O-ring (2 req'd)
171	7G276	Bulkhead assembly — wiring connector
172	7G276	Bulkhead assembly — connector (molded lead frame)
173	7Z484	Seal — 6.07 x 1.70 O-ring (2 req'd)
174	7G484	Solenoid valve — transmission shift
175	7G136	Solenoid valve — transmission torque converter clutch
176	N807178-S1000	Bolt — M6-1.0 x 16 hex head (retains 7D136 and 7G484 to 7A100)

177	7Z136	Seal — 0.489 x 0.070 O-ring
178	7Z484	Seal — 0.176 x 0.070 O-ring
A	—	Intermediate clutch assembly
B	—	Intermediate one-way clutch
C	—	Reverse clutch assembly
D	—	Forward clutch assembly
E	—	Direct clutch assembly

Bushings, Bearing and Thrust Washer Locator

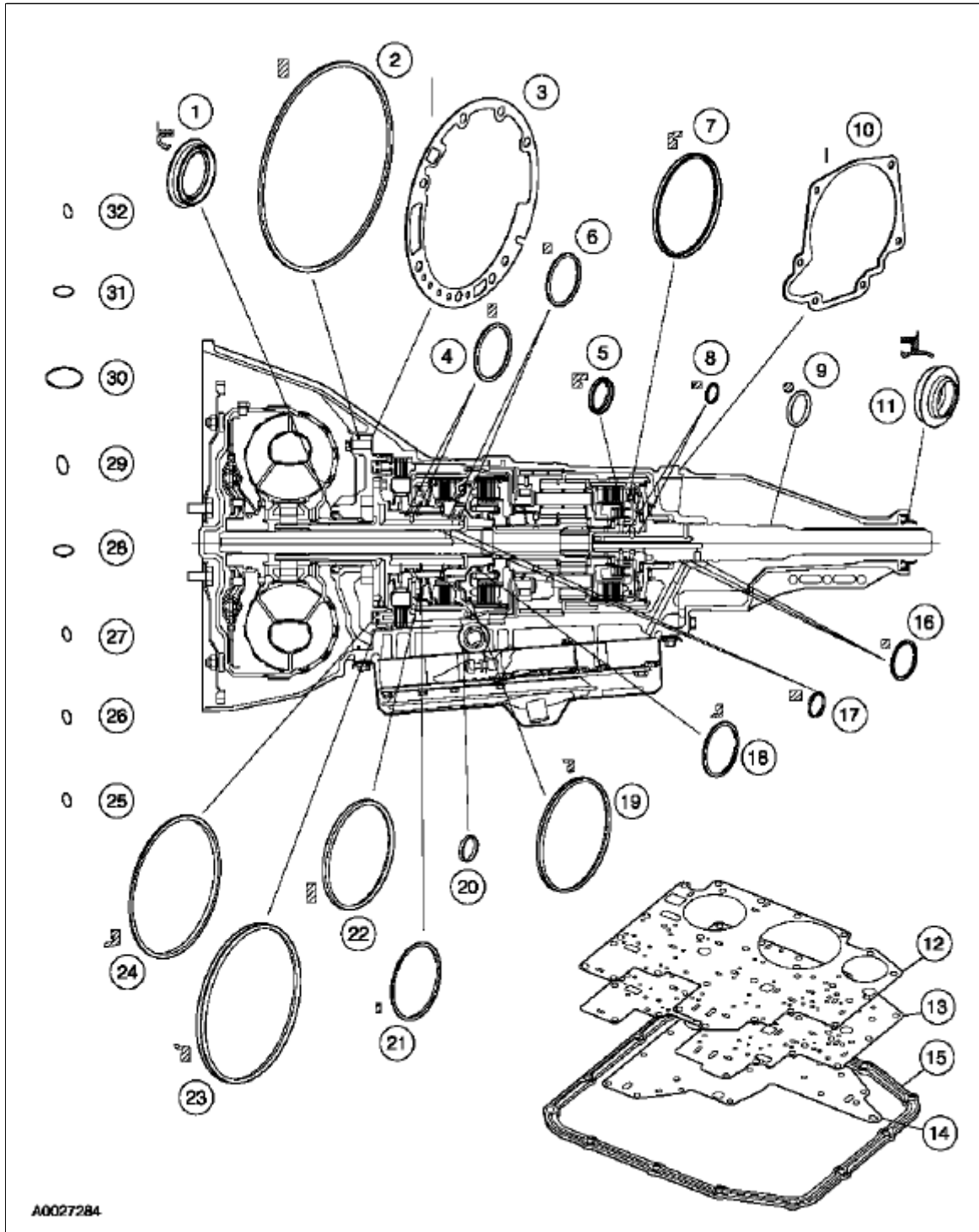


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Item	Part Number	Description
1	7D014	Pump No.1 thrust washer (select fit)
2	7A166	Forward clutch No. 2 bearing and race assembly
3	7F231	Forward clutch bearing and race assembly — front No. 3
4	7F244	Forward clutch hub bearing and race assembly No. 4
5	7F244	Forward clutch sun gear bearing and race assembly No. 5
6	7F241	Planet assembly bearing and race No. 6
7	7F243, 7F237	Direct clutch inner bearing, race assembly No. 7 and direct clutch inner bearing support No. 7
8	7F240	Direct clutch outer bearing and race assembly No. 8
9	7F242	Outer bearing and race assembly — rear No. 9
10	—	Extension bushing (part of 7A039)
11	7025	Case bushing
12	7B233	Output shaft bushing
13	7B375	Planet carrier bushing — rear
14	7F209	Forward clutch sun gear bushing
15	7N193	Reverse clutch sun gear bushing

16	7B374	Carrier bushing — front
17	7A132	Planetary support bushing
18	7F218	Reverse clutch drum bushing — rear
19	7B261	Front pump support bushing
20	7F217	Reverse clutch drum bushing — front
21	7B258	Front pump bushing
22	7B261	Front pump support bushing

Seals, Rings and Gasket Locator

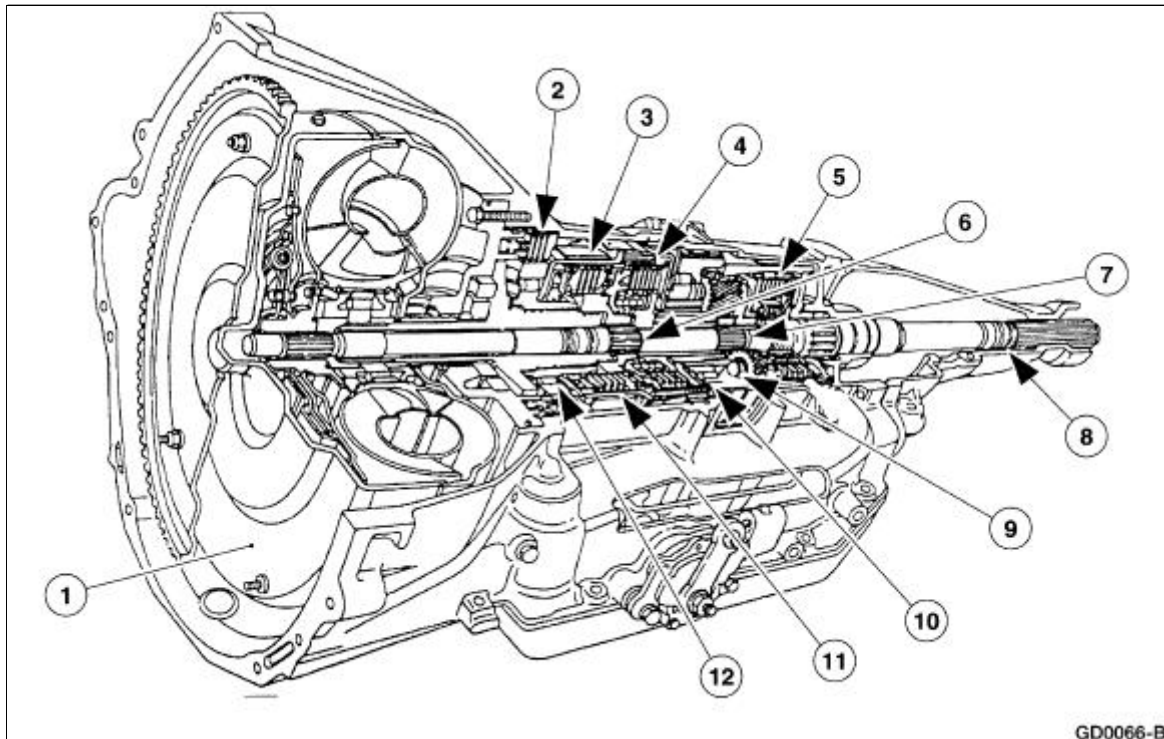


Item	Part Number	Description
1	7A248	Front pump seal assembly
2	7A248	Front pump seal
3	7A136	Front pump gasket

4	7D020	Reverse clutch cylinder seal (2 req'd)
5	7C099	Direct clutch piston inner seal
6	7D019	Forward clutch cylinder
7	7A548	Direct clutch piston outer seal
8	7F274	Output shaft to direct clutch cylinder seal (2 req'd)
9	87054-S94	O-ring seal (piloted) (model dependent)
10	7086	Extension gasket
11	7052	Extension housing seal assembly
12	7C155	Control valve body upper gasket
13	7D100	Valve body separator plate lower gasket
14	7H173	Valve body cover plate gasket
15	7A191	Transmission pan to case gasket
16	7F273	Output shaft to case seal (3 req'd)
17	7B497	Input shaft seal (2 req'd)
18	7C099	Forward clutch piston inner seal
19	7A548	Forward clutch piston outer seal
20	7B498	Manual control lever seal assembly
21	7D403	Reverse clutch piston outer seal
22	7D404	Reverse clutch piston inner seal
23	7F224	Intermediate clutch piston outer seal
24	7F225	Intermediate clutch piston inner seal
25	391308-S	Fill tube level indicator seal
26	7Z484	TCC solenoid seal (large)
27	7Z136	TCC solenoid seal (small)
28	7Z484	Shift solenoid seal (2 req'd)
29	N811757-S100	Output shaft speed sensor seal
30	7Z276	Bulkhead seal (1 req'd)
31	N805862-S	Pressure control solenoid seal (large)
32	391131	Pressure control solenoid seal (small)

Main Components and Functions

Transmission Main Components — Sectional View



GD0066-B

Item	Part Number	Description
1	7902	Torque converter
2	7B164	Intermediate clutch (friction)
3	7B164	Reverse clutch (friction)
4	7B164	Forward clutch (friction)
5	7B164	Direct clutch (friction)
6	7F207	Forward clutch cylinder and shaft
7	7F351	Shaft — intermediate stub
8	7060	Output shaft
9	7A089	Planetary one-way clutch
10	7D095	Reverse clutch band
11	7F196	Overdrive band
12	7A089	Intermediate one-way clutch

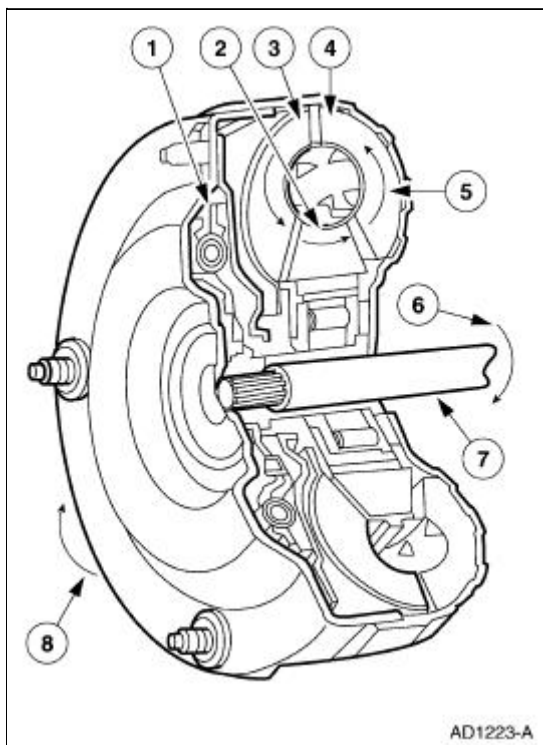
Torque Converter

The torque converter transmits and multiplies torque. The torque converter is a four-element device:

- impeller assembly
- turbine assembly
- reactor assembly
- clutch and damper assembly

The standard torque converter components operate as follows:

- Rotation of the converter housing and impeller set the fluid in motion.
- The turbine reacts to the fluid motion from the impeller, transferring rotation to the geartrain through the input shaft.
- The reactor redirects fluid going back into the impeller, allowing for torque multiplication.
- The clutch and damper assembly dampens powertrain torsional vibration and provides a direct mechanical connection for improved efficiency.
- Power is transmitted from the torque converter to the planetary gearsets and other components through the input shaft.



Item	Part Number	Description
1	—	Converter clutch and damper (part of 7902)
2	—	Reactor (part of 7902)
3	—	Turbine (part of 7902)

4	—	Impeller (part of 7902)
5	—	Fluid motion
6	—	Transmission input rotation
7	—	Input shaft
8	—	Engine rotation

Geartrain

Power is transmitted from the torque converter to the Ravigneaux geartrain components through the input shaft and forward clutch cylinder.

- The geartrain contains a Ravigneaux planetary set connected by dual pinion gears.
- By holding or driving certain components of the gearset, four forward ratios and one reverse ratio are obtained and transmitted to the output shaft. The ratios are as follows:

Gear Ratio	
1st	2.84 to 1
2nd	1.55 to 1
3rd	1.00 to 1
4th	0.70 to 1
Reverse	2.32 to 1

- Components of the geartrain can be held by bands or clutches and driven by clutches only.

The 4R70W uses:

- two bands.
- two one-way clutches (one roller, one mechanical diode).
- four friction clutches.

Planetary Gearset

The planetary gearset in the transmission is a Ravigneaux-type set consisting of the following components:

- forward clutch sun gear
- reverse clutch sun gear
- a pinion carrier
- long and short pinions
- output ring gear

Components are held or driven to produce forward and reverse gear ratios.

Input Shaft

The forward clutch cylinder and shaft transfers speed and torque from the converter turbine to the geartrain. This shaft is splined to the turbine on one end and to the forward clutch sun gear and stub shaft on the other end.

Stub Shaft

The stub shaft transfers power from the input shaft to the planet carrier (through the direct clutch) during third and fourth gear operation.

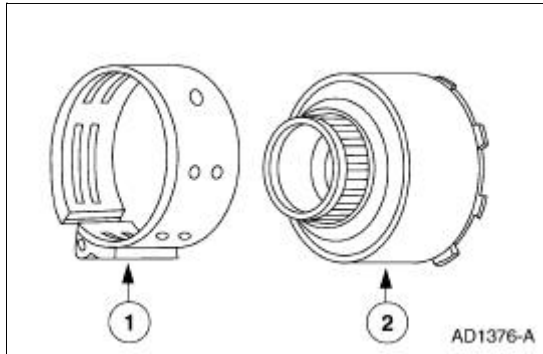
Output Shaft

The output shaft provides torque to the driveshaft and rear axle assembly. It is driven by the ring gear of the planetary gearset.

Apply Components

There are eight apply components used to drive or hold the planetary gearset components.

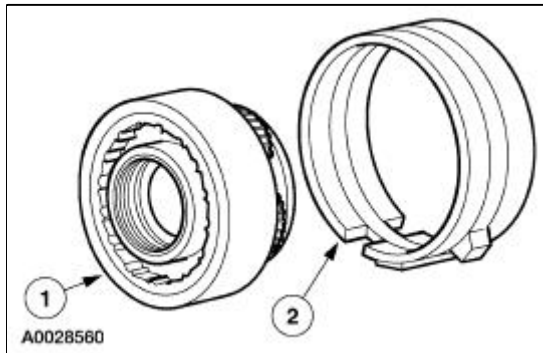
Band—Overdrive



Item	Part Number	Description
1	7F196	Overdrive band assembly
2	7D044	Reverse clutch drum assembly

The overdrive band holds the reverse clutch drum stationary in fourth gear and manual 2. This action causes the reverse sun gear to be held in these ranges.

Band—Low and Reverse

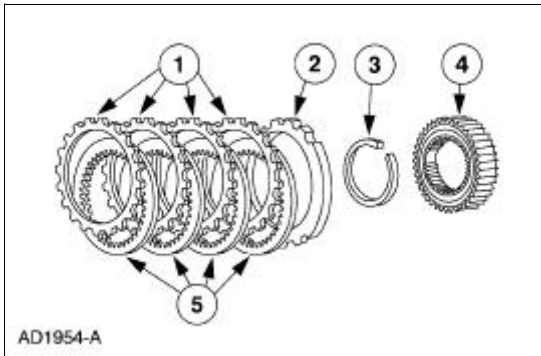


Item	Part Number	Description
1	7A398	Planetary assembly
2	7D095	Reverse band assembly

The low and reverse band holds the pinion carrier in reverse. The reverse band also applies in manual 1 position to provide engine braking.

Clutch—Intermediate

Intermediate Clutch Disassembled View

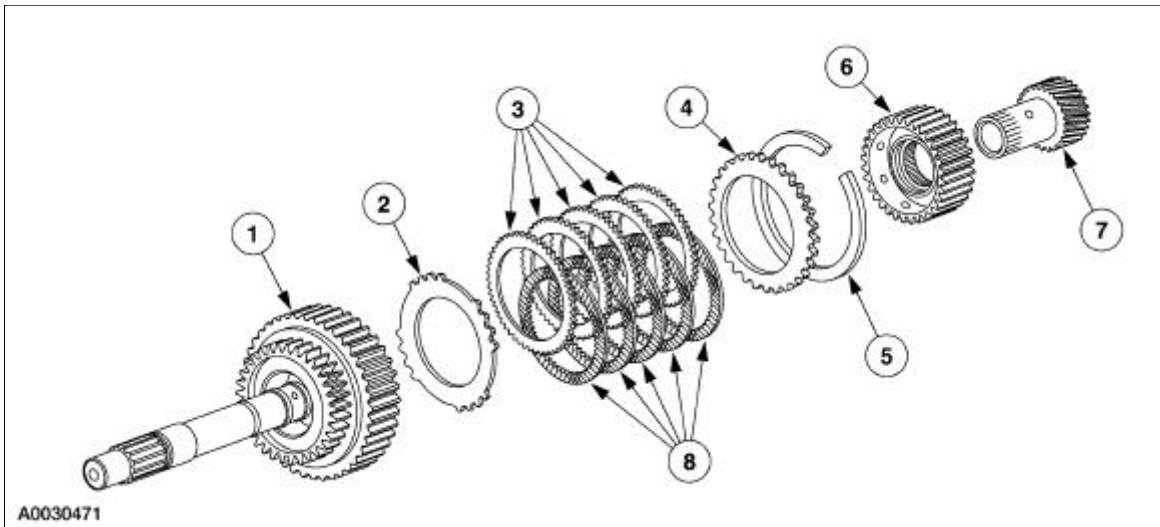


AD1954-A

Item	Part Number	Description
1	7B442	Intermediate clutch plates (steel)
2	7B066	Intermediate clutch pressure plate
3	391267-S	Retaining ring
4	7A089	Intermediate one-way clutch assembly
5	7B164	Intermediate clutch plates (friction)

The intermediate clutch works with the intermediate one-way clutch to hold the reverse sun gear stationary in second gear. The intermediate clutch remains applied in third and fourth gears, but does not transmit power.

Clutch—Forward

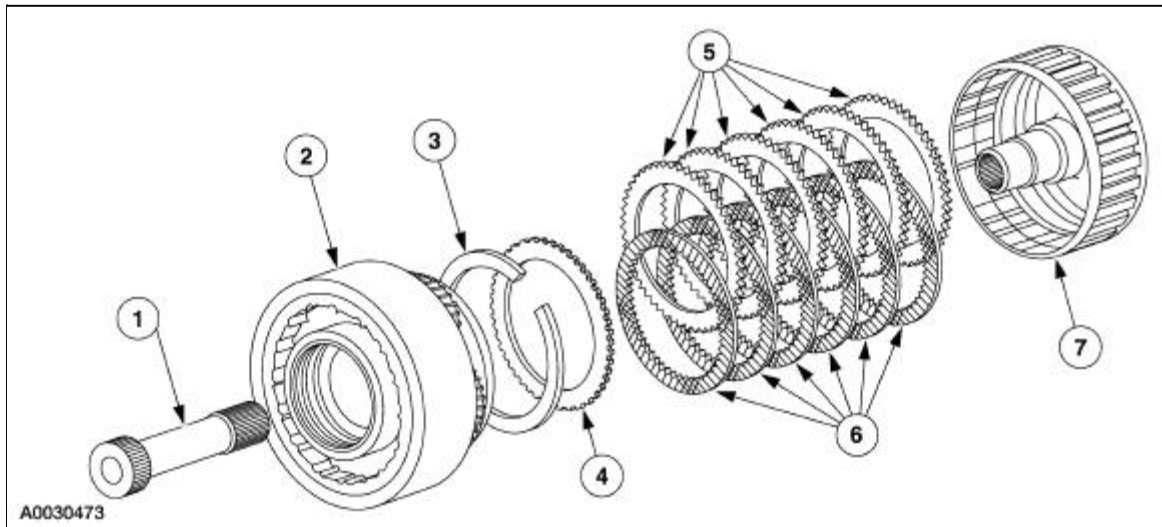


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Item	Part Number	Description
1	7F207	Forward clutch cylinder and input shaft assembly
2	7E085	Rear clutch pressure plate spring
3	7B442	Forward clutch plate external spline (steel)
4	7B066	Forward clutch pressure plate
5	7D483	Snap ring — retaining (select fit)
6	7B067	Forward clutch hub
7	7A399	Forward clutch sun gear assembly
8	7B164	Forward clutch plate internal spline (friction)

The forward clutch couples the forward clutch cylinder and input shaft to the forward sun gear in first, second, and third gears. The forward clutch is not applied in fourth gear.

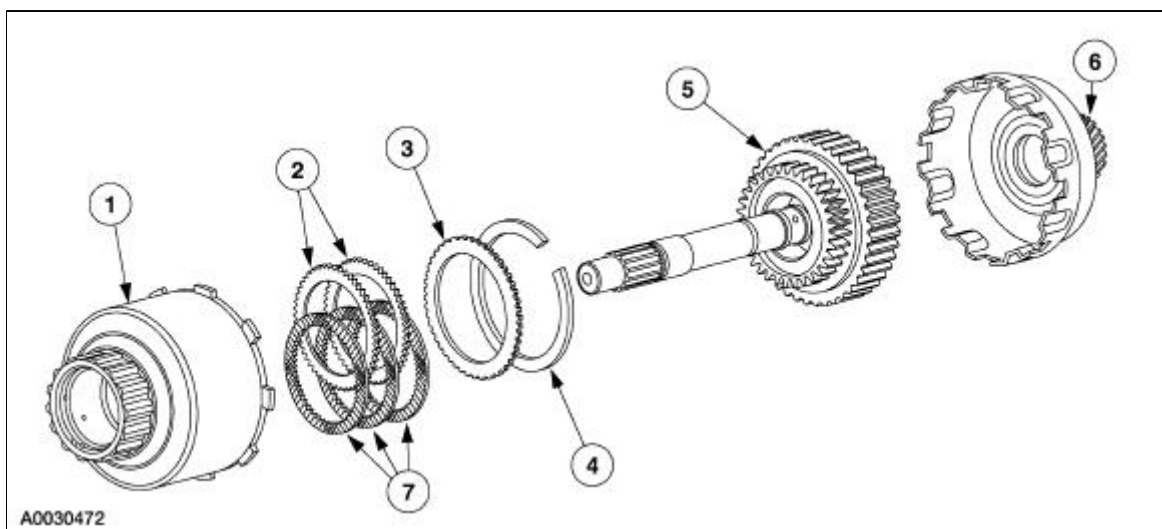
Clutch—Direct



Item	Part Number	Description
1	7F351	Intermediate stub shaft
2	7A398	Planetary assembly
3	7D483	Direct clutch pressure plate retaining ring (select fit)
4	7B066	Direct clutch pressure plate
5	7B442	Direct clutch plates external splined (steel)
6	7B164	Direct clutch plates internal splined (friction)
7	7F283	Direct clutch cylinder assembly

The direct clutch couples the input shaft to the planet carrier through the stub shaft in third and fourth gears.

Clutch—Reverse

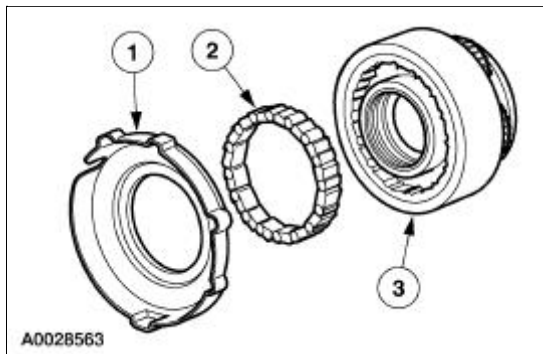


Item	Part Number	Description
1	7D044	Reverse clutch drum assembly

2	7B442	Reverse clutch plate external splined (steel)
3	7B066	Reverse clutch pressure plate (rear)
4	7D483	Reverse clutch pressure plate retaining ring (select fit)
5	7F207	Forward clutch cylinder and input shaft assembly
6	7A019	Reverse clutch sun gear assembly
7	7B164	Reverse clutch plate internal splined (friction)

The reverse clutch couples the input shaft to the reverse sun gear, applied in reverse range only.

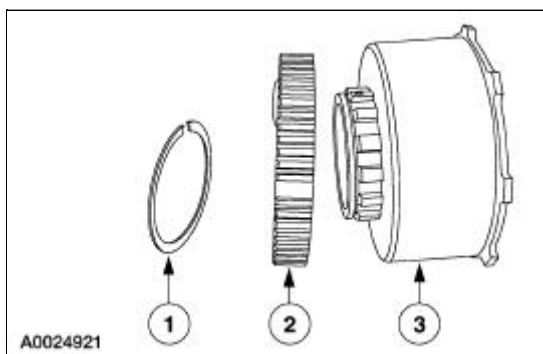
One-Way Clutch—Planetary (Low)



Item	Part Number	Description
1	7A130	Planetary gear support assembly
2	7A089	Planetary one-way clutch cage and spring roller assembly
3	7A398	Planetary assembly

The planetary (low) one-way clutch is a roller clutch that holds the planetary gearset in first gear, (D) and D ranges. During automatic coasting downshifts into first gear ((D) and D ranges), the planetary one-way clutch freewheels so there is no engine braking.

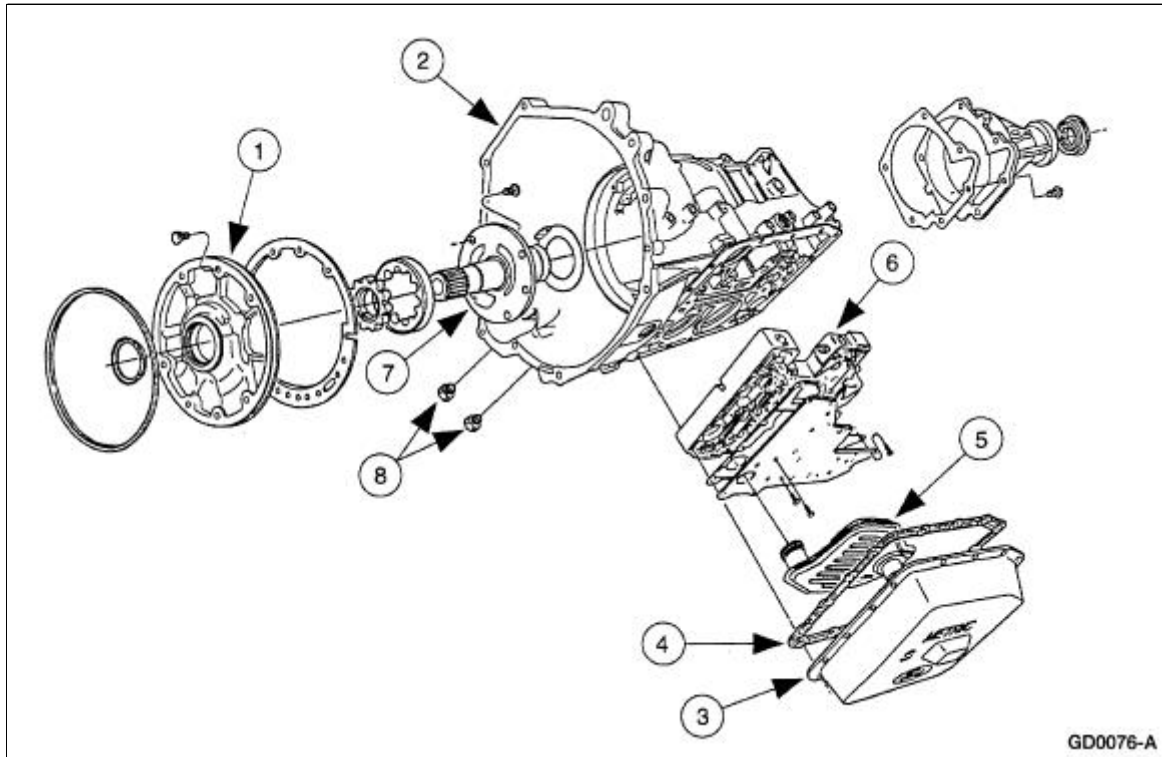
One-Way Clutch—Intermediate



Item	Part Number	Description
1	391267-S	Retaining ring
2	7A089	Intermediate one-way clutch assembly
3	7D044	Reverse clutch drum assembly

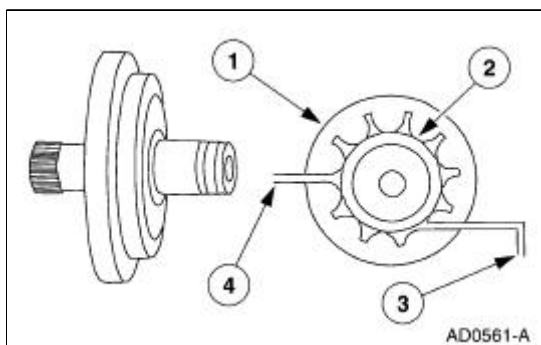
The intermediate one-way clutch works with the intermediate friction clutch to hold the reverse clutch drum and reverse sun gear stationary in second gear during acceleration. The intermediate one-way clutch freewheels in third gear and during coasting in second gear, (D) and D ranges.

Hydraulic System



Item	Part Number	Description
1	7A106	Front pump body assembly
2	7005	Case assembly
3	7A194	Transmission pan
4	7A191	Transmission pan gasket
5	7A098	Fluid filter and seal assembly
6	7A100	Main control assembly
7	7A108	Front pump support assembly
8	7D273	Fluid tube connector assembly (2 req'd)

Fluid Pump



Item	Part Number	Description
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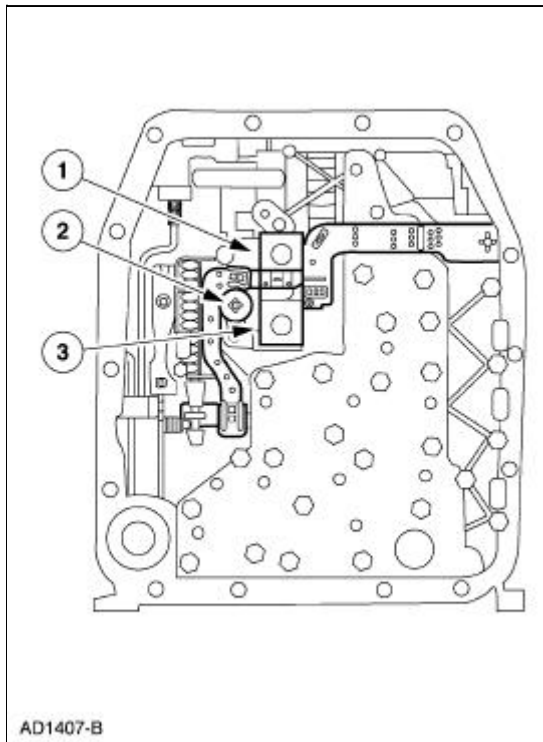
1	—	Outer rotor (part of 7A103)
2	—	Inner rotor (part of 7A103)
3	—	Outlet
4	—	Inlet

The transmission uses a gerotor-type design front pump support and gear. The pump provides the volume of fluid needed to charge the torque converter, main control assembly, cooling system and lube system. Pump pressure is regulated by the main regulator valve. The pump has an internal boost circuit which is more efficient at lower engine speeds.

Filter

All fluid drawn from the transmission pan by the pump passes through the filter. The filter and its accompanying seal are part of the fluid path from the sump (pan) to the fluid pump.

Main Control

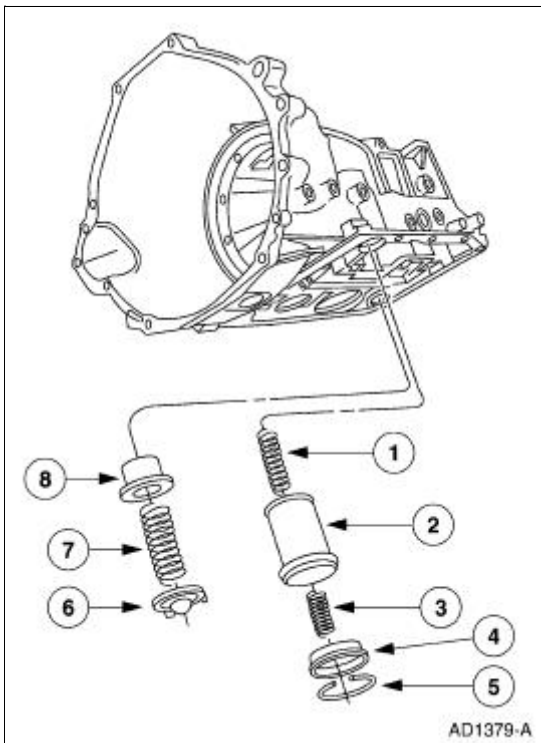


Item	Part Number	Description
1	—	Shift solenoid A (part of 7G484)
2	7G136	Torque converter clutch solenoid
3	—	Shift solenoid B (part of 7G484)

The main control valve body houses three electronic solenoids:

- two shift solenoids
- one torque converter clutch solenoid (TCC solenoid)

Accumulators



Item	Part Number	Description
1	7F284	Spring — 1-2 shift accumulator (model dependent)
2	7F251	Piston — 1-2 shift accumulator
3	7F284	Spring — 1-2 shift accumulator (model dependent)
4	7H300	Cover and seal assembly — 1-2 accumulator
5	7384	Ring — 2-1/16 retaining type HU internal
6	7B264	Retainer — 2-3 shift accumulator piston
7	7F285	Spring — 2-3 shift accumulator piston
8	7H292	Piston — 2-3 shift accumulator

The transmission uses two accumulators:

- 1-2 Accumulator — The 1-2 accumulator is used to soften the 1-2 shift by absorbing some of the pressure directed to the intermediate clutch. Constant line pressure is applied to the middle section of the 1-2 accumulator piston, opposing the intermediate clutch pressure, until the pressure is high enough to overcome line pressure. The top of the piston is exhausted to the sump.
- 2-3 Accumulator — The 2-3 accumulator is used to soften the 2-3 shift by absorbing some of the direct clutch pressure. Forward clutch pressure is applied to the top side of the 2-3 accumulator piston, holding the piston down until clutch pressure is high enough to overcome it. The middle section of the piston is exhausted to the sump.

Transmission Electronic Control System

The powertrain control module (PCM) and its input/output network control the following transmission operations:

- Shift timing
- Line pressure (shift feel)
- Torque converter clutch

The transmission control is separate from the engine control strategy in the PCM, although some of the input signals are shared. When determining the best operating strategy for transmission operation, the PCM uses input information from certain engine-related and driver-demand related sensors and switches.

In addition, the PCM receives input signals from certain transmission-related sensors and switches. The PCM also uses these signals when determining transmission operating strategy.

Using all of these input signals, the PCM can determine when the time and conditions are right for a shift, or when to apply or release the torque converter clutch (TCC). It will also determine the best line pressure needed to optimize shift feel. To accomplish this, the PCM uses hydraulic solenoids to control transmission operation.

The following provides a brief description of each of the sensors and actuators used to control transmission operation.

Powertrain Control Module (PCM)

The operation of the transmission is controlled by the powertrain control module (PCM). Many input sensors provide information to the PCM. The PCM then controls actuators which determine transmission operation.

Air Conditioning (A/C) Clutch

An electromagnetic clutch is energized when the clutch cycling pressure switch closes. The switch is located on the suction accumulator/drier. The closing of the switch completes the circuit to the clutch and draws it into engagement with the compressor driveshaft. When the A/C clutch is engaged, electronic pressure control (EPC) is adjusted by the PCM to compensate for additional load on the engine.

Brake Pedal Position (BPP) Switch

The brake pedal position (BPP) switch tells the PCM when the brakes are applied. The torque converter clutch disengages when the brakes are applied. The BPP switch closes when the brakes are applied and opens when they are released.

Engine Coolant Temperature (ECT) Sensor

The engine coolant temperature (ECT) sensor detects temperature of engine coolant and supplies the information to the powertrain control module. The ECT sensor is used to control torque converter clutch (TCC) operation. The ECT is installed in the heater outlet fitting or cooling passage on the engine. For engine control applications, the ECT signal is used to modify ignition timing, EGR flow and air-to-fuel ratio as a function of engine coolant temperature.

Ignition Coil — Coil On Plug

The engine uses eight separate coil per plug units. Each coil per plug unit is controlled by the powertrain control module (PCM).

Each coil per plug unit is mounted directly above each spark plug and activates its own spark plug in the correct sequence as controlled by the PCM.

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for additional information on the ignition system.

Intake Air Temperature (IAT) Sensor

The intake air temperature (IAT) sensor provides the sequential fuel injection (SFI) system mixture temperature information. The IAT sensor is used both as a density corrector for air flow calculation and to proportion cold enrichment fuel flow. The IAT sensor is installed in the air cleaner inlet tube. The IAT sensor is also used in determining EPC pressures.

Mass Air Flow (MAF) Sensor

The mass air flow (MAF) sensor measures the mass of air flowing into the engine. The MAF sensor output signal is used by the powertrain control module to calculate injector pulse width. For transmission strategies, the mass air flow sensor is used to regulate EPC, shift and torque converter clutch scheduling.

Transmission Control Switch (TCS) and Transmission Control Indicator Lamp (TCIL)

The transmission control switch (TCS) is a momentary contact switch. When the switch is pressed, a signal is sent to the PCM to allow automatic shifts from first through fourth gears or first through third gears only. The PCM energizes the transmission control indicator lamp (TCIL) when the switch is off. The TCIL indicates overdrive cancel mode activated (lamp on). When the TCIL is flashing, it indicates electronic pressure control (EPC) circuit shorted or a monitored sensor failure.

Throttle Position (TP) Sensor

The throttle position (TP) sensor is a potentiometer mounted on the throttle body. The TP sensor detects the position of the throttle plate and sends this information to the PCM. The TP sensor is used for shift scheduling, electronic pressure control (EPC) and TCC control.

Digital Transmission Range (TR) Sensor

The digital transmission range (TR) sensor is located on the outside of the transmission at the manual lever. The digital sensor completes the start circuit in PARK and NEUTRAL, and the back-up lamp circuit in REVERSE. The digital sensor also opens/closes a set of four switches that are monitored by the PCM to determine the position of the manual lever (P, R, N, D, 2, 1).

Output Shaft Speed (OSS) Sensor

The output shaft speed (OSS) sensor is a magnetic pickup, located at the output shaft ring gear, that sends a signal to the powertrain control module (PCM) to indicate transmission output shaft speed. The OSS sensor is used for torque converter clutch (TCC) control, shift scheduling and to determine electronic pressure control (EPC).

Electronic Pressure Control (EPC) Solenoid

The EPC solenoid regulates transmission pressure. EPC valve pressure is used to control line pressure.

Torque Converter Clutch (TCC) Solenoid

The TCC solenoid is used to control the apply and release of the TCC.

Shift Solenoid — SSA, SSB

Two on/off shift solenoids provide gear selection of first through fourth gears by controlling the pressure to the three shift valves. One unit containing the two shift solenoids is located in the main control valve body. The shift solenoids are two-way, normally open style.

Solenoid Operation Chart

Selector Lever Position	PCM Commanded Gear	Solenoids		
		SSA	SSB	TCC
P/R/N	1	ON	OFF	HD
(D)	1	ON	OFF	HD
(D)	2	OFF	OFF	EC
(D)	3	OFF	ON	EC
(D)	4	ON	ON	EC
w/OD OFF				
1	1	ON	OFF	HD
2	2	OFF	OFF	EC
3	3	OFF	ON	EC
Manual 2	2	OFF	OFF	EC
Manual 1	1	ON	OFF	HD
1 ^a	2	OFF	OFF	EC

^a When a manual pull-in occurs above a calibrated speed, the transmission will not downshift from the higher gear until the vehicle speed drops below this calibrated speed.

EC = Electronically Controlled

HD = Hydraulically Disabled

Transmission Fluid Temperature (TFT) Sensor

The transmission fluid temperature (TFT) sensor is located on the lead frame assembly near the shift solenoids on the main control valve body. It is a temperature-sensitive device called a thermistor. It sends a voltage signal to the PCM. The voltage signal varies with transmission fluid temperature. The PCM uses this signal to determine whether a cold start shift schedule is necessary. The shift schedule is compensated when the transmission fluid temperature is cold. The PCM also inhibits (TCC) operation at low transmission fluid temperatures and corrects electronic pressure control.

Vehicle Speed (VSS) Sensor

The source of vehicle speed (VSS) is model dependent. Possible sources of vehicle speed input are anti-lock brake sensor (ABS), a gear-driven vehicle speed sensor (VSS), or an output shaft speed sensor (OSS). The VSS signal is either an A/C signal whose frequency changes with speed, or an SCP data message depending on the source. Some applications will have both. The vehicle speed signal is an input to various vehicle subsystems such as the powertrain control module (PCM), instrument cluster (speedometer and odometer), speed control system, etc. The vehicle speed source must be operational to enter output state control (OSC) mode for diagnostics.

Regardless of the type of vehicle speed system, the PCM always uses the OSS for transmission and

engine control.

Diagnostic Strategy

Troubleshooting an electronically controlled automatic transmission is simplified by using the proven method of diagnosis. One of the most important things to remember is that there is a definite procedure to follow.

NOTE: Do not take any short cuts or assume that critical checks or adjustments have already been made.

Follow the procedures as written to avoid missing critical components or steps.

To properly diagnose a concern have the following publications available:

- Transmission Reference Manual.
- Powertrain Control/Emissions Diagnosis (PC/ED) manual.
- TSBs and OASIS Messages.
- Wiring Diagram.

These publications provide the information required when diagnosing transmission concerns.

Use the Diagnostic Flow Chart as a guide and follow the steps as indicated.

Preliminary Inspection

- Know and understand the customer's concern.
- Verify the concern by operating the vehicle.
- Check the fluid levels and condition.
- Check for non-factory add-on items.
- Check shift linkages for proper adjustment.
- Check TSBs and OASIS messages regarding the concern.

Diagnostics

- Carry out on-board diagnostic procedures key on engine off (KOEO) and key on engine running (KOER).
- Record all diagnostic trouble codes (DTCs).
- Repair all non-transmission codes first.
- Repair all transmission codes second.
- Erase all continuous codes and attempt to repeat them.
- Repair all continuous codes.
- If only pass codes are obtained, refer to [Diagnosis By Symptom](#) for further information and diagnosis.

Follow the diagnostic sequence to diagnose and repair the concern the first time.

Diagnostic Flow Chart

Diagnostic Flow Chart		
<ul style="list-style-type: none"> ● Know and understand the customer concerns ● Check the fluid level and condition ● Verify the concern by operating the vehicle ● Check for non-factory-installed items and verify correct installation ● Check the shift linkage adjustments ● Check TSBs and OASIS messages for vehicle concerns ● Carry out quick test both KOER and KOEO ● Record all codes <p>1) Did you record any diagnostic trouble codes?</p>	Yes	<ul style="list-style-type: none"> - REPAIR all hard diagnostic trouble codes. FOLLOW the pinpoint tests. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual first, then this Workshop Manual.
	No	<ul style="list-style-type: none"> - REFER to Diagnosis By Symptom in this section, then GO to Step 5.
2) Are any continuous test memory codes present?	Yes	<ul style="list-style-type: none"> - CLEAR codes and CARRY OUT drive cycle test.
	No	<ul style="list-style-type: none"> - GO to Step 4.
3) Did the continuous test memory codes reappear?	Yes	<ul style="list-style-type: none"> - REPAIR all continuous test memory codes. FOLLOW the pinpoint tests. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual then the transmission reference manual, then this workshop manual, then GO to Step 4.
	No	<ul style="list-style-type: none"> - GO to Step 4.
4) Is the concern repaired?	Yes	<ul style="list-style-type: none"> - CARRY OUT the final quick test to verify that no diagnostic trouble codes are present. CLEAR memory codes.
	No	<ul style="list-style-type: none"> - REFER to Diagnosis By Symptom in this section.
5) Are there any electrical concerns?	Yes	<ul style="list-style-type: none"> - INSTALL the scan tool and CARRY OUT the output state control test, then GO to Step 6.
	No	<ul style="list-style-type: none"> - REFER to the hydraulic and mechanical routine to diagnose and REPAIR the concern, then GO to Step 7.
6) Was the transmission concern corrected when the scan tool was installed?	Yes	<ul style="list-style-type: none"> - REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual, intermittent fault diagnosis section and use the scan tool to diagnose cause of concern in the processor, vehicle harness or external inputs (sensors or switches).

	No	- REFER to the hydraulic and mechanical routine to diagnose the concern, then GO to Step 7.
7) Is the concern repaired?	Yes	- CARRY OUT the final quick test to verify that no diagnostic trouble codes are present. CLEAR memory codes.
	No	- Get assistance from technical hotline.

Preliminary Inspection

The following items must be checked prior to beginning the diagnostic procedures:

Know and Understand the Concern

In order to correctly diagnose a concern, first understand the customer complaint or condition. Customer contact may be required in order to begin to verify the concern. Understand the conditions, including when the concern occurs. For example:

- Hot or cold vehicle temperature
- Hot or cold ambient temperature
- Vehicle driving conditions
- Vehicle loaded/unloaded

After understanding when and how the concern occurs, proceed to Verification of Condition.

Verification of Condition

This section provides information that must be used in both determining the actual cause of customer concerns and carrying out the appropriate procedures.

The following procedures must be used when verifying customer concerns for the transmission.

Determine Customer Concern

NOTE: Some transmission conditions can cause engine concerns. An electronic pressure control short circuit can cause engine misfiring. The torque converter clutch not disengaging will stall the engine.

Determine customer concerns relative to vehicle use and dependent driving conditions, paying attention to the following items:

- Hot or cold vehicle operating temperature
- Hot or cold ambient temperatures
- Type of terrain
- Vehicle loaded/unloaded
- City/highway driving
- Upshifting
- Downshift
- Coasting
- Engagement
- Noise/vibration — check for dependencies, either rpm dependent, vehicle speed dependent, shift dependent, gear dependent, range dependent, or temperature dependent.

Check Fluid Level and Condition

Fluid Level Check



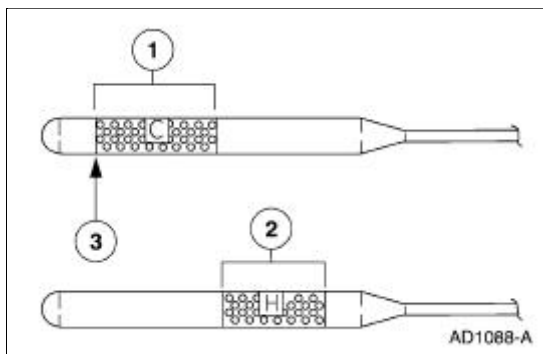
CAUTION: The vehicle should not be driven if the fluid level indicator shows the fluid below the DO NOT DRIVE mark or internal failure could result.

NOTE: If the vehicle has been operated for an extended period, at high highway speeds, in city traffic, during hot weather, or while pulling a trailer, the fluid needs to cool down to obtain an accurate reading.

NOTE: The fluid level reading on the indicator will differ from operating and ambient temperatures. The correct reading should be within the normal operating temperature range.

Under normal circumstances the fluid level should be checked during normal maintenance. If the transmission starts to slip, shifts slowly, or shows signs of fluid leaking, the fluid level should be checked.

1. With the transmission in P (PARK), the engine at idle, foot pressed on the brake, move the range selector lever through each gear and allow engagement of each gear. Place the transmission range selector lever in the P position.
2. Wipe the fluid level indicator cap and remove the indicator.
3. Wipe the indicator with a clean cloth.
4. Install the indicator back in the filler tube until it is fully seated, then remove the indicator. The fluid level should be within the normal operating temperature range.



Item	Description
1	Fluid level at room temperature 10°-35°C (50°-95°F)
2	Fluid level at operating temperature 66°-77°C (150°-170°F)
3	Do not drive mark

High Fluid Level

A fluid level that is too high may cause the fluid to become aerated due to the churning action of the rotating internal parts. This will cause erratic control pressure, foaming, loss of fluid from the vent tube, and possible transmission failure. If an overfill reading is indicated, drain and refill the transmission.

Low Fluid Level

A low fluid level could result in poor transmission engagement, slipping, or failure. This could also indicate a leak in one of the transmission seals or gaskets.

Adding Fluid



CAUTION: The use of any other type of transmission fluid than specified could result in transmission failure.

If fluid needs to be added, add fluid in 0.25L (1/2 pint) increments through the filler tube. Do not overfill the fluid. For fluid type, refer to the specification chart.

Fluid Condition Check

1. Check the fluid level.
 2. Observe the color and the odor. The color under normal circumstances should be dark reddish, not brown or black or have a burnt odor.
 3. Hold the fluid level indicator over a white facial tissue and allow the fluid to drip onto the facial tissue and examine the stain.
 4. If evidence of solid material is found, the transmission fluid pan should be removed for further inspection.
 5. If the stain is a foamy pink color this may indicate coolant in the transmission. The engine cooling system should also be inspected at this time.
 6. If fluid contamination or transmission failure is confirmed by the sediment in the bottom of the fluid pan, the transmission must be disassembled and completely cleaned. This includes the torque converter and cooler tubes. The oil-to-air cooler will need to be installed.
 7. Carry out diagnostic checks and adjustments. Refer to [Diagnosis By Symptom](#) in this section.
-

Road Testing Vehicle

NOTE: Always drive the vehicle in a safe manner according to the driving conditions and obey all traffic laws.

The shift point road test and torque converter operation tests provide diagnostic information on transmission shift controls and torque converter operation.

Shift Point Road Test

This test verifies that the shift control system is operating correctly.

1. Bring engine and transmission up to normal operating temperature.
2. Operate vehicle with transmission range selector lever in (D) position.
3. **NOTE:** Shift speed ranges are approximate for all applications. For specific applications (engine, axle ratio and application) refer to the Automatic Transmission Specification Issue, available from Ford Customer Service Division.

Apply minimum throttle and observe speeds at which upshift occurs and torque converter engages; refer to the 4R70W Shift Speeds chart in this section.

4. With the transmission in Overdrive (fourth gear), press the transmission control switch. The transmission should downshift to third gear. Release the accelerator pedal; engine braking should occur.
5. Press accelerator pedal to floor, wide open throttle (WOT). Transmission should shift from third to second gear, or third to first, depending on vehicle speed. Torque converter clutch should disengage and then reapply.
6. With the transmission in (D) position and speed above 80 km/h (50 mph) and less than half throttle, move the transmission range selector lever from (D) position to manual 2 position and remove pressure from the accelerator pedal. Transmission should immediately downshift into second gear. With vehicle remaining in manual 2 position, move the transmission range selector lever into manual 1 position, and release accelerator pedal. Transmission should downshift into first gear at speeds approximately below 45-56 km/h (28-35 mph).
7. If transmission fails to upshift/downshift or torque converter clutch does not apply and release, refer to [Diagnosis By Symptom](#) in this section.

Shift Speeds 4.6L 4V MACH 1 (3.55:1 Axle Ratio)

Throttle Position	Shift	MPH	Km/H
Light throttle	1-2	10-14	16-23
	2-3	18-22	29-35
1.25 volts	3-4	34-37	55-60
	4-3	22-25	35-40
Closed throttle	3-2	12-16	19-26
	2-1	11-7	18-11
Wide open throttle	1-2	36-44	58-71
	2-3	75-83	121-134
	3-2	70	113
	2-1	33	53

Shift Speeds 4.6L 2V HO (3:27:1 Axle

Ratio)

Throttle Position	Shift	MPH	Km/H
Light throttle	1-2	9-12	14-19
TP voltage	2-3	14-18	23-29
1.25 volts	3-4	36-38	58-61
Closed throttle	4-3	26-22	42-35
	3-2	15-11	24-18
	2-1	12-8	19-13
Wide open throttle	1-2	29-44	47-71
	2-3	74-80	119-129
	3-2	73	117
	2-1	32	51

Shift Speeds 3.8L (3:27:1 Axle Ratio)

Throttle Position	Shift	MPH	Km/H
Light throttle	1-2	6-10	10-16
TP voltage	2-3	18-22	29-35
1.25 volts	3-4	28-30	45-48
Closed throttle	4-3	24-22	39-35
	3-2	14-12	22-19
	2-1	6-8	10-13
Wide open throttle	1-2	36-40	58-64
	2-3	74-70	119-112
	3-2	67	108
	2-1	28	45

Shift Speeds 3.8L (3:08:1 Axle Ratio)

Throttle Position	Shift	MPH	Km/H
Light throttle	1-2	6-10	10-16
TP voltage	2-3	16-20	26-32
1.25 volts	3-4	38-42	61-68
Closed throttle	4-3	34-28	55-45
	3-2	16-13	26-21
	2-1	9-7	14-11
Wide open throttle	1-2	38-45	61-72
	2-3	72-76	116-122
	3-2	71	114
	2-1	31	50

Torque Converter Diagnosis

Prior to the installation of a new or remanufactured torque converter, all diagnostic procedures must be followed. This is to prevent the unnecessary installation of torque converters. Only after a complete diagnostic evaluation can the decision be made to install a new or remanufactured torque converter.

Begin with the normal diagnostic procedures as follows:

1. Preliminary inspection.
2. Know and understand the customer's concern.
3. Verify the condition — carry out the torque converter operation test.
4. Carry out diagnostic procedures.
 - Carry out on-board diagnostics; refer to Diagnostics.
 - Repair all non-transmission related DTCs first.
 - Repair all transmission DTCs.
 - Rerun on-board diagnostic to verify repair.
 - Carry out Line Pressure Test. For additional information, refer to [Special Testing Procedures](#) in this section.
 - Carry out Stall Speed Test. For additional information, refer to [Special Testing Procedures](#) in this section.
 - Carry out Diagnostic Routines. For additional information, refer to [Diagnosis By Symptom](#) in this section.
 - Use the Diagnosis by Symptom Index to locate the appropriate routine that best describes the symptom(s). The routine will list all possible components that may cause or contribute to the symptom. Check each component listed; diagnose and repair as required before changing the torque converter.

Torque Converter Operation Test

This test verifies that the torque converter clutch control system and the torque converter are operating correctly.

5. Carry out Quick Test with scan tool. For additional information, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Check for DTCs.
6. Connect a tachometer to the engine.
7. Bring the engine to normal operating temperature by driving the vehicle at highway speeds for approximately 15 minutes in (D) position.
8. After normal operating temperature is reached, maintain a constant vehicle speed of about 80 km/h (50 mph) and tap brake pedal with the left foot.
9. Engine rpm should increase when brake pedal is tapped, and decrease about five seconds after pedal is released. If this does not occur, see torque converter operation concerns. For additional information, refer to [Diagnosis By Symptom](#) in this section.

10. If the vehicle stalls in (D) or manual 2 at idle with vehicle at a stop, move the transmission range selector lever to manual 1 position. If the vehicle stalls, see torque converter operation concerns. For additional information, refer to [Diagnosis By Symptom](#) in this section. If the vehicle does not stall in (D), refer to [Diagnosis By Symptom](#) in this section.
11. If the vehicle exhibits a vibration during the road test, complete the Road Test Evaluation Form. This form will aid the technician in determining the source of the vibration.

NOTE: The following is a list of common vehicle concerns that have been misdiagnosed as torque converter clutch shudder. For diagnosis of the following items refer to the appropriate sections of the workshop manual and the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

- spark plugs - check for cracks, high resistance or broken insulators
- plug wires
- fuel injector - filter may be plugged
- fuel contamination - poor engine performance
- EGR valve - valve may let in too much exhaust gas and cause engine to run lean
- vacuum leak - engine will not get correct air/fuel mixture
- MAP/MAF sensor - incorrect air/fuel mixture
- HO2S sensor - too rich/lean air/fuel mixture
- fuel pressure - may be too low
- engine mounts - loose/damaged mounts can cause vibration concerns
- axle joints - check for vibration

Torque Converter Road Evaluation Form		
1) Does the Torque Converter Engage/Disengage?	Yes	• GO to Step 2.
	No	• REFER to Diagnosis By Symptom — Torque Converter No Apply Routine 240/340 and Always Applied Routine 241/341 in this section for further diagnosis information. Repair as required, verify converter operation and then continue.
2) Does vibration occur during 3-4 or 4-3 shift at: light, medium, or heavy throttle?	Light	• May be torque converter clutch shudder. GO to Step 3.
	Medium	• May be torque converter clutch shudder. GO to Step 3.
	Heavy	• Not torque converter clutch shudder — converter does not engage due to PCM strategy. REFER to Section 100-04 and Diagnosis By Symptom — Noise/Vibration Routine 254/354 in this section for further diagnosis.
3) Is the problem vehicle speed dependent	Yes	• Not torque converter clutch shudder

(operating at steady speed, i.e. 64 km/h (40 mph) regardless of transmission range. Verify by manually selecting 2nd, OD cancel, and OD.		— REFER to Section 100-04 and Diagnosis By Symptom — Noise/Vibration Routine 254/354 in this section for further diagnosis.
	No	• GO to Step 4.
4) Is the problem engine-rpm dependent? (Occurs at the same engine rpm independent of transmission gear. Verify by holding same rpm in each transmission gear.)	Yes	• Not torque converter clutch shudder — REFER to Section 100-04 and Diagnosis By Symptom — Noise/Vibration Routine 254/354 in this section for further diagnosis.
	No	• GO to Step 5.
5) Does the problem occur in coast, steady speed, or reverse range?	Yes	• Not torque converter clutch shudder — REFER to Section 100-04 and Diagnosis By Symptom — Noise/Vibration Routine 254/354 in this section for further diagnosis.
	No	• GO to Step 6.
6) Does vibration occur during extended light brake application?	Yes	• Not torque converter clutch shudder — REFER to Section 100-04 , Section 206-00 and Diagnosis By Symptom — Noise/Vibration Routine 254/354 in this section for further diagnosis.
	No	• GO to Step 7.
7) If one of the driving modes in Step 2 identifies a vibration which was not present in Steps 3-6, then there is a strong possibility that the vibration is caused by the torque converter clutch function. Carry out the repair procedures as found under Disassembly/Assembly.		

Visual Inspection

This inspection will identify modifications or additions to the vehicle operating system that may affect diagnosis. Inspect the vehicle for non-Ford factory add-on devices such as:

- electronic add-on items:
 - air conditioning
 - generator (alternator)
 - engine turbo
 - cellular telephone
 - cruise control
 - CB radio
 - linear booster
 - backup alarm signal
 - computer
- Vehicle modification:

These items, if not installed correctly, will affect the powertrain control module (PCM), or transmission function. Pay particular attention to add-on wiring splices in the PCM harness or transmission wiring harness, abnormal tire size, or axle ratio changes.

- Leaks; refer to Leak Inspection.
- Correct linkage adjustments; refer to [Section 307-05](#).

Shift Linkage Check

Check for a misadjustment in shift linkage by matching the detents in the transmission range selector lever with those of the manual lever in the transmission. If they match, the misadjustment is in the indicator. Do not adjust the shift linkage.

Hydraulic leakage at the manual control valve can cause delay in engagements and/or slipping while operating if the linkage is not correctly adjusted. Refer to [Section 307-05](#) for shift linkage adjustment.

Check TSBs and OASIS




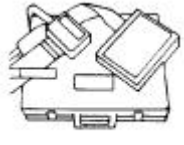



Refer to all technical service bulletins (TSB) and OASIS messages which pertain to the transmission concern and follow the procedure as described.




Carry Out On-Board Diagnostics (KOEO, KOER)

After a road test, with the vehicle warm and before disconnecting any connectors, carry out the Quick Test using the scan tool. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Diagnosics

Special Tool(s)

 <p>ST1565-A</p>	<p>Transmission Fluid Pressure Gauge 307-004 (T57L-77820-A)</p>
 <p>ST1392-A</p>	<p>Air Test Plate, Transmission 307-246 (T92P-7006-A)</p>
 <p>ST1633-A</p>	<p>Alignment Gauge, TR Sensor 307-351 (T97L-70010-A)</p>
 <p>ST1391-A</p>	<p>Breakout Box, EEC-V Control System 418-049 (T94L-50-EEC-V) or equivalent</p>
 <p>ST1632-A</p>	<p>MLP-TR Cable 418-F107 (007-00111) or equivalent</p>
 <p>ST2332-A</p>	<p>Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052 or equivalent scan tool</p>
 <p>ST1389-A</p>	<p>Transmission Tester 307-F016 (007-00130) or equivalent</p>
	<p>Trans Tester TR/MLP Overlay</p>

	and Manual 007-00131 or equivalent
 ST1137-A	73 III Automotive Meter 105-R0057 or equivalent
 ST1300-A	UV Leak Detector Kit 164-R0756 or equivalent

Diagnosing an electronically controlled automatic transmission is simplified by using the following procedures. One of the most important things to remember is that there is a definite procedure to follow. **DO NOT TAKE SHORT CUTS OR ASSUME THAT CRITICAL CHECKS OR ADJUSTMENTS HAVE ALREADY BEEN MADE.** Follow the procedures as written to avoid missing critical components or steps. By following the diagnostic sequence, the technician will be able to diagnose and repair the concern the first time.

On-Board Diagnostics With Diagnostic Tool

NOTE: For detailed instruction and other diagnostic methods using the scan tool, refer to the scan tool tester manual and the Powertrain Control/Emissions Diagnosis (PC/ED) manual. These quick tests should be used to diagnose the powertrain control module (PCM) and should be carried out in order.

- **Quick Test 1.0 - Visual Inspection**
- **Quick Test 2.0 - Set Up**
- **Quick Test 3.0 - Key On, Engine Off (KOEO)**
- **Quick Test 4.0 - Continuous Memory**
- **Quick Test 5.0 - Key On, Engine Running (KOER)**
 - Special Test Mode
 - Wiggle Test
 - Output Test Mode
 - PCM Reset Mode
 - Clearing DTCs
 - OBD II Drive Cycle
- **Other Scan Tool Features**

For further information on other diagnostic testing features using the scan tool, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Other diagnostic methods include the following:

- Parameter Identification (PID) Access Mode
- Freeze Frame Data Access Mode

- Oxygen Sensor Monitor Mode



Output State Control (OSC) Mode

Output State Control (OSC) allows the technician to take control of certain parameters to function the transmission. For example, OSC allows the technician to shift the transmission only when he/she commands a gear change. If the technician commands 1st gear in OSC, the transmission will remain in 1st gear until the technician commands the next gear. Another example, the technician can command a shift solenoid to turn on or off when carrying out an electrical circuit check. OSC has two modes of operation for transmission, the BENCH MODE and the DRIVE MODE. Each mode/parameter has a unique set of vehicle operating requirements that the technician is required to meet before being allowed to operate OSC.

NOTE: To operate OSC the digital transmission range (TR) sensor must be operational. No Diagnostic Trouble Codes (DTCs) related to the digital TR sensor can be present.

To operate OSC the vehicle speed source must be operational. No diagnostic codes (DTCs) related to this source can be present. The vehicle speed source can vary depending on vehicle configuration. Technicians should verify which input source is applicable for their vehicle application. The following are potential vehicle speed sources:

- anti-lock braking system (ABS)
 - output shaft speed (OSS) sensor
 - vehicle speed sensor
-
- The vehicle requirements **MUST BE MET** when **SENDING** the OSC value. Refer to individual test modes for vehicle requirements.
 - If the vehicle requirements are **NOT MET** when **SENDING** the OSC value, an **ERROR MESSAGE** will appear. When the **ERROR MESSAGE** is received, OSC is aborted and must be restarted.
 - If **AFTER SENDING** an OSC value, and the vehicle requirements are no longer met, the PCM will cancel the OSC value and **NO ERROR** message will appear. Once the vehicle requirements are met again, the PCM will automatically **SEND** the previous OSC value without any additional actions required by the service technician.
 - The OSC value **XXX** may be sent anytime to cancel OSC.

Output State Control (OSC) Procedures

- Carry out visual inspection and vehicle preparation as required.
- Select "Vehicle and Engine Selection" menu.
- Select appropriate vehicle and engine.
- Select "Diagnostic Data Link."
- Select "Powertrain Control Module."
- Select "Output Test Mode."
- Select "KOEO On-Demand Self Test and KOER On-Demand Self Tests."
- Carry out test and record DTCs.
- Repair all NON-Transmission DTCs.
- Repair all digital TR Sensor DTCs.

- Repair all vehicle speed DTCs.
- Make sure that the vehicle speed sensor and digital TR sensors are functional.
- Select "Active Command Modes."
- Select "Trans - Bench Mode or Trans - Drive Mode."

OSC — Transmission Bench Modes

The following Transmission Bench Modes may be used or required during diagnostics.

SSA, SSB and TCC in BENCH MODE

The BENCH MODE allows the technician to carry out electrical circuit checks on the following components:

- SSA - activates SSA OFF or ON.
- SSB - activates SSB OFF or ON.
- Transmission converter clutch (TCC) - activates TCC OFF or ON.

OSC "SSA, SSB, TCC" BENCH MODE operates ONLY when:

- the digital TR sensor is operational and no digital TR sensor DTCs are present.
- the vehicle speed input is operational and no VSS sensor DTCs are present.
- the transmission range selector lever is in P.
- the key is ON.
- the engine is OFF.

OSC Command Values

- OFF - turns solenoid OFF.
- ON - turns solenoid ON.
- XXX - cancels OSC value sent.
- SEND - sends the values to PCM.

BENCH MODE Procedure for SSA, SSB and TCC

Follow operating instructions from the scan tool menu screen:

- Select "Output State Control."
- Select "Trans - Bench Mode."
- Select "PIDs" to be monitored.
- Monitor all selected PIDs during test.
- Select "Parameters - SSA, SSB or TCC."
- Select "ON" to turn solenoid ON.
- Press "SEND" to send command ON.
- Select "OFF" to turn solenoid OFF.
- Press "SEND" to send command OFF.

- Select "XXX" to cancel at any time.
- Press "SEND."

EPC in BENCH MODE

The BENCH MODE is also used to test the functionality of the transmission's electronic pressure control. During BENCH MODE, the electronic pressure control (EPC) solenoid can ramp up/down in increments of 103 kPa (15 psi) from zero to 620 kPa (90 psi) and 620 kPa (90 psi) to zero psi.

The OSC functions for the parameter EPC allows the technician to choose the following options:

- EPC - activates EPC to selected values.
- 00 - sets EPC pressure to 00 kPa (00 psi).
- 15 - sets EPC pressure to 103 kPa (15 psi).
- 30 - sets EPC pressure to 206 kPa (30 psi).
- 45 - sets EPC pressure to 310 kPa (45 psi).
- 60 - sets EPC pressure to 411 kPa (60 psi).
- 75 - sets EPC pressure to 517 kPa (75 psi).
- 90 - sets EPC pressure to 620 kPa (90 psi).

To carry out an EPC BENCH MODE pressure functionality test, install a pressure gauge in the EPC port. The following requirements are required to carry out this test:

- VSS and digital TR sensor operational
- No VSS and digital TR sensor DTCs
- Transmission range selector lever in P
- Key ON
- Engine ON
- Engine speed at least 1,500 rpm for accurate EPC pressure measurement

To carry out an EPC BENCH MODE solenoid circuit pinpoint test, the following requirements are required.

- VSS and digital TR sensor operational
- No VSS and digital TR sensor DTCs
- Transmission range selector lever in P
- Key ON
- Engine OFF

OSC Command Values

- 00 - sets EPC pressure to 00 kPa (00 psi).
- 15 - sets EPC pressure to 103 kPa (15 psi).
- 30 - sets EPC pressure to 206 kPa (30 psi).
- 45 - sets EPC pressure to 310 kPa (45 psi).
- 60 - sets EPC pressure to 411 kPa (60 psi).

- 75 - sets EPC pressure to 517 kPa (75 psi).
- 90 - sets EPC pressure to 620 kPa (90 psi).
- XXX - cancels OSC value sent.
- SEND - sends the values to PCM.

BENCH MODE Procedure for EPC

Follow operating instructions from the scan tool menu screen:

- Select "Output State Control."
- Select "Trans - Bench Mode."
- Select "PIDs" to be monitored.
- Monitor all selected PIDs during test.
- Select "Parameters - EPC."
- Select Value "0-620 kPa (0-90 psi)."
- Press "SEND" to send command.
- Select "XXX" to cancel at any time.
- Press "SEND."

OSC — Transmission DRIVE MODES

The DRIVE MODE allows control of three transmission parameters. Each mode/parameter has a unique set of vehicle operating requirements that the technician is required to meet before being allowed to operate OSC. The recommended procedure, when using the DRIVE MODE, is to control one parameter at a time.

The DRIVE MODE allows the technician to carry out the following functions on the transmission:

- GR_CM - allows upshifts or downshifts.
- TCC - engages or disengages the torque converter clutch.
- EPC - increases/decreases EPC pressure.

GR_CM in DRIVE MODE

This OSC function is used to test the transmission shift functions.

The OSC functions for the GR_CM parameter allows the technician to choose the following options:

- 1 - PCM selects 1st gear.
- 2 - PCM selects 2nd gear.
- 3 - PCM selects 3rd gear.
- 4 - PCM selects 4th gear.

OSC "GR_CM" Mode operates ONLY when:

- the digital TR sensor is operational and no digital TR sensor DTCs are present.
- the vehicle speed sensor is operational and no VSS sensor DTCs are present.

- the engine is ON.
- the TCC is OFF.
- the transmission range selector lever is in O/D.
- the vehicle speed is greater than 3.2 km/h (2 mph).

OSC Command Values

- 1 - PCM selects 1st gear.
- 2 - PCM selects 2nd gear.
- 3 - PCM selects 3rd gear.
- 4 - PCM selects 4th gear.
- XXX - cancels OSC value sent.
- SEND - sends the values to PCM.

DRIVE MODE Procedure for GR_CM

Follow operating instructions from the scan tool menu screen.

- Select "Output State Control."
- Select "Trans - DRIVE MODE."
- Select "PIDs" to be monitored.
- Monitor all selected PIDs during test.
- Select "Parameters - GR_CM."
- Select Value "1-4."
- Press "SEND" to send command.
- Re-Select Value "1-4."
- Press "SEND" to send command.
- Select "XXX" to cancel at any time.
- Press "SEND."

TCC in DRIVE MODE

This OSC function is used to test whether the torque converter clutch is engaging and disengaging correctly.

The OSC functions for the TCC parameter allows the technician to choose the following:

- TCC - activates TCC OFF and ON.
- ON - turns TCC solenoid ON.
- OFF - turns TCC solenoid OFF.

OSC "TCC OFF" DRIVE MODE operates ONLY when:

- the digital TR sensor is operational and no digital TR sensor DTCs are present.
- the vehicle speed sensor is operational and no VSS sensor DTCs are present.

- the engine is ON.
- the transmission range selector lever is in O/D.
- the vehicle speed is greater than 3.2 km/h (2 mph).

OSC "TCC ON" DRIVE MODE operates ONLY when:

- the digital TR sensor is operational and no digital TR sensor DTCs are present.
- the vehicle speed sensor is operational and no VSS sensor DTCs are present.
- the engine is ON.
- the transmission range selector lever is in O/D.
- the vehicle speed is greater than 3.2 km/h (2 mph).
- the transmission is in 2nd gear or higher.
- the TFT is between 15 and 135°C (60 and 275°F).
- the brake is not applied "OFF" below 32 km/h (20 mph).
- (Not an excessive load on engine (engine lugging).

OSC Command Values

- OFF - turns TCC OFF.
- ON - turns TCC ON.
- XXX - cancels OSC value sent.
- SEND - sends the values to PCM.

Drive Mode Procedures for TCC

Follow operating instructions from the scan tool menu screen.

- Select "Output State Control."
- Select "Trans - Drive Mode."
- Select "PIDs" to be monitored.
- Monitor all selected PIDs during test.
- Select "Parameters - TCC."
- Select "ON" to turn solenoid ON.
- Press "SEND" to send command ON.
- Select "OFF" to turn solenoid OFF.
- Press "SEND" to send command OFF.
- Select "XXX" to cancel at any time.
- Press "SEND."

EPC in DRIVE MODE

This OSC function is used to increase the EPC pressure while testing the transmission shift functions. This OSC function can only increase the EPC pressure greater than what the PCM normally commands. If an OSC value, such as (75) or (90) psi is sent, the upshifts and downshifts should exhibit a firmer shift. Firmer shifts would indicate that the EPC pressure control is working at higher

pressures. The best test for the EPC is to use the BENCH MODE and a hydraulic pressure gauge. Using EPC in the BENCH MODE will confirm that the EPC is working at both the higher and lower pressures.

The OSC functions for the parameter EPC allows the technician to choose the following options:

- EPC - activates EPC to selected values
 - 00 - sets EPC pressure to 00 kPa (00 psi).
 - 15 - sets EPC pressure to 103 kPa (15 psi).
 - 30 - sets EPC pressure to 206 kPa (30 psi).
 - 45 - sets EPC pressure to 310 kPa (45 psi).
 - 60 - sets EPC pressure to 411 kPa (60 psi).
 - 75 - sets EPC pressure to 517 kPa (75 psi).
 - 90 - sets EPC pressure to 620 kPa (90 psi).

OSC "EPC" DRIVE MODE operates ONLY when:

- the digital TR sensor is operational and no digital TR sensor DTCs are present.
- the vehicle speed sensor is operational and no VSS sensor DTCs are present.
- the transmission range selector lever is in O/D.
- the pressure gauge is installed.
- the key is ON.
- the engine is ON.
- the vehicle speed is greater than 3.2 km/h (2 mph).
- the OSC value for EPC must be greater than what the PCM commands (see EPC PID).

OSC Command Values

- 00 - sets EPC pressure to 00 kPa (00 psi).
- 15 - sets EPC pressure to 103 kPa (15 psi).
- 30 - sets EPC pressure to 206 kPa (30 psi).
- 45 - sets EPC pressure to 310 kPa (45 psi).
- 60 - sets EPC pressure to 411 kPa (60 psi).
- 75 - sets EPC pressure to 517 kPa (75 psi).
- 90 - sets EPC pressure to 620 kPa (90 psi).
- XXX - cancels OSC value sent.
- SEND - sends the values to PCM.

DRIVE MODE Procedure for EPC.

Follow operating instructions from the scan tool menu screen.

- Select "Output State Control."
- Select "Trans - Drive Mode."
- Select "PIDs" to be monitored.

- Monitor all selected PIDs during test.
- Select "Parameters - EPC."
- Select Value "0-620 kPa (0-90 psi)."
- Press "SEND" to send command.
- Re-Select Value "0-620 kPa (0-90 psi)."
- Press "SEND" to send command.
- Select "XXX" to cancel at any time.
- Press "SEND."

Using Output State Control and Accessing PIDs

To confirm that the OSC value was sent by the scan tool and the EEC has accepted the OSC substitution, a corresponding PID for each OSC parameter must be monitored. Additional PIDs should be monitored to help the technician adequately diagnose the transmission.

The following is a list of OSC parameters and their corresponding PID:

OSC PARAMETER CHART

OSC Parameter	PID	Additional PIDs
SSA	SSA	SS1F
SSB	SSB	SS2F
TCC	TCC	TCCF, TCCMACT (do not use PID TCCMCMD during OSC)
EPC	EPC	—
GR_CM	GEAR	TRANRAT

To confirm that the OSC substitution occurred, SEND the OSC value and monitor the corresponding PID value. If no ERROR MESSAGE was received and the value of the corresponding PID remains the same as the value sent from OSC, then the OSC substitution was successful.

Transmission Drive Cycle Test

NOTE: Always drive the vehicle in a safe manner according to driving conditions and obey all traffic laws.

NOTE: The Transmission Drive Cycle Test must be followed exactly. Malfunctions must occur four times consecutively for shift error DTC code to be set, and five times consecutively for continuous TCC code to set.

NOTE: When carrying out the Transmission Drive Cycle Test, refer to the Solenoid Application Chart for correct solenoid operation.

After carrying out the Quick Test, use the Transmission Drive Cycle Test for checking continuous codes.

1. Record and then erase Quick Test codes.
2. Warm engine to normal operating temperature.
3. Make sure transmission fluid level is correct.
4. With transmission in OVERDRIVE, moderately accelerate from stop to 80 km/h (50 mph). This allows the transmission to shift into fourth gear. Hold speed and throttle open steady for a minimum of 15 seconds.
5. With transmission in fourth gear and maintaining steady speed and throttle opening, lightly apply and release brake to operate stoplamps. Then hold speed and throttle steady for a minimum of five seconds.
6. Brake to a stop and remain stopped for a minimum of 20 seconds.
7. Repeat steps 4 through 6 at least five times.
8. Carry out Quick Test and record continuous DTCs.
 - If the DTCs are still present, refer to the Diagnostic Trouble Code Chart. Repair all non transmission DTCs first as they can directly affect the operation of the transmission. Repeat the Quick Test and the Road Test to verify the correction. Erase the DTCs, carry out the Drive Cycle Test and repeat the Quick Test after completing repair on the DTC.
 - If the continuous test passes and a concern is still present, refer to [Diagnosis By Symptom](#) in this section, OASIS messages, and TSBs for concerns.

After On-Board Diagnostic

NOTE: The vehicle wiring harness, PCM and non-transmission sensors may affect transmission operations. Repair these concerns first.

After the on-board diagnostic procedures are completed, repair all DTCs.

Begin with non-transmission related DTCs, then repair any transmission related DTCs. Use the diagnostic trouble code chart for information on condition and symptoms. This chart will be helpful in referring to the correct manual(s) and aids in diagnosing internal transmission concerns and external non-transmission inputs. The pinpoint tests are used in diagnosing transmission electrical concerns. Make sure that the vehicle wiring harness and the PCM are diagnosed as well. The Powertrain

Control/Emissions Diagnosis (PC/ED) manual will aid in diagnosing non-transmission electronic components.

Before Pinpoint Tests

NOTE: Prior to entering pinpoint tests, check the PCM wiring harness for tight connections, bent or broken pins, corrosion, loose wires, correct routing, correct seals and their condition. Check the PCM, sensors and actuators for damage. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

NOTE: If a concern still exists after electrical diagnosis has been carried out, refer to [Diagnosis By Symptom](#) in this section.

If DTCs appear while carrying out the on-board diagnostics, refer to the [Diagnostic Trouble Code Charts](#) for the appropriate repair procedure. Prior to entering pinpoint tests, refer to any TSBs and OASIS messages for transmission concerns.

Diagnostic Trouble Code Charts

Diagnostic Trouble Code Chart

Five Digit DTC	Component	Description	Condition	Symptom	Action
P0102 P0103 P1100 P1101	MAF	MAF concerns	MAF system has a malfunction which may cause a transmission concern.	High or low EPC pressure, incorrect shift schedule. Incorrect torque converter clutch engagement scheduling. Symptoms similar to a throttle position (TP) failure.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0112	IAT	IAT indicates 125°C (257°F) (grounded)	Voltage drop across IAT exceeds scale set for temperature 125°C (257°F).	Incorrect EPC pressure, either high or low, results in harsh or soft shifts.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0113	IAT	IAT indicates -40°C (-40°F) (open circuit)	Voltage drop across IAT exceeds scale set for temperature -40°C (-40°F).	Incorrect EPC pressure, either high or low, results in harsh or soft shifts.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0114	IAT	IAT out of on-board diagnostic range	IAT temperature higher or lower than expected during KOEO and KOER.	Rerun on-board diagnostic at normal operating temperature.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0117	ECT	ECT indicates 125°C (257°F)	Voltage drop across ECT exceeds scale set for temperature 125°C (257°F) (grounded).	Torque converter clutch will always be off, resulting in reduced fuel economy.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0118	ECT	ECT indicates -40°C (-40°F)	Voltage drop across ECT exceeds scale set for temperature -40°C (-40°F) (open circuit).	Torque converter clutch will always be off, resulting in reduced fuel economy.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0122 P0123 P1120	TP	TP concern	PCM has detected an error that may cause a transmission concern.	Harsh engagements, firm shift feel, abnormal shift schedule, torque converter clutch does not engage, torque converter clutch cycling.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0300-	Electronic	EI systems	EI system has a	Harsh	REFER to the

P0308 P0320 P0340 P1351- P1364	Ignition (EI)	concerns	malfunction which may cause a transmission concern.	engagements and shifts, late WOT shifts, no torque converter clutch engagement.	Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0503 P0500 P1500 P1502	VSS	Insufficient VSS input	PCM detected a loss of vehicle speed signal during operation.	Possible loss of speedometer or speedometer fluctuation.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1702	Digital TR	Intermittent DTC codes P0705 or P0708	Refer to DTC codes P0705 or P0708 condition.	Refer to DTC codes P0705 or P0708 symptom.	Go To Pinpoint Test C.
P1704	Digital TR	Digital TR circuit reading in between gear position during KOEO/KOER	Digital TR sensor or shift cable incorrectly adjusted; or digital TR circuit failure.	Wrong commanded EPC pressure. Digital TR reading the wrong gear position.	Go To Pinpoint Test C.
P0705	Digital TR sensor	Digital TR circuit failure	Digital TR circuits, indicating an invalid pattern in TR_D. Condition caused by a short to ground or an open in TR4, TR3A, TR2, and or TR1 circuits. This DTC cannot be set by an incorrectly adjusted digital TR sensor.	Increase in EPC pressure (harsh shifts). Defaults to (D) or D for all gear positions. In (D) position trans stuck in D or manual 2.	Go To Pinpoint Test C.
P0707	Digital TR sensor, wiring, PCM	Digital TR sensor circuit below minimum voltage	Digital TR sensor, circuit or PCM shorted or grounded.	Increase in EPC pressure.	Go To Pinpoint Test C.
P0708	Digital TR	Digital TR sensor circuit TR3A open	Digital TR sensor circuit TR3A reading 2.6v - 5.0v (open circuit). This DTC cannot be set by an incorrectly adjusted digital TR sensor.	Increase in EPC pressure. Defaults to (D) or D for all gear ranges.	Go To Pinpoint Test C.
P1705	Digital TR sensor	Digital TR self test was not carried out in PARK or NEUTRAL	Vehicle not in PARK or NEUTRAL during on-board diagnostic.	Rerun on-board diagnostic in PARK or NEUTRAL.	Go To Pinpoint Test C.
P0712	TFT, wiring, PCM	157°C (315°F) indicated TFT sensor circuit grounded	Voltage drop across TFT sensor exceeds scale set for temperature of 157°C (315°F).	Firm shift feel.	Go To Pinpoint Test B.

P0713	TFT, wiring, PCM	-40°C (-40°F) indicated TFT sensor circuit open	Voltage drop across TFT sensor exceeds scale set for temperature - 40°C (-40°F).	Firm shift feel.	Go To Pinpoint Test B.
P1710	TFT	TFT sensor in range malfunction	PCM detected TFT not changing.	Firm shift, TCIL flashing, increase in EPC.	Go To Pinpoint Test B.
P1711	TFT	TFT out of on-board diagnostic range	Transmission not at operating temperature during on-board diagnostic.	Warm vehicle to normal operating temperature.	Go To Pinpoint Test B.
P1713	TFT wiring PCM	TFT continually reading cold	TFT sensor in range low failure.	Firm shift feel. Substitute ECT for TFT	Go To Pinpoint Test B.
P1718	TFT, wiring, PCM	TFT continually reading hot	TFT sensor in range high failure.	Firm shift feel. Substitute ECT for TFT	Go To Pinpoint Test B.
P1783	TFT	Transmission over temperature condition indicated	Transmission fluid temperature exceeded 127°C (270°F).	Increase in EPC pressure.	Go To Pinpoint Test B.
P0720	OSS	Insufficient input from output shaft speed sensor	PCM detected a loss of OSS signal during operation.	Harsh shifts, abnormal shift schedule, no torque converter clutch activation.	Go To Pinpoint Test E.
P0721	OSS	OSS sensor signal noisy	PCM has detected an erratic OSS signal.	Harsh shifts, abnormal shift schedule, no torque converter clutch engagement.	Go To Pinpoint Test E.
P0722	OSS wiring	Insufficient input from OSS	PCM has detected a loss of OSS signal.	Harsh shifts, abnormal shift schedule, no torque converter clutch engagement.	Go To Pinpoint Test E.
P0741 **	TCC, internal components	TCC slippage detected	The PCM picked up an excessive amount of slippage during normal vehicle operation.	TCC slippage/erratic or no torque converter clutch operation. Flashing Transmission Control Indicator Lamp (TCIL).	GO to Diagnosis By Symptom.
P0743 *	TCC, wiring, PCM	TCC solenoid circuit failure during on-board diagnostic	TCC solenoid circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	Short circuit: engine stalls in second (OD, 2 range) at low idle speeds with brake applied. Open circuit: torque converter clutch never engages.	Go To Pinpoint Test A.
P1746	EPC, wiring,	Shorted PCM	Voltage through	Open circuit causes	Go To Pinpoint

*	PCM	output driver	EPC solenoid is checked. An error will be noted if tolerance is exceeded.	maximum EPC pressure, harsh engagements and shifts.	Test D .
P1747 *	EPC, wiring, PCM	EPC solenoid circuit failure, shorted circuit or output driver	Voltage through EPC solenoid is checked. An error will be noted if tolerance is exceeded.	Short circuit causes minimum EPC pressure (minimum capacity) and limits engine torque (alternate firm).	Go To Pinpoint Test D .
P1760	EPC, wiring, PCM	EPC solenoid circuit failure, shorted circuit or output driver	PCM detected a loss of EPC during operation.	Unexpected reduction in engine torque.	Go To Pinpoint Test D .
P0750 a	SSA, wiring, PCM	SSA solenoid circuit failure	SSA circuit failed to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	Incorrect gear selection depending on condition mode and manual lever position. See Solenoid On/Off Chart.	Go To Pinpoint Test A .
P0753	SSA, wiring, PCM	SSA electrical circuit failure	SSA circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	Incorrect gear depending on condition mode and manual lever position. See Solenoid Off/On Chart. Flashing Transmission Control Indicator Lamp (TCIL).	Go To Pinpoint Test A .
P0751	SSA, wiring, PCM	Shift solenoid A functional failure	Mechanical or hydraulic failure of the shift solenoid.	Incorrect gear selection depending on failure mode manual lever position.	REFER to Solenoid Operation Chart. Go To Pinpoint Test A .
P0781 b	SSA or internal parts	1-2 shift error	Engine rpm drop not detected when 1-2 shift was commanded by PCM.	Incorrect gear selection depending on failure or mode and manual lever position. Shift errors may also be due to other internal transmission concerns (stuck valves, damaged friction material).	REFER to Solenoid Operation Chart. Go To Pinpoint Test A .
P1714	SSA, internal components	SSA malfunction	Mechanical failure of the solenoid detected.	Incorrect gear selection depending on condition, mode and manual lever position. See Solenoid Operation Chart.	Go To Pinpoint Test F .
P0755 a	SSB, wiring, PCM	SSB solenoid circuit failure	SSB circuit fails to provide voltage	Incorrect gear selection depending	Go To Pinpoint Test A .

			drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	on condition mode and manual lever position. See Solenoid On/Off Chart.	
P0756	SSB	Shift solenoid B functional failure	Mechanical or hydraulic failure of the shift solenoid.	Incorrect gear selection depending on failure mode and manual lever position.	REFER to Solenoid Operation Chart. Go To Pinpoint Test A .
P1715	SSB	SSB malfunction	Mechanical failure of the solenoid detected.	Incorrect gear selection depending on condition, mode and manual lever position. See Solenoid Operation Chart.	Go To Pinpoint Test F .
P0758	SSB, wiring, PCM	SSB electrical circuit failure	SSB circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	Incorrect gear depending on condition mode and manual lever position. See Solenoid Off/On Chart. Flashing Transmission Control Indicator Lamp (TCIL).	Go To Pinpoint Test A .
P0782 ^b	SSA, SSB or internal parts	2-3 shift error	Engine rpm drop not detected when 2-3 shift was commanded by PCM.	Incorrect gear selection depending on failure or mode and manual lever position. Shift errors may also be due to other internal transmission concerns (stuck valves, damaged friction material).	REFER to Solenoid Operation Chart. Go To Pinpoint Test A .
P0783 ^b	SSA, SSB or internal parts	3-4 shift error	Engine rpm drop not detected when 3-4 shift was commanded by PCM.	Incorrect gear selection depending on failure or mode and manual lever position. Shift errors may also be due to other internal transmission concerns (stuck valves, damaged friction material).	REFER to Solenoid Operation Chart. Go To Pinpoint Test A .
P1116	ECT	ECT out of on-board diagnostic range	ECT temperature higher or lower than expected during KOEO and KOER.	Rerun on-board diagnostic at normal operating temperature.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1124	TP	TP voltage high/low for on-board diagnostic	TP was not in the correct position for on-board diagnostic.	Rerun at appropriate throttle position per application.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED)

					manual.
P1460	A/C	A/C clutch cycling pressure switch error	A/C or defrost on condition may result from A/C clutch being on during on-board diagnostic.	DTC set during on-board diagnostic, repeat with A/C off. Failed on, EPC pressure slightly low with A/C OFF.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1636	PCM	PCM detected internal error	—	—	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1703	BPP	BPP switch circuit failed.	Brake ON/OFF circuit failure.	Failed ON or not connected — torque converter clutch will not engage at less than 1/3 throttle. Failed OFF or not connected — torque converter clutch will not disengage when brake is applied.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1703	BPP	Brake not actuated during on-board diagnostic	Brake not cycled during KOER.	Failed OFF or not connected — torque converter clutch will not engage at less than 1/3 throttle. Failed OFF or not connected — torque converter clutch will not disengage when brake is applied.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0740	TCC, wiring, PCM	TCC electrical circuit failure	TCC circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failed during on-board diagnostic.	Short circuit: engine stalls in second (OD, 2 range) at low idle speeds with brake applied. Open circuit: torque converter clutch never engages. Flashing Transmission Control Indicator Lamp (TCIL).	Go To Pinpoint Test A.
P1740	TCC	TCC malfunction	Mechanical failure of the solenoid detected.	Failed ON — Engine stalls in 2nd (O/D, Manual 2 ranges) at low idle speeds with brake applied. Failed OFF — Torque Converter never applies.	Go To Pinpoint Test F.
P1741 b	TCC, internal	Excessive torque	Excessive variations in slip	Engine rpm oscillation is	Go To Pinpoint Test A.

	components	converter clutch engagement error	(engine speed surge) across the torque converter clutch.	present in 3rd gear.	
P1742	TCC, internal components	TCC solenoid failed ON	TCC solenoid has failed on by electric, mechanical or hydraulic concern.	Harsh shifts.	Go To Pinpoint Test A .
P1743	TCC, internal components	TCC solenoid failed ON	TCC solenoid has failed ON by electric, mechanical or hydraulic concern.	Harsh shifts.	Go To Pinpoint Test A .
P1744	TCC	TCC	The PCM picked up an excessive amount of TCC slippage during normal vehicle operation.	TCC slippage/erratic or no torque converter clutch operation.	GO to Diagnosis by Symptom.
P1767	TCC	TCC solenoid circuit failure during OBD Test	TCC solenoid circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM Driver failure during OBD Test.	Short circuit: engine stalls in second (O/D, 2 range) at low idle speeds with brake applied. Open circuit: Torque Converter never engages.	Go To Pinpoint Test A .
P1780	TCS	TCS not changing states	TCS not cycled during self-test. TCS circuit open or shorted.	Rerun on-board diagnostic and cycle switch. No OD cancel when switch is cycled.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
—	TCIL	TCIL circuit failure	TCIL circuit open or shorted.	Failed on, OD cancel mode on. No flashing TCIL for EPC failure or sensor. Failed off, OD cancel mode never indicated. No flashing TCIL for EPC sensor failure.	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual
P1709	PNP switch	PNP switch out of self-test range	Vehicle not in PARK or NEUTRAL during on-board diagnostic.	Rerun on-board diagnostic in PARK or NEUTRAL.	Go To Pinpoint Test C .

^a Output circuit check, generated only by electrical symptoms.

^b May also be generated by some other non-electric transmission hardware system.

Rotunda Transmission Tester

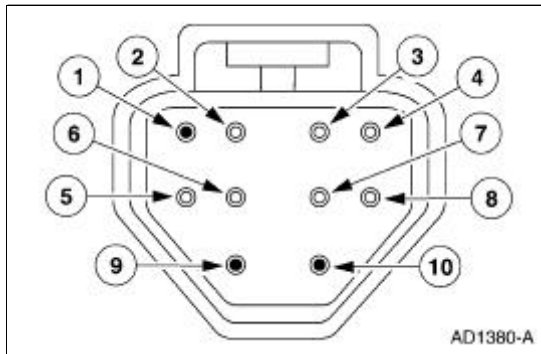
The Transmission Tester is used to diagnosis the digital transmission range sensor and is used in conjunction with the pinpoint tests. The tests should be carried out in order. Installing the Transmission Tester allows separation of the vehicle electronics from transmission electronics; refer to the Transmission Tester manual for these tests.

- Digital Transmission Range (TR) Sensor Testing

- Resistance/Continuity Test
 - Voltage Test - PARK/NEUTRAL, Reversing Lamp, and Optional Circuits
-

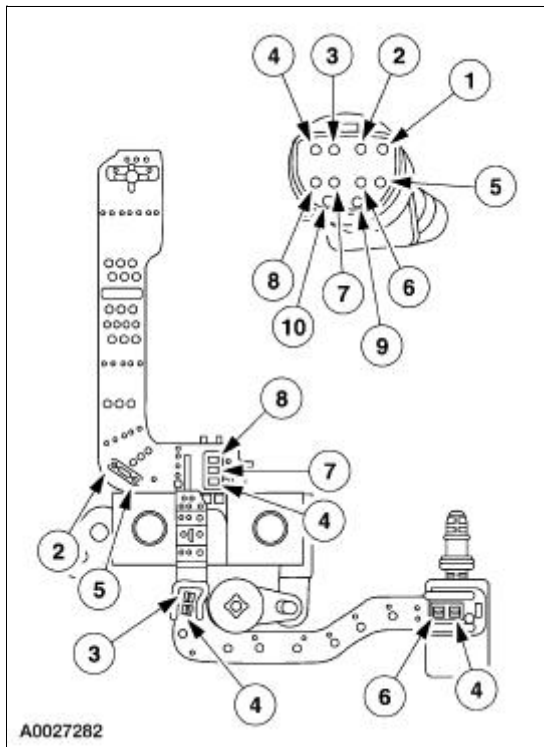
Transmission Connector Layouts

Transmission Vehicle Harness Connector



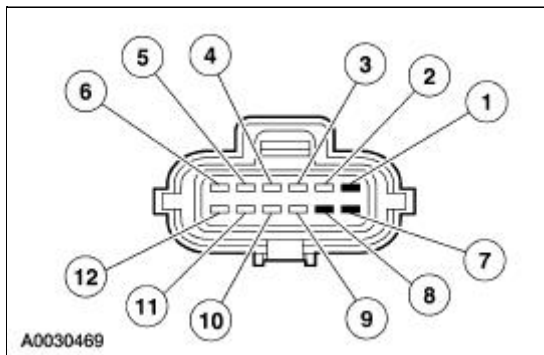
Pin Number	Circuit	Circuit Function
1	—	NOT USED
2	—	Signal Return
3	—	Torque Converter Clutch (TCC) Solenoid
4	—	Vehicle Power
5	—	Transmission Fluid Temperature (TFT) Input
6	—	Electronic Pressure Control (EPC) Solenoid
7	—	SSA
8	—	SSB
9	—	NOT USED
10	—	NOT USED

Transmission Internal Harness Connector



Pin Number	Circuit	Circuit Function
1	—	NOT USED
2	—	Signal Return Transmission Fluid Temperature (TFT)
3	—	Torque Converter Clutch (TCC)
4	—	Vehicle Power To Solenoid
5	—	Transmission Fluid Temperature (TFT)
6	—	Electronic Pressure Control
7	—	SSA
8	—	SSB
9	—	NOT USED
10	—	NOT USED

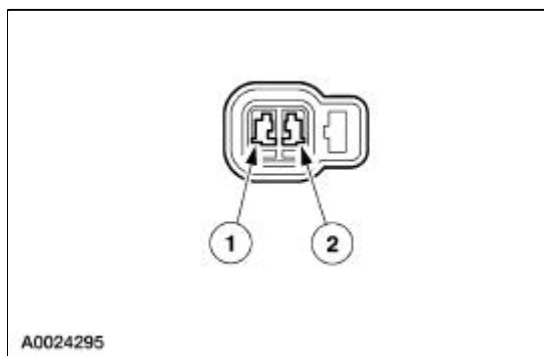
Digital Transmission Range (TR) Sensor Connector



Pin Number	Circuit	Circuit Function

1	—	NOT USED
2	—	Signal Return
3	—	TR3A
4	—	TR1
5	—	TR2
6	—	TR4
7	—	NOT USED
8	—	NOT USED
9	—	Fused Power Feed
10	—	Starter Control
11	—	Reverse
12	—	Starter to Starter Interrupt Relay

Output Shaft Speed (OSS) Sensor Harness Connector



Pin Number	Circuit	Circuit Function
1	—	Output Shaft Speed (OSS) Sensor
2	—	Signal Return

Digital Transmission Range (TR) Sensor Diagnosis Chart

Selector Position	PID: TR	PID: TR_D				PID: TR_V (volts)
		TR4	TR3A	TR2	TR1	TR3A (PCM Pin 64 to sigtrn)
PARK	P/N	0	0	0	0	0.0 Volts
In Between	REV	0	1	0	0	1.3 - 1.8 Volts
REVERSE	REV	1	1	0	0	1.3 - 1.8 Volts
In Between	REV	0	1	0	0	1.3 - 1.8 Volts
NEUTRAL	NTRL	0	1	1	0	1.3 - 1.8 Volts
In Between	O/D ^a	1	1	1	0	1.3 - 1.8 Volts
OVERDRIVE	O/D ^a	1	1	1	1	1.3 - 1.8 Volts
In Between	Man 2	1	0	1	1	0.0 Volts

Manual 2	Man 2	1	0	0	1	0.0 Volts
In Between	Man 2	1	0	1	1	0.0 Volts
Manual 1	Man 1	0	0	1	1	0.0 Volts

^a Will read "Drive" if O/D is canceled.

- A. TR_V is the voltage at the PCM pin 64 (TR3A Circuit) to signal return.
- B. "In Between" reading could be caused by a shift cable or digital TR sensor misaligned or a digital TR sensor circuit failure of TR1, TR2, TR3A, or TR4.
- C. TR_D: 1= Open Digital TR switch, 0= Closed Digital TR switch.
- D. EEC-V Control System Breakout Box Readings: Taken from PCM signal pins for TR1, TR2, TR3A, TR4 to signal return.

- **Voltages for TR1, TR2, TR4:**

- 0 = 0.0 volts.

- 1 = 9.0 - 14.0 volts.

- **Voltage for TR3A:**

- 0 = 0.0 volts.

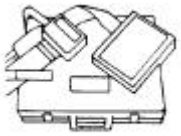






- 1 = 1.3 - 1.8 volts.

Wiggle Test Information For Open/Shorts

- TR4, TR3A, TR2, and TR1 are all closed in PARK. PARK is a good position to check for intermittent open circuits (with scan tool monitoring TR_D).
 - TR4, TR3A, TR2, and TR1 are all open in OVERDRIVE, so OVERDRIVE is a good position to check for shorts to ground. To determine the shorted components while observing TR_D, unplug the TR and see if the short goes away. If the short is still present, unplug the transmission harness and see if the short goes away. If the short is still present, then the short is in the PCM or vehicle harness. Remove the suspect circuit(s) wire from the PCM vehicle harness. If the short is still present, then the PCM has an internal failure. Otherwise the failure is in the vehicle harness.
-

Pinpoint Tests — OSC Equipped Vehicles

Special Tool(s)

 <p>ST1391-A</p>	<p>Breakout Box, EEC-V Control System 418-049 (T94L-50-EEC-V) or equivalent</p>
 <p>ST1632-A</p>	<p>MLP-TR Cable 418-F107 (007-00111) or equivalent</p>
 <p>ST2332-A</p>	<p>Worldwide Diagnostic System (WDS) 418-F224</p> <p>New Generation STAR (NGS) Tester 418-F052 or equivalent scan tool</p>
 <p>ST1389-A</p>	<p>Transmission Tester 307-F016 (007-00130) or equivalent</p>
	<p>Trans Tester TR/MLP Overlay and Manual 007-00131 or equivalent</p>
 <p>ST1137-A</p>	<p>73 III Automotive Meter 105-R0057 or equivalent</p>
 <p>ST2545-A</p>	<p>Gauge, Transmission Solenoid Connectors 307-426</p>

Any time an electrical connector or solenoid body is disconnected, inspect the connector for pin condition, corrosion and contamination. Also inspect the connector seal for damage. Clean, repair or install a new connector as required.

Shift Solenoids Pre-Diagnosis

Use the following shift solenoid operation information when carrying out Pinpoint Test A.

Solenoid Operation Chart

Gear Lever Position	PCM Commanded Gear	Solenoids		
		SSA	SSB	TCC
P/R/N	1	ON	OFF	HD
(D)	1	ON	OFF	HD
(D)	2	OFF	OFF	EC
(D)	3	OFF	ON	EC
(D)	4	ON	ON	EC
(D)				
w/OD OFF				
1	1	ON	OFF	HD
2	2	OFF	OFF	EC
3	3	OFF	ON	EC
Manual 2	2	OFF	OFF	EC
Manual 1	1	ON	OFF	HD
1 ^a	2	OFF	OFF	EC

^a When a manual pull-in occurs above a calibrated speed the transmission will downshift from the higher gear until the vehicle speed drops below this calibrated speed.

EC = Electronically controlled.

HD = Hydraulically disabled.

Shift Solenoid Failure Mode Chart "Always Off"

Failed off due to powertrain control module and or vehicle wiring concerns, shift solenoid electrically or hydraulically stuck off.

SSA ALWAYS OFF:	Gear Lever Position		
	(D)	2	1
PCM Gear Commanded	Actual Gear Obtained		
1	2	2	2
2	2	2	2
3	3	2 ^a	2 ^a
4	3	2 ^a	2 ^a

^a No engine braking.

	Gear Lever Position		
	(D)	2	1
SSB ALWAYS OFF:	(D)	2	1
PCM Gear Commanded	Actual Gear Obtained		
1	1	1	1
2	2	2	2
3	2	2	2
4	1	1	1

Shift Solenoid Failure Mode Chart "Always On"

Failed on due to powertrain control module and or vehicle wiring concerns, shift solenoid electrically or hydraulically stuck on.

	Gear Lever Position		
	(D)	2	1
SSA ALWAYS ON:	(D)	2	1
PCM Gear Commanded	Actual Gear Obtained		
1	1	1	1
2	1	1	1
3	4	2 ^a	2 ^a
4	4	2 ^a	2 ^a

^a No engine braking.

	Gear Lever Position		
	(D)	2	1
SSB ALWAYS ON:	(D)	2	1
PCM Gear Commanded	Actual Gear Obtained		
1	4	2 ^a	2 ^a
2	3	2 ^a	2 ^a
3	3	2 ^a	2 ^a
4	4	2 ^a	2 ^a

^a No engine braking.

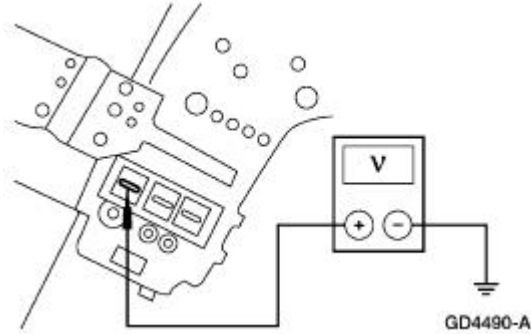
PINPOINT TEST A: SHIFT AND TORQUE CONVERTER CLUTCH SOLENOIDS

Test Step	Result / Action to Take
NOTE: Read and record all DTCs. All digital TR Sensor and VSS DTCs must be repaired before entering Output State Control (OSC).	
NOTE: Refer to the Transmission Internal Harness illustration preceding these pinpoint tests.	

NOTE: Refer to the Transmission Vehicle Harness Connector illustration preceding these pinpoint tests.

<p>A1 ELECTRONIC DIAGNOSTICS</p> <ul style="list-style-type: none"> ● Select PARK. ● Key in OFF position. ● Check to make sure the transmission harness connector is fully seated, pins are fully engaged in connector and in good condition before proceeding. ● Connect the diagnostic tool. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Diagnostic Data Link. ● Enter the following diagnostic mode on the diagnostic tool: PCM. ● Enter the following diagnostic mode on the diagnostic tool: Active Command Modes. ● Enter the following diagnostic mode on the diagnostic tool: Output State Control (OSC). ● Enter the following diagnostic mode on the diagnostic tool: Trans-Bench Mode. ● Does vehicle enter Trans-Bench Mode? 	<p>Yes GO to A2.</p> <p>No REPEAT procedure to enter Trans-Bench Mode. If vehicle did not enter Trans-Bench Mode, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM.</p>								
<p>A2 WIGGLE TEST</p> <ul style="list-style-type: none"> ● Select PIDs to be monitored. <table border="1"> <thead> <tr> <th>PID Command</th> <th>PID Actual</th> </tr> </thead> <tbody> <tr> <td>SSA</td> <td>SS1F</td> </tr> <tr> <td>SSB</td> <td>SS2F</td> </tr> <tr> <td>TCC</td> <td>TCCF</td> </tr> </tbody> </table> <ul style="list-style-type: none"> ● Select "ON" to turn suspect solenoid on. ● Press "SEND". ● Wiggle all wiring and connectors to the transmission. Monitor the Solenoid State for changes. ● Select "OFF" to turn solenoid off. ● Press "SEND". ● Does the suspect solenoid(s) fault state change? 	PID Command	PID Actual	SSA	SS1F	SSB	SS2F	TCC	TCCF	<p>Yes REPAIR open or short in the vehicle harness or connector.</p> <p>No GO to A3.</p>
PID Command	PID Actual								
SSA	SS1F								
SSB	SS2F								
TCC	TCCF								
<p>A3 SOLENOID FUNCTIONAL CHECK</p> <ul style="list-style-type: none"> ● Monitor each solenoid state. ● Turn each solenoid ON and OFF. ● Does the solenoid turn ON and OFF when commanded and can solenoid activation be heard? 	<p>Yes GO to A4.</p> <p>No GO to A5.</p>								
<p>A4 OSC TRANS-DRIVE MODE (GR_CM OR TCC)</p> <ul style="list-style-type: none"> ● Carry out OSC Trans-Drive Mode. ● Select GR_CM for Shift Solenoids or follow procedures for GR_CM as listed. ● Select TCC for Torque Converter Clutch Solenoid. Follow procedures of TCC in Drive Mode as listed. ● Does the transmission upshift and downshift or torque converter engage/disengage when commanded? 	<p>Yes CLEAR all DTCs. ROAD TEST to verify if concern is still present. If concern is still present, REFER to Diagnosis By Symptom in this section to diagnose shift or torque converter concern.</p> <p>No GO to A5.</p>								
<p>A5 CHECK FOR BATTERY VOLTAGE</p> <ul style="list-style-type: none"> ● Remove transmission fluid pan. 	<p>Yes</p>								

- Visually inspect the lead frame and connectors for damage.
- Key in ON position.
- Measure the voltage with the positive lead to VPWR solenoid pin and negative lead to a good ground.



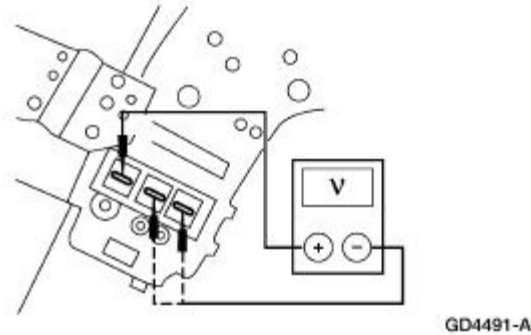
- Is the voltage greater than 10 volts?

GO to [A6](#).

No
CHECK for open or short circuit in harness, or solenoid.

A6 ELECTRICAL SIGNAL CHECK

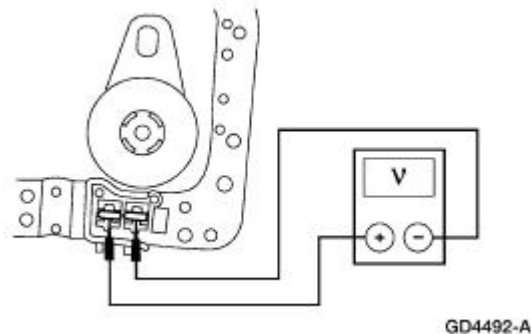
- Measure the voltage with the positive lead connected to VPWR solenoid pin and the negative lead to the signal pin of the appropriate solenoid.



Yes
GO to [A7](#).

No
CHECK for open or short circuit in harness, solenoid or a PCM concern.

- Enter the following diagnostic mode on the diagnostic tool: Trans-Bench Mode.
- Select Parameter SSA, SSB or TCC.
- Select "ON".
- Press "SEND".
- Turn the solenoids ON and OFF, while monitoring the voltage, solenoid state on the scan tool (ON and OFF), and listen for the solenoid to activate (click).
- Measure the voltage with the positive lead to VPWR pin and the negative lead to the TCC pin.

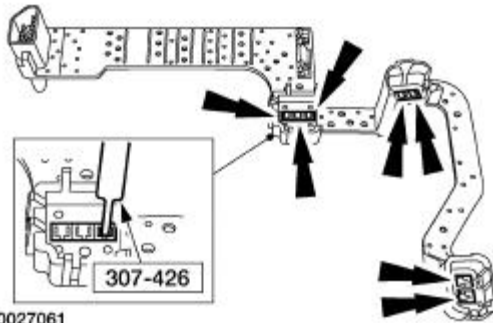


- Enter the following diagnostic mode on the diagnostic tool: Select Parameter TCC.
- Select "ON".
- Press "SEND".
- Turn the solenoid ON and OFF, while monitoring the voltage, solenoid state on the scan tool (ON and OFF),

- and listen for the solenoid to activate (click).
- Select "OFF", press "SEND".
- **Does the voltage and solenoid state change?**

A7 CHECK LEAD FRAME CONNECTIONS

- Key in OFF position.
- Disconnect: Lead Frame.
- Inspect for damaged or pushed out pins, corrosion, ect.
- Using the special tool, check each of the lead frame connector pins.



A0027061

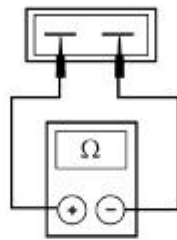
- **Does the special tool go through the lead frame connector pins?**

Yes
INSTALL a new lead frame. GO to [A8](#).

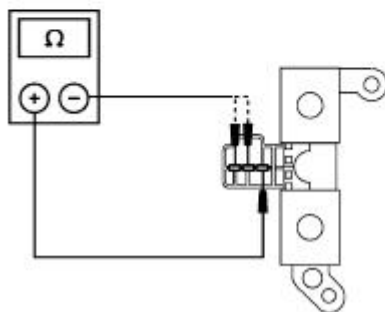
No
GO to [A8](#).

A8 CHECK SOLENOID RESISTANCE AT SOLENOID

- Key in OFF position.
- Disconnect the appropriate solenoid from the lead frame.
- Measure the solenoid resistance between the pins of the solenoid.



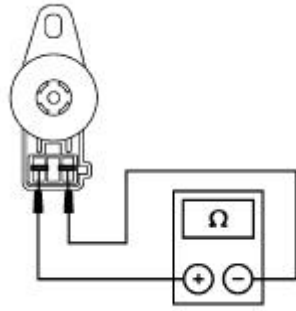
GD3386-A



AD1391-A

Yes
GO to [A9](#).

No
INSTALL a new solenoid.



AD1392-A

- Measure the resistance for each solenoid (SSA, SSB or TCC) as follows:

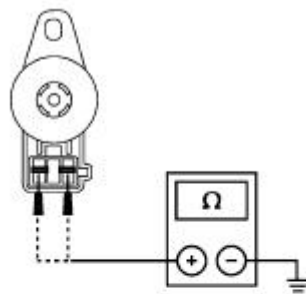
Solenoid	Resistance (ohms)
SSA	20-30
SSB	20-30
TCC	10-16

- Are the resistances correct?

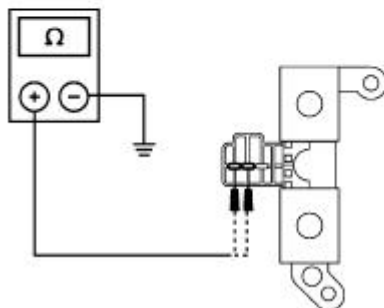
A9 CHECK SOLENOID FOR SHORT TO GROUND

- Check for continuity between engine ground and appropriate solenoid pin with ohmmeter or other low current tester. Connection should show infinite resistance (no continuity).

Solenoid	Terminal
SSA	+/-
SSB	+/-
TCC	+/-



AD1393-A



AD1394-A

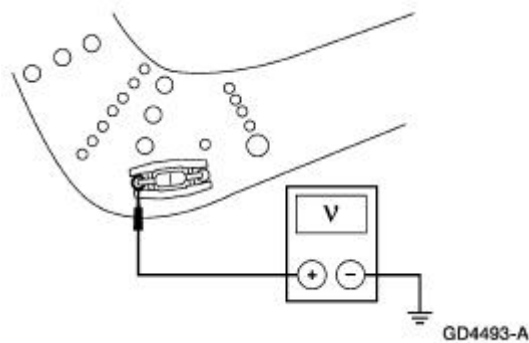
- Is there continuity?

Yes
INSTALL a new solenoid.

No
REFER to [Diagnosis By Symptom](#) in this section for diagnosis of shift or torque converter concerns.

PINPOINT TEST B: TRANSMISSION FLUID TEMPERATURE (TFT) SENSOR

Test Step	Result / Action to Take
NOTE: Refer to the Transmission Connector Layouts preceding these pinpoint tests.	
<p>B1 ELECTRONIC DIAGNOSTICS</p> <ul style="list-style-type: none"> ● Check to make sure the transmission harness connector is fully seated, pins are fully engaged in connector and in good condition before proceeding. ● Connect the diagnostic tool. ● Key in ON position. ● Select Diagnostic Data Link. ● Select PCM. ● Select PID/Data Monitor and Record. ● Enter the following diagnostic mode on the diagnostic tool: PIDs; TFT, TFTV. ● Does the vehicle enter PID/Data Monitor and Record? 	<p>Yes GO to B2.</p> <p>No REPEAT procedure to enter PID. If vehicle did not enter PID, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM.</p>
<p>B2 WARM-UP/COOL-DOWN CYCLE</p> <ul style="list-style-type: none"> ● While monitoring the TFT PIDs, carry out the following test: If transmission is cold, run transmission to warm it up. If transmission is warm, allow transmission to cool down. ● Do the TFT PIDs increase as the transmission is warmed up or decrease as the transmission is cooled or does the TFT or TFTV drop in and out of range? 	<p>Yes If the TFT PIDs increase as the transmission is warmed or decrease as the transmission is cooled, CLEAR all DTCs. ROAD TEST to verify if concern is still present. If concern is still present, REFER to Diagnosis By Symptom in this section to diagnose transmission overheating.</p> <p>If the TFT or TFTV drop in and out of range, INSPECT for intermittent concern in the internal/external harness, sensor or connector.</p> <p>No GO to B3.</p>
<p>B3 ELECTRICAL SIGNAL CHECK</p> <ul style="list-style-type: none"> ● Key in ON position. ● Remove transmission fluid pan. ● Visually inspect the lead frame and connectors for damage. ● Measure the voltage with the positive lead to positive TFT at sensor pin and negative lead to a good ground. 	<p>Yes GO to B4.</p> <p>No CHECK for open or short circuit in vehicle harness, internal harness or a PCM concern.</p>



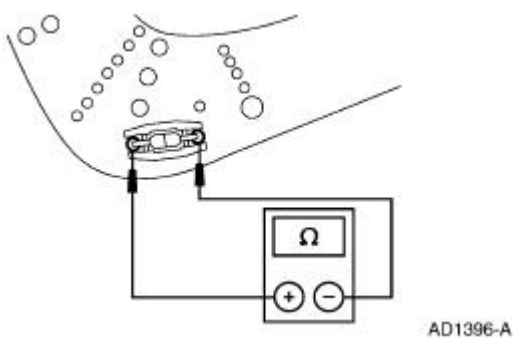
- Is the voltage present?

B4 CHECK RESISTANCE OF TFT SENSOR

- Disconnect: Transmission Harness .
- Measure the resistance between the positive TFT and negative TFT pins at transmission connector, using the following:

Transmission Fluid Temperature

°C	°F	Resistance (Ohms)
-40 to -20	-40 to -4	967K - 284K
-19 to -1	-3 - 31	284K - 100K
0 - 20	32 - 68	100K - 37K
21 - 40	69 - 104	37K - 16K
41 - 70	105 - 158	16K - 5K
71 - 90	159 - 194	5K - 2.7K
91 - 110	195 - 230	2.7K - 1.5K
111 - 130	231 - 266	1.5K - 0.8K
131 - 150	267 - 302	0.8K - 0.54K



- Is the resistance correct?

Yes


REFER to [Diagnosis By Symptom](#) in this section to diagnose an overheating concern.

No

INSTALL a new internal harness (sensor is part of harness).


PINPOINT TEST C: DIGITAL TRANSMISSION RANGE (TR) SENSOR

Test Step	Result / Action to Take
NOTE: Refer to the Digital Transmission Range (TR) Sensor Connector illustration preceding these pinpoint tests.	
NOTE: Refer to the Digital Transmission Range (TR) Sensor Diagnosis Chart preceding these pinpoint tests.	

C1 VERIFY DIAGNOSTIC TROUBLE CODES	
<ul style="list-style-type: none"> ● Select PARK. ● Key in OFF position. ● NOTE: DTC codes P0705 and P0708 cannot be set by an incorrectly adjusted digital TR sensor. ● Carry out on board diagnostic test. ● Are only DTC codes P0705, P0708 present? 	<p>Yes GO to C4.</p> <p>No GO to C2.</p>
C2 VERIFY DIGITAL TRANSMISSION RANGE SENSOR ALIGNMENT	
<ul style="list-style-type: none"> ● Check to make sure the digital TR sensor harness connector is fully seated, pins are fully engaged in connector and in good condition before proceeding. ● Apply the parking brake. ● Select NEUTRAL. ● Disconnect the shift cable/linkage from the manual lever. ● Verify that the digital TR Sensor Alignment Tool fits in the appropriate slots. ● Is the digital TR sensor adjustment OK? 	<p>Yes GO to C3.</p> <p>No ADJUST the digital TR sensor. PLACE transmission range selector lever in P and CLEAR DTCs. REPEAT OBD Tests.GO to C3.</p>
C3 VERIFY SHIFT CABLE/LINKAGE ADJUSTMENT	
<ul style="list-style-type: none"> ● Place the manual lever in the overdrive position. ● Select DRIVE. ● Reconnect the shift cable/linkage. ● Verify that the shift cable/linkage is adjusted OK. Refer to Section 307-05. ● Is the shift cable/linkage adjusted OK? 	<p>Yes GO to C4.</p> <p>No ADJUST the shift cable/linkage. REFER to Section 307-05.</p>
C4 CHECK ELECTRICAL SIGNAL OPERATION	
<ul style="list-style-type: none"> ● Select PARK. ● Disconnect: Digital TR Sensor. ●  CAUTION: Do not pry on connector. This will damage the connector and result in a transmission concern. ● Press the button and pull out on the digital TR harness connector. ● Inspect both ends of the connector for damage or pushed-out pins, corrosion, loose wires and missing or damaged seals. ● Are the connector, pins and harness damaged? 	<p>Yes REPAIR as required. CLEAR DTCs and REPEAT OBD Tests.</p> <p>No If diagnosing a DTC, GO to C5.</p> <p>If diagnosing a starting concern or a reversing lamp concern, GO to C10.</p>
C5 CHECK ELECTRICAL SYSTEM OPERATION (DIGITAL TR AND PCM)	
<ul style="list-style-type: none"> ● Key in OFF position. ● Connect the diagnostic tool. ● Connect: Digital TR Sensor. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: TR PIDS TR, TR_D, TR_V. ● Move transmission range selector lever into each gear and stop. ● Observe any of the following PIDs, TR and TR_D, TR_V (vehicle dependent) while wiggling harness, tapping on sensor, or driving the vehicle. Use PIDs TR, and TR_D for DTCs P0705, P1704, and P1705. Use PIDs TR, and TR_V for DTC P0708. ● Compare the PIDs to the Digital Transmission Range (TR) Sensor Diagnosis Chart. ● Do the PIDs TR, TR_D and TR_V match the Digital Transmission Range (TR) Sensor Diagnosis chart, and does the TR_D PID remain steady when the 	<p>Yes The problem is not in the digital TR sensor system. REFER to Diagnosis By Symptom in this section for further diagnosis.</p> <p>No If TR_D changes when wiggling harness, tapping on the sensor, or driving the vehicle, the problem may be intermittent.</p> <p>GO to C6.</p>

harness is wiggled, the sensor is tapped, or the vehicle driven?

C6 CHECK DIGITAL TRANSMISSION RANGE SENSOR OPERATION

- Disconnect: Digital TR Sensor .
-  **CAUTION: Do not pry on connector. This will damage the connector and result in a transmission concern.**
- Connect: TR-E Cable to Transmission Tester.
- Connect: TR-E Cable to Digital TR Sensor.
- Place the Digital TR Overlay onto Transmission Tester.
- Carry out Sensor Test as instructed on the Digital TR Overlay.
- **Does the status lamp on the tester TRS-E cable match the selected gear positions?**


Yes

Concern is not in the digital TR sensor, GO to [C7](#).

No

INSTALL a new digital TR sensor. CLEAR DTCs and REPEAT OBD Tests.

C7 CHECK PCM HARNESS CIRCUITS FOR OPENS

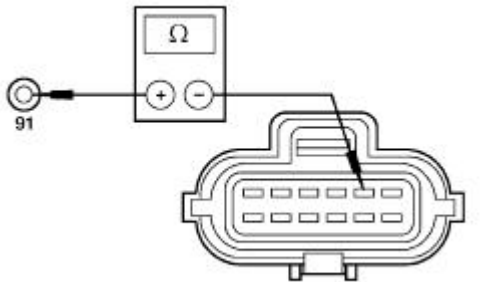
- Key in OFF position.
- Disconnect: Powertrain Control Module (PCM) .
- Inspect for damaged or pushed-out pins, corrosion or loose wires.
- Disconnect: Digital TR Sensor.
-  **CAUTION: Do not pry the connector. This will damage the connector and result in a transmission concern.**
- Disconnect the digital TR sensor connector.
- Install the EEC-V Control System Breakout Box.
- Measure the resistance between the PCM test pin 91 at the EEC-V Control System Breakout Box and signal return circuit pin 2 at digital TR sensor connector harness side.

Yes

GO to [C8](#).

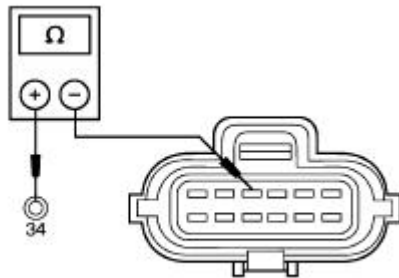
No

REPAIR open circuit(s). RECONNECT all components. CLEAR DTCs. REPEAT OBD Tests.



GD2142-A

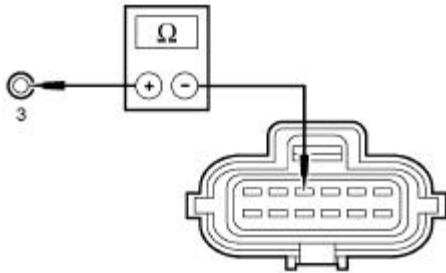
- For vehicles equipped with a 4.6L engine measure the resistance between the PCM test pin 34 at the EEC-V Control System Breakout Box and TR1 circuit pin 4 at digital TR sensor connector harness side.



AD1665-A

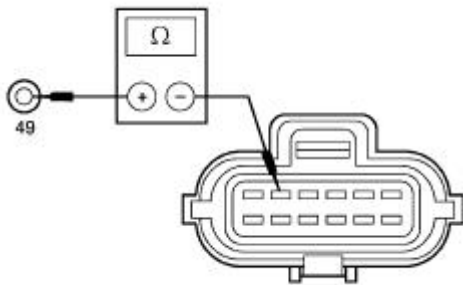
- For vehicles equipped with a 3.8L engine measure the resistance between the PCM test pin 3 at the EEC-V

Control System Breakout Box and TR1 circuit pin 4 at digital TR sensor connector harness side.



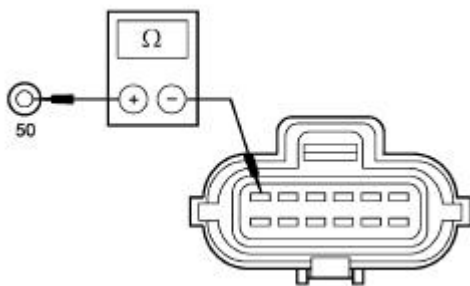
A0008651

- Measure the resistance between the PCM test pin 49 at the EEC-V Control System Breakout Box and TR2 circuit pin 5 at digital TR sensor connector harness side.



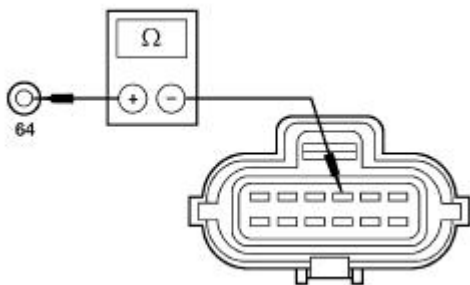
GD2144-A

- Measure the resistance between the PCM test pin 50 at the EEC-V Control System Breakout Box and TR4 circuit pin 6 at digital TR sensor connector harness side.



GD2145-A

- Measure the resistance between the PCM test pin 64 at the EEC-V Control System Breakout Box and TR3A circuit pin 3 at digital TR sensor connector harness side.



GD2146-A

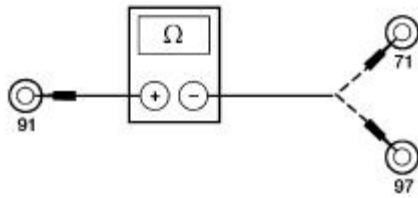
- Are all resistances less than 5 ohms?

C8 CHECK PCM HARNESS CIRCUITS FOR SHORT TO GROUND OR POWER

- Measure the resistance between PCM test pin 91 and

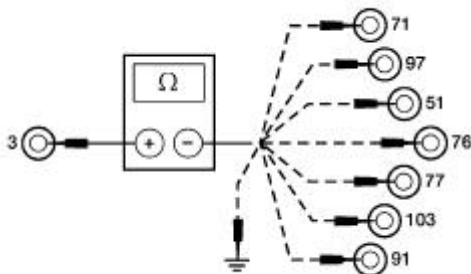
Yes

test pins 71 and 97 at the EEC-V Control System Breakout Box.



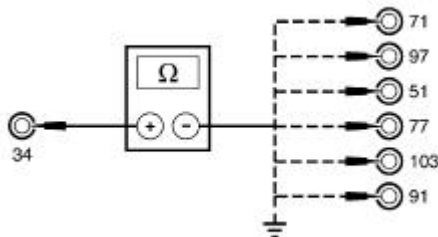
GD2254-A

- For vehicles equipped with a 3.8L engine measure the resistance between PCM test pin 3 and test pins 71, 97, 51, 76, 77, 103, and 91 at the EEC-V Control System Breakout Box and chassis ground.



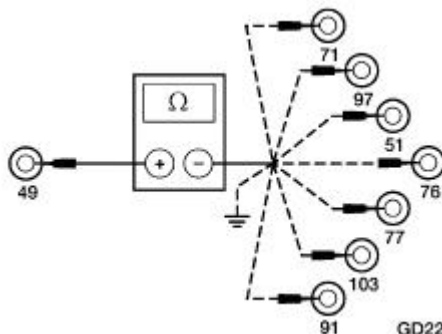
GD4496-A

- For vehicles equipped with a 4.6L engine measure the resistance between PCM test pin 34 and test pins 71, 97, 51, 77, 103, and 91 at the EEC-V Control System Breakout Box and chassis ground.



A0008652

- For vehicles equipped with a 3.8L engine measure the resistance between PCM test pin 49 and test pins 71, 97, 51, 76, 77, 103, and 91 at the EEC-V Control System Breakout Box and chassis ground.



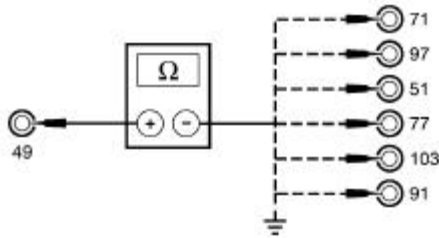
GD2256-A

- For vehicles equipped with a 4.6L engine measure the resistance between PCM test pin 49 and test pins 71,

GO to [C9](#).

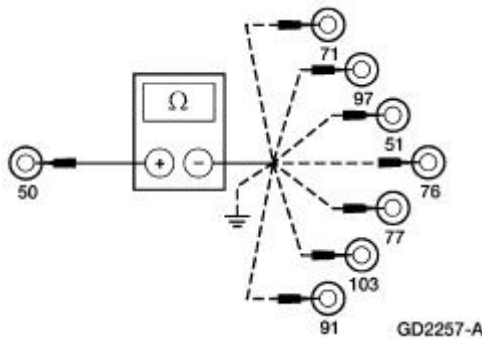
No
REPAIR short circuit(s).
RECONNECT all components.
CLEAR DTCs. REPEAT OBD
Tests.

97, 51, 77, 103, and 91 at the EEC-V Control System Breakout Box and chassis ground.



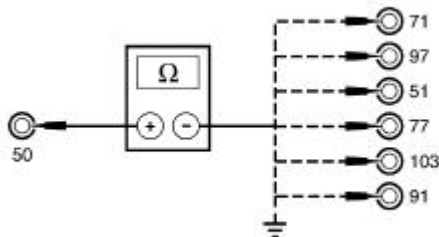
A0008653

- For vehicles equipped with a 3.8L engine measure the resistance between PCM test pin 50 and test pins 71, 97, 51, 76, 77, 103, and 91 at the EEC-V Control System Breakout Box and chassis ground.



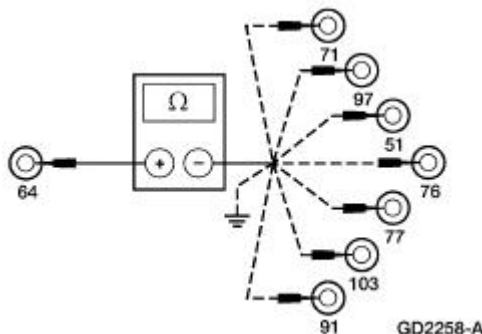
GD2257-A

- For vehicles equipped with a 4.6L engine measure the resistance between PCM test pin 50 and test pins 71, 97, 51, 77, 103, and 91 at the EEC-V Control System Breakout Box and chassis ground.



A0008654

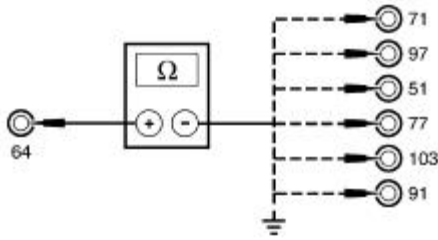
- For vehicles equipped with a 3.8L engine measure the resistance between PCM test pin 64 and test pins 71, 97, 51, 76, 77, 103, and 91 at the EEC-V Control System Breakout Box and ground.



GD2258-A

- For vehicles equipped with a 4.6L engine measure the resistance between PCM test pin 64 and test pins 71,

97, 51, 77, 103, and 91 at the EEC-V Control System Breakout Box and chassis ground.

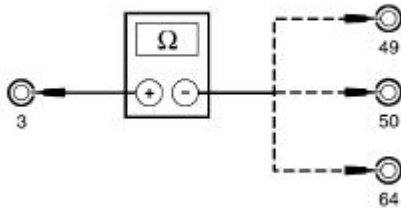


A0008655

- Are all resistances greater than 10,000 ohms?

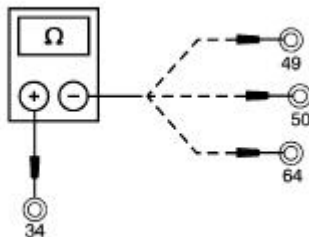
C9 CHECK FOR SHORT BETWEEN TR/PCM INPUT SIGNAL CIRCUITS

- For vehicles equipped with a 3.8L engine measure the resistance between test pin 3 and pins 49, 50, and 64 at the EEC-V Control System Breakout Box.



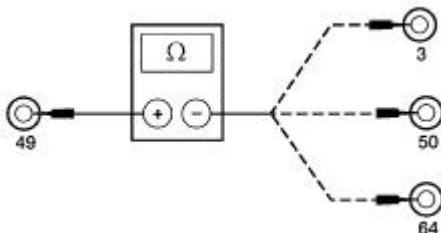
A0008656

- For vehicles equipped with a 4.6L engine measure the resistance between test pin 34 and pins 49, 50, and 64 at the EEC-V Control System Breakout Box.



AD1666-A

- For vehicles equipped with a 3.8L engine measure the resistance between test pin 49 and pins 3, 50, and 64 at the EEC-V Control System Breakout Box.



GD2260-A

- For vehicles equipped with a 4.6L engine measure the

Yes

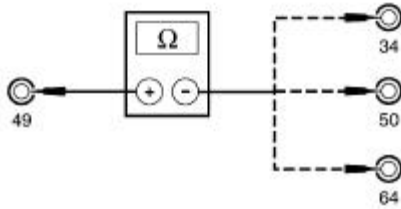
INSTALL a new PCM. REFER to [Section 303-14](#).

RECONNECT all components. CLEAR DTCs. REPEAT OBD Tests.

No

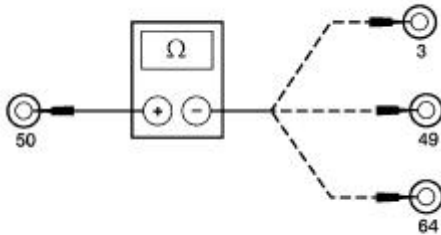
REPAIR shorts on circuits having less than 10,000 ohms between other TR/PCM input signal circuits. RECONNECT all components. CLEAR DTCs. REPEAT OBD Tests.

resistance between test pin 49 and pins 34, 50, and 64 at the EEC-V Control System Breakout Box.



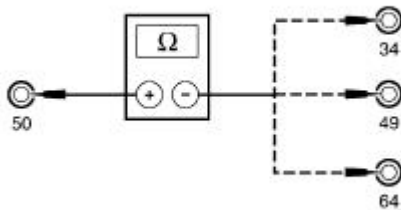
A0008659

- For vehicles equipped with a 3.8L engine measure the resistance between test pin 50 and pins 3, 49, and 64 at the EEC-V Control System Breakout Box.



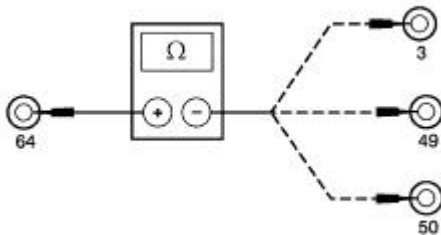
GD2261-A

- For vehicles equipped with a 4.6L engine measure the resistance between test pin 50 and pins 34, 49, and 64 at the EEC-V Control System Breakout Box.



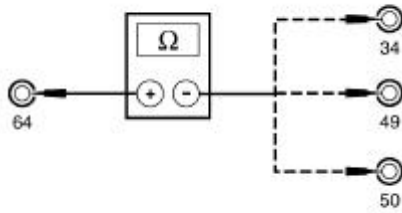
A0008657

- For vehicles equipped with a 3.8L engine measure the resistance between test pin 64 and pins 3, 49, and 50 at the EEC-V Control System Breakout Box.



GD2262-A

- For vehicles equipped with a 4.6L engine measure the resistance between test pin 64 and pins 34, 49, and 50 at the EEC-V Control System Breakout Box.



A0008658

- Are all the resistances greater than 10,000 ohms?

C10 CHECK THE NON-PCM INTERNAL CIRCUITS OF SENSOR

- Connect: TRS-E Cable to Transmission.
- Connect: TRS-E Cable to Digital TR Sensor.
- Place the Digital TR Overlay onto Transmission Tester.
- Carry out Switch Test as instructed on the Digital TR Overlay.
- **Does the status lamp on the tester indicate RED for the correct gear position?**

Yes

Concern is not in the digital TR sensor. For starting system concerns, REFER to [Section 303-06](#). For reversing lamp concerns, REFER to [Section 417-01](#). For optional circuits, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis.

No

INSTALL a new digital TR sensor. CLEAR DTCs. REPEAT OBD Tests.

PINPOINT TEST D: ELECTRICAL PRESSURE CONTROL (EPC) SOLENOID

Test Step	Result / Action to Take
NOTE: Refer to the Transmission Internal Harness illustration preceding these pinpoint tests.	
NOTE: Read and record all DTCs. All digital TR Sensor and VSS DTCs must be repaired before entering Output State Control (OSC).	
D1 ELECTRONIC DIAGNOSTICS	
<ul style="list-style-type: none"> ● Key in OFF position. ● Select PARK. ● Check to make sure the transmission harness connector is fully seated, pins are fully engaged in the connector and in good condition before proceeding. ● Connect the diagnostic tool. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Diagnostic Data Link. ● Enter the following diagnostic mode on the diagnostic tool: PCM. ● Enter the following diagnostic mode on the diagnostic tool: Active Command Modes. ● Enter the following diagnostic mode on the diagnostic tool: Output State Control (OSC). ● Enter the following diagnostic mode on the diagnostic tool: Trans-Bench Mode. ● Does the vehicle enter the Trans-Bench Mode? 	<p>Yes GO to D2.</p> <p>No REPEAT procedure to ENTER Trans-Bench Mode. If vehicle did not enter OSC, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM.</p>

D2 SOLENOID FUNCTIONAL TEST

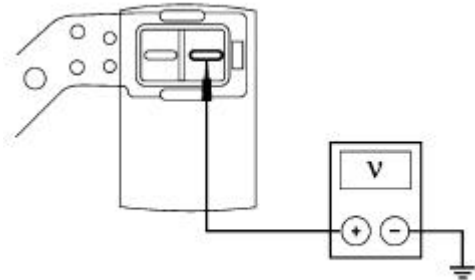
- Install 2,060 kPa (300 psi) pressure gauge into EPC tap.
- Monitor pressure gauge.
- Enter the following diagnostic mode on the diagnostic tool:
Parameter; EPC.
- Select value - 15, 30, 45, 60, 70 or 90 psi.
- Press "SEND".
- Select another value "0-90 psi".
- Press "SEND".
- Enter the following diagnostic mode on the diagnostic tool:
XXX.
- Press "SEND".
- **Does the pressure reading match the commanded pressure?**

Yes
CLEAR DTCs. REPEAT OBD Tests.

No
GO to [D3](#).

D3 CHECK FOR BATTERY VOLTAGE

- Remove transmission fluid pan.
- Visually inspect the lead frame connectors for damage.
- Key in ON position.
- Measure the voltage with positive lead to VPWR solenoid pin and negative lead to a good ground.



GD4494-A

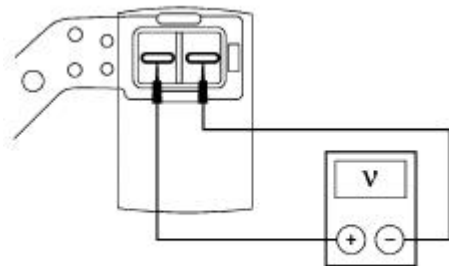
- **Is voltage greater than 10 volts?**

Yes
GO to [D4](#).

No
REPAIR the circuit. CLEAR the DTCs. REPEAT the OBD Tests.

D4 ELECTRICAL SIGNAL CHECK

- Measure the voltage with positive lead connected to VPWR solenoid pin and connect negative lead to the signal pin of the EPC solenoid.



GD4495-A

- Turn the solenoids ON and OFF, while monitoring the voltage reading, solenoid state on the scan tool (ON and OFF), listen for the solenoid to activate (click).
- Enter the following diagnostic mode on the diagnostic tool:
Trans-Bench Mode.
- Enter the following diagnostic mode on the diagnostic tool:
Parameter EPC.
- Select a value "0-90 psi".
- Press "SEND".
- Select another value "0-90 psi".
- Press "SEND".
- Enter the following diagnostic mode on the diagnostic tool:

Yes
GO to [D5](#).

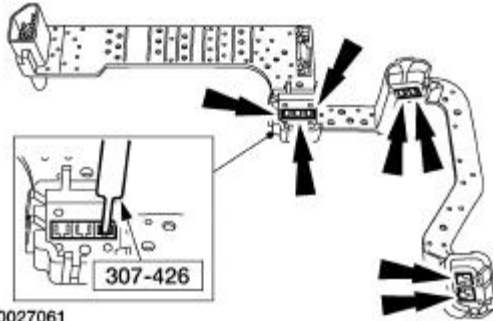
No
CHECK for open or short circuit in harness or PCM.

XXX.

- Press "SEND".
- **Does the voltage and solenoid state change?**

D5 CHECK LEAD FRAME CONNECTIONS

- Key in OFF position.
- Disconnect: Lead Frame.
- Inspect for damaged or pushed out pins, corrosion, etc.
- Using the special tool, check each of the lead frame connector pins.



- **Does the special tool go through the lead frame connector pins?**

Yes

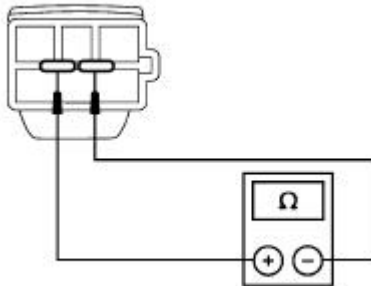
INSTALL a new lead frame.
GO to [D6](#).

No

GO to [D6](#).

D6 CHECK SOLENOID RESISTANCE AT SOLENOID

- Disconnect: Transmission Harness .
- Measure the resistance between the pins of the solenoid.



- Measure the resistance of the EPC solenoid.
- **Is the resistance between 2.48 and 5.66 ohms?**

Yes

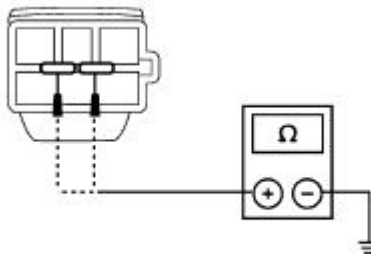
GO to [D7](#).

No

INSTALL a new solenoid.
CLEAR the DTCs. REPEAT
the OBD Tests.

D7 CHECK SOLENOID FOR SHORT TO GROUND

- Check for continuity between engine GROUND and the EPC solenoid terminals with ohmmeter or other low current tester (less than 200 milliamps). Connection should show infinite resistance (no continuity).



- **Is there continuity?**

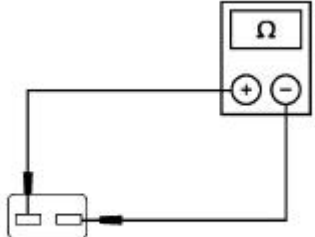
Yes

INSTALL a new solenoid.
CLEAR the DTCs. REPEAT
the OBD Tests.

No

REFER to [Diagnosis By Symptom](#) in this section for diagnosis of pressure concerns.

PINPOINT TEST E: OUTPUT SHAFT SPEED (OSS) SENSORS

Test Step	Result / Action to Take
<p>NOTE: Refer to the Output Shaft Speed (OSS) Sensor Harness Connector illustration preceding these pinpoint tests.</p>	
<p>E1 ELECTRONIC DIAGNOSTICS</p>	
<ul style="list-style-type: none"> ● Check to make sure the transmission harness connector is fully seated, pins are fully engaged in connector and in good condition before proceeding. ● Connect the diagnostic tool. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Diagnostic Data Link. ● Enter the following diagnostic mode on the diagnostic tool: PCM. ● Select PID/Data Monitor and Record. ● Select the PID OSS. ● Does vehicle enter PID/Data Monitor and Record? 	<p>Yes GO to E2.</p> <p>No REPEAT procedure to ENTER PID. If vehicle did not enter PID, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM.</p>
<p>E2 DRIVE CYCLE TEST</p>	
<ul style="list-style-type: none"> ● While monitoring the OSS Speed PID, drive the vehicle so that the transmission upshifts and downshifts through all gears. ● Does the OSS Speed PID increase and decrease with engine and vehicle speed? 	<p>Yes CLEAR all DTCs. ROAD TEST to verify if concern is still present. If concern is still present, REFER to Diagnosis By Symptom in this section.</p> <p>No If the OSS Speed PID does not increase and decrease with engine and vehicle speed, INSPECT for open or short in vehicle harness, sensor, a PCM concern, or internal hardware concern.</p> <p>If the sensor signal is erratic, INSPECT for intermittent concern in the internal/external harness, sensor, or connector.</p> <p>If the sensor signal is steady, GO to E3.</p>
<p>E3 CHECK RESISTANCE OF OSS SENSOR</p>	
<ul style="list-style-type: none"> ● Disconnect the vehicle harness connector from the OSS sensor. ● Measure the resistance between the OSS sensor pins. <div style="text-align: center;">  <p>The diagram illustrates a multimeter with a resistance symbol (Ω) on its display. Two leads are connected to the multimeter: one to the positive (+) terminal and one to the negative (-) terminal. These leads are then connected to the two pins of a two-pin connector, representing the OSS sensor pins.</p> </div> <p style="text-align: center;">AD1084-B</p>	<p>Yes REFER to Diagnosis By Symptom for concern diagnosis.</p> <p>No INSTALL a new OSS sensor.</p>

- Record the resistance.

Sensor	Resistance (ohms)	Temperature
OSS	791 to 1,795	-40°C to 160°C (-40°F to 320°F)

- Is the resistance within specification?

PINPOINT TEST F: SOLENOID MECHANICAL FAILURE

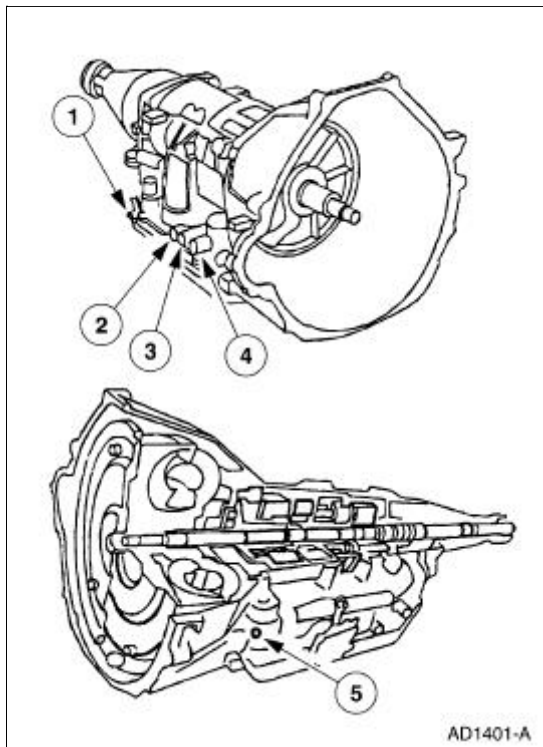
Test Step	Result / Action to Take
NOTE: Repair all other DTCs before repairing the following DTCs: P1714, P1715, P1740.	
F1 ELECTRONIC DIAGNOSIS	
<ul style="list-style-type: none"> ● Connect the diagnostic tool. ● Carry out KOEO test. ● Are only DTCs P1714, P1715, P1740 present? 	<p>Yes REPAIR the other DTCs first. CLEAR DTCs and CARRY OUT Transmission Drive Cycle Test. REPEAT Quick Test.</p> <p>No INSTALL a new solenoid and or body. REFER to the Diagnostic Trouble Code Charts in this section for code description. GO to F2.</p>
F2 TRANSMISSION DRIVE CYCLE TEST	
<ul style="list-style-type: none"> ● Carry out transmission drive cycle test. ● Carry out On-Board Diagnostic Test. ● Does the vehicle upshift and downshift OK? 	<p>Yes GO to F3.</p> <p>No REFER to Diagnosis By Symptom in this section to diagnose shift concerns.</p>
F3 RETRIEVE DTCS	
<ul style="list-style-type: none"> ● Connect the diagnostic tool. ● Carry out KOEO test until continuous DTCs have been displayed. ● Are DTCs P1714, P1715, P1740 still present? 	<p>Yes INSTALL a new PCM. REFER to Section 303-14 . ROAD TEST and REPEAT Quick Test.</p> <p>No Testing completed. If a concern still exists, REFER to Diagnosis By Symptom in this section for concern diagnosis.</p>

Special Testing Procedures

The special tests are designed to aid the technician in diagnosing the hydraulic and mechanical portion of the transmission.

Engine Idle Speed Check

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the engine idle speed.



Item	Part Number	Description
1	—	Direct clutch pressure tap
2	—	Forward clutch pressure tap
3	—	Electronic pressure control (EPC) pressure tap
4	—	Intermediate clutch pressure tap
5	—	Line pressure tap

Line Pressure Test

⚠ CAUTION: Carry out the line pressure test prior to carrying out the stall speed test. If the line pressure is low at stall, do not carry out stall speed test or further transmission damage will occur. Do not maintain WOT in any transmission range for more than five seconds.

This test verifies that the line pressure is within specification.

1. Connect pressure gauge to line pressure tap.

2. Start engine and check line pressures. Refer to the Line Pressure Chart to determine if line pressure is within specification.

Line Pressure Chart

Application	Range	Idle		WOT Stall	
		EPC	Line Pressure	EPC	Line Pressure
4.6L	P, N, OD, 2, 1	207-276 kPa (30-40 psi)	552-689 kPa (80- 100 psi)	689-758 kPa (100-110 psi)	1310-1448 kPa (190-210 psi)
4.6L	R	13-82 kPa (2- 12 psi)	441-683 kPa (64- 99 psi)	572-655 kPa (83-95 psi)	1427-1855 kPa (207-269 psi)
3.8L	P, N, OD, 2, 1	138-207 kPa (20-30 psi)	448-586 kPa (65- 85 psi)	689-758 kPa (100-110 psi)	1310-1448 kPa (190-210 psi)
3.8L	R	103-172 kPa (15-25 psi)	448-620 kPa (65- 90 psi)	572-662 kPa (83-96 psi)	1427-1862 kPa (207-270 psi)

Clutch Pressure Chart 3.8L

Transmission Pressures with TP at 1.5 Volts and Vehicle Speed Above 8 Km/h (5 MPH)					
Gear	EPC Tap ^a	Line Pressure Tap	Forward Clutch Tap	Intermediate Clutch Tap	Direct Clutch Tap
M1	172-241 kPa (25-35 psi)	517-655 kPa (75- 95 psi)	448-586 kPa (65- 85 psi)	0-34 kPa (0-5 psi)	0-34 kPa (0-5 psi)
M2	103-241 kPa (15-25 psi)	413-551 kPa (60- 80 psi)	344-482 kPa (50- 70 psi)	393-517 kPa (55-75 psi)	0-34 kPa (0-5 psi)
1	172-241 kPa (25-35 psi)	517-655 kPa (75- 95 psi)	448-586 kPa (65- 85 psi)	0-34 kPa (0-5 psi)	0-34 kPa (0-5 psi)
2	103-241 kPa (15-25 psi)	413-551 kPa (60- 80 psi)	358-468 kPa (52- 68 psi)	379-517 kPa (55-75 psi)	0-34 kPa (0-5 psi)
3	137-206 kPa (20-30 psi)	413-517 kPa (60- 75 psi)	413-517 kPa (60- 75 psi)	413-551 kPa (60-80 psi)	379-517 kPa (55-75 psi)
4	172-241 kPa (25-35 psi)	517-655 kPa (75- 95 psi)	0-34 kPa (0-5 psi)	482-620 kPa (70-90 psi)	448-586 kPa (65-85 psi)

^a EPC readings will vary due to EEC strategy. These values are approximate pressures. Actual clutch apply pressures should be within 69-103 kPa (10-15 psi) of line pressure. For additional information on testing, refer to the Clutch Pressure Test in this section.

Clutch Pressure Chart 4.6L

Transmission Pressures with TP at 1.5 Volts and Vehicle Speed Above 8 Km/h (5 MPH)					
Gear	EPC Tap ^a	Line Pressure Tap	Forward Clutch Tap	Intermediate Clutch Tap	Direct Clutch Tap
M1	172-241 kPa (25-35 psi)	517-655 kPa (75- 95 psi)	448-586 kPa (65- 85 psi)	0-34 kPa (0-5 psi)	0-34 kPa (0-5 psi)
M2	103-241 kPa (15-25 psi)	413-551 kPa (60- 80 psi)	344-482 kPa (50- 70 psi)	393-517 kPa (55-75 psi)	0-34 kPa (0-5 psi)
1	172-241 kPa	517-655 kPa (75-	448-586 kPa (65-	0-34 kPa (0-5 psi)	0-34 kPa (0-5

	(25-35 psi)	95 psi)	85 psi)		psi)
2	103-241 kPa (15-25 psi)	413-544 kPa (60- 79 psi)	344-482 kPa (50- 70 psi)	379-517 kPa (55-75 psi)	0-34 kPa (0-5 psi)
3	172-241 kPa (25-35 psi)	517-655 kPa (75- 95 psi)	372-579 kPa (54- 84 psi)	482-613 kPa (70-89 psi)	379-586 kPa (55-85 psi)
4	241-310 kPa (35-45 psi)	620-758 kPa (90- 110 psi)	0-34 kPa (0-5 psi)	586-730 kPa (85- 105 psi)	551-689 kPa (80-100 psi)

^a EPC readings will vary due to EEC strategy. These values are approximate pressures. Actual clutch apply pressures should be within 69-103 kPa (10-15 psi) of line pressure. For additional information on testing, refer to the Clutch Pressure Test in this section.

3. Place the ignition switch in the OFF position. If line pressure is not within specification, check EPC pressure.
4. Connect pressure gauge to EPC pressure tap.
5. Start engine and check EPC pressure. Use the line pressure chart for specifications.
6. If EPC pressure is not within specification, [Go To Pinpoint Test E](#) to diagnose EPC operation. If EPC operation is OK, see the line pressure diagnosis chart for line pressure concern causes.

Line Pressure Diagnosis Chart

Test Results	Possible Source
High At Idle — In All Positions	<ul style="list-style-type: none"> • Wiring Harnesses
	<ul style="list-style-type: none"> • Run Quick Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	<ul style="list-style-type: none"> • EPC Solenoid • Main Regulator Valve
Low At Idle — In All Positions	<ul style="list-style-type: none"> • Low Fluid Level
	<ul style="list-style-type: none"> • Control Bodies
	<ul style="list-style-type: none"> • Leakage in Pump
	<ul style="list-style-type: none"> • Damaged Gaskets on Separator Valve
	<ul style="list-style-type: none"> • Damaged Separator Plate
	<ul style="list-style-type: none"> • Restricted Inlet Filter
	<ul style="list-style-type: none"> • Case Bolts
	<ul style="list-style-type: none"> • Loose Main Control Valve Body
	<ul style="list-style-type: none"> • EPC Solenoid O-Ring
	<ul style="list-style-type: none"> • EPC Solenoid Bracket
	<ul style="list-style-type: none"> • Case
	<ul style="list-style-type: none"> • Sticking Main Regulator Valve • Damaged Inlet Tube Seal on Inlet Filter
Low In Park Only	<ul style="list-style-type: none"> • Valve Body • Low/Reverse Servo
Low In Reverse Only	<ul style="list-style-type: none"> • Separator Plate
	<ul style="list-style-type: none"> • Low/Reverse Servo or Valve Bodies

	• Reverse Clutch
Low In Neutral Only	• Valve Body
Low In Overdrive Only	• Forward Clutch • Valve Body
Low In 1st Position Only	• Forward Clutch
	• Valve Body • Low/Reverse Servo
Low In 2nd Only	• Intermediate Clutch
	• Valve Bodies • Forward Clutch

Stall Speed Test



WARNING: Apply the parking brake firmly while carrying out each stall test.



CAUTION: Carry out line pressure test prior to carrying out stall test. If the line pressure is low at stall, do not carry out stall test or further transmission damage will occur.

The stall speed test checks:

- the torque converter clutch operation and installation.
- the holding ability of the forward clutch.
- the reverse clutch (the low-reverse bands).
- the planetary one-way clutch.
- the engine driveability.

Conduct this test with the engine coolant and transmission fluid at correct levels and at normal operating temperature.

Apply the parking brake firmly for each stall speed test.

1. Find the specified stall rpm for the vehicle; see the stall speed diagnosis chart. Use a grease pencil to mark the rpm on the dial of a tachometer.

Stall Speed

Application	Min.	Max.
3.8L engine	2,240	2,619
4.6L 2V engine	2,339	2,738
4.6L 4V MACH 1 engine	2,375	2,767

2. Connect a tachometer to the engine.
3. **NOTE:** If the rpm recorded by the tachometer exceeds the maximum limits, release the accelerator pedal immediately because clutch or band slippage is indicated.

In each of the following ranges (D), 2, 1, R, press the accelerator pedal to the floor and hold it

just long enough to let the engine get to wide open throttle (WOT). While making this test, do not hold the throttle open for more than 5 seconds at a time.

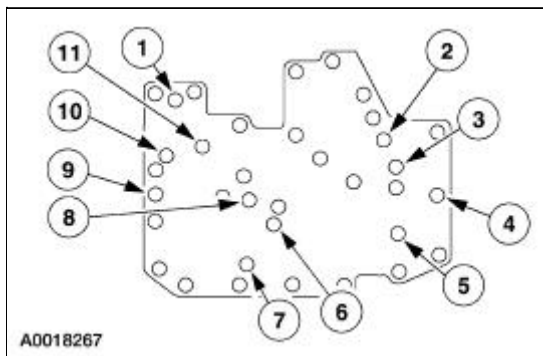
4. Note the results in each range.
5. After each range, move the shift control selector lever to NEUTRAL and run the engine at 1,000 rpm for about 15 seconds to cool the torque converter before making the next test.
6. Refer to the stall speed diagnosis chart for corrective actions.

Stall Speed Diagnosis Chart

Selector Position	Stall Speeds High	Stall Speeds Low
(D)	Planetary One-Way Clutch	
(D), 2 and 1	Forward Clutch or Intermediate Clutch	
(D), 2, 1 and R	Carry Out Pressure Test	Torque Converter Stator One-Way Clutch or Engine Driveability Concerns
R	Reverse Clutch or Low Reverse Band or Servo	

Air Pressure Tests

Transmission Air Test Plate



Item	Part Number	Description
1	—	Converter bypass
2	—	Direct clutch
3	—	Forward clutch
4	—	2-3 accumulator, top
5	—	2-3 accumulator, bottom
6	—	Reverse servo
7	—	Overdrive servo, apply
8	—	Overdrive servo, release
9	—	Intermediate clutch
10	—	Reverse clutch
11	—	1-2 accumulator, apply

A no-drive condition can exist even with correct transmission fluid pressure because of inoperative clutches or bands. An erratic shift can be located through a series of checks by substituting air pressure for fluid pressure to determine the location of the malfunction.

Follow the procedure to determine the location of the inoperative clutch or band by introducing air pressure into the various test plate passages.

NOTE: Use only dry, regulated 276 kPa (40 psi) maximum air pressure.

Apply air to the appropriate passage(s). A dull thud should be felt or heard or movement could be observed when the clutch component applies. There should be no hissing sound when the component is applied.

Cover the vent hole in the test plate with a clean, lint-free shop towel to prevent spray when the air is applied. Plugging the vent hole during testing will result in inaccurate results.

1. Drain transmission fluid and remove the transmission fluid pan.
2. Remove the main control valve body.
3. Install transmission test plate and gasket. Tighten bolts to 10 Nm (89 lb-in).
4. **NOTE:** Do not apply air to the test plate vent hole.

Apply air to the appropriate clutch port (refer to the Transmission Air Test Plate illustration). A dull thud may be heard or movement felt when the component is applied or released. If clutch seals or check balls are leaking a hissing sound may be heard.


If the servos do not operate, disassemble, clean and inspect them to locate the source of the concern.

If air pressure applied to the clutch passages fails to operate a clutch, or operates clutches simultaneously, inspect the fluid passages in the case.

If air pressure applied to the accumulator fails to operate an accumulator, remove and inspect case passages and piston.

Clutch Pressure Test

The Clutch Pressure Test will diagnose a low-pressure condition or leakage in a clutch circuit. A difference of 103 kPa (15 psi) or more between the clutch pressure and line pressure will prevent a normal shift.

1.  **CAUTION: Pressure gauges affect the shift quality of the transmission. Care must be taken not to accelerate or decelerate rapidly. Possible transmission failure can result.**

Attach 0-2068 kPa (0-300 psi) pressure gauges to the line pressure tap and the appropriate clutch pressure tap according to Band and Clutch Application Chart A&B. Gauges must be accurate enough to distinguish a 103 kPa (15 psi) difference. (If this test is done in conjunction with a control pressure test, pressure gauges will be attached to all pressure taps.) Have sufficient flexible hose available to read the gauges in the vehicle.

2. Drive the vehicle. When pressure is applied to the clutch, note the difference between the line pressure gauge and the corresponding clutch pressure gauge.
3. If the difference in pressures is less than 103 kPa (15 psi), the corresponding clutch circuit does not have a pressure loss. The gauges on the line pressure tap and appropriate clutch pressure tap can be switched to confirm that gauge calibration differences are not the cause.

4. If the difference is greater than 103 kPa (15 psi), there is a leak in the corresponding clutch pressure circuit. The gauges on the line pressure tap and clutch pressure tap can be switched to confirm that gauge calibration differences are not the cause. Carry out the appropriate procedure to correct the clutch leak problem.
-

Leakage Inspection



CAUTION: Do not try to stop the fluid leak by increasing the torque beyond specifications. This may cause damage to the case threads.

Check the fluid filler tube connection at the transmission case. If leakage is found here, install a new grommet.

Check the VSS plug or VSS sensor O-ring (model dependent). If leakage is found install a new O-ring.

Check fluid lines and fittings between the transmission and the cooler in the radiator tank for looseness, wear, or damage. If leakage cannot be stopped by tightening a fluid tube nut, install new parts. When fluid is found leaking between the case and cooler line fitting, check for missing or damaged O-ring, then tighten the fitting to maximum specification.

If the leak continues, install a new cooler line fitting and tighten to specification. The same procedure should be followed for fluid leaks between the radiator cooler and the cooler line fittings in this section; refer to [Section 307-02](#).

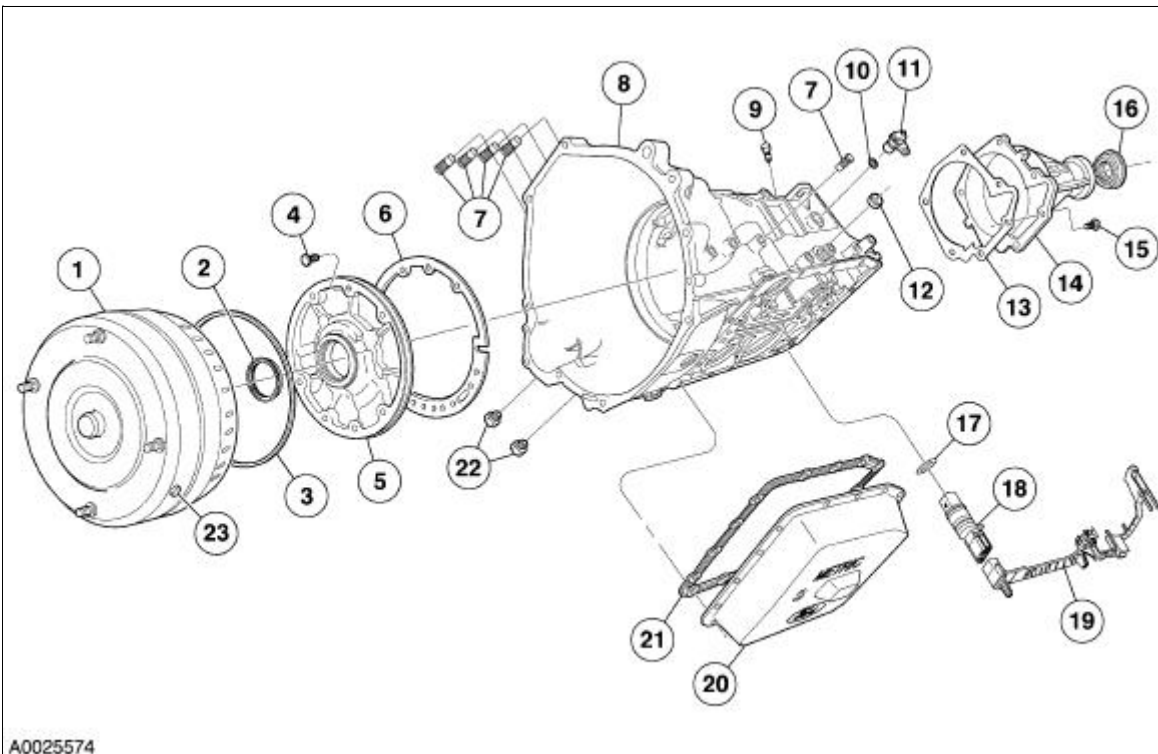
Check the engine coolant in the radiator. If transmission fluid is present in the coolant, the cooler in the radiator is probably leaking.

The cooler can be further checked for leaks by disconnecting the lines for the cooler fittings and applying no more than 345 kPa (50 psi) air pressure to the fittings. Remove the radiator cap to relieve the pressure buildup at the exterior of the oil cooler tank. If the cooler is leaking and or will not hold pressure, install a new cooler.

If leakage is found at the transmission range selector lever, install a new seal.

If leakage is found at the transmission internal harness connector, install a new O-ring.

4R70W External Sealing



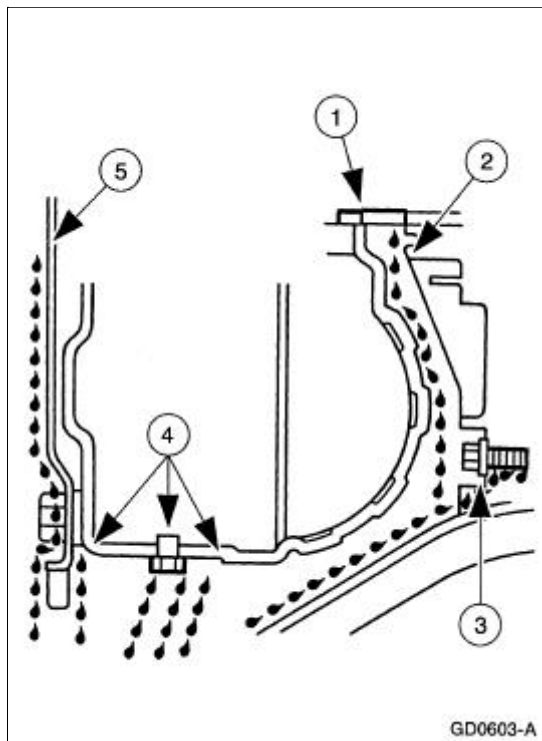
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Item	Part Number	Description
1	7902	Torque converter
2	7A248	Front pump seal
3	7A248	Front pump seal
4	N605789-S101	Bolt
5	7A106	Front pump body assembly
6	7A136	Pump gasket
7	390318-S2	Pipe plug — 1/8 — 27 Dryseal tapered
8	7005	Case
9	7034	Vent
10	N811757-S100	Speed sensor seal
11	7H103	Output shaft speed (OSS) sensor
12	7B498	Manual control lever seal assembly
13	7086	Extension housing gasket
14	7A039	Extension housing
15	N803737-S1101	Bolt — M8-1.25 x 30
15	N606047-S101	Bolt — M8-1.25 x 70
15	N803521-S1101	Bolt — M8-1.25 x 1.25 x 0.54
15	N811524-S101	Bolt — M8-1.25 x 42
16	7052	Oil seal
17	7Z276	Seal — bulkhead assembly
18	7G276	Bulkhead assembly wiring connector
19	7G276	Molded lead frame
20	7A194	Transmission fluid pan
21	7A191	Gasket

22	7D273	Fluid tube connector
23	87650-S2	Converter drain plug

Fluid Leakage in Torque Converter Area

In diagnosing and correcting fluid leaks in the front pump support and gear and torque converter area, use the following procedures to locate the exact cause of the leakage. Leakage at the front of transmission, as evidenced by fluid around the torque converter housing, may have several sources. By careful observation it is possible, in many instances, to pinpoint the source of leak before removing the transmission from the vehicle. The paths which the fluid takes to reach the bottom of the torque converter housing are shown in the illustration. The five steps following correspond with the numbers in the illustration.



1. Fluid leaking by the front pump seal lip will tend to move along the impeller hub and onto the back of the impeller housing. Except in the case of a total seal failure, fluid leakage by the lip of the seal will be deposited on the inside of the torque converter housing only, near the outside diameter of the housing.
2. Fluid leakage by the outside diameter of the front pump seal and front pump body will follow the same path that leaks by the inside diameter of the front pump seal follow.
3. Fluid that leaks by a front pump to case bolt or pump gasket will be deposited on the inside of the torque converter housing only. Fluid will not be deposited on the back of the torque converter.
4. Fluid leakage from the converter drain plug, (model dependent) converter seal weld or converter to flexplate stud weld will appear at the outside diameter of the torque converter on the back face of the flexplate and in the converter housing only near the flexplate. Fluid leaks from the torque converter will leave a ring of fluid around the inside of the torque converter housing.
5. **NOTE:** White facial tissue paper may aid in determining the color (red is transmission fluid) and source of the leaking fluid.

Engine oil leaks are sometimes incorrectly diagnosed as transmission pump gasket leaks. The

following areas of possible leakage should also be checked to determine if engine oil leakage is causing the concern.

- a. Leakage at the engine valve cover gasket may allow oil to flow over the torque converter housing or seep down between the torque converter housing and cylinder block causing oil to be present in or at the bottom of the torque converter housing.
- b. Oil galley plug leaks will allow oil to flow down the rear face of the cylinder block to the bottom of the torque converter housing.
- c. Leakage at the crankshaft rear oil seal will work back to the flexplate, and then into the torque converter housing.
- d. Leakage at engine oil pressure sensor.

Leak Check Test

1. Remove the fluid level indicator and note the color of the fluid. Original factory fill fluid is dyed red to aid in determining if leakage is from the engine or transmission. Unless a considerable amount of makeup fluid has been added or the fluid has been changed, the red color should assist in pinpointing the leak.
2. Remove the torque converter housing cover. Clean off any fluid from the top and bottom of the torque converter housing, front of the case and rear face of the engine and oil pan. Clean the torque converter area by washing with a suitable nonflammable solvent and blow dry with compressed air.
3. Wash out the torque converter housing, the front of the flexplate and the converter drain plugs. The torque converter housing may be washed out using cleaning solvent and a squirt-type oil can. Blow all washed areas dry with compressed air.
4. Start and run the engine until the transmission reaches its normal operating temperature. Observe the back of the cylinder block and top of the torque converter housing for evidence of fluid leakage. Raise the vehicle on a hoist; refer to [Section 100-02](#) and run the engine at fast idle, then at engine idle, occasionally shifting to the Overdrive and Reverse ranges to increase pressure within the transmission. Observe the front of the flexplate, back of the cylinder block (in as far as possible), and inside the torque converter housing and front of the case. Run the engine until fluid leakage is evident and the probable source of leakage can be determined.

Leak Check Test With Black Light Used With 12 Volt Master UV Diagnostic Inspection Kit

Oil soluble aniline or fluorescent dyes premixed at the rate of 2.5ml (1/2 teaspoon) of dye powder to 0.235L (1/2 pint) of transmission fluid have proved helpful in locating the source of fluid leakage. Such dyes may be used to determine whether an engine oil or transmission fluid leak is present, or if the fluid in the fluid cooler leaks into the engine cooling system. A black light must be used with the fluorescent dye solution.

Transmission Fluid Cooler



CAUTION: Whenever a transmission has been disassembled to install new parts, the cooler bypass valve (CBV), all transmission fluid coolers (in tank and auxiliary) and transmission fluid cooler lines must be cleaned and backflushed. Use a suitable the torque converter/fluid cooler cleaner.

NOTE: Cleaning and backflushing the transmission fluid cooling system along with following all the normal cleaning and inspection procedures in this section during disassembly and reassembly will keep contamination from reentering the transmission and causing a repeat repair.

When internal wear or damage has occurred in the transmission, metal particles, clutch plate material, or band material may have been carried into the torque converter and transmission fluid cooler. These contaminants are a major cause of recurring transmission troubles and must be removed from the system before the transmission is put back into use.

Transmission Fluid Cooler Flow Test



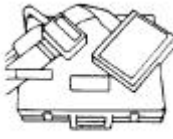




NOTE: The transmission linkage/cable adjustment, fluid level and line pressure must be within specification before carrying out this test. Refer to [Section 307-05](#) for adjustments.



1. Remove fluid level indicator from fluid filler tube.
2. Place funnel in fluid filler tube.
3. Position the vehicle on a hoist. For additional information, refer to [Section 100-02](#).
4. Remove the cooler return line (top fitting) from the fitting on the transmission case.
5. Connect one end of a hose to the cooler return line and route other end of the hose up to a point where it can be inserted into the funnel at the fluid filler tube.
6. Remove the safety stands and lower the vehicle. Insert end of hose into the funnel.
7. Start the engine and run it at idle with the transmission in NEUTRAL.
8. When fluid flows from the hose in a steady stream, a liberal amount of fluid should be observed. "Liberal" is about 1 liter (1 quart) delivered in 15 seconds. If a liberal flow is observed, the test is complete.
9. If the flow is not liberal, stop the engine. Disconnect the hose from the cooler return line and connect it to the converter outlet fitting (bottom fitting) on the transmission case.
10. Repeat steps 6 and 7. If flow is now approximately 1 liter (1 quart) in 15 seconds, refer to [Transmission Fluid Cooler — Backflushing and Cleaning](#) in this section. If the flow is still not approximately 1 liter (1 quart) in 15 seconds, repair or install pump and or converter.

For the installation of new transmission fluid cooler or tubes, refer to [Section 307-02](#).

Diagnosis By Symptom

Special Tool(s)

 <p>ST1565-A</p>	<p>Transmission Fluid Pressure Gauge 307-004 (T57L-77820-A)</p>
 <p>ST1392-A</p>	<p>Air Test Plate, Transmission 307-246 (T92P-7006-A)</p>
 <p>ST1391-A</p>	<p>Breakout Box, EEC-V Control System 418-049 (T94L-50-EEC-V) or equivalent</p>
 <p>ST1632-A</p>	<p>MLP-TR Cable 418-F107 (007-00111) or equivalent</p>
 <p>ST2332-A</p>	<p>Worldwide Diagnostic System (WDS) 418-F224</p> <p>New Generation STAR (NGS) Tester 418-F052 or equivalent scan tool</p>
 <p>ST1389-A</p>	<p>Transmission Tester 307-F016 (007-00130) or equivalent</p>
	<p>Trans Tester TR/MLP Overlay and Manual 007-00131 or equivalent</p>
	<p>73 III Automotive Meter</p>

 <p>ST1137-A</p>	105-R0057 or equivalent
 <p>ST1300-A</p>	UV Leak Detector Kit 164-R0756 or equivalent

The Diagnosis by Symptom charts give the technician diagnostic information, direction, and suggest possible components, using a symptom as a starting point.

The Diagnosis by Symptom charts are divided into two categories: Electrical Routines, indicated by 200 series numbers, and Hydraulic/Mechanical Routines, indicated by 300 series numbers. The Electrical Routines list the possible electrical components that could cause or contribute to the symptom described. The Hydraulic/Mechanical Routines list the possible hydraulic or mechanical components that could cause or contribute to the symptom described.

Diagnosis by Symptom Chart Directions

1. Using the Diagnosis by Symptom Index, select the Concern/Symptom that best describes the condition.
2. Refer to the routine indicated in the Diagnosis by Symptom Index.
3. Always begin diagnosis of a symptom with:
 - a. preliminary inspections.
 - b. verifications of condition.
 - c. checking the fluid levels.
 - d. carrying out other test procedures as directed.
4. **NOTE:** Not all concerns and conditions with electrical components will set a diagnostic trouble code (DTC). Be aware that the components listed may still be the cause. Verify correct function of these components prior to proceeding to the Hydraulic/Mechanical Routine listed.

Begin with the Electrical Routine, if indicated. Follow the reference or action required statements. Always carry out the on-board diagnostic tests as required. Never skip steps. Repair as required. If the concern is still present after electrical diagnosis, then proceed to the Hydraulic/Mechanical Routine listed.

5. The Hydraulic/Mechanical Routines list possible hydraulic or mechanical components that could cause the concern. These components are listed in the removal sequence and by most probable cause. All components listed must be inspected to ensure correct repair.

Diagnosis by Symptom Index

Title	Routines	
	Electrical a	Hydraulic/ Mechanical

Engagement Concerns		
No Forward	201	301
No REVERSE	202	302
Harsh REVERSE	203	303
Harsh Forward	204	304
Delayed/Soft Reverse	205	305
Delayed/Soft Forward	206	306
Shift Concerns		
Some/All Shifts Missing	210	310
Timing Concerns		
—Early/Late	211	311
—Erratic/Hunting	212	312
Feel		
—Soft/Slipping	213	313
—Harsh	214	314
No 1st Gear, Engages in Higher Gear	215	315
No Manual 1st Gear	216	316
No Manual 2nd Gear	217	317
Torque Converter Operation Concerns		
No Apply	240	340
Always Applied/Stalls Vehicle	241	341
Cycling/Shudder/Chatter	242	342
Other Concerns		
No Engine Braking in 2nd Gear, Manual 2nd or Manual 1st Position	250	350
Gearshift Lever Efforts High	251	351
External Leaks	252	352
Vehicle Driveability Concerns	253	353
Noise/Vibration in Forward or Reverse	254	354
Engine Will Not Crank	255	355
No PARK (P) Range	256	356
Overheating	257	357

^a Carry out electrical routine first.

Diagnostic Routines

Engagement Concern: No Forward

Possible Component	Reference/Action
201 — ELECTRICAL ROUTINE	
• No Electrical Concerns	
301 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
• Incorrect level	• Adjust fluid to correct level.
• Condition	• Inspect as under Fluid Condition Check; refer to Verification of

	Condition.
Shift Linkage	
<ul style="list-style-type: none"> • Damaged or incorrectly adjusted 	<ul style="list-style-type: none"> • Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05. Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify the digital transmission range (TR) sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
<ul style="list-style-type: none"> • Low forward clutch pressure, low line pressure 	<ul style="list-style-type: none"> • Check pressure at line and forward clutch tap. Refer to Line Pressure Chart for specification. If pressures are low, check the following components: oil filter and seal assembly, main controls, pump assembly, forward clutch assembly.
Fluid Filter and Seal Assembly	
<ul style="list-style-type: none"> • Plugged, damaged 	<ul style="list-style-type: none"> • Install a new filter and seal assembly.
<ul style="list-style-type: none"> • Filter seal damaged 	
Main Controls	
<ul style="list-style-type: none"> • 3-4 shift valve, main regulator valve, manual valve — stuck, damaged 	<ul style="list-style-type: none"> • Inspect for damage. Repair as required.
<ul style="list-style-type: none"> • Bolts not tightened to specifications 	<ul style="list-style-type: none"> • Tighten bolts to specifications.
<ul style="list-style-type: none"> • Gaskets damaged 	<ul style="list-style-type: none"> • Inspect gaskets for damage and install a new gasket.
<ul style="list-style-type: none"> • 2-3 accumulator and seals damaged 	<ul style="list-style-type: none"> • Inspect piston, seals and bore for damage. Repair as required.
<ul style="list-style-type: none"> • Pressure regulator valve 	<ul style="list-style-type: none"> • Inspect the diameter for wear.
Pump Assembly	
<ul style="list-style-type: none"> • Bolts not tightened to specifications 	<ul style="list-style-type: none"> • Tighten bolts to specifications.
<ul style="list-style-type: none"> • Porosity/cross leaks/ball missing or leaking, plugged hole 	<ul style="list-style-type: none"> • Inspect for porosity and leaks. Repair as required.
<ul style="list-style-type: none"> • No. 3 and No. 4 seal rings damaged 	<ul style="list-style-type: none"> • Inspect seals for damage. Repair as required.
<ul style="list-style-type: none"> • Gaskets damaged 	<ul style="list-style-type: none"> • Inspect for damage and install a new gasket.
Forward Clutch Assembly	
<ul style="list-style-type: none"> • Seals, piston damaged 	<ul style="list-style-type: none"> • Inspect seals for damage. Repair as required.
<ul style="list-style-type: none"> • Check balls damaged, missing, mislocated, not seating correctly 	<ul style="list-style-type: none"> • Inspect for mislocation, poor seating, damage. Install a new cylinder as required.
<ul style="list-style-type: none"> • Friction elements damaged or worn 	<ul style="list-style-type: none"> • Check for abnormal wear, damage. Repair as required.
One-Way Clutch Assembly (Planetary)	
<ul style="list-style-type: none"> • Worn, damaged or assembled incorrectly 	<ul style="list-style-type: none"> • Inspect for damage. Repair as required.
Output Shaft	

· Damaged

· Inspect for damage. Install new components as required.

Engagement Concern: No Reverse

Possible Component	Reference/Action
202 — ELECTRICAL ROUTINE	
· No Electrical Concerns	
302 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust fluid to correct level.
· Condition	· Inspect condition of fluid.
Shift Linkage	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Low reverse clutch pressure, low reverse band pressure, low line pressure	· Check pressure at line pressure tap; refer to Line Pressure Chart for specifications. If pressures are low, check the following components: oil filter and seal assembly, main controls, reverse servo, pump assembly, reverse clutch assembly.
Fluid Filter and Seal Assembly	
· Plugged, damaged	· Install a new filter and seal assembly.
Main Controls	
· No. 6 shuttle ball, manual valve, main regulator valve, 1-2 accumulator seals stuck or damaged	· Inspect for damage. Repair as required.
· Loose bolts	· Tighten bolts to specifications.
· Gasket damaged	· Inspect for damage and install a new gasket.
Low/Reverse Servo	
· Seals (piston and cover) damaged	· Inspect for damage. Repair as required.
· Servo cover retaining ring damaged	
· Anchor pins (case) damaged	
Pump Assembly	
· Loose bolts	· Tighten bolts to specifications.
· Porosity/cross leaks/ball missing or leaking, plugged hole	· Inspect pump assembly. Install new as required.
· Gasket damaged	· Inspect for damage and install a new gasket.
· No. 1 and 2 seal rings damaged	· Inspect for damage. Repair as required.
Reverse Clutch Assembly	

<ul style="list-style-type: none"> Seals, piston damaged 	<ul style="list-style-type: none"> Inspect for damage. Repair as required.
<ul style="list-style-type: none"> Check ball missing or damaged 	
<ul style="list-style-type: none"> Friction elements damaged or worn 	
Low/Reverse Band	
<ul style="list-style-type: none"> Band, servo, anchor pins damaged or worn 	<ul style="list-style-type: none"> Inspect for damage. Repair as required.

Engagement Concern: Harsh Reverse

Possible Component	Reference/Action
203 — ELECTRICAL ROUTINE	
Powertrain Control System	<ul style="list-style-type: none"> Carry out Self-Test; refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out engagement test, EPC test and Go To Pinpoint Test B or Go To Pinpoint Test D. Check idle speed. Repair as required. Clear DTCs, road test and repeat Self-Test.
<ul style="list-style-type: none"> Electrical inputs/outputs, vehicle wiring harnesses, PCM, TFT sensor, EPC solenoid 	
303 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
<ul style="list-style-type: none"> Incorrect level 	<ul style="list-style-type: none"> Adjust fluid to correct level.
<ul style="list-style-type: none"> Condition 	<ul style="list-style-type: none"> Inspect condition of fluid.
Engine Driveline	
<ul style="list-style-type: none"> Looseness in the driveshaft, U-joints or the engine mounts 	<ul style="list-style-type: none"> Repair as required.
Shift Linkage	
<ul style="list-style-type: none"> Damaged or incorrectly adjusted 	<ul style="list-style-type: none"> Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05. Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
<ul style="list-style-type: none"> High line pressure, high EPC pressure 	<ul style="list-style-type: none"> Check pressure at line and EPC pressure taps; refer to Line Pressure Chart for specifications. If high, check the following components: main controls, oil filter and seal assembly.
Fluid Filter and Seal Assembly	
<ul style="list-style-type: none"> Plugged or damaged 	<ul style="list-style-type: none"> Install a new filter and seal assembly.
<ul style="list-style-type: none"> Filter seal damaged 	
Main Controls	
<ul style="list-style-type: none"> No. 6 shuttle ball, No. 5 check ball, manual valve, main regulator valve stuck, damaged or missing 	<ul style="list-style-type: none"> Inspect for damage. Repair as required.
<ul style="list-style-type: none"> Bolts not tightened to specifications 	<ul style="list-style-type: none"> Tighten bolts to specifications.

• Gasket damaged	• Inspect for damage and install a new gasket.
• EPC solenoid stuck or damaged	• Inspect for damage, contamination. Carry out EPC test in Routine No. 203. Repair as required.
Low Reverse Servo	
• Seals (piston and cover) damaged	• Inspect for damage. Repair as required.
• Servo cover retaining ring assembled incorrectly	
• Anchor pins (case) damaged	
Pump Assembly	
• Bolts not tightened to specifications	• Tighten bolts to specifications.
• Porosity/cross leaks	• Inspect pump assembly. Install new as required.
• Gasket damaged	• Inspect for damage and install a new gasket.
• No. 1 and No. 2 seal rings damaged	• Inspect for damage. Repair as required.
Reverse Clutch Assembly	
• Seals, piston damaged	• Inspect for damage. Repair as required.
• Check ball missing or damaged	
• Friction elements damaged, worn	
• Return spring piston damaged, worn	
Low Reverse Band	
• Band, servo, anchor pin damaged or worn	• Inspect for damage. Repair as required.

Engagement Concern: Harsh Forward

Possible Component	Reference/Action
204 — ELECTRICAL ROUTINE	
Powertrain Control System	<ul style="list-style-type: none"> • Carry out Self-Test; refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Carry out engagement test and EPC test. Go To Pinpoint Test B or Go To Pinpoint Test D. Check idle speed. Repair as required. Clear DTCs, road test and repeat Self-Test.
<ul style="list-style-type: none"> • Electrical inputs/outputs, vehicle wiring harnesses, PCM, TFT sensor, EPC solenoid 	
304 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
• Incorrect level	• Adjust fluid to correct level.
• Condition	• Inspect condition of fluid.
Engine Driveline	
• Looseness in the driveshaft, U-joints or	• Repair as required.

the engine mounts	
Incorrect Pressures	
<ul style="list-style-type: none"> High forward clutch pressure, high line pressure, high EPC pressure 	<ul style="list-style-type: none"> Check pressure at line, EPC and forward pressure taps. Refer to Line Pressure Chart for specifications. If pressures are high, check the following possible components: main controls, pump assembly.
Main Controls	
<ul style="list-style-type: none"> Main regulator valve stuck, damaged 	<ul style="list-style-type: none"> Inspect and repair as required.
<ul style="list-style-type: none"> Bolts not tightened to specifications 	<ul style="list-style-type: none"> Tighten bolts to specifications.
<ul style="list-style-type: none"> Gaskets damaged 	<ul style="list-style-type: none"> Inspect for damage and install a new gasket.
<ul style="list-style-type: none"> EPC solenoid stuck or damaged 	<ul style="list-style-type: none"> Inspect for damage or contamination. Carry out EPC test in Routine 204. Repair as required.
Case	
<ul style="list-style-type: none"> 2-3 accumulator seal/retainer stuck, damaged 	<ul style="list-style-type: none"> Inspect for damage. Repair as required.
Pump Assembly	
<ul style="list-style-type: none"> Bolts not tightened to specifications 	<ul style="list-style-type: none"> Tighten bolts to specifications.
<ul style="list-style-type: none"> Porosity/cross leaks 	<ul style="list-style-type: none"> Inspect for porosity/leaks. Install a new pump as required.
<ul style="list-style-type: none"> Gaskets damaged 	<ul style="list-style-type: none"> Inspect for damage and install a new gasket.
Forward Clutch Assembly	
<ul style="list-style-type: none"> Check balls missing or damaged 	<ul style="list-style-type: none"> Inspect for mislocation, poor seating, damage. Install a new forward clutch cylinder.
<ul style="list-style-type: none"> Friction element damaged or worn 	<ul style="list-style-type: none"> Inspect for damage. Repair as required.
<ul style="list-style-type: none"> Forward clutch wave spring damaged 	<ul style="list-style-type: none"> Inspect for damage. Repair as required.
<ul style="list-style-type: none"> Forward clutch return spring damaged 	<ul style="list-style-type: none"> Inspect for damage. Repair as required.

Engagement Concern: Delayed/Soft Reverse

Possible Component	Reference/Action
205 — ELECTRICAL ROUTINE	
	<ul style="list-style-type: none"> No Electrical Concerns
305 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
<ul style="list-style-type: none"> Incorrect level 	<ul style="list-style-type: none"> Adjust fluid to correct level.
<ul style="list-style-type: none"> Condition 	<ul style="list-style-type: none"> Inspect condition of fluid.
Shift Linkage	
<ul style="list-style-type: none"> Damaged or incorrectly adjusted 	<ul style="list-style-type: none"> Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05. Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor

	as necessary.
Incorrect Pressures	
<ul style="list-style-type: none"> Low reverse clutch pressure, low reverse band pressure, low line pressure 	<ul style="list-style-type: none"> Check pressure at line tap; refer to Line Pressure Chart for specifications. If pressures are low, check the following components: main controls, pump assembly, reverse clutch assembly, reverse servo.
Fluid Filter and Seal Assembly	
<ul style="list-style-type: none"> Plugged, damaged 	<ul style="list-style-type: none"> Install a new filter and seal assembly.
	<ul style="list-style-type: none"> Filter seal damaged
Main Controls	
<ul style="list-style-type: none"> No. 6 shuttle ball, manual valve, main regulator valve stuck or damaged 	<ul style="list-style-type: none"> Inspect for damage. Repair as required.
<ul style="list-style-type: none"> Bolts not tightened to specifications 	<ul style="list-style-type: none"> Tighten bolts to specifications.
<ul style="list-style-type: none"> Gaskets damaged 	<ul style="list-style-type: none"> Inspect for damage and install a new gasket.
Case	
<ul style="list-style-type: none"> 1-2 accumulator seals stuck or damaged 	<ul style="list-style-type: none"> Inspect for damage. Repair as required.
Low Reverse Servo	
<ul style="list-style-type: none"> Seals (piston and cover) damaged 	<ul style="list-style-type: none"> Inspect for damage. Repair as required.
<ul style="list-style-type: none"> Servo cover retaining ring assembled incorrectly 	
Pump Assembly	
<ul style="list-style-type: none"> Bolts not tightened to specification 	<ul style="list-style-type: none"> Tighten bolts to specification.
<ul style="list-style-type: none"> Porosity/cross leaks/ball missing or leaking 	<ul style="list-style-type: none"> Inspect pump assembly. Install new as required.
<ul style="list-style-type: none"> Gaskets damaged 	<ul style="list-style-type: none"> Inspect for damage and install a new gasket.
<ul style="list-style-type: none"> No. 1 and No. 2 seal rings damaged 	<ul style="list-style-type: none"> Inspect for damage. Repair as required.
Reverse Clutch Assembly	
<ul style="list-style-type: none"> Seals, piston damaged 	<ul style="list-style-type: none"> Inspect for damage. Install new components as required.
<ul style="list-style-type: none"> Check ball missing or damaged 	
<ul style="list-style-type: none"> Friction elements damaged, worn 	
<ul style="list-style-type: none"> Return spring and piston damaged, worn 	
Low Reverse Band	
<ul style="list-style-type: none"> Damaged, worn 	<ul style="list-style-type: none"> Inspect for damage. Repair as required.

Engagement Concern: Delayed/Soft Forward

Possible Component	Reference/Action
206 — ELECTRICAL ROUTINE	
	<ul style="list-style-type: none"> • No Electrical Concerns
306 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
<ul style="list-style-type: none"> • Incorrect level 	<ul style="list-style-type: none"> • Adjust fluid to correct level.
<ul style="list-style-type: none"> • Condition 	<ul style="list-style-type: none"> • Inspect condition of fluid.
Shift Linkage	
<ul style="list-style-type: none"> • Damaged or incorrectly adjusted 	<ul style="list-style-type: none"> • Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05. Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
<ul style="list-style-type: none"> • Low forward clutch pressure, low line pressure, low EPC pressure 	<ul style="list-style-type: none"> • Check pressure at line, forward clutch and EPC taps; refer to Line Pressure Chart for specifications. If pressures are low, check the following components: oil filter and seal assembly, main controls and pump assembly.
Fluid Filter and Seal Assembly	
<ul style="list-style-type: none"> • Plugged, damaged 	<ul style="list-style-type: none"> • Install a new filter and seal assembly.
<ul style="list-style-type: none"> • Filter seal damaged 	
Main Controls	
<ul style="list-style-type: none"> • 3-4 shift valve, main regulator valve stuck or damaged 	<ul style="list-style-type: none"> • Inspect and repair as required.
<ul style="list-style-type: none"> • Bolts not tightened to specifications 	<ul style="list-style-type: none"> • Tighten bolts to specifications.
<ul style="list-style-type: none"> • Gaskets damaged 	<ul style="list-style-type: none"> • Inspect for damage and repair as required.
Case	
<ul style="list-style-type: none"> • 2-3 or 1-2 accumulator, bore damaged or stuck 	<ul style="list-style-type: none"> • Inspect for damage. Repair as required.
Pump Assembly	
<ul style="list-style-type: none"> • Bolts not tightened to specification 	<ul style="list-style-type: none"> • Tighten bolts to specifications.
<ul style="list-style-type: none"> • Porosity/cross leaks 	<ul style="list-style-type: none"> • Inspect pump assembly. Repair as required.
<ul style="list-style-type: none"> • Gaskets damaged 	<ul style="list-style-type: none"> • Inspect for damage. Repair as required.
<ul style="list-style-type: none"> • No. 3 and No. 4 seal rings damaged 	<ul style="list-style-type: none"> • Inspect for damage. Repair as required.
Forward Clutch Assembly	
<ul style="list-style-type: none"> • Seals, piston damaged 	<ul style="list-style-type: none"> • Inspect for damage. Repair as required.
<ul style="list-style-type: none"> • Check balls missing, damaged 	<ul style="list-style-type: none"> • Inspect for mislocation, poor seating, damage. Install a new cylinder as required.
<ul style="list-style-type: none"> • Friction elements damaged, worn 	<ul style="list-style-type: none"> • Check for damage. Repair as required.

Shift Concerns: Some/All Shifts Missing

Possible Component	Reference/Action
210 — ELECTRICAL ROUTINE	
Powertrain Control System	<ul style="list-style-type: none"> Carry out Self-Test; refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A, Go To Pinpoint Test C or Go To Pinpoint Test E. Repair as required. Clear DTCs, road test and repeat Self-Test.
<ul style="list-style-type: none"> Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, output shaft speed (OSS) sensor, digital TR sensor 	
310 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	<ul style="list-style-type: none"> Adjust fluid to correct level. Inspect condition of fluid.
<ul style="list-style-type: none"> Incorrect level Condition 	
Shift Linkage, Digital TR Sensor	<ul style="list-style-type: none"> Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05. Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary. Refer to the following shift routine(s) for further diagnosis: <ul style="list-style-type: none"> Shift 1-2, Routine 220/320 Shift 2-3, Routine 221/321 Shift 3-4, Routine 222/322 Shift 4-3, Routine 223/323 Shift 3-2, Routine 224/324 Shift 2-1, Routine 225/325
<ul style="list-style-type: none"> Damaged or incorrectly adjusted 	

Shift Concerns: Timing Concerns — Early/Late

Possible Component	Reference/Action
211 — ELECTRICAL ROUTINE	
Powertrain Control System	<ul style="list-style-type: none"> Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A, Go To Pinpoint Test C or Go To Pinpoint Test E. Repair as required. Clear DTCs, road test and repeat Self-Test.
<ul style="list-style-type: none"> Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, EPC solenoid, TFT sensor, OSS 	
311 — HYDRAULIC/MECHANICAL ROUTINE	
Other	<ul style="list-style-type: none"> Verify vehicle has original equipment. Refer to Certification Label and Safety Standard Certification Label. Changes in tire size or axle ratio will affect shift timing.
<ul style="list-style-type: none"> Tire size change, axle ratio change 	
Fluid	<ul style="list-style-type: none"> Adjust fluid to correct level. Inspect condition of fluid.
<ul style="list-style-type: none"> Incorrect level Condition 	
Powertrain Control System	<ul style="list-style-type: none"> Refer to Routine 253.
<ul style="list-style-type: none"> Engine driveability concerns 	

Incorrect Pressures	<ul style="list-style-type: none"> • Line pressure, EPC pressure • Check pressure at line and EPC taps; refer to Line Pressure Chart for specifications. If not OK, check the main controls. If OK, refer to the shift routine(s) for further diagnosis: <ul style="list-style-type: none"> ■ Shift 1-2, Routine 320 ■ Shift 2-3, Routine 321 ■ Shift 3-4, Routine 322 ■ Shift 4-3, Routine 323 ■ Shift 3-2, Routine 324 ■ Shift 2-1, Routine 325
Main Controls	
<ul style="list-style-type: none"> • EPC solenoid, stuck or damaged hydraulically or mechanically 	<ul style="list-style-type: none"> • Inspect for damage, contamination. Carry out EPC tests in Routine No. 211. Repair as required.
<ul style="list-style-type: none"> • Valves, accumulators, seals stuck or damaged or assembled incorrectly 	<ul style="list-style-type: none"> • Inspect for damage. Repair as required.
<ul style="list-style-type: none"> • Gaskets damaged 	<ul style="list-style-type: none"> • Inspect for damage and install a new gasket.
<ul style="list-style-type: none"> • Solenoid screen blocked or damaged 	<ul style="list-style-type: none"> • Clean or install a new screen.

Shift Concerns: Timing Concerns — Erratic/Hunting

Possible Component	Reference/Action
212 — ELECTRICAL ROUTINE	
Powertrain Control System	
<ul style="list-style-type: none"> • Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, torque converter clutch (TCC) solenoid, digital TR sensor, output shaft speed (OSS) 	<ul style="list-style-type: none"> • Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis. Go To Pinpoint Test A , Go To Pinpoint Test C or Go To Pinpoint Test E . Repair as required. Clear DTCs, road test and repeat Self-Test.
<ul style="list-style-type: none"> • Poor engine performance 	<ul style="list-style-type: none"> • Refer to Routine 253.
312 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
<ul style="list-style-type: none"> • Incorrect level 	<ul style="list-style-type: none"> • Adjust fluid to correct level.
<ul style="list-style-type: none"> • Condition 	<ul style="list-style-type: none"> • Inspect condition of fluid.
Main Controls	
<ul style="list-style-type: none"> • Valves, accumulators, seals, assembled wrong, stuck or damaged 	<ul style="list-style-type: none"> • Inspect for damage. Repair as required.
<ul style="list-style-type: none"> • Gaskets damaged 	<ul style="list-style-type: none"> • Inspect for damage and install a new gasket.
<ul style="list-style-type: none"> • Solenoid screen blocked or damaged 	<ul style="list-style-type: none"> • Clean or install a new screen.
Torque Converter Clutch	
<ul style="list-style-type: none"> • Torque converter 	<ul style="list-style-type: none"> • Refer to Torque Converter Operation Concerns: Cycling/Shudder/Chatter Hydraulic/Mechanical Routine 342.
Specific Shifts	
	<ul style="list-style-type: none"> • Refer to the following shift routine(s) for further diagnosis:

- Shift 1-2, Routine 320
- Shift 2-3, Routine 321
- Shift 3-4, Routine 322
- Shift 4-3, Routine 323
- Shift 3-2, Routine 324
- Shift 2-1, Routine 325

Shift Concerns: Feel — Soft/Slipping

Possible Component	Reference/Action
213 — ELECTRICAL ROUTINE	
Powertrain Control System	
<ul style="list-style-type: none"> · Electrical inputs/outputs, vehicle wiring harnesses, PCM, EPC solenoid, OSS 	<ul style="list-style-type: none"> · Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test D or Go To Pinpoint Test E . Repair as required. Clear DTCs, road test and repeat Self-Test.
<ul style="list-style-type: none"> · Engine driveability concerns 	<ul style="list-style-type: none"> · Refer to Routine 253.
313 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
<ul style="list-style-type: none"> · Incorrect level 	<ul style="list-style-type: none"> · Adjust fluid to correct level.
<ul style="list-style-type: none"> · Condition 	<ul style="list-style-type: none"> · Inspect condition of fluid.
Incorrect Pressures	
<ul style="list-style-type: none"> · Low line pressure, low EPC pressure 	<ul style="list-style-type: none"> · Check pressures at line and EPC taps; refer to Line Pressure Chart for specifications. If pressures are low or all shifts are soft/slipping, go to main controls. If pressures are OK and a specific shift is soft/slipping, refer to the following routine(s) for further diagnosis: <ul style="list-style-type: none"> ■ Shift 1-2, Routine 320 ■ Shift 2-3, Routine 321 ■ Shift 3-4, Routine 322 ■ Shift 4-3, Routine 323 ■ Shift 3-2, Routine 324 ■ Shift 2-1, Routine 325
Main Controls	
<ul style="list-style-type: none"> · Main regulator valve, overdrive servo regulator valve stuck, damaged or assembled incorrectly 	<ul style="list-style-type: none"> · Inspect for damage. Repair as required.
<ul style="list-style-type: none"> · EPC solenoid stuck or damaged 	<ul style="list-style-type: none"> · Inspect for damage and contamination. Carry out EPC tests in Routine 213. Repair as required.
Case	
<ul style="list-style-type: none"> · 1-2 accumulator stuck or damaged 	<ul style="list-style-type: none"> · Inspect for damage. Repair as required.
Filter and Seal Assembly	
<ul style="list-style-type: none"> · Filter plugged, damaged 	<ul style="list-style-type: none"> · Inspect for damage. Install a new filter as required.
<ul style="list-style-type: none"> · Seal damaged or cut 	<ul style="list-style-type: none"> · Inspect for damage. Replace as required.

Shift Concerns: Feel — Harsh

Possible Component	Reference/Action
214 — ELECTRICAL ROUTINE	
Powertrain Control System	
<ul style="list-style-type: none"> Electrical inputs/outputs, vehicle wiring harnesses, PCM, EPC solenoid, OSS 	<ul style="list-style-type: none"> Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test D or Go To Pinpoint Test E. Repair as required. Clear DTCs, road test and repeat Self-Test.
<ul style="list-style-type: none"> Engine driveability concerns 	<ul style="list-style-type: none"> Refer to Routine 253.
314 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
<ul style="list-style-type: none"> Incorrect level 	<ul style="list-style-type: none"> Adjust fluid to correct level.
<ul style="list-style-type: none"> Condition 	<ul style="list-style-type: none"> Inspect condition of fluid.
Incorrect Pressures	
<ul style="list-style-type: none"> High line pressure, high EPC pressure 	<ul style="list-style-type: none"> Check pressures at line and EPC taps. See the to Line Pressure Chart for specifications. If pressures are high or all shifts are harsh, go to Main Controls. If pressures are OK and a specific shift is harsh, refer to the following shift routine(s) for further diagnosis: <ul style="list-style-type: none"> Shift 1-2, Routine 320 Shift 2-3, Routine 321 Shift 3-4, Routine 322 Shift 4-3, Routine 323 Shift 3-2, Routine 324 Shift 2-1, Routine 325
Main Controls	
<ul style="list-style-type: none"> Main regulator valve, overdrive servo regulator valve stuck, damaged or assembled incorrectly 	<ul style="list-style-type: none"> Inspect for damage. Repair as required.
<ul style="list-style-type: none"> EPC solenoid stuck or damaged 	<ul style="list-style-type: none"> Inspect for damage or contamination. Carry out EPC tests in Routine 214. Repair as required.

Shift Concerns: No 1st Gear, Engages In Higher Gear

Possible Component	Reference/Action
215 — ELECTRICAL ROUTINE	
Powertrain Control System	
<ul style="list-style-type: none"> Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, digital transmission range TR sensor 	<ul style="list-style-type: none"> Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A or Go To Pinpoint Test C. Repair as required. Clear DTCs, road test and repeat Self-Test.
315 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Digital TR Sensor	
<ul style="list-style-type: none"> Damaged or incorrectly adjusted 	<ul style="list-style-type: none"> Inspect and repair as required. Verify transmission shift cable adjustment. Refer to Section 307-05. Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted.

	Adjust the digital TR sensor as necessary.
Incorrect Pressures	<ul style="list-style-type: none"> • Check for which pressures are on and refer to Band/Clutch Application Chart 601 and corresponding routines. <ul style="list-style-type: none"> ■ 324, 301 ■ 325, 301 ■ 323, 324, 325, 301 ■ 324 ■ 325 ■ 323, 324, 325 ■ Refer to appropriate mechanical diagnosis.
<ul style="list-style-type: none"> • Low reverse clutch pressure, low reverse band pressure, low line pressure <ul style="list-style-type: none"> ● Forward Off, Intermediate Off, Direct X ● Forward Off, Intermediate X, Direct Off ● Forward Off, Intermediate X, Direct X ● Forward X, Intermediate Off, Direct X ● Forward X, Intermediate X, Direct Off ● Forward X, Intermediate X, Direct X ● Forward X, Intermediate Off, Direct Off 	
Mechanical	<ul style="list-style-type: none"> • Refer to Transmission Disassembly and Assembly.
<ul style="list-style-type: none"> • Bands, clutches or seals damaged or worn 	

X = pressure applied

Shift Concerns: No Manual 1st Gear

Possible Component	Reference/Action
216 — ELECTRICAL ROUTINE	
Powertrain Control System	<ul style="list-style-type: none"> • Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A or Go To Pinpoint Test C . Repair as required. Clear DTCs, road test and repeat Self-Test.
<ul style="list-style-type: none"> • Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, digital TR sensor 	
316 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Cable, Digital TR Sensor	<ul style="list-style-type: none"> • Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
<ul style="list-style-type: none"> • Damaged or incorrectly adjusted 	
Incorrect Pressures	<ul style="list-style-type: none"> • Check pressure at line and EPC pressure taps; refer to Line Pressure Chart for specifications. If pressures are low, check the following components: oil filter and seal assembly, main controls, reverse clutch assembly and reverse servo assembly.
<ul style="list-style-type: none"> • Low reverse clutch pressure, low reverse band pressure, low line pressure, low EPC pressure 	
Fluid Filter and Seal Assembly	<ul style="list-style-type: none"> • Install a new filter and seal assembly.
<ul style="list-style-type: none"> • Plugged or damaged 	

Main Controls	
<ul style="list-style-type: none"> No. 6 shuttle ball, manual valve, main regulator valve, low servo modulator valve stuck, damaged or assembled incorrectly 	<ul style="list-style-type: none"> Inspect for damage. Repair as required.
<ul style="list-style-type: none"> Bolts not tightened to specifications 	<ul style="list-style-type: none"> Tighten bolts to specifications.
<ul style="list-style-type: none"> Gaskets damaged 	<ul style="list-style-type: none"> Inspect for damage and install a new gasket.
Low Reverse Servo	
<ul style="list-style-type: none"> Seals (piston and cover) damaged 	<ul style="list-style-type: none"> Inspect for damage. Repair as required.
	<ul style="list-style-type: none"> Servo cover retaining ring assembled incorrectly.
	<ul style="list-style-type: none"> Anchor pins (case) damaged.

Shift Concerns: No Manual 2nd Gear

Possible Component	Reference/Action
217 — ELECTRICAL ROUTINE	
Powertrain Control System	
<ul style="list-style-type: none"> Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, digital TR sensor 	<ul style="list-style-type: none"> Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A or Go To Pinpoint Test C. Repair as required. Clear DTCs, road test and repeat Self-Test.
317 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Cable, Digital TR Sensor	
<ul style="list-style-type: none"> Damaged or incorrectly adjusted 	<ul style="list-style-type: none"> Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05. Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Main Controls	
<ul style="list-style-type: none"> 3-4 shift valve, 1-2 and 2-3 shift valve, 3-4 capacity modulator valve stuck, damaged or assembled incorrectly 	<ul style="list-style-type: none"> Inspect for damage. Repair as required.
<ul style="list-style-type: none"> Bolts not tightened to specifications 	<ul style="list-style-type: none"> Tighten bolts to specifications.
<ul style="list-style-type: none"> Gaskets damaged 	<ul style="list-style-type: none"> Inspect for damage and install a new gasket.

Shift Concerns: 1-2 Shift (Automatic)

Possible Component	Reference/Action
220 — ELECTRICAL ROUTINE	
Powertrain Control System	
<ul style="list-style-type: none"> Electrical inputs/outputs, 	<ul style="list-style-type: none"> Carry out Self-Test. Refer to the Powertrain Control/Emissions

vehicle wiring harnesses, PCM, shift solenoids, OSS	Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A or Go To Pinpoint Test E . Repair as required. Clear DTCs, road test and repeat Self-Test.
· Poor engine performance	· Refer to Routine 253.
320 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Digital TR Sensor	
· Damaged or incorrectly adjusted	· Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
· Intermediate clutch pressure, line pressure	· Check pressure at line and intermediate clutch taps; see the line pressure chart for specifications. If not OK, check the main controls.
Main Controls	
· 1-2 shift valve, stuck or damaged	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specification.
· Shift solenoid SSA malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
· Gasket damaged	· Inspect for damage and install a new gasket.
· No. 8 ball not seating	· Inspect for damage. Repair as required.
Case	
· 1-2 accumulator stuck or damaged	· Inspect for damage. Repair as required.
Pump	
· Porosity/cross leaks, balls missing, damaged or leaking	· Inspect for porosity/leaks, balls missing. Install a new pump as required.
· Gasket damaged	· Inspect for damage and install a new gasket.
Intermediate Clutch Assembly	
· Seals damaged	· Inspect for damage. Repair as required.
· Piston damaged	· Inspect for damage. Repair as required.
· Friction elements damaged or worn	· Inspect for damage. Repair as required.
Intermediate One-Way Clutch Assembly	
· Not holding or damaged	· Inspect for damage. Repair as required.
Planetary One-Way Clutch Assembly	
· Not overrunning or damaged	· Inspect for damage. Repair as required.
1-2 Accumulator	
· Damaged accumulator	· Inspect for damage. Repair as required.

piston	
• Springs damaged or broken	• Inspect for damage. Repair as required.
• Case bore scored	• Inspect for damage. Repair as required.

Shift Concerns: 2-3 Shift (Automatic)

Possible Component	Reference/Action
221 — ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, OSS	• Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A or Go To Pinpoint Test E . Repair as required. Clear DTCs, road test and repeat Self-Test.
• Engine driveability concerns	• Refer to Routine 253.
321 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage	
• Damaged or incorrectly adjusted	• Inspect and repair as required. Verify transmission shift cable adjustment. Refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
• Direct clutch pressure	• Check pressure at direct clutch tap; refer to Line Pressure Chart for specifications. If not OK, check the main controls.
Main Controls	
• 2-3 shift valve, check ball No. 9 or No. 3, solenoid pressure regulator valve, damaged or assembled incorrectly	• Inspect for damage. Repair as required.
• Bolts not tightened to specifications	• Tighten bolts to specifications.
• Shift solenoid SSB malfunction	• Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
• Gaskets damaged	• Inspect for damage and install a new gasket.
• Output shaft seals damaged or cup plug leaking or missing	• Inspect for damage and repair as required.
• 2-3 accumulator damaged or stuck	• Inspect piston seal and bore for damage. Repair as required.
• Solenoid screen (in main control) blocked or damaged	• Clean or install a new screen.
Intermediate One-Way Clutch Assembly	
• Not overrunning or damaged	• Inspect for damage. Repair as required.
Output Shaft	
• Seal rings damaged	• Inspect for damage. Repair as required.
• Cup plug damaged or missing	

Direct Clutch Assembly	
• Seals or piston damaged	• Inspect for damage. Repair as required.
• Friction elements worn or damaged	• Inspect for damage. Repair as required.
• Check ball not seating	• Inspect for damage. Repair as required.
• Return spring assembly damaged	• Inspect for damage. Repair as required.
Case	
• Output shaft rear seals leaking or damaged	• Inspect for damage. Repair as required. Inspect case for damaged seal area. If damaged, install a new case.
2-3 Accumulator	
• Damaged accumulator piston	• Inspect for damage. Repair as required.
• Springs damaged or broken	• Inspect for damage. Repair as required.
• Case bore scored	• Inspect for damage. Repair as required.

Shift Concerns: 3-4 Shift (Automatic)

Possible Component	Reference/Action
222 — ELECTRICAL ROUTINE	
Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, OSS, transmission control switch (TCS)	• Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A or Go To Pinpoint Test E . Repair as required. Clear DTCs, road test and repeat Self-Test.
• Engine driveability concerns	• Refer to Routine 253.
322 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Digital TR Sensor	
• Damaged or incorrectly adjusted	• Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Incorrect Pressures	
• Forward clutch pressure, direct clutch pressure, line pressure	• Check line, direct and forward clutch pressures at appropriate taps; refer to Line Pressure Chart for specifications. If pressures are out of specification, check main controls.
Main Controls	
• 3-4 shift valve, solenoid pressure regulator valve, OD servo regulator, 3-4 capacity modulator valve, 1-2 and 2-3 shift valves stuck, damaged or assembled incorrectly	• Inspect for damage. Repair as required.
• Bolts not tightened to specifications	• Tighten bolts to specifications.
• SSA or SSB malfunction	• Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as

	required.
• Gaskets damaged	• Inspect for damage and install a new gasket.
• OD servo rod and piston cushion spring or seals damaged	• Inspect for damage. Repair as required.
• Worn or damaged OD servo anchor pins	• Inspect for damage. Repair as required.
• No. 2, No. 4, No. 7 and No. 9 check balls damaged or missing	• Inspect for damage. Repair as required.
• Solenoid screen blocked or damaged	• Clean or install a new screen.
Pump	
• Porosity/cross leaks, balls missing, damaged or leaking	• Inspect for porosity/leaks, balls missing. Install a new pump as required.
• Gaskets damaged	• Inspect for damage. Install new gaskets as required.
OD Band	
• OD band and reverse clutch drum assembly damaged, worn or assembled incorrectly	• Inspect for damage. Repair as required.
• Intermediate one-way clutch assembly damaged	• Inspect for damage. Repair as required.
Forward Clutch Assembly	
• Seals or piston damaged	• Inspect for damage. Repair as required.
• Friction elements worn or damaged	• Inspect for damage. Repair as required.
• Check ball stuck, damaged or not seating correctly	• Inspect for damage. Repair as required.
Input Shaft	
• Seals damaged	• Inspect for damage. Repair as required.

Shift Concerns: 4-3 Shift (Automatic)

Possible Component	Reference/Action
223 — ELECTRICAL ROUTINE	
Powertrain Control System	<ul style="list-style-type: none"> • Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A. Repair as required. Clear DTCs, road test and repeat Self-Test.
<ul style="list-style-type: none"> • Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids, transmission control switch (TCS) 	
323 — HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	<ul style="list-style-type: none"> • Check line and forward clutch at pressure taps; refer to Line Pressure Chart for specifications. If out of specification, check the main controls.
<ul style="list-style-type: none"> • Forward clutch pressure, line pressure 	
Main Controls	<ul style="list-style-type: none"> • Inspect for damage. Repair as required.
<ul style="list-style-type: none"> • 3-4 shift valve, solenoid pressure regulator valve, OD servo regulator, 3-4 capacity modulator, 1-2 and 2-3 shift valves stuck, damaged or assembled 	

incorrectly	
<ul style="list-style-type: none"> • Check balls No. 2, No. 7, No. 9 damaged, missing or not seating correctly 	<ul style="list-style-type: none"> • Inspect for damage. Repair as required.
<ul style="list-style-type: none"> • Bolts not tightened to specifications 	<ul style="list-style-type: none"> • Tighten bolts to specification.
<ul style="list-style-type: none"> • SSA malfunction 	<ul style="list-style-type: none"> • Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
<ul style="list-style-type: none"> • Gaskets damaged 	<ul style="list-style-type: none"> • Inspect for damage and install a new gasket.
<ul style="list-style-type: none"> • OD servo, seal, rod damaged 	<ul style="list-style-type: none"> • Inspect for damage. Repair as required.
<ul style="list-style-type: none"> • Solenoid screen blocked or damaged 	<ul style="list-style-type: none"> • Clean or install a new screen.
Pump	
<ul style="list-style-type: none"> • Porosity/cross leaks, balls missing, damaged or leaking 	<ul style="list-style-type: none"> • Inspect for porosity/leaks, balls missing. Install a new pump as required.
<ul style="list-style-type: none"> • Seal rings damaged 	<ul style="list-style-type: none"> • Inspect for damage. Repair as required.
<ul style="list-style-type: none"> • Gaskets damaged 	<ul style="list-style-type: none"> • Inspect for damage and install a new gasket.
Overdrive Band	
<ul style="list-style-type: none"> • OD band and reverse clutch assembly damaged, worn or assembled incorrectly 	<ul style="list-style-type: none"> • Inspect for damage. Repair as required.
<ul style="list-style-type: none"> • Intermediate one-way clutch assembly damaged 	<ul style="list-style-type: none"> • Inspect for damage. Repair as required.
Forward Clutch Assembly	
<ul style="list-style-type: none"> • Seals or piston damaged 	<ul style="list-style-type: none"> • Inspect for damage. Repair as required.
<ul style="list-style-type: none"> • Friction elements damaged, worn 	<ul style="list-style-type: none"> • Inspect for damage. Repair as required.
<ul style="list-style-type: none"> • Check ball stuck, damaged or not seating correctly 	<ul style="list-style-type: none"> • Inspect for damage. Repair as required.
<ul style="list-style-type: none"> • Forward clutch piston and return spring damaged 	<ul style="list-style-type: none"> • Inspect for damage. Repair as required.
Input Shaft	
<ul style="list-style-type: none"> • Seals damaged 	<ul style="list-style-type: none"> • Inspect for damage. Repair as required.

Shift Concerns: 3-2 Shift (Automatic)

Possible Component	Reference/Action
224 — ELECTRICAL ROUTINE	
Powertrain Control System	<ul style="list-style-type: none"> • Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A. Repair as required. Clear DTCs, road test and repeat Self-Test.
<ul style="list-style-type: none"> • Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids 	
324 — HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	<ul style="list-style-type: none"> • Check pressure at direct clutch tap; refer to Line Pressure Chart for specifications. If not within specification, check the main controls.
<ul style="list-style-type: none"> • Direct clutch 	
Main Controls	

<ul style="list-style-type: none"> • 2-3 shift valve stuck or damaged 	<ul style="list-style-type: none"> • Inspect for damage. Repair as required.
<ul style="list-style-type: none"> • Check balls damaged or missing 	<ul style="list-style-type: none"> • Inspect for damage. Repair as required.
<ul style="list-style-type: none"> • Bolts not tightened to specifications 	<ul style="list-style-type: none"> • Tighten bolts to specifications.
<ul style="list-style-type: none"> • SSB malfunction 	<ul style="list-style-type: none"> • Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
<ul style="list-style-type: none"> • Gaskets damaged 	<ul style="list-style-type: none"> • Inspect for damage and install a new gasket.
Intermediate One-Way Clutch	
<ul style="list-style-type: none"> • Not holding or damaged 	<ul style="list-style-type: none"> • Inspect for damage. Repair as required.
<ul style="list-style-type: none"> • Intermediate one-way retaining clutch snap ring not seated 	<ul style="list-style-type: none"> • Inspect for damage. Repair as required.
Direct Clutch Assembly	
<ul style="list-style-type: none"> • Seals or piston damaged 	<ul style="list-style-type: none"> • Inspect for damage. Repair as required.
<ul style="list-style-type: none"> • Friction element damaged, worn 	<ul style="list-style-type: none"> • Inspect for damage. Repair as required.
<ul style="list-style-type: none"> • Check ball stuck, damaged or not seating correctly 	<ul style="list-style-type: none"> • Inspect for damage. Repair as required.

Shift Concerns: 2-1 Shift (Automatic)

Possible Component	Reference/Action
225 — ELECTRICAL ROUTINE	
Powertrain Control System	<ul style="list-style-type: none"> • Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A. Repair as required. Clear DTCs, road test and repeat Self-Test.
<ul style="list-style-type: none"> • Electrical inputs/outputs, vehicle wiring harnesses, PCM, shift solenoids 	
325 — HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	<ul style="list-style-type: none"> • Check pressure at intermediate clutch tap; refer to Line Pressure Chart for specifications. If not within specifications, check main controls and pump.
<ul style="list-style-type: none"> • Intermediate clutch 	
Main Controls	<ul style="list-style-type: none"> • Inspect for damage. Repair as required. • Tighten bolts to specifications. • Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage; repair as required. • Inspect for damage and install a new gasket.
<ul style="list-style-type: none"> • 1-2 shift valve, 1-2 accumulator solenoid pressure regulator valve stuck, damaged or assembled wrong 	
<ul style="list-style-type: none"> • Bolts not tightened to specifications 	
<ul style="list-style-type: none"> • SSA malfunction 	
<ul style="list-style-type: none"> • Gaskets damaged 	

Pump	
· Gaskets damaged	· Inspect for damage and install a new gasket.
· Porosity/cross leaks	· Inspect for leak/porosity. Install a new pump as required.
Intermediate Clutch Assembly	
· Piston damaged	· Inspect for damage. Repair as required.
· Friction elements damaged, worn	· Inspect for damage. Repair as required.
· End clearance incorrect	· Inspect and correct; refer to Transmission Assembly.
Intermediate One-Way Clutch	
· Damaged	· Inspect for damage. Repair as required.
· Intermediate one-way clutch retaining snap ring not seated	· Inspect for damage. Repair as required.
Planetary One-Way Clutch	
· Not holding or damaged	· Inspect for damage. Repair as required.

Torque Converter Clutch Operation Concerns: No Apply

Possible Component	Reference/Action
240 — ELECTRICAL ROUTINE	
Powertrain Control System	<ul style="list-style-type: none"> · Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test B or Go To Pinpoint Test E. Repair as required. Clear codes, road test and repeat Self-Test.
<ul style="list-style-type: none"> · Electrical inputs/outputs, vehicle wiring harnesses, PCM, torque converter clutch (TCC) solenoid, TFT sensor, OSS 	
340 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage	<ul style="list-style-type: none"> · Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05. Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
<ul style="list-style-type: none"> · Damaged or incorrectly adjusted 	
Incorrect Pressures	<ul style="list-style-type: none"> · Check pressure at line and EPC taps; refer to Line Pressure Chart for specifications. If pressure is low, check EPC and main regulator valve. If within specifications, check the main controls.
<ul style="list-style-type: none"> · Low line pressure, low EPC pressure 	
Main Controls	<ul style="list-style-type: none"> · Inspect for damage. Repair as required. · Tighten bolts to specifications. · Clean or install a new screen. · Activate solenoid using scan tool. If solenoid operation
<ul style="list-style-type: none"> · Solenoid pressure regulator valve, manual valve, bypass clutch control valve and plunger, converter pressure limit valve, drain back valve stuck, damaged or assembled incorrectly 	
<ul style="list-style-type: none"> · Bolts not tightened to specifications 	
<ul style="list-style-type: none"> · Solenoid screen blocked or damaged 	
<ul style="list-style-type: none"> · TCC solenoid malfunction 	

	cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Pump Assembly	
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Porosity/cross leaks, balls leaking	· Inspect for porosity/leaks, ball missing. Install a new pump as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Input Shaft	
· Seals damaged	· Inspect for damage. Repair as necessary.
Torque Converter Assembly	
· Leakage, friction material damaged, internal seals damaged	· Inspect torque converter. Repair or install a new or remanufactured torque converter as required.

Torque Converter Clutch Operation Concerns: Always Applied/Stalls Vehicle

Possible Component	Reference/Action
241 — ELECTRICAL ROUTINE	
Powertrain Control System	
· Electrical inputs/outputs, vehicle wiring harnesses, PCM, torque converter clutch (TCC) solenoid, TFT sensor	· Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test B or Go To Pinpoint Test A . Repair as required. Clear DTCs, road test and repeat Self-Test.
341 — HYDRAULIC/MECHANICAL ROUTINE	
Main Control	
· Drain back valve, torque converter clutch (TCC) and plunger stuck, damaged or assembled incorrectly	· Inspect for damage. Repair as required.
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· TCC solenoid malfunction	· Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
· No. 7 ball incorrect seating	· Inspect for damage. Repair as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Pump Assembly	
· Bolts not tightened to specifications	· Tighten bolts to specifications.
· Ball missing, leaking, porosity/cross leaks	· Inspect for porosity/leaks, balls missing. Install a new pump as required.
· Gaskets damaged	· Inspect for damage and install a new gasket.
Input Shaft	
· Seals damaged	· Inspect for damage. Repair as required.
Torque Converter Assembly	

<ul style="list-style-type: none"> · No end clearance 	<ul style="list-style-type: none"> · Inspect converter and install a new or remanufactured torque converter as required.
<ul style="list-style-type: none"> · Piston plate damaged or stuck to cover 	<ul style="list-style-type: none"> · If cover is heat-stained, install a new converter and determine the cause of the overheat condition.

Torque Converter Clutch Operation Concerns: Cycling/Shudder/Chatter

Possible Component	Reference/Action
242 — ELECTRICAL ROUTINE	
Powertrain Control System	
<ul style="list-style-type: none"> · Electrical inputs/outputs, vehicle wiring harnesses, PCM, torque converter clutch (TCC) solenoid, OSS 	<ul style="list-style-type: none"> · Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test E. Repair as required. Clear DTCs, road test and repeat Self-Test.
<ul style="list-style-type: none"> · Speed control equipped vehicles 	<ul style="list-style-type: none"> · Evaluate with speed control off.
342 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
<ul style="list-style-type: none"> · Condition 	<ul style="list-style-type: none"> · Inspect fluid condition. If burnt, drain fluid and converter. Install a new fluid and filter assembly. Bring vehicle to normal operating temperature. Carry out Transmission Drive Cycle Test. Carry out Transmission Self-Test. If condition still exists, continue diagnostics.
Main Controls	
<ul style="list-style-type: none"> · Solenoid pressure regulator valve, No. 7 check ball, bypass clutch control valve and plunger, converter pressure limit valve stuck, damaged or assembled incorrectly 	<ul style="list-style-type: none"> · Inspect for damage. Repair as required.
<ul style="list-style-type: none"> · Bolts not tightened to specifications 	<ul style="list-style-type: none"> · Tighten bolts to specifications.
<ul style="list-style-type: none"> · Solenoid screen blocked or damaged 	<ul style="list-style-type: none"> · Clean or install a new screen.
<ul style="list-style-type: none"> · TCC solenoid malfunction 	<ul style="list-style-type: none"> · Activate solenoid using scan tool. If solenoid operation cannot be felt when placing hand on solenoid, install a new solenoid. Inspect O-rings for damage. Repair as required.
<ul style="list-style-type: none"> · Gaskets damaged 	<ul style="list-style-type: none"> · Inspect for damage and install a new gasket.
Pump Assembly	
<ul style="list-style-type: none"> · Bolts not tightened to specification 	<ul style="list-style-type: none"> · Tighten bolts to specification.
<ul style="list-style-type: none"> · Porosity/cross leaks, missing balls or leaking 	<ul style="list-style-type: none"> · Inspect for porosity/leaks or missing balls. Install a new pump as required.
<ul style="list-style-type: none"> · Gaskets damaged 	<ul style="list-style-type: none"> · Inspect for damage and install a new gasket.
Input Shaft	
<ul style="list-style-type: none"> · Seals damaged 	<ul style="list-style-type: none"> · Inspect for damage. Repair as required.
Torque Converter	
<ul style="list-style-type: none"> · Excessive end clearance 	<ul style="list-style-type: none"> · Inspect converter. Install a new or re-manufactured torque converter as required.

Other Concerns: No Engine Braking In Manual 2nd Or Manual 1st Position

Possible Component	Reference/Action
250 — ELECTRICAL ROUTINE	
	• No Electrical Concerns
350 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage	
• Damaged or incorrectly adjusted	• Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Main Controls	
• 3-4 shift valve, 1-2 and 2-3 shift valve, gaskets, 3-4 capacity modulator valve, stuck or damaged or assembled incorrectly	• Inspect for damage. Repair as required.
• OD servo assembly damaged or stuck in manual 2nd only.	• Inspect cover, piston and seal for damage. Repair as required.
• Low/Reverse servo assembly damaged or stuck in manual 1st only	• Inspect cover, piston and seal for damage. Repair as required.
Overdrive	
• Reverse band, manual 1st (only) damaged	• Inspect for damage. Repair as required.
• OD band, reverse clutch drum assembly worn or damaged (manual 2nd only)	• Inspect for damage. Repair as required.
Reverse Band (Manual 1st Only)	
• Damaged or incorrectly adjusted	• Inspect for damage. Repair as required.

Other Concerns: Shift Lever Efforts High

Possible Component	Reference/Action
251 — ELECTRICAL ROUTINE	
	• No Electrical Concerns
351 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Digital TR Sensor	
• Damaged or incorrectly adjusted	• Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05 . Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
• Brake shift interlock system, solenoid damaged	• Refer to the appropriate brake section in the workshop manual.
Manual Lever	
• Retaining pin damaged, nut loose, detent spring bent or damaged or Park	• Inspect for damage. Repair as required.

mechanism damaged	
Main Controls	
<ul style="list-style-type: none"> Manual valve stuck or damaged 	<ul style="list-style-type: none"> Inspect for damage. Repair as required.
<ul style="list-style-type: none"> Bolts not tightened to specifications 	<ul style="list-style-type: none"> Tighten bolts to specifications.

Other Concerns: External Leaks

Possible Component	Reference/Action
252 — ELECTRICAL ROUTINE	
Powertrain Control System	<ul style="list-style-type: none"> Inspect for leakage and repair as required.
<ul style="list-style-type: none"> Electrical inputs/outputs, sensor seals leaking (digital TR, OSS, vehicle speed sensor VSS, if equipped, or transmission connector) 	
352 — HYDRAULIC/MECHANICAL ROUTINE	
Case	<ul style="list-style-type: none"> Check the vent for free breathing. Check the fluid level. Check the transmission for overheat conditions. Repair as required.
<ul style="list-style-type: none"> Case vent, case porosity, case cracked 	
Seals/Gaskets	<ul style="list-style-type: none"> Remove all traces of lubricant on exposed surfaces of the transmission. Check the vent for free breathing. Operate the transmission at normal temperatures and perform fluid leakage check. Repair as required.
<ul style="list-style-type: none"> Leakage at gaskets, seals, etc. (refer to external sealing illustration for potential leak locations) 	
Other	<ul style="list-style-type: none"> Locate the source of the leak. Repair as required.
<ul style="list-style-type: none"> Cooler fitting, cooler lines pressure tap, converter drain plug, band anchor pins 	

Other Concerns: Poor Vehicle Performance

Possible Component	Reference/Action
253 — ELECTRICAL ROUTINE	
Powertrain Control System	<ul style="list-style-type: none"> Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test A, Go To Pinpoint Test B or Go To Pinpoint Test C. Repair as required. Clear codes, road test and repeat Self-Test. Also refer to Routines 241/341 Torque Converter Operation Concern: Always Applied. Inspect air intake/air filter system. Check the fuel system and fuel pressure. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Inspect the exhaust system for restriction. Refer to Section 309-00.
<ul style="list-style-type: none"> Electrical inputs/outputs, vehicle wiring harnesses, shift solenoids, digital TR sensor, torque converter clutch (TCC) solenoid, transmission fluid temperature (TFT) sensor 	
<ul style="list-style-type: none"> Engine driveability concerns 	
353 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Digital TR Sensor	

<ul style="list-style-type: none"> · Damaged or incorrectly adjusted 	<ul style="list-style-type: none"> · Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05. Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
Verify Correct Shift Scheduling and Engagements	
<ul style="list-style-type: none"> · See Reference/Action 	<ul style="list-style-type: none"> · Go to the appropriate diagnostic routines.
Torque Converter Clutch Always Applied	
<ul style="list-style-type: none"> · See Reference/Action 	<ul style="list-style-type: none"> · Go to Hydraulic/Mechanical Routine 241/341.
Torque Converter Clutch	
<ul style="list-style-type: none"> · Damaged 	<ul style="list-style-type: none"> · Inspect torque converter. Install a new converter as outlined.

Other Concerns: Noise/Vibration — Forward Or Reverse

Possible Component	Reference/Action
254 — ELECTRICAL ROUTINE	
	<ul style="list-style-type: none"> · No Electrical Concerns
354 — HYDRAULIC/MECHANICAL ROUTINE	
For Noises/Vibrations That Change With Engine Speed	
<ul style="list-style-type: none"> · Converter components/balance weight 	<ul style="list-style-type: none"> · Locate source of disturbance. Repair as required.
<ul style="list-style-type: none"> · Fluid level (low) pump cavitation 	
<ul style="list-style-type: none"> · Pump assembly 	
<ul style="list-style-type: none"> · Engine drive accessories 	
<ul style="list-style-type: none"> · Cooler lines grounding out 	
<ul style="list-style-type: none"> · Flexplate 	
For Noises/Vibrations That Change With Vehicle Speed	
<ul style="list-style-type: none"> · Engine mounts loose or damaged 	<ul style="list-style-type: none"> · Locate source of disturbance and repair as required.
<ul style="list-style-type: none"> · Driveline concerns: <ul style="list-style-type: none"> ■ U-joints ■ Rear axle ■ Suspension ■ Modifications <p>1st Gear:</p> <ul style="list-style-type: none"> ■ Low one-way clutch ■ Gearset ■ Friction elements 	<ul style="list-style-type: none"> · Refer to the following shift routine(s) for further diagnosis: <ul style="list-style-type: none"> ■ Shift 1-2, Routine 320 ■ Shift 2-3, Routine 321 ■ Shift 3-4, Routine 322 ■ Shift 4-3, Routine 323 ■ Shift 3-2, Routine 324 ■ Shift 2-1, Routine 325 ■ Torque Converter Cycling 242/342
<ul style="list-style-type: none"> · 2nd Gear: <ul style="list-style-type: none"> ■ Intermediate one-way clutch ■ Intermediate clutch piston bleed hole out of 	

<ul style="list-style-type: none"> 12 o'clock position ■ Friction elements 	
<ul style="list-style-type: none"> • 3rd Gear: <ul style="list-style-type: none"> ■ Torque converter ■ Case to planet support spring ■ Friction elements 	
<ul style="list-style-type: none"> • 4th Gear: <ul style="list-style-type: none"> ■ Gear set ■ Friction elements ■ Torque converter 	
<ul style="list-style-type: none"> • Reverse: <ul style="list-style-type: none"> ■ Gear set ■ Friction elements 	
<ul style="list-style-type: none"> • Output shaft splines worn or damaged 	
Other Noises/Vibrations	
<ul style="list-style-type: none"> • Main controls, valve resonance 	<ul style="list-style-type: none"> • Locate source of disturbance and repair as required.
<ul style="list-style-type: none"> • Shift cable: <ul style="list-style-type: none"> ■ Vibration ■ Grounding ■ Cooler lines ■ Grounding 	

Other Concerns: Engine Will Not Crank

Possible Component	Reference/Action
255 — ELECTRICAL ROUTINE	
Powertrain Control System	<ul style="list-style-type: none"> • Carry out Self-Test. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the Powertrain Control System. Go To Pinpoint Test C. Repair and adjust as required.
<ul style="list-style-type: none"> • Electrical inputs/outputs, vehicle wiring harnesses, engine starting system hardware, digital TR sensor 	
355 — HYDRAULIC/MECHANICAL ROUTINE	
Shift Linkage, Digital TR Sensor	<ul style="list-style-type: none"> • Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05. Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
<ul style="list-style-type: none"> • Damaged or incorrectly adjusted 	

Other Concerns: No Park (P) Range

Possible Component	Reference/Action
256 — ELECTRICAL ROUTINE	
<ul style="list-style-type: none"> • No Electrical Concerns 	
356 — HYDRAULIC/MECHANICAL ROUTINE	

Shift Linkage, Digital TR Sensor	<ul style="list-style-type: none"> Inspect and repair as required. Verify transmission shift cable adjustment; refer to Section 307-05. Adjust transmission shift cable as necessary. After repairing transmission shift cable, verify that the digital TR sensor is correctly adjusted. Adjust the digital TR sensor as necessary.
<ul style="list-style-type: none"> Damaged or incorrectly adjusted 	
Park Mechanism	<ul style="list-style-type: none"> Inspect for damage or incorrect assembly and repair as required.
<ul style="list-style-type: none"> Output shaft ring, parking brake pawl, parking pawl return spring, park rod guide cup, parking pawl shaft, parking pawl actuating rod, manual lever detent spring damaged or assembled incorrectly 	

Other Concerns: Overheating

Possible Component	Reference/Action
257 — ELECTRICAL ROUTINE	
Refer to Routine 240/340, Torque Converter Operation Concern: No Apply	
357 — HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
<ul style="list-style-type: none"> Incorrect level 	<ul style="list-style-type: none"> Adjust fluid to correct level.
<ul style="list-style-type: none"> Condition 	<ul style="list-style-type: none"> Inspect condition of fluid.
Other	
<ul style="list-style-type: none"> Damaged, blocked or reversed cooler lines or restriction in the transmission oil cooler 	<ul style="list-style-type: none"> Inspect for damage and correct installation. Repair as required.
Vehicle Concerns Causing Engine Overheating	
	<ul style="list-style-type: none"> Refer to the appropriate engine cooling section.
Main Controls	
<ul style="list-style-type: none"> Drain back valve, torque clutch control valve, converter limit valve stuck, damaged or assembled incorrectly 	<ul style="list-style-type: none"> Inspect for damage and repair as required.
Torque Converter Clutch	
<ul style="list-style-type: none"> No apply 	<ul style="list-style-type: none"> Refer to Routine 240/340.

Transmission Fluid Cooler — Backflushing and Cleaning


1.  **CAUTION: Do not use any supplemental transmission fluid additives or cleaning agents. The use of these products could cause internal transmission components to fail; this will effect the operation of the transmission.**

Conduct backflushing with a suitable torque converter/fluid cooler cleaner. Test your equipment to make sure that a vigorous fluid flow is present before proceeding. Install a new filter in the flush equipment if flow is weak or contaminated.

2. To aid in attaching the cleaner to the transmission steel cooler lines, connect two additional rubber hoses to the transmission end of the steel transmission cooler lines as described below.
 - Connect the cleaner tank pressure line to the steel transmission cooler return line (longest line).
 - Connect a tank return hose to the steel transmission cooler pressure line (shorter line). Place the outlet end of this hose in the solvent tank reservoir.
 3. Turn on solvent pump and allow the solvent to circulate a minimum of 5 minutes (cycling switch on and off will help dislodge contaminants in cooler system).
 4. Switch off the solvent pump and disconnect the solvent pressure hose from the transmission cooler return line.
 5. Use compressed air to blow out the cooler(s) and lines (blow air into the transmission cooler return line) until all solvent is removed.
 6. Remove the rubber return hose from the remaining steel cooler line.
-

Transmission Fluid Drain and Refill

Special Tool(s)

 ST2654-A	Automatic Transmission Flush and Fill Machine 211-00018
	Automatic Transmission Flush and Fill Machine 199-00010 or equivalent

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM	MERCON®V

Draining



CAUTION: Always refer to the instructions supplied with the flush and fill machine.

NOTE: Draining fluid from the transmission by removing only the fluid pan is acceptable for vehicles that do not have a torque converter drain plug, for normal or severe duty fluid maintenance.

NOTE: A new procedure for draining and adding transmission fluid using a suitable transmission flush and fill machine has been added. The following procedure has different methods for draining and refilling the listed vehicles:

- All vehicles using a suitable flush and fill machine.
- Vehicles equipped with a torque converter drain plug.
- Vehicles without a torque converter drain plug.

Use the method that is applicable to your vehicle.

All vehicles using a suitable flush and fill machine

1. With the vehicle in NEUTRAL, position on a hoist. For additional information, refer to [Section 100-02](#).
2. Use a suitable flush and fill machine to change the fluid.
3. When connecting the flush and fill machine, connect the machine to the fluid cooler tube after the fluid cooler on the cooler return line. This will help remove any foreign material trapped in the fluid coolers.

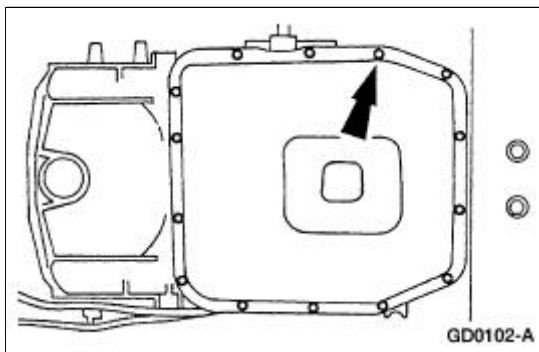
Refill

4. Use only clean automatic transmission fluid.
5. Once the fluid exchange has been completed, disconnect the flush and fill machine. Reconnect any disconnected fluid cooler tubes.
6. With the engine running and the transmission at normal operating temperature 66-77°C (150-170°F), check and adjust the transmission fluid level, and check for any leaks. If fluid is needed, add fluid in increments of 0.24-liter (0.5-pint) until the correct level is achieved (fluid should be in the cross-hatched area of the fluid level indicator).

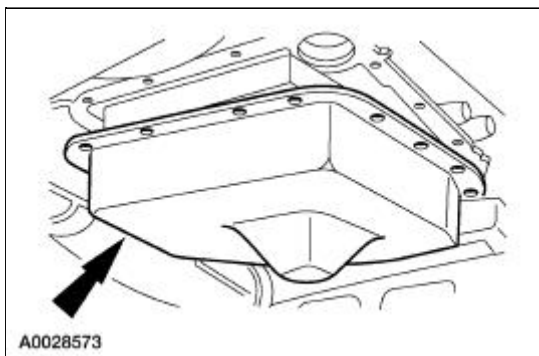
Draining

Vehicles equipped with a torque converter drain plug

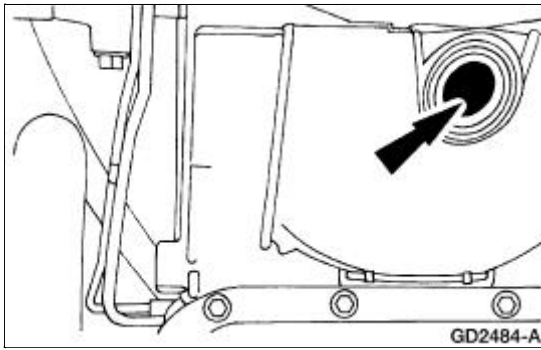
1. With the vehicle in NEUTRAL, position on a hoist. For additional information, refer to [Section 100-02](#).
2. Loosen the transmission fluid pan bolts and allow the fluid to drain.



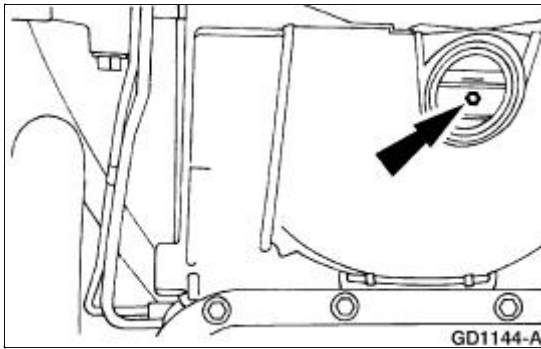
3. After the fluid has drained, remove the transmission fluid pan.



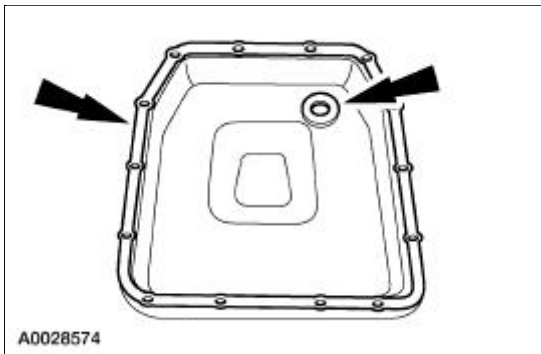
4. Do not remove the fluid filter. It is not necessary to change the fluid filter during a normal maintenance fluid change.
5. Remove the torque converter drain plug cover.



6. Remove the torque converter drain plug and discard.



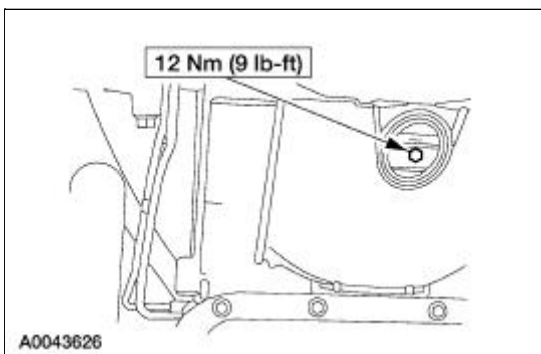
7. Clean and inspect the transmission fluid pan, transmission fluid pan gasket and magnet.



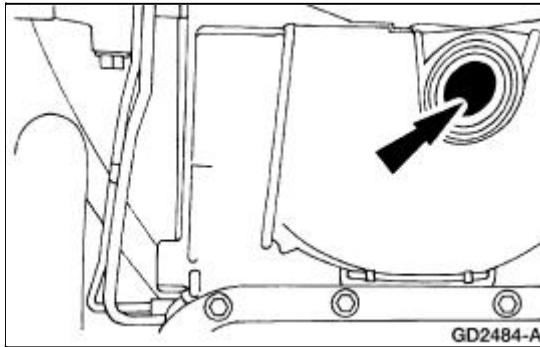
8. Thoroughly flush the cooler tubes. For additional information, refer to [Transmission Fluid Cooler — Backflushing and Cleaning](#) in this section.

Refill

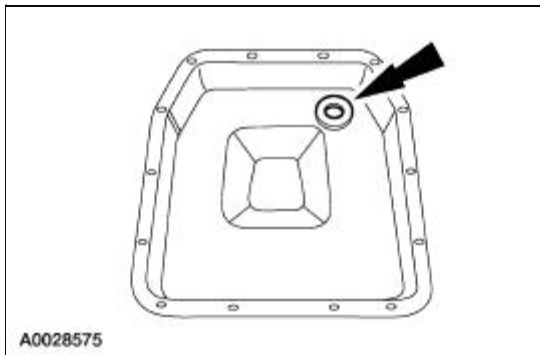
9. After the torque converter has drained, install a new drain plug.



10. Install the torque converter drain plug cover.



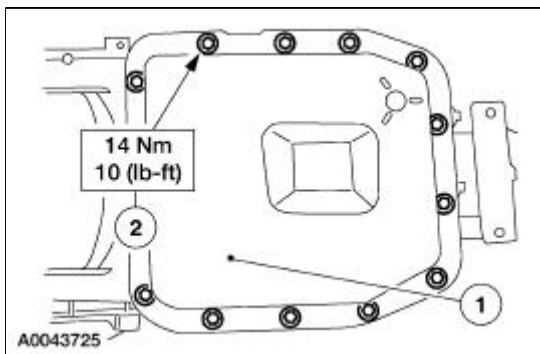
11. Position the magnet into the transmission fluid pan.



12. **NOTE:** The fluid pan gasket is reusable, clean and inspect for damage. If not damaged, the gasket should be reused.

Install the fluid pan and gasket.

1. Position the fluid pan with the gasket in place.
2. Install the bolts.



13. **⚠ CAUTION:** The use of any other transmission fluid can result in the transmission failing to operate in a normal manner or transmission failure.

Fill the transmission.

- Add 4.7 liters (5 qts) of clean automatic transmission fluid to the transmission through the fluid filler tube.

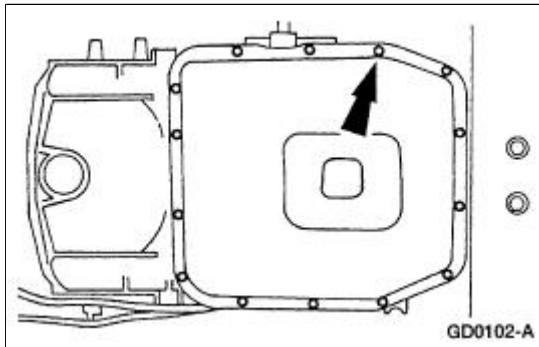
14. Start the engine. Move the transmission range selector lever through all the gear ranges, checking for engagements.
15. With the engine running and the transmission at normal operating temperature 66-77°C (150-

170°F), check and adjust the transmission fluid level, and check for any leaks. If fluid is needed, add fluid in increments of 0.24-liter (0.5-pint) until the correct level is achieved (fluid should be in the cross-hatched area of the fluid level indicator).

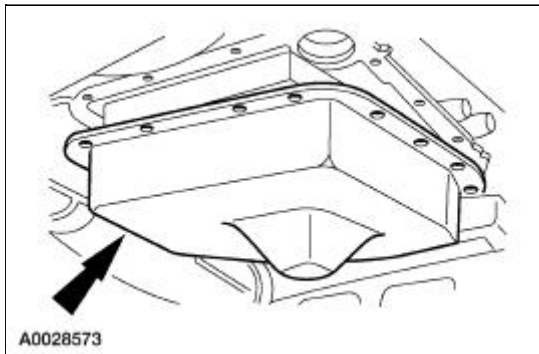
Draining

Vehicles without a torque converter drain plug

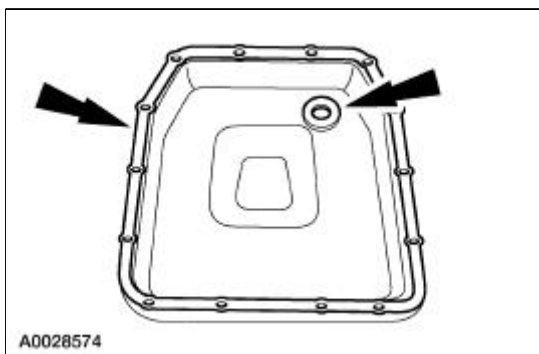
1. With the vehicle in NEUTRAL, position on a hoist. For additional information, refer to [Section 100-02](#).
2. Loosen the transmission fluid pan bolts and allow the fluid to drain.



3. After the fluid has drained, remove the transmission fluid pan.



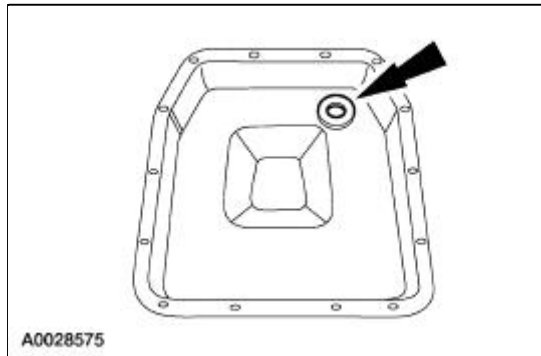
4. Do not remove the fluid filter. It is not necessary to change the fluid filter during a normal maintenance fluid change.
5. Clean and inspect the transmission fluid pan, transmission fluid pan gasket and magnet.



6. Thoroughly flush the cooler tubes. For additional information, refer to [Transmission Fluid Cooler — Backflushing and Cleaning](#) in this section.

Refill

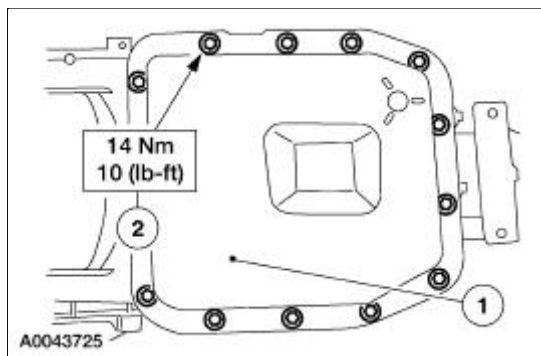
7. Position the magnet into the transmission fluid pan.



8. **NOTE:** The fluid pan gasket is reusable, clean and inspect for damage. If not damaged, the gasket should be reused.

Install the fluid pan and gasket.

1. Position the fluid pan with the gasket in place.
2. Install the bolts.



9. **CAUTION:** The use of any other transmission fluid can result in the transmission failing to operate in a normal manner or transmission failure.

Fill the transmission.

- Add 4.7 liters (5 qts) of clean automatic transmission fluid to the transmission through the fluid filler tube.
10. Start the engine. Move the transmission range selector lever through all the gear ranges, checking for engagements.
 11. With the engine running and the transmission at normal operating temperature 66-77°C (150-170°F), check and adjust the transmission fluid level, and check for any leaks. If fluid is needed, add fluid in increments of 0.24-liter (0.5-pint) until the correct level is achieved (fluid should be in the cross-hatched area of the fluid level indicator).
-

Fluid Pan, Gasket and Filter

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

1. Normal maintenance requires periodic automatic transmission fluid changes. If a major repair, such as a clutch, band, bearing, etc., is required, the automatic transmission will also have to be removed for repair. At this time, the torque converter, transmission cooler and tubes must be thoroughly flushed to remove any dirt. The transmission fluid needs to be changed if evidence of fluid contamination is found. When used under continuous or severe conditions, the transmission and torque converter should be drained and refilled with fluid as specified.

2.  **CAUTION: Do not use any supplemental transmission fluid additives or cleaning agents. The use of these products could cause internal transmission components to fail; this will effect the operation of the transmission.**

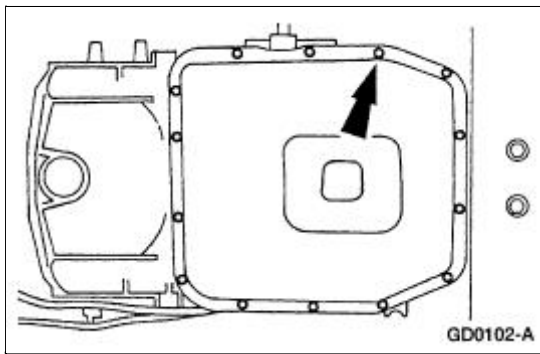
 **CAUTION: Use of a fluid other than specified could result in transmission failure.**

Refer to the vehicle certification label affixed to the LH front door lock face panel or door pillar for the transmission code.

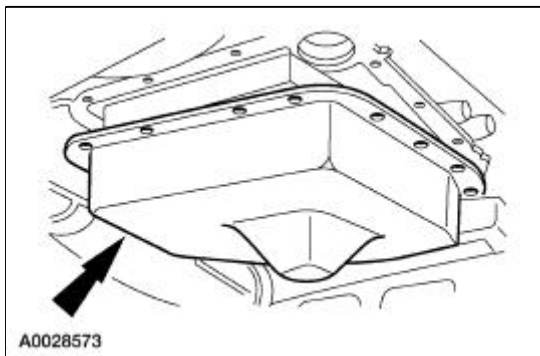
3. When filling a dry transmission and torque converter, refer to General Specifications chart in this section for capacity. Check the fluid level.

Removal

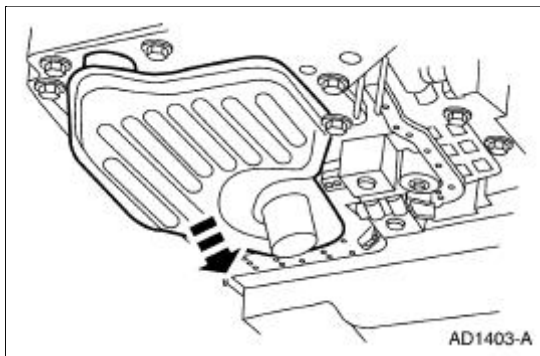
1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
3. Place a drain pan under the transmission fluid pan.
4. Drain transmission fluid.
 - Loosen the transmission fluid pan bolts and allow fluid to drain. After fluid is drained remove the bolts.



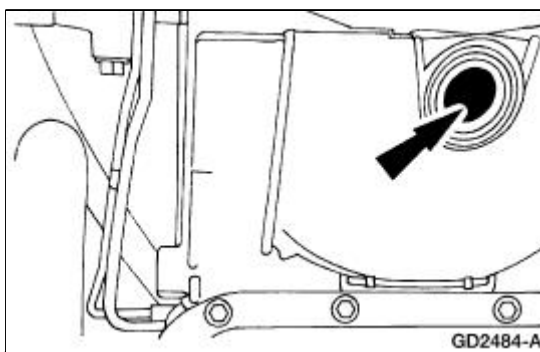
5. Remove the transmission fluid pan and transmission fluid pan gasket.



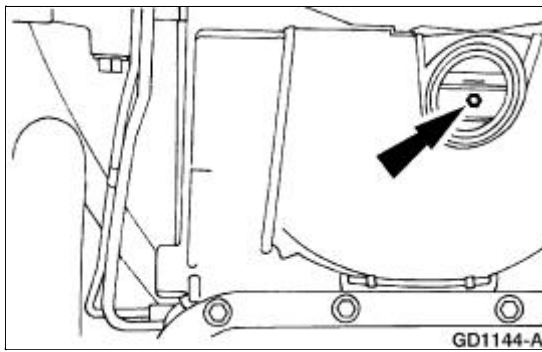
6. Pull down evenly and remove the transmission fluid filter and seal.



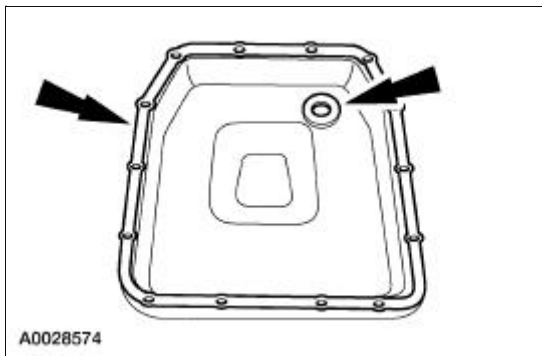
7. Remove torque converter housing plug.



8. Remove the torque converter drain plug and drain the torque converter.
 - Rotate the crankshaft to access the drain plug.



9. Clean and inspect the transmission fluid pan, gasket and magnet.

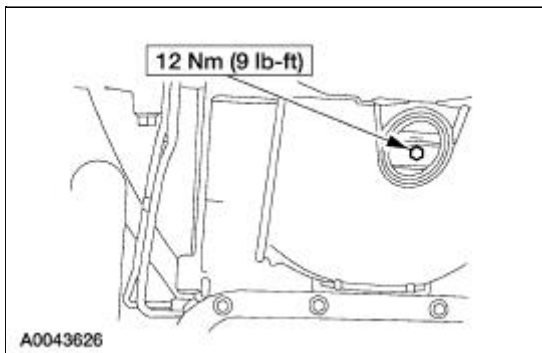


10. Flush the fluid cooler tubes. For additional information, refer to [Transmission Fluid Cooler — Backflushing and Cleaning](#) in this section.

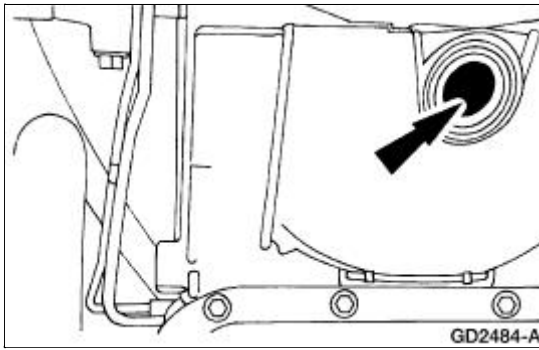
Installation


1. **NOTE:** A new torque converter drain plug must be used.

Install the torque converter drain plug.



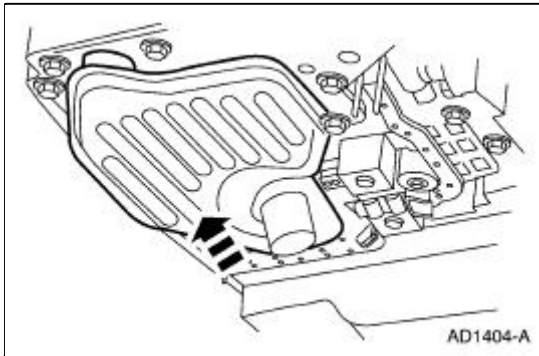
2. Install the torque converter housing plug.



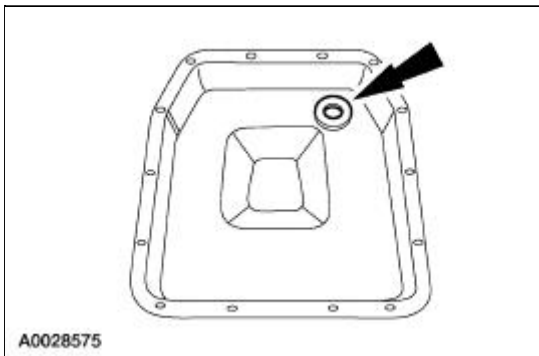
3.  **CAUTION:** If installing a new filter, and the seal remains in the main control bore, carefully use a small screwdriver to remove the seal. Use care not to damage the main control bore.

NOTE: If transmission is being repaired for a contamination-related failure, use a new filter and seal. The filter may be reused if no excessive contamination is present.

Install a new fluid filter and seal as required.



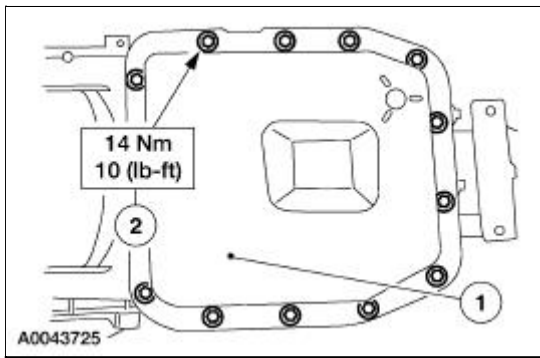
4. Position the pan magnet into the transmission fluid pan.



5. **NOTE:** The transmission fluid pan gasket is reusable. Clean and inspect for damage; if not damaged, the gasket should be reused.

Install the transmission fluid pan and gasket.

1. Position the transmission fluid pan and gasket.
2. Install the transmission fluid pan bolts.



6. Lower the vehicle.
7. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

Connect the battery ground cable. For additional information, refer to [Section 414-01](#).

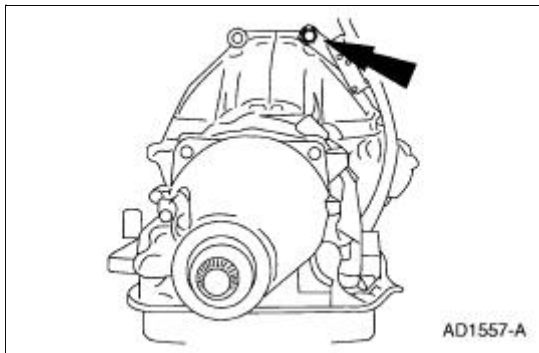
8. **NOTE:** When filling a dry transmission and converter, start with a minimum of 4.7 liters (5 quarts).

Fill the transmission to the correct level with clean automatic transmission fluid.

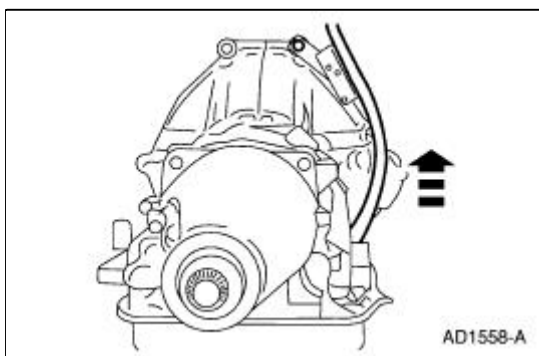
Transmission Filler Tube

Removal

1. Remove the bolt.

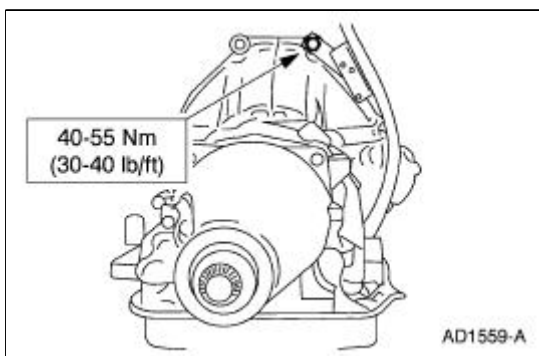


2. Remove the fluid filler tube.




Installation

1. To install, reverse the removal procedure.




Main Control Valve Body

Special Tool(s)

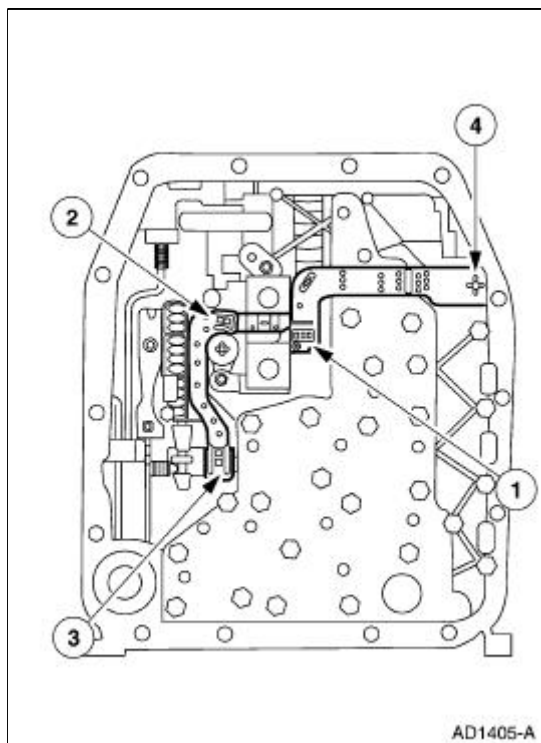
 ST2545-A	Gauge, Transmission Solenoid Connectors 307-426
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Removal

1. Drain transmission fluid and remove the transmission fluid pan and filter. For additional information, refer to [Fluid Pan, Gasket and Filter](#).
2.  **CAUTION: Do not pull on the molded lead frame. This may cause damage to the connector ends. Carefully pry up on the locking tabs to disconnect the solenoids. Disconnect the molded lead frame from the solenoids.**

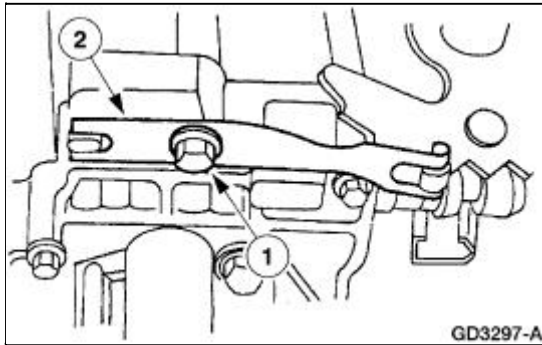
Disconnect the molded lead frame from the solenoids.

1. Disconnect the shift solenoid SSA and SSB.
2. Disconnect the torque converter clutch (TCC).
3. Disconnect the electronic pressure control (EPC) solenoid.
4. Disconnect the bulkhead inter-connector.

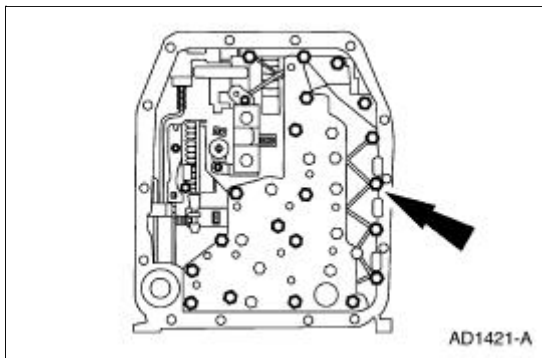


3. Remove the manual control valve detent lever spring.
 1. Remove the bolt.

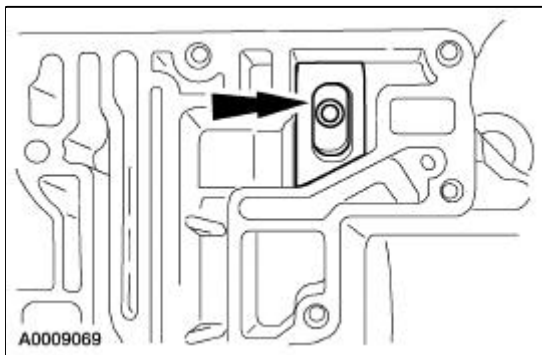
2. Remove the manual control valve detent lever spring.



4. Remove the 24 valve body-to-case bolts.



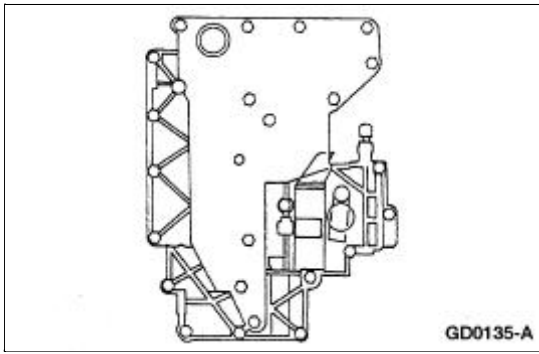
5. Remove the main control valve body and discard the pump outlet screen.



Installation

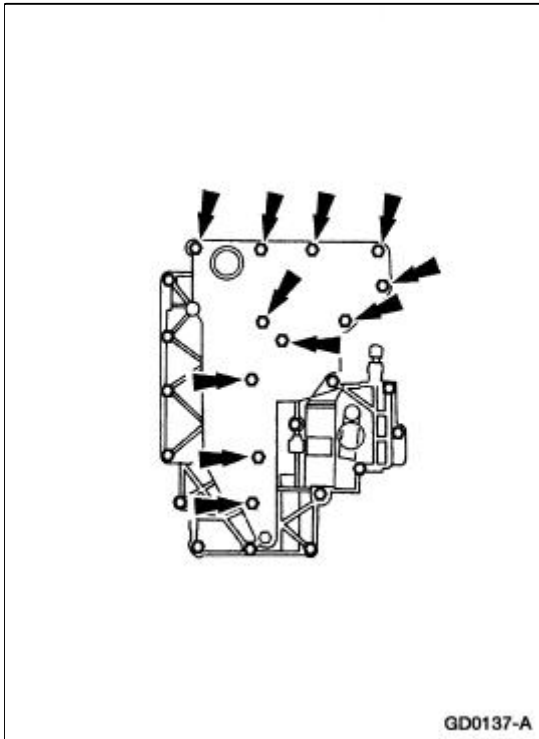
1. **NOTE:** Make sure that the drive pin of the manual valve detent lever assembly engages the manual valve in the correct location prior to installing the bolts.

Position the main control valve body gasket and main control valve body using the two alignment bolts as a guide.



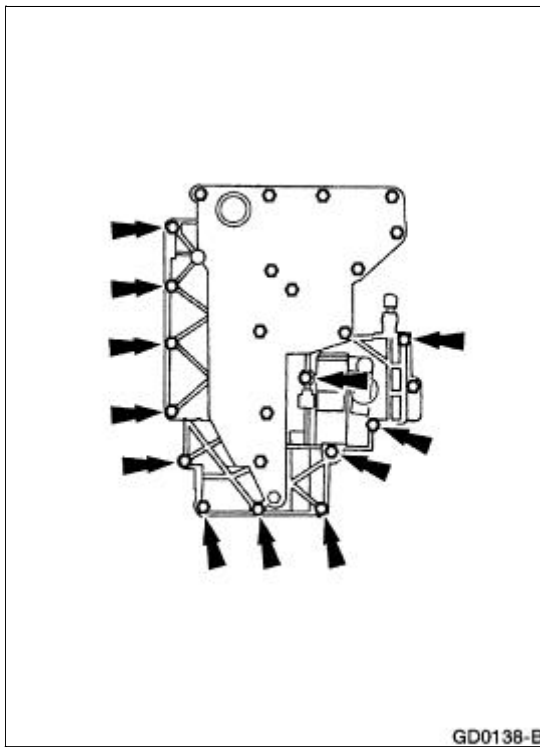
2. **NOTE:** The main control valve body bolts will be tightened in later steps.

Loosely install the bolts.

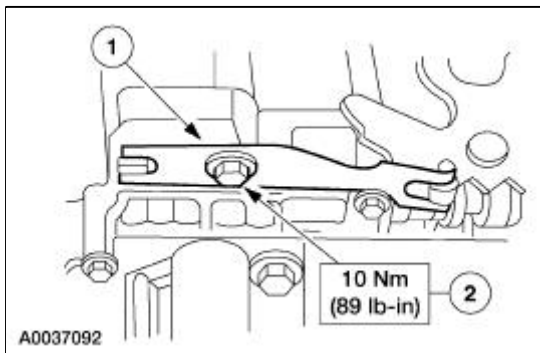


3. **NOTE:** The main control valve body bolts will be tightened in later steps.

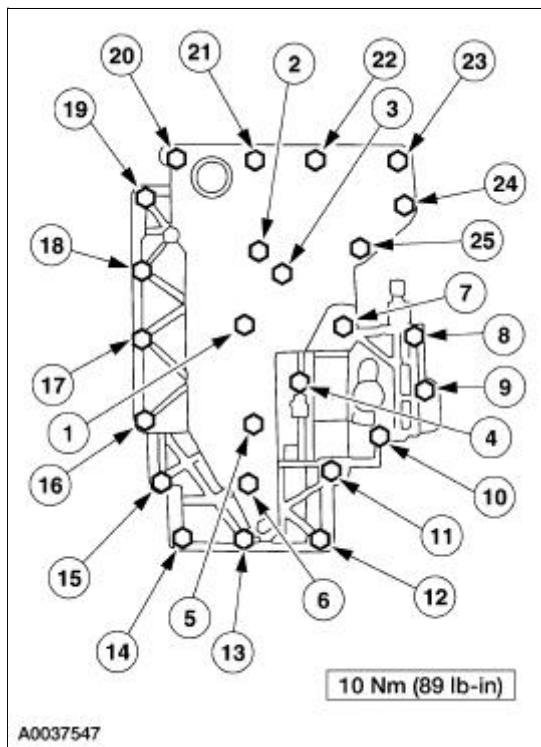
Loosely install the bolts.



4. Install the manual control valve detent lever spring.
 1. Position the manual control valve detent lever spring.
 2. Install the bolt.

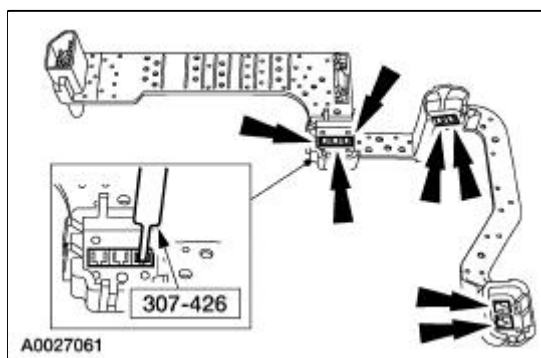


5. Tighten the main control valve body bolts in the sequence shown.



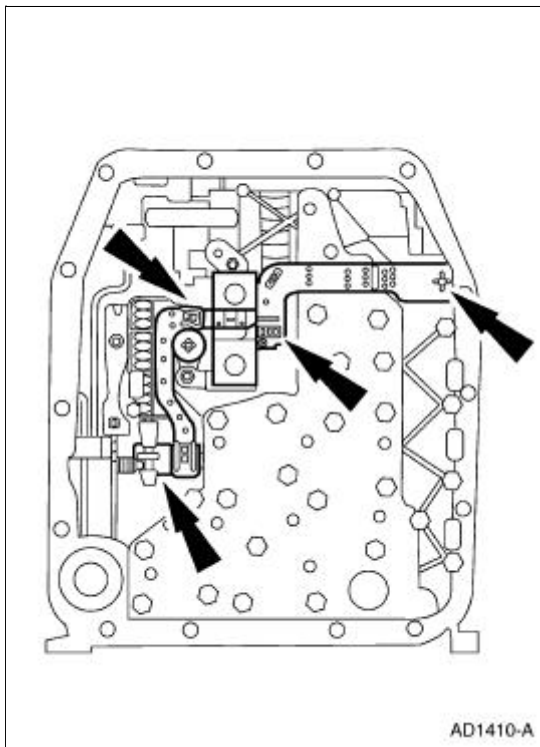
6. Inspect the lead frame for damage.

- Using the special tool, check all lead frame solenoid connections. The gauge should fit tightly and not fall out after being inserted.
- If the special tool passes through any lead frame connector pins or does not feel like it makes a good contact, install a new lead frame.

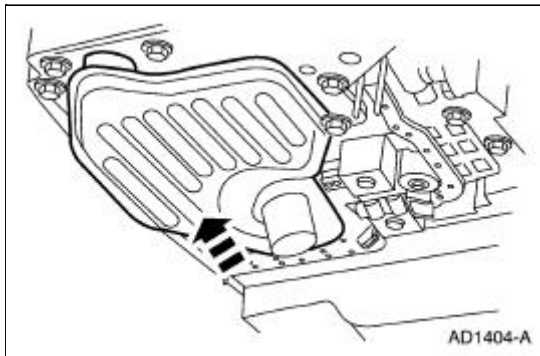


7. Connect the molded lead frame to the solenoids.

- Connect the bulkhead inter-connector by pressing it in place by hand and fully seating the connector in place.
- Connect the EPC solenoid by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.
- Connect the TCC by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.
- Connect the shift solenoid SSA and SSB by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.






8. Install the transmission filter and pan. For additional information, refer to [Fluid Pan, Gasket and Filter](#) in this section.



Extension Housing Seal and Gasket

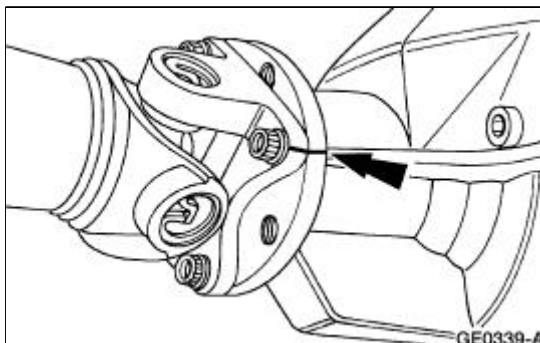
Special Tool(s)

 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST1188-A	Installer, Transmission Extension Housing Fluid Seal 308-002 (T61L-7657-A)
 ST1192-A	Remover, Transmission Fluid Seal 307-048 (T74P-77248-A)

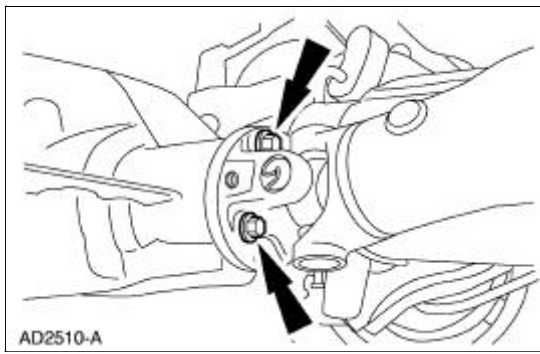
Removal

1. Drain the transmission fluid. For additional information, refer to [Fluid Pan, Gasket and Filter](#) in this section.
2. **NOTE:** The output shaft and driveshaft are a balanced assembly.

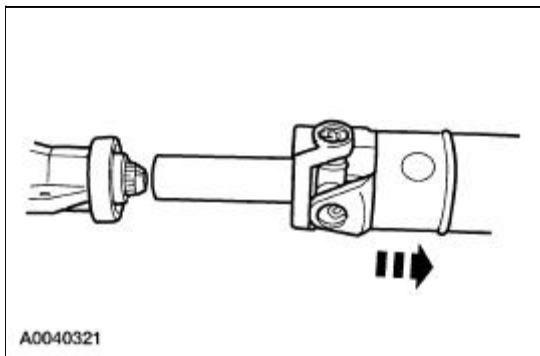
Mark the driveshaft flange and the rear companion flange for correct alignment during assembly.



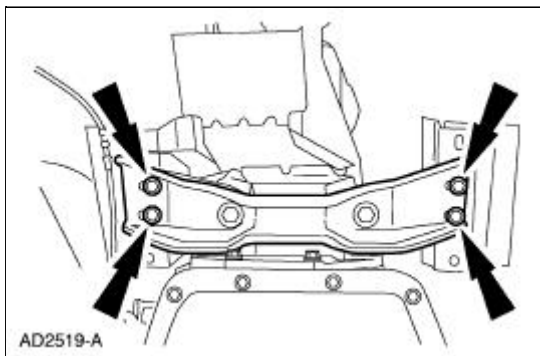
3. Remove the four driveshaft bolts.



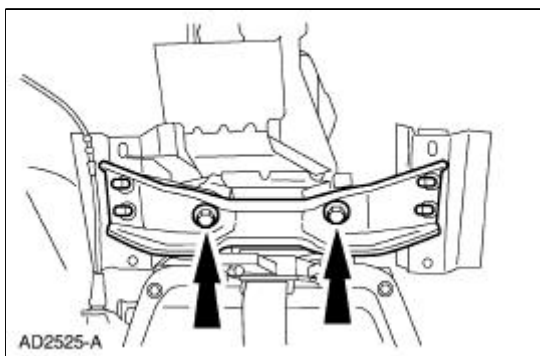
4. Separate the driveshaft from the transmission.



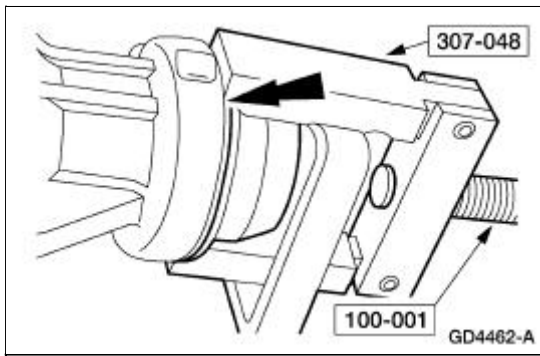
5. Use a high-lift transmission jack to support the transmission.
6. Remove the transmission crossmember bolts.



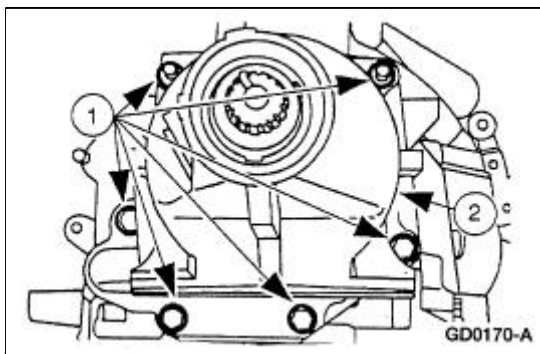
7. Remove the transmission mount and crossmember.



8. Using the special tools, remove the extension housing seal.

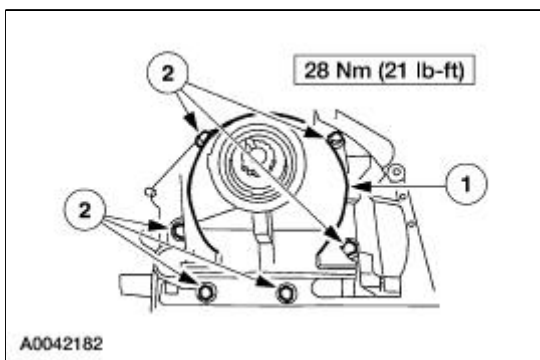


9. Lower the transmission to access the extension housing bolts.
10. Remove the extension housing and gasket.
 1. Remove the bolts and the nuts.
 2. Remove the extension housing and gasket.

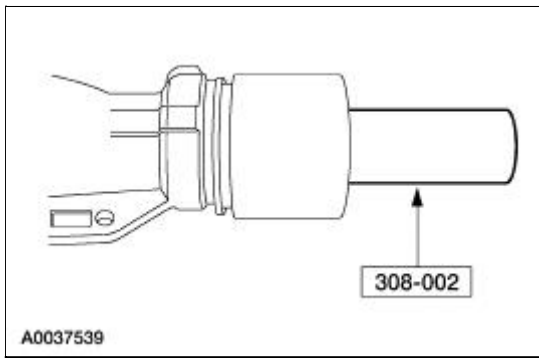


Installation

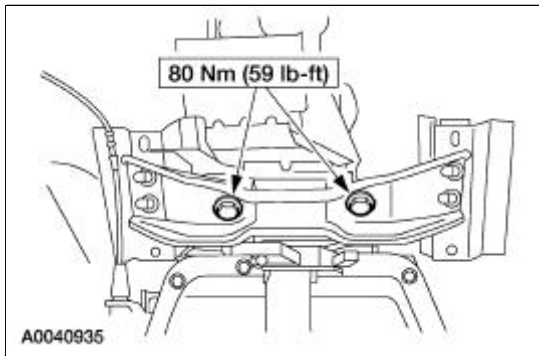
1. Install the extension housing and gasket.
 1. Install the extension housing gasket and housing.
 2. Install the bolts and the nuts.



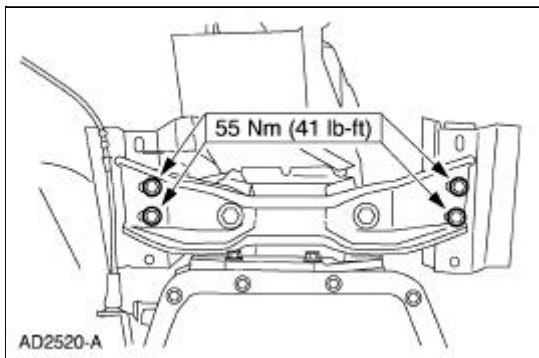
2. Using the special tool, install the new extension housing seal.



3. Raise and position the transmission.
4. Install the transmission mount and crossmember.



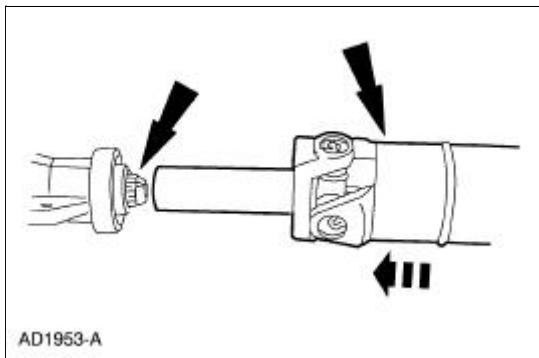
5. Install the transmission crossmember bolts.



6. Remove high-lift transmission jack.
7. **NOTE:** The output shaft and the driveshaft are a balanced assembly.

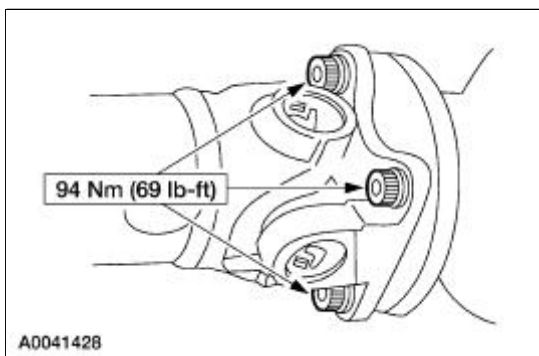
Install the driveshaft.

- Align the yellow dots and position the driveshaft on the transmission.
- Install the driveshaft.



- NOTE:** To maintain driveshaft balance, align the marks made during disassembly for the rear axle flange and the driveshaft yoke.


Install the four bolts.



- Install the filter and pan. For additional information, refer to [Fluid Pan, Gasket and Filter](#) in this section.
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Electronic Pressure Control (EPC) Solenoid

Special Tool(s)

 ST2545-A	Gauge, Transmission Solenoid Connectors 307-426
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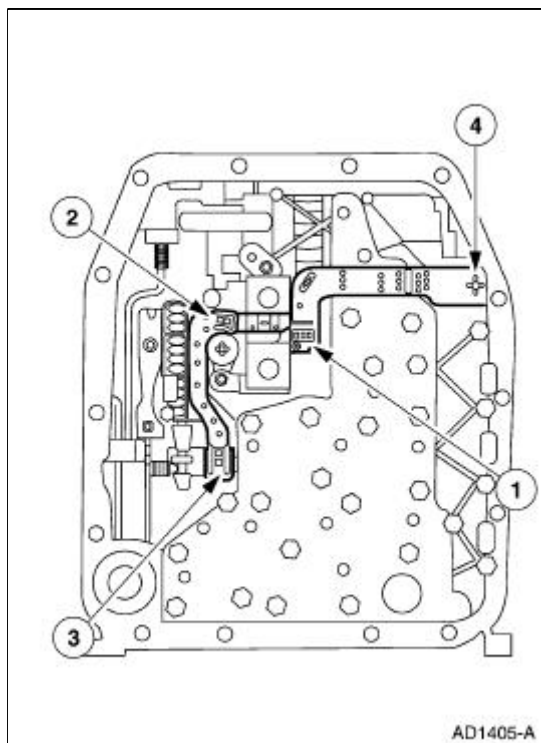
Removal

1. Remove the manual control lever. For additional information, refer to [Manual Control Lever Shaft and Seal](#) in this section.

2.  **CAUTION: Do not pull on the molded lead frame. This may cause damage to the connector ends. Carefully pry up on the locking tabs to disconnect the solenoids. Disconnect the molded lead frame from the solenoids.**

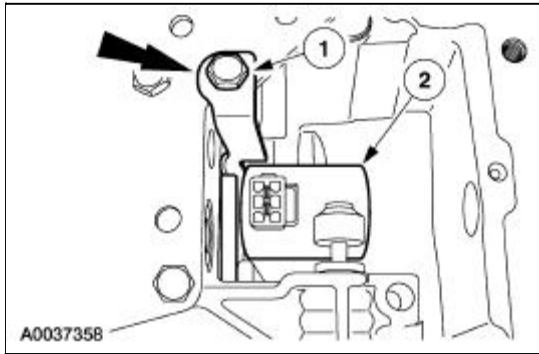
Disconnect the molded lead frame from the solenoids.

1. Disconnect the shift solenoid SSA and SSB.
2. Disconnect the torque converter clutch (TCC).
3. Disconnect the electronic pressure control (EPC) solenoid.
4. Disconnect the bulkhead inter-connector.



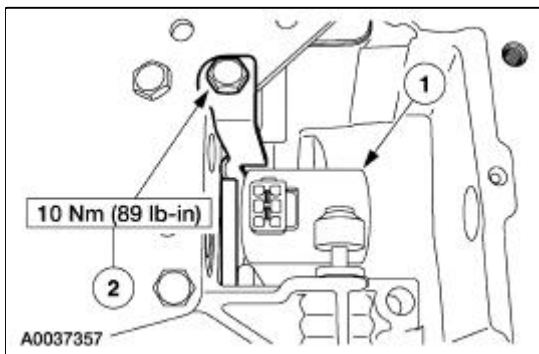
3. Remove the EPC solenoid.
 1. Remove the bolt and EPC solenoid bracket.

2. Remove the EPC solenoid.

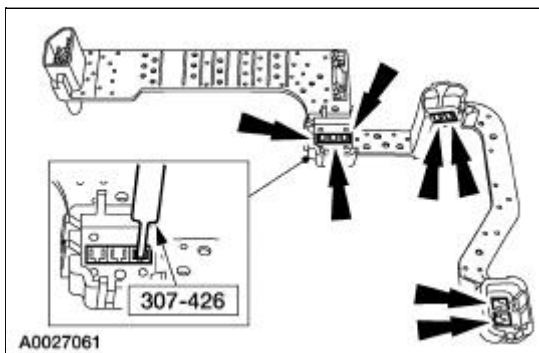


Installation

1. Install the EPC solenoid.
 1. Install the EPC solenoid.
 2. Install the EPC solenoid bracket and bolt.



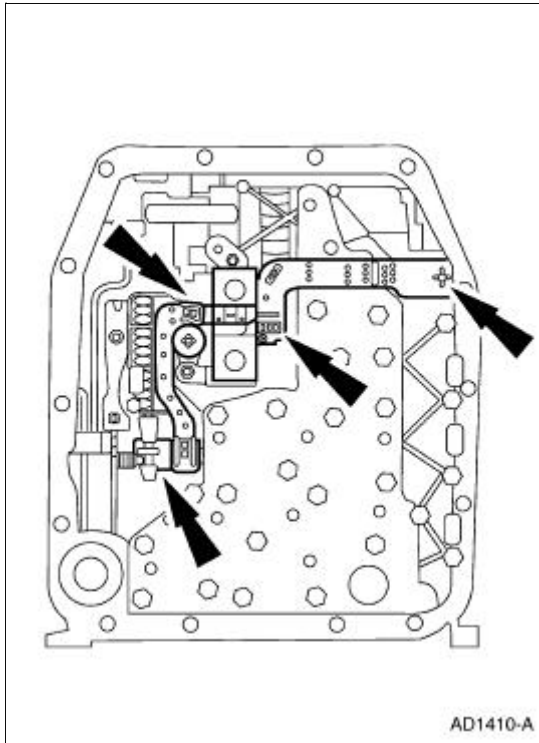
2. Inspect the lead frame for damage.
 - Using the special tool, check all lead frame solenoid connections. The gauge should fit tightly and not fall out after being inserted.
 - If the special tool passes through any lead frame connector pins or does not feel like it makes a good contact, install a new lead frame.



3. Connect the molded lead frame to the solenoids.
 - Connect the bulkhead inter-connector by pressing it in place by hand and fully seating the connector in place.
 - Connect the EPC solenoid by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.
 - Connect the TCC by pressing it in place by hand and fully seating the connector in place.

Make sure that the terminals pass fully through the connector slots.



- Connect the shift solenoid SSA and SSB by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.



4. Install the manual control lever. For additional information, refer to [Manual Control Lever Shaft and Seal](#) in this section.
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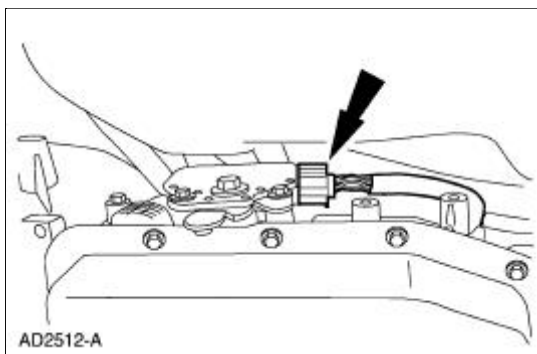
Manual Control Lever Shaft and Seal

Special Tool(s)

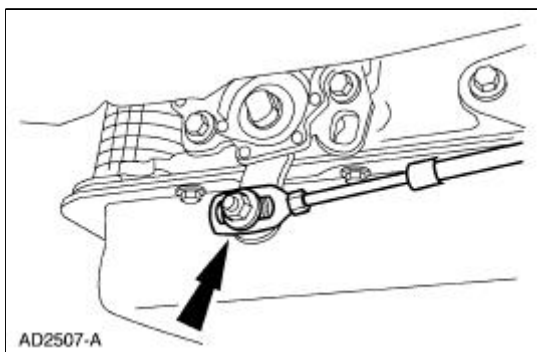
 ST1199-A	Installer, Shift Shaft Fluid Seal 307-050 (T74P-77498-A)
 ST1633-A	Alignment Gauge, TR Sensor 307-351 (T97L-70010-A)

Removal

1. Drain the transmission fluid and remove the fluid pan and filter. For additional information, refer to [Fluid Pan, Gasket and Filter](#) in this section.
2. Disconnect the digital transmission range (TR) sensor electrical connector.

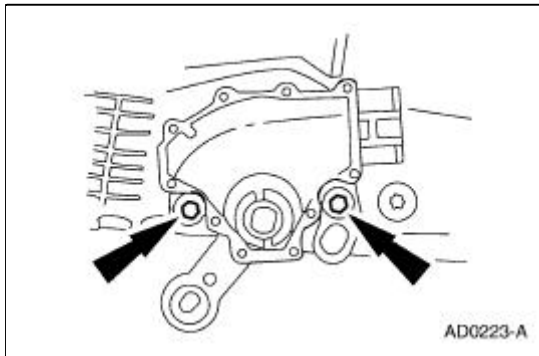


3. Disconnect the transmission shift linkage.

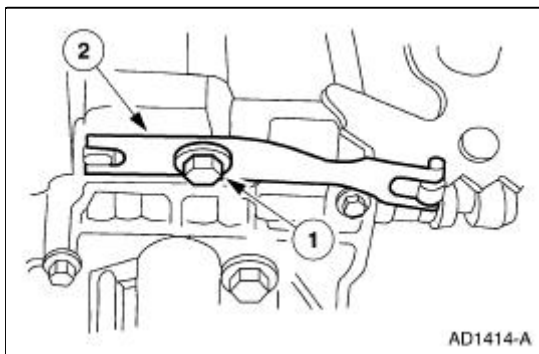


4. Remove the digital TR sensor.

- Remove the bolts.
- Remove the digital TR sensor.

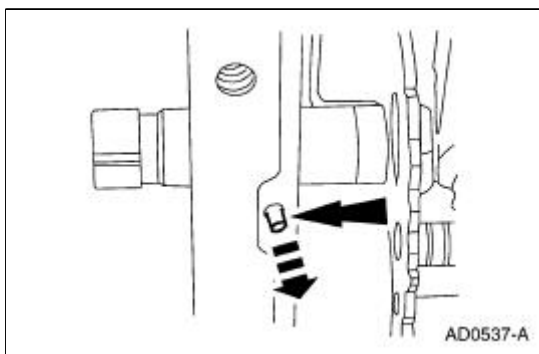


5. Remove the manual control valve detent lever spring.
 1. Remove the bolt.
 2. Remove the manual control valve detent lever spring.

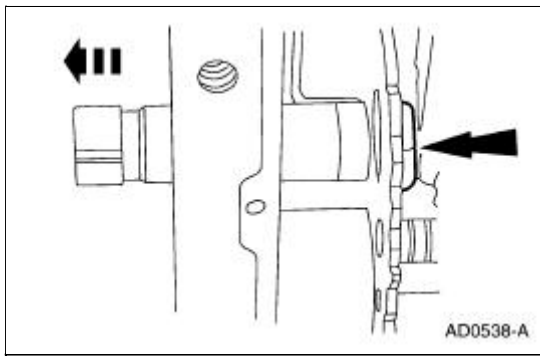


6. **NOTE:** Use a shop cloth to protect the transmission case surface.

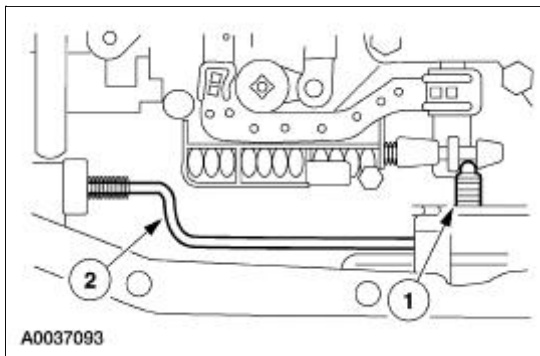
Remove the manual lever shaft retaining pin.




7. Remove the nut and slide the manual control lever shaft out of the case.

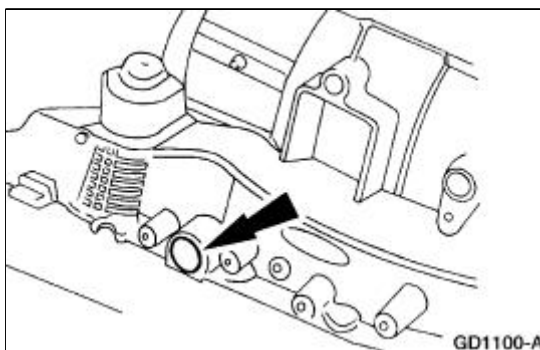


8. Remove the parking lever actuating rod.
 1. Remove the manual valve detent lever.
 2. Remove the parking lever actuating rod.



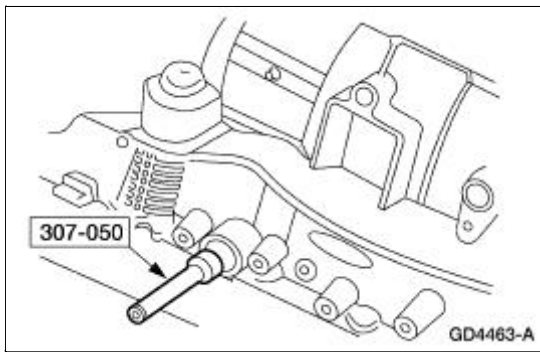
9.  **CAUTION:** Use care not to damage the manual control lever shaft bore. New seal may leak due to damage to the bore.

Remove the manual control lever shaft seal.

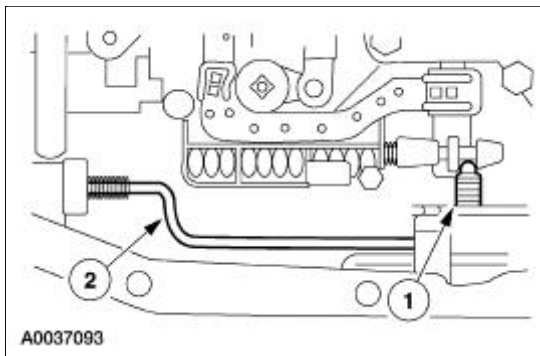


Installation

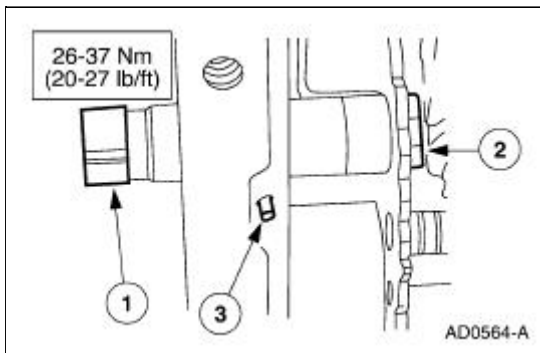
1. Using the special tool, install the manual control lever seal.



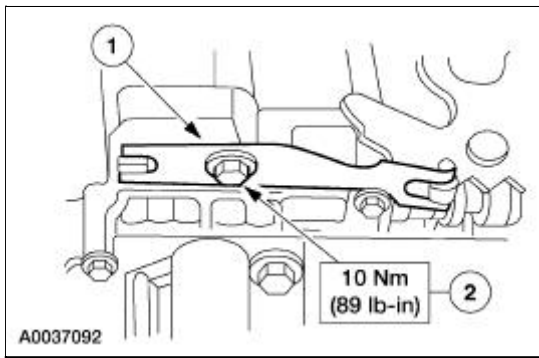
2. Install the parking lever actuating rod.
 1. Install the parking lever actuating rod.
 2. Install the manual valve detent lever.



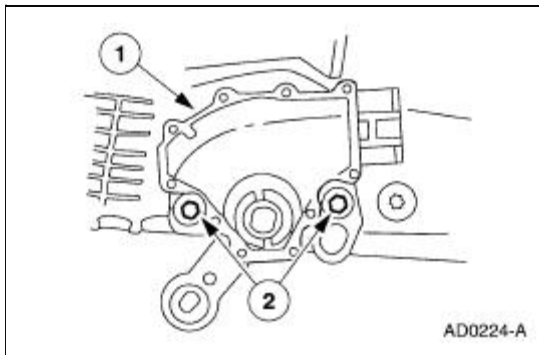
3. Install the manual control lever shaft.
 1. Install the manual control lever shaft.
 2. Install the nut.
 3. Install the manual lever shaft retaining pin.



4. Install the manual valve detent lever spring.
 1. Position the manual valve detent lever spring.
 2. Install the bolt.



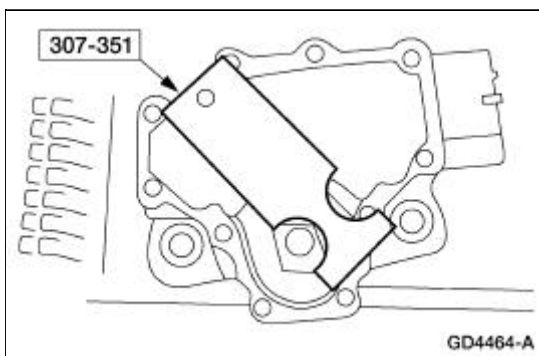
5. Install the digital TR sensor.
 1. Install the digital TR sensor.
 2. Loosely install the bolts.



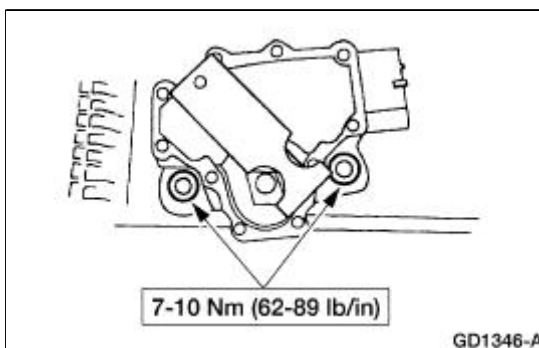
6. **NOTE:** The tool is designed to fit snug.

NOTE: Manual shift lever shaft must be in the neutral position.

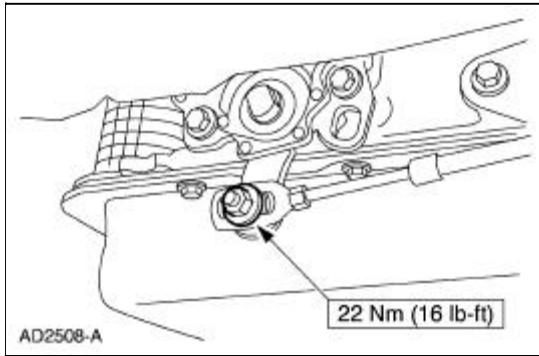
Using the special tools, align the digital TR sensor slots.



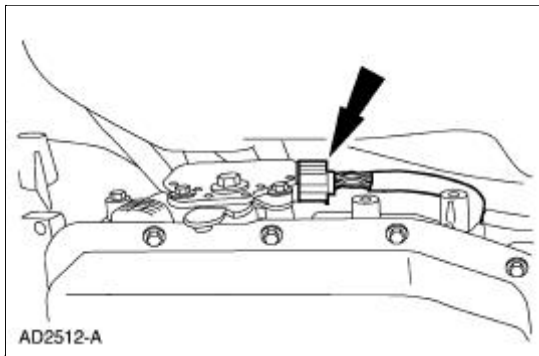
7. Tighten the bolts.



8. With manual lever in overdrive, connect the shift control cable.



9. Install the digital TR sensor electrical connector.



10. Install the filter and transmission fluid pan. For additional information, refer to [Fluid Pan, Gasket and Filter](#) in this section.
-

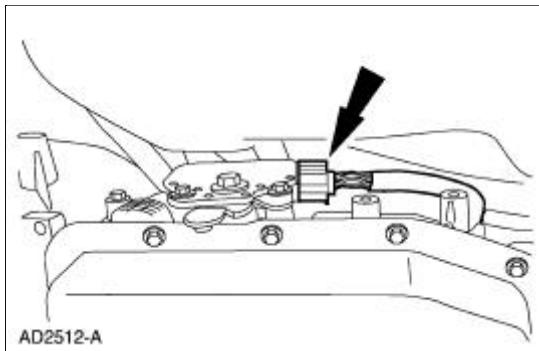
Digital Transmission Range (TR) Sensor

Special Tool(s)

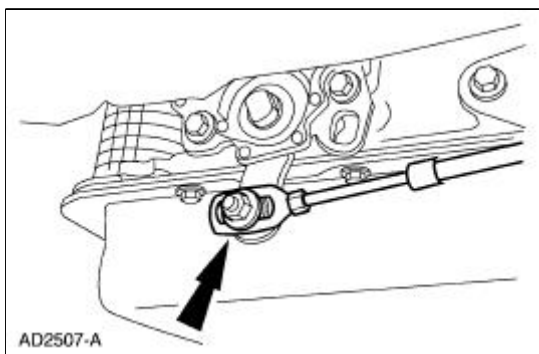


Removal

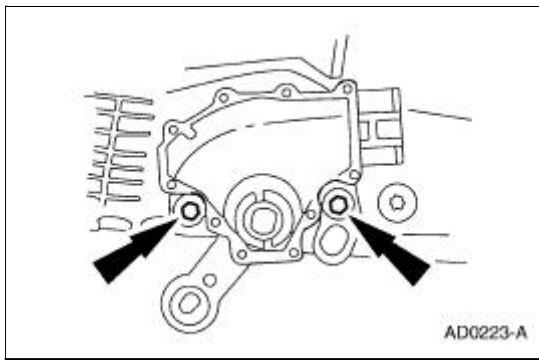
1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
3. Disconnect the connector.



4. Disconnect the manual lever shift control cable.

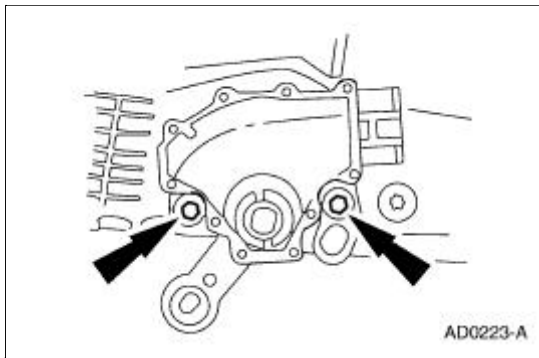


5. Remove the digital TR bolts and the TR sensor.



Installation

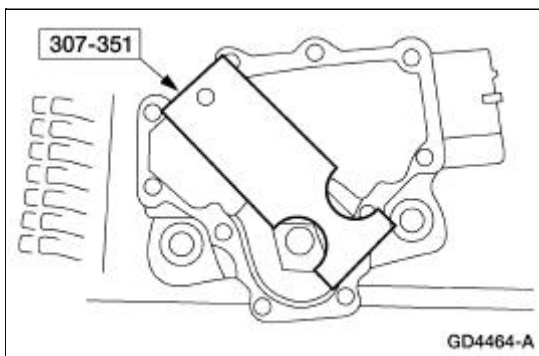
1. Install the digital TR sensor and loosely install the bolts.



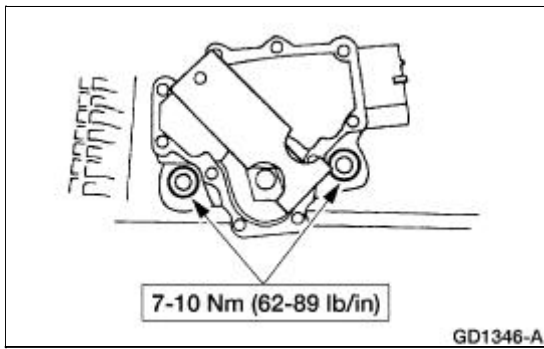
2. **NOTE:** The tool is designed to fit snugly.

NOTE: Manual shift lever shaft must be in the neutral position.

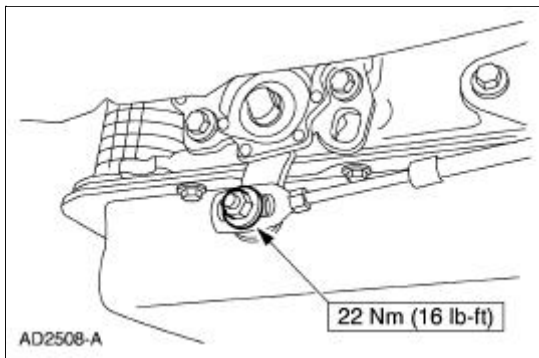
Using the special tool, align the digital TR sensor slots.



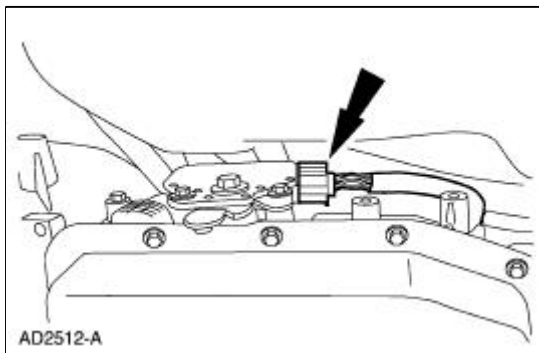
3. Tighten the bolts.



4. With the manual lever in overdrive connect the shift lever control cable.



5. Install the digital TR sensor electrical connector.






6. Lower the vehicle.
7. **NOTE:** When the battery is disconnected and reconnected, some abnormal driving symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

Connect the battery ground cable.

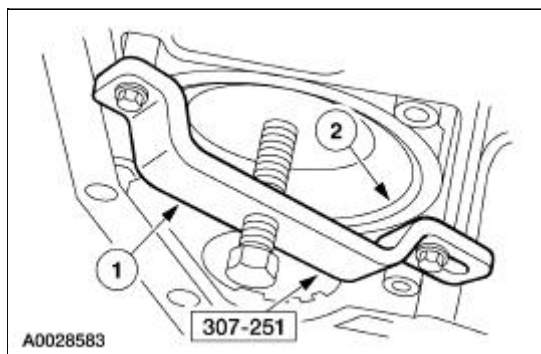
Reverse Servo Assembly

Special Tool(s)

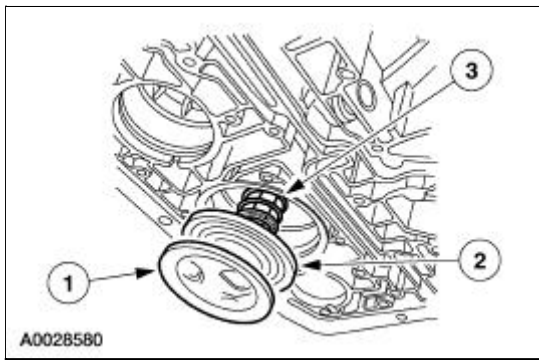
	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
	Remover/Installer, Servo Piston 307-251 (T92P-70023-A)
	Installer, Servo Piston 307-073 (T80L-77030-A)

Removal

1. Remove the main control valve body. For additional information, refer to [Main Control Valve Body](#) in this section.
2. Using the special tool, remove the reverse band servo retaining ring.
 1. Compress the servo spring.
 2. Remove the reverse band servo retaining ring.



3. Remove the reverse servo assembly.
 1. Remove the reverse band servo cover.
 2. Remove the reverse band servo piston and rod.
 3. Remove the reverse band servo spring.



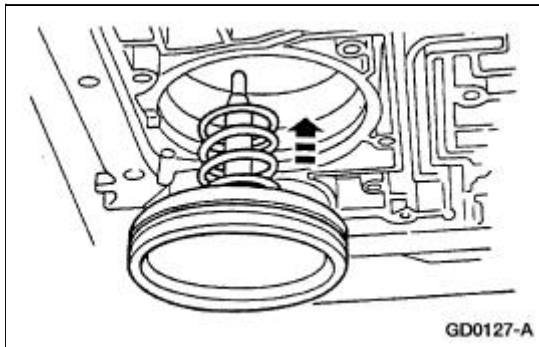
Installation

NOTE: This is not an ordinary installation procedure and does not compensate for band wear.

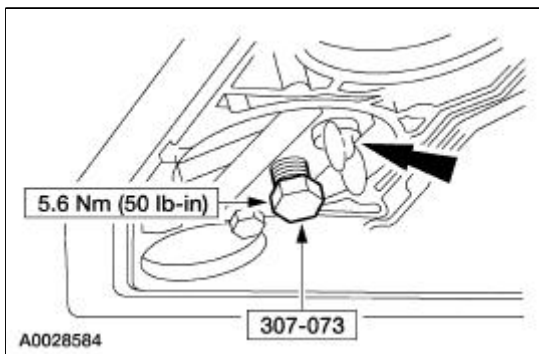
1. **NOTE:** Lubricate the reverse piston seal to facilitate assembly and prevent damage to the seal.

Install the reverse servo return spring and piston.

- Do not install the piston cover.

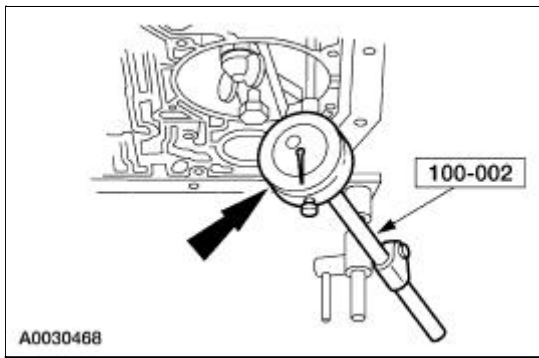


2. Install the special tool and tighten the band apply bolt.

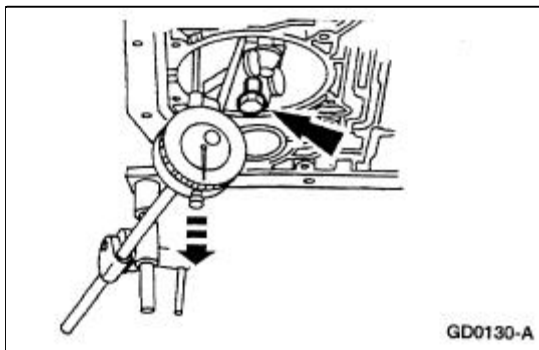


3. Attach the special tool to the transmission.

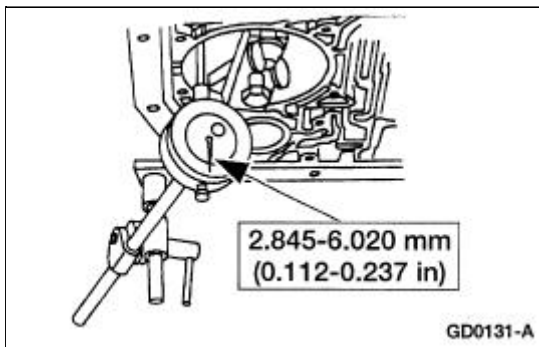
- Position the indicator stem on the flat portion of the reverse servo piston and zero the dial indicator.



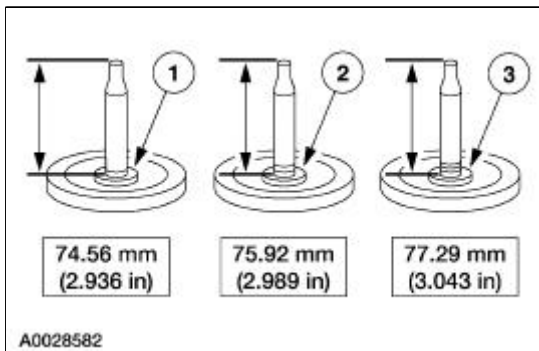
4. Loosen the bolt until the piston stops against the tool.



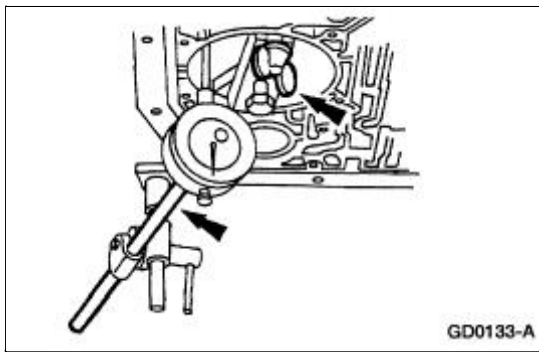
5. Verify that the amount of piston travel on the dial indicator is within specification.



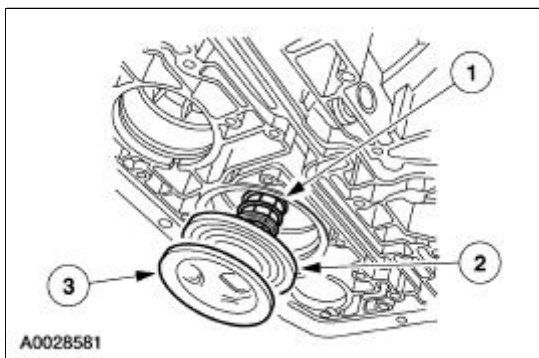
6. If piston travel is not within specification, select and install the correct servo piston assembly to bring the servo piston travel within specification.
 1. One groove
 2. Two groove
 3. Three groove



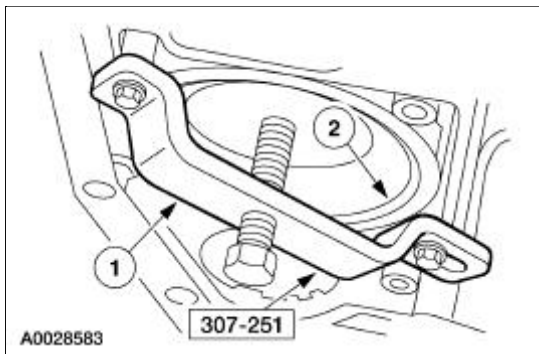
7. Remove the dial indicator and servo selection tool.



8. Install the correct reverse servo assembly.
 1. Install the reverse band servo spring.
 2. Install the reverse band servo piston and rod.
 3. Install the reverse band servo cover.




9. Using the special tool, install the reverse servo retaining ring.
 1. Compress the servo spring.
 2. Install the reverse band servo retaining ring.



10. Install the main control valve body. For additional information, refer to [Main Control Valve Body](#) in this section.
-

Overdrive Servo

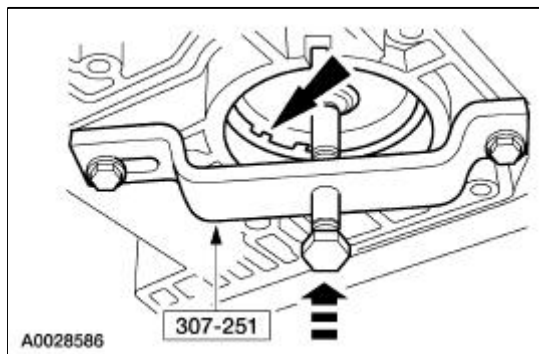
Special Tool(s)

 ST1210-A	Remover/Installer, Servo Piston 307-251 (T92P-70023-A)
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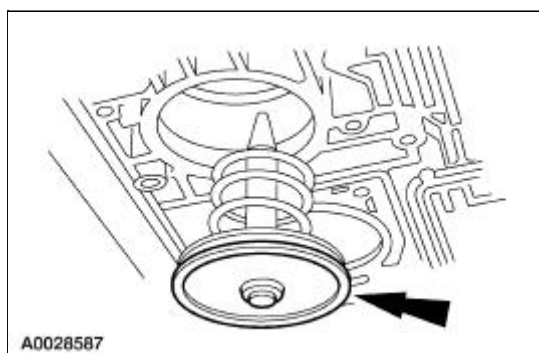
Removal

1. Remove the main control valve body. For additional information, refer to [Main Control Valve Body](#) in this section.
2. **NOTE:** If the tool is not available, extreme care must be taken. Spring pressure will force overdrive servo piston assembly out of case. Case bore damage may result from trying to pry on overdrive servo internal retaining ring.

Using the special tool, compress the servo spring to remove the overdrive servo retaining ring.



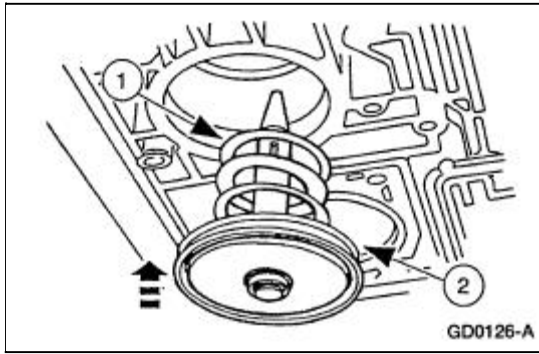
3. Remove the overdrive servo piston and return spring.



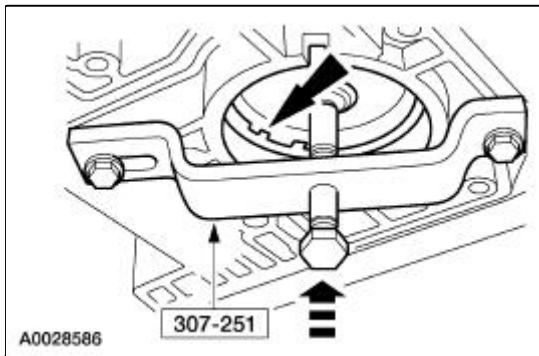
Installation

1. Install the overdrive servo piston assembly.
 1. Install the overdrive servo piston return spring.

2. Install the overdrive servo piston assembly.



2. Use the special tool to install the overdrive servo piston retaining ring.

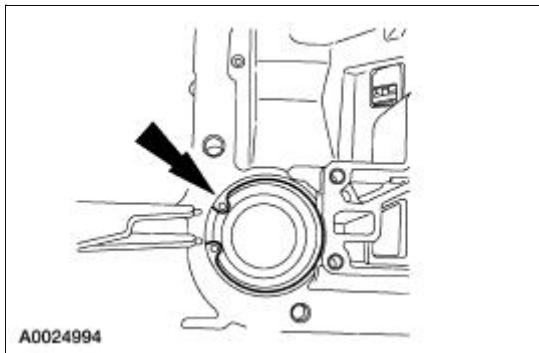


3. Install the main control valve body. For additional information, refer to [Main Control Valve Body](#) in this section.
-

1-2 Accumulator

Removal

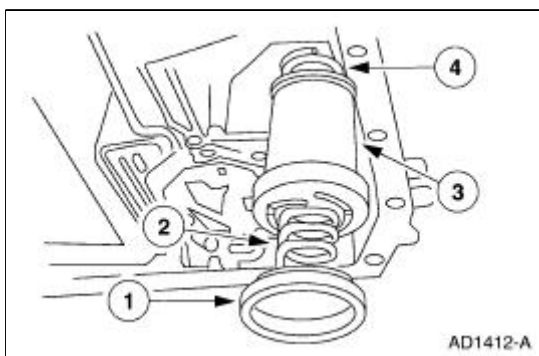
1. Compress the 1-2 accumulator cover and remove the accumulator piston retaining ring.



2. **NOTE:** Note the location of the 1-2 accumulator springs for reference during assembly.

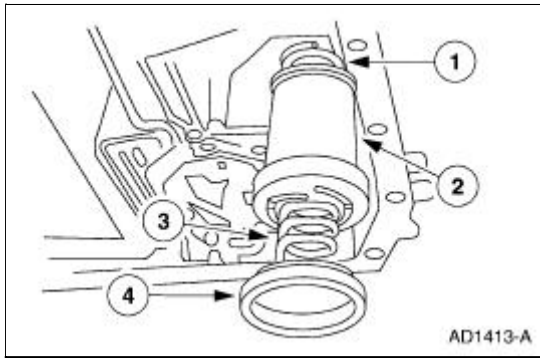
Remove the 1-2 accumulator.

1. Remove the 1-2 accumulator cover.
2. Remove the lower 1-2 accumulator spring.
3. Remove the accumulator piston.
4. Remove the upper 1-2 accumulator spring.

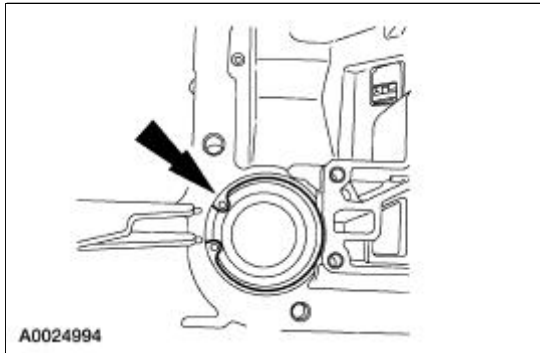


Installation

1. Install the 1-2 accumulator.
 1. Install the 1-2 accumulator upper spring.
 2. Install the accumulator piston.
 3. Install the 1-2 accumulator lower spring.
 4. Install the cover and seal assembly.



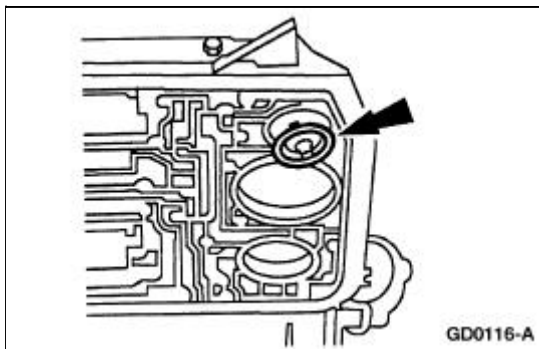
2. Compress the accumulator and install the accumulator piston retaining ring.



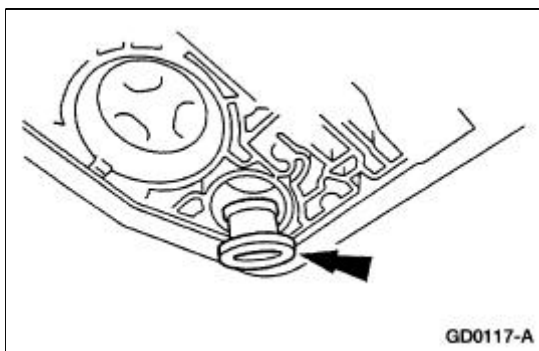
2-3 Accumulator

Removal

1. Remove the main control valve body. For additional information, refer to [Main Control Valve Body](#) in this section.
2. Remove the 2-3 accumulator piston retainer.

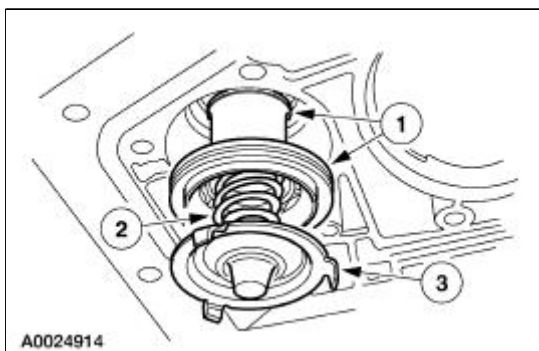


3. Remove the accumulator piston and spring.



Installation

1. Install the 2-3 accumulator assembly.
 1. Install the accumulator piston.
 2. Install the accumulator piston spring.
 3. Install the accumulator spring retainer.

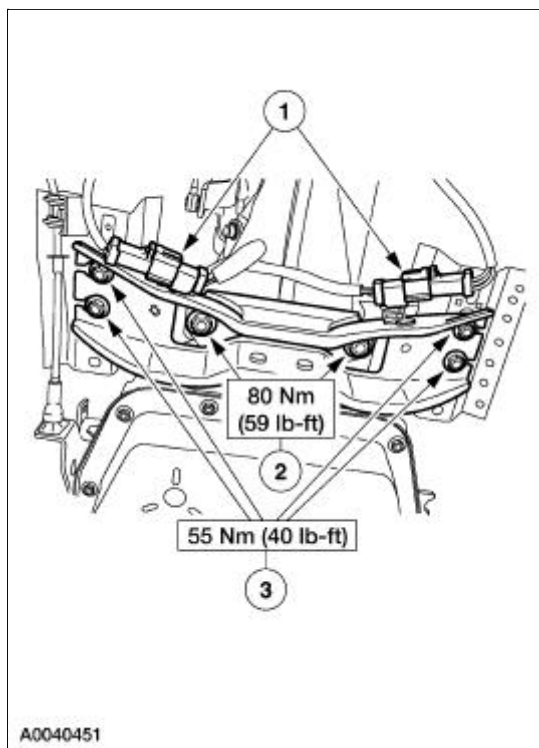


2. Install the main control valve body. For additional information, refer to [Main Control Valve Body](#) in this section.
-

Transmission Support Crossmember

Removal and Installation

1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Support the transmission with a suitable transmission jack.
3. Remove the crossmember.
 1. Disconnect the HO2S sensors and position them aside.
 2. Remove the bolts from the crossmember to the extension housing.
 3. Remove the bolts from the crossmember to the body and remove the crossmember.



4. To install, reverse the removal procedure.

Transmission

Special Tool(s)



CAUTION: Whenever a transmission has been disassembled to install new parts the transmission fluid cooler tubes must be cleaned and backflushed. Use a suitable torque converter/fluid cooler cleaner. If equipped a new oil-to-air cooler must also be installed.

When internal wear or damage has occurred in the transmission, metal particles, clutch plate material or band material may have been carried into the torque converter and fluid cooler. These contaminants are a major cause of recurring transmission troubles and must be removed from the system before the transmission is put back into use.

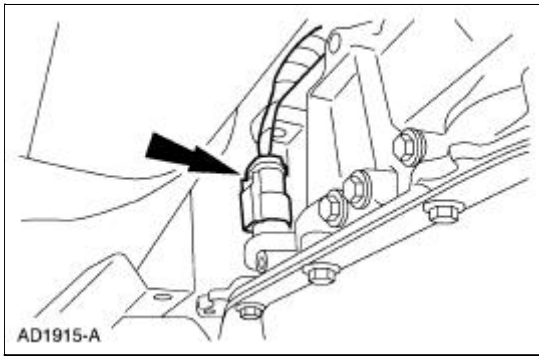
CAUTION: After transmission is removed for a major overhaul, it is important to completely clean all transmission components, including torque converter, oil-to-air cooler if equipped, cooler inlet tube, main control valve body, clutches and all coasting booster valve shuttle balls after any transmission repair that generates contamination. These contaminants are a major cause for recurring transmission concerns and must be removed from the system before the transmission is returned to use.

The cleaning of foreign material from the direct clutch check ball is often omitted. This omission can lead to repeat repair of the transmission.

If equipped a new oil-to-air cooler must be installed under the following conditions; for installation refer to [Section 307-02](#).

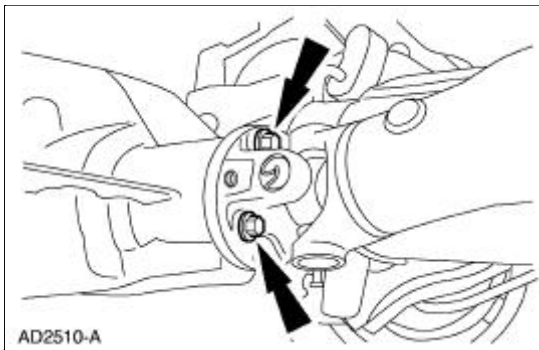
- Evidence of transmission assembly or fluid contamination is found due to the following transmission or converter failure modes:
 - major metallic failure
 - multiple clutches or clutch plate failures
 - sufficient component wear which results in metallic contamination.

1. Place the transmission range selector lever in NEUTRAL.
2. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
3. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
4. Remove the dual converter Y pipe. For additional information, refer to [Section 309-00](#).
5. Disconnect the transmission harness electrical connector.

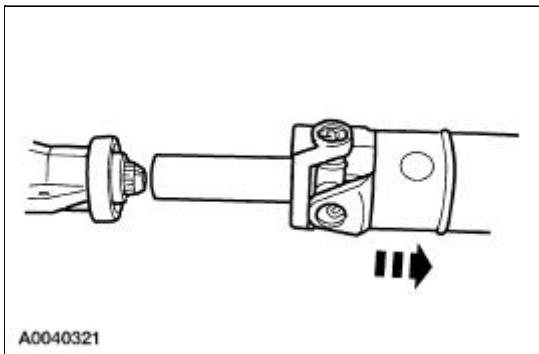


6. If transmission disassembly is required, drain the transmission fluid.
7. **NOTE:** To maintain the initial driveshaft balance, mark the REAR driveshaft yoke and the axle pinion flange so they may be installed in their original positions.

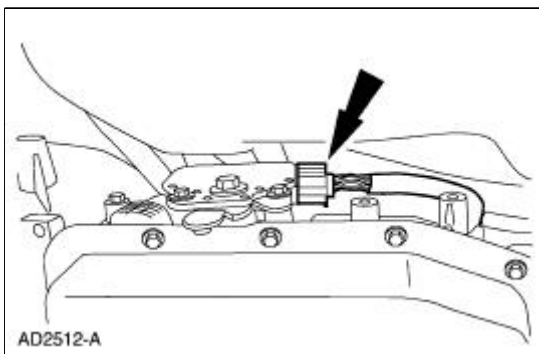
Remove the driveshaft bolts.



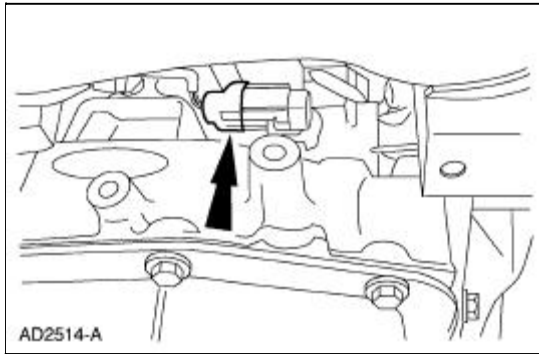
8. Separate the driveshaft from the transmission.



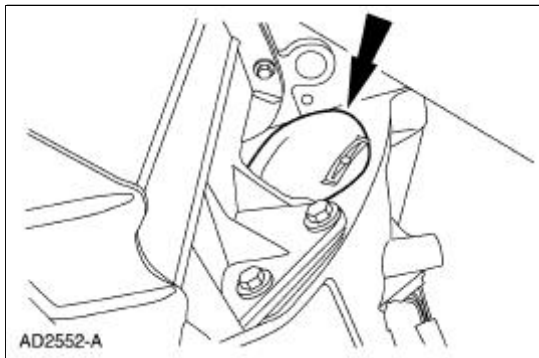
9. Disconnect the connector.



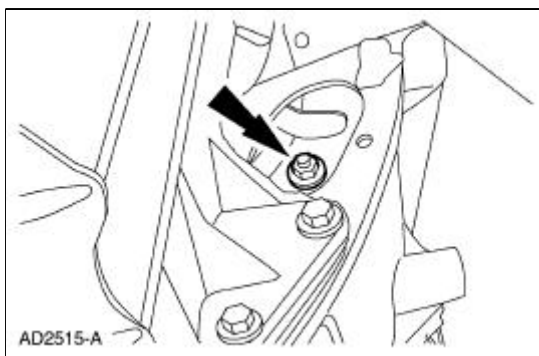
10. Disconnect the connector.



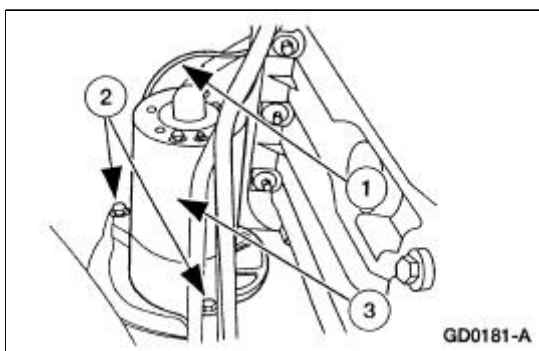
11. Remove the cover.



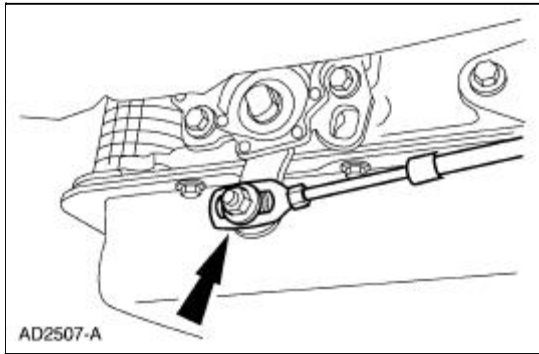
12. Remove the four nuts.



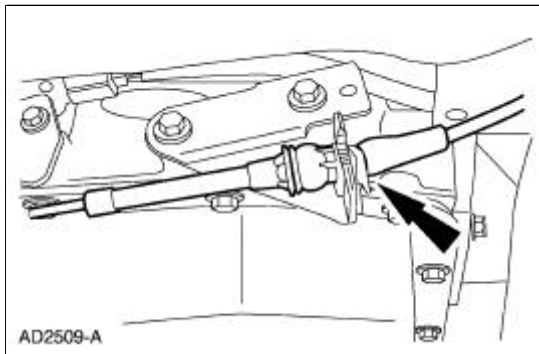
13. Remove the starter.
1. Disconnect the electrical connectors.
 2. Remove the bolts.
 3. Remove the starter.



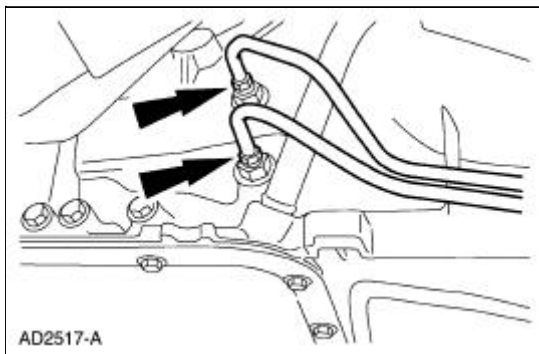
14. Disconnect the transmission shift linkage.



15. Remove the cable from the bracket.

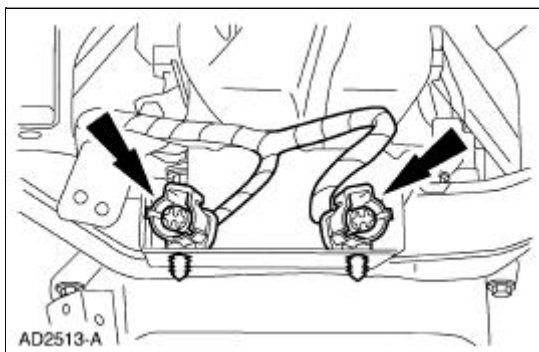


16. Disconnect the transmission fluid cooler tubes.

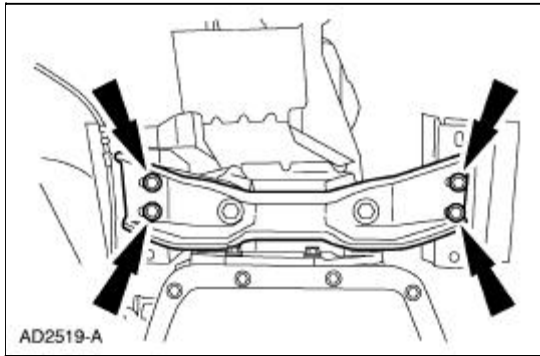


17. Position the high-lift jack under the transmission.

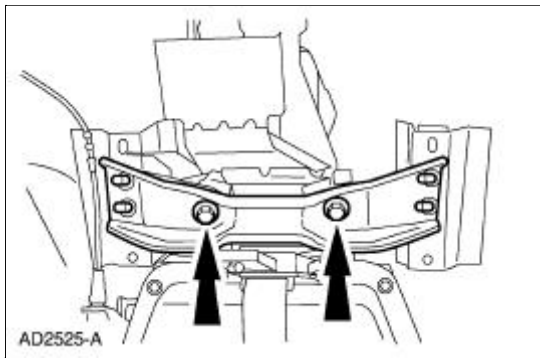
18. Unclip the connectors.



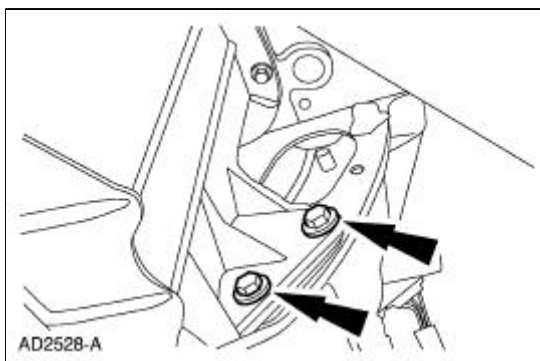
19. Remove the bolts.



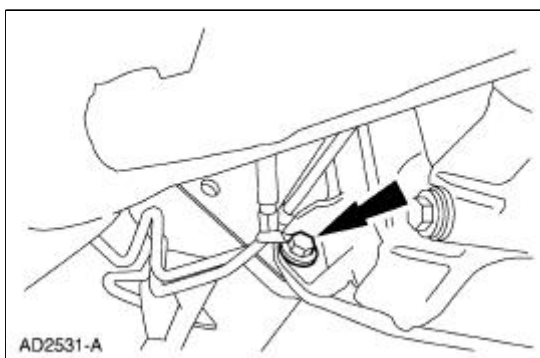
20. Remove the bolts.



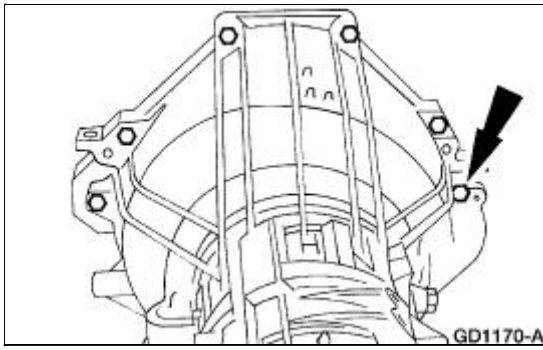
21. Remove the bolts.



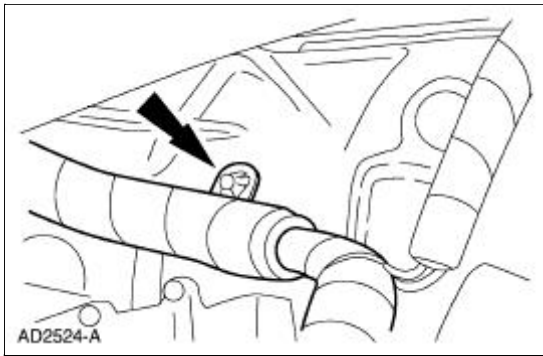
22. Remove the bolt.



23. Remove the bolts.

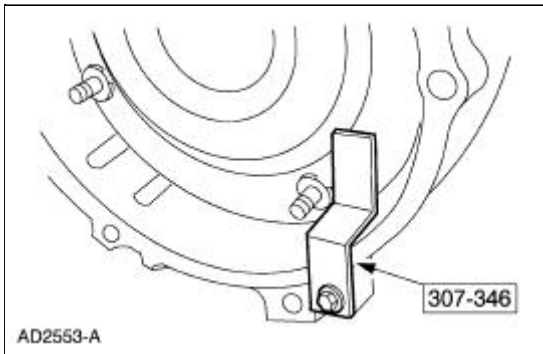


24. Unclip the harness.



25.  **WARNING:** The torque converter is heavy and may result in injury if it falls out of the transmission. Secure the torque converter in the transmission.








Using the special tool, secure the torque converter in the transmission then lower the transmission from the vehicle.






26. Carry out the transmission fluid cooler backflushing and cleaning. For additional information, refer to [Transmission Fluid Cooler — Backflushing and Cleaning](#).
-

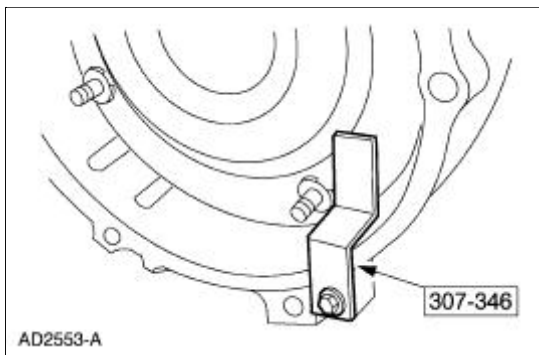
Transmission

Special Tool(s)

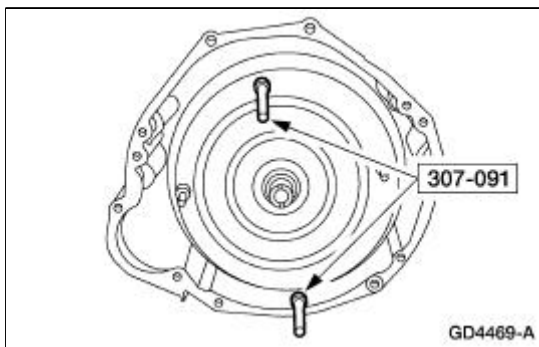
 <p>ST1185-A</p>	<p>Slide Hammer 100-001 (T50T-100-A)</p>
 <p>ST1186-A</p>	<p>Holding Fixture, Transmission 307-003 (T57L-500-B)</p>
 <p>ST1187-A</p>	<p>Slide Hammer 307-005 (T59L-100-B)</p>
 <p>ST1192-A</p>	<p>Remover, Transmission Fluid Seal 307-048 (T74P-77248-A)</p>
 <p>ST1631-A</p>	<p>Handle, Torque Converter 307-091 (T81P-7902-C)</p>
 <p>ST1208-A</p>	<p>Remover, Transmission Fluid Pump 307-221 (T89T-70010-A)</p>
 <p>ST1210-A</p>	<p>Remover/Installer, Servo Piston 307-251 (T92P-70023-A)</p>
	<p>Remover, Torque Converter Fluid Seal</p>

 <p>ST1192-A</p>	<p>307-309 (T94P-77001-BH)</p>
 <p>ST1636-A</p>	<p>Retainer, Torque Converter 307-346 (T97T-7902-A)</p>
 <p>ST1200-A</p>	<p>Remover, Bearing Cup 308-047 (T77F-1102-A)</p>

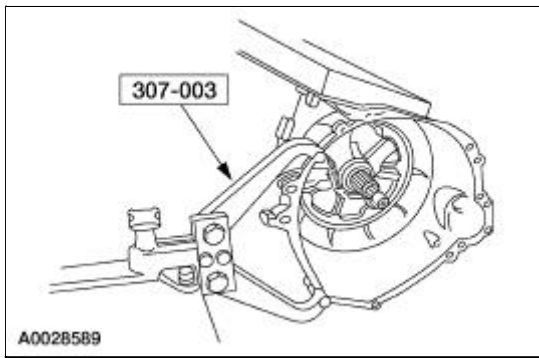
1. Remove the special tool.



2. Using the special tools, remove torque converter.



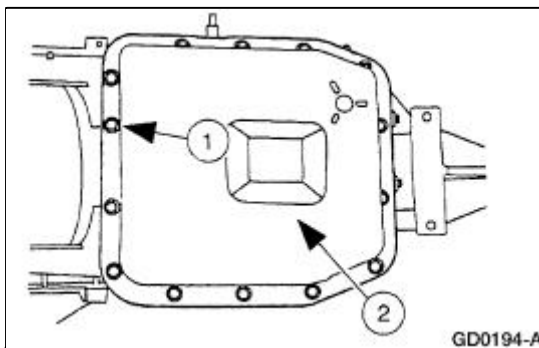
3. Using the special tool, mount the transmission to the bench.



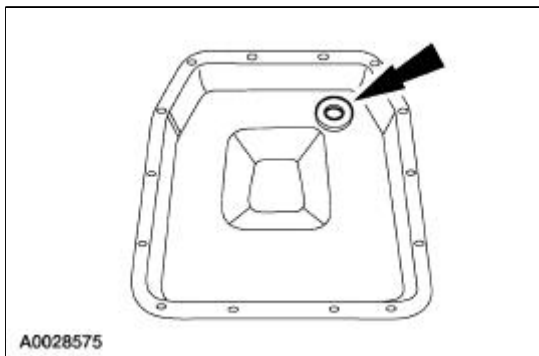
4. **NOTE:** If the transmission fluid pan gasket is not damaged, it may be reused.

Remove the transmission fluid pan and transmission fluid pan gasket.

1. Remove the bolts.
2. Remove the transmission fluid pan and transmission fluid pan to case gasket.



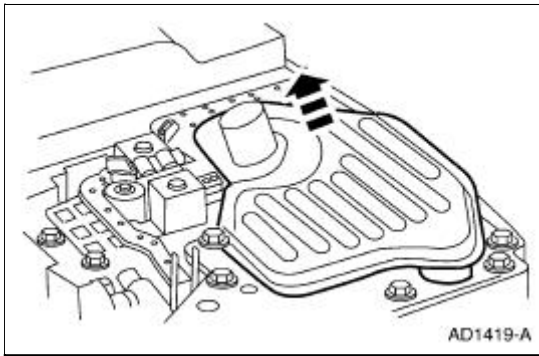
5. Clean the transmission fluid pan and pan magnet.




6. **⚠ CAUTION:** If installing a new filter, and grommet remains in the main control bore, carefully use a small screwdriver to remove the grommet. Use care not to damage the main control bore.

NOTE: If transmission is being repaired for a contamination-related failure, use a new filter and seal. The filter may be reused if no excessive contamination is present.

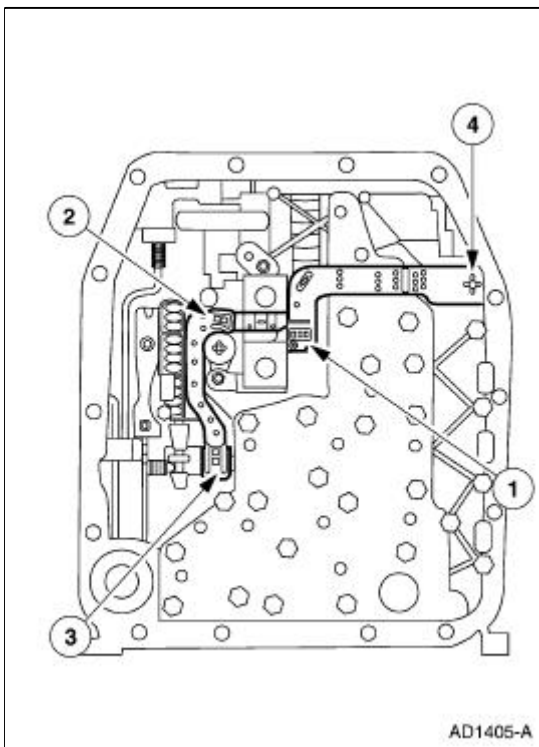
Remove the fluid filter and grommet.



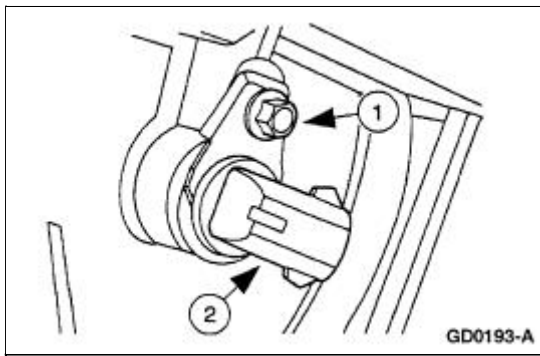
7.  **CAUTION: Do not pull on the molded lead frame. This may cause damage to the connector ends. Carefully pry up on the locking tabs to disconnect the solenoids. Disconnect the molded lead frame from the solenoids.**

Disconnect the molded lead frame from the solenoids.

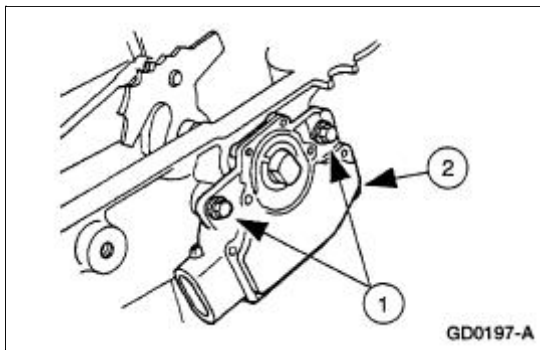
1. Disconnect the shift solenoid SSA and SSB.
2. Disconnect the torque converter clutch (TCC).
3. Disconnect the electronic pressure control (EPC) solenoid.
4. Disconnect the bulkhead inter-connector.



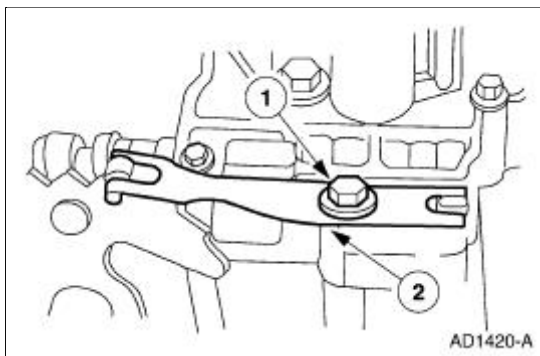
8. Remove the output shaft speed (OSS) sensor.
1. Remove the bolt.
 2. Remove the OSS sensor.



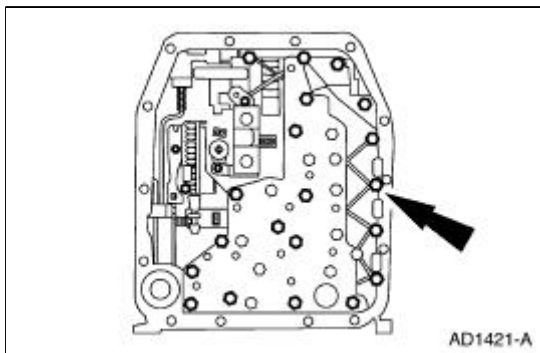
9. Remove the digital transmission range (TR) sensor.
 1. Remove the bolts.
 2. Remove the digital TR sensor.



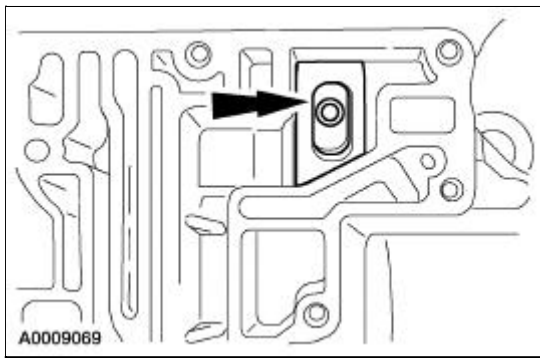
10. Remove the manual control valve detent lever spring.
 1. Remove the bolt.
 2. Remove the manual control valve detent lever spring.



11. Remove the 24 main control valve body bolts and the main control valve body.

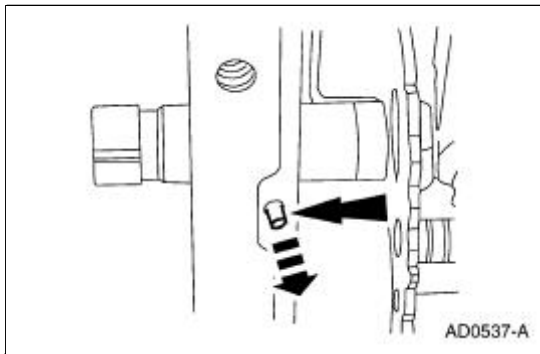


12. Remove and discard the pump outlet screen.



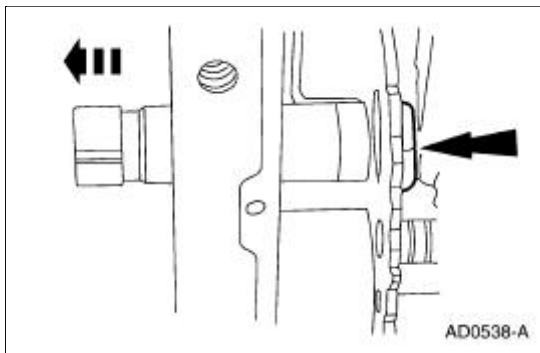
13. **NOTE:** Use a shop cloth to protect the transmission case surface.

Remove the manual lever shaft retaining pin.



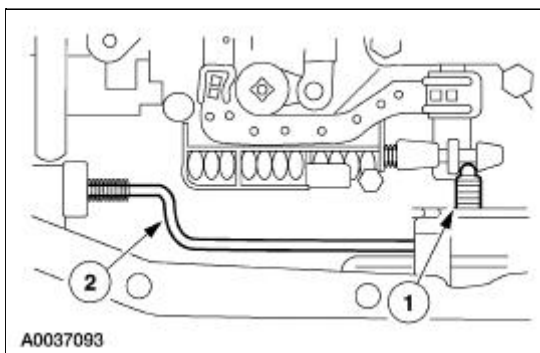
14. Remove the manual lever shaft inner nut.


- Slide the manual control lever shaft out of the case while removing the inner nut.



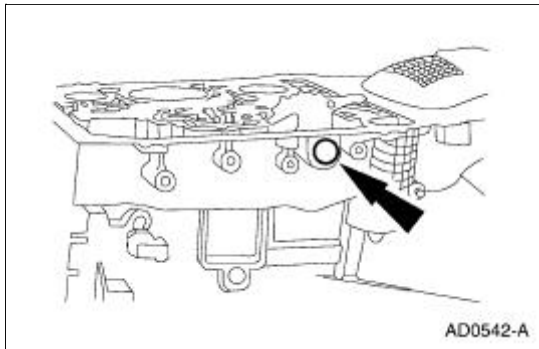
15. Remove the parking lever actuating rod.

1. Remove the manual valve detent.
2. Remove the parking lever actuating rod.

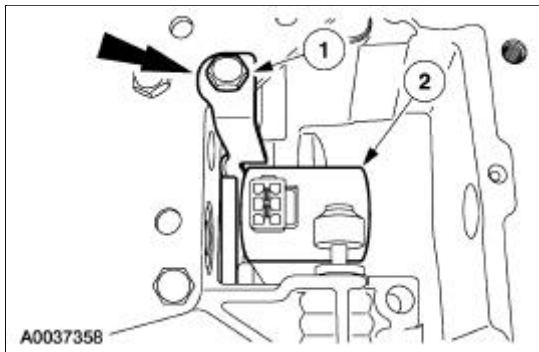


16.  **CAUTION:** Use care not to damage the manual control lever shaft bore. If the bore is damaged the new seal may leak.

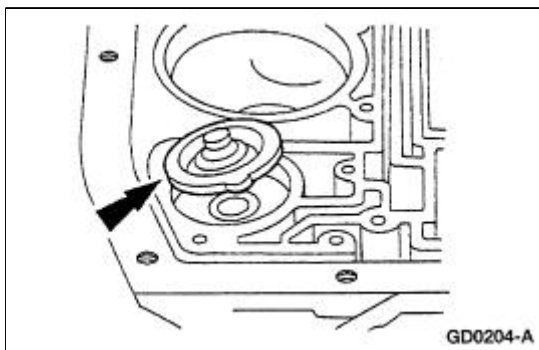
Remove the manual control lever shaft seal.



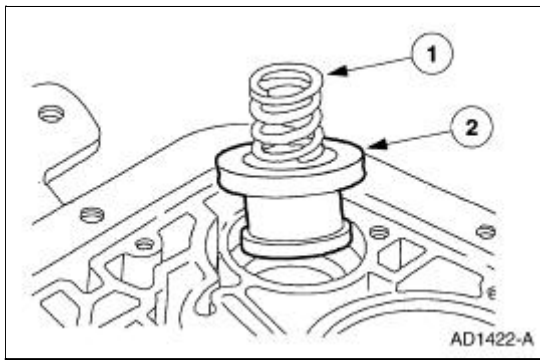
17. Remove the EPC solenoid.
1. Remove the bolt and EPC solenoid bracket.
 2. Remove the EPC solenoid.



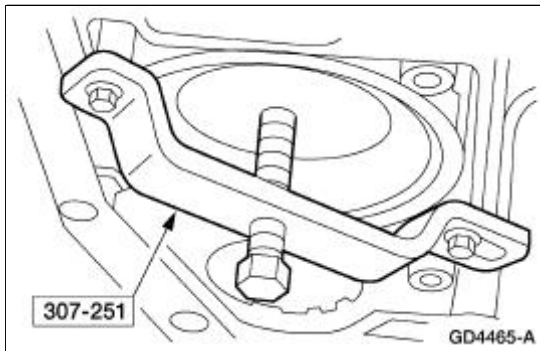
18. Remove the 2-3 accumulator spring retainer.



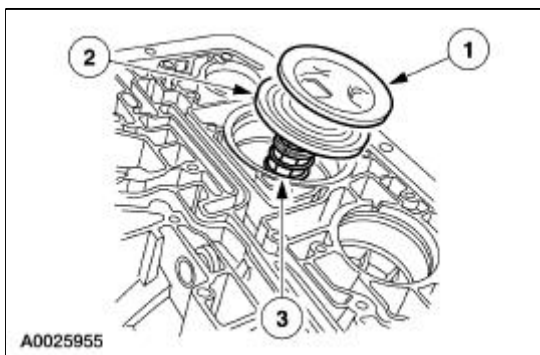
19. Remove the 2-3 accumulator piston.
1. Remove the 2-3 accumulator spring.
 2. Remove the 2-3 accumulator piston.



20. Using the special tool, remove the reverse band servo retaining ring.

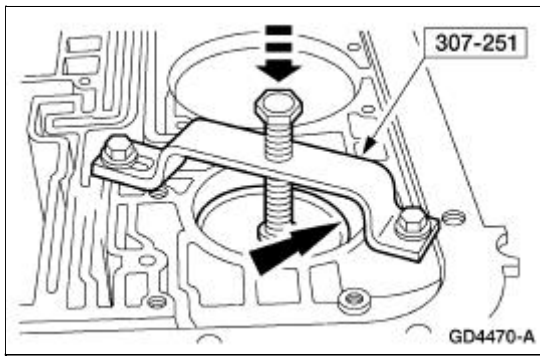


21. Remove the reverse servo assembly.
1. Remove the reverse band servo cover.
 2. Remove the reverse band servo piston and rod.
 3. Remove the reverse band servo spring.

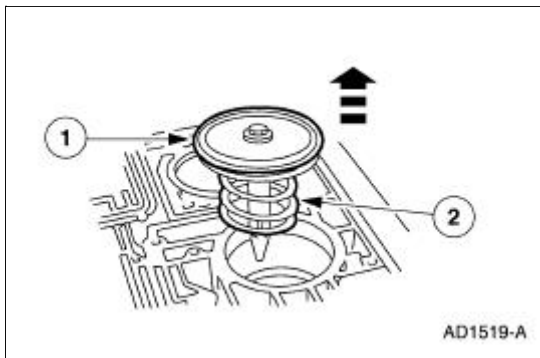


22. **NOTE:** If tool is not available, extreme care must be taken. Spring pressure will force overdrive servo piston assembly out of case. Case bore damage may result from trying to pry on internal retaining ring.

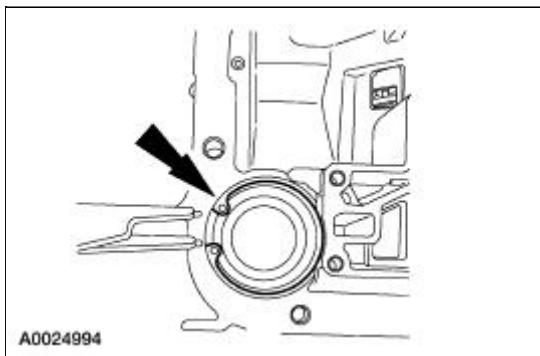
Using the special tool, compress the piston spring, then remove the overdrive servo piston retainer.



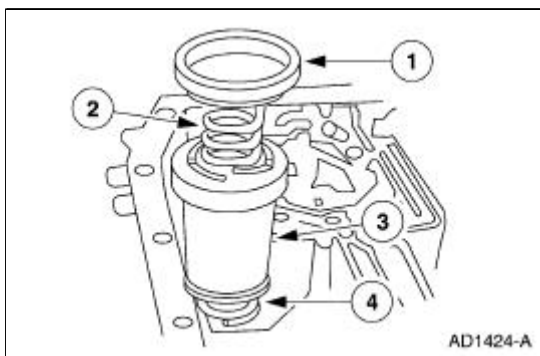
23. Remove the overdrive servo piston.
1. Remove the overdrive servo piston.
 2. Remove the overdrive servo piston return spring.



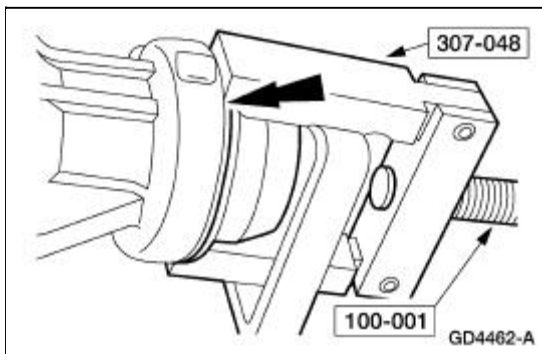
24. Compress the 1-2 accumulator cover and remove the retaining ring.



25. Remove the 1-2 accumulator upper spring.
1. Remove the 1-2 accumulator spring cover.
 2. Remove the 1-2 accumulator lower spring.
 3. Remove the 1-2 accumulator.
 4. Remove the 1-2 accumulator upper spring.



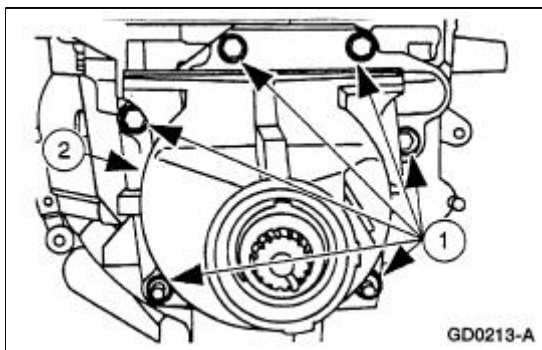
26. Using the special tools, remove the extension housing seal.



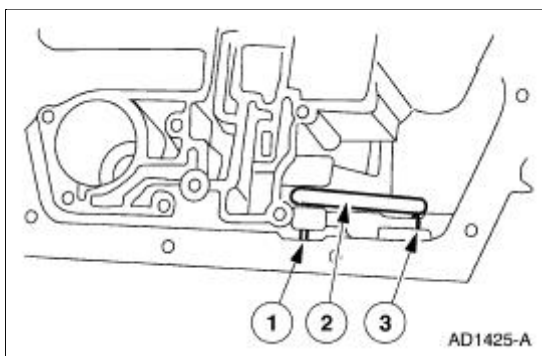
27. **NOTE:** These bolts have been coated with a sealant. High break torque may be required to remove these bolts.

Remove the extension housing.


1. Remove the four bolts and two nuts.
2. Remove the extension housing and the extension housing gasket.



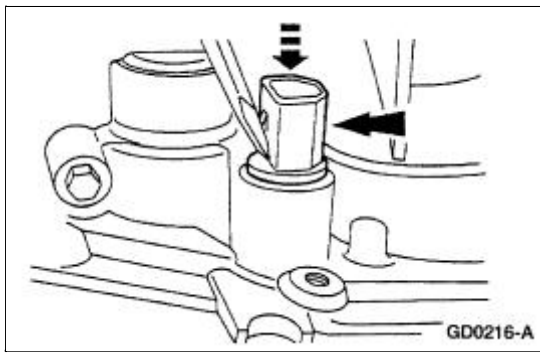
28. Remove the parking pawl.
1. Remove the parking pawl shaft.
 2. Remove the parking pawl return spring.
 3. Remove the parking pawl.



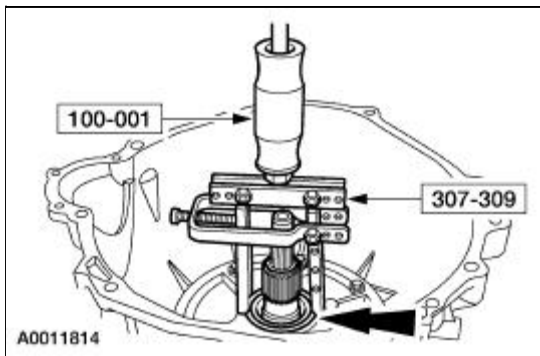
29. Rotate the transmission to the vertical position with the output shaft towards the floor.

30.  **CAUTION:** Extreme care must be taken during transmission connector removal. Do not use a hammer on the connector body.

Place a screwdriver on the flat portion of the connector and push the connector out through the bottom of the case.

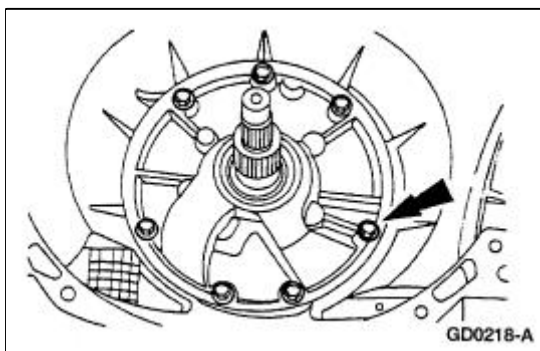


31. Using the special tools, remove the front pump seal.

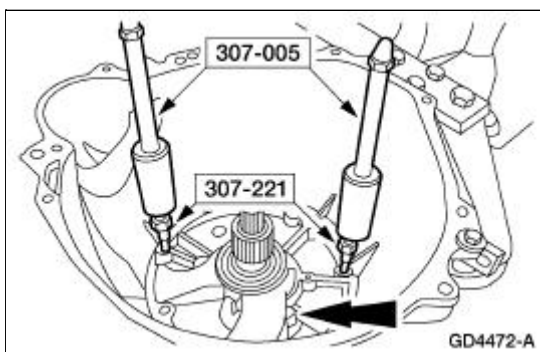


32. **NOTE:** These bolts have been coated with sealant. High break torque may be required to remove the bolts.

Remove the bolts.

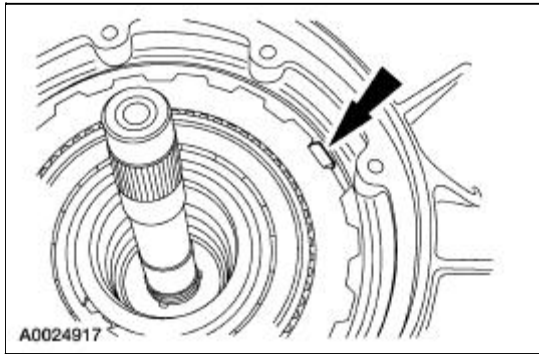



33. Using the special tools, remove the front pump support.



34. Remove and discard the pump gasket.

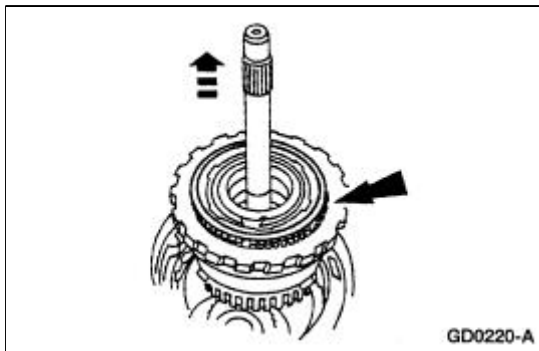
35. Remove the intermediate anti-rattle clip, if equipped.



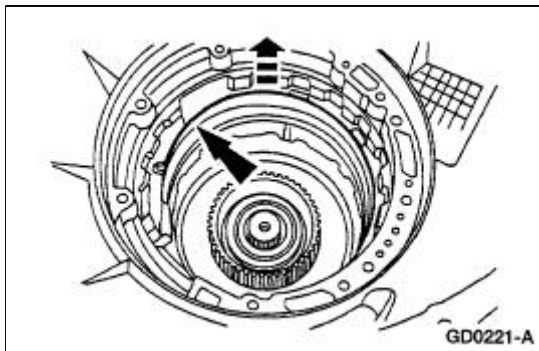
36.  **CAUTION:** Remove the assembly carefully to prevent damage to the overdrive band friction material by the reverse clutch drive lugs.

Remove the following components as an assembly:

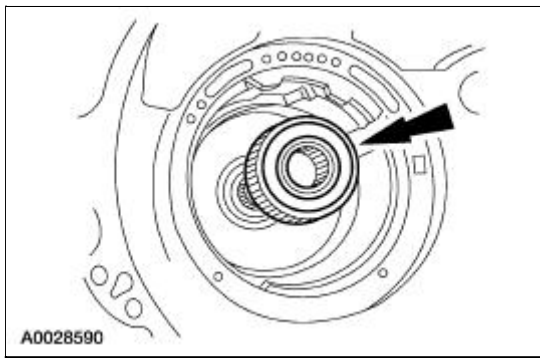
- Intermediate clutch pack.
- Intermediate one-way clutch.
- Reverse clutch.
- Forward clutch assembly.



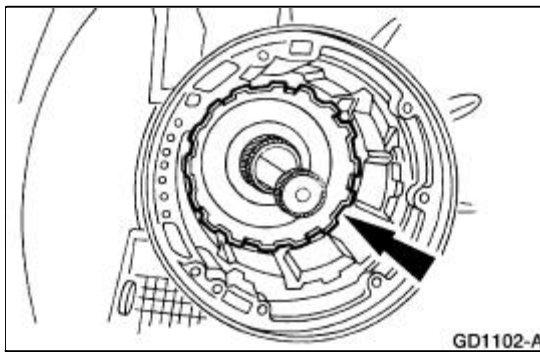
37. Disengage and remove the overdrive band.



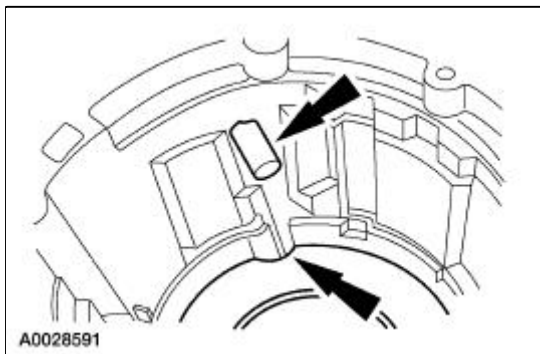
38. Remove the forward clutch hub and the No. 3 forward clutch hub front bearing.



39. Remove the intermediate stub shaft.

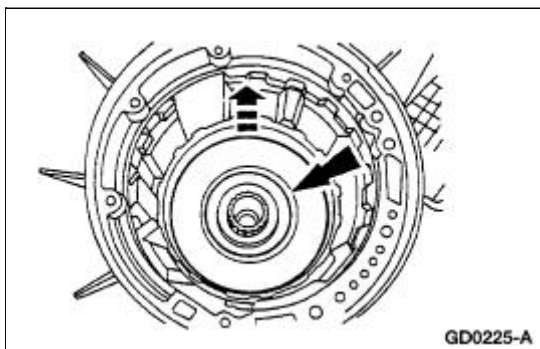


40. Align the reverse sun shell with the overdrive band anchor pin for removal.

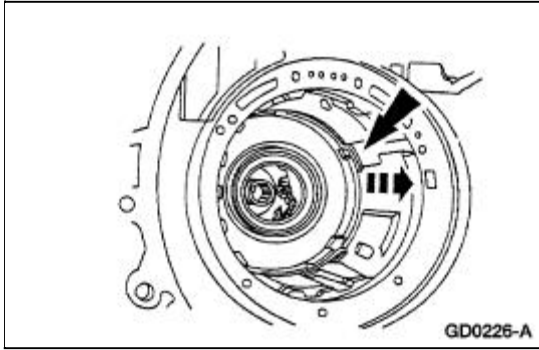


41. Remove the following components as an assembly:

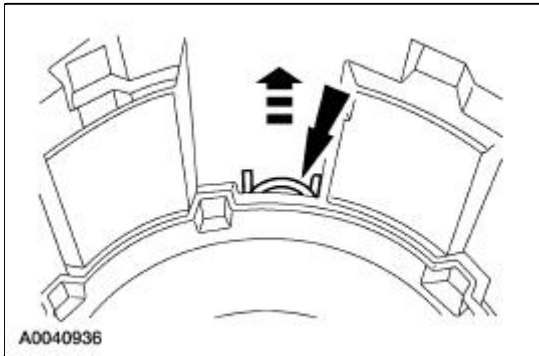
- Forward clutch sun gear.
- No. 5 forward clutch sun gear bearing.
- Reverse clutch sun gear.
- No. 4 forward clutch hub bearing.



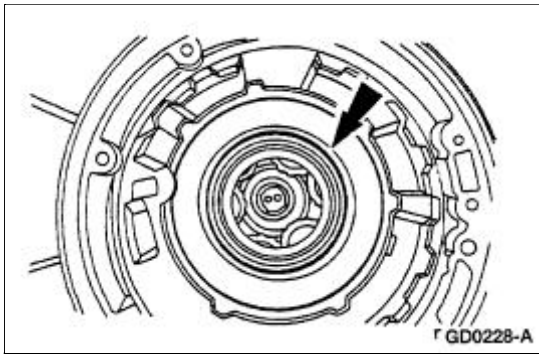
42. Remove the center support retaining ring and note location for assembly.



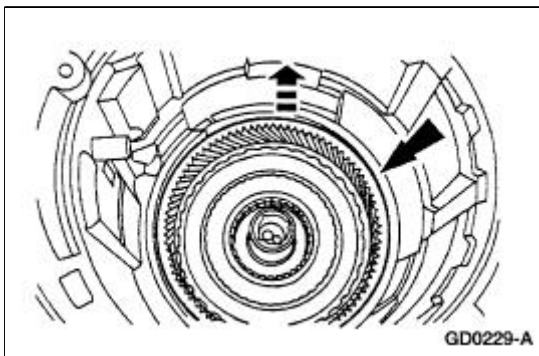
43. Remove the case to planet support spring.



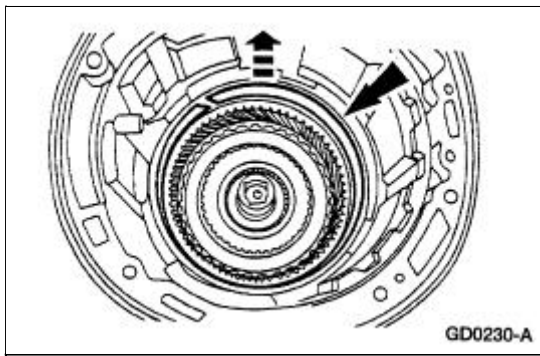
44. Remove the planetary gear support and planetary as an assembly.



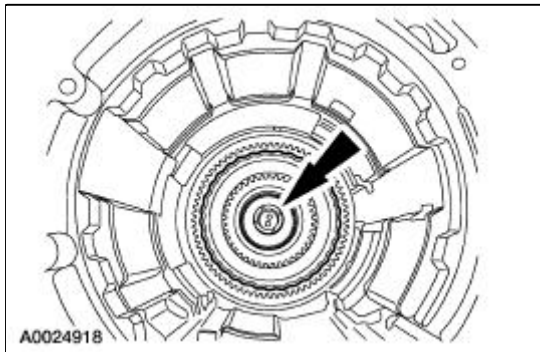
45. Remove the reverse clutch band.



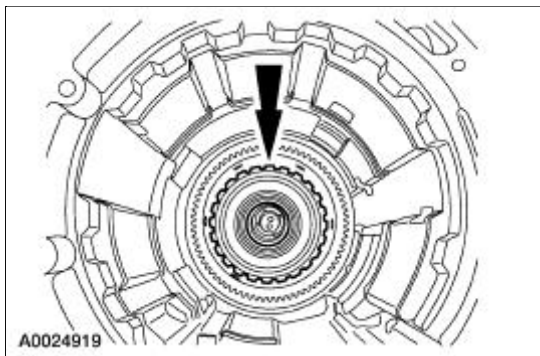
46. Remove the retaining ring.



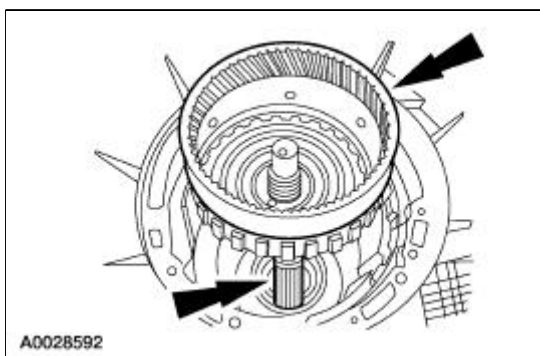
47. Remove the direct clutch pack.



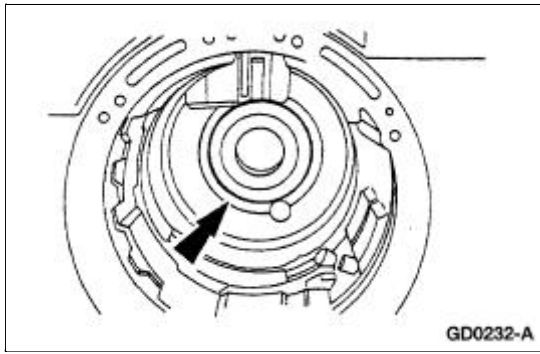
48. Remove the No. 8 bearing.



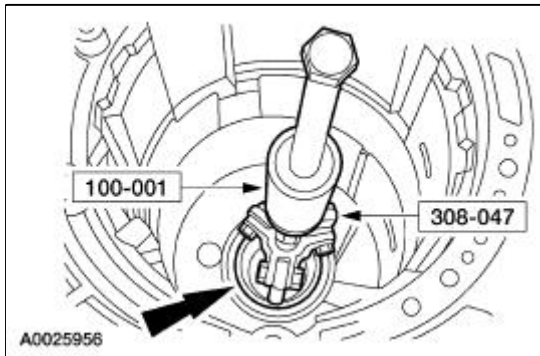
49. Remove the output shaft, output shaft ring gear assembly and direct clutch.



50. Remove the No. 9 case rear bearing.



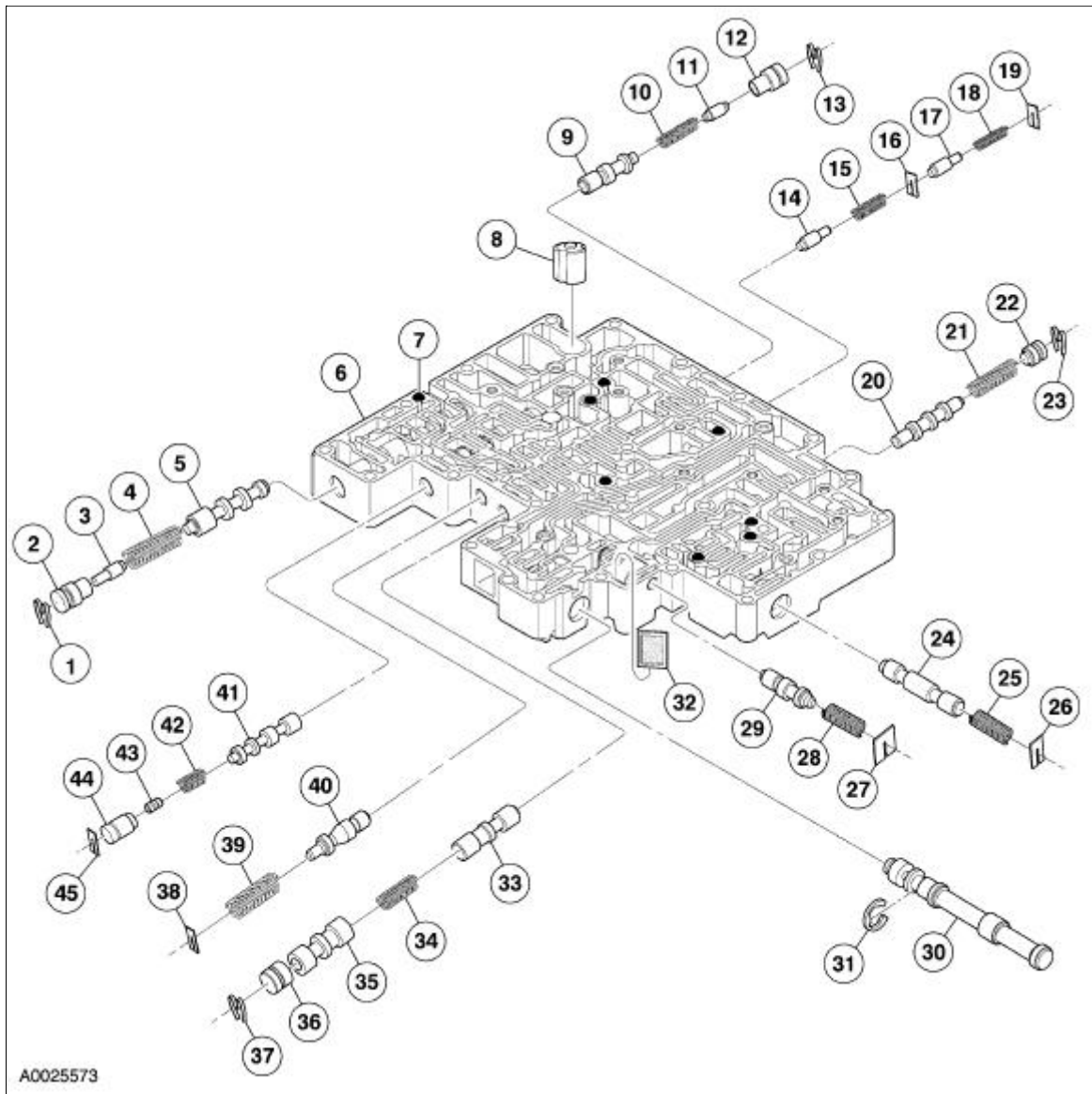
51. Inspect and if necessary, use the special tools to remove the rear case bushing.



Main Control Valve Body

Disassembly

Main Control Valve Body — Disassembled View

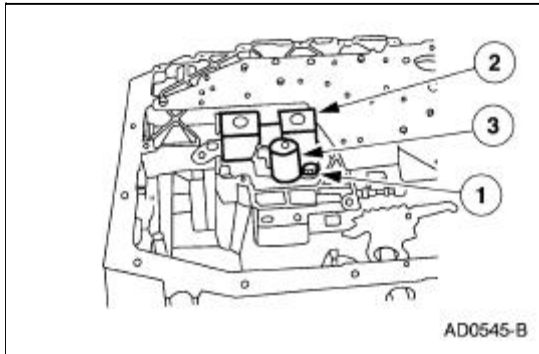


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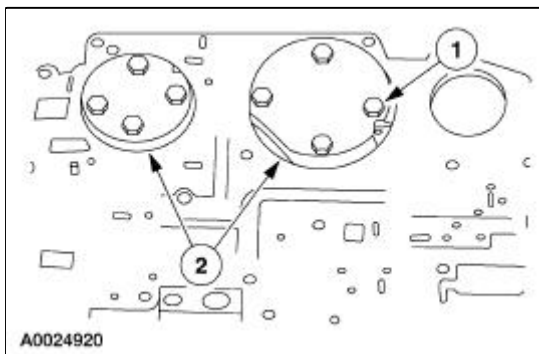
Item	Part Number	Description
1	—	Valve plug retainer (part of 7A100)
2	—	Main pressure booster valve sleeve (part of 7A100)
3	—	Main pressure booster valve (part of 7A100)
4	—	Main pressure regulator valve spring (part of 7A100)
5	—	Main regulator valve (part of 7A100)

6	7A100	Main control valve body assembly
7	7E195	Check ball (8 req'd)
8	7H171	Converter drain back valve
9	—	Pressure regulator valve (part of 7A100)
10	—	Pressure regulator valve spring (part of 7A100)
11	—	Regulator boost plunger (part of 7A100)
12	—	Regulator boost sleeve (part of 7A100)
13	—	Valve retainer (part of 7A100)
14	—	Capacity modulator valve (part of 7A100)
15	—	Capacity modulator valve spring (part of 7A100)
16	—	Spring retaining plate (part of 7A100)
17	—	Capacity modulator valve (part of 7A100)
18	—	Capacity modulator valve spring (part of 7A100)
19	—	Spring retaining plate (part of 7A100)
20	—	3-4 shift valve (part of 7A100)
21	—	3-4 shift valve spring (part of 7A100)
22	—	Valve retainer plug (part of 7A100)
23	—	Valve plug retainer (part of 7A100)
24	—	2-3 backout valve (part of 7A100)
25	—	2-3 backout valve spring (part of 7A100)
26	—	Spring retaining plate (part of 7A100)
27	—	Spring retaining plate (part of 7A100)
28	—	Pressure regulator valve spring (part of 7A100)
29	—	Pressure regulator valve (part of 7A100)
30	—	Control manual valve (part of 7A100)
31	—	Retaining ring (part of 7A100)
32	—	Solenoid screen
33	—	1-2 shift valve (part of 7A100)
34	—	2-3 shift valve spring (part of 7A100)
35	—	2-3 valve (part of 7A100)
36	—	Valve retaining plug (part of 7A100)
37	—	Valve plug retainer (part of 7A100)
38	—	Spring retaining plate (part of 7A100)
39	—	Pressure regulator valve spring (part of 7A100)
40	—	Pressure regulator valve (part of 7A100)
41	—	Bypass clutch control valve (part of 7A100)
42	—	Bypass clutch control valve spring (part of 7A100)
43	—	Bypass clutch control valve plunger (part of 7A100)
44	—	Bypass clutch control plunger sleeve (part of 7A100)

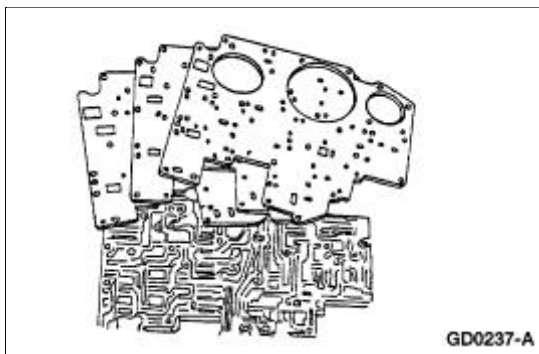
1. Remove the torque converter clutch (TCC) solenoid and the shift solenoid.
 1. Remove the bolt.
 2. Remove the shift solenoid.
 3. Remove the TCC solenoid.



2. Remove the two reinforcement plates.
 1. Remove the bolts.
 2. Remove the plates.

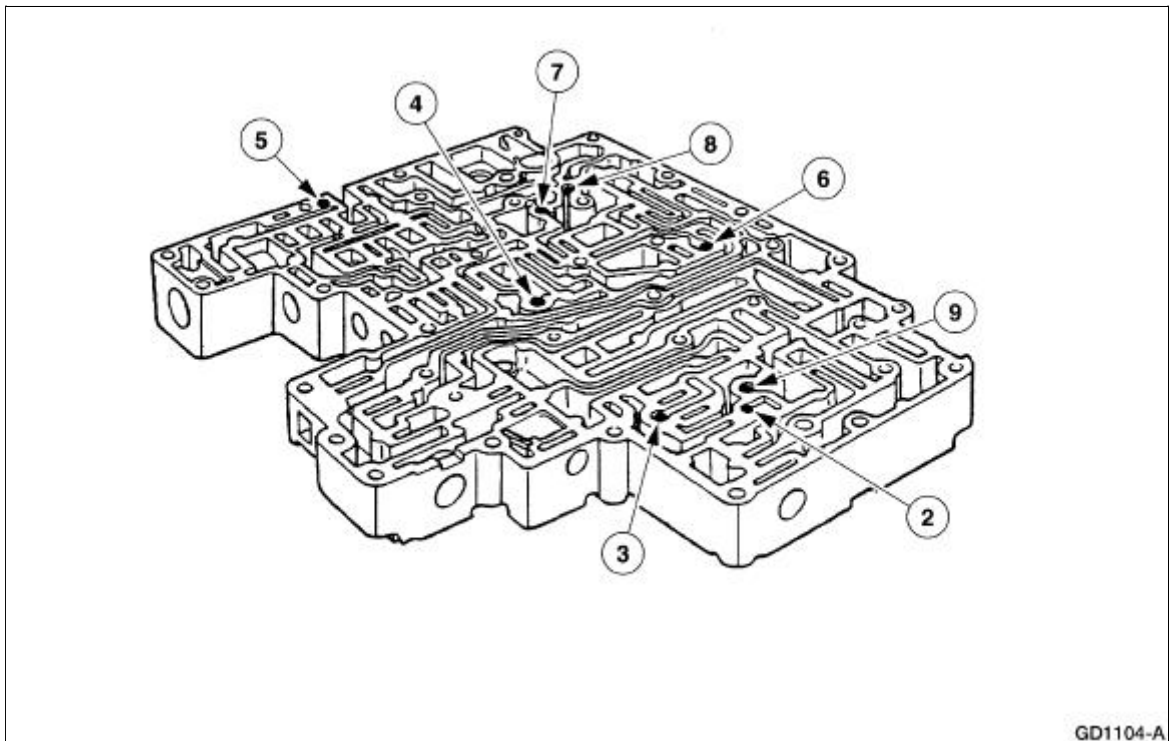


3. Remove the separator plate and discard the gaskets.

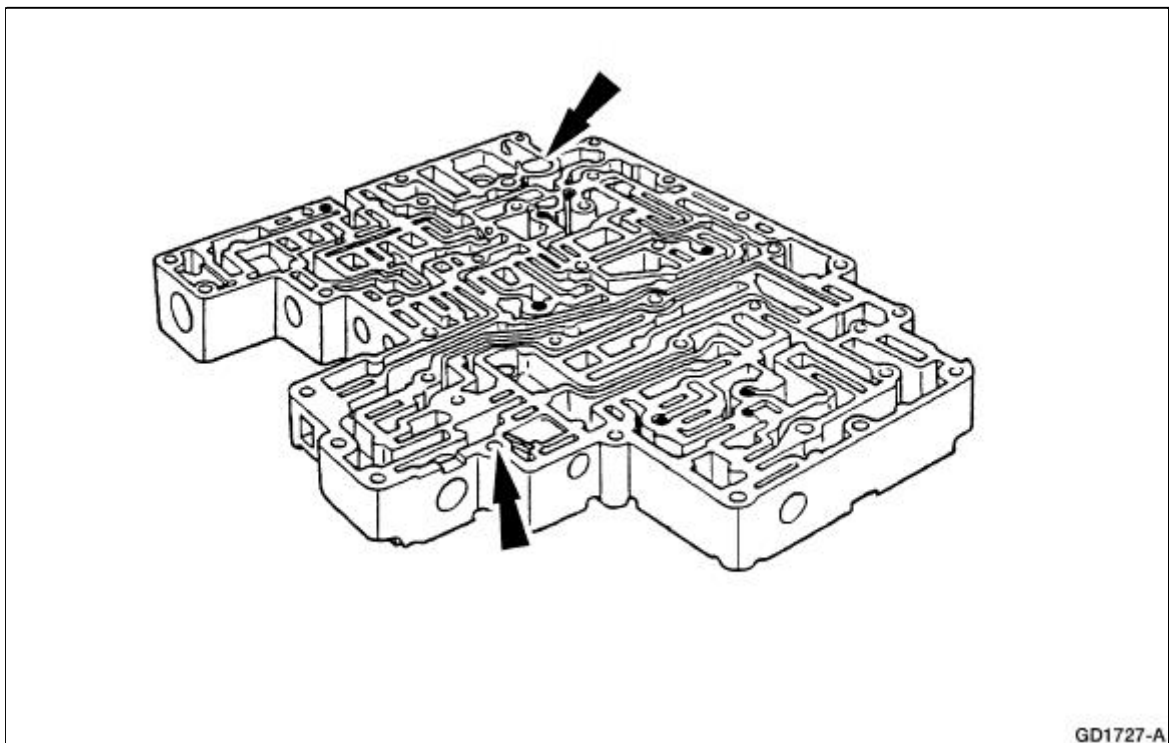


4. **NOTE:** Note the location of the eight coasting booster valve shuttle balls for assembly.

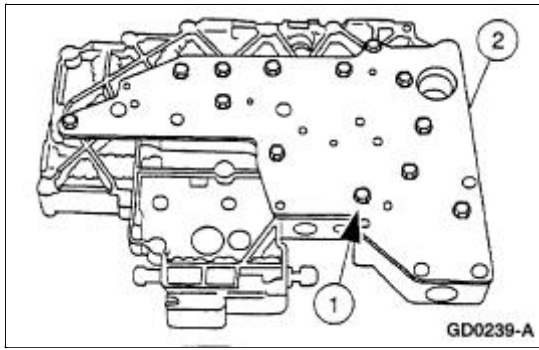
Remove the eight coasting booster valve shuttle balls.



5. Remove the converter drain back valve and solenoid pressure supply screen.



6. Remove the main control valve body cover plate.
 1. Remove the 13 bolts.
 2. Remove the valve body cover plate and gasket.



Assembly

1.  **CAUTION:** Before beginning assembly, carry out and inspect the following:

When building up subassemblies and assembling the transmission, **ALWAYS** use new gaskets and seals.

All fasteners must be tightened to the torque specification indicated. In addition to appearing in the section, the necessary torques can be found in the General Specifications Chart.

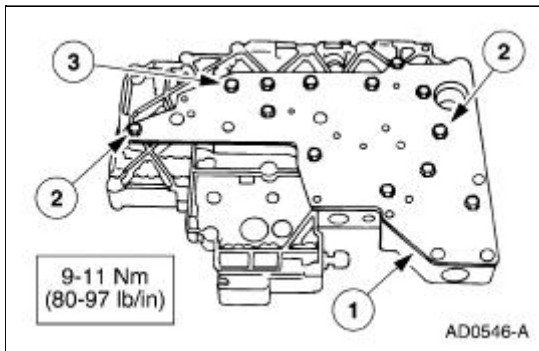
When building up subassemblies, each component part should be lubricated with clean transmission fluid. It is also good practice to lubricate the subassemblies as they are installed in the case.

Needle bearings, thrust washers and seals should be lightly coated with petroleum jelly during subassembly buildup or transmission assembly.

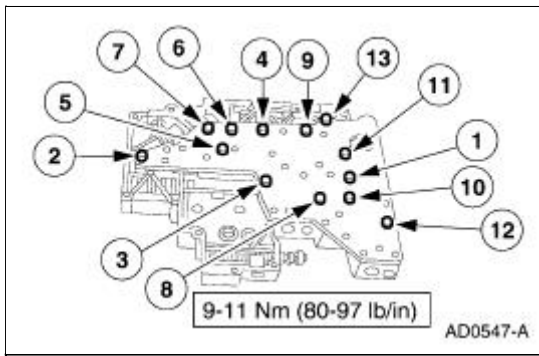
Many components and surfaces in the transmission are precision machined. Careful handling during disassembly, cleaning, inspection and assembly can prevent unnecessary damage to machined surfaces.

Install the valve body cover plate.

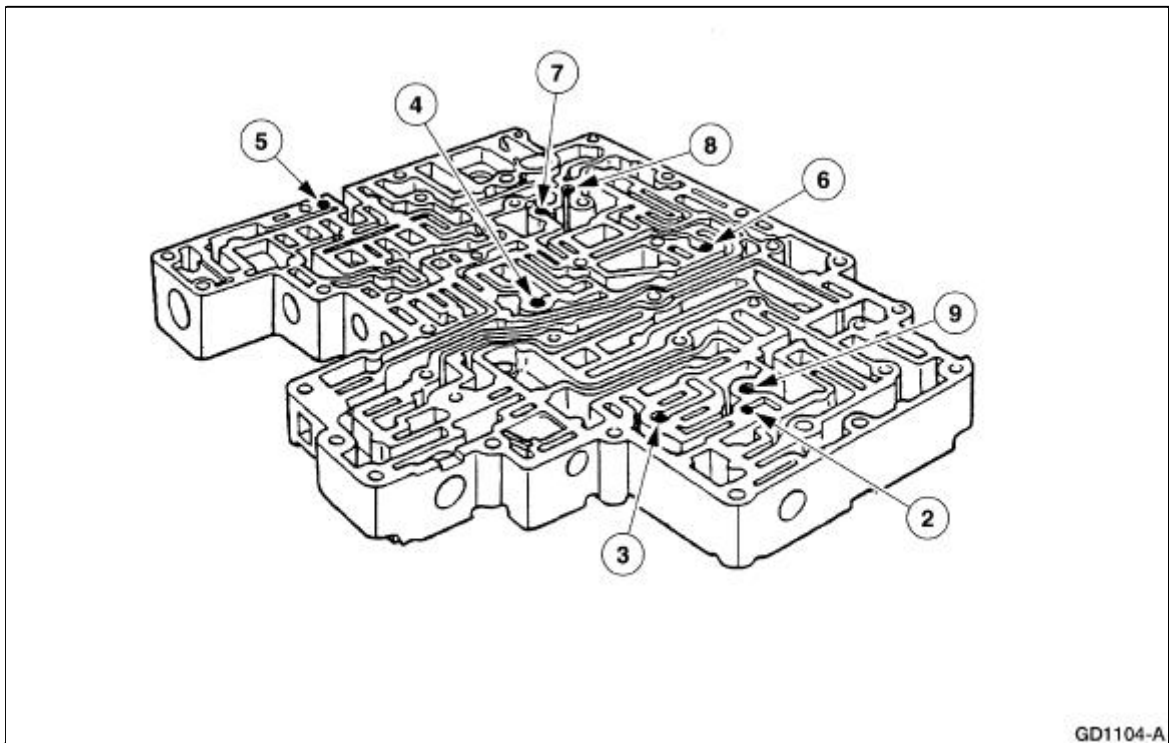
1. Position the valve body cover plate gasket and cover plate.
2. Install the two guide pin bolts.
3. Install the bolts.



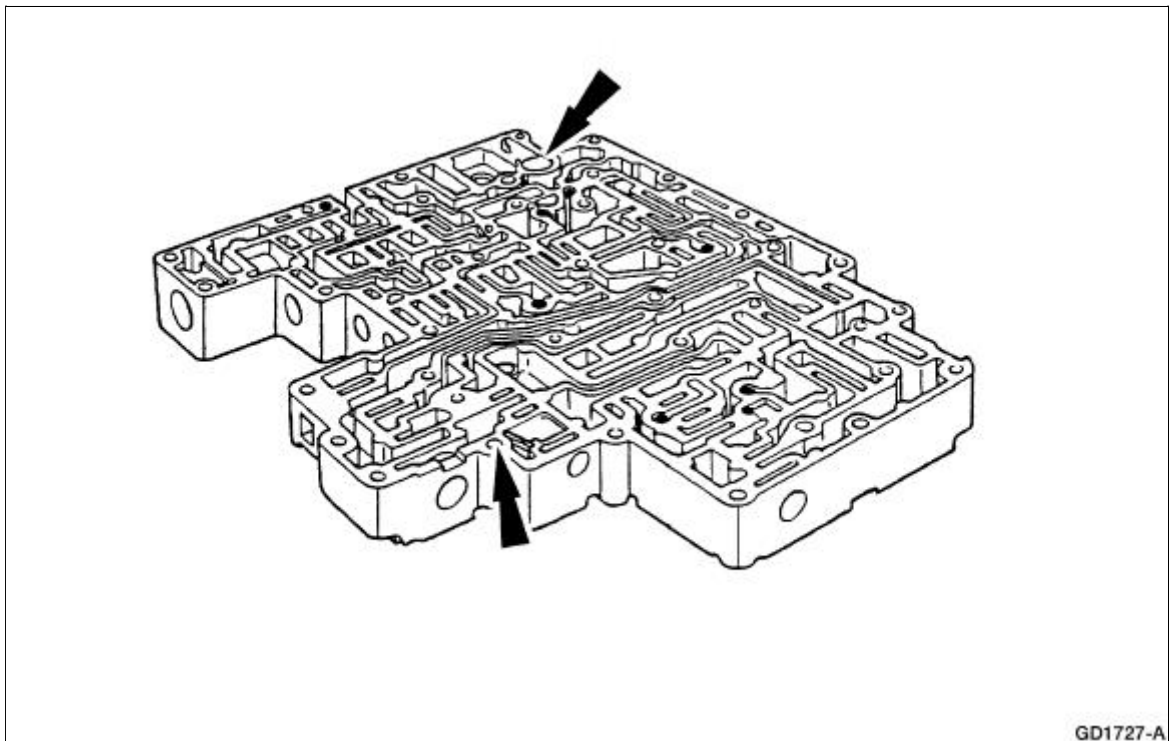
2. Tighten the bolts in the sequence shown.



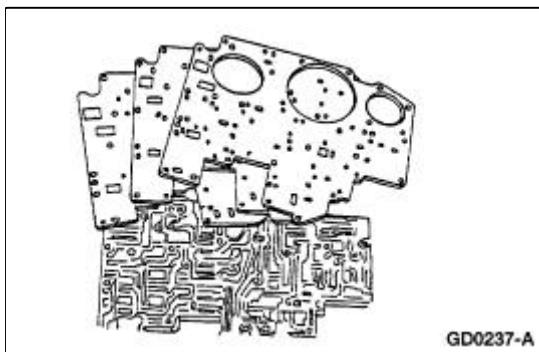
3. Install the eight coasting booster valve shuttle balls.



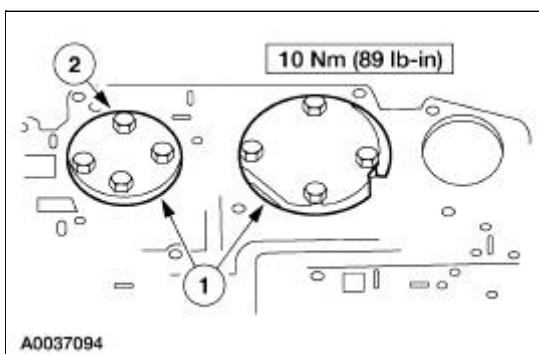
4. Install the converter drain back valve and solenoid pressure supply screen.



5. Install the separator plate and gaskets.



6. Install the two reinforcement plates.
 1. Position the plates.
 2. Install the bolts.

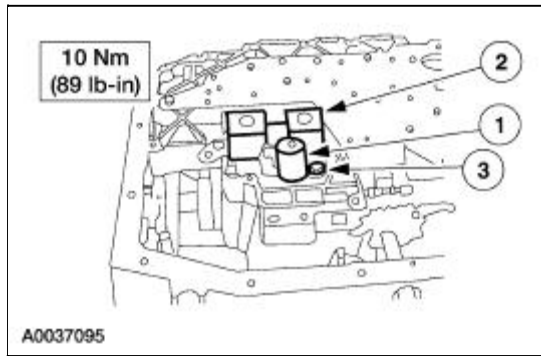


7. **NOTE:** Inspect the shift solenoid O-rings and TCC solenoid O-rings for damage.

Install the shift solenoid.



1. Position the TCC solenoid.
2. Position the shift solenoid.

3. Install the bolt.

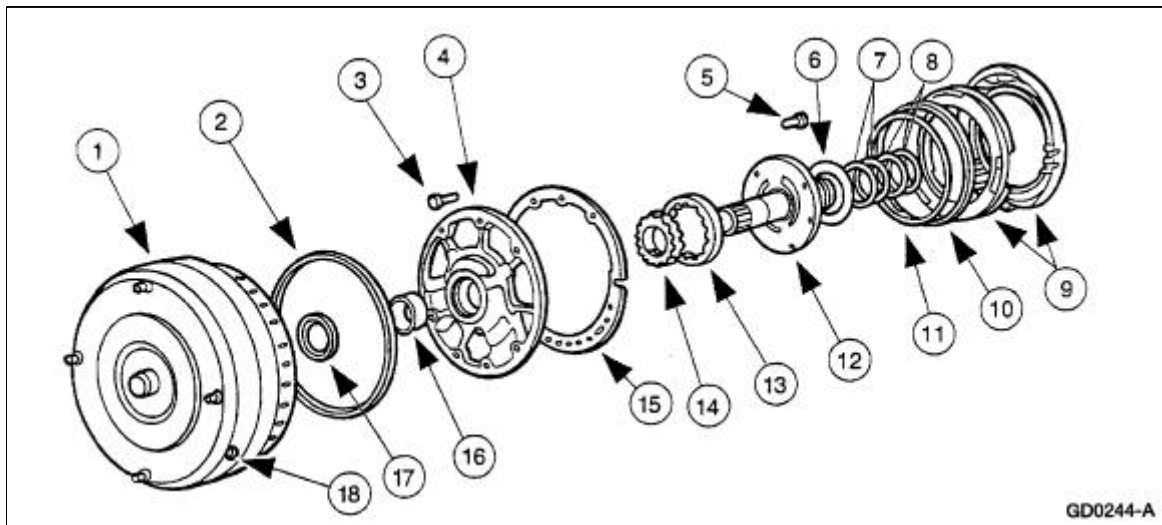


Pump and Intermediate Clutch Piston

Special Tool(s)

 <p>ST1189-A</p>	Installer, Front Pump Fluid Seal 307-014 (T63L-77837-A)
 <p>ST1914-A</p>	Protector, Piston Seal 307-339 (T95L-77005-A)

Pump and Intermediate Clutch Piston — Disassembled View



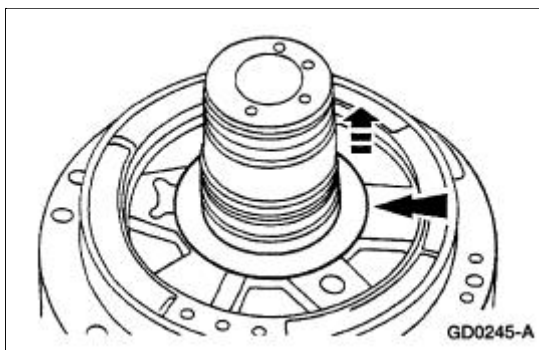
GD0244-A

Item	Part Number	Description
1	7902	Torque converter
2	7A248	Front pump O-ring
3	N605789-S101	Bolt
4	—	Pump body assembly
5	N605787-S1000	Front pump support bolt
6	7D014	No. 1 pump support thrust washer
7	7D020	Reverse clutch cylinder seal
8	7D019	Forward clutch cylinder seal
9	7E005	Intermediate clutch piston
10	7F224	Intermediate clutch piston outer seal

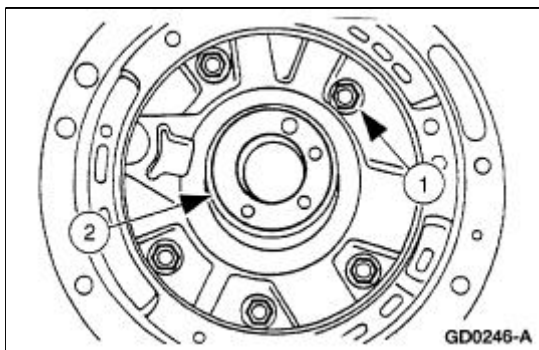
11	7F225	Intermediate clutch piston inner seal
12	7A108	Pump support
13	—	Pump outer gerotor gear
14	—	Pump inner gerotor gear
15	7A136	Pump gasket
16	—	Pump bushing
17	7A248	Pump inner seal
18	391855-S100	Converter drain plug

Disassembly

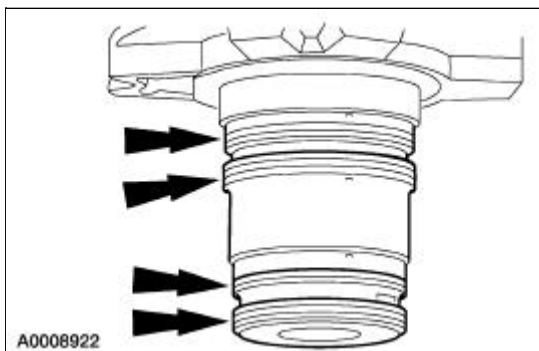
1. Remove the No. 1 selective pump support thrust washer.



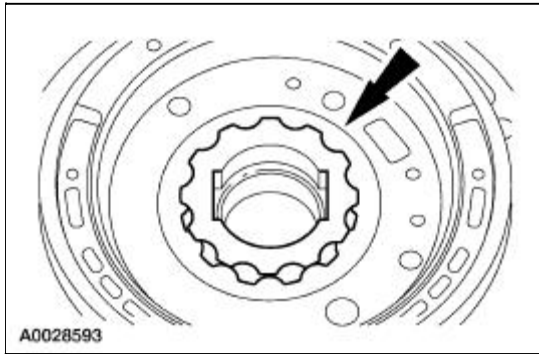
2. Remove the front pump support.
 1. Remove the bolts.
 2. Remove the front pump support.



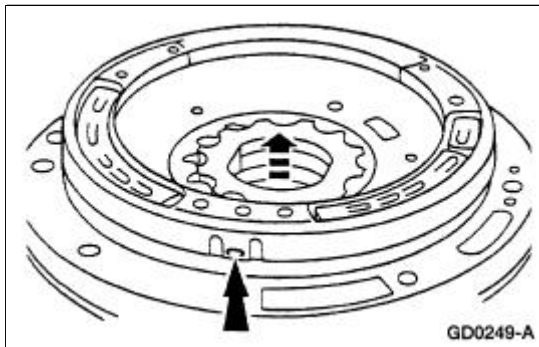
3. Remove the seal rings.



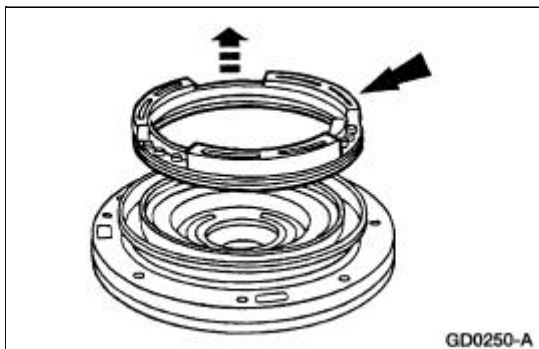
4. Remove the inner and outer pump gerotor gears.



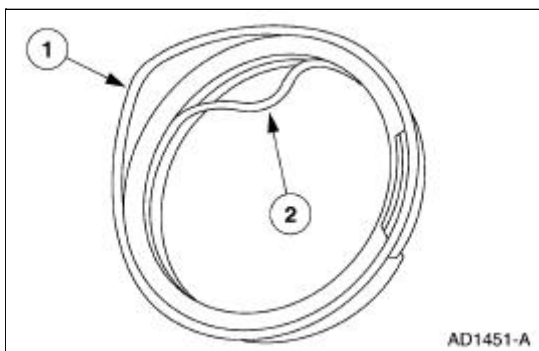
5. Carefully pry spring retainer tabs and remove the spring retainer assembly.



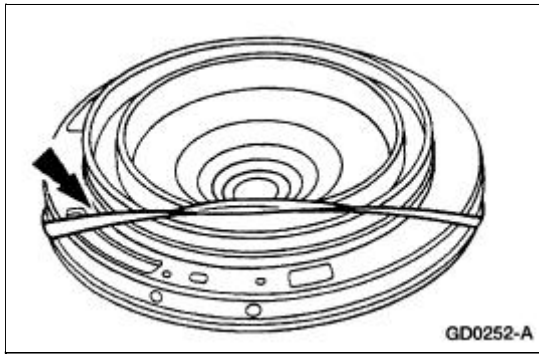
6. Remove the intermediate clutch piston.



7. Remove the clutch piston seals.
1. Remove the intermediate clutch piston outer seal.
2. Remove the intermediate clutch piston inner seal.

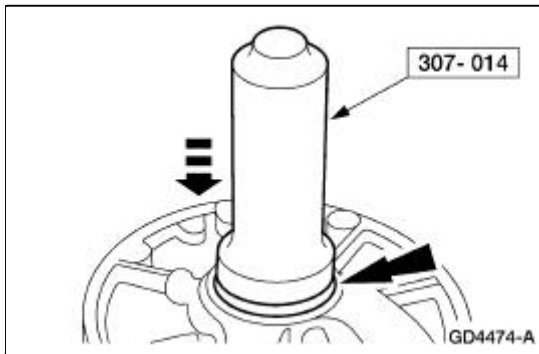


8. Remove and discard the front pump seal.

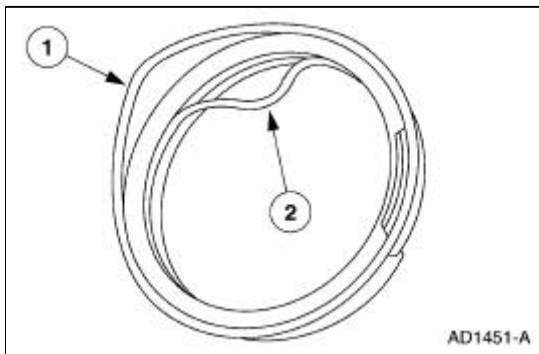


Assembly

1. Using the special tool, install the front pump seal assembly.

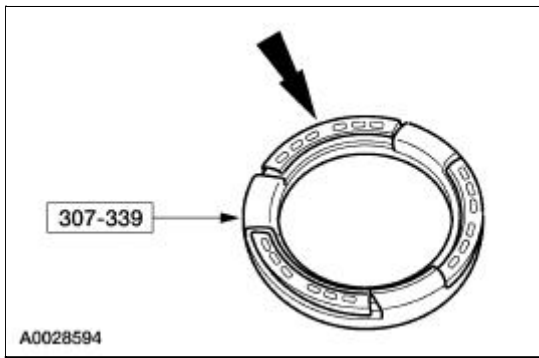


2. Install the clutch piston seals.
 1. Install the intermediate clutch piston outer seal.
 2. Install the intermediate clutch piston inner seal.

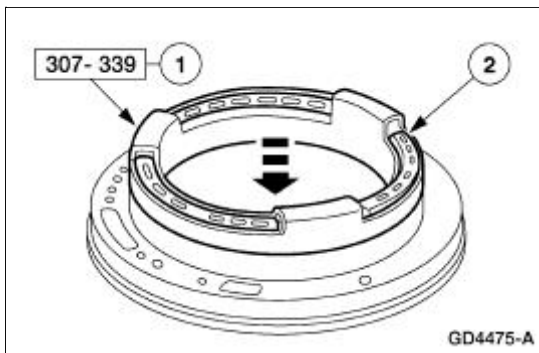



3. **NOTE:** Coat the intermediate clutch piston outer seal, inner seal and pump body with petroleum jelly.

Install the intermediate clutch piston into the special tool.



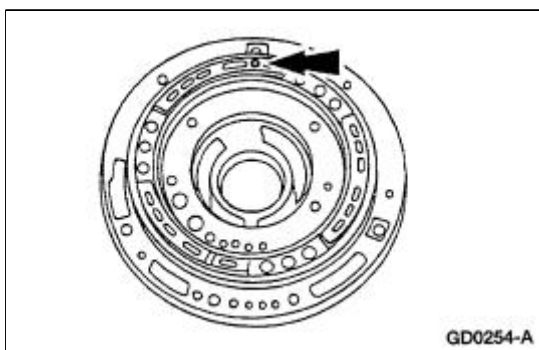
4. Using the special tool, install the intermediate clutch piston.
 1. Position the intermediate clutch piston and the special tool onto the pump body.
 2. Push the intermediate clutch piston to the bottom of the pump body bore, exerting even pressure and remove the special tool.



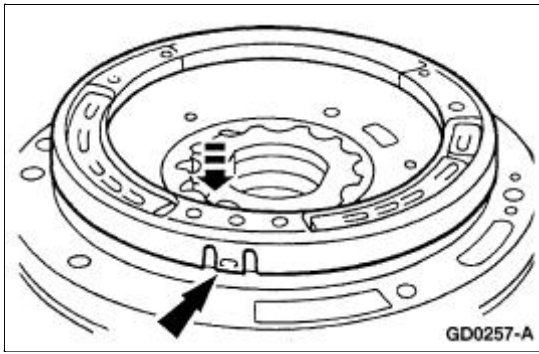
5.  **CAUTION:** The piston bleed hole must be located at 12 o'clock position (towards the top of the transmission). Shift problems may occur if installed incorrectly.

NOTE: The piston bleed hole is the only round hole in the pump body.

Locate the piston bleed hole.

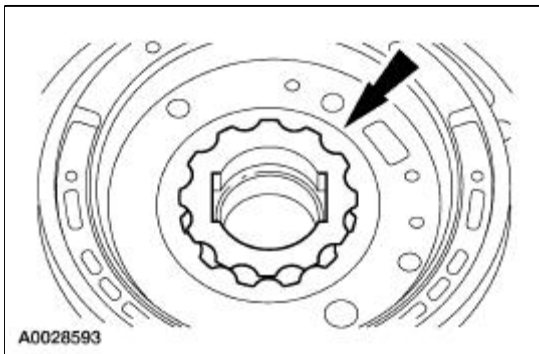


6. Install by snapping the spring retainer assembly on pump body.



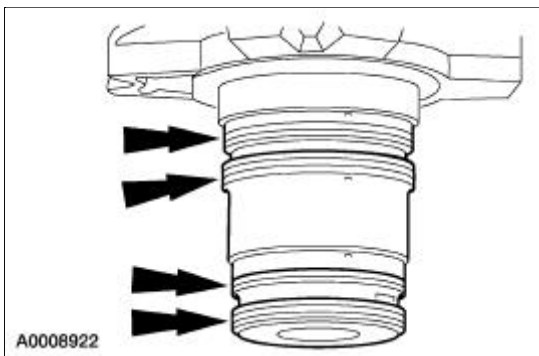
7. **NOTE:** The flats on the inner fluid pump gear have steps that must face the pump body or damage will result.

Install the inner and outer fluid pump gerotor gears.

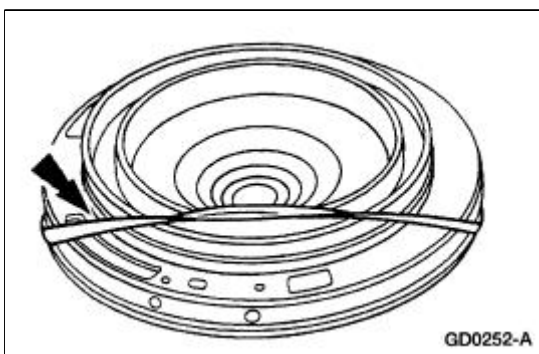


8. **NOTE:** The reverse clutch cylinder seal rings are larger than the forward clutch cylinder seals.

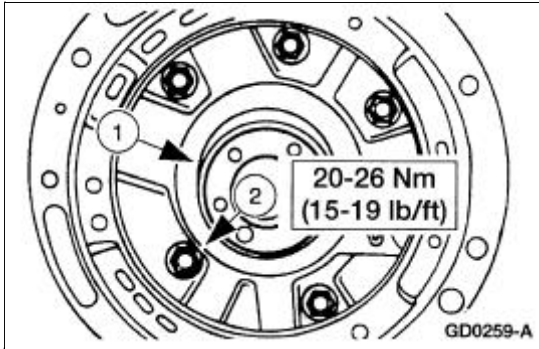
Install the seal rings.



9. Install a new front pump seal.

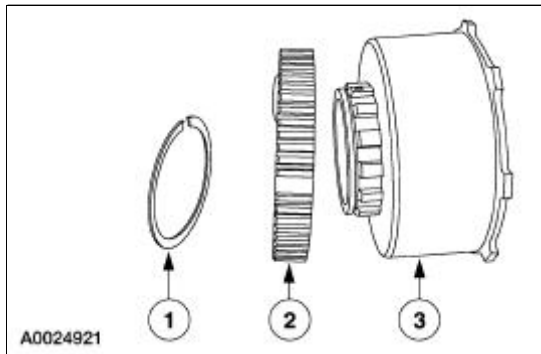


10. Assemble the front pump.
 1. Position the pump support to the pump body assembly.
 2. Install the bolts.



Intermediate One-Way Clutch

Intermediate Clutch Cylinder Disassembled View



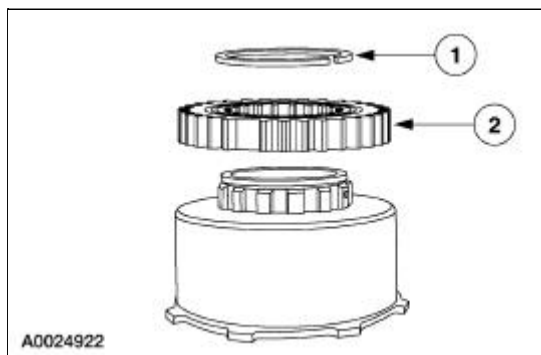
Item	Part Number	Description
1	391267-S	Retaining ring
2	7A089	Intermediate one-way clutch assembly
3	7D044	Reverse clutch drum

Disassembly

1. **NOTE:** One tab that locks the reverse clutch drum into the reverse sun shell may be removed. This is done for balancing purposes.

Remove the intermediate one-way clutch.

1. Remove the snap ring.
2. Remove the intermediate one-way clutch.

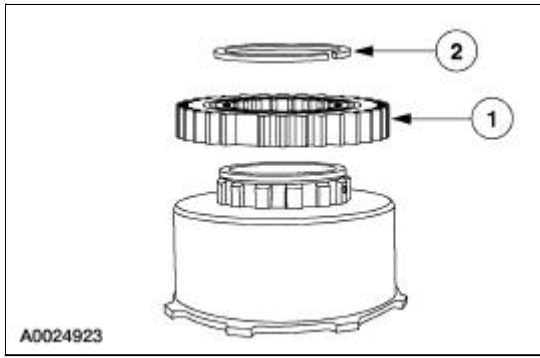


Assembly

1. **NOTE:** The intermediate one-way clutch must rotate counterclockwise when installed on the reverse clutch drum and will make a ratchet sound.





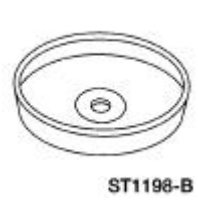
Install the intermediate one-way clutch.

1. Install the intermediate one-way clutch.
2. Install the snap ring.



Reverse Clutch

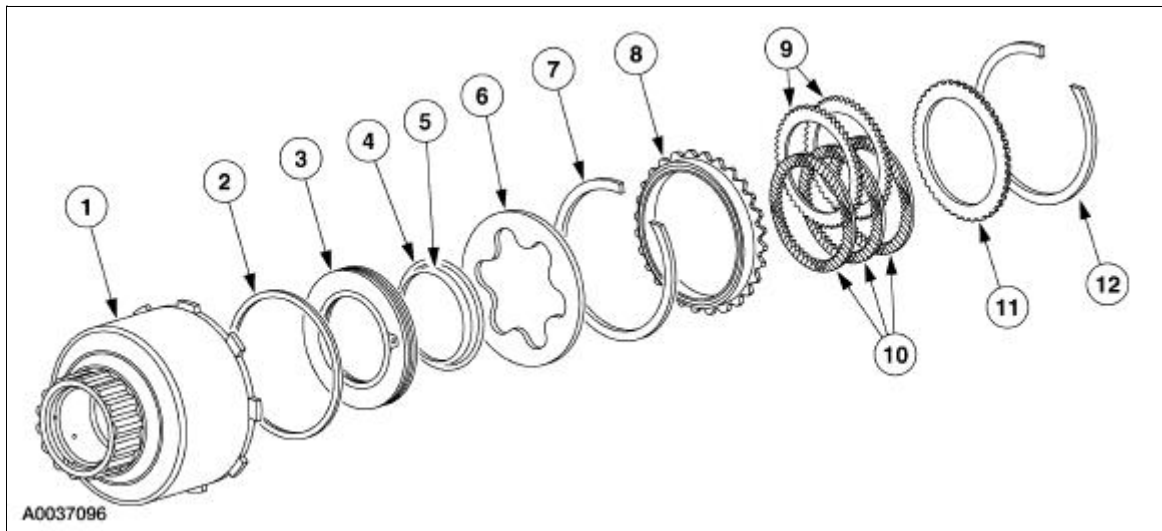
Special Tool(s)

 <p>ST1214-A</p>	<p>Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)</p>
 <p>ST1190-A</p>	<p>Compressor, Clutch Spring 307-015 (T65L-77515-A)</p>
 <p>ST1206-A</p>	<p>Protector, Transmission Reverse Clutch Outer Fluid Seal 307-424</p>
 <p>ST1207-A</p>	<p>Protector, Transmission Reverse Clutch Inner Fluid Seal 307-425</p>
 <p>ST1198-B</p>	<p>Compressor, Clutch Spring 307-086 (T80L-77405-A)</p>

Material

Item	Specification
<p>MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM</p>	<p>MERCON® V</p>

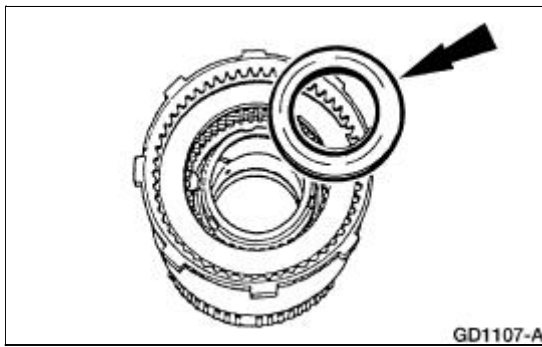
Reverse Clutch Disassembled View



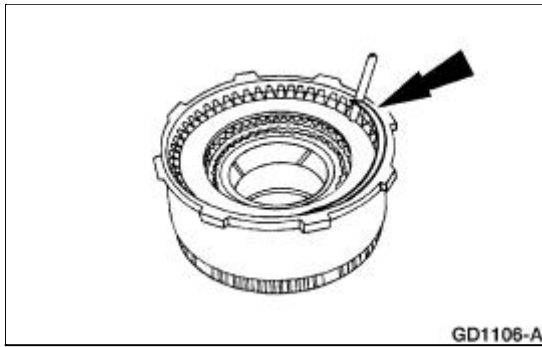
Item	Part Number	Description
1	7D044	Reverse clutch drum
2	7D403	Reverse clutch piston outer seal
3	7D402	Reverse clutch piston
4	7D404	Reverse clutch piston inner seal
5	7D256	Reverse clutch piston spring pressure ring
6	7B070	Reverse clutch piston spring
7	7A577	Reverse clutch piston spring ring
8	7B066	Reverse clutch front pressure plate
9	7B442	Reverse clutch external spline plates (steel)
10	7B164	Reverse clutch internal spline plates (friction)
11	7B066	Reverse clutch rear pressure plate
12	7D483	Reverse clutch retaining ring (select fit)

Disassembly

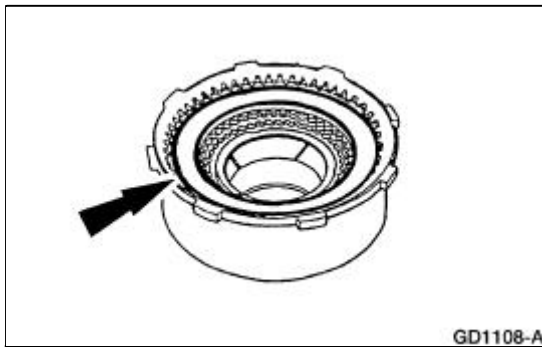
1. Inspect the clutch cylinder thrust surfaces, piston bore and clutch plate serrations for scores or burrs. Minor scores or burrs may be removed with a crocus cloth. Install a new clutch cylinder if badly scored or damaged.
2. Check fluid passage in the clutch cylinder for obstructions. Clean out all fluid passages. Inspect the clutch piston for scores and install new if necessary. Inspect check balls for freedom of movement and correct seating.
3. Check clutch release spring for distortion and cracks. Install a new spring (including the wave spring) if distorted or cracked.
4. Inspect the composition clutch plates, steel clutch plates and clutch pressure plate for worn or scored bearing surfaces. Install new parts if they are deeply scored or burred.
5. Check the clutch plates for flatness and fit on clutch hub serrations. Discard any plate that does not slide freely on serrations or that is not flat.
6. Check clutch hub thrust surfaces for scores and clutch hub splines for wear.
7. Remove the No. 2 forward clutch bearing.



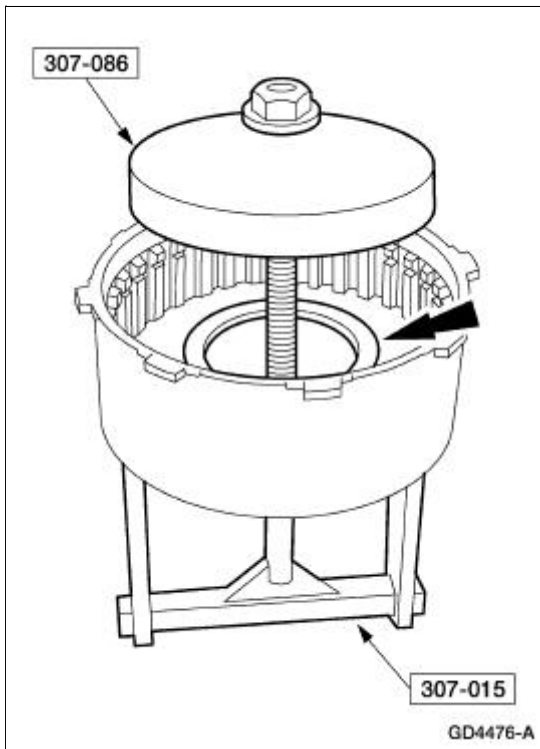
8. Remove the reverse clutch selective retaining ring.



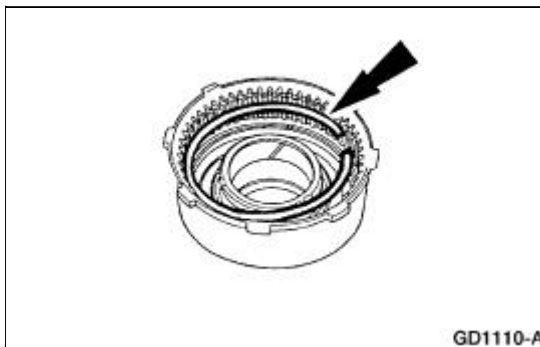
9. Remove the reverse clutch pack.



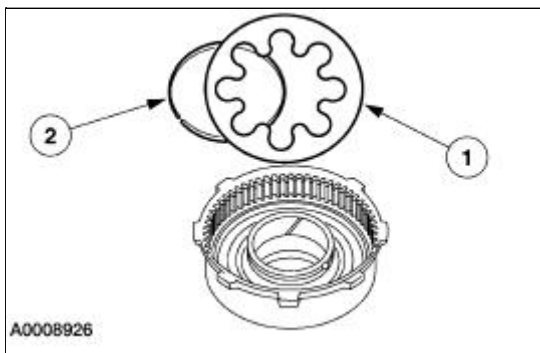
10. Using the special tools, compress the reverse clutch piston spring.



11. Remove the reverse clutch piston spring retaining ring.

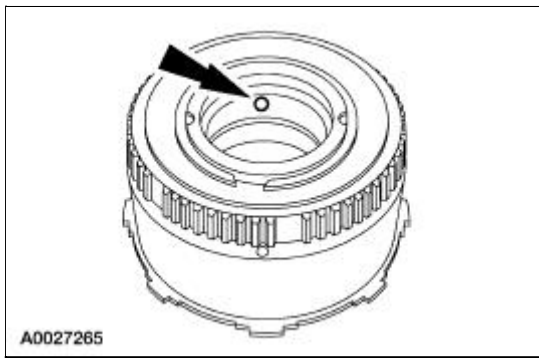


12. Remove the reverse clutch piston spring pressure ring.
 1. Remove the reverse clutch piston spring.
 2. Remove the reverse clutch piston spring pressure ring.

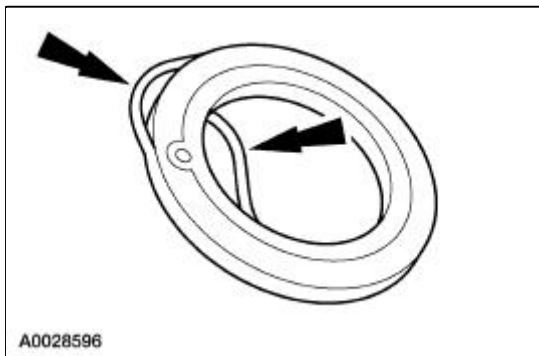


13. **NOTE:** To ease reverse clutch piston removal, it may be necessary to apply air pressure to the reverse clutch drum. Block the opposite hole.

Remove the reverse clutch piston.



14. Remove the reverse clutch piston inner and outer seals.



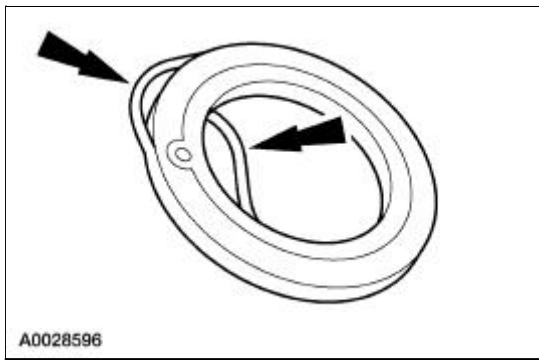
Assembly

1. **NOTE:** One tab that locks the reverse clutch drum into the reverse sun shell may be removed. This is done for balancing purposes.

Inspect the clutch cylinder thrust surfaces, piston bore and clutch plate serrations for scores or burrs. Minor scores or burrs may be removed with crocus cloth. Install a new clutch cylinder if badly scored or damaged.

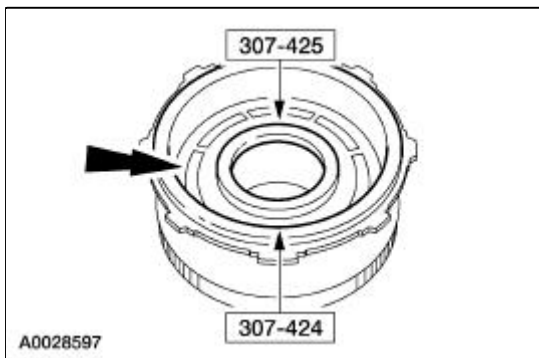
2. Check the fluid passage in the clutch cylinder for obstructions. Clean out all fluid passages. Inspect clutch piston for scores and install new if necessary. Inspect the check balls for freedom of movement and correct seating.
3. Check the clutch release spring for distortion and cracks. Install a new spring (including wave spring) if distorted or cracked.
4. Inspect the composition clutch plates, steel clutch plates and clutch pressure plate for worn or scored bearing surfaces. Install new parts if they are deeply scored or burred.
5. Check the clutch plates for flatness and fit on the clutch hub serrations. Discard any plate that does not slide freely on serrations or that is not flat.
6. Check the clutch hub thrust surfaces for scores and clutch hub splines for wear.
7. **NOTE:** The piston check ball must be present and moving freely.

Install a new reverse clutch piston inner and outer seals.



8. **NOTE:** Coat the reverse clutch piston inner seal, outer seal, drum sealing area and special tools with petroleum jelly.

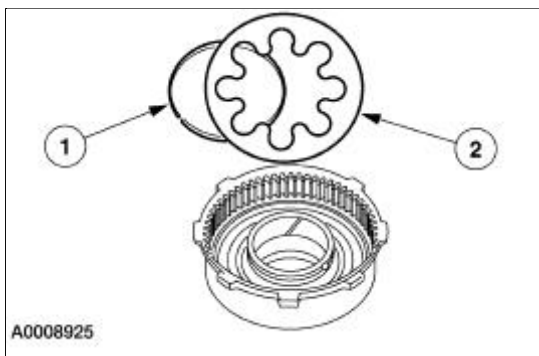
Using the special tools, install the reverse clutch piston using even pressure to push it to the bottom of the reverse clutch drum.



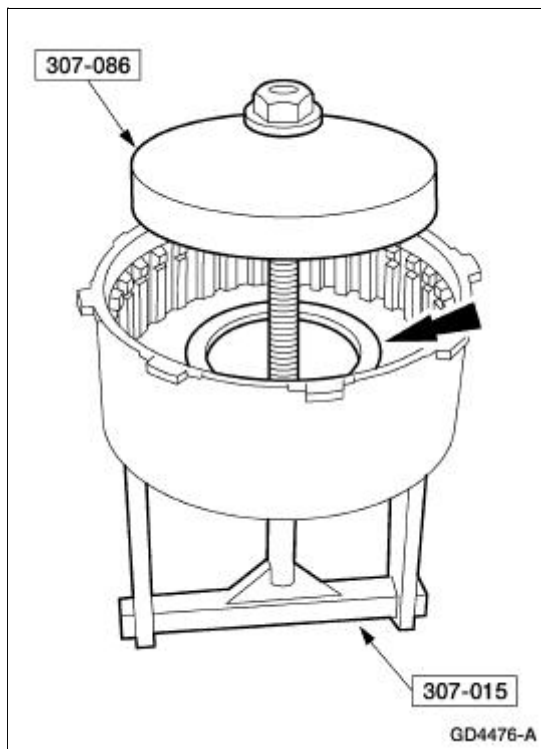
9. **NOTE:** The dished side of the reverse clutch piston spring must face the reverse clutch piston.

Install the reverse clutch piston spring.

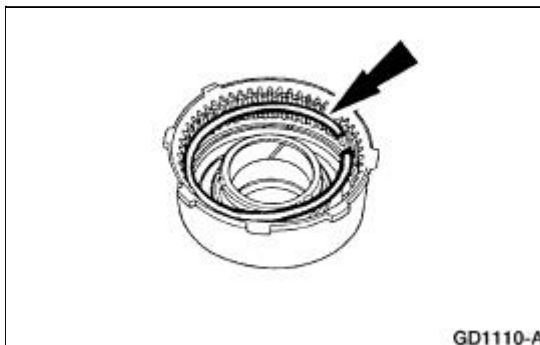
1. Install the reverse clutch piston spring pressure ring.
2. Install the reverse clutch piston spring.



10. Using the special tools, compress the reverse clutch piston spring.



11. Install the reverse clutch piston spring retaining ring.

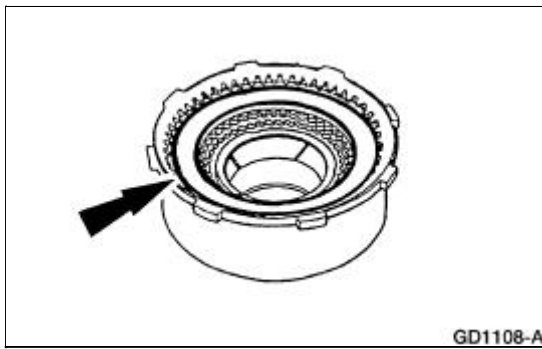


12. Remove the special tool.

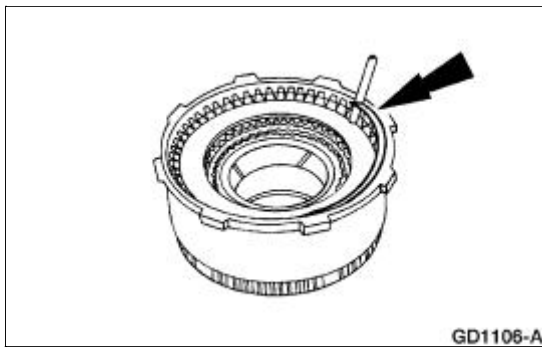
13.  **CAUTION: Install the pressure plates with the flat sides facing the clutch pack.**

NOTE: Before assembly, soak the new clutch discs in clean automatic transmission fluid for 15 minutes.

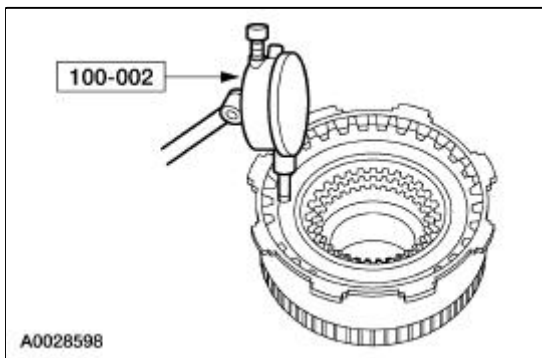
Install the reverse clutch front pressure plate, clutch pack and reverse clutch rear pressure plate.



14. Install the reverse clutch pressure plate retainer snap ring.



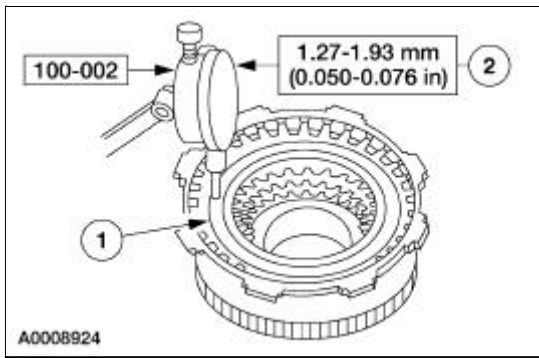
15. Install the special tool on the reverse clutch pack.
- Push downward on the clutch pack.
 - Release pressure and zero the dial indicator.



16. Using the special tool check the reverse clutch pack clearance.
1. Lift up on the clutch pack until it fully seats against the reverse clutch pressure plate retainer.
 2. Read the dial indicator.
 - If clearance is not within specifications, install the correct size retaining ring.

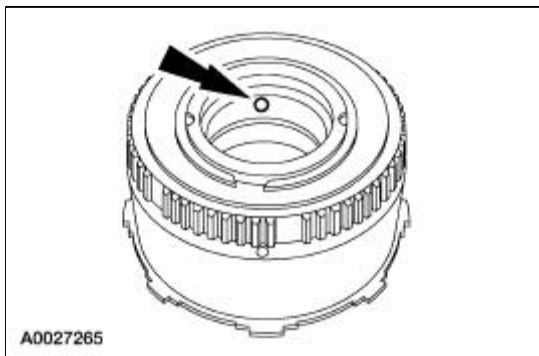
Selective Retaining Rings

Specification
1.52-1.62 mm (0.060-0.064 inch)
1.87-1.98 mm (0.074-0.078 inch)
2.23-2.33 mm (0.088-0.092 inch)
2.59-2.69 mm (0.102-0.106 inch)






17. Check the clutch for correct operation.

- Apply air pressure to the reverse clutch drum. The clutch should be heard and felt to work without leakage.



Forward Clutch Cylinder

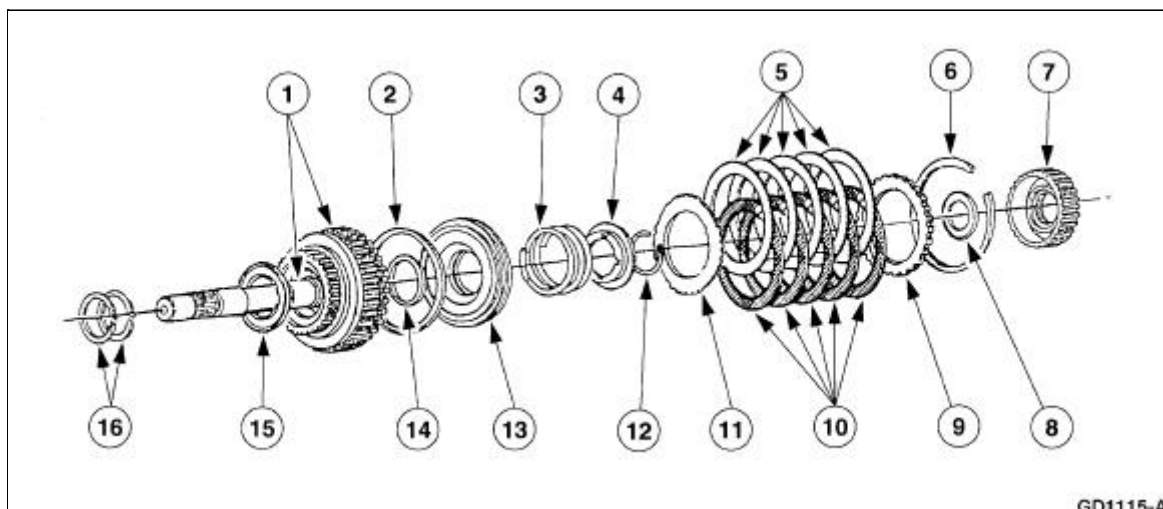
Special Tool(s)

 <p>ST1214-A</p>	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
 <p>ST1209-A</p>	Compressor, Clutch Spring 307-096 (T81P-70235-A)
 <p>ST2693-A</p>	Protector, Transmission Forward Clutch Outer Fluid Seal 307-423

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

Forward Clutch — Disassembled View



GD1115-A

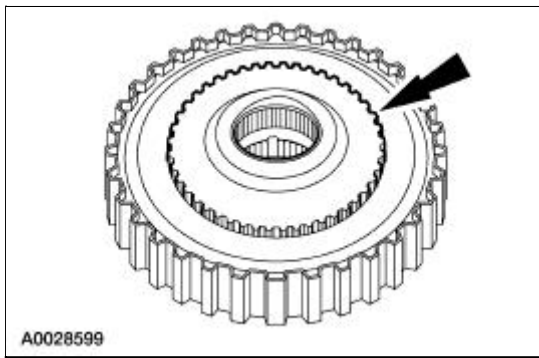
Item	Part Number	Description

1	7F207	Forward clutch cylinder and shaft
2	7A548	Forward clutch piston outer seal
3	7A480	Forward clutch piston return spring
4	7A527	Forward clutch retainer return spring
5	7B442	Forward clutch external spline plate (steel)
6	7D483	Retaining snap ring
7	7B067	Forward clutch hub
8	7F231	No. 3 forward clutch hub front bearing
9	7B066	Forward clutch pressure plate
10	7B164	Forward clutch internal spline plates (friction)
11	7E085	Forward clutch pressure spring
12	388099-S	Retaining snap ring
13	7A262	Forward clutch piston
14	7C099	Forward clutch piston inner seal
15	7A166	No. 2 forward clutch bearing
16	7B497	Input shaft seal

Disassembly

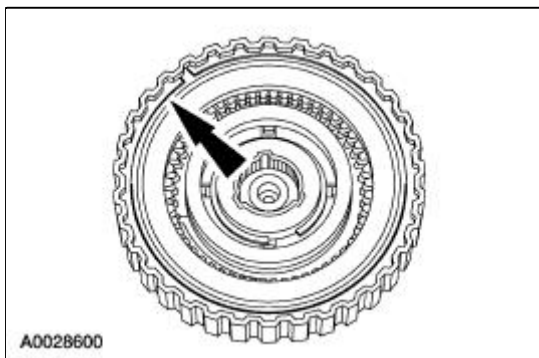
1. Inspect the clutch cylinder thrust surfaces, piston bore and clutch plate serrations for scores or burrs. Minor scores or burrs may be removed with crocus cloth. Install a new clutch cylinder if it is badly scored or damaged.
2. Check the fluid passage in the clutch cylinder for obstructions. Clean out all the fluid passages. Inspect the clutch piston for scores and install a new piston if necessary. Inspect check balls for freedom of movement and correct seating.
3. Check the clutch release spring for distortion and cracks. Install a new spring (including wave spring) if distorted or cracked.
4. Inspect the composition clutch plates, steel clutch plates and clutch pressure plate for worn or scored bearing surfaces. Install new parts if they are deeply scored or burred.
5. Check the clutch plates for flatness and fit on clutch hub serrations. Discard any plate that does not slide freely on serrations or that is not flat.
6. Check the clutch hub thrust surfaces for scores and clutch hub splines for wear.
7. **NOTE:** The forward clutch hub may remain in the shell during disassembly.

Remove the forward clutch hub and the No. 3 forward clutch hub front bearing.

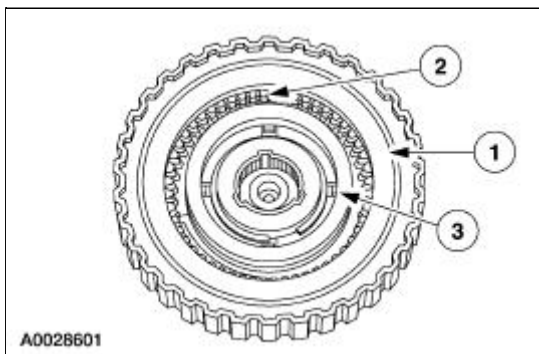



8. **NOTE:** To aid handling, the forward clutch assembly may be set in the extension housing or a hole in the work bench.

Remove the forward clutch pack selective retaining ring.

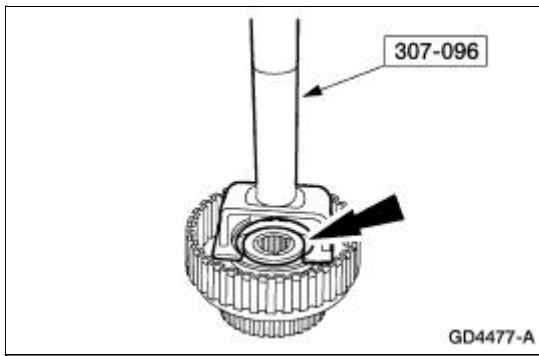


9. Remove the following components.
1. Remove the pressure plate.
 2. Remove the clutch pack.
 3. Remove the pressure spring.

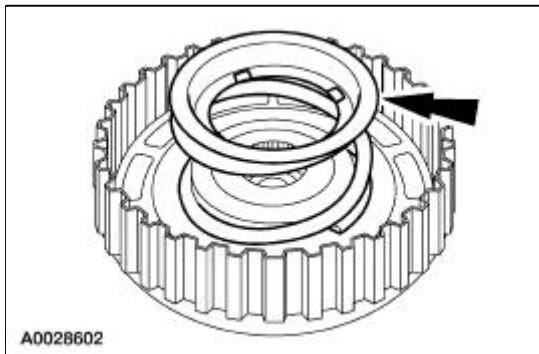


10.  **CAUTION:** Apply only enough pressure to release pressure on the retaining ring. If too much pressure is applied, the spring may break.

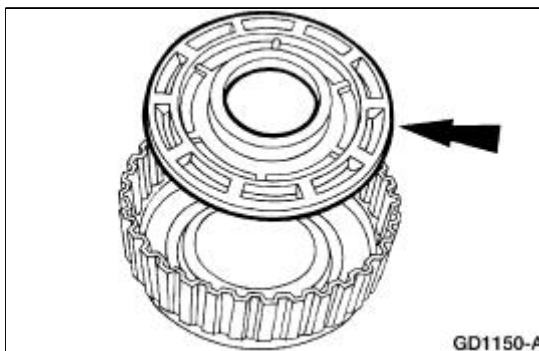
Using the special tool, remove the forward clutch retaining ring.



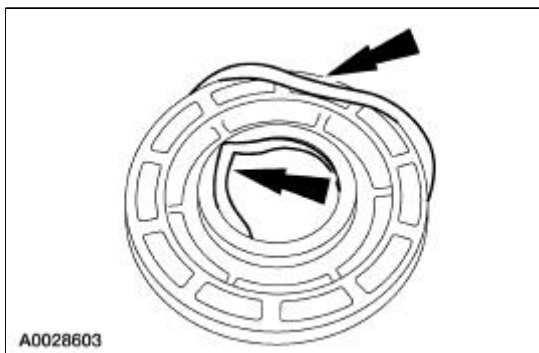
11. Slowly release the press and remove the forward clutch from the press.
12. Remove the forward clutch retainer and the return spring.



13. **NOTE:** Air pressure may be required to remove the forward clutch piston.
Remove the forward clutch piston.

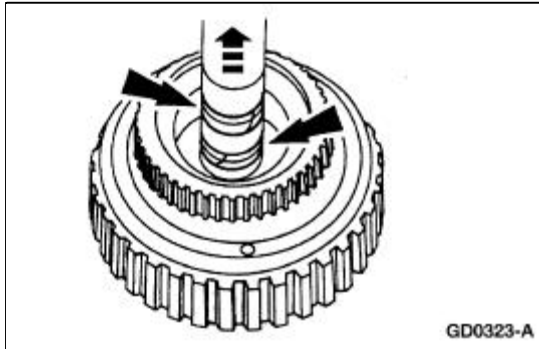


14. Remove the inner and outer forward clutch piston seals.

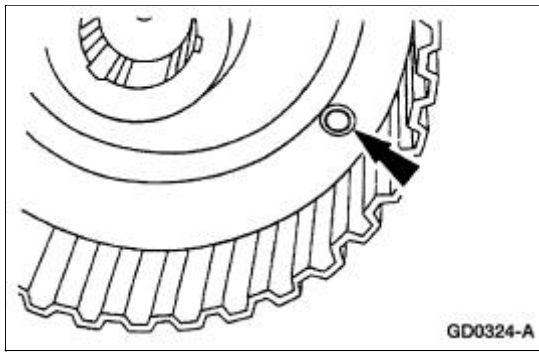


15. **NOTE:** The seals are solid seals, however, when installing new seals use scarf-cut seals.

Remove the forward clutch input shaft seals.



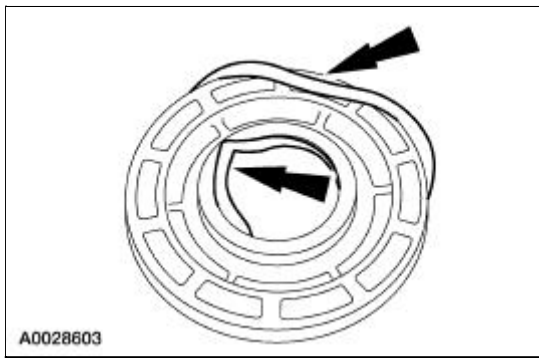
16. Make sure the check ball in the clutch cylinder is free and clean. Check for correct seating.



Assembly

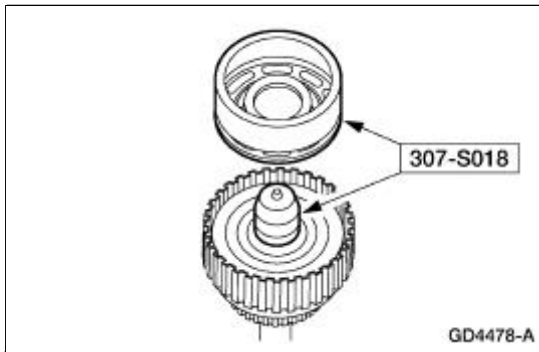
1. Inspect the clutch cylinder thrust surfaces, piston bore and clutch plate serrations for scores or burrs. Minor scores or burrs may be removed with crocus cloth. Install a new clutch cylinder if badly scored or damaged.
2. Check the fluid passage in the clutch cylinder for obstructions. Clean out all fluid passages. Inspect the clutch piston for scores and install a new piston if necessary. Inspect check balls for freedom of movement and correct seating.
3. Check the clutch release spring for distortion and cracks. Install a new spring (including the wave spring) if distorted or cracked.
4. Inspect composition clutch plates, steel clutch plates and clutch pressure plate for worn or scored bearing surfaces. Install new parts if they are deeply scored or burred.
5. Check the clutch plates for flatness and fit on the clutch hub serrations. Discard any plate that does not slide freely on serrations or that is not flat.
6. Check the clutch hub thrust surfaces for scores and the clutch hub splines for wear.
7. **NOTE:** To aid handling, the forward clutch assembly may be set in the extension housing or a hole in the work bench.

Install the inner and outer forward clutch piston seals. Note the direction of the sealing rings before installation.



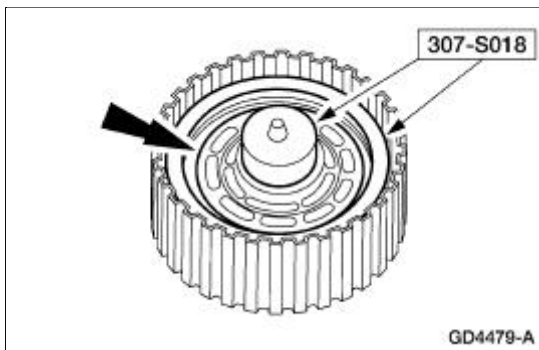
8. **NOTE:** Coat the piston seals and clutch drum sealing area with petroleum jelly.

Position the special tools on the clutch piston.

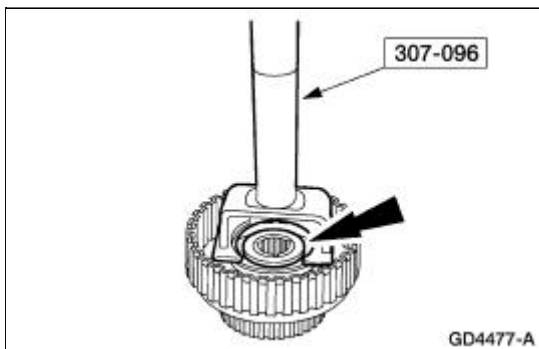


9. Using the special tools, install the forward clutch piston into the clutch drum.

- Push the piston to the bottom of the drum using even pressure.



10. Using the special tool, compress the piston return spring and install the retaining ring.

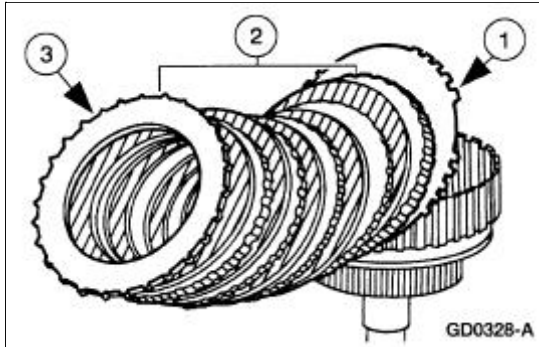


11. Slowly release the press pressure and remove the forward clutch.

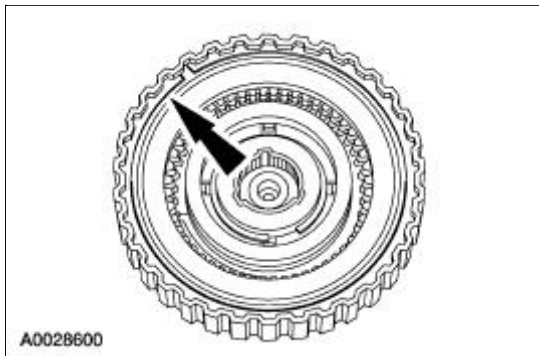
12. **NOTE:** Before assembly, soak the new clutch discs in clean automatic transmission fluid for 15 minutes.

Install the clutch pack assembly.

1. Install the pressure ring.
2. Install the clutch pack.
3. Install the pressure plate.

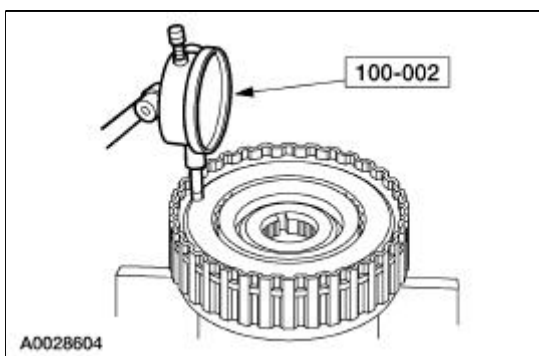


13. Install the clutch pack retaining ring.



14. Install the special tool on the forward clutch pack.

- Push downward on the clutch pack.
- Release pressure and zero the dial indicator.



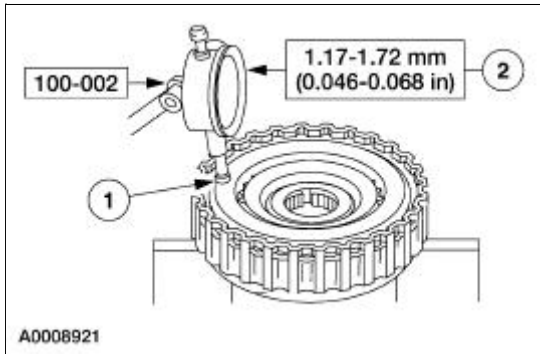
15. Using the special tool, check the clutch pack clearance.

1. Lift up on the clutch pack until it fully seats against the clutch pressure plate retainer.
2. Read the dial indicator.
 - If the clearance is not within specifications, install the correct size retaining ring.

Selective Retaining Ring

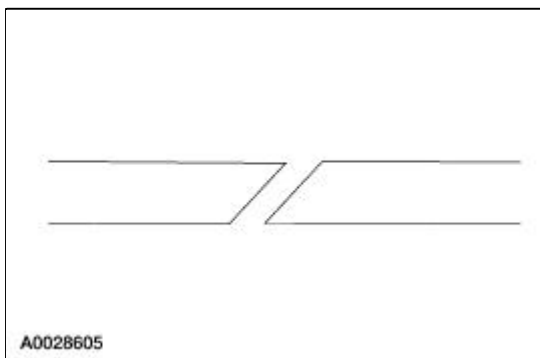
Specification

1.52-1.62 mm (0.060-0.064 inch)
1.87-1.98 mm (0.074-0.078 inch)
2.24-2.34 mm (0.088-0.092 inch)
2.59-2.69 mm (0.102-0.106 inch)

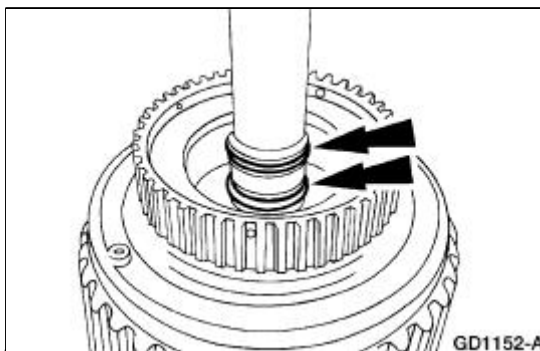


16. **NOTE:** Make sure the scarf-cut seals are mated correctly.

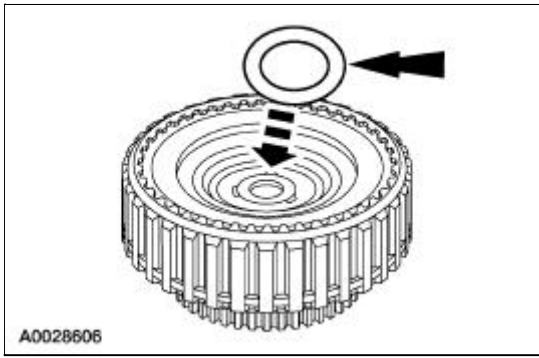
Slide the two scarf-cut seals on the input shaft.



17. Install the two scarf-cut seals on the input shaft.

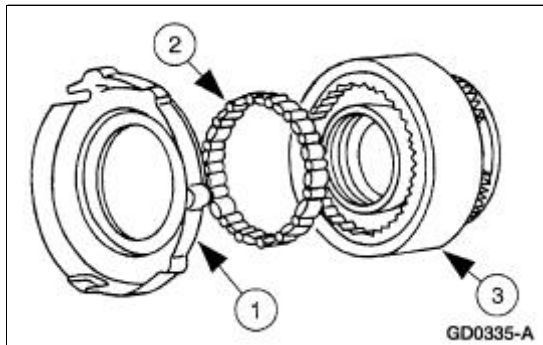


18. Install the No. 3 forward clutch hub front bearing and the forward clutch hub.



A0028606

Planetary Gear Support Assembly and Planetary One-Way Clutch

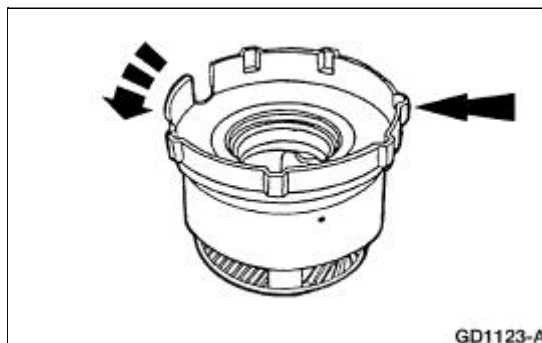


Item	Part Number	Description
1	7A130	Planetary gear support
2	7A089	Planetary one-way clutch
3	7A398	Planetary assembly

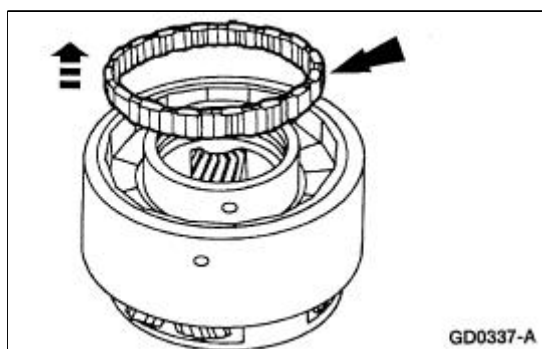
Disassembly and Assembly

1. **NOTE:** Inspect the outer and inner races for scores or damaged surface areas where rollers contact the races. Inspect the rollers and springs for excessive wear or damage. Inspect the spring and cage for bent or damaged spring retainers.

Rotate the center support counterclockwise and lift to remove the planetary gear support.



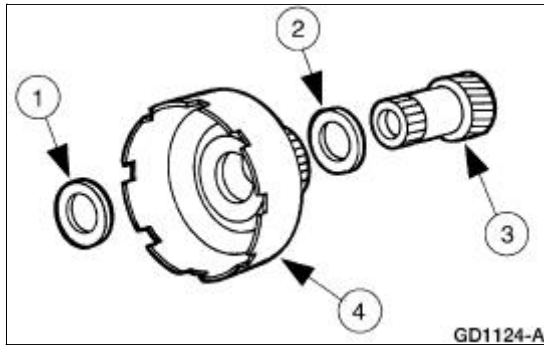
2. Remove the planetary one-way clutch.



3. To assemble, reverse the disassembly procedure.

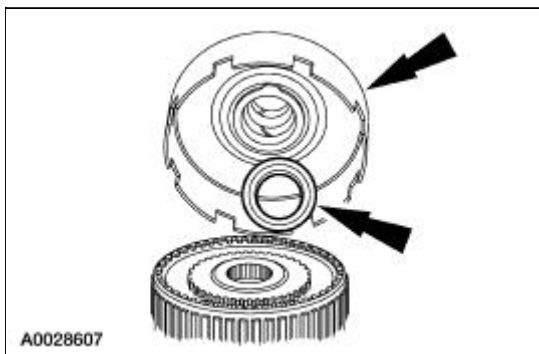
Reverse Sun Gear

Disassembly

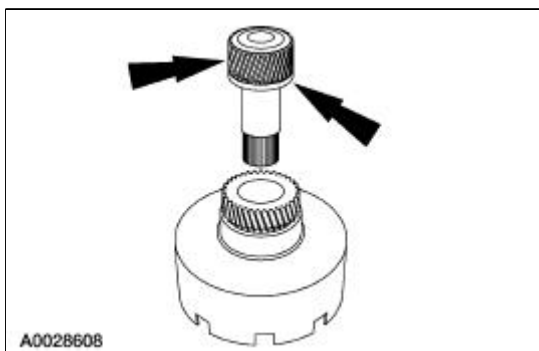


Item	Part Number	Description
1	7C096	Forward clutch hub bearing No. 4
2	7F244	Forward clutch sun gear bearing No. 5
3	7A399	Forward clutch sun gear
4	7A019	Reverse sun gear assembly

1. Remove the reverse clutch sun gear assembly and the No. 4 forward clutch hub bearing and race.



2. Remove the forward clutch sun gear assembly and the No. 5 forward clutch sun gear bearing and race.

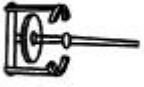




Assembly

1. The forward clutch sun gear and reverse sun gear assembly are assembled as part of the transmission assembly procedure.
-

Output Shaft and Direct Clutch Cylinder

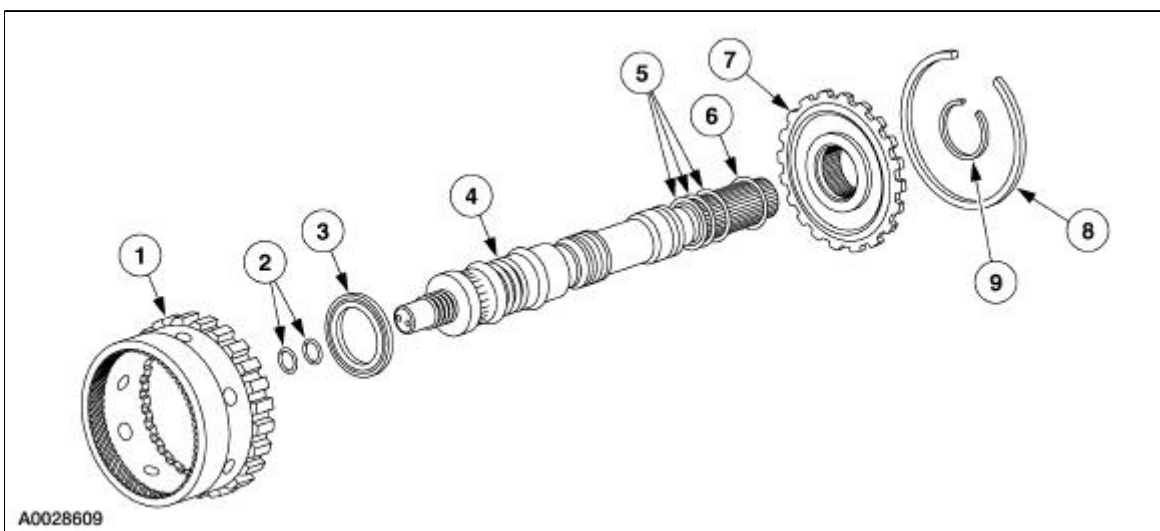
Special Tool(s)

 ST1190-A	Compressor, Clutch Spring 307-015 (T65L-77515-A)
 ST1204-A	Protector, Piston Seal 307-080 (T80L-77234-A)
 ST1901-A	Protector, Transmission Direct Clutch Outer Fluid Seal 307-422

Material

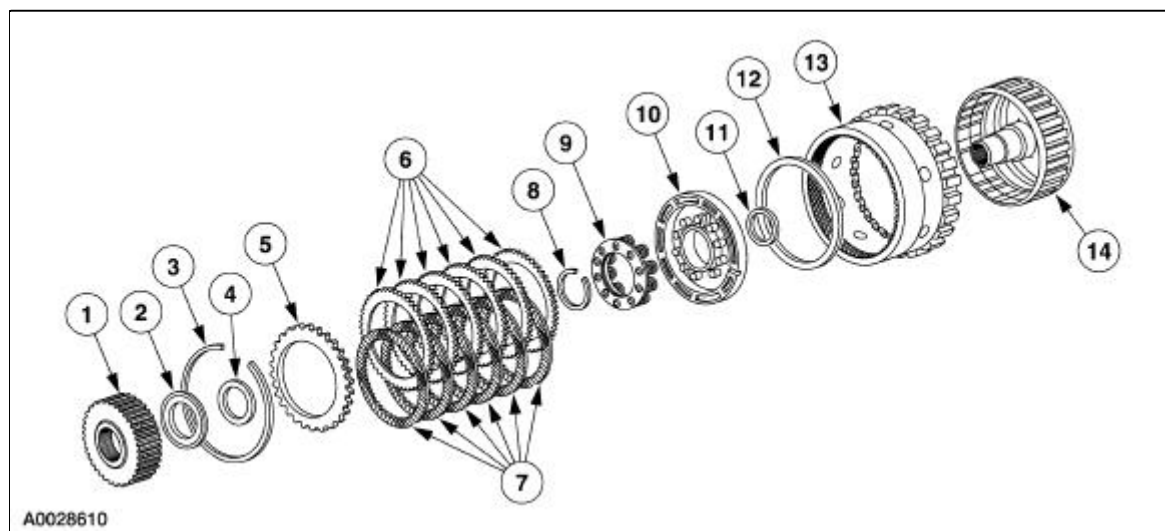
Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

Output Shaft, Direct Clutch Cylinder and Ring Gear Disassembled View



Item	Part Number	Description
1	7A233	Output shaft ring gear assembly
2	7F274	Output shaft to direct clutch cylinder seal (2 req'd)
3	7F240	Direct clutch outer bearing and race assembly No. 8
4	7060	Output shaft
5	7F273	Output shaft to case seal (3 req'd)
6	87054-S94	O-ring seal
7	7D164	Output shaft hub
8	97713-S	Retaining snap ring
9	7C122	Snap ring

Direct Clutch Disassembled View

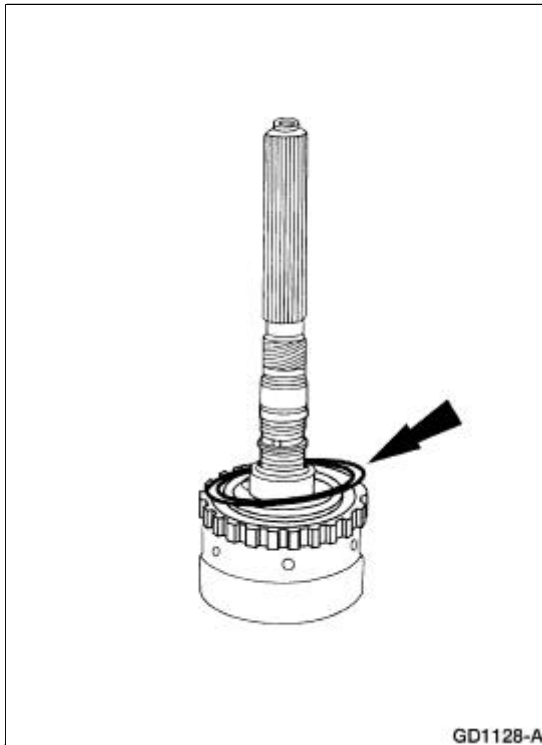


Item	Part Number	Description
1	7F236	Direct clutch hub
2	7F243	No. 7 direct clutch bearing
3	7D483	Direct clutch pressure plate retaining ring
4	7F237	Direct clutch inner bearing support
5	7B066	Direct clutch pressure plate
6	7B442	Direct clutch external spline plates (steel)
7	7B164	Direct clutch internal spline plates (friction)
8	388104-S2	Retaining ring
9	7F235	Direct clutch retainer and spring assembly
10	7A262	Direct clutch piston
11	7C099	Direct clutch piston inner seal
12	7A548	Direct clutch piston outer seal
13	7A233	Output shaft ring gear
14	7F283	Direct clutch cylinder

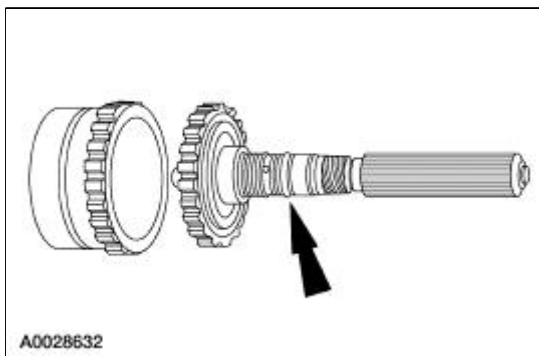
Disassembly

1. **NOTE:** The index mark on the output shaft must be aligned with the index mark on the output shaft ring gear during the assembly procedure.

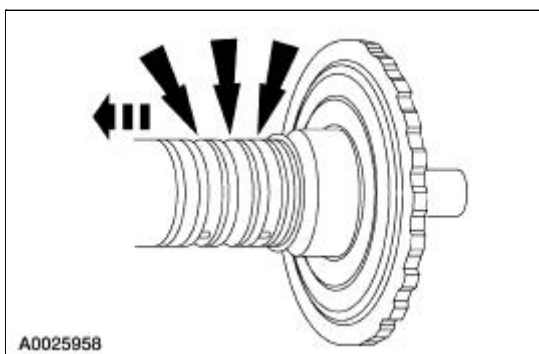
Remove the ring gear snap ring.



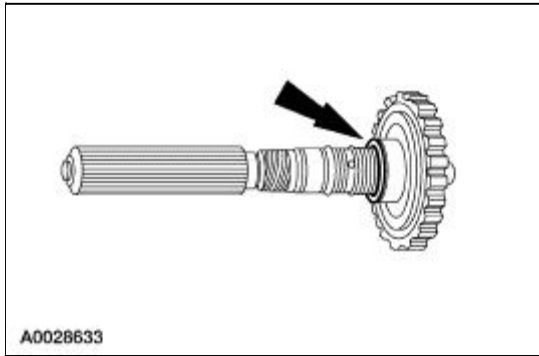
2. Separate the ring gear and output shaft.



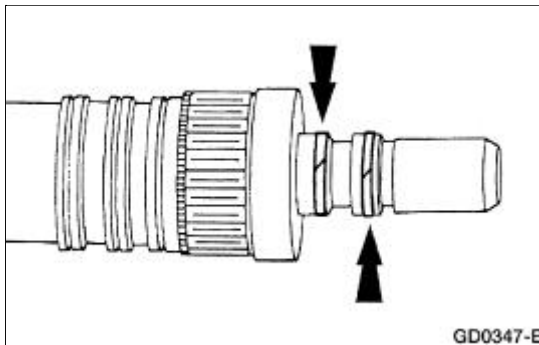
3. Remove the three output shaft seal rings.



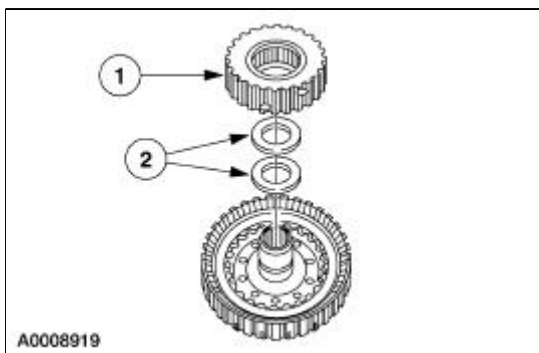
4. Remove the output shaft hub snap ring and the output shaft hub.



5. Remove the two direct clutch seal rings.



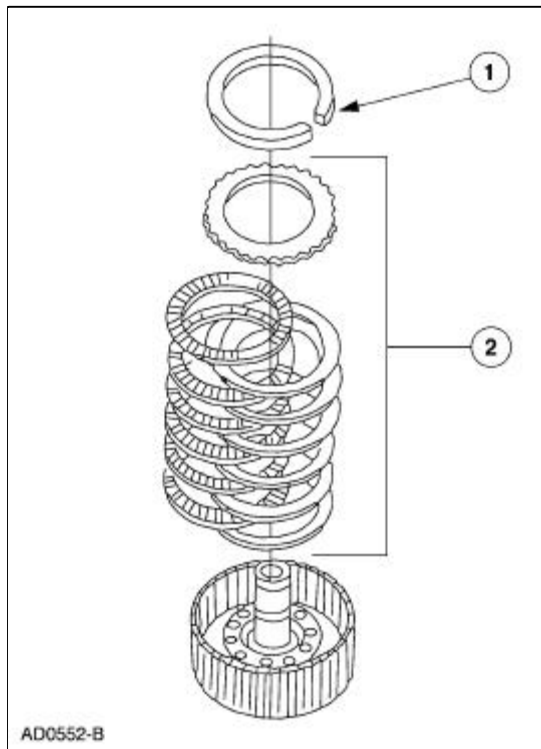
6. Remove the No. 7 direct clutch inner bearing support.
 1. Remove the direct clutch hub.
 2. Remove the No. 7 direct clutch inner bearing support.



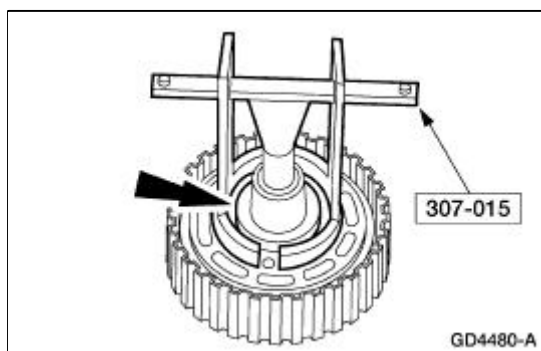
7. Inspect the clutch cylinder thrust surfaces, piston bore and clutch plate serrations for scores or burrs. Minor scores or burrs may be removed with a crocus cloth. Install a new clutch cylinder if badly scored or damaged.
8. Check the fluid passage in the clutch cylinder for obstructions. Clean out all fluid passages. Inspect the clutch piston for scores and install new if necessary. Inspect the check balls for freedom of movement and correct seating.
9. Check clutch release spring for distortion and cracks. Install a new spring (including wave spring) if distorted or cracked.
10. Inspect composition clutch plates, steel clutch plates and clutch pressure plate for worn or scored bearing surfaces. Install new parts if they are deeply scored or burred.
11. Check the clutch plates for flatness and fit on the clutch hub serrations. Discard any plate that

does not slide freely on the serrations or that is not flat.

12. Check the clutch hub thrust surfaces for scores and clutch hub splines for wear.
13. Remove the direct clutch pack.
 1. Remove the selective retaining ring.
 2. Remove the direct clutch pack.



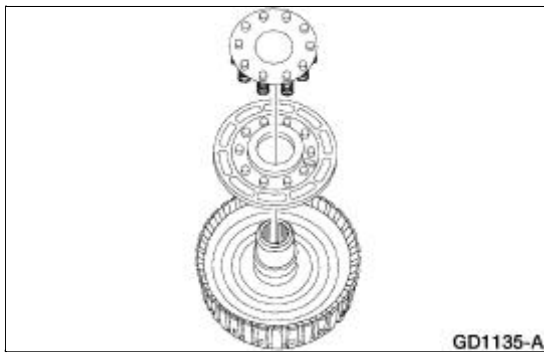
14. Using the special tool, compress the piston return spring and remove the snap ring.



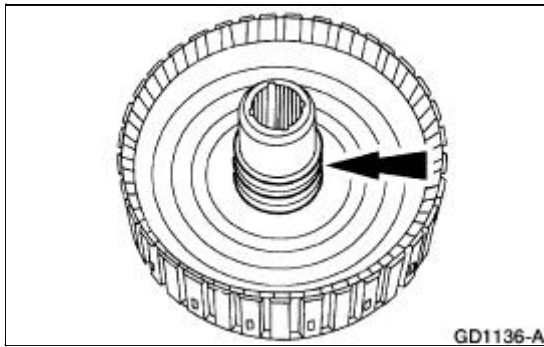
15.  **WARNING: Wear safety glasses when using compressed air.**

NOTE: If necessary, use regulated compressed air 207 kPa (30 psi) max pressure to remove the clutch piston.

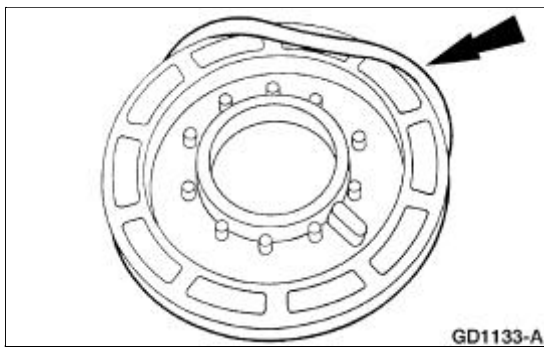
Remove the support and spring assembly and piston.



16. Remove the inner piston seal.



17. Remove the outer piston seal.

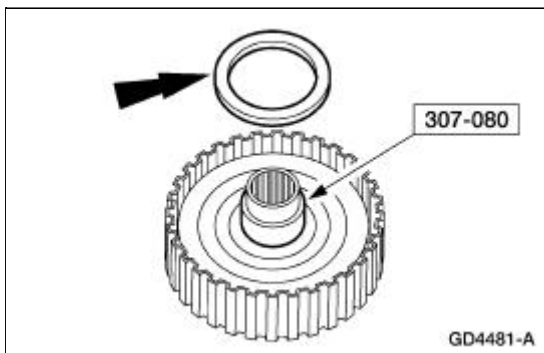


Assembly

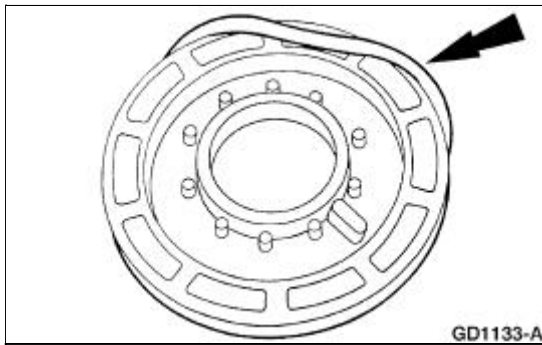
1. **NOTE:** Lubricate direct clutch piston inner seal and seal protector with petroleum jelly.

Using the special tool, install the inner piston seal.

- Install the seal with sealing lip facing down.

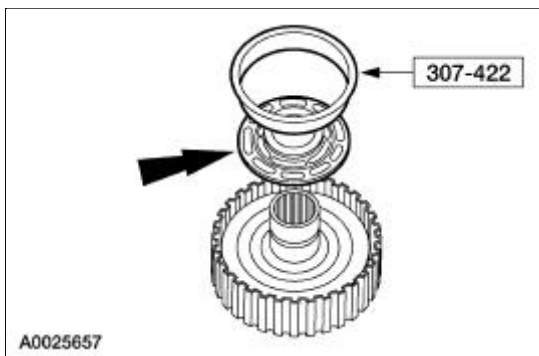


2. Install the clutch piston outer seal so that when the piston is installed the sealing lip points toward the bottom of the cylinder.

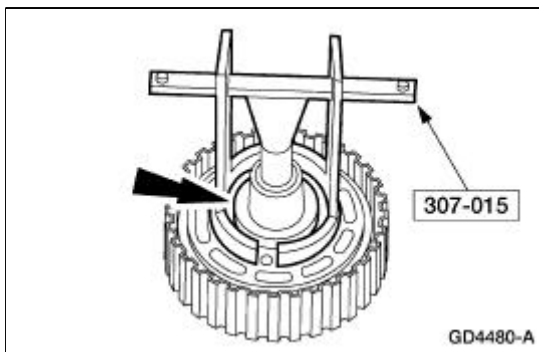


3. **NOTE:** Coat the inner and outer direct clutch piston seals, clutch cylinder sealing area and piston inner sealing area with petroleum jelly.

Using the special tool, install the direct clutch piston.



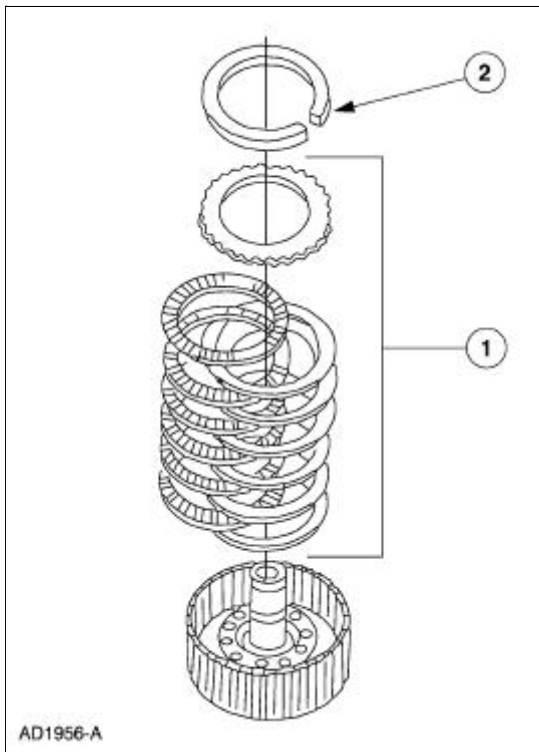
4. Install the piston return spring and retainer assembly.
5. Using the special tool, compress the piston return spring and install the retaining ring.



6. **NOTE:** Before assembly, soak new clutch discs in clean automatic transmission fluid for 15 minutes.

Install the clutch pack retaining ring.

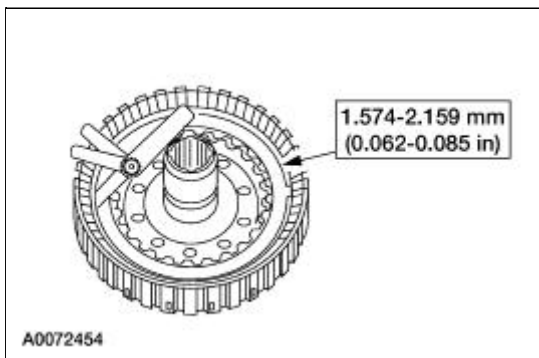
1. Alternate external spline (steel) plates and internal spline (friction) plates, starting with a steel plate and ending with the friction plate.
2. Install the clutch pack retaining ring.



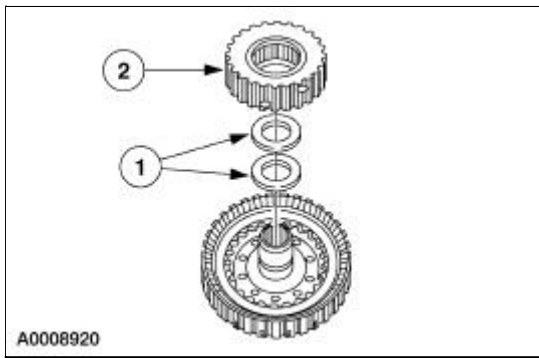
7. Use a feeler gauge to check the clearance between the clutch pack selective retaining ring and the pressure plate.
 - If the clearance is not within specifications, install the correct size retaining ring and recheck the clearance.

Selective Retaining Ring

Specification
1.52-1.62 mm (0.060-0.064 inch)
1.87-1.98 mm (0.074-0.078 inch)
2.24-2.34 mm (0.088-0.092 in)
2.59-2.69 mm (0.102-0.106 inch)



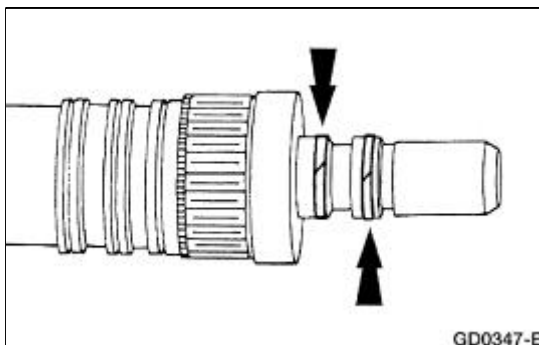
8. Install the direct clutch hub.
 1. Install the No.7 direct clutch inner bearing support.
 2. Install the direct clutch hub.



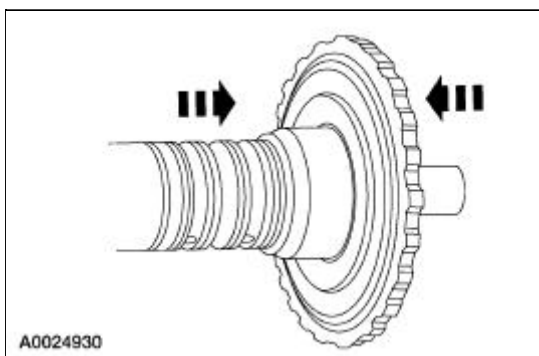
NOTE: Inspect the output shaft bearing surfaces for scores. Inspect the output shaft splines for wear. Inspect all bushings.

9.  **CAUTION:** Make sure the seals are lapped correctly. Internal damage may occur.

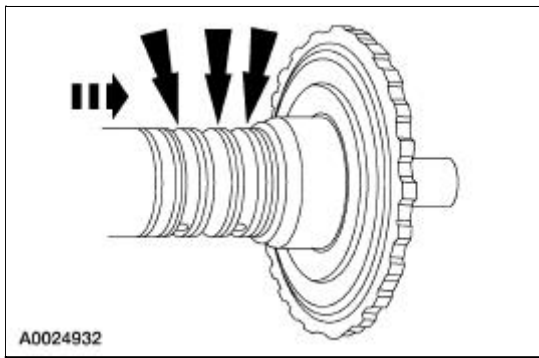
Install the two direct clutch seal rings.



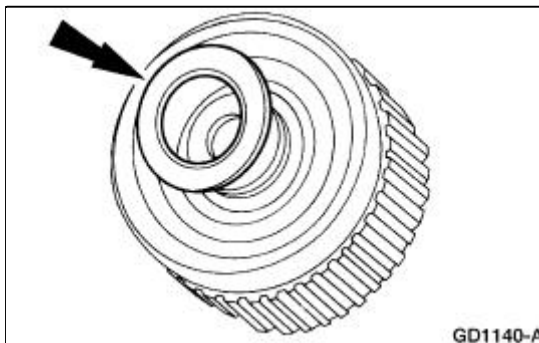
10. Install the output shaft hub.
- Position the output shaft hub.
 - Install the retaining ring.



11. Install the three output shaft seal rings.

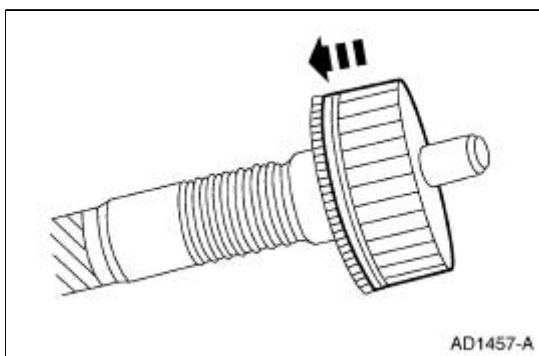


12. Install the No. 8 needle bearing on the direct clutch cylinder.



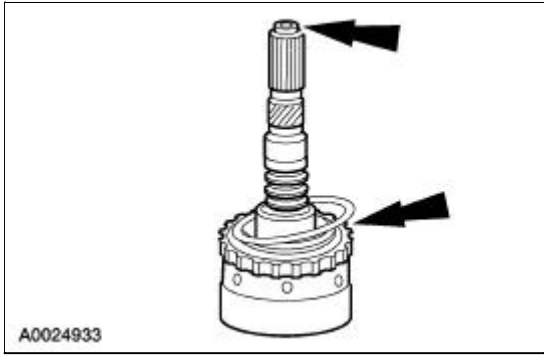
13. **NOTE:** Direct clutch cylinder may be installed after the output shaft ring gear is installed to the output shaft hub.

Assemble the direct clutch on the output shaft.



14. **⚠ CAUTION:** The index mark on the output shaft must be aligned with the index mark on the output shaft ring gear.

Align the index marks on output shaft and the output shaft ring gear and install the ring gear on the output shaft.



A0024933

Torque Converter

1. A new or remanufactured torque converter must be installed if one or more of the following statements is true:
 - A torque converter malfunction has been determined based on complete diagnostic procedures.
 - Converter stud or studs, impeller hub or bushing are damaged.
 - Discoloration (due to overheating).
 - The torque converter is found to be out of specification when carrying out one of the following torque converter checks:
 - One-Way Clutch Check
 - End Play Check
 - Stator to Turbine Interference Check
 - Stator to Impeller Interference Check
 - Torque Converter Leak Check
 - Evidence of transmission assembly or fluid contamination due to the following transmission or converter failure modes:
 - Major metallic failure.
 - Multiple clutches or clutch plate failures.
 - Sufficient component wear which results in metallic contamination.
-

Torque Converter Cleaning And Inspection

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

1. If a new torque converter is being installed, continue with Substep 2 of Step 2.
 2. If a new torque converter is not being installed, the following procedures must be performed:
 1. The torque converter must be thoroughly cleaned.
 - Torque converters with drain plugs can be cleaned by using a suitable torque converter/fluid cooler cleaner.
 - Torque converters without drain plugs can be cleaned by hand. Partially fill the torque converter using only recommended transmission fluid for the applicable transmission. Hand agitate the torque converter and then thoroughly drain the fluid. Refill the torque converter with clean automatic transmission fluid specified for transmission, and reinstall.
 2. All in-tank and auxiliary coolers must be thoroughly cleaned by forward and backward flushing. For additional information, refer to [Transmission Fluid Cooler — Backflushing and Cleaning](#) in this section.
 3. All cooler lines must be thoroughly cleaned by backward and forward flushing. For additional information, refer to [Transmission Fluid Cooler — Backflushing and Cleaning](#) in this section.
 4. All Cooler Bypass Valves (CBV), if equipped, must be thoroughly cleaned.
 5. Carry out the Transmission Fluid Cooler Flow Test. For additional information, refer to [Transmission Fluid Cooler — Backflushing and Cleaning](#) in this section.
 6. If the transmission cooling system fails the Transmission Fluid Cooler Flow Test, a new fluid cooler, cooler bypass valve, and/or cooler lines must be installed. For additional information, refer to [Section 307-02](#).
 7. If new coolers are to be installed, use only factory approved service parts.
-

Torque Converter Flushing

Material

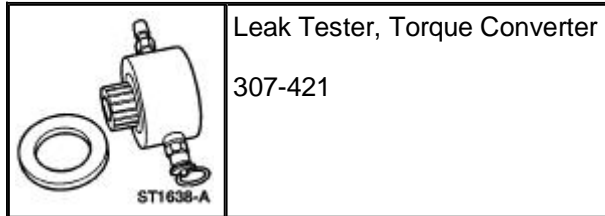
Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

NOTE: When the transmission has been repaired for internal damage the torque converter must be cleaned using a mechanically agitated cleaner.

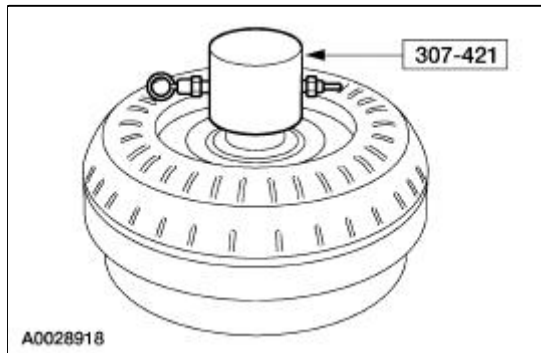
1. Using a suitable torque converter/fluid cooler cleaner, clean and flush the torque converter.
 2. After flushing, drain the remainder of the solvent.
 3. Add 1.9 liter (2 qt.) of clean transmission fluid to the converter and agitate by hand.
 4. Thoroughly drain the solution.
-

Torque Converter Leak Check

Special Tool(s)

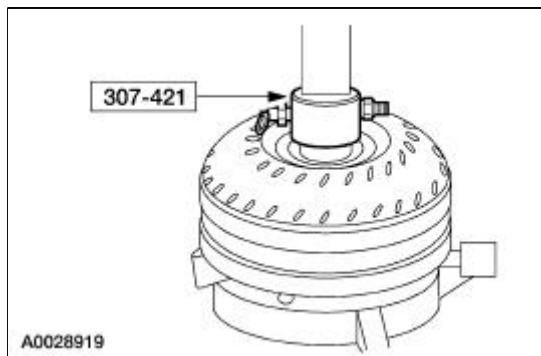


1. Clean the outside surface of the torque converter.
2. Install the special tool into the converter hub.



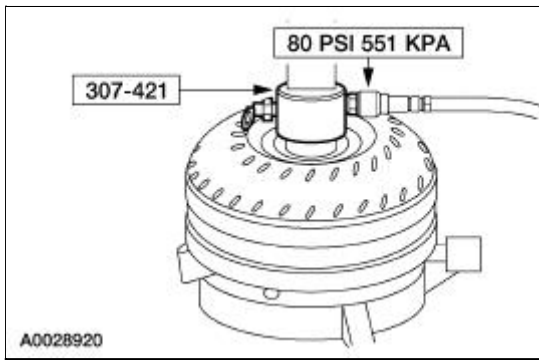
3.  **WARNING:** Always follow correct safety procedures while using press. Failure to follow these instructions may result in personal injury.

Install the torque converter with the installed special tool into the arbor press.
Secure the press, apply enough force to seal the tool into the torque converter.

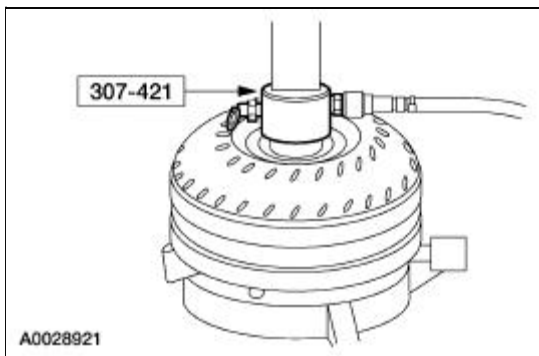


4. **NOTE:** Use clean dry shop air.

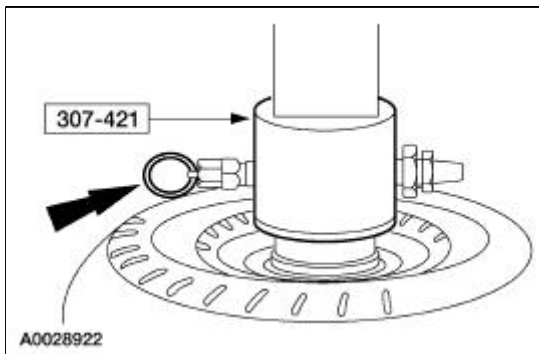
Apply air pressure to the valve on the special tool.



5. With air pressure applied to the valve, inspect for leaks at the converter hub, seams, drain plug and studs. A soap bubble solution may be applied around these areas to aid in diagnosis. If a leak is found around the drain plug, install a new drain plug and recheck the torque converter. If any other leaks are present, install a new or remanufactured torque converter.



6. Remove the air hose. Release pressure and then slowly release the press. Remove the torque converter. Remove the special tool.

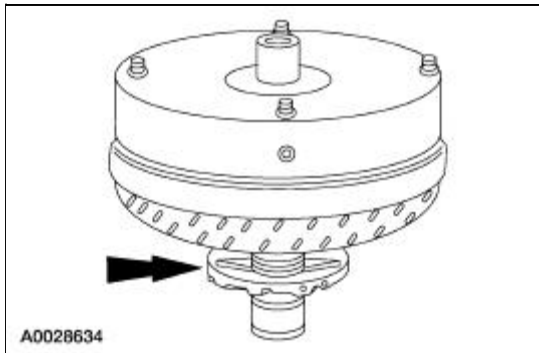


Torque Converter Impeller to Pump Stator Interference Check

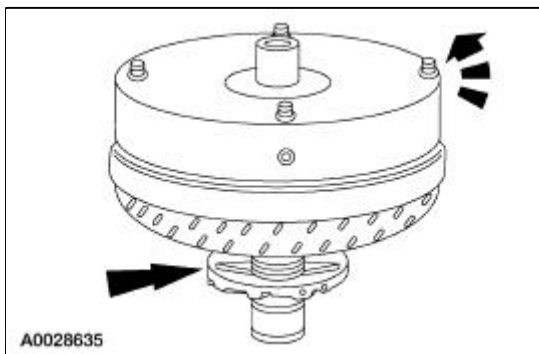
1. **NOTE:** Front pump support may remain in front pump support and gear during this test.

Position the front pump support with the splines up.

2. Mount the torque converter on the front pump support with the splines on the one-way clutch inner race, engaging the mating splines of the front pump support.





3. Hold the front pump support stationary and rotate the torque converter counterclockwise.
 - The torque converter should rotate freely with no signs of scraping.
 - If there are signs of scraping, install a new or remanufactured torque converter.

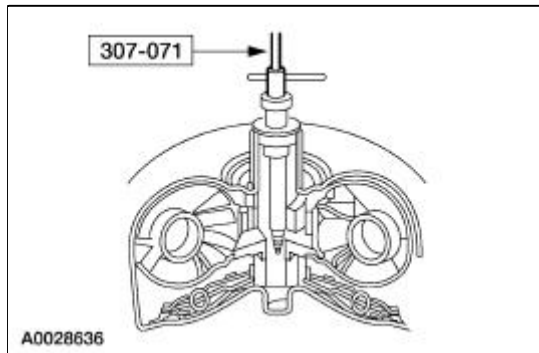


Torque Converter End Play Check

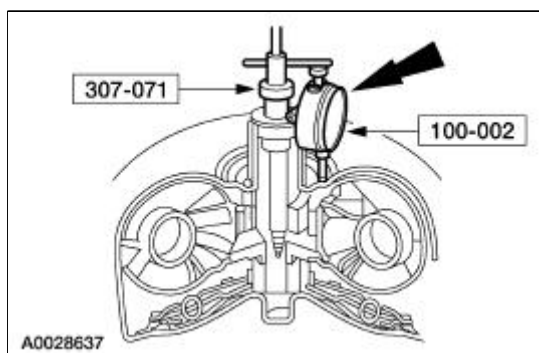
Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
 ST1196-A	End Play Gauge, Torque Converter 307-071 (T80L-7902-A) or equivalent

1. Install the special tool into the torque converter pump drive.
 - Tighten the inner post until the tool is securely locked.



2. Install the special tool on the converter pump drive hub and zero the dial indicator.

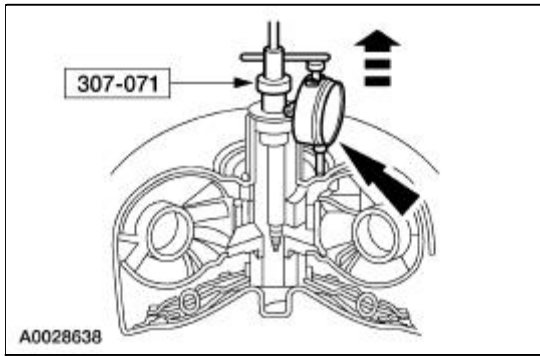


3. Lift up on the special tool and note the dial indicator reading.
 - If the reading exceeds end play limits, install a new or remanufactured torque converter.

Torque Converter End Play





New or Rebuilt Torque Converter	Used Torque Converter
0.355-1.04 mm (0.014-0.041 inch) Max.	0.355-1.87 mm (0.014-0.074 inch) Max.



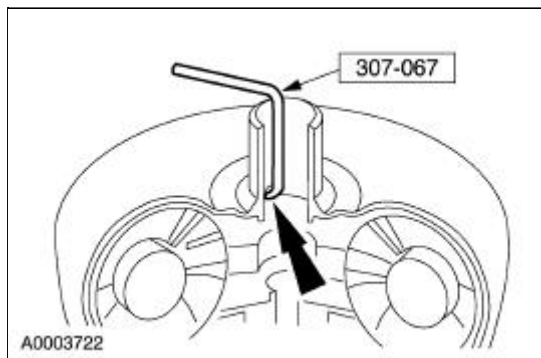
4. Remove the special tools.
-

Torque Converter One-Way Clutch Check

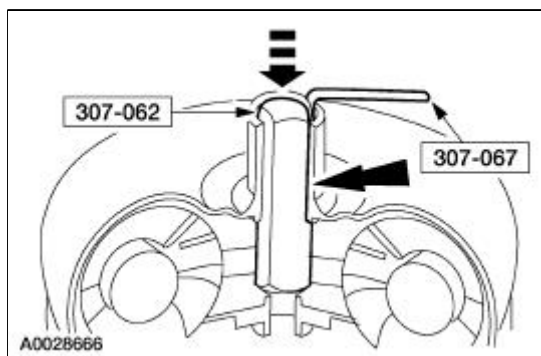
Special Tool(s)

 ST1193-A	Holding Tool, One-Way Clutch 307-062 (T76L-7902-C) or equivalent
 ST1195-A	Holding Tool, Torque Converter Clutch 307-067 (T77L-7902-R) or equivalent

1. Install the special tool in one of the grooves in the stator thrust washer.

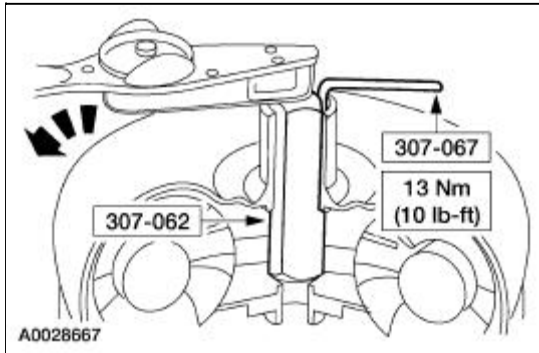


2. Install the special tool in the converter pump drive.



3. Use a torque wrench to turn the special tool counterclockwise while holding the special tool stationary.
 - The converter should lock up and hold torque.
 - The torque converter one-way clutch should rotate freely in the clockwise direction.
 - Try the clutch for lockup and hold in at least five positions.

- If the torque converter fails the lockup test torque, install a new or remanufactured torque converter.

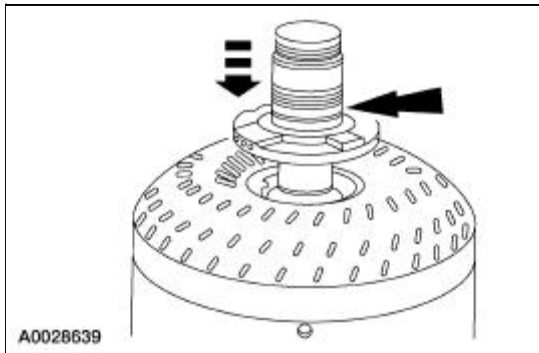


Torque Converter Turbine to Pump Stator Interference Check

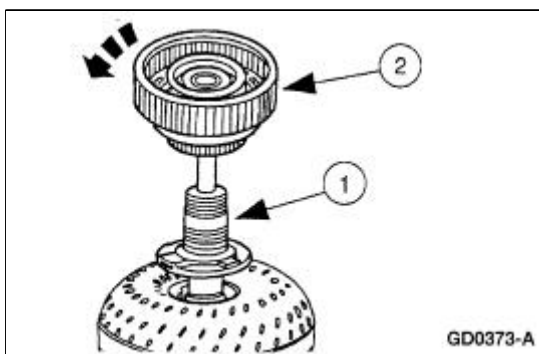
1. **NOTE:** Front pump support may remain in front pump support and gear during this test.

Position the torque converter with the pump drive up.

2. Install the front pump support to engage the mating splines of the front pump support shaft on the torque converter.





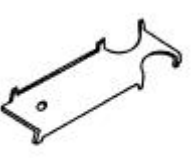




3. Install the forward clutch cylinder and shaft, engaging the splines with the rear clutch hub.
4. Check for stator to turbine interference.
 1. Hold the front pump support stationary.
 2. Attempt to rotate the forward clutch cylinder and shaft.
 - The turbine and torque converter clutch assemblies should rotate in both directions, not exceeding maximum torque of 9.5 Nm (7 lb-ft), without any signs of metallic interference or scraping noise.

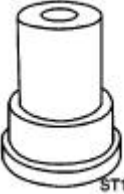
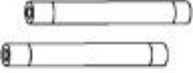








5. If interference exists, the stator front thrust washer may be worn, allowing the stator to hit the turbine. In such cases, a new or remanufactured torque converter must be installed.
 - The converter crankshaft pilot should be checked for nicks or damaged surfaces that could cause interference when installing the torque converter into the crankshaft. Check the converter front impeller hub for nicks or sharp edges that would damage the pump seal.

Transmission

Special Tool(s)

 <p>ST1214-A</p>	<p>Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)</p>
 <p>ST2467-A</p>	<p>Rubber Tip Air Nozzle 100-D009 (D93L-7000-A)</p>
 <p>ST1633-A</p>	<p>Alignment Gauge, TR Sensor 307-351 (T97L-70010-A)</p>
 <p>ST1185-A</p>	<p>Slide Hammer 100-001 (T50T-100-A)</p>
 <p>ST1199-A</p>	<p>Installer, Shift Shaft Fluid Seal 307-050 (T74P-77498-A)</p>
 <p>ST1197-A</p>	<p>Shim Selection Gauge 307-072 (T80L-77003-A)</p>
 <p>ST1202-A</p>	<p>Installer, Servo Piston 307-073 (T80L-77030-A)</p>
	<p>Remover/Installer, Transmission Extension Housing</p>

 <p>ST1216-A</p>	<p>307-077 (T80L-77110-A)</p>
 <p>ST1631-A</p>	<p>Handle, Torque Converter 307-091 (T81P-7902-C)</p>
 <p>ST1940-A</p>	<p>Test Plate Screw Set, Transmission 307-126 (T82P-7006-C)</p>
 <p>ST1392-A</p>	<p>Air Test Plate, Transmission 307-246 (T92P-7006-A)</p>
 <p>ST1210-A</p>	<p>Remover/Installer, Servo Piston 307-251 (T92P-70023-A)</p>
 <p>ST1636-A</p>	<p>Retainer, Torque Converter 307-346 (T97T-7902-A)</p>
 <p>ST1188-A</p>	<p>Installer, Transmission Extension Housing Oil Seal 308-002 (T61L-7657-A)</p>
 <p>ST2545-A</p>	<p>Gauge, Transmission Solenoid Connectors 307-426</p>

Material

Item	Specification
Multi-Purpose Grease	ESB-M1C93-

D0AZ-19584-AA	B
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V



CAUTION: Before beginning assembly, carry out and inspect the following:

When building up subassemblies and assembling the transmission, **ALWAYS** use new gaskets and seals.

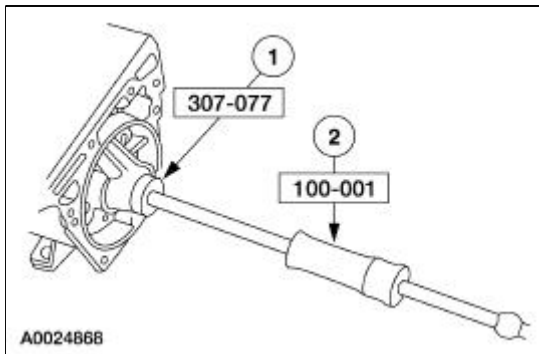
All fasteners must be tightened to the torque specification indicated. In addition to appearing in the section, the necessary torques can be found in the General Specifications Chart.

When building up subassemblies, each component part should be lubricated with clean transmission fluid. It is also good practice to lubricate the subassemblies as they are installed in the case.

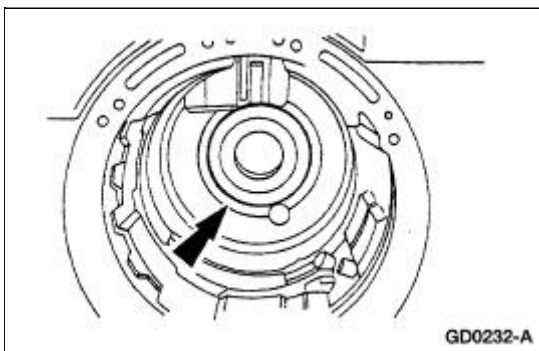
Needle bearings, thrust washers and seals should be lightly coated with petroleum jelly during subassembly buildup or transmission assembly.

Many components and surfaces in the transmission are precision machined. Careful handling during disassembly, cleaning, inspection and assembly can prevent unnecessary damage to machined surfaces.

1. Use the special tools to install the rear case bushing if removed.
 1. Position the rear case bushing and the special tool inside the case.
 2. Assemble the special tools through the back of the case.

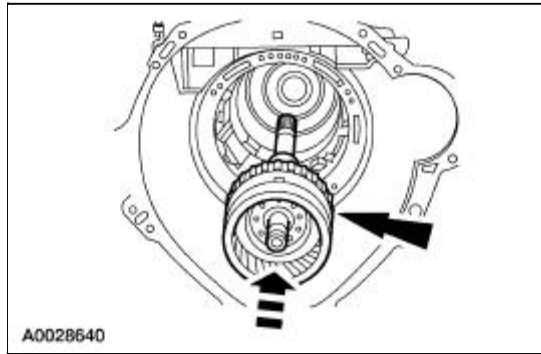


2. Place the transmission in the vertical position.
3. Coat the No. 9 case rear bearing with petroleum jelly and install on the case boss.

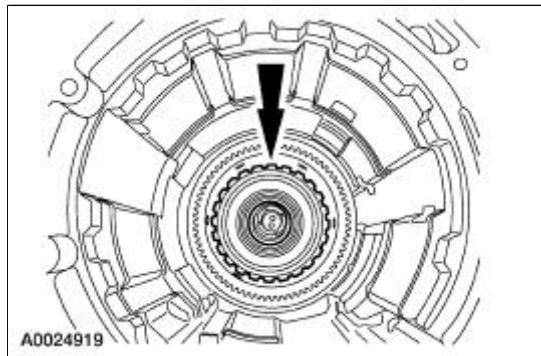


4.  **CAUTION:** Be sure the No. 7 needle bearing and direct clutch hub are installed as shown in the Subassembly section. Internal damage and shift problems may occur.

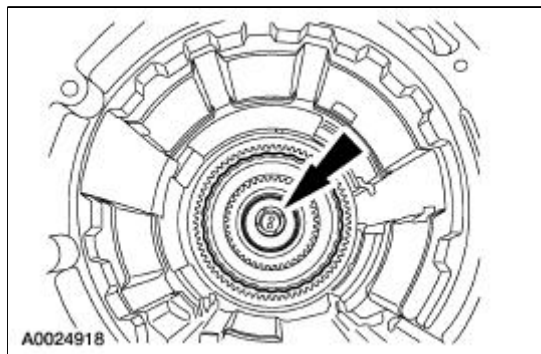
Install the output shaft and output shaft ring gear.



5. Install the No. 8 bearing.

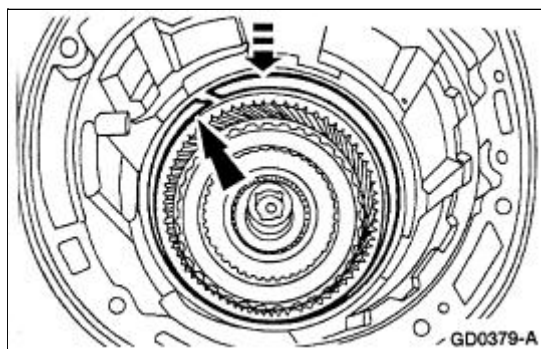


6. Install the direct clutch.



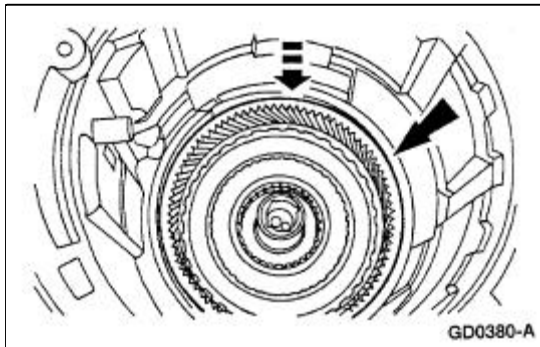
7. **NOTE:** The reverse band support retaining ring is used for assembly purposes during production. The reverse band support retaining ring is not required during assembly and it will not affect the operation of the transmission.

Install the reverse band support retaining ring.



8. **NOTE:** Make sure the band is seated on the anchor pins.

Install the reverse band.

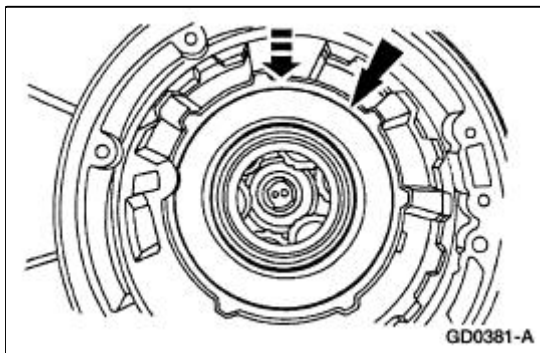


9. **NOTE:** The planetary assembly and planetary gear support cannot be installed unless the notch cut in the planetary gear support is aligned with the overdrive band anchor pin.

NOTE: The top of the planetary gear support must be below the snap ring groove.

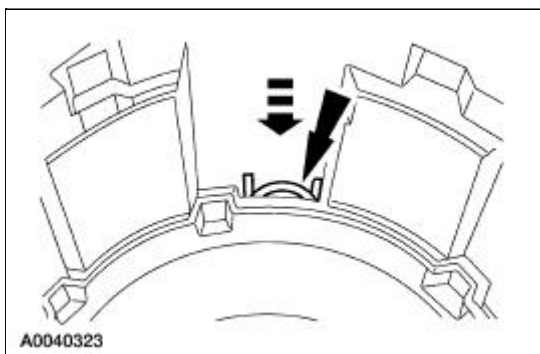
Install the planetary assembly and planetary gear support as a unit.

- Rotate the output shaft to fully seat the planetary assembly.



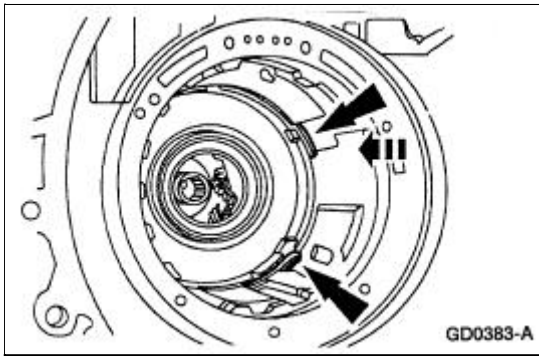
10. **NOTE:** The planet support spring must be compressed and installed below the snap ring groove. When the planet support spring is installed correctly both ends of the spring will be visible.

Install the case to the planet support spring located at the 1 o'clock position.

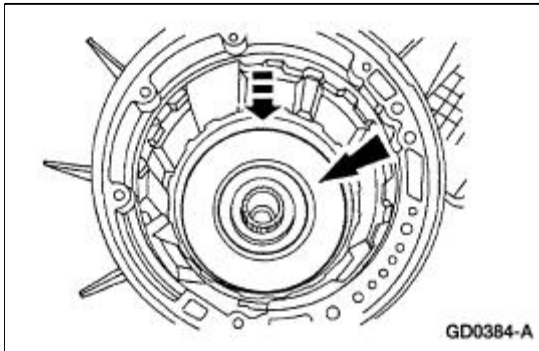


11. Install the center support retaining ring.

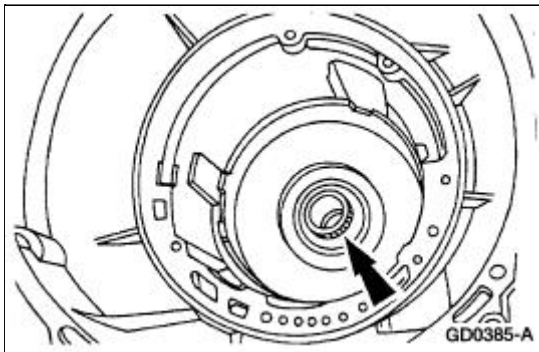
- Reference the retaining ring tabs to the band anchor pin location.



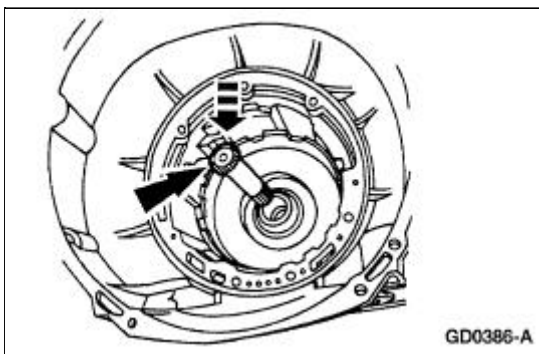
12. Install the forward clutch sun gear, the No. 5 forward clutch sun gear bearing and the reverse sun gear.



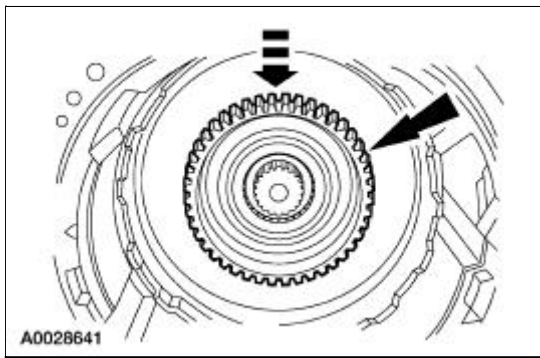
13. Install the No. 4 forward clutch hub bearing.



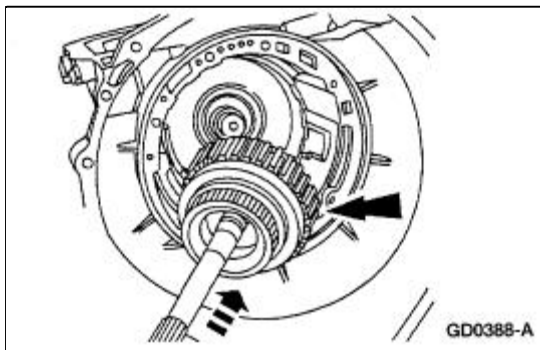
14. Install the intermediate stub shaft.



15. Install the forward clutch hub and the No. 3 forward clutch hub front bearing.



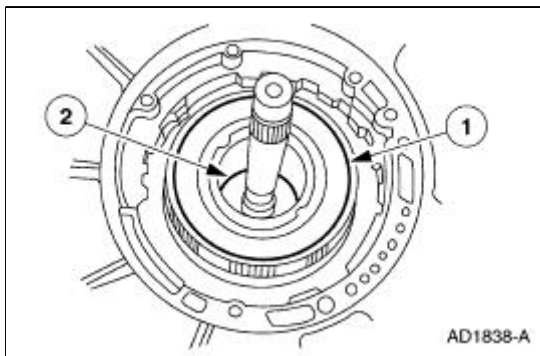
16. Install the forward clutch assembly.



17. **NOTE:** Make sure the reverse clutch cylinder lugs are completely seated in the notches of the reverse sun gear.

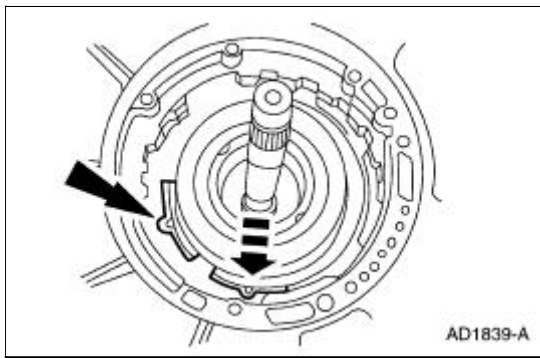
Install the reverse clutch cylinder assembly.

1. Install the reverse clutch cylinder.
2. Install the No. 2 forward clutch bearing.

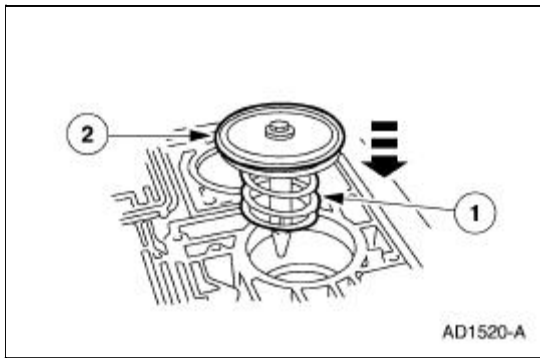


18. Install the overdrive band.

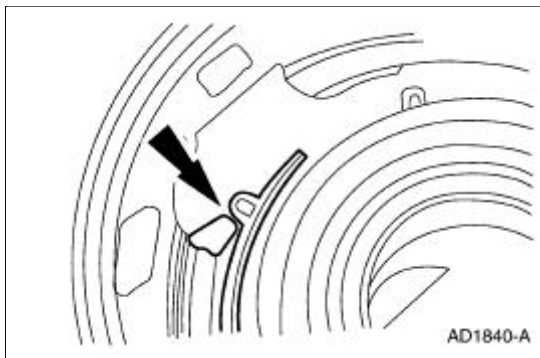
- Position the overdrive band pocket onto the anchor pin.



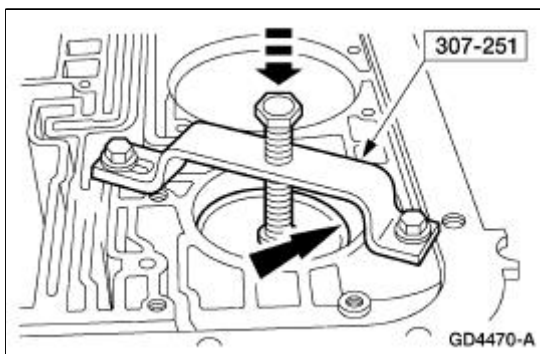
19. Install the overdrive servo spring.
 1. Install the overdrive servo piston return spring.
 2. Install the overdrive servo piston.



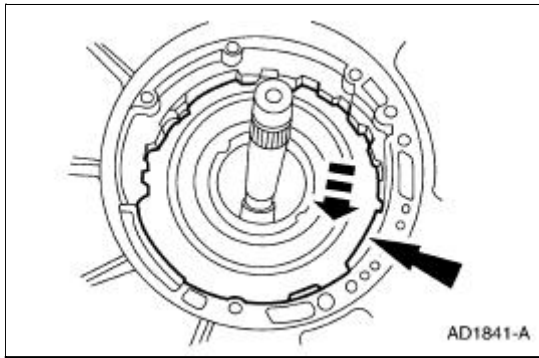
20. Verify the tip of the piston assembly engages the pocket of the overdrive band.



21. Using the special tool, compress the overdrive servo assembly and install the overdrive servo retaining ring.

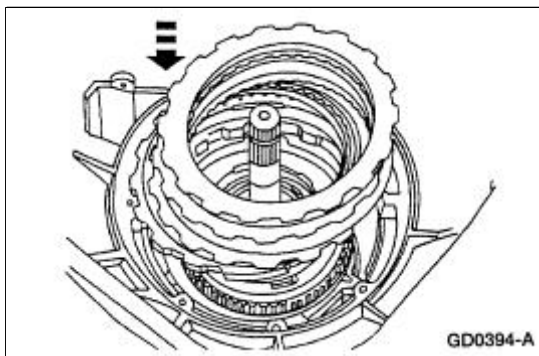


22. Install the intermediate clutch pressure plate.



23. **NOTE:** Before assembly, soak the new clutch discs in clean automatic transmission fluid for 15 minutes.

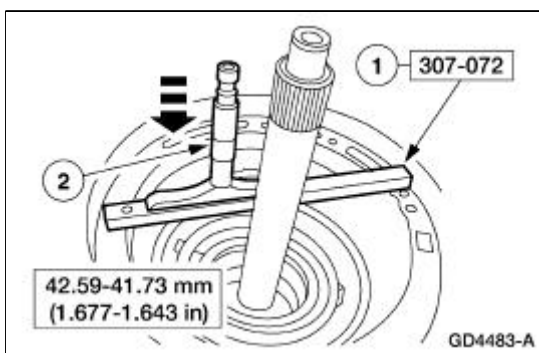
Install the intermediate clutch pack and selective steel plate.



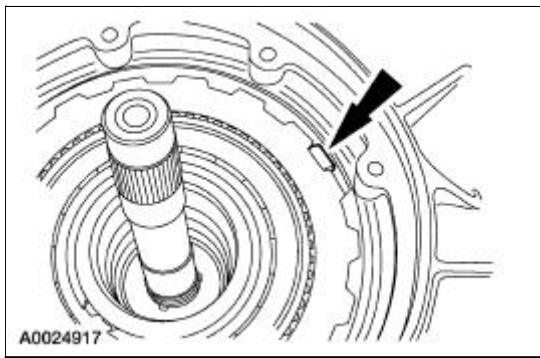
24. Using the special tool, check the intermediate clutch clearance.
1. Position the special tool on the pump case mounting surface.
 2. Maintaining downward pressure, use a depth micrometer to measure and verify intermediate clutch clearance is within specification.
- If the intermediate clutch is not within specification, install a correct selective plate.

Selective Steel Plates

Specification
1.80-1.70 mm (0.071-0.067 inch)
2.05-1.95 mm (0.081-0.077 inch)
2.31-2.20 mm (0.091-0.087 inch)
2.56-2.46 mm (0.101-0.097 inch)



25. Install the intermediate anti-rattle clip, if equipped.

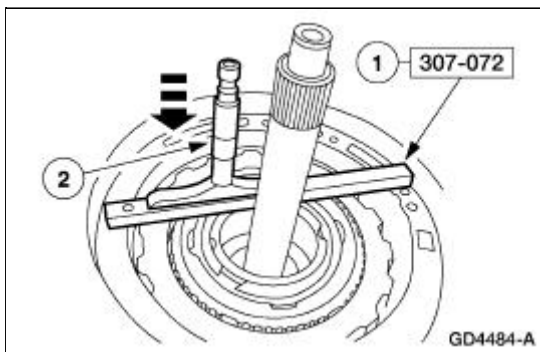


26. Using the special tool, measure end clearance for the No.1 front pump thrust washer.
1. Position the special tool on the pump case mounting surface.
 2. Maintaining downward pressure, use a depth micrometer to measure end play clearance.

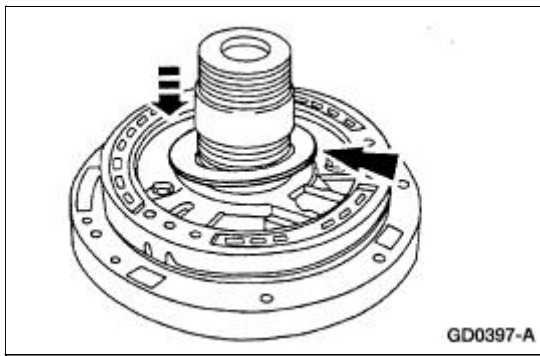
Use the No.1 thrust washer chart to select the correct washer.

No.1 Thrust Washer Chart

Depth	Thickness	Color Code
37.706-38.184 mm (1.485-1.503 inch)	1.270-1.372 mm (0.050-0.054 inch)	Green
38.185-38.641 mm (1.504-1.521 inch)	1.727-1.829 mm (0.068-0.072 inch)	Yellow
38.642-39.073 mm (1.522-1.538 inch)	2.159-2.261 mm (0.085-0.089 inch)	Natural
39.074-39.505 mm (1.539-1.555 inch)	2.591-2.692 mm (0.102-0.106 inch)	Red
39.506-40.165 mm (1.556-1.581 inch)	3.023-3.124 mm (0.119-0.123 inch)	Blue

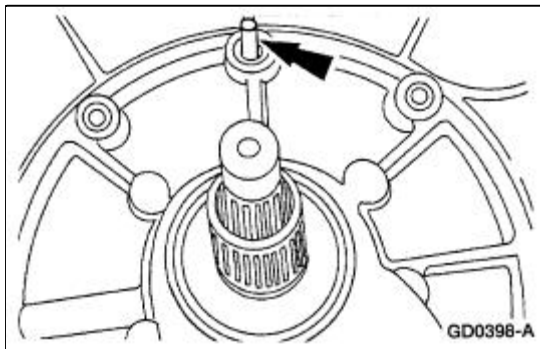


27. Install the No.1 front pump support thrust washer.
- Use petroleum jelly to hold the washer in place.



28. **NOTE:** The alignment pin is a fabricated M8 x 1.25 mm (0.05 in) bolt with the head removed.

Install an alignment pin at the top of the case.

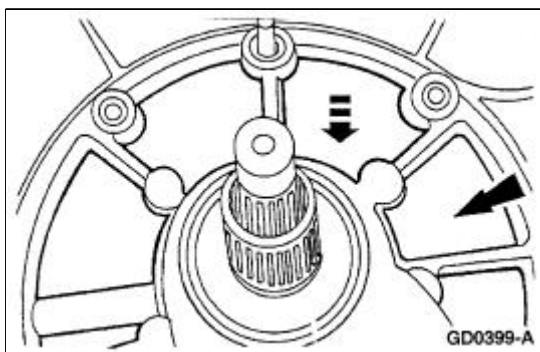


29. **NOTE:** Make sure the gasket is positioned correctly and the case passages are not covered.

Install the pump gasket.

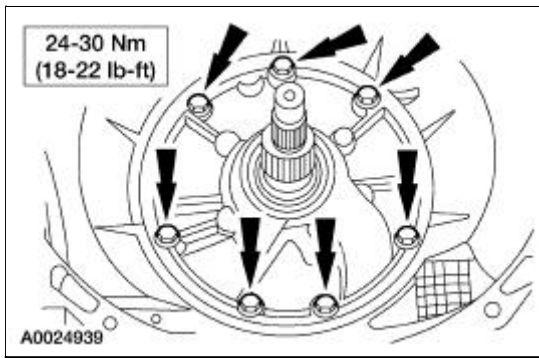
30. **NOTE:** To aid assembly, shake the input shaft while pushing down on the pump.

Install the pump assembly.

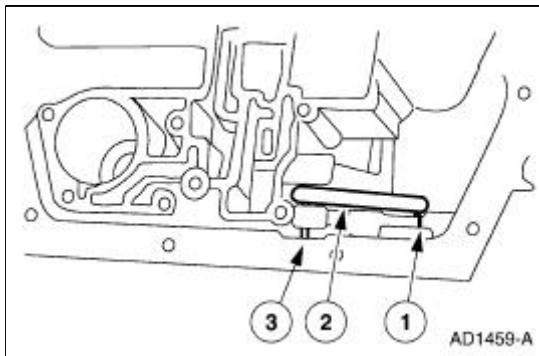


31. Remove the alignment pin and install the front pump bolts.

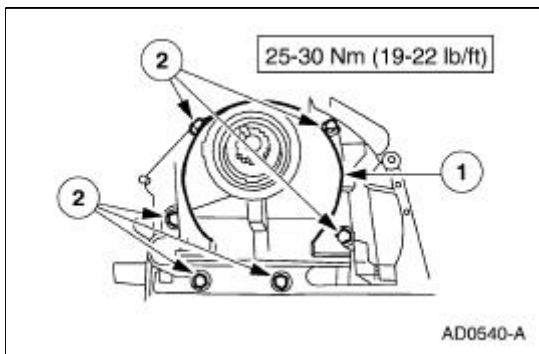
- Alternate bolt tightening to set the pump.



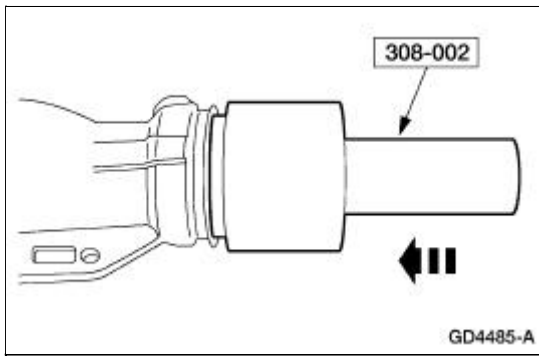
32. Rotate the transmission to the horizontal position.
33. Install the parking pawl.
 1. Position the parking pawl return spring.
 2. Position the parking pawl.
 3. Install the parking pawl shaft.



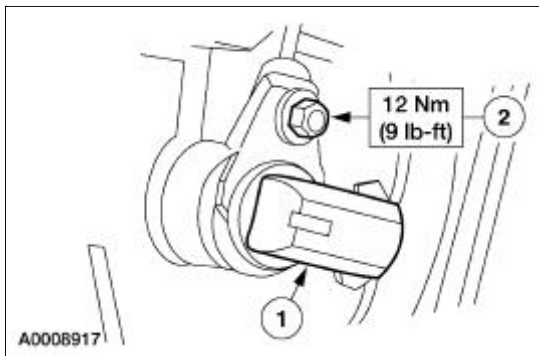
34. Install a new extension housing gasket and the extension housing.
 1. Position the extension housing.
 2. Install the four bolts and two nuts.



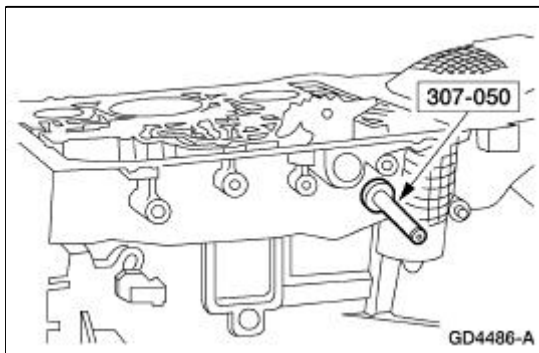
35. Using the special tool, install a new extension housing seal.



36. Install the output shaft speed (OSS) sensor.
1. Position the OSS sensor.
 2. Install the bolt.



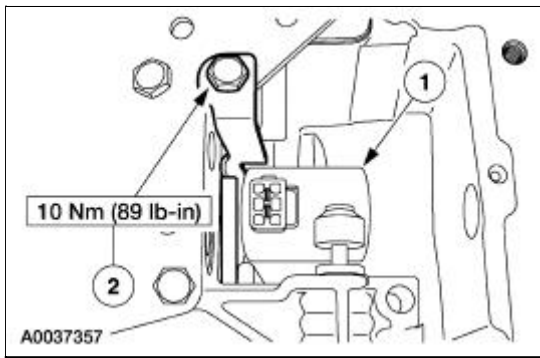
37. Using the special tool, install the manual control lever seal.



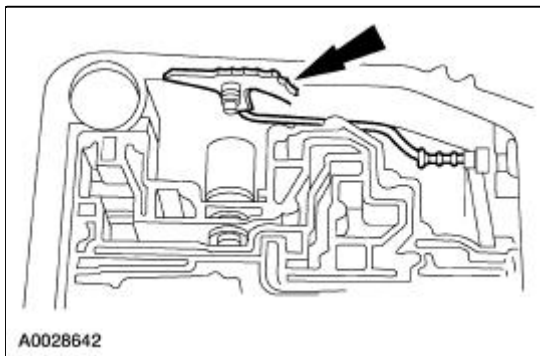
38. **NOTE:** Lubricate the electronic pressure control (EPC) solenoid O-rings with clean automatic transmission fluid.

Install the EPC solenoid.

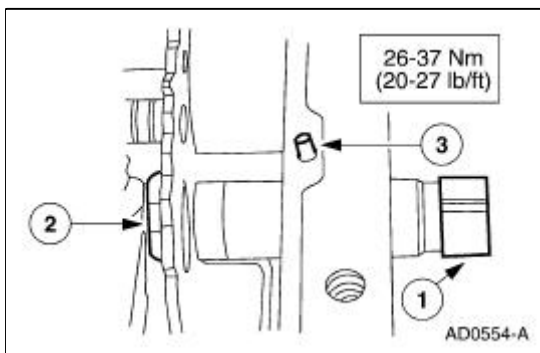
1. Install the EPC solenoid.
2. Install the EPC solenoid bracket and bolt.



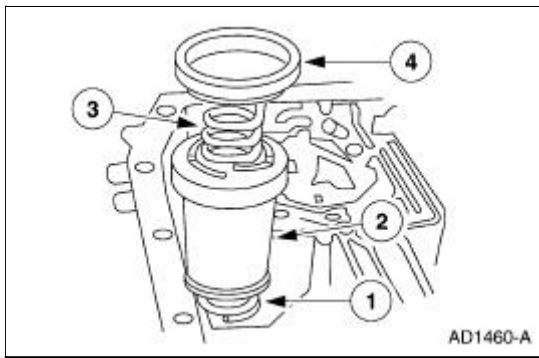
39. Install the manual valve detent lever and parking lever actuating rod.



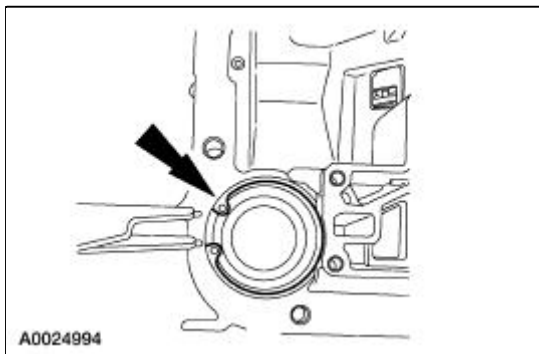
40. Install the manual control lever shaft.
1. Slide the manual control shaft into the case.
 2. Install the manual lever shaft inner nut.
 3. Install the manual lever shaft retaining pin.



41. Install the 1-2 accumulator piston assembly.
1. Install the 1-2 accumulator upper spring.
 2. Install the 1-2 accumulator.
 3. Install the 1-2 accumulator lower spring.
 4. Install the 1-2 accumulator cover and seal.



42. Install the 1-2 accumulator retaining ring.

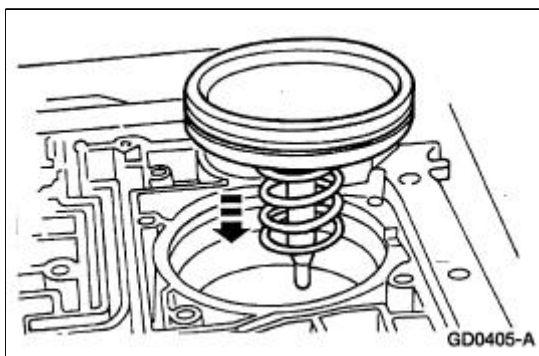


43. **NOTE:** This is not an ordinary installation procedure and does not compensate for band wear. When new piston and rod assembly installation becomes necessary, or when a new reverse band has been installed, the reverse piston and rod length must be adjusted.

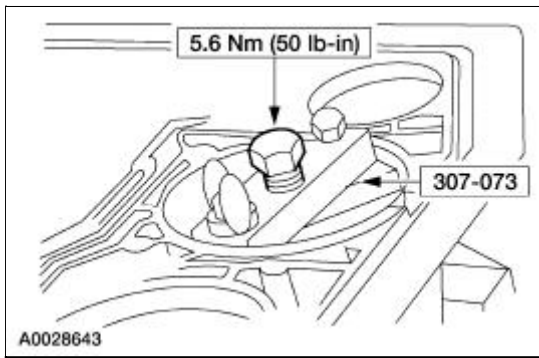
NOTE: Lubricate the reverse piston seal to facilitate assembly and prevent damage to the seal.

NOTE: Do not install the reverse servo piston cover and seal at this time.

Install the reverse servo piston and rod assembly.

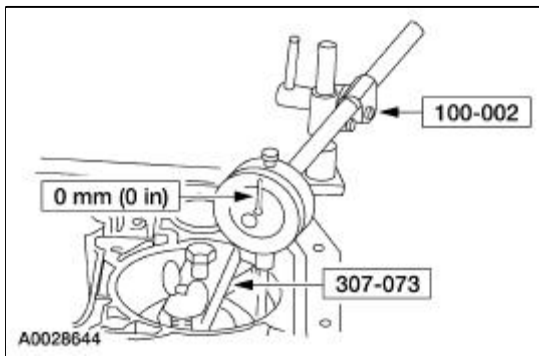


44. Install the special tool.
- Tighten the bolt.

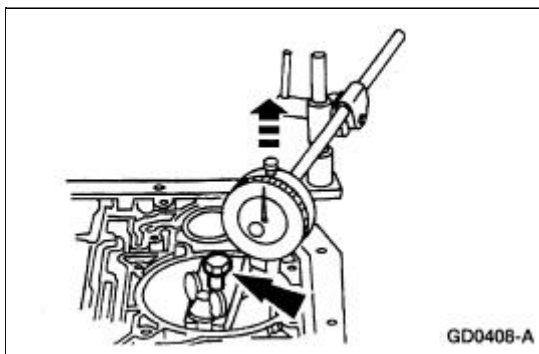


45. Install the special tool.

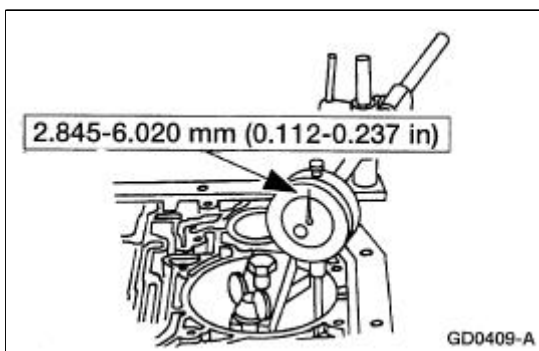
- Position the indicator stem on the flat portion of the reverse servo piston and zero the dial indicator.



46. Loosen the bolt until the piston stops against the tool.

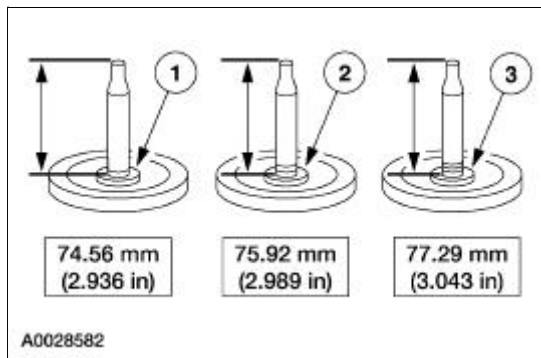


47. Verify that the amount of piston travel on the dial indicator is within specification.

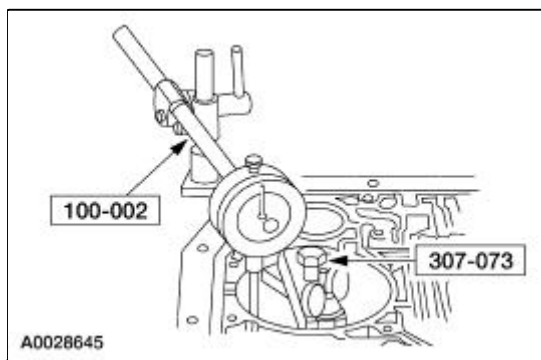


48. If piston travel is not within specification, select and install the correct servo assembly to bring the servo piston travel within specification.

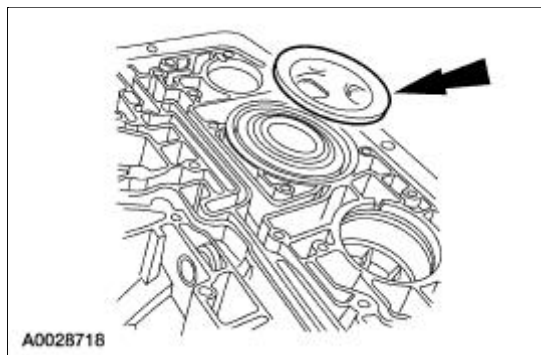
1. One groove
2. Two grooves
3. Three grooves



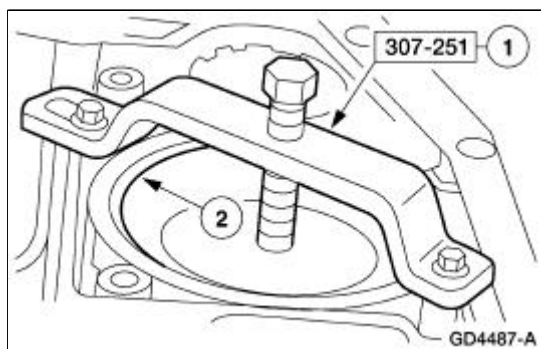
49. Remove the special tools.



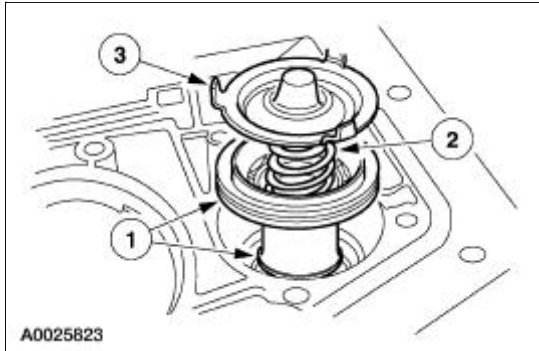
50. Install the reverse servo piston cover and seal assembly.



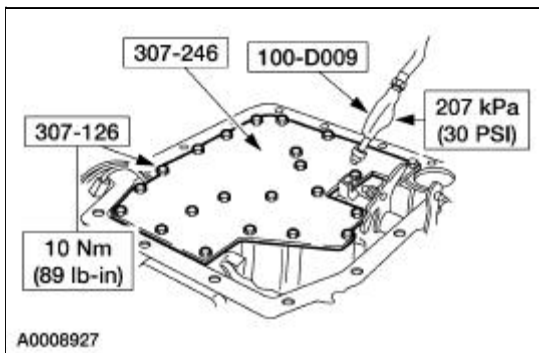
51. Using the special tool, install the reverse servo retaining ring.
 1. Compress the reverse band servo.
 2. Install the reverse band servo retaining ring.



52. Install the 2-3 accumulator assembly.
1. Install the accumulator piston.
 2. Install the accumulator piston spring.
 3. Install the accumulator spring retainer.

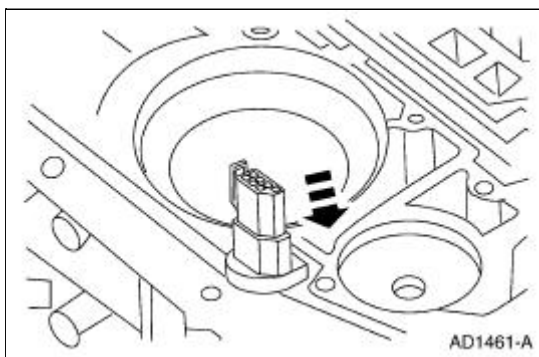


53. Using the special tools apply regulated air pressure to the test ports. Verify that the components are applied and released.



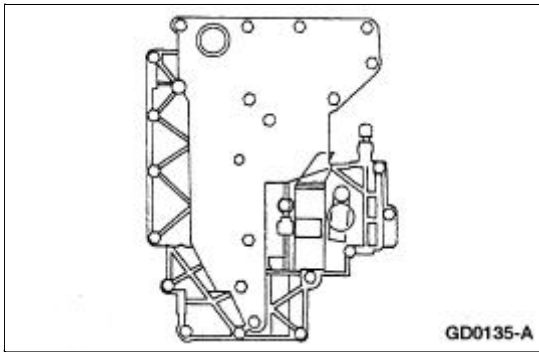
54. **NOTE:** The tab on the electrical connector is secured by main control valve body.

Install the electrical connector into the case.



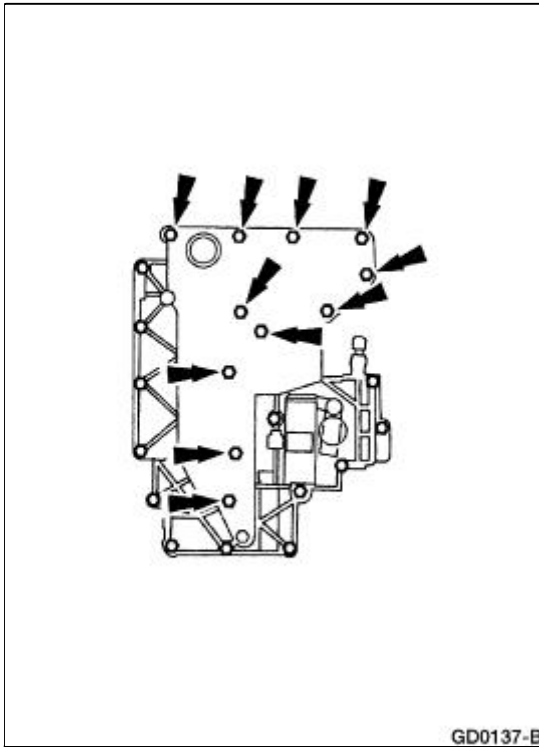
55. **NOTE:** The alignment bolts are valve body assembly bolts and are in the valve body.

Align the main control valve body alignment bolts and position the main control valve body.



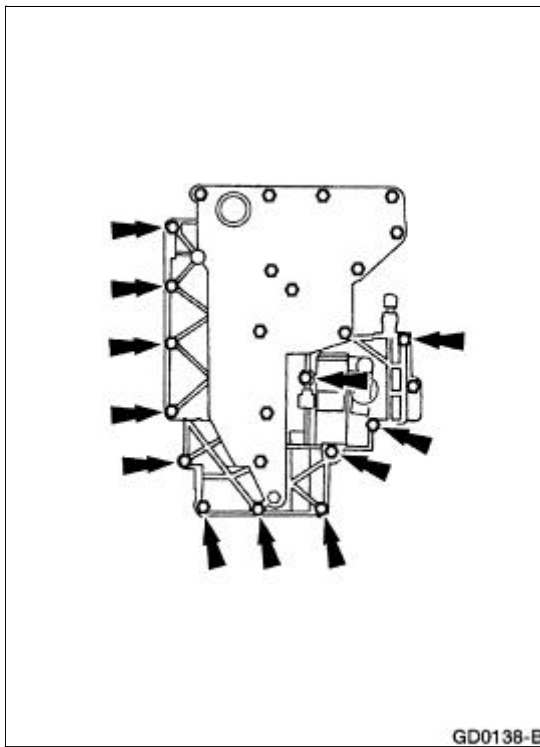
56. **NOTE:** The main control valve body bolts will be tightened in later steps.

Loosely install the 11 long main control valve body bolts.

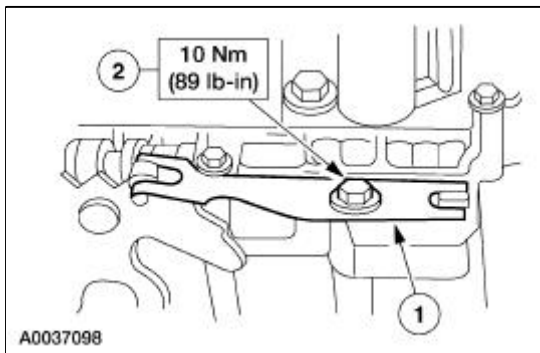


57. **NOTE:** The main control valve body bolts will be tightened in later steps.

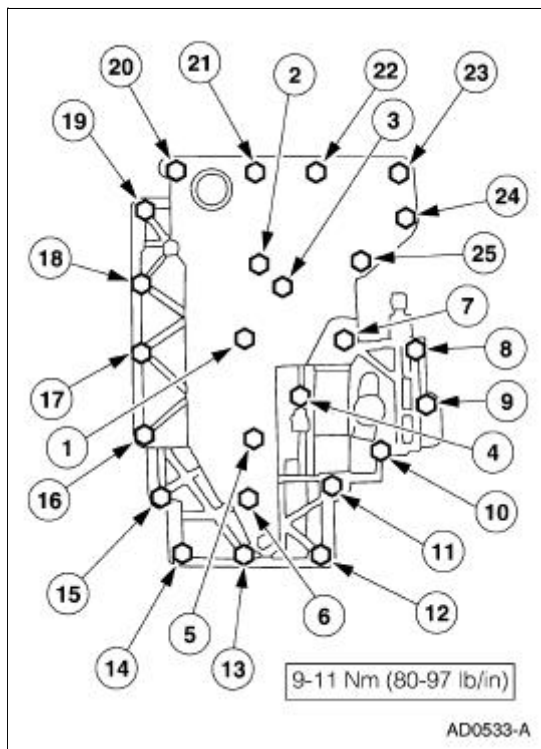
Loosely install the 12 short main control valve body bolts.



58. Install the manual control valve detent lever spring.
1. Position the manual control valve detent lever spring.
 2. Install the bolt.

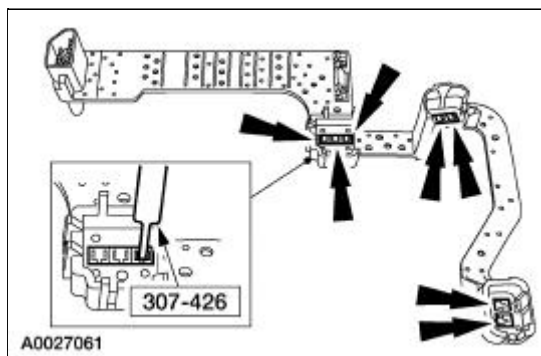


59. Tighten the bolts in the sequence shown.



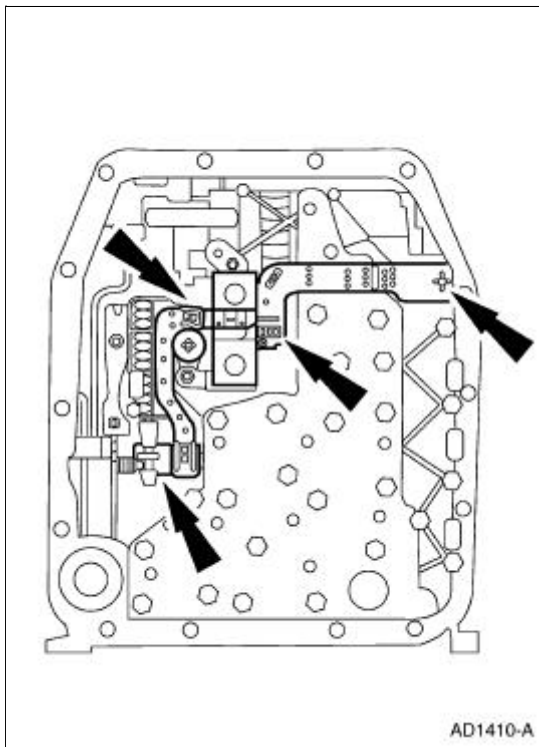
60. Inspect the lead frame for damage.

- Using the special tool, check all the lead frame solenoid connections. The gauge should fit tightly and not fall out after being inserted.
- If the special tool passes through any lead frame connector pins or does not feel like it makes a good contact, install a new lead frame.

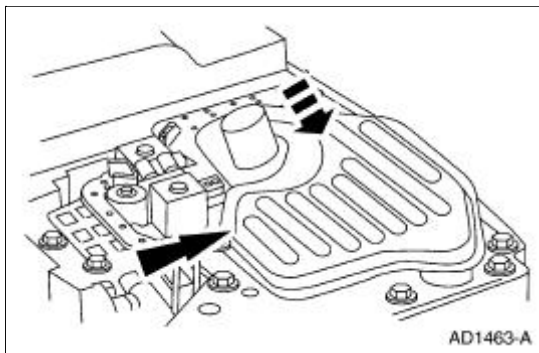


61. Connect the molded lead frame to the solenoids.

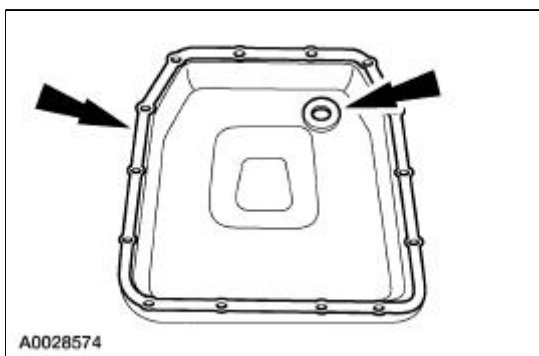
- Connect the bulkhead inter-connector by pressing it in place by hand and fully seating the connector in place.
- Connect the EPC solenoid by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.
- Connect the TCC by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.
- Connect the shift solenoid SSA and SSB by pressing it in place by hand and fully seating the connector in place. Make sure that the terminals pass fully through the connector slots.



62. Install the fluid filter and seal assembly.



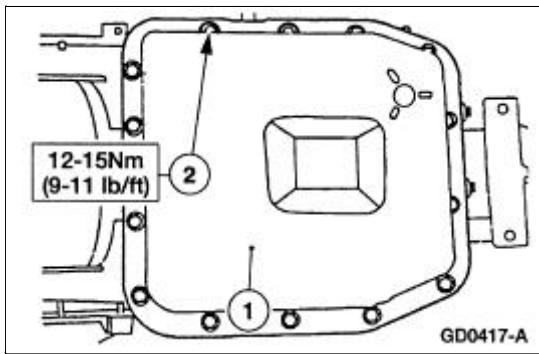
63. Position the pan magnet onto the fluid pan.



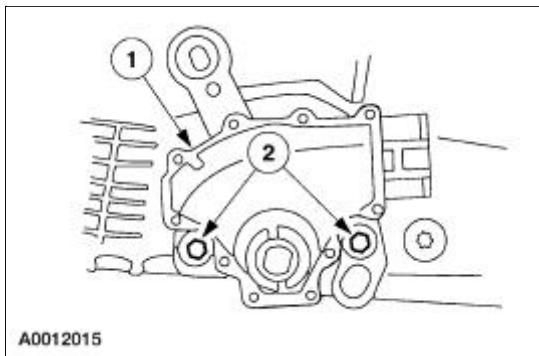
64. **NOTE:** The pan gasket is reusable; clean and inspect for damage. If not damaged, the gasket should be reused.

Install the fluid pan.

1. Position the transmission fluid pan.
2. Install the 14 transmission fluid pan bolts.



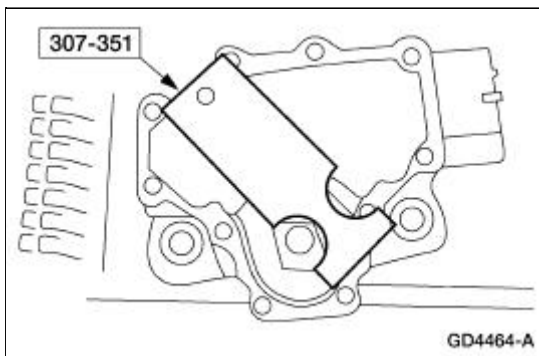
65. Install the digital transmission range (TR) sensor.
1. Install the digital TR sensor.
 2. Loosely install the digital TR bolts.



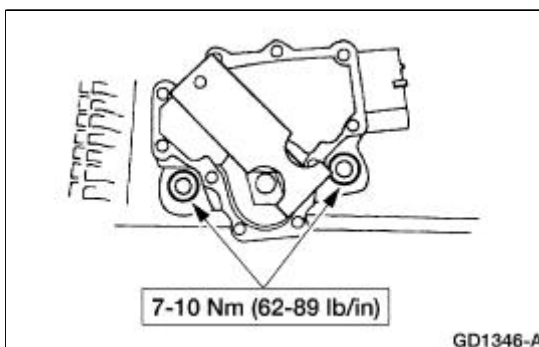
66. **NOTE:** The tool is designed to fit snugly.

NOTE: Manual shift lever must be in the neutral position.

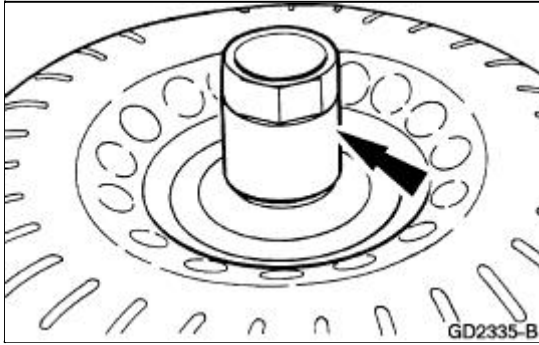
Using the special tool, align the digital TR sensor slots.




67. Tighten the bolts.



68. Lightly lubricate the converter hub with clean automatic transmission fluid.

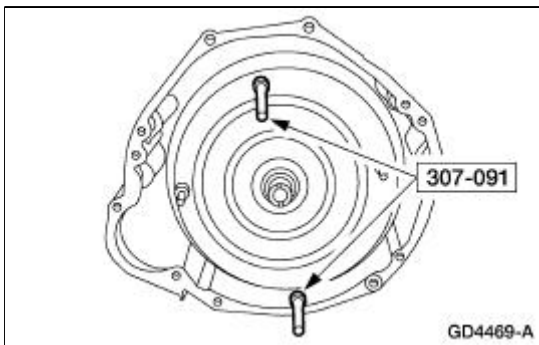


69.  **WARNING:** The torque converter can fall out if the transmission is tipped.

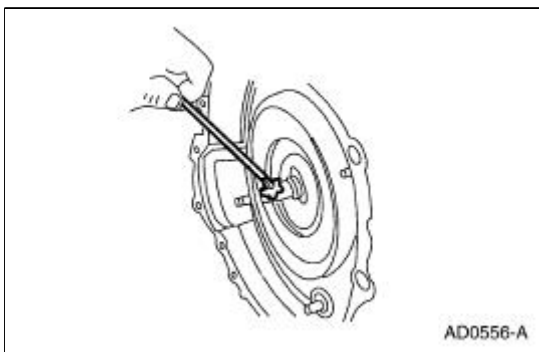
 **CAUTION:** Make sure the converter hub is fully engaged in the front pump support and gear and rotates freely. Do not damage the hub seal.

 **CAUTION:** If the torque converter slides out, the hub seal may be damaged.

Using the special tools, install the torque converter.



70. Lubricate the torque converter pilot hub with multi-purpose grease.




Transmission

Special Tool(s)


 ST1636-A	Retainer, Torque Converter 307-346 (T97T-7902-A)
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Material

Item	Specification
Multi-Purpose Grease D0AZ-19584-AA	ESB-M1C93- B
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

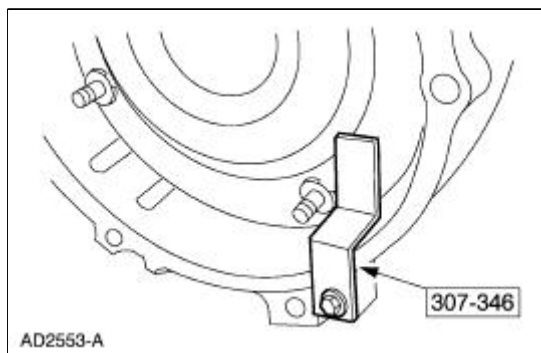
-  **CAUTION:** During this move, to avoid damage, do not allow the transmission to get into a nose-down position as this will cause the torque converter to move forward and disengage from the pump gear. The converter housing is piloted into position by dowels in the rear of the engine block. The torque converter must rest squarely against the flexplate. This indicates that the converter pilot is not binding in the engine crankshaft.

Position and secure the transmission on the high-lift transmission jack.

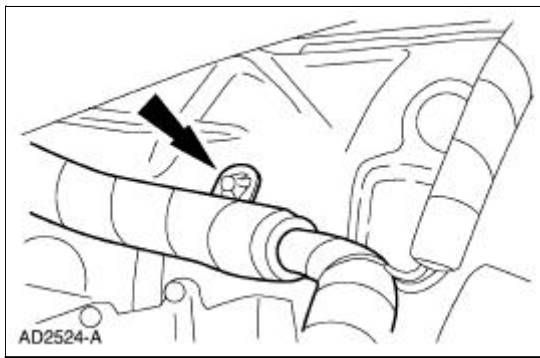
-  **CAUTION:** Make sure the torque converter is fully seated in the transmission before positioning the transmission to the engine.

Using the special tool, install the transmission to the engine.

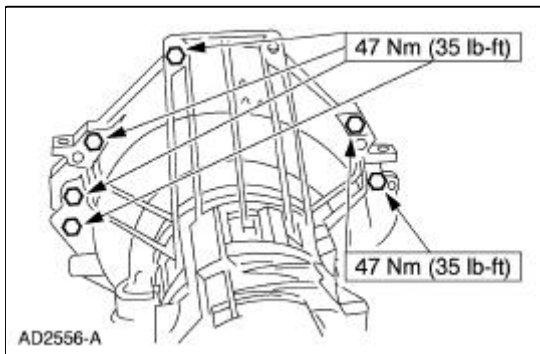
- Align the orange balancing marks on the converter stud and the flexplate bolt hole.



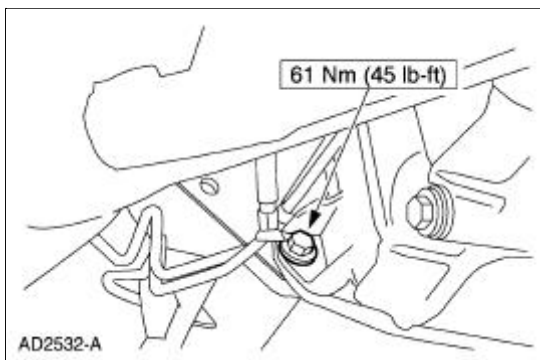
3. Reconnect the harness.



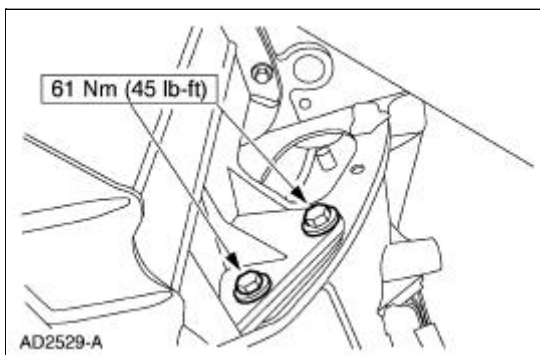
4. Install the bolts.



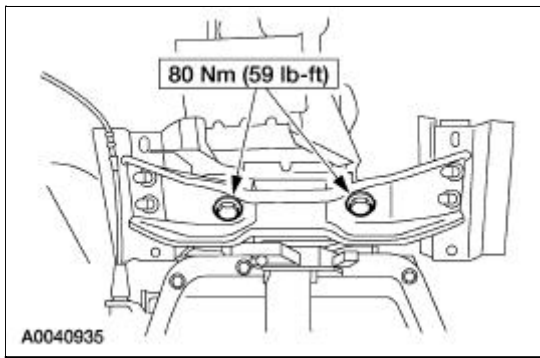
5. Install the bolt.



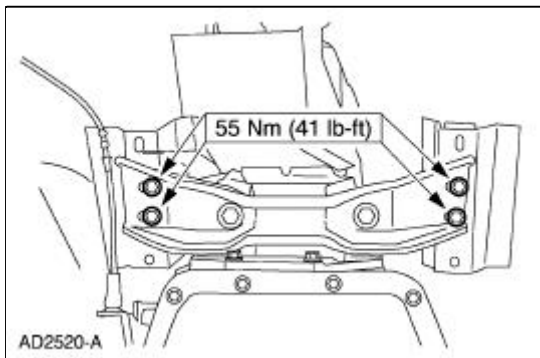
6. Install the bolts.



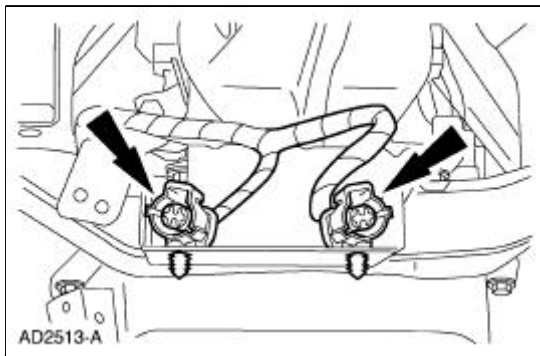
7. Install the bolts.



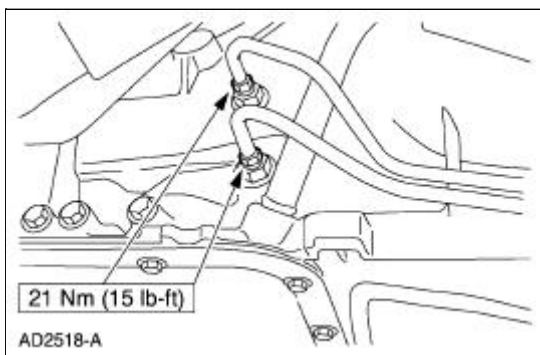
8. Install the bolts.



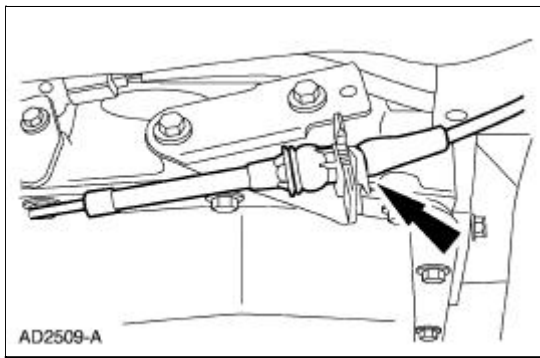
9. Reconnect the connectors.



10. Connect the transmission fluid cooler tubes.

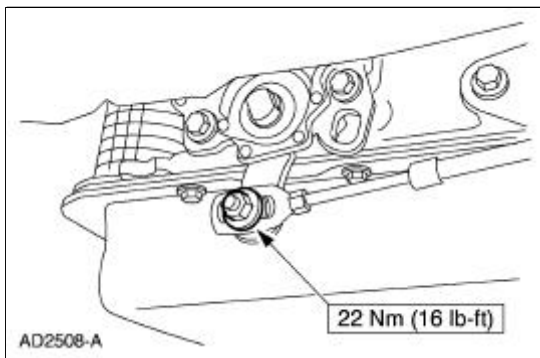


11. Install the shift cable.

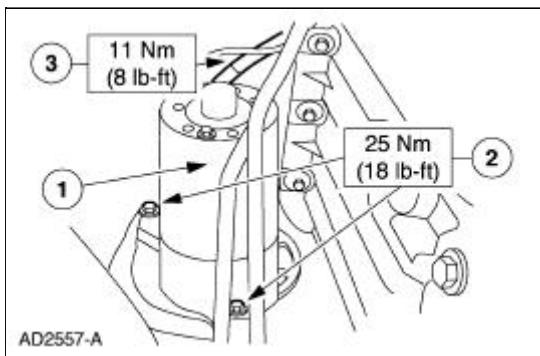


12. **NOTE:** The manual lever must be in the overdrive position.

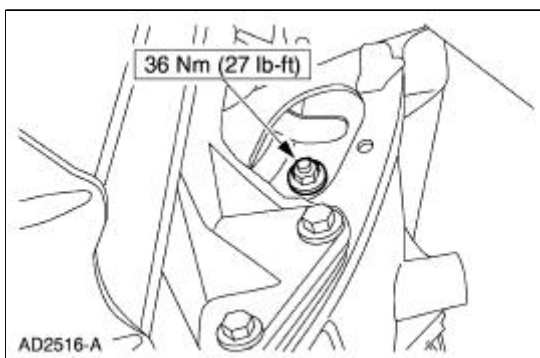
Connect the shift cable at the manual lever.



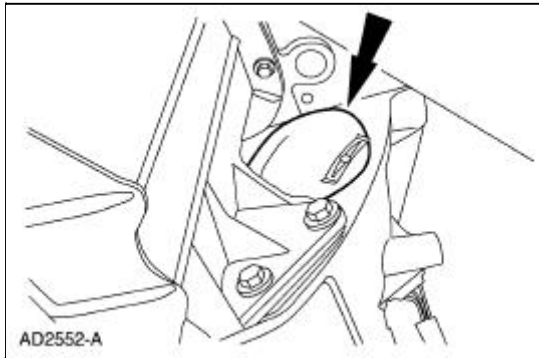
13. Install the starter.
1. Position the starter.
 2. Install the bolts.
 3. Connect the wires.



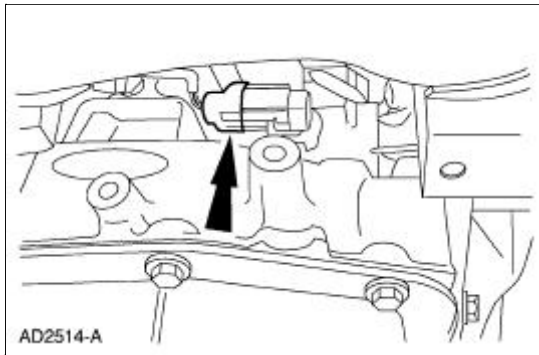
14. Install the four nuts.



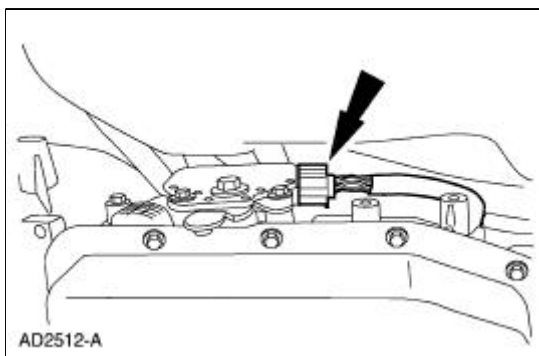
15. Install the cover.



16. Reconnect the connector.



17. Reconnect the connector.

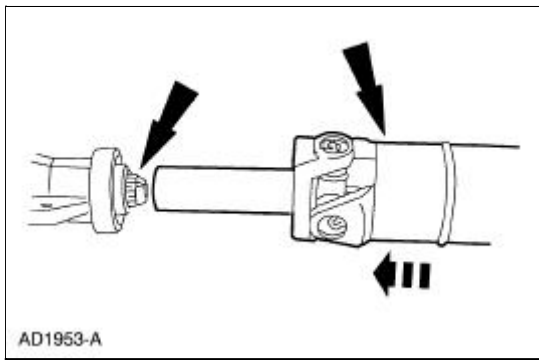


18. Install the dual converter Y pipe.

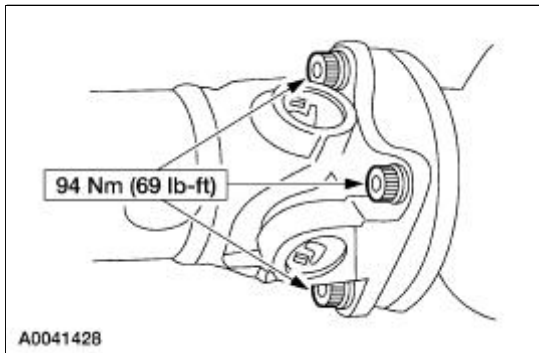
19. **NOTE:** The output shaft and the drive shaft are a balanced assembly.

Install the driveshaft.

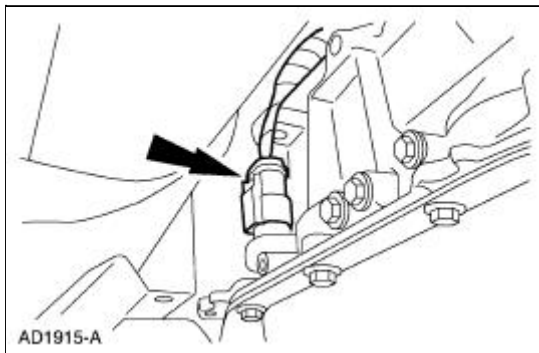
- Align the yellow dots and position the driveshaft on the transmission.
- Position the driveshaft to the rear differential.



20. Install the bolts.

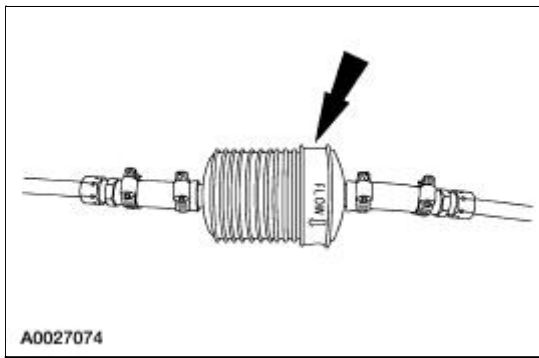


21. Connect the connector.



22. Use the following guidelines for the in-line transmission fluid filter:

- If the transmission was overhauled and the vehicle was equipped with an in-line fluid filter, install a new in-line fluid filter.
- If the transmission was overhauled and the vehicle was not equipped with an in-line fluid filter, install a new in-line fluid filter kit.
- If the transmission is being installed for a non-internal repair, do not install an in-line filter or filter kit.
- If installing a Ford authorized remanufactured transmission, install the in-line transmission fluid filter that is supplied.
Prior to lowering the vehicle, install a new in-line transmission filter or a filter kit.



23. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more until the vehicle relearns the strategy.

Connect the battery ground cable.

24. If required, fill the transmission with clean automatic transmission fluid.
25. Check the transmission for correct operation.
-

General Specifications

Item	Specification
Fluid	
MERCON® V Automatic Transmission Fluid XT-5-QM	MERCON® V

Torque Specifications

Description	Nm	lb-ft
Fluid cooler tube nut at radiator	32	24
Cooler line bracket to engine nut	48	35
Fluid cooler tube nut at transmission	21	15

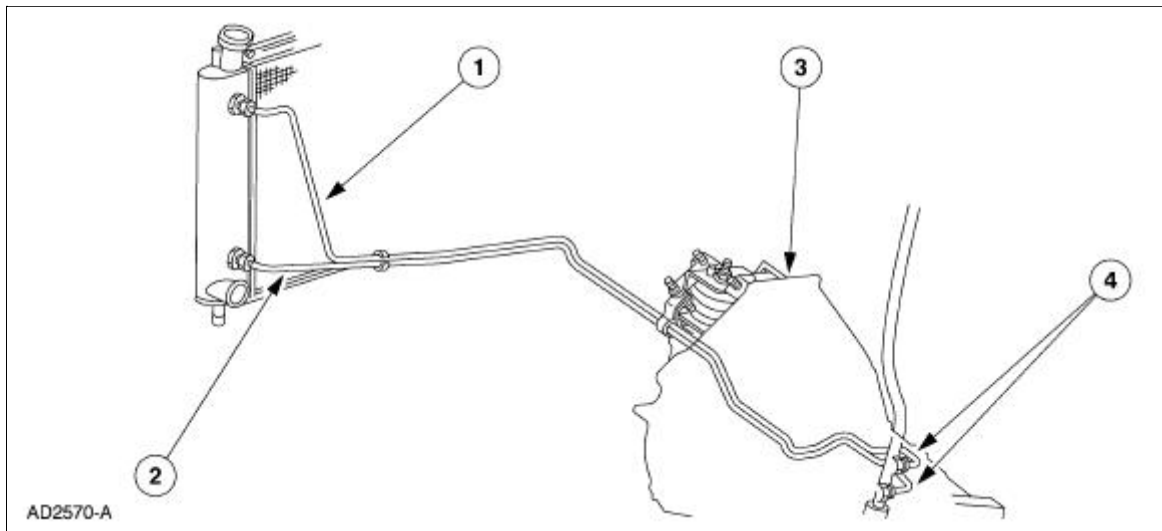
Transmission Cooling —Integral

This vehicle with an automatic transmission is equipped with an integral transmission fluid cooler. The cooler is contained inside of the radiator outlet tank and cannot be serviced separately. The cooler transfers heat from the transmission fluid to the engine coolant.

For transmission fluid cooler flow test, refer to [Section 307-01](#).

For transmission fluid cooler backflushing and cleaning, refer to [Section 307-01](#).

Transmission Fluid Cooler Tubes



Item	Part Number	Description
1	—	Fluid cooler inlet tube
2	—	Fluid cooler outlet tube
3	7005	Transmission case
4	—	Transmission case fittings

Transmission Cooling

Inspection and Verification



WARNING: Never remove the radiator cap under any conditions while the engine is operating. Failure to follow these instructions could result in personal injury and/or damage to the cooling system or engine. To avoid having scalding hot coolant or steam blow out of the radiator, use extreme care when removing the radiator cap from a hot radiator. Wait until the engine has cooled, then wrap a thick cloth around the radiator cap and turn it slowly to the first stop. Step back while the pressure is released from the cooling system. When you are certain all the pressure has been released, press down on the radiator cap (with a cloth), turn and remove.

The transmission fluid cooler is integral to the radiator (8005). Whenever leaks or damage to the radiator are found, install an entire new radiator. For additional information, refer to [Section 303-03A](#) or [Section 303-03B](#).

Symptom Chart

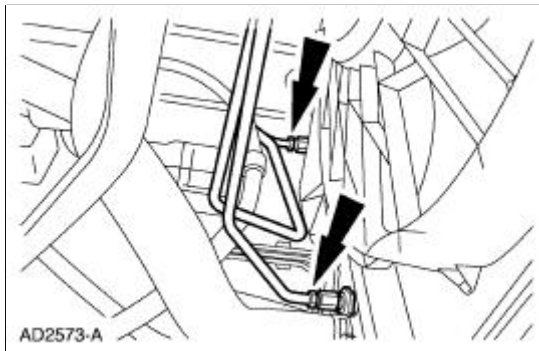
SYMPTOM CHART

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● Transmission Overheating 	<ul style="list-style-type: none"> ● Damaged radiator. ● System leaks. ● Incorrect fluid level. ● Fluid condition. ● Damaged, blocked, reversed, leaking or restricted cooler lines or cooler tubes. ● Engine concerns causing transmission to overheat. ● Excessive towing loads. ● Incorrect idle or performance. 	<ul style="list-style-type: none"> ● REPAIR or install a new radiator. For additional information, REFER to Section 303-03A or Section 303-03B. ● INSPECT for leaks. REPAIR as necessary. ● ADJUST to proper level. ● INSPECT according to instructions under Fluid Condition Check. REFER to Section 307-01. ● INSPECT cooler lines and tubes. REPAIR or flush as necessary. ● INSPECT engine cooling system. For additional information, REFER to Section 303-03A or Section 303-03B. ● CHECK gross vehicle weight. ● REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

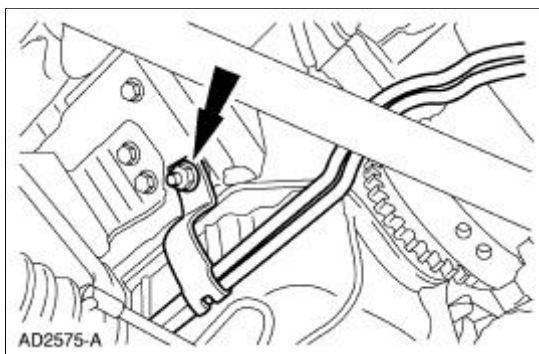
Transmission Fluid Cooler Tubes

Removal

1. Disconnect the battery cables.
2. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
3. Remove the nuts.

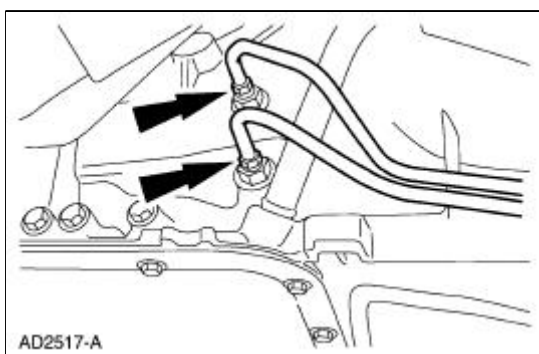


4. Remove the fluid cooler tube bracket at the engine.



5. **NOTE:** Use a backup wrench to hold the case fitting secure.

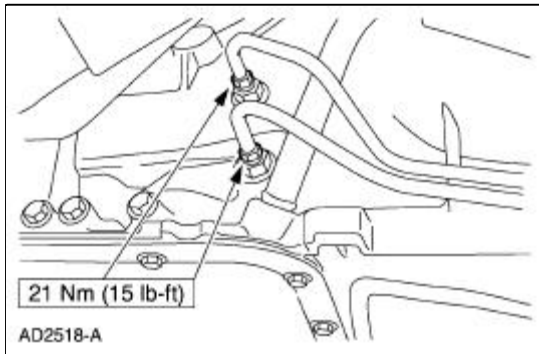
Remove the fluid cooler tubes at the transmission.



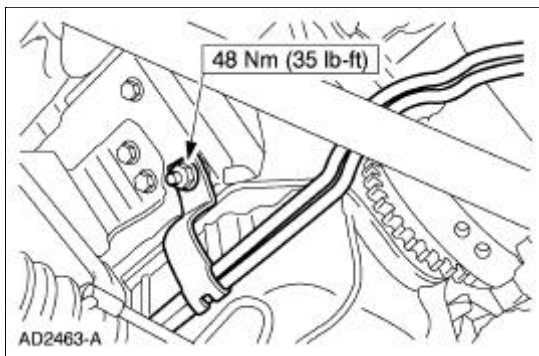
Installation

1. **NOTE:** Use a backup wrench to hold the case fitting secure.

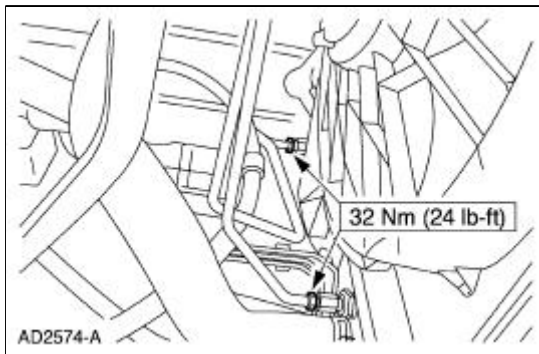
Install the fluid cooler tubes at the transmission.



2. Install the fluid cooler tube bracket at the engine.



3. Install the nuts.



4. Lower the vehicle.
 5. Connect the battery cables.
 6. Fill the transmission with fluid and verify proper operation.
 - Use Motorcraft MERCON® V Automatic Transmission Fluid XT-5-QM or equivalent meeting MERCON® V specification.
-

Torque Specifications

Description	Nm	lb-ft	lb-in
Steering Column Nuts	40	30	—
Shift Interlock Cable	7	—	62
Shift Cable Bracket	12	9	—

External Controls

The transmission shift cable transfers the transmission operating mode from the gearshift lever to the automatic transmission (7003). The indicated position of the transmission floor mounted selector lever is transferred to the transmission through the cable and down to the manual control lever on the transmission.

Shift Interlock System

The brake/shift interlock mechanism is used on vehicles equipped with an automatic transmission. This system is used to prevent shifting from PARK unless the brake pedal is depressed. The brake/shift interlock system consists of an actuator attached to the key interlock assembly and necessary wiring. The shift lock actuator is energized when the ignition switch is turned to the run position, locking the floor mounted transmission range selector lever in the PARK position. When the brake pedal is depressed, the shift lock actuator is deactivated and the floor mounted transmission range selector lever can be moved out of the PARK position.

Transmission Control Switch (TCS)


The transmission control switch (TCS) is a momentary contact switch that is located on the floor mounted transmission range selector lever. Pushing the TCS will either disengage or engage the overdrive function of the automatic transmission. If the OVERDRIVE is disengaged, the word O/D OFF will illuminate on the instrument cluster.

External Controls

Refer to Wiring Diagrams Cell [37](#), Shift Lock for schematic and connector information.

Refer to Wiring Diagrams Cell [29](#), Transmission Control for schematic and connector information.

Special Tool(s)

 ST1137-A	73 Digital Multimeter 105-R0051 or equivalent
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Inspection and Verification

1. Verify the customer concern by operating the transmission external control.
2. Visually inspect for obvious signs of mechanical and electrical damage; refer to the following chart:

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> ● Shift control linkage binding. ● Shift lock actuator. ● Shift control cable. ● Interlock cable. 	<ul style="list-style-type: none"> ● Circuitry. ● Central junction box (CJB) fuse: <ul style="list-style-type: none"> ■ 17 (15A) ■ 28 (15A) ■ 35 (15A) ● Brake pedal position (BPP) switch. ● Wiring harness. ● Loose or corroded connections. ● Bulb.

3. If the concern is not visually evident, determine the symptom. GO to [Symptom Chart](#).

Symptom Chart

SYMPTOM CHART

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● The shift interlock system does not release/lock correctly 	<ul style="list-style-type: none"> ● Circuitry. ● CJB Fuse 17 (15A) or Fuse 35 (15A). ● Shift lock actuator. ● Brake pedal position (BPP) switch. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test A.

<ul style="list-style-type: none"> ● The shift control is out of correct gear relationship 	<ul style="list-style-type: none"> ● Transmission shift cable and bracket. ● Retainer bracket. ● Shift control linkage out of adjustment. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test B.
<ul style="list-style-type: none"> ● Transmission range indicator does not correspond to the gear 	<ul style="list-style-type: none"> ● Transmission shift cable bracket. ● Transmission shift cable loose from the transmission retainer bracket. ● Shift linkage. 	<ul style="list-style-type: none"> ● TIGHTEN the bolts holding transmission shift cable bracket. ● TIGHTEN the bolts. ● VERIFY digital transmission range (DTR) sensor range for correct adjustment. REFER to Section 307-01.
<ul style="list-style-type: none"> ● The Transmission Control Switch (TCS) Is Inoperative 	<ul style="list-style-type: none"> ● CJB Fuse 28 (15A). ● TCS. ● TCS not cycled during self-test. ● Powertrain control module (PCM). ● Circuitry. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test C.
<ul style="list-style-type: none"> ● The Transmission Control Indicator Lamp (TCIL) Is Not Operating Correctly 	<ul style="list-style-type: none"> ● Bulb. ● Instrument cluster. ● Powertrain control module. 	<ul style="list-style-type: none"> ● REFER to Section 413-01.
<ul style="list-style-type: none"> ● Excessive Shift Effort 	<ul style="list-style-type: none"> ● Transmission shift cable. ● Cable bracket. 	<ul style="list-style-type: none"> ● INSTALL a new transmission shift cable. ● ADJUST the cable. TIGHTEN the screws.
<ul style="list-style-type: none"> ● Transmission Range Selector Lever Will Not Shift 	<ul style="list-style-type: none"> ● Transmission shift cable. ● Broken transmission shift cable. 	<ul style="list-style-type: none"> ● INSTALL a new transmission shift cable. ● INSTALL a new transmission shift cable.

Pinpoint Tests

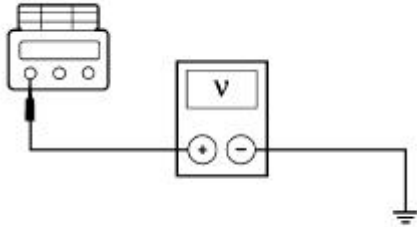
PINPOINT TEST A: THE SHIFT INTERLOCK SYSTEM DOES NOT RELEASE/LOCK CORRECTLY

Test Step	Result / Action to Take
A1 TEST THE BRAKE LIGHTS	
<ul style="list-style-type: none"> ● Key in ON position. ● Apply the brake pedal and observe the stoplamps. ● Do the stoplamps illuminate? 	<p>Yes GO to A2.</p> <p>No REFER to Section 417-</p>

[01.](#)

A2 CHECK CIRCUIT 511 (LG) FOR AN OPEN

- Key in OFF position.
- Disconnect: Shift Lock Actuator C2127.
- Measure the voltage between the shift lock actuator C2127-3, Circuit 511 (LG), harness side and ground while depressing and releasing the brake pedal.



GD4459-A

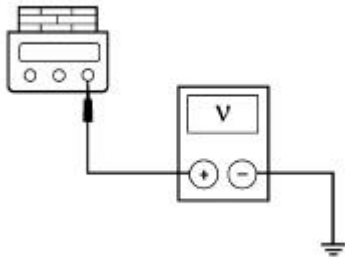
- Is the voltage greater than 10 volts with the brake pedal depressed and 0 volts with the brake pedal released?

Yes
GO to [A3.](#)

No
REPAIR the circuit. TEST the system for normal operation.

A3 CHECK CIRCUIT 294 (WH/LB) FOR AN OPEN

- Key in ON position.
- Measure the voltage between shift lock actuator C2127-1, Circuit 294 (WH/LB), harness side and ground.



GD2180-A

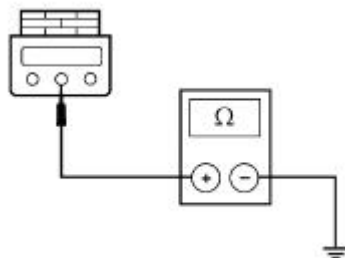
- Is the voltage greater than 10 volts?

Yes
GO to [A4.](#)

No
REPAIR the circuit. TEST the system for normal operation.

A4 TEST CIRCUIT 1205 (BK) FOR AN OPEN

- Measure the resistance between shift lock actuator C2127-2, Circuit 1205 (BK), harness side and ground.



GD2181-A

- Is the resistance less than 5 ohms?

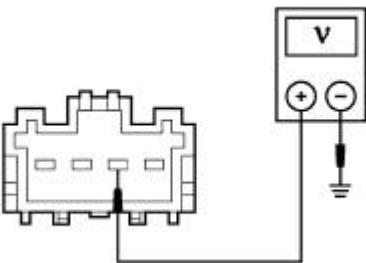
Yes
INSTALL a new shift lock actuator. REFER to [Brake Shift Interlock Actuator](#) .
TEST the system for normal operation.

No
REPAIR the circuit. TEST the system for normal operation.

PINPOINT TEST B: THE SHIFT CONTROL IS OUT OF CORRECT GEAR RELATIONSHIP

Test Step	Result / Action to Take
B1 CHECK THE SHIFT CONTROL LINKAGE	<p>Yes GO to B2.</p> <p>No REPAIR as necessary. TEST the system for normal operation.</p>
<ul style="list-style-type: none"> ● Key in ON position. ● Apply the brake pedal. ● Actuate the transmission range selector lever in all ranges. ● Observe the shift control linkage during operation. ● Is the shift control linkage OK? 	
B2 CHECK THE TRANSMISSION SHIFT CABLE	
<ul style="list-style-type: none"> ● Check the transmission shift cable and bracket installation and tightness. ● Is the transmission shift cable correctly installed and adjusted? 	<p>Yes GO to B3.</p> <p>No REPAIR as necessary. TEST the system for normal operation.</p>
B3 CHECK THE LINKAGE/CABLE FOR CORRECT GEAR RELATIONSHIP	<p>Yes VERIFY the correct adjustment of the digital transmission range (DTR) sensor. REFER to Section 307-01 . Adjust the digital DTR sensor if necessary. TEST the system for normal operation.</p> <p>No ADJUST the transmission shift cable. REFER to Cable Adjustment . TEST the system for normal operation.</p>
<ul style="list-style-type: none"> ● Apply the brake pedal. ● Actuate the transmission range selector lever in all ranges. ● Does the indicator match the gear selection? 	

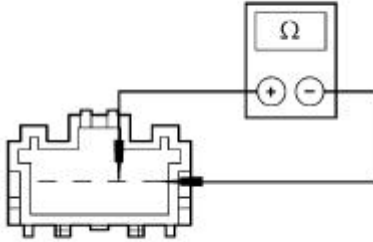
PINPOINT TEST C: THE TRANSMISSION CONTROL SWITCH (TCS) IS INOPERATIVE

Test Step	Result / Action to Take
C1 CHECK THE VOLTAGE TO THE TRANSMISSION CONTROL SWITCH	<p>Yes GO to C2.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Transmission Control Switch C279. ● Key in ON position. ● Measure the voltage between TCS C279-3, Circuit 911 (WH/LG), harness side and ground.  <p>AD2459-A</p>	

- Is the voltage greater than 10 volts?

C2 CHECK THE TCS

- Measure the resistance between TCS Pin 3 (component side), and TCS Pin 4 (component side), while depressing and releasing the TCS.



GD4460-A

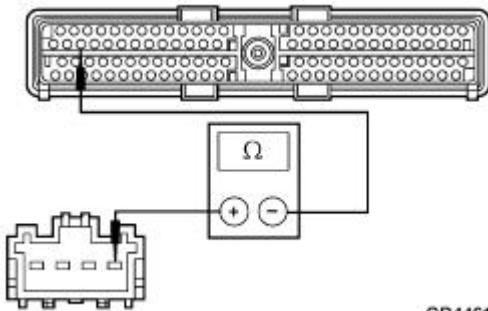
- Is the resistance less than 5 ohms with the TCS depressed and greater than 10,000 ohms with the TCS released?

Yes
GO to [C3](#).

No
INSTALL a new TCS. Test the system for normal operation.

C3 CHECK CIRCUIT 224 (TN/WH) FOR AN OPEN

- Key in OFF position.
- Disconnect: PCM C175.
- Measure the resistance between TCS C279-4, Circuit 224 (TN/WH), harness side and PCM C175-29, Circuit 224 (TN/WH), harness side.



GD4461-A

- Is the resistance less than 5 ohms?

Yes
REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

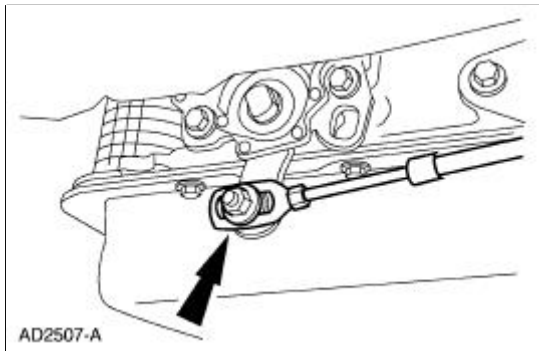
No
REPAIR the circuit. TEST the system for normal operation.

Cable Adjustment

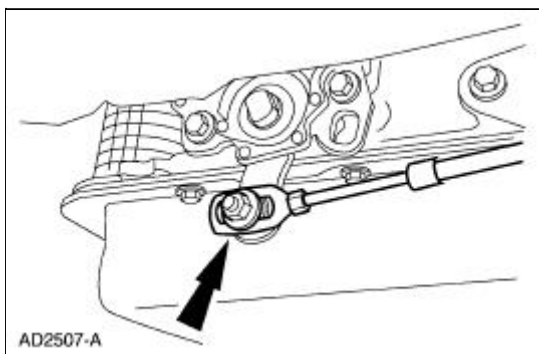
1. **NOTE:** Make sure that the range selector lever is tight against the rearward overdrive stop.

Place the transmission range selector lever in the overdrive position.

2. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
3. Loosen the manual control lever nut.



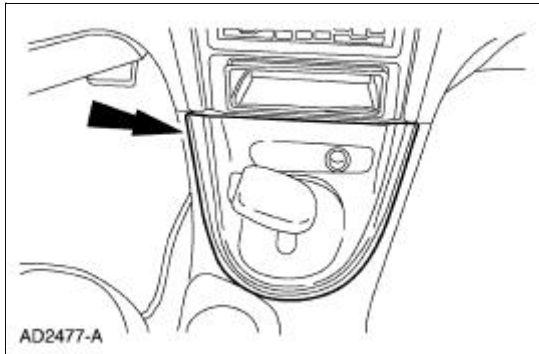
4. Place the transmission manual control lever in the overdrive position.
5. Tighten the nut on the manual control lever.



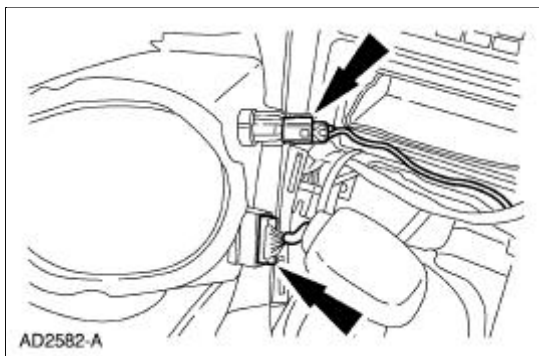
Brake Shift Interlock Actuator

Removal

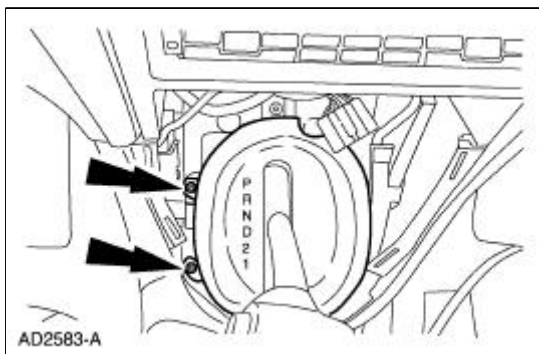
1. Remove the shifter top control panel.



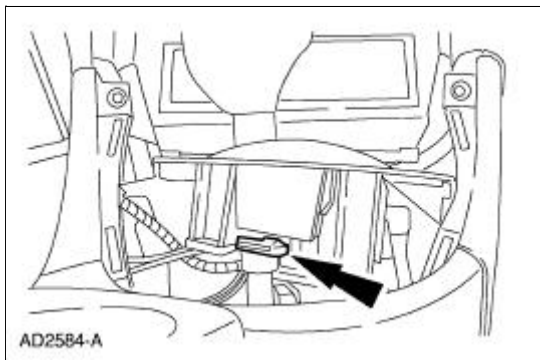
2. Disconnect the electrical connectors.



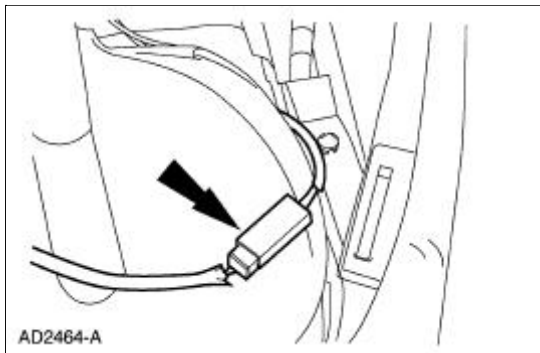
3. Remove the shifter bezel.




4. Remove the bulb from the bezel.

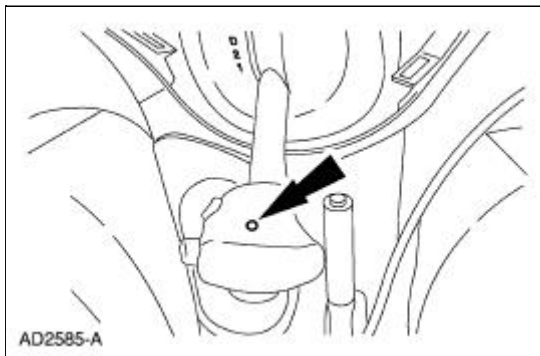


5. Disconnect the electrical connector.

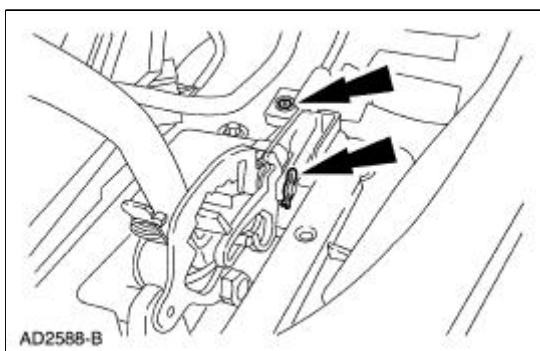


6.  **CAUTION:** Extra force may be needed to lift up on the handle. Do not pull too far or damage to the overdrive cancel button may result, as the wires may be pulled out of the switch.

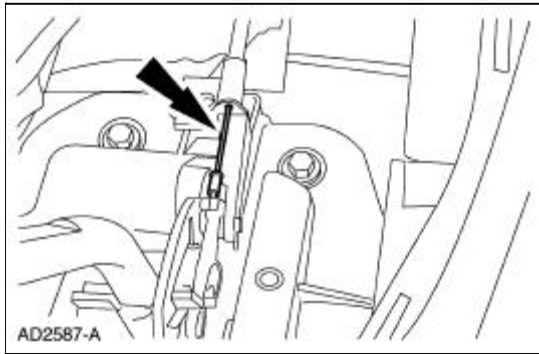
Remove the screw and the handle.



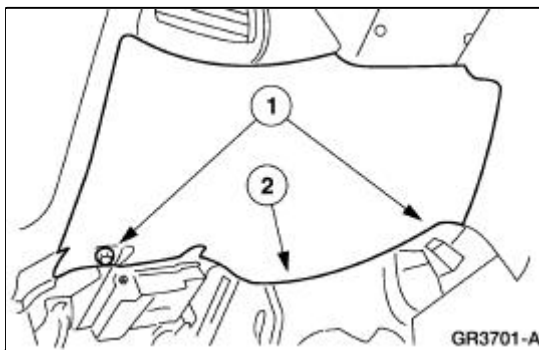
7. Remove the clip and bolt from the brake shift interlock cable.



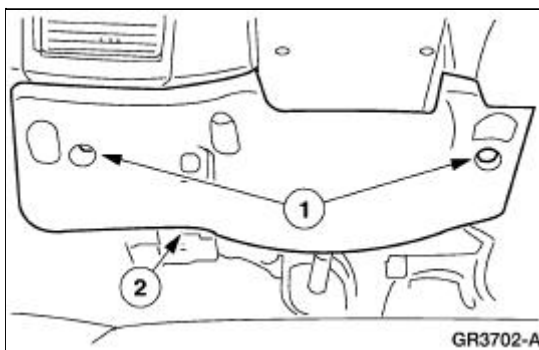
8. Disconnect the shift interlock cable.



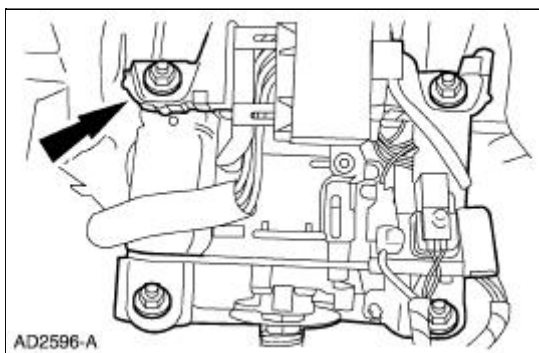
9. Remove the instrument panel steering column cover.
 1. Remove the screws.
 2. Remove the instrument panel steering column cover.



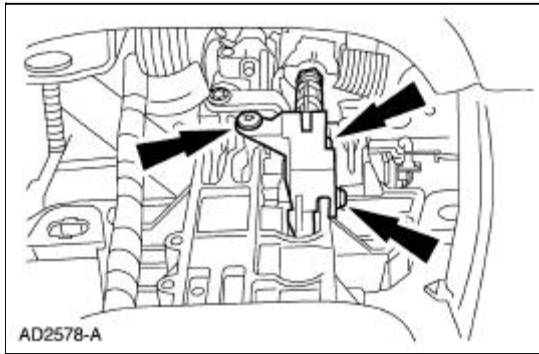
10. Remove the instrument panel reinforcement.
 1. Remove the screws.
 2. Remove the instrument panel reinforcement.



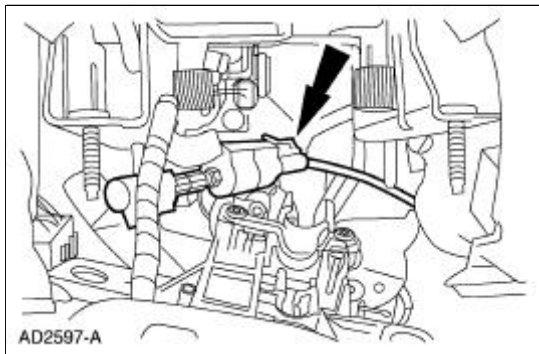
11. Remove the nuts and lower the steering column.



12. Remove the screws from the brake shift interlock cable.

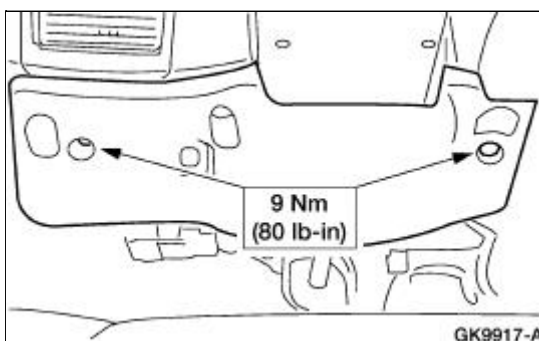
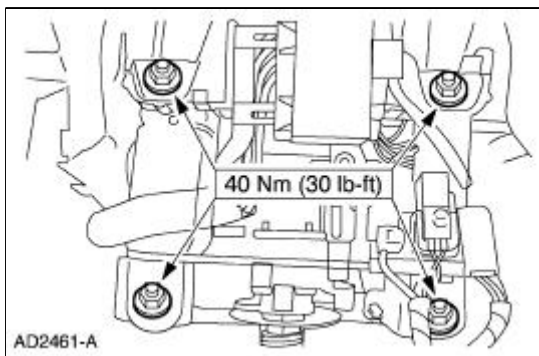


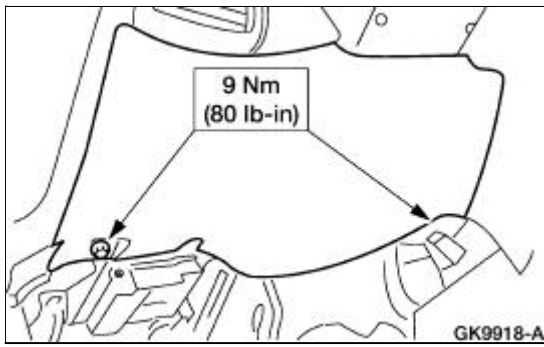
13. Remove the brake shift cable interlock actuator.



Installation

1. To install, reverse the removal procedure.

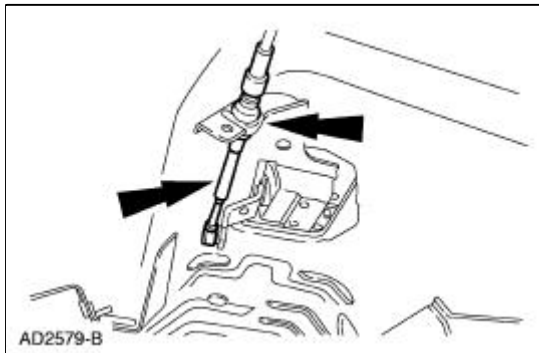




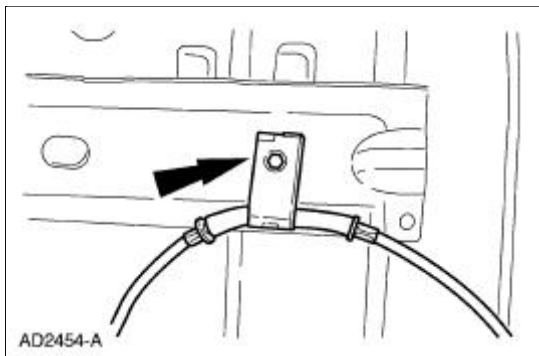
Cable and Bracket

Removal

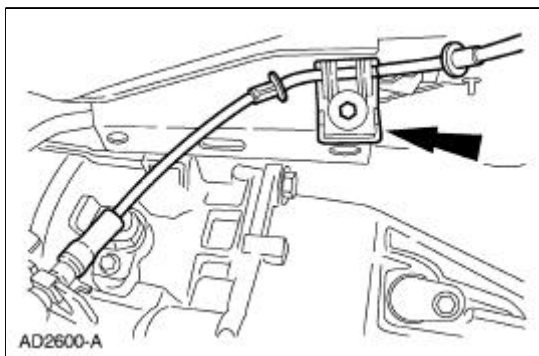
1. Raise the vehicle on a hoist. For additional information, refer to [Section 100-02](#).
2. Remove the cable shift from the shifter lever and bracket and discard the clip.



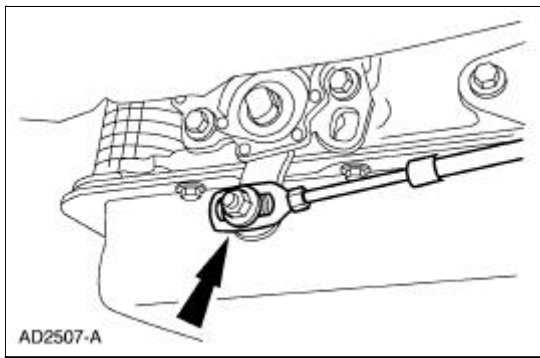
3. Remove the bolt from the cable.



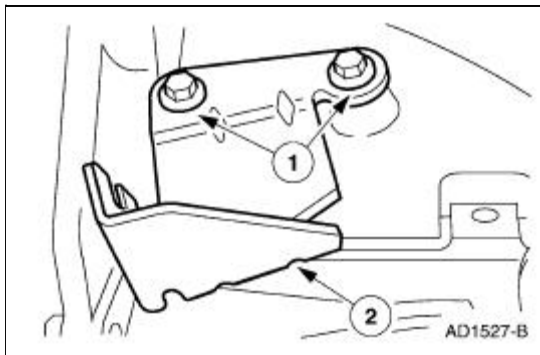
4. Remove the bolt from the cable.



5. Disconnect the transmission range selector lever cable from the TR sensor lever.



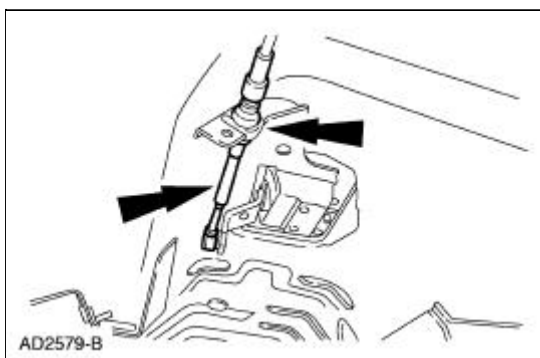
6. Remove the transmission shift cable bracket (7B229) from the transmission.
 1. Remove the bolts.
 2. Remove the bracket.



Installation

1. **NOTE:** It is necessary to install a new plastic clip prior to installation.

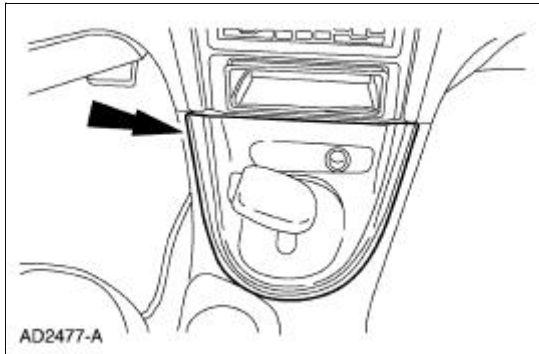
To install, reverse the removal procedure.



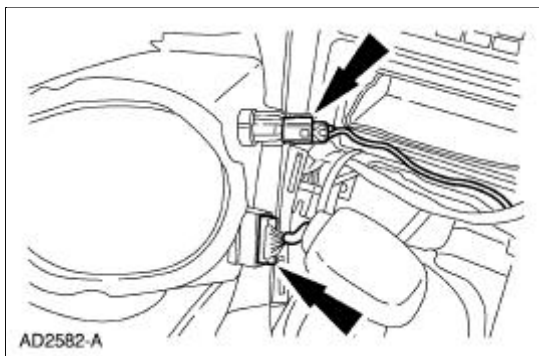
Selector Lever

Removal

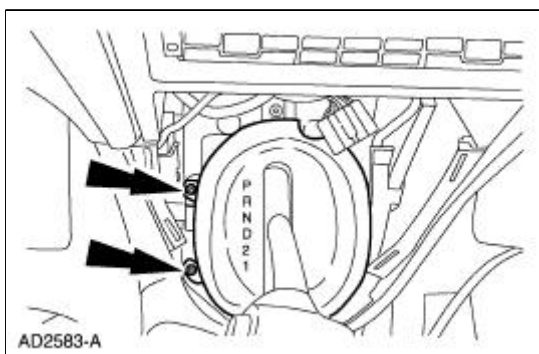
1. Remove the shifter top control panel.



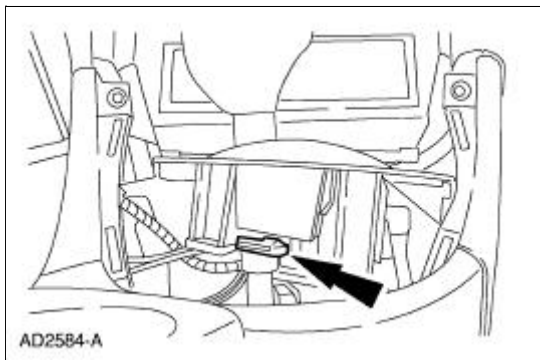
2. Disconnect the electrical connectors.



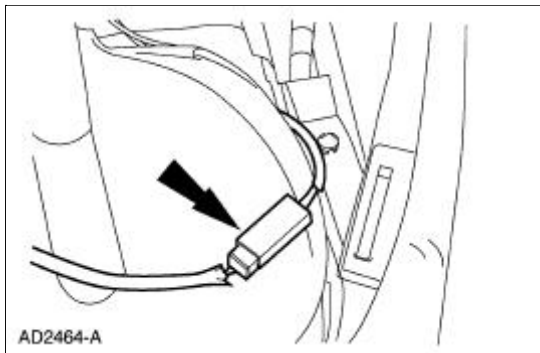
3. Remove the shifter bezel.



4. Remove the bulb from the bezel.

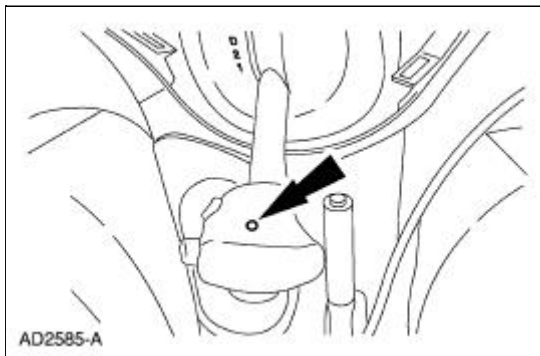


5. Disconnect the TCS connector.

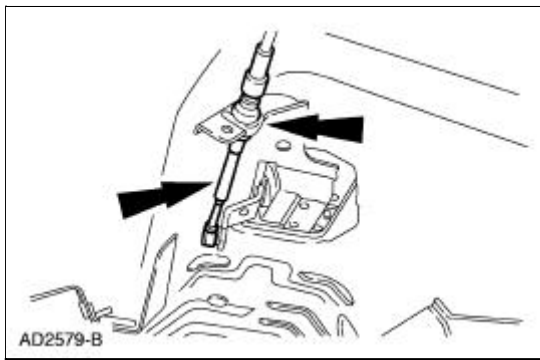


6.  **CAUTION:** Extra force may be needed to lift up on the handle. Do not pull too far or damage to the overdrive cancel button may result, as the wires may be pulled out of the switch.

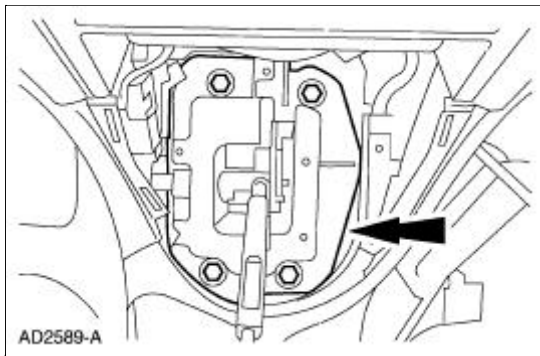
Remove the screw and the handle.



7. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
8. Disconnect the shift cable and discard the plastic clip.



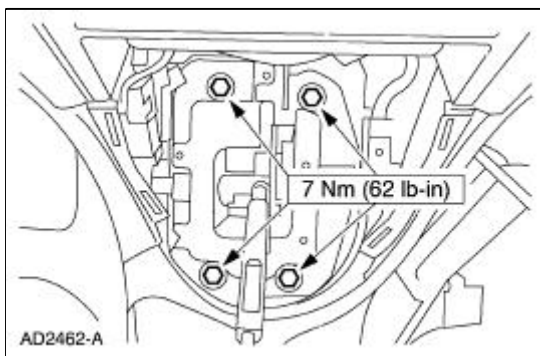
9. Lower the vehicle.
10. Remove the shifter.



Installation

1. **NOTE:** It is necessary to install a new plastic clip prior to installation.

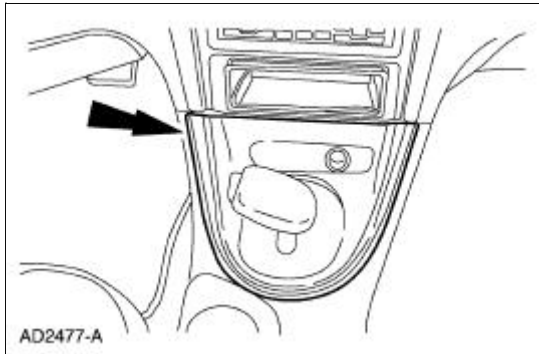
To install, reverse the removal procedure.



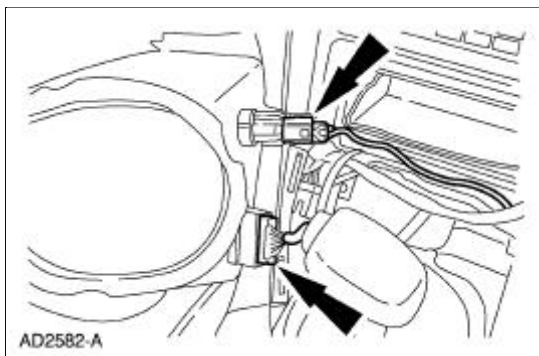
Transmission Control Switch

Removal

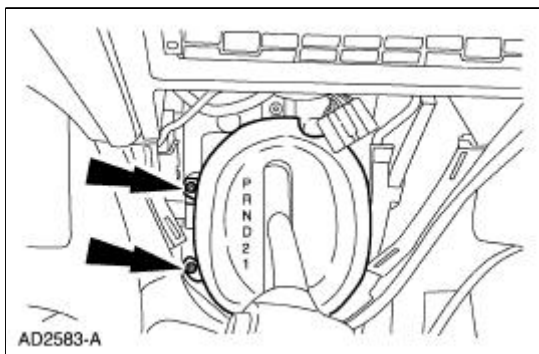
1. Remove the shifter top control panel.



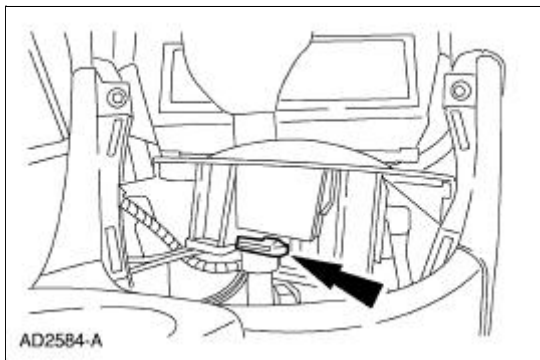
2. Disconnect the electrical connectors.



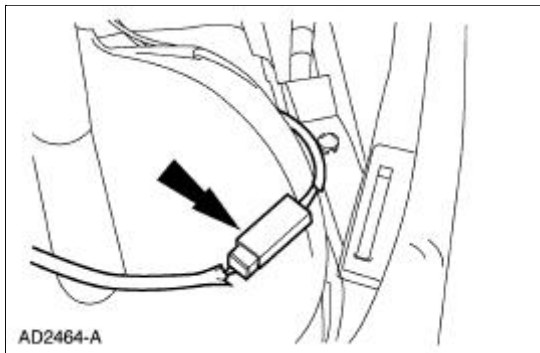
3. Remove the shifter bezel.



4. Remove the bulb from the bezel.

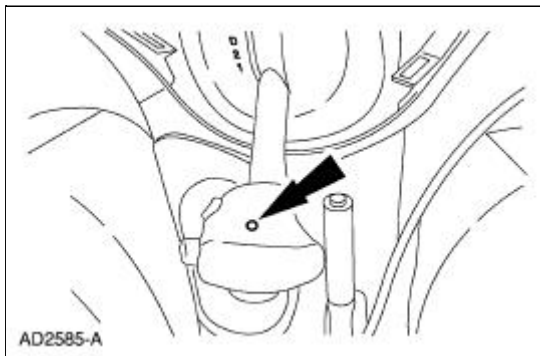


5. Disconnect the TCS connector.

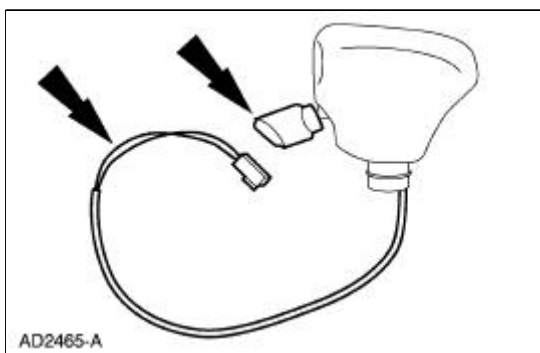


6.  **CAUTION:** Extra force may be needed to lift up on the handle. Do not pull too far or damage to the overdrive cancel button may result, as the wires may be pulled out of the switch.

Remove the screw and the handle.



7. Remove the transmission control switch.



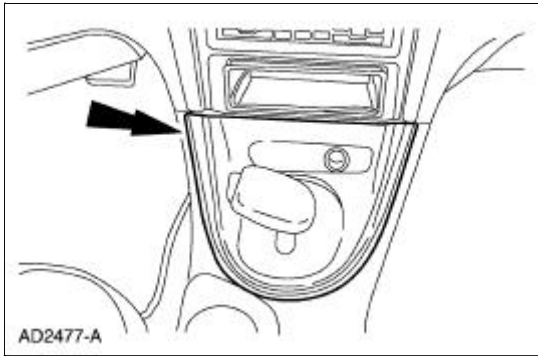
Installation

1. To install, reverse the removal procedure.
-

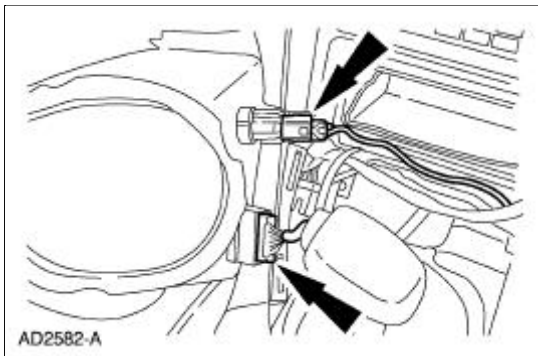
Bezel

Removal

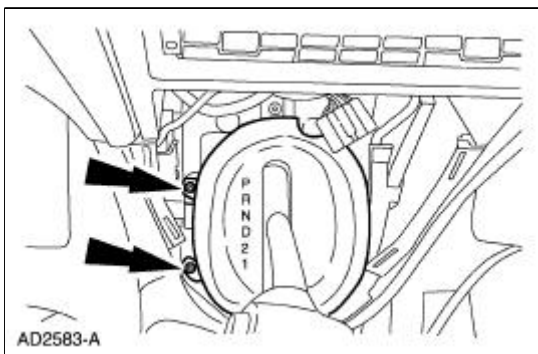
1. Remove the shifter top control panel.



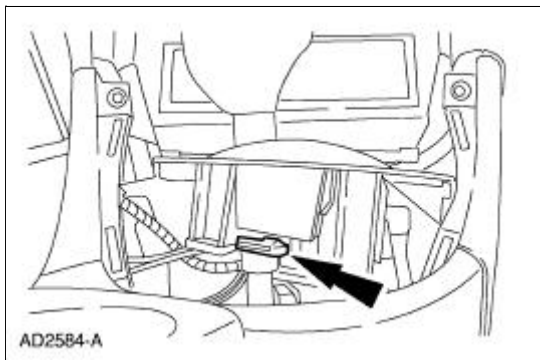
2. Disconnect the electrical connectors.



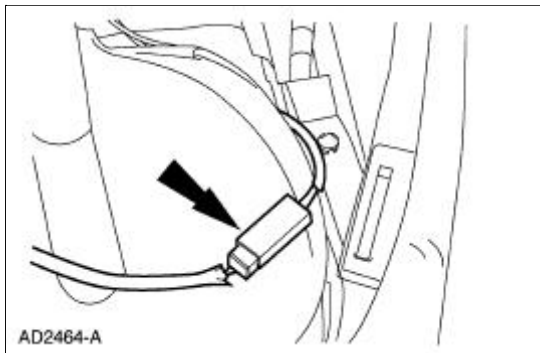
3. Remove the shifter bezel.



4. Remove the bulb from the bezel.

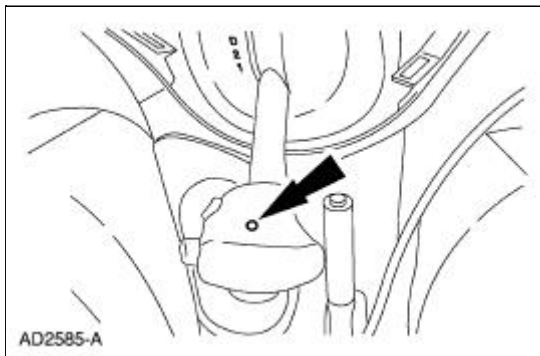


5. Disconnect the connector.



6.  **CAUTION:** Extra force may be needed to lift up on the handle. Do not pull too far or damage to the overdrive cancel button may result, as the wires may be pulled out of the switch.

Remove the screw and the handle.



7. Remove the bezel.

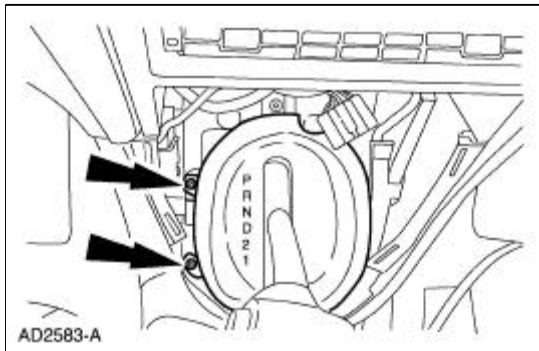
Installation

1. To install, reverse the removal procedure.
-

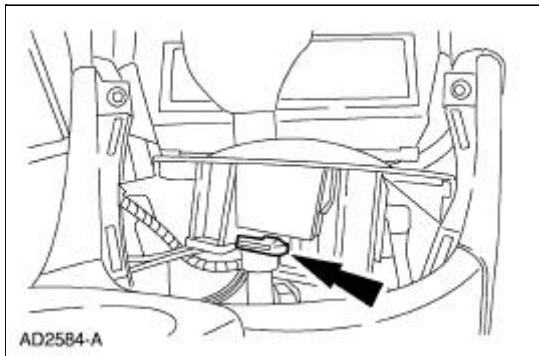
Bulb

Removal and Installation

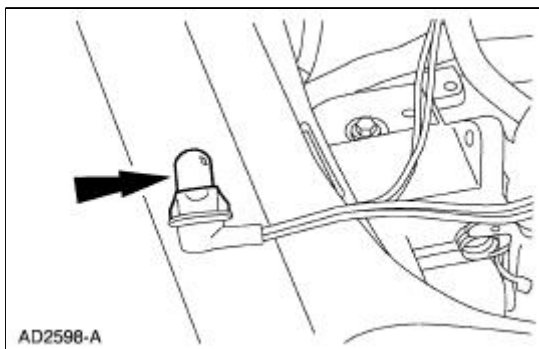
1. Remove the floor console. For additional information, refer to [Section 501-12](#).
2. Remove the bolts, then position the bezel upward.



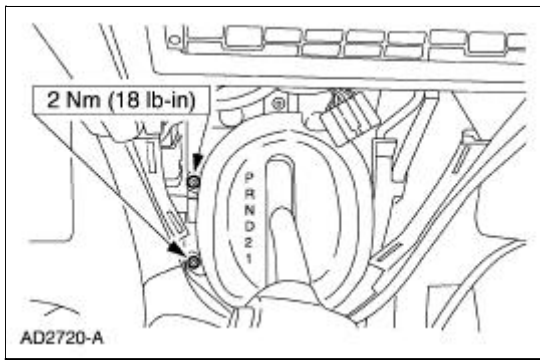
3. Remove the bulb socket from the bezel.



4. Remove the bulb.



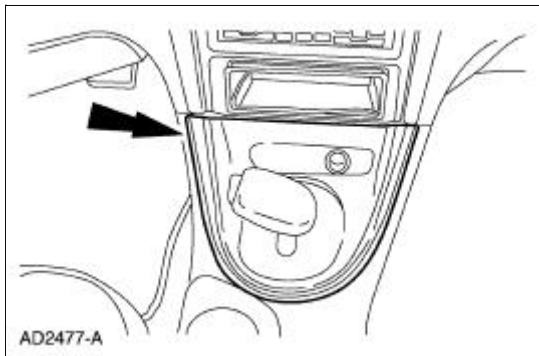
5. To install, reverse the removal procedure.



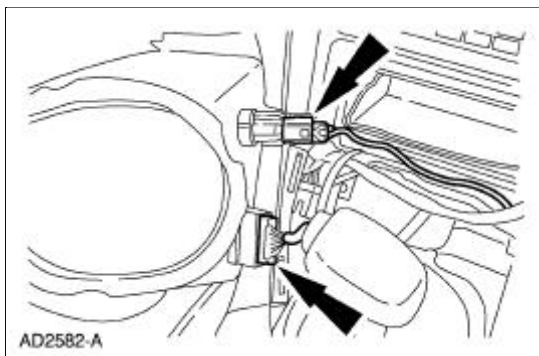
Knob

Removal

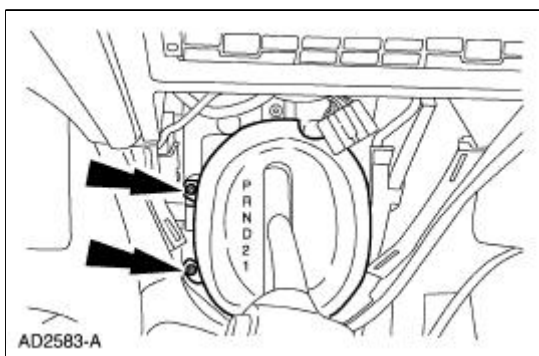
1. Remove the shifter top control panel.



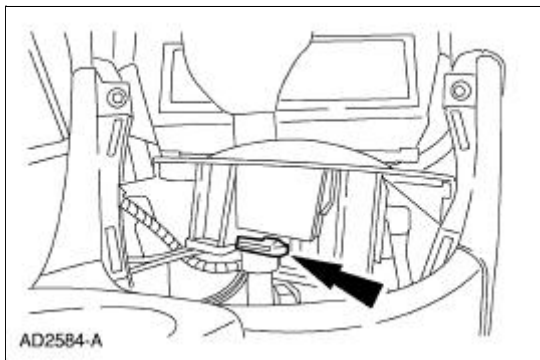
2. Disconnect the electrical connectors.



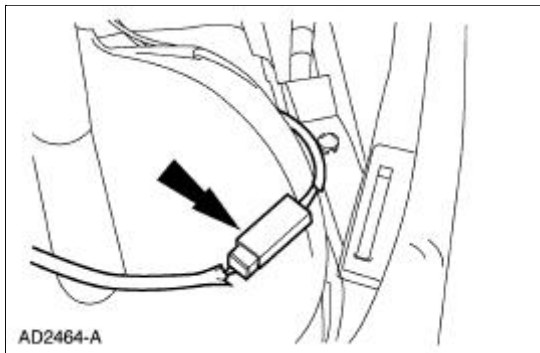
3. Remove the shifter bezel.




4. Remove the bulb from the bezel.

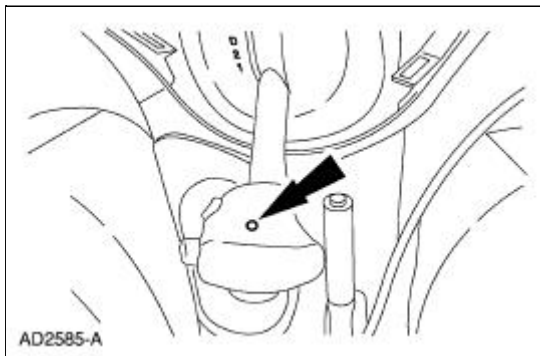


5. Disconnect the TCS connector.

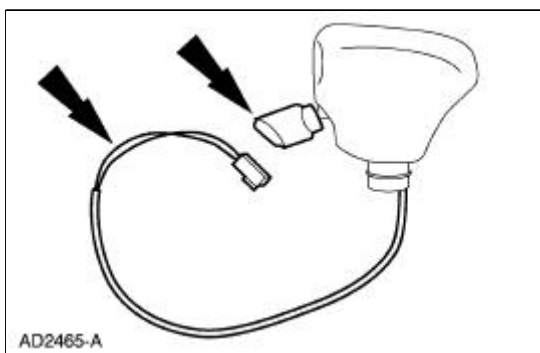


6.  **CAUTION:** Extra force may be needed to lift up on the handle. Do not pull too far or damage to the overdrive cancel button may result, as the wires may be pulled out of the switch.

Remove the screw and the handle.



7. Remove the transmission control switch.



Installation

1. To install, reverse the removal procedure.
-

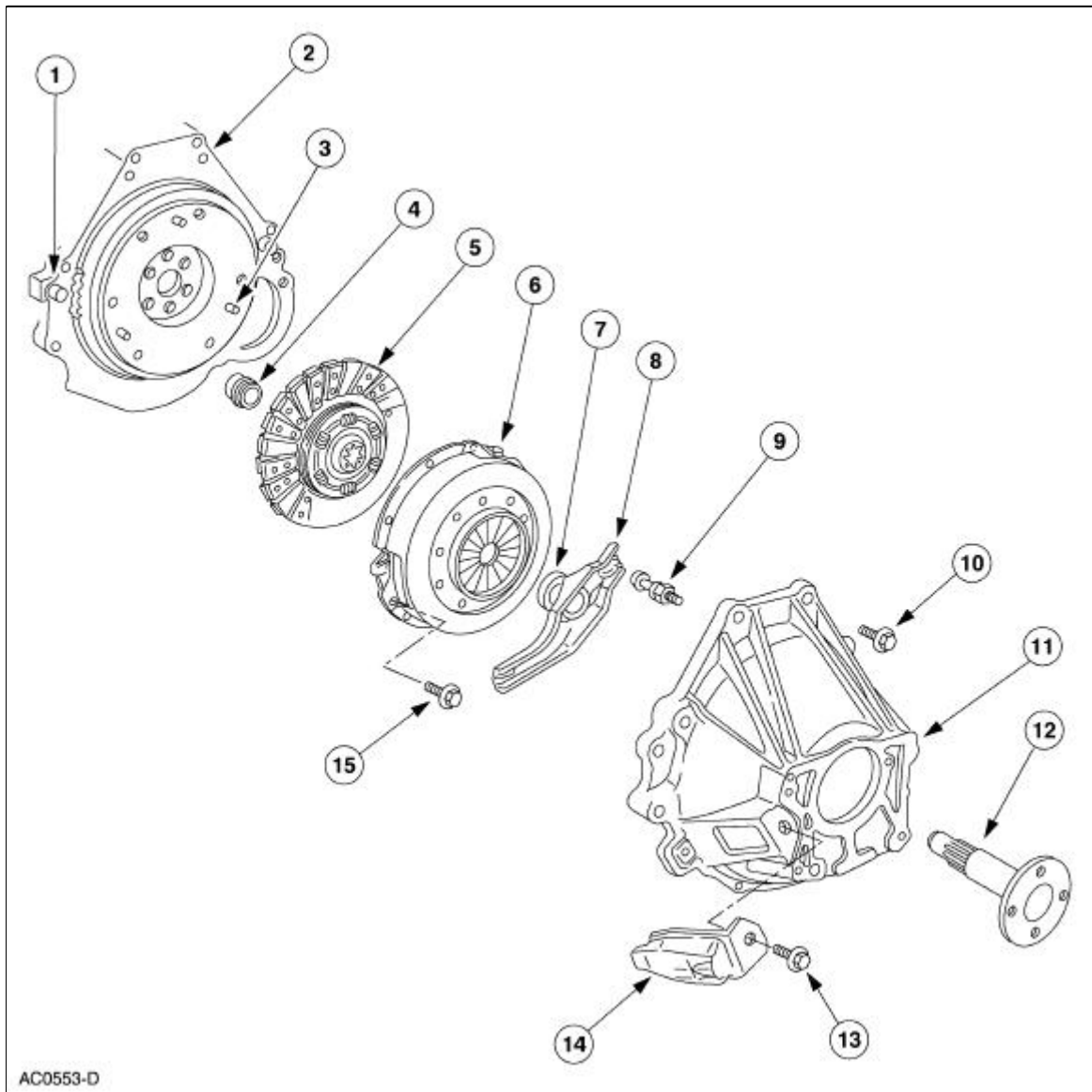
General Specifications

Item	Specification
Pressure plate	
Pressure spring	Belleville
Sensor spring	Belleville
Clutch Disc (3.8L)	
Clutch diameter	280 mm (11.0 inches)
Number of springs	5
Color identification	none
Clutch Disc (4.6L 2V)	
Clutch diameter	280 mm (11.0 inches)
Number of springs	4
Color identification	none
Lubricants (Spec and Capacity) Fluid	
T50D-MERCON® Multi-Purpose ATF Transmission Fluid XT-2-QDX	2.6L (2.8 qt)
TR3650-Synthetic MERCON® (ATF) Transmission Fluid E6AZ-19582-B	3.6L (7.5 pt)

Manual Transmission and Clutch

The primary function of the clutch is to couple and uncouple engine power to the transmission upon driver command. For additional information, refer to [Section 308-01](#).

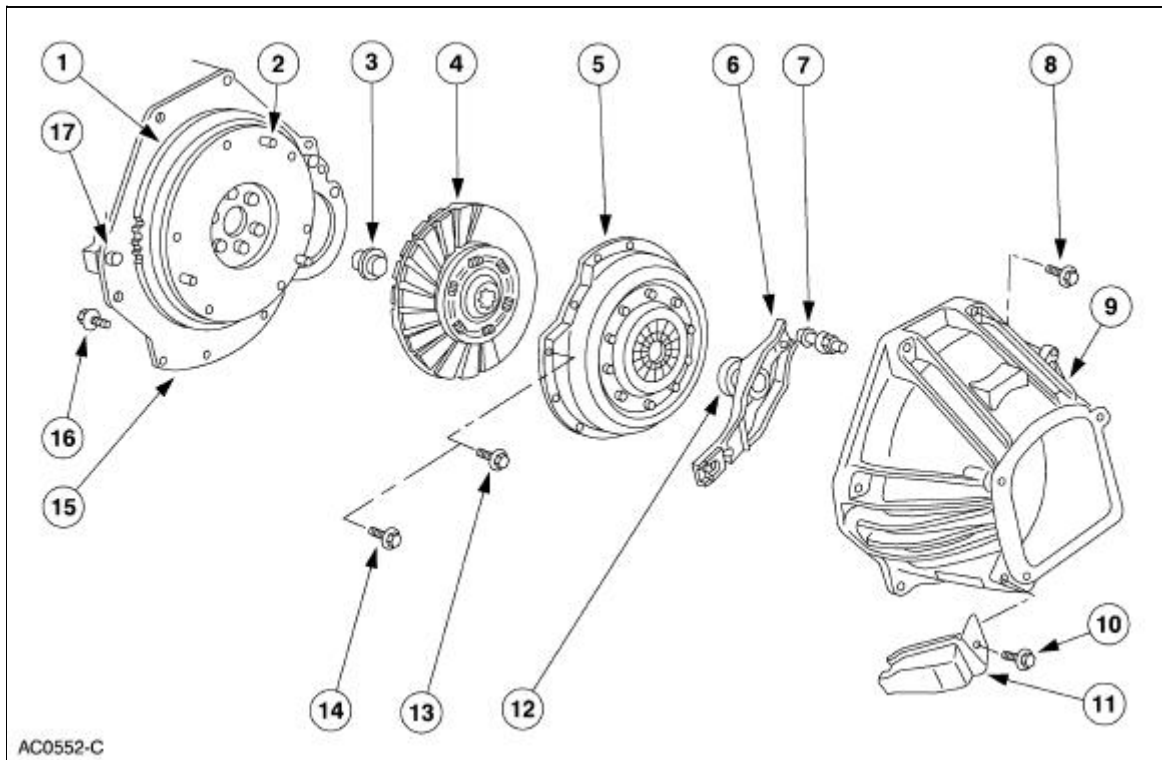
Clutch Disc and Clutch Pressure Plate — 3.8L



Item	Part Number	Description
1	6397	Flywheel housing to block dowel (2 req'd)
2	—	Rear face of block and flywheel (part of 6010)
3	6397	Flywheel to clutch pressure plate dowel (3 req'd)
4	7600	Pilot bearing
5	7550	Clutch disc
6	7563	Clutch pressure plate

7	7548	Clutch release hub and bearing
8	7515	Clutch release lever
9	7B602	Clutch release lever stud
10	N606063-S2	Bolt (6 req'd)
11	6392	Flywheel housing
12	7050	Main drive gear bearing retainer
13	55981-S36M	Bolt
14	7513	Clutch release lever dust shield
15	N807508-S2	Screw and washer assembly

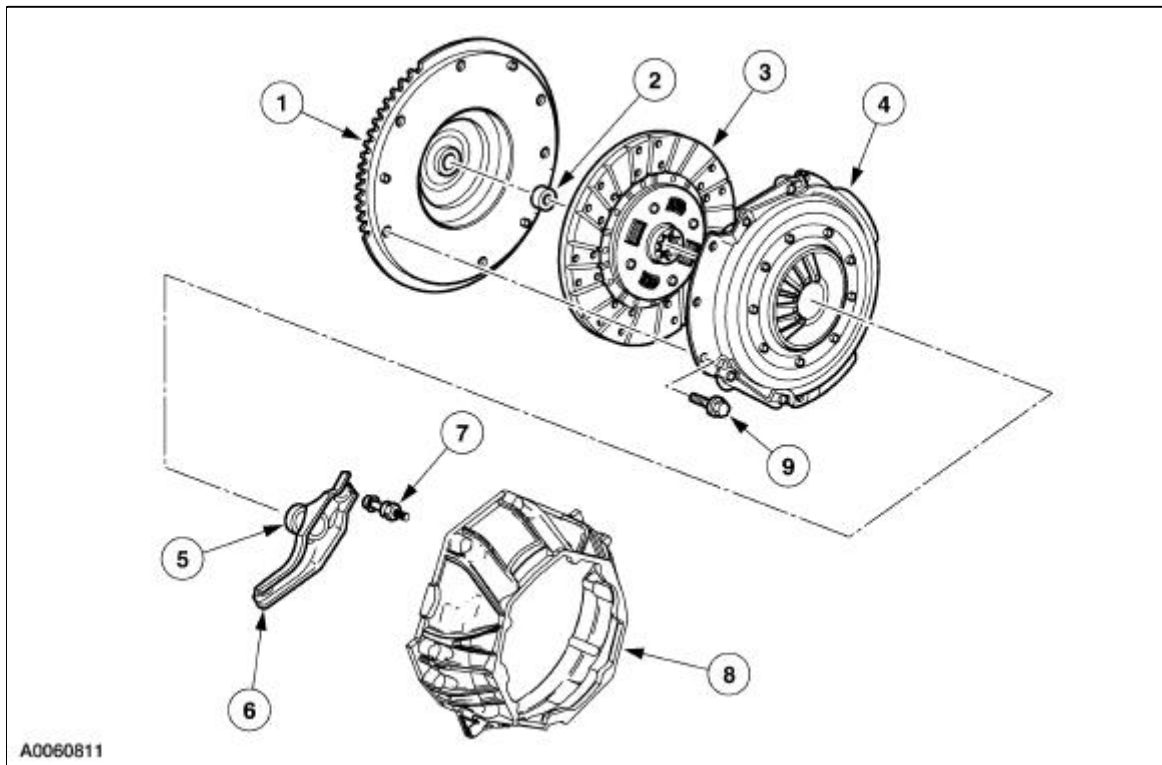
Clutch Disc and Clutch Pressure Plate — 4.6L (2V)



Item	Part Number	Description
1	6375	Flywheel
2	6397	Flywheel to clutch pressure plate dowel (3 req'd)
3	7600	Pilot bearing
4	7550	Clutch disc
5	7563	Clutch pressure plate
6	7515	Clutch release lever
7	7B602	Clutch release lever stud
8	N606063-S2	Bolt (6 req'd)
9	6392	Flywheel housing
10	55981-S36M	Bolt
11	7513	Clutch release lever dust shield

12	7548	Clutch release hub and bearing
13	N808969-S100	Bolt
14	N808969-S100	Bolt (6 req'd)
15	—	Rear face of block and flywheel (part of 6010)
16	—	Bolt (3 req'd)
17	6397	Flywheel housing to block dowel (2 req'd)

Clutch Disc and Clutch Pressure Plate — 4.6L (4V)



Item	Part Number	Description
1	6375	Flywheel
2	7600	Pilot bearing
3	7550	Clutch disc
4	7563	Clutch pressure plate
5	7548	Clutch release hub and bearing
6	7515	Clutch release lever
7	7B602	Clutch release lever stud
8	6392	Flywheel housing
9	N808969-S100	Clutch pressure plate bolt (6 req'd)

- The clutch is a single plate, dry friction clutch disc. The clutch disc has a splined hub with integral torsional springs. The clutch disc hub attaches to the input shaft.
- Engine output is coupled to the transmission input shaft by friction existing between the clutch disc facings and the flywheel/clutch pressure plate assembly. The extent of this friction is directly related to the composition of the facing material and the magnitude of the clamping

forces exerted by the clutch pressure plate and the flywheel on the facings. These factors limit the amount of torque that can be transmitted without slippage.

- The clamping force is obtained from a diaphragm spring contained within the clutch pressure plate assembly. This force is developed during the attachment of the clutch pressure plate assembly to the flywheel.
 - The clutch system is disengaged when the clutch pedal is pressed and is accomplished when the release fingers are fully displaced toward the flywheel. This displacement removes the spring load from the clutch pressure plate and eliminates the coupling friction between the engine and the transmission.
 - When the clutch pedal is depressed a cable connected to the clutch release lever, hub and bearing actuates the clutch pressure plate diaphragm spring, releasing pressure on the clutch disc. This eliminates the engagement between the transmission and the engine.
-

Manual Transmission and Clutch

Inspection and Verification

It is important to get an accurate description of the concern before any diagnosis can be carried out. Ask questions as to whether it occurs when hot or cold, during shifting, driving at a particular speed or in a particular gear. If possible, have the customer demonstrate the concern.

- With the vehicle at a complete stop, shift through all the gears and evaluate the noise at different engine rpm. Check for any noises in NEUTRAL at different engine rpm.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● Clutch slippage 	<ul style="list-style-type: none"> ● Clutch pedal sticking. ● Pressure plate diaphragm spring damaged or weakened. ● Clutch pressure plate damaged. ● Clutch disc facing damaged or worn excessively. ● Clutch disc facing surface hardened or oil-coated. ● Clutch release hub and bearing binding. ● Flywheel glazed or damaged. ● loose pressure plate to flywheel bolts 	<ul style="list-style-type: none"> ● Go To Pinpoint Test A.
<ul style="list-style-type: none"> ● Clutch chatter or shudder 	<ul style="list-style-type: none"> ● Loose or worn engine mount. ● Loose pressure plate to flywheel bolts ● Oil on clutch disc facing. ● Clutch pressure plate damaged 	<ul style="list-style-type: none"> ● Go To Pinpoint Test B.

	<ul style="list-style-type: none"> or excessive runout. ● Clutch disc facing surface hardened or damaged. ● Flywheel surface glazed or damaged. ● Transmission input shaft eccentric or not perpendicular. 	
<ul style="list-style-type: none"> ● Clutch drag 	<ul style="list-style-type: none"> ● Clutch drag. ● Cable release linkage outside the flywheel housing worn, cracked, bent. ● Excessive runout or damaged clutch disc. ● Clutch disc splines rusted or worn. ● Loose pressure plate to flywheel bolts. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test C.
<ul style="list-style-type: none"> ● Clutch pedal pulsation 	<ul style="list-style-type: none"> ● Clutch disc damaged or worn. ● Excessive flywheel runout. ● Loose pressure plate to flywheel bolts. ● Improperly assembled release lever to pivot stud. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test D.
<ul style="list-style-type: none"> ● Clutch related vibrations 	<ul style="list-style-type: none"> ● Engine component grounding against frame. ● Loose flywheel bolts. ● Excessive flywheel runout. ● Imbalanced clutch pressure plate. ● Accessory drive belt loose or damaged. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test E.
<ul style="list-style-type: none"> ● Hard shifting 	<ul style="list-style-type: none"> ● Manual transmission concern. ● Loose pressure plate to flywheel bolts. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test F.

<ul style="list-style-type: none"> ● Excessive noise 	<ul style="list-style-type: none"> ● Pilot bearing worn or damaged. ● Excessive crankshaft end play. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test G.
<ul style="list-style-type: none"> ● Transmission difficult to shift 	<ul style="list-style-type: none"> ● Lubricant. ● Internal shift mechanism. ● Sliding gears, synchronizers. ● Housings, shaft. ● Loose pressure plate to flywheel bolts. 	<ul style="list-style-type: none"> ● ADD or DRAIN AND FILL with specified lubricant. ● CHECK the internal shift mechanism for smooth operation. REPAIR or INSTALL a new mechanism as necessary. ● CHECK for free movement of gears and synchronizers. REPAIR or INSTALL new components as necessary. ● CHECK for binding condition between the input shaft and the engine crankshaft pilot bearing or bushing. REPAIR or INSTALL new components as necessary. REFER to Section 308-03A or Section 308-03B. ● CHECK for loose bolts at the pressure plate. INSTALL new components as necessary. REFER to Section 308-01.
<ul style="list-style-type: none"> ● NOTE: While verifying the condition, determine whether the noise is gear rollover noise, release bearing rub or some other transmission-related noise. Gear rollover noise, inherent in manual transmissions, is caused by the constant mesh gears turning at the engine idle speed while the clutch is engaged and the transmission is in NEUTRAL. Release bearing rub is sometimes mistaken for mainshaft bearing noise. Gear rollover noise will disappear when the clutch is disengaged or when the transmission is engaged in gear. 	<ul style="list-style-type: none"> ● Lubricant. 	<ul style="list-style-type: none"> ● ADD or DRAIN AND FILL with specified lubricant.

<p>Release bearing rub will disappear when the clutch is engaged. In the event that a bearing is damaged, the noise is more pronounced while engaged in gear under load or coast than in NEUTRAL.</p> <p>Noisy in forward gears</p>	<ul style="list-style-type: none"> ● Components grounding out on the transmission. ● Components housing bolts. ● Bearings or gears. 	<ul style="list-style-type: none"> ● CHECK for screws, bolts, etc., of body or other components grounding out. CORRECT as necessary. ● CHECK the torque on the transmission-to-flywheel housing bolts and the flywheel housing-to-engine block bolts. TIGHTEN the bolts to specification. REFER to Section 308-01. ● INSPECT the bearings. INSPECT the gears and gear teeth for wear or damage. INSTALL new components as necessary. REFER to Section 308-01.
<ul style="list-style-type: none"> ● Gears clash when shifting from one forward gear to another 	<ul style="list-style-type: none"> ● Pilot bearing. ● Gear teeth and/or synchronizer. ● Engine idle speed too high. 	<ul style="list-style-type: none"> ● CHECK for a binding condition between the input shaft and the engine crankshaft pilot bearing. INSTALL new components as necessary. REFER to Section 308-01. ● REPAIR or INSTALL new components as necessary. REFER to Section 308-03A or Section 308-03B. ● REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
<ul style="list-style-type: none"> ● Transmission jumps out of gear 	<ul style="list-style-type: none"> ● Transmission range selector lever boot. ● Transmission-to-engine mounting bolts. 	<ul style="list-style-type: none"> ● INSTALL a new boot if exceptionally stiff. REFER to Section 308-03A or Section 308-03B. ● TIGHTEN the bolts to specification.

	<ul style="list-style-type: none"> ● Crankshaft pilot bearing. ● Internal damage. 	<ul style="list-style-type: none"> ● INSTALL a new bearing. ● INSPECT the synchronizer sleeves for free movement on their hubs. INSPECT the synchronizer blocking rings for widened index slots, rounded clutch teeth and smooth internal surface. CHECK countershaft cluster gear for excessive end play. CHECK shift forks for worn or loose mounting on shift rails. INSPECT the synchronizer sliding sleeve and the gear clutch teeth for wear or damage. REPAIR or INSTALL a new component as necessary. ● If worn or damaged, INSTALL new gears. REFER to Section 308-03A or Section 308-03B.
<ul style="list-style-type: none"> ● Transmission will not shift into one gear—all others OK 	<ul style="list-style-type: none"> ● Manual shift linkage. ● Backup switch ball. ● Internal components. 	<ul style="list-style-type: none"> ● REPAIR or INSTALL new components as necessary. ● If REVERSE is the problem, CHECK backup switch for ball frozen in extended position. ● INSPECT the shift rail and fork system, synchronizer system and the gear clutch teeth for restricted travel. REPAIR or INSTALL new components as necessary.
<ul style="list-style-type: none"> ● Transmission is locked in one gear and cannot be shifted out of that gear 	<ul style="list-style-type: none"> ● Internal components. ● Fork on rail. 	<ul style="list-style-type: none"> ● INSPECT the problem gears, shift rails, forks and the synchronizer for wear or damage. REPAIR as necessary. REFER to Section 308-03A or Section 308-03B. ● CHECK the shift rail interlock system. REFER to Section 308-03A or Section 308-03B.
<ul style="list-style-type: none"> ● Transmission leaks 	<ul style="list-style-type: none"> ● Lubricant. 	<ul style="list-style-type: none"> ● CHECK the level and type.

	<ul style="list-style-type: none"> ● Other component leaking. ● False report. ● Internal components. ● Fill and drain plugs. 	<ul style="list-style-type: none"> ● IDENTIFY leaking fluid as engine, power steering, or transmission fluid. REPAIR as necessary. ● REMOVE all traces of lube on the exposed transmission surfaces. CHECK the vent for free breathing. OPERATE the transmission and INSPECT for new leakage. REPAIR as necessary. REFER to Section 308-03A or Section 308-03B. ● INSPECT for leaks at the input shaft bearing retainer seal and the shift rail expansion plug. REFER to Section 308-03A or Section 308-03B. INSPECT for leaks at the top cover gasket. INSPECT the case for sand holes or cracks. REPAIR or INSTALL a new case as necessary. REFER to Section 308-03A or Section 308-03B. ● CHECK fill and drain plugs and bore threads. REPAIR as necessary. TIGHTEN plugs to specified torque value. REFER to Section 308-03A or Section 308-03B.
<ul style="list-style-type: none"> ● Bearing failure 	<ul style="list-style-type: none"> ● Other part failure. ● Raceways or rollers. ● Lubricant. ● Towing vehicle further than 80 km (50 miles) with driveshaft installed. Mainshaft tapered bearing and needle caged bearings are especially susceptible to damage. ● Vibration break-up of retainer and brinelling of races. ● Bearing(s). 	<ul style="list-style-type: none"> ● REMOVE, DISASSEMBLE and CLEAN the transmission. Inspect for damaged parts and install new components as necessary. (Note: RESET the bearing preload if any new tapered bearings are installed). REFER to Section 308-03A or Section 308-03B. ● DETERMINE the cause of vibration and CORRECT. Otherwise PROCEED as above.

	<ul style="list-style-type: none"> ● Shafts or bore. ● Overloading of vehicle. ● Incorrect preload. ● Input shaft oil dam. 	<ul style="list-style-type: none"> ● Install new components as necessary and verify the oil dam installation is correct. REFER to Section 308-03A or Section 308-03B . CHECK for correct installation of the snap ring on the mainshaft next to the oil dam.
	<ul style="list-style-type: none"> ● Oil baffle in the input bearing shim pack. 	<ul style="list-style-type: none"> ● INSTALL a new oil baffle, making sure it is not damaged during assembly. REFER to Section 308-03A or Section 308-03B .

Pinpoint Tests

PINPOINT TEST A: CLUTCH SLIPPAGE

Test Step	Result / Action to Take
A1 INSPECT THE CLUTCH LINKAGE	
<ul style="list-style-type: none"> ● Key in OFF position. ● Block the wheels and apply the parking brake. ● Depress and slowly release the clutch pedal. ● Does the clutch pedal release without binding? 	<p>Yes GO to A2.</p> <p>No INSPECT the clutch pedal. REFER to Section 308-02 .</p>
A2 CARRY OUT A STALL TEST	
<ul style="list-style-type: none"> ● Key in START position. ● Block the wheels and apply the parking brake. ● Place the transmission in fourth gear. ● Increase the engine speed to 2000 rpm and slowly release the clutch pedal. ● Does the engine stall within five seconds? 	<p>Yes The clutch is not slipping. VERIFY the customer concern.</p> <p>No INSPECT the clutch components for damage.</p>

PINPOINT TEST B: CLUTCH CHATTER OR SHUDDER

Test Step	Result / Action to Take
B1 CHECK ENGINE OR TRANSMISSION MOUNTS	
<ul style="list-style-type: none"> ● Inspect all the engine and transmission mounts for looseness or damage. Refer to Section 303-01A or Section 303-01B and Section 308-03A or Section 308-03B . ● Are any of the engine or transmission mounts 	<p>Yes TIGHTEN or INSTALL new engine mounts or transmission mounts. TEST the system for normal operation.</p>

loose or damaged?	No GO to B2 .
B2 INSPECT PRESSURE PLATE BOLTS	
<ul style="list-style-type: none"> Inspect the pressure plate-to-flywheel bolts. Are any of the pressure plate-to-flywheel bolts loose? 	Yes TIGHTEN or INSTALL new bolts. REFER to Section 308-01 . TEST the system for normal operation. No GO to B3 .
B3 INSPECT PRESSURE PLATE	
<ul style="list-style-type: none"> Remove the clutch pressure plate. Refer to Section 308-01. Inspect the clutch pressure plate. Refer to Pressure Plate Check. Are any signs of damage present on the clutch pressure plate? 	Yes INSTALL a new clutch pressure plate. REFER to Section 308-01 . TEST the system for normal operation. No GO to B4 .
B4 CHECK CLUTCH DISC	
<ul style="list-style-type: none"> Carry out the clutch disc inspection procedure. Refer to Disc Check. Is the clutch disc OK? 	Yes GO to B5 . No INSTALL a new clutch disc. REFER to Section 308-01 . TEST the system for normal operation.
B5 INSPECT THE FLYWHEEL	
<ul style="list-style-type: none"> Inspect the flywheel for damage and runout. Refer to Flywheel Runout Check. Is the flywheel OK? 	Yes GO to B6 . No REPAIR or INSTALL a new flywheel as necessary. REFER to Section 308-01 . TEST the system for normal operation.
B6 INSPECT THE INPUT SHAFT	
<ul style="list-style-type: none"> INSPECT the input shaft for signs of wear or damage. Are any signs of wear or damage present on the input shaft? 	Yes INSTALL a new input shaft. REFER to Section 308-03A or Section 308-03B . No VERIFY the customer concerns. GO to Symptom Chart if necessary.

PINPOINT TEST C: CLUTCH DRAG

Test Step	Result / Action to Take
C1 CHECK HIGH SHIFTING EFFORTS	
<ul style="list-style-type: none"> Key in START position. Set parking brake. With the shift control selector in REVERSE, 	Yes Clutch system OK. No

<p>clutch disengaged and engine idling, move the shift lever to a position halfway between REVERSE and NEUTRAL.</p> <ul style="list-style-type: none"> ● Slowly engage clutch. The transmission will behave as if it is in NEUTRAL. ● Gear clash can now be heard if an attempt is made to shift into REVERSE with the clutch engaged. Reserve can now be measured. ● While maintaining light pressure on the shift selector, slowly press the clutch pedal to the floor. The gear clash will stop and the shift selector will slide into the REVERSE position. ● Is there a minimum 19.05 mm (0.750 inch) clutch pedal reserve? 	<p>CHECK the clutch pressure plate and clutch disc. INSTALL a new clutch pressure plate or clutch disc if necessary. REFER to Section 308-01 . TEST the system for normal operation.</p>
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PINPOINT TEST D: CLUTCH PEDAL PULSATION

Test Step	Result / Action to Take
D1 CHECK THE CLUTCH PEDAL PULSATION	
<ul style="list-style-type: none"> ● Key in START position. ● With the transmission in NEUTRAL, slowly press the clutch pedal. ● Does the clutch pedal pulsate while being pressed? 	<p>Yes GO to D2 .</p> <p>No VERIFY customer concern. GO to Symptom Chart if necessary.</p>
D2 INSPECT PRESSURE PLATE BOLTS	
<ul style="list-style-type: none"> ● Inspect the pressure plate-to-flywheel bolts. ● Are any of the pressure plate-to-flywheel bolts loose? 	<p>Yes TIGHTEN or INSTALL new bolts. REFER to Section 308-01 . TEST the system for normal operation.</p> <p>No GO to D3 .</p>
D3 INSPECT THE CLUTCH PRESSURE PLATE	
<ul style="list-style-type: none"> ● Remove the clutch pressure plate. Refer to Section 308-01 . ● INSPECT the clutch pressure plate for damage. Refer to Pressure Plate Check . ● Are there any signs of damage present on the clutch pressure plate? 	<p>Yes INSTALL a new clutch pressure plate. REFER to Section 308-01 . TEST the system for normal operation.</p> <p>No GO to D4 .</p>
D4 INSPECT THE CLUTCH DISC	
<ul style="list-style-type: none"> ● Carry out the clutch disc inspection procedure. Refer to Disc Check . ● Is the clutch disc OK? 	<p>Yes GO to D5 .</p> <p>No INSTALL a new clutch disc. REFER to Section 308-01 . TEST the system for normal operation.</p>
D5 INSPECT THE FLYWHEEL	

<ul style="list-style-type: none"> ● Inspect the flywheel for damage and runout. Refer to Flywheel Runout Check. ● Is flywheel OK? 	<p>Yes GO to D6.</p> <p>No TIGHTEN, RESURFACE or INSTALL a new flywheel as necessary. REFER to Section 308-01. TEST the system for normal operation.</p>
<p>D6 INSPECT RELEASE LEVER INTERFACE TO PIVOT STUD</p>	<p>Yes INSTALL a new pivot stud and release lever. REFER to Section 308-01. TEST the system for normal operation.</p> <p>No VERIFY customer concern. GO to Symptom Chart if necessary.</p>
<ul style="list-style-type: none"> ● Inspect the release lever and the pivot stud for damage or misalignment. ● Are there any signs of damage present or misalignment between the release lever and pivot stud? 	

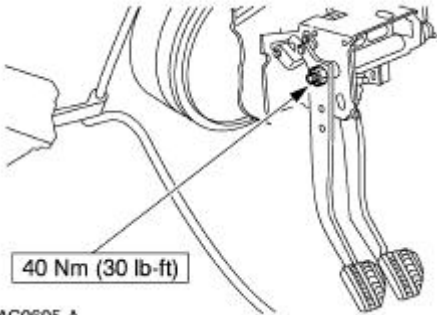
PINPOINT TEST E: CLUTCH RELATED VIBRATIONS

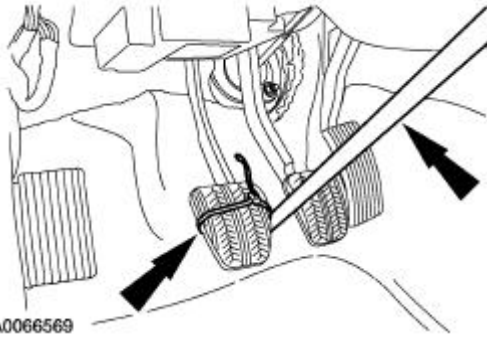
Test Step	Result / Action to Take
<p>E1 CHECK FOR ENGINE COMPONENT GROUNDING</p>	<p>Yes REPAIR the components as necessary. TEST the system for normal operation.</p> <p>No GO to E2.</p>
<ul style="list-style-type: none"> ● Raise the vehicle on a hoist. Refer to Section 100-02. ● Check the engine and transmission mounts for grounding. ● Check for exhaust manifolds or other engine component grounding on the body or frame. ● Is there evidence of grounding on the body or frame? 	
<p>E2 CHECK FOR ACCESSORY DRIVE VIBRATIONS</p>	<p>Yes REFER to Section 303-05 to diagnose the accessory drive belt components.</p> <p>No STOP the engine and INSTALL the drive belt. GO to E3.</p>
<ul style="list-style-type: none"> ● Key in START position. ● Remove the accessory drive belt. ● Does the vibration stop when the accessory drive belt is removed from the engine? 	
<p>E3 CHECK FOR RELEASE BEARING NOISE</p>	<p>Yes INSTALL a new clutch release hub and bearing. REFER to Section 308-01.</p> <p>No GO to E4.</p>
<ul style="list-style-type: none"> ● Key in START position. ● Depress and hold the clutch pedal. ● Is a whirring, grating, or grinding noise present only when pedal is pushed? 	
<p>E4 INSPECT THE FLYWHEEL</p>	<p>Yes VERIFY customer concern. GO to Symptom Chart if necessary.</p> <p>No</p>
<ul style="list-style-type: none"> ● Key in OFF position. ● Remove the transmission. Refer to Section 308-03A or Section 308-03B. ● Carry out a flywheel check. Refer to Flywheel Runout Check. 	

- Is the flywheel OK?

TIGHTEN, RESURFACE or INSTALL a new flywheel. REFER to [Section 308-01](#). TEST the system for normal operation.

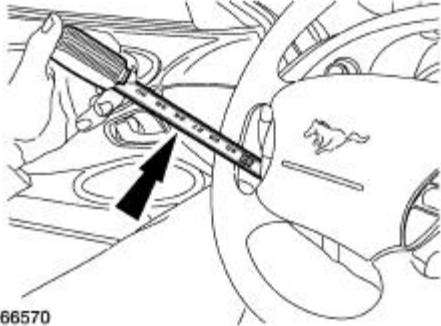
PINPOINT TEST F: HARD SHIFTING

Test Step	Result / Action to Take
F1 CHECK THE CLUTCH RELEASE CABLE	
<ul style="list-style-type: none"> ● NOTE: Check the upper shift boot for twisting. ● NOTE: Check the engine idle speed. ● Inspect the clutch release cable for wear or damage. Make sure the clutch release cable is correctly routed and that all the fasteners are installed. ● Are there any fasteners missing or is the cable worn, damaged or incorrectly routed? 	<p>Yes REPAIR or INSTALL a new clutch release cable as necessary. TEST the system for normal operation.</p> <p>No GO to F2.</p>
F2 CHECK THE CLUTCH PEDAL	
<ul style="list-style-type: none"> ● Loosen the clutch pedal shaft nut. ● Lift the clutch pedal to the most upward position. ● While holding the clutch pedal in the most upward position, tighten the nut.  <p>40 Nm (30 lb-ft)</p> <p>AC0605-A</p> <ul style="list-style-type: none"> ● Was the clutch pedal incorrectly adjusted? 	<p>Yes VERIFY customer concern. TEST the system for normal operation.</p> <p>No GO to F3.</p>
F3 CHECK THE CLUTCH PEDAL QUADRANT	
<ul style="list-style-type: none"> ● Pull up on the clutch pedal to the upstop. Pulling up on the pedal ensures that the quadrant is free to rotate through its complete range of motion against the spring load of the quadrant. ● Is the clutch pedal quadrant binding? 	<p>Yes INSTALL a new quadrant. TEST the system for normal operation.</p> <p>No GO to F4.</p>
F4 MEASURE THE CLUTCH RESERVE	
<p>NOTE: Do not check the clutch system after the road test. Allow the vehicle to cool down before carrying out the clutch reserve check. NOTE: Remove the floor mat, if equipped, to allow the clutch pedal to travel to the downstop.</p> <ul style="list-style-type: none"> ● Install a cable tie to the lower clutch pedal, then attach a tape measure to the cable tie. 	<p>Yes INSTALL a new pressure plate and clutch disc. REINSTALL the transmission. RECHECK the clutch reserve. TEST the system of normal operation.</p> <p>No GO to F5.</p>



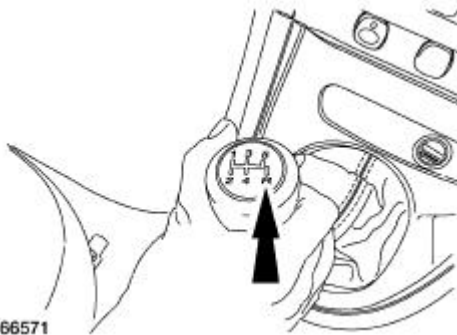
A0066569

- Pull the tape measure up to the steering wheel. Position it through the steering wheel opening.



A0066570

- Depress the clutch fully and start the vehicle.
- Shift the transmission into reverse gear, then move the shift lever forward to the position in between reverse gear and neutral. Slowly release the clutch pedal (if the vehicle creeps rearward, move the shift lever forward a little more). The transmission will behave as if in neutral, but the reverse gear synchronizer will be bypassed.



A0066571

- With the clutch pedal up, gently pull the shift lever toward the reverse gear position. Gear clash can now be heard.

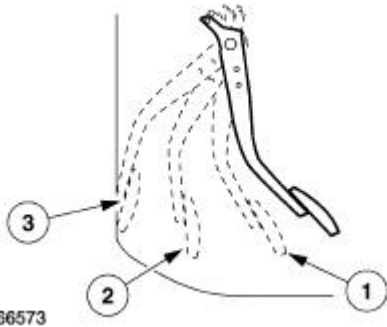


A0066572

- Slowly depress the clutch pedal. Using the steering wheel inner seam as a reference, note the measurement when the gear clash stops or the shift lever slides into reverse gear. Depress the clutch pedal to the downstop. The difference between the measurement taken when the gear clash

stopped and the measurement taken at the downstop is the clutch reserve.

Item	Pedal Position
1	Gear clash begins
2	Gear clash ends
3	Clutch pedal downstop



- Is the clutch reserve less than 19 mm (0.75 inch)?

F5 INSPECT THE RELEASE LEVER AND PIVOT STUD

- Remove the transmission.
- Inspect the release lever and the pivot stud for wear, damage or misalignment.
- Is the release lever or pivot stud worn, damaged or misaligned?

Yes
INSTALL a new release lever or pivot stud as necessary. TEST the system for normal operation.

No
GO to [F6](#).

F6 INSPECT THE RELEASE BEARING

- Inspect the release bearing for wear or damage. Make sure the release lever is seated in the release bearing pocket.
- Is the release bearing worn or damaged?

Yes
INSTALL a new release bearing. TEST the system for normal operation.

No
GO to [F7](#).

F7 INSPECT THE PILOT BEARING

- Inspect the pilot bearing for wear or damage.
- Is the pilot bearing worn or damaged?

Yes
INSTALL a new pilot bearing. TEST the system for normal operation.

No
GO to [F8](#).

F8 INSPECT THE CLUTCH PRESSURE PLATE TO FLYWHEEL BOLTS

- Measure the clutch pressure plate to flywheel bolts.
- Is the bolt torque greater than or equal to 65 Nm (48 lb-ft)?

Yes
INSTALL a new pressure plate and clutch disc. Note the condition of the removed components (wear, damage or oil contamination). For oil

	contamination, REPAIR as necessary. TEST the system for normal operation. If the transmission is still hard to shift, GO to F9 .
	No TIGHTEN the bolts to 80 Nm (59 lb-ft). TEST the system for normal operation. If the transmission is still hard to shift, GO to F9 .
F9 INSPECT THE TRANSMISSION	
<ul style="list-style-type: none"> ● Remove the transmission. ● Disassemble the transmission. Refer to Section 308-03B. ● Carry out the following: <ul style="list-style-type: none"> ● inspect all the shift rails for excessive scuffing or wear. ● check the interlock pins on the shift rail. ● make sure the interlock bolts are tighten to 31 Nm (23 lb-ft). ● inspect the shift pads for wear or cracking. ● inspect the shift forks for wear or damage. ● check the synchronizer rings (of the affected gear[s]) for wear or damage. ● check the synchronizer hubs (of the affected gear[s]) for wear or damage. ● inspect the clutching teeth of the affected gear. ● Are there any internal components worn or damaged? 	Yes INSTALL new components or REPAIR as necessary. TEST the system for normal operation. No ASSEMBLE and INSTALL the transmission. TEST the system for normal operation.



PINPOINT TEST G: EXCESSIVE NOISE


Test Step	Result / Action to Take
G1 TRANSMISSION NEUTRAL GEAR ROLLOVER TEST	
<ul style="list-style-type: none"> ● Start the engine and let it idle with the transmission in neutral and the clutch engaged (pedal up). If noise is excessive, depress the clutch pedal to stop the transmission input shaft from rotating. ● Does the noise stop when the clutch pedal is depressed? 	Yes INSPECT the clutch component for damage. REFER to General Procedures in this section. No GO to G2 .
G2 CHECK THE PILOT BEARING	
<ul style="list-style-type: none"> ● Inspect the pilot bearing for damage. Refer to Bearing. ● Is the pilot bearing OK? 	Yes GO to G3 . No INSTALL a new pilot bearing. REFER to Section 308-01 .
G3 CHECK TORSION SPRINGS	
<ul style="list-style-type: none"> ● Inspect the torsion springs for fatigue or breakage. ● Are there any signs of fatigue or breakage? 	Yes INSTALL a new clutch disc. REFER to Section 308-01 . TEST the system for normal operation.


No
INSPECT the crankshaft end
play. REFER to [Section 303-
01A](#) or [Section 303-01B](#).

Disc Check


Special Tool(s)


	Brake/Automobile Brake Drum System with Vacuum 164-R3622 or equivalent
	Dial Indicator/Magnetic Base 100-D002 (D78P-4201-B) or equivalent

 **WARNING:** Dust and dirt present on wheel brake and clutch assemblies may contain asbestos fibers that are hazardous to health when made airborne by cleaning with compressed air or by dry brushing. Failure to follow these instructions may result in personal injury.

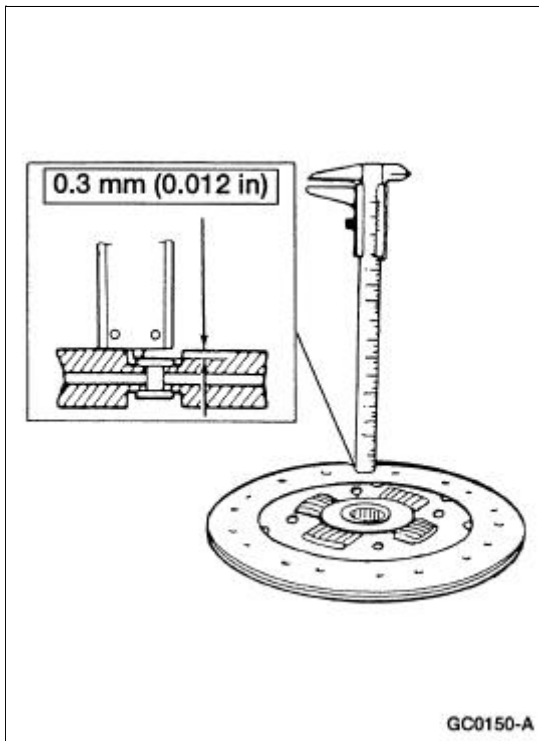
 **WARNING:** Wheel brake assemblies and clutch facings should be cleaned using a vacuum cleaner recommended for use with asbestos fibers such as the brake automobile brake drum system with vacuum. Dust and dirt from the vacuum should be disposed of in a manner that prevents dust exposure such as sealed bags. The bag must be labeled according to OSHA instructions and the trash hauler notified as to the bag's contents. Failure to follow these instructions may result in personal injury.

 **WARNING:** If a vacuum suitable for asbestos is not available, cleaning should be done wet. If dust generation is still possible, technicians should wear government-approved toxic dust purifying respirators. Failure to follow these instructions may result in personal injury.

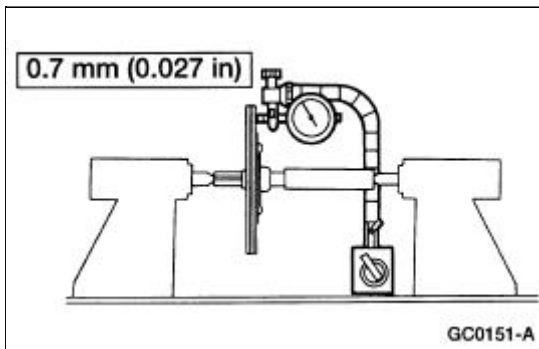
 **WARNING:** Grinding or sanding on the brake linings, pads, rotors, drums or clutch facings should be done only while using correct exhaust-ventilated equipment. Failure to follow these instructions may result in personal injury.

 **WARNING:** OSHA requires areas where asbestos dust generation is possible to be isolated and posted with warning signs. Only technicians concerned with carrying out brake or clutch service should be present in the area. Failure to follow these instructions may result in personal injury.

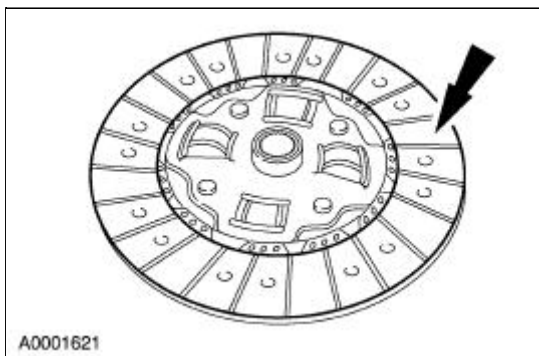
1. Check the clutch disc lining surface for hardening or the presence of oil.
2. Check for a worn clutch disc lining. Measure the minimum allowable depth to the rivet heads with a slide caliper.



3. Check for loose clutch disc lining rivets.
4. Use the special tool to check the maximum allowable runout of the clutch disc.



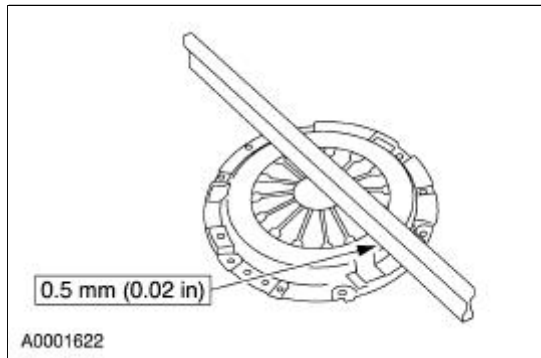
5. Use an emery cloth to remove minor imperfections in the clutch disc lining surface.



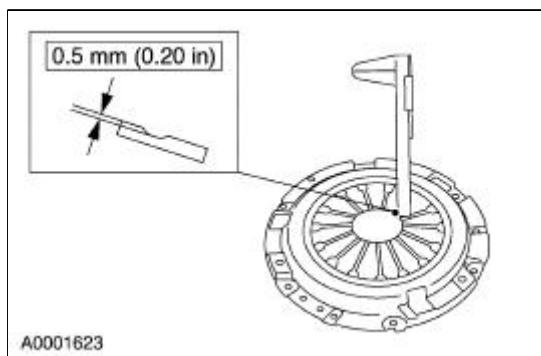
6. Check for wear or rust on the splines. If necessary, clean them with an emery cloth.
7. Check the clutch disc (7550) for cracking, scoring, discoloration or other surface marks. Install a new clutch disc as necessary.

Pressure Plate Check

1. Check the clutch pressure plate surface for scoring, cracks or discoloration. Minor scratches or discoloration should be removed with a fine emery cloth.
2. Measure the flatness of the clutch pressure plate surface with a straightedge and a feeler gauge.



3. Check the diaphragm spring fingers for discoloration, scoring, bent or broken segments and spring ends that are higher or lower than the rest.
4. Measure the wear of the diaphragm spring fingers.

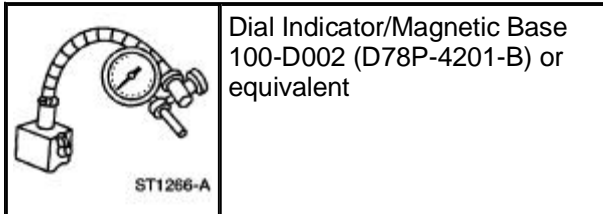


Flywheel Check

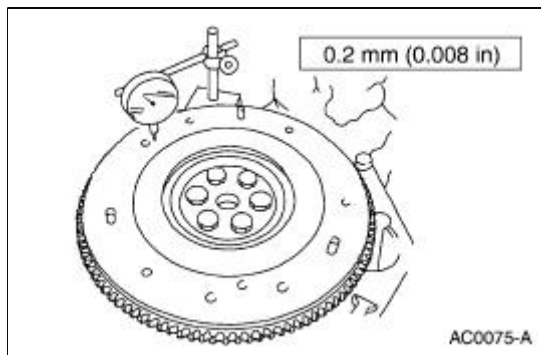
1. Check the flywheel surface for scoring, cracks or discoloration. Minor scratches or discoloration should be removed with a fine emery cloth.
-

Flywheel Runout Check

Special Tool(s)



1. Mount the special tool so that the indicator contact point rides on the clutch disc contact surface.
2. Turn the flywheel (6375); if the runout exceeds the maximum allowance, install a new flywheel.

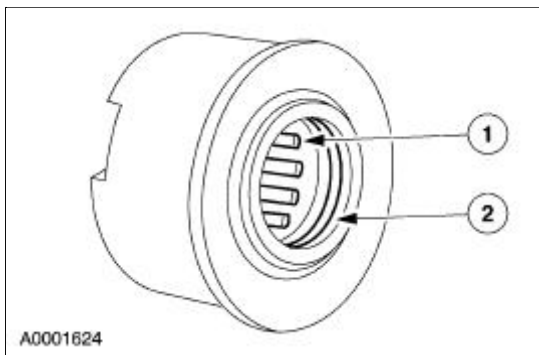


Bearing

1.  **CAUTION: The pilot bearing is a sealed bearing and must not be immersed in any type of cleaning fluid.**

Inspect the pilot bearing (7118) for:

1. needle rollers for scoring, worn or broken rollers, cracked roller cage inadequate grease or discoloration.
 2. seal leakage.
- misalignment and looseness in the crankshaft.

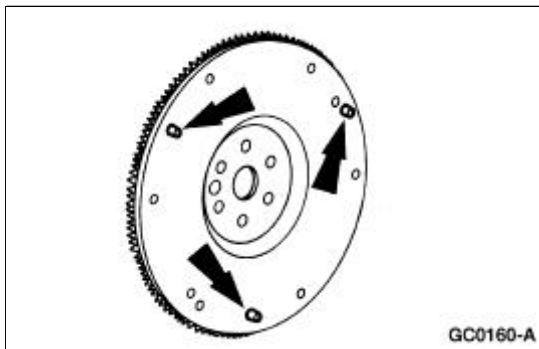


Dowels —Flywheel

Removal

1. **NOTE:** Take care not to damage the flywheel dowel holes or the surface areas around the flywheel dowel during removal.

Remove the flywheel dowels by using a drift pin where the flywheel dowel is installed in an open hole and a pair of locking pliers where the flywheel dowel is installed in a blind hole.



Installation

1. **NOTE:** Care should be taken to drive the flywheel dowel squarely into place until it is fully seated and to not damage the surrounding surface areas.

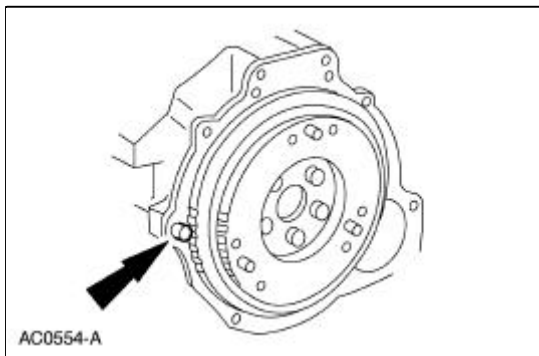
Install all flywheel dowels by driving them into place using a brass or plastic mallet.

Dowels —Flywheel Housing to Block

Removal

1. **NOTE:** Take care not to damage the flywheel housing to block dowel holes or the surface areas around the flywheel housing to block dowel hole during removal.

Remove the two flywheel housing to block dowels using a drift pin where the flywheel housing to block dowel is installed in an open hole and a pair of locking pliers where the flywheel housing to block dowel is installed in a blind hole.



Installation

1. **NOTE:** Care should be taken to drive the flywheel housing to block dowel squarely into place until it is fully seated without damaging the surrounding surface areas.

Install all flywheel housing to block dowels by driving them into place using a brass or plastic mallet.

General Specifications

Item	Specification
Pressure Plate	
Pressure plate diameter (3.8L)	280 mm (11.0 in)
Pressure plate diameter 4.6L (2V)	280 mm (11.0 in)
Pressure plate diameter 4.6L (4V)	280 mm (11.0 in)
Clutch Disc	
Clutch diameter (3.8L) 280 mm (11.0 in)	Number of springs: 5 plain Color identification: none
Clutch diameter (4.6L 2V) 280 mm (11.0 in)	Number of springs: 4 plain Color identification: none
Clutch diameter (4.6L 4V) 280 mm (11.0 in)	Number of springs: 5 plain Color identification: no paint daub
Fluid and Lubricants	
Motorcraft Premium Long-Life Grease XG-1-C or equivalent	ESA-M1C75-B

Torque Specifications

Description	Nm	lb-ft
Pressure plate to flywheel bolt (3.8L)	33	24
Pressure plate to flywheel bolts 4.6L (2V)	45 + 60°	33 + 60°
Pressure plate-to-flywheel bolts 4.6L (4V)	45 + 60°	33 + 60°

Clutch

The primary function of the clutch is to couple and uncouple engine power to the transmission upon driver command. For additional information, refer to [Section 308-02](#).


- The clutch is a single plate, dry friction clutch disc. The clutch disc has a splined hub (with integral torsional dampening springs) which attaches the clutch disc to the input shaft.
 - Engine output is coupled to the input shaft by the friction existing between the clutch disc facings and the flywheel/clutch pressure plate assembly. The extent of this friction is directly related to the composition of the facing material and the magnitude of the clamping force exerted by the clutch pressure plate. These factors limit the amount of torque that can be transmitted without slippage.
 - The clamping force is obtained from a diaphragm spring contained within the clutch pressure plate assembly. This force is developed during the attachment of the clutch pressure plate to the flywheel.
 - The clutch system is disengaged when the clutch pedal is depressed and engaged when the clutch pedal is released. This displacement removes the spring load from the clutch pressure plate and eliminates the coupling friction between the engine and the transmission.
 - When the clutch pedal is depressed, a cable connected to the clutch release lever, hub and bearing actuates the clutch pressure plate diaphragm spring, releasing pressure on the clutch disc. This eliminates the engagement between the transmission and the engine.
-

Clutch

Refer to [Section 308-00](#) .

Disc and Pressure Plate —3.8L and 4.6L (2V) Engines

Special Tool(s)

 ST1926-A	Clutch Aligner 308-020 (T74P-7137-K)
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Material

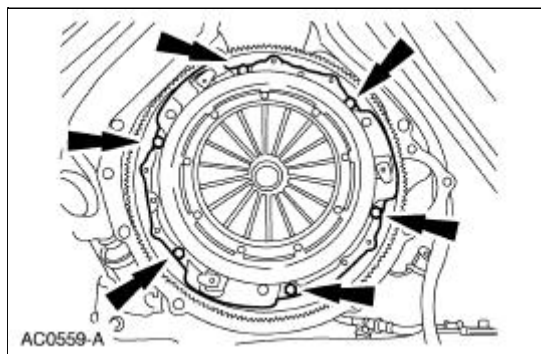
Item	Specification
Premium Long Life Grease XG-1-C	ESA-M1C75-B

1. Remove the transmission. For additional information, refer to [Section 308-03A](#) (T5OD) or [Section 308-03B](#) (TR3650).

2.  **CAUTION: Loosen the bolts evenly to prevent clutch pressure plate damage.**

NOTE: If the parts are to be reused, mark the clutch pressure plate and the flywheel.

Remove the bolts and remove the clutch pressure plate and the clutch disc.

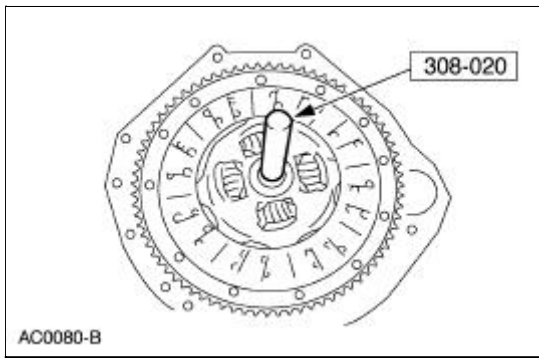


Installation

NOTE: Clean the clutch pressure plate and flywheel with a commercial alcohol-based solvent so surfaces are free from oil film.

Do not use cleaners with a petroleum base. Do not immerse the clutch pressure plate in the solvent.

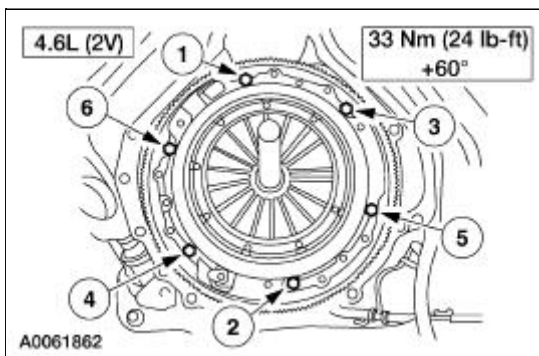
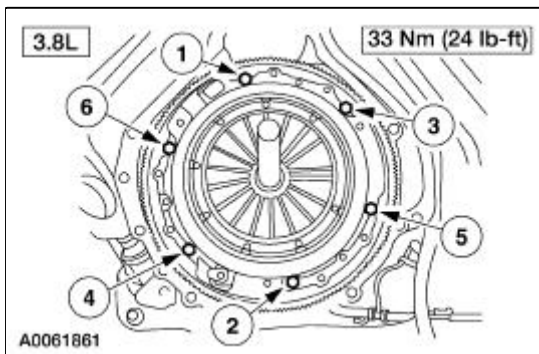
1. Position the clutch disc on the flywheel.
 - Using the special tool, align the clutch disc.



2. **NOTE:** If reusing the clutch pressure plate, align the plate using the marks made during removal.

Using the special tool, align the clutch pressure plate and install it on the dowels.

- Install the bolts in the sequence shown.
- Remove the special tool.




3. **NOTE:** Before installing the transmission, the ball stud, the clutch release lever and the input shaft must be cleaned and lubricated with grease.

Install the transmission. For additional information, refer to [Section 308-03A](#) (T5OD) or [Section 308-03B](#) (TR3650).

Disc and Pressure Plate —4.6L (4V) Engine

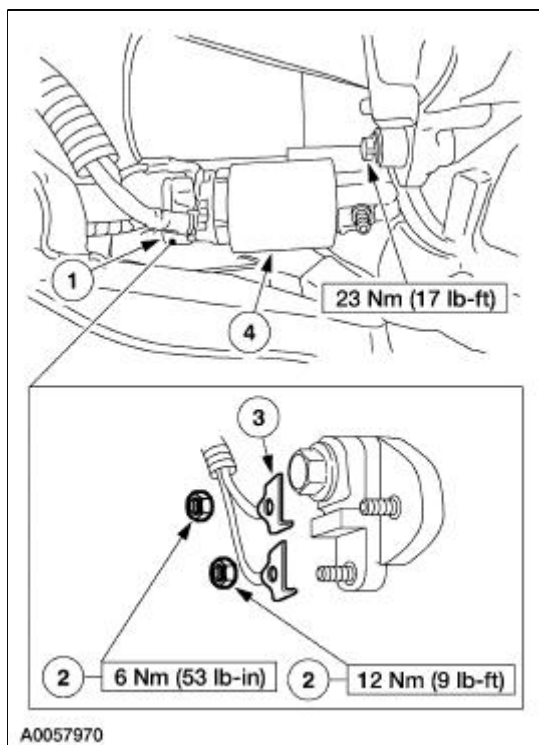
Special Tool(s)

 ST1926-A	Clutch Aligner 308-020 (T74P-7137-K)
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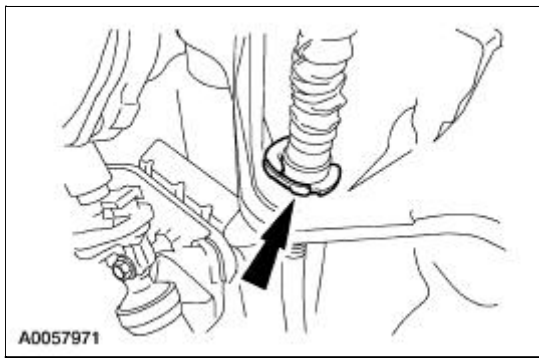
Material

Item	Specification
Premium Long Life Grease XG-1-C	ESA-M1C75-B

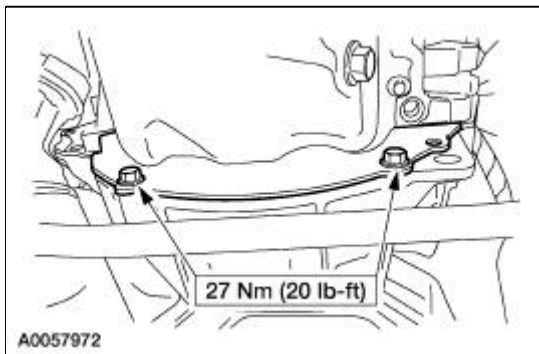
1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Remove the transmission. For additional information, refer to [Section 308-03C](#).
3. Remove the starter.
 1. Remove the terminal cap.
 2. Remove the nuts.
 3. Remove the wires and position them aside.
 4. Remove the two bolts and the starter.



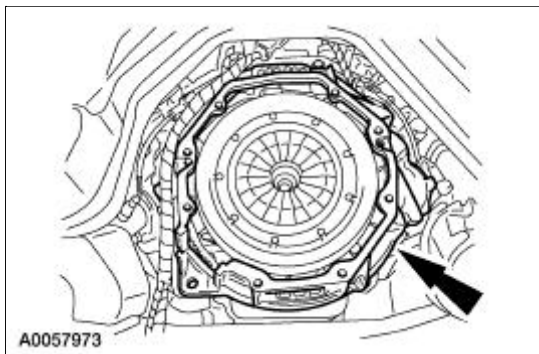
4. Remove the clutch cable clip, then pull the cable through the clutch housing.



5. Remove the two bolts and the inspection cover.



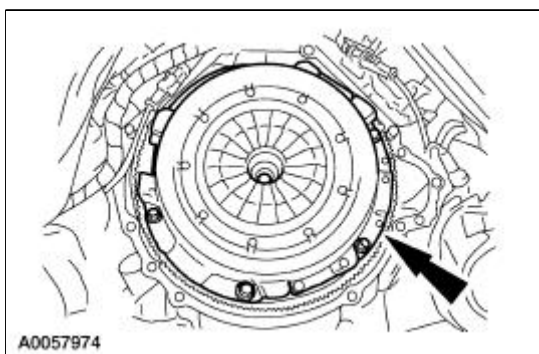
6. Remove the seven bolts and the clutch housing.



7.  **CAUTION: Loosen the bolts evenly to prevent damage to the pressure plate.**

NOTE: If the pressure plate is to be reused, index-mark the pressure plate to the flywheel.

Remove the six bolts and the pressure plate and disc.



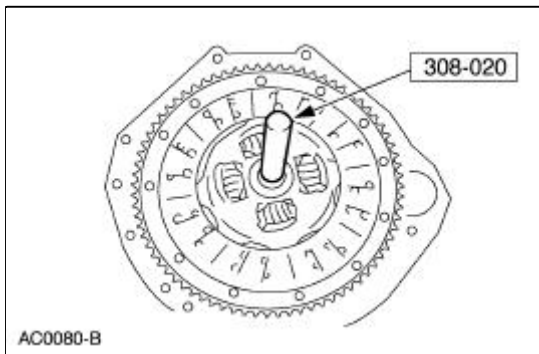
Installation

1. **NOTE:** Clean the clutch pressure plate and flywheel with a commercial alcohol-based solvent so surfaces are free from oil film. Do not use cleaners with a petroleum base.

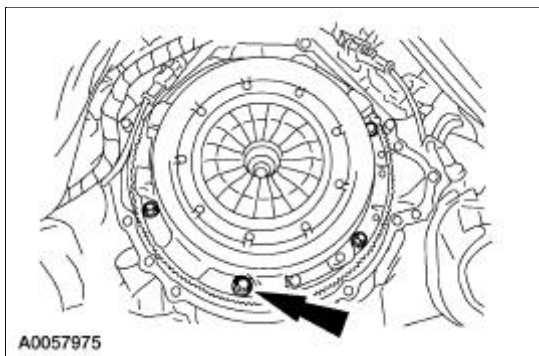
NOTE: Before installing the transmission, the ball stud, the clutch release lever and the input shaft must be cleaned and lubricated with grease.

To install, reverse the removal procedure.

- Using the special tool, align the clutch disc and pressure plate to the flywheel.

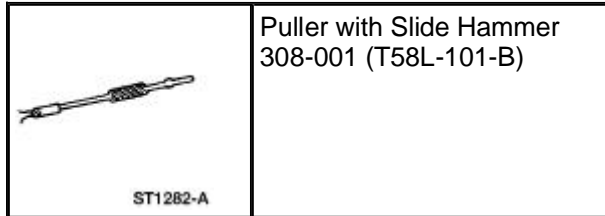


2. Tighten the pressure plate bolts in two stages.
 - Stage 1: Tighten the bolts to 45 Nm (33 lb-ft).
 - Stage 2: Tighten the bolts an additional 60 degrees.

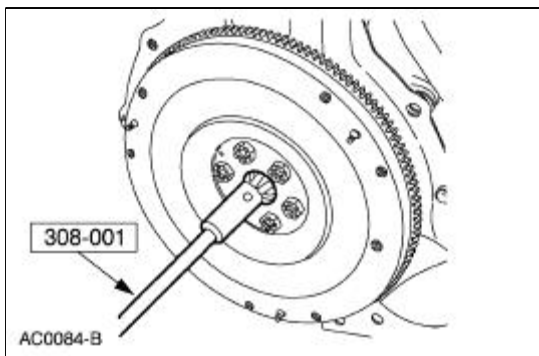


Pilot Bearing

Special Tool(s)

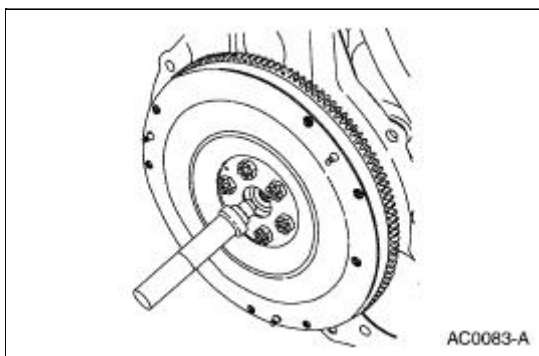


1. Remove the clutch disc and the clutch pressure plate. For additional information, refer to [Disc and Pressure Plate—3.8L and 4.6L \(2V\) Engines](#) or [Disc and Pressure Plate—4.6L \(4V\) Engine](#) in this section.
2. Using the special tool, remove the pilot bearing from the flywheel.



Installation

1. Insert the pilot bearing into the crankshaft.




2. Install the clutch disc and the clutch pressure plate. For additional information, refer to [Disc and Pressure Plate—3.8L and 4.6L \(2V\) Engines](#) or [Disc and Pressure Plate—4.6L \(4V\) Engine](#) in this section.

Flywheel Ring Gear

Removal

1. Remove the flywheel. For additional information, refer to [Section 303-01A](#), [Section 303-01B](#) or [Section 303-01C](#).


2.  **WARNING:** This procedure should be carried out only by a correctly equipped and experienced acetylene torch operator. Tongs must be used or asbestos gloves worn when handling the heated flywheel ring gear. Failure to follow these instructions can result in personal injury.


 **CAUTION:** Tap the flywheel ring gear evenly to prevent binding.

Remove the flywheel ring gear from the flywheel.

- Evenly heat the flywheel ring gear with an acetylene torch and use a brass drift to drive the flywheel ring gear off the flywheel.

Installation

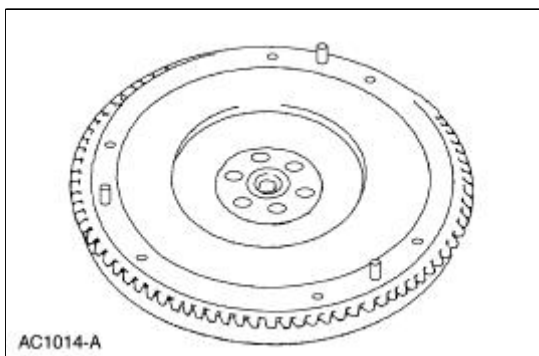
1.  **WARNING:** This procedure should be carried out only by a properly equipped and experienced acetylene torch operator. Tongs must be used or asbestos gloves worn when handling the heated flywheel ring gear. Failure to follow these instructions can result in personal injury.

 **CAUTION:** Do not heat the flywheel ring gear beyond 261°C (500°F). Use heat-indicating crayons to prevent overheating.

 **CAUTION:** Keep the torch moving to prevent hot spots.

Evenly heat the flywheel ring gear with an acetylene torch.

- Install the flywheel ring gear with the bevel on the flywheel ring gear facing the rear of the flywheel.
- Use a brass drift to tap the flywheel ring gear into position, reheat as necessary.



2. Install the flywheel. For additional information, refer to [Section 303-01A](#), [Section 303-01B](#) or [Section 303-01C](#).

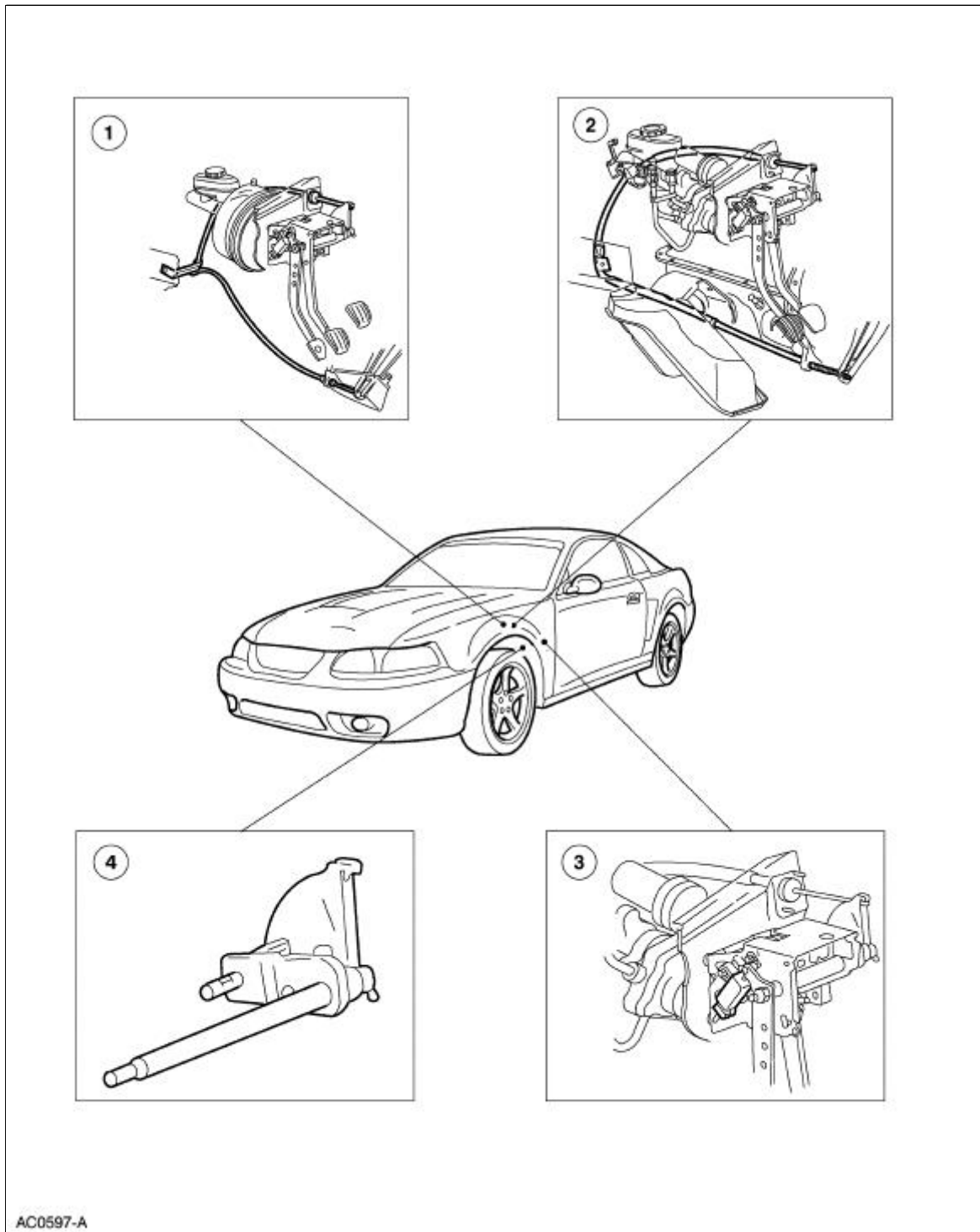
General Specifications

Item	Specification
Clutch System	
System adjustment	Self adjusting
Fluid and Lubricant	
Super Premium SAE 10W-30 XO-10W-30-BSP	WSS-M2C153-G

Torque Specifications

Description	Nm	lb-ft	lb-in
Brake booster nuts	25	18	—
Brake pedal support bracket to cowl bolt	25	18	—
Clutch pedal retaining nut	40	30	—
Clutch release lever cable bracket screw (3.8L)	10	—	89
Clutch release lever cable to bulkhead screws	4	—	35
Clutch release lever cable to crossmember retaining screw	8	—	71
Clutch release lever cable to master cylinder retaining screw (4.6L)	8	—	71
Instrument panel reinforcement screws	9	—	80
Instrument panel steering column cover screws	9	—	80

Clutch Controls



AC0597-A

Item	Part Number	Description
1	7535	Clutch release lever cable (3.8L)
2	7535	Clutch release lever cable (4.6L)
3	11A152	Clutch pedal position (CPP) switch

The clutch control system engages and disengages the clutch. The clutch control system disengages the clutch when the clutch pedal is depressed and engages the clutch when the clutch pedal is released. Clutch pedal motion is transmitted by the clutch release lever cable to the clutch release lever. The clutch release hub and bearing engages the clutch pressure plate diaphragm spring, releasing the pressure on the clutch disc which in turn disengages the transmission from the engine.

The clutch adjusts automatically to compensate for clutch disc wear. The clutch linkage is self-adjusting.

The clutch pedal position (CPP) switch prevents the starter motor from engaging unless the clutch pedal is depressed all the way to the floor. The switch plunger is contacted by the clutch pedal and extends as the clutch pedal is pressed. The clutch pedal position switch is electrically connected in line with the ignition switch and the starter motor relay coil. The CPP also turns off the speed control when the clutch pedal is depressed.

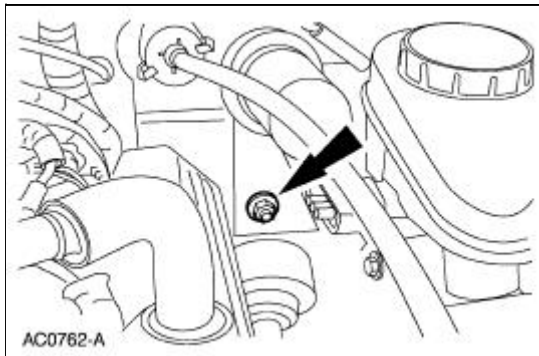
Clutch Controls

Refer to [Section 308-00](#) .

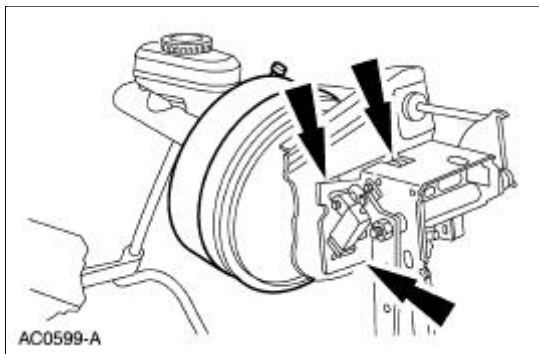
Clutch Pedal —Quadrant and Pawl Assembly

Removal

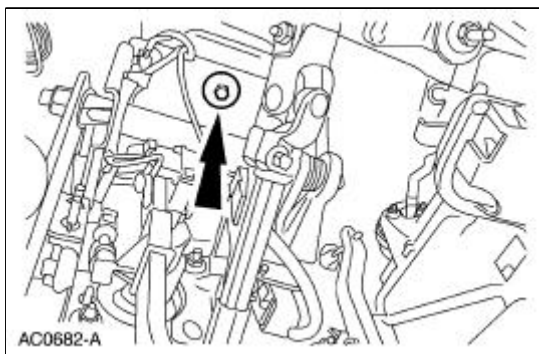
1. Disconnect the battery ground cable (14301). For additional information, refer to [Section 414-01](#).
2. Loosen the nut from inside the engine compartment.



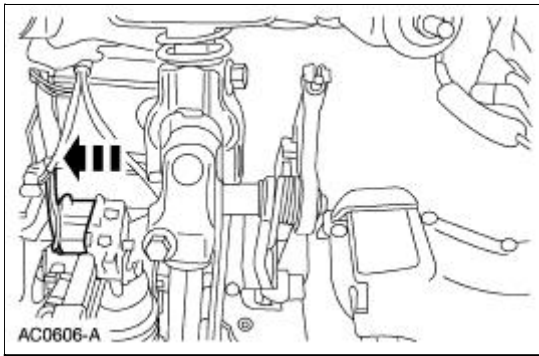
3. Loosen the nuts from inside the vehicle.



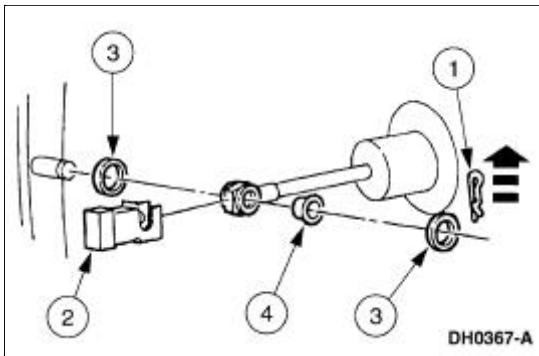
4. Loosen the screw.



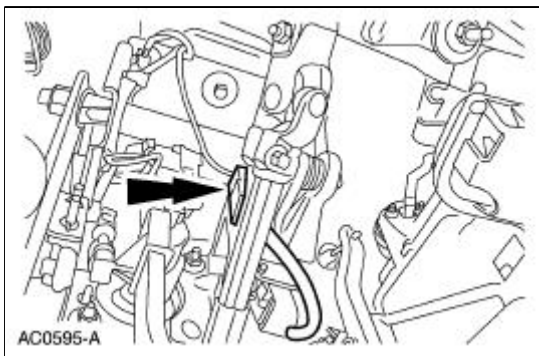
5. Disconnect the brake pedal position (BPP) switch electrical connector.



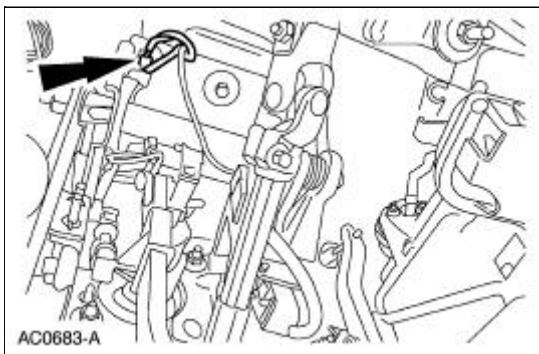
6. Disconnect the brake pedal-to-power brake booster push rod.
 1. Remove the self-locking pin.
 2. Remove the BPP switch from the brake master cylinder push rod.
 3. Remove the brake master cylinder push rod spacers (2B129).
 4. Remove the brake master cylinder push rod bushing (2474).




7. Disconnect the clutch pedal position (CPP) switch electrical connector.



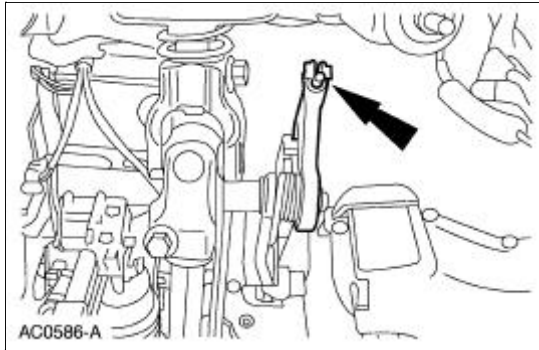
8. Disconnect the deactivation switch connector from the wiring harness.



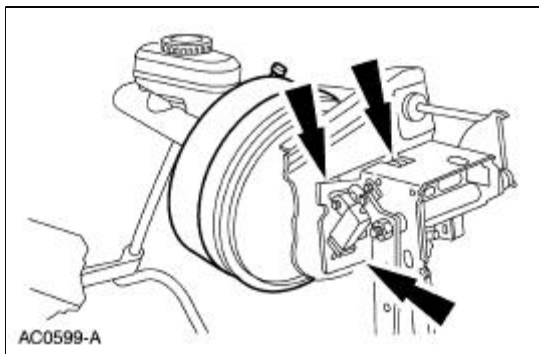
9.  **WARNING: Do not allow the quadrant to snap rearward. Failure to follow this instruction may result in personal injury.**

NOTE: Lift the clutch pedal all the way up to release the clutch release lever cable (7K553).

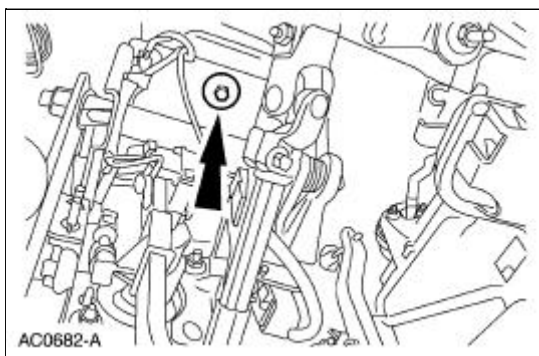
Rotate the clutch pedal adjuster quadrant (7L583) and unhook the clutch release lever cable (7K553).



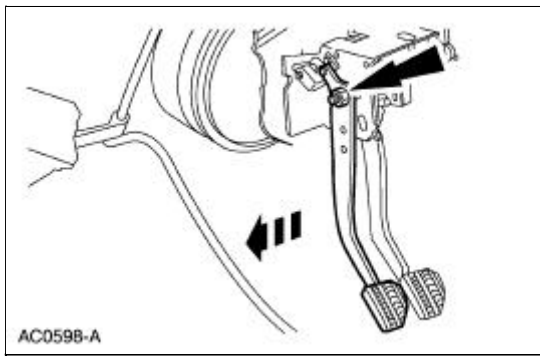
10. Remove the nuts.



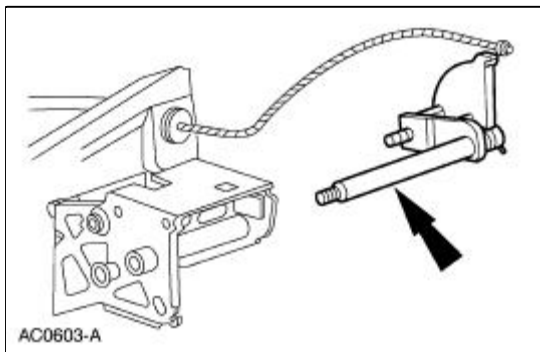
11. Remove the screw.



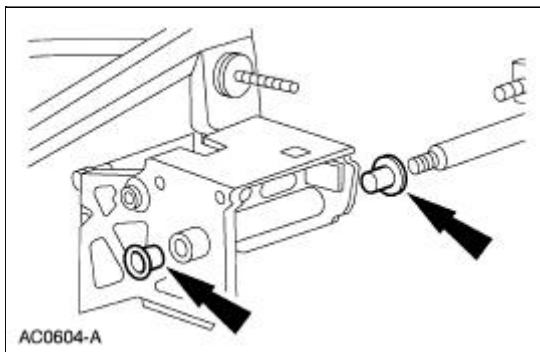
12. Remove the nut and the clutch pedal (7519).



13. Remove the self-adjusting mechanism.



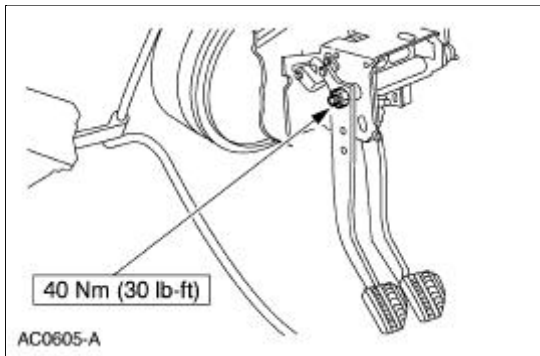
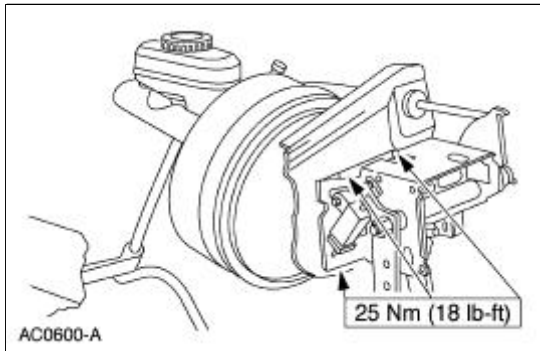
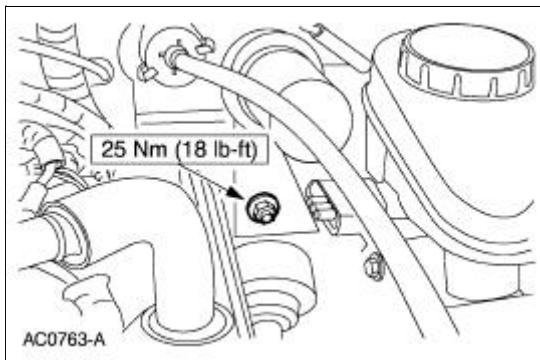
14. Remove the self-adjusting mechanism shaft bushings.



Installation

1. **NOTE:** Before the installation of the clutch pedal shaft or clutch pedal, remove and inspect the brake and clutch pedal bushings. Clean and lubricate with a light film of engine oil meeting Ford specification WSS-M2C153-G and replace the brake and clutch pedal bushing if excessive wear is evident.

To install, reverse the removal procedure.

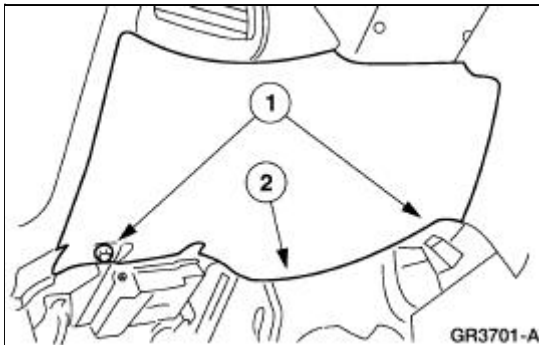


Release Cable —Clutch

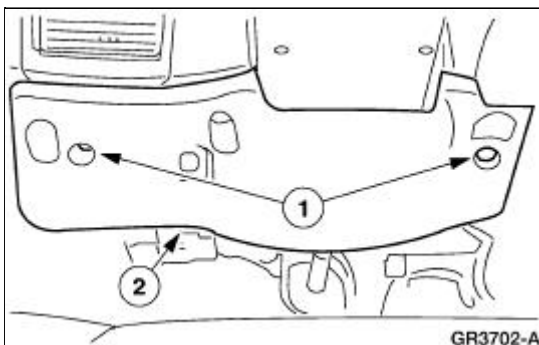
Removal

⚠ CAUTION: Whenever the clutch release lever cable (7K553) is disconnected for any reason, such as transmission removal, clutch pedal components or clutch release lever cable replacement, it is imperative the correct method for installing the clutch release lever cable be followed. Incorrect installation may damage components or cause system failure.

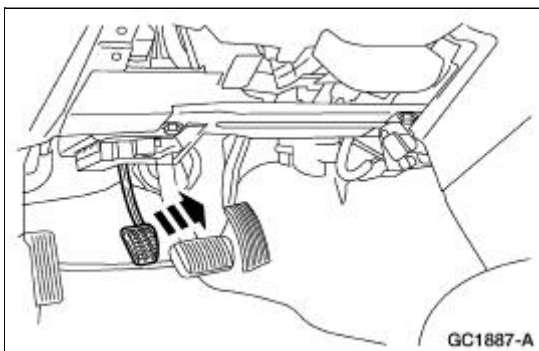
1. Remove the instrument panel steering column cover.
 1. Remove the screws.
 2. Remove the instrument panel steering column cover.



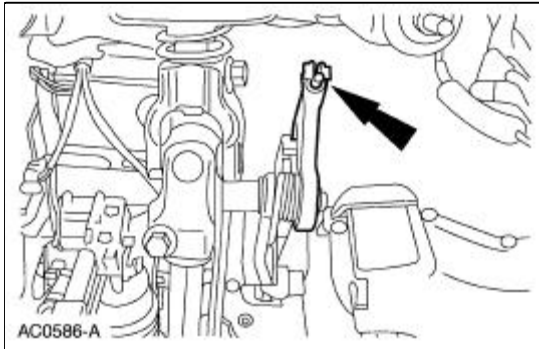
2. Remove the instrument panel reinforcement.
 1. Remove the screws.
 2. Remove the instrument panel reinforcement.



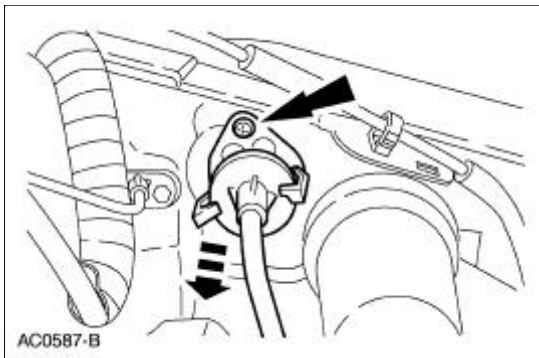
3. Lift the clutch pedal (7519) to its most upward position.



4. Remove the front seat. For additional information, refer to [Section 501-10](#).
5. Unhook the clutch release lever cable (7K553) from the clutch pedal adjuster quadrant (7L583).

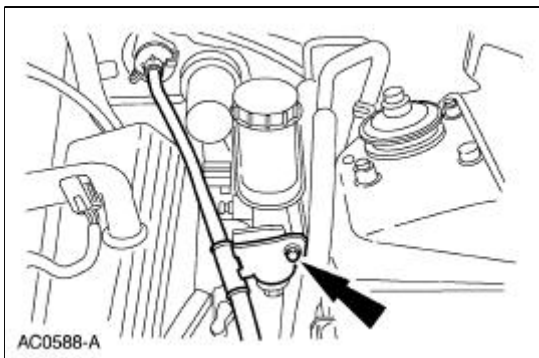


6. Open the hood, remove the screws and the clutch release cable (7K553).

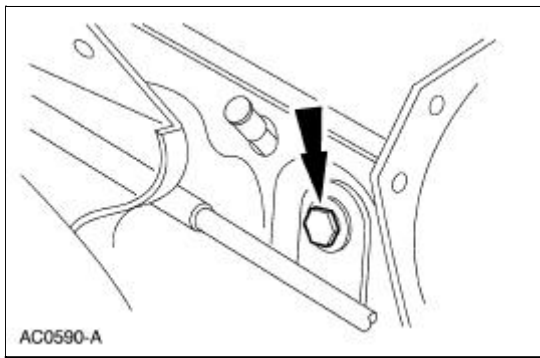


7. **NOTE:** On 4.6L vehicles only

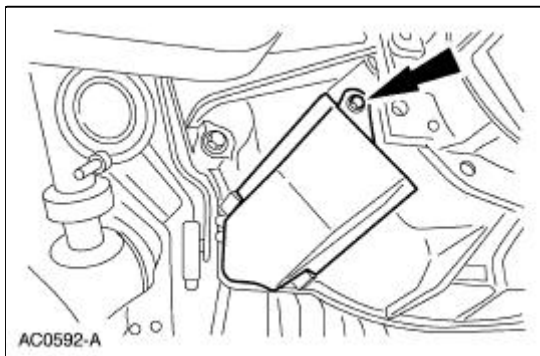
Remove the bolt and the clutch release lever cable bracket from the brake master cylinder (2140).



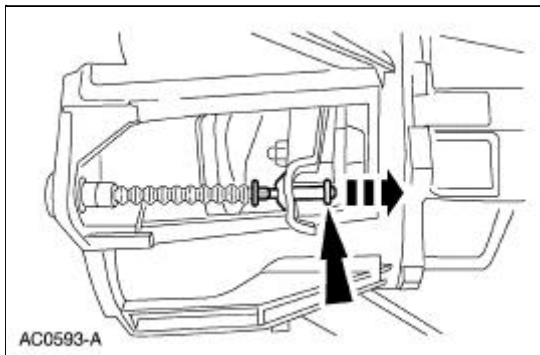
8. Raise the vehicle. For additional information, refer to [Section 100-02](#).
9. Remove the screw from the clutch release lever cable clamp.



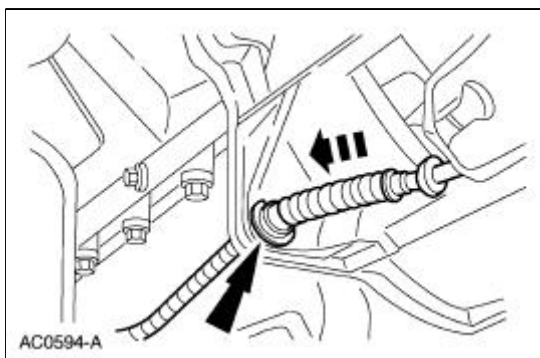
10. Remove the screw and the dust shield.



11. Pull the clutch release lever cable (7K553) and remove from the clutch release lever (7515).

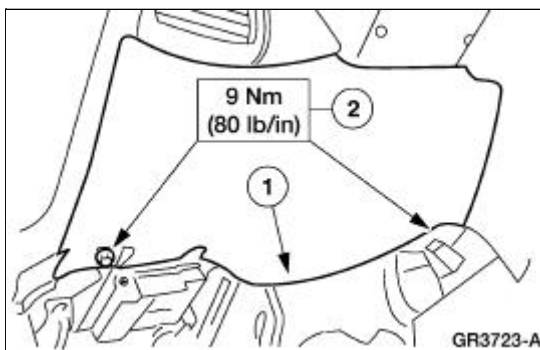
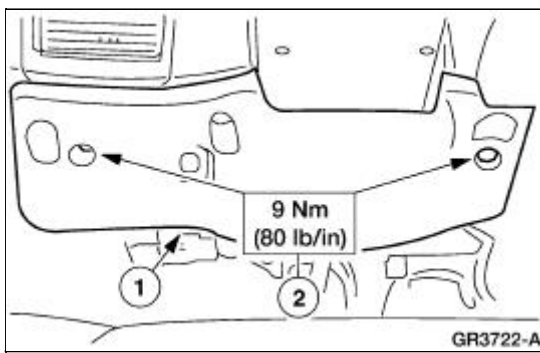
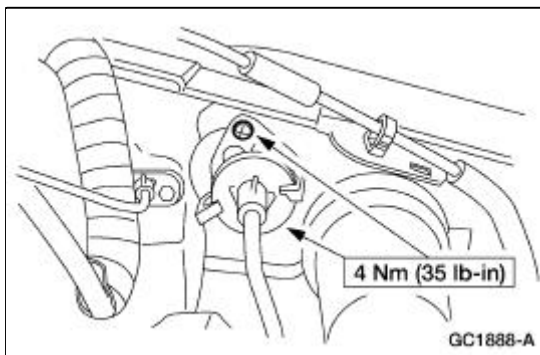
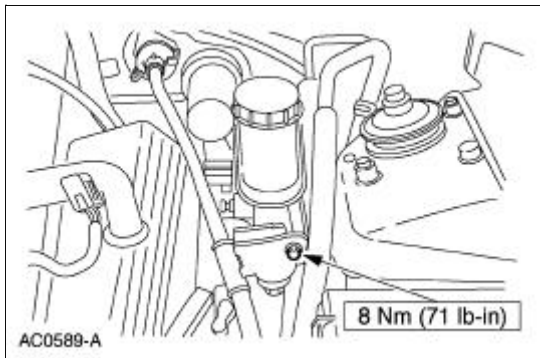
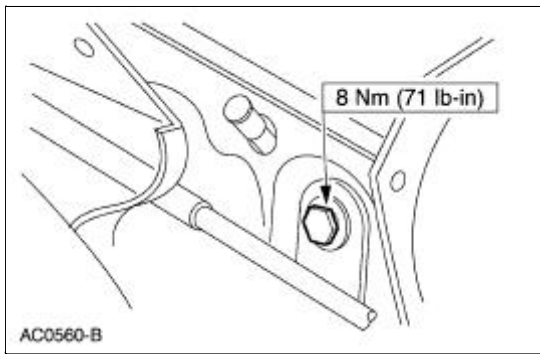


12. Remove the C-clip from the clutch release lever cable and remove the clutch release lever cable from the vehicle.



Installation

1. To install, reverse the removal procedure.



General Specifications

Item	Specification
Lubricants and Sealants	
Multi-Purpose Grease D0AZ-19584-AA	ESB-M1C93-B
Threadlock and Sealer E0AZ-19554-AA	WSK-M2G351-A5
Clear Silicone Rubber D6AZ-19562-AA	ESB-M4G92-A
Pipe Sealant with Teflon® D8AZ-19554-A	ESR-M18P7-A
MERCON® Multi-Purpose ATF Transmission Fluid XT-2-QDX	Mercon®
Preload	
Output shaft preload	0.0127 mm (0.0005 in) - 0.1016 mm (0.004 in)
Synchronizer	
Synchronizer blocking ring to conical face runout	0.5 mm (0.02 in)
End Play	
Countershaft cluster gear end play	0.0254 mm (0.001 in) - 0.127 mm (0.005 in)
Output shaft end play	0.0127 mm (0.0005 in) - 0.1016 mm (0.004 in)

Torque Specifications

Description	Nm	lb-ft	lb-in
Bolt retaining gearshift lever to extension housing	18	13	—
Screw retaining inner shift boot to floor pan	10	—	89
Bolt retaining gear shift lever to gear shift stub shaft	37	27	—
Bolt retaining OSS to case	10	—	89
Bolt retaining countershaft rear bearing retainer to case	21	15	—
Shift lever reverse pin	40	30	—
Reversing lamp switch	37	27	—
Bolt retaining case cover to case	12	9	—
Bolt retaining extension housing to case	54	40	—
Bolt retaining input shaft bearing retainer to case	21	15	—
Drain plug	23	17	—
Bolt retaining transmission to block	75	55	—
Bolt retaining engine plate to transmission	27	20	—

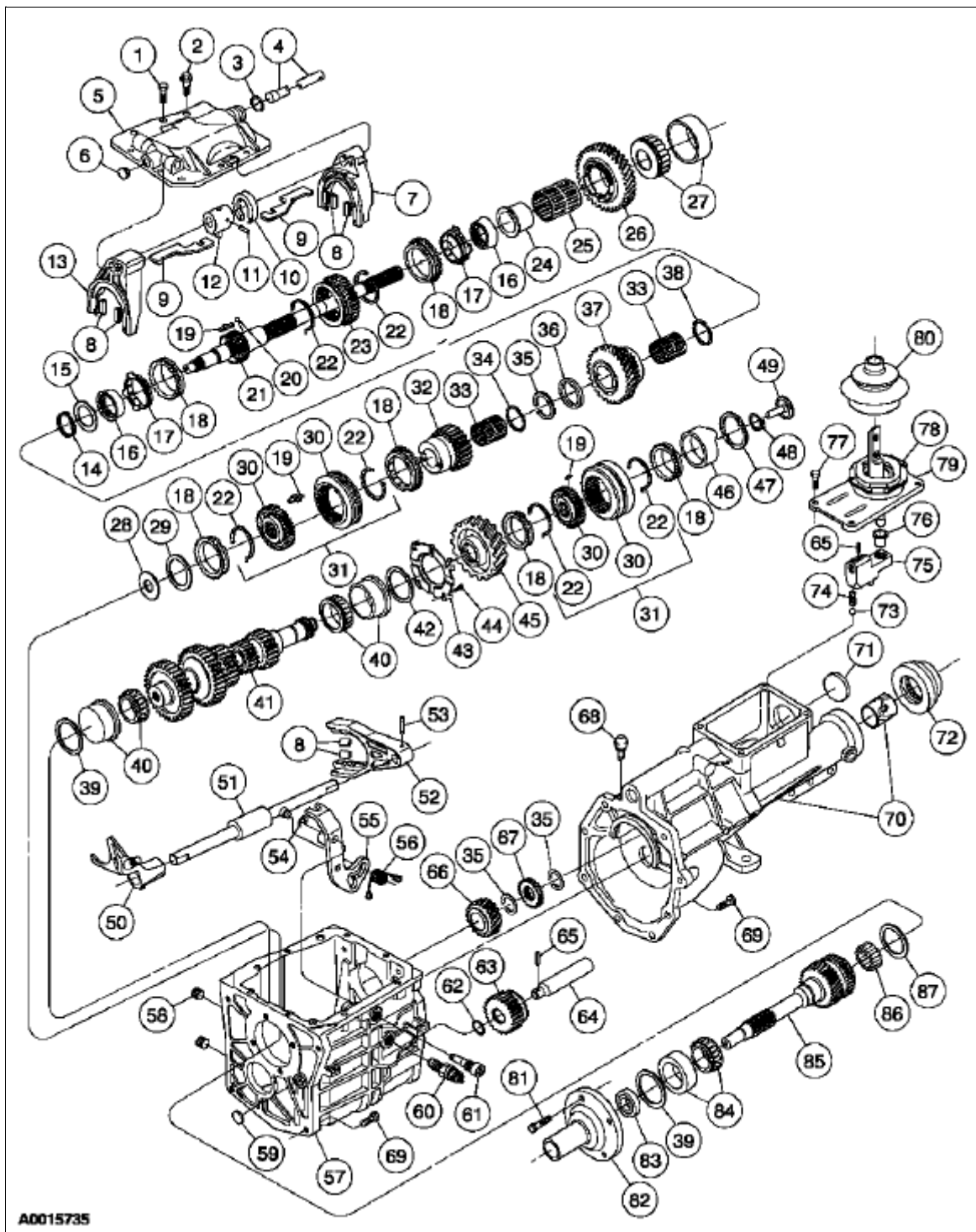
Bolt retaining crossmember to frame	41	30	—
Bolt retaining crossmember to transmission support	58	43	—
Nut retaining dual converter Y-pipe to exhaust manifold	40	30	—
Nut retaining dual converter Y-pipe flange to muffler	35	26	—
Bolt retaining driveshaft centering yoke to pinion flange	112	83	—

Manual Transmission

The T5OD 5-speed transmission:

- fifth speed gear functions as an overdrive gear.
- forward gears are synchronized and helical cut.
- shift interlock system prevents the engagement of more than one gear.

Transmission, Manual Five-Speed



A0015735

Item	Part Number	Description
1	E602162-S71	Bolt
2	N800037-S2	Bolt
3	87038-S91	O-ring
4	7358	Main shift control shaft
5	7222	Case cover
6	74113-S	Plug
7	7230	Gear shifter fork 1-2 shift
8	7L082	Gear shift fork insert

9	7N232	Gear shift plate
10	7K201	Gear selector interlock sleeve
11	305078-S	Pin
12	7302	Selector body
13	7230	Gear shifter fork 3-4 shift
14	7160	Output shaft bearing snap ring
15	7117	Second speed synchronizer thrust washer
16	7175	First and second gear synchronizer inner cone
17	7174	First and second gear synchronizer outer cone
18	7107	Synchronizer blocking ring
19	7A044	Synchronizer hub insert (also part of 7124)
20	7K218	First and second speed synchronizer hub ball
21	7061	Output shaft assembly
22	7109	Synchronizer hub insert spring (also part of 7124)
23	7124	Sleeve (also part of 7061)
24	7173	First gear bearing spacer
25	7127	First gear bearing
26	7100	First gear
27	7065	Output shaft rear bearing
28	7D234	Thrust bearing
29	7D235	Thrust washer
30	—	Synchronizer hub (part of 7124)
31	7124	Synchronizer assembly
32	7B340	Third gear
33	7B369	Third speed bearing
34	7B320	Third speed gear bearing spacer
35	7064	Snap ring
36	7119	Thrust washer
37	7102	Second gear
38	7728	Second speed gear bearing spacer
39	7693	Countershaft front bearing seal
40	7F431	Countershaft bearing assembly
41	7113	Countershaft cluster gear
42	7L172	Countershaft rear bearing adjustment shim
43	7195	Countershaft rear bearing retainer
44	7C210	Bolt
45	7144	Fifth speed cluster gear
46	7M000	Reverse brake ring
47	7G042	Thrust washer
48	7059	Fifth speed synchronizer retaining snap ring
49	7L276	Oil pick-up funnel

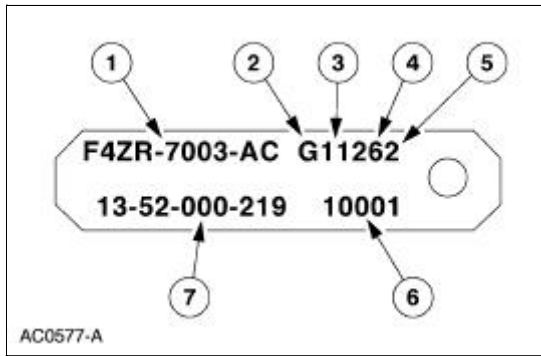
50	7230	Reverse shift fork
51	7240	Reverse gear shift rail
52	7230	Fifth gear shifter fork
53	357479-S15	Split pin
54	371197-S	Reverse gearshift lever retaining clip
55	7K002	Reverse gearshift lever
56	7E485	Reverse positioning spring
57	7005	Case
58	87675-S	Case plug
59	74113-S	Plug
60	15520	Reversing lamp switch
61	7K024	Shift lever reverse pin
62	7E397	Reverse gear overtravel stop
63	7141	Reverse idler gear and bushing
64	7140	Reverse idler gear shaft
65	357479-S15	Pin
66	7K316	Fifth speed driven gear
67	7H150	Output shaft speed wheel
68	7034	Vent
69	E800152-S72	Bolt
70	7A039	Extension housing
71	7K381	Extension plug
72	7052	Extension housing fluid seal
73	372720-S	Detent ball
74	7234	Shifter detent spring
75	7F018	Gearshift offset lever
76	7K453	Gearshift shaft bushing
77	7A443	Bolt
78	7C108	Gearshift lower boot clamp
79	7210	Gearshift lever
80	7277	Gearshift lever boot
81	N602187-S100	Bolt
82	7050	Input shaft bearing retainer
83	7052	Input shaft seal
84	7025	Input bearing assembly
85	7017	Input shaft
86	7118	Roller bearing (15 req'd)
87	7L357	Input shaft bearing spacer

Transmission Identification

The transmission identification tag is located under the lower left bolt that retains the extension

housing (7A039) to the case (7005).

Transmission Identification Tag



Item	Part Number	Description
1	—	Transmission assembly number
2	—	Build date code—month
3	—	Build date code—day
4	—	Build date code—year
5	—	Shift Number
6	—	Serial number
7	—	Wg. identification number (Located on the extension housing bolt on the LH side of the transmission)

Manual Transmission

Refer to [Section 308-00](#) .

Seal

Special Tool(s)

 ST2199-A	Installer, Transmission Extension Housing Oil Seal 308-227 (T94P-7657-A)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST2200-A	Remover, Bushing 307-001 (TOOL-1175-AC) or Equivalent

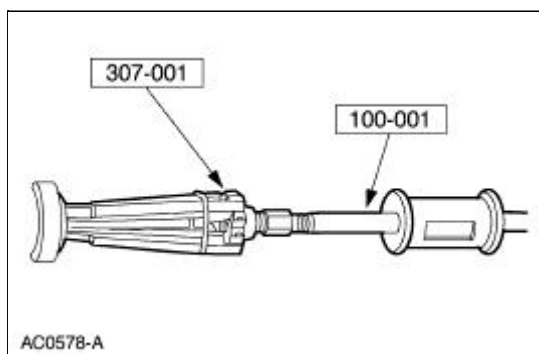
Removal

1. With the vehicle in NEUTRAL, raise and support the vehicle. For additional information, refer to [Section 100-02](#).

2.  **CAUTION:** Index-mark the driveshaft flange and pinion flange, and the driveshaft slip yoke and transmission output shaft.

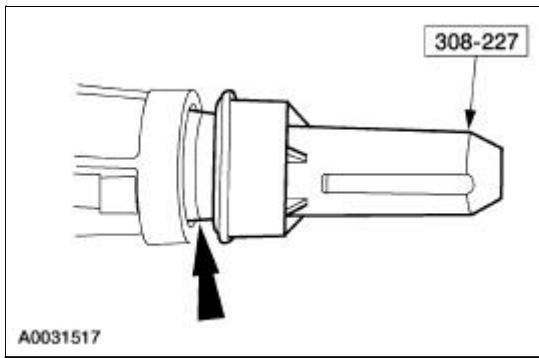
Remove the driveshaft. For additional information, refer to [Section 205-01](#).

3. Using the special tools, remove the extension housing fluid seal.



Installation

1. Using the special tool, install the extension housing fluid seal.



2.  **CAUTION: Align the index marks.**

Install the driveshaft. For additional information, refer to [Section 205-01](#).

3. Check the transmission fluid level, add fluid if necessary.
 4. Lower the vehicle.
-

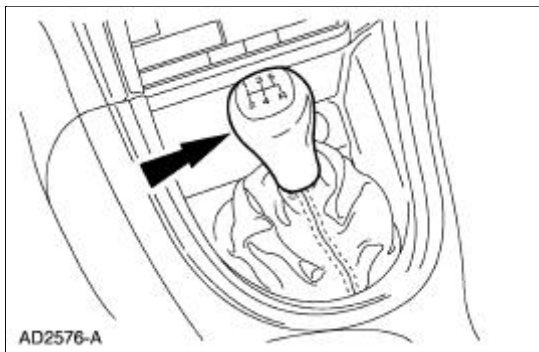
Gearshift Lever and Boot

Material

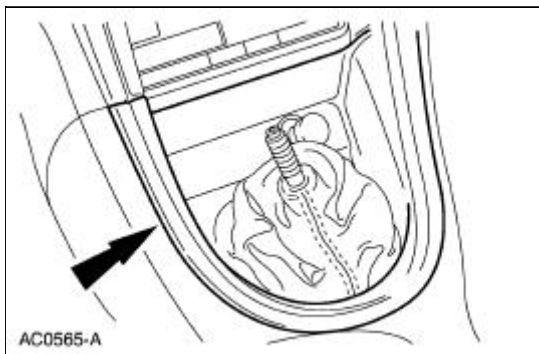
Item	Specification
Clear Silicone Rubber D6AZ-19562-AA or equivalent	ESB-M4G92-A

Removal and Installation

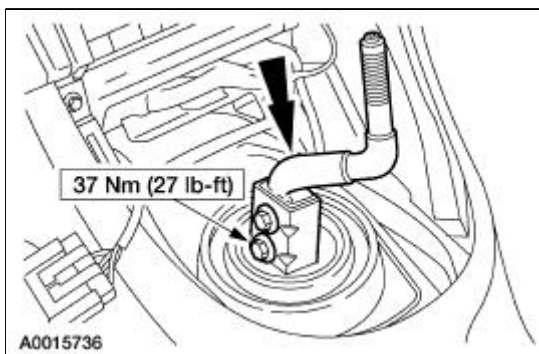
1. Remove the gearshift lever knob.



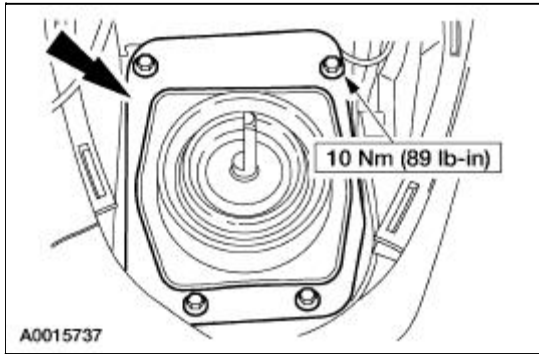
2. Remove the console panel gearshift plate. Lift the gearshift lever boot over the gearshift lever.



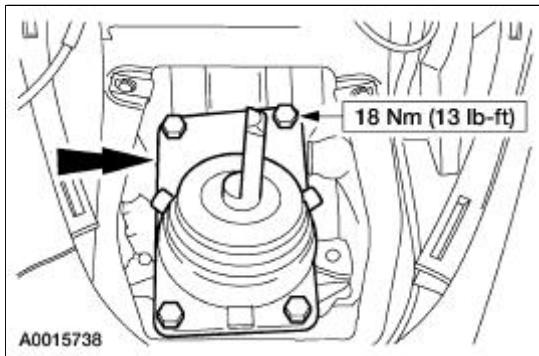
3. Remove the bolts and the shift lever.



4. Remove the screws and the inner shifter boot.



5. Remove the bolts and the gearshift lever.



6. Remove the gearshift lever boot.

7.  **CAUTION: Cover the opening in the extension housing to prevent contamination.**

Clean the gearshift lever mounting surfaces.

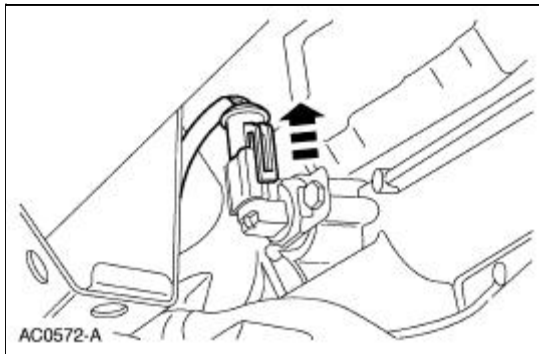
8. To install, reverse the removal procedure.

- Apply a 3.2-mm (1/8-in) bead of silicone rubber to the sealing surface on the gearshift lever.
-

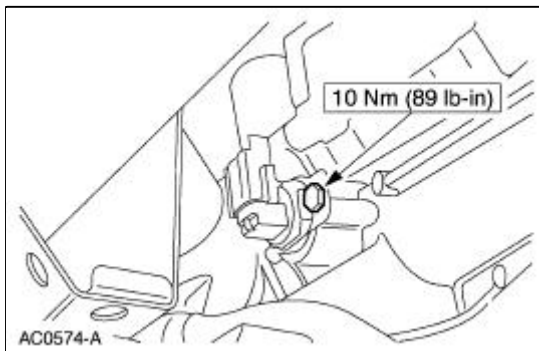
Output Shaft Speed (OSS) Sensor

Removal and Installation

1. With the vehicle in NEUTRAL, raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Disconnect the electrical connector.



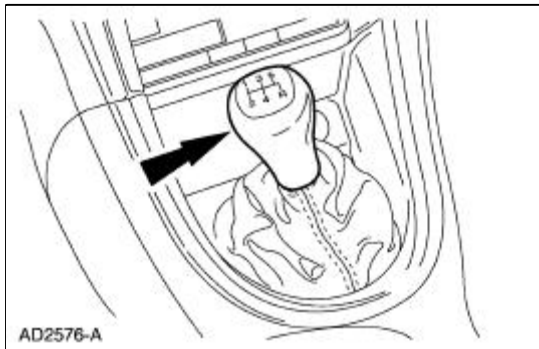
3. Remove the output shaft speed (OSS) sensor.



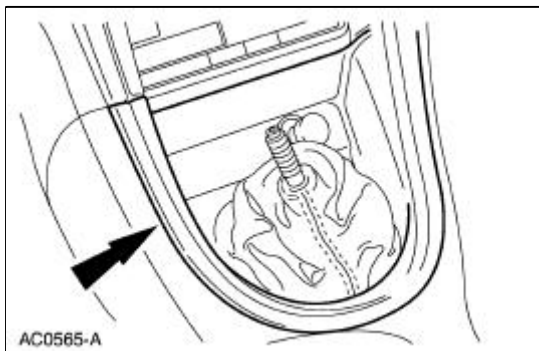
4. To install, reverse the removal procedure.

Transmission

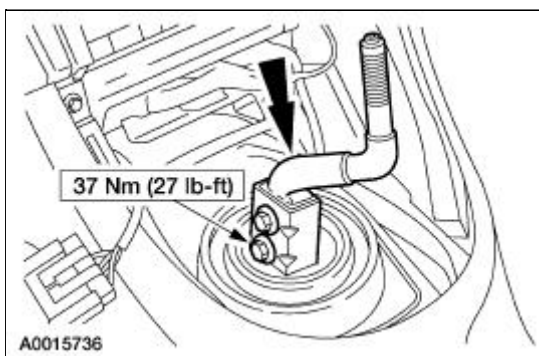
1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Lift up on the clutch pedal and secure it in place.
3. Remove the gearshift lever knob (7213).



4. Remove the console panel gearshift plate. Lift the gearshift lever boot over the gearshift lever (7210).

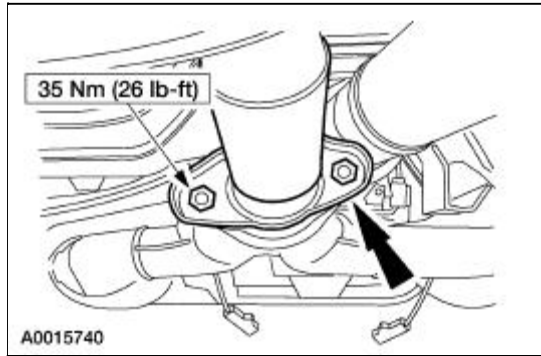


5. Remove the bolts and the shift lever.

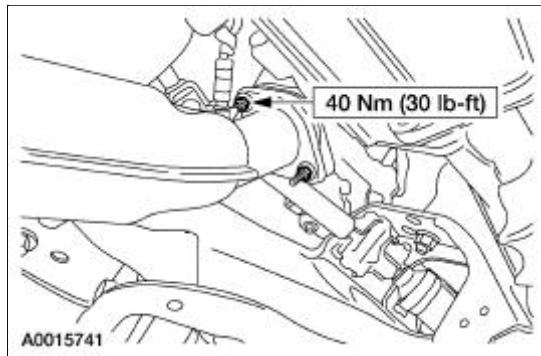


6. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
7. Disconnect the heated oxygen sensor electrical connectors.

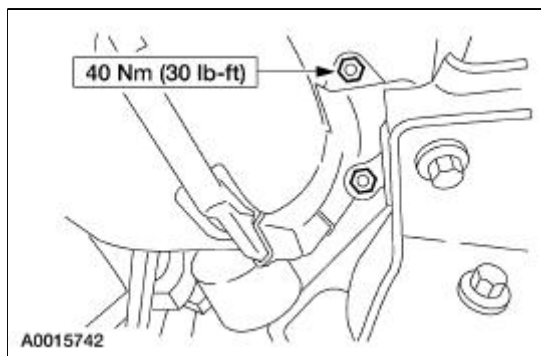
8. Remove the nuts. Position and secure the muffler and tailpipe out of the way.



9. Remove the LH nuts.

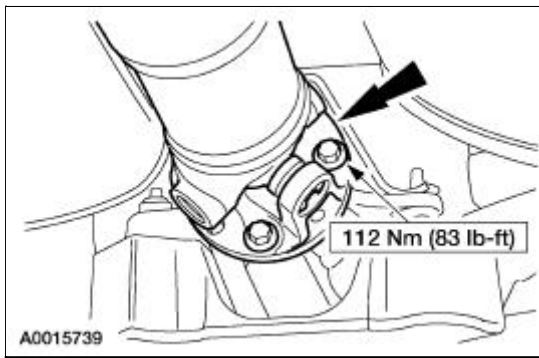


10. Remove the RH nuts.

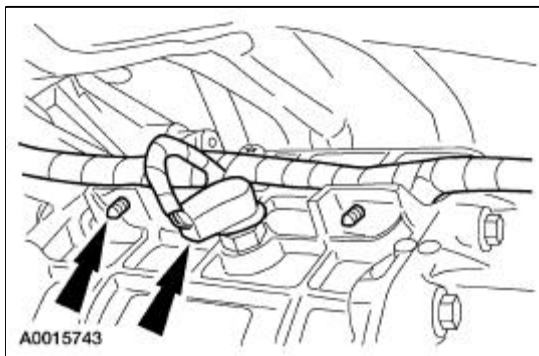


11. Remove the dual converter Y-pipe.
12.  **CAUTION:** Index-mark the driveshaft flange and pinion flange, and the driveshaft slip yoke and transmission output shaft.

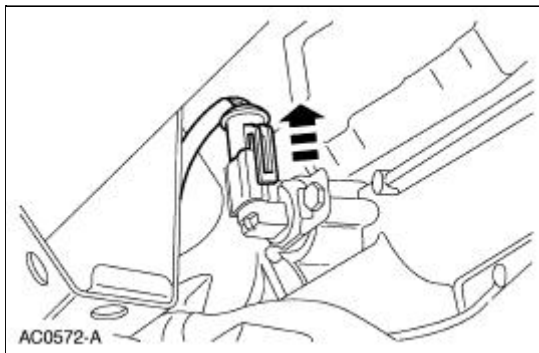
Remove the driveshaft. For additional information, refer to [Section 205-01](#).



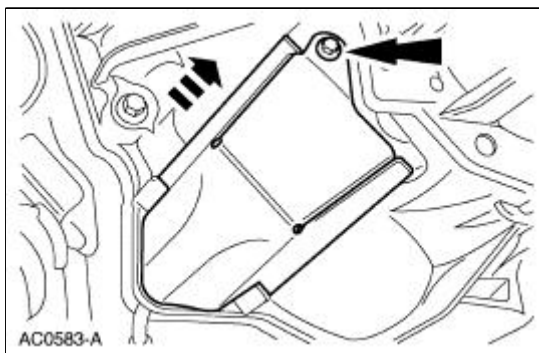
13. Disconnect the reversing lamp switch electrical connector. Disconnect the wiring harness from the transmission.



14. Remove the starter motor (11001). For additional information, refer to [Section 303-06](#).
15. Disconnect the output shaft speed sensor (OSS) electrical connector. Disconnect the wiring harness from the transmission.

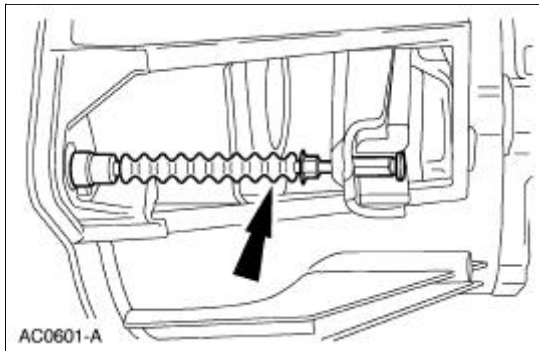


16. Remove the bolt and the clutch release lever cover.

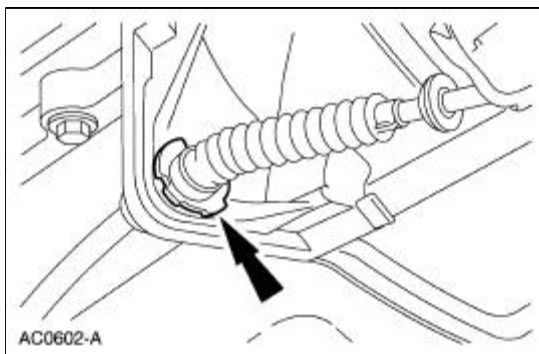


17.  **CAUTION: To prevent damage, do not depress the clutch pedal with the transmission removed.**

Disengage the clutch release cable from the clutch release fork.

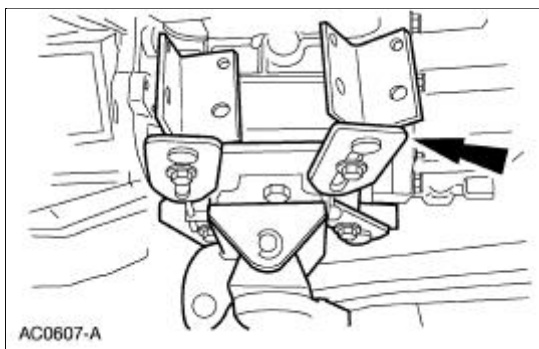


18. Remove the clutch cable retainer and remove the clutch cable from the transmission.

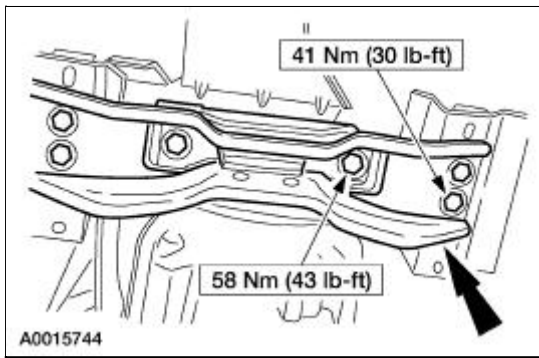


19. If transmission disassembly is necessary, drain the transmission fluid.

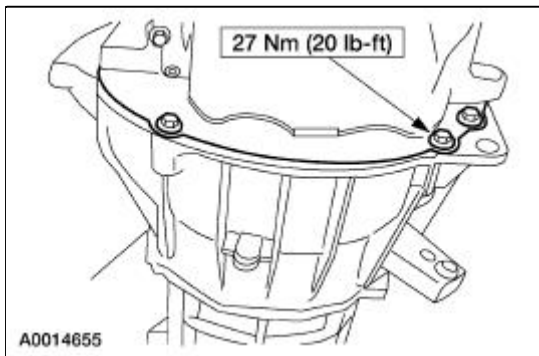
20. Position a transmission jack and support the transmission.



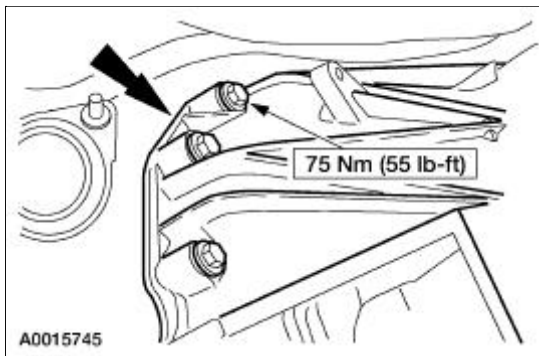
21. Remove the bolts and the transmission crossmember.



22. Remove the bolts.

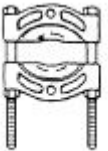
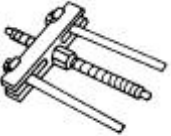


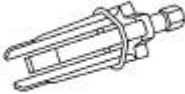




23. Lower the transmission and remove the five bolts.



Transmission

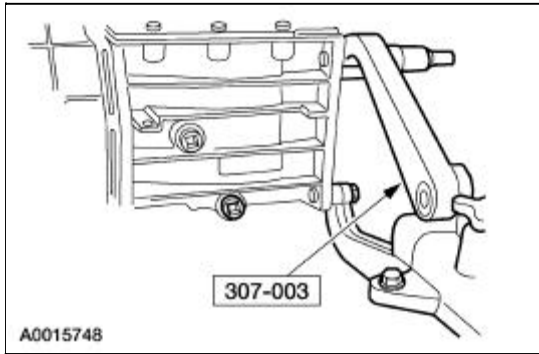
Special Tool(s)

 ST1368-A	Bearing Puller 205-D064 (D84L-1123-A) or Equivalent
 ST1516-A	Front Hub Tool 204-069 (T81P-1104-C)
 ST1186-A	Holding Fixture 307-003 (T57L-500-B)
 ST1185-A	Impact Slide Hammer 100-001 (T50T-100-A)
 ST2200-A	Puller 307-001 (TOOL-1175-AC) or Equivalent
 ST1302-A	Staking Punch 308-056 (T77J-7025-F)

1. Remove the clutch release hub and bearing and the clutch release lever. For additional information, refer to [Section 308-01](#).
2.  **WARNING: Make sure protective eyewear is in place.**

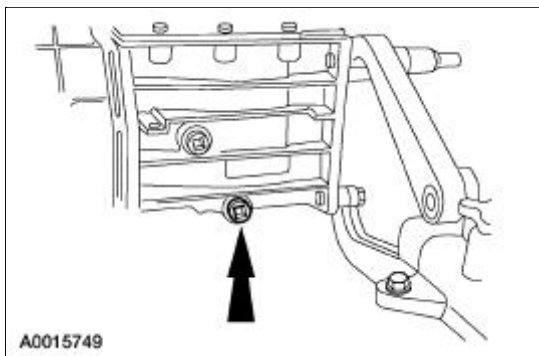
Clean the transmission exterior with solvent and dry with compressed air. During disassembly, clean all components with solvent and dry with compressed air.

3. Attach the transmission to the special tool.



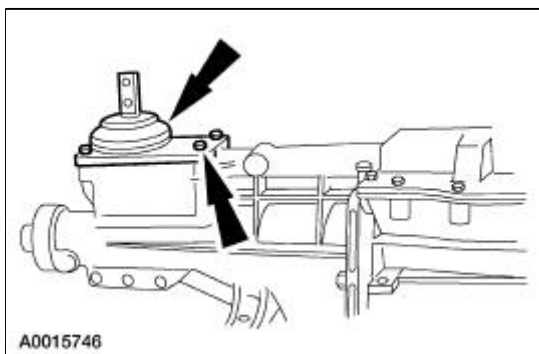
4. **NOTE:** Position a drain pan under the transmission.


Remove the case plug.



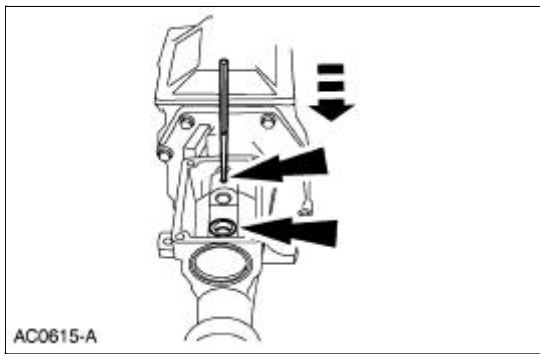
5. **NOTE:** Position the gearshift lever in NEUTRAL.

Remove the bolts and the gearshift lever.

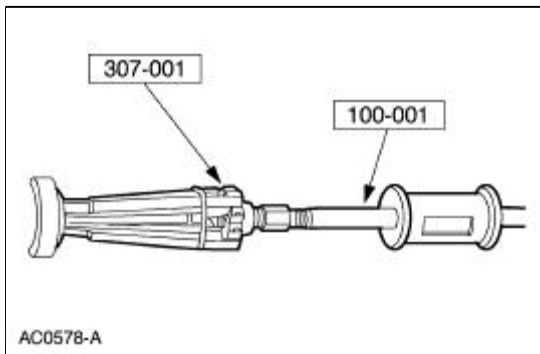


6.  **CAUTION:** Do not attempt to remove the gearshift offset lever with the extension housing bolted in place. A lug, located on the bottom of the gearshift offset lever, meshes with the detent plate preventing enough rearward movement of the gearshift offset lever to allow removal.

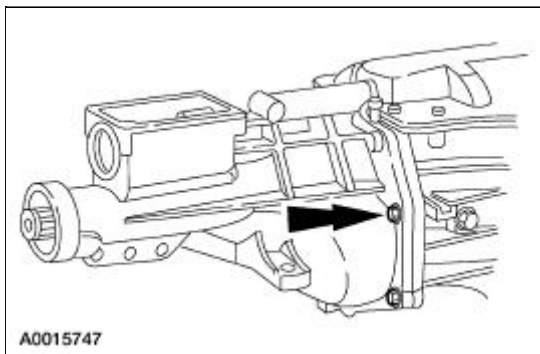
Remove the split pin and the gearshift shaft bushing.



- Using the special tools, remove the extension housing fluid seal.

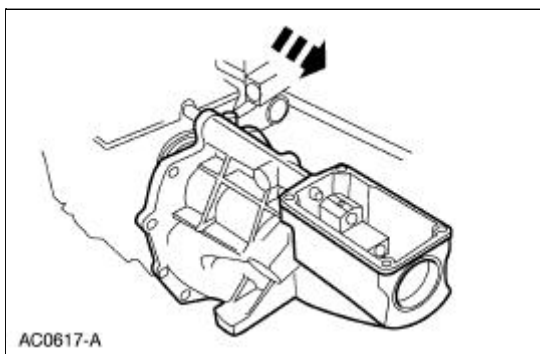


- Remove the seven bolts and the identification tag.

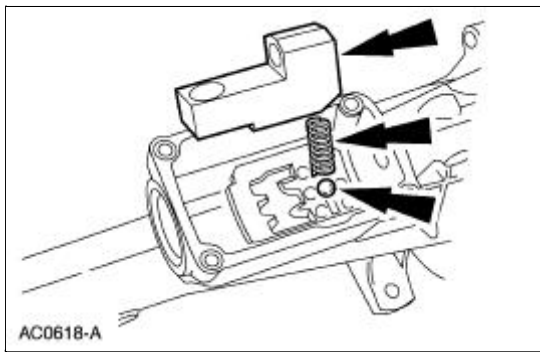


- ⚠ CAUTION: The gearshift offset lever is under spring pressure.**

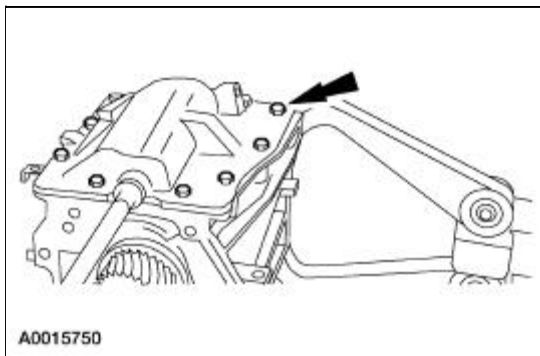
While applying downward pressure on the gearshift offset lever, remove the extension housing and the gearshift offset lever as an assembly.



- Remove the gearshift offset lever, the split pin, the shifter detent spring, and the detent ball.

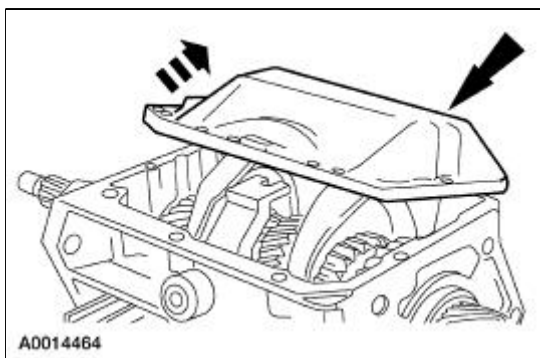


11. Remove the bolts.



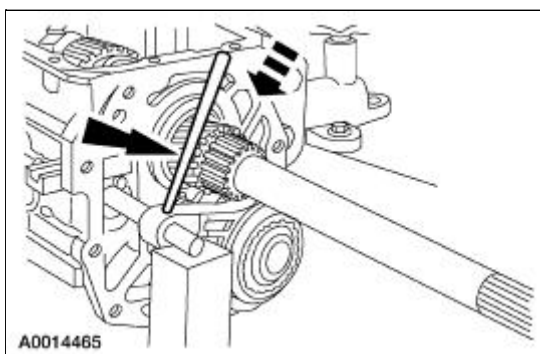
12. Remove the case cover.

- Lift the case cover and slide it toward the filler plug side of the case to clear the reverse gearshift lever.

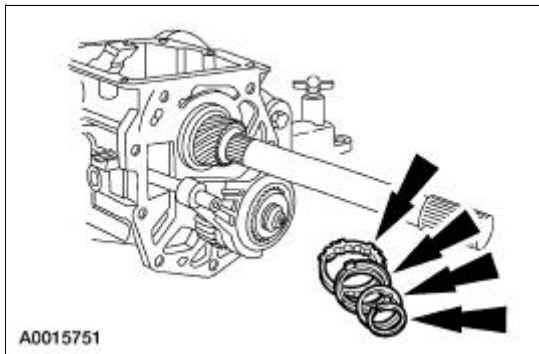


13.  **CAUTION: Support the reverse gear shift rail (7240) with a block of wood.**

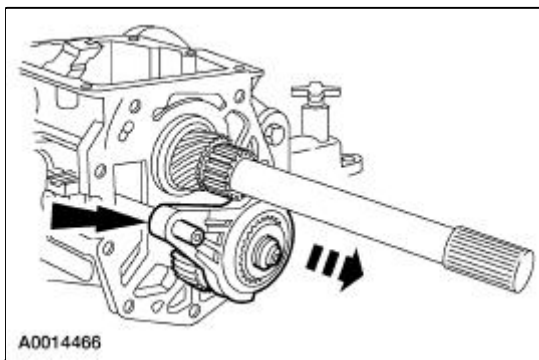
Remove the split pin.



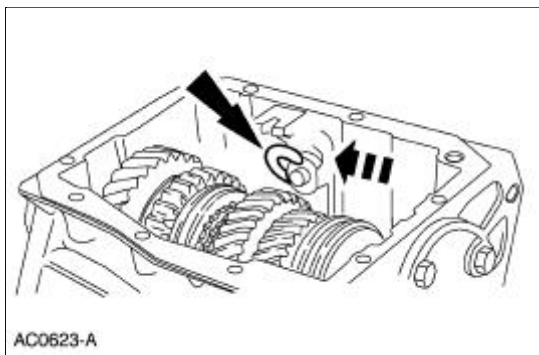
14. Remove the fifth speed synchronizer retaining snap ring, the thrust washer (7G042), the reverse brake ring (7M000), and the synchronizer blocking ring (7107).



15. Remove the fifth speed cluster gear (7144), the synchronizer blocking ring (7107), the synchronizer assembly (7124), and the fifth gear shifter fork (7230) as an assembly.

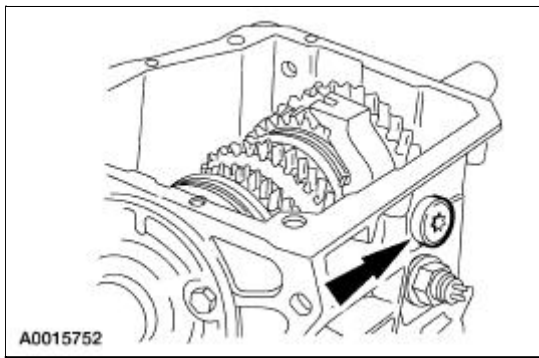


16. Remove the reverse gearshift lever retaining clip.

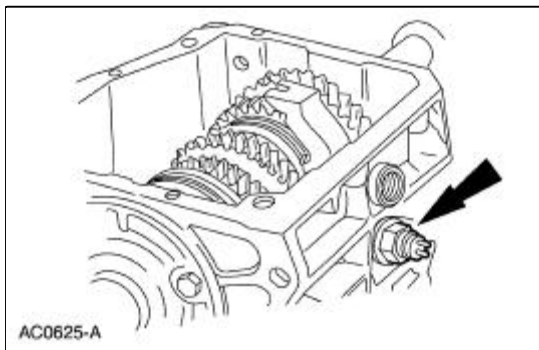


17. **NOTE:** Do not remove the reverse gearshift lever (7K002) at this time.

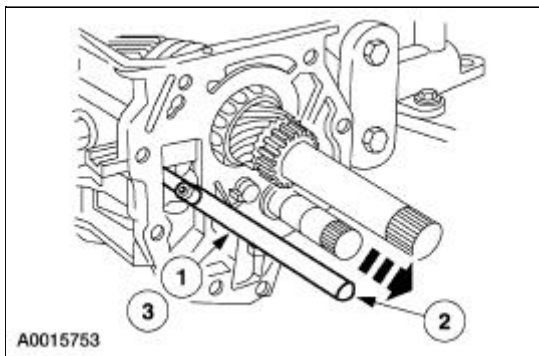
Using a TORX® bit driver, remove the shift lever reverse pin (7K024).



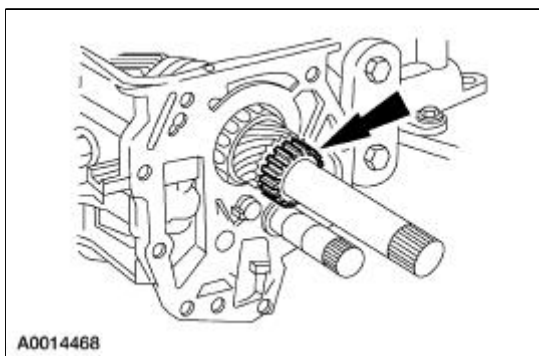
18. Remove the reversing lamp switch (15520).



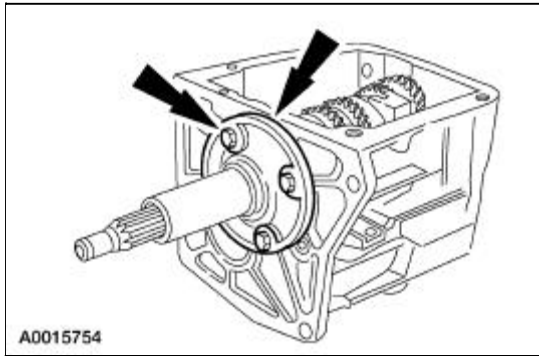
19. Remove the reverse gear shift rail.
1. Rotate the reverse gear shift rail clockwise to disengage the ball stud from the reverse gearshift lever.
 2. Pull the reverse gear shift rail rearward slightly.
 3. Rotate the reverse gear shift rail counterclockwise to align the ball stud with the slot in the case and remove the reverse gear shift rail.




20. Remove the snap ring and the output shaft speed wheel (7H150).



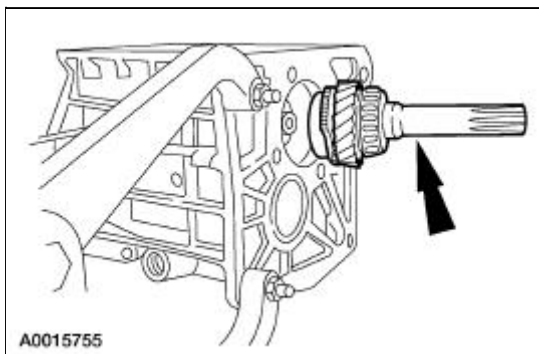
21. Remove the four bolts and the input shaft bearing retainer (7050).



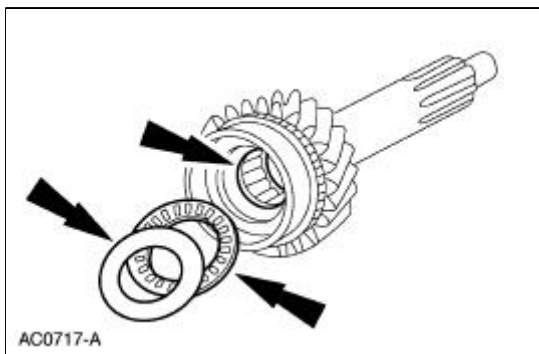
22.  **CAUTION:** Do not drop the 15 roller bearings (7118), the input shaft bearing spacer (7L357), the thrust bearing (7D234), and the thrust washer (7D235) from the rear of the input shaft (7017).

Remove the input shaft.

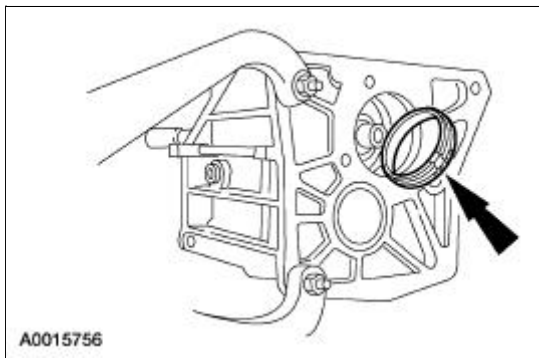
- Rotate the input shaft until the flat on the fourth gear clutching teeth aligns with the countershaft cluster gear (7113).



23. Remove the thrust washer, the thrust bearing, the input shaft bearing spacer, and the 15 roller bearings.

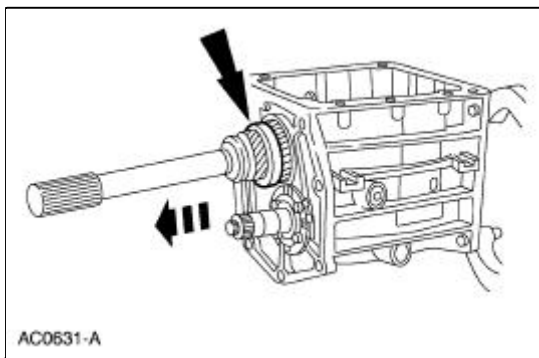


24. Remove the fourth speed synchronizer blocking ring (7107).

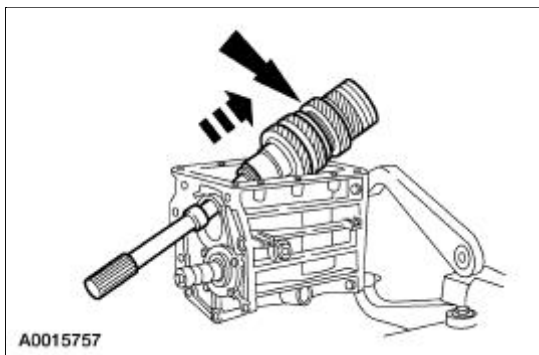


25. **NOTE:** If the output shaft rear bearing cup sticks, it is misaligned in the case bore. To free the output shaft rear bearing cup, work the output shaft assembly (7061) back and forth in the case (7005).

Remove the output shaft rear bearing cup.



26. Remove the output shaft assembly.

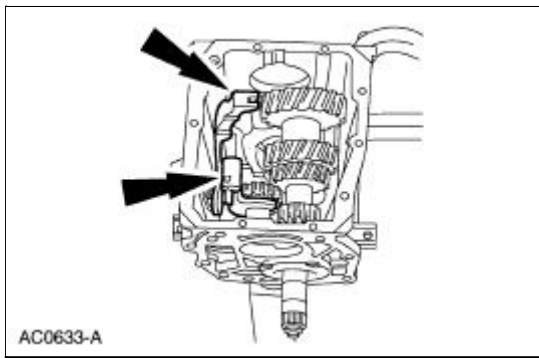


27. **NOTE:** Observe the location of the reverse gearshift lever, the reverse shift fork (7230), and the reverse positioning spring (7E485).

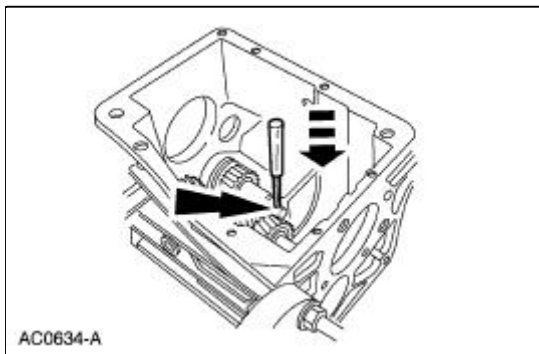
NOTE: Observe the rotation action of the reverse positioning spring.

Remove the reverse gearshift lever, the reverse shift fork, and the reverse positioning spring as an assembly.

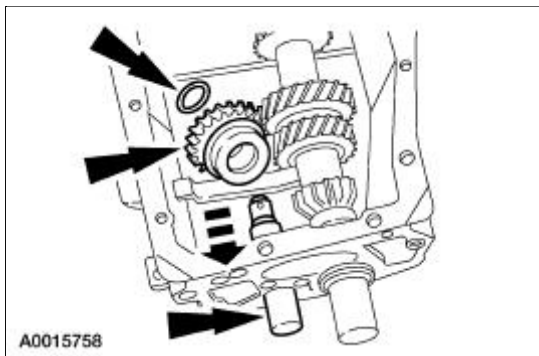
- Hold the reverse gearshift lever and lift it upward as straight up as possible to remove the assembly.



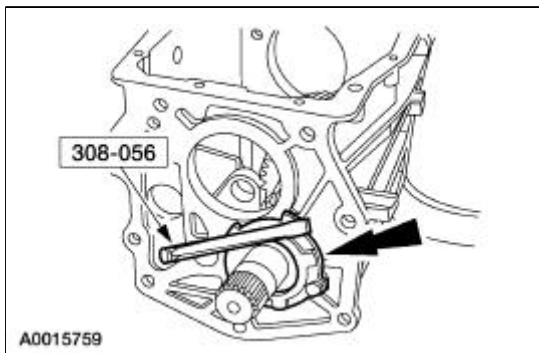
28. Remove the pin.



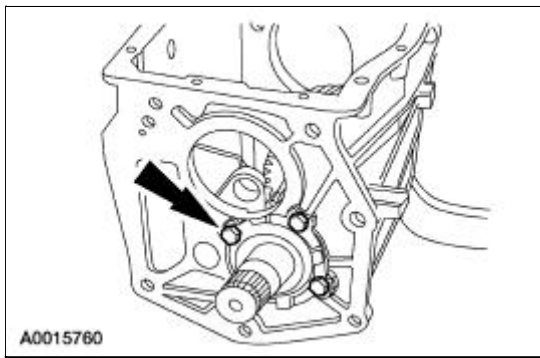
29. Remove the reverse idler gear shaft (7140), the reverse idler gear and bushing (7141), and the reverse gear overtravel stop (7E397).



30. Using the special tool, flatten the tabs on the countershaft rear bearing retainer (7195).

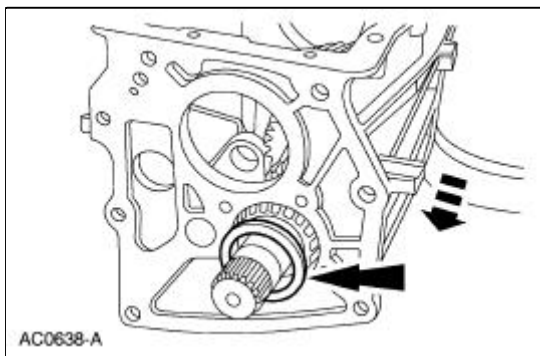


31. Remove the four bolts, the countershaft rear bearing retainer, and the shim (7L172).

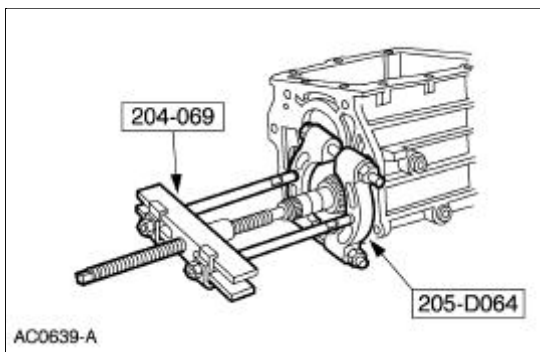


32. **NOTE:** If the bearing race sticks in the case, it is misaligned in the case bore. To free the race, work the countershaft cluster gear back and forth.

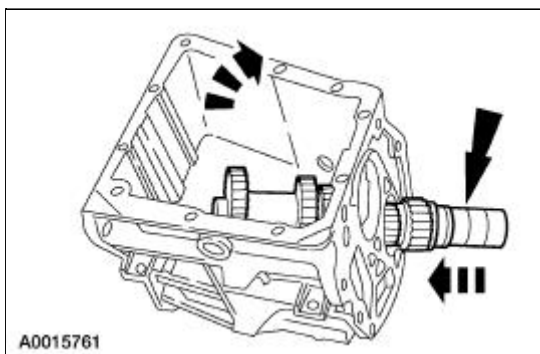
Remove the bearing race.



33. Using the special tools, remove the rear countershaft bearing assembly (7F431).



34. Move the countershaft cluster gear rearward through the bearing bore. Tilt the assembly upward and remove it from the case.

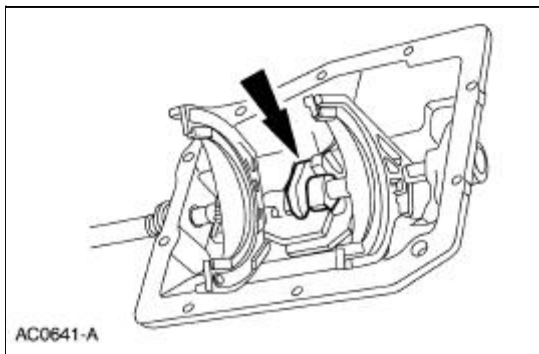


Selector Plate

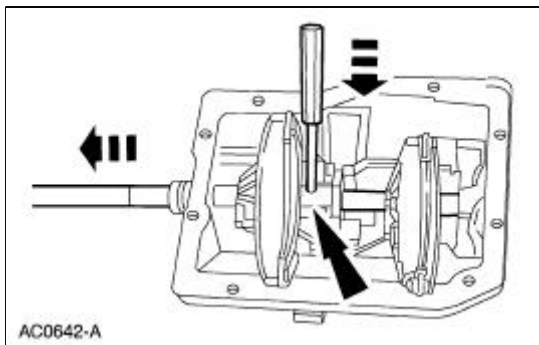
Disassembly

1. **NOTE:** Mark the position of each gear shifter fork (7230).

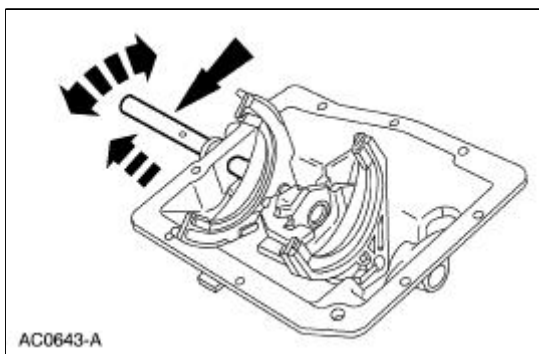
Place the gear shift plates (7N232) and the gear selector interlock sleeve (7K201) in the neutral position to center the gear shift plates and the selector body (7302).



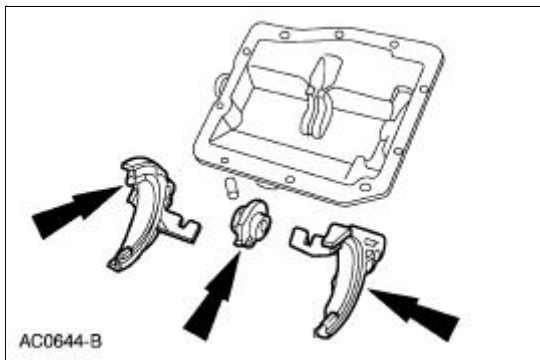
2. Rotate the main shift control shaft (7358) counterclockwise and pull it rearward to access the pin. Remove the pin.



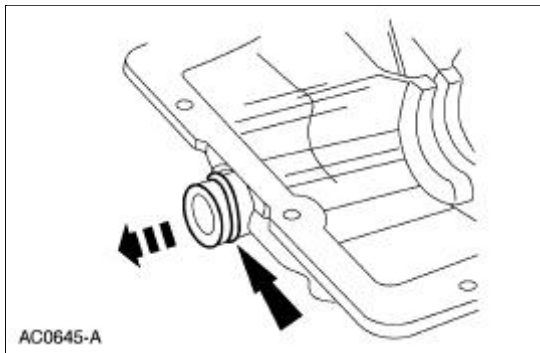
3. Using a twisting motion, remove the main shift control shaft.



4. Remove the gear shifter forks, the gear shift plates, the pin, the gear selector interlock sleeve, and the selector body.

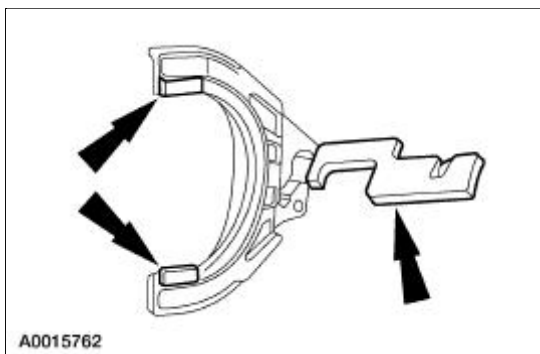


5. Remove the O-ring (N800037-S2).



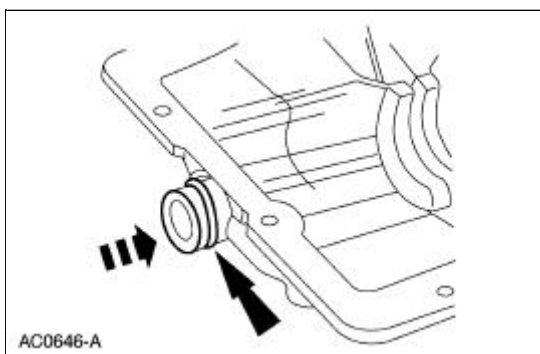
6.  **CAUTION:** Note the orientation of the gear shift plate for assembly reference.

Remove the gear shift plate and the gear shift fork inserts (7L082) from the shifter forks.

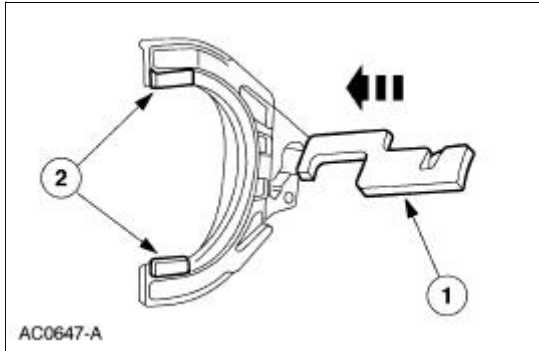


Assembly

1. Install the new O-ring.

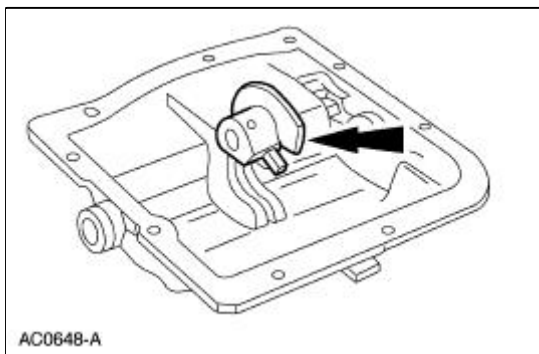


2. Assemble the gear shifter forks.
 1. Install the gear shift plate into the gear shifter fork.
 2. Install the gear shift fork inserts.



3. **NOTE:** Position the narrow side of the C-shaped gear selector interlock sleeve in the case cover slot. Position the roll pin hole in the selector body toward the rear of the cover.

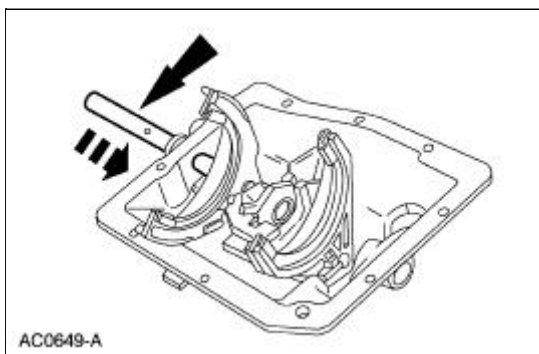
Install the gear selector interlock sleeve and the selector body as an assembly.




4. Lubricate the main shift control shaft with petroleum jelly.
5. **NOTE:** The 1-2 gear shifter fork is the larger shifter fork. The gear shifter fork offset lever must face the cover. Position the gear shift plate attached to the 3-4 gear shifter fork under the gear shift plate attached to the 1-2 gear shifter fork.

Position the gear shifter forks and the main shift control shaft in the cover.

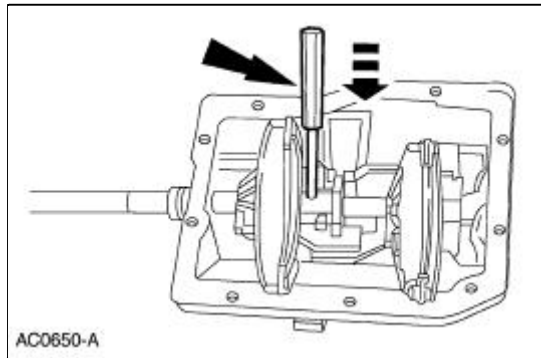
- Slide the shaft through the cover and shift the components until the shaft stops against the cover.



6.  **CAUTION:** Install the pin slightly below the selector body surface. Failure to countersink the pin may result in interference between the pin and the gear selector interlock sleeve during shifts.


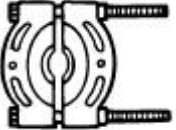
NOTE: The flat on the main shift control shaft must face upward.

Install the pin.



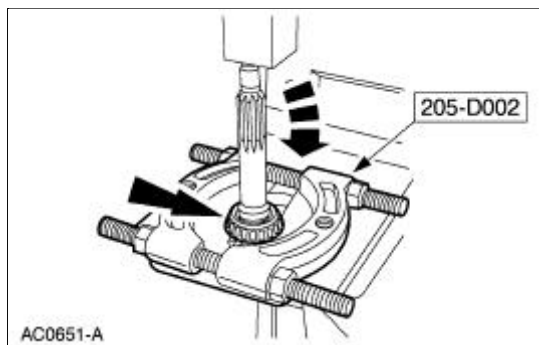
Input Shaft and Bearing

Special Tool(s)

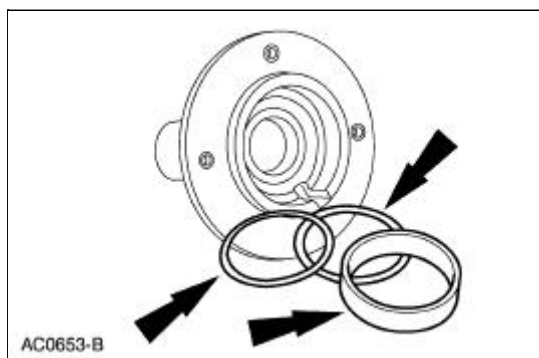
 <p>ST2355-A</p>	Input Shaft Seal Replacer 308-220 (T94P-7025-AH)
 <p>ST1895-A</p>	Pinion Bearing Cone Remover 205-D002 (D79L-4621-A) or Equivalent

Disassembly

1. Using the special tool and a press, remove the input bearing (7025).



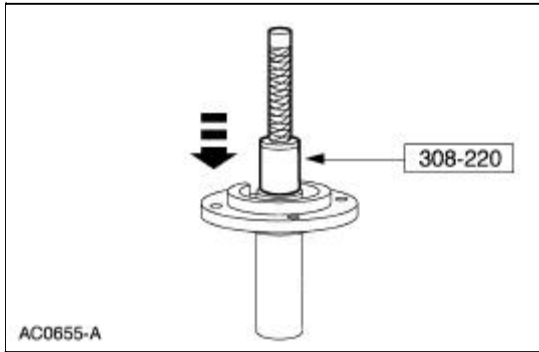
2. Remove the bearing race and the end play selective shims.



3. Remove the input shaft seal (7052).

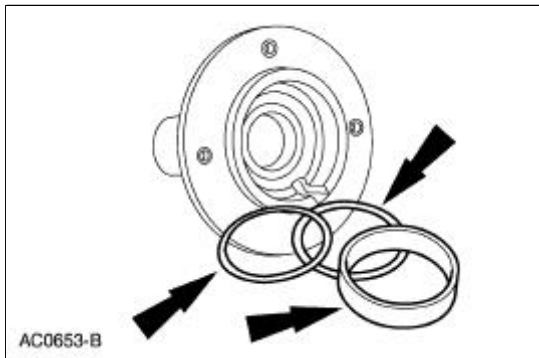
Assembly

1. Using the special tool, install the input shaft seal.

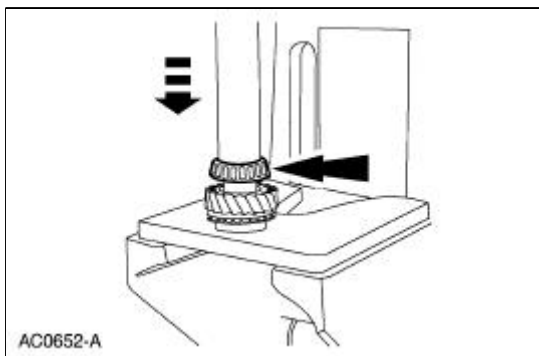


2. **NOTE:** In installing a new input shaft seal as part of a transmission overhaul, do not install the end play selective shims at this time.

Instal the end play selective shims and the bearing race.



3. Using a press and a capped length of pipe, install the input bearing.



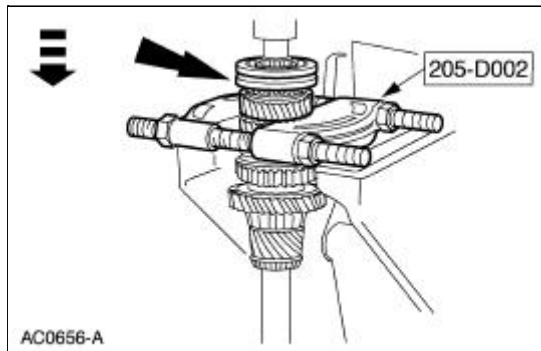
Output Shaft

Special Tool(s)

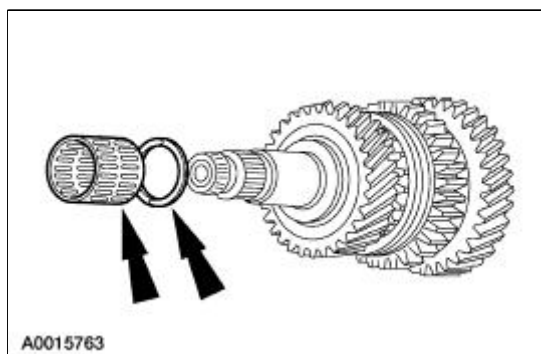
 <p>ST1895-A</p>	Pinion Bearing Cone Remove 205-D002 (D79L-4621-A) or Equivalent
 <p>ST2406-A</p>	Spiral Snap Ring Replacer 308-096 (T85P-7025-A)

Disassembly

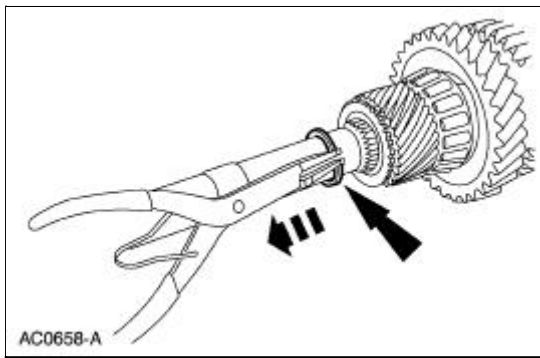
1. Using the special tool and a press, remove the third/fourth gear synchronizer assembly (7124), the third speed synchronizer blocking ring (7107), and the third gear (7B340) as an assembly.



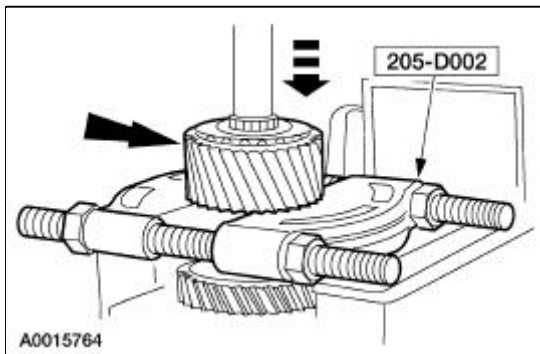
2. Remove the third speed bearing (7B369) and the third speed gear bearing spacer (7B320).



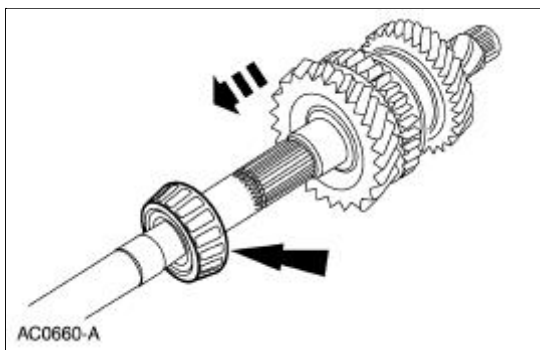
3. Remove the snap ring.



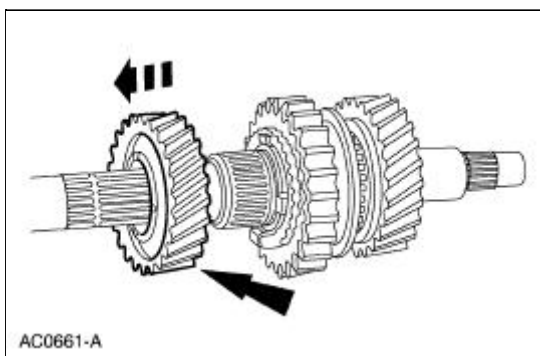
4. Using the special tool and a press, remove the fifth speed driven gear (7K316).



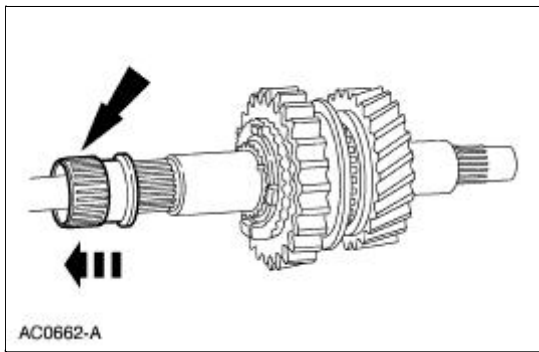
5. Remove the output shaft rear bearing (7065).



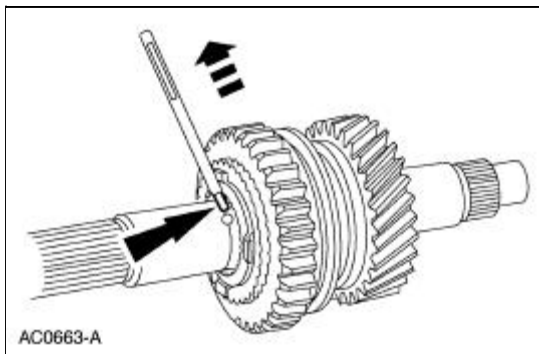
6. Remove the first gear (7100).



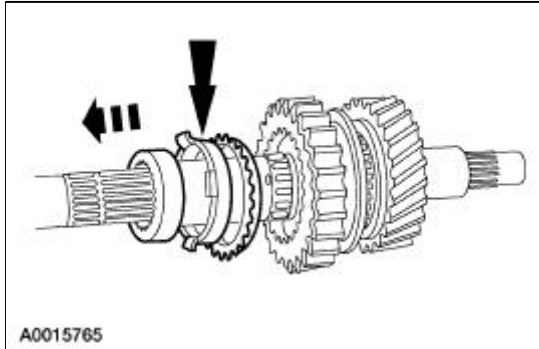
7. **NOTE:** The first gear bearing spacer (7173) fits snugly on the output shaft assembly (7061).
Remove the first gear bearing (7127) and the spacer as an assembly.



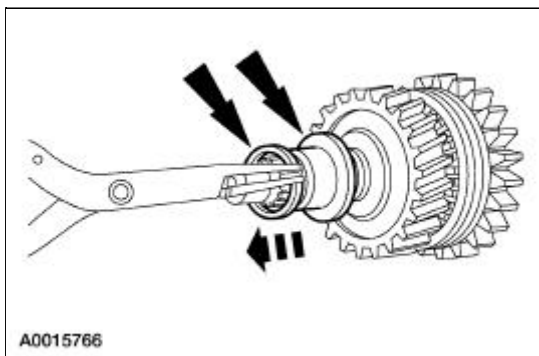
8. Remove the first and second speed synchronizer hub ball (7K218).



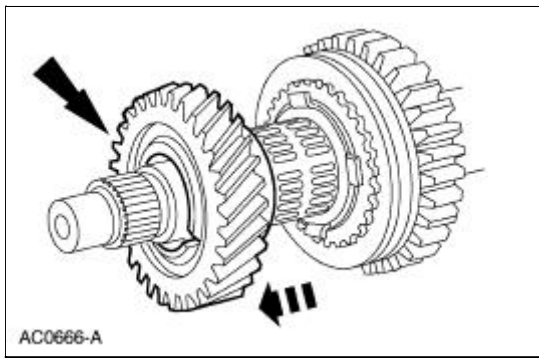
9. Remove the first speed synchronizer inner cone (7175), the first speed synchronizer outer cone (7174), and the first speed synchronizer blocking ring (7107) as an assembly.



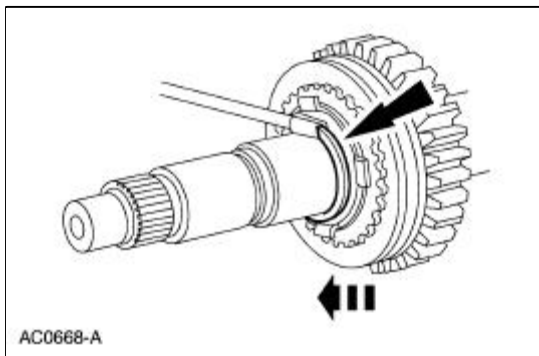
10. Remove the snap ring and the thrust washer (7119).



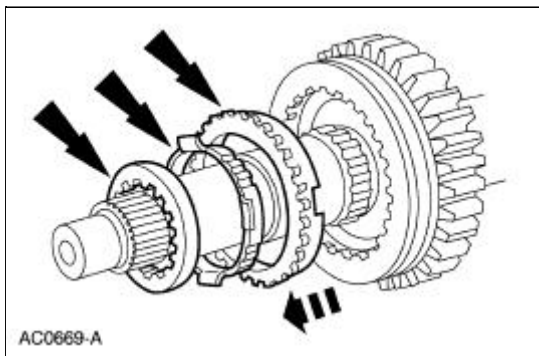
11. Remove the second gear (7102), the second speed bearing (7B369), and the second speed gear bearing spacer (7728).




12. Remove the output shaft bearing snap ring and the second speed synchronizer thrust washer (7117).



13. Remove the second speed synchronizer inner cone (7175), the second speed synchronizer outer cone (7174), and the second speed synchronizer blocking ring (7107) as an assembly.

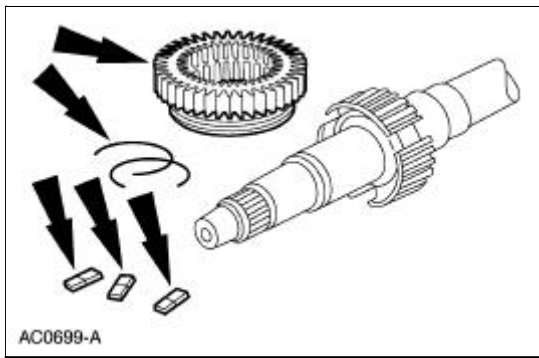


14. Remove the first and second gear synchronizer sliding sleeve (7124).

15.  **CAUTION: Note the orientation of the synchronizer hub insert springs (7109) and the synchronizer hub inserts (7A044) for assembly reference.**

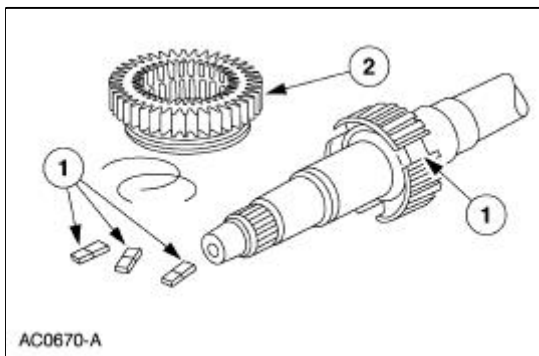
NOTE: The first and second gear synchronizer sliding sleeve, the hub, and the output shaft are an assembly. Do not attempt to separate the hub from the output shaft. Only the synchronizer hub insert springs and the synchronizer hub inserts are available separately.

Remove the synchronizer hub insert springs and the hub inserts.



Assembly

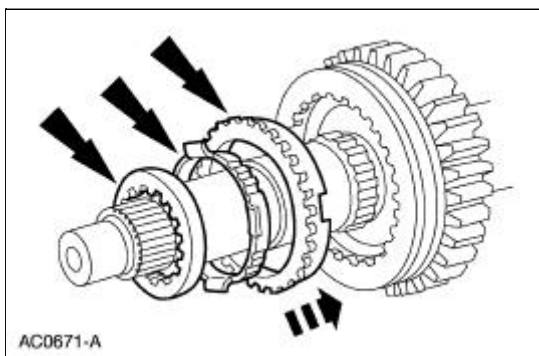
1. Soak the blocking rings in transmission fluid for ten minutes.
 - Use MERCON® Multi-Purpose ATF Transmission Fluid XT-2-QDX or equivalent.
2. Assemble the first and second synchronizer.
 1. Install the synchronizer hub insert springs and the synchronizer inserts into the synchronizer hub.
 2. Install the sliding sleeve onto the hub.



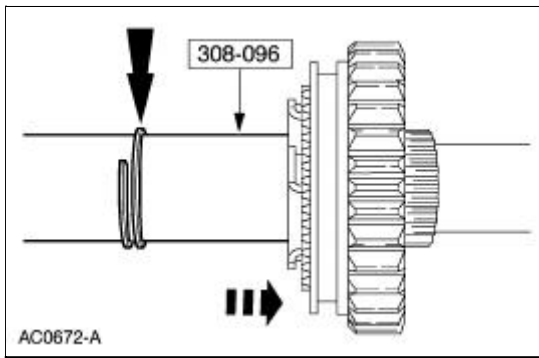
3. **NOTE:** If not done so previously, soak the blocking ring in MERCON® Multi-Purpose ATF Transmission Fluid XT-2-QDX or equivalent for ten minutes.

NOTE: Align the slots in the synchronizer blocking ring with the tabs in the first and second speed synchronizer.

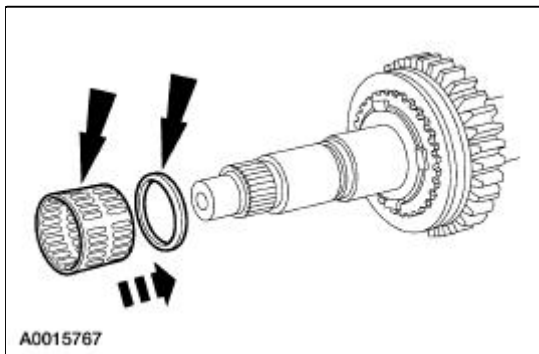
Install the second speed synchronizer blocking ring and the inner and outer cones as an assembly.



4. Install the second speed synchronizer thrust washer.
5. Using the special tool, install the output shaft bearing snap ring.

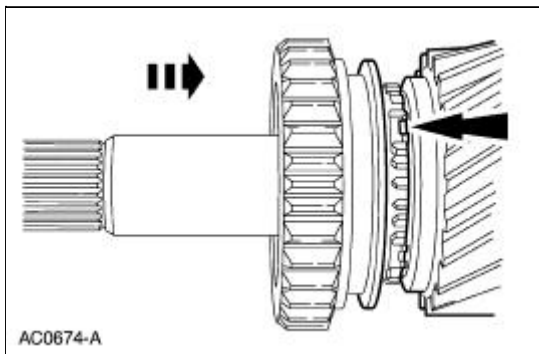


6. Install the second speed gear bearing spacer and the second speed bearing.

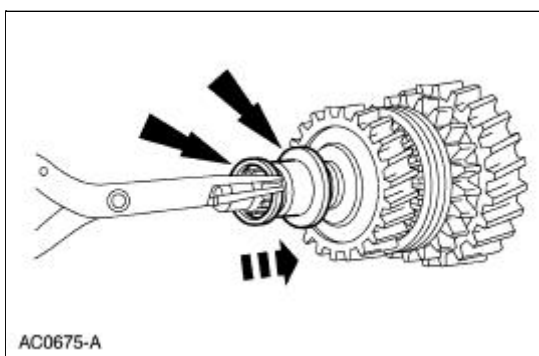


7. **NOTE:** Align the slots in the second gear with the tabs on the synchronizer blocking ring.

Install the second gear onto the output shaft.



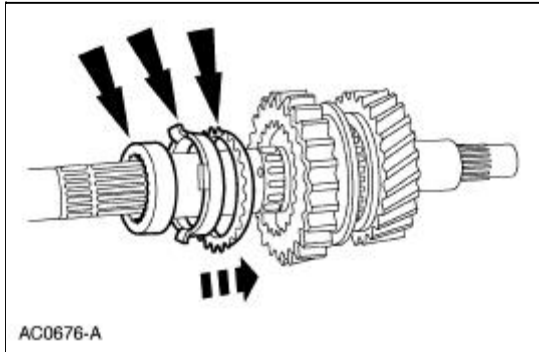
8. Install the thrust washer and the snap ring.



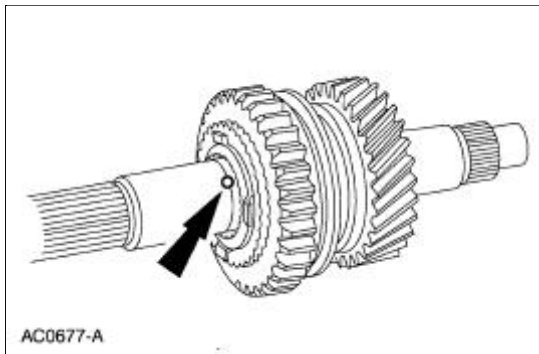
9. **NOTE:** If not done so previously, soak the blocking ring in MERCON® Multi-Purpose ATF Transmission Fluid XT-2-QDX or equivalent for ten minutes.

NOTE: Align the slot in the synchronizer blocking ring with the tab on the first and second synchronizer.

Install the first speed synchronizer blocking ring and the inner and outer cones as an assembly.

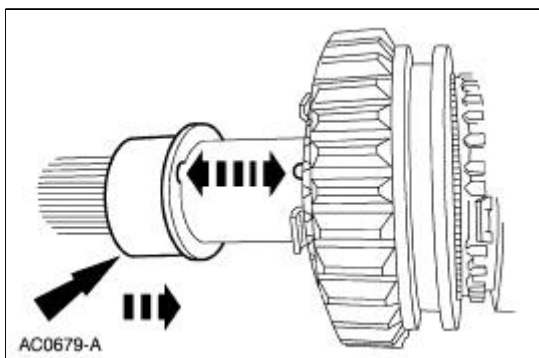


10. Install the first and second speed synchronizer hub ball.



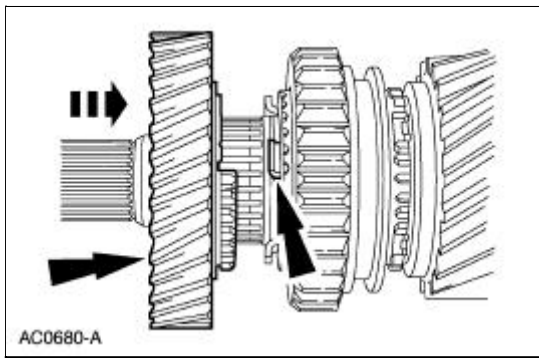
11. **NOTE:** Align the notch in the first gear bearing spacer with the first and second speed synchronizer ball.

Install the first gear bearing spacer and the first gear bearing.

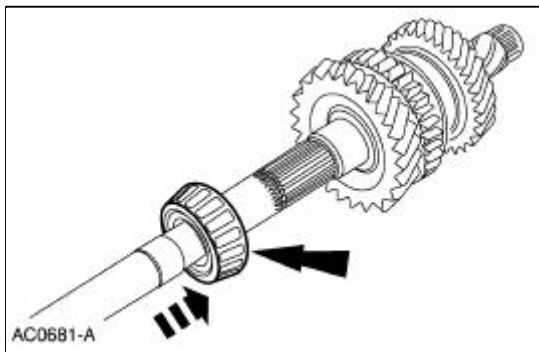


12. **NOTE:** Align the slots on the synchronizer blocking ring with the slots on the first gear.

Install the first gear.



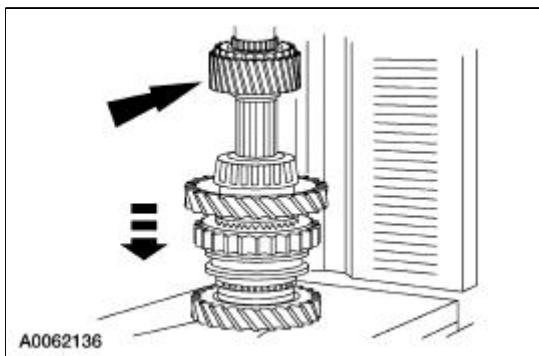
13. Install the output shaft rear bearing.



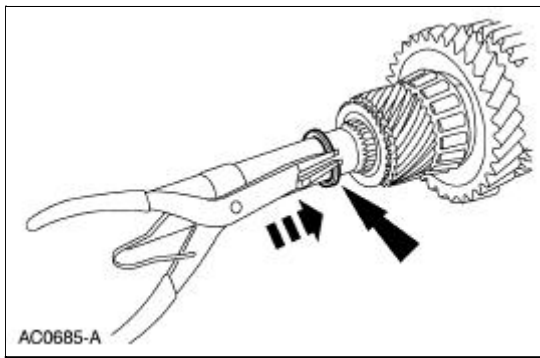
14. Lubricate the splines of the fifth speed driven gear with petroleum jelly.

15.  **CAUTION: Align the output shaft splines and the splines of the fifth speed driven gear or damage will occur.**

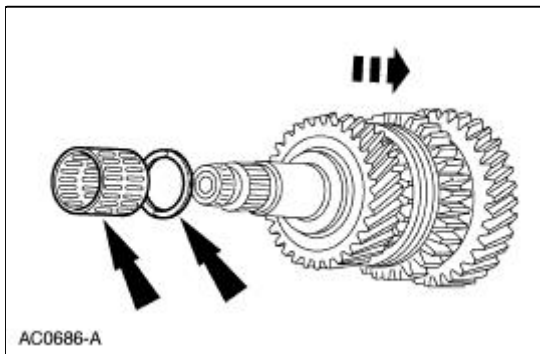
Position the fifth speed driven gear on the output shaft. Using a press and a capped length of pipe 31.7 mm (1.26 in) inside diameter X 356 mm (14.24 in) long, install the fifth speed driven gear.



16. Install the snap ring.



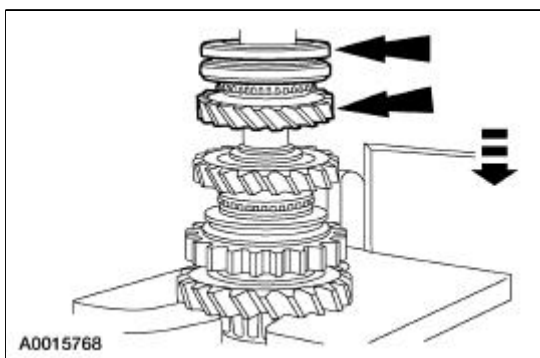
17. Install the third speed gear bearing spacer and the third speed bearing.



18. **⚠ CAUTION:** Before pressing the components together, verify that the synchronizer hub faces the short end of the output shaft. Hold the third gear against the synchronizer to maintain the synchronizer blocking ring alignment.


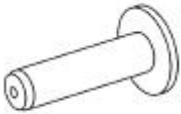

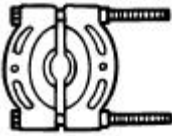



NOTE: If not done so previously, soak the blocking ring in MERCON® Multi-Purpose ATF Transmission Fluid XT-2-QDX or equivalent for ten minutes.

Using a 1-1/2 inch deep well socket and a press, install the third gear, the third speed synchronizer blocking ring, and the third/fourth gear synchronizer assembly.



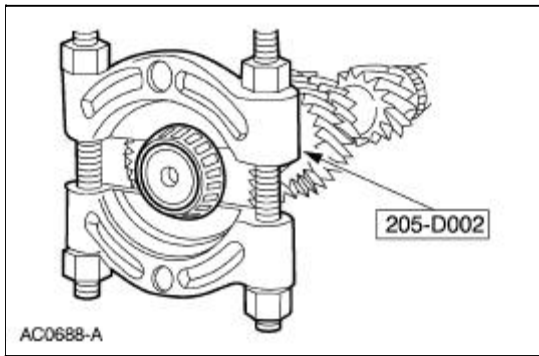
Countershaft Bearing


Special Tool(s)

 <p>ST2356-A</p>	<p>Bearing Replacer 308-061 (T77J-7025-L)</p>
 <p>ST2358-A</p>	<p>Front Bearing Replacer 308-062 (T77J-7025-M)</p>
 <p>ST2357-A</p>	<p>Mainshaft Front Bearing Replacer 308-081 (T82T-7003-DH)</p>
 <p>ST1895-A</p>	<p>Pinion Bearing Cone Remover 205-D002 (D79L-4621-A) or Equivalent</p>
 <p>ST2359-A</p>	<p>Pinion Bearing Cone Replacer 205-011 (T57L-4621-B)</p>
 <p>ST1303-A</p>	<p>Remover and Replacer Tube 308-024 (T75L-7025-B)</p>
 <p>ST2147-A</p>	<p>Remover and Replacer Tube 308-052 (T77J-7025-B)</p>

Disassembly

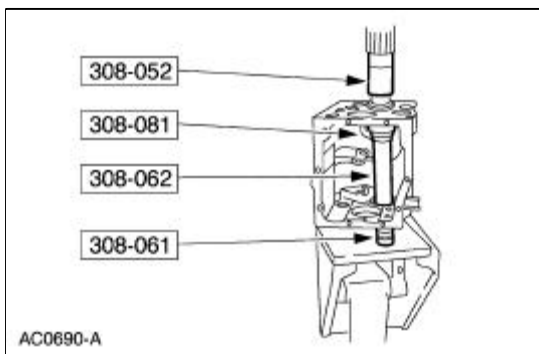
1. Using the special tool and a press, remove the countershaft bearing assembly (7F431).



2.  **CAUTION:** Failure to correctly support the case (7005) during bearing race removal will result in permanent distortion of the case.

NOTE: Remove the front countershaft bearing race only if damaged or worn.

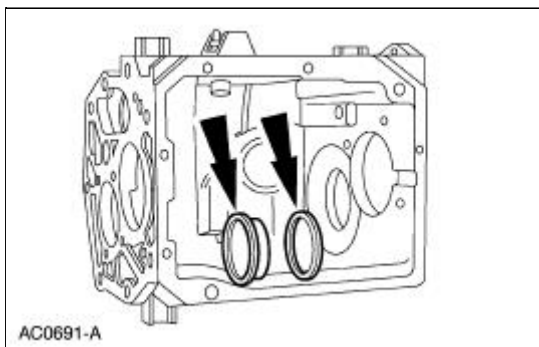
Using the special tools and a press, remove the bearing race and the countershaft front bearing seal (7693).



Assembly

NOTE: Position the countershaft in the transmission case before installing the rear countershaft bearing.

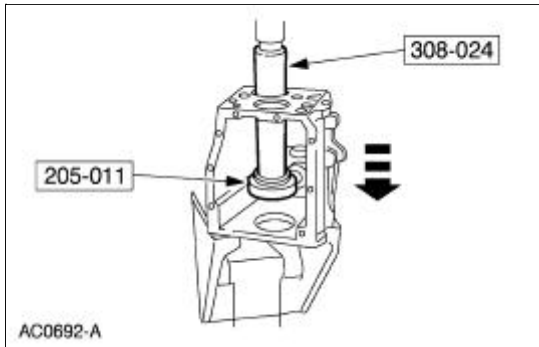
1. Install the countershaft front bearing seal on the bearing race.



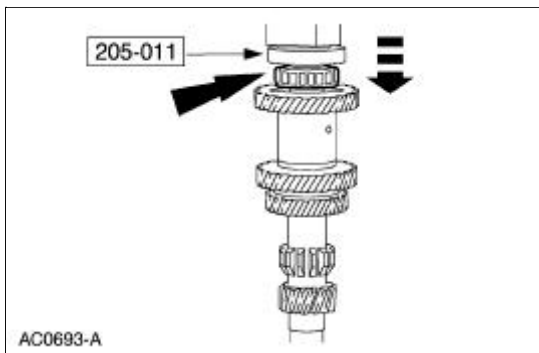
2. Coat the outside diameter of the bearing race with sealer.
 - Use Threadlock and Sealer E0AZ-19554-AA or equivalent meeting Ford specification WSK-M2G351-5A.

3.  **CAUTION: Failure to correctly support the case during bearing race installation will result in permanent distortion of the case.**

Using the special tools and a press, install the bearing race.



4. Using the special tool and a press, install the front countershaft bearing.



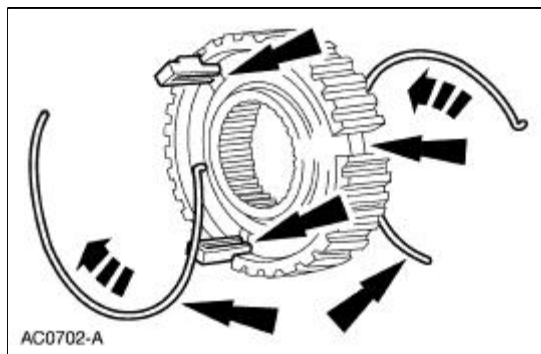
Synchronizers

Disassembly

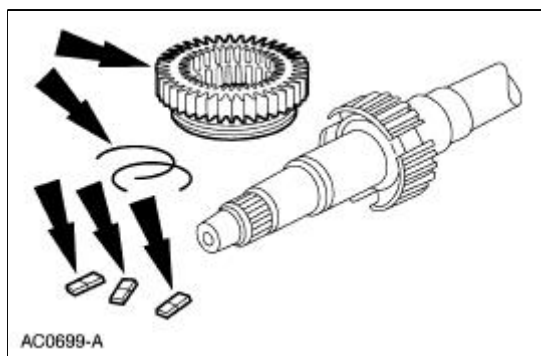
NOTE: This procedure applies to all synchronizer assemblies (7124). The synchronizers are slightly different in design. Notation is made where procedural differences occur.

1. On the third/fourth speed synchronizer and the fifth speed synchronizer, scribe an alignment mark on the sliding sleeve and the hub for assembly reference.
2. **NOTE:** Only the synchronizer hub insert springs (7109) and the synchronizer hub inserts (7A044) are available separately.

Remove the synchronizer hub inserts and the hub insert springs.



3. The first/second speed synchronizer sliding sleeve, the hub, and the output shaft are an assembly. Do not attempt to separate the hub from the output shaft. Discard the entire assembly if wear or damage to the synchronizer or output shaft is evident.



4. On the third/fourth speed synchronizer and the fifth speed synchronizer, remove the sliding sleeve.

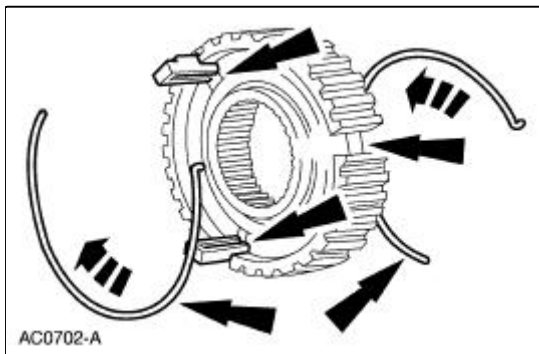
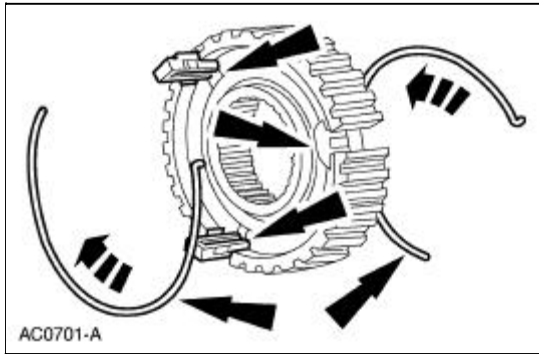
Assembly


1. **NOTE:** Both synchronizer hub insert springs engage the same synchronizer hub insert but rotate in the opposite direction.

NOTE: The third/fourth speed synchronizer uses the winged synchronizer hub inserts.

Install the synchronizer hub inserts and the hub insert springs. Verify that the spring tabs are

positioned over the hub inserts.


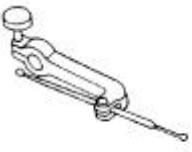
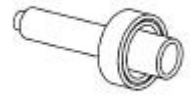





2.  **CAUTION:** Match the alignment marks made during disassembly. The sleeve and the hub have an extremely close fit. Hold the sleeve and hub square to prevent jamming. Do not force the sleeve onto the hub.

On the third/fourth speed synchronizer and the fifth speed synchronizer, install the sliding sleeve.

Transmission

Special Tool(s)

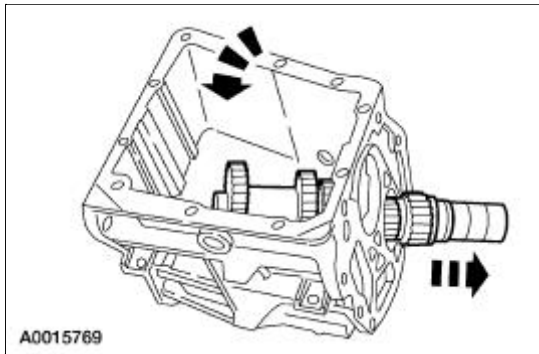
 <p>ST1897-A</p>	<p>Dial Indicator with Bracketry 100-002 (TOOL-4201-C) or Equivalent</p>
 <p>ST1348-A</p>	<p>Gauge, Clutch Housing 308-021 (T75L-4201-A)</p>
 <p>ST2199-A</p>	<p>Extension Housing Seal Replacer 308-227 (T94P-7657-A)</p>
 <p>ST1186-A</p>	<p>Holding Fixture 307-003 (T57L-500-B)</p>
 <p>ST2147-A</p>	<p>Remover and Replacer Tube 308-052 (T77J-7025-B)</p>
 <p>ST2360-A</p>	<p>Torrington Bearing Installer 308-083 (T83P-7025-AH)</p>

Material

Item	Specification
<p>Motorcraft MERCON® Multi- Purpose (ATF) Transmission Fluid XT-2-QDX</p>	<p>MERCON®</p>
<p>Pipe Sealant with Teflon®</p>	<p>ESR-M18P7-</p>

D8AZ-19554-A	A
Multi-Purpose Grease D0AZ-19554-AA	ESB-M1C93- B
Clear Silicone Rubber D6AZ-19562-AA	ESB-M4G92- A
Motorcraft Premium Long Life Grease XG-1-C	ESA-M1C75- B

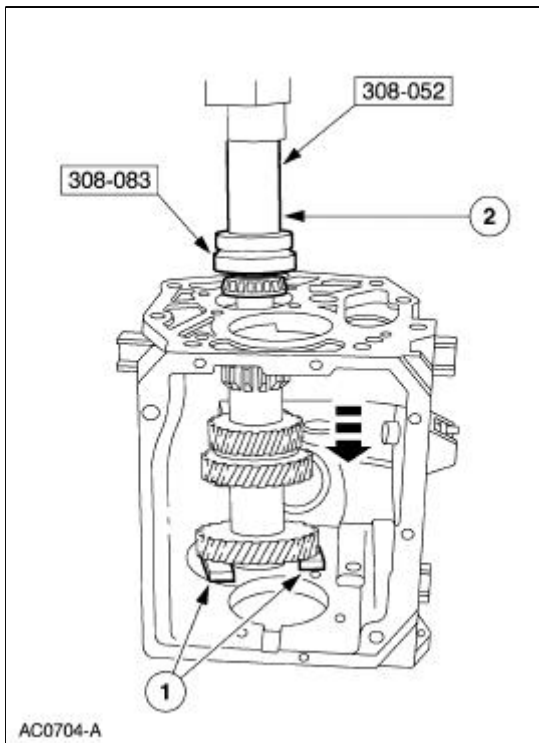
1. Soak the blocking rings in transmission fluid for ten minutes.
2. Position the countershaft cluster gear in the case.



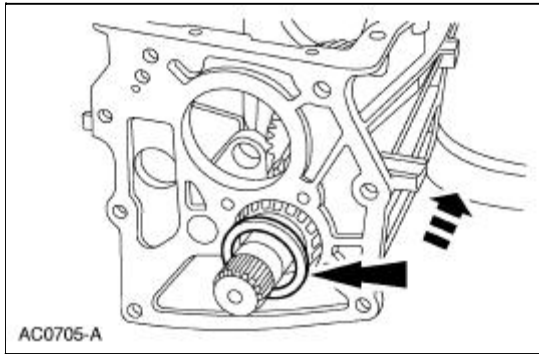
3. **⚠ CAUTION: Failure to correctly support the case during bearing installation will result in permanent distortion of the case.**

Using a the special tools and a press, install the rear countershaft bearing assembly.

1. Position two 6.35 mm (0.25 in) pieces of bar stock between the countershaft and the case.
2. Using a the special tools and a press, install the rear countershaft bearing assembly.

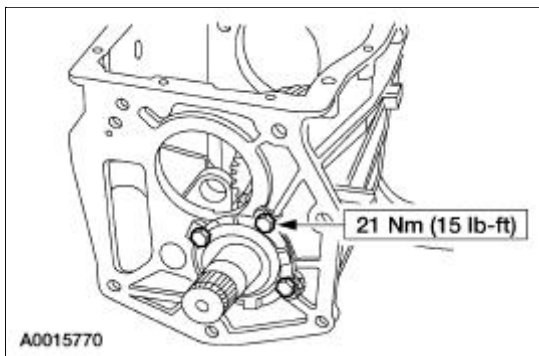


4. Install the rear countershaft bearing race.

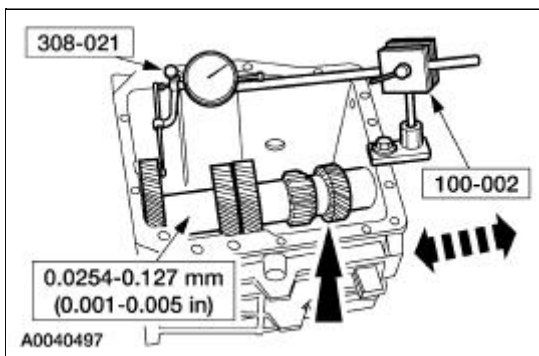


5. **NOTE:** Do not install the shims at this time.

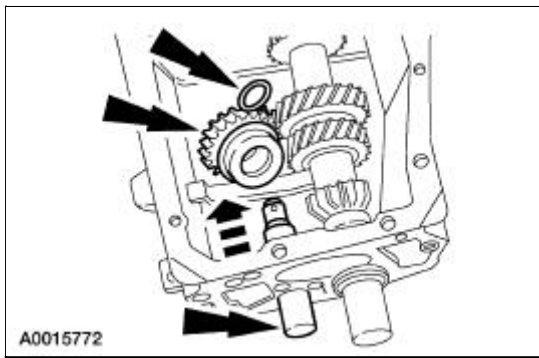
Install the countershaft rear bearing retainer.



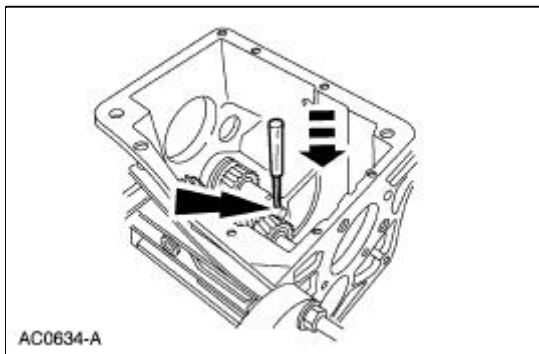
6. Using the special tool, measure the countershaft cluster gear end play.
 - If the end play is not within the specifications, remove the countershaft rear bearing retainer, and install the necessary thickness shim(s). Reinstall the countershaft rear bearing retainer, and recheck the end play.
 - Bend the tabs of the countershaft rear bearing retainer over the bolts when the end play adjustment is complete.



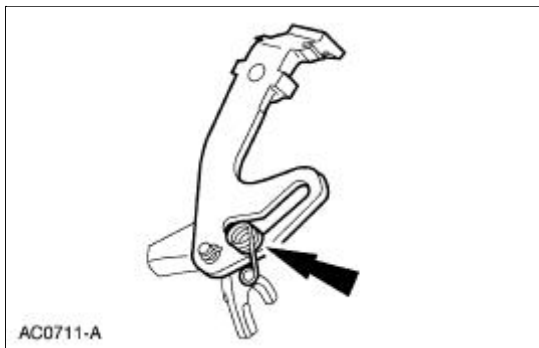
7. Position the reverse idler gear and bushing in the case with the shift lever groove facing the rear of the case. Install the reverse idler gear shaft and the reverse gear overtravel stop.



8. Install the pin.



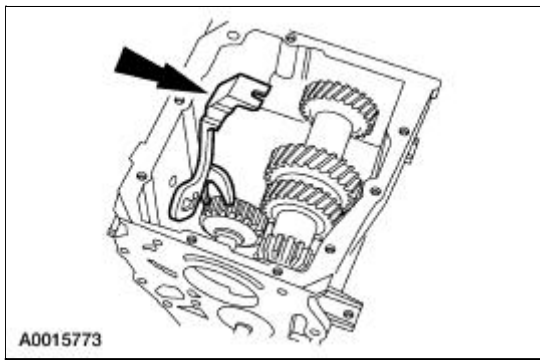
9. Align the reverse gearshift lever, the reverse shift fork, and the reverse positioning spring.



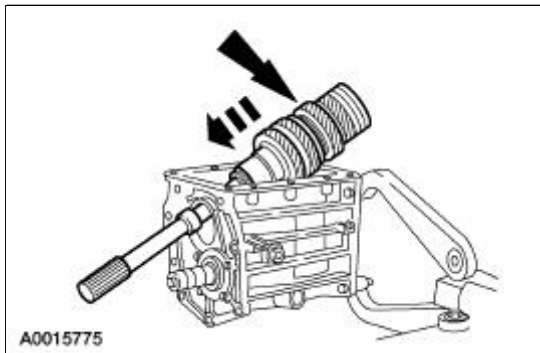
10. **NOTE:** Observe the reverse positioning spring rotation. The spring must rotate counterclockwise into its installed position.

Install the reverse shift fork.

- Place the reverse idler gear and bushing into the NEUTRAL position. Align the reverse shift fork and the reverse idler gear and bushing. Push downward on the reverse shift fork until fully engaged into the reverse idler gear and bushing.

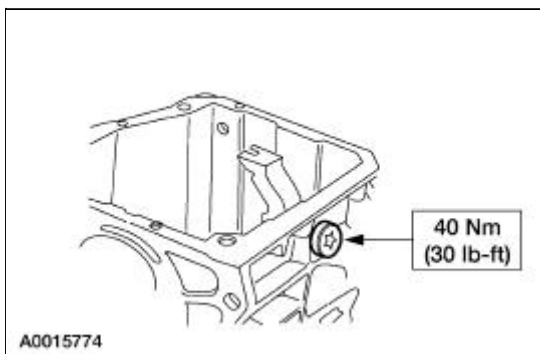


11. Install the output shaft assembly.

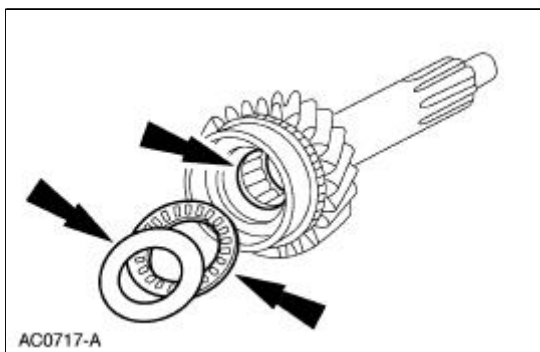


12. **NOTE:** Position the looped end of the reverse positioning spring around the shift lever reverse pin.

Apply pipe sealant to the shift lever reverse pin threads and install the pin.



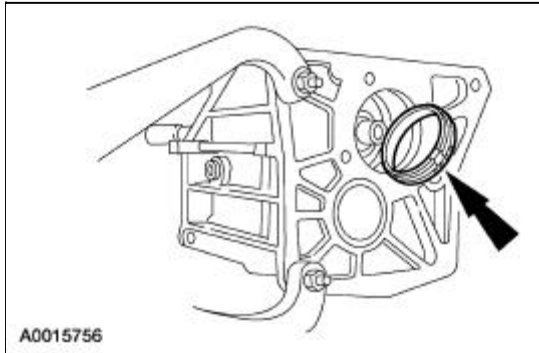
13. Install the roller bearings, the input shaft bearing spacer, the thrust bearing, and the thrust washer.
 - Coat the 15 bearings, the spacer, the thrust bearing, and the thrust washer with grease.



14. **NOTE:** If not done so previously, soak the blocking ring in MERCON® Multi-Purpose ATF Transmission Fluid XT-2-QDX or equivalent for ten minutes.

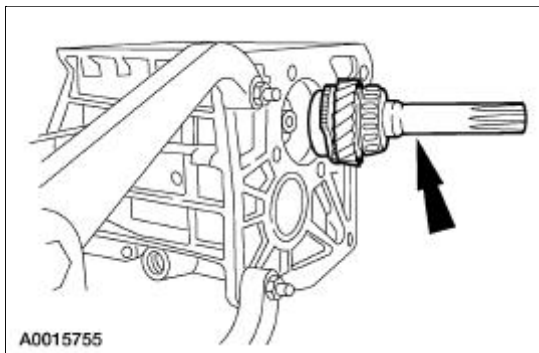
Install the fourth speed synchronizer blocking ring.

- Align the notches in the synchronizer blocking ring and the synchronizer hub inserts.



15. **NOTE:** Verify that the fourth speed synchronizer blocking ring is still in position.

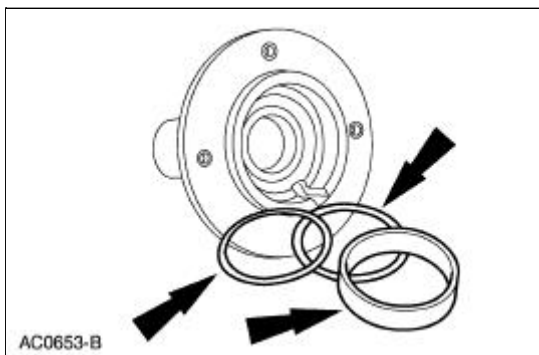
Align the flat on the fourth gear clutching teeth with the countershaft cluster gear and install the input shaft.



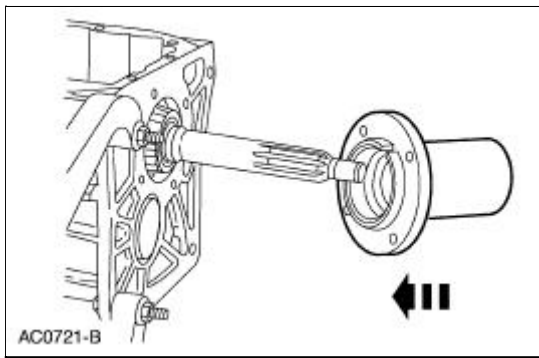
16. **NOTE:** Do not install the end play shims at this time.

NOTE: Do not apply sealant to the input shaft bearing retainer at this time.

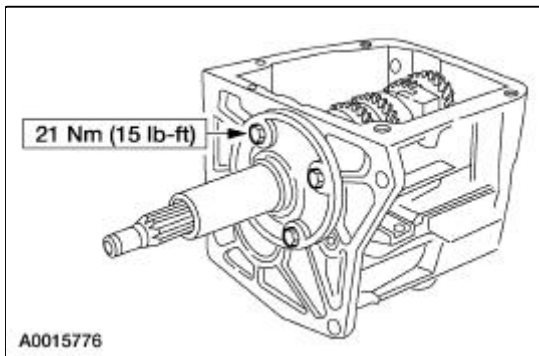
Install the bearing race in the bearing retainer.



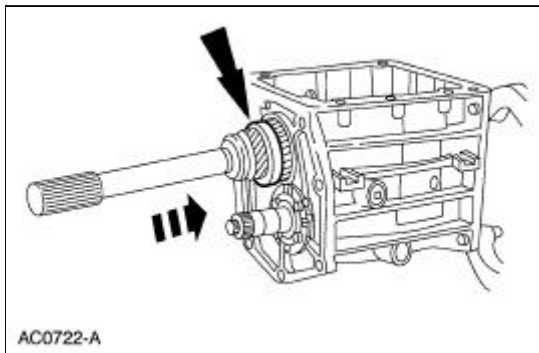
17. Install the input shaft bearing retainer with the notch facing upward.



18. Install the bolts.

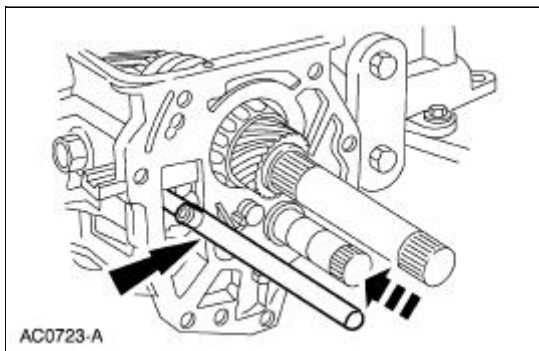


19. Install the output shaft rear bearing cup.



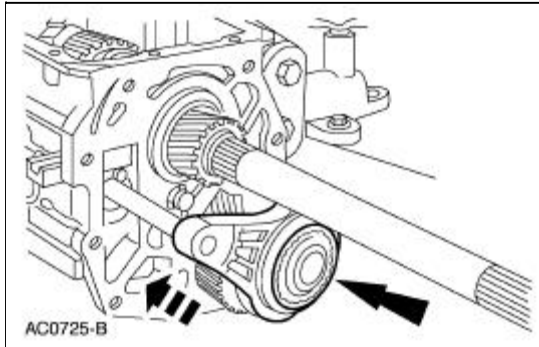
20. Install the reverse gear shift rail.

- Align the ball stud with the slot in the case and align the reverse gear shift rail with the reverse shift fork. Once the ball stud enters the case, rotate the reverse gear shift rail until the ball aligns with the reverse gearshift lever. Rotate the reverse gear shift rail counterclockwise until the ball stud fully engages the reverse gearshift lever.



21. **NOTE:** If not done so previously, soak the blocking ring in transmission fluid for ten minutes.

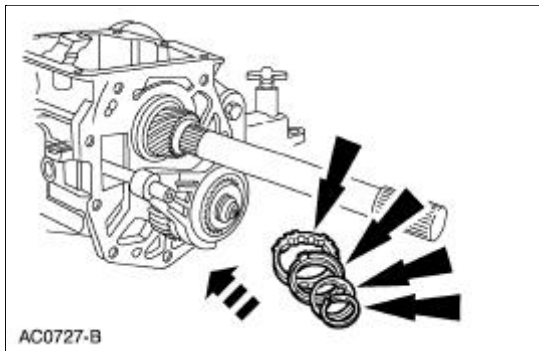
Install the fifth speed cluster gear, the synchronizer blocking ring, the synchronizer assembly, and the fifth gear shifter fork as an assembly.



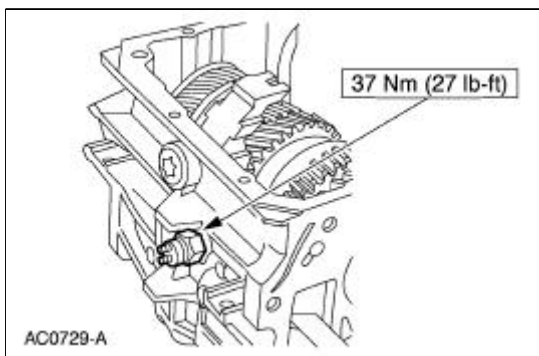
22. **CAUTION:** To prevent component damage when installing the extension housing (7A039), the alignment tab on the reverse brake ring (7M000) must engage the alignment slot in the extension housing.

NOTE: If not done so previously, soak the blocking ring in transmission fluid for ten minutes.

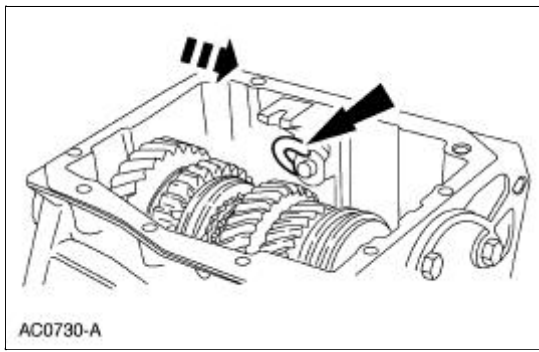
Install the synchronizer blocking ring, the reverse brake ring, the thrust washer, and the fifth speed synchronizer retaining snap ring.



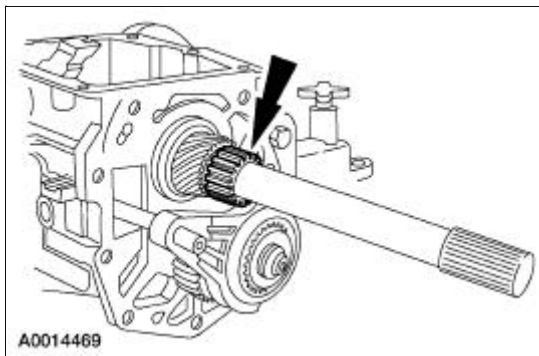
23. Apply pipe sealant to the reversing lamp switch threads and install the switch.



24. Install the reverse gearshift lever retaining clip.



25. Install the output shaft speed wheel and the snap ring.



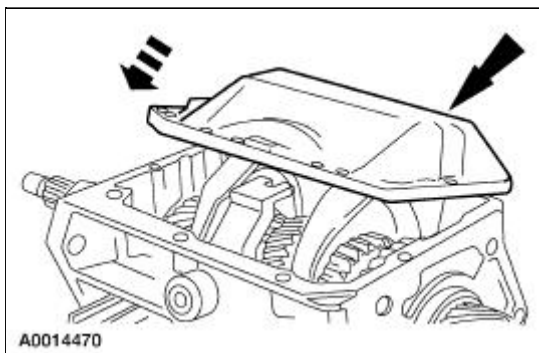
26.  **CAUTION:** Do not under any circumstance apply silicone sealant to the top of the transmission case. The sealant could fall into the transmission and affect transmission operation.

Apply a 3.2-mm (1/8-in) bead of silicone rubber to the sealing surface on the case cover.

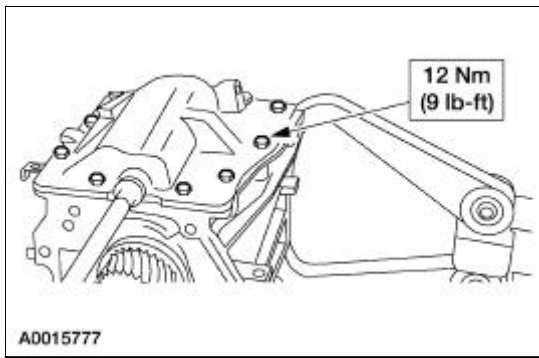
27. **NOTE:** Verify that all of the synchronizers are in the NEUTRAL position and the gear shifter forks in the cover are in the NEUTRAL position.

Install the case cover.

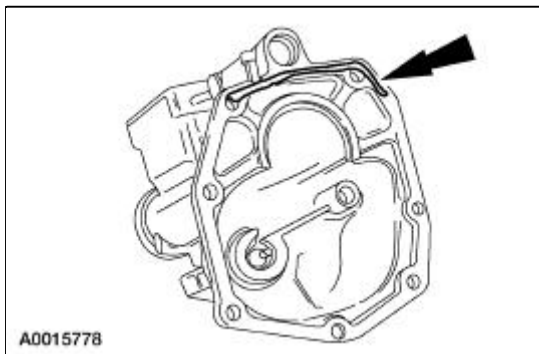
- Position the cover toward the filler plug side of the transmission and lower it until the gear shifter forks engage the synchronizers. Continue to lower the cover and move it into position to engage the reverse gearshift lever.



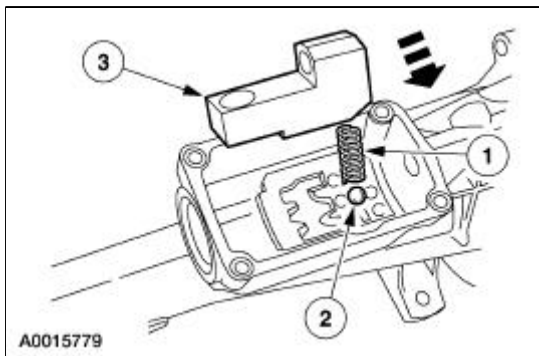
28. Install the bolts.



29. Apply a 3.2-mm (1/8-in) bead of silicone rubber to the sealing surface on the extension housing.



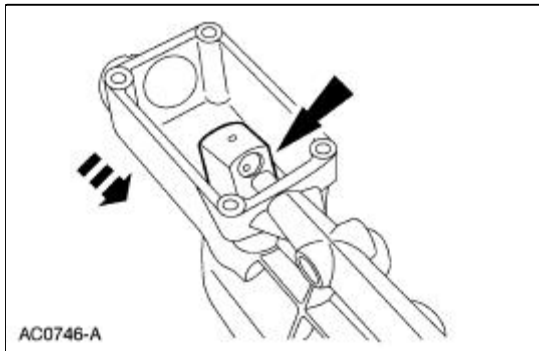
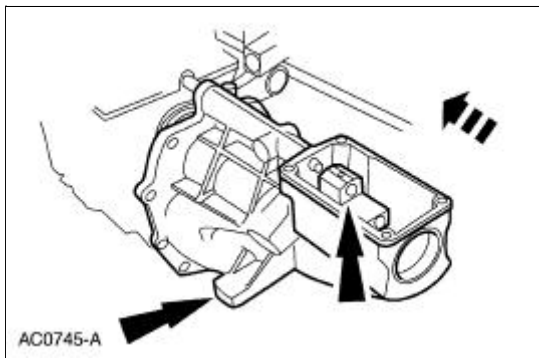
30. Install the detent ball, the shifter detent spring, and the gearshift offset lever.
1. Coat the shifter detent spring with petroleum jelly and install it in the gearshift offset lever.
 2. Lubricate the detent plate and install the detent ball in the neutral position on the plate.
 3. Position the gearshift offset lever in the extension housing with the gear shift interlock spring over the detent ball.



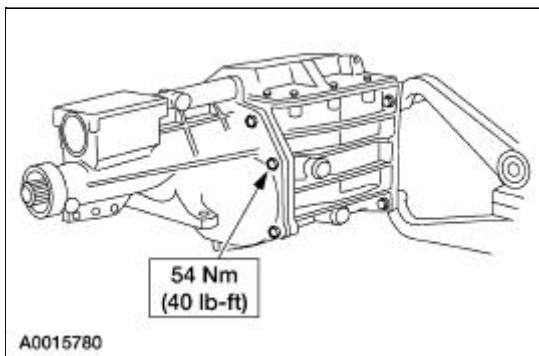
31. **⚠ CAUTION:** To prevent component damage, the alignment tab on the reverse brake ring must align with the alignment slot in the extension housing.

NOTE: Verify that the oil pick-up funnel engages the fifth gear synchronizer.

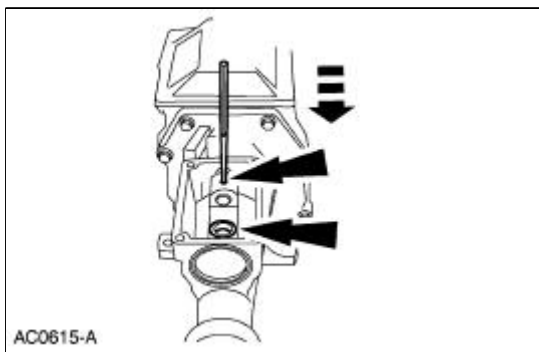
Slide the gearshift offset lever and the extension housing into place as an assembly. Press downward on the gearshift offset lever to compress the shifter interlock spring and push the gearshift offset lever and extension housing into place.



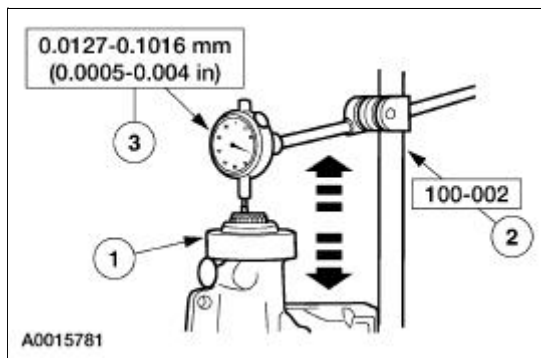
32. Install the identification tag and the bolts.



33. Install the split pin and the gearshift shaft bushing.



34. Using the special tools, measure the output shaft end play.
1. Place the transmission in a vertical position.
 2. Install the special tool.
 3. Push upward on the input shaft and record the dial indicator reading.

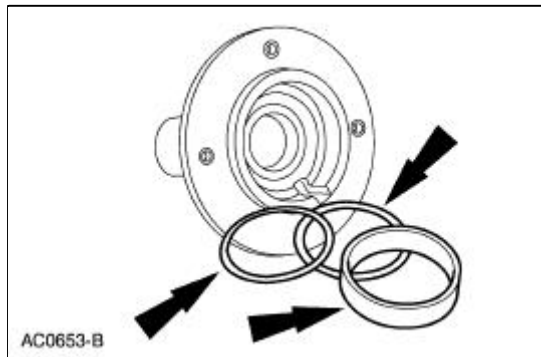


35. **⚠ CAUTION:** Install the thickest shim closest to the front bearing cup to provide support for the cup.

⚠ CAUTION: Although zero end play is the ideal, end play up to mm (0.002 in) is an acceptable tolerance. Do not overload the bearings with a shim that is too thick as damage may occur.

NOTE: Select a shim with a thickness equal to the dial indicator reading. This will provide zero end play.

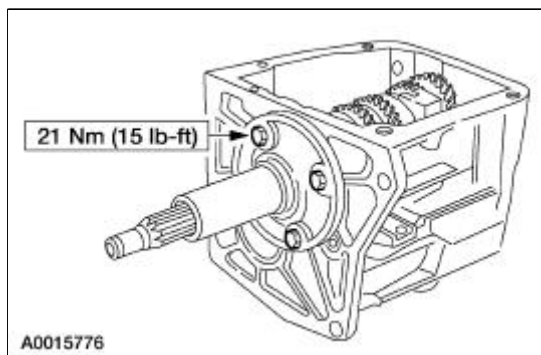
Rotate the transmission to the horizontal position and remove the input shaft bearing retainer. Remove the bearing race and install the necessary shim(s).



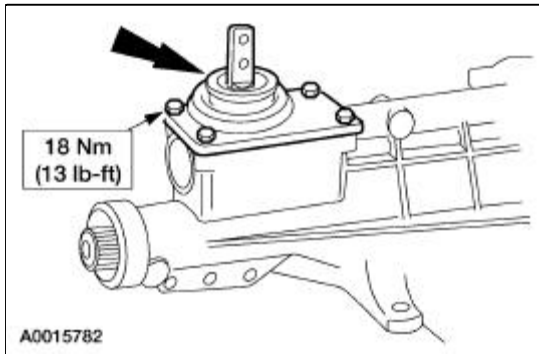
36. **⚠ CAUTION:** Do not cover the notch in the input shaft bearing retainer with sealer.

Apply a 3.2-mm (1/8-inch) bead of silicone rubber to the sealing surface on the input shaft bearing retainer.

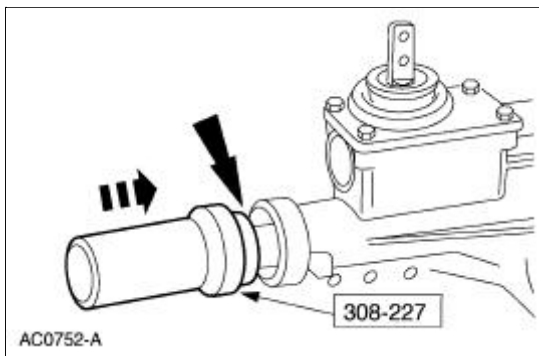
37. Install the input shaft bearing retainer and the four bolts.



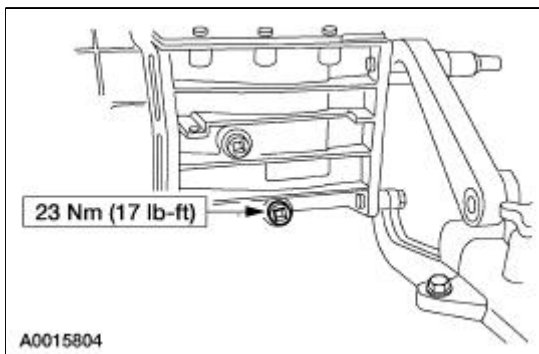
38. Apply a 3.2-mm (1/8-inch) bead of silicone rubber to the sealing surface on the gearshift lever.
39. Install the gearshift lever.



40. Using the special tool, install the extension housing fluid seal.



41. Install the case plug.



42. **NOTE:** Before installing the transmission, the ball stud, clutch release lever and the input shaft must be cleaned and lubricated with grease.

Install the clutch release hub and bearing and the clutch release lever. For additional information, refer to [Section 308-01](#).

Transmission

1. **NOTE:** Before installing the transmission, the ball stud, clutch release lever and the input shaft must be cleaned and lubricated. Use Motorcraft Premium Long-Life Grease XG-1-C or XG-1-K or equivalent meeting Ford specification ESA-M1C75-B.

To install, reverse the removal procedure. Refer to [Transmission](#) in this section.

- Check, and as necessary, fill the transmission with MERCON® Multi-Purpose ATF Transmission Fluid XT-2-QDX or equivalent. The total fill capacity is 2.6L (2.8 qt).
-

General Specifications

Item	Specification
Lubricants and Sealants	
Premium Long-Life Grease XG-1-C, K or T	ESA-M1C75-B
Threadlock and Sealer E0AZ-19554-AA	WSK-M2G351-A5
Black Silicone Rubber D6AZ-19562-BA	ESB-M4G92-A
Pipe Sealant with Teflon® D8AZ-19554-A	ESR-M18P7-A
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®
Synchronizer	
Synchronizer blocking ring to conical face runout	0.5 mm (0.02 in)
End Play	
Input shaft end play	0.02286 mm (0.0009 in) - 0.0508 mm (0.002 in)
Countershaft cluster gear end play	0.0 mm (0.0 in) - 0.076 mm (0.003 in)
Output shaft end play	0.0012 mm (0.0005 in) - 0.100 mm (0.004 in)

Torque Specifications

Description	Nm	lb-ft	lb-in
Gearshift lever to extension housing bolt	23	13	—
Gear shift lever to gear shift stub shaft bolt	37	27	—
OSS to case bolt	10	—	89
Reverse idler gear bolt	27	20	—
Fifth/reverse lockout bolt	20	15	—
Clutch housing to transmission main case bolt	31	23	—
Extension housing to transmission main case bolt	31	23	—
Drain plug	23	17	—
Reversing lamp switch	37	27	—
Fill plug	17	13	—
Transmission to engine bolt	75	55	—
Engine plate to transmission bolt	27	20	—
Crossmember to frame bolt	41	30	—

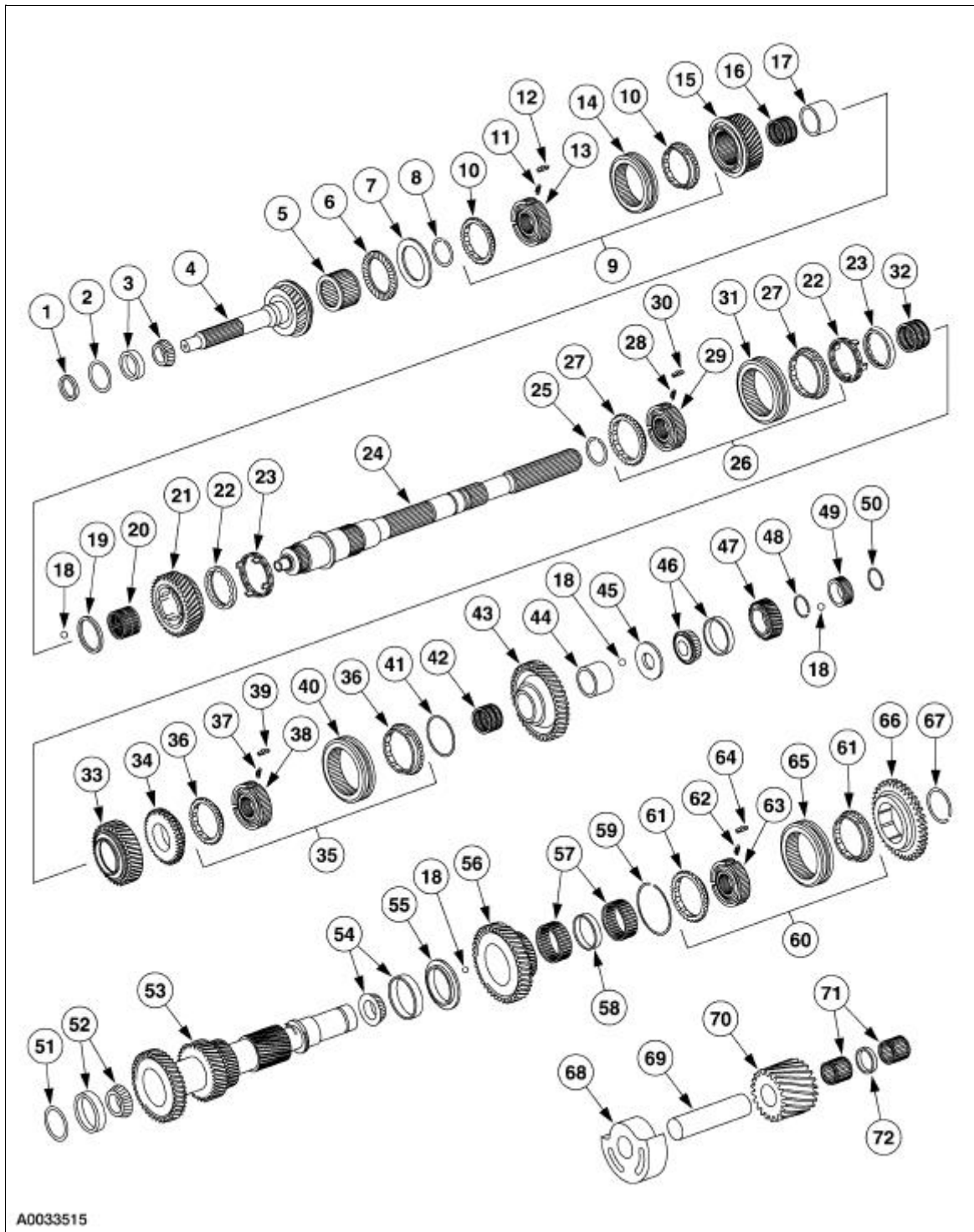
Crossmember to transmission support bolt	58	43	—
Driveshaft flange to pinion flange bolt	112	83	—

Manual Transmission

The TR3650 five-speed manual transmission features the following:

- The fifth speed gear functions as an overdrive gear.
- The forward gears are synchronized and helical cut.
- The reverse gear operates through a constant-mesh, fully synchronized system.
- The shift interlock system prevents the engagement of more than one gear.
- The countershaft is serviced as an assembly.
- An aluminum main case, extension housing and bell housing.

Transmission Internal Components — Disassembled View



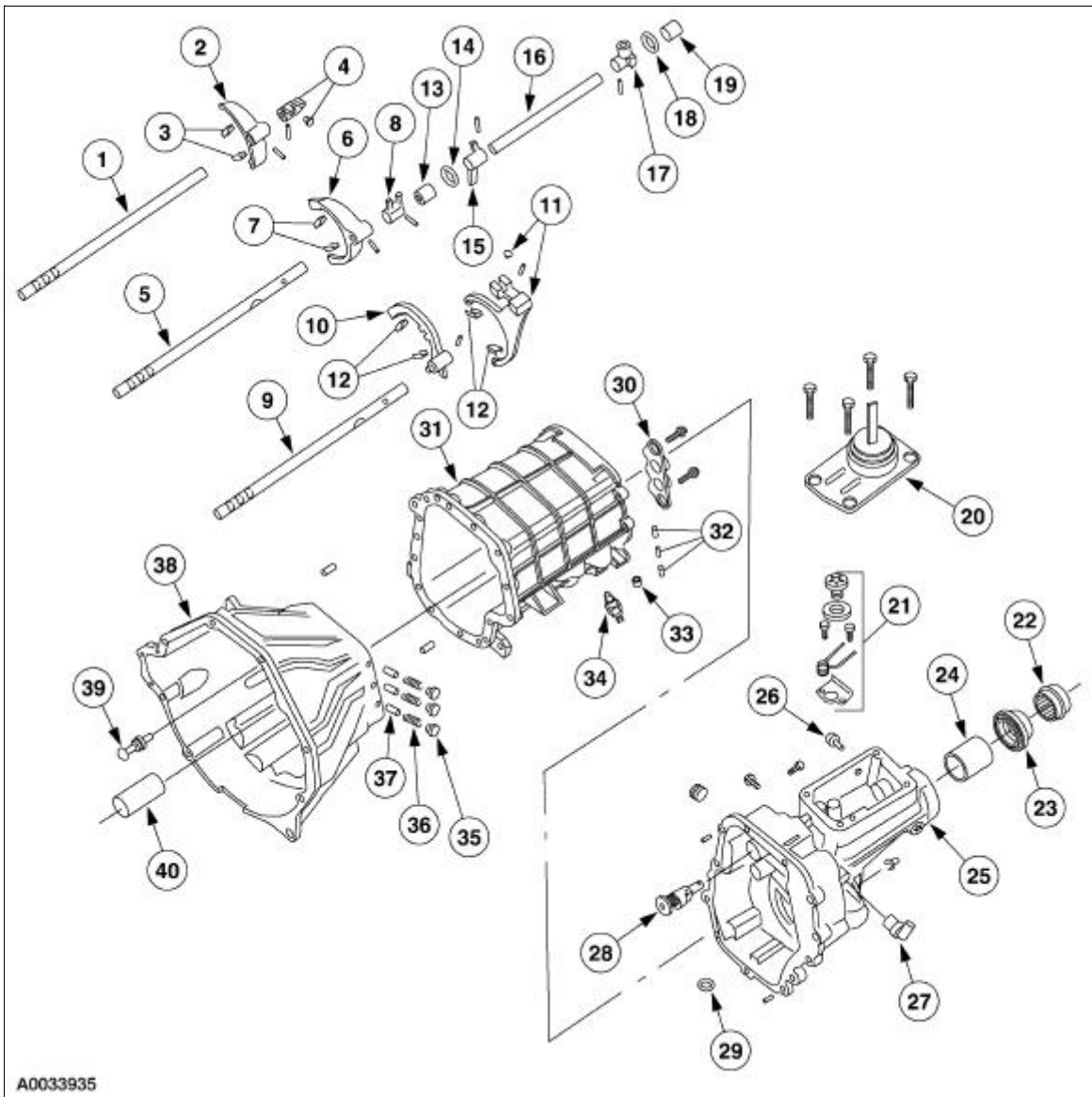
A0033515

Item	Part Number	Description
1	7052	Input shaft seal
2	7L172	Shim
3	7025	Input shaft front bearing and cup
4	7017	Input shaft
5	7025	Input shaft pocket bearing
6	—	Input shaft thrust bearing
7	—	Input shaft thrust washer

8	7064	Retaining ring
9	7124	Third/fourth gear synchronizer assembly
10	7107	Third/fourth gear synchronizer blocking ring
11	—	Third/fourth gear synchronizer spring (part of 7124)
12	—	Third/fourth gear synchronizer insert (part of 7124)
13	—	Third/fourth gear synchronizer hub (part of 7124)
14	—	Third/fourth gear synchronizer sleeve (part of 7124)
15	7B340	Third gear
16	7B369	Third gear needle bearing
17	—	Third gear bushing
18	—	Check ball
19	—	Thrust washer
20	—	Second gear needle bearing
21	7102	Second gear
22	7175	First/second gear synchronizer inner cone
23	7174	First/second gear synchronizer outer cone
24	7061	Output shaft
25	—	Retaining ring
26	7124	First/second gear synchronizer assembly
27	7107	First/second gear synchronizer blocking ring
28	—	First/second gear synchronizer spring (part of 7124)
29	—	First/second gear synchronizer hub (part of 7124)
30	—	First/second gear synchronizer insert (part of 7124)
31	—	First/second gear synchronizer sleeve (part of 7124)
32	7127	First gear needle bearing
33	7100	First gear
34	—	Reverse clutch cone
35	7124	Reverse gear synchronizer assembly
36	7107	Reverse gear synchronizer blocking ring
37	—	Reverse gear synchronizer spring (part of 7124)
38	—	Reverse gear synchronizer hub (part of 7124)
39	—	Reverse gear synchronizer insert (part of 7124)
40	—	Reverse gear synchronizer sleeve (part of 7124)
41	—	Retaining ring
42	7N168	Reverse needle bearing
43	7C238	Reverse driven gear
44	—	Reverse gear bushing

45	—	Selector gate
46	7025	Mainshaft rear bearing and cup
47	7K316	Mainshaft fifth gear
48	—	Retaining ring
49	7H150	Output shaft speed (OSS) sensor
50	—	Retaining ring
51	7L172	Shim
52	7025	Countershaft front bearing and cup
53	7113	Countershaft
54	7025	Countershaft rear bearing and cup
55	—	Thrust bearing
56	7144	Countershaft fifth gear
57	—	Countershaft fifth gear needle bearing
58	—	Countershaft fifth gear bearing spacer
59	—	Retaining ring
60	7124	Fifth gear synchronizer assembly
61	7107	Fifth gear synchronizer blocking ring
62	—	Fifth gear synchronizer spring (part of 7124)
63	—	Fifth gear synchronizer hub (part of 7124)
64	—	Fifth gear synchronizer insert (part of 7124)
65	—	Fifth gear synchronizer sleeve (part of 7124)
66	—	Fifth gear clutch cone
67	—	Retaining ring
68	—	Reverse idler gear support
69	7140	Reverse idler gear shaft
70	7141	Reverse idler gear
71	7E169	Reverse idler gear needle bearing
72	—	Reverse idler gear bearing spacer

Transmission Case and Shift Components — Disassembled View



A0033935

Item	Part Number	Description
1	7358	First/second shift rail
2	7239	First/second shift fork
3	7L082	Shift fork inserts
4	—	First/second shift finger
5	7241	Third/fourth shift rail
6	7230	Third/fourth shift fork
7	7L082	Shift fork inserts
8	—	Third/fourth shift finger
9	7242	Fifth/reverse shift rail
10	—	Reverse gear shift fork
11	—	Fifth gear shift fork
12	7L082	Shift fork inserts
13	—	Shift arm bearing
14	—	Spacer
15	—	Shift arm selector inhibitor

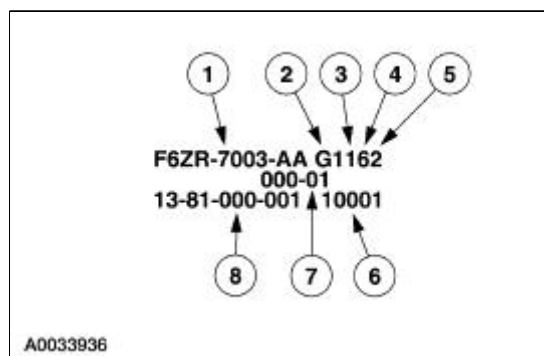
16	7240	Main shift rail
17	7F018	Gearshift offset lever
18	—	Spacer
19	—	Bearing
20	7210	Gearshift lever
21	—	Gearshift plate and spring
22	—	Shipping seal
23	7052	Output shaft seal
24	—	Extension housing bushing
25	7A039	Extension housing
26	7034	Vent
27	—	Vehicle speed sensor (VSS)
28	—	Fifth/reverse gear lockout
29	7L027	Magnet
30	7K201	Shift interlock plate
31	7005	Transmission main case
32	—	Interlock pins
33	7A010	Drain plug
34	15520	Reverse lamp switch
35	—	Detent plug
36	—	Detent spring
37	—	Detent
38	6392	Clutch housing
39	7B602	Ball stud
40	—	Bearing

Transmission Identification

The transmission identification tag is located under the lower bolt that retains the extension housing to the main case.

The five speed overdrive (TR3650) transmission is available for the Mustang 4.6L (2V).

Transmission Identification



	Part	
--	-------------	--

Item	Number	Description
1	—	Transmission assembly number
2	—	Build date code—month
3	—	Build date code—day
4	—	Build date code—year
5	—	Shift number
6	—	Serial number
7	—	Service repair code
8	—	Identification number located on left lower side of transmission case

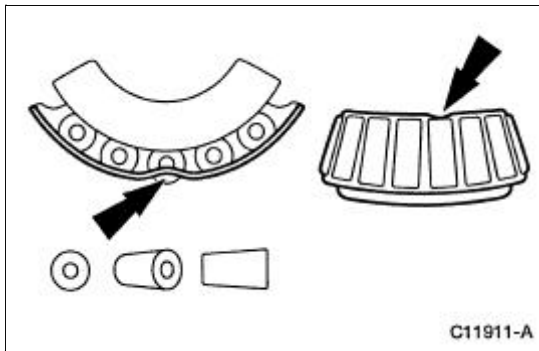
Manual Transmission

Refer to [Section 308-00](#) .

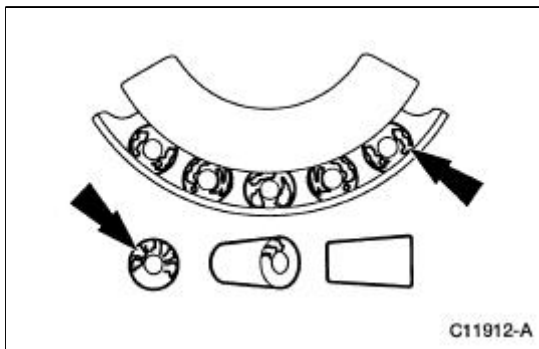
Bearings — Inspection

NOTE: If any of the following conditions exist, install a new bearing.

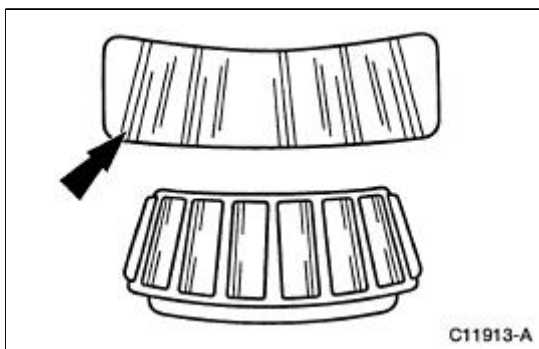
1. Inspect the bearing for a bent cage.



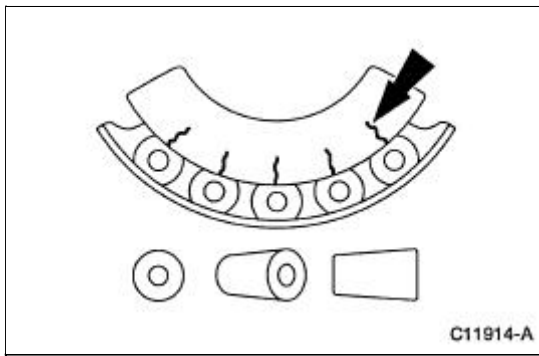
2. Inspect bearings for galling (metal smears on roller ends).
 - Galling is caused by overheating, poor lubrication or an overload situation.
 - If galling is found, install a new bearing and inspect the seals.



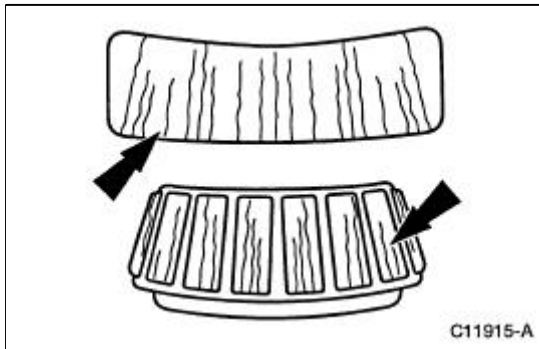
3. Inspect the bearing for brinelling (surface indentations in the raceway).



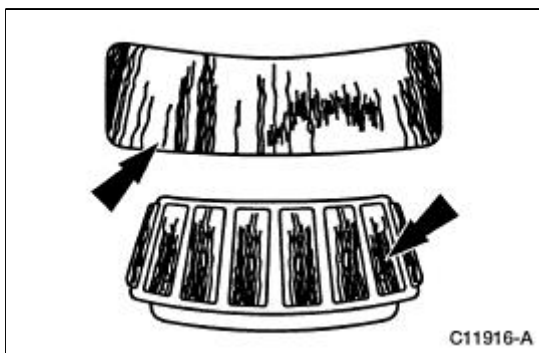
4. Inspect bearing for cracked inner race.



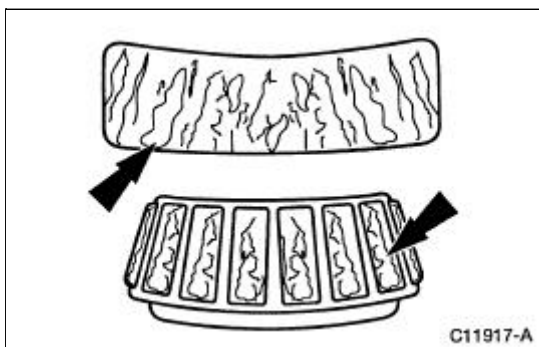
5. Inspect the bearing and raceway for etching.
 - If etching is present, inspect the seals.



6. Inspect the bearing for heat discoloration (dark blue).
 - If heat discoloration is evident, check the bearing and race for loss of temper. Draw a file across the component. If the file cuts the metal, there is a loss of temper.



7. Inspect the bearing for fatigue spalling (metal flaking).



Seal

Special Tool(s)

 ST2199-A	Installer, Transmission Extension Housing Oil Seal 308-227 (T94P-7657-A)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST2200-A	Remover, Bushing 307-001 (TOOL-1175-AC) or Equivalent

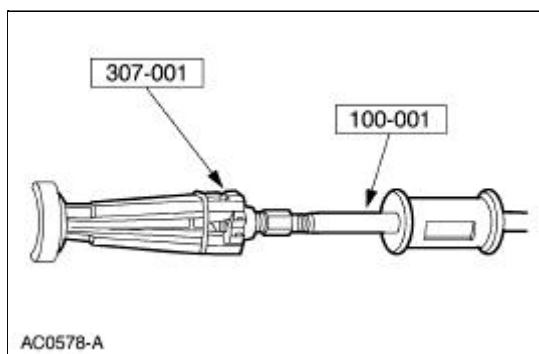
Removal

1. With the vehicle in NEUTRAL, raise and support the vehicle. For additional information, refer to [Section 100-02](#).

2.  **CAUTION: Index-mark the driveshaft flange and pinion flange, and the driveshaft slip yoke and transmission output shaft.**

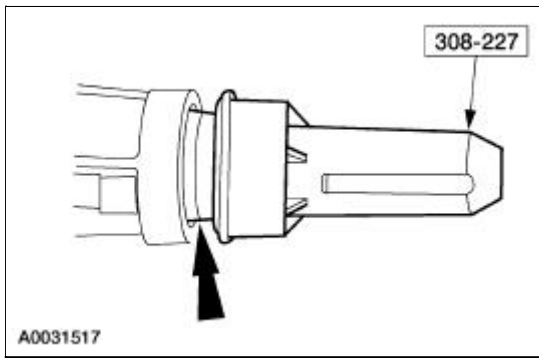
Remove the driveshaft. For additional information, refer to [Section 205-01](#).

3. Using the special tools, remove the extension housing fluid seal.



Installation

1. Using the special tool, install the extension housing fluid seal.



2.  **CAUTION: Align the index marks.**

Install the driveshaft. For additional information, refer to [Section 205-01](#).

3. Check the transmission fluid level, add fluid if necessary.
 4. Lower the vehicle.
-

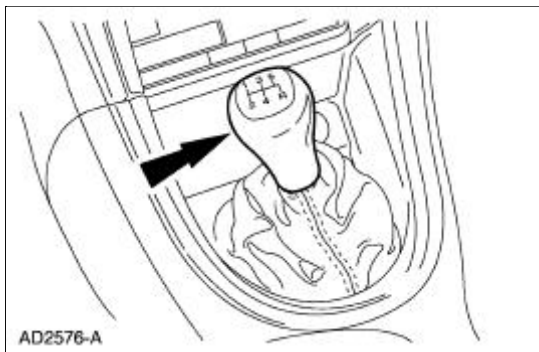
Gearshift Lever and Boot

Material

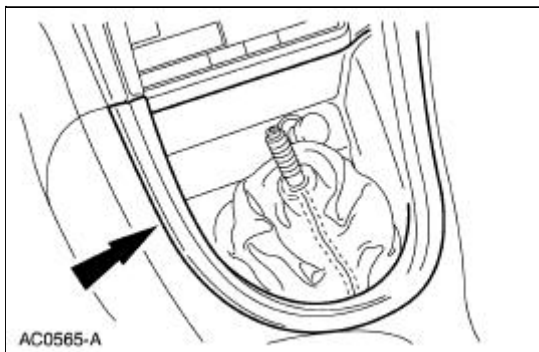
Item	Specification
Clear Silicone Rubber D6AZ-19562-AA or equivalent	ESB-M4G92-A

Removal and Installation

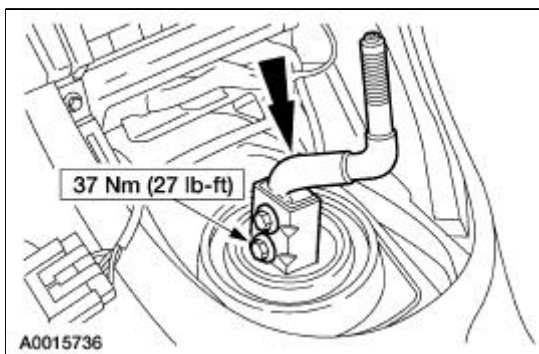
1. Remove the gearshift lever knob.



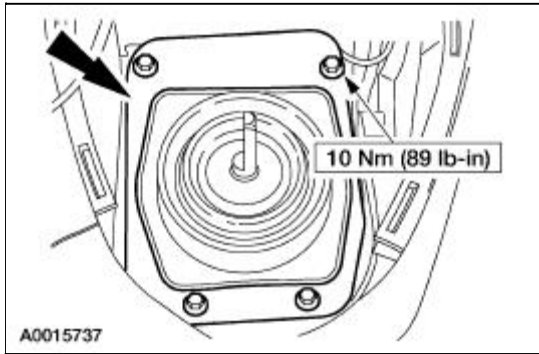
2. Remove the console panel gearshift plate. Lift the gearshift lever boot over the gearshift lever.



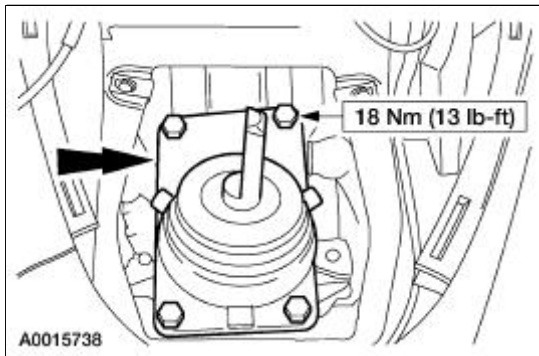
3. Remove the bolts and the shift lever.



4. Remove the screws and the inner shifter boot.



5. Remove the bolts and the gearshift lever.



6. Remove the gearshift lever boot.

7.  **CAUTION: Cover the opening in the extension housing to prevent contamination.**

Clean the gearshift lever mounting surfaces.

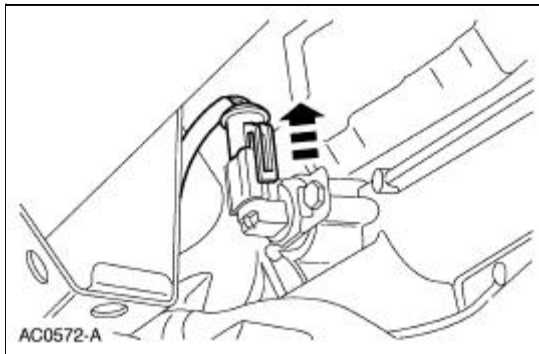
8. To install, reverse the removal procedure.

- Apply a 3.2-mm (1/8-in) bead of silicone rubber to the sealing surface on the gearshift lever.
-

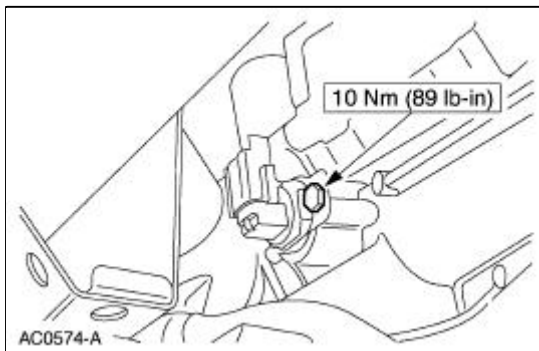
Output Shaft Speed (OSS) Sensor

Removal and Installation

1. With the vehicle in NEUTRAL, raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Disconnect the electrical connector.



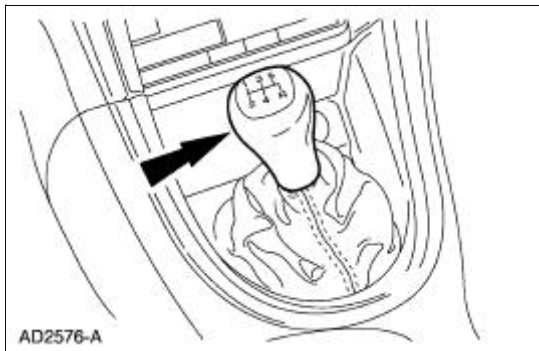
3. Remove the output shaft speed (OSS) sensor.



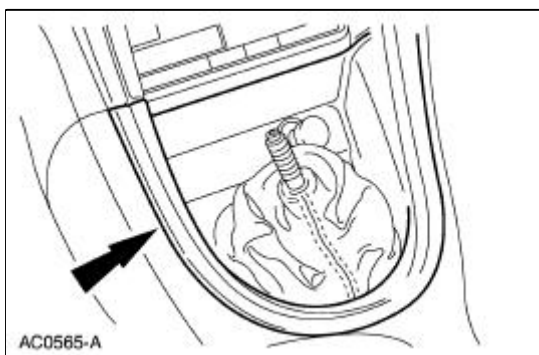
4. To install, reverse the removal procedure.

Transmission

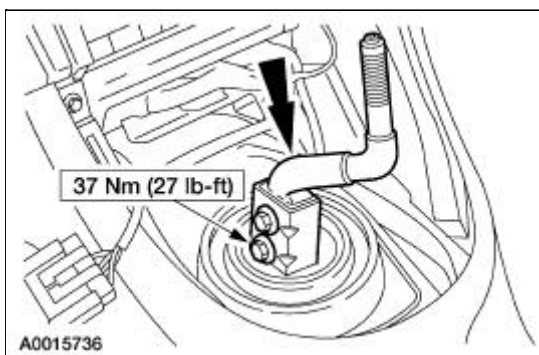
1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Remove the gearshift lever knob.




3. Remove the console panel gearshift plate. Lift the gearshift lever boot over the gearshift lever.

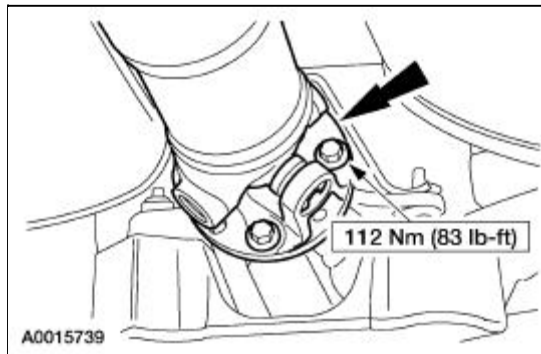


4. Remove the bolts and the shift lever.

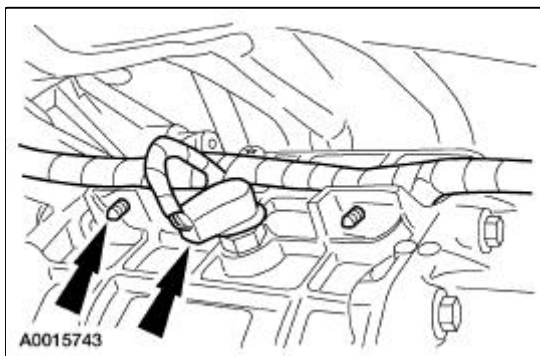


5. With the vehicle in NEUTRAL, raise and support the vehicle. For additional information, refer to [Section 100-02](#).
6. Remove the dual converter H-pipe. For additional information, refer to [Section 309-00](#).
7.  **CAUTION:** Index-mark the driveshaft flange and pinion flange, and the driveshaft slip yoke and transmission output shaft.

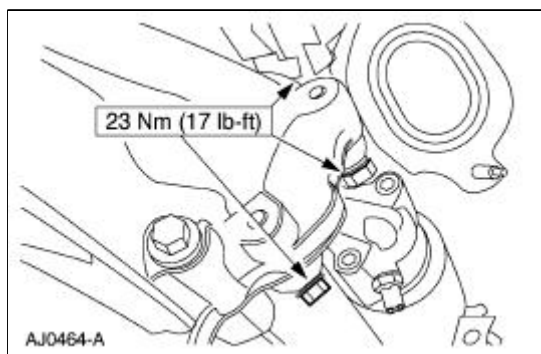
Remove the driveshaft. For additional information, refer to [Section 205-01](#).



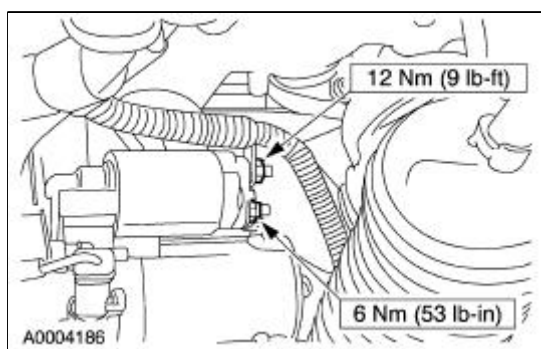
8. Disconnect the reversing lamp switch electrical connector. Disconnect the wiring harness from the transmission.



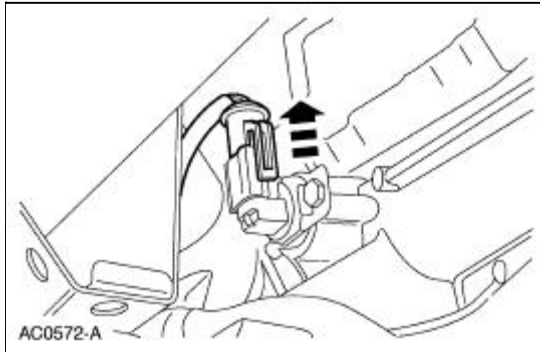
9. Remove the starter motor. For additional information, refer to [Section 303-06](#).
10. Remove the bolts.



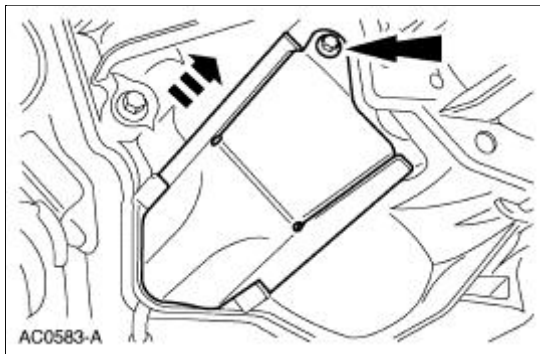
11. Remove the starter solenoid nuts and position the wires aside.




12. Remove the starter motor.
13. Disconnect the OSS sensor electrical connector. Disconnect the wiring harness from the transmission.

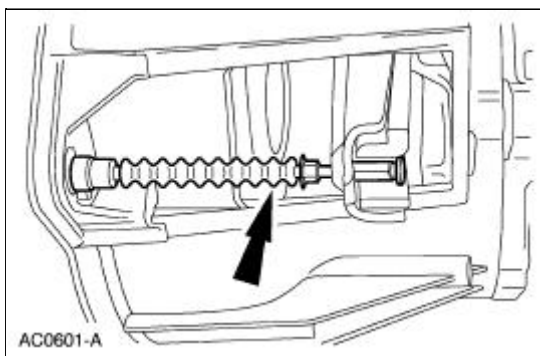


14. Remove the bolt and the clutch release lever cover.

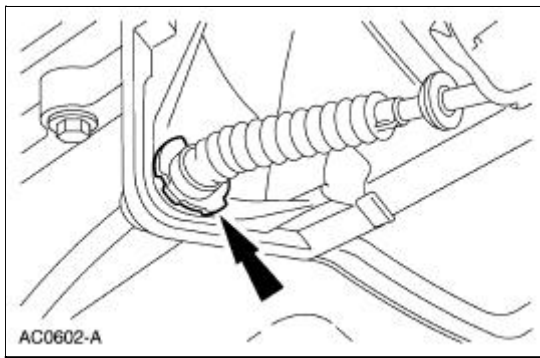


15.  **CAUTION: To prevent component damage, do not depress the clutch pedal with the transmission removed.**

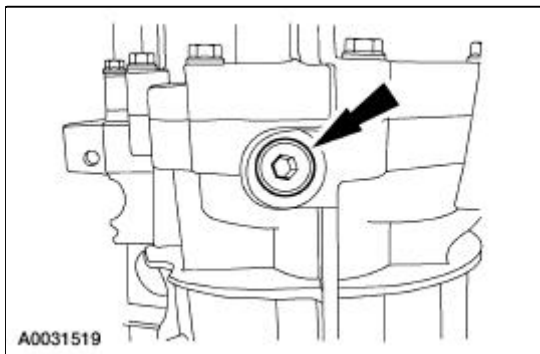
Disengage the clutch release cable from the clutch release fork.



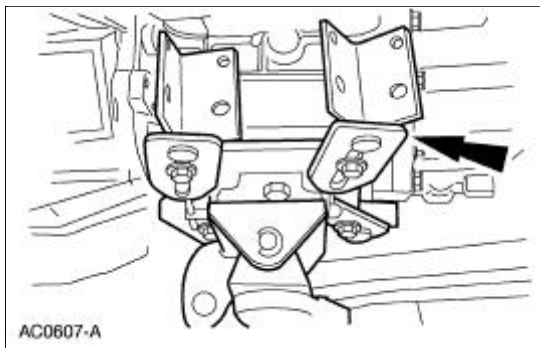
16. Remove the clutch cable retainer and remove the clutch cable from the transmission.



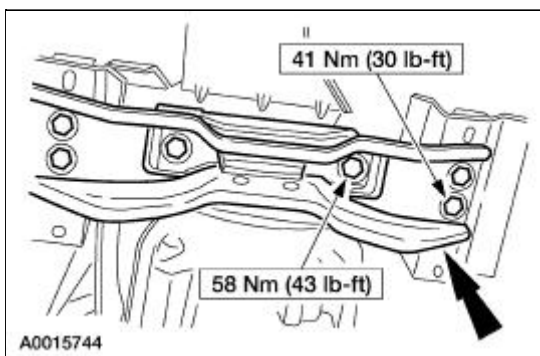
17. If transmission disassembly is necessary, drain the transmission fluid.



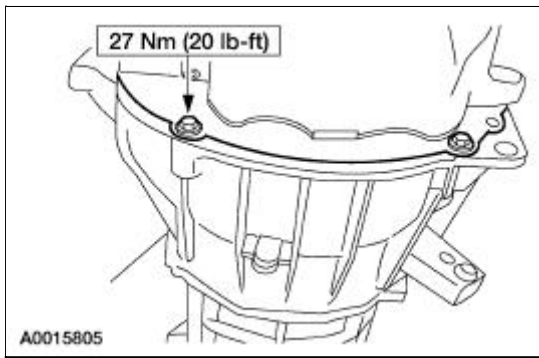
18. Position a transmission jack and support the transmission.



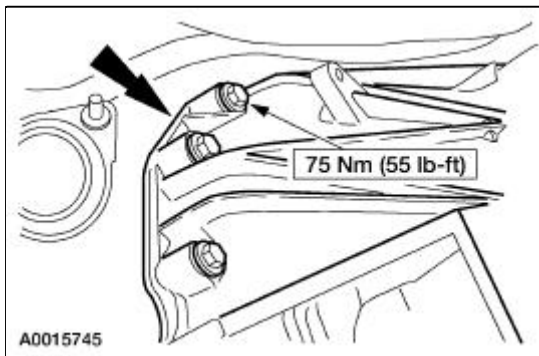
19. Remove the bolts and the transmission crossmember.



20. Remove the bolts.



21. Lower the transmission and remove the five bolts.



Transmission

Special Tool(s)

 ST1305-A	Remover, Mainshaft Bearing 308-058 (T77J-7025-H)
 ST1304-A	Screw, Bearing Removal tube 308-092 (T84T-7025-B)
 ST1186-A	Holding Fixture, Transmission 307-003 (T57L-500-B)
 ST2200-A	Remover, Bushing 307-001 (TOOL-1175-AC)
 ST1303-A	Remover/Installer, Bearing Tube 308-024 (T75L-7025-B)

Disassembly

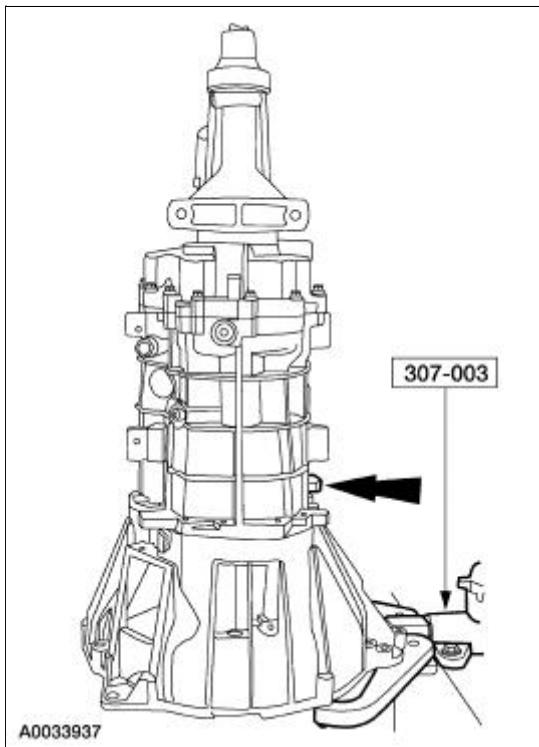
NOTE: During disassembly, if any roll pins, retaining rings or bearings are removed, install new components. Install bearings and bearing cups as a set.

1. Remove the clutch release hub and bearing and the clutch release lever. For additional information, refer to [Section 308-01](#).

2.  **WARNING: Make sure protective eye wear is in place.**

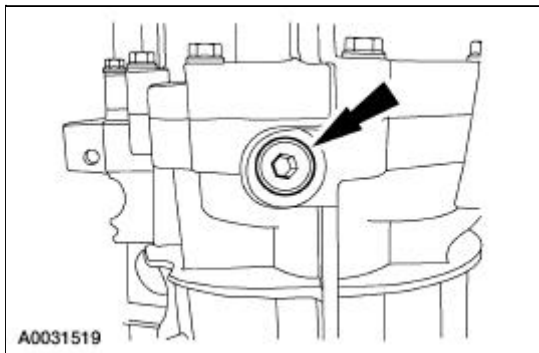
Clean the transmission exterior with solvent and dry with compressed air. During disassembly, clean all components with solvent and dry with compressed air.

3. Attach the transmission to the special tool.

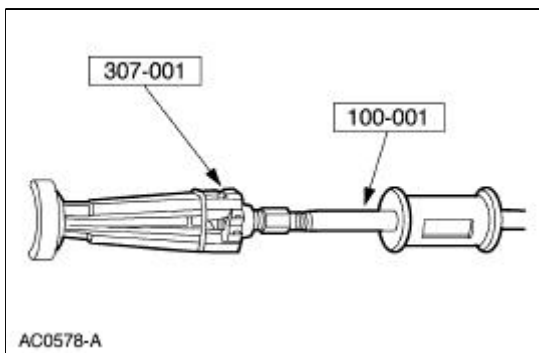


4. **NOTE:** Position a drain pan under the transmission.

Remove the case plug, then rotate the transmission to a horizontal position.



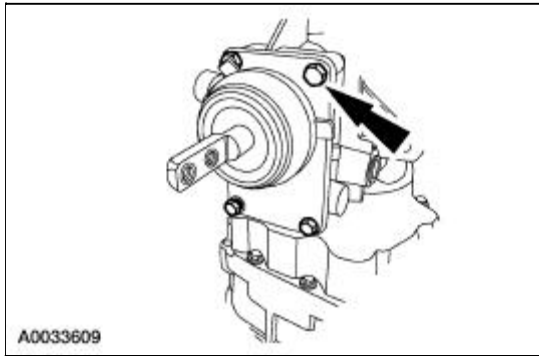
5. Using the special tools, remove the extension housing fluid seal.



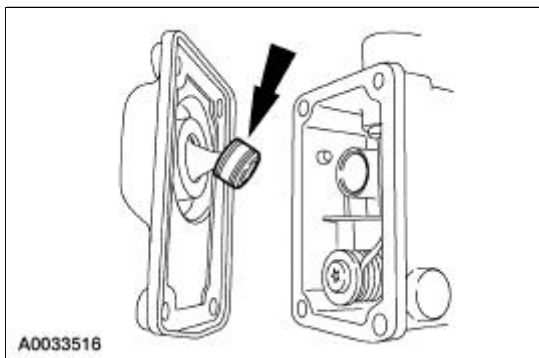
6. **NOTE:** Rotate the transmission to a vertical position.

NOTE: Position the gearshift lever in NEUTRAL.

Remove the bolts and the gearshift lever.

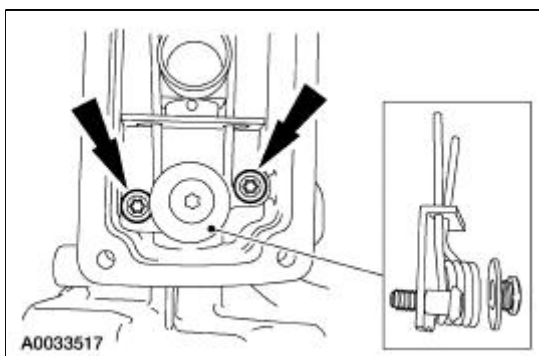


7. Inspect the gearshift offset lever insert and O-ring for wear or damage. Install a new insert as necessary.

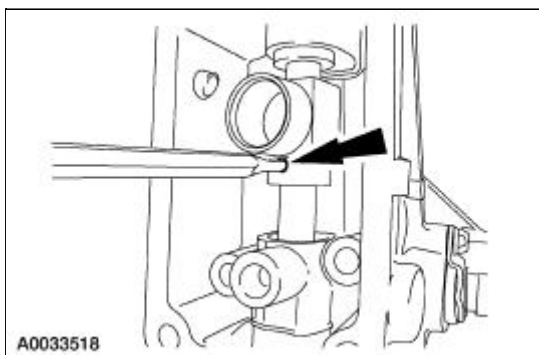


8. **NOTE:** If necessary, remove the spring and plate for disassembly.

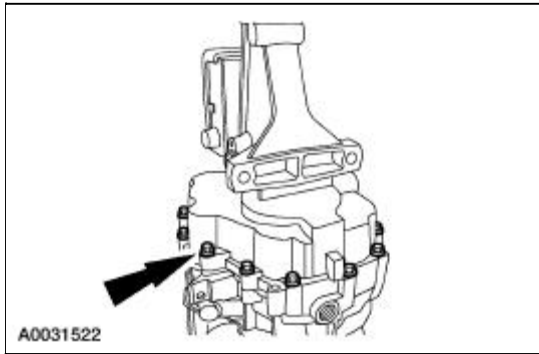
Remove the bolts and the shift spring and plate.



9. Using a 5/32-inch drift and a hammer, drive the split pin downward.

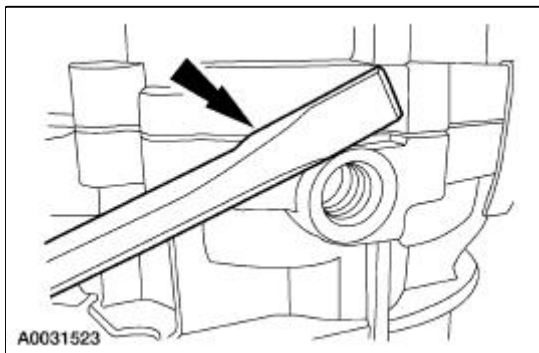


10. Remove the 12 bolts.

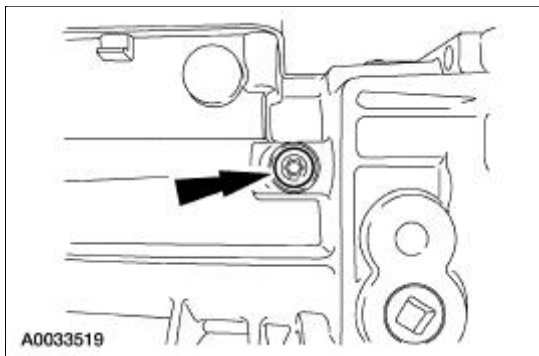


11. Using a flat-blade screwdriver, separate the extension housing, then remove the gearshift offset lever from the transmission case.

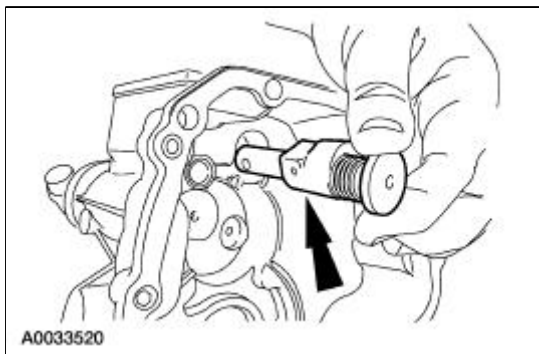
- Remove and discard the split pin from the gearshift offset lever during removal.



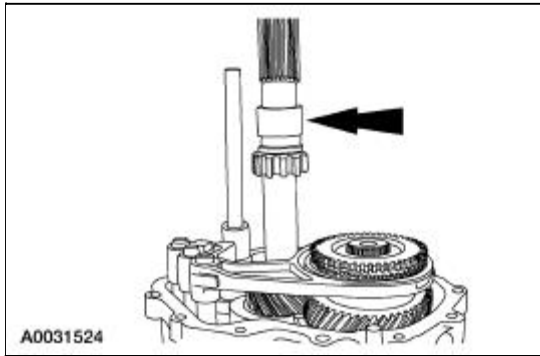
12. Remove the fifth/reverse gear lockout bolt.



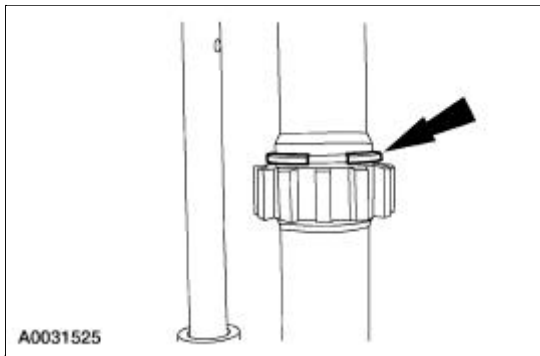
13. Remove the fifth/reverse gear lockout.



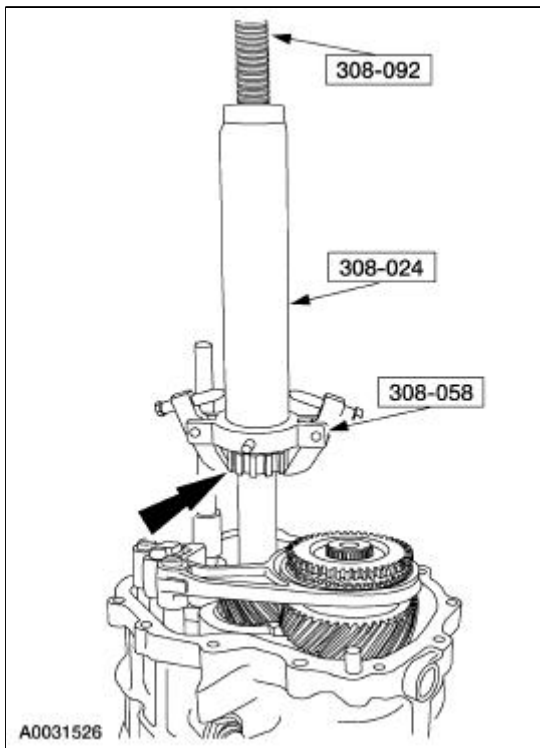
14. Remove the shipping seal.



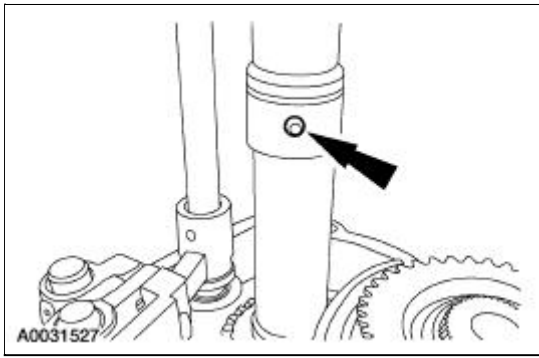
15. Remove the OSS sensor tone wheel retaining ring.



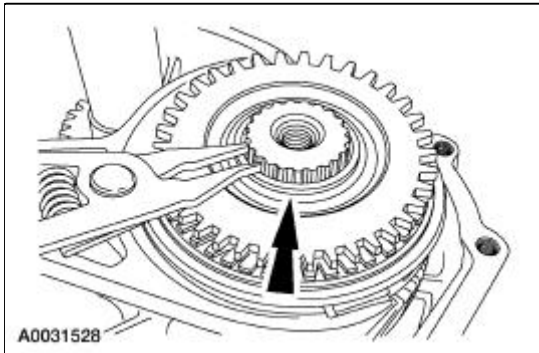
16. Using the special tools, remove the OSS sensor tone wheel.



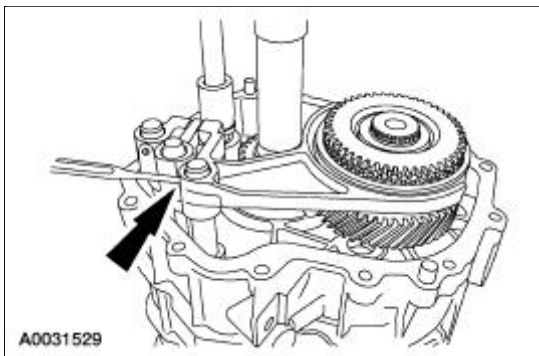
17. Remove the OSS sensor tone wheel check ball.



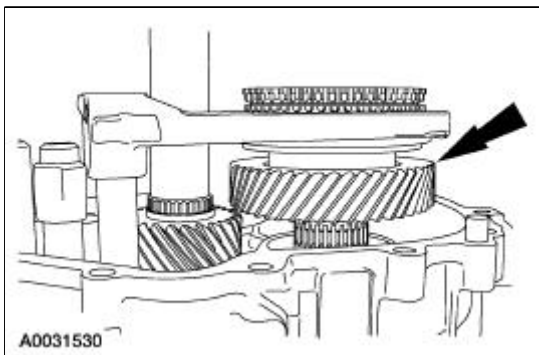
18. Remove and discard the fifth gear synchronizer retaining ring.



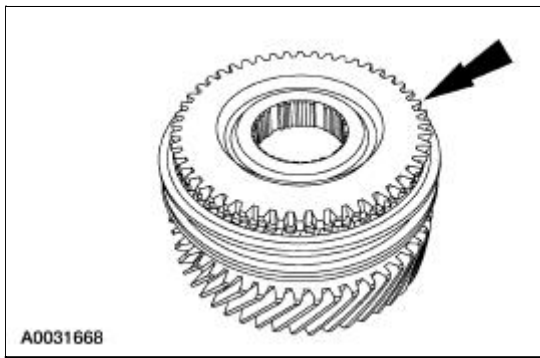
19. Using a 5/32-inch drift and a hammer, remove and discard the pin from the fifth gear shift fork.



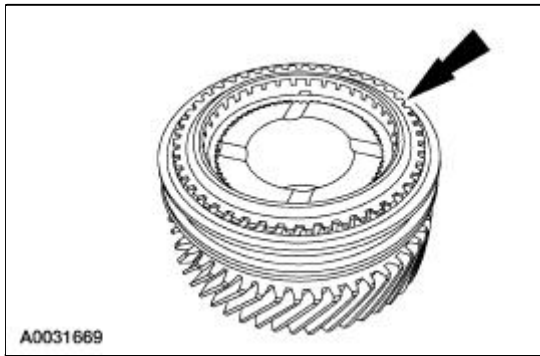
20. Remove the fifth gear shift fork, synchronizer assembly, synchronizer cone and the fifth gear as an assembly.



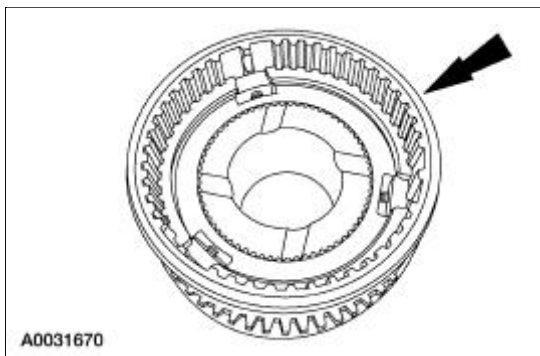
21. Remove the fifth gear clutch cone.



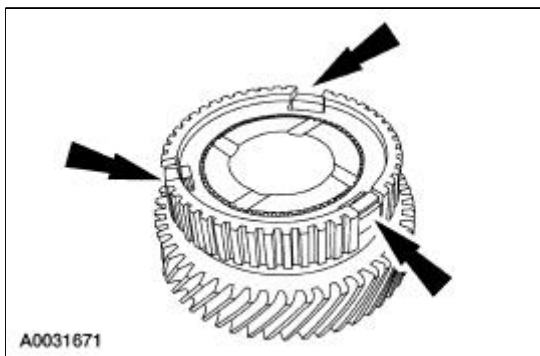
22. Remove the fifth gear synchronizer blocking ring.
- Inspect the blocking ring for wear or damage. Install new blocking rings as necessary.



23. Remove the fifth gear synchronizer sleeve from the synchronizer hub.

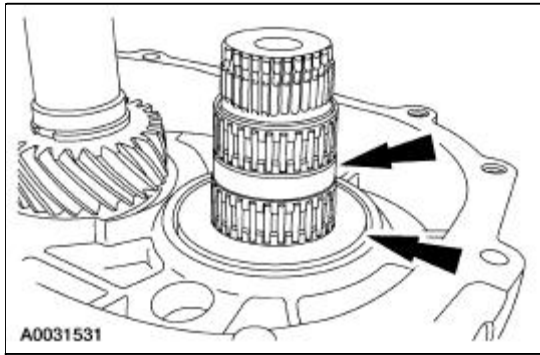


24. Remove the synchronizer inserts and the springs.

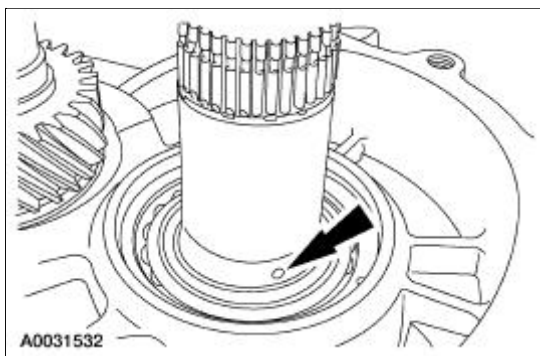


25. Remove the needle bearings and the thrust washer.
- The fifth gear needle bearing is three separate pieces: bearing, spacer, bearing

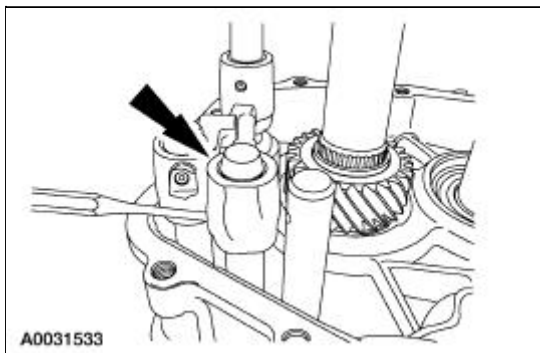
- Inspect the needle bearing for wear or damage. Install new bearings as necessary.



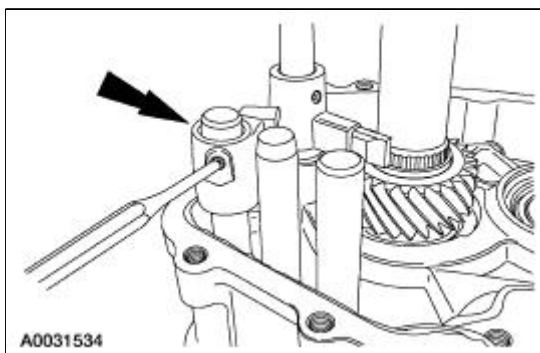
26. Remove the check ball.



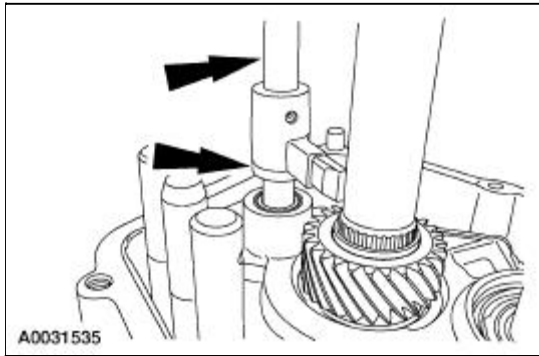
27. Using a 5/32-inch drift and a hammer, drive out the split pin, then remove the third/fourth shift finger. Discard the split pin.



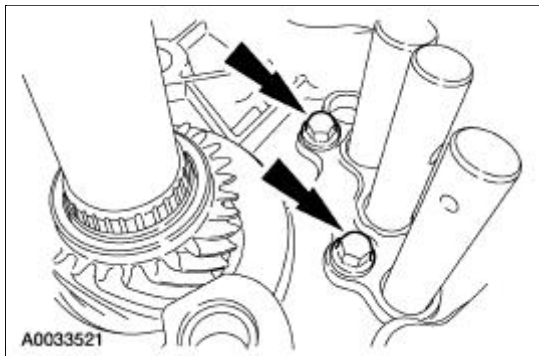
28. Using a 5/32-inch drift and a hammer, drive out the split pin, then remove the first/second shift finger. Discard the split pin.



29. Remove the main shift rail and the plastic spacer.

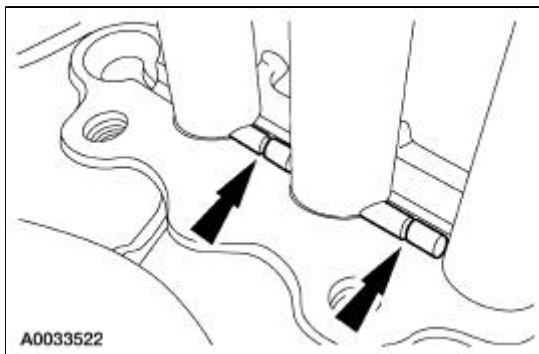


30. Remove the bolts and the shift interlock plate.

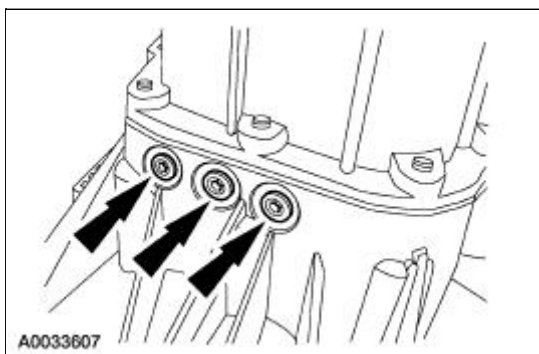


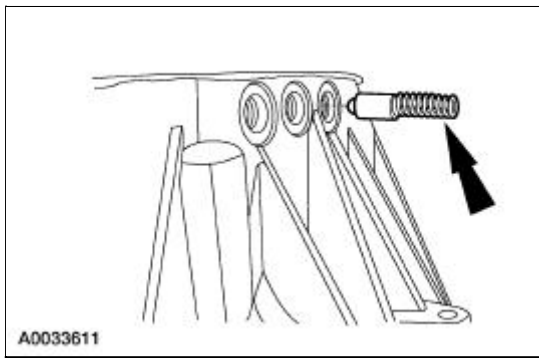
31. Using a magnet, remove the interlock pins.

- One lock pin in the center rail, two between the rails.



32. Remove the three detent plugs, springs and the detents.

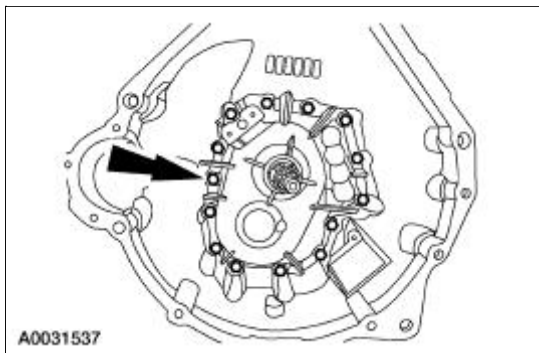




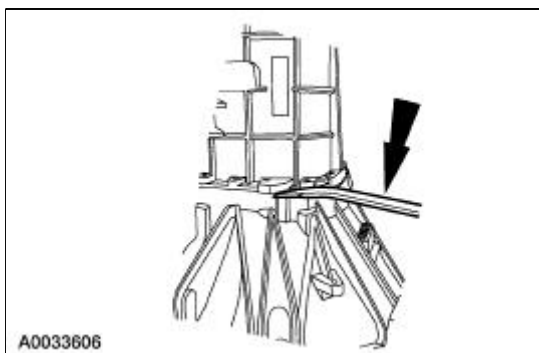
33.  **CAUTION: Do not remove all the bolts while in the horizontal position.**

Remove the bolts.

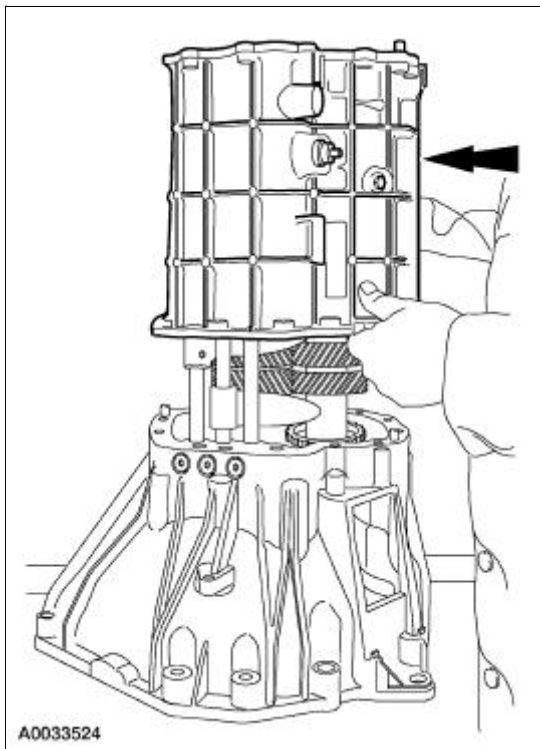
- Rotate the transmission to a horizontal position. Remove 12 bolts, leaving two opposing bolts in. Rotate the transmission to a vertical position, then remove the remaining two bolts.



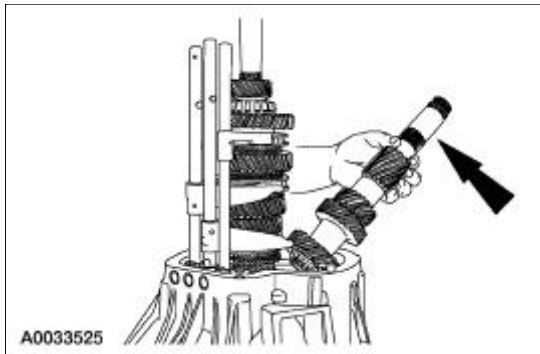
34. Carefully pry the clutch housing from the transmission main case.



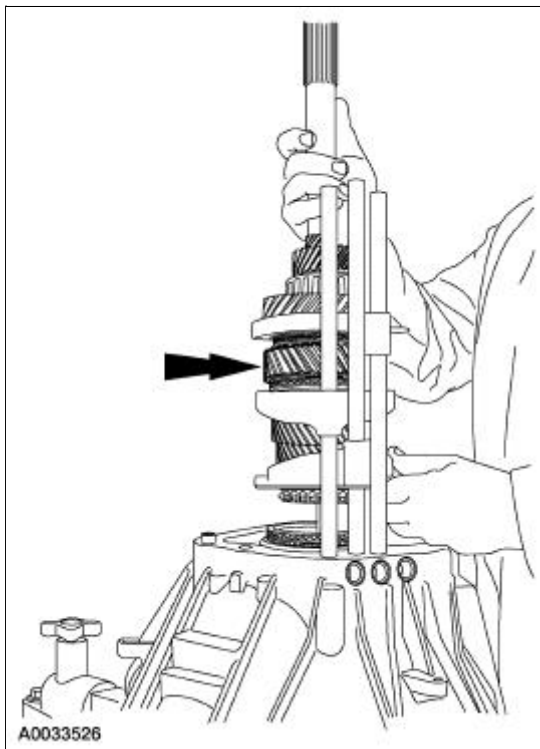
35. Remove the transmission main case from the clutch housing.



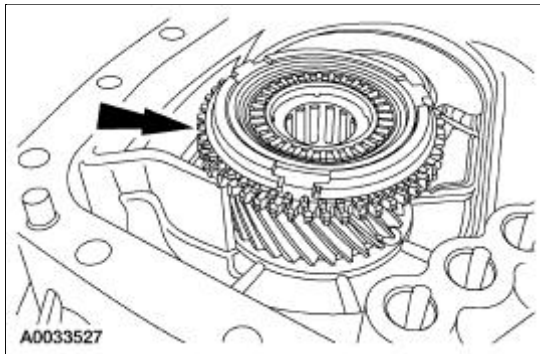
36. Lift the mainshaft 13 mm (0.50 in) upward, tilt the countershaft outward and remove the countershaft.



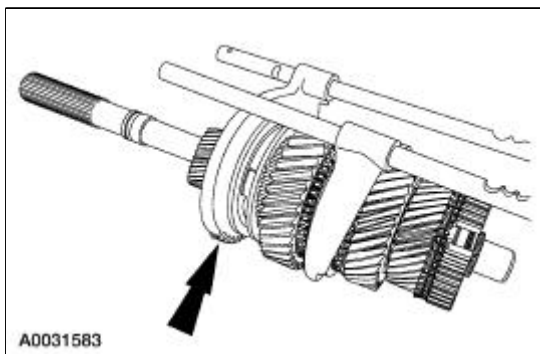
37. Remove the mainshaft and shift assembly.



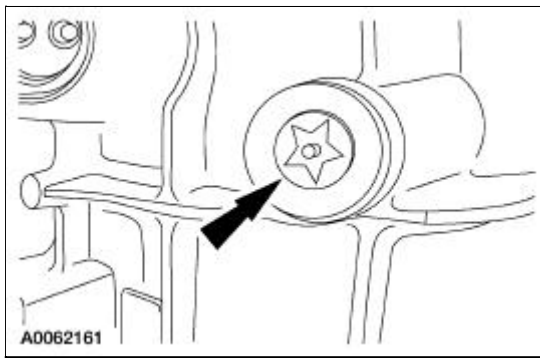
38. Remove the input shaft. For input shaft disassembly, refer to [Input Shaft and Bearing](#) in this section.



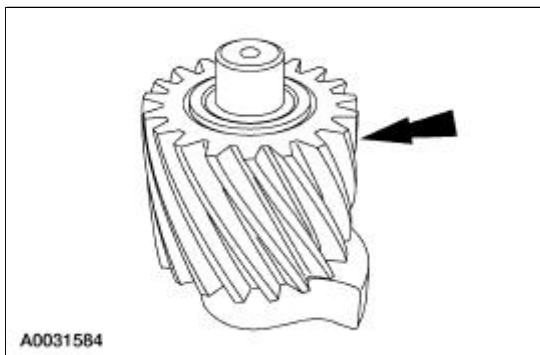
39. Remove the shift rails and shift forks from the main shaft. For gearshift rail and fork disassembly, refer to [Gearshift Rail and Fork](#) in this section.



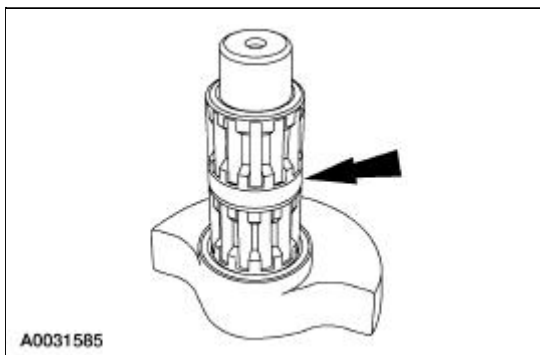
40. Remove the reverse idler shaft bolt. Remove and discard the seal.



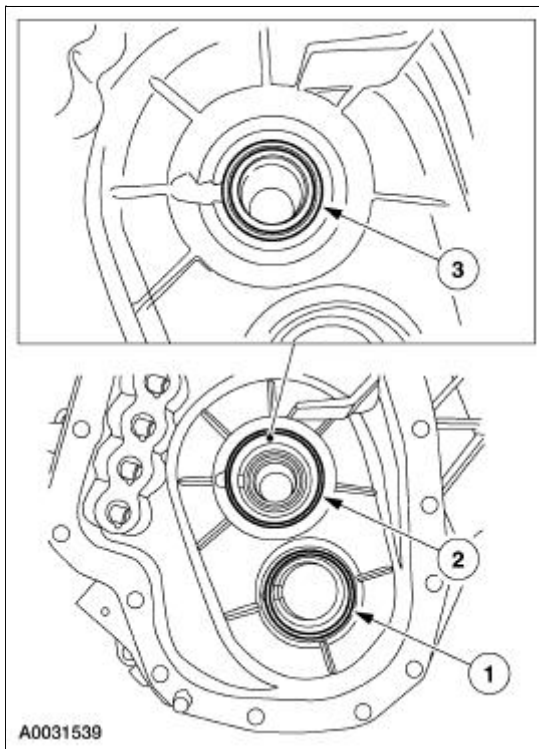
41. Remove the reverse idler gear assembly.
42. Remove the reverse idler gear from the shaft.
 - Inspect the gear for wear or damage. Install a new gear as necessary.



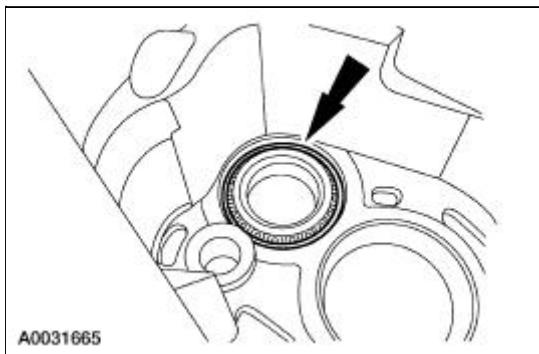
43. Remove the reverse idler gear bearing.
 - The reverse idler gear is three separate pieces: bearing, spacer, bearing.
 - Inspect the bearing for wear or damage. Install new bearings as necessary.



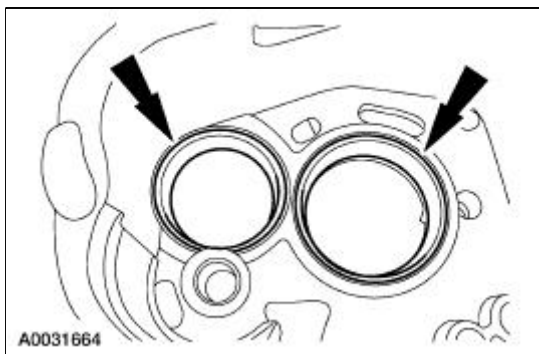
44. Disassemble the clutch housing.
 1. Remove the countershaft bearing cup and shim.
 2. Remove the input shaft bearing cup and shim.
 3. Remove the input shaft seal.
 - Carefully pry out from the inside of the case.



45. Remove the rear countershaft bearing.

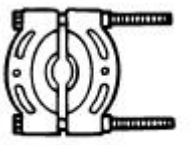



46. Remove the rear countershaft bearing cup and the rear output shaft bearing cup.



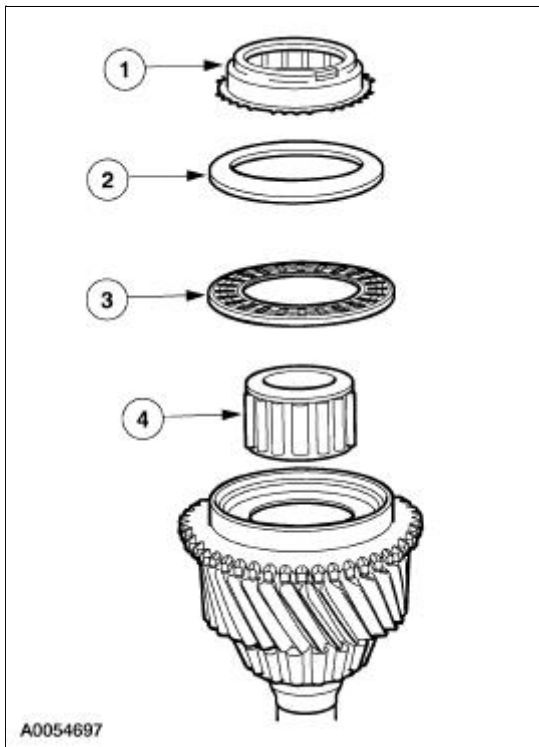
Input Shaft and Bearing

Special Tool(s)

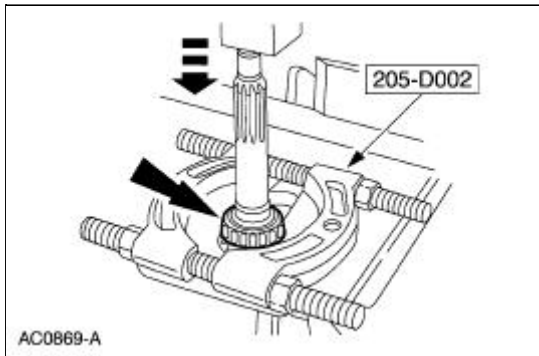
 <p>ST1895-A</p>	Remover, Driver Pinion Bearing Cone 205-D002 (D79L-4621-A) or equivalent
 <p>ST2388-A</p>	Installer, Drive Pinion Bearing Cone 205-011 (T57L-4621-B)
 <p>ST1303-A</p>	Remover/Installer, Bearing Tube 308-024 (T75L-7025-B)

Disassembly and Assembly

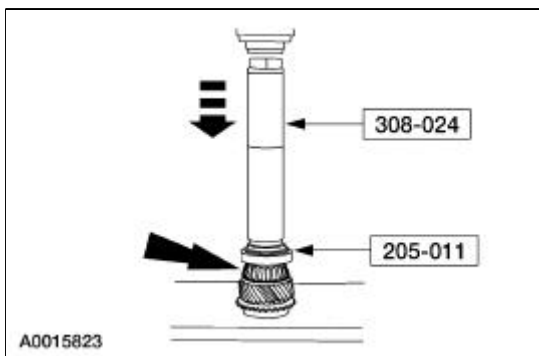
1. Disassemble the input shaft.
 1. Remove the third/fourth synchronizer blocking ring.
 2. Remove the input shaft thrust washer.
 3. Remove the input shaft thrust bearing.
 4. Remove the input shaft pocket bearing.
 - Inspect all components for wear or damage. Install new components as necessary.



2. Using the special tool and a press, remove the input shaft front bearing assembly. Discard the bearing.



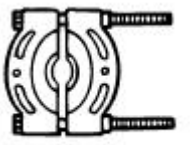

3. Inspect the input shaft and bearings for wear or damage. Install new components as necessary.
4. Using the special tools and a press, install the new input shaft front bearing.



5. Install the input shaft pocket bearing, the washer, input shaft bearing and the third/fourth synchronizer blocking ring.
 - Lubricate the bearing and bearing race with petroleum jelly.

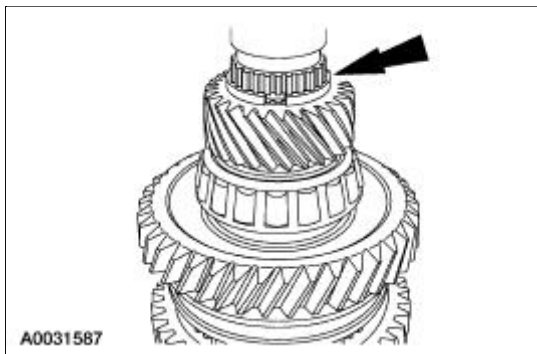
Output Shaft

Special Tool(s)


 <p>ST1895-A</p>	Remover, Drive Pinion Bearing Cone 205-D002 (D79L-4621-A) or equivalent
 <p>ST2388-A</p>	Installer, Drive Pinion Bearing Cone 205-011 (T57L-4621-B)

Disassembly

1. Remove the retaining ring above fifth gear.

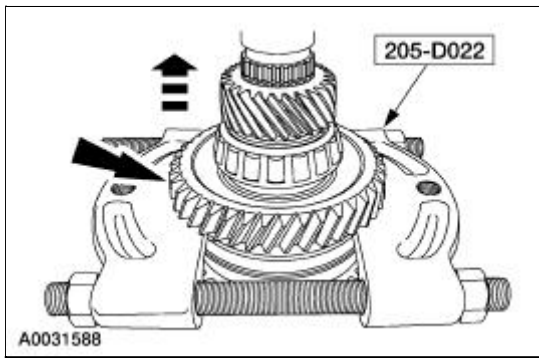


2.  **CAUTION:** Hand tighten the special tool to prevent gear damage.

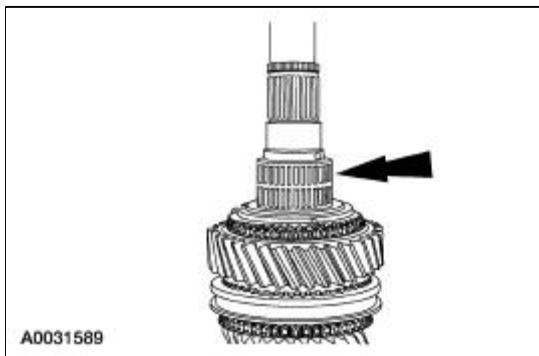
 **CAUTION:** Support the output shaft while using the press to prevent damage to the shaft or gears.

Using the special tool, press fifth gear, the spacer, the output shaft bearing and reverse gear from the output shaft.

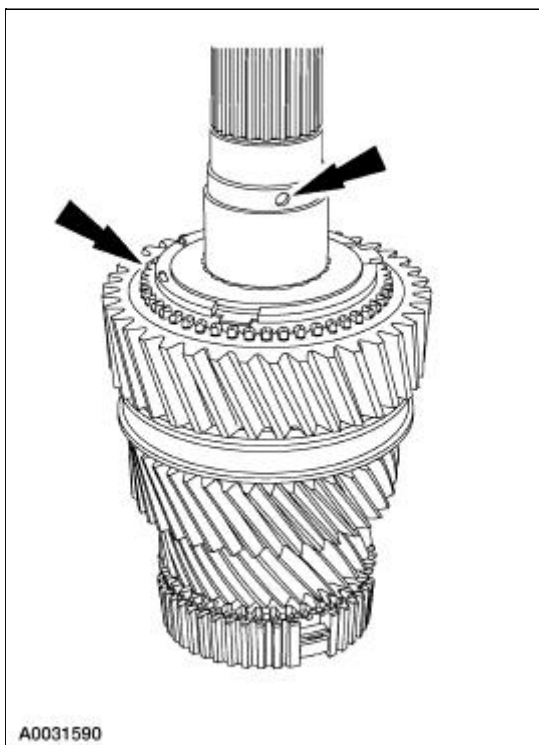
- Discard the output shaft bearing.



3. Remove reverse gear needle bearing.
 - Inspect the needle bearing for wear or damage. Install a new needle bearing as necessary.

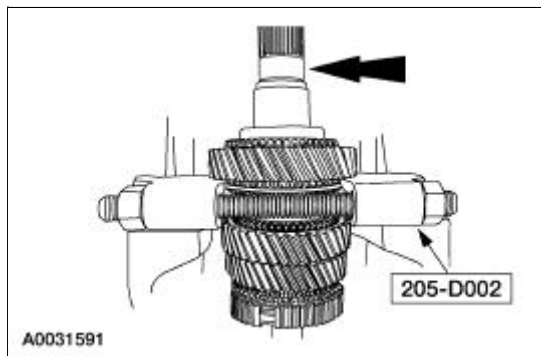


4. Remove the check ball and the blocking ring.
 - Inspect the blocking ring for wear or damage. Install new blocking rings as necessary.



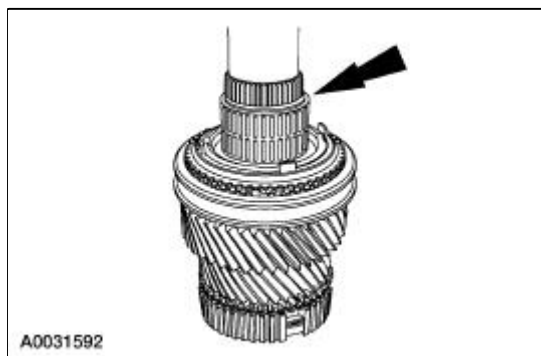
5. **NOTE:** Install the special tool with the flat side facing first gear.

Using the special tools, press the bearing spacer, the reverse gear synchronizer cone and first gear from the output shaft.



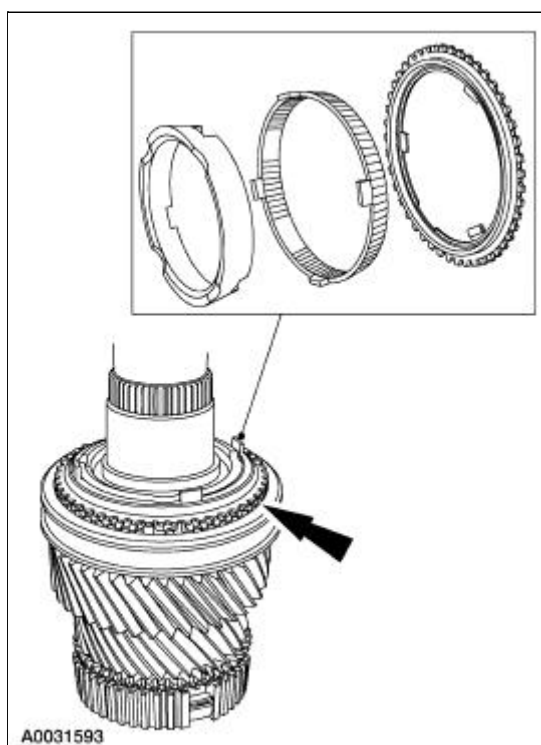
6. Remove the first gear needle bearing.

- Inspect the needle bearing for wear or damage. Install a new needle bearing as necessary.



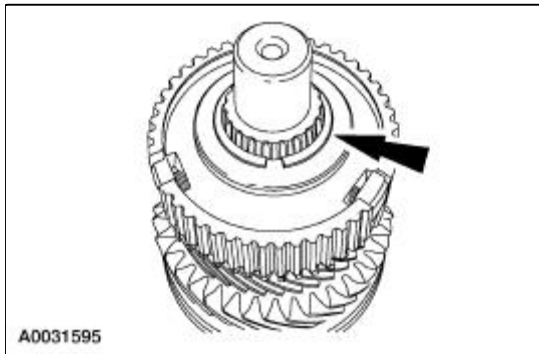
7. Remove the first gear synchronizer inner cone, the first gear synchronizer outer cone and the first gear synchronizer blocking ring.

- Inspect all components for wear or damage. Install new components as necessary.

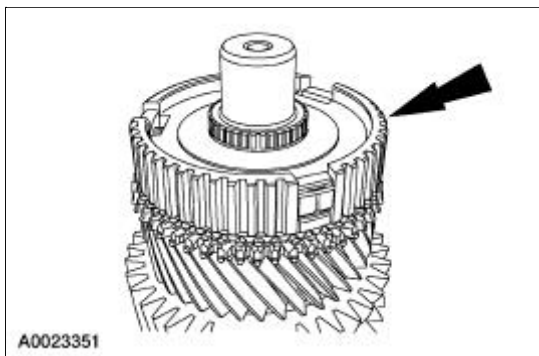


8. **NOTE:** Reposition the output shaft on the press with the input shaft end facing upward.

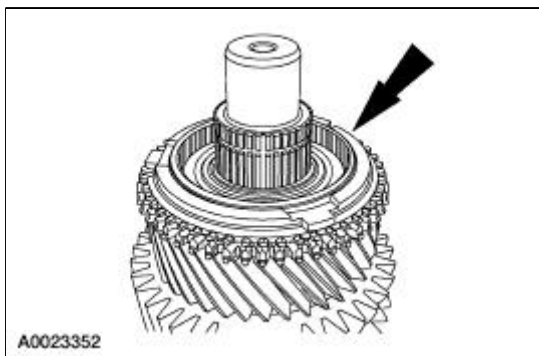
Remove and discard the retaining ring.



9. Remove the third/fourth synchronizer hub.

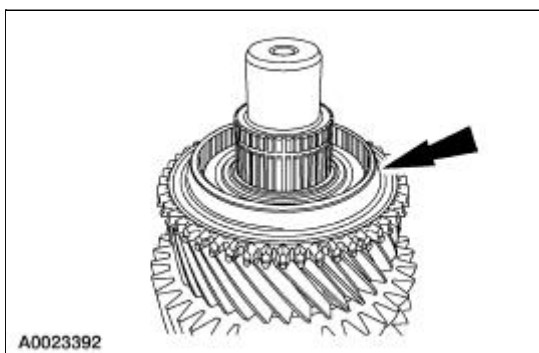


10. Remove the third/fourth blocking ring.



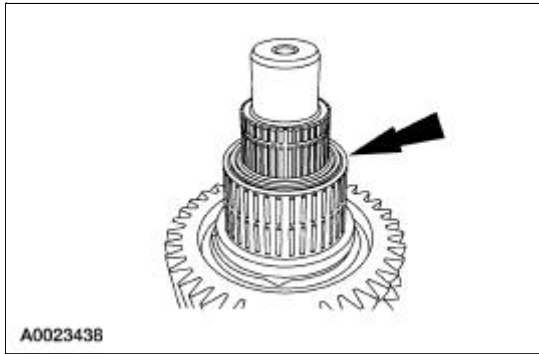
11. Remove the third gear.

- Inspect the gear for wear or damage. Install a new gear as necessary.



12. Remove the third gear needle bearing.

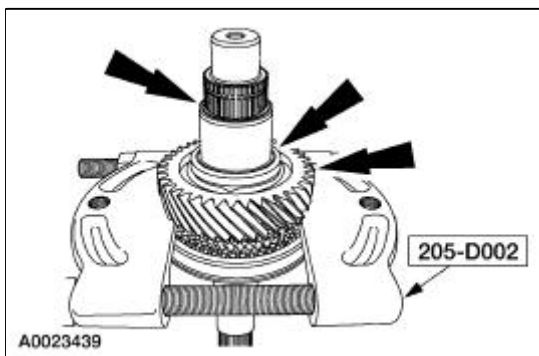
- Inspect the needle bearing for wear or damage. Install a new needle bearing as necessary.



13. **NOTE:** Install the special tool behind second gear with the flat side of the tool facing second gear.

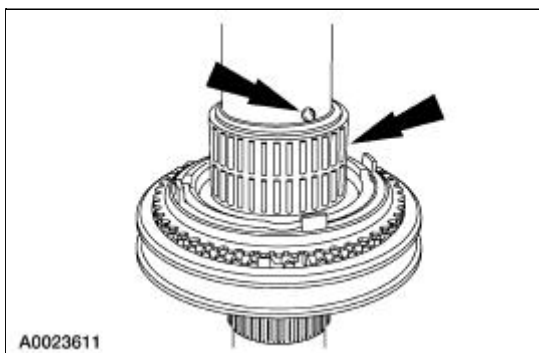
Using the special tool, remove the spacer, second gear thrust washer and second gear.

- Inspect the gear for wear or damage. Install a new gear as necessary.



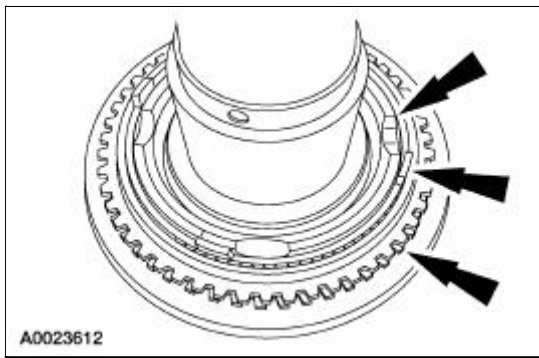
14. Remove the check ball and second gear needle bearing.

- Inspect the needle bearing for wear or damage. Install a new needle bearing as necessary.

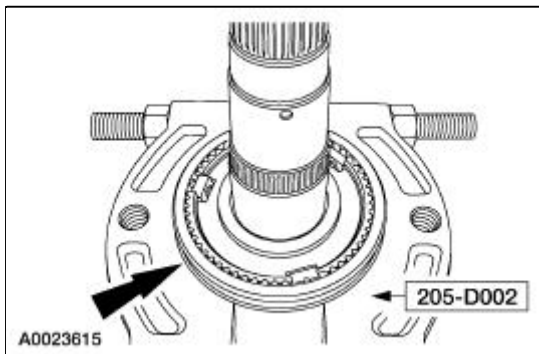


15. Remove the second gear synchronizer inner cone, second gear synchronizer outer cone and the second gear synchronizer blocking ring.

- Inspect all components for wear or damage. Install new components as necessary.



16. Remove the snap ring, then using the special tool, press off the first/second gear synchronizer.



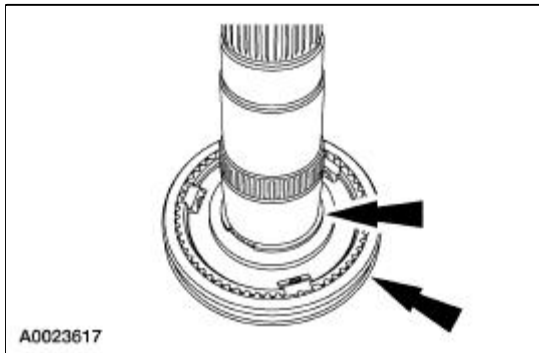
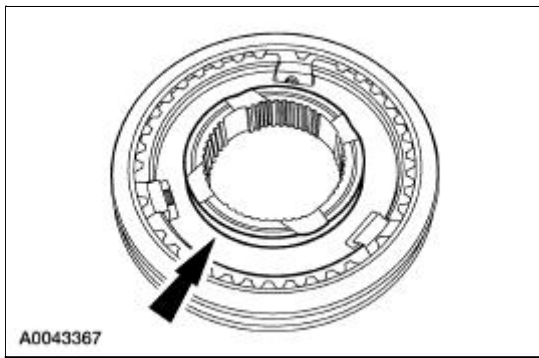
Assembly

1. Carry out the following before reassembling:
 - Inspect the gears for broken or cracked teeth. Check for unusual wear patterns.
 - Inspect the thrust washers for face wear, cracks, scoring and for signs of heat damage.
 - Inspect the bearings, bearing cups and the synchronizers for wear or damage.
 - Inspect the output shaft for scoring or worn or damaged splines. Install new components as necessary.
2. Lubricate all components with the recommended transmission fluid when reassembling.
3. **NOTE:** Position the output shaft with the output end facing upward.

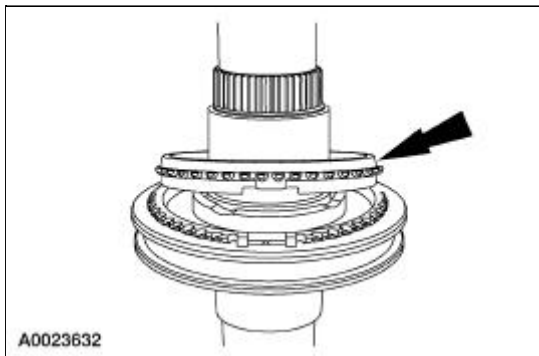
NOTE: Install the synchronizer assembly with the deeper center flange of the synchronizer hub facing toward the rear of the output shaft.

Install the first/second synchronizer assembly on the output shaft, then install a new retaining ring.

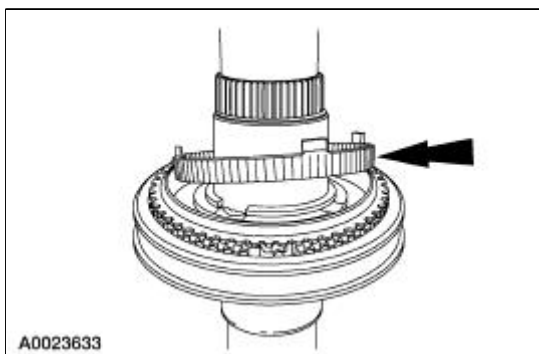
- It may be necessary to press the hub into position on the shaft.



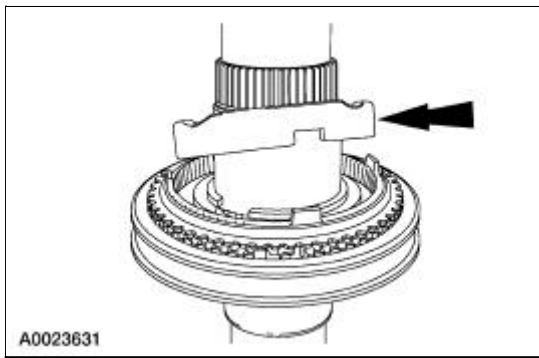
4. Install the first gear synchronizer blocking ring.
 - Align the blocking ring tabs with the synchronizer assembly.



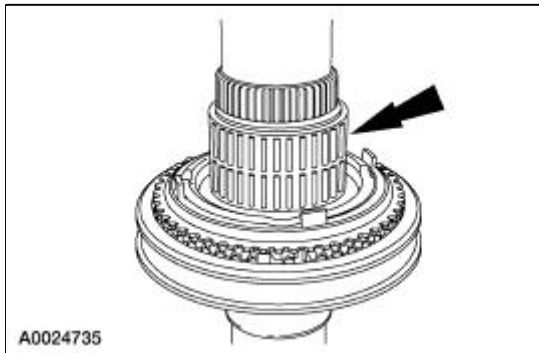
5. Install the outer first gear synchronizer cone.



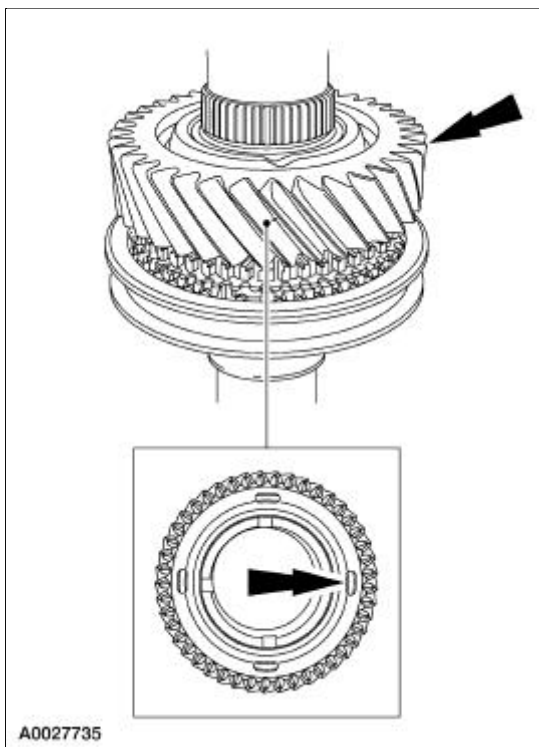
6. Install the inner first gear synchronizer cone. Rotate the inner cone till it is seated.



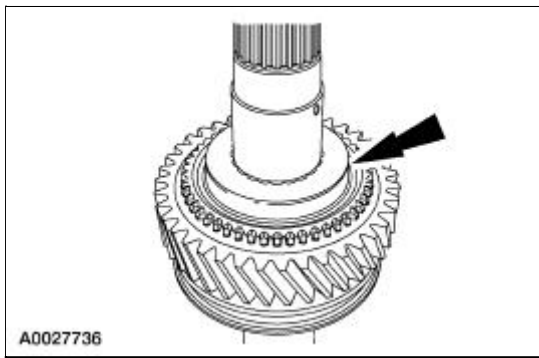
7. Install the first gear needle bearing.
 - Apply petroleum jelly to the bearing.



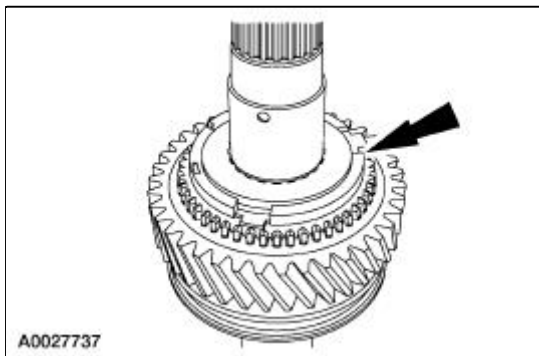
8. Install first gear.
 - Rotate the gear to align the gear slots with the inner cone tabs.



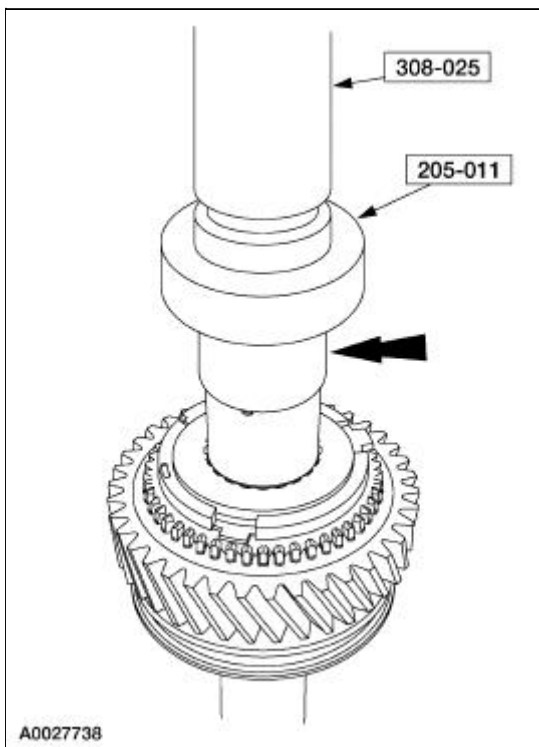
9. Install the reverse synchronizer cone.



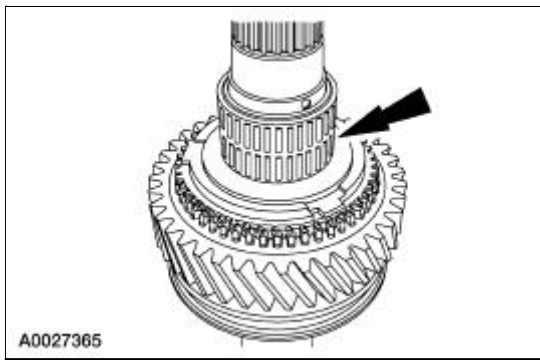
10. Install the reverse gear blocking ring.



11. Using the special tools, install the reverse gear bearing spacer.

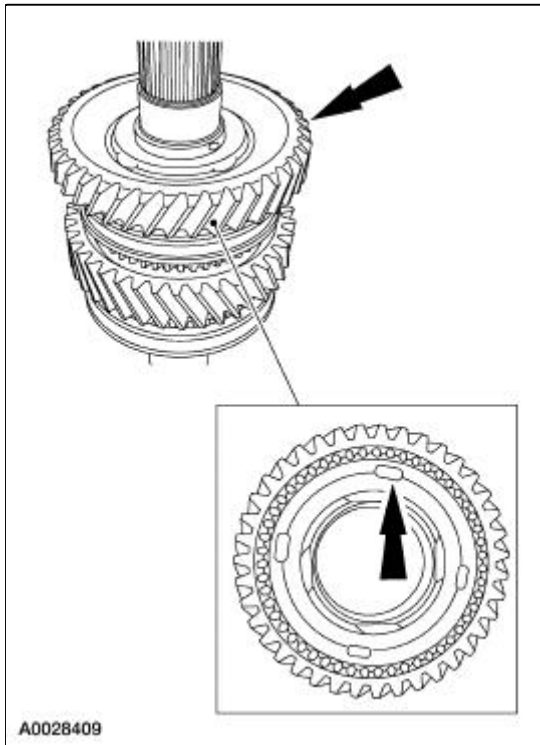


12. Install reverse gear needle bearing.
 - Apply petroleum jelly to the bearing.



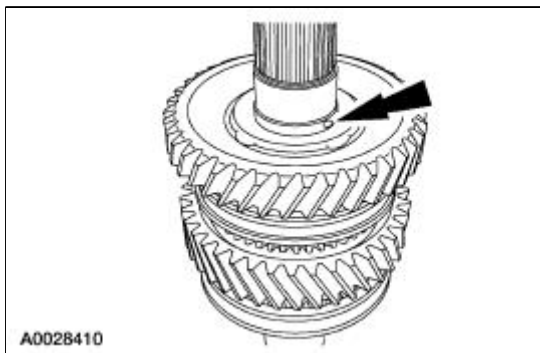
13. Install reverse gear.

- Rotate the gear to align the gear slots with the inner cone tabs.

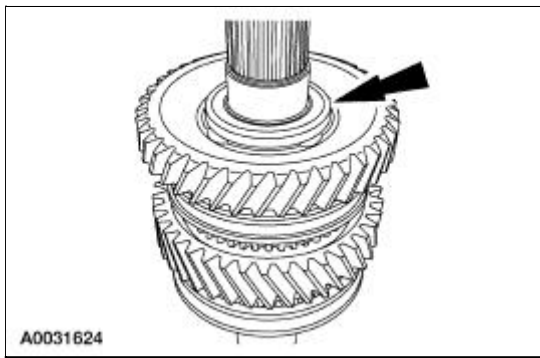


14. Install the check ball.

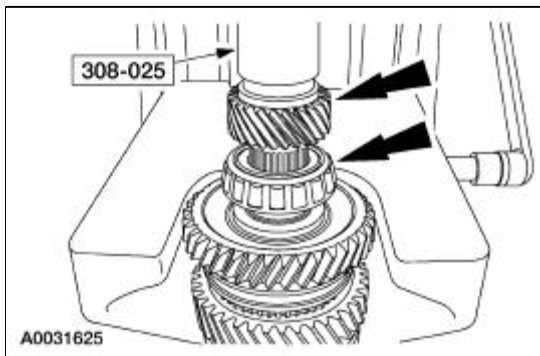
- Use petroleum jelly to hold the check ball in place.



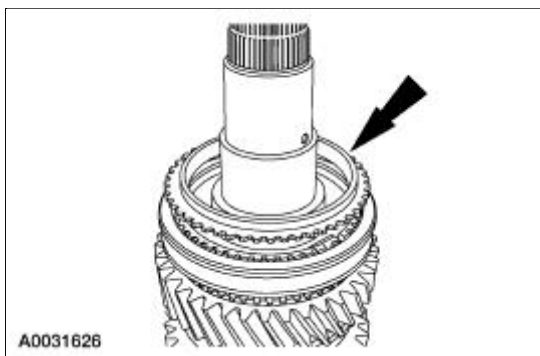
15. Install the thrust washer. Be sure to align the slot in the washer with the check ball.



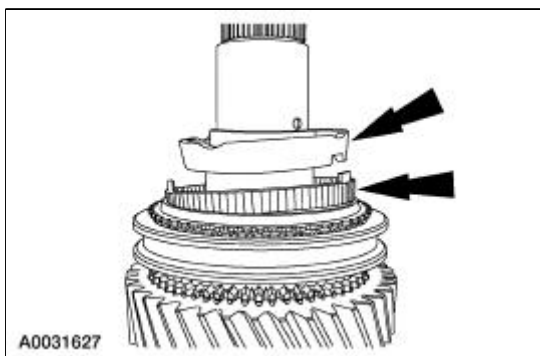
16. Install a new rear output shaft bearing, then fifth gear. Using the special tool, press both the bearing and gear into place.



17. Reposition the output shaft with the input end facing upward.
18. Install the second gear synchronizer blocking ring. Rotate the blocking ring until seated.

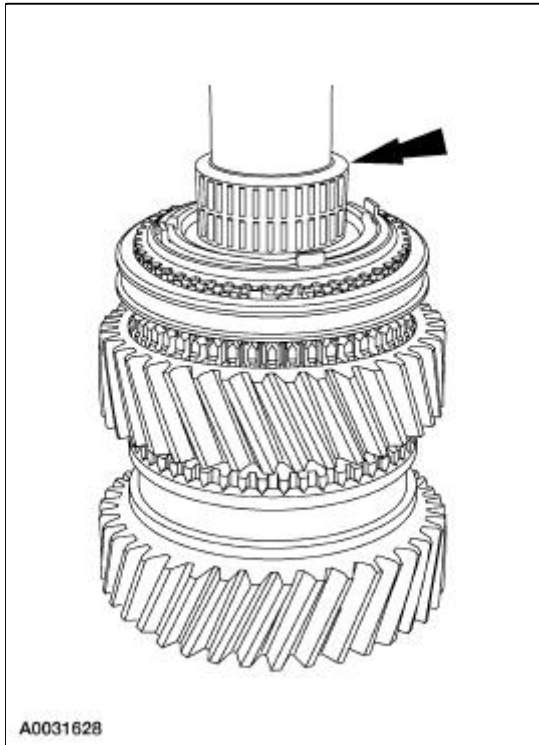


19. Install the second gear synchronizer outer cone and the second gear synchronizer inner cone.



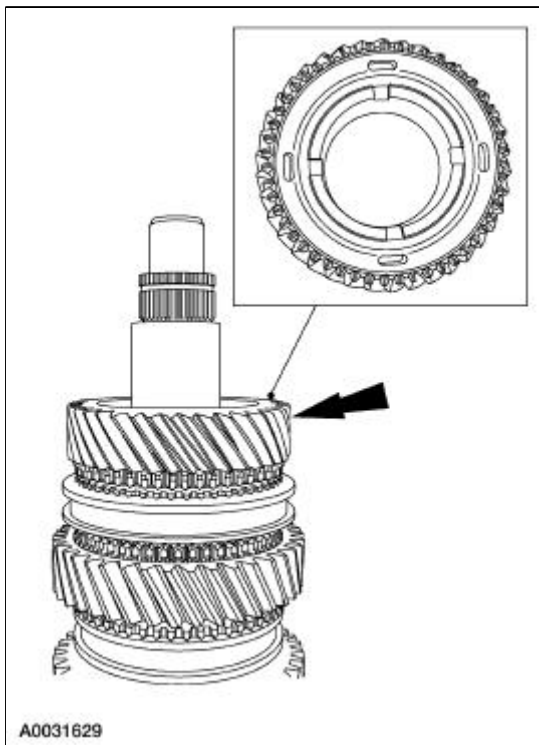
20. Install the second gear bearing.

- Apply petroleum jelly to the bearing.



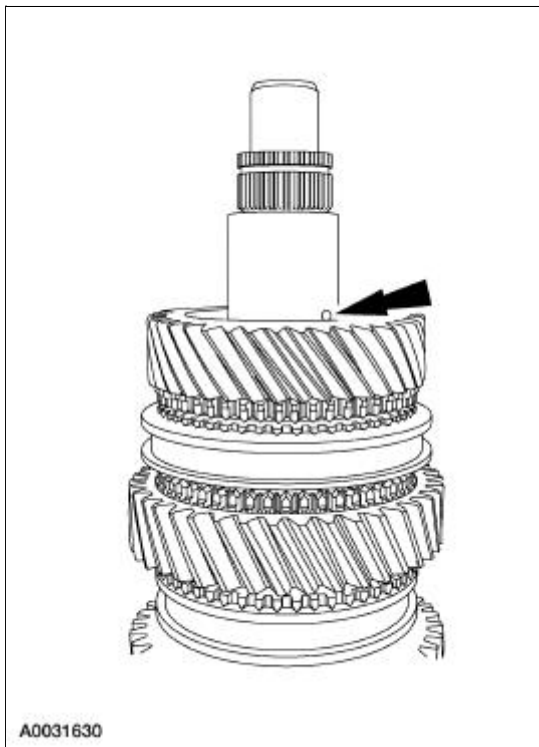
21. Install second gear.

- Rotate the gear to align the gear slots with the inner cone tabs.

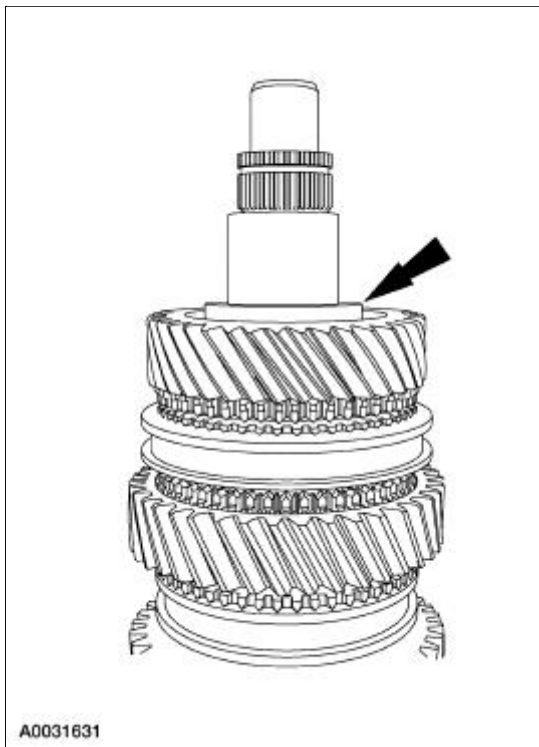


22. Install the check ball.

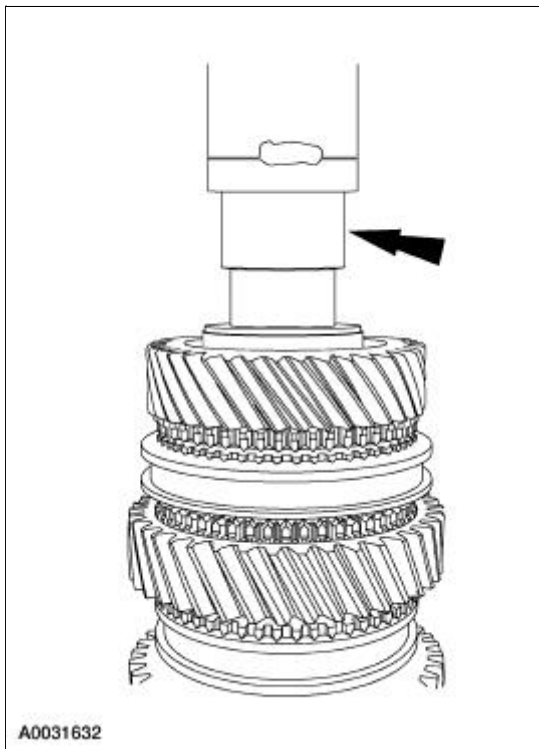
- Use petroleum jelly to hold the check ball in place.



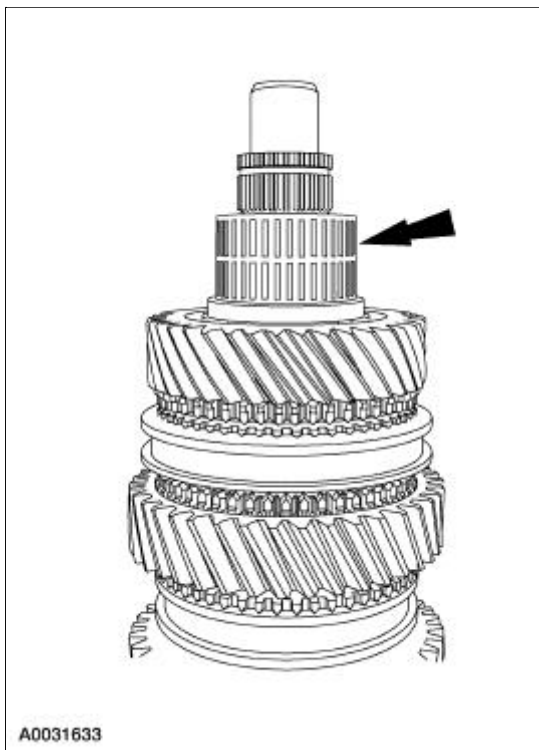
23. Install the thrust washer. Be sure to align the slot in the washer with the check ball.



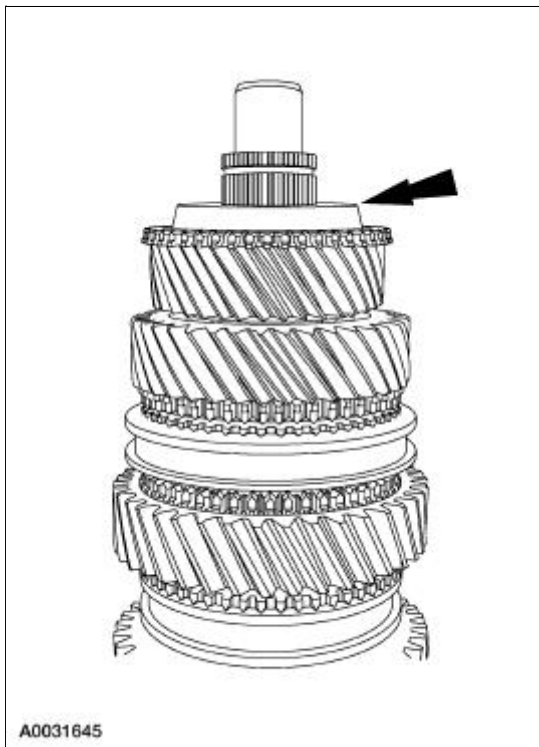
24. Press the bearing spacer onto the output shaft.



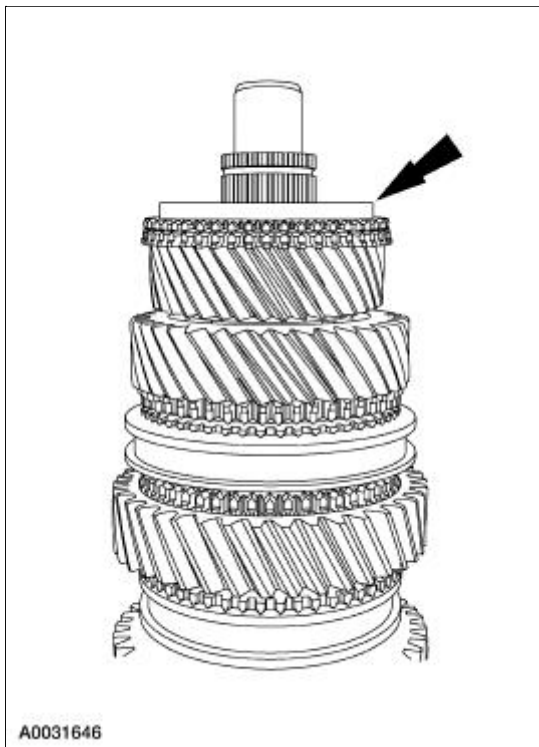
25. Install the third gear bearing.
- Apply petroleum jelly to the bearing.



26. Install third gear.

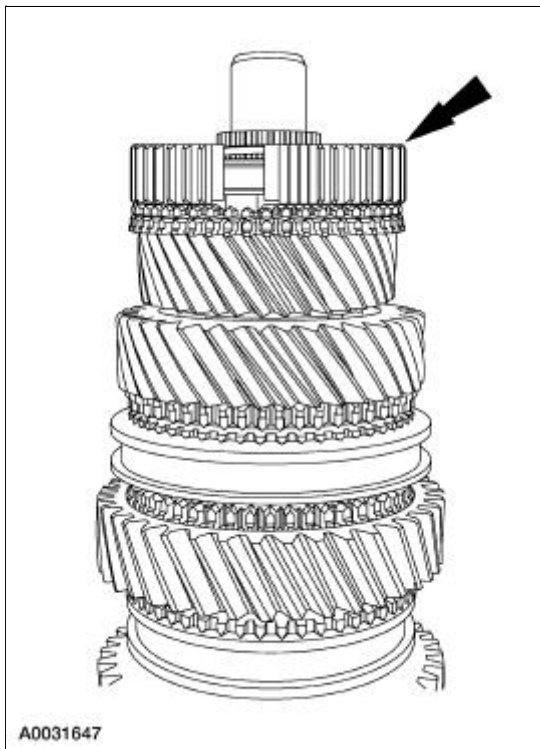


27. Install the third gear synchronizer blocking ring.

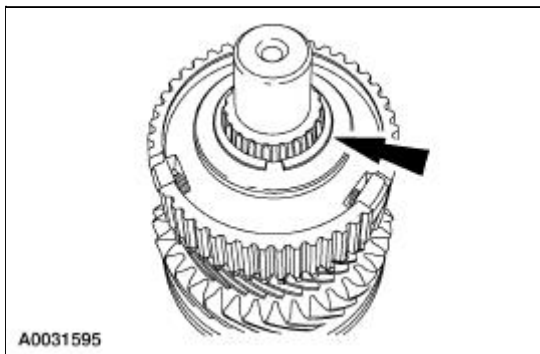


28. Install the third/fourth gear synchronizer body.

- Install the synchronizer body with the raised center facing downward.
- Rotate the blocking ring until seated.

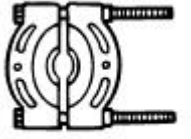



29. Install a new retaining ring.



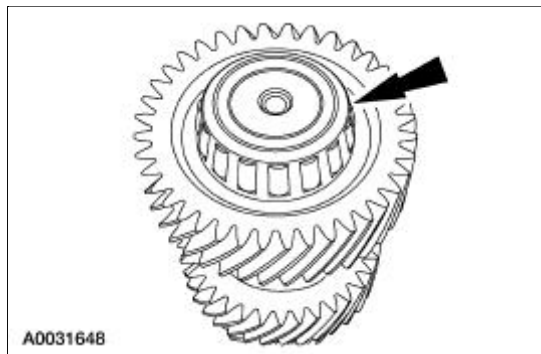
Countershaft Bearing

Special Tool(s)

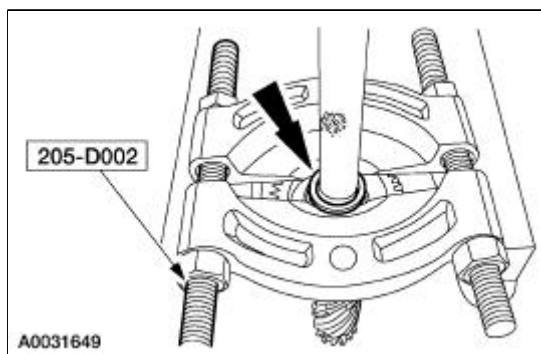
 <p>ST1895-A</p>	Remover, Drive Pinion Bearing Cone 205-D002 (D79L-4621-A) or equivalent
 <p>ST2388-A</p>	Installer, Drive Pinion Bearing Cone 205-011 (T57L-4621-B)

Disassembly and Assembly

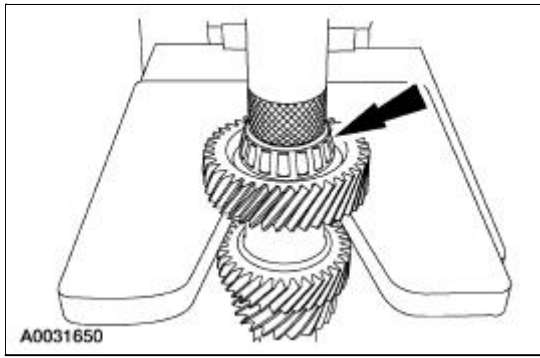
1. Cut the outer cage, then remove the outer cage and rollers.



2. Using the special tool and a press, remove the inner bearing.



3. Using the special tools, install the new countershaft bearing.

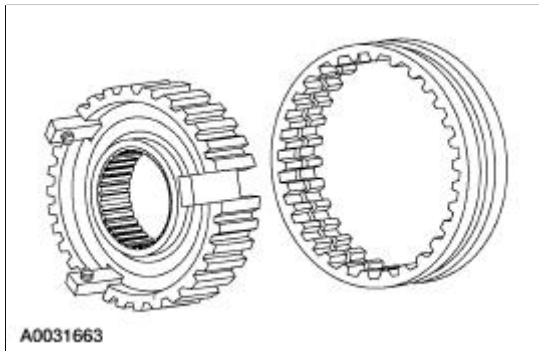



Synchronizers

Disassembly and Assembly

NOTE: This procedure applies to all synchronizer assemblies.

1. Scribe an alignment mark on the sliding sleeve and the hub for assembly reference.
2. Remove the sliding sleeve, then remove the synchronizer struts and the springs.






3. Install the synchronizer struts and the springs.
4.  **CAUTION:** Match the alignment marks made during disassembly. The sleeve and the hub have an extremely close fit. Hold the sleeve and hub square to prevent jamming. Do not force the sleeve onto the hub.

Install the sliding sleeve.

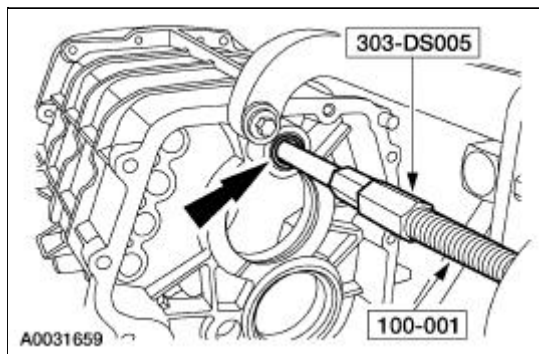
Gearshift Rail Bushing

Special Tool(s)

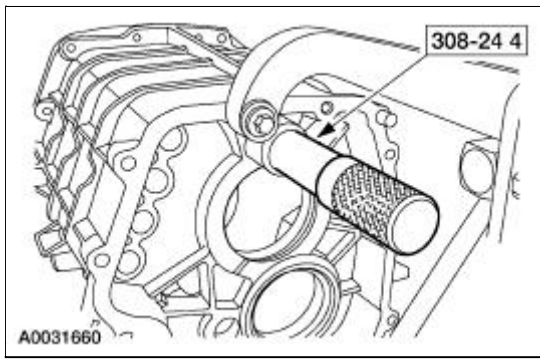
 ST1144-A	Universal Puller Set 303-DS005 (D80L-100-A) or equivalent
 ST1085-B	Installer, Shift Rail Bushing 308-244 (T96P-7025-F)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

Disassembly and Assembly

1. Using the special tools, remove the gearshift rail bearing from the transmission case. Discard the bearing.



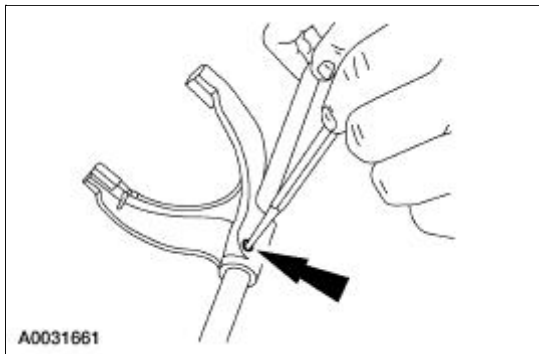
2. Using the special tool, install the main shift rail bearing.



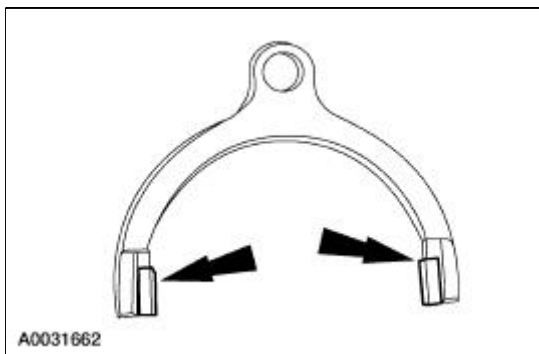
Gearshift Rail and Fork

Disassembly and Assembly

1. Using a 5/32-inch drift and a hammer, remove and discard the split pin. Slide the shift fork from the shift rail.

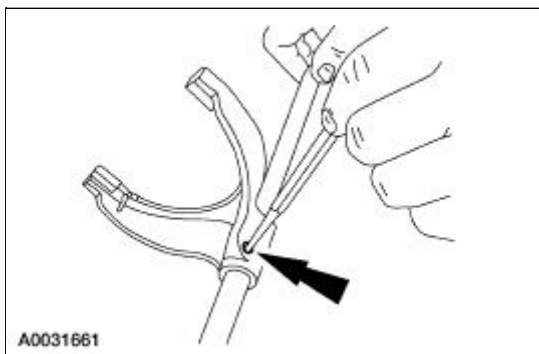


2. Remove the gearshift fork inserts.

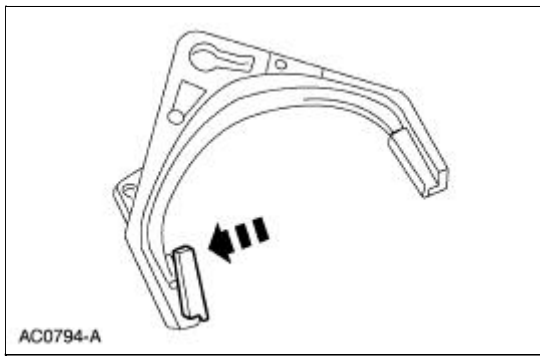


3.  **CAUTION:** Support the shift rail to prevent damage to the parts.

Position the gearshift fork on the shift rail. Align the split pin hole and install a new split pin.








4. Install the gear shift fork inserts.



Transmission

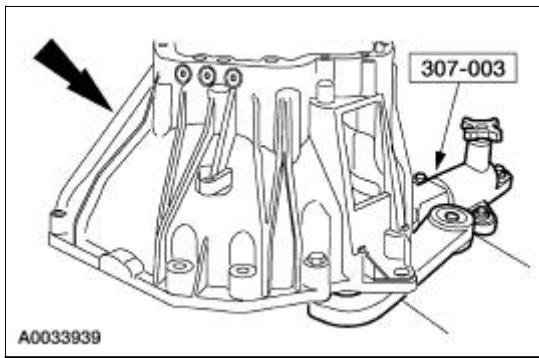
Special Tool(s)

 <p>ST1214-A</p>	<p>Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent</p>
 <p>ST1186-A</p>	<p>Holding Fixture, Transmission 307-003 (T57L-500-B)</p>
 <p>ST1303-A</p>	<p>Remover/Installer, Bearing Tube 308-024 (T75L-7025-B)</p>
 <p>ST2338-A</p>	<p>Replacer/Adapter 308-239 (T96P-7025-A)</p>
 <p>ST2199-A</p>	<p>Installer, Transmission Extension Housing Oil Seal 308-227 (T94P-7657-A)</p>

Material

Item	Specification
<p>Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX</p>	<p>MERCON</p>
<p>Premium Long Life Grease XG-1-C, K or T</p>	<p>ESA-M1C75-B</p>

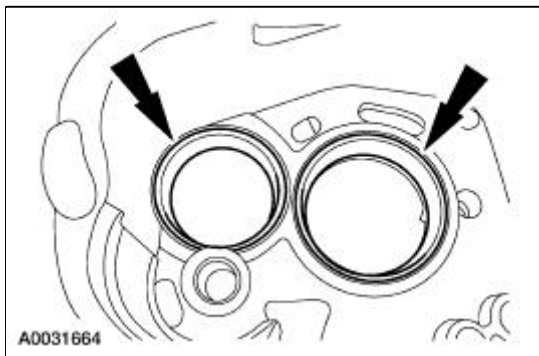
1. Lubricate all components with transmission fluid during assembly.
2. Attach the clutch housing to the special tool.



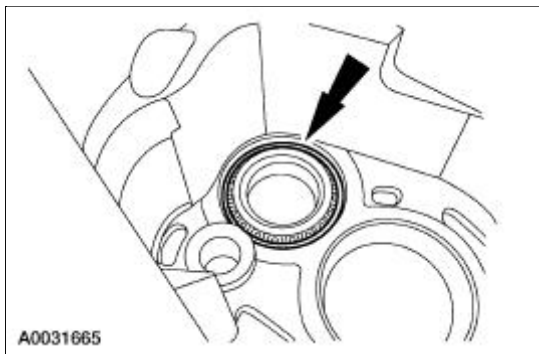
3. **NOTE:** If a new rear output shaft bearing was installed or a new rear countershaft bearing is being used, install new bearing cups.

Install the rear countershaft bearing cup and the rear output shaft bearing cup.

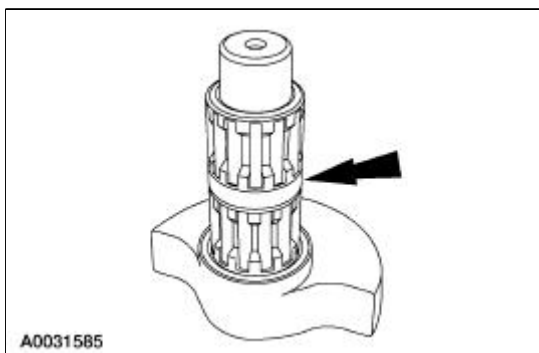
- Lubricate the bearing cups and the shift rail bearing with petroleum jelly.



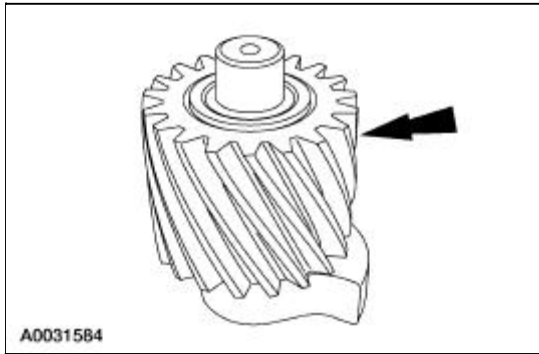
4. Install the rear countershaft bearing.



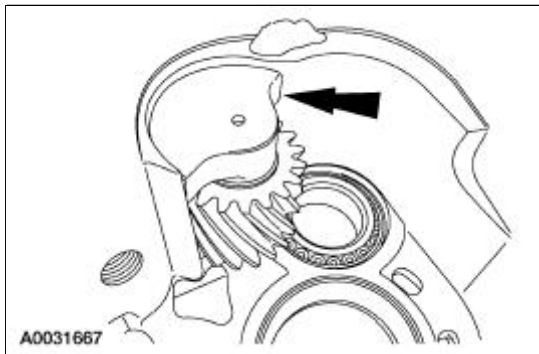
5. Install the reverse idler gear bearings and spacer on the shaft.



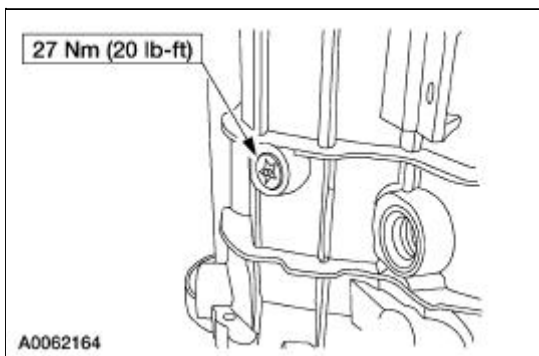
6. Install the reverse idler gear on the shaft.



7. Install the reverse idler gear into the case.



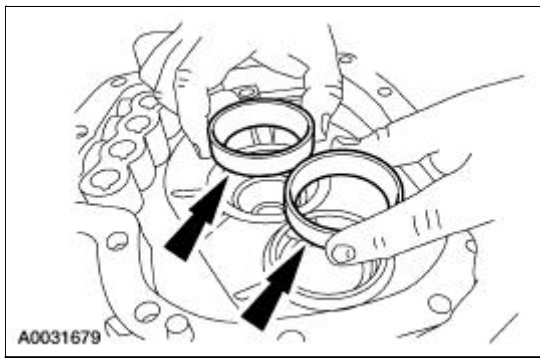
8. Install a new seal on the reverse idler bolt, then install the bolt in the transmission case.



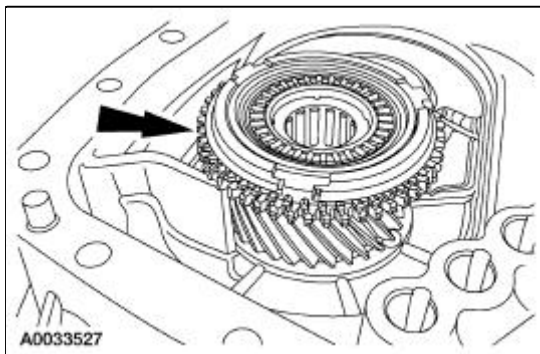
9. **NOTE:** If a new front input shaft bearing or front countershaft bearing was installed, install new bearing cups.

Install the front input shaft bearing cup and the front countershaft bearing cup. Do not install the shims at this time.

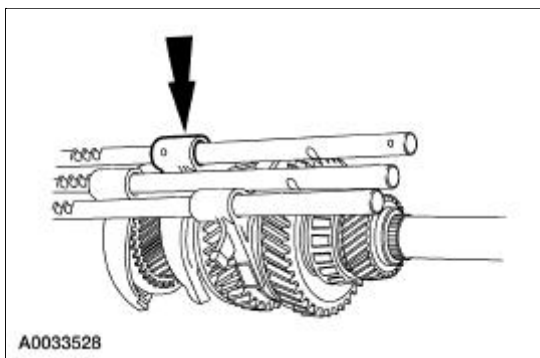
- Install the transmission main case.



10. Install the input shaft.

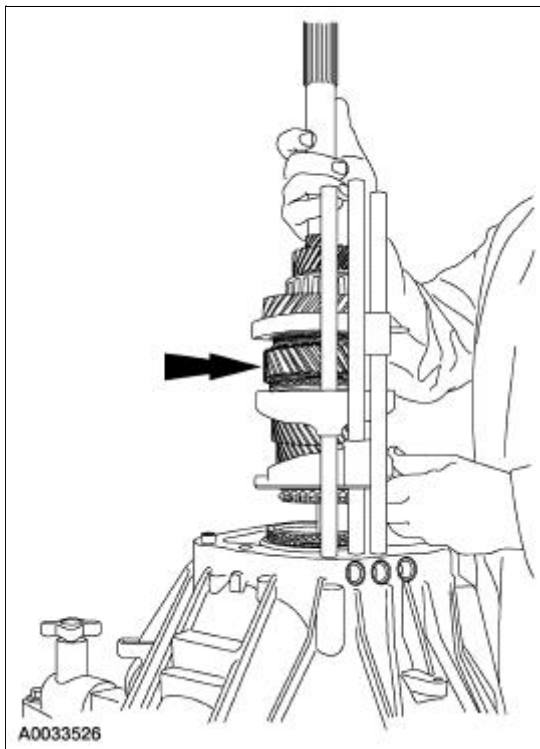


11. Install the shift rails and shift forks on the mainshaft.



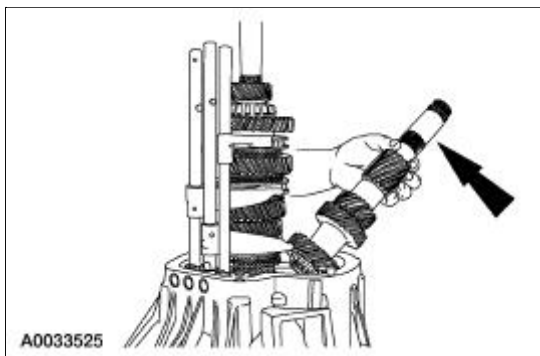
12. Install the mainshaft onto the clutch housing.

- The notches on the shift rail should be pointing upward.
- Align the shift rails in the bores.

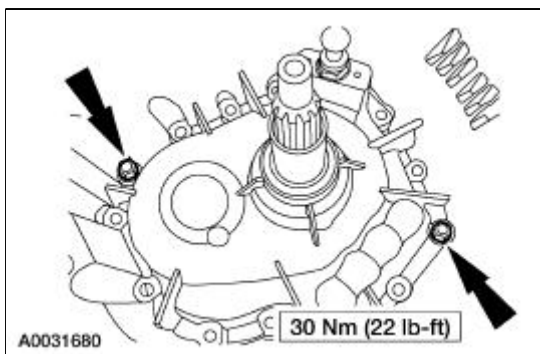


13. Install the countershaft.

- Lift the mainshaft upward, tilt the countershaft and install.



14. Install the case with two opposing bolts.

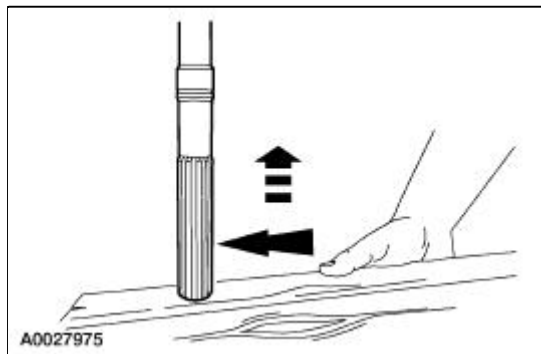
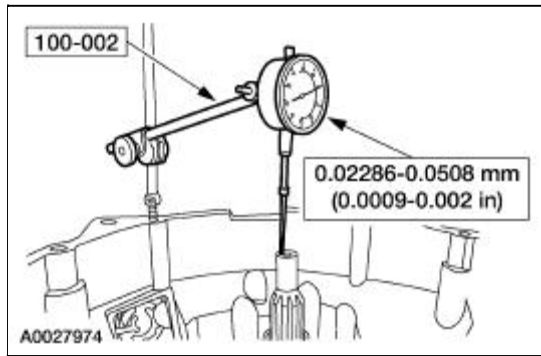


15. **NOTE:** Rotate the transmission so that the input shaft is pointing upward.

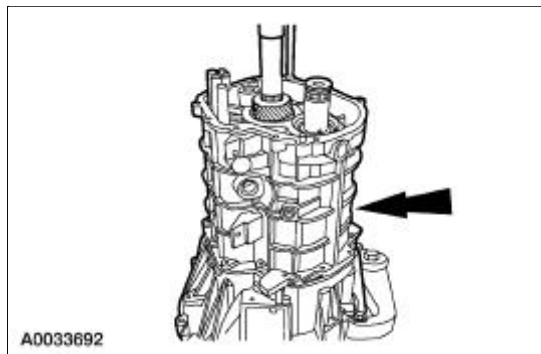
NOTE: Rotate the input shaft to seat the bearings.

Using the special tools, measure the input shaft end play by applying an upward load on the

output shaft. Record the measurement.

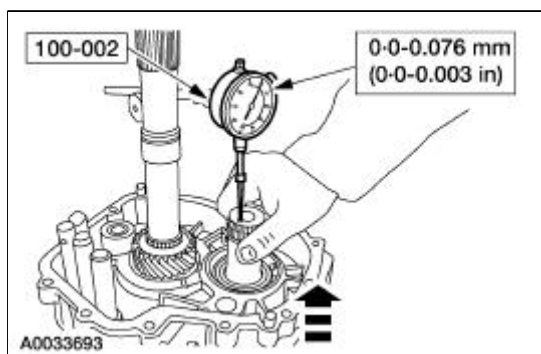


16. Rotate the transmission so that the input shaft is pointing downward.

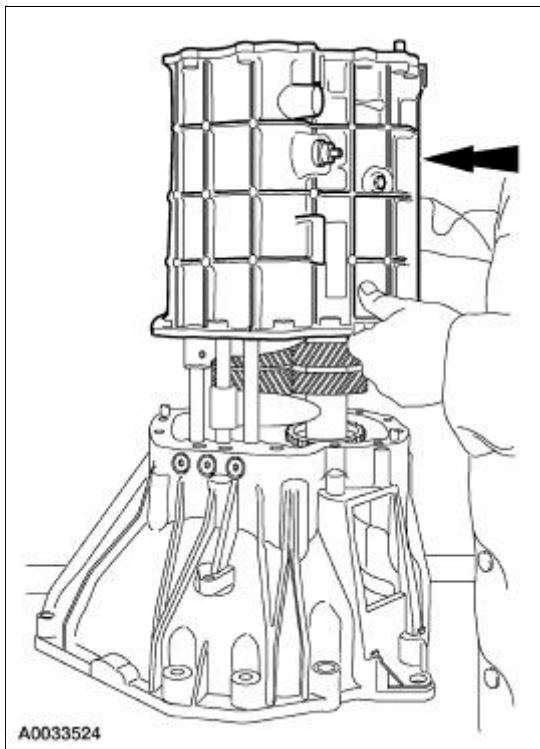


17. **NOTE:** Rotate the countershaft to seat the bearings.

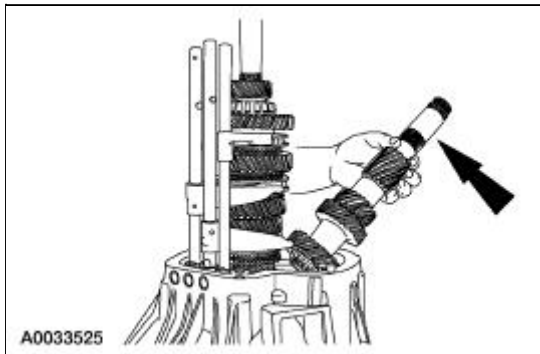
Using the special tools, measure the countershaft gear end play by pulling upward on the countershaft. Record the measurement.



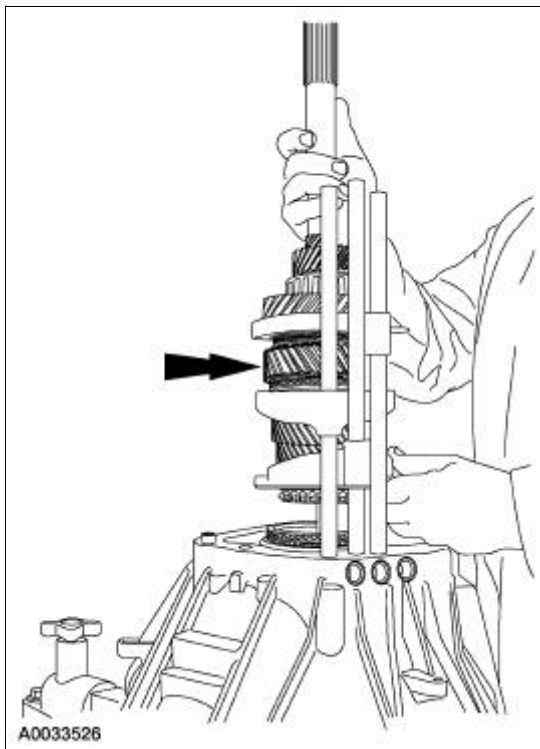
18. Remove the two bolts and lift the transmission main case off.



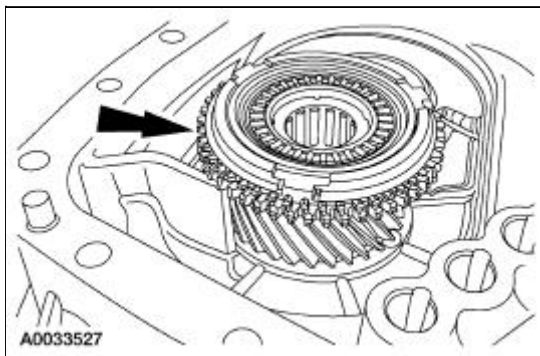
19. Remove the countershaft.



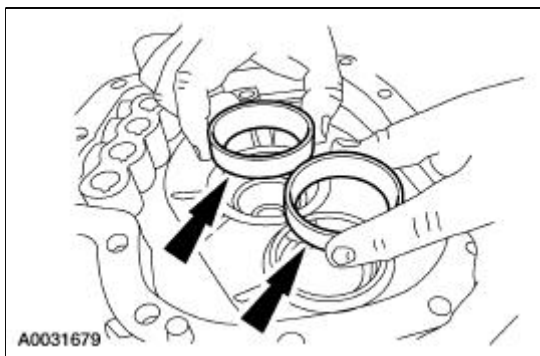
20. Remove the mainshaft.



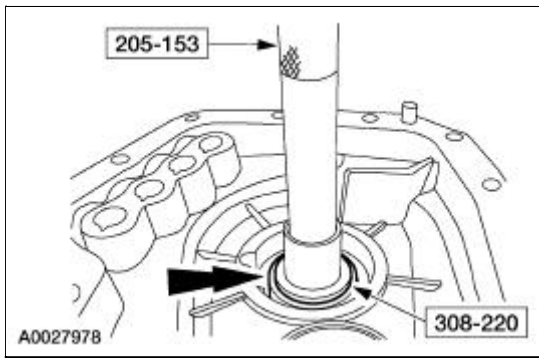
21. Remove the input shaft.



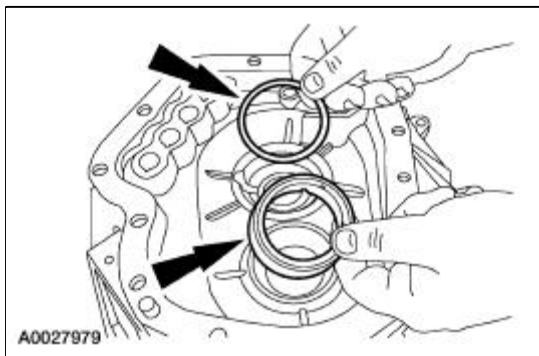
22. Remove the front input shaft bearing cup and the front countershaft bearing cup.



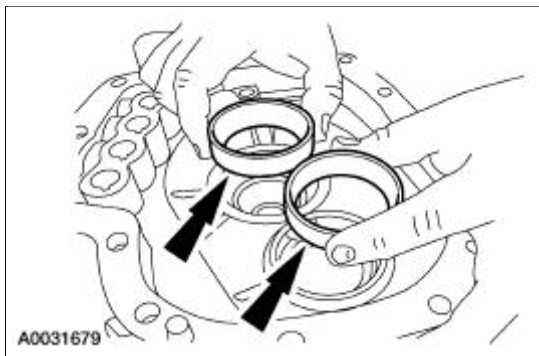
23. Using the special tools, install the new input shaft seal.



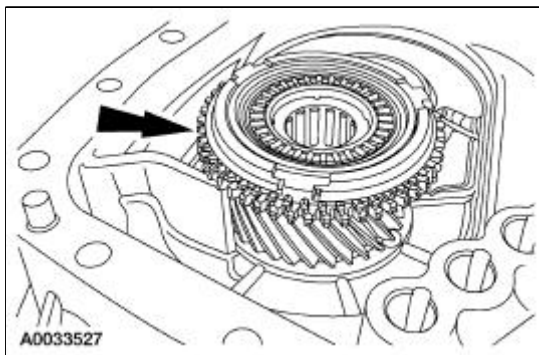
24. Using the recorded end play measurements, select and install the appropriate shims to achieve the correct end play.



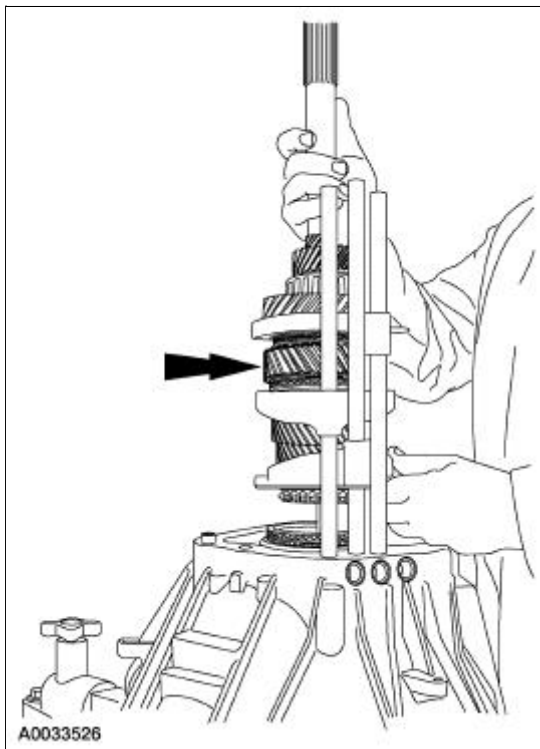
25. Install the front input shaft bearing cup and the front countershaft bearing cup.



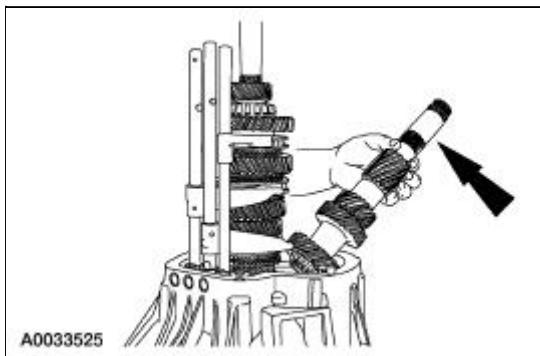
26. Install the input shaft.



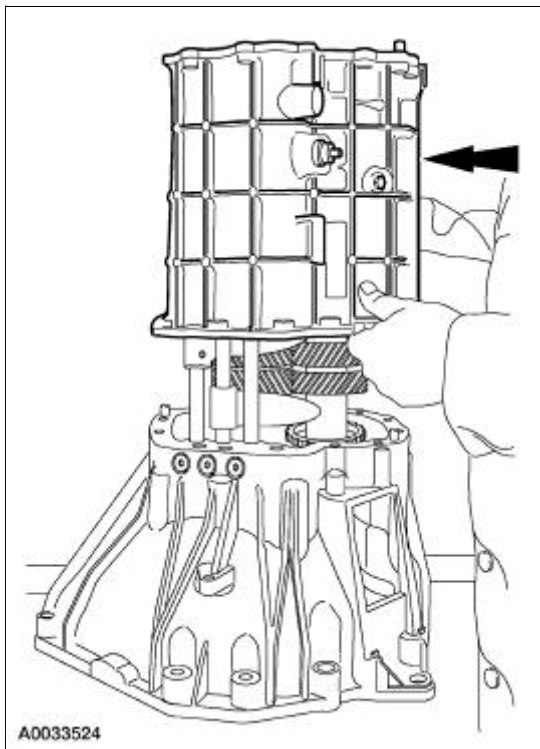
27. Install the mainshaft.



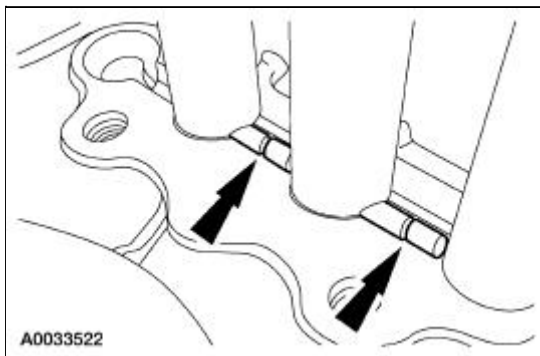
28. Install the countershaft.



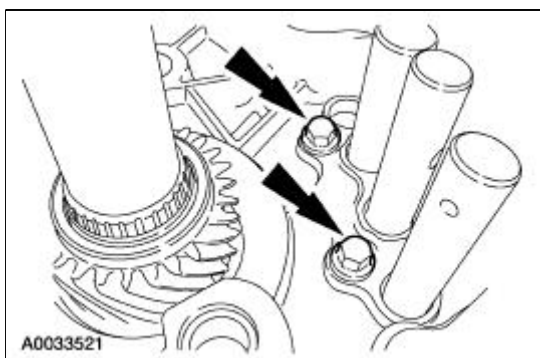
29. Clean the mating surfaces of the transmission main case and the clutch housing. Apply a bead of silicone rubber to the sealing surface on the clutch housing then install the transmission main case. Tighten the bolts in a star pattern.

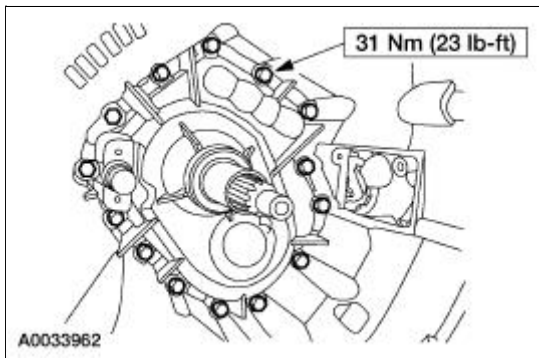


30. Install the lock pins.

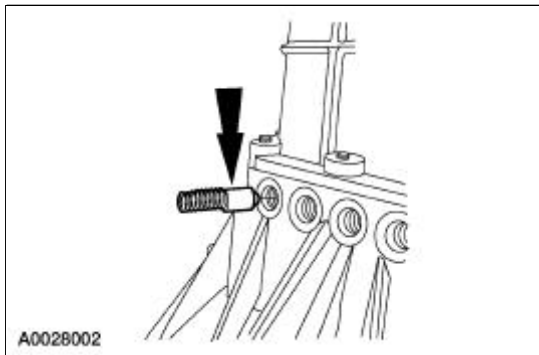


31. Install the lock plate.

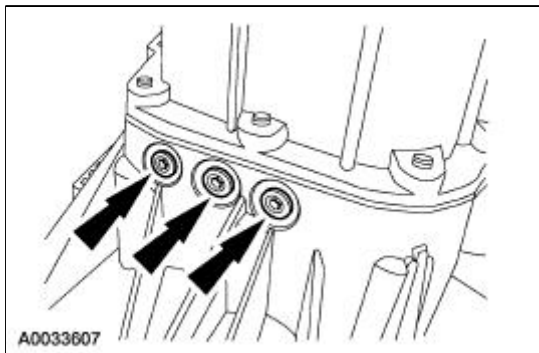




32. Install the detents and the detent springs.

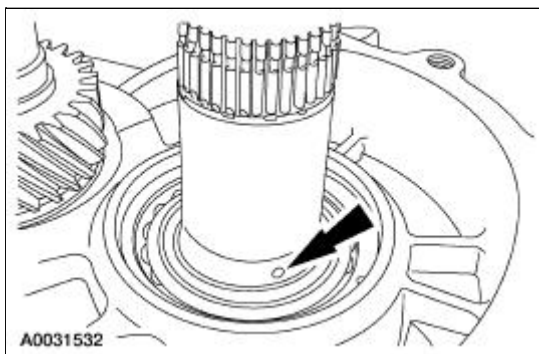


33. Install the detent plugs.

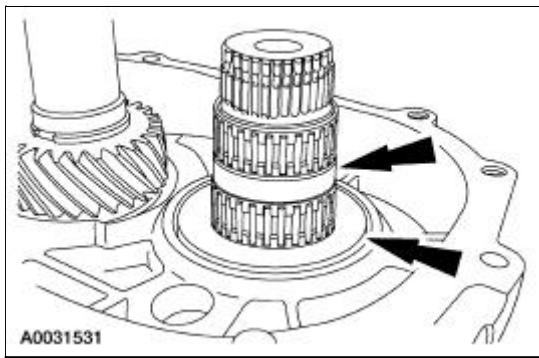


34. Install the check ball.

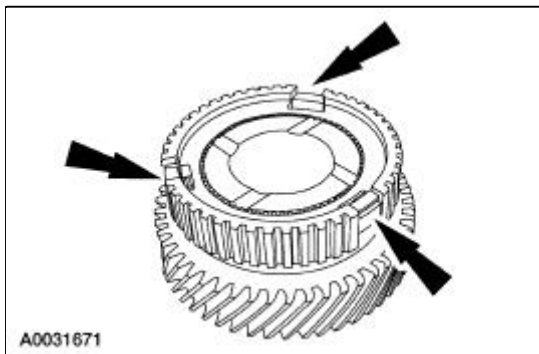
- Use petroleum jelly to hold the check ball in place.



35. Install the thrust washer and the three-piece fifth gear needle bearing.

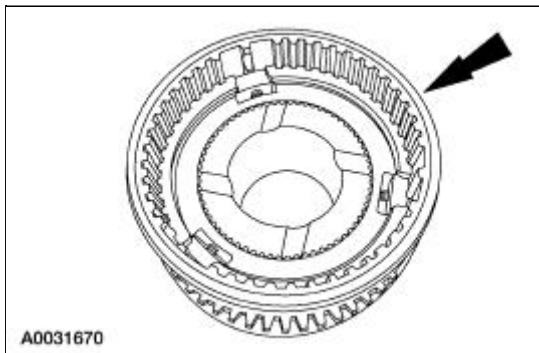


36. Install the synchronizer springs and inserts.

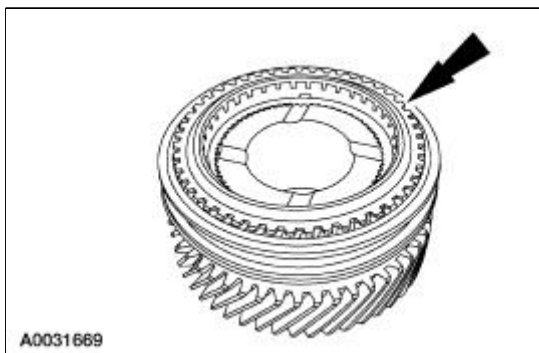


37. Install the sliding sleeve on the synchronizer hub.

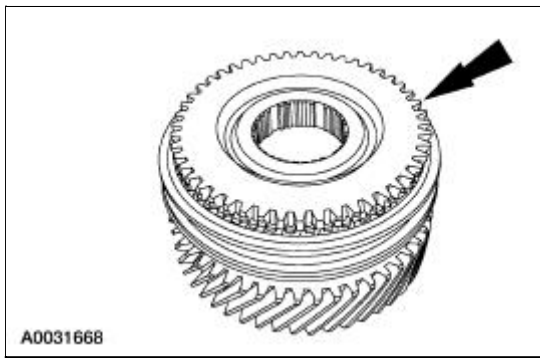
- Align the pockets in the blocking ring with the struts in the synchronizer.
- The sliding sleeve is not reversible. Install the sleeve with the bevel edge away from the gear.



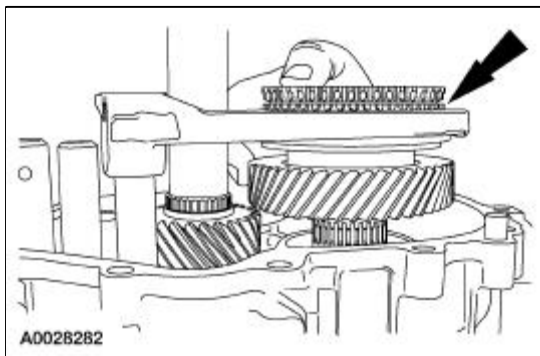
38. Install fifth gear blocking ring.



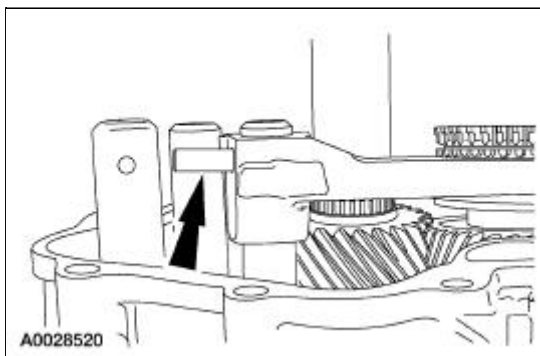
39. Install the fifth gear synchronizer cone.



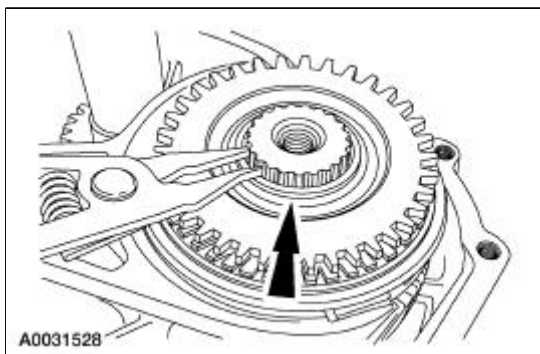
40. Install the fifth gear shift fork, the synchronizer assembly, the synchronizer cone and fifth gear as an assembly.



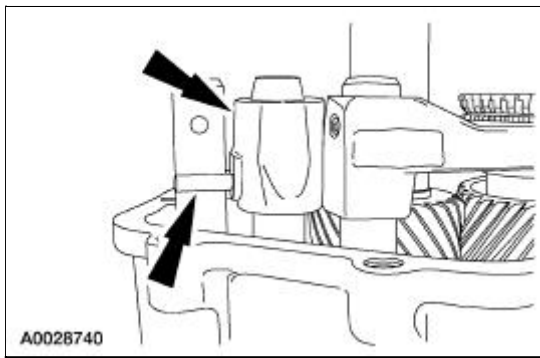
41. Install a new split pin.
- Install the pin until it is flush with the fork.



42. Install a new snap ring.

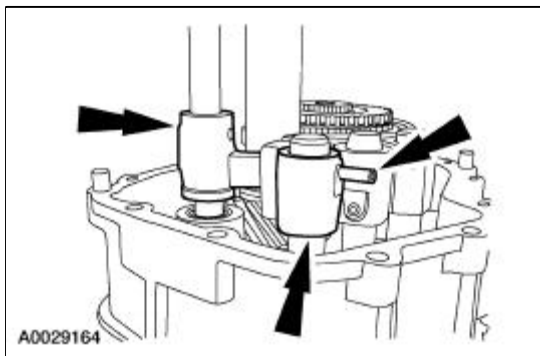


43. Install the third/fourth shift finger, then install a new split pin.
- Install the split pin until it is flush with the shift finger.



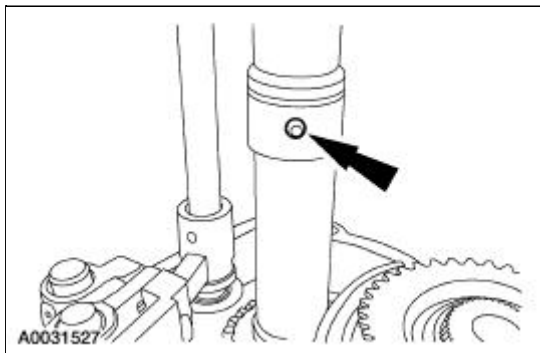
44. Install the control rail and the plastic spacer, then install the first/second shift finger. Install a new split pin.

- Install the split pin until it is flush with the shift finger.

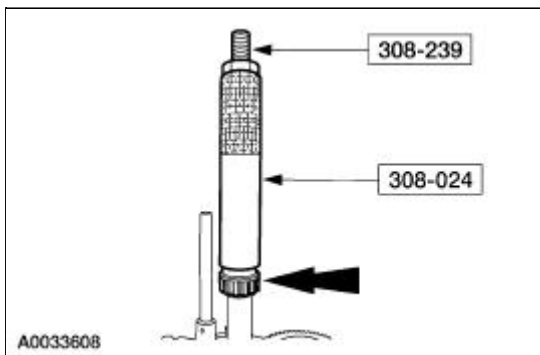


45. Install the OSS sensor tone wheel check ball.

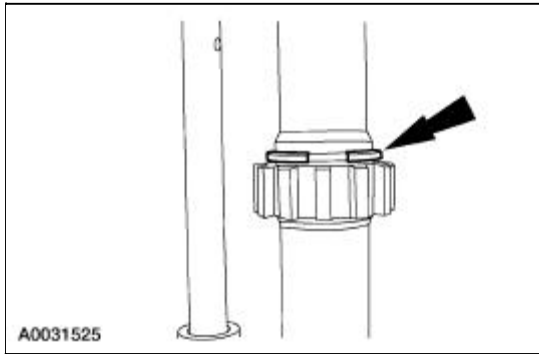
- Use petroleum jelly to hold the check ball in place.



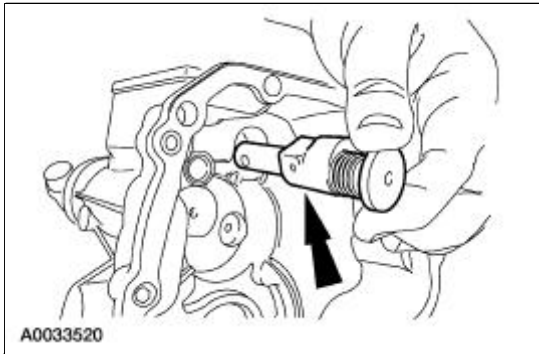
46. Place the OSS sensor tone wheel on the output shaft, aligning the slot in the OSS wheel with the check ball. Using the special tool, install the OSS sensor tone wheel.



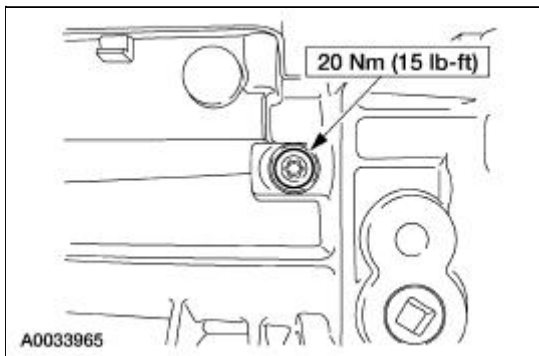
47. Install a new OSS sensor tone wheel retaining ring.



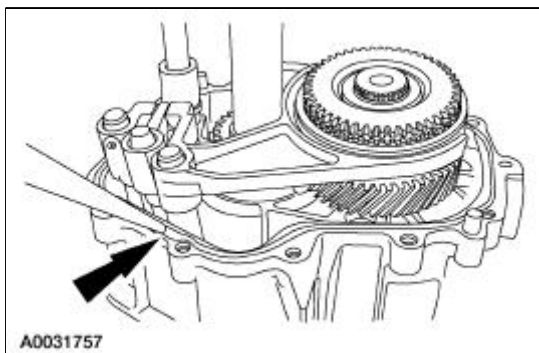
48. Install the fifth/reverse gear lockout.



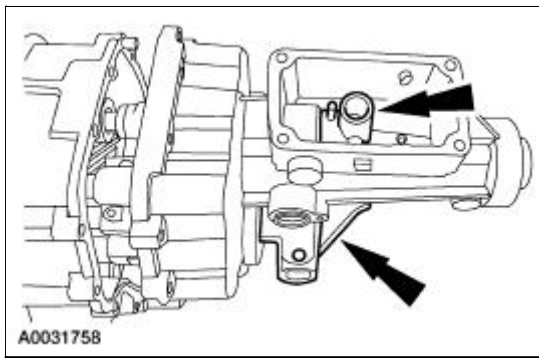
49. Install the bolt.



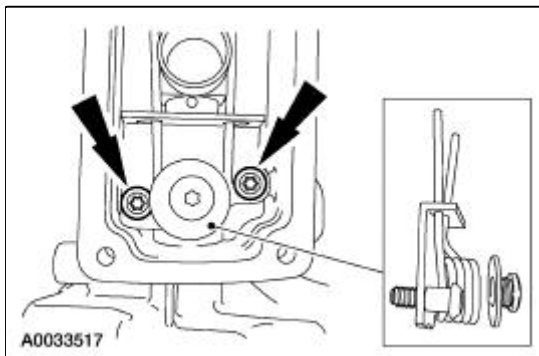
50. Clean the mating surfaces of the transmission main case and the extension housing. Apply a bead of silicone rubber to the sealing surface of the transmission case.



51. Install the extension housing and at the same time install the gear shift off-set lever.



52. Install the shift spring and bracket.

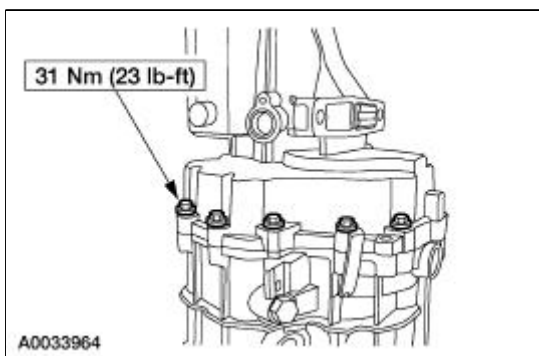


53. Install a new split pin in the gear shift off-set lever.

- The split pin should be flush in the gear shift off-set lever.

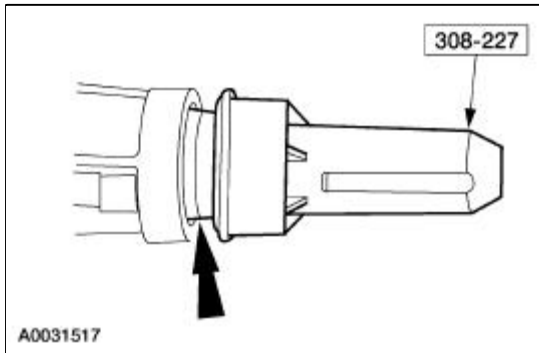
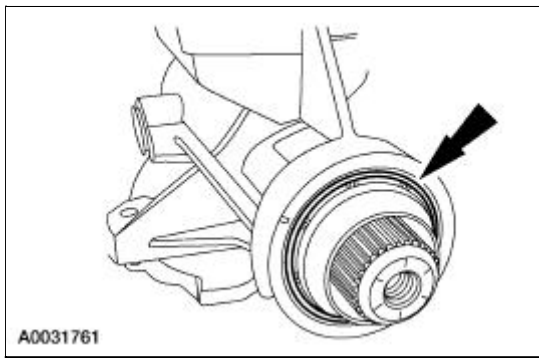
54. Seat the extension housing and tighten the bolts to specification.

- Fill the gear shift off-set lever with petroleum jelly.

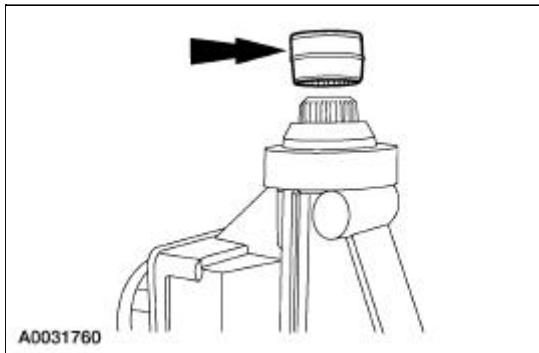


55. Using the special tool, install a new extension housing seal.

- Lubricate the seal with transmission fluid.



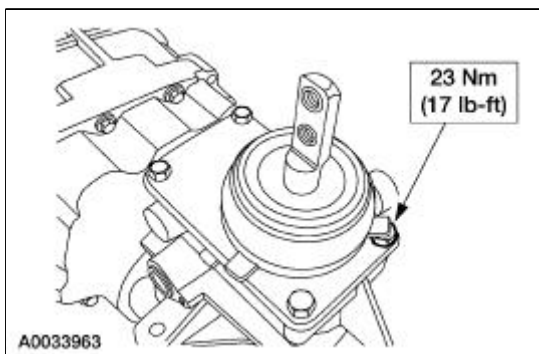
56. Install the shipping seal.



57. Rotate the transmission to a horizontal position.

58. Clean the mating surfaces of the shift cover opening surface and the shift cover. Apply a bead of silicone rubber to the shift cover opening surface.

59. Install the gear shift lever.



60. **NOTE:** Before installing the transmission, the ball stud, the clutch release lever and the input

shaft guide tube must be cleaned and lubricated.

Install the clutch release hub and bearing and the clutch release lever. For additional information, refer to Section 308-01.

61. Fill the transmission with transmission fluid to the specified level.

- Transmission capacity is 3.6 liters (7.5 pints).
-

Transmission

Material

Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON
Pipe Sealant with Teflon® D8AZ-19554-A or equivalent	WSK-M2G350-A2
Premium Long Life Grease XG-1-C, K or T or equivalent	ESA-M1C75-B

1. **NOTE:** Before installing the transmission, the ball stud, clutch release lever and the input shaft must be cleaned and lubricated. Use Motorcraft Premium Long-Life Grease XG-1-C or XG-1-K or equivalent meeting Ford specification ESA-M1C75-B.

To install, reverse the removal procedure. For additional information, refer to [Transmission](#) in this section.

- Check, and as necessary, fill the transmission with transmission fluid. The total fill capacity is 3.6L (7.5 pt).
2. Apply sealant to the fill plug threads and install the fill plug.
 - Use pipe sealant with Teflon®.
-

General Specifications

Item	Specification
Lubricants and Sealants	
Premium Long-Life Grease XG-1-C, K or T	ESA-M1C75-B
Threadlock and Sealer E0AZ-19554-AA	WSK-M2G351-A5
Black Non-Acid Cure Silicone Rubber E7TZ-19562-A	ESL-M4G273-A
Pipe Sealant with Teflon® D8AZ-19554-A	ESR-M18P7-A
Preload	
Input/output shaft preload	0.0 mm (in) - 0.05 mm (0.002 in)
Countershaft cluster gear preload	0.0 mm (in) - 0.05 mm (0.002 in)
Countershaft extension preload	0.05 mm (in) - 0.13 mm (0.005 in)
Fluid	
DEXRON III® (ATF) Transmission Fluid XT-2-QDX	DEXRON III®
Capacity	3.9 L (4.1 qt.)
Synchronizer	
Synchronizer blocking ring to conical face runout 1st, 2nd, 3rd, 4th, 5th & 6th gear	0.38 mm (0.01 in)
Synchronizer blocking ring to conical face runout Reverse gear	0.75 mm (0.03 in)

Torque Specifications

Description	Nm	lb-ft	lb-in
Transmission-to-clutch adapter housing bolts	35	26	—
Crossmember-to-frame bolts	41	30	—
Crossmember-to-transmission support bolts	58	43	—
OSS sensor bolt	10	—	7
Gearshift lever boot bolts	10	—	89
Lower gearshift lever bolts	20	15	—
Upper gearshift lever bolts	37	27	—
Shift dent	40	30	—
Shift lever guide bolts	27	20	—

Guide plate bolts	22	16	—
Reverse lockout solenoid bolt	18	13	—
Drain plug	27	20	—
Reversing lamp switch	27	20	—
Fill plug	27	20	—
Reverse idler shaft bracket bolts	25	18	—
Extension housing bolts	35	26	—
Shift dent cover bolts	20	15	—
Adapter plate plug	27	20	—

Manual Transmission

The T56 six-speed manual transmission features the following:

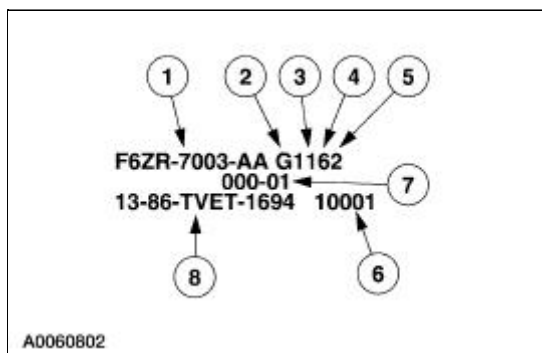
- six forward speeds and one reverse speed.
- forward gears are synchronized and helical cut.
- a reverse gear operates through a constant-mesh, fully synchronized system.
- a shift interlock system prevents the engagement of more than one gear.
- a countershaft with two sections, the countershaft cluster and the countershaft extension. The countershaft cluster is serviced as an assembly, the countershaft extension components are serviced.
- two tapered roller bearings on the output shaft.
- two tapered roller bearings on the countershaft cluster.
- a tapered roller bearing on the input shaft.
- a tapered roller bearing on the countershaft extension.
- countershaft cluster endplay controlled by shims located in the transmission adapter plate.
- countershaft extension endplay controlled by shims located in the extension housing.
- input/output shaft endplay is controlled by shims located in the transmission adapter plate.
- removable wear pads on the shift forks.
- an aluminum main case, extension housing, adapter plate and clutch housing.

Transmission Identification

The transmission identification tag is located under the lower bolt that retains the extension housing to the main case.

The six speed (T56) transmission is available for the Mustang 4.6L (4V).

Transmission Identification



Item	Part Number	Description
1	—	Transmission assembly number
2	—	Build date code — month

3	—	Build date code — day
4	—	Build date code — year
5	—	Shift number
6	—	Serial number
7	—	Service repair code
8	—	Identification number located on left lower side of transmission case

Manual Transmission

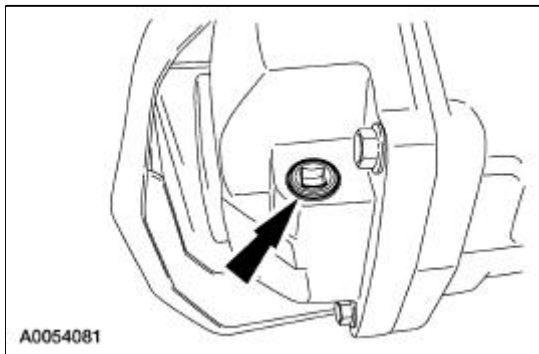
Refer to [Section 308-00](#) .

Transmission Draining and Filling

Material

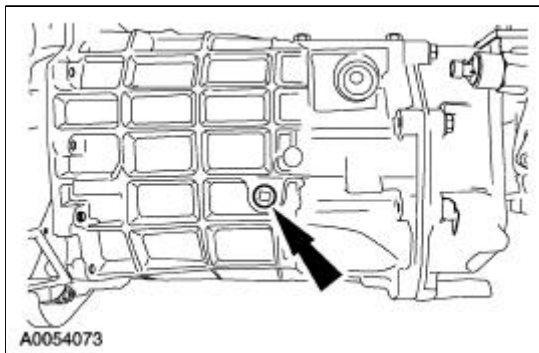
Item	Specification
DEXRON III® (ATF) Transmission Fluid XT-2-QDX	DEXRON III®

1. Remove the drain plug and drain the transmission.
 - Position a suitable drain pan under the transmission.

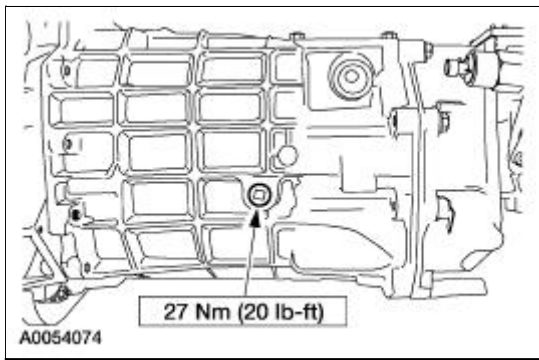


2. Clean and install the drain plug.
3. **NOTE:** Before removing, clean the area around the filler plug.

Remove the filler plug.



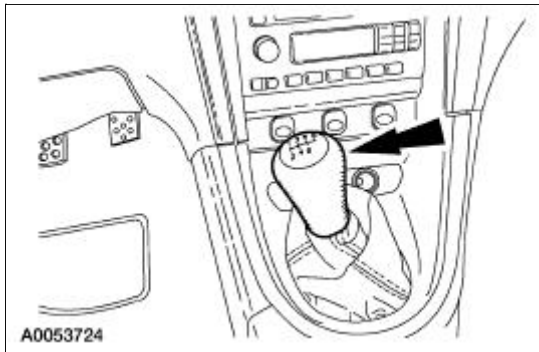
4. Using a suitable oil suction gun, fill the transmission to the correct level with the specified fluid.
 - Transmission capacity is 3.9 liters (4.1 quarts).



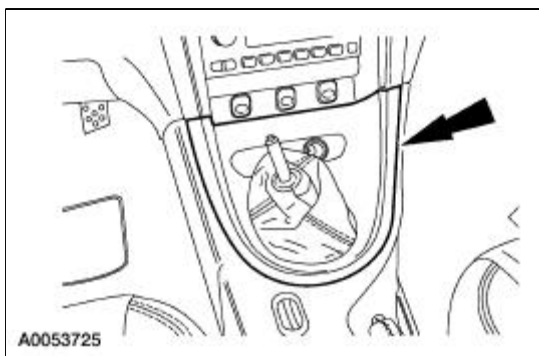
5. Install the filler plug.
-

Transmission

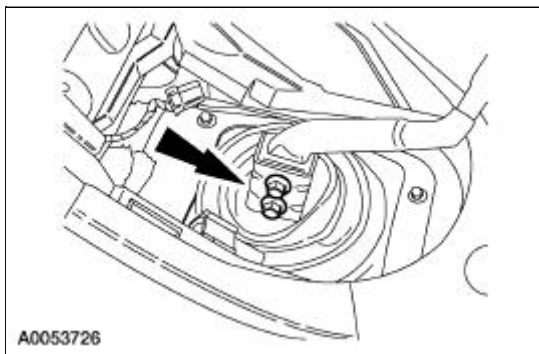
1. Remove the gearshift lever knob.



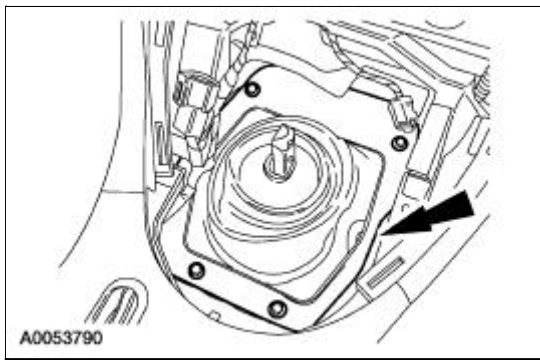
2. Remove the console panel gearshift plate. Disconnect the cigar lighter electrical connector, then lift the gearshift lever boot over the gearshift lever.



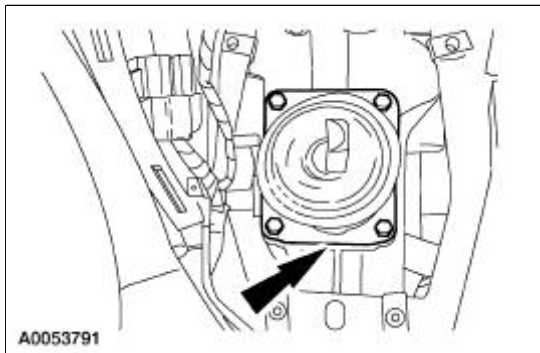
3. Remove the bolts and the upper gearshift lever.



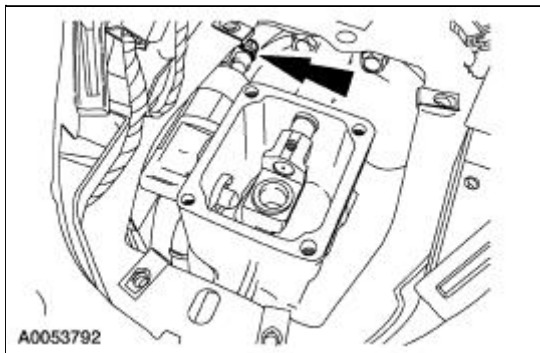
4. Remove the bolts and the lower gearshift lever boot.



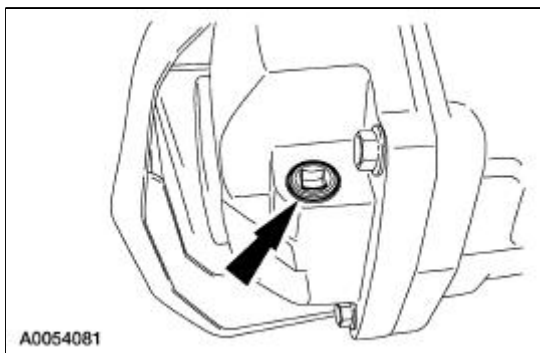
5. Remove the bolts and the lower gearshift lever.



6. Disconnect the reverse lockout solenoid electrical connector.



7. With the vehicle in NEUTRAL, raise and support the vehicle. For additional information, refer to [Section 100-02](#).
8. Drain the transmission fluid.

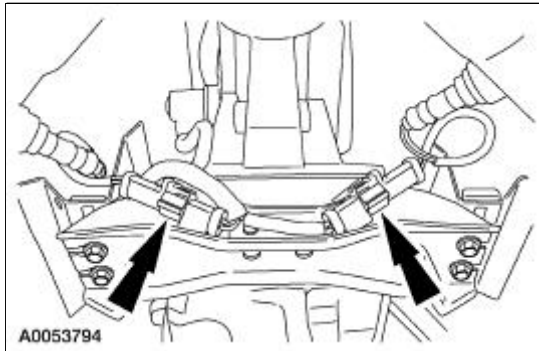


9.  **CAUTION:** Index-mark the driveshaft flange and pinion flange, and the driveshaft

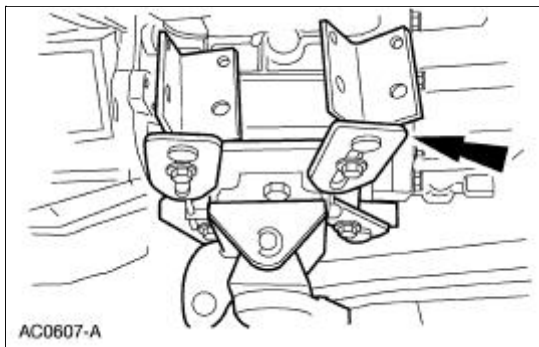
slip yoke and transmission output shaft.

Remove the driveshaft. For additional information, refer to [Section 205-01](#).

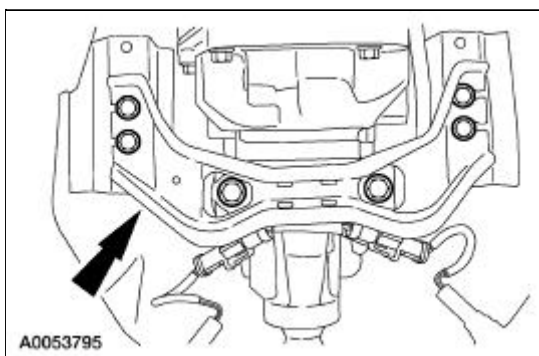
10. Disconnect the heated oxygen sensor (HO2S) electrical connectors from the crossmember.



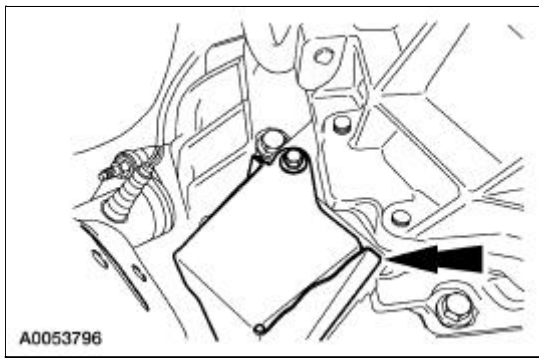
11. Position a transmission jack and support the transmission.



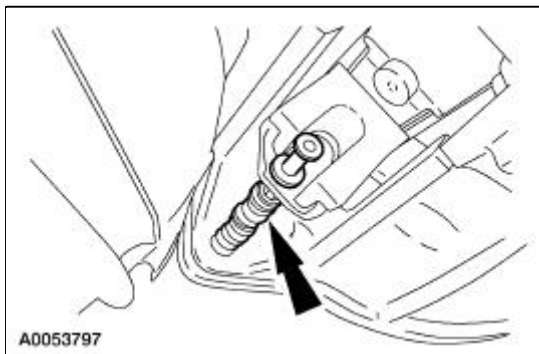
12. Remove the bolts and the transmission crossmember.



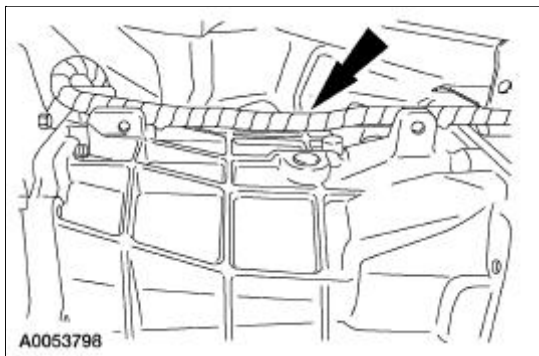
13. Remove the bolt and the clutch release lever cover.



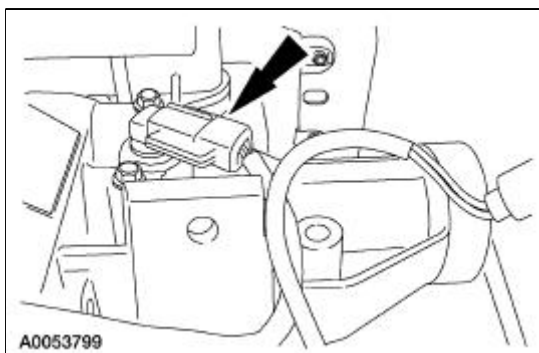
14. Disengage the clutch release cable from the clutch release fork.



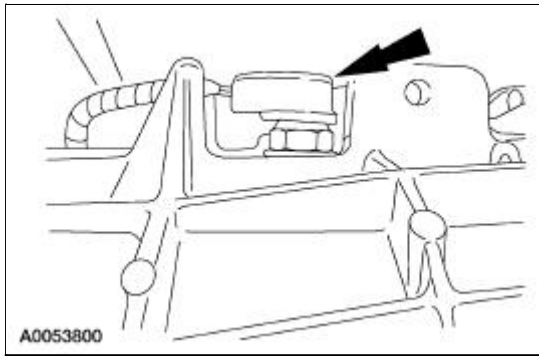
15. Disconnect the wiring harness from the transmission.



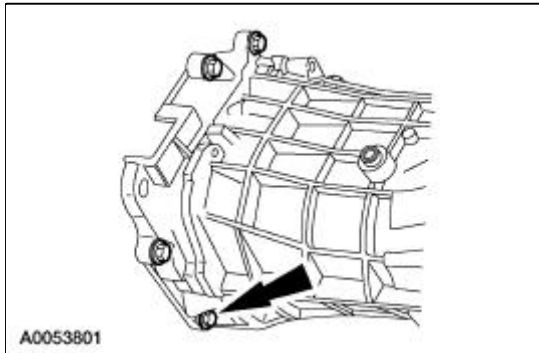
16. Disconnect the output shaft speed (OSS) sensor electrical connector.



17. Disconnect the reverse lamp electrical connector.





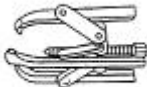



18. Remove the eight transmission-to-clutch adapter housing bolts.



19. Move the transmission rearward until the input shaft is clear of the pressure plate, then lower the rear of the transmission while moving it forward to clear the exhaust pipe. Lower the transmission from the vehicle.
-

Transmission

Special Tool(s)

 ST1186-A	Holding Fixture, Transmission 307-003 (T57L-500-B)
 ST1368-A	Puller, Bearing 205-D064 (D84L-1123-A)
 ST1184-A	2 or 3 Jaw Puller 205-D027 (D80L-1013-A)
 ST1305-A	Remover, Mainshaft Bearing 308-058 (T77J-7025-H)
 ST2163-A	Remover/Installer, Bearing Tube 308-025 (T75L-7025-C)
 ST1304-A	Removal Screw, Bearing Tube 308-092 (T84T-7025-B)

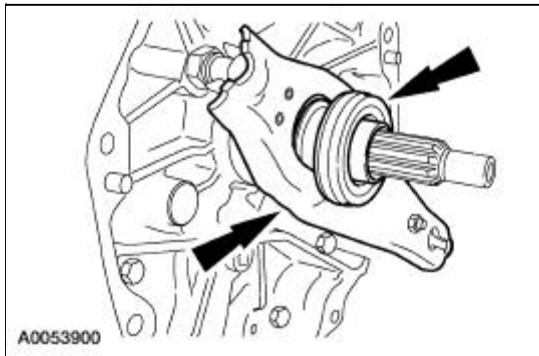
Disassembly

NOTE: During disassembly, if any roll pins, retaining rings or bearings are removed, install new components. Install bearings and bearing cups as a set only.

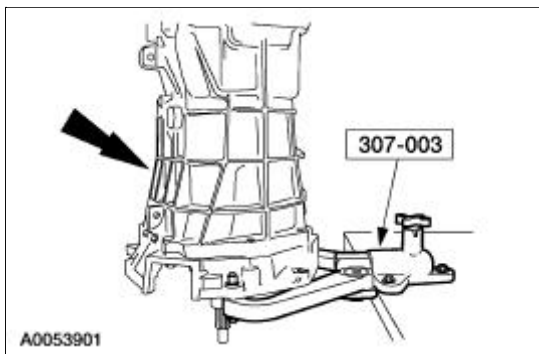
-  **WARNING:** Make sure protective eye wear is in place.

Clean the transmission exterior with solvent and dry with compressed air. During disassembly, clean all components with solvent and dry with compressed air.

2. Remove the clutch release hub and bearing and the clutch release lever.

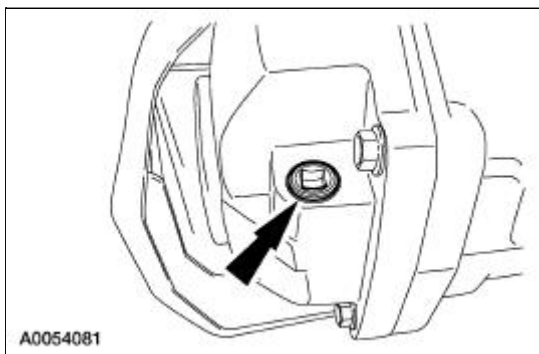


3. Attach the transmission to the special tool.

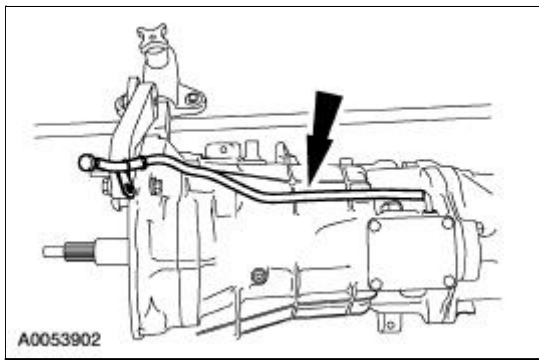


4. Rotate the transmission to a horizontal position.
5. **NOTE:** Position a drain pan under the transmission.

If the transmission was not drained during removal, drain the transmission.



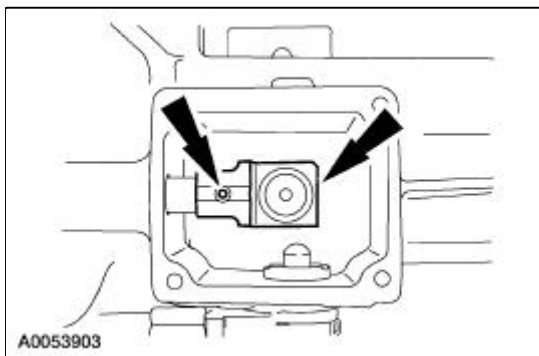
6. Remove the vent hose.



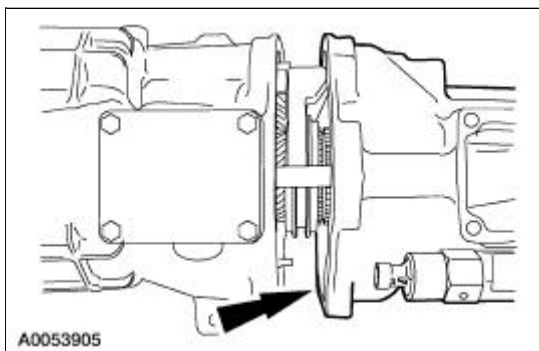
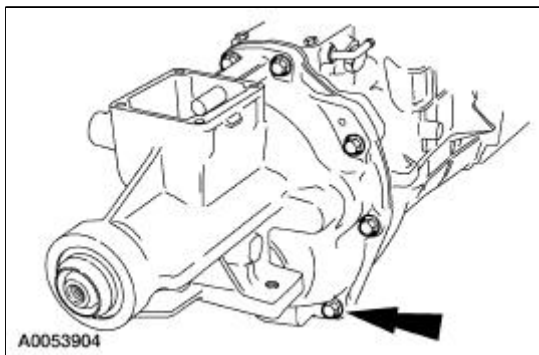
7. **NOTE:** Position the gearshift lever in third/fourth neutral position.

Using a 5/32-inch drift and a hammer, drive the roll pin downward, then remove the rear offset shift lever.

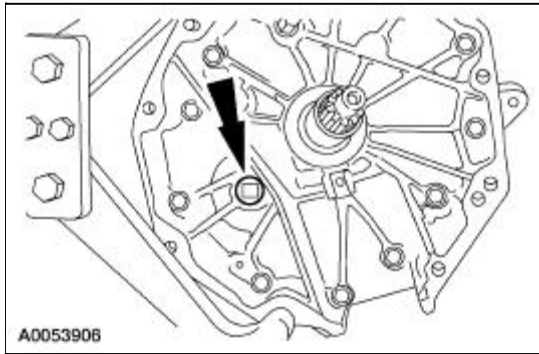
- Inspect the rear offset shift lever for wear or damage. Install a new lever as necessary.
- Discard the roll pin.



8. Remove the eight bolts and carefully separate the extension housing from the transmission.

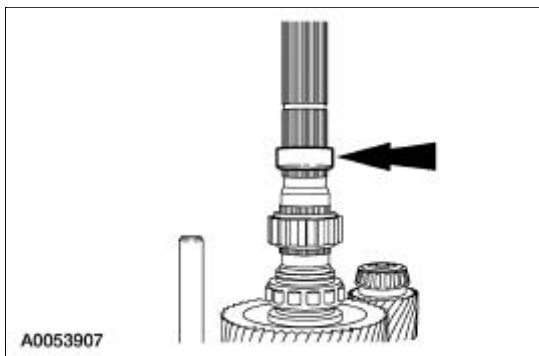


9. Remove the plug from the transmission adapter plate.

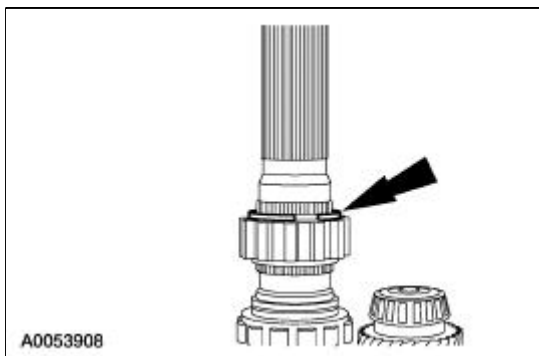


10. **NOTE:** Rotate the transmission to a vertical position.

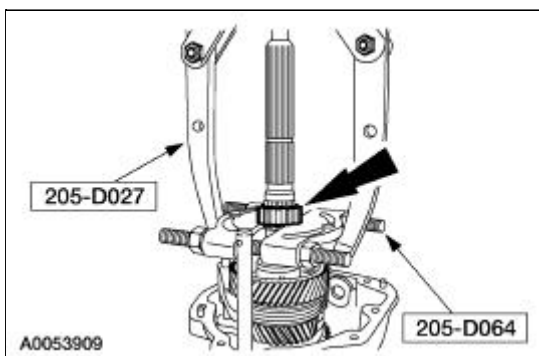
Remove the shipping seal.



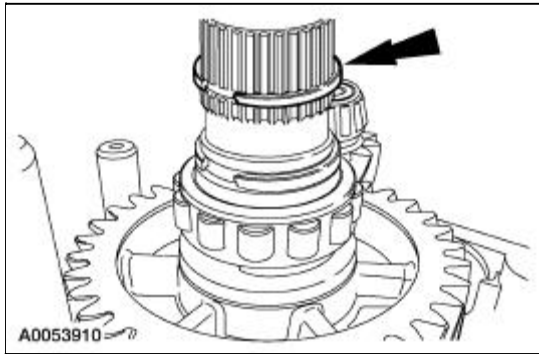
11. Remove the output shaft speed (OSS) sensor tone wheel retaining ring.



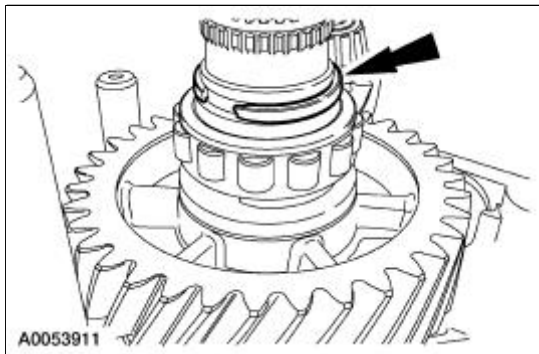
12. Using the special tools, remove the OSS sensor tone wheel.



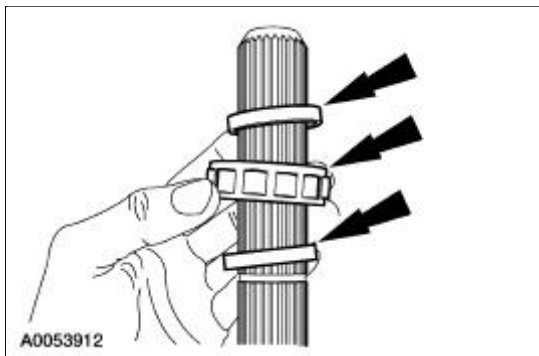
13. Remove and discard the OSS sensor tone wheel lower retaining ring.



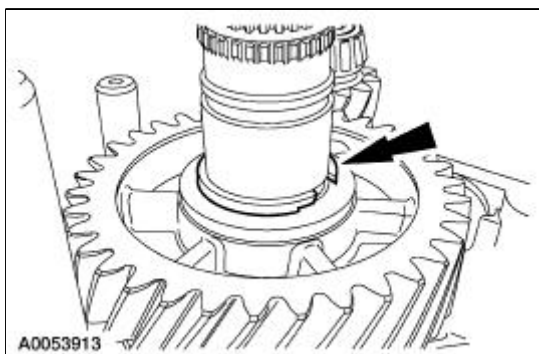
14. Remove and discard the rear mainshaft roller bearing snap ring.



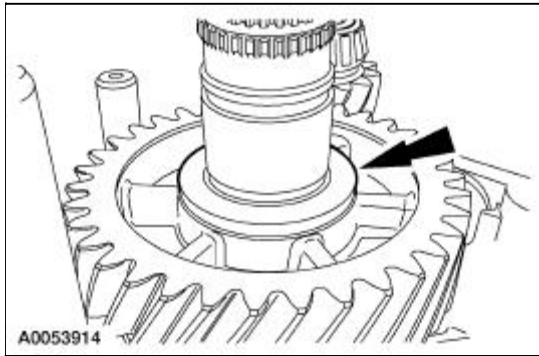
15. Remove the upper spacer, the rear mainshaft roller bearing and the lower spacer.
- Inspect the rear mainshaft roller bearing for wear or damage. Install a new bearing as necessary.



16. Remove and discard the reverse gear snap ring.

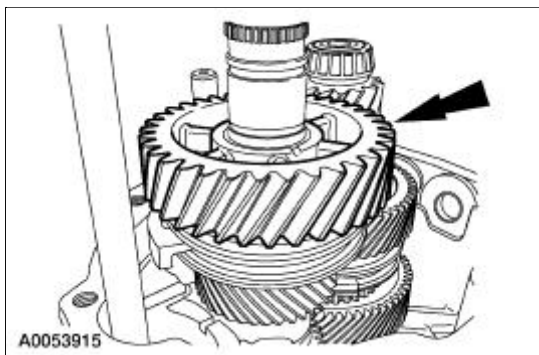


17. Remove the reverse gear thrust washer.

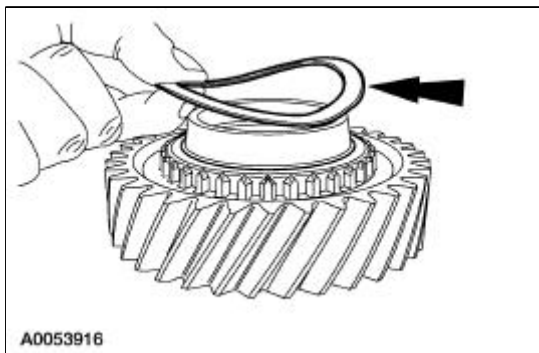


18. Remove the reverse gear.

- Inspect reverse gear for wear or damage. Install a new gear as necessary.

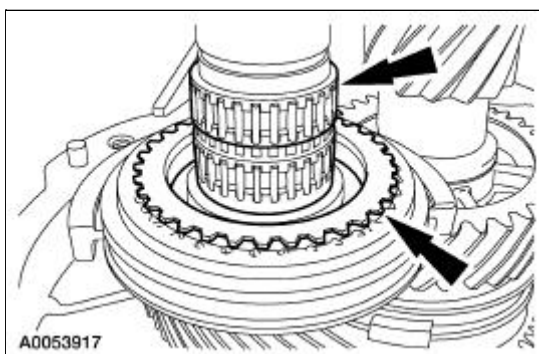


19. Remove the wave washer from the reverse gear.

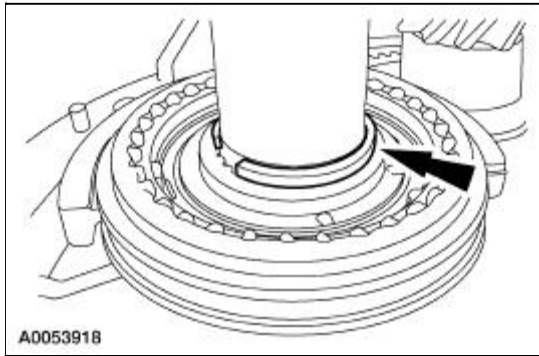


20. Remove the reverse gear needle bearing and the reverse gear synchronizer blocking ring.

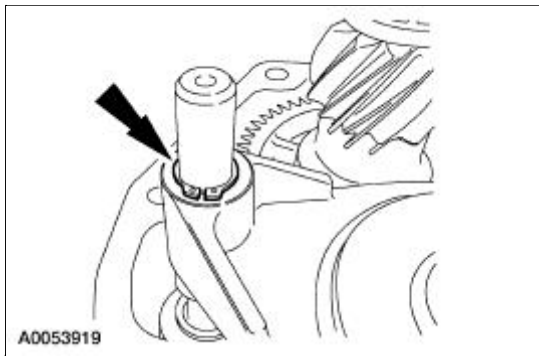
- Inspect the needle bearing for wear or damage. Install a new bearing as necessary.



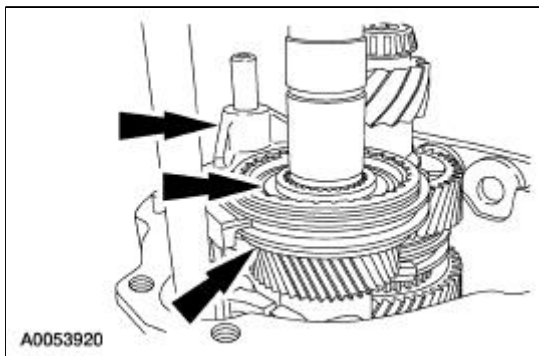
21. Remove the reverse gear synchronizer snap ring.



22. Remove the reverse shift fork snap ring.



23. Remove the reverse shift fork, the reverse synchronizer and the thrust washer as an assembly.



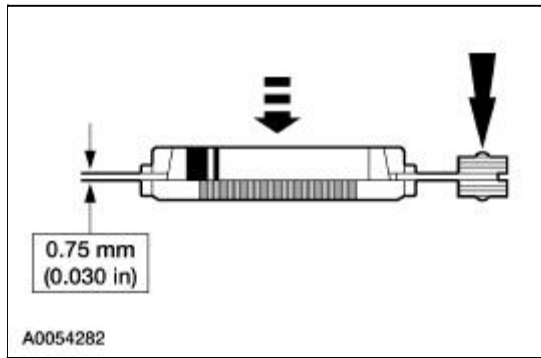
24. Inspect the synchronizer for the following:

- Check for worn, nicked or broken teeth. Install a new synchronizer as necessary.
- Check keys for wear or distortion. Check the springs for distortion. Install a new synchronizer as necessary.

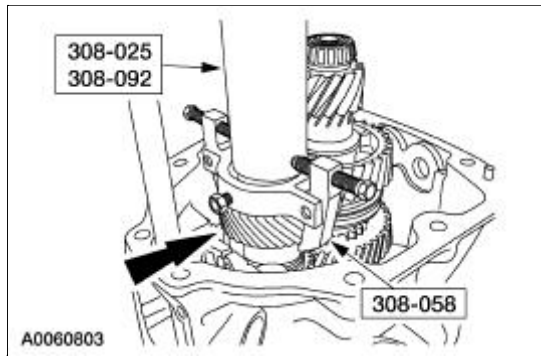
25. Inspect the synchronizer blocking ring for the following:

- Check for wear or damage. Install a new synchronizer blocking ring as necessary.
- Check the clearance between the synchronizer blocking ring and the gear.
 - Position the blocking ring onto the gear. Make sure the correct blocking ring is measured with the correct gear and that the blocking ring is fully seated on the gear.
 - Insert a feeler gauge and measure the clearance, while applying pressure and rotating the blocking ring. The measurement should be the same around the entire circumference. If the clearance is less than 0.75 mm (0.030 in), install new

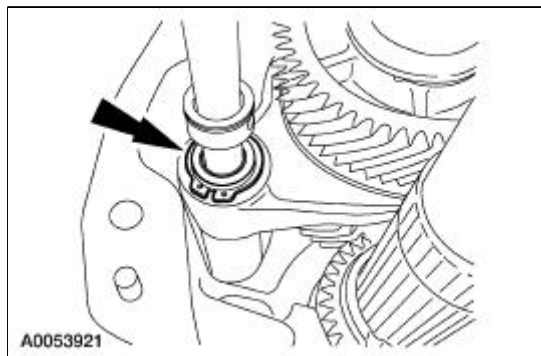
blocking ring.



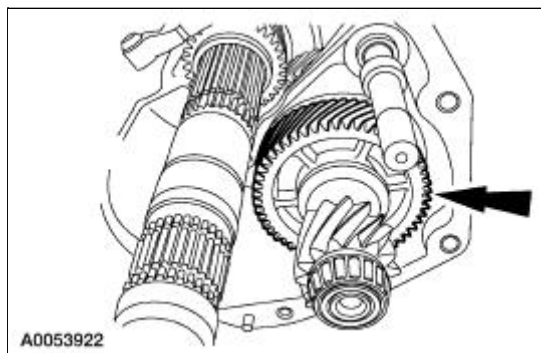
26. Using the special tools, remove the fifth/sixth driven gear.



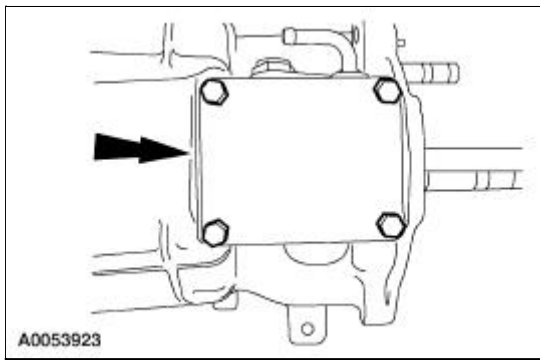
27. Remove the fifth/sixth shift fork snap ring.



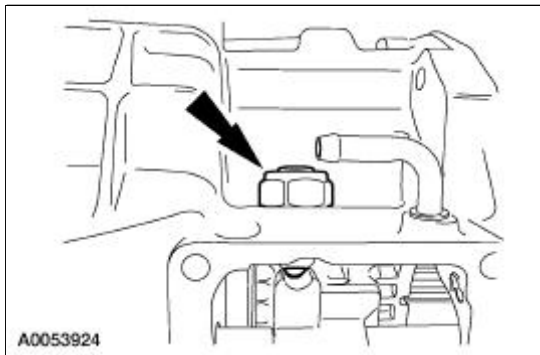
28. Rotate the transmission to the horizontal position, then remove the countershaft extension as an assembly.



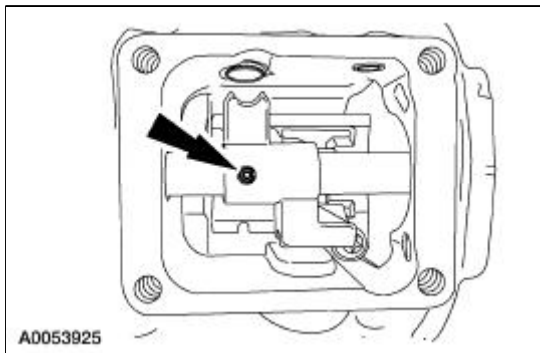
29. Remove the shift detent cover.



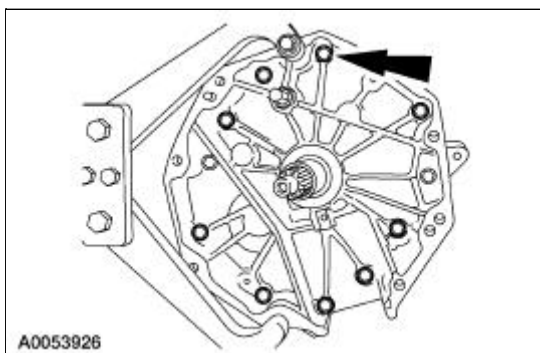
30. Remove the shift detent assembly.



31. Using a 5/32-inch drift and a hammer, drive the roll pin downward.

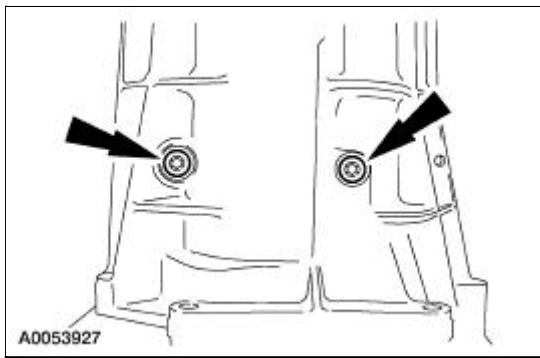


32. Remove nine of the adapter-to-transmission case bolts.

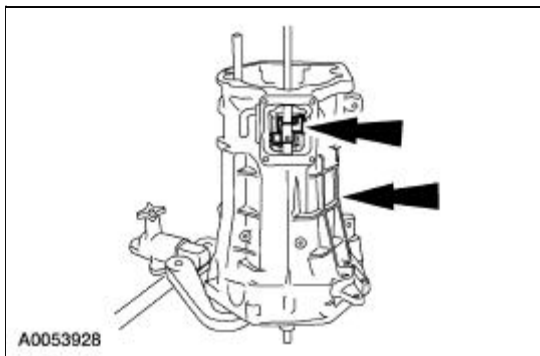


33. **NOTE:** Rotate the transmission to a vertical position.

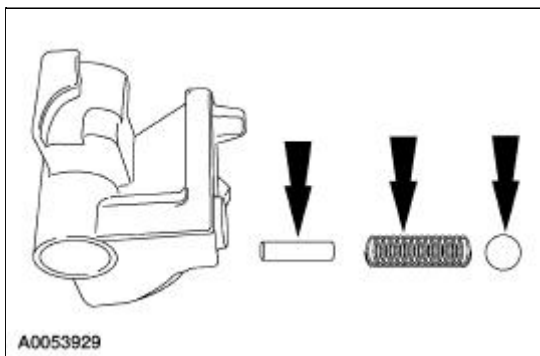
Remove the shift lever guide bolts.



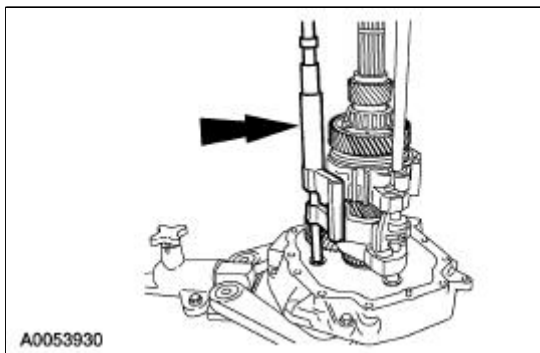
34. Remove the two remaining adapter-to-transmission case bolts, then remove the transmission case and the front offset lever.
- Slide the transmission case upward, off the mainshaft and shift rails. Hold the offset lever against the guide plate to prevent the release of the dent ball and spring.



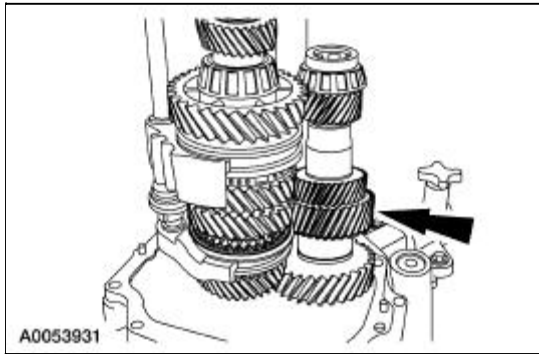
35. Remove the dent ball, spring and roll pin from the front offset lever.



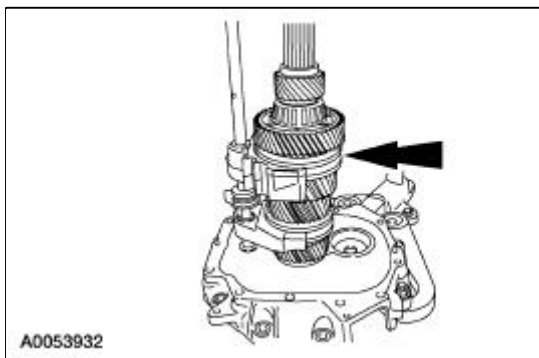
36. Rotate the fifth/sixth and reverse shift levers from the shift interlock plate, then remove the fifth/sixth and reverse shift rail assembly.



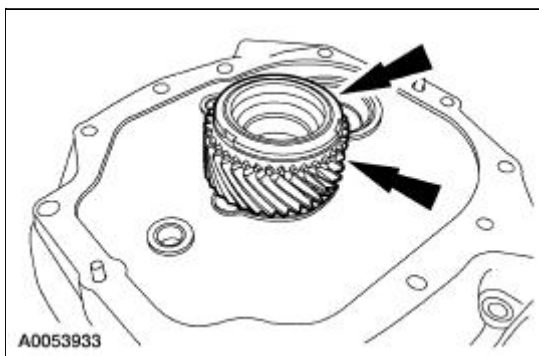
37. Lift up the mainshaft, then remove the countershaft.



38. Remove the mainshaft and shift rail as an assembly. Separate the shift rail assembly from the mainshaft on the work bench.

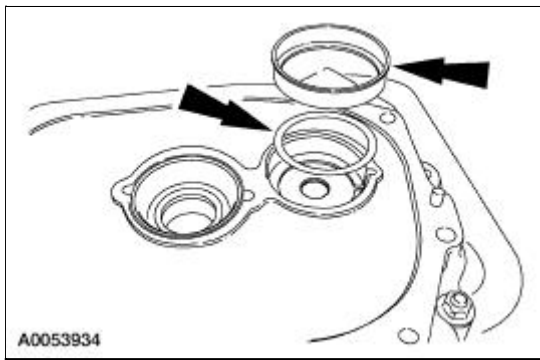


39. Remove the input shaft and fourth gear synchronizer blocking ring.

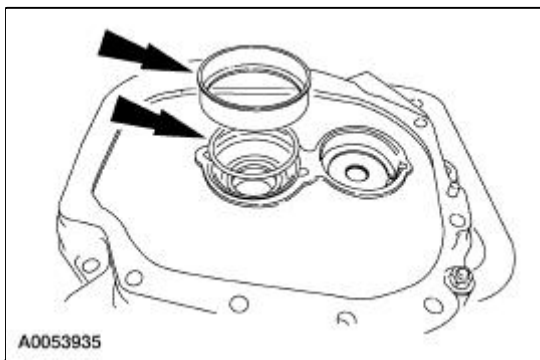


40. Remove the countershaft bearing cup and the countershaft shim.

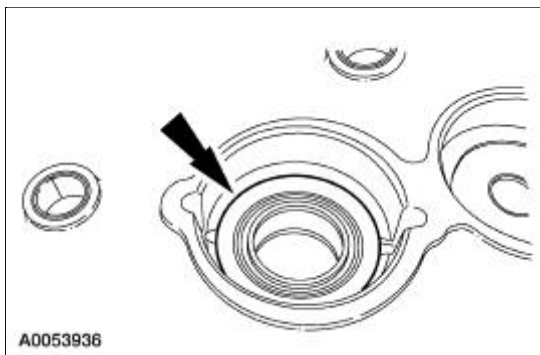
- Inspect the cup for wear or damage. Install a new cup and bearing as necessary.
- Inspect the cup bore for wear, scratches or grooves. Install a new transmission adapter plate as necessary.



41. Remove the input shaft bearing cup and input shaft shim.
- Inspect the cup for wear or damage. Install a new cup and bearing as necessary.
 - Inspect the cup bore for wear, scratches or grooves. Install a new transmission adapter plate as necessary.



42. Remove and discard the input shaft seal.



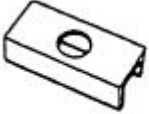
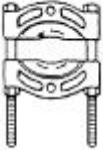


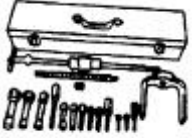
43.  **WARNING: Make sure protective eye wear is in place.**

Clean the transmission adapter plate with solvent and dry with compressed air. Inspect the adapter plate for cracks. Clean and check the sealing surface for nicks or scratches.

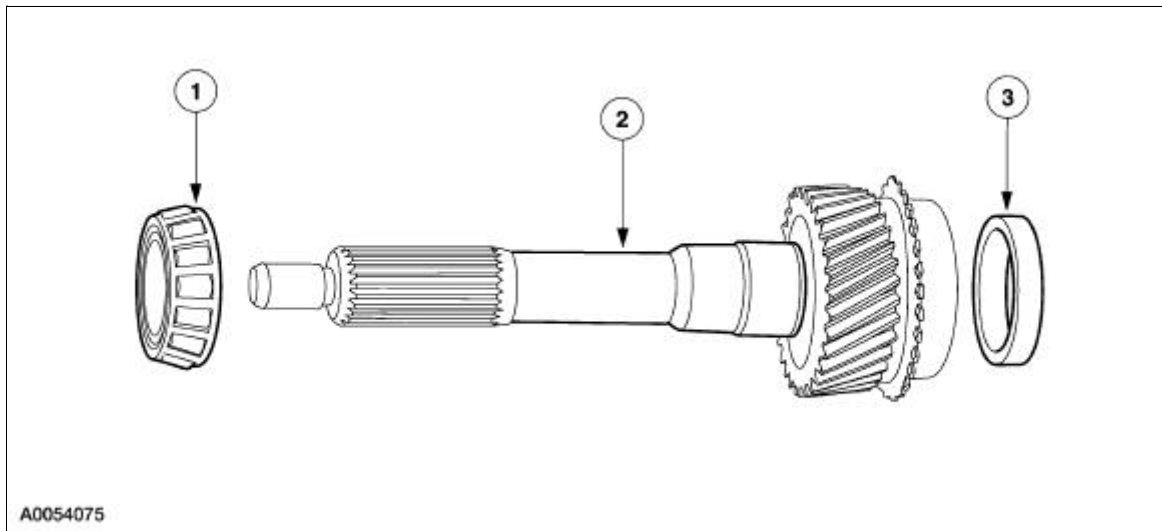
- If the adapter plate is cracked, install a new plate. If the sealing surface has nicks or scratches, use a soft stone or crocus cloth to remove.
-

Input Shaft and Bearing

Special Tool(s)

 ST1254-A	Plate, Bearing/Oil Seal 205-090 (T75L-1165-B)
 ST1368-A	Puller, Bearing 205-D064 (D84L-1123-A)
 ST1308-A	Installer, Drive Pinion Bearing Cone 205-004 (T53T-4621-B)
 ST2451-A	Adapter Set, Step Plate 205-DS011 (D80L-630-A)
 ST1144-A	Universal Puller Set 303-DS005 (D80L-100-A)

Disassembly and Assembly



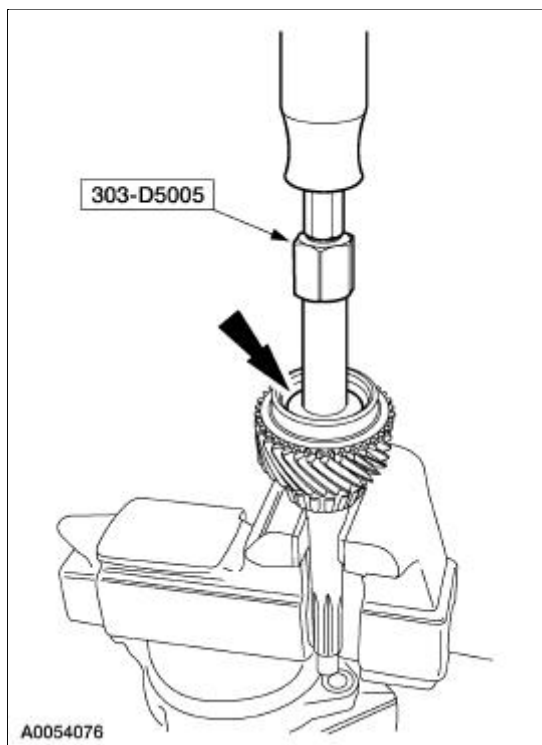
A0054075

Item	Part Number	Description
1	7025	Input shaft bearing
2	7017	Input shaft
3	—	Input shaft bearing cup

1.  **CAUTION: Use a vise with brass jaws or wood blocks.**

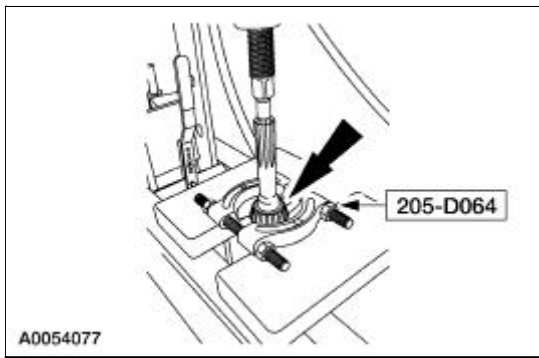
Secure the input shaft in a vise. Using the special tools and a slide hammer, remove the input shaft bearing cup.

- Inspect the cup for wear or damage. Install a new bearing cup and bearing as necessary.

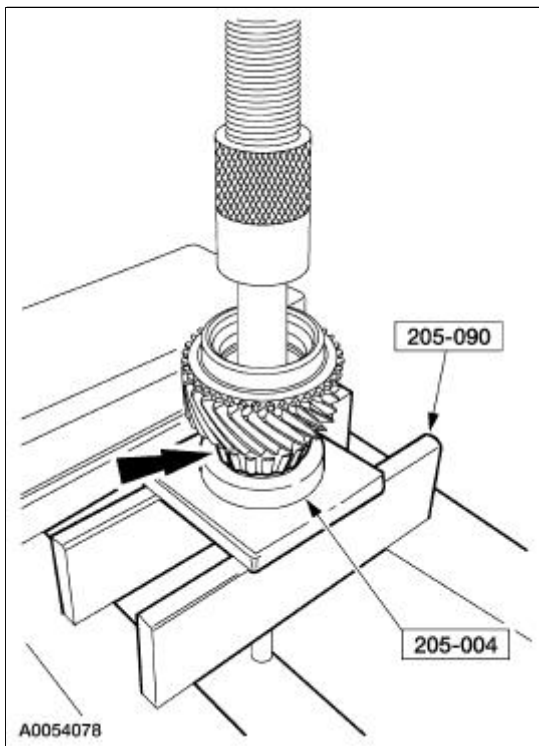


A0054076

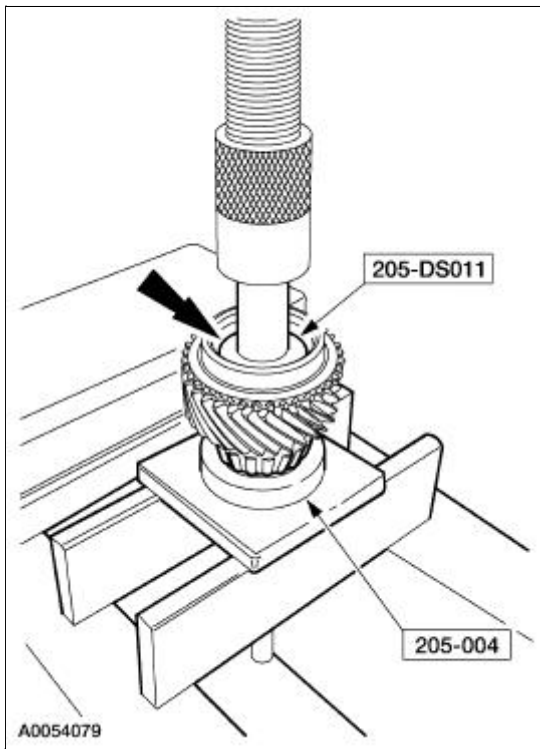
2. Using the special tool and a press, remove the input shaft front bearing.



3. Inspect the input shaft and bearing for wear or damage. Install new components as necessary.
4. Using the special tools and a press, install a new input shaft bearing.
 - Lubricate the bearing with petroleum jelly.

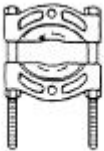





5. Using a suitable driver and the press, install the input shaft bearing cup.
 - Lubricate the bearing cup with petroleum jelly.

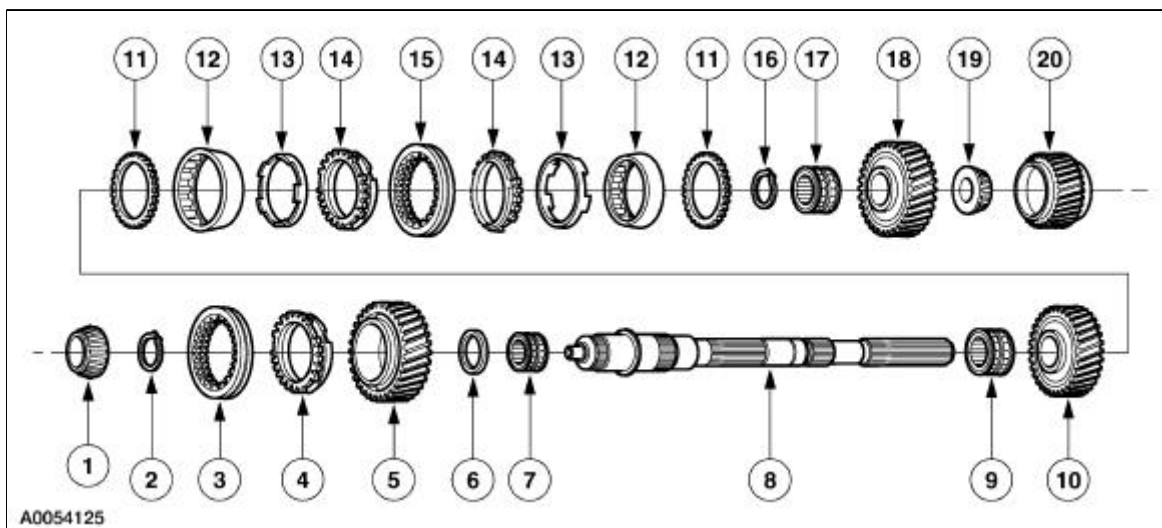


Output Shaft

Special Tool(s)

 <p>ST1368-A</p>	<p>Puller, Bearing 205-D064 (D84L-1123-A)</p>
 <p>ST1255-A</p>	<p>Adapter for 303-224 (Handle) 205-153 (T80T-4000-W)</p>
 <p>ST2231-A</p>	<p>Installer, Output Shaft Rear Bearing 308-401</p>
 <p>ST2163-A</p>	<p>Remover/Installer, Bearing Tube 308-025 (T75L-7025-C)</p>


Disassembly



Item	Part Number	Description
1	7025	Output shaft front bearing

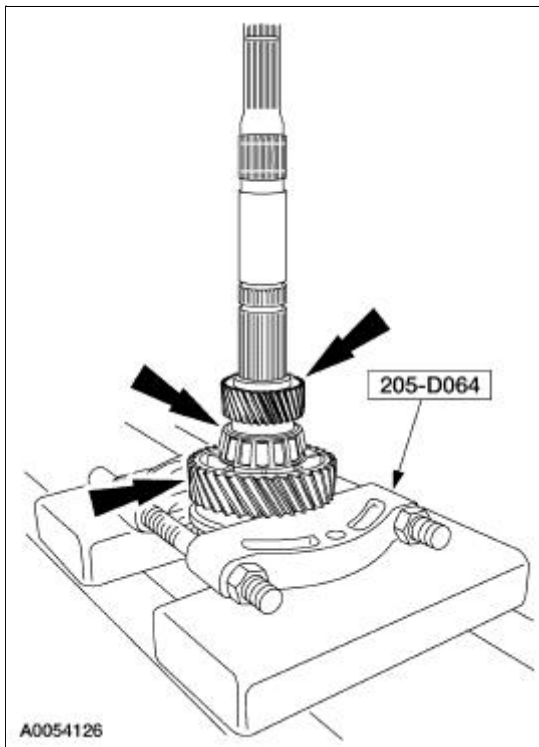
2	—	Snap ring
3	7124	Third/fourth synchronizer assembly
4	7107	Third/fourth synchronizer blocking ring
5	7B340	Third gear
6	—	Spacer
7	—	Third gear needle bearing
8	7061	Output shaft
9	—	Second gear needle bearing
10	7102	Second gear
11	—	Thrust washer
12	—	Synchronizer inner cone
13	—	Synchronizer friction cone
14	7107	Second gear synchronizer blocking ring
15	7124	First/second synchronizer assembly
16	—	Snap ring
17	—	First gear needle bearing
18	7100	First gear
19	—	Output shaft rear bearing
20	—	Fifth driven gear

1.  **CAUTION: Hand tighten the special tool to prevent gear damage.**

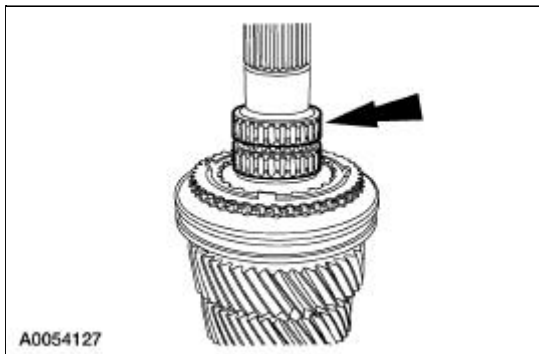
 **CAUTION: Support the output shaft while using the press to prevent damage to the shaft or gears.**

Using the special tool and a press, remove first gear, the output shaft rear bearing and the fifth driven gear.

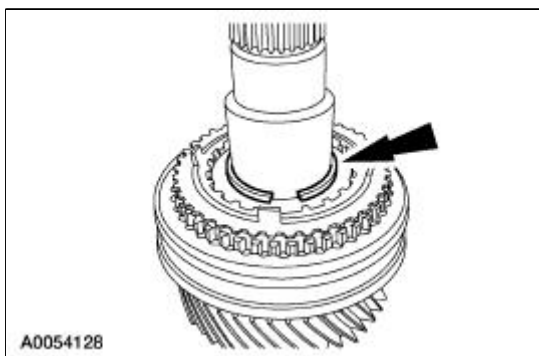
- Discard the output shaft bearing.
- Inspect the gear for wear or damage. Install a new gear as necessary.



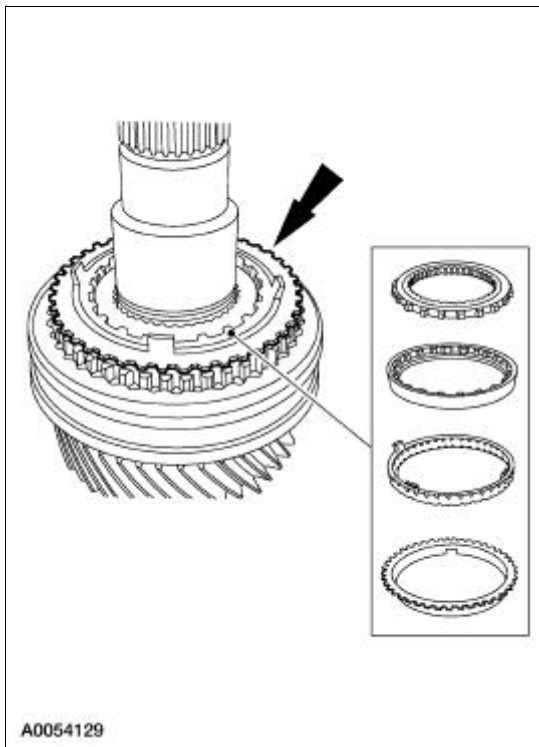
2. Remove the first gear needle bearing.
 - Inspect the needle bearing for wear or damage. Install a new needle bearing as necessary.



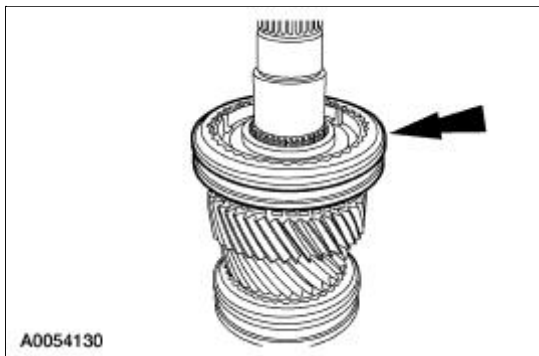
3. Remove and discard the snap ring.



4. Remove the first gear synchronizer thrust washer, the inner cone, the friction cone and the first gear synchronizer blocking ring.
 - Inspect all components for wear or damage. Install new components as necessary.



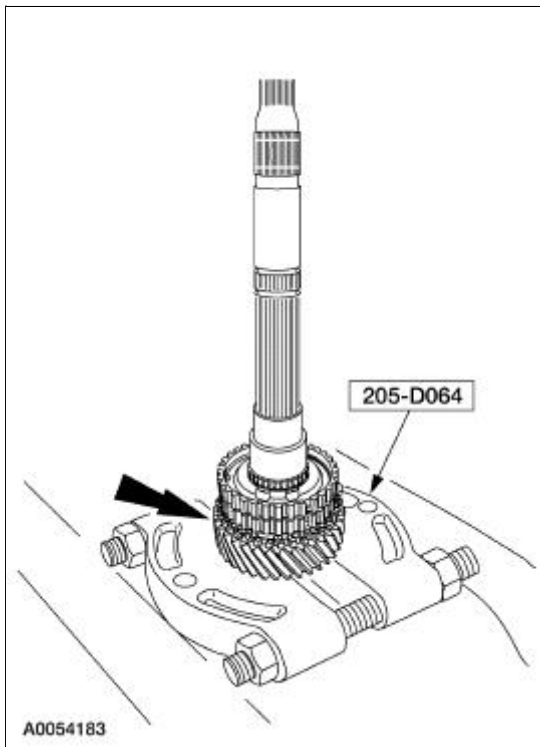
5. Remove the synchronizer spring, then remove the synchronizer sleeve.



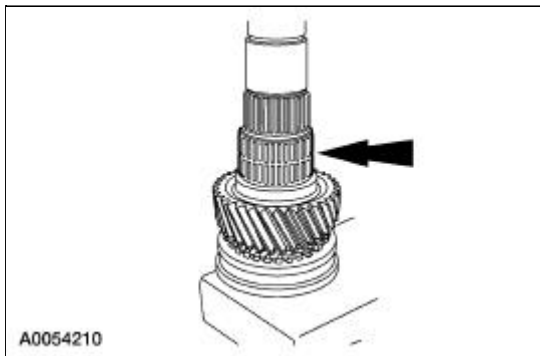
6. **NOTE:** Install the special tool behind second gear with the flat side of the tool facing second gear.

Using the special tool, remove the second gear, the second gear synchronizer thrust washer, the inner cone, the friction cone, the second gear synchronizer blocking ring and the synchronizer hub.

- Inspect the gear for wear or damage. Install a new gear as necessary.
- Inspect the all synchronizer components for wear or damage. Install a new components as necessary.



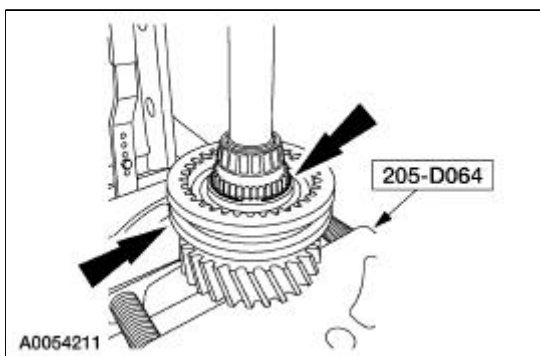
7. Remove the second gear needle bearing.
 - Inspect the needle bearing for wear or damage. Install a new needle bearing as necessary.



8. **NOTE:** Reposition the output shaft on the press with the input shaft end facing upward.

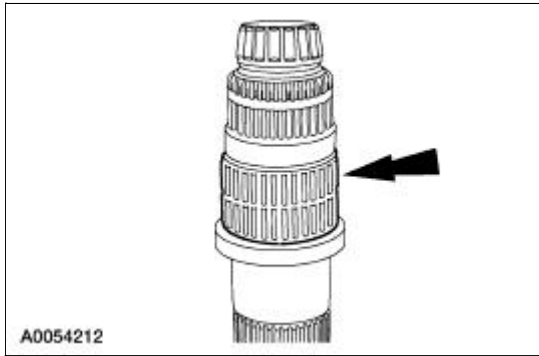
Remove and discard the snap ring, then using the special tool, remove the third/fourth gear synchronizer assembly, the third gear synchronizer blocking ring and the third gear.

- Inspect the gear for broken or cracked teeth. Install a new gear as necessary.



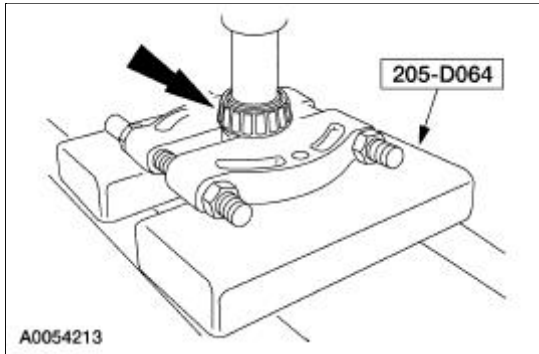
9. Remove the third gear needle bearing.

- Inspect the needle bearing for wear or damage. Install a new needle bearing as necessary.



10. **NOTE:** Install the special tool with the flat side facing the bearing.

Using the special tool, press the output shaft front bearing from the output shaft.

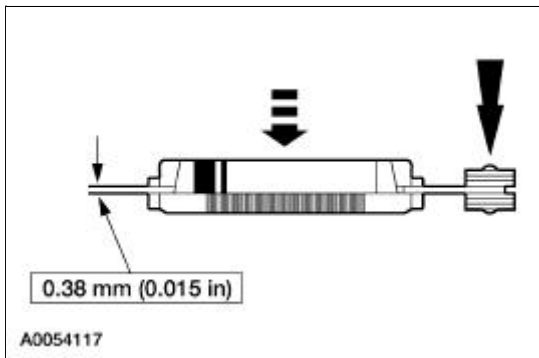


11. Inspect the synchronizers.

- Check for worn, nicked or broken teeth. Install a new synchronizer as necessary.
- Check keys for wear or distortion. Install a new synchronizer as necessary.
- Check springs for distortion. Install a new synchronizer as necessary.

12. Inspect the synchronizer blocking rings.

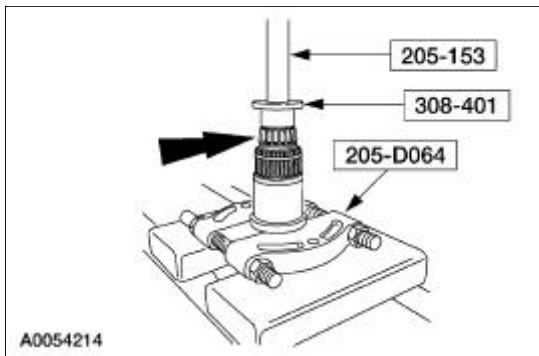
- Check for wear or damage. Install new synchronizer blocking rings as necessary.
- Check the clearance between the synchronizer blocking ring and the gear.
 - Position the blocking ring onto the gear. Make sure the correct blocking ring is measured with the correct gear and that the blocking ring is fully seated on the gear.
 - Insert a feeler gauge and measure the clearance, while applying pressure and rotating the blocking ring. The measurement should be the same around the entire circumference. If the clearance is less than 0.38 mm (0.015 in), install new blocking rings.



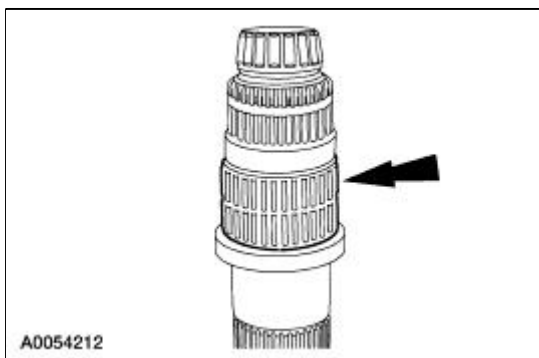
13. Inspect the output shaft for scoring or worn or damaged splines. Install a new output shaft as necessary.

Assembly

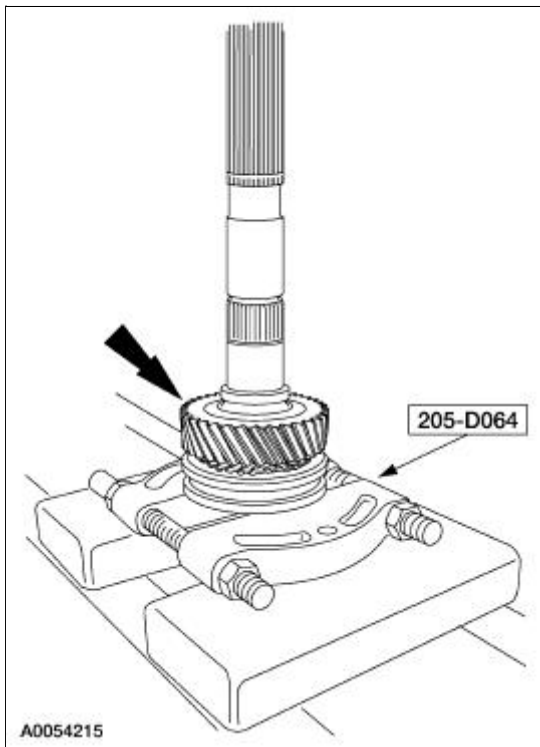
1. Lubricate all components with the recommended transmission fluid when reassembling.
2. Using the special tools, press the output shaft front bearing on the output shaft.



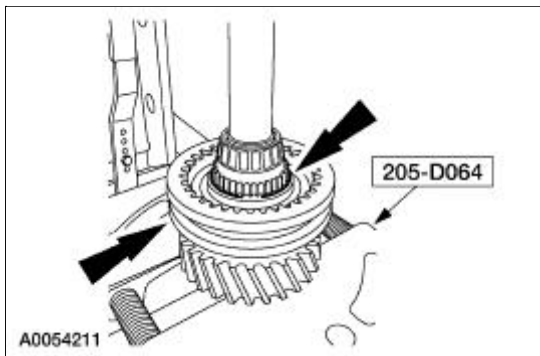
3. Install the third gear bearing.
 - Apply petroleum jelly to the bearing.



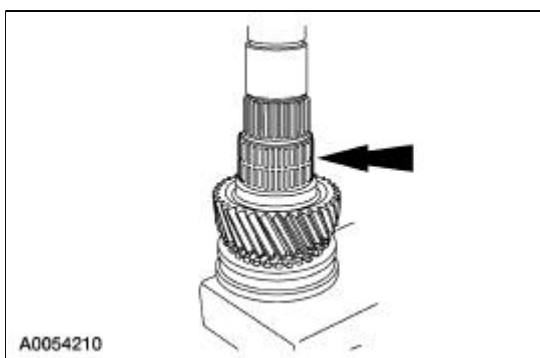
4. Install third gear, the third gear synchronizer blocking ring and the third/fourth gear synchronizer assembly. Position the output shaft with the output end facing upward. Using the special tool, press the third/fourth gear synchronizer assembly into place.
 - Install the synchronizer body with the groove facing third gear.
 - Stop press operation before keys engage the blocking ring slots. Lift and rotate the third gear and the blocking ring until the keys are seated in the blocking ring.



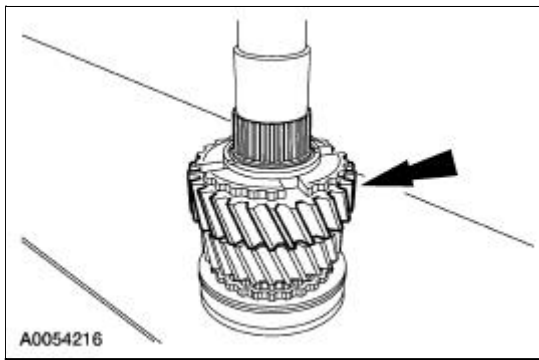
5. Install a new snap ring.



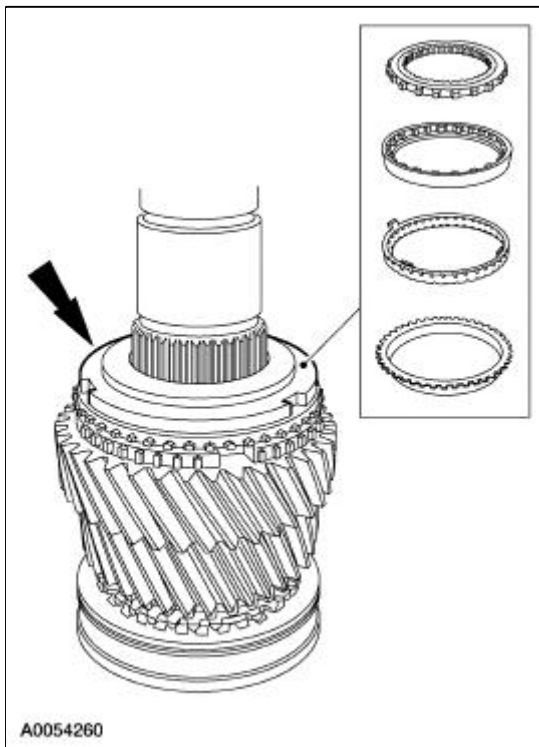
6. Install the second gear needle bearing.
 - Apply petroleum jelly to the bearing.



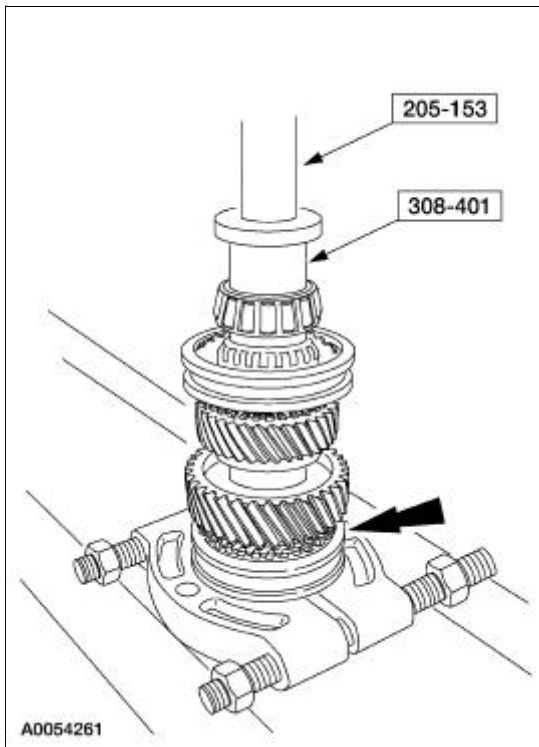
7. Install second gear.



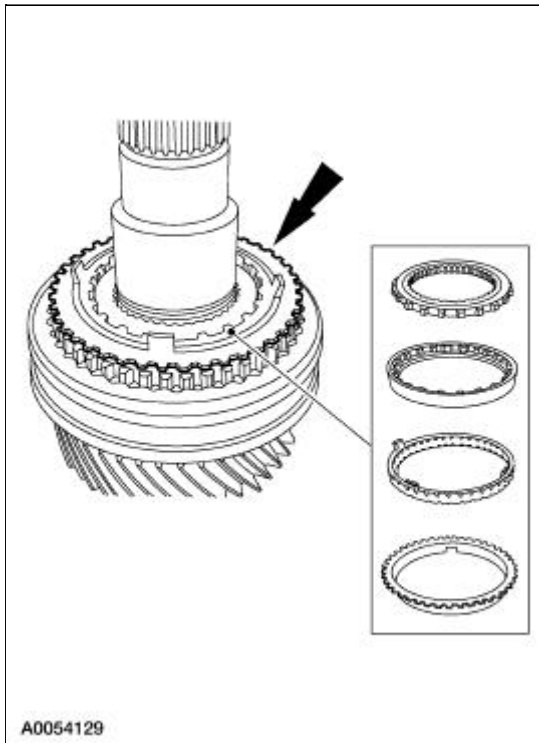
8. Install the second gear synchronizer thrust washer, the inner cone, the friction cone and the second gear synchronizer blocking ring.
 - Align the blocking ring tabs with the second gear slots.



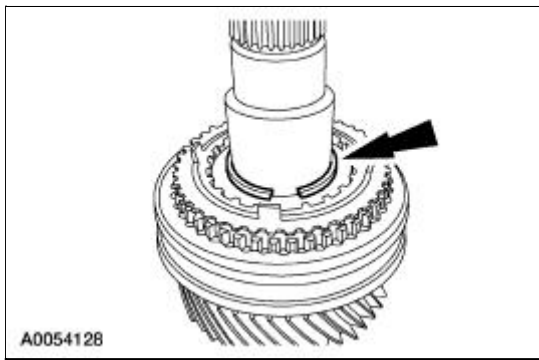
9. Install the first/second gear synchronizer assembly. Position the output shaft with the output end facing downward. Using the special tools, press the first/second gear synchronizer assembly into place.
 - Install the synchronizer with the groove on the sleeve facing first gear.
 - Stop press operation before keys engage the blocking ring slots. Lift and rotate the second gear and the blocking ring until the keys are seated in the blocking ring.



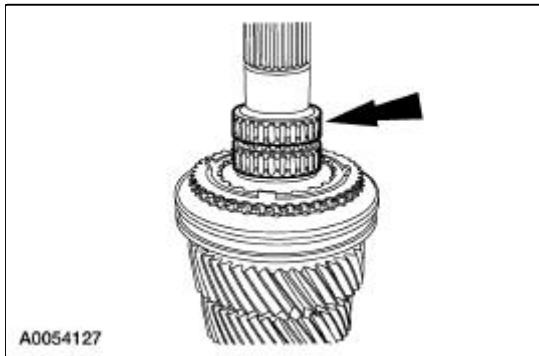
10. Install the first gear synchronizer thrust washer, the inner cone, the friction cone and the first gear synchronizer blocking ring.



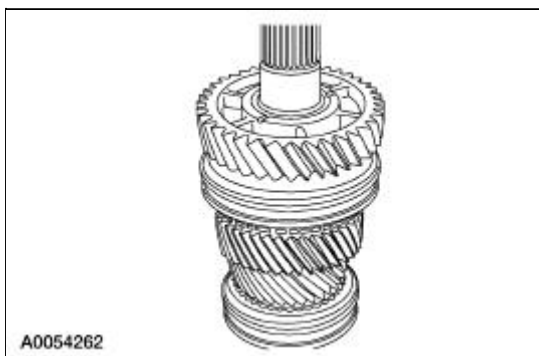
11. Install a new snap ring.



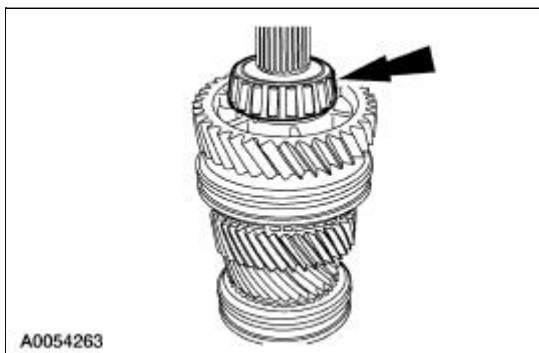
12. Install the first gear needle bearing.
 - Apply petroleum jelly to the bearing.



13. Install first gear.
 - Rotate the gear to align the gear slots with the inner cone tabs.



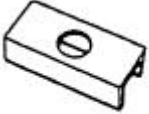
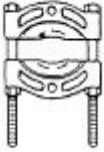



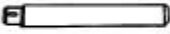
14. Install a new rear output shaft bearing.



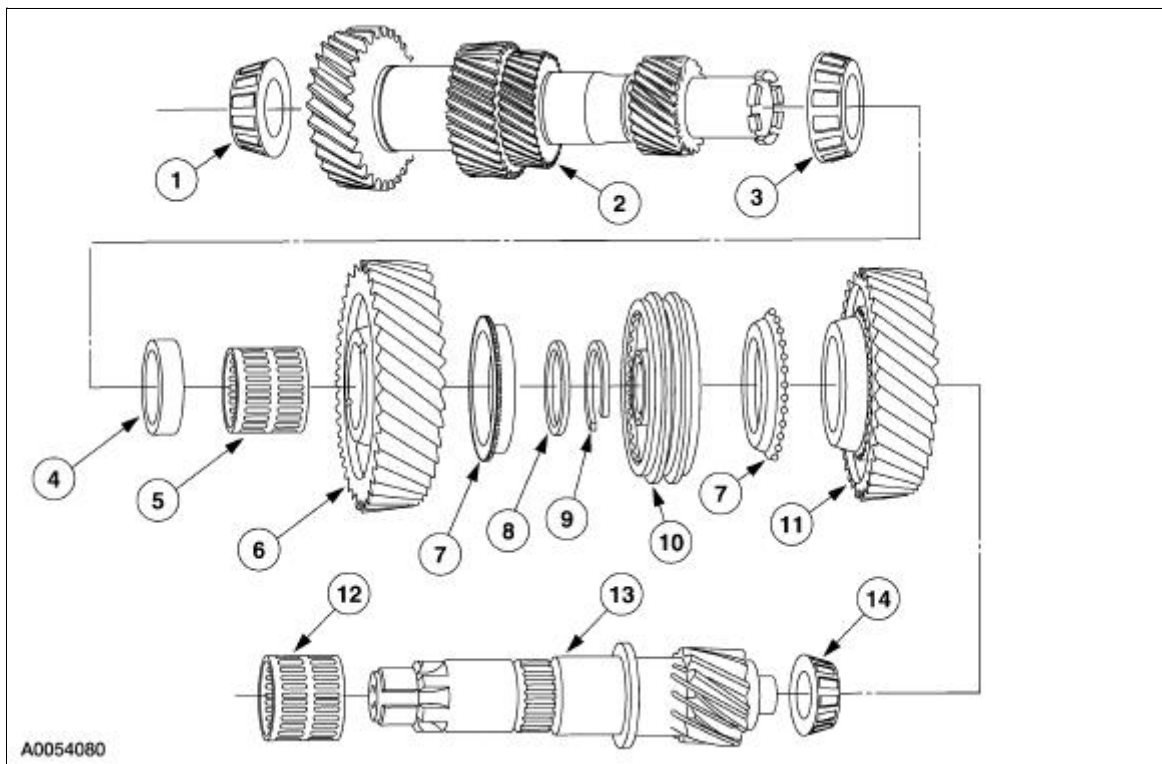
15. Using the special tools, install the fifth driven gear.

Countershaft

Special Tool(s)

 ST1254-A	Plate, Bearing Oil Seal 205-090 (T75L-1165-B)
 ST1368-A	Puller, Bearing 205-D064 (D84L-1123-A)
 ST1308-A	Installer, Drive Pinion Bearing Cone 205-004 (T53T-4621-B)
 ST1937-A	Remover/Installer, Bearing Tube 308-025 (T75L-7025-C)
 ST2231-A	Installer, Output Shaft Rear Bearing 308-401
 ST1255-A	Adapter for 303-224 (Handle) 205-153 (T80T-4000-W)

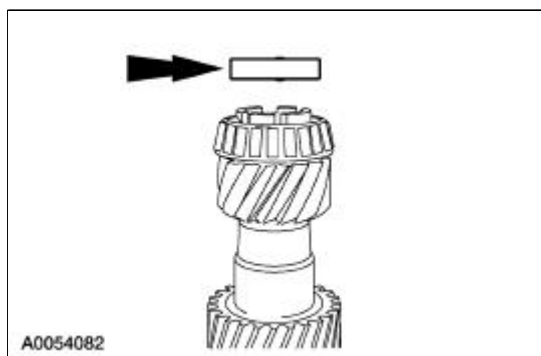
Disassembly and Assembly



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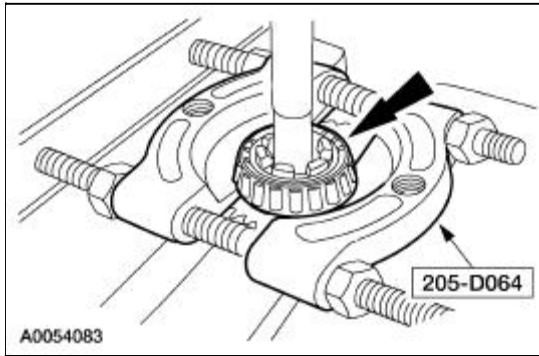
Item	Part Number	Description
1	7025	Countershaft front bearing
2	7113	Countershaft
3	—	Countershaft rear bearing
4	—	Thrust washer
5	—	Sixth gear needle bearing
6	—	Sixth gear
7	—	Synchronizer blocking ring
8	—	Spacer
9	—	Snap ring
10	—	Fifth/sixth synchronizer assembly
11	—	Fifth gear
12	—	Fifth gear needle bearing
13	—	Countershaft extension
14	—	Countershaft extension bearing

1. Remove the thrust washer.

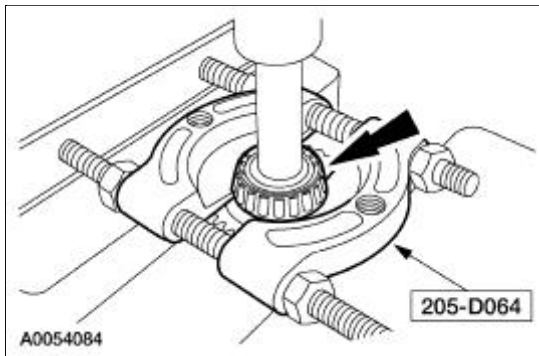


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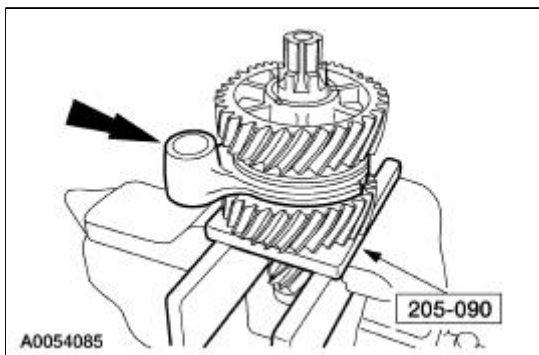
- Using the special tool and a press, remove the countershaft rear bearing.



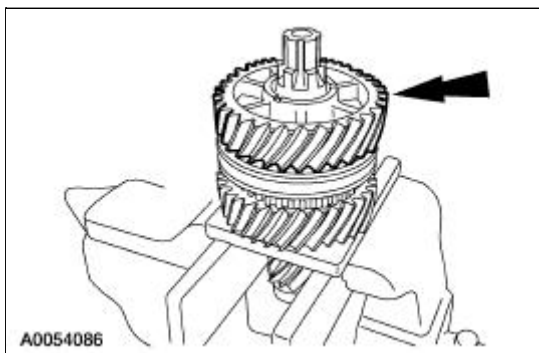
- Using the special tool and a press, remove the countershaft front bearing.



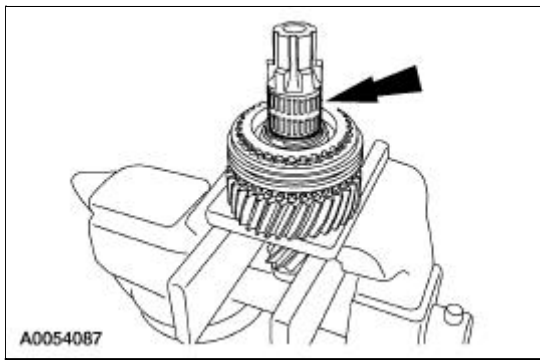
- Place the special tool in a vise. Position the countershaft extension in the tool with the sixth drive gear facing upward. Remove the fifth/sixth shift fork.



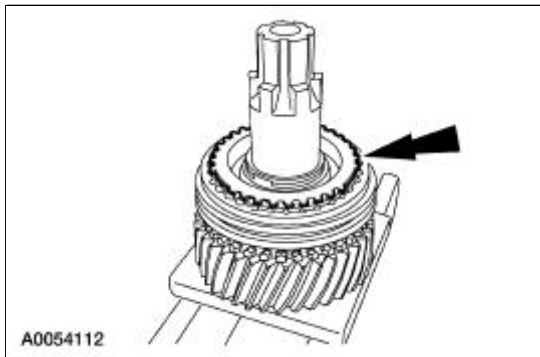
- Remove the sixth drive gear.



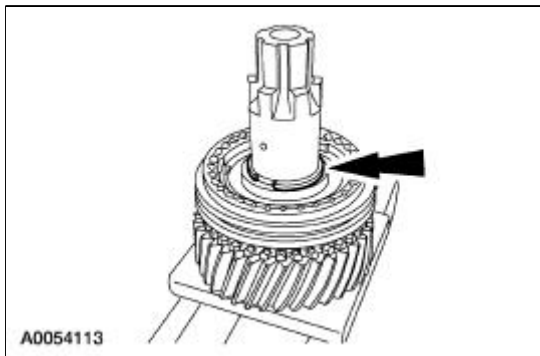
- Remove the sixth drive gear needle bearing.



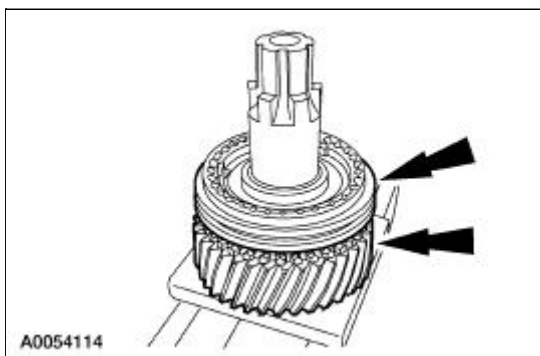
7. Remove the sixth drive gear synchronizer blocking ring.



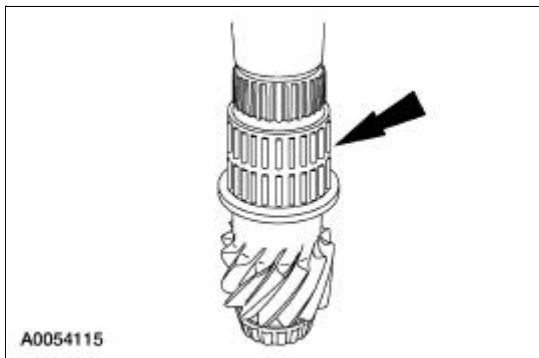
8. Remove and discard the fifth/sixth synchronizer snap ring.



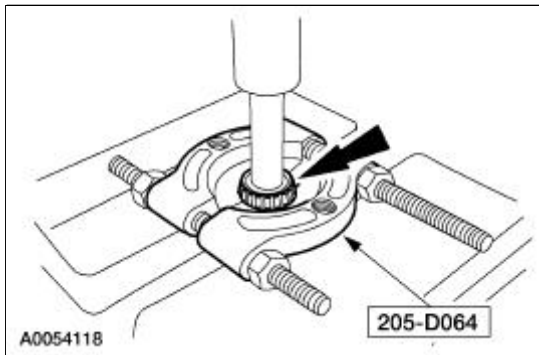
9. Using the special tool, press the fifth/sixth synchronizer and the fifth drive gear off the shaft.



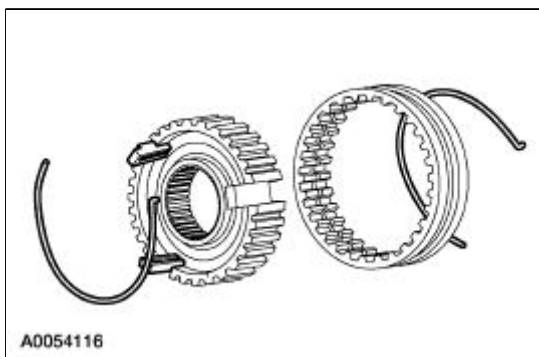
10. Remove the fifth drive gear needle bearing.



11. Using the special tool, remove the countershaft extension bearing.



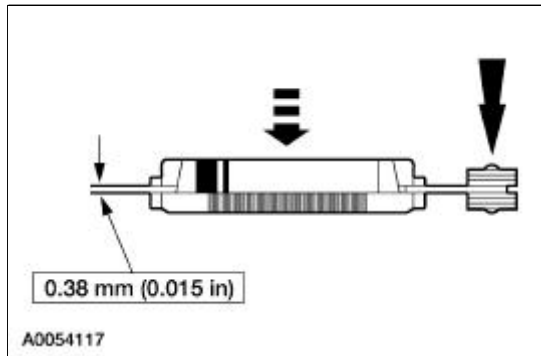
12. Inspect the countershaft and countershaft extension.
 - Check the shaft surface for wear or damage. Install a new shaft as necessary.
 - Check the gear teeth for wear, pitting, scoring, spalling or fractures. Install new components as necessary.
13. Disassemble the fifth/sixth gear synchronizer assembly.



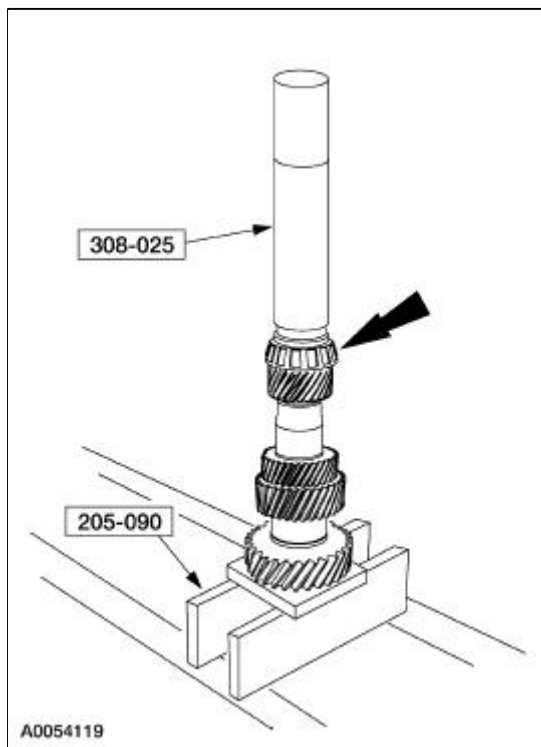
14. Inspect the fifth/sixth synchronizer.
 - Check for worn, nicked or broken teeth. Install a new synchronizer as necessary.
 - Check keys for wear or distortion. Install a new synchronizer as necessary.
 - Check springs for distortion. Install a new synchronizer as necessary.
15. Inspect the fifth/sixth synchronizer blocking rings.
 - Check for wear or damage. Install new synchronizer blocking rings as necessary.
 - Check the clearance between the synchronizer blocking ring and the gear.
 - Position the blocking ring onto the gear. Make sure the correct blocking ring is measured with the correct gear and that the blocking ring is fully seated on the

gear.

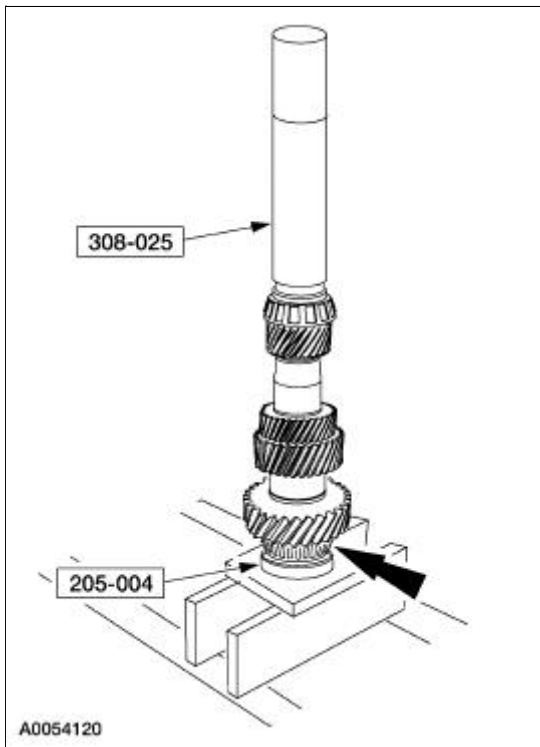
- Insert a feeler gauge and measure the clearance, while applying pressure and rotating the blocking ring. The measurement should be the same around the entire circumference. If the clearance is less than 0.38 mm (0.015 in), install new blocking rings.



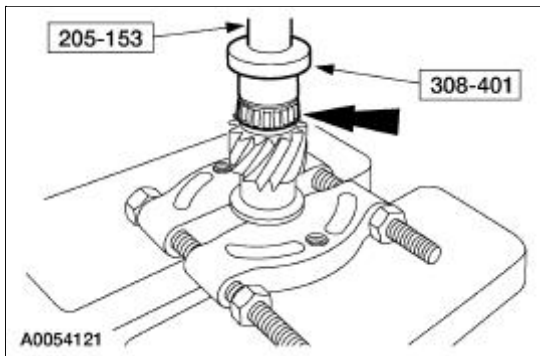
16. Using the special tools, install the countershaft rear bearing.



17. Using the special tools, install the countershaft front bearing.



18. Using the special tools, install the countershaft extension bearing.



19. To assemble, reverse the disassembly procedure.

- Assemble the synchronizer assembly before installing.
-

Synchronizers

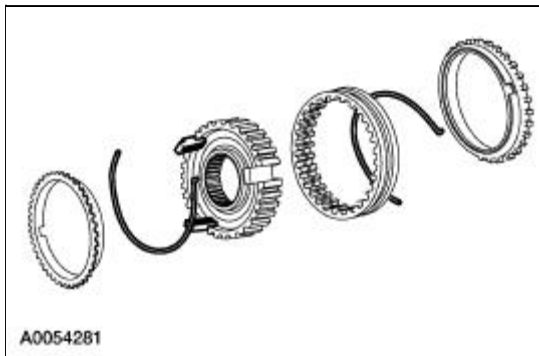
Disassembly and Assembly


NOTE: This procedure applies to all synchronizer assemblies.

1. **NOTE:** Synchronizer components are not interchangeable. During disassembly, mark each individual synchronizer for assembly. Synchronizer hubs and sleeves are a selected assembly and should be kept together as originally assembled. Blocking rings are not interchangeable, do not mix.

Scribe an alignment mark on the sliding sleeve and the hub for assembly reference.

2. Using a screwdriver, remove the spring. Turn the synchronizer over and remove the second spring. Remove the sliding sleeve and the synchronizer struts from the hub.



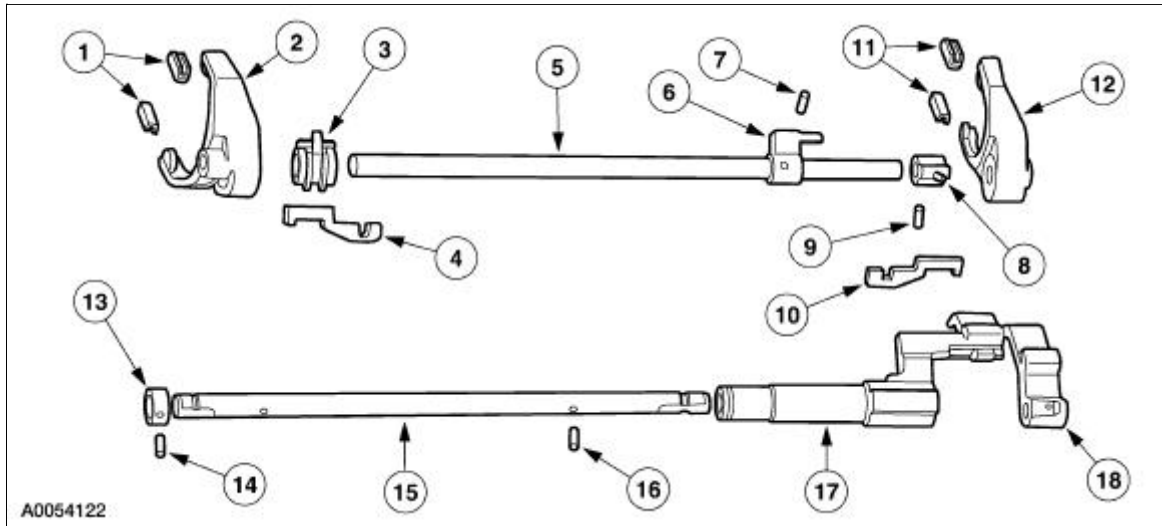
3.  **CAUTION:** Match the alignment marks made during disassembly. The sleeve and the hub have an extremely close fit. Hold the sleeve and hub square to prevent jamming. Do not force the sleeve onto the hub.

Assemble the synchronizer as follows:

- Position the synchronizer sleeve on the hub. Make sure to align key openings in the hub with the synchronizer sleeve.
- Install the keys with the slots facing the hub.
- Install the spring. Locate the tang to one of the key slots and position into place. Install the second spring. Locate the spring tang on the same key but position in the opposite direction.

Gearshift Rail and Fork

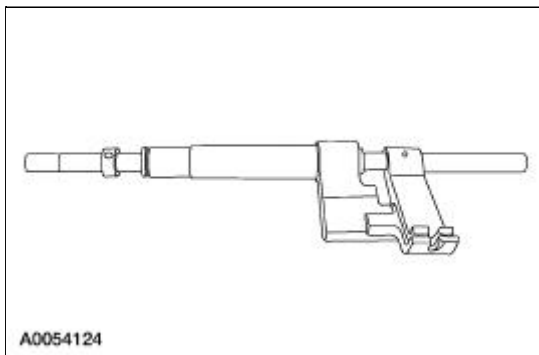
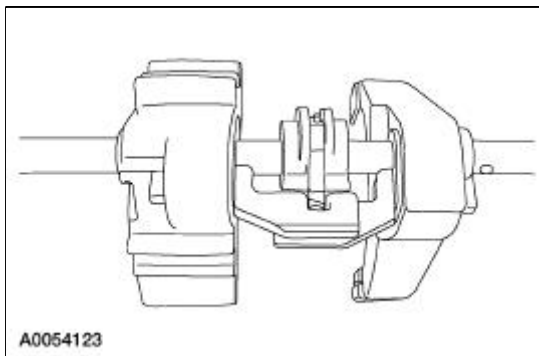
Disassembly and Assembly



Item	Part Number	Description
1	—	First/second shift fork pad
2	—	First/second shift fork
3	—	Interlock plate
4	—	Shift link
5	—	First/second, third/fourth shift rail
6	—	Gear select solenoid lever
7	—	Roll pin
8	—	Selector pin
9	—	Roll pin
10	—	Shift link
11	—	Third/fourth shift fork pad
12	—	Third/fourth shift fork
13	—	Shift rail collar
14	—	Roll pin
15	—	Fifth/sixth shift rail
16	—	Roll pin
17	—	Fifth/sixth shift rail lever
18	—	Reverse shift rail lever



1. Disassemble the first/second and third/fourth shift rail as follows:
 - Rotate the interlock plate until it is opposite of the shift links.
 - Slide off the third/fourth shift fork and shift link. Separate the link from the fork.
 - Slide off the first/second shift fork and shift link. Separate the link from the fork.

- Remove the interlock plate.
 - Using a 5/32-inch drift and a hammer, remove and discard the roll pins. Slide the gear select solenoid lever and the selector pin from the shift rail.
2. Disassemble the fifth/sixth and reverse shift rail as follows:
- Using a 5/32-inch drift and a hammer, remove and discard the roll pins. Slide the collar and the reverse shift lever from the shift rail.
 - Slide off the fifth/sixth shift lever and shift link.
3. Inspect the shift rail components.
- Check the rails, shift forks, shift levers and shift links for wear or damage. Install new components as necessary.
 - Check the shift fork pads for wear. Install new pads as necessary.
4. To assemble, reverse the disassembly procedure.
- Install new roll pins.

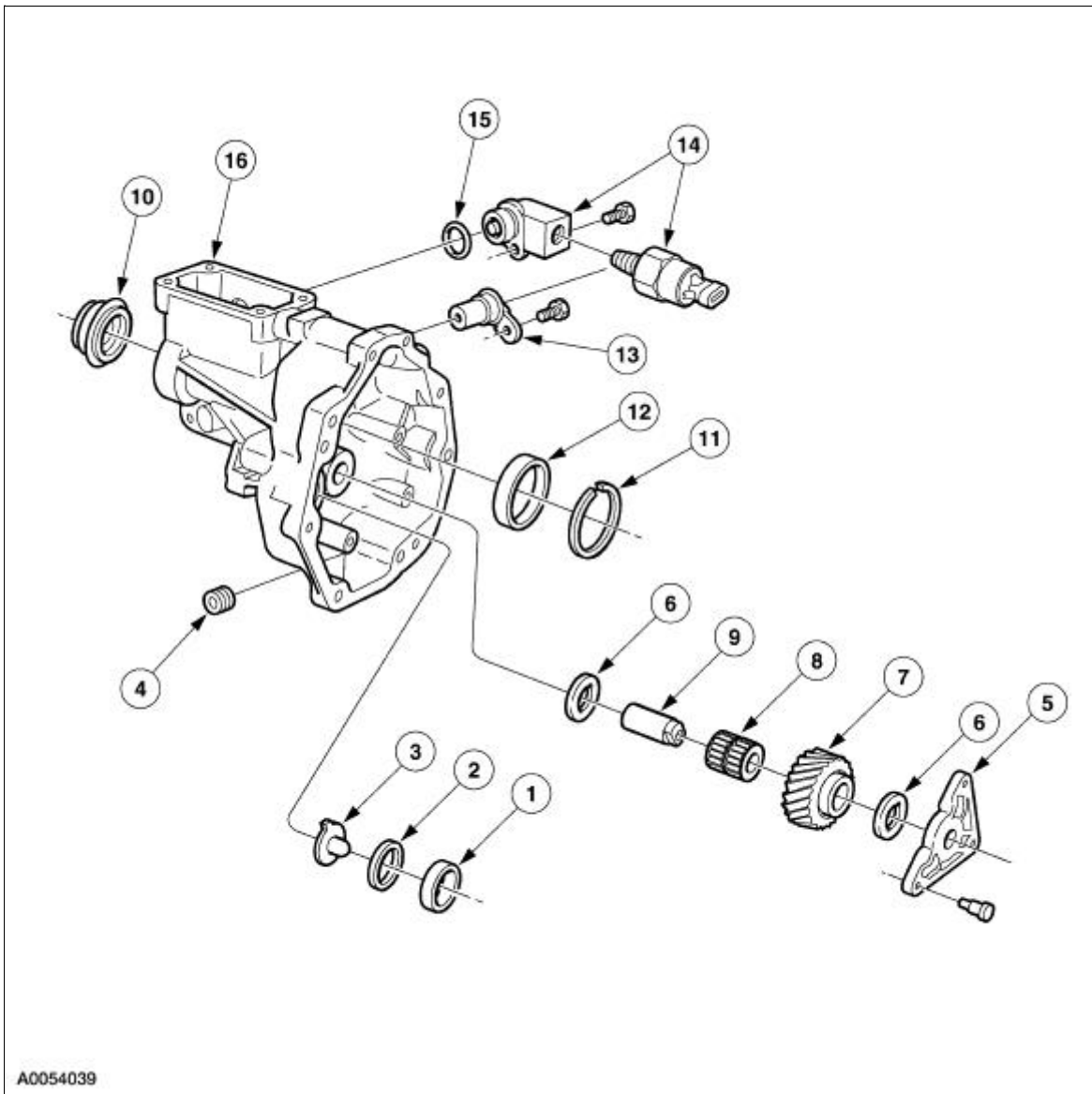


Extension Housing

Special Tool(s)

 <p>ST1555-A</p>	Installer, Bearing Cup 204-039 (T77F-1217-B)
 <p>ST1255-A</p>	Adapter for 303-224 (Handle) 205-153 (T80T-4000-W)

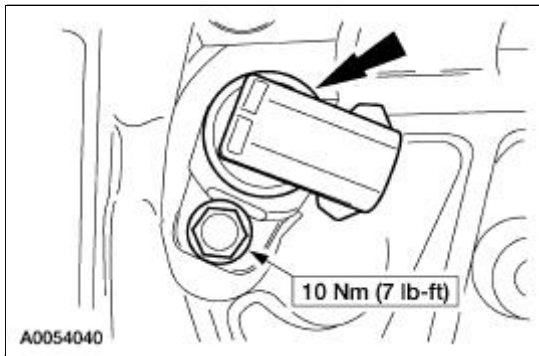
Disassembly and Assembly



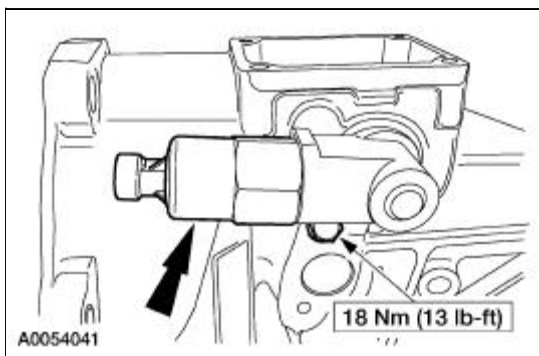
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Item	Part Number	Description
1	—	Countershaft extension bearing cup
2	—	Countershaft extension bearing shim
3	—	Fluid funnel
4	—	Case plug
5	—	Reverse idler shaft bracket
6	—	Reverse idler gear thrust washer
7	7141	Reverse idler gear
8	—	Reverse idler gear needle bearing
9	7140	Reverse idler gear shaft
10	7052	Extension housing seal
11	—	Snap ring
12	—	Mainshaft bearing cup
13	—	Output shaft speed (OSS) sensor
14	—	Reverse lockout solenoid
15	—	O-ring

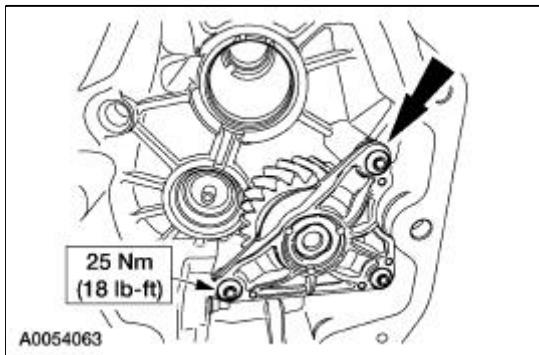
1. Remove the bolt and the output shaft speed (OSS) sensor.



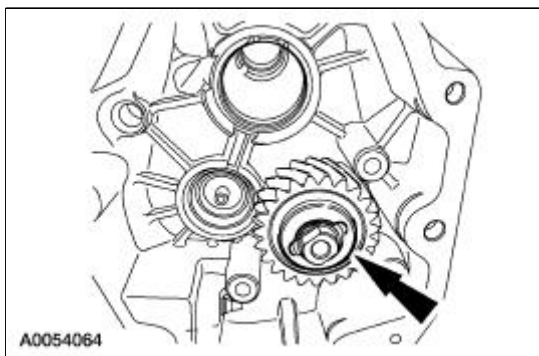
2. Remove the bolt and the reverse lockout solenoid.



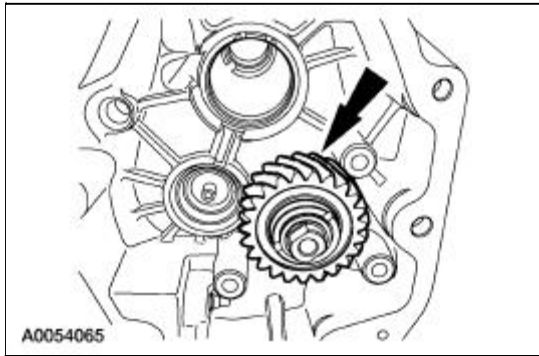
3. Remove the bolts and the reverse idler shaft bracket.



4. Remove the reverse idler gear thrust washer.



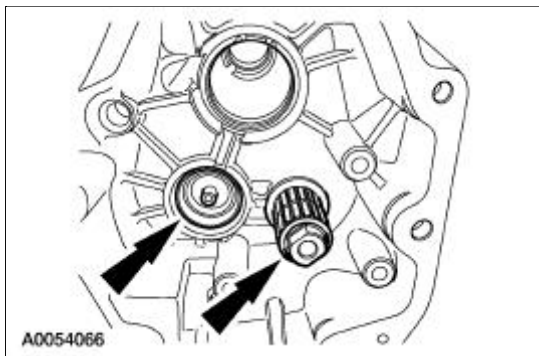
5. Remove the reverse idler gear.



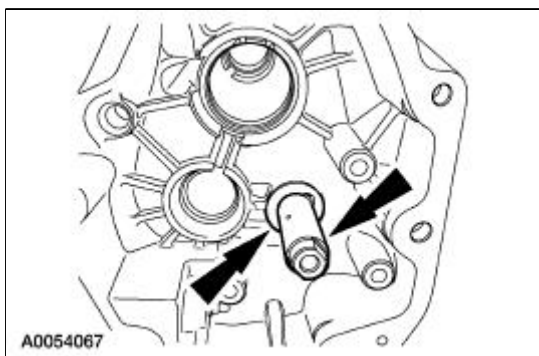
6. **NOTE:** If the countershaft extension bearing was installed new, install a new bearing cup.

Remove the reverse idler gear needle bearing and countershaft extension bearing cup.

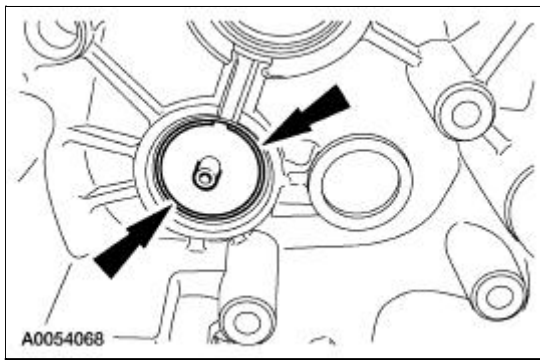
- Inspect the needle bearing for wear or damage. Install a new bearing as necessary.
- Inspect the bearing cup for wear or damage. Install a new bearing and bearing cup as necessary.



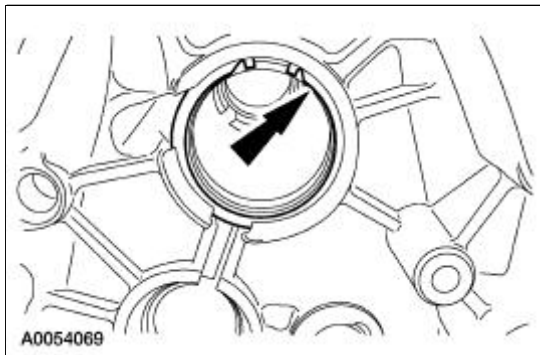
7. Remove the reverse idler gear thrust washer and the reverse idler gear shaft.



8. Remove the countershaft extension bearing shim and the fluid funnel.

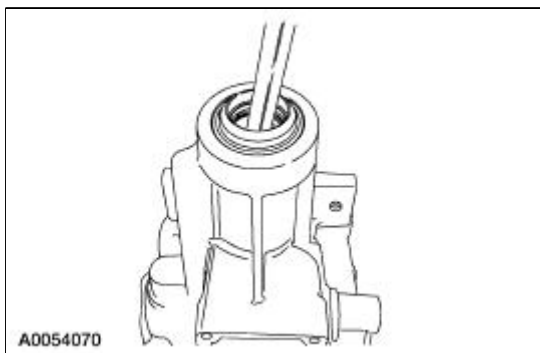


9. Remove the snap ring.

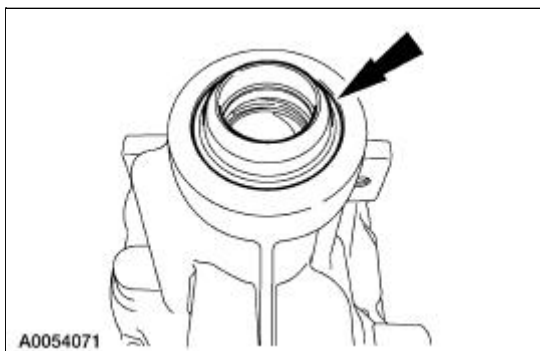


10. **NOTE:** If the mainshaft bearing was install new, install a new bearing cup.

Position the extension housing with the seal facing upward. Using a brass drift, remove the mainshaft bearing cup.



11. Remove and discard the extension housing seal.

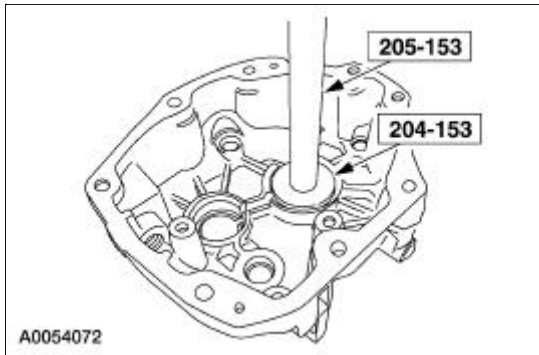


12.  **WARNING: Make sure protective eye wear is in place.**

Clean the housing with solvent and dry with compressed air. Clean and check the sealing surface for nicks or scratches. Inspect the housing for cracks.

- If the housing is cracked, install a new housing. If the sealing surface has nicks or scratches, use a soft stone or crocus cloth to remove.

13. Using the special tools, install the mainshaft bearing cup.



14. Using a suitable driver, install the extension housing seal.
- Install the seal with the drain hole at the six o'clock position.
15. To assemble, reverse the disassembly procedure.
-

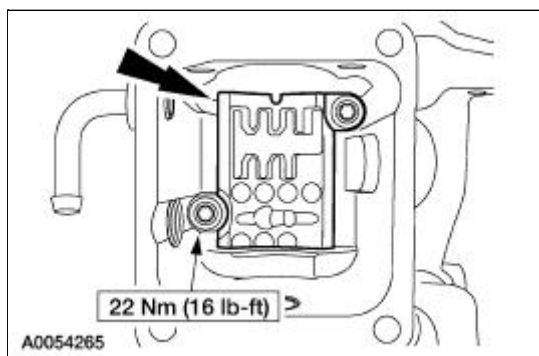
Transmission Case

Special Tool(s)

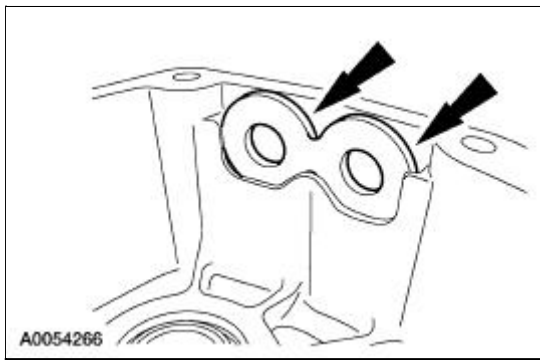
 ST2336-A	Handle 205-D055 (D81L-4000-A)
 ST1555-A	Installer, Bearing Cup 204-039 (T77F-1217-B)
 ST1555-A	Installer, Drive Pinion Bearing Cup 205-054 (T71P-4616-A)
 ST2245-A	Installer, Rear Axle Oil Seal 205-155 (T80T-4000-Y)

Disassembly and Assembly

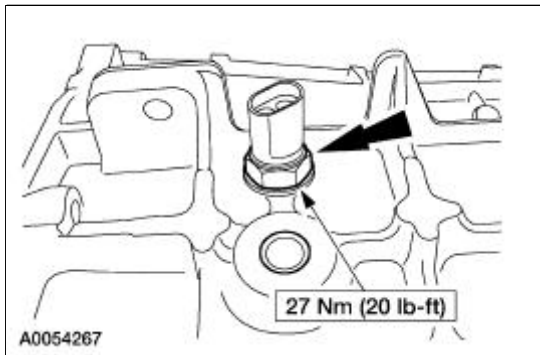
1. Remove the bolts and the guide plate.
 - Inspect the plate for wear or damage. Install a new plate as necessary.



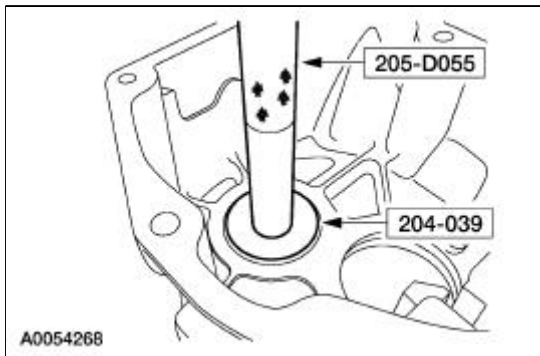
2. Remove the case magnets.



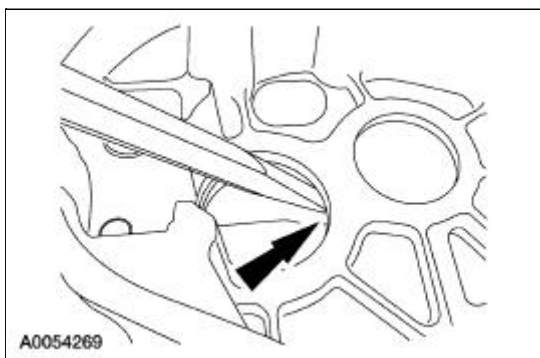
3. Remove the reverse lamp switch.



4. Using the special tools, remove the countershaft bearing cup.



5. Using a brass drift, remove mainshaft bearing cup.



6. Inspect the countershaft and mainshaft bearing cups for wear or damage. Install new components as necessary.

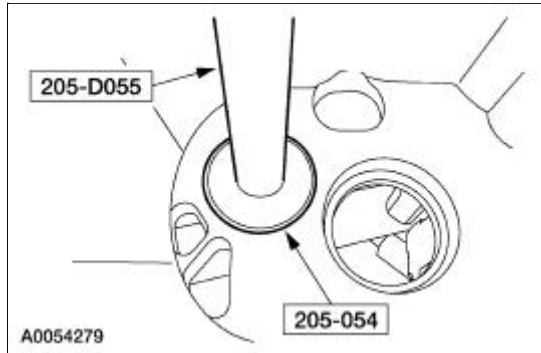
7.  **WARNING: Make sure protective eye wear is in place.**

Clean the case with solvent and dry with compressed air. Clean and check the sealing surface for nicks or scratches. Inspect the case for cracks.

- If the case is cracked, install a new case. If the sealing surface has nicks or scratches, use a soft stone or crocus cloth to remove.

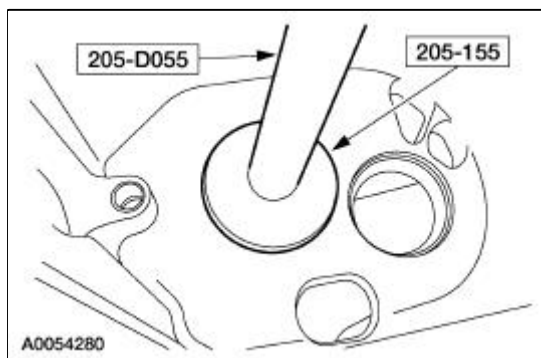
8. **NOTE:** If a new countershaft bearing is being installed, install a new bearing cup. Always install new bearings and cups in a set.

Using the special tools, install the countershaft bearing cup.



9. **NOTE:** If a new mainshaft bearing is being installed, install a new bearing cup. Always install new bearings and cups in a set.






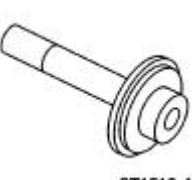
Using the special tools, install the mainshaft bearing cup.



10. To assemble, reverse the disassembly procedure.
-

Transmission

Special Tool(s)

 <p>ST1214-A</p>	<p>Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent</p>
 <p>ST1186-A</p>	<p>Holding Fixture, Transmission 307-003 (T57L-500-B)</p>
 <p>ST2163-A</p>	<p>Remover/Installer, Bearing Tube 308-025 (T75L-7025-C)</p>
 <p>ST1555-A</p>	<p>Installer, Bearing Cup 204-039 (T77F-1217-B)</p>
 <p>ST1255-A</p>	<p>Adapter for 303-224 (Handle) 205-153 (T80T-4000-W)</p>
 <p>ST1513-A</p>	<p>Installer, Axle Shaft Oil Seal 205-123 (T78P-1177-A)</p>

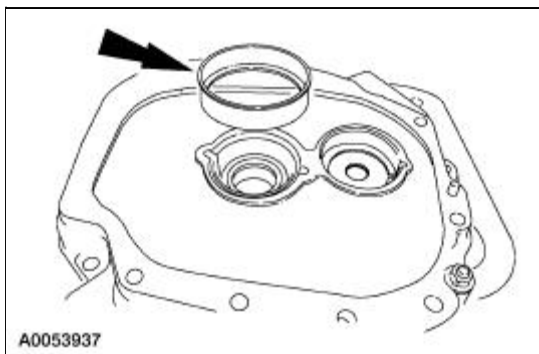
Material

Item	Specification
<p>DEXRON III® (ATF) Transmission Fluid XT-2-QDX or equivalent</p>	<p>DEXRON III®</p>
<p>Premium Long Life Grease</p>	<p>ESA-M1C75-B</p>

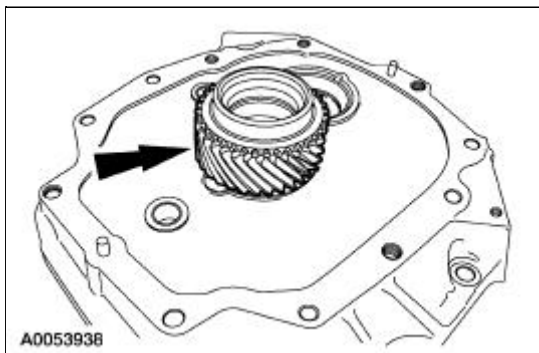
XG-1-C, K or T	
Threadlock and Sealer E0AZ-19554-AA	WSK-M2G351-A5 (type II)
Black Non-Acid Cure Silicone Rubber E7TZ-19562-A	ESL-M4G273-A

1. Lubricate all components with transmission fluid during assembly.
2. Attach the transmission adapter plate to the special tool.
3. **NOTE:** If a new front input shaft bearing or front countershaft bearing was installed, install new bearing cups.

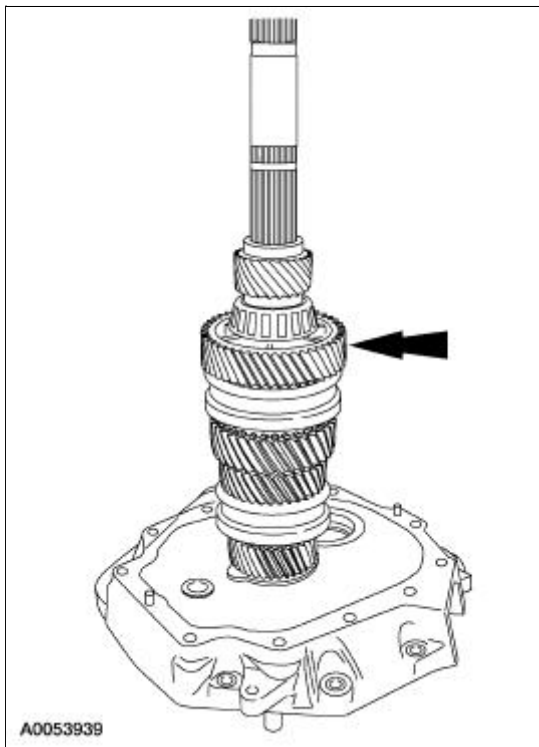
Install the input shaft bearing cup and the countershaft bearing cup. Do not install the shims at this time.



4. Install the input shaft.

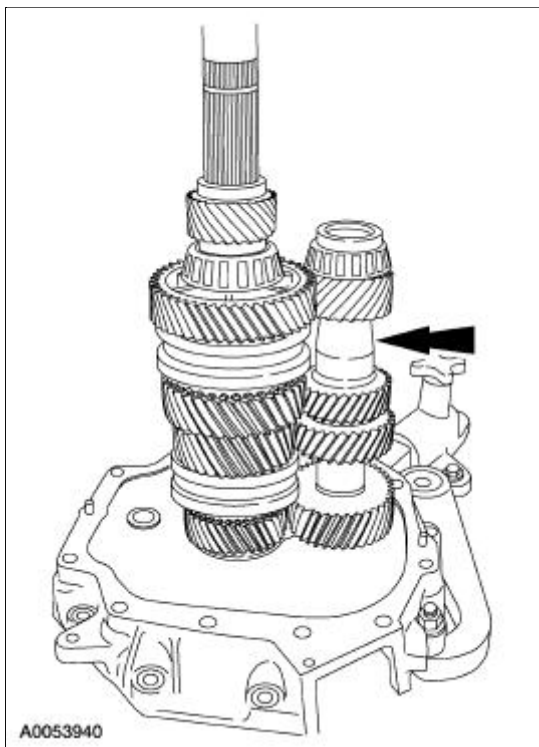


5. Install the mainshaft onto the input shaft.

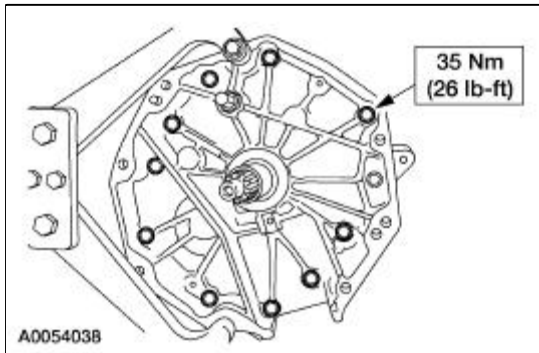
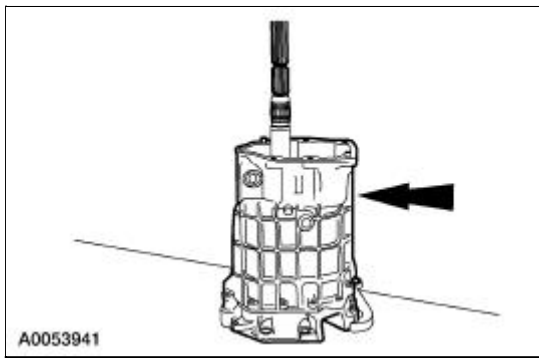


6. Install the countershaft.

- Lift the mainshaft upward, tilt the countershaft and install.



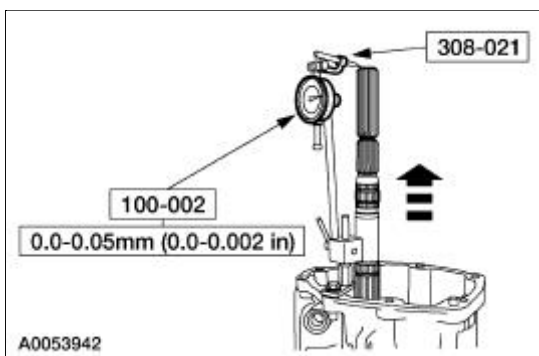
7. Install the transmission case and tighten the bolts.



8. **NOTE:** Rotate the transmission so that the input shaft is pointing downward.

NOTE: Rotate the input shaft/mainshaft to seat the bearings.

Using the special tools, measure the input shaft/mainshaft end play by applying an upward load on the input shaft. Record the measurement.

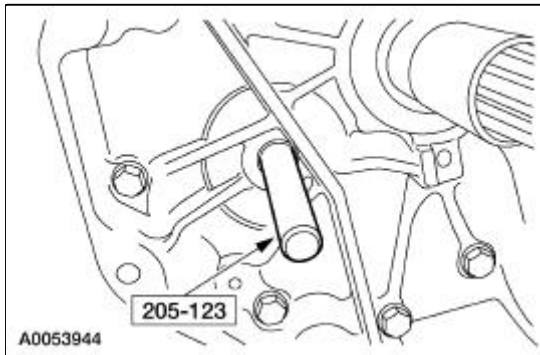
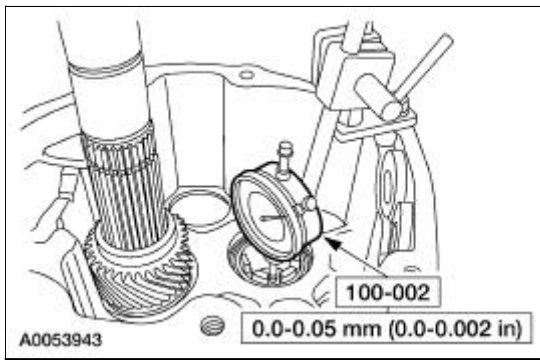


9. Reposition the special tool on the countershaft. Place the tip of the dial between the fingers on the countershaft.

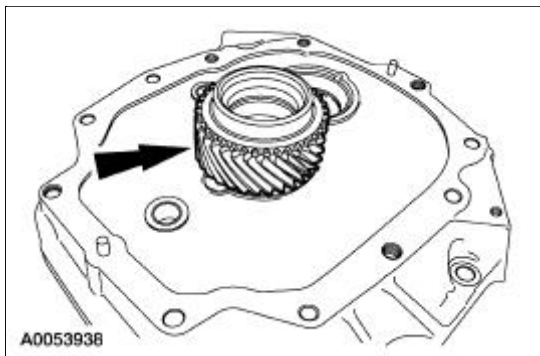
10. **NOTE:** Rotate the countershaft to seat the bearings.

Using the special tools, measure the countershaft gear end play by pushing upward on the countershaft. Record the measurement.

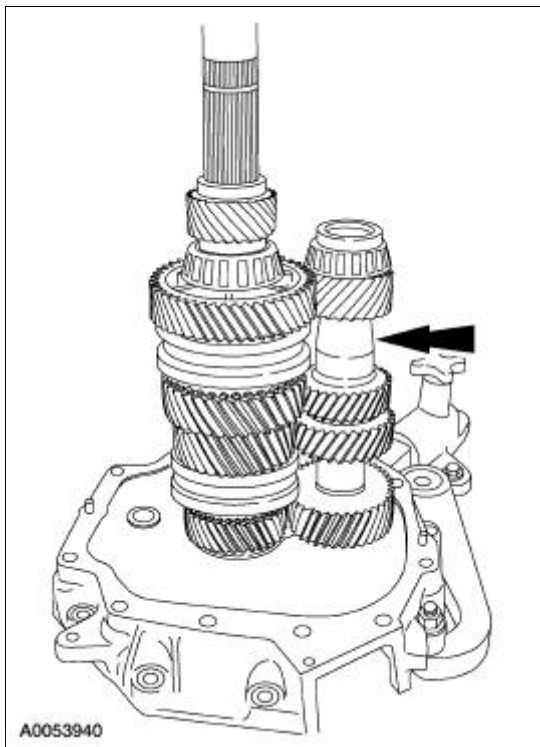
- Unscrew the installer from the handle. Insert the handle into the adapter plate plug hole.



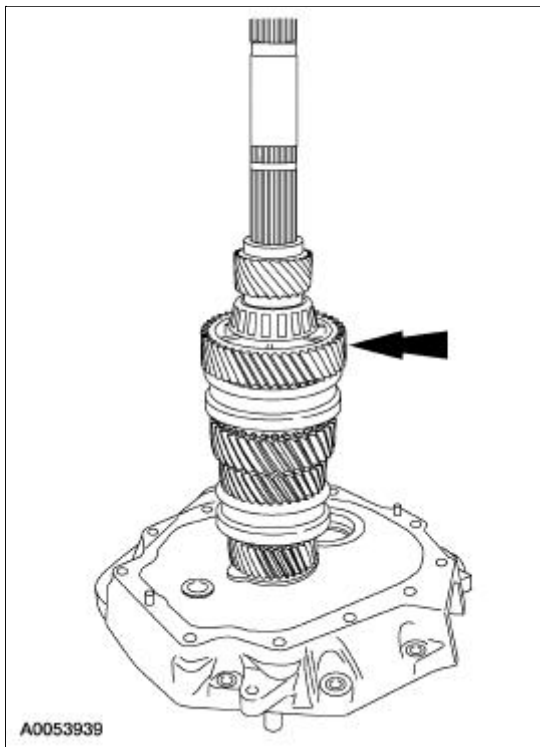
11. Remove the bolts and the transmission case.



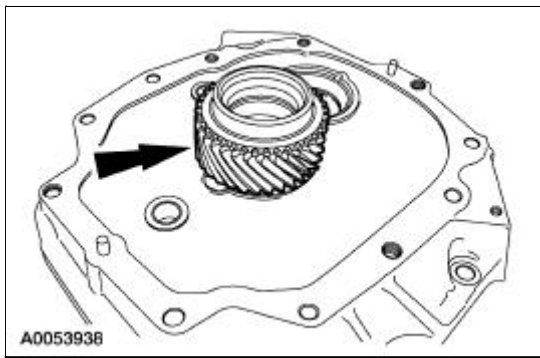
12. Remove the countershaft.



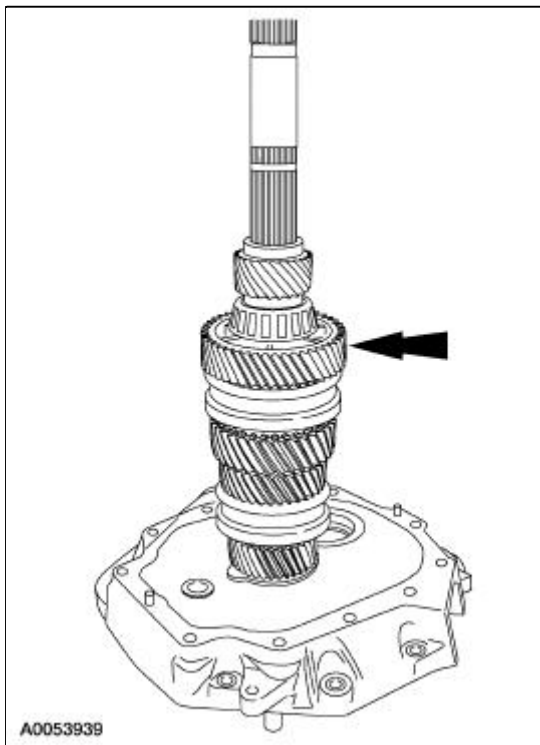
13. Remove the mainshaft.



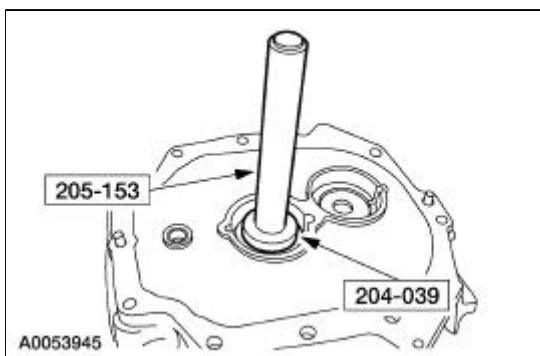
14. Remove the input shaft.



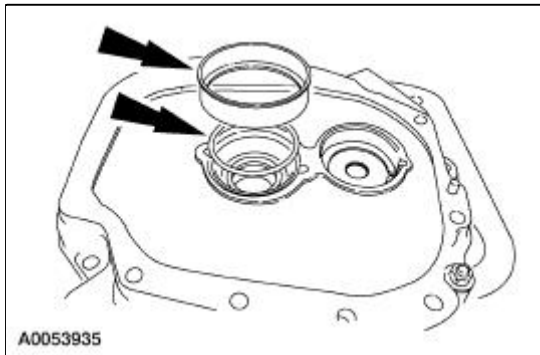
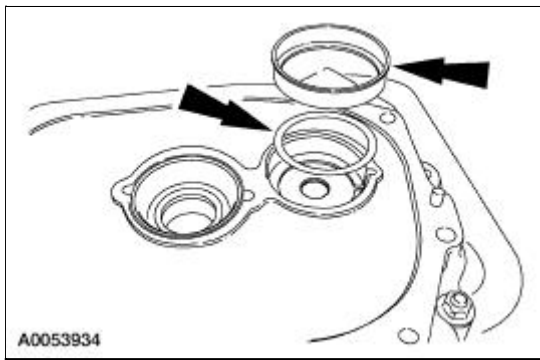
15. Remove the input shaft bearing cup and the countershaft bearing cup.



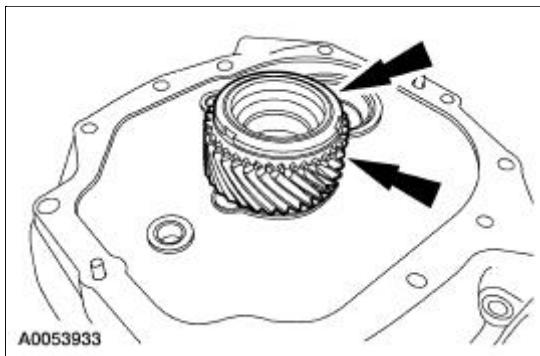
16. Using the special tools, install the new input shaft seal.



17. Using the recorded end play measurements, select and install the appropriate shims to achieve the proper end play. Install the front input shaft bearing cup and the front countershaft bearing cup.
- Lubricate the bearing cups with petroleum jelly.

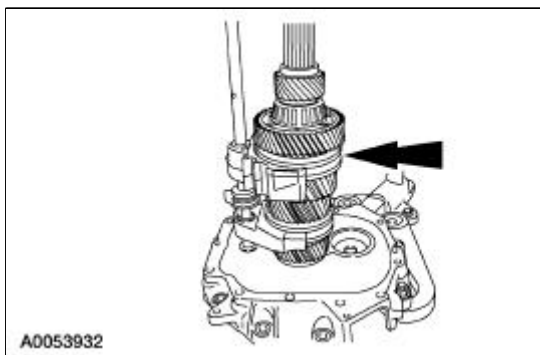


18. Install the input shaft and fourth gear synchronizer blocking ring.

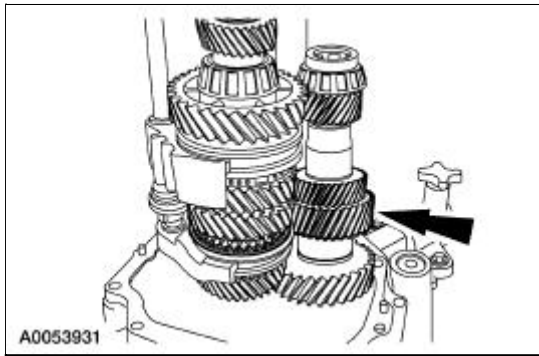


19. Assemble the shift rail assembly to the mainshaft, then install the mainshaft and shift rail as an assembly.

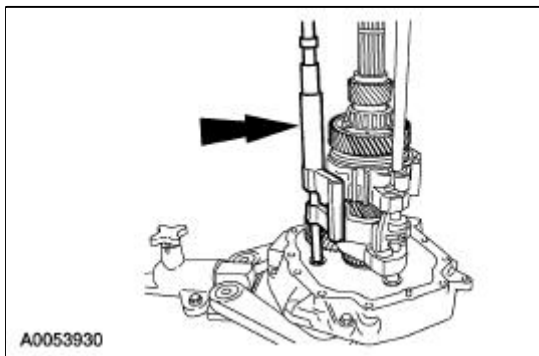
- Rotate the mainshaft to engage the fourth gear synchronizer blocking ring with the synchronizer keys.



20. Lift up the mainshaft, then install the countershaft.

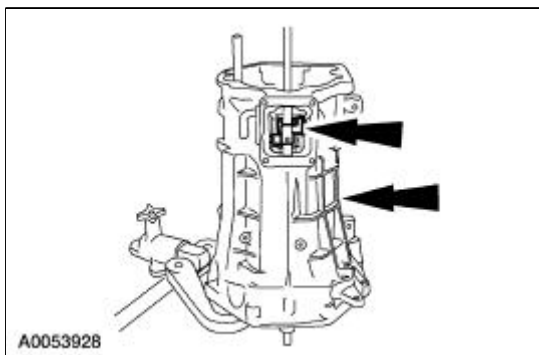


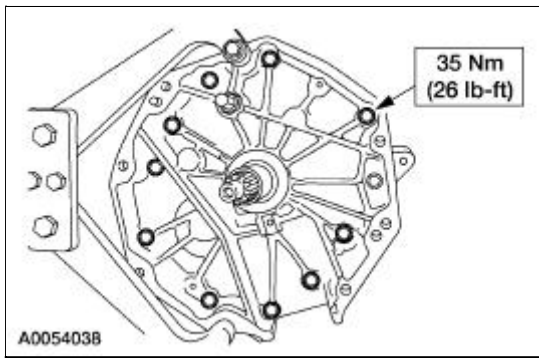
21. Install the fifth/sixth and reverse shift rail assembly and align the slots of the shift levers with the shift interlock plate.



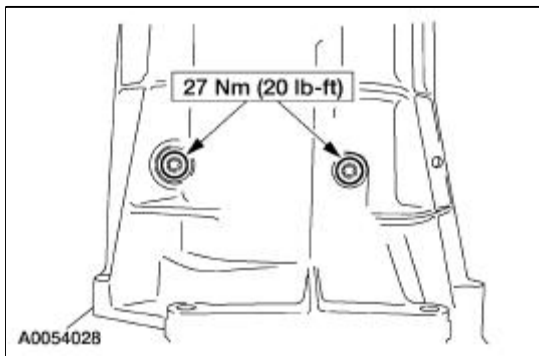
22. Clean the mating surfaces of the transmission main case and the transmission adapter plate. Apply a bead of silicone rubber to the sealing surface on the transmission adapter plate. Install the spring and detent ball into the front offset lever, then install the transmission case and the front offset lever.

- Make sure the transmission is in neutral to keep the third/fourth gear shift rail from engaging.
- Compress the front offset lever against the guide plate when installing.
- Tighten the bolts in a star pattern.

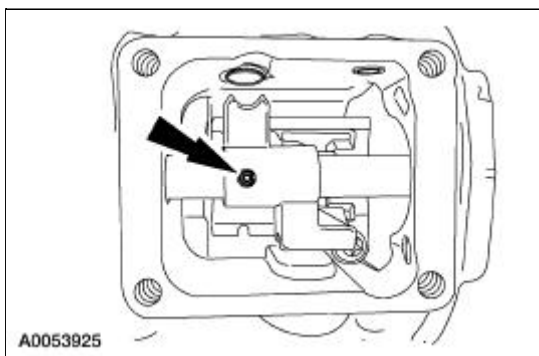




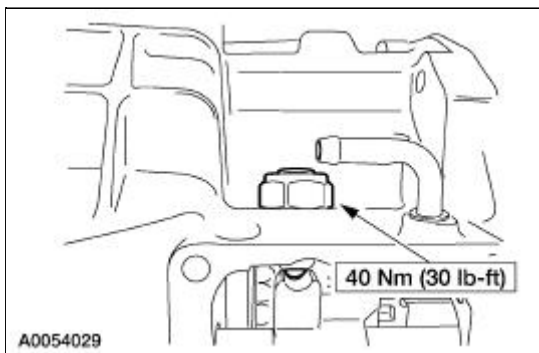
23. Apply threadlock and sealer to the threads of the shift lever guide bolts, then install the bolts.
- Pull up on the fifth/sixth shift rail to align the slot of the interlock plate with the guide bolt hole.



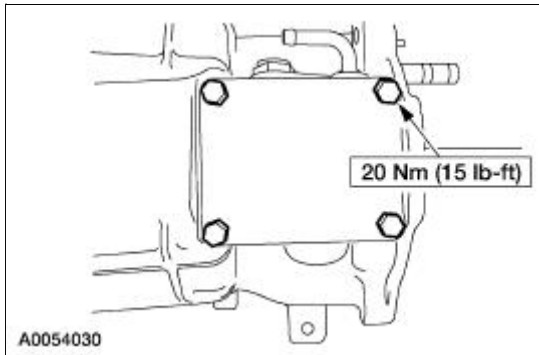
24. Install a new front offset lever roll pin.
- Install the pin until it is flush with the lever.



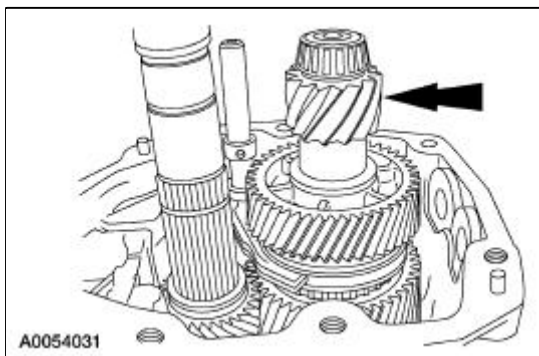
25. Apply threadlock and sealer to the threads of the shift detent, then install the shift detent assembly.



26. Clean the mating surfaces of the transmission main case and the shift detent cover. Apply a bead of silicone rubber to the sealing surface on the transmission case. Install the cover and tighten the bolts.

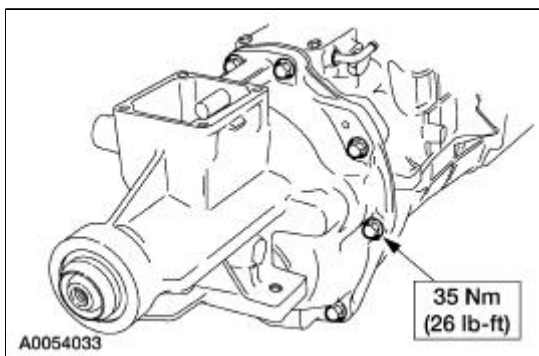


27. Rotate the transmission to a horizontal position. Install the countershaft extension assembly and the fifth/sixth gear shift fork. Make sure the splines are fully engaged.



28. **NOTE:** Remove the countershaft extension shim from the extension housing.

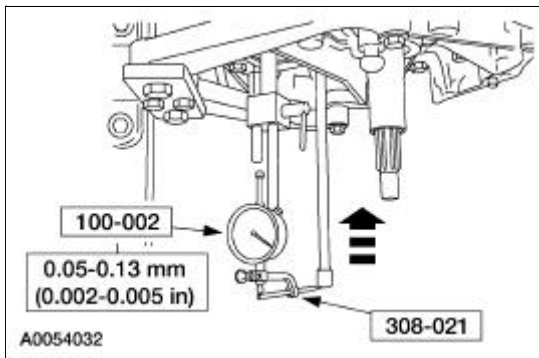
Install the extension housing and tighten the bolts.



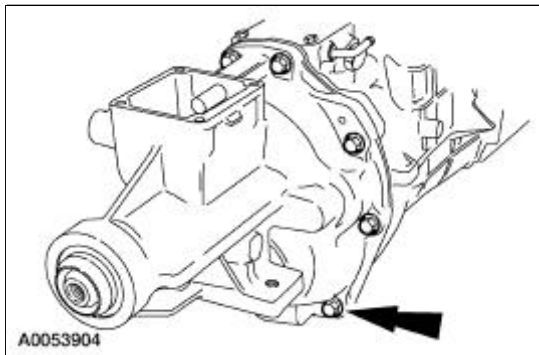
29. **NOTE:** Rotate the transmission to the vertical position.

Using the special tools, measure the countershaft extension end play by pushing upward on the countershaft extension. Record the measurement.

- Insert a suitable bar into the adapter plate plug hole until it engages the countershaft extension.



30. Remove the extension housing.

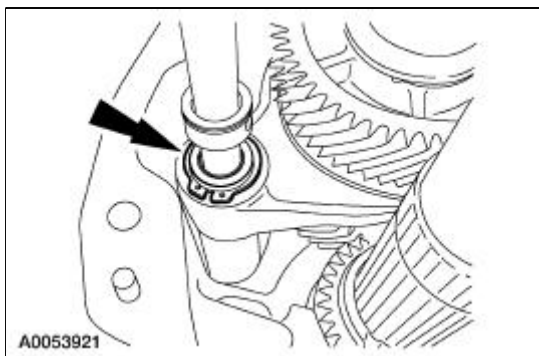


31. **NOTE:** If a new countershaft extension bearing was installed, install a new bearing cup.

Using the recorded end play measurement, select and install the appropriate shims to achieve the proper end play. Install the countershaft extension bearing cup.

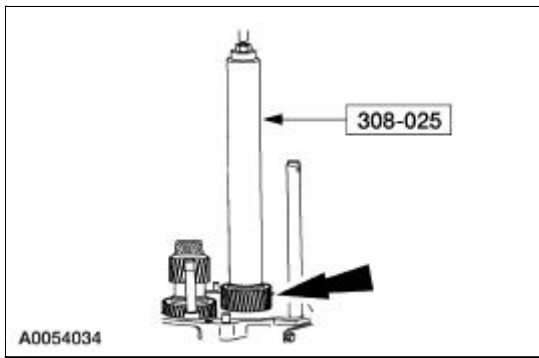
- Lubricate the bearing cup with petroleum jelly.

32. Install the fifth/sixth shift fork snap ring.

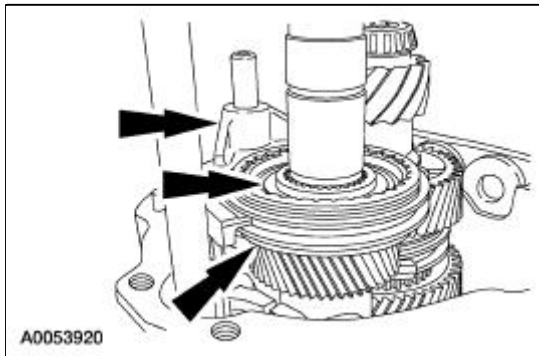


33. Using the special tool, press the fifth/sixth driven gear.

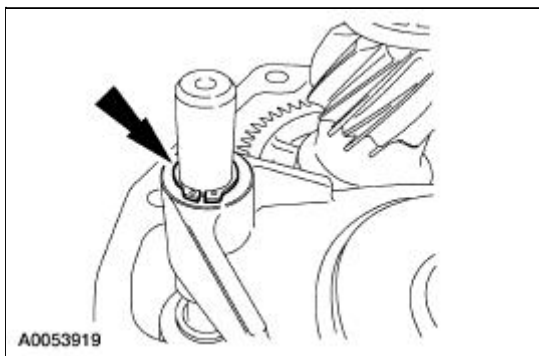
- Align the splines of the fifth/sixth driven gear with the drive gear on the countershaft extension.



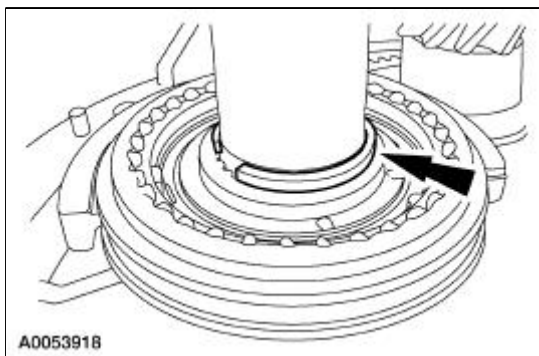
34. Install the reverse shift fork, the reverse synchronizer and the thrust washer as an assembly.
- Align the pockets in the blocking ring with the struts in the synchronizer.



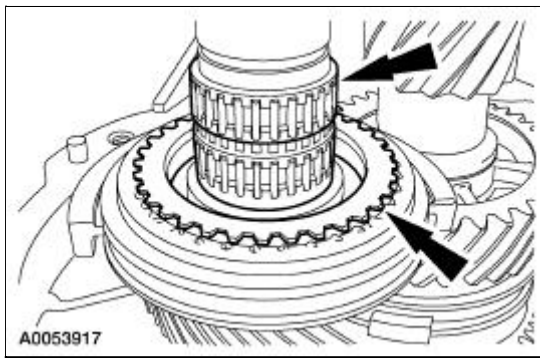
35. Install the reverse shift fork snap ring.



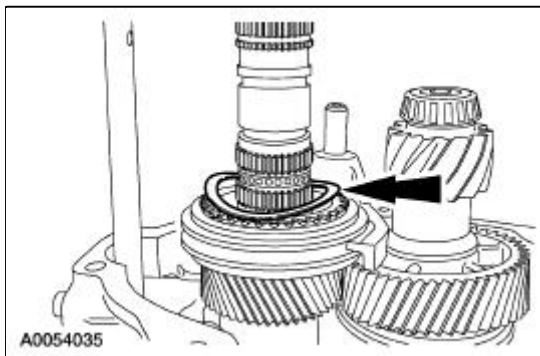
36. Install a new reverse gear synchronizer snap ring.



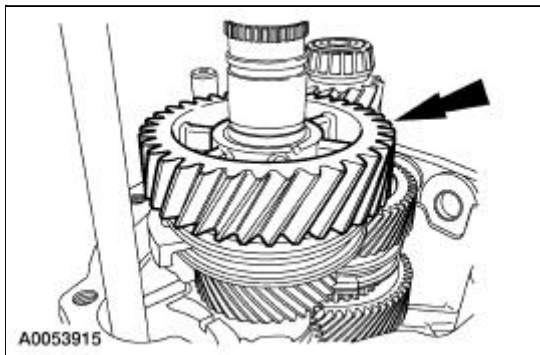
37. Install the reverse gear needle bearing and the reverse gear synchronizer blocking ring.



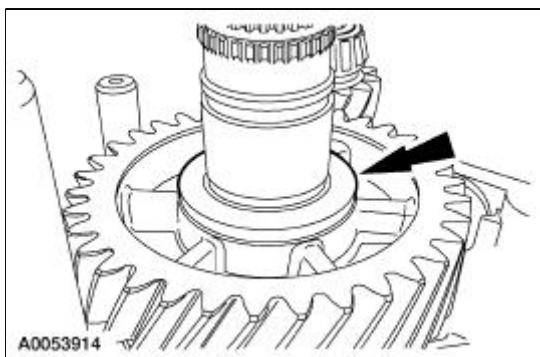
38. Install the reverse gear wave washer.



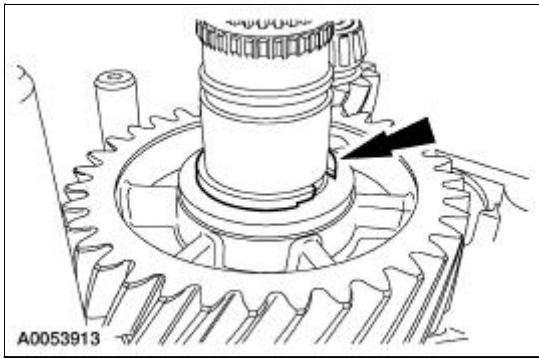
39. Install reverse gear.



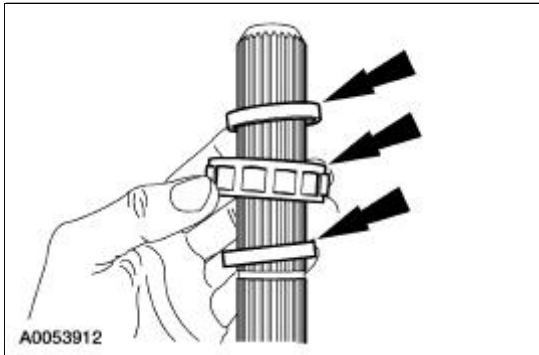
40. Install the reverse gear thrust washer.



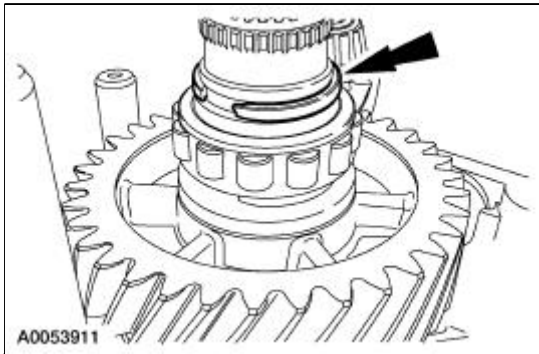
41. Install a new reverse gear snap ring.



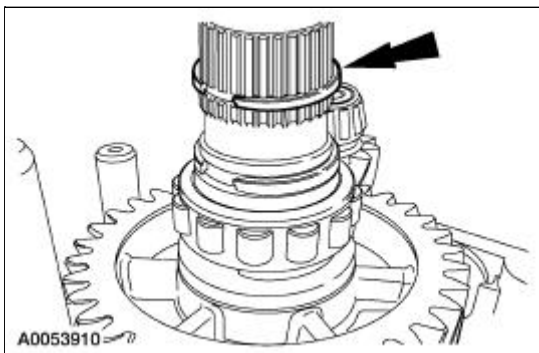
42. Install the lower spacer, the rear mainshaft roller bearing and the upper spacer.



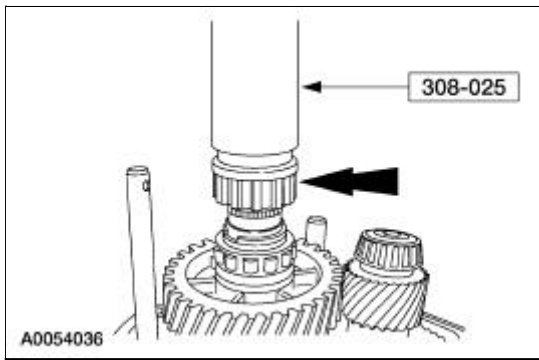
43. Install the rear mainshaft roller bearing snap ring.



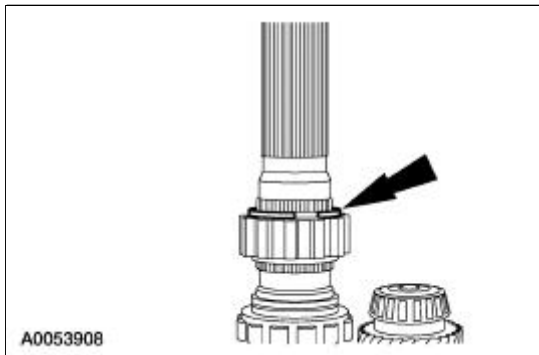
44. Install a new output speed shaft (OSS) sensor tone wheel lower retaining ring.



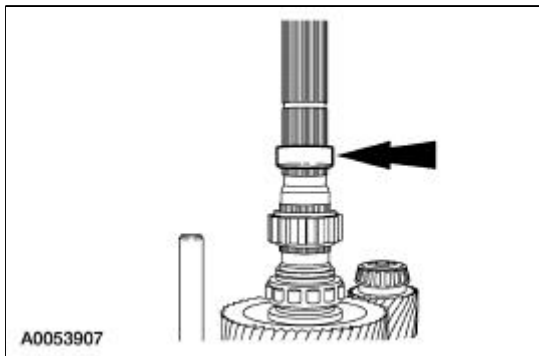
45. Using the special tool, install the OSS sensor tone wheel.



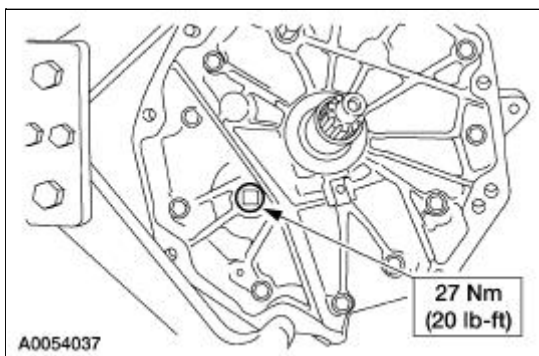
46. Install a new OSS sensor tone wheel retaining ring.



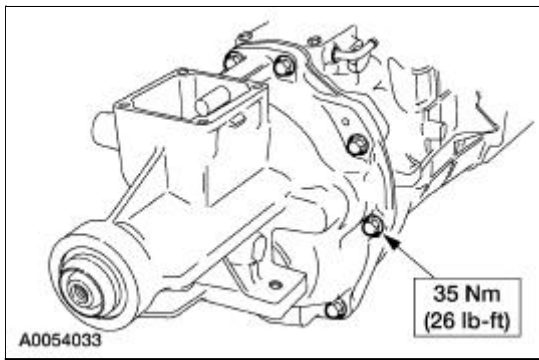
47. Install the shipping seal.



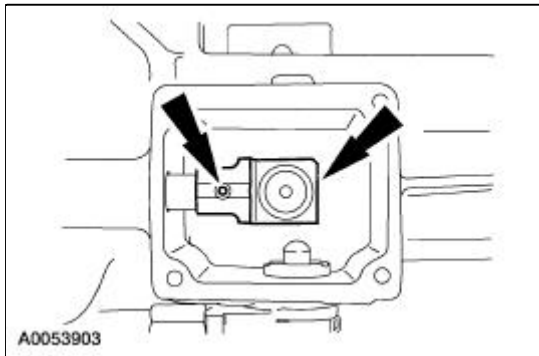
48. Apply threadlock and sealer to the threads of the plug, then install the plug into the transmission adapter plate.



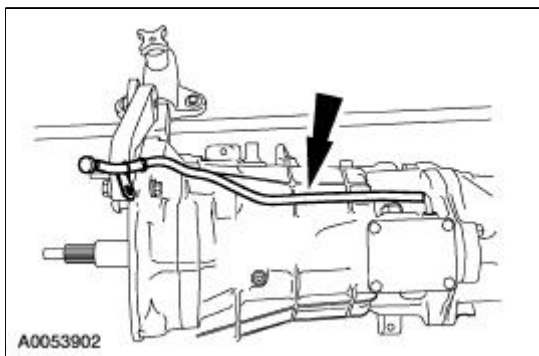
49. Clean the mating surfaces of the transmission main case and the extension housing. Apply a bead of silicone rubber to the sealing surface on the transmission case. Install the extension housing and tighten the bolts.



50. Install the rear offset shift lever, then install a new roll pin.
- Install the pin until it is flush with the lever.

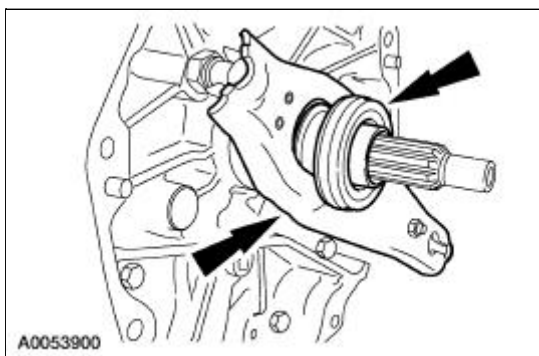


51. Install the vent hose.



52. **NOTE:** Before installing the transmission, the ball stud, the clutch release lever and the input shaft guide tube must be cleaned and lubricated.

Install the clutch release lever and the clutch release hub and bearing.



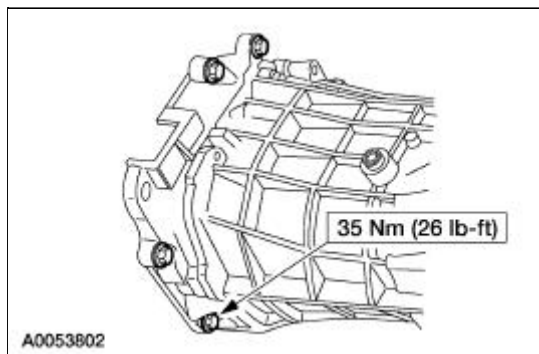
Transmission

Material

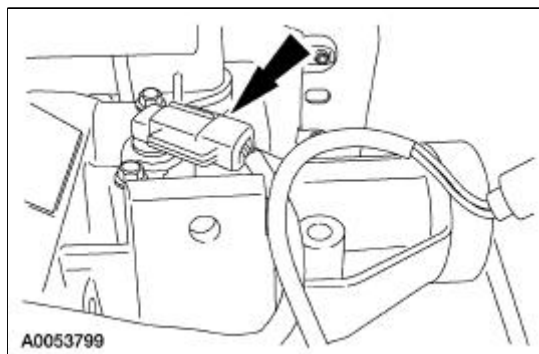
Item	Specification
DEXRON III® (ATF) Transmission Fluid XT-2-QDX or equivalent	DEXRON III®
Pipe Sealant with Teflon® D8AZ-19554-A or equivalent	WSK-M2G350- A2
Premium Long Life Grease XG-1-C, K or T or equivalent	ESA-M1C75-B

1. **NOTE:** Before installing the transmission, the ball stud, clutch release lever and the input shaft must be cleaned and lubricated with grease.

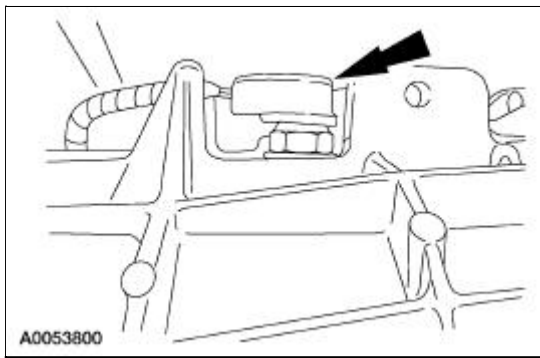
Position the transmission to the clutch adapter housing. Install the eight transmission-to-clutch adapter housing bolts.



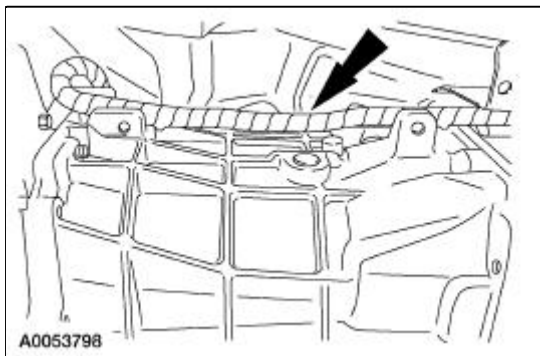
2. Connect the output shaft speed (OSS) sensor electrical connector.



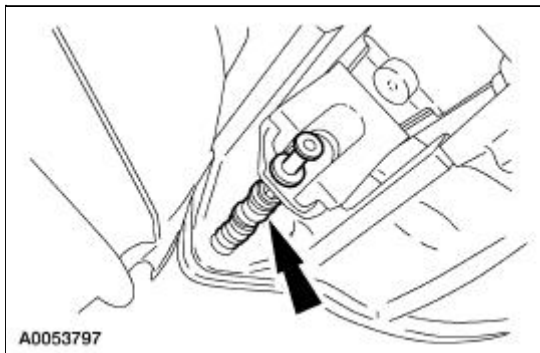
3. Connect the reverse lamp electrical connector.



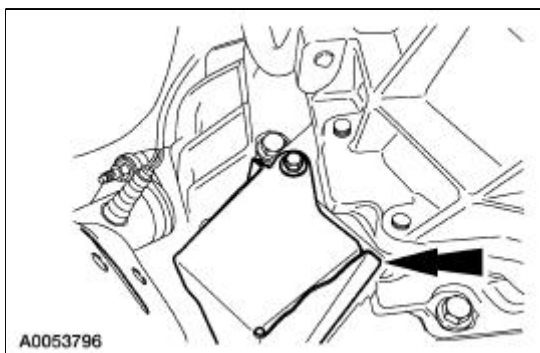
4. Connect the wiring harness to the transmission.



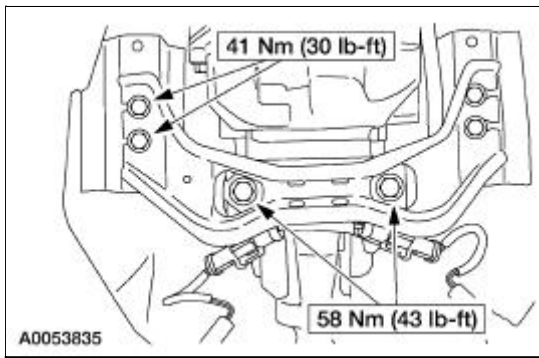
5. Connect the clutch release cable to the clutch release fork.



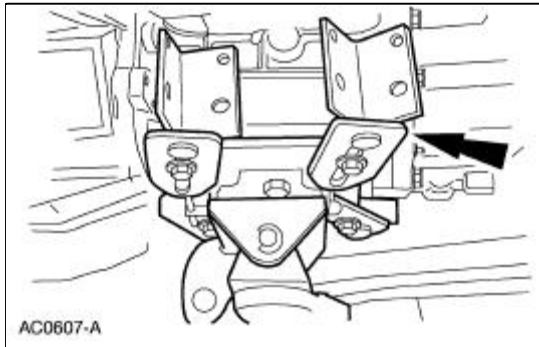
6. Install the clutch release lever cover and bolt.



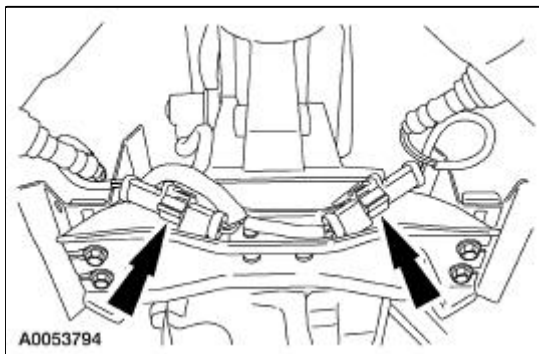
7. Install the transmission crossmember and the bolts.



8. Remove the transmission jack from the transmission.



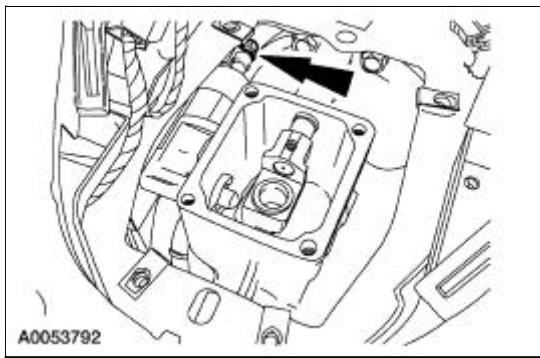
9. Connect the heated oxygen sensor (HO2S) electrical connectors to the crossmember.



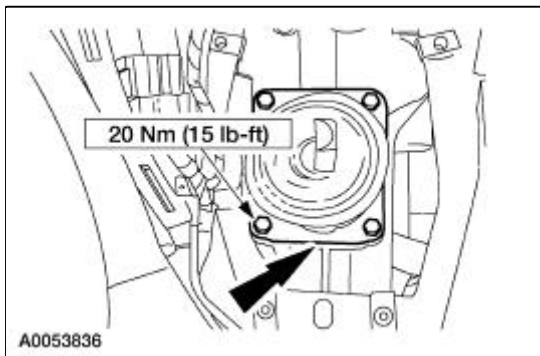
10. **⚠ CAUTION: Align the index marks on the driveshaft flange and pinion flange, and the driveshaft slip yoke and transmission output shaft.**

Install the driveshaft. For additional information, refer to [Section 205-01](#).

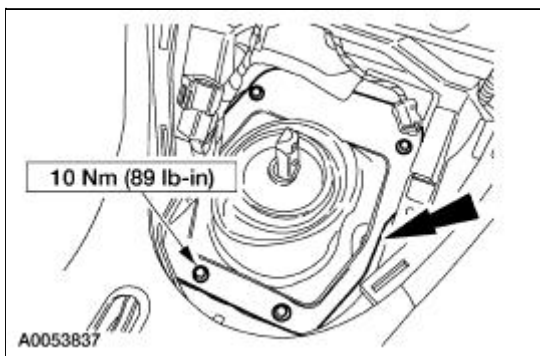
11. Fill the transmission to capacity with the specified transmission fluid. Apply sealant to the fill plug threads and install the fill plug.
 - The total fill capacity is 3.9L (4.1 qt).
12. Lower the vehicle.
13. Connect the reverse lockout solenoid electrical connector.



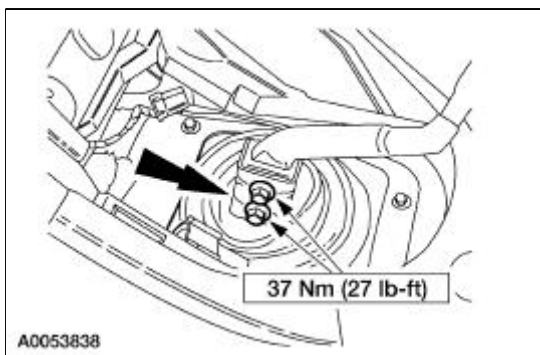
14. Install the lower gearshift lever and the bolts.



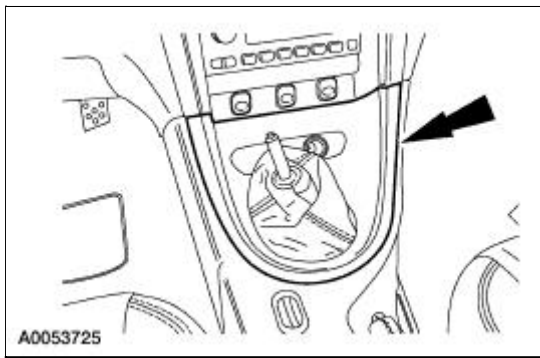
15. Install the lower gearshift lever boot and the bolts.



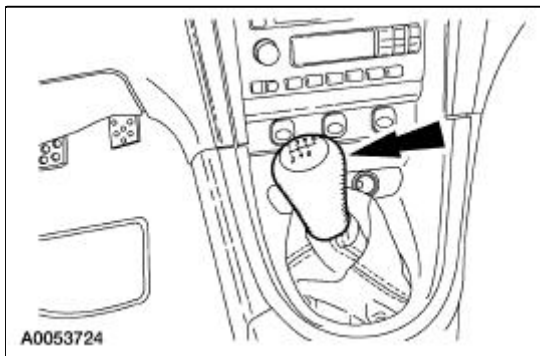
16. Install the upper gearshift lever and the bolts.



17. Connect the cigar lighter electrical connector. Install the console panel gearshift plate.



18. Install the gearshift lever knob.



Torque Specifications

Description	Nm	lb-ft
Dual converter-to-exhaust manifold nuts	40	30
Sleeve U-bolt nuts	55	41
Dual converter-to-inlet pipe flange nuts	35	26

Exhaust System

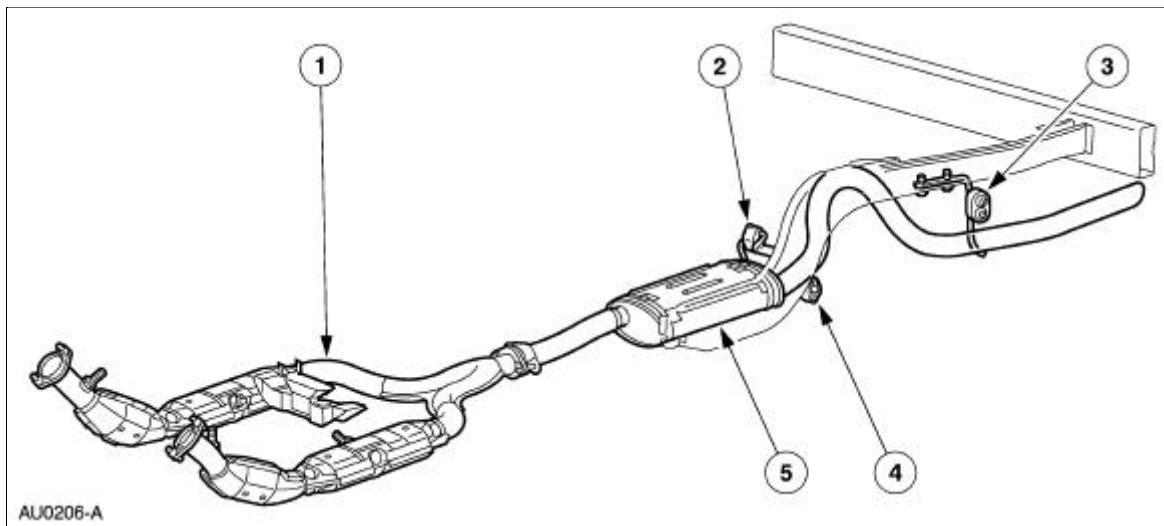
! WARNING: The normal operating temperature of the exhaust system is very high. Never attempt to repair any part of the system until it has cooled. Be especially careful when working around the three way catalytic converter. The temperature of the three way catalytic converter rises to a high level after only a few minutes of engine operation.

! CAUTION: When repairing exhaust system or removing exhaust components, disconnect all heated oxygen sensors (HO2S) at the wiring connectors to prevent damage to the heated oxygen sensors and wiring harness. For additional information, refer to [Section 303-14](#) for location of the heated oxygen sensors.

The exhaust system:

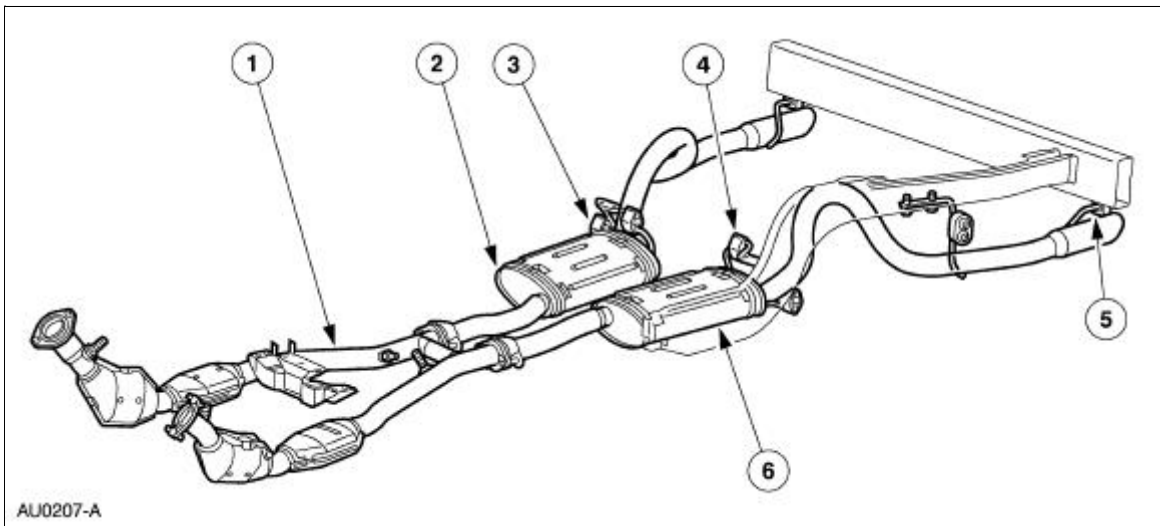
- contains dual three-way catalytic converters.
- has a crossover pipe downstream of the three way catalytic converters (4.6L).
- has two upstream heated oxygen sensors mounted before the three-way catalytic converters.
- the production muffler and tailpipe assembly is a one-piece design exhaust system.

Exhaust System — 3.8L



Item	Part Number	Description
1	5F250	Dual converter assembly
2	5D255	Insulator bracket assembly
3	5A246	Insulator bracket, (tailpipe)
4	5D255	Insulator bracket assembly
5	5232	Muffler

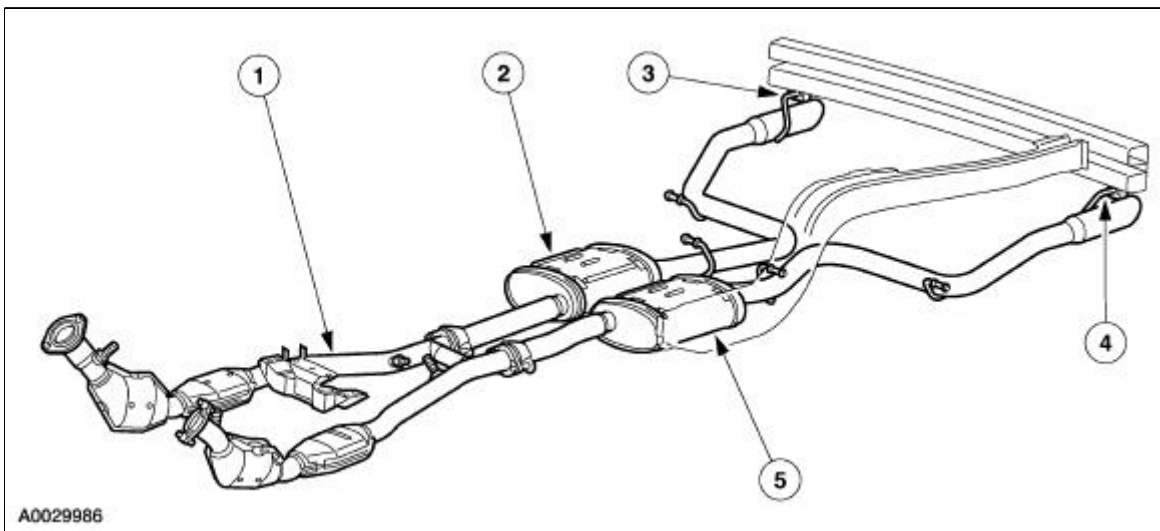
Exhaust System — 4.6L (2V)



AU0207-A

Item	Part Number	Description
1	5F250	Dual converter assembly
2	5230	Muffler, RH
3	5260	Insulator bracket assembly, RH
4	5260	Insulator bracket assembly, LH
5	5A246	Insulator bracket, tailpipe (2 req'd)
6	5230	Muffler, LH

Exhaust System — 4.6L (4V)



A0029986

Item	Part Number	Description
1	5F250	Dual converter assembly
2	5230	Muffler, RH
3	5260	Insulator bracket assembly, RH
4	5260	Insulator bracket assembly, LH
5	5230	Muffler, LH

Exhaust System

Symptom Chart

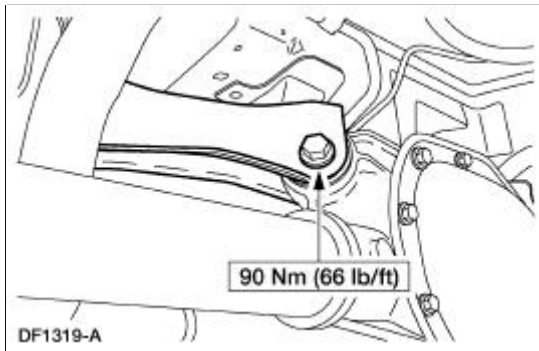
Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none">Noisy or leaking exhaust	<ul style="list-style-type: none">Broken or loose clamps, hangers or isolators.Punctures in the muffler (5230).Broken, loose or missing exhaust manifold fasteners or gaskets.Loose heated oxygen or catalyst monitor sensor.Exhaust system misalignment.Broken or loose catalyst internal components.	<ul style="list-style-type: none">REPAIR as necessary. ALIGN exhaust system. LOOSEN all fasteners joining the exhaust system and SHAKE the system to isolate the concern. REPAIR as necessary.
<ul style="list-style-type: none">Loss of power	<ul style="list-style-type: none">Kinked or damaged exhaust pipe.Clogged three-way catalytic converter (5F250).Foreign object in the exhaust system.	<ul style="list-style-type: none">REPAIR as necessary.

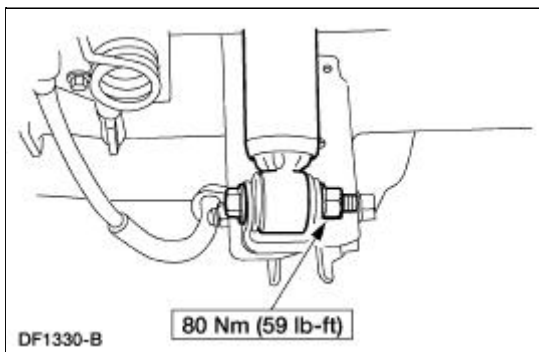
Muffler —3.8L

Removal and Installation

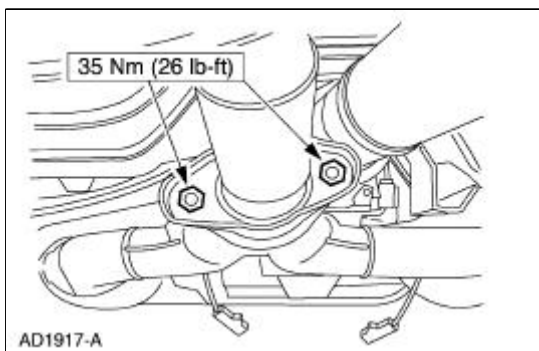
1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Support the rear axle with a suitable jack.
3. Remove the upper arm-to-differential bolt.



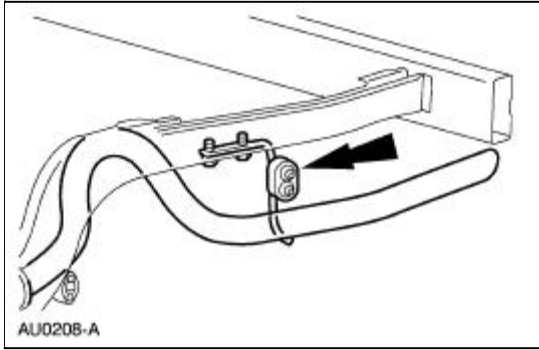
4. Remove the nut and bolt and disconnect the rear shock absorbers (18124) from the axle housing.
 - Discard the nut.



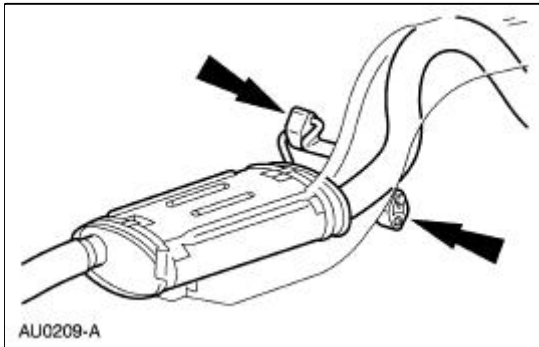
5. Lower the rear axle.
6. Remove the dual converter assembly flange nuts.



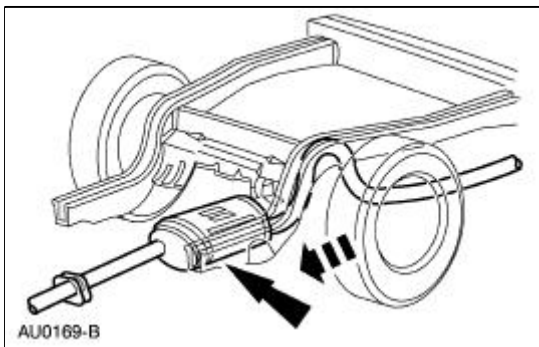
7. Remove the exhaust pipe assembly (5232) from the rear exhaust hanger insulator (5260).



8. Remove the exhaust hanger insulators.



9. Remove the muffler (5230).



10.  **CAUTION: Do not use oil or grease-based lubricants on insulators as they deteriorate the rubber.**

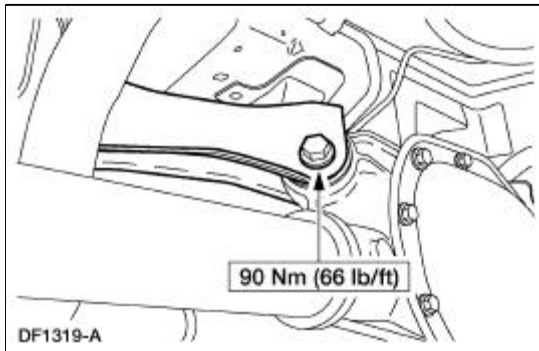
NOTE: A soap-and-water solution will ease installation of the exhaust hanger insulators.

To install, reverse the removal procedure.

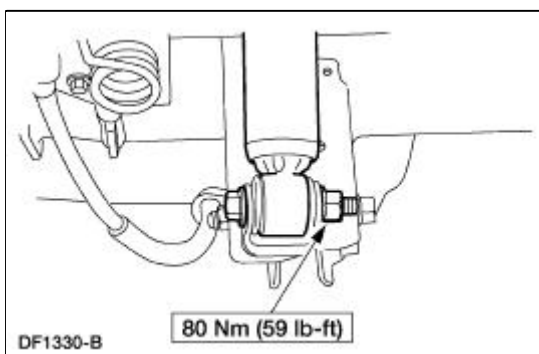
Muffler —4.6L (2V)

Removal and Installation

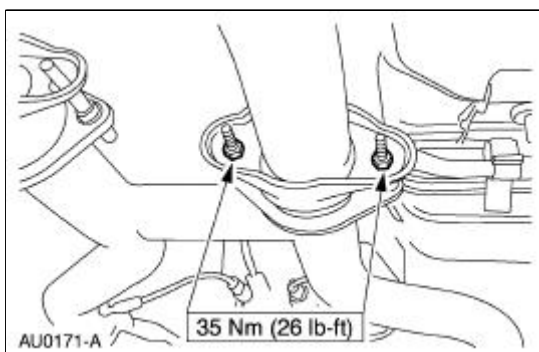
1. Use a jack to support and lower the rear axle.
2. Remove the upper arm-to-differential bolt.



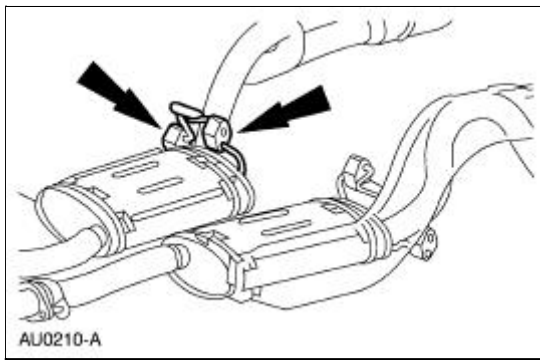
3. Remove the nut and bolt, and disconnect the rear shock absorbers (18124) from the axle housing.
 - Discard the nut.



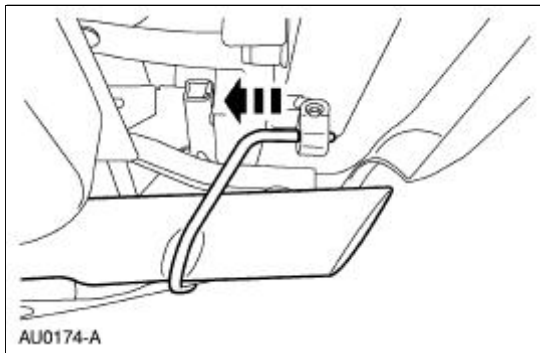
4. Lower the rear axle.
5. Remove the dual converter assembly nuts. (RH shown, LH similar.)



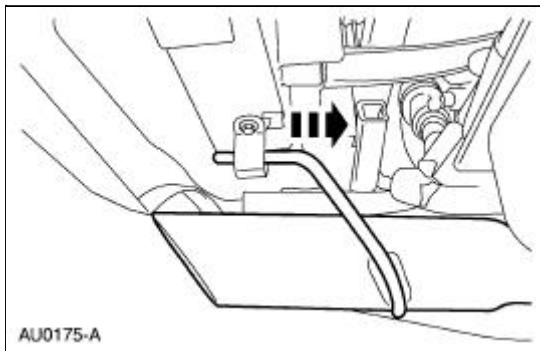
6. Remove the RH intermediate exhaust hanger insulator.



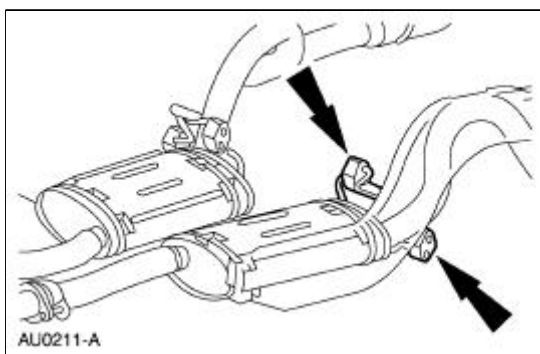
7. Remove the RH muffler (5230) from the rear exhaust hanger insulator (5260).



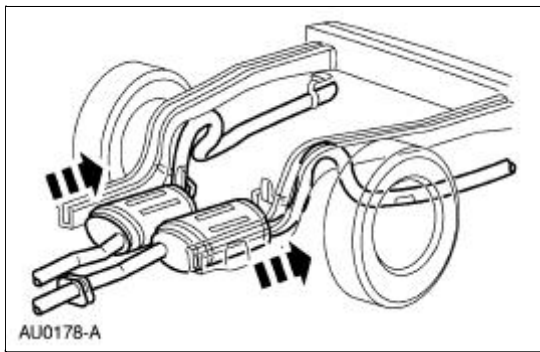
8. Remove the LH muffler (5230) from the rear exhaust hanger insulator (5260).



9. Remove the LH intermediate exhaust hanger insulator.



10. Remove the LH and RH mufflers.



11.  **CAUTION: Do not use oil or grease-based lubricants on the insulators as they deteriorate the rubber.**

NOTE: A soap-and-water solution will ease installation of the exhaust hanger insulators.

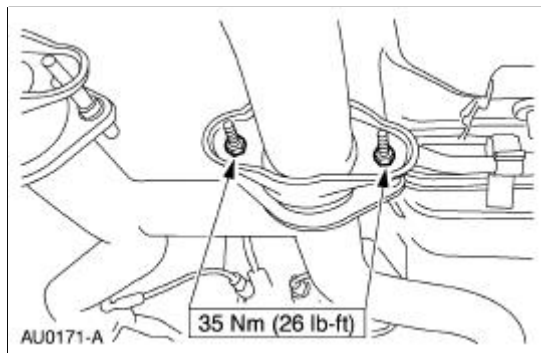
To install, reverse the removal procedure.

Muffler —4.6L (4V)

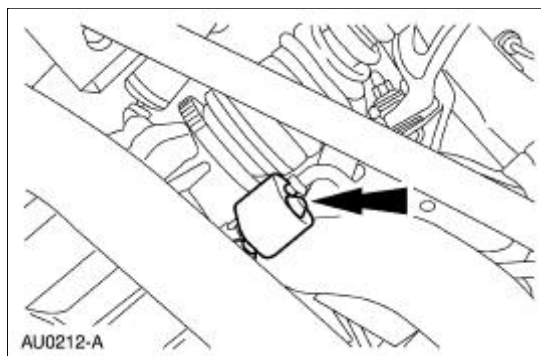
Removal and Installation

1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. **NOTE:** RH side shown, LH side similar.

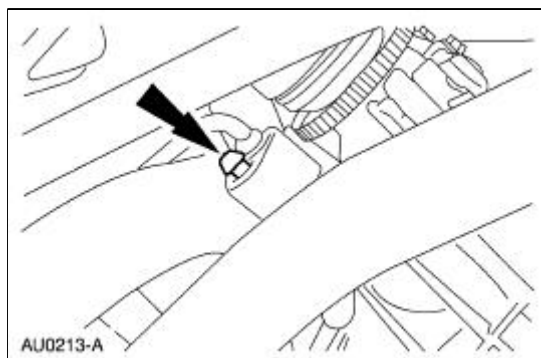
Remove the dual converter assembly nuts.



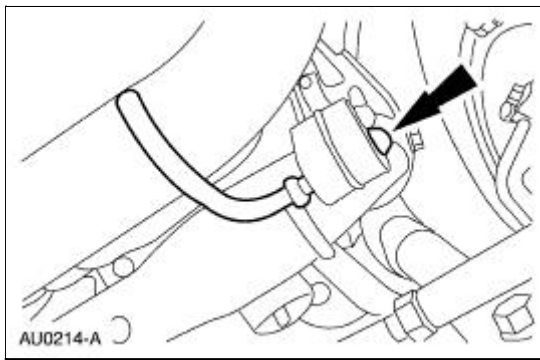
3. Remove the RH exhaust hanger insulator (5260).



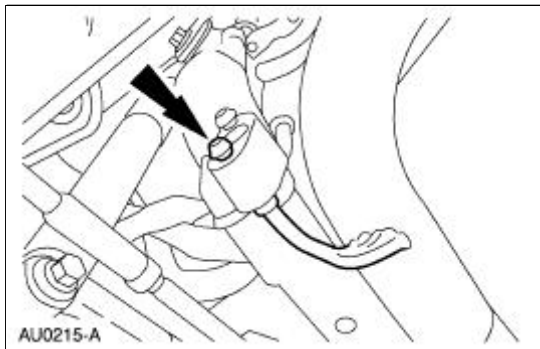
4. Remove the LH exhaust hanger insulator (5260).



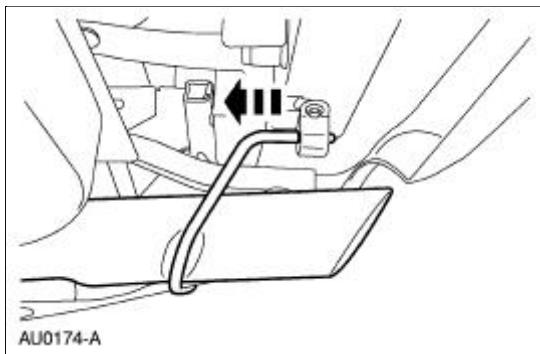
5. Remove the RH intermediate exhaust pipe hanger insulator.



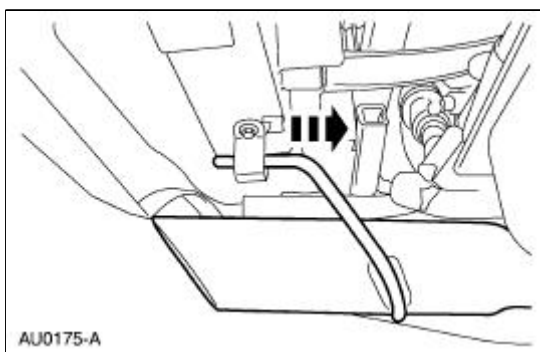
6. Remove the LH exhaust pipe hanger insulator.



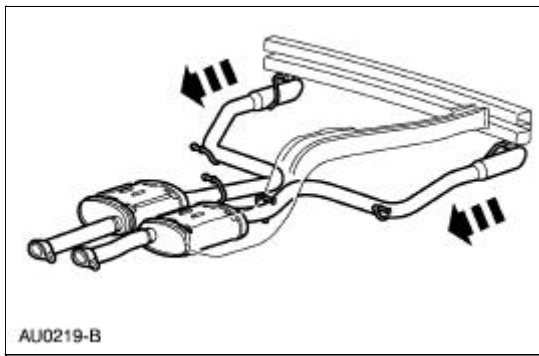
7. Remove the RH exhaust pipe hanger insulator.



8. Remove the LH exhaust pipe hanger insulator.



9. Remove the RH and LH mufflers.



10.  **CAUTION:** Do not use oil or grease-based lubricants on the insulators as they deteriorate the rubber.


NOTE: A soap-and-water solution will ease installation of the exhaust hanger insulators.

To install, reverse the removal procedure.

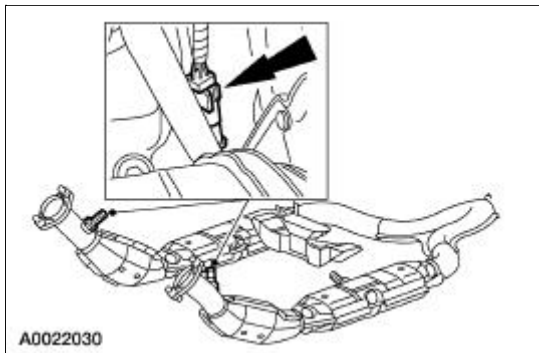
Dual Converter Y-Pipe —3.8L

Removal

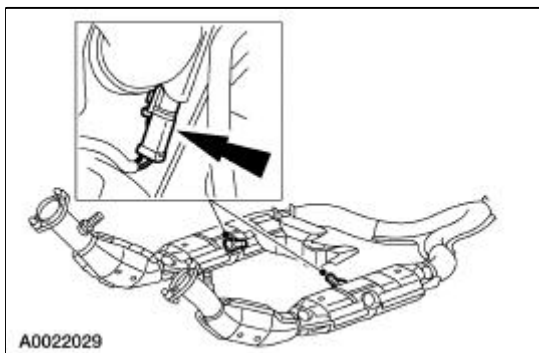
NOTE: The RH and LH catalytic converters are serviceable separately.

1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2.  **CAUTION:** When repairing the exhaust system or removing exhaust components, disconnect all heated oxygen sensors (HO2S) (9F472) and catalyst monitor sensors at the wiring connectors to prevent damage to the sensors and wiring harnesses.

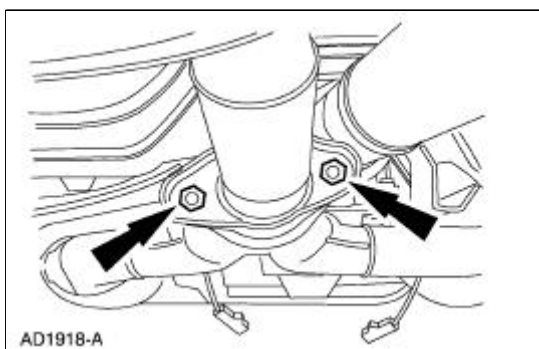
Disconnect the RH and LH HO2S connectors.



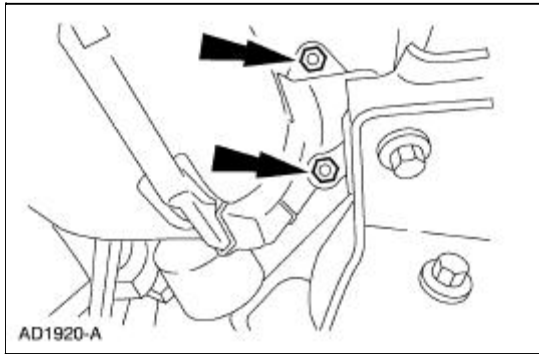
3. Disconnect the RH and LH catalyst monitor sensor connectors.



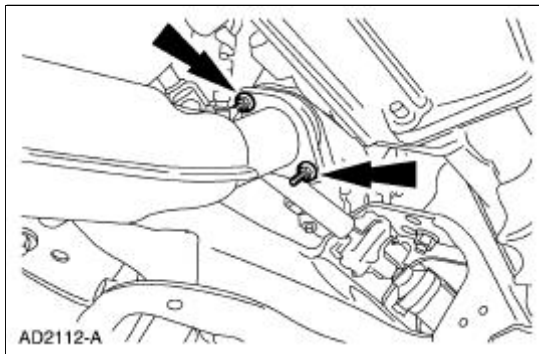
4. Remove the dual converter assembly nuts.



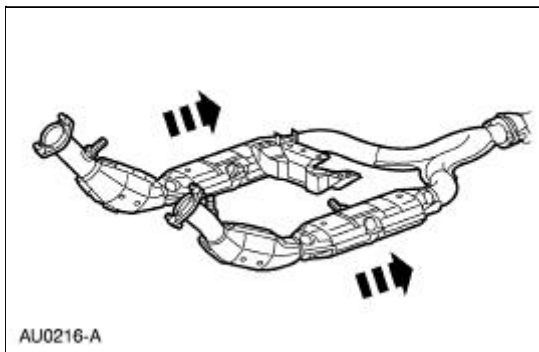
5. Remove the RH exhaust manifold flange nuts.



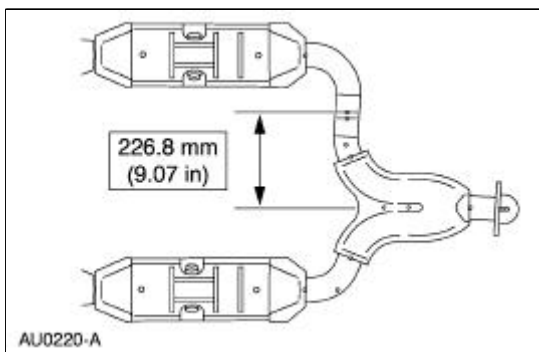
6. Remove the LH exhaust manifold flange nuts.



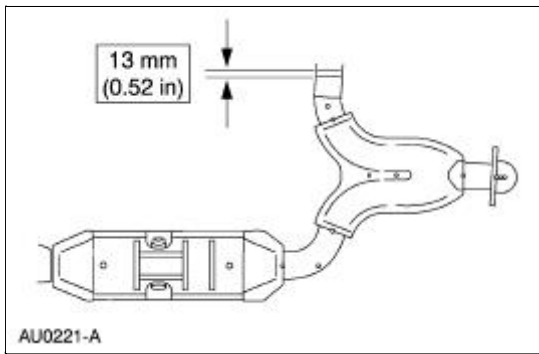
7. Remove the dual converter (5F250) assembly.



8. If necessary, use the two spot welds as a baseline, measure 226.8 mm (9.07 in) and cut the pipe.

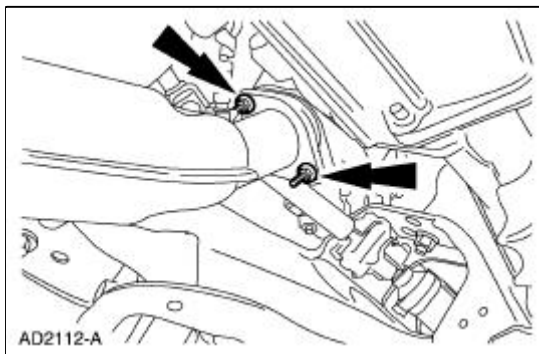


9. Remove 13 mm (0.52 in) from the LH dual converter.

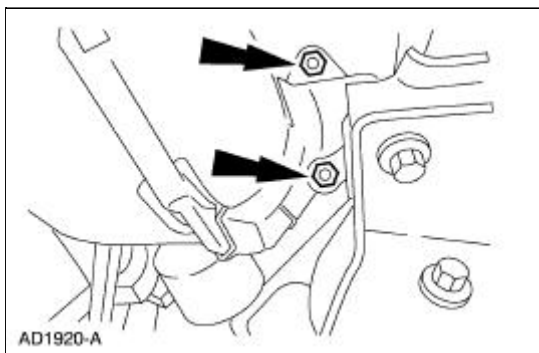


Installation

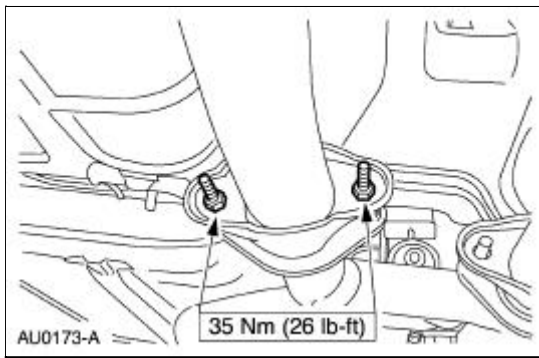
1. Position the LH dual converter.
 - Snug the LH converter-to-manifold nuts.



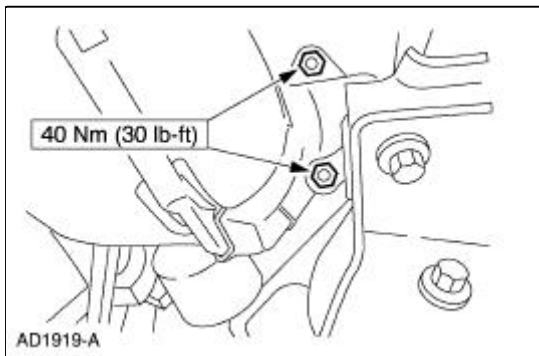
2. Position the RH dual converter pipe.
 - Snug the RH converter-to-manifold nuts.



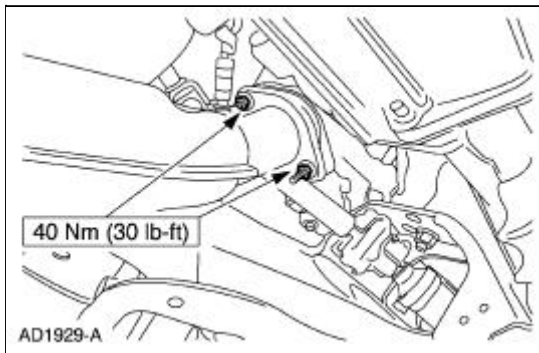
3. If necessary, position the LH and RH dual converter pipes into the sleeve and install the clamps. Tighten the clamps to 55 Nm (41 lb-ft).
4. Install the dual converter assembly nuts.



5. Tighten the LH converter-to-manifold nuts.



6. Tighten the RH converter-to-manifold nuts.




7. Connect the RH and LH HO2S connectors.
 8. Connect the RH and LH catalyst monitor sensor connectors.
 9. Lower the vehicle.
-

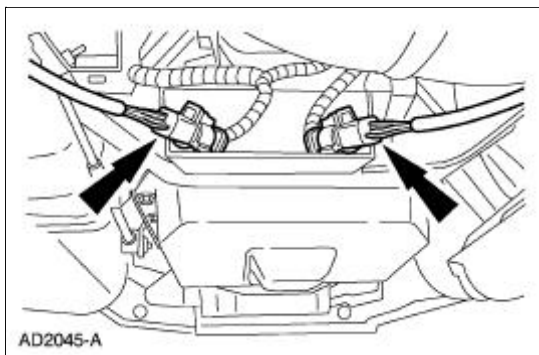
Dual Converter H-Pipe —4.6L (2V and 4V)

Removal

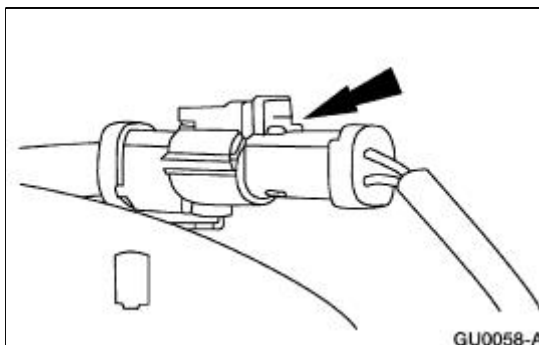
NOTE: The RH and LH catalytic converters are serviced separately.

1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2.  **CAUTION:** When repairing exhaust system or removing the exhaust components, disconnect all heated oxygen sensors (HO2S) (9F472) at the wiring connectors to prevent damage to the heated oxygen sensors and wiring harness.

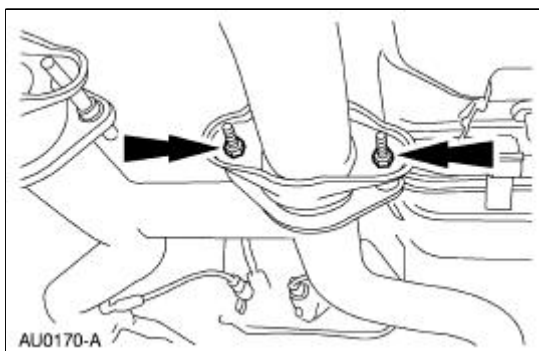
Disconnect the downstream RH and LH heated oxygen sensor connectors (9F472).



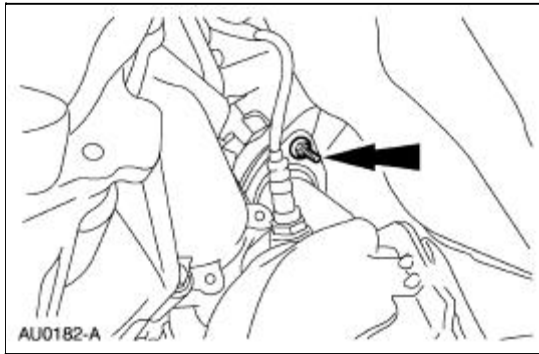
3. Disconnect the two upstream RH and LH catalyst monitor sensor connectors.



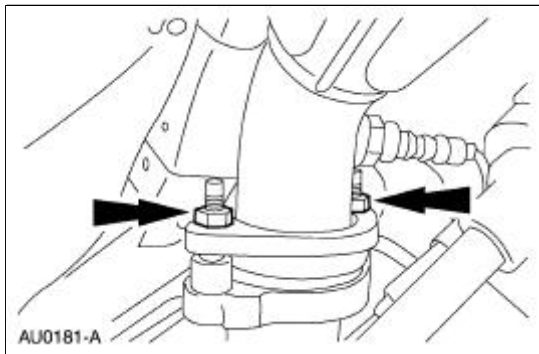
4. Remove the dual converter assembly nuts. (RH shown, LH similar.)



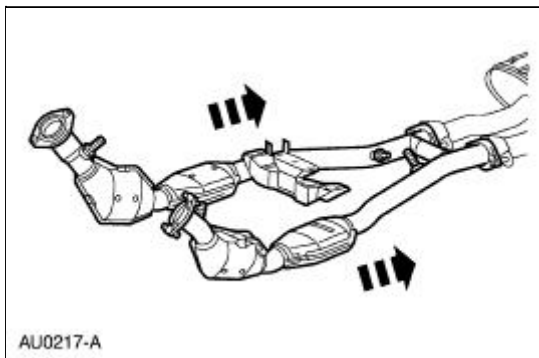
5. Remove the RH exhaust manifold flange nuts.



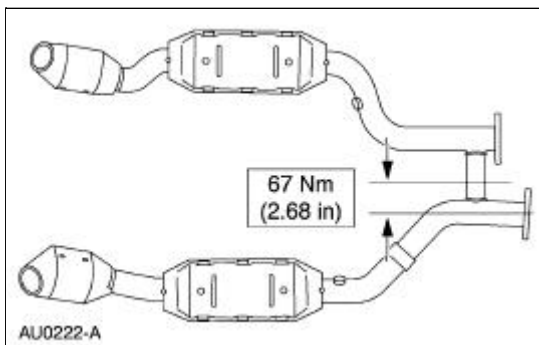
6. Remove the LH exhaust manifold flange nuts.



7. Remove the dual converter H-pipe.



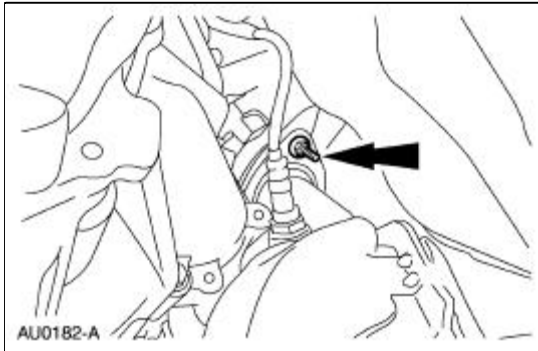
8. If necessary, use the center of the LH flange as a baseline, measure 67 mm (2.68 in) and cut the cross-over pipe.



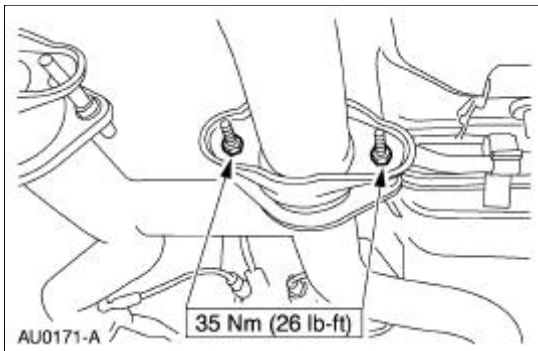
9. If necessary, use the center of the RH flange as a baseline, measure 83.9 mm (3.35 in) and cut the cross-over pipe.

Installation

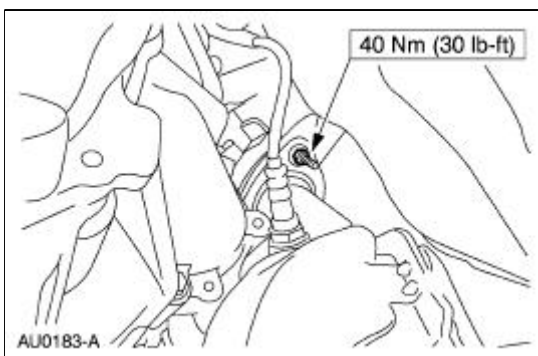
1. Position the LH and RH dual converter pipe.
 - Snug the converter-to-manifold nuts.



2. Position the muffler and install the dual converter assembly nuts. (RH shown, LH similar.)



3. If necessary, position the sleeve and clamps. Tighten the clamps to 55 Nm (41 lb-ft).
4. Tighten the four converter-to-manifold nuts.



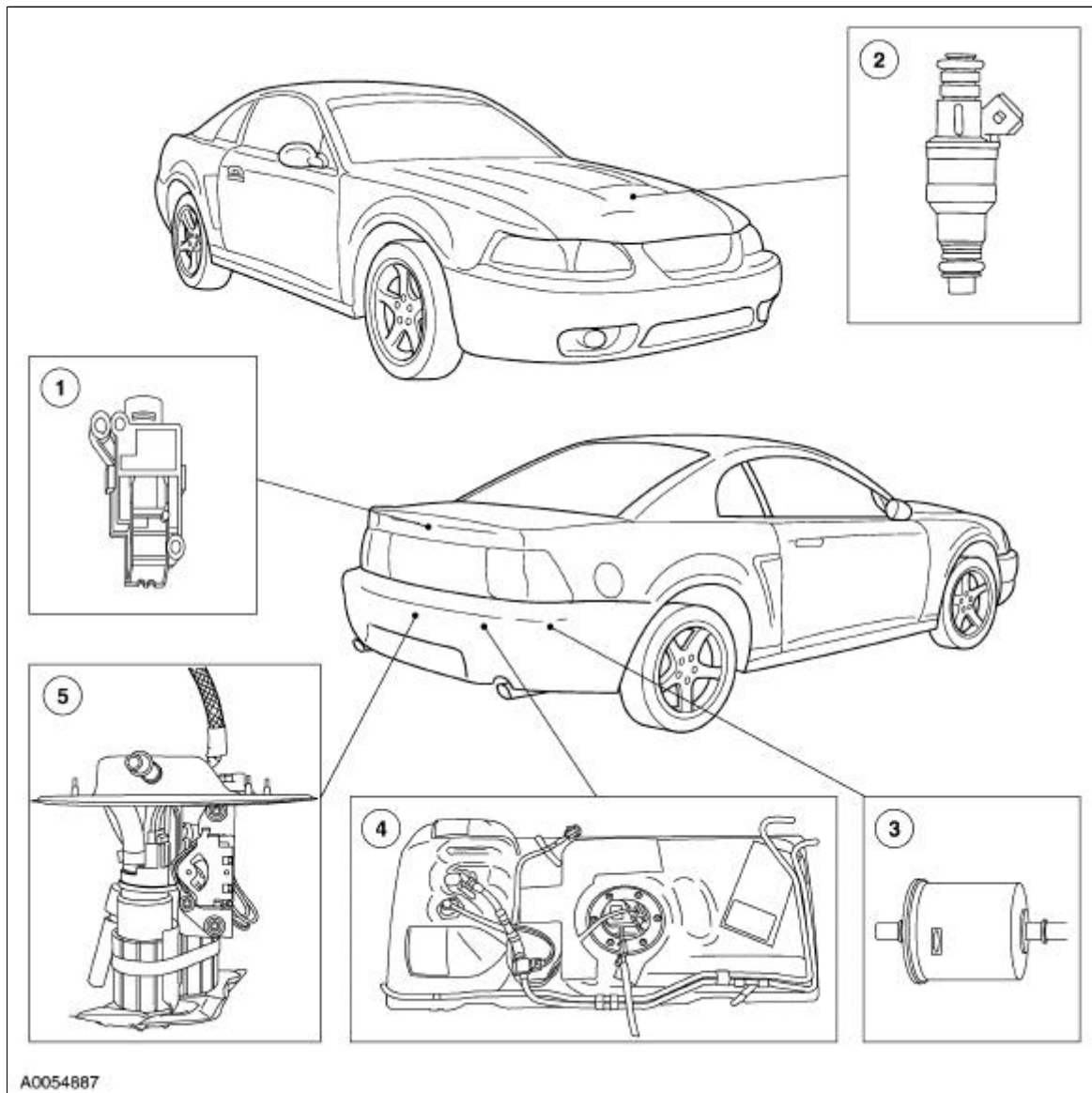
5. Connect the two upstream RH and LH heated oxygen sensor connectors.
 6. Connect the two downstream RH and LH catalyst monitor sensor connectors.
-

General Specifications

Item	Specification
Fuel tank capacity	59.42 liters (15.7 gallons)
Key on, engine off fuel pressure	207-345 kPa (30-50 psi)
Engine running fuel pressure (idle)	152-255 kPa (27-37 psi)
Lubricants	
SAE 5W-20 Super Premium Synthetic Blend Motor Oil XO-5W20-QSP	WSS-M2C153-H

Fuel System

Component Location



A0054887

Item	Part Number	Description
1	9341	Inertia fuel shutoff switch
2	9F593	Fuel injector
3	9155	Fuel filter
4	9002	Fuel tank
5	9H307	Fuel pump module and flange assembly

⚠ WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

The vehicle:

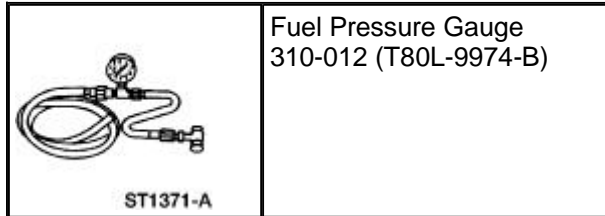
- uses a returnless fuel system.
 - is equipped with a multiport fuel injection (MFI) system.
 - uses separately controlled fuel injectors (9F593) for each cylinder. The fuel injectors are mounted to the intake manifold.
 - fuel injectors are supplied with pressurized fuel from the fuel pump (9350) through the fuel injection supply manifold (9D280).
 - fuel injection supply manifold is controlled by the electronic fuel delivery module which is enabled by the powertrain control module (PCM) (12A650).
-

Fuel System

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Pressure Relief

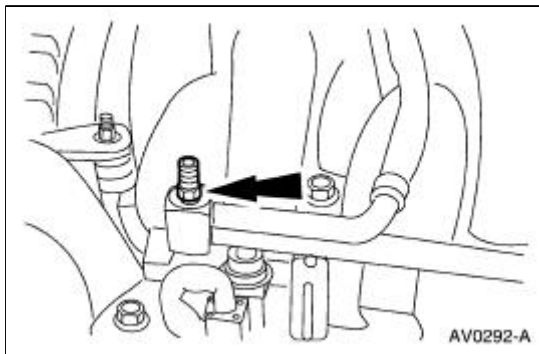
Special Tool(s)



⚠ WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

⚠ WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before servicing or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved to prevent accidental spraying of fuel, causing personal injury or a fire hazard.

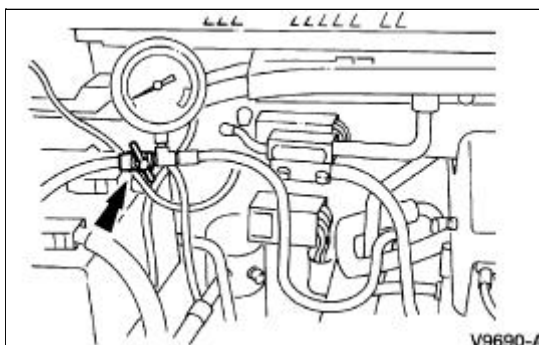
1. Remove the Schrader valve cap and install the Fuel Pressure Gauge.



2. **⚠ CAUTION:** Open the manual valve slowly on the Fuel Pressure Gauge.



Relieve the fuel pressure.


- Place the fuel in a suitable container.



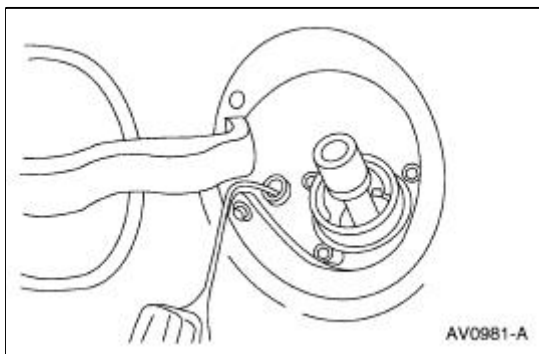
Fuel Tank Draining

Special Tool(s)

 ST1134-A	Fuel Storage Tanker 164-R3202 or equivalent
 ST2134-A	Fuel Tank Drain Hose 310-F013

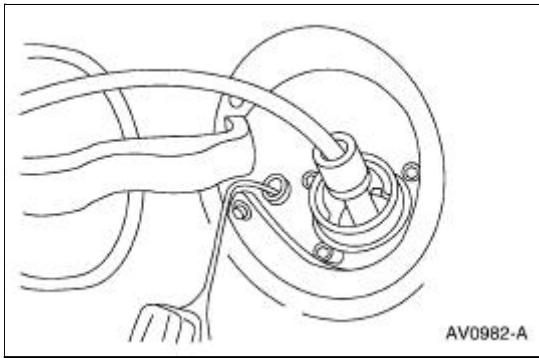
 **WARNING:** Do not smoke or carry lighted tobacco or an open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Remove the fuel tank filler cap.
3. Insert the hose guide into the filler neck.



4. **NOTE:** Insert the hose until the stop contacts the guide tube. If the stop does not contact the guide tube, remove the hose and repeat the procedure.



Insert the chamfered end of the hose into the filler neck through the guide tube.



5. Attach the Fuel Storage Tanker to the hose and remove the fuel.
 6. Remove the hose and the hose guide.
-

Spring Lock Couplings


Special Tool(s)


 ST1146-A	Disconnect Tool, Spring Lock Coupling (3/8 inch yellow) 310-D004 (D87L-9280-A) or equivalent
 ST1147-A	Disconnect Tool, Spring Lock Coupling (1/2 inch green) 310-D005 (D87L-9280-B) or equivalent

Material

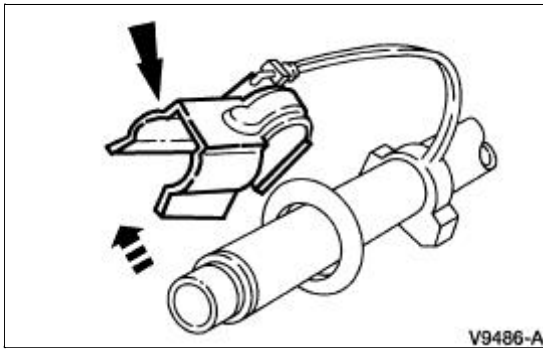
Item	Specification
SAE 5W-20 Super Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Disconnect

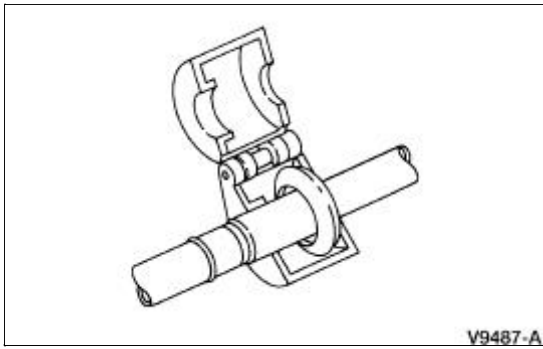
 **WARNING:** Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

 **WARNING:** Fuel in the fuel system remains under high pressure even when the engine is not running. Before servicing or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved to prevent accidental spraying of fuel, causing personal injury or a fire hazard.

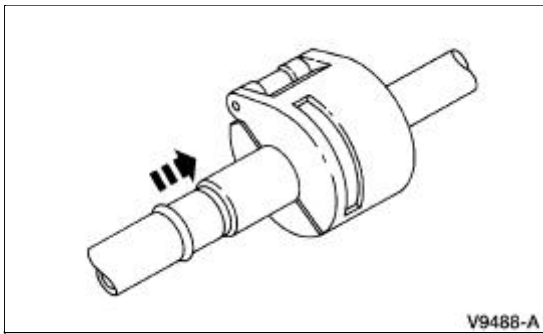
1. Relieve the fuel system pressure. For additional information, refer to [Pressure Relief](#) in this section.
2. Remove the fuel tube clip.



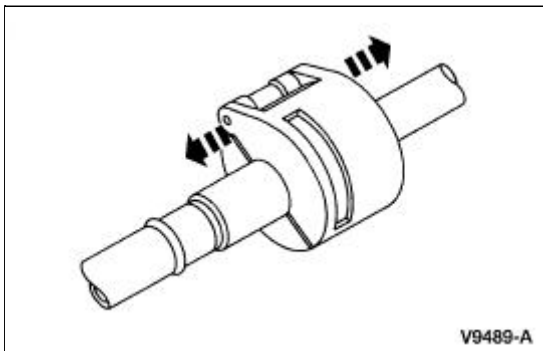
3. Install the Spring Lock Coupler Tool.



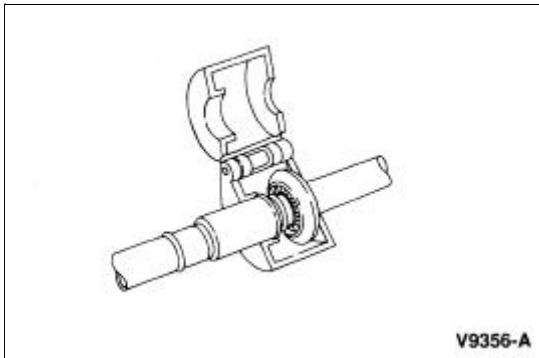
4. Close and push the Spring Lock Coupler Tool into the open side of the cage.



5. Separate the fitting.



6. Remove the Spring Lock Coupler Tool.

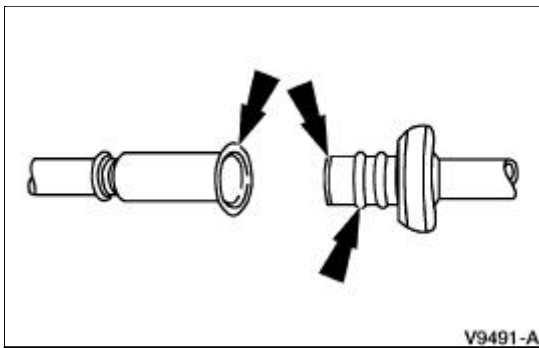


Connect

1. **NOTE:** Inspect and clean both the coupling ends. Lubricate the O-ring seals with clean engine oil.


Connect the fitting.

- Pull on the fitting to make sure it is fully engaged.
- Install the safety clip.



Fuel Line Fittings —Push Connect


Special Tool(s)


 ST1399-A	Disconnect Tool, Spring Lock Coupling 310-S039 (T90T-9550-S)
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Material

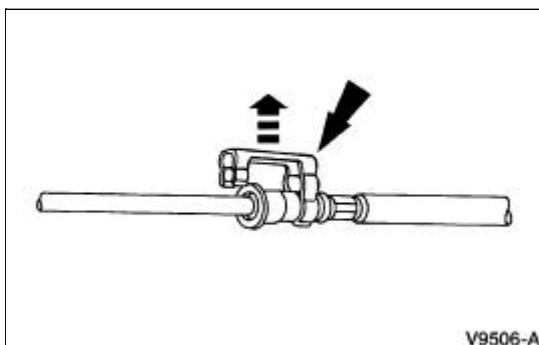
Item	Specification
SAE 5W-20 Super Premium Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Disconnect

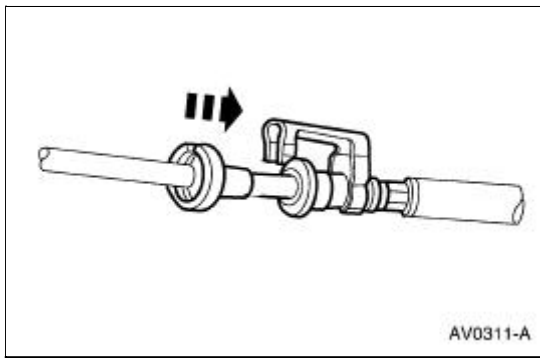
 **WARNING:** Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

 **WARNING:** Fuel in the fuel system remains under high pressure even when the engine is not running. Before servicing or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved to prevent accidental spraying of fuel, causing personal injury or a fire hazard.

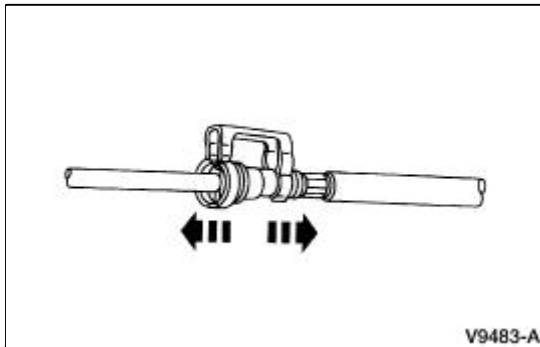
1. Relieve the fuel system pressure. For additional information, refer to [Pressure Relief](#) in this section.
2. Disconnect the safety clip from the male hose.



3. Install the Fuel Line Disconnect Set and push into the fitting.



4. Separate the fittings.
 - Clean and inspect the fittings for damage.

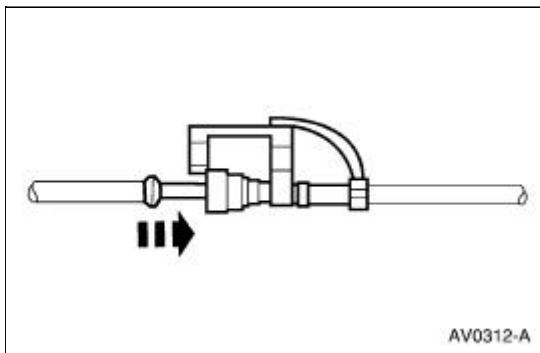


Connect

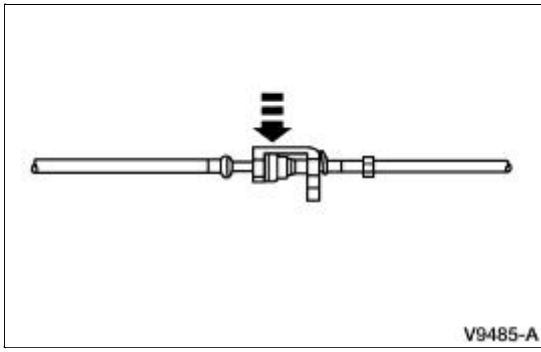
1. **NOTE:** Lubricate the tube end with clean engine oil to ease assembly.

Connect the fitting.

- Align the tube to the fitting and push until you hear a click.



2. Pull on the fitting to make sure it is fully engaged, then install the safety clip.





Fittings —R-Clip

Material

Item	Specification
SAE 5W-20 Super Premium Synthetic Blend Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

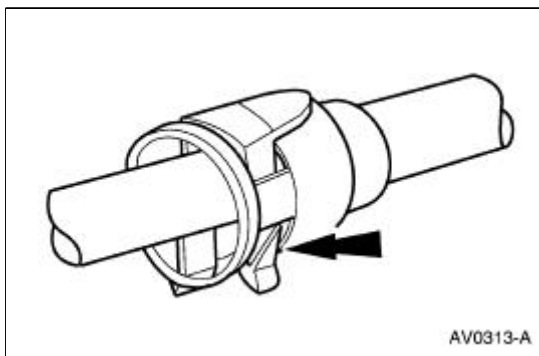
Disconnect

 **WARNING:** Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

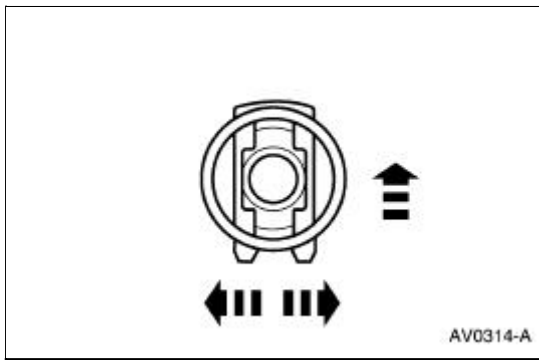
 **WARNING:** Fuel in the fuel system remains under high pressure even when the engine is not running. Before servicing or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved to prevent accidental spraying of fuel, causing possible personal injury or a fire hazard.

 **CAUTION:** Do not use any tools. The use of tools may cause a deformity in the clip components which may cause fuel leaks.

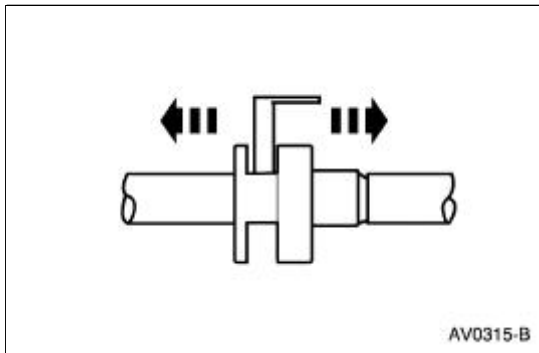
1. Relieve the fuel system pressure. For additional information, refer to [Pressure Relief](#) in this section.
2. Remove the shipping tab by bending.



3. Spread the R-clip legs and push the clip into the fitting.

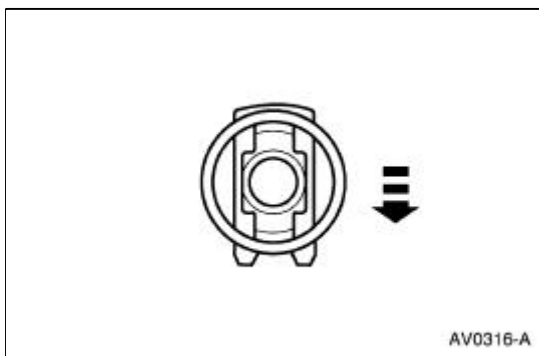


4. Separate the fitting from the tube.

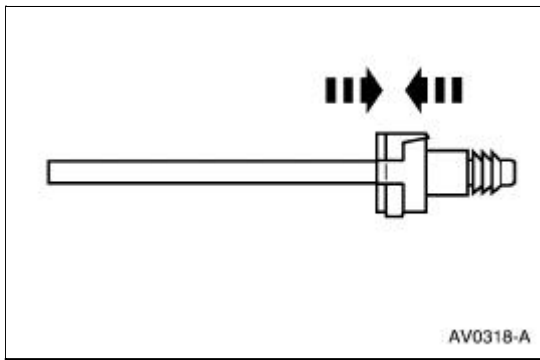


Connect

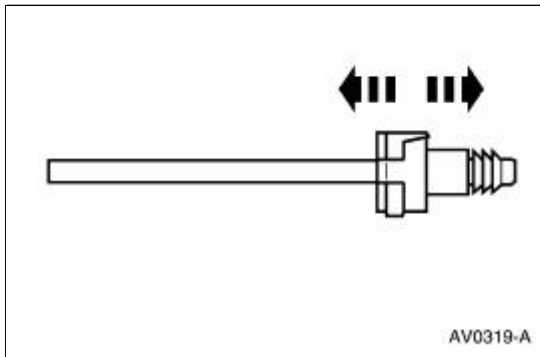
1. **NOTE:** Apply a light coat of clean engine oil.
Clean and inspect the fitting and the tube for damage.
2. Insert the R-clip into the fitting.



3. Insert the tube in the fitting and push together until a click is heard.




4. Pull on the connection to make sure it is fully engaged.



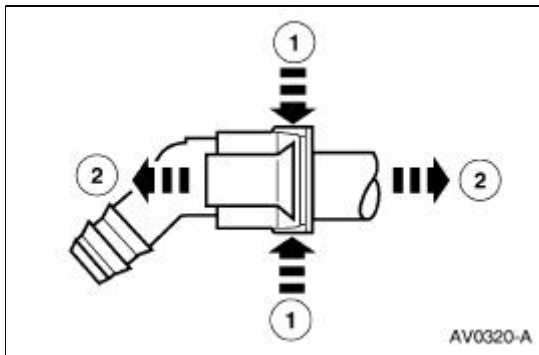
Fittings — Vapor Tube

Disconnect

1.  **WARNING:** The evaporative emission system contains fuel vapor and condensed fuel vapor. Although not present in large quantities, it still presents the danger of explosion or fire. Disconnect the battery ground cable from the battery to minimize the possibility of an electrical spark occurring, possibly causing a fire or explosion if fuel vapor or fuel liquid is present in the area.

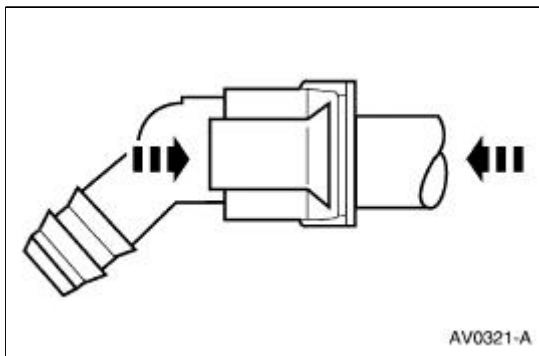
Disconnect the battery ground cable.

2. Disconnect the vapor tube from the fitting.
 1. Squeeze the fitting.
 2. Disconnect the vapor tube from the fitting.

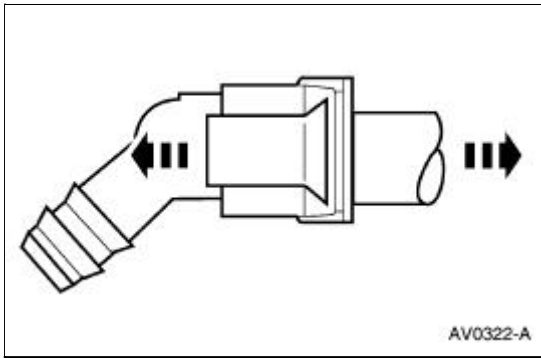


Connect

1. Clean and inspect the fitting and the tube for damage.
2. Push the tube into the fitting until it snaps in place.



3. Pull on the connection to make sure the fitting is secure.



General Specifications

Item	Specification
Lubricants	
Premium Long Life Grease XG-1-C or XG-1-K	ESA-M1C75-B
Serfactant (Merpol)	ESE-M99B144-B

Torque Specifications

Description	Nm	lb-ft	lb-in
Fuel tank support strap bolts	35	26	—
Fuel tank filler pipe support bracket bolt	8	—	71
Fuel delivery module bolts	10	—	89
Fuel filter bracket bolts	10	—	89

Fuel Tank And Lines



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

The vehicle utilizes a returnless fuel system consisting of:

- the fuel tank.
- a fuel tank filler pipe which contains a restrictor plate to permit only unleaded fuel to be pumped into the fuel tank.
- a 1/8 turn fuel tank filler cap.
- a fuel filter providing filtration to protect the fuel injectors.
- a single fuel line accommodating the returnless fuel system.
- a fuel injection supply manifold which contains a differential pressure sensor and a fuel temperature sensor.
- a fuel pump and sender assembly which provides pressurized fuel to the engine and contains:
 - an inlet filter.
 - a check valve which maintains system pressure after the pump is shut off.
 - a pressure relief valve for overpressure protection in the event of restricted flow.

The fuel pump is controlled by an electronic fuel pump driver module which is enabled by the powertrain control module (PCM). Electrical power to the fuel pump is provided through the inertia fuel shutoff (IFS) switch, which is located in the luggage compartment.

Fuel Tank And Lines

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Fuel Tank

Material

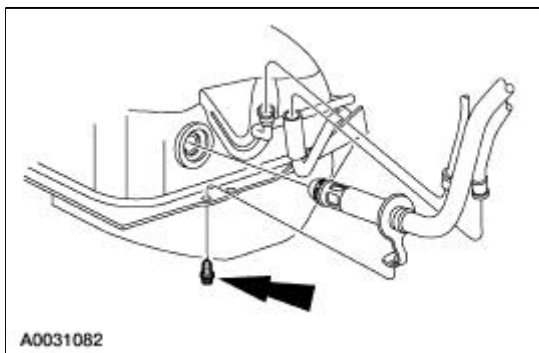
Item	Specification
Serfactant (Merpol)	ESE-M99B144-B

Removal

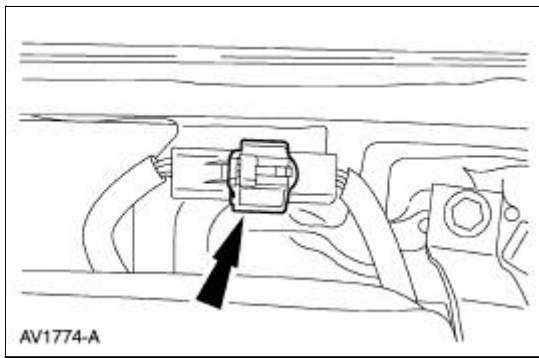
⚠ WARNING: Do not smoke, carry lighted tobacco or an open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited, possibly resulting in personal injury.

⚠ WARNING: Fuel supply lines on all vehicles equipped with fuel injected engines will remain pressurized for long periods of time after engine shutdown. Fuel system pressure must be relieved prior to fuel system service to prevent possible personal injury or a fire hazard.

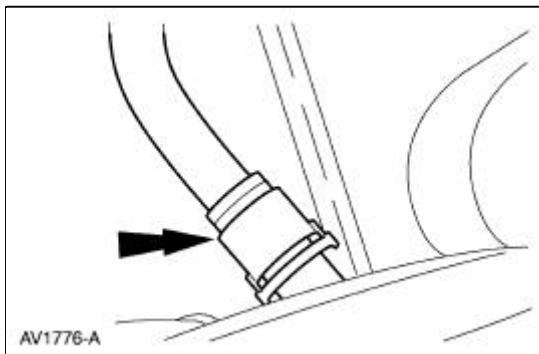
1. Disconnect the battery. For additional information, refer to [Section 414-01](#).
2. Relieve the fuel system pressure. For additional information, refer to [Section 310-00](#).
3. Drain the fuel tank. For additional information, refer to [Section 310-00](#).
4. Raise the vehicle. For additional information, refer to [Section 100-02](#).
5. Remove the filler pipe bolt and disconnect the filler pipe hose connections to the fuel tank.



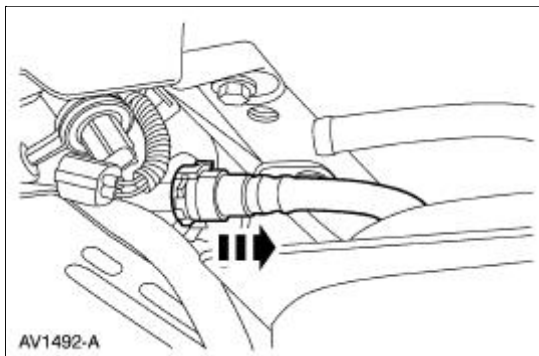
6. Disconnect the fuel tank electrical connector.



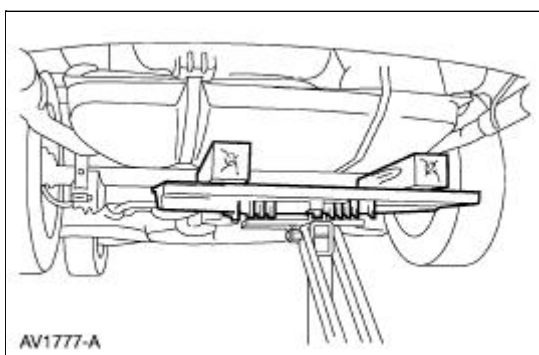
7. Disconnect the vapor tube fitting at the left front of the fuel tank.



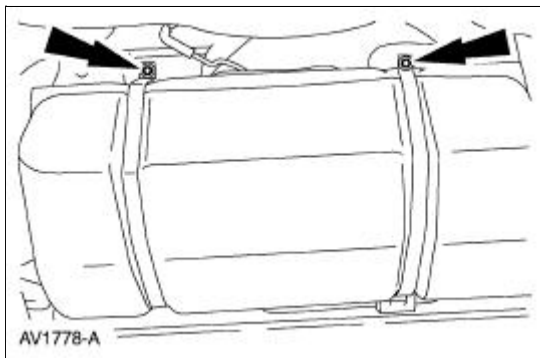
8. Disconnect the EVAP canister tube and hose.



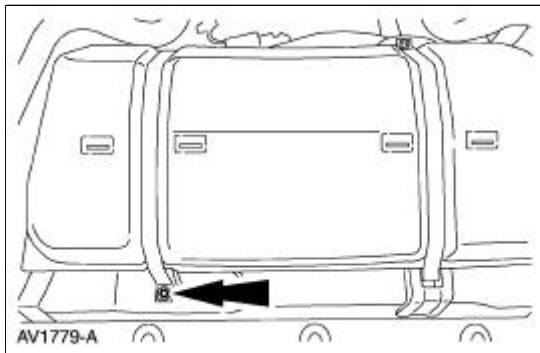
9. Place a safety support under the fuel tank.




10. Remove the front bolts from the fuel tank support straps and swing the LH strap out of the way.



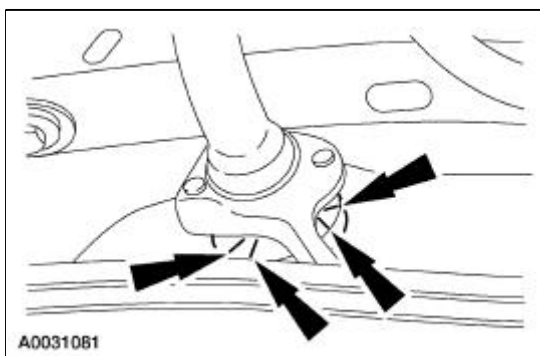
11. Remove the RH fuel tank support strap bolt and remove the strap.



12. Partially lower the fuel tank and disconnect the fuel line. For additional information, refer to [Section 310-00](#).


13.  **CAUTION: The filler pipe grommet must be removed prior to removing the fuel tank from the filler pipe or damage to the fill tube check valve will occur.**

Cut outer edge of pipe-to-tank grommet to facilitate pipe removal and carefully remove the grommet from the fuel tank. Take care to avoid damage to the filler pipe check valve.



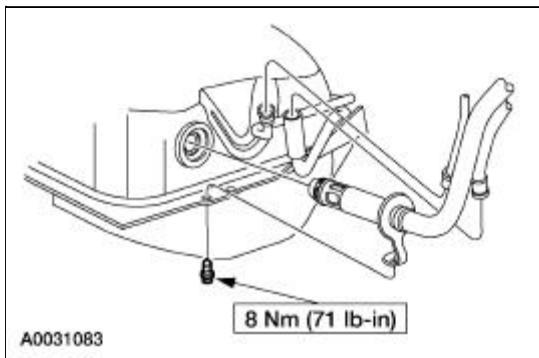
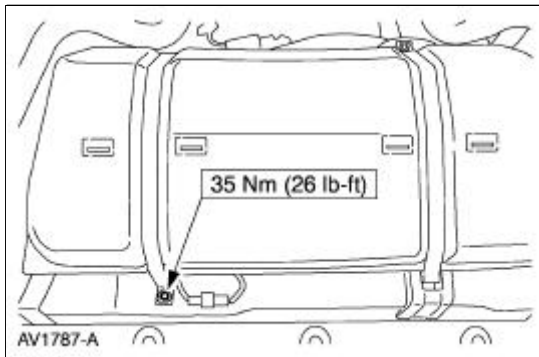
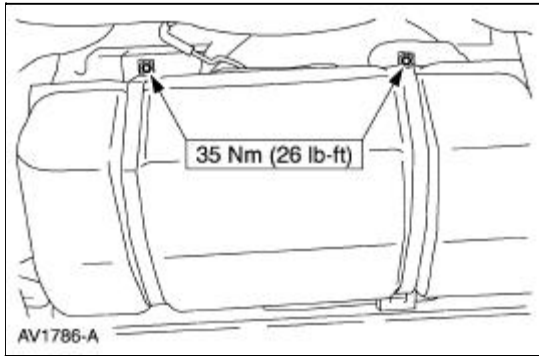
14. Lower the fuel tank from the vehicle.

Installation

1.  **CAUTION: Lubricate the filler pipe check valve area and the tank-to-filler pipe grommet with Serfactant prior to assembly or damage to the filler pipe check valve will occur.**


NOTE: A new grommet must be used for the installation procedure due to its destruction during removal.


To install, reverse the removal procedure.



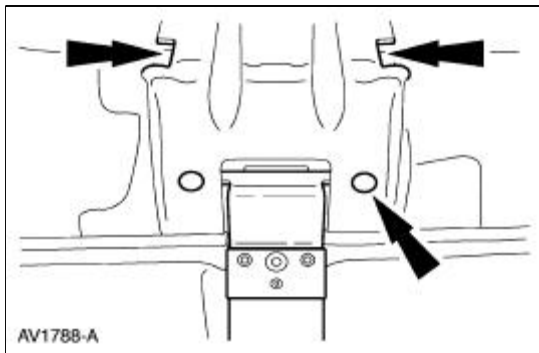
Support Straps

Removal

 **WARNING:** Do not smoke, carry lighted tobacco or an open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited, possibly resulting in personal injury.

 **WARNING:** Fuel supply lines on all vehicles equipped with fuel injected engines will remain pressurized for long periods of time after engine shutdown. Fuel system pressure must be relieved prior to fuel system service to prevent possible personal injury or a fire hazard.

1. Remove the fuel tank. For additional information, refer to [Fuel Tank](#) in this section.
2. Slide the strap and the retaining pin into the recess and remove the strap retaining pin.



3. Remove the strap.

Installation

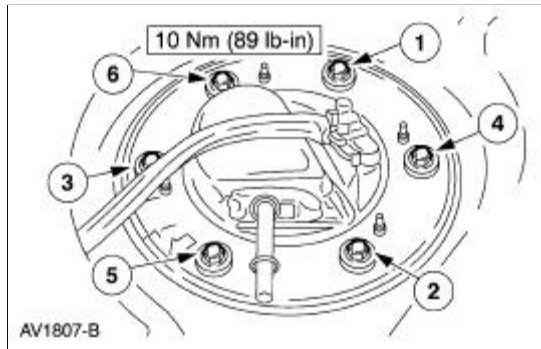
1. To install, reverse the removal procedure.
-

Fuel Pump Module

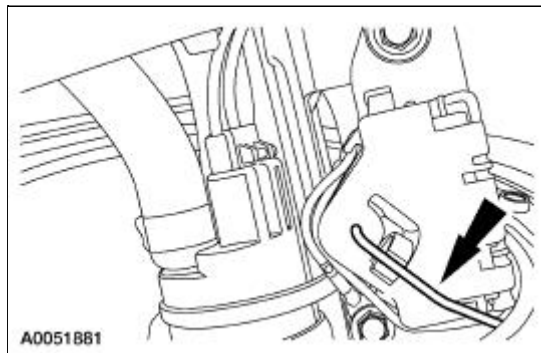
Removal and Installation

1. Remove the fuel tank. For additional information, refer to [Fuel Tank](#) in this section.
2. **NOTE:** For installation, tighten the bolts in the sequence shown.

Remove the module assembly flange bolts.



3. Clean the area around the fuel delivery module mounting flange.
4. Lift the fuel pump, carefully detach the fuel float arm and remove the fuel pump from the fuel tank.



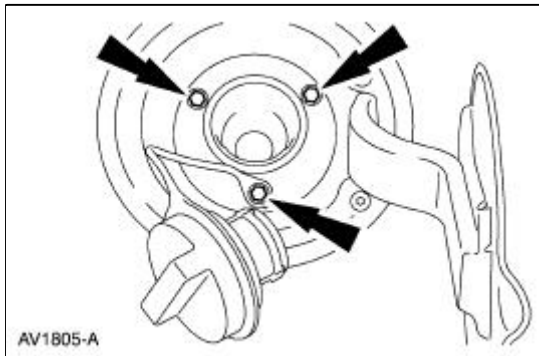
5. **NOTE:** Install a new fuel pump O-ring.

To install, reverse the removal procedure.

Fuel Tank Filler Pipe

Removal

1. Remove the fuel tank. For additional information, refer to [Fuel Tank](#) in this section.
2. Remove the bolts from the filler pipe housing.




3. Remove the bolts from the filler pipe rubber boot-to-floor pan.
4. Remove the hose attached to the upper part of the pipe.
5. Rotate the pipe downward to clear the filler pipe pocket and pull it into the trunk area.

Installation

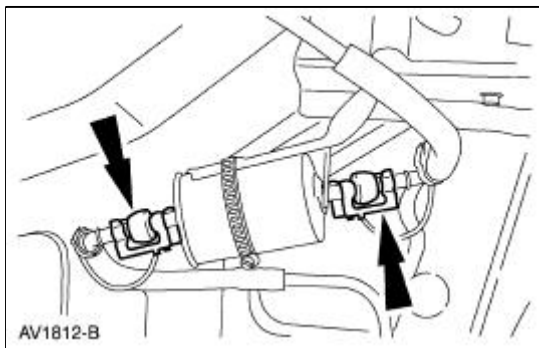
1. To install, reverse the removal procedure.
-

Fuel Filter

Removal

 **WARNING:** Fuel supply lines on all vehicles equipped with fuel injected engines will remain pressurized for long periods of time after engine shutdown. Fuel system pressure must be relieved prior to fuel system service to prevent possible personal injury or a fire hazard.

1. Disconnect the battery. For additional information, refer to [Section 414-01](#).
2. Relieve the fuel system pressure. For additional information, refer to [Section 310-00](#).
3. Raise the vehicle. For additional information, refer to [Section 100-02](#).
4. Disconnect the filter push connect fittings. For additional information, refer to [Section 310-00](#).
5. Unsnap the filter from the bracket and remove.



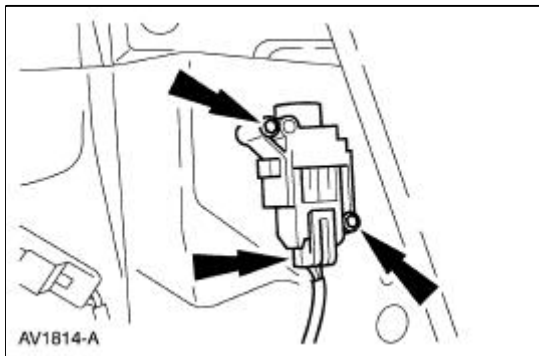
Installation

1. To install, reverse the removal procedure.
-

Inertia Fuel Shutoff (IFS) Switch

Removal

1. Disconnect the battery. For additional information, refer to [Section 414-01](#).
2. Open the luggage compartment.
3. Remove the inertia fuel shutoff (IFS) switch electrical connector and screws and remove the switch.

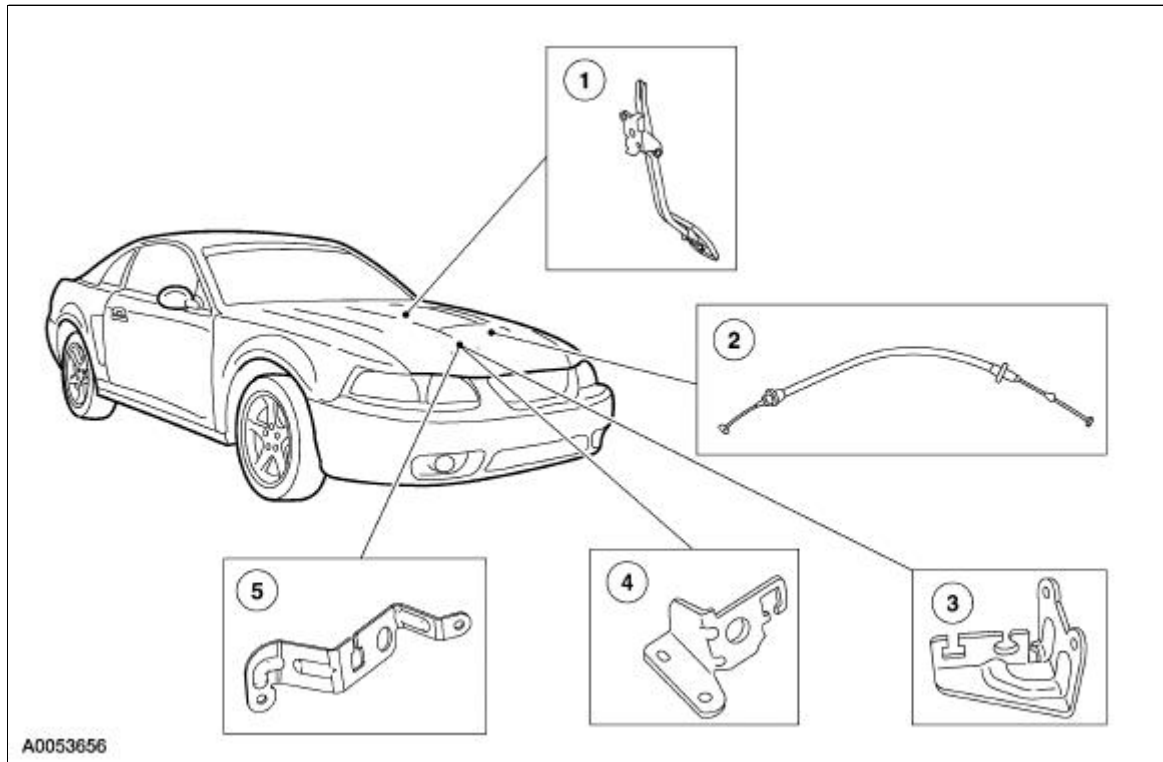


Installation

1. To install, reverse the removal procedure.
-

Acceleration Control

Component Locations



Item	Part Number	Description
1	9725	Accelerator pedal and shaft
2	9A758	Accelerator cable
3	9728	Accelerator cable bracket, 3.8L
4	9728	Accelerator cable bracket, 4.6L (2V)
5	—	Accelerator cable bracket, Supercharged engine

The throttle is controlled by the accelerator cable which is connected to the accelerator pedal and shaft.

- The accelerator pedal and shaft should travel smoothly from the idle to the wide-open throttle (WOT) positions. Hesitation on return or prevention of return to the idle position must not occur.
- Surrounding components such as wiring, hoses, sound insulator and floor covering must not contact the sliding inner member of the accelerator cable or the accelerator pedal and shaft.
- The sliding inner member of the accelerator cable should not be lubricated and is not serviceable.

Acceleration Control

Inspection and Verification

1. Verify the customer's concern by operating the acceleration control system to duplicate the condition.
2. Inspect to determine if any of the following mechanical concerns apply:

Visual Inspection Chart

Mechanical
<ul style="list-style-type: none"> ● damaged accelerator pedal and shaft ● damaged linkage ● damaged accelerator cable ● high engine idle speed ● damaged throttle body

3. If the inspection reveals an obvious concern that can be readily identified, repair as required.
4. If the concern remains after the inspection, determine the symptom(s) and GO to [Symptom Chart](#).

Symptom Chart

Symptom Chart

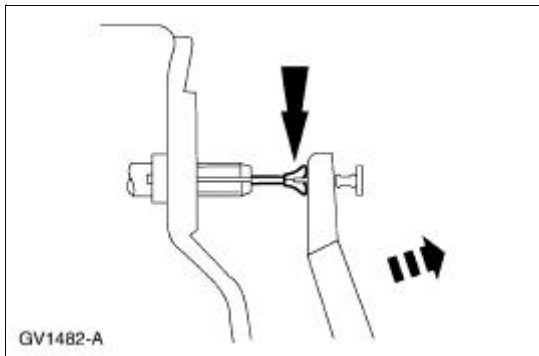
Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● Excessive effort needed to depress accelerator pedal and shaft 	<ul style="list-style-type: none"> ● Worn accelerator lever pivot bushing. ● Accelerator cable binding. ● Worn or damaged throttle body. 	<ul style="list-style-type: none"> ● INSTALL a new accelerator pedal and shaft. ● INSTALL a new accelerator cable. ● INSTALL a new throttle body. REFER to Section 303-04A or Section 303-04B.
<ul style="list-style-type: none"> ● Accelerator pedal and shaft feels rough or raspy 	<ul style="list-style-type: none"> ● Frayed or binding accelerator cable. ● Worn or damaged throttle body. 	<ul style="list-style-type: none"> ● INSTALL a new accelerator cable. ● INSTALL a new throttle body. REFER to Section 303-04A or Section 303-04B.
<ul style="list-style-type: none"> ● Accelerator pedal and shaft binds or sticks 	<ul style="list-style-type: none"> ● Kinked accelerator cable. 	<ul style="list-style-type: none"> ● INSTALL a new accelerator cable.

	<ul style="list-style-type: none"> ● Foreign object caught in accelerator pedal linkage. ● Worn or damaged throttle body. 	<ul style="list-style-type: none"> ● CHECK the accelerator pedal linkage. ● INSTALL a new throttle body. REFER to Section 303-04A or Section 303-04B.
<ul style="list-style-type: none"> ● High engine idle speed 	<ul style="list-style-type: none"> ● Kinked accelerator cable. ● Foreign object caught in accelerator pedal linkage. ● Incorrect engine idle speed. 	<ul style="list-style-type: none"> ● INSTALL a new accelerator cable. ● CHECK the accelerator pedal linkage. ● REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the idle control system.

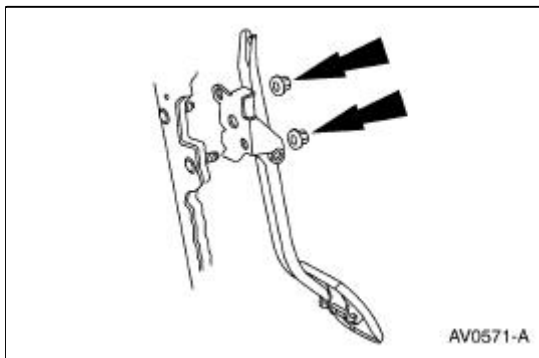
Accelerator Pedal and Shaft

Removal and Installation

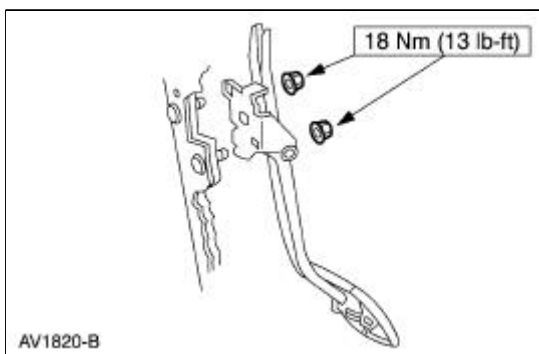
1. Push the accelerator cable nylon bushing out of the accelerator pedal and shaft arm.



2. Remove the accelerator pedal and shaft.
 - Remove the nuts.
 - Remove the accelerator pedal and shaft.



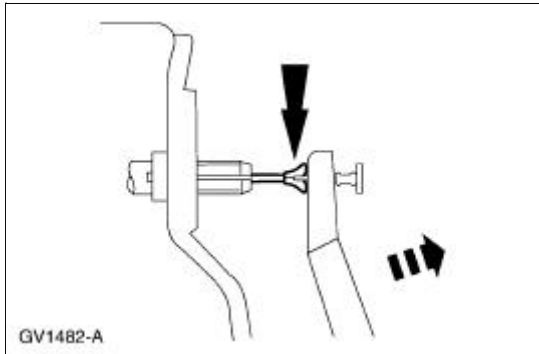
3. To install, reverse the removal procedure.



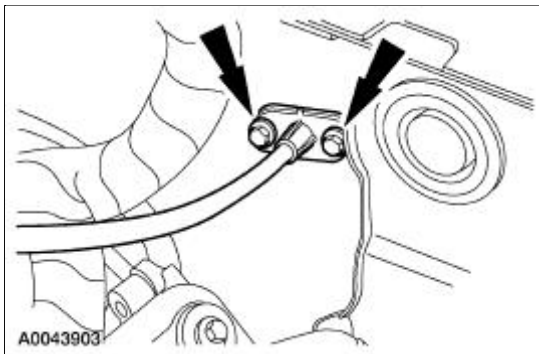
Accelerator Cable —3.8L

Removal and Installation

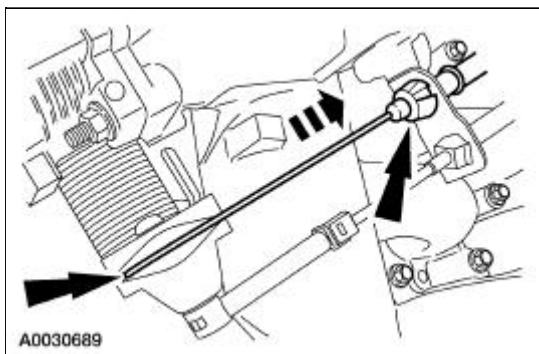
1. Push the accelerator cable nylon bushing out of the accelerator pedal and shaft arm.



2. Remove the bolts retaining the accelerator cable to the dash panel.



3. Disconnect the accelerator cable from the throttle body by rotating the throttle body full open and aligning the cable with the release slot.

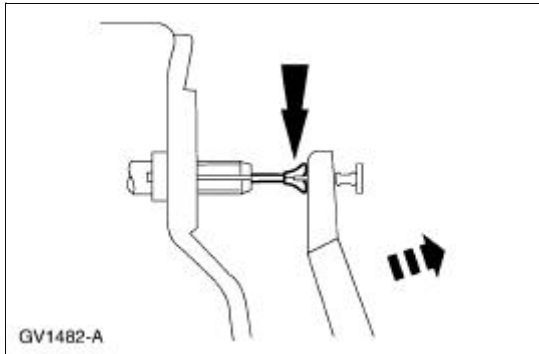


4. Disconnect the accelerator cable from the retaining bracket by compressing the locking tabs and back-feeding the cable through the bracket and out of the engine compartment.
5. To install, reverse the removal procedure.

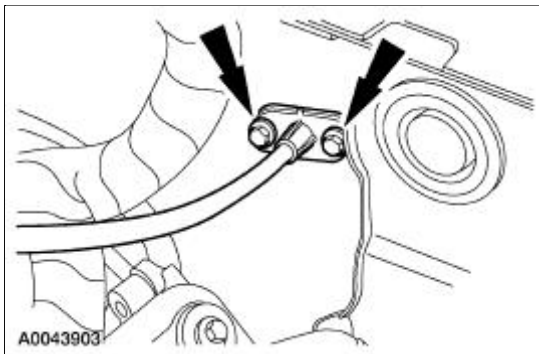
Accelerator Cable —4.6L (2V)

Removal and Installation

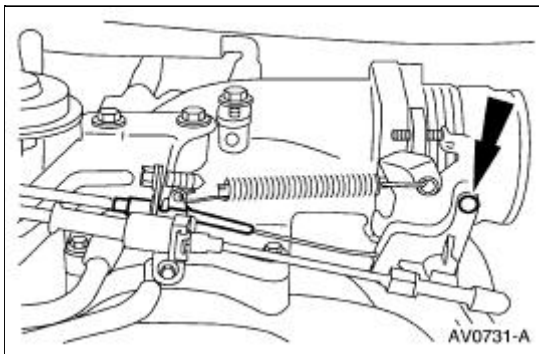
1. Push the accelerator cable nylon bushing out of the accelerator pedal and shaft arm.



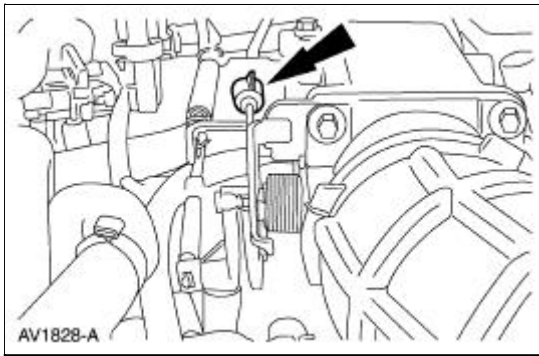
2. Remove the bolts retaining the accelerator cable to the dash panel.



3. Disconnect the accelerator cable from the throttle body by rotating the throttle body full open and aligning the cable with the release slot.



4. Disconnect the accelerator cable from the retaining bracket by compressing the locking tabs and back-feeding the cable through the bracket and out of the engine compartment.

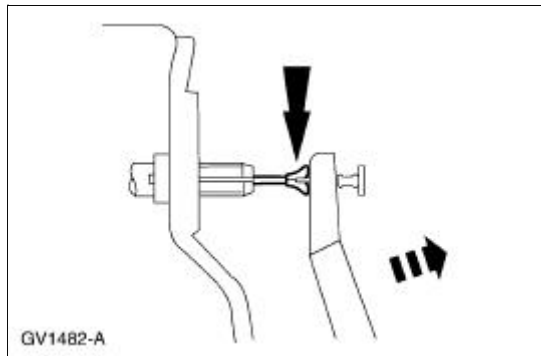


5. To install, reverse the removal procedure.
-

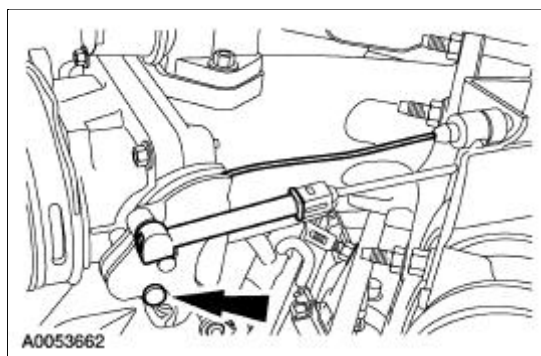
Accelerator Cable —Supercharged Engine

Removal and Installation

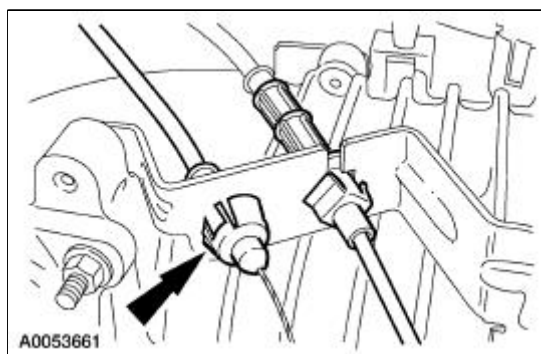
1. Push the accelerator cable nylon bushing out of the accelerator pedal and shaft arm.



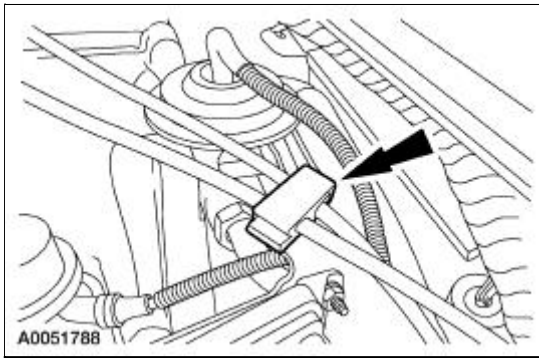
2. Disconnect the accelerator cable from the throttle cam.



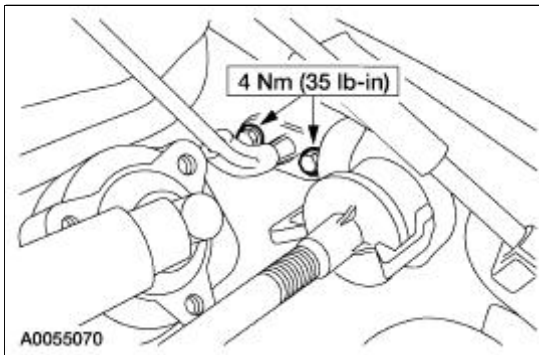
3. Depress the tabs and disconnect the accelerator cable from the bracket.



4. Release the clip and position the accelerator cable aside.



5. Remove the bolts and the accelerator cable.

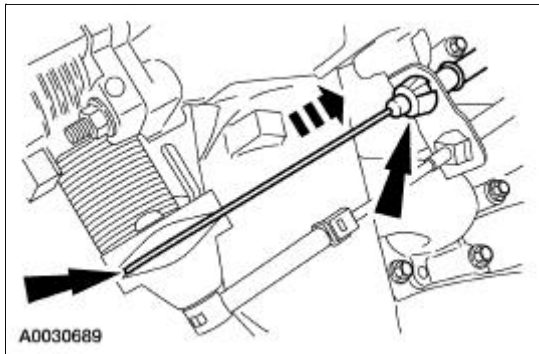


6. To install, reverse the removal procedure.
-

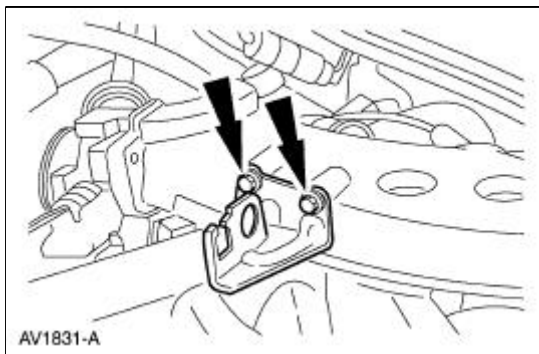
Accelerator Cable Bracket —3.8L

Removal and Installation

1. Disconnect the speed control cable from the throttle body and the bracket. For additional information, refer to [Section 310-03](#).
2. Disconnect the accelerator cable from the throttle body by rotating the throttle body full open and aligning the cable with the release slot.



3. Compress the accelerator cable locking tabs and disconnect the accelerator cable from the accelerator cable bracket.
4. Remove the bolts and the accelerator cable bracket.

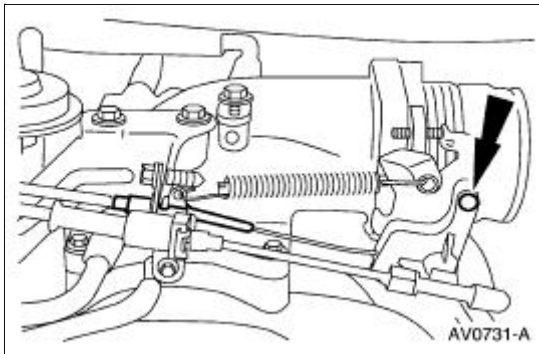


5. To install, reverse the removal procedure.

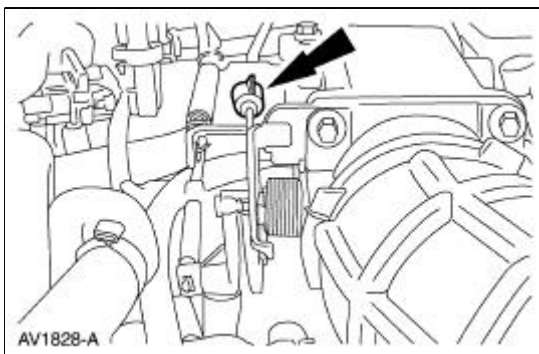
Accelerator Cable Bracket —4.6L (2V)

Removal and Installation

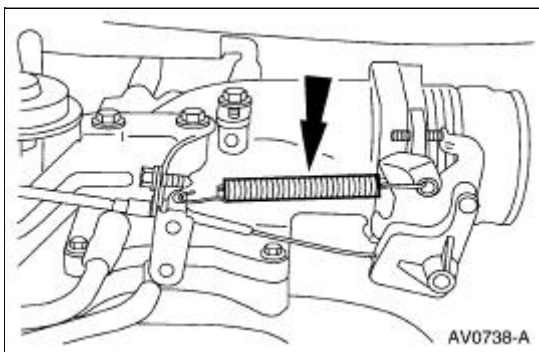
1. Disconnect the speed control cable from the throttle body and the bracket. For additional information, refer to [Section 310-03](#).
2. Disconnect the accelerator cable from the throttle body by rotating the throttle body full open and aligning the cable with the release slot.



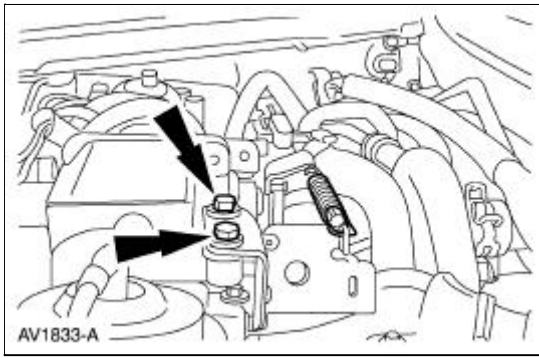
3. Compress the accelerator cable locking tabs and disconnect the accelerator cable from the accelerator cable bracket.



4. Remove the spring.



5. Remove the bolts and the accelerator cable bracket.

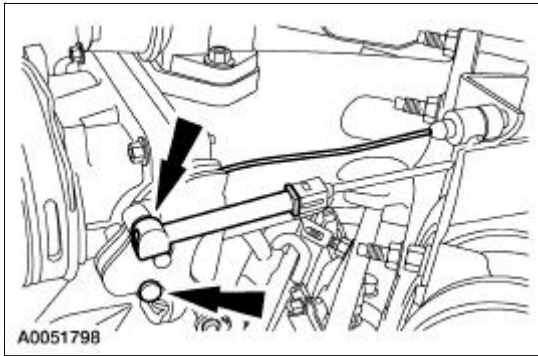


6. To install, reverse the removal procedure.

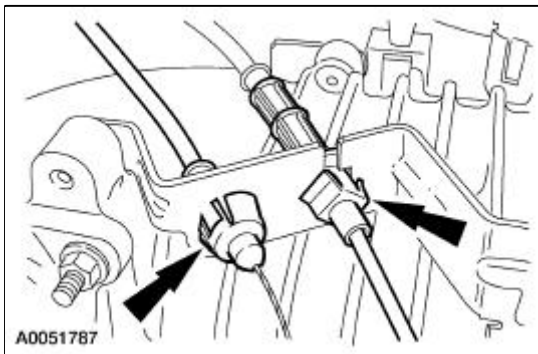
Accelerator Cable Bracket —Supercharged Engine

Removal and Installation

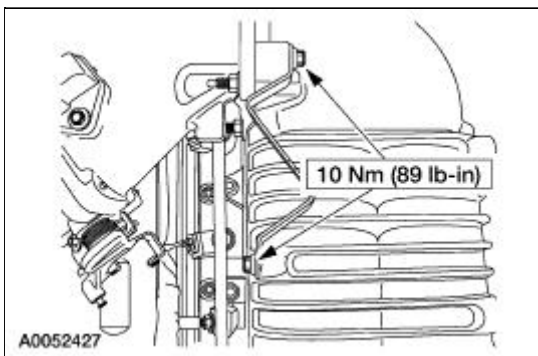
1. Disconnect the accelerator cable and speed control cable.



2. Depress the tabs and disconnect the accelerator cable and speed control cable from the accelerator cable bracket



3. Remove the bolts and the accelerator cable bracket.



4. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft	lb-in
Accelerator pedal and shaft nuts	18	13	—
Accelerator cable bracket (Supercharged engine)	10	—	89
Accelerator cable bolts (Supercharged engine)	4	—	35

Torque Specifications

Description	Nm	lb-ft	lb-in
Battery ground cable	7-10	—	62-89
Horn contact screws	6.5-7.5	—	58-66
Speed control actuator switch screws	6.5-7.5	4.8-5.5	—
Speed control servo bracket bolt	7	—	62

Speed Control



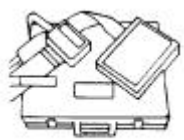
The speed control system consists of the following components:

- speed control actuator cable (9A825)
 - deactivator switch
 - output shaft sensor (OSS)
 - speed control actuator switches (9C888)
 - brake pedal position (BPP) switch (13480)
 - speed control servo (9C735)
 - clutch pedal position switch (manual transmission only)
-

Speed Control

Refer to Wiring Diagrams Cell [31](#), Speed Control for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool
 ST1137-A	73 Digital Multimeter or equivalent 105-R0051
 ST1391-A	Breakout Box, EEC-V Control System 418-049, or equivalent 014-00950

Principles of Operation

The speed control system is designed to maintain vehicle speed above 48 km/h (30 mph). After the ON switch is depressed, depressing the SET/ACCEL switch will activate the speed control servo. To increase a set speed, either depress and hold for continuous acceleration, or momentarily tap the SET/ACCEL switch for 1.6 km/h (1 mph) acceleration increments. To decrease a set speed, depress and hold the COAST switch until the target speed is reached, or momentarily tap the COAST switch for 1.6 km/h (1 mph) deceleration increments. When the speed control system has been disabled by tapping the brake pedal, the RESUME switch can be depressed and the vehicle will return to the original set speed if the vehicle is traveling over 48 km/h (30 mph) and the OFF switch has not been depressed.

NOTE: The deactivator switch is provided as an additional safety feature. Normally, when the brake pedal is depressed, an electrical signal from the brake lamp circuit to the speed control servo will deactivate the system. Under increased brake pedal effort, the deactivator switch will open and remove power to the speed control servo, releasing the throttle independent of the speed control servo.

NOTE: The air bag sliding contact provides the electrical interface between the steering column wiring and the speed control actuator switches in the steering wheel.

The inputs to the speed control servo are the:

- vehicle speed signal.

- speed control actuator switches.
- brake pedal position (BPP) switch.
- clutch pedal position (CPP) switch.
- deactivator switch.

The output of the speed control servo is the:

- speed control actuator cable controlling the throttle position.

Inspection and Verification

NOTE: If any concerns are noted with the speedometer, stoplamps, or horn, address those concerns by referring to their associated sections before continuing speed control diagnosis.

1. Verify the customer concern by operating the speed control system.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> ● Deactivator switch ● Speed control actuator cable not attached to throttle ● Speed control actuator cable not fully seated to the engine bracket 	<ul style="list-style-type: none"> ● Central junction box (CJB) Fuse: <ul style="list-style-type: none"> ■ 15 (15A) ■ 33 (15A) ■ 35 (15A) ● Battery junction box (BJB) fuse: <ul style="list-style-type: none"> ■ HORN (20A) ● Wiring harness ● Loose or corroded connections ● Speed control actuator switches

3. If the fault is not visually evident, verify the symptom and GO to the Symptom chart.

Symptom Chart

NOTE: New speed control diagnostic software is available in Version 12 or higher for the diagnostic tool. When using this software, it is necessary to use Next Generation Speed Control Adapter 007-00586 with the diagnostic tool.

NOTE: Refer to the Wiring Diagrams for connector numbers stated in the Pinpoint Test.

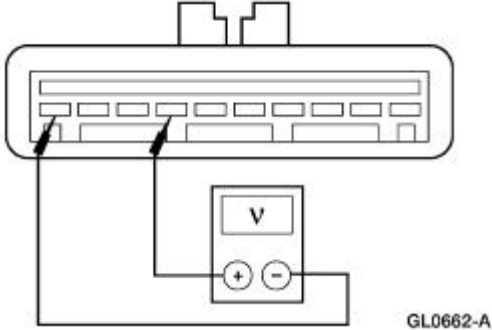
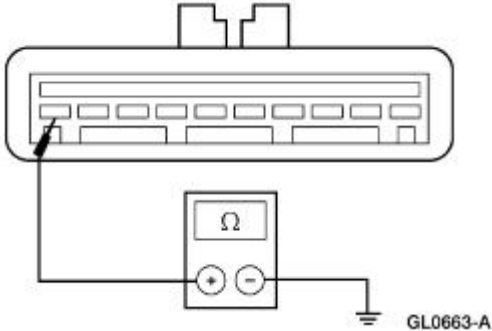
Symptom Chart

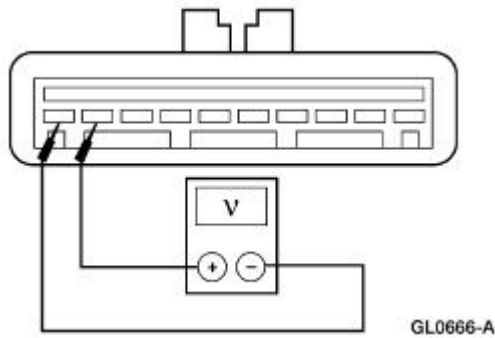
Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● The speed control is 	<ul style="list-style-type: none"> ● Central junction 	<ul style="list-style-type: none"> ● Go To Pinpoint Test A.

<p>inoperative</p>	<p>box (CJB) fuse 17 (15A), 33 (15A).</p> <ul style="list-style-type: none"> ● Battery junction box (BJB) fuse HORN (20A). ● Circuitry. ● Deactivator switch. ● Clutch pedal position (CPP) switch. ● Speed control actuator switch. ● Speed control servo. ● Powertrain control module (PCM). 	
<ul style="list-style-type: none"> ● The set speed fluctuates 	<ul style="list-style-type: none"> ● Circuitry. ● Speed control servo. ● Powertrain control module (PCM). ● Engine. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test B . ● REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
<ul style="list-style-type: none"> ● The speed control does not disengage when the brakes are applied 	<ul style="list-style-type: none"> ● Central junction box (CJB) fuse 33 (15A). ● Circuitry. ● Brake pedal position (BPP) switch. ● Speed control servo. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test C .
<ul style="list-style-type: none"> ● The speed control does not disengage when the clutch is applied 	<ul style="list-style-type: none"> ● Clutch pedal position (CPP) switch. ● Speed control servo. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test D .
<ul style="list-style-type: none"> ● The speed control switch is inoperative— COAST 	<ul style="list-style-type: none"> ● Speed control actuator switch. ● Speed control servo. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test E .
<ul style="list-style-type: none"> ● The speed control switch is inoperative— SET/ACCEL 	<ul style="list-style-type: none"> ● Speed control actuator switch. ● Speed control servo. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test F .
<ul style="list-style-type: none"> ● The speed control switch is inoperative— RESUME 	<ul style="list-style-type: none"> ● Speed control actuator switch. ● Speed control servo. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test G .
<ul style="list-style-type: none"> ● The speed control switch is inoperative—OFF 	<ul style="list-style-type: none"> ● Speed control actuator switch. ● Speed control servo. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test H .

Pinpoint Tests

PINPOINT TEST A: THE SPEED CONTROL IS INOPERATIVE

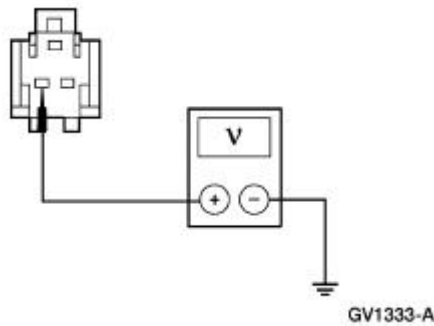
Test Step	Result / Action to Take
<p>A1 CHECK THE SPEED CONTROL SERVO VOLTAGE AND GROUND</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Speed Control Servo C122. ● Key in ON position. ● Measure the voltage between speed control servo C122 Pin 7, Circuit 294 (WH/LB), harness side and speed control servo C122 Pin 10, Circuit 1205 (BK), harness side.  <ul style="list-style-type: none"> ● Is voltage greater than 10 volts? 	<p>Yes GO to A3.</p> <p>No GO to A2.</p>
<p>A2 CHECK THE CIRCUIT 1205 (BK) FOR AN OPEN</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Measure the resistance between speed control servo C122 Pin 10, Circuit 1205 (BK), harness side and ground.  <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes REPAIR Circuit 294 (WH/LB). TEST the system for normal operation.</p> <p>No REPAIR Circuit 1205 (BK). TEST the system for normal operation.</p>
<p>A3 CHECK DEACTIVATOR SWITCH CIRCUITRY</p> <ul style="list-style-type: none"> ● Measure the voltage between speed control servo C122 Pin 9, Circuit 636 (OG), harness side and speed control servo C122 Pin 10, Circuit 1205 (BK), harness side. 	<p>Yes GO to A6.</p> <p>No GO to A4.</p>



- Is the voltage greater than 10 volts?

A4 CHECK CIRCUIT 10 (LG/RD) FOR AN OPEN

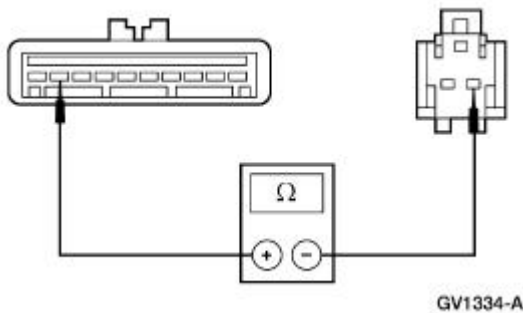
- Disconnect: Deactivator Switch C2210.
- Measure the voltage between deactivator switch C2210 Pin 1, Circuit 10 (LG/RD), harness side and ground.



- Is the voltage greater than 10 volts?

A5 CHECK CIRCUIT 636 (OG) FOR AN OPEN

- Measure the resistance between speed control servo C122 Pin 9, Circuit 636 (OG), harness side and deactivator switch C2210 Pin 2, Circuit 636 (OG), harness side.



- Is the resistance less than 5 ohms?

A6 CHECK THE SPEED CONTROL ACTUATOR SWITCH ON CIRCUITRY

- Measure the voltage between speed control servo C122 Pin 5, Circuit 151 (LB/BK), harness side and speed control servo C122 Pin 10, Circuit 1205 (BK), harness side, while the speed control actuator switch ON is depressed.

Yes
GO to [A5](#).

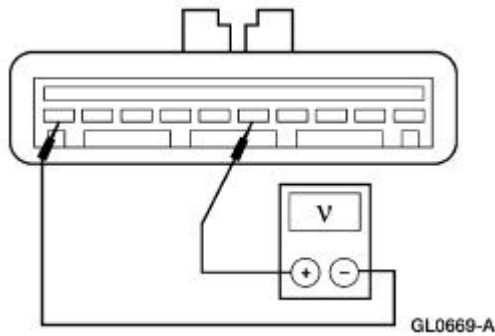
No
REPAIR the circuit.
TEST the system for normal operation.

Yes
INSTALL a new deactivator switch; REFER to [Switch—Deactivator](#). TEST the system for normal operation.

No
REPAIR the circuit.
TEST the system for normal operation.

Yes
GO to [A9](#).

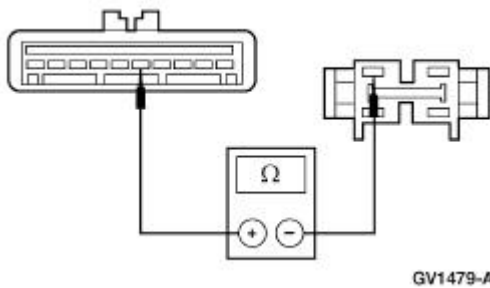
No
GO to [A7](#).



- Is the voltage greater than 10 volts?

A7 CHECK CIRCUIT 151 (LB/BK) FOR AN OPEN

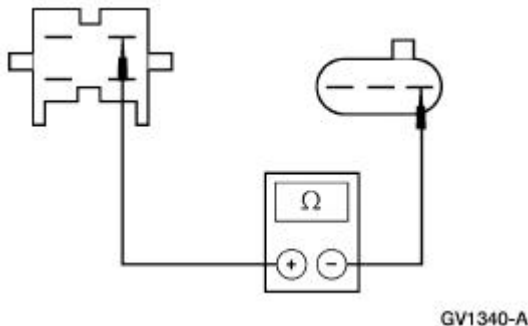
- Disconnect: Air Bag Sliding Contact C218a.
- Measure the resistance between speed control servo C122 Pin 5, Circuit 151 (LB/BK), harness side and air bag sliding contact C218a Pin 4, Circuit 151 (LB/BK), harness side.



- Is the resistance less than 5 ohms?

A8 CHECK THE AIR BAG SLIDING CONTACT

- Remove the air bag; REFER to [Section 501-20B](#).
- Disconnect: Speed Control Actuator Switch.
- Measure the resistance between bottom of air bag sliding contact Pin 1 (component side) and top of air bag sliding contact Pin 3 (component side).



- Is the resistance less than 5 ohms?

A9 CHECK THE SPEED CONTROL ACTUATOR SWITCH ON CIRCUITRY FOR SHORT TO POWER

- Key in ON position.
- Measure the voltage between speed control servo C122 Pin 5, Circuit 151 (LB/BK), harness side and speed control servo C122 Pin 10, Circuit 1205 (BK), harness side.

Yes
GO to [A8](#).

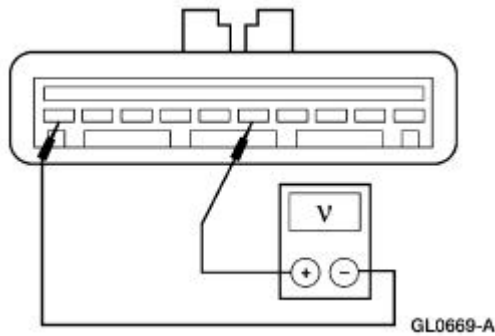
No
REPAIR the circuit.
TEST the system for normal operation.

Yes
INSTALL a new speed control actuator switch; REFER to [Switch—Speed Control Actuator](#). TEST the system for normal operation.

No
INSTALL a new air bag sliding contact; REFER to [Section 501-20B](#). TEST the system for normal operation.

Yes
GO to [A10](#).

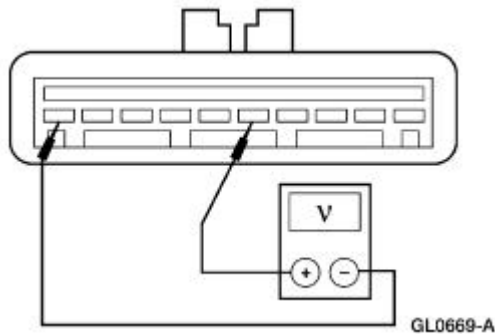
No
GO to [A12](#).



- Is any voltage present?

A10 CHECK CIRCUIT 151 (LB/BK) FOR SHORT TO POWER

- Key in OFF position.
- Disconnect: Air Bag Sliding Contact C218a.
- Key in ON position.
- Measure the voltage between speed control servo C122 Pin 5, Circuit 151 (LB/BK), harness side and speed control servo C122 Pin 10, Circuit 1205 (BK), harness side.



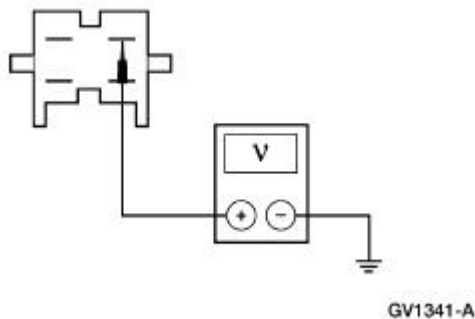
- Is any voltage present?

Yes
REPAIR the circuit.
TEST the system for normal operation.

No
GO to [A11](#).

A11 CHECK THE AIR BAG SLIDING CONTACT

- Key in OFF position.
- Remove the air bag; REFER to [Section 501-20B](#).
- Disconnect: Speed Control Actuator Switch.
- Key in ON position.
- Measure the voltage between bottom of air bag sliding contact Pin 1 (component side) and ground.



- Is any voltage present?

Yes
INSTALL a new air bag sliding contact; REFER to [Section 501-20B](#).
TEST the system for normal operation.

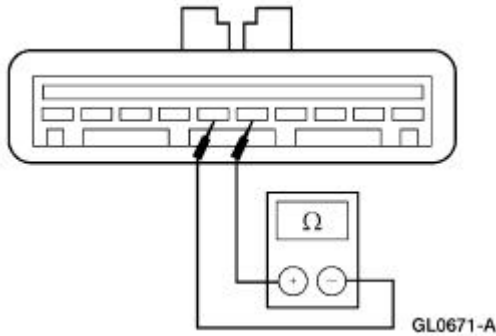
No
INSTALL a new speed control actuator switch; REFER to [Switch—Speed Control Actuator](#). TEST the system for normal operation.

A12 CHECK THE SPEED CONTROL ACTUATOR SET/ACCEL CIRCUITRY

- Key in OFF position.
- Measure the resistance between speed control servo C122 Pin 5, Circuit 151 (LB/BK), harness side and speed control servo C122 Pin 6, Circuit 848 (DG/OG), harness side, while the speed control actuator switch SET/ACCEL is depressed.

Yes
GO to [A13](#).

No
INSTALL a new speed control actuator switch;

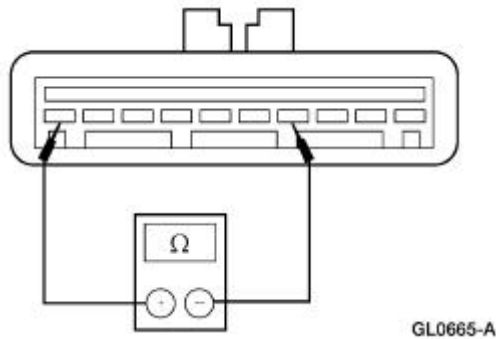


- Is the resistance between 612 and 748 ohms?

REFER to [Switch—Speed Control Actuator](#) . TEST the system for normal operation.

A13 CHECK THE BPP SWITCH CIRCUITRY

- Measure the resistance between speed control servo C122 Pin 4, Circuit 511 (LG), harness side, and speed control servo C122 Pin 10, Circuit 1205 (BK), harness side.



- Is the resistance less than 20 ohms?

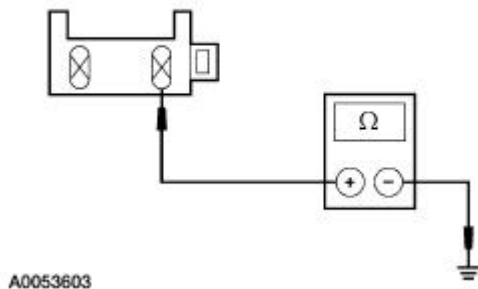
Yes
GO to [A16](#) .

No
If automatic transmission, REPAIR Circuit 511 (LG) and Circuit 810 (LG/RD) as necessary. TEST the system for normal operation.

If manual transmission, GO to [A14](#) .

A14 CHECK CIRCUIT 511 (LG) AND CIRCUIT 810 (RD/LG) FOR AN OPEN

- Disconnect: CPP Switch C2072.
- Measure the resistance between CPP Switch C2072 Pin 1, Circuit 511 (LG), harness side and ground.



- Is the resistance less than 20 ohms?

Yes
GO to [A15](#) .

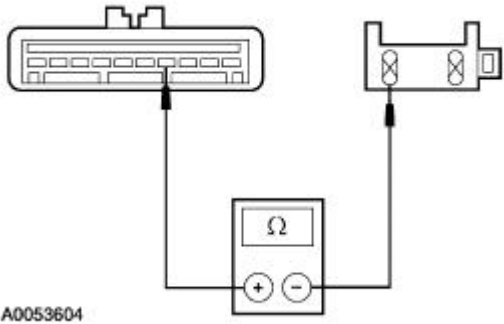
No
REPAIR Circuit 511 (LG) and Circuit 810 (LG/RD) as necessary. TEST the system for normal operation.

A15 CHECK CIRCUIT 511 (LG) FOR AN OPEN

- Measure the resistance between speed control servo C122 Pin 4, Circuit 511 (LG), harness side and CPP switch C2072 Pin 2, Circuit 511 (LG), harness side.

Yes
INSTALL a new CPP switch. TEST the system for normal operation.

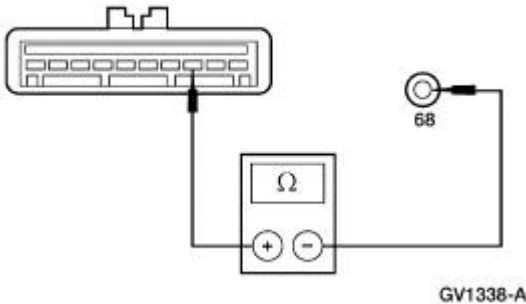
No
REPAIR the circuit. TEST the system for normal operation.



- Is the resistance less than 5 ohms?

A16 CHECK CIRCUIT 239 (WH/OG) FOR AN OPEN

- Disconnect: PCM C175.
- Connect EEC-V 104-Pin Breakout Box.
- Measure the resistance between speed control servo C122 pin 3, circuit 239 (WH/OG), harness side and Breakout Box, EEC-V Control System pin 68, circuit 239 (WH/OG), harness side.



- Is the resistance less than 5 ohms?

Yes
GO to [A17](#).

No
REPAIR the circuit.
TEST the system for normal operation.

A17 CHECK THE SPEED CONTROL SERVO

- INSTALL a known good speed control servo.
- Test drive the vehicle for correct operation.
- Does the speed control operate correctly?

Yes
INSTALL a new speed control servo; REFER to [Actuator—Speed Control Servo](#). TEST the system for normal operation.

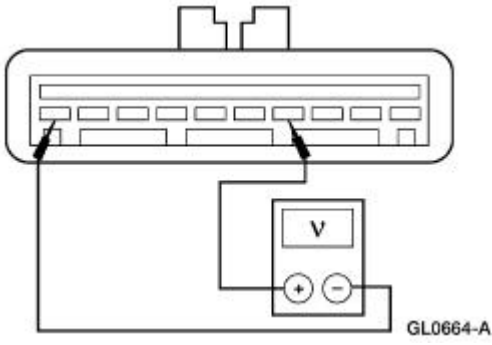
No
INSTALL a new PCM; REFER to [Section 303-14](#). TEST the system for normal operation.

PINPOINT TEST B: THE SET SPEED FLUCTUATES

Test Step	Result / Action to Take
B1 CHECK THAT CONDITION OCCURS ONLY WHILE USING SPEED CONTROL	
<ul style="list-style-type: none"> ● Check that the condition does not occur when driving without speed control. ● Does the condition occur without speed control? 	<p>Yes REPAIR engine as necessary. TEST the system for normal operation.</p> <p>No GO to B2.</p>

<p>B2 CHECK THE SPEED CONTROL ACTUATOR CABLE</p> <ul style="list-style-type: none"> ● NOTE: The speed control actuator cable must be disconnected at both ends while carrying out this test. ● Check the speed control actuator cable for sticking or binding at the speed control servo and throttle body. ● Is the speed control actuator cable OK? 	<p>Yes GO to B3.</p> <p>No INSTALL a new speed control actuator cable; REFER to Actuator Cable—Speed Control. TEST the system for normal operation.</p>
<p>B3 CHECK THE SPEED CONTROL SERVO</p> <ul style="list-style-type: none"> ● INSTALL a known good speed control servo. ● Test drive the vehicle for correct operation. ● Does the speed control operate correctly? 	<p>Yes INSTALL a new speed control servo; REFER to Actuator—Speed Control Servo. TEST the system for normal operation.</p> <p>No INSTALL a new PCM; REFER to Section 303-14. TEST the system for normal operation.</p>

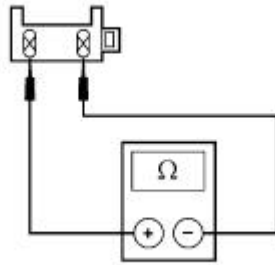
PINPOINT TEST C: THE SPEED CONTROL DOES NOT DISENGAGE WHEN THE BRAKES ARE APPLIED

Test Step	Result / Action to Take
<p>C1 CHECK THE BPP SWITCH CIRCUITRY</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Speed Control Servo C122 . ● Measure the voltage between speed control servo C122 Pin 4, Circuit 511 (LG), harness side and speed control servo C122 Pin 10, Circuit 1205 (BK), harness side, while depressing the brake pedal.  <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes INSTALL a new speed control servo; REFER to Actuator—Speed Control Servo . TEST the system for normal operation.</p> <p>No REPAIR Circuit 810 (RD/LG) and Circuit 511 (LG) as necessary. TEST the system for normal operation.</p>

PINPOINT TEST D: THE SPEED CONTROL DOES NOT DISENGAGE WHEN THE CLUTCH IS APPLIED

Test Step	Result / Action to Take
<p>D1 CHECK THE CLUTCH PEDAL POSITION (CPP) SWITCH</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: CPP Switch C2072. ● Measure the resistance between CPP switch pin 2 (component side) and CPP switch pin 1 (component side), 	<p>Yes INSTALL a new speed control servo; REFER to Actuator—Speed Control</p>

while depressing and releasing clutch pedal.



GV1339-A

- Is the resistance greater than 10,000 ohms with the clutch pedal depressed and less than 5 ohms with the clutch pedal released?

[Servo](#). TEST the system for normal operation.

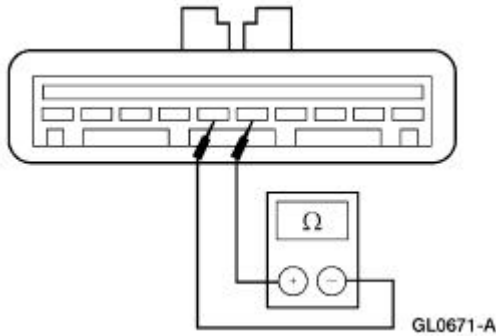
No
INSTALL a new CPP switch. TEST the system for normal operation.

PINPOINT TEST E: THE SPEED CONTROL SWITCH IS INOPERATIVE—COAST

Test Step	Result / Action to Take
E1 CHECK THE SPEED CONTROL ACTUATOR SWITCH	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Speed Control Servo C122. ● Measure the resistance between speed control servo C122 Pin 5, Circuit 151 (LB/BK), harness side and speed control servo C122 Pin 6, Circuit 848 (DG/OG), harness side, while pressing the speed control actuator switch COAST. <p>GL0671-A</p> <ul style="list-style-type: none"> ● Is the resistance between 108 and 132 ohms? 	<p>Yes INSTALL a new speed control servo; REFER to Actuator—Speed Control Servo. TEST the system for normal operation.</p> <p>No INSTALL a new speed control actuator switch; REFER to Switch—Speed Control Actuator. TEST the system for normal operation.</p>

PINPOINT TEST F: THE SPEED CONTROL SWITCH IS INOPERATIVE—SET/ACCEL

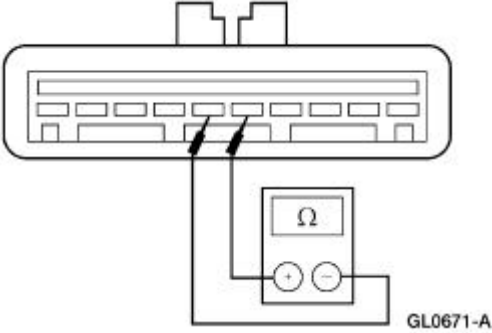
Test Step	Result / Action to Take
F1 CHECK THE SPEED CONTROL ACTUATOR SWITCH	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Speed Control Servo C122. ● Measure the resistance between speed control servo C122 Pin 5, Circuit 151 (LB/BK), harness side and speed control servo C122 Pin 6, Circuit 848 (DG/OG), harness side, while pressing the speed control actuator switch SET/ACCEL. 	<p>Yes INSTALL a new speed control servo; REFER to Actuator—Speed Control Servo. TEST the system for normal operation.</p>



- Is the resistance between 612 and 748 ohms?

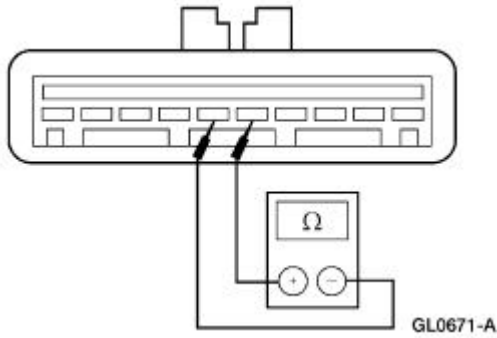
No
 INSTALL a new speed control actuator switch; REFER to [Switch—Speed Control Actuator](#). TEST the system for normal operation.

PINPOINT TEST G: THE SPEED CONTROL SWITCH IS INOPERATIVE — RESUME

Test Step	Result / Action to Take
<p>G1 CHECK THE SPEED CONTROL ACTUATOR SWITCH</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Speed Control Servo C122. ● Measure the resistance between speed control servo C122 Pin 5, Circuit 151 (LB/BK), harness side and speed control servo C122 Pin 6, Circuit 848 (DG/OG), harness side while pressing the speed control actuator switch RESUME.  <ul style="list-style-type: none"> ● Is the resistance between 1,980 and 2,420 ohms? 	<p>Yes INSTALL a new speed control servo; REFER to Actuator—Speed Control Servo. TEST the system for normal operation.</p> <p>No INSTALL a new speed control actuator switch; REFER to Switch—Speed Control Actuator. TEST the system for normal operation.</p>

PINPOINT TEST H: THE SPEED CONTROL SWITCH IS INOPERATIVE—OFF

Test Step	Result / Action to Take
<p>H1 CHECK THE SPEED CONTROL ACTUATOR SWITCH</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Speed Control Servo C122. ● Measure the resistance between speed control servo C122 Pin 5, Circuit 151 (LB/BK), harness side and speed control servo C122 Pin 6, Circuit 848 (DG/OG), harness side while pressing the speed control actuator switch OFF. 	<p>Yes INSTALL a new speed control servo; REFER to Actuator—Speed Control Servo. TEST the system for normal operation.</p> <p>No</p>

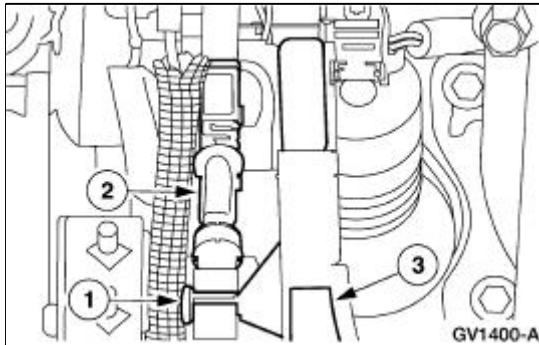


- Is the resistance less than 5 ohms?

INSTALL a new speed control actuator switch; REFER to [Switch—Speed Control Actuator](#). TEST the system for normal operation.

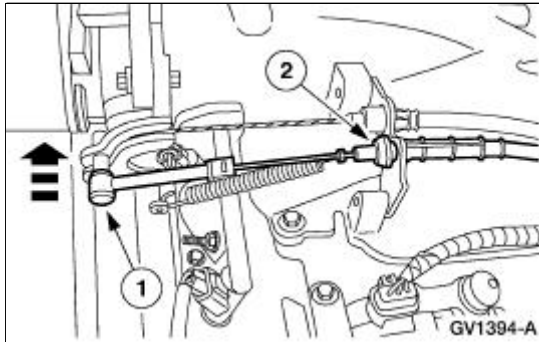
Switch Adjustment —Deactivator

1. Adjust the deactivator switch.
 1. Disconnect the switch hook from the brake pedal.
 2. Depress the switch hook and plunger into the deactivator switch body until the adjustment locking tab snaps into place within the hook.
 3. Depress the brake pedal and reattach the switch hook.

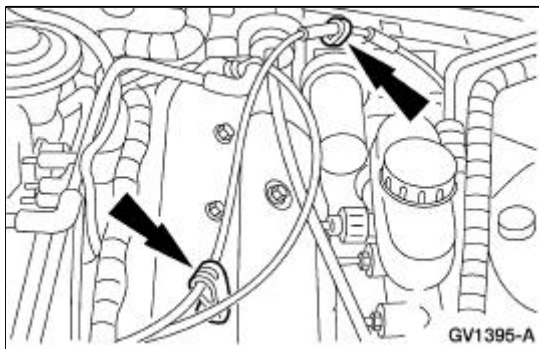


Actuator Cable —Speed Control

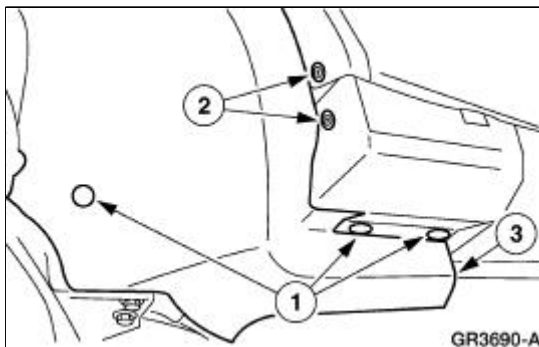
1. Remove the speed control actuator cable end from the throttle body.
 1. Lift the speed control cable from the throttle nailhead.
 2. Release the speed control cable from the throttle bracket.



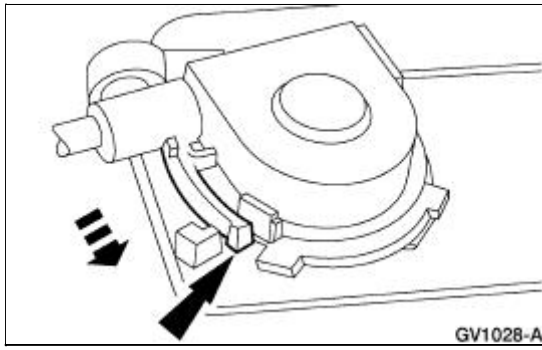
2. Remove the speed control cable from the retaining clips.



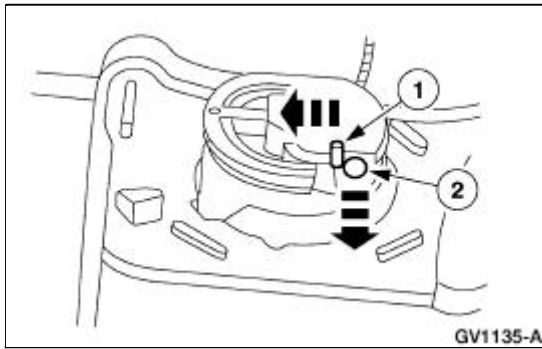
3. Remove the LH front wheel and tire assembly. For additional information, refer to [Section 204-04](#)
4. Position aside the LH front splash shield.
 1. Remove the pin-type retainers.
 2. Remove the screws.
 3. Position aside the LH front splash shield.



5. Depress the locking tab and rotate the speed control actuator cable cap to remove.



6. Disconnect the speed control actuator cable from the speed control servo pulley.
 1. Gently push in the retaining spring.
 2. Disconnect the speed control cable slug from the speed control servo pulley.

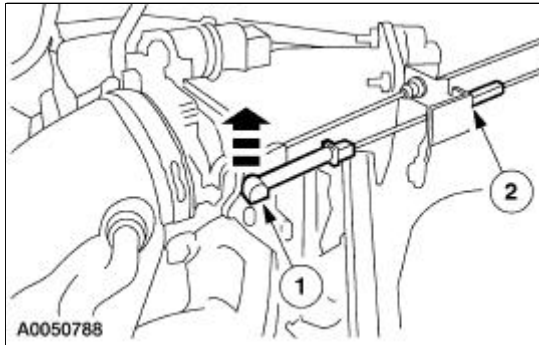


Installation

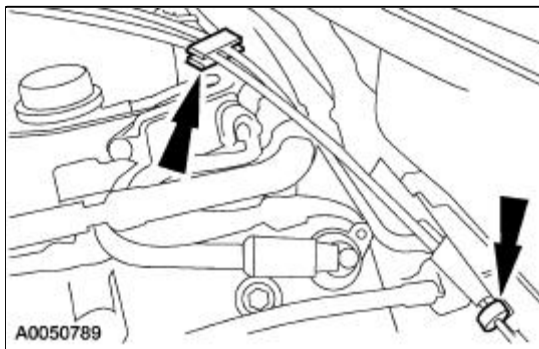
1. To install, reverse the removal procedure.
-

Actuator Cable —Speed Control-Cobra

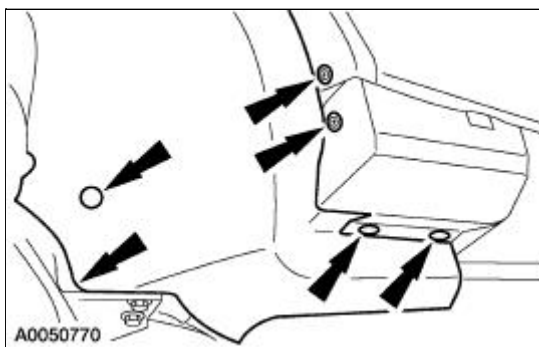
1. Remove the speed control actuator cable end from the throttle body.
 1. Lift the speed control cable from the throttle nailhead.
 2. Release the speed control cable from the throttle bracket.



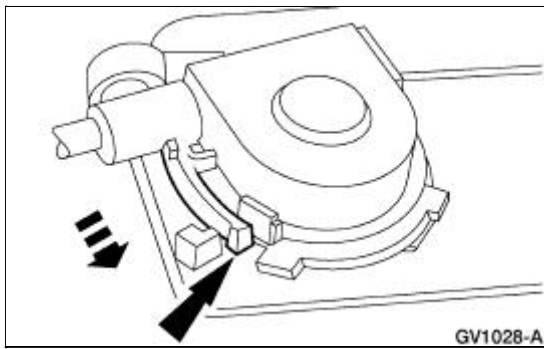
2. Remove the speed control cable from the retaining clips.



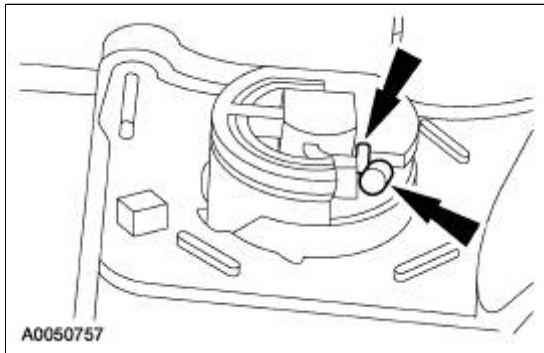
3. Remove the LH front wheel and tire assembly. For additional information, refer to [Section 204-04](#).
4. Position aside the LH front splash shield.
 - Remove the pin-type retainers.
 - Remove the screws.



5. Depress the locking tab and rotate the speed control actuator cable cap to remove.



6. Gently push in the retaining spring while disconnecting the speed control actuator cable from the speed control actuator pulley.



Installation

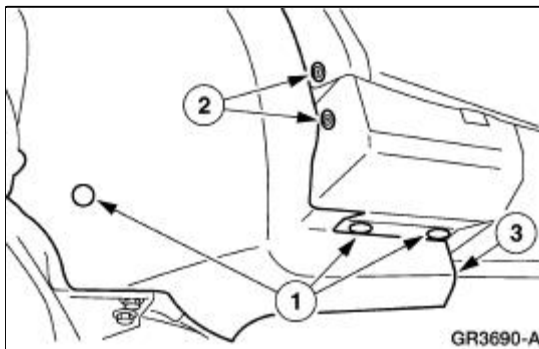
1. To install, reverse the removal procedure.
-

Actuator —Speed Control Servo

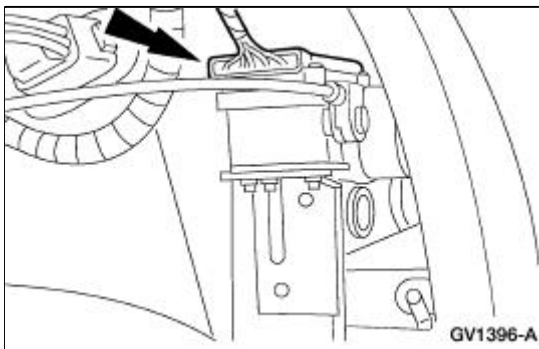
1.  **CAUTION:** Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage may result.

Disconnect the battery ground cable.

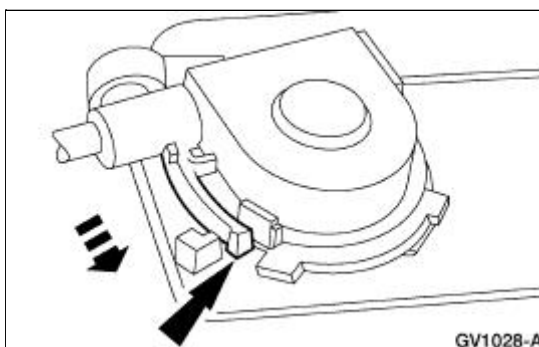
2. Remove the LH wheel and tire; refer to [Section 204-04](#).
3. Position aside the LH front splash shield.
 1. Remove the pin-type retainers.
 2. Remove the screws.
 3. Position aside the LH front splash shield.



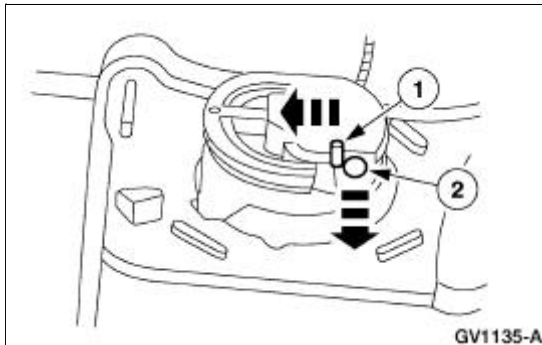
4. Disconnect the speed control servo electrical connector.



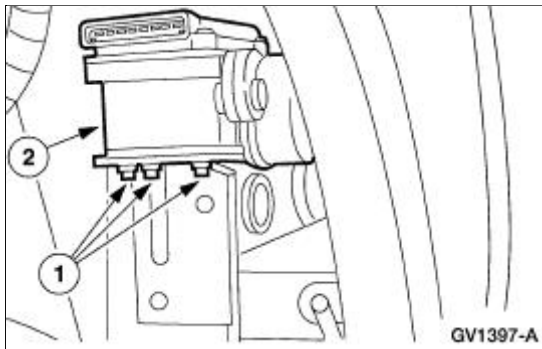
5. Depress the locking tab and rotate the speed control actuator cable cap to remove.



6. Disconnect the speed control cable from the throttle nailhead.
7. Disconnect the speed control actuator cable from the speed control servo pulley.
 1. Gently push in the retaining spring.
 2. Disconnect the speed control cable slug from the speed control servo pulley.



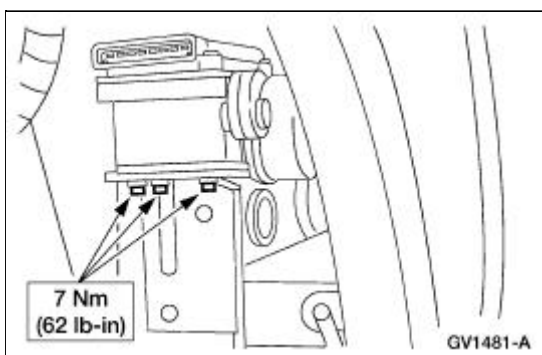
8. Remove the speed control servo.
 1. Remove the bolts.
 2. Remove the speed control servo.



Installation

1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

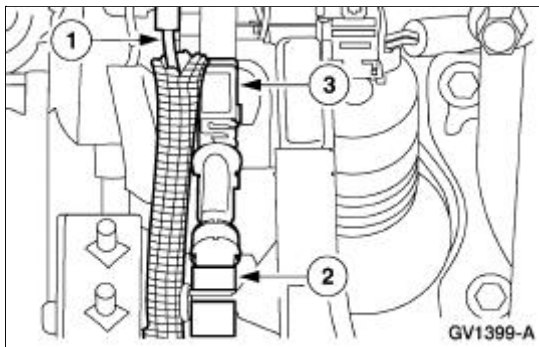
To install, reverse the removal procedure.



Switch —Deactivator

Removal

1. Disconnect the battery ground cable.
2. Remove the deactivator switch.
 1. Disconnect the deactivator switch electrical connector.
 2. Detach the lower deactivator switch hook.
 3. Detach the upper deactivator pivot.



Installation

1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

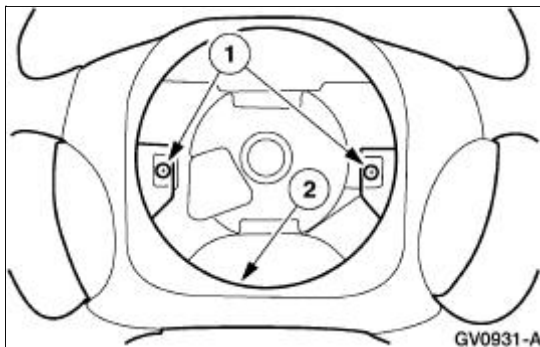
To install, reverse the removal procedure.

- Adjust the deactivator switch, refer to [Switch Adjustment—Deactivator](#)
-

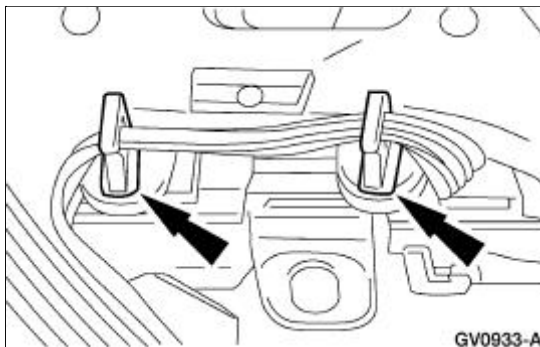
Switch —Speed Control Actuator

Removal

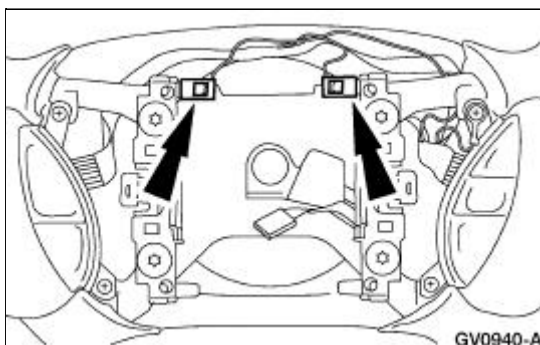
1. Remove the steering wheel; refer to [Section 211-04](#).
2. Remove the steering wheel rear cover.
 1. Remove the screws.
 2. Remove the steering wheel rear cover.



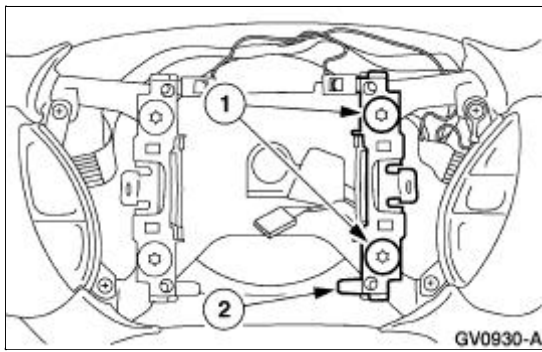
3. Remove the ribbon harness from the clips.



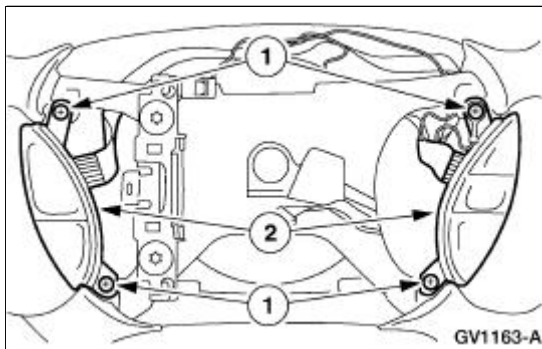
4. Remove the horn contact electrical connectors.



5. Remove the right side horn contact.
 1. Remove the screws.
 2. Remove the contact.

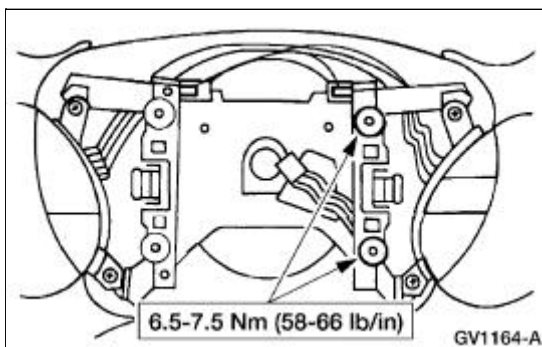
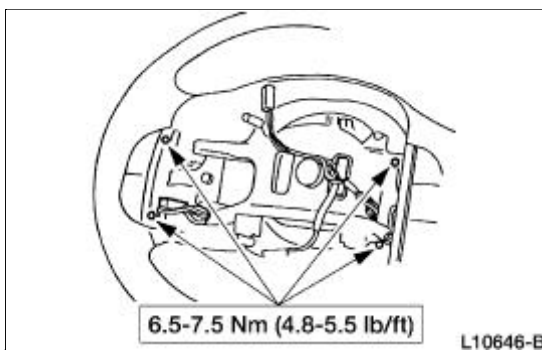


6. Remove the speed control actuator switch assembly.
 1. Remove the screws.
 2. Remove the speed control actuator switch assembly.



Installation

1. To install, reverse the removal procedure.



General Specifications

Item	Specification
A/C Compressor	
Type	FS-10 swashplate, 5 double-acting pistons
Displacement	170 cc (10.4 cu in)
Rotation	Clockwise
A/C Pressure Relief Valve ^a	
Open pressures	3,792-4,137 kPa (550-600 psi)
A/C Pressure Sensor	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
Coolant Hose Lubricant	
MERPOL®	ESE-M99B144-B
Evaporator Core Orifice	
Color	Orange
Diameter	1.45 mm (0.057 in)
Magnetic Clutch	
Air gap clearance	0.35-0.75 mm (0.014-0.030 in)
Dual Function Pressure Switch (V8) ^a	
Fan on/open	2,137-2,344 kPa (310-340 psi)
Fan off/close	1,655-2,137 kPa (240-310 psi)
Clutch off/open	2,999-3,275 kPa (435-475 psi)
Clutch on/closed	1,517-1,931 kPa (220-280 psi)
Pressure Cutoff Switch (V6) ^a	
Open	2,999-3,275 kPa (435-475 psi)
Close	1,586-1,999 kPa (230-290 psi)
A/C Cycling Switch Open and Closed Pressures ^a	
Open pressure	145-159 kPa (21-23 psi)
Close pressure	290 kPa (42 psi)
Refrigerant Lubricant and Capacity	
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B
Capacity	254 ml (8.6 oz)
Refrigerant and Capacity	
R134a Refrigerant YN-19	WSH-M17B19-A
Capacity	.96 kg (34 oz)
Refrigerant System Cleaner	
A/C Systems Flushing Solvent F4AZ-19579-A	—


^a Manifold gauge set pressures may vary slightly depending on the distance between the service


gauge port valve and the A/C pressure relief valve, the A/C cycling switch, the pressure cutoff switch (V6), and the dual function pressure switch (V8) location.


Torque Specifications

Description	Nm	lb-in
Peanut fitting nut	8	71


Climate Control System

 **WARNING:** To avoid accidental deployment and possible injury, the air bag system backup power supply must be depleted before repairing any climate control components. To deplete the backup power supply, disconnect the battery ground cable and wait one minute. Failure to follow these instructions may result in personal injury.

 **WARNING:** Carbon monoxide is colorless, odorless and dangerous. If it is necessary to operate the engine with the vehicle in a closed area such as a garage, always use an exhaust collector to vent the exhaust gases outside the closed area.

 **WARNING:** R-134a is classified as a safe refrigerant, but misuse can make it dangerous. The following precautions must be observed:

- Always wear safety goggles when repairing an air conditioning system.
- Avoid contact with liquid refrigerant R-134a. R-134a vaporizes at approximately -25°C (-13°F) under atmospheric pressure and it will freeze skin tissue.
- Never allow refrigerant R-134a gas to escape in quantity in an occupied space. R-134a is non-toxic, but it will displace the oxygen needed to support life.
- Never use a torch in an atmosphere containing R-134a gas. R-134a is non-toxic at all normal conditions, but when it is exposed to high temperatures, such as a torch flame, it decomposes. During decomposition it releases irritation and toxic gases (as described in the MSDS sheet from the manufacturer). Decomposition products are hydrofluoric acid, carbon dioxide and water.
- Do not allow any portion of the charged air conditioning system to become too hot. The pressure in an air conditioning system rises as the temperature rises and temperatures of approximately 85°C (185°F) can be dangerous.
- Allow the engine to cool sufficiently prior to carrying out maintenance or serious burns and injury can occur.

 **CAUTION:** To avoid damaging the vehicle or A/C components, the following precautions must be observed:

- The A/C refrigerant of all vehicles must be identified and analyzed prior to refrigerant charging. Failure to do so can contaminate the shop bulk refrigerant and other vehicles.
- Do not add R-12 refrigerant to an A/C system that requires the use of R-134a refrigerant. These two types of refrigerant must never be mixed. Doing so can damage the A/C system.
- Charge the A/C system with the engine running only at the low-pressure side to prevent refrigerant slugging from damaging the A/C compressor.
- Use only R-134a refrigerant. Due to environmental concerns, when the air conditioning system is drained, the refrigerant must be collected using refrigerant recovery/recycling equipment. Federal law REQUIRES that R-134a be recovered into appropriate recovery equipment and the process be conducted by qualified technicians who have been certified by an approved organization, such as MACS, ASI etc. Use of a recovery machine dedicated to R-134a is necessary to reduce the possibility of oil and refrigerant incompatibility concerns. Refer to the instructions provided by the equipment manufacturer when removing refrigerant from or charging the air conditioning system.

- Refrigerant R-134a must not be mixed with air for leak testing or used with air for any other purpose above atmospheric pressure. R-134a is combustible when mixed with high concentrations of air and higher pressures.
- A number of manufacturers are producing alternative refrigerant products that are designed to be used instead of R-134a refrigerant. The use of any unauthorized substitute refrigerant can severely damage the A/C components. If repair is required, use only new or recycled refrigerant R-134a.



CAUTION: To avoid contamination of the A/C system, always observe the following:

- Keep service tools and the work area clean.
- Never open or loosen a connection before discharging the system.
- When loosening a connection, if any residual pressure is evident, allow it to leak out before opening the fitting.
- Evacuate a system that has been opened to install a new component or one that has been discharged through leakage before charging.
- Seal an open fitting with a cap or plug immediately after disconnecting a component from the system.
- Clean the outside of the fittings thoroughly before disconnecting a component from the system.
- Do not remove the sealing caps from a new component until ready to install.
- Refrigerant oil will absorb moisture from the atmosphere if left uncapped. Do not open an oil container until ready to use, and install the cap immediately after using. Store the oil in a clean, moisture-free container.
- Install a new O-ring seal before connecting an open fitting. Coat the fitting and the O-ring seal with refrigerant oil before connecting.
- When installing a refrigerant line, avoid sharp bends. Position the line away from the exhaust or any sharp edges that can chafe the line.
- Do not open a refrigerant system or uncap a new component unless it is as close as possible to room temperature. This will prevent condensation from forming inside a component that is cooler than the surrounding air.

The manual climate control system heats or cools the vehicle depending on the function selector switch position and the temperature selected.

- The function selector switch position determines heating or cooling and air distribution.
- The temperature control setting determines the air temperature.
- The heater blower motor switch (18578) varies the blower motor speed.

Principles of Operation

There are four main principles involved with the basic theory of operation:

- heat transfer
- latent heat of vaporization
- relative humidity
- effects of pressure

Heat Transfer

If two substances of different temperature are placed near each other, the heat in the warmer substance will transfer to the colder substance.

Latent Heat of Vaporization

When a liquid boils (converts to a gas), it absorbs heat without raising the temperature of the resulting gas. When the gas condenses (reverts back to a liquid), it gives off heat without lowering the temperature of the resulting liquid.

Relative Humidity

The amount of moisture (water vapor content) that the air can hold is directly related to the air temperature. The more heat there is in the air, the more moisture the air can hold. The lower the moisture content in the air, the more comfortable you feel. Removing moisture from the air lowers its relative humidity and improves personal comfort.

Effects of Pressure on Boiling or Condensation

As the pressure is increased on a liquid, the temperature at which the liquid boils (converts to a gas) also increases. Conversely, when the pressure on a liquid is reduced, its boiling point is also reduced. When in the gas state, an increase in pressure causes an increase in temperature, while a decrease in pressure will decrease the temperature of the gas.

Compressor Anti-Slugging Strategy

Liquid refrigerant may accumulate in the A/C compressor under certain conditions. To alleviate damage to the A/C compressor, compressor anti-slugging strategy (CASS) is utilized.

CASS is initiated only under specific conditions:

- the ignition is off for more than 8 hours
- the ambient temperature is above -4°C (25°F)
- battery voltage is above 8.5 volts during engine cranking

When these conditions are present, the powertrain control module (PCM) will activate the A/C control relay prior to cranking of the engine. The A/C control relay engages the A/C compressor for approximately 4-15 A/C compressor revolutions or a maximum of 2 seconds (depending upon vehicle application), allowing the liquid refrigerant to be pushed from the A/C compressor. CASS is initiated by the PCM regardless of the function selector switch position or the EATC system settings.

The Refrigerant Cycle

During stabilized conditions (air conditioning system shut down), the refrigerant is in a vaporized state and pressures are equal throughout the system. When the A/C compressor (19703) is in operation, it increases pressure on the refrigerant vapor, raising its temperature. The high-pressure and high-temperature vapor is then released into the top of the A/C condenser core (19712).

The A/C condenser core, being close to ambient temperature, causes the refrigerant vapor to condense into a liquid when heat is removed from the refrigerant by ambient air passing over the fins and tubing. The now liquid refrigerant, still at high pressure, exits from the bottom of the A/C condenser core and enters the inlet side of the A/C evaporator core orifice (19D990).

The A/C evaporator core orifice is the restriction in the refrigerant system that creates the high pressure buildup upstream of the A/C evaporator core (19860) and separates the high and low pressure sides of the A/C system. As the liquid refrigerant leaves this restriction, its pressure and boiling point are reduced.

The liquid refrigerant is now at its lowest pressure and temperature. As it passes through the A/C

evaporator core, it absorbs heat from the passenger compartment airflow passing over the plate/fin sections of the A/C evaporator core. This addition of heat causes the refrigerant to boil (convert to a gas). The now cooler passenger compartment air can no longer support the same humidity level of the warmer air and this excess moisture condenses on the exterior of the evaporator coils and fins and drains outside the vehicle.

The suction accumulator/drier (19C836) is designed to remove moisture from the refrigerant and to prevent any liquid refrigerant that may not have been vaporized in the A/C evaporator core from reaching the A/C compressor. The A/C compressor is designed to pump refrigerant vapor only, as liquid refrigerant will not compress and can damage the A/C compressor.

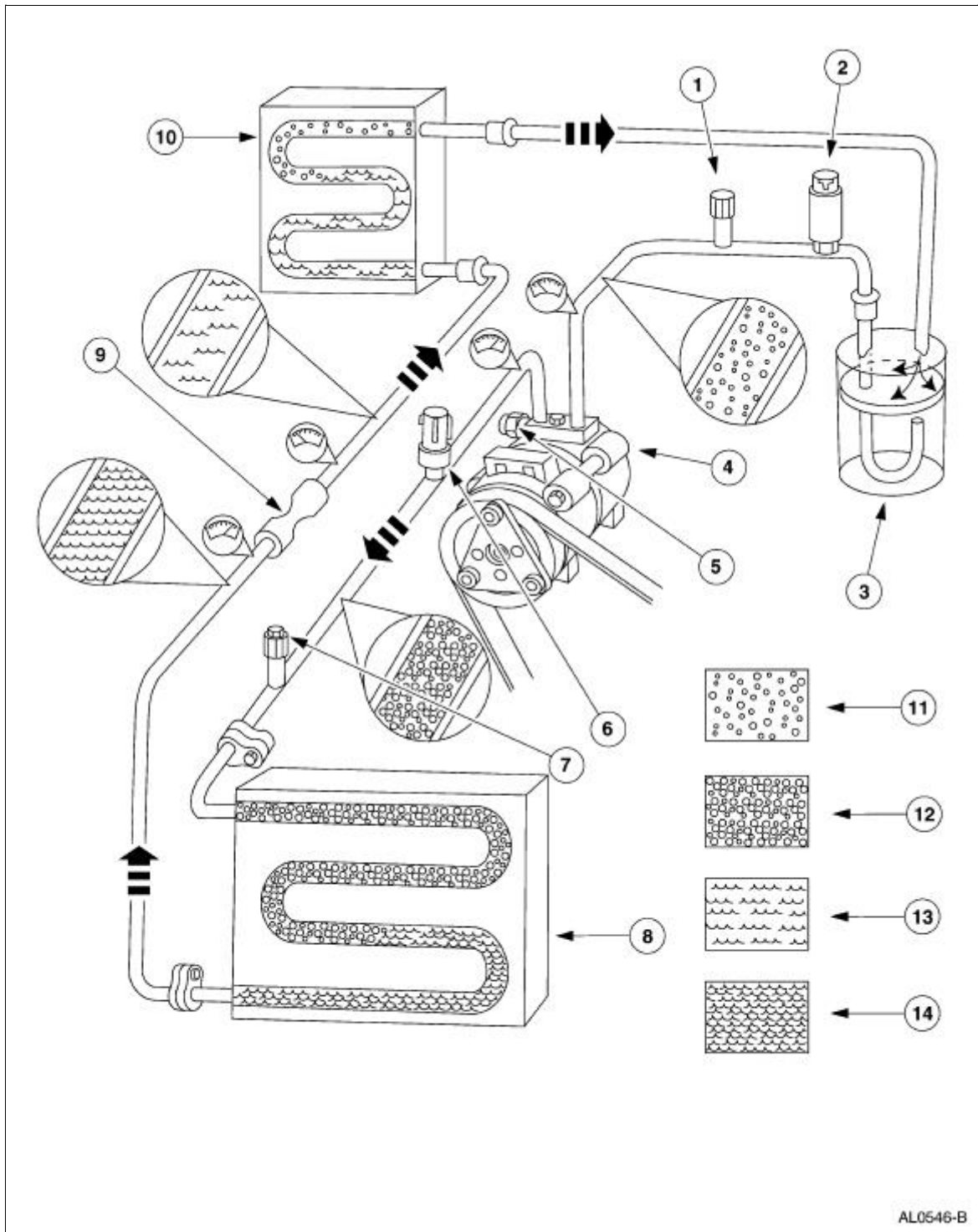
The refrigerant cycle is now repeated with the A/C compressor again increasing the pressure and temperature of the refrigerant.

The A/C cycling switch (19E561) interrupts compressor operation before the external temperature of the A/C evaporator core gets low enough to cause the condensed water vapor (excess humidity) to turn to ice. It does this by monitoring low side line pressure. It is known that a refrigerant pressure of approximately 210 kPa (30 psi) will yield an operating temperature of 0°C (32°F). The A/C cycling switch controls system operation in an effort to maintain this temperature.

The high side line pressure is also monitored so that the A/C compressor operation can be interrupted if system pressure becomes too high.

The A/C compressor pressure relief valve (19D644) will open and vent refrigerant to relieve unusually high system pressure.

Clutch Cycling Orifice Tube Type Refrigerant System



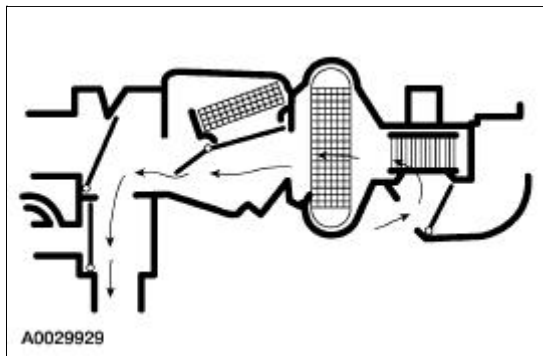
AL0546-B

Item	Part Number	Description
1	19D701	A/C charge valve port (low side)
2	19E561	A/C cycling switch
3	19C836	Suction accumulator/drier
4	19703	A/C compressor
5	19D644	A/C compressor pressure relief valve
6	19D594	A/C pressure cutoff switch
7	19D701	A/C charge valve port (high side)
8	19712	A/C condenser core

9	19D990	A/C evaporator core orifice
10	19860	A/C evaporator core
11	—	Low pressure vapor
12	—	High pressure vapor
13	—	Low pressure liquid
14	—	High pressure liquid

System Air Flow Description

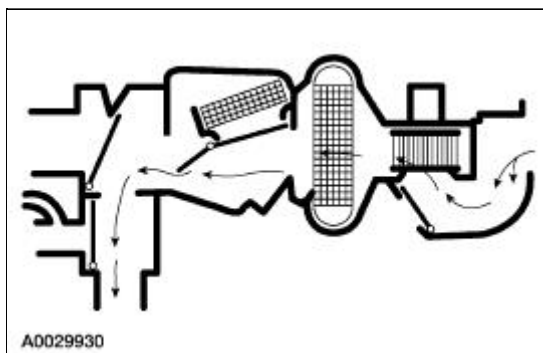
MAX A/C



When MAX A/C is selected:

- The air inlet door vacuum control motor is at full vacuum, closing off outside air and admitting only recirculated air.
- The panel/defrost door vacuum control motor is at full vacuum and the panel/floor door vacuum control motor is at no vacuum, directing airflow to the instrument panel A/C registers. A small amount of airflow from the side window demisters will be present.
- Blended air temperature is available.
- The A/C compressor will operate if the outside temperature is above approximately 6°C (43°F).
- The blower motor is on.

NORM A/C

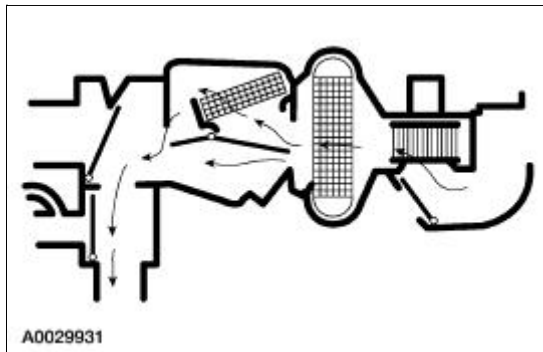


When NORM A/C is selected:

- The air inlet door vacuum control motor is at no vacuum, admitting only outside air into the passenger compartment.

- The panel/defrost door vacuum control motor is at full vacuum and the panel/floor door vacuum control motor is at no vacuum, directing airflow to the instrument panel A/C registers. A small amount of airflow from the side window demisters will be present.
- Blended air temperature is available.
- The A/C compressor will operate if the outside air temperature is above approximately 6°C (43° F).
- The blower motor is on.

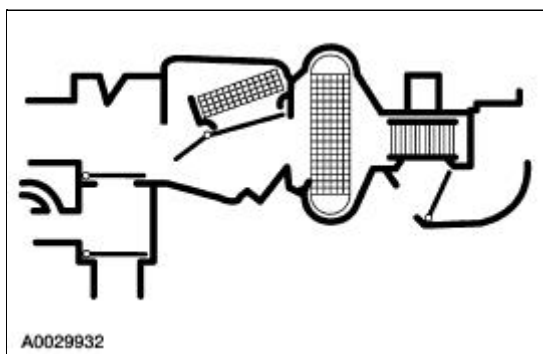
PANEL



When PANEL is selected:

- The air inlet door vacuum control motor is at no vacuum, admitting only outside air into the passenger compartment.
- The panel/defrost door vacuum control motor is at full vacuum and the panel/floor door vacuum control motor is at no vacuum, directing airflow to the instrument panel A/C registers. A small amount of airflow from the side window demisters will be present.
- The temperature can be adjusted to heat the air, but the air cannot be cooled below the outside temperature.
- The A/C compressor will not operate.
- The blower motor is on.

OFF



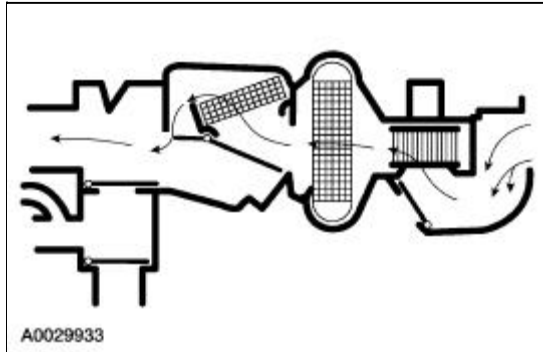
When OFF is selected:

- The air inlet door vacuum control motor is at full vacuum, closing off outside air from entering the passenger compartment.
- The panel/floor door vacuum control motor is at full vacuum and the panel/defrost door vacuum

control motor is at no vacuum, closing off airflow to the defrost duct, side window demisters, floor duct and instrument panel A/C registers.

- The A/C compressor will not operate.
- The blower motor is off.

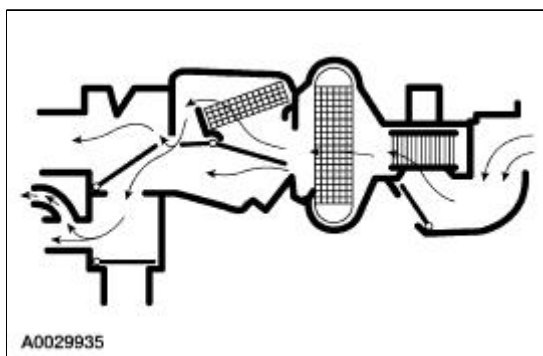
FLOOR



When FLOOR is selected:

- The air inlet door vacuum control motor is at no vacuum, admitting only outside air into the passenger compartment.
- The panel/floor door vacuum control motor is at full vacuum and the panel/defrost door vacuum control motor is at no vacuum, directing airflow to the floor duct. A small amount of airflow from the side window demisters will be present.
- The temperature can be adjusted to heat the air, but the air cannot be cooled below the outside temperature.
- The A/C compressor will not operate.
- The blower motor is on.

FLOOR/DEFROST

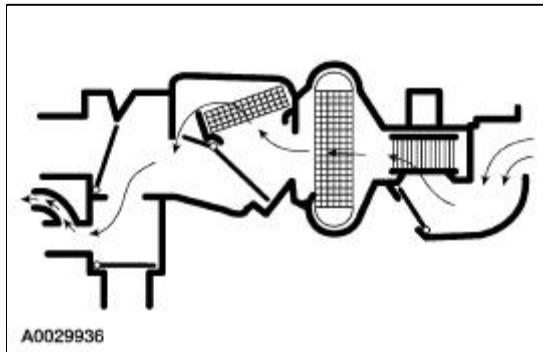


When FLOOR/DEFROST is selected:

- The air inlet door vacuum control motor is at no vacuum, admitting only outside air into the passenger compartment.
- The panel/floor door vacuum control motor is at partial vacuum and the panel/defrost door vacuum control motor is at no vacuum, directing airflow to the floor duct, the defroster duct, and the side window demisters.
- The temperature can be adjusted to heat or cool the air below the outside temperature.

- The A/C compressor will operate if the outside air temperature is above approximately 6°C (43° F).
- The blower motor is on.

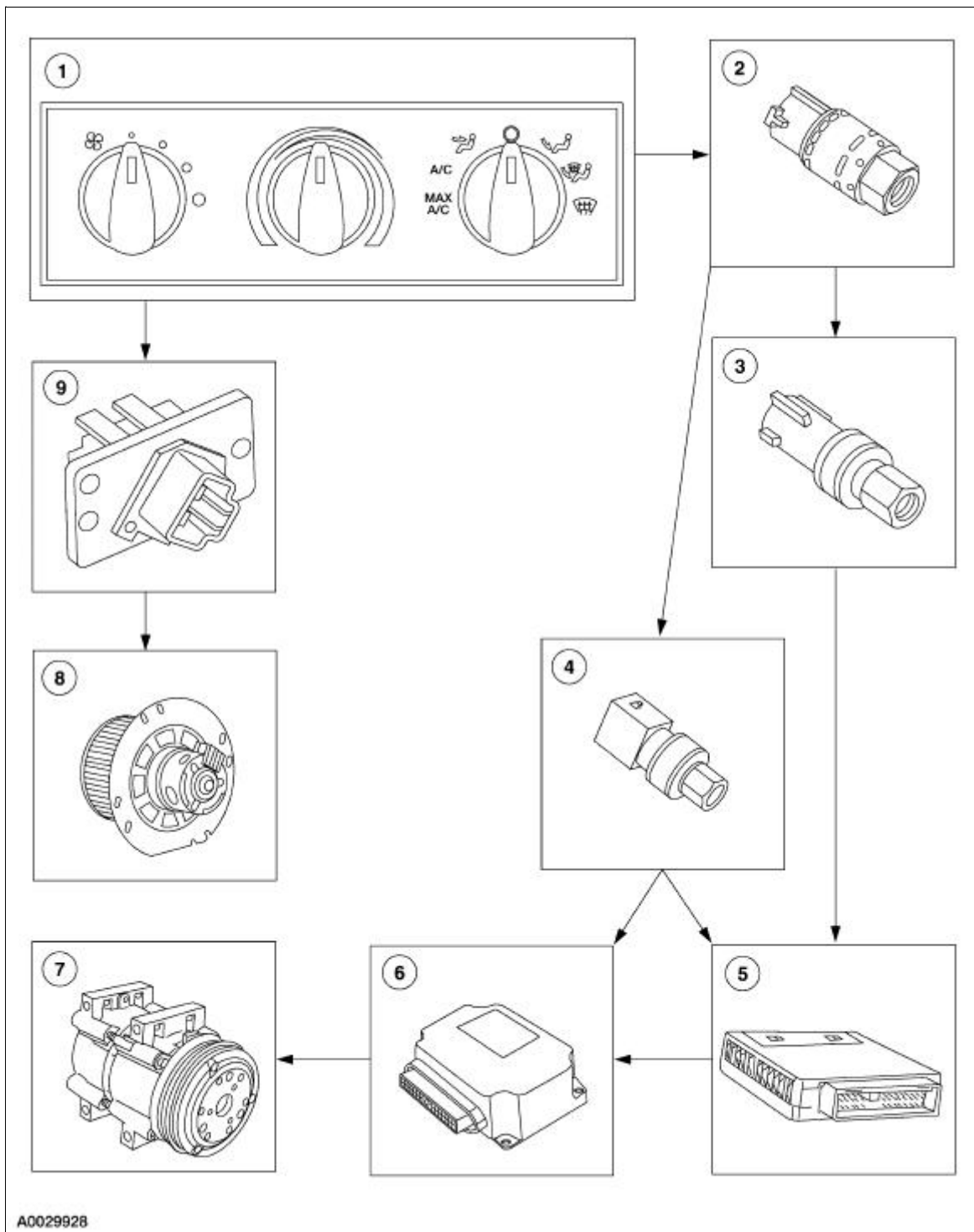
DEFROST



When DEFROST is selected:

- The air inlet door vacuum control motor is at no vacuum, admitting only outside air into the passenger compartment.
- The panel/floor door and panel/defrost door vacuum control motors are at no vacuum, directing airflow to the defroster duct and the side window demisters.
- The temperature can be adjusted to heat or cool the air below the outside temperature.
- The A/C compressor will operate if the outside air temperature is above approximately 6°C (43° F).
- The blower motor is on.

Electrical Components



A0029928

Item	Part Number	Description
1	19980	Manual A/C control assembly
2	19E561	A/C cycling switch
3	19D594	A/C pressure cutoff switch (V6)
4	19D594	A/C pressure cutoff switch (V8)
5	12A650	Powertrain control module
6	12B581	Constant control relay module
7	19703	A/C compressor
8	19805	Blower motor

9

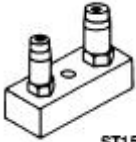


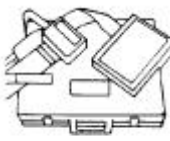


18591




Heater blower motor resistor

Climate Control System

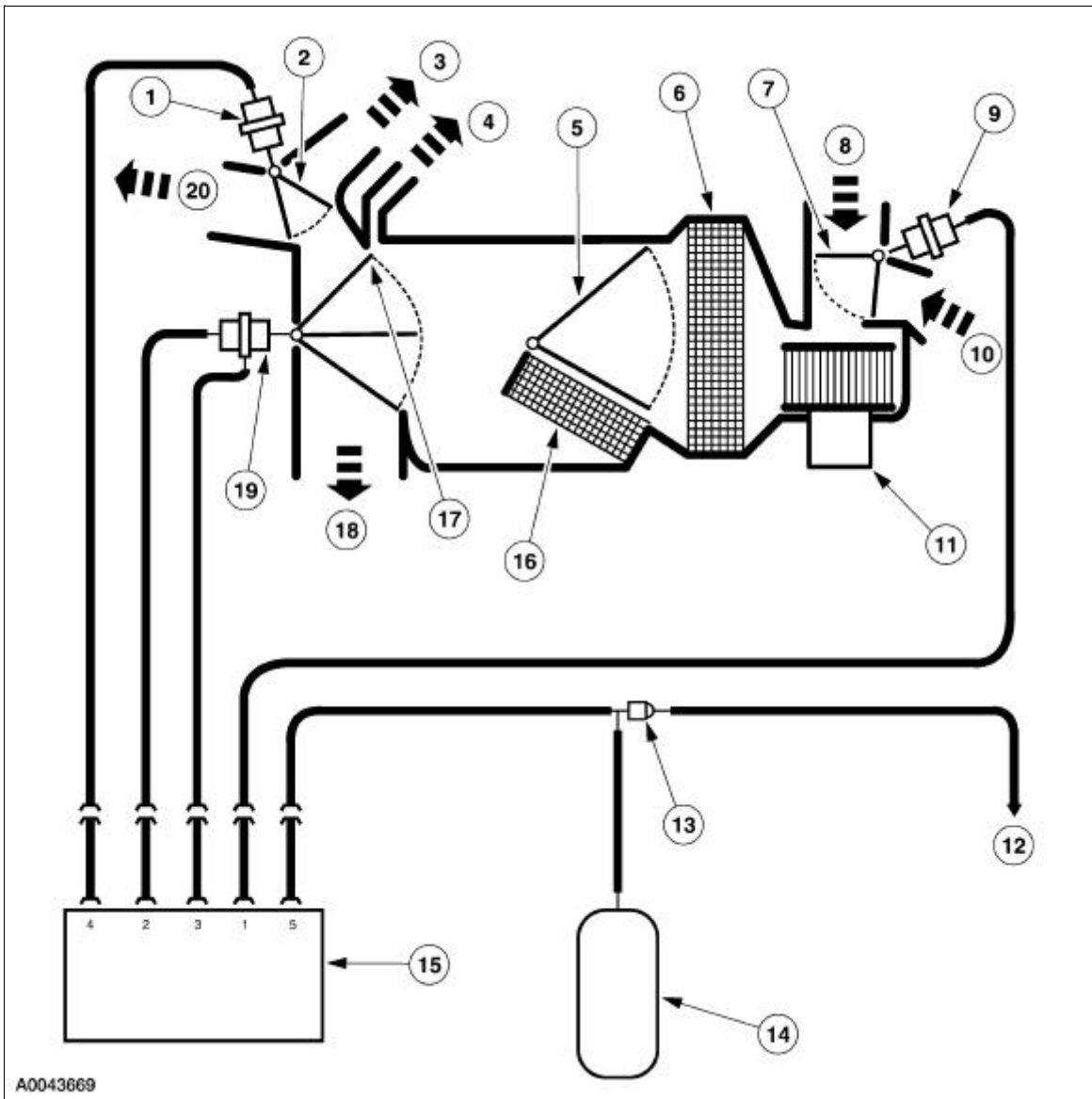
Refer to Wiring Diagrams Cell [54](#), Air Conditioner/Heater for schematic and connector information.

Special Tool(s)

 <p>ST1501-A</p>	<p>Connector, Refrigerant Pressure Line 412-093 (T94P-19623-E)</p>
 <p>ST1252-A</p>	<p>Set, A/C Fittings 412-DS028 (014-00333, D93L-19703-B) or equivalent</p>
 <p>ST1176-A</p>	<p>Vacuum Pump Kit 416-D002 (D95L-7559-A) or equivalent</p>
 <p>ST1391-A</p>	<p>Breakout Box, EEC-V Control System 418-049 (014-00950, T94L-50-EEC-V)</p>
 <p>ST2332-A</p>	<p>Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool</p>
 <p>ST1474-A</p>	<p>Pressure Test Kit 014-R1072 or equivalent</p>
	<p>77 III Automotive Meter 105-R0056 or equivalent</p>

 <p>ST1137-A</p>	
 <p>ST1928-A</p>	R-134a Manifold Gauge Set 176-R032A or equivalent
 <p>ST2351-A</p>	Refrigerant Leak Detector 216-00001 or equivalent

Vacuum Schematic—Manual Climate Control System

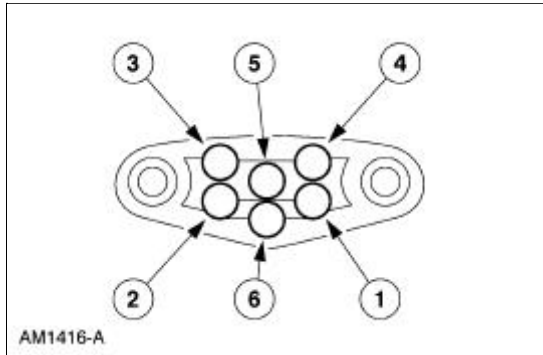


A0043669

Item	Part Number	Description
1	18A318	Vacuum control motor, panel/defrost door
2	18A478	Panel/defrost door (full vacuum position)
3	—	Defrost airflow
4	—	Side window demister airflow
5	18B545	Temperature blend door (full heat position)
6	19860	A/C evaporator core
7	19A813	Air inlet door (full vacuum position)
8	—	Outside air inlet
9	18A318	Vacuum control motor—air inlet door
10	—	Recirculated air inlet
11	19805	Blower motor
12	—	Vacuum from the engine intake manifold
13	19A563	A/C vacuum check valve
14	19A566	A/C vacuum reservoir tank and bracket
15	19B888	A/C-heater function selector switch

16	18476	Heater core
17	18A559	Panel/floor door (full vacuum position)
18	—	Floor airflow
19	18A318	Vacuum control motor—floor/panel door
20	—	Panel vent airflow

Function Selector Switch Vacuum Connector



Port No.	Hose Color	Function
1	White	Air inlet door
2	Red	Panel/floor door
3	Blue	Panel/floor door
4	Yellow	Panel/defrost door
5	Black	Vacuum source
6	—	Not used

Function Selector Switch Vacuum Application Chart

Switch Port	Color	Function	Function Selector Switch Position						
			MAX A/C	A/C	Vent	OFF	Floor	FLR/ DEF	Defrost
1	White	Recirc/Fresh	V	NV	NV	V	NV	NV	NV
2	Red	Floor	NV	NV	NV	V	V	NV	NV
3	Blue	Panel/floor	NV	NV	NV	V	V	V	NV
4	Yellow	Panel/defrost	V	V	V	NV	NV	NV	NV
5	Black	Vacuum source	V	V	V	V	V	V	V

V=Vacuum

NV=No Vacuum

Inspection and Verification

1. Verify the customer's concern by operating the climate control system to duplicate the condition.

- Inspect to determine if one of the following mechanical or electrical concerns apply:

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> Loose, missing or damaged A/C compressor drive belt. Loose or disconnected A/C clutch. Loose, misrouted or damaged vacuum lines. ^a Broken or leaking refrigerant lines. Broken or leaking vacuum control motor. 	<ul style="list-style-type: none"> Open fuses. Blower motor inoperative. A/C compressor inoperative. Circuitry open/shorted. Disconnected electrical connectors.

^a A leak in the vacuum control circuit may occur during acceleration (slow leak), at all times (large leak), or only when specific functions are selected (indicating a leak in that portion of the circuit). The vacuum hoses used in the passenger compartment control circuit are constructed from PVC plastic material. The vacuum hoses used in the engine compartment are constructed of Hytrel®. Because of the materials used, never pinch the vacuum hoses off during diagnosis to locate a leak. A wood golf tee can be used as a plug when it is necessary to plug one end of a vacuum hose for leak test purposes.

- If the inspection reveals obvious concerns that can be readily identified, repair as required.
- If the concern remains after the inspection, connect the scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If the vehicle selection cannot be entered:
 - check that the program card is correctly installed.
 - check the connections to the vehicle.
 - check the ignition switch position.

If the scan tool still does not allow the vehicle selection to be entered, refer to the scan tool manual.

- Carry out the DATA LINK DIAGNOSTIC TEST using the scan tool. If the scan tool responds with:
 - CKT 914, CKT 915 or CKT 70 = ALL MODULE NO RESPONSE/NOT EQUIPPED, go to Communication System Diagnostics in [Section 418-00](#) to diagnose network concern.
 - If the powertrain control module (PCM) is not listed for a communication concern, turn the A/C function selector switch to OFF and execute self-test diagnostics for the PCM.
- If any PCM DTCs are retrieved, and are related to the concern, go to the Powertrain Control Module Diagnostic Trouble Code (DTC) Index to continue diagnostics.
- If no DTCs related to the concern are retrieved, go to the Symptom Chart to continue diagnostics.

Powertrain Control Module Diagnostic Trouble Code (DTC) Index

DTC	Description	Action
P1460	WOT A/C cutout circuit malfunction	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1464	A/C demand out of self-test range	GO to DTC P1464.

Symptom Chart

Symptom Chart

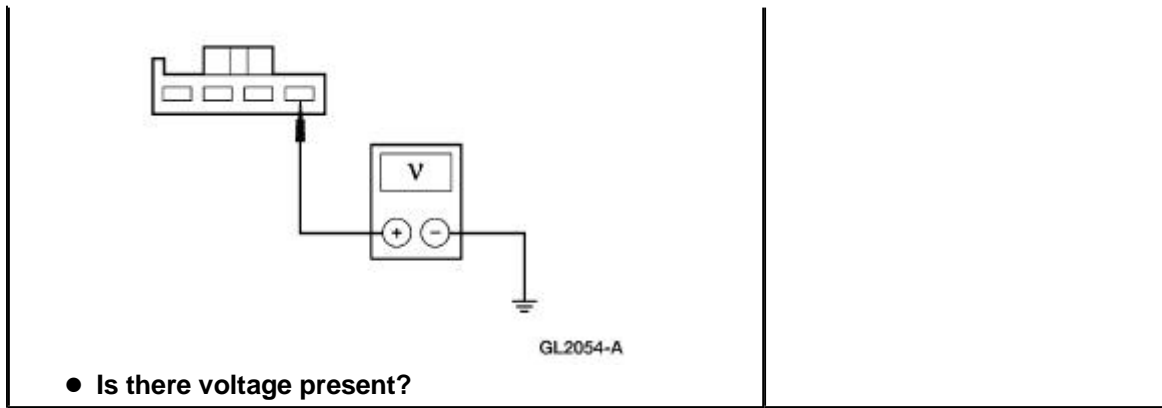
Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● Incorrect/erratic direction of airflow from outlet(s) 	<ul style="list-style-type: none"> ● No vacuum to A/C heater function switch selector. ● A/C heater function selector switch leaks vacuum. ● Kinked/pinched vacuum hose. ● Leaking vacuum control motor. ● Leaking A/C vacuum check valve. ● Leaking A/C vacuum reservoir tank and bracket. ● Vacuum actuator arm not connected to door crank. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test A.
<ul style="list-style-type: none"> ● Insufficient, erratic, or no heat 	<ul style="list-style-type: none"> ● Low engine coolant level. ● Thermostat stuck open. ● Disengaged/damaged temperature cable. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test B.
<ul style="list-style-type: none"> ● The A/C does not operate/does not operate correctly 	<ul style="list-style-type: none"> ● CASS strategy failure. ● Open fuses. ● A/C clutch relay. ● Shorted blend door actuator. ● Powertrain control module. ● Circuitry short/open. ● A/C cycling switch damaged. ● A/C system discharged/low charge. ● Function selector switch damaged. ● A/C pressure cut-off switch damaged. ● A/C compressor clutch damaged. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test C.
<ul style="list-style-type: none"> ● The A/C is always on 	<ul style="list-style-type: none"> ● Circuitry short/open. ● A/C cycling switch. ● A/C heater function selector switch. ● Constant control relay module. ● Incorrect A/C clutch air gap. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test D.
<ul style="list-style-type: none"> ● Insufficient A/C cooling 	<ul style="list-style-type: none"> ● Restricted A/C evaporator core orifice. ● Low refrigerant level. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test E.
<ul style="list-style-type: none"> ● No operation in all the temperature settings 	<ul style="list-style-type: none"> ● Damaged blend door actuator cable. ● Damaged air temperature control door. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test F.
<ul style="list-style-type: none"> ● The blower motor does not operate 	<ul style="list-style-type: none"> ● Open fuse. ● Circuitry open/shorted. ● Damaged heater blower motor switch (18578). ● Damaged heater blower motor switch resistor (18591). ● Damaged blower motor relay. ● Damaged blower motor. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test G.
<ul style="list-style-type: none"> ● The blower motor operates continuously in 	<ul style="list-style-type: none"> ● Circuitry short/open. ● Damaged heater blower 	<ul style="list-style-type: none"> ● Go To Pinpoint

high speed	<ul style="list-style-type: none"> motor switch resistor. ● Damaged heater blower motor switch. 	Test H.
<ul style="list-style-type: none"> ● No operation in high blower setting 	<ul style="list-style-type: none"> ● Circuitry short/open. ● Damaged heater blower motor switch. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test L.
<ul style="list-style-type: none"> ● No operation in lower speeds 	<ul style="list-style-type: none"> ● Circuitry short/open. ● Damaged heater blower motor switch resistor. ● Damaged heater blower motor switch. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test J.

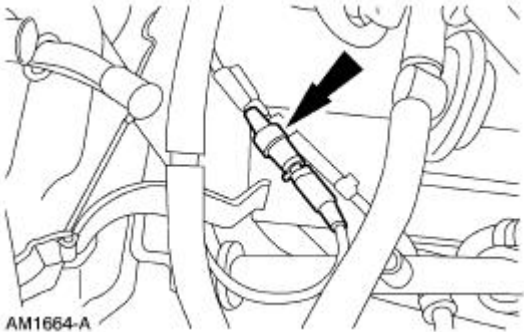
Pinpoint Tests

PINPOINT TEST P1464: DTC P1464: A/C DEMAND OUT OF SELF-TEST RANGE

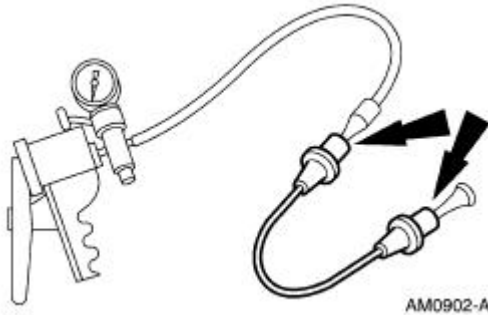
Test Step	Result / Action to Take
P14641 RECHECK FOR THE DTC	
<ul style="list-style-type: none"> ● Key in ON position. ● Make sure the function selector switch is in the OFF position. ● Enter the following diagnostic mode on the diagnostic tool: PCM Self-Test. ● Is DTC P1464 retrieved? 	<p>Yes GO to P14642.</p> <p>No The system is functioning correctly. This DTC will set if the A/C is turned on when carrying out the PCM self-test.</p>
P14642 CHECK PID ACCS WITH THE A/C CONTROL DISCONNECTED	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Function Selector Switch C294c. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: PCM PID ACCS. ● Does PID ACCS read ON? 	<p>Yes GO to P14643.</p> <p>No INSTALL a new function selector switch. REFER to Section 412-04. REPEAT the PCM self-test and verify DTC P1464 is no longer retrieved.</p>
P14643 CHECK CIRCUIT 348 (VT) FOR A SHORT TO B+	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: PCM C175. ● Key in ON position. ● Measure the voltage at the function selector switch C294c-4, circuit 348 (VT), the harness side and ground. 	<p>Yes REPAIR circuit 348 (VT) for a short to B+. REPEAT the PCM self-test and verify DTC P1464 is no longer retrieved.</p> <p>No INSTALL a new powertrain control module. REFER to Section 303-14. REPEAT the PCM self-test and verify DTC P1464 is no longer retrieved.</p>



PINPOINT TEST A: INCORRECT/ERRATIC DIRECTION OF AIRFLOW FROM OUTLET

Test Step	Result / Action to Take
<p>A1 CHECK AIRFLOW FROM DEFROSTER OUTLETS</p> <ul style="list-style-type: none"> ● Key in START position. ● Place the heater blower motor switch in the HI position and rotate the function selector switch to each position. ● Check for correct airflow from each function selector switch position at engine idle and during engine speed acceleration. ● Is there airflow from defroster outlets under all conditions? 	<p>Yes GO to A2.</p> <p>No If the airflow is from defroster outlets in all switch positions only under engine speed acceleration, GO to A19.</p> <p>If the airflow is incorrect under one or more conditions, GO to A13.</p> <p>If the airflow is correct under all conditions, RETURN to the Symptom Chart.</p>
<p>A2 CHECK THE VACUUM SUPPLY HOSE</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Verify the vacuum supply hose is connected between the engine manifold and the A/C vacuum check valve.  <p>AM1664-A</p> <ul style="list-style-type: none"> ● Is the hose connected? 	<p>Yes GO to A3.</p> <p>No RECONNECT the hose. TEST the system for normal operation.</p>
<p>A3 LEAK CHECK THE VACUUM SUPPLY HOSE</p>	

- Disconnect: Vacuum Supply Hose.
- Connect one end of the vacuum supply hose to a vacuum pump and test for leaks.



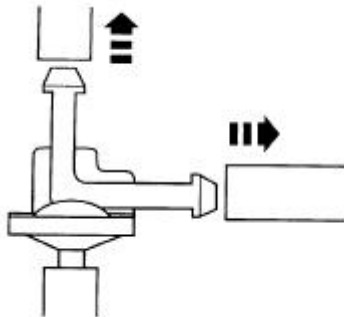
- Does the hose leak?

Yes
REPAIR or INSTALL a new vacuum hose.
TEST the system for normal operation.

No
GO to [A4](#).

A4 CHECK THE VACUUM CHECK VALVE

- Key in START position.
- Check the A/C vacuum check valve for correct installation by removing (one at a time) the reservoir hose and the control assembly source hose from the A/C vacuum check valve. Check for vacuum.



- Is vacuum available at both check valve ports?

Yes
GO to [A6](#).

No
GO to [A5](#).

A5 INSPECT THE VACUUM CHECK VALVE

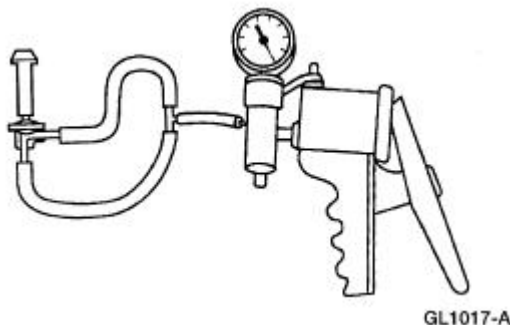
- Key in OFF position.
- Disconnect: A/C Vacuum Check Valve.
- Inspect the A/C vacuum check valve for an obstruction and correct operation. Airflow through the A/C vacuum check valve should be in the direction toward the engine (engine connection site is marked "VAC").
- Is the A/C vacuum check valve plugged or obstructed?

Yes
INSTALL a new A/C vacuum check valve.
TEST the system for normal operation.

No
GO to [A6](#).

A6 LEAK TEST THE VACUUM CHECK VALVE

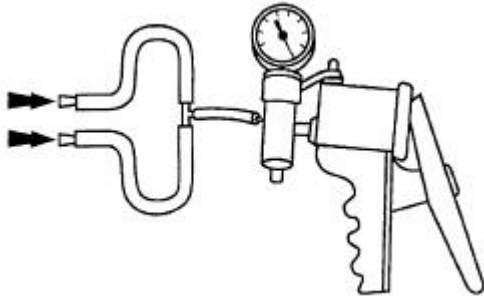
- Key in OFF position.
- Disconnect: Vacuum Check Valve.
- Connect the A/C vacuum check valve to a vacuum pump with two hoses and a tee fitting.



Yes
INSTALL a new A/C vacuum check valve.
TEST the system for normal operation.

No
RECONNECT the A/C vacuum check valve.
GO to [A7](#).

- Pump 51 kPa (15 in-Hg) vacuum on the A/C vacuum check valve and observe the gauge reading.
- If the vacuum loss exceeds 3.37 kPa (1 in-Hg) per minute, remove the A/C vacuum check valve from the tester and plug the vacuum hoses. Pump 51 kPa (15 in-Hg) of vacuum with the tester to be certain the hoses and tester are not the cause of the leak.

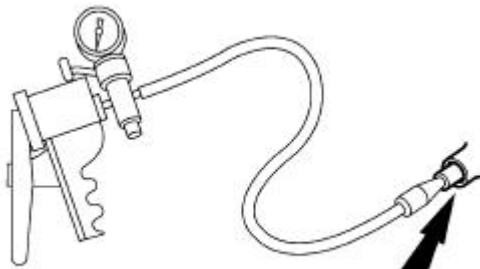


GL1018-A

- Does the A/C vacuum check valve lose more than 3.37 kPa (1 in-Hg) of vacuum in one minute?

A7 CHECK THE VACUUM RESERVOIR

- Disconnect: A/C Vacuum Reservoir Tank.
- Use a vacuum pump to leak test the A/C vacuum reservoir tank.



AM0954-A

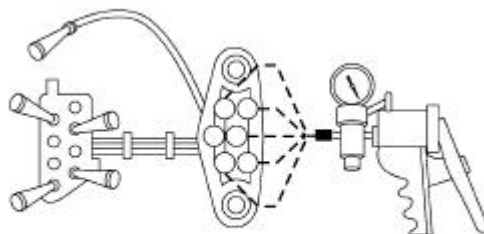
- Does the reservoir leak?

Yes
INSTALL a new A/C vacuum reservoir tank. TEST the system for normal operation.

No
RECONNECT the A/C vacuum reservoir tank. GO to [A8](#).

A8 CHECK THE SUPPLY HOSE

- Disconnect: Function Selector Switch Supply Hose.
- Use a vacuum pump to leak test the function selector switch supply hose.



AM2194-A

- Does the function selector switch supply hose leak?

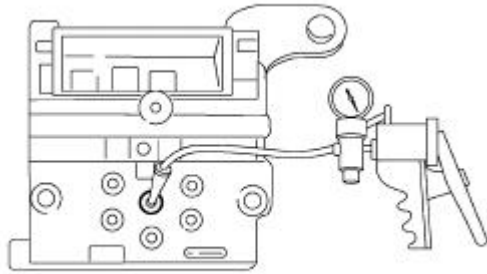
Yes
REPAIR or INSTALL a new function selector switch supply hose. TEST the system for normal operation.

No
RECONNECT the function selector switch supply hose. GO to [A9](#).

A9 CHECK THE CONTROL ASSEMBLY

- Disconnect: In-line Vacuum Harness.
- Connect a vacuum pump to the black hose and plug the other hoses.

Yes
NOTE the function selector switch position where the vacuum drops. GO to [A10](#).



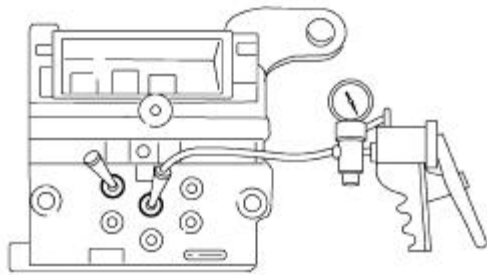
AM2195-A

- At each function selector switch position, apply 51 kPa (15 in-Hg) of vacuum and check for vacuum drop.
- **Does the vacuum drop exceed 3.37 kPa (1 in-Hg) per minute?**

No
RECONNECT the in-line vacuum harness connector. GO to [A11](#).

A10 LEAK TEST THE CONTROL ASSEMBLY

- Disconnect: Function Selector Switch Vacuum.
- Connect a vacuum pump to the function selector switch supply port and plug the control port that indicated a leak in Step A9.



AM2196-A

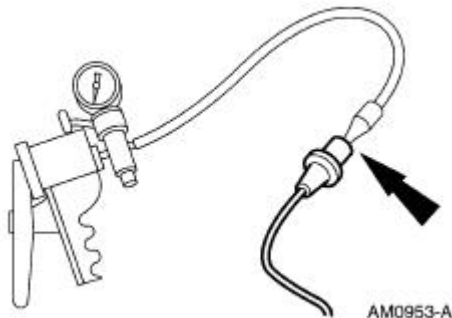
- Select the function selector switch position that indicated a leak in Step A9 and then apply 51 kPa (15 in-Hg) of vacuum.
- **Does the vacuum drop exceed 1.68 kPa (0.5 in-Hg) per minute?**

Yes
INSTALL a new function selector switch. TEST the system for normal operation.

No
RECONNECT the function selector switch vacuum connector. GO to [A12](#).

A11 CHECK THE SUPPLY HOSE FOR OBSTRUCTIONS

- Disconnect: Mode Selector Switch Supply Hose.
- Connect a vacuum pump to the supply hose and try to pull a vacuum. If the vacuum pump can pull a vacuum, the hose is plugged. If the vacuum pump pulls a partial vacuum, the hose is restricted.



AM0953-A

- **Is the hose plugged or restricted?**

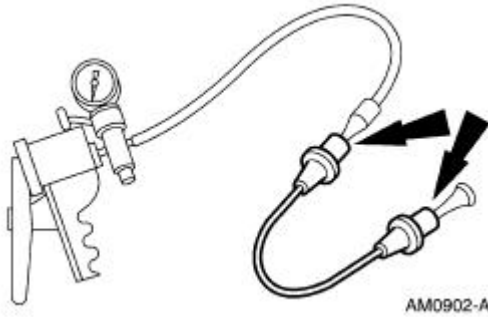
Yes
INSTALL a new supply hose. TEST the system for normal operation.

No
RECONNECT the A/C damper door switch supply hose. GO to [A15](#).

A12 LEAK TEST THE JUMPER VACUUM HARNESS

- Disconnect:
- Disconnect the suspect hose.
- Plug one end of the suspect hose and attach a vacuum pump to the other end. Apply 51 kPa (15 in-Hg) of vacuum to the hose.

Yes
REPAIR or INSTALL a new vacuum jumper harness. TEST the



- Does the vacuum drop?

system for normal operation.

No
REPAIR or INSTALL a new function selector switch. TEST the system for normal operation.

A13 REVIEW THE VEHICLE'S HISTORY

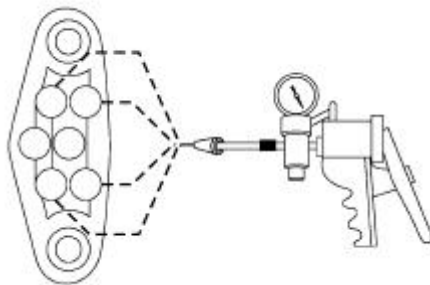
- Key in OFF position.
- Review the vehicles history.
- Did the climate control system function correctly prior to this concern?

Yes
GO to [A16](#).

No
GO to [A14](#).

A14 CHECK THE VACUUM HOSES TO DAMPER DOORS

- Connect a vacuum pump to each hose and try to pull a vacuum. If the vacuum pump can pull a vacuum, the hose is plugged. If the vacuum pump pulls a partial vacuum, the hose is restricted.



- Is a hose plugged or restricted?

Yes
INSTALL a new vacuum hose. TEST the system for normal operation.

No
GO to [A15](#).

A15 CHECK THE VACUUM HARNESS

- Compare the vacuum hose color in each vacuum harness to the vacuum diagram.
- Does the hose color agree with the schematics?

Yes
GO to [A16](#).

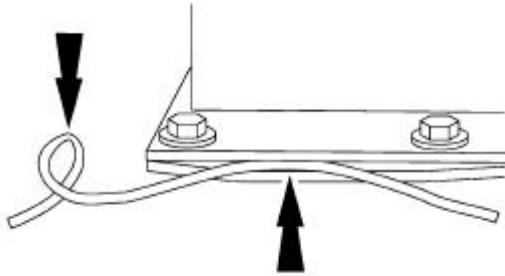
No
INSTALL a new vacuum harness. TEST the system for normal operation.

A16 CHECK A/C VACUUM CIRCUIT

- Check the A/C vacuum circuit for pinched or kinked vacuum hose.

Yes
REPAIR or INSTALL a new vacuum hose. TEST the system for normal operation.

No
GO to [A17](#).

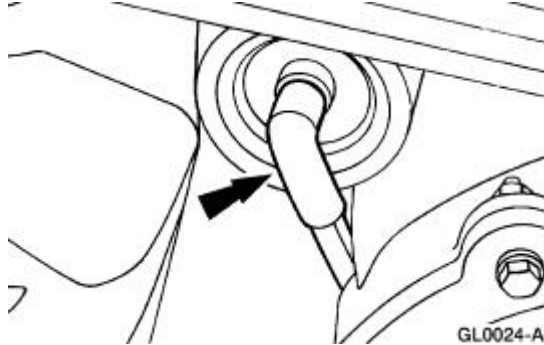


AM0351-B

- Is the hose pinched or kinked?

A17 CHECK VACUUM CIRCUIT CONNECTIONS

- Check each vacuum hose connection to determine if it is partially connected or disconnected.



GL0024-A

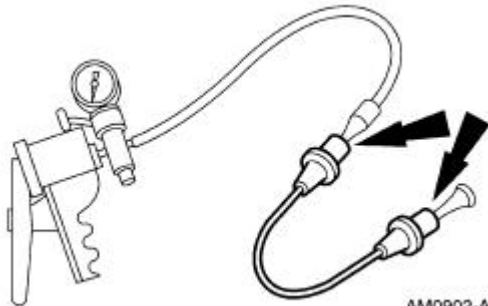
- Is a vacuum hose disconnected or partially connected?

Yes
RECONNECT the hose. TEST the system for normal operation.

No
GO to [A18](#).

A18 CHECK THE VACUUM HOSE

- Disconnect the suspect hose.
- Plug one end of the hose and attach a vacuum pump to the other end. Check for a leak in the hose.



AM0902-A

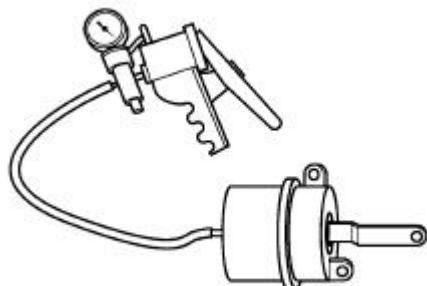
- Does the vacuum hose leak?

Yes
REPAIR or INSTALL a new hose. TEST the system for normal operation.

No
GO to [A19](#).

A19 CHECK THE VACUUM CONTROL MOTOR

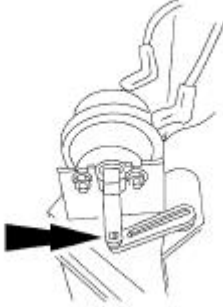
- Disconnect: Vacuum Control Motor.
- Check the vacuum control motor for leaks with a vacuum pump.



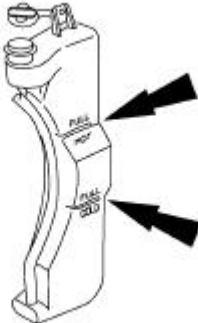

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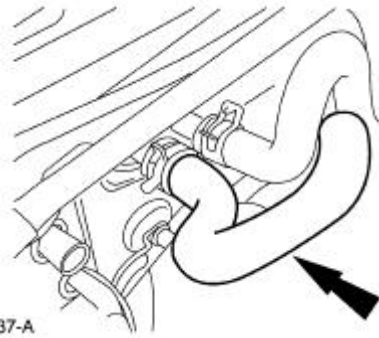
Yes
GO to [A20](#).

No
INSTALL a new vacuum control motor. TEST the system for normal operation.

<ul style="list-style-type: none"> ● Does the vacuum control motor hold a vacuum? 	
A20 CHECK THE VACUUM CONTROL MOTOR INSTALLATION	
<ul style="list-style-type: none"> ● Key in OFF position. ● Check the attachment of the vacuum control motor arm to damper door.  <p style="text-align: center;">AL0158-A</p> <ul style="list-style-type: none"> ● Is the vacuum control motor arm attached to the door or door crank arm? 	<p>Yes REPAIR or INSTALL a new damper door. TEST the system for normal operation.</p> <p>No CONNECT the vacuum control motor arm to the door and check operation. TEST the system for normal operation.</p>

PINPOINT TEST B: INSUFFICIENT, ERRATIC, OR NO HEAT

Test Step	Result / Action to Take
<p style="text-align: center;">B1 CHECK FOR CORRECT ENGINE COOLANT LEVEL</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Check the engine coolant level when hot and cold.  <p style="text-align: center;">AM2235-A</p> <ul style="list-style-type: none"> ● Is the engine coolant at the correct level (hot/cold) as indicated on the engine coolant recovery reservoir? 	<p>Yes GO to B2.</p> <p>No GO to B3.</p>
<p style="text-align: center;">B2 CHECK FOR HOT WATER TO THE HEATER CORE INLET HOSE</p> <p> WARNING: The heater core inlet hose will become too hot to handle and may cause serious burns if the system is working correctly.</p> <ul style="list-style-type: none"> ● Key in START position. ● Allow the engine to reach normal operating temperature. ● Feel the heater core inlet hose. 	<p>Yes GO to B4.</p> <p>No TEST the engine cooling system for correct operation. REFER to Section 303-03A or Section 303-03B.</p>



AM2237-A

- Is the heater core inlet hose too hot to handle?

B3 CHECK THE ENGINE COOLING SYSTEM INCLUDING RADIATOR CAP FOR LEAKS

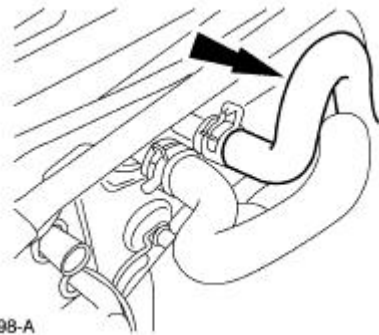
- Fill the engine cooling system to specified level.
- **NOTE:** It is not necessary to check the components separately at this time.
- Pressure check the engine cooling system. Refer to [Section 303-03A](#) or [Section 303-03B](#).
- **Does the engine cooling system, including the radiator cap, hold pressure?**

Yes
GO to [B4](#).

No
Pressure test the heater core. REFER to Component Tests, Heater Core — Pressure Test.

B4 CHECK THE HEATER CORE OUTLET HOSE FOR HOT WATER

- Feel the heater core outlet hose.



AM2198-A

- Is the heater core outlet hose cool or cold?

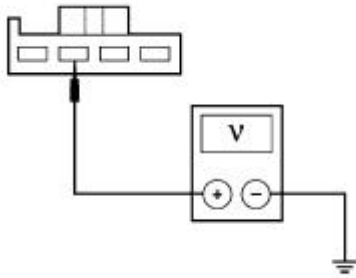
Yes
TEST the heater core for a plugged or partially plugged condition. REFER to [Section 303-03A](#) or [Section 303-03B](#).

No
GO to [Pinpoint Test E](#).

PINPOINT TEST C: THE A/C DOES NOT OPERATE/DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
C1 CHECK THE PCM PID WACF	
<ul style="list-style-type: none"> ● Connect the diagnostic tool. ● Turn the function selector to the OFF position. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: ● Monitor the PCM PID WACF while turning the function selector. ● Does the PCM PID WACF read YES? 	<p>Yes REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.</p> <p>No GO to C2.</p>
C2 CHECK THE PCM PID WACF WITH THE A/C ON	
<ul style="list-style-type: none"> ● Turn the function selector switch to the A/C position. ● Enter the following diagnostic mode on the diagnostic 	<p>Yes REFER to the Powertrain</p>

<p>tool:</p> <ul style="list-style-type: none"> ● Monitor the PCM PID WACF while turning the function selector. ● Does the PCM PID WACF read YES? 	<p>Control/Emissions Diagnosis (PC/ED) manual.</p> <p>No GO to C3.</p>
C3 CHECK THE PCM PID ACCS WITH THE A/C ON	
<ul style="list-style-type: none"> ● Key in START position. ● Make sure the engine is at idle. ● Enter the following diagnostic mode on the diagnostic tool: PCM PID ACCS. ● Monitor the PCM PID ACCS while turning the function selector. ● Does the PCM PID ACCS read ON? 	<p>Yes GO to C4.</p> <p>No GO to C6.</p>
C4 CHECK PCM PID WAC WITH THE A/C ON	
<p>NOTE: When PCM PID WACF is YES, this is the same fault as DTC P1460.</p> <ul style="list-style-type: none"> ● Enter the following diagnostic mode on the diagnostic tool: PCM PID WAC. ● Monitor the PCM PID WAC while turning the function selector. ● Does the PCM PID WAC read ON? 	<p>Yes GO to C20.</p> <p>No GO to C5.</p>
C5 CHECK THE INPUT SIGNAL TO THE PCM	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: PCM C175. ● Key in ON position. ● Measure the voltage at PCM C175-41, circuit 198 (DG/OG), harness side and ground. <div style="text-align: center;"> <p style="text-align: center;">GL2059-A</p> </div> <ul style="list-style-type: none"> ● Is the voltage reading greater than 10 volts? 	<p>Yes INSTALL a new powertrain control module. TEST the system for normal operation.</p> <p>No GO to C6.</p>
C6 CHECK THE REFRIGERANT PRESSURE	
<ul style="list-style-type: none"> ● Key in OFF position. ● Connect the manifold gauge set. Refer to Refrigerant System Tests in this section. ● Is the system pressure 345-1,724kPa (50-250psi)? 	<p>Yes GO to C7.</p> <p>No REPAIR the leaks and RETEST the system for normal operation. REFER to Section 412-03.</p>
C7 CHECK THE SUPPLY TO THE FUNCTION SELECTOR SWITCH	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Function Selector Switch C294c. ● Key in ON position. ● Measure the voltage at the function selector switch C294c-2, circuit 883 (PK/LB), harness side and ground. 	<p>Yes GO to C17.</p> <p>No GO to C8.</p>

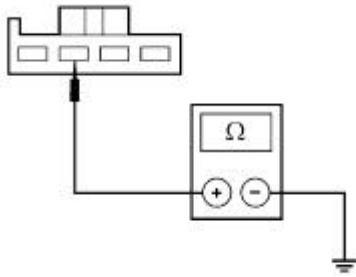


GL2055-A

- Is the voltage reading greater than 10 volts?

C8 CHECK CIRCUIT 883 (PK/LB) FOR A SHORT TO GROUND

- Key in OFF position.
- Measure the resistance between the function selector switch C294c-2, circuit 883 (PK/ LB) harness side and ground.



GL2053-A

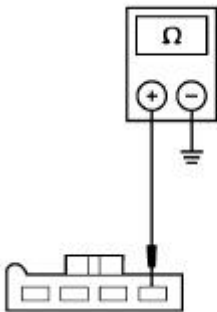
- Is the resistance less than 5 ohms?

Yes
GO to [C9](#).

No
GO to [C11](#).

C9 CHECK CIRCUIT 348 (VT) FOR SHORT TO GROUND

- Disconnect: A/C Cycling Switch C130.
- Measure the resistance between the function selector switch C294c-4, circuit 348 (VT) harness side and ground.



AM0586-A

- Is the resistance reading less than 10,000 ohms?

Yes
REPAIR circuit 348 (VT). TEST the system for normal operation.

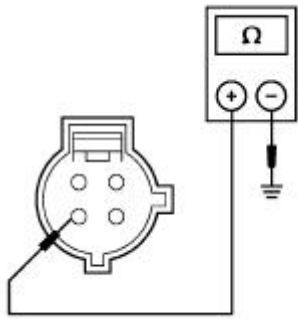
No
GO to [C10](#).

C10 CHECK FOR A SHORTED FUNCTION SELECTOR SWITCH

- Connect: Function Selector Switch C294c.
- Measure the resistance between the A/C cycling switch C130-4, circuit 348 (VT) harness side and ground.

Yes
INSTALL a new function selector switch. REFER to [Section 412-04](#). TEST the system for normal operation.

No
GO to [C13](#).

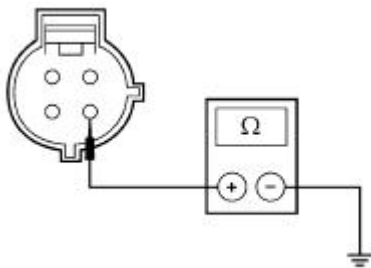


AM1018-A

- Turn the function selector switch to each of the following positions and note the resistance reading:
 - MAX A/C
 - A/C
 - VENT
 - FLOOR
 - MIX
 - DEFROST
- Are any of the readings less than 10,000 ohms?

C11 CHECK CIRCUIT C198 (DG/OG) FOR A SHORT TO GROUND

- Connect: A/C Cycling Switch C130.
- Disconnect: A/C Pressure Cut-off Switch C1078.
- **NOTE:** The A/C pressure cut-off switch C1078 for the 3.8L engine is shown, C1078 for the 4.6L engines is similar. The pin locations and the circuits are identical.
- Measure the resistance between the A/C pressure cut-off switch C1078-3, circuit 198 (DG/OG), harness side and ground.



GL2056-A

- Is the resistance reading less than 10,000 ohms?

Yes
GO to [C14](#).

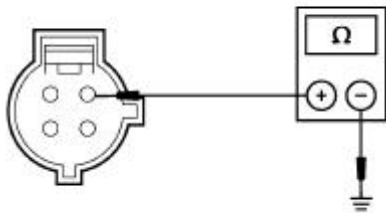
No
GO to [C12](#).

C12 CHECK THE A/C CYCLING SWITCH FOR A SHORT TO GROUND

- Disconnect: A/C Cycling Switch C130.
- **NOTE:** The A/C pressure cut-off switch C1078 for the 3.8L engine is shown, C1078 for the 4.6L engines is similar. The pin locations and the circuits are identical.
- Measure the resistance between the A/C pressure cut-off switch C1078-2, circuit 420 (DB/YE), harness side and ground.

Yes
REPAIR circuit C420 (DB/YE) for a short to ground. TEST for normal operation.

No
INSTALL a new A/C cycling switch. REFER to [Section 412-03](#). TEST system for normal operation.

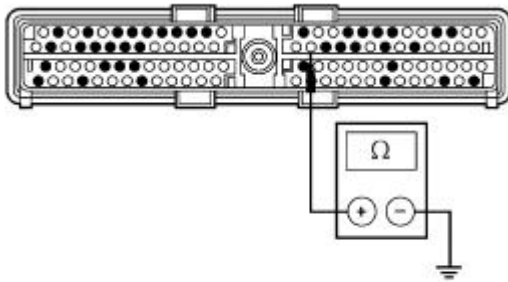


AM2248-A

- Is the resistance reading less than 10,000 ohms?

C13 CHECK CIRCUIT 198 (DG/OG) FOR A SHORT TO GROUND

- Connect: A/C Pressure Cut-off Switch C1078.
- Measure the resistance between PCM C175-41, circuit 198 (DG/OG), harness side and ground.

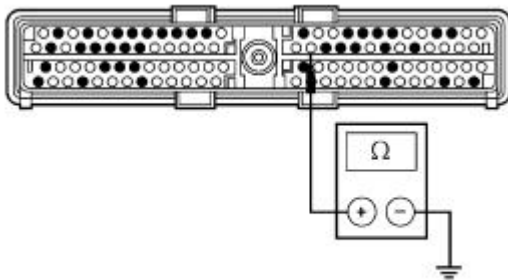


GL2058-A

- Is the resistance less than 10,000 ohms?

C14 CHECK THE A/C PRESSURE CUT-OFF SWITCH

- Disconnect: A/C Pressure Cut-off Switch C1078.
- Measure the resistance between the Rotunda EEC-V Breakout Box pin 41, circuit 198 (DG/OG), and ground.



GL2058-A

- Is the resistance less than 10,000 ohms?

C15 CHECK THE FUNCTION SELECTOR SWITCH

- Key in OFF position.
- Connect: Function Selector Switch C294c.
- Disconnect: A/C Cycling Switch C130.
- Key in ON position.
- Turn the function selector switch to the A/C position.
- Measure the voltage between C130-4, circuit 348 (VT), harness side and ground.

Yes
GO to [C15](#).

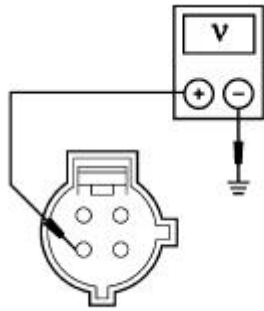
No
INSTALL a new A/C fuse (15A). TEST the system for normal operation. If the fuse opens, install a new PCM. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Yes
REPAIR circuit 198 (DG/OG) for a short to ground. TEST the system for normal operation.

No
INSTALL a new A/C pressure cut-off switch. REFER to [Section 412-03](#).

Yes
GO to [C17](#).

No
GO to [C16](#).

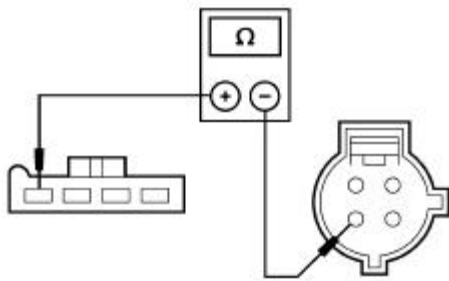


AM0722-A

- Is the voltage reading greater than 10 volts?

C16 MEASURE THE RESISTANCE OF CIRCUIT 348 (VT)

- Key in OFF position.
- Disconnect: Function Selector Switch C294c.
- Measure the resistance between the A/C function selector switch C294c-1, circuit 348 (VT), harness side and A/C cycling switch C130-4, circuit 348 (VT), harness side.

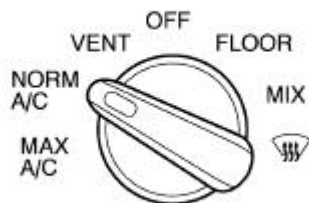


AM2249-A

- Is the resistance reading less than 5 ohms?

C17 MEASURE THE VOLTAGE TO THE A/C PRESSURE CUT-OFF SWITCH

- Key in OFF position.
- Connect: A/C Cycling Switch C130.
- Disconnect: A/C Pressure Cut-off Switch C1078.
- Turn the function selector switch to the A/C position.



AM1452-A

- **NOTE:** The A/C pressure cut-off switch C1078 for the 3.8L engine is shown, C1078 for the 4.6L engines is similar. The pin locations and the circuits are identical.
- Measure the voltage at the A/C high pressure cut-off switch C1078-2 circuit 420 (DB/YE), harness side and ground.

Yes

INSTALL a new function selector switch. REFER to [Section 412-04](#). TEST the system for normal operation.

No

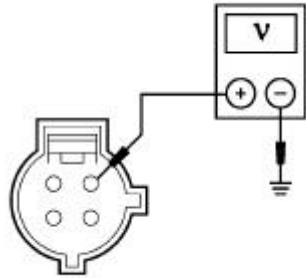
REPAIR circuit 348 (VT) for an open. TEST the system for normal operation.

Yes

GO to [C19](#).

No

GO to [C18](#).

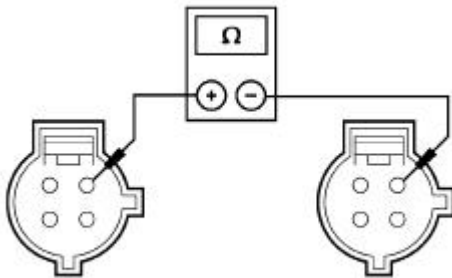


AM2250-A

- Is the voltage reading greater than 10 volts?

C18 CHECK THE A/C CYCLING SWITCH

- Key in OFF position.
- Disconnect: A/C Cycling Switch C130.
- **NOTE:** The A/C pressure cut-off switch C1078 for the 3.8L engine is shown, C1078 for the 4.6L engines is similar. The pin locations and the circuits are identical.
- Measure the resistance between A/C cycling switch C130-2, circuit 420 (DB/YE), harness side and the A/C high pressure cut-off switch C1078-2, circuit 420 (DB/YE), harness side.



AM2251-A

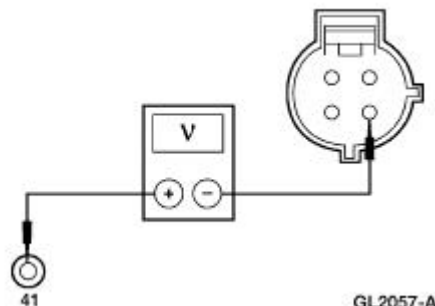
- Is the resistance less than 5 ohms?

Yes
 INSTALL a new A/C cycling switch. REFER to [Section 412-03](#). TEST the system for normal operation.

No
 REPAIR circuit 420 (DB/YE) for an open. TEST the system for normal operation.

C19 CHECK THE A/C PRESSURE CUT-OFF SWITCH

- Key in OFF position.
- **NOTE:** The A/C pressure cut-off switch C1078 for the 3.8L engine is shown, C1078 for the 4.6L engines is similar. The pin locations and the circuits are identical.
- Measure the resistance between Rotunda Breakout Box pin 41 and A/C high pressure cut-off switch C1078-3, circuit 198 (DG/OG), harness side.



GL2057-A

- Is the resistance less than 5 ohms?

Yes
 INSTALL a new A/C pressure cut-off switch. REFER to [Section 412-03](#). TEST the system for normal operation.

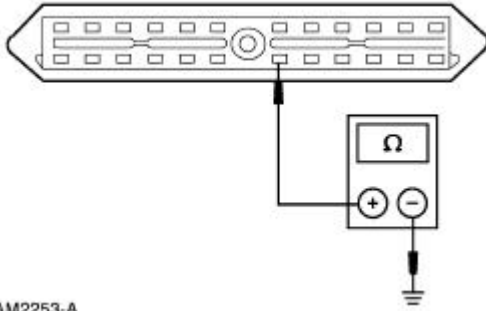
No
 REPAIR circuit 198 (DG/OG) for an open. TEST the system for normal operation.

C20 CHECK THE GROUND CIRCUIT AT THE CONSTANT CONTROL RELAY MODULE

- Key in OFF position.

Yes

- Disconnect: CCRM C1262.
- Measure the resistance of CCRM C1262-18, circuit 1205 (BK), harness side and ground.



AM2253-A

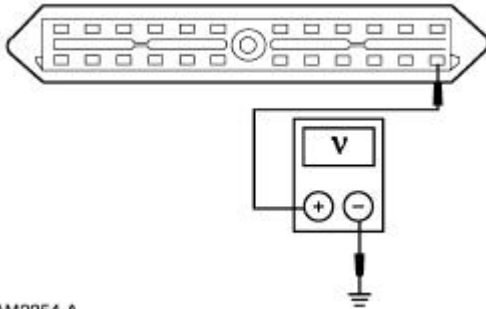
- Is the resistance reading less than 5 ohms?

GO to [C21](#).

No
REPAIR circuit 1205 (BK) for an open. TEST the system for normal operation.

C21 CHECK CIRCUIT 20 (WH/LB) AT THE CONSTANT CONTROL RELAY MODULE

- Key in ON position.
- Measure the voltage at the CCRM C1262-13, circuit 20 (WH/LB), harness side and ground.



AM2254-A

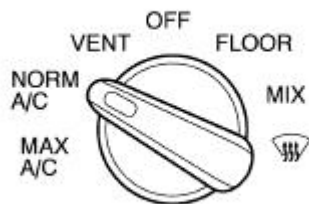
- Is the voltage reading greater than 10 volts?

Yes
GO to [C22](#).

No
REPAIR circuit 20 (WH/LB) for an open. TEST the system for normal operation.

C22 CHECK THE POWER TO THE A/C CLUTCH

- Key in OFF position.
- Connect: CCRM 1262.
- Disconnect: A/C Clutch C100.
- Turn the function selector to the A/C position.

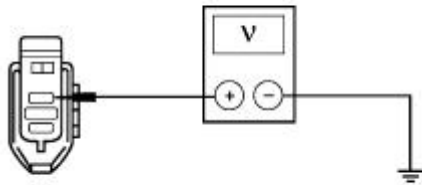


AM1452-A

- Measure the voltage at the A/C clutch C100, circuit 347 (BK/YE), harness side and ground.

Yes
GO to [C24](#).

No
GO to [C23](#).

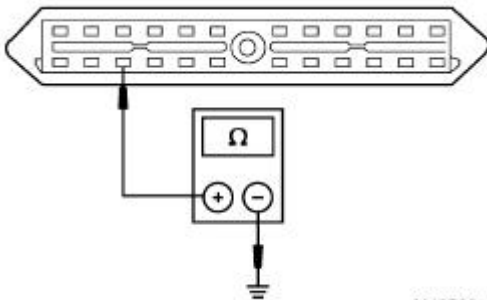


GL0225-A

- Is the voltage greater than 10 volts?

C23 CHECK CIRCUIT 331 (PK/YE) FOR AN OPEN.

- Key in OFF position.
- Disconnect: CCRM C1262.
- Key in ON position.
- Enter the following diagnostic mode on the diagnostic tool:
- In the Active Command Mode command the PCM outputs ON.
- Measure the resistance between the CCRM C1262-22, circuit 331 (PK/YE), harness side and ground.

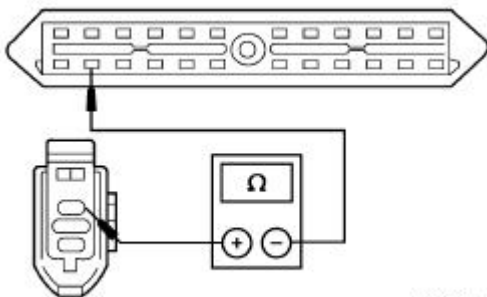


AM0733-A

- Is the resistance reading less than 5 ohms?

C24 CHECK CIRCUIT 347 (BK/YE)

- Key in OFF position.
- Measure the resistance between CCRM C1262-23, circuit 347 (BK/YE), harness side and A/C clutch C100-1, harness side.



AM0724-A

- Is the resistance less than 5 ohms?

C25 CHECK CIRCUIT 347 (BK/YE) FOR A SHORT TO GROUND.

- Measure the resistance between A/C clutch C100-2, circuit 1205 (BK), harness side and the CCRM C1262-16, circuit 1205 (BK) harness side.

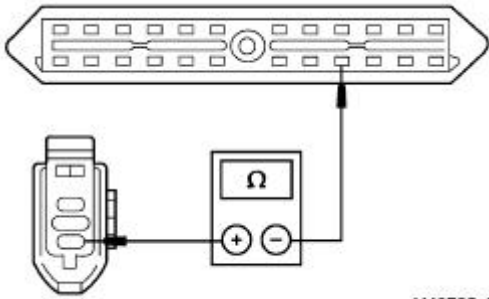
Yes
GO to [C24](#).

No
REPAIR circuit 331 (PK/YE) for an open. TEST the system for normal operation.

Yes
GO to [C25](#).

No
REPAIR circuit 347 (BK/YE) for an open. TEST the system for normal operation.

Yes
INSTALL a new constant control relay module. TEST the system for normal operation.

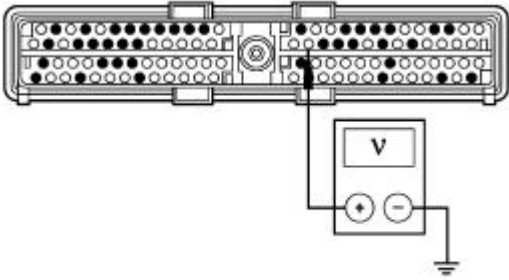


AM0725-A

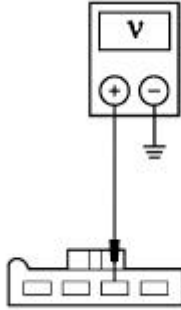
- Is the resistance less than 5 ohms?

No
REPAIR circuit 1205 (BK) for an open. TEST the system for normal operation.

PINPOINT TEST D: THE A/C IS ALWAYS ON

Test Step	Result / Action to Take
<p>D1 CHECK PCM PID WACF</p> <ul style="list-style-type: none"> ● Turn the function selector switch to the OFF position. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: PCM PID WACF. ● Does the PCM PID WACF read YES? 	<p>Yes REPAIR circuit 331 (PK/YE) for a short to ground. TEST the system for normal operation.</p> <p>No GO to D2.</p>
<p>D2 CHECK PID ACCS WITH A/C OFF</p> <ul style="list-style-type: none"> ● Enter the following diagnostic mode on the diagnostic tool: PCM PID ACCS. ● Does the PCM PID ACCS read ON? 	<p>Yes GO to D3.</p> <p>No GO to D5.</p>
<p>D3 CHECK FOR A FALSE INPUT SIGNAL TO THE PCM</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: PCM C175. ● Key in ON position. ● Turn the function selector switch to the OFF position. ● Measure the voltage between PCM C175-41, circuit 198 (DG/OG) harness side and ground.  <p style="text-align: center;">GL2059-A</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to D4.</p> <p>No INSTALL a new powertrain control module. REFER to Section 303-14. TEST the system for normal operation.</p>
<p>D4 CHECK CIRCUIT 198 (DG/OG) FOR A SHORT TO B+</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Function Selector Switch C294c. ● Connect: PCM C175. ● Key in ON position. ● Measure the voltage at the function selector switch 	<p>Yes REPAIR circuit 348 (PK) for a short to B+. TEST the system for normal operation.</p>

C294c-3, circuit 348 (PK), harness side and ground.



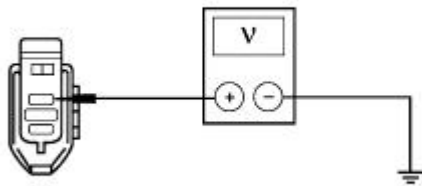
AM0582-A

- Is there voltage present?

No
INSTALL a new function selector switch. REFER to [Section 412-04](#). TEST the system for normal operation.

D5 CHECK FOR A SHORTED CLUTCH INPUT

- Key in OFF position.
- Disconnect: A/C Clutch C100.
- Key in ON position.
- Measure for voltage at the A/C clutch C100, circuit 347 (BK/YE), harness side and ground.



GL0225-A

- Is there voltage present?

Yes
INSTALL a new constant control relay module. TEST the system for normal operation.

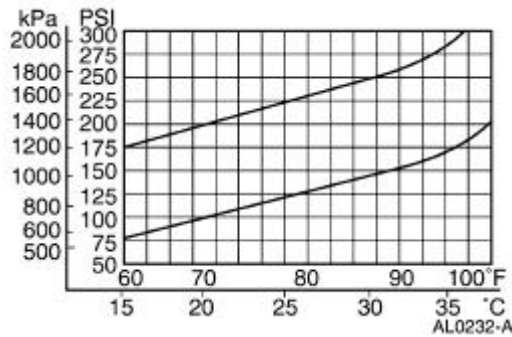
No
CHECK the clutch air gap. REFER to [Air Conditioning \(A/C\) Clutch Air Gap Adjustment](#).

PINPOINT TEST E: INSUFFICIENT A/C COOLING

Test Step	Result / Action to Take
<p>E1 CHECK THE CENTER A/C REGISTER DISCHARGE TEMPERATURE</p>	
<ul style="list-style-type: none"> ● Carry out the refrigerant system tests. Refer to Refrigerant System Tests in this section. ● Use the recorded data from the refrigerant system tests to plot a vertical line for ambient temperature and a horizontal line for center A/C register discharge temperature. <p style="text-align: center;">AL0238-A</p> <ul style="list-style-type: none"> ● Is the intersection of the two lines within the upper and lower limits? 	<p>Yes The tests indicate that the system is functioning normally.</p> <p>No GO to E2.</p>

E2 CHECK FOR NORMAL DISCHARGE PRESSURE

- Use the recorded data from the refrigerant system tests to plot a vertical line for ambient temperature and a horizontal line for compressor discharge (high) pressure.



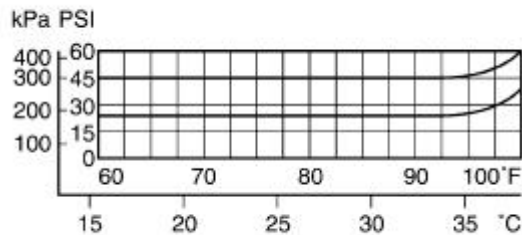
- Is the intersection of the two lines within the upper and lower limits?

Yes
GO to [E3](#).

No
GO to [E8](#).

E3 EVALUATE THE SYSTEM LOW PRESSURE PERFORMANCE

- Use the recorded data from the refrigerant system tests to plot a vertical line for ambient temperature and a horizontal line for compressor suction (low) pressure.



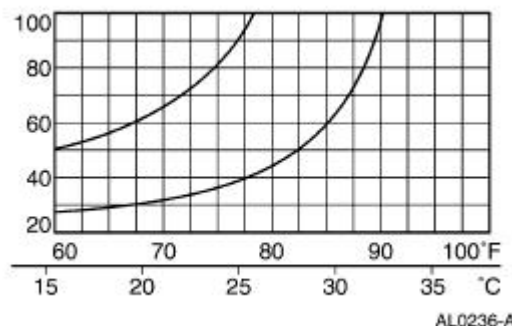
- Is the intersection of the two lines within the upper and lower limits?

Yes
GO to [E4](#).

No
GO to [E6](#).

E4 CHECK FOR A SLOW OR CONTINUOUS RUN A/C CLUTCH CYCLE RATE

- Use the recorded data from the refrigerant system tests to plot a vertical line for ambient temperature and a horizontal line for total A/C clutch cycle time (time ON plus time OFF) in seconds.



- Is the intersection of the two lines above the upper limit?

Yes
GO to [E5](#).

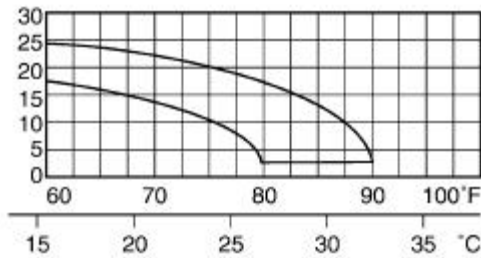
No
INSTALL a new A/C evaporator core due to a partially restricted or plugged condition. REFER to [Section 412-02](#). TEST the system for normal operation.

E5 CHECK FOR A LONG OR CONTINUOUS A/C CLUTCH OFF TIME

- Use the recorded data from the refrigerant system tests

Yes

to plot a vertical line for ambient temperature and a horizontal line for A/C clutch OFF time in seconds.



AL0235-A

- Is the intersection of the two lines above the upper limit?

DISCHARGE and RECOVER the system to remove excessive moisture or refrigerant oil. REFER to [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#). TEST the system for normal operation.

No
GO to [E7](#).

E6 CHECK FOR A HIGH SUCTION PRESSURE

- Refer to the data plot used to evaluate the system low pressure performance in Step E3.
- Is the intersection of the two lines above the upper limit?

Yes
REMOVE the A/C evaporator core orifice to repair missing or damaged (leaking) O-ring seals. REFER to [Section 412-03](#). TEST the system for normal operation.

No
INSTALL a new A/C cycling switch when the intersection of the two lines is below the lower limit. REFER to [Section 412-03](#). TEST the system for normal operation.

E7 CHECK THE AMBIENT TEMPERATURE

- Refer to the data plot used to evaluate the system A/C clutch OFF time in Step E5.
- Is the ambient temperature above 26°C (80°F)?

Yes
This is normal operation for the refrigerant system in high humidity conditions.

No
DISCHARGE and RECOVER the system to correct an overcharge condition. REFER to [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#). TEST the system for normal operation.

E8 CHECK FOR A HIGH DISCHARGE PRESSURE

- Refer to the data plot used to evaluate the system high pressure performance in Step E2.
- Is the intersection of the two lines above the upper limit?

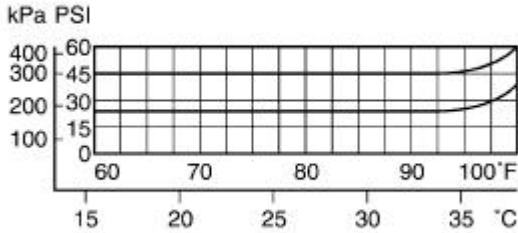
Yes
GO to [E9](#).

No
GO to [E11](#).

E9 CHECK FOR A NORMAL LOW PRESSURE

- Use the recorded data from the refrigerant system tests to plot a vertical line for ambient temperature and a horizontal line for compressor suction (low) pressure.

Yes
REFER to [Section 303-03A](#) or [Section 303-03B](#). to diagnose the engine cooling system. TEST the system for normal operation.



AL0233-A

- Is the intersection of the two lines within the upper and lower limits?

No
GO to [E10](#).

E10 CHECK FOR A NORMAL TO LOW SUCTION PRESSURE

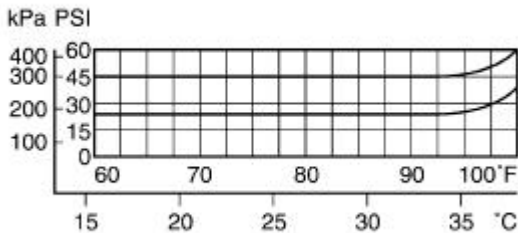
- Refer to the data plot used to evaluate the system low pressure performance in Step E9.
- Is the intersection of the two lines below the lower limit?

Yes
INSTALL a new A/C evaporator core orifice due to a partially restricted or plugged condition. REFER to [Section 412-03](#). TEST the system for normal operation.

No
INSPECT the A/C condenser core (19712) for a partially blocked or inadequate airflow. TEST the system for normal operation.

E11 CHECK FOR A NORMAL SUCTION PRESSURE

- Use the recorded data from the refrigerant system tests to plot a vertical line for ambient temperature and a horizontal line for compressor suction (low) pressure.



AL0233-A

- Is the intersection of the two lines within the upper and lower limits?

Yes
GO to [E12](#).

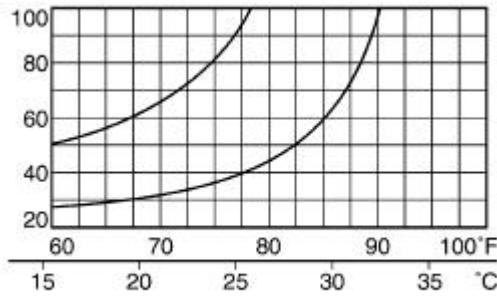
No
GO to [E15](#).

E12 CHECK FOR A SLOW A/C CLUTCH CYCLE RATE

- Use the recorded data from the refrigerant system tests to plot a vertical line for ambient temperature and a horizontal line for total A/C clutch cycle time (time ON plus time OFF) in seconds.

Yes
INSTALL a new evaporator to compressor suction line (19D742) due to a partially restricted or plugged condition. REFER to [Section 412-03](#). TEST the system for normal operation.

No
GO to [E13](#).

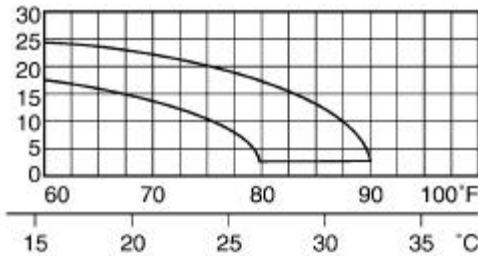


AL0236-A

- Is the intersection of the two lines above the upper limit?

E13 CHECK FOR A NORMAL A/C CLUTCH OFF TIME

- Use the recorded data from the refrigerant system tests to plot a vertical line for ambient temperature and a horizontal line for A/C clutch OFF time in seconds.



AL0235-A

- Is the intersection of the two lines within the upper and lower limits?

Yes
INSPECT the A/C evaporator core due to a low or restricted airflow. TEST the system for normal operation.

No
GO to [E14](#).

E14 CHECK FOR A LONG A/C CLUTCH OFF TIME

- Refer to the data plot used to evaluate the system A/C clutch OFF time performance in Step E13.
- Is the intersection of the two lines above the upper limit?

Yes
INSTALL a new A/C condenser core due to a partially restricted or plugged condition. REFER to [Section 412-03](#). TEST the system for normal operation.

No
EVACUATE and RECHARGE the system when the intersection of the two lines is below the lower limit. REFER to [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#). TEST the system for normal operation.

E15 CHECK FOR A MISSING A/C EVAPORATOR CORE ORIFICE

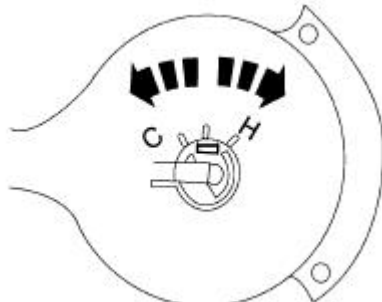
- Remove the A/C evaporator core orifice tube. Refer to [Section 412-03](#).
- Is the A/C evaporator core orifice missing?

Yes
INSTALL a new A/C evaporator core orifice. REFER to [Section 412-03](#). TEST the system for normal operation.

No

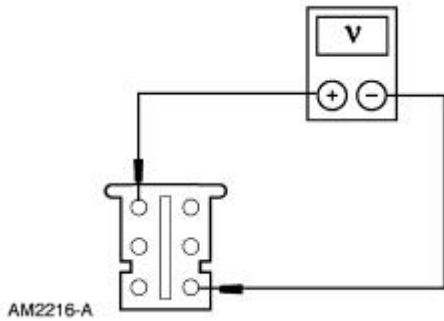
INSTALL a new A/C compressor due to low performance. REFER to [Section 412-03](#). TEST the system for normal operation.

PINPOINT TEST F: NO OPERATION IN ALL TEMPERATURE SETTINGS

Test Step	Result / Action to Take
F1 CHECK THE TEMPERATURE CONTROL <ul style="list-style-type: none"> ● Start the engine and run at idle. Allow the engine to reach normal operating temperature. ● Place the function selector switch in the NORMAL A/C position. ● Adjust the temperature control to full warm position, and physically feel the discharge air temperature at the center panel vents. ● Rotate the temperature control to full cold position, and physically feel the discharge air temperature at the center panel vents. ● Does the discharge air temperature vary? 	<p>Yes The temperature blend door is functioning correctly. RETURN to the symptom chart.</p> <p>No GO to F2.</p>
F2 CHECK FOR A BROKEN A/C TEMPERATURE CONTROL CABLE <ul style="list-style-type: none"> ● Remove the climate control assembly to gain access to the control cable head. ● Move the temperature control from full warm to full cold. ● Inspect the cable control head as you move the temperature control.  <p>AM2141-A</p> <ul style="list-style-type: none"> ● Does the alignment mark on the control head move? 	<p>Yes INSTALL a new evaporator housing. REFER to Section 412-02.</p> <p>No INSTALL a new temperature control cable assembly. REFER to Section 412-04.</p>

PINPOINT TEST G: THE BLOWER MOTOR DOES NOT OPERATE/DOES NOT OPERATE CORRECTLY

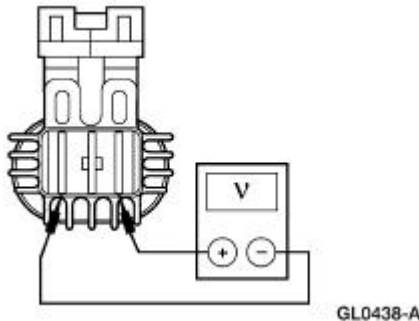
Test Step	Result / Action to Take
G1 CHECK FOR VOLTAGE AT C238 <ul style="list-style-type: none"> ● Disconnect: Blower Motor Jumper C238. ● Key in ON position. ● Turn the blower motor selector to LOW. ● Turn the function selector to FLOOR. ● Check for voltage between C238-6, circuit 249 (DB/LG) and C238-3, circuit 261 (OG/BK). 	<p>Yes GO to G2.</p> <p>No GO to G4.</p>



- Is the voltage greater than 10 volts?

G2 CHECK THE BLOWER MOTOR FOR VOLTAGE

- Key in OFF position.
- Connect: Blower Motor Jumper C238.
- Disconnect: Blower Motor C2066.
- Key in ON position.
- Measure voltage between terminals of blower motor.



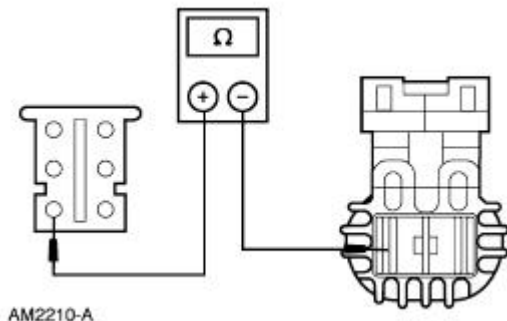
- Check for voltage between circuit 249 (DB/LG) and circuit 261 (OG/BK).
- Is the voltage greater than 10 volts?

Yes
INSTALL a new blower motor. REFER to [Section 412-02](#). TEST the system for normal operation.

No
GO to [G3](#).

G3 CHECK THE A/C BLOWER MOTOR JUMPER WIRE

- Key in OFF position.
- Disconnect: Blower Motor Jumper C238.
- Key in ON position.
- Check circuit 261 (OG/BK) for an open between C2066 and C238-4.



- Is the resistance greater than 5 ohms?

Yes
REPAIR circuit 261 (OG/BK). TEST the system for normal operation.

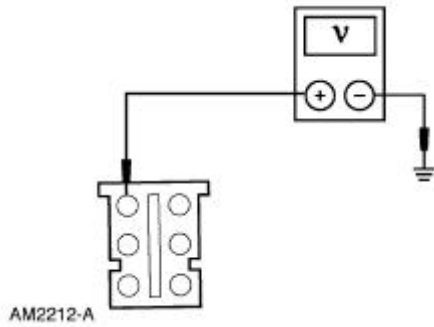
No
INSTALL a new blower motor. REFER to [Section 412-02](#). TEST the system for normal operation.

G4 CHECK CIRCUIT 249 (DB/LG)

- Check for voltage between C238-6, circuit 249 (DB/LG), harness side and ground.

Yes
GO to [G5](#).

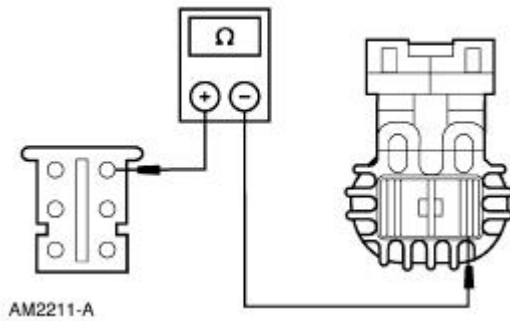
No
GO to [G8](#).



- Is the voltage greater than 10 volts?

G5 CHECK CIRCUIT 249 (DB/LG) FOR OPEN

- Check the resistance on circuit 249 (DB/LG) between C238-3 and C2066.



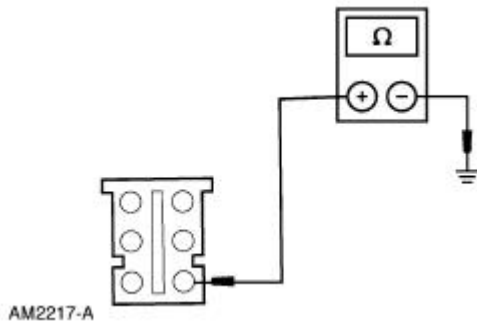
- Is resistance less than 10,000 ohms?

Yes
REPAIR circuit 249 (DB/LG) for an open. TEST the system for normal operation.

No
GO to [G6](#).

G6 CHECK THE BLOWER MOTOR GROUND

- Key in OFF position.
- Measure the resistance between the jumper C238-3, circuit 261 (OG/BK), and ground.



- Is the resistance less than 5 ohms?

Yes
GO to [G7](#).

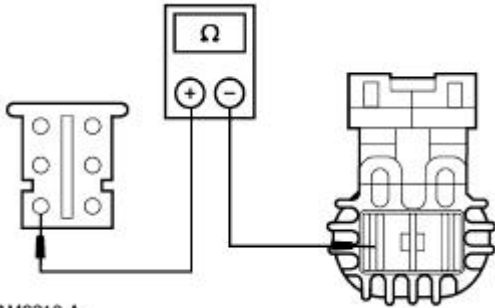
No
GO to [G10](#).

G7 CHECK CIRCUIT 261 (OG/BK) FOR AN OPEN CIRCUIT

- Measure the resistance between the A/C blower motor jumper C238-3, circuit 261 (OG/BK) and the blower motor switch C294a-1.

Yes
REPAIR the blower motor jumper. TEST the system for normal operation.

No
INSTALL a new blower motor. REFER to [Section 412-02](#). TEST the system for normal operation.

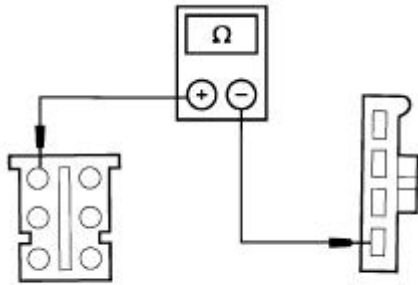


AM2210-A

- Is the resistance more than 10,000 ohms?

G8 CHECK CIRCUIT 249 (DB/LG) FOR AN OPEN CIRCUIT

- Key in OFF position.
- Disconnect: Function Selector Switch C294c.
- Measure the resistance between C238-3, circuit 249 (DB/LG), harness side and C294c-4 harness side.

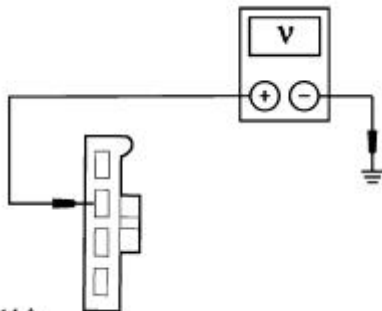


AM2213-A

- Is the resistance more than 10,000 ohms?

G9 CHECK CIRCUIT 181 (BN/OG), FOR VOLTAGE

- Measure the voltage between C294c-2, circuit 181 (BN/OG), harness side and ground.



AM2214-A

- Is the voltage greater than 10 volts?

G10 CHECK CIRCUIT 1205 (BK) FOR AN OPEN

Yes
REPAIR circuit 249 (DB/LG) for an open. TEST the system for normal operation.

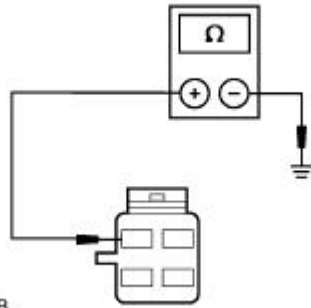
No
GO to [G9](#).

Yes
INSTALL a new function selector switch. REFER to [Section 412-04](#). TEST the system for normal operation.

No
REPAIR circuit 181 (BN/OG) for an open. TEST the system for normal operation.

Yes
INSTALL a new blower motor switch. REFER to [Section 412-04](#). TEST the system for normal operation.

No
REPAIR circuit 1205 (BK). TEST the system for normal operation.



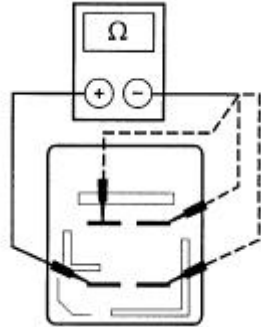
AM2215-B

- Check the resistance between C294a-3, circuit 1205 (B/K) harness side and ground.
- Is the resistance less than 5 ohms?

PINPOINT TEST H: THE BLOWER MOTOR OPERATES CONTINUOUSLY IN HIGH SPEED

Test Step	Result / Action to Take				
<p>H1 CHECK THE FUNCTION SELECTOR SWITCH</p> <ul style="list-style-type: none"> ● Key in ON position. ● Set the blower motor speed to low. ● Check for blower motor operation in each function selector switch position. ● Does the blower motor operate on high in all of the function selector positions? 	<p>Yes GO to H2.</p> <p>No If the blower motor operates in the OFF position, GO to H4.</p>				
<p>H2 CHECK CIRCUIT 261 (OG/BK) FOR A SHORT TO GROUND</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: A/C Blower Motor C2066. ● Disconnect: Blower Motor Resistor C2185. ● Disconnect: Blower Motor Switch C294a. ● Measure the resistance between C2066 circuit 261 (OG/BK), and ground. <p style="text-align: center;">GL0985-A</p> <ul style="list-style-type: none"> ● Is the resistance greater than 10,000 ohms? 	<p>Yes GO to H3.</p> <p>No REPAIR circuit 261 (OG/BK) for a short to ground. TEST the system for normal operation.</p>				
<p>H3 CHECK THE BLOWER MOTOR SWITCH OPERATION</p> <ul style="list-style-type: none"> ● Measure the resistance of the blower motor switch. Refer to the chart shown. <p>Blower Motor Switch Test</p> <table border="1"> <thead> <tr> <th>Switch Position</th> <th>Conductivity Between Terminals</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> </tr> </tbody> </table>	Switch Position	Conductivity Between Terminals			<p>Yes INSTALL a new heater blower motor switch resistor. REFER to Section 412-04 . TEST the system for normal operation.</p> <p>No</p>
Switch Position	Conductivity Between Terminals				

Low	None
Medium/low	2 and 3 only
Medium/high	2, 3 and 4 only
High	1, 2 and 4 only



- Is the resistance less than 5 ohms?

INSTALL a new heater blower motor switch. REFER to [Section 412-04](#). TEST the system for normal operation.

H4 CHECK THE FUNCTION SELECT SWITCH FOR A SHORT TO BATTERY

- Key in OFF position.
- Disconnect: Function Selector Switch C294c.
- Key in ON position.
- Did the blower motor stop operating?

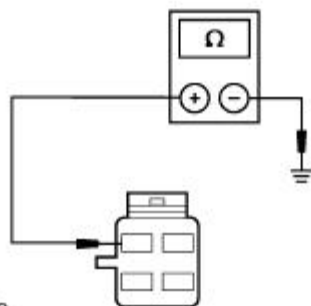
Yes
INSTALL a new function selector switch. REFER to [Section 412-04](#). TEST the system for normal operation.

No
REPAIR circuit 249 (DB/LG) for a short to battery. TEST the system for normal operation.

PINPOINT TEST I: NO OPERATION IN HIGH BLOWER SETTING

Test Step	Result / Action to Take
I1 CHECK CIRCUIT 261 (OG/BK) FOR AN OPEN CIRCUIT <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Blower Motor Switch C294a. ● Key in ON position. ● Turn the function selector switch to the FLOOR position. ● Measure the voltage between blower motor switch C294a, circuit 261 (OG/BK), harness side and ground. <p>The diagram shows a voltmeter with a voltage symbol (V) and polarity (+/-) indicators. One probe is connected to a terminal on a blower motor switch, and the other probe is connected to a ground symbol. The label 'AM0419-A' is positioned below the diagram.</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to I2.</p> <p>No REPAIR circuit 261 (OG/BK) for an open circuit. TEST the system for normal operation.</p>
I2 CHECK CIRCUIT 1205 (BK) FOR AN OPEN	

- Measure the resistance between C294a-3, circuit 1205 (BK), harness side and ground.



AM2215-B

- Is the resistance less than 10,000 ohms?

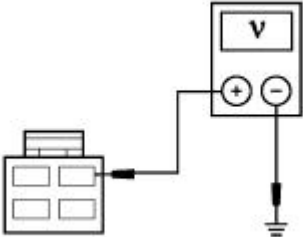
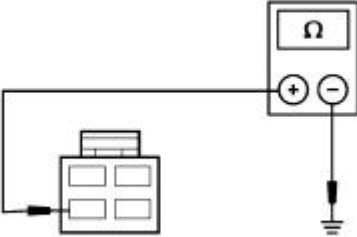
Yes

REPAIR circuit 1205 (BK) for an open. TEST the system for normal operation.

No

INSTALL a new blower motor switch. REFER to [Section 412-04](#). TEST the system for normal operation.

PINPOINT TEST J: NO OPERATION IN LOWER SPEEDS

Test Step	Result / Action to Take
<p>J1 CHECK CIRCUIT 261 (OG/BK) FOR AN OPEN</p> <ul style="list-style-type: none"> ● Disconnect: Blower Motor Resistor C294a. ● Key in ON position. ● Turn the function selector switch to the FLOOR position. ● Set the blower motor switch to low. ● Measure the voltage between the blower motor resistor C2185-4, circuit 261 (OG/BK), jumper side and ground.  <p>AM2225-A</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to J2.</p> <p>No REPAIR circuit 261 (OG/BK) for an open circuit between the blower motor and the blower motor resistor. TEST the system for normal operation.</p>
<p>J2 CHECK CIRCUIT 1205 (BK) FOR AN OPEN</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Measure the resistance between the blower motor resistor C2185-1, circuit 1205 (BK), jumper side and ground.  <p>AM2224-A</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes INSTALL a new blower motor resistor. REFER to Section 412-03. TEST the system for normal operation.</p> <p>No REPAIR circuit 1205 (BK) for an open between the blower motor resistor and ground. TEST the system for normal operation.</p>

Heater Core



WARNING: Carbon monoxide gas is colorless, odorless and dangerous. If it is necessary to operate the engine with the vehicle in a closed area such as a garage, always use an exhaust collector to vent the exhaust gases outside the closed area. Failure to follow these instructions may result in personal injury.

1. **NOTE:** Testing of returned heater cores reveals that a large percentage of heater cores are good and did not require installation of a new heater core. If a heater core leak is suspected, the heater core must be tested by following the Plugged Heater Core Component Test before the Heater Core Pressure Test. Carry out a system inspection by checking the heater system thoroughly as follows:

Inspect for evidence of coolant leakage at the heater water hose to heater core attachments. A coolant leak in the heater water hose could follow the heater core tube to the heater core and appear as a leak in the heater core.



CAUTION: Spring-type clamps are installed as original equipment. Installation and overtightening of non-specification clamps can cause leakage at the heater water hose connection and damage the heater core.

2. Check the integrity of the heater water hose clamps.

Heater Core—Plugged



WARNING: The heater core inlet hose will become too hot to handle if the system is working correctly.

1. Check to see that the engine coolant is at the correct level.
2. Start the engine and turn on the heater.
3. When the engine coolant reaches operating temperature, feel the heater core outlet hose to see if it is hot.
If it is not hot:
 - the heater core may have an air pocket.
 - the heater core may be plugged.
 - the thermostat is not working correctly.

Heater Core—Pressure Test

Use the radiator/heater core pressure tester to carry out the pressure test.

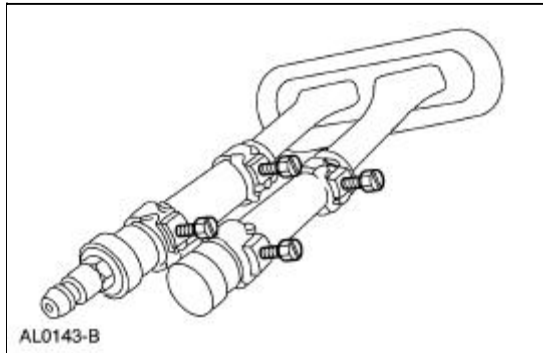
1. **NOTE:** Due to space limitations, a bench test may be necessary for pressure testing.

Drain the coolant from the cooling system. For additional information, refer to [Section 303-03A](#) or [Section 303-03B](#).

2. Disconnect the heater water hoses from the heater core. For additional information, refer to

[Section 412-02](#) .

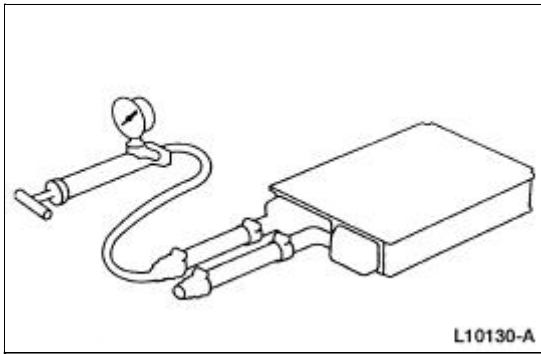
3. Install a short piece of heater water hose, approximately 101 mm (4 inches) long on each heater core tube.
4. Fill the heater core and heater water hoses with water and install Plug BT-7422-B and adapter BT-7422-A from the radiator/heater core pressure tester in the heater water hose ends. Secure the heater water hoses, plug and adapter with hose clamps.



5. Attach the pump and gauge assembly from the radiator/heater core pressure tester to the adapter.
6. Close the bleed valve at the base of the gauge. Pump 241 kPa (35 psi) of air pressure into the heater core.
7. Observe the pressure gauge for a minimum of three minutes.
8. If the pressure drops, check the heater water hose connections to the core tubes for leaks. If the heater water hoses do not leak, remove the heater core from the vehicle and carry out the bench test.

Heater Core—Bench Test

1. Remove the heater core from the vehicle. For additional information, refer to [Section 412-02](#) .
2. Drain all of the coolant from the heater core.
3. Connect the 101 mm (4 inch) test heater water hoses with plug and adapter to the core tubes. Then connect the radiator/heater core pressure tester to the adapter.
4. Apply 241 kPa (35 psi) of air pressure to the heater core. Submerge the heater core in water.
5. If a leak is observed, install a new heater core.



A/C Evaporator/Condenser Core—On-Vehicle Leak Test

1. Discharge and recover the refrigerant. For additional information, refer to [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) in this section.
2. **NOTE:** DO NOT leak test an A/C evaporator core with the suction accumulator/drier (19C836) attached to the core tubes.

Disconnect the suspect A/C evaporator core or A/C condenser core from the A/C system. For additional information, refer to [Section 412-03](#).

3. Clean the spring lock couplings. For additional information, refer to [Spring Lock Coupling](#) in this section.
4. Connect the appropriate test fittings from the A/C Test Fitting Set to the evaporator or condenser tube connections.
5. **NOTE:** The automatic shut-off valves on some gauge set hoses do not open when connected to the test fittings. If available, use hoses without shut-off valves. If hoses with shut-off valves are used, make sure the valve opens when attached to the test fittings or install an adapter which will activate the valve. The test is not valid if the shut-off valve does not open.

Connect the red and blue hoses from the manifold gauge set to the test fittings on the A/C evaporator core or A/C condenser core. Connect the yellow hose to a known good vacuum pump.

6. Open both gauge set valves and start the vacuum pump. Allow the vacuum pump to operate for a minimum of 45 minutes after the gauge set low pressure gauge indicates 101 kPa (30 in-Hg). The 45-minute evacuation is necessary to remove any refrigerant from oil left in the A/C evaporator core or A/C condenser core. If the refrigerant is not completely removed from the oil, outgassing will degrade the vacuum and appear as a refrigerant leak.
7. If the low pressure gauge reading will not drop to 101 kPa (30 in-Hg) when the valves on the gauge and manifold set are open and the vacuum pump is operating, close the gauge set valves and observe the low pressure gauge. If the pressure rises rapidly to zero, a large leak is indicated. Recheck the test fitting connections and gauge set connections before installing a new A/C evaporator core or A/C condenser core.
8. After evacuating for 45 minutes, close the gauge set valves and stop the vacuum pump. Observe the low pressure gauge; it should remain at the 101 kPa (30 in-Hg) mark.
 - If the low pressure gauge reading rises 34 or more kPa (10 or more in-Hg) of vacuum from the 101 kPa (30 in-Hg) position in 10 minutes, a leak is indicated.
 - If a very small leak is suspected, wait 30 minutes and observe the vacuum gauge.
 - If a small amount of vacuum is lost, operate the vacuum pump with gauge valves open for an additional 30 minutes to remove any remaining refrigerant from the oil in the A/C

evaporator core or A/C condenser core. Then recheck for loss of vacuum.

- If a very small leak is suspected, allow the system to sit overnight with vacuum applied and check for vacuum loss.
9. If the A/C evaporator core or A/C condenser core does leak, as verified by the above procedure, install a new A/C evaporator core or A/C condenser core. For additional information, refer to [Section 412-03](#).

A/C Compressor—External Leak Test

1. Install the A/C pressure test adapter on the rear head of the A/C compressor using the existing manifold retaining bolt.
 2. Connect the high and low pressure lines of a manifold gauge set or a refrigerant recovery/recycling station such as the R-134a A/C Service Center to the corresponding fittings on the A/C pressure test adapter.
 3. Attach the center hose of the manifold gauge set to a refrigerant container standing in an upright position.
 4. Hand-rotate the compressor shaft 10 complete revolutions to distribute the oil inside the A/C compressor.
 5. Open the low pressure gauge valve, the high pressure gauge valve and the valve on the refrigerant container to allow the refrigerant vapor to flow into the A/C compressor.
 6. Using the Refrigerant Leak Detector, check for leaks at the compressor shaft seal and the compressor center seal.
 7. If a shaft seal leak is found, install a new shaft seal. For additional information, refer to [Section 412-03](#). If an external leak is found at the center joint of the A/C compressor, install a new A/C compressor.
 8. When the leak test is complete, recover the refrigerant. For additional information, refer to [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) in this section.
-

Air Conditioning (A/C) System Check — Retail Procedure

NOTE: This Retail Procedure is not eligible for claiming on Ford paid repairs (warranty and ESP).

NOTE: The engine should be run at idle for 10 minutes with the air conditioning on and set to MAX A/C before carrying out this retail procedure.

NOTE: Read and follow all of the Warnings, Cautions and Notes at the beginning of this section before continuing.

1. Visual inspection

Open the hood and visually inspect the heating and air conditioning systems for the following:

- Coolant reservoir for correct coolant level
- Heater hoses for deterioration or loose connections
- Radiator and condenser for debris or damaged fins restricting airflow, loose mounting or connections
- Accessory drive belt(s) and cooling fan(s) for wear or physical damage
- Refrigerant lines and connections for physical damage or loose connections
- Compressor for physical damage or loose connections
- Suction accumulator/drier for physical damage or loose connections
- Wiring and connectors for excessive wear, loose or damaged connections, or incorrect routing

2. A/C refrigerant analysis

- Carry out air conditioning refrigerant analysis. For additional information, refer to [Refrigerant Identification Testing](#) in this section.
- If the refrigerant fails the analysis, discontinue diagnosis and make recommendations for repairs.
- If the refrigerant passes the analysis, carry out the air conditioning system check.

3. Air conditioning system check

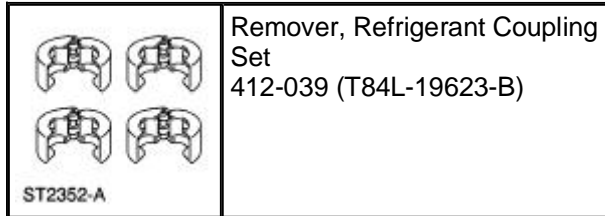
- Connect manifold gauge set or charging station with gauges to refrigerant system.
- With the vehicle in park, parking brake set, thermometer installed in center panel vent, and air conditioning system on and set to MAX A/C, start the engine.
- Record air refrigerant system pressures while running the engine at 1,500 rpm and allow engine to return to idle.
- Operate the blower motor in all control positions and check for correct blower speed changes.
- With the blower motor on HI, operate air discharge mode selector in all positions and check for correct airflow in each position.
- Operate the temperature blend selector in all positions and check for correct change in discharge temperature. Check the air discharge temperature with the selector in the coolest position and the air conditioning on and set to MAX A/C to determine if the air discharge temperature is acceptable for the current ambient air temperature.
- Carry out the EATC self-test (if applicable).
If the refrigerant system pressures were low, carry out the refrigerant system leak test.

4. Refrigerant system leak test

- Use either an ultraviolet (UV) or an electronic leak detector to check for leaks at all refrigerant lines, connections, and components.
After all tests have been completed, report all findings and recommended repairs to your service advisor before carrying out further diagnostic procedures.
-

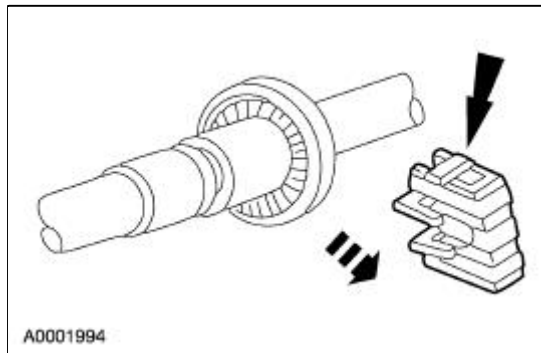
Spring Lock Coupling

Special Tool(s)

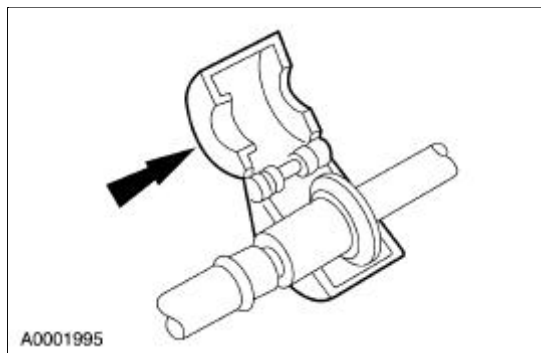


Disconnect

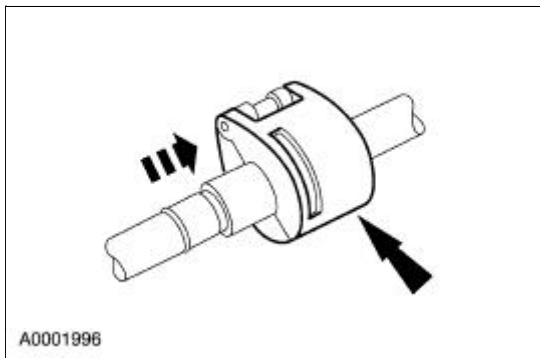
1. Remove the A/C tube lock coupling clip (19E746), if equipped.



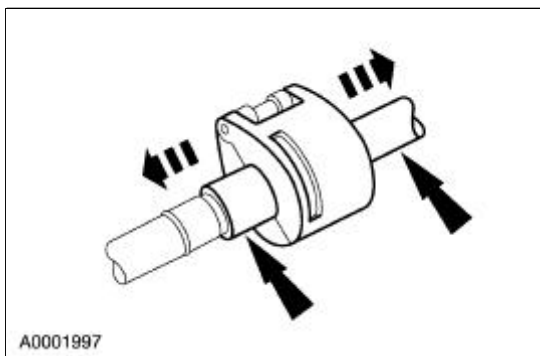
2. Fit the special tool to the spring lock coupling.




3. Push the tool into the cage opening to release the female fitting from the A/C tube lock coupling spring (19E576).

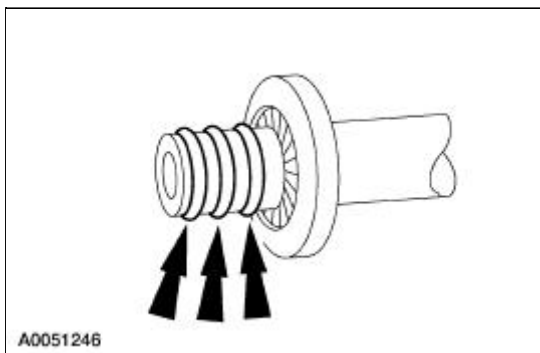



4. Pull the spring lock coupling fittings apart.



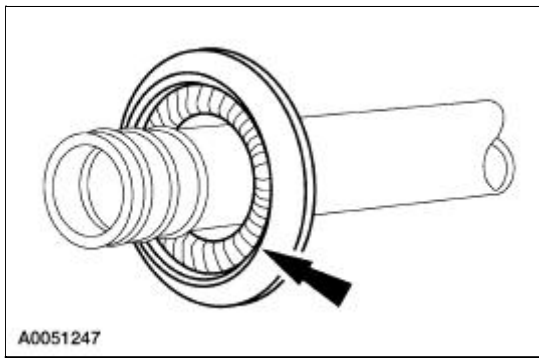
5.  **CAUTION:** Do not use metal tools to remove the O-ring seals. They can cause axial scratches across the O-ring seal grooves, resulting in refrigerant leaks.

Remove the O-ring seals with a non-metallic tool.



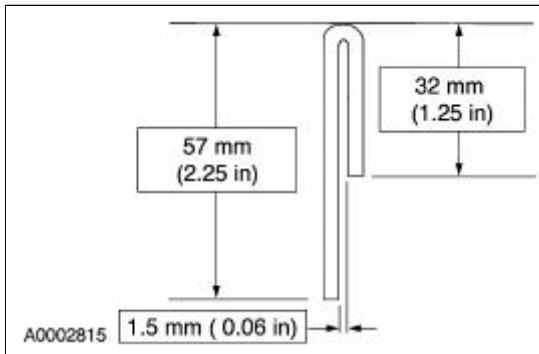
6.  **CAUTION:** Do not use a screwdriver or similar tool to remove the A/C tube lock coupling spring; this can cause axial scratches across the O-ring seal grooves resulting in refrigerant leaks.

Remove the A/C tube lock coupling spring with a small hooked wire.



Cleaning

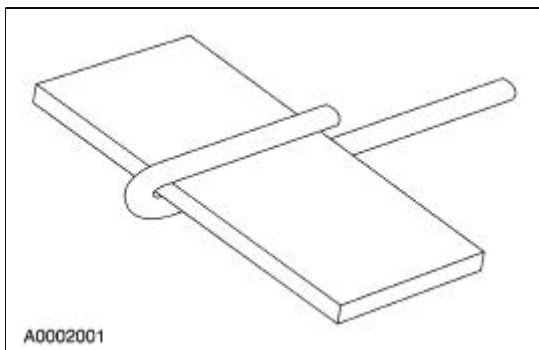
1. Fabricate a cleaning tool from a 1/8 inch diameter brazing rod.




2. Cut an abrasive pad from maroon colored 3M Scotch Brite® with the dimensions corresponding to the coupling size.

Coupling Size	Pad Size
3/8 inch	25 x 50 mm (1 x 2 inch)
1/2 inch	25 x 50 mm (1 x 2 inch)
5/8 inch	25 x 76 mm (1 x 3 inch)
3/4 inch	25 x 102 mm (1 x 4 inch)

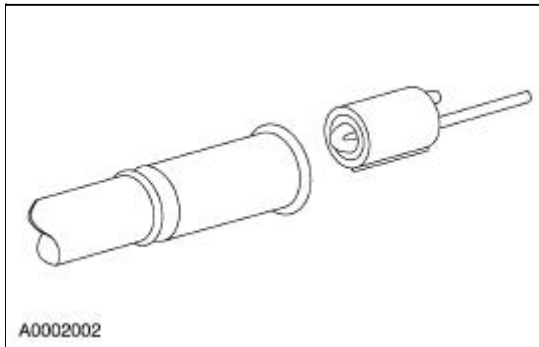
3. Assemble the pad to the tool.



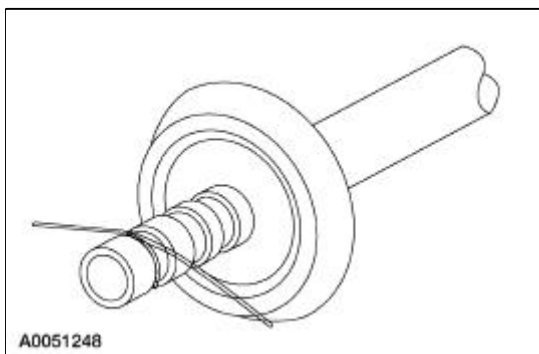
4. Coat the abrasive pad with PAG Refrigerant Compressor Oil (R-134a Systems) or equivalent.
5. Roll the pad on the tool and install it in a variable speed drill motor.
6.  **CAUTION: Maintain low speed drill rotation when inserting or removing the cleaning**

tool to prevent axial scratches which may cause future leaks.

Polish for one minute at moderate speed (less than 1,500 rpm) or until the surface is clean and free of scratches or foreign material.



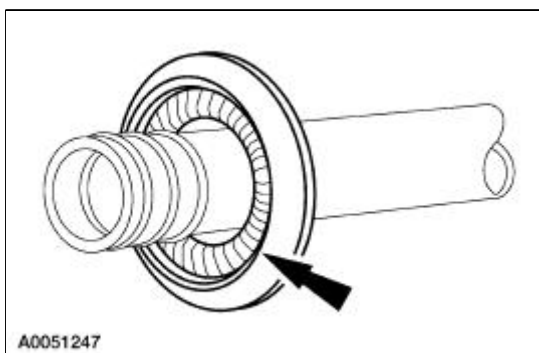
7. Clean the fitting with a lint-free cloth.
8. Inspect the surface for grooves or scratches. If grooves and scratches are still present, install a new component.
9. Clean the O-ring seal grooves with a 300 mm (12 inch) length of natural fiber string.
 - Loop the string around the grooves and pull the string back and forth.



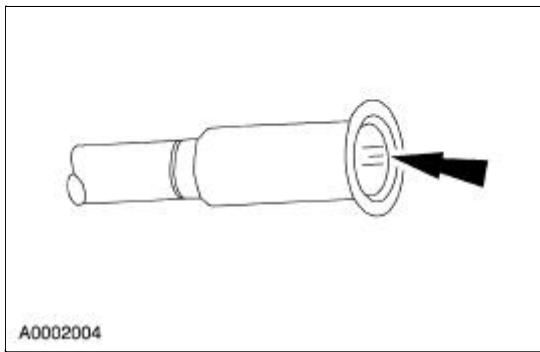
10. Remove any foreign material from the grooves with a lint-free cloth.

Connect

1. Install the A/C tube lock coupling spring.



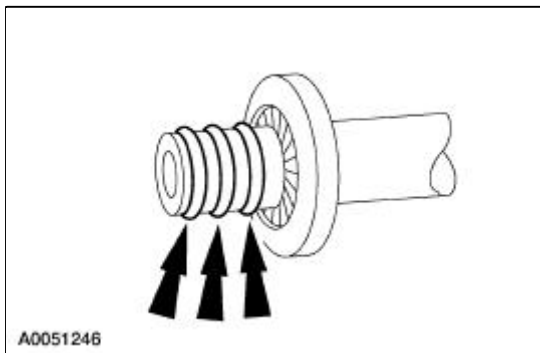
2. Lubricate the inside of the coupling with PAG Refrigerant Compressor Oil (R-134a Systems) or equivalent.



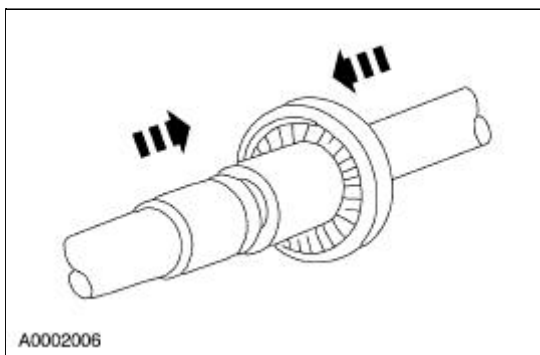
3.  **CAUTION:** Use only the new O-ring seals. The use of any O-ring seals other than those specified in the Ford Master Parts Catalog may result in intermittent leakage during vehicle operation.

Install the O-ring seals.

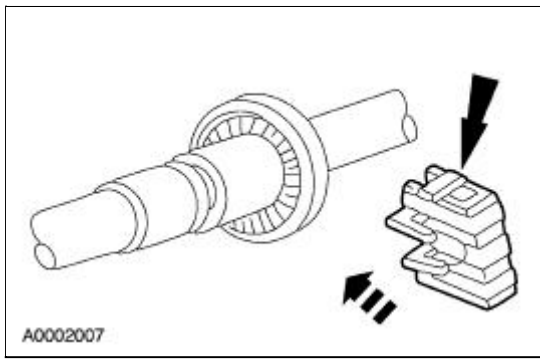
- Lubricate the O-ring seals with PAG Refrigerant Compressor Oil (R-134a Systems) or equivalent.



4. Connect the spring lock coupling fittings with a twisting motion until the A/C tube lock coupling spring snaps over the flared end of the female fitting.





5. Install the A/C tube lock coupling clip.



Heater Hose Coupling


Special Tool(s)


 ST1648-A	Remover, Heater Hose Inlet Tube 412-042 (T85T-18539-AH)
 ST2589-A	Disconnect Tool, Heater Hose 412-127

Material

Item	Specification
MERPOL® —	ESE-M99B144-B

Disconnect

 **CAUTION:** Do not attempt to install a new bushing, spacer or O-rings in the heater hose coupling; damage to the heater hose coupling can result. If the heater hose coupling is the cause of a coolant leak, the affected heater hose must be replaced as an assembly.

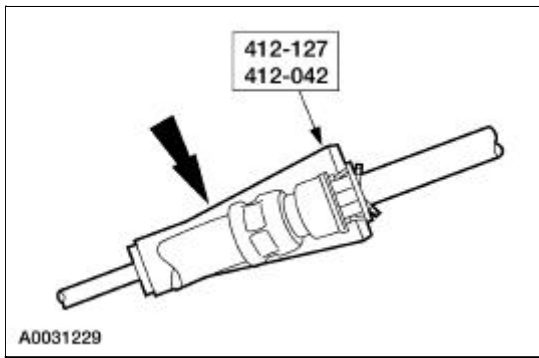
-  **WARNING:** The engine must be off, fully cool and the cooling system fully depressurized before attempting to disconnect any heater water hoses. Failure to comply with this warning can result in serious injury or burns from hot liquid escaping out of the engine cooling system.

Depressurize the engine cooling system.

- Push the heater hose toward the tube to fully expose the locking tabs.
- NOTE:** When compressing the white coupling retainer with the special tool, the special tool must be perpendicular to and on the highest point of the coupling.

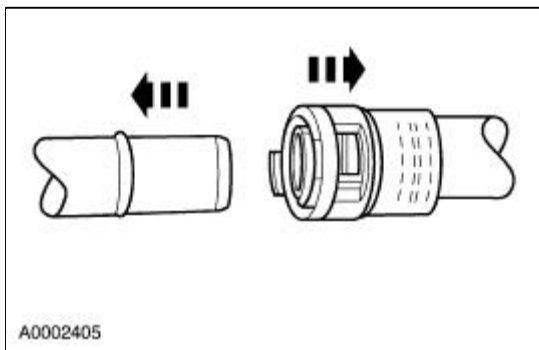
NOTE: If the heater hose coupling is accessible, the retainer tabs can be compressed by hand to disconnect the heater hose.

Push the special tool over the coupling retainer windows to compress the retainer locking tabs.

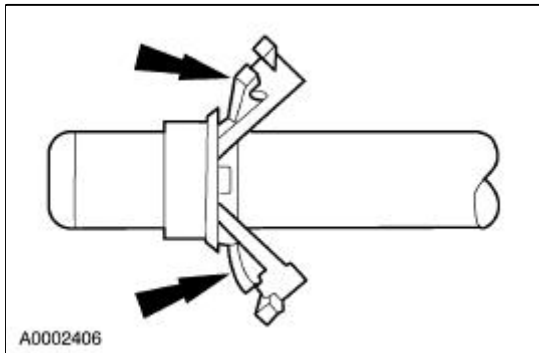


4. **NOTE:** A slight twisting motion while pulling on the heater water hose may be necessary to assist in the removal.

Pull the heater hose away from the heater core tube.

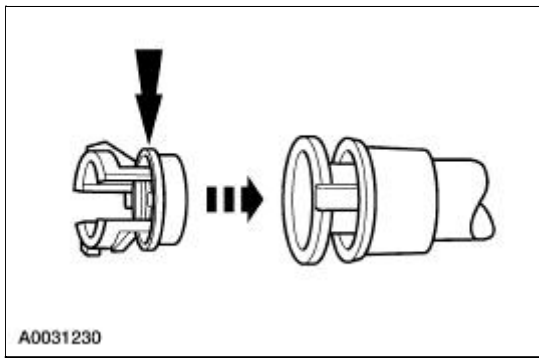


5. Spread the retainer tabs apart and slide the retainer off the tube.
 - Discard the retainer.

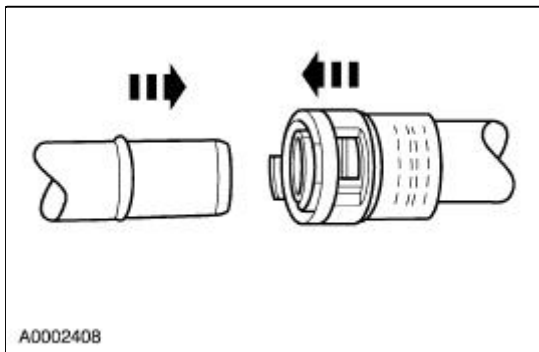


Connect

1. Clean the tubes and lubricate with coolant hose lubricant or plain water.
2. Install a new coupling retainer (18D434) into the heater hose coupling housing.



3. Push the heater hose coupling onto the tube.



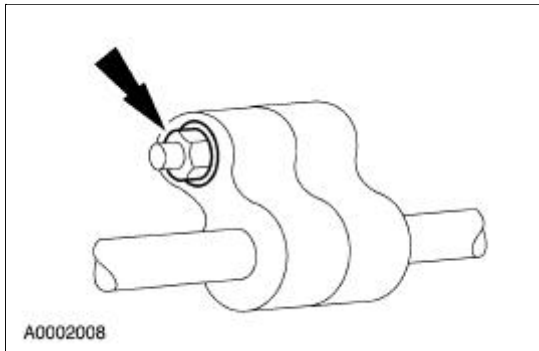
4. Make sure the heater hose coupling is fully engaged by lightly pulling on the heater hose.
-

Air Conditioning Line (Peanut) Fitting

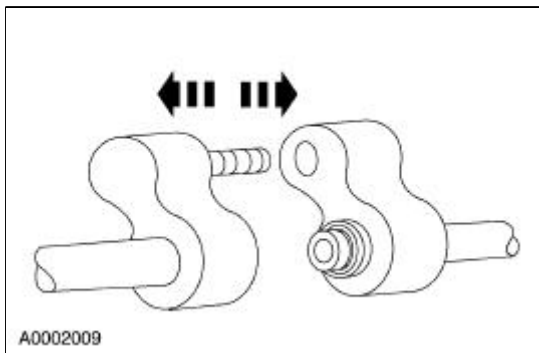
Disconnect


1.  **CAUTION:** Support the female fitting with a wrench to prevent the tubes from twisting.

Remove the nut from the peanut fitting.

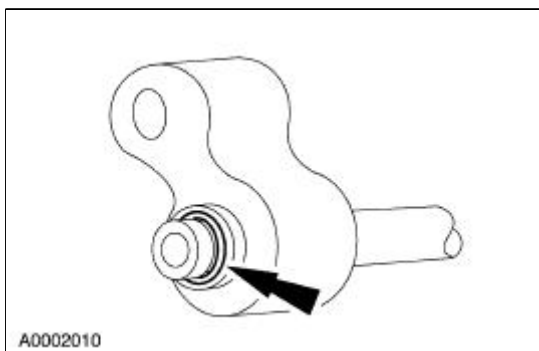


2. Pull the peanut fitting apart.




3.  **CAUTION:** Do not use metal tools to remove the O-ring seal. They can cause axial scratches across the O-ring seal groove, resulting in refrigerant leaks.

Remove the O-ring seal with a non-metallic tool.

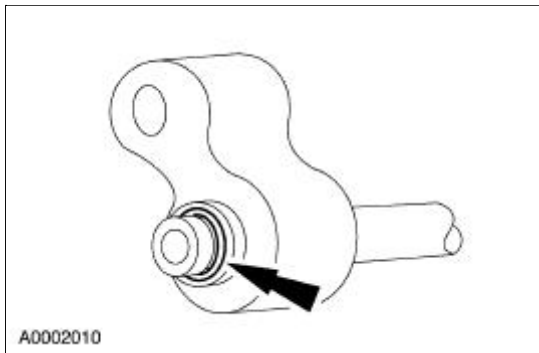


Connect

1. Clean all dirt or foreign material from the fittings.
2.  **CAUTION: Use only the new O-ring seals. The use of any O-ring seals other than those specified in the Ford Master Parts Catalog may result in intermittent leakage during vehicle operation.**

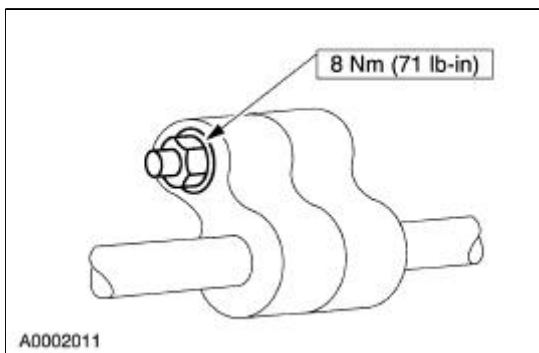
Install the O-ring seal.

- Lubricate the O-ring seal with PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B.



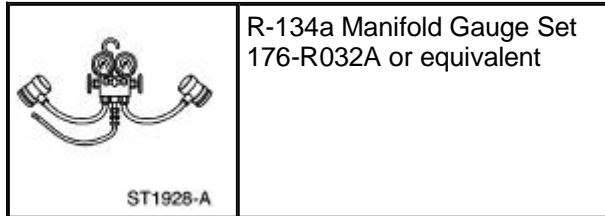
3. Lubricate the inside of the fittings with PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B.
4. **NOTE:** When correctly assembled, the male and female fittings should be flush.

Assemble the male and female fittings together.



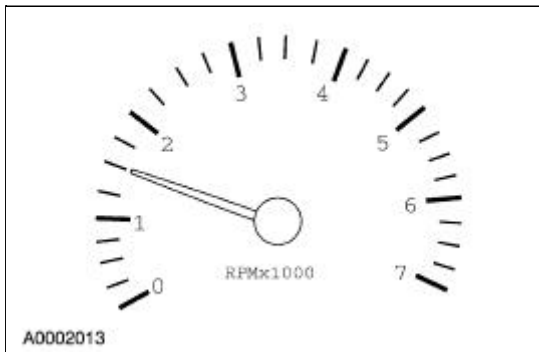
Refrigerant System Tests

Special Tool(s)



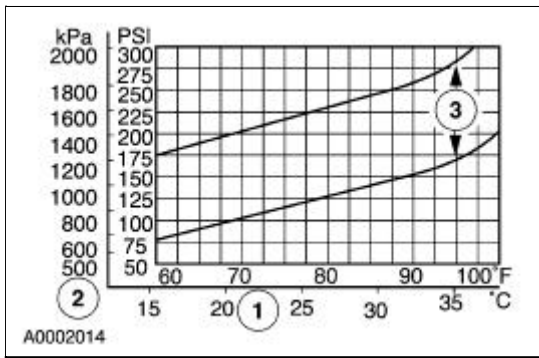
1. Connect the R-134a Manifold Gauge Set. For additional information, refer to [Manifold Gauge Set Connection](#) in this section.
2. Adjust the climate controls for maximum cooling.
 - Start the engine.
 - Select MAX A/C operation.
 - Set the blower motor speed to maximum.
3. Stabilize the in-vehicle temperature at 21-27°C (70-80°F).
4. **NOTE:** When the ambient temperatures exceed 38°C (100°F), do not run the engine above normal idle speed.

Maintain the engine speed at 1,500 rpm.



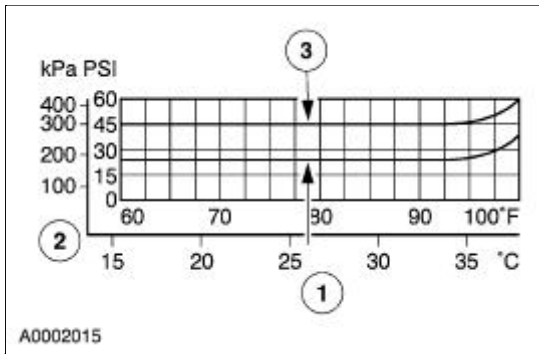
5. Determine the compressor discharge (high) pressure.
 1. Record the ambient temperature.
 2. Record the discharge (high) pressure.
 3. **NOTE:** In ambient temperatures between 38-43°C (100-110°F), the system performance pressures will be the same as those for ambient temperatures shown on the chart in the 32-38°C (90-100°F) range.

The system performance is acceptable when the pressure reading falls between the upper and lower limits shown.



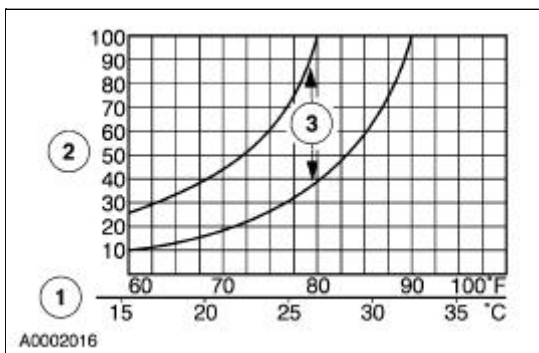
6. Determine the compressor suction (low) pressure.
 1. Record the ambient temperature.
 2. Record the suction (low) pressure.
 3. **NOTE:** In ambient temperatures between 38-43°C (100-110°F), the system performance pressures will be the same as those for ambient temperatures shown on the chart in the 32-38°C (90-100°F) range.

The system performance is acceptable when the pressure reading falls between the upper and lower limits shown.



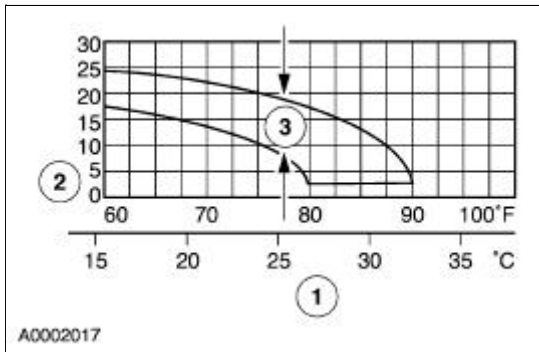
7. Determine the A/C clutch ON time.
 1. Record the ambient temperature.
 2. Record the A/C clutch ON time in seconds.
 3. **NOTE:** When the ambient temperature is above 26°C (80°F), the A/C clutch may not cycle.

The system performance is acceptable when the recorded time falls between the upper and lower limits shown.



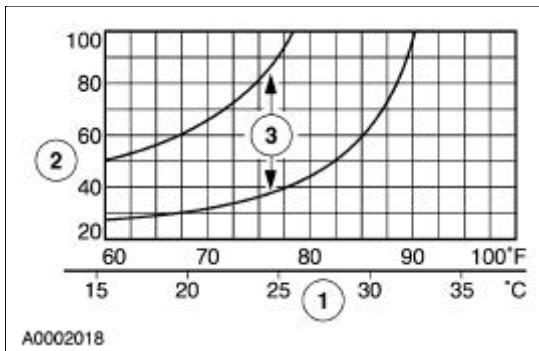
8. Determine the A/C clutch OFF time.
 1. Record the ambient temperature.
 2. Record the A/C clutch OFF time in seconds.
 3. **NOTE:** When the ambient temperature is above 26°C (80°F), the A/C clutch may not cycle.

The system performance is acceptable when the recorded time falls between the upper and lower limits shown.



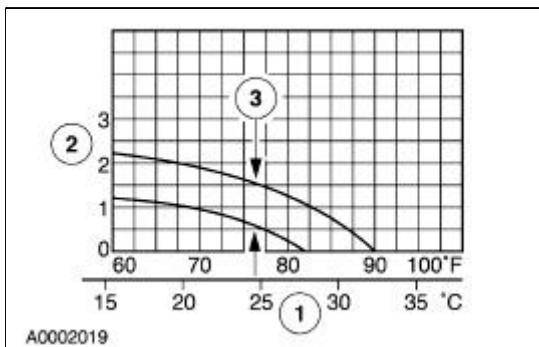
9. Determine the total A/C clutch cycle time.
 1. Record the ambient temperature.
 2. Record the time the A/C clutch is engaged plus the time it is disengaged (time ON plus time OFF).
 3. **NOTE:** When the ambient temperature is above 26°C (80°F), the A/C clutch may not cycle.

The system performance is acceptable when the recorded time falls between the upper and lower limits shown.



10. Determine the A/C clutch cycle rate per minute.
 1. Record the ambient temperature.
 2. Record the number of A/C clutch cycles occurring in one minute.
 3. **NOTE:** When the ambient temperature is above 26°C (80°F), the A/C clutch may not cycle.

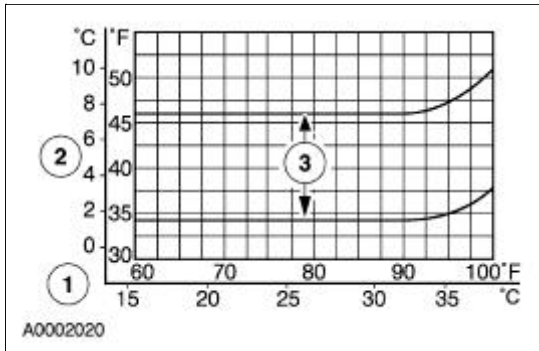
The system performance is acceptable when the recorded number of cycles falls between the upper and lower limits shown.



11. Determine the center A/C register discharge temperature.
 1. Record the ambient temperature.

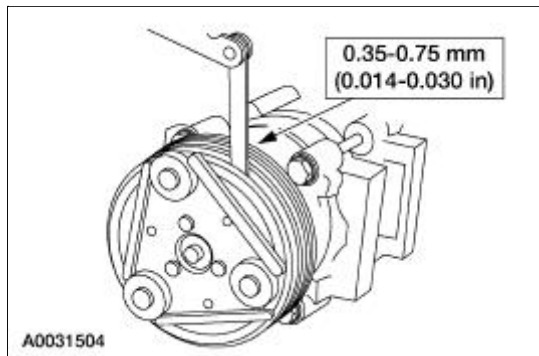
2. Record the center A/C register discharge temperature.
3. **NOTE:** In ambient temperatures between 38-43°C (100-110°F), the A/C register discharge temperatures will be the same as those for ambient temperatures shown on the chart in the 32-38°C (90-100°F) range.

The system performance is acceptable when the center A/C register discharge temperature falls between the upper and lower limits shown.



Air Conditioning (A/C) Clutch Air Gap Adjustment

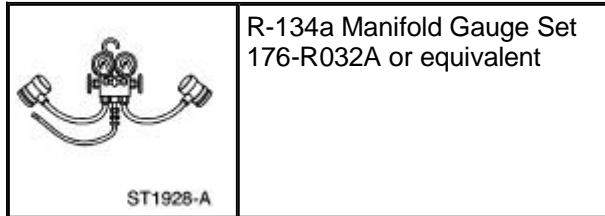
1. Check the A/C clutch air gap at three equally-spaced places between the A/C clutch hub (2884) and the A/C clutch pulley (2E884).



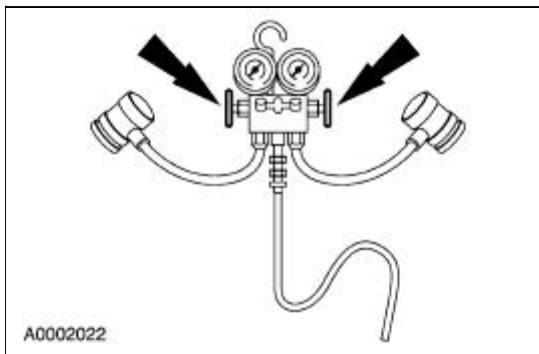
2. Remove the A/C clutch. Add or remove spacers between the A/C clutch and the compressor shaft until clearance is within specification. For additional information, refer to [Section 412-03](#).
-

Manifold Gauge Set Connection

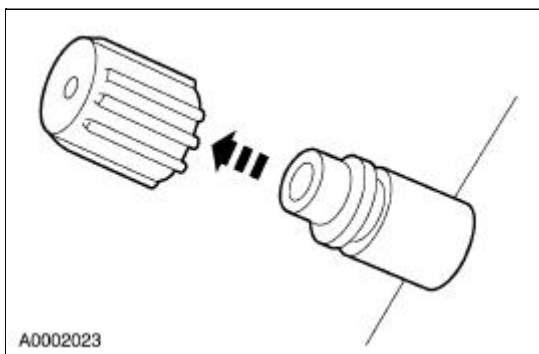
Special Tool(s)



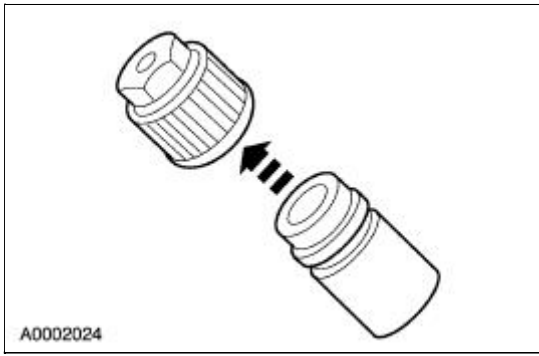
1. Turn both valves on the R-134a Manifold Gauge Set clockwise to close the low- and high-pressure hoses to the center manifold and center hose.



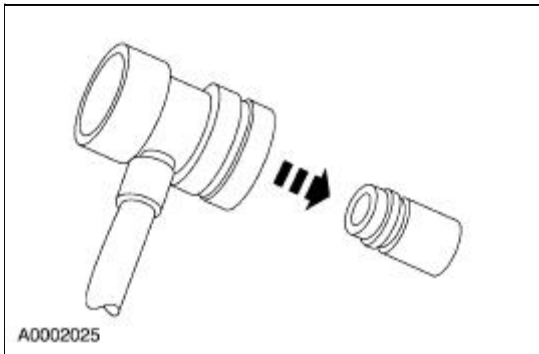
2. Remove the A/C charging valve cap (19D702) from the low-pressure service gauge port valve.



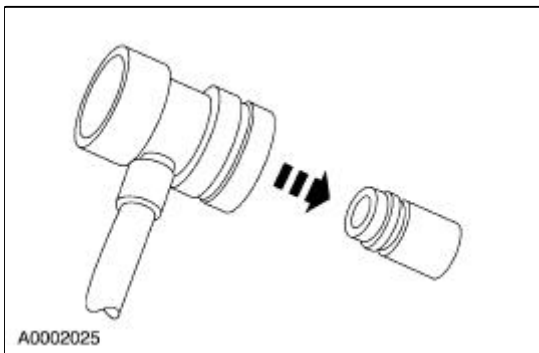
3. Remove the A/C charging valve cap from the high-pressure service gauge port valve.



4. Connect the R-134a Manifold Gauge Set low-pressure hose and the R-134a low side quick disconnect to the low-pressure service gauge port valve.

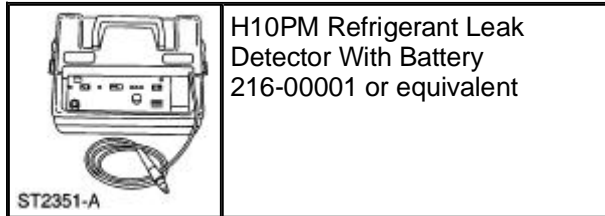


5. Connect the R-134a Manifold Gauge Set high-pressure hose and the R-134a high side quick disconnect to the high-pressure service gauge port valve.



Electronic Leak Detection

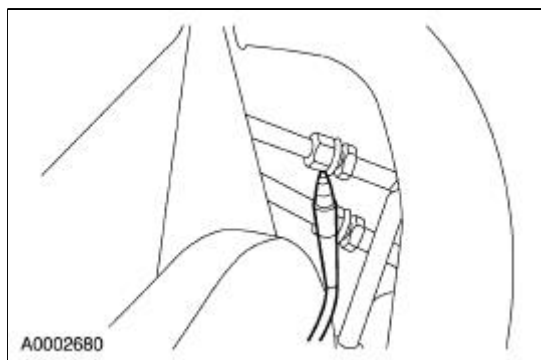
Special Tool(s)



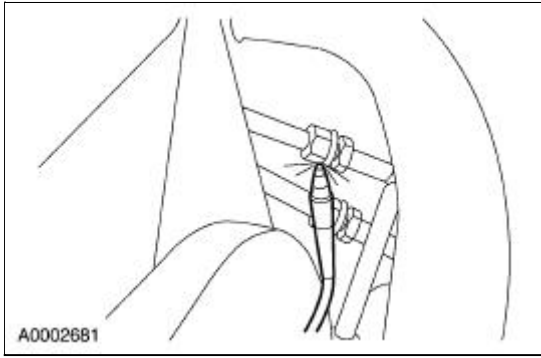
⚠ CAUTION: Good ventilation is necessary in the area where electronic A/C leak testing is to be carried out. If the surrounding air is contaminated with refrigerant gas, the leak detector will indicate this gas all the time. Odors from other chemicals such as anti-freeze, diesel fuel, disc brake cleaner, or other cleaning solvents can cause the same problem. A fan, even in a well-ventilated area, is very helpful in removing small traces of contamination from the air that might affect the leak detector.

1. **NOTE:** The system pressure should be between 413-551 kPa (60-80 psi) at 24°C (75°F) with the engine off.

Leak test the refrigerant system using the Refrigerant Leak Detector. Follow the instructions included with the leak detector for handling and operation techniques.

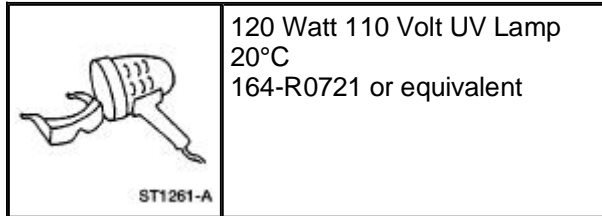


2. If a leak is found, discharge and recover the refrigerant. For additional information, refer to [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) in this section.
 - Repair the system.
 - Test the system for normal operation.



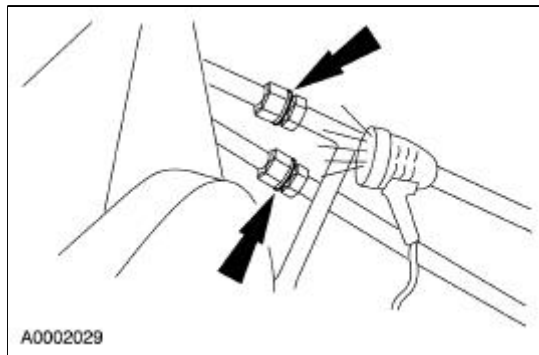
Tracer Dye Leak Detection

Special Tool(s)

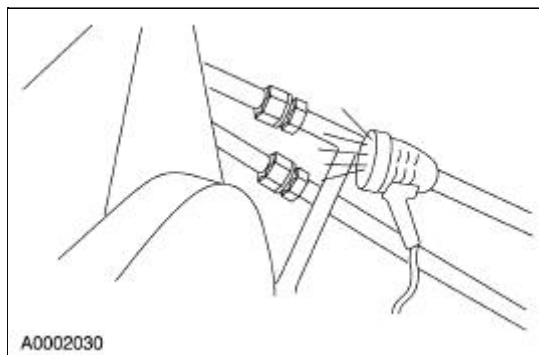


NOTE: Ford Motor Company vehicles are produced with a permanent leak tracer dye incorporated into the A/C system. The location of leaks can be pinpointed by the bright yellow-green glow of the tracer dye. Since more than one leak can exist, always inspect each component.

1. Check for leaks using a 120 Watt UV spot lamp.
 - Scan all components, fittings and lines of the A/C system.


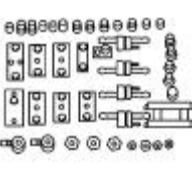


2. After the leak is repaired, remove any traces of tracer dye with a general purpose oil solvent.
3. Verify the repair by operating the system for a short time and inspect with the UV spot lamp.





Air Conditioning (A/C) System Flushing


Special Tool(s)

 ST2466-A	A/C Flush and Purge Machine 219-00022 (part of 219-00023) or equivalent
 ST2469-A	A/C Flush and Purge Fitting Kit 219-00024 (part of 219-00023) or equivalent

 **WARNING:** Use extreme care and observe all safety and service precautions related to the use of refrigerants.

 **WARNING:** Due to refrigerant hazards, always wear safety goggles and non-penetrable gloves when working on or flushing A/C systems.

 **CAUTION:** An A/C refrigerant analyzer must be used before the recovery of any vehicle's A/C refrigerant. Failure to do so puts the shop's bulk refrigerant at risk of contamination. If the vehicle's A/C refrigerant is contaminated, refer the customer to the service facility that carried out the last A/C service. If the customer wishes to pay the additional cost, use the A/C recovery equipment that is designated for recovering contaminated A/C refrigerant. All contaminated A/C refrigerant must be disposed of as hazardous waste. For all equipment, follow the equipment manufacturer's procedures and instructions.

 **CAUTION:** Suction accumulator/drier, muffler, hoses, thermal expansion valve, and fixed orifice tube should be removed when flushing the A/C system. Internal plumbing of these devices makes it impossible to correctly remove any residual-flushing agent. Except for the hoses, these components are typically discarded after A/C system contamination. Hoses can normally be reused unless they are clogged with foreign material. The 3.785 liters (1 gallon) of A/C Systems Flushing Solvent F4AZ-19579-A and FL1-A filter used in A/C Flush and Purge Machine 219-00022 are intended for use on one vehicle only. They may be used to flush both the A/C condenser core and the A/C evaporator core on an individual vehicle, but under no circumstances should they be used on more than one vehicle.

1. **NOTE:** Prior to using the A/C Flush and Purge Machine 219-00022 for the first time, review the operating instructions.

NOTE: Only the A/C Flush and Purge Machine kit 219-00023, which includes A/C Flush and Purge Machine 219-00022, A/C Flush and Purge Fitting Kit 219-00024, and the Ford Part number F4AZ-19579-A A/C Systems Flushing Solvent, is approved for use on Ford vehicles. No other flushing device or solvent is approved for flushing heat exchangers. Use of any other flusher or solvent may cause damage to the A/C system and the flushing unit.




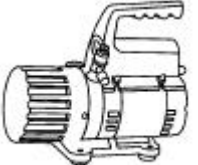
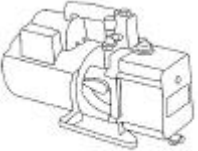
Ford Motor Company has approved a procedure to provide technicians with a non-CFC method of flushing contaminated A/C system heat exchangers, A/C evaporator core, and A/C condenser core. The procedure allows the specific components to be cleaned and flushed while installed in their normal in-vehicle location. The types of contamination flushed include particle matter that results from A/C compressor or desiccant failure within the suction accumulator/drier and gummy residue that can form when refrigerant oil is overheated during A/C compressor seizure. The flushing process is a two-step procedure that involves the use of an A/C Flush and Purge Machine 219-00022 to:

- Circulate the flushing solvent through the heat exchanger in the reverse direction of normal refrigerant flow (back-flushing). Particulate matter picked up during flushing is filtered from the returning solvent before the solvent is returned to the reservoir for continued circulation.
 - Remove the flushing solvent from the heat exchanger. In this step of the procedure, pressurized air 621-862 kPa (90-125 psi) is used to push and evaporate any remaining flush solvent from the heat exchanger.
2. Discharge the A/C system. Observe all safety precautions. For additional information, refer to the procedure in this section.
 3. Disconnect the refrigerant lines from the heat exchanger(s) to be flushed.
 4. Connect the A/C Flush and Purge Machine 219-00022 and A/C Flush and Purge Fitting Kit 219-00024 to the heat exchanger to be flushed. Do not flush through the A/C evaporator core orifice, mufflers or hoses. Internal plumbing and material make-up of these components make it impossible to correctly remove foreign material or residual flushing solvent.
 5. Use 3.785 liters (one gallon) of A/C Systems Flushing Solvent part number F4AZ-19579-A to flush the heat exchanger for a minimum of 15 minutes. The flush solvent may be used for one or both heat exchangers in the A/C system. However, the flush solvent is intended for one vehicle only. The filter used on the flushing unit is also intended for use on one vehicle only.
 6. Flush the component for a minimum of 15 minutes.
 7. Apply 621-862 kPa (90-125 psi) pressurized air to the component for a minimum of 30 minutes. The 30-minute purge time is required to force and evaporate all residual solvent from the A/C system component. Failure to successfully remove all residual solvent within the component can result in system damage when reconnected and operated. Dispose of the used flush solvent and filter in accordance with local, state and federal emissions.
 8. **NOTE:** A/C system filtering as described in this section is optional if system flushing is carried out. However, the filter kit use is recommended after flushing if the A/C system contamination is extensive.

Install a new A/C evaporator core orifice in any vehicle being serviced for A/C compressor or desiccant failure.
 9. Install new refrigerant hoses if clogged with foreign material.
 10. Reconnect the heat exchanger being serviced.
 11. Add additional refrigerant oil as required. For additional information, refer to the procedure in this section.
 12. Evacuate, leak test and charge the A/C system. For additional information, refer to the procedure in this section.
 13. Check the system for normal operation.

Air Conditioning (A/C) System Recovery, Evacuation and Charging

Special Tool(s)

 ST1228-A	R-134a A/C Refrigerant Center 176-00002 or equivalent
 ST1834-A	R-134a A/C Refrigerant Center 023-00153 or equivalent
 ST1928-A	R-134a Manifold Gauge Set 176-R032A or equivalent
 ST1685-A	1.2 CFM Vacuum Pump 023-00162 or equivalent
 ST1686-A	4.0 CFM Vacuum Pump 023-00163 or equivalent

Refrigerant System Recovery

NOTE: Ford Motor Company recommends use of an A/C service center to carry out recovery, evacuation, and charging of the refrigerant system. If an A/C service center is not available, refrigerant system recovery, evacuation, and charging may be accomplished using a separate recovery station, vacuum pump, charging cylinder, and manifold gauge set.

1. Prior to recovering the refrigerant system, you must verify the purity of the refrigerant. For additional information, refer to [Refrigerant Identification Testing](#) in this section.
2. **NOTE:** Some R-134a service centers require the use of an A/C manifold gauge set. For additional information, refer to [Manifold Gauge Set Connection](#) in this section.

Connect an R-134a A/C service center to the low- and high-pressure service gauge port valves.

3. Recover the refrigerant from the system following the operating instructions provided by the equipment manufacturer.
4. Once the service center has recovered the vehicle A/C system refrigerant, close the service center inlet valve (if equipped). Then switch off the power supply.
5. Allow the vehicle A/C system to remain closed for about two minutes. Observe the system vacuum level as shown on the gauge. If the vacuum does not decrease, disconnect the refrigerant center hose(s).
6. If the system vacuum does decrease, repeat Steps 2 through 5 until the vacuum level remains stable for two minutes.
7. Carry out the required repairs.

Refrigerant System Evacuation

NOTE: Ford Motor Company recommends use of an A/C service center to carry out recovery, evacuation, and charging of the refrigerant system. If an A/C service center is not available, refrigerant system recovery, evacuation, and charging may be accomplished using a separate recovery station, vacuum pump, charging cylinder, and manifold gauge set.

1. Connect an R-134a service center to the low- and high-pressure service gauge port valves.
2. Evacuate the system until the low-pressure gauge reads at least 99.4 kPa (29.5 in-Hg) of vacuum and as close to 101.1 kPa (30 in-Hg) as possible. Continue to operate the vacuum pump for a minimum of 45 minutes.
3. Turn off the vacuum pump. Observe the low-pressure gauge for five minutes to make sure that the system vacuum is held. If vacuum is not held for five minutes, leak test the system, service the leak, and evacuate the system again.

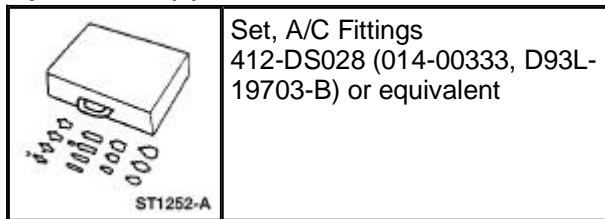
Refrigerant System Charging

NOTE: Ford Motor Company recommends use of an A/C service center to carry out recovery, evacuation, and charging of the refrigerant system. If an A/C service center is not available, refrigerant system recovery, evacuation, and charging may be accomplished using a separate recovery station, vacuum pump, charging cylinder, and manifold gauge set.

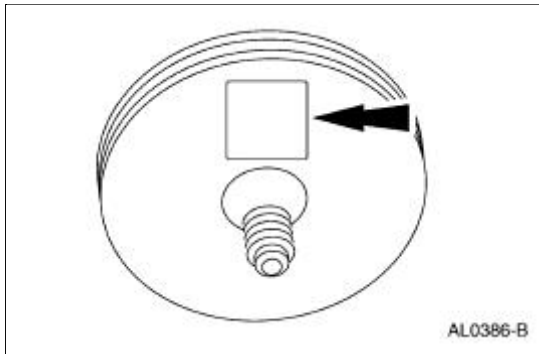
1. Correctly oil match the system to verify that the correct amount of refrigerant oil is present in the system. For additional information, refer to [Refrigerant Oil Adding](#) in this section.
 2. Charge the system with the specified amounts of refrigerant oil and refrigerant.
 3. When no more refrigerant is being drawn into the system, start the engine and select MAX A/C operation. Adjust the blower motor speed to the maximum and allow the remaining refrigerant to be drawn into the system. Continue to add refrigerant into the system until the specified weight of R-134a has been added. Close the charging cylinder valve and allow the system to pull any remaining refrigerant from the hose. When the low-pressure drops to approximately 207 kPa (30 psi), close the charging hose valve.
-

Refrigerant System Filtering Following Air Conditioning (A/C) Component Installation

Special Tool(s)



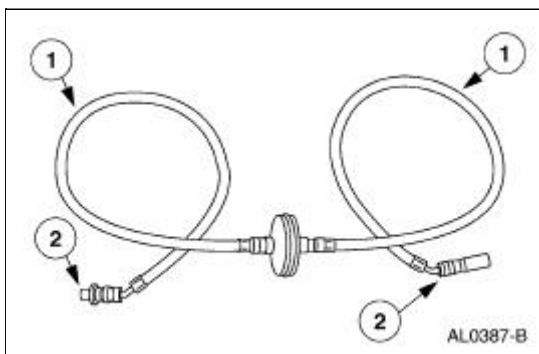
1. Install the new A/C compressor. For additional information, refer to [Section 412-03](#).
2. Install the new suction accumulator/drier. For additional information, refer to [Section 412-03](#).
3. Install the new A/C evaporator core orifice. For additional information, refer to [Section 412-03](#).
4. Orient the filter inlet toward the A/C condenser core.



5. **NOTE:** The pancake filter is not permanently installed and will be removed at the end of this procedure.

Temporarily install the pancake filter between the A/C condenser core and the condenser to evaporator tube.

1. Use flexible refrigerant hose of 17,238 kPa (2,500 psi) burst rating.
2. Make the connections using the A/C Test Fitting Set.



6. Correctly oil match the system. For additional information, refer to [Refrigerant Oil Adding](#) in this section.
 7. Evacuate and charge the system. For additional information, refer to [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) in this section.
 8. Check all refrigerant system hoses, lines and the position of the newly installed filters to be sure they do not interfere with other engine compartment components. If necessary, use tie straps to make adjustments.
 9. Provide adequate airflow to the front of the vehicle (with a fan, if necessary). Select MAX A/C operation and set the blower motor speed to maximum. Start the engine and let it idle briefly. Make sure the A/C system is operating correctly.
 10. Gradually bring the engine up to 1,200 rpm by running it at lower rpms for short periods (first at 800 rpm, then at 1,000 rpm). Set the engine at 1,200 rpm and run it for one hour with the A/C system operating.
 11. Stop the engine.
 12. Recover the refrigerant from the system. For additional information, refer to [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) in this section.
 13. Remove the fittings, flexible hoses and pancake filter from between the and the condenser to evaporator tube.
 14. Discard the pancake filter. It can be used one time only.
 15. Reconnect the condenser to evaporator tube to the A/C condenser core.
 16. Evacuate and charge the system. For additional information, refer to [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) in this section.
-

Refrigerant Oil Adding



CAUTION: During normal A/C operation, oil is circulated through the system with the refrigerant, and a small amount is retained in each component. If certain components of the system are removed for new installation, some of the refrigerant oil will go with the component. To maintain the original total oil charge, it is necessary to compensate for the oil lost by adding oil to the system with the new part.

1. **NOTE:** Service A/C compressors are shipped without compressor oil.

Rotate the A/C compressor shaft six to eight revolutions while collecting oil in a clean measuring device.

- If the amount of oil drained from the old A/C compressor is between 85-142 ml (3-5 ounces), pour the same amount plus 30 ml (1 ounce) of clean PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) WSH M1C231-B or equivalent into the new A/C compressor.
 - If the amount of oil that was removed from the old A/C compressor is greater than 142 ml (5 ounces), pour the same amount drained of clean PAG Refrigerant Compressor Oil (R-134a Systems) or equivalent into the new A/C compressor.
 - If the amount of oil that was removed from the old A/C compressor is less than 85 ml (3 ounces), pour 85 ml (3 ounces) of clean PAG Refrigerant Compressor Oil (R-134a Systems) or equivalent into the new A/C compressor.
2. For the suction accumulator/drier, drill one 13 mm (0.52 in) hole in the suction accumulator/drier cylinder and drain the oil into a calibrated container.
 - Add a quantity of new oil to match that drained from the old suction accumulator/drier plus 60 ml (2 ounces) of clean PAG Refrigerant Compressor Oil (R-134a Systems) or equivalent.
 3. For the A/C evaporator core, add 89 ml (3 ounces) of clean PAG Refrigerant Compressor Oil (R-134a Systems) or equivalent to the suction accumulator/drier inlet tube.
 4. For the A/C condenser core, add 30 ml (1 ounce) of clean PAG Refrigerant Compressor Oil (R-134a Systems) or equivalent to the A/C condenser core or the suction accumulator/drier inlet tube.
 5. Add 60 ml (2 ounces) of clean PAG Refrigerant Compressor Oil (R-134a Systems) or equivalent to the suction accumulator/drier inlet tube when carrying out each of the following repairs:
 - installation of a new A/C evaporator core orifice
 - installation of a new A/C compressor pressure relief valve (19D644)
 - installation of a new refrigerant line
 - repair of an O-ring seal leak
 - repair of a charge port leak
 6. Installation of new components that do not require discharge of refrigerant and resulting oil loss, such as the A/C cycling switch and the A/C pressure transducer, do not require additional oil.
-

Inspection and Assembly Requirements —Following an A/C Compressor Failure



CAUTION: To prevent refrigerant system contamination and possible failure of the new A/C compressor, carry out the following procedures.

1. **NOTE:** A dirty A/C evaporator core orifice or a condenser to evaporator tube containing black refrigerant oil and particles indicates that the A/C compressor has failed and a new A/C compressor must be installed.

Remove and discard the A/C evaporator core orifice. For additional information, refer to [Section 412-03](#).

2. Remove the A/C compressor. For additional information, refer to [Section 412-03](#).
 - Drain the residual refrigerant oil from the A/C compressor and measure the volume for correct system oil matching. For additional information, refer to [Refrigerant Oil Adding](#) in this section.
3. **NOTE:** The suction accumulator/drier and A/C evaporator core orifice cannot be cleaned and a new A/C evaporator core orifice must be installed.

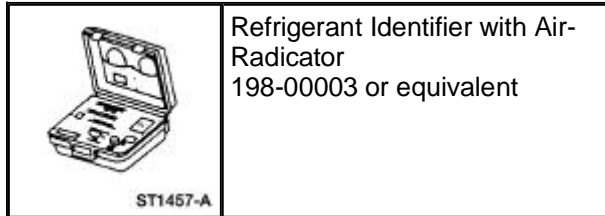
Remove the suction accumulator/drier. For additional information, refer to [Section 412-03](#).

- Drain the residual refrigerant oil from the suction accumulator/drier and measure the volume for correct oil system matching. For additional information, refer to [Refrigerant Oil Adding](#) in this section.
4. **NOTE:** System flushing is the preferred method of cleaning. However, if flushing equipment is not available, carry out system filtering.

Carry out an A/C system flushing or filtering procedure:
 - If A/C system flushing equipment is available, clean the A/C evaporator core and the A/C condenser core by flushing. For additional information, refer to [Flushing](#) in this section.
 - If A/C system flushing equipment is not available, carry out a system filtering procedure. For additional information, refer to [Refrigerant Oil Adding After A/C Component Replacement](#) in this section.
 5. Install a new A/C compressor. For additional information, refer to [Section 412-03](#).
 6. Install the new suction accumulator/drier. For additional information, refer to [Section 412-03](#).
 7. Install the new A/C evaporator core orifice. For additional information, refer to [Section 412-03](#).
 8. Correctly oil match the system. For additional information, refer to [Refrigerant Oil Adding](#) in this section.
 9. Evacuate and charge the system. For additional information, refer to [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) in this section.
-


Refrigerant Identification Testing

Special Tool(s)




1. **NOTE:** An A/C refrigerant analyzer must be used to identify gas samples taken directly from the refrigeration system or storage containers prior to recovering or charging the refrigerant system.

Follow the instructions included with the Deluxe Refrigerant Diagnostic Tool to obtain the sample for testing.

2. The diagnostic tool will display one of the following:
 - If the purity level of R-134a or R-12 is 98% or greater by weight, the green "PASS" light emitting diode (LED) will light. The weight concentrations of R-134a, R-12, R-22, hydrocarbons, and air will be displayed on the digital display.
 - If refrigerants R-134a or R-12 do not meet the 98% purity levels, the red "FAIL" LED will light and a horn will sound alerting the user of potential hazards. The weight concentrations of R-134a, R-12, R-22, and hydrocarbons will be displayed on the digital display.
 - If hydrocarbon concentrations are 2% or greater by weight, the red "FAIL" LED will light, "Hydrocarbon High" will be displayed on the digital display, and a horn will sound alerting the user of potential hazards. The weight concentrations of R-134a, R-12, R-22, and hydrocarbons will also be displayed on the digital display.
3. The percentage of air contained in the sample will be displayed if the R-134a or R-12 content is 98% or greater. The diagnostic tool eliminates the effect of air when determining the refrigerant sample content because air is not considered a contaminant, although air can affect A/C system performance. When the diagnostic tool has determined that a refrigerant source is pure (R-134a or R-12 is 98% or greater by weight) and air concentration levels are 2% or greater by weight, the diagnostic tool will prompt the user if an air purge is desired.
4. If contaminated refrigerant is detected, repeat the refrigerant identification test to verify that the refrigerant is indeed contaminated.
5.  **CAUTION:** If contaminated refrigerant is detected, **DO NOT** recover the refrigerant into R-134a or R-12 recovery/recycling equipment.

Recover any contaminated refrigerant using suitable recovery-only equipment designed for capturing and storing contaminated refrigerant. For additional information, refer to [Contaminated Refrigerant Handling](#) in this section.

Contaminated Refrigerant Handling

1.  **CAUTION:** If contaminated refrigerant is detected, **DO NOT** recover the refrigerant into your recovery/recycling equipment.

Recover the contaminated refrigerant using suitable recovery-only equipment designed for capturing and storing contaminated refrigerant.

- This equipment must only be used to recover contaminated refrigerant to prevent the spread to other vehicles.
- If this equipment is not available, contact an A/C repair facility in your area with the correct equipment to carry out this repair.

2. Determine and correct the cause of the customer's initial concern.
3. **NOTE:** Residual refrigerant oil in the suction accumulator/drier must be drained and measured for correct oil system matching. For additional information, refer to [Refrigerant Oil Adding](#) in this section.

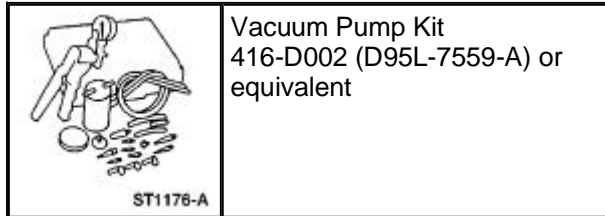
The suction accumulator/drier cannot be cleaned and a new suction accumulator/drier must be installed.


Remove the suction accumulator/drier. For additional information, refer to [Section 412-03](#).

4. Clean the A/C evaporator core and the A/C condenser core by flushing. For additional information, refer to [Air Conditioning \(A/C\) System Flushing](#) in this section.
 5. Install the new suction accumulator/drier. For additional information, refer to [Section 412-03](#).
 6. Correctly oil match the system. For additional information, refer to [Refrigerant Oil Adding](#) in this section.
 7. Evacuate and charge the system. For additional information, refer to [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) in this section.
 8. Dispose of contaminated refrigerant according to all federal, state and local regulations.
-

Vacuum Hose Repair —Mini-Tube

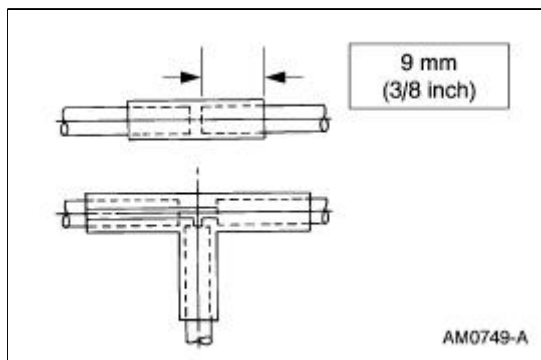
Special Tool(s)



1. Measure the length of the damaged area of the mini-tube vacuum hose.
2. Cut a piece of standard 1/8 inch inner diameter vacuum hose approximately 25 mm (1 inch longer than the damaged area of the mini-tube vacuum hose).
3. Cut off the mini-tube vacuum hose on each side of the damaged area.
4.  **WARNING:** Read the warning information on the product label to prevent possible personal injury.

Dip the mini-tube hose ends in commercially available paint thinner containing methyl ethyl ketone (MEK). This solvent will seal the mini-tube in the vacuum hose.

5. Insert the ends of the mini-tube vacuum hose approximately 9 mm (3/8 inch) into the ends of the standard 1/8 inch repair vacuum hose section.



6. Shake the repair joint after assembly to make sure the solvent is dispersed and the vacuum line is not plugged.
7. Test the system for a vacuum leak in the repair area.
 - Use the Vacuum Tester or equivalent.

Torque Specifications

Description	Nm	lb-in
Steering column reinforcement	9	80
Instrument panel steering column cover bolts	9	80
Duct RH instrument panel register	9	80

Air Distribution

NOTE: The air distribution system of this vehicle cannot be equipped with a cabin air filter.

There are two sources of air available to the air distribution system:

- outside air
- recirculated air

Recirculated air is only used during MAX A/C.

Air distribution within the vehicle is determined by the function selector switch position. Airflow control doors are used to direct airflow within the air plenum chamber. Vacuum control motors (18A318) are used to position these airflow control doors. Refer to [Section 412-00](#) for a description and operation of each of the system functions.

The air distribution system is designed to provide airflow from the defrost nozzle when no vacuum is applied to any of the vacuum control motors. This is done to prevent a situation where defrost cannot be obtained due to a system vacuum leak.

Air enters the passenger compartment from the:

- instrument panel A/C register (19893).
- heater outlet floor duct (18C433).
- windshield defroster hose nozzle (18490).
- side window demisters.

Passenger compartment air is exhausted from the vehicle through open windows or body air vents.

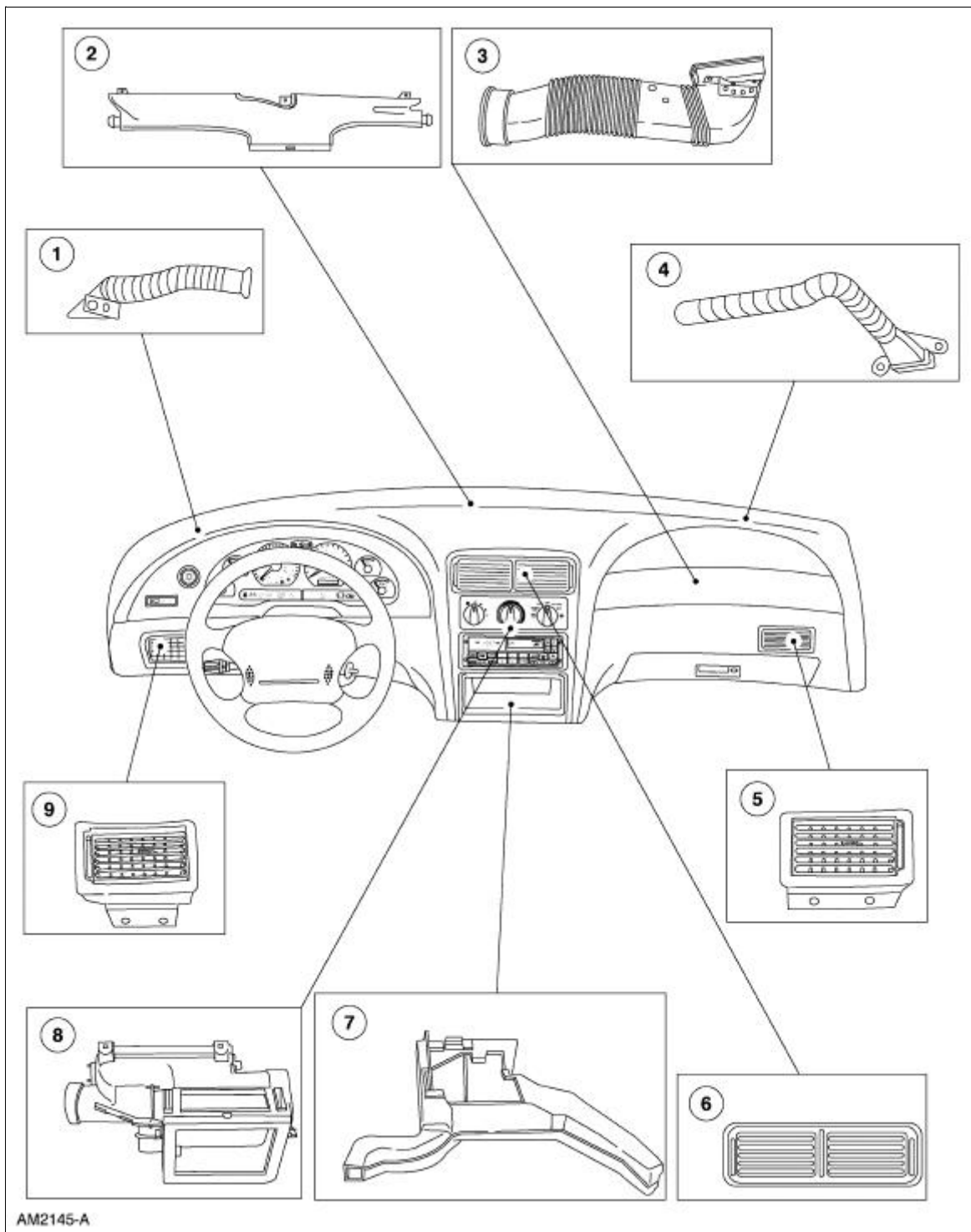
Instrument Panel Registers

There are A/C registers on the left and right sides of the instrument panel and in the center instrument panel finish panel.

The LH and RH A/C registers are only serviceable as assemblies.

The center A/C registers are not serviceable as assemblies. The registers are installed with the instrument panel center finish panel assembly.

Component Locations



AM2145-A

Item	Part Number	Description
1	19E630	LH demister nozzle duct
2	18490	Defroster duct
3	19B680	A/C evaporator register duct—(RH)
4	19E630	RH demister nozzle duct
5	19893	A/C evaporator register —(RH)
6	19893	A/C evaporator register —(center)
7	18C433	Floor duct
8	18471	Heater air plenum chamber

9

19893

A/C evaporator register —(LH)

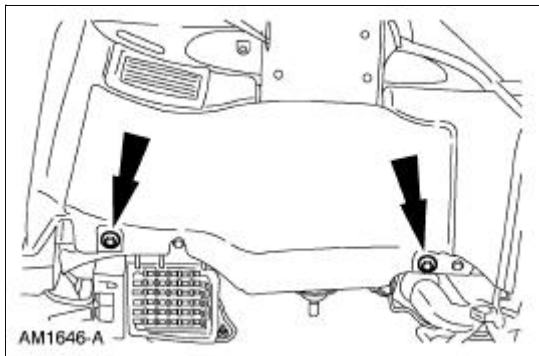
Air Distribution

For additional information, refer to [Section 412-00](#).

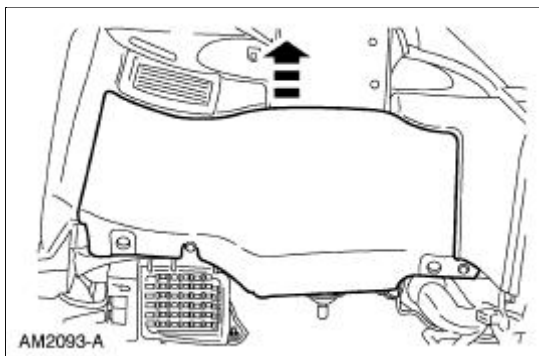
Register —LH

Removal

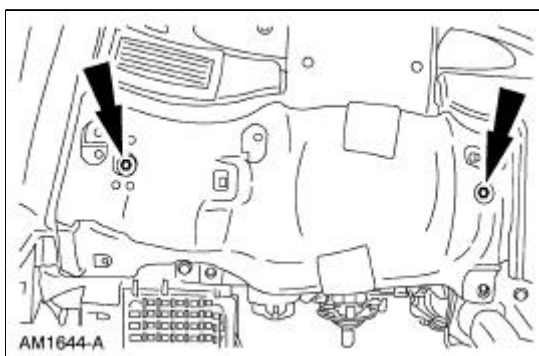
1. Remove the instrument panel steering column cover bolts.



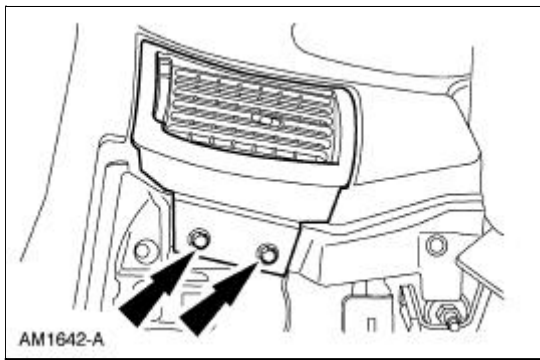
2. Unsnap and remove the instrument panel steering column cover.



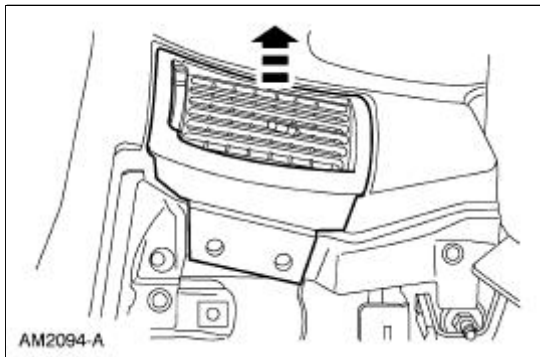
3. Remove the bolts and the steering column reinforcement.



4. Remove the screws.

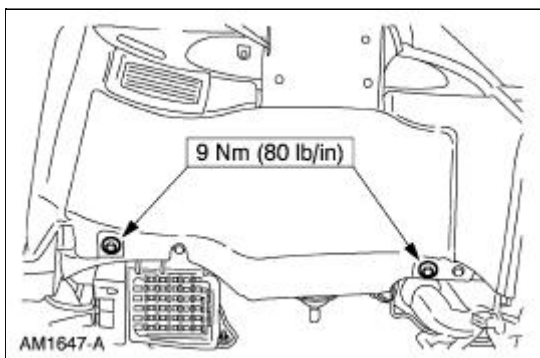
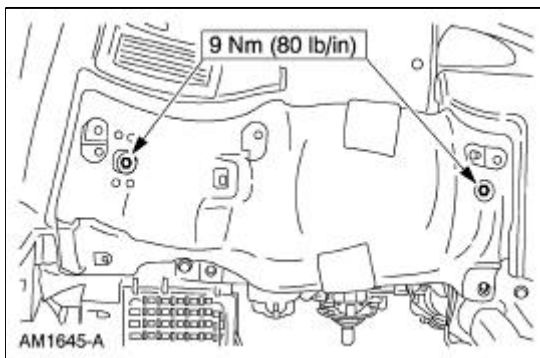


5. Remove the register.



Installation

1. To install, reverse the removal procedure.



Register —Center

Removal and Installation

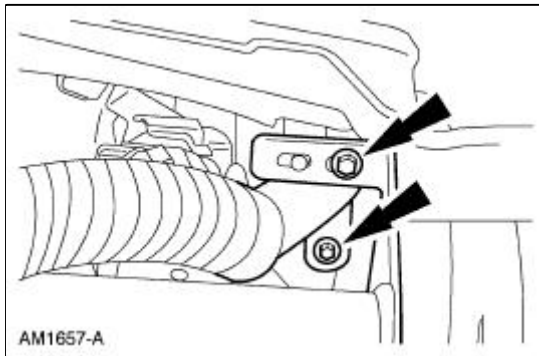
NOTE: The center register is incorporated into the instrument panel center finish panel.

For additional information, refer to [Section 501-12](#).

Nozzle —LH Demister and Hose

Removal

1. Remove the instrument panel. For additional information, refer to [Section 501-12](#).
2. Remove the screws.



3. Remove the hose and the nozzle from the instrument panel.

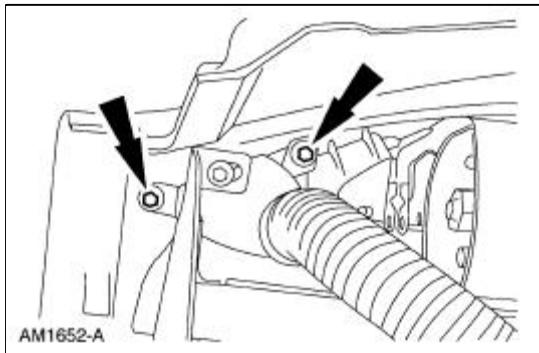
Installation

1. To install, reverse the removal procedure.
-

Nozzle —RH Demister and Hose

Removal

1. Remove the instrument panel. For additional information, refer to [Section 501-12](#).
2. Remove the screws.



3. Remove the hose and the nozzle from the instrument panel.

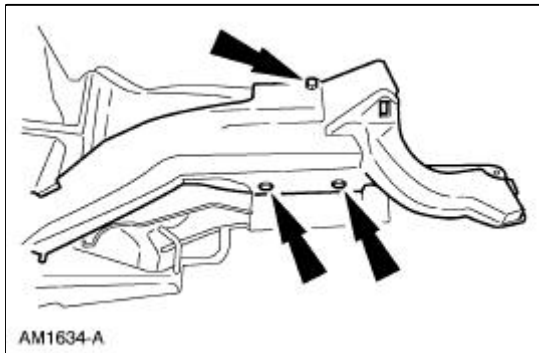
Installation

1. To install, reverse the removal procedure.
-

Duct —Floor

Removal

1. Remove the evaporator core housing. For additional information, refer to [Section 412-02](#).
2. Remove the screws and remove the heater outlet floor duct.



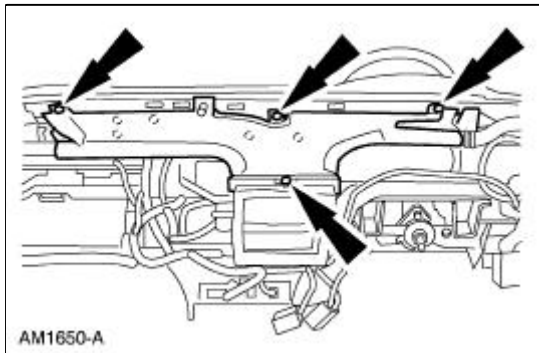
Installation

1. To install, reverse the removal procedure.
-

Duct —Defroster

Removal

1. Remove the instrument panel. For additional information, refer to [Section 501-12](#).
2. Remove the screws and remove the defroster duct.



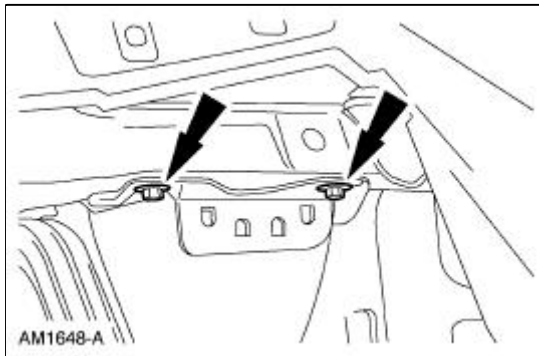
Installation

1. To install, reverse the removal procedure.
-

Duct —RH Instrument Panel Register

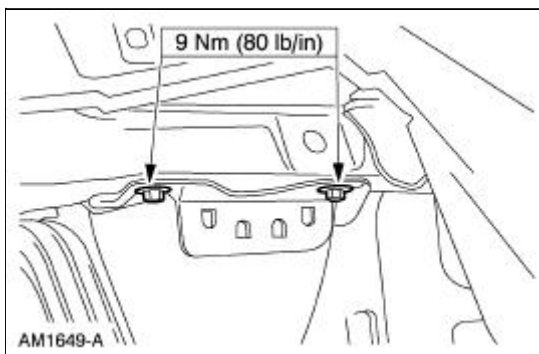
Removal

1. Remove the instrument panel. For additional information, refer to [Section 501-12](#).
2. Remove the screws and remove the duct.



Installation

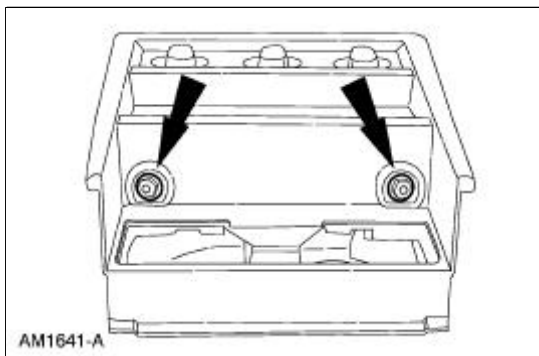
1. To install, reverse the removal procedure.



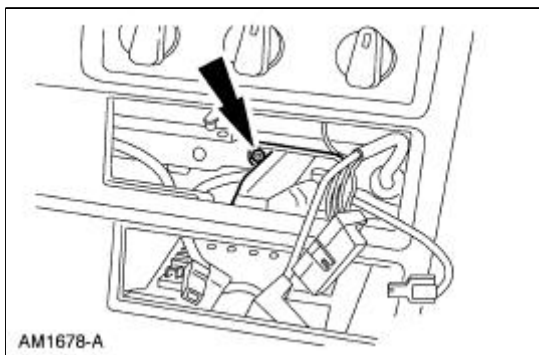
Plenum Chamber

Removal

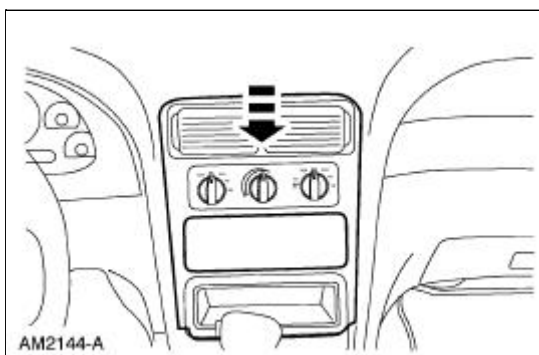
1. Remove the instrument panel. For additional information, refer to [Section 501-12](#).
2. Remove the audio unit. For additional information, refer to [Section 415-01](#).
3. If equipped, remove the CD player. For additional information, refer to [Section 415-01](#).
4. Remove the instrument panel center finish panel screws.



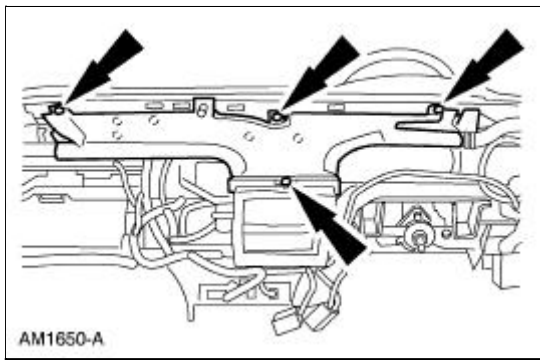
5. Remove the instrument panel center finish panel screw.



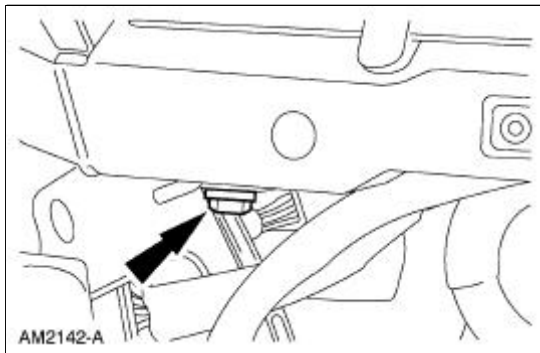
6. Unsnap and remove the instrument panel center finish panel.



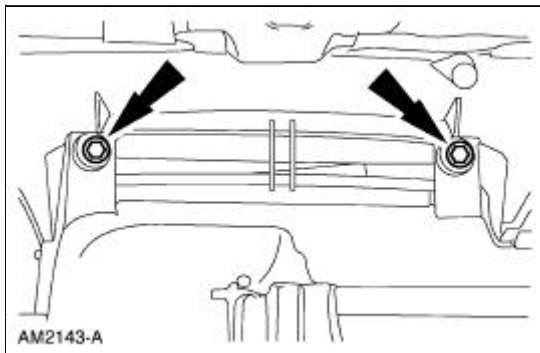
7. Remove the screws and remove the defroster duct.



8. Remove the screw.



9. Remove the screws and remove the plenum chamber.



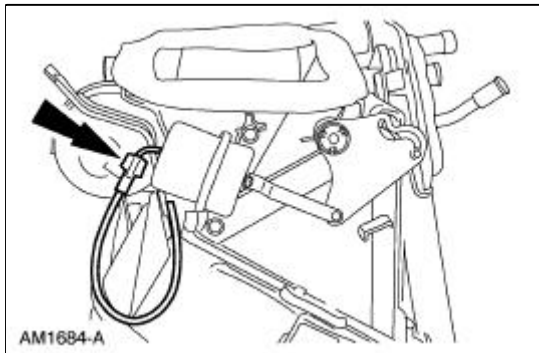
Installation

1. To install, reverse the removal procedure.
-

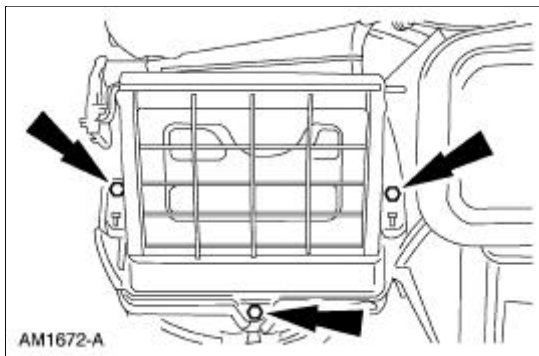
Door —Air Inlet Duct

Removal

1. Remove the evaporator core housing. For additional information, refer to [Section 412-02](#).
2. Disconnect the vacuum line.



3. Remove the screws and remove the duct.



Installation

1. To install, reverse the removal procedure.
-

General Specifications

Item	Specification
Lubricant	
MERPOL®	ESE-M99B144-B
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

Torque Specifications

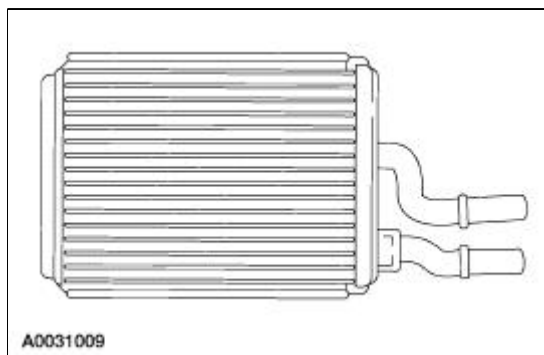
Description	Nm	lb-in
Interior evaporator core housing bracket nut and bolts	8	71

Heating and Defrosting

The heating and defrosting system has the following features:

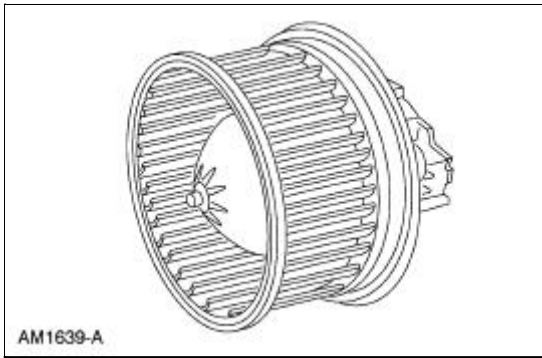
- Controls the temperature and, during A/C operation, reduces the relative humidity of the air inside the vehicle.
- Delivers heated or cooled air to maintain the vehicle interior temperature and comfort level.
- Controls the A/C blower motor speed.
- Cooling or heating can be adjusted to maintain the desired temperature.
- System uses a reheat method to provide conditioned air to the passenger compartment.
- The blower motor (19805) draws outside air through the air inlet duct from just below the windshield during all system operations except for MAX A/C cooling (when recirculated air is used).
- All airflow from the blower motor passes through the A/C evaporator core (19860).
- The temperature is then regulated by reheating a portion of the air and blending it with the remaining cool air to the desired temperature.
- The temperature blending is varied by the air temperature control door, which regulates the amount of air that flows through and around the heater core (18476), where it is then mixed and distributed.

Heater Core



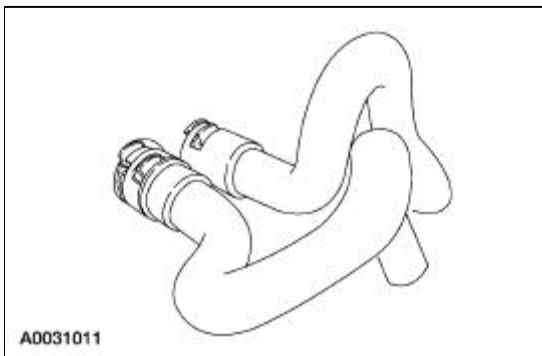
The heater core (18476) consists of fins and tubes arranged to extract heat from the engine coolant and transfer it to air passing through the heater core.

Blower Motor



The A/C blower motor (19805) pulls air from the air inlet and forces it into the plenum assembly where it is mixed and distributed.

Heater Hoses



NOTE: The heater water hoses connect to the heater core using quick disconnect couplers. The couplers are an integral part of the hose assemblies and cannot be separately serviced.

The heater water hoses (18472) provide a flexible connection between the engine and cooling system allowing hot water to travel from the engine to the heater core.

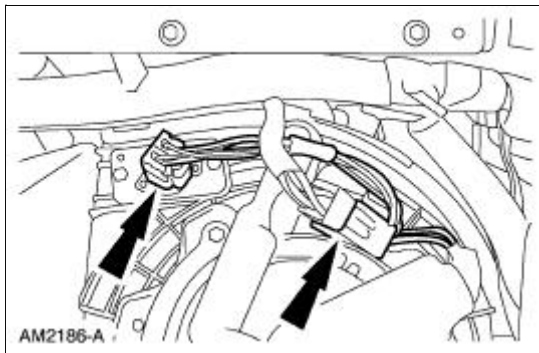
Heating and Defrosting

Refer to [Section 412-00](#) .

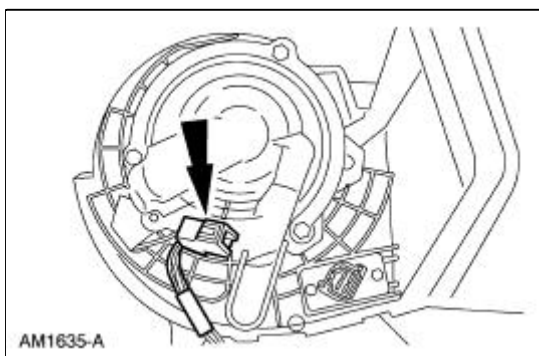
Blower Motor

Removal

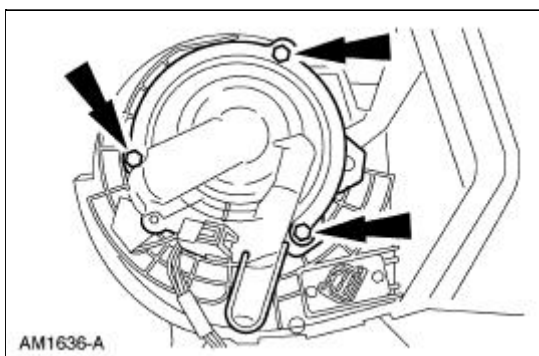
1. Disconnect the jumper wire.



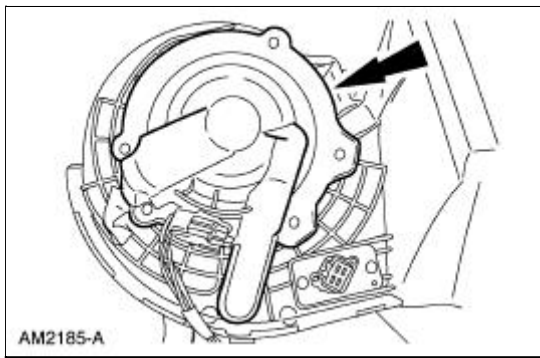
2. Disconnect the main harness.



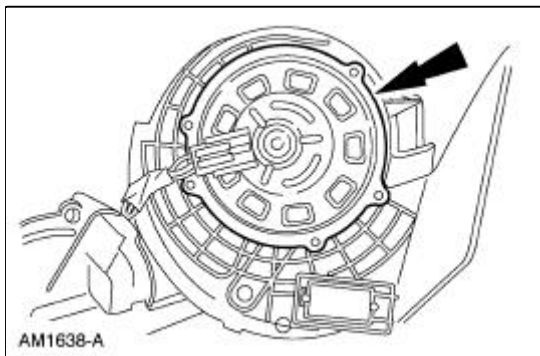
3. Remove the screws.



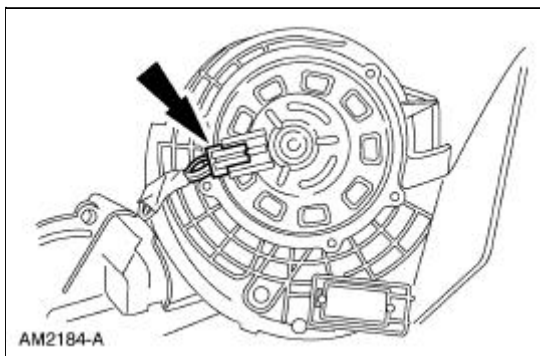
4. Separate the cover from the motor.



5. Separate the motor from the housing.



6. Disconnect the jumper from the motor.
 - Remove the blower motor.



Installation

1. To install, reverse the removal procedure.
-

Evaporator Core Housing

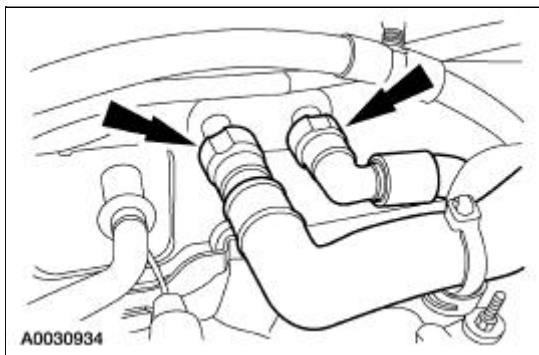
Material

Item	Specification
PAG Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B
MERPOL® NA	ESE-M99B144-B

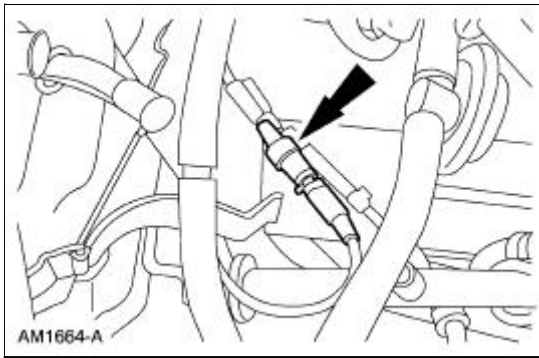
Removal

NOTE: The evaporator core is not separately serviceable, it is serviced only with the evaporator core housing assembly.

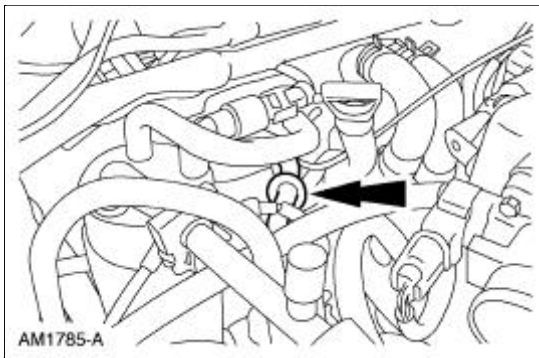
1. Disconnect the battery ground cable.
2. Recover the refrigerant. For additional information, refer to [Section 412-00](#).
3. Drain the cooling system. For additional information, refer to [Section 303-03A](#) or [Section 303-03B](#).
4. Remove the instrument panel. For additional information, refer to [Section 501-12](#).
5. Disconnect the heater hose couplings from the heater core. For additional information, refer to [Section 412-00](#).



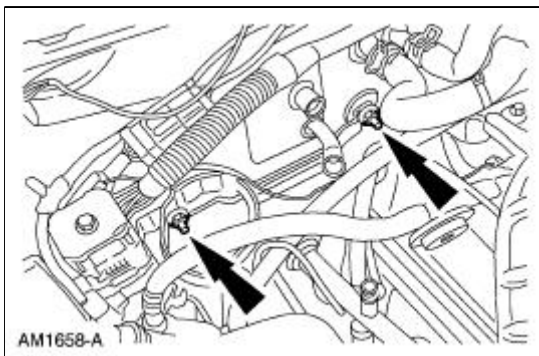
6. Disconnect the vacuum connector.



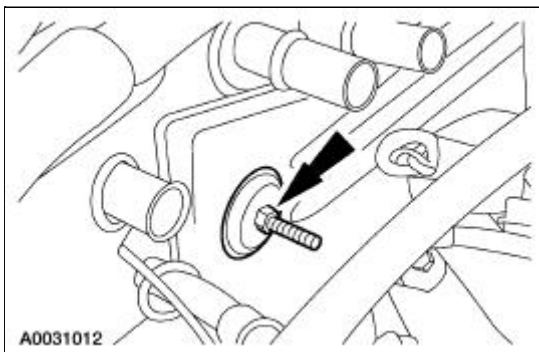
7. Remove the suction accumulator/drier. For additional information, refer to [Section 412-03](#).
8. Disconnect the A/C liquid line.
 - Discard the O-ring seals.



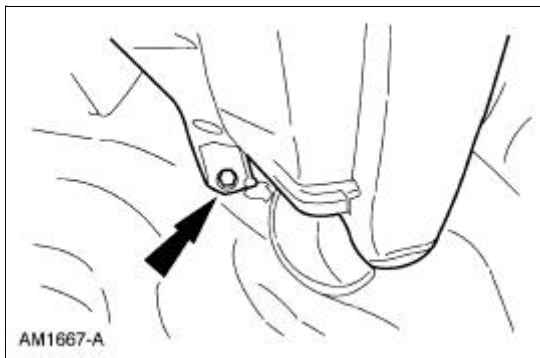
9. Remove the evaporator core housing nuts.



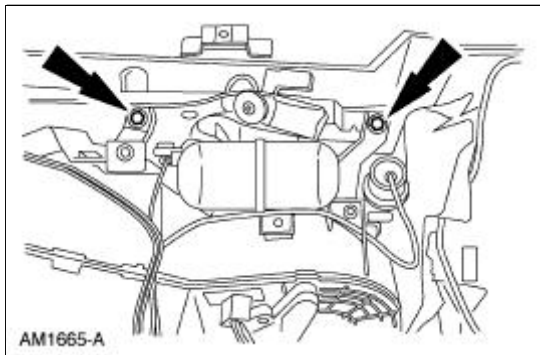
10. Remove the nut.



11. Remove the screw.



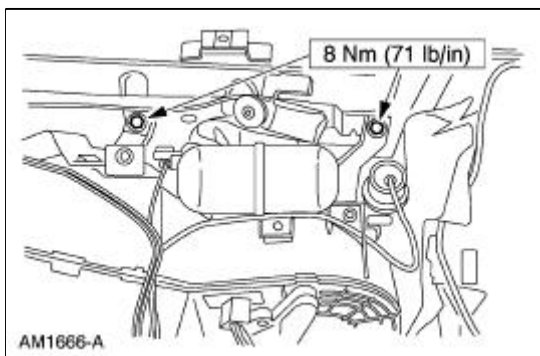
12. Remove the interior evaporator core housing bolts.



13. Remove the evaporator core housing.

Installation

1. To install, reverse the removal procedure.
 - Lubricate the coolant hoses with coolant hose lubricant or plain water only, if needed.
 - Install new O-ring seals lubricated with PAG oil.

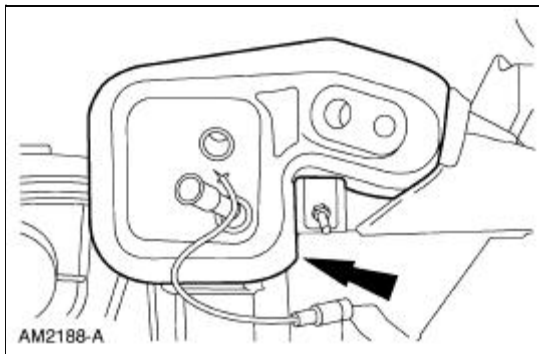


Heater Core

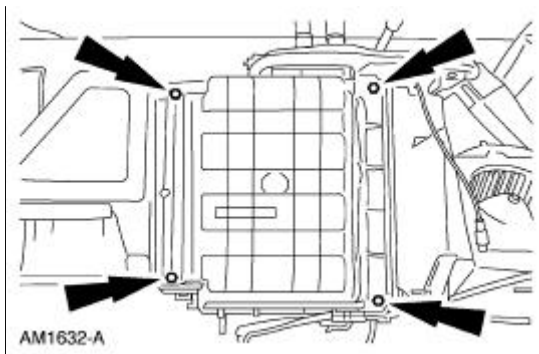
Removal

NOTE: If a heater core leak is suspected, the heater core must be pressure leak tested before it is removed from the vehicle. For additional information, refer to [Section 412-00](#).

1. Remove the evaporator core housing. For additional information, refer to [Evaporator Core Housing](#) in this section.
2. Remove the foam weather seal.



3. Remove the screws and remove the heater core cover.



4. Remove the heater core.

Installation

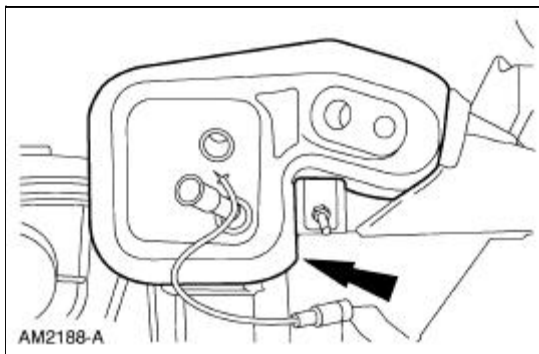
1. **NOTE:** Be sure to install a new oval foam weather seal around the heater core inlet and outlet tubes.

To install, reverse the removal procedure.

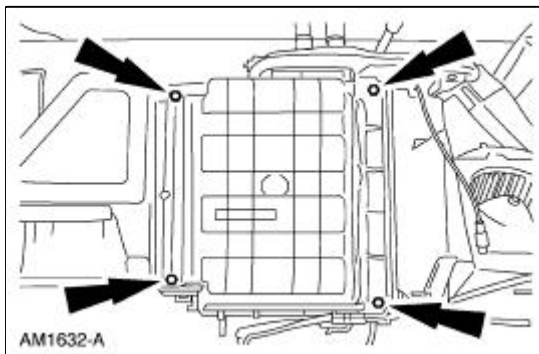
Evaporator Core Housing

Disassembly

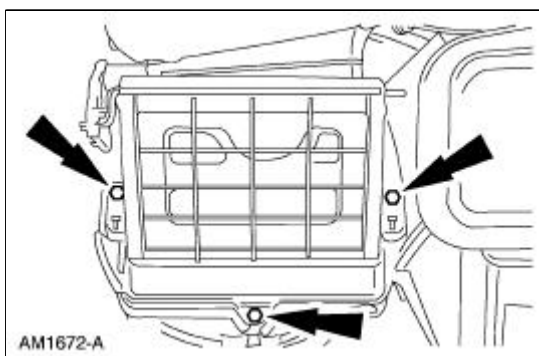
1. Remove the evaporator core housing. For additional information, refer to [Evaporator Core Housing](#) in this section.
2. Remove the foam weather seal.



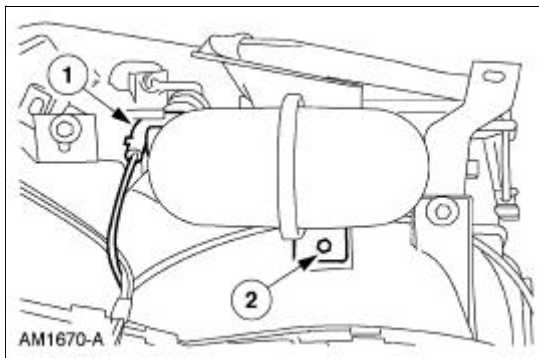
3. Remove the screws and remove the heater core.



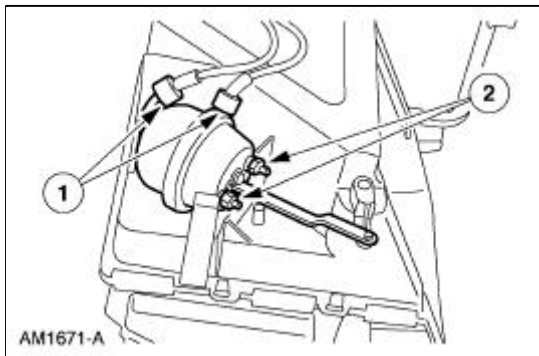
4. Remove the screws and remove the A/C recirculating air duct.



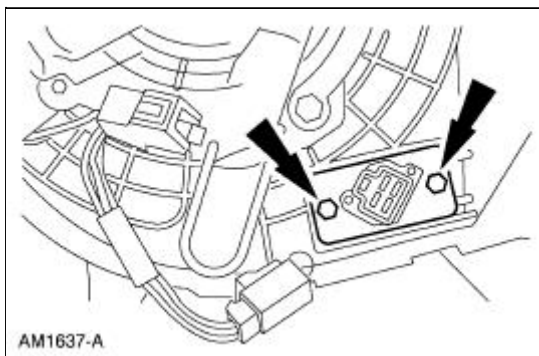
5. Remove the vacuum reservoir.
 1. Disconnect the vacuum line.
 2. Remove the screw.



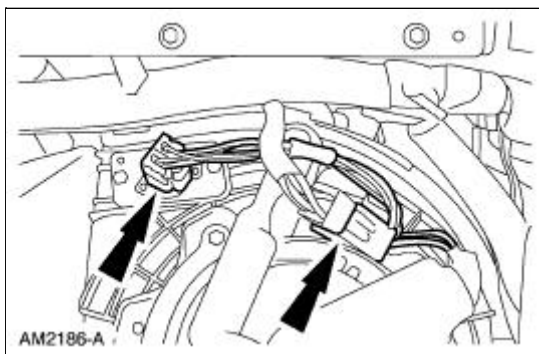
6. Remove the heater air damper door motor.
 1. Disconnect the vacuum lines.
 2. Loosen the nuts and unclip the motor.



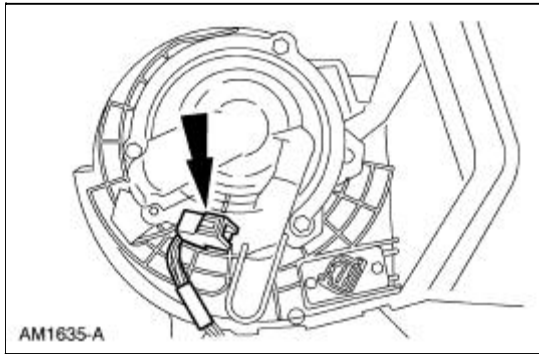
7. Release the vacuum harness from the housing.
8. Remove the screws and remove the resistor.



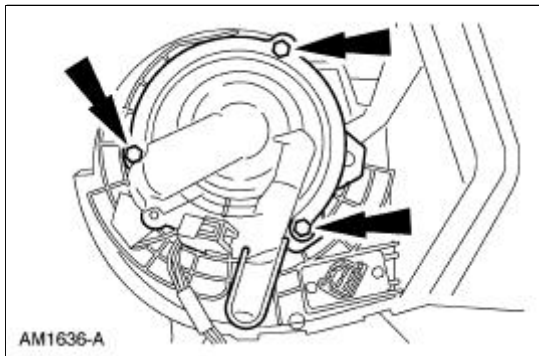
9. Disconnect the jumper wire.



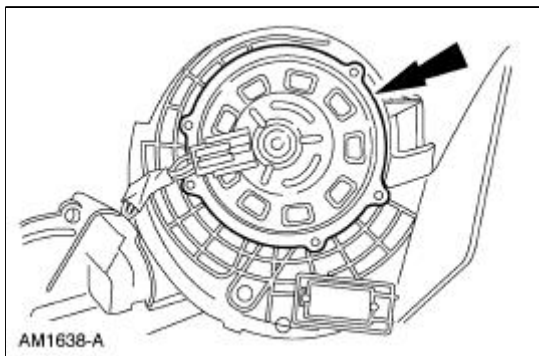
10. Disconnect the main harness.



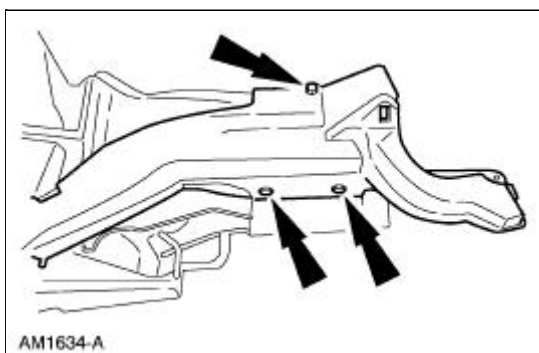
11. Remove the screws.



12. Remove the blower motor.



13. Remove the screws and remove the duct.



14. Remove the mounting brackets.

Assembly

1. To assemble, reverse the disassembly procedure.
-

General Specifications

Item	Specification
Lubricant	
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (MC YN-12-C)	WSH-M1C231-B

Torque Specifications

Description	Nm	lb-ft	lb-in
A/C compressor mounting bolts	25	18	—
A/C manifold retaining bolt	20	15	—
3.8L engine A/C compressor mounting bracket bolts	47	35	—
3.8L engine A/C compressor mounting bracket nut	25	18	—
A/C compressor clutch retaining bolt	13	10	—
Suction accumulator/drier clamp screw	8	—	71
Coolant bottle bolts	10	—	89
Peanut fittings	8	—	71
Radiator bracket bolts	9	—	81
Condenser core bracket bolts	5	—	44
A/C muffler bracket nut	25	18	—

Air Conditioning

The A/C refrigerant system is a clutch cycling orifice tube type. The system components are:

- A/C compressor (19703)
- A/C clutch (2884)
- A/C condenser core (19712)
- A/C evaporator core (19860)
- suction accumulator (19C836)
- connecting refrigerant lines

The refrigeration system operation is controlled by the:

- A/C evaporator core orifice (19D990).
- A/C cycling switch (19E561).
- A/C compressor pressure relief valve (19D644).
- Refrigerant containment switch (3.8L) (19D594).
- Dual-function pressure switch (4.6L) (19D594).

The refrigerant system incorporates an A/C compressor controlled by an A/C cycling switch.

The A/C cycling switch senses A/C evaporator core pressure to control A/C compressor operation.

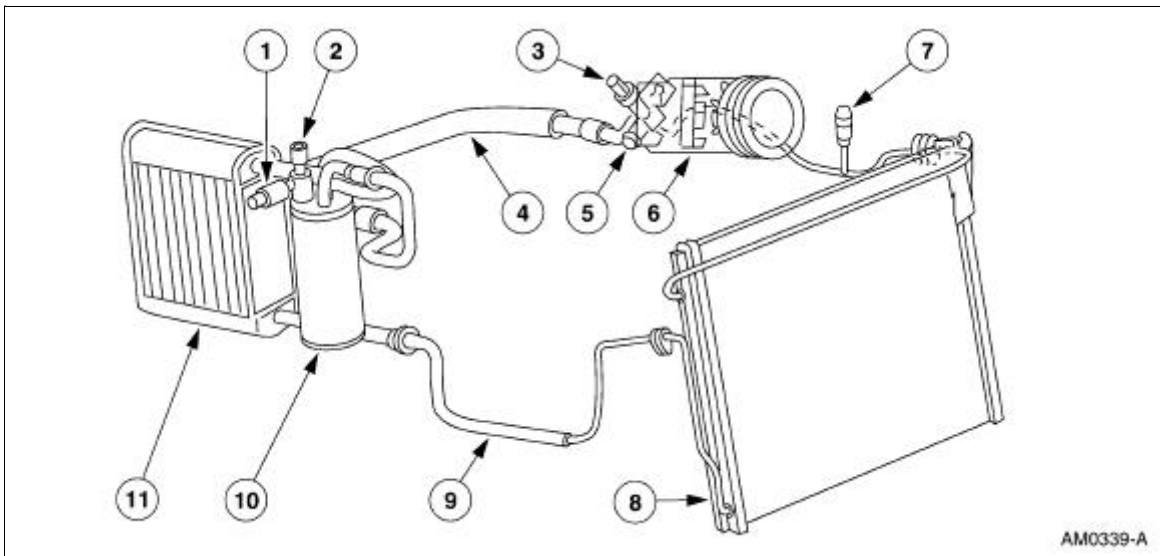
An A/C compressor pressure relief valve is installed in the A/C manifold and tube (19D734) to protect the refrigerant system against excessively high refrigerant pressures.

An evaporator core orifice is installed in the A/C evaporator core inlet tube to meter the liquid refrigerant into the A/C evaporator core.

A refrigerant containment switch is installed on 3.8L vehicles to cut-off A/C compressor operation in the event of abnormally high refrigerant system pressure.

A dual-function pressure switch is used on 4.6L vehicles for cooling fan control, and to cut-off A/C compressor operation in the event of abnormally high refrigerant system pressure.

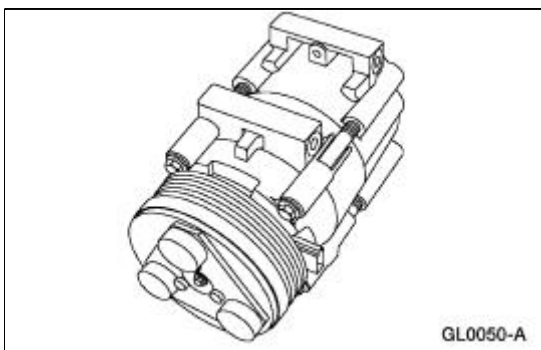
Refrigeration System Components



AM0339-A

Item	Part Number	Description
1	19E561	A/C cycling switch
2	19D701	A/C charge port valve (low side)
3	19D594	Refrigerant containment switch (3.8L vehicles)
3	19D594	Dual-function pressure switch (4.6L vehicles)
4	19D734	A/C manifold and tube
5	19D644	A/C compressor pressure relief valve
6	19703	A/C compressor
7	19D701	A/C charge port valve (high side)
8	19712	A/C condenser core
9	19835	Condenser to evaporator tube
10	19C836	Suction accumulator
11	—	A/C evaporator core (part of 19850 assembly)

A/C Compressor and Clutch Assembly

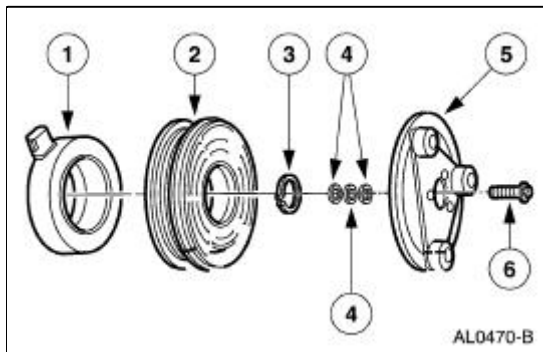


NOTE: Internal A/C compressor components are not serviced separately. The FS-10 A/C compressor is serviced only as an assembly. The A/C clutch pulley, A/C clutch field coil (19D798) and the shaft seal are serviceable.

The FS-10 A/C compressor has the following characteristics:

- A ten-cylinder swashplate design utilizing the tangential design mount.

- A one-piece lip-type seal (installed from the front of the A/C compressor) is used to seal it at the shaft opening in the assembly.
- Five double-acting pistons operate within the cylinder assembly. The pistons are actuated by a swashplate that converts the rotating action of the shaft to a reciprocating force.
- Reed-type discharge valves are located between the cylinder assembly and the head at each end of the A/C compressor.
- The A/C compressor uses PAG oil, or equivalent. This oil contains special additives required for the A/C compressor.
- The A/C compressor oil from vehicles equipped with an FS-10 A/C compressor may have some dark colored streaking while maintaining a normal oil viscosity. This is normal for the A/C compressor and is caused by break-in wear of the piston rings.

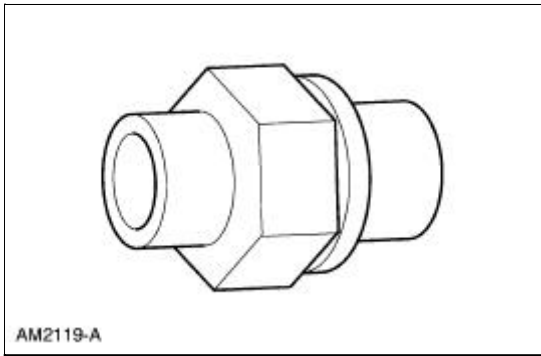


Item	Part Number	Description
1	19D798	A/C clutch field coil
2	19D784	A/C clutch pulley
3	N805338-S2	Pulley snap ring
4	19D648	A/C clutch hub spacer
5	19D786	Disk and hub assembly
6	N805332-S2	A/C clutch bolt

The magnetic A/C clutch has the following characteristics:

- It drives the compressor shaft.
- When the battery positive voltage (B+) is applied to the A/C clutch field coil, the clutch plate and hub assembly is drawn toward the A/C clutch pulley.
- The magnetic force locks the clutch plate and hub assembly and the A/C clutch pulley together as one unit, causing the compressor shaft to rotate.
- When (B+) is removed from the A/C clutch field coil, springs in the clutch plate and hub assembly move the clutch plate away from the A/C clutch pulley.

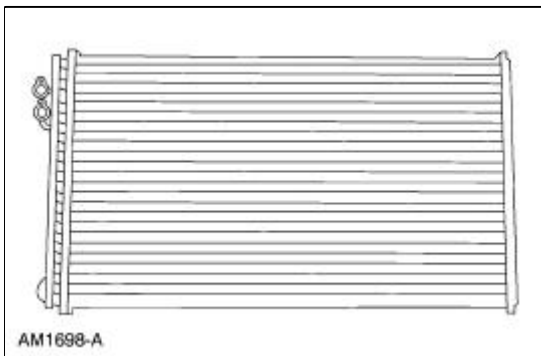
A/C Compressor Pressure Relief Valve



An A/C compressor pressure relief valve is incorporated into the compressor A/C manifold and tube to:

- relieve unusually high refrigerant system discharge pressure buildups. For specifications regarding operating pressure(s), refer to [Section 412-00](#).
- prevent damage to the A/C compressor and other system components.
- avoid total refrigerant loss by closing after the excessive pressure has been relieved.

A/C Condenser Core



The A/C condenser core has the following characteristics:

- It is an aluminum fin and tube design heat exchanger located in front of the vehicle radiator (8005).
- It cools compressed refrigerant gas by allowing air to pass over fins and tubes to extract heat and by condensing gas to liquid refrigerant as it is cooled.

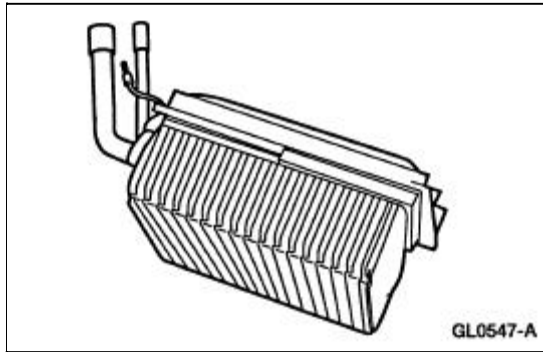
Refrigerant Lines

The condenser to evaporator tube (19835) contains the high pressure liquid refrigerant upstream of the evaporator core orifice.

The A/C manifold and tube (19D734) is attached to the A/C compressor, is sealed with O-ring seals, and has the following features:

- The upstream side contains low pressure refrigerant gas.
- The downstream side contains high pressure refrigerant gas and a fitting used to mount a serviceable high pressure A/C charge port valve.
- The downstream side also contains a fitting used to mount the refrigerant containment switch (3.8L) or dual-function pressure switch (4.6L). A long-travel Schrader-type valve stem core is installed in the fitting so that the switch can be removed without discharging the A/C system.

A/C Evaporator Core



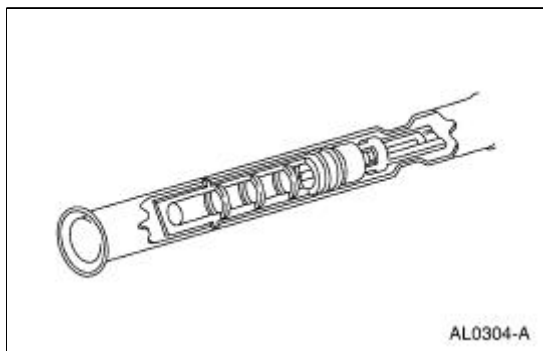
NOTE: The evaporator core is not separately serviceable, it is serviced only with the evaporator core housing assembly.

NOTE: Installation of a new suction accumulator is not required when repairing the air conditioning system except when there is physical evidence of contamination from a failed A/C compressor or damage to the suction accumulator.

The A/C evaporator core is the plate/fin type with a unique refrigerant flow path.

- A mixture of refrigerant and oil enters the bottom of the A/C evaporator core through the A/C evaporator core inlet tube and moves out of the A/C evaporator core through the A/C evaporator core outlet tube.
- This flow pattern accelerates the flow of refrigerant and oil through the A/C evaporator core.

Evaporator Core Orifice



NOTE: The evaporator core orifice is an integral part of the condenser to evaporator line and should be installed as an assembly with the line.

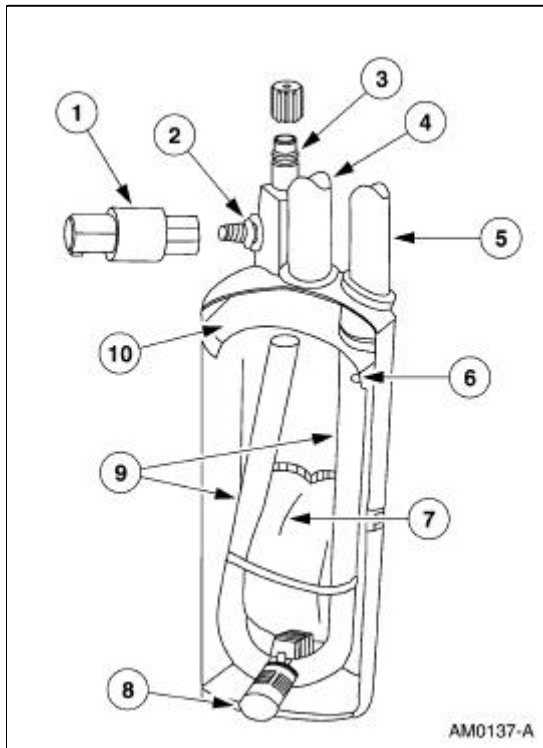
NOTE: A new evaporator core orifice should be installed whenever a new A/C compressor is installed.

The evaporator core orifice has the following characteristics:

- It is located in the A/C condenser to evaporator line.
- It has filter screens located on the inlet and outlet ends of the tube body.
- The inlet filter screen acts as a strainer for the liquid refrigerant flowing through the evaporator core orifice.
- O-ring seals on the evaporator core orifice prevent the high-pressure liquid refrigerant from bypassing the evaporator core orifice.

- Adjustment or repair cannot be made to the evaporator core orifice assembly. A new evaporator core orifice must be installed as a unit.

Suction Accumulator



Item	Part Number	Description
1	19E561	A/C cycling switch
2	—	O-ring seal (part of 19C836)
3	19D701	Low pressure service gauge port valve
4	—	Inlet from A/C evaporator core (part of 19C836)
5	—	Outlet to A/C compressor (part of 19C836)
6	—	Anti-siphon hole (part of 19C836)
7	—	Desiccant bag (part of 19C836)
8	—	Oil return orifice filter (part of 19C836)
9	—	Vapor return tube (part of 19C836)
10	—	Suction accumulator dome (part of 19C836)

NOTE: Installation of a new suction accumulator is not required when repairing the air conditioning system except when there is physical evidence of contamination from a failed A/C compressor or damage to the suction accumulator.

In addition to the preceding condition, a new suction accumulator should be installed if one of the following conditions exist:

- The suction accumulator is perforated.
- The refrigerant system has been opened to the atmosphere for a period of time longer than required to make a minor repair.
- There is evidence of moisture in the system such as internal corrosion of metal refrigerant lines or the refrigerant oil is thick and dark.

The suction accumulator (19C836) is mounted to the A/C accumulator bracket (19D606) to the right of the vehicle centerline. The inlet tube of the suction accumulator attaches directly to the A/C evaporator core outlet tube and the outlet tube attaches to the A/C manifold and tube.

After entering the inlet of the suction accumulator, the heavier oil-laden refrigerant contacts an internally mounted dome (which serves as an umbrella) and drips down onto the bottom of the canister.

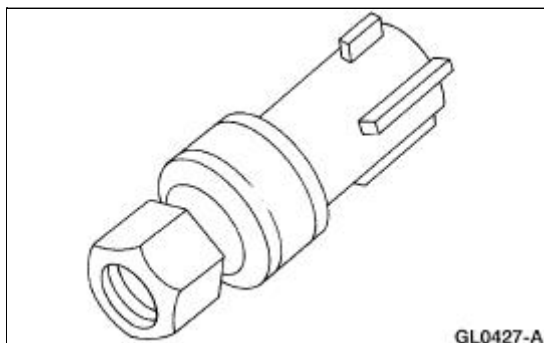
- A small diameter oil bleed hole, in the bottom of the vapor return tube, allows the accumulated heavier liquid refrigerant and oil mixture to reenter the compressor suction line at a controlled rate.
- As the heavier mixture passes through the small diameter liquid bleed hole, it has a second chance to vaporize and recirculate through the A/C compressor without causing compressor damage due to slugging.
- A fine mesh screened filter fits tightly around the bottom of the vapor return tube to filter out refrigerant system contaminant particles.
- A desiccant bag is mounted inside the canister to absorb any moisture which may be in the refrigerant system.
- A fitting located on the top of the suction accumulator is used to attach the A/C cycling switch. A long-travel Schrader-type valve stem core is installed in the fitting so that the A/C cycling switch can be removed without discharging the A/C system.

A/C Cycling Switch

The A/C cycling switch is mounted on a Schrader-type valve fitting on the top of the suction accumulator.

- A valve depressor, located inside the threaded end of the A/C cycling switch, presses in on the Schrader valve stem.
- This allows the suction pressure inside the suction accumulator to control the operation of the A/C cycling switch.
- The electrical switch contacts open when the suction pressure drops. The contacts close when the suction pressure rises. For specifications regarding operating pressure(s), refer to [Section 412-00](#).
- The A/C cycling switch will control the A/C evaporator core pressure at a point where the plate/fin surface temperature will be maintained slightly above freezing.
- This prevents icing of the A/C evaporator core and blockage of air flow.
- It is not necessary to discharge the refrigerant system to remove the A/C cycling switch.

Dual-Function Pressure Switch (4.6L)



The dual-function pressure switch is used to interrupt A/C compressor operation in the event of high

system discharge pressures.

- The dual-function pressure switch is mounted on a Schrader valve-type fitting on the high pressure side of the A/C manifold and tube.
- It is not necessary to discharge the refrigerant system to remove the dual-function pressure switch.
- A valve depressor, located inside the threaded end of the dual-function pressure switch, presses on the Schrader valve stem.
- This allows the dual-function pressure switch to monitor the compressor discharge pressure.
- When the compressor discharge pressure rises, the switch contacts open, disengaging the A/C compressor. When the pressure drops, the contacts close to allow operation of the A/C compressor. For specifications regarding operating pressure(s), refer to [Section 412-00](#).

The dual-function pressure switch has a second set of electrical contacts used for high-speed cooling fan control.

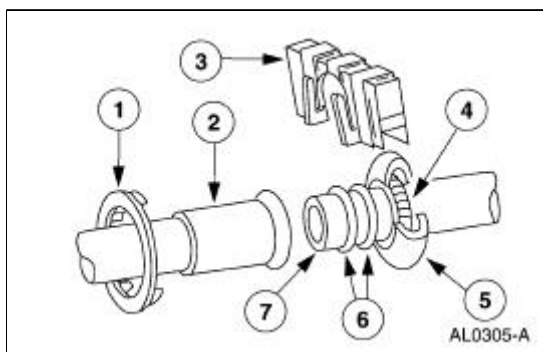
- When the compressor discharge pressure rises, the contacts close and engage the high speed fan control. When the pressure drops, the contacts open and the high speed fan control is disengaged.

Refrigerant Containment Switch (3.8L)

The refrigerant containment switch is used to interrupt A/C compressor operation in the event of high system discharge pressures.

- The refrigerant containment switch is mounted on a Schrader-type valve fitting on the high pressure side of the compressor manifold and tube assembly.
- A valve depressor, located inside the threaded end of the refrigerant containment switch, presses on the Schrader valve stem.
- This allows the refrigerant containment switch to monitor the A/C compressor discharge pressure.
- When the A/C compressor discharge pressure rises, the switch contacts open, disengaging the A/C compressor. When the pressure drops, the contacts close to allow operation of the A/C compressor. For additional information regarding operating pressure(s), refer to [Section 412-00](#).
- It is not necessary to discharge the refrigerant system to remove the refrigerant containment switch.

Spring Lock Coupling



Item	Part Number	Description
1	—	Plastic indicator ring (part of 19D690)

2	—	Female fitting (part of 19860)
3	19E746	A/C tube lock coupling clip
4	19E576	A/C tube lock coupling spring
5	—	Cage (part of 19D690)
6	—	O-ring seals (part of 19D690)
7	—	Male fitting (part of 19835)

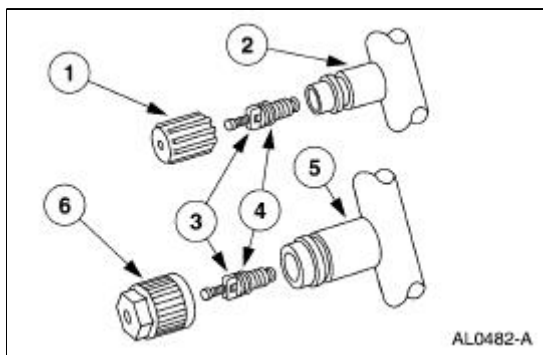
The spring lock coupling is a refrigerant line coupling held together by a garter spring inside a circular cage.

- When the coupling is connected together, the flared end of the female fitting slips behind the garter spring inside the cage of the male fitting.
- The garter spring and cage then prevent the flared end of the female fitting from pulling out of the cage.
- Three O-ring seals are used to seal between the two halves of the A/C condenser core couplings. All other couplings have two O-ring seals.
- Use only the O-ring seals listed in the Ford Master Parts Catalog for the spring lock coupling.
- A plastic indicator ring is used on the spring lock couplings of the A/C evaporator core to indicate, during vehicle assembly, that the coupling is connected. Once the coupling is connected, the indicator ring is no longer necessary but will remain captive by the coupling near the cage opening.
- The indicator ring may also be used during repair operations to indicate connection of the coupling.
- An A/C tube lock coupling clip (19E746) may be used to secure the coupling but is not required.

Service Gauge Port Valves

The high-pressure service gauge port valve is located on the A/C manifold and tube.

The low pressure service gauge port valve is located on the suction accumulator.



Item	Part Number	Description
1	19D702	A/C charging valve cap
2	19D701	Low pressure service gauge port valve (part of 19C836)
3	19D701	Schrader-type valve
4	—	O-ring seal (part of 19D701)
5	19D701	High pressure service gauge port valve (part of

		19D734)
6	19D702	A/C charging valve cap

The fitting is an integral part of the refrigeration line or component.

- Special couplings are required for both the high side and low side service gauge ports.
 - A new Schrader-type valve core can be installed if the seal leaks.
 - Always install the A/C charging valve cap (19D702) on the service gauge port valves after repairing the refrigerant system.
-

Air Conditioning

Refer to [Section 412-00](#) .

Air Conditioning (A/C) Compressor —3.8L

Material

Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

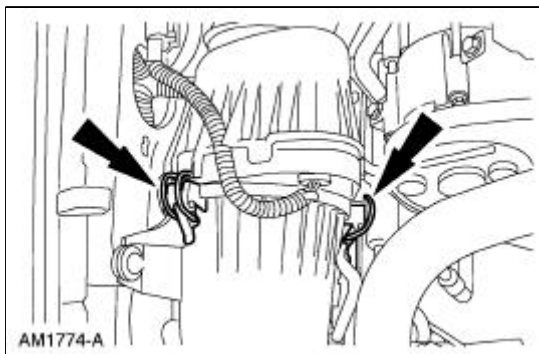
Removal and Installation

 **CAUTION:** If installing a new air conditioning compressor due to an internal failure of the old unit, you must carry out the following procedures to remove contamination from the air conditioning system.

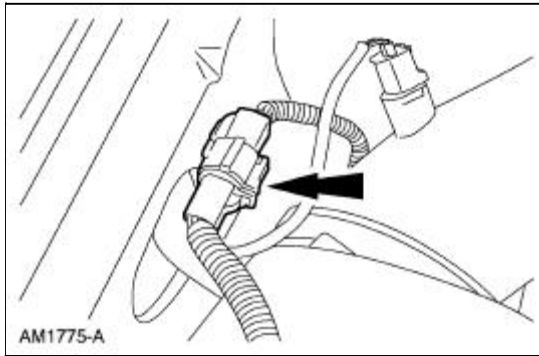
- If A/C flushing equipment is available, carry out the flushing of the air conditioning system prior to installing a new air conditioning compressor. For additional information, refer to [Section 412-00](#).
- If A/C flushing equipment is not available, carry out filtering of the air conditioning system after a new air conditioning compressor has been installed. For additional information, refer to [Section 412-00](#).
- Install a new evaporator core orifice (19D990), as directed by the A/C flushing or filtering procedure.
- Install a new suction accumulator (19C836), as directed by the A/C flushing or filtering procedure.

NOTE: Installation of a new suction accumulator is not required when repairing the air conditioning system except when there is physical evidence of system contamination from a failed A/C compressor or damage to the suction accumulator.

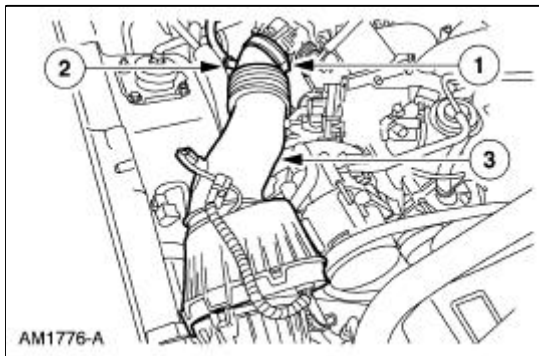
1. If flushing of the air conditioning system has not been performed, recover the refrigerant. For additional information, refer to [Section 412-00](#).
2. Disconnect the battery. For additional information, refer to [Section 414-01](#)
3. Unlatch the air breather.



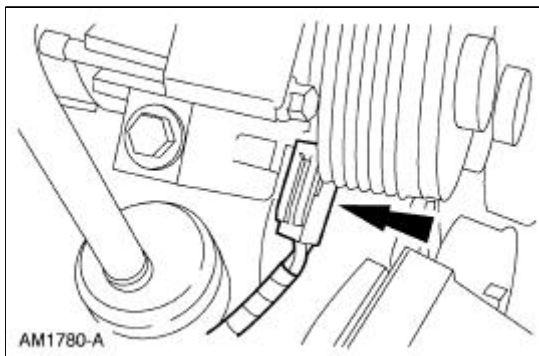
4. Disconnect the mass airflow (MAF) sensor electrical connector.



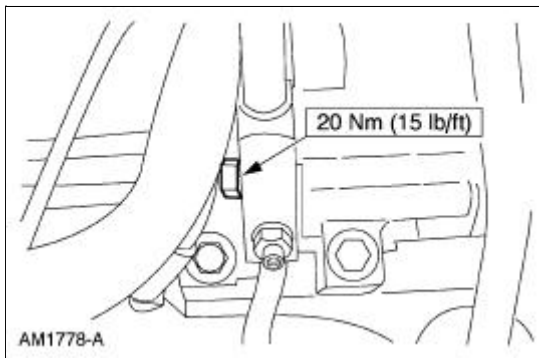
5. Remove the air cleaner outlet tube (9B659).
 1. Loosen the clamp.
 2. Disconnect the crankcase ventilation tube (6758).
 3. Remove the air cleaner outlet tube assembly.



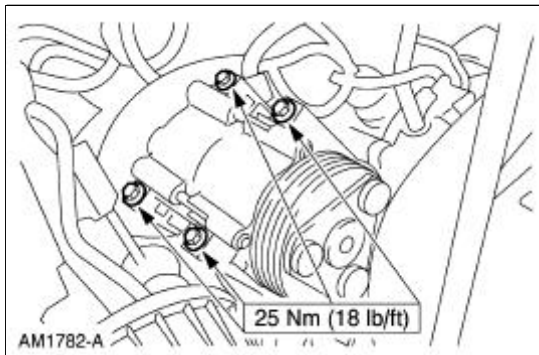
6. Remove the drive belt (8620) from the A/C compressor pulley.
7. Disconnect the electrical compressor clutch connector.



8. Remove the bolt and disconnect the A/C manifold and tube (19D734).
 - Discard the O-ring seals.



9. Remove the bolts and the A/C compressor.



10. To install, reverse the removal procedure.
 - Install new O-ring seals lubricated in clean PAG oil.
 - If filtering of the refrigerant system is not to be performed, lubricate the refrigerant system with the correct amount of clean PAG oil. For additional information, refer to [Section 412-00](#).
 11. If filtering of the air conditioning system is not to be performed, evacuate, leak test and charge the refrigerant system. For additional information, refer to [Section 412-00](#).
-

Air Conditioning (A/C) Compressor —4.6L

Material

Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

Removal and Installation

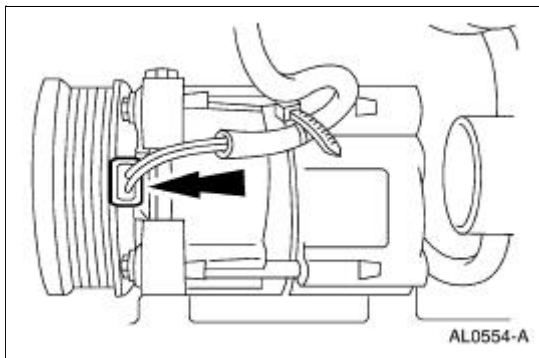


CAUTION: If installing a new air conditioning compressor due to an internal failure of the old unit, you must carry out the following procedures to remove contamination from the air conditioning system.

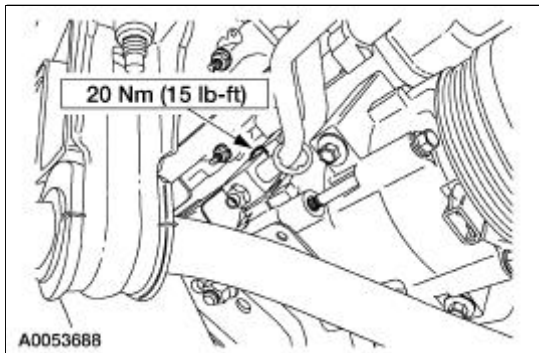
- If A/C flushing equipment is available, carry out the flushing of the air conditioning system prior to installing a new air conditioning compressor. For additional information, refer to [Section 412-00](#).
- If A/C flushing equipment is not available, carry out filtering of the air conditioning system after a new air conditioning compressor has been installed. For additional information, refer to [Section 412-00](#).
- Install a new evaporator core orifice (19D990), as directed by the A/C flushing or filtering procedure.
- Install a new suction accumulator (19C836), as directed by the A/C flushing or filtering procedure.

NOTE: Installation of a new suction accumulator is not required when repairing the air conditioning system except when there is physical evidence of system contamination from a failed A/C compressor or damage to the suction accumulator.

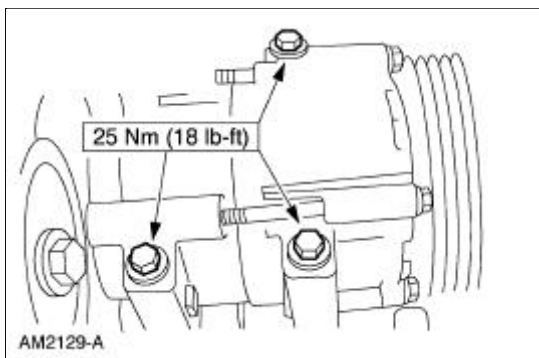
1. If flushing of the air conditioning system has not been performed, recover the refrigerant. For additional information, refer to [Section 412-00](#).
2. Remove the drive belt from the A/C compressor pulley.
3. Raise the vehicle. For additional information, refer to [Section 100-02](#).
4. Disconnect the A/C compressor electrical connector.



5. Remove the bolt and detach the manifold and tube assembly.



6. Remove the compressor.
 1. Remove the bolts.
 2. Remove the compressor.

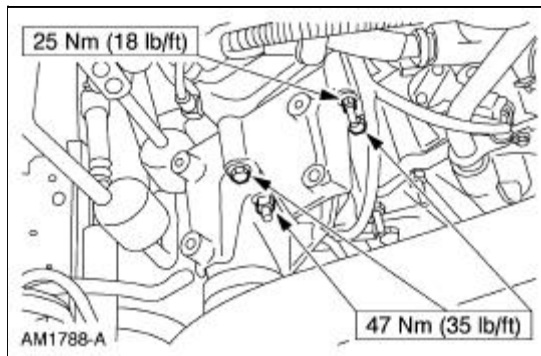


7. To install, reverse the removal procedure.
 - Install new O-ring seals lubricated in clean PAG oil.
 - If filtering of the refrigerant system is not to be performed, lubricate the refrigerant system with the correct amount of clean PAG oil. For additional information, refer to [Section 412-00](#).
 8. If filtering of the refrigerant system is not to be performed, evacuate, leak test and charge the refrigerant system. For additional information, refer to [Section 412-00](#).
-

Air Conditioning (A/C) Compressor Bracket —3.8L

Removal and Installation

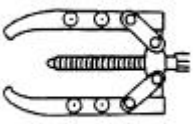
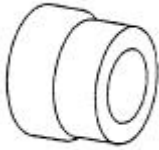



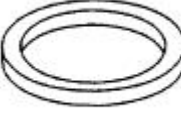

1. Remove the A/C compressor (19703). For additional information, refer to [Air Conditioning \(A/C\) Compressor—3.8L](#) in this section.
2. Remove the three bolts and one nut.



3. Remove the A/C compressor mounting bracket.
 4. To install, reverse the removal procedure.
-

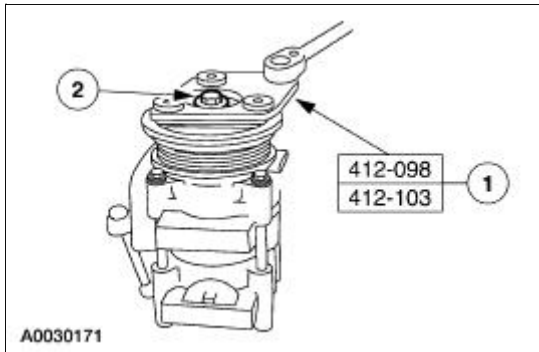
Clutch And Clutch Field Coil

Special Tool(s)

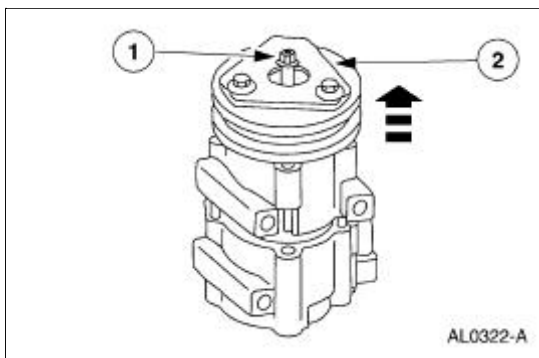
 <p>ST1260-A</p>	<p>2-Jaw Puller 205-D026 (D80L-1002-L) or equivalent</p>
 <p>ST1232-A</p>	<p>Installer, A/C Compressor Coil 412-065 (T89P-19623-EH)</p>
 <p>ST1235-A</p>	<p>Holding Fixture, Compressor Clutch (3.8L vehicles) 412-098 (T94P-19703-AH)</p>
 <p>ST2584-A</p>	<p>Holding Fixture, Compressor Clutch (4.6L vehicles) 412-103 (T95L-19703-AH)</p>
 <p>ST1220-A</p>	<p>Remover, Differential Bearing 205-116 (T77F-4220-B1)</p>
 <p>ST1234-A</p>	<p>Installer, A/C Compressor Field Coil 412-078 (T91L-19623-CH)</p>
 <p>ST1233-A</p>	<p>Remover, A/C Compressor Field Coil 412-067 (T89P-19623-FH)</p>

Removal

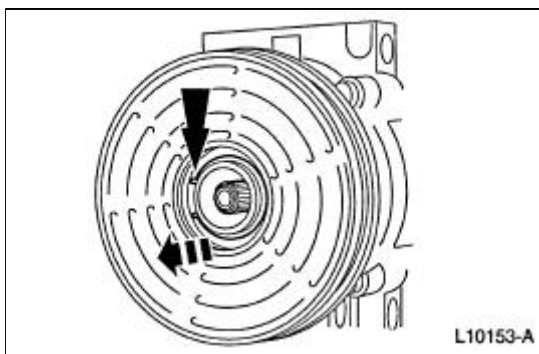
1. Remove the A/C compressor (19703). For additional information, refer to [Air Conditioning \(A/C\) Compressor—3.8L](#) or [Air Conditioning \(A/C\) Compressor—4.6L](#) in this section.
2. Remove the bolt.
 1. Hold the A/C disc and hub assembly (19D786) with the special tool.
 2. Remove the bolt.



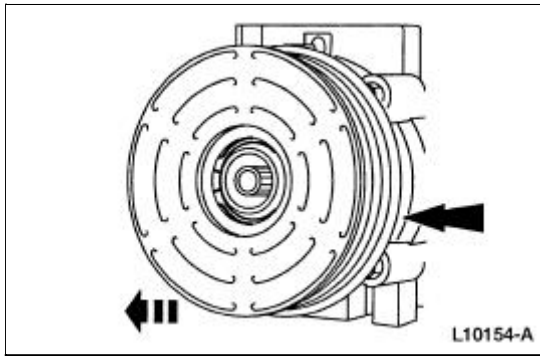
3. Remove the A/C disc and hub assembly and the A/C clutch hub spacer (19D648).
 1. Thread an 8 x 1.25 mm bolt into the A/C clutch to force it from the compressor shaft.
 2. Lift the A/C disc and hub assembly and the A/C clutch hub spacer from the compressor shaft.



4. Remove the pulley snap ring.



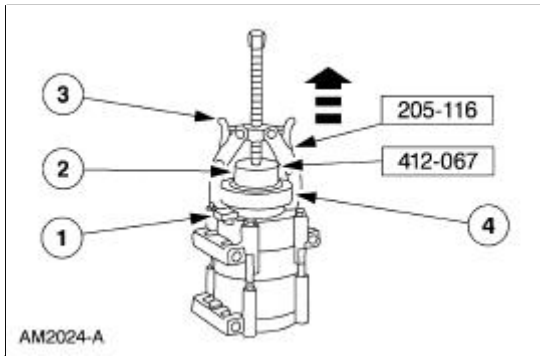
5. Remove the A/C clutch pulley (2E884).



6. **⚠ CAUTION: Do not use air tools. The A/C clutch field coil (19D798) can be easily damaged.**

Remove the A/C clutch field coil.

1. Note the location of the A/C clutch field coil electrical connector.
2. Install the special tool on the nose opening of the A/C compressor.
3. Install the special tool.
4. Remove the A/C clutch field coil.

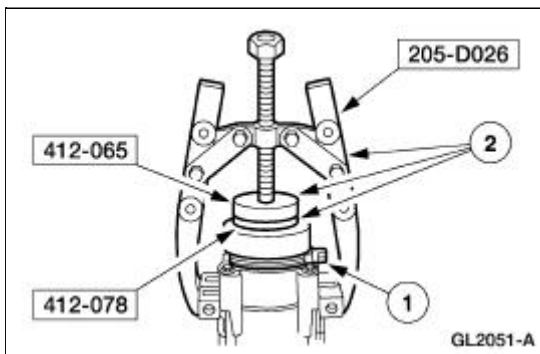


Installation

1. Clean the A/C disc and field coil and pulley mounting surfaces.
2. **⚠ CAUTION: Do not use air tools. The A/C clutch field coil can be easily damaged.**

Install the A/C clutch field coil.

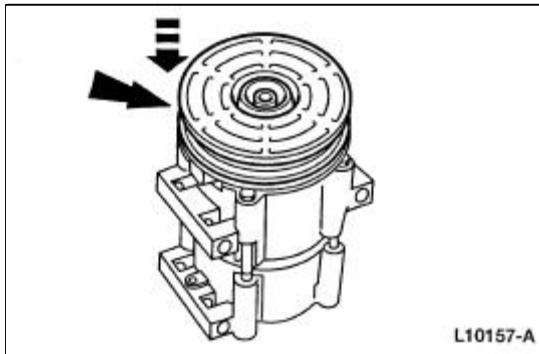
1. Place the A/C clutch field coil on the A/C compressor with the A/C clutch field coil electrical connector correctly positioned.
2. Using the special tools, install the A/C field coil.



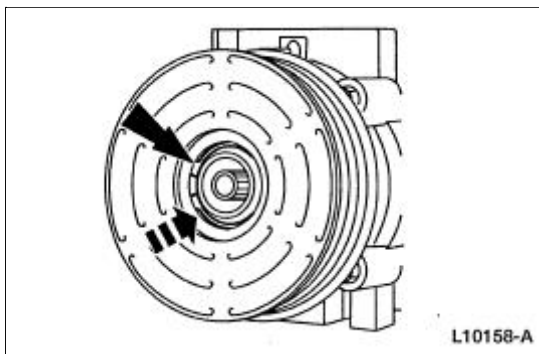
3. **NOTE:** The A/C clutch pulley is a tight fit on the A/C compressor head. It must be correctly

aligned during installation.

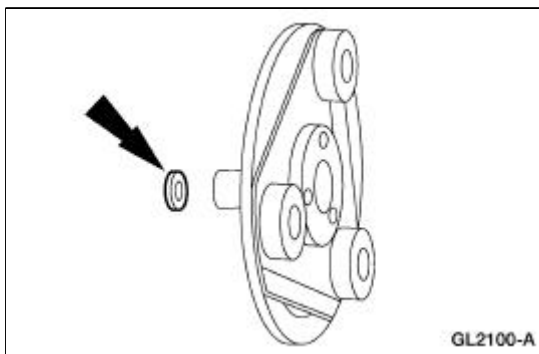
Install the A/C clutch pulley.



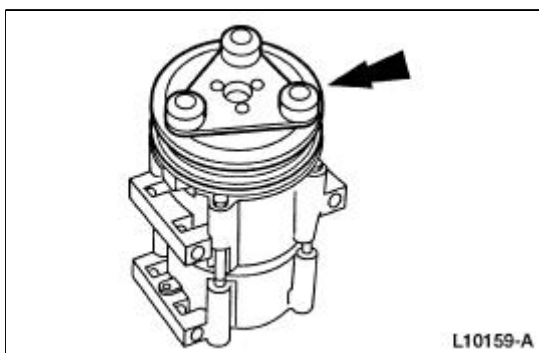
4. Install the pulley snap ring with the bevel side out.



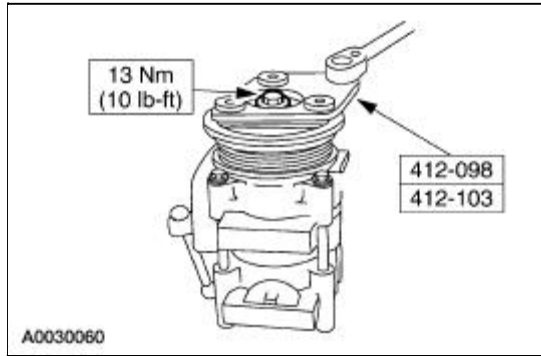
5. Place one nominal thickness A/C clutch hub spacer inside the clutch hub spline opening.



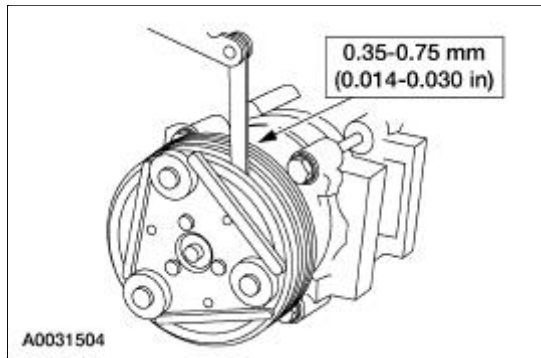
6. Install the A/C clutch.



- Using the special tool, install the A/C disc and hub assembly retaining bolt.





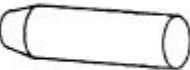
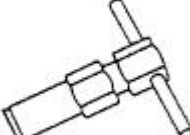



- Measure and adjust the clutch air gap by removing or adding A/C clutch hub spacers.



- Install the A/C compressor. For additional information, refer to [Air Conditioning \(A/C\) Compressor—3.8L](#) or [Air Conditioning \(A/C\) Compressor—4.6L](#) in this section.
-

Air Conditioning (A/C) Compressor Shaft Seal

Special Tool(s)

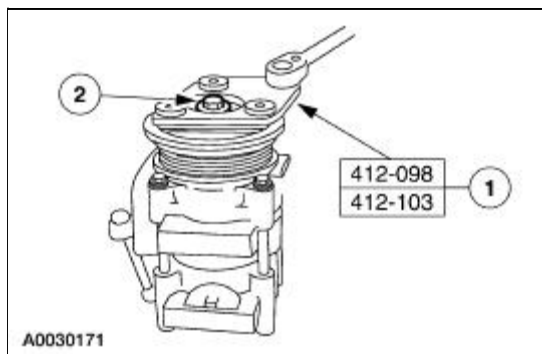
 <p>ST1235-A</p>	<p>Holding Fixture, Compressor Clutch (3.8L vehicles) 412-098 (T94P-19703-AH)</p>
 <p>ST2584-A</p>	<p>Holding Fixture, Compressor Clutch (4.6L vehicles) 412-103 (T95L-19703-AH)</p>
 <p>ST1230-A</p>	<p>Protector, A/C Compressor Shaft Oil Seal 412-061 (T89P-19623-CH)</p>
 <p>ST1229-A</p>	<p>Remover, A/C Compressor Shaft Oil Seal 412-059 (T89P-19623-BH)</p>
 <p>ST1228-A</p>	<p>Installer, A/C Compressor Shaft Oil Seal 412-058 (T89P-19623-AH)</p>
 <p>ST1231-A</p>	<p>Remover, A/C Compressor Snap Ring 412-063 (T89P-19623-DH)</p>
 <p>ST1219-A</p>	<p>Remover, O-ring Seal 100-010 (T71P-19703-C)</p>

Material

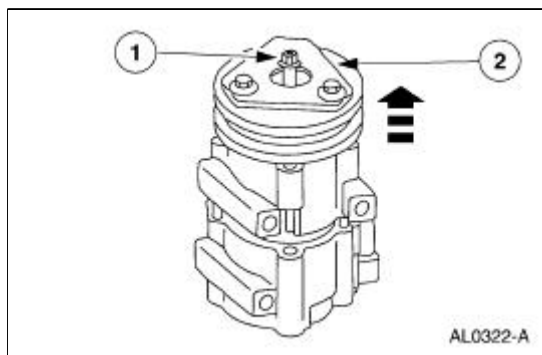
Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (MC YN-12-C)	WSH-M1C231-B

Removal

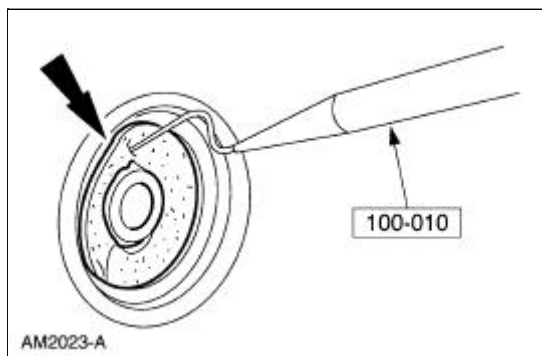
1. Remove the A/C compressor (19703). For additional information, refer to [Air Conditioning \(A/C\) Compressor—3.8L](#) or [Air Conditioning \(A/C\) Compressor—4.6L](#) in this section.
2. Remove the bolt.
 1. Hold the A/C disc and hub assembly (19D786) with the special tool.
 2. Remove the bolt.



3. Remove the A/C disc and hub assembly and spacer (19D648).
 1. Thread an 8 x 1.25 mm (0.05 in) bolt into the A/C disc and hub assembly to force it from the compressor shaft.
 2. Lift the A/C disc and hub assembly and spacer from the compressor shaft.

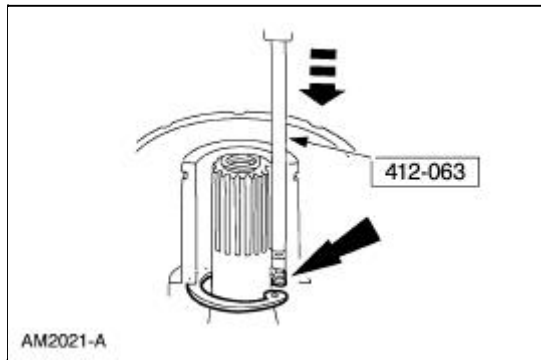


4. Using the special tool, remove the shaft seal felt from the nose of the A/C compressor.

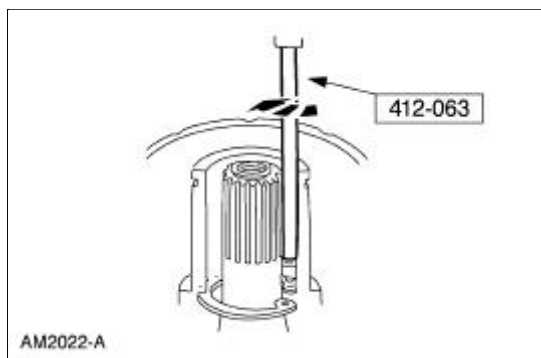


5. Clean the compressor nose area.

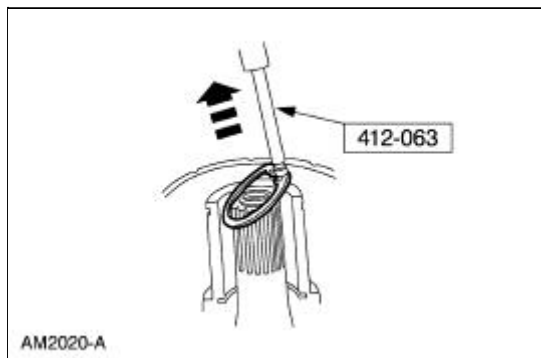
6. Insert the tip of the special tool into one of the snap ring eyes.



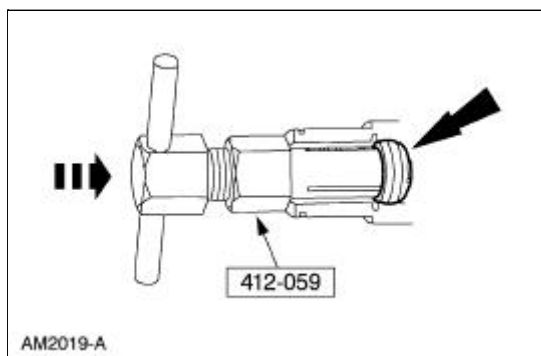
7. Rotate the special tool to position the tool tip and the snap ring eye closest to the A/C compressor shaft.



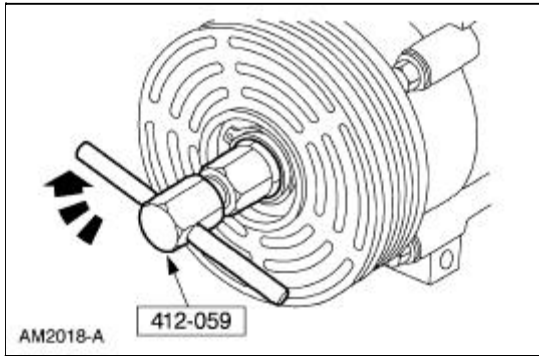
8. Pull the special tool up quickly while keeping the tool shaft against the side of the nose opening and remove the snap ring.



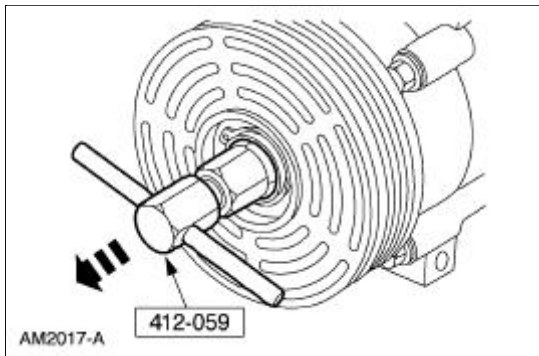
9. Engage the special tool into the inside diameter of the shaft seal.




10. Turn the tool handle clockwise to expand the tool tip inside the shaft seal.



11. Pull the seal from the A/C compressor.

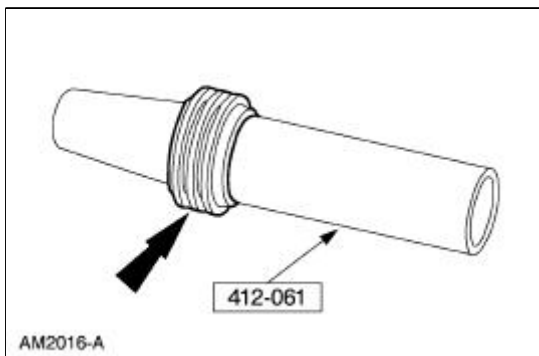


Installation

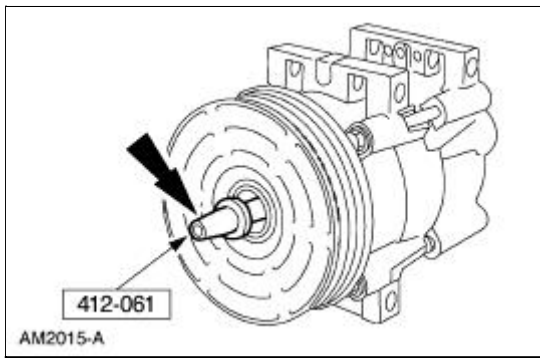
1.  **CAUTION:** To prevent refrigerant system contamination, do not allow dirt or other foreign materials to enter the A/C compressor.

Clean the A/C compressor nose area.

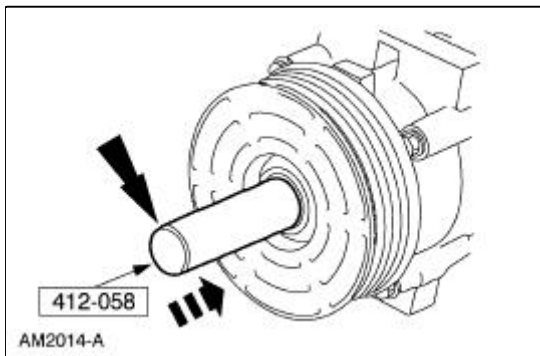
2. Place the shaft seal on the special tool. Lubricate the shaft seal and the special tool with PAG oil or equivalent.



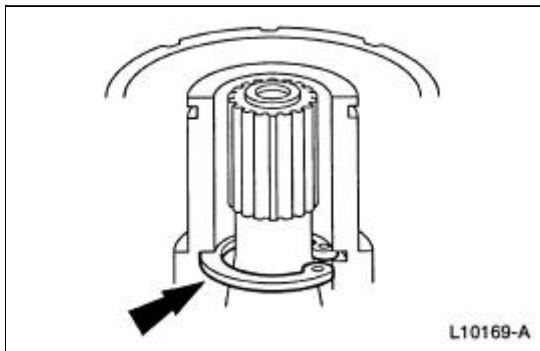
3. Position the shaft seal and the special tool over the A/C compressor shaft.



4. Using the special tool, push the shaft seal onto the A/C compressor shaft until seated.

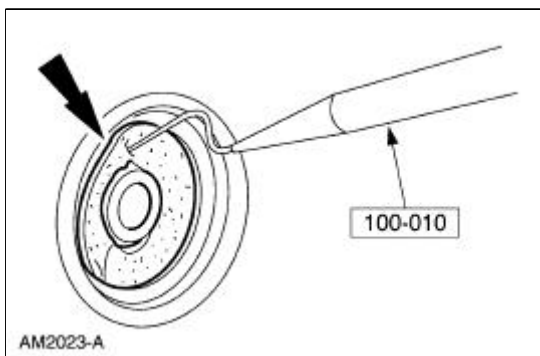


5. Install the shaft seal snap ring.

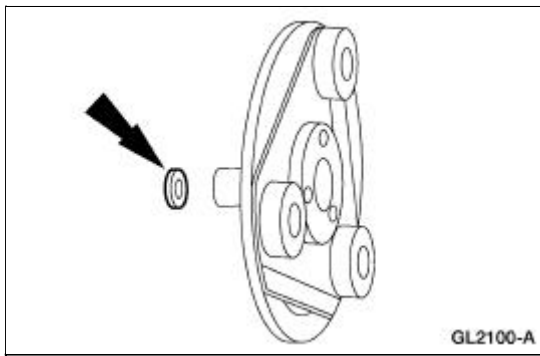


6. Carry out the A/C compressor external leak test. For additional information, refer to Component Tests in [Section 412-00](#).

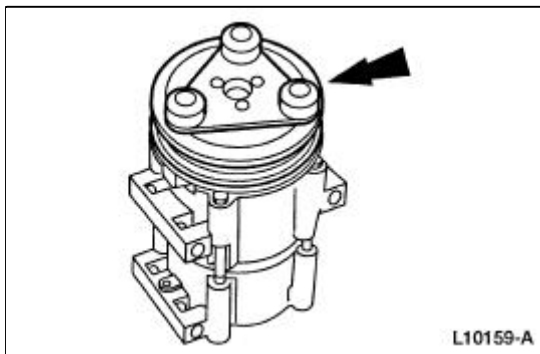
7. Install the shaft seal felt.



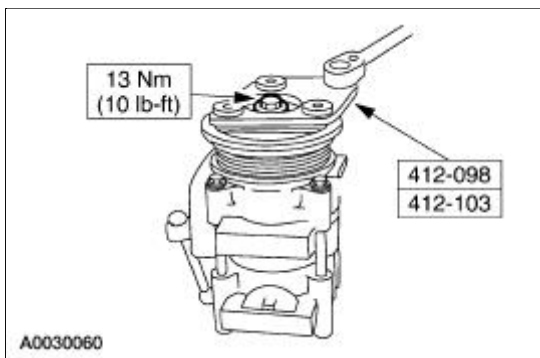
8. Install the A/C clutch hub spacer.



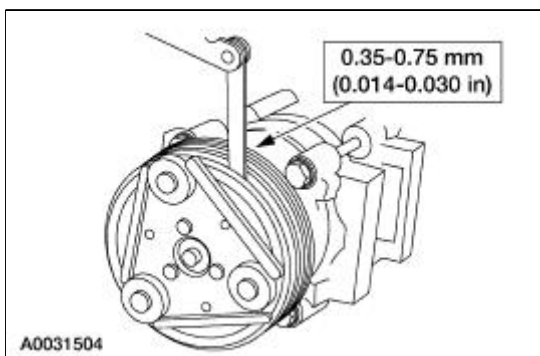
9. Install the A/C disc and hub assembly.



10. Using the special tool, install the A/C disc and hub assembly retaining bolt.



11. Measure and adjust the clutch air gap by removing or adding spacers as needed.



12. Install the A/C compressor. For additional information, refer to [Air Conditioning \(A/C\) Compressor—3.8L](#) or [Air Conditioning \(A/C\) Compressor—4.6L](#) in this section.

Evaporator Core

Removal and Installation

NOTE: The evaporator core is not separately serviceable, it is serviced only with the evaporator core housing assembly.

NOTE: Installation of a new suction accumulator is not required when repairing the air conditioning system except when there is physical evidence of contamination from a failed A/C compressor or damage to the suction accumulator.

NOTE: If an evaporator core leak is suspected, the evaporator core must be leak tested before it is removed from the vehicle. For additional information, refer to [Section 412-00](#).

1. Remove the evaporator core housing. For additional information, refer to [Section 412-02](#).
 2. Transfer the components from the old evaporator core housing to the new evaporator core housing.
 3. Install the evaporator core housing. For additional information, refer to [Section 412-02](#).
-

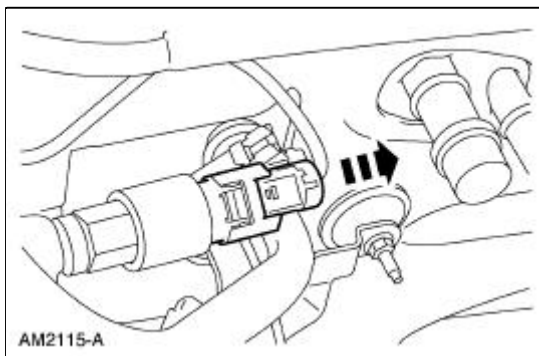
Suction Accumulator

Material

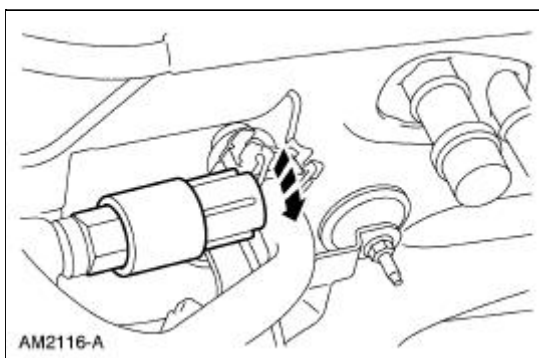
Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

Removal and Installation

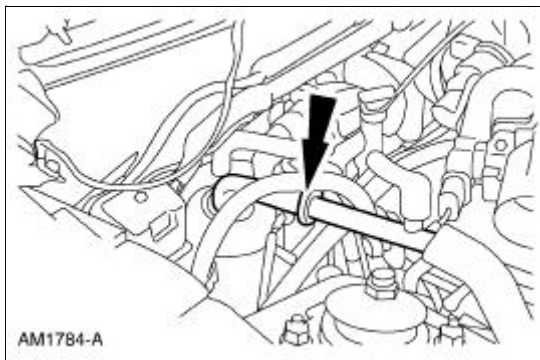
1. Recover the refrigerant. For additional information, refer to [Section 412-00](#).
2. Disconnect the A/C cycling switch electrical connector.



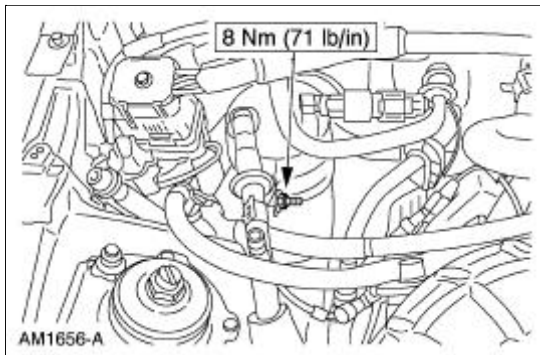
3. Remove the cycling switch.



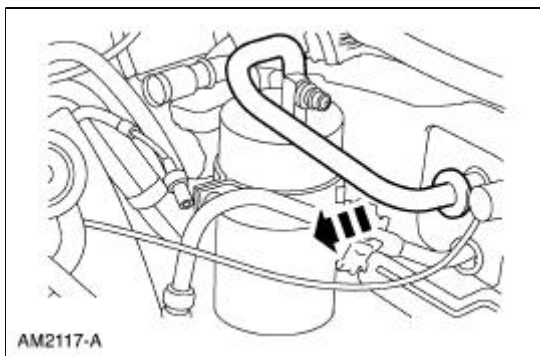
4. Disconnect the suction line spring lock coupling.
 - Discard the O-ring seals.



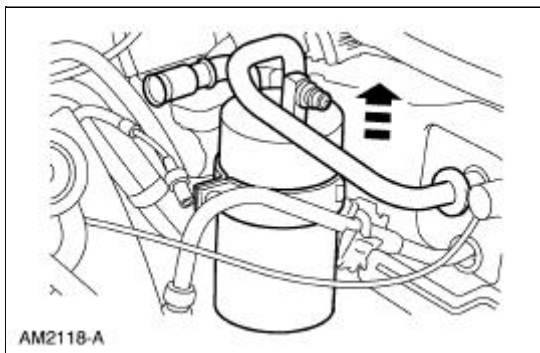
5. Remove the clamp nut.



6. Disconnect the suction accumulator from the evaporator outlet.
 - Discard the O-ring seals.



7. Remove the suction accumulator.



8. To install, reverse the removal procedure.
 - Install new O-ring seals lubricated in clean PAG oil.

- Lubricate the refrigerant system with the correct amount of clean PAG oil. For additional information, refer to [Section 412-00](#).
9. Evacuate, leak test and charge the refrigerant system. For additional information, refer to [Section 412-00](#).
-

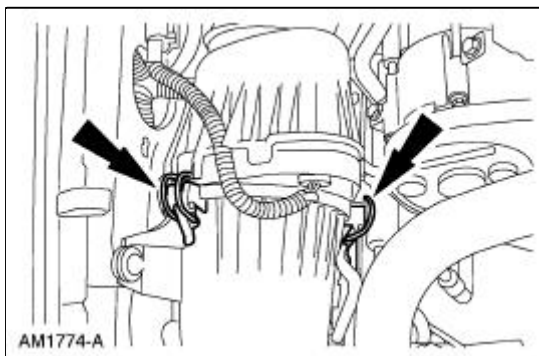
Air Conditioning (A/C) Pressure Relief Valve —3.8L

Material

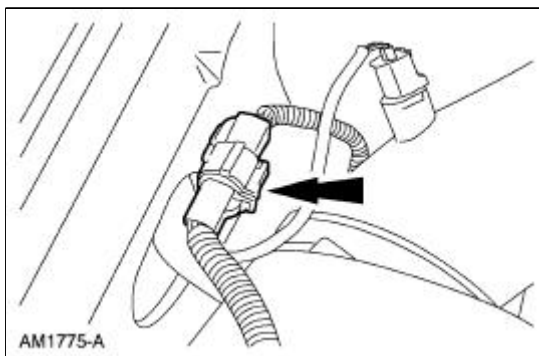
Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

Removal and Installation

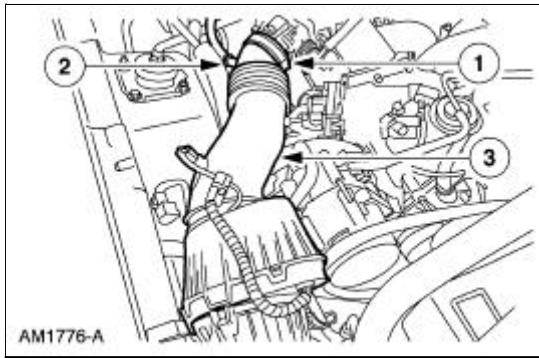
1. Recover the refrigerant. For additional information, refer to [Section 412-00](#).
2. Unlatch the breather.



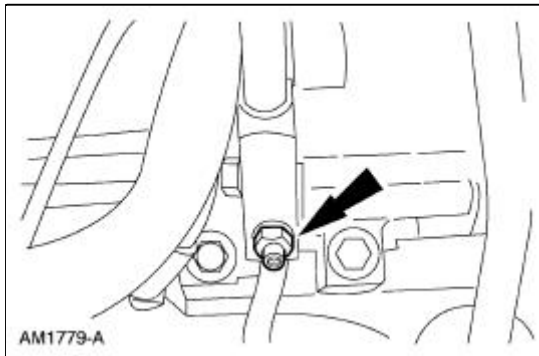
3. Disconnect the mass air flow (MAF) sensor electrical connector.



4. Remove the air cleaner outlet tube.
 1. Loosen the clamp.
 2. Disconnect the crankcase ventilation tube.
 3. Remove the air cleaner outlet tube.



5. Remove the A/C compressor pressure relief valve.
 - Discard the O-ring seal.



6. To install, reverse the removal procedure.
 - Install a new O-ring seal lubricated in clean PAG oil.
 7. Evacuate, leak test and charge the refrigerant system. For additional information, refer to [Section 412-00](#).
-

Air Conditioning (A/C) Pressure Relief Valve —4.6L

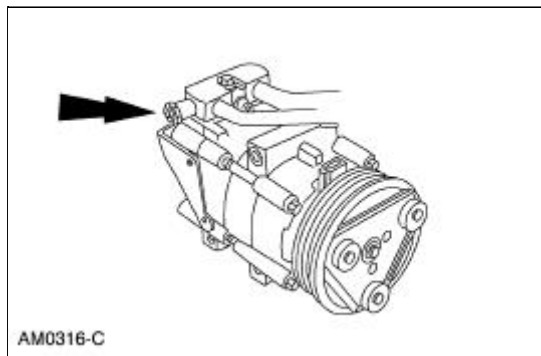
Material

Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

Removal and Installation

NOTE: Installation of a new suction accumulator is not required when repairing the air conditioning system except when there is physical evidence of contamination from a failed A/C compressor or damage to the suction accumulator.

1. Recover the refrigerant. For additional information, refer to [Section 412-00](#).
2. Raise the vehicle. For additional information, refer to [Section 100-02](#).
3. Remove the A/C compressor pressure relief valve (19D644).
 - Discard the O-ring seal.



4. To install, reverse the removal procedure.
 - Install a new O-ring seal lubricated in clean PAG oil.

Condenser Core

Material

Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

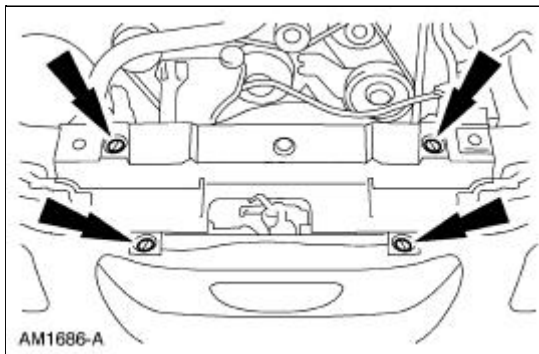
Removal and Installation

NOTE: If an A/C condenser core leak is suspected, the A/C condenser core must be leak tested before it is removed from the vehicle. For additional information, refer to [Section 412-00](#).

NOTE: Installation of a new suction accumulator is not required when repairing the air conditioning system except when there is physical evidence of contamination from a failed A/C compressor or damage to the suction accumulator.

All vehicles

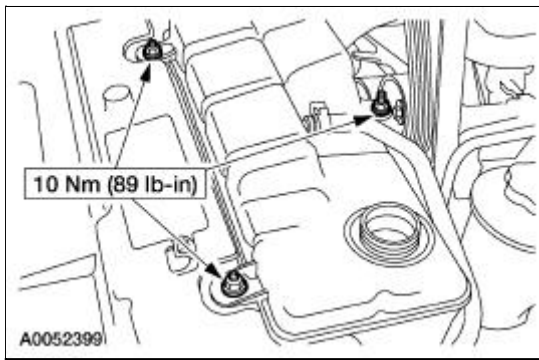
1. Recover the refrigerant. For additional information, refer to [Section 412-00](#).
2. Remove the pin-type retainers and remove the upper radiator sight shield.



3. Remove the air cleaner and air cleaner outlet tube. For additional information, refer to [Section 303-12](#).

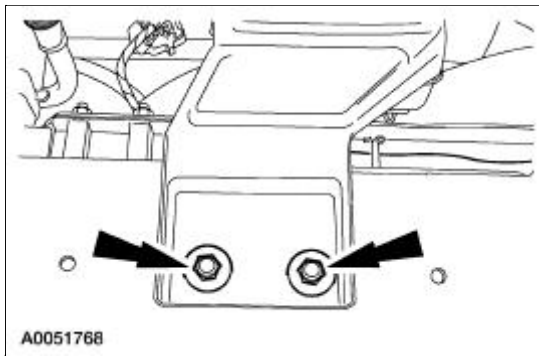
4.6L (2V), 4.6L (4V) vehicles

4. Remove the bolts and position the coolant bottle aside.



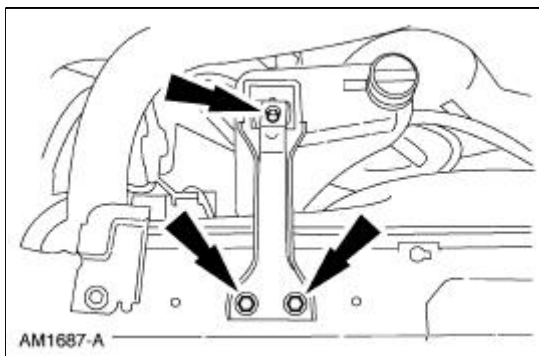
4.6L (4V) vehicles

5. Remove the bolts and position the coolant bottle aside.

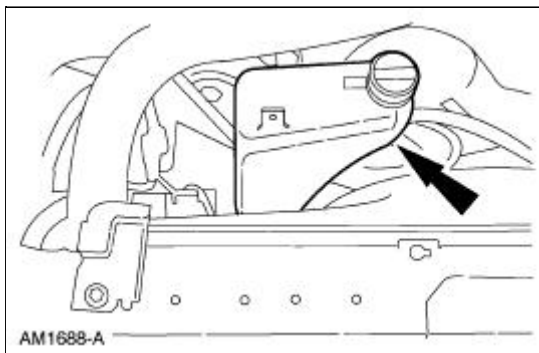


3.8L vehicles

6. Remove the bolts.

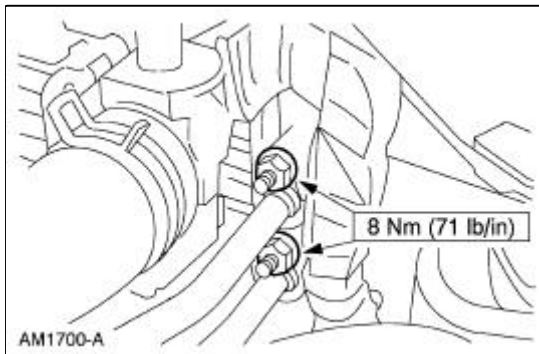


7. Remove the bracket and the coolant bottle.



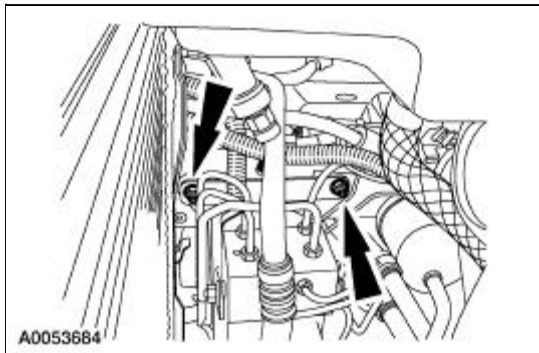
All vehicles

8. Remove the nuts and disconnect the lines.
 - Discard the O-ring seals.

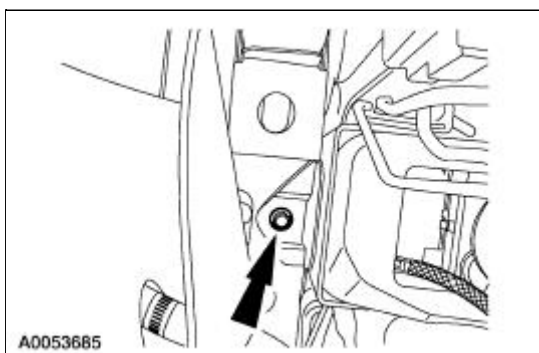


Vehicles with 4WABS

9. Remove the hydraulic control unit upper bracket bolts.



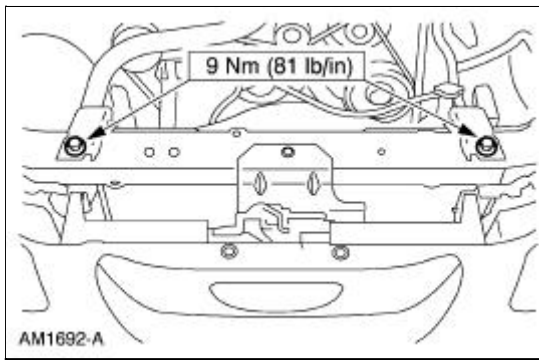
10. Raise the vehicle.
11. Remove the hydraulic control unit lower bracket bolt and position the hydraulic control unit aside.



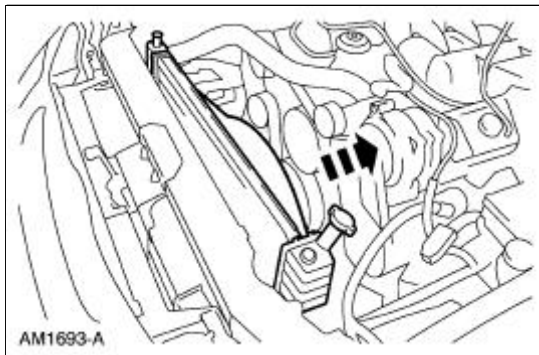
12. Lower the vehicle.

All vehicles

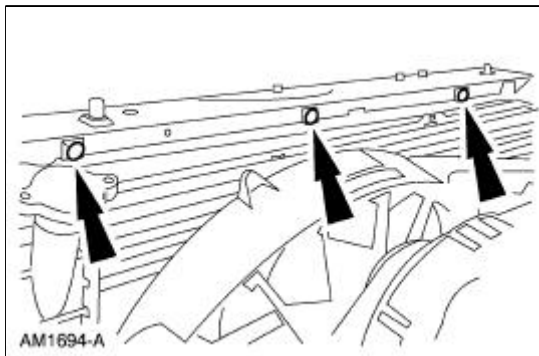
13. Remove the bolts and the radiator brackets.



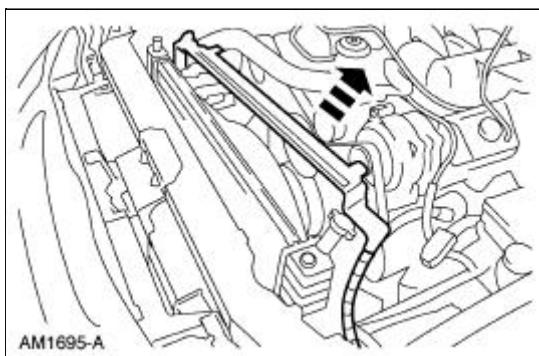
14. Position the radiator rearward.



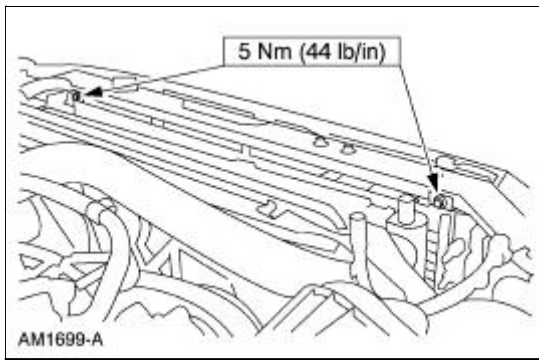
15. Remove the pin-type retainers.



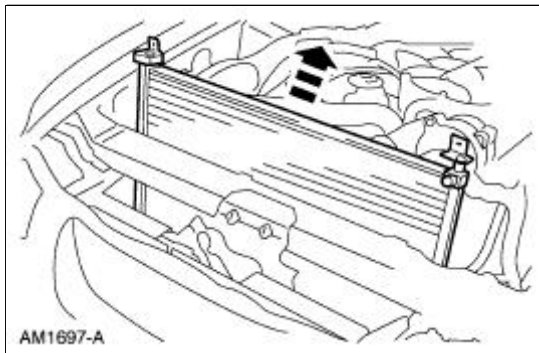
16. Position the wiring harness rearward.



17. Remove the condenser bolts.



18. Remove the condenser core.



19. To install, reverse the removal procedure.
- Install new O-ring seals lubricated in clean PAG oil.
 - Lubricate the refrigerant system with the correct amount of clean PAG oil. For additional information, refer to [Section 412-00](#).
20. Evacuate, leak test and charge the refrigerant system. For additional information, refer to [Section 412-00](#).
-

Compressor Manifold and Tube Assembly —3.8L

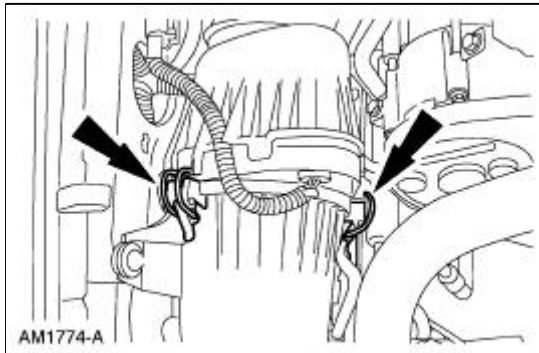
Material

Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

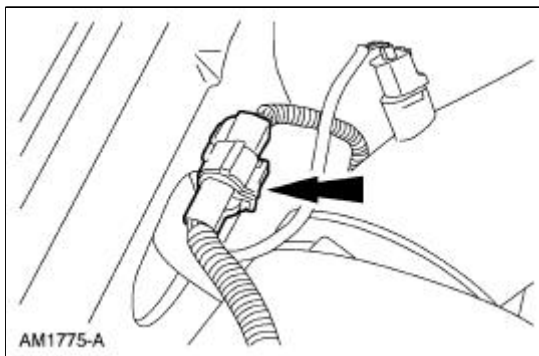
Removal and Installation

NOTE: Installation of a new suction accumulator is not required when repairing the air conditioning system except when there is physical evidence of contamination from a failed A/C compressor or damage to the suction accumulator.

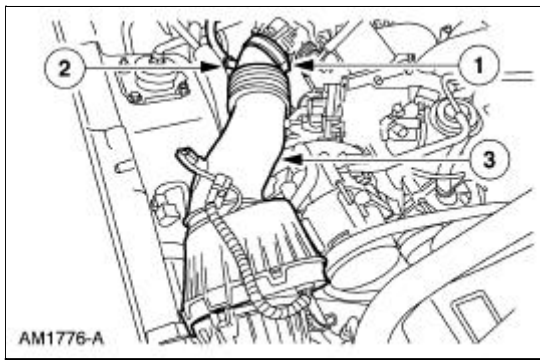
1. Recover the refrigerant. For additional information, refer to [Section 412-00](#).
2. Unlatch the air breather.



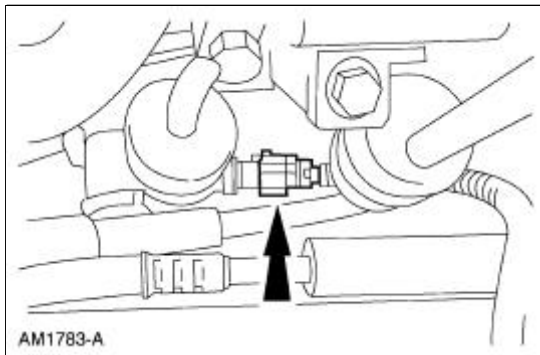
3. Disconnect the mass air flow (MAF) sensor electrical connector.



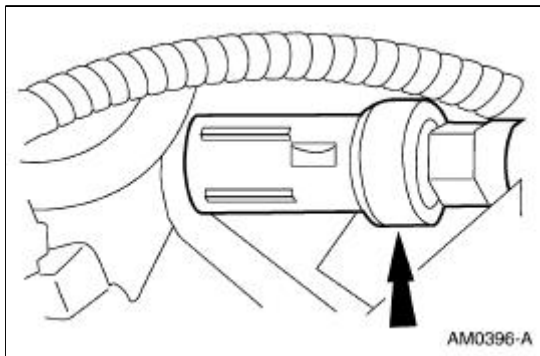
4. Remove the air cleaner outlet tube.
 1. Loosen the clamp.
 2. Disconnect the crankcase ventilation tube.
 3. Remove the air cleaner outlet tube.



5. Disconnect the refrigerant containment switch (RCS) electrical connector.

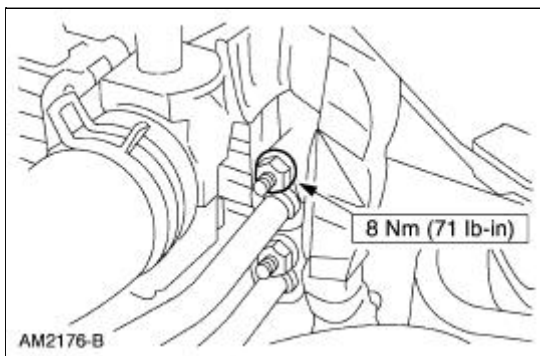


6. Remove the RCS.



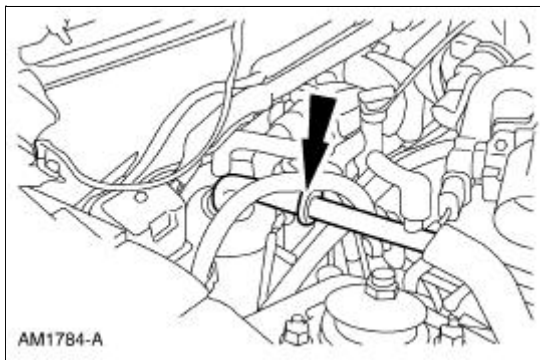
7. Remove the nut and disconnect A/C fitting.

- Discard the O-ring seal.

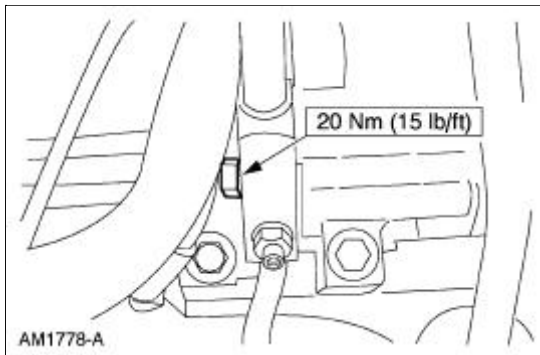


8. Disconnect the spring lock coupling.

- Discard the O-ring seals.



9. Remove the bolt.



10. Remove the manifold and tube assembly.
 - Discard the O-ring seals.
 11. To install, reverse the removal procedure.
 - Install new O-ring seals lubricated in clean PAG oil.
 - Lubricate the refrigerant system with the correct amount of clean PAG oil. For additional information, refer to [Section 412-00](#).
 12. Evacuate, leak test and charge the refrigerant system. For additional information, refer to [Section 412-00](#).
-

Compressor Manifold and Tube Assembly —4.6L

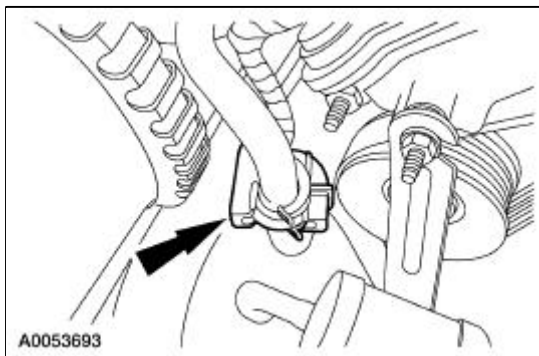
Material

Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

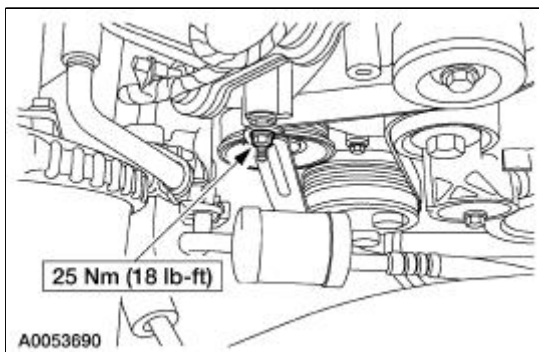
Removal and Installation

NOTE: Installation of a new suction accumulator is not required when repairing the air conditioning system except when there is physical evidence of contamination from a failed A/C compressor or damage to the suction accumulator.

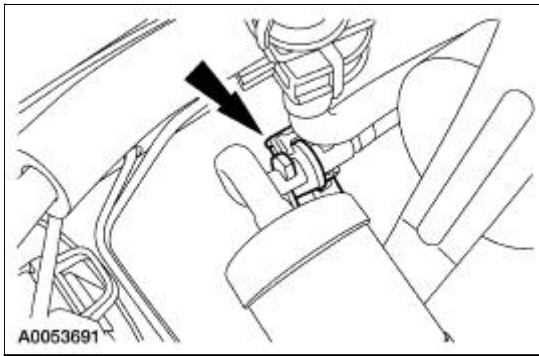
1. Recover the refrigerant. For additional information, refer to [Section 412-00](#).
2. Disconnect the suction line spring lock coupling.
 - Discard the O-ring seals.



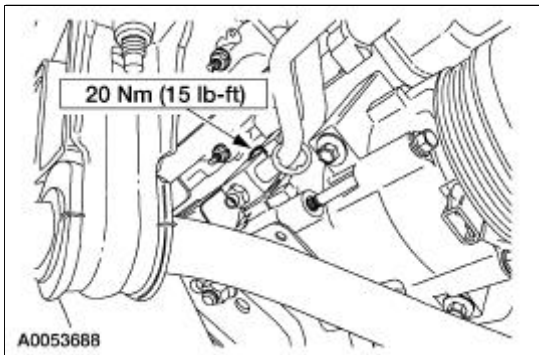
3. Remove the A/C muffler bracket nut.



4. Disconnect the spring lock coupling.
 - Discard the O-ring seals.



5. Raise the vehicle. For additional information, refer to [Section 100-02](#).
6. Remove the bolt and the compressor manifold assembly.
 - Discard the O-ring seals.



7. To install, reverse the removal procedure.
 - Install new O-ring seals lubricated in clean PAG oil.
 - Lubricate the refrigerant system with the correct amount of clean PAG oil. For additional information, refer to [Section 412-00](#).
 8. Evacuate, leak test and charge the refrigerant system. For additional information, refer to [Section 412-00](#).
-

Suction Accumulator to Compressor Line —4.6L

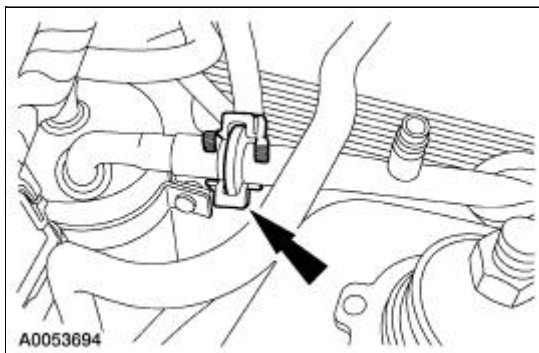
Material

Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

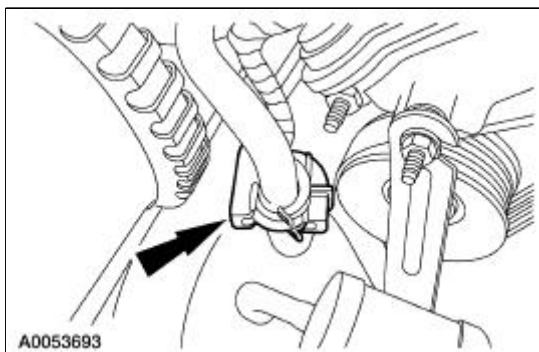
Removal and Installation

NOTE: Installation of a new suction accumulator is not required when repairing the air conditioning system except when there is physical evidence of contamination from a failed A/C compressor or damage to the suction accumulator.

1. Recover the refrigerant. For additional information, refer to [Section 412-00](#).
2. Remove the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).
3. Disconnect the spring lock coupling at the suction accumulator.
 - Discard the O-ring seals.



4. Disconnect the spring lock coupling at the compressor manifold.
 - Discard the O-ring seals.



5. Remove the suction accumulator to compressor line.

6. To install, reverse the removal procedure.
 - Install new O-ring seals lubricated in clean PAG oil.
 - Lubricate the refrigerant system with the correct amount of clean PAG oil. For additional information, refer to [Section 412-00](#).
 7. Evacuate, leak test and charge the refrigerant system. For additional information, refer to [Section 412-00](#).
-

Compressor to Condenser Discharge Line —4.6L

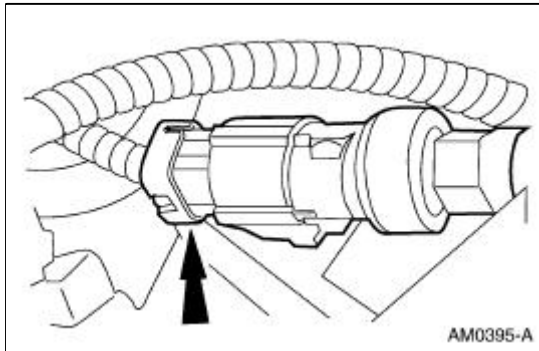
Material

Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

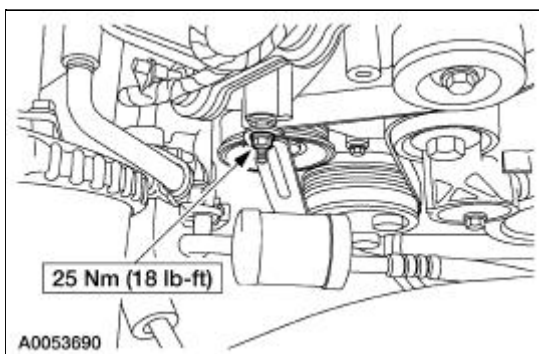
Removal and Installation

NOTE: Installation of a new suction accumulator is not required when repairing the air conditioning system except when there is physical evidence of contamination from a failed A/C compressor or damage to the suction accumulator.

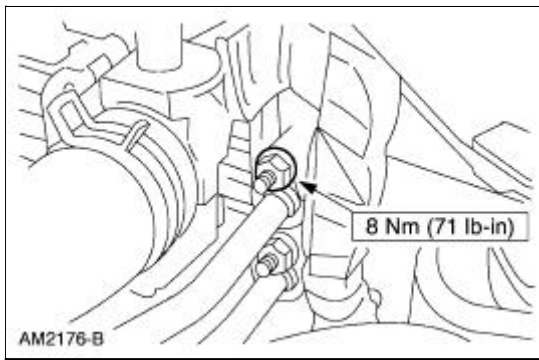
1. Recover the refrigerant. For additional information, refer to [Section 412-00](#).
2. Disconnect the dual-function pressure switch electrical connector and remove the switch.



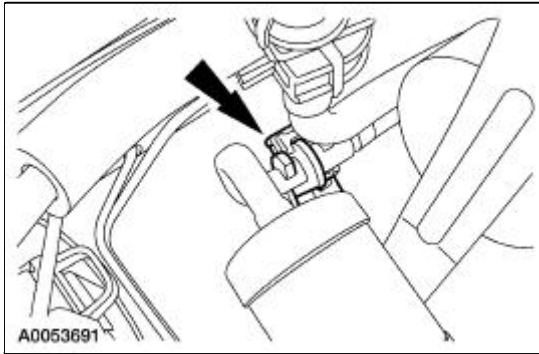
3. Remove the A/C muffler bracket nut.



4. Disconnect the fitting at the condenser.
 - Discard the O-ring seal.



5. Disconnect the spring lock coupling at the compressor manifold and tube.
 - Discard the O-ring seals.



6. Remove the compressor to condenser discharge line.
 7. To install, reverse the removal procedure.
 - Install new O-ring seals lubricated in clean PAG oil. For additional information, refer to [Section 412-00](#).
 - Lubricate the refrigerant system with the correct amount of clean PAG oil. For additional information, refer to [Section 412-00](#).
 8. Evacuate, leak test and charge the refrigerant system. For additional information, refer to [Section 412-00](#).
-

Condenser to Evaporator Line

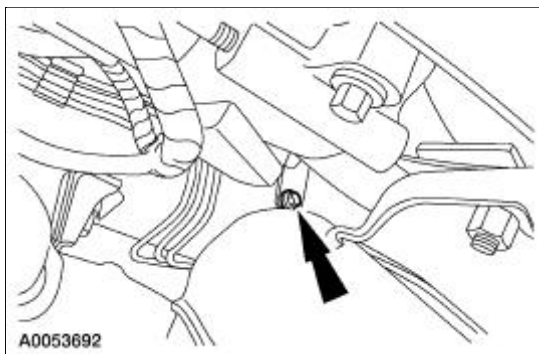
Material

Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

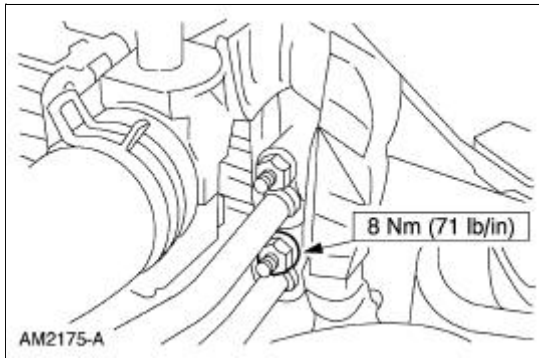
Removal and Installation

NOTE: Installation of a new suction accumulator is not required when repairing the air conditioning system except when there is physical evidence of contamination from a failed A/C compressor or damage to the suction accumulator.

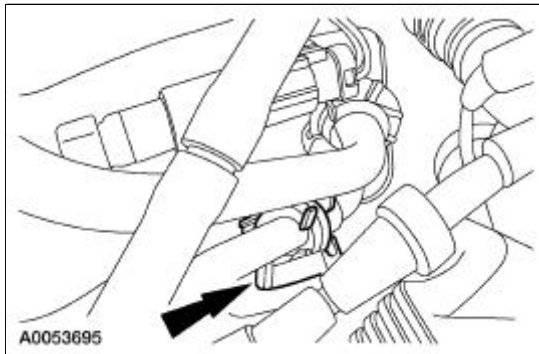
1. Recover the refrigerant. For additional information, refer to [Section 412-00](#).
2. Remove the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).
3. Raise the vehicle. For additional information, refer to [Section 100-02](#).
4. Remove the line bracket pin-type retainer.



5. Lower the vehicle.
6. Remove the nut and disconnect the fitting at the condenser.
 - Discard the O-ring seal.



7. Disconnect the spring lock coupling at the evaporator core.
 - Discard the O-ring seals.



8. Remove the condenser to evaporator line.
 9. To install, reverse the removal procedure.
 - Install new O-ring seals lubricated in clean PAG oil.
 - Lubricate the refrigerant system with the correct amount of clean PAG oil. For additional information, refer to [Section 412-00](#).
 10. Evacuate, leak test and charge the refrigerant system. For additional information, refer to [Section 412-00](#).
-

Control Components

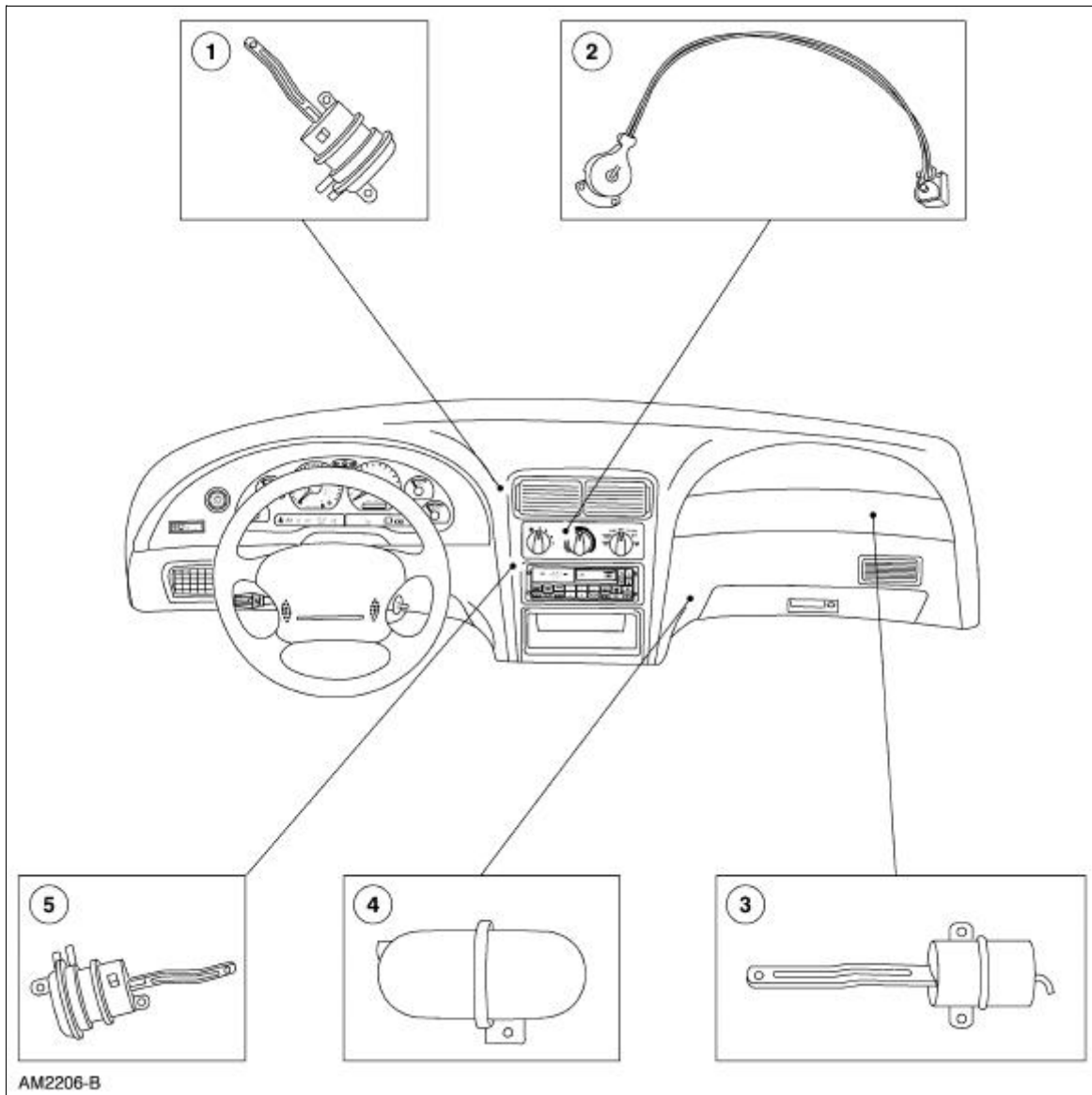
Manual A/C

The climate control system heats or cools the vehicle interior depending on the function selector position and the temperature selected. Function selector position determines heating or cooling and air distribution. The temperature blend control setting determines air temperature.

The manual climate control components are used to:

- select air inlet source (outside or recirculated).
- select blower motor speed.
- select discharge air temperature (temperature blend).
- select discharge air location (defrost, panel, floor).
- select A/C compressor clutch operation.

Component Locations



AM2206-B

Item	Part Number	Description
1	18A318	Vacuum control motor (panel/defrost door)
2	19988	Temperature blend door actuator cable
3	18A318	Vacuum control motor (air inlet door)
4		A/C vacuum reservoir tank and bracket (part of 18454)
5	18A318	Vacuum control motor (floor/panel door)

Control System Inputs

Climate Control Assembly

The climate control assembly has three system controls:

- The blower motor switch controls blower motor speed by adding or bypassing resistors in the heater blower motor resistor.
- The temperature selection is accomplished with a manually-controlled blend door actuator that controls positioning of the temperature blend door. Movement of the control knob (18519) from

COOL (blue) to WARM (red) causes a corresponding movement on the air temperature control door and determines the temperature that the system will maintain.

- The A/C heater function selector switch combines a vacuum selector valve for direct control of the vacuum control motors and electrical input to the instrument control module.

Control System Outputs

Blower Motor Switch Resistor

The heater blower motor switch resistor has the following features:

- The assembly is located on the passenger side of the plenum assembly behind the glove compartment (06010).
- Three resistance elements are mounted on the resistor board to provide four A/C blower motor speeds.
- Depending on the heater blower motor switch position, series resistance is added or bypassed in the A/C blower motor circuit to decrease or increase A/C blower motor speed.
- An overheating protective device (thermal limiter) will open the resistor coil circuit when the temperature reaches 105°-110°C (221°-230°F), interrupting the blower motor operation in all speeds except HI.
- The thermal limiter cannot be reset and is not serviceable.

Control Actuators

Temperature Control Cable

The temperature control cable (19988) has the following features:

- The cable assembly has a constant tension (pull-pull) dual cable design.
- The pull-pull design allows for constant smooth communication between the temperature control knob and the air temperature blend door.
- The control cable can only be installed as an assembly.

Vacuum Control Motors

The vacuum control motors (18A318) control the position of the doors directing the air flow to the different outlets. There are two types of vacuum control motors used in this system:

- Single-diaphragm for air inlet and windshield defroster door operations.
- Double-diaphragm for air damper door operations.

Single-diaphragm motors have two positions:

- Shaft extended with no vacuum applied.
- Shaft retracted with vacuum applied.

Double-diaphragm motors have three positions:

- Shaft extended with no vacuum applied to either port.
- Shaft halfway retracted with vacuum applied to only one port.

- Shaft fully retracted with vacuum applied to both ports.

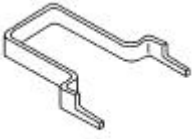


Control Components

Refer to [Section 412-00](#) .

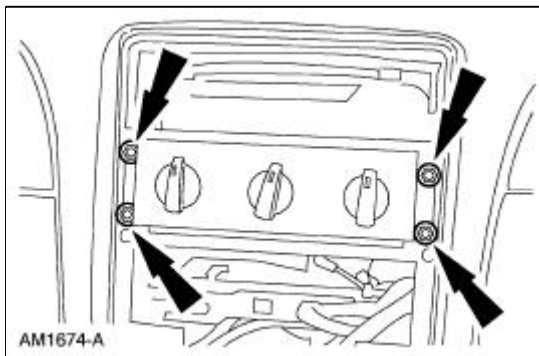
Control Assembly

Special Tool(s)

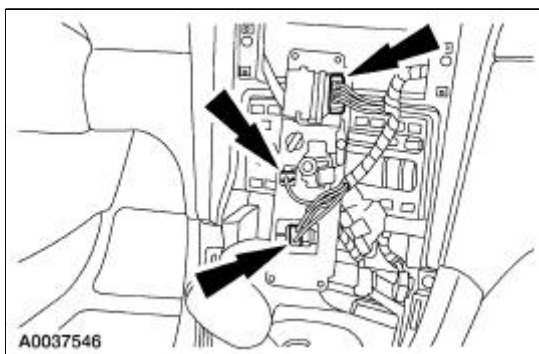
 ST2198-A	Remover, Heater Control Cable Retainer 412-088 (T94P-18532-A)
---	---

Removal

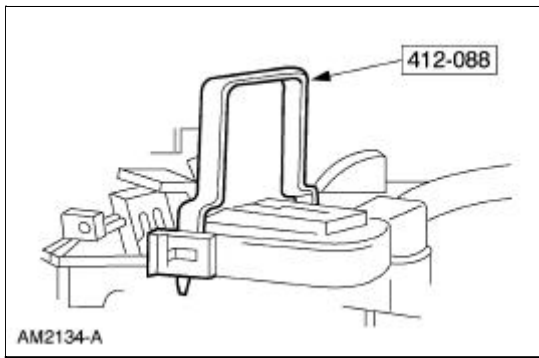
1. Remove the center instrument panel register. For additional information, refer to [Section 412-01](#).
2. Remove the screws.



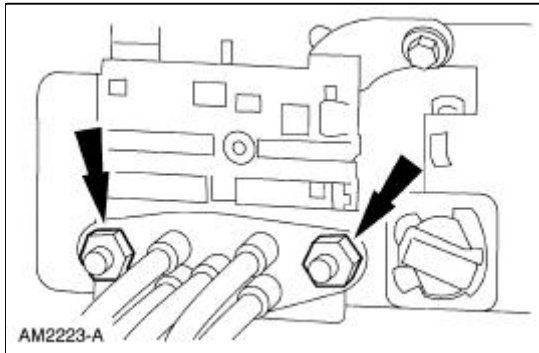
3. Disconnect the connectors.



4. Using the special tool, disconnect the temperature control cable from the control head.

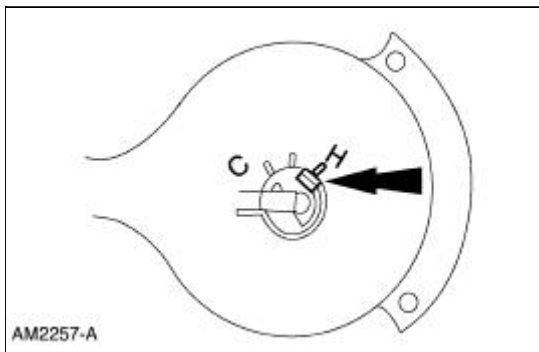


5. Remove the nuts and disconnect the vacuum connector.

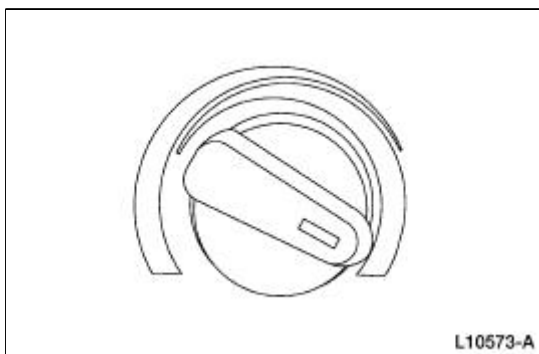


Installation

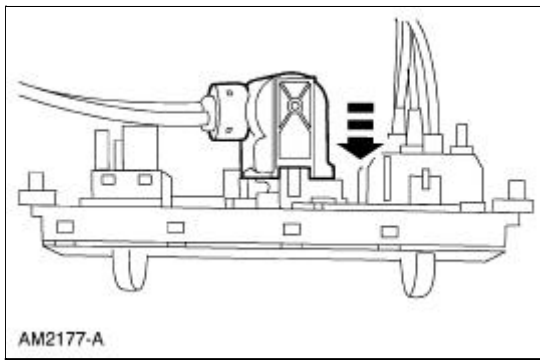
1. Align the blend door driver to the full heat position.



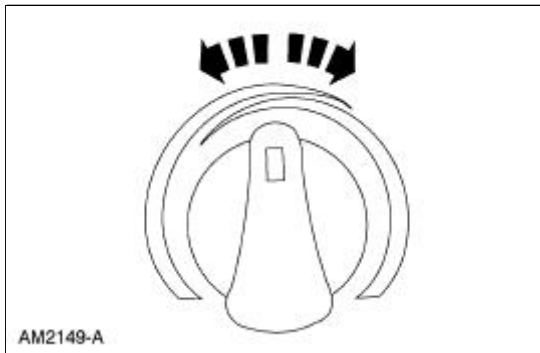
2. Place the temperature control knob in the full WARM position.



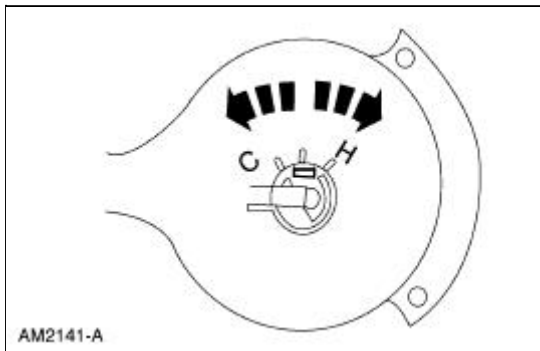
3. Attach the cable drive to the control head.



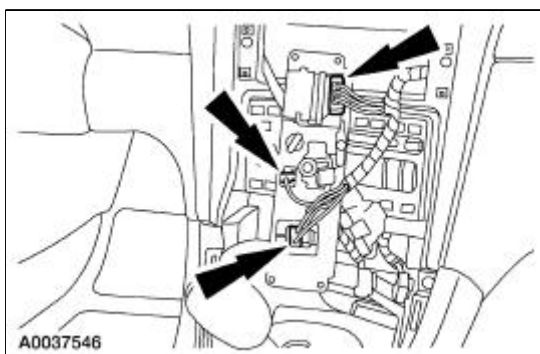
4. Rotate the knob back and forth from full WARM to full COOL.



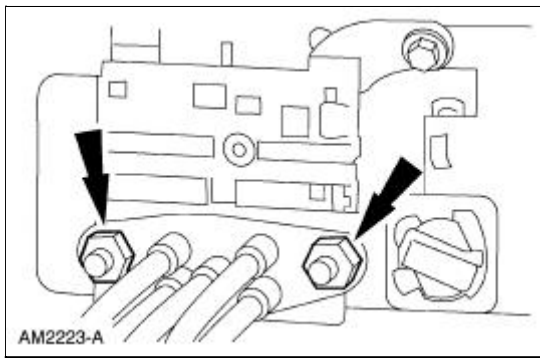
5. Check the cable control for correct range of movement.



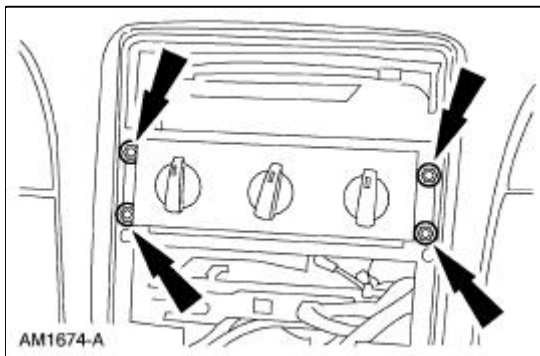
6. Connect the electrical connectors.



7. Install the vacuum connector and nuts.



8. Install the control head.



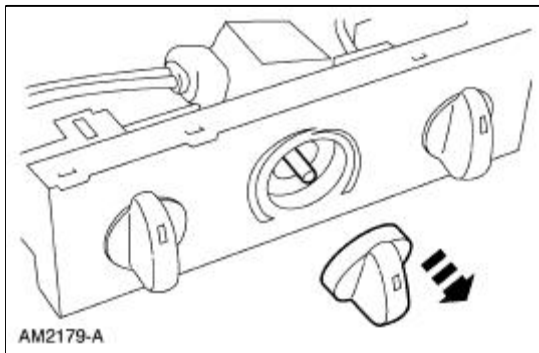
9. Install the center instrument panel register. For additional information, refer to [Section 412-01](#).
-

Switch

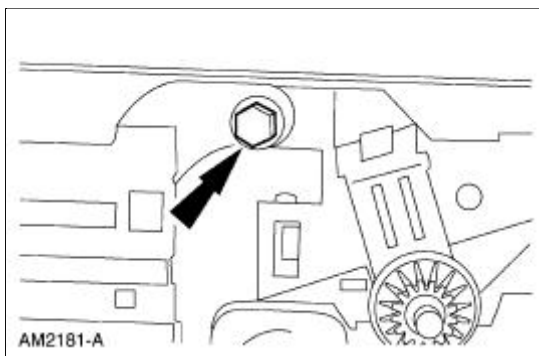
Removal

1. Remove the climate control assembly. For additional information, refer to [Control Assembly](#) in this section.
2. **NOTE:** All three switches are removed the same.

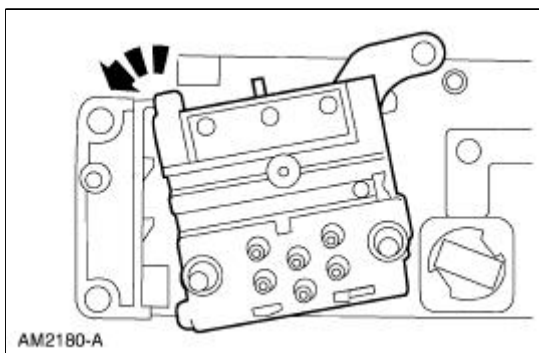
Remove the knob.



3. Remove the screw.



4. Rotate the switch and remove it from the control head assembly.



Installation

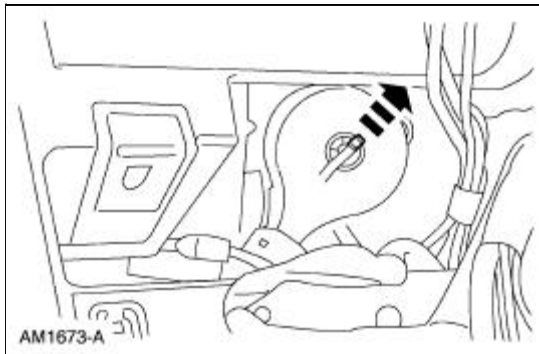
1. To install, reverse the removal procedure.



Actuator —Temperature Control Cable

Removal

1. Remove the control assembly. For additional information, refer to [Control Assembly](#) in this section.
2. Unsnap and remove the drive assembly.



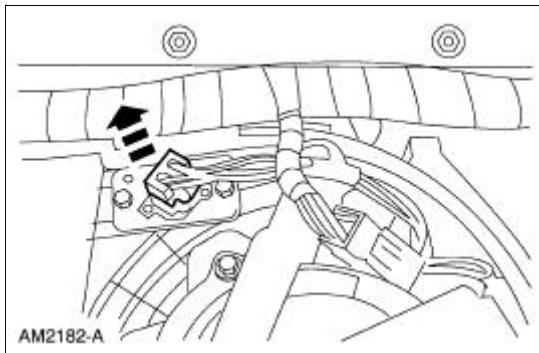
Installation

1. To install, reverse the removal procedure.
-

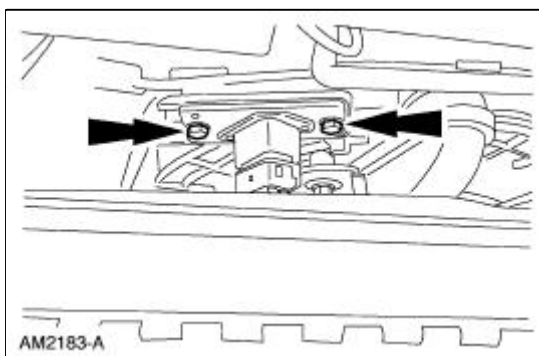
Resistor

Removal

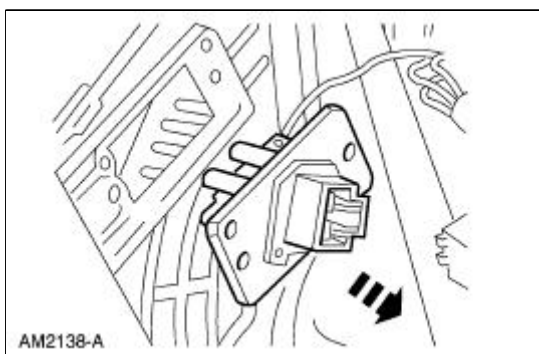
1. Disconnect the connector.



2. Remove the screws.



3. Remove the resistor.



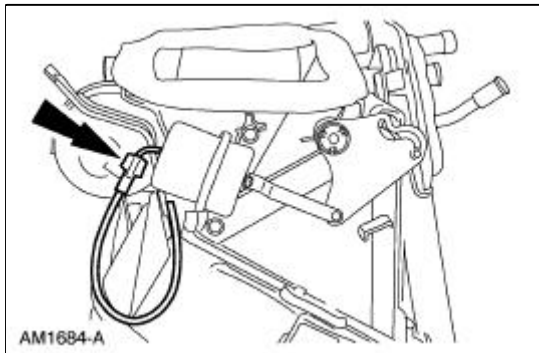
Installation

1. To install, reverse the removal procedure.

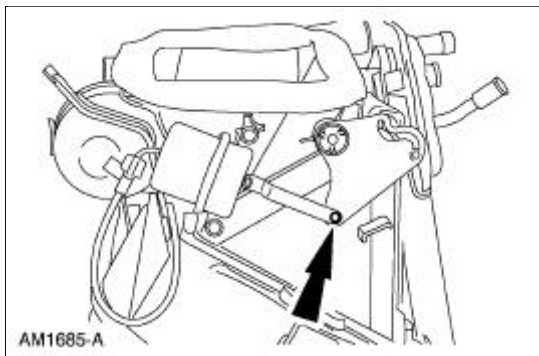
Vacuum Control Motor —Air Inlet Duct Door

Removal

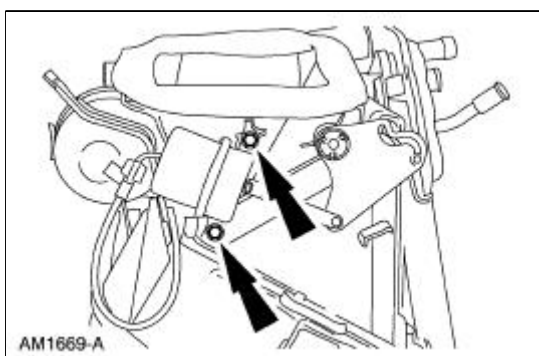
1. Remove the instrument panel. For additional information, refer to [Section 501-12](#).
2. Disconnect the vacuum hose.



3. Disconnect the control arm.



4. Remove the vacuum control motor.
 - Remove the screws.



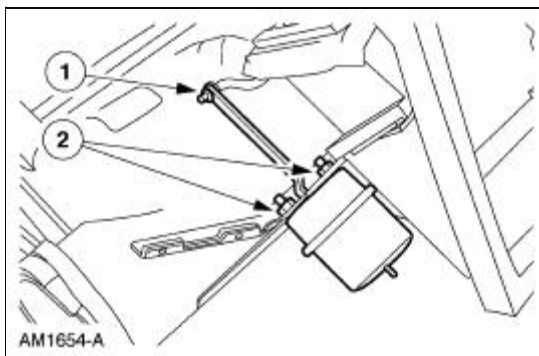
Installation

1. To install, reverse the removal procedure.

Vacuum Control Motor —Air Damper Door

Removal

1. Remove the instrument panel. For additional information, refer to [Section 501-12](#).
2. Disconnect the vacuum hose.
3. Remove the vacuum control motor.
 1. Remove the steel clip.
 2. Loosen the nuts.



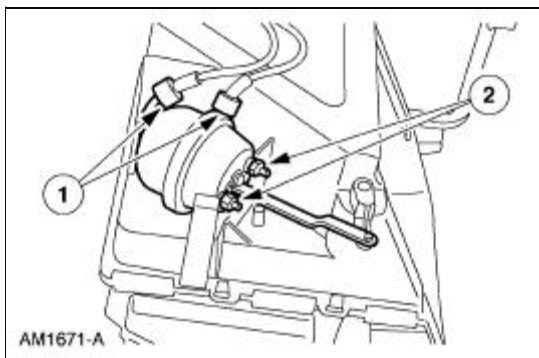
Installation

1. To install, reverse the removal procedure.
-

Vacuum Control Motor —Windshield/Defroster Door

Removal

1. Remove the instrument panel. For additional information, refer to [Section 501-12](#).
2. Unclip the control arm.
3. Remove the vacuum control motor.
 1. Disconnect the vacuum lines.
 2. Loosen the nuts.



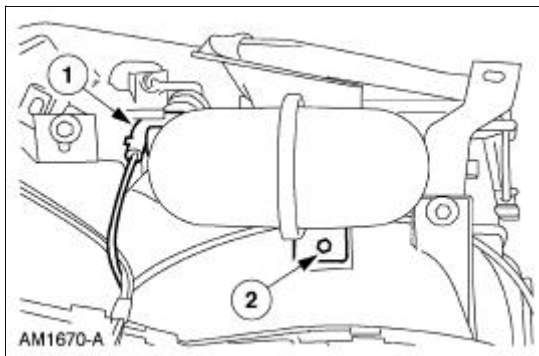
Installation

1. To install, reverse the removal procedure.
-

Vacuum Reservoir Tank

Removal

1. Access the vacuum reservoir tank through the glove compartment.
2. Remove the reservoir.
 1. Disconnect the vacuum connector.
 2. Remove the screw.



Installation

1. To install, reverse the removal procedure.
-

Instrument Cluster and Panel Illumination

The instrument cluster and panel illumination system illuminates the following components:


- instrument cluster (10849)
- audio unit (18806)
- A/C-heater control
- fog lamp switch
- transmission range indicator
- traction control switch
- rear window defrost control switch

The instrument cluster is a hybrid electronic cluster (HEC), which uses both hardwired circuitry and the standard corporate protocol (SCP) communication network to transmit and receive information. The Mustang instrument cluster backlighting has illumination bulbs that are installed separately from the instrument cluster. The Cobra instrument cluster has a laminated, electroluminescent applique to backlight the cluster. The electroluminescent applique and instrument cluster must be installed as an assembly.

Instrument Cluster and Panel Illumination

Refer to Wiring Diagrams Cell [71](#), Instrument Illumination for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
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Inspection and Verification

NOTE: A new instrument cluster must be reconfigured. Refer to [Section 418-01](#).

NOTE: The instrument panel dimmer switch is a part of the headlamp switch.

1. Verify the customer concern.
2. Visually inspect for obvious signs of electrical damage.

Visual Inspection Chart

Electrical
<ul style="list-style-type: none"> ● Central junction box (CJB) fuses: <ul style="list-style-type: none"> ■ 5 (15A) ■ 21 (5A) ■ 34 (20A) ■ 37 (5A) ■ 32 (15A) ■ 27 (20A) ● Circuitry ● Damaged switch

3. If the fault is not visually evident, determine the symptom and proceed to the Symptom Chart.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● The control illumination is inoperative 	<ul style="list-style-type: none"> ● Central junction box (CJB) fuse 37 (5A). ● Circuitry. ● Headlamp switch. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test A.
<ul style="list-style-type: none"> ● The instrument cluster illumination is inoperative 	<ul style="list-style-type: none"> ● Circuitry. ● Instrument cluster. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test B.

	<ul style="list-style-type: none"> ● Bulb(s). 	
<ul style="list-style-type: none"> ● The climate control illumination is inoperative 	<ul style="list-style-type: none"> ● Circuitry. ● Bulb(s). 	<ul style="list-style-type: none"> ● Go To Pinpoint Test C.
<ul style="list-style-type: none"> ● The audio system illumination is inoperative 	<ul style="list-style-type: none"> ● Circuitry. ● Audio unit. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test D.
<ul style="list-style-type: none"> ● A single illumination source is inoperative 	<ul style="list-style-type: none"> ● Circuitry. ● Switch. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test E.

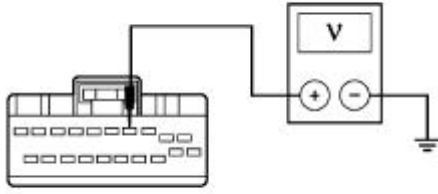
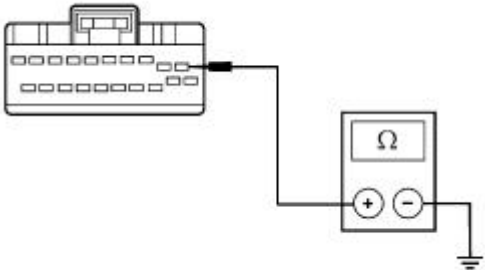
Pinpoint Tests

PINPOINT TEST A: THE CONTROL ILLUMINATION IS INOPERATIVE

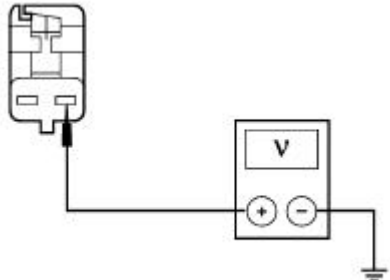
Test Step	Result / Action to Take
A1 CHECK PARKING LAMPS	
<ul style="list-style-type: none"> ● Place the headlamp switch in the ON position. ● Are the exterior lamps on? 	<p>Yes Place the headlamp switch in the OFF position. GO to A2.</p> <p>No REFER to Section 417-01.</p>
A2 CHECK HEADLAMP SWITCH	
<ul style="list-style-type: none"> ● Key in OFF position. ● Carry out the headlamp switch components test; <p>Refer to Wiring Diagrams Cell 149 for schematic and connector information.</p> <ul style="list-style-type: none"> ● Is the headlamp switch OK? 	<p>Yes RECONNECT the headlamp switch. GO to A3.</p> <p>No INSTALL a new headlamp switch. REFER to Section 417-01. TEST the system for normal operation.</p>
A3 CHECK CIRCUIT 1045 (DB/WH)	
<ul style="list-style-type: none"> ● Place the headlamp switch in the ON position. ● Rotate the instrument panel dimmer switch to the full illumination position. ● Measure voltage between central junction box (CJB) fuse 37 (5A) and ground. ● Is the voltage greater than 10 volts? 	<p>Yes REPAIR circuit 19 (LB/RD). TEST the system for normal operation.</p> <p>No REPAIR circuit 1045 (DB/WH). TEST the system for normal operation.</p>

PINPOINT TEST B: THE INSTRUMENT CLUSTER ILLUMINATION IS INOPERATIVE

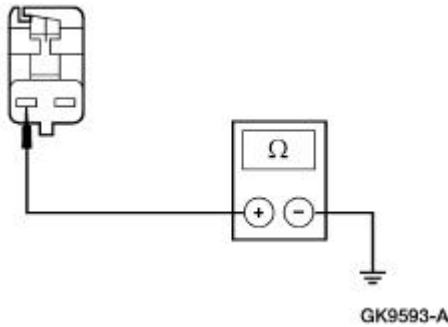
Test Step	Result / Action to Take
B1 CHECK VOLTAGE TO INSTRUMENT CLUSTER ILLUMINATION	
<ul style="list-style-type: none"> ● Disconnect: Instrument Cluster . ● Place the headlamp switch in the ON position. ● Rotate the instrument panel dimmer switch to the full 	<p>Yes GO to B2.</p>

<p>illumination position.</p> <ul style="list-style-type: none"> ● Measure the voltage between the instrument cluster C220b pin 4, circuit 19 (LB/RD), harness side and ground.  <p style="text-align: center;">GK9589-A</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>No REPAIR the circuit. TEST the system for normal operation.</p>
B2 CHECK GROUND TO INSTRUMENT CLUSTER	
<ul style="list-style-type: none"> ● Place the headlamp switch in the OFF position. ● Measure the resistance between the instrument cluster C220b pin 1, circuit 1205 (BK), harness side and ground.  <p style="text-align: center;">GK9848-A</p> <ul style="list-style-type: none"> ● Are the resistances less than 5 ohms? 	<p>Yes INSTALL a new instrument cluster. REFER to Section 413-01 . TEST the system for normal operation.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>

PINPOINT TEST C: THE CLIMATE CONTROL ILLUMINATION IS INOPERATIVE

Test Step	Result / Action to Take
<p>C1 CHECK VOLTAGE TO CLIMATE CONTROL ILLUMINATION</p> <ul style="list-style-type: none"> ● Disconnect: Function Selector Switch C294b . ● Place the headlamp switch in the ON position. ● Rotate the instrument panel dimmer switch to the full illumination position. ● Measure the voltage between the function selector switch C294b pin 2, circuit 19 (LB/RD), harness side and ground.  <p style="text-align: center;">GK9592-A</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to C2 .</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
C2 CHECK GROUND TO CLIMATE CONTROL	

- Measure the resistance between the function selector switch C294b pin 1, circuit 1205 (BK), harness side and ground.

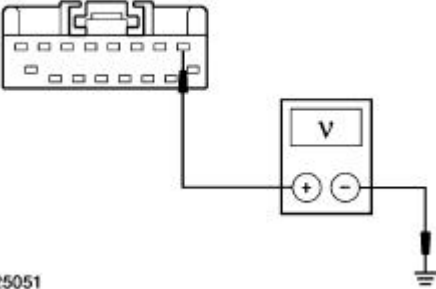
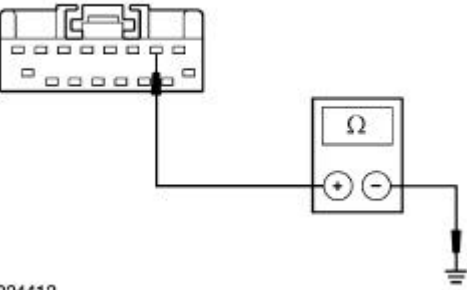


- Is the resistance less than 5 ohms?

Yes
 INSTALL new illumination bulb(s). REFER to [Section 412-04](#).

No
 REPAIR the circuit. TEST the system for normal operation.

PINPOINT TEST D: THE AUDIO SYSTEM ILLUMINATION IS INOPERATIVE

Test Step	Result / Action to Take
<p>D1 CHECK VOLTAGE TO AUDIO UNIT</p> <ul style="list-style-type: none"> ● Disconnect: Audio Unit C290a. ● Place the headlamp switch in the ON position. ● Rotate the instrument panel dimmer switch to the full illumination position. ● Measure the voltage between the audio unit C290a pin 1, circuit 19 (LB/RD), harness side and ground.  <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to D2.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<p>D2 CHECK GROUND TO AUDIO UNIT</p> <ul style="list-style-type: none"> ● Measure the resistance between the audio unit C290a pin 2, circuit 1205 (BK), harness side and ground.  <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes REMOVE the audio unit and SEND it to an authorized Ford audio systems repair facility. TEST the system for normal operation.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>

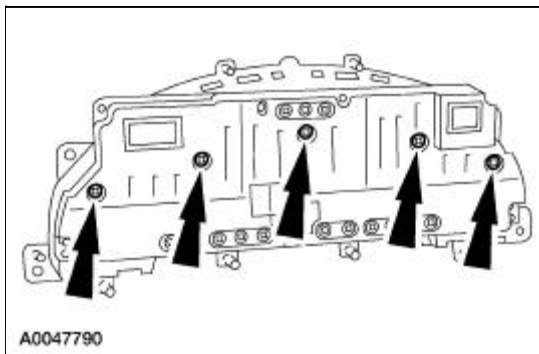
PINPOINT TEST E: A SINGLE ILLUMINATION SOURCE IS INOPERATIVE

Test Step	Result / Action to Take
E1 CHECK VOLTAGE TO THE SINGLE ILLUMINATION SOURCE	<p>Yes GO to E2.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<ul style="list-style-type: none"> ● Disconnect: Inoperative Illumination Source. ● Place the headlamp switch in the ON position. ● Rotate the instrument panel dimmer switch to the full illumination position. ● Measure the voltage between the inoperative illumination source, circuit 19 (LB/RD), harness side and ground. ● Is the voltage greater than 10 volts? 	
E2 CHECK SINGLE ILLUMINATION SOURCE GROUND	<p>Yes INSTALL a new component in question. TEST the system for normal operation.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<ul style="list-style-type: none"> ● Measure the resistance between inoperative illumination source, circuit 1205 (BK), harness side and ground. ● Is the resistance less than 5 ohms? 	

Instrument Cluster Bulb

Removal and Installation

1. Remove the instrument cluster. For additional information, refer to [Section 413-01](#).
2. Remove the necessary instrument cluster bulbs by rotating the bulb one quarter turn counterclockwise and lifting straight out of the instrument cluster.

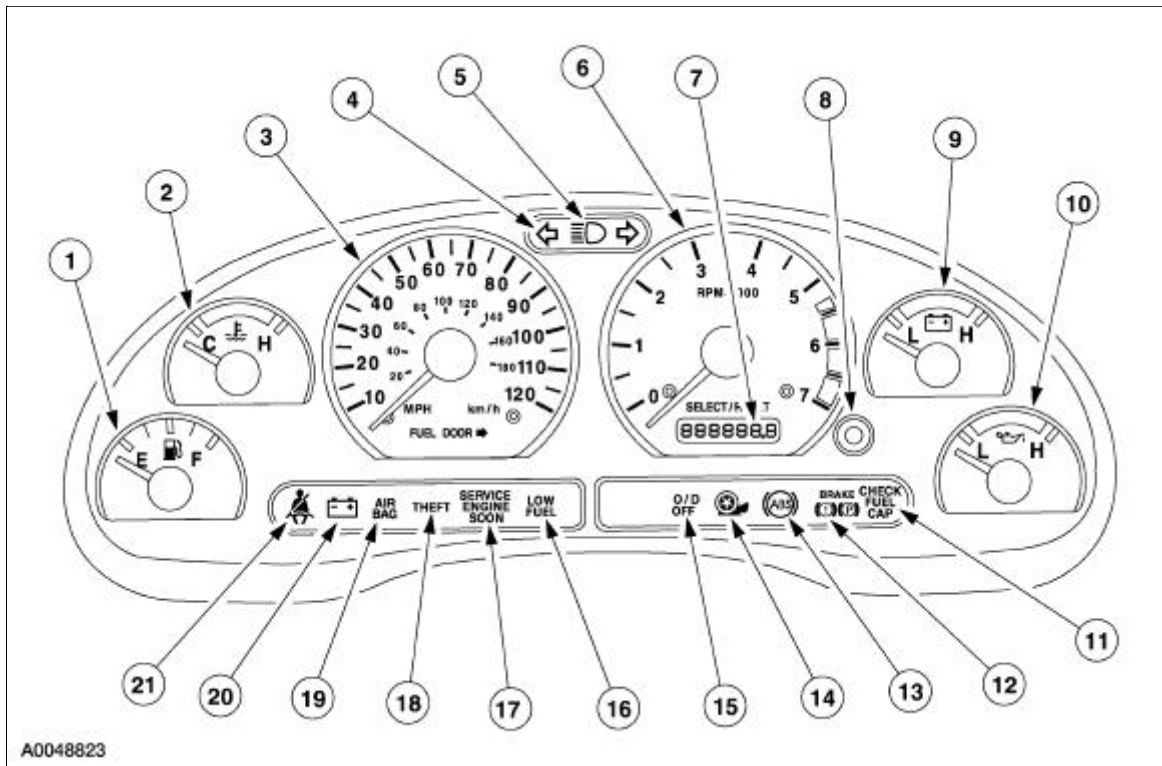


3. To install, reverse the removal procedure.
-

Instrument Cluster

The instrument cluster (10849) consists of the following components:

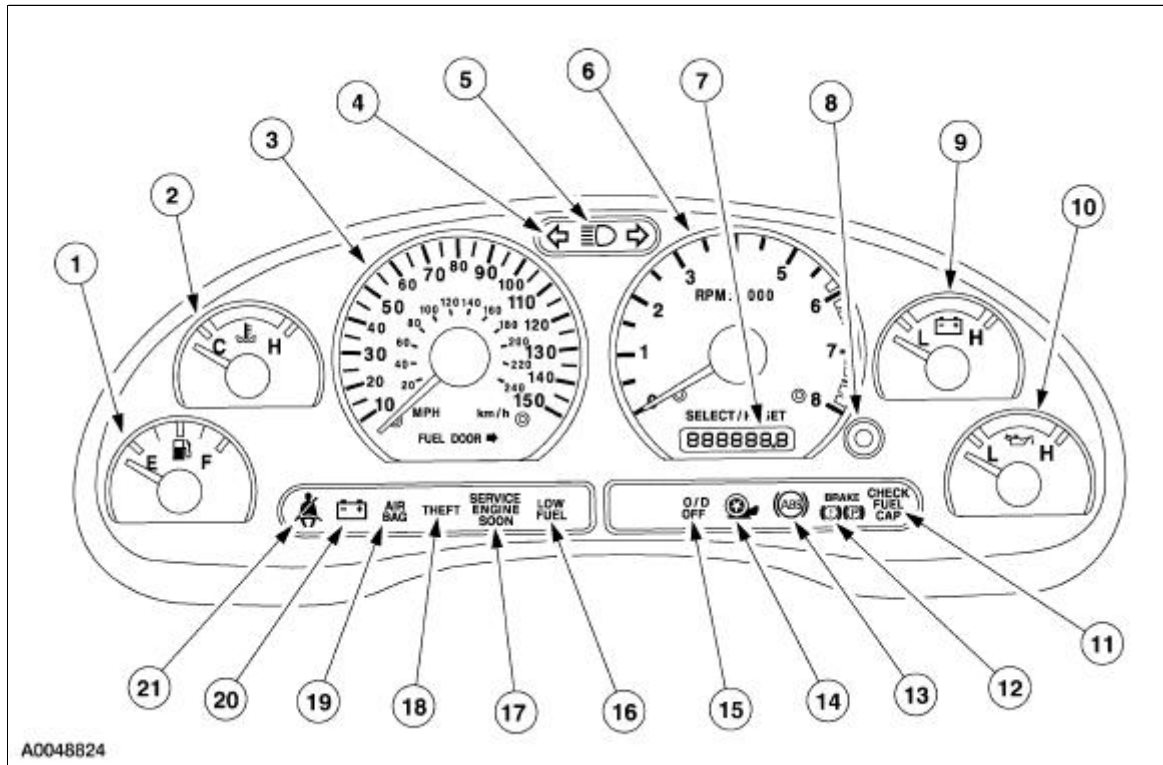
Instrument Cluster—Base 3.8L Engine



Item	Part Number	Description
1	—	Fuel gauge
2	—	Engine coolant temperature gauge
3	—	Speedometer
4	—	Turn signal/hazard indicator
5	—	High beam indicator
6	—	Tachometer
7	—	Odometer
8	—	Trip odometer reset button
9	—	Voltmeter gauge
10	—	Oil pressure gauge
11	—	CHECK FUEL CAP indicator
12	—	BRAKE warning indicator
13	—	ABS warning indicator
14	—	Traction control indicator
15	—	Overdrive off (O/D OFF) indicator (automatic)

		transmission)
16	—	LOW FUEL level indicator
17	—	SERVICE ENGINE SOON indicator
18	—	THEFT indicator
19	—	AIR BAG warning indicator
20	—	Charging system indicator
21	—	Safety belt warning indicator

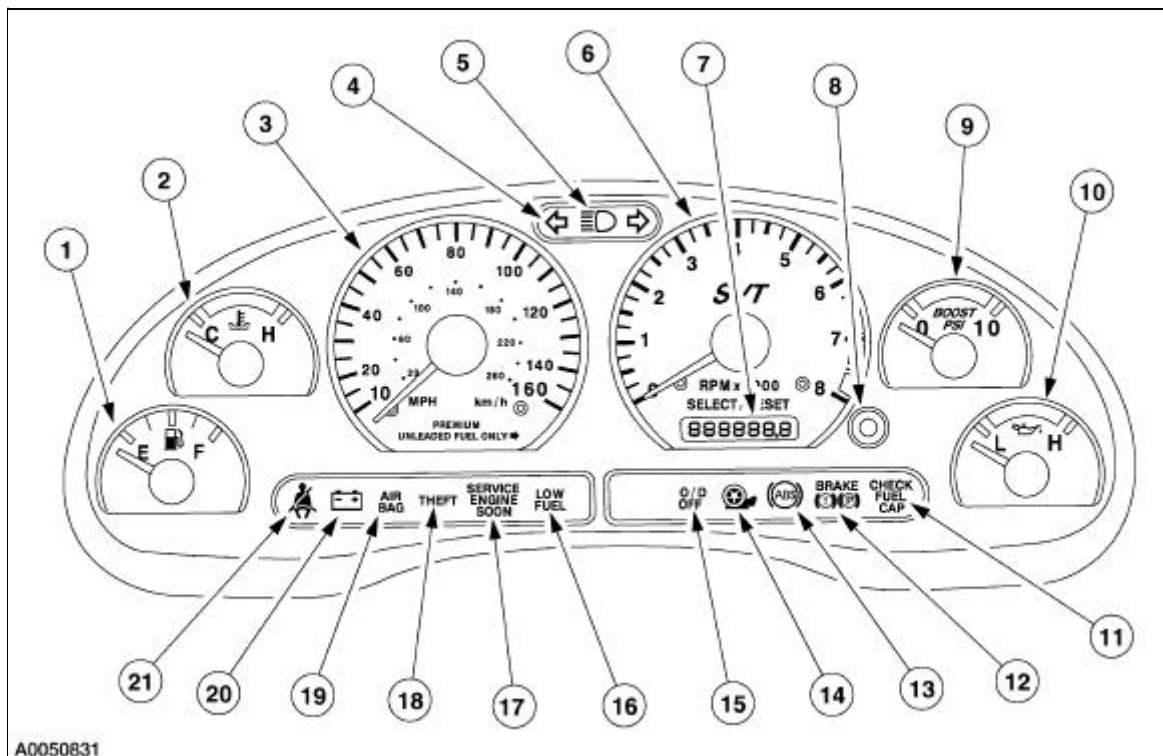
Instrument Cluster—Base 4.6L Engine



Item	Part Number	Description
1	—	Fuel gauge
2	—	Engine coolant temperature gauge
3	—	Speedometer
4	—	Turn signal/hazard indicator
5	—	High beam indicator
6	—	Tachometer
7	—	Odometer
8	—	Trip odometer reset button
9	—	Voltmeter gauge
10	—	Oil pressure gauge
11	—	CHECK FUEL CAP indicator
12	—	BRAKE warning indicator
13	—	ABS warning indicator

14	—	Traction control indicator
15	—	Overdrive off (O/D OFF) indicator (automatic transmission)
16	—	LOW FUEL level indicator
17	—	SERVICE ENGINE SOON indicator
18	—	THEFT indicator
19	—	AIR BAG warning indicator
20	—	Charging system indicator
21	—	Safety belt warning indicator

Instrument Cluster—Cobra




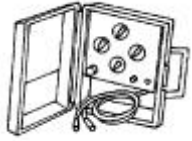

Item	Part Number	Description
1	—	Fuel gauge
2	—	Engine coolant temperature gauge
3	—	Speedometer
4	—	Turn signal/hazard indicator
5	—	High beam indicator
6	—	Tachometer
7	—	Odometer
8	—	Trip odometer reset button
9	—	Boost gauge
10	—	Oil pressure gauge
11	—	CHECK FUEL CAP indicator
12	—	BRAKE warning indicator

13	—	ABS warning indicator
14	—	Traction control indicator
15	—	Overdrive off (O/D OFF) indicator (automatic transmission)
16	—	LOW FUEL level indicator
17	—	SERVICE ENGINE SOON indicator
18	—	THEFT indicator
19	—	AIR BAG warning indicator
20	—	Charging system indicator
21	—	Safety belt warning indicator

Instrument Cluster

Refer to Wiring Diagrams Cell [60](#), Instrument Cluster for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool
 ST1388-A	Instrument Gauge System Tester 014-R1063 or equivalent
 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Principles of Operation

NOTE: A new instrument cluster must be reconfigured. Refer to [Section 418-01](#).

The instrument cluster is a hybrid electronic cluster (HEC). The instrument cluster uses both hardwired and the standard corporate protocol (SCP) communication network to transmit and receive information. As a technician it is very important to understand:

- where the input originates from.
- all information necessary in order for a feature to operate.
- which module(s) receive(s) the input or command message.
- does the module which received the input control the output of the feature, or does it output a message over the SCP network to another module?
- which module controls the output of the feature.

The instrument cluster carries out a display prove-out to verify that the warning/indicator miniature bulbs for monitored systems are functioning correctly. When the ignition switch is in the ON position with the engine off, the following warning indicators will prove out:

- anti-lock brake (ABS) warning indicator

- air bag warning indicator
- BRAKE warning indicator
- charging system indicator
- fail safe cooling warning indicator
- low coolant level indicator
- low fuel warning indicator
- traction control indicator

Instrument Cluster Replacement

When it is necessary to install a new instrument cluster, contact the Instrument Cluster Program.

Gauge Indication Systems

Tachometer

Engine rpm information is relayed to the instrument cluster from the powertrain control module (PCM) over the standard corporate protocol (SCP) network.

Speedometer

The instrument cluster receives the vehicle speed signal from the PCM over the SCP network and displays it on the speedometer gauge. If the instrument cluster receives no vehicle speed signal after one second, the speedometer defaults to 0.0 km/h (0.0 mph).

Odometer

The instrument cluster receives an odometer message from the PCM and stores the mileage in memory. When the instrument cluster fails to receive the odometer message for more than two seconds, the odometer will display dashes.

Fuel Gauge

The fuel sender is hardwired to the fuel gauge. When the instrument cluster fails to receive the fuel level signal for more than 33 seconds, the fuel level gauge will move below E (empty). If the fuel level signal operates correctly for more than 33 seconds, the fuel gauge will return to the correct position.

Fuel fills of less than 9.5 liters (2.5 gallons) require at least 10 minutes to update the fuel gauge indication.

Engine Coolant Temperature Gauge

Engine coolant temperature information is received by the instrument cluster from the PCM over the SCP network. Engine coolant temperatures above 121°C (250°F) will cause the gauge to indicate above the normal band. If the engine coolant temperature information is missing or invalid for five seconds, the temperature gauge will indicate below the cold (C) position.

Voltage Gauge (except Cobra)

The voltage gauge displays the system voltage as measured at the instrument cluster run input.

Boost Gauge (Cobra only)

The boost pressure gauge on the instrument cluster receives and measures the boost pressure directly from the intake manifold. The boost pressure gauge will display between 0.0-0.48 kpa (0.0-10 psi) boost pressure dependent upon accelerator position, engine load, and engine rpm.

LOW FUEL Level Indicator

The low fuel level indicator is hardwired from the fuel sender to the instrument cluster. The instrument cluster will illuminate the low fuel indicator when the usable fuel quantity is less than 1/8 tank (15%) of fuel tank capacity.

Oil Pressure Gauge

The oil pressure gauge is hardwired from the oil pressure switch to the instrument cluster. The oil pressure gauge will indicate either normal or no oil pressure.

CHECK FUEL CAP

The CHECK FUEL CAP indicator is used to indicate significant leaks in the fuel tank evaporative system due to a loose fuel cap. Fuel tank pressure is monitored by the PCM. If a leak is detected the PCM signals a fault to the instrument cluster via the SCP network. Once the PCM has detected a loose fuel cap and the CHECK FUEL CAP indicator is illuminated, the indicator will remain illuminated until the fuel cap is secured and the vehicle has been running for several minutes. For additional information, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

BRAKE Warning Indicator

The BRAKE warning indicator activates when the generic electronic module (GEM) detects the ignition switch circuits are in the RUN state, when the GEM detects low brake fluid level, or that the parking brake is applied. The BRAKE warning indicator will prove out starting when the GEM detects that the ignition circuits have made a transition to RUN or START from OFF, ACC, or keyout and ending when either three seconds have elapsed or when the GEM detects the ignition circuits have made a transition to OFF, ACC, or keyout.

Safety Belt Warning Indicator

The safety belt switch is hardwired to the GEM. The safety belt warning indicator will be illuminated when the GEM sends a ground signal to the instrument cluster.

ABS Warning Indicator

The ABS warning indicator will be illuminated when the anti-lock brake control module sends a ground signal to the instrument cluster. The prove-out of the ABS indicator is controlled by the anti-lock brake control module.

SERVICE ENGINE SOON Indicator

The SERVICE ENGINE SOON indicator receives its signal from the PCM over the SCP network. If the instrument cluster does not receive a message from the PCM within five seconds, the instrument cluster will illuminate the SERVICE ENGINE SOON indicator and log a diagnostic trouble code (DTC).

High Beam Indicator

The high beam indicator will illuminate when the steering column multifunction switch is in the high beam position by sending a battery signal to the instrument cluster.

Right and Left Turn Indicator

The right and left turn indicators will illuminate when the steering column multifunction switch is in either turn signal position or hazard lamps position by sending a battery signal to the instrument cluster.

AIR BAG Warning Indicator

The AIR BAG warning indicator will be illuminated when the restraint control module (RCM) sends a ground signal to the instrument cluster. The prove-out of the AIR BAG warning indicator is controlled by the RCM.

THEFT Indicator

The THEFT indicator provides a passive anti-theft system (PATS) prove-out. The THEFT indicator will prove out for three seconds following the ignition switch cycle and will flash following an ignition switch OFF transition to indicate that PATS is active.

Charging System Indicator

The charging system indicator will be illuminated when the generator provides a ground signal to the instrument cluster. The instrument cluster provides a prove-out when the ignition switch is in the RUN position with the engine off. When the engine is started, the generator removes the ground to the instrument cluster and extinguishes the charging system indicator.

Overdrive Off (O/D OFF) Indicator

The O/D OFF indicator is controlled by the off/on message sent from the PCM over the SCP network. The instrument cluster does not provide a prove-out for the O/D OFF indicator, but will remain illuminated if the overdrive has been commanded off following the instrument cluster prove-out.

Traction Control Indicator

During initialization, the instrument cluster will receive the traction control system state status message from the traction control module to determine if the vehicle is equipped with traction control. If the vehicle is equipped with traction control, this information will be stored in random access memory (RAM) and the indicator will prove out for three seconds during each ignition cycle. If this message is not received, the instrument cluster will assume that the vehicle is not traction control equipped and the indicator will remain off. When the traction control is active, the traction control module sends the instrument cluster a traction control active signal and the instrument cluster illuminates the traction control indicator. When the traction control is inactive, the traction control module removes the traction control active signal and the instrument cluster turns off the indicator.

In the event of a traction control failure, the traction control indicator will remain off and the ABS indicator will illuminate.

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
● Fuel tank	● Central junction box (CJB) fuse(s):

<ul style="list-style-type: none"> ● Engine coolant level ● Accessory drive belt ● Engine oil level ● Parking brake position switch ● Brake fluid level ● Boost gauge pressure line 	<ul style="list-style-type: none"> ■ 5 (15A) ■ 7 (15A) ■ 11 (15A) ■ 13 (15A) ■ 21 (5A) ■ 23 (15A) ■ 24 (30A) ■ 29 (15A) ■ 30 (15A) ■ 32 (15A) ■ 34 (20A) ■ 35 (15A) ■ 37 (5A) ■ 38 (20A) ■ 39 (5A)
	<ul style="list-style-type: none"> ● Circuitry

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
 - check that the program card is correctly installed.
 - check the connections to the vehicle.
 - check the ignition switch position.
5. If the diagnostic tool still does not power up, refer to the diagnostic tool operating manual.
6. Carry out the DATA LINK DIAGNOSTICS test. If the diagnostic tool responds with:
 - CKT914, CKT915 OR CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to [Section 418-00](#).
 - NO RESP/NOT EQUIP for the instrument cluster, [Go To Pinpoint Test A](#) or for the generic electronic module (GEM), [Go To Pinpoint Test W](#).
 - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out the self-test diagnostics for the instrument cluster or the GEM.
7. If the DTCs retrieved are related to the concern, go to the Instrument Cluster Diagnostic Trouble Code (DTC) Index or the GEM Diagnostic Trouble Code Index to continue diagnostics.
8. If no DTCs related to the concern are retrieved, proceed to the Symptom Chart to continue diagnostics.

Instrument Cluster Self-Diagnostic Mode

To enter the instrument cluster self-diagnostic mode, press and hold the instrument cluster SELECT/RESET button, turn the ignition switch to the RUN position, and then continue pressing the SELECT/RESET button (five seconds) until tEst is displayed in the odometer. The SELECT/RESET button must be released within three seconds of the odometer tEst display to begin the self-diagnostic mode. Press the SELECT/RESET button to advance through the following steps until dtc is displayed. Depressing the SELECT/RESET button will display any stored continuous DTCs before proceeding to the next step.

Odometer Display	Description
GAGE	Activates gauge sweep of all gauges, then displays present gauge values. Also carries out the checksum tests on ROM and EE.
All segments illuminated	Illuminates all odometer segments.
bulb	Illuminates all micro-controlled indicators and LEDs. Install a new indicator or LED as necessary.
r	Returns to normal operation of all micro-controlled indicators and LEDs and displays hexadecimal value for ROM level (used when requesting assistance from the hotline).
EE	Displays hexadecimal value for EE level (used when requesting assistance from the hotline).
dt	Displays hexadecimal coding of final manufacturing test date (used when requesting assistance from the hotline).
dtc	Displays continuous DTCs in hexadecimal format. Pressing the SELECT/RESET button will display any DTCs stored before proceeding to the next step.
enG	Displays the English speed in mph. Speedometer will indicate present speed within tolerances. Display will show 0 if input is not received, if input received is invalid for one second or more, or if speed is 0.
m	Displays the metric speed data (km/h). Speedometer will indicate present speed within tolerances. Display will show 0 if input is not received, if input received is invalid for one second or more, or if speed is 0.
tAc	Displays the tachometer data received from the PCM via the SCP network within tolerances. Tachometer will indicate present rpm. Display will show 0 if input is not received, if input received is invalid for one second or more, or if engine rpm is 0.
FUEL	<p>Displays the code (0-255) for the fuel sender input to the instrument cluster. The fuel gauge will display a filtered fuel level value. This filter will keep the pointer from moving suddenly or erratically.</p> <ul style="list-style-type: none"> ● 255 = open send +/- 0 ● 232 = full stop +/- 0 ● 215 = full mark +/- 10 ● 178 = 3/4 mark +/- 8 ● 138 = 1/2 mark +/- 7 ● 93 = 1/4 mark +/- 5 ● 41 = E mark +/- 4 ● 54=LOW FUEL (0-59) ● 0-18=short (0-20 max)
OIL	Displays the code (0-250) for the oil pressure switch input to the instrument cluster. Oil pressure gauge will indicate present oil pressure. Normal oil pressure (greater than 6 psi) will display a value between 000 and 176. A low oil pressure or an inoperative engine oil pressure switch (less than 6 psi) will display a value greater than 176.
dEGC	<p>Display of engine temperature in degrees C input from cylinder head temperature sensor.</p> <ul style="list-style-type: none"> ● 49 C = "C" mark ● 60 C = normal band start ● 120 C = normal band end ● -40 C = no SCP message for 5 seconds
bAtt	Displays the code (0-255) for the battery voltage input to the instrument cluster. Battery voltage gauge will indicate present battery voltage.

	<ul style="list-style-type: none"> ● 93-102 = 6.9-9.1 volts (low voltage) ● 115-124 = 8.5-10.7 volts (norm band start) ● 215-225 = 15.8-18 volts (norm band end) ● 230-241 = 16.9-19.1 volts (high voltage)
rhEo	Displays the present decimal rheostat dimming input, 0-255 (used when requesting assistance from the hotline).
rhi rhS rho	Not used.
Cr	Displays the present RUN/START sense input. Display will show -h for high input with the ignition switch in the START position and -L for low input with the ignition switch in the RUN position.
PA-PE7	Not used.
GAGE	Repeats test display cycle.

To exit the instrument cluster self-diagnostic mode, turn the ignition switch to the OFF position or press and hold the SELECT/RESET button for three or more seconds and release.

Instrument Cluster Diagnostic Trouble Code (DTC) Index

Diagnostic Tool Displayed DTC	Self-Diagnostic Mode Displayed DTC	Description	Source	Action
B1202	9202	Fuel Sender Open Circuit	Instrument Cluster	Go To Pinpoint Test B.
B1204	9204	Fuel Sender Short to Ground	Instrument Cluster	Go To Pinpoint Test B.
B1317	9317	Battery Voltage High	Instrument Cluster	Section 414-00.
B1318	9318	Battery Voltage Low	Instrument Cluster	Section 414-00.
B1342	9342	ECU is Defective	Instrument Cluster	INSTALL a new instrument cluster; REFER to Instrument Cluster in this section. TEST the system for normal operation.
B1343	9343	Heated Backlight Input Circuit Failure	Instrument Cluster	Section 501-11.
B1356	9356	Ignition Run Circuit Open	Instrument Cluster	Go To Pinpoint Test A.
B1364	9364	Ignition Start Circuit Open	Instrument Cluster	Go To Pinpoint Test A.
B2143	A143	Odometer NVM Memory Failure	Instrument Cluster	Go To Pinpoint Test J.
C1284	5284	Oil Pressure Switch Failure	Instrument Cluster	Go To Pinpoint Test C.
P1197	1197	Mileage Switch Circuit Failure	Instrument Cluster	Go To Pinpoint Test J.

GEM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1218	Horn Relay Coil Circuit Short to VBatt	GEM	REFER to Section 501-14B .
B1312	Lamp Headlamp Input Circuit Short to Battery	GEM	REFER to Section 413-09 .
B1317	Battery Voltage High	GEM	REFER to Section 414-00 .
B1318	Battery Voltage Low	GEM	REFER to Section 414-00 .
B1322	Driver Door Ajar Circuit Short to Ground	GEM	REFER to Section 417-02 .
B1330	Passenger Door Ajar Circuit Short to Ground	GEM	REFER to Section 417-02 .
B1334	Decklid Ajar Rear Door Circuit Short to Ground	GEM	REFER to Section 417-02 .
B1339	Chime Input Request Circuit Short to Battery	GEM	REFER to Section 413-09 .
B1340	Chime Input Request Circuit Short to Ground	GEM	REFER to Section 413-09 .
B1342	ECU is Defective	GEM	Clear the DTCs. Retrieve the DTCs. If DTC B1342 is retrieved, INSTALL a new GEM. REFER to Section 419-10 .
B1353	Ignition Key-In Circuit Open	GEM	REFER to Section 413-09 .
B1359	Ignition Run/Acc Circuit Failure	GEM	REFER to Section 211-05 .
B1396	Power Door Lock Circuit Short to Battery	GEM	REFER to Section 501-14B .
B1397	Power Door Unlock Circuit Short to Battery	GEM	REFER to Section 501-14B .
B1405	Driver Power Window Down Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1408	Driver Power Window Up Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1426	Lamp Safety Belt Circuit Short to Battery	GEM	Go To Pinpoint Test K .
B1428	Lamp Safety Belt Circuit Failure	GEM	Go To Pinpoint Test K .
B1431	Wiper Brake/Run Relay Circuit Failure	GEM	REFER to Section 501-16 .
B1432	Wiper Brake/Run Relay Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1434	Wiper Hi/Low Speed Relay Coil Circuit Failure	GEM	REFER to Section 501-16 .
B1436	Wiper Hi/Low Speed Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1438	Wiper Mode Select Switch Circuit Failure	GEM	REFER to Section 501-16 .
B1441	Wiper Mode Select Switch Circuit Short to Ground	GEM	REFER to Section 501-16 .

B1446	Wiper Park Sense Circuit Failure	GEM	REFER to Section 501-16 .
B1448	Wiper Park Sense Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1450	Wiper Wash/Delay Switch Circuit Failure	GEM	REFER to Section 501-16 .
B1453	Wiper Wash/Delay Switch Circuit Short to Ground	GEM	REFER to Section 501-16 .
B1458	Wiper Washer Pump Motor Relay Circuit Failure	GEM	REFER to Section 501-16 .
B1460	Wiper Washer Pump Motor Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1462	Safety Belt Switch Circuit Failure	GEM	REFER to Section 413-09 .
B1466	Wiper Hi/Low Speed Not Switching	GEM	REFER to Section 501-16 .
B1473	Wiper Low Speed Circuit Motor Failure	GEM	REFER to Section 501-16 .
B1476	Wiper High Speed Circuit Motor Failure	GEM	REFER to Section 501-16 .
B1551	Decklid Release Circuit Failure	GEM	REFER to Section 501-14B .
B1553	Decklid Release Circuit Short to Battery	GEM	REFER to Section 501-14B .
B1555	Ignition Run/Start Circuit Failure	GEM	REFER to Section 211-05 .
B1687	Lamp Dome Input Circuit Short to Battery	GEM	REFER to Section 417-02 .
B2486	Parklamp Output Relay Driver Circuit Failure	GEM	REFER to Section 419-01 .
B2488	Parklamp Output Relay Driver Short to Battery	GEM	REFER to
C1189	Brake Fluid Level Sensor Input Short Circuit to Ground	GEM	Go To Pinpoint Test O .
C1223	Lamp Brake Warning Output Circuit Failure	GEM	Go To Pinpoint Test O .
C1225	Lamp Brake Warning Output Circuit Short to Battery	GEM	Go To Pinpoint Test O .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none"> No communication with the generic electronic module (GEM) 	<ul style="list-style-type: none"> Central junction box (CJB) fuse (s): <ul style="list-style-type: none"> 7 (15A). 39 (5A). 43 	<ul style="list-style-type: none"> Go To Pinpoint Test W

	<ul style="list-style-type: none"> (20A). ● Battery junction box (BJB) fuse 12 (40A). ● Circuitry. ● GEM. 	
<ul style="list-style-type: none"> ● No communication with the instrument cluster 	<ul style="list-style-type: none"> ● Central junction box (CJB) fuse (s): <ul style="list-style-type: none"> ■ 11 (15A). ■ 21 (5A). ■ 34 (20A). ● Circuitry. ● Standard corporate protocol (SCP) network. ● Instrument cluster. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test A.
<ul style="list-style-type: none"> ● Incorrect fuel gauge indication 	<ul style="list-style-type: none"> ● Circuitry. ● Fuel pump module. ● Instrument cluster. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test B.
<ul style="list-style-type: none"> ● Incorrect oil pressure gauge indication 	<ul style="list-style-type: none"> ● Circuitry. ● Engine oil pressure switch. ● Instrument cluster. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test C.
<ul style="list-style-type: none"> ● Incorrect temperature gauge indication 	<ul style="list-style-type: none"> ● Circuitry. ● Engine coolant temperature sensor. ● Powertrain control module (PCM). ● Instrument cluster. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test D.
<ul style="list-style-type: none"> ● Incorrect voltage gauge indication—except Cobra 	<ul style="list-style-type: none"> ● Circuitry. ● Generator. ● Standard corporate protocol (SCP) network. ● Instrument cluster. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test E.
<ul style="list-style-type: none"> ● Incorrect tachometer indication 	<ul style="list-style-type: none"> ● Standard corporate protocol (SCP) network. ● Powertrain control module (PCM). ● Instrument cluster. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test F.
<ul style="list-style-type: none"> ● Incorrect boost gauge 	<ul style="list-style-type: none"> ● Pressure line. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test G.

indication—Cobra only	<ul style="list-style-type: none"> ● Instrument cluster. 	
<ul style="list-style-type: none"> ● The LOW FUEL warning indicator is never/always on 	<ul style="list-style-type: none"> ● LOW FUEL warning indicator bulb. ● Standard corporate protocol (SCP) network. ● Instrument cluster. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test H.
<ul style="list-style-type: none"> ● Oil gauge reads normal with engine off 	<ul style="list-style-type: none"> ● Instrument cluster. 	<ul style="list-style-type: none"> ● INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation.
<ul style="list-style-type: none"> ● The speedometer is inoperative 	<ul style="list-style-type: none"> ● Standard corporate protocol (SCP) network. ● Powertrain control module (PCM). ● Instrument cluster. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test I.
<ul style="list-style-type: none"> ● The odometer is inoperative 	<ul style="list-style-type: none"> ● Circuitry. ● Powertrain control module (PCM). ● Instrument cluster. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test J.
<ul style="list-style-type: none"> ● The safety belt warning indicator is inoperative (chime is operative)/does not operate correctly 	<ul style="list-style-type: none"> ● Circuitry. ● Generic electronic module (GEM). ● Instrument cluster. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test K.
<ul style="list-style-type: none"> ● Inaccurate speedometer reading 	<ul style="list-style-type: none"> ● Instrument cluster. ● Powertrain control module (PCM). 	<ul style="list-style-type: none"> ● Go To Pinpoint Test L.
<ul style="list-style-type: none"> ● The O/D OFF indicator is never on 	<ul style="list-style-type: none"> ● Circuitry. ● O/D cancel switch. ● O/D OFF indicator bulb. ● Standard corporate protocol (SCP) network. ● Powertrain control module (PCM). ● Instrument cluster. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test M.
<ul style="list-style-type: none"> ● The O/D OFF indicator is always on 	<ul style="list-style-type: none"> ● Circuitry. ● O/D cancel switch. 	<ul style="list-style-type: none"> ● REFER to the Powertrain Control/Emissions Diagnosis (PC/ED)

	<ul style="list-style-type: none"> ● Powertrain control module (PCM). 	<ul style="list-style-type: none"> ● manual.
<ul style="list-style-type: none"> ● The CHECK FUEL CAP INDICATOR is never on 	<ul style="list-style-type: none"> ● Circuitry. ● Standard corporate protocol (SCP) network. ● Powertrain control module (PCM). 	<ul style="list-style-type: none"> ● Go To Pinpoint Test N.
<ul style="list-style-type: none"> ● The CHECK FUEL CAP INDICATOR is always on 	<ul style="list-style-type: none"> ● Circuitry. ● Powertrain control module (PCM). ● Fuel system. 	<ul style="list-style-type: none"> ● REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
<ul style="list-style-type: none"> ● The BRAKE warning indicator is never/always on 	<ul style="list-style-type: none"> ● Circuitry. ● Low brake fluid level. ● Brake fluid level switch. ● Parking brake switch. ● Instrument cluster. ● Generic electronic module (GEM). 	<ul style="list-style-type: none"> ● Go To Pinpoint Test O.
<ul style="list-style-type: none"> ● The charging system warning indicator is never/always on 	<ul style="list-style-type: none"> ● Circuitry. ● Generator. ● Charging system warning indicator bulb. ● Instrument cluster. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test P.
<ul style="list-style-type: none"> ● The high beam indicator is never/always on 	<ul style="list-style-type: none"> ● Circuitry. ● High beam indicator bulb. ● Instrument cluster. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test Q.
<ul style="list-style-type: none"> ● The air bag warning indicator is never/always on 	<ul style="list-style-type: none"> ● Circuitry. ● Air bag warning indicator bulb. ● Instrument cluster. ● Restraint control module (RCM). 	<ul style="list-style-type: none"> ● REFER to Section 501-20B.
<ul style="list-style-type: none"> ● The anti-lock brake system (ABS) warning indicator is never on 	<ul style="list-style-type: none"> ● Circuitry. ● ABS warning indicator bulb. ● Anti-lock brake control module. ● Instrument cluster. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test R.
<ul style="list-style-type: none"> ● The ABS warning indicator is always on 	<ul style="list-style-type: none"> ● Circuitry. ● Anti-lock brake control module. 	<ul style="list-style-type: none"> ● REFER to Section 206-09A or Section 206-09B.

<ul style="list-style-type: none"> ● The SERVICE ENGINE SOON indicator is never/always on 	<ul style="list-style-type: none"> ● Circuitry. ● SERVICE ENGINE SOON indicator bulb. ● Powertrain control module (PCM). ● Instrument cluster. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test S.
<ul style="list-style-type: none"> ● The turn/hazard indicator is never/always on 	<ul style="list-style-type: none"> ● Circuitry. ● Turn/hazard bulb(s). ● Instrument cluster. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test T.
<ul style="list-style-type: none"> ● The THEFT indicator is never/always on 	<ul style="list-style-type: none"> ● Circuitry. ● THEFT indicator LED. ● Instrument cluster. 	<ul style="list-style-type: none"> ● REFER to Section 419-01.
<ul style="list-style-type: none"> ● The traction control indicator is never/always on 	<ul style="list-style-type: none"> ● Circuitry. ● Traction control switch. ● Standard corporate protocol (SCP) network. ● Powertrain control module (PCM). ● ABS module. ● Instrument cluster. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test U.
<ul style="list-style-type: none"> ● The integrated circuit display is inoperative/erratic 	<ul style="list-style-type: none"> ● Instrument cluster. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test V.
<ul style="list-style-type: none"> ● The instrument cluster is inoperative 	<ul style="list-style-type: none"> ● Central junction box (CJB) fuse (s): <ul style="list-style-type: none"> ■ 11 (15A). ■ 21 (5A). ■ 34 (20A). ● Circuitry. ● Instrument cluster. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test V.

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE INSTRUMENT CLUSTER

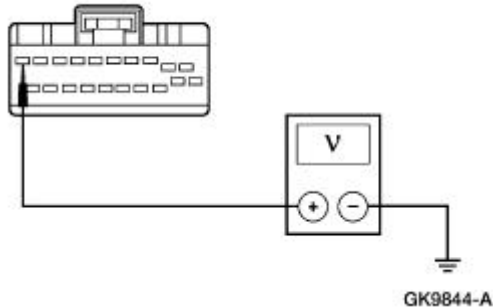
Test Step	Result / Action to Take
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A1 CHECK THE BATTERY POWER SUPPLY TO THE INSTRUMENT CLUSTER



CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.

- Key in OFF position.
- Disconnect: Instrument Cluster C220b.
- Measure voltage between the instrument cluster C220b pin 10, circuit 729 (RD/WH), harness side and ground.



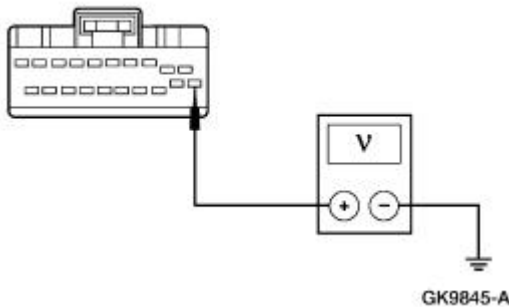
- Is the voltage greater than 10 volts?

Yes
GO to [A2](#).

No
REPAIR the circuit.
TEST the system for normal operation.

A2 CHECK THE RUN POWER SUPPLY TO THE INSTRUMENT CLUSTER

- Key in ON position.
- Measure the voltage between the instrument cluster C220b pin 11, circuit 489 (PK/BK), harness side and ground.



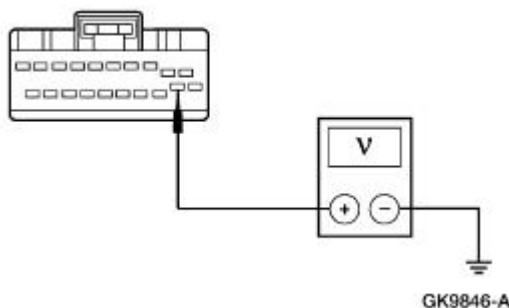
- Is the voltage greater than 10 volts?

Yes
GO to [A3](#).

No
REPAIR the circuit.
TEST the system for normal operation.

A3 CHECK THE RUN/START POWER SUPPLY TO THE INSTRUMENT CLUSTER

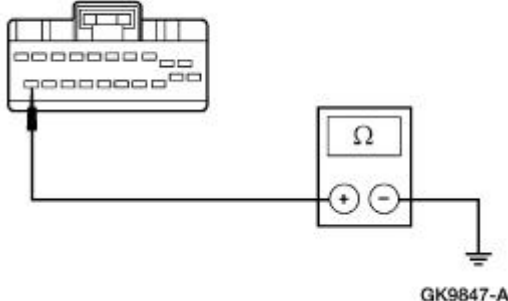
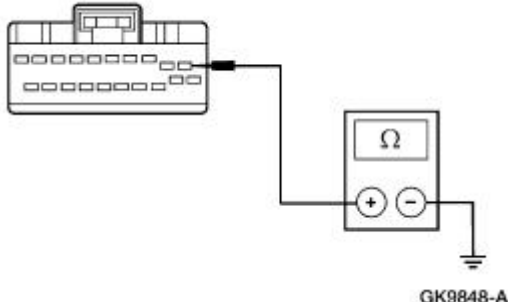
- Key in OFF position.
- Disconnect: Instrument Cluster C220b.
- Key in ON position.
- Measure the voltage between the instrument cluster C220b pin 12, circuit 20 (WH/LB), harness side and ground.




- Is the voltage greater than 10 volts?

Yes
GO to [A4](#).

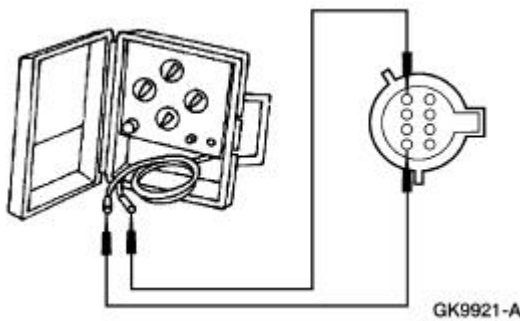
No
REPAIR the circuit.
TEST the system for normal operation.

<p>A4 CHECK GROUND CIRCUIT 397 (BK/WH) FOR AN OPEN</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Measure the resistance between the instrument cluster C220b pin 20, circuit 397 (BK/WH), harness side and ground.  <p>● Is the resistance less than 5 ohms?</p>	<p>Yes GO to A5.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<p>A5 CHECK GROUND CIRCUIT 1205 (BK) FOR OPEN</p> <ul style="list-style-type: none"> ● Measure the resistance between the instrument cluster C220b pin 1, circuit 1205 (BK), harness side and ground.  <p>● Is the resistance less than 5 ohms?</p>	<p>Yes REFER to Section 418-00.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>

PINPOINT TEST B: INCORRECT FUEL GAUGE INDICATION

Test Step	Result / Action to Take
<p>B1 CARRY OUT THE INSTRUMENT CLUSTER FUEL GAUGE ACTIVE COMMAND</p> <p> CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector. NOTE: Fuel fills of less than 9.5 liters (2.5 gallons) require at least 10 minutes to update the fuel gauge indication.</p> <ul style="list-style-type: none"> ● Key in ON position. ● Select the instrument cluster FUELLEVEL active command. Trigger, monitor, and scroll FUELLEVEL at: 0% , 50%, and 100%. ● Does the fuel gauge display: below E at 0%, half at 50%, and F at 100%? 	<p>Yes GO to B2.</p> <p>No GO to B8.</p>
<p>B2 CHECK THE FUEL GAUGE OPERATION</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Fuel Pump Assembly C463. ● Connect one lead of the Instrument Gauge System Tester to the fuel pump module C463 pin 5, circuit 29 (YE/WH), harness side and the other lead of the Instrument Gauge System Tester to the 	<p>Yes GO to B3.</p> <p>No GO to B5.</p>

fuel pump module C463 pin 8, circuit 327 (BK/OG), harness side.



- Set the Instrument Gauge System Tester to 160 ohms.
- Key in ON position.
- Turn the ignition switch to RUN for one second.
- Key in OFF position.
- Set Instrument Gauge System Tester to 15 ohms.
- Key in ON position.
- **NOTE:** The fuel gauge should read E or below when carrying out this test step.
- Wait one minute and read the fuel gauge.
- Key in OFF position.
- Set Instrument Gauge System Tester to 160 ohms.
- Key in ON position.
- **NOTE:** The fuel gauge should read F (full) or above when carrying out this test step.
- Wait one minute and read the fuel gauge.
- Key in OFF position.
- **Does the fuel gauge operate correctly?**

B3 CHECK THE FUEL TANK

- Check the fuel tank for any damage or deformation.
- **Is the fuel tank OK?**

Yes
GO to [B4](#).

No
INSTALL a new fuel tank; REFER to [Section 310-01](#). TEST the system for normal operation.

B4 CHECK THE FUEL PUMP ASSEMBLY

- Check the fuel pump assembly in-tank mounting, float, float rod, wiring and connections for damage or obstruction.
- **Is the fuel pump assembly and wiring OK?**

Yes
INSTALL a new fuel sender. TEST the system for normal operation.

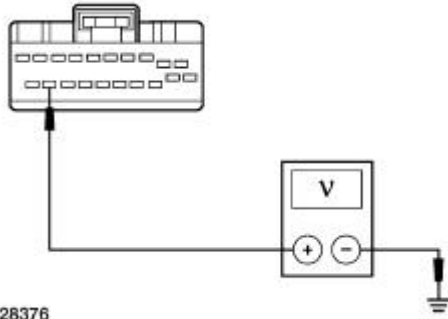
No
REPAIR as necessary. TEST the system for normal operation.

B5 CHECK CIRCUIT 29 (YE/WH) FOR SHORT TO POWER

- Disconnect: Instrument Cluster C220b.
- Key in ON position.
- Measure the voltage between the instrument cluster C220b pin 19, circuit 29 (YE/WH), harness side and ground.

Yes
REPAIR the circuit. TEST the system for normal operation.

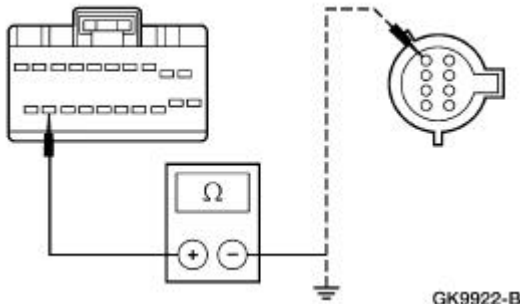
No
GO to [B6](#).



- Is any voltage present?

B6 CHECK THE FUEL PUMP ASSEMBLY FEED CIRCUIT 29 (YE/WH)

- Key in OFF position.
- Measure the resistances between the instrument cluster C220b pin 19, circuit 29 (YE/WH), harness side and the fuel pump module C463 pin 5, circuit 29 (YE/WH), harness side; and between the instrument cluster C220b pin 19, circuit 29 (YE/WH), harness side and ground.



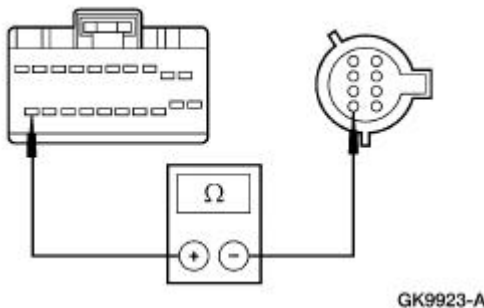
- Is the resistance less than 5 ohms between the instrument cluster and the fuel pump module and greater than 10,000 ohms between the instrument cluster and ground?

Yes
GO to [B7](#).

No
REPAIR the circuit.
TEST the system for normal operation.

B7 CHECK FUEL PUMP MODULE GROUND CIRCUIT 327 (BK/OG) AND CIRCUIT 397 (BK/WH)

- Measure the resistance between the instrument cluster C220b pin 20, circuit 397 (BK/WH), harness side and the fuel pump module C463 pin 8, circuit 327 (BK/OG), harness side.



- Is the resistance less than 5 ohms?

Yes
GO to [B8](#).

No
REPAIR the circuit(s) in question. TEST the system for normal operation.

B8 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION

- Disconnect all instrument cluster connectors.
- Check for:
 - corrosion
 - pushed-out pins
- Connect all instrument cluster connectors and make sure they seat correctly.


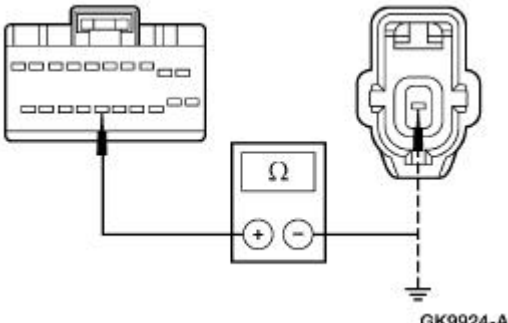
Yes
INSTALL a new instrument cluster.
REFER to [Instrument Cluster](#) in this section.
TEST the system for

- Operate the system and verify the concern is still present.
- **Is the concern still present?**

normal operation.

No
The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST C: INCORRECT OIL PRESSURE GAUGE INDICATION

Test Step	Result / Action to Take
<p>C1 CHECK THE INSTRUMENT CLUSTER OPERATION</p> <p> CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.</p> <ul style="list-style-type: none"> ● Connect the diagnostic tool. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. ● Trigger the instrument cluster active command OIL GAUGE. Scroll to 0%, 50%, and 100%. ● Did the gauge display L at 0%, the middle of the gauge at 50%, and H at 100%? 	<p>Yes GO to C2.</p> <p>No GO to C3.</p>
<p>C2 CHECK CIRCUIT 31 (WH/RD) FOR OPEN OR SHORT TO GROUND</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Instrument Cluster C220b. ● Disconnect: Oil Pressure Switch C103. ● Measure the resistances between the instrument cluster C220b pin 16, circuit 31 (WH/RD), harness side and the oil pressure switch C103, circuit 31 (WH/RD), harness side; and between the instrument cluster C220b pin 16, circuit 31 (WH/RD), harness side and ground.  <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms between the instrument cluster and the oil pressure switch, and greater than 10,000 ohms between the instrument cluster and ground? 	<p>Yes INSTALL a new oil pressure switch. TEST the system for normal operation.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<p>C3 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION</p> <ul style="list-style-type: none"> ● Disconnect all instrument cluster connectors. 	<p>Yes INSTALL a new</p>

<ul style="list-style-type: none"> ● Check for: <ul style="list-style-type: none"> ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● Is the concern still present? 	<p>instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation.</p> <p>No The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p>
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PINPOINT TEST D: INCORRECT TEMPERATURE GAUGE INDICATION

Test Step	Result / Action to Take
<p>D1 CARRY OUT THE INSTRUMENT CLUSTER ENGINE COOLANT TEMPERATURE GAUGE ACTIVE COMMAND</p> <ul style="list-style-type: none"> ● Connect the diagnostic tool. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. ● Trigger instrument cluster active command ENGCOOLNT. Monitor the engine coolant temperature gauge while adjusting the ENGCOOLNT active command to read 50% and 100%. ● Does the temperature gauge start at cold, move to half at 50%, and full hot at 100%? 	<p>Yes REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.</p> <p>No GO to D2.</p>
<p>D2 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION</p> <ul style="list-style-type: none"> ● Disconnect all instrument cluster connectors. ● Check for: <ul style="list-style-type: none"> ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● Is the concern still present? 	<p>Yes INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation.</p> <p>No The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p>

PINPOINT TEST E: INCORRECT VOLTAGE GAUGE INDICATION—EXCEPT COBRA

Test Step	Result / Action to Take
E1 CHECK THE INSTRUMENT CLUSTER	



CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.

- Connect the diagnostic tool.
- Key in ON position.
- Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command.
- Trigger the instrument cluster voltage gauge active command. Scroll to 0%, 50%, and 100%.
- **Did the voltage gauge indicate L at 0%, the middle of the gauge at 50%, and H at 100%?**

Yes
GO to [E2](#).

No
GO to [E4](#).

E2 CHECK CHARGING SYSTEM

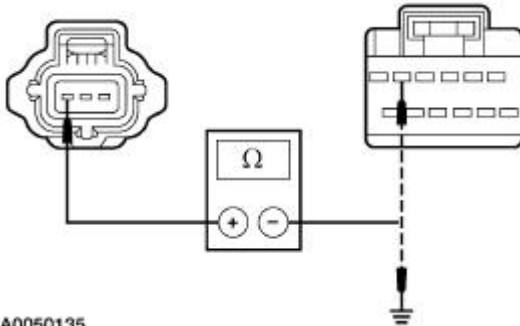
- Check the charging system operation. REFER to [Section 414-00](#).
- **Is the charging system operating correctly?**

Yes
GO to [E3](#).

No
REPAIR the charging system as needed. REFER to [Section 414-00](#).

E3 CHECK CIRCUIT 904 (LG/RD) FOR OPEN OR SHORT TO GROUND

- Key in OFF position.
- Disconnect: Instrument Cluster C220a.
- Disconnect: Generator C102a.
- Measure resistance between the generator C102a pin 1, circuit 904 (LG/RD), harness side and the instrument cluster C220a pin 5, circuit 904 (LG/RD), harness side; and between the generator C102a pin 1, circuit 904 (LG/RD), harness side and ground.



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- **Is the resistance less than 5 ohms between the generator and the instrument cluster; and greater than 10,000 ohms between the generator and ground?**

Yes
The system is operating correctly at this time.

No
REPAIR the circuit. TEST the system for normal operation.

E4 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION

- Disconnect all instrument cluster connectors.
- Check for:
 - corrosion
 - pushed-out pins
- Connect all instrument cluster connectors and make sure they seat correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new instrument cluster. REFER to [Instrument Cluster](#) in this section. TEST the system for normal operation.

No
The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs.

PINPOINT TEST F: INCORRECT TACHOMETER INDICATION

Test Step	Result / Action to Take
F1 CHECK THE TACHOMETER OPERATION <ul style="list-style-type: none"> ● Connect the diagnostic tool. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. ● Trigger the instrument cluster active command TCHOMETER. Scroll to 0%, 50%, and 100%. ● Did the tachometer display read 0 at 0%, half the tachometer display at 50%, and the full tachometer display at 100%? 	<p>Yes REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.</p> <p>No GO to F2.</p>
F2 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION <ul style="list-style-type: none"> ● Disconnect all instrument cluster connectors. ● Check for: <ul style="list-style-type: none"> ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● Is the concern still present? 	<p>Yes INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation.</p> <p>No The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p>

PINPOINT TEST G: INCORRECT BOOST GAUGE INDICATION—COBRA ONLY

Test Step	Result / Action to Take
G1 CHECK BOOST GAUGE PRESSURE LINE <ul style="list-style-type: none"> ● Disconnect the boost gauge pressure line from the intake manifold. ● Apply 69 kPa (10 psi) to the boost gauge pressure line. ● Does the boost gauge indicate maximum boost pressure? 	<p>Yes CHECK for a plugged manifold fitting. TEST the system for normal operation.</p> <p>No GO to G2.</p>
G2 CHECK THE BOOST GAUGE <ul style="list-style-type: none"> ● Disconnect the boost gauge pressure line from the instrument cluster. ● Apply 10 psi to the boost gauge. ● Does the boost gauge indicate maximum boost pressure? 	<p>Yes INSTALL a new boost gauge pressure line. TEST the system for normal operation.</p> <p>No INSTALL a new instrument cluster. REFER to</p>

[Instrument Cluster](#) in this section. TEST the system for normal operation.

PINPOINT TEST H: THE LOW FUEL WARNING INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
H1 CARRY OUT THE INSTRUMENT CLUSTER WARNING LAMPS AND CHIME ACTIVE COMMAND USING THE DIAGNOSTIC TOOL	
<ul style="list-style-type: none"> ● Key in OFF position. ● Connect the diagnostic tool. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. ● Select the instrument cluster WARNING LAMPS AND CHIME active command. Trigger the ALL LAMPS active command. Observe the LOW FUEL warning indicator. ● Is the LOW FUEL warning indicator illuminating? 	<p>Yes GO to H2.</p> <p>No GO to H3.</p>
H2 THE LOW FUEL GAUGE WARNING INDICATOR IS NEVER/ALWAYS ON	
<ul style="list-style-type: none"> ● Check the fuel gauge for correct operation. ● Is the fuel gauge operating correctly? 	<p>Yes GO to H3.</p> <p>No Go To Pinpoint Test B.</p>
H3 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
<ul style="list-style-type: none"> ● Disconnect all instrument cluster connectors. ● Check for: <ul style="list-style-type: none"> ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● Is the concern still present? 	<p>Yes INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation.</p> <p>No The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p>

PINPOINT TEST I: THE SPEEDOMETER IS INOPERATIVE


Test Step	Result / Action to Take
I1 TEST THE INSTRUMENT CLUSTER	
<ul style="list-style-type: none"> ● Carry out the instrument cluster self-diagnostic mode. ● Did the gauge sweep? 	<p>Yes REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.</p> <p>No</p>

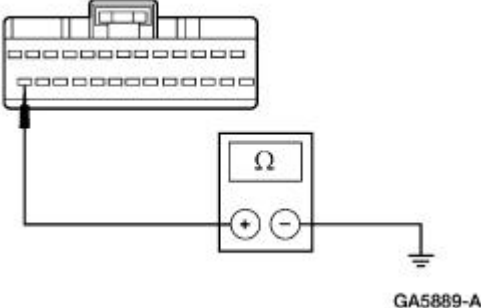
	GO to J2 .
I2 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
<ul style="list-style-type: none"> ● Disconnect all instrument cluster connectors. ● Check for: <ul style="list-style-type: none"> ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● Is the concern still present? 	<p>Yes INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation.</p> <p>No The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p>

PINPOINT TEST J: THE ODOMETER IS INOPERATIVE

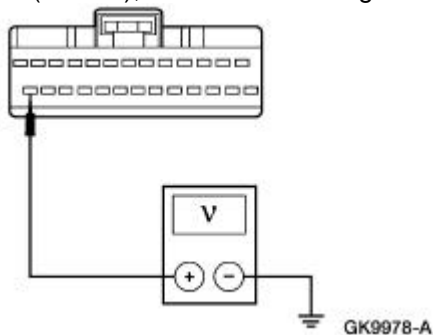
Test Step	Result / Action to Take
J1 CHECK THE ODOMETER DISPLAY	
<ul style="list-style-type: none"> ● Key in ON position. ● Is the odometer displaying all dashes? 	<p>Yes REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.</p> <p>No GO to J2.</p>
J2 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
<ul style="list-style-type: none"> ● Disconnect all instrument cluster connectors. ● Check for: <ul style="list-style-type: none"> ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● Is the concern still present? 	<p>Yes INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation.</p> <p>No The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p>

PINPOINT TEST K: THE SAFETY BELT INDICATOR IS INOPERATIVE (CHIME IS OPERATIVE)/DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
K1 CHECK IF THE GEM IS RECEIVING THE CORRECT IGNITION SWITCH STATUS	
 CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector. <ul style="list-style-type: none"> ● Connect the diagnostic tool. 	<p>Yes GO to K2.</p> <p>No REFER to Section 211-05.</p>

<ul style="list-style-type: none"> ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Generic Electronic Module (GEM) PID. ● Monitor the GEM PIDs IGN_KEY, IGN_S, IGN_R, and IGN_A, while inserting the ignition key and cycling the ignition switch through all the positions. ● Did the PIDs agree with the ignition switch positions? 	
K2 CHECK IF THE GEM IS RECEIVING THE CORRECT SAFETY BELT SWITCH STATUS	
<ul style="list-style-type: none"> ● Monitor GEM PID D_SBELT while buckling and unbuckling the driver safety belt. ● Did the PID display IN with the safety belt buckled and OUT with the safety belt unbuckled? 	<p>Yes GO to K3.</p> <p>No REFER to Section 413-09.</p>
K3 CHECK THE GEM FOR INTERNAL OPEN OR SHORT	
<ul style="list-style-type: none"> ● Key in OFF position. ● Monitor the safety belt warning indicator when turning the ignition from the OFF to the ON position. ● Key in ON position. ● Did the safety belt warning indicator illuminate for approximately three seconds and turn off? 	<p>Yes GO to K10.</p> <p>No GO to K4.</p>
K4 DETERMINE IF SAFETY BELT INDICATOR CIRCUIT IS SHORTED TO GROUND	
<ul style="list-style-type: none"> ● Buckle the driver safety belt. ● Is the safety belt indicator always on? 	<p>Yes GO to K5.</p> <p>No GO to K7.</p>
K5 CHECK IF THE GEM IS INTERNALLY GROUNDED	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: GEM C201e. ● Key in ON position. ● Observe the safety belt warning indicator. ● Is the safety belt warning indicator always on? 	<p>Yes GO to K6.</p> <p>No GO to K10.</p>
K6 CHECK CIRCUIT 450 (DG/LG) FOR A SHORT TO GROUND	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Instrument Cluster C220a. ● Measure the resistance between the GEM C201e pin 26, circuit 450 (DG/LG), harness side and ground.  <ul style="list-style-type: none"> ● Is the resistance greater than 10,000 ohms? 	<p>Yes GO to K11.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
K7 CHECK CIRCUIT 450 (DG/LG) FOR A SHORT TO BATTERY	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: GEM C201e. ● Disconnect: Instrument Cluster C220a. 	<p>Yes REPAIR the circuit. TEST the system for normal</p>

- Measure the voltage between the GEM C201e pin 26, circuit 450 (DG/LG), harness side and ground.



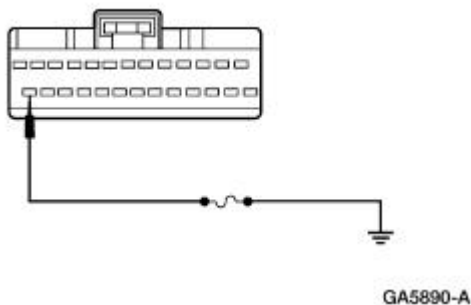
- **Is any voltage present?**

operation.

No
GO to [K8](#).

K8 CHECK THE GEM MODULE FOR AN INTERNAL OPEN

- Connect: Instrument Cluster C220a.
- Install a fused (10A) jumper wire between the GEM C201e pin 26, circuit 450 (DG/LG), harness side and ground.



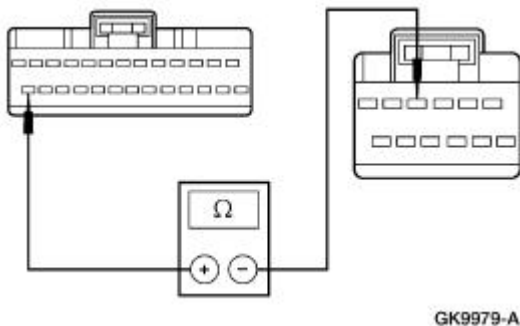
- Key in ON position.
- **Did the safety belt indicator illuminate?**

Yes
GO to [K10](#).

No
GO to [K9](#).

K9 CHECK CIRCUIT 450 (DG/LG) FOR AN OPEN

- Key in OFF position.
- Disconnect: Instrument Cluster C220a.
- Measure the resistance between the GEM C201e pin 26, circuit 450 (DG/LG), harness side and instrument cluster C220a pin 4, circuit 450 (DG/LG), harness side.



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

Yes
GO to [K11](#).

No
REPAIR the circuit. TEST the system for normal operation.

K10 CHECK FOR CORRECT GEM OPERATION

- Disconnect all GEM connectors.
- Check for:
 - corrosion
 - pushed-out pins
- Connect all GEM connectors and make sure they seat correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new GEM. REFER to [Section 419-10](#). TEST the system for normal operation.

No
The system is operating correctly at this time.

	Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.
K11 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
<ul style="list-style-type: none"> ● Disconnect all instrument cluster connectors. ● Check for: <ul style="list-style-type: none"> ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● Is the concern still present? 	<p>Yes INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation.</p> <p>No The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p>

PINPOINT TEST L: INACCURATE SPEEDOMETER READING

Test Step	Result / Action to Take
L1 CHECK SPEEDOMETER OPERATION	
<ul style="list-style-type: none"> ● Connect the diagnostic tool. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. ● Trigger the instrument cluster active command SPDOMETER. Scroll to 0%, 50%, and 100%. ● Did the speedometer display read 0 at 0%, half the speedometer display at 50%, and the full speedometer display at 100%? 	<p>Yes REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.</p> <p>No GO to L2.</p>
L2 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
<ul style="list-style-type: none"> ● Disconnect all instrument cluster connectors. ● Check for: <ul style="list-style-type: none"> ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● Is the concern still present? 	<p>Yes INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation.</p> <p>No The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p>

PINPOINT TEST M: THE O/D OFF INDICATOR IS NEVER ON

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Test Step	Result / Action to Take
M1 CHECK THE O/D OFF INDICATOR OPERATION	
<ul style="list-style-type: none"> ● Key in ON position. ● Observe the O/D OFF indicator. ● Is the O/D OFF indicator always on? 	<p>Yes GO to M2.</p> <p>No GO to M3.</p>
M2 CHECK THE INSTRUMENT CLUSTER	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Instrument Cluster C220a. ● Key in ON position. ● Observe the O/D OFF indicator. ● Did the indicator turn off? 	<p>Yes REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.</p> <p>No GO to M4.</p>
M3 CHECK THE INSTRUMENT CLUSTER OPERATION	
<ul style="list-style-type: none"> ● Carry out the instrument cluster self-diagnostic mode. ● Did the O/D OFF indicator illuminate? 	<p>Yes REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.</p> <p>No GO to M4.</p>
M4 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
<ul style="list-style-type: none"> ● Disconnect all instrument cluster connectors. ● Check for: <ul style="list-style-type: none"> ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● Is the concern still present? 	<p>Yes INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation.</p> <p>No The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p>

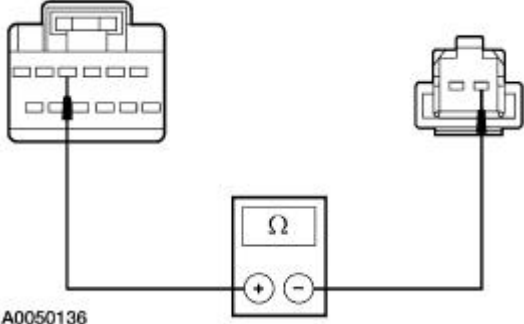
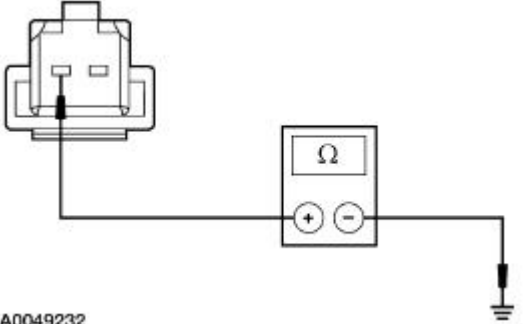
PINPOINT TEST N: THE CHECK FUEL CAP INDICATOR IS NEVER ON

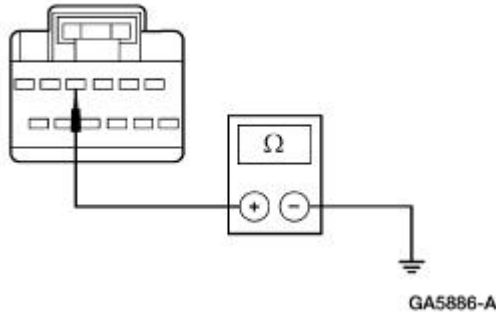
Test Step	Result / Action to Take
N1 RETREIVE AND RECORD DTCS FROM CONTINUOUS AND ON-DEMAND SELF-TESTS—PCM	
<p>NOTE: Once the check fuel cap indicator does turn on, it does not turn off unless the fuel cap has been correctly secured and the vehicle has been driven for several minutes.</p> <ul style="list-style-type: none"> ● Use recorded PCM DTCs from the continuous and on-demand self-test. ● Are any DTCs recorded? 	<p>Yes If PCM DTC P0457, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.</p> <p>No GO to N2.</p>
N2 CARRY OUT THE INSTRUMENT CLUSTER	

INDICATOR LAMP CONTROL III ACTIVE COMMAND USING THE DIAGNOSTIC TOOL	<p>Yes REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.</p> <p>No GO to N3.</p>
<ul style="list-style-type: none"> ● Connect the diagnostic tool. ● Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. ● Select the instrument cluster INDICATOR LAMP CONTROL III active command. Trigger the CHECK FUEL CAP active command ON. Observe the CHECK FUEL CAP indicator. ● Does the CHECK FUEL CAP indicator illuminate? 	
N3 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	<p>Yes INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation.</p> <p>No The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p>
<ul style="list-style-type: none"> ● Disconnect all instrument cluster connectors. ● Check for: <ul style="list-style-type: none"> ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● Is the concern still present? 	

PINPOINT TEST O: THE BRAKE WARNING INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
O1 CHECK IF THE GEM IS RECEIVING THE CORRECT IGNITION SWITCH STATUS	
<p> CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.</p> <ul style="list-style-type: none"> ● Connect the diagnostic tool. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Generic Electronic Module (GEM) PID. ● Monitor GEM PIDs IGN_KEY, IGN_S, IGN_R, and IGN_A while cycling the ignition switch through all positions and then removing the key from ignition switch. ● Do the PIDs agree with the ignition switch status? 	<p>Yes GO to O2.</p> <p>No REFER to Section 211-05.</p>
O2 DETERMINE IF GEM IS RECEIVING THE CORRECT PARKING BRAKE INPUT	
<ul style="list-style-type: none"> ● Monitor GEM PID PRK_BRK while applying and releasing the parking brake. ● Did the PID read ON with the parking brake applied, and OFF with the parking brake released? 	<p>Yes GO to O3.</p> <p>No GO to O5.</p>
O3 DETERMINE IF BRAKE WARNING INDICATOR CIRCUIT IS OPEN OR GROUNDED	
<ul style="list-style-type: none"> ● Verify that the parking brake is released. ● Is the instrument cluster BRAKE warning indicator off? 	<p>Yes GO to O4.</p>

	<p>No GO to O11.</p>
<p>O4 DETERMINE IF GEM IS SENDING THE CORRECT OUTPUT SIGNAL</p>	
<ul style="list-style-type: none"> ● Trigger the GEM active command BKFLD LOW. ● Did the instrument cluster BRAKE warning indicator illuminate? 	<p>Yes GO to O14.</p> <p>No GO to O9.</p>
<p>O5 CHECK CIRCUIT BETWEEN THE PARKING BRAKE SWITCH AND THE GEM FOR A SHORT TO GROUND</p>	
<ul style="list-style-type: none"> ● Monitor PID PRK_BRK while applying and releasing the parking brake. ● Did the PID read ON with the parking brake applied and with the parking brake released? 	<p>Yes GO to O8.</p> <p>No GO to O6.</p>
<p>O6 CHECK CIRCUIT 128 (VT/YE) AND CIRCUIT 22 (LB/BK) FOR AN OPEN</p>	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Parking Brake Switch C306. ● Disconnect: GEM C201d. ● Measure the resistance between the GEM C201d pin 4, circuit 128 (VT/YE), harness side and the parking brake switch C306 pin 1, circuit 22 (LB/BK), harness side.  <p>A0050136</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes GO to O7.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<p>O7 CHECK CIRCUIT 1205 (BK) FOR OPEN</p>	
<ul style="list-style-type: none"> ● Measure the resistance between the parking brake switch C306 pin 2, circuit 1205 (BK), harness side and ground.  <p>A0049232</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes INSTALL a new parking brake switch. TEST the system for normal operation.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<p>O8 CHECK CIRCUIT 128 (VT/YE) FOR A SHORT TO GROUND</p>	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Parking Brake Switch C306. ● Disconnect: GEM C201d. ● Measure the resistance between the GEM C201d pin 4, circuit 128 (VT/YE), harness side and ground. 	<p>Yes REPAIR or INSTALL a new parking brake switch as needed. TEST the system for normal operation.</p>

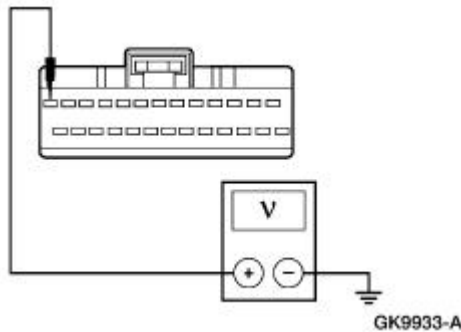


- Is the resistance greater than 10,000 ohms?

No
REPAIR the circuit. TEST the system for normal operation.

O09 CHECK CIRCUIT 128 (VT/YE) FOR SHORT TO BATTERY

- Key in OFF position.
- Disconnect: GEM C201e.
- Disconnect: Instrument Cluster C220b.
- Key in ON position.
- Measure the voltage between the GEM C201e pin 13, circuit 128 (VT/YE), harness side and ground.



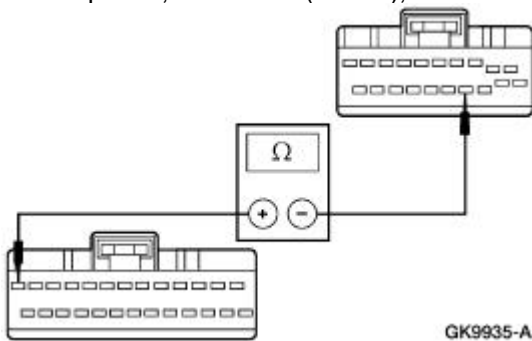
- Is any voltage indicated?

Yes
REPAIR the circuit. TEST the system for normal operation.

No
GO to [O10](#).

O10 CHECK CIRCUIT 128 (VT/YE) FOR AN OPEN

- Key in OFF position.
- Measure the resistance between the GEM C201e pin 13, circuit 128 (VT/YE), harness side and the instrument cluster C220b pin 14, circuit 128 (VT/YE), harness side.



- Is the resistance less than 5 ohms?

Yes
GO to [O15](#).

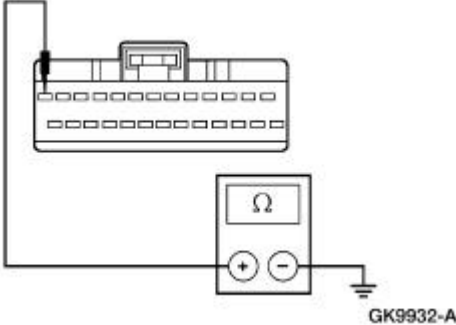
No
REPAIR the circuit. TEST the system for normal operation.

O11 CHECK THE BRAKE FLUID LEVEL SWITCH FOR AN INTERNAL GROUND


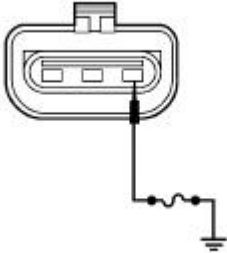
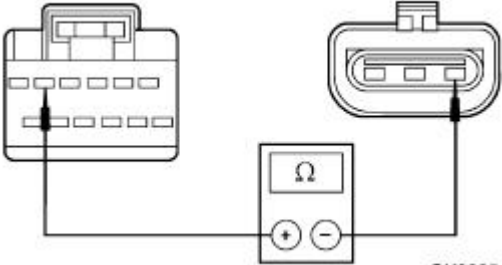
- Key in OFF position.
- Disconnect: Brake Fluid Level Switch C124.
- Key in ON position.
- With the parking brake released, observe the BRAKE warning indicator.
- Is the BRAKE warning indicator always on?

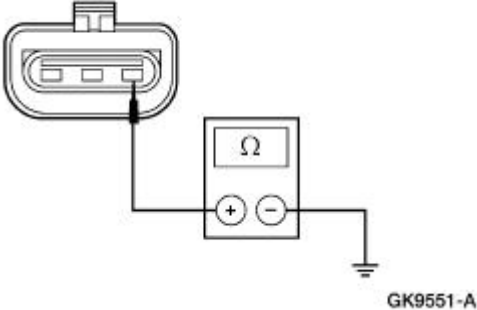
Yes
GO to [O12](#).

No
INSTALL a new brake fluid level switch. TEST the system for normal operation.


O12 DETERMINE IF THE GEM IS INTERNALLY GROUNDED	<p>Yes GO to O13.</p> <p>No GO to O14.</p>
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: GEM C201e. ● Key in ON position. ● Observe the BRAKE warning indicator. ● Is BRAKE warning indicator always on? 	O13 CHECK CIRCUIT 128 (VT/YE) FOR SHORT TO GROUND BETWEEN GEM AND INSTRUMENT CLUSTER <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Instrument Cluster C220b. ● Measure the resistance between the GEM C201e pin 13, circuit 128 (VT/YE), harness side and ground.  <ul style="list-style-type: none"> ● Is resistance greater than 10,000 ohms? <p>Yes GO to O15.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
O14 CHECK FOR CORRECT GEM OPERATION	<p>Yes INSTALL a new GEM. REFER to Section 419-10. TEST the system for normal operation.</p> <p>No The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p>
<ul style="list-style-type: none"> ● Disconnect all GEM connectors. ● Check for: <ul style="list-style-type: none"> ● corrosion ● pushed-out pins ● Connect all GEM connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● Is the concern still present? 	O15 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION <ul style="list-style-type: none"> ● Disconnect all instrument cluster connectors. ● Check for: <ul style="list-style-type: none"> ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● Is the concern still present? <p>Yes INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation.</p> <p>No The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p>

PINPOINT TEST P: THE CHARGING SYSTEM WARNING INDICATOR IS NEVER/ALWAYS ON

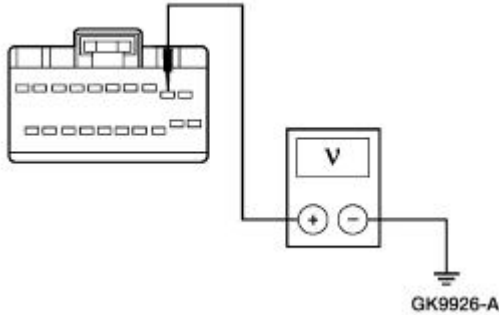
Test Step	Result / Action to Take
P1 CHECK THE CHARGING SYSTEM	
<p> CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.</p> <ul style="list-style-type: none"> ● Check the charging system operation. Refer to Section 414-00. ● Is the charging system operating correctly? 	<p>Yes GO to P2.</p> <p>No REFER to Section 414-00.</p>
P2 CHECK CHARGING SYSTEM WARNING INDICATOR WITH ENGINE OFF	
<ul style="list-style-type: none"> ● Key in ON position. ● Observe the charging system warning indicator. ● Is the charging system warning indicator on? 	<p>Yes GO to P5.</p> <p>No GO to P3.</p>
P3 CHECK THE INSTRUMENT CLUSTER INPUT	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Generator C102c. ● Connect a fused (10A) jumper wire between the generator C102c pin 1, circuit 904 (LG/RD), harness side and ground. <div style="text-align: center;">  <p>GK9549-A</p> </div> <ul style="list-style-type: none"> ● Key in ON position. ● Does the charging system indicator illuminate? 	<p>Yes INSTALL a new generator. REFER to Section 414-02. TEST the system for normal operation.</p> <p>No GO to P4.</p>
P4 CHECK CIRCUIT 904 (LG/RD) FOR OPEN	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Instrument Cluster C220a . ● Measure the resistance between the instrument cluster C220a pin 5, circuit 904 (LG/RD), harness side and the generator C102c pin 1, circuit 904 (LG/RD), harness side. <div style="text-align: center;">  <p>GK9925-A</p> </div> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes GO to P7.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
P5 CHECK THE GENERATOR	

<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Generator C102c. ● Key in ON position. ● Does the charging system indicator illuminate? 	<p>Yes GO to P6.</p> <p>No INSTALL a new generator. REFER to Section 414-02. TEST the system for normal operation.</p>
P6 CHECK CIRCUIT 904 (LG/RD) FOR SHORT TO GROUND	
<ul style="list-style-type: none"> ● Key in OFF position. ● Measure the resistance between the generator C102c pin 1, circuit 904 (LG/RD), harness side and ground.  <ul style="list-style-type: none"> ● Is the resistance greater than 10,000 ohms? 	<p>Yes GO to P7.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
P7 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
<ul style="list-style-type: none"> ● Disconnect all instrument cluster connectors. ● Check for: <ul style="list-style-type: none"> ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● Is the concern still present? 	<p>Yes INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation.</p> <p>No The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p>

PINPOINT TEST Q: THE HIGH BEAM INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
<p>Q1 CHECK THE HIGH BEAM LAMP OPERATION</p> <p> CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.</p> <ul style="list-style-type: none"> ● Key in ON position. ● Operate the high beams. ● Do the high beams operate correctly? 	<p>Yes GO to Q2.</p> <p>No REFER to Section 417-01.</p>
<p>Q2 CHECK CIRCUIT 932 (GY/WH) AND CIRCUIT 12 (LG/BK) FOR AN OPEN</p>	

- Key in OFF position.
- Disconnect: Instrument Cluster C220b.
- Key in ON position.
- Measure the voltage between the instrument cluster C220b pin 2, circuit 12 (LG/BK), harness side and ground, while turning the high beams on and off.



- Is the voltage 0 volts with the high beams off and greater than 10 volts with the high beams on?

Yes
GO to [Q3](#).

No
REPAIR the circuit. TEST the system for normal operation.


Q3 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION

- Disconnect all instrument cluster connectors.
- Check for:
 - corrosion
 - pushed-out pins
- Connect all instrument cluster connectors and make sure they seat correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

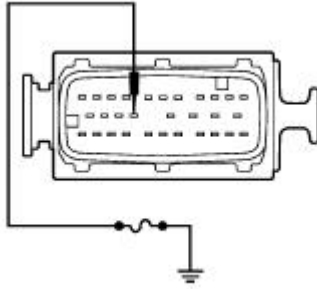
Yes
INSTALL a new instrument cluster. REFER to [Instrument Cluster](#) in this section. TEST the system for normal operation.

No
The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST R: THE ABS WARNING INDICATOR IS NEVER ON

Test Step	Result / Action to Take
R1 CHECK THE ABS WARNING INDICATOR OPERATION  CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector. <ul style="list-style-type: none"> ● Key in ON position. ● Observe the ABS warning indicator. The ABS indicator should prove out for approximately six seconds then turn off. ● Does the ABS warning indicator operate correctly? 	<p>Yes The system is operating normally at this time.</p> <p>No If the indicator is inoperative, GO to R2.</p> <p>If the indicator is always on, REFER to Section 206-09A or Section 206-09B.</p>
R2 CHECK THE INSTRUMENT CLUSTER INPUT <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Anti-Lock Brake Control Module C135. ● Connect a fused (10A) jumper wire between the anti-lock brake control module C135 pin 16, circuit 603 (DG), harness 	<p>Yes REFER to Section 206-09A or Section 206-09B.</p>

side and ground.



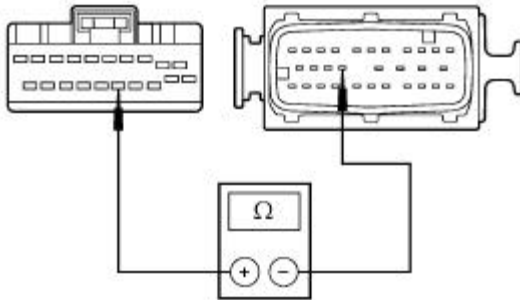
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- Key in ON position.
- Does the ABS indicator illuminate?

No
GO to [R3](#).

R3 CHECK CIRCUIT 603 (DG) FOR AN OPEN

- Key in OFF position.
- Disconnect: Instrument Cluster C220b.
- Measure the resistance between the instrument cluster C220b pin 15, circuit 603 (DG), harness side and the anti-lock brake control module C135 pin 16, circuit 603 (DG), harness side.



GK9973-A

- Is the resistance less than 5 ohms?

Yes
GO to [R4](#).

No
REPAIR the circuit. TEST the system for normal operation.

R4 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION

- Disconnect all instrument cluster connectors.
- Check for:
 - corrosion
 - pushed-out pins
- Connect all instrument cluster connectors and make sure they seat correctly.
- Operate the system and verify the concern is still present.
- Is the concern still present?

Yes
INSTALL a new instrument cluster. REFER to [Instrument Cluster](#) in this section. TEST the system for normal operation.


No
The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

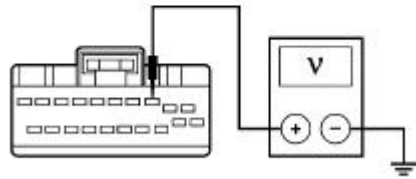
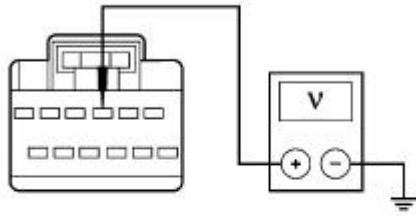
PINPOINT TEST S: THE SERVICE ENGINE SOON INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
S1 CARRY OUT THE INSTRUMENT	

CLUSTER SERVICE ENGINE SOON INDICATOR ACTIVE COMMAND	<p>Yes REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.</p> <p>No GO to S2.</p>
S2 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	<p>Yes INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation.</p> <p>No The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p>
<ul style="list-style-type: none"> ● Connect the diagnostic tool. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. ● Trigger the instrument cluster active command MIL. ● Did the SERVICE ENGINE SOON indicator illuminate? 	
<ul style="list-style-type: none"> ● Disconnect all instrument cluster connectors. ● Check for: <ul style="list-style-type: none"> ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● Is the concern still present? 	

PINPOINT TEST T: THE TURN/HAZARD INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
T1 CHECK THE TURN SIGNAL AND HAZARD LAMPS OPERATION	<p>Yes GO to T2.</p> <p>No REFER to Section 417-01.</p>
<p> CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.</p> <ul style="list-style-type: none"> ● Key in ON position. ● Operate the left and right turn signals. ● Operate the hazard lamps. ● Do the turn signals and hazard lamps operate correctly? 	<p>Yes GO to T3.</p> <p>No REPAIR the circuit (s) in question. TEST the system for normal operation.</p>
T2 CHECK THE CIRCUIT IN QUESTION — CIRCUIT 2 (WH/LB) (RH) OR CIRCUIT 3 (LG/WH) (LH)	<p>Yes GO to T3.</p> <p>No REPAIR the circuit (s) in question. TEST the system for normal operation.</p>
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Instrument Cluster C220a (RH) or C220b (LH). ● Key in ON position. ● Measure the voltage between the instrument cluster C220a pin 3, circuit 3 (LG/WH), harness side and ground, while the steering column multifunction switch is placed in the left turn position (LH); or between the instrument cluster C220b pin 3, circuit 2 (WH/LB), harness side and ground, while the steering column multifunction switch is placed in the right turn position (RH). 	



GK9927-A

- Does the voltage alternate between 0 volts and 10 volts with the turn signal on?

T3 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION

- Disconnect all instrument cluster connectors.
- Check for:
 - corrosion
 - pushed-out pins
- Connect all instrument cluster connectors and make sure they seat correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
 INSTALL a new instrument cluster. REFER to [Instrument Cluster](#) in this section. TEST the system for normal operation.


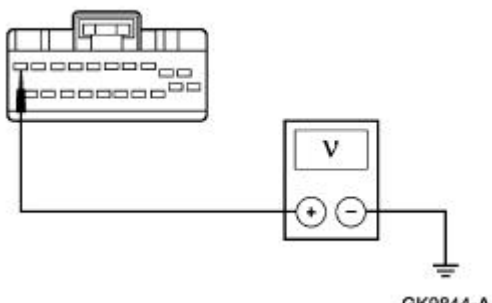
No
 The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

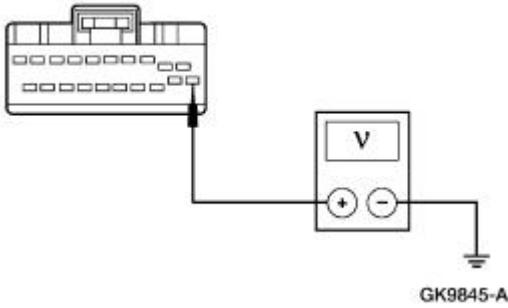
PINPOINT TEST U: THE TRACTION CONTROL INDICATOR IS NEVER/ALWAYS ON

Test Step	Result / Action to Take
U1 DETERMINE IF THE TRACTION CONTROL INDICATOR IS ALWAYS ON	
<ul style="list-style-type: none"> ● Observe the traction control indicator. ● Is the indicator always on? 	<p>Yes REFER to Section 206-09B.</p> <p>No</p>

	GO to U2 .
U2 DETERMINE IF INSTRUMENT CLUSTER IS AT FAULT	
<ul style="list-style-type: none"> ● Connect the diagnostic tool. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster Active Command. ● Trigger the instrument cluster active command TRAC OFF. ● Did the traction control indicator illuminate? 	<p>Yes REFER to Section 206-09B.</p> <p>No GO to U3.</p>
U3 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION	
<ul style="list-style-type: none"> ● Disconnect all instrument cluster connectors. ● Check for: <ul style="list-style-type: none"> ● corrosion ● pushed-out pins ● Connect all instrument cluster connectors and make sure they seat correctly. ● Operate the system and verify the concern is still present. ● Is the concern still present? 	<p>Yes INSTALL a new instrument cluster. REFER to Instrument Cluster in this section. TEST the system for normal operation.</p> <p>No The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p>

PINPOINT TEST V: THE INSTRUMENT CLUSTER IS INOPERATIVE

Test Step	Result / Action to Take
V1 CHECK THE BATTERY POWER SUPPLY TO THE INSTRUMENT CLUSTER	
<p> CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Instrument Cluster C220b. ● Measure voltage between the instrument cluster C220b pin 10, circuit 729 (RD/WH), harness side and ground.  <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to V2.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
V2 CHECK THE RUN POWER SUPPLY TO THE INSTRUMENT CLUSTER	
<ul style="list-style-type: none"> ● Key in ON position. ● Measure the voltage between the instrument cluster C220b pin 11, circuit 489 (PK/BK), harness side and ground. 	<p>Yes GO to V3.</p>

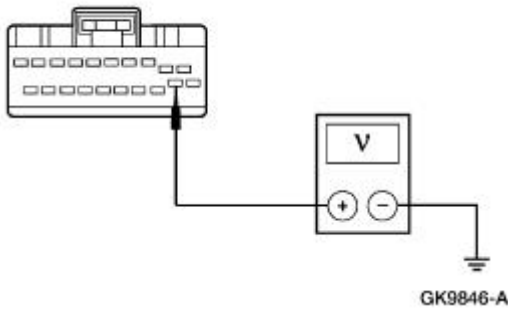


- Is the voltage greater than 10 volts?

No
REPAIR the circuit. TEST the system for normal operation.

V3 CHECK RUN/START POWER SUPPLY TO THE INSTRUMENT CLUSTER

- Key in OFF position.
- Disconnect: Instrument Cluster C220b.
- Key in ON position.
- Measure the voltage between the instrument cluster C220b pin 12, circuit 20 (WH/LB), harness side and ground.



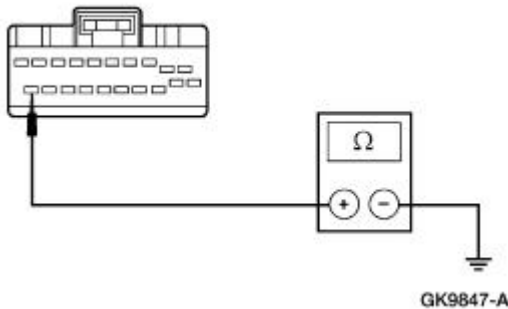
- Is the voltage greater than 10 volts?

Yes
GO to [V4](#).

No
REPAIR the circuit. TEST the system for normal operation.

V4 CHECK GROUND CIRCUIT 397 (BK/WH) FOR AN OPEN

- Key in OFF position.
- Measure the resistance between the instrument cluster C220b pin 20, circuit 397 (BK/WH), harness side and ground.



- Is the resistance less than 5 ohms?

Yes
GO to [V5](#).

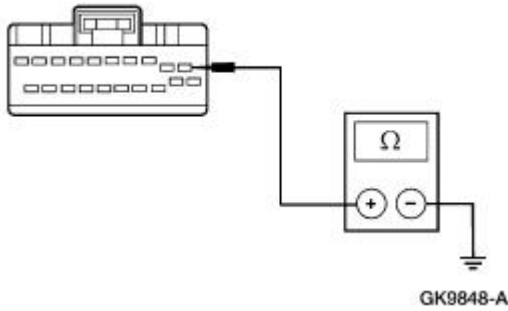
No
REPAIR the circuit. TEST the system for normal operation.

V5 CHECK GROUND CIRCUIT 1205 (BK) FOR OPEN

- Measure the resistance between the instrument cluster C220b pin 1, circuit 1205 (BK), harness side and ground.

Yes
GO to [V6](#).

No
REPAIR the circuit. TEST the system for normal operation.



- Is the resistance less than 5 ohms?

V6 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION

- Disconnect all instrument cluster connectors.
- Check for:
 - corrosion
 - pushed-out pins
- Connect all instrument cluster connectors and make sure they seat correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**


Yes

INSTALL a new instrument cluster. REFER to [Instrument Cluster](#) in this section. TEST the system for normal operation.

No

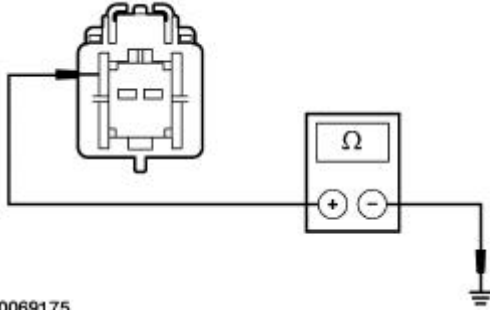
The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST W: NO COMMUNICATION WITH THE GENERIC ELECTRONIC MODULE (GEM)

Test Step	Result / Action to Take															
<p> CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.</p>																
<p>W1 CHECK THE GENERIC ELECTRONIC MODULE (GEM) POWER SUPPLY</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Generic Electronic Module (GEM) C201a. ● Disconnect: GEM C201b. ● Key in ON position. ● Using the following table, measure the voltage between the GEM, harness side and ground. <table border="1"> <thead> <tr> <th>Connector</th> <th>Pin</th> <th>Circuit</th> </tr> </thead> <tbody> <tr> <td>C201a</td> <td>4</td> <td>400 (LB/BKK)</td> </tr> <tr> <td>C201a</td> <td>1</td> <td>1006 (DG/WH)</td> </tr> <tr> <td>C201b</td> <td>2</td> <td>1001 (WH/YE)</td> </tr> <tr> <td>C201b</td> <td>3</td> <td>193 (YE/LG)</td> </tr> </tbody> </table> <ul style="list-style-type: none"> ● Are the voltages greater than 10 volts? 	Connector	Pin	Circuit	C201a	4	400 (LB/BKK)	C201a	1	1006 (DG/WH)	C201b	2	1001 (WH/YE)	C201b	3	193 (YE/LG)	<p>Yes GO to W2.</p> <p>No REPAIR the circuit(s) in question. TEST the system for normal operation.</p>
Connector	Pin	Circuit														
C201a	4	400 (LB/BKK)														
C201a	1	1006 (DG/WH)														
C201b	2	1001 (WH/YE)														
C201b	3	193 (YE/LG)														
<p>W2 CHECK THE GEM GROUND CIRCUIT 397 (BK/WH) FOR</p>																

OPEN

- Key in OFF position.
- Measure the resistance between the GEM C201b pin 4, circuit 397 (BK/WH), harness side and ground.



A0069175

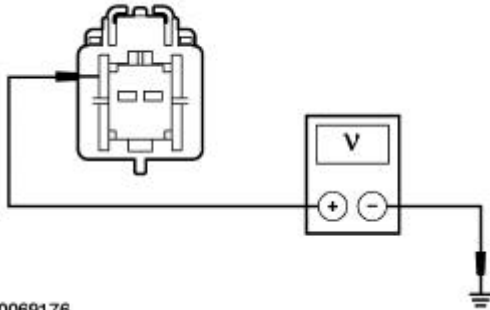
- Is the resistance less than 5 ohms?

Yes
GO to [W3](#).

No
REPAIR the circuit(s) in question. TEST the system for normal operation.

W3 CHECK CIRCUIT 397 (BK/WH) FOR SHORT TO POWER

- Measure the voltage between the GEM C201b pin 4, circuit 397 (BK/WH), harness side and ground.



A0069176

- Is any voltage present?


Yes
REPAIR the circuit. TEST the system for normal operation.

No
REFER to [Section 418-00](#).

Instrument Cluster

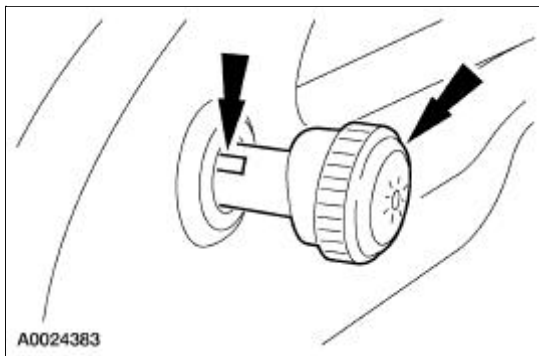
Removal and Installation

All vehicles

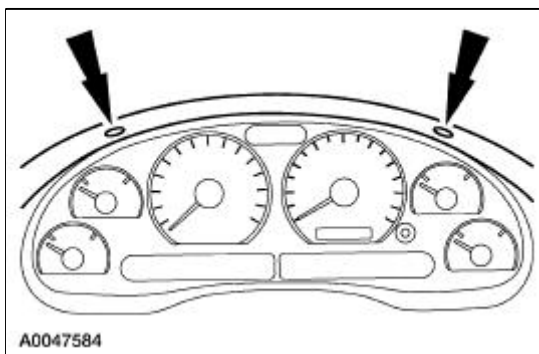
1.  **CAUTION: Electronic modules are sensitive to electrical charges. If exposed to these charges, damage may result.**

Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).

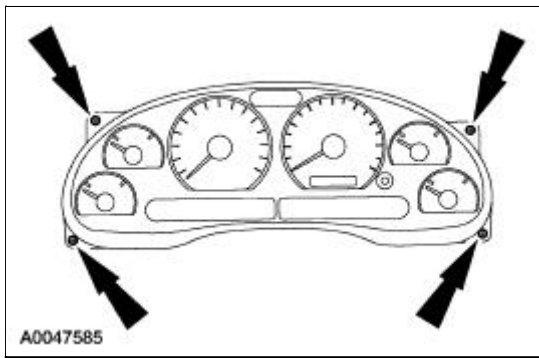
2. Remove the headlamp switch knob.
 - Pull out the headlamp switch knob and insert a thin tool in the slot to release the knob from the shaft.



3. Remove the screws and remove the instrument cluster finish panel.

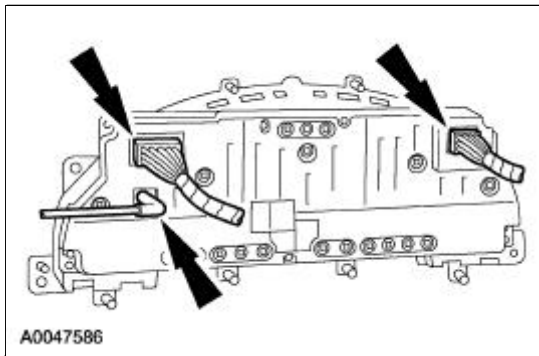


4. Remove the screws and pull the instrument cluster forward to expose the electrical connector.



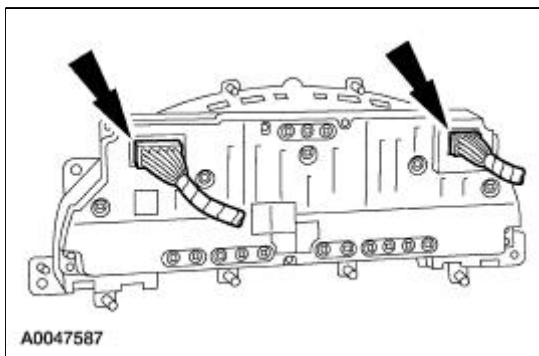
Cobra only

5. Disconnect the electrical connectors and boost pressure line and remove the instrument cluster.



Except Cobra

6. Disconnect the electrical connectors and remove the instrument cluster.



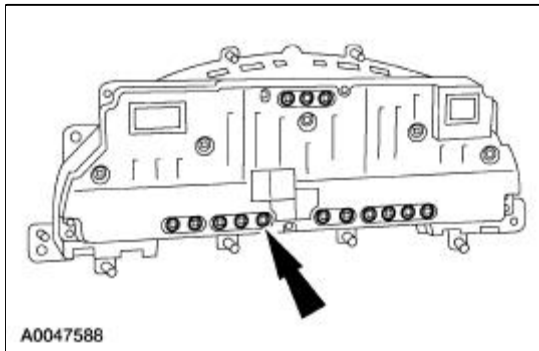
All vehicles

7. To install, reverse the removal procedure.
-

Warning Indicator Bulb

Removal and Installation

1. Remove the instrument cluster. Refer to [Instrument Cluster](#) in this section.
2. Remove the necessary instrument cluster bulbs by rotating one quarter turn counterclockwise.

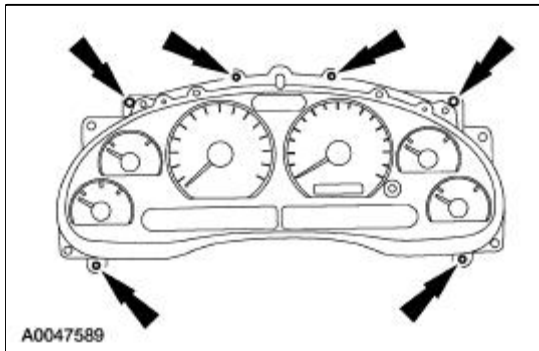


3. To install, reverse the removal procedure.
-

Instrument Cluster Lens

Removal and Installation

1. Remove the instrument cluster. Refer to [Instrument Cluster](#) in this section.
2. Remove the screws and remove the instrument cluster lens.



3. To install, reverse the removal procedure.
-

Torque Specifications

Description	Nm	lb-ft	lb-in
Horn retaining screw	10	—	89
Horn switch retaining bolts	5	—	40
Driver side air bag module retaining screws	12	9	—

Horn


The horn system consists of the following:

- dual horns (one high-pitched, one low-pitched)
 - horn switch (located underneath the driver side air bag module [043B13]).
 - horn relay (located in the central junction box [CJB]).
-

Horn

Refer to Wiring Diagrams Cell [44](#), Horns/Cigar Lighter for schematic and connector information.

Special Tool(s)

 ST1137-A	73 Digital Multimeter or equivalent 105-R0051
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Inspection and Verification

1. Verify the customer concern by operating the horn (13832).
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> ● Damaged horns ● Damaged horn switch ● Damaged air bag sliding contact (14A664) 	<ul style="list-style-type: none"> ● Blown battery junction box (BJB) Fuse Horn Relay (20A) ● Damaged wiring harness ● Damaged connections ● Damaged horn relay ● Damaged horn switch

3. If fault is not visually evident, determine the symptom and proceed to Symptom Chart.

Symptom Chart

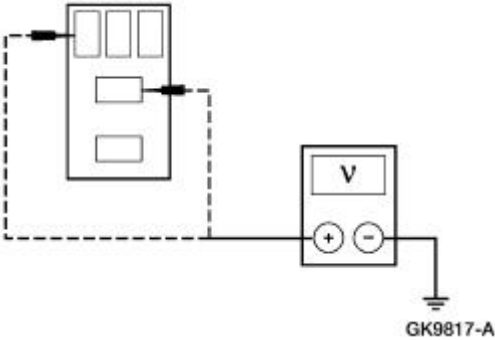
Symptom Chart

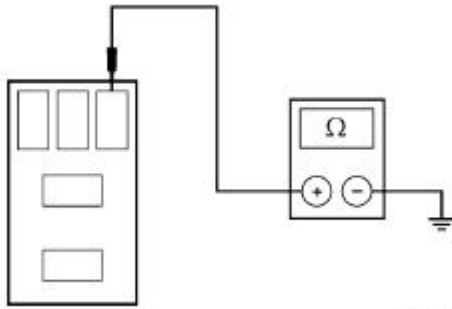
Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● The horn does not sound 	<ul style="list-style-type: none"> ● BJB Fuse Horn Relay (20A). ● Circuitry. ● Horn relay. ● Air bag sliding contact. ● Horn switch. ● Horns. 	<ul style="list-style-type: none"> ● GO to Pinpoint Test A.
<ul style="list-style-type: none"> ● The horn sounds continuously 	<ul style="list-style-type: none"> ● Circuitry. ● Horn relay. ● Remote entry system (generic electronic module [GEM]) 	<ul style="list-style-type: none"> ● GO to Pinpoint Test B.

	module. ● Horn switch.	
--	---------------------------	--

Pinpoint Tests

PINPOINT TEST A: THE HORN DOES NOT SOUND

Test Step	Result / Action to Take						
<p>A1 CHECK POWER SUPPLY TO HORN RELAY</p> <ul style="list-style-type: none"> ● Disconnect: Horn Relay. ● Measure the voltage between the horn relay connector Pin 2, Circuit 460 (YE/LB), harness side and ground; and between the horn relay connector Pin 5, Circuit 460 (YE/LB), harness side and ground.  <ul style="list-style-type: none"> ● Are the voltages greater than 10 volts? 	<p>Yes GO to A2.</p> <p>No REPAIR the circuit in question. TEST the system for normal operation.</p>						
<p>A2 CHECK HORN RELAY</p> <ul style="list-style-type: none"> ● Check the horn relay; refer to Wiring Diagrams Cell 149. ● Is the horn relay OK? 	<p>Yes GO to A3.</p> <p>No INSTALL a new horn relay. TEST the system for normal operation.</p>						
<p>A3 CHECK HORN SWITCH SIGNAL TO HORN RELAY</p> <ul style="list-style-type: none"> ● Measure the resistance between horn relay connector Pin 1, Circuit 6 (YE/LG), harness side and ground under the following conditions: <p>Horn Switch Position</p> <table border="1" style="width: 100%;"> <thead> <tr> <th>Horn Switch Position</th> <th>Resistance</th> </tr> </thead> <tbody> <tr> <td>Pressed</td> <td>Less than 5 ohms</td> </tr> <tr> <td>Released</td> <td>Greater than 10,000 ohms</td> </tr> </tbody> </table>	Horn Switch Position	Resistance	Pressed	Less than 5 ohms	Released	Greater than 10,000 ohms	<p>Yes GO to A4.</p> <p>No GO to A5.</p>
Horn Switch Position	Resistance						
Pressed	Less than 5 ohms						
Released	Greater than 10,000 ohms						

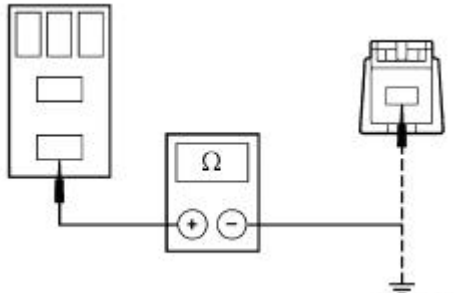


GK6602-A

- Are the resistances correct?

A4 CHECK WIRE BETWEEN HORN RELAY AND HORN

- Key in OFF position.
- Disconnect: Horn C1262.
- Disconnect: Horn C1261.
- Measure the resistance between the horn relay connector Pin 3, Circuit 1 (DB), harness side and horn C1261 or horn C1256 harness side; and between the horn relay connector Pin 3, Circuit 1 (DB), harness side and ground.



GK9818-A

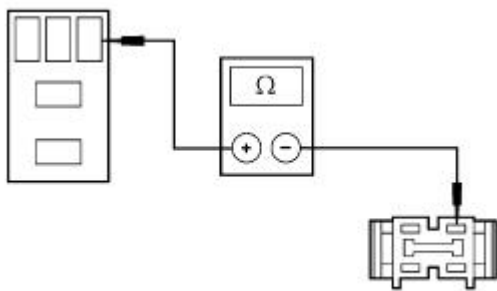
- Is the resistance less than 5 ohms between the horn relay and the horns, and greater than 10,000 ohms between the horn relay and ground?

Yes
INSTALL new horns.
TEST the system for normal operation.

No
REPAIR the circuit.
TEST the system for normal operation.

A5 CHECK WIRE BETWEEN HORN RELAY AND AIR BAG SLIDING CONTACT

- Key in OFF position.
- Deactivate the air bag system; refer to [Section 501-20B](#).
- Disconnect: Air Bag Sliding Contact C218a.
- Measure the resistance between air bag sliding contact C218a Pin 2, Circuit 6 (YE/LG), harness side and horn relay connector Pin 1, Circuit 6 (YE/LG) harness side.



GK9819-A

- Is the resistance less than 5 ohms?

Yes
GO to [A6](#).

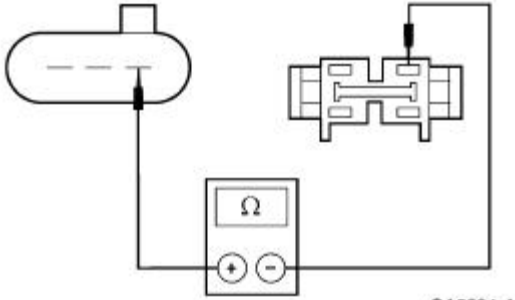
No
REPAIR the circuit.
TEST the system for normal operation.

A6 CHECK AIR BAG SLIDING CONTACT

- Disconnect the steering wheel switch harness from the air bag sliding contact.
- Measure the resistance between upper air bag sliding contact

Yes
GO to [A7](#).

connector Pin 3, Circuit 6 (component side), and air bag sliding contact C218a Pin 2, Circuit 6 (component side).



- Is the resistance less than 5 ohms?

No
 INSTALL a new air bag sliding contact. REFER to [Section 501-20B](#). TEST the system for normal operation.

A7 CHECK THE STEERING WHEEL SWITCH HARNESS

- Inspect the steering wheel switch harness for chafing, opens or possible short to ground.
- Is the steering wheel switch harness OK?

Yes
 INSTALL a new horn switch. REFER to [Switch—Horn](#). TEST the system for normal operation.

No
 INSTALL a new steering wheel switch harness. TEST the system for normal operation.

PINPOINT TEST B: THE HORN SOUNDS CONTINUOUSLY

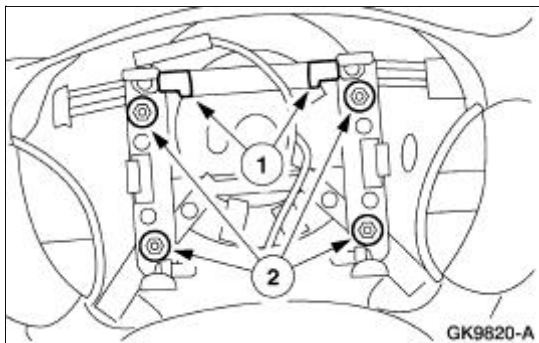
Test Step	Result / Action to Take
B1 CHECK HORN CIRCUIT 1 (DB)	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Horn Relay. ● Does the horn continue to sound? 	<p>Yes REPAIR Circuit 1 (DB) for short to battery. TEST the system for normal operation.</p> <p>No GO to B2.</p>
B2 CHECK HORN RELAY	
<ul style="list-style-type: none"> ● Check the horn relay; refer to Wiring Diagrams Cell 149. ● Is the horn relay OK? 	<p>Yes REINSTALL the horn relay. GO to B3.</p> <p>No INSTALL a new horn relay. TEST the system for normal operation.</p>
B3 CHECK CIRCUIT 6 (YE/LG)	
<ul style="list-style-type: none"> ● Disconnect: Air Bag Sliding Contact C218a . ● Does the horn continue to sound? 	<p>Yes GO to B4.</p> <p>No RECONNECT the air bag sliding contact. GO to B5.</p>
B4 CHECK GEM INPUT	
<ul style="list-style-type: none"> ● Disconnect: GEM C201e. 	<p>Yes</p>

<ul style="list-style-type: none"> ● Does the horn continue to sound? 	REPAIR Circuit 6 (YE/LG). TEST the system for normal operation. No INSTALL a new GEM; REFER to Section 419-10 . TEST the system for normal operation.
B5 CHECK THE AIR BAG SLIDING CONTACT	
<ul style="list-style-type: none"> ● Deactivate the air bag system. Refer to Section 501-20B. ● Disconnect the steering wheel switch harness from the air bag sliding contact. ● Does the horn continue to sound? 	Yes INSTALL a new air bag sliding contact. REFER to Section 501-20B . TEST the system for normal operation. No GO to B6 .
B6 CHECK STEERING WHEEL SWITCH HARNESS	
<ul style="list-style-type: none"> ● Inspect the steering wheel switch harness for shorts, opens, or any damage. ● Is the steering wheel switch harness OK? 	Yes INSTALL a new horn switch. REFER to Switch—Horn . TEST the system for normal operation. No INSTALL a new steering wheel switch harness. TEST the system for normal operation.

Switch —Horn

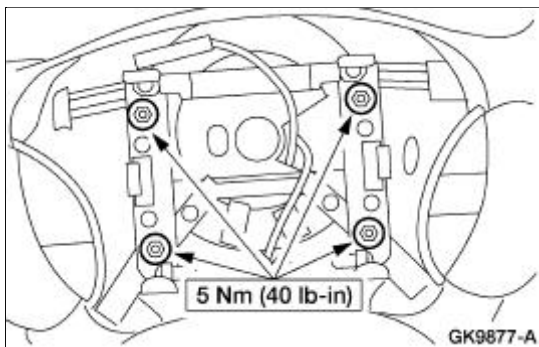
Removal

1. Remove the driver side air bag module (043B13). Refer to [Section 501-20B](#).
2. Remove the switches.
 1. Disconnect the horn wire from the switches.
 2. Remove the horn switch screws and remove the switches.



Installation

1. To install, reverse the removal procedure.
 - Prove out the air bag system. Refer to [Section 501-20B](#).



Warning Devices

The warning device system consists of the following components:

- door ajar switches
 - generic electronic module (GEM)
 - key-in-ignition warning switch
 - safety belt switch
 - parklamp switch
-



Gauges And Warning Devices

Refer to Wiring Diagrams Cell [59](#), Generic Electronic Module for schematic and connector information.

Refer to Wiring Diagrams Cell [60](#), Instrument Cluster for schematic and connector information.

Refer to Wiring Diagrams Cell [66](#), Warning Chime for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F048, or equivalent diagnostic tool

Principles of Operation

Key-In-Ignition Warning Chime

The key-in-ignition warning chime activates when the generic electronic module (GEM) detects the ignition switch circuits are in the OFF or ACC states and when the GEM detects the driver door is ajar from the driver door ajar circuits. Refer to the Chime Duration Table in this section for audible output, duration time, and priority ratings.

Airbag Warning Chime

The airbag warning chime activates when the GEM detects the ignition switch circuits are in the RUN state and when the GEM detects a chime is requested from the airbag system circuit. Refer to the Chime Duration Table for audible output, duration time, and priority ratings.

Door Ajar Warning Chime

The door ajar warning chime activates when the GEM detects the ignition switch circuits are in the RUN state and when the GEM detects the driver or passenger door is ajar from the driver and passenger door ajar circuits. Refer to the Chime Duration Table in this section for audible output, duration time, and priority ratings.

Headlamps Left on Warning Chime

The headlamps left on warning chime activates when the GEM detects the ignition switch circuits are in the KEYOUT state, when the GEM detects the driver door is ajar from the driver door ajar circuit,

and when the GEM detects the headlamps or parklamps are on from the exterior lamp circuits. Refer to the Chime Duration Table in this section for audible output, duration time, and priority ratings.

Safety Belt Warning Chime

The safety belt warning chime and safety belt warning lamp activate when the GEM detects the ignition switch circuits are in the RUN or START state and when the GEM detects the safety belt is unbuckled from the safety belt circuit. The safety belt warning lamp indicator will prove out for three seconds whenever the GEM detects that the ignition circuits make a transition to RUN from OFF, ACC, or KEYOUT state. Refer to the Chime Duration Table in this section for audible output, duration time, and priority ratings.

Belt Minder

NOTE: Belt minder is a configurable item. If configuring using a diagnostic tool, refer to [Section 418-01](#). To configure without using a diagnostic tool, refer to [Belt Minder Deactivating/Activating](#) in this section.

The belt minder feature supplements the current safety belt warning function. The belt minder feature is enabled after the current safety belt warning is complete. If the driver safety belt is not buckled approximately five seconds after the safety belt warning light has turned off, the belt minder reminds the driver that their safety belt is unbuckled by intermittently sound a chime and illuminating the safety belt warning lamp in the instrument cluster. While activated, the belt minder alternates the chime and indicator from on for six seconds to off for 30 seconds.

The belt minder reminder stops when:

- the drive seat belt is buckled.
- the ignition is turned to OFF or ACC.
- five minutes have elapsed since belt minder has started.

Chime Duration Table

Feature	Audible Output	Duration	Priority
Safety belt	Chime, 60/minute 740 Hz	6.0 seconds	1
Key-in-ignition	Chime, 120/minute 740 Hz	Continuous	2
Headlamps left on	Chime, 240/minute 740 Hz	Continuous	3
Airbag	Single tone, 1,000 Hz	Continuous	4
Door ajar	Single tone, 1,000 Hz	1.0 second	7

Inspection and Verification

NOTE: Upon installation of a new GEM, the module must be reconfigured. For additional information, refer to [Section 418-01](#).

1. The warning lamps are a GEM controlled system; refer to [Section 419-10](#).
2. Verify the customer concern by operating the system in question.
3. Visually inspect for the following obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> ● Switch(es) 	<ul style="list-style-type: none"> ● Central junction box (CJB) fuses: <ul style="list-style-type: none"> ■ 28 (15A) ■ 32 (15A) ■ 39 (5A) ● Circuitry

4. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
 - check that the program card is correctly installed.
 - check the connections to the vehicle.
 - check the ignition switch position.
5. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.
6. Carry out the Data Link Diagnostic Test. If the diagnostic tool responds with:
 - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to [Section 418-00](#).
 - NO RESP/NOT EQUIP for GEM, go to Pinpoint Test A.
 - NO RESP/NOT EQUIP for RCM, refer to [Section 501-20B](#).
 - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the GEM.
7. If the DTCs retrieved are related to the concern, go to the GEM Diagnostic Trouble Code (DTC) Index to continue diagnostics.
8. If no DTCs related to the concern are retrieved, proceed to the Symptom Chart to continue diagnostics.
9. If the DTCs retrieved are for the RCM, refer to [Section 501-20B](#).

GEM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1340	Chime Input Request Circuit Short to Ground	GEM	Go To Pinpoint Test C .
B1342	ECU Is Defective	GEM	CLEAR the DTCs. TEST the system for normal operation. RETRIEVE the DTCs. If DTC B1342 is retrieved, INSTALL a new GEM. REFER to Section 419-10 .
B1353	Ignition Key-In Circuit Open	GEM	Go To Pinpoint Test B .
B1462	Safety Belt Switch Circuit Failure	GEM	Go To Pinpoint Test F .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none"> No communication with the generic electronic module (GEM) 	<ul style="list-style-type: none"> Central junction box (CJB) fuses: <ul style="list-style-type: none"> 39 (5A). 32 (15A). Circuitry. Generic electronic module (GEM). 	<ul style="list-style-type: none"> Go To Pinpoint Test A.
<ul style="list-style-type: none"> The key-in-ignition chime does not operate correctly 	<ul style="list-style-type: none"> Central junction box (CJB) fuses: <ul style="list-style-type: none"> 28 (15A). 32 (15A). Central junction box (CJB). Driver door ajar switch. Key-in ignition switch. Circuitry. Generic electronic module (GEM). Ignition switch. 	<ul style="list-style-type: none"> Go To Pinpoint Test B.
<ul style="list-style-type: none"> A chime does not operate correctly—air bag 	<ul style="list-style-type: none"> Restraint control module (RCM). Circuitry. Generic electronic module (GEM). Ignition switch. 	<ul style="list-style-type: none"> Go To Pinpoint Test C.
<ul style="list-style-type: none"> The door ajar chime does not operate correctly 	<ul style="list-style-type: none"> Driver door ajar switch. Passenger door ajar switch. Circuitry. Generic electronic module (GEM). Ignition switch. 	<ul style="list-style-type: none"> Go To Pinpoint Test D.
<ul style="list-style-type: none"> The headlamp on reminder chime does not operate correctly 	<ul style="list-style-type: none"> Headlamp switch . Circuitry. Generic electronic module (GEM). Driver door ajar switch. Ignition switch. 	<ul style="list-style-type: none"> Go To Pinpoint Test E.
<ul style="list-style-type: none"> The safety belt warning chime does not operate correctly 	<ul style="list-style-type: none"> Circuitry. Safety belt switch. Generic electronic module (GEM). Ignition switch. 	<ul style="list-style-type: none"> Go To Pinpoint Test F.
<ul style="list-style-type: none"> The belt minder feature does not operate correctly 	<ul style="list-style-type: none"> Circuitry. Safety belt switch. Generic electronic module (GEM). Ignition switch. 	<ul style="list-style-type: none"> Go To Pinpoint Test F.

Pinpoint Tests



CAUTION: Before removing and installing the generic electronic module (GEM) or its connectors, disconnect the battery. Failure to follow this caution will result in the GEM storing many erroneous DTCs, and it may exhibit erratic operation after installation.



CAUTION: Be careful when probing the central junction box (CJB), or any connectors. Damage will result to the connector receptacle if the probe or terminal used is too large.



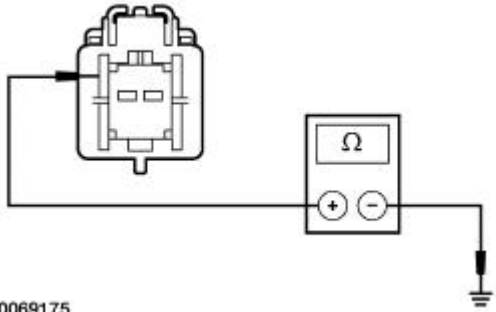
CAUTION: Electronic modules are sensitive to static discharges. If exposed to these charges, damage may result.

NOTE: If continuous DTCs are recorded and the symptom is not present when carrying out the pinpoint tests, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

Complete the entire pinpoint test related to the symptom before installing a new GEM.

PINPOINT TEST A: NO COMMUNICATION WITH THE GENERIC ELECTRONIC MODULE (GEM)

Test Step	Result / Action to Take															
<p>A1 CHECK THE GENERIC ELECTRONIC MODULE (GEM) POWER SUPPLY</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Generic Electronic Module (GEM) C201a. ● Disconnect: GEM C201b. ● Key in ON position. ● Using the following table, measure the voltage between the GEM, harness side and ground. <table border="1"> <thead> <tr> <th>Connector</th> <th>Pin</th> <th>Circuit</th> </tr> </thead> <tbody> <tr> <td>C201a</td> <td>4</td> <td>400 (LB/BK)</td> </tr> <tr> <td>C201a</td> <td>1</td> <td>1006 (DG/WH)</td> </tr> <tr> <td>C201b</td> <td>2</td> <td>1001 (WH/YE)</td> </tr> <tr> <td>C201b</td> <td>3</td> <td>193 (YE/LG)</td> </tr> </tbody> </table> <ul style="list-style-type: none"> ● Are the voltages greater than 10 volts? 	Connector	Pin	Circuit	C201a	4	400 (LB/BK)	C201a	1	1006 (DG/WH)	C201b	2	1001 (WH/YE)	C201b	3	193 (YE/LG)	<p>Yes GO to A2.</p> <p>No REPAIR the circuit(s) in question. TEST the system for normal operation.</p>
Connector	Pin	Circuit														
C201a	4	400 (LB/BK)														
C201a	1	1006 (DG/WH)														
C201b	2	1001 (WH/YE)														
C201b	3	193 (YE/LG)														
<p>A2 CHECK THE GEM GROUND CIRCUIT 397 (BK/WH) FOR OPEN</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Measure the resistance between the GEM C201b pin 4, circuit 397 (BK/WH), harness side and ground. 	<p>Yes GO to A3.</p> <p>No REPAIR the circuit(s) in question. TEST the system for normal operation.</p>															

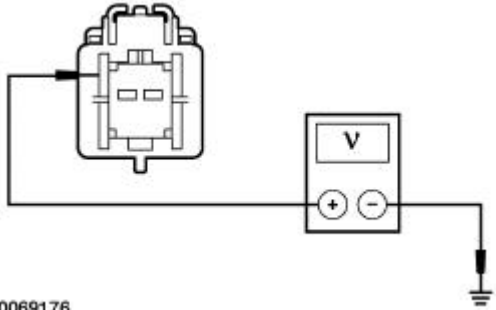


A0069175

- Is the resistance less than 5 ohms?

A3 CHECK CIRCUIT 397 (BK/WH) FOR SHORT TO POWER

- Measure the voltage between the GEM C201b pin 4, circuit 397 (BK/WH), harness side and ground.



A0069176

- Is any voltage present?

Yes
REPAIR the circuit. TEST the system for normal operation.

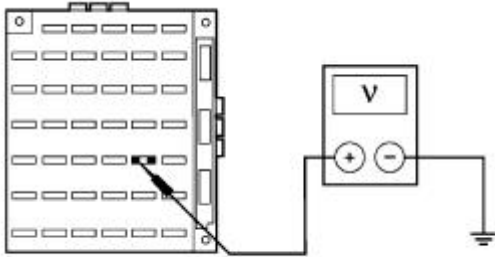
No
REFER to [Section 418-00](#).

PINPOINT TEST B: THE KEY-IN-IGNITION CHIME DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
B1 CHECK IGNITION STATES	
<ul style="list-style-type: none"> ● Connect the diagnostic tool. ● Enter the following diagnostic mode on the diagnostic tool: GEM PID. ● Monitor the GEM PIDS IGN_KEY, IGN_A, IGN_S, and IGN_R while cycling the ignition switch through the OFF, ACC, RUN, START and key out positions. ● Do the PID values agree with the ignition switch states? 	<p>Yes GO to B2.</p> <p>No GO to B4.</p>
B2 CHECK GEM INTERNAL TONE OPERATION	
<ul style="list-style-type: none"> ● Enter the following diagnostic mode on the diagnostic tool: GEM Active Command. ● Trigger the GEM Active Command CHIME ON and OFF. ● Does the chime operate correctly? 	<p>Yes GO to B3.</p> <p>No GO to B11.</p>
B3 CHECK GEM INPUT FROM DOOR AJAR CIRCUIT	
<ul style="list-style-type: none"> ● Enter the following diagnostic mode on the diagnostic tool: GEM PID. ● Monitor the GEM PID D_DR_SW, while opening and closing the driver door. ● Do the GEM PID D_DR_SW values indicate CLOSED and AJAR correctly? 	<p>Yes GO to B11.</p> <p>No Go To Pinpoint Test D.</p>
B4 CHECK GEM INPUT VOLTAGE FROM IGNITION SWITCH AT	

CJB FUSE 28 (15A)

- Disconnect: CJB Fuse 28 (15A).
- Measure the voltage between CJB fuse 28 (15A), pin 1, harness side and ground while cycling the ignition switch through all positions.



GK9855-A

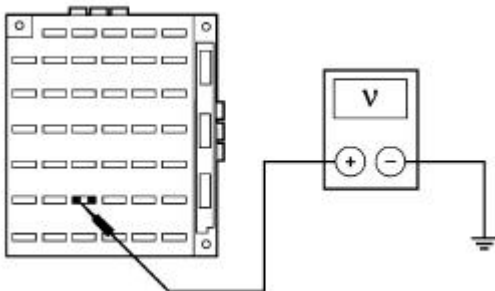
- Is the voltage greater than 10 volts in the RUN and START positions only?

Yes
GO to [B5](#).

No
REPAIR the CJB.
REPEAT the self-test.
CLEAR the DTCs.

B5 CHECK GEM INPUT VOLTAGE FROM IGNITION SWITCH AT CJB FUSE 32 (15A)

- Disconnect: CJB Fuse 32 (15A).
- Measure the voltage between CJB fuse 32 (15A), pin 1, harness side and ground while cycling the ignition switch through all positions.



GK9856-A

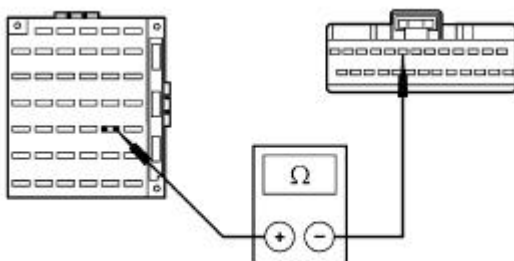
- Is the voltage greater than 10 volts in the RUN and ACC positions only?

Yes
GO to [B6](#).

No
REPAIR the CJB.
REPEAT the self-test.
CLEAR the DTCs.

B6 CHECK GEM VOLTAGE INPUT CIRCUITS FOR OPEN — IGNITION SWITCH CIRCUIT 911 (WH/LG)

- Disconnect: CJB Fuse 28 (15A).
- Disconnect: GEM C201e.
- Insert the ignition key. Measure the resistance between GEM C201e pin 8, circuit 911 (WH/LG), harness side and CJB Fuse 28 (15A) pin 2, circuit 911 (WH/LG), harness side.



GK9857-A

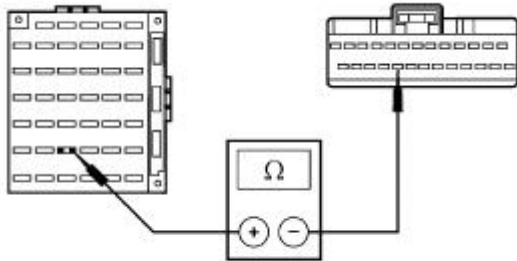
- Is the resistance less than 5 ohms?

Yes
GO to [B7](#).

No
REPAIR the circuit.
REPEAT the self-test.
CLEAR the DTCs.

B7 CHECK GEM VOLTAGE INPUT CIRCUITS FOR OPEN — IGNITION SWITCH CIRCUIT 1002 (BK/PK)

- Measure the resistance between GEM C201e pin 22, circuit 1002 (BK/PK), harness side and CJB Fuse 32 (15A), pin 2, circuit 1002 (BK/PK), harness side.



GK9858-A

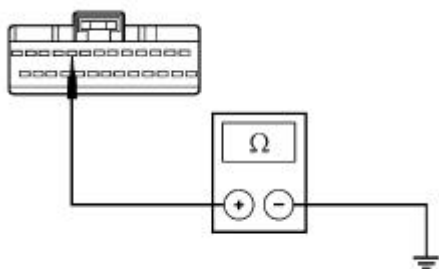
- Is the resistance less than 5 ohms?

Yes
GO to [B8](#).

No
REPAIR the circuit.
REPEAT the self-test.
CLEAR the DTCs.

B8 CHECK GEM INPUT CIRCUIT FOR OPEN — KEY-IN-IGNITION SWITCH CIRCUIT 158 (BK/PK)

- Measure the resistance between GEM C201e pin 9, circuit 158 (BK/PK), harness side and ground.



GK9859-A

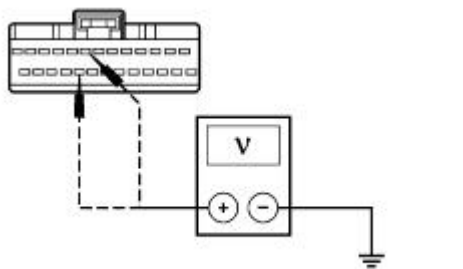
- Is the resistance less than 5 ohms?

Yes
GO to [B9](#).

No
REPAIR circuit 158 (BK/PK) and key-in-ignition switch for failure. REFER to [Switch—Key-In-Ignition Warning](#). REPEAT the self-test. CLEAR the DTCs.

B9 CHECK GEM VOLTAGE INPUT CIRCUITS FOR SHORT TO POWER — IGNITION SWITCH CIRCUITS 911 (WH/LG), AND 1002 (BK/PK)

- Key in OFF position.
- Disconnect: CJB Fuse 28 (15A).
- Disconnect: CJB Fuse 32 (15A).
- Disconnect: GEM C201e.
- Remove the ignition key. Measure the voltage between GEM C201e pin 8, circuit 911 (WH/LG), harness side and ground, and between GEM C201e pin 22, circuit 1002 (BK/PK), harness side and ground.



GA5925-A

- Are the voltages greater than 10 volts?

Yes
REPAIR the circuit in question. REPEAT the self-test. CLEAR the DTCs.

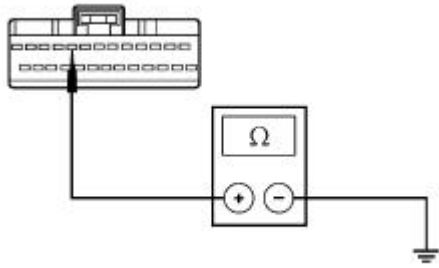
No
GO to [B10](#).

B10 CHECK GEM INPUT CIRCUIT FOR SHORT TO GROUND — KEY-IN-IGNITION SWITCH CIRCUIT 158 (BK/PK)

- Disconnect: GEM C201e.
- Remove the ignition key. Measure the resistance between GEM C201e pin 9, circuit 158 (BK/PK), harness side and

Yes
GO to [B11](#).

ground.



GK9859-A

- Is the resistance greater than 10,000 ohms?

No
REPAIR the circuit.
REPEAT the self-test.
CLEAR the DTCs.

B11 CHECK FOR CORRECT MODULE OPERATION

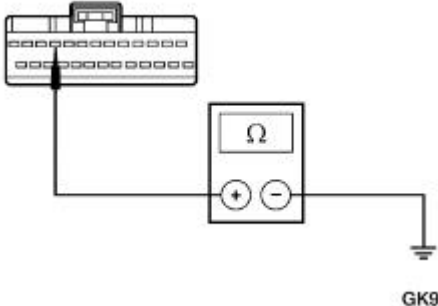
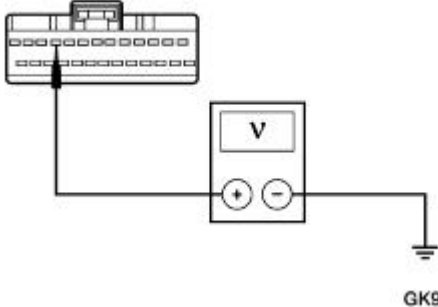
- Check:
 - for corrosion
 - for pushed-out pins
 - connector seated correctly
- Connect any disconnected connectors.
- Make sure all other system connectors are fully seated.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

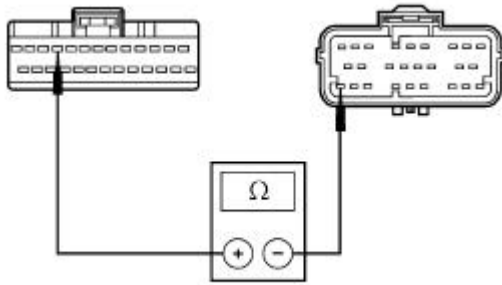
Yes
INSTALL a new GEM.
REFER to [Section 419-10](#). CLEAR the DTCs.
REPEAT the GEM self-test.

No
The system is operating correctly at this time.
Concern may have been caused by a loose or corroded connector.
CLEAR the DTCs.
REPEAT the self-test.

PINPOINT TEST C: A CHIME DOES NOT OPERATE CORRECTLY—AIR BAG

Test Step	Result / Action to Take
C1 CHECK CONTINUOUS DTCs AND RESTRAINT CONTROL MODULE (RCM)	
<ul style="list-style-type: none"> ● Connect the diagnostic tool. ● Enter the following diagnostic mode on the diagnostic tool: RCM On-Demand Self-Test. ● Carry out Continuous DTCs and On Demand RCM Self-Tests. ● Are any RCM DTCs received? 	<p>Yes REFER to Section 501-20B.</p> <p>No GO to C2.</p>
C2 CHECK IGNITION STATES	
<ul style="list-style-type: none"> ● Enter the following diagnostic mode on the diagnostic tool: GEM PID. ● Monitor the GEM PIDS IGN_KEY, IGN_A, IGN_S, and IGN_R while cycling the ignition switch through the OFF, ACC, RUN, START and key out positions. ● Do the PID values agree with the ignition switch states? 	<p>Yes GO to C3.</p> <p>No Go To Pinpoint Test B.</p>
C3 CHECK GEM INTERNAL TONE OPERATION	
<ul style="list-style-type: none"> ● Enter the following diagnostic mode on the diagnostic tool: GEM Active Command. ● Trigger the GEM active command CHIME ON and OFF. ● Does the chime operate correctly? 	<p>Yes GO to C4.</p> <p>No</p>

	GO to C8 .
C4 CHECK GEM INPUT FROM RCM — AIR BAG WARNING CHIME	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: RCM C2041. ● Enter the following diagnostic mode on the diagnostic tool: GEM PID. ● Monitor the GEM PID ABCHIME. ● Does the GEM PID ABCHIME read ON? 	Yes GO to C5 . No GO to C6 .
C5 CHECK CIRCUIT 1083 (LB/BK) FOR SHORT TO GROUND	
<ul style="list-style-type: none"> ● Disconnect: RCM C2041. ● Disconnect: GEM C201e. ● Measure resistance between GEM C201e pin 10, circuit 1083 (LB/BK), harness side and ground.  <ul style="list-style-type: none"> ● Is the resistance greater than 10,000 ohms? 	Yes GO to C8 . No REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs.
C6 CHECK CIRCUIT 1083 (LB/BK) FOR SHORT TO POWER	
<ul style="list-style-type: none"> ● Disconnect: RCM C2041e. ● Disconnect: GEM C201e. ● Measure the voltage between GEM C201e pin 10, circuit 1083 (LB/BK), harness side and ground.  <ul style="list-style-type: none"> ● Is voltage greater than 10 volts? 	Yes REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs. No GO to C7 .
C7 CHECK CIRCUIT 1083 (LB/BK) FOR OPEN	
<ul style="list-style-type: none"> ● Disconnect: RCM C2041e. ● Disconnect: GEM C201e. ● Measure the resistance between GEM C201e pin 10, circuit 1083 (LB/BK), harness side and RCM C2041e pin 26, circuit 1083 (LB/BK), harness side. 	Yes GO to C8 . No REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs.



GK9863-A

- Is the resistance less than 5 ohms?

C8 CHECK FOR CORRECT MODULE OPERATION

- Check:
 - for corrosion
 - for pushed-out pins
 - connector seated correctly
- Connect any disconnected connectors.
- Make sure all other system connectors are fully seated.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes

INSTALL a new GEM. REFER to [Section 419-10](#). CLEAR the DTCs. REPEAT the GEM self-test.

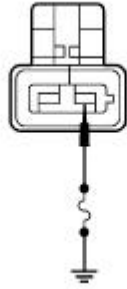
No

The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST D: THE DOOR AJAR CHIME DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
D1 CHECK IGNITION STATES	
<ul style="list-style-type: none"> ● Connect the diagnostic tool. ● Enter the following diagnostic mode on the diagnostic tool: GEM PID. ● Monitor the GEM PIDS IGN_KEY, IGN_A, IGN_S, and IGN_R while cycling the ignition switch through the OFF, ACC, RUN, START and key out positions. ● Do the PID values agree with the ignition switch states? 	<p>Yes GO to D2.</p> <p>No GO to Pinpoint Test B.</p>
D2 CHECK GEM INTERNAL TONE OPERATION	
<ul style="list-style-type: none"> ● Enter the following diagnostic mode on the diagnostic tool: GEM Active Command. ● Trigger the GEM active command CHIME ON and OFF. ● Does the chime operate correctly? 	<p>Yes GO to D3.</p> <p>No GO to D17.</p>
D3 CHECK GEM INPUT — DRIVER DOOR AJAR CIRCUIT	
<ul style="list-style-type: none"> ● Enter the following diagnostic mode on the diagnostic tool: GEM PID. ● Monitor the GEM PID D_DR_SW while opening and closing the driver door. ● Do the GEM PID D_DR_SW values indicate CLOSED and AJAR correctly? 	<p>Yes GO to D4.</p> <p>No GO to D5.</p>
D4 CHECK GEM INPUT — PASSENGER DOOR AJAR CIRCUIT	

<ul style="list-style-type: none"> ● Enter the following diagnostic mode on the diagnostic tool: GEM PID. ● Monitor the GEM PID P_DR_SW while opening and closing the passenger door. ● Do the GEM PID P_DR_SW values indicate CLOSED and AJAR correctly? 	<p>Yes GO to D17.</p> <p>No GO to D11.</p>
<p>D5 CHECK CIRCUIT 765 (YE/BK) AND DRIVER DOOR AJAR SWITCH FOR OPEN OR SHORT TO GROUND</p>	
<ul style="list-style-type: none"> ● Enter the following diagnostic mode on the diagnostic tool: GEM PID. ● Monitor the GEM PID D_DR_SW while opening and closing the driver door. ● Does the GEM PID D_DR_SW value indicate AJAR with driver door closed? 	<p>Yes GO to D6.</p> <p>No GO to D8.</p>
<p>D6 ISOLATE SHORT TO GROUND ON CIRCUIT 765 (YE/BK)</p>	
<ul style="list-style-type: none"> ● Disconnect: Driver Door Ajar Switch C526. ● Enter the following diagnostic mode on the diagnostic tool: GEM PID. ● Monitor the GEM PID D_DR_SW. ● Does GEM PID D_DR_SW read CLOSED? 	<p>Yes INSTALL a new driver door ajar switch. REFER to Section 501-14A. REPEAT the self-test. CLEAR the DTCs.</p> <p>No GO to D7.</p>
<p>D7 CHECK CIRCUIT 765 (YE/BK) FOR SHORT TO GROUND BETWEEN GEM AND DRIVER DOOR AJAR SWITCH</p>	
<ul style="list-style-type: none"> ● Disconnect: GEM C201c. ● Measure the resistance between GEM C201c pin 13, circuit 765 (YE/BK), harness side and ground. <div> <p>The diagram shows a GEM C201c module with a multimeter connected to pin 13. The multimeter is set to measure resistance (Ω) and is connected to ground. The label GK9864-A is located below the diagram.</p> </div> <ul style="list-style-type: none"> ● Is the resistance greater than 10,000 ohms? 	<p>Yes GO to D17.</p> <p>No REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs.</p>
<p>D8 CHECK CIRCUIT 765 (YE/BK) FOR OPEN</p>	
<ul style="list-style-type: none"> ● Disconnect: Driver Door Ajar Switch C526. ● Enter the following diagnostic mode on the diagnostic tool: GEM PID. ● Connect a 10A fused jumper wire between driver door ajar switch C526 pin 2, circuit 765 (YE/BK), harness side and ground while monitoring GEM PID D_DOOR. 	<p>Yes GO to D10.</p> <p>No GO to D9.</p>

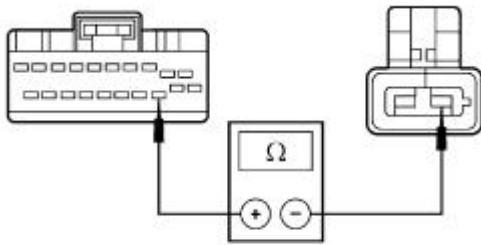


GK9865-A

- Does GEM PID D_DR_SW indicate AJAR with jumper wire installed?

D9 CHECK CIRCUIT 765 (YE/BK) FOR OPEN BETWEEN GEM AND DRIVER DOOR AJAR SWITCH

- Disconnect: GEM C201c.
- Measure the resistance between GEM C201c pin 13, circuit 765 (YE/BK), harness side and driver door ajar switch C526 pin 2, circuit 765 (YE/BK), harness side.



GK9866-A

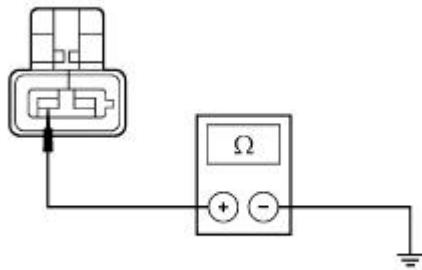
- Is the resistance less than 5 ohms?

Yes
GO to [D17](#).

No
REPAIR the circuit.
REPEAT the self-test.
CLEAR the DTCs.

D10 CHECK CIRCUIT 1205 (BK) FOR OPEN BETWEEN DRIVER DOOR AJAR SWITCH AND GROUND

- Disconnect: Driver Door Ajar Switch C526.
- Measure the resistance between driver door ajar switch C526 pin 1, circuit 1205 (BK), harness side and ground.



GK9867-A

- Is the resistance less than 5 ohms?

Yes
INSTALL a new driver door ajar switch. REFER to [Section 501-14A](#). REPEAT the self-test. CLEAR the DTCs.

No
REPAIR the circuit.
REPEAT the self-test.
CLEAR the DTCs.

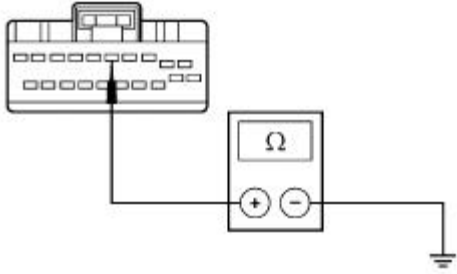

D11 ISOLATE OPEN OR SHORT TO GROUND ON CIRCUIT 761 (GN/RD)

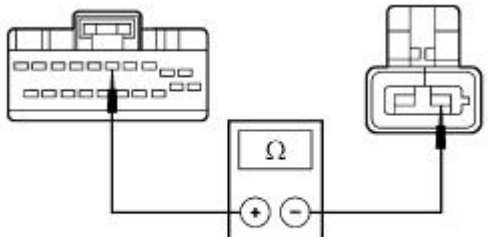
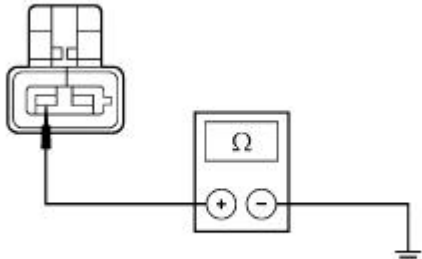
- Enter the following diagnostic mode on the diagnostic tool: GEM PID.
- Monitor the GEM PID P_DR_SW, while opening and closing the passenger door.
- Does the GEM PID P_DR_SW value indicate AJAR with the passenger door closed?

Yes
GO to [D12](#).

No
GO to [D14](#).

D12 ISOLATE SHORT TO GROUND ON CIRCUIT 761 (GN/RD)

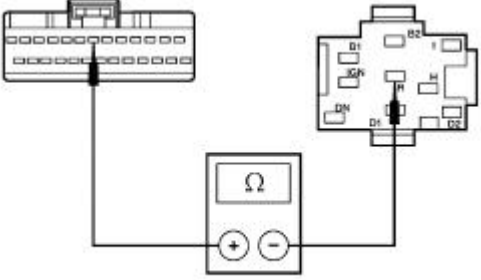
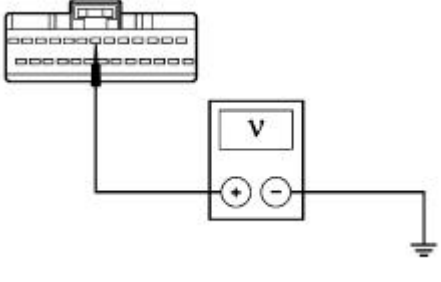
<ul style="list-style-type: none"> ● Disconnect: Passenger Door Ajar Switch C602. ● Enter the following diagnostic mode on the diagnostic tool: GEM PID. ● Monitor the GEM PID P_DR_SW. ● Does GEM PID P_DR_SW read CLOSED? 	<p>Yes INSTALL a new passenger door ajar switch. REFER to Section 501-14A. REPEAT the self-test. CLEAR the DTCs.</p> <p>No GO to D13.</p>
<p>D13 CHECK CIRCUIT 761 (GN/RD) FOR SHORT TO GROUND BETWEEN GEM AND PASSENGER DOOR AJAR SWITCH</p>	
<ul style="list-style-type: none"> ● Disconnect: GEM C201c. ● Measure the resistance between GEM C201c pin 5, circuit 761 (GN/RD), harness side and ground.  <p style="text-align: center;">GK9868-A</p> <ul style="list-style-type: none"> ● Is the resistance greater than 10,000 ohms? 	<p>Yes GO to D17.</p> <p>No REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs.</p>
<p>D14 ISOLATE OPEN CIRCUIT 761 (GN/RD)</p>	
<ul style="list-style-type: none"> ● Disconnect: Passenger Door Ajar Switch C602. ● Enter the following diagnostic mode on the diagnostic tool: GEM PID. ● Connect a 10A fused jumper wire between the passenger door ajar switch C602 pin 2, circuit 761 (GN/RD), harness side and ground while monitoring the GEM PID P_DR_SW.  <p style="text-align: center;">GK9865-A</p> <ul style="list-style-type: none"> ● Does GEM PID P_DR_SW read AJAR with jumper wire installed? 	<p>Yes GO to D16.</p> <p>No GO to D15.</p>
<p>D15 CHECK FOR OPEN ON CIRCUIT 761 (GN/RD) BETWEEN GEM AND PASSENGER DOOR AJAR SWITCH</p>	
<ul style="list-style-type: none"> ● Disconnect: GEM C201c. ● Measure the resistance between GEM C201c pin 5, circuit 761 (GN/RD), harness side and passenger door ajar switch C602 pin 2, circuit 761 (GN/RD), harness side. 	<p>Yes GO to D17.</p> <p>No REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs.</p>

 <p style="text-align: center;">GK9869-A</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	
<p>D16 CHECK CIRCUIT 1205 (BK) FOR OPEN BETWEEN PASSENGER DOOR AJAR SWITCH AND GROUND</p>	
<ul style="list-style-type: none"> ● Measure the resistance between passenger door ajar switch C602 pin 1, circuit 1205 (BK), harness side and ground.  <p style="text-align: center;">GK9867-A</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes INSTALL a new passenger door ajar switch. REFER to Section 501-14A. REPEAT the self-test. CLEAR the DTCs.</p> <p>No REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs.</p>
<p>D17 CHECK FOR CORRECT MODULE OPERATION</p>	
<ul style="list-style-type: none"> ● Check: <ul style="list-style-type: none"> ● for corrosion ● for pushed-out pins ● connector seated correctly ● Connect any disconnected connectors. ● Make sure all other system connectors are fully seated. ● Operate the system and verify the concern is still present. ● Is the concern still present? 	<p>Yes INSTALL a new GEM. REFER to Section 419-10. CLEAR the DTCs. REPEAT the GEM self-test.</p> <p>No The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p>

PINPOINT TEST E: THE HEADLAMP ON REMINDER CHIME DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
<p>E1 CHECK FOR CORRECT OPERATION OF THE HEADLAMP SWITCH</p>	
<ul style="list-style-type: none"> ● Cycle the headlamp switch through all positions to verify correct operation of exterior lighting circuits. ● Do all exterior lamps operate correctly? 	<p>Yes GO to E2.</p> <p>No REFER to Section 417-01.</p>

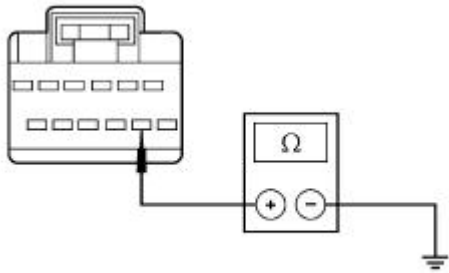
E2 CHECK IGNITION STATES	
<ul style="list-style-type: none"> ● Connect the diagnostic tool. ● Enter the following diagnostic mode on the diagnostic tool: GEM PID. ● Monitor the GEM PIDS IGN_KEY, IGN_A, IGN_S, and IGN_R while cycling the ignition switch through the OFF, ACC, RUN, START and key out positions. ● Do the PID values agree with the ignition switch states? 	<p>Yes GO to E3.</p> <p>No Go To Pinpoint Test B.</p>
E3 CHECK GEM INTERNAL TONE OPERATION	
<ul style="list-style-type: none"> ● Enter the following diagnostic mode on the diagnostic tool: GEM Active Command. ● Trigger the GEM active command CHIME ON and OFF. ● Does the chime operate correctly? 	<p>Yes GO to E4.</p> <p>No GO to E9.</p>
E4 CHECK GEM INPUT FROM DOOR AJAR CIRCUIT	
<ul style="list-style-type: none"> ● Enter the following diagnostic mode on the diagnostic tool: GEM PID. ● Monitor the GEM PID D_DR_SW while opening and closing the driver door. ● Do the GEM PID D_DR_SW values indicate CLOSED and AJAR correctly? 	<p>Yes GO to E5.</p> <p>No GO to Pinpoint Test D.</p>
E5 MONITOR EXTERIOR LAMP INPUT FOR CORRECT STATE	
<ul style="list-style-type: none"> ● Key in OFF position. ● Enter the following diagnostic mode on the diagnostic tool: GEM PID. ● Monitor the GEM PID PARK_SW, while triggering the headlamp switch ON and OFF. ● Do the GEM PID PARK_SW values indicate ON and OFF correctly? 	<p>Yes GO to E9.</p> <p>No GO to E6.</p>
E6 CHECK EXTERIOR LAMP INPUT CIRCUIT FOR SHORT TO POWER — GEM PID PARK_SW	
<ul style="list-style-type: none"> ● Key in OFF position. ● Enter the following diagnostic mode on the diagnostic tool: GEM PID. ● Monitor the GEM PID PARK_SW, while opening and closing the driver door. ● Does the GEM PID PARK_SW value always indicate ON? 	<p>Yes GO to E8.</p> <p>No GO to E7.</p>
E7 CHECK CIRCUIT 14 (BN) FOR OPEN	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: GEM C201c. ● Disconnect: Headlamp Switch C205. ● Measure the resistance between GEM C201c pin 7, circuit 14 (BN), harness side and headlamp switch C205 pin R, circuit 14 (BN), harness side. 	<p>Yes GO to E9.</p> <p>No REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs.</p>

 <p style="text-align: center;">GK9870-A</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	
E8 TEST CIRCUIT 14 (BN) FOR SHORT TO BATTERY	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: GEM C201c. ● Set the headlamp switch in the OFF position. Measure the voltage between GEM C201c pin 7, circuit 14 (BN), harness side and ground.  <p style="text-align: center;">GK9871-A</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs.</p> <p>No GO to E9.</p>
E9 CHECK FOR CORRECT MODULE OPERATION	
<ul style="list-style-type: none"> ● Check: <ul style="list-style-type: none"> ● for corrosion ● for pushed-out pins ● connector seated correctly ● Connect any disconnected connectors. ● Make sure all other system connectors are fully seated. ● Operate the system and verify the concern is still present. ● Is the concern still present? 	<p>Yes INSTALL a new GEM. REFER to Section 419-10. CLEAR the DTCs. REPEAT the GEM self-test.</p> <p>No The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p>

PINPOINT TEST F: THE SAFETY BELT WARNING CHIME DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
F1 CHECK IGNITION STATES	
<p>NOTE: Verify the belt minder is activated before diagnosing.</p> <ul style="list-style-type: none"> ● Connect the diagnostic tool. ● Enter the following diagnostic mode on the diagnostic tool: GEM PID. 	<p>Yes GO to F2.</p> <p>No Go To Pinpoint Test B.</p>

<ul style="list-style-type: none"> ● Monitor the GEM PIDS IGN_KEY, IGN_A, IGN_S, and IGN_R while cycling the ignition switch through the OFF, ACC, RUN, START and key out positions. ● Do the PID values agree with the ignition switch states? 	
F2 DETERMINE IF THE GEM IS RECEIVING CORRECT SAFETY BELT SWITCH STATUS	
<ul style="list-style-type: none"> ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: GEM PID. ● Monitor the GEM PID D_SBELT while buckling and unbuckling the driver safety belt. ● Does the GEM PID D_SBELT read OUT and IN correctly? 	Yes GO to F3 . No GO to F5 .
F3 CHECK THE GEM INTERNAL TONE OPERATION	
<ul style="list-style-type: none"> ● Enter the following diagnostic mode on the diagnostic tool: GEM Active Command. ● Trigger the GEM active command CHIME ON and OFF. ● Does the chime operate correctly? 	Yes GO to F4 . No GO to F11 .
F4 CHECK THE SAFETY BELT WARNING LAMP OPERATION	
<ul style="list-style-type: none"> ● Cycle the ignition switch from OFF to RUN while monitoring the instrument cluster safety belt indicator lamp. ● Does instrument cluster safety belt indicator lamp illuminate for approximately three seconds? 	Yes GO to F11 . No REFER to Section 413-01 .
F5 DETERMINE IF CIRCUIT 85 (BN/LB) IS OPEN OR SHORTED TO GROUND	
<ul style="list-style-type: none"> ● Enter the following diagnostic mode on the diagnostic tool: GEM PID. ● Monitor the GEM PID D_SBELT, while buckling and unbuckling the driver safety belt. ● Does the GEM PID D_SBELT value indicate OUT with the driver safety belt buckled? 	Yes GO to F6 . No GO to F8 .
F6 ISOLATE THE SHORT TO GROUND ON CIRCUIT 85 (BN/LB)	
<ul style="list-style-type: none"> ● Disconnect: Safety Belt Switch C323. ● Enter the following diagnostic mode on the diagnostic tool: GEM PID. ● Monitor the GEM PID D_SBELT. ● Does the GEM PID D_SBELT value indicate IN? 	Yes INSTALL a new safety belt switch. REPEAT the self-test. CLEAR the DTCs. No GO to F7 .
F7 CHECK CIRCUIT 85 (BN/LB) FOR A SHORT TO GROUND BETWEEN GEM AND SAFETY BELT SWITCH	
<ul style="list-style-type: none"> ● Disconnect: GEM C201d. ● Measure the resistance between GEM C201d pin 8, circuit 85 (BN/LB), harness side and ground. 	Yes GO to F11 . No REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs.



GK9872-A

- Is the resistance greater than 10,000 ohms?

F8 ISOLATE OPEN ON CIRCUIT 85 (BN/LB)

- Disconnect: Safety Belt Switch C323.
- Enter the following diagnostic mode on the diagnostic tool: GEM PID.
- Connect a 10A fused jumper wire between safety belt switch C323 pin 2, circuit 85 (BN/LB), harness side and ground while monitoring GEM PID D_SBELT.



GK9873-A

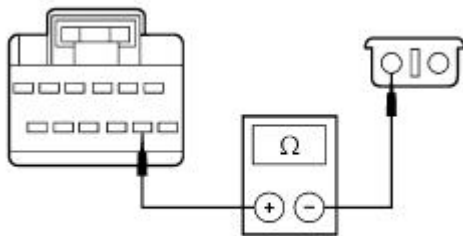
- Does GEM PID GEM PID D_SBELT read OUT with jumper wire installed?

Yes
GO to [F10](#).

No
GO to [F9](#).

F9 CHECK CIRCUIT 85 (BN/LB) FOR OPEN BETWEEN GEM AND SEATBELT SWITCH

- Disconnect: Safety Belt Switch C323.
- Disconnect: GEM C201b.
- Measure the resistance between GEM C201b pin 8, circuit 85 (BN/LB), harness side and safety belt switch C323 pin 2, circuit 85 (BN/LB), harness side.



GK9874-A

- Is the resistance less than 5 ohms?

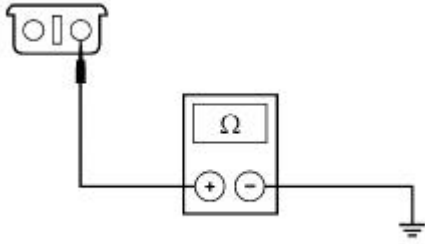
Yes
GO to [F11](#).

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

F10 CHECK CIRCUIT 1205 (BK) FOR AN OPEN CIRCUIT BETWEEN SAFETY BELT SWITCH AND GROUND

- Disconnect: Safety Belt Switch C323.
- Measure the resistance between the safety belt switch C323 pin 1, circuit 1205 (BK), harness side and ground.

Yes
INSTALL a new safety belt switch. REPEAT the self-test. CLEAR the DTCs.



GK9875-A

- Is the resistance less than 5 ohms?

No
REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs.

F11 CHECK FOR CORRECT MODULE OPERATION

- Check:
 - for corrosion
 - for pushed-out pins
 - connector seated correctly
- Connect any disconnected connectors.
- Make sure all other system connectors are fully seated.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
INSTALL a new GEM. REFER to [Section 419-10](#). CLEAR the DTCs. REPEAT the GEM self-test.

No
The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Belt Minder Deactivating/Activating

Preparation

1. Before deactivating/activating the belt minder, set the parking brake.
2. Place the gearshift in P (Park) (automatic transmission) or the neutral position (manual transmission).
3. Place the ignition switch in the OFF position.
4. Close all the vehicle doors.
5. Unbuckle the driver safety belt.
6. Place the parklamps/headlamps switch in the OFF position. (If the vehicle is equipped with Autolamps, this will not affect the procedure.)

Deactivating/Activating

1. Turn the ignition switch to the RUN position. (Do not start the engine.)
2. Wait until the safety belt warning lamp turns off. (approximately one to two minutes)
3. **NOTE:** Steps 3 through 5 must be completed within 60 seconds or the procedure must be repeated.

Buckle then unbuckle the safety belt three times, ending with the safety belt unbuckled. This portion of the procedure can be done before or during belt minder warning activation.

4. Turn the parklamps/headlamps on then off.
5. Buckle then unbuckle the safety belt three times ending with the safety belt unbuckled. After this step the safety belt warning lamp will be illuminated for three seconds.
6. Within seven seconds of the safety belt warning lamp turning off, buckle then unbuckle the safety belt. This will enable the belt minder if disabled or disable the belt minder if enabled.
7. The following sequence of events confirm the belt minder is enabled:
 - flashing of the safety belt warning belt lamp four times per second for three seconds
 - three seconds with the safety belt lamp off
 - flashing the safety belt lamp four times per second for three seconds again
8. The safety belt lamp flashing four times per second for three seconds provides confirmation that the belt minder is disabled.
9. After confirmation, the deactivation/activation procedure is complete.

Switch —Door Ajar

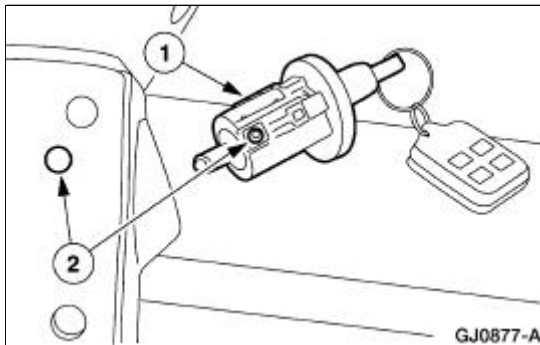
Removal and Installation

For additional information, refer to [Section 501-14A](#).

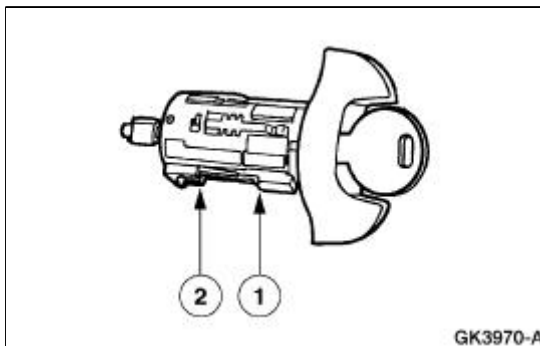
Switch —Key-In-Ignition Warning

Removal

1. Remove the ignition switch lock cylinder.
 1. Insert the ignition key and turn to the RUN position.
 2. Insert a punch in the access hole of the steering column and press the release tab while pulling out the ignition switch lock cylinder.

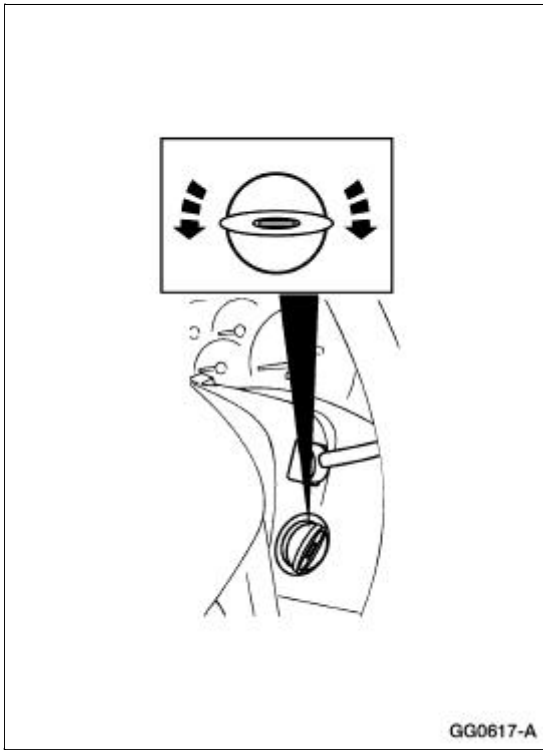


2. Remove the key-in-ignition warning switch.
 1. Release the clip.
 2. Push the key-in-ignition warning switch off the rear of the ignition switch lock cylinder.



Installation

1. To install, reverse the removal procedure.
 - Verify ignition switch lock cylinder operation.



GG0617-A

Module —Generic Electronic (GEM)

Removal and Installation

For additional information, refer to [Section 419-10](#).

General Specifications

Item	Specification
Generator	
4.6L, Cobra	120 amps @ 6,000 pulley rpm (2.87:1 ratio) internal regulator
4.6L, Mach1	120 amps @ 6,000 pulley rpm (2.72:1 ratio) internal regulator
4.6L, 2V	110 amps @ 6,000 pulley rpm (3.16:1 ratio) internal regulator
3.8L	110 amps @ 6,000 pulley rpm (2.79:1 ratio) internal regulator

Charging System

The charging system is a negative ground system consisting of the following:

- generator
- internal voltage regulator
- charging system warning indicator
- storage battery
- necessary wiring and cables

The generator is belt-driven by the engine accessory drive system.

With the ignition key in the run position, voltage is applied through the warning indicator I circuit to the voltage regulator. This turns the regulator on, allowing current to flow from battery sense A circuit to the generator field coil. When the engine is started, the generator begins to generate alternating current (AC) which is converted to direct current (DC) internally. This current is then supplied to the vehicle's electrical system through the output terminal (B+) of the generator.

Once the generator begins generating current, a voltage signal is taken from the generator stator and fed back to the internal regulator. This voltage feedback signal (typically half the battery voltage) is used to turn off the warning indicator.

With the system functioning normally, the generator output current is determined by the voltage of the A circuit. This A circuit voltage (battery sense circuit) is compared to a set voltage internal to the regulator, and the regulator controls the generator field current to maintain the correct generator output.

The set voltage will vary with temperature and is typically higher in cold temperatures than in warm temperatures. This allows for better battery recharge in the winter and reduces the chance of overcharging in the summer.

The battery is a 12 volt direct current source connected in a negative ground system. The battery case is sealed and includes two vent holes to release gases. The battery has three major functions:

- engine cranking power source
- voltage stabilizer for the electrical system
- temporary power when electrical loads exceed the generator output current

Circuit Description

Battery Output Terminal (B+)

The generator output is supplied through the battery positive output (B+) terminal on the back of the generator to the battery and electrical system.

I Circuit 904 (LG/RD)

The I (ignition) circuit is used to turn on the voltage regulator. This circuit is powered up with the ignition key in the run position. This circuit is also used to turn the charging system warning indicator on if there is a fault in the charging system operation.



A Circuit 36 (YE/WH)

The A circuit or battery sense circuit is used to sense battery voltage. This voltage is used by the regulator to determine generator output. This circuit is also used to supply current to the generator field (rotor). The amount of current supplied to the rotor determines generator output.

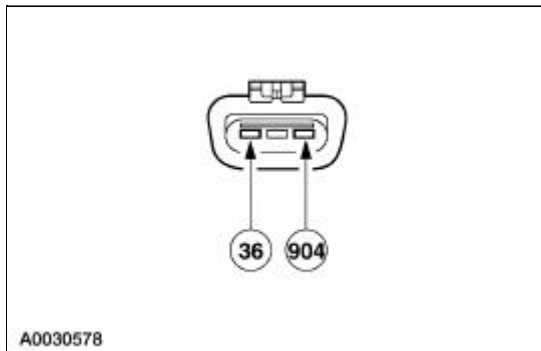
Charging System

Refer to Wiring Diagrams Cell [12](#), Charging System for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2173-A	SABRE Premium Battery and Electrical System Tester 010-00736 or equivalent

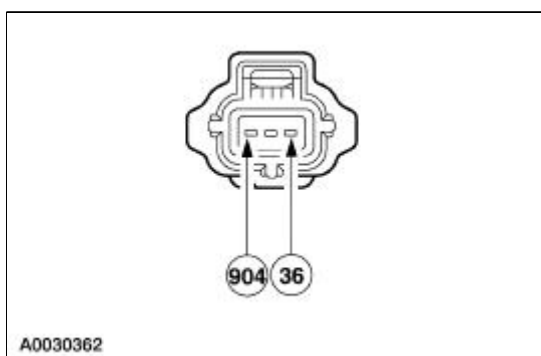
Principles of Operation



Connector C102c End View

A Circuit 36 (YE/WH)

I Circuit 904 (LG/RD)



Connector C102a End View
A Circuit 36 (YE/WH)
I Circuit 904 (LG/RD)

Functionality

With the ignition switch in the RUN position, voltage is applied through the warning indicator I circuit 904 (LG/RD) to the voltage regulator. This turns the regulator on, allowing current to flow from battery sense A circuit 36 (YE/WH) to the generator field coil. When the engine is started, the generator begins to generate alternating current (AC) which is internally converted to direct current (DC). This current is then supplied to the vehicle's electrical system through the output (B+) terminal of the generator.

Once the generator begins generating current, a voltage signal is taken from the generator stator and fed back to the regulator internally. This voltage feedback signal (typically half the battery voltage) is used to turn off the warning indicator.

With the system functioning normally, the generator output current is determined by the voltage of the A circuit. The A circuit voltage is compared to a set voltage internal to the regulator, and the regulator controls the generator field current to maintain the correct generator output.

The set voltage will vary with temperature and is typically higher in cold temperatures and lower in warm temperatures. This allows for better battery recharge in the winter and reduces the chance of overcharging in the summer.

Battery Positive Output Circuit 38 (B+) (BK/OG)

The generator output is supplied through the battery positive output (B+) terminal on the back of the generator to the battery and electrical system.

I Circuit 904 (LG/RD)

The I (ignition) circuit is used to turn on the voltage regulator. This circuit is powered up with the ignition key in the run position. This circuit is also used to turn the charging system warning indicator on if there is a fault in the charging system operation.

A Circuit 36 (YE/WH)

The A circuit or battery sense circuit is used to sense battery voltage. This voltage is used by the regulator to determine generator output. This circuit is used to supply current to the generator field (rotor). The amount of current supplied to the rotor will determine generator output.

Inspection and Verification



WARNING: Batteries contain sulfuric acid. Avoid contact with skin, eyes, or clothing. Also, shield your eyes when working near batteries to protect against possible splashing of the acid solution. In case of acid contact with skin or eyes, flush immediately with water for a minimum of 15 minutes and get prompt medical attention. If acid is swallowed, call a physician immediately.



WARNING: Batteries normally produce explosive gases which can cause personal injury. Therefore, do not allow flames, sparks or lighted substances to come near the battery. When charging or working near a battery, always shield your face and protect your eyes. Always

provide ventilation.



WARNING: When lifting a plastic-cased battery, excessive pressure on the end walls could cause acid to spew through the vent caps resulting in personal injury, damage to the vehicle or to the battery. Lift with a battery carrier or with your hands on opposite corners.

1. Verify the customer concern by operating the engine to duplicate the concern.
2. Inspect the charging system (battery, generator cable, harness connectors, connections) to determine if any obvious mechanical or electrical concerns exist. If found, repair as necessary and test the system for normal operation. Refer to the following tables:

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> ● Battery case, posts, hold-down clamp, cables and connections ● Generator drive (serpentine) belt for condition and tension. Refer to Section 303-05. ● Generator pulley 	<ul style="list-style-type: none"> ● Battery junction box (BJB) fuse 20 (20A) ● Fuse links ● Circuitry ● Battery charge warning indicator ● Cables

3. Check the operation of the charging system warning indicator lamp (instrument cluster). Normal operation is as follows:
 - With the ignition switch OFF, the charging system warning indicator should be OFF.
 - With the ignition switch in RUN and the engine off, the charging system warning indicator light should be on.
 - With the engine running, the charging system warning indicator light should be off.
4. Verify the battery is being charged. Carry out the Battery—Load Test. Refer to Component Tests in this section.

Normal Charging System Voltages

Ignition Switch Position	A Circuit 36 (YE/WH)	I Circuit 904 (LG/RD)	Generator B+ Circuit 38 (BK/OG)	Battery	Engine to battery ground	Charging System Warning Indicator Operation
OFF	12V	0V	12V	12V	0V	Off
RUN-engine off	12V	1-3V	12V	12V	0V	Illuminated
RUN-engine running	13-15V	13-15V	13-15V	13-15V	0V	Off

5. If the customer concern is verified after the initial inspection, refer to the Symptom Chart to determine which tests to carry out.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none"> Battery is discharged or voltage is low 	<ul style="list-style-type: none"> Circuitry. High key-off current drain(s). Battery. Generator. 	<ul style="list-style-type: none"> Go To Pinpoint Test A.
<ul style="list-style-type: none"> The charging system warning indicator is on with the engine running (the system voltage does not increase) 	<ul style="list-style-type: none"> Circuitry. Voltage regulator. Generator. 	<ul style="list-style-type: none"> Go To Pinpoint Test B.
<ul style="list-style-type: none"> The system overcharges (the battery voltage is greater than 15.5 volts) 	<ul style="list-style-type: none"> Circuitry. Voltage regulator. Generator. 	<ul style="list-style-type: none"> Go To Pinpoint Test C.
<ul style="list-style-type: none"> The charging system warning indicator is on with the engine running and the battery increases voltage 	<ul style="list-style-type: none"> Circuitry. Instrument cluster. Voltage regulator. Generator. 	<ul style="list-style-type: none"> Go To Pinpoint Test D.
<ul style="list-style-type: none"> The charging system warning indicator is off with the ignition switch in the RUN position and the engine off 	<ul style="list-style-type: none"> Bulb. Circuitry. Instrument cluster. Voltage regulator. Generator. 	<ul style="list-style-type: none"> Go To Pinpoint Test E.
<ul style="list-style-type: none"> The charging system warning indicator flickers or is intermittent 	<ul style="list-style-type: none"> Central junction box (CJB) fuse 5 (15A). Generator connector unplugged (C102a). Circuitry. Generator. 	<ul style="list-style-type: none"> Go To Pinpoint Test F.
<ul style="list-style-type: none"> The generator is noisy 	<ul style="list-style-type: none"> Bolts or brackets. Drive belt. Generator or pulley. 	<ul style="list-style-type: none"> Go To Pinpoint Test G.
<ul style="list-style-type: none"> Radio interference 	<ul style="list-style-type: none"> Generator. Circuitry. In-vehicle entertainment system. 	<ul style="list-style-type: none"> Go To Pinpoint Test F.

Pinpoint Tests



CAUTION: Do not make jumper connections except as directed. Incorrect connections may damage the voltage regulator test terminals, fuses, or fuse links.



CAUTION: Do not allow any metal object to come in contact with the generator housing and internal diode cooling fins.

NOTE: All voltage measurements are referenced to the negative (-) battery post unless otherwise specified.

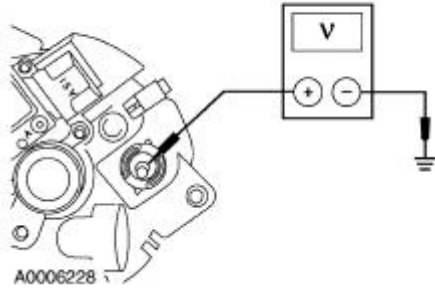
PINPOINT TEST A: BATTERY IS DISCHARGED OR VOLTAGE IS

LOW

Test Step	Result / Action to Take
A1 CHECK BATTERY CONDITION	
<ul style="list-style-type: none"> ● Carry out the Battery—Condition Test to determine if the battery can hold a charge and is OK for use. Refer to Section 414-01. ● Is the battery OK? 	<p>Yes GO to A2.</p> <p>No INSTALL a new battery. REFER to Section 414-01. TEST the system for normal operation.</p>
A2 CHECK THE GENERATOR OUTPUT	
<ul style="list-style-type: none"> ● Carry out the On-Vehicle Generator Load/No Load Test. Refer to Component Tests in this section. ● Is the generator OK? 	<p>Yes GO to A3.</p> <p>No GO to Pinpoint Test B.</p>
A3 CHECK FOR CURRENT DRAINS	
<ul style="list-style-type: none"> ● Carry out the Battery—Drain Test. Refer to Component Tests in this section. ● Are there any excessive current drains? 	<p>Yes REPAIR as necessary. TEST the system for normal operation.</p> <p>No GO to A4.</p>
A4 CHECK FOR CURRENT DRAINS WHICH SHUT OFF WHEN THE BATTERY IS DISCONNECTED	
<ul style="list-style-type: none"> ● Carry out the Battery—Electronic Drains Which Shut Off When the Battery Cable is Disconnected Test. Refer to Component Tests in this section. ● Are there any current drains which shut off when the battery is disconnected? 	<p>Yes REPAIR as necessary. TEST the system for normal operation.</p> <p>No GO to Pinpoint Test B.</p>

PINPOINT TEST B: THE CHARGING SYSTEM WARNING INDICATOR IS ON WITH THE ENGINE RUNNING (THE BATTERY VOLTAGE DOES NOT INCREASE)

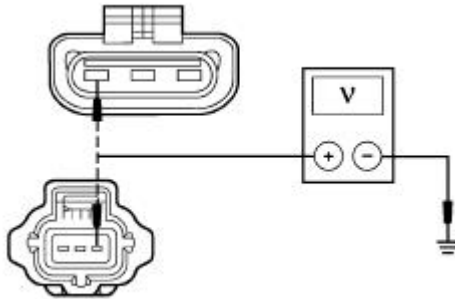
Test Step	Result / Action to Take
B1 CHECK GENERATOR B+ CIRCUIT 38 (BK/OG)	
<ul style="list-style-type: none"> ● Disconnect: Generator B+ C102b. ● Measure the voltage between the generator C102b, circuit 38 (BK/OG), component side and ground. 	<p>Yes GO to B2.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>



- Is the voltage equal to battery positive voltage (B+)?

B2 CHECK GENERATOR A CIRCUIT 36 (YE/WH)

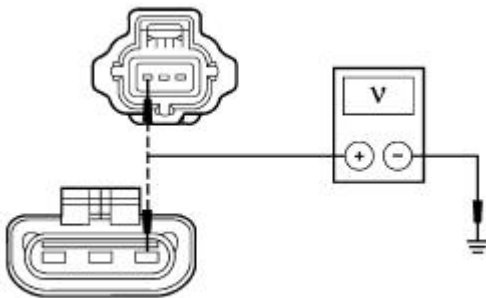
- Disconnect: Generator C102c (4.6L 4V) or C102a (3.8L or 4.6L 2V).
- Measure the voltage between the generator C102c (4.6L 4V) or C102a (3.8L or 4.6L 2V) pin 3, circuit 36 (YE/WH), harness side and ground.



- Is the voltage equal to battery positive voltage (B+)?

B3 CHECK I CIRCUIT 904 (LG/RD) FOR AN OPEN

- Key in ON position.
- With the ignition switch in the RUN position and the engine off, measure the voltage between the generator C102c (4.6L 4V) or C102a (3.8L or 4.6L 2V) pin 1, circuit 904 (LG/RD), harness side and ground.



- Is the voltage equal to battery positive voltage (B+)?

B4 CHECK FOR VOLTAGE DROP IN B+ CIRCUIT 38 (YE/WH)

- Key in START position.
- With the engine at 2,000 rpm, measure the voltage drop between the generator C102b, circuit 38 (BK/OG), component side and positive battery terminal.

Yes
GO to [B3](#).

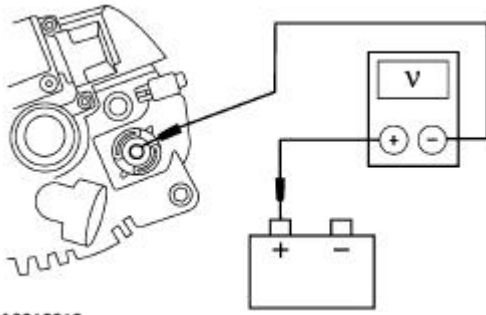
No
REPAIR the circuit.
TEST the system for normal operation.

Yes
GO to [B4](#).

No
REPAIR the circuit.
TEST the system for normal operation.

Yes
INSTALL a new generator. REFER to [Section 414-02](#).
TEST the system for normal operation.

No



A0012310

- Is the voltage drop less than 0.5 volt?

REPAIR high resistance in the B+ circuit 38 (BK/OG). TEST the system for normal operation.

PINPOINT TEST C: THE SYSTEM OVERCHARGES (THE BATTERY VOLTAGE IS GREATER THAN 15.5 VOLTS)

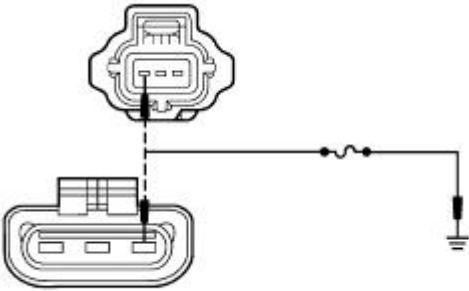
Test Step	Result / Action to Take
<p>C1 CHECK FOR VOLTAGE DROP IN A CIRCUIT 36 (YE/WH)</p> <ul style="list-style-type: none"> ● Disconnect: Generator C102c (4.6L 4V) or C102a (3.8L or 4.6L 2V). ● Key in ON position. ● Measure the voltage drop between the generator C102c (4.6L 4V) or C102a (3.8L or 4.6L 2V) pin 3, circuit 36 (YE/WH), harness side and positive battery terminal. <p>A0030365</p> <ul style="list-style-type: none"> ● Is the voltage drop less than 0.5 volt? 	<p>Yes GO to C2.</p> <p>No REPAIR the high resistance in A circuit 36 (YE/WH). TEST the system for normal operation.</p>
<p>C2 CHECK GENERATOR AND BATTERY GROUND CONNECTIONS</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Check the ground connections between the voltage regulator and the generator and the engine, and the battery and the engine. ● Are all ground connections clean and tight? 	<p>Yes INSTALL a new generator. REFER to Section 414-02. TEST the system for normal operation.</p> <p>No REPAIR ground connections as necessary. TEST the system for normal operation.</p>

PINPOINT TEST D: THE CHARGING SYSTEM WARNING INDICATOR IS ON WITH THE ENGINE RUNNING AND THE BATTERY

INCREASES VOLTAGE

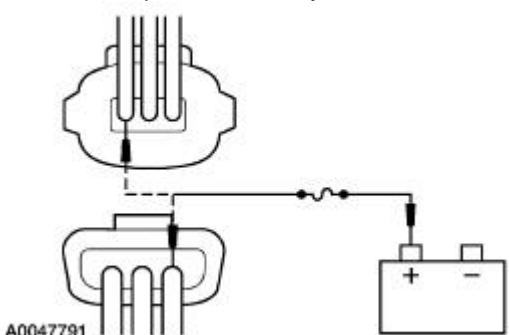
Test Step	Result / Action to Take
D1 CHECK I CIRCUIT 904 (LG/RD) FOR A SHORT TO GROUND	
<ul style="list-style-type: none"> ● Disconnect: Generator C102c (4.6L 4V) or C102a (3.8L or 4.6L 2V). ● Key in ON position. ● With the ignition switch in the RUN position, check the charging system warning indicator. ● Is the charging system warning indicator illuminated? 	<p>Yes REPAIR circuit 904 (LG/RD) for a short to ground. TEST the system for normal operation.</p> <p>No INSTALL a new generator. REFER to Section 414-02. TEST the system for normal operation.</p>

PINPOINT TEST E: THE CHARGING SYSTEM WARNING INDICATOR IS OFF WITH THE IGNITION SWITCH IN THE RUN POSITION AND THE ENGINE OFF

Test Step	Result / Action to Take
E1 CHECK THE CHARGING SYSTEM WARNING INDICATOR LAMP	
<ul style="list-style-type: none"> ● Disconnect: Generator C102c (4.6L 4V) or C102a (3.8L or 4.6L 2V). ● With the engine off, connect a fused (15A) jumper wire between the generator C102c (4.6L 4V) or C102a (3.8L or 4.6L 2V) pin 1, circuit 904 (LG/RD), harness side and ground.  <p>A0030366</p> <ul style="list-style-type: none"> ● Key in ON position. ● Is the charging system warning indicator lamp illuminated? 	<p>Yes INSTALL a new generator. REFER to Section 414-02. TEST the system for normal operation.</p> <p>No REFER to Section 413-01 for diagnosis and testing of the instrument cluster.</p>

PINPOINT TEST F: THE CHARGING SYSTEM WARNING INDICATOR LAMP FLICKERS OR IS INTERMITTENT

Test Step	Result / Action to Take
F1 CHECK FOR LOOSE CONNECTIONS	
<ul style="list-style-type: none"> ● Check all generator, battery, and power distribution connections for looseness, corrosion, loose or bent terminals, or loose eyelets. ● Are all connections clean and tight? 	<p>Yes GO to F2.</p> <p>No</p>

	REPAIR as necessary. TEST the system for normal operation.
F2 CHECK FUSE	
<ul style="list-style-type: none"> ● Key in START position. ● With the engine running, check battery junction box (BJB) fuse 20 (20A) in circuit 36 (YE/WH) for looseness by wiggling the fuse and noting the charging system warning indicator lamp operation. ● Does the charging system warning indicator lamp flicker? 	<p>Yes REPAIR loose fuse connections as necessary. TEST the system for normal operation.</p> <p>No GO to F3.</p>
F3 CHECK A CIRCUIT 36 (YE/WH) CONNECTIONS	
<ul style="list-style-type: none"> ● Key in OFF position. ● Connect a fused jumper wire between the generator C102c, (4.6L 4V) or C102a (3.8L or 4.6L 2V) pin 3, circuit 36 (YE/WH), harness side and the positive battery terminal.  <p>A0047791</p> <ul style="list-style-type: none"> ● Key in START position. ● With the engine running, note the charging system warning indicator operation. ● Does the charging system warning indicator lamp flicker? 	<p>Yes REFER to Section 414-02. TEST the system for normal operation.</p> <p>No REPAIR loose connection(s) in circuits. TEST the system for normal operation.</p>

PINPOINT TEST G: THE GENERATOR IS NOISY

Test Step	Result / Action to Take
G1 CHECK FOR ACCESSORY DRIVE NOISE	
<ul style="list-style-type: none"> ● Check the accessory drive belt for damage and correct installation. Check the accessory mounting brackets and generator pulley for looseness or misalignment. ● Is the accessory drive OK? 	<p>Yes GO to G2.</p> <p>No REPAIR as necessary. REFER to Section 303-05 for diagnosis and testing of the accessory drive system. TEST the system for normal operation.</p>
G2 CHECK GENERATOR MOUNTING	
<ul style="list-style-type: none"> ● Check the generator mounting for loose bolts or misalignment. ● Is the generator mounted correctly? 	<p>Yes GO to G3.</p> <p>No REPAIR as necessary. TEST the system for normal operation.</p>
G3 CHECK GENERATOR FOR ELECTRICAL	

NOISE	<p>Yes GO to G4.</p> <p>No INSTALL a new generator. REFER to Section 414-02. TEST the system for normal operation.</p>
<ul style="list-style-type: none"> ● Disconnect: Generator C102c (4.6L 4V) or C102a (3.8L or 4.6L 2V). ● Key in START position. ● With the engine running, turn the headlights on, rear defroster on, and the blower motor to the HI position. ● Is the noise still present? 	
G4 CHECK GENERATOR FOR MECHANICAL NOISE	<p>Yes INSTALL a new generator. REFER to Section 414-02. TEST the system for normal operation.</p> <p>No REFER to Section 303-00 to diagnose the source of engine noise.</p>
<ul style="list-style-type: none"> ● Key in OFF position. ● Connect: Generator C102c (4.6L 4V) or C102a (3.8L or 4.6L 2V). ● Key in START position. ● Turn all accessories off. With the engine running, use a stethoscope or equivalent listening device to probe the generator for unusual mechanical noise. ● Is the generator the noise source? 	

PINPOINT TEST H: RADIO INTERFERENCE

Test Step	Result / Action to Take
H1 VERIFY GENERATOR IS SOURCE OF RADIO INTERFERENCE	<p>Yes REFER to Section 415-00 for diagnosis and testing of the in-vehicle entertainment system.</p> <p>No INSTALL a new generator. REFER to Section 414-02. TEST the system for normal operation.</p>
<ul style="list-style-type: none"> ● Key in START position. ● With the engine running, tune the radio to a station where the interference is present. ● Key in OFF position. ● Disconnect: Generator C102c (4.6L 4V) or C102a (3.8L or 4.6L 2V). ● Key in START position. ● With the engine running, note any radio interference. ● Is the interference present with the generator disconnected? 	

Component Tests

Battery—Load Test

1. With the engine running, turn the A/C on, the blower motor on high speed and the headlamps on high beam.
2. Increase the engine speed to approximately 2,000 rpm. The voltage should increase a minimum of 0.5 volt above the base voltage.
 - If the voltage does not increase as specified, carry out the Generator On-Vehicle Tests. For additional information, refer to Generator On-Vehicle Tests in this section.
 - If the voltage increases as specified, the charging system is operating normally.

Battery—Drain Tests

NOTE: No production vehicle should have more than a 50 mA (0.050 amp) continuous draw.

Check for current drains on the battery in excess of 50 milliamps (0.050 amp) with all the electrical accessories off and the vehicle at rest. Current drains can be tested with the following procedure:



WARNING: Do not attempt this test on a lead-acid battery that has recently been recharged. Explosive gases can cause personal injury.



CAUTION: To prevent damage to the meter, do not crank the engine or operate accessories that draw more than 10A.

NOTE: Many modules draw 10 mA (0.010 amp) or more continuously.

NOTE: Use an in-line ammeter between the battery positive or negative post and its respective cable.

NOTE: Typically, a drain of approximately one amp can be attributed to an engine compartment lamp, glove compartment lamp, or luggage compartment lamp staying on continually. Other component failures or wiring shorts may be located by selectively pulling fuses to pinpoint the location of the current drain. When the current drain is found, the meter reading will fall to an acceptable level. If the drain is still not located after checking all the fuses, it may be due to the generator.

NOTE: To accurately test the drain on a battery, an in-line digital ammeter must be used. Use of a test lamp or voltmeter is not an accurate method due to the number of electronic modules.

1. Make sure the junction box/fuse panels are accessible without turning on interior and underhood lights.
2. Drive the vehicle at least five minutes and over 48 km/h (30 mph) to turn on and exercise vehicle systems.
3. Allow the vehicle to sit with the key off for at least 40 minutes to allow modules to time out/power down.
4. Connect a fused jumper wire between the negative battery cable and the negative battery post to prevent modules from resetting and to catch capacitive drains.
5. Disconnect the negative battery cable from the post without breaking the connection of the jumper wire.
6. **NOTE:** It is very important that continuity is not broken between the battery and the negative battery cable when connecting the meter. If this happens, the entire procedure must be repeated.

Connect the tester between the negative battery cable and the post. The meter must be capable of reading milliamps and should have a 10 amp capability.

7. **NOTE:** If the meter settings need to be switched or the test leads need to be moved to another jack, the jumper wire must be reinstalled to avoid breaking continuity.

Remove the jumper wire.

NOTE: Amperage draw will vary from vehicle to vehicle depending on the equipment package. Compare to a comparable vehicle for reference.

NOTE: No production vehicle should have more than a 50 mA (0.050 amp) draw.

8. If the draw is found to be excessive, pull fuses from the battery/central junction box one at a time and note the current drop. Do not reinstall the fuses until you are finished testing.
9. Check the wiring schematic in the wiring diagram for any circuits that run from the battery without passing through the battery/central junction box. Disconnect these circuits if the draw is still excessive.

Battery—Electronic Drains Which Shut Off When the Battery Cable is Disconnected

1. Repeat the steps of the battery drain testing.
2. Make sure all doors are closed and accessories are off. Without starting the engine, turn the ignition switch to RUN for a moment and then OFF. Wait a few minutes for the illuminated entry lamps to turn off if equipped.
3. Connect the ammeter and read the amperage draw.

The current reading (current drain) should be less than 50 mA (0.05 amp). If the current drain exceeds 50 mA (0.05 amp) after a few minutes, and if this drain did not show in previous tests, the drain is most likely caused by an inoperative electronic component. As in previous tests, remove the fuses from the battery/central junction box one at a time to locate the problem circuit.

Generator On-Vehicle Tests



CAUTION: To prevent damage to the generator, do not make jumper wire connections except as directed.



CAUTION: Do not allow any metal object to come in contact with the housing and the internal diode cooling fins with key on or off. A short circuit will result and burn out the diodes.

NOTE: Battery posts and cable clamps must be clean and tight for accurate meter indications.

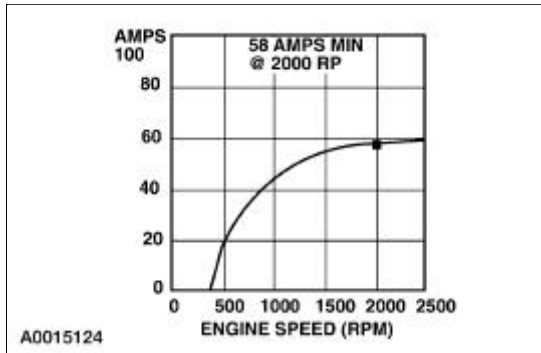
NOTE: Refer to the Battery Tester Procedure Manual for complete directions for testing the charging system.

1. Turn off all lamps and electrical components.
2. Place the vehicle in transmission range NEUTRAL and apply the parking brake.
3. Carry out the Load Test and No-Load Test according to the following component tests:

Generator On-Vehicle Tests—Load Test

1. Switch the battery tester to the ammeter function.
2. Connect the positive and negative leads of the battery tester to the corresponding battery terminals.
3. Connect the current probe to the generator B+ output terminal, circuit 38 (BK/OG).

4. With the engine running, turn the A/C on, the blower motor on high speed and the headlamps on high beam.
5. Increase the engine speed to approximately 2,000 rpm. The voltage should increase a minimum of 0.5 volt above the base voltage.
 - If the voltage does not increase as specified, carry out the Generator On-Vehicle Tests—No Load Test. For additional information, refer to Generator On-Vehicle Tests in this section.
 - If the voltage increases as specified, the charging system is operating normally.
6. With the engine running at 2,000 rpm, adjust the tester load bank to determine the output of the generator. Generator output should be at least 58 amps.



Generator On-Vehicle Tests—No Load Test

1. Switch the battery tester to the voltmeter function.
 2. Connect the voltmeter positive lead to the generator B+ output terminal, circuit 38 (BK/OG) and the negative lead to ground.
 3. Turn all electrical accessories off.
 4. With the engine running at 2,000 rpm, check the generator output voltage. The voltage should be between 13.0 and 15.0 volts. If not, refer to the Symptom Chart.
-

General Specifications

Item	Specification
Manufacturer	Motorcraft
Voltage	12 volt
Amps at -17.7°C (0°F) cold crank	540
Minutes—reserve capacity	100
Amps/hrs.—20 hour rate	55
Location	Left front of engine compartment


Torque Specifications

Description	Nm	lb-ft	lb-in
Battery cable harness front support bracket nut	25	18	—
Battery cable terminal bolts	7	—	62
Battery hold-down bolt	10	—	89
Battery junction box nut	20	15	—
Battery tray bolts	11	8	—
Front lower cable harness bracket nuts	11	8	—
Generator B+ cable nut	8	—	71
Battery cable bracket nut (left upper)	25	18	—
Battery ground cable nut (engine block)	25	18	—
Battery ground cable at the radiator support bolt	12	9	—
Positive battery cable nut (starter solenoid)	12	9	—
Positive battery wire nut (starter solenoid)	6	—	53
Right engine mount cable harness bracket nut	25	18	—


Battery and Cables

Vehicles are equipped with a 12 volt maintenance-free battery that contains a built-in hydrometer. The hydrometer eye indication is as follows:

- A green dot means the battery is OK.
- A yellow dot, red dot, or when the green dot is not visible, means the battery needs to be charged.

 **WARNING:** Batteries normally produce explosive gases which can cause personal injury. Therefore, do not allow flames, sparks or lighted substances to come near the battery. When charging or working near a battery, always shield your face and protect your eyes. Always provide ventilation.

 **WARNING:** When lifting a battery, excessive pressure on the end walls could cause acid to leak out through the vent caps, resulting in personal injury, damage to the vehicle or the battery.


 **WARNING:** Keep out of the reach of children. Batteries contain sulfuric acid. Avoid contact with skin, eyes, or clothing. Also, shield your eyes when working near the battery to protect against possible splashing of the acid solution. In case of acid contact with skin or eyes, flush immediately with water for a minimum of 15 minutes and get prompt medical attention. If acid is swallowed, call a physician immediately.

Ford Motor Company strongly recommends that lead-acid batteries be returned to an authorized recycling facility for disposal.



Battery

Special Tool(s)

 <p>ST2442-A</p>	<p>Micro 490 Digital Battery Analyzer 162-00004</p>
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Inspection and Verification

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> ● Battery ● Battery mounting 	<ul style="list-style-type: none"> ● Battery cables ● Battery posts

3. If an obvious cause for a concern is found, correct the cause before proceeding to the next step.
4. If the fault is not visually evident, proceed to the pinpoint test.

Pinpoint Tests

PINPOINT TEST A: BATTERY CONDITION TEST


Test Step	Result / Action to Take
<p>A1 TEST BATTERY CONDITION</p> <p>NOTE: No battery with a red test-eye should be replaced. The red eye only means the battery is discharged, not necessarily defective. NOTE: Failure to fully charge the battery before retesting may cause false readings.</p> <ul style="list-style-type: none"> ● Verify the battery condition using the Battery Analyzer. ● Is the battery OK? 	<p>Yes</p> <p>Does the meter read, GOOD BATTERY? RETURN the battery to service. REFER to Section 414-00.</p> <p>Does the meter read, GOOD-RECHARGE? CHARGE the battery and RETURN to service. REFER to Section 414-00.</p> <p>Does the meter read, CHARGE & RETEST? Fully CHARGE the battery and RETEST.</p>


No

Does the meter read, REPLACE BATTERY? INSTALL a new battery.

Does the meter read, BAD CELL-REPLACE? INSTALL a new battery.


Battery Disconnect


 **WARNING:** Batteries normally produce explosive gases which can cause personal injury. Therefore, do not allow flames, sparks or lighted substances to come near the battery, always shield your face and protect your eyes. Always provide ventilation. Failure to follow these instructions may result in personal injury.

 **WARNING:** To avoid accidental deployment and possible injury, the backup power supply must be depleted before repairing or installing any front or side air bag supplemental restraint system (SRS) components and before repairing, installing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches. Failure to follow these procedures may result in personal injury.

Refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

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

 **WARNING:** When lifting a battery, excessive pressure on the end walls could cause acid to spew through the vent caps, resulting in personal injury. Lift with a battery carrier or with your hands on opposite corners. Failure to follow these instructions may result in personal injury.

 **WARNING:** Keep out of the reach of children. Batteries contain sulfuric acid. Avoid contact with skin, eyes or clothing. Also, shield your eyes when working near the battery to protect against possible splashing of the acid solution. In case of acid contact with the skin or eyes, flush immediately with water for a minimum of 15 minutes and get prompt medical attention. If acid is swallowed, call a physician immediately. Failure to follow these instructions may result in personal injury.

1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven to relearn its strategy.

Disconnect the battery ground cable.

2. Disconnect the positive battery cable.
 3. To install, reverse the removal procedure.
-

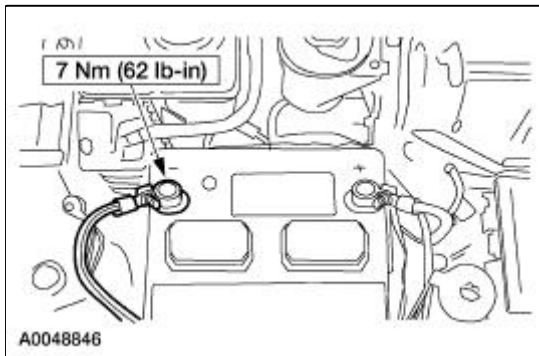
Battery

Removal and Installation

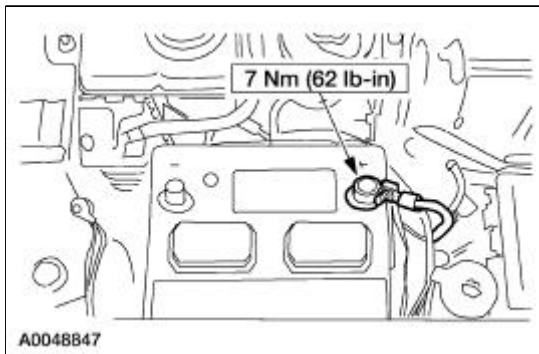
⚠ WARNING: Batteries normally produce explosive gases which can cause personal injury. Therefore, do not allow flames, sparks or lighted substances to come near the battery. When charging or working near a battery, always shield your face and protect your eyes. Always provide ventilation. Failure to follow these instructions may result in personal injury.

⚠ WARNING: Keep out of the reach of children. Batteries contain sulfuric acid. Avoid contact with skin, eyes, or clothing. Also, shield your eyes when working near the battery to protect against possible splashing of the acid solution. In case of acid contact with skin or eyes, flush immediately with water for a minimum of 15 minutes and get prompt medical attention. If acid is swallowed, call a physician immediately. Failure to follow these instructions may result in personal injury.

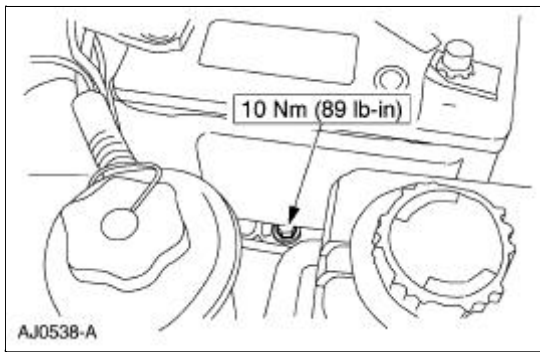
1. Loosen the bolt and disconnect the battery ground cable.




2. Loosen the bolt and disconnect the positive battery cable.

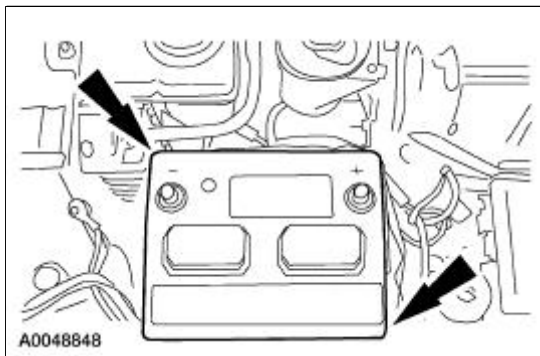


3. Remove the bolt and the battery hold-down.



4.  **WARNING:** When lifting a battery, excessive pressure on the end walls may cause acid to leak out through the vent caps, resulting in personal injury, damage to the vehicle or the battery. Failure to follow these instructions may result in personal injury.

Remove the battery by lifting from the corners of the battery.





5. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle needs to be driven to relearn the strategy.

To install, reverse the removal procedure.

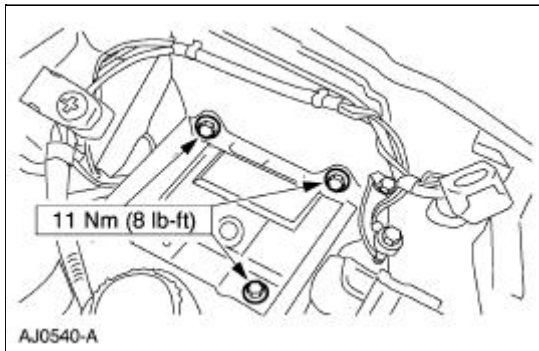
Battery Tray

Removal and Installation

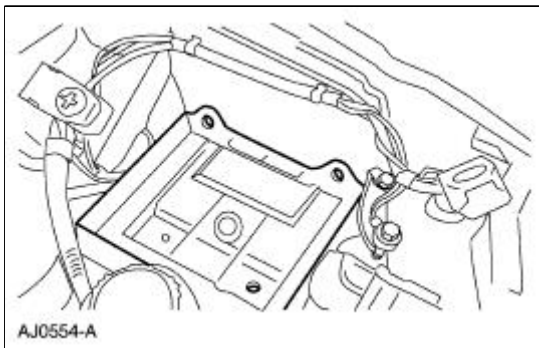
 **WARNING:** Batteries normally produce explosive gases which can cause personal injury. Therefore, do not allow flames, sparks or lighted substances to come near the battery. When charging or working near a battery, always shield your face and protect your eyes. Always provide ventilation. Failure to follow these instructions may result in personal injury.

 **WARNING:** Keep out of the reach of children. Batteries contain sulfuric acid. Avoid contact with skin, eyes, or clothing. Also, shield your eyes when working near the battery to protect against possible splashing of the acid solution. In case of acid contact with skin or eyes, flush immediately with water for a minimum of 15 minutes and get prompt medical attention. If acid is swallowed, call a physician immediately. Failure to follow these instructions may result in personal injury.

1. Remove the battery. For additional information, refer to [Battery](#) in this section.
2. Remove the battery tray bolts and washers.



3. Remove the battery tray.



4. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle needs to be driven to relearn the strategy.

To install, reverse the removal procedure.

Battery Cables

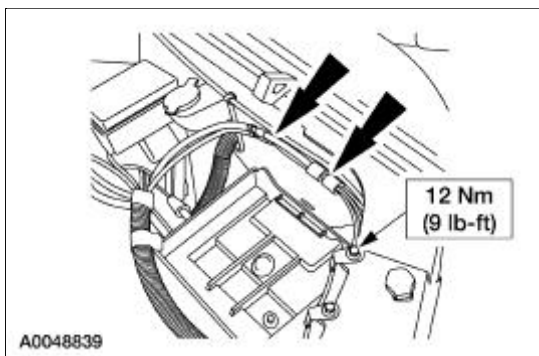
Removal

⚠ WARNING: Batteries normally produce explosive gases which can cause personal injury. Therefore, do not allow flames, sparks or lighted substances to come near the battery. When charging or working near a battery, always shield your face and protect your eyes. Always provide ventilation. Failure to follow these instructions may result in personal injury.

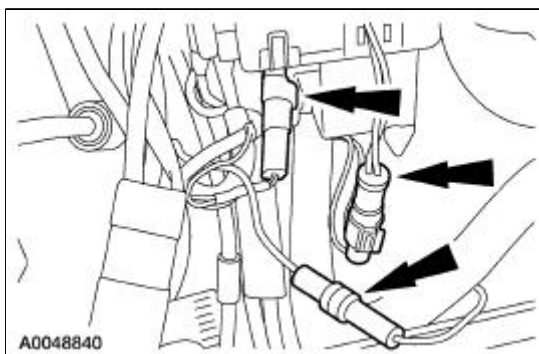
⚠ WARNING: Keep out of the reach of children. Batteries contain sulfuric acid. Avoid contact with skin, eyes, or clothing. Also, shield your eyes when working near the battery to protect against possible splashing of the acid solution. In case of acid contact with skin or eyes, flush immediately with water for a minimum of 15 minutes and get prompt medical attention. If acid is swallowed, call a physician immediately. Failure to follow these instructions may result in personal injury.

All vehicles

1. Remove the battery. For additional information, refer to [Battery](#) in this section.
2. If equipped, unplug the engine heater intermediate connection.
3. Remove the battery ground cable harness bolt from the radiator support and release the cable harness locators.



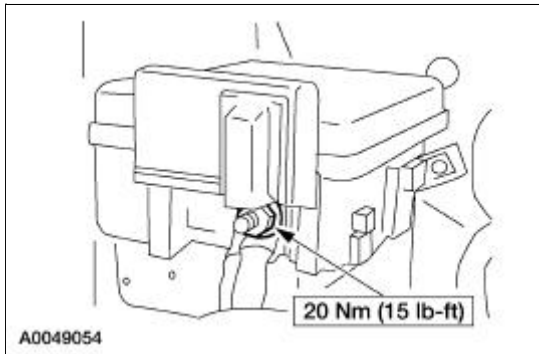
4. Disconnect the battery cable harness electrical connectors.



5. **⚠ CAUTION:** The square terminal from the battery must be installed first, followed by

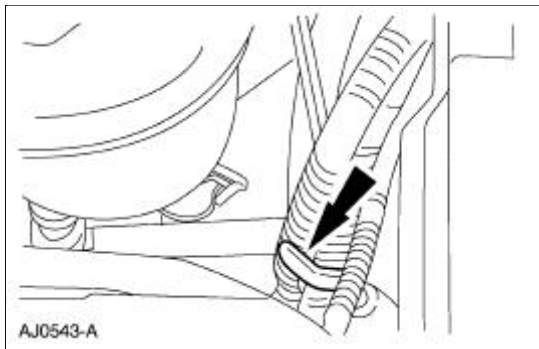
the round terminal from the generator. Reversing this sequence may cause circuit failure or arcing.

Remove the battery junction box nut and position the positive battery cable and generator B+ cable aside.



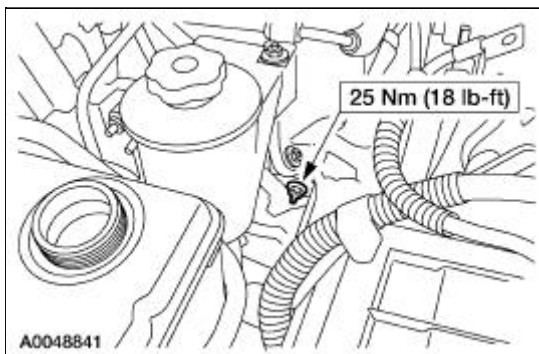
Vehicles with 3.8L and 4.6L 2V engines

6. Remove the cable harness front support bracket by removing the nut, and position the bracket aside.



Vehicles with 4.6L 4V engines

7. Remove the nut and position the left upper battery cable bracket aside.

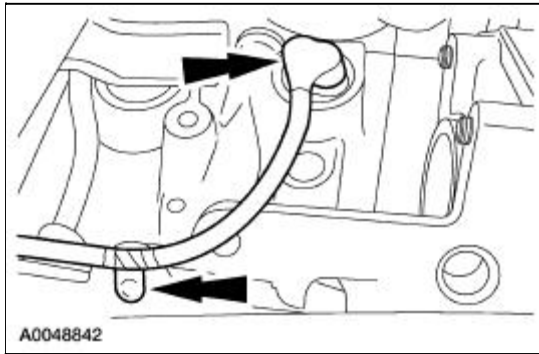


All vehicles

8. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
9. **NOTE:** 4.6L 4V shown; 3.8L and 4.6L 2V similar.

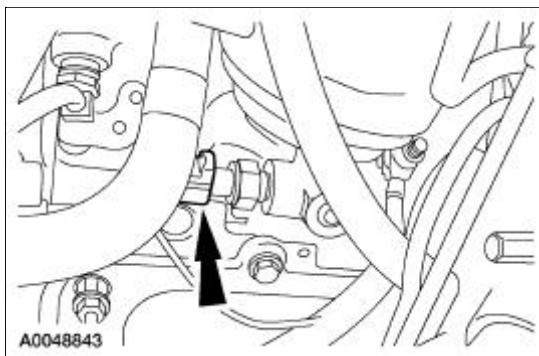
If equipped, remove the block heater plug from the block heater and the harness locators from


the oil pan clips.



10. **NOTE:** 4.6L 4V shown; 3.8L and 4.6L 2V similar.

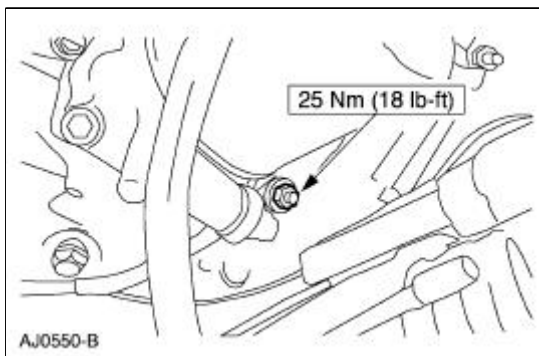
Disconnect the oil pressure sender unit electrical connector.



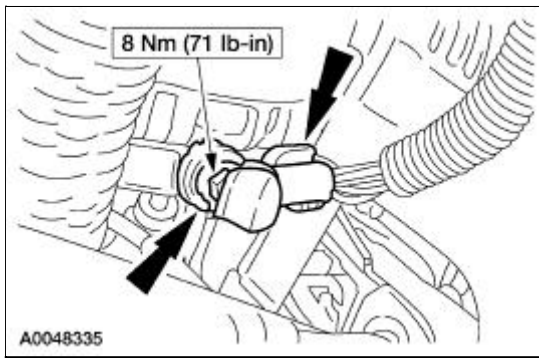
11.  **CAUTION:** Failure to tighten the negative cable ground nut may cause ground circuit failure or arcing.

NOTE: 4.6L 2V shown; 3.8L and 4.6L 4V similar.

Remove the battery ground cable nut at the engine block.

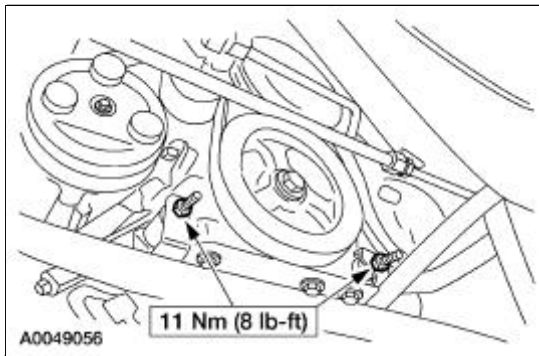


12. Remove the nut and disconnect the generator electrical connections.
- Position the cover aside.



13. **NOTE:** 4.6L 2V shown; 3.8L and 4.6L 4V similar.

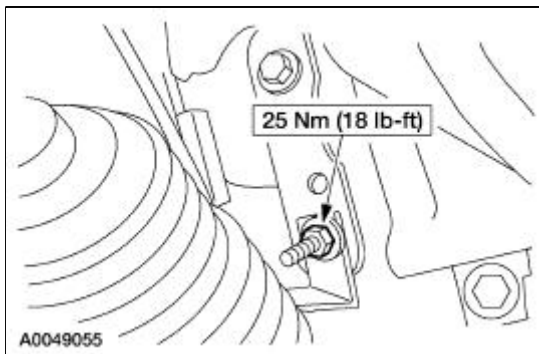
Remove the front lower cable harness bracket nuts.



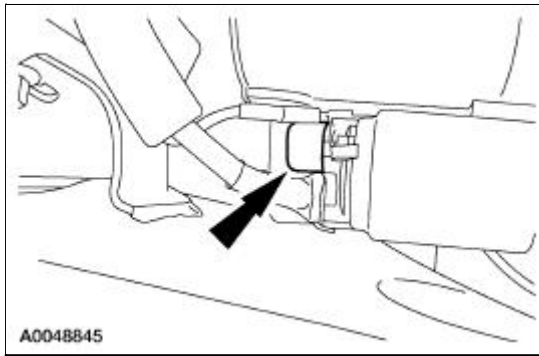
14. Pull the harness assembly downward until it clears the engine/radiator area.

15. **NOTE:** 4.6L 2V shown; 3.8L and 4.6L 4V similar.

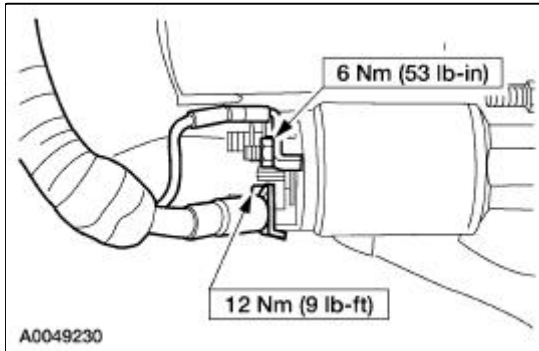
Remove the right engine mount cable harness bracket nut.



16. Remove the cover from the starter solenoid connections.



17. Remove the nuts and disconnect the starter solenoid electrical connections.



18. Pull the harness forward until it clears the motor mount, then remove the entire battery cable harness from the vehicle.

Installation

1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle needs to be driven to relearn the strategy.

To install, reverse the removal procedure.

General Specifications

Item	Specification
Generator 6G, 3.8L	1R3U-BA
Generator 6G, 4.6L 2V	XR3U-AB
Generator 4G, 4.6L 4V	2R3V-AA
Generator, 3.8L	65-110 amp (max) @ 1,500-6,000 gen rpm (3.03:1 ratio)
Generator, 4.6L 2V	50-110 amp (max) @ 1,500-6,000 gen rpm (3.16:1 ratio)
Generator, 4.6L 4V	58-120 amp (max) @ 1,500-6,000 gen rpm (2.87:1 ratio)
Electronic regulator internal to generator	—

Torque Specifications

Description	Nm	lb-ft	lb-in
Generator lower mounting bolts, 4.6L 2V	25	18	—
Generator mounting bolt, 3.8L upper	25	18	—
Generator mounting bolt, 3.8L lower	47	35	—
Generator upper mounting bolts, 4.6L 4V	50	37	—
Generator lower mounting bolt, 4.6L 4V	25	18	—
Generator mounting support bracket bolts, 4.6L 2V	10	—	89
Battery positive cable nut (B+) at generator	8	—	71

Generator

The charging system consists of the:

- generator (GEN)
- internal voltage regulator


The generator has an internal voltage regulator that is not installed separately. The generator and voltage regulator are installed as an assembly.

Generator

Refer to [Section 414-00](#) .

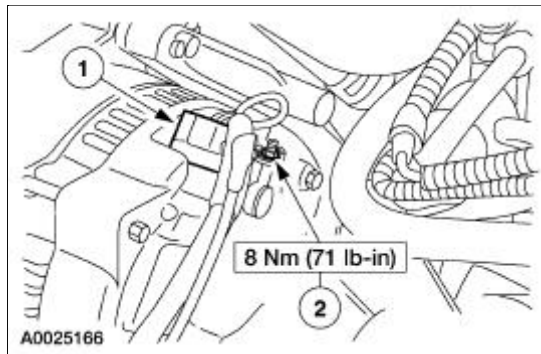
Generator —3.8L

Removal and Installation

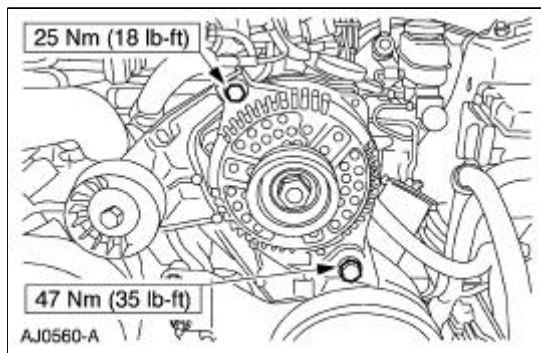
1. Disconnect the battery (10655). For additional information, refer to [Section 414-01](#).
2. Relieve the accessory drive belt (8620) tension and remove the belt from the generator pulley. Leave the belt in place for reinstallation. For additional information, refer to [Section 303-05](#).
3.  **CAUTION:** This is a new style connector that has a press-to-release tab. Pulling on the tab could result in damage to the connector or harness.

Disconnect the generator (10300).

1. Disconnect the generator electrical connectors.
2. Remove the battery positive cable nut.



4. Remove the generator.
 - Remove the upper and lower generator bolts.

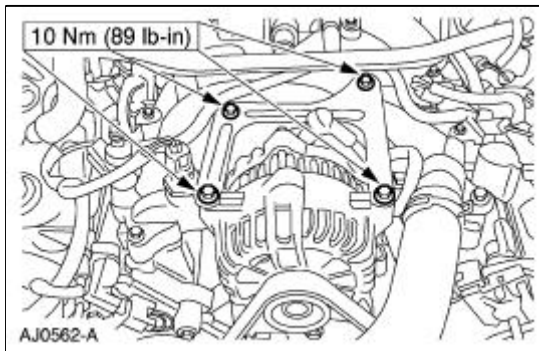


5. To install, reverse the removal procedure.

Generator —4.6L 2V

Removal and Installation

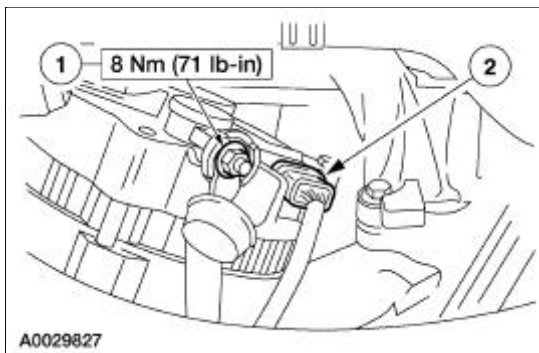
1. Disconnect the battery (10655). For additional information, refer to [Section 414-01](#).
2. Relieve the accessory drive belt (8620) tension and remove the belt from the generator pulley. Leave the belt in place for reinstallation. For additional information, refer to [Section 303-05](#).
3. Remove the bolts on the upper generator bracket and remove the bracket.



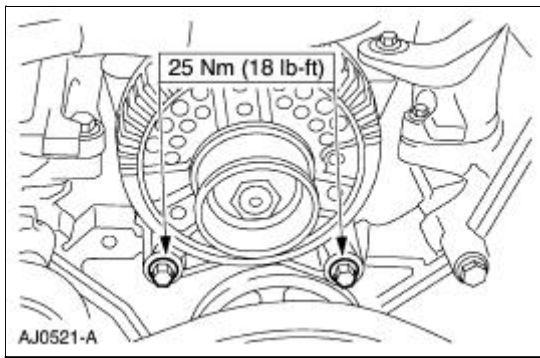
4.  **CAUTION:** This is a new style connector that has a press-to-release tab. Pulling on the tab could result in damage to the connector or harness.

Disconnect the generator electrical connections.

1. Remove the battery positive cable nut (1) and cable.
2. Disconnect the generator electrical connector.



5. Remove the lower generator bolts and remove the generator.

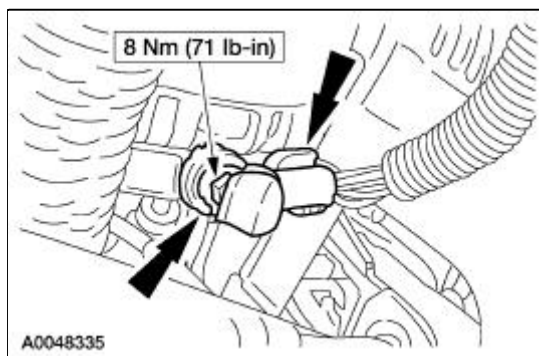


6. To install, reverse the removal procedure.
-

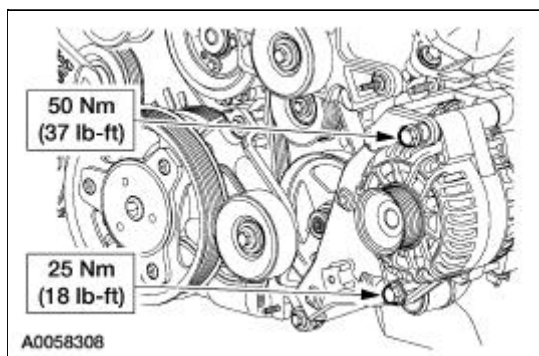
Generator —4.6L 4V

Removal and Installation

1. Disconnect the battery. For additional information, refer to [Section 414-01](#).
2. Relieve the accessory drive belt tension and remove the belt from the generator pulley.
3. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
4. Disconnect the generator electrical connections.
 - Disconnect the electrical connector.
 - Position the cover aside, and remove the nut and battery positive cable.



5. Remove the upper and lower generator bolts.




6. Remove the generator by lifting up and pulling it forward.
7. To install, reverse the removal procedure.

Audio System

Refer to Wiring Diagrams Cell [130](#), Radio for schematic and connector information.

Special Tool(s)

 <p>ST1137-A</p>	<p>73III Automotive Meter 105-R0057 or equivalent</p>
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Inspection and Verification

1. Verify the customer concern by operating the electronic audio system with the engine running.
2. Visually inspect the following for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> ● Audio unit ● Antenna or antenna cable ● Speakers mounting/speaker cones ● Radio ignition interference capacitor, radio frequency interference suppression bond or radio receiver hood bonding strap cleanliness 	<ul style="list-style-type: none"> ● Battery junction box (BJB) fuses: <ul style="list-style-type: none"> ■ 3 (40A) ■ 4 (40A) ■ 6 (40A) ● Central junction box (CJB) fuses: <ul style="list-style-type: none"> ■ 6 (20A) ■ 27 (25A) ■ 32 (15A) ● Ignition switch ● Circuitry ● Audio unit

3. If the concern remains and the fault is not detected, proceed to the Symptom Chart to continue diagnostics.

Symptom Chart

Symptom Chart

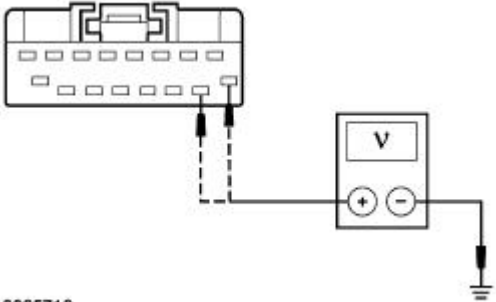
Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● The audio unit is inoperative/does not operate 	<ul style="list-style-type: none"> ● Central junction box 	<ul style="list-style-type: none"> ● Go To Pinpoint Test A.

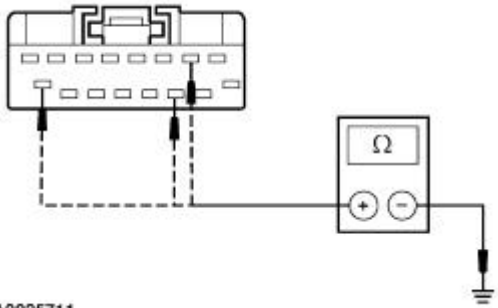
correctly	<ul style="list-style-type: none"> (CJB) fuses: <ul style="list-style-type: none"> ■ 6 (20A). ■ 27 (25A). ■ 32 (15A). ● Battery junction box (BJB) fuses: <ul style="list-style-type: none"> ■ 3 (40A). ■ 4 (40A). ■ 6 (40A). ● Circuitry. ● Audio unit. ● Ignition switch. 	
● Audio unit display blank — audio unit operates	● Audio unit.	● REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.
● Tape player only inoperative	● Audio unit.	● REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.
● Poor reception	<ul style="list-style-type: none"> ● Antenna connections. ● Antenna cable. ● Noise suppression equipment. ● Audio unit. ● Generator. ● Ignition system. 	● Go To Pinpoint Test B.
● Poor reception — FM only	● FM signal out of range.	● INFORM customer of methods for obtaining best reception.
● Continuous SEEK/SCAN in AM/FM	<ul style="list-style-type: none"> ● Antenna. ● Antenna connections. ● Audio unit. 	● Go To Pinpoint Test C.
● No sound from one or more of the speakers — not all speakers	<ul style="list-style-type: none"> ● Speaker(s). ● Circuitry. ● Audio unit. ● Subwoofer amplifier. 	● Go To Pinpoint Test D.
● No sound from all of the	● Audio unit.	● Go To Pinpoint Test

speakers	<ul style="list-style-type: none"> ● Subwoofer amplifier. ● Circuitry. 	E.
<ul style="list-style-type: none"> ● Poor quality sound from one or more speakers (not all speakers) 	<ul style="list-style-type: none"> ● Speaker(s). ● Circuitry. ● Audio unit. ● Subwoofer amplifier. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test E.
<ul style="list-style-type: none"> ● Poor quality sound from all speakers 	<ul style="list-style-type: none"> ● Audio unit. ● Speaker(s). ● Circuitry. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test G.
<ul style="list-style-type: none"> ● The subwoofer is inoperative 	<ul style="list-style-type: none"> ● Subwoofer. ● Subwoofer amplifier. ● Circuitry. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test H.
<ul style="list-style-type: none"> ● Loud popping when cycling the ignition switch 	<ul style="list-style-type: none"> ● Audio unit. ● Circuitry. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test L.
<ul style="list-style-type: none"> ● One or more audio control buttons (such as volume, seek, tune and scan) are not functional in either radio, tape, or CD mode or all modes 	<ul style="list-style-type: none"> ● Audio unit. 	<ul style="list-style-type: none"> ● REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.
<ul style="list-style-type: none"> ● When the headlamp switch is in park or headlamp position and the ignition switch is in the RUN or ACC position, the audio unit back lighting is inoperative — all other I/P lighting functions are normal 	<ul style="list-style-type: none"> ● Circuitry. ● Audio unit. 	<ul style="list-style-type: none"> ● REFER to Section 413-00.
<ul style="list-style-type: none"> ● The audio unit has two items that can be dimmed—the audio unit display and the control buttons; one dims and the other does not 	<ul style="list-style-type: none"> ● Audio unit. 	<ul style="list-style-type: none"> ● REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.
<ul style="list-style-type: none"> ● Irregular operation of display and indicator LEDs 	<ul style="list-style-type: none"> ● Audio unit. 	<ul style="list-style-type: none"> ● REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.
<ul style="list-style-type: none"> ● Response time between pressing any of the audio control buttons and system response is more than two seconds 	<ul style="list-style-type: none"> ● Audio unit. 	<ul style="list-style-type: none"> ● REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.

Pinpoint Tests

PINPOINT TEST A: THE AUDIO UNIT IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
A1 CHECK OPERATION OF THE AUDIO UNIT	
<ul style="list-style-type: none"> ● Key in ON position. ● Turn on the audio unit. ● Is the audio unit display illuminated? 	<p>Yes GO to A2.</p> <p>No GO to A4.</p>
A2 CHECK FOR SOUND COMING FROM THE SPEAKERS	
<ul style="list-style-type: none"> ● Verify that sound is coming from all the speakers. ● Is there sound coming from all the speakers? 	<p>Yes GO to A3.</p> <p>No GO to Pinpoint Test C.</p>
A3 CHECK THE AUDIO UNIT CONTROLS AND FEATURES	
<ul style="list-style-type: none"> ● Refer to the owner literature for audio system controls. ● Verify that the controls and features operate correctly. ● Do the controls and features operate correctly? 	<p>Yes System operation is normal at this time.</p> <p>No REMOVE the audio unit and SEND it to an authorized Ford audio system facility. TEST the system for normal operation.</p>
A4 CHECK VOLTAGE AT THE AUDIO UNIT	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Audio Unit C290b. ● Key in ON position. ● Measure the voltage between the audio unit C290b pin 10, circuit 1002 (BK/PK), harness side and ground, and between the audio unit C290b pin 9, circuit 828 (VT/LB), harness side and ground. <div style="text-align: center;">  <p style="font-size: small;">A0025710</p> </div> <ul style="list-style-type: none"> ● Are the voltages greater than 10 volts? 	<p>Yes GO to A5.</p> <p>No REPAIR the circuit (s) in question. TEST the system for normal operation.</p>
A5 CHECK THE GROUND CIRCUITS TO THE AUDIO UNIT	
<ul style="list-style-type: none"> ● Key in OFF position. ● Measure the resistance between the audio unit C290b pin 2, circuit 1205 (BK), harness side and ground; and between the audio unit C290b pin 11, circuit 694 (BK/LG), harness side and ground; and between the audio unit C290b pin 16, circuit 694 (BK/LG), harness side and ground 	<p>Yes REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the</p>



A0025711

- Are the resistances less than 5 ohms?

system for normal operation.

No
REPAIR the circuit (s) in question. TEST the system for normal operation.

PINPOINT TEST B: POOR RECEPTION

Test Step	Result / Action to Take
B1 CHECK ANTENNA CABLE CONNECTIONS	<p>Yes GO to B2.</p> <p>No CLEAN and SECURE the antenna connections as necessary. TEST the system for normal operation.</p>
<ul style="list-style-type: none"> ● Key in OFF position. ● Check the antenna connections including the extension cable. ● Check to make sure the antenna is securely mounted to the vehicle body at ground points. ● Are the connections clean, secure, and in metal-to-metal contact? 	
B2 CHECK SUPPRESSION EQUIPMENT/MOUNTING AND CONNECTING CIRCUITS	<p>Yes GO to B3.</p> <p>No CLEAN, SECURE, or INSTALL new suppression equipment as necessary. TEST the system for normal operation.</p>
<ul style="list-style-type: none"> ● Check all necessary suppression equipment and the radio frequency interference suppression bond. Refer to Section 415-01. ● Check the radio receiver hood bonding strap and the body-to-chassis straps for integrity, cleanliness, and metal-to-metal contact. ● NOTE: The capacitor mounting points are used to complete the electrical circuit and must be mounted securely to clean surfaces. ● Check the mounting and connecting circuits of the radio ignition interference capacitor for integrity, cleanliness, and metal-to-metal contact. ● Are the connections clean, secure, and in metal-to-metal contact? 	
B3 CHECK RADIO IGNITION INTERFERENCE CAPACITOR	<p>Yes INSTALL a new radio ignition interference capacitor. TEST the system for normal operation.</p> <p>No GO to B4.</p>
<ul style="list-style-type: none"> ● Check the operation of the radio ignition interference capacitor by substituting it with a known good component. ● Key in START position. ● Turn the audio unit on and check the radio reception. 	

<ul style="list-style-type: none"> ● Is the noise eliminated? 	
B4 CHECK GENERATOR	
<ul style="list-style-type: none"> ● Key in OFF position. ● Check the generator by disconnecting the wiring from the voltage regulator. ● Key in START position. ● Turn on the audio unit and check the radio reception. ● Is the noise eliminated? 	<p>Yes INSTALL a new generator. REFER to Section 414-02. TEST the system for normal operation.</p> <p>No GO to B5.</p>
B5 CHECK IGNITION CIRCUITS	
<ul style="list-style-type: none"> ● Key in OFF position. ● Check the ignition circuits for correct routing, grounding, and integrity of connections. ● Are the ignition components OK? 	<p>Yes GO to B6.</p> <p>No REPAIR the ignition system as necessary. TEST the system for normal operation.</p>
B6 SUBSTITUTE ANTENNA	
<ul style="list-style-type: none"> ● Substitute a known good antenna. Ground the antenna base to an unpainted metal surface on the vehicle. ● Key in START position. ● Verify the operation of the audio unit. ● Is the noise eliminated? 	<p>Yes INSTALL a new antenna. TEST the system for normal operation.</p> <p>No GO to B7.</p>
B7 SUBSTITUTE ANTENNA CABLE	
<ul style="list-style-type: none"> ● Key in OFF position. ● Substitute a known good antenna cable. ● Key in START position. ● Verify the operation of the audio unit. ● Is the noise eliminated? 	<p>Yes INSTALL a new antenna cable. TEST the system for normal operation.</p> <p>No GO to B8.</p>
B8 SUBSTITUTE AUDIO UNIT	
<ul style="list-style-type: none"> ● Key in OFF position. ● Substitute a known good audio unit. ● Key in START position. ● Verify the operation of the audio unit. ● Is the noise eliminated? 	<p>Yes REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.</p> <p>No GO to B9.</p>
B9 SUBSTITUTE SUBWOOFER AMPLIFIER	
<ul style="list-style-type: none"> ● Key in OFF position. ● Substitute a known good subwoofer amplifier. ● Key in START position. ● Verify the operation of the audio unit. ● Is the noise eliminated? 	<p>Yes REMOVE the subwoofer amplifier and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.</p> <p>No GO to B10.</p>
B10 REPOSITION COMPONENTS	
<ul style="list-style-type: none"> ● Key in OFF position. ● Determine if the noise can be eliminated by repositioning the antenna cable, speaker circuits, or audio unit power feed circuits away from other circuits or brackets. ● Key in START position. ● Verify the operation of the audio unit. 	<p>Yes Permanently REPOSITION the components as needed. TEST the system for normal operation.</p> <p>No GROUND various parts (for example, engine, fenders, quarter panels, stone deflectors, body sheet metal) of the vehicle to the frame using a</p>

<ul style="list-style-type: none"> ● Is the noise eliminated? 	jumper cable. When noise is eliminated, PROVIDE a permanent ground where necessary. TEST the system for normal operation.
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PINPOINT TEST C: CONTINUOUS SEEK/SCAN IN AM/FM

Test Step	Result / Action to Take
C1 CHECK OPERATION OF THE SEEK/SCAN FUNCTIONS	
<ul style="list-style-type: none"> ● Key in ON position. ● Operate the SEEK/SCAN functions with the audio unit in both AM and FM tuner modes. ● Do the SEEK/SCAN functions search continuously? 	<p>Yes GO to C2.</p> <p>No The system is OK.</p>
C2 CHECK ANTENNA FOR DAMAGE	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Antenna Lead Terminal. ● Measure the resistance between the antenna cable lead terminal and the end of the antenna grid wire. ● Is the resistance less than 8 ohms? 	<p>Yes GO to C3.</p> <p>No REPAIR the antenna. REFER to Section 415-02</p>
C3 SUBSTITUTE ANTENNA EXTENSION CABLE	
<ul style="list-style-type: none"> ● Substitute a known good antenna cable between the audio unit and the antenna. ● Key in START position. ● Check the operation of the audio unit. ● Is the noise eliminated? 	<p>Yes INSTALL a new antenna extension cable. REFER to Section 415-02. TEST the system for normal operation.</p> <p>No REINSTALL the original cable. REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.</p>

PINPOINT TEST D: NO SOUND FROM ONE OR MORE OF THE SPEAKERS — NOT ALL SPEAKERS

Test Step	Result / Action to Take
D1 CHECK FOR SOUND	
<ul style="list-style-type: none"> ● Key in ON position. ● Turn on the audio unit. ● Are all speakers without sound? 	<p>Yes GO to Pinpoint Test E.</p> <p>No For convertible, GO to D2.</p> <p>For coupe, GO to D4.</p>

For Mach 1000 subwoofer speakers, GO to [D8](#).

D2 CHECK CIRCUITS BETWEEN THE AFFECTED SPEAKER(S) AND SUBWOOFER AMPLIFIERS

- Disconnect: Subwoofer Amplifier C4108a.
- Disconnect: Subwoofer Amplifier C4109b.
- Disconnect: Affected Speaker(s).
- Measure the resistance between the subwoofer amplifier and the affected speaker(s) and between the subwoofer amplifier and ground as follows:

Speaker Circuits

Affected Speaker Pin	Subwoofer Amplifier Pin	Circuit
RF 1 (convertible only)	LH 7	822 (BK/LG)
RF 2 (convertible only)	LH 8	287 (BK/WH)
LF 1 (convertible only)	LH 7	822 (BK/LG)
LF 2 (convertible only)	LH 8	287 (BK/WH)
RR 1	RH 7	822 (BK/LG)
RR 2	RH 8	287 (BK/WH)
LR 1	RH 7	822 (BK/LG)
LR 2	RH 8	287 (BK/WH)

- Are the resistances less than 5 ohms between the subwoofer amplifier and the affected speaker(s) and greater than 10,000 ohms between the subwoofer amplifier and ground?

Yes
GO to [D3](#).

No
REPAIR the circuit (s) in question.
TEST the system for normal operation.

D3 CHECK CIRCUITS BETWEEN THE AUDIO UNIT AND THE SUBWOOFER AMPLIFIERS

- Disconnect: Audio Unit C290b.
- Disconnect: Subwoofer Amplifier C4108a.
- Disconnect: Subwoofer Amplifier C4109b.
- Measure the resistance between the subwoofer amplifier and the audio unit C290b and between the subwoofer amplifier and ground as follows:

Speaker Circuits

Audio Unit C290b Pin	Subwoofer Amplifier Pin	Circuit
2	LH 5	167 (BN/OG)
6	RH 5	169 (LG/BK)
1	LH 6	168 (RD/BK)
5	RH 6	172 (LB/RD)

- Are the resistances less than 5 ohms between the subwoofer amplifier and the audio unit and greater than 10,000 ohms between the subwoofer amplifier and ground?

Yes
GO to [D6](#).

No
REPAIR the circuit (s) in question.
TEST the system for normal operation.

D4 CHECK CIRCUITS BETWEEN THE AFFECTED SPEAKER(S) AND SUBWOOFER AMPLIFIER

- Disconnect: Subwoofer Amplifier C4109b.
- Disconnect: Affected Speaker(s).
- Measure the resistance between the subwoofer amplifier and the

Yes
GO to [D5](#).

affected speaker(s) and between the subwoofer amplifier and ground as follows:

Speaker Circuits

Affected Speaker Pin	Subwoofer Amplifier Pin	Circuit
RR 1	7	822 (BK/LG)
RR 2	8	287 (BK/WH)
LR 1	7	822 (BK/LG)
LR 2	8	287 (BK/WH)

- Are the resistances less than 5 ohms between the subwoofer amplifier and affected speaker(s) and greater than 10,000 ohms between the subwoofer amplifier and ground?

No
REPAIR the circuit (s) in question. TEST the system for normal operation.

D5 CHECK CIRCUITS BETWEEN THE AUDIO UNIT AND THE SUBWOOFER AMPLIFIER

- Disconnect: Audio Unit C290b.
- Disconnect: Subwoofer Amplifier C4109b.
- Measure the resistance between the subwoofer amplifier C4109b pin 5, circuit 169 (LG/BK), harness side and the audio unit C290a pin 6, circuit 169 (LG/BK), harness side and between the subwoofer amplifier C4109b pin 5, circuit 169 (LG/BK), harness side and ground; and between the subwoofer amplifier C4109b pin 6, circuit 172 (LB/RD), harness side and the audio unit C290a pin 5, circuit 172 (LB/RD), harness side and between the subwoofer amplifier C4109b pin 6, circuit 172 (LB/RD), harness side and ground.
- Are the resistances less than 5 ohms between the subwoofer amplifier and the audio unit and greater than 10,000 ohms between the subwoofer amplifier and ground?

Yes
GO to [D6](#).

No
REPAIR the circuit (s) in question. TEST the system for normal operation.

D6 CHECK SPEAKER(S)

- Key in OFF position.
- Substitute the affected speaker with a known good component.
- Key in ON position.
- Turn on the audio unit.
- Is the affected speaker(s) operational?

Yes
INSTALL a new speaker. TEST the system for normal operation.

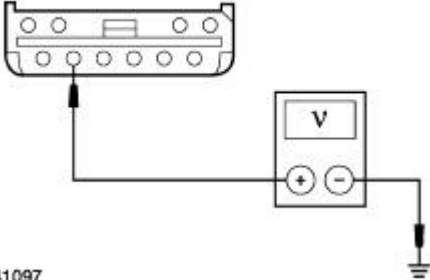
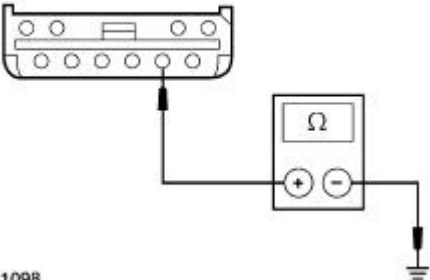
No
GO to [D7](#).

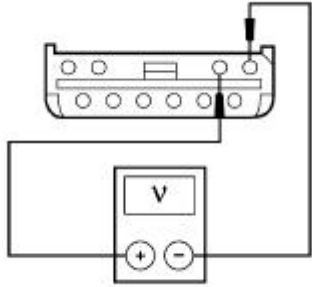
D7 CHECK THE AUDIO UNIT

- Key in OFF position.
- Substitute the affected audio unit with a known good component.
- Key in ON position.
- Turn on the audio unit.
- Is the affected speaker(s) operational?

Yes
SEND the audio unit to an authorized Ford audio system repair facility. TEST the system for normal operation.

No
REMOVE the subwoofer amplifier and SEND it to an authorized Ford audio system repair facility. TEST the system

	for normal operation.
D8 CHECK FOR POWER TO THE AFFECTED SUBWOOFER AMPLIFIER	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Mach 1000 Affected Subwoofer Amplifier. ● Measure the voltage between affected subwoofer amplifier pin 5, circuit 828 (VT/LB) (left amplifiers) and ground, or between pin 5, circuit 829 (WH/VT) (right amplifiers) and ground.  <p>A0041097</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to D9.</p> <p>No REPAIR the circuit (s) in question. TEST the system for normal operation.</p>
D9 CHECK FOR GROUND TO THE AFFECTED SUBWOOFER AMPLIFIER	
<ul style="list-style-type: none"> ● NOTE: Ground circuit 694 is located in the same cavity in all four subwoofer amplifiers. ● Measure the resistance between affected subwoofer amplifier pin 2, circuit 694 (BK/LG) and ground.  <p>A0041098</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes GO to D10.</p> <p>No REPAIR the circuit (s) in question. TEST the system for normal operation.</p>
D10 CHECK FOR AN AUDIO SIGNAL TO THE AFFECTED SUBWOOFER AMPLIFIER	
<ul style="list-style-type: none"> ● Key in ON position. ● NOTE: Audio signal circuits 169 and 172 are located in the same cavity on all four subwoofer amplifiers. ● Turn on the audio unit and check for a fluctuating AC voltage between affected subwoofer amplifier pin 8, circuit 172 (LB/RD) and pin 7, circuit 169 (LG/BK). 	<p>Yes GO to D12.</p> <p>No GO to D11.</p>



A0041099

- Does the voltage vary as the volume is adjusted?

D11 CHECK AUDIO SIGNAL CIRCUITS AT THE AFFECTED SUBWOOFER AMPLIFIER FOR OPEN AND SHORT TO GROUND

- Key in OFF position.
- Disconnect: Audio Unit C290a.
- Measure the resistance between the affected subwoofer amplifier and the audio unit C290a, and between the affected subwoofer amplifier and ground as follows:

Speaker Circuits

Audio Unit C290a Pin	Subwoofer Amplifier Pin	Circuit
2	8	172 (LB/RD)
8	7	169 (LG/BK)

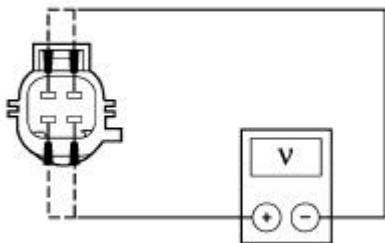
- Is the resistance less than 5 ohms between the audio unit and subwoofer amplifier and greater than 10,000 ohms between the subwoofer amplifier and ground?

Yes
SEND the audio unit to an authorized Ford audio system repair facility. TEST the system for normal operation.

No
REPAIR the circuit (s) in question. TEST the system for normal operation.

D12 CHECK FOR AN AUDIO SIGNAL AT THE AFFECTED SUBWOOFER

- Key in OFF position.
- Connect: Affected Subwoofer Amplifier.
- Disconnect: Affected Subwoofer Speaker .
- Key in ON position.
- Turn on the audio unit and check for a fluctuating AC voltage between affected subwoofer as follows: For right subwoofer pin 4, circuit 187 (DB/OG) and pin 2, circuit 189 (LG/BK) harness side; and between pin 3, circuit 179 (OR/RD) and pin 1, circuit 176 (PK/LG) harness side. For left subwoofer pin 1, circuit 187 (DB/OR) and pin 3, circuit 189 (LG/BK) harness side; and between pin 2, circuit 179 (OR/RD) and pin 4, circuit 176 (PK/LG) harness side.



A0041100

- Does the voltage vary as the volume is adjusted?

Yes
INSTALL a new subwoofer speaker.

No
GO to [D13](#).

D13 CHECK FOR AN OPEN AND SHORT TO GROUND BETWEEN THE AFFECTED SUBWOOFER AND ITS RESPECTIVE AMPLIFIERS

- Key in OFF position.

Yes

- Disconnect: Respective Amplifier to Subwoofer Speaker Connector.
- Measure the resistance between the affected subwoofer speaker and its respective amplifiers, and between the affected subwoofer speaker and ground as follows:

INSTALL a new subwoofer amplifier.

Speaker Circuits—Right Side

Affected Subwoofer Speaker Pin	Respective Amplifier Pin	Circuit
1	4	176 (PK/LG)
3	3	179 (OR/RD)
2	4	189 (TN/LB)
4	3	187 (DB/OR)

No
REPAIR the circuit (s) in question. TEST the system for normal operation.

Speaker Circuits—Left Side

Affected Subwoofer Speaker Pin	Respective Amplifier Pin	Circuit
1	4	176 (PK/LG)
3	3	179 (OR/RD)
2	4	189 (TN/LB)
4	3	187 (DB/OR)

- Is the resistance less than 5 ohms between the amplifier and subwoofer speaker and greater than 10,000 ohms between the subwoofer speaker harness and ground?

PINPOINT TEST E: NO SOUND FROM ALL OF THE SPEAKERS

Test Step	Result / Action to Take
E1 CHECK FOR AUDIO UNIT OPERATION	
<ul style="list-style-type: none"> ● Key in ON position. ● Turn the audio unit on. ● Does the audio unit display illuminate? 	<p>Yes GO to E2.</p> <p>No GO to Pinpoint Test A.</p>
E2 CHECK THE SPEAKER OPERATION	
<ul style="list-style-type: none"> ● Check the operation of all speakers. ● Are all speakers inoperative? 	<p>Yes REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.</p>

No
GO to [Pinpoint Test D.](#)

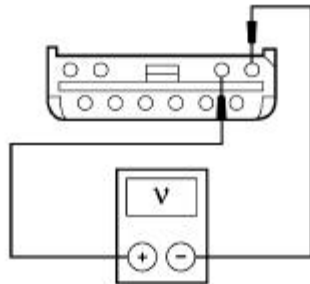
PINPOINT TEST F: POOR QUALITY SOUND FROM ONE OR MORE SPEAKERS (NOT ALL SPEAKERS)

Test Step	Result / Action to Take																											
<p>F1 CHECK SOUND QUALITY</p> <ul style="list-style-type: none"> ● Key in ON position. ● Turn on the audio unit. ● Carry out the speaker walk-around test by pressing preset buttons 3 and 6 simultaneously. ● Do all speakers have poor sound quality? 	<p>Yes REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.</p> <p>No For convertible, GO to F2.</p> <p>For coupe, GO to F4.</p> <p>For Mach 1000 subwoofer speakers, GO to F6.</p>																											
<p>F2 CHECK CIRCUITS BETWEEN AFFECTED SPEAKER(S) AND SUBWOOFER AMPLIFIERS</p> <ul style="list-style-type: none"> ● Disconnect: Subwoofer Amplifier C4108a. ● Disconnect: Subwoofer Amplifier C4109b. ● Disconnect: Affected Speaker(s). ● Measure the resistance between the subwoofer amplifier and the affected speaker(s) and between subwoofer amplifier and ground as follows: <p>Speaker Circuits</p> <table border="1"> <thead> <tr> <th>Affected Speaker Pin</th> <th>Subwoofer Amplifier Pin</th> <th>Circuit</th> </tr> </thead> <tbody> <tr> <td>RF 1 (convertible only)</td> <td>LH 7</td> <td>822 (BK/LG)</td> </tr> <tr> <td>RF 2 (convertible only)</td> <td>LH 8</td> <td>287 (BK/WH)</td> </tr> <tr> <td>LF 1 (convertible only)</td> <td>LH 7</td> <td>822 (BK/LG)</td> </tr> <tr> <td>LF 2 (convertible only)</td> <td>LH 8</td> <td>287 (BK/WH)</td> </tr> <tr> <td>RR 1</td> <td>RH 7</td> <td>822 (BK/LG)</td> </tr> <tr> <td>RR 2</td> <td>RH 8</td> <td>287 (BK/WH)</td> </tr> <tr> <td>LR 1</td> <td>RH 7</td> <td>822 (BK/LG)</td> </tr> <tr> <td>LR 2</td> <td>RH 8</td> <td>287 (BK/WH)</td> </tr> </tbody> </table> <ul style="list-style-type: none"> ● Are the resistances less than 5 ohms between the subwoofer amplifier and the affected speaker(s) and greater than 10,000 	Affected Speaker Pin	Subwoofer Amplifier Pin	Circuit	RF 1 (convertible only)	LH 7	822 (BK/LG)	RF 2 (convertible only)	LH 8	287 (BK/WH)	LF 1 (convertible only)	LH 7	822 (BK/LG)	LF 2 (convertible only)	LH 8	287 (BK/WH)	RR 1	RH 7	822 (BK/LG)	RR 2	RH 8	287 (BK/WH)	LR 1	RH 7	822 (BK/LG)	LR 2	RH 8	287 (BK/WH)	<p>Yes GO to F3.</p> <p>No REPAIR the circuit (s) in question. TEST the system for normal operation.</p>
Affected Speaker Pin	Subwoofer Amplifier Pin	Circuit																										
RF 1 (convertible only)	LH 7	822 (BK/LG)																										
RF 2 (convertible only)	LH 8	287 (BK/WH)																										
LF 1 (convertible only)	LH 7	822 (BK/LG)																										
LF 2 (convertible only)	LH 8	287 (BK/WH)																										
RR 1	RH 7	822 (BK/LG)																										
RR 2	RH 8	287 (BK/WH)																										
LR 1	RH 7	822 (BK/LG)																										
LR 2	RH 8	287 (BK/WH)																										

ohms between the subwoofer amplifier and ground?																
F3 CHECK CIRCUITS BETWEEN THE AUDIO UNIT AND THE SUBWOOFER AMPLIFIERS																
<ul style="list-style-type: none"> ● Disconnect: Audio Unit C290b. ● Disconnect: Subwoofer Amplifier C4108b. ● Disconnect: Subwoofer Amplifier C4109b. ● Measure the resistance between subwoofer amplifier and audio unit C290a and between subwoofer amplifier and ground as follows: <p>Speaker Circuits</p> <table border="1"> <thead> <tr> <th>Audio Unit C290a Pin</th> <th>Subwoofer Amplifier Pin</th> <th>Circuit</th> </tr> </thead> <tbody> <tr> <td>2</td> <td>LH 5</td> <td>167 (BN/OG)</td> </tr> <tr> <td>6</td> <td>RH 5</td> <td>169 (LG/BK)</td> </tr> <tr> <td>1</td> <td>LH 6</td> <td>168 (RD/BK)</td> </tr> <tr> <td>5</td> <td>RH 6</td> <td>172 (LB/RD)</td> </tr> </tbody> </table> <ul style="list-style-type: none"> ● Are the resistances less than 5 ohms between the subwoofer amplifier and the audio unit and greater than 10,000 ohms between the subwoofer amplifier and ground? 	Audio Unit C290a Pin	Subwoofer Amplifier Pin	Circuit	2	LH 5	167 (BN/OG)	6	RH 5	169 (LG/BK)	1	LH 6	168 (RD/BK)	5	RH 6	172 (LB/RD)	<p>Yes GO to F6.</p> <p>No REPAIR the circuit (s) in question. TEST the system for normal operation.</p>
Audio Unit C290a Pin	Subwoofer Amplifier Pin	Circuit														
2	LH 5	167 (BN/OG)														
6	RH 5	169 (LG/BK)														
1	LH 6	168 (RD/BK)														
5	RH 6	172 (LB/RD)														
F4 CHECK CIRCUITS BETWEEN AFFECTED SPEAKER(S) AND SUBWOOFER AMPLIFIER																
<ul style="list-style-type: none"> ● Disconnect: Subwoofer Amplifier C4109b. ● Disconnect: Affected Speaker(s). ● Measure the resistance between subwoofer amplifier and the affected speaker(s) and between subwoofer amplifier and ground as follows: <p>Speaker Circuits</p> <table border="1"> <thead> <tr> <th>Affected Speaker Pin</th> <th>Subwoofer Amplifier Pin</th> <th>Circuit</th> </tr> </thead> <tbody> <tr> <td>RR 1</td> <td>7</td> <td>822 (BK/LG)</td> </tr> <tr> <td>RR 2</td> <td>8</td> <td>287 (BK/WH)</td> </tr> <tr> <td>LR 1</td> <td>7</td> <td>822 (BK/LG)</td> </tr> <tr> <td>LR 2</td> <td>8</td> <td>287 (BK/WH)</td> </tr> </tbody> </table> <ul style="list-style-type: none"> ● Are the resistances less than 5 ohms between the subwoofer amplifier and the affected speaker(s) and greater than 10,000 ohms between the subwoofer amplifier and ground? 	Affected Speaker Pin	Subwoofer Amplifier Pin	Circuit	RR 1	7	822 (BK/LG)	RR 2	8	287 (BK/WH)	LR 1	7	822 (BK/LG)	LR 2	8	287 (BK/WH)	<p>Yes GO to F5.</p> <p>No REPAIR the circuit (s) in question. TEST the system for normal operation.</p>
Affected Speaker Pin	Subwoofer Amplifier Pin	Circuit														
RR 1	7	822 (BK/LG)														
RR 2	8	287 (BK/WH)														
LR 1	7	822 (BK/LG)														
LR 2	8	287 (BK/WH)														
F5 CHECK CIRCUITS BETWEEN THE AUDIO UNIT AND THE SUBWOOFER AMPLIFIER																
<ul style="list-style-type: none"> ● Disconnect: Audio Unit C290b. ● Disconnect: Subwoofer Amplifier C4109b. ● Measure the resistance between the subwoofer amplifier C4109b pin 5, circuit 169 (LG/BK), harness side and the audio unit C290a pin 6, circuit 169 (LG/BK), harness side and between the subwoofer amplifier C4109b pin 5, circuit 169 (LG/BK), harness side and ground; and between the subwoofer amplifier C4109b pin 6, circuit 172 (LB/RD), harness side and the audio unit C290a pin 5, circuit 172 (LB/RD), harness side and between the subwoofer amplifier C4109b pin 6, circuit 172 (LB/RD), harness side and ground. ● Are the resistances less than 5 ohms between the subwoofer amplifier and the audio unit and greater than 10,000 ohms between the subwoofer amplifier and ground? 	<p>Yes GO to F10.</p> <p>No REPAIR the circuit (s) in question. TEST the system for normal operation.</p>															
F6 CHECK FOR AN AUDIO SIGNAL TO THE SUBWOOFER																

AMPLIFIER HARNESS

- Key in OFF position.
- Disconnect: Mach 1000 Affected Subwoofer Amplifier.
- Key in ON position.
- **NOTE:** Audio signal circuits 169 and 172 are located in the same cavity on all four subwoofers.
- Turn on the audio unit and check for a fluctuating AC voltage between affected subwoofer amplifier pin 8, circuit 172 (LB/RD) and pin 7, circuit 169 (LG/BK).



A0041099

- Does the voltage vary as the volume is adjusted?

Yes
GO to [F8](#).

No
GO to [F7](#).

F7 CHECK AUDIO SIGNAL CIRCUITS AT THE AFFECTED SUBWOOFER AMPLIFIER FOR OPEN AND SHORT TO GROUND

- Key in OFF position.
- Disconnect: Audio Unit C290a.
- Measure the resistance between the affected subwoofer amplifier and the audio unit C290a and between the affected subwoofer amplifier and ground as follows:

Speaker Circuits

Audio Unit C290a Pin	Affected Subwoofer Amplifier Pin	Circuit
2	8	172 (LB/RD)
8	7	169 (LG/BK)

- Is the resistance less than 5 ohms between the audio unit and subwoofer amplifier harness and greater than 10,000 ohms between the subwoofer amplifier harness and ground?

Yes
SEND the audio unit to an authorized Ford audio system repair facility. TEST the system for normal operation.

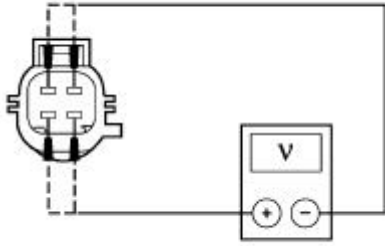
No
REPAIR the circuit (s) in question. TEST the system for normal operation.

F8 CHECK FOR AN AUDIO SIGNAL AT THE AFFECTED SUBWOOFER

- Key in OFF position.
- Connect: Affected Subwoofer Amplifier.
- Disconnect: Affected Subwoofer Speaker.
- Key in ON position.
- Turn on the audio unit and check for a fluctuating AC voltage between affected subwoofer as follows: For right subwoofer pin 4, circuit 187 (DB/OG) and pin 2, circuit 189 (LG/BK) harness side; and between pin 3, circuit 179 (OR/RD) and pin 1, circuit 176 (PK/LG) harness side. For left subwoofer pin 1, circuit 187 (DB/OR) and pin 3, circuit 189 (LG/BK) harness side; and between pin 2, circuit 179 (OR/RD) and pin 4, circuit 176 (PK/LG) harness side.

Yes
INSTALL a new subwoofer speaker

No
GO to [F9](#)



A0041100

- Does the voltage vary as the volume is adjusted?

F9 CHECK FOR AN OPEN AND SHORT TO GROUND BETWEEN THE AFFECTED SUBWOOFER AND ITS RESPECTIVE AMPLIFIERS

- Key in OFF position.
- Disconnect: Affected Subwoofer.
- Disconnect: Respective Amplifier.
- Measure the resistance between the affected subwoofer speaker and its respective amplifiers, and between the affected subwoofer speaker and ground as follows:

Speaker Circuits—Right Side

Affected Subwoofer Speaker Pin	Respective Amplifier Pin	Circuit
1	4	176 (PK/LG)
3	3	179 (OR/RD)
2	4	189 (TN/LB)
4	3	187 (DB/OR)

Speaker Circuits—Left Side

Affected Subwoofer Speaker Pin	Respective Amplifier Pin	Circuit
1	4	176 (PK/LG)
3	3	179 (OR/RD)
2	4	189 (TN/LB)
4	3	187 (DB/OR)

- Is the resistance less than 5 ohms between the amplifier and subwoofer speaker and greater that 10,000 ohms between the subwoofer speaker harness and ground?

Yes
INSTALL a new subwoofer amplifier.

No
REPAIR the circuit (s) in question. TEST the system for normal operation.

F10 CHECK SPEAKER(S)

- Key in OFF position.
- Substitute the affected speaker with a known good component.
- Key in ON position.

Yes
INSTALL a new speaker. TEST the

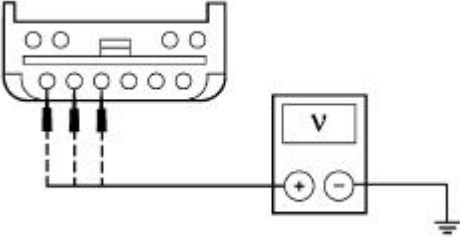
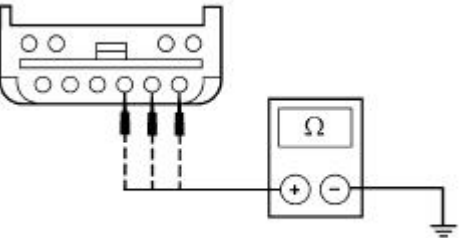
<ul style="list-style-type: none"> ● Turn on the audio unit. ● Is the sound quality OK? 	<p>system for normal operation.</p> <p>No GO to F7.</p>
F11 CHECK THE AUDIO UNIT	
<ul style="list-style-type: none"> ● Key in OFF position. ● Substitute the affected audio unit with a known good component. ● Key in ON position. ● Turn on the audio unit. ● Is the sound quality OK? 	<p>Yes SEND the audio unit to an authorized Ford audio system repair facility. TEST the system for normal operation.</p> <p>No REMOVE the subwoofer amplifier and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.</p>

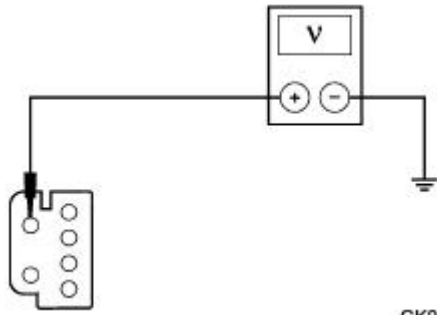
PINPOINT TEST G: POOR QUALITY SOUND FROM ALL SPEAKERS

Test Step	Result / Action to Take
G1 CHECK POOR SOUND QUALITY IN ALL SPEAKERS	
<ul style="list-style-type: none"> ● Key in ON position. ● Turn on the audio unit. ● Carry out the speaker walk-around test by pressing preset buttons 3 and 6 simultaneously. ● Is there poor quality or distortion in all speakers? 	<p>Yes REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.</p> <p>No GO to Pinpoint Test F.</p>

PINPOINT TEST H: THE SUBWOOFER IS INOPERATIVE

Test Step	Result / Action to Take
H1 CHECK THE SUBWOOFER OPERATION	
<ul style="list-style-type: none"> ● Key in ON position. ● Turn on the audio unit and listen for correct subwoofer operation. ● Are all subwoofers inoperative? 	<p>Yes GO to H16.</p> <p>No For convertible, GO to H2.</p> <p>For coupe, GO to H6.</p>

	<p>For Mach 1000 subwoofer speakers, GO to H10.</p>
<p>H2 CHECK POWER TO THE SUBWOOFER AMPLIFIERS</p>	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: LH Subwoofer Amplifier C4108a. ● Disconnect: RH Subwoofer Amplifier C4109b. ● Key in ON position. ● Turn on the audio unit. ● Measure the voltage between the subwoofer amplifiers pin 4, circuit 828 (VT/LB), harness side and ground; and between the subwoofer amplifiers pin 5, circuit 828 (VT/LB), harness side and ground; and between the subwoofer amplifiers pin 6, circuit 828 (VT/LB), harness side and ground.  <p style="text-align: center;">GK9835-A</p> <ul style="list-style-type: none"> ● Are the voltages greater than 10 volts? 	<p>Yes GO to H3.</p> <p>No REPAIR the circuit (s) in question. TEST the system for normal operation.</p>
<p>H3 CHECK GROUND TO THE SUBWOOFER AMPLIFIERS</p>	
<ul style="list-style-type: none"> ● Measure the resistance between the subwoofer amplifiers C4108a (LH) or C4109a (RH) pin 1, circuit 694 (BK/LG), harness side and ground; and between the subwoofer amplifiers C4108a (LH) or C4109a (RH) pin 2, circuit 694 (BK/LG), harness side and ground; and between the subwoofer amplifiers C4108a (LH) or C4109a (RH) pin 3, circuit 694 (BK/LG), harness side and ground.  <p style="text-align: center;">GK9836-A</p> <ul style="list-style-type: none"> ● Are the resistances less than 5 ohms? 	<p>Yes GO to H4.</p> <p>No REPAIR the circuit (s) in question. TEST the system for normal operation.</p>
<p>H4 CHECK THE SUBWOOFER AMPLIFIER ENABLE CIRCUIT FOR POWER</p>	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Subwoofer Amplifier C4109b. ● Disconnect: Subwoofer Amplifier C4108b. ● Key in ON position. ● Turn the audio unit on. ● Measure the voltage between the LH subwoofer amplifier C4108b pin 2, circuit 173 (DG/VT), harness side and ground; and between the RH subwoofer amplifier C4109b pin 2, circuit 174 (GY/BK), harness side and ground. 	<p>Yes GO to H5.</p> <p>No REPAIR the circuit (s) in question. TEST the system for normal operation.</p>



GK9837-A

- Is voltage indicated?

H5 CHECK THE AUDIO UNIT

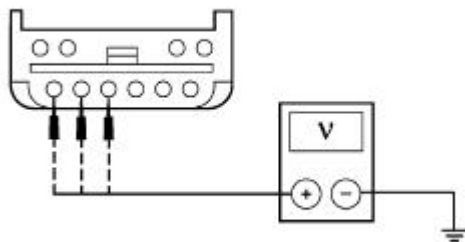
- Substitute a known good audio unit.
- Verify the operation of the audio unit.
- Does the audio unit operate correctly?

Yes
SEND the audio unit to an authorized Ford audio system repair facility. TEST the system for normal operation.

No
REMOVE the subwoofer amplifier and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.

H6 CHECK THE VOLTAGE TO THE SUBWOOFER AMPLIFIER

- Key in OFF position.
- Disconnect: Subwoofer Amplifier C4109b.
- Key in ON position.
- Turn on the audio unit.
- Measure the voltage between the subwoofer amplifier C4109b pin 5, circuit 828 (VT/LB), harness side and ground; between the subwoofer amplifier C4109b pin 6, circuit 828 (VT/LB), harness side and ground; and between the subwoofer amplifier C4109b pin 7, circuit 828 (VT/LB), harness side and ground.



GK9835-A

- Are the voltages greater than 10 volts?

Yes
GO to [H7](#).

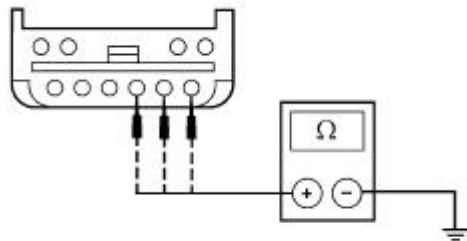
No
REPAIR the circuit (s) in question. TEST the system for normal operation.

H7 CHECK THE GROUND TO THE SUBWOOFER AMPLIFIER

- Measure the resistance between the subwoofer amplifier C4109b pin 1, circuit 694 (BK/LG), harness side and ground; between the

Yes
GO to [H8](#).

subwoofer amplifier C4109b pin 2, circuit 694 (BK/LG), harness side and ground; and between the subwoofer amplifier C4109b pin 3, circuit 694 (BK/LG), harness side and ground.



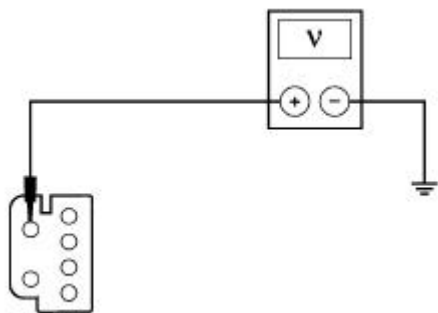
GK9836-A

- Are the resistances less than 5 ohms?

No
REPAIR the circuit (s) in question.
TEST the system for normal operation.

H8 CHECK THE SUBWOOFER ENABLE CIRCUIT FOR POWER

- Key in OFF position.
- Disconnect: Subwoofer Amplifier C4109b.
- Key in ON position.
- With the audio unit turned on, measure the voltage between the subwoofer amplifier C4109b pin 2, circuit 173 (DG/VT), harness side and ground.



GK9837-A

- Is voltage indicated?

Yes
GO to [H9](#).

No
REPAIR the circuit (s) in question.
TEST the system for normal operation.

H9 CHECK CIRCUITS BETWEEN THE AUDIO UNIT AND THE SUBWOOFER AMPLIFIER

- Disconnect: Audio Unit C290b.
- Disconnect: Subwoofer Amplifier C4109b.
- Measure the resistance between the subwoofer amplifier C4109b pin 5, circuit 169 (LG/BK), harness side and the audio unit C290a pin 6, circuit 169 (LG/BK), harness side and between the subwoofer amplifier C4109b pin 5, circuit 169 (LG/BK), harness side and ground; and between the subwoofer amplifier C4109b pin 6, circuit 172 (LB/RD), harness side and the audio unit C290a pin 5, circuit 172 (LB/RD), harness side and between the subwoofer amplifier C4109b pin 6, circuit 172 (LB/RD), harness side and ground.
- Are the resistances less than 5 ohms between the subwoofer amplifier and the audio unit and greater than 10,000 ohms between the subwoofer amplifier and ground?

Yes
GO to [H10](#).

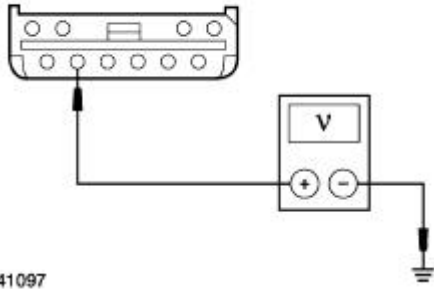
No
REPAIR the circuit (s) in question.
TEST the system for normal operation.

H10 CHECK FOR POWER TO THE AFFECTED SUBWOOFER AMPLIFIER

- Key in OFF position.
- Disconnect: Mach 1000 Affected Subwoofer Amplifier.
- Measure the voltage between affected amplifier harness pins 1 and 2, circuit 828 (VT/LB) (left amplifiers) and ground, and between pins 4 and 5, circuit 829 (WH/VT) (right amplifiers) and ground.

Yes
GO to [H11](#).

No
REPAIR the circuit (s) in question.
TEST the system for normal



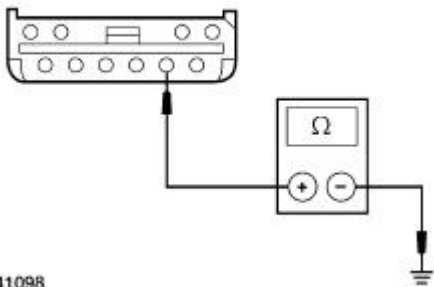
A0041097

- Is the voltage greater than 10 volts?

operation.

H11 CHECK FOR GROUND TO THE SUBWOOFER AMPLIFIER HARNESS

- **NOTE:** Ground circuit 694 is located in the same cavity in all four subwoofer amplifiers.
- Measure the resistance between subwoofer amplifier pins 2, circuit 694 (BK/LG) and ground.



A0041098

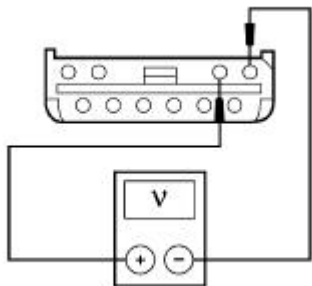
- Is the resistance less than 5 ohms?

Yes
GO to [H12](#).

No
REPAIR the circuit (s) in question.
TEST the system for normal operation.

H12 CHECK FOR AN AUDIO SIGNAL TO THE AFFECTED SUBWOOFER AMPLIFIER

- Key in ON position.
- **NOTE:** Audio signal circuits 169 and 172 are located in the same cavity on all four subwoofers.
- Turn on the audio unit and check for a fluctuating AC voltage between affected subwoofer amplifier pin 8, circuit 172 (LB/RD) and pin 7, circuit 169 (LG/BK).



A0041099

- Does the voltage vary as the volume is adjusted?

Yes
GO to [H14](#).

No
GO to [H13](#).

H13 CHECK AUDIO SIGNAL CIRCUITS AT THE AFFECTED SUBWOOFER AMPLIFIER FOR OPEN AND SHORT TO GROUND

- Key in OFF position.
- Disconnect: Audio Unit C290a.
- Measure the resistance between the affected subwoofer amplifier and the audio unit C290a, and between the affected subwoofer amplifier and ground as follows:

Yes
SEND the audio unit to an authorized Ford audio system

Speaker Circuits

Audio Unit C290a Pin	Subwoofer Amplifier Harness Pin	Circuit
2	8	172 (LB/RD)
8	7	169 (LG/BK)

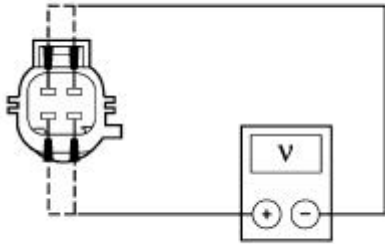
- Is the resistance less than 5 ohms between the audio unit and subwoofer amplifier harness and greater than 10,000 ohms between the subwoofer amplifier harness and ground?

repair facility. TEST the system for normal operation.

No
REPAIR the circuit (s) in question. TEST the system for normal operation.

H14 CHECK FOR AN AUDIO SIGNAL AT THE AFFECTED SUBWOOFER

- Key in OFF position.
- Connect: Affected Subwoofer Amplifier.
- Disconnect: Affected Subwoofer Speaker.
- Key in ON position.
- Turn on the audio unit and check for a fluctuating AC voltage between affected subwoofer as follows: For right subwoofer pin 4, circuit 187 (DB/OG) and pin 2, circuit 189 (LG/BK) harness side; and between pin 3, circuit 179 (OR/RD) and pin 1, circuit 176 (PK/LG) harness side. For left subwoofer pin 1, circuit 187 (DB/OR) and pin 3, circuit 189 (LG/BK) harness side; and between pin 2, circuit 179 (OR/RD) and pin 4, circuit 176 (PK/LG) harness side.



A0041100

- Does the voltage vary as the volume is adjusted?

Yes
INSTALL a new subwoofer speaker.

No
GO to [H15](#).

H15 CHECK FOR AN OPEN AND SHORT TO GROUND BETWEEN THE AFFECTED SUBWOOFER AND ITS RESPECTIVE AMPLIFIERS

- Key in OFF position.
- Disconnect: Affected Subwoofer.
- Disconnect: Respective Amplifier.
- Measure the resistance between the affected subwoofer speaker and its respective amplifiers, and between the affected subwoofer speaker and ground as follows:

Speaker Circuits—Right Side

Affected Subwoofer Speaker Pin	Respective Amplifier Pin	Circuit
1	4	176 (PK/LG)
3	3	179 (OR/RD)
2	4	189 (TN/LB)

Yes
INSTALL a new subwoofer amplifier.

No
REPAIR the circuit (s) in question. TEST the system for normal operation.

4	3	187 (DB/OR)
---	---	----------------

Speaker Circuits—Left Side

Affected Subwoofer Speaker Pin	Respective Amplifier Pin	Circuit
1	4	176 (PK/LG)
3	3	179 (OR/RD)
2	4	189 (TN/LB)
4	3	187 (DB/OR)

- Is the resistance less than 5 ohms between the amplifier and subwoofer speaker and greater than 10,000 ohms between the subwoofer speaker harness and ground?

H16 CHECK THE AUDIO UNIT

- Substitute a known good audio unit.
- Verify the operation of the audio unit.
- **Does the audio unit operate correctly?**

Yes
SEND the audio unit to an authorized Ford audio system repair facility. TEST the system for normal operation.

No
REMOVE the subwoofer amplifier and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.

PINPOINT TEST I: LOUD POPPING WHEN CYCLING THE IGNITION SWITCH—CONVERTIBLE

Test Step	Result / Action to Take
I1 CHECK SUBWOOFERS FOR LOUD POPS	
<ul style="list-style-type: none"> ● Key in ON position. ● Listen to see whether the loud pops are from the LH or RH subwoofer amplifiers for the convertible. ● Are the pops from both subwoofer 	<p>Yes REMOVE the audio unit and SEND it to an authorized Ford audio system repair facility. TEST the system for normal operation.</p>

amplifiers for the convertible?

No

If the loud pops are from the convertible LH subwoofer amplifier only, REPAIR circuit 173 (DG/VT). TEST the system for normal operation.

If the loud pops are from the convertible RH subwoofer amplifier only, REPAIR circuit 174 (GY/BK). TEST the system for normal operation.

Torque Specifications

Description	Nm	lb-ft	lb-in
Battery ground cable bolt	10	—	89
Amplifier bracket to body nut	25	18	—

Audio System

The Mustang is available with the following audio systems:

- M100 CD AM/FM
- CDX6-AM/FM with six CD in-dash
- MP3 single CD AM/FM (optional)

The M100 system is equipped with four premium speakers. The CDX6 six disc changer audio unit comes with the Mach 460 or Mach 1000 systems and speed-sensitive volume control. The Mach 460 system consists of eight speakers and two subwoofer amplifiers. The Mach 1000 option adds two additional subwoofers and four additional amplifiers located in the luggage compartment.

Refer to the owner literature for complete audio system operating controls and functions.

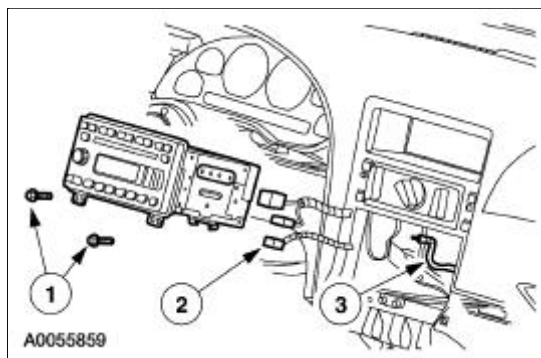
Audio System

Refer to [Section 415-00](#) .

Audio Unit

Removal and Installation

1. Remove the instrument panel center finish panel. For additional information, refer to [Section 501-12](#).
2. Remove the audio unit.
 1. Remove the screws.
 2. Disconnect electrical connectors.
 3. Disconnect antenna cable.



3. To install, reverse the removal procedure.
-

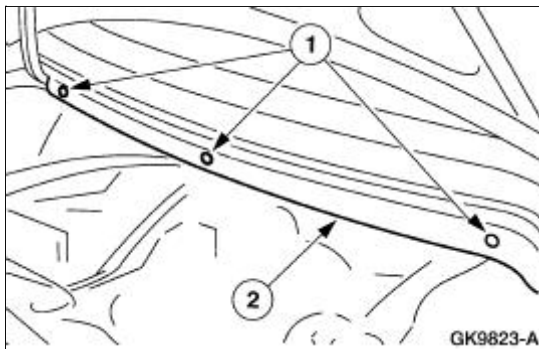
Subwoofer Amplifier —Convertible

Removal and Installation

1. **NOTE:** The convertible top needs to be in the up position to remove the subwoofer amplifiers.

From inside the luggage compartment, remove the forward panel.

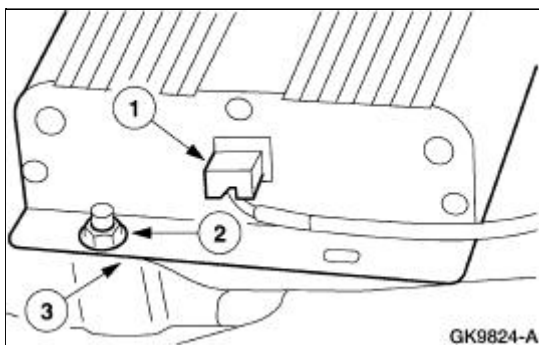
1. Remove the pin-type retainers.
2. Remove the forward panel.



2. **NOTE:** LH and RH subwoofer amplifiers are similar.

Remove the subwoofer amplifiers.

1. Disconnect the electrical connectors.
2. Remove the nuts.
3. Remove the subwoofer amplifiers.

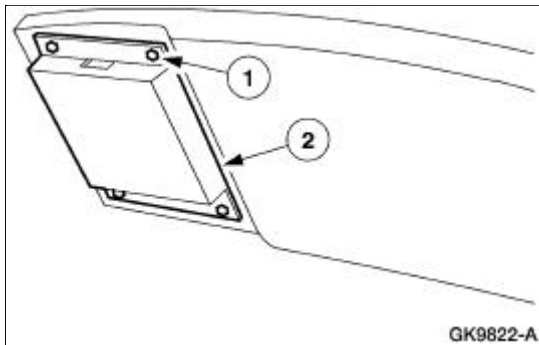


3. To install, reverse the removal procedure.

Subwoofer Amplifier —Coupe

Removal and Installation

1. Remove the subwoofer amplifier.
 1. Remove the screws.
 2. Remove the subwoofer amplifier.

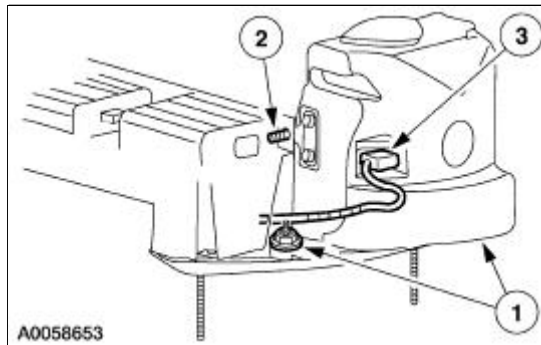


2. To install, reverse the removal procedure.
-

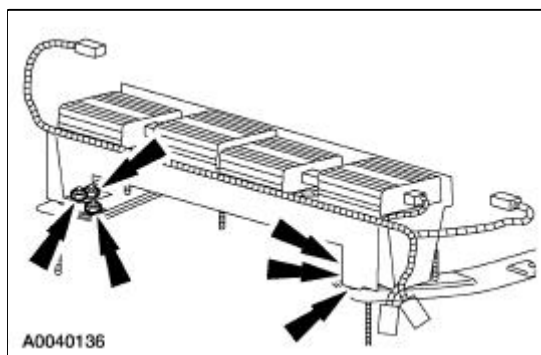
Subwoofer Amplifier —Mach 1000

Removal and Installation

1. Remove the subwoofer assembly.
 1. Remove the two attaching nuts.
 2. Remove the screw.
 3. Disconnect the electrical connectors.



2. Remove the subwoofer amplifiers.
 - Remove the bracket-to-body attaching nuts.
 - Disconnect the electrical connectors.



3. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-in
Battery ground cable	10	89

Antenna

The antenna system consists of:

- antenna mast
- antenna base and cable
- antenna lead-in cable

The radio antenna uses a two-piece coaxial cable to connect the audio unit to the antenna. The front antenna lead-in cable is connected to the audio unit and has an in-line connector at the RH cowl side.

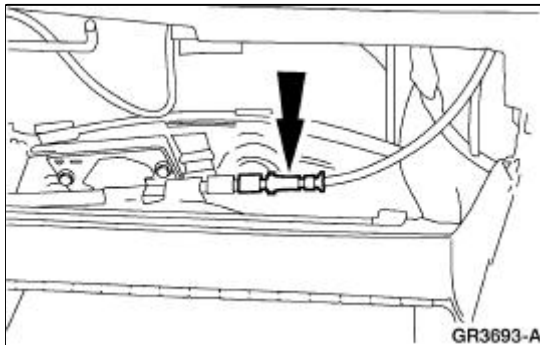
Antenna

Refer to [Section 415-00](#) .

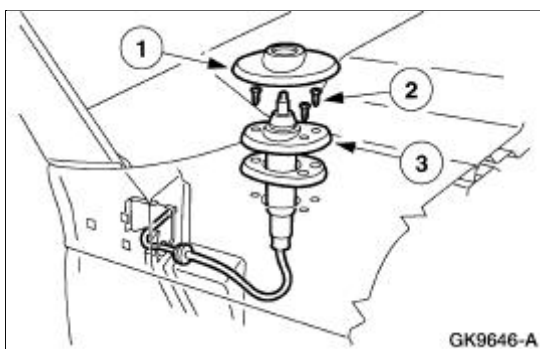
Antenna

Removal

1. Lower the glove compartment by releasing the stops from the instrument panel.
2. Disconnect the antenna in-line connector.



3. Remove the antenna base and cable.
 1. Remove the radio antenna base cap.
 2. Remove the screws.
 3. Remove the antenna base and cable.
 - Disconnect the antenna cable grommet.



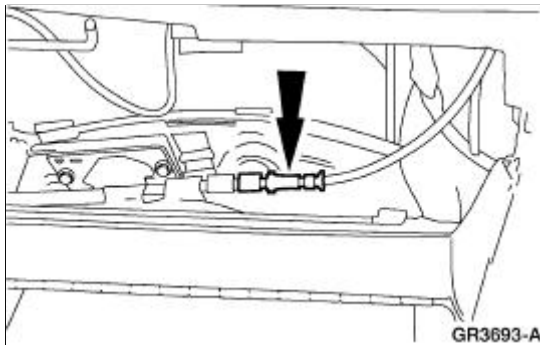
Installation

1. To install, reverse the removal procedure.

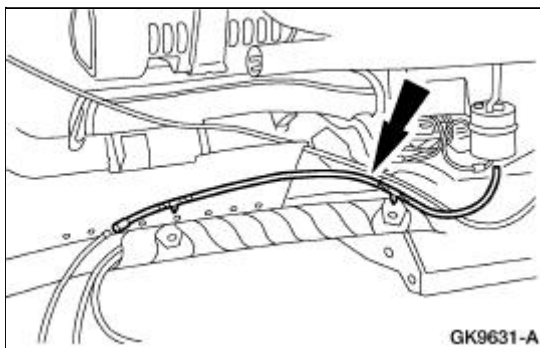
Cable —Antenna Lead In

Removal

1. Remove the audio unit. Refer to [Section 415-01](#).
2. Lower the glove compartment by releasing the stops from the instrument panel.
3. Disconnect the antenna in-line connector.



4. Remove the antenna lead in cable.
 1. Disconnect the pin-type retainers.
 2. Remove the antenna lead in cable.



Installation

1. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft	lb-in
Subwoofer nut (coupe)	10	—	89
Subwoofer nut (Mach 1000)	25	18	—

Speakers

NOTE: Premium sound speakers (18808) are labeled with either 6 OHMS or 8 OHMS.

- The coupe has a four-speaker system, with two door-mounted speakers and two in the package tray panel (46506).
 - On the convertible, the two rear speakers are located behind the quarter trim panel. (31012)
 - The MACH 460 subwoofer system has eight speakers. On the coupe, two are located in each door and four are in the subwoofer assembly. On the convertible, two speakers are in each door and two are mounted in each subwoofer assembly behind the rear quarter trim panels. Both the coupe and convertible subwoofer assemblies are not repairable.
 - The MACH 1000 has all the components of the MACH 460 system plus two additional subwoofers located on each side of the trunk and four additional amplifiers. These subwoofers can be serviced independently.
-

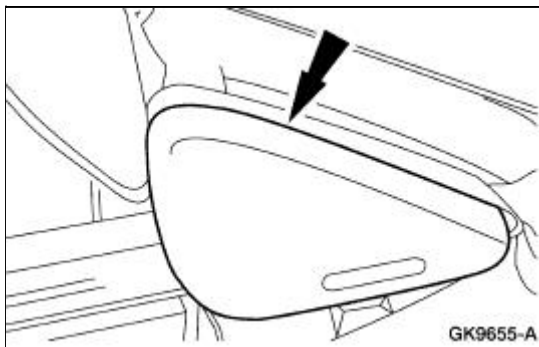
Speakers

Refer to [Section 415-00](#) .

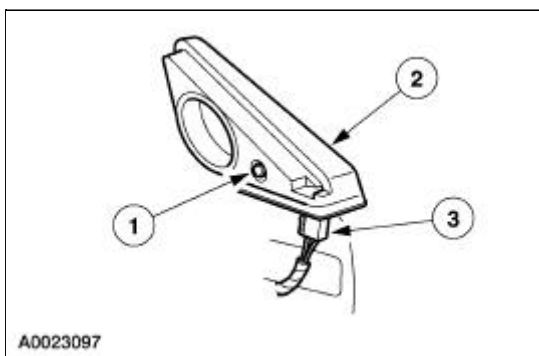
Door Speaker —Upper

Removal and Installation

1. Remove the front door trim panels (239420). For additional information, refer to [Section 501-05](#).
2. Remove the upper speaker access cover.



3. Remove the upper speaker housing.
 1. Remove the screw.
 2. Remove the upper speaker housing.
 3. Disconnect the electrical connector.

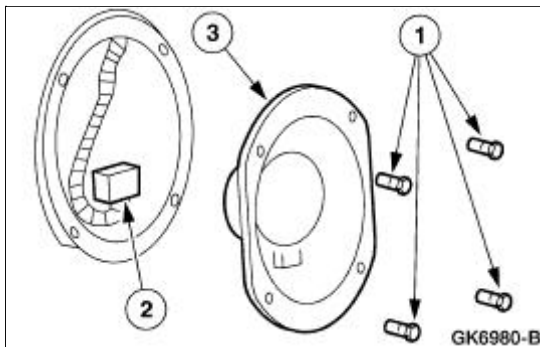


4. To install, reverse the removal procedure.
-

Door Speaker —Lower

Removal and Installation

1. Remove the front door trim panel (239420). For additional information, refer to [Section 501-05](#).
2. Remove the speaker (18808).
 1. Remove the screws.
 2. Disconnect the electrical connector.
 3. Remove the speaker.

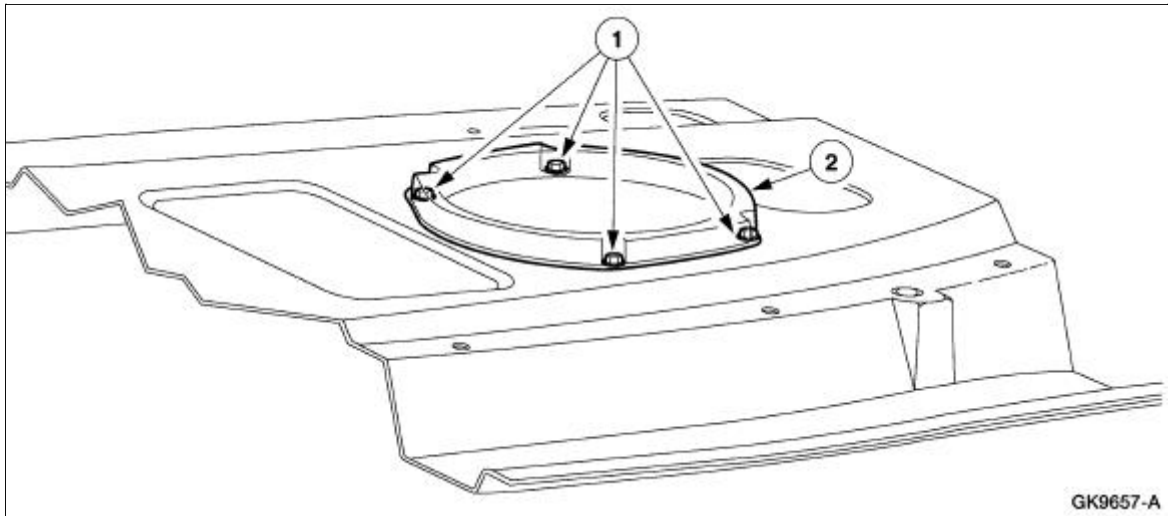


3. To install, reverse the removal procedure.
-

Speaker —Package Tray (Coupe)

Removal and Installation

1. Remove the package tray trim panel. Refer to [Section 501-05](#).
2. Remove the speaker.
 1. Remove the screws.
 2. Remove the speaker.
 - Disconnect the electrical connector.

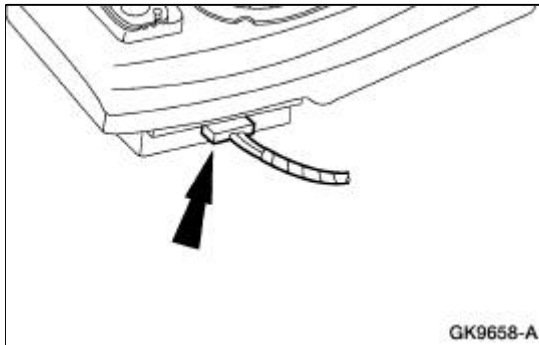


3. To install, reverse the removal procedure.

Subwoofer Speaker —Coupe

Removal and Installation

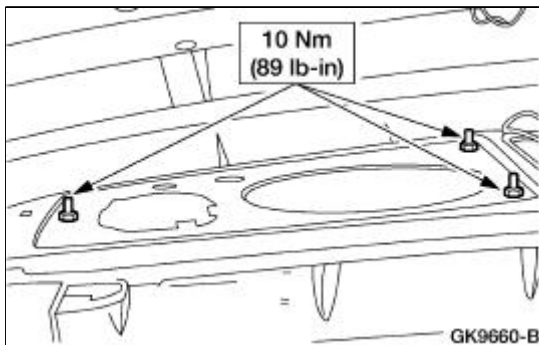
1. Remove the package tray trim panel. For additional information, refer to [Section 501-05](#).
2. Disconnect the two subwoofer assembly amplifier electrical connectors.



3. **NOTE:** Do not let the subwoofer assembly fall into the luggage compartment; support the subwoofer assembly before removing the fasteners.

Remove the six nuts.

- From inside the luggage compartment, remove the subwoofer assembly.
- Transfer the amplifiers to the new subwoofer assembly.

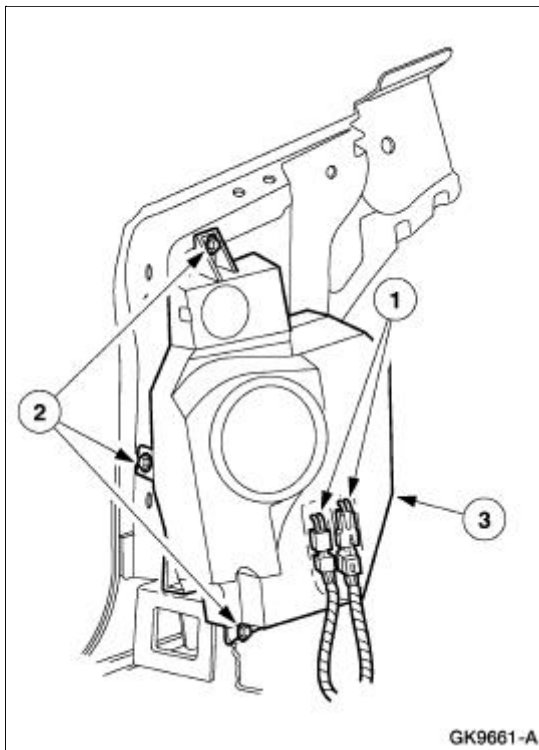


4. To install, reverse the removal procedure.

Subwoofer Speaker —Convertible

Removal and Installation

1. Remove the rear quarter trim panel. For additional information, refer to [Section 501-05](#).
2. Remove the subwoofer assembly.
 1. Disconnect the electrical connectors.
 2. Remove the screws.
 3. Remove the subwoofer assembly.

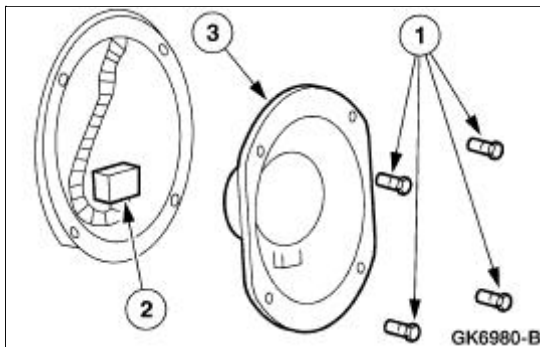


3. To install, reverse the removal procedure.
-

Quarter Panel Speaker

Removal and Installation

1. Remove the rear quarter trim panel. For additional information, refer to [Section 501-05](#).
2. Remove the speaker (18808).
 1. Remove the screws.
 2. Disconnect the electrical connector.
 3. Remove the speaker.



3. To install, reverse the removal procedure.
-

Torque Specifications

Description	Nm	lb-in
Battery ground cable bolt	10	89
Rear lamp nuts	6	53

Exterior Lighting


The exterior lighting system consists of the following components:

- headlamps (13008)
 - parking lamps
 - rear lamps (13404)
 - high mounted stoplamp
 - license lamps
 - front turn lamps
 - reversing lamps
 - fog lamps (if equipped)
 - headlamp switch (11654)
 - fog lamp switch (if equipped)
 - brake pedal position (BPP) switch (13480)
 - multifunction switch (13K359)
 - digital transmission range (DTR) sensor (A/T)
 - reversing lamp switch (M/T)
 - electronic flasher
 - fog lamp relays (if equipped)
-

Headlamps

Refer to Wiring Diagrams Cell [85](#), Headlamps for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter or equivalent 105-R0057
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Inspection and Verification

1. Verify the customer concern by operating the headlamps.
2. Visually inspect for the following obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> ● Damaged headlamp switch (11654) ● Damaged multifunction switch (13K359) 	<ul style="list-style-type: none"> ● Battery junction box (BJB) fuse 2 (30A) ● Central junction box (CJB) fuse(s): <ul style="list-style-type: none"> ■ 38 (20A) ■ 4 (7.5A) (RH) ■ 10 (7.5A) (LH) ● Damaged wiring harness ● Loose or corroded connections ● Headlamp bulb

3. If the concern is not visually evident, determine the symptom and proceed to Symptom Chart.

Symptom Chart

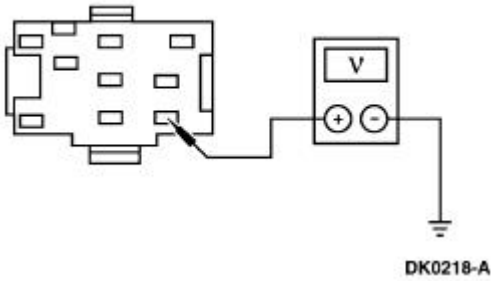
Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● Both headlamps are inoperative 	<ul style="list-style-type: none"> ● Battery junction box (BJB) fuse 2 (30A). ● Headlamp switch. ● Circuitry. ● Multifunction switch. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test A.
<ul style="list-style-type: none"> ● The low beams are inoperative 	<ul style="list-style-type: none"> ● Circuitry. ● Multifunction switch. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test B.

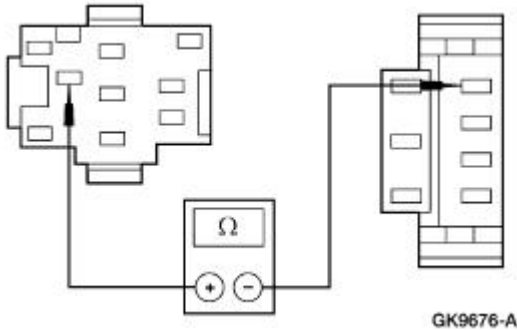
<ul style="list-style-type: none"> ● The high beams are inoperative 	<ul style="list-style-type: none"> ● Central junction box (CJB) fuse 38 (20A). ● Circuitry. ● Multifunction switch. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test C.
<ul style="list-style-type: none"> ● One low beam headlamp is inoperative 	<ul style="list-style-type: none"> ● Central junction box (CJB) fuse (s): <ul style="list-style-type: none"> ■ 10 (7.5A) (LH). ■ 4 (7.5A) (RH). ● Headlamp bulb. ● Circuitry. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test D.
<ul style="list-style-type: none"> ● One high beam headlamp is inoperative 	<ul style="list-style-type: none"> ● Headlamp bulb. ● Circuitry. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test E.
<ul style="list-style-type: none"> ● The headlamps are on continuously 	<ul style="list-style-type: none"> ● Headlamp switch. ● Circuitry. ● Multifunction switch. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test F.
<ul style="list-style-type: none"> ● The flash-to-pass feature is inoperative 	<ul style="list-style-type: none"> ● Circuitry. ● Multifunction switch. 	<ul style="list-style-type: none"> ● CHECK Circuit 196 (DB/OG) for an open. REPAIR if necessary. IF OK, INSTALL a new multifunction switch; REFER to Section 211-05. TEST the system for normal operation.

Pinpoint Tests

PINPOINT TEST A: BOTH HEADLAMPS ARE INOPERATIVE

Test Step	Result / Action to Take
<p>A1 CHECK THE VOLTAGE TO THE HEADLAMP SWITCH</p> <ul style="list-style-type: none"> ● Disconnect: Headlamp Switch C205. ● Measure the voltage between headlamp switch C205 Pin B1, Circuit 196 (DB/OG), harness side and ground.  <p>DK0218-A</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to A2.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<p>A2 CHECK CIRCUIT 15 (RD/YE) FOR OPEN</p> <ul style="list-style-type: none"> ● Disconnect: Multifunction Switch C202a. 	<p>Yes</p>

- Measure the resistance between headlamp switch C205 Pin H, Circuit 15 (RD/YE), harness side and multifunction switch C202a Pin 15, Circuit 15 (RD/YE), harness side.



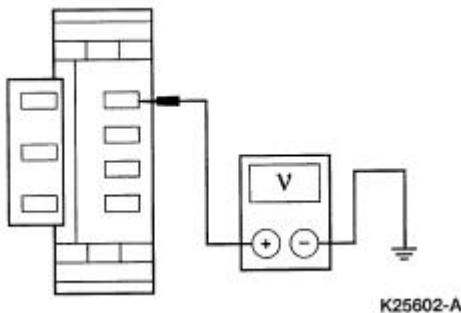
- Is the resistance less than 5 ohms?

RECONNECT headlamp switch C205. GO to [A3](#).

No
REPAIR the circuit. TEST the system for normal operation.

A3 CHECK THE VOLTAGE TO THE MULTIFUNCTION SWITCH

- Place the headlamp switch in the ON position.
- Measure the voltage between multifunction switch C202a Pin 15, Circuit 15 (RD/YE), harness side and ground.



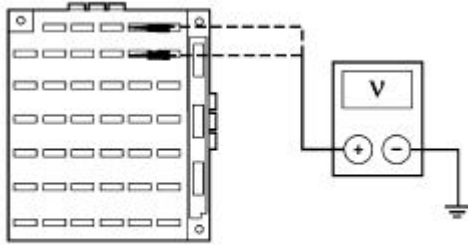
- Is the voltage greater than 10 volts?

Yes
INSTALL a new multifunction switch; REFER to [Section 211-05](#). TEST the system for normal operation.

No
INSTALL a new headlamp switch; REFER to [Lamp Switch—Headlamp](#) in this section. TEST the system for normal operation.

PINPOINT TEST B: THE LOW BEAMS ARE INOPERATIVE

Test Step	Result / Action to Take
B1 CHECK THE VOLTAGE TO CJB FUSE 4 (7.5A) AND CJB FUSE 10 (7.5A)	
<ul style="list-style-type: none"> ● Key in OFF position. ● Place the multifunction switch in the low beam position. ● Remove Fuse 4 (7.5A) and Fuse 10 (7.5A) from the CJB. ● Place the headlamp switch in the ON position. ● Measure the voltage between the following CJB fuse terminals and ground: <ul style="list-style-type: none"> ■ Fuse 4 connector. ■ Fuse 10 connector. 	<p>Yes Go To Pinpoint Test D.</p> <p>No GO to B2.</p>

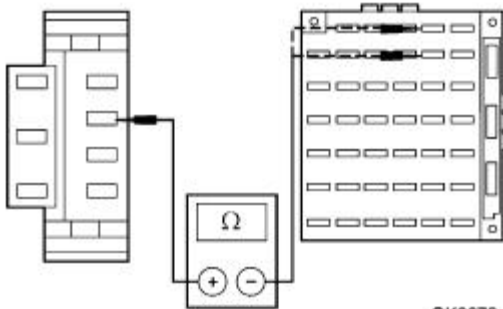


GK9677-A

- Are the voltages greater than 10 volts?

B2 CHECK CIRCUIT 13 (RD/BK) FOR OPEN

- Disconnect: Multifunction Switch C202a.
- Measure the resistance between multifunction switch C202a Pin 13, Circuit 13 (RD/BK), harness side and CJB Fuse 4 and Fuse 10.



GK9676-A

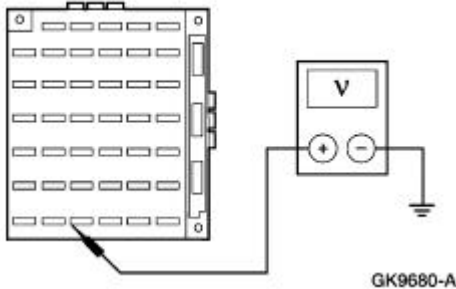
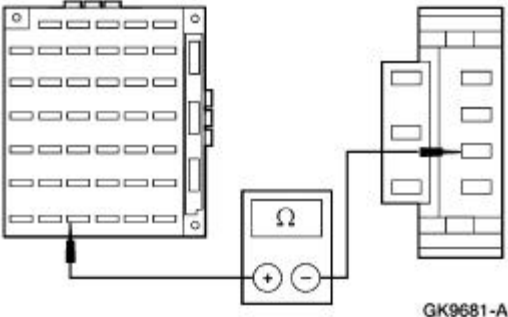
- Are the resistances less than 5 ohms?

Yes
 INSTALL a new multifunction switch; REFER to [Section 211-05](#). TEST the system for normal operation.

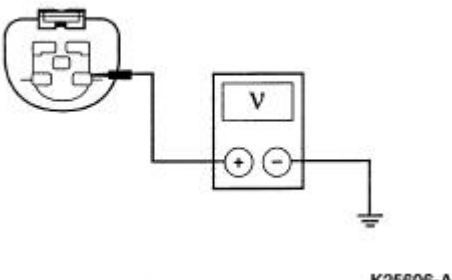
No
 REPAIR the circuit. TEST the system for normal operation.

PINPOINT TEST C: THE HIGH BEAMS ARE INOPERATIVE

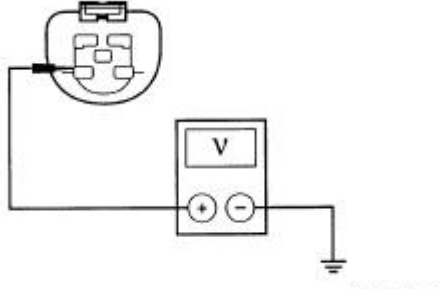
Test Step	Result / Action to Take
C1 CHECK THE CIRCUIT 12 (LG/BK) <ul style="list-style-type: none"> • Disconnect: LH Headlamp C1021. • Measure the resistance between LH headlamp C1021 Pin 2, Circuit 12 (LG/BK), harness side and CJB Fuse 38 (20A). <p style="text-align: right;">GK9971-A</p> <ul style="list-style-type: none"> • Is the resistance less than 5 ohms? 	<p>Yes RECONNECT the LH headlamp (13008). GO to C2.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
C2 CHECK THE VOLTAGE TO CJB FUSE 38 (20A) <ul style="list-style-type: none"> • Place the headlamp switch in the ON position. • Place the multifunction switch in the high beam position. • Measure the voltage between CJB Fuse 38 (20A) and ground. 	<p>Yes Go To Pinpoint Test E.</p> <p>No</p>

 <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>GO to C3.</p>
<p>C3 CHECK CIRCUIT 632 (GY/OG) FOR OPEN</p>	
<ul style="list-style-type: none"> ● Disconnect: Multifunction Switch C202a. ● Measure the resistance between the CJB Fuse 38 (20A), and multifunction switch C202a Pin 12, Circuit 632 (GY/OG), harness side.  <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes INSTALL a new multifunction switch; REFER to Section 211-05. TEST the system for normal operation.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>

PINPOINT TEST D: ONE LOW BEAM HEADLAMP IS INOPERATIVE

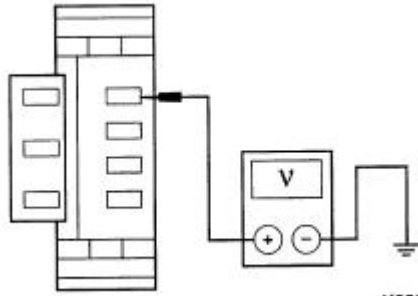
Test Step	Result / Action to Take
<p>D1 CHECK THE VOLTAGE TO THE INOPERATIVE HEADLAMP BULB</p> <ul style="list-style-type: none"> ● Disconnect: Inoperative Headlamp. ● Place the headlamp switch in the ON position. ● Place the multifunction switch in the low beam position. ● Measure the voltage between RH headlamp C1041 Pin 3, Circuit 1056 (DB/LG), or LH headlamp C1021 Pin 3, Circuit 1055 (WH/LG), harness side and ground.  <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes INSTALL a new headlamp bulb; REFER to Bulb—Headlamp in this section. TEST the system for normal operation.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>

PINPOINT TEST E: ONE HIGH BEAM HEADLAMP IS INOPERATIVE

Test Step	Result / Action to Take
E1 CHECK THE VOLTAGE TO THE INOPERATIVE HEADLAMP BULB	<p>Yes INSTALL a new headlamp bulb; REFER to Bulb—Headlamp in this section. TEST the system for normal operation.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Inoperative Headlamp. ● Place the headlamp switch in the ON position. ● Place the multifunction switch in the high beam position. ● Measure the voltage between LH headlamp C1021 Pin 2, Circuit 12 (LG/BK), or RH headlamp C1041 Pin 2, Circuit 12 (LG/BK), harness side and ground. <div style="text-align: center;">  <p>K25607-A</p> </div> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	

PINPOINT TEST F: THE HEADLAMPS ARE ON CONTINUOUSLY

Test Step	Result / Action to Take
F1 CHECK THE HEADLAMP SWITCH	<p>Yes GO to F2.</p> <p>No INSTALL a new headlamp switch; REFER to Lamp Switch—Headlamp in this section. TEST the system for normal operation.</p>
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Headlamp Switch C205. ● Are the headlamps on? 	
F2 CHECK THE MULTIFUNCTION SWITCH	<p>Yes GO to F4.</p> <p>No GO to F3.</p>
<ul style="list-style-type: none"> ● Disconnect: Multifunction Switch C202a. ● Are the headlamps on? 	
F3 CHECK CIRCUIT 15 (RD/YE) FOR SHORT TO POWER	<p>Yes REPAIR the circuit. TEST the system for normal operation.</p> <p>No INSTALL a new multifunction switch; REFER to Section 211-05. TEST the system for normal operation.</p>
<ul style="list-style-type: none"> ● Measure the voltage between multifunction switch C202a Pin 15, Circuit 15 (RD/YE), harness side and ground. 	

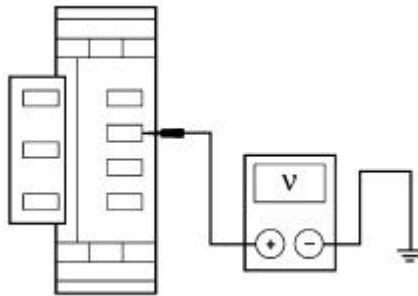


K25602-A

- Is the voltage greater than zero volts?

F4 CHECK CIRCUIT 13 (RD/BK) FOR SHORT TO POWER

- Remove Fuse 4 (7.5A) and Fuse 10 (7.5A) from the CJB.
- Measure the voltage between multifunction switch C202a Pin 507, Circuit 13 (RD/BK), harness side and ground.



GK1709-A

- Is the voltage greater than 0 volts?

Yes

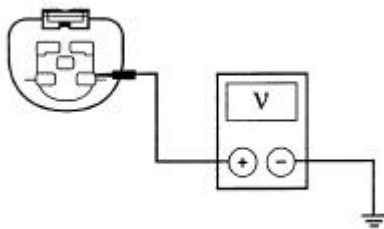
REPAIR the circuit. TEST the system for normal operation.

No

GO to [F5](#).

F5 CHECK CIRCUIT 1056 (DB, LG) FOR VOLTAGE

- Disconnect: Headlamp C1041.
- Measure the voltage between RH headlamp C1041 Pin 3, Circuit 1056 (DB/LG), harness side and ground.



K25606-A

- Is the voltage greater than 0 volts?

Yes

REPAIR Circuit 1056 (DB/LG). TEST the system for normal operations.


No

REPAIR Circuit 1055 (WH/LG). TEST the system for normal operations.

Stoplamps

Refer to Wiring Diagrams Cell [90](#), Turn/Stop/Hazard Lamps for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter or equivalent 105-R0057
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Inspection and Verification

1. Verify the customer concerns.
2. Visually inspect for the following obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> ● Brake pedal position (BPP) switch 	<ul style="list-style-type: none"> ● Central junction box (CJB) fuse 41 (15A) ● Circuitry ● Bulb(s)

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the concern is not visually evident, determine the symptom and refer to the Symptom Chart.

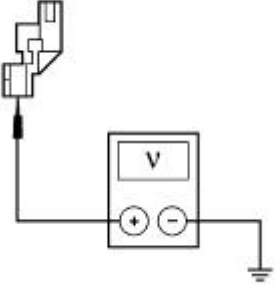
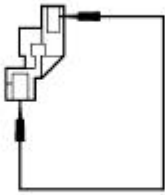
Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● The stoplamps are inoperative 	<ul style="list-style-type: none"> ● Central junction box (CJB) fuse 41 (15A). ● Circuitry. ● Brake pedal position (BPP) switch. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test G.
<ul style="list-style-type: none"> ● One or more stoplamps are inoperative 	<ul style="list-style-type: none"> ● Circuitry. ● Multifunction switch. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test H.
<ul style="list-style-type: none"> ● The stoplamps are on continuously 	<ul style="list-style-type: none"> ● Brake pedal position (BPP) switch. ● Multifunction switch. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test I.

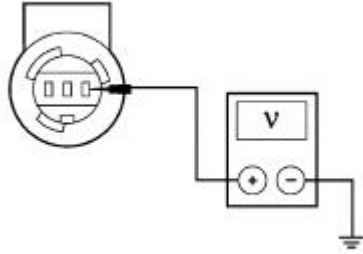
Pinpoint Tests

PINPOINT TEST G: THE STOPLAMPS ARE INOPERATIVE

Test Step	Result / Action to Take
<p>G1 CHECK CIRCUIT 10 (LG/RD) FOR AN OPEN</p> <ul style="list-style-type: none"> ● Disconnect: Brake Pedal Position (BPP) Switch C278. ● Measure the voltage between the BPP switch C278, circuit 10 (LG/RD), harness side and ground.  <p style="text-align: right;">GK2337-A</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to G2.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<p>G2 CHECK THE CIRCUIT 810 (RD/LG) FOR AN OPEN</p> <ul style="list-style-type: none"> ● Connect a 10A fused jumper wire between C278, circuit 10 (LG/RD), harness side and C278, circuit 810 (RD/LG), harness side.  <p style="text-align: right;">GK2338-A</p> <ul style="list-style-type: none"> ● Do the stoplamps illuminate? 	<p>Yes INSTALL a new BPP switch. REFER to Lamp Switch—Brake Pedal Position (BPP) in this section. TEST the system for normal operation.</p> <p>No REPAIR circuit 810 (RD/LG) or 569 (DG) as necessary. TEST the system for normal operation.</p>

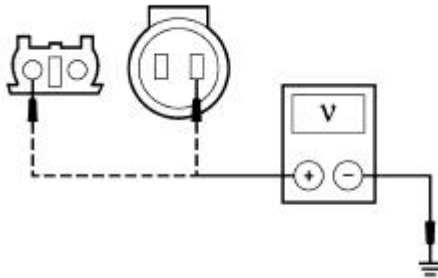
PINPOINT TEST H: ONE OR MORE STOPLAMPS ARE INOPERATIVE

Test Step	Result / Action to Take
<p>H1 CHECK THE VOLTAGE TO THE INOPERATIVE STOPLAMP</p> <ul style="list-style-type: none"> ● Disconnect: Inoperative Stoplamp. ● If a rear stoplamp is inoperative, measure the voltage between the inoperative stoplamp connector circuit 9 (LG/OG) (LH) or circuit 5 (OG/LB) (RH), harness side and ground, while pressing the brake pedal. 	<p>Yes REPAIR circuit 1205 (BK). TEST the system for normal operation.</p> <p>No If high mounted stoplamp, REPAIR circuit 569 (DG). TEST the system for normal</p>



GK9682-A

- If the high mounted stoplamp is inoperative, measure the voltage between the inoperative high mounted stoplamp C475 (C4199 for Cobra) pin 1, circuit 569 (DG), harness side and ground while pressing the brake pedal.

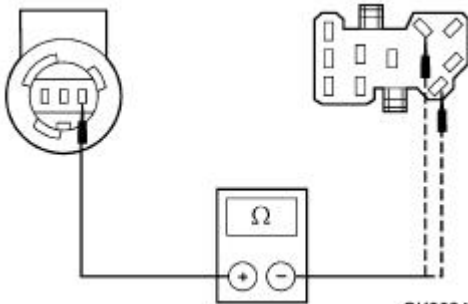


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- Is the voltage greater than 10 volts?

H2 CHECK CIRCUIT 9 (LG/OG) OR 5 (OG/LB) FOR AN OPEN

- Disconnect: Multifunction Switch C202b.
- Measure the resistance between the inoperative stoplamp connector and multifunction switch C202b pin 9, circuit 9 (LG/OG) (LH), or C202b pin 5, circuit 5 (OG/LB) (RH).



GK9684-A

- Is the resistance less than 5 ohms?

operation.

If rear stoplamp, GO to [H2](#).

Yes
INSTALL a new multifunction switch. REFER to [Section 211-05](#). TEST the system for normal operation.

No
REPAIR the circuit in question. TEST the system for normal operation.

PINPOINT TEST I: THE STOPLAMPS ARE ON CONTINUOUSLY


Test Step	Result / Action to Take
I1 CHECK THE BRAKE PEDAL POSITION (BPP) SWITCH	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: BPP Switch C278. ● Do the stoplamps continue to illuminate? 	<p>Yes GO to I2.</p> <p>No INSTALL a new BPP switch. REFER to Lamp Switch—Brake Pedal Position (BPP). TEST the system for normal</p>

	operation.
I2 CHECK THE SPEED CONTROL SYSTEM	
<ul style="list-style-type: none"> ● Disconnect: Speed Control Servo C122. ● Do the stoplamps continue to illuminate? 	<p>Yes GO to I3.</p> <p>No REFER to Section 310-03.</p>
I3 CHECK CIRCUIT 511 (LG) FOR SHORT TO POWER	
<ul style="list-style-type: none"> ● Disconnect: Central Junction Box (CJB) Fuse 35 (15A). ● Do the stoplamps continue to illuminate? 	<p>Yes GO to I4.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
I4 CHECK CIRCUIT 810 (LG/RD) FOR SHORT TO POWER	
<ul style="list-style-type: none"> ● Disconnect: CJB Fuse 41 (15A). ● Do the stoplamps continue to illuminate? 	<p>Yes GO to I5.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
I5 CHECK THE MULTIFUNCTION SWITCH	
<ul style="list-style-type: none"> ● Disconnect: Multifunction Switch C202b. ● Do the stoplamps continue to illuminate? 	<p>Yes If the high mounted stoplamp is illuminated, REPAIR circuit 569 (DG) or 511 (LG) as necessary. TEST the system for normal operation.</p> <p>If only the LH stoplamp is illuminated, REPAIR circuit 9 (LG/OG). TEST the system for normal operation.</p> <p>If only the RH stoplamp is illuminated, REPAIR circuit 5 (OG/LB). TEST the system for normal operation.</p> <p>No INSTALL a new multifunction switch. REFER to Section 211-05. TEST the system for normal operation.</p>

Turn Signal and Hazard Lamps

Refer to Wiring Diagrams Cell [90](#), Turn/Stop/Hazard Lamps for schematic and connector information.

Special Tool(s)

 <p>ST1137-A</p>	<p>73 III Automotive Meter 105-R0057 or equivalent</p>
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Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for the following obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> ● Multifunction switch 	<ul style="list-style-type: none"> ● Central junction box (CJB) Fuse 13 (15A). ● CJB Fuse 18 (15A). ● Circuitry ● Electronic flasher ● Turn signal/hazard lamp

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart.

Symptom Chart

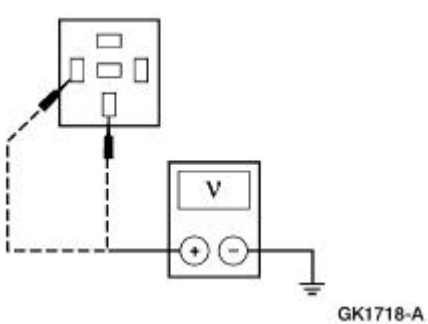
Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● The turn signal lamps are never on 	<ul style="list-style-type: none"> ● Central junction box (CJB) fuse 13 (15A). ● CJB Fuse 18 (15A). ● Circuitry. ● Multifunction switch. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test J .

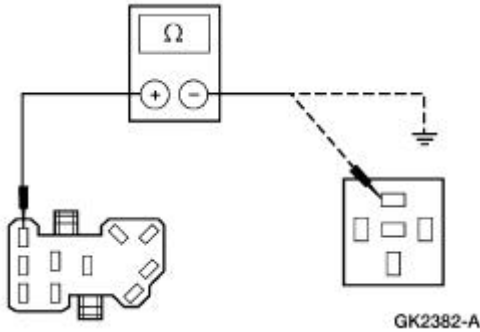
	<ul style="list-style-type: none"> ● Electronic flasher. 	
<ul style="list-style-type: none"> ● The hazard flasher lamps are never on 	<ul style="list-style-type: none"> ● Central junction box (CJB) fuse 13 (15A). ● Circuitry. ● Multifunction switch. ● Electronic flasher. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test K.
<ul style="list-style-type: none"> ● One turn signal/hazard lamp is never on 	<ul style="list-style-type: none"> ● Turn signal/hazard flasher lamp. ● Circuitry. 	<ul style="list-style-type: none"> ● REPAIR inoperative turn signal/hazard flasher lamp circuit <ul style="list-style-type: none"> ■ LF Circuit 3 (LG/WH). ■ RF Circuit 2 (WH/LB). ■ LR Circuit 9 (LG/OG). ■ RR Circuit 5 (OG/LB).
<ul style="list-style-type: none"> ● The turn signal lamps are always on 	<ul style="list-style-type: none"> ● Multifunction switch. 	<ul style="list-style-type: none"> ● INSTALL a new multifunction switch; REFER to Section 211-05. TEST the system for normal operation.
<ul style="list-style-type: none"> ● The hazard flasher lamps are always on 	<ul style="list-style-type: none"> ● Multifunction switch. 	<ul style="list-style-type: none"> ● INSTALL a new multifunction switch; REFER to Section 211-05. TEST the system for normal operation.

Pinpoint Tests

PINPOINT TEST J: THE TURN SIGNAL LAMPS ARE NEVER ON

Test Step	Result / Action to Take
<p>J1 CHECK THE VOLTAGE TO THE ELECTRONIC FLASHER</p> <ul style="list-style-type: none"> ● Disconnect: Electronic Flasher C2141. ● Key in ON position. ● Measure the voltage between the following electronic flasher C2141 circuits, harness side and ground. <ul style="list-style-type: none"> ■ Pin 2, Circuit 1039 (BK/YE). ■ Pin 3, Circuit 383 (RD/WH).  <p>● Are the voltages greater than 10 volts?</p>	<p>Yes GO to J2.</p> <p>No REPAIR the circuit in question. TEST the system for normal operation.</p>
<p>J2 CHECK CIRCUIT 44 (LB)</p> <ul style="list-style-type: none"> ● Key in OFF position. 	<p>Yes</p>

- Disconnect: Multifunction Switch C202b.
- Measure the resistance between multifunction switch C202b Pin 44, Circuit 44 (LB), harness side and the electronic flasher C2141 Pin 1, Circuit 44 (LB), harness side; and between multifunction switch C202b Pin 44, Circuit 44 (LB), harness side and ground.



- Is the resistance less than 5 ohms between the multifunction switch and the electronic flasher, and greater than 10,000 ohms between the multifunction switch and ground?

GO to [J3](#).

No
REPAIR the circuit.
TEST the system for normal operation.

J3 CHECK THE CONTINUITY OF THE MULTIFUNCTION SWITCH

- Carry out the multifunction switch component test.
- Refer to Wiring Diagrams Cell [149](#) for schematic and connector information.
- Is the switch OK?

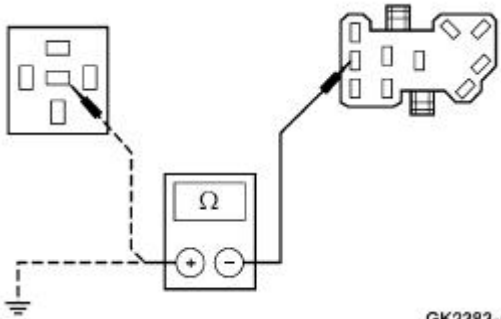
Yes
INSTALL a new electronic flasher.
TEST the system for normal operation.

No
INSTALL a new multifunction switch.
REFER to [Section 211-05](#). TEST the system for normal operation.

PINPOINT TEST K: THE HAZARD FLASHER LAMPS ARE NEVER ON

Test Step	Result / Action to Take
K1 CHECK THE VOLTAGE TO THE ELECTRONIC FLASHER <ul style="list-style-type: none"> ● Disconnect: Electronic Flasher C2141. ● Measure the voltage between electronic flasher C2141 Pin 3, Circuit 383 (RD/WH), harness side and ground. <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to K2.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
K2 CHECK CIRCUIT 385 (WH/RD) <ul style="list-style-type: none"> ● Disconnect: Multifunction Switch C202b. 	<p>Yes</p>

- Measure the resistance between multifunction switch C202b Pin 385, Circuit 385 (WH/RD), harness side and electronic flasher C2141 Pin 4, Circuit 385 (WH/RD), harness side; and between multifunction switch C202b Pin 385, Circuit 385 (WH/RD), harness side and ground.



- Is the resistance less than 5 ohms between the multifunction switch and the electronic flasher, and greater than 10,000 ohms between the multifunction switch and ground?

GO to [K3](#).

No
REPAIR the circuit.
TEST the system for normal operation.

K3 CHECK THE CONTINUITY OF THE MULTIFUNCTION SWITCH

- Carry out the multifunction switch component test.

Refer to Wiring Diagrams Cell [149](#) for schematic and connector information.

- Is the switch OK?


Yes
INSTALL a new electronic flasher.
TEST the system for normal operation.

No
INSTALL a new multifunction switch;
REFER to [Section 211-05](#). TEST the system for normal operation.

Parking, Rear and License Lamps

Refer to Wiring Diagrams Cell [92](#), Exterior for schematic and connector information.

Special Tool(s)

 <p>ST1137-A</p>	<p>73 III Automotive Meter or equivalent 105-R0057</p>
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Inspection and Verification

1. Verify the customer concern by operating the parking lamps.
2. Visually inspect for the following obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> ● Damaged multifunction switch (13K359) ● Damaged headlamp switch (11654) 	<ul style="list-style-type: none"> ● Blown battery junction box (BJB) Fuse 2 (30A) ● Damaged wiring harness ● Loose or corroded connections ● Damaged parking, rear or license lamp

3. If the concern is not visually evident, determine the symptom and proceed to Symptom Chart.

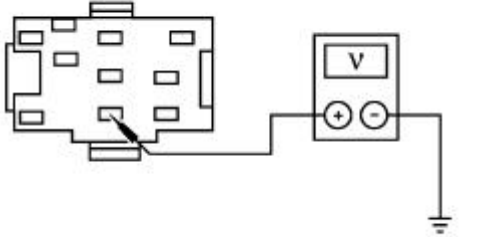
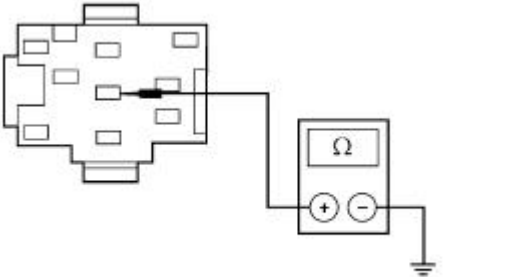
Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● The parking, rear or license lamps are inoperative 	<ul style="list-style-type: none"> ● BJB Fuse 2 (30A). ● Circuitry. ● Headlamp switch. 	<ul style="list-style-type: none"> ● GO to Pinpoint Test L.
<ul style="list-style-type: none"> ● One or more parking, rear or license bulbs(s) is inoperative 	<ul style="list-style-type: none"> ● Parking, rear or license bulb(s). ● Circuitry. 	<ul style="list-style-type: none"> ● GO to Pinpoint Test M.
<ul style="list-style-type: none"> ● The parking, rear or license lamps are on continuously 	<ul style="list-style-type: none"> ● Headlamp switch. ● Circuitry. 	<ul style="list-style-type: none"> ● GO to Pinpoint Test N.

Pinpoint Tests

PINPOINT TEST L: THE PARKING, REAR OR LICENSE LAMPS ARE INOPERATIVE

Test Step	Result / Action to Take
<p>L1 CHECK THE VOLTAGE TO THE HEADLAMP SWITCH</p> <ul style="list-style-type: none"> ● Disconnect: Headlamp Switch C205. ● Measure the voltage between headlamp switch C205 Pin B2, Circuit 195 (TN/WH), harness side and ground.  <p>● Is the voltage greater than 10 volts?</p>	<p>Yes GO to L2.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<p>L2 CHECK CIRCUIT 14 (BN) FOR OPEN</p> <ul style="list-style-type: none"> ● Measure the resistance between headlamp switch C205 Pin R, Circuit 14 (BN), harness side and ground.  <p>● Is the resistance less than 5 ohms?</p>	<p>Yes INSTALL a new headlamp switch; REFER to Lamp Switch—Headlamp. TEST the system for normal operation.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>

PINPOINT TEST M: ONE OR MORE PARKING, REAR OR LICENSE LAMP(S) IS INOPERATIVE

Test Step	Result / Action to Take
<p>M1 CHECK THE VOLTAGE TO THE INOPERATIVE LAMP(S)</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Inoperative Lamp. ● Place the headlamp switch in the parking lamps ON position. ● Measure the voltage between inoperative lamp connector Circuit 14 (BN), harness side and ground. ● Is the voltage greater than 10 volts? 	<p>Yes REPAIR Circuit 1205 (BK) for an open. TEST the system for normal operation.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>


PINPOINT TEST N: THE PARKING, REAR OR LICENSE LAMPS ARE ON CONTINUOUSLY

Test Step	Result / Action to Take
N1 CHECK THE HEADLAMP SWITCH	
<ul style="list-style-type: none">● Key in OFF position.● Disconnect: Headlamp Switch C205.● Key in ON position.● Are the parking, rear or licences lamps on?	

Fog Lamps

Refer to Wiring Diagrams Cell [86](#), Fog Lamps for schematic and connector information.

Special Tool(s)

 <p>ST1137-A</p>	<p>73 III Automotive Meter or equivalent 105-R0057</p>
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Principles of Operation

The fog lamps will only illuminate when the low beam or parking lamps are illuminated. Voltage from the parking lamp circuit is used to activate the fog lamp relay when the fog lamp switch is ON. Voltage from the high beam headlamp circuit will activate the fog lamp interrupt relay. When the fog lamp interrupt relay is active, the ground path is removed from the fog lamp relay, turning off the fog lamps.

Inspection and Verification

1. Verify the customer concern by operating the fog lamps.
2. Visually inspect for the following obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> ● Damaged headlamp switch (11654) ● Damaged fog lamp switch ● Damaged multifunction switch (13K359) 	<ul style="list-style-type: none"> ● Blown battery junction box (BJB) Fuse 27 (20A) ● Blown central junction box (CJB) Fuse 38 (20A) ● Damaged wiring harness ● Loose or corroded connections ● Damaged fog lamp relay ● Damaged fog lamp interrupt relay ● Damaged fog lamp

3. If the concern is not visually evident, determine the symptom and proceed to Symptom Chart.

Symptom Chart

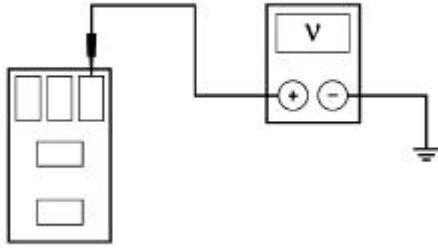
Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none"> The fog lamps are inoperative 	<ul style="list-style-type: none"> BJB Fuse 27 (20A). CJB Fuse 38 (20A). Circuitry. Fog lamp relay. Fog lamp interrupt relay. Headlamp switch. Fog lamp switch. Multifunction switch. 	<ul style="list-style-type: none"> GO to Pinpoint Test O.
<ul style="list-style-type: none"> The individual fog lamp is inoperative 	<ul style="list-style-type: none"> Fog lamp bulb. Circuitry. 	<ul style="list-style-type: none"> GO to Pinpoint Test P.
<ul style="list-style-type: none"> The fog lamps are on continuously 	<ul style="list-style-type: none"> Fog lamp relay. Circuitry. Fog lamp switch. 	<ul style="list-style-type: none"> GO to Pinpoint Test Q.

Pinpoint Tests

PINPOINT TEST O: THE FOG LAMPS ARE INOPERATIVE

Test Step	Result / Action to Take
O1 CHECK THE PARK LAMPS	
<ul style="list-style-type: none"> Place the headlamp switch in the PARK position. Place the multifunction switch in low beam position. Do the park lamps illuminate? 	<p>Yes Turn off the headlamp switch. GO to O2.</p> <p>No GO to Pinpoint Test L.</p>
O2 CHECK THE FOG LAMP RELAYS	
<ul style="list-style-type: none"> Disconnect: Fog Lamp Relay. Disconnect: Fog Lamp Interrupt Relay. Check the fog lamp relay and fog lamp interrupt relay; refer to Wiring Diagrams Cell 149. Are the relays OK? 	<p>Yes GO to O3.</p> <p>No INSTALL new relay(s). TEST the system for normal operation.</p>
O3 CHECK THE CIRCUIT 12 (LG/BK)	
<ul style="list-style-type: none"> Measure the voltage between fog lamp interrupt relay connector Pin 1, Circuit 12 (LG/BK), harness side and ground. 	<p>Yes GO to O4.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>

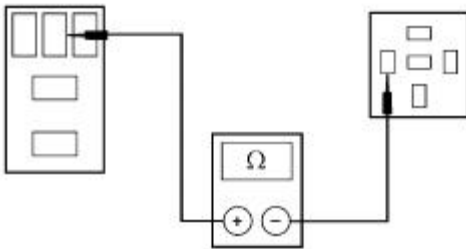


GA5887-A

- Is the voltage greater than 0 volts?

O4 CHECK CIRCUIT 275 (YE)

- Measure the resistance between fog lamp interrupt relay connector Pin 4, Circuit 275 (YE), harness side and fog lamp relay connector Pin 85, Circuit 275 (YE), harness side.



GK9686-A

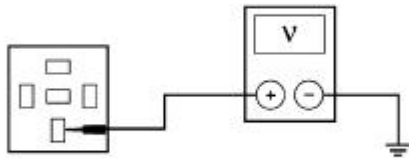
- Is the resistance less than 5 ohms?

Yes
GO to [O5](#).

No
REPAIR the circuit. TEST the system for normal operation.

O5 CHECK CIRCUIT 477 (LB/BK) FOR OPEN

- Measure the voltage between fog lamp relay connector Pin 30, Circuit 477 (LB/BK), harness side and ground.



GN1437-A

- Is the voltage greater than 10 volts?

Yes
GO to [O6](#).

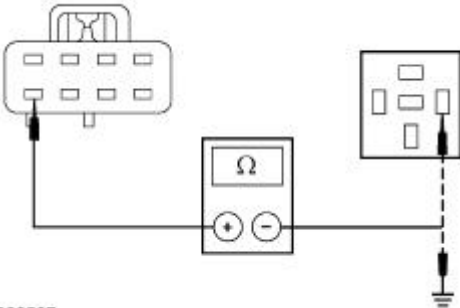
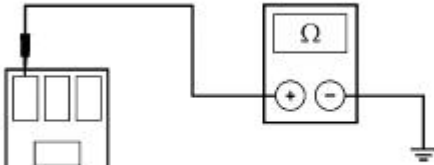
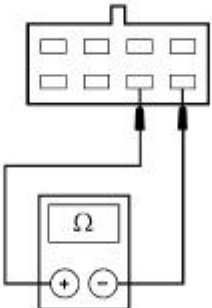
No
REPAIR the circuit. TEST the system for normal operation.

O6 CHECK CIRCUIT 188 (WH/BK)

- Disconnect: Fog Lamp Switch C240.
- Measure the resistance between fog lamp switch C240 Pin 1, Circuit 188 (WH/BK), harness side and fog lamp relay connector Pin 86, Circuit 188 (WH/BK), harness side; and between fog lamp switch C240 Pin 1, Circuit 188 (WH/BK), harness side and ground.

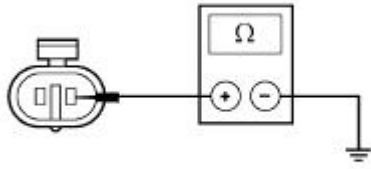
Yes
GO to [O7](#).

No
REPAIR the circuit. TEST the system for normal operation.

 <p>A0033567</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	
<p>O7 CHECK CIRCUIT 1205 (BK)</p>	
<ul style="list-style-type: none"> ● Measure the resistance between fog lamp interrupt relay connector Pin 2, Circuit 1205 (BK), and ground.  <p>GA5888-A</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes GO to O8.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<p>O8 CHECK THE FOG LAMP SWITCH</p>	
<ul style="list-style-type: none"> ● Measure the resistance between fog lamp switch C240 Pin 1, Circuit 188 (WH/BK), connector side and fog lamp switch C240 Pin 2, Circuit 14 (BN), connector side with the fog lamp switch on.  <p>A0033570</p> <ul style="list-style-type: none"> ● Is the resistance less then 5 ohms? 	<p>Yes REPAIR Circuit 478 (TN/OG). TEST the system for normal operation.</p> <p>No INSTALL a new fog lamp switch. TEST the system for normal operation.</p>

PINPOINT TEST P: THE INDIVIDUAL FOG LAMP IS INOPERATIVE

Test Step	Result / Action to Take
<p>P1 CHECK THE GROUND TO THE FOG LAMP</p>	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Inoperative Fog Lamp. ● Measure the resistance between inoperative fog lamp C162 Pin 1 (RH) or C152 Pin 1 (LH), Circuit 1205 (BK), harness side and ground. 	<p>Yes REPAIR Circuit 478 (TN/OG) for open. TEST the system for normal operation.</p>



GK9730-A

- Is the resistance less than 5 ohms?

No
REPAIR Circuit 1205 (BK). TEST the system for normal operation.


PINPOINT TEST Q: THE FOG LAMPS ARE ON CONTINUOUSLY

Test Step	Result / Action to Take
Q1 CHECK THE FOG LAMP RELAY	
<ul style="list-style-type: none"> ● Disconnect: Fog Lamp Relay. ● Are the fog lamps off? 	<p>Yes GO to Q2.</p> <p>No REPAIR Circuit 478 (TN/OG). TEST the system for normal operation.</p>
Q2 CHECK FOG LAMP RELAY	
<ul style="list-style-type: none"> ● Check the fog lamp relay; refer to Wiring Diagrams Cell 149. ● Is the fog lamp relay OK? 	<p>Yes RECONNECT the fog lamp relay. GO to Q3.</p> <p>No INSTALL a new fog lamp relay. TEST the system for normal operation.</p>
Q3 CHECK FOG LAMP SWITCH	
<ul style="list-style-type: none"> ● Disconnect: Fog Lamp Switch C240. ● Are the fog lamps off? 	<p>Yes INSTALL a new fog lamp switch. TEST the system for normal operation.</p> <p>No REPAIR Circuit 188 (WH/BK) for short. TEST the system for normal operation.</p>

Reversing Lamps

Refer to Wiring Diagrams Cell [93](#), Backup Lamps for schematic and connector information.

Special Tool(s)

 <p>ST1137-A</p>	<p>73III Automotive Meter or equivalent 105-R0057</p>
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Inspection and Verification

1. Verify the customer concern by operating the reversing lamps.
2. Visually inspect for obvious signs of mechanical and electrical damage; refer to the following chart:

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> ● Damaged digital transmission range (DTR) sensor (automatic transmission [A/T]) ● Damaged reversing lamp switch (manual transmission [M/T]) 	<ul style="list-style-type: none"> ● Blown central junction box (CJB) Fuse 11 (15A) ● Damaged wiring harness ● Loose or corroded connections ● Damaged reversing lamp ● Damaged DTR sensor (automatic transmission [A/T]) ● Damaged reversing lamp switch (manual transmission [M/T])

3. If the concern is not visually evident, determine the symptom and proceed to Symptom Chart.

Symptom Chart

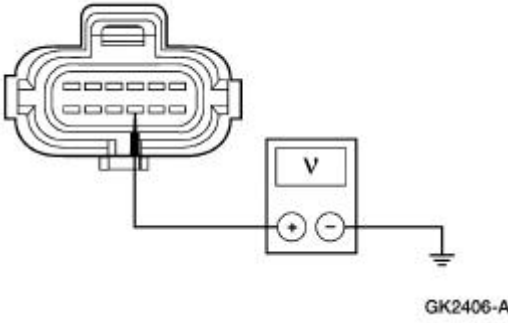
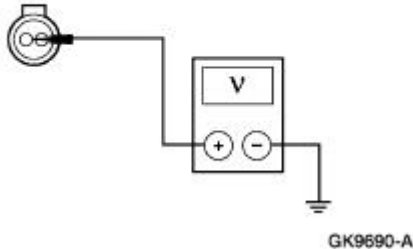
Symptom Chart

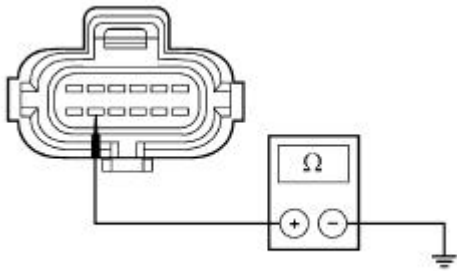
Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● The reversing lamps are inoperative 	<ul style="list-style-type: none"> ● CJB Fuse 11 (15A). ● Bulbs. ● Circuitry. ● DTR sensor (A/T). ● Reversing lamp switch (M/T). 	<ul style="list-style-type: none"> ● GO to Pinpoint Test R.

<ul style="list-style-type: none"> ● The individual reversing lamp is inoperative 	<ul style="list-style-type: none"> ● Bulb. ● Circuitry. 	<ul style="list-style-type: none"> ● GO to Pinpoint Test S.
<ul style="list-style-type: none"> ● The reversing lamps are on continuously 	<ul style="list-style-type: none"> ● Circuitry. ● DTR sensor (A/T). ● Reversing lamp switch (M/T). 	<ul style="list-style-type: none"> ● GO to Pinpoint Test T.

Pinpoint Tests

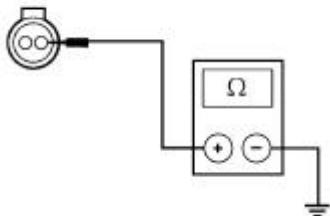
PINPOINT TEST R: THE REVERSING LAMPS ARE INOPERATIVE

Test Step	Result / Action to Take
<p>R1 CHECK THE VOLTAGE TO THE DTR SENSOR (A/T) OR THE REVERSING LAMP SWITCH (M/T)</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: DTR Sensor C167 (A/T). ● Disconnect: Reversing Lamp Switch C169 (M/T). ● Key in ON position. ● If equipped with A/T, measure the voltage between DTR sensor C167 Pin 9, Circuit 1087 (OG), harness side and ground.  <p style="text-align: center;">GK2406-A</p> <ul style="list-style-type: none"> ● If equipped with M/T, measure the voltage between reversing lamp switch C169, Circuit 1087 (OG), harness side and ground.  <p style="text-align: center;">GK9690-A</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to R2.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<p>R2 CHECK CIRCUIT 140 (BK/PK) FOR OPEN</p> <ul style="list-style-type: none"> ● Key in OFF position. ● If equipped with A/T, measure the resistance between DTR sensor C167 Pin 11, Circuit 140 (BK/PK), harness side and ground. 	<p>Yes INSTALL a new DTR sensor (A/T) or reversing lamp switch (M/T); REFER to Section 307-01, Section 308-03A or Section 308-03B. TEST the</p>



GK2407-A

- If equipped with M/T, measure the resistance between reversing lamp switch C169, Circuit 140 (BK/PK), harness side and ground.



GK9691-A

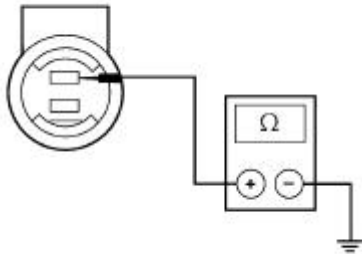
- Is the resistance less than 5 ohms?

system for normal operation.

No
GO to [R3](#).

R3 CHECK REVERSING LAMPS GROUND

- Disconnect: Inoperative Reversing Lamp.
- Measure the resistance between LH reversing lamp C451, Circuit 1205 (BK), or RH reversing lamp C461, Circuit 1205 (BK), harness side and ground.



GK9692-A

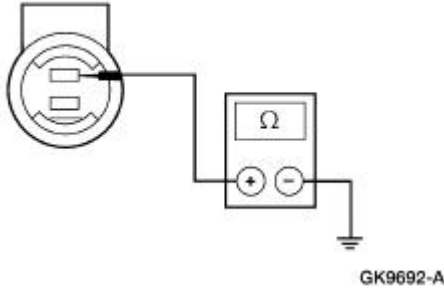
- Is the resistance less than 5 ohms?

Yes
REPAIR Circuit 140 (BK/PK) for open. TEST the system for normal operation.

No
REPAIR the circuit. TEST the system for normal operation.

PINPOINT TEST S: THE INDIVIDUAL REVERSING LAMP IS INOPERATIVE

Test Step	Result / Action to Take
S1 CHECK REVERSING LAMPS GROUND	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Inoperative Reversing Lamp. ● Measure the resistance between LH reversing lamp C451, Circuit 1205 (BK), or RH reversing lamp C461, Circuit 1205 (BK), harness side and ground. 	<p>Yes REPAIR Circuit 140 (BK/PK) for open. TEST the system for normal operation.</p>



- Is the resistance less than 5 ohms?

No
REPAIR the circuit.
TEST the system for
normal operation.

PINPOINT TEST T: THE REVERSING LAMPS ARE ON CONTINUOUSLY

Test Step	Result / Action to Take
T1 CHECK THE CONTINUITY OF THE DTR SENSOR (A/T) OR THE REVERSING LAMP SWITCH (M/T)	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: DTR Sensor C167 (A/T). ● Disconnect: Reversing Lamp Switch C169 (M/T). ● Set the parking brake. ● Key in ON position. ● Select REVERSE. ● Are the reversing lamps illuminated? 	<p>Yes REPAIR Circuit 140 (BK/PK) for short to battery. TEST the system for normal operation.</p> <p>No INSTALL a new DTR sensor (A/T) or reversing lamp switch (M/T); REFER to Section 307-01, Section 308-03A, or Section 308-03B. TEST the system for normal operation.</p>

Headlamp Adjustment

Headlamp Aiming

1. The headlamp aiming procedure depends on the type of beam pattern the headlamp is equipped with. Vehicles may come equipped with visual optical right (VOR), visual optical left (VOL), or SAE only (includes sealed beam type) headlamps. To identify the headlamp beam pattern, look on the headlamp lens. Molded in small letters on the headlamp lens is one of the following:
 - SAE
 - VOR or SAE
 - VOL or SAE
2. Once the headlamp beam pattern is identified, aim the headlamps using one of the following methods as applicable.
 - Photometric aimers can aim SAE, VOR and VOL type headlamps. This is the preferred method of headlamp aiming.
 - Visual or screen method aiming can be used to aim SAE, VOR and VOL type headlamps.
 - Mechanical aimers can be used only with SAE type headlamps. Lamps that can be aimed mechanically will have three nibs molded into the lens of the lamp.

Photometric Aiming

1. For the photometric aiming procedure, refer to the appropriate photometric headlamp aimer instruction manual.

Screen Method Aiming

All headlamp types

NOTE: Horizontal aim is not necessary for VOR or VOL headlamps.

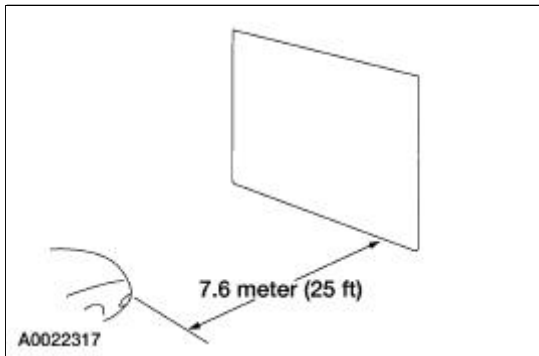
NOTE: Consult your state vehicle inspection manual for recommended tolerance ranges for visual aiming.

NOTE: The sight shield may need to be positioned or removed for access to the adjusters.

1. Before starting headlamp adjustment:
 - Check the tire inflation.
 - Check that no other load is in the vehicle other than a half tank of fuel.
 - Check that the headlamps are clean.
 - Check for correct headlamp operation.

- Check that the vehicle is on level ground.
 - If the vehicle is equipped with air suspension, make sure that the switch is on.
2. **NOTE:** The vertical wall or screen must be a minimum of 2.4 meters (8 feet) wide.

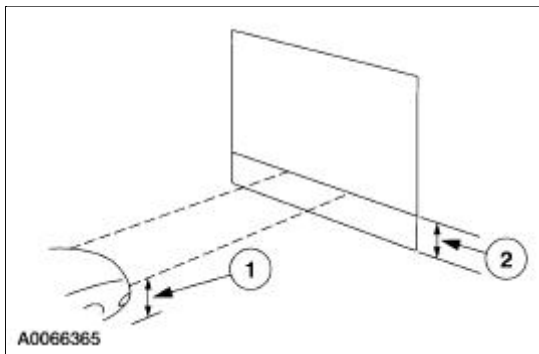
Park the vehicle on a level surface approximately 7.6 meters (25 feet) from the vertical wall or screen directly in front of it.



3. **NOTE:** The center of the lamp is marked by a 3 mm (0.12 in) circle on the headlamp lens.

Mark a horizontal reference line on the vertical wall or screen.

1. Measure the center of the headlamp height to ground and record.
2. Make a 2.4 meter (8 foot) horizontal mark (masking tape) on the vertical wall or screen at the same distance from the ground as previously recorded.



4. **NOTE:** This procedure should be done in a dark environment to effectively see the headlamp beam pattern.

Turn on the low beam headlamps to illuminate the wall or screen and open the hood.

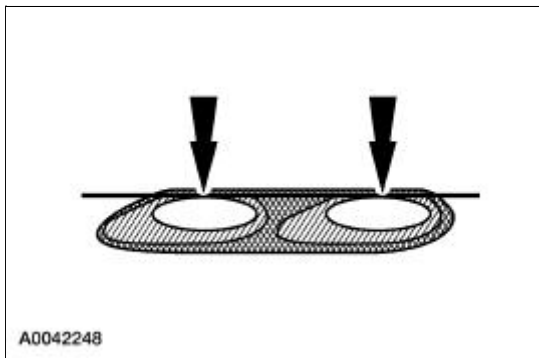
5. **NOTE:** For SAE type headlamps, the appearance of the beam pattern may vary between vehicles.

On the wall or screen, locate the high intensity area of the beam pattern. Place the top edge of the high intensity zone even with the horizontal reference line.

VOR type headlamps

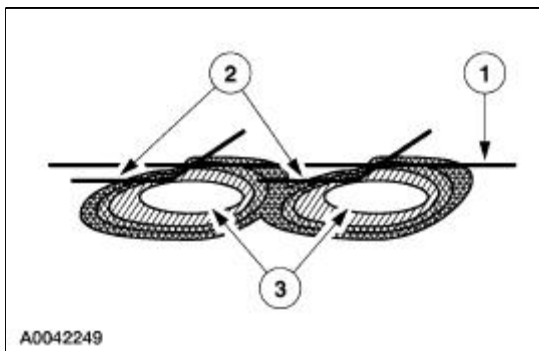
6. **NOTE:** The appearance of the VOR beam pattern may vary between vehicles.

Identify at the top edge of this high intensity area a distinct horizontal cutoff in the beam pattern. If the top edge of this cutoff is not even with the horizontal reference line, the headlamp beam will need to be adjusted.



VOL type headlamps

7. For VOL type headlamps, there will be a distinct cutoff in the left portion of the beam pattern. The edge of this cutoff should be positioned 50.2 mm (2 in) below the horizontal reference line.
 1. Horizontal reference line.
 2. Top edge of the beam pattern.
 3. High intensity zone.




Mechanical Aiming

1. For the mechanical aiming procedure, refer to the appropriate mechanical headlamp aimer instruction manual.
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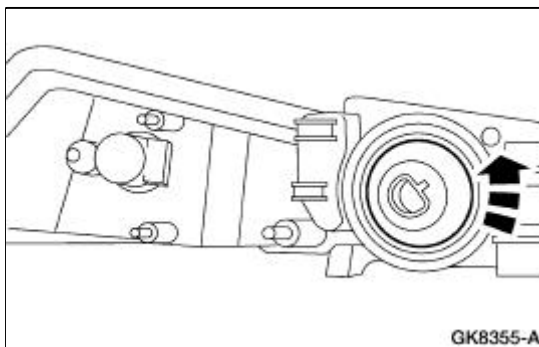
Bulb —Headlamp

Removal

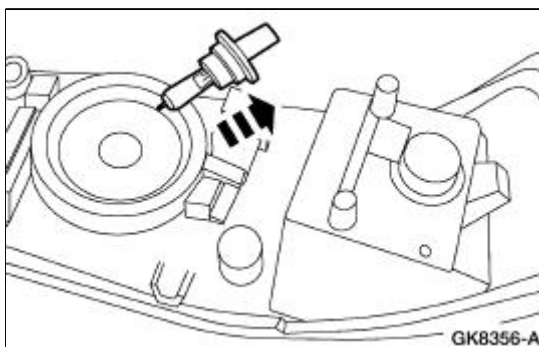
 **WARNING:** The halogen bulb contains gas under pressure. The bulb may shatter if the glass envelope is scratched or if the bulb is dropped. Handle the bulb only by its base. Grasp the bulb only by its base. Avoid touching the glass envelope.

NOTE: The headlamp bulb should not be removed from the headlamp until just before a replacement bulb is installed. Removing the bulb for an extended period of time may effect headlamp bulb performance. Contaminants may enter the headlamp where they can settle on the lens and reflector. Never turn on the headlamps with the bulb removed.


1. Remove the headlamp assembly. For additional information, refer to [Lamp Assembly—Headlamp](#).
2. Rotate the headlamp bulb retainer counterclockwise.



3. Remove the headlamp bulb and retainer.
 - Grasp the headlamp bulb by its base and remove the bulb.



Installation

1.  **WARNING:** The halogen bulb contains gas under pressure. The bulb may shatter if the glass envelope is scratched or if the bulb is dropped. Handle the bulb only by its base. Grasp the bulb only by its base. Avoid touching the glass envelope.

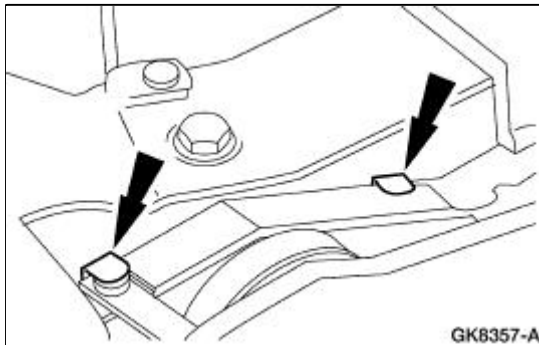
To install, reverse the removal procedure.

Lamp Assembly —Headlamp

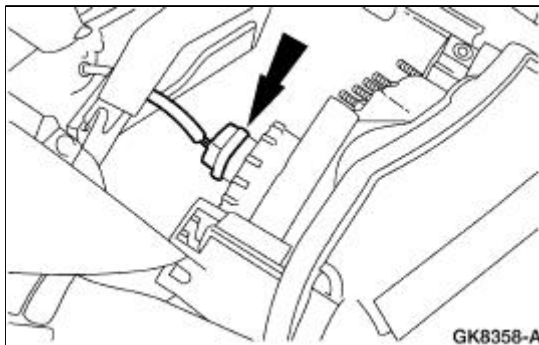
Removal

1. **NOTE:** Make sure that the headlamp switch and the ignition switch are in the OFF position.

Raise the headlamp retainers.



2. Remove the headlamp assembly.
 - Disconnect the electrical connectors and replace the lamp if necessary.



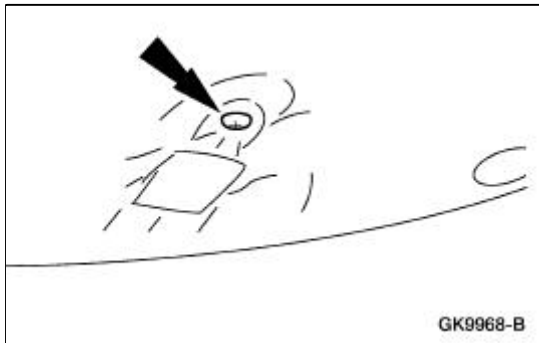
Installation

1. To install, reverse the removal procedure.
 - If necessary, adjust the headlamps. For additional information, refer to [Headlamp Adjustment](#) in this section.
-

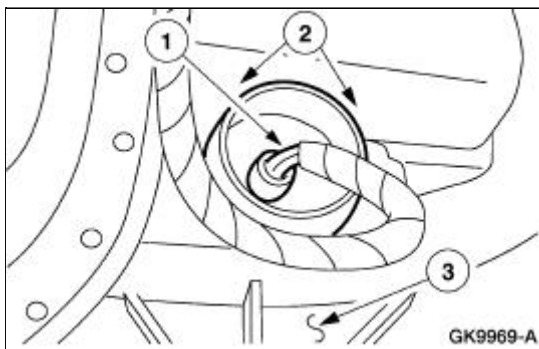
Lamp Assembly —Fog Lamp (GT)

Removal

1. Raise and support the vehicle.
2. Remove the screw.



3. Partially lower the vehicle and remove the fog lamp assembly.
 1. Disconnect the electrical connector.
 2. Remove the two screws.
 3. Remove the fog lamp assembly and replace the bulb if necessary.



Installation

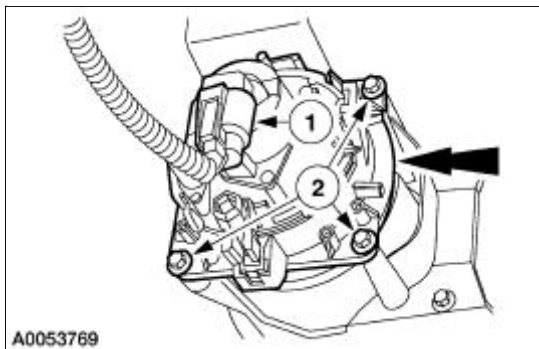
1. **NOTE:** Be sure the fascia clip is correctly installed on the bottom side of the fog lamp assembly bracket.

To install, reverse the removal procedure.

Lamp Assembly —Fog Lamp (Cobra)

Removal and Installation

1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#)
2. Remove the fog lamp assembly.
 1. Disconnect the electrical connector.
 2. Remove the four screws.

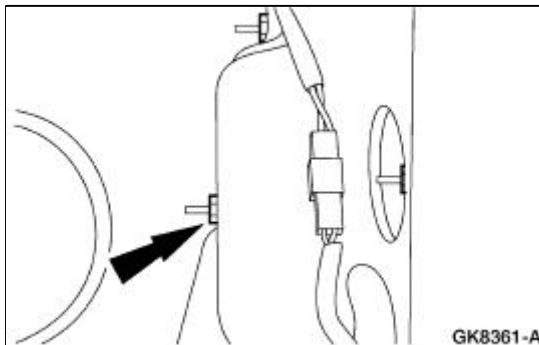


3. To install, reverse the removal procedure.
-

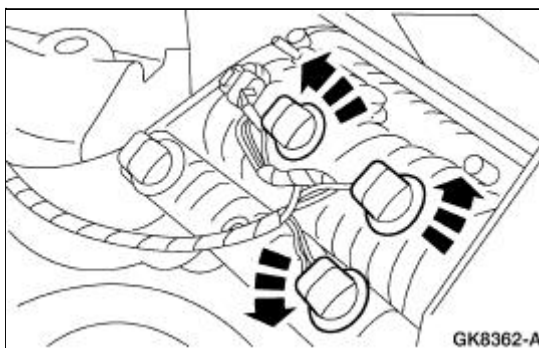
Lamp Assembly —Rear

Removal

1. Position the luggage compartment trim aside.
 - Remove the two retainers.
2. Remove the four rear lamp nuts.

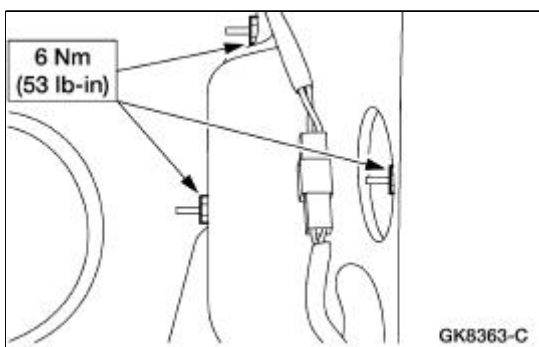


3. Remove the rear lamp assembly, disconnect the electrical connectors and replace the bulbs if necessary.



Installation

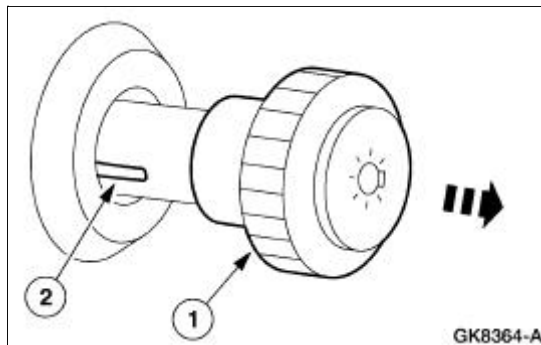
1. To install, reverse the removal procedure.



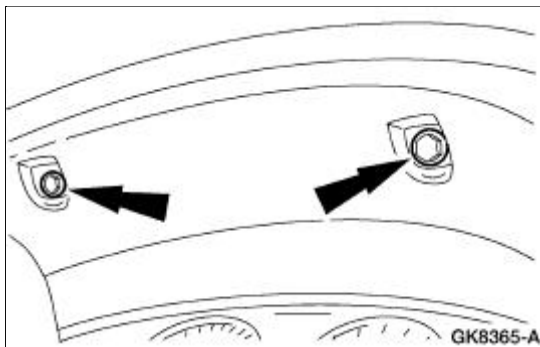
Lamp Switch —Headlamp

Removal

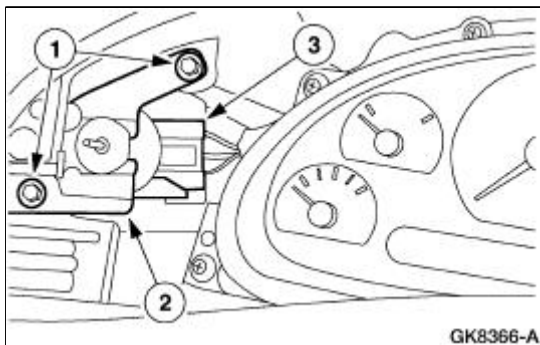
1. Disconnect the battery ground cable.
2. Remove the headlamp switch knob.
 1. Pull the headlamp switch knob out.
 2. Insert a thin tool into the slot, pull and remove the headlamp switch knob.



3. Remove the instrument panel cluster finish panel.
 - Remove the screws and remove the finish panel.



4. Remove the headlamp switch.
 1. Remove the screws.
 2. Remove the switch.
 3. Disconnect the electrical connectors.



Installation

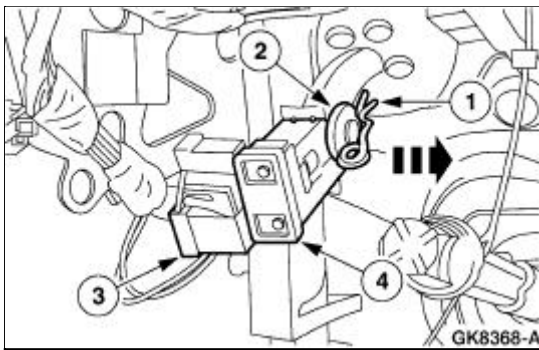
1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

To install, reverse the removal procedure.

Lamp Switch —Brake Pedal Position (BPP)

Removal

1. Disconnect the battery ground cable.
2. Remove the brake pedal position (BPP) switch.
 1. Remove the clip.
 2. Remove the retainer.
 3. Disconnect the electrical connector.
 4. Remove the BPP switch.



Installation

1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

To install, reverse the removal procedure.

Interior Lighting

The interior lighting system consists of the following:

- map/dome lamp assembly
 - rear-high mount/cargo lamp assembly
 - dimmer switch
 - door ajar switch (located on the door latches)
 - rear view mirror interior lamp (convertible only)
 - courtesy lamp
 - vanity mirror lamp assembly
 - transmission range indicator
-



Interior Lighting

Refer to Wiring Diagrams Cell [111](#), Remote Control Alarm and Lock System for schematic and connector information.

Refer to Wiring Diagrams Cell [59](#), Generic Electronic Module for schematic and connector information.

Refer to Wiring Diagrams Cell [89](#), Courtesy Lamps for schematic and connector information.

Special Tool(s)

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

Principles of Operation

Battery Saver

The battery saver feature provides automatic shut-off of power to demand and courtesy lamp circuitry. When the generic electronic module (GEM) detects the ignition switch circuits are in the key OFF or removed ignition key positions, power will be disabled after individual time-out periods of 30 minutes for the demand lamps, and 10 minutes for the courtesy lamps. However, the time-out period for the courtesy lamps changes to 30 minutes when the GEM detects that the luggage compartment lid is ajar by means of the luggage compartment lid ajar circuit, or if the dome lamp is switched on by means of the dome lamp circuit. When the GEM detects that the ignition switch is in the RUN, ACC, or START positions, the battery saver feature is disabled.

The battery saver timer for the demand lamps is reset when the GEM detects that the ignition switch is in the OFF or key out positions or when the GEM detects any one of the following conditions:

- the driver or passenger door becomes ajar, as detected by the door ajar circuit
- the luggage compartment lid becomes ajar, as detected by the luggage compartment lid ajar circuit
- the dome lamp switch is activated, as detected by the dome lamp switch circuit

The battery saver timer for the courtesy lamps is reset when the GEM detects that the ignition switch is in the OFF or key out positions or when the GEM detects the driver or passenger door becomes ajar

as detected by the door ajar circuit. For vehicles equipped with the remote keyless entry feature, any signal the GEM detects when a valid remote transmitter button is depressed will reset both the demand and courtesy lamp battery saver timers. This battery saver relay then restores power to both the demand and courtesy lamp circuits.

Base Courtesy and Extended Lighting

The base courtesy lighting feature provides interior lighting for the convenience of the vehicle's occupants. The courtesy lamps consist of the map/dome lamps for the coupe and the map lamps for the convertible. All lamps designated as courtesy lamps will be illuminated whenever the GEM detects that the driver or passenger doors become ajar, by means of the driver or passenger door ajar circuits. The courtesy lamps will also be illuminated when the GEM detects that the dome lamp switch has been activated, by means of the dome lamp switch circuit.

The extended courtesy lighting feature provides temporary extended illumination of the courtesy lamps after the customer has entered the vehicle. The courtesy lamps will remain illuminated for 25 seconds after the GEM detects that the driver and passenger doors are closed, as detected by the door ajar circuits. The extended courtesy lighting feature will be terminated after the 25 second time-out period, or if the GEM detects that the ignition switch has been moved from the OFF position to either the RUN, ACC, or START positions.

Demand Lighting

The GEM does not provide any special features to the demand lighting group with the exception of providing a power source when the battery saver feature is active. The demand lighting group consists of the luggage compartment lamp, the driver and passenger vanity mirror lamps, and the map lamps.

Illuminated Entry with Remote Keyless Entry

The illuminated entry with remote keyless entry feature, provides power to the courtesy lamps when the remote transmitter is used. When the GEM detects that the ignition switch is in the OFF or key out positions, and it detects that a valid remote transmitter unlock button has been depressed, power to the courtesy lamps will be enabled. The courtesy lamp circuit will remain powered until one of the following occurs:

- The GEM detects that the ignition switch has been moved from the OFF, to the RUN, START, or ACC position.
- The GEM detects any valid remote transmitter lock button is depressed.
- The courtesy lamp circuit has been powered for 25 seconds.

If the GEM detects any valid remote transmitter unlock button has been depressed, and the ignition switch is in the OFF or key out position during the 25 second time-out, the courtesy lamp circuits will remain powered for an additional 25 seconds.

Inspection and Verification

1. The interior lighting system is a generic electronic module (GEM) controlled system.
2. Verify the customer concern by operating the interior lighting system.
3. Visually inspect for the following obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> ● Switch(es) 	<ul style="list-style-type: none"> ● CJB Fuses: <ul style="list-style-type: none"> ■ 7 (20A) ■ 32 (15A) ■ 39 (5A) ● Wiring harness ● Connections ● Lamps ● Circuitry

4. If the concern remains after the inspection, connect the scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If the scan tool does not communicate with the vehicle:
 - check that the program card is correctly installed.
 - check the connections to the vehicle.
 - check the ignition switch position.
5. If the scan tool still does not communicate with the vehicle, refer to the scan tool manual.
6. Carry out the DATA LINK DIAGNOSTIC TEST. If the scan tool responds with:
 - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to [Section 418-00](#).
 - NO RESP/NOT EQUIP for GEM, go to Pinpoint Test A.
 - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the GEM.
7. If the DTCs retrieved are related to the concern, go to GEM Diagnostic Trouble Code (DTC) Index to continue diagnostics.
8. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

GEM Diagnostic Trouble Code (DTC) Index

GEM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1322	Driver Door Ajar Circuit Short to Ground	GEM	REFER to Section 417-02 .
B1330	Passenger Door Ajar Circuit Short to Ground	GEM	REFER to Section 417-02 .
B1334	Decklid Ajar Rear Door Circuit Short to Ground	GEM	REFER to Section 417-02 .
B1342	ECU Is Defective	GEM	CLEAR the DTC. Retrieve the DTCs. If DTC B1342 is retrieved, INSTALL a new GEM. For additional information, REFER to Section 419-10 .
B1397	Power Door unlock Circuit Short to Battery	GEM	REFER to Section 501-14B .
B1405	Driver Power Window Down Circuit Short to Battery	GEM	REFER to Section 501-11 .

B1408	Driver Power Window Up Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1410	Driver Power Window Motor Circuit Failure	GEM	REFER to Section 501-11 .
B1426	Lamp Safety Belt Circuit Short to Battery	GEM	REFER to Section 413-01 .
B1428	Lamp Safety Belt Circuit Failure	GEM	REFER to Section 413-01 .
B1431	Wiper Brake/Run Relay Circuit Failure	GEM	REFER to Section 501-16 .
B1432	Wiper Brake/Run Relay Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1434	Wiper Hi/Low Speed Relay Coil Circuit Failure	GEM	REFER to Section 501-16 .
B1436	Wiper Hi/Low Speed Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1438	Wiper Mode Select Switch Circuit Failure	GEM	REFER to Section 501-16 .
B1441	Wiper Mode Select Switch Circuit Short to Ground	GEM	REFER to Section 501-16 .
B1446	Wiper Park Sense Circuit Failure	GEM	REFER to Section 501-16 .
B1448	Wiper Park Sense Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1450	Wiper Wash/Delay Switch Circuit Failure	GEM	REFER to Section 501-16 .
B1453	Wiper Wash/Delay Switch Circuit Short to Ground	GEM	REFER to Section 501-16 .
B1458	Wiper Washer Pump Motor Relay Circuit Failure	GEM	REFER to Section 501-16 .
B1460	Wiper Washer Pump Motor Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1462	Safety Belt Switch Circuit Failure	GEM	REFER to Section 413-09 .
B1466	Wiper Hi/Low Speed Not Switching	GEM	REFER to Section 501-16 .
B1473	Wiper Low Speed Circuit Motor Failure	GEM	REFER to Section 501-16 .
B1476	Wiper High Speed Circuit Motor Failure	GEM	REFER to Section 501-16 .
B1551	Decklid Release Circuit Failure	GEM	REFER to Section 501-14B .
B1553	Decklid Release Circuit Short to Battery	GEM	REFER to Section 501-14B .
B1555	Ignition Run/Start Circuit Failure	GEM	REFER to Section 211-05 .
B1687	Lamp Dome Input Circuit Short to Battery	GEM	REFER to Section 417-02 .
B2486	LF Side Repeater Lamp	GEM	REFER to Section 417-01 .

	Output Circuit Failure		
B2488	RF Side Repeater Lamp Output Circuit Failure	GEM	REFER to Section 417-01 .
C1189	Brake Fluid Level Sensor Input Short Circuit to Ground	GEM	REFER to Section 413-01 .
C1223	Lamp Brake Warning Output Circuit Failure	GEM	REFER to Section 413-01 .
C1225	Lamp Brake Warning Output Circuit Short to Battery	GEM	REFER to Section 413-01 .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none"> No communication with the generic electronic module 	<ul style="list-style-type: none"> CJB Fuse 39 (5A) GEM. Circuitry. 	<ul style="list-style-type: none"> GO to Pinpoint Test A.
<ul style="list-style-type: none"> The courtesy lamps are inoperative 	<ul style="list-style-type: none"> CJB Fuse 7 (20A). Door ajar switch (es). Courtesy lamp assemblies. Circuitry. GEM. Ignition Switch. Headlamp Switch. 	<ul style="list-style-type: none"> GO to Pinpoint Test B.
<ul style="list-style-type: none"> The demand lighting is inoperative 	<ul style="list-style-type: none"> CJB Fuse 7 (20A). Circuitry. GEM. Door ajar switch (es). Demand lamp assemblies. Ignition Switch. Headlamp Switch. 	<ul style="list-style-type: none"> GO to Pinpoint Test C.
<ul style="list-style-type: none"> The illuminated entry is inoperative when using the remote transmitter 	<ul style="list-style-type: none"> Remote transmitter. GEM. 	<ul style="list-style-type: none"> GO to Pinpoint Test D.
<ul style="list-style-type: none"> The battery saver does not deactivate after timeout 	<ul style="list-style-type: none"> Circuitry. GEM. 	<ul style="list-style-type: none"> GO to Pinpoint Test E.

Pinpoint Tests



CAUTION: Before removing and installing the GEM or its connectors, disconnect the

battery. Failure to follow this caution will result in the GEM storing many erroneous DTCs and may result in the GEM exhibiting erratic operation after installation.



CAUTION: Be careful when probing the central junction box (CJB), battery junction box (BJB), or any connectors. Damage will result to the connector receptacle if the probe being used is too large.



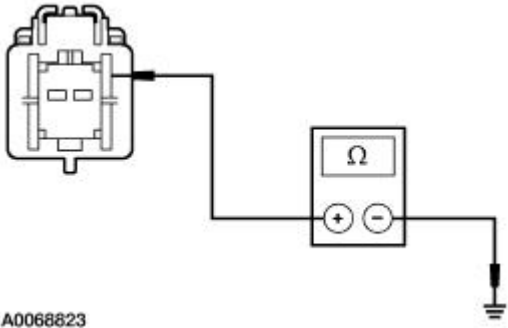
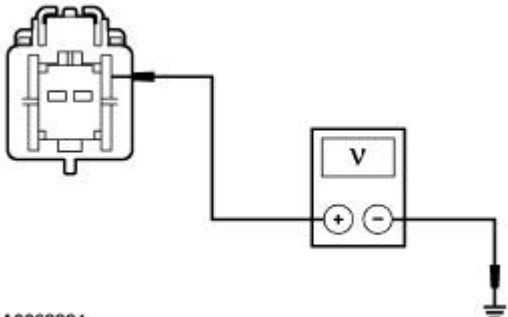
CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage may result.

NOTE: If continuous DTCs are recorded and the symptom is not present when carrying out the pinpoint tests, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

NOTE: Complete the entire pinpoint test related to the symptom before installing a new GEM.

PINPOINT TEST A: NO COMMUNICATION WITH THE GENERIC ELECTRONIC MODULE

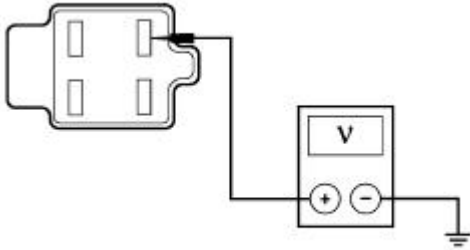
Test Step	Result / Action to Take															
CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.																
<p>A1 GENERIC ELECTRONIC MODULE (GEM) POWER SUPPLY</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Generic Electronic Module (GEM) C201a. ● Disconnect: GEM C201b. ● Key in ON position. ● Using the following table, measure the voltage between the GEM, harness side and ground. <table border="1"> <thead> <tr> <th>Connector</th> <th>Pin</th> <th>Circuit</th> </tr> </thead> <tbody> <tr> <td>C201a</td> <td>2</td> <td>400 (LB/BK)</td> </tr> <tr> <td>C201a</td> <td>3</td> <td>1006 (DG/WH)</td> </tr> <tr> <td>C201b</td> <td>1</td> <td>1001 (WH/YE)</td> </tr> <tr> <td>C201b</td> <td>4</td> <td>193 (YE/LG)</td> </tr> </tbody> </table> <ul style="list-style-type: none"> ● Are the voltages greater than 10 volts? 	Connector	Pin	Circuit	C201a	2	400 (LB/BK)	C201a	3	1006 (DG/WH)	C201b	1	1001 (WH/YE)	C201b	4	193 (YE/LG)	<p>Yes GO to A2.</p> <p>No REPAIR the circuit(s) in question. TEST the system for normal operation.</p>
Connector	Pin	Circuit														
C201a	2	400 (LB/BK)														
C201a	3	1006 (DG/WH)														
C201b	1	1001 (WH/YE)														
C201b	4	193 (YE/LG)														
<p>A2 CHECK THE GEM GROUND CIRCUIT 397 (BK/WH) FOR OPEN</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Measure the resistance between the GEM C201b pin 2, circuit 397 (BK/WH), harness side and ground. 	<p>Yes GO to A3.</p> <p>No REPAIR the circuit(s) in question. TEST the system for normal operation.</p>															

 <p>A0068823</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	
<p>A3 CHECK CIRCUIT 397 (BK/WH) FOR SHORT TO POWER</p>	
<ul style="list-style-type: none"> ● Measure the voltage between GEM C201b pin 2, circuit 397 (BK/WH), harness side and ground.  <p>A0068824</p> <ul style="list-style-type: none"> ● Is any voltage present? 	<p>Yes REPAIR the circuit. TEST the system for normal operation.</p> <p>No REFER to Section 418-00.</p>

PINPOINT TEST B: THE COURTESY LAMPS ARE INOPERATIVE

Test Step	Result / Action to Take
<p>B1 CHECK IGNITION STATES</p>	
<ul style="list-style-type: none"> ● Monitor the GEM PIDS IGN_KEY, IGN_A, IGN_S, and IGN_R while cycling the ignition switch through the OFF, ACC, RUN, START and key out positions. ● Do the PID values agree with the ignition switch positions? 	<p>Yes GO to B2.</p> <p>No For key-in-ignition concerns, REFER to Section 413-09.</p>
<p>B2 CHECK THE DOOR AJAR INPUT TO THE GEM</p>	
<ul style="list-style-type: none"> ● Monitor the GEM PID D_DOOR, and P_DOOR, while opening and closing the driver and passenger doors. ● Do the GEM PIDS D_DOOR and P_DOOR agree with the driver and passenger door positions? 	<p>Yes GO to B3.</p> <p>No REFER to Section 413-09.</p>
<p>B3 CHECK THE DOME LAMP SWITCH STATUS INPUT TO THE GEM — MONITOR THE GEM PID DOMESW</p>	
<ul style="list-style-type: none"> ● Monitor the GEM PID DOMESW, while activating, and deactivating the dome lamp switch. ● Does the GEM PID DOMESW agree with the dome lamp switch position? 	<p>Yes GO to B4.</p> <p>No GO to B13.</p>
<p>B4 CHECK THE LUGGAGE COMPARTMENT LID AJAR INPUT TO THE GEM — MONITOR THE GEM PID DECKLID</p>	

<ul style="list-style-type: none"> ● Monitor the GEM PID DECKLID, while opening and closing the luggage compartment lid. ● Does the GEM PID DECKLID agree with the dome switch position? 	<p>Yes GO to B5.</p> <p>No GO to B16.</p>
B5 CHECK THE COURTESY LAMP CIRCUITS	
<ul style="list-style-type: none"> ● Close the luggage compartment lid and all doors are closed. ● Turn the dome and map lamp switches to the off position. ● Are the courtesy lamps illuminated? 	<p>Yes GO to B12.</p> <p>No GO to B6.</p>
B6 CHECK THE GEM CONTROL OF THE COURTESY LAMPS	
<ul style="list-style-type: none"> ● Trigger the GEM active command COURTESYL ON and then OFF. ● Do the courtesy lamps illuminate when the GEM active command COURTESYL ON is triggered, and go out when the GEM active command COURTESYL OFF is triggered? 	<p>Yes INSTALL a new GEM. For additional information, REFER to Section 419-10. REPEAT the self-test. CLEAR the DTCs.</p> <p>No GO to B7.</p>
B7 CHECK THE GEM FOR AN INTERNAL FAULT	
<ul style="list-style-type: none"> ● Trigger the GEM active command COURTESYL ON, then OFF. ● Can an audible click be heard coming from the GEM, while triggering the active command COURTESYL ON? 	<p>Yes GO to B8.</p> <p>No INSTALL a new GEM. For additional information, REFER to Section 419-10. REPEAT the self-test. CLEAR the DTCs.</p>
B8 CHECK CIRCUIT 1034 (BK/WH) FOR VOLTAGE	
<ul style="list-style-type: none"> ● Disconnect the dome lamp C929 (coupe) or map lamp C978 (convertible) ● Trigger the GEM active command COURTESYL ON. ● Measure the voltage between dome/map lamp C929 (coupe) Pin 3 or map lamp C978 (convertible) Pin 4, Circuit 1034 (BK/WH), harness side and ground. <div style="text-align: center;"> </div> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to B11.</p> <p>No GO to B9.</p>
B9 CHECK CIRCUIT 1006 (DG/WH) FOR OPEN	
<p>NOTE: Verify battery voltage at CJB Fuse 7 (20A) before carrying out this test.</p> <ul style="list-style-type: none"> ● Disconnect: GEM C201a. ● Measure the voltage between GEM C201a Pin 1, Circuit 1006 (DG/WH), harness side and ground. 	<p>Yes GO to B10.</p> <p>No REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs.</p>

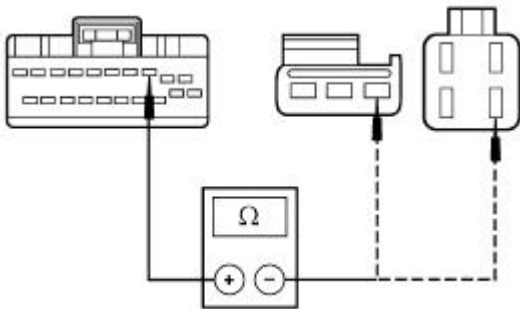


GK9903-A

- Is the voltage greater than 10 volts?

B10 CHECK CIRCUIT 1034 (BK/WH) FOR OPEN

- Disconnect: GEM C201c.
- Measure the resistance between GEM C201c Pin 3, Circuit 1034 (BK/WH), harness side and dome/map lamp C929 (coupe) Pin 3 or map lamp C978 (convertible) Pin 4, Circuit 1034 (BK/WH), harness side.

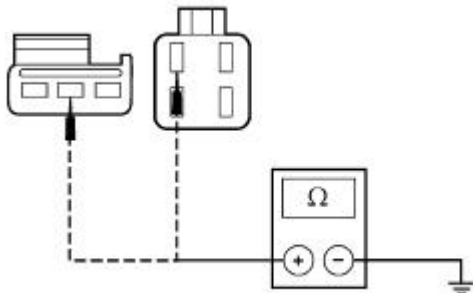


GK9904-A

- Is the resistance less than 5 ohms?

B11 CHECK CIRCUIT 1205 (BK) FOR OPEN

- Measure the resistance between dome/map lamp C929 (coupe) Pin 2 or map lamp C978 (convertible) Pin 1, Circuit 1205 (BK), harness side and ground.



GK9905-A

- Is the resistance less than 5 ohms?

B12 CHECK CIRCUIT 1034 (BK/WH) FOR SHORT TO BATTERY

- Measure the voltage between GEM C201c Pin 3, Circuit 1034 (BK/WH), harness side and ground.

Yes

INSTALL a new GEM. For additional information, REFER to [Section 419-10](#). REPEAT the self-test. CLEAR the DTCs.

No

REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs.

Yes

INSTALL a new dome/map lamp assembly. For additional information, REFER to [Lamp Assembly—Map/Dome](#).

No

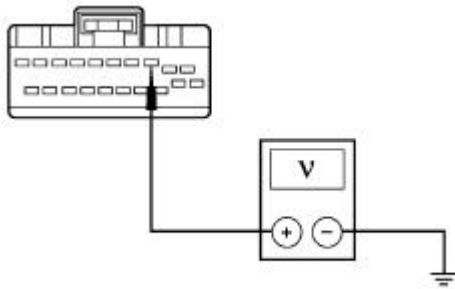
REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs.

Yes

REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs.

No

INSTALL a new GEM. For additional information, REFER to [Section 419-10](#). REPEAT the self-test. CLEAR the DTCs.



GK9906-A

- Is the voltage greater than 10 volts?

B13 CHECK THE COURTESY LAMP OPERATION — MONITOR THE GEM PID DOMESW

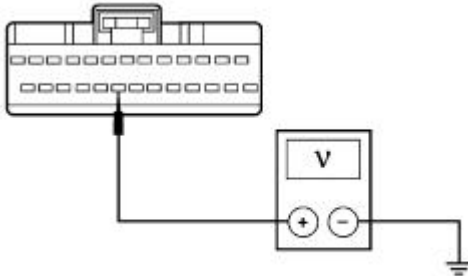
- Monitor the GEM PID DOMESW, while moving the interior lamp switch from the OFF to the ON position.
- Does the GEM PID DOMESW value always indicate ON?

Yes
GO to [B15](#).

No
GO to [B14](#).

B14 CHECK CIRCUIT 706 (GY) FOR OPEN

- Disconnect: GEM C201e.
- Measure the voltage between GEM C201e Pin 21, Circuit 706 (GY), harness side and ground.



GK9907-A

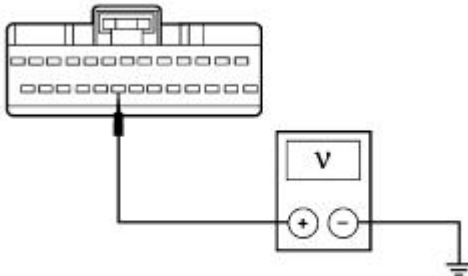
- Is the voltage greater than 10 volts?

Yes
INSTALL a new GEM. For additional information, REFER to [Section 419-10](#). REPEAT the self-test. CLEAR the DTCs.

No
REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs.

B15 CHECK CIRCUIT 706 (GY) FOR SHORT TO BATTERY

- Measure the voltage between GEM C201e Pin 21, Circuit 706 (GY), harness side and ground.



GK9907-A

- Is the voltage greater than 10 volts?

Yes
REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs.

No
INSTALL a new GEM. For additional information, REFER to [Section 419-10](#). REPEAT the self-test. CLEAR the DTCs.

B16 CHECK CIRCUIT 486 (BN/WH) FOR OPEN OR SHORT TO GROUND — MONITOR THE GEM PID DECKLID

- Monitor the GEM PID DECKLID, while opening and closing the luggage compartment lid.
- Does the GEM PID DECKLID agree with the luggage compartment lid position?

Yes
GO to [B17](#).

No
GO to [B19](#).

B17 CHECK LUGGAGE COMPARTMENT SOLENOID FOR SHORT TO GROUND

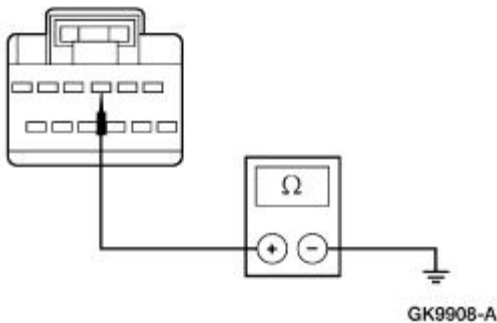
- Key in OFF position.
- Disconnect: Luggage Compartment Solenoid C430.
- Monitor the GEM PID DECKLID.
- **Does the GEM PID DECKLID indicate closed?**

Yes
INSTALL a new luggage compartment solenoid. For additional information, REFER to [Section 501-14A](#). REPEAT the self-test. CLEAR the DTC.

No
GO to [B18](#).

B18 CHECK CIRCUIT 486 (BN/WH) FOR SHORT TO GROUND

- Disconnect: GEM C201d.
- Measure the resistance between GEM C201d Pin 3, Circuit 486 (BN/WH), harness side and ground.



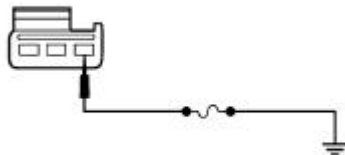
- **Is the resistance greater than 10,000 ohms?**

Yes
INSTALL a new GEM. For additional information, REFER to [Section 419-10](#). REPEAT the self-test. CLEAR the DTCs.

No
REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs.

B19 CHECK CIRCUIT 486 (BN/WH) FOR AN OPEN — MONITOR GEM PID DECKLID

- Disconnect: Luggage Compartment Solenoid C430.
- Monitor the GEM PID DECKLID.
- Connect a 10A fused jumper between luggage compartment solenoid C430 Pin 3, Circuit 486 (BN/WH), harness side and ground.



- **Does the GEM PID DECKLID indicate AJAR with the jumper installed?**

Yes
GO to [B21](#).

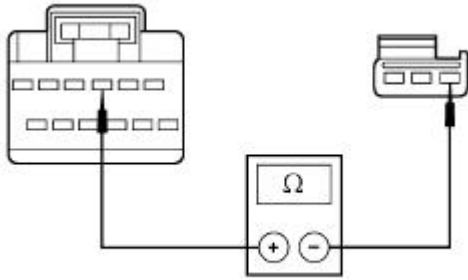
No
GO to [B20](#).

B20 CHECK CIRCUIT 486 (BN/WH) FOR OPEN

- Disconnect: GEM C201d.
- Measure the resistance between GEM C201d Pin 3, Circuit 486 (BN/WH), harness side and luggage compartment solenoid C430 Pin 3, Circuit 486 (BN/WH) harness side.

Yes
INSTALL a new GEM. For additional information, REFER to [Section 419-10](#). REPEAT the self-test. CLEAR the DTCs.

No
REPAIR the circuit. REPEAT the self-test.



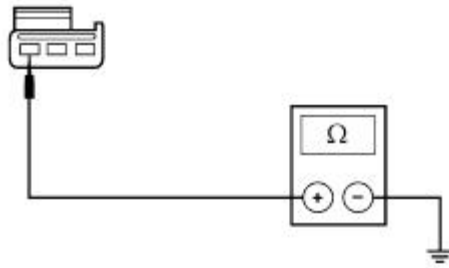
GK9910-A

- Is the resistance less than 5 ohms?

CLEAR the DTCs.

B21 CHECK GROUND CIRCUIT 1205 (BK) FOR OPEN

- Measure the resistance between luggage compartment lid switch C430 Pin 1, Circuit 1205 (BK), harness side and ground.



GN2312-A

- Is the resistance less than 5 ohms?

Yes

INSTALL a new luggage compartment solenoid. For additional information, REFER to [Section 501-14A](#) . REPEAT the self-test. CLEAR the DTCs.

No

REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs.

PINPOINT TEST C: THE DEMAND LIGHTING IS INOPERATIVE

Test Step	Result / Action to Take
C1 CHECK GEM SUPPLIED POWER TO THE DEMAND LAMPS	
<ul style="list-style-type: none"> ● Turn on both map lamps by depressing the map lamp switches. ● Turn on both vanity mirror lamps. ● Open the luggage compartment lid. ● Do any of the lamps illuminate? 	<p>Yes GO to C8 .</p> <p>No GO to C2 .</p>
C2 CHECK IGNITION STATES	
<ul style="list-style-type: none"> ● Monitor the GEM PIDS IGN_KEY, IGN_A, IGN_S, and IGN_R while cycling the ignition switch through the OFF, ACC, RUN, START and key out positions. ● Do the PID values agree with the ignition switch positions? 	<p>Yes GO to C3 .</p> <p>No For key-in-ignition concerns, REFER to Section 413-09 .</p>
C3 CHECK DRIVER AND PASSENGER DOOR AJAR INPUTS TO THE GEM	
<ul style="list-style-type: none"> ● Monitor the GEM PIDs D_DOOR and P_DOOR, while opening and closing the driver and passenger doors. ● Did the GEM PIDs D_DOOR and P_DOOR agree with the driver and passenger door positions? 	<p>Yes GO to C4 .</p> <p>No REFER to Section 413-09 .</p>

C4 CHECK INTERIOR LAMP SWITCH INPUT TO THE GEM — MONITOR GEM PID DOMESW

- Monitor the GEM PID DOMESW, while moving the interior lamp switch from the OFF to the ON position.
- **Does the GEM PID DOMESW values agree with the interior lamp switch positions?**

Yes
GO to [C5](#).

No
GO to [Pinpoint Test B](#).

C5 CHECK THE LUGGAGE COMPARTMENT LID AJAR INPUT TO THE GEM — MONITOR THE GEM PID DECKLID

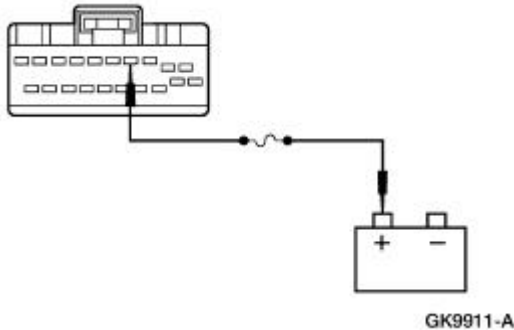
- Monitor the GEM PID DECKLID, while opening, and closing, the luggage compartment lid.
- **Does the GEM PID DECKLID agree with the luggage compartment lid position?**

Yes
GO to [C6](#).

No
GO to [Pinpoint Test B](#).

C6 CHECK CIRCUIT 705 (LG/OG) FOR OPEN

- Turn on both map lamps using the switches in the rear view mirror.
- Turn on both vanity mirror lamps.
- Open the luggage compartment lid.
- Disconnect: GEM C201c.
- Connect a fused jumper (20A) between GEM C201c Pin 4, Circuit 705 (LG/OG), harness side and battery positive terminal.



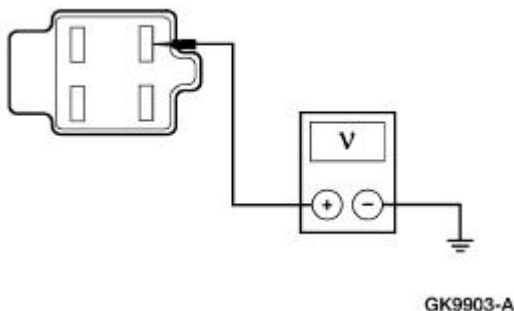
- **Do the demand lamps illuminate?**

Yes
GO to [C7](#).

No
REPAIR the circuit.
REPEAT the self-test.
CLEAR the DTCs.

C7 CHECK CIRCUIT 1006 (DG/WH) FOR OPEN

- NOTE:** Verify battery voltage at CJB Fuse 7 (20A) before carrying out this test.
- Disconnect: GEM C201a.
 - Measure the voltage between GEM C201a Pin 1, Circuit 1006 (DG/WH), harness side and ground.



- **Is the voltage greater than 10 volts?**

Yes
INSTALL a new GEM. For additional information, REFER to [Section 419-10](#). REPEAT the self-test.
CLEAR the DTCs.

No
REPAIR the circuit.
REPEAT the self-test.
CLEAR the DTCs.

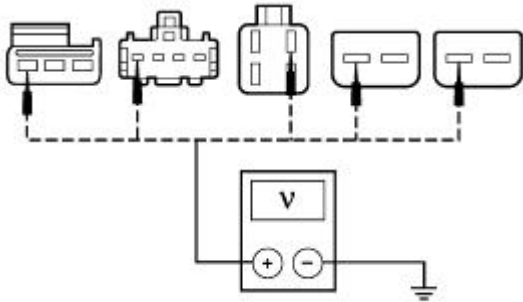
C8 CHECK CIRCUIT 705 (LG/OG) FOR VOLTAGE AT INOPERATIVE DEMAND LAMP

- Key in OFF position.
- Disconnect inoperative demand lamp, dome/map C929

Yes
GO to [C9](#).

(coupe), map C907 (convertible), right hand vanity C906, left hand vanity C978, or luggage compartment C4111.

- Measure the voltage between inoperative demand lamp, Circuit 705 (LG/OG), harness side and ground.



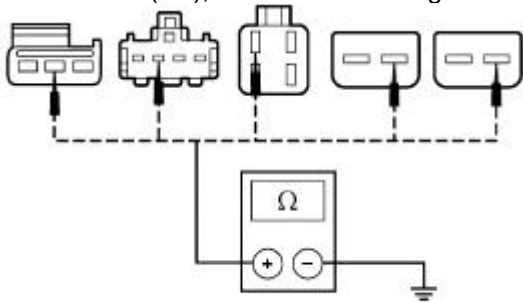
GK9912-A

- Is the voltage greater than 10 volts?

No
REPAIR the circuit in question. REPEAT the self-test. CLEAR the DTCs.

C9 CHECK CIRCUIT 1205 (BK) FOR OPEN AT INOPERATIVE DEMAND LAMP

- Measure the resistance between inoperative demand lamp Circuit 1205 (BK), harness side and ground.



GK9913-A

- Is the resistance less than 5 ohms?

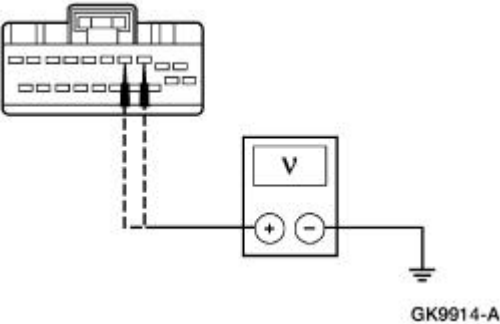
Yes
INSTALL a new demand lamp assembly. REPEAT the self-test. CLEAR the DTCs.

No
REPAIR the circuit in question. REPEAT the self-test. CLEAR the DTCs.

PINPOINT TEST D: THE ILLUMINATED ENTRY IS INOPERATIVE WHEN USING THE REMOTE TRANSMITTER

Test Step	Result / Action to Take
D1 CHECK THE REMOTE TRANSMITTER INPUT TO THE GEM	
<ul style="list-style-type: none"> ● Remove the ignition key from the ignition. ● Depress the lock and then the unlock buttons on the remote transmitter. ● Do the doors lock when the lock button is depressed and unlock when the unlock button is depressed? 	<p>Yes GO to D2.</p> <p>No REFER to Section 501-14B.</p>
D2 CHECK OPERATION OF ILLUMINATED ENTRY WITHOUT REMOTE TRANSMITTER	
<ul style="list-style-type: none"> ● Open the driver door. ● Do the courtesy lamps illuminate? 	<p>Yes INSTALL a new GEM. For additional information, REFER to Section 419-10. REPEAT the self-test. CLEAR the DTCs.</p> <p>No GO to Pinpoint Test B.</p>

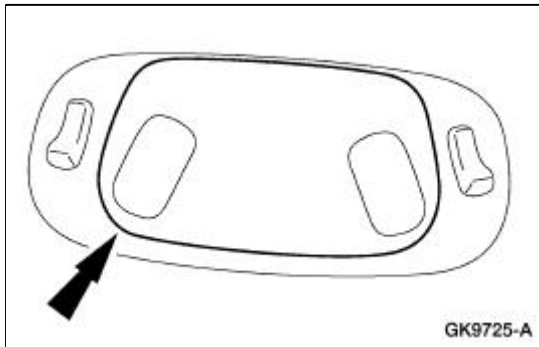
PINPOINT TEST E: THE BATTERY SAVER DOES NOT DEACTIVATE AFTER TIMEOUT

Test Step	Result / Action to Take
<p>E1 CHECK THE GEM CONTROL OF THE BATTERY SAVER FUNCTION — TRIGGER THE GEM ACTIVE COMMAND BATT SAVR ON</p> <ul style="list-style-type: none"> ● Trigger the GEM active command BATT SAVR ON and then OFF. ● Do the courtesy lamps illuminate and turn off when the GEM active command BATT SAVR is triggered ON and OFF? 	<p>Yes INSTALL a new GEM. For additional information, REFER to Section 419-10. REPEAT the self-test. CLEAR the DTCs.</p> <p>No GO to E2.</p>
<p>E2 CHECK CIRCUITS 1034 (BK/WH), AND 705 (LG/OG), FOR SHORT TO BATTERY</p> <ul style="list-style-type: none"> ● Disconnect: GEM C201c. ● Measure the voltage between GEM C292 Pin 3, Circuit 1034 (BK/WH), harness side and ground; and between GEM C292 Pin 4, Circuit 705 (LG/OG), harness side and ground.  <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes REPAIR the circuit in question. REPEAT the self-test. CLEAR the DTCs.</p> <p>No INSTALL a new GEM. For additional information, REFER to Section 419-10. REPEAT the self-test. CLEAR the DTCs.</p>

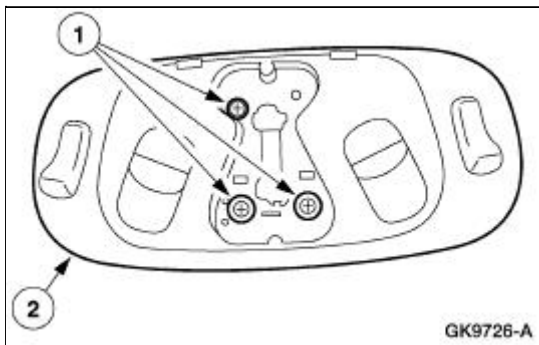
Lamp Assembly —Map/Dome

Removal

1. Disconnect the battery ground cable.
2. Remove the lamp lens from the lamp assembly.



3. Remove the lamp assembly.
 1. Remove the screws.
 2. Remove the lamp assembly.
 - Disconnect the electrical connectors.



Installation

1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-in
Battery ground cable screw	8	71
Daytime running lamps control module bolts	9	80


Daytime Running Lamps (DRL)

The daytime running lamp (DRL) system consists of a daytime running lamp module and bracket assembly (15A270). The module is located on the front bumper reinforcement.

Daytime Running Lamps (DRL)

Refer to Wiring Diagrams Cell [97](#), Daytime Running Lamps for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter or equivalent 105-R0057
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Principles of Operation

Daytime Running Lamps (DRL)

The daytime running lamps (DRL) system operates the low beam headlamps at a reduced intensity. The DRL module (15A270) supplies pulse width modulated (PWM) voltage, approximately 75%-92% of battery voltage, to the low beam headlamps when the following conditions are met:

- The parking brake control is released.
- The high beam headlamps are disabled.
- The ignition switch (11572) is in the RUN position.

The DRL module remains enabled when the low beam headlamps are turned on.

Inspection and Verification

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none">● Damaged DRL module● Damaged parking brake signal switch and bracket (15A851)	<ul style="list-style-type: none">● Blown battery junction box (BJB) Maxi-Fuse FOG+DRL (20A)● Damaged wiring harness● Loose or corroded connection● Damaged DRL module● Damaged parking brake signal switch and bracket

3. Verify the headlamps are operating correctly. Correct any concerns before proceeding to the

next step. For additional information, refer to [Section 417-01](#).

4. Verify the parking brake control is fully released.
5. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
6. If the concern is not visually evident, verify the symptom and refer to the Symptom Chart.

Symptom Chart

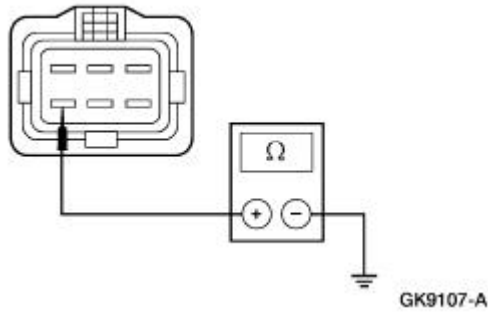
Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● The daytime running lamps are inoperative 	<ul style="list-style-type: none"> ● BJB Maxi-Fuse FOG+DRL (20A). ● Circuitry. ● Parking brake signal switch and bracket. ● DRL module. 	<ul style="list-style-type: none"> ● GO to Pinpoint Test A.
<ul style="list-style-type: none"> ● The daytime running lamps are on with the parking brake set 	<ul style="list-style-type: none"> ● Circuitry. ● Parking brake signal switch and bracket. ● DRL module. 	<ul style="list-style-type: none"> ● GO to Pinpoint Test B.
<ul style="list-style-type: none"> ● The daytime running lamps are on with the ignition switch off 	<ul style="list-style-type: none"> ● Circuitry. ● Ignition switch. ● DRL module. 	<ul style="list-style-type: none"> ● GO to Pinpoint Test C.
<ul style="list-style-type: none"> ● The low beam headlamps are on at full intensity in DRL mode 	<ul style="list-style-type: none"> ● Circuitry. ● Headlamp switch. ● DRL module. 	<ul style="list-style-type: none"> ● GO to Pinpoint Test D.
<ul style="list-style-type: none"> ● The low beam headlamps are on at reduced intensity with the headlamp switch on 	<ul style="list-style-type: none"> ● Circuitry. ● Headlamp switch. 	<ul style="list-style-type: none"> ● REFER to Section 417-01.

Pinpoint Tests

PINPOINT TEST A: THE DAYTIME RUNNING LAMPS ARE INOPERATIVE

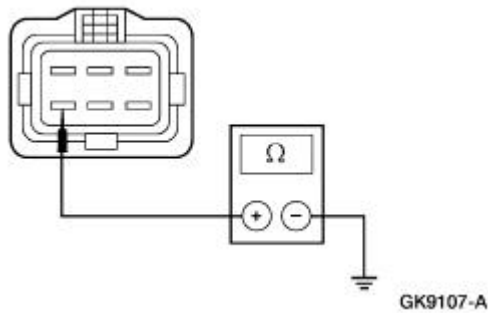
Test Step	Result / Action to Take
A1 CHECK THE PARKING BRAKE SWITCH SIGNAL CIRCUIT TO THE DRL MODULE FOR SHORT TO GROUND	
<p>NOTE: Verify the parking brake control is fully released for this step.</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: DRL Module C1030. ● Measure the resistance between DRL module C1030 Pin 6, Circuit 22 (LB/BK), harness side and ground. 	<p>Yes GO to A3.</p> <p>No GO to A2.</p>



- Is the resistance greater than 10,000 ohms?

A2 CHECK THE PARKING BRAKE SWITCH

- Disconnect: Parking Brake Switch C306.
- Measure the resistance between DRL module C1030 Pin 6, Circuit 22 (LB/BK), harness side and ground.



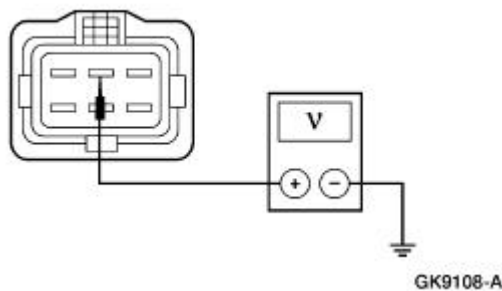
- Is the resistance greater than 10,000 ohms?

Yes
 INSTALL a new parking brake signal switch and bracket.
 TEST the system for normal operation.

No
 REPAIR the circuit. TEST the system for normal operation.

A3 CHECK VOLTAGE TO THE DRL MODULE

- Measure the voltage between DRL module C1030 Pin 2, Circuit 477 (LB/BK), harness side and ground.



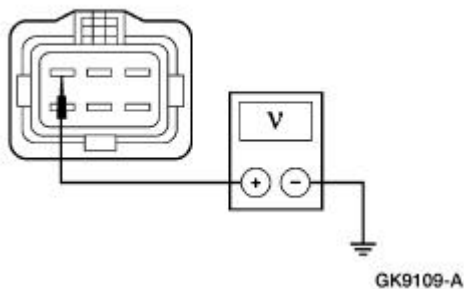
- Is the voltage greater than 10 volts?

Yes
 GO to [A4](#).

No
 REPAIR the circuit. TEST the system for normal operation.

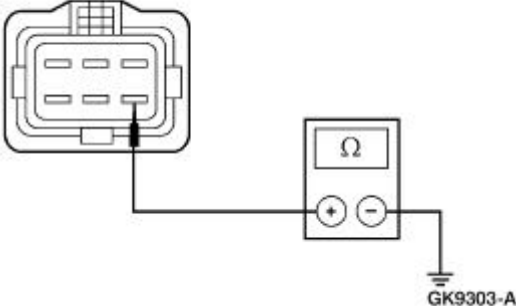
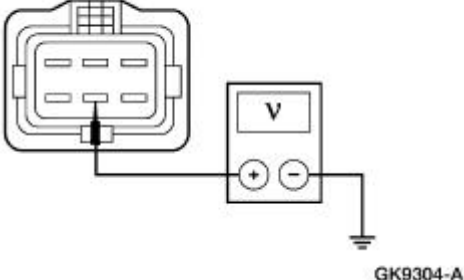
A4 CHECK IGNITION SENSE INPUT

- Key in ON position.
- Measure the voltage between DRL module C1030 Pin 3, Circuit 298 (VT/OG), harness side and ground.

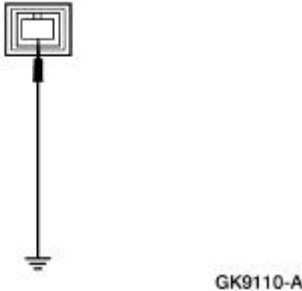


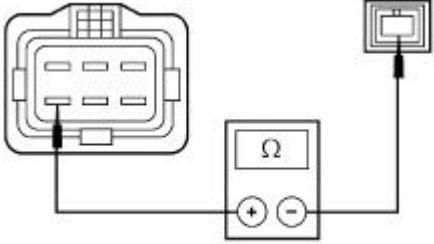
Yes
 GO to [A5](#).

No
 REPAIR the circuit. TEST the system for normal operation.

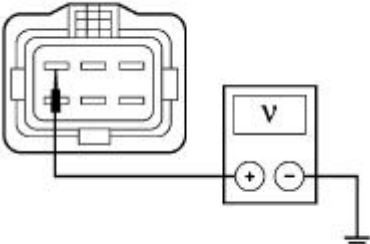
<ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	
A5 CHECK THE DRL MODULE GROUND — CIRCUIT 1205 (BK)	
<ul style="list-style-type: none"> ● Measure the resistance between DRL module C1030 Pin 4, Circuit 1205 (BK), harness side and ground.  <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes GO to A6.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
A6 CHECK THE HIGH BEAM DISABLE INPUT CIRCUIT FOR SHORT TO BATTERY — CIRCUIT 12 (LG/BK)	
<ul style="list-style-type: none"> ● Measure the voltage between DRL module C1030 Pin 5, Circuit 12 (LG/BK), harness side and ground.  <ul style="list-style-type: none"> ● Is voltage indicated? 	<p>Yes REPAIR the circuit. TEST the system for normal operation.</p> <p>No INSTALL a new DRL module. REFER to Module—Daytime Running Lamps (DRL). TEST the system for normal operation.</p>

PINPOINT TEST B: THE DAYTIME RUNNING LAMPS ARE ON WITH THE PARKING BRAKE SET

Test Step	Result / Action to Take
B1 CHECK THE PARKING BRAKE SWITCH	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Parking Brake Switch C306. ● Connect a 10A fused jumper wire between parking brake switch C306, Circuit 22 (LB/BK), harness side and ground.  <ul style="list-style-type: none"> ● Key in ON position. 	<p>Yes INSTALL a new parking brake signal switch and bracket. TEST the system for normal operation.</p> <p>No GO to B2.</p>

<ul style="list-style-type: none"> ● Do the DRL turn off? 	
B2 CHECK THE PARKING BRAKE SWITCH SIGNAL CIRCUIT	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: DRL Module C1030. ● Measure the resistance between parking brake switch C306, Circuit 22 (LB/BK), harness side and DRL module C1030 Pin 6, Circuit 22 (LB/BK), harness side.  <p style="text-align: center;">GK9111-A</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes INSTALL a new DRL module. REFER to Module—Daytime Running Lamps (DRL) . TEST the system for normal operation.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>

PINPOINT TEST C: THE DAYTIME RUNNING LAMPS ARE ON WITH THE IGNITION SWITCH OFF

Test Step	Result / Action to Take
<p>C1 CHECK THE IGNITION SWITCH INPUT TO THE DRL MODULE FOR VOLTAGE</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: DRL Module C1030. ● Measure the voltage between DRL module C1030 Pin 3, Circuit 298 (VT/OG), harness side and ground.  <p style="text-align: center;">GK9109-A</p> <ul style="list-style-type: none"> ● Is voltage indicated? 	<p>Yes GO to C2 .</p> <p>No INSTALL a new DRL module. REFER to Module—Daytime Running Lamps (DRL) . TEST the system for normal operation.</p>
C2 CHECK THE IGNITION SWITCH	
<ul style="list-style-type: none"> ● Check the ignition switch; refer to the Wiring Diagrams Cell 149. ● Is the ignition switch OK? 	<p>Yes REPAIR Circuit 298 (VT/OG) for short to battery. TEST the system for normal operation.</p> <p>No INSTALL a new ignition switch. REFER to Section 211-05 . TEST the system for normal operation.</p>

PINPOINT TEST D: THE LOW BEAM HEADLAMPS ARE ON AT FULL INTENSITY IN DRL MODE

Test Step	Result / Action to Take
D1 CHECK THE LOW BEAM HEADLAMPS INPUT	
<ul style="list-style-type: none">● Disconnect: DRL Module C1030.● Are the low beam headlamps still on at full intensity?	

Yes
REFER to [Section 417-01](#).

No
INSTALL a new DRL module. REFER to [Module—Daytime Running Lamps \(DRL\)](#). TEST the system for normal operation.

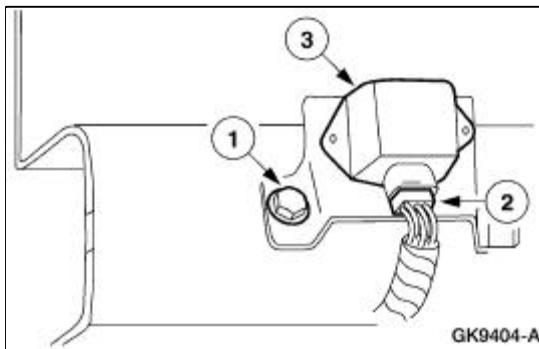
Module —Daytime Running Lamps (DRL)

Removal


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

Disconnect the battery ground cable.

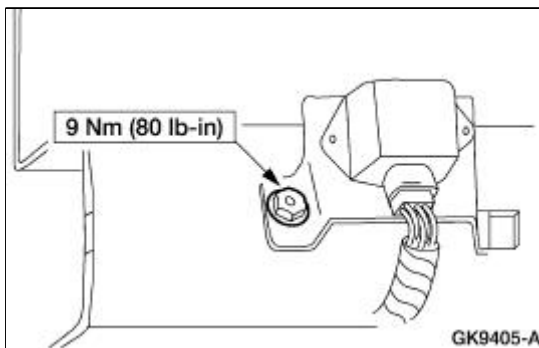
2. Remove the daytime running lamps (DRL) module and bracket assembly (15A270).
 1. Remove the nut.
 2. Disconnect the electrical connector.
 3. Remove the DRL module and bracket assembly.



Installation

1.  **CAUTION:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 10 miles (16 km) or more to relearn the strategy.

To install, reverse the removal procedure.

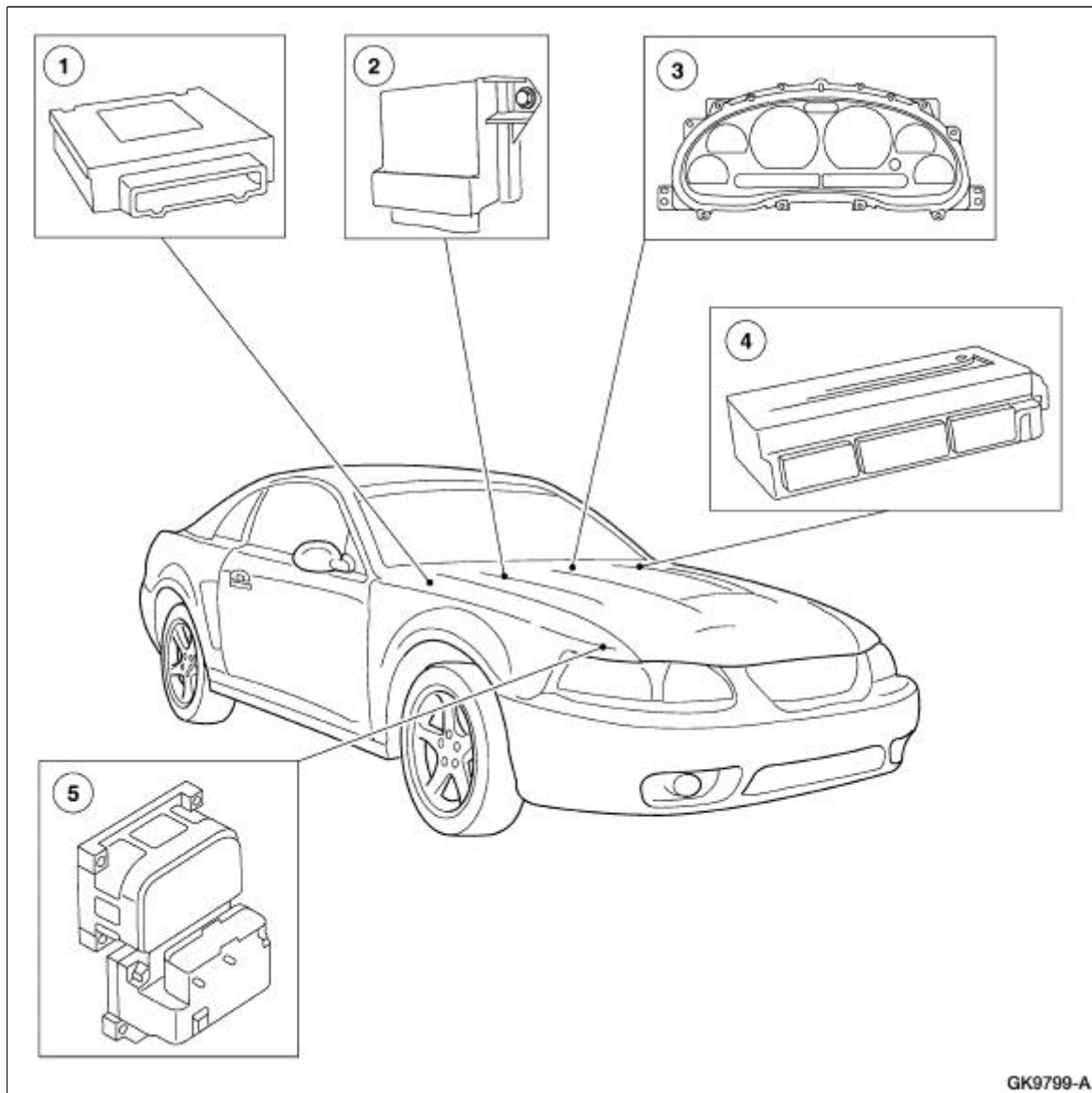


General Specifications

Item	Specification
Heat shrink tube overlap mm (inch)	12.7 (0.5)
Wire insulation removal length (twist side) mm (inch)	37.2 (1.5)
Wire insulation removal length (receiving side) mm (inch)	19.5 (0.75)
Raychem SCT® Heat Shrink Tubing, Motorcraft part number WT-5627	ESB-M99D56-A2

Communications Network

Module Communications Network





Item	Part Number	Description
1	12A650	Powertrain Control Module (PCM)
2	—	Restraint Control Module (RCM)
3	10849	Hybrid Electronic Cluster (HEC)
4	14B205	Generic Electronic Module (GEM)
5	2C219	Anti-Lock Brake System / Traction Control (ABS/TC) Module

Communications Network

Refer to Wiring Diagrams Cell [14](#), Multiplex Communication Network for schematic and connector information.

Special Tool(s)

 ST1137-A	73 Digital Multimeter or equivalent 105-R0051
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

Principles of Operation

The vehicle has two module communications networks. The standard corporate protocol (SCP) which is an unshielded twisted pair cable (data bus plus, Circuit 914 [TN/OG] and data bus minus, Circuit 915 [PK/LB]), and the international standards organization (ISO) 9141 network which is a single wire (Circuit 70 [LB/WH]). The diagnostic tool can connect to both networks through the data link connector (DLC). This makes diagnosis and testing of these systems easier by allowing one smart tester to be able to diagnose and control any module on the two networks from one connector. The DLC can be found under the instrument panel between the steering column and the radio.

The ISO 9141 communication network does not permit inter-module communication. When the diagnostic tool communicates to modules on the ISO 9141 communication network, the diagnostic tool must ask for all information; the modules cannot initiate communications.

The SCP network will remain operational even with the severing of one of the bus wires. Communications will also continue if one of the bus wires is shorted to ground or battery positive voltage (B+) or if some, but not all, termination resistors are lost.

Unlike the SCP communication network, the ISO 9141 communication network will not function if the wire is shorted to chassis ground or battery positive voltage (B+). Also, if one of the modules on the ISO 9141 network loses power or shorts internally, communications to that module will fail.

The powertrain control module (PCM) is on the SCP communication network. The PCM controls the engine for better fuel economy, emissions control, and failure mode detection and storage. Refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual Section 3 for diagnosis and testing of the PCM.

The restraint control module (RCM) is on the ISO 9141 network. The RCM controls the deployment of the air bags based on sensor input. For additional information, refer to [Section 501-20B](#).

The generic electronic module (GEM) is on the ISO 9141 network. The GEM module controls a variety of systems including one touch down windows, wipers, perimeter anti-theft, and warning chimes. For additional information, refer to [Section 419-10](#).

The anti-lock brake control module communicates over the ISO 9141 communication network when not equipped with traction control and communicates over the SCP communication network when it is equipped with the traction control option. The anti-lock brake control module controls the brake pressure to the four wheels to keep the vehicle under control while braking. For additional information on anti-lock brake control module without traction control, refer to [Section 206-09A](#). For additional information on anti-lock brake control module with traction control, refer to [Section 206-09B](#).

The instrument cluster is on the SCP communication network. The instrument cluster displays driver information. The instrument cluster incorporates the PATS control module functions. For additional information on the PATS system, refer to [Section 419-01](#). For additional information on the instrument cluster, refer to [Section 413-01](#).

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of electrical damage.

Visual Inspection Chart

Electrical
<ul style="list-style-type: none">● Central junction box (CJB) Fuse 31 (5A)● Damaged wiring harness● Loose or corroded connections● Anti-lock brake control module without traction control (optional)● Anti-lock brake control module with traction control (optional)● Generic electronic module (GEM)● Restraint control module (RCM)● Powertrain control module (PCM)● Instrument cluster

3. If the concern remains after the inspection, connect diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from diagnostic tool menu. If diagnostic tool does not communicate with the vehicle:
 - check that the program card is correctly installed.
 - check that the correct version of the program card is installed.
 - check the connections to the vehicle.
 - check the ignition switch position.

If the diagnostic tool still does not communicate with the vehicle, go to Pinpoint Test H.

4. Go to Pinpoint Test PC.

System Precheck

PINPOINT TEST PC: DATA LINK DIAGNOSTICS NETWORK TEST

Test Step	Result / Action to Take
PC1 DATA LINK DIAGNOSTICS NETWORK TEST	
<ul style="list-style-type: none"> ● Run the Data Link Diagnostics Network Test. ● Is SYSTEM PASSED obtained? 	<p>Yes Test PASSED. RETURN to the Symptom Chart of the section for the module in question.</p> <p>No If no response from the diagnostic tool, GO to Pinpoint Test H.</p> <p>If CKT70=ALL ECUS NO RESP / NOT EQUIP, GO to Pinpoint Test F.</p> <p>If CKT914 or CKT915=ALL ECUS NO RESP / NOT EQUIP, GO to Pinpoint Test G.</p> <p>If CKT70, CKT914, or CKT915=SOME ECUS NO RESP/NOT EQUIP, REFER to Symptom Chart.</p> <p>If the module in question is NO RESPONSE ON CKT914 (BUS+), or NO RESPONSE ON CKT915 (BUS-), REFER to Symptom Chart.</p> <p>If the module in question is NO RESPONSE/NOT EQUIPPED, REFER to Symptom Chart.</p>

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● The module does not respond to the diagnostic tool — anti-lock brake control module 	<ul style="list-style-type: none"> ● Wire or connection in SCP communication network (with traction control). ● Wire or connection in ISO 9141 communication network (without traction control). ● Anti-lock brake control module without traction control (optional). ● Anti-lock brake control module with traction control (optional). 	<ul style="list-style-type: none"> ● GO to Pinpoint Test A.
<ul style="list-style-type: none"> ● The module does not respond to the diagnostic tool — generic electronic module (GEM) 	<ul style="list-style-type: none"> ● Wire or connection in ISO 9141 communication network. ● GEM. 	<ul style="list-style-type: none"> ● GO to Pinpoint Test B.
<ul style="list-style-type: none"> ● The module does not respond to the diagnostic tool — restraint control module (RCM) 	<ul style="list-style-type: none"> ● Wire or connection in ISO 9141 communication network. ● RCM. 	<ul style="list-style-type: none"> ● GO to Pinpoint Test C.
<ul style="list-style-type: none"> ● The module does not respond to the diagnostic 	<ul style="list-style-type: none"> ● Wire or connection in SCP communication network. 	<ul style="list-style-type: none"> ● GO to Pinpoint

tool — instrument cluster	<ul style="list-style-type: none"> ● Instrument cluster. 	Test D.
<ul style="list-style-type: none"> ● The module does not respond to the diagnostic tool — powertrain control module (PCM) 	<ul style="list-style-type: none"> ● Wire or connection in SCP communication network. ● PCM. 	<ul style="list-style-type: none"> ● GO to Pinpoint Test E.
<ul style="list-style-type: none"> ● No module/network communication — ISO 9141 network 	<ul style="list-style-type: none"> ● Wire or connection in ISO 9141 communication network. ● ISO 9141 networked modules. 	<ul style="list-style-type: none"> ● GO to Pinpoint Test F.
<ul style="list-style-type: none"> ● No module/network communication — SCP network 	<ul style="list-style-type: none"> ● Wire or connection in SCP communication network. ● SCP networked modules. 	<ul style="list-style-type: none"> ● GO to Pinpoint Test G.
<ul style="list-style-type: none"> ● No module/network communication — no power to the diagnostic tool 	<ul style="list-style-type: none"> ● CJB Fuse 31 (5A). ● DLC pins. ● Scan tool. ● Circuitry. 	<ul style="list-style-type: none"> ● GO to Pinpoint Test H.

Pinpoint Tests



CAUTION: Be careful when probing the CJB, battery junction box (BJB) or any connectors. Damage will result to the connector receptacle if the probe or terminal being used is too large.

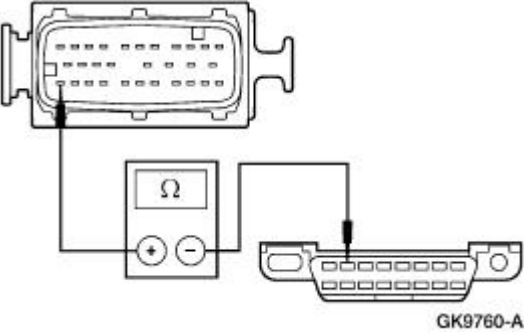
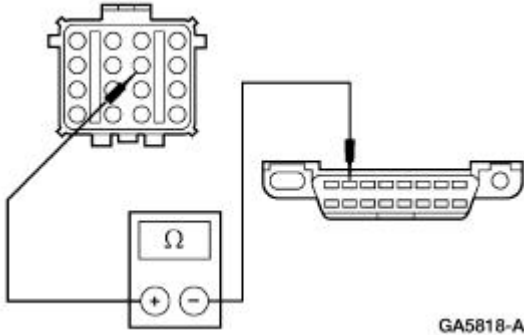


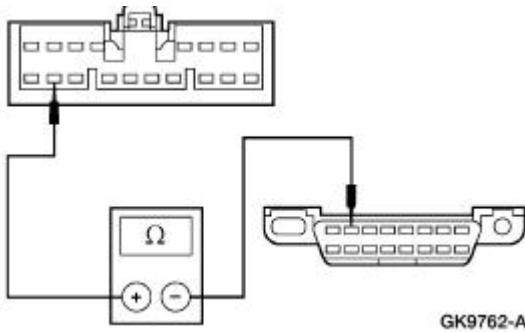
CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage may result.

NOTE: If DTCs are recorded and the symptom is not present when carrying out the pinpoint tests, an intermittent concern may be the cause. Always check for loose connections and corroded pins.

PINPOINT TEST A: THE MODULE DOES NOT RESPOND TO THE DIAGNOSTIC TOOL — ANTI-LOCK BRAKE CONTROL MODULE

Test Step	Result / Action to Take
A1 CHECK THE VEHICLE FOR TRACTION CONTROL	
<ul style="list-style-type: none"> ● Check the vehicle for a traction control disable switch. ● Is a traction control disable switch present? 	<p>Yes GO to A2.</p> <p>No GO to A9.</p>
A2 CHECK ANTI-LOCK BRAKE CONTROL MODULE C141 FOR DAMAGE	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Anti-Lock Brake Control Module C135. ● Inspect the anti-lock brake control module C135 for damage; repair as necessary. ● Connect: Anti-Lock Brake Control Module C135. ● Connect the diagnostic tool. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Diagnostic Data Link. 	<p>Yes GO to A3.</p> <p>No GO to A6.</p>

<ul style="list-style-type: none"> ● Was the result retrieved ABS: NO RESPONSE ON CKT914 (BUS+)? 	
<p>A3 CHECK FOR OPEN BETWEEN DLC C251 AND ANTI-LOCK BRAKE CONTROL MODULE C135 — CIRCUIT 914 (TN/OG)</p>	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect the diagnostic tool. ● Disconnect: Anti-Lock Brake Control Module C135. ● Measure the resistance between anti-lock brake control module C135 Pin 30, Circuit 914 (TN/OG), harness side and DLC C251 Pin 2, Circuit 914 (TN/OG), harness side.  <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes INSTALL a new anti-lock brake control module. REFER to Section 206-09B. TEST the system for normal operation.</p> <p>No GO to A4.</p>
<p>A4 CHECK CIRCUIT 914 (TN/OG) BETWEEN DLC C251 AND IN-LINE C144 FOR OPEN</p>	
<ul style="list-style-type: none"> ● Disconnect: In-Line C144. ● Check in-line C144 for damage; repair as necessary. ● Measure the resistance between in-line C144 Pin 6, Circuit 914 (TN/OG), harness side and DLC C251 Pin 2, Circuit 914 (TN/OG), harness side.  <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes REPAIR Circuit 914 (TN/OG) between anti-lock brake control module C135 and in-line C144. For additional information, REFER to Communication Circuit Wiring Repair. TEST the system for normal operation.</p> <p>No GO to A5.</p>
<p>A5 CHECK CIRCUIT 914 (TN/OG) BETWEEN DLC C251 AND IN-LINE C215 FOR OPEN</p>	
<ul style="list-style-type: none"> ● Disconnect: In-Line C215. ● Check in-line C215 for damage; repair as necessary. ● Measure the resistance between in-line C215 Pin 10, Circuit 914 (TN/OG), harness side and DLC C251 Pin 2, Circuit 914 (TN/OG), harness side. 	<p>Yes REPAIR Circuit 914 (TN/OG) between in-line C144 and in-line C215. For additional information, REFER to Communication Circuit Wiring Repair. TEST the system for normal operation.</p> <p>No REPAIR Circuit 914 (TN/OG) between DLC C251 and in-line C215. For additional</p>

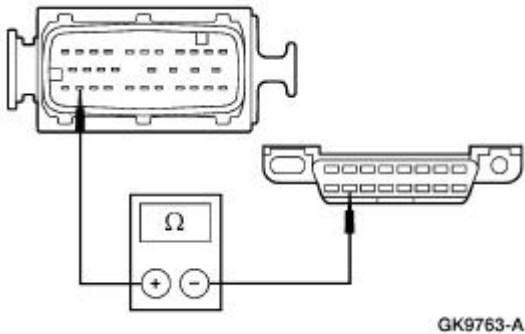


- Is the resistance less than 5 ohms?

information, REFER to [Communication Circuit Wiring Repair](#). TEST the system for normal operation.

A6 CHECK FOR OPEN BETWEEN DLC C251 AND ANTI-LOCK BRAKE CONTROL MODULE C135 — CIRCUIT 915 (PK/LB)

- Key in OFF position.
- Disconnect the diagnostic tool.
- Measure the resistance between anti-lock brake control module C135 Pin 29, Circuit 915 (PK/LB), harness side and DLC C251 Pin 10, Circuit 915 (PK/LB), harness side.



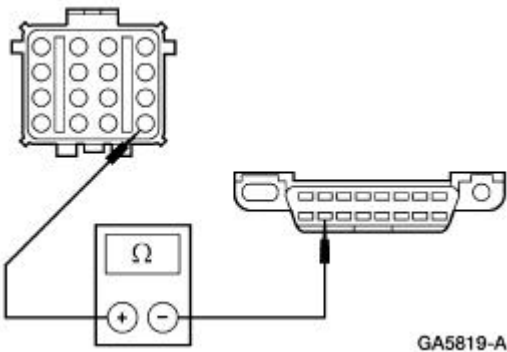
- Is the resistance less than 5 ohms?

Yes
INSTALL a new anti-lock brake control module. REFER to [Section 206-09B](#). TEST the system for normal operation.

No
GO to [A7](#).

A7 CHECK CIRCUIT 915 (PK/LB) BETWEEN DLC C251 AND IN-LINE C144 FOR OPEN

- Disconnect: In-Line C144.
- Check in-line C144 for damage; repair as necessary.
- Measure the resistance between in-line C144 Pin 13, Circuit 915 (PK/LB), harness side and DLC C251 Pin 10, Circuit 915 (PK/LB), harness side.



- Is the resistance less than 5 ohms?

Yes
REPAIR Circuit 915 (PK/LB) between anti-lock brake control module C135 and in-line C144. For additional information, REFER to [Communication Circuit Wiring Repair](#). TEST the system for normal operation.

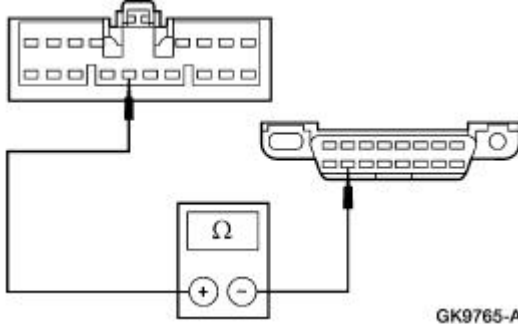
No
GO to [A8](#).

A8 CHECK CIRCUIT 915 (PK/LB) BETWEEN DLC C251 AND IN-LINE C215 FOR OPEN

- Disconnect: In-Line C215.
- Check in-line C215 for damage; repair as necessary.
- Measure the resistance between in-line C215 Pin 13, Circuit 915 (PK/LB), harness side and DLC C251 Pin

Yes
REPAIR Circuit 915 (PK/LB) between in-line C144 and in-line C215. For additional

10, Circuit 915 (PK/LB), harness side.



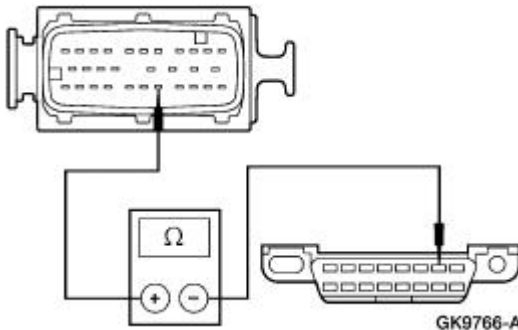
- Is the resistance less than 5 ohms?

information, REFER to [Communication Circuit Wiring Repair](#). TEST the system for normal operation.

No
REPAIR Circuit 915 (PK/LB) between DLC C251 and in-line C215. For additional information, REFER to [Communication Circuit Wiring Repair](#). TEST the system for normal operation.

A9 CHECK FOR OPEN BETWEEN THE DLC C251 AND ANTI-LOCK BRAKE CONTROL MODULE C135 — CIRCUIT 70 (LB/WH)

- Key in OFF position.
- Disconnect: Anti-Lock Brake Control Module C135.
- Inspect anti-lock brake control module C135 for damage, repair as necessary.
- Measure the resistance between anti-lock brake control module C135 Pin 24, Circuit 70 (LB/WH), harness side and DLC C251 Pin 7, Circuit 70 (LB/WH), harness side.



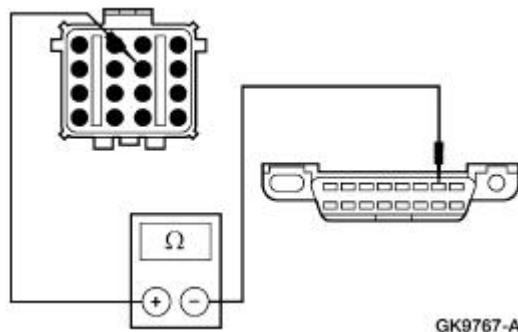
- Is the resistance less than 5 ohms?

Yes
INSTALL a new anti-lock brake control module. REFER to [Section 206-09A](#). TEST the system for normal operation.

No
GO to [A10](#).

A10 CHECK FOR OPEN BETWEEN THE DLC C251 AND IN-LINE C140

- Disconnect: In-Line C140.
- Inspect in-line C140 for damage, repair as necessary.
- Measure the resistance between in-line C140 Pin 7, Circuit 70 (LB/WH), harness side and DLC C251 Pin 7, Circuit 70 (LB/WH), harness side.



- Is the resistance less than 5 ohms?

Yes
REPAIR Circuit 70 (LB/WH) between in-line C140 and anti-lock brake control module C135. TEST the system for normal operation.

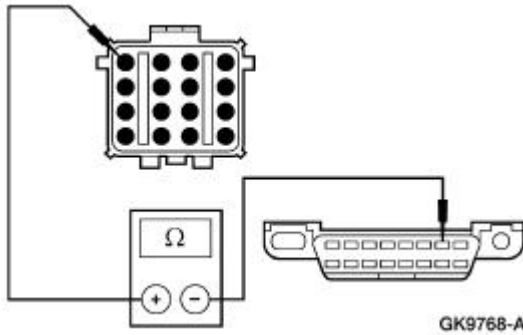
No
GO to [A11](#).

A11 CHECK FOR OPEN BETWEEN THE DLC C251 AND IN-LINE C314

- Disconnect: In-Line C314.
- Inspect in-line C314 for damage, repair as necessary.

Yes
REPAIR Circuit 70 (LB/WH)

- Measure the resistance between in-line C314 Pin 1, Circuit 70 (LB/WH), harness side and DLC C257 Pin 7, Circuit 70 (LB/WH), harness side.



- Is the resistance less than 5 ohms?

between in-line C314 and in-line C140. TEST the system for normal operation.

No
REPAIR Circuit 70 (LB/WH) between in-line C314 and DLC C251. TEST the system for normal operation.

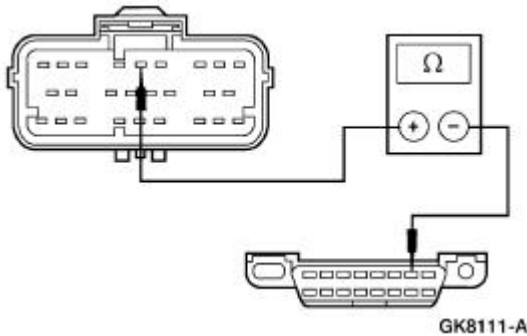
PINPOINT TEST B: THE MODULE DOES NOT RESPOND TO THE DIAGNOSTIC TOOL — GENERIC ELECTRONIC MODULE (GEM)

Test Step	Result / Action to Take
<p>B1 CHECK FOR OPEN BETWEEN THE DLC C251 AND GEM C201e</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: GEM C201e. ● Inspect GEM C201e for damage, repair as necessary. ● Measure the resistance between GEM C201e Pin 6, Circuit 70 (LB/WH), harness side and DLC C251 Pin 7, Circuit 70 (LB/WH), harness side. <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes INSTALL a new GEM. For additional information, REFER to Section 419-10. TEST the system for normal operation.</p> <p>No REPAIR Circuit 70 (LB/WH) between the GEM C201e and DLC C251. TEST the system for normal operation.</p>

PINPOINT TEST C: THE MODULE DOES NOT RESPOND TO THE DIAGNOSTIC TOOL — RESTRAINT CONTROL MODULE (RCM)

Test Step	Result / Action to Take
<p>C1 CHECK CIRCUIT 70 (LB/WH) FOR OPEN</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Inspect the DLC C251 and diagnostic tool terminal for damage; repair as necessary. ● Deactivate the air bag system. Refer to Section 501-20B. ● Disconnect: RCM C2041. ● Inspect RCM C2041 for damage, repair as necessary. ● Measure the resistance between DLC C251 Pin 7, Circuit 70 	<p>Yes INSTALL a new RCM. REFER to Section 501-20B. TEST the system for normal operation.</p> <p>No</p>

(LB/WH), harness side and RCM C2041 Pin 5, Circuit 70 (LB/WH), harness side.



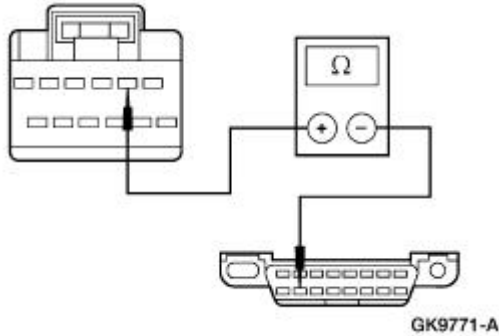
- Is the resistance less than 5 ohms?

REPAIR Circuit 70 (LB/WH) between RCM C2041 and DLC C251 . TEST the system for normal operation.

PINPOINT TEST D: THE MODULE DOES NOT RESPOND TO THE DIAGNOSTIC TOOL — INSTRUMENT CLUSTER

Test Step	Result / Action to Take
<p>D1 CHECK INSTRUMENT CLUSTER C220a FOR DAMAGE</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Instrument Cluster C220a. ● Inspect instrument cluster C220a for damage; repair as necessary. ● Connect: Instrument Cluster C220a. ● Connect the diagnostic tool. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Diagnostic Data Link. ● Was the result received ICM: NO RESPONSE ON CKT914 (BUS+)? 	<p>Yes GO to D2 .</p> <p>No GO to D3 .</p>
<p>D2 CHECK FOR OPEN BETWEEN DLC C251 PIN 2 AND INSTRUMENT CLUSTER C220a PIN 1 — CIRCUIT 914 (TN/OG)</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect the diagnostic tool. ● Disconnect: Instrument Cluster C220a. ● Measure the resistance between instrument cluster C220a Pin 1, Circuit 914 (TN/OG), harness side and DLC C251 Pin 2, Circuit 914 (TN/OG), harness side. <p style="text-align: center;">GK9770-A</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes INSTALL a new instrument cluster. For additional information, REFER to Section 413-01 . TEST the system for normal operation.</p> <p>No REPAIR Circuit 914 (TN/OG) between instrument cluster C220a and DLC C251. For additional information, REFER to Communication Circuit Wiring Repair . TEST the system for normal operation.</p>
<p>D3 CHECK FOR OPEN BETWEEN DLC C251 PIN 10 AND INSTRUMENT CLUSTER C220a PIN 2 — CIRCUIT 915 (PK/LB)</p> <ul style="list-style-type: none"> ● Key in OFF position. 	<p>Yes</p>

- Disconnect the diagnostic tool.
- Measure the resistance between instrument cluster C220a Pin 2, Circuit 915 (PK/LB), harness side and DLC C251 Pin 10, Circuit 915 (PK/LB), harness side.



- Is the resistance less than 5 ohms?

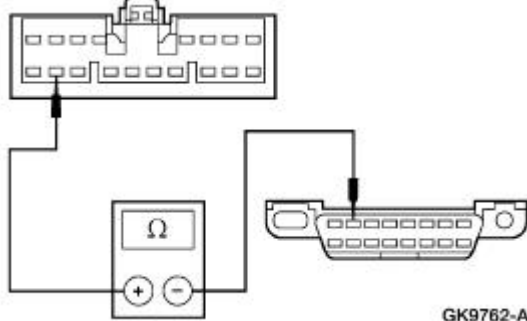
INSTALL a new instrument cluster. For additional information, REFER to [Section 413-01](#). TEST the system for normal operation.

No
REPAIR Circuit 915 (PK/LB) between instrument cluster C220a and DLC C251. For additional information, REFER to [Communication Circuit Wiring Repair](#). TEST the system for normal operation.

PINPOINT TEST E: THE MODULE DOES NOT RESPOND TO THE DIAGNOSTIC TOOL — POWERTRAIN CONTROL MODULE (PCM)

Test Step	Result / Action to Take
<p>E1 CHECK PCM C175 FOR DAMAGE</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: PCM C175. ● Inspect PCM C175 for damage; repair as necessary. ● Connect: PCM C175. ● Connect the diagnostic tool. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Diagnostic Data Link. ● Was the result received PCM: NO RESPONSE ON CKT914 (BUS+)? 	<p>Yes GO to E2.</p> <p>No GO to E4.</p>
<p>E2 CHECK FOR OPEN BETWEEN DLC C251 PIN 2 AND PCM C175 PIN 16 — CIRCUIT 914 (TN/OG)</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect the diagnostic tool. ● Disconnect: PCM C175. ● Measure the resistance between PCM C175 Pin 16, Circuit 914 (TN/OG), harness side and DLC C251 Pin 2, Circuit 914 (TN/OG), harness side. <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual Section 3. TEST the system for normal operation.</p> <p>No GO to E3.</p>
<p>E3 CHECK CIRCUIT 914 (TN/OG) BETWEEN DLC C251 AND IN-LINE C215 FOR OPEN</p> <ul style="list-style-type: none"> ● Disconnect: In-Line C215. 	<p>Yes</p>

- Check in-line C215 for damage; repair as necessary.
- Measure the resistance between in-line C215 Pin 10, Circuit 914 (TN/OG), harness side and DLC C251 Pin 2, Circuit 914 (TN/OG), harness side.



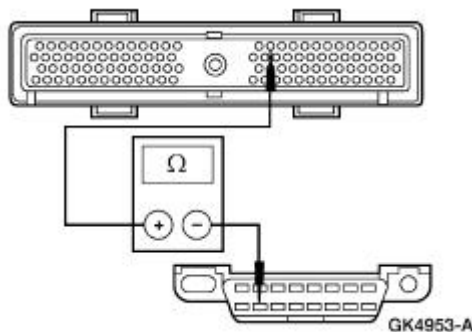
- Is the resistance less than 5 ohms?

REPAIR Circuit 914 (TN/OG) between PCM C175 and in-line C215. For additional information, REFER to [Communication Circuit Wiring Repair](#) . TEST the system for normal operation.

No
REPAIR Circuit 914 (TN/OG) between DLC C251 and in-line C215. For additional information, REFER to [Communication Circuit Wiring Repair](#) . TEST the system for normal operation.

E4 CHECK FOR OPEN BETWEEN DLC C251 PIN 10 AND PCM C175 PIN 15 — CIRCUIT 915 (PK/LB)

- Key in OFF position.
- Disconnect the diagnostic tool.
- Measure the resistance between PCM C175 Pin 15, Circuit 915 (PK/LB), harness side and DLC C251 Pin 10, Circuit 915 (PK/LB), harness side.



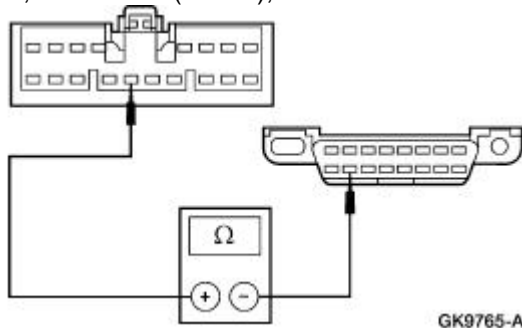
- Is the resistance less than 5 ohms?

Yes
REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual Section 3. TEST the system for normal operation.

No
GO to [E5](#) .

E5 CHECK CIRCUIT 915 (PK/LB) BETWEEN DLC C251 AND IN-LINE C215 FOR OPEN

- Disconnect: In-Line C215.
- Check in-line C215 for damage; repair as necessary.
- Measure the resistance between in-line C215 Pin 13, Circuit 915 (PK/LB), harness side and DLC C251 Pin 10, Circuit 915 (PK/LB), harness side.

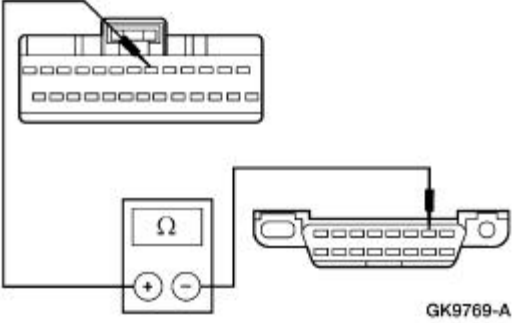
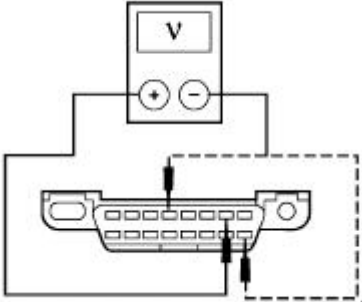


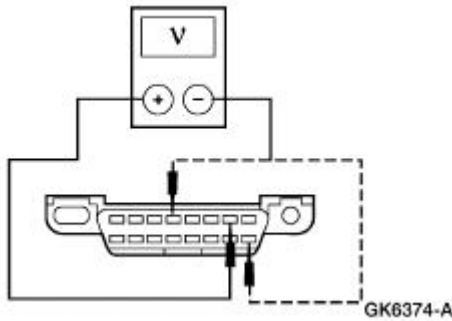
- Is the resistance less than 5 ohms?

Yes
REPAIR Circuit 915 (PK/LB) between PCM C175 and in-line C215. For additional information, REFER to [Communication Circuit Wiring Repair](#) . TEST the system for normal operation.

No
REPAIR Circuit 915 (PK/LB) between DLC C251 and in-line C215. For additional information, REFER to [Communication Circuit Wiring Repair](#) . TEST the system for normal operation.

PINPOINT TEST F: NO MODULE/NETWORK COMMUNICATION — ISO 9141 COMMUNICATION NETWORK

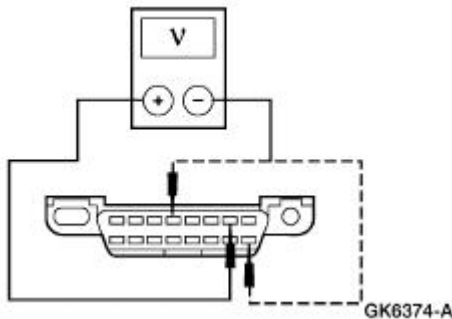
Test Step	Result / Action to Take
<p>F1 CHECK CIRCUIT 70 (LB/WH) FOR OPEN</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Inspect the DLC C251 Pin 7, Circuit 70 (LB/WH) for damage, repair as necessary. ● Disconnect: GEM C201e. ● Measure the resistance between GEM C201e Pin 6, Circuit 70 (LB/WH), harness side and DLC C251 Pin 7, Circuit 70 (LB/WH), harness side.  <p style="text-align: right;">GK9769-A</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes GO to F2.</p> <p>No REPAIR Circuit 70 (LB/WH) between the GEM C201e and DLC C251. TEST the system for normal operation.</p>
<p>F2 CHECK FOR SHORT TO GROUND AND POWER AT DLC C251 — GEM C201e DISCONNECTED</p> <ul style="list-style-type: none"> ● Key in ON position. ● Measure the voltage between DLC C251 Pin 7, Circuit 70 (LB/WH), harness side and C251 Pin 4, Circuit 1205 (BK); and between DLC C251 Pin 7, Circuit 70 (LB/WH), harness side and C251 Pin 16, Circuit 1047 (LG/RD), harness side.  <p style="text-align: right;">GK6374-A</p> <ul style="list-style-type: none"> ● Is the voltage indicated in either measurement zero volts? 	<p>Yes CONNECT the GEM module C201e. GO to F3.</p> <p>No INSTALL a new GEM. For additional information, REFER to Section 419-10. TEST the system for normal operation.</p>
<p>F3 CHECK FOR SHORT TO GROUND AND POWER AT DLC C251 — IN-LINE C314 DISCONNECTED</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: In-Line C314. ● Key in ON position. ● Measure the voltage between DLC C251 Pin 7, Circuit 70 (LB/WH), harness side and C251 Pin 4, Circuit 1205 (BK); and between DLC C251 Pin 7, Circuit 70 (LB/WH), harness side and C251 Pin 16, Circuit 1047 (LG/RD), harness side. 	<p>Yes GO to F4.</p> <p>No GO to F5.</p>



- Is the voltage indicated in either measurement zero volts?

F4 CHECK FOR SHORT TO GROUND AND POWER AT DLC C251 — RCM C2041 DISCONNECTED

- Key in OFF position.
- Deactivate the air bag system; REFER to [Section 501-20B](#).
- Disconnect: RCM C2041.
- Key in ON position.
- Measure the voltage between DLC C251 Pin 7, Circuit 70 (LB/WH), harness side and C251 Pin 4, Circuit 1205 (BK); and between DLC C251 Pin 7, Circuit 70 (LB/WH), harness side and C251 Pin 16, Circuit 1047 (LG/RD), harness side.



- Is the voltage indicated in either measurement zero volts?

Yes
REPAIR Circuit 70 (LB/WH) between DLC C251, GEM C201e, RCM C2041, and in-line C314. TEST the system for normal operation.

No
INSTALL a new RCM. REFER to [Section 501-20B](#). TEST the system for normal operation.

F5 CHECK FOR THE ANTI-LOCK BRAKE CONTROL MODULE

- Key in OFF position.
- Connect: In-Line C3141.
- Check the vehicle for any version of the anti-lock brake control module.
- Is the vehicle equipped with any version of the anti-lock brake control module (with or without traction control)?

Yes
GO to [F6](#).

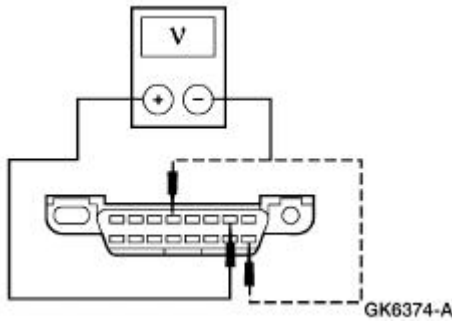
No
GO to [F7](#).

F6 CHECK FOR SHORT TO GROUND AND POWER AT DLC C251 — ANTI-LOCK BRAKE CONTROL MODULE C135 DISCONNECTED

- Disconnect: Anti-Lock Brake Control Module C135.
- Key in ON position.
- Measure the voltage between DLC C251 Pin 7, Circuit 70 (LB/WH), harness side and C251 Pin 4, Circuit 1205 (BK); and between DLC C251 Pin 7, Circuit 70 (LB/WH), harness side and C251 Pin 16, Circuit 1047 (LG/RD), harness side.

Yes
GO to [F7](#).

No
INSTALL a new anti-lock brake control module. For additional information on the anti-lock brake control module without traction control, REFER to

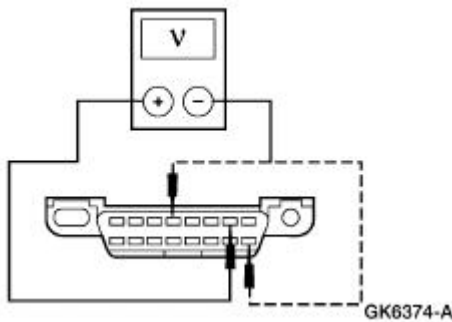


- Is the voltage indicated in either measurement zero volts?

[Section 206-09A](#) . For additional information on the anti-lock brake control module with traction control, REFER to [Section 206-09B](#) . TEST the system for normal operation.

F7 CHECK FOR SHORT TO GROUND AND POWER AT DLC C251 — IN-LINE C140 DISCONNECTED

- Key in OFF position.
- Disconnect: In-Line C140.
- Key in ON position.
- Measure the voltage between DLC C251 Pin 7, Circuit 70 (LB/WH), harness side and C251 Pin 4, Circuit 1205 (BK); and between DLC C251 Pin 7, Circuit 70 (LB/WH), harness side and C251 Pin 16, Circuit 1047 (LG/RD), harness side.




- Is the voltage indicated in either measurement zero volts?

Yes
REPAIR Circuit 70 (LB/WH) between in-line C314 and in-line C140. TEST the system for normal operation.

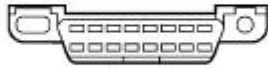
No
REPAIR Circuit 70 (LB/WH) between in-line C140 and the anti-lock brake control module C135. TEST the system for normal operation.

PINPOINT TEST G: NO MODULE/NETWORK COMMUNICATION — SCP NETWORK

Test Step	Result / Action to Take
<p>G1 CHECK DIAGNOSTIC TOOL PINS FOR DAMAGE</p>	
<ul style="list-style-type: none"> ● Inspect diagnostic tool pins for damage.  <p style="text-align: center;">GK2632-A</p> <ul style="list-style-type: none"> ● Are the diagnostic tool pins OK? 	<p>Yes GO to G2 .</p> <p>No REPAIR the diagnostic tool terminals. TEST the system for normal operation.</p>

G2 CHECK DLC C251 PINS 2 AND 10 FOR DAMAGE

- Key in OFF position.
- Inspect the DLC C251 pins for damage.



GK2633-A

- Are the pins OK?

Yes
GO to [G3](#).

No
REPAIR the DLC C251. TEST the system for normal operation.

G3 CHECK THE VEHICLE FOR THE ANTI-LOCK BRAKE CONTROL MODULE

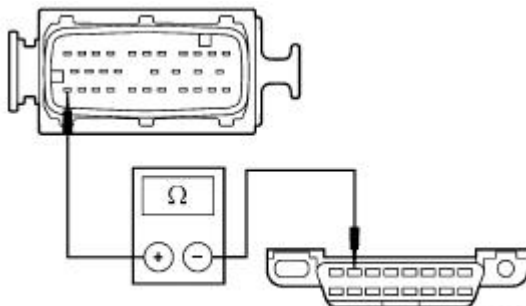
- Check the vehicle for any version of the anti-lock brake control module.
- Is the vehicle equipped with any version of the anti-lock brake control module (with or without traction control)?

Yes
GO to [G4](#).

No
GO to [G7](#).

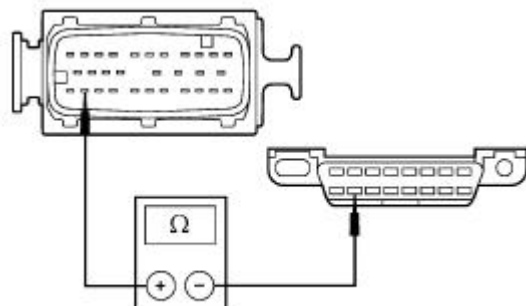
G4 CHECK CIRCUIT 914 (TN/OG) AND CIRCUIT 915 (PK/LB) FOR OPEN — ANTI-LOCK BRAKE CONTROL MODULE C135 DISCONNECTED

- Disconnect: Anti-Lock Brake Control Module C135.
- Measure the resistance between anti-lock brake control module C135 Pin 30, Circuit 914 (TN/OG), harness side and DLC C251 Pin 2, Circuit 914 (TN/OG), harness side.



GK9760-A

- Measure the resistance between anti-lock brake control module C135 Pin 29, Circuit 915 (PK/LB), harness side and DLC C251 Pin 10, Circuit 915 (PK/LB), harness side.



GK9763-A

- Are the resistances less than 5 ohms?

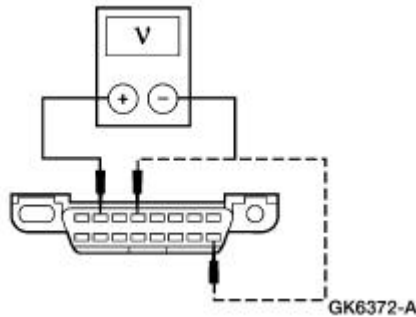
Yes
GO to [G5](#).

No
REPAIR the circuit(s) in question between in-line C215 and DLC C251. For additional information, REFER to [Communication Circuit Wiring Repair](#). TEST the system for normal operation.

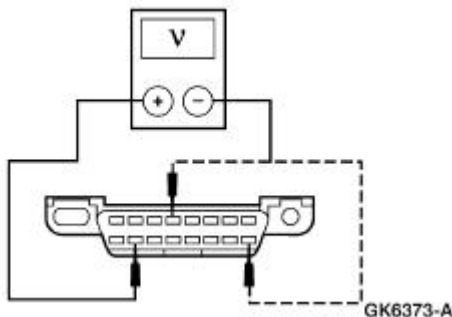
G5 CHECK CIRCUIT 914 (TN/OG) AND CIRCUIT 915

(PK/LB) FOR THE SOURCE OF THE CONCERN — ANTI-LOCK BRAKE CONTROL MODULE C135 DISCONNECTED

- Key in ON position.
- Measure the voltage between DLC C251 Pin 2, Circuit 914 (TN/OG), harness side and C251 Pin 4, Circuit 1205 (BK); and between DLC C251 Pin 2, Circuit 914 (TN/OG), harness side and C251 Pin 16, Circuit 1047 (LG/RD), harness side.



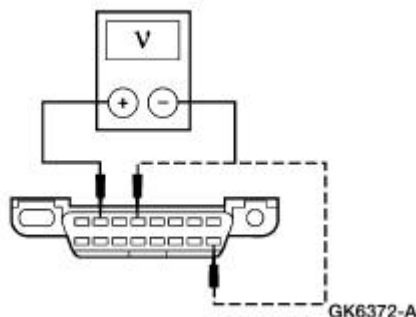
- Measure the voltage between DLC C251 Pin 10, Circuit 915 (PK/LB), harness side and C251 Pin 4, Circuit 1205 (BK); and between DLC C251 Pin 10, Circuit 915 (PK/LB), harness side and C251 Pin 16, Circuit 1047 (LG/RD), harness side.



- Is the voltage zero volts for any measurement?

G6 CHECK CIRCUIT 914 (TN/OG) AND CIRCUIT 915 (PK/LB) FOR THE SOURCE OF THE CONCERN — IN-LINE C144 DISCONNECTED

- Key in OFF position.
- Disconnect: In-Line C144.
- Key in ON position.
- Measure the voltage between DLC C251 Pin 2, Circuit 914 (TN/OG), harness side and C251 Pin 4, Circuit 1205 (BK); and between DLC C251 Pin 2, Circuit 914 (TN/OG), harness side and C251 Pin 16, Circuit 1047 (LG/RD), harness side.



- Measure the voltage between DLC C251 Pin 10, Circuit 915 (PK/LB), harness side and C251 Pin 4,

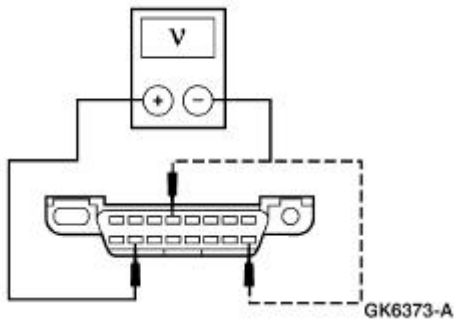
Yes
GO to [G6](#).

No
INSTALL a new anti-lock brake control module. For additional information on the anti-lock brake control module without traction control, REFER to [Section 206-09A](#). For additional information on the anti-lock brake control module with traction control, REFER to [Section 206-09B](#). TEST the system for normal operation.

Yes
GO to [G8](#).

No
REPAIR the circuit(s) in question between in-line C144 and the anti-lock brake control module C135. REFER to [Communication Circuit Wiring Repair](#). TEST the system for normal operation.

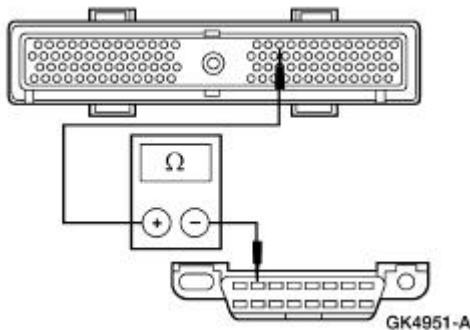
Circuit 1205 (BK); and between DLC C251 Pin 10, Circuit 915 (PK/LB), harness side and C251 Pin 16, Circuit 1047 (LG/RD), harness side.



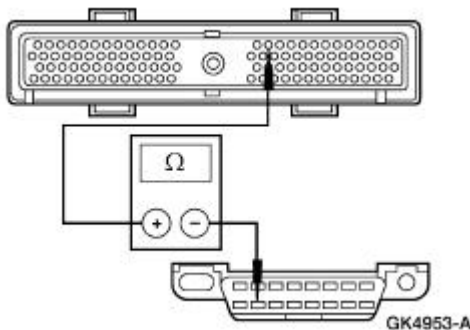
- Is the voltage zero volts for any measurement?

G7 CHECK CIRCUIT 914 (TN/OG) AND CIRCUIT 915 (PK/LB) FOR OPEN — PCM C175 DISCONNECTED

- Disconnect: PCM C175.
- Measure the resistance between PCM C175 Pin 16, Circuit 914 (TN/OG), harness side and DLC C251 Pin 2, Circuit 914 (TN/OG), harness side.



- Measure the resistance between PCM C175 Pin 15, Circuit 915 (PK/LB), harness side and DLC C251 Pin 10, Circuit 915 (PK/LB), harness side.



- Are the resistances less than 5 ohms?

G8 CHECK CIRCUIT 914 (TN/OG) AND CIRCUIT 915 (PK/LB) FOR THE SOURCE OF THE CONCERN — PCM C175 DISCONNECTED

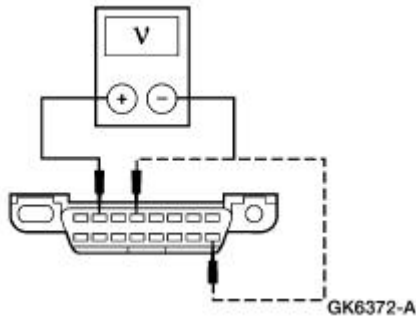
- Key in OFF position.
- Disconnect: PCM C175.
- Key in ON position.
- Measure the voltage between DLC C251 Pin 2, Circuit 914 (TN/OG), harness side and C251 Pin 4, Circuit 1205 (BK); and between DLC C251 Pin 2, Circuit 914 (TN/OG), harness side and C251 Pin 16, Circuit 1047 (LG/RD), harness side.

Yes
GO to [G8](#).

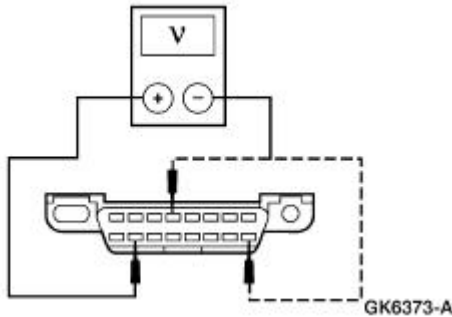
No
REPAIR the circuit(s) in question between in-line C215 and DLC C251. For additional information, REFER to [Communication Circuit Wiring Repair](#). TEST the system for normal operation.

Yes
GO to [G9](#).

No
REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual Section 3 for diagnosis and testing.



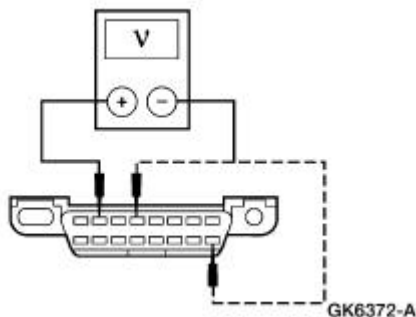
- Measure the voltage between DLC C251 Pin 10, Circuit 915 (PK/LB), harness side and C251 Pin 4, Circuit 1205 (BK); and between DLC C251 Pin 10, Circuit 915 (PK/LB), harness side and C251 Pin 16, Circuit 1047 (LG/RD), harness side.



- Is the voltage zero volts for any measurement?

G9 CHECK CIRCUIT 914 (TN/OG) AND CIRCUIT 915 (PK/LB) FOR THE SOURCE OF THE CONCERN — IN-LINE C215 DISCONNECTED

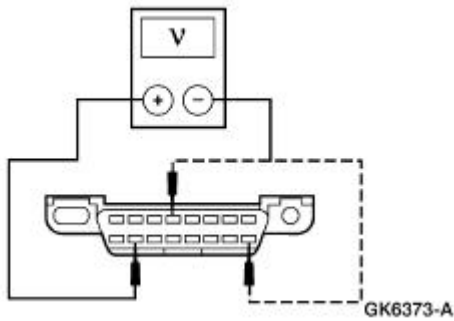
- Key in OFF position.
- Disconnect: In-Line C215.
- Key in ON position.
- Measure the voltage between DLC C251 Pin 2, Circuit 914 (TN/OG), harness side and C251 Pin 4, Circuit 1205 (BK); and between DLC C251 Pin 2, Circuit 914 (TN/OG), harness side and C251 Pin 16, Circuit 1047 (LG/RD), harness side.



- Measure the voltage between DLC C251 Pin 10, Circuit 915 (PK/LB), harness side and C251 Pin 4, Circuit 1205 (BK); and between DLC C251 Pin 10, Circuit 915 (PK/LB), harness side and C251 Pin 16, Circuit 1047 (LG/RD), harness side.

Yes
GO to [G10](#).

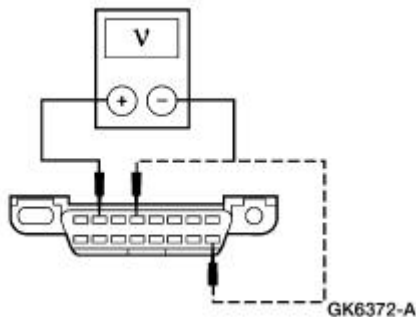
No
REPAIR the circuit(s) in question between in-line C215, in-line C144 (if equipped with the anti-lock brake control module), and the PCM C175. For additional information, REFER to [Communication Circuit Wiring Repair](#). TEST the system for normal operation.



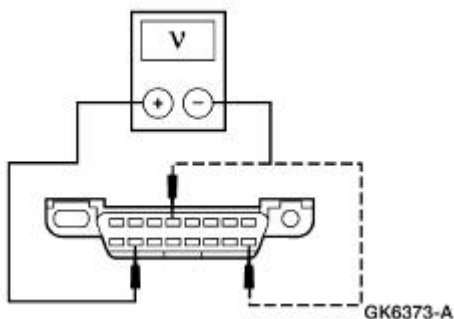
- Is the voltage zero volts for any measurement?

G10 CHECK CIRCUIT 914 (TN/OG) AND CIRCUIT 915 (PK/LB) FOR THE SOURCE OF THE CONCERN — INSTRUMENT CLUSTER C220a DISCONNECTED

- Key in OFF position.
- Disconnect: Instrument Cluster C220a.
- Key in ON position.
- Measure the voltage between DLC C251 Pin 2, Circuit 914 (TN/OG), harness side and C251 Pin 4, Circuit 1205 (BK); and between DLC C251 Pin 2, Circuit 914 (TN/OG), harness side and C251 Pin 16, Circuit 1047 (LG/RD), harness side.



- Measure the voltage between DLC C251 Pin 10, Circuit 915 (PK/LB), harness side and C251 Pin 4, Circuit 1205 (BK); and between DLC C251 Pin 10, Circuit 915 (PK/LB), harness side and C251 Pin 16, Circuit 1047 (LG/RD), harness side.



- Is the voltage zero volts for any measurement?

Yes



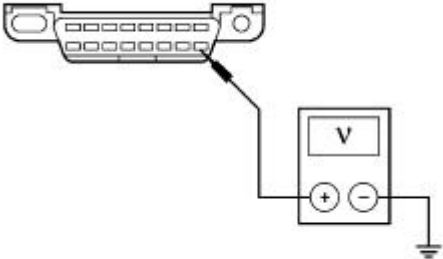
REPAIR the circuit(s) in question between in-line C215, DLC C251, and the instrument cluster C220a. For additional information, REFER to [Communication Circuit Wiring Repair](#). TEST the system for normal operation.

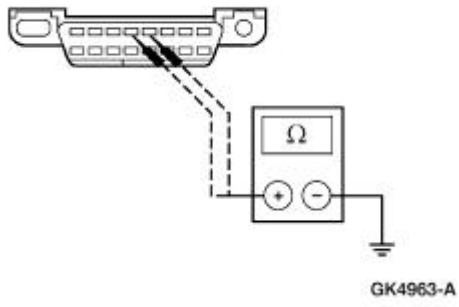
No

INSTALL a new instrument cluster. For additional information, REFER to [Section 413-01](#). TEST the system for normal operation.

PINPOINT TEST H: NO MODULE / NETWORK COMMUNICATION — NO POWER TO THE DIAGNOSTIC TOOL

Test Step	Result / Action to Take


H1 CHECK DIAGNOSTIC TOOL PINS FOR DAMAGE	<p>Yes GO to H2.</p> <p>No REPAIR diagnostic tool pins. TEST the system for normal operation.</p>
<ul style="list-style-type: none"> Inspect diagnostic tool pins.  <p style="text-align: center;">GK2632-A</p> <ul style="list-style-type: none"> Are the pins OK? 	<ul style="list-style-type: none"> Key in OFF position. Inspect the DLC C251 pins for damage.  <p style="text-align: center;">GK2633-A</p> <ul style="list-style-type: none"> Are the pins OK?
H2 CHECK DLC C251 FOR DAMAGE	<p>Yes GO to H3.</p> <p>No REPAIR DLC C251. TEST the system for normal operation.</p>
<ul style="list-style-type: none"> Measure the voltage between DLC C251 Pin 16, Circuit 1047 (LG/RD), harness side and ground.  <p style="text-align: center;">GK2634-A</p> <ul style="list-style-type: none"> Is the voltage greater than 10 volts? 	<p>Yes GO to H4.</p> <p>No REPAIR Circuit 1047 (LG/RD). TEST the system for normal operation.</p>
H3 CHECK VOLTAGE TO DLC C251 PIN 16 — CIRCUIT 1047 (LG/RD)	<p>Yes CHECK diagnostic tool. TEST the system for normal operation.</p> <p>No REPAIR the circuit in question. TEST the system for normal operation.</p>
H4 CHECK THE DLC GROUND — CIRCUIT 1205 (BK) AND CIRCUIT 651 (BK/YE)	



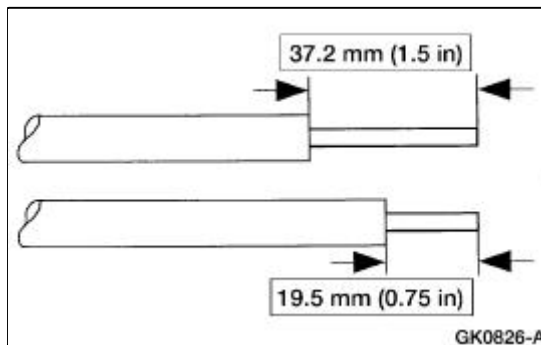
- Is the resistance less than 5 ohms?

Communication Circuit Wiring Repair

Special Tool(s)

 ST1171-A	Heat Gun 107-R0300 or equivalent
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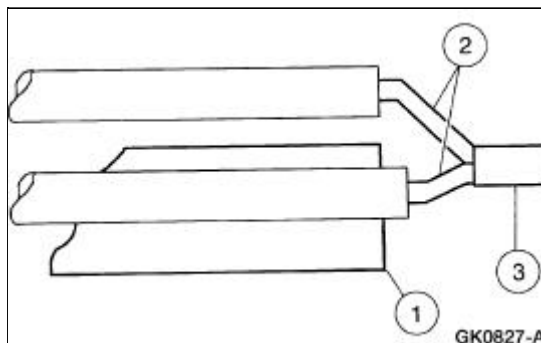
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01.
2. Strip the wires.



3. **NOTE:** Use rosin core mildly activated (RMA) solder, not acid core solder.

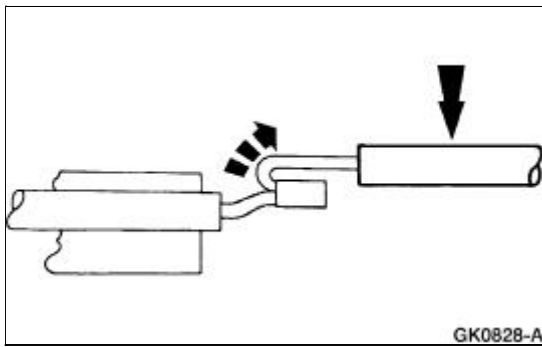
Solder the wires.

1. Install the heat shrink tube.
2. Twist the wires together.
3. Solder the wires together.

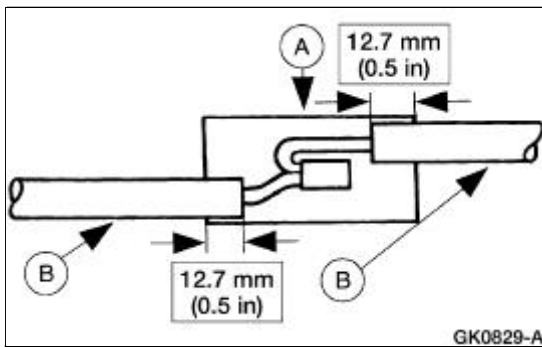


4. **NOTE:** Wait for the solder to cool before moving the wires.

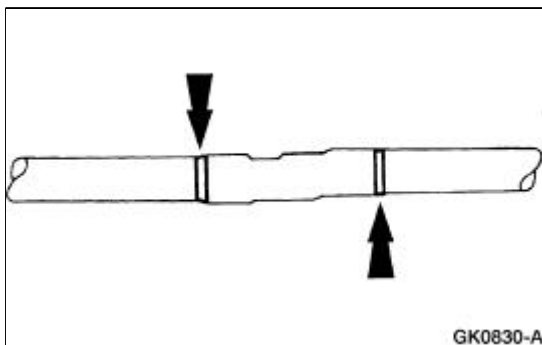
Bend the wires back in a straight line.



5. Position the (A) heat shrink tube over the (B) wire repair.
 - Overlap the heat shrink tube on both wires.




6. Use the heat gun to heat the repaired area until adhesive flows out both ends of the heat shrink tube.



7. Reconnect the battery ground cable.
-

Module Configuration

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052 or equivalent diagnostic tool
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Principles of Operation

Some modules must be programmed as part of the repair procedure. If this procedure is not followed the module will not function correctly and may set a number of DTCs, including B2477 or P1639, which indicate that some necessary data has not been programmed into the module.

Modules that need programming should not be exchanged between vehicles. In most cases the parameter values or settings are unique to that vehicle, and if not set correctly will cause concerns or faults.

Some programmable parameters, such as belt minder on/off, can be changed from the factory setting at the customer's request.

WDS will automatically attempt to retrieve the module configuration information from all modules, and from a backup location in the powertrain control module (PCM) when vehicle ID is carried out. If the module and the PCM do not contain correct information the diagnostic tool will either request "As Built" data or display a list of items that you will need to manually configure. The diagnostic tool will program the module based on the data you enter.

There are three different methods that are used for module programming:

- programmable module installation (PMI)
- calibration update
- programmable parameters

Some modules do not support all three methods.

Programmable Module Installation (PMI)

The programmable module installation (PMI) method is used when a new programmable module is installed on the vehicle. It is no longer necessary to command the diagnostic tool to gather module option content from the old module. The diagnostic tool automatically obtains any available module option content information from the old module during the vehicle ID routine that runs when the diagnostic tool is initially connected to the vehicle. It is important that you connect WDS to the vehicle and allow it to identify the vehicle and obtain configuration data prior to removing any modules.

Calibration Update

Calibration update is used to install a new calibration and strategy into a module. The updates are usually issued to fix a concern in the module software and would normally be addressed by a technical service bulletin (TSB). This method has been used by the PCM for several years. Other modules will be adopting this strategy as well.

Programmable Parameters

This method is used to configure parameters that can be modified in service. These are typically at the preference of the customer. Not all features controlled by the module are listed in this configuration method. Refer to the Module Configuration Index for a list of features by system.

If a module that has been modified using programmable parameters needs to be installed, the PMI procedure will maintain the parameters in their altered state if WDS is able to communicate with the old module during Vehicle ID. Otherwise you may need to use programmable parameters to return them to the altered state.

Vehicle Identification (VID) Block

Some PCMs contain a memory area called a vehicle identification (VID) block. The VID block is used to store backup data for each programmable module, as well as, powertrain configuration information.

If the diagnostic tool cannot retrieve module option content information from the suspect module, the diagnostic tool will attempt to extract backup information from the PCM's VID block.

The PCM VID block contains the factory settings for the configurable modules unless the PCM is flashed with a new calibration, in which case some PCM parameters may be modified.

As-Built Data Center

The As-Built Data Center maintains a record of the vehicle configuration in a database. The vehicle's VIN is required to obtain this information. The As-Built Data Center records the applicable module configurations stored in each module before the vehicle leaves the factory. The As-Built Data Center will always reflect the original build of the vehicle as it left the factory. Only contact the As-Built Data Center when directed to do so by the diagnostic tool.

Inspection and Verification

1. Visually inspect for obvious signs of electrical damage. Refer to the following chart:

Visual Inspection Chart

Electrical
<ul style="list-style-type: none">● Wiring harness● Connectors

Configurable Modules

The vehicle contains the following modules that are configurable:

- generic electronic module (GEM)

Programmable Parameters Index

System	Programmable Parameter Items
Warnings & Chimes	Belt Minder



Torque Specifications

Description	Nm	lb-in
Battery ground cable	10	89
Steering column opening reinforcement bolts	9	80
Steering column opening cover bolts	9	80

Anti-Theft — Passive Anti-Theft System (PATS)

The passive anti-theft system (PATS) contains the following components:

- theft indicator
- encoded ignition key
- transceiver module
- instrument cluster
- powertrain control module (PCM)
- standard corporate protocol (SCP) communication network

The PATS uses radio frequency identification technology to deter a driveaway theft. Passive means that it does not require any activity from the user. This system is known as SecuriLock® in North America, Safeguard® in the U.K. and PATS in continental Europe. This information can be found in owners literature.

The PATS uses a specially encoded ignition key. Each encoded ignition key contains a permanently installed electronic device called a transponder. Each transponder contains a unique electronic identification code, with over 72 million billion combinations.

Each encoded ignition key must be programmed into the vehicle's instrument cluster (the instrument cluster is also known as a hybrid electronic cluster [HEC]), before it can be used to start the engine. There are special diagnostic procedures outlined in the workshop manual that must be carried out if new encoded ignition keys are to be installed.

The encoded key is larger than a traditional ignition key. The key does not require batteries and should last the life of the vehicle.

The transceiver module communicates with the encoded ignition key. This module is located behind the steering column shroud and contains an antenna connected to a small electronics module. During each vehicle start sequence, the transceiver module reads the encoded ignition key identification code and sends the data to the instrument cluster.

The control functions are contained in the instrument cluster. This module carries out all of the PATS functions such as receiving the identification code from the encoded ignition key and controlling engine enable. The instrument cluster initiates the key interrogation sequence when the vehicle ignition switch is turned to RUN or START.

The PATS uses the PCM to enable or disable the engine. The instrument cluster communicates with the PCM over the SCP network in order to enable engine operation. The instrument cluster and the PCM use sophisticated messages in order to prevent a theft. The instrument cluster and the PCM share security data (when first installed together) that makes them a matched pair. After this security data sharing, these modules will not function in other vehicles. The shared PCM ID is remembered even if the battery is disconnected. The instrument cluster also stores the vehicle's key identification code even if the battery is disconnected. There are special diagnostic procedures outlined in this workshop manual that may be carried out if either a new instrument cluster or PCM needs to be installed.

All elements of PATS must be functional before the engine is allowed to start. If any of the components are not working correctly, the vehicle will not start.

PATS uses a visual theft indicator. This indicator will prove out for three seconds when the ignition

switch is turned to RUN or START under normal operation. If there is a PATS problem, this indicator will either flash rapidly or glow steadily (for more than three seconds) when the ignition switch is turned to RUN or START. PATS also "blips" the theft indicator every two seconds at ignition OFF to act as a visual theft deterrent.



The PATS is not compatible with aftermarket remote start systems, which allow the vehicle to be started from outside the vehicle. These systems may reduce the vehicle security level, and also may cause no-start issues. Remote start systems must be removed before investigation of PATS-related no-start issues.

Anti-Theft — Passive Anti-Theft System (PATS)

Refer to Wiring Diagrams Cell [112](#), Anti-Theft for schematic and connector information.

Refer to Wiring Diagrams Cell [60](#), Instrument Cluster for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

Inspection and Verification

NOTE: PATS must be reconfigured upon installment of a new instrument cluster. Refer to [Section 418-00](#).

1. Verify the customer concern by duplicating the condition.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> ● Ignition lock cylinder ● Encoded ignition key (PATS key) ● Use of non-encoded ignition key (key without the molded plastic head, non-PATS key) ● Use of a non-programmed encoded ignition key 	<ul style="list-style-type: none"> ● Central junction box fuses: <ul style="list-style-type: none"> ■ 5 (15A) ■ 21 (5A) ■ 34 (20A) ● PATS transceiver ● Connectors ● Ignition switch

3. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
 - check that the program card is correctly installed.

- check the connections to the vehicle.
 - check the ignition switch position.
4. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.
 5. Carry out the DATA LINK DIAGNOSTIC TEST. If diagnostic tool responds with:
 - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to [Section 418-00](#).
 - NO RESP/NOT EQUIP for instrument cluster, go to Pinpoint Test A.
 - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the instrument cluster.
 6. If the DTCs retrieved are related to the concern, go to Instrument Cluster Diagnostic Trouble Code (DTC) Index to continue diagnostics.
 7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

Instrument Cluster Diagnostic Trouble Code (DTC) Index

Instrument Cluster Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1202	Fuel Sender Open Circuit	ICM	REFER to Section 413-01 .
B1204	Fuel Sender Short to Ground	ICM	REFER to Section 413-01 .
B1213	Anti-Theft Number of Programmed Keys is Below Minimum	ICM	GO to Pinpoint Test D .
B2103 or B1232	Antenna Not Connected — Defective Transceiver	ICM	GO to Pinpoint Test E .
B1317	Battery Voltage High	ICM	REFER to Section 414-00 .
B1318	Battery Voltage Low	ICM	REFER to Section 414-00 .
B1342	ECU Is Defective	ICM	REFER to Section 413-01 .
B1356	Ignition Run Circuit Open	ICM	REFER to Section 211-05 .
B1364	Ignition Start Circuit Open	ICM	REFER to Section 211-05 .
B1600	PATS Ignition Key Transponder Signal Is Not Received — Damaged Key or Non-PATS Key	ICM	GO to Pinpoint Test F .
B1601	PATS Received Incorrect Key-Code From Ignition Key Transponder (Unprogrammed Encoded Ignition Key)	ICM	GO to Pinpoint Test G .
B1602	PATS Received Invalid Format Of Key-Code From Ignition Key Transponder (Partial Key Read)	ICM	GO to Pinpoint Test H .
B1681	PATS Transceiver Signal Is Not Received (Not Connected, Damaged, or Wiring)	ICM	GO to Pinpoint Test I .

B2139	PCM ID Does Not Match Between Instrument Cluster and PCM	ICM	GO to Pinpoint Test J .
B2141	NVM Configuration Failure (No PCM ID Exchange Between Instrument Cluster and PCM)	ICM	GO to Pinpoint Test K .
B2143	NVM Memory Failure	ICM	REFER to Section 413-01
C1284	Oil Pressure Switch Failure	ICM	REFER to Section 413-01 .
U1147	SCP Invalid or Missing Data for Vehicle Security	PCM/SCP	GO to Pinpoint Test C .
U1262	Missing SCP Message	J1850	REFER to Section 418-00 .

Symptom Chart

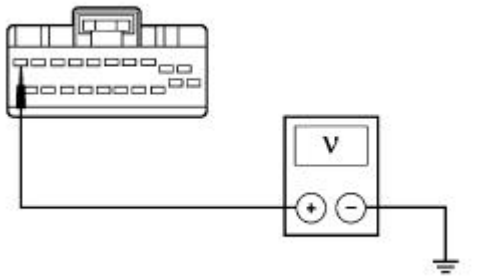
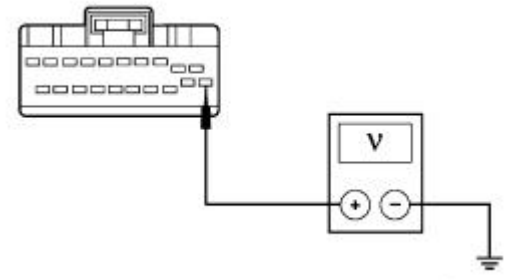
Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none"> No communication with the instrument cluster 	<ul style="list-style-type: none"> Central junction box Fuses: <ul style="list-style-type: none"> 5 (15A) 21 (5A) 34 (20A) Circuitry Instrument cluster 	<ul style="list-style-type: none"> GO to Pinpoint Test A.
<ul style="list-style-type: none"> The anti-theft indicator is always/never on — no three second theft indicator prove out 	<ul style="list-style-type: none"> Instrument cluster Theft indicator 	<ul style="list-style-type: none"> GO to Pinpoint Test B.
<ul style="list-style-type: none"> The vehicle does not start — theft indicator proves out for three seconds as normal 	<ul style="list-style-type: none"> Less than two keys programmed to the system Transceiver not connected/defective Circuitry Transceiver internal antenna damaged NON-PATS key, damaged key or no code received Partial key read of PATS key Unprogrammed PATS key No PCM ID stored in PATS PATS/PCM ID do not match Problem with SCP link 	<ul style="list-style-type: none"> CARRY OUT Instrument Cluster On-Demand Self-Test. RETRIEVE DTCs. If DTCs are present, GO to Instrument Cluster Diagnostics Trouble Code (DTC) Index. If no DTCs are retrieved, CHECK for other possible no-start causes. CLEAR the stored DTCs. CYCLE the ignition key from OFF to RUN. RETRIEVE continuous DTCs. If DTCs are present, GO to Instrument Cluster Diagnostics Trouble Code (DTC) Index. If no

		DTCs are retrieved, CHECK for other possible causes.
<ul style="list-style-type: none"> The anti-theft system does not operate correctly — the vehicle starts but flashes a fault code on the theft indicator at key on 	<ul style="list-style-type: none"> Incorrect PCM calibration 	<ul style="list-style-type: none"> GO to Pinpoint Test C.

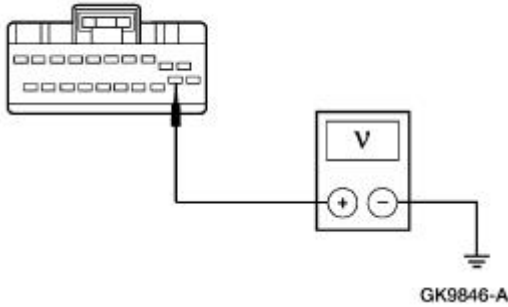
Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE INSTRUMENT CLUSTER

Test Step	Result / Action to Take
<p>A1 CHECK THE BATTERY POWER SUPPLY TO THE INSTRUMENT CLUSTER</p> <ul style="list-style-type: none"> Key in OFF position. Disconnect: Instrument Cluster C220b. Measure voltage between instrument cluster C220b Pin 10, Circuit 729 (RD/WH), harness side and ground.  <p>• Is the voltage greater than 10 volts?</p>	<p>Yes GO to A2.</p> <p>No REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs.</p>
<p>A2 CHECK THE RUN POWER SUPPLY TO THE INSTRUMENT CLUSTER</p> <ul style="list-style-type: none"> Key in ON position. Measure the voltage between instrument cluster C220b Pin 11, Circuit 489 (PK/BK), harness side and ground.  <p>• Is the voltage greater than 10 volts?</p>	<p>Yes GO to A3.</p> <p>No REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs.</p>
<p>A3 CHECK RUN/START POWER SUPPLY TO THE INSTRUMENT</p>	

CLUSTER

- Measure the voltage between the instrument cluster C220b Pin 12, Circuit 20 (WH/LB), harness side and ground.



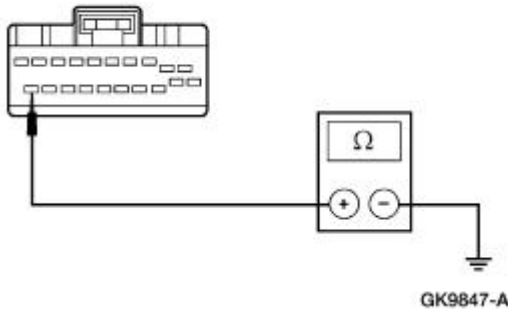
- Is the voltage greater than 10 volts?

Yes
GO to [A4](#).

No
REPAIR Circuit 20 (WH/LB). REPEAT the self-test. CLEAR the DTCs.

A4 CHECK GROUND CIRCUIT 397 (BK/WH) FOR AN OPEN

- Key in OFF position.
- Measure the resistance between instrument cluster C220b Pin 20, Circuit 397 (BK/WH), harness side and ground.



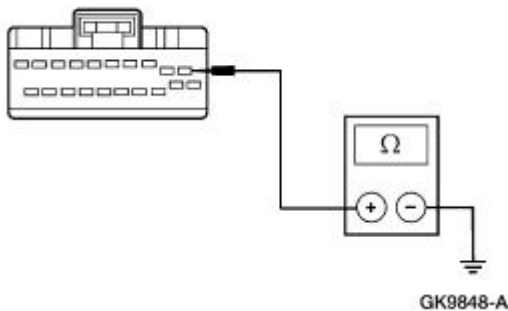
- Is the resistance less than 5 ohms?

Yes
GO to [A5](#).

No
REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs.

A5 CHECK GROUND CIRCUIT 1205 (BK) FOR OPEN

- Measure the resistance between instrument cluster C220b Pin 1, Circuit 1205 (BK), harness side and ground.



- Is the resistance less than 5 ohms?

Yes
REFER to [Section 418-00](#).

No
REPAIR the circuit. REPEAT the self-test. CLEAR the DTCs.

PINPOINT TEST B: THE ANTI-THEFT INDICATOR IS ALWAYS/NEVER ON — NO THREE SECOND THEFT INDICATOR PROVE OUT

Test Step	Result / Action to Take
B1 ENTER THE INSTRUMENT CLUSTER ACTIVE COMMAND MODE	

<ul style="list-style-type: none"> ● Key in OFF position. ● Connect the diagnostic tool. ● Enter the instrument cluster active command mode. ● Can the instrument cluster active command mode be entered? 	<p>Yes GO to B2.</p> <p>No Go To Pinpoint Test A.</p>
B2 TRIGGER THE ANTI-THEFT INDICATOR	
<ul style="list-style-type: none"> ● Trigger the instrument cluster active command WARNING LAMPS AND CHIME to ON. ● Does the anti-theft indicator illuminate? 	<p>Yes The anti-theft indicator is OK. VERIFY the concern with the customer.</p> <p>No GO to B3.</p>
B3 CHECK THE ANTI-THEFT INDICATOR	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Anti-Theft LED. ● Measure the resistance between the pins of the anti-theft LED in both directions. <div style="text-align: center;"> <p style="text-align: right; font-size: small;">GK2498-A</p> </div> <ul style="list-style-type: none"> ● Is the resistance greater than 10,000 ohms in one direction, and 10-20 ohms in the other direction? 	<p>Yes INSTALL a new instrument cluster; for additional information, REFER to Section 413-01. CYCLE the ignition to RUN using two encoded ignition keys. Go To Pinpoint Test J to initialize the module. REPEAT the self-test. CLEAR the DTCs.</p> <p>No INSTALL a new anti-theft LED. For additional information, REFER to Section 413-01. REPEAT the self-test. CLEAR the DTCs.</p>

PINPOINT TEST C: THE ANTI-THEFT SYSTEM DOES NOT OPERATE CORRECTLY — THE VEHICLE STARTS BUT FLASHES A FAULT CODE ON THE THEFT INDICATOR AT KEY ON

Test Step	Result / Action to Take
C1 CHECK THE ANTI-THEFT INDICATOR FOR CORRECT OPERATION	
<ul style="list-style-type: none"> ● Key in START position. ● Verify the theft indicator proves out correctly. ● Does the vehicle start once the theft proves out? 	<p>Yes If the vehicle starts, VERIFY correct PCM calibration for vehicle. REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual Section 3.</p> <p>No GO to C2.</p>
C2 CHECK THE PCM DIAGNOSTIC CAPABILITY	
<ul style="list-style-type: none"> ● Connect the diagnostic tool. ● Retrieve and document continuous DTCs. ● Enter the following 	<p>Yes GO to C3.</p> <p>No REFER to Section 418-00.</p>

<p>diagnostic mode on the diagnostic tool: Clear Continuous DTCs.</p> <ul style="list-style-type: none"> ● Enter the following diagnostic mode on the diagnostic tool: PCM Self-Test. ● Does diagnostic tool communicate with the PCM? 	
C3 RETRIEVE THE PCM DTCS	
<ul style="list-style-type: none"> ● Retrieve and document continuous DTCs. ● Is DTC P1260 recorded? 	<p>Yes GO to C4.</p> <p>No VERIFY PCM power and ground. REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual Section 3.</p>
C4 CHECK THE COMMUNICATION NETWORK	
<ul style="list-style-type: none"> ● Repeat Inspection and Verification steps 3 through 7; refer to Inspection and Verification. ● Key in OFF position. ● Retrieve and document continuous DTCs. ● Enter the following diagnostic mode on the diagnostic tool: Clear Continuous DTCs. ● Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster On-Demand Self-Test. ● Is DTC U1147 retrieved? 	<p>Yes INSTALL a new instrument cluster; for additional information, REFER to Section 413-01. CYCLE the ignition to RUN using two encoded ignition keys. Go To Pinpoint Test J to initialize the module. REPEAT the self-test. CLEAR the DTCs. If DTC U1147 is still present, INSTALL a new PCM; for additional information, REFER to Section 303-14. TEST the system for normal operation. (You must follow Pinpoint Test J to initialize module.)</p> <p>No System is OK.</p>

PINPOINT TEST D: THE ANTI-THEFT SYSTEM DOES NOT OPERATE CORRECTLY — ANTI-THEFT NUMBER OF PROGRAMMED KEYS IS BELOW MINIMUM

Test Step	Result / Action to Take
D1 USE THE DTCS FROM THE INSTRUMENT CLUSTER SELF-TESTS	
<ul style="list-style-type: none"> ● Use the recorded results from the Instrument Cluster Continuous and On-Demand Self-Tests. ● Is DTC B1213 the only DTC retrieved? 	<p>Yes GO to D2.</p> <p>No REPAIR the other DTCs retrieved. REPEAT the Instrument Cluster On-Demand Self-Test. CLEAR the DTCs.</p>
D2 CHECK FOR PROGRAMMED	

ENCODED IGNITION KEYS — MONITOR THE INSTRUMENT CLUSTER PID NUMKEYS	
<ul style="list-style-type: none"> ● Monitor the instrument cluster PID NUMKEYS. ● Does the instrument cluster PID NUMKEYS display less than two encoded ignition keys programmed? 	<p>Yes GO to D3.</p> <p>No System is OK.</p>
D3 PROGRAM ENCODED IGNITION KEYS	
<ul style="list-style-type: none"> ● NOTE: Two programmed encoded ignition keys must be available to start the vehicle. ● Cut a new encoded ignition key. ● Key in ON position. ● Program the new encoded ignition key. ● Does the theft indicator illuminate for three seconds, and then go out? 	<p>Yes CLEAR the DTCs. CARRY OUT the Instrument Cluster On-Demand Self-Test to verify all codes have been cleared. REPEAT the self-test. CLEAR the DTCs.</p> <p>No If the theft indicator is on continuously, REPEAT TEST STEP D3 with a second new encoded ignition key. If the theft indicator is flashing, RETRIEVE DTCs stored for the new fault and REPAIR the other DTC(s) retrieved.</p>

PINPOINT TEST E: THE ANTI-THEFT SYSTEM DOES NOT OPERATE CORRECTLY — ANTENNA NOT CONNECTED OR DEFECTIVE TRANSCEIVER

Test Step	Result / Action to Take
E1 INSPECT THE PATS TRANSCEIVER FOR CORRECT INSTALLATION	
<ul style="list-style-type: none"> ● Key in OFF position. ● Verify the PATS transceiver is correctly installed; refer to Module—Passive Anti-Theft Transceiver. ● Connect the diagnostic tool. ● Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster On-Demand Self-Test. ● Retrieve and document continuous DTCs. ● Enter the following diagnostic mode on the diagnostic tool: Clear Continuous DTCs. ● Is DTC B1232 or B2103 retrieved? 	<p>Yes INSTALL a new PATS transceiver module; for additional information, REFER to Module—Passive Anti-Theft Transceiver. REPEAT the Instrument Cluster On-Demand Self-Test. CLEAR the DTCs.</p> <p>No System is OK.</p>

PINPOINT TEST F: THE ANTI-THEFT SYSTEM DOES NOT OPERATE CORRECTLY — PATS IGNITION KEY TRANSPONDER SIGNAL IS NOT RECEIVED (DAMAGED KEY OR NON-PATS KEY)

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Test Step	Result / Action to Take
<p>NOTE: Large metallic objects, electronic debit transponder devices or a second key on the same key ring as the PATS ignition key may cause vehicle starting problems and record DTCs under certain conditions. If a fault cannot be identified, examine the customer's key for such objects or devices. If present, inform the customer that they need to keep these objects from touching the PATS ignition key while starting the engine. These objects and devices cannot damage the PATS ignition key, but can cause a momentary problem if they are too close to the key during engine start. If a problem occurs, turn ignition OFF and restart the engine with all other objects on the key ring held away from the ignition key. Check to ensure the encoded ignition key used by the customer is an approved Ford encoded ignition key (encoded ignition keys from Rotunda, Ilco, Curtis, or Strattec are approved Ford encoded ignition keys).</p>	
<p>F1 USE THE DTCS FROM THE INSTRUMENT CLUSTER SELF-TESTS</p>	<p>Yes GO to F2.</p> <p>No If other DTCs are retrieved, REFER to Instrument Cluster Diagnostic Trouble Code (DTC) Index.</p> <p>If no DTCs are retrieved, system is OK.</p>
<p>F2 PROGRAM A NEW ENCODED IGNITION KEY</p>	<p>Yes GO to F3.</p> <p>No If no other DTCs are retrieved, system is OK.</p> <p>If other DTCs are retrieved, REFER to Instrument Cluster Diagnostic Trouble Code (DTC) Index.</p>
<ul style="list-style-type: none"> ● Key in OFF position. ● NOTE: Check to make sure the customer and replacement encoded ignition keys are approved Ford encoded PATS ignition keys. Unapproved PATS keys do not always operate correctly over different temperature ranges (encoded ignition keys from Rotunda, Ilco, or Strattec are approved encoded ignition keys). ● Cut a new encoded ignition key. ● Key in ON position. ● Program the new encoded ignition key; for additional information, refer to Key Programming—Erase All Key Codes and Program Two Keys. ● Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster On-Demand Self-Test. ● Is DTC B1600 still present? 	
<p>F3 INSTALL A NEW PATS TRANSCEIVER</p>	<p>Yes INSTALL a new instrument cluster; for additional information, REFER to Section 413-01. CYCLE the ignition to RUN using two encoded ignition keys. Go To Pinpoint Test J to initialize the module. REPEAT the self-test. CLEAR the DTCs.</p> <p>No System is OK.</p>
<ul style="list-style-type: none"> ● Key in OFF position. ● Install a new PATS transceiver; for additional information, refer to Module—Passive Anti-Theft Transceiver. ● Key in ON position. ● NOTE: Use the customer's original encoded ignition key, not the encoded ignition key that was cut in the previous step. ● Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster On-Demand Self-Test. ● Is DTC B1600 retrieved? 	

PINPOINT TEST G: THE ANTI-THEFT SYSTEM DOES NOT OPERATE

CORRECTLY — PATS RECEIVED INCORRECT KEY-CODE FROM IGNITION KEY TRANSPONDER (UNPROGRAMMED ENCODED IGNITION KEY)

Test Step	Result / Action to Take
<p>NOTE: Large metallic objects, electronic debit transponder devices or a second key on the same key ring as the PATS ignition key may cause vehicle starting problems and record DTCs under certain conditions. If a fault cannot be identified, examine the customer's key for such objects or devices. If present, inform the customer that they need to keep these objects from touching the PATS ignition key while starting the engine. These objects and devices cannot damage the PATS ignition key, but can cause a momentary problem if they are too close to the key during engine start. If a problem occurs, turn ignition OFF and restart the engine with all other objects on the key ring held away from the ignition key. Check to ensure the encoded ignition key used by the customer is an approved Ford encoded ignition key (encoded ignition keys from Rotunda, Ilco, Curtis, or Strattec are approved Ford encoded ignition keys).</p>	
G1 USE THE DTCS FROM THE INSTRUMENT CLUSTER SELF TESTS	
<ul style="list-style-type: none"> ● Use the recorded results from the Instrument Cluster Continuous and On-Demand Self-Tests. ● Is DTC B1601 recorded? 	<p>Yes GO to G2.</p> <p>No System is OK. CHECK all customer encoded ignition keys with Instrument Cluster On-Demand Self-Test to verify all other encoded ignition keys are programmed.</p>
G2 CHECK FOR PROGRAMMED ENCODED IGNITION KEYS — MONITOR THE INSTRUMENT CLUSTER PID NUMKEYS	
<ul style="list-style-type: none"> ● Monitor the instrument cluster PID NUMKEYS. ● Does the instrument cluster PID NUMKEYS display 8? 	<p>Yes ERASE and REPROGRAM the key codes; for additional information, REFER to Key Programming—Erase All Key Codes and Program Two Keys. REPEAT the self-test. CLEAR the DTCs.</p> <p>No GO to G3.</p>
G3 CHECK THE NUMBER OF PROGRAMMED ENCODED IGNITION KEYS AVAILABLE	
<ul style="list-style-type: none"> ● Verify there are at least two currently programmed encoded ignition keys available with the vehicle. ● Are at least two currently programmed encoded ignition keys available with the vehicle? 	<p>Yes GO to G4.</p> <p>No CUT a new encoded ignition keys so that at least two encoded ignition keys are available. PROGRAM the encoded ignition keys; Key Programming—Erase All Key Codes and Program Two Keys. GO to G4.</p>
G4 VERIFY THE INSTRUMENT CLUSTER PID SPARE_KY INDICATES ENABLE	
<ul style="list-style-type: none"> ● Monitor the instrument cluster PID SPARE_KY. ● Does the instrument cluster PID SPARE_KY indicate ENABLE? 	<p>Yes REFER to Key Programming—Erase All Key Codes and Program Two Keys. CLEAR the DTCs, REPEAT the self-test GO to G5.</p> <p>No REFER to Key Programming—Enable/Disable Spare</p>

	<p>Key Programming to enable the PID SPARE KEY to ENABLE. TEST the system for normal operation. Once completed, GO to G5.</p>
G5 CHECK THE ENCODED IGNITION KEYS FOR CORRECT OPERATION	
<ul style="list-style-type: none"> ● Key in OFF position. ● Key in ON position. ● Start the vehicle using the first encoded ignition key. ● Key in ON position. ● Start the vehicle with the second ignition key. ● Key in OFF position. ● Does the vehicle start correctly using both encoded ignition keys? 	<p>Yes System is OK. If there are additional keys that need to be programmed, for additional information, REFER to Key Programming—Program a Key Using Two Programmed Keys.</p> <p>No GO to G6.</p>
G6 RETRIEVE THE INSTRUMENT CLUSTER DTCS — CHECK FOR DTC B1601	
<ul style="list-style-type: none"> ● Retrieve and document continuous DTCs. ● Enter the following diagnostic mode on the diagnostic tool: Clear Continuous DTCs. ● Carry out a instrument cluster self-test using both ignition keys from Step G5. ● Is DTC B1601 retrieved? 	<p>Yes INSTALL a new instrument cluster; for additional information, REFER to Section 413-01. CYCLE the ignition to RUN using two encoded ignition keys. GO to Pinpoint Test J to initialize the vehicle. REPEAT the self-test. CLEAR the DTCs.</p> <p>No System is OK.</p> <p>If other DTCs are retrieved, REFER to Instrument Cluster Module Diagnostic Trouble Code (DTC) Index.</p>

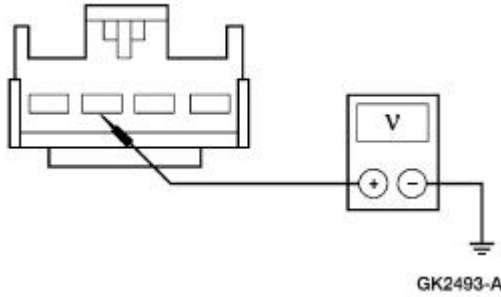
PINPOINT TEST H: THE ANTI-THEFT SYSTEM DOES NOT OPERATE CORRECTLY — PATS RECEIVED INVALID FORMAT OF KEY-CODE FROM IGNITION KEY TRANSPONDER (PARTIAL KEY READ)

Test Step	Result / Action to Take
<p>NOTE: Large metallic objects, electronic debit transponder devices or a second key on the same key ring as the PATS ignition key may cause vehicle starting problems and record DTCs under certain conditions. If a fault cannot be identified, examine the customer's key for such objects or devices. If present, inform the customer that they need to keep these objects from touching the PATS ignition key while starting the engine. These objects and devices cannot damage the PATS ignition key, but can cause a momentary problem if they are too close to the key during engine start. If a problem occurs, turn ignition OFF and restart the engine with all other objects on the key ring held away from the ignition key. Check to ensure the encoded ignition key used by the customer is an approved Ford encoded ignition key (encoded ignition keys from Rotunda, Ilco, Curtis, or Strattec are approved Ford encoded ignition keys).</p>	
H1 USE THE DTCS FROM THE INSTRUMENT CLUSTER SELF TESTS	
<ul style="list-style-type: none"> ● Use the recorded results from the Instrument Cluster Continuous and On-Demand Self-Tests. ● Is DTC B1602 retrieved? 	<p>Yes GO to H2.</p> <p>No System is OK. CHECK all customer encoded ignition keys with Instrument Cluster On-Demand Self-Test to verify all other keys are programmed.</p>

H2 OBTAIN A NEW ENCODED IGNITION KEY	<p>Yes GO to H3.</p> <p>No System is OK. If the customer has any remaining encoded keys at home, instruct them to carry out Key Programming—Program a Key Using Two Programmed Keys on each remaining key. This procedure is detailed in the Owners Guide.</p>
<ul style="list-style-type: none"> ● Key in OFF position. ● Cut a new encoded ignition key. ● Key in ON position. ● Program a new encoded ignition key; for additional information, refer to Key Programming—Erase All Key Codes and Program Two Keys. ● Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster On-Demand Self-Test. ● Is DTC B1602 retrieved? 	<p>Yes REFER to Instrument Cluster Diagnostic Trouble Code (DTC) Index.</p> <p>No System is OK.</p>
H3 INSTALL A NEW PATS TRANSCEIVER	
<ul style="list-style-type: none"> ● Key in OFF position. ● Install a new PATS transceiver; for additional information, refer to Module—Passive Anti-Theft Transceiver. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster On-Demand Self-Test. ● Are any DTCs retrieved? 	

PINPOINT TEST I: THE ANTI-THEFT SYSTEM DOES NOT OPERATE CORRECTLY — PATS TRANSCEIVER SIGNAL IS NOT RECEIVED (NOT CONNECTED, DAMAGED, OR WIRING)

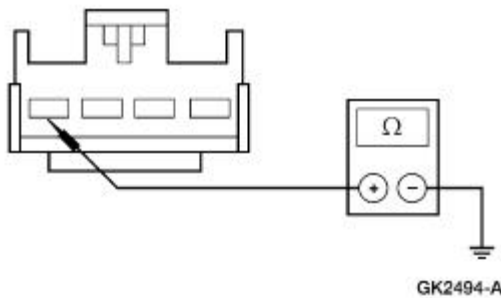
Test Step	Result / Action to Take
I1 USE THE DTCS FROM THE INSTRUMENT CLUSTER SELF TESTS	
<ul style="list-style-type: none"> ● Use the recorded results from the Instrument Cluster Continuous and On-Demand Self-Tests. ● Is DTC B1681 retrieved? 	<p>Yes GO to I2.</p> <p>No System is OK.</p>
I2 CHECK THE PATS TRANSCEIVER FOR VOLTAGE — CIRCUIT 20 (WH/LB)	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: PATS Transceiver C252. ● Key in ON position. ● Measure the voltage between PATS transceiver C252 Pin 2, Circuit 20 (WH/LB), harness side and ground. 	<p>Yes GO to I3.</p> <p>No REPAIR Circuit 20 (WH/LB). REPEAT the self-test. CLEAR the DTCs.</p>



- Is the voltage greater than 9 volts?

I3 CHECK THE PATS TRANSCIEVER GROUND — CIRCUIT 397 (BK/WH)

- Key in OFF position.
- Measure the resistance between PATS transceiver C252 Pin 1, Circuit 397 (BK/WH), harness side and ground.



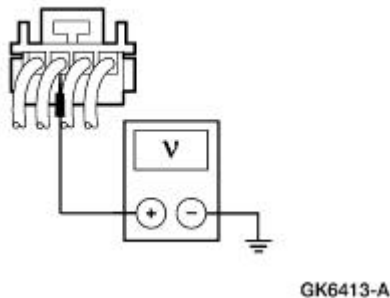
- Is the resistance less than 5 ohms?

Yes
GO to [I4](#).

No
REPAIR Circuit 397 (BK/WH).
REPEAT the self-test. CLEAR the DTCs.

I4 CHECK THE PATS TRANSCIEVER RECEIVE CIRCUIT FOR VOLTAGE — CIRCUIT 1216 (GY/OG)

- Connect: PATS Transceiver C252.
- Key in ON position.
- Measure the voltage by back probing between PATS transceiver C252 Pin 3, Circuit 1216 (GY/OG), harness side and ground.



- Is the voltage greater than 9 volts?

Yes
GO to [I6](#).

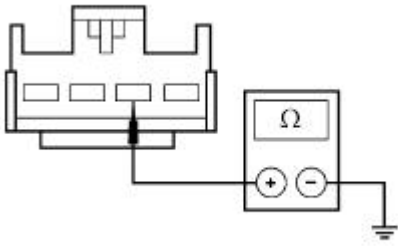
No
GO to [I5](#).

I5 CHECK THE PATS TRANSCIEVER RECEIVE CIRCUIT FOR SHORT TO GROUND — CIRCUIT 1216 (GY/OG)

- Key in OFF position.
- Disconnect: PATS Transceiver C252.
- Measure the resistance between PATS transceiver C252 Pin 3, Circuit 1216 (GY/OG), harness side and ground.

Yes
GO to [I6](#).

No
CHECK Circuit 1216 (GY/OG) for short to ground. If the circuit is OK, INSTALL a new instrument



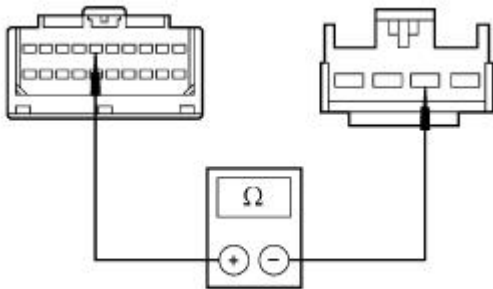
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- Is the resistance greater than 100 ohms?

cluster; for additional information, REFER to [Section 413-01](#). CYCLE the ignition key to RUN using two encoded ignition keys. GO to [Pinpoint Test J](#) to initialize the module. REPEAT the self-test. CLEAR the DTCs. If the circuit is not OK, REPAIR Circuit 1216 (GY/OG). CLEAR the DTCs. TEST the system for normal operation.

16 CHECK CIRCUIT 1216 (GY/OG) FOR OPEN

- Key in OFF position.
- Disconnect: PATS Transceiver C252.
- Disconnect: Instrument Cluster C220a.
- Measure the resistance between PATS transceiver C252 Pin 3, Circuit 1216 (GY/OG), harness side and instrument cluster C220a Pin 7, Circuit 1216 (GY/OG), harness side.



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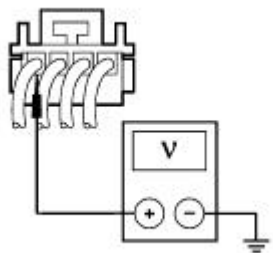
- Is the resistance less than 5 ohms?

Yes
GO to [17](#).

No
REPAIR Circuit 1216 (GY/OG). CLEAR the DTCs. TEST the system for normal operation.

17 CHECK THE PATS TRANSCIEVER TRANSMIT CIRCUIT FOR VOLTAGE — CIRCUIT 1215 (WH/LG)

- Key in OFF position.
- Connect: PATS Transceiver C252.
- Connect: Instrument Cluster C220a.
- Key in ON position.
- Measure the voltage by back probing between PATS transceiver C252 Pin 4, Circuit 1215 (WH/LG), harness side and ground.



GK6414-A

- Is the voltage greater than 9 volts?

Yes
GO to [19](#).

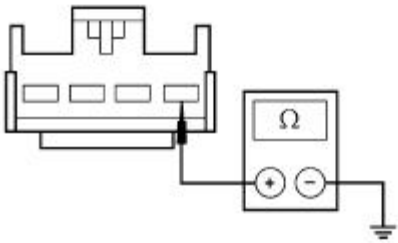
No
GO to [18](#).

18 CHECK THE PATS TRANSCIEVER TRANSMIT CIRCUIT FOR OPEN — CIRCUIT 1215 (WH/LG)

- Key in OFF position.
- Disconnect: PATS Transceiver C252.
- Measure the resistance between PATS transceiver

Yes
GO to [19](#).

C252 Pin 4, Circuit 1215 (WH/LG), harness side and ground.



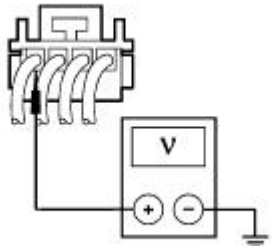
GK6405-A

- Is the resistance greater than 100 ohms?

No
CHECK Circuit 1215 (WH/LG) for short to ground. If the circuit is OK, INSTALL a new instrument cluster; for additional information, REFER to [Section 413-01](#). CYCLE the ignition to RUN using two encoded ignition keys. GO to [Pinpoint Test J](#) to initialize the module. REPEAT the self-test. CLEAR the DTCs. If the circuit is not OK, REPAIR Circuit 1215 (WH/LG). REPEAT the self-test. CLEAR the DTCs.

I9 CHECK THE PATS TRANSMIT CIRCUIT FOR CORRECT OPERATION — CIRCUIT 1215 (WH/LG)

- Connect: PATS Transceiver C252.
- Key in ON position.
- Trigger the instrument cluster active command RF SIGNAL to ON.
- Measure the voltage by back probing between PATS transceiver C252 Pin 4, Circuit 1215 (WH/LG), harness side and ground.



GK6414-A

- Does the voltage drop from greater than 9 volts to less than 1 volt when the instrument cluster active command is triggered on?

Yes
GO to [I10](#).

No
CHECK Circuit 1215 (WH/LG) for continuity to instrument cluster C220aPin 8. If the circuit is OK, INSTALL a new instrument cluster; for additional information, REFER to [Section 413-01](#). CYCLE the ignition to RUN using two encoded ignition keys. GO to [Pinpoint Test J](#) to initialize the module. REPEAT the self-test. CLEAR the DTCs. If the circuit is not OK, REPAIR Circuit 1215 (WH/LG). REPEAT the self-test. CLEAR the DTCs.

I10 CHECK THE PATS SYSTEM WITH A NEW PATS TRANSCIEVER INSTALLED

- Key in OFF position.
- Install a new PATS transceiver; for additional information, refer to [Anti-Theft—Passive Anti-Theft System \(PATS\)](#).
- Key in ON position.
- Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster On-Demand Self-Test.
- Is DTC B1681 retrieved?

Yes
GO to [I11](#).

No
System is OK.

I11 CHECK THE PATS SYSTEM WITH NEW INSTRUMENT CLUSTER

- Key in OFF position.
- Install a new instrument cluster; for additional information, refer to [Section 413-01](#). Cycle the ignition to RUN using two encoded ignition keys. Go to Pinpoint Test J to initialize the module. REPEAT the self-test. CLEAR the DTCs.
- Key in ON position.
- Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster On-Demand Self-Test.
- Is DTC B1681 retrieved?

Yes
REPAIR Circuit 397 (BK/WH), 20 (WH/LB), 1215 (WH/LG), and 1216 (GY/OG). REPEAT the self-test. CLEAR the DTCs.

No
If no DTCs are retrieved, the system is OK.

If other DTCs are retrieved, REFER to Instrument Cluster Diagnostic Trouble Code (DTC) Index.

PINPOINT TEST J: THE ANTI-THEFT SYSTEM DOES NOT OPERATE CORRECTLY — PCM ID DOES NOT MATCH BETWEEN INSTRUMENT CLUSTER AND PCM

Test Step	Result / Action to Take
J1 USE THE DTCs FROM THE INSTRUMENT CLUSTER SELF TESTS	
<ul style="list-style-type: none"> ● Use the recorded results from the Instrument Cluster Continuous and On-Demand Self-Tests. ● Is DTC B2139 recorded? 	<p>Yes GO to J2.</p> <p>No System is OK.</p>
J2 CLEAR PCM ID FROM INSTRUMENT CLUSTER AND PCM	
<ul style="list-style-type: none"> ● Carry out the security access procedure for the instrument cluster. For additional information, refer to Security Access—Procedure. ● NOTE: DO NOT carry out ignition key code erase. ● Select FSF card PARAMETER RESET command for instrument cluster. ● Use diagnostic card for PCM Active Command Keep Alive Memory Reset. ● Key in OFF position. ● Select FSF card PARAMETER RESET command for PCM. ● Key in ON position. ● Turn the ignition switch to RUN for three seconds. ● Enter the following diagnostic mode on the diagnostic tool: Clear Continuous DTCs. ● Key in OFF position. ● Enter the following diagnostic mode on the diagnostic tool: Retrieve Continuous DTCs. ● Is DTC B2139 retrieved? 	<p>Yes VERIFY PCM calibration is correct for the vehicle. If correct, REPEAT Step J2. If fault code persists, INSTALL a new instrument cluster; for additional information, REFER to Section 413-01. CYCLE the ignition to RUN using two encoded ignition keys. REPEAT Pinpoint Test J. CLEAR the DTCs. TEST the system for normal operation. If DTC B2139 still exists, INSTALL a new PCM; for additional information, REFER to Section 303-14. REPEAT the self-test. CLEAR the DTCs.</p> <p>No System is OK. CHECK for any other DTCs. REFER to the instrument cluster Diagnostic Trouble Code Index.</p>


PINPOINT TEST K: THE ANTI-THEFT SYSTEM DOES NOT OPERATE

CORRECTLY — NVM CONFIGURATION FAILURE (NO PCM ID EXCHANGED BETWEEN INSTRUMENT CLUSTER AND PCM)

Test Step	Result / Action to Take
<p>K1 USE THE DTCS FROM THE INSTRUMENT CLUSTER SELF TESTS</p> <ul style="list-style-type: none"> ● Use the recorded results from the Instrument Cluster Continuous and On-Demand Self-Tests. ● Are any DTCs recorded? 	<p>Yes If DTC B2141 only is retrieved, GO to K2.</p> <p>If DTC U1147 is retrieved with DTC B2141, GO to Pinpoint Test C.</p> <p>No System is OK.</p>
<p>K2 CARRY OUT KEEP ALIVE MEMORY RESET FROM PCM</p> <ul style="list-style-type: none"> ● Use diagnostic card for PCM Active Command — Keep Alive Memory Reset. ● Key in OFF position. ● Key in ON position. ● Leave the key in the run position for thirty seconds. ● Key in OFF position. ● Start the vehicle. ● Does the vehicle start? 	<p>Yes System is OK.</p> <p>No GO to K3.</p>
<p>K3 RETRIEVE THE INSTRUMENT CLUSTER DTCS</p> <ul style="list-style-type: none"> ● Enter the following diagnostic mode on the diagnostic tool: Clear Continuous DTCs. ● Key in OFF position. ● Key in ON position. ● Key in OFF position. ● Enter the following diagnostic mode on the diagnostic tool: Instrument Cluster On-Demand Self-Test. ● Is DTC B2141 retrieved? 	<p>Yes REPEAT K2. If the fault persists, verify the PCM calibration. If the calibration is OK, INSTALL a new instrument cluster. for additional information, REFER to Section 413-01. Cycle the ignition key to run using two encoded ignition keys. GO to Pinpoint Test J to initialize the module. REPEAT the self-test. CLEAR the DTCs.</p> <p>No REFER to the DTC index.</p>

Key Programming —Erase All Key Codes and Program Two Keys

Special Tool(s)

	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052 or equivalent diagnostic tool
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NOTE: This procedure is used when a customer needs keys programmed into the system and does not have two programmed ignition keys available. This procedure is also useful when programmed ignition key(s) have been lost or the ignition switch assembly has been replaced, and it is desired to erase key(s) from the passive anti-theft system (PATS) memory.

NOTE: This procedure will erase all programmed ignition keys from the vehicle memory and the vehicle will not start until two keys have been reprogrammed to the vehicle.

NOTE: Two PATS encoded keys with the correct mechanical cut must be available to perform this procedure. One or both of them may be the customer's original keys.

NOTE: If additional keys are to be programmed, refer to Key Programming — Program a Key Using Two Programmed Keys. If the remaining keys are with the customer and are not available with the vehicle, then instruct the customer to refer to the Owners Guide under the "Programming Spare [SecuriLock® (North America), Safeguard® (U.K.) or PATS for all other markets] Keys Procedure" for instructions on programming the remaining keys.

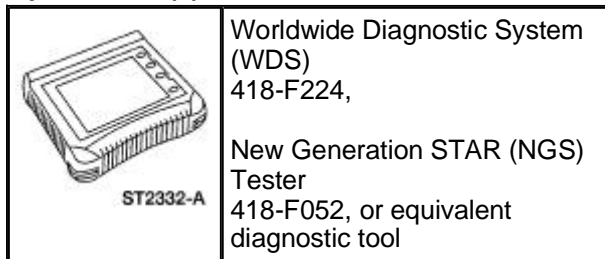
1. Turn the ignition switch from OFF to RUN.
2. Enter diagnostic tool. Follow the SECURITY ACCESS PROCEDURE to obtain security access.
3. From diagnostic tool menu, select IGNITION KEY CODE ERASE.
4. **NOTE:** Do NOT select any additional commands from this menu.

Turn the ignition switch to OFF and disconnect diagnostic tool.

5. Insert the first encoded key into the ignition lock cylinder and turn the switch to RUN for three seconds.
 6. Insert the second encoded key into the ignition lock cylinder and turn the switch to RUN for three seconds.
 7. The vehicle should now start with both ignition keys.
-

Key Programming —Program a Key Using Two Programmed Keys

Special Tool(s)



NOTE: This procedure only works if two or more programmed ignition keys are available and it is desired to program additional key(s). If two keys are not available, follow the procedure in [Key Programming—Erase All Key Codes and Program Two Keys](#).

NOTE: PID SPARE_KY must be enabled for this procedure to operate. If this Parameter Identification (PID) Index is not enabled, follow the security access procedure and select Spare Key Programming Switch: Enabled.

NOTE: If the programming procedure is successful, the new key(s) will start the vehicle and the THEFT INDICATOR will illuminate for approximately three seconds.

NOTE: If the programming procedure is not successful, the new key(s) will not start the vehicle and the THEFT INDICATOR will flash. If the programming procedure was not successful, repeat the key programming procedure from Step 1. If the failure repeats, check Circuit 729 (RD/WH) (hot at all times) in instrument cluster for proper battery voltage. Repair the circuit if voltage is not present. For additional information, refer to Diagnosis and Testing to review diagnostic trouble codes (DTCs) and perform pinpoint tests as required.

NOTE: A maximum of eight ignition keys can be programmed to a passive anti-theft system (PATS) equipped vehicle. Use PID NUMKEYS to determine how many keys are programmed to the vehicle.

NOTE: If the steps are not performed as outlined, the programming procedure will end.

NOTE: Ignition keys must have correct mechanical key cut for the vehicle and must be a PATS encoded key.


1. Insert the first programmed ignition key into the ignition lock cylinder and turn the ignition switch from OFF to RUN (maintain the ignition switch in RUN for one second).
2. Turn the ignition switch to OFF and remove the first key from the ignition lock cylinder.
3. Within five seconds of turning the ignition switch to OFF, insert the second programmed ignition key into the ignition lock cylinder and turn the ignition switch from OFF to RUN (maintain the ignition switch in RUN for one second).
4. Turn the ignition switch to OFF and remove the second key from the ignition lock cylinder.
5. Within 10 seconds of turning the ignition lock cylinder to OFF, insert the unprogrammed ignition key (new key) into the ignition lock cylinder and turn the ignition switch from OFF to RUN

(maintain the ignition switch in RUN for 1 second).

6. If it is desired to program additional key(s), repeat the key programming procedure from the beginning.
-

Key Programming —Enable/Disable Spare Key Programming

Special Tool(s)

	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool
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NOTE: The spare key programming switch is a diagnostic tool programmable switch that provides the capability to enable/disable the spare key programming procedure. This procedure is in the Owners Guide spare key programming procedure or in this section under [Key Programming—Program a Key Using Two Programmed Keys](#). This programmable switch is provided as a convenience for rental company fleets or other fleet purchasers who may not want the spare key programming procedure available to the vehicle driver.

NOTE: The spare key programming switch state can be viewed by instrument cluster PID SPARE_KY.

1. Insert a programmed ignition key into the ignition lock cylinder and turn the ignition switch to RUN.
2. Enter diagnostic tool. Follow the SECURITY ACCESS PROCEDURE. For additional information, refer to [Security Access—Procedure](#) to obtain security access.
3. **NOTE:** The default setting on delivery of all new vehicles is <ENABLE>.


From diagnostic tool menu, select SPARE KEY PROGRAMMING SWITCH selection to the desired setting:

<ENABLE> Spare key programming procedure is accessible.

<DISABLE> Spare key programming procedure is not accessible.

Key Programming —Additional Key With One Programmed Key

Special Tool(s)

	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool
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NOTE: This procedure is used when a customer needs to have an additional key programmed into the vehicle without erasing stored key codes, but does not have two programmed keys available. This procedure is also useful when attempting to determine if an ignition key is defective, as a new key can be installed without erasing keys or without having two programmed keys available.


NOTE: Before programming, the new key must have the correct mechanical cut for the ignition lock.

NOTE: If eight keys are already programmed, this procedure will not allow any further ignition keys to be programmed without erasing all stored key codes first. The number of keys programmed into the system can be determined using the PID NUMKEYS.

1. Turn the ignition switch from the OFF position to the RUN position using the new, unprogrammed ignition key.
 2. Enter diagnostic tool using the Ford Service Function (FSF) card and enter the appropriate instrument cluster. Follow Security Access to obtain security access. For additional information, refer to [Security Access—Procedure](#).
 3. From the diagnostic tool menu Select: IGNITION KEY CODE PROGRAM.
 4. Turn the ignition switch to the OFF position and disconnect diagnostic tool.
 5. Attempt to start the engine with the new ignition key. The vehicle engine should start and run normally.
-

Security Access —Procedure

Special Tool(s)

 <p>ST2332-A</p>	<p>Worldwide 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool</p>
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NOTE: The security access procedure is utilized to obtain passive anti-theft system (PATS) security access. PATS security access must be granted to erase ignition keys, enable/disable the spare key programming switch or perform parameter resets for the instrument cluster. The security access procedure invokes an inherent 10 minute time delay prior to granting security access during which diagnostic tool must remain connected to the vehicle. Once security access has been granted, a security access command menu is displayed that offers various command options (refer to PATS Configuration Command Index).

NOTE: Select only the commands required by the appropriate pinpoint test.

1. From diagnostic tool: Using the Ford Service Function (FSF) card, select the appropriate instrument cluster. Enter SECURITY ACCESS PROCEDURE. This procedure will take 10 minutes to perform, during which the ignition switch must be in RUN and the diagnostic tool must be connected to the vehicle.
 2. After the 10-minute security access procedure has been completed, a new menu will be displayed with command options. Select only those functions required before exiting out of this menu. Once exited out of this menu, the security access procedure must be performed again to perform additional commands.
-

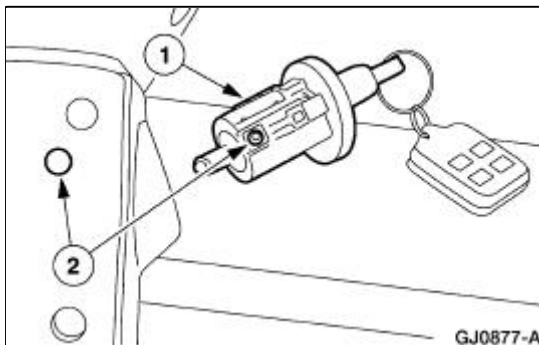
Module —Passive Anti-Theft Transceiver

Removal

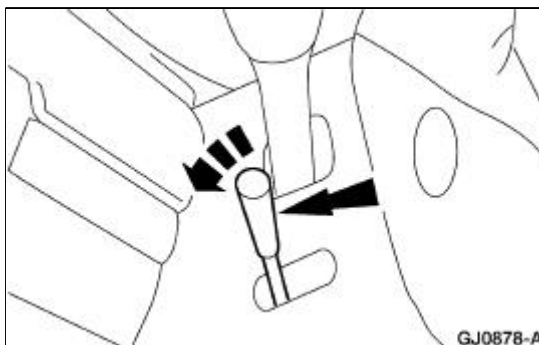
1.  **CAUTION: Electronic modules are sensitive to electrical charges. If exposed to these charges, damage may result.**

Disconnect the battery ground cable (14301).

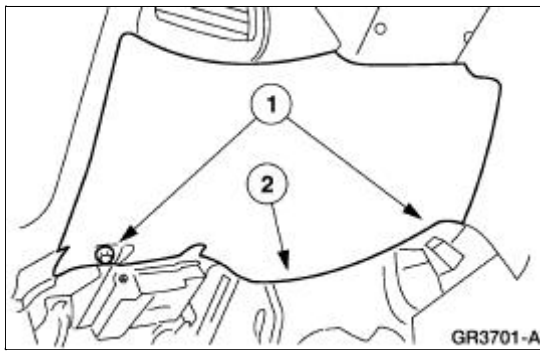
2. Remove the ignition switch lock cylinder (11582).
 1. Insert the ignition key into the ignition switch lock cylinder and turn to the RUN position.
 2. Insert a punch in the access hole of the steering column and press the release tab while pushing out the ignition switch lock cylinder.



3. Unscrew the tilt wheel handle and shank and remove.



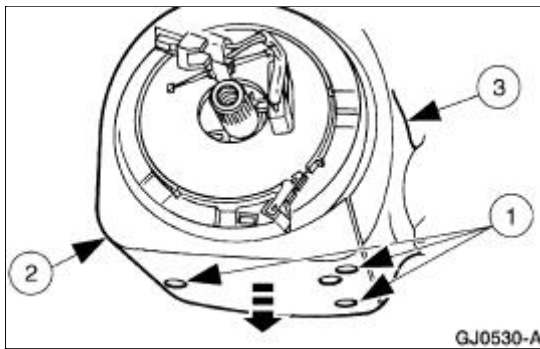
4. Remove the instrument panel steering column opening cover.
 1. Remove the screws.
 2. Remove the LH instrument panel steering column opening cover.



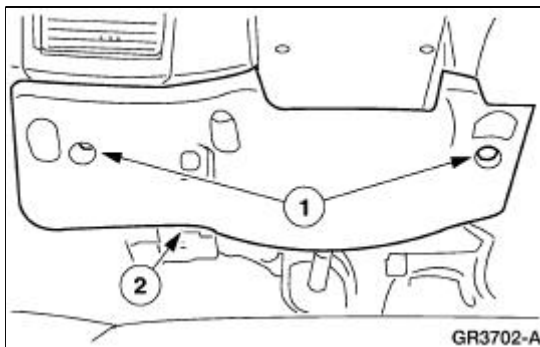
5. **NOTE:** The steering wheel has been removed for clarity.

Remove the upper and lower steering column shrouds.

1. Remove the screws.
2. Remove the lower steering column shroud.
3. Remove the upper steering column shroud.



6. Remove the instrument panel steering column opening cover reinforcement.
1. Remove the bolts.
 2. Remove the instrument panel steering column opening cover reinforcement.

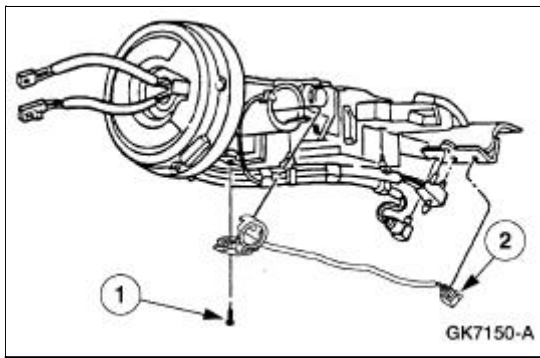


7. **NOTE:** The steering wheel has been removed for clarity.

Remove the anti-theft transceiver module.

1. Remove the screw from the bottom of the transceiver module.
2. **NOTE:** Only apply pressure or leverage below the key cylinder lower rib.

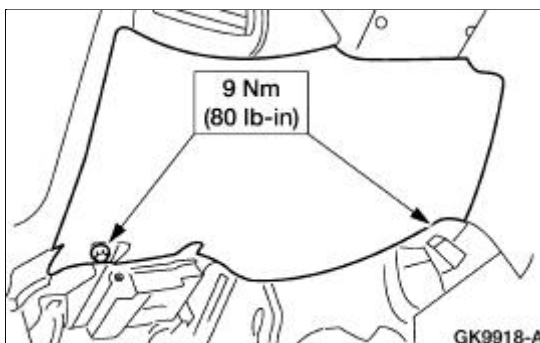
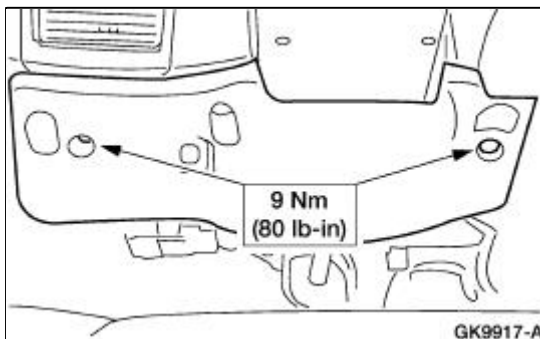
Disconnect the electrical connector and remove the module.



Installation

1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

To install, reverse the removal procedure.



Torque Specifications

Description	Nm	lb-in
Battery ground cable bolt	7-10	62-89

Module Controlled Functions

The generic electronic module (GEM)(14B205) is the only multifunction control module on this vehicle.

The GEM controls the following functions:

- warning chimes and warning lamps
 - one-touch down window
 - windshield washers and wipers
 - battery saver
 - illuminated entry with keyless remote entry
 - interior lighting
-

Multifunction Electronic Module

For warning chime concerns, refer to [Section 413-09](#) .

For courtesy lamps/illuminated entry and battery saver concerns, refer to [Section 417-02](#) .

For one-touch window concerns, refer to [Section 501-11](#) .

For wiper/washer control and interval timer concerns, refer to [Section 501-16](#) .

For keyless entry and power door lock concerns, refer to [Section 501-14B](#) .

For anti-theft concerns, refer to [Section 419-01](#) .

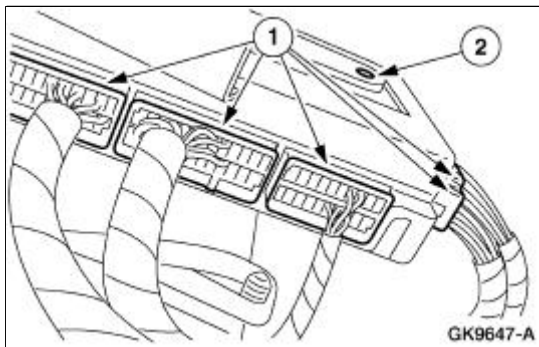
Module —Generic Electronic (GEM)

Removal

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

Disconnect the battery ground cable (14301).

2. Remove the generic electronic module (GEM)(14B205).
 1. Remove the five electrical connectors.
 2. Release the locking tab and slide the module off the bracket.



Installation

1. **NOTE:** When the battery (10655) is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 10 mile s (16 km) or more to relearn the strategy.

To install, reverse the removal procedure.

General Specifications

Item	Specification
Adhesives	
Weatherstrip and Rubber Adhesive E8AZ-19552-A	ESB-M2G14-A
Lubricants	
Silicone Lubricant C0AZ-19553-AA	ESR-M13P4-A
Sealers	
HB Fuller E709-19554-B	ESB-M4G162-A
3M Strip Caulk-Black 051135-08578	ESB-M4G32-A
Silicone Gasket and Sealant F7AZ-19554-EA	WSK-M2G343-A4

Body

Body and Sheet Metal

The body:

- Is a unibody open cowl structure.
 - Is constructed of a lightweight, all-steel material with removable bolted hood (16612), front fenders (16005), doors, and luggage compartment lid.
-

Insulation

Insulation is comprised of urethane, PVC, and recycled felt. Insulation is installed:

- Under the roof panel (50202).
 - Above and below the instrument panel (04304).
 - On the cowl sides.
 - Over the front and rear floor areas.
 - On a Coupe, in the B and C-pillar sections.
 - Under the hood.
-

Body Sealer Types And Applications

Liquid Butyl Sealer

HB Fuller E709-19554-B or equivalent meeting Ford Specification ESB-M4G162-A:

- Does not run.
- Is fast drying.
- Remains semi-elastic.
- Can be used for seam sealing on the floorpan, wheelhouse, body rocker panels, door openings, and drip rails.

Caulking Cord

3M Strip Caulk-Black 051135-08578 or equivalent meeting Ford specification ESB-M4G32-A:

- Is a heavy-bodied, plastic base with a filler.
- Is commonly known as perma-gum.
- Is used on spot-welds holes, around moulding clips, and between surfaces not sealed with a gasket.

Weatherstrip Adhesive

Weatherstrip and Rubber Adhesive E8AZ-19552-A or equivalent meeting Ford specification ESB-M2G14-A:

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

Silicone Lubricant

Silicone Lubricant C0AZ-19553-AA meeting Ford specification ESR-M13P4-A:

- Is used to keep the door and the window weatherstrip pliable and soft.
 - Should be applied to the weatherstrip at every lubrication period.
 - Makes the door easier to close.
 - Retards weatherstrip squeaks.
 - Retards weatherstrip wear.
 - Helps retain door window alignment by reducing friction between the glass frame and the rubber weatherstrip.
 - Should not be used prior to painting.
-

Body System

Inspection and Verification

Leaks

NOTE: Trim will reveal the location of most leaks.

1. Remove any trim or carpet in the general area of the leak.
2. Road test or water test the vehicle.
3. Inspect for a dust pattern around the area in question. Inspect for water paths near and above the area in question.
4. Some leaks can be located by placing bright light under the vehicle, removing any necessary trim or carpet, and inspecting the interior of the body at joints and weld lines.

Noise

Wind noise, rattles, and their sources are detected by driving the vehicle at highway speeds. The vehicle should be driven in four different directions with all of the windows closed, the radio off, the blower motor off, and all of the ventilation ducts open.

Most wind noise leaks will occur at the door and window seals or at the sheet metal joints in the door or the door opening.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none">● Dust and Water Leaks	<ul style="list-style-type: none">● Body sealer missing.● Opening in weldings or body joints.● Components not fully installed.● Components missing.● Components damaged.	<ul style="list-style-type: none">● REMOVE trim panel. CHECK for leaks and SEAL with appropriate sealer. ROAD TEST or WATER TEST for leaks. RECHECK for leaks; USE light under the vehicle with trim removed. CHECK interior of body at joints and weld lines.
<ul style="list-style-type: none">● Dust/Water Leaks at Floor Pan and Grommets	<ul style="list-style-type: none">● Missing or damaged plugs and/or grommets.	<ul style="list-style-type: none">● CHECK plugs for proper installation. REPLACE if necessary.
<ul style="list-style-type: none">● Door Drain Holes Collecting Water	<ul style="list-style-type: none">● Holes clogged with mud or road tar.	<ul style="list-style-type: none">● CLEAN drain holes of dirt and foreign material. CHECK drain holes regularly. TEST the system for normal operation.

<ul style="list-style-type: none"> ● Wind Noise, Air Entering Vehicle Through Small Holes in Body 	<ul style="list-style-type: none"> ● Leaks at door and window seals or sheet metal joints in doors or door openings. 	<ul style="list-style-type: none"> ● SEAL leaks with Silicone Gasket and Sealant F7AZ-19554-EA meeting Ford specifications WSK-M2G343-A4. ROAD TEST.
<ul style="list-style-type: none"> ● Rattles 	<ul style="list-style-type: none"> ● Loose objects in wells, pillars, and quarter panels. ● Misalignment (if tightening bolts does not eliminate rattle). ● Weatherstripping and/or anti-squeak material. 	<ul style="list-style-type: none"> ● CHECK doors by carefully STRIKING underside of door with a rubber mallet. LISTEN for loose objects in door. REPAIR. TIGHTEN body bolts and screws. ● ADJUST the alignment of the doors or panels. ● APPLY additional sealer. INSTALL in proper location to eliminate rattle.

Torque Specifications

Description	Nm	lb-ft	lb-in
Hood latch support screws	12	9	—
Hood latch retaining screws	12	9	—
Hood latch control handle and cable retaining screws	3	—	27
Hood latch support nuts	10	—	89
Fender bolts	12	9	—
Grille opening panel bolts	3	—	27
Rear hood hinge to body bolts	9	—	80
Front hood hinge to body bolts	13	10	—

Front End Body Panels

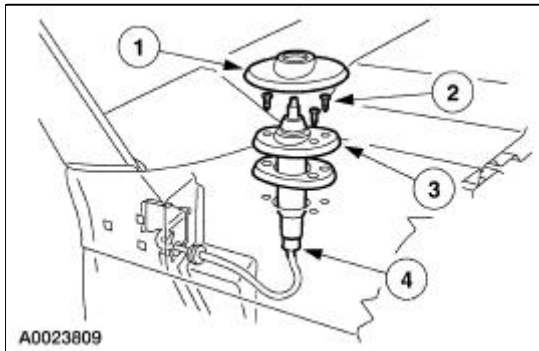
The front end body panel components consist of the following:

- air deflectors
 - cowl grille
 - fenders
 - fender splash shields
 - hood
 - hood hinges
 - hood weatherstrip
 - radiator grille opening panel
-

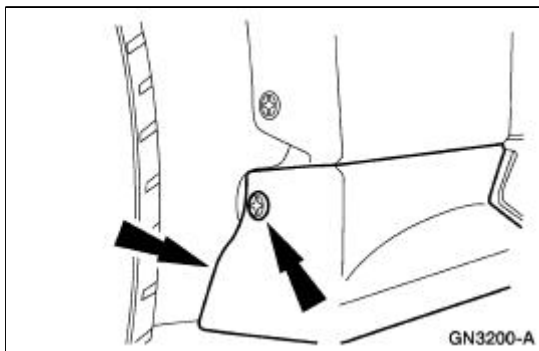
Fender

Removal and Installation

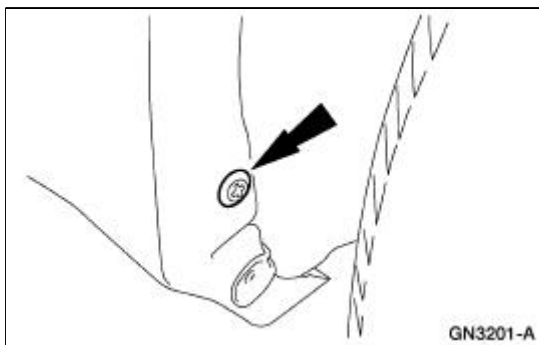
1. On the RH fender, remove the antenna base.
 1. Remove the antenna base cap.
 2. Remove the screws.
 3. Remove the antenna base.
 4. Disconnect the antenna cable from the antenna base.



2. Remove the front bumper cover. For additional information, refer to [Section 501-19](#).
3. Remove the screw, the two pin-type retainers and the front rocker panel moulding.

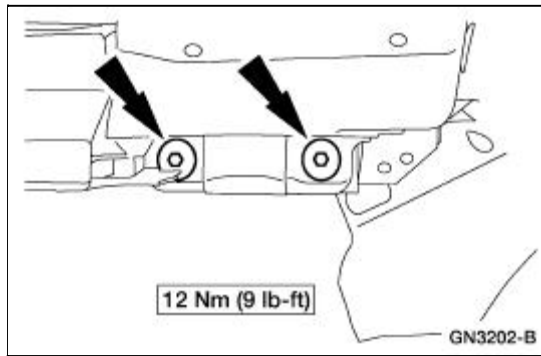


4. Remove the fender splash shield screw.

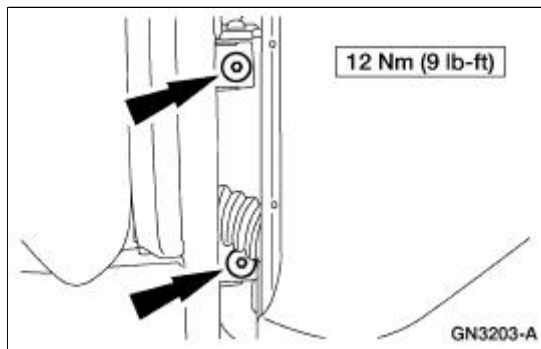


5. **NOTE:** Position the fender splash shield aside.

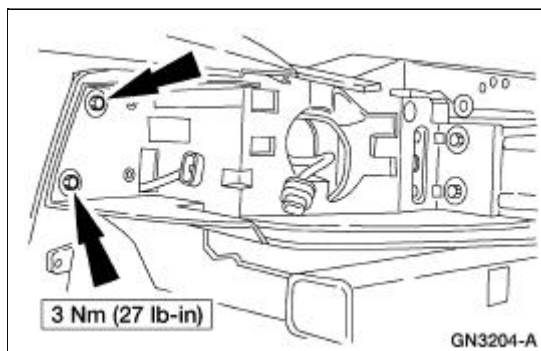
Remove the lower fender bolts and, if equipped, remove the shims.



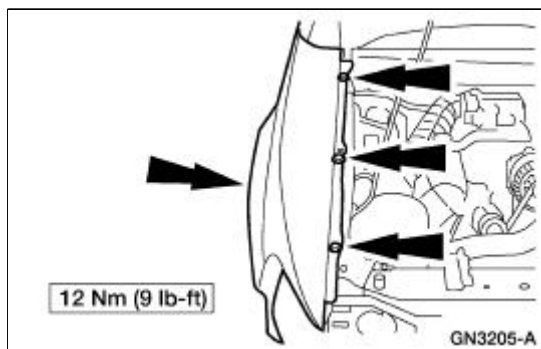
6. Through the door opening, remove the inner fender bolts.



7. Remove the radiator grille opening panel to fender bolts.



8. Remove the upper bolts and the fender.



9. **NOTE:** On the RH fender, feed the antenna cable through the fender opening.

To install, reverse the removal procedure.

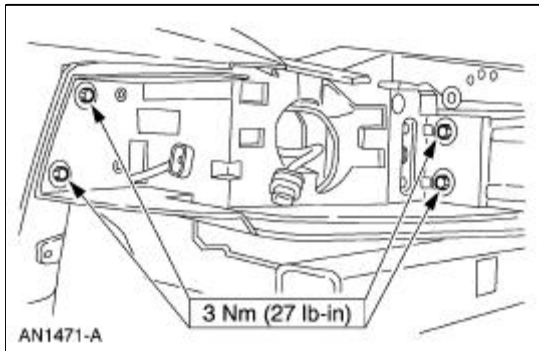
- Check the fender alignment and adjust as needed.



Radiator Grille Opening Panel

Removal and Installation

1. Remove the front bumper cover. For additional information, refer to [Section 501-19](#).
2. Remove the eight bolts (four on each side) and the radiator grille opening panel.



3. To install, reverse the removal procedure.
-

General Specifications

Item	Specification
Premium Long Life Grease XG-1-C or XG-1-K	ESA-M1C75-B
Silicone Lubricant (Aerosol) F5AZ-19553-AA	ESR-M13P4-A
Multi-Purpose Grease Spray XL-5	ESB-M1C93-B
Flowable air dry paintable caulk	ESB-M4G24-A
Door clearance: bottom of the door to the rocker panel	3.0-7.0 mm (0.118-0.275 in) parallel top to bottom within 2.0 mm (0.08 in)
Door clearance: front and rear of the door to the body	3.0-7.0 mm (0.118-0.275 in) parallel with the body opening within 1.0 mm (0.04 in)
Door flushness: door to the front fender	-1.0-0.00 mm (-0.04-0.00 in)

Torque Specifications

Description	Nm	lb-ft	lb-in
Door latch striker plate bolts	25	18	—
Door hinge nuts and bolts	30	22	—
Luggage compartment lid hinge bolts	30	22	—
Luggage compartment lid hinge nuts	13	10	—
Rear spoiler nuts/screws	9	—	80

Body Closures

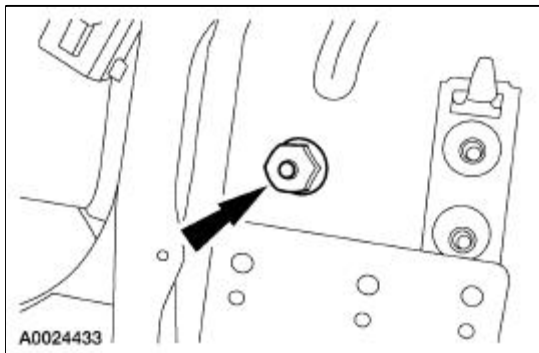
The body closures consist of the following components:

- door checks
 - front door
 - front door latch strikers
 - front door hinges
 - front door opening weatherstrips
 - hood
 - hood (Cobra) with heat extractor scoops
 - hood (Mach I) with shaker opening
 - hood heat extractor scoops (Cobra)
 - hood hinges
 - hood support rod
 - hood weatherstrip
 - luggage compartment lid
 - luggage compartment lid hinges
 - luggage compartment lid hydraulic lifts
 - luggage compartment lid latch striker
 - luggage compartment lid weatherstrip
-

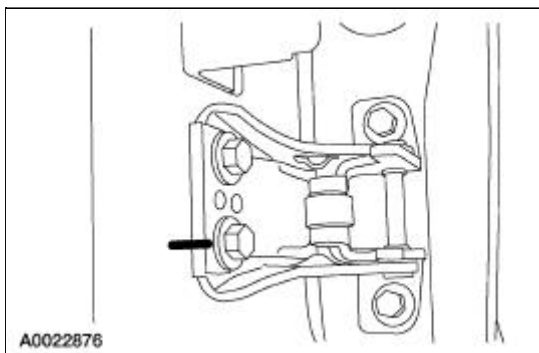
Hinge Adjustment

NOTE: The door should be adjusted for even and parallel fit with the body opening and surrounding panels as well as making sure that the anti-chuck pin is not binding on convertible models.

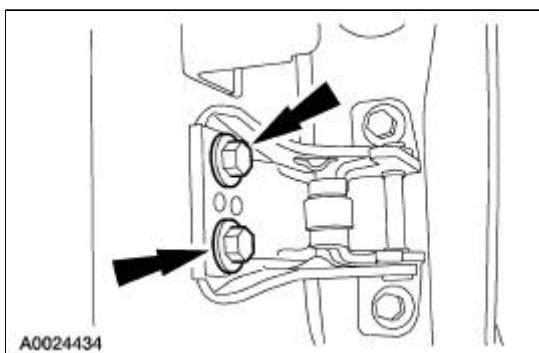
1. Remove the A-pillar lower trim panel.
2. Position the electrical connectors aside.
3. Loosen the lower front door hinge-to-body nut enough to permit movement.



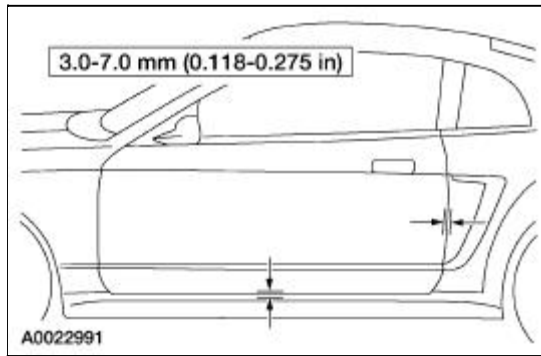
4. Remove the fender. For additional information, refer to [Section 501-02](#).
5. Mark the position of the upper and lower front door hinges to the body to use as reference points.



6. Loosen the four upper and lower front door hinge-to-body bolts enough to permit movement.

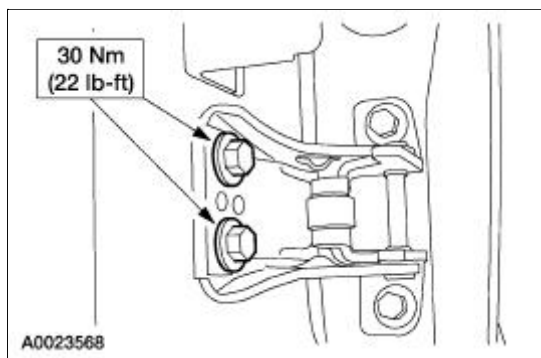


7. Adjust the front door to specification.

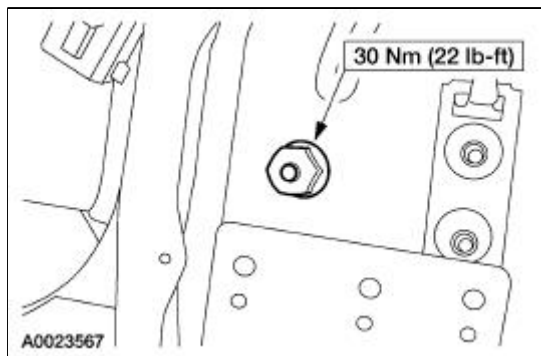


8. **NOTE:** After adjusting the door hinge, verify that the door can be closed easily and fits tightly.

Tighten the front door hinge to body bolts.



9. Tighten the front door hinge to body nut.

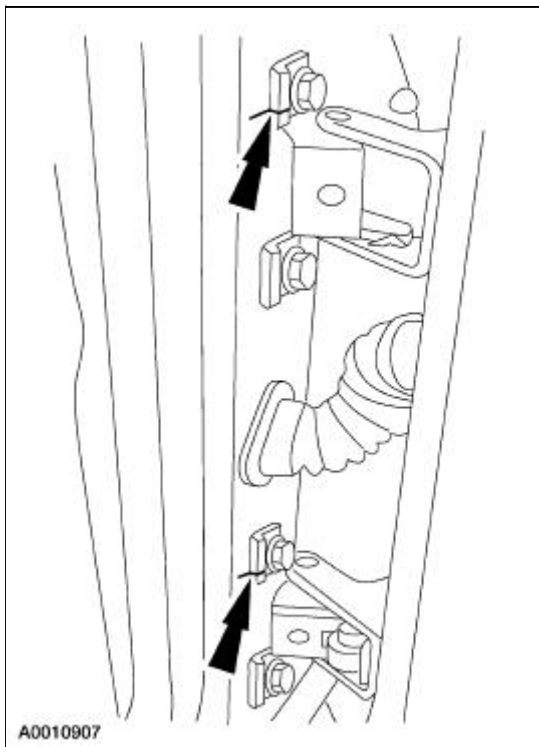


10. Install the electrical connectors.
 11. Install the A-pillar lower trim panel.
 12. Install the fender. For additional information, refer to [Section 501-02](#).
-

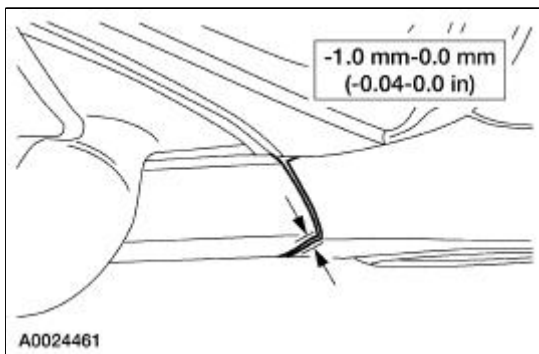
Door Alignment

NOTE: The door should be adjusted for even and parallel fit with the body opening and surrounding panels as well as making sure that the anti-chuck pin is not binding on convertible models.

1. Mark the position of the front door hinges to the front door to use as reference points.
2. Loosen the front door hinge-to-front door bolts enough to permit movement.

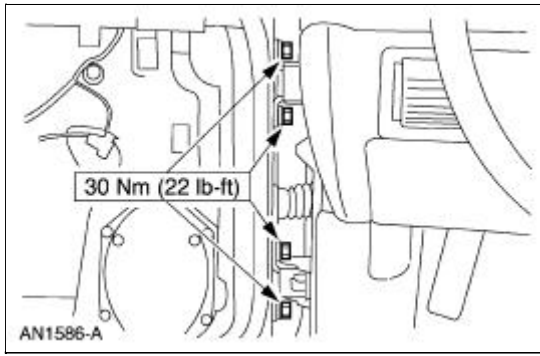


3. Adjust the front door alignment to specification.



4. **NOTE:** After aligning the door, verify that the door can be closed easily and fits tightly.

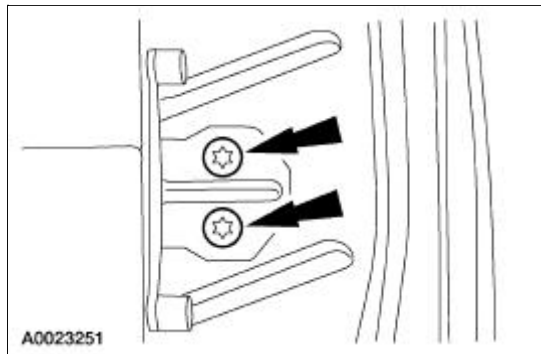
Tighten the front door hinge-to-front door bolts.



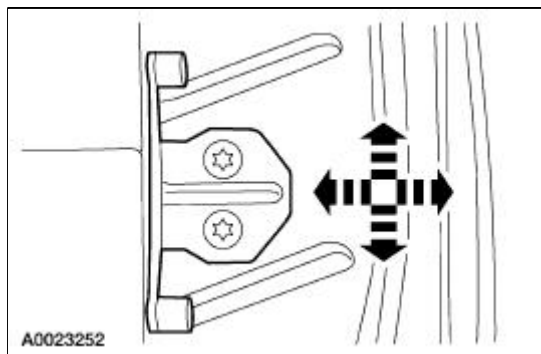
Striker Adjustment

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

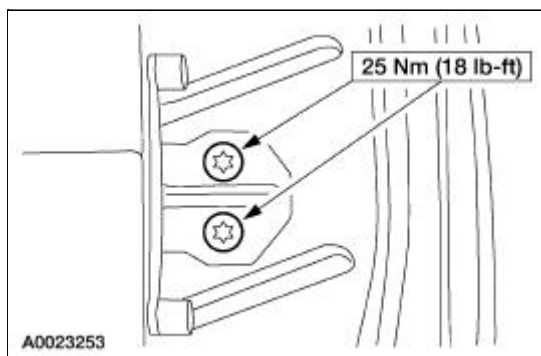
1. Loosen the door latch striker plate bolts.



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



3. Tighten the door latch striker plate bolts.



4. Check the adjustment. Repeat the procedure as necessary.

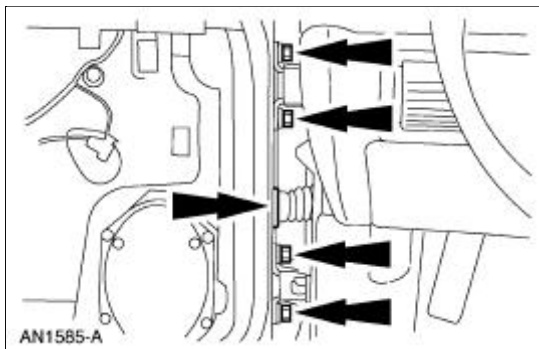
Door

Removal

1. Remove the door trim panel. For additional information, refer to [Section 501-05](#).
2. Disconnect the necessary electrical connectors to remove the harness and grommet from the door.
3. **NOTE:** This procedure requires an assistant.

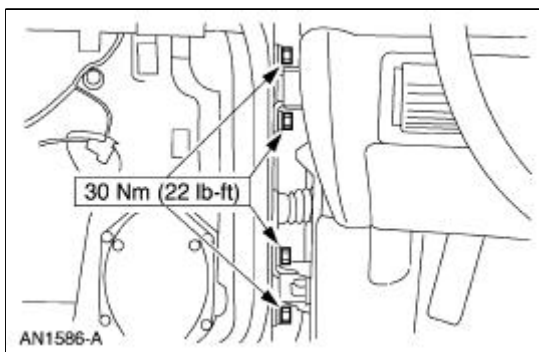
NOTE: Mark the location of the door hinge on the door.

Remove bolts and the door.



Installation

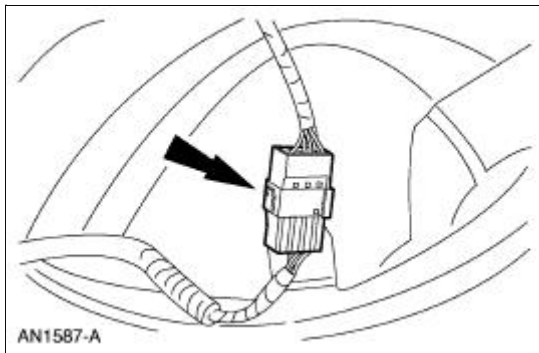
1. To install, reverse the removal procedure.



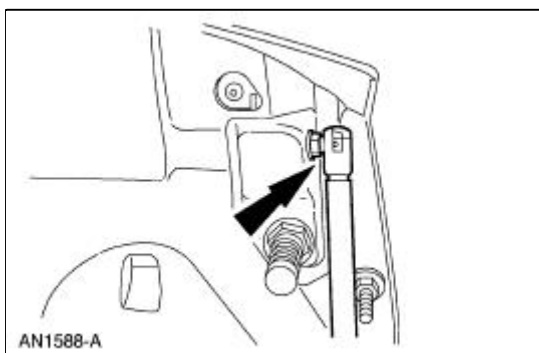
Luggage Compartment Lid —Hinge

Removal

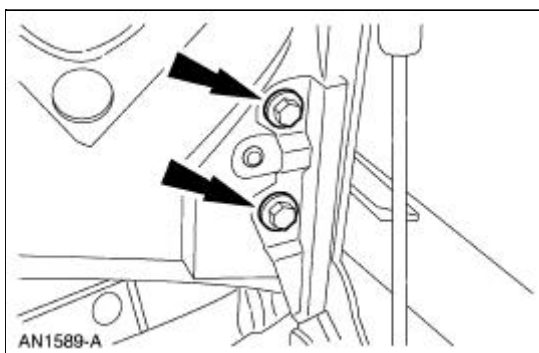
1. Disconnect the electrical connector.



2. Remove the lift cylinder.

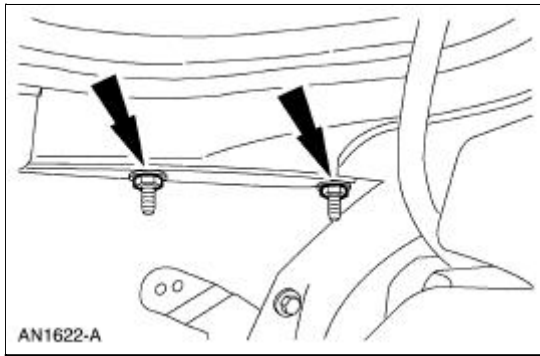


3. Remove the luggage compartment lid hinge bolts.



4. **NOTE:** Remove the sealer around the luggage compartment lid hinge if necessary.

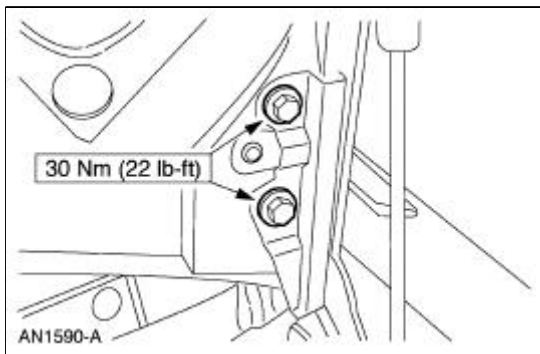
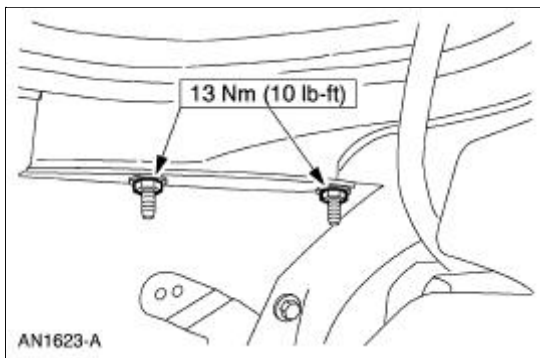
Remove the nuts and the luggage compartment lid hinge.



Installation

1. **NOTE:** If removed, apply new sealer.

To install, reverse the removal procedure.



General Specifications

Item	Specification
Adhesives	
Headliner Adhesive	WSS-M2G355-B
F1VY-19562-A	

Torque Specifications

Description	Nm	lb-ft
Safety belt guide bolt	40	30
Safety belt anchor bolt	40	30
Rear seat backrest bolster bolts	11	8
Rear seat backrest bolts	11	8

Interior Trim


The interior trim consists of:

- A-pillar lower trim panels
 - door trim panels
 - headliner (coupe)
 - package tray trim panel (coupe)
 - quarter trim panels
 - upper quarter trim panels (coupe)
 - scuff plates
 - sun visors
 - tether anchor covers (coupe)
 - windshield side garnish mouldings
-

Trim Panel —Door

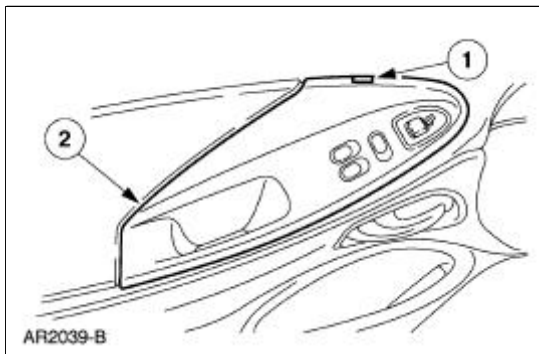
Removal

All vehicles

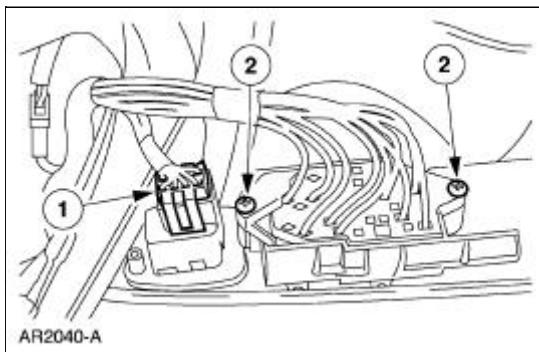
1.  **CAUTION:** Use a shop towel or similar material between the tool and the front door trim panel or damage to the front door trim panel may occur.

Position the window regulator switch plate (14527) aside.

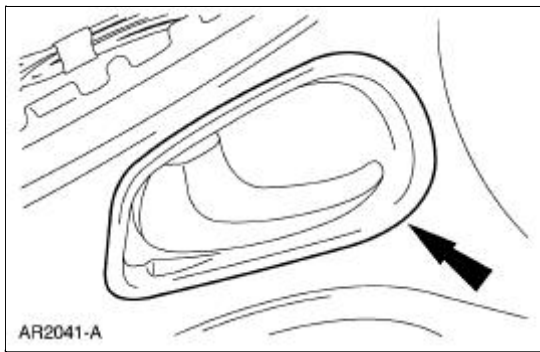
1. Pull at the service notch.
2. Lift to release the clip at the rear edge.



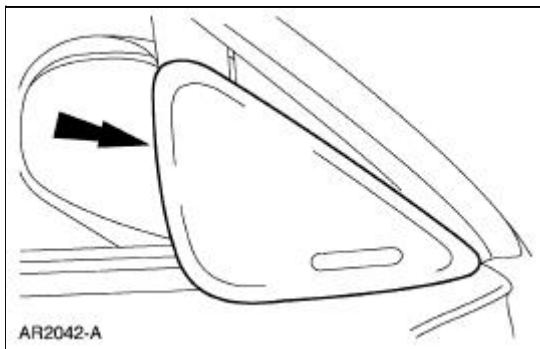
2. Remove the window regulator switch plate.
 1. Disconnect the power mirror electrical connector.
 2. Remove the screws and the window regulator switch plate.



3. Remove the door latch release handle cup (22634).

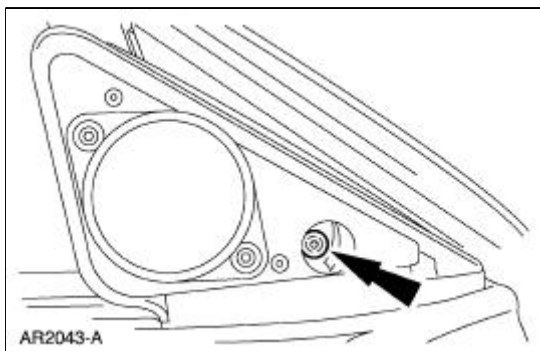


4. Remove the cover.



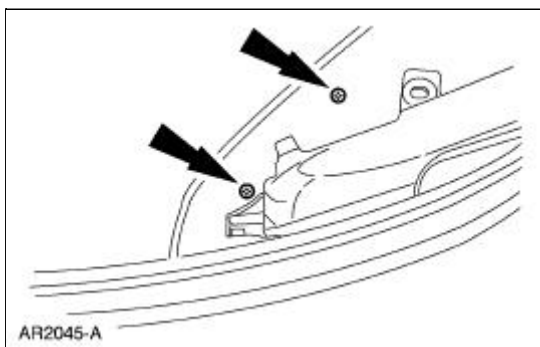
Vehicles with Mach 460 Premium Sound System

5. Remove the screw and the speaker.
 - Disconnect the electrical connector.

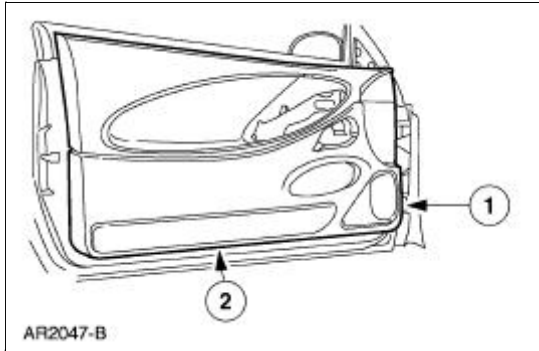


All vehicles

6. Remove the screws.



7. Remove the door trim panel (23942).
 1. Remove the pin-type retainer.
 2. Lift up the door trim panel to remove.



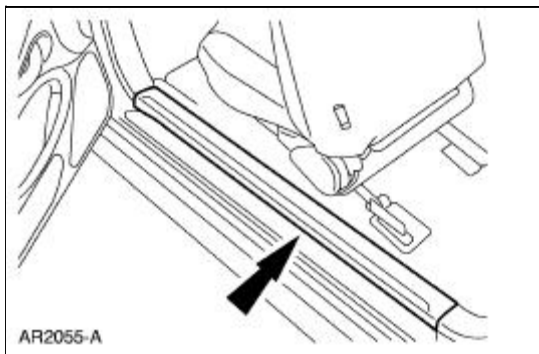
Installation

1. To install, reverse the removal procedure.
-

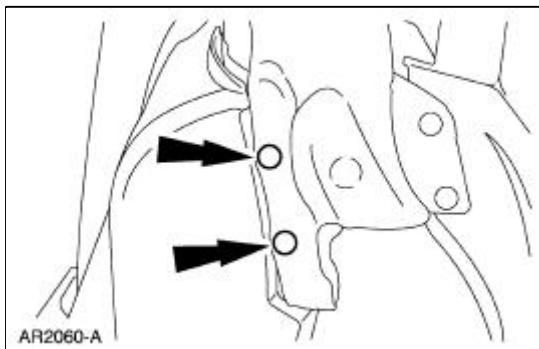
Trim Panel —Quarter, Coupe

Removal and Installation

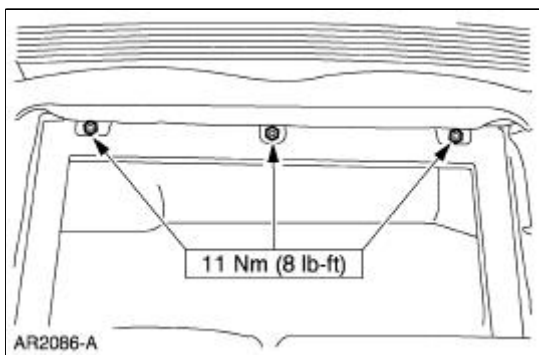
1. Remove the upper quarter trim panel. For additional information, refer to [Trim Panel—Upper Quarter](#) in this section.
2. Remove the scuff plate.



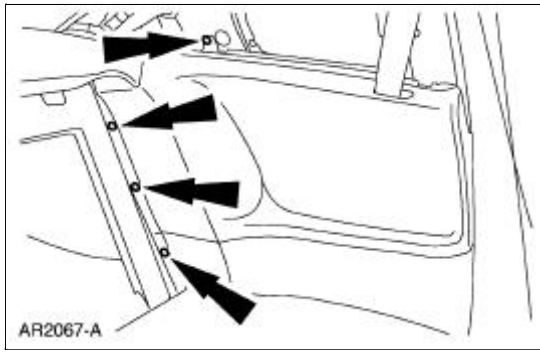
3. Remove the pin-type retainers.



4. Lower the rear seat backrests.
5. Remove the bolts and the rear seat backrest bolster.



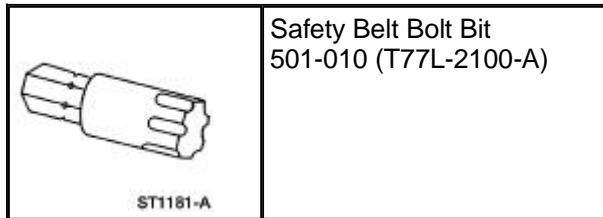
6. Remove the quarter trim panel pin-type retainers.



7. Remove the lower quarter trim panel.
 8. To install, reverse the removal procedure.
-

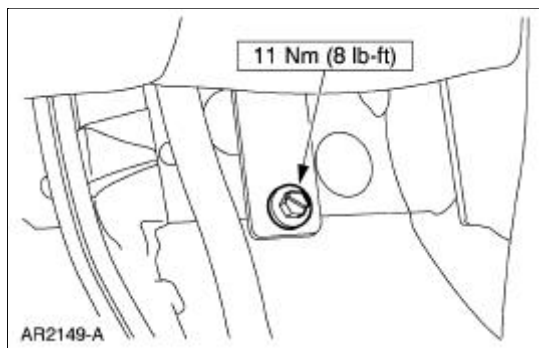
Trim Panel —Quarter, Convertible

Special Tool(s)

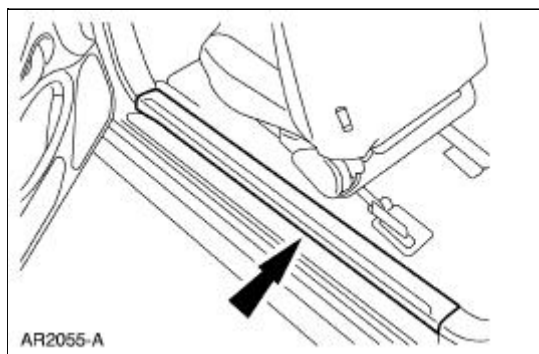


Removal and Installation

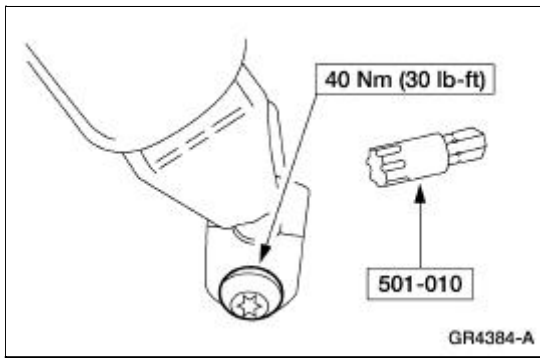
1. Lower the convertible top to the full down position.
2. Remove the rear seat cushion.
3. Remove the two bolts and the rear seat backrest.



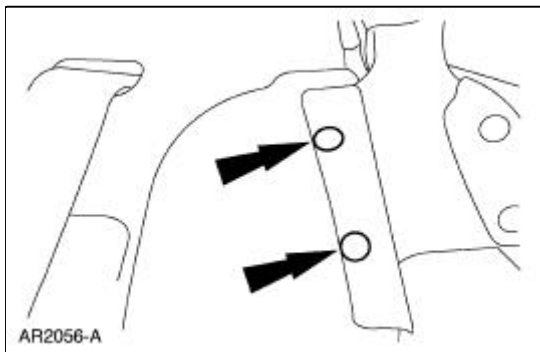
4. Remove the scuff plate.



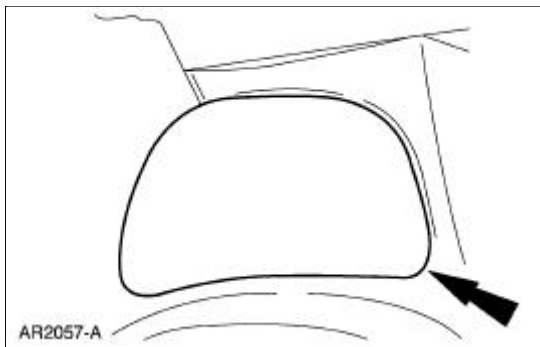
5. Using the special tool, remove the front safety belt anchor bolt.



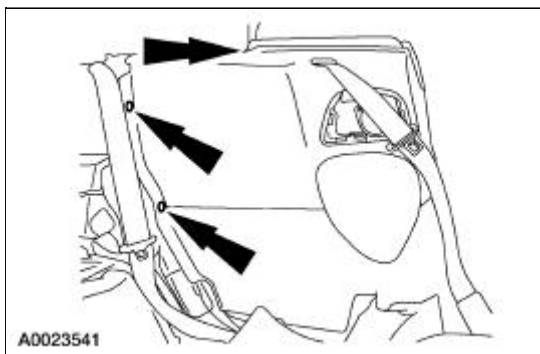
6. Remove the pin-type retainers.



7. Remove the speaker grille.



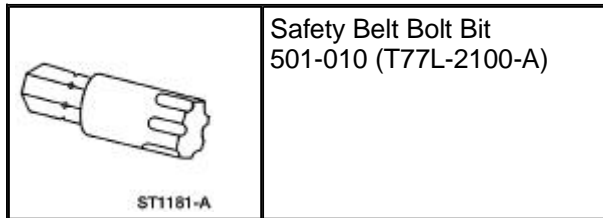
8. Remove the pin-type retainers and the quarter trim panel.



9. To install, reverse the removal procedure.

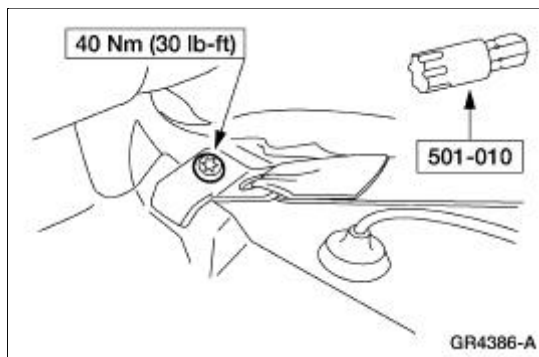
Trim Panel —Upper Quarter

Special Tool(s)

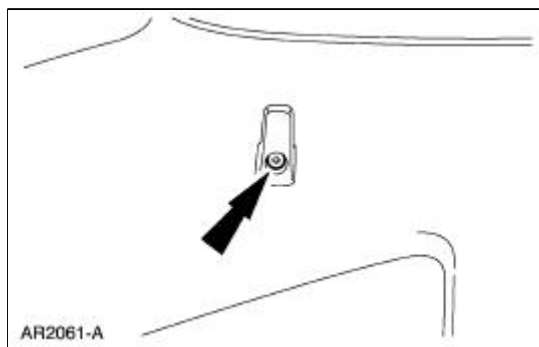


Removal and Installation

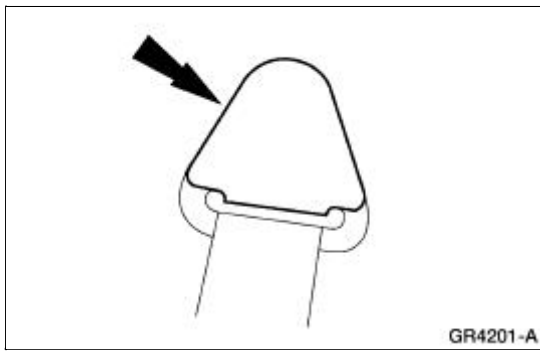
1. Remove the rear seat cushion.
2. Using the special tool, remove the rear safety belt anchor bolt.



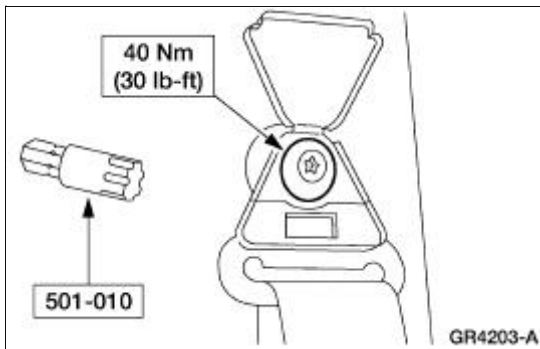
3. Remove the screw and the coat hook.



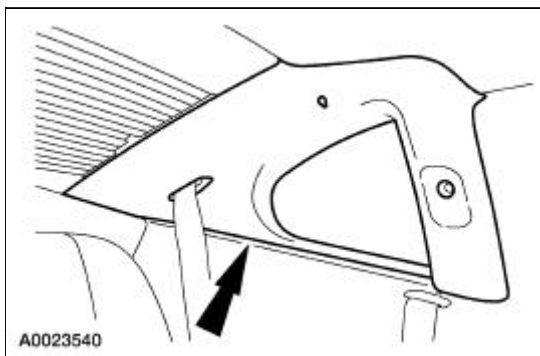
4. Open the front safety belt guide bolt cover.



5. Using the special tool, remove the front safety belt guide bolt.



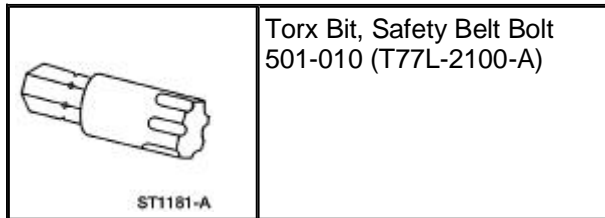
6. Remove the upper quarter trim panel.



7. To install, reverse the removal procedure.
-

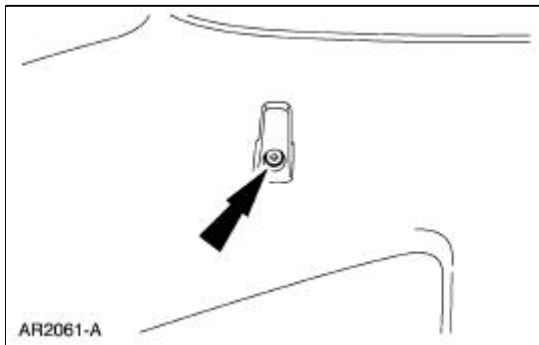
Trim Panel —Package Tray

Special Tool(s)



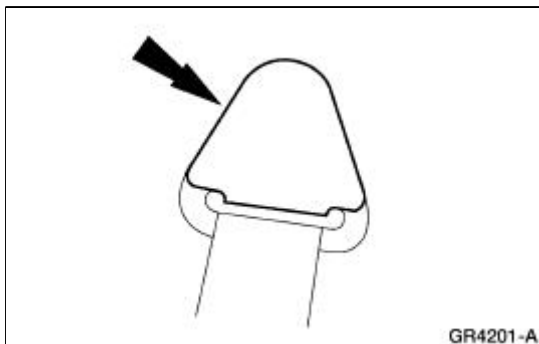
Removal and Installation

1. Remove the screw and the coat hook.

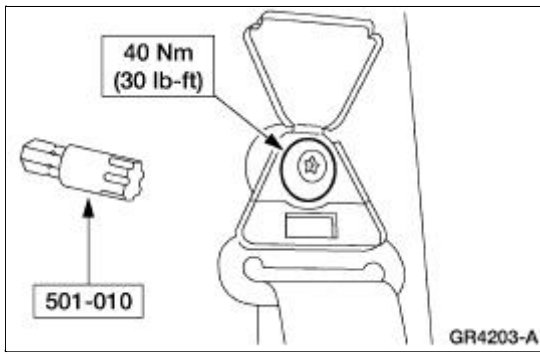


2. **NOTE:** Inspect the shoulder safety belt guide cover for damage. If the shoulder safety belt guide cover is damaged or the cover does not remain closed, install a new shoulder safety belt guide cover.

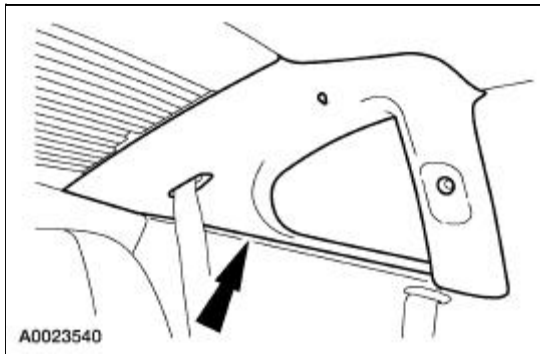
Open the safety belt cover.



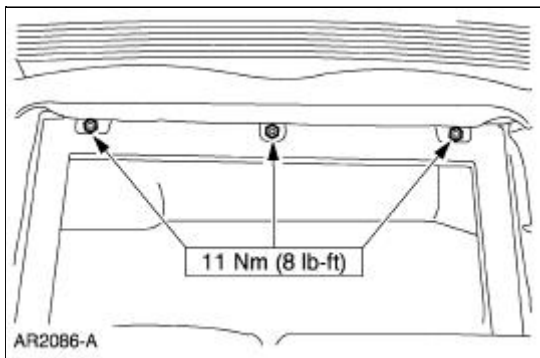
3. Using the special tool, remove the front safety belt guide bolt and position the safety belt guide aside.



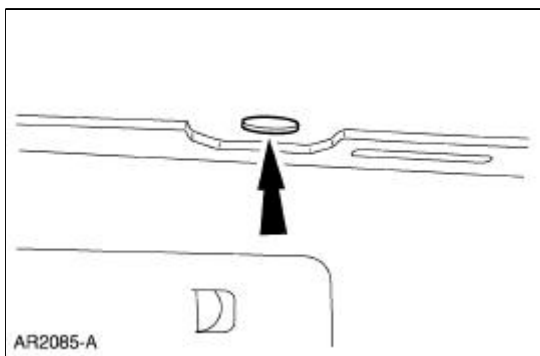
4. Position the upper trim panel aside.



5. Lower the seat backrests.
6. Remove the bolts and the rear seat backrest bolster.



7. Remove the two pin-type retainers and the package tray trim panel.

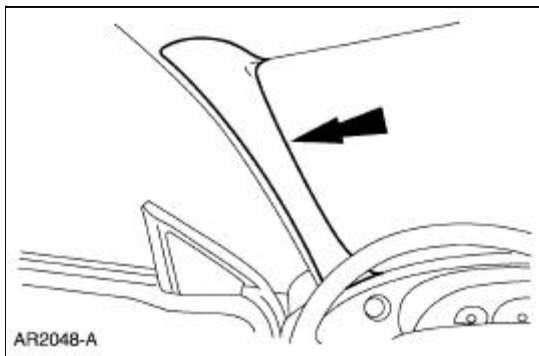


8. To install, reverse the removal procedure.

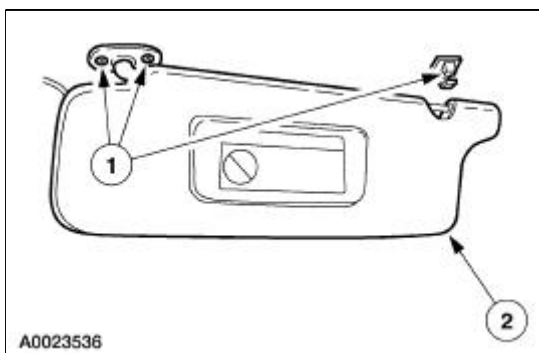
Headliner

Removal

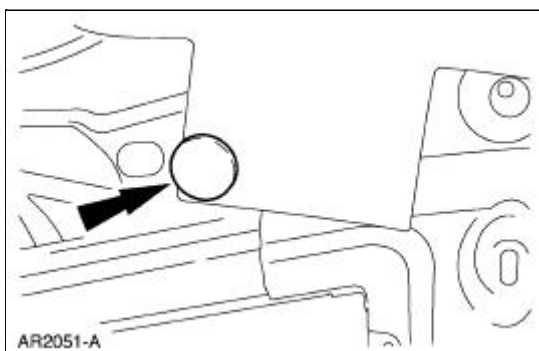
1. Remove the two upper quarter panels. For additional information, refer to [Trim Panel—Upper Quarter](#) in this section.
2. Remove the two windshield side garnish mouldings.



3. Remove the two sun visors.
 1. Remove the six screws.
 2. Position the sun visors aside.
 - If equipped, disconnect the electrical connectors.



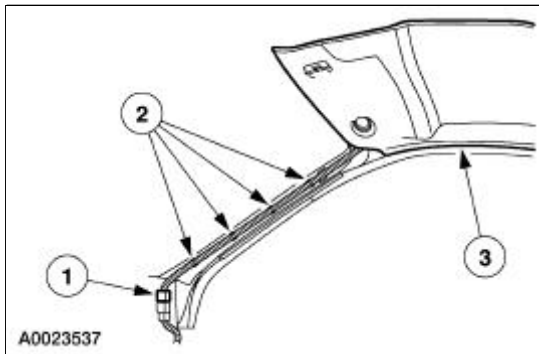
4. Remove the two pin-type retainers.



5.  **CAUTION: Folding the headliner will result in damage to the headliner.**

Remove the headliner.

1. Disconnect the electrical connector.
2. Release the wiring harness locators.
3. Remove the headliner.

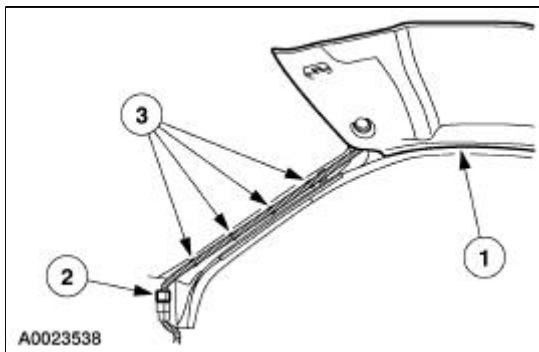


Installation

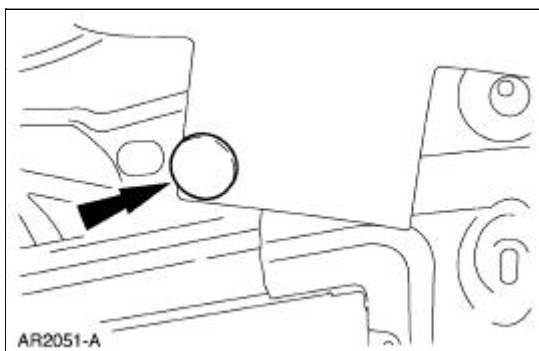
1.  **CAUTION: Folding the headliner will result in damage to the headliner.**

Install the headliner.

1. Position the headliner.
 - Apply Headliner Adhesive F1VY-19562-A meeting Ford specification WSS-M2G355-B, to the headliner using the existing pattern.
2. Connect the electrical connector.
3. Engage the wiring harness locators.

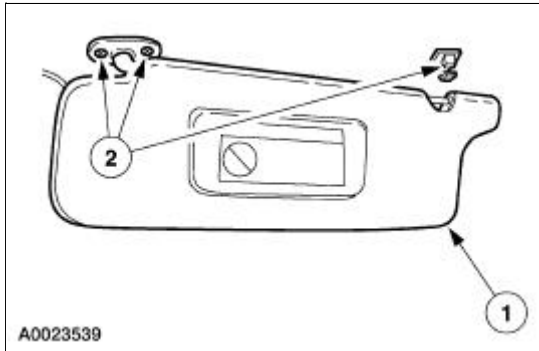


2. Install the two pin-type retainers.

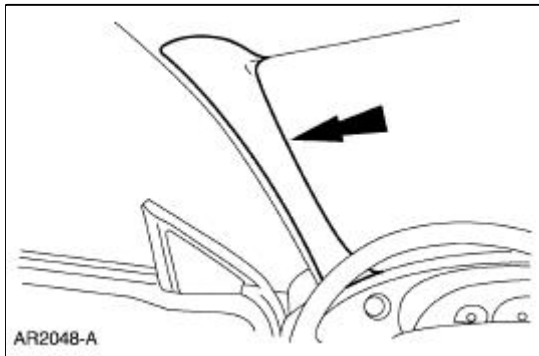


3. Install the two sun visors.

1. Position the sun visors.
 - If equipped, connect the electrical connectors.
2. Install the screws.



4. Install the two windshield side garnish mouldings.



5. Install the two upper quarter trim panels. For additional information, refer to [Trim Panel—Upper Quarter](#) in this section.
-

Torque Specifications

Description	Nm	lb-in
Hood scoop	3	27
Radiator grille screws	6	53
Rear spoiler nuts/screws	9	80
Roof side moulding screws	3	27
Roof side moulding nuts	3	27

Exterior Trim and Ornamentation

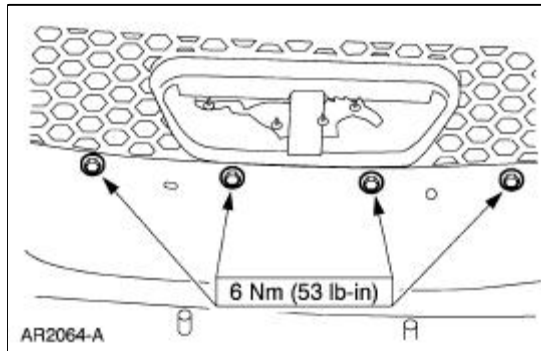
The exterior trim and ornamentation consists of the following components:

- body side scoop
 - hood scoop (if equipped)
 - front spoiler (Mach 1)
 - radiator grille
 - rear spoiler (if equipped)
 - rocker panel moulding
 - roof side moulding
-

Radiator Grille

Removal and Installation

1. Remove the front bumper cover. For additional information, refer to [Section 501-19](#).
2. Remove the screws and the radiator grille.

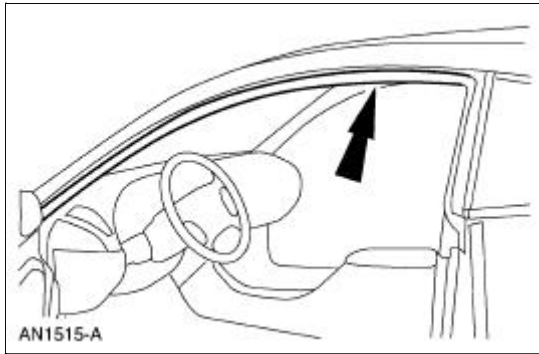


3. To install, reverse the removal procedure.
-

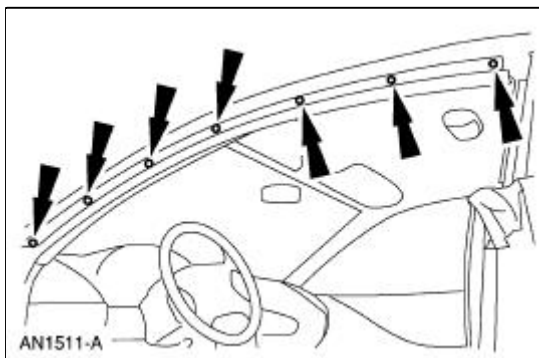
Moulding —Roof Side

Removal and Installation

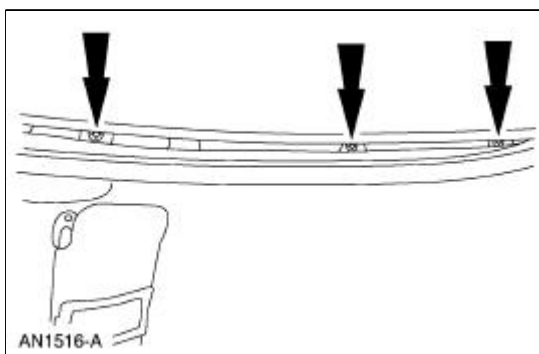
1. Remove the weatherstrip.



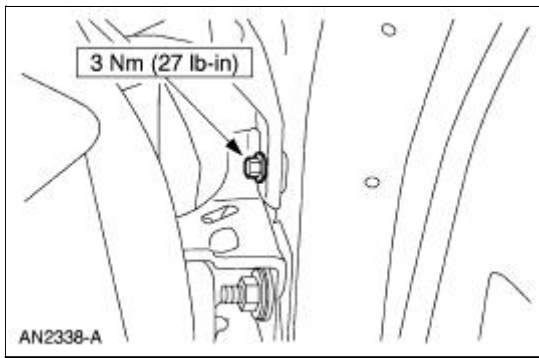
2. Remove the exterior roof side moulding screws.



3. Remove the interior roof side moulding screws.

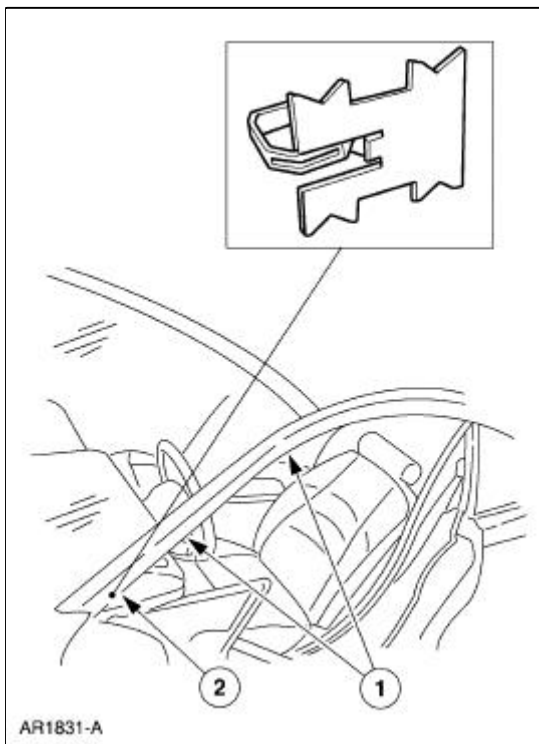


4. Remove the roof side moulding screw.

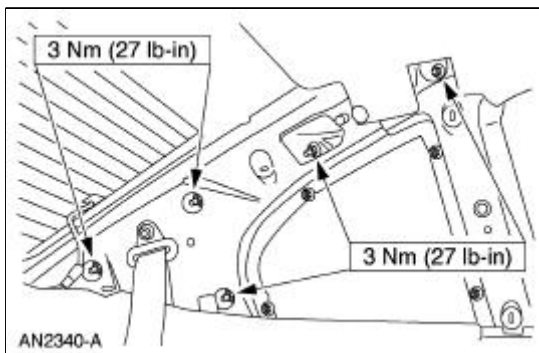


5. Release the clips.
 1. Lift up to release the two clips.
 2. **NOTE:** Grasp the roof side moulding and lift up to release the money clip.

Remove the money clip.



6. Remove the upper quarter trim panel. For additional information, refer to [Section 501-05](#).
7. Remove the nuts and the roof side moulding.

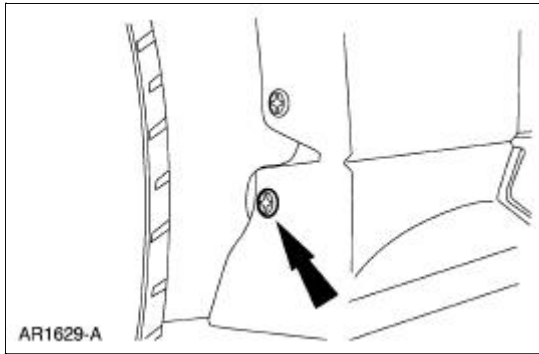


8. To install, reverse the removal procedure.

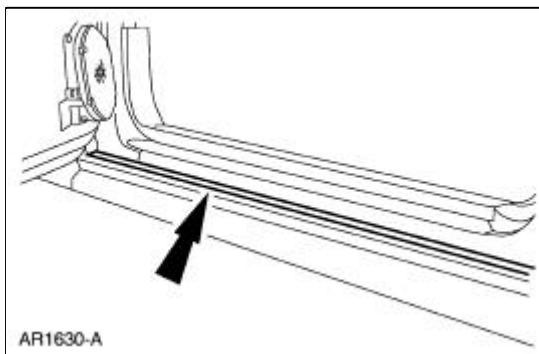
Moulding —Rocker Panel

Removal

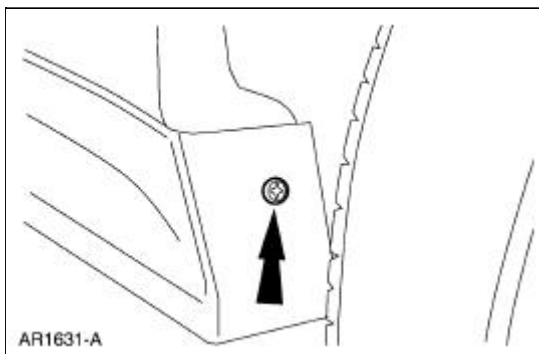
1. Remove the front rocker panel moulding screw.



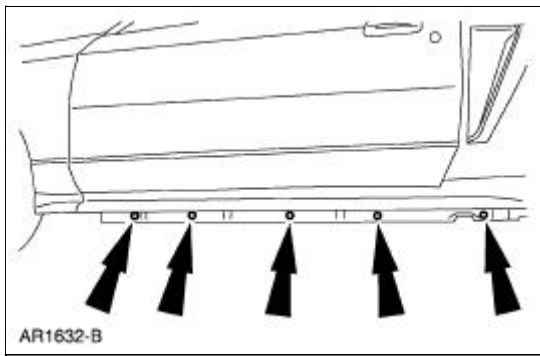
2. Remove the strip.



3. Remove the rear rocker panel moulding screw.



4. Remove the pin-type retainers and the rocker panel moulding.



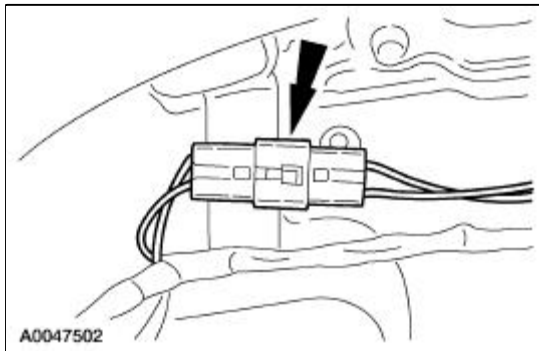
Installation

1. To install, reverse the removal procedure.
-

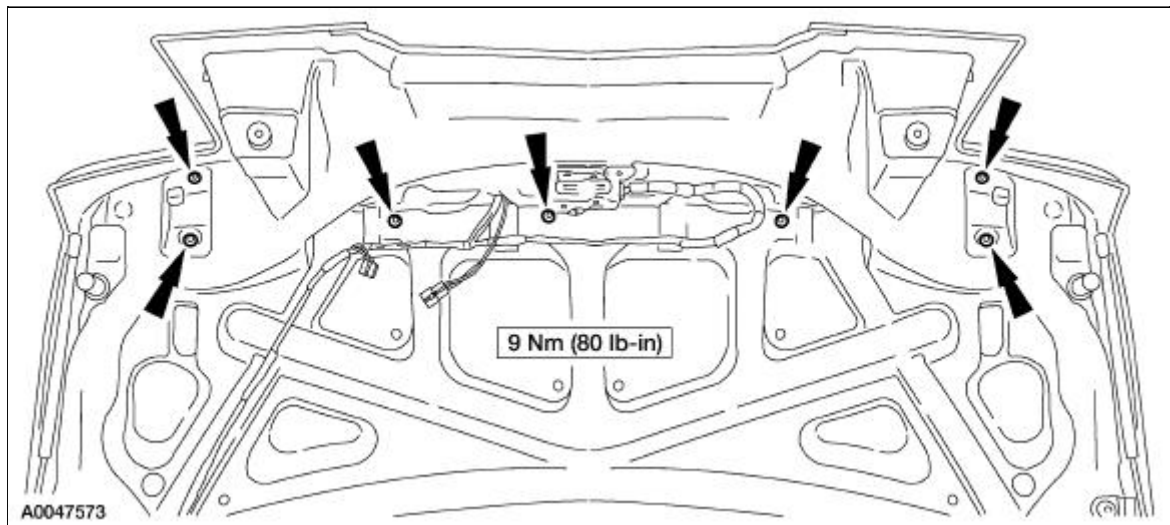
Rear Spoiler

Removal and Installation

1. Open the luggage compartment lid.
2. Disconnect the high mounted stoplamp electrical connector.

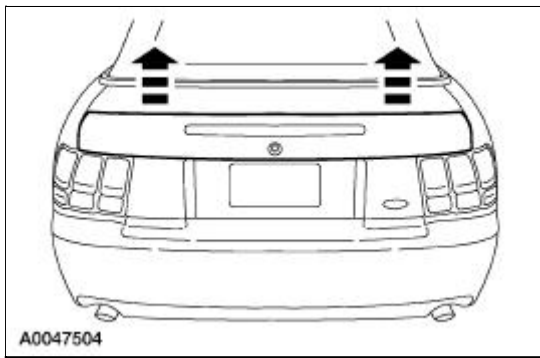


3. Remove the screws and the nuts.



4.  **CAUTION:** Use care not damage the pin-type retainers and pin-type retainer seals during removal.

Release the spoiler from the two pin-type retainers in an upward motion.



5. To install, reverse the removal procedure.
 - Inspect the pin-type retainer seals. Install new pin-type retainer seals if damaged.
-

Torque Specifications

Description	Nm	lb-ft	lb-in
Exterior rear view mirror nuts	12	9	—
Exterior rear view mirror motor screws	7	—	62

Rear View Mirrors



The rear view mirror system consists of the following components:

- exterior rear view mirror
 - exterior rear view mirror control
 - exterior rear view mirror glass
 - exterior rear view mirror motor
 - interior rear view mirror
 - exterior rear view mirror (Cobra) (manual folding)
-

Rear View Mirrors

Refer to Wiring Diagrams Cell [124](#), Power Mirrors for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2574-A	Flex Probe Kit 105-R025B or equivalent

Inspection and Verification

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> ● Exterior rear view mirrors ● Interior rear view mirror 	<ul style="list-style-type: none"> ● Central junction box (CJB) fuse 19 (15A) ● Wiring harness ● Connections ● Exterior rear view mirror control ● Exterior rear view mirror motor

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the concern is not visually evident, verify the symptom and refer to the Symptom Chart.

Symptom Chart

Refer to the Wiring Diagrams for connector numbers stated in the pinpoint tests.

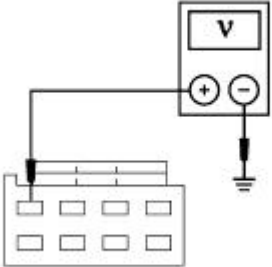
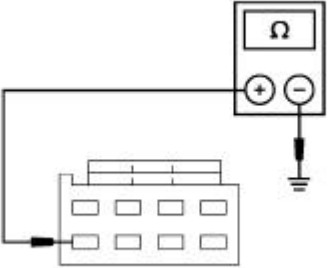
SYMPTOM CHART

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● The mirrors are inoperative 	<ul style="list-style-type: none"> ● Exterior rear view mirror control. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test A.

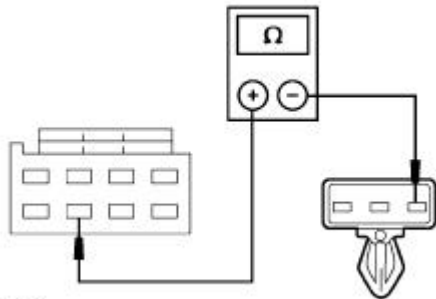
	<ul style="list-style-type: none"> ● Central junction box (CJB) fuse 19 (15A). ● Circuitry. 	
<ul style="list-style-type: none"> ● A single mirror is inoperative 	<ul style="list-style-type: none"> ● Exterior rear view mirror control. ● Exterior rear view mirror motor. ● Circuitry. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test B.
<ul style="list-style-type: none"> ● A single mirror does not function with switch logic 	<ul style="list-style-type: none"> ● Exterior rear view mirror control. ● Exterior rear view mirror motor. ● Circuitry. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test C.

Pinpoint Tests

PINPOINT TEST A: THE MIRRORS ARE INOPERATIVE

Test Step	Result / Action to Take
<p>A1 CHECK CIRCUIT 326 (WH/VT)</p> <ul style="list-style-type: none"> ● Disconnect: Exterior Rear View Mirror Control C527. ● Measure the voltage between exterior rear view mirror control C527 pin 1, circuit 326 (WH/VT), harness side and ground.  <p>AN1574-A</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to A2.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<p>A2 CHECK CIRCUIT 1205 (BK) FOR AN OPEN</p> <ul style="list-style-type: none"> ● Measure the resistance between exterior rear view mirror control C527 pin 5, circuit 1205 (BK), harness side and ground.  <p>AN1577-A</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes GO to A3.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<p>A3 CHECK CIRCUIT 542 (YE) FOR AN OPEN</p>	

- Measure the resistance between passenger exterior rear view mirror C622 pin C, circuit 542 (YE), harness side and exterior rear view mirror control C527 pin 6, circuit 542 (YE), harness side.



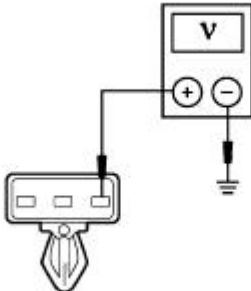
AN1578-A

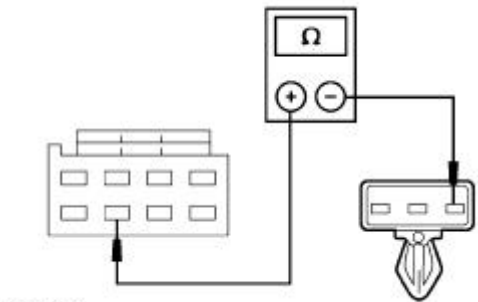
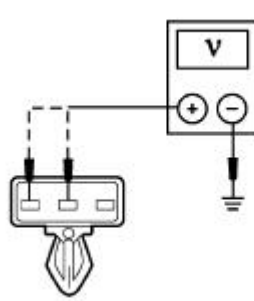
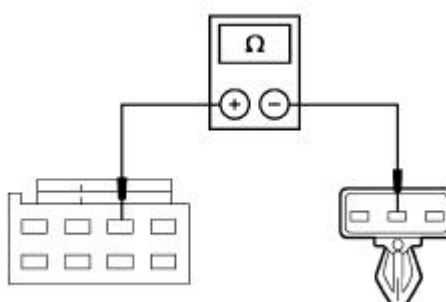
- Is the resistance less than 5 ohms?

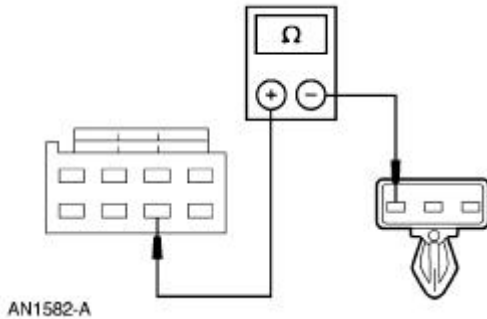
Yes
 INSTALL a new exterior rear view mirror control. REFER to [Switch—Exterior Rear View Mirror Control](#) in this section.

No
 REPAIR the circuit. TEST the system for normal operation.

PINPOINT TEST B: A SINGLE MIRROR IS INOPERATIVE

Test Step	Result / Action to Take
<p>B1 CHECK THE COMMON FEED INPUT</p>	
<ul style="list-style-type: none"> ● Disconnect: Exterior Rear View Mirror C516 (Driver) C622 (Passenger). ● Disconnect the inoperative exterior rear view mirror C516 driver side or C622 passenger side. ● Measure the voltage between driver exterior rear view mirror C516 pin C, circuit 542 (YE), harness side and ground; or between passenger exterior rear view mirror C622 pin C, circuit 542 (YE), harness side and ground.  <p>AN1579-A</p> <ul style="list-style-type: none"> ● Select the inoperative side and actuate the exterior rear view mirror control to the down position, then the right position. ● Are the voltages greater than 10 volts? 	<p>Yes GO to B3.</p> <p>No GO to B2.</p>
<p>B2 CHECK CIRCUIT 542 (YE) FOR AN OPEN</p>	
<ul style="list-style-type: none"> ● Disconnect: Exterior Rear View Mirror Control C527. ● Measure the resistance between exterior rear view mirror control C527 pin 6, circuit 542 (YE), harness side and driver exterior rear view mirror C516 pin C, circuit 542 (YE), harness side; or between exterior rear view mirror control C527 pin 6, circuit 542 (YE), harness side and passenger exterior rear view mirror C622 pin C, circuit 542 (YE), harness side. 	<p>Yes INSTALL a new exterior rear view mirror control. REFER to Switch—Exterior Rear View Mirror Control in this section. TEST the system for normal operation.</p>

 <p>AN1578-A</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>No REPAIR the circuit. TEST the system for normal operation.</p>
<p>B3 CHECK THE UP/DOWN INPUT</p>	
<ul style="list-style-type: none"> ● Measure the voltage between driver exterior rear view mirror C516 pin B, circuit 541 (DB), harness side and ground; or between passenger exterior rear view mirror C622 pin A, circuit 544 (VT), harness side and ground.  <p>AN1580-A</p> <ul style="list-style-type: none"> ● Actuate the exterior rear view mirror control to the up position. ● Are the voltages greater than 10 volts? 	<p>Yes GO to B6.</p> <p>No GO to B4 for driver inoperative or GO to B5 for passenger inoperative.</p>
<p>B4 CHECK CIRCUIT 541 (DB) FOR AN OPEN</p>	
<ul style="list-style-type: none"> ● Disconnect: Exterior Rear View Mirror Control C527. ● Measure the resistance between exterior rear view mirror control C527 pin 3, circuit 541 (DB), harness side and driver exterior rear view mirror C516 pin B, circuit 541 (DB), harness side.  <p>AN1581-A</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes INSTALL a new exterior rear view mirror control. REFER to Switch—Exterior Rear View Mirror Control in this section. TEST the system for normal operation.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<p>B5 CHECK CIRCUIT 544 (VT) FOR AN OPEN</p>	
<ul style="list-style-type: none"> ● Disconnect: Exterior Rear View Mirror Control C527. ● Measure the resistance between exterior rear view mirror control C527 pin 7, circuit 544 (VT), harness side and passenger exterior rear view mirror C622 pin A, circuit 544 (VT), harness side. 	<p>Yes INSTALL a new exterior rear view mirror control. REFER to Switch—Exterior Rear View Mirror Control in this section. TEST the system for normal</p>



AN1582-A

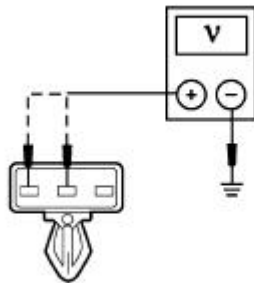
- Is the resistance less than 5 ohms?

operation.

No
REPAIR the circuit.
TEST the system for normal operation.

B6 CHECK THE LEFT/RIGHT INPUT

- Measure the voltage between driver exterior rear view mirror C516 pin A, circuit 540 (RD), harness side and ground; or between passenger exterior rear view mirror C622 pin B, circuit 543 (DG), harness side and ground.



AN1580-A

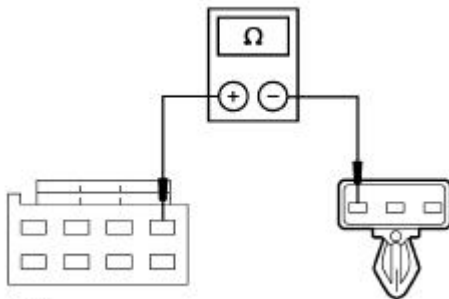
- Actuate the exterior rear view mirror control to the left position.
- Is the voltage greater than 10 volts?

Yes
INSTALL a new exterior rear view mirror motor. REFER to [Mirror—Motor](#) in this section. TEST the system for normal operation.

No
GO to [B7](#) for driver inoperative or GO to [B8](#) for passenger inoperative.

B7 CHECK CIRCUIT 540 (RD) FOR AN OPEN

- Disconnect: Exterior Rear View Mirror Control C527.
- Measure the resistance between exterior rear view mirror control C527 pin 4, circuit 540 (RD), harness side and driver exterior rear view mirror C516 pin A, circuit 540 (RD), harness side.



AN1583-A

- Is the resistance less than 5 ohms?

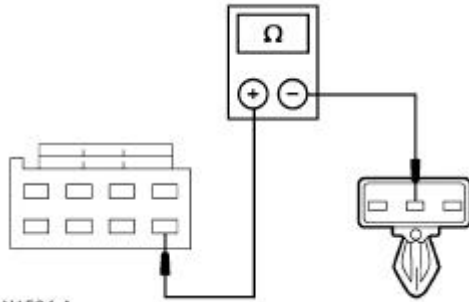
Yes
INSTALL a new exterior rear view mirror control. REFER to [Switch—Exterior Rear View Mirror Control](#) in this section. TEST the system for normal operation.

No
REPAIR the circuit.
TEST the system for normal operation.

B8 CHECK CIRCUIT 543 (DG) FOR AN OPEN

- Disconnect: Exterior Rear View Mirror Control C527.
- Measure the resistance between exterior rear view mirror control C527 pin 8, circuit 543 (DG), harness side and passenger exterior rear view mirror C622 pin B, circuit 543 (DG), harness side.

Yes
INSTALL a new exterior rear view mirror control. REFER to [Switch—Exterior Rear View Mirror Control](#) in this section. TEST the system for normal



AN1584-A

- Is the resistance less than 5 ohms?

operation.

No
REPAIR the circuit.
TEST the system for
normal operation.

PINPOINT TEST C: A SINGLE MIRROR DOES NOT FUNCTION WITH SWITCH LOGIC

Test Step			Result / Action to Take
C1 CHECK THE EXTERIOR REAR VIEW MIRROR LOGIC			<p>Yes INSTALL a new exterior rear view mirror motor. REFER to Mirror—Motor in this section. TEST the system for normal operation.</p> <p>No GO to C2.</p>
<ul style="list-style-type: none"> ● Disconnect: Exterior Rear View Mirror C516 (Driver), or C622 (Passenger). ● Disconnect the suspect exterior rear view mirror C516 driver or C622 passenger. ● Measure for voltage or resistance at the suspect exterior rear view mirror harness side, while actuating the exterior rear view mirror control according to the following chart. 			
	Exterior rear view mirror control position	Measure for voltage or resistance	
Driver			
540 (RD)	Left	Greater than 10 volts	
540 (RD)	Right	Less than 5 ohms	
541 (DB)	Up	Greater than 10 volts	
541 (DB)	Down	Less than 5 ohms	
542 (YE)	Left	Less than 5 ohms	
542 (YE)	Right	Greater than 10 volts	
542 (YE)	Up	Less than 5 ohms	
542 (YE)	Down	Greater than 10 volts	
	Exterior rear view mirror control	Measure for voltage or	

Circuit	position	resistance
Passenger		
543 (DG)	Left	Greater than 10 volts
543 (DG)	Right	Less than 5 ohms
544 (VT)	Up	Greater than 10 volts
544 (VT)	Down	Less than 5 ohms
542 (YE)	Left	Less than 5 ohms
542 (YE)	Right	Greater than 10 volts
542 (YE)	Up	Less than 5 ohms
542 (YE)	Down	Greater than 10 volts

- Is the circuit logic OK?

C2 CHECK THE EXTERIOR REAR VIEW MIRROR CONTROL

- Remove the exterior rear view mirror control. Leave the harness connected.
- Measure for voltage or resistance at exterior rear view mirror control C527 while actuating the exterior rear view mirror control according to the following chart.

Pin	Circuit	Exterior rear view mirror control position	Measure for resistance or voltage
6	542 (YE)	Left	Less than 5 ohms
6	542 (YE)	Right	Greater than 10 volts
6	542 (YE)	Up	Less than 5 ohms
6	542 (YE)	Down	Greater than 10 volts
Driver side selected			
4	540 (RD)	Left	Greater than 10 volts
4	540 (RD)	Right	Less than 5 ohms
3	541 (DB)	Up	Greater than 10 volts
3	541 (DB)	Down	Less than 5 ohms
Passenger side selected			
8	543	Left	Greater than 10

Yes
REPAIR the circuits. TEST the system for normal operation.

No
INSTALL a new exterior rear view mirror control. REFER to [Switch—Exterior Rear View Mirror Control](#) in this section. TEST the system for normal operation.

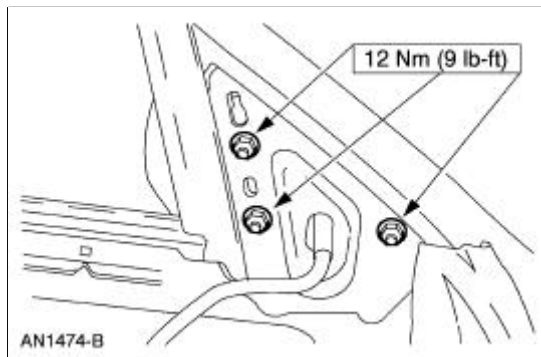
	(DG)		volts
8	543 (DG)	Right	Less than 5 ohms
7	544 (VT)	Up	Greater than 10 volts
7	544 (VT)	Down	Less than 5 ohms

- Is the circuit logic OK?
-

Mirror —Power Exterior Rear View

Removal

1. Remove the door trim panel. For additional information, refer to [Section 501-05](#).
2. Disconnect the power exterior rear view mirror electrical connector.
3. Remove the nuts and the power exterior rear view mirror.



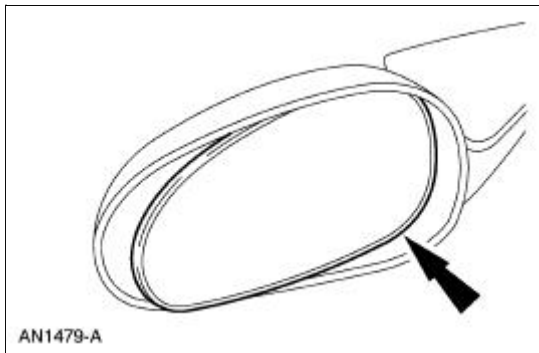
Installation

1. To install, reverse the removal procedure.
-

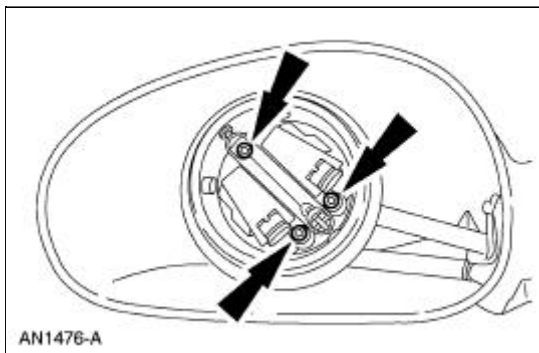
Mirror —Motor

Removal

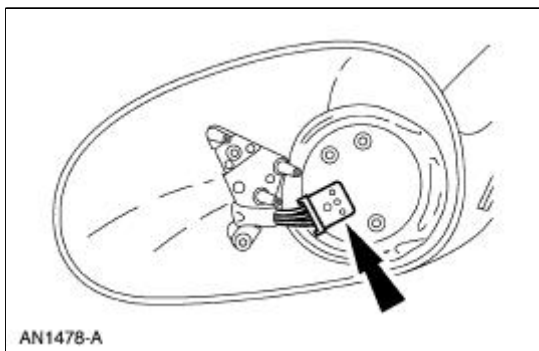
1. Push in the upper edge of the mirror glass to the maximum travel.



2. Grasp the bottom of the mirror glass, pull outward and remove the mirror glass.
3. Remove the mirror motor screws.



4. Disconnect the mirror motor electrical connector.

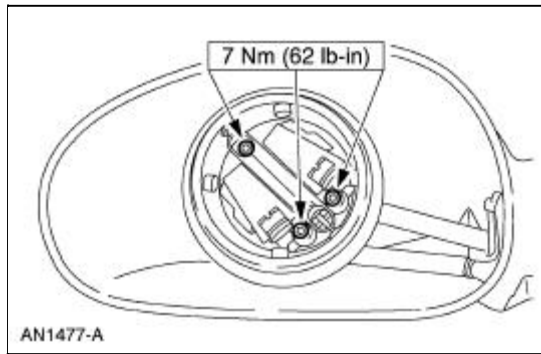


5. Remove the mirror motor.

Installation


1. **NOTE:** When installing the mirror glass, make sure it snaps completely into the mirror motor.

To install, reverse the removal procedure.



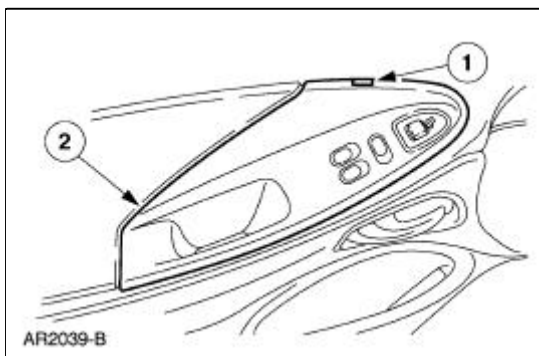
Switch —Exterior Rear View Mirror Control

Removal

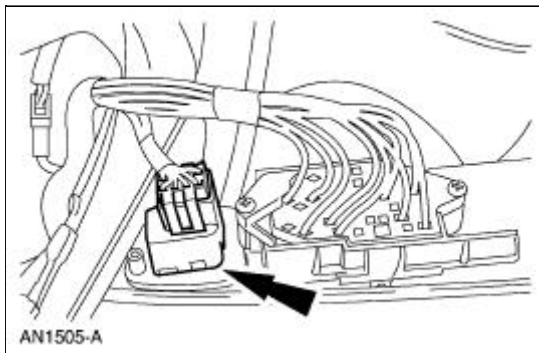
1.  **CAUTION:** Use a shop towel or similar material between the tool and the front door trim panel or damage to the front door trim panel may occur.

Position the window regulator switch plate aside.

1. Pull at service notch.
2. Lift to release the clip at the rear edge.



2. Remove the power exterior rear view mirror control switch.
 - Disconnect the electrical connector.



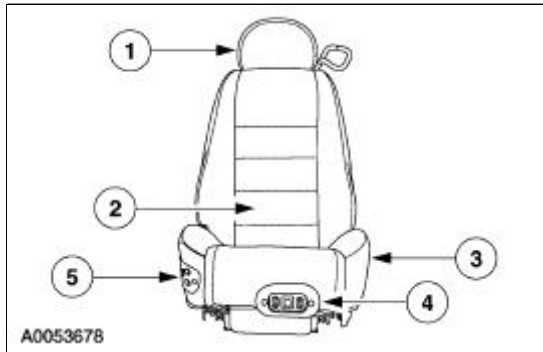
Installation

1. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft	lb-in
Front seat track to floorpan bolts and nuts	35	26	—
Front seat track to cushion bolts	20	15	—
Seat latch bolts	27	20	—
Seat backrest latch bolts	55	41	—
Front seat backrest pivot bolt	23	17	—
Rear seat backrest to body bolt	11	8	—
Safety belt guide screws	4	—	35

Seats



Item	Part Number	Description
1	611A08	Front seat backrest head restraint
2	65500	Front seat backrest pad adjuster
3	14C715	Seat control switch
4	14A701	Lumbar control switch
5	—	Bolster and lumbar control switches (Cobra only)

Seats — Front Power

The front power seat features:

- a six-way seat regulator control switch (14A701) located on the front of the seat.
- a seat track (61705) mounted under the seat.
- a seat regulator motor (14547) and gear housing mounted on the seat track (61705).
- an optional power lumbar switch located on the outboard side of the seat (14C715).
- a manual seat backrest release handle on the outboard rear corner of the seat.
- an optional power bolster and lumbar switches located on the inboard side of the seat (Cobra only)

Seats — Power Lumbar Support

NOTE: The pump and solenoid module are serviced as an assembly with the front seat cushion frame (Cobra only). The backrest bolster/lumbar adjusting pads are serviced together and the cushion bolsters are serviced separately.

The power lumbar support system consists of:

- seat control switch (14C715)
- front seat backrest pad adjusting pump (65530)
- front seat adjusting motor drive tube (618B62)
- system wiring and circuit protection
- front seat backrest adjusting hose (65528)
- driver backrest and cushion bolster (Cobra)
- driver bolster and lumbar adjusting pad pump motor and solenoid module (Cobra)
- driver bolster and lumbar control switch (Cobra)
- driver seat cushion adjusting hose (Cobra)

Seats — Front Seat Backrest Latch

NOTE: Under no circumstances are the front seat backrest latch components to be repaired as individual components. If a front seat backrest latch (62648) or component is non-functional or damaged, a new front seat backrest latch must be installed.

A release handle on the outboard rear corner of the seat backrest is manually operated to unlock the front seat backrest latch.

Rear Seat

The rear seat cushion pad and frame (600A88) is retained in the following manner:


- Pins are located on the bottom front of the rear seat cushion pad and frame which secure the rear seat cushion pad and frame to the front floor pan (11135).
 - The pins are inserted into locking plates on the floor crossmember with a push button release.
 - The bottom of the rear seatback frame is retained with screws to the front floor pan.
-

Seats

Refer to Wiring Diagrams Cell [120](#), Power Seats for schematic and connector information.

Refer to Wiring Diagrams Cell [122](#), Power Lumbar Seats for schematic and connector information.

Special Tool(s)

 ST1137-A	73 III Automotive Meter 105-R0057
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Inspection and Verification

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> ● Front seat track. ● Seat at limit(s) of travel. 	<ul style="list-style-type: none"> ● Battery junction box (BJB) Fuse Power Seat (25A). ● Loose, corroded or damaged connectors. ● Seat regulator control switch. ● Lumbar seat control switch. ● Lumbar motor. ● Bolster and lumbar control switches (cobra)

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the concern is not visually evident, verify the symptom. GO to [Symptom Chart](#).

Symptom Chart

Refer to the Wiring Diagram manual for the connector numbers cited in the pinpoint tests.

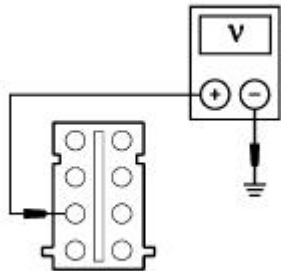
SYMPTOM CHART

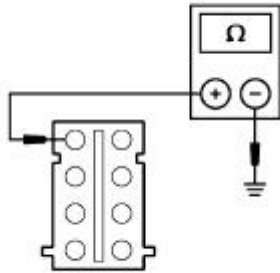
Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● The power seat is inoperative 	<ul style="list-style-type: none"> ● BJB Fuse Power Seat (25A). ● Seat regulator control switch. ● Circuitry. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test A.

	<ul style="list-style-type: none"> ● Seat track. 	
<ul style="list-style-type: none"> ● The power seat does not move vertically — front 	<ul style="list-style-type: none"> ● Seat regulator control switch. ● Seat track. ● Circuitry. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test B.
<ul style="list-style-type: none"> ● The power seat does not move vertically — rear 	<ul style="list-style-type: none"> ● Seat regulator control switch. ● Seat track. ● Circuitry. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test C.
<ul style="list-style-type: none"> ● The power seat does not move horizontally 	<ul style="list-style-type: none"> ● Seat regulator control switch. ● Seat track. ● Circuitry. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test D.
<ul style="list-style-type: none"> ● The power lumbar is inoperative 	<ul style="list-style-type: none"> ● Lumbar motor. ● Lumbar seat control switch. ● Circuitry. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test E.
<ul style="list-style-type: none"> ● The power bolster/lumbar is inoperative (Cobra only) 	<ul style="list-style-type: none"> ● Bolster/lumbar pump and solenoid module. ● Bolster/lumbar seat control switches. ● Circuitry. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test F.

Pinpoint Tests

PINPOINT TEST A: THE POWER SEAT IS INOPERATIVE

Test Step	Result / Action to Take
<p>A1 CHECK CIRCUIT 566 (DG)</p> <ul style="list-style-type: none"> ● Disconnect: Seat Regulator Control Switch C360. ● Measure the voltage between seat regulator control switch C360-2, Circuit 566 (DG), harness side and ground.  <p>AR2071-A</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to A2.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<p>A2 CHECK CIRCUIT 1205 (BK) FOR AN OPEN</p> <ul style="list-style-type: none"> ● Measure the resistance between seat regulator control switch C360-4, Circuit 1205 (BK), harness side and ground. 	<p>Yes GO to A3.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>



AR2074-A

- Is the resistance less than 5 ohms?

A3 CHECK THE SEAT REGULATOR CONTROL SWITCH

- Carry out the seat regulator control switch component test. Refer to Wiring Diagrams.
- Did the seat regulator control switch pass?

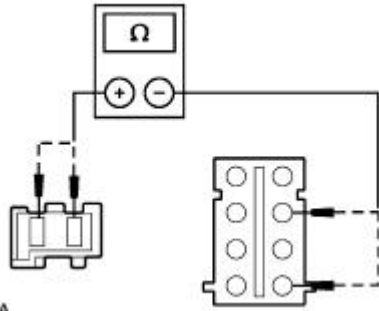
Yes
CHECK for obstructed or binding seat track. If no obstructions are found, INSTALL a new seat track. REFER to [Seat Track](#). TEST the system for normal operation.

No
INSTALL a new seat regulator control switch. REFER to [Switch—Seat Regulator Control](#). TEST the system for normal operation.

PINPOINT TEST B: THE POWER SEAT DOES NOT MOVE VERTICALLY — FRONT

Test Step	Result / Action to Take
<p>B1 CHECK THE MOTOR SUPPLY CIRCUITS</p> <ul style="list-style-type: none"> ● Disconnect: Front Height Motor C382. ● NOTE: Make sure all connectors are connected on the seat. ● Measure the resistance between front height motor C382, Circuit 979 (RD/LB), harness side and ground and between front height motor C382, Circuit 990 (YE/LB), harness side and ground. 	<p>Yes GO to B3.</p> <p>No GO to B2.</p>
<p>AR2075-A</p> <ul style="list-style-type: none"> ● Are the resistances less than 5 ohms? 	
<p>B2 CHECK CIRCUIT 979 (RD/LB) AND 990 (YE/LB) FOR AN OPEN</p> <ul style="list-style-type: none"> ● Disconnect: Seat Regulator Control Switch C360. ● Measure the resistance between front height motor C382, Circuit 979 (RD/LB), harness side and seat regulator control switch C360-7, 	<p>Yes INSTALL a new seat regulator</p>

Circuit 979 (RD/LB), harness side; then between front height motor C382, Circuit 990 (YE/LB), harness side and seat regulator control switch C360-5, Circuit 990 (YE/LB), harness side.



AR2076-A

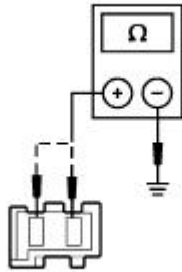
- Is the resistance less than 5 ohms?

control switch. REFER to [Switch—Seat Regulator Control](#). TEST the system for normal operation.

No
REPAIR the circuit. TEST the system for normal operation.

B3 CHECK CIRCUIT 979 (RD/LB) AND 990 (YE/LB) FOR A SHORT TO GROUND

- Measure the resistance between front height motor C382, Circuit 979 (RD/LB), harness side and ground and between front height motor C382, Circuit 990 (YE/LB), harness side and ground.



AR2075-A

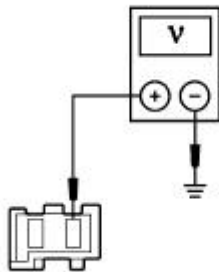
- Are the resistances greater than 10,000 ohms?

Yes
GO to [B4](#).

No
REPAIR the circuit. TEST the system for normal operation.

B4 CHECK THE UP POSITION INPUT

- Connect: Seat Regulator Control Switch C360.
- Measure the voltage between front height motor C382, Circuit 979 (RD/LB), harness side and ground.



AR2077-A

- Actuate the seat regulator control switch to the front UP position.
- Is the voltage greater than 10 volts?

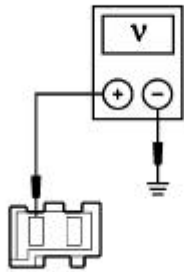
Yes
GO to [B5](#).

No
INSTALL a new seat regulator control switch. REFER to [Switch—Seat Regulator Control](#). TEST the system for normal operation.

B5 CHECK THE DOWN POSITION INPUT

- Measure the voltage between front height motor C382, Circuit 990 (YE/LB), harness side and ground.

Yes
INSTALL a new seat track. REFER to [Seat Track](#). TEST the system for normal operation.

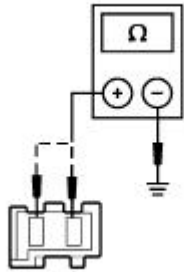
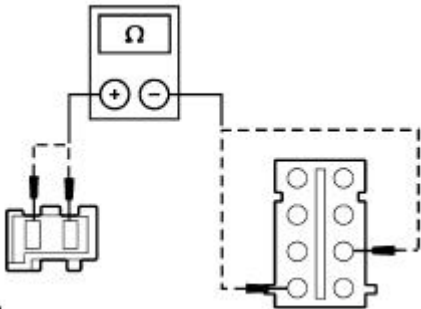


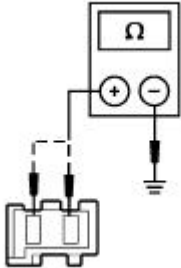
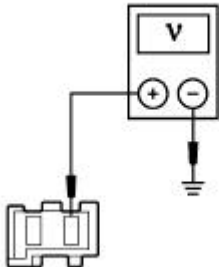
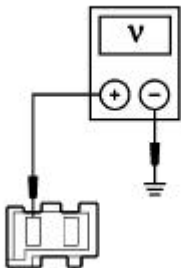
AR2078-A

- Actuate the seat regulator control switch to the front DOWN position.
- Is the voltage greater than 10 volts?

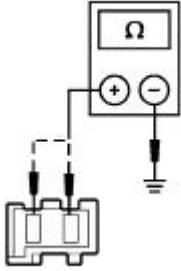
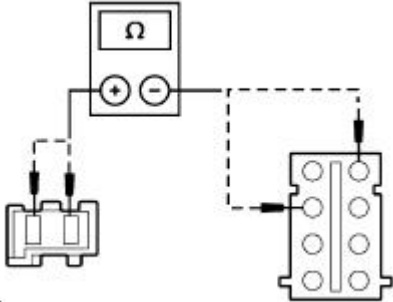
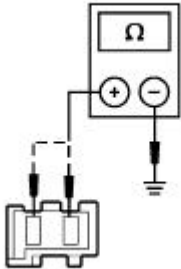
No
 INSTALL a new seat regulator control switch. REFER to [Switch—Seat Regulator Control](#). TEST the system for normal operation.

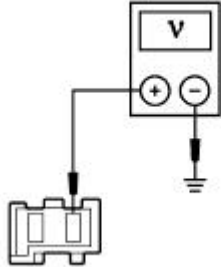
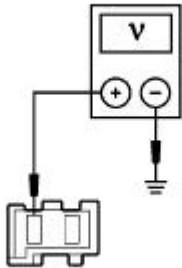
PINPOINT TEST C: THE POWER SEAT DOES NOT MOVE VERTICALLY — REAR

Test Step	Result / Action to Take
<p>C1 CHECK THE MOTOR SUPPLY CIRCUITS</p> <ul style="list-style-type: none"> ● Disconnect: Rear Height Motor C363. ● NOTE: Make sure all connectors are connected on the seat. ● Measure the resistance between rear height motor C363, Circuit 983 (RD/LG), harness side and ground and between rear height motor C363, Circuit 982 (YE/LG), harness side and ground.  <p>AR2075-A</p> <ul style="list-style-type: none"> ● Are the resistances less than 5 ohms? 	<p>Yes GO to C3.</p> <p>No GO to C2.</p>
<p>C2 CHECK CIRCUIT 983 (RD/LG) AND 982 (YE/LG) FOR AN OPEN</p> <ul style="list-style-type: none"> ● Disconnect: Seat Regulator Control Switch C360. ● Measure the resistance between rear height motor C363, Circuit 983 (RD/LG), harness side and seat regulator control switch C360-1, Circuit 983 (RD/LG), harness side; then between rear height motor C363, Circuit 982 (YE/LG), harness side and seat regulator control switch C360-6, Circuit 982 (YE/LG), harness side.  <p>AR2079-A</p>	<p>Yes INSTALL a new seat regulator control switch. REFER to Switch—Seat Regulator Control. TEST the system for normal operation.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>

<ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	
<p>C3 CHECK CIRCUIT 983 (RD/LG) AND 982 (YE/LG) FOR A SHORT TO GROUND</p>	
<ul style="list-style-type: none"> ● Measure the resistance between rear height motor C363, Circuit 983 (RD/LG), harness side and ground; and between rear height motor C363, Circuit 982 (YE/LG), harness side and ground.  <p>AR2075-A</p> <ul style="list-style-type: none"> ● Are the resistances greater than 10,000 ohms? 	<p>Yes GO to C4.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<p>C4 CHECK THE UP POSITION INPUT</p>	
<ul style="list-style-type: none"> ● Connect: Seat Regulator Control Switch C360. ● Measure the voltage between rear height motor C363, Circuit 983 (RD/LG), harness side and ground.  <p>AR2077-A</p> <ul style="list-style-type: none"> ● Actuate the seat regulator control switch to the rear UP position. ● Is the voltage greater than 10 volts? 	<p>Yes GO to C5.</p> <p>No INSTALL a new seat regulator control switch. REFER to Switch—Seat Regulator Control. TEST the system for normal operation.</p>
<p>C5 CHECK THE DOWN POSITION INPUT</p>	
<ul style="list-style-type: none"> ● Measure the voltage between rear height motor C363, Circuit 982 (YE/LG), harness side and ground.  <p>AR2078-A</p> <ul style="list-style-type: none"> ● Actuate the seat regulator control switch to the rear DOWN position. ● Is the voltage greater than 10 volts? 	<p>Yes INSTALL a new seat track. REFER to Seat Track. TEST the system for normal operation.</p> <p>No INSTALL a new seat regulator control switch. REFER to Switch—Seat Regulator Control. TEST the system for normal operation.</p>

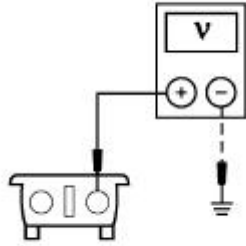
PINPOINT TEST D: THE POWER SEAT DOES NOT MOVE HORIZONTALLY

Test Step	Result / Action to Take
<p>D1 CHECK THE MOTOR SUPPLY CIRCUITS</p> <ul style="list-style-type: none"> ● Disconnect: Horizontal Motor C362. ● NOTE: Make sure all connectors are connected on the seat. ● Measure the resistance between horizontal motor C362, Circuit 981 (RD/WH), harness side and ground; and between horizontal motor C362, Circuit 980 (YE/WH), harness side and ground.  <p>AR2075-A</p> <ul style="list-style-type: none"> ● Are the resistances less than 5 ohms? 	<p>Yes GO to D3.</p> <p>No GO to D2.</p>
<p>D2 CHECK CIRCUIT 981 (RD/WH) AND 980 (YE/WH) FOR AN OPEN</p> <ul style="list-style-type: none"> ● Disconnect: Seat Regulator Control Switch C360. ● Measure the resistance between horizontal motor C362, Circuit 981 (RD/WH), harness side and seat regulator control switch C360-3, Circuit 981 (RD/WH), harness side; then between horizontal motor C362, Circuit 980 (YE/WH), harness side and seat regulator control switch C360-8, Circuit 980 (YE/WH), harness side.  <p>AR2080-A</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes INSTALL a new seat regulator control switch. REFER to Switch—Seat Regulator Control. TEST the system for normal operation.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<p>D3 CHECK CIRCUIT 981 (RD/WH) AND 980 (YE/WH) FOR A SHORT TO GROUND</p> <ul style="list-style-type: none"> ● Measure the resistance between horizontal motor C362, Circuit 981 (RD/WH), harness side and ground; and between horizontal motor C362, Circuit 980 (YE/WH), harness side and ground.  <p>AR2075-A</p> <ul style="list-style-type: none"> ● Are the resistances greater than 10,000 ohms? 	<p>Yes GO to D4.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>

<p>D4 CHECK THE REARWARD POSITION INPUT</p> <ul style="list-style-type: none"> ● Connect: Seat Regulator Control Switch C360. ● Measure the voltage between horizontal motor C362, Circuit 981 (RD/WH), harness side and ground.  <p>AR2077-A</p> <ul style="list-style-type: none"> ● Actuate the seat regulator control switch to the REARWARD position. ● Is the voltage greater than 10 volts? 	<p>Yes GO to D5.</p> <p>No INSTALL a new seat regulator control switch. REFER to Switch—Seat Regulator Control. TEST the system for normal operation.</p>
<p>D5 CHECK THE FORWARD POSITION INPUT</p> <ul style="list-style-type: none"> ● Measure the voltage between horizontal motor C362, Circuit 980 (YE/WH), harness side and ground.  <p>AR2078-A</p> <ul style="list-style-type: none"> ● Actuate the seat regulator control switch to the FORWARD position. ● Is the voltage greater than 10 volts? 	<p>Yes INSTALL a new seat track. REFER to Seat Track. TEST the system for normal operation.</p> <p>No INSTALL a new seat regulator control switch. REFER to Switch—Seat Regulator Control. TEST the system for normal operation.</p>

PINPOINT TEST E: THE POWER LUMBAR IS INOPERATIVE

Test Step	Result / Action to Take
<p>E1 CHECK THE LUMBAR COMPRESSOR OPERATION</p> <ul style="list-style-type: none"> ● Actuate the lumbar seat control switch to the inflate position. ● Did the lumbar compressor motor run? 	<p>Yes GO to E6.</p> <p>No GO to E2.</p>
<p>E2 CHECK CIRCUIT 566 (DG)</p> <ul style="list-style-type: none"> ● Disconnect: Lumbar Seat Control Switch C361. ● Measure the voltage between lumbar seat control switch C361, Circuit 566 (DG), harness side and ground. 	<p>Yes GO to E3.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>

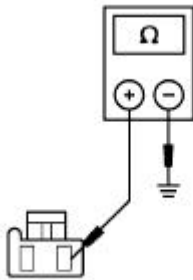


AR2081-A

- Is the voltage greater than 10 volts?

E3 CHECK CIRCUIT 1205 (BK) FOR AN OPEN

- Disconnect: Lumbar Motor C366.
- Measure the resistance between lumbar motor C366, Circuit 1205 (BK), harness side and ground.



AR1520-A

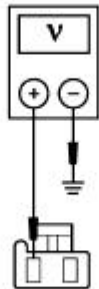
- Is the resistance less than 5 ohms?

Yes
GO to [E4](#).

No
REPAIR the circuit. TEST the system for normal operation.

E4 CHECK THE POWER SUPPLY TO THE LUMBAR MOTOR

- Connect: Lumbar Seat Control Switch C361.
- Measure the voltage between lumbar motor C366, Circuit 51 (BK/WH), harness side and ground.



AR1521-A

- Actuate the lumbar seat control switch the inflate position.
- Is the voltage greater than 10 volts?

Yes
INSTALL a new lumbar motor. REFER to [Lumbar Motor](#). TEST the system for normal operation.

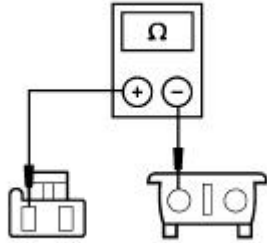
No
GO to [E5](#).

E5 CHECK CIRCUIT 51 (BK/WH) FOR AN OPEN

- Disconnect: Lumbar Seat Control Switch C361.
- Measure the resistance between lumbar seat control switch C361, Circuit 51 (BK/WH), harness side and lumbar motor C366, Circuit 51 (BK/WH), harness side.

Yes
INSTALL a new lumbar seat control switch. REFER to [Lumbar Control Switch](#). TEST the system for normal operation.

No
REPAIR the circuit. TEST the system for normal operation.



AR2084-A

- Is the resistance less than 5 ohms?

E6 CHECK THE LUMBAR ADJUSTING SYSTEM

- Actuate the lumbar seat control switch to the inflate position while observing the seat backrest lumbar adjusting pad.
- Did the seat backrest lumbar adjusting pad inflate?

Yes
GO to [E10](#).

No
GO to [E7](#).

E7 CHECK THE SEAT BACKREST LUMBAR ADJUSTING PAD

- Visually inspect the seat backrest lumbar adjusting pad.
- Is the seat backrest lumbar adjusting pad damaged?

Yes
INSTALL a new seat backrest lumbar adjusting pad. REFER to [Lumbar Assembly](#). TEST the system for normal operation.

No
GO to [E8](#).

E8 CHECK AIR FLOW FROM LUMBAR COMPRESSOR

- Disconnect the seat backrest lumbar adjusting hose from the lumbar motor.
- Actuate the lumbar seat control switch to the inflate position while feeling for air at the motor connection.
- Is air felt at the lumbar motor hose connection?

Yes
GO to [E9](#).

No
INSTALL a new lumbar motor. REFER to [Lumbar Motor](#). TEST the system for normal operation.

E9 CHECK THE AIR FLOW FROM THE LUMBAR SEAT CONTROL SWITCH

- Reconnect the hose to the lumbar motor.
- Disconnect the seat backrest lumbar adjusting hose at the lumbar seat control switch.
- Actuate the lumbar seat control switch to the inflate position.
- Is air felt at the seat backrest lumbar adjusting hose?

Yes
GO to [E10](#).

No
INSTALL a new seat backrest lumbar adjusting hose. TEST the system for normal operation.

E10 CHECK THE SYSTEM FOR LEAKS

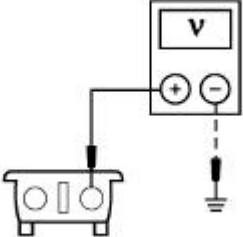
- Reconnect the hose at the lumbar seat control switch.
- Disconnect the seat backrest lumbar adjusting hose at the seat backrest lumbar adjusting pad.
- Install an in-line pressure gauge on the hose.
- Actuate the lumbar seat control switch to the inflate position until the gauge reads 34.47 kPa (5 psi). The system should hold pressure for three hours.
- After three hours, is the pressure reading 32.41 kPa (4.7

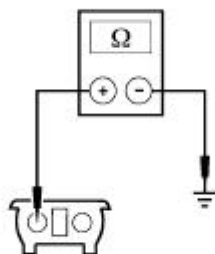
Yes
The system is operating correctly. TEST the system for normal operation.

No
GO to [E11](#).

psi) or more?	
E11 CHECK THE SEAT BACKREST LUMBAR ADJUSTING PAD FOR LEAKS	
<ul style="list-style-type: none"> ● Remove the in-line pressure gauge. ● Use a hand pump and inflate the seat backrest lumbar adjusting pad to 34.47 kPa (5 psi). The seat backrest lumbar adjusting pad should hold pressure for three hours. ● After three hours, is the pressure reading 32.41 kPa (4.7 psi) or more? 	<p>Yes INSTALL a new lumbar seat control switch. REFER to Lumbar Control Switch. TEST the system for normal operation.</p> <p>No INSTALL a new seat backrest lumbar adjusting pad. REFER to Lumbar Assembly. TEST the system for normal operation.</p>

PINPOINT TEST F: THE POWER BOLSTER/LUMBAR IS INOPERATIVE — DRIVER

Test Step	Result / Action to Take
F1 CHECK THE BOLSTER/LUMBAR COMPRESSOR OPERATION	
<ul style="list-style-type: none"> ● Actuate the bolster/lumbar seat control switches. ● Does the bolster/lumbar compressor motor run? 	<p>Yes GO to F5.</p> <p>No GO to F2.</p>
F2 CHECK CIRCUIT (BK) FOR VOLTAGE	
<ul style="list-style-type: none"> ● Disconnect: Bolster/lumbar pump and solenoid module. ● Measure the voltage at bolster/lumbar pump and solenoid module pin 1 (BK), harness side and ground. <div style="text-align: center;">  <p>AR2081-A</p> </div> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to F3.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
F3 CHECK CIRCUIT (LG) FOR AN OPEN	
<ul style="list-style-type: none"> ● Measure the resistance between bolster/lumbar pump and solenoid module pin 2, (LG), harness side and ground. 	<p>Yes GO to F4.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>



A0054344

- Is the resistance less than 5 ohms?

F4 CHECK THE BOLSTER/LUMBAR SEAT CONTROL SWITCHES

- Carry out the bolster/lumbar seat control switch component test.

Refer to Wiring Diagrams Cell [149](#) for schematic and connector information.

- Did the seat control switches pass?

Yes
INSTALL a new bolster/lumbar pump and solenoid module. REFER to [Lumbar Motor](#) . TEST the system for normal operation.

No
INSTALL a new bolster/lumbar seat control switch. REFER to [Lumbar Control Switch](#) . TEST the system for normal operation.

F5 CHECK THE LUMBAR ADJUSTING SYSTEM

- Actuate the bolster/lumbar seat control switches to the inflate position while observing the seat backrest lumbar adjusting pad, backrest bolster and cushion bolster.
- Did the seat bolsters/lumbar adjusting pads inflate?

Yes
GO to [F9](#) .

No
For seat backrest lumbar, GO to [F6](#) . For seat backrest bolster, GO to [F10](#) . For seat cushion bolster, GO to [F14](#) .

F6 CHECK THE SEAT BACKREST LUMBAR ADJUSTING PAD

- Visually inspect the seat backrest lumbar adjusting pad.
- Is the seat backrest lumbar adjusting pad damaged?

Yes
INSTALL a new seat backrest lumbar adjusting pad. REFER to [Lumbar Assembly](#) . TEST the system for normal operation.

No
GO to [F7](#) .

F7 CHECK AIR FLOW FROM LUMBAR COMPRESSOR

- Disconnect the seat backrest lumbar adjusting hose from the connection at the seat pivot bolt.
- Actuate the lumbar seat control switch to the inflate position while feeling for air at the connection.
- Is air felt at the lumbar motor hose connection?

Yes
GO to [F8](#) .

No
INSTALL a new bolster/lumbar pump and solenoid module. REFER to

	Front Seat Cushion . TEST the system for normal operation.
F8 CHECK THE SYSTEM FOR LEAKS	
<ul style="list-style-type: none"> ● Reconnect the hose at the seat backrest lumbar pivot bolt. ● Disconnect the seat backrest lumbar adjusting hose at the seat backrest lumbar adjusting pad. ● Install an in-line pressure gauge on the hose. ● Actuate the lumbar seat control switch to the inflate position until the gauge reads 34.47 kPa (5 psi). The system should hold pressure for three hours. ● After three hours, is the pressure reading 32.41 kPa (4.7 psi) or more? 	<p>Yes The system is operating correctly. TEST the system for normal operation.</p> <p>No GO to F9 .</p>
F9 CHECK THE SEAT BACKREST LUMBAR ADJUSTING PAD FOR LEAKS	
<ul style="list-style-type: none"> ● Remove the in-line pressure gauge. ● Use a hand pump and inflate the seat backrest lumbar adjusting pad to 34.47 kPa (5 psi). The seat backrest lumbar adjusting pad should hold pressure for three hours. ● After three hours, is the pressure reading 32.41 kPa (4.7 psi) or more? 	<p>Yes INSTALL a new bolster/lumbar pump and solenoid module. REFER to Lumbar Motor . TEST the system for normal operation.</p> <p>No INSTALL a new seat backrest lumbar adjusting pad. REFER to Lumbar Assembly . TEST the system for normal operation.</p>
F10 CHECK THE SEAT BACKREST BOLSTER ADJUSTING PADS	
<ul style="list-style-type: none"> ● Visually inspect the seat backrest bolster adjusting pad. ● Is the seat backrest bolster adjusting pad damaged? 	<p>Yes INSTALL a new seat backrest bolster adjusting pad. REFER to Lumbar Assembly . TEST the system for normal operation.</p> <p>No GO to F11 .</p>
F11 CHECK AIR FLOW FROM BOLSTER COMPRESSOR	
<ul style="list-style-type: none"> ● Disconnect the seat backrest bolster adjusting hose from the connection at the seat pivot bolt. ● Actuate the bolster seat control switch to the inflate position while feeling for air at the connection. ● Is air felt at the lumbar motor hose connection? 	<p>Yes GO to F12 .</p> <p>No INSTALL a new bolster/lumbar pump and solenoid module. REFER to Lumbar Motor . TEST the system for normal operation.</p>
F12 CHECK THE SYSTEM FOR LEAKS	
<ul style="list-style-type: none"> ● Reconnect the hose at the seat backrest bolster pivot bolt. ● Disconnect the seat backrest bolster adjusting hose at the seat backrest bolster adjusting pad. ● Install an in-line pressure gauge on the hose. 	<p>Yes The system is operating correctly. TEST the system for normal operation.</p>

<ul style="list-style-type: none"> ● Actuate the bolster seat control switch to the inflate position until the gauge reads 34.47 kPa (5 psi). The system should hold pressure for three hours. ● After three hours, is the pressure reading 32.41 kPa (4.7 psi) or more? 	<p>No GO to F13.</p>
<p>F13 CHECK THE SEAT BACKREST BOLSTER ADJUSTING PAD FOR LEAKS</p>	
<ul style="list-style-type: none"> ● Remove the in-line pressure gauge. ● Use a hand pump and inflate the seat backrest bolster adjusting pad to 34.47 kPa (5 psi). The seat backrest bolster adjusting pad should hold pressure for three hours. ● After three hours, is the pressure reading 32.41 kPa (4.7 psi) or more? 	<p>Yes INSTALL a new bolster/lumbar pump and solenoid module. REFER to Lumbar Motor . TEST the system for normal operation.</p> <p>No INSTALL a new seat backrest bolster adjusting pad. REFER to Lumbar Assembly . TEST the system for normal operation.</p>
<p>F14 CHECK THE SEAT CUSHION BOLSTER ADJUSTING PADS</p>	
<ul style="list-style-type: none"> ● Visually inspect the seat cushion bolster adjusting pad. ● Is the seat cushion bolster adjusting pad damaged? 	<p>Yes INSTALL a new seat cushion bolster adjusting pad. REFER to Lumbar Assembly . TEST the system for normal operation.</p> <p>No GO to F15.</p>
<p>F15 CHECK AIR FLOW FROM BOLSTER COMPRESSOR</p>	
<ul style="list-style-type: none"> ● Disconnect the seat cushion bolster adjusting hose from the connection at the seat pivot bolt. ● Actuate the bolster seat control switch to the inflate position while feeling for air at the connection. ● Is air felt at the bolster motor hose connection? 	<p>Yes GO to F16.</p> <p>No INSTALL a new bolster/lumbar pump and solenoid module. REFER to Lumbar Motor . TEST the system for normal operation.</p>
<p>F16 CHECK THE SYSTEM FOR LEAKS</p>	
<ul style="list-style-type: none"> ● Reconnect the hose at the seat cushion bolster pivot bolt. ● Disconnect the seat cushion bolster adjusting hose at the seat cushion bolster adjusting pad. ● Install an in-line pressure gauge on the hose. ● Actuate the bolster seat control switch to the inflate position until the gauge reads 34.47 kPa (5 psi). The system should hold pressure for three hours. ● After three hours, is the pressure reading 32.41 kPa (4.7 psi) or more? 	<p>Yes The system is operating correctly. TEST the system for normal operation.</p> <p>No GO to F17.</p>
<p>F17 CHECK THE SEAT CUSHION BOLSTER ADJUSTING PAD FOR LEAKS</p>	
<ul style="list-style-type: none"> ● Remove the in-line pressure gauge. 	<p>Yes</p>

- Use a hand pump and inflate the seat cushion bolster adjusting pad to 34.47 kPa (5 psi). The seat cushion bolster adjusting pad should hold pressure for three hours.
- **After three hours, is the pressure reading 32.41 kPa (4.7 psi) or more?**

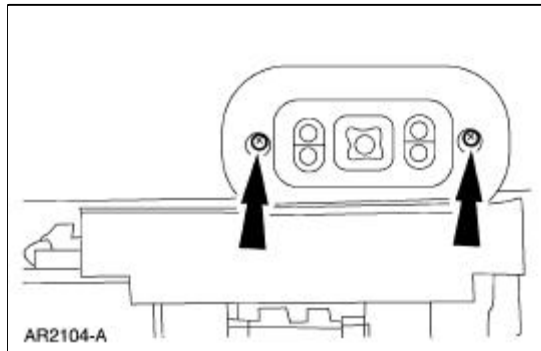
INSTALL a new bolster/lumbar pump and solenoid module. REFER to [Lumbar Motor](#). TEST the system for normal operation.

No
INSTALL a new seat cushion bolster adjusting pad. REFER to [Lumbar Assembly](#). TEST the system for normal operation.

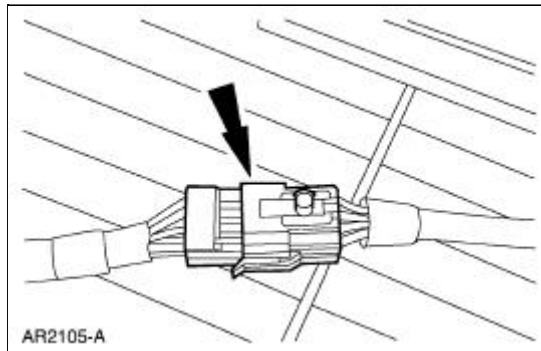
Switch —Seat Regulator Control

Removal and Installation

1. Disconnect the battery. For additional information, refer to [Section 414-01](#).
2. Remove the screws and position the seat regulator control switch aside.



3. Disconnect the electrical connector and remove the seat regulator control switch.



4. To install, reverse the removal procedure.
-

Lumbar Control Switch

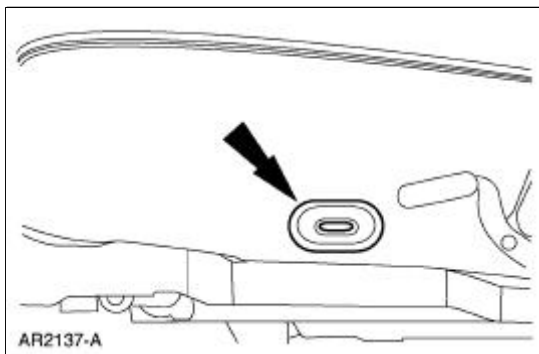
Removal and Installation

All vehicles

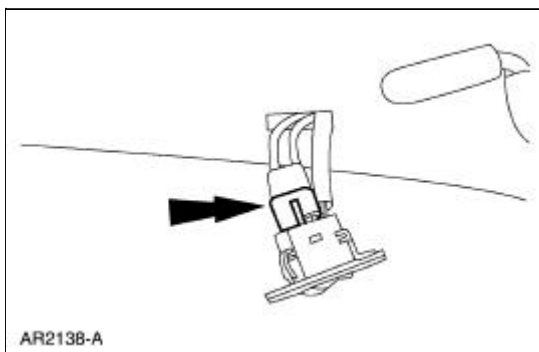
1. Remove the front seat. For additional information, refer to [Seat—Front Power](#) in this section.

Vehicles with standard power lumbar

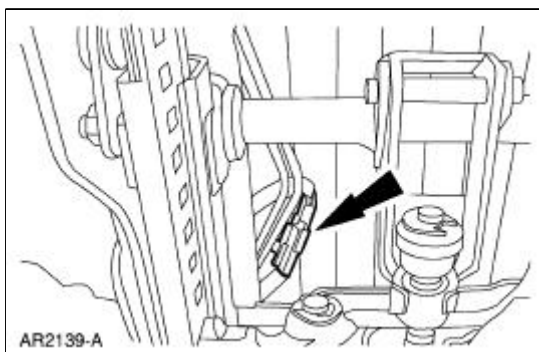
2. Pull to remove the lumbar control switch (14C715).



3. Disconnect the power lumbar support air hoses.



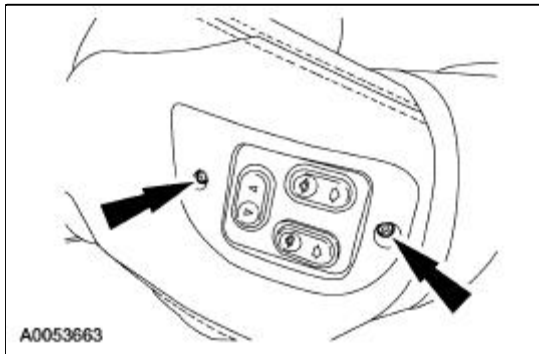
4. Disconnect the lumbar seat control switch electrical connector.



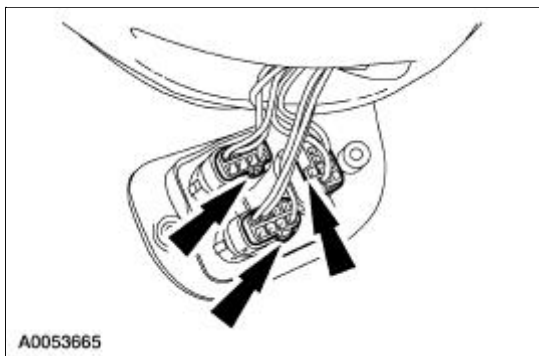
5. Remove the lumbar seat control switch.

Vehicles with power bolster and lumbar

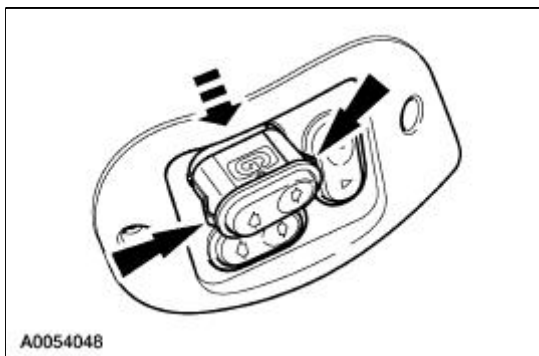
6. Remove the two screws for the power bolster and lumbar switch bezel.



7. Disconnect the power lumbar switch and the bolster switches.



8. Pinch the release tabs on the affected switch and push the switch through the bezel.



All vehicles

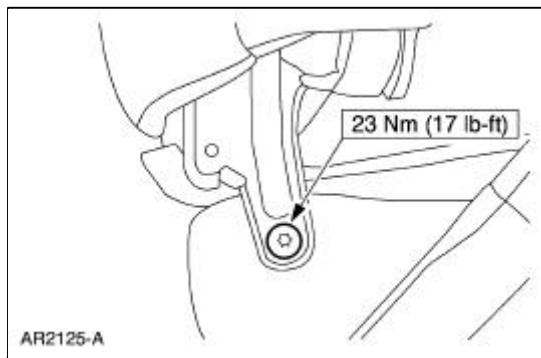
9. To install, reverse the removal procedure.
-

Front Seat Backrest

Removal and Installation

All vehicles

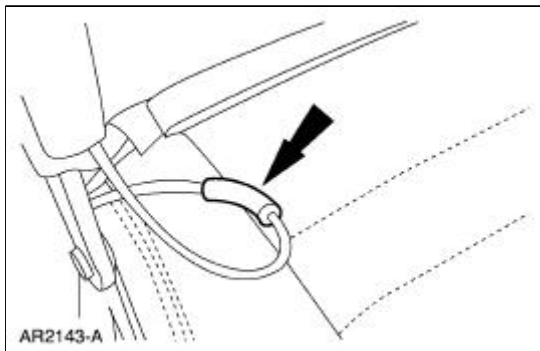
1. Remove the seat. For additional information, refer to [Seat—Front Power](#) in this section.
2. Remove the front seat backrest latch. For additional information, refer to [Latch—Front Seat Backrest](#) in this section.
3. Remove the pivot bolt and seat backrest.



Vehicles with standard power lumbar

4. **NOTE:** When installing the seat backrest pivot bolt, make sure the hose is in front of the pivot bolt.

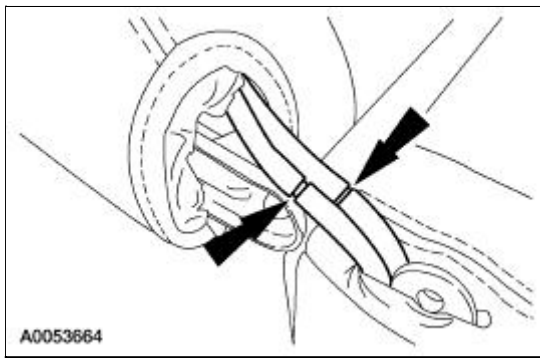
Disconnect the power lumbar air supply hose.



Vehicles with power bolster and lumbar

5. **NOTE:** When installing the seat backrest pivot bolt, make sure the hoses are in front of the pivot bolt.

Disconnect the power lumbar and bolster hoses.



All vehicles

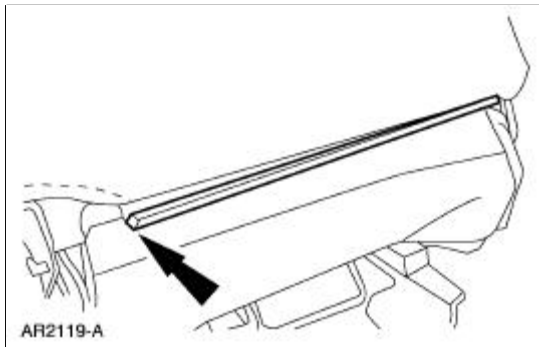
6. To install, reverse the removal procedure.
-

Lumbar Assembly

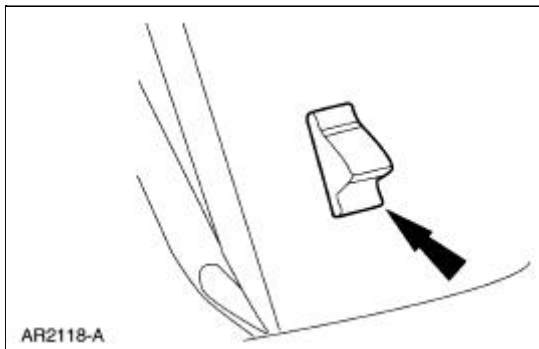
Removal and Installation

All vehicles

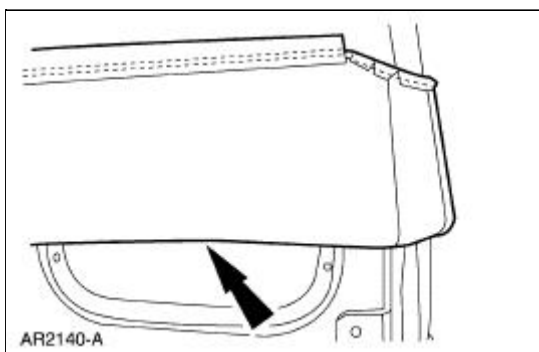
1. Remove the front seat. For additional information, refer to [Seat—Front Power](#) in this section.
2. Release the J-clip.



3. Remove the seat backrest latch handle knob (62762).



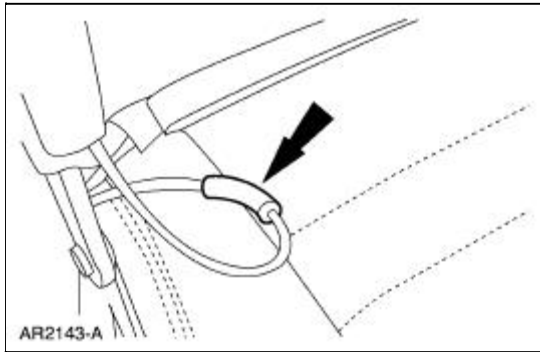
4. Pull the seat backrest trim cover up to the top of the seat.



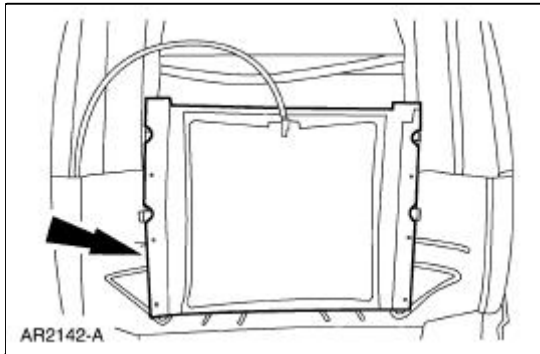
5. Remove the seat backrest foam pad from the seat backrest frame.

Vehicles with standard power lumbar

6. Disconnect the power lumbar support air hose.

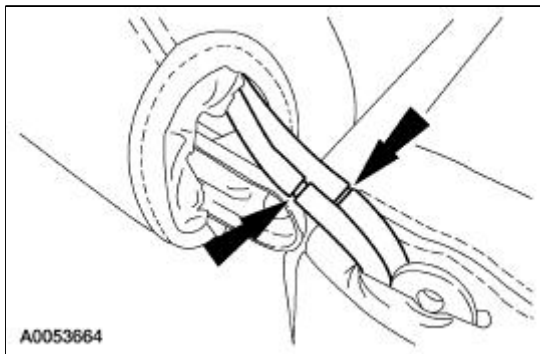


7. Remove the seat backrest adjuster (65500).

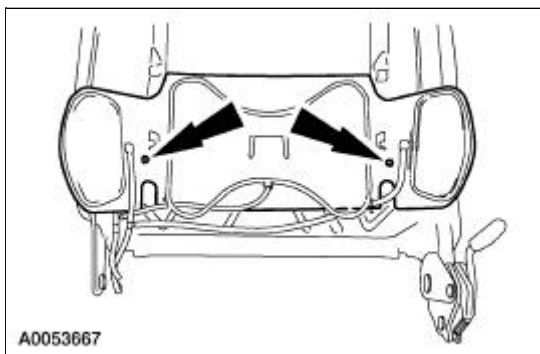


Vehicles with power bolster and lumbar

8. Disconnect the lumbar and bolster air supply hoses.



9. Remove the two screws and remove the lumbar and bolster adjuster pad.



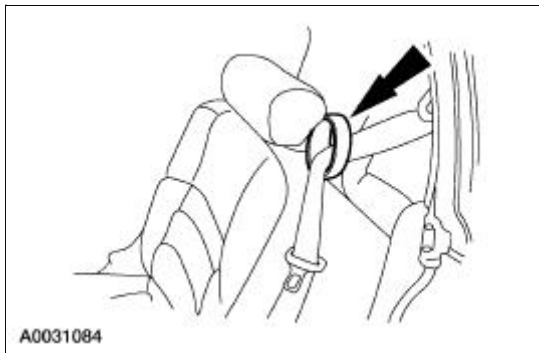
All vehicles

10. To install, reverse the removal procedure.
-

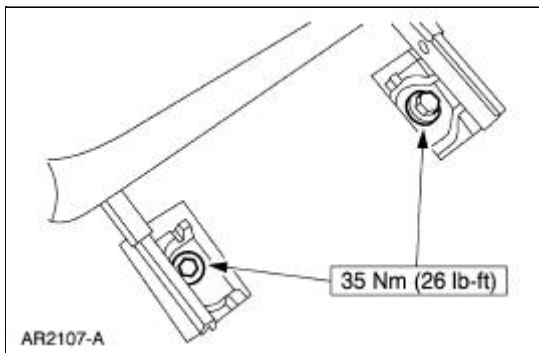
Seat —Front Power

Removal and Installation

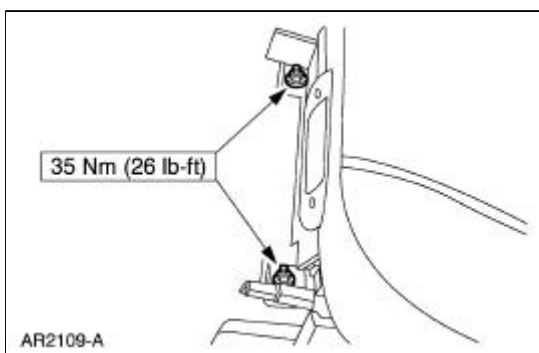
1. Remove the safety belt through the opening in the safety belt guide.



2. Move the seat forward.
3. Remove the bolt covers and remove the seat track bolts.

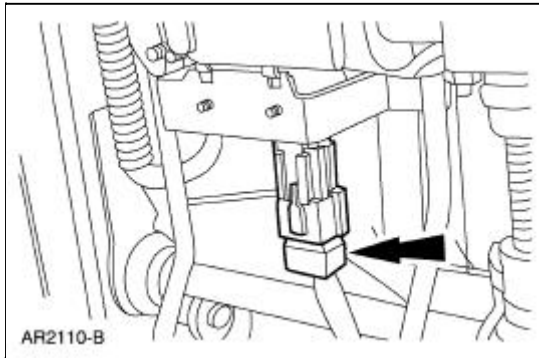


4. Move the seat rearward.
5. Remove the seat track nuts.



6. Move the seat forward.
7. Disconnect the battery. For additional information, refer to [Section 414-01](#).

8. Disconnect the power seat electrical connector.

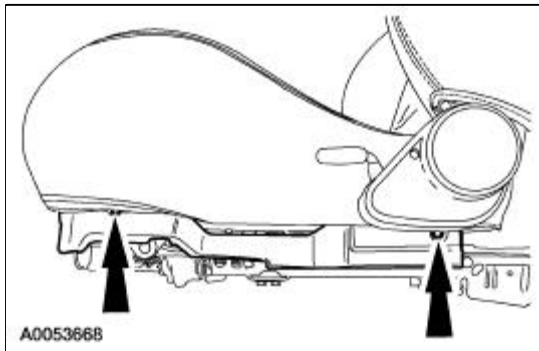


9. Remove the power seat.
 10. To install, reverse the removal procedure.
-

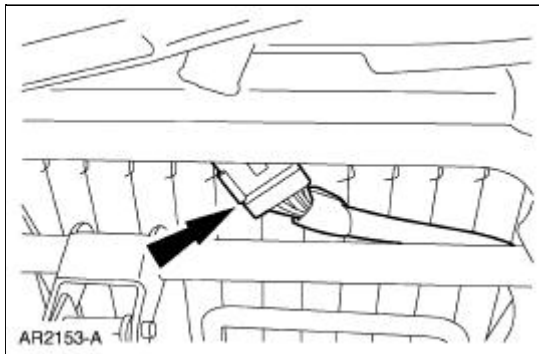
Seat Track

Removal and Installation

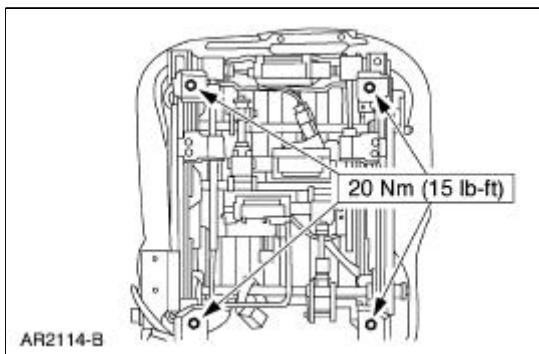
1. Remove the front seat. For additional information, refer to [Seat—Front Power](#) in this section.
2. Remove the outboard seat trim shield.



3. Disconnect the electrical connector.



4. Remove the seat track bolts.



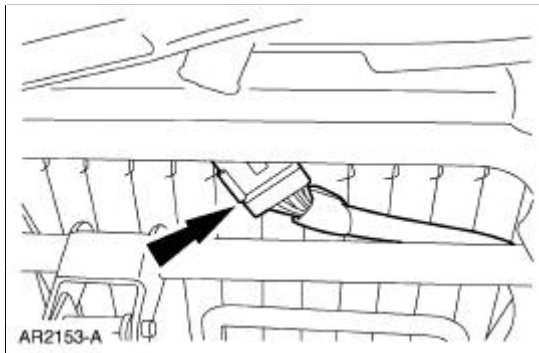
5. To install, reverse the removal procedure.

Lumbar Motor

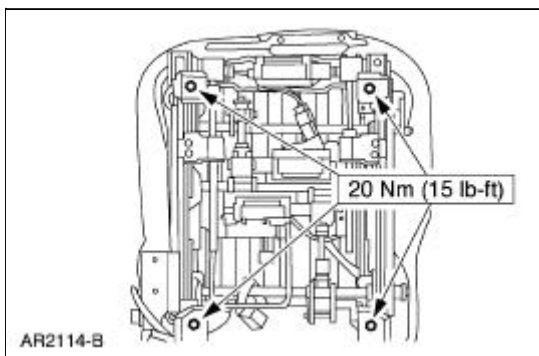
Removal and Installation

All vehicles

1. Remove the front seat. For additional information, refer to [Seat—Front Power](#) in this section.
2. Disconnect the power seat track electrical connector.

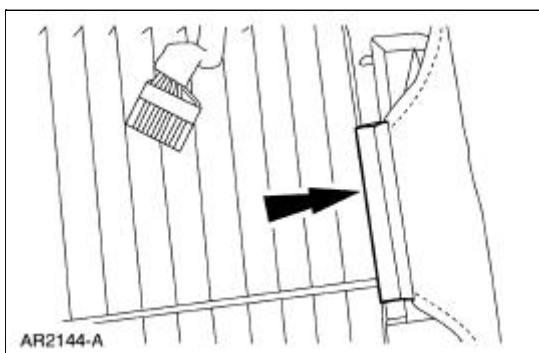


3. Remove the four seat track bolts.

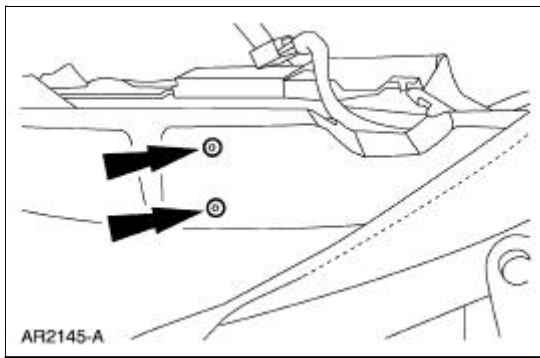


Vehicles with standard power lumbar

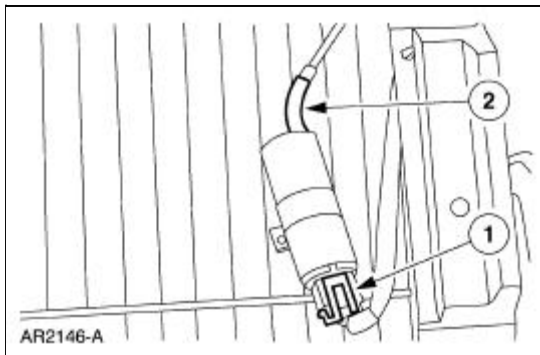
4. Release the J-clip.



5. Remove the front seat backrest pad adjusting pump screws.

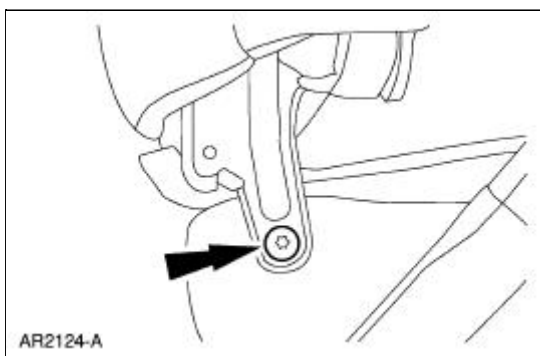


6. Remove the front seat backrest pad adjusting pump (65530).
 1. Disconnect the electrical connector.
 2. Disconnect the power lumbar support air hose.

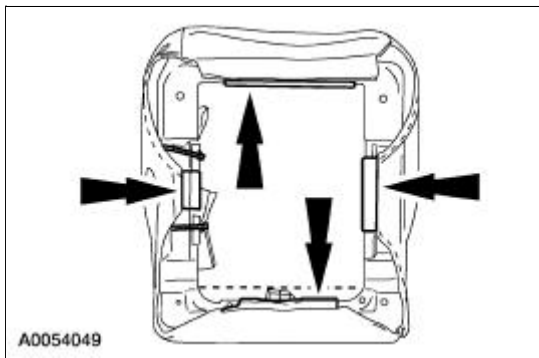


Vehicles with power bolster and lumbar

7. Remove the driver seat backrest latch. For additional information, refer to [Latch—Front Seat Backrest](#) in this section.
8. Remove the pivot bolt and seat backrest.
 - Disconnect the power lumbar support air hoses.



9. Release the J-clips.



10. **NOTE:** When removing the cushion from the frame, it is not necessary to remove the trim cover from the cushion foam pad.

Remove the cushion foam pad from the frame.

11. **NOTE:** The lumbar and bolster pump and solenoid module is serviced as part of the cushion frame assembly.

Install a new seat cushion frame assembly.

All vehicles

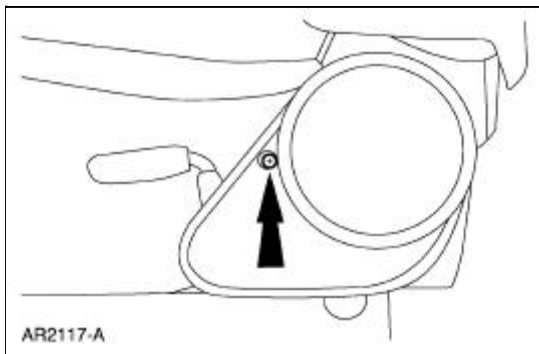
12. To install, reverse the removal procedure.
-

Latch —Front Seat Backrest

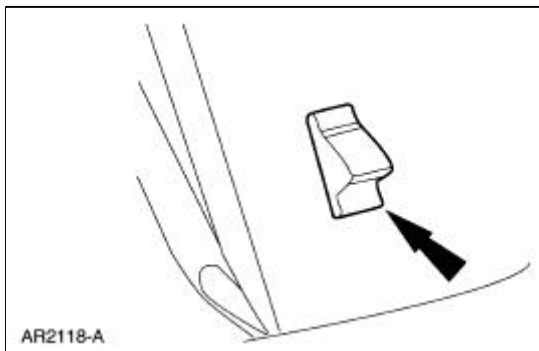
Removal

NOTE: The power seat backrest adjuster assembly must be installed as a new unit. Repair of the power seat backrest adjuster assembly components is not acceptable and should not be attempted.

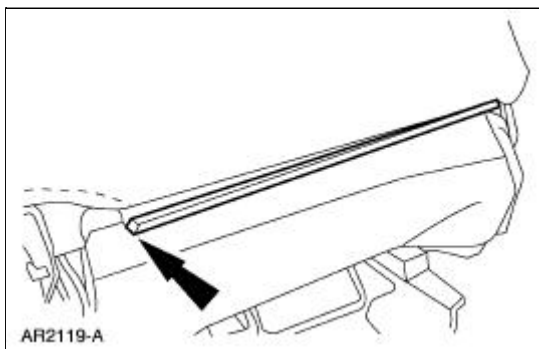
1. Remove the two screws and the seat backrest latch cover.



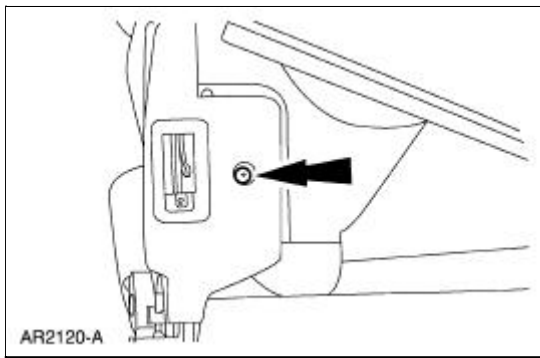
2. Remove the seat backrest latch handle knob (62762).



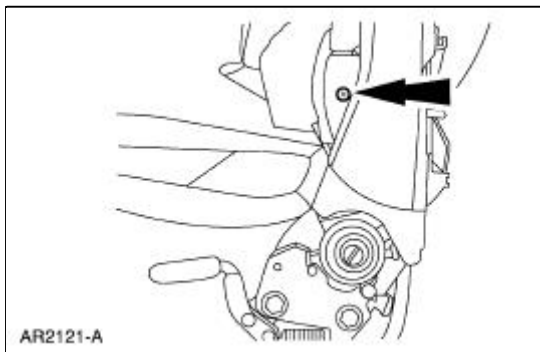
3. Release the J-retainer.



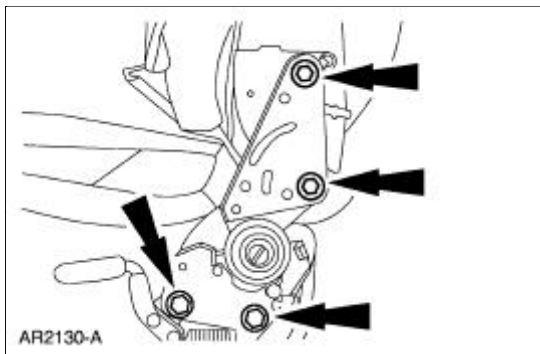
4. Remove the screw.



5. Remove the front seat backrest latch upper cover (62766).

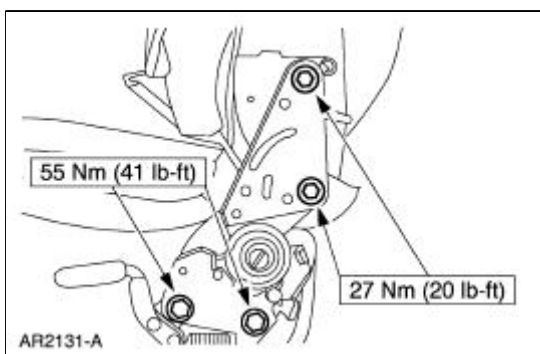


6. Remove the bolts and the seat backrest latch.



Installation

1. To install, reverse the removal procedure.



Front Seat Cushion

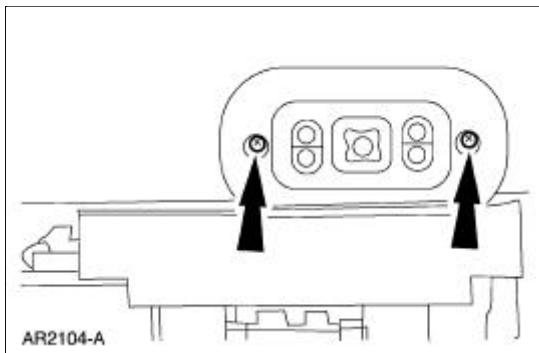
Disassembly and Assembly

All vehicles

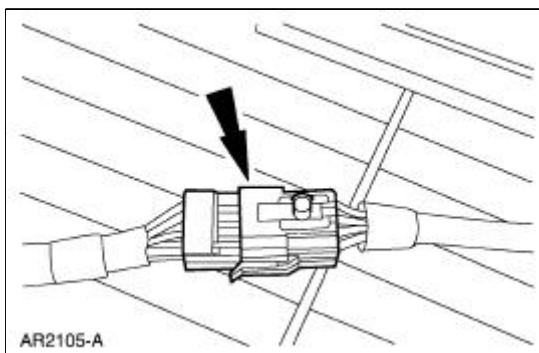
1. Remove the seat track. For additional information, refer to [Seat Track](#) in this section.
2. Remove the seat backrest. For additional information, refer to [Front Seat Backrest](#) in this section.

Vehicles with power seat

3. Remove the screws in the power seat control switch.

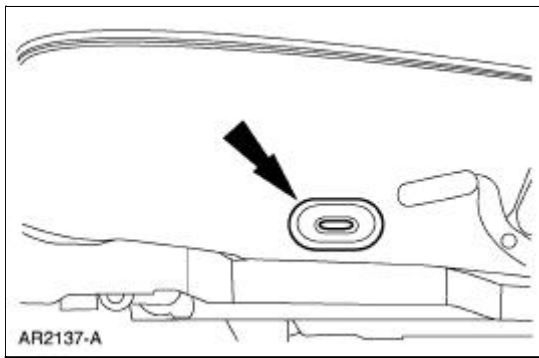


4. Disconnect the electrical connector and remove the power seat control switch.

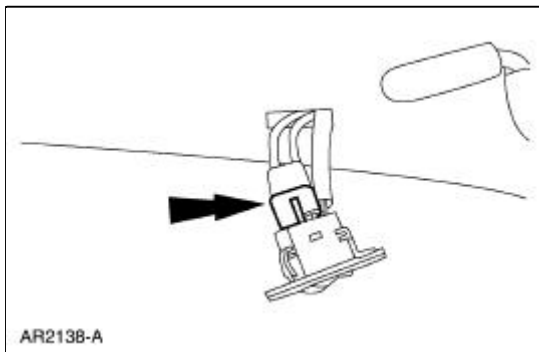


Vehicles with standard power lumbar

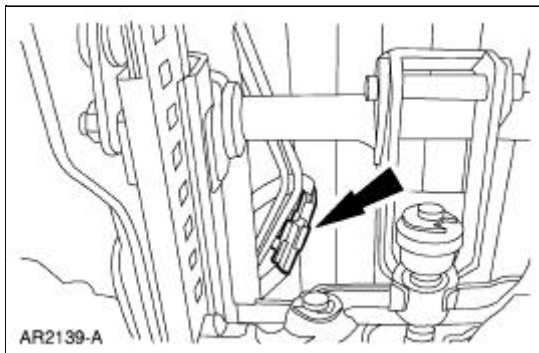
5. Remove the lumbar control switch (14C715).



6. Disconnect the power lumbar support air hoses.



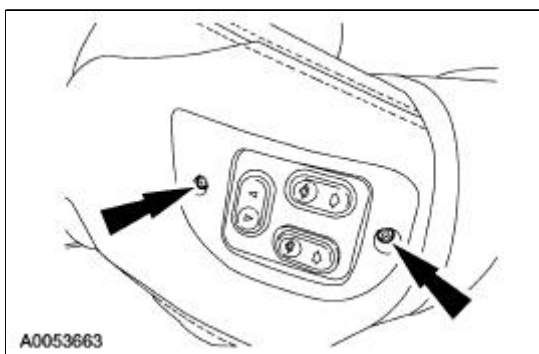
7. Disconnect the lumbar seat control switch electrical connector and remove the lumbar control switch.



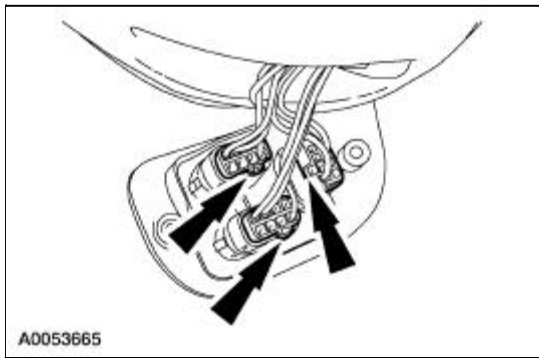
Vehicles with power bolster and lumbar

NOTE: For vehicles with lumbar and bolster, the pump and solenoid module are serviced as part of the seat cushion frame.

8. Remove the power lumbar and bolster seat switch screws.

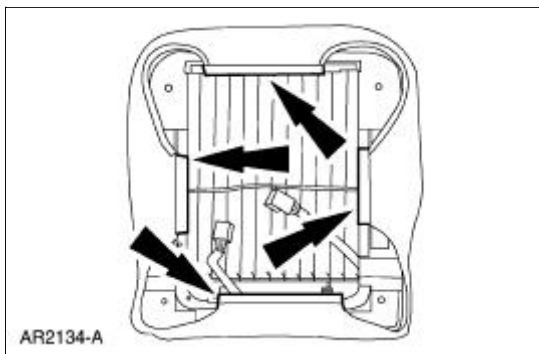


9. Disconnect the lumbar and bolster control switches.

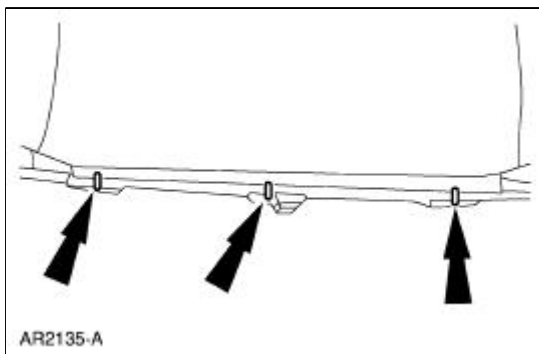


All vehicles

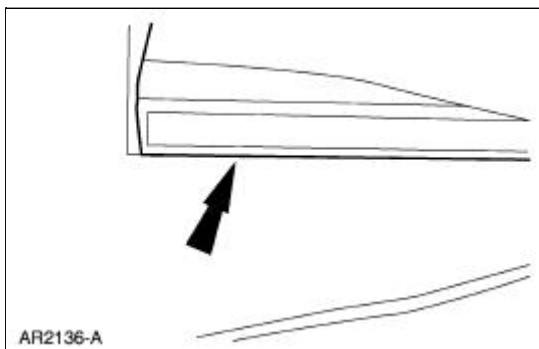
10. Remove the J-clips.



11. Remove the hog rings.



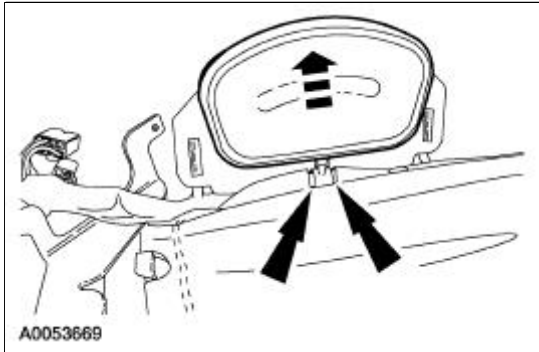
12. Remove the front seat cushion cover (62900) from the front seat cushion pad (632A22).



13. Remove the front seat cushion frame and spring (63100).

Vehicles with power cushion bolster

14. Disconnect the hoses from the two bolster adjuster pads (one shown) and slide the bolster adjuster pad up and off the seat cushion frame.



All vehicles

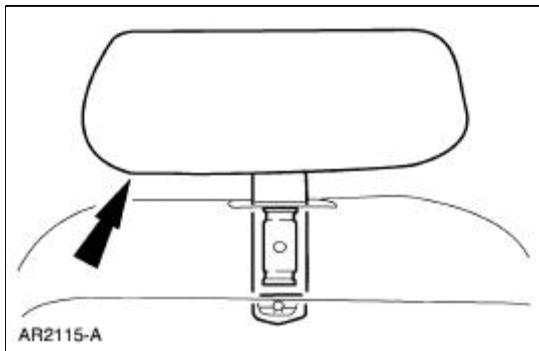
15. To assemble, reverse the disassembly procedure.
-

Front Seat Backrest

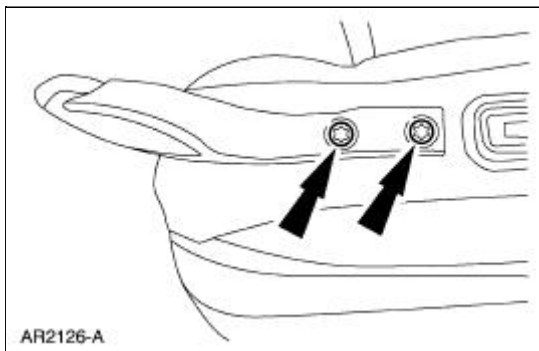
Disassembly and Assembly

All vehicles

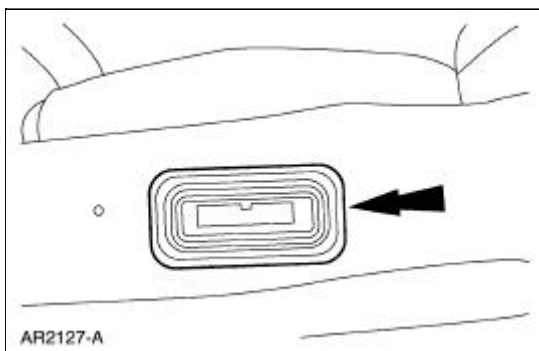
1. Remove the front seat backrest. For additional information, refer to [Front Seat Backrest](#) in this section.
2. Remove the front seat backrest head restraint (611A08).



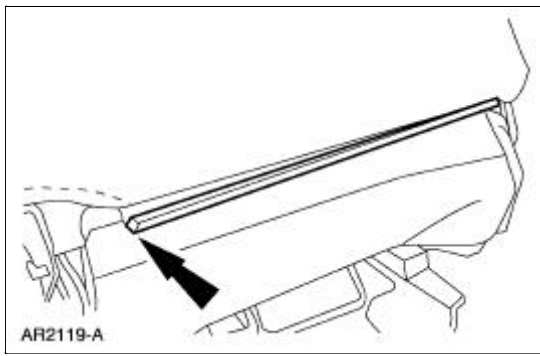
3. Remove the screws and the safety belt guide.



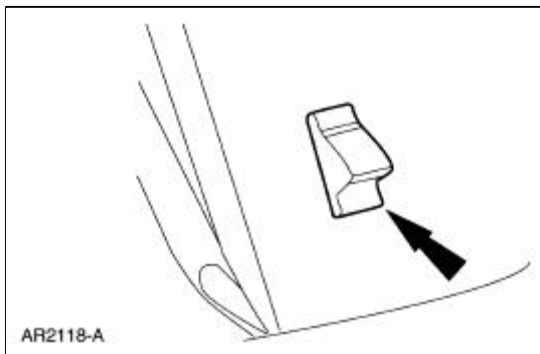
4. Remove the front seat headrest guide rod sleeve (610A16).



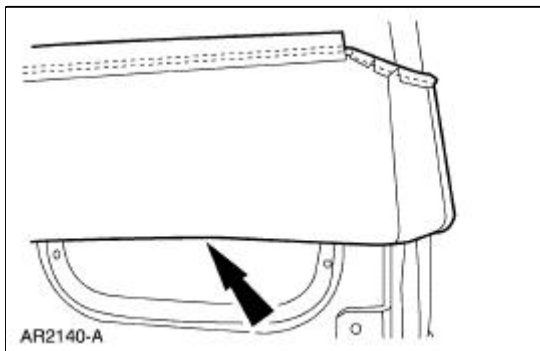
5. Release the J-clip.



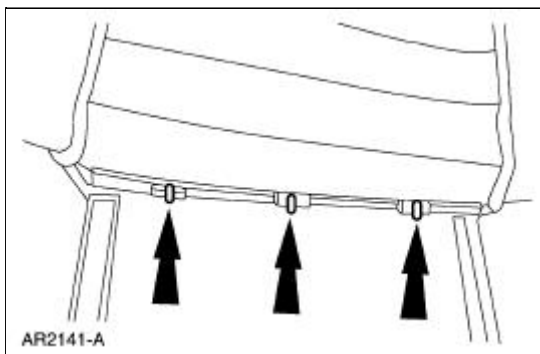
6. Remove the seat backrest latch handle knob.



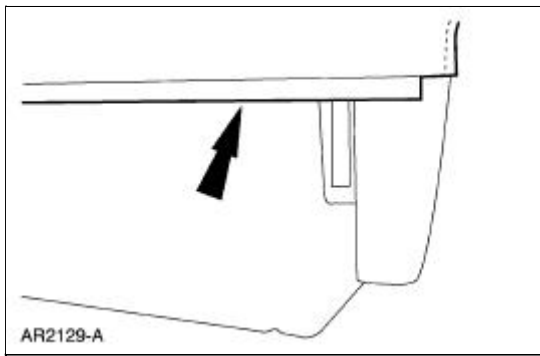
7. Pull the seat backrest trim cover upward.



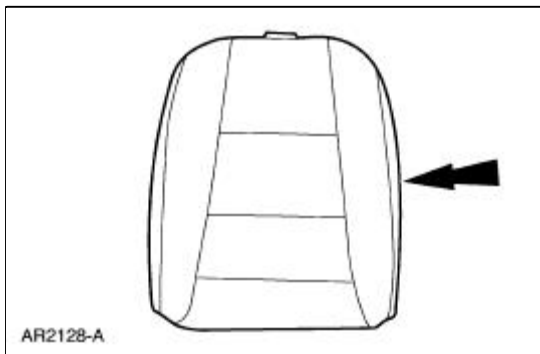
8. Remove the hog rings.



9. Remove the front seat backrest trim cover (64416) from the front seat backrest pad.

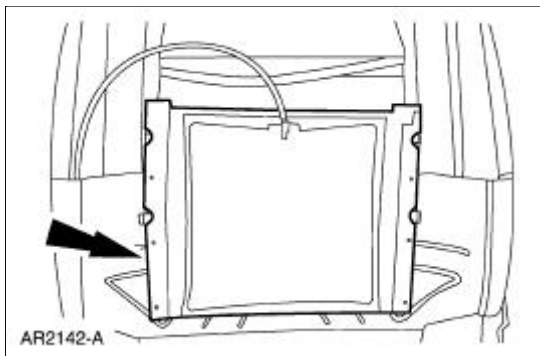


10. Release the front seat backrest frame (61018) from the front seat backrest foam pad.



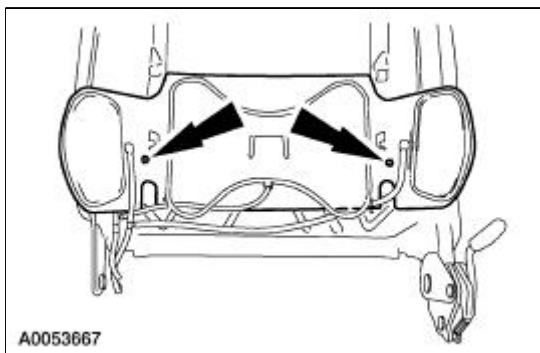
Vehicles with standard power lumbar

11. Remove the seat backrest lumbar adjuster pad.



Vehicles with power bolster and lumbar

12. Remove the two screws and the seat backrest lumbar and bolster adjuster pad.



All vehicles

13. To assemble, reverse the disassembly procedure.
-

**WINDOW REGULATOR ELECTRIC DRIVE
CURRENT DRAW**

Description	Specification
No Load	5 amperes or less at 12.8 volts

General Specifications

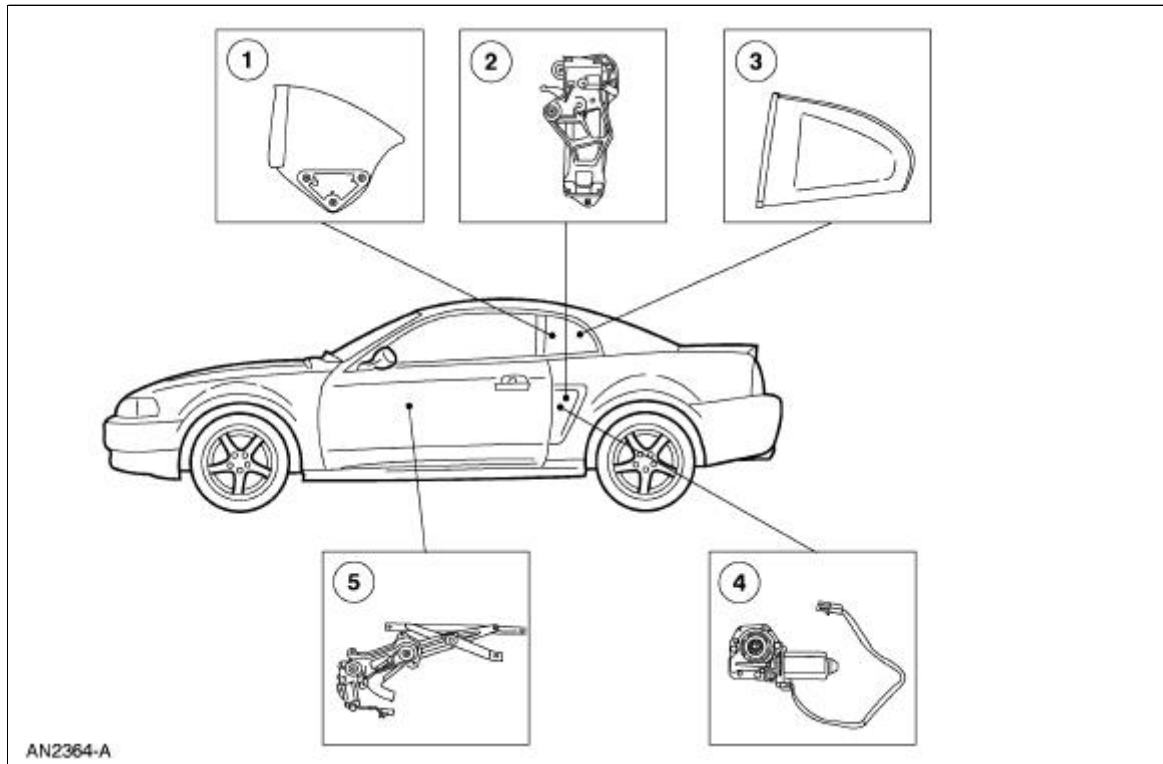
Item	Specification
Silicone Lubricant F7AZ-19G208-BA	ESR-M13P4-A
Multi-Purpose Grease Spray F5AZ-19G209-BA	ESR-M1C159-A
Multi-Purpose Grease DOAZ-19584-AA	ESB-M1C93-B
Rear Window Defroster Repair D8AZ-19562-AA or equivalent	WSB-M4J58-B
Urethane Glass Prep Essex U-401	WSB-M2G314-B
Dark Walnut Metallic Acrylic Lacquer Touch Up Paint ALBZ-19500-5858A or equivalent	ESR-M2-P100-C
Urethane Metal Primer Essex U-413	WSB-M2G234-C
Urethane Adhesive Essex U-216	WSB-M2G316-B
Urethane Adhesive Essex 400 HV	WSB-M2G316-B
Urethane Glass Primer Essex U-402	WSB-M5B280-C

Torque Specifications

Description	Nm	lb-ft	lb-in
Exterior weatherstrip screw	2	—	18
Window run screws	13	10	—
Window regulator motor screws	10	—	89
Upper regulator mounting nuts	13	10	—
Rear door window regulator motor screws	6	—	53
Quarter window regulator nuts	9	—	80
Door window stop bracket screws	12	9	—
Door window glass inner stabilizer bolts	12	9	—
Quarter window glass nuts	3	—	27
Convertible quarter glass retaining bolts/nut	9	—	80
Window regulator equalizer arm nuts	9	—	80
Window regulator nuts	9	—	80
Quarter window regulator nuts	9	—	80

Glass, Frames and Mechanisms

Component Location



Item	Part Number	Description
1	7629710	Convertible quarter window glass
2	7630306	Convertible quarter glass window regulator
3	6329710	Coupe quarter window glass
4	7623394	Convertible quarter window regulator motor
5	6323200	Window regulator with motor

Windshield Glass

The windshield exterior mouldings are installed with the windshield glass. The windshield exterior mouldings cannot be replaced without removal of the windshield.

Window Regulator Control Switch

Power windows are standard on all models. On coupe models, only the front door window glass can be raised or lowered. The quarter window glass is fixed. On the convertible models, all four windows can be raised or lowered. On all models, the window regulator control switches are available only to the front seat passengers. There are no window regulator controls for the back seat passengers. Quarter window glass operations are controlled by the driver window regulator control switch.

Window, One-Touch Down

The LH window one-touch down feature is activated by momentarily pressing the driver window

regulator control switch to the down position. This allows the front door window glass to move downward until it is fully lowered. Momentarily pressing the window regulator control switch while the window glass is moving downward will stop the front door window glass.

Window Glass, Door

The bottom of the door window glass is mounted on a slider bracket which is part of the front door window regulator. Door window glass bracket spacers provide attachment points for the door window glass and prevent direct contact between the slider bracket and the door window glass.

Window Glass, Quarter

The rear quarter window glasses on convertible models are driven by a window regulator motor and guide assembly.

Window Glass, Rear



On the coupe, the rear window upper garnish mouldings are installed with the rear window glass. The rear window upper garnish mouldings cannot be replaced without removing the rear window glass.

Glass, Frames and Mechanisms

Refer to Wiring Diagrams Cell [100](#), Power Windows for schematic and connector information.

Refer to Wiring Diagrams Cell [56](#), Rear Window Defrost for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool
 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Principles of Operation

Power Window Control

NOTE: Battery power and ground must be removed before disconnecting the GEM connectors to avoid setting false DTCs.

The driver power window one-touch down operation is controlled by the generic electronic module (GEM). This feature functions only when the ignition switch is in the RUN or ACCY positions. The GEM determines ignition switch position by monitoring the key-in ignition, RUN/ACCY and RUN/START circuits. The one-touch down operation is requested of the GEM by momentarily pressing the driver window regulator control switch DOWN for 62 ms to 320 ms. The GEM uses the initial voltage input from the down switch to begin the one-touch down operation. If the voltage input was less than 320 ms, the GEM will maintain the voltage supply to the motor down circuit. The GEM will maintain the operation until:

- seven seconds expires.
- motor stall is detected by monitoring the current draw.
- a voltage input is received by the GEM on either the up or down switch circuits.

The ground for one-touch down operation does not pass through the GEM. The ground is supplied through the driver window regulator control switch as with normal operation. If the GEM continues to see voltage on the down circuit for more than 320 ms after initial activation the GEM will not effect operation. The down circuit through the GEM is a direct connection to the motor in its normal state. This allows the driver window regulator control switch to control the motor for normal operation.

The passenger window motors are hardwired directly to the window regulator control switches.

Inspection and Verification

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> ● Power window regulator ● Window run weatherstrip ● Door window glass 	<ul style="list-style-type: none"> ● Central junction box (CJB) circuit breaker 43 (20A), fuse 39 (5A) or 23 (15A) ● Battery junction box (BJB) fuse HTD BL (40A) ● Generic electronic module (GEM) ● Window regulator control switch ● Window regulator motor ● Instrument cluster module (ICM) ● Heated rear window relay ● Rear window defrost switch ● Heated rear window grid ● Circuitry

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the diagnostic tool does not communicate with the vehicle, refer to the diagnostic tool manual.
5. Carry out the DATA LINK DIAGNOSTIC TEST. If the diagnostic tool responds with:
 - CKT 914, CKT 915 or CKT70 - ALL ECUS NO RESP/NOT EQUIP, refer to [Section 418-00](#).
 - NO RESP/NOT EQUIP for the generic electronic module (GEM), go to Pinpoint Test A.
 - NO RESP/NOT EQUIP for the instrument cluster module (ICM), refer to [Section 413-01](#).
 - System passed, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the GEM or ICM.
6. If the GEM or ICM DTCs retrieved are related to the concern, go to the GEM or ICM Diagnostic Trouble Code (DTC) Index.
7. If no DTCs related to the concern are retrieved, proceed to the Symptom Chart to continue diagnostics.

GEM DIAGNOSTIC TROUBLE CODE (DTC) INDEX

DTC	Description	Source	Action
B1217	Horn Relay Output Driver Circuit Failure	GEM	GO to Section 501-14B .
B1218	Horn Relay Output Driver Short to Battery	GEM	GO to Section 501-14B .
B1312	Lamp Headlamp Input Circuit	GEM	GO to Section 413-09 .

	Short to Battery		
B1317	Battery Voltage High	GEM	GO to Section 414-00 .
B1318	Battery Voltage Low	GEM	GO to Section 414-00 .
B1322	Door Ajar Driver Circuit Short to Ground	GEM	GO to Section 417-02 .
B1330	Door Ajar Passenger Circuit Short to Ground	GEM	GO to Section 417-02 .
B1334	Decklid Ajar Rear Door Circuit Short to Ground	GEM	GO to Section 417-02 .
B1339	Chime Input Request Circuit Short to Battery	GEM	GO to Section 413-09 .
B1340	Chime Input Request Circuit Short to Ground	GEM	GO to Section 413-09 .
B1342	ECU is Defective	GEM	CLEAR the DTC. RETRIEVE the DTCs. If DTC B1342 is retrieved, INSTALL a new GEM. REFER to Section 419-10 .
B1353	Ignition Key-in Circuit Open	GEM	GO to Section 413-09 .
B1359	Ignition RUN/ACC Circuit Failure	GEM	GO to Section 211-05 .
B1396	Power Door Lock Circuit Short to Battery	GEM	GO to Section 501-14B .
B1397	Power Door Unlock Circuit Short to Battery	GEM	GO to Section 501-14B .
B1405	Power Window Driver Down Circuit Short to Battery	GEM	GO to Pinpoint Test D for convertible or Pinpoint Test E for coupe.
B1408	Power Window Driver Up Circuit Short to Battery	GEM	GO to Pinpoint Test D for convertible or Pinpoint Test E for coupe.
B1410	Power Window Driver Motor Circuit Failure	GEM	GO to Pinpoint Test D for convertible or Pinpoint Test E for coupe.
B1426	Lamp Safety Belt Circuit Short to Battery	GEM	REFER to Section 413-01 .
B1428	Lamp Safety Belt Circuit Failure	GEM	REFER to Section 413-01 .
B1431	Wiper Brake/run Relay Circuit Failure	GEM	GO to Section 501-16 .
B1432	Wiper Brake/run Relay Circuit Short to Battery	GEM	GO to Section 501-16 .
B1434	Wiper High/low Speed Relay Coil Circuit Failure	GEM	GO to Section 501-16 .
B1436	Wiper High/low Speed Relay Coil Circuit Short to Battery	GEM	GO to Section 501-16 .
B1438	Wiper Mode Select Switch Circuit Failure	GEM	GO to Section 501-16 .
B1441	Wiper Mode Select Switch Circuit Short to Ground	GEM	GO to Section 501-16 .
B1446	Wiper Park Sense Circuit Failure	GEM	GO to Section 501-16 .
B1448	Wiper Park Sense Circuit Short to Battery	GEM	GO to Section 501-16 .

B1450	Wiper Wash/delay Switch Circuit Failure	GEM	GO to Section 501-16 .
B1453	Wiper Wash/delay Switch Circuit Short to Ground	GEM	GO to Section 501-16 .
B1458	Wiper Washer Pump Motor Relay Circuit Failure	GEM	GO to Section 501-16 .
B1460	Wiper Washer Pump Motor Relay Circuit Short to Battery	GEM	GO to Section 501-16 .
B1462	Safety Belt Switch Circuit Failure	GEM	GO to Section 413-09 .
B1466	Wiper High/low Speed Not Switching	GEM	GO to Section 501-16 .
B1473	Wiper Low Speed Circuit Motor Failure	GEM	GO to Section 501-16 .
B1476	Wiper High Speed Circuit Motor Failure	GEM	GO to Section 501-16 .
B1498	Decklid Punch-out Sensor Ground Short	GEM	GO to Section 419-01 .
B1551	Decklid Release Circuit Failure	GEM	GO to Section 501-14B .
B1553	Decklid Release Circuit Short to Battery	GEM	GO to Section 501-14B .
B1555	Ignition RUN/START Circuit Failure	GEM	GO to Section 211-05 .
B1603	Lamp Anti-Theft Indicator Circuit Failure	GEM	GO to Section 419-01 .
B1605	Lamp Anti-Theft Indicator Circuit Short to Battery	GEM	GO to Section 419-01 .
B1687	Lamp Dome Input Circuit Short to Battery	GEM	GO to Section 417-02 .
B1833	Door Unlock Disarm Switch Circuit Short to Ground	GEM	GO to Section 419-01 .
B2486	Parklamp Output Relay Driver Circuit Failure	GEM	GO to Section 419-01 .
B2488	Parklamp Output Relay Driver Circuit Short to Battery	GEM	GO to Section 419-01 .
C1189	Brake Fluid Level Sensor Input Circuit Short to Ground	GEM	REFER to Section 413-01 .
C1223	Lamp Brake Warning Output Circuit Failure	GEM	REFER to Section 413-01 .
C1225	Lamp Brake Warning Output Circuit Short to Battery	GEM	REFER to Section 413-01 .

ICM DIAGNOSTIC TROUBLE CODE (DTC) INDEX

DTC	Description	Source	Action
B1343	Heated Backlight Input Circuit Failure	ICM	GO to Pinpoint Test H .

Symptom Chart

Refer to the Wiring Diagrams for the connector numbers stated in pinpoint tests.


Symptom Chart

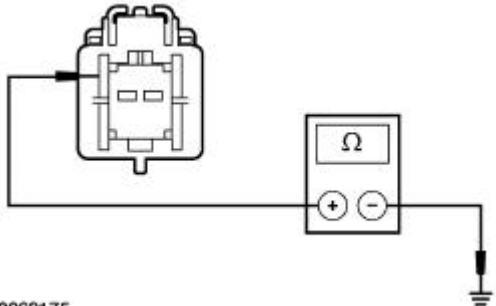
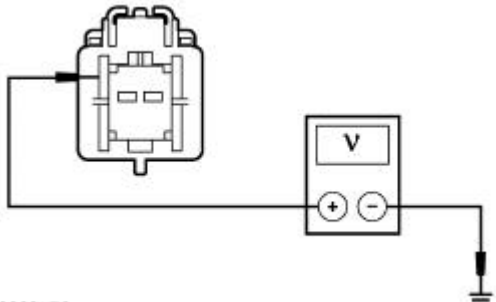
Condition	Possible Sources	Action
<ul style="list-style-type: none"> No communication with the generic electronic module (GEM) 	<ul style="list-style-type: none"> Central junction box (CJB) fuse 39 (5A). GEM. Circuitry. 	<ul style="list-style-type: none"> GO to Pinpoint Test A.
<ul style="list-style-type: none"> All power windows are inoperative — convertible 	<ul style="list-style-type: none"> Circuitry. CJB circuit breaker 43 (20A). Window regulator control switch. 	<ul style="list-style-type: none"> GO to Pinpoint Test B.
<ul style="list-style-type: none"> All power windows are inoperative — coupe 	<ul style="list-style-type: none"> Circuitry. CJB circuit breaker 43 (20A). Window regulator control switch. 	<ul style="list-style-type: none"> GO to Pinpoint Test C.
<ul style="list-style-type: none"> A single power window is inoperative — driver, convertible 	<ul style="list-style-type: none"> Circuitry. CJB fuse 43 (20A). Ignition switch. Window regulator motor. Window regulator control switch. GEM. 	<ul style="list-style-type: none"> GO to Pinpoint Test D.
<ul style="list-style-type: none"> A single power window is inoperative — driver, coupe 	<ul style="list-style-type: none"> Circuitry. CJB fuse 43 (20A). Ignition switch. Window regulator motor. Window regulator control switch. GEM. 	<ul style="list-style-type: none"> GO to Pinpoint Test E.
<ul style="list-style-type: none"> The one-touch down feature is inoperative 	<ul style="list-style-type: none"> Circuitry. CJB fuse 43 (20A). Ignition switch. Window regulator motor. Window regulator control switch. GEM. 	<ul style="list-style-type: none"> For convertible, GO to Pinpoint Test D. For coupe, GO to Pinpoint Test E.
<ul style="list-style-type: none"> A single power window is inoperative — passenger 	<ul style="list-style-type: none"> Circuitry. Driver window regulator control switch. Window regulator motor. Passenger window regulator control switch. 	<ul style="list-style-type: none"> GO to Pinpoint Test F.
<ul style="list-style-type: none"> A single power window is 	<ul style="list-style-type: none"> Circuitry. 	<ul style="list-style-type: none"> GO to Pinpoint

inoperative — rear, convertible only	<ul style="list-style-type: none"> Window regulator motor. Driver window regulator control switch. 	Test G .
<ul style="list-style-type: none"> The defrost system is inoperative 	<ul style="list-style-type: none"> BJB fuse HTD BL (30A). CJB fuse 23 (15A). Circuitry. Instrument cluster module (ICM). Rear window defrost switch. Heated rear window grid. 	<ul style="list-style-type: none"> GO to Pinpoint Test H.
<ul style="list-style-type: none"> The defrost system will not shut off automatically 	<ul style="list-style-type: none"> Circuit. ICM. Rear window defrost switch. 	<ul style="list-style-type: none"> GO to Pinpoint Test I.

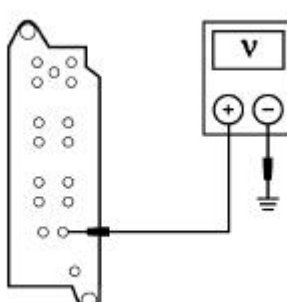
Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE GENERIC ELECTRONIC MODULE (GEM)

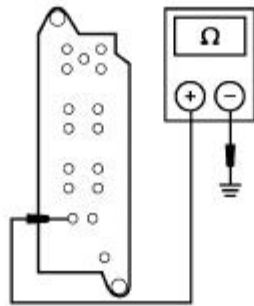
Test Step	Result / Action to Take															
 CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.																
A1 CHECK THE GENERIC ELECTRONIC MODULE (GEM) POWER SUPPLY <ul style="list-style-type: none"> Key in OFF position. Disconnect: Generic Electronic Module (GEM) C201a. Disconnect: GEM C201b. Key in ON position. Using the following table, measure the voltage between the GEM, harness side and ground. <table border="1"> <thead> <tr> <th>Connector</th> <th>Pin</th> <th>Circuit</th> </tr> </thead> <tbody> <tr> <td>C201a</td> <td>4</td> <td>400 (LB/BK)</td> </tr> <tr> <td>C201a</td> <td>1</td> <td>1006 (DG/WH)</td> </tr> <tr> <td>C201b</td> <td>2</td> <td>1001 (WH/YE)</td> </tr> <tr> <td>C201b</td> <td>3</td> <td>193 (YE/LG)</td> </tr> </tbody> </table> <ul style="list-style-type: none"> Are the voltages greater than 10 volts? 	Connector	Pin	Circuit	C201a	4	400 (LB/BK)	C201a	1	1006 (DG/WH)	C201b	2	1001 (WH/YE)	C201b	3	193 (YE/LG)	<p>Yes GO to A2.</p> <p>No REPAIR the circuit(s) in question. TEST the system for normal operation.</p>
Connector	Pin	Circuit														
C201a	4	400 (LB/BK)														
C201a	1	1006 (DG/WH)														
C201b	2	1001 (WH/YE)														
C201b	3	193 (YE/LG)														
A2 CHECK THE GEM GROUND CIRCUIT 397 (BK/WH) FOR OPEN <ul style="list-style-type: none"> Key in OFF position. Measure the resistance between the GEM C201b pin 4, circuit 397 (BK/WH), harness side and ground. 	<p>Yes GO to A3.</p> <p>No</p>															

 <p>A0069175</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>REPAIR the circuit(s) in question. TEST the system for normal operation.</p>
<p>A3 CHECK CIRCUIT 397 (BK/WH) FOR SHORT TO POWER</p>	
<ul style="list-style-type: none"> ● Measure the voltage between the GEM C201b pin 4, circuit 397 (BK/WH), harness side and ground.  <p>A0069176</p> <ul style="list-style-type: none"> ● Is any voltage present? 	<p>Yes REPAIR the circuit. TEST the system for normal operation.</p> <p>No REFER to Section 418-00.</p>

PINPOINT TEST B: ALL POWER WINDOWS ARE INOPERATIVE — CONVERTIBLE

Test Step	Result / Action to Take
<p>B1 CHECK THE POWER SUPPLY TO THE WINDOW REGULATOR CONTROL SWITCH</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Driver Window Regulator Control Switch C537. ● Key in ON position. ● Measure the voltage between driver window regulator control switch C537 pin 15, circuit 400 (LB/BK), harness side and ground.  <p>AN2405-A</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to B2.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<p>B2 CHECK CIRCUIT 1205 (BK) FOR AN OPEN</p>	
<ul style="list-style-type: none"> ● Measure the resistance between driver window regulator 	<p>Yes</p>

control switch C537 pin 14, circuit 1205 (BK), harness side and ground.



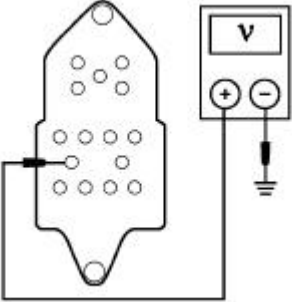
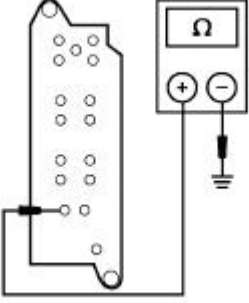
AN2407-A

- Is the resistance less than 5 ohms?

INSTALL a new driver window regulator control switch. REFER to [Switch—Window Regulator Control](#) in this section. TEST the system for normal operation.

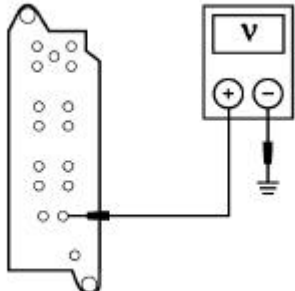
No
REPAIR the circuit. TEST the system for normal operation.

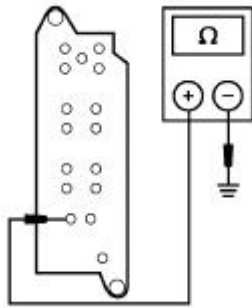
PINPOINT TEST C: ALL POWER WINDOWS ARE INOPERATIVE — COUPE

Test Step	Result / Action to Take
<p>C1 CHECK THE POWER SUPPLY TO THE WINDOW REGULATOR CONTROL SWITCH</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Driver Window Regulator Control Switch C508. ● Key in ON position. ● Measure the voltage between driver window regulator control switch C508 pin 10, circuit 400 (LB/BK), harness side and ground.  <p>AN2408-A</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to C2.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<p>C2 CHECK CIRCUIT 1205 (BK) FOR AN OPEN</p> <ul style="list-style-type: none"> ● Measure the resistance between driver window regulator control switch C508 pin 14, circuit 1205 (BK), harness side and ground.  <p>AN2407-A</p>	<p>Yes INSTALL a new driver window regulator control switch. REFER to Switch—Window Regulator Control in this section. TEST the system for normal operation.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>

- Is the resistance less than 5 ohms?

PINPOINT TEST D: A SINGLE POWER WINDOW IS INOPERATIVE — DRIVER, CONVERTIBLE

Test Step	Result / Action to Take
<p>D1 CHECK THE IGNITION SWITCH INPUT TO THE GEM</p> <ul style="list-style-type: none"> ● Select GEM PID IGN_A, IGN_R, IGN_S and IGN_KEY. ● Insert the ignition key in the ignition switch and turn to each position while monitoring PIDs. ● Did the PID values agree with the ignition switch positions? 	<p>Yes GO to D2.</p> <p>No REFER to Section 211-05 for ignition switch diagnosis.</p>
<p>D2 CHECK THE DRIVER WINDOW REGULATOR CONTROL SWITCH INPUT TO THE GEM</p> <ul style="list-style-type: none"> ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: GEM PID D_UP_SW and D_DN_SW. ● Actuate the driver window regulator control switch to the UP and DOWN position. ● Did the PID values agree with the driver window regulator control switch positions? 	<p>Yes GO to D9.</p> <p>No GO to D3.</p>
<p>D3 CHECK THE POWER SUPPLY TO THE WINDOW REGULATOR CONTROL SWITCH</p> <ul style="list-style-type: none"> ● Disconnect: Driver Window Regulator Control Switch C537. ● Key in ON position. ● Measure the voltage between driver window regulator control switch C537 pin 15, circuit 400 (LB/BK), harness side and ground. <div style="text-align: center;">  <p>AN2405-A</p> </div> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to D4.</p> <p>No GO to D8.</p>
<p>D4 CHECK CIRCUIT 1205 (BK) FOR AN OPEN</p> <ul style="list-style-type: none"> ● Measure the resistance between driver window regulator control switch C537 pin 14, circuit 1205 (BK), harness side and ground. 	<p>Yes GO to D5.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>



AN2407-A

- Is the resistance less than 5 ohms?

D5 CHECK THE DRIVER WINDOW REGULATOR CONTROL SWITCH

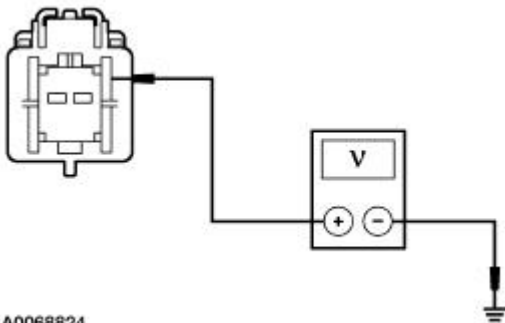
- Carry out the driver window regulator control switch component test. Refer to the Wiring Diagrams Cell 149, Component Testing.
- Did the driver window regulator control switch pass?

Yes
GO to [D6](#).

No
INSTALL a new driver window regulator control switch. REFER to [Switch—Window Regulator Control](#) in this section. TEST the system for normal operation.

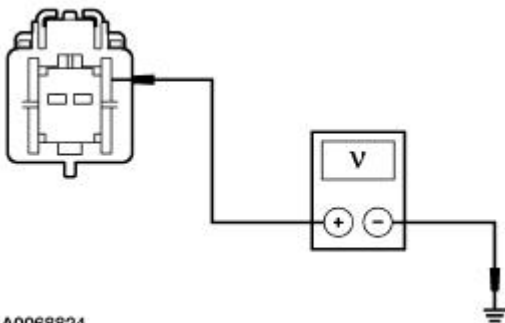
D6 CHECK CIRCUIT 226 (WH/BK) FOR A SHORT TO BATTERY

- Key in OFF position.
- Disconnect: GEM C201a.
- Measure the voltage between GEM C201a pin 2, circuit 226 (WH/BK), harness side and ground.



A0068824

- Key in ON position.
- Measure the voltage between GEM C201a pin 2, circuit 226 (WH/BK), harness side and ground.



A0068824

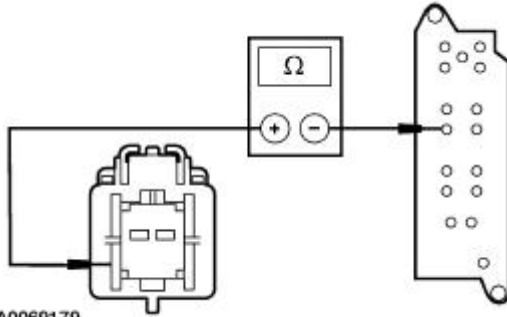
- Is either voltage greater than 10 volts?

Yes
REPAIR the circuit. TEST the system for normal operation.

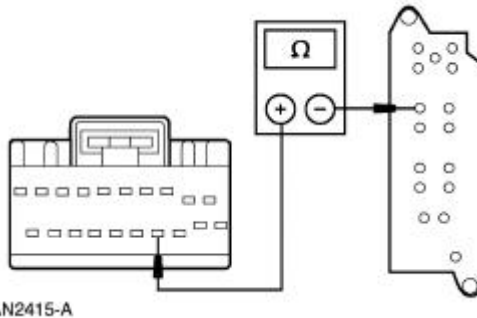
No
GO to [D7](#).

D7 CHECK CIRCUIT 991 (TN/LB) AND 992 (WH/BK) FOR AN OPEN

- Key in OFF position.
- Disconnect: GEM C201c.
- Measure the resistance between driver window regulator control switch C537 pin 8, circuit 991 (TN/LB), harness side and GEM C201a pin 3, circuit 991 (TN/LB), harness side.



- Measure the resistance between driver window regulator control switch C537 pin 6, circuit 992 (WH/BK), harness side and GEM C201c pin 14, circuit 992 (WH/BK), harness side.



- Are the resistances less than 5 ohms?

Yes

INSTALL a new GEM. REFER to [Section 419-10](#). TEST the system for normal operation.

No

REPAIR the circuit. TEST the system for normal operation.

D8 CHECK CIRCUIT 400 (LB/BK) FOR AN OPEN

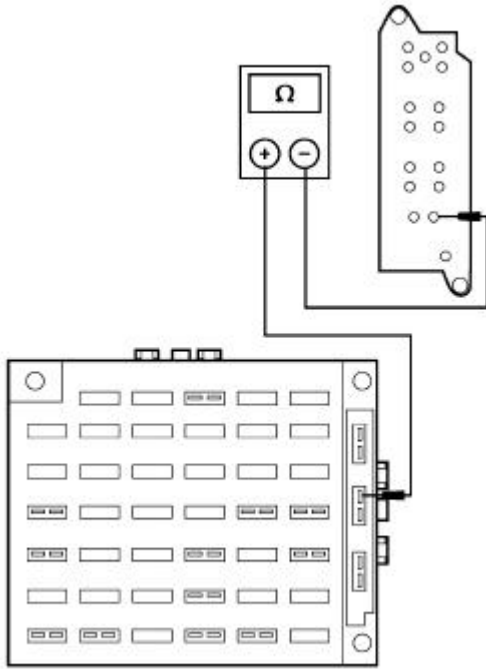
- Key in OFF position.
- Disconnect: CJB Circuit Breaker 43 (20A).
- Measure the resistance between driver window regulator control switch C537 pin 15, circuit 400 (LB/BK), harness side and CJB circuit breaker 43 (20A) output pin, circuit 400 (LB/BK).

Yes

REPAIR the power supply to CJB circuit breaker 43 (20A). TEST the system for normal operation.

No

REPAIR the circuit. TEST the system for normal operation.



AN2416-A

- Is the resistance less than 5 ohms?

D9 CHECK THE GEM CONTROL OF THE DRIVER POWER WINDOW

- Key in ON position.
- Enter the following diagnostic mode on the diagnostic tool: GEM Active Command FRONT WINDOW CONTROL.
- Trigger DR DOWN ON.
- **Did the driver window move down?**

Yes
INSTALL a new GEM. REFER to [Section 419-10](#). TEST the system for normal operation.

No
GO to [D10](#).

D10 CHECK THE WINDOW REGULATOR MOTOR OPERATION

- Disconnect: Driver Window Regulator Motor C518.
- Connect a 20 amp fused jumper wire between battery positive and one pin of the window regulator motor (component side).
- Momentarily connect a jumper wire between second pin of the window regulator motor and ground.
- Reverse the jumper wires on the window regulator motor.
- **Did the window regulator motor operate in both directions?**

Yes
GO to [D11](#).

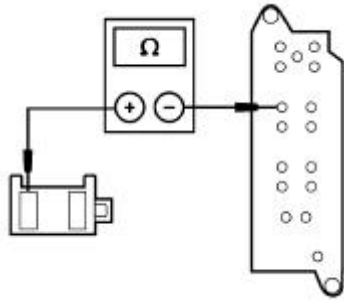
No
INSTALL a new window regulator motor. REFER to [Motor—Window Regulator](#) in this section. TEST the system for normal operation.

D11 CHECK CIRCUIT 992 (WH/BK) FOR AN OPEN BETWEEN THE DRIVER WINDOW MOTOR AND THE WINDOW REGULATOR CONTROL SWITCH

- Disconnect: Driver Window Regulator Control Switch C537.
- Measure the resistance between driver window regulator control switch C537 pin 6, circuit 992 (WH/BK), harness side and driver window regulator motor C518, circuit 992 (WH/BK), harness side.

Yes
GO to [D12](#).

No
REPAIR the circuit. TEST the system for normal operation.

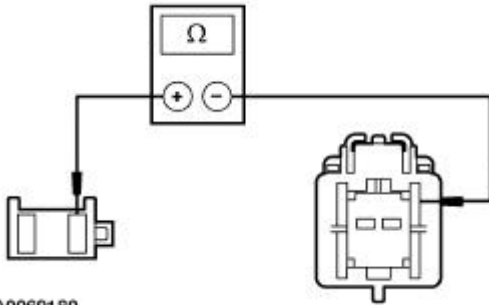


AN2417-A

- Is the resistance less than 5 ohms?

D12 CHECK CIRCUIT 226 (WH/BK) FOR AN OPEN

- Disconnect: GEM C201a.
- Measure the resistance between GEM C201a pin 2, circuit 226 (WH/BK), harness side and driver window regulator motor C518, circuit 226 (WH/BK), harness side.

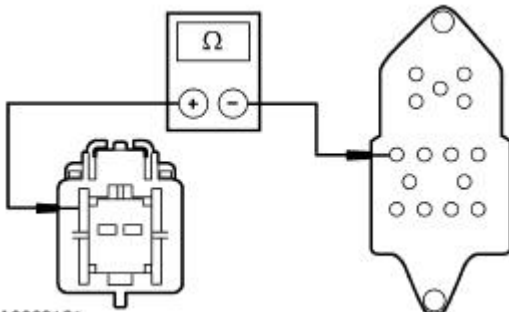


A0069180

- Is the resistance less than 5 ohms?

D13 CHECK CIRCUIT 400 (LB/BK) FOR AN OPEN TO THE GEM

- Key in OFF position.
- Disconnect: CJB Circuit Breaker 43 (20A).
- Measure the resistance between GEM C021a pin 4, circuit 400 (LB/BK), harness side and CJB circuit breaker 43 (20A) output pin, circuit 400 (LB/BK).



A0069181

- Is the resistance less than 5 ohms?

Yes
GO to [D13](#).

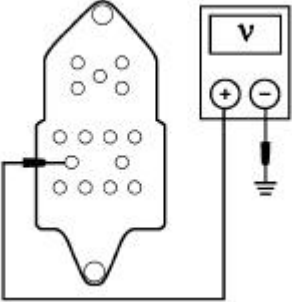
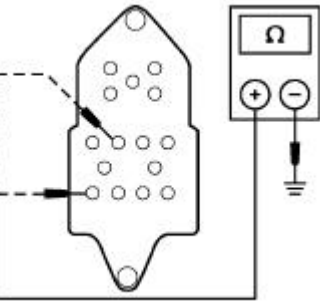
No
REPAIR the circuit. TEST the system for normal operation.

Yes
INSTALL a new GEM. REFER to [Section 419-10](#). TEST the system for normal operation.

No
REPAIR the circuit. TEST the system for normal operation.

PINPOINT TEST E: A SINGLE POWER WINDOW IS INOPERATIVE — DRIVER, COUPE

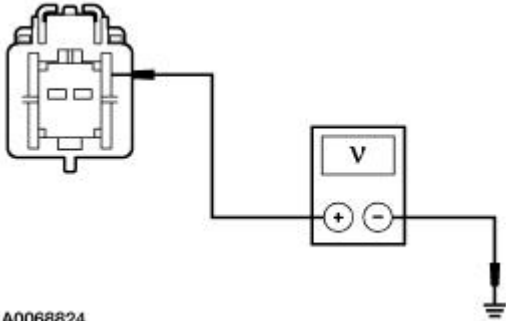
Test Step	Result / Action to Take
E1 CHECK THE IGNITION SWITCH INPUT TO THE GEM	
<ul style="list-style-type: none"> ● Select GEM PID IGN_A, IGN_R, IGN_S and IGN_KEY. ● Insert the ignition key in the ignition switch and turn to each 	<p>Yes GO to E2.</p>

<p>position while monitoring PIDs.</p> <ul style="list-style-type: none"> ● Did the PID values agree with the ignition switch positions? 	<p>No REFER to Section 211-05 for ignition switch diagnosis.</p>
<p>E2 CHECK THE DRIVER WINDOW REGULATOR CONTROL SWITCH INPUT TO THE GEM</p>	
<ul style="list-style-type: none"> ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: GEM PID D_UP_SW and D_DN_SW. ● Actuate the driver window regulator control switch to the UP and DOWN position. ● Did the PID values agree with the driver window regulator control switch positions? 	<p>Yes GO to E9.</p> <p>No GO to E3.</p>
<p>E3 CHECK THE POWER SUPPLY TO THE WINDOW REGULATOR CONTROL SWITCH</p>	
<ul style="list-style-type: none"> ● Disconnect: Driver Window Regulator Control Switch C508. ● Key in ON position. ● Measure the voltage between driver window regulator control switch C508 pin 10, circuit 400 (LB/BK), harness side and ground.  <p>AN2408-A</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to E4.</p> <p>No GO to E8.</p>
<p>E4 CHECK CIRCUIT 1205 (BK) FOR AN OPEN</p>	
<ul style="list-style-type: none"> ● Measure the resistance between driver window regulator control switch C508 pin 7, circuit 1205 (BK), harness side and ground; and between driver window regulator control switch C508 pin 12, circuit 1205 (BK), harness side and ground.  <p>AN2420-A</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes GO to E5.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<p>E5 CHECK THE DRIVER WINDOW REGULATOR CONTROL SWITCH</p>	
<ul style="list-style-type: none"> ● Carry out the driver window regulator control switch component test. Refer to the Wiring Diagrams Cell 149, Component Testing. ● Did the driver window regulator control switch pass? 	<p>Yes GO to E6.</p> <p>No INSTALL a new driver</p>

window regulator control switch. REFER to [Switch—Window Regulator Control](#) in this section. TEST the system for normal operation.

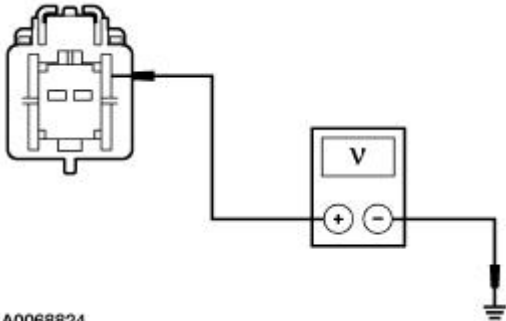
E6 CHECK CIRCUIT 226 (WH/BK) FOR A SHORT TO BATTERY

- Key in OFF position.
- Disconnect: GEM C201a.
- Measure the voltage between GEM C201a pin 2, circuit 226 (WH/BK), harness side and ground.



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- Key in ON position.
- Measure the voltage between GEM C201a pin 2, circuit 226 (WH/BK), harness side and ground.



A0068824

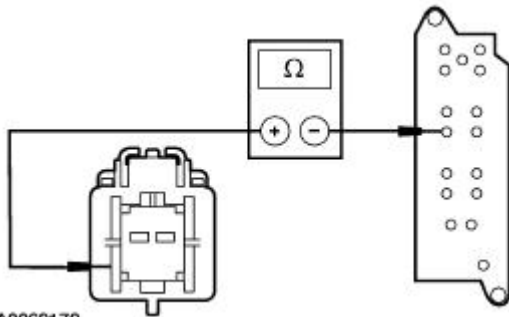
- Is either voltage greater than 10 volts?

Yes
REPAIR the circuit.
TEST the system for normal operation.

No
GO to [E7](#).

E7 CHECK CIRCUIT 991 (TN/LB) AND 992 (WH/BK) FOR AN OPEN

- Key in OFF position.
- Disconnect: GEM C201c.
- Measure the resistance between driver window regulator control switch C508 pin 6, circuit 991 (TN/LB), harness side and GEM C201a pin 3, circuit 991 (TN/LB), harness side.

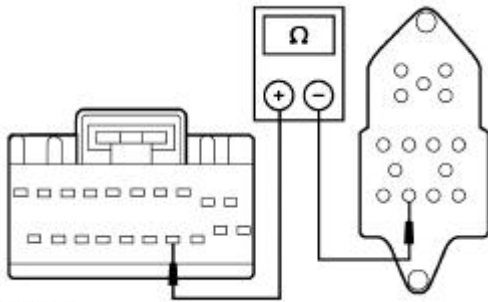


A0069179

- Measure the resistance between driver window regulator control switch C508 pin 13, circuit 992 (WH/BK), harness side and GEM C201c pin 14, circuit 992 (WH/BK), harness side.

Yes
INSTALL a new GEM.
REFER to [Section 419-10](#). TEST the system for normal operation.

No
REPAIR the circuit.
TEST the system for normal operation.



AN2422-A

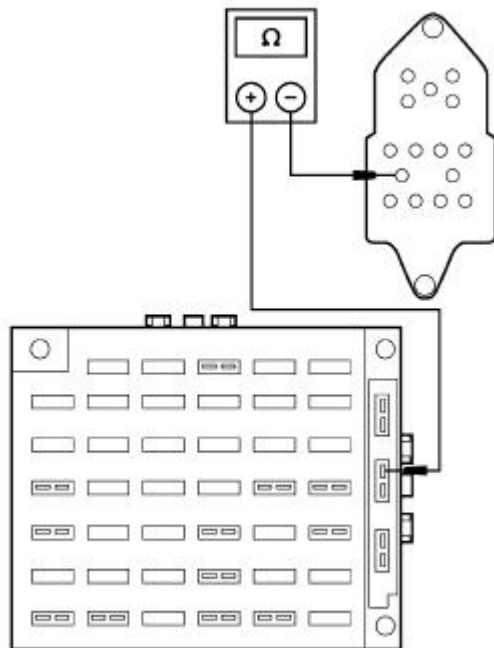
- Are the resistances less than 5 ohms?

E8 CHECK CIRCUIT 400 (LB/BK) FOR AN OPEN

- Key in OFF position.
- Disconnect: CJB Circuit Breaker 43 (20A).
- Measure the resistance between driver window regulator control switch C508 pin 10, circuit 400 (LB/BK), harness side and CJB circuit breaker 43 (20A) output pin, circuit 400 (LB/BK).

Yes
REPAIR the power supply to CJB circuit breaker 43 (20A). TEST the system for normal operation.

No
REPAIR the circuit. TEST the system for normal operation.



AN2423-A

- Is the resistance less than 5 ohms?

E9 CHECK THE GEM CONTROL OF THE DRIVER POWER WINDOW

- Key in ON position.
- Enter the following diagnostic mode on the diagnostic tool: GEM Active Command FRONT WINDOW CONTROL.
- Trigger DR DOWN ON.
- Did the driver window move down?

Yes
INSTALL a new GEM. REFER to [Section 419-10](#). TEST the system for normal operation.

No
GO to [E10](#).

E10 CHECK THE WINDOW REGULATOR MOTOR OPERATION

- Disconnect: Driver Window Regulator Motor C518.
- Connect a 20 amp fused jumper wire between battery positive and one pin of the window regulator motor (component side).
- Momentarily connect a jumper wire between the second pin of

Yes
GO to [E11](#).

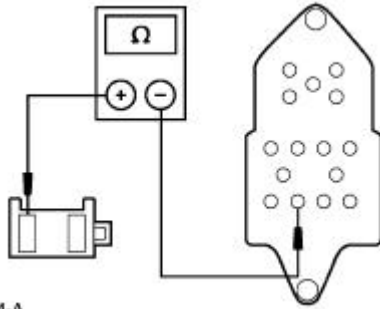
No

- the window regulator motor and ground.
- Reverse the jumper wires on the window regulator motor.
- **Did the window regulator motor operate in both directions?**

INSTALL a new window regulator motor. REFER to [Motor—Window Regulator](#) in this section. TEST the system for normal operation.

E11 CHECK CIRCUIT 992 (WH/BK) FOR AN OPEN BETWEEN THE DRIVER WINDOW MOTOR AND THE WINDOW REGULATOR CONTROL SWITCH

- Disconnect: Driver Window Regulator Control Switch C508.
- Measure the resistance between driver window regulator control switch C508 pin 13, circuit 992 (WH/BK), harness side and driver window motor C518, circuit 992 (WH/BK), harness side.



AN2424-A

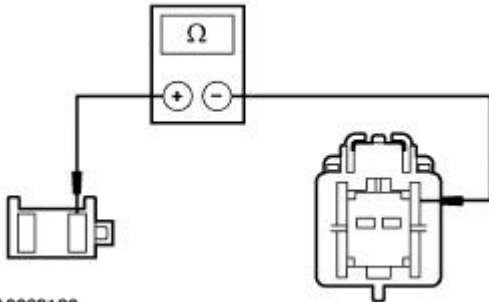
- **Is the resistance less than 5 ohms?**

Yes
GO to [E12](#) .

No
REPAIR the circuit.
TEST the system for normal operation.

E12 CHECK CIRCUIT 226 (WH/BK) FOR AN OPEN

- Disconnect: GEM C201a.
- Measure the resistance between GEM C201a pin 2, circuit 226 (WH/BK), harness side and driver window motor C518, circuit 226 (WH/BK), harness side.



A0069180

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

Yes
GO to [E13](#) .

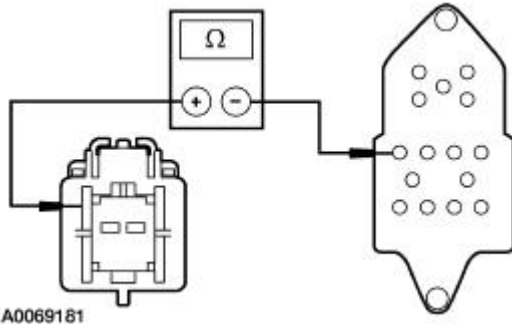
No
REPAIR the circuit.
TEST the system for normal operation.

E13 CHECK CIRCUIT 400 (LB/BK) FOR AN OPEN TO THE GEM

- Key in OFF position.
- Disconnect: CJB Circuit Breaker 43 (20A).
- Measure the resistance between GEM C201a pin 4 circuit 400 (LB/BK), harness side and CJB circuit breaker 43 (20A) output pin, circuit 400 (LB/BK).

Yes
INSTALL a new GEM.
REFER to [Section 419-10](#) . TEST the system for normal operation.

No
REPAIR the circuit.
TEST the system for normal operation.

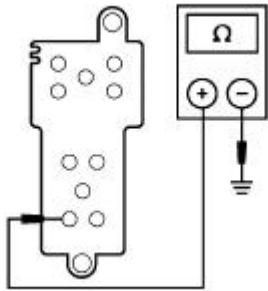


A0069181

- Is the resistance less than 5 ohms?

PINPOINT TEST F: A SINGLE POWER WINDOW IS INOPERATIVE — PASSENGER FRONT

Test Step	Result / Action to Take
<p>F1 CHECK THE OPERATION FROM THE DRIVER WINDOW REGULATOR CONTROL SWITCH</p> <ul style="list-style-type: none"> ● Key in ON position. ● Operate the passenger window from the driver window regulator control switch. ● Is the passenger window inoperative from the driver window regulator control switch? 	<p>Yes GO to F2.</p> <p>No GO to F15.</p>
<p>F2 CHECK CIRCUIT 334 (RD/YE) FOR GROUND</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Passenger Window Regulator Motor C623. ● Measure the resistance between passenger window regulator motor C623, circuit 334 (RD/YE), harness side and ground. <p>AN2425-A</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes GO to F8.</p> <p>No GO to F3.</p>
<p>F3 CHECK CIRCUIT 314 (TN/LB) FOR GROUND</p> <ul style="list-style-type: none"> ● Disconnect: Passenger Window Regulator Control Switch C629. ● Measure the resistance between passenger window regulator control switch C629 pin 9, circuit 314 (TN/LB), harness side and ground. 	<p>Yes GO to F7.</p> <p>No GO to F4 for convertible or GO to F5 for coupe.</p>

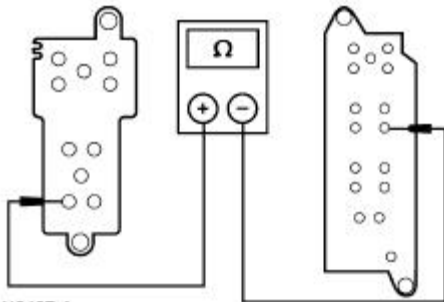


AN2426-A

- Is the resistance less than 5 ohms?

F4 CHECK CIRCUIT 314 (TN/LB) FOR AN OPEN (CONVERTIBLE)

- Disconnect: Driver Window Regulator Control Switch C537.
- Measure the resistance between driver window regulator control switch C537 pin 9, circuit 314 (TN/LB), harness side and passenger window regulator control switch C629 pin 9, circuit 314 (TN/LB), harness side.

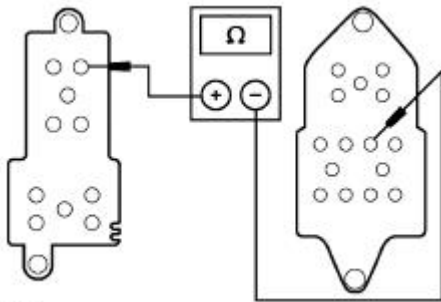


AN2427-A

- Is the resistance less than 5 ohms?

F5 CHECK CIRCUIT 314 (TN/LB) FOR AN OPEN (COUPE)

- Disconnect: Driver Window Regulator Control Switch C508.
- Measure the resistance between driver window regulator control switch C508 pin 8, circuit 314 (TN/LB), harness side and passenger window regulator control switch C629 pin 9, circuit 314 (TN/LB), harness side.



AN2428-A

- Is the resistance less than 5 ohms?

F6 CHECK PASSENGER UP GROUND CIRCUIT 1205 (BK) FOR AN OPEN

- Measure the resistance between driver window regulator control switch C508 pin 9, circuit 1205 (BK), harness side and ground.

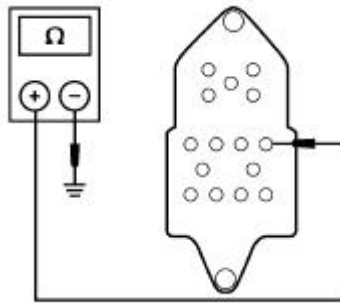
Yes
 INSTALL a new driver window regulator control switch. REFER to [Switch—Window Regulator Control](#) in this section. TEST the system for normal operation.

No
 REPAIR the circuit. TEST the system for normal operation.

Yes
 GO to [F6](#).

No
 REPAIR the circuit. TEST the system for normal operation.

Yes
 INSTALL a new driver window regulator control switch. REFER to [Switch—Window Regulator Control](#) in this



AN2429-A

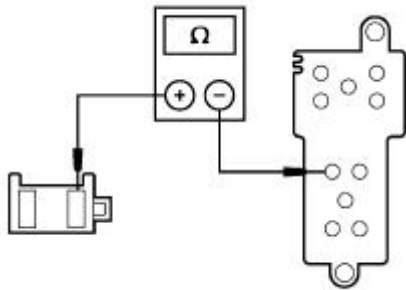
- Is the resistance less than 5 ohms?

section. TEST the system for normal operation.

No
REPAIR the circuit. TEST the system for normal operation.

F7 CHECK CIRCUIT 334 (RD/YE) FOR AN OPEN

- Measure the resistance between passenger window regulator control switch C629 pin 6, circuit 334 (RD/YE), harness side and passenger window motor C623, circuit 334 (RD/YE), harness side.



AN2430-A

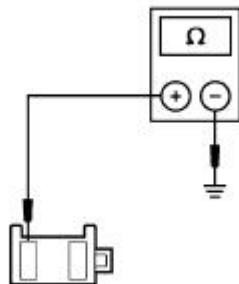
- Is the resistance less than 5 ohms?

Yes
INSTALL a new passenger window regulator control switch. TEST the system for normal operation.

No
REPAIR the circuit. TEST the system for normal operation.

F8 CHECK CIRCUIT 333 (YE/RD) FOR GROUND

- Measure the resistance between passenger window regulator motor C623, circuit 333 (YE/RD), harness side and ground.



AN2431-A

- Is the resistance less than 5 ohms?

Yes
GO to [F14](#).

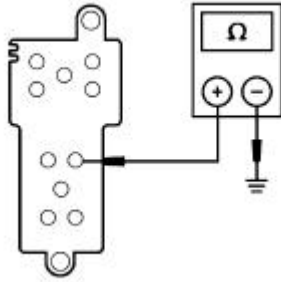
No
GO to [F9](#).

F9 CHECK CIRCUIT 313 (WH/YE) FOR GROUND

- Disconnect: Passenger Window Regulator Control Switch C629.
- Measure the resistance between passenger window regulator control switch C629 pin 7, circuit 313 (WH/YE), harness side and ground.

Yes
GO to [F13](#).

No
GO to [F10](#) for convertible or GO to [F11](#) for coupe.

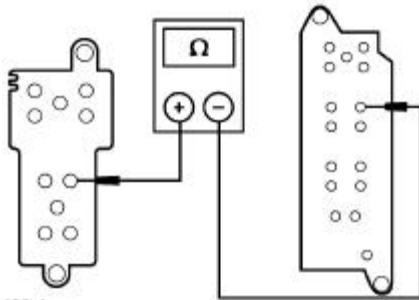


AN2432-A

- Is the resistance less than 5 ohms?

F10 CHECK CIRCUIT 313 (WH/YE) FOR AN OPEN (CONVERTIBLE)

- Disconnect: Driver Window Regulator Control Switch C537.
- Measure the resistance between driver window regulator control switch C537 pin 7, circuit 313 (WH/YE), harness side and passenger window regulator control switch C629 pin 7, circuit 313 (WH/YE), harness side.

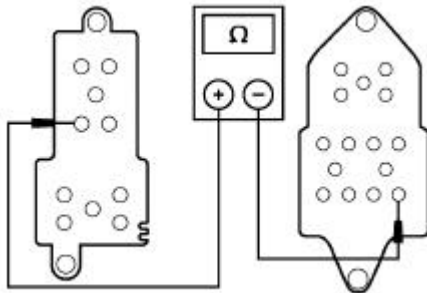


AN2433-A

- Is the resistance less than 5 ohms?

F11 CHECK CIRCUIT 313 (WH/YE) FOR AN OPEN (COUPE)

- Disconnect: Driver Window Regulator Control Switch C508.
- Measure the resistance between driver window regulator control switch C508 pin 15, circuit 313 (WH/YE), harness side and passenger window regulator control switch C629 pin 7, circuit 313 (WH/YE), harness side.



AN2434-A

- Is the resistance less than 5 ohms?

F12 CHECK PASSENGER DOWN GROUND CIRCUIT 1205 (BK) FOR AN OPEN

- Measure the resistance between driver window regulator control switch C508 pin 14, circuit 1205 (BK), harness side and ground.

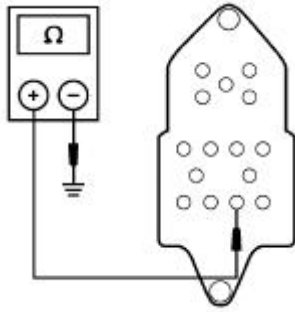
Yes
 INSTALL a new driver window regulator control switch. REFER to [Switch—Window Regulator Control](#) in this section. TEST the system for normal operation.

No
 REPAIR the circuit. TEST the system for normal operation.

Yes
 GO to [F12](#).

No
 REPAIR the circuit. TEST the system for normal operation.

Yes
 INSTALL a new driver window regulator control switch. REFER to [Switch—Window Regulator Control](#) in this



AN2435-A

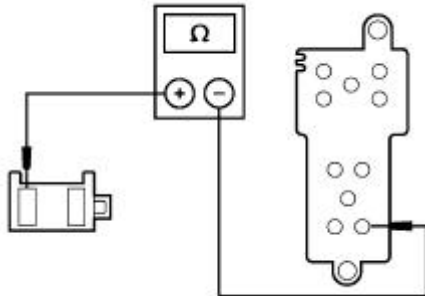
- Is the resistance less than 5 ohms?

section. TEST the system for normal operation.

No
REPAIR the circuit. TEST the system for normal operation.

F13 CHECK CIRCUIT 333 (YE/RD) FOR AN OPEN

- Measure the resistance between passenger window regulator control switch C629 pin 10, circuit 333 (YE/RD), harness side and passenger window regulator motor C623, circuit 333 (YE/RD), harness side.



AN2436-A

- Is the resistance less than 5 ohms?

Yes
INSTALL a new passenger window regulator control switch. TEST the system for normal operation.

No
REPAIR the circuit. TEST the system for normal operation.

F14 CHECK THE DRIVER WINDOW REGULATOR CONTROL SWITCH

- Carry out the driver window regulator control switch component test. REFER to Wiring Diagrams Cell 149, Component Testing.
- Is the driver window regulator control switch OK?

Yes
INSTALL a new passenger window regulator motor. REFER to [Motor—Window Regulator](#) in this section. TEST the system for normal operation.

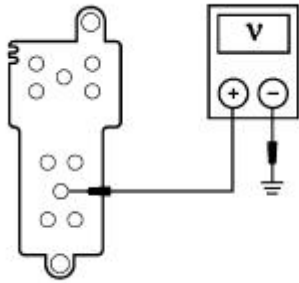
No
INSTALL a new driver window regulator control switch. REFER to [Switch—Window Regulator Control](#) in this section. TEST the system for normal operation.

F15 CHECK THE POWER SUPPLY TO THE PASSENGER WINDOW REGULATOR CONTROL SWITCH

- Key in OFF position.
- Disconnect: Passenger Window Regulator Control Switch C629.
- Key in ON position.
- Measure the voltage between passenger window regulator control switch C629 pin 8, circuit 194 (PK), harness side and ground.

Yes
INSTALL a new passenger window regulator control switch. TEST the system for normal operation.

No



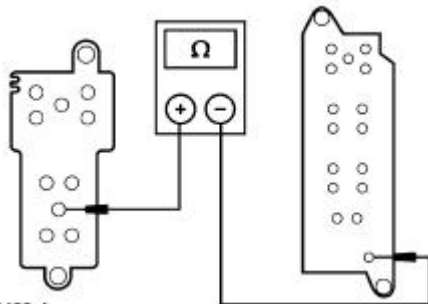
AN2438-A

- Is the voltage greater than 10 volts?

For convertible, GO to [F16](#). For coupe, REPAIR the circuit. TEST the system for normal operation.

F16 CHECK CIRCUIT 194 (PK) FOR AN OPEN

- Key in OFF position.
- Disconnect: Driver Window Regulator Control Switch C537.
- Measure the resistance between driver window regulator control switch C537 pin 16, circuit 194 (PK), harness side and passenger window regulator control switch C629 pin 8, circuit 194 (PK), harness side.



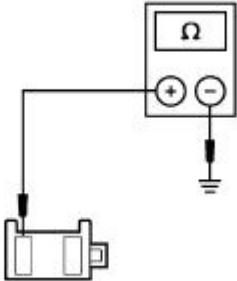
AN2439-A

- Is the resistance less than 5 ohms?

Yes
INSTALL a new driver window regulator control switch. REFER to [Switch—Window Regulator Control](#) in this section. TEST the system for normal operation.

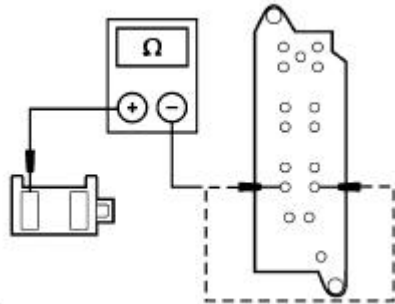
No
REPAIR the circuit. TEST the system for normal operation.

PINPOINT TEST G: A SINGLE POWER WINDOW IS INOPERATIVE — REAR, CONVERTIBLE ONLY

Test Step	Result / Action to Take
<p>G1 CHECK CIRCUIT 316 (YE/LB) OR 319 (YE/BK) FOR GROUND</p> <ul style="list-style-type: none"> ● Disconnect: Rear Window Regulator Motor C3118 LH or C3119 RH. ● Measure the resistance between left rear window regulator motor C3118, circuit 316 (YE/LB), harness side and ground; or between right rear window regulator motor C3119, circuit 319 (YE/BK), harness side and ground.  <p>AN2431-A</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes GO to G3.</p> <p>No GO to G2.</p>

G2 CHECK CIRCUIT 316 (YE/LB) OR 319 (YE/BK) FOR AN OPEN

- Disconnect: Driver Window Regulator Control Switch C537.
- Measure the resistance between left rear window regulator motor C3118, circuit 316 (YE/LB), harness side and driver window regulator control switch C537 pin 12, circuit 316 (YE/LB), harness side; or between right rear window regulator motor C3119, circuit 319 (YE/BK), harness side and driver window regulator control switch C537 pin 13, circuit 319 (YE/BK), harness side.



AN2440-A

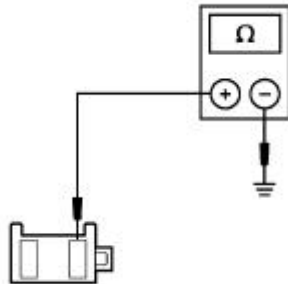
- Is the resistance less than 5 ohms?

Yes
INSTALL a new driver window regulator control switch. REFER to [Switch—Window Regulator Control](#) in this section. TEST the system for normal operation.

No
REPAIR the circuit. TEST the system for normal operation.

G3 CHECK CIRCUIT 317 (GY/OG) OR 320 (RD/BK) FOR GROUND

- Measure the resistance between left rear window regulator motor C3118, circuit 317 (GY/OG), harness side and ground; or between right rear window regulator motor C3119, circuit 320 (RD/BK), harness side and ground.



AN2425-A

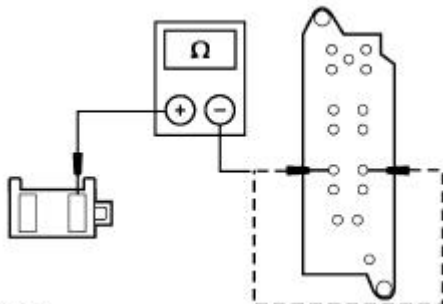
- Is the resistance less than 5 ohms?

Yes
GO to [G5](#).

No
GO to [G4](#).

G4 CHECK CIRCUIT 317 (GY/OG) OR 320 (RD/BK) FOR AN OPEN

- Disconnect: Driver Window Regulator Control Switch C537.
- Measure the resistance between left rear window regulator motor C3118, circuit 317 (GY/OG), harness side and driver window regulator control switch C537 pin 10, circuit 317 (GY/OG), harness side; or between right rear window regulator motor C3119, circuit 320 (RD/BK), harness side and driver window regulator control switch C537 pin 11, circuit 320 (RD/BK), harness side.



AN2441-A

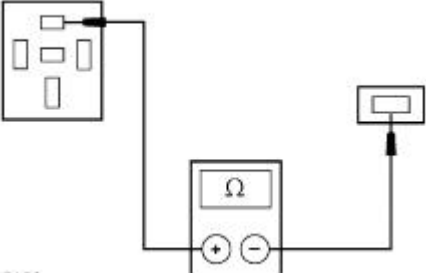
- Is the resistance less than 5 ohms?

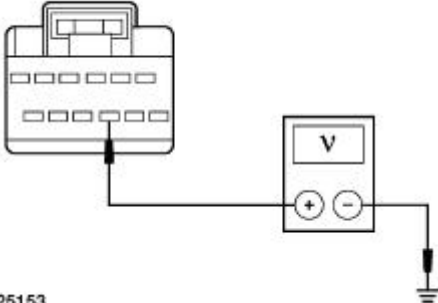
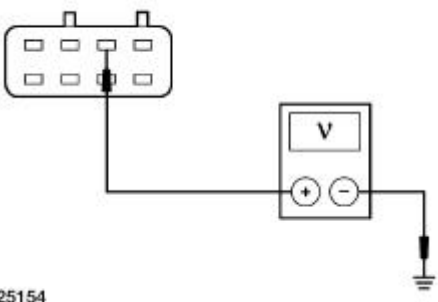
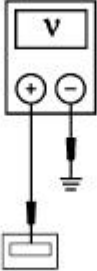
Yes
INSTALL a new driver window regulator control switch. REFER to [Switch—Window Regulator Control](#) in this section. TEST the system for normal operation.

No
REPAIR the circuit. TEST the system for normal operation.

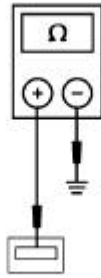
G5 CHECK DRIVER WINDOW REGULATOR CONTROL SWITCH	
<ul style="list-style-type: none"> ● Disconnect: Driver Window Regulator Control Switch C537. ● Carry out the driver window regulator control switch component test. REFER to Wiring Diagrams Cell 149, Component Testing. ● Is the driver window regulator control switch OK? 	<p>Yes INSTALL a new rear window regulator motor. REFER to Motor—Window Regulator Quarter in this section. TEST the system for normal operation.</p> <p>No INSTALL a new driver window regulator control switch. REFER to Switch—Window Regulator Control in this section. TEST the system for normal operation.</p>

PINPOINT TEST H: THE DEFROST SYSTEM IS INOPERATIVE

Test Step	Result / Action to Take
<p>H1 CHECK POWER TO INDICATOR LIGHT</p> <ul style="list-style-type: none"> ● Key in ON position. ● Depress the rear window defrost switch to ON. ● Is the rear window defrost switch indicator ON? 	<p>Yes GO to H2.</p> <p>No GO to H3.</p>
<p>H2 CHECK CIRCUIT 186 (BR/LB) FOR AN OPEN</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Heated Rear Window Relay. ● Disconnect: Heated Rear Window Grid Power Supply Connector C402a. ● Measure the resistance between heated rear window relay, circuit 186 (BN/LB), harness side and heated rear window grid C402a, circuit 186 (BN/LB), harness side.  <p>A0025152</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes GO to H7.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<p>H3 CHECK THE DIAGNOSTIC TROUBLE CODES (DTCS)</p> <ul style="list-style-type: none"> ● Refer to the results from the previous instrument cluster module (ICM) self-test. ● Was DTC B1343 retrieved? 	<p>Yes GO to H4.</p>

	<p>No GO to H6.</p>
<p>H4 CHECK CIRCUIT 175 (BK/YE)</p> <ul style="list-style-type: none"> ● Disconnect: ICM C220a. ● Key in ON position. ● Measure the voltage between ICM C220a pin 9, circuit 175 (BK/YE), harness side and ground.  <p>A0025153</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to H5.</p> <p>No GO to H16.</p>
<p>H5 CHECK CIRCUIT 175 (BK/YE) FOR A SHORT TO POWER</p> <ul style="list-style-type: none"> ● Disconnect: Rear Window Defrost Switch C241. ● Measure the voltage between rear window defrost switch C241 pin 2, circuit 175 (BK/YE), harness side and ground.  <p>A0025154</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.</p> <p>No INSTALL a new rear window defrost switch. REFER to Rear Window Defrost Switch in this section. TEST the system for normal operation.</p>
<p>H6 CHECK THE REAR HEATED WINDOW GRID POWER</p> <ul style="list-style-type: none"> ● Disconnect: Heated Rear Window Grid Power Supply Connector C402a. ● Key in ON position. ● Depress the rear window defrost switch to ON. ● Measure the voltage between heated rear window grid C402a circuit 186 (BN/LB), harness side and ground.  <p>AN1273-A</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to H7.</p> <p>No GO to H8.</p>
<p>H7 CHECK THE REAR WINDOW GROUND</p> <ul style="list-style-type: none"> ● Key in OFF position. 	<p>Yes</p>

- Disconnect: Heated Rear Window Grid Ground Connector C402b.
- Measure the resistance between heated rear window grid C402b, circuit 1205 (BK), harness side and ground.



AN1274-A

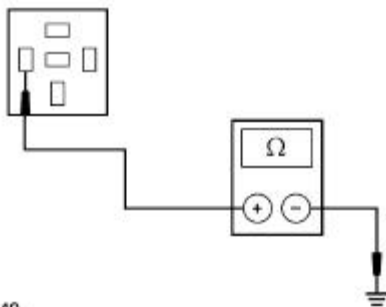
- Is the resistance less than 5 ohms?

CARRY OUT the heated rear window grid wire test. REFER to Grid Wire Test in Component Tests in this section. TEST the system for normal operation.

No
REPAIR the circuit. TEST the system for normal operation.

H8 CHECK CIRCUIT 727 (YE/BK)

- Disconnect: Heated Rear Window Relay.
- Depress the rear window defrost switch to ON.
- Measure the resistance between heated rear window relay pin 85, circuit 727 (YE/BK), harness side and ground.



A0010649

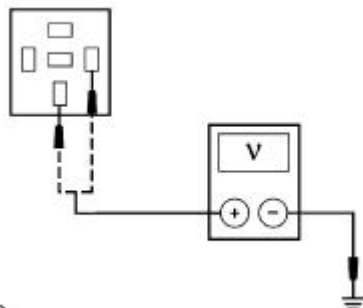
- Is the resistance less than 5 ohms?

Yes
GO to [H9](#).

No
GO to [H11](#).

H9 CHECK CIRCUIT 185 (BK) FOR POWER

- Measure the voltage between heated rear window relay pin 86 and pin 30, circuit 185 (BK), harness side and ground.



A0010652

- Are the voltages greater than 10 volts?

Yes
GO to [H10](#).

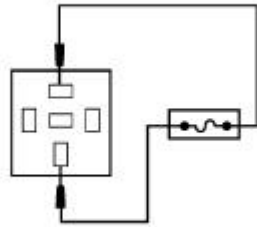
No
REPAIR the supply circuit. TEST the system for normal operation.

H10 CHECK CIRCUIT 186 (BR/LB) FOR AN OPEN

- Using a fused jumper wire (15A), jumper across the heated rear window relay pin 30, circuit 185 (BK), harness side and the heated rear window relay pin 87, circuit 186 (BR/LB), harness side.

Yes
INSTALL a new heated rear window relay. TEST the system for normal operation.

No
REPAIR circuit 186



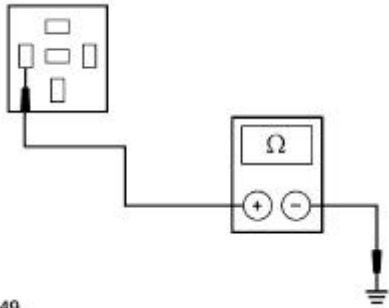
A0010654

- Is the rear window defrost switch indicator ON?

(BR/LB). TEST the system for normal operation.

H11 CHECK ICM OUTPUT

- Trigger the ICM active command R DEFRLY to ON.
- Measure the resistance between the heated rear window relay pin 85, circuit 727 (YE/BK), harness side and ground.



A0010649

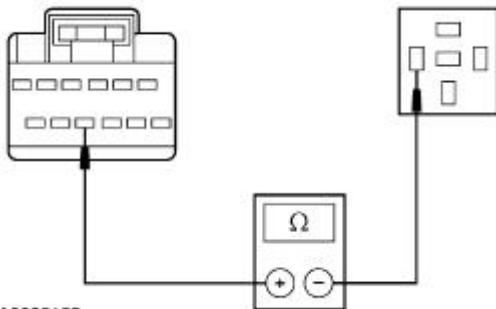
- Is the resistance less than 5 ohms?

Yes
GO to [H13](#).

No
GO to [H12](#).

H12 CHECK CIRCUIT 727 (YE/BK) FOR AN OPEN

- Key in OFF position.
- Measure the resistance between ICM C220a pin 10, circuit 727 (YE/BK), harness side and the heated rear window relay pin 85, circuit 727 (YE/BK), harness side.



A0025155

- Is the resistance less than 5 ohms?

Yes
GO to [H16](#).

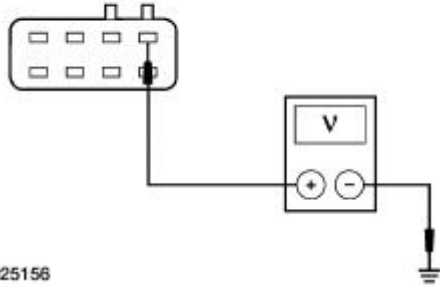
No
REPAIR the circuit. TEST the system for normal operation.

H13 CHECK POWER TO REAR WINDOW DEFROST SWITCH

- Disconnect: Rear Window Defrost Switch C241.
- Key in ON position.
- Measure the voltage between the rear window defrost switch C241 pin 1, circuit 883 (PK/LB), harness side and ground.

Yes
GO to [H14](#).

No
REPAIR the supply circuit. TEST the system for normal operation.

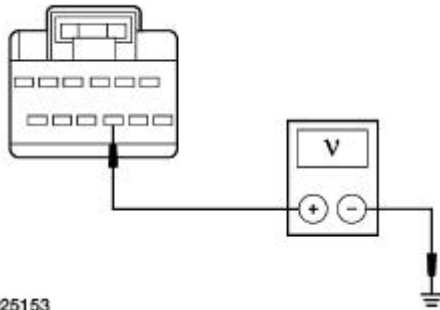


A0025156

- Is the voltage greater than 10 volts?

H14 CHECK INPUT TO THE ICM

- Connect: Rear Window Defrost Switch C241.
- Depress the rear window defrost switch to ON.
- Measure the voltage between ICM C220a pin 9, circuit 175 (BK/YE), harness side and ground.



A0025153

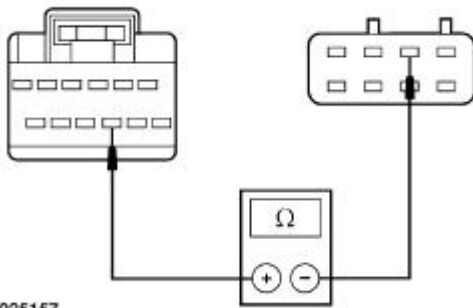
- Is the voltage greater than 10 volts?

Yes
GO to [H16](#).

No
GO to [H15](#).

H15 CHECK CIRCUIT 175 (BK/YE) FOR AN OPEN

- Key in OFF position.
- Measure the resistance between ICM C220a pin 9, circuit 175 (BK/YE), harness side and the rear window defrost switch C241 pin 2, circuit 175 (BK/YE), harness side.



A0025157

- Is the resistance less than 5 ohms?

Yes
INSTALL a new rear window defrost switch. REFER to [Rear Window Defrost Switch](#) in this section. TEST the system for normal operation.

No
REPAIR the circuit. TEST the system for normal operation.

H16 CHECK THE ICM FOR CORRECT OPERATION

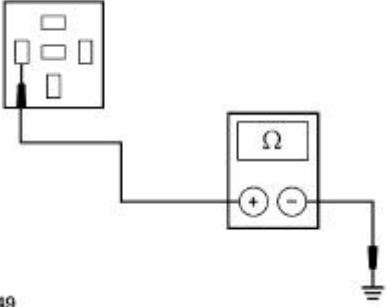
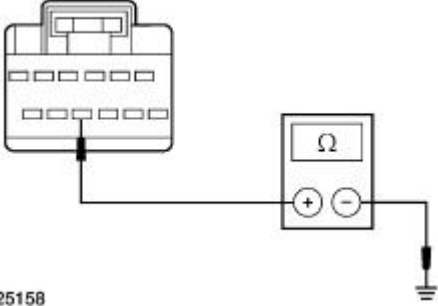
- Disconnect all ICM connectors.
- Check for:
 - corrosion
 - pushed-out pins
- Connect all ICM connectors and make sure they seat correctly.
- Operate the system and verify the concern is still present.
- Is the concern still present?

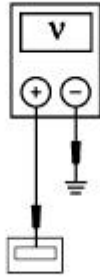
Yes
INSTALL a new ICM. REFER to [Section 413-01](#). CLEAR the DTCs. REPEAT the self-test.

No
The system is operating correctly at this time. Concern may have been

caused by a loose or corroded connector.
CLEAR the DTCs.
REPEAT the self-test.

PINPOINT TEST I: THE DEFROST SYSTEM WILL NOT SHUT OFF AUTOMATICALLY

Test Step	Result / Action to Take
<p>I1 CHECK CIRCUIT 727 (YE/BK)</p> <ul style="list-style-type: none"> ● Disconnect: Heated Rear Window Relay. ● Key in ON position. ● Depress the rear window defroster switch to OFF. ● Measure the resistance between heated rear window relay pin 85, circuit 727 (YE/BK) , harness side and ground.  <p>A0010649</p> <ul style="list-style-type: none"> ● Is the resistance greater than 10,000 ohms? 	<p>Yes GO to I3.</p> <p>No GO to I2.</p>
<p>I2 CHECK CIRCUIT 727 (YE/BK) FOR A SHORT TO GROUND</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Measure the resistance between instrument cluster module (ICM) C220a pin 10, circuit 727 (YE/BK) , harness side and ground.  <p>A0025158</p> <ul style="list-style-type: none"> ● Is the resistance greater than 10,000 ohms? 	<p>Yes GO to I4.</p> <p>No REPAIR the circuit. TEST the system for normal operation.</p>
<p>I3 CHECK CIRCUIT 186 (BN/LB) FOR A SHORT TO POWER</p> <ul style="list-style-type: none"> ● Disconnect: Heated Rear Window Grid Power Supply Connector C402a. ● Measure the voltage between heated rear window grid C402a circuit 186 (BN/LB), harness side and ground. 	<p>Yes REPAIR the circuit. TEST the system for normal operation.</p> <p>No INSTALL a new heated rear window relay. TEST the system for normal operation.</p>



AN1273-A

- Is the voltage greater than 10 volts?

I4 CHECK THE ICM FOR CORRECT OPERATION

- Disconnect all ICM connectors.
- Check for:
 - corrosion
 - pushed-out pins
- Connect all ICM connectors and make sure they seat correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

Yes
 INSTALL a new ICM. REFER to [Section 413-01](#). CLEAR the DTCs. REPEAT the self-test.

No
 The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Component Tests

Grid Wire Test

1. Using a bright lamp inside the vehicle, inspect the wire grid from the exterior. A broken grid wire will appear as a brown spot.
2. Run the engine at idle. Set the rear window defrost switch to ON. The indicator light should come on.
3. Working from the interior of the vehicle with a voltmeter, contact the broad red-brown stripes of the rear glass window positive lead to battery side and negative lead to ground side. The meter should read 10-13 volts. A lower voltage reading indicates a loose ground connection.
4. Contact a good ground point with the negative lead of the meter. The voltage reading should not differ.
5. With the negative lead of the meter grounded, touch each grid line of the heated rear window glass at its midpoint with the positive lead. A reading of approximately 6 volts indicates that the line is good. A reading of zero volts indicates that the line is broken between the midpoint and the B+ side of the grid line. A reading of 12 volts indicates that the circuit is broken between the midpoint of the grid line and ground.

Heated Window Grid Wire Repair

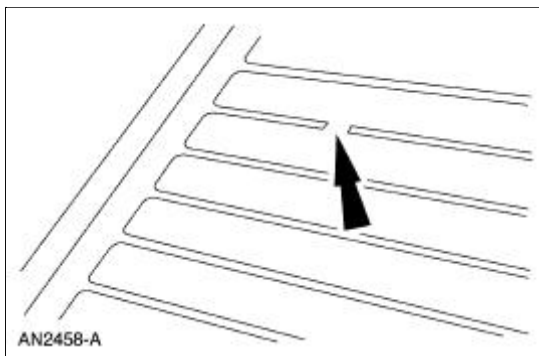
Material

Item	Specification
Dark Walnut Metallic Acrylic Lacquer Touch-up Paint ALBZ-19500-5858A or equivalent	ESR-M2-P100-C
Rear Window Defroster Repair D8AZ-19562-AA or equivalent	WSB-M4J58-B

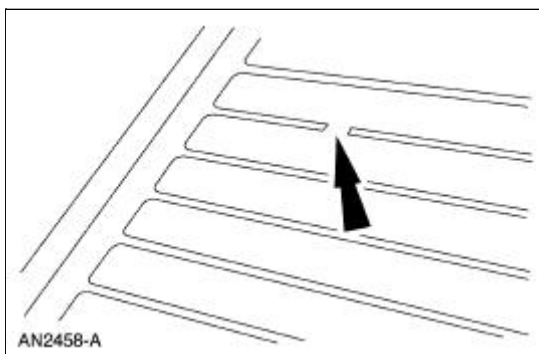
1. **NOTE:** A single break or any breaks which exceed 25 mm (1 inch) in one grid cannot be repaired. Install a new rear window glass.

NOTE: If the first layer of the heated rear window grid (brown) is damaged or missing, it will be necessary to apply touch-up paint on the glass prior to applying the silver rear window defroster repair.

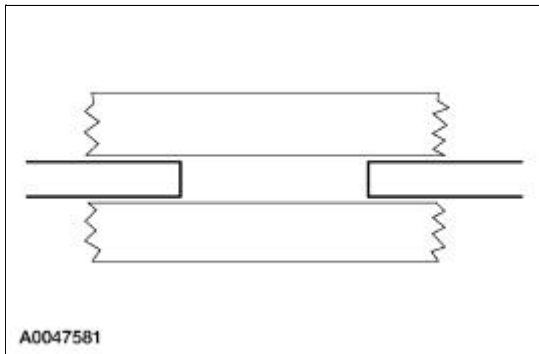
Repair any inoperative grid wires using rear window defroster repair.



2. Bring the vehicle up to room temperature of at least 16° C (60° F) or above.
3. Clean the entire grid line repair area with a non-alcohol based window cleaner and 0000 steel wool.
4. Mark the location of the grid break on the exterior of the rear window glass.



- Using cellulose tape, mask the area directly above and below the grid break. The break area should be at the center of the mask.



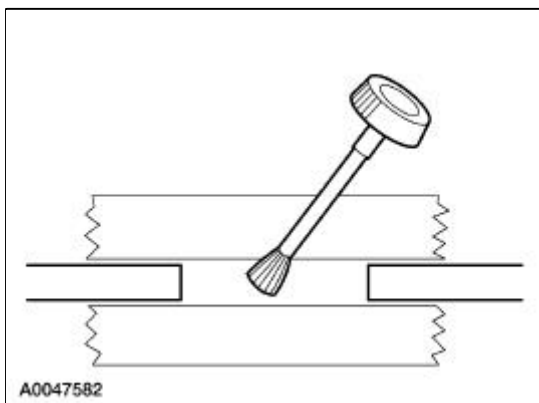
- NOTE:** If the brown layer is not broken or missing, apply only the silver grid repair compound to the break.


NOTE: If both the brown and silver layers of the grid are broken or missing, apply a coating of the brown touch-up paint across the break in the grid line first. Do not overlap the silver grid line with the brown paint. Several applications may be necessary to achieve a color match.

NOTE: Extend the silver repair coating at least 6.35 mm (0.25 inch) on both sides of the break area.

NOTE: Allow at least five minutes of drying time between applications.

Apply the repair coating to the grid break area in several smooth, continuous strokes. Apply three applications of the grid repair compound.



- After five minutes or after the repair area has dried completely, remove the mask.
-  **CAUTION: Be careful not to damage the grid line with the razor blade. If this occurs, additional repair may be necessary.**

Remove any excess repair compound above or below the grid line with a razor blade.


- NOTE:** The repair coating will air-dry in approximately one minute and can be energized within three minutes.

NOTE: Optimum adhesion occurs after approximately 24 hours.

After optimum hardness is achieved, clean the repaired area with a non-alcohol based window cleaner.

Lead Terminal Repair

Special Tool(s)

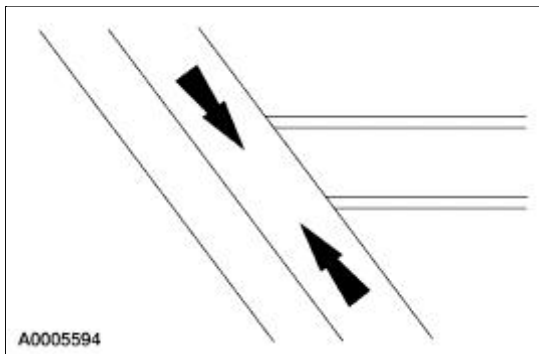
 ST1110-A	Heat Gun 107-R0300 or equivalent
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Material

Item	Specification
Rear Window Defroster Repair D8AZ-19562-AA	WSB-M4J58-B

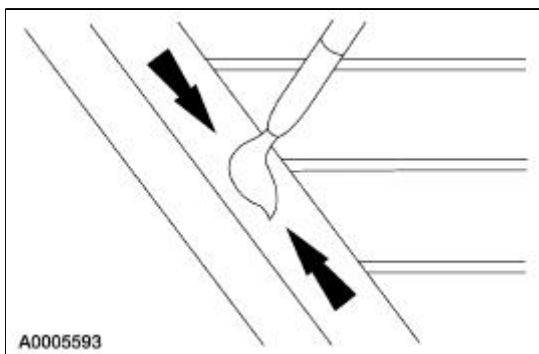
1. **NOTE:** The rear window glass must be at room temperature at the time of the repair.


Clean the bus bar in the area to be repaired with steel wool (3/0 to 4/0 grade).



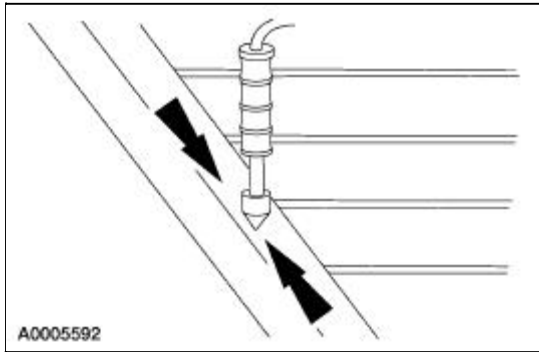
2. **NOTE:** Allow 10 minutes of drying time between the coats.


Apply three coats of rear window defroster repair to the surface.



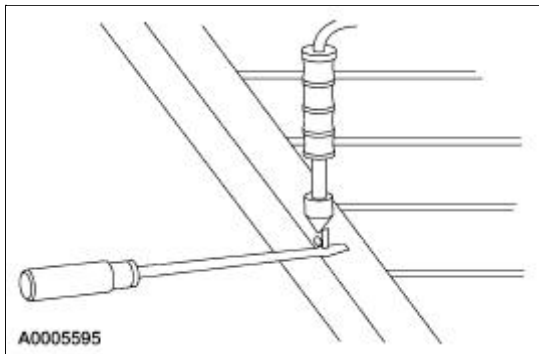
3.  **CAUTION:** Do not overheat the rear window glass or damage to the rear window glass may occur.

Tin the bus bar repair area with solder.



4.  **CAUTION:** To prevent overheating the rear window glass, remove the soldering gun as soon as the solder flows.

Preheat the rear window glass in the area to be repaired using the special tool and solder the terminal to the bus bar.

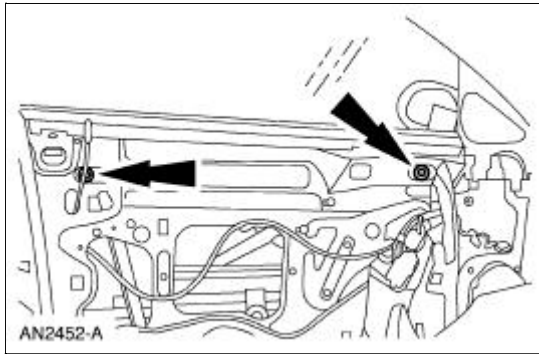


5. **NOTE:** Turn the heated rear window switch ON for five minutes prior to the final inspection of the repair.

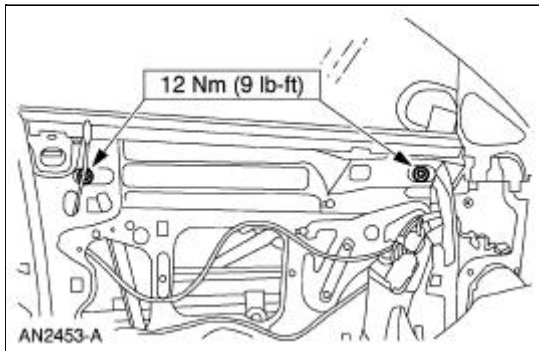
Apply rear window defroster repair to the area as needed.

Door Window Glass Adjustment —Height Stop Adjustment

1. Close the front door.
2. Loosen the screws.

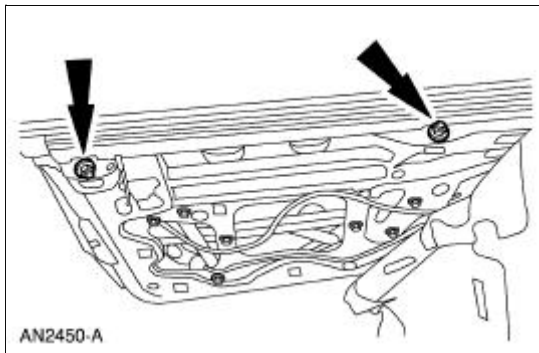


3. Raise the door window glass to the desired height.
4. Tighten the screws.

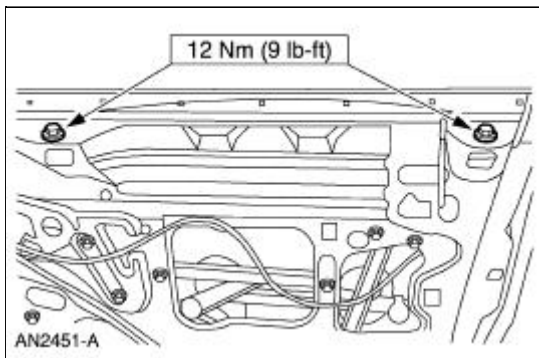


Door Window Glass Adjustment — Stabilizer

1. Raise the door window glass to the full up position.
2. Loosen the bolts.

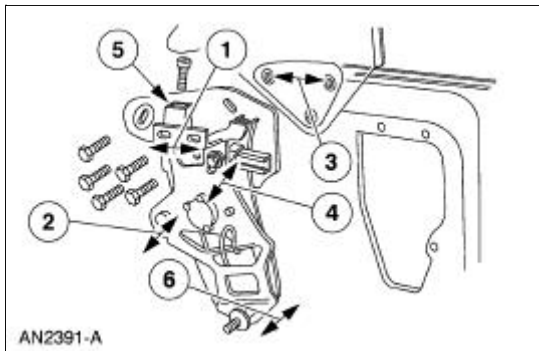


3. Push the door window glass inner stabilizers firmly against the door window glass.
4. Tighten the bolts.



Rear Quarter Window Glass Adjustment —Convertible


1. Adjust the quarter window glass for correct fit.
 1. horizontal adjustment
 2. regulator plate tilt
 3. glass to regulator tilt
 4. front high/low up stop
 5. rear high/low/tilt channel stop
 6. inboard/outboard tilt



AN2391-A

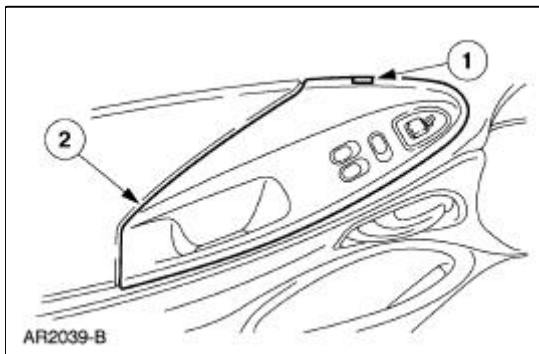
Switch —Window Regulator Control

Removal

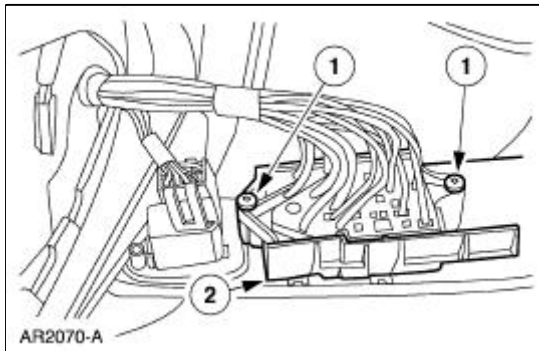
1.  **CAUTION:** Use a shop towel or similar material between the tool and the door trim panel or damage to the door trim panel may occur.

Position the window regulator switch plate aside.

1. Pull at the service notch.
2. Lift to release the clip at the rear edge.



2. Remove the window regulator control switch.
 1. Remove the screws.
 2. Disconnect the connectors.



Installation

1. To install, reverse the removal procedure.




Rear Window Defrost Switch

Removal and Installation

1. Remove the instrument panel center finish panel. For additional information, refer to [Section 501-12](#).
 2. Release the clips and remove the rear window defrost switch.
 3. To install, reverse the removal procedure.
-

Rear Window Glass

Special Tool(s)

 ST1109-A	Rotunda Pneumatic Knife with Offset Blade 107-R1511 or equivalent
 ST2085-A	The Pumper 164-R2459 or equivalent
 ST1320-A	Rotunda Interior Auto Glass Cut-Out Knife Kit 164-R2450 or equivalent

Removal


Convertible

1. For removal of the back window glass, refer to [Section 501-18](#).

Coupe

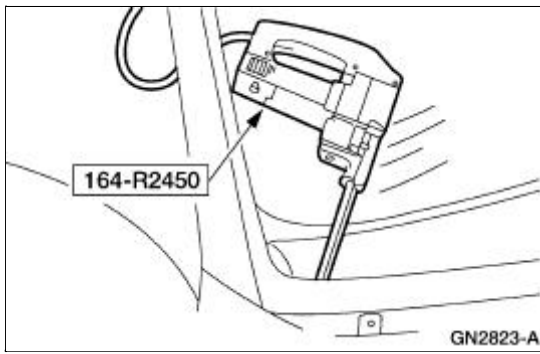


WARNING: To prevent glass splinters from entering eyes or cutting hands, wear safety glasses and heavy gloves when cutting glass from the vehicle.

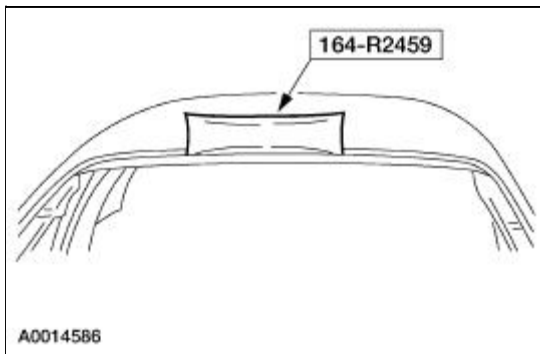
2. Remove the roof side trim moulding. For additional information, refer to [Section 501-08](#).
3. Lower the rear portion of the headliner.
4. Remove the outer lip of the moulding using a utility knife.
5. Using a soft brush or vacuum, remove any dirt or foreign material from the pinch weld.
6.  **CAUTION:** Care must be taken to prevent scratching the pinch weld.

NOTE: Lubricate the existing urethane adhesive with water to aid the special tool while cutting.

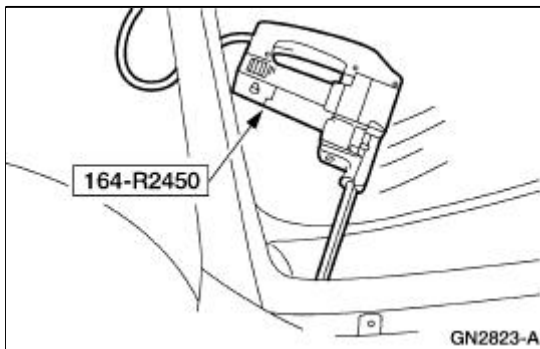
Using the special tool, starting at the top center of the back window glass, cut the urethane adhesive from the glass and work down the sides.



7. Using the special tool, distance the back window glass from the body.



8. Using the special tool, cut the remaining urethane adhesive and remove the back window glass



9. Using a soft brush or vacuum, clean the pinch weld.

Installation

Convertible

1. For installation of the back window glass, refer to [Section 501-18](#).

Coupe

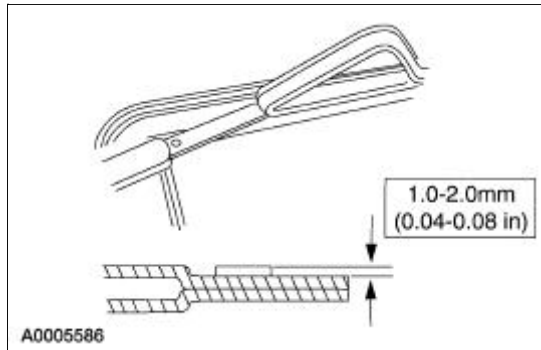
⚠ CAUTION: After installing the urethane installed back window glass, the vehicle should not be driven until the urethane adhesive has cured. The curing time at temperatures above 13° C (55°F) and relative humidity above 50% is 12-24 hours (Refer to ESSEX drive away chart for cure times as temperatures and humidity vary.). Inadequate curing of the urethane adhesive may adversely affect the strength of the urethane adhesive bond.

2. Dry-fit the back window glass by centering it side-to-side and by adjusting the setting blocks (if equipped) to get the correct position of the part top-to-bottom. Make alignment marks with tape

or non-staining grease pencil on both the glass and the vehicle body.

3.  **CAUTION: Care must be taken to avoid scratching the pinch weld.**

Trim the remaining urethane adhesive on the pinch weld using only the full-cut method. In this method, most of the existing urethane is removed leaving a level bead around the entire pinch weld.



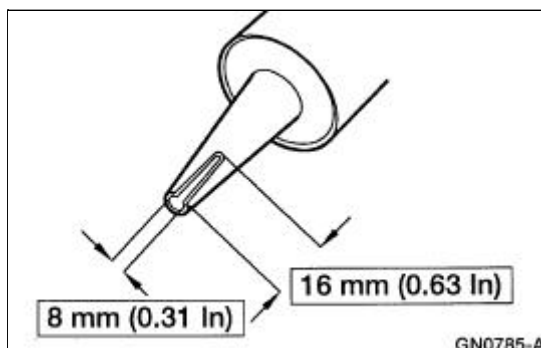
4. Using a wool applicator, apply the Urethane Metal Primer Essex U-413 meeting Ford specification WSB-M234-C to any exposed metal on the pinch weld. Allow 6 to 10 minutes to dry.
5. If reinstalling the original back window glass, remove the urethane adhesive from the back window glass.
6. **NOTE:** If a new back window glass is to be installed, attach the new moulding to the edge of the glass starting at the top center then work down the sides and around the corners.


If installing a new back window glass, clean the inside of the glass surface with an alcohol-free cleaner to make sure the ceramic-coated area is clean.

7.  **CAUTION: Wipe off the urethane glass prep immediately after each application because it flash dries. Apply deliberate strokes, making sure not to overlap the applied area.**

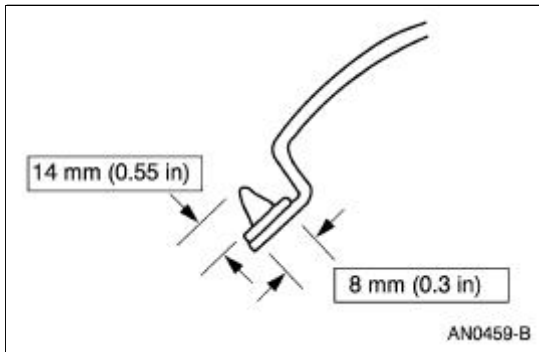
If installing a new back window glass, apply Urethane Glass Prep Essex U-401 meeting Ford specification WSB-M2G314-B twice around the class surface to be prepped.


8. If installing a new back window glass, apply Urethane Glass Primer Essex U-402 meeting Ford specification WSB-M5B280-C to the same area that was in the previous step. Allow five minutes to dry.
9. Cut the applicator tip to specification.



10.  **CAUTION:** If the vehicle is to be driven within 24 hours of urethane adhesive application, Urethane Adhesive Essex U-216 meeting Ford specification WSB-M2G316-B must be used due to its one hour cure time.

Apply a bead of Urethane Adhesive Essex 400-HV or Essex U-216 meeting Ford specification WSB-M2G316-B to the pinch weld.



11.  **CAUTION:** Open a window to prevent the back window glass from being pushed out by air pressure when the door is closed.

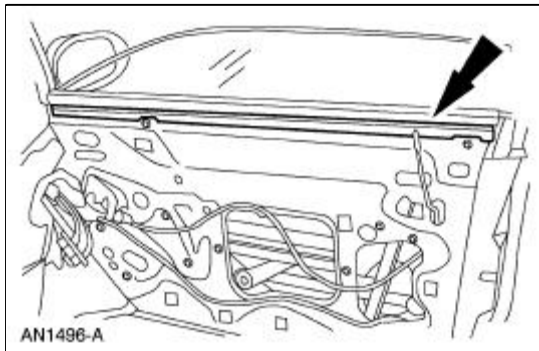
Using the alignment marks install the back window glass.

12. After the glass is set, check for water leaks and add urethane adhesive where needed.
13. Install the headliner.
14. Install the roof side trim moulding. For additional information, refer to [Section 501-08](#).
-

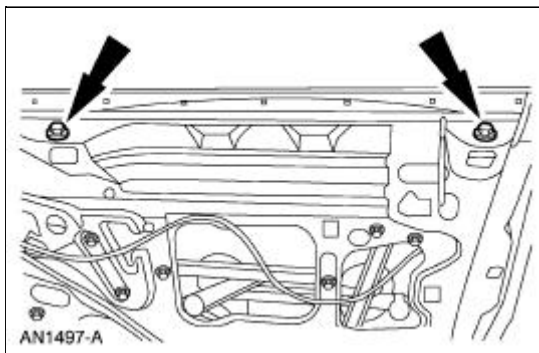
Window Glass —Door

Removal

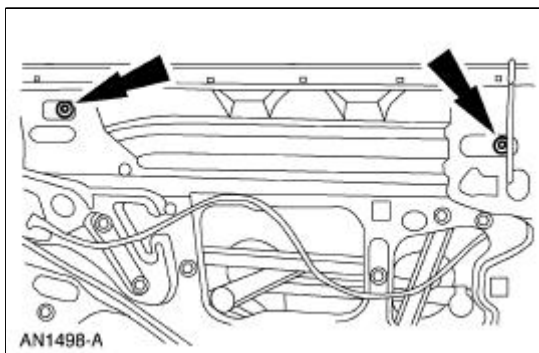
1. Remove the door trim panel. For additional information, refer to [Section 501-05](#).
2. Remove the interior weatherstrip.



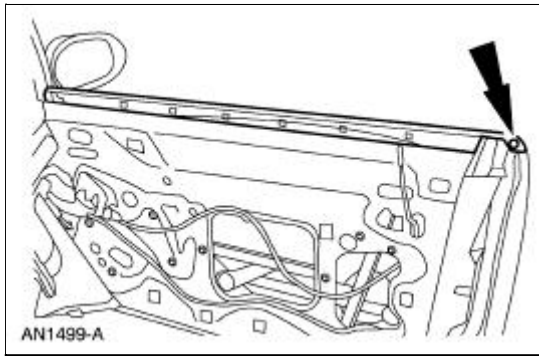
3. Remove the bolts and the stabilizers.



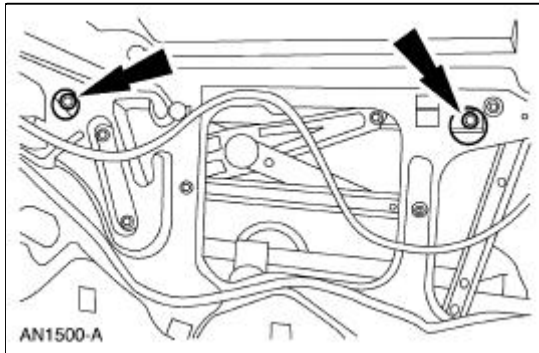
4. Remove the bolts and the upstop brackets.



5. Remove the rivet and the exterior weatherstrip.



6. Remove the rivets.



7. Tip the front of the glass down to clear the door filler and remove the door window glass.

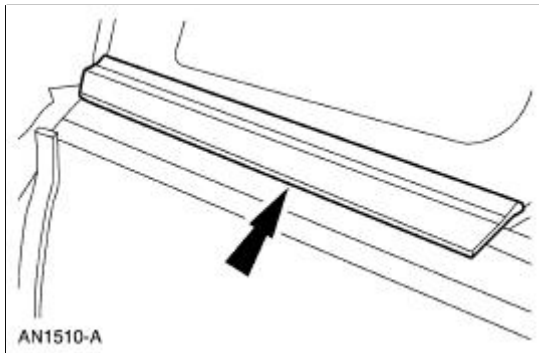
Installation

1. To install, reverse the removal procedure.
-

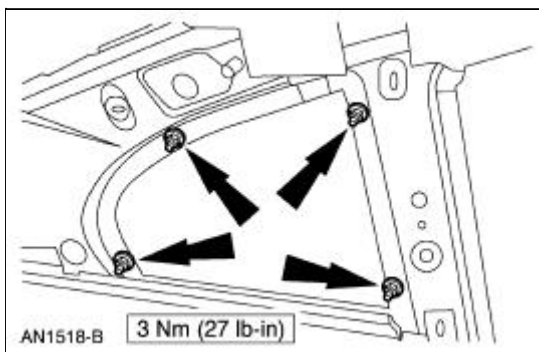
Window Glass —Quarter

Removal

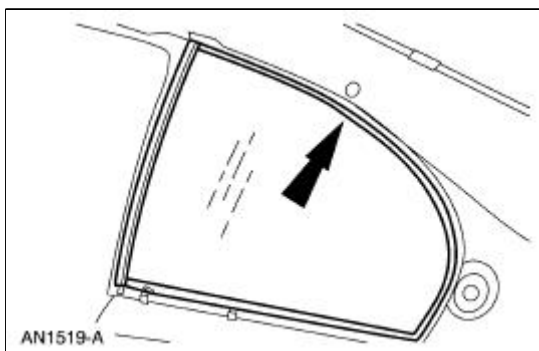
1. Remove the quarter trim panel. For additional information, refer to [Section 501-05](#).
2. Remove the roof side trim moulding. For additional information, refer to [Section 501-08](#).
3. Remove the exterior quarter glass weatherstrip.



4. Remove the nuts.



5. Remove the quarter window glass.



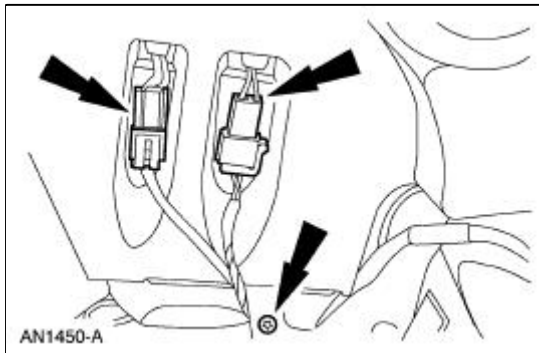
Installation

1. To install, reverse the removal procedure.

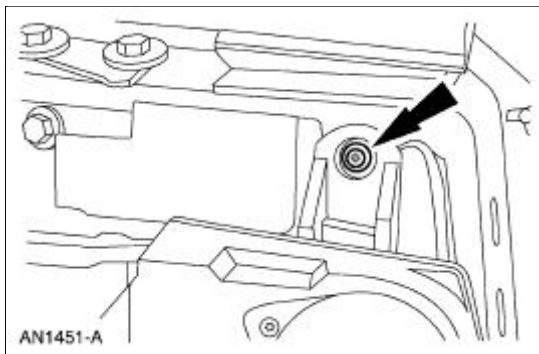
Window Glass —Quarter, Convertible

Removal

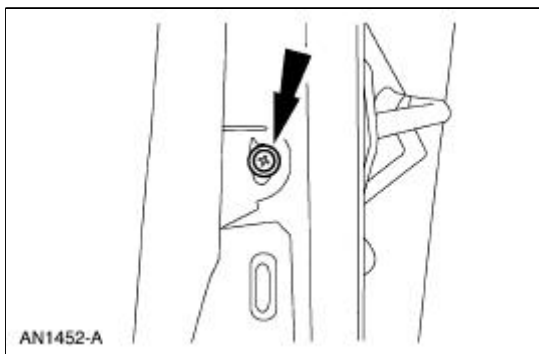
1. Remove the quarter trim panel. For additional information, refer to [Section 501-05](#).
2. Disconnect the connectors and remove the screw.



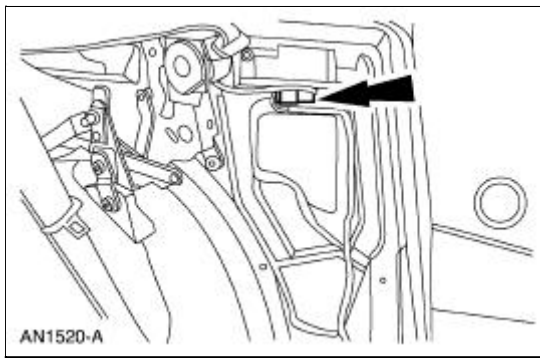
3. Remove the screw.



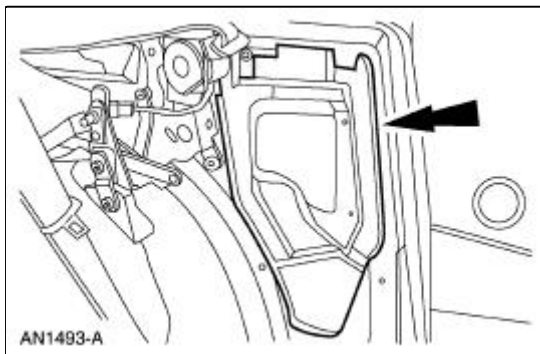
4. Remove the screw and the speaker.



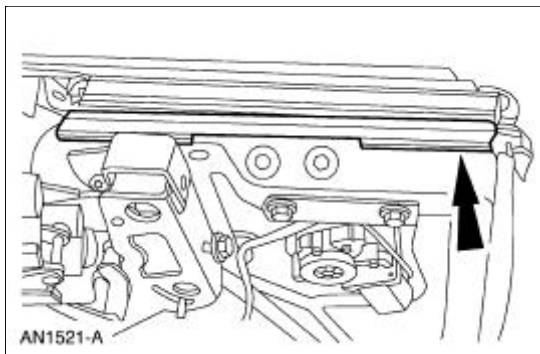
5. Disconnect the electrical connector.



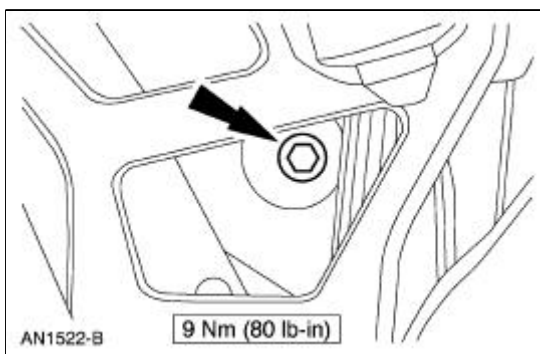
6. Remove the watershield.



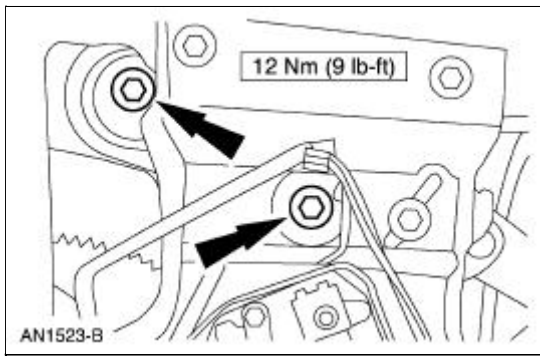
7. Remove the interior weatherstrip.



8. Remove the bolt.



9. Remove the bolts and the glass.



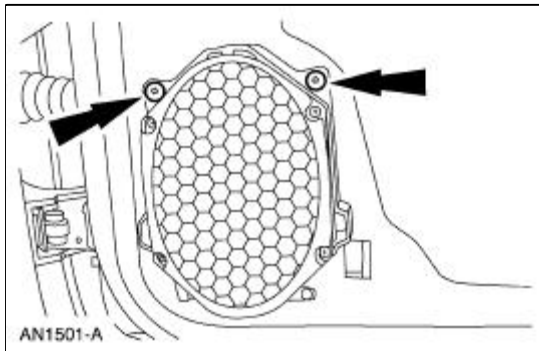
Installation

1. To install, reverse the removal procedure.
-

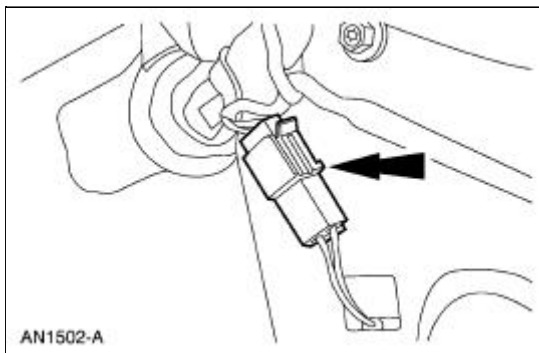
Motor —Window Regulator

Removal

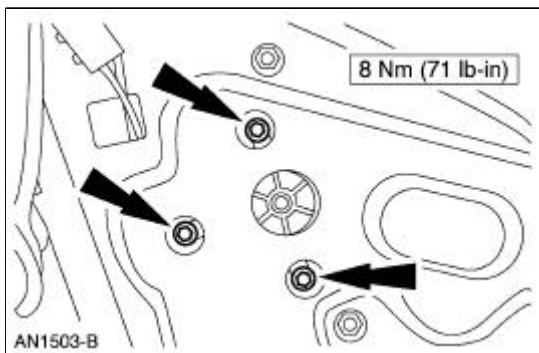
1. Remove the door trim panel. For additional information, refer to [Section 501-05](#).
2. Remove the screws and the speaker.



3. Disconnect the electrical connector.



4. Remove the screws and the window regulator motor.



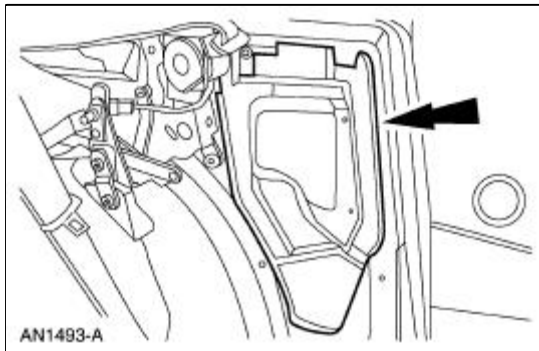
Installation

1. To install, reverse the removal procedure.

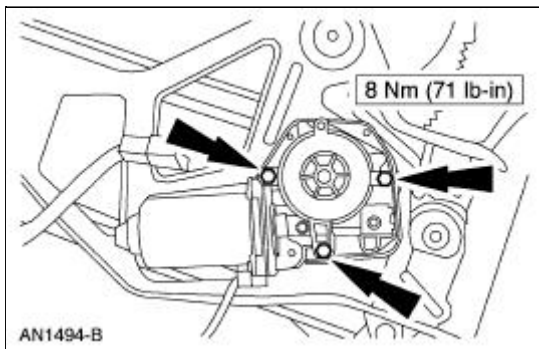
Motor —Window Regulator, Quarter

Removal

1. Remove the quarter trim panel. For additional information, refer to [Section 501-05](#).
2. Remove the watershield.



3. Remove the quarter glass window regulator motor.



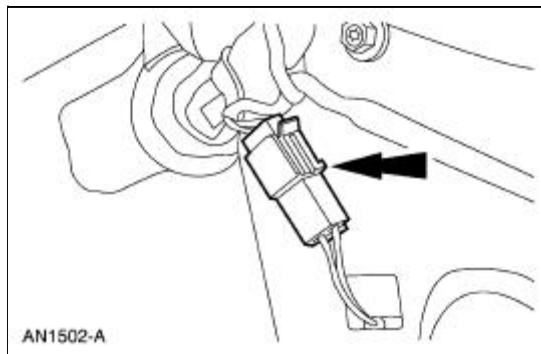
Installation

1. To install, reverse the removal procedure.
-

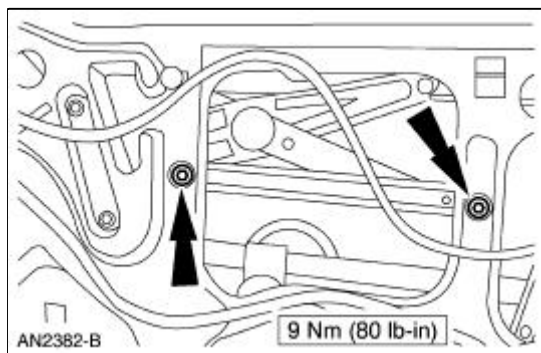
Window Regulator —Power

Removal

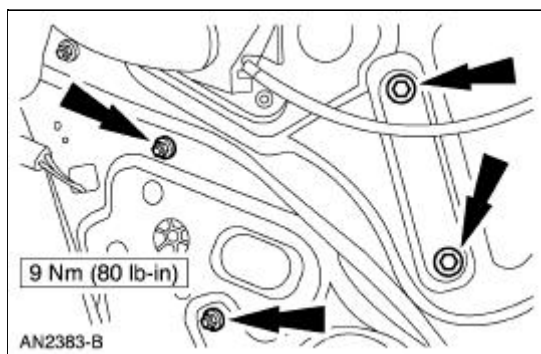
1. Remove the door window glass. For additional information, refer to [Window Glass—Door](#) in this section.
2. Disconnect the electrical connector.



3. Remove the channel.



4. Remove the regulator.



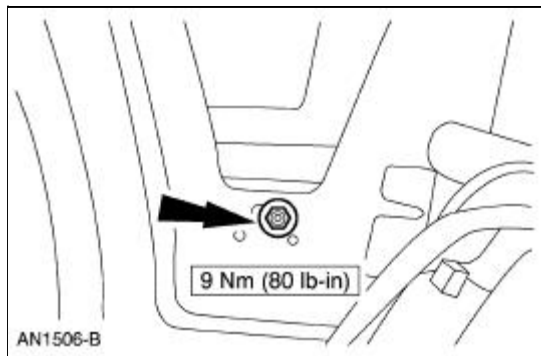
Installation

1. To install, reverse the removal procedure.

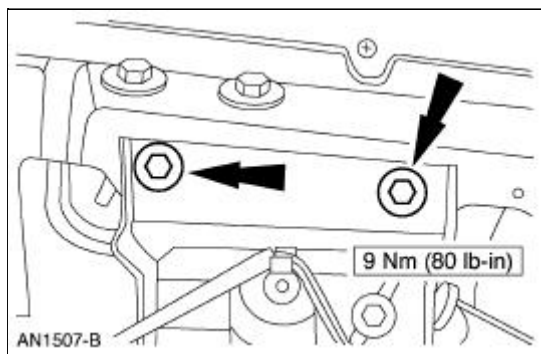
Window Regulator —Quarter

Removal

1. Remove the quarter window glass. For additional information, refer to [Window Glass—Quarter](#) in this section.
2. Remove the nut.



3. Remove the screws and the rear quarter window regulator.






Installation

1. To install, reverse the removal procedure.

Windshield Glass

Special Tool(s)

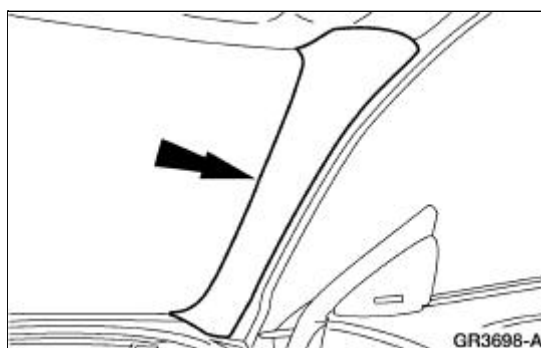
 ST1109-A	Rotunda Pneumatic Knife with Offset Blade 107-R1511 or equivalent
 ST2085-A	The Pumper 164-R2459 or equivalent
 ST1320-A	Rotunda Interior Auto Glass Cut-Out Knife Kit 164-R2450 or equivalent

Removal

All vehicles

 **WARNING:** To prevent glass splinters from entering eyes or cutting hands, wear safety glasses and heavy gloves when cutting glass from the vehicle.

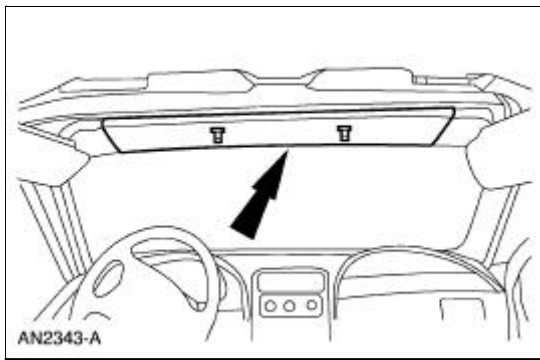
1. Remove the RH and LH windshield side garnish mouldings.
 - If equipped with a convertible top, remove the pin-type retainers.



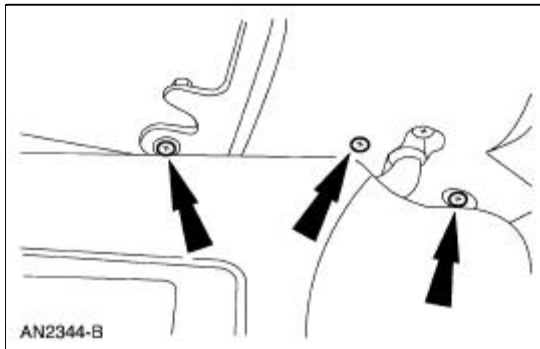
2. Remove the interior rear view mirror.

Convertible

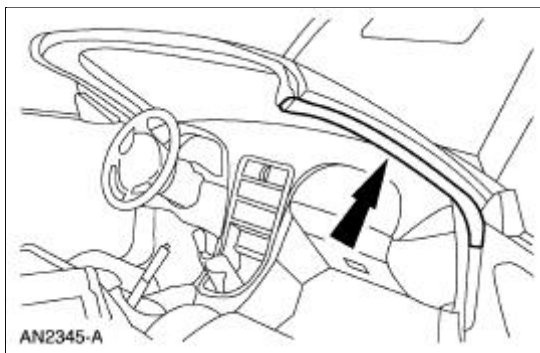
3. Remove the visor trim moulding.



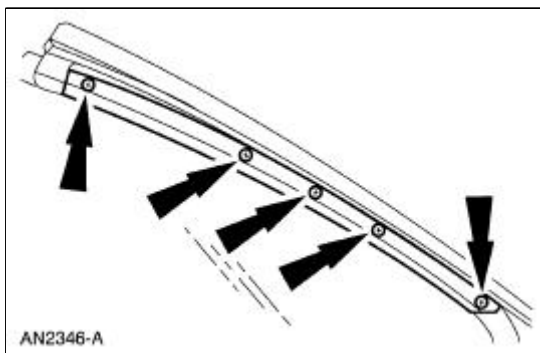
4. Remove the screws and the sun visors.
 - Disconnect the electrical connector(s).



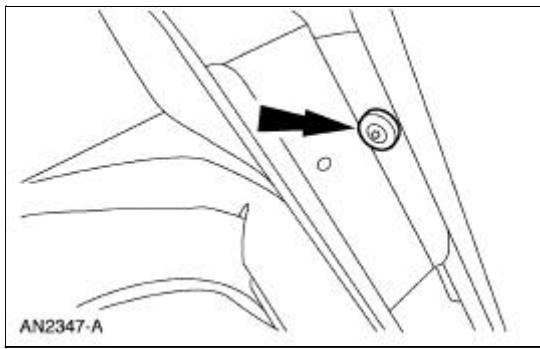
5. Remove the weatherstrips.



6. Remove the screws and the weatherstrip retainers.

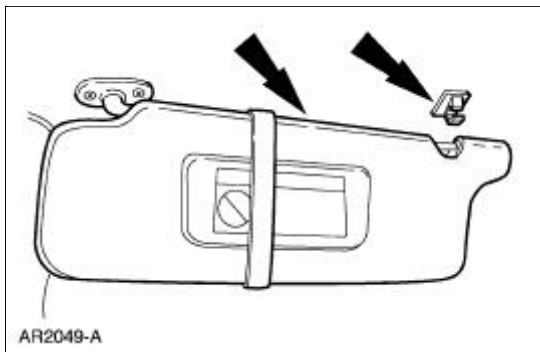


7. Remove the screw and the exterior A-pillar moulding.



Coupe

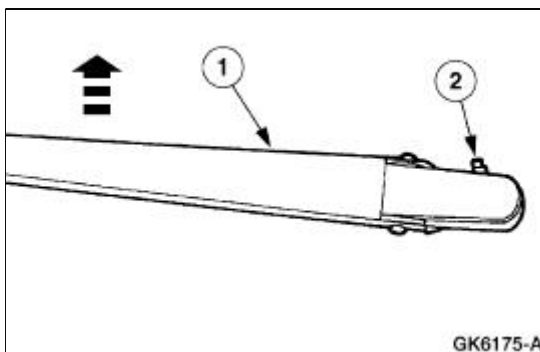
8. Remove the sun visors and clips
 - Remove the screws.
 - Remove the clips.



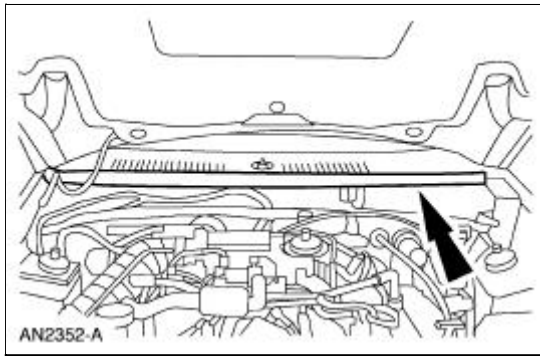
9. Remove the roof side trim moulding. For additional information, refer to [Section 501-08](#).
10. Lower the front portion of the headliner.

All vehicles

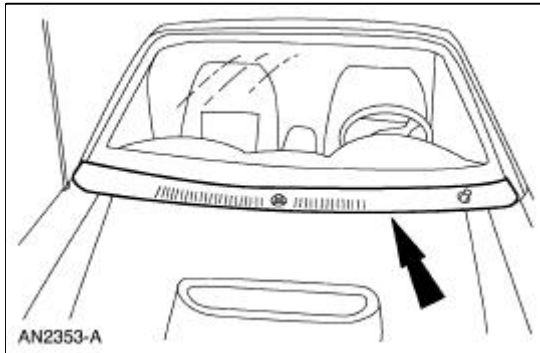
11. Remove the two windshield wiper pivot arms.
 1. Raise up on the pivot arms.
 2. Release the retainer tabs, and release the windshield wiper pivot arms.



12. Remove the cowl grille weatherstrip.



13. Remove the cowl grille.



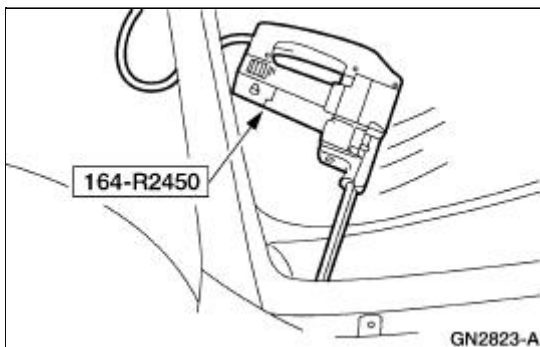
14. Using a soft brush or vacuum, clean any dirt or foreign material from the pinch weld.

15.  **CAUTION: Cover the instrument panel to prevent possible damage.**

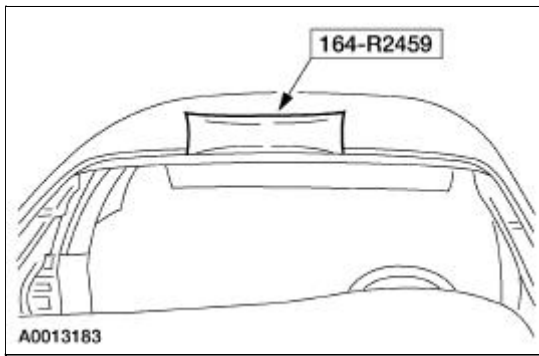
-  **CAUTION: Care must be taken to prevent scratching the pinch weld.**

NOTE: Lubricate the existing urethane adhesive with water to aid the special tool while cutting.

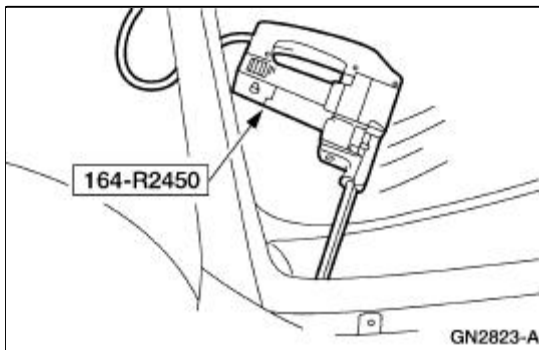
Using the special tool, starting at the top center of the windshield cut the urethane adhesive from the windshield glass and work down the sides.



16. Using the special tool, distance the windshield glass from the body.



17. Using the special tool cut the urethane adhesive and remove the windshield.



18. Using a soft brush or vacuum, remove any dirt or foreign material from the pinch weld.

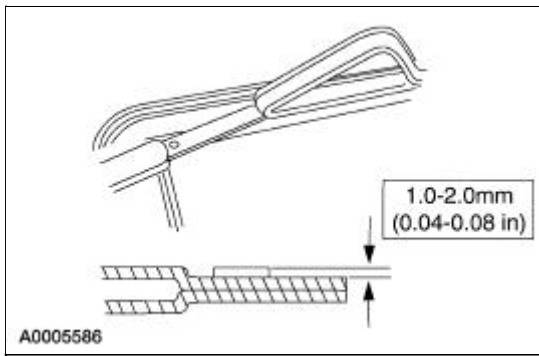
Installation

All vehicles

⚠ CAUTION: After installing the urethane installed windshield, the vehicle should not be driven until the urethane adhesive has cured. The curing time at temperatures above 13°C (55° F) and relative humidity above 50% is 12-24 hours (Refer to ESSEX drive away chart for cure times as temperatures and humidity vary). Inadequate curing of the urethane adhesive may adversely affect the strength of the urethane adhesive bond.

1. Dry-fit the windshield glass by centering it side-to-side and by adjusting the setting blocks (if equipped) to get the correct position of the part top-to-bottom. Make alignment marks with tape or non-staining grease pencil on both the glass and the vehicle body.
2. **⚠ CAUTION:** Care must be taken to avoid scratching the pinch weld.

Trim the remaining urethane on the pinch weld using only the full-cut method. In this method, most of the existing urethane is removed leaving a level bead around the entire pinch weld.

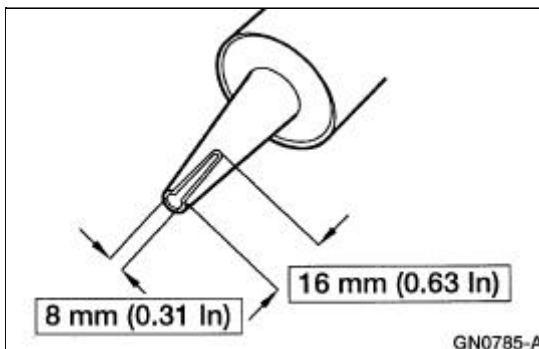


3. Using a wool applicator, apply the Urethane Metal Primer Essex U-413 meeting Ford specification WSB-M2G234-C to any exposed metal on the pinch weld. Allow 6 to 10 minutes to dry.
4. If reinstalling the original windshield glass, remove the excess urethane adhesive from the windshield glass.
5. If installing a new windshield glass, clean the inside of the glass surface with an alcohol-free cleaner to make sure the ceramic-coated area is clean.

6. **⚠ CAUTION: Wipe off the urethane glass prep immediately after each application because it flash dries. Apply deliberate strokes, making sure not to overlap the applied area.**

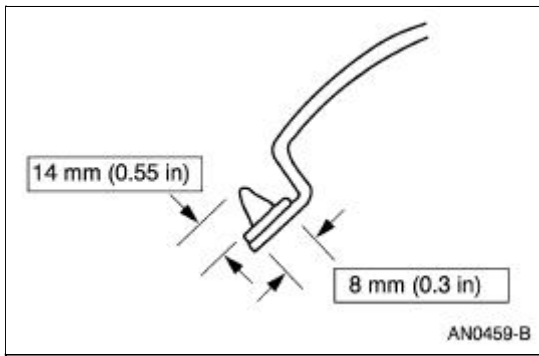
If installing a new windshield glass, apply Urethane Glass Prep Essex U-401 meeting Ford specification WSB-M2G314-B twice around the class surface to be prepped.


7. If installing a new windshield glass, apply Urethane Glass Primer Essex U-402 meeting Ford specification WSB-M5B280-C to the same area that was in the previous step. Allow five minutes to dry.
8. Cut the applicator tip to specification.



9. **⚠ CAUTION: If the vehicle is to be driven within 24 hours of urethane adhesive application, Urethane Adhesive Essex U-216 meeting Ford specification WSB-M2G316-B must be used due to its one hour cure time.**

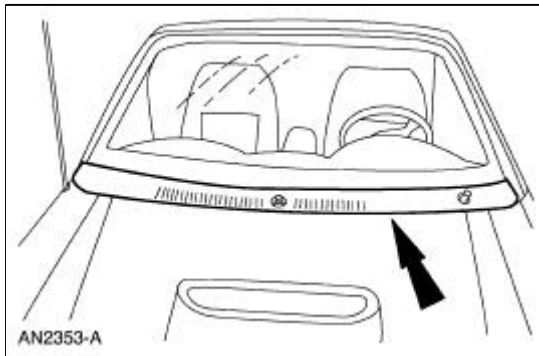
Apply a bead of Urethane Adhesive Essex 400-HV or Essex U-216 meeting Ford specification WSB-M2G316-B to the pinch weld.



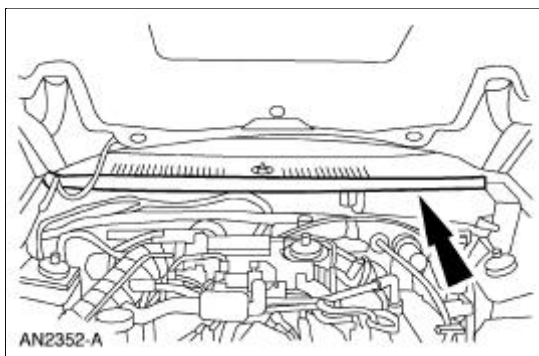
10.  **CAUTION:** Open a window to prevent the windshield glass from being pushed out by air pressure when a door is closed.

Using the alignment marks install the windshield glass.

11. After the glass is set, check for water leaks and add urethane adhesive where needed.
12. Install the cowl grille.



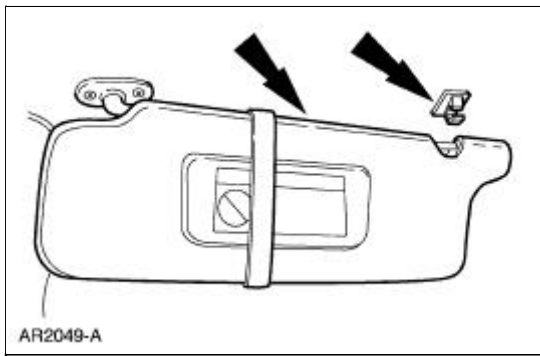
13. Install the cowl grille weatherstrip.



14. Install the two windshield wiper pivot arms.
- Position the arms.
 - Install the windshield wiper pivot arms.
15. Install the headliner.

Coupe

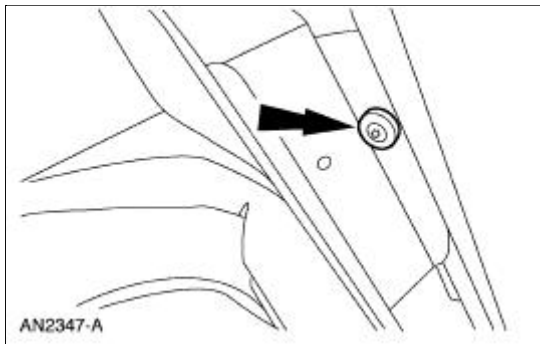
16. Install the sun visors and clips.



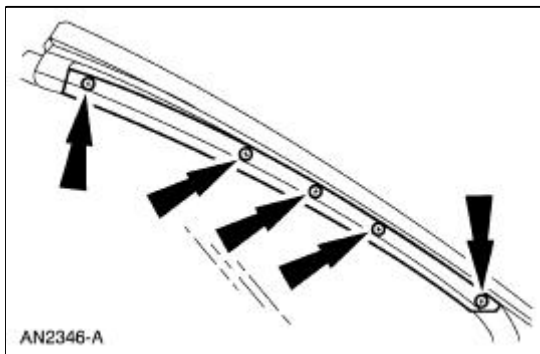
17. Install the roof side trim moulding. For additional information, refer to [Section 501-08](#).

Convertible

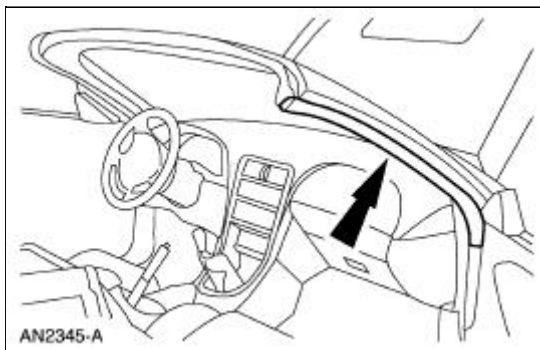
18. Install the exterior A-pillar moulding and screw.



19. Install the weatherstrip retainers.

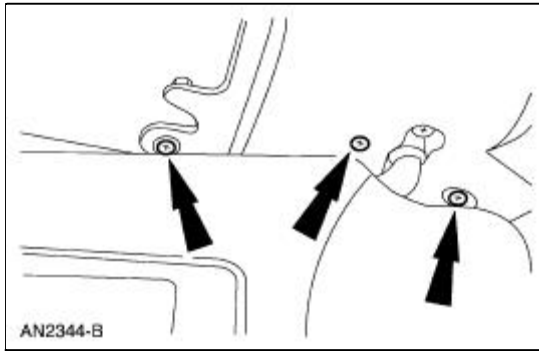


20. Install the weatherstrips.

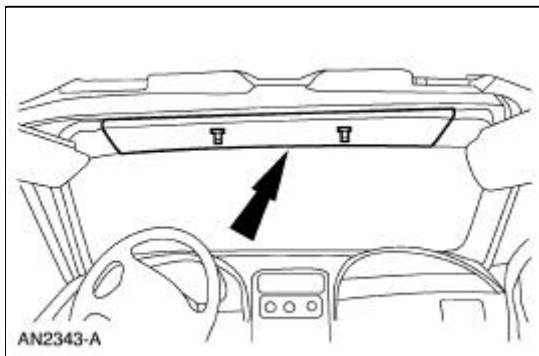


21. Position the sun visors and install the screws.

- Connect the electrical connector(s).

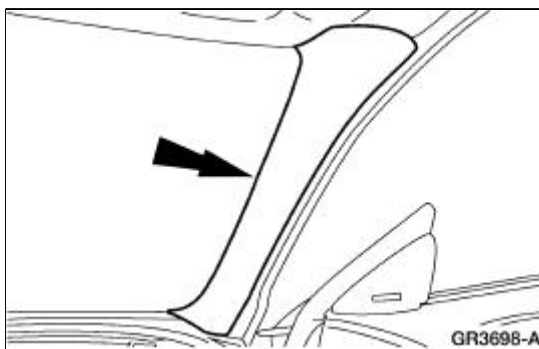


22. Install the visor trim moulding.



All vehicles

23. Install the RH and LH windshield side garnish moulding.
- If equipped with a convertible top, install the pin-type retainers.

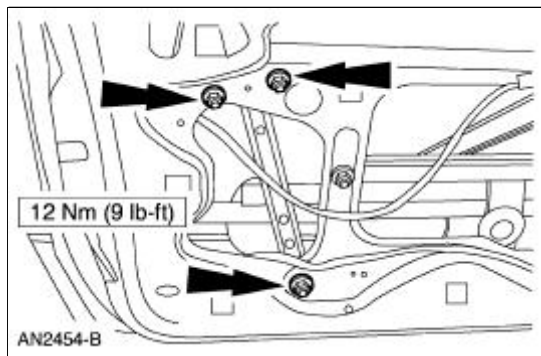


24. Install the interior rear view mirror.
-

Door Glass Run Retainer

Removal

1. Remove the door trim panel. For additional information, refer to [Section 501-05](#).
2. Remove the watershield.
3. Position the door window glass in the full up position.
4. Remove the nuts and the door glass run.



Installation

1. To install, reverse the removal procedure.
-

Torque Specifications

Description	Nm	lb-ft	lb-in
Bulkhead wiring harness electrical connector bolt	5	—	44
Floor console screws	2	—	18
Instrument panel support bolts	9	—	80
Instrument panel support nut	48	35	—
Intermediate shaft pinch bolt	47	35	—
Instrument panel reinforcement screws	9	—	80
Instrument panel steering column cover screws	9	—	80

Instrument Panel

The instrument panel consists of the following components:

- instrument cluster
 - instrument panel finish panels
 - audio unit
 - A/C controls
 - glove compartment door
 - passenger air bag module
 - glove compartment
 - instrument panel steering column cover
 - instrument panel reinforcement
 - instrument panel defroster grille
-

Console —Floor

The floor console consists of the following components:

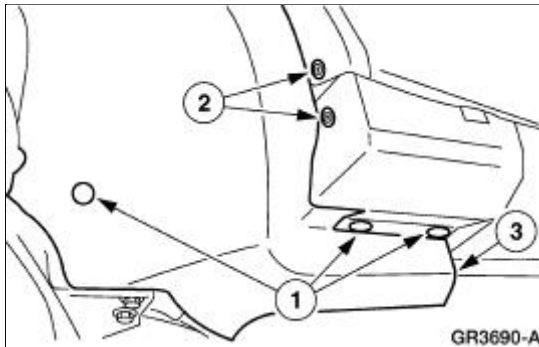
- console glove compartment
 - console glove compartment door
 - beverage holder
 - cigar lighter knob and element
 - power point
 - glove compartment hinge
 - console finish panel
 - coin holder
 - convertible top control switch (if equipped)
-

Instrument Panel

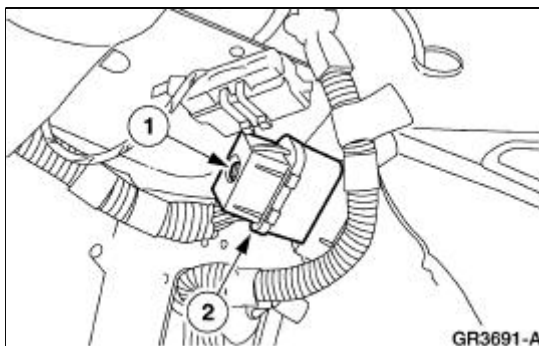
Removal

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

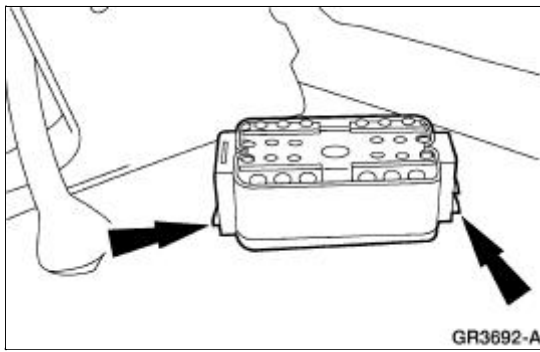
1. Remove the driver air bag module. For additional information, refer to [Section 501-20B](#).
2. Remove the passenger air bag module. For additional information, refer to [Section 501-20B](#).
3. Remove the LH front wheel and tire assembly. For additional information, refer to [Section 204-04](#).
4. Position the LH fender splash shield away from the dash panel.
 1. Remove the pin-type retainers.
 2. Remove the screws.
 3. Position the LH fender splash shield away from the dash panel.



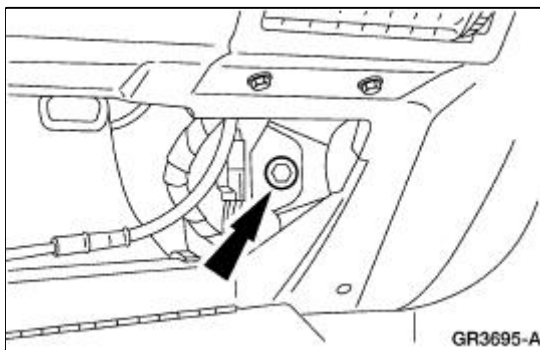
5. Disconnect the bulkhead electrical connector from inside the fender opening.
 1. Loosen the bolt.
 2. Disconnect the bulkhead electrical connector.



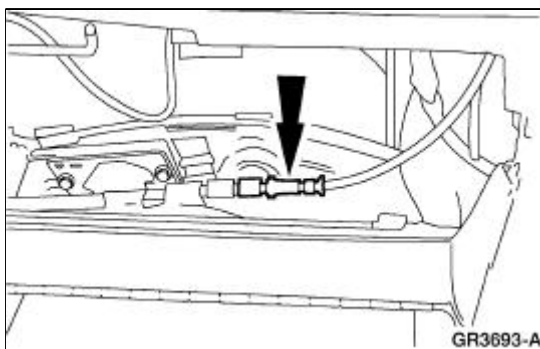
6. Release the bulkhead electrical connector from the dash panel.



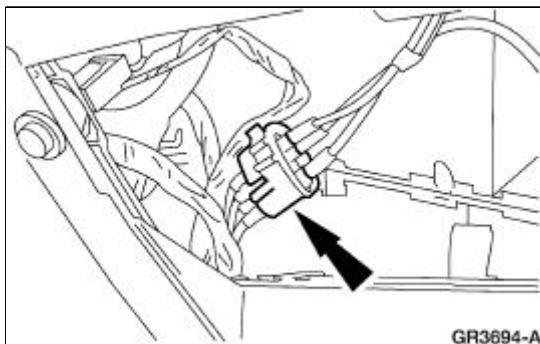
7. Install the LH front wheel and tire assembly. For additional information, refer to [Section 204-04](#).
8. Remove the floor console. For additional information, refer to [Floor Console](#) in this section.
9. Remove the upper RH instrument panel support bolt.



10. Disconnect the antenna in-line connector.

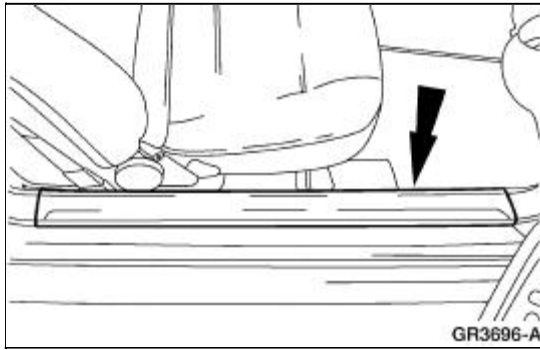


11. Disconnect the climate control vacuum harness connector.

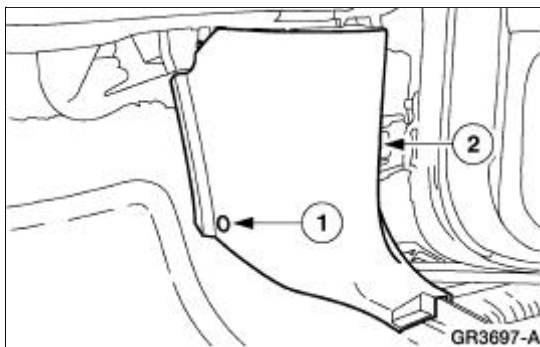


12. Close the glove compartment.

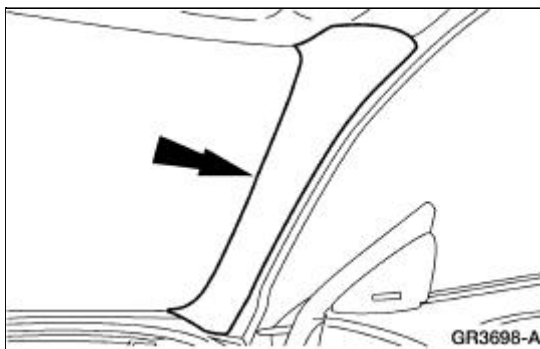
13. Remove the LH and RH scuff plates.



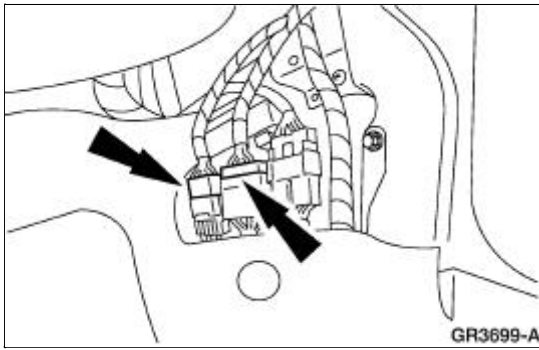
14. Remove the LH and RH A-pillar lower trim panels.
1. Remove the pin-type retainers.
 2. Remove the A-pillar lower trim panels.



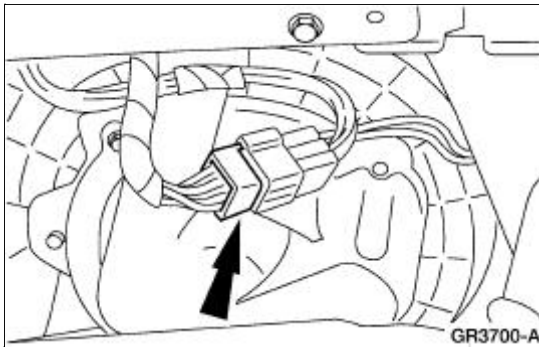
15. Remove the LH and RH windshield side garnish mouldings.
- If equipped with a convertible top, remove the pin-type retainers.



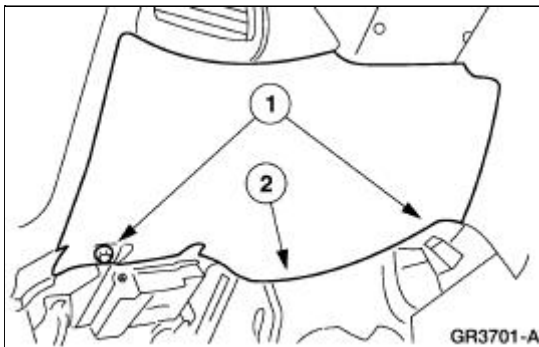
16. Position the LH and RH door weatherstrips aside.
17. Disconnect the RH main wiring harness electrical connectors.



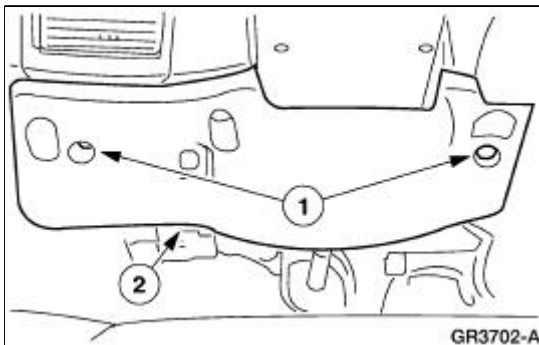
18. Disconnect the climate control wiring harness connector.



19. Remove the instrument panel steering column cover.
 1. Remove the screws.
 2. Remove the instrument panel steering column cover.

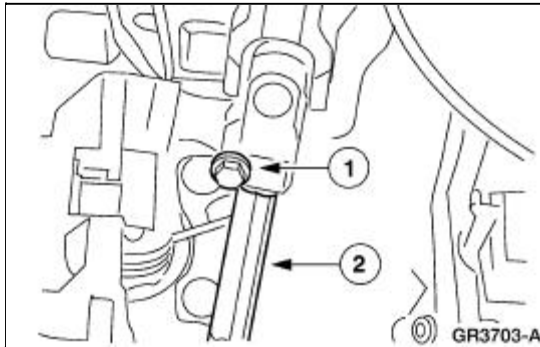


20. Remove the instrument panel reinforcement.
 1. Remove the screws.
 2. Remove the instrument panel reinforcement.



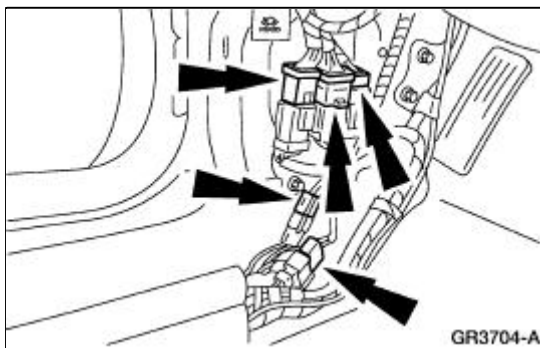
21. Separate the intermediate shaft from the steering column shaft.
 1. Remove the pinch bolt.

2. Separate the intermediate shaft from the steering column shaft.

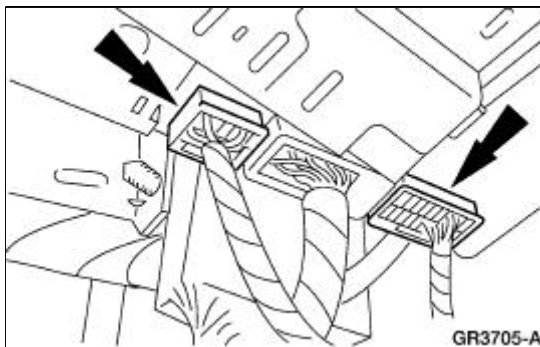


22. **NOTE:** The corner of the carpet may have to be pulled back slightly to carry out this step.

Disconnect the LH main wiring harness electrical connectors.

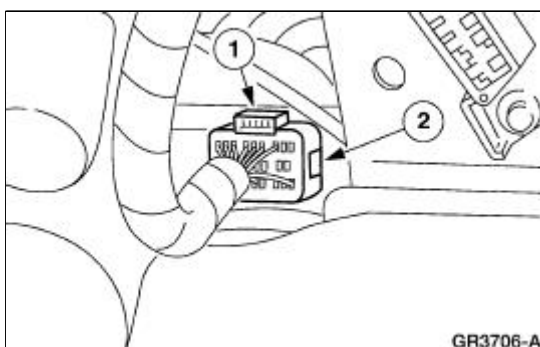


23. Disconnect the generic electronic module (GEM) electrical connectors.

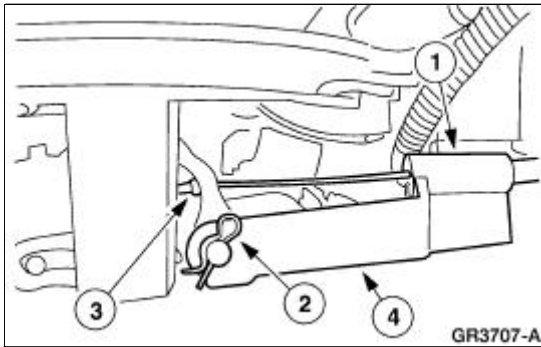


24. Disconnect the electronic crash sensor (ECS) module electrical connector.

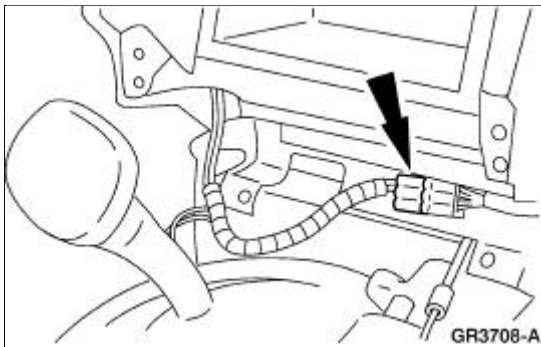
1. Release the locking tab.
2. Disconnect the ECS module electrical connector.



25. If equipped, disconnect the shift interlock assembly from the selector lever.
1. Remove the screw.
 2. Remove the R-clip.
 3. Disconnect the shift interlock cable.
 4. Disconnect the shift interlock assembly from the selector lever.



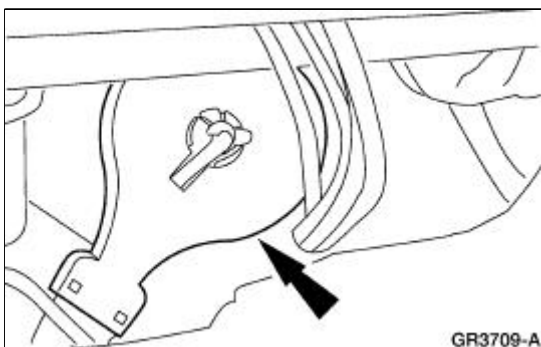
26. Remove the audio unit. For additional information, refer to [Section 415-01](#).
27. If equipped, disconnect the shifter assembly electrical connector.



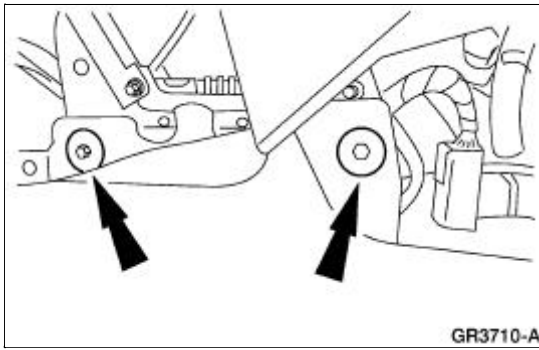
28. **NOTE:** This step is being carried out through the audio unit opening.

NOTE: Rotate the temperature control switch to the cool position.

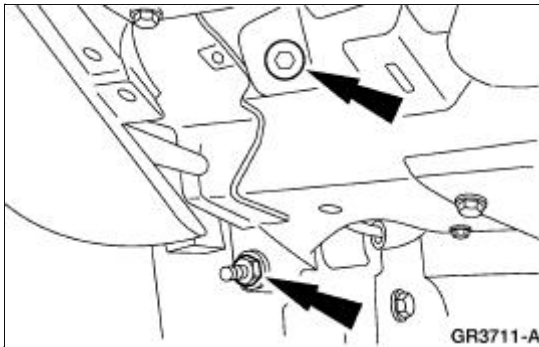
Release the temperature control cable from the blend door.



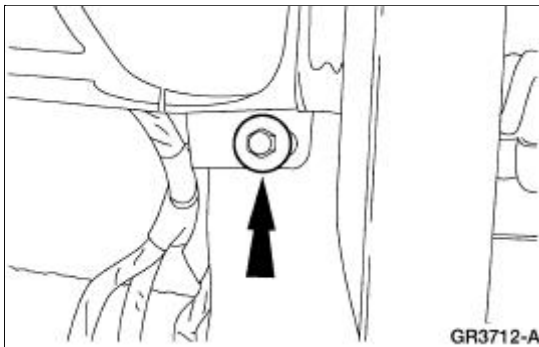
29. Remove the four center instrument panel support bolts.



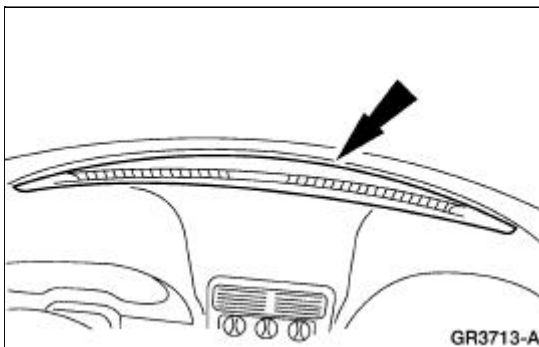
30. Remove the LH instrument panel support bolt and nut.



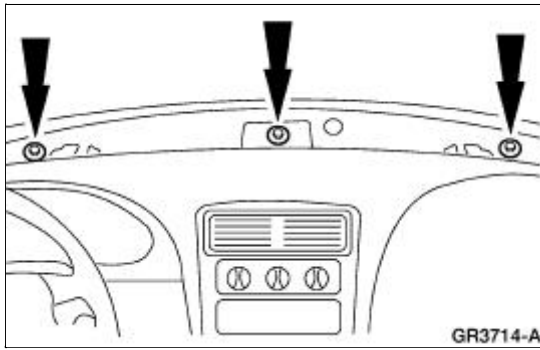
31. Remove the RH instrument panel support bolt.



32. Remove the instrument panel defroster grille.



33. Remove upper instrument panel support bolts.



34. **NOTE:** Two technicians are necessary to carry out this step.

Remove the instrument panel.

Installation

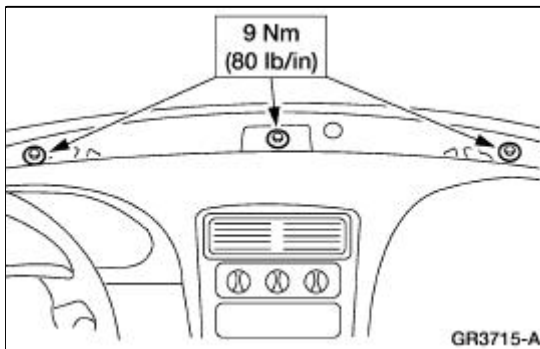


CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage may result.

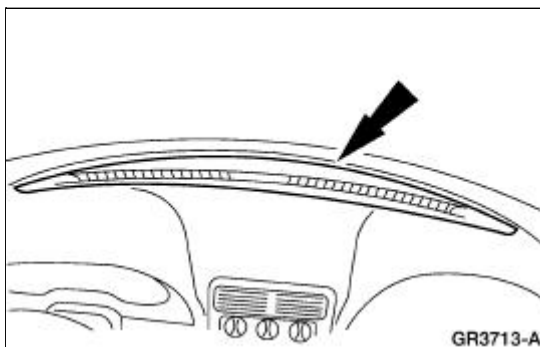
1. **NOTE:** Two technicians are necessary to carry out this step.

Install the instrument panel.

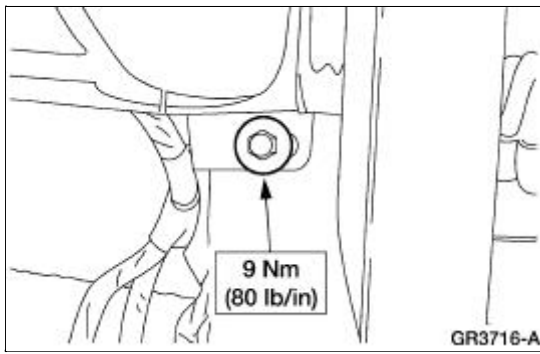
2. Install the upper instrument panel support bolts.



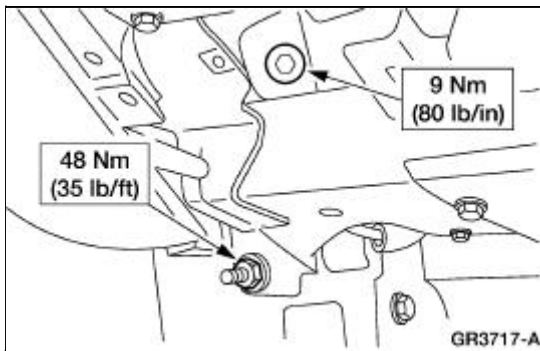
3. Install the instrument panel defroster grille.



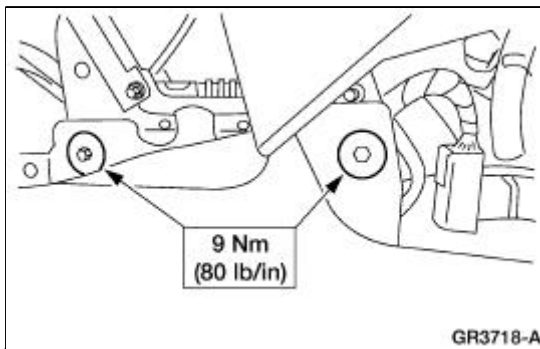
4. Install the RH instrument panel support bolt.



5. Install the LH instrument panel support bolt and nut.

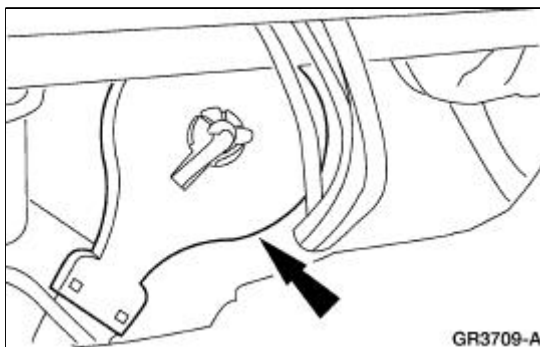


6. Install the four center instrument panel support bolts.

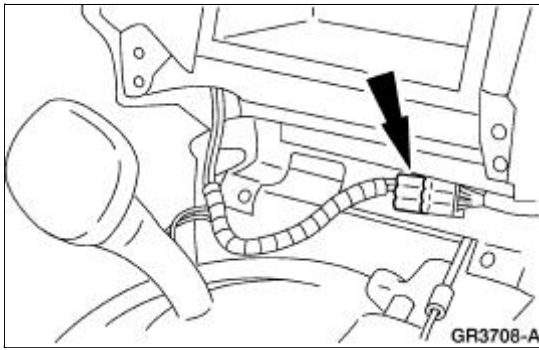


7. **NOTE:** This step is being carried out through the audio unit opening.

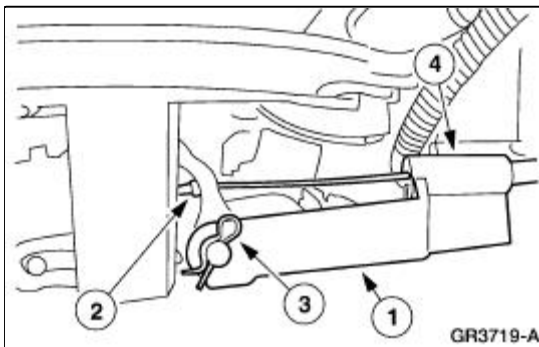
Install the temperature control cable to the blend door.



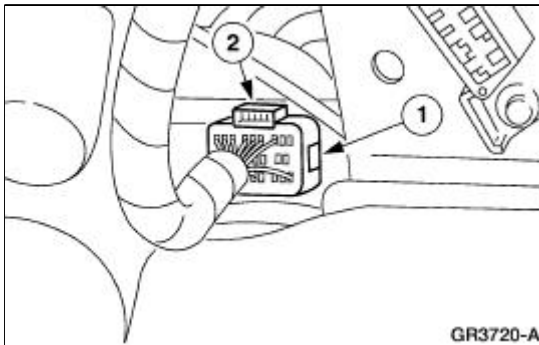
8. If equipped, connect the shifter assembly electrical connector.



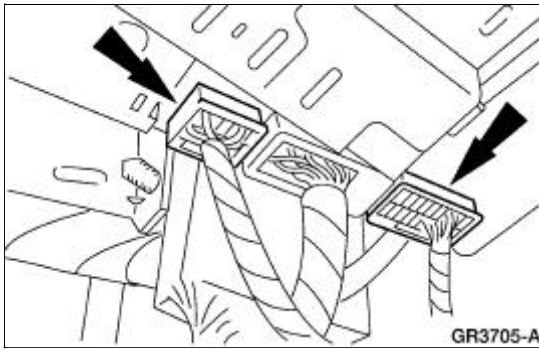
9. Install the audio unit. For additional information, refer to [Section 415-01](#).
10. If equipped, connect the shift interlock assembly to the selector lever.
 1. Position the shift interlock assembly.
 2. Connect the shift interlock cable.
 3. Install the R-clip.
 4. Install the screw.



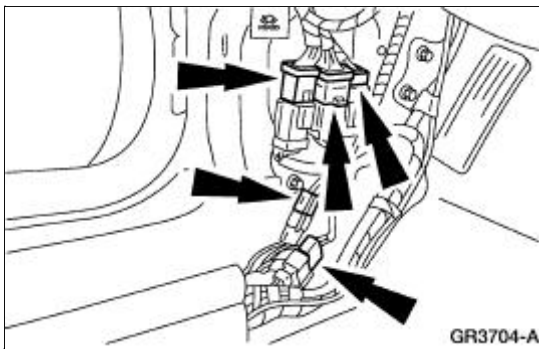
11. Connect the ECS module electrical connector.
 1. Connect the ECS module electrical connector.
 2. Engage the locking tab.



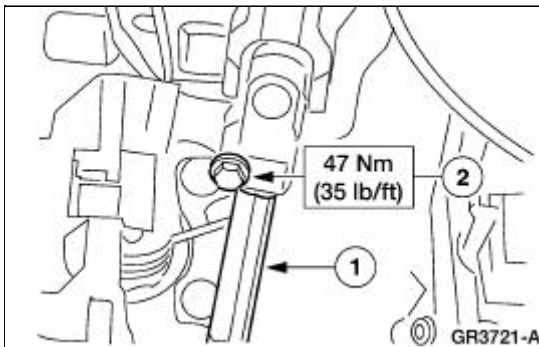
12. Connect the GEM electrical connectors.



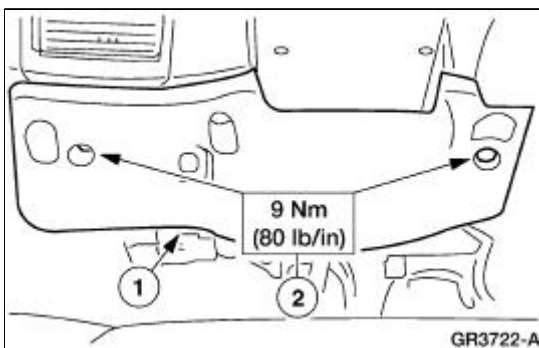
13. Connect the LH main wiring harness electrical connectors.



14. Connect the intermediate shaft to the steering column.
 1. Connect the intermediate shaft to the steering column.
 2. Install the pinch bolt.

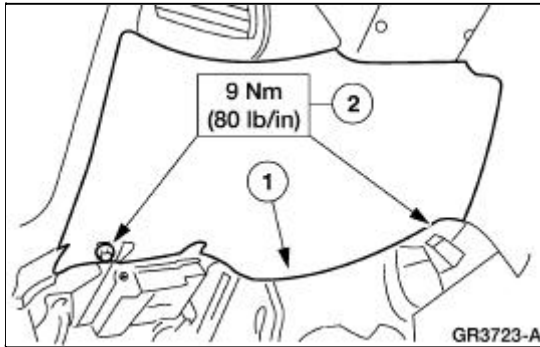


15. Install the instrument panel reinforcement.
 1. Position the instrument panel reinforcement.
 2. Install the screws.

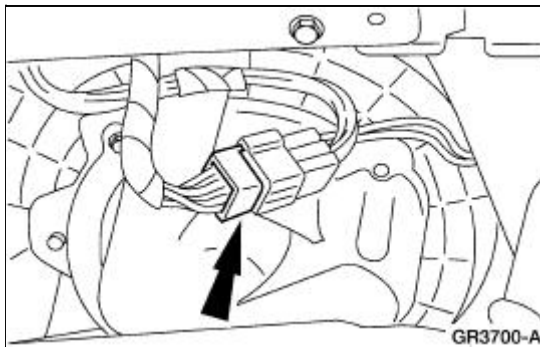


16. Install the instrument panel steering column cover.
 1. Position the instrument panel steering column cover.

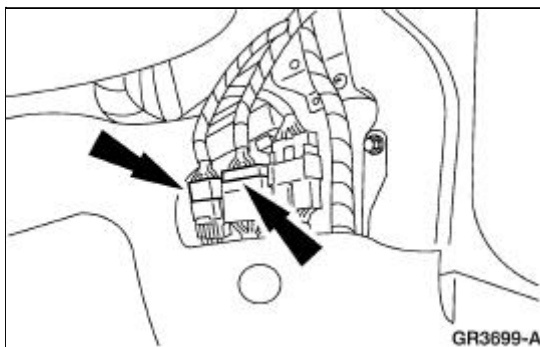
2. Install the screws.



17. Connect climate control wiring harness connector.



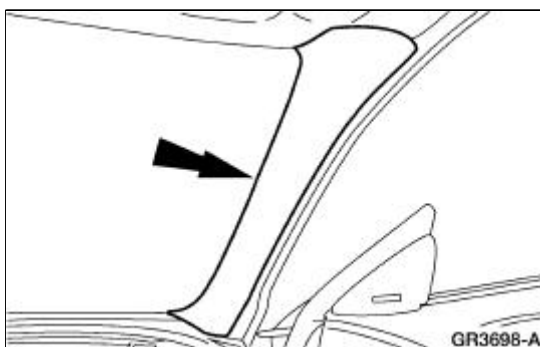
18. Connect the RH main harness electrical connectors.



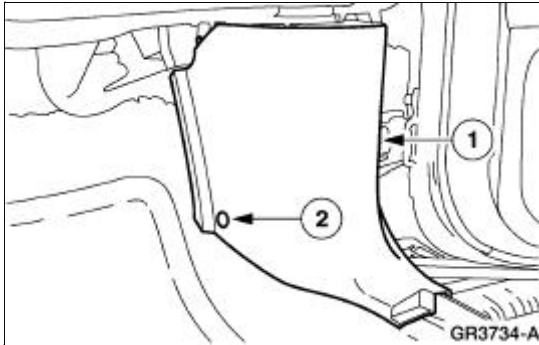
19. Install the LH and RH door weatherstrips.

20. Install the LH and RH windshield side garnish mouldings.

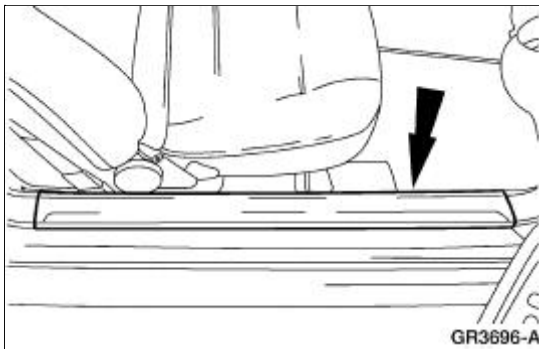
- If equipped with a convertible top, install the pin-type retainers.



21. Install the LH and RH A-pillar lower trim panels.
 1. Position the LH and RH A-pillar lower trim panels.
 2. Install the pin-type retainers.

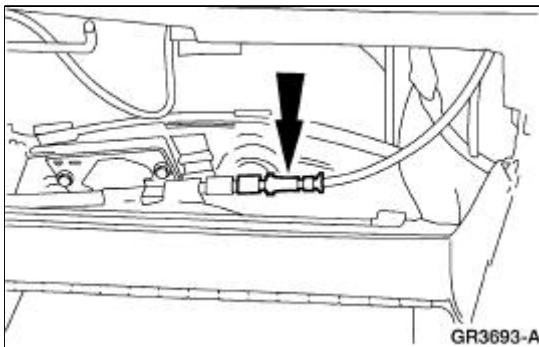


22. Install the LH and RH scuff plates.

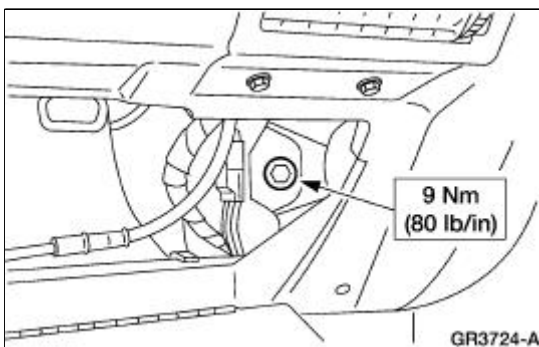


23. Open the glove compartment.

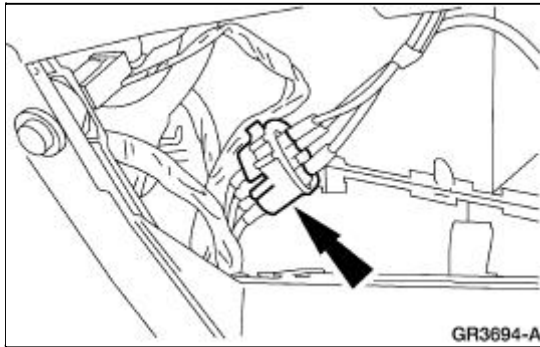
24. Connect the antenna in-line connector.



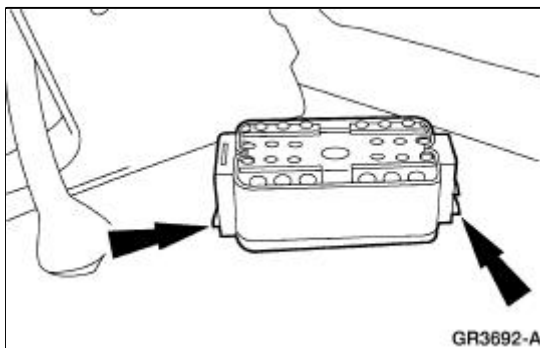
25. Install the upper RH instrument panel support bolt.



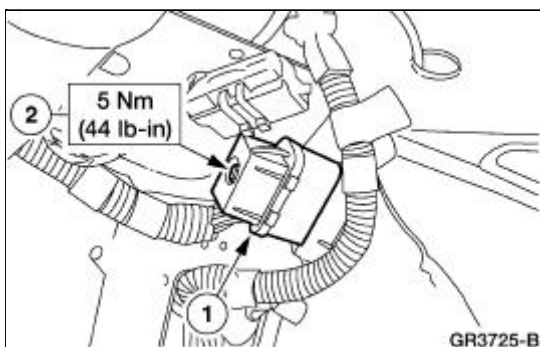
26. Connect the climate control vacuum harness connector.



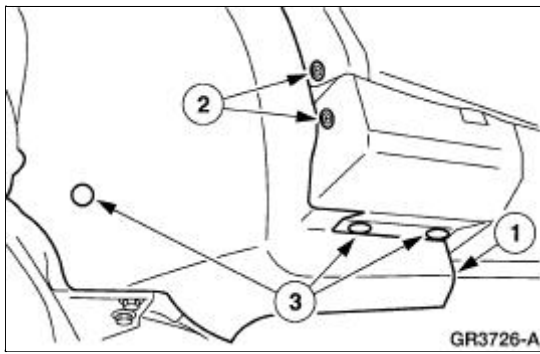
27. Install the floor console. For additional information, refer to [Floor Console](#) in this section.
28. Remove the LH front wheel and tire assembly. For additional information, refer to [Section 204-04](#).
29. Insert the bulkhead electrical connector into the dash panel.



30. Connect the bulkhead electrical connector.
1. Connect the bulkhead electrical connector.
 2. Tighten the bolt.



31. Install the LH front splash shield.
1. Position the LH front splash shield.
 2. Install the screws.
 3. Install the pin-type retainers.



32. Install the LH front wheel and tire assembly. For additional information, refer to [Section 204-04](#).
 33. Install the passenger air bag module. For additional information, refer to [Section 501-20B](#).
 34. Install the driver air bag module. For additional information, refer to [Section 501-20B](#).
-

Instrument Panel —Center Finish Panel

Removal and Installation

All vehicles

1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).

Vehicles with automatic transmission

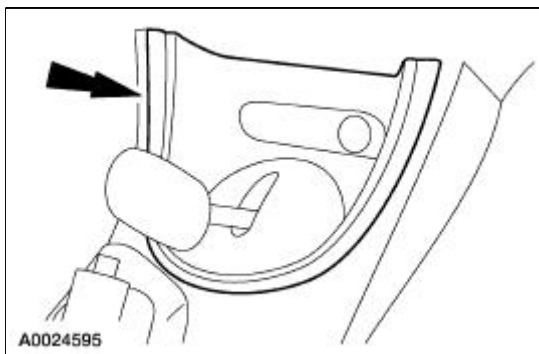
2. Place the selector lever in the 1 position.

Vehicles with manual transmission

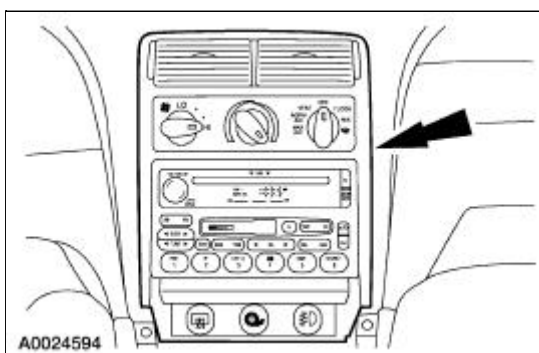
3. Remove the gearshift lever handle.

All vehicles

4. Remove the floor console finish panel.
 - Disconnect the electrical connector.



5. Remove the instrument panel center finish panel.
 - Disconnect the electrical connector.



6. To install, reverse the removal procedure.

Floor Console

Removal and Installation

All vehicles

1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Apply the parking brake.

Vehicles with automatic transmission

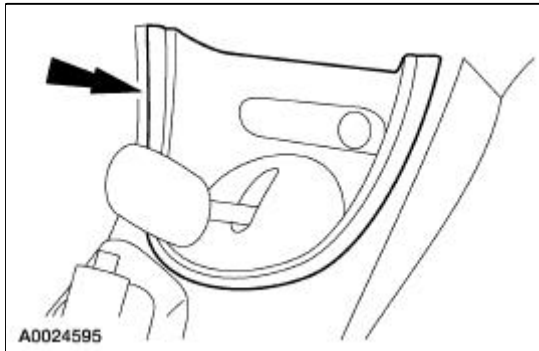
3. Place the selector lever in the 1 position.

Vehicles with manual transmission

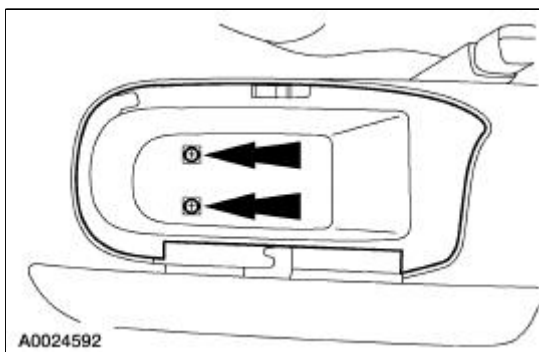
4. Remove the gearshift lever handle.

All vehicles

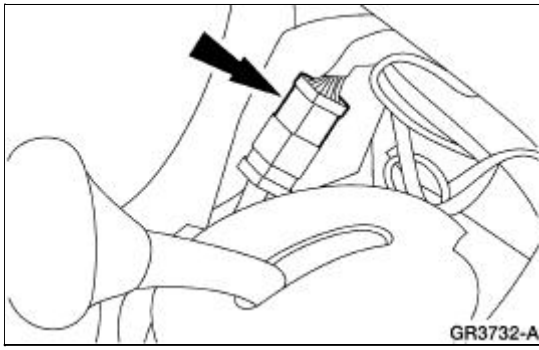
5. Remove the floor console finish panel.
 - Disconnect the electrical connector.



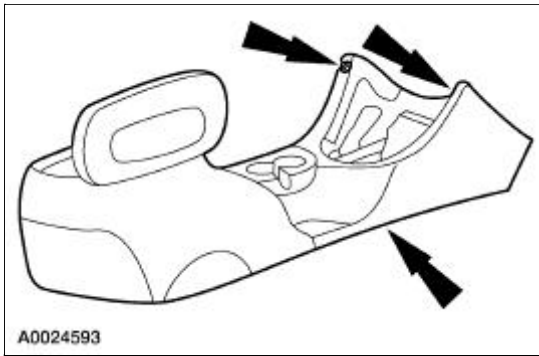
6. Open the floor console glove compartment door.
7. Remove the floor console screws.



8. Disconnect the floor console electrical connector.



9. Remove the screws and the floor console.



10. To install, reverse the removal procedure.

General Specifications

Item	Specification
Lubricants	
Multi-Purpose Grease Spray F5AZ-19G209-AA	ESR-M1C159-A
Penetrating and Lock Lubricant E8AZ-19A501-B	—

Torque Specifications

Description	Nm	lb-ft	lb-in
Door latch screws	12	9	—
Luggage compartment lid screws	9	—	80
Exterior door handle nuts	9	—	80
Luggage compartment lid latch striker screws	12	9	—
Fuel tank filler door retaining screws	3	—	27
Door latch striker plate screws	25	18	—

LOCK REPAIR/REPLACEMENT SPECIFICATIONS

Part Number	Lock Repair Package Name
F85Z-11582-AA	Ignition Cylinder
F8ZZ-6321990-AA	Door Lock
XR32-6343262-BA	Luggage Compartment Lid
	Luggage Compartment Lid, Remote
F8DZ-5406082-AA	Glove Box
F8DZ-5421970-AA	Lock Lever Kit

Handles, Locks, Latches And Mechanisms

Lock Cylinders

Individual lock cylinders are repaired by discarding the inoperative lock cylinder and building a new lock cylinder using the appropriate lock repair package. The lock repair package includes a detailed instruction sheet to build the new lock cylinder to the current key code of the vehicle.

Latch System

The door latch system consists of:

- front door latch remote control and cable assembly
- front door latch (21812)
- door latch control rod knob (21850)
- door handle (22404) and front door latch actuating rod (22152)
- lock cylinder (22050) and front door latch control cylinder rod (22134)
- door latch striker plate (22008)
- front door latch remote control cable (221A00)
- door lock cylinder (21990)
- window regulator switch plates (14524)
- adjunct actuator (218B20)
- circuit wiring and circuit protection
- front door lock switch (14017)
- luggage compartment lid latch with mechanical interior release handle and cable
- luggage compartment lid lock cylinder

Refer to [Section 501-14B](#).

Luggage Compartment Lid Remote Control Lock Switch

The luggage compartment remote control system consists of:

- luggage compartment remote control lock switch (19C542) located in the glove compartment (06010)
- remote control lock actuator (part of the luggage compartment lid latch)
- circuit wiring and circuit protection

Refer to [Section 501-14B](#).

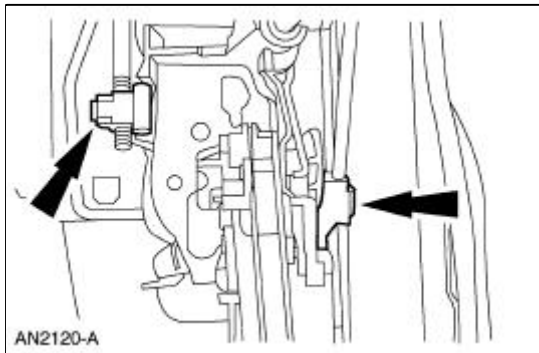
Locks, Latches And Mechanisms

Refer to [Section 501-14B](#) for power door lock and luggage compartment lid remote control lock switch diagnostics.

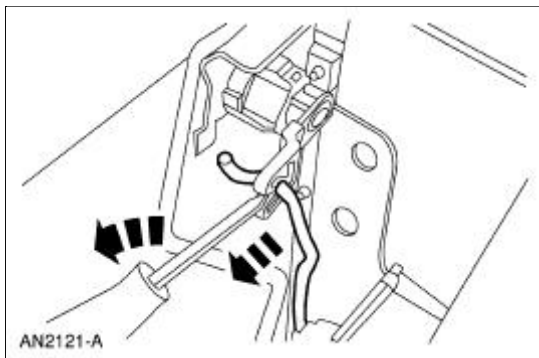
Latch —Door

Removal

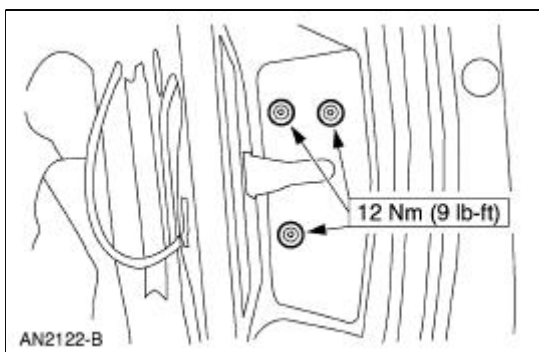
1. Remove the door trim panel (23942). For additional information, refer to [Section 501-05](#).
2. Release the actuating rods by opening the clips.



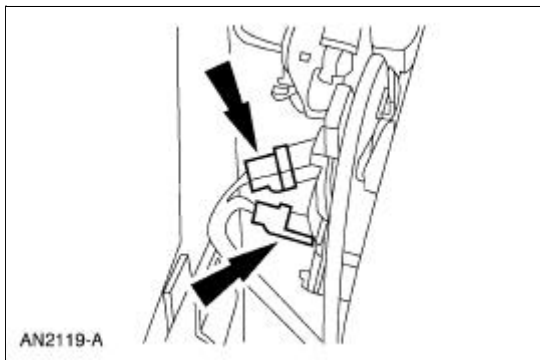
3. Using a screwdriver, release the lock cylinder actuating rod.



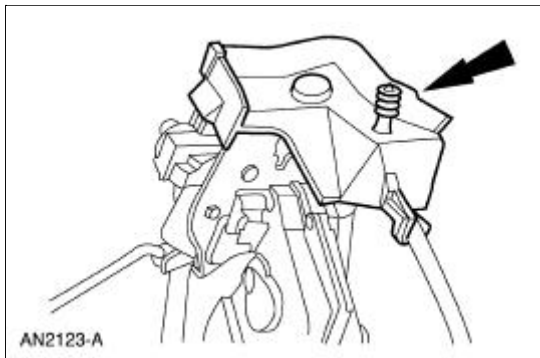
4. Remove the door latch screws.



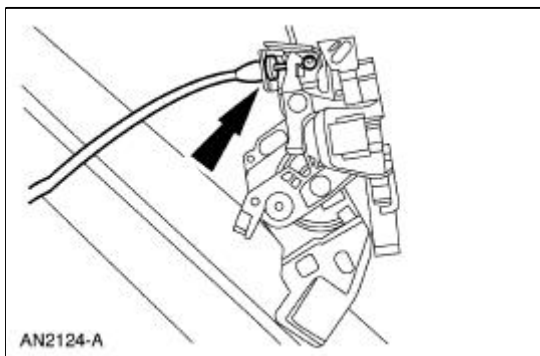
5. Disconnect the door ajar switch and the actuator electrical connectors.



6. Remove the water shield.



7. Release the interior door handle actuating cable.



8. Remove the door latch.

Installation

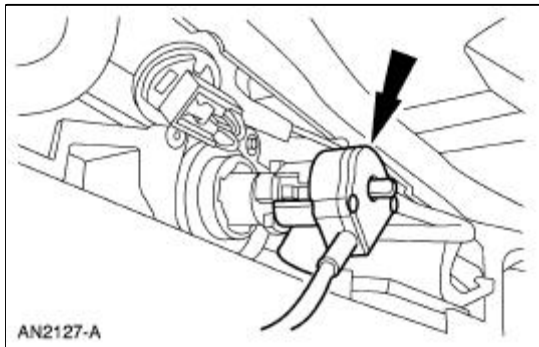
1. To install, reverse the removal procedure.
-

Latch —Luggage Compartment Lid

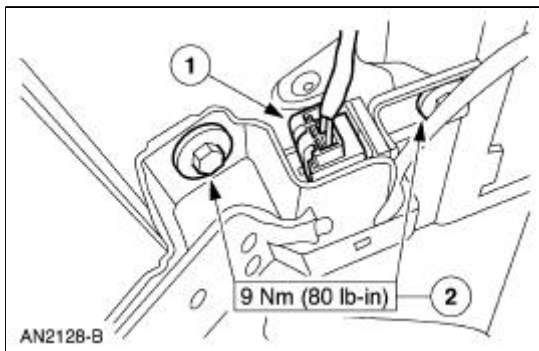
Removal

1. **NOTE:** The luggage compartment lid latch is equipped with mechanical interior release handle.

Disconnect the luggage compartment lid lock actuator (432A38) cable.



2. Remove the luggage compartment lid latch (43200).
 1. Disconnect the electrical connector.
 2. Remove the three bolts.



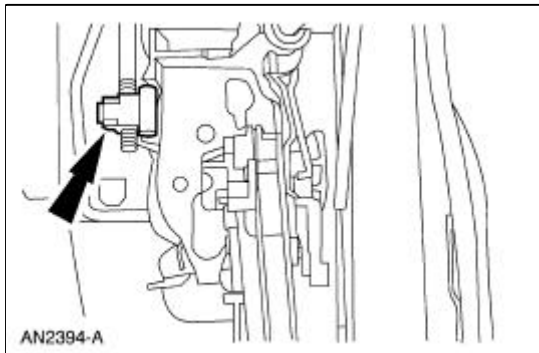
Installation

1. To install, reverse the removal procedure.

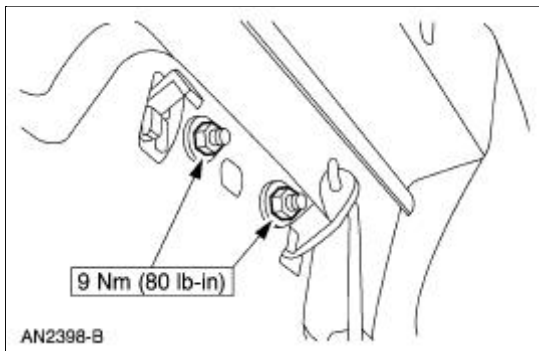
Handle —Exterior Door

Removal

1. Remove the door trim panel (23942). For additional information, refer to [Section 501-05](#).
2. Release the exterior door handle actuating rod by opening the clip.



3. Remove the exterior door handle nuts.



4. Remove the exterior door handle.

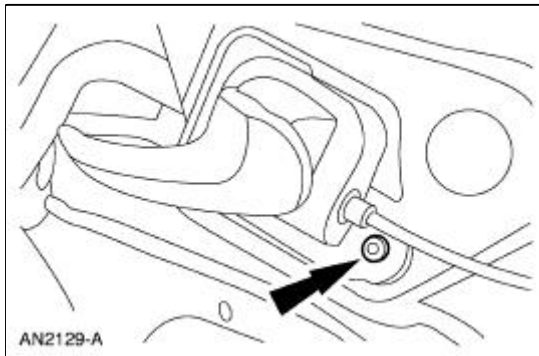
Installation

1. To install, reverse the removal procedure.
-

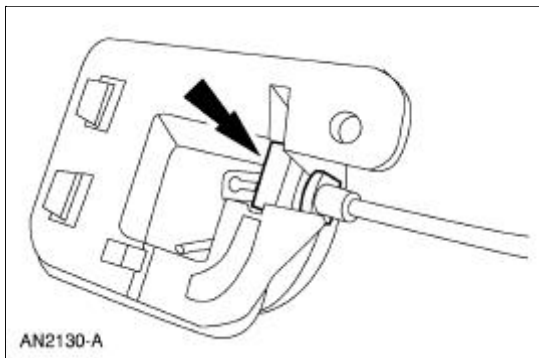
Handle —Interior Door

Removal

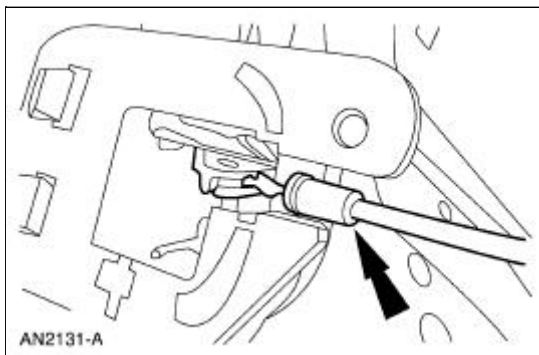
1. Remove the door trim panel (23942). For additional information, refer to [Section 501-05](#).
2. Remove the rivet.



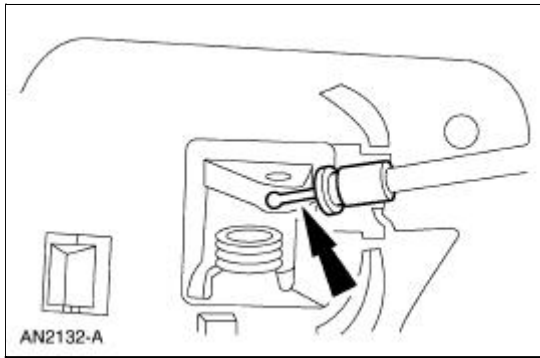
3. Remove the cable clip.



4. Release the cable housing from the interior handle.



5. Release the actuating cable from the interior handle and remove the handle.



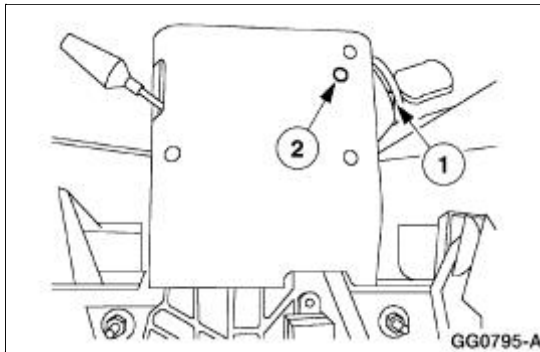
Installation

1. To install, reverse the removal procedure.
-

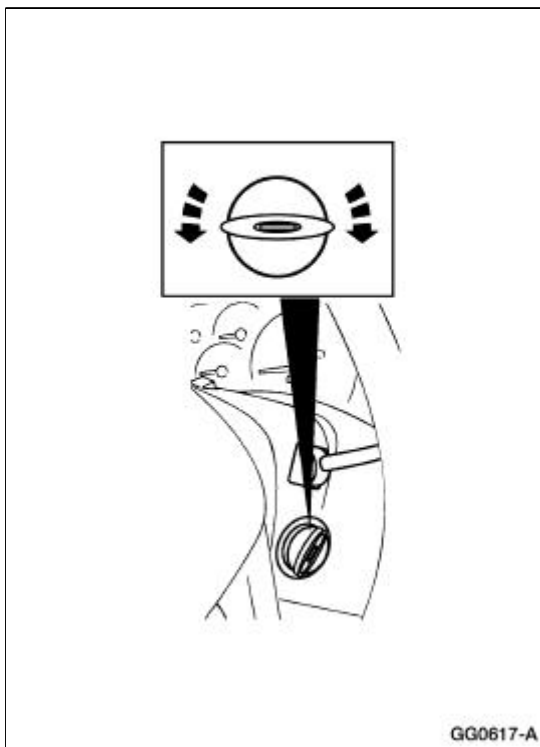
Ignition Lock Cylinder —Functional

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Remove the ignition switch lock cylinder (11582).
 1. Insert the ignition key and turn to the RUN position.
 2. Using a 1/8-inch drift, press the ignition switch lock cylinder release pin through the access hole while pulling out the ignition switch lock cylinder.



3. To install, reverse the removal procedure.
 - Verify ignition switch lock cylinder operation.



Ignition Lock Cylinder —Non-Functional

Removal and Installation

1. **NOTE:** Make sure the front wheels are in the straight-ahead position.

Disconnect the battery ground cable (14301) and wait at least one minute to allow the depletion of the restraint system backup power supply. For additional information, refer to [Section 414-01](#).

2.  **WARNING:** To avoid the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the deactivation procedure.

Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

3.  **WARNING:** To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the steering wheel removal and installation procedure.

Remove the steering wheel assembly. For additional information, refer to Wheel in this section.

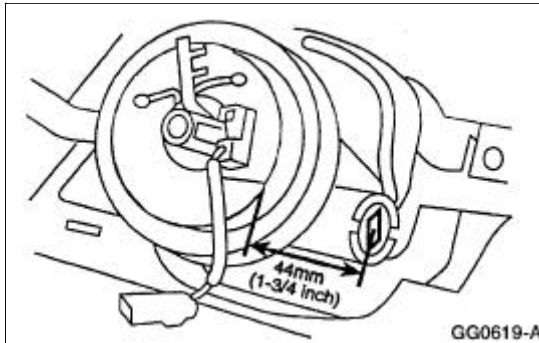
4. Twist off the cap from the ignition switch cylinder.



5. **NOTE:** The lock cylinder is repaired by discarding the inoperative lock cylinder and building a new lock cylinder using the appropriate lock repair package (F85Z-11582-AA). The lock repair package includes a detailed instruction sheet to build the new lock cylinder to the current key code of the vehicle.

Remove the ignition switch lock cylinder.

- Use a 1/8-inch diameter drill bit to drill out the lock cylinder retaining pin.
- Use a 3/8-inch drill bit to drill down the middle of the ignition lock key slot until the ignition switch lock cylinder breaks loose.
- Remove and discard the ignition switch lock cylinder and clean the drill shavings from the steering column.

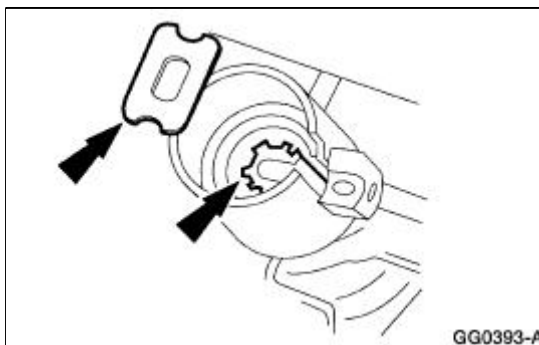


6. Remove the bearing retainer.



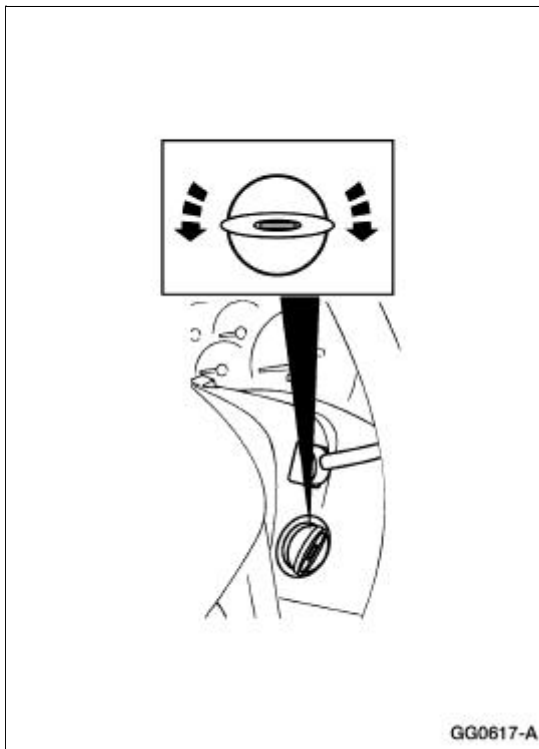
7. Remove the bearing and gear.

- Thoroughly clean all drill shavings from the steering column and inspect it for damage.



8. To install, reverse the removal procedure.

- Install a new ignition switch lock cylinder.
- Verify ignition switch lock cylinder operation.



9.  **WARNING: To avoid the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the reactivation procedure.**

Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

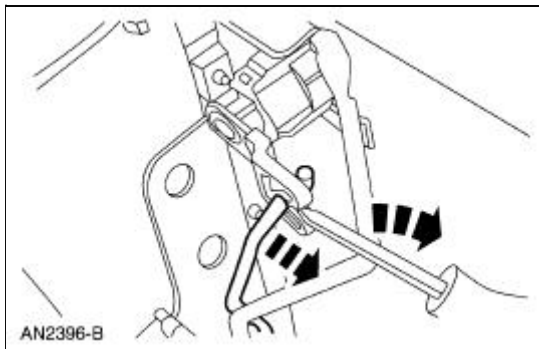
Lock Cylinder —Door

Removal

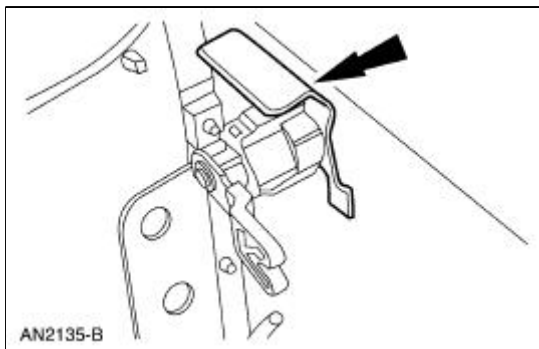
1. **NOTE:** Individual lock cylinders are repaired by discarding the inoperative cylinder and building a new lock cylinder using the appropriate lock repair package. The lock repair package includes a detailed instruction sheet to build the new lock cylinder to the current key code of the vehicle.

Remove the door trim panel (23942). For additional information, refer to [Section 501-05](#).

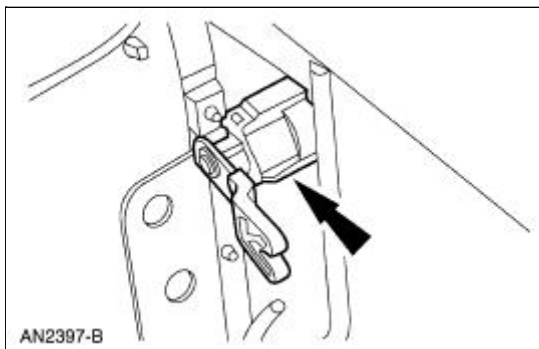
2. Using a screwdriver, release the lock cylinder actuating rod.



3. Remove the door lock cylinder retainer.



4. Remove the door lock cylinder (21990).



5. If necessary, transfer the lock cylinder arm to the new door lock cylinder (21990).

Installation

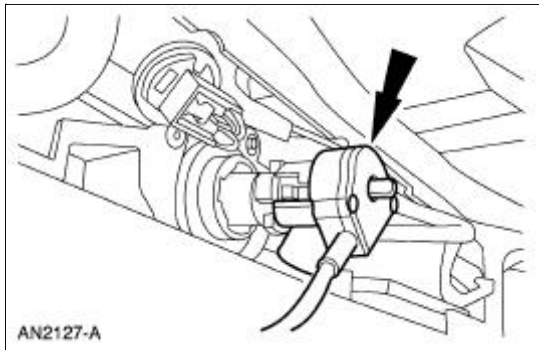
1. To install, reverse the removal procedure.
-

Lock Cylinder —Luggage Compartment Lid

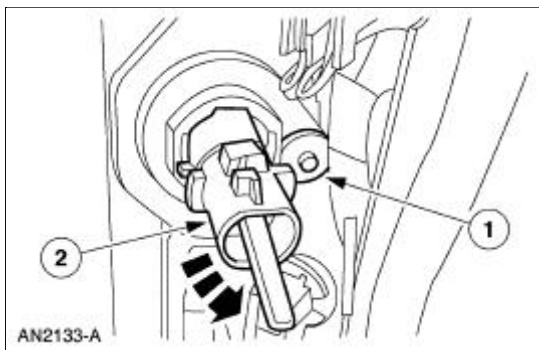
Removal

1. **NOTE:** Individual lock cylinders are repaired by discarding the inoperative cylinder and building a new lock cylinder using the appropriate lock repair package. The lock repair package includes a detailed instruction sheet to build the new lock cylinder to the current key code of the vehicle.

Disconnect the luggage compartment lid lock actuator (432A38) cable.



2. Remove the luggage compartment lid lock cylinder (43262).
 1. Remove the rivet.
 2. Rotate the lock cylinder counterclockwise to remove.



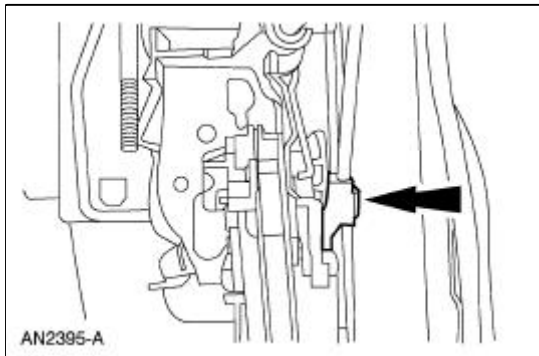
Installation

1. To install, reverse the removal procedure.

Push Button Rod —Door

Removal

1. Remove the door trim panel (23942). For additional information, refer to [Section 501-05](#).
2. Release the push button rod by opening the clip.



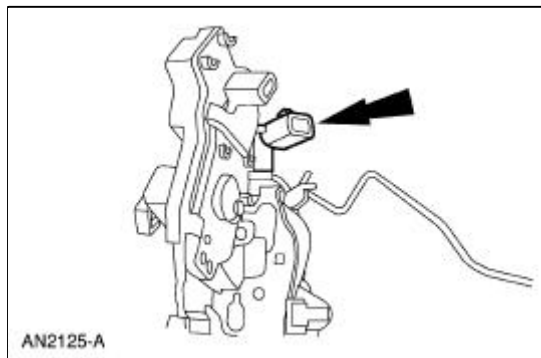
Installation

1. To install, reverse the removal procedure.
-

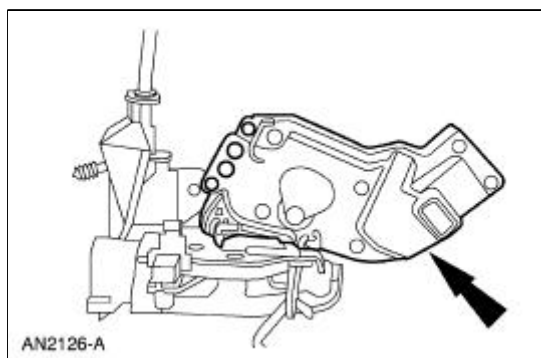
Actuator —Door Lock

Removal

1. Remove the door trim panel (23942). For additional information, refer to [Section 501-05](#).
2. Remove the door latch (21812). For additional information, refer to [Latch—Door](#).
3. Remove the door ajar switch.
 - Release the locking tab.



4. Remove the adjunct actuator.



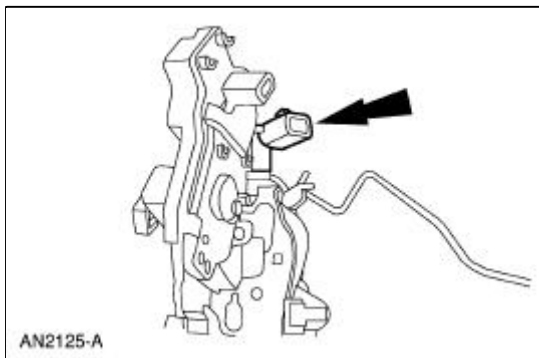
Installation

1. To install, reverse the removal procedure.
-

Switch —Door Ajar Switch

Removal

1. Remove the door trim panel (23942). For additional information, refer to [Section 501-05](#).
2. Remove the door latch (21812). For additional information, refer to [Latch—Door](#).
3. Remove the door ajar switch.
 - Release the locking tab.



Installation

1. To install, reverse the removal procedure.
-

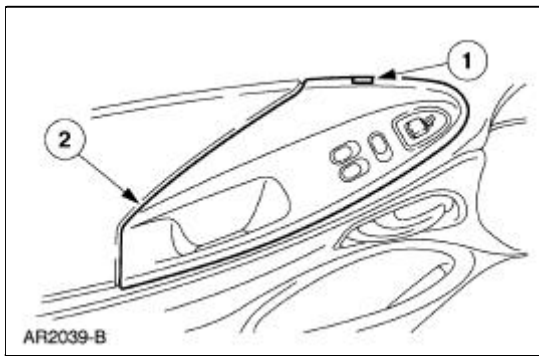
Switch —Door Lock

Removal

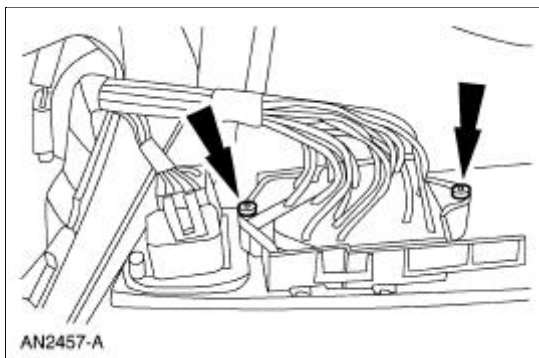
1.  **CAUTION:** Place a rag between the window regulator switch plate and the door trim panel to avoid damaging the door trim panel.

Position the window regulator switch plate (14524) aside.

1. Pull at service notch.
2. Lift to release the clip at the rear edge.



2. Remove the screws and the door lock switch (14017).



Installation

1. To install, reverse the removal procedure.

Keyless Entry

The electronic door lock system has two main components:



- generic electronic module (GEM)(14B204)
 - keyless entry remote transmitter (15K601)
-

Keyless Entry

Refer to Wiring Diagrams Cell [59](#), Generic Electronic Module for schematic and connector information.

Refer to Wiring Diagrams Cell [111](#), Remote Keyless Entry (RKE) for schematic and connector information.

Special Tool(s)

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

Principles of Operation

NOTE: Battery power and ground must be removed before disconnecting the GEM connectors to avoid setting false codes.

Power Locks Operation

The power locks feature allows the customer to lock and unlock the doors via momentary switches located on the driver and passenger door. When the GEM detects a momentary press of the driver or passenger lock button, the GEM will supply power to the driver or passenger lock actuators for approximately 250 ms from relays internal to the GEM. When the GEM detects a momentary press of the driver or passenger unlock button, the GEM will supply power to the driver or passenger unlock actuators for approximately 250 ms from relays internal to the GEM.

Remote Keyless Entry Door Locks Operation

The remote entry feature allows the customer to unlock the driver door, unlock all doors, and lock all doors using a valid remote transmitter as long as the ignition switch is not in RUN or START. The driver door is unlocked whenever the GEM detects a valid remote transmitter unlock transmission. All the doors are unlocked when the GEM detects a second valid remote transmitter unlock transmission within three seconds of the first transmission. All the doors are locked when the GEM detects a valid remote transmitter lock transmission. If the GEM detects a second valid remote transmitter lock transmission within three seconds of the first transmission, the doors will lock again, the horn will sound for 20 ms and the parking lamps will flash for 200 ms to indicate the doors are locked. If the GEM detects the driver or passenger door is ajar during the second lock transmission, the doors are locked again and the horn is sounded twice. If the GEM detects a valid remote transmitter lock transmission within three seconds of detecting a valid remote transmitter unlock transmission, the

GEM will lock all the doors.

Remote Keyless Entry Luggage Compartment Operation

The luggage compartment lid is released whenever the GEM detects a valid remote transmitter luggage compartment release transmission.

Panic Alarm Operation

The panic alarm feature allows the vehicle to initiate an alarm for 2.75 minutes to identify itself using a valid remote transmitter. The panic alarm is activated whenever the GEM detects the ignition switch is in the OFF position or if the key is removed from the ignition, and the GEM detects a valid PANIC response from the remote transmitter. When the panic alarm is activated, the GEM:

- illuminates the courtesy lamps.
- flashes the parking lamps.
- toggles the horn on and off.

The panic alarm is deactivated whenever GEM detects:

- if the key causes a transition of the ignition switch circuits to
 - ACC.
 - RUN.
 - START.
- the remote transmitter
 - panic button.
 - unlock button.

The panic alarm is also deactivated after 2.75 minutes have gone by.

Remote Transmitter Programming Operation

This feature allows the customer to program up to four different transmitter identification codes (TIC) for four remote transmitters to the vehicle at any time. For additional information, refer to [Programming—Keyless Entry Remote Transmitter](#).

Inspection and Verification

1. The keyless entry system is a generic electronic module (GEM).
2. Verify the customer concern by using the remote transmitters to operate the keyless entry system.
3. Visually inspect for the following obvious signs of mechanical and electrical damage.

Visual Inspection Chart

--	--

Mechanical	Electrical
<ul style="list-style-type: none"> ● Binding latches 	<ul style="list-style-type: none"> ● CJB Fuses: <ul style="list-style-type: none"> ■ 39 (5A) ■ 19 (15A) ■ 25 (25A) ● BJB Fuse POWER WINDOWS (40A) ● Damaged wiring harness ● Loose or corroded connector(s) ● Circuitry open/shorted ● Damaged relays ● Remote transmitter ● Remote transmitter batteries

4. If the concern remains after the inspection, connect the scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If the scan tool does not communicate with the vehicle:
 - check that the program card is correctly installed.
 - check the connections to the vehicle.
 - check the ignition switch position.
5. If the scan tool still does not communicate with the vehicle, refer to the scan tool manual.
6. Carry out the DATA LINK DIAGNOSTIC TEST. If the scan tool responds with:
 - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to [Section 418-00](#).
 - NO RESP/NOT EQUIP for GEM, go to Pinpoint Test A.
 - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs, and carry out the self-test diagnostics for the GEM.
7. If the DTCs retrieved are related to the concern, go to the GEM Diagnostic Trouble Code (DTC) Index to continue diagnostics.
8. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

GEM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1217	Horn Relay Coil Circuit Failure	GEM	GO to Pinpoint Test E .
B1218	Horn Relay Coil Circuit Short to Vbatt	GEM	GO to Pinpoint Test E .
B1312	Lamp Headlamp Input Circuit Short to Battery	GEM	REFER to Section 417-01 .
B1317	Battery Voltage High	GEM	REFER to Section 414-00 .
B1318	Battery Voltage Low	GEM	REFER to Section 414-00 .
B1322	Driver Door Ajar Circuit Short to Ground	GEM	REFER to Section 417-02 .
B1330	Passenger Door Ajar Circuit Short to Ground	GEM	REFER to Section 417-02 .
B1334	Decklid Ajar Rear Door Circuit	GEM	REFER to Section 417-02 .

	Short to Ground		
B1339	Chime Input Request Circuit Short to Battery	GEM	REFER to Section 413-09 .
B1340	Chime Input Request Circuit Short to Ground	GEM	REFER to Section 413-09 .
B1342	ECU Is Defective	GEM	CLEAR the DTC. Retrieve the DTCs. If DTC B1342 is retrieved, INSTALL a new GEM. REFER to Section 419-10 .
B1353	Ignition Key-In Circuit Open	GEM	REFER to Section 413-09 .
B1359	Ignition Run/Acc Circuit Failure	GEM	REFER to Section 211-05 .
B1396	Power Door Lock Circuit Short to Battery	GEM	GO to Pinpoint Test B .
B1397	Power Door Unlock Circuit Short to Battery	GEM	GO to Pinpoint Test B .
B1405	Driver Power Window Down Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1408	Driver Power Window Up Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1833	Door Unlock Disarm Switch Circuit Short to Ground	GEM	REFER to Section 419-01 .
B1498	Decklid Punch-Out Sensor Ground Short.	GEM	GO to Pinpoint Test D .
B1603	Lamp Anti-Theft Indicator Circuit Failure	GEM	REFER to Section 413-01 .
B1410	Driver Power Window Motor Circuit Failure	GEM	REFER to Section 501-11 .
B1426	Lamp Safety Belt Circuit Short to Battery	GEM	REFER to Section 413-01 .
B1428	Lamp Safety Belt Circuit Failure	GEM	REFER to Section 413-01 .
B1431	Wiper Brake/Run Relay Circuit Failure	GEM	REFER to Section 501-16 .
B1432	Wiper Brake/Run Relay Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1434	Wiper Hi/Low Speed Relay Coil Circuit Failure	GEM	REFER to Section 501-16 .
B1436	Wiper Hi/Low Speed Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1438	Wiper Mode Select Switch Circuit Failure	GEM	REFER to Section 501-16 .
B1441	Wiper Mode Select Switch Circuit Short to Ground	GEM	REFER to Section 501-16 .
B1446	Wiper Park Sense Circuit Failure	GEM	REFER to Section 501-16 .
B1448	Wiper Park Sense Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1450	Wiper Wash/Delay Switch Circuit Failure	GEM	REFER to Section 501-16 .
B1453	Wiper Wash/Delay Switch Circuit Short to Ground	GEM	REFER to Section 501-16 .

B1458	Wiper Washer Pump Motor Relay Circuit Failure	GEM	REFER to Section 501-16 .
B1460	Wiper Washer Pump Motor Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1462	Safety Belt Switch Circuit Failure	GEM	REFER to Section 413-09 .
B1466	Wiper Hi/Low Speed Not Switching	GEM	REFER to Section 501-16 .
B1473	Wiper Low Speed Circuit Motor Failure	GEM	REFER to Section 501-16 .
B1476	Wiper High Speed Circuit Motor Failure	GEM	REFER to Section 501-16 .
B1551	Decklid Release Circuit Failure	GEM	GO to Pinpoint Test D .
B1553	Decklid Release Circuit Short to Battery	GEM	GO to Pinpoint Test D .
B1555	Ignition Run/Start Circuit Failure	GEM	REFER to Section 211-05 .
B1687	Lamp Dome Input Circuit Short to Battery	GEM	REFER to Section 417-02 .
B2486	LF Side Repeater Lamp Output Circuit Failure	GEM	REFER to Section 417-01 .
B1605	Lamp Anti-Theft Indicator Circuit Short to Battery	GEM	REFER to Section 501-16 .
B2488	RF Side Repeater Lamp Output Circuit Failure	GEM	REFER to Section 417-01 .
C1189	Brake Fluid Level Sensor Input Short Circuit to Ground	GEM	REFER to Section 413-01 .
C1223	Lamp Brake Warning Output Circuit Failure	GEM	REFER to Section 413-01 .
C1225	Lamp Brake Warning Output Circuit Short to Battery	GEM	REFER to Section 413-01 .

Symptom Chart


Symptom Chart

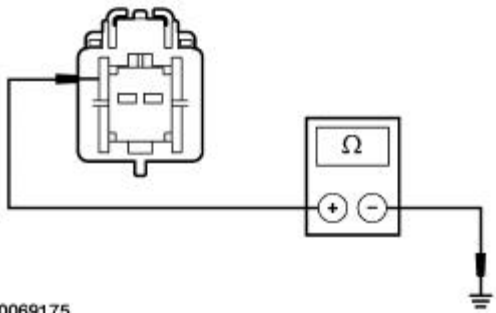
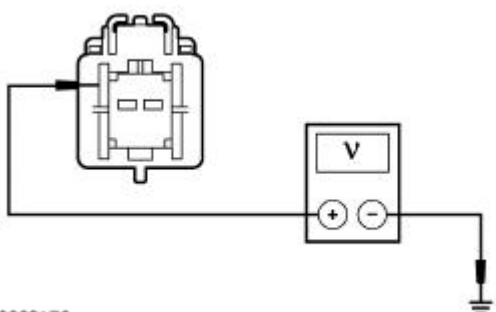
Condition	Possible Sources	Action
<ul style="list-style-type: none"> No communication with the generic electronic module 	<ul style="list-style-type: none"> Circuitry. CJB Fuse 39 (5A). GEM. 	<ul style="list-style-type: none"> GO to Pinpoint Test A.
<ul style="list-style-type: none"> All door locks are inoperative 	<ul style="list-style-type: none"> CJB Fuse 19 (15A). BJB Fuse POWER WINDOWS (40A). Circuitry. GEM. Switches. Lock actuators. 	<ul style="list-style-type: none"> GO to Pinpoint Test B.
<ul style="list-style-type: none"> The doors do not lock/unlock using the remote transmitter 	<ul style="list-style-type: none"> Ignition switch. GEM. 	<ul style="list-style-type: none"> GO to Pinpoint

	<ul style="list-style-type: none"> ● Remote transmitter. ● Remote transmitter batteries. 	Test C.
<ul style="list-style-type: none"> ● The luggage compartment door is inoperative using the remote transmitter 	<ul style="list-style-type: none"> ● CJB Fuse 25 (25A). ● Remote transmitter batteries. ● Remote transmitter. ● GEM. ● Circuitry. ● Luggage compartment lid release relay. 	<ul style="list-style-type: none"> ● GO to Pinpoint Test D.
<ul style="list-style-type: none"> ● Panic function does not operate correctly 	<ul style="list-style-type: none"> ● GEM. ● Driver door unlock relay. ● Circuitry. ● Remote transmitter and batteries. ● Courtesy lamps. ● Horn relay. ● Horn. ● Parklamps. 	<ul style="list-style-type: none"> ● GO to Pinpoint Test E.

Pinpoint Tests

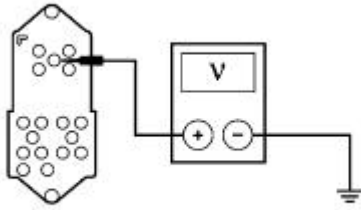
PINPOINT TEST A: NO COMMUNICATION WITH THE GENERIC ELECTRONIC MODULE

Test Step	Result / Action to Take															
 CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.																
A1 CHECK THE GENERIC ELECTRONIC MODULE (GEM) POWER SUPPLY <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Generic Electronic Module (GEM) C201a. ● Disconnect: GEM C201b. ● Key in ON position. ● Using the following table, measure the voltage between the GEM, harness side and ground. <table border="1"> <thead> <tr> <th>Connector</th> <th>Pin</th> <th>Circuit</th> </tr> </thead> <tbody> <tr> <td>C201a</td> <td>4</td> <td>400 (LB/BK)</td> </tr> <tr> <td>C201a</td> <td>1</td> <td>1006 (DG/WH)</td> </tr> <tr> <td>C201b</td> <td>2</td> <td>1001 (WH/YE)</td> </tr> <tr> <td>C201b</td> <td>3</td> <td>193 (YE/LG)</td> </tr> </tbody> </table> <ul style="list-style-type: none"> ● Are the voltages greater than 10 volts? 	Connector	Pin	Circuit	C201a	4	400 (LB/BK)	C201a	1	1006 (DG/WH)	C201b	2	1001 (WH/YE)	C201b	3	193 (YE/LG)	<p>Yes GO to A2.</p> <p>No REPAIR the circuit(s) in question. TEST the system for normal operation.</p>
Connector	Pin	Circuit														
C201a	4	400 (LB/BK)														
C201a	1	1006 (DG/WH)														
C201b	2	1001 (WH/YE)														
C201b	3	193 (YE/LG)														
A2 CHECK THE GEM GROUND CIRCUIT 397 (BK/WH) FOR OPEN <ul style="list-style-type: none"> ● Key in OFF position. 	<p>Yes</p>															

<ul style="list-style-type: none"> ● Measure the resistance between the GEM C201b pin 4, circuit 397 (BK/WH), harness side and ground.  <p>A0069175</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>GO to A3.</p> <p>No REPAIR the circuit(s) in question. TEST the system for normal operation.</p>
A3 CHECK CIRCUIT 397 (BK/WH) FOR SHORT TO POWER	
<ul style="list-style-type: none"> ● Measure the voltage between the GEM C201b pin 4, circuit 397 (BK/WH), harness side and ground.  <p>A0069175</p> <ul style="list-style-type: none"> ● Is any voltage present? 	<p>Yes REPAIR the circuit. TEST the system for normal operation.</p> <p>No REFER to Section 418-00.</p>

PINPOINT TEST B: ALL DOOR LOCKS ARE INOPERATIVE

Test Step	Result / Action to Take
<p>B1 CHECK POWER LOCK INPUTS TO THE GEM</p> <ul style="list-style-type: none"> ● Connect the diagnostic tool. ● Monitor the GEM PIDS DR_LOCK, DR_UNLK, PD_LOCK, PD_UNLK, while depressing the driver and passenger power door lock and unlock switches. ● Do the PID values agree with the switch positions? 	<p>Yes GO to B11.</p> <p>No GO to B2.</p>
<p>B2 ISOLATE BETWEEN THE DRIVER AND PASSENGER POWER DOOR LOCK SWITCHES</p> <p>NOTE: This PID may not be supported in the normal scan tool PID list. It can be located in the Function test — "Transmitter Tic/Data". When this test is activated, the appropriate results may be obtained when pressing the keyfob buttons.</p> <ul style="list-style-type: none"> ● Connect the diagnostic tool. ● Monitor the GEM PIDS DR_LOCK and DR_UNLK, while depressing the driver power door lock and unlock switches. ● Do the PID values agree with the switch positions? 	<p>Yes GO to B7.</p> <p>No GO to B3.</p>
<p>B3 CHECK CIRCUIT 326 (WH/VT) FOR VOLTAGE — DRIVER SIDE</p> <ul style="list-style-type: none"> ● Disconnect: Master Window/Door Lock Control Switch C508. ● Measure the voltage between master window/door lock control switch C508 Pin 3, Circuit 326 (WH/VT), harness side and ground. 	<p>Yes GO to B4.</p> <p>No</p>



GN3147-A

- Is the voltage greater than 10 volts?

REPAIR Circuit 326 (WH/VT). REPEAT the self-test. CLEAR the DTCs.

B4 CHECK THE DRIVER POWER DOOR LOCK SWITCH FOR CORRECT OPERATION

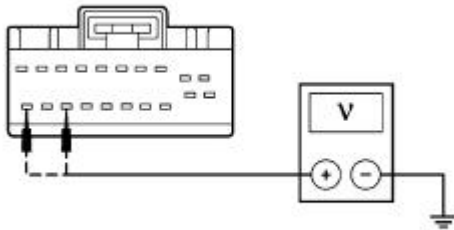
- Carry out the master window/door lock control switch component test. REFER to Wiring Diagrams Cell 149, Component Testing.
- Is the master window/door lock control switch OK?

Yes
GO to [B5](#).

No
INSTALL a new master window/door lock control switch. REPEAT the self-test. CLEAR the DTCs.

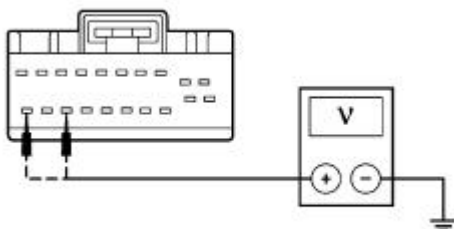
B5 CHECK CIRCUITS 129 (LG) AND 1014 (VT) FOR SHORT TO POWER

- Key in OFF position.
- Disconnect: GEM C201c.
- Measure the voltage between GEM C201c Pin 20, Circuit 129 (LG), harness side and ground; and between GEM C201c Pin 18, Circuit 1014 (VT), harness side and ground.



GN3148-A

- Key in ON position.
- Measure the voltage between GEM C201c Pin 20, Circuit 129 (LG), harness side and ground; and between GEM C201c Pin 18, Circuit 1014 (VT), harness side and ground.

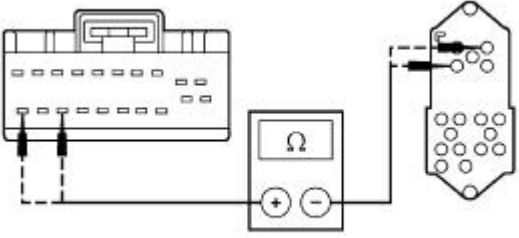
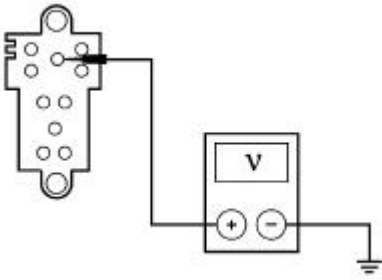


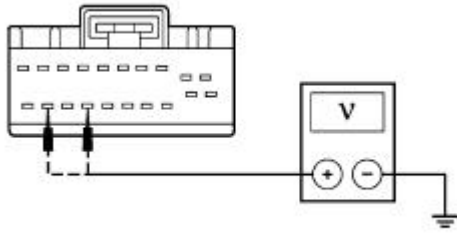
GN3148-A

- Key in OFF position.
- Are the voltages greater than 10 volts?

Yes
REPAIR the circuit in question. REPEAT the self-test. CLEAR the DTCs.

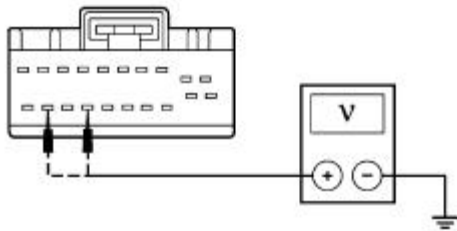
No
GO to [B6](#).

<p>B6 CHECK CIRCUITS 129 (LG) AND 1014 (VT) FOR OPEN</p>	<p>Yes INSTALL a new GEM. For additional information, REFER to Section 419-10. REPEAT the self-test. CLEAR the DTCs.</p> <p>No REPAIR the circuit in question. REPEAT the self-test. CLEAR the DTCs.</p>
<ul style="list-style-type: none"> ● Measure the resistance between master window/door lock control switch C508 Pin 4, Circuit 129 (LG), harness side and GEM C201c Pin 20, Circuit 129 (LG), harness side; and between master window/door lock control switch C508 Pin 2, Circuit 1014 (VT), harness side and GEM C201c 2 Pin 18, Circuit 129 (LG), harness side.  <p style="text-align: center;">GN3149-A</p> <ul style="list-style-type: none"> ● Are the resistances less than 5 ohms? 	<p>Yes GO to B8.</p> <p>No REPAIR Circuit 326 (WH/VT). REPEAT the self-test. CLEAR the DTCs.</p>
<p>B7 CHECK CIRCUIT 326 (WH/VT) FOR VOLTAGE — PASSENGER SIDE</p> <ul style="list-style-type: none"> ● Disconnect: Passenger Window/Door Lock Control Switch C629. ● Measure the voltage between passenger/window door lock control switch C629 Pin 3, Circuit 326 (WH/VT), harness side and ground.  <p style="text-align: center;">GN3150-A</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to B9.</p> <p>No INSTALL a new master window/door lock control switch. REPEAT the self-test. CLEAR the DTCs.</p>
<p>B8 CHECK THE PASSENGER POWER DOOR LOCK SWITCH FOR CORRECT OPERATION</p> <ul style="list-style-type: none"> ● Carry out the passenger window/door lock control switch component test. REFER to Wiring Diagrams Cell 149, Component Testing. ● Is the master window/door lock control switch OK? 	<p>Yes GO to B9.</p> <p>No REPAIR the circuit in question. REPEAT the self-test. CLEAR the DTCs.</p>
<p>B9 CHECK CIRCUITS 119 (PK/YE) AND 120 (PK/LG) FOR SHORT TO POWER</p>	<p>Yes REPAIR the circuit in question. REPEAT the self-test. CLEAR the DTCs.</p> <p>No GO to B10.</p>
<ul style="list-style-type: none"> ● Disconnect: GEM C201c. ● Measure the voltage between GEM C201c Pin 19, Circuit 119 (PK/YE), harness side and ground; and between GEM C201c Pin 17, Circuit 120 (PK/LG), harness side and ground. 	



GN3151-A

- Key in ON position.
- Measure the voltage between GEM C201c Pin 19, Circuit 119 (PK/YE), harness side and ground; and between GEM C201c Pin 17, Circuit 120 (PK/LG), harness side and ground.

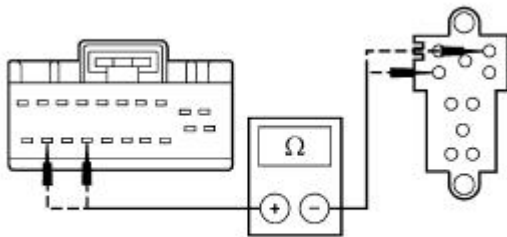


GN3151-A

- Key in OFF position.
- **Are the voltages greater than 10 volts?**

B10 CHECK CIRCUITS 119 (PK/YE) AND 120 (PK/LG) FOR OPEN

- Measure the resistance between passenger window/door lock control switch C629 Pin 2, Circuit 119 (PK/YE), harness side and GEM C201c Pin 19, Circuit 119 (PK/YE), harness side; and between passenger window/door lock control switch C629 Pin 4, Circuit 120 (PK/LG), harness side and GEM C201c Pin 17, Circuit 120 (PK/LG), harness side.



GN3152-A

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

Yes
INSTALL a new GEM. For additional information, REFER to [Section 419-10](#). REPEAT the self-test. CLEAR the DTCs.

No
REPAIR the circuit in question. REPEAT the self-test. CLEAR the DTCs.

B11 CHECK GEM CONTROL OF THE POWER DOOR LOCKS

- Connect the diagnostic tool.
- Trigger the GEM active command LOCK, UNLOCK, DD UNLOCK, and DD LOCK ON and OFF.
- **Do the doors lock and unlock?**

Yes
INSTALL a new GEM. For additional information, REFER to [Section 419-10](#). REPEAT the self-test. CLEAR the DTCs.

No
GO to [B12](#).

B12 ISOLATE BETWEEN DRIVER AND PASSENGER POWER LOCK ACTUATORS

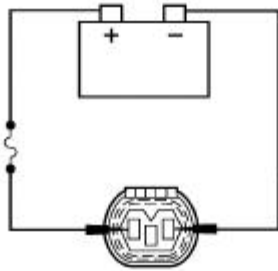
- Connect the diagnostic tool.
- Trigger the GEM active command LOCK and DD UNLOCK ON and OFF.
- **Did the driver door lock and unlock?**

Yes
GO to [B17](#).

No
GO to [B13](#).

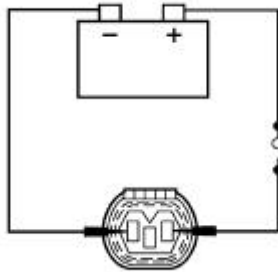
B13 CHECK THE DRIVER POWER LOCK ACTUATOR OPERATION

- Disconnect: Driver Door Lock Actuator C525.
- Momentarily connect a fused (40A) jumper wire between battery and driver door lock actuator Pin 1, component side; and connect a jumper wire between ground and driver door lock actuator Pin 2, component side.



GN3170-A

- Reverse the jumper wire connections and momentarily connect.



GN3171-A

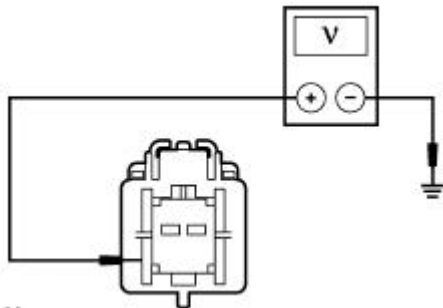
- **Did the driver door lock and unlock?**

Yes
GO to [B14](#).

No
INSTALL a new driver door lock actuator. For additional information, REFER to [Actuator](#). REPEAT the self-test. CLEAR the DTCs.

B14 CHECK CIRCUIT 193 (YE/LG) FOR OPEN

- NOTE:** Verify voltage at BJB Fuse POWER WINDOWS (40A) before completing this step.
- Disconnect: GEM C201b.
 - Measure the voltage between GEM C201b Pin 3, Circuit 193 (YE/LG), harness side and ground.



A0069182

- **Is the voltage greater than 10 volts?**

Yes
GO to [B15](#).

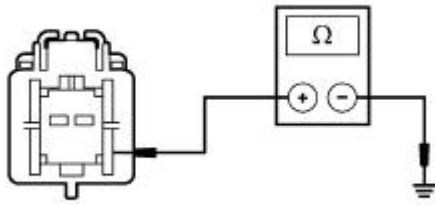
No
REPAIR Circuit 193 (YE/LG). REPEAT the self-test. CLEAR the DTCs.

B15 CHECK CIRCUIT 1205 (BK) FOR OPEN

- Measure the resistance between GEM C201b Pin 1, Circuit 1205

Yes
GO to [B16](#).

(BK), harness side and ground.



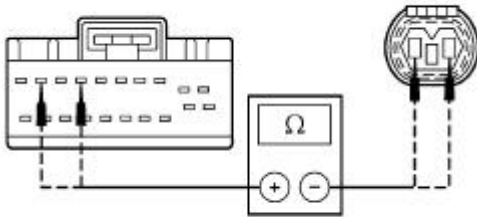
A0069183

- Is the resistance less than 5 ohms?

No
REPAIR Circuit 1205 (BK). REPEAT the self-test. CLEAR the DTCs.

B16 CHECK CIRCUITS 163 (PK/YE) AND 1015 (RD/WH) FOR OPEN

- Disconnect: GEM C201c.
- Measure the resistance between driver door lock actuator C525 Pin 2, Circuit 1015 (RD/WH), harness side and GEM C201c Pin 9, Circuit 1015 (RD/WH), harness side; and between driver door lock actuator C525 Pin 1, Circuit 163 (RD/OG), harness side, and GEM C201c Pin 7, Circuit 163 (RD/OG), harness side.



GN3157-A

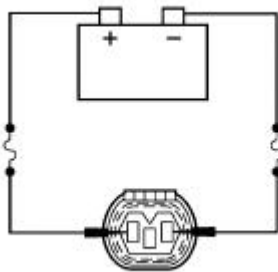
- Are the resistances less than 5 ohms?

Yes
INSTALL a new GEM. For additional information, REFER to [Section 419-10](#). REPEAT the self-test. CLEAR the DTCs.

No
REPAIR the circuit in question. REPEAT the self-test. CLEAR the DTCs.

B17 CHECK THE PASSENGER POWER LOCK ACTUATOR OPERATION

- Disconnect: Passenger Door Lock Actuator C603.
- Momentarily connect a fused (40A) jumper wire between battery and passenger door lock actuator Pin 1, component side; and connect a jumper wire between ground and passenger door lock actuator Pin 2, component side.

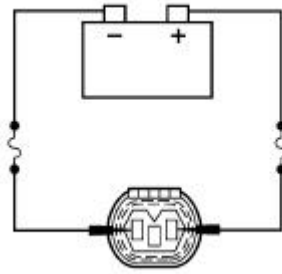


GN3153-A

- Reverse the jumper wire connections and momentarily connect.

Yes
GO to [B18](#).

No
INSTALL a new passenger door lock actuator. REFER to [Actuator](#). REPEAT the self-test. CLEAR the DTCs.

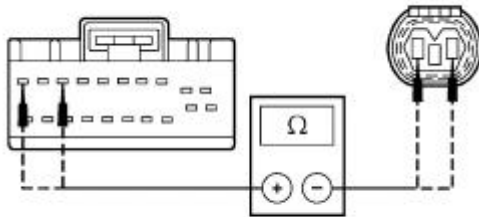


GN3154-A

- Did the passenger door lock and unlock?

B18 CHECK CIRCUITS 163 (RD/OG), 1015 (RD/WH), 117 (PK/BK), AND 118 (PK/OG) FOR OPEN

- Disconnect: GEM C201c.
- Measure the resistance between passenger door lock actuator C603 Pin 2, Circuit 1015 (RD/WH), harness side and GEM C201c Pin 10, Circuit 117 (PK/BK), harness side; and between passenger door lock actuator C603 Pin 1, Circuit 163 (RD/OG), harness side, and GEM C201c Pin 8, Circuit 118 (PK/OG), harness side.



GN3158-A

- Are the resistances less than 5 ohms?

Yes
INSTALL a new GEM. For additional information, REFER to [Section 419-10](#) . REPEAT the self-test. CLEAR the DTCs.

No
REPAIR the circuit in question. REPEAT the self-test. CLEAR the DTCs.

PINPOINT TEST C: THE DOORS DO NOT LOCK/UNLOCK USING THE REMOTE TRANSMITTER

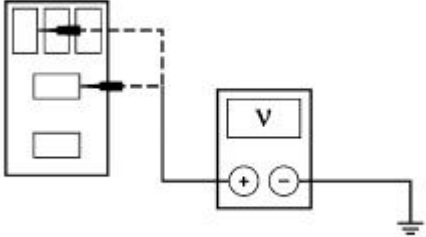
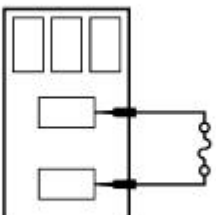
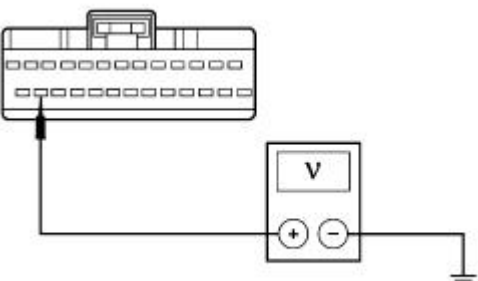
Test Step	Result / Action to Take
C1 CHECK THE LOCK OPERATION USING THE DRIVER DOOR LOCK SWITCH	
<ul style="list-style-type: none"> ● Lock and unlock the doors using the driver door lock switch. ● Do all the doors lock and unlock correctly? 	<p>Yes GO to C2 .</p> <p>No GO to Pinpoint Test B .</p>
C2 CHECK IGNITION STATES	
<ul style="list-style-type: none"> ● Connect the diagnostic tool. ● Monitor the GEM PIDS IGN_KEY, IGN_A, IGN_S, and IGN_R while cycling the ignition switch through the OFF, ACC, RUN, START and key out positions. ● Do the PID values agree with the ignition switch positions? 	<p>Yes GO to C3 .</p> <p>No For key-in-ignition concerns, REFER to Section 413-09 .</p>
C3 CHECK THE GEM FUNCTION TEST TIC/DATA	
NOTE: This PID may not be supported in	Yes

<p>the normal scan tool PID list. It can be located in the Function Test — "Transmitter Tic/DATA". When this test is activated, the appropriate results may be obtained when pressing the keyfob buttons.</p> <ul style="list-style-type: none"> ● Remove the ignition key from the ignition. ● Connect the diagnostic tool. ● Monitor the GEM FUNCTION TEST TIC/DATA while pressing the lock and unlock buttons on the remote transmitter. ● Does LAST DATA RECEIVED match the button presses of the remote transmitter? 	<p>INSTALL a new GEM. For additional information, REFER to Section 419-10. REPEAT the self-test. CLEAR the DTCs.</p> <p>No GO to C4.</p>
<p>C4 CHECK THE BATTERIES IN THE REMOTE TRANSMITTER</p>	<p>Yes SYSTEM is OK. REPEAT the self-test. CLEAR the DTCs.</p> <p>No GO to C5.</p>
<ul style="list-style-type: none"> ● Install new batteries in the remote transmitter. ● Connect the diagnostic tool. ● Monitor the GEM FUNCTION TEST TIC/DATA while pressing the lock and unlock buttons on the remote transmitter. ● Does LAST DATA RECEIVED match the button presses of the remote transmitter? 	
<p>C5 REPROGRAM THE REMOTE TRANSMITTERS TO THE GEM</p>	<p>Yes SYSTEM is OK. REPEAT the self-test. CLEAR the DTCs.</p> <p>No PROGRAM a new remote transmitter to the vehicle. For additional information, REFER to Programming—Keyless Entry Remote Transmitter. REPEAT the self-test. CLEAR the DTCs. If the problem still remains, INSTALL a new GEM and program the remote transmitters to the vehicle. For additional information, REFER to Section 419-10. REPEAT the self-test. CLEAR the DTCs.</p>
<ul style="list-style-type: none"> ● NOTE: When carrying out the following procedure it must be noted that all previous programmed remote transmitters will be erased. The customer needs to be informed that any remote transmitters not present during the programming mode will not operate the vehicle. All remote transmitters must be programmed at the same time. ● Reprogram the remote transmitter to the GEM. For additional information, refer to Programming—Keyless Entry Remote Transmitter. ● Connect the diagnostic tool. ● Monitor the GEM FUNCTION TEST TIC/DATA while pressing the lock and unlock buttons on the remote transmitter. ● Does LAST DATA RECEIVED match the button presses of the remote transmitter? 	

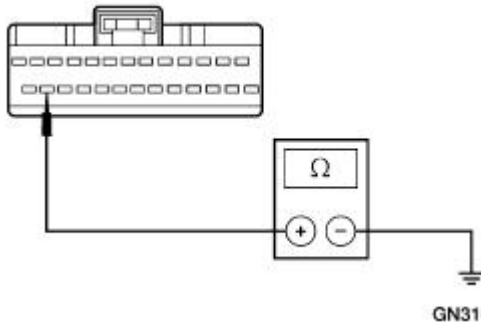
PINPOINT TEST D: THE LUGGAGE COMPARTMENT DOOR IS INOPERATIVE USING THE REMOTE TRANSMITTER

Test Step	Result / Action to Take
<p>D1 CHECK IGNITION STATES</p>	
<ul style="list-style-type: none"> ● Connect the diagnostic tool. ● Monitor the GEM PIDS IGN_KEY, IGN_A, IGN_S, and IGN_R while cycling the ignition switch through the OFF, ACC, RUN, START and key out positions. 	<p>Yes GO to D2.</p> <p>No</p>

<ul style="list-style-type: none"> ● Do the PID values agree with the ignition switch positions? 	<p>REFER to Section 413-09 for key-in-ignition warning chime concerns.</p>
<p>D2 CHECK THE GEM PID LAST DATA RECEIVED FOR LUGGAGE COMPARTMENT</p>	
<ul style="list-style-type: none"> ● Remove the ignition key from the ignition. ● Connect the diagnostic tool. ● Monitor the GEM PID LAST DATA RECEIVED while pressing and releasing the luggage compartment, panic, lock, and unlock buttons of the remote transmitter. ● Does LAST DATA RECEIVED match the button presses of the remote transmitter? 	<p>Yes GO to D5.</p> <p>No GO to D3.</p>
<p>D3 CHECK THE BATTERIES IN THE REMOTE TRANSMITTER</p>	
<ul style="list-style-type: none"> ● Install new batteries in the remote transmitter. ● Connect the diagnostic tool. ● Monitor the GEM FUNCTION TEST TIC/DATA while pressing the luggage compartment button on the remote transmitter. ● Does LAST DATA RECEIVED match the button presses of the remote transmitter? 	<p>Yes SYSTEM is OK. REPEAT the self-test. CLEAR the DTCs.</p> <p>No GO to D4.</p>
<p>D4 REPROGRAM THE REMOTE TRANSMITTERS TO THE GEM</p>	
<ul style="list-style-type: none"> ● NOTE: When carrying out the following procedure, it must be noted that all previous programmed remote transmitters will be erased. The customer needs to be informed that any remote transmitters not present during the programming mode will not operate the vehicle. All remote transmitters must be programmed at the same time. ● Reprogram the remote transmitter to the GEM. For additional information, refer to Programming—Keyless Entry Remote Transmitter. ● Connect the diagnostic tool. ● Monitor the GEM FUNCTION TEST TIC/DATA while pressing the lock and unlock buttons on the remote transmitter. ● Does LAST DATA RECEIVED match the button presses of the remote transmitter? 	<p>Yes SYSTEM is OK. REPEAT the self-test. CLEAR the DTCs.</p> <p>No PROGRAM a new remote transmitter to the vehicle. For additional information, REFER to Programming—Keyless Entry Remote Transmitter. REPEAT the self-test. CLEAR the DTCs. If the problem still remains, INSTALL a new GEM and program the remote transmitters to the vehicle. For additional information, REFER to Section 419-10. REPEAT the self-test. CLEAR the DTCs.</p>
<p>D5 CHECK THE GEM OUTPUT TO THE LUGGAGE COMPARTMENT</p>	
<ul style="list-style-type: none"> ● Trigger the GEM active command RELEASE to ON and OFF. ● Did the luggage compartment release? 	<p>Yes INSTALL a new GEM. For additional information, REFER to Section 419-10. REPEAT the self-test. CLEAR the DTCs.</p> <p>No GO to D6.</p>
<p>D6 CHECK CIRCUIT 931 (OG) FOR OPEN</p>	
<ul style="list-style-type: none"> ● Disconnect: Luggage Compartment Lid Release Relay. ● Measure the voltage between luggage compartment lid release relay Pin 2, Circuit 931 (OG), harness side and ground; and between luggage compartment lid release 	<p>Yes GO to D7.</p> <p>No</p>

<p>relay Pin 5 Circuit 931 (OG), harness side and ground</p>  <p style="text-align: center;">GN3159-A</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>REPAIR Circuit 931 (OG). REPEAT the self-test. CLEAR the DTCs.</p>
D7 BYPASS THE GEM AND RELAY CONTROL	
<ul style="list-style-type: none"> ● Momentarily connect a 25A jumper wire between the luggage compartment lid release relay Pin 3 and Pin 5.  <p style="text-align: center;">GN3173-A</p> <ul style="list-style-type: none"> ● Did the luggage compartment lid release? 	<p>Yes GO to D8.</p> <p>No GO to D12.</p>
D8 CHECK LUGGAGE COMPARTMENT LID RELEASE RELAY	
<ul style="list-style-type: none"> ● Carry out the luggage compartment lid release relay. REFER to Wiring Diagrams Cell 149, Component Testing. ● Is the luggage compartment lid release relay OK? 	<p>Yes GO to D9.</p> <p>No INSTALL a new luggage compartment lid release relay. REPEAT the self-test. CLEAR the DTCs.</p>
D9 CHECK CIRCUIT 599 (PK/LG) FOR SHORT TO POWER	
<ul style="list-style-type: none"> ● Disconnect: GEM C201c. ● Measure the voltage between GEM C201c Pin 25, Circuit 599 (PK/LG), harness side and ground.  <p style="text-align: center;">GN3160-A</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes REPAIR Circuit 599 (PK/LG). REPEAT the self-test. CLEAR the DTCs.</p> <p>No GO to D10.</p>
D10 CHECK CIRCUIT 599 (PK/LG) FOR SHORT TO GROUND	
<ul style="list-style-type: none"> ● Measure the resistance between GEM C201c Pin 25, 	<p>Yes</p>

Circuit 599 (PK/LG), harness side and ground.



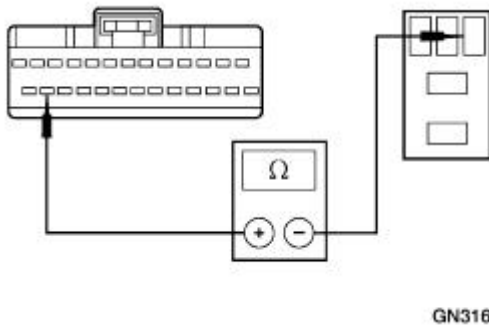
- Is the resistance greater than 10,000 ohms?

GO to [D11](#).

No
REPAIR Circuit 599 (PK/LG).
REPEAT the self-test. CLEAR the DTCs.

D11 CHECK CIRCUIT 599 (PK/LG) FOR OPEN

- Measure the resistance between GEM C201c Pin 25, Circuit 599 (PK/LG), harness side and luggage compartment lid release relay Pin 1, Circuit 599 (PK/LG), harness side.



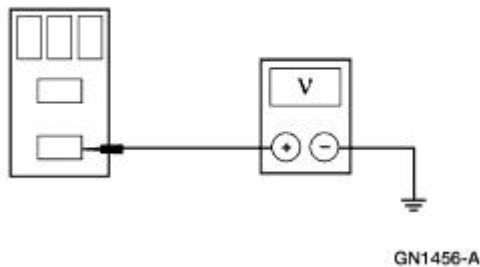
- Is the resistance less than 5 ohms?

Yes
INSTALL a new GEM. For additional information, REFER to [Section 419-10](#). REPEAT the self-test. CLEAR the DTCs.

No
REPAIR Circuit 599 (PK/LG).
REPEAT the self-test. CLEAR the DTCs.

D12 CHECK CIRCUIT 84 (VT/YE) FOR SHORT TO POWER

- Disconnect: GEM C201c.
- Measure the voltage between luggage compartment lid release relay Pin 3, Circuit 84 (VT/YE), harness side and ground.



- Is the voltage greater than 10 volts?

Yes
REPAIR Circuit 84 (VT/YE).
REPEAT the self-test. CLEAR the DTCs.

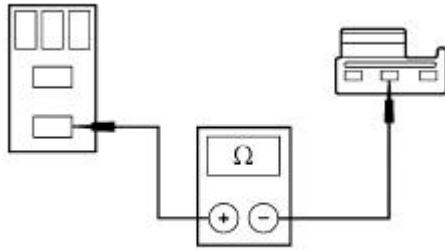
No
GO to [D13](#).

D13 CHECK CIRCUIT 84 (VT/YE) FOR OPEN

- Disconnect: Luggage Compartment Lid Release Solenoid C430.
- Measure the resistance between luggage compartment lid release relay Pin 3, Circuit 84 (VT/YE), harness side and luggage compartment lid release solenoid C430 Pin 2, Circuit 84 (VT/YE), harness side.

Yes
GO to [D14](#).

No
REPAIR Circuit 84 (VT/YE).
REPEAT the self-test. CLEAR the DTCs.

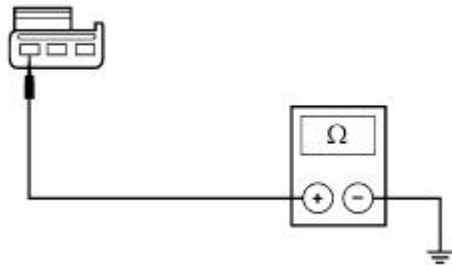


GN3163-A

- Is the resistance less than 5 ohms?

D14 CHECK CIRCUIT 1205 (BK) FOR OPEN

- Measure the resistance between luggage compartment lid release solenoid C430 Pin 1, Circuit 1205 (BK), harness side and ground.



GN2312-A

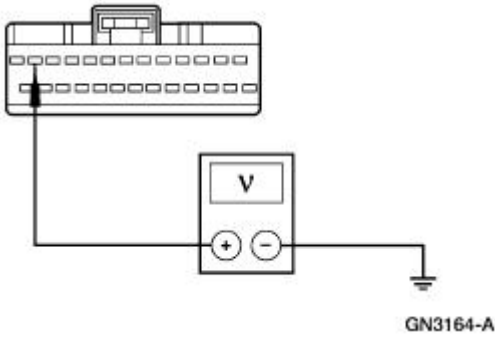
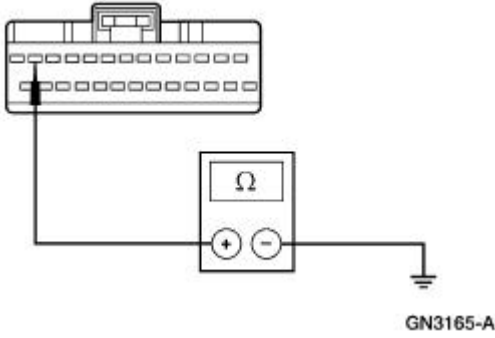
- Is the resistance less than 5 ohms?

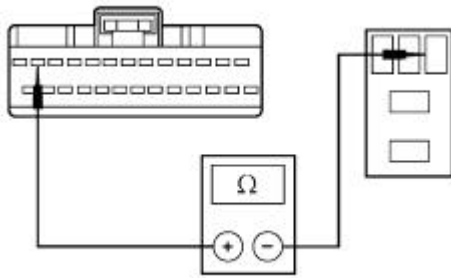
Yes
 INSTALL a new luggage compartment lid release switch. REPEAT the self-test. CLEAR the DTCs.

No
 REPAIR Circuit 1205 (BK). REPEAT the self-test. CLEAR the DTCs.

PINPOINT TEST E: PANIC FUNCTION DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
E1 CHECK IGNITION STATES	
<ul style="list-style-type: none"> ● Connect the diagnostic tool. ● Monitor the GEM PIDS IGN_KEY, IGN_A, IGN_S, and IGN_R while cycling the ignition switch through the OFF, ACC, RUN, START and key out positions. ● Do the PID values agree with the ignition switch positions? 	<p>Yes GO to E2.</p> <p>No REFER to Section 413-09.</p>
E2 CHECK THE GEM PID LAST DATA RECEIVED FOR PANIC	
<ul style="list-style-type: none"> ● Remove the ignition key from the ignition. ● Connect the diagnostic tool. ● Monitor the GEM PID LAST DATA RECEIVED while pressing and releasing the luggage compartment, panic, lock, and unlock buttons of the remote transmitter. ● Does LAST DATA RECEIVED match the button presses of the remote transmitter? 	<p>Yes GO to E3.</p> <p>No GO to Pinpoint Test D.</p>
E3 CHECK THE COURTESY LAMPS	
<ul style="list-style-type: none"> ● Connect the diagnostic tool. ● Trigger the GEM active command COURTESYL ON and OFF. ● Do the courtesy lamps illuminate and turn off? 	<p>Yes GO to E4.</p> <p>No REFER to Section 417-02. TEST the system for</p>

	normal operation.
E4 CHECK THE GEM OUTPUT TO THE HORN	
<ul style="list-style-type: none"> ● Connect the diagnostic tool. ● Trigger the GEM active command HORN ON and OFF. ● Did the horn sound and turn off? 	<p>Yes GO to E5.</p> <p>No GO to E6.</p>
E5 CHECK THE GEM OUTPUT TO THE PARKING LAMPS	
<ul style="list-style-type: none"> ● Connect the diagnostic tool. ● Trigger the GEM active command PARKLAMPS ON and OFF. ● Did the parking lamps illuminate and turn off? 	<p>Yes INSTALL a new GEM. For additional information, REFER to Section 419-10. REPEAT the self-test. CLEAR the DTCs.</p> <p>No GO to E10.</p>
E6 CHECK CIRCUIT 6 (YE/LG) FOR SHORT TO POWER	
<ul style="list-style-type: none"> ● Disconnect: Horn Relay. ● Disconnect: GEM C201c. ● Measure the voltage between GEM C201c Pin 12, Circuit 6 (YE/LG), harness side and ground.  <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes GO to E7.</p> <p>No REPAIR Circuit 6 (YE/LG). REPEAT the self-test. CLEAR the DTCs.</p>
E7 CHECK CIRCUIT 6 (YE/LG) FOR SHORT TO GROUND	
<ul style="list-style-type: none"> ● Measure the resistance between GEM C201c Pin 12, Circuit 6 (YE/LG), harness side and ground.  <ul style="list-style-type: none"> ● Is the resistance greater than 10,000 ohms? 	<p>Yes GO to E8.</p> <p>No REPAIR Circuit 6 (YE/LG). REPEAT the self-test. CLEAR the DTCs.</p>
E8 CHECK CIRCUIT 6 (YE/LG) FOR OPEN	
<ul style="list-style-type: none"> ● Measure the resistance between GEM C201c Pin 12, Circuit 6 (YE/LG), harness side and horn relay Pin 1, Circuit 6 (YE/LG), harness side. 	<p>Yes GO to E9.</p> <p>No REPAIR Circuit 6 (YE/LG). REPEAT the self-test. CLEAR the DTCs.</p>



GN3166-A

- Is the resistance less than 5 ohms?

E9 CHECK THE HORN FOR NORMAL OPERATION

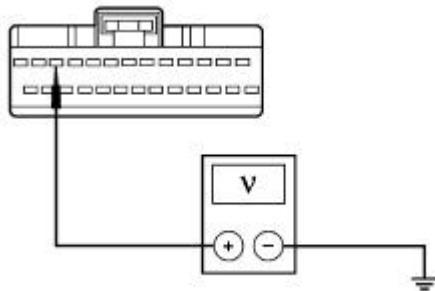
- Depress the steering wheel horn switch.
- Did the horn sound?

Yes
 INSTALL a new GEM. For additional information, REFER to [Section 419-10](#). REPEAT the self-test. CLEAR the DTCs.

No
 REFER to [Section 413-06](#).

E10 CHECK CIRCUIT 1032 (WH/BK) FOR SHORT TO POWER

- Disconnect: Parking Lamp Relay.
- Disconnect: GEM C201e.
- Measure the voltage between GEM C201e Pin 11, Circuit 1032 (WH/BK), harness side and ground.



GN3167-A

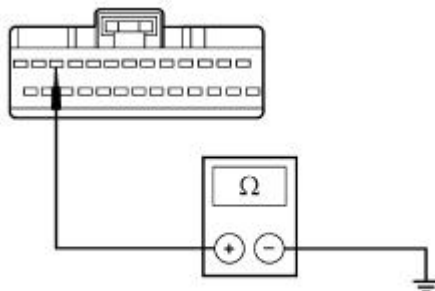
- Is the voltage greater than 10 volts?

Yes
 GO to [E11](#).

No
 REPAIR Circuit 1032 (WH/BK). REPEAT the self-test. CLEAR the DTCs.

E11 CHECK CIRCUIT 1032 (WH/BK) FOR SHORT TO GROUND

- Measure the resistance between GEM C201e Pin 11, Circuit 1032 (WH/BK), harness side and ground.



GN3168-A

- Is the resistance greater than 10,000 ohms?

Yes
 GO to [E12](#).

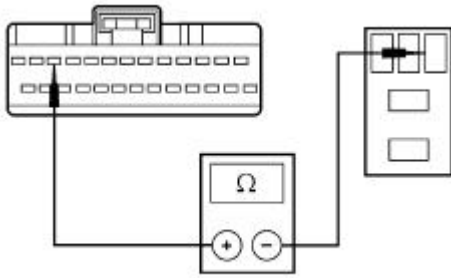
No
 REPAIR Circuit 1032 (WH/BK). REPEAT the self-test. CLEAR the DTCs.

E12 CHECK CIRCUIT 1032 (WH/BK) FOR OPEN

- Measure the resistance between GEM C201e Pin 11, Circuit

Yes

1032 (WH/BK), harness side and parking lamp relay Pin 1, Circuit 1032 (WH/BK), harness side.



GN3169-A

- Is the resistance less than 5 ohms?

GO to [E13](#).

No
REPAIR Circuit 1032 (WH/BK). REPEAT the self-test. CLEAR the DTCs.

E13 CHECK THE PARKING LAMPS FOR NORMAL OPERATION

- Turn the parking lamps on with the headlamp switch.
- Did the parking lamps turn on and off with the headlamp switch?

Yes
INSTALL a new GEM. For additional information, REFER to [Section 419-10](#). REPEAT the self-test. CLEAR the DTCs.

No
REFER to [Section 417-01](#).

Programming —Keyless Entry Remote Transmitter

NOTE: All keyless entry remote transmitters (15K601) must be programmed at the same time.

NOTE: All previous transmitter identification codes (TIC's) will be erased when programming mode is entered.

NOTE: To program (or reprogram) the keyless entry remote transmitters into the generic electronic module (GEM)(14B204), perform the following steps.

1. Turn the ignition from OFF to RUN eight times within 10 seconds, ending in RUN. If the GEM has successfully entered program mode, it will lock and unlock all the doors.
2. **NOTE:** The first TIC must be entered within 7.5 seconds of entering the program mode and additional TICs must be entered within 7.5 seconds of the first TIC. The programming mode is exited whenever the timing constraints are not met.

Press any button on a keyless entry remote transmitter, and the doors will lock and then unlock to confirm that each keyless entry remote transmitter has been programmed.

3. If the door locks do not respond for any keyless entry remote transmitter, wait for several seconds and press the button again.
 4. Turn the ignition switch to the OFF position, or wait up to five minutes after step 1, to exit program mode. If a keyless entry remote transmitter has been programmed (or reprogrammed), the GEM will lock and unlock all the doors one last time.
-

Actuator

Removal and Installation

For additional information, refer to [Section 501-14A](#).

Module —Generic Electronic (GEM)

Removal and Installation

For additional information, refer to [Section 419-10](#).

General Specifications

Item	Specification
RH wiper blade to top edge of cowl top vent panel	55-88mm (2.16-3.18 inches)
LH wiper blade to top edge of cowl top vent panel	56-80mm (2.20-3.14 inches)

Torque Specifications

Description	Nm	lb-ft	lb-in
Windshield wiper mounting arm and pivot shaft bolt.	15	11	—
Windshield wiper motor bolts.	15	11	—
Windshield washer fluid reservoir screw.	6	—	53
Battery Ground Cable	10	—	89

Wipers and Washers

The wiper and washer system consists of the following components:




- windshield wiper mounting arm and pivot shaft
 - pivot arms
 - windshield wiper blades
 - windshield washer reservoir
 - windshield washer pump
 - windshield wiper motor
 - generic electronic module (GEM)
 - multi-function switch
 - windshield washer nozzle and bracket
-

Wipers and Washers

Refer to Wiring Diagrams Cell [59](#), Generic Electronic Module for schematic and connector information.

Refer to Wiring Diagrams Cell [81](#), Interval Wiper/Washer for schematic and connector information.

Special Tool(s)

 <p>ST1453-A</p>	<p>Alternator, Regulator, Battery and Starter Tester (ARBST) or equivalent 010-00725</p>
 <p>ST1137-A</p>	<p>73 Digital Multimeter or equivalent 105-R0051</p>
 <p>ST2332-A</p>	<p>Worldwide Diagnostic System (WDS) 418-F224</p> <p>New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool</p>

Principles of Operation

Multifunction Wipers

The front wiper/washer feature controls the speed of the front windshield wipers and the amount of washer fluid sprayed on the front windshield when requested by the customer. There are five (5) wiper modes: OFF, LOW, HIGH, INTERVAL, and WASH.

Wiper Motor Speeds HIGH and LOW

There are two wiper speeds, HIGH and LOW. When the GEM detects the ignition switch circuits are in the RUN or ACC states, and the GEM detects a high or low speed request from the wiper mode circuits, the GEM will activate the wiper ON and OFF and the wiper speed circuits accordingly.

Wiper Motor Speeds Interval

There are one to seven wiper speed intervals, ranging from 1.5 seconds to 20 seconds in delay time respectively, which can be selected. When the GEM detects the ignition switch circuits are in the RUN or ACC states, and the GEM detects an interval selection of 1 through 7 from the delay/wash circuits, the GEM will activate the wiper ON and OFF and the wiper speed circuits accordingly.

Washers

When the GEM detects the ignition switch circuits are in RUN or ACC states, and the GEM detects a WASH request from the wiper delay/wash circuits, the GEM will activate the washer pump relay circuit for as long as the request is present up to 10 seconds.

Activation of the washer pump when in INTERVAL or OFF is delayed until a wash request is active for a minimum amount of time. In this scenario, the wash request must be present continuously for at least 210 ms. This allows a wash request that is present for less than 210 ms, to provide additional functionality by initiating a single wipe, called "mist wipe". The mist wipe function is a single wipe at low speed without activating the washer motor.

When in LOW or HIGH, any WASH request, regardless of the length of time it is present, will activate the washer pump. When in INTERVAL or OFF mode, upon deactivation of the washer motor, this feature shall provide two wipes at low speed before returning to the INTERVAL or OFF state as defined by the inputs. These additional wipes are provided to clear residual washer fluid from the front windshield.

Inspection and Verification

1. Verify the customer concern by operating the wiper/washer system.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none">● Hoses to windshield washer pump● Wiper linkage	<ul style="list-style-type: none">● CJB Fuse 39 (5A)● CJB Fuse 26 (30A)● Wiring harness● Loose or corroded connector(s)● Relays● Motors● Multifunction switch● GEM

3. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If diagnostic tool does not communicate with the vehicle:
 - Check that the program card is correctly installed.
 - Check the connections to the vehicle.
 - Check the ignition switch position.
4. If diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.
5. Carry out the DATA LINK DIAGNOSTIC TEST. If diagnostic tool responds with:
 - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to [Section 418-00](#).
 - NO RESPONSE/NOT EQUIPPED for GEM, go to Pinpoint Test A.
 - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the GEM.

6. If the DTCs retrieved are related to the concern, go to GEM Diagnostic Trouble Code (DTC) Index to continue diagnostics.
7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

GEM Diagnostic Trouble Code (DTC) Index

GEM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1217	Horn Relay Coil Circuit Failure	GEM	REFER to Section 413-06 .
B1218	Horn Relay Coil Circuit Short to Vbatt	GEM	REFER to Section 413-06 .
B1312	Lamp Headlamp Input Circuit Short to Battery	GEM	REFER to Section 417-01 .
B1317	Battery Voltage High	GEM	REFER to Section 414-00 .
B1318	Battery Voltage Low	GEM	REFER to Section 414-00 .
B1322	Driver Door Ajar Circuit Short to Ground	GEM	REFER to Section 417-02 .
B1330	Passenger Door Ajar Circuit Short to Ground	GEM	REFER to Section 417-02 .
B1334	Decklid Ajar Rear Door Circuit Short to Ground	GEM	REFER to Section 417-02 .
B1339	Chime Input Request Circuit Short to Battery (FOJ)	GEM	REFER to Section 413-09 .
B1340	Chime Input Request Circuit Short to Ground	GEM	REFER to Section 413-09 .
B1342	ECU Is Defective	GEM	CLEAR the DTCs. Retrieve the DTCs. If DTC B1342 is retrieved, INSTALL a new GEM. REFER to Section 419-10 .
B1353	Ignition Key-In Circuit Open	GEM	REFER to Section 413-09 .
B1359	Ignition Run/Acc Circuit Failure	GEM	REFER to Section 211-05 .
B1396	Power Door Lock Circuit Short to Battery	GEM	REFER to Section 501-14B .
B1397	Power Door Unlock Circuit Short to Battery	GEM	REFER to Section 501-14B .
B1405	Driver Power Window Down Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1408	Driver Power Window Up Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1410	Driver Power Window Motor Circuit Failure	GEM	REFER to Section 501-11 .
B1426	Lamp Safety Belt Circuit Short to Battery	GEM	REFER to Section 413-01 .
B1428	Lamp Safety Belt Circuit Failure	GEM	REFER to Section 413-01 .
B1431	Wiper Brake/Run Relay Circuit Failure	GEM	GO to Pinpoint Test B .
B1432	Wiper Brake/Run Relay Circuit	GEM	GO to Pinpoint Test B .

	Short to Battery		
B1434	Wiper HIGH and LOW Speed Relay Coil Circuit Failure	GEM	GO to Pinpoint Test B .
B1436	Wiper HIGH and LOW Speed Relay Coil Circuit Short to Battery	GEM	GO to Pinpoint Test B .
B1438	Wiper Mode Select Switch Circuit Failure	GEM	GO to Pinpoint Test B .
B1441	Wiper Mode Select Switch Circuit Short to Ground	GEM	GO to Pinpoint Test B .
B1446	Wiper Park Sense Circuit Failure	GEM	GO to Pinpoint Test B .
B1448	Wiper Park Sense Circuit Short to Battery	GEM	GO to Pinpoint Test B .
B1450	Wiper Wash/Delay Switch Circuit Failure	GEM	GO to Pinpoint Test C .
B1453	Wiper Wash/Delay Switch Circuit Short to Ground	GEM	GO to Pinpoint Test C .
B1458	Wiper Washer Pump Motor Relay Circuit Failure	GEM	GO to Pinpoint Test C .
B1460	Wiper Washer Pump Motor Relay Coil Circuit Short to Battery	GEM	GO to Pinpoint Test C .
B1462	Safety Belt Switch Circuit Failure	GEM	REFER to Section 413-09 .
B1466	Wiper HIGH and LOW Speed Not Switching	GEM	GO to Pinpoint Test B .
B1473	Wiper Low Speed Circuit Motor Failure	GEM	GO to Pinpoint Test B .
B1476	Wiper High Speed Circuit Motor Failure	GEM	GO to Pinpoint Test B .
B1551	Decklid Release Circuit Failure	GEM	REFER to Section 501-14B .
B1553	Decklid Release Circuit Short to Battery	GEM	REFER to Section 501-14B .
B1555	Ignition Run/Start Circuit Failure	GEM	REFER to Section 211-05 .
B1687	Lamp Dome Input Circuit Short to Battery	GEM	REFER to Section 417-02 .
B2486	LF Side Repeater Lamp Output Circuit Failure	GEM	REFER to Section 417-01 .
B2488	RF Side Repeater Lamp Output Circuit Failure	GEM	REFER to Section 417-01 .
C1189	Brake Fluid Level Sensor Input Short Circuit to Ground	GEM	REFER to Section 413-01 .
C1223	Lamp Brake Warning Output Circuit Failure	GEM	REFER to Section 413-01 .
C1225	Lamp Brake Warning Output Circuit Short to Battery	GEM	REFER to Section 413-01 .

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none"> No communication with the generic electronic module 	<ul style="list-style-type: none"> CJB Fuse 39 (5A). Circuitry. GEM. 	<ul style="list-style-type: none"> GO to Pinpoint Test A.
<ul style="list-style-type: none"> The wipers are inoperative 	<ul style="list-style-type: none"> CJB Fuse 26 (30A). Ignition switch. Circuitry. GEM. Multifunction switch (13K359). Wiper ON/OFF relay. Wiper HIGH/LOW relay. Wiper motor. 	<ul style="list-style-type: none"> GO to Pinpoint Test B.
<ul style="list-style-type: none"> The wipers stay on continuously 	<ul style="list-style-type: none"> Circuitry. GEM. Multifunction switch. Wiper ON/OFF relay. Wiper HIGH/LOW relay. Wiper motor. 	<ul style="list-style-type: none"> GO to Pinpoint Test B.
<ul style="list-style-type: none"> The HIGH and LOW wiper speeds do not operate correctly 	<ul style="list-style-type: none"> Circuitry. GEM. Multifunction switch. Wiper HIGH/LOW relay. Wiper motor. DTC B1434. 	<ul style="list-style-type: none"> GO to Pinpoint Test B.
<ul style="list-style-type: none"> The intermittent wiper mode does not operate correctly 	<ul style="list-style-type: none"> Circuitry. GEM. Multifunction switch. Wiper motor. 	<ul style="list-style-type: none"> GO to Pinpoint Test B.
<ul style="list-style-type: none"> The washer pump is inoperative 	<ul style="list-style-type: none"> CJB Fuse 26 (30A). Circuitry. GEM. Multifunction switch. Washer pump relay. Washer pump. Ignition switch. 	<ul style="list-style-type: none"> GO to Pinpoint Test C.
<ul style="list-style-type: none"> The low wiper speed does not operate correctly 	<ul style="list-style-type: none"> Circuitry. Multifunction switch. Wiper HIGH/LOW relay. Wiper motor. GEM. DTC B1473. DTC B1434. 	<ul style="list-style-type: none"> GO to Pinpoint Test B.

Pinpoint Tests



CAUTION: Before removing and installing the GEM or its connectors, disconnect the battery. Failure to follow this caution will result in the GEM storing many erroneous DTCs and it may exhibit erratic operation after installation.



CAUTION: Be careful when probing the central junction box (CJB), battery junction box (BJB) or any connectors. Damage will result to the connector receptacle if the probe being used is too large.



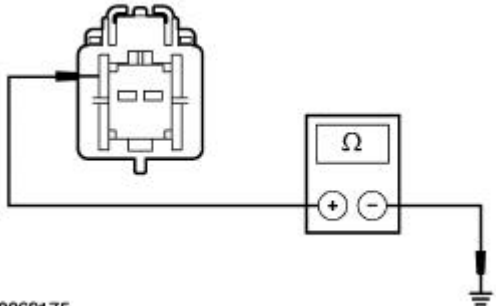
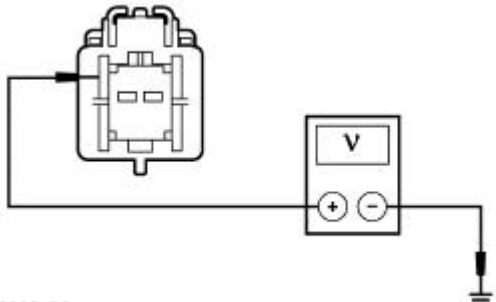
CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage may result.

NOTE: If continuous DTCs are recorded and the symptom is not present when carrying out the pinpoint tests, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

NOTE: Complete the entire pinpoint test related to the symptom before installing a new GEM.

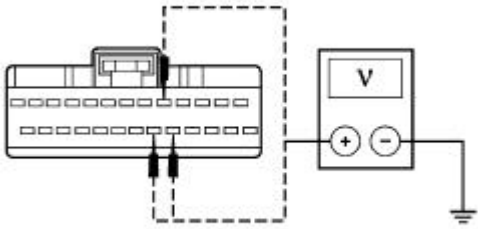
PINPOINT TEST A: NO COMMUNICATION WITH THE GENERIC ELECTRONIC MODULE (GEM)

Test Step	Result / Action to Take															
CAUTION: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.																
A1 CHECK THE GENERIC ELECTRONIC MODULE (GEM) POWER SUPPLY <ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Generic Electronic Module (GEM) C201a. ● Disconnect: GEM C201b. ● Key in ON position. ● Using the following table. measure the voltage between the GEM, harness side and ground. <table border="1"> <thead> <tr> <th>Connector</th> <th>Pin</th> <th>Circuit</th> </tr> </thead> <tbody> <tr> <td>C201a</td> <td>4</td> <td>400 (LB/BK)</td> </tr> <tr> <td>C201a</td> <td>1</td> <td>1006 (DG/WH)</td> </tr> <tr> <td>C201b</td> <td>2</td> <td>1001 (WH/YE)</td> </tr> <tr> <td>C201b</td> <td>3</td> <td>193 (YE/LG)</td> </tr> </tbody> </table> <ul style="list-style-type: none"> ● Are the voltages greater than 10 volts? 	Connector	Pin	Circuit	C201a	4	400 (LB/BK)	C201a	1	1006 (DG/WH)	C201b	2	1001 (WH/YE)	C201b	3	193 (YE/LG)	<p>Yes GO to A2.</p> <p>No REPAIR the circuit(s) in question. TEST the system for normal operation.</p>
Connector	Pin	Circuit														
C201a	4	400 (LB/BK)														
C201a	1	1006 (DG/WH)														
C201b	2	1001 (WH/YE)														
C201b	3	193 (YE/LG)														
A2 CHECK THE GEM GROUND CIRCUIT 397 (BK/WH) FOR OPEN <ul style="list-style-type: none"> ● Key in OFF position. ● Measure the resistance between the GEM C201b pin 4, circuit 397 (BK/WH), harness side and ground. 	<p>Yes GO to A3.</p> <p>No REPAIR the circuit(s) in question. TEST the system</p>															

 <p>A0069175</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>for normal operation.</p>
<p>A3 CHECK CIRCUIT 397 (BK/WH) FOR SHORT TO POWER</p>	
<ul style="list-style-type: none"> ● Measure the voltage between the GEM C201b pin 4, circuit 397 (BK/WH), harness side and ground.  <p>A0069176</p> <ul style="list-style-type: none"> ● Is any voltage present? 	<p>Yes REPAIR the circuit. TEST the system for normal operation.</p> <p>No REFER to Section 418-00.</p>

PINPOINT TEST B: WINDSHIELD WIPERS DO NOT OPERATE / OPERATE CORRECTLY

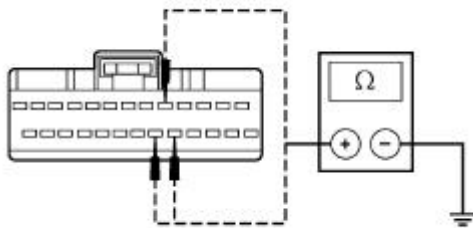
Test Step	Result / Action to Take
<p>B1 DETERMINE IF GEM IS RECEIVING CORRECT IGNITION SWITCH STATUS</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Connect the diagnostic tool. ● NOTE: If the vehicle is equipped with a manual transmission, depress the clutch while turning the ignition switch to START. ● Monitor the GEM PIDs IGN_S, IGN_R IGN_A, and IGN_KEY while turning the ignition switch through the START, RUN, OFF and ACC positions. ● Do the GEM PID values agree with the ignition switch positions? 	<p>Yes GO to B2.</p> <p>No REFER to Section 413-09.</p>
<p>B2 DETERMINE IF GEM IS RECEIVING CORRECT WIPER SWITCH STATUS FROM MULTIFUNCTION SWITCH</p> <ul style="list-style-type: none"> ● Key in ON position. ● Monitor PID WPMODE, while moving through all wiper control positions on the multifunction switch. ● Do the GEM PID values agree with switch positions? 	<p>Yes GO to B3.</p> <p>No GO to B6.</p>
<p>B3 TEST GEM CONTROL OF WIPER ON/OFF RELAY</p> <ul style="list-style-type: none"> ● Trigger the GEM active command WIPER RLY ON and OFF. ● Do the wipers turn ON and OFF? 	<p>Yes GO to B4.</p>

	<p>No GO to B10.</p>								
<p>B4 TEST THE GEM CONTROL OF WIPER HIGH/LOW RELAY</p>									
<ul style="list-style-type: none"> ● Trigger the GEM active command WIPER RLY to ON. ● Trigger the GEM active command SPEED RLY ON and OFF. ● Does wiper speed change on activation and deactivation of SPEED RLY command? 	<p>Yes GO to B5.</p> <p>No GO to B16.</p>								
<p>B5 DETERMINE IF GEM IS RECEIVING CORRECT WIPER POSITION STATUS</p>									
<ul style="list-style-type: none"> ● Monitor GEM PID WPPRKSX while turning the wipers ON using the multifunction switch. ● Do the PID values agree with the wiper position? 	<p>Yes INSTALL a new GEM. For additional information, REFER to Section 419-10. CLEAR the DTCs. REPEAT the self-test.</p> <p>No GO to B27.</p>								
<p>B6 TEST THE MULTIFUNCTION SWITCH FOR NORMAL OPERATION</p>									
<ul style="list-style-type: none"> ● Disconnect: Multifunction Switch C202a. ● Check the multifunction switch. Refer to Wiring Diagrams, Cell 149, Component Testing. ● Is the multifunction switch OK? 	<p>Yes GO to B7.</p> <p>No INSTALL a new multifunction switch; REFER to Section 211-05. REPEAT the self-test. CLEAR the DTCs.</p>								
<p>B7 CHECK CIRCUITS 682 (DB), 684 (PK/YE), AND 680 (LB/OG) FOR SHORT TO BATTERY BETWEEN THE GEM AND THE MULTIFUNCTION SWITCH</p>									
<ul style="list-style-type: none"> ● Disconnect: GEM C201e. ● Key in ON position. ● Using the following table, measure the voltage between the GEM C201e Pins, harness side and ground. <table border="1"> <thead> <tr> <th>Pin</th> <th>Circuit</th> </tr> </thead> <tbody> <tr> <td>5</td> <td>682 (DB)</td> </tr> <tr> <td>18</td> <td>684 (PK/YE)</td> </tr> <tr> <td>19</td> <td>680 (LB/OG)</td> </tr> </tbody> </table>  <p style="text-align: center;">GK9940-A</p> <ul style="list-style-type: none"> ● Are the voltages greater than 10 volts? 	Pin	Circuit	5	682 (DB)	18	684 (PK/YE)	19	680 (LB/OG)	<p>Yes REPAIR the circuit(s) in question. REPEAT the self-test. CLEAR the DTCs.</p> <p>No GO to B8.</p>
Pin	Circuit								
5	682 (DB)								
18	684 (PK/YE)								
19	680 (LB/OG)								
<p>B8 CHECK CIRCUITS 682 (DB), 684 (PK/YE), AND 680</p>									

(LB/OG) FOR SHORT TO GROUND BETWEEN THE GEM AND THE MULTIFUNCTION SWITCH

- Key in OFF position.
- Using the following table, measure the resistance between the GEM C201e Pins, harness side and ground.

Pin	Circuit
5	682 (DB)
18	684 (PK/YE)
19	680 (LB/OG)



GK9941-A

- Are the resistances greater than 10,000 ohms?

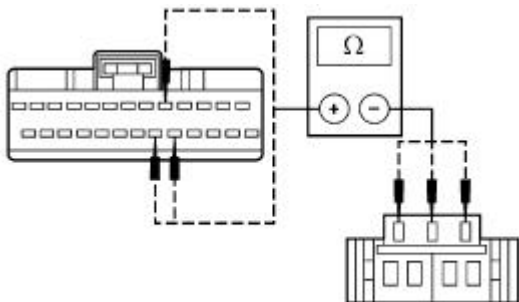
Yes
REPAIR the circuit(s) in question. REPEAT the self-test. CLEAR the DTCs.

No
GO to [B9](#).

B9 CHECK CIRCUITS 682 (DB), 684 (PK/YE), AND 680 (LB/OG) FOR AN OPEN CONDITION BETWEEN GEM AND MULTIFUNCTION SWITCH

- Using the following table, measure the resistance between the GEM C201e Pins, harness side and multifunction switch C202a Pins, harness side.

GEM	Multifunction Switch	Circuit
C260 Pin 5	C202a Pin 685	682 (DB)
C260 Pin 18	C202a Pin 590	684 (PK/YE)
C260 Pin 19	C202a Pin 993	680 (LB/OG)



GK9942-A

- Are the resistances less than 5 ohms?

Yes
INSTALL a new GEM. For additional information, REFER to [Section 419-10](#). REPEAT the self-test. CLEAR the DTCs.

No
REPAIR circuit(s) in question. REPEAT the self-test. CLEAR the DTCs.

B10 CHECK CIRCUITS 65 (DG) FOR OPEN CIRCUIT CONDITION BETWEEN BJB AND CJB

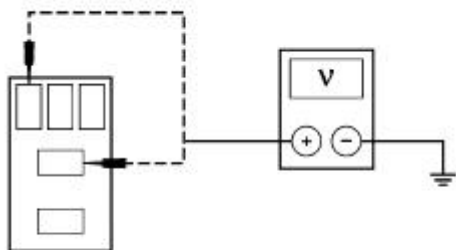
NOTE: Verify voltage at CJB F26 (30A) before carrying out this test.

- Disconnect: Wiper On/Off Relay.
- Measure the voltage between BJB ON and OFF wiper

Yes
GO to [B11](#).

No

relay Pin 5, Circuit 65 (DG), harness side and ground; and between BJB wiper ON/OFF relay Pin 2, Circuit 65 (DG), harness side and ground.



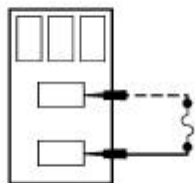
GK9943-A

- Are the voltages greater than 10 volts?

REPAIR circuit(s) in question.
REPEAT the self-test.
CLEAR the DTCs.

B11 ISOLATE PROBLEM BETWEEN GEM AND BJB

- Key in OFF position.
- Connect a fused jumper wire (30A) between wiper ON/OFF relay Pin 3 and Pin 5, harness side.



GK9944-B

- Key in ON position.
- Did the wiper motor activate?

Yes
GO to [B12](#).

No
GO to [B22](#).

B12 CARRY OUT THE WIPER ON/OFF RELAY COMPONENT TEST

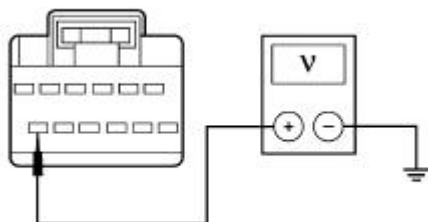
- Check the wiper ON and OFF relay; refer to Wiring Diagrams, Cell 149, Component Testing.
- Is the ON/OFF wiper relay OK?

Yes
GO to [B13](#).

No
INSTALL a new wiper ON/OFF relay. REPEAT the self-test. CLEAR the DTCs.

B13 CHECK CIRCUIT 646 (YE/WH) FOR SHORT TO BATTERY BETWEEN GEM AND BJB

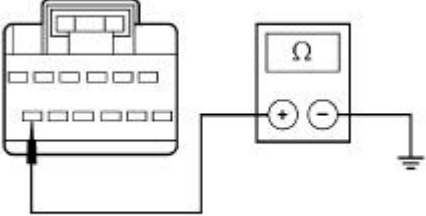
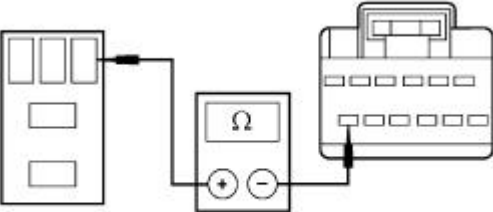
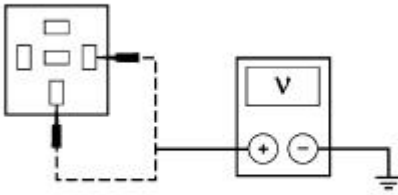
- Disconnect: Wiper On/Off Relay.
- Disconnect: GEM C201d.
- Measure the voltage between GEM C201d 3 Pin 12, Circuit 646 (YE/WH), harness side and ground.



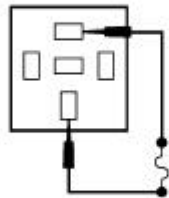
GK9945-A

Yes
REPAIR Circuit 646 (YE/WH). REPEAT the self-test. CLEAR the DTCs.

No
GO to [B14](#).

<ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	
<p>B14 CHECK CIRCUIT 646 (YE/WH) FOR SHORT TO GROUND BETWEEN GEM AND BJB</p>	
<ul style="list-style-type: none"> ● Measure the resistance between GEM C201d Pin 12, Circuit 646 (YE/WH), harness side and ground.  <p style="text-align: center;">GK9946-A</p> <ul style="list-style-type: none"> ● Is the resistance greater than 10,000 ohms? 	<p>Yes GO to B15.</p> <p>No REPAIR Circuit 646 (YE/WH). REPEAT the self-test. CLEAR the DTCs.</p>
<p>B15 CHECK CIRCUIT 646 (YE/WH) FOR OPEN BETWEEN GEM AND BJB</p>	
<ul style="list-style-type: none"> ● Measure the resistance between GEM C201d Pin 12, Circuit 646 (YE/WH), harness side and BJB wiper ON/OFF relay Pin 1, Circuit 646 (YE/WH), harness side.  <p style="text-align: center;">GK9947-A</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes INSTALL a new GEM. For additional information REFER to Section 419-10. REPEAT the self-test. CLEAR the DTCs.</p> <p>No REPAIR Circuit 646 (YE/WH). REPEAT the self-test. CLEAR the DTCs.</p>
<p>B16 CHECK CIRCUITS 65 (DG) AND 61 (YE/RD) FOR OPEN CONDITION BETWEEN BJB AND CJB</p>	
<ul style="list-style-type: none"> ● Disconnect: Wiper HIGH/LOW Relay. ● Trigger the GEM active command WIPER RLY to ON. ● Measure the voltages between BJB wiper HIGH/LOW relay Pin 86, Circuit 65 (DG), harness side and ground; and between BJB wiper HIGH/LOW relay Pin 30, Circuit 61 (YE/RD), harness side and ground.  <p style="text-align: center;">GK9948-A</p> <ul style="list-style-type: none"> ● Are the voltages greater than 10 volts? 	<p>Yes GO to B17.</p> <p>No REPAIR circuit in question. REPEAT the self-test. CLEAR the DTCs.</p>
<p>B17 ISOLATE THE PROBLEM BETWEEN THE GEM AND THE BJB</p>	
<ul style="list-style-type: none"> ● Trigger the GEM active command WIPER RLY to ON. 	<p>Yes</p>

- Connect a fused jumper wire (30A) between wiper HIGH/LOW relay Pin 30, Circuit 61 (YE/RD), harness side and Pin 87, Circuit 58 (WH), harness side.



GK9949-B

- Did the wiper motor speed increase with the jumper installed and slow down with the jumper removed?

GO to [B18](#).

No
GO to [B26](#).

B18 CARRY OUT COMPONENT TEST ON WIPER HIGH/LOW RELAY

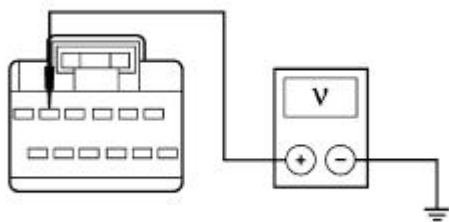
- Check the wiper HIGH/LOW relay; refer to Wiring Diagrams, Cell 149, Component Testing.
- Is the wiper HIGH/LOW relay OK?

Yes
GO to [B19](#).

No
INSTALL a new wiper HIGH/LOW relay. REPEAT the self-test. CLEAR the DTCs.

B19 CHECK CIRCUIT 647 (GY/LB) FOR SHORT TO BATTERY BETWEEN GEM AND BJB

- Disconnect: GEM C201d.
- Measure voltage between GEM C201d Pin 5, Circuit 647 (GY/LB), harness side and ground.



GK9950-A

- Is the voltage greater than 10 volts?

Yes
REPAIR Circuit 647 (GY/LB). REPEAT the self-test. CLEAR the DTCs.

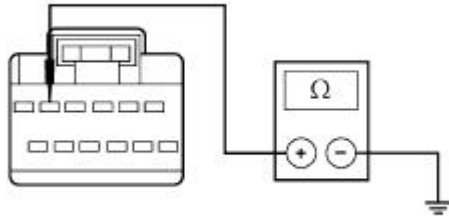
No
GO to [B20](#).

B20 CHECK CIRCUIT 647 (GY/LB) FOR SHORT TO GROUND BETWEEN GEM AND BJB

- Measure the resistance between GEM C201d Pin 5, Circuit 647 (GY/LB), harness side and ground.

Yes
GO to [B21](#).

No
REPAIR Circuit 647 (GY/LB). REPEAT the self-test. CLEAR the DTCs.

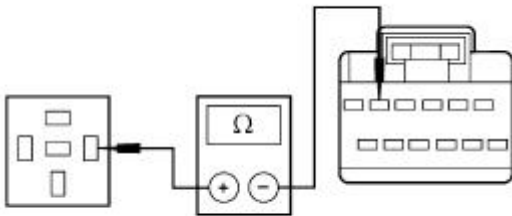


GK9951-A

- Is the resistance greater than 10,000 ohms?

B21 CHECK CIRCUIT 647 (GY/LB) FOR OPEN CONDITION BETWEEN GEM AND BJB

- Measure the resistance between GEM C201d Pin 5, Circuit 647 (GY/LB), harness side and wiper HIGH/LOW relay Pin 85, Circuit 647 (GY/LB), harness side.



GK9952-A

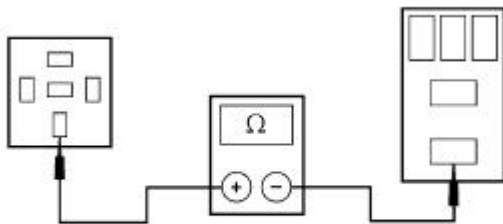
- Is the resistance less than 5 ohms?

Yes
 INSTALL a new GEM.
 REFER to [Section 419-10](#).
 REPEAT the self-test.
 CLEAR the DTCs.

No
 REPAIR Circuit 647 (GY/LB).
 REPEAT the self-test.
 CLEAR the DTCs.

B22 CHECK CIRCUIT 61 (YE/RD) FOR OPEN CIRCUIT CONDITION BETWEEN WIPER ON/OFF AND HIGH/LOW RELAYS

- Disconnect: Wiper HIGH/LOW Relay.
- Disconnect: Wiper ON/OFF Relay.
- Measure the resistance between wiper ON/OFF relay Pin 3, Circuit 61 (YE/RD), harness side and wiper HIGH/LOW relay Pin 30, Circuit 61 (YE/RD), harness side.



GK9953-A

- Is the resistance less than 5 ohms?

Yes
 GO to [B23](#).

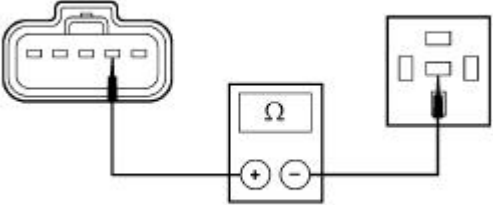
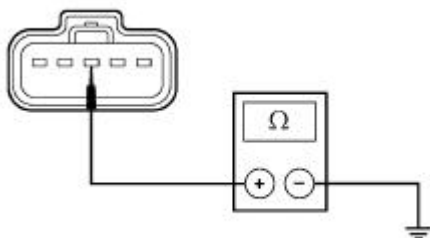
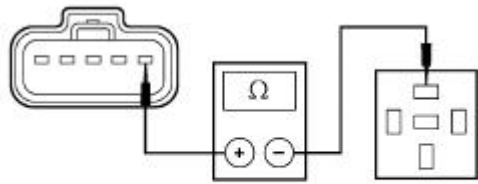
No
 REPAIR Circuit 61 (YE/RD).
 REPEAT the self-test.
 CLEAR the DTCs.

B23 CARRY OUT THE WIPER HIGH/LOW RELAY COMPONENT TEST

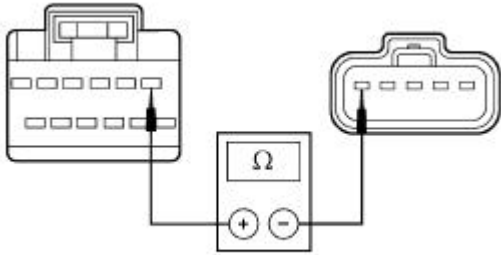
- Check the wiper HIGH/LOW relay; refer to Wiring Diagrams, Cell 149, Component Testing.
- Is the wiper HIGH/LOW relay OK?

Yes
 GO to [B24](#).

No
 INSTALL a new wiper HIGH/LOW relay. REPEAT the self-test. CLEAR the

<p>B24 CHECK CIRCUIT 56 (DB/OG) FOR AN OPEN CIRCUIT BETWEEN THE WIPER HIGH/LOW RELAY AND THE WIPER MOTOR</p>	<p>DTCs.</p>
<ul style="list-style-type: none"> ● Disconnect: Wiper Motor C125. ● Measure the resistance between wiper HIGH/LOW relay Pin 87A, Circuit 56 (DB/OG), harness side and wiper motor C125 Pin 4, Circuit 56 (DB/OG), harness side.  <p style="text-align: center;">GK9954-A</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes GO to B25.</p> <p>No REPAIR Circuit 56 (DB/OG). REPEAT the self-test. CLEAR the DTCs.</p>
<p>B25 CHECK CIRCUIT 1205 (BK) FOR OPEN CIRCUIT CONDITION BETWEEN WIPER MOTOR AND GROUND</p>	
<ul style="list-style-type: none"> ● Measure the resistance between wiper motor C125 Pin 3, Circuit 1205 (BK), harness side and ground.  <p style="text-align: center;">GK9955-A</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes CARRY OUT the windshield wiper motor component test. REFER to Component Test. If the component fails, INSTALL a new wiper motor; REFER to Motor—Windshield Wiper. REPEAT the self-test. CLEAR the DTCs.</p> <p>No REPAIR Circuit 1205 (BK). REPEAT the self-test. CLEAR the DTCs.</p>
<p>B26 CHECK CIRCUIT 58 (WH) FOR AN OPEN CIRCUIT BETWEEN THE WIPER HIGH/LOW RELAY AND THE WIPER MOTOR</p>	
<ul style="list-style-type: none"> ● Disconnect: Wiper Motor C125. ● Measure the resistance between wiper motor C125 Pin 5, Circuit 58 (WH), harness side and wiper HIGH/LOW relay Pin 87, Circuit 58 (WH), harness side.  <p style="text-align: center;">GA5943-A</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes CARRY OUT the windshield wiper motor component test. REFER to Component Test. If the component fails, INSTALL a new wiper motor; REFER to Motor—Windshield Wiper. REPEAT the self-test. CLEAR the DTCs.</p> <p>No REPAIR Circuit 58 (WH). REPEAT the self-test. CLEAR the DTCs.</p>
<p>B27 CHECK CIRCUIT 28 (BK/PK) FOR OPEN CIRCUIT CONDITION BETWEEN THE WIPER HIGH/LOW RELAY AND THE WIPER MOTOR</p>	

- Disconnect: Wiper Motor C125.
- Disconnect: GEM C201d.
- Measure the resistance between wiper motor C125 Pin 1, Circuit 28 (BK/PK), harness side and GEM C201d Pin 1, Circuit 58 (WH), harness side.



GK9957-A

- Is the resistance less than 5 ohms?

Yes
 INSTALL a new wiper motor;
 REFER to [Motor—Windshield Wiper](#) . REPEAT the self-test.
 CLEAR the DTCs.

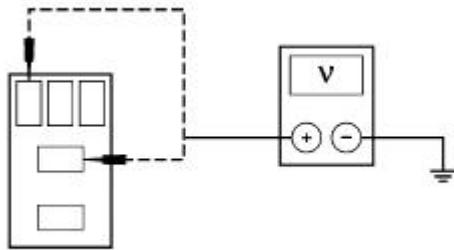
No
 REPAIR Circuit 28 (BK/PK).
 REPEAT the self-test.
 CLEAR the DTCs.

PINPOINT TEST C: WINDSHIELD WASHERS DO NOT OPERATE / OPERATE CORRECTLY

Test Step	Result / Action to Take
C1 DETERMINE IF GEM IS RECEIVING CORRECT IGNITION SWITCH STATUS	
<ul style="list-style-type: none"> ● Key in OFF position. ● Connect the diagnostic tool. ● NOTE: If the vehicle is equipped with a manual transmission, depress the clutch while turning the ignition switch to START. ● Monitor the GEM PIDs IGN_S, IGN_R, IGN_A, and IGN_KEY while turning the ignition switch through the START, RUN, OFF and ACC positions. ● Do the GEM PID values agree with the ignition switch positions? 	<p>Yes GO to C2 .</p> <p>No REFER to Section 413-09 .</p>
C2 DETERMINE IF GEM IS RECEIVING CORRECT WIPER SWITCH STATUS FROM MULTIFUNCTION SWITCH	
<ul style="list-style-type: none"> ● Key in ON position. ● Monitor GEM PID WPMODE while activating all wiper control positions on the multifunction switch. ● Does the GEM PID values agree with switch positions? 	<p>Yes GO to C3 .</p> <p>No GO to Pinpoint Test B .</p>
C3 CHECK GEM CONTROL OF THE WASHER ON/OFF RELAY	
<ul style="list-style-type: none"> ● Trigger GEM active command WASH RLY ON and OFF. ● Do washers turn ON and OFF? 	<p>Yes INSTALL a new GEM; REFER to Section 419-10 . REPEAT the self-test. CLEAR the DTCs.</p> <p>No GO to C4 .</p>
C4 CHECK CIRCUIT 65 (DG) FOR OPEN CIRCUIT BETWEEN CJB AND WASHER ON/OFF RELAY	
NOTE: Verify voltage at CJB F26 (30A) before carrying out this	Yes

test.

- Disconnect: Washer ON/OFF Relay.
- Measure the voltage between washer ON/OFF relay Pin 2, Circuit 65 (DG), harness side and ground; and washer ON/OFF relay Pin 3, Circuit 65 (DG), harness side and ground.



GK9943-A

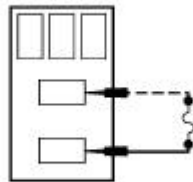
- Are the voltages greater than 10 volts?

GO to [C5](#).

No
REPAIR the circuit in question. REPEAT the self-test. CLEAR the DTCs.

C5 ISOLATE THE PROBLEM BETWEEN GEM AND BJB

- Connect a fused jumper wire (30A) between washer ON/OFF relay Pin 3, Circuit 65 (DG), harness side and Pin 5, Circuit 941 (BK/WH), harness side.



GK9944-B

- Did the washer motor activate?

Yes
GO to [C6](#).

No
GO to [C10](#).

C6 CARRY OUT WASHER ON/OFF RELAY COMPONENT TEST

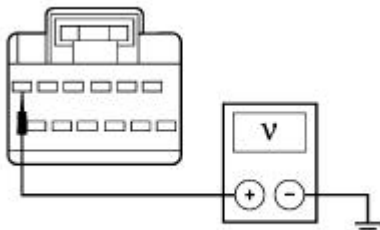
- Check the washer ON/OFF relay; refer to Wiring Diagrams, Cell 149, Component Testing.
- Is the washer ON/OFF relay OK?

Yes
GO to [C7](#).

No
INSTALL a new wiper ON/OFF relay.
REPEAT the self-test.
CLEAR the DTCs.

C7 CHECK CIRCUIT 686 (TN/RD) FOR SHORT TO BATTERY BETWEEN GEM AND BJB

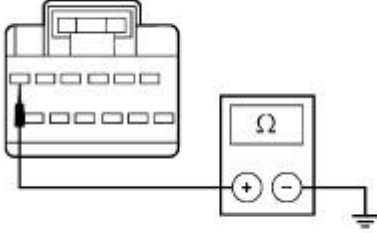
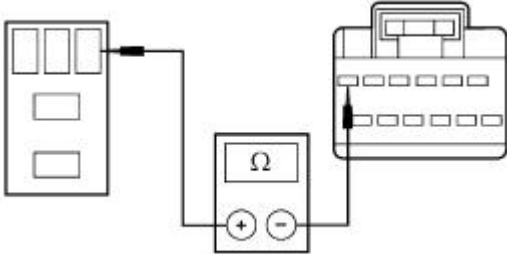
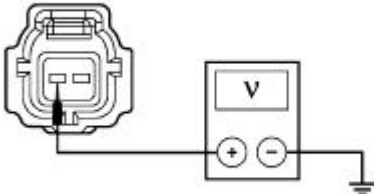
- Disconnect: GEM C201d.
- Measure the voltage between GEM C201d Pin 6, Circuit 686 (TN/RD), harness side and ground.

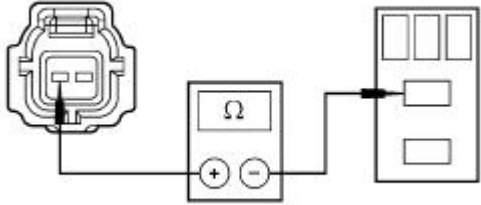
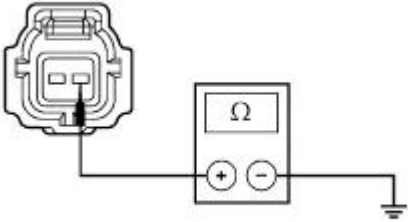


GK9958-A

Yes
REPAIR Circuit 686 (TN/RD). REPEAT the self-test. CLEAR the DTCs.

No
GO to [C8](#).

<ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	
C8 CHECK CIRCUIT 686 (TN/RD) FOR SHORT TO GROUND BETWEEN GEM AND BJB	
<ul style="list-style-type: none"> ● Measure the resistance between GEM C201d Pin 6, Circuit 686 (TN/RD), harness side and ground.  <p style="text-align: center;">GK9959-A</p> <ul style="list-style-type: none"> ● Is the resistance greater than 10,000 ohms? 	<p>Yes GO to C9.</p> <p>No REPAIR Circuit 686 (TN/RD). REPEAT the self-test. CLEAR the DTCs.</p>
C9 CHECK CIRCUIT 686 (TN/RD) FOR AN OPEN CIRCUIT BETWEEN GEM AND WASHER ON/OFF RELAY	
<ul style="list-style-type: none"> ● Measure the resistance between GEM C201d Pin 6, Circuit 686 (TN/RD), harness side and washer ON/OFF relay Pin 1, Circuit 686 (TN/RD), harness side.  <p style="text-align: center;">GK9960-A</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes INSTALL a new GEM; REFER to Section 419-10. REPEAT the self-test. CLEAR the DTCs.</p> <p>No REPAIR Circuit 686 (TN/RD). REPEAT the self-test. CLEAR the DTCs.</p>
C10 CHECK CIRCUIT 941 (BK/WH) FOR SHORT TO BATTERY BETWEEN BJB AND WASHER MOTOR	
<ul style="list-style-type: none"> ● Disconnect: Washer Pump Motor C137. ● Measure the voltage between washer pump C137 Pin 1, Circuit 941 (BK/WH), harness side and ground.  <p style="text-align: center;">GK9961-A</p> <ul style="list-style-type: none"> ● Is the voltage greater than 10 volts? 	<p>Yes REPAIR Circuit 941 (BK/WH). REPEAT the self-test. CLEAR the DTCs.</p> <p>No GO to C11.</p>
C11 CHECK CIRCUIT 941 (BK/WH) FOR OPEN BETWEEN THE BJB AND THE WASHER MOTOR	
<ul style="list-style-type: none"> ● Measure the resistance between washer pump C137 Pin 1, Circuit 941 (BK/WH), harness side and washer pump relay Pin 5, Circuit 941 (BK/WH), harness side. 	<p>Yes GO to C12.</p> <p>No</p>

 <p style="text-align: center;">GK9962-A</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>REPAIR Circuit 941 (BK/WH). REPEAT the self-test. CLEAR the DTCs.</p>
C12 CHECK CIRCUIT 1205 (BK) FOR AN OPEN	
<ul style="list-style-type: none"> ● Measure the resistance between washer pump C137 Pin 2, Circuit 1205 (BK), harness side and ground.  <p style="text-align: center;">GK9963-A</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes INSTALL a new washer motor. REPEAT the self-test. CLEAR the DTCs.</p> <p>No REPAIR Circuit 1205 (BK). REPEAT the self-test. CLEAR the DTCs.</p>

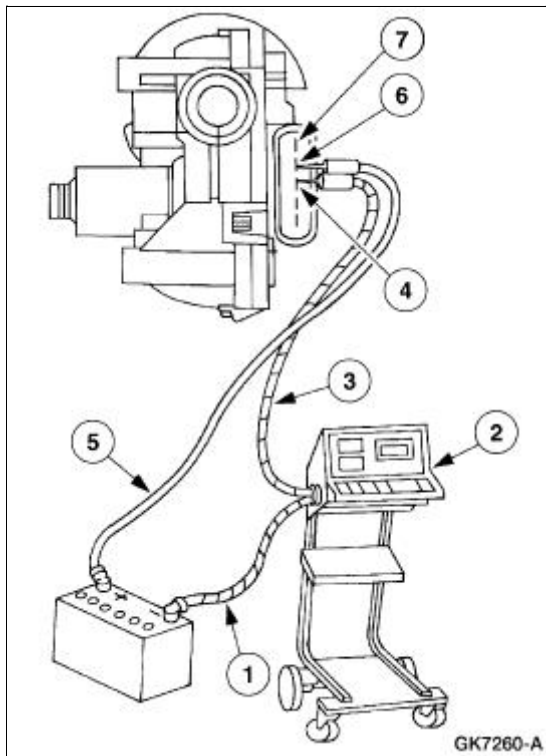
Component Test

Windshield Wiper Motor



CAUTION: Do not handle the wiper motor abusively when diagnosing the wiper operations. Failure to follow this caution may result in damage to the motor magnets and will make the wiper motor inoperative. Rough handling of new replacement wiper motors may also damage the motor magnets.

Use Alternator, Regulator, Battery and Starter Tester (ARBST) to test the wiper motor on the vehicle.



To test the wiper motor, disconnect the windshield wiper mounting arm and pivot shaft from the windshield wiper motor; refer to [Pivot Arm](#).

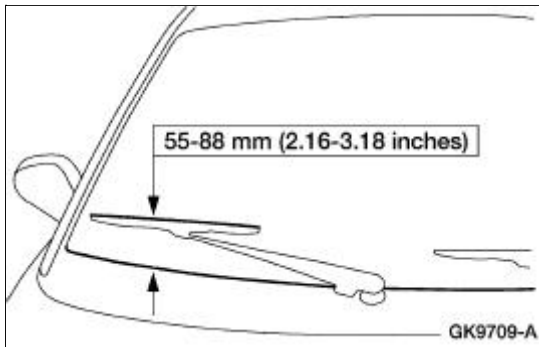
Disconnect the wiper motor. Connect the (1) green lead from (2) (ARBST) to the battery negative (-) post. Connect the (3) red lead from ARBST to the wiper motor (4) common brush terminal (terminal 3).

Test the low speed mode by connecting a (5) cable from the battery positive (+) post to the (6) low speed brush terminal (terminal 4) and measure the current draw. If the current draw is greater than 3.5 amperes, install a new windshield wiper motor.

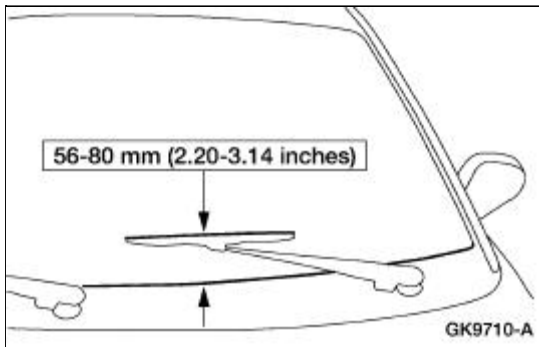
Test the high speed mode by connecting a cable from the battery positive (+) post to the (7) high speed brush terminal (terminal 5) and measure the current draw. If the current draw is greater than 5.5 amperes, install a new wiper motor.

Wiper Blade and Pivot Arm Adjustment

1. Cycle and park the windshield wipers.
2. Verify that the distance between the center of the RH windshield wiper blade and the top edge of the cowl top vent panel is within specification.



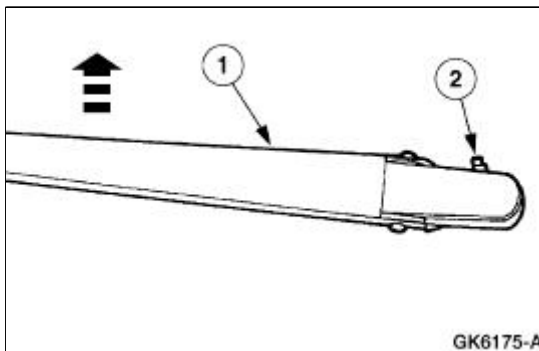
3. Verify that the distance between the center of the LH windshield wiper blade and the top edge of the cowl top vent panel is within specification.



4. If the distance is not within specification, remove the windshield wiper pivot arms and reposition to specification.

Remove the pivot arm.

1. Pull up on the pivot arm.
2. Pull out on the retainer tab and remove the pivot arm.



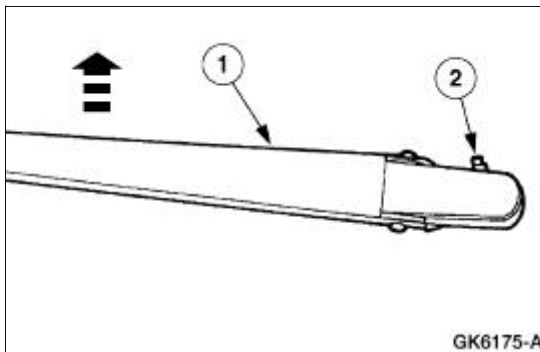
Pivot Arm

Removal

1. **NOTE:** New windshield wiper pivot arms need to be installed as an assembly.

Remove the pivot arm.

1. Pull up on the pivot arm.
2. Pull out on the retainer tab and remove the pivot arm.



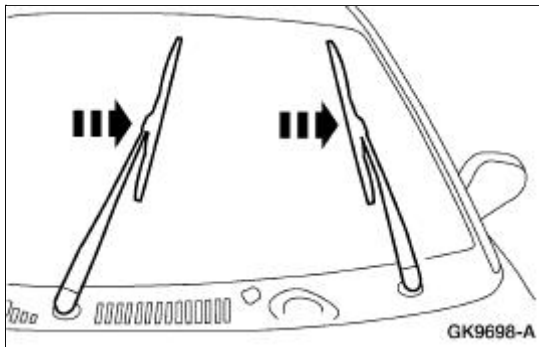
Installation

1. To install, reverse the removal procedure.
-

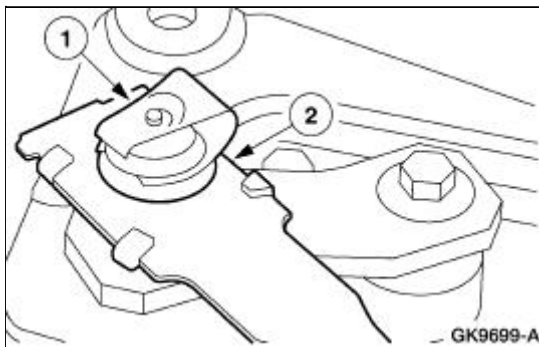
Mounting Arm and Pivot Shaft

Removal

1. Park the windshield wipers in the full upright position. This will allow for easy access to the retaining clip on the wiper motor output shaft.



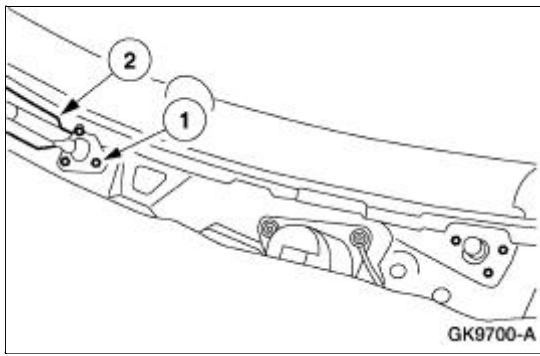
2. Remove the cowl top vent panels.
3. Disconnect the battery ground cable.
4. Disconnect the mounting arm and pivot shaft linkage from the wiper motor output shaft.
 1. Remove the clip.
 2. Disconnect the mounting arm and pivot shaft linkage from the wiper motor output shaft.



5. **NOTE:** It is necessary to lower the hood to remove the mounting arm and pivot shaft.

Remove the mounting arm and pivot shaft.

1. Remove the bolts.
2. Remove the mounting arm and pivot shaft through the RH cowl chamber opening.

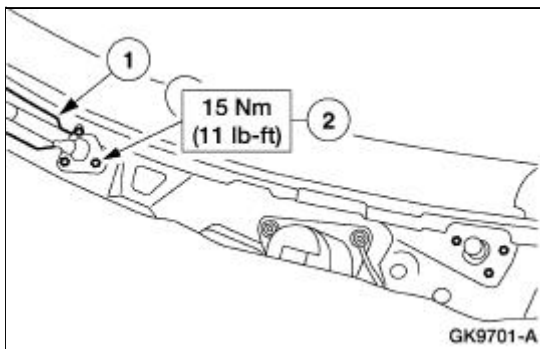


Installation

1. **NOTE:** Prior to installing the mounting arm and pivot shaft, install the retaining clip onto the end of the mounting arm and pivot shaft linkage.

Install the mounting arm and pivot shaft.

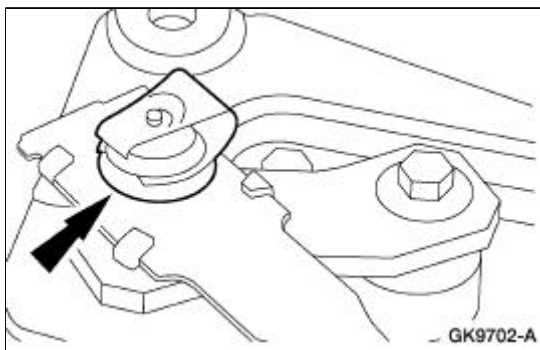
1. Install through the RH cowl chamber opening.
2. Install the bolts.



2. **NOTE:** It is necessary to lower the hood to install the mounting arm and pivot shaft linkage onto the wiper motor output shaft.

Install the mounting arm and pivot shaft linkage onto the wiper motor output shaft.

- Snap the mounting arm and pivot shaft linkage onto the wiper motor output shaft.



3. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

Reconnect the negative battery cable.


4. Cycle the wiper motor to the park position.

5. Install the cowl top vent panels.

- Adjust wiper pivot arms as necessary. Refer to [Wiper Blade and Pivot Arm Adjustment](#).
-

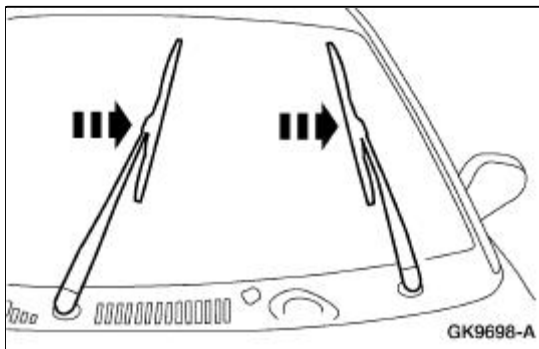
Motor —Windshield Wiper

Removal

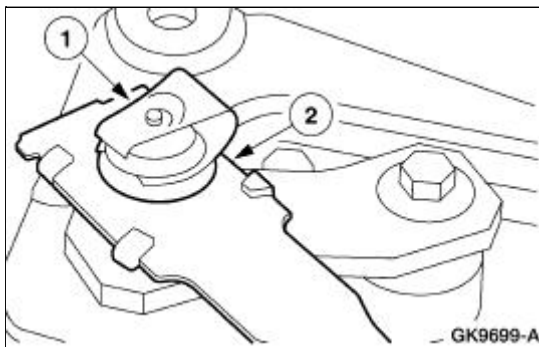
 **CAUTION:** The internal permanent magnets used in the windshield wiper motor are made of a glass-like material. To avoid damaging the magnets, do not strike the motor with a hammer or any other object.

NOTE: The windshield wiper motor is not a repairable item. If worn or damaged, install a new wiper motor.

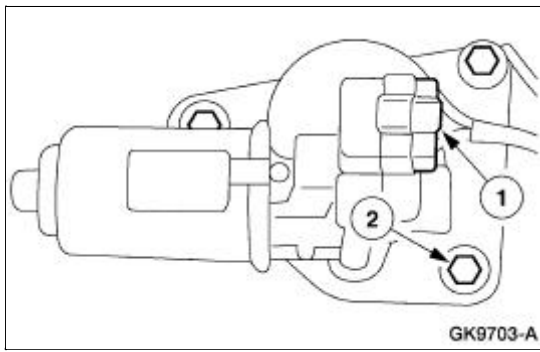
1. Park the windshield wipers in the full upright position. This will allow for easy access to the retaining clip on the wiper motor output shaft.



2. Remove the cowl top vent panels.
3. Disconnect the negative battery cable.
4. Disconnect the mounting arm and pivot shaft linkage from the wiper motor output shaft.
 1. Remove the clip.
 2. Disconnect the mounting arm and pivot shaft linkage.



5. Remove the wiper motor.
 1. Disconnect the electrical connector.
 2. Remove the bolts.

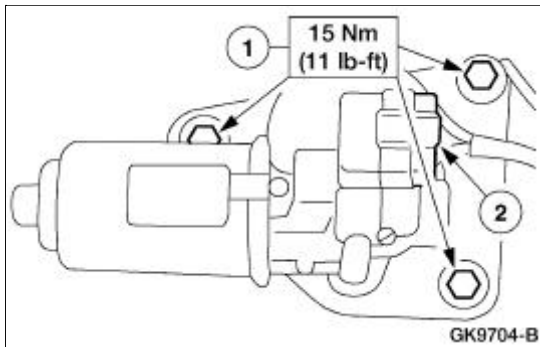


Installation

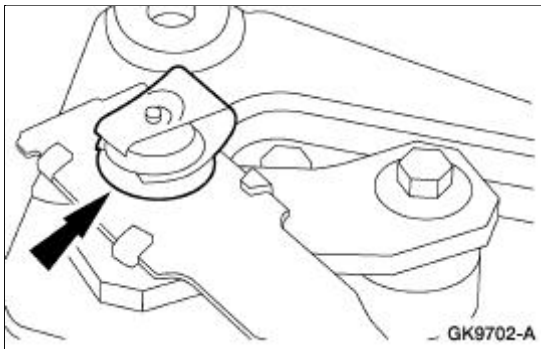
1. **NOTE:** Install the retaining clip onto the mounting arm and pivot shaft linkage prior to the installation of the wiper motor.

Install the wiper motor

1. Install the bolts.
2. Connect the electrical connector.



2. Snap the mounting arm and pivot shaft linkage onto the wiper motor output shaft.




3. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

Reconnect the negative battery cable.

4. Cycle the wiper motor to the park position.
5. Install the cowl top vent panels.
 - Adjust pivot arms as necessary. Refer to [Wiper Blade and Pivot Arm Adjustment](#) .

Washer Pump

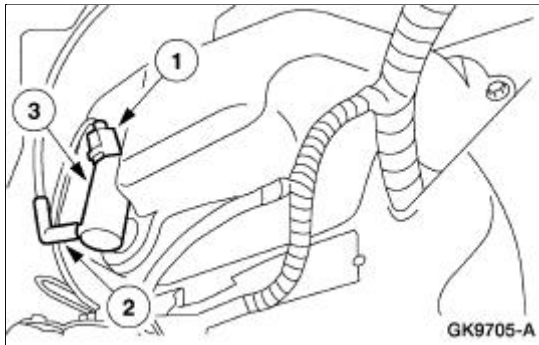
Removal

1. Remove the LF wheel and tire. Refer to [Section 204-04](#).
2. Position the front portion of the LF inner splash shield aside.
3.  **WARNING: Windshield washer solution contains methanol, which is poisonous. Observe all cautions and warnings indicated on label of washer solution container.**

NOTE: To prevent spilling windshield washer fluid, drain the windshield washer reservoir before removal.

Remove the washer pump.

1. Disconnect the electrical connector.
2. Disconnect washer hose from the washer pump.
3. Remove the washer pump.



Installation

1.  **WARNING: Windshield washer solution contains methanol, which is poisonous. Observe all cautions and warnings indicated on label of washer solution container.**


 **CAUTION: Do not operate the windshield washer pump prior to filling the windshield reservoir.**

To install, reverse the removal procedure.

- Fill the windshield washer reservoir.

Reservoir

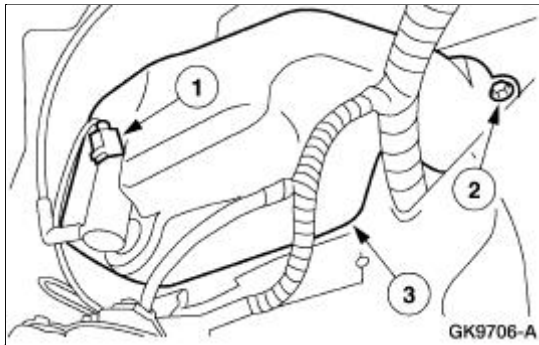
Removal

1. Remove the LF wheel and tire. Refer to [Section 204-04](#).
2. Position the front portion of the LF inner splash shield aside.
3.  **WARNING: Windshield washer solution contains methanol, which is poisonous. Observe all cautions and warnings indicated on label of washer solution container.**

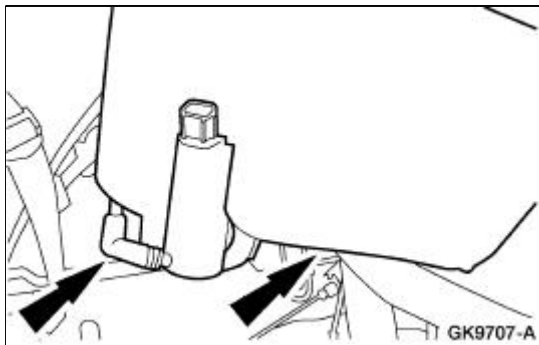
NOTE: To prevent spilling windshield washer fluid, drain the windshield washer reservoir before removal.

Position windshield washer reservoir aside.

1. Disconnect the electrical connector.
2. Remove the bolt.
3. Position windshield washer reservoir aside.



4. Remove the washer fluid reservoir.
 - Disconnect the windshield washer pump hose.



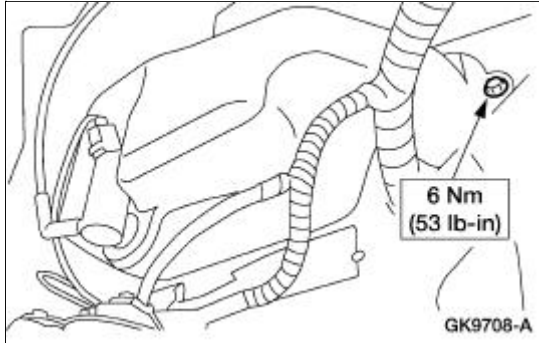
Installation

1.  **WARNING: Windshield washer solution contains methanol, which is poisonous. Observe all cautions and warnings indicated on label of washer solution container.**

 **CAUTION:** Do not operate the windshield washer pump prior to filling the windshield reservoir.

To install, reverse the removal procedure.

- Fill the windshield washer reservoir.



Module —Generic Electronic (GEM)

For additional information, refer to [Section 419-10](#).

Switch —Multi-Function

Removal and Installation

For additional information, refer to [Section 211-05](#).

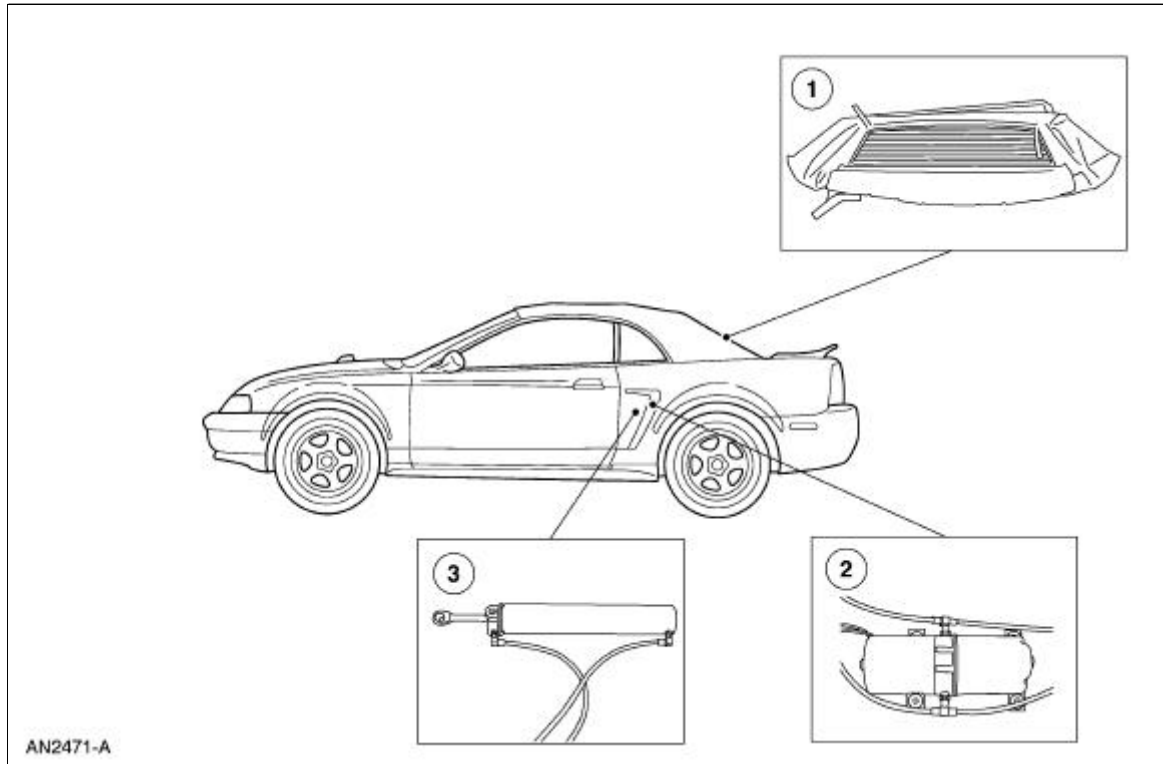
General Specifications

Item	Specification
Mercon® multi-purpose automatic transmission fluid XT-2-QDX	—

Torque Specifications

Description	Nm	lb-ft	lb-in
Cylinder mounting nut	23	17	—
Rail seal screws	3	—	27
Side rail bolts	63	46	—
Cylinder upper mounting bolt	17	13	—
Cylinder retaining bolts	22	16	—
Front safety belt retractor bolts and nut	30	20	—
Front seal screws	5	—	44
Cylinder rod mounting bolts	12	9	—
Side rail to header bolts	23	17	—
Tacking strip nuts	7	—	62
Hydraulic line to lift cylinder nuts	9	—	80
Hydraulic line to motor nuts	12	9	—
B-Hinge lock nut	4	—	35
Balance linkage bolts	22	16	—
Adjusting cam set screw	6	—	53

Convertible Top



Item	Part Number	Description
1	7652500	Rear glass assembly
2	76533A00	Motor assembly
3	011702	Lift cylinder with hydraulic lines

Rear Window Glass Assembly

The convertible top assembly is equipped with a rear window glass assembly. The rear window glass assembly is permanently attached to the folding top rear window curtain and cannot be opened. The rear window glass must be repaired separately.

Stay Pad

The stay pad is attached to the bows and is repaired as a component.


Hydraulic System

The convertible top hydraulic system is comprised of the lift cylinders, the motor, the connecting hydraulic lines and a convertible top switch. The hydraulic system, except for the convertible top switch, is removed as an assembly, but the components may be repaired separately.

Convertible Top

Refer to Wiring Diagrams Cell [103](#), for schematic and connector information.

Special Tool(s)

 <p>ST1137-A</p>	<p>73 III Automotive Meter 105-R0057 or equivalent</p>
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Principles of Operation

The convertible top will only operate with the parking brake engaged and the ignition switch in the RUN position. When the parking brake is engaged, the raise and lower relay coils are grounded through the parking brake switch. The convertible top switch supplies power to the raise or lower relay coil when raise or lower is selected. This power energizes the coil causing the relay contacts to close which supplies battery power to the convertible top motor/pump assembly. The normal state of the relay is connected to ground. When the raise or lower relay is operating, the other relay remains in its normal state supplying the motor/pump ground.

Convertible Top Adjustments

The convertible top adjustments must be made by a qualified technician.

Inspection and Verification

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> ● Convertible top brackets and frame ● Hydraulic motor and pump ● Hydraulic lift cylinders ● Door and quarter window glass adjustment 	<ul style="list-style-type: none"> ● Central junction box (CJB) Fuse 20 (15A) ● Battery junction box (BJB) circuit breaker CONV TOP (30A) ● Wiring harness ● Loose or corroded connections ● Raise or lower relays ● Parking brake switch ● Convertible top switch

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the concern is not visually evident, verify the symptom and refer to the Symptom Chart.

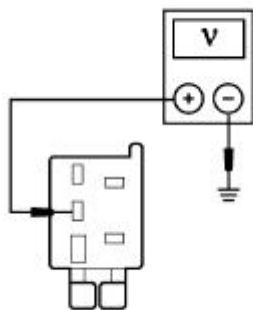
Symptom Chart

SYMPTOM CHART

Condition	Possible Sources	Action
<ul style="list-style-type: none"> The convertible top does not raise/lower 	<ul style="list-style-type: none"> Convertible top switch. Central junction box (CJB) Fuse 20 (15A). Parking brake switch. Lower relay. Raise relay. Circuitry. 	<ul style="list-style-type: none"> Go To Pinpoint Test A.
<ul style="list-style-type: none"> The convertible top hesitates/comes up uneven 	<ul style="list-style-type: none"> Convertible top adjustment. Hydraulic lift cylinders. Hydraulic system. 	<ul style="list-style-type: none"> Go To Pinpoint Test B.
<ul style="list-style-type: none"> The convertible top does not raise or does not go up all the way 	<ul style="list-style-type: none"> Convertible top adjustment. Hydraulic lift cylinders. Hydraulic system. 	<ul style="list-style-type: none"> Go To Pinpoint Test C.
<ul style="list-style-type: none"> The convertible top hydraulic system 	<ul style="list-style-type: none"> Convertible top adjustment. Hydraulic lift cylinders. Hydraulic motor/pump assembly. Hydraulic system. 	<ul style="list-style-type: none"> Go To Pinpoint Test D.

PINPOINT TEST A: THE CONVERTIBLE TOP DOES NOT RAISE/LOWER

Test Step	Result / Action to Take
<p>A1 CHECK THE CONVERTIBLE TOP OPERATION</p> <p>NOTE: The parking brake must be applied for the convertible top system to operate.</p> <ul style="list-style-type: none"> Key in ON position. Depress the convertible top switch in RAISE and LOWER positions while listening for motor operation. Does the convertible top motor assembly operate in both directions? 	<p>Yes Go To Pinpoint Test C.</p> <p>No GO to A2.</p>
<p>A2 CHECK THE POWER SUPPLY TO THE CONVERTIBLE TOP SWITCH</p> <ul style="list-style-type: none"> Key in OFF position. Disconnect: Convertible Top Switch C3115. Key in ON position. Measure the voltage between convertible top switch C3115 pin 4, circuit 296 (WH/PK), harness side and ground. 	<p>Yes GO to A3.</p> <p>No REPAIR circuit 296 (WH/PK). TEST the system for normal operation.</p>



AN1558-A

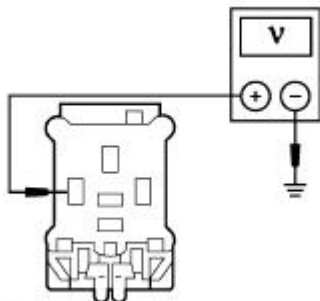
- Is the voltage greater than 10 volts?

A3 CHECK CIRCUIT 588 (VT) FOR AN OPEN

- Key in OFF position.
- Connect: Convertible Top Switch C3115.
- Disconnect: Raise Relay C4063.
- Key in ON position.
- Depress and hold the convertible top switch in the RAISE position.
- Measure the voltage between raise relay C4063 pin 85, circuit 588 (VT), harness side and ground.

Yes
GO to [A4](#).

No
GO to [A5](#).



AN1562-A

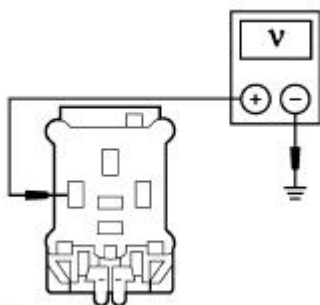
- Is the voltage greater than 10 volts?

A4 CHECK CIRCUIT 688 (GY/LB) FOR VOLTAGE

- Key in OFF position.
- Disconnect: Lower Relay C4064.
- Key in ON position.
- Depress and hold the convertible top switch in the LOWER position.
- Measure the voltage between lower relay C4064 pin 85, circuit 688 (GY/LB), harness side and ground.

Yes
GO to [A9](#).

No
GO to [A8](#).



AN1562-A

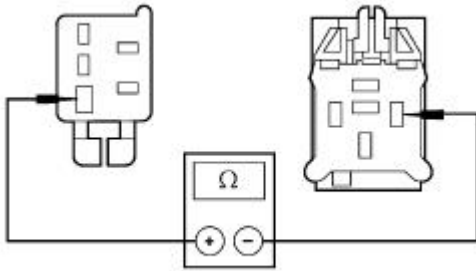
- Is the voltage greater than 10 volts?

A5 CHECK CIRCUIT 588 (VT) FOR OPEN

- Key in OFF position.
- Disconnect: Convertible Top Switch C3115.
- Measure the resistance between convertible top switch C3115 pin 3, circuit 588 (VT), harness side and raise relay C4063 pin 85,

Yes
INSTALL a new convertible top switch. REFER to [Convertible](#)

circuit 588 (VT), harness side.



GA6011-A

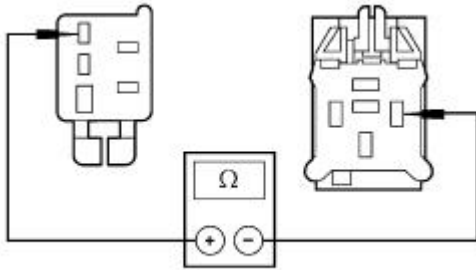
- Is the resistance less than 5 ohms?

[Top Switch](#) in this section. TEST the system for normal operation.

No
REPAIR Circuit 588 (VT). TEST the system for normal operation.

A6 CHECK CIRCUIT 688 (GY/LB) FOR OPEN

- Key in OFF position.
- Disconnect: Convertible Top Switch C3115.
- Measure the resistance between convertible top switch C3115 pin 5, circuit 688 (GY/LB), harness side and lower relay C4064 pin 85, circuit 688 (GY/LB), harness side.



GA6012-A

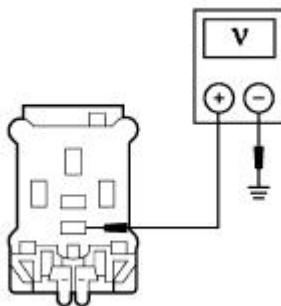
- Is the resistance less than 5 ohms?

Yes
INSTALL a new convertible top switch. REFER to [Convertible Top Switch](#) in this section. TEST the system for normal operation.

No
REPAIR circuit 688 (GY/LB). TEST the system for normal operation.

A7 CHECK THE BATTERY SUPPLY TO THE RELAYS

- Measure the voltage between raise relay C4063 pin 87, circuit 170 (RD/LB), harness side and ground; and between lower relay C4064 pin 87, circuit 170 (RD/LB), harness side and ground.



AN1563-A

- Are the voltages greater than 10 volts?

Yes
GO to [A8](#).

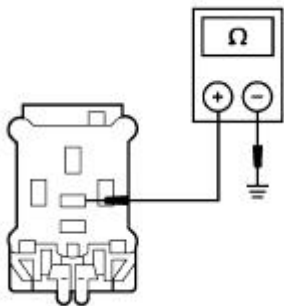
No
REPAIR circuit 170 (RD/LB). TEST the system for normal operation.

A8 CHECK CIRCUIT 1205 (BK) FOR AN OPEN

- Key in OFF position.
- Measure the resistance between raise relay C4063 pin 87A, circuit 1205 (BK), harness side and ground; and between lower relay C4064 pin 87A, circuit 1205 (BK), harness side and ground.

Yes
GO to [A9](#).

No
REPAIR the circuit. TEST the system for normal operation.



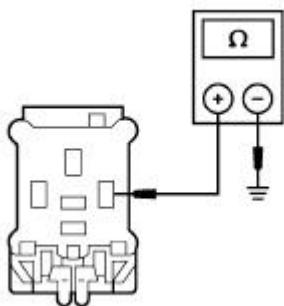
AN1565-A

- Are the resistances greater than 10,000 ohms?

A9 CHECK FOR PARKING BRAKE GROUND

- Measure the resistance between raise relay C4063 pin 86, circuit 977 (VT/WH), harness side and ground; and between lower relay C4064 pin 86, circuit 977 (VT/WH), harness side and ground.

Yes
GO to [A11](#). **Yes**
GO to [A10](#).



AN1566-A

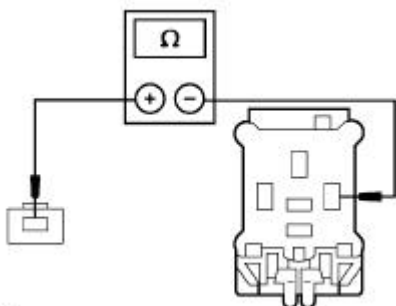
- Are the resistances less than 5 ohms?

A10 CHECK THE PARKING BRAKE SWITCH

- Disconnect: Parking Brake Switch C306.
- Measure the resistance between raise relay C4063 pin 86, circuit 977 (VT/WH), harness side and parking brake switch C306, circuit 22 (LB/BK), harness side; and between lower relay C4064 pin 86, circuit 977 (VT/WH), harness side and parking brake switch C306, circuit 22 (LB/BK), harness side.

Yes
INSTALL a new parking brake switch. REFER to [Section 206-05](#). TEST the system for normal operation.

No
REPAIR the circuit in question. TEST the system for normal operation.



AN1567-A

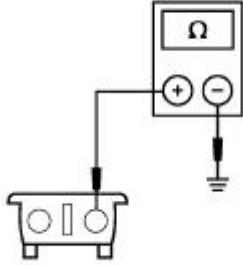
- Are the resistances less than 5 ohms?

A11 CHECK THE CONVERTIBLE TOP MOTOR LOWER CIRCUIT

- Connect: Raise Relay C4063.
- Connect: Lower Relay C4064.
- Disconnect: Convertible Top Motor C4062.
- Measure the resistance between convertible top motor C4062, circuit 902 (YE), harness side and ground.

Yes
GO to [A13](#).

No
GO to [A12](#).

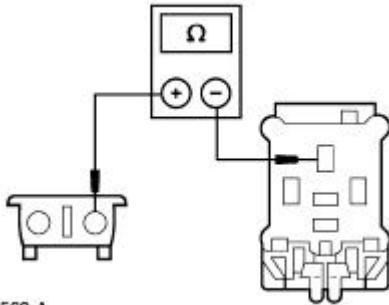


AN1568-A

- Is the resistance less than 5 ohms?

A12 CHECK CIRCUIT 902 (YE) FOR AN OPEN

- Disconnect: Lower Relay C4064.
- Measure the resistance between lower relay C4064 pin 30, circuit 902 (YE), harness side and convertible top motor C4062, circuit 902 (YE), harness side.



AN1569-A

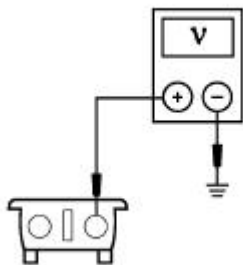
- Is the resistance less than 5 ohms?

Yes
INSTALL a new lower relay. TEST the system for normal operation.

No
REPAIR the circuit. TEST the system for normal operation.

A13 CHECK THE LOWER INPUT TO THE MOTOR

- Key in ON position.
- Measure the voltage between convertible top motor C4062, circuit 902 (YE), harness side and ground.



AN1570-A

- Depress and hold the convertible top switch in the LOWER position.
- Is the voltage greater than 10 volts?

Yes
GO to [A14](#).

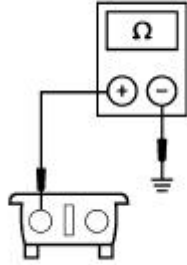
No
INSTALL a new lower relay. TEST the system for normal operation.

A14 CHECK THE CONVERTIBLE TOP MOTOR RAISE CIRCUIT

- Key in OFF position.
- Measure the resistance between convertible top motor C4062, circuit 903 (RD), harness side and ground.

Yes
GO to [A16](#).

No
GO to [A15](#).

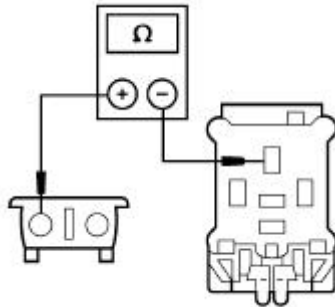


AN1571-A

- Is the resistance less than 5 ohms?

A15 CHECK CIRCUIT 903 (RD) FOR AN OPEN

- Disconnect: Raise Relay C4063.
- Measure the resistance between raise relay C4063 pin 30, circuit 903 (RD), harness side and convertible top motor C4062, circuit 903 (RD), harness side.



AN1572-A

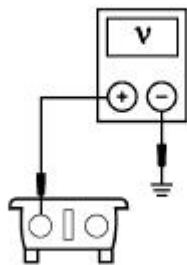
- Is the resistance less than 5 ohms?

Yes
INSTALL a new raise relay. TEST the system for normal operation.

No
REPAIR the circuit. TEST the system for normal operation.

A16 CHECK THE RAISE INPUT TO THE MOTOR

- Key in ON position.
- Depress and hold the convertible top switch in the RAISE position.
- Measure the voltage between convertible top motor C4062, circuit 903 (RD), harness side and ground.



AN1573-A

- Is the voltage greater than 10 volts?

Yes
INSTALL a new convertible top motor; REFER to [Hydraulic System, Lift Cylinder and Motor](#) in this section. TEST the system for normal operation.

No
INSTALL a new raise relay. TEST the system for normal operation.

PINPOINT TEST B: THE CONVERTIBLE TOP HESITATES/COMES UP UNEVEN

Test Step	Result / Action to Take
B1 CHECK THE CONVERTIBLE TOP UP/DOWN OPERATION	
NOTE: The parking brake must be applied for the	Yes

<p>convertible top system to operate.</p> <ul style="list-style-type: none"> ● Key in ON position. ● Actuate the convertible top switch to the LOWER and RAISE positions. ● Did the convertible top operate to the full down and full up position without hesitating? 	<p>ADJUST the convertible top linkage. TEST the system for normal operation.</p> <p>No GO to B2.</p>
B2 CHECK THE MOTOR OPERATION	
<ul style="list-style-type: none"> ● Gain access to the convertible top motor/pump assembly. ● Operate the convertible top to the LOWER and RAISE positions while listening to the motor. ● Did the motor stop and then continue at any time? 	<p>Yes Go To Pinpoint Test A.</p> <p>No GO to B3.</p>
B3 CHECK THE CONVERTIBLE TOP LINKAGE	
<ul style="list-style-type: none"> ● Operate the convertible top to the LOWER and RAISE positions while observing the convertible top linkage. ● Did the linkage operate smoothly without binding? 	<p>Yes Go To Pinpoint Test D.</p> <p>No ADJUST the convertible top linkage. TEST the system for normal operation.</p>

PINPOINT TEST C: THE CONVERTIBLE TOP DOES NOT RAISE OR DOES NOT GO UP ALL THE WAY

Test Step	Result / Action to Take
C1 CHECK THE CONVERTIBLE TOP OPERATION	
<p>NOTE: The parking brake must be applied for the convertible top system to operate.</p> <ul style="list-style-type: none"> ● Key in ON position. ● Actuate the convertible top switch to the RAISE position. ● Did the motor operate? 	<p>Yes GO to C2.</p> <p>No Go To Pinpoint Test A.</p>
C2 CHECK THE CONVERTIBLE TOP LINKAGE	
<ul style="list-style-type: none"> ● Operate the convertible top to the LOWER and RAISE positions while observing the convertible top linkage. ● Did the linkage bind and prevent the convertible top from raising? 	<p>Yes ADJUST the convertible top linkage. TEST the system for normal operation.</p> <p>No Go To Pinpoint Test D.</p>

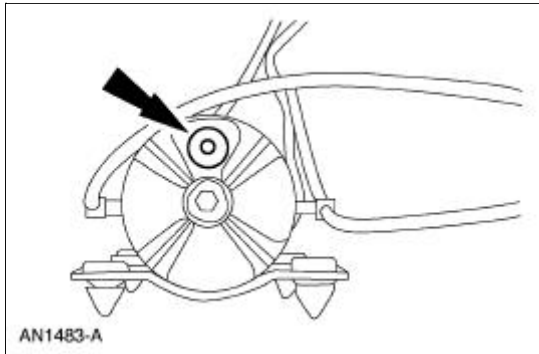
PINPOINT TEST D: THE CONVERTIBLE TOP HYDRAULIC SYSTEM

Test Step	Result / Action to Take
D1 CHECK THE FLUID LEVEL	
<p>NOTE: The fluid level should be even with the bottom of the filler plug hole.</p> <p>NOTE: Place an absorbent cloth below the filler plug when checking the fluid level.</p> <ul style="list-style-type: none"> ● Remove the filler plug and check the 	<p>Yes GO to D3.</p> <p>No GO to D2.</p>

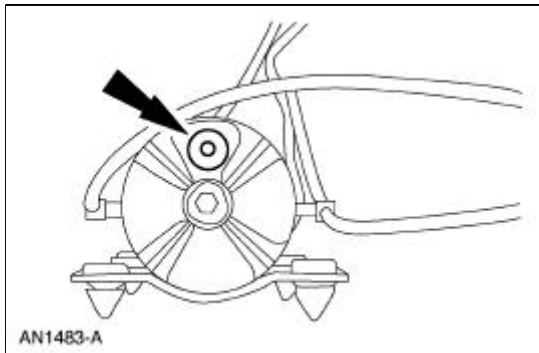
<p>fluid level.</p> <ul style="list-style-type: none"> ● Is the fluid level OK? 	
<p>D2 CHECK THE HYDRAULIC SYSTEM FOR LEAKS</p>	
<ul style="list-style-type: none"> ● Inspect all fittings and hoses for leaks. ● Are any leaks noticed? 	<p>Yes REPAIR the leaking fittings or INSTALL new hoses as necessary. TEST the system for normal operation.</p> <p>No GO to D3.</p>
<p>D3 BLEED THE HYDRAULIC SYSTEM</p>	
<ul style="list-style-type: none"> ● Bleed the hydraulic system. Refer to System Bleeding in this section. ● Does the system operate correctly after bleeding? 	<p>Yes OPERATE the convertible top up and down three times. INSPECT the hydraulic system for leaks or loss of fluid. REPAIR as necessary if loss of fluid is detected.</p> <p>No GO to D4.</p>
<p>D4 CHECK THE CONVERTIBLE TOP</p>	
<ul style="list-style-type: none"> ● Remove the hydraulic system from the vehicle. Refer to Hydraulic System, Lift Cylinder and Motor in this section. ● Operate the convertible top assembly up and down manually. ● Does the convertible top bind? 	<p>Yes ADJUST the convertible top. INSTALL the hydraulic system; REFER to Hydraulic System, Lift Cylinder and Motor in this section. TEST the system for normal operation.</p> <p>No GO to D5.</p>
<p>D5 CHECK THE HYDRAULIC SYSTEM OUT OF THE VEHICLE</p>	
<ul style="list-style-type: none"> ● Bleed the hydraulic system. Refer to System Bleeding in this section. ● Does the system operate correctly after bleeding? 	<p>Yes CHECK all fittings and hoses for leaks. REPAIR as necessary if loss of fluid is detected. INSTALL the hydraulic system; REFER to Hydraulic System, Lift Cylinder and Motor in this section. TEST the system for normal operation.</p> <p>No GO to D6.</p>
<p>D6 CHECK THE LIFT CYLINDERS</p>	
<ul style="list-style-type: none"> ● Operate the hydraulic system using a 12 volt power source. ● Did the lift cylinders extend and retract? 	<p>Yes INSTALL a new motor/pump assembly. REFER to Hydraulic System, Lift Cylinder and Motor in this section. TEST the system for normal operation.</p> <p>No INSTALL a new lift cylinder. REFER to Hydraulic System, Lift Cylinder and Motor in this section. TEST the system for normal operation.</p>

System Bleeding

1. If required, remove the hydraulic system from the vehicle. Refer to [Hydraulic System, Lift Cylinder and Motor](#) in this section.
2. Remove the fill plug at the end of the hydraulic pump.



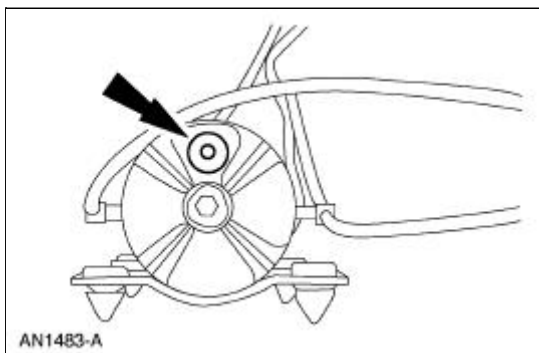
3. Fill the pump with Mercon® Multi-Purpose Automatic Transmission Fluid XT-2-QDX or equivalent to the bottom of the fill hole and install the fill plug.



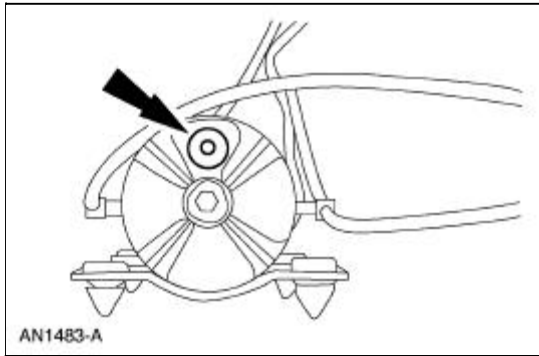
4. **NOTE:** Some noise squeal may be noticed due to the air in the system.

Connect a 12-volt power source to the motor connector and operate the motor until the cylinders are fully extended. Reverse the 12-volt connection to fully retract the cylinders. Repeat this procedure three times.

5. Remove the fill plug and check the fluid level. Fill the pump with MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX or equivalent to the bottom of the fill hole.



6. Install a fill plug.



7. Install the hydraulic system in the vehicle. Refer to [Hydraulic System, Lift Cylinder and Motor](#) in this section.
-

Linkage Adjustment

Material

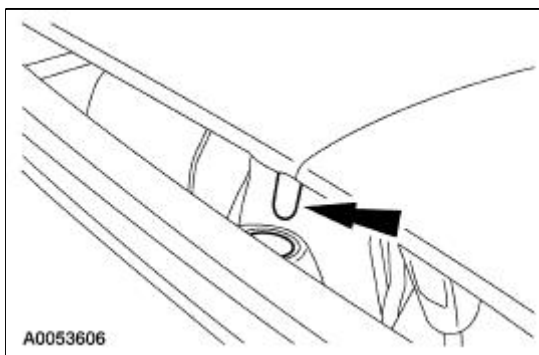
Item	Specification
Threadlock and Sealer E0AZ-19554-AA	WSK-M2G351-A5 (type II)
Shoulder Bolt Kit F5ZZ-76539A04-A	—

NOTE: Before starting the adjustment process, inspect the top for damage, make sure that the door window glass and rear quarter glass are correctly adjusted then completely lower all window glass.

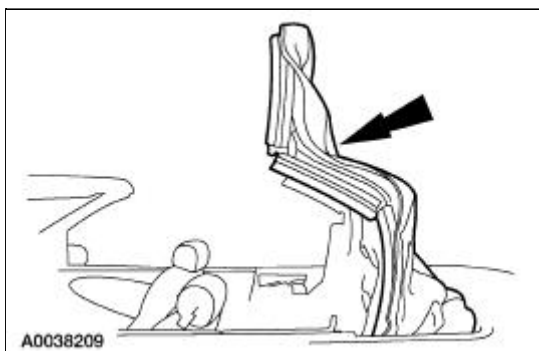
NOTE: After each adjustment make sure the convertible top operates correctly.

The Convertible Top Dowel Pins Fall Forward (Overshoot) or Rearward (Undershoot). The Receiver Cups — Cam Bolt Adjustment.

1. Remove the quarter trim panel. For additional information, refer to [Section 501-05](#).
2. Close the convertible top and examine the position of the dowel pins relative to the receiver cups.



3. Move the convertible top to the half-open position to access the cam bolt.



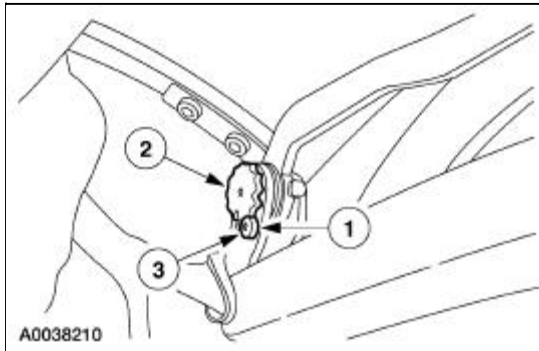
4. **NOTE:** Rotating the top of the cam bolt toward the front of the vehicle will lengthen the top, increase the tension on the top and increase pull-down effort. Rotating the cam bolt in the

opposite direction will have the opposite effect.

NOTE: Turn the adjusting cam one notch at a time.

Adjust the adjusting cam as needed.

1. Remove the cam stop set screw.
2. Rotate the adjusting cam.
3. Install the cam stop set screw.

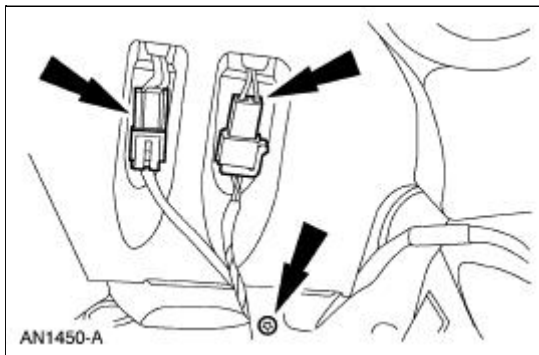


5. Make sure the convertible top operate correctly.
6. Install the quarter trim panel. For additional information, refer to [Section 501-05](#).
7. Close the convertible top.

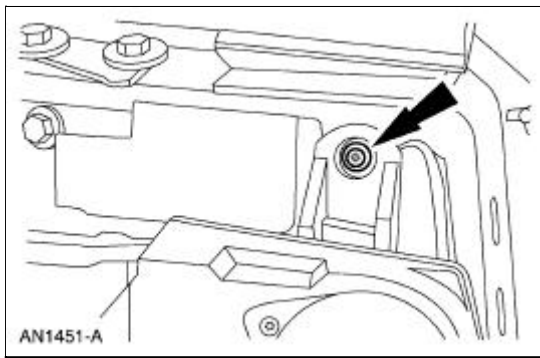
Convertible Top Lifts Up Unevenly — Lift Cylinder and C-pivot Inspection

8. Remove the quarter trim panel. For additional information, refer to [Section 501-05](#).
9. **NOTE:** This step applies to vehicles equipped with the Mach sound system.

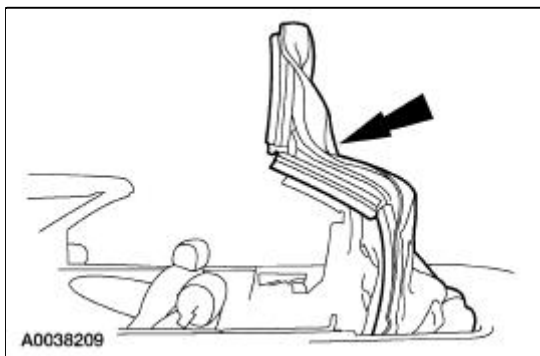
Remove the screws and disconnect the electrical connectors.



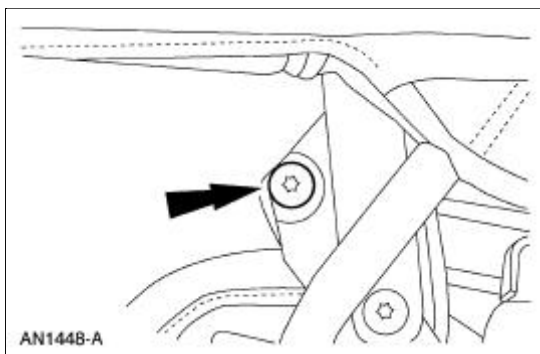
10. Remove the screws.



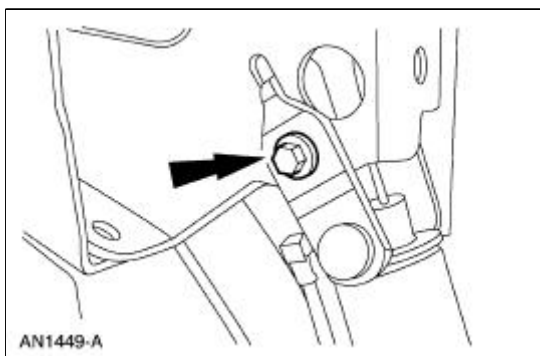
11. Remove the speakers. For additional information, refer to [Section 415-03](#).
12. Move the convertible top to the half-open position and support the convertible top in that position.



13. Remove the lift cylinder rod mounting bolts.



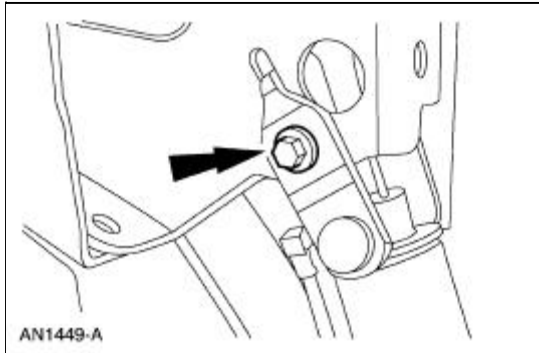
14. Remove the nuts and support the lift cylinders.



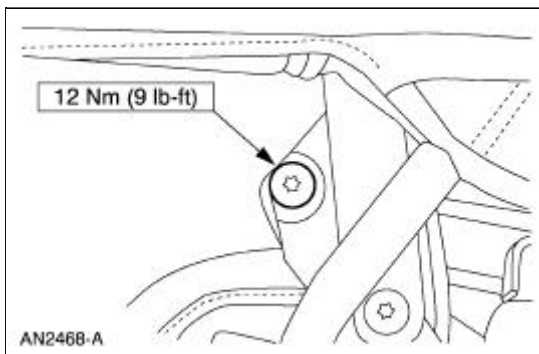
15. Using the convertible top switch, retract the lift cylinder rods and check for bent or binding rods.

If one rod bottoms out 25mm (1 inch) or more before the other, the lagging lift cylinder may be bent and will need to be replaced.

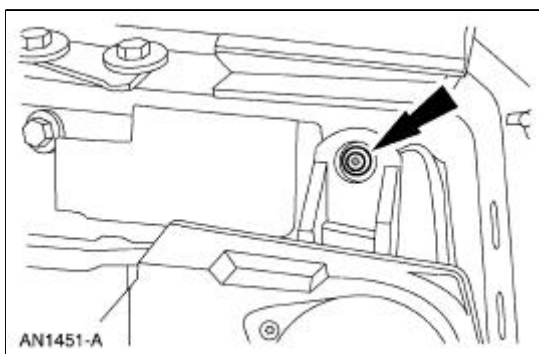
16. With the lift cylinder rods retracted, manually lower the convertible top.
17. Manually lift each side rail 7.5-10 cm (3-4 inches) to check for obvious binding. Side arms should have equal resistance, side-to-side. If the resistance is noted, loosen the clamp load of the c-pivot rivet with using a center pinch. If a dramatic resistance is still noted replace the c-pivot rivet with shoulder bolt kit (F5ZZ-76539A04-A).
18. Position the lift cylinders and install the nuts.



19. Install the two cylinder rod mounting bolts.

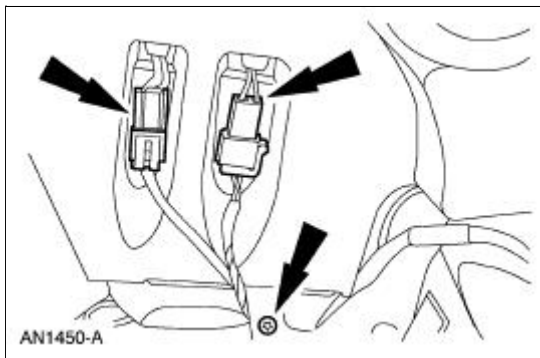


20. Install the speakers. For additional information, refer to [Section 415-03](#).
21. Install the screws.



NOTE: This step applies to vehicles equipped with the Mach sound system.

22. Install the screws and connect the electrical connectors.



23. Install the quarter trim panel. For additional information, refer to [Section 501-05](#).
24. Make sure the convertible top operate correctly.
25. Close the convertible top.

Convertible Top No. 1 Bow is Not Flush to the Header — Balance Link Adjustment.



CAUTION: Over adjustment of the balance link can cause the convertible top to bind up in the convertible top well.

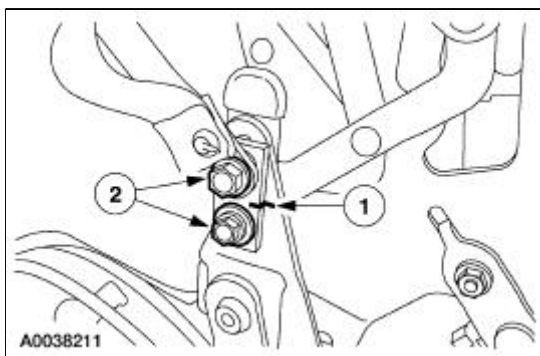


CAUTION: If the balance link is raised the B-hinge must be adjusted to keep the door window glass from striking the convertible top, preventing the door from closing.

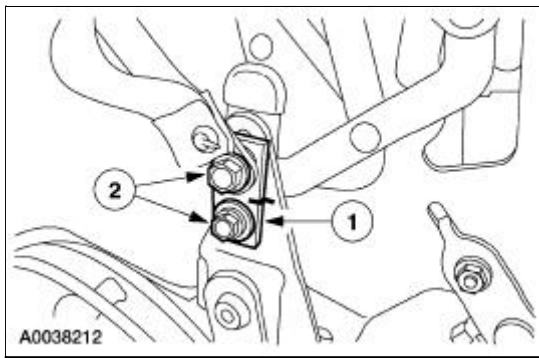
26. Remove the quarter trim panel. For additional information, refer to [Section 501-05](#).

NOTE: Lowering the balance link will raise the No. 1 bow position to the vehicle header and increase the pull down effort. Raising the balance link will lower the No. 1 bow to the header of the vehicle and decrease the pull-down effort.

27. Adjust the balance link assembly.
 1. Scribe a mark on the balance link.
 2. Loosen the bolts.



28. Tighten the balance link assembly.
 1. Move the balance link assembly.
 2. Tighten the bolts.



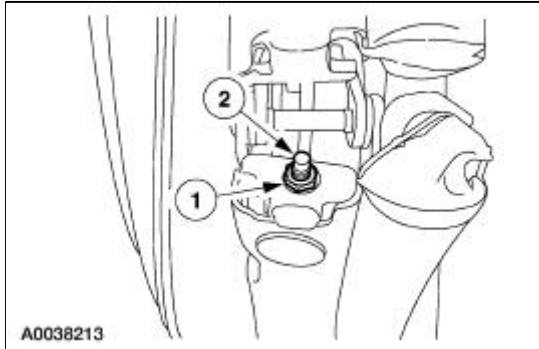
29. Make sure the convertible top operates correctly.
30. Install the quarter trim panel. For additional information, refer to [Section 501-05](#).
31. Close the convertible top.

Convertible Top Appears Low at the Center of the Door Window Glass — B-hinge Adjustment

32. Remove the quarter trim panel. For additional information, refer to [Section 501-05](#).

NOTE: If the B-hinge set screw is adjusted to raise or lower the B-hinge, inspect the header height, top pull down and dowl and receiver clearance. Adjust the cam bolt and balance link as necessary.

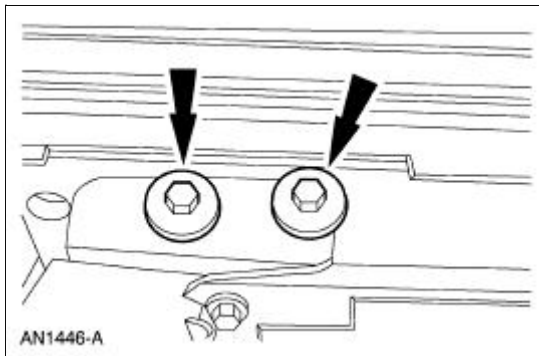
33. Tighten the lock nut.
 - Use Threadlock and sealer on the lock nut.



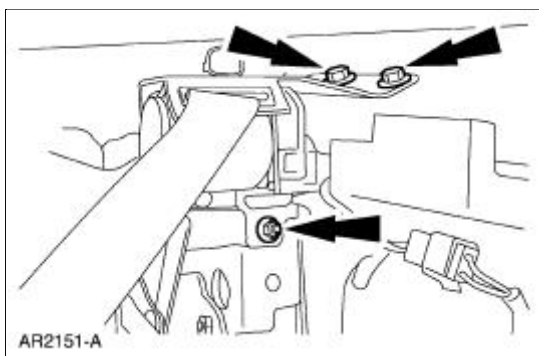
34. Tighten the lock nut.
 - Threadlock and sealer on the lock nut.
 35. Make sure the convertible top operate correctly.
 36. Install the quarter trim panel. For additional information, refer to [Section 501-05](#).
 37. Close the convertible top.
-

Convertible Top Assembly —Side Rail, Folding Top

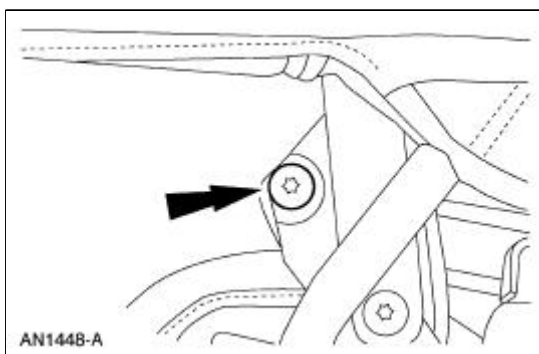
1. Remove the side quarter trim panel. For additional information, refer to [Section 501-05](#).
2. If necessary, remove the bolts.



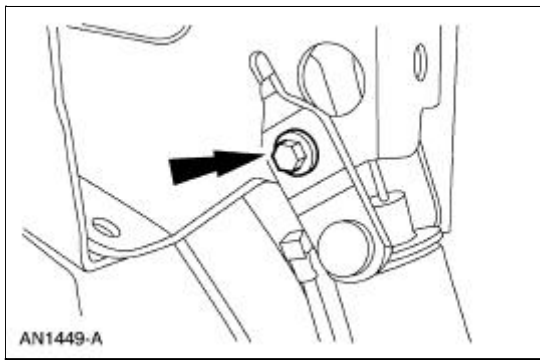
3. Remove the nut and bolts and position the front safety belt retractor aside.



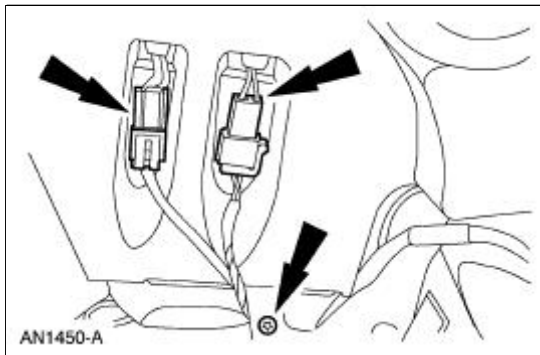
4. Remove the two cylinder rod mounting bolts.



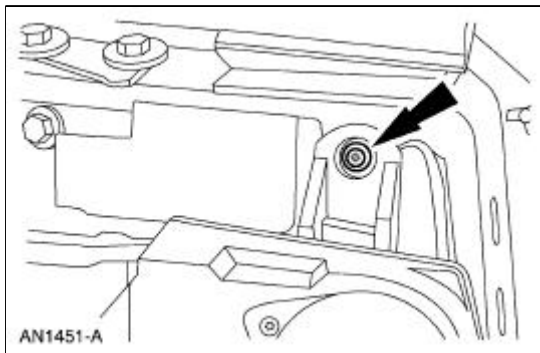
5. Remove the cylinder rod mounting nut.



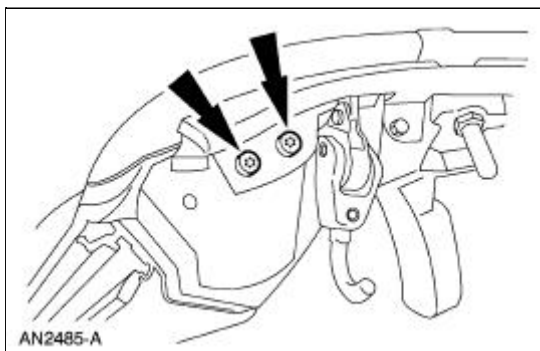
6. Remove the screw and disconnect the two electrical connectors.



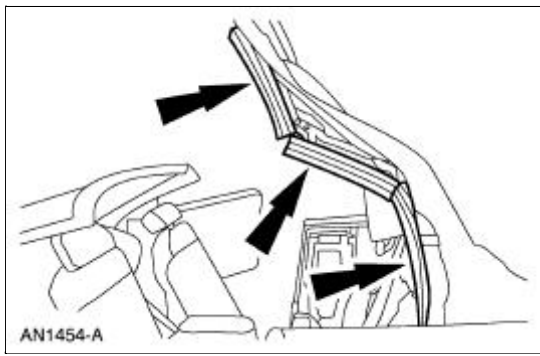
7. Remove the screw.



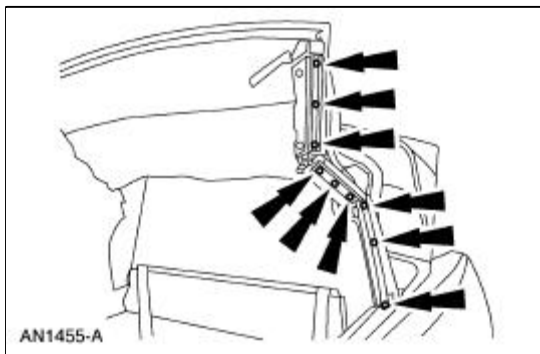
8. Remove the speaker.
9. Remove the screws and the front seal.



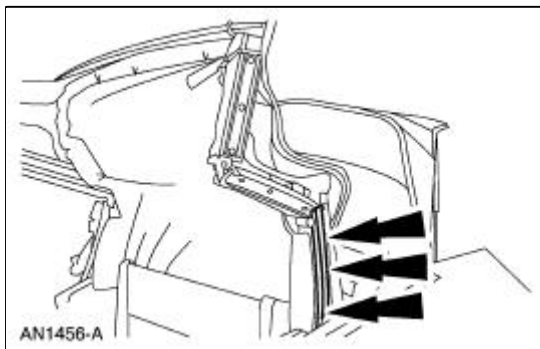
10. Remove the rail seals.



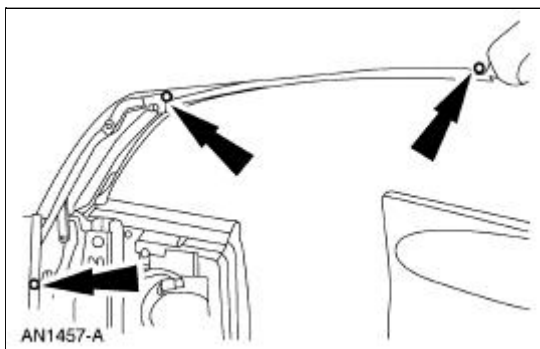
11. Remove the rail seal retainers.



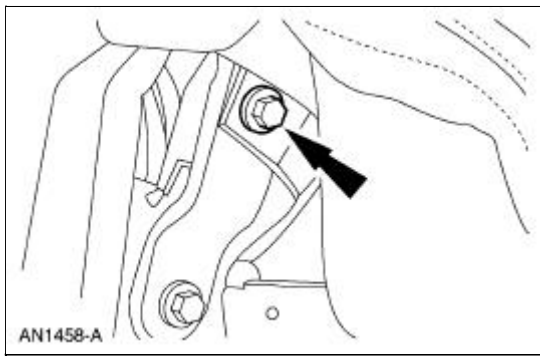
12. Remove the headliner pin-type retainers.



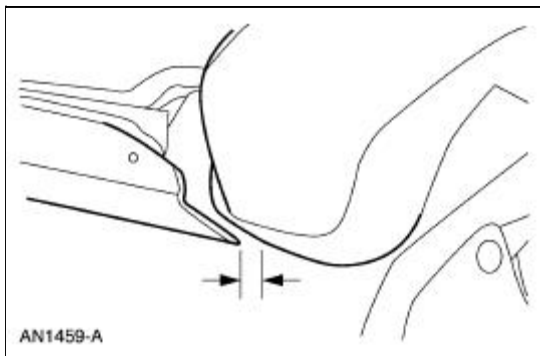
13. Remove the headliner screws.



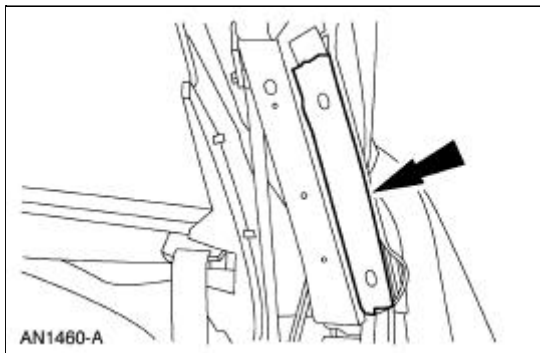
14. Remove the speed nut.



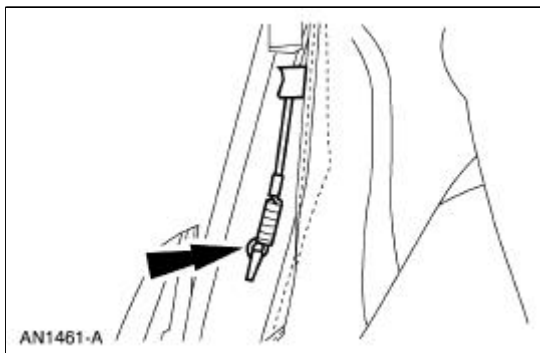
15. Measure the gap between the front of the side rail and the header. Record the figure and the position of the folding top.



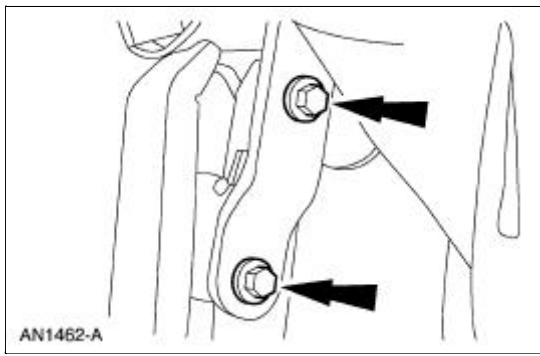
16. Separate the vinyl top cover flap from the rear rail.



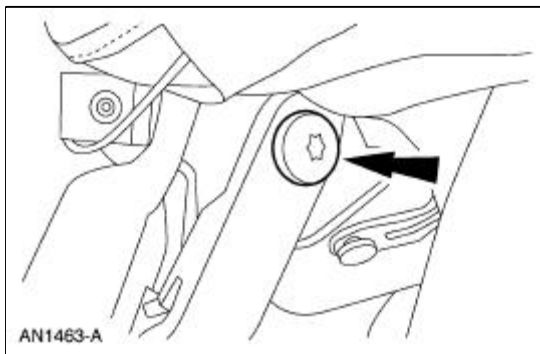
17. Disconnect the side tension cable from the rear rail.



18. Remove the two bolts.



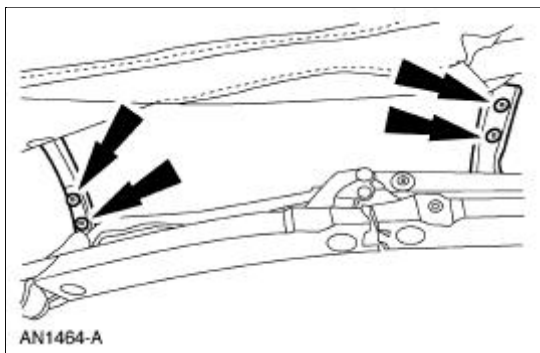
19. Loosen the bolt, but do not remove it.



20. **NOTE:** Do not latch the folding top after re-positioning.

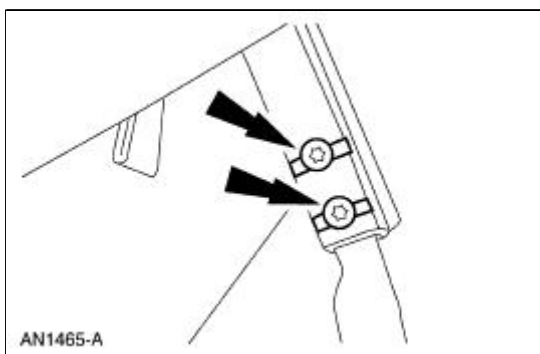
Position the folding top in the full up position.

21. Disconnect the number two and number three bows from the side rail assembly.

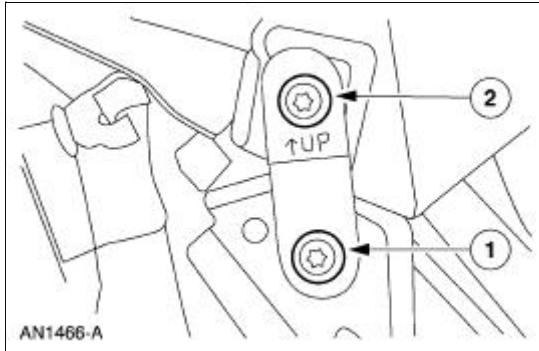


22. **NOTE:** Mark the centerline locations for the number four bow screws.

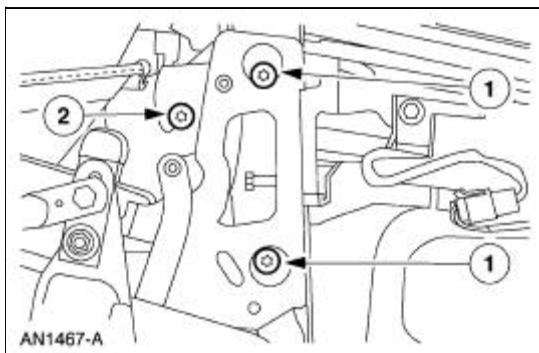
Remove the screws.



23. Disconnect the mounting bracket.
 1. Loosen the bottom bolt.
 2. Remove the upper bolt.

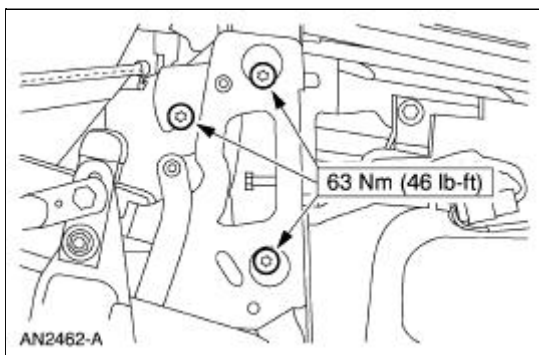


24. Remove the side rail.
 1. Remove the two bolts.
 2. Loosen the bolt.



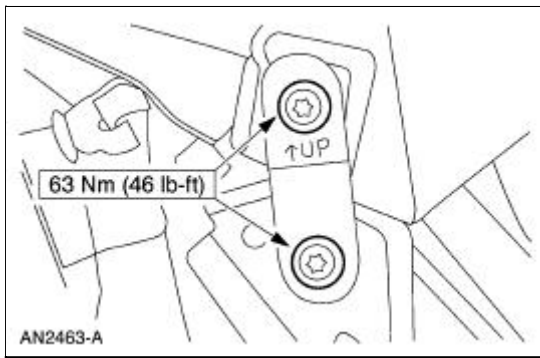
Installation

1. Position the side rail and install the bolts.



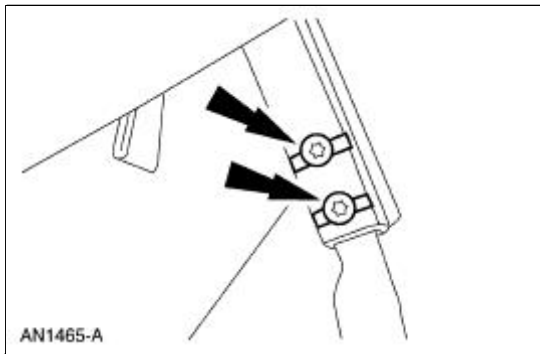
2. **NOTE:** Tighten the bottom bolt first.

Connect the mounting bracket and install the bolts.

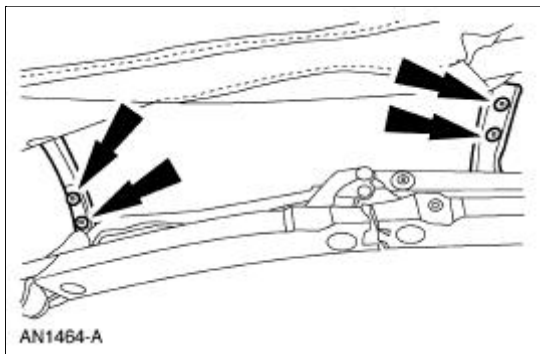


3. **NOTE:** Line up the marks in the number four bow.

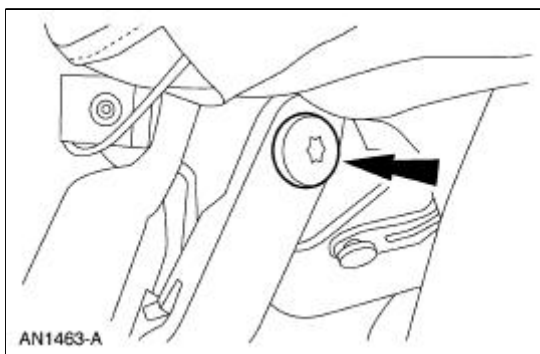
Tighten the bolt.



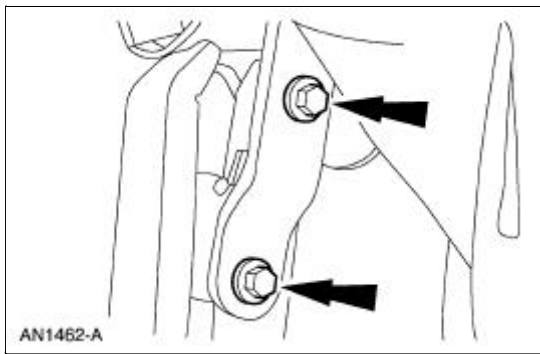
4. Connect the number two and number three bows to the side rail assembly.



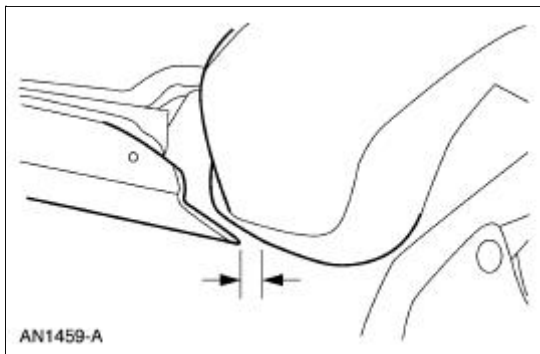
5. Tighten the bolt.



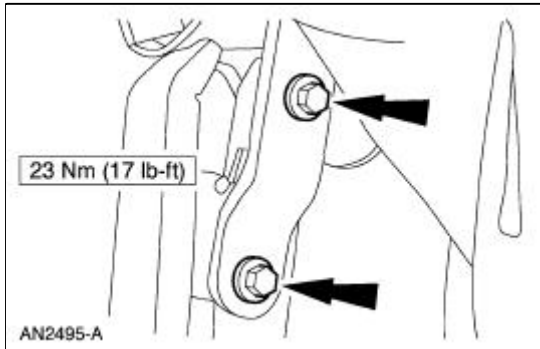
6. Hand-tighten the two bolts.



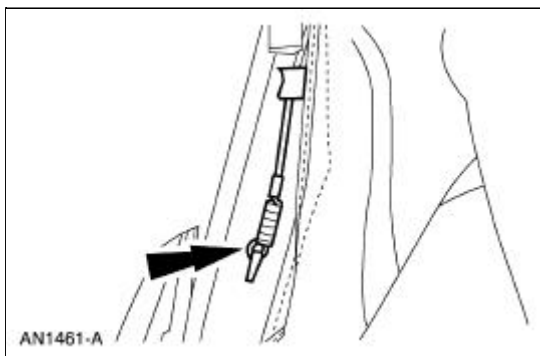
7. Adjust the gap between the front of the side rail and the header to the previously recorded dimensions.



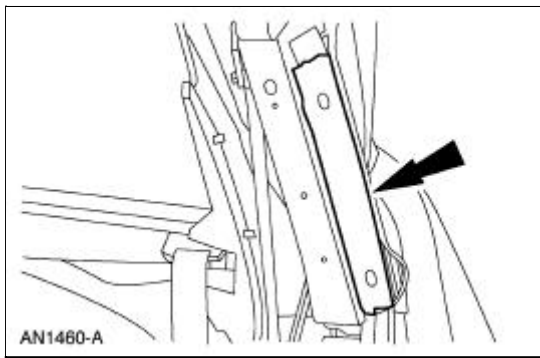
8. Tighten the bolts.



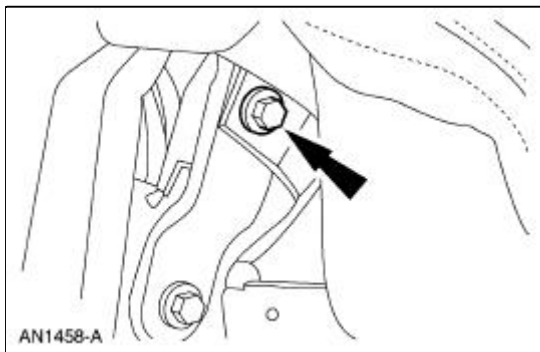
9. Connect the cable to the rear rail.



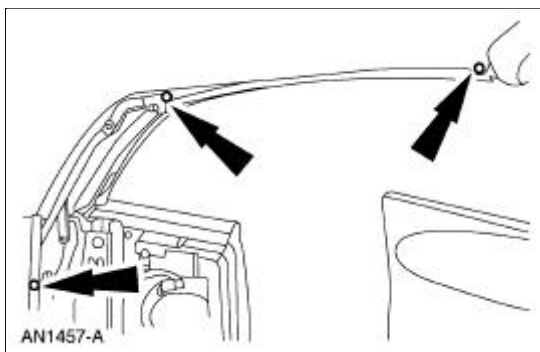
10. Attach the vinyl top cover flap to the rear rail.



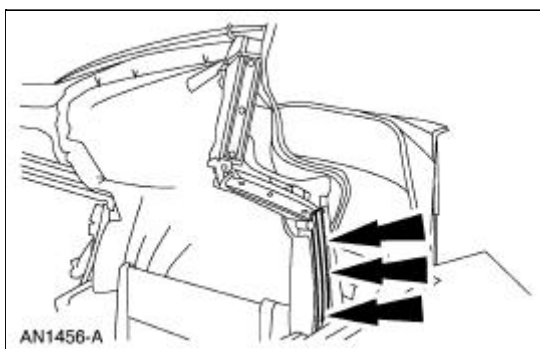
11. Install the speed nut.



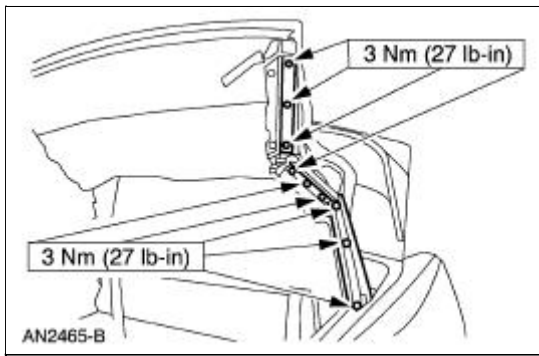
12. Install the headliner screws.



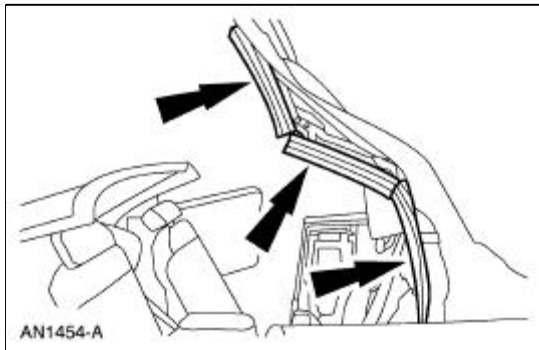
13. Attach the headliner pin-type retainers.



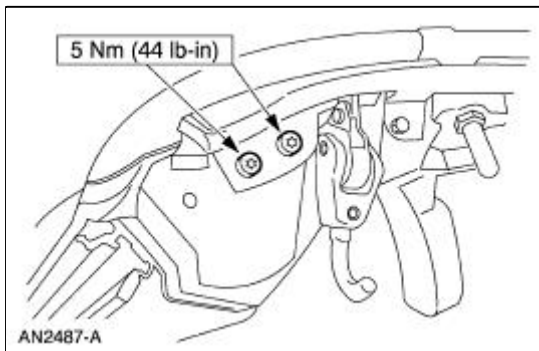
14. Install the rail seal screws.



15. Install the rail seals.

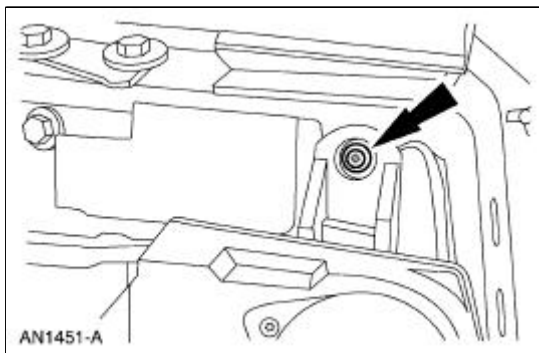


16. Install the screws and the front seal.

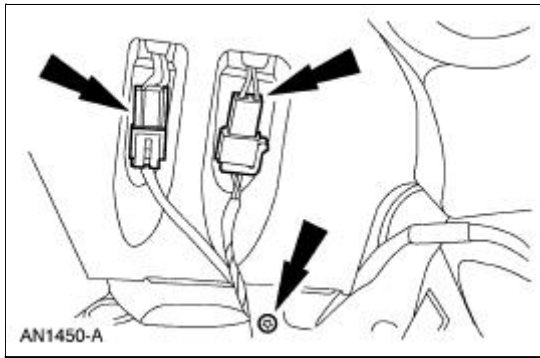


17. Install the speaker.

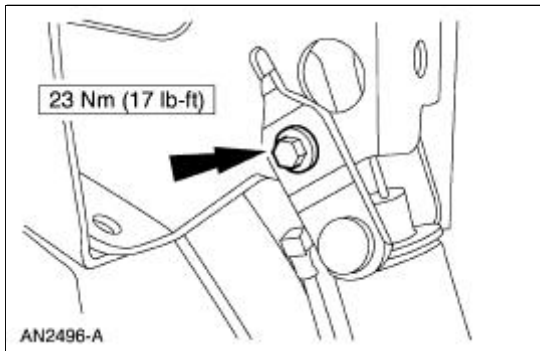
18. Install the screw.



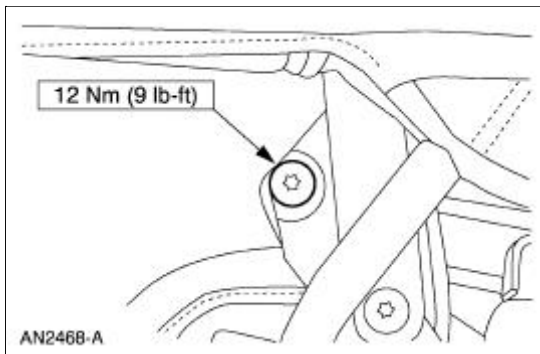
19. Install the screw and connect the electrical connectors.



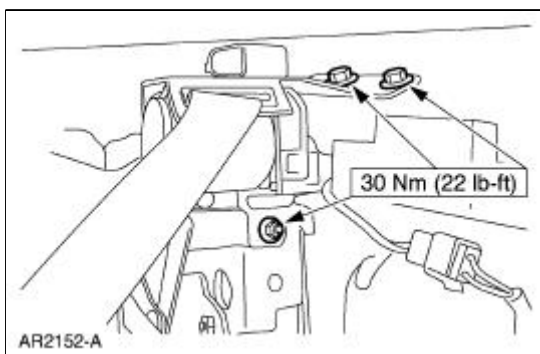
20. Position the cylinders and install the nuts.



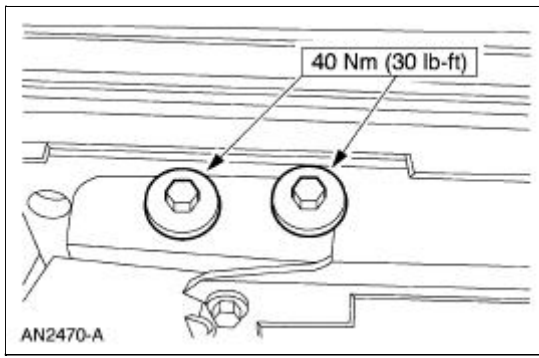
21. Install the two cylinder rod mounting bolts.



22. Install the front safety belt retractor.



23. Install the bolts.

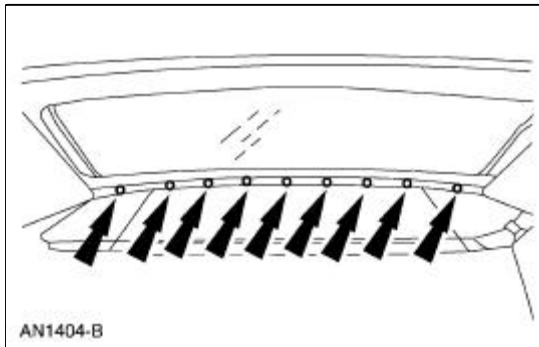


24. Install the side quarter trim panel. For additional information, refer to [Section 501-05](#).
-

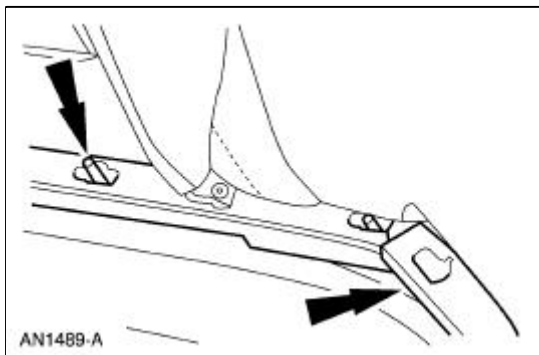
Convertible Top Assembly —Rear Window Glass

Removal

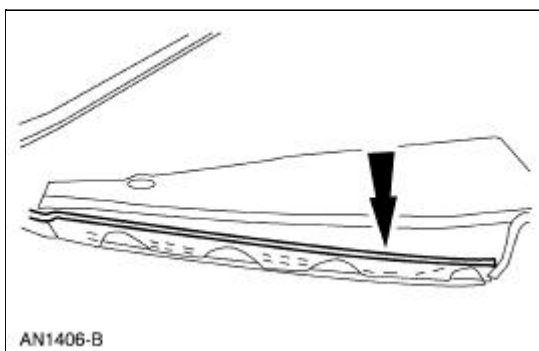
1. Remove the rear defrost connectors if necessary.
2. Remove the nuts retaining the well sling and convertible top tacking strips.



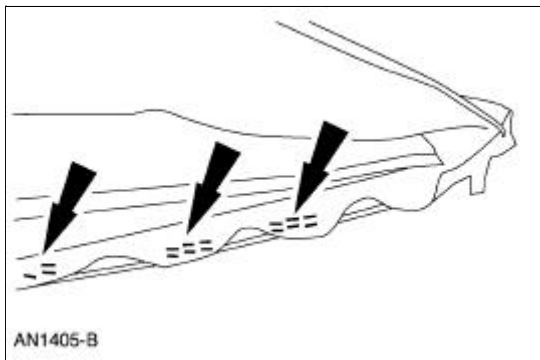
3. Remove the three tacking strips.



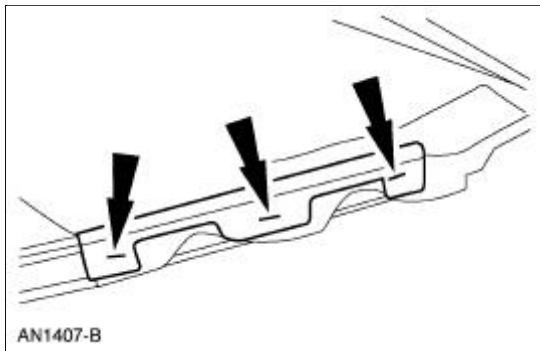
4. Mark the top of the convertible top skin around the top of all three tacking strips with a grease pencil.



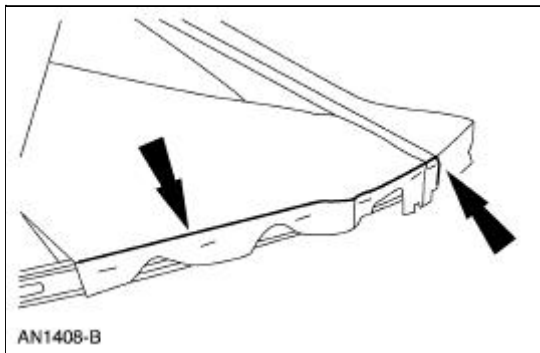
5. Remove the visible staples.



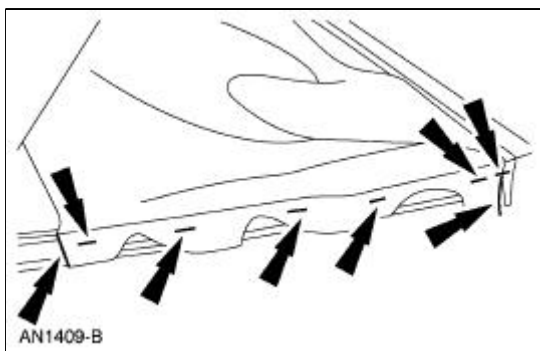
6. Remove the water diverter.



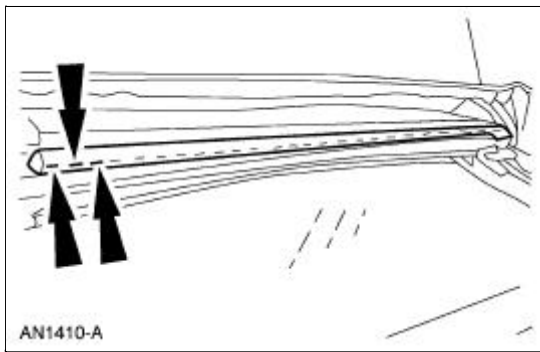
7. Mark the winter seal at the top, bottom and the forward edge of the rear tacking strip.



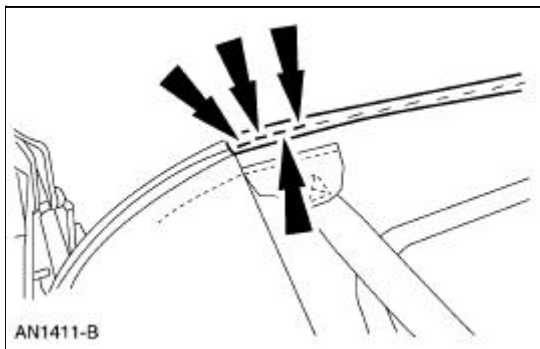
8. Remove the winter seal.



9. Lift the rear cover assembly over the convertible top exposing the top of the rear window glass assembly.
10. Remove all of the staples in the cover assembly along the number four bow.



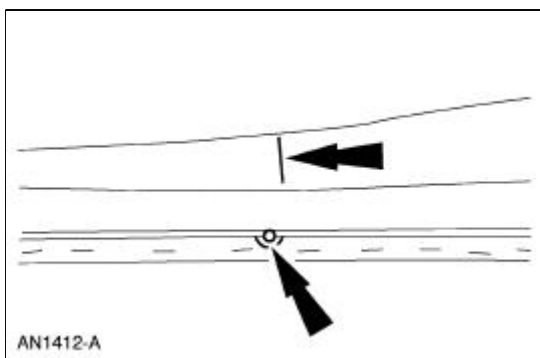
11. Remove all of the staples in the rear window glass assembly along the number four bow.



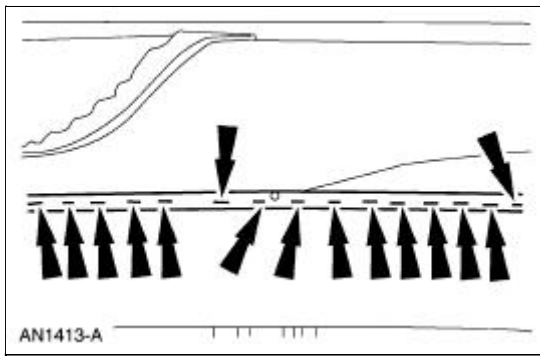
12. Remove the rear window glass assembly.

Installation

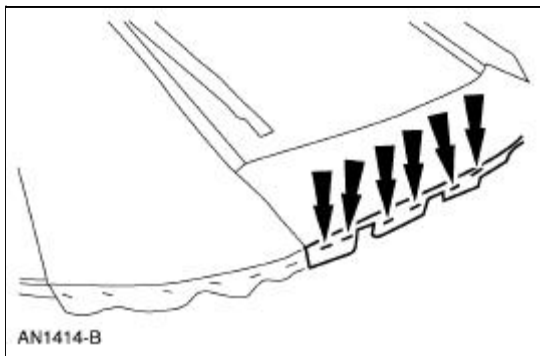
1. Overlay the new rear window glass assembly over the old rear window glass assembly and transpose the markings with a grease pencil.
2. Center the V-notch on the new rear window glass assembly to the center mark on the top of the number four bow.



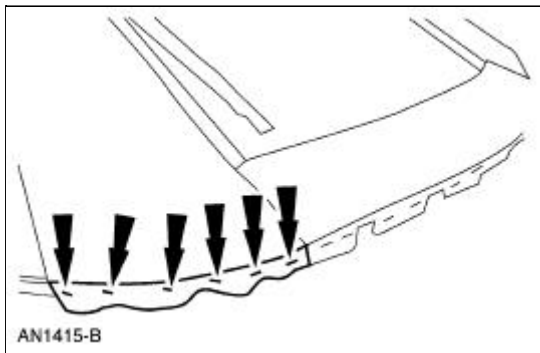
3. Align the rear window glass assembly to the top groove of the number four bow and staple the entire length.



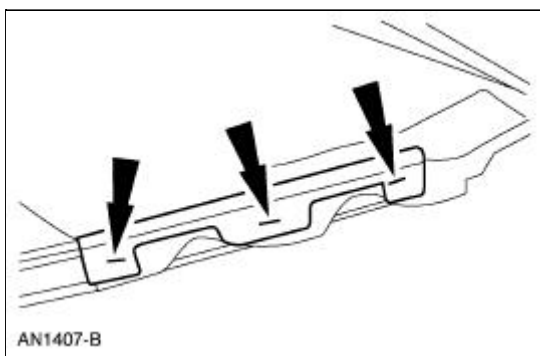
4. Starting at the center of the lower rear tacking strip, align the top edge of the rear belt to the reference line and staple.



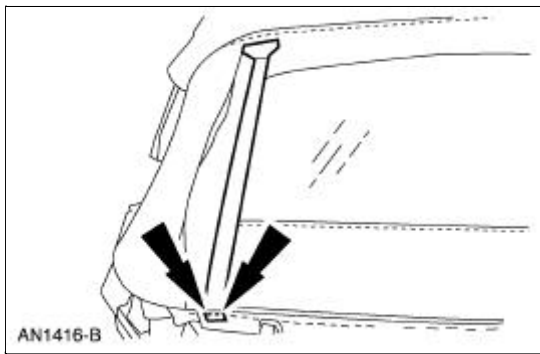
5. Repeat the procedure for both rear tacking strip sides.



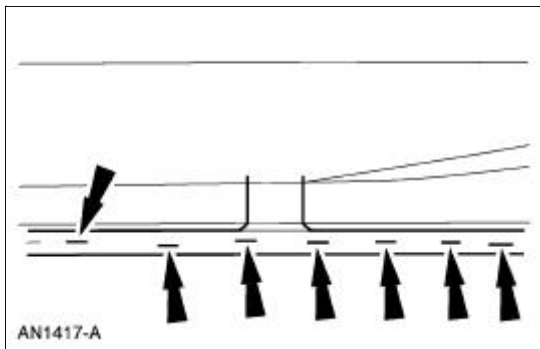
6. Position and staple the water diverter.



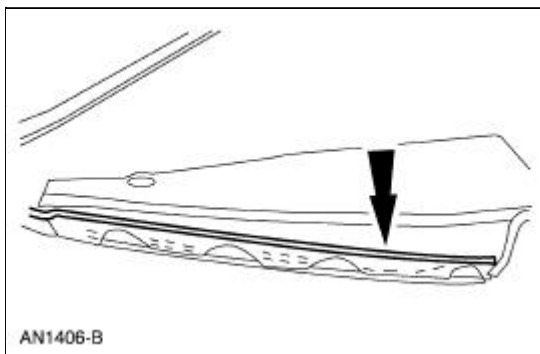
7. If necessary, align the elastic straps with the edge of the rear window glass assembly and staple in place.



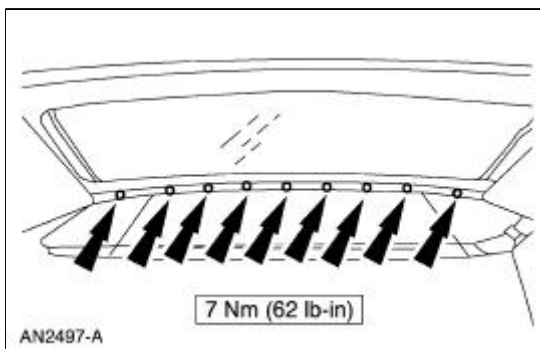
8. Align the center line mark on the cover assembly to the V-notch on the rear window glass assembly and staple the entire length.



9. Align the top edge of the quarter tacking strip to the reference line on the convertible top cover and staple.



10. Install the tacking strips over the body studs.
11. Tighten the tacking strip nuts.



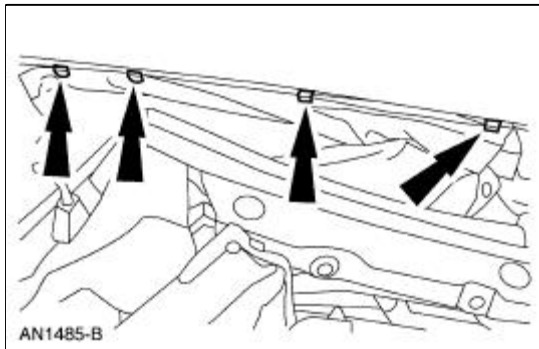
12. Install the well sling.

13. If necessary, connect the rear defroster connectors.

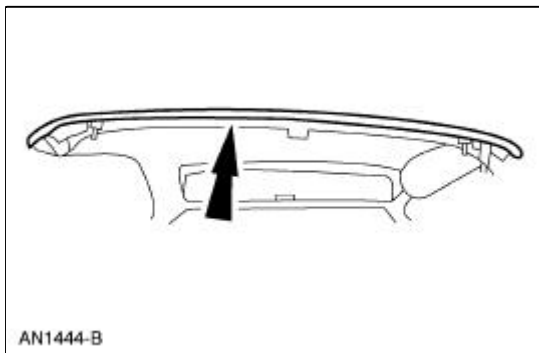
Convertible Top Material

Removal

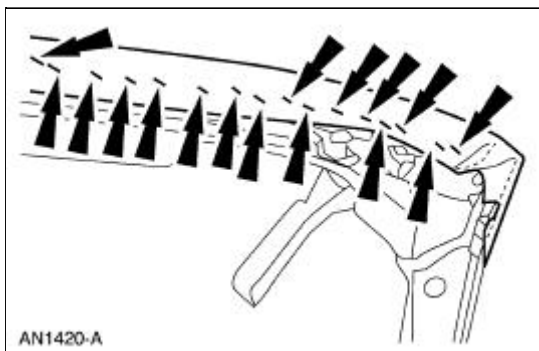
1. Remove the rear exterior trim mouldings.
2. Remove the clips.



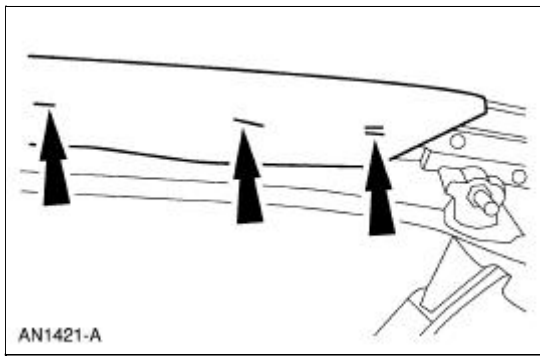
3. Remove the 13 Torx® screws and the seal compression panel.



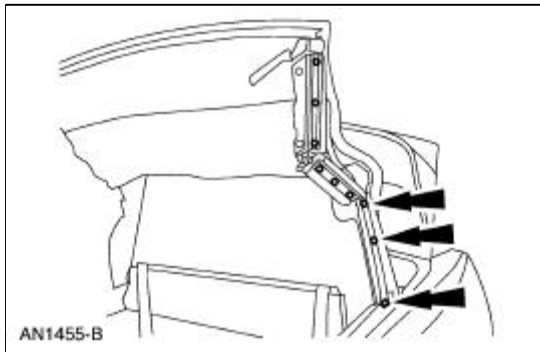
4. Remove the staples.



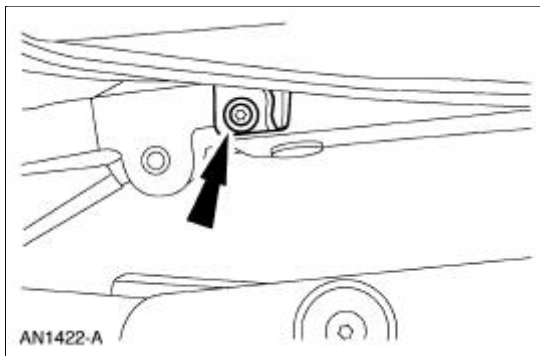
5. Remove the staples from the number one bow.



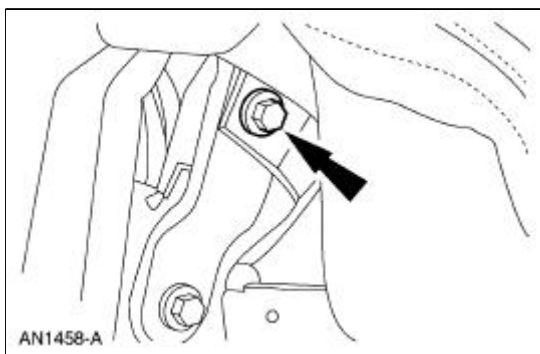
6. Remove the rear rail weatherstrip retainers from each side.



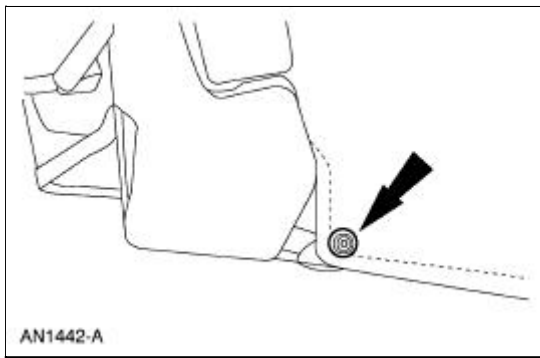
7. Raise the front of the folding top assembly.
8. Remove the screw and the center elastic straps.



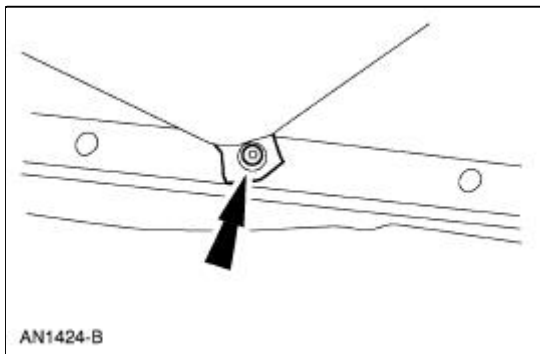
9. Remove the speed nut and the front elastic straps.



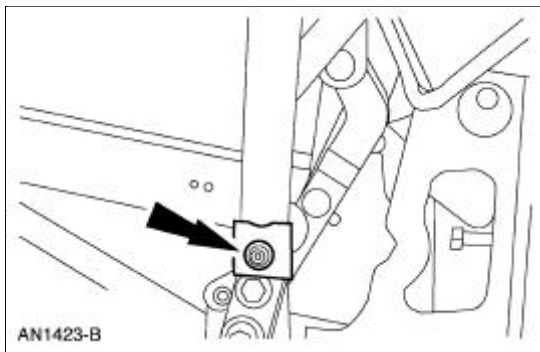
10. Remove the screw and the front elastic strap.



11. Remove the screw and the rear elastic straps.

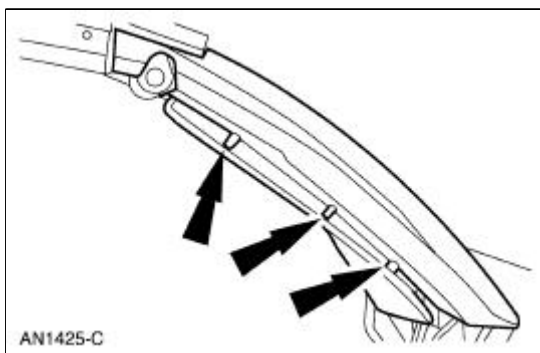


12. Remove the screw and the rear elastic straps.

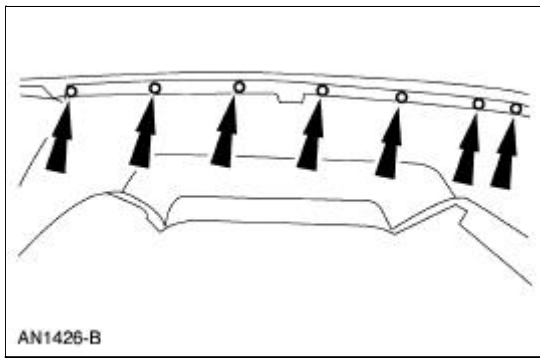


13. **NOTE:** Install new plastic roof headlining retaining pins if they were removed.

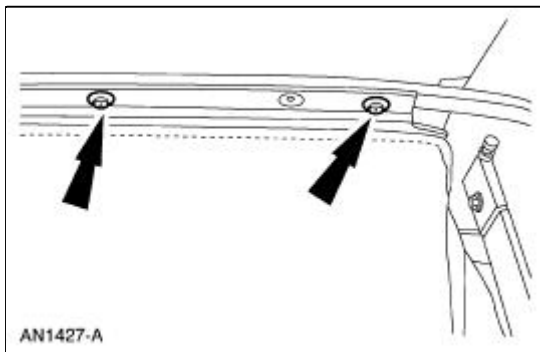
Disengage the roof headlining from the folding roof rear side rail.



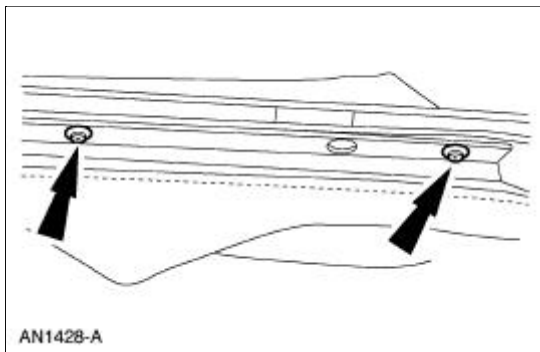
14. Remove the screws from the number four bow.



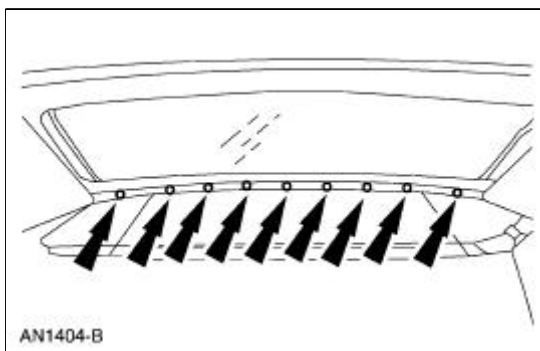
15. Remove the screws from the number three bow.



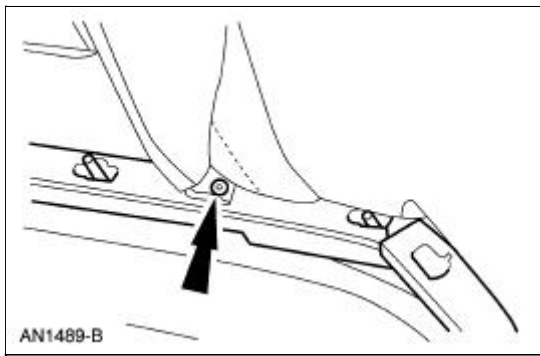
16. Remove the screws from the number two bow.



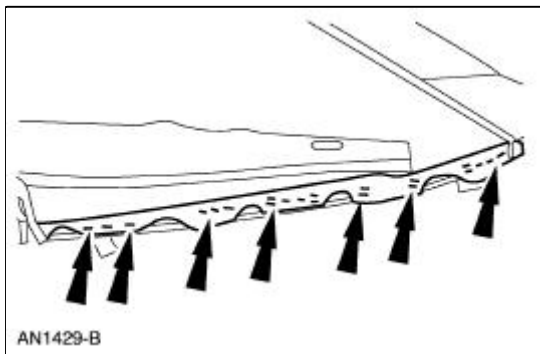
17. Remove the headlining.
18. Remove the nuts retaining the well sling and convertible top tacking strips.



19. Remove screws and the three tacking strips.

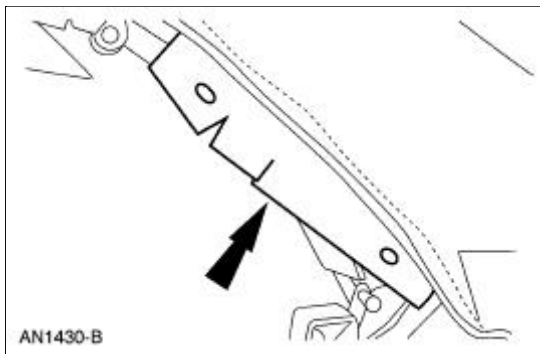


20. Remove the staples.

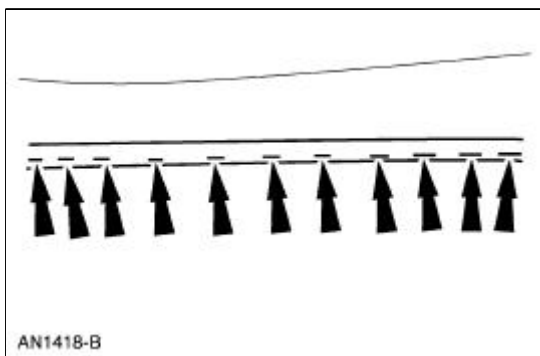


21. **NOTE:** All adhesive tape must be removed from the folding roof rear side rail.

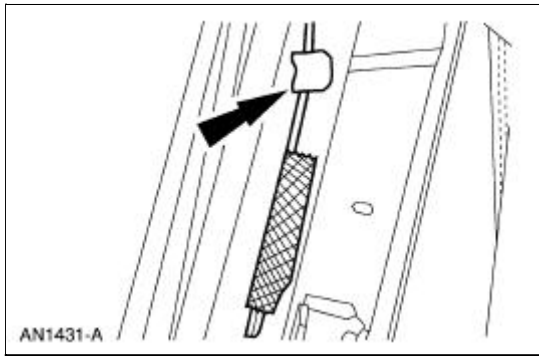
Pull the roof outside cover flaps to disengage from each folding roof rear side rail.



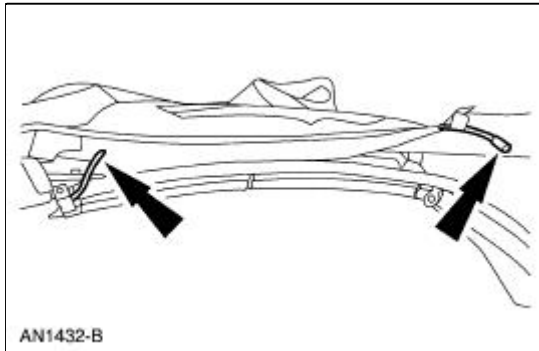
22. Remove the staples from the entire length of the number four bow.



23. Disengage the cable from each side.

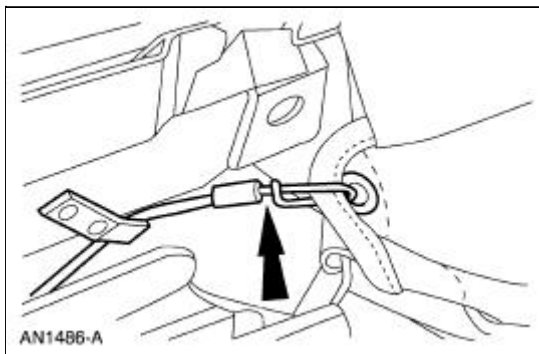


24. Remove the cable from the cover assembly.



25. **NOTE:** The cable is spring-loaded. Use care not to lose the cable end during disassembly.

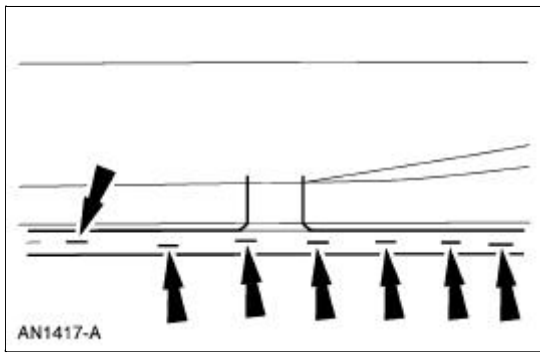
Disconnect the trim tension cable.



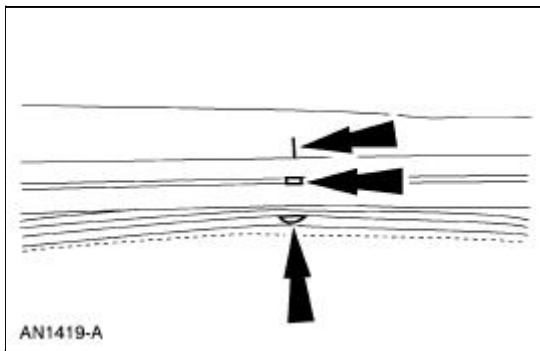
26. Remove the cover from the frame.

Installation

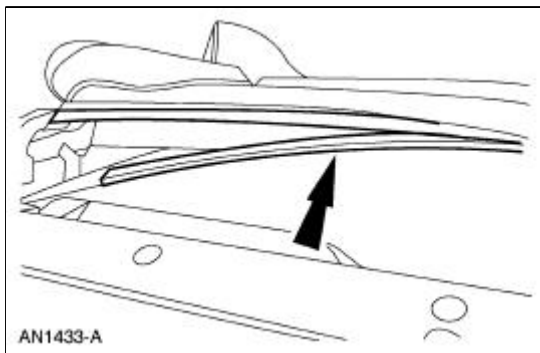
1. Align the center mark on the cover assembly to the V-notch on the rear glass assembly and staple the entire length of the number four bow.



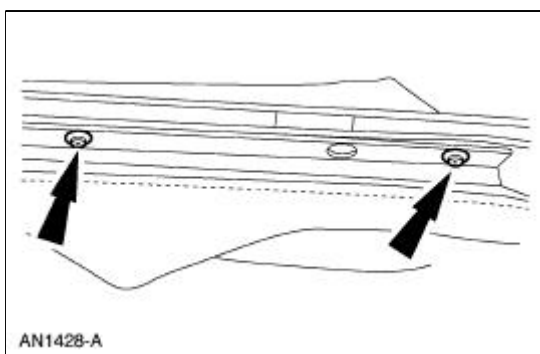
2. Center the listing sleeve on the bottom of the folding top number two bow.



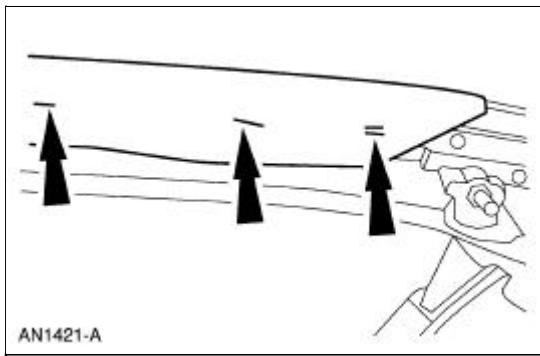
3. Position the listing sleeve onto the number two bow with the headliner retainer.



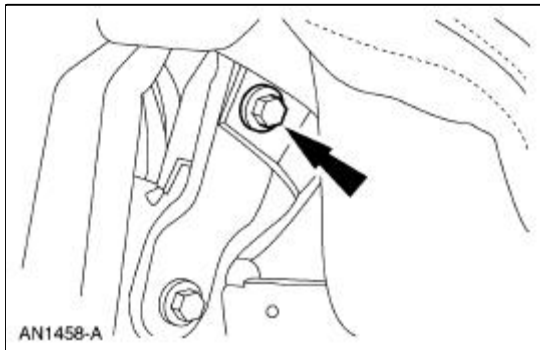
4. Install the screws for the number two bow.



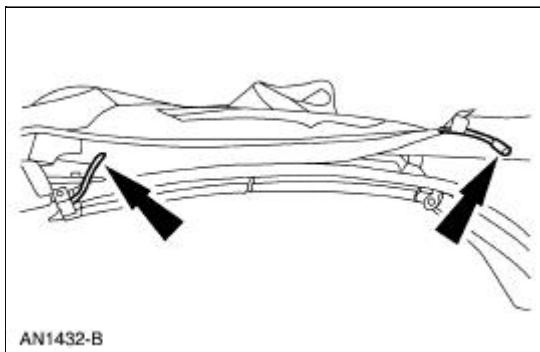
5. Pull the roof headlining over the top of the folding top header (number one bow) and staple the underside.



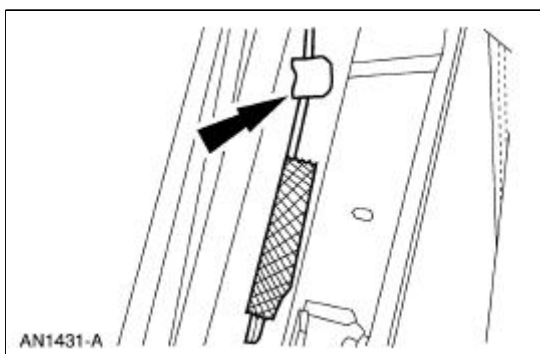
6. Connect the headliner front elastic strip with the speed nut.



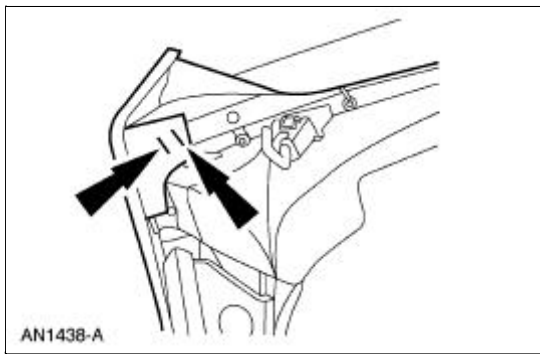
7. Pull the folding top tension cable through the retainer in the roof outside cover.



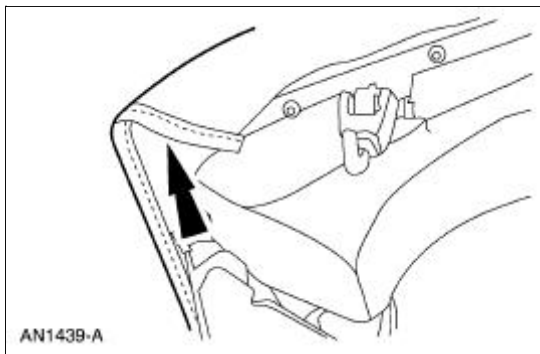
8. Engage the cable to the spring retainer.



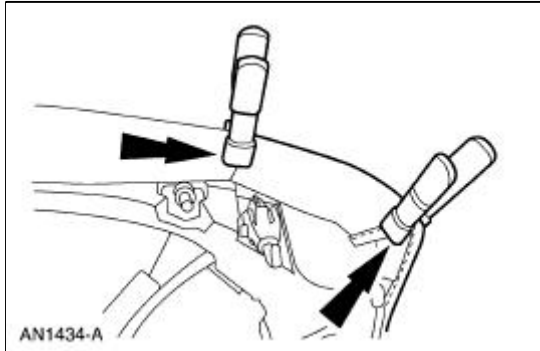
9. Staple the flap at the front of the roof outside cover to the tacking strip on the underside of the folding top header panel.



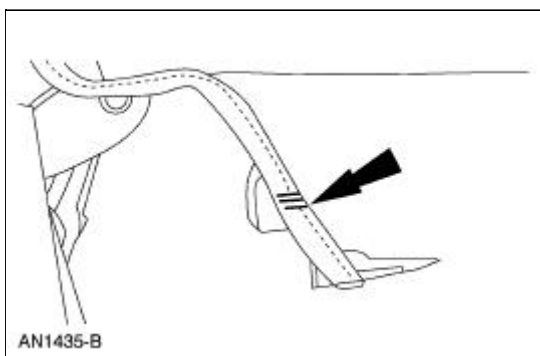
10. Pull the front corner of the roof outside cover over the folding top header and staple to the tacking strip.



11. Fold the tab under the folding top header (number one bow) and clamp.

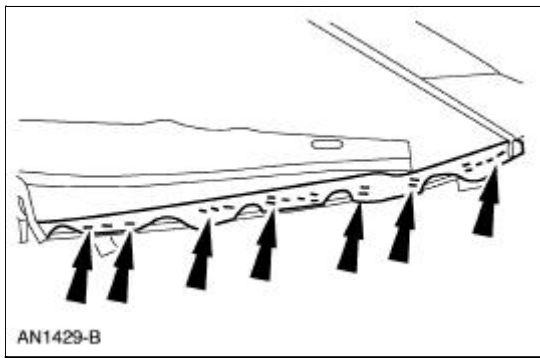


12. Staple the rear of the roof outside cover to the side tacking strip.

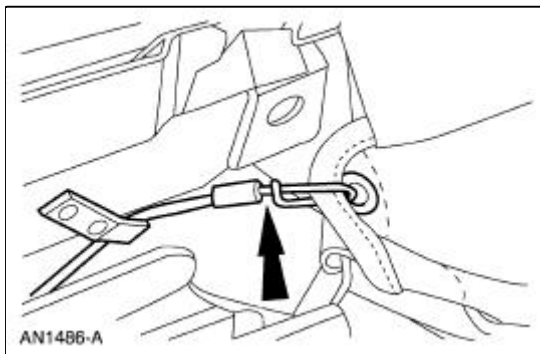


13. **NOTE:** Make sure there are no wrinkles in the roof outside cover.

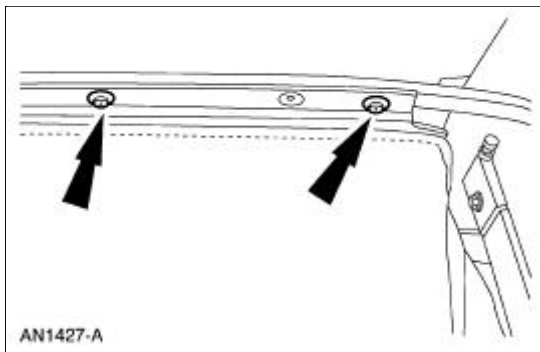
Install the remaining staples along the rear of the roof outside cover.



14. Install the folding top tension cable through the eyelet of the roof outside cover.

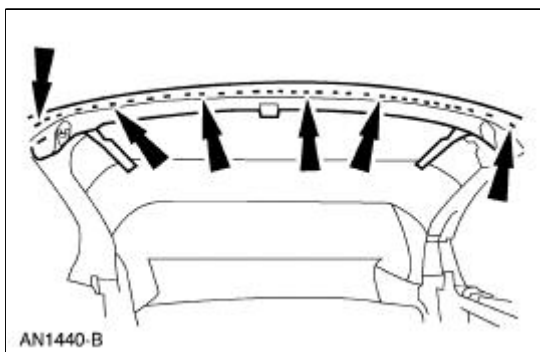


15. Position the headliner retainer to the number three and four bow and install the screws.

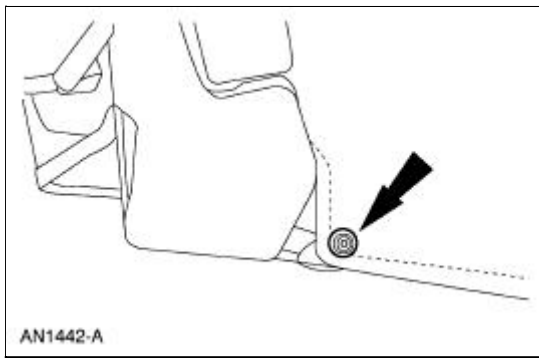


16. **NOTE:** Make sure there are no wrinkles on the top of the roof outside cover.

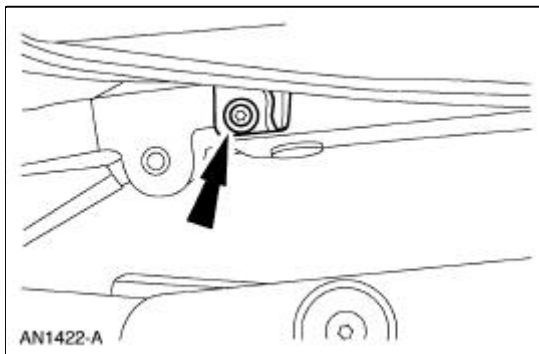
Support the top and staple the underside of the folding top header panel from the center to the sides.



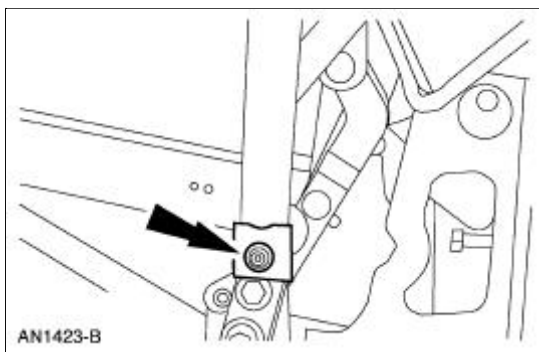
17. Install the screws through the headlining and the strap into the front side rail.



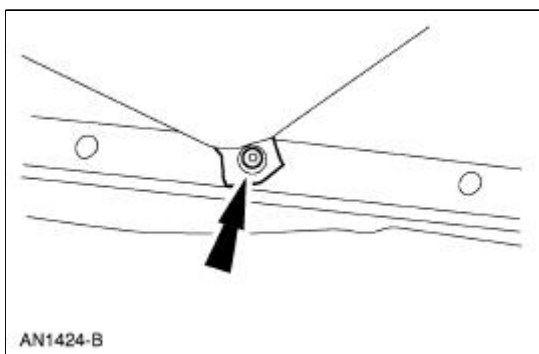
18. Position the center elastic strap to the rear of the folding top center rail and install the screw.



19. Position the rear elastic strap and install the screw.

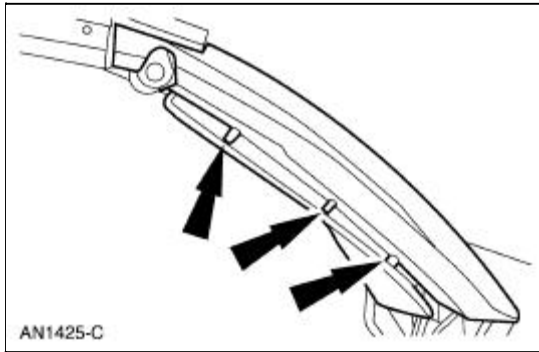


20. Position the rear elastic strap and install the screw.

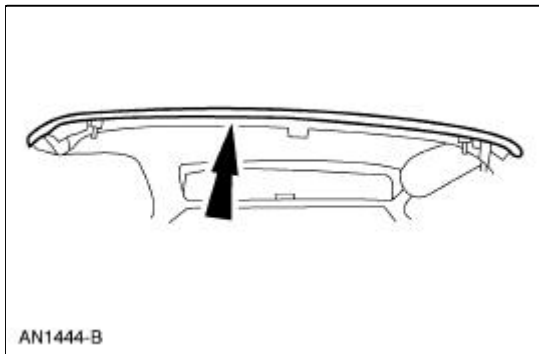


21. Trim the excess roof outside cover along the rear tacking strips and around the tacking strip mounting holes.
22. **NOTE:** Install new plastic roof headlining retaining pins if they were removed.

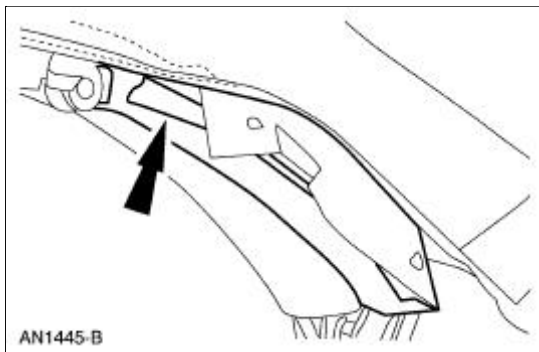
Engage the roof headlining into the folding roof rear side rail.



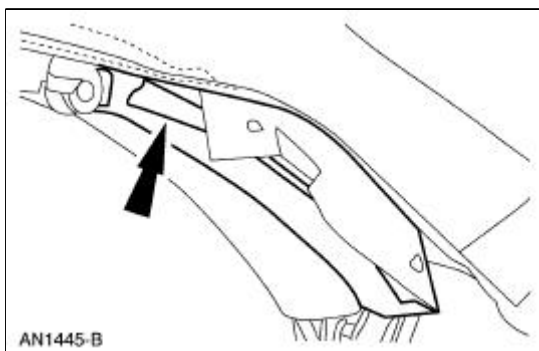
23. Install the seal compression panel.



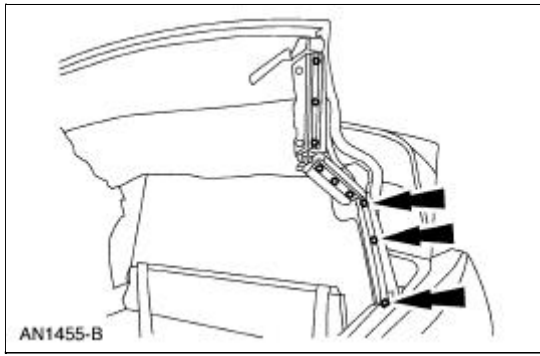
24. Install two-sided tape on the rear rail.



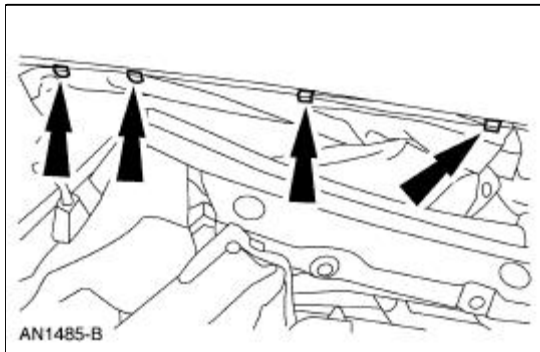
25. Install the flap onto the rear rail.



26. Install the rear weatherstrip retainers.



27. Install the clips.



28. Install the exterior mouldings.

Stay Pad —Convertible Top

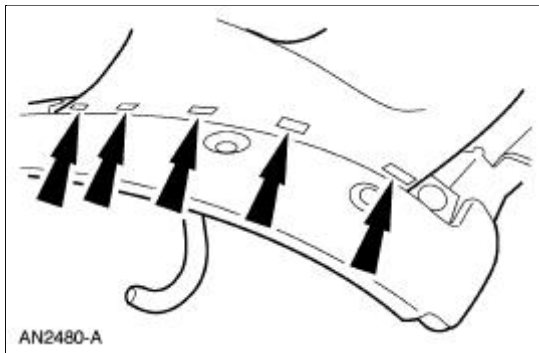
Removal

1. Remove the convertible top material. For additional information, refer to [Convertible Top Material](#) in this section.
2. Remove the rear window glass. For additional information, refer to [Convertible Top Assembly—Rear Window Glass](#) in this section.
3. **NOTE:** Mark the old stay pad staple locations and transfer to the new stay pads.

Remove the staples from all of the bows.

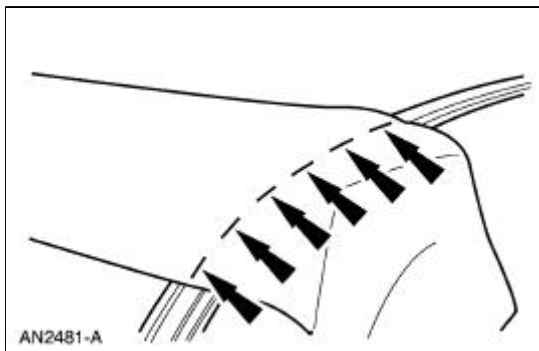
Installation

1. Staple the stay pad to the number one bow.

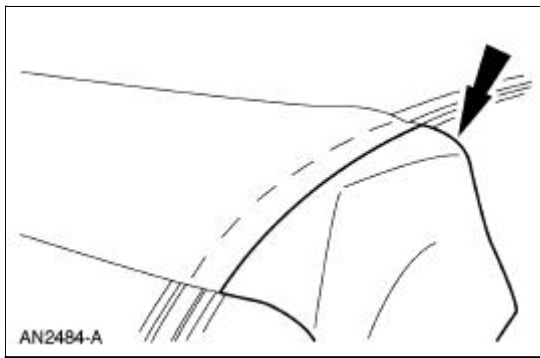


2. **NOTE:** The stay pad should be tight between the number one and number four bows.

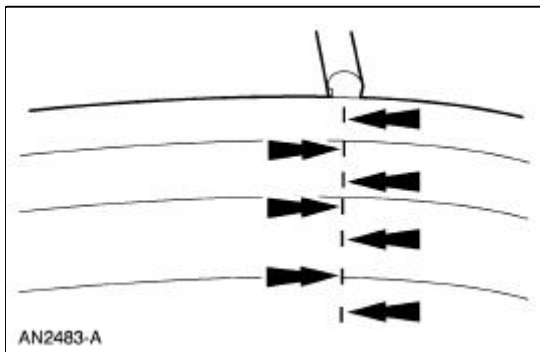
Staple the stay pad to the number four bow.



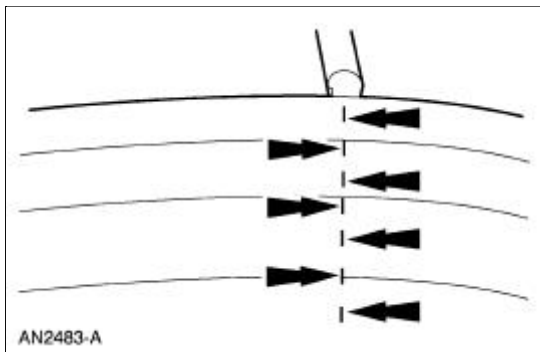
3. Cut the excess stay pad material from the rear of the number four bow.



4. Staple the stay pad to the number two bow.



5. Staple the stay pad to the number three bow.

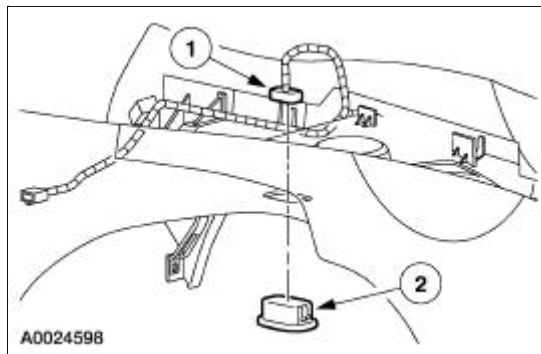


6. Install the rear window glass. For additional information, refer to [Convertible Top Assembly—Rear Window Glass](#) in this section.
 7. Install the convertible top material. For additional information, refer to [Convertible Top Material](#) in this section.
-

Convertible Top Switch

Removal and Installation

1. Remove the floor console. For additional information, refer to [Section 501-12](#).
2. Remove the convertible top switch.
 1. Disconnect the electrical connector.
 2. Release the clips.



3. To install, reverse the removal procedure.
-

Hydraulic System, Lift Cylinder and Motor

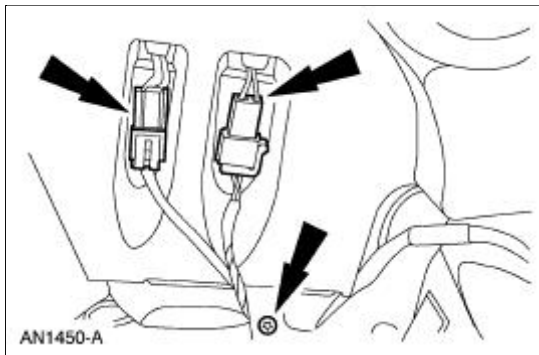
Removal

NOTE: The convertible top hydraulic components are removed from the vehicle as an assembly. The hydraulic components are individually repaired and the system must be bled before being installed into the vehicle.

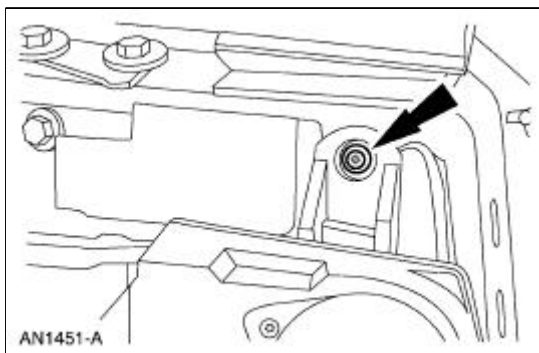
Hydraulic system

1. Unlatch the convertible top.
2. Remove the rear quarter trim panel. For additional information, refer to [Section 501-05](#).
3. **NOTE:** This step applies to vehicles equipped with the Mach sound system.

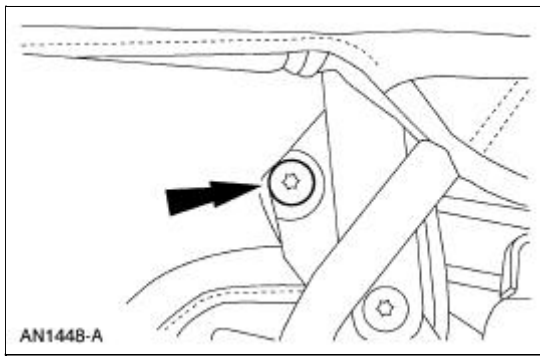
Remove the screw and disconnect the electrical connectors.



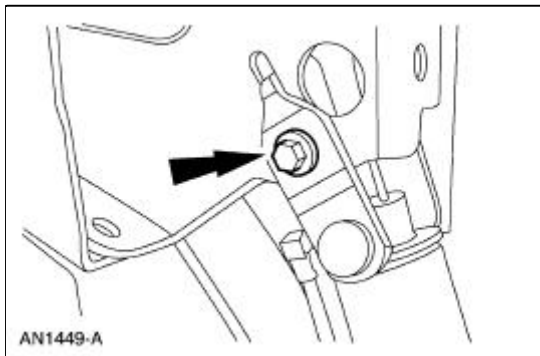
4. Remove the screws.



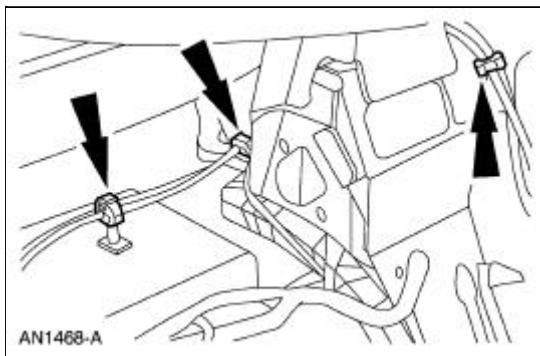
5. Remove the speakers.
6. Remove the two cylinder rod mounting bolts.



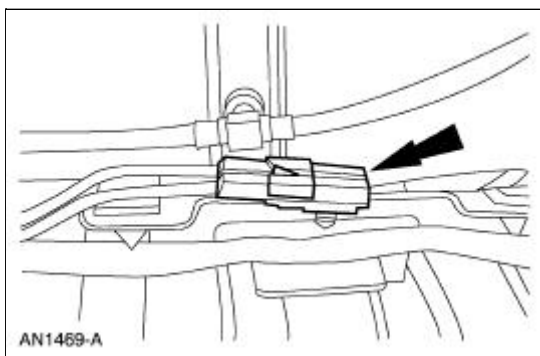
7. Fully lower the lift cylinders.
8. Remove the nuts and the lift cylinders.



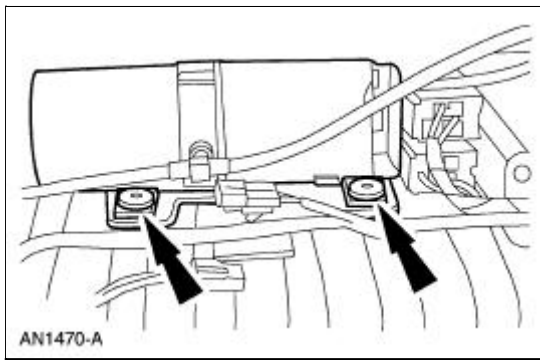
9. Release the hydraulic line retainers on each side.



10. Disconnect the motor electrical connector.



11. Pull up on the motor to release the rubber retainers.

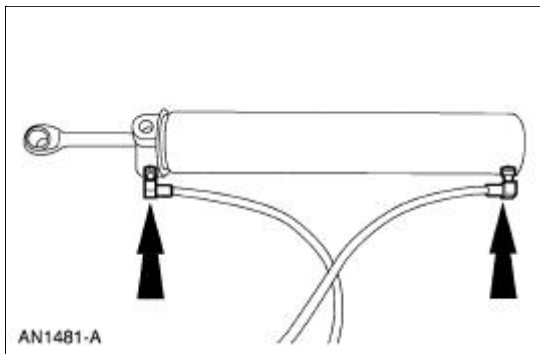


12. Remove the motor and cylinders as an assembly.

Lift cylinder

13. **NOTE:** Prior to their removal, mark the upper and lower hydraulic lines to insure correct installation on the new cylinder.

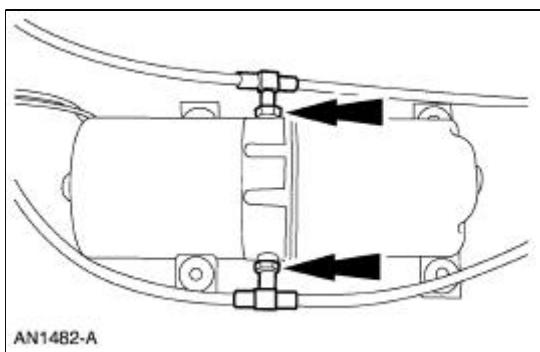
Remove the hydraulic lines from the cylinder.



Motor assembly

14. **NOTE:** Prior to removal, mark the hydraulic lines to insure correct installation of the motor assembly.

Remove the hydraulic lines from the motor assembly.



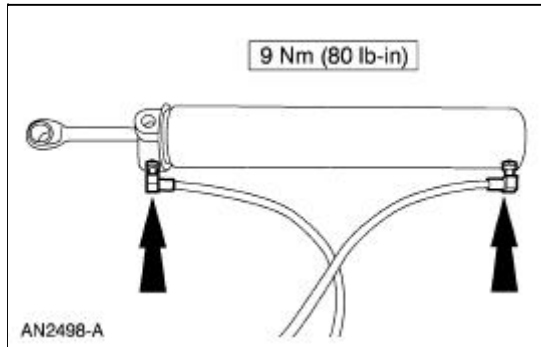
Installation

Lift cylinder

1. **NOTE:** Be sure that each fitting is installed in the correct position on the folding top hydraulic component.

NOTE: Make sure that the tetra seal is installed in the bottom of each of the folding top hydraulic cylinder ports before attaching the upper and lower hose fittings.

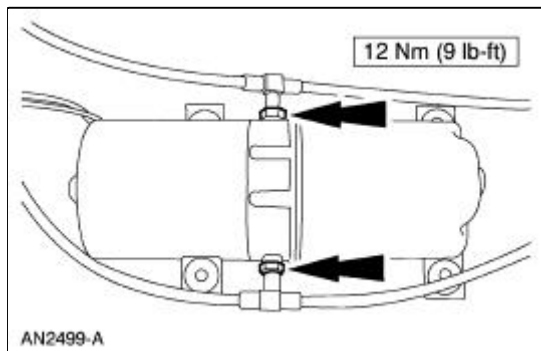
Install the hydraulic lines using a thread locker onto the lift cylinder.



Motor assembly

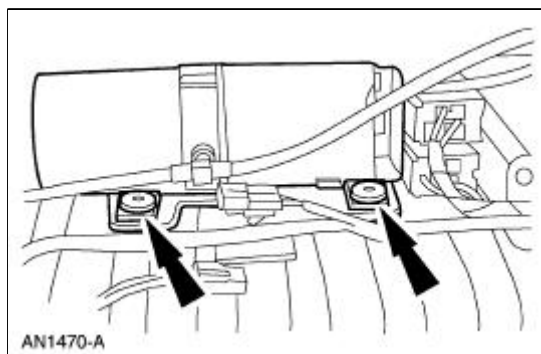
2. **NOTE:** Be sure that each fitting is installed in the correct position on the folding top hydraulic component.

Install the hydraulic lines using a thread locker onto the motor assembly.

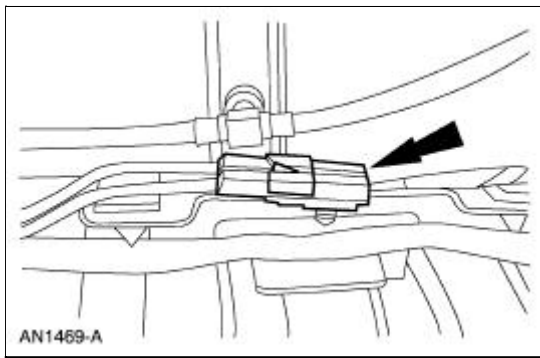


Hydraulic system

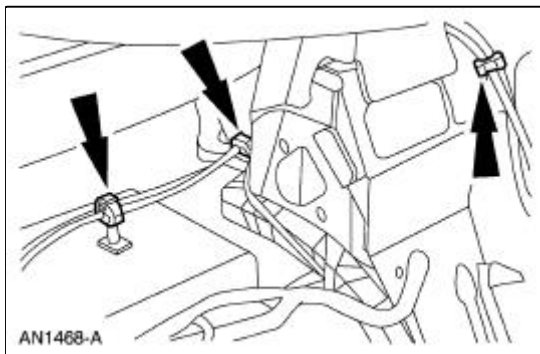
3. Bleed the hydraulic system. For additional information, refer to [System Bleeding](#) in this section.
4. Install the motor and cylinders as an assembly.
5. Position the motor assembly.



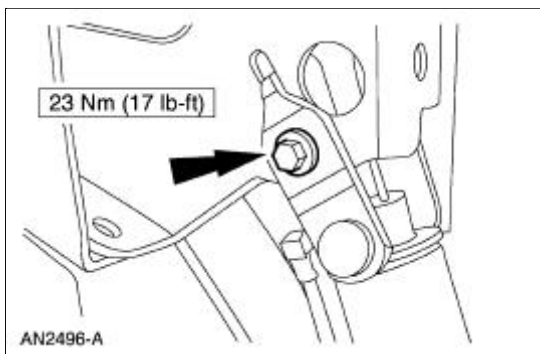
6. Connect the motor electrical connector.



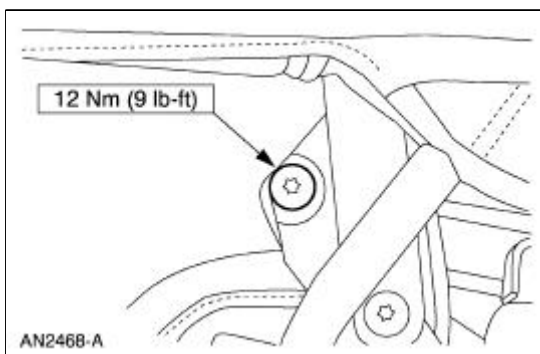
7. Engage the hydraulic line retainers on each side.



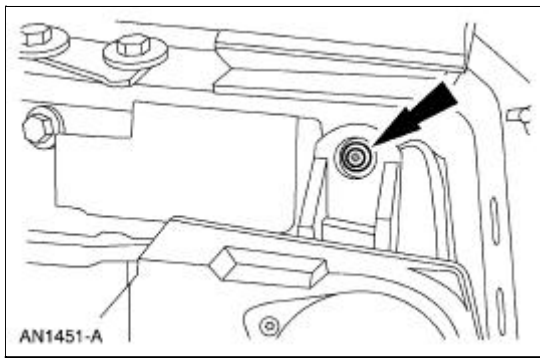
8. Position the lift cylinders and install the nuts.



9. Install the two cylinder rod mounting bolts.

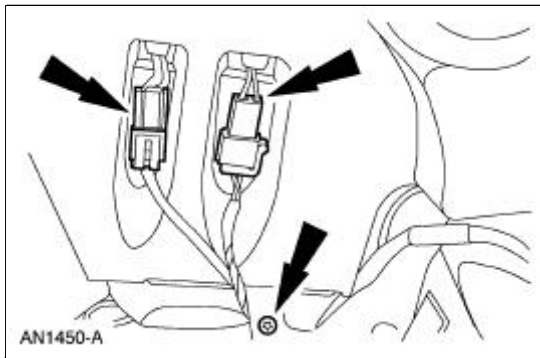


10. Install the speakers.
11. Install the screws.



12. **NOTE:** This step applies to vehicles equipped with the Mach sound system.

Install the screw and connect the electrical connectors.



13. Install the rear quarter trim panel. For additional information, refer to [Section 501-05](#).

14. Latch the convertible top.

Torque Specifications

Description	Nm	lb-ft	lb-in
Front bumper bolts	40	30	—
Rear bumper bolts	23	17	—
Front bumper cover nuts	5	—	44
Rear bumper cover nuts	7	—	62
Exhaust outlet pipe bumper bracket bolts	18	13	—
Rear bumper tongue to frame rail bolts	63	46	—
Rear bumper brace bolts	48	35	—
Intercooler radiator bracket bolts	20	15	—

Bumpers



CAUTION: Never apply excessive heat to the bumper cover surface. Heat could cause distortion of the bumper cover.

The bumper systems consist of the following components:

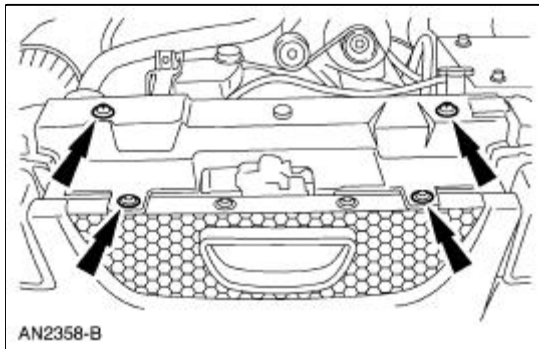
- front bumper
 - front bumper cover
 - front bumper cover (Cobra)
 - front bumper isolator
 - rear bumper
 - rear bumper brace
 - rear bumper cover
 - rear bumper cover (Cobra)
 - rear bumper isolator
-

Front Bumper Cover

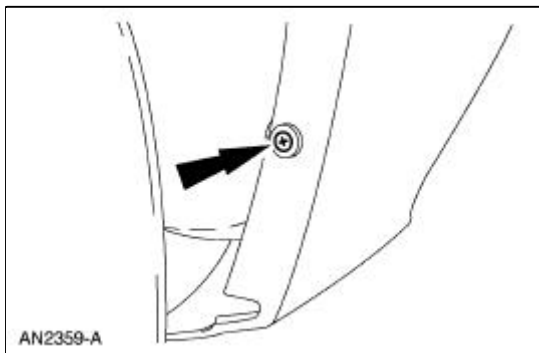
Removal and Installation

NOTE: Mustang shown, GT and Cobra similar.

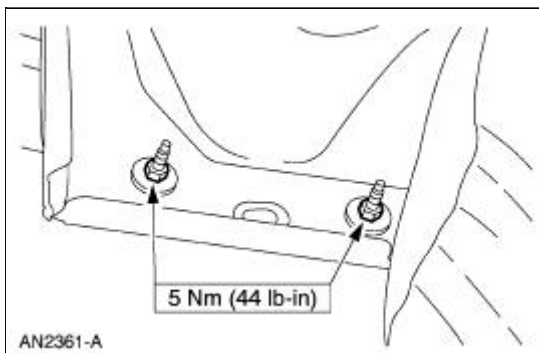
1. Remove the pin-type retainers and the radiator upper sight shield.



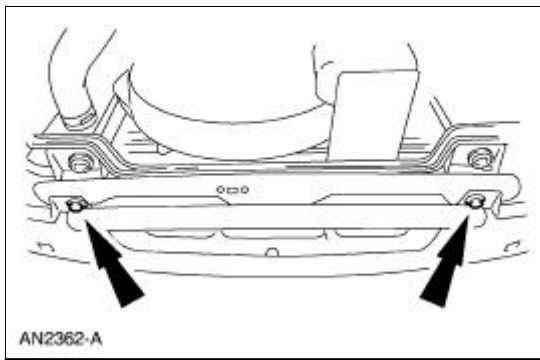
2. Remove the two pin-type retainers (one each side).



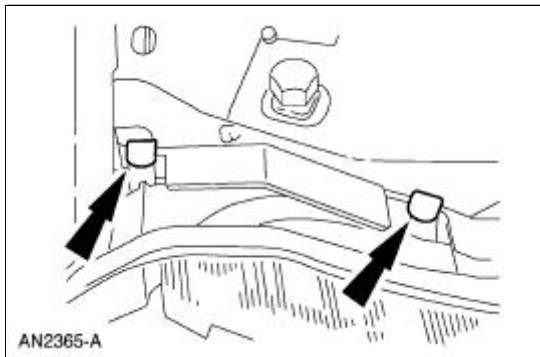
3. Remove the four front bumper cover nuts (two each side).



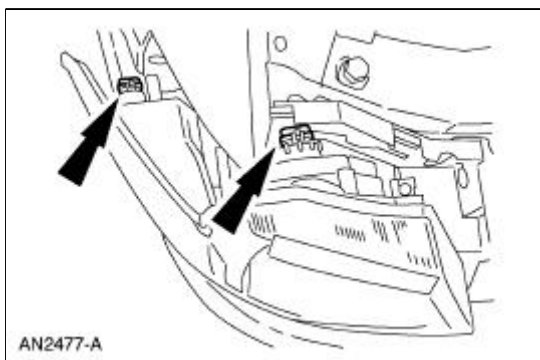
4. Remove the lower bumper cover pin-type retainers.



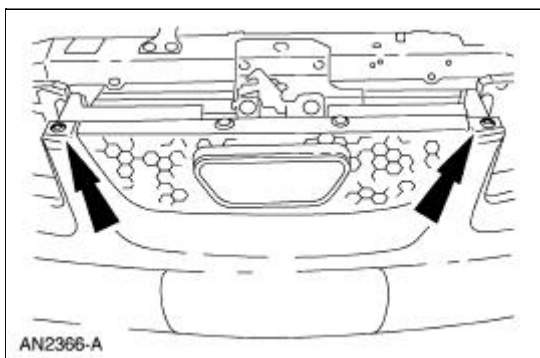
5. Remove the four headlamp mounting clips.



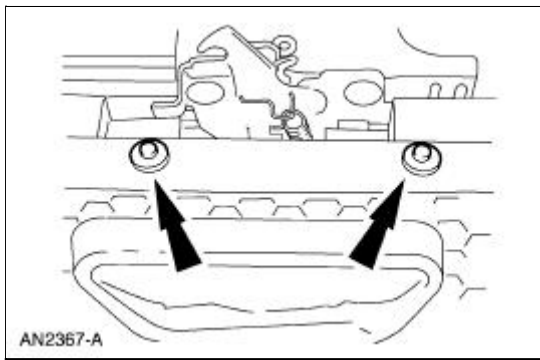
6. Disconnect the parking lamp and the headlamp electrical connectors (two each) and remove the two headlamps.



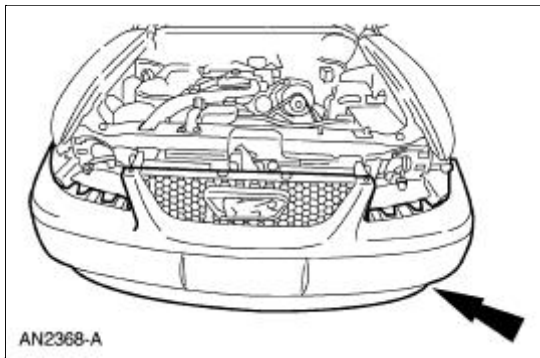
7. Remove the pin-type retainers.



8. If equipped, remove the pin-type retainers.



9. If equipped, disconnect the fog lamp electrical connectors.
10. Lift up on the tabs and remove the front bumper cover.

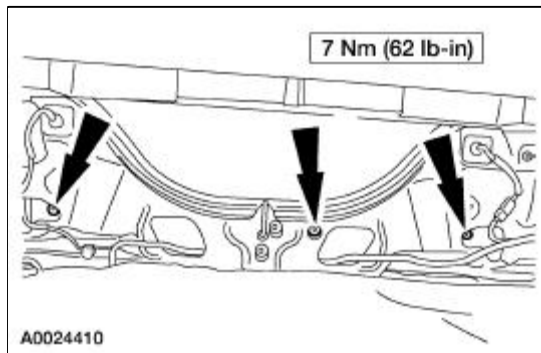


11. To install, reverse the removal procedure.
-

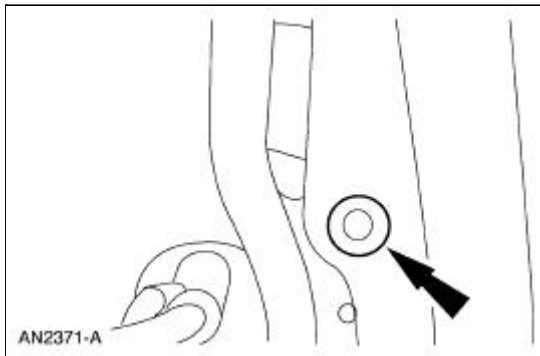
Rear Bumper Cover

Removal and Installation

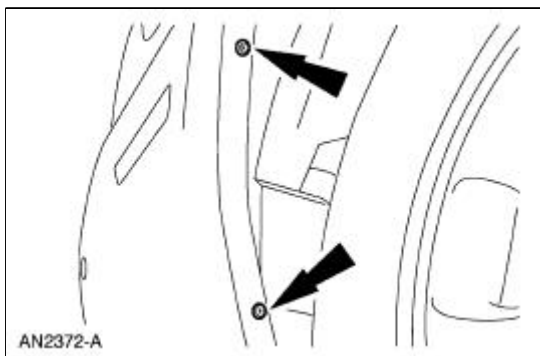
1. Remove the luggage compartment trim panel covers.
2. Remove the seven rear bumper cover nuts.



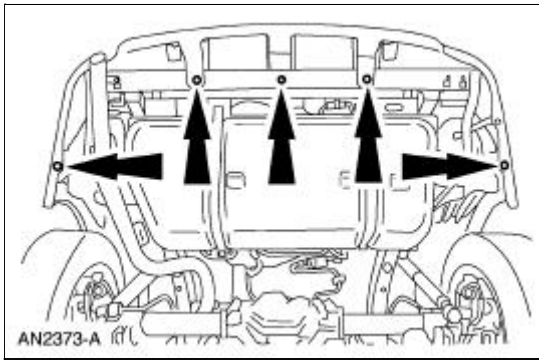
3. Remove the fuel drain hose.



4. Remove the four bumper cover screws (two each side).



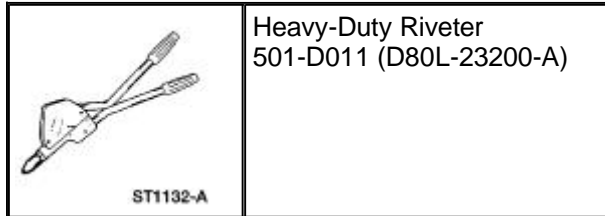
5. Remove the pin-type retainers and the rear bumper cover.



6. To install, reverse the removal procedure.

Front Bumper

Special Tool(s)



Removal and Installation

All vehicles except Cobra

1. Remove the front bumper cover. For additional information, refer to [Front Bumper Cover](#) in this section.

Cobra

2. Remove the charge air cooler. For additional information, refer to [Section 303-12](#).

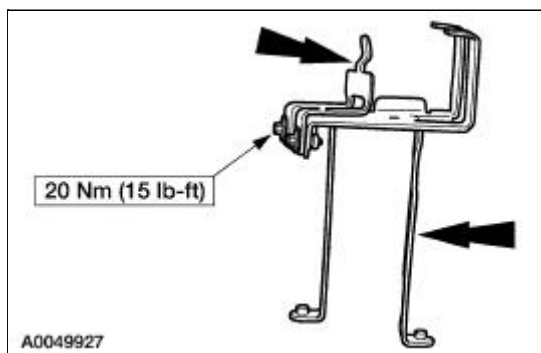
All vehicles

3. Remove the two rivets and the front bumper isolator.

Cobra

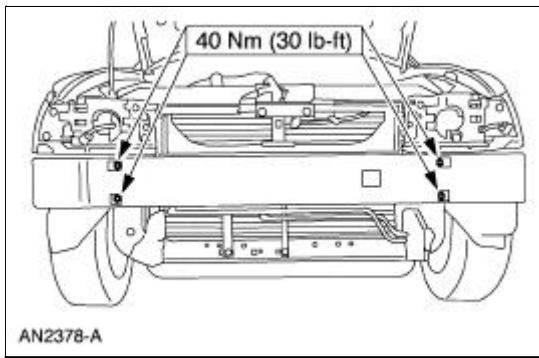
4. **NOTE:** The charge air cooler bracket is removed for clarity.

Remove the four bolts and the two intercooler radiator brackets.



All vehicles

5. Remove the bolts and the front bumper.



6. To install, reverse the removal procedure.
-

Rear Bumper

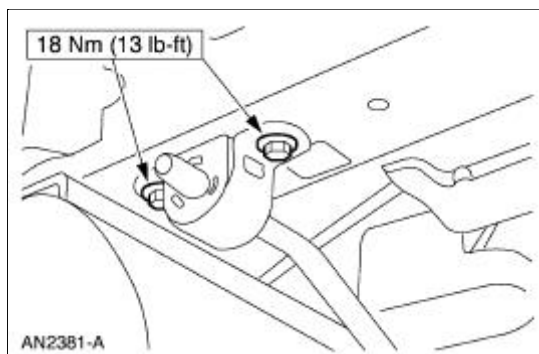
Removal and Installation

All vehicles

1. Remove the rear bumper cover. For additional information, refer to [Rear Bumper Cover](#) in this section.
2. Remove the rear bumper cover isolator.

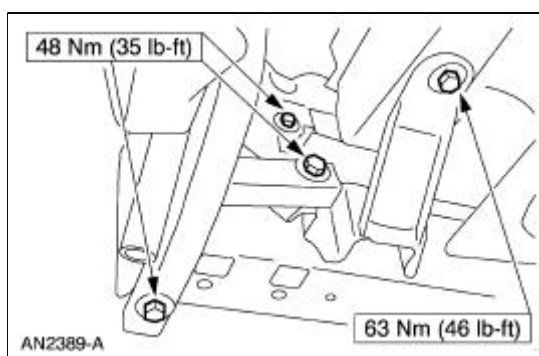
Vehicles with 4.6L engines

3. Remove the bolts and the exhaust outlet pipe bumper bracket.

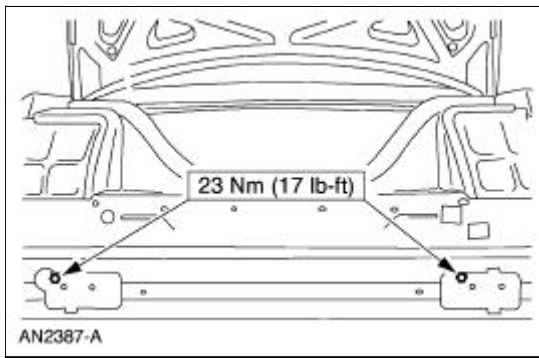


All vehicles

4. Remove the rear bumper brace and tongue bolts.



5. Remove the bolts and the rear bumper.





6. To install, reverse the removal procedure.
-

Torque Specifications

Description	Nm	lb-ft
D-Ring bolt	40	30
Front safety belt retractor bolt, convertible only	30	22
Front safety belt retractor nut, convertible only	30	22
Safety belt retractor bolt	40	30
Safety belt buckle to seat frame nut	40	30
Safety belt buckle to floorpan bolt	40	30
Safety belt anchor bolt	40	30
Tether anchor bolts	20	15


Safety Belt System

 **WARNING:** All safety belt assemblies include retractors, buckles, front seat belt buckle support assemblies (slide bar, if so equipped), shoulder belt height adjuster (if equipped), child safety seat tether bracket assemblies (if equipped) and attaching hardware should be inspected after any collision. Ford recommends new safety belt assemblies be installed unless a qualified technician finds the assemblies show no damage and operate correctly. Safety belt assemblies not in use during a collision should also be inspected and new assemblies installed if either damage or incorrect operation is noted.

 **WARNING:** Each seating position in the vehicle has a specific safety belt assembly which consists of one buckle and one tongue. The safety belt assembly is designed to be used as a pair and is not to be used across seating positions.

A continuous-loop, single retractor active restraint system is used on this vehicle for both the front seats and the rear seats.

Safety Belt, Lap/Shoulder—Dual Locking Mode

 **WARNING:** Rear-facing infant seats should never be placed in the front seats. Failure to follow these instructions may result in personal injury.

The dual locking mode retractor on the shoulder belt portion of the combination lap/shoulder safety belt for the front seat passenger and rear seat outboard passengers operates in two ways:

1. In the vehicle-sensitive (emergency locking) mode, the shoulder belt retractor will allow the occupant freedom of movement, locking tightly only on hard braking, hard cornering or impacts of approximately 8 km/h (5 mph) or more. The front and rear outboard safety belt retractors can also be made to lock by pulling/jerking on the belt.
2. In the automatic locking mode, the shoulder belt retractor locks automatically and remains locked when the combination lap/shoulder safety belt is buckled, restricting occupant movement. This mode provides tight lap/shoulder belt fit on the occupant and on a child safety seat or infant carrier installation restraint.

When the combination lap/shoulder belt is unbuckled and allowed to retract completely, the retractor switches to the vehicle sensitive (emergency) locking mode.

The automatic locking mode must be used when installing a child safety seat on the front passenger seat and rear outboard seats where dual locking retractors are provided.

Safety Belt Warning System

The safety belt warning indicator illuminates and a chime sounds to remind the occupants to fasten their safety belts.

The conditions of operation for the safety belt warning indicator and chime are as follows:

- If the driver safety belt is not buckled before the ignition switch is turned to ON, then the safety belt warning indicator illuminates for one to two minutes and the warning chime sounds for four to eight seconds.

- If the driver safety belt is buckled while the warning indicator is illuminated and the reminder chime is sounding, then the safety belt warning indicator and reminder chime turn off.
- If the driver safety belt is buckled before the ignition switch is turned to ON, then the safety belt warning light will turn on for 3 seconds and then off. The indicator chime will remain off.

Belt Minder (if equipped)

The Belt Minder feature is a supplemental warning to the safety belt warning function. This feature provides additional reminders to the driver that the driver's safety belt is unbuckled by intermittently sounding a chime and illuminating the safety belt warning lamp in the instrument cluster.

If...	Then...
The driver's safety belt is not buckled approximately 5 seconds after the safety belt warning light has turned off...	The Belt Minder feature is activated — the safety belt warning light illuminates and the warning chime sounds for 6 seconds every 30 seconds, repeating for approximately 5 minutes or until safety belt is buckled.
The driver's safety belt is buckled while the safety belt indicator light is illuminated and the safety belt warning chime is sounding...	The Belt Minder feature will not activate.
The driver's safety belt is buckled before the ignition switch is turned to the ON position...	The Belt Minder feature will not activate.

Safety Belt Extension

A safety belt that is too short even when fully extended can be lengthened. The safety belt extension (611C22) is available. This assembly will add approximately 20 cm (8 inches) to the length of the safety belt. Use the safety belt extension only if the safety belt is too short when fully extended. Do not use the safety belt extension to alter the fit of the shoulder belt across the torso. Safety belt extensions are available at no cost from any authorized Ford or Lincoln-Mercury dealer.

Lower Anchors and Tethers for Children (LATCH)

The lower anchors and tethers for children (LATCH) system is a standardized and uniform attachment system for installing child safety seats in passenger vehicles. LATCH-equipped child safety seats have two lower attachments that connect to the vehicle portion of the LATCH system.

The vehicle portion of the system consists of two attachment points (6-mm wires) bolted to the floor pan at both second row outboard seating positions. The attachment points protrude from the biteline between the seat cushion and seat backrest.

If a child safety seat was in use during a collision, inspect the vehicle portion of the system for damage. If any of the attachment points (6-mm wires) are damaged, a new one must be installed. See the appropriate removal and installation procedure in this section for service.

Attaching Safety Seats with Tether Straps

Some manufacturers make child safety seats that include a tether strap that goes over the back of the vehicle seat and attaches to an anchoring point. Other manufacturers offer the tether strap as an accessory. Contact the manufacturer of the child safety seat for information about ordering a tether strap.



WARNING: It is important that the bolt/anchor be securely tightened to specification. Otherwise, the child's safety seat may not be correctly secured and the child could be injured in case of a sudden stop or accident.

Instructions for installing the child safety belt anchor tether kit are included in the kit with the tether attachment.

Safety Belt System

Inspection and Verification

1. Verify the customer's concern by operating the active restraint system to duplicate the condition.
2. Inspect to determine if any of the following mechanical or electrical concerns apply:

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> ● Inspect the safety belt webbing for integrity. 	<ul style="list-style-type: none"> ● Open fuse. ● Bare, broken or disconnected wire. ● Connector not tightly engaged. ● Safety belt warning indicator lamp burned out or broken.

3. If the inspection reveals an obvious concern(s) that can be readily identified, repair as required. With the exception of removing a twist from the safety belt webbing, do not attempt to repair a component of the safety belt system; new components must be installed.
4. If the concern remains after the inspection, determine the symptom. GO to [Symptom Chart](#).

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● The safety belt warning chime does not operate, the safety belt warning indicator lamp is OK 	<ul style="list-style-type: none"> ● Virtual image cluster (VIC). ● Circuitry. ● Driver seat module. 	<ul style="list-style-type: none"> ● REFER to Section 413-01.
<ul style="list-style-type: none"> ● The safety belt warning indicator lamp does not operate, the safety belt warning chime is OK 	<ul style="list-style-type: none"> ● Burned-out bulb. ● Circuitry. ● Driver seat module. 	<ul style="list-style-type: none"> ● REFER to Section 413-01.
<ul style="list-style-type: none"> ● Neither the safety belt warning chime nor the safety belt warning indicator lamp operates 	<ul style="list-style-type: none"> ● Safety belt buckle switch. ● Driver seat module. 	<ul style="list-style-type: none"> ● REFER to Section 413-01.

	<ul style="list-style-type: none"> ● Circuitry. 	
<ul style="list-style-type: none"> ● Excessive pressure on the occupant during normal wear, the webbing cannot be extracted, excessive slack in webbing does not retract 	<ul style="list-style-type: none"> ● Front safety belt retractor and tongue. ● Rear safety belt retractor and tongue. 	<ul style="list-style-type: none"> ● Carry out the Functional Test. REFER to Component Test. INSTALL a new retractor and tongue if necessary.

Component Test

Carry out the appropriate Functional Test(s) as determined in Inspection and Verification.

Functional Test I (Buckle and Tongue)

The safety belt buckle and tongue assembly must operate freely during the latching and unlatching function. Fasten the safety belt by inserting the tongue (male portion) into the buckle (female portion).

1. Verify the following during the latching sequence:
 - Tongue insertion is not hindered by excessive effort.
 - A click is heard when the buckle latches the tongue.
2. Verify the system integrity by forcefully pulling on the belt webbing.
3. Unlatch the belt by fully depressing the buckle release button, and allowing the belt to release and retract.
4. Verify the following during the unlatching process:
 - Push-button depression does not require excessive effort.
 - Tongue can be removed easily from the buckle.
5. Repeat the above steps three times.
6. If the inspection reveals an obvious concern(s) that can be readily identified, service as required. Do not attempt to carry out any repair on the buckle and tongue assembly. If a concern exists with either component, a new safety belt buckle and safety belt and retractor assembly must be installed.

Functional Test II (Retractor)

The safety belt and retractor assembly must be freely operational for extraction and retraction of the safety belt webbing between full extension and in-vehicle stowed positions.


1. Extract and retract the safety belt between the full extension and stowed positions.
2. Verify the retractor operates without excessive effort or binding.
3. Install a new safety belt buckle retractor and tongue assembly if no obvious concerns are noticed and the complaint has been verified.

Functional Test III (System Road Test Inspection)

1. **NOTE:** If the RH or the rear safety belts are to be tested, the assistance of a passenger is required.


Fasten the safety belts and proceed to a safe area.


2. Attain a speed of 8 km/h (5 mph).

3.  **WARNING:** The driver and passenger must be prepared to brace themselves if the retractor does not lock.


Test the safety belts.

1. Grasp the shoulder harness and prepare to lean forward.

2.  **WARNING:** The maximum brake application should be on dry concrete or equivalent hard surface, **NEVER** on wet pavement or gravel.


 **WARNING:** The driver and passenger must be prepared to brace themselves in the event the retractor does not lock.

Make a maximum brake application without a skid.

3. **NOTE:** Do not jerk on the safety belt webbing when carrying out this test. Lean forward slightly when the brake application is made.
4. The safety belts should lock up with minimum webbing extension.
5. If there is a lockup of both shoulder straps, the safety belt assemblies are functioning correctly. Should either or both retractors fail to lock up at the 8 km/h (5 mph) speed, repeat the test at a constant 24 km/h (15 mph) speed. (This test must be carried out with the assistance of a RH front or rear passenger if the RH front or rear safety belts are to be tested).
6.  **CAUTION:** Before installing a new safety belt assembly, inspect the mounting area for damage and distortion. If the retractor of a new safety belt assembly has been bolted into a damaged or distorted mounting area, the retractor could be warped and may not function. If this is the case, remove the retractor and return the sheet metal to the original configuration and install another complete safety belt assembly.

If the retractors do not lock up at the 24 km/h (15 mph) test, return the vehicle for service of malfunctioning safety belts.

Functional Test IV (Automatic Locking Retractor)

 **WARNING:** After any vehicle collision, the safety belt system at all outboard seating positions (except driver, which has no "automatic locking retractor" feature) must be checked by a qualified technician to verify that the "automatic locking" feature for child seats is still functioning correctly, in addition to other checks for correct safety belt system function. A new safety belt and retractor assembly must be installed if the safety belt assembly's "automatic locking retractor" feature or any other safety belt function is not operating correctly when checked according to the procedures in the workshop manual. Failure to install a new safety belt and retractor assembly could increase the risk of injury in collisions.

1. Position the seat back into the full up position.

2. Position the height adjuster in the full down or up position.
 3. Latch the seat belt buckle and tongue assembly.
 4. Pull the shoulder belt out until the automatic locking retractor (ALR) feature is activated.
 5. Release the shoulder belt and allow it to retract until it stops.
 6. Pull on the shoulder belt to check that the belt has remained in the ALR mode. If the belt is not locked, install a new safety belt and retractor assembly.
 7. Unlatch the safety belt tongue from the buckle and allow the safety belt to retract to its stowed position.
 8. Pull the shoulder belt to verify the retractor assembly has converted automatically out of the ALR mode. If the shoulder belt remains locked in the stowed position, install a new safety belt and retractor assembly.
-

Safety Belt Cleaning

1.  **WARNING: Do not bleach or re-dye the webbing, as the webbing may weaken.**

Clean the safety belt webbing only with a mild soap solution recommended for cleaning upholstery or carpets. Follow the instructions provided with the soap.

Safety Belt Maintenance



WARNING: All safety belt assemblies include retractors, buckles, front seat belt buckle support assemblies (slide bar, if so equipped), shoulder belt height adjuster (if equipped), child safety seat tether bracket assemblies (if equipped) and attaching hardware should be inspected after any collision. Ford recommends new safety belt assemblies be installed unless a qualified technician finds the assemblies show no damage and operate correctly. Safety belt assemblies not in use during a collision should also be inspected and new assemblies installed if either damage or incorrect operation is noted.

1. The safety belt assemblies should be periodically inspected to make sure that they have not become damaged and that they remain in correct operating condition, particularly if they have been subjected to severe stress.
 2. Before installing the new safety belt assembly, the safety belt retaining areas must be inspected for damage and distortion. If the retaining points are damaged and distorted, the sheet metal must be reworked back to its original shape and structural integrity.
 3. Install the new safety belt(s) using the appropriate instructions. Carry-out the Functional Test Procedure. For additional information, refer to [Safety Belt System](#) in this section.
-

Safety Belt With Anchor Plate Thread Damage

1. **NOTE:** The following is for 7/16-20 bolts only.

NOTE: The lap/shoulder safety belts are factory-installed in their correct locations. If the safety belts are removed for any reason, they must be installed; refer to removal and installation. The anchor bolts must be hand-started and then tightened to the correct torque specifications as noted in the Torque Specifications table in this section.

Remove the broken or stripped bolt.

2. Drill out the internal threads in the safety belt anchor plate with a 27/64 inch drill bit.
3. Rethread the anchor plate with a 1/2-13 tap.
4. Blow out the chips.
5. **NOTE:** New parts are to be used in place of the original parts; refer to the Parts Replacement Chart—Safety Belt with Damaged Weld Nut Anchor Plate Threads in Specifications in this section.

Install the attachment parts in the correct sequence. For additional information, refer to the procedure in this section. Install a new bolt, hand-tighten and then tighten to correct torque specifications as noted in the Torque Specifications table in this section.

Replacement of the Weld Nut and Reinforcement

1. **NOTE:** The following is for Coupe, Front and Rear, and Convertible rear only.

NOTE: If the safety belt anchor nuts or reinforcements are stripped or missing, a new nut/reinforcement plate must be installed.

Expose the suspect anchor point.

2. Drill out two 8 mm (0.32 in) (5/16 inch) diameter access holes adjacent to the weld nut clearance hole.
 3. Thread a length of copper welding wire through the clearance hole and position to secure the weld nut and washer.
 4. Use MIG wire feed welder and plug weld a 7/16 inch weld nut and standard washer in place at the two 8 mm (5/16 inch) holes.
 5. Metal finish as necessary.
 6. Install the restraint system.
 7. Carry out the Functional Test. For additional information, refer to [Safety Belt System](#) in this section.
-

Safety Belt Procedure After a Collision

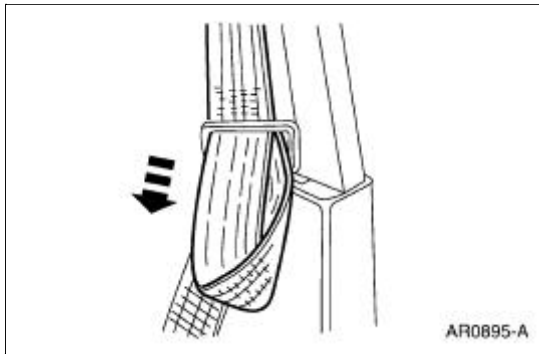


WARNING: All safety belt assemblies include retractors, buckles, front seat belt buckle support assemblies (slide bar, if so equipped), shoulder belt height adjuster (if equipped), child safety seat tether bracket assemblies (if equipped) and attaching hardware should be inspected after any collision. Ford recommends new safety belt assemblies be installed unless a qualified technician finds the assemblies show no damage and operate correctly. Safety belt assemblies not in use during a collision should also be inspected and new assemblies installed if either damage or incorrect operation is noted.

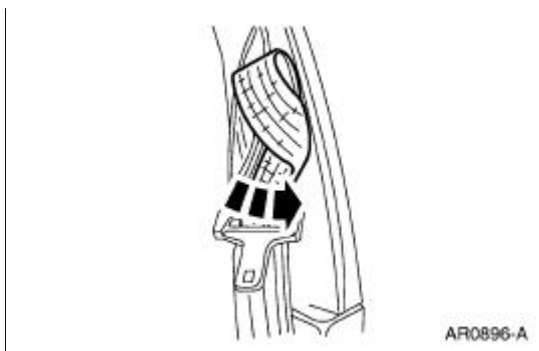
1. Before installing a new safety belt assembly, the safety belt attaching areas must be inspected for damage and distortion. If the attaching points are damaged and distorted, the sheet metal must be worked back to its original shape and structural integrity.
 2. Install the new safety belt(s); refer to the procedure in this section. Carry-out the Functional Test. For additional information, refer to [Safety Belt System](#) in this section.
-

Safety Belt Tongue Rotated on Belt

1. Grasp the belt tongue and pull the belt webbing down to form a loop through the upper (longer and narrower) slot in the tongue.

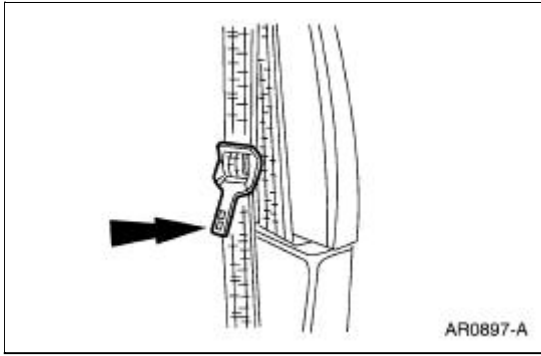


2. Rotate and fold the belt webbing over itself within the slot to remove the twist.
3. Pull the excess belt webbing back through the upper slot in the belt tongue.
4. Grasp the belt tongue and pull the belt webbing up to form a loop through the low slot in the tongue.
5. Rotate and fold the belt webbing over itself within the slot to remove the twist.



6. Pull the excess belt webbing through the slot.
7. **NOTE:** Dual slot tongue shown; single slot tongue is similar.

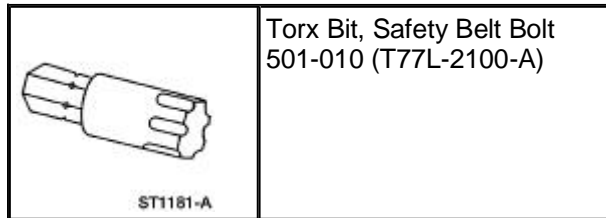
The safety belt tongue should face inward when completed.



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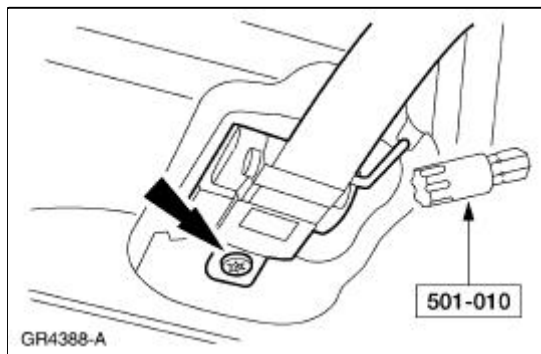
Retractor —Front Seat Safety Belt, Coupe

Special Tool(s)

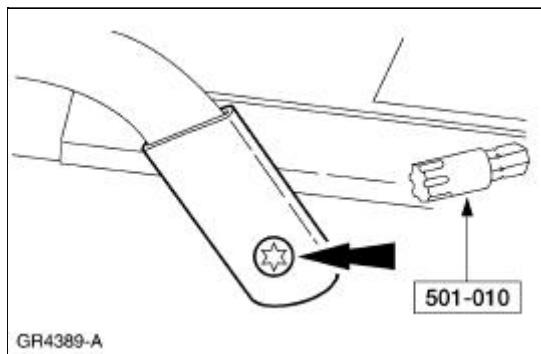


Removal

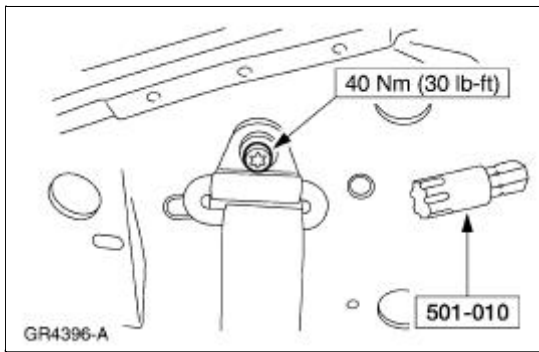
1. Remove the quarter trim panel (31012). For additional information, refer to [Section 501-05](#).
2. Using the special tool, remove the bolt and the safety belt retractor.
 - Remove the mastic seal.



3. Using the special tool, remove the safety belt anchor bolt.



4. Using the special tool, remove the D-ring bolt.

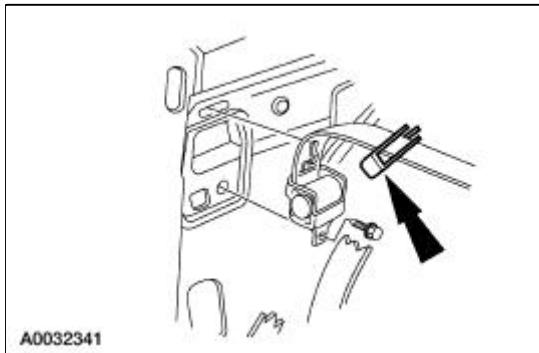


Installation

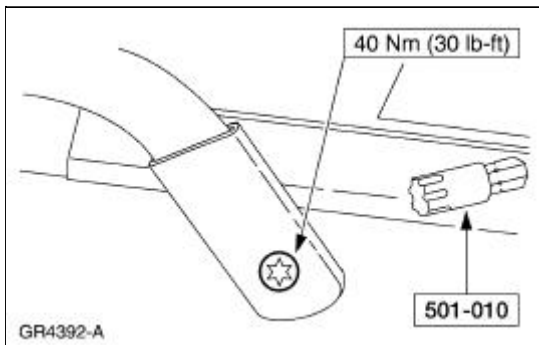
NOTE: Make sure the retractor tongue faces inboard.

NOTE: Make sure the safety belt is not twisted.

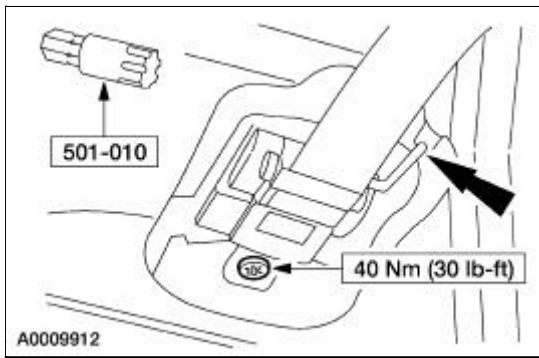
1. The shipping clip must remain attached prior to the installation of the retractor into the vehicle. The clip must be removed after the retractor is installed.



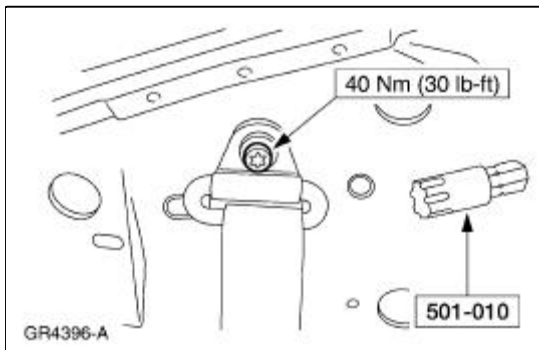
2. Position the safety belt anchor. Using the special tool, install the safety belt bolt.



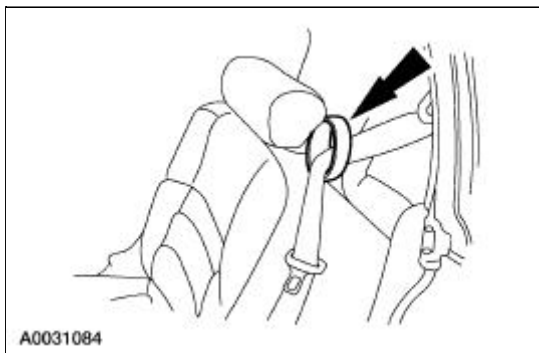
3. Install a new mastic seal around the safety belt retractor before installing the retractor in the vehicle.
4. Position the safety belt retractor. Using the special tool, install the bolt.



5. Using the special tool, install the D- ring bolt.



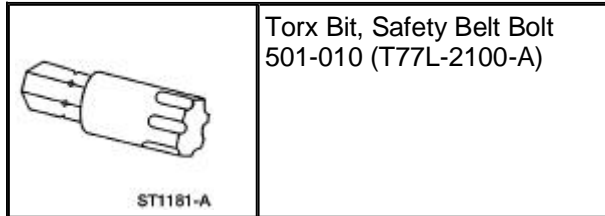
6. Install the quarter trim panel. For additional information, refer to [Section 501-05](#).
7. The shoulder belt must pass through the belt holder on the top of the seatback.



8. Check the active restraint system for correct operation.
-

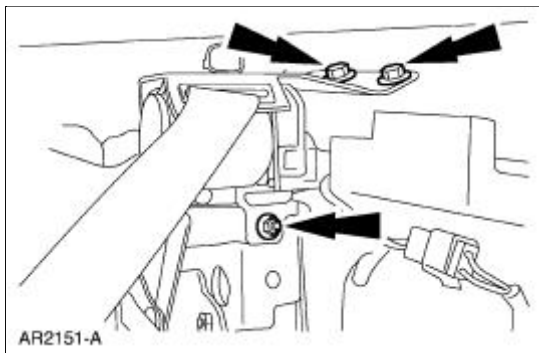
Retractor —Front Seat Safety Belt, Convertible

Special Tool(s)



Removal

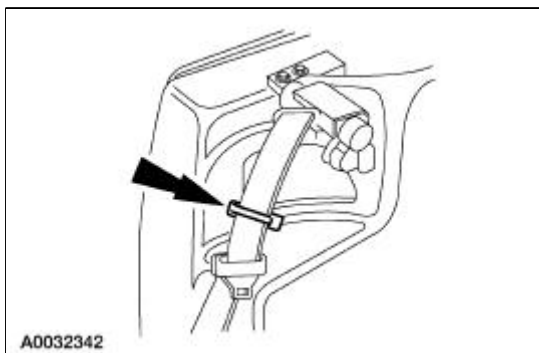
1. Remove the quarter trim panel (31012). For additional information, refer to [Section 501-05](#).
2. Remove the nut and bolts and safety belt retractor.



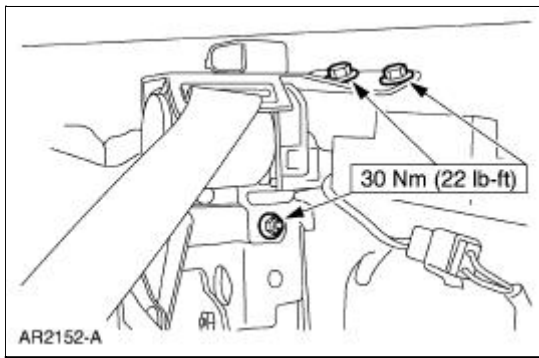
Installation

NOTE: Make sure the safety belt is not twisted.

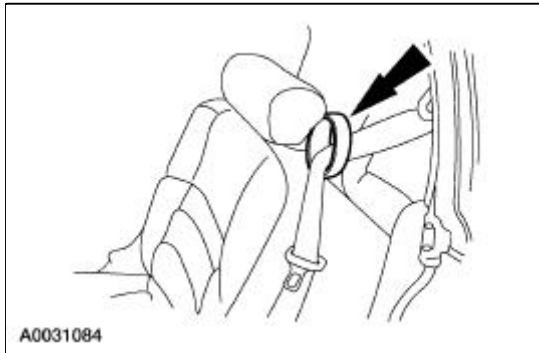
1. The shipping clip must remain attached prior to the installation of the retractor into the vehicle. The clip must be removed after the retractor is installed.



2. Position the safety belt retractor. Install the nut and bolts.



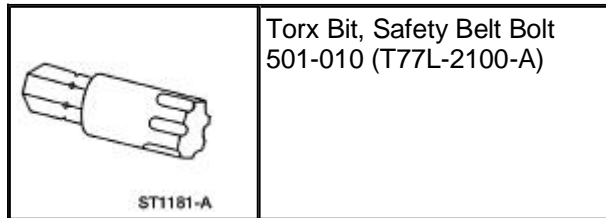
3. The shoulder belt must pass through the belt holder on the top of the seatback.



4. Install the quarter trim panel. For additional information, refer to [Section 501-05](#).
 5. Check the active restraint system for correct operation.
-

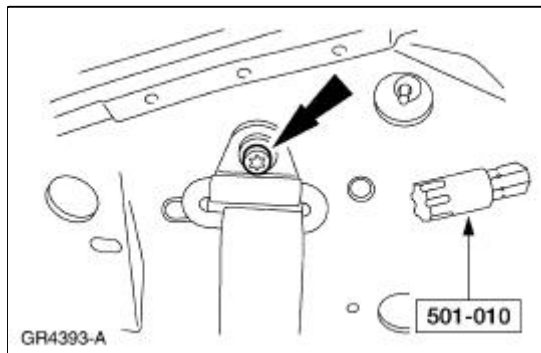
Retractor —Rear Seat Safety Belt, Coupe

Special Tool(s)

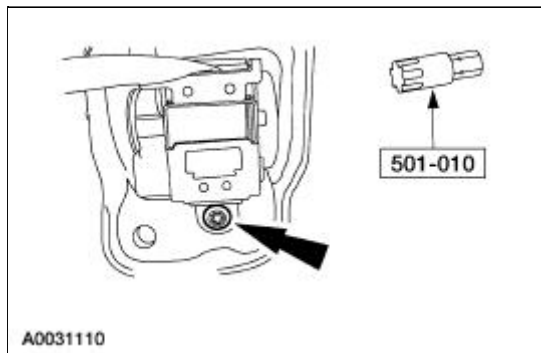


Removal

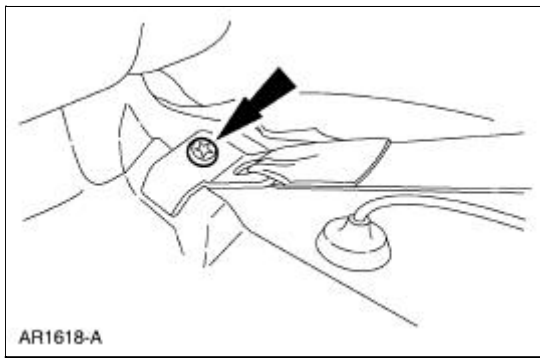
1. Remove the quarter trim panel (31012) and the angel wing trim. For additional information, refer to [Section 501-05](#).
2. Using the special tool, remove the D-ring bolt.



3. Using the special tool, remove the bolt and the safety belt retractor (611B68).



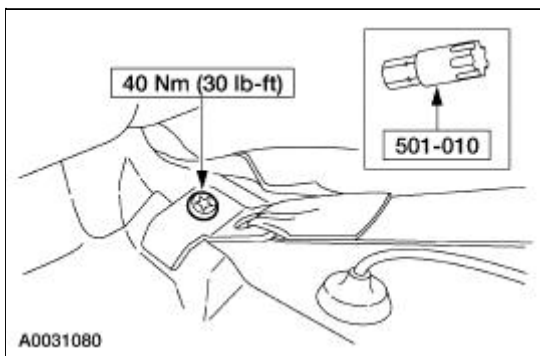
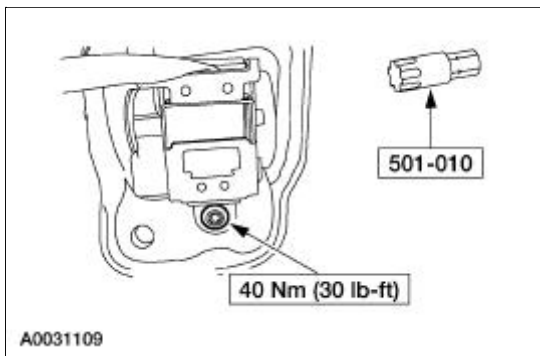
4. Remove the bolt.



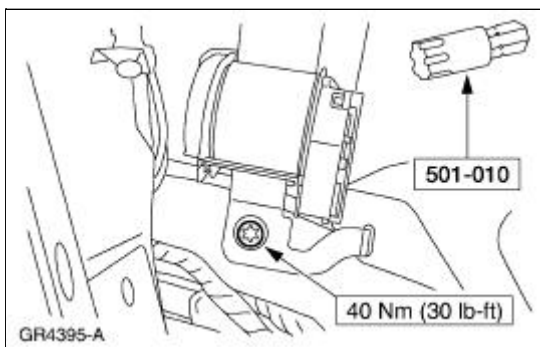
Installation

NOTE: Make sure the safety belt is not twisted when inserting it in the quarter trim panel.

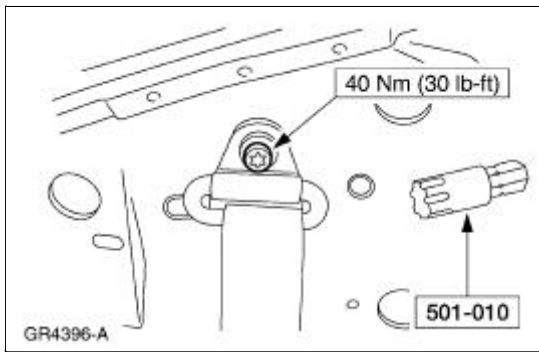
1. Install the bolt.



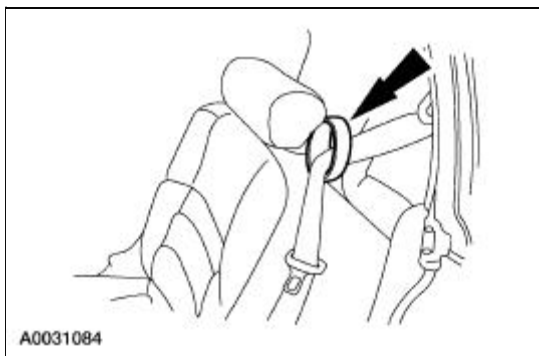
2. Using the special tool, install the safety belt retractor and the bolt.



3. Using the special tool, install the D-ring bolt.



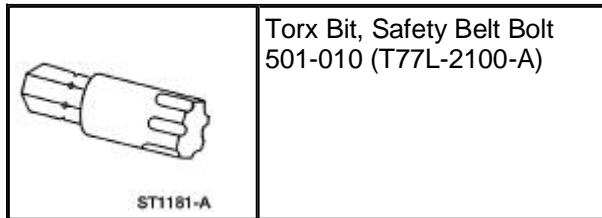
4. Install the quarter trim panel (31012) and the angel wing trim. For additional information, refer to [Section 501-05](#).
5. Make sure the shoulder belt passes through the belt holder on the top of the seatback.



6. Check the active restraint system for correct operation.
-

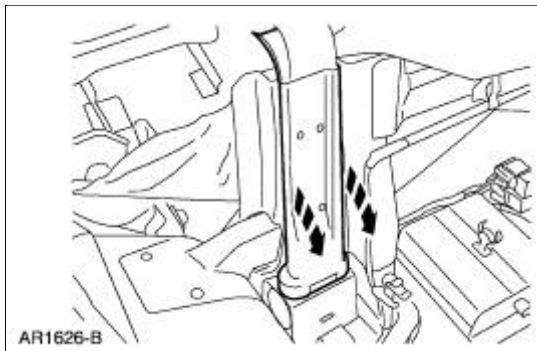
Retractor —Rear Seat Safety Belt, Convertible

Special Tool(s)

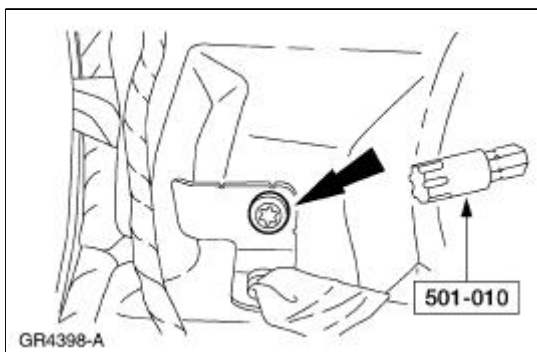


Removal

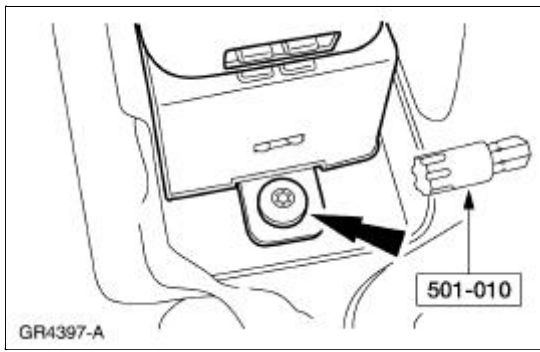
1. Remove the rear seat cushion.
2. Remove the luggage compartment front lining board (45444).
3. Release the safety belt guide.



4. Using the special tool, remove the safety belt anchor bolt.



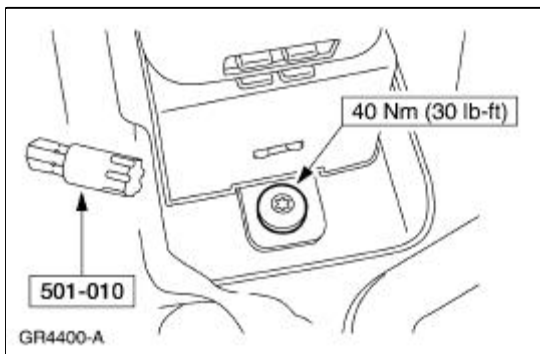
5. Using the special tool, remove the bolt and the rear safety belt retractor.



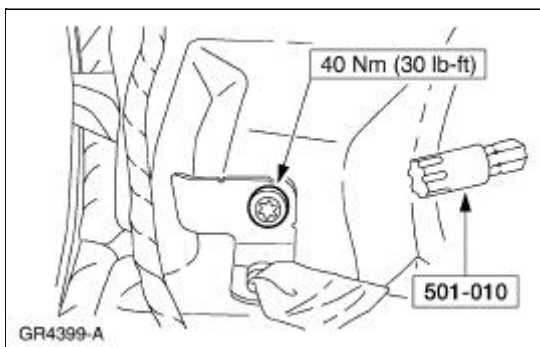
Installation

NOTE: Make sure the safety belt is not twisted when inserting it in the quarter trim panel.

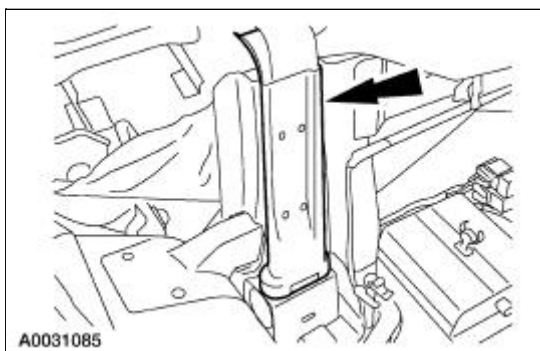
1. Using the special tool, install the bolt and the rear safety belt retractor.



2. Using the special tool, install the safety belt anchor bolt.

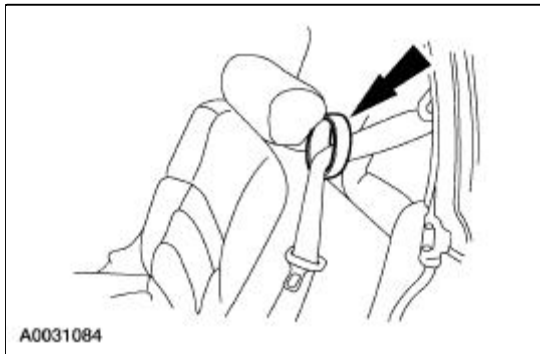


3. Install the safety belt guide.



4. Install the luggage compartment front lining board.

5. Install the rear seat cushion.
6. Make sure the shoulder belt passes through the belt holder on the top of the seatback.



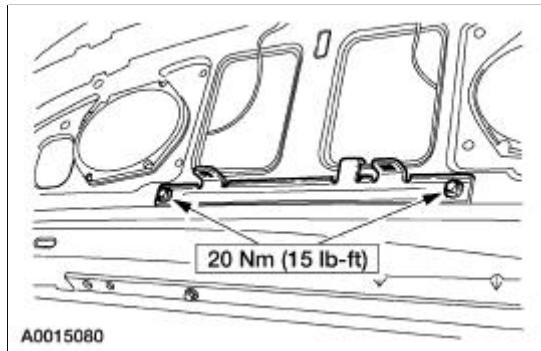
7. Check the active restraint system for correct operation.
-

Child Safety Seat Belt —Tether Anchor

Removal and Installation

Hard top only

1. Remove the package tray. For additional information, refer to [Section 501-05](#).
2. Remove the bolts and the tether anchor bracket.

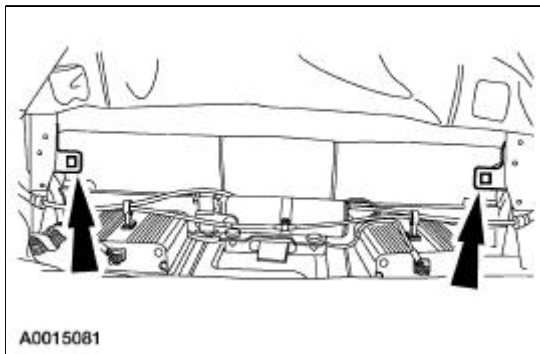


Convertible only

3. **NOTE:** Rework the sheet metal to its original condition and structural integrity.

The convertible model tether anchors are part of the sheet metal.

- These are accessed through the trunk by removing the trunk front trim.



Hard top only

4. **NOTE:** Rework the sheet metal to its original condition and structural integrity.

To install, reverse the removal procedure.

Hard top and convertible

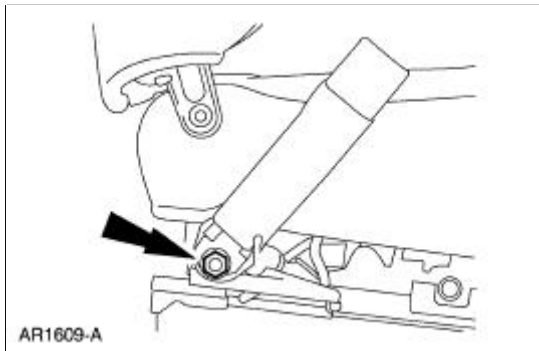
5. Check the restraint system for correct operation.

Safety Belt Buckle —Front Seat

Removal

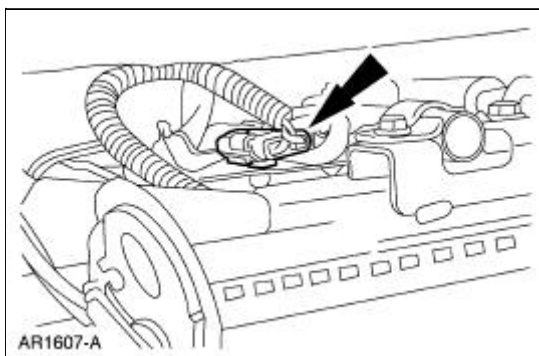
Driver and passenger seat

1. Remove the front seat. For additional information, refer to [Section 501-10](#).
2. Remove the nut and the safety belt buckle.



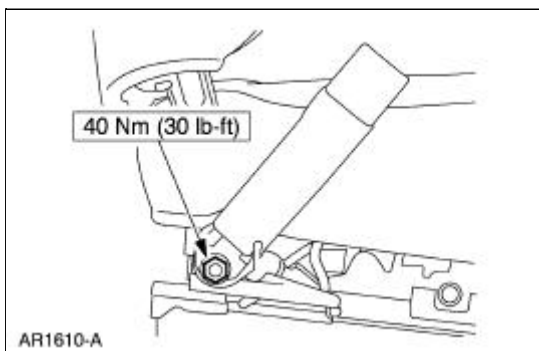
Driver seat only

3. Disconnect the safety belt buckle electrical connector.



Installation

1. To install, reverse the removal procedure.

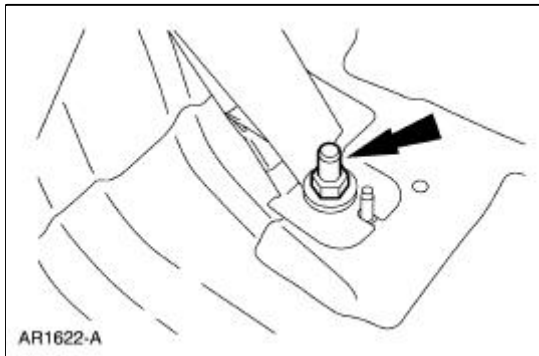


2. Check the restraint system for correct operation.

Safety Belt Buckle —Rear Seat

Removal

1. Remove the rear seat cushion.
2. Remove the bolt and the safety belt buckle.

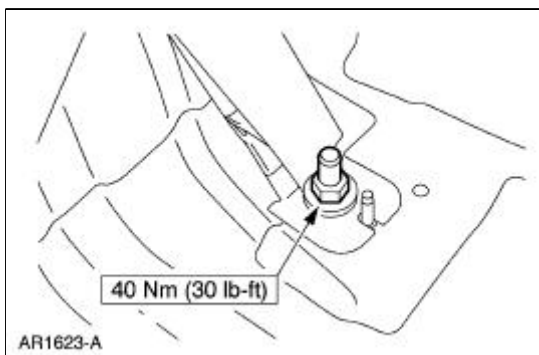


Installation

1. **NOTE:** LH and RH rear seat safety belt buckles have different anchor plates. Make sure correct part is used when installing buckle and anchor plate in the anchor locator feature.

NOTE: LH rear seat safety belt buckle anchor plate shown.

To install, reverse the removal procedure.



2. Make sure the safety belt buckles are routed correctly and are placed through the seat cushion.
3. Check the restraint system for correct operation.

Child Safety Seat Tether Anchor —LATCH

Removal and Installation

1. Remove the lower anchors and tethers for children (LATCH) attachment fasteners.
 2. Remove the LATCH attachment.
 3. To install, reverse the removal procedure.
-

Torque Specifications

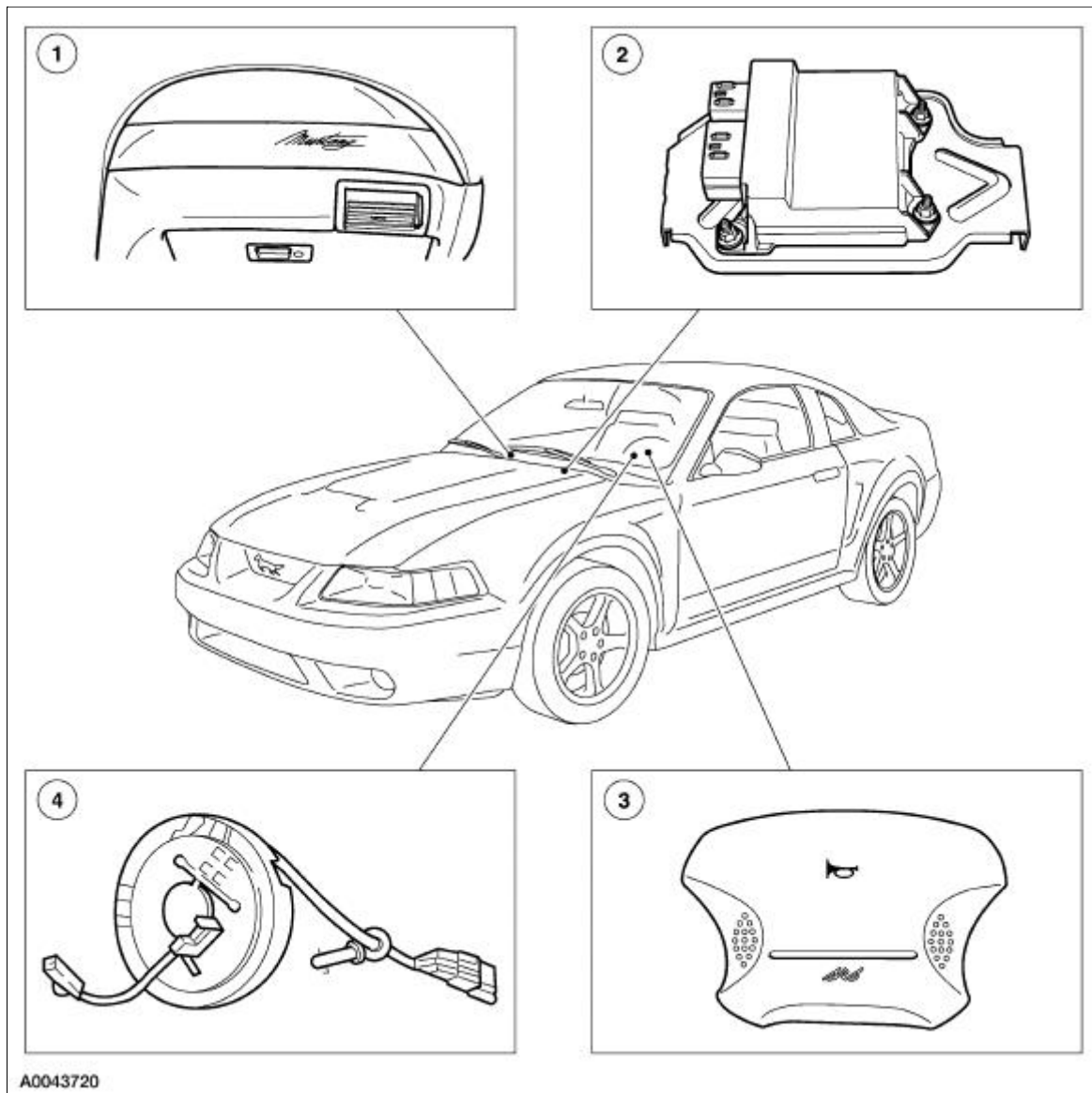
Description	Nm	lb-ft	lb-in
Restraints control module bracket bolts	12	9	—
Driver air bag bolts	9	—	80
Passenger air bag bolts	9	—	80
Crash sensor grounding screw (N802455-S190) Weld nut repair screw (8 mm)	15	11	—
Grounding screw (6 mm) (N806327-S190)	12	9	—

Air Bag Supplemental Restraint System (SRS)

The air bag supplemental restraint system (SRS) is designed to provide increased collision protection for front seat occupants in addition to that provided by the three-point safety belt system. Safety belt use is necessary to obtain the best occupant protection and to receive the full advantages of the SRS.

The air bag supplemental restraint system (SRS) components are shown in the following illustration.

Air Bag Supplemental Restraint System (SRS) Components



Item	Part Number	Description
1	044A74	Passenger air bag module
2	14B321	Restraints control module (RCM)
3	043B13	Driver air bag module
4	14A664	Clockspring

Driver Air Bag Module

The driver air bag module:

- is installed as an assembly.
- is mounted in the center of the steering wheel.

Clockspring

The clockspring:

- is mounted on the steering column, behind the steering wheel.
- provides a continuous electrical path from the restraints control module (RCM) to the driver air bag.

Passenger Air Bag Module

The passenger air bag module:

- is installed as an assembly.
- is mounted in the RH side of the instrument panel.

Restraints Control Module (RCM)

The restraints control module (RCM) performs the following functions:

- signals the inflators to deploy the air bags in the event of a deployable crash.
- monitors the air bag supplemental restraint system (SRS) for faults.
- illuminates the air bag indicator if a fault is detected.
- flashes the air bag indicator to indicate the lamp fault code (LFC) detected.
- communicates through the data link connector (DLC) the current or historical diagnostic trouble codes (DTCs).
- signals the generic electronic module (GEM) to activate a chime if the air bag indicator is not available and another SRS fault exists.

NOTE: The safing sensor is internal to the RCM and is not repaired separately.

The RCM monitors the SRS for possible faults. If a fault is detected while the ignition switch is in the RUN position, the RCM will illuminate the air bag indicator located in the instrument cluster.

When the ignition is cycled (turned off and then on), the air bag indicator will begin its prove out sequence. During prove out the air bag indicator will illuminate for six seconds, go off for two seconds and then, if a system fault exists, flash the two-digit LFC. The air bag indicator will flash the LFC five times, then it will remain illuminated for the rest of the key cycle. The RCM will also communicate the

current and historical DTCs through the DLC, using a scan tool. If the air bag indicator does not function, and the system detects a fault condition, the RCM will signal the GEM to activate an audible chime. The chime is a series of five sets of five tone bursts. If the chime is heard, the SRS and the air bag indicator require repair.

LFCs are prioritized. If two or more faults occur at the same time, the fault having the highest priority will be displayed. After that fault has been corrected, the next highest priority fault will be displayed.

The RCM includes a backup power supply. This feature provides sufficient backup power to deploy the air bags in the event that the ignition circuit is damaged in a collision before the safing and air bag sensors determine that deployment is required. The backup power supply will deplete its stored energy approximately one minute after the battery ground cable is disconnected.

Electrical System

The electrical system that supports the air bag supplemental restraint system (SRS):

- is powered from the battery through the ignition circuit.
- provides the electrical path from the restraints control module (RCM) to the air bag modules.
- provides the electrical path from the RCM to the air bag indicator.
- provides the electrical path from the RCM to the data link connector (DLC).
- provides the electrical path from the RCM to the generic electronic module (GEM).

Sensor



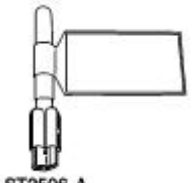
WARNING: The restraints control module (RCM) orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) has been involved in a collision in which the center tunnel area has been damaged, inspect the mounting and bracket for deformation. If damaged, the RCM must be replaced whether or not the air bags have deployed. In addition, make sure the area of the RCM mounting is restored to its original condition.

The SRS contains two sensors which are integral to the RCM. The RCM is mounted on the center tunnel under the instrument panel.

Air Bag Supplemental Restraint System (SRS)

Refer to Wiring Diagrams Cell [46](#), Air Bag for schematic and connector information.

Special Tool(s)

 ST2506-A	Diagnostic Tool, Restraint System 418-F088 (105-R0012)
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Restraint System Diagnostic Tool Warning



WARNING: This tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

Diagnosing Customer Concerns Without Hard DTCs

If a lamp fault code (LFC) is reported by the customer but is not present when the vehicle comes in for service, follow the Diagnostic Instructions procedure in this section to identify the intermittent DTC.

Once the DTC is known, read the Normal Operation section of the pinpoint test for the DTC involved.

- Follow the deactivation procedure in this section.
- Determine the location of components involved in creating that code.
- Perform a thorough visual inspection of:
 - components.
 - connectors.
 - splices and wiring harnesses.
 - pinched wires.
 - worn insulation on conductors.

Refer to the Possible Causes section of the pinpoint test for the DTC involved, which lists the common concerns that relate to the DTC. Concerns are listed according to priority.

Diagnosing Customer Concerns with Hard DTCs



WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

Most air bag supplemental restraint system (SRS) diagnostic procedures will require the use of the deactivation and reactivation procedures in this section.

The deactivation and reactivation require the installation and removal of restraint system diagnostic tools. These procedures require removal of driver air bag module, and the disconnection of the passenger air bag module. This reduces the risk of deployment of air bag modules and safety belt pretensioners while diagnostics are being carried out.

Restraint system diagnostic tools are required to carry out diagnosis and testing of the supplemental restraint system (SRS). It is not acceptable to short-circuit the air bag module connections with a jumper wire. If a jumper wire is used to short-circuit the air bag module connections, a lamp fault code (LFC) will be displayed.



WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

The reactivation procedure requires the removal of any restraint system diagnostic tools installed and the reconnection of any air bag modules disconnected.

Deactivation Procedure



WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to [Air Bag Supplemental Restraint System \(SRS\)](#) in this section.


The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury.

NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road.**

NOTE: After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

1.  **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**


Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.


The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).


Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).

2. Wait at least one minute for the backup power supply in the restraints control module (RCM) to deplete its stored energy.

3.  **WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.**


 **WARNING: Do not set an air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.**

Remove the driver air bag module from the vehicle. Refer to [Driver Air Bag Module](#) in this section.

4.  **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

Connect a restraint system diagnostic tool to the vehicle harness at the top of the steering column.


5. Disconnect the passenger air bag module electrical connector.


6.  **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

Connect a restraint system diagnostic tool to the vehicle harness.

7. Reconnect the battery ground cable. For additional information, refer to [Section 414-01](#).

Reactivation Procedure


1.  **WARNING: The restraint system diagnostic tool must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury.**

 **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**


Disconnect the battery ground cable. Refer to [Section 414-01](#).

2. Wait at least one minute for the backup power supply in the restraints control module (RCM) to deplete its stored energy.
3. Remove the restraint system diagnostic tool from the vehicle harness connector at the top of the

steering column.

4.  **WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.**

Install the driver air bag module. Refer to [Driver Air Bag Module](#) in this section.

5.  **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

Remove the restraint system diagnostic tool from the vehicle harness connector at the passenger air bag module.

6. Connect the passenger air bag module electrical connector.
7. Reconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
8. Prove out the system.

Prove Out Procedure

Turn the ignition switch from the OFF to the RUN position and visually monitor the air bag indicator with the air bag modules or restraint system diagnostic tools installed. The air bag indicator will light continuously for approximately six seconds and then turn off. If an air bag supplemental restraint system (SRS) fault is present, the air bag indicator will either:

- fail to light.
- remain lit continuously.
- flash.

The flashing might not occur until approximately 30 seconds after the ignition switch has been turned from the OFF to the RUN position. This is the time required for the restraints control module (RCM) to complete the testing of the SRS. If the air bag indicator is inoperative and an SRS fault exists, a chime will sound in a pattern of five sets of five beeps. If this occurs, the air bag indicator will need to be repaired before diagnosis can continue.

Glossary

Restraint System Diagnostic Tool

Restraint system diagnostic tools are used to simulate air bag module connections to the system.

Disconnect the Component

Disconnect the component means disconnect the component vehicle harness connector. It does not mean remove the component. Do not reconnect a disconnected component unless instructed to do so.

Deactivate the System

Deactivate the system means to perform the deactivation procedure. Refer to Deactivation Procedure in this section.

Prove Out the System

Prove out the system means to turn the ignition switch from the OFF to the RUN position and visually monitor the air bag indicator with the air bag modules installed. Refer to Prove Out Procedure in this section.

Reactivate the System

Reactivate the system means to perform the reactivation procedure. Refer to Reactivation Procedure in this section.

Reconnect the System

Reconnect the system means to reconnect all system components. Refer to Air Bag System Reconnect Checklist in this section.

Install a New Component

Install a new component means to remove the existing component and install a new authorized part obtained from Ford Customer Service Division.

Verify the System

Verify the system means to prove out the system with restraint system diagnostic tools for the air bag modules in place of components.


Air Bag System Reconnect Checklist

The checklist below should be completed following diagnosis or repair of any air bag system concern.

1. Is the connector at the base of the steering column connected?
 2. Are the air bag modules connected?
 3. Is the restraints control module (RCM) connected?
 4. Is the vehicle battery connected?
-

Diagnostic Instructions — Air Bag Supplemental Restraint System (SRS)

Special Tool(s)

	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool
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The symptom chart can be used to help locate the air bag supplemental restraint system (SRS) concerns if no diagnostic trouble codes (DTCs) are retrieved and the listed symptoms are observed. Whether or not the listed symptoms are observed, always perform the following.

1. Retrieve all DTCs stored in the restraints control module (RCM) memory. Refer to Retrieve/Clear Continuous DTCs in this section.
2. Run the On-Demand Self Test to determine what DTCs are currently being sensed by the restraints control module (RCM) (14B321). Refer to On-Demand Self Test in this section.
3. If the stored DTCs are different than the current DTCs, always repair the current DTCs first.
4. If memory displays different continuous DTCs than the On-Demand Self-Test, perform in the following order:
 - On-Demand Self-Test.
 - Memory (Retrieve/Clear Continuous DTCs).

A DTC can indicate several concerns. The DTCs are to assist in system diagnosis and are not to be considered definitive. Always refer to the pinpoint test corresponding to the DTC to determine where the concern lies and to repair the concern correctly.

The SRS diagnostics can be divided into three sections.

- Diagnostic test modes
- PID/data monitor and record
- Active command modes

Diagnostic Test Modes

Two menu options are available under the diagnostic test modes.

- Retrieve/Clear Continuous DTCs.
- On-Demand Self Test.

Retrieve/Clear Continuous DTCs

During vehicle operation, the restraints control module (RCM) will detect and store both intermittent and hard fault DTCs in nonvolatile memory. The DTC strategy employed by the RCM incorporates a time-out scheme for determining when a concern exists in the system. This requires a concern to exist for up to one minute in the system before the RCM will detect it. For the RCM to determine that a concern no longer exists, the concern must be absent for up to one minute. The actual detection time-outs vary with each DTC. The DTCs can be retrieved with a scan tool. Any DTCs stored in the RCM will be displayed on the scan tool along with a brief description of the DTC. If no DTCs are present, the scan tool will display a SYSTEM PASSED message. This option can also be used to clear DTCs from the RCM memory, as long as the concern no longer exists. Once 128 key cycles have been recorded since the concern was last detected, the DTC will automatically be removed from memory.

To retrieve or clear DTCs, follow these steps.

1. Connect the scan tool to the data link connector (DLC).
2. Turn the ignition switch to the RUN position.
3. Follow manufacturer's instructions for the scan tool being used.
4. All continuous DTCs will be displayed. Before proceeding with the clearing operation, make note of the DTCs displayed because, once cleared, they cannot be retrieved.
5. The scan tool will retrieve DTCs again after clearing DTCs and, if any remain, they will be displayed. Hard DTCs will be redisplayed after clearing DTCs since they cannot be cleared from the RCM.

On-Demand Self Test

The On-Demand Self Test option is used to verify that no electrical concerns exist with the air bag supplemental restraint system (SRS). Upon entering the self test, the restraints control module (RCM) will make an electrical check of each electrical component in the system. If a concern is detected, a DTC is displayed on the scan tool with a brief description of the DTC. Concerns detected during the self test are not stored in memory, unless the same concern was also detected during normal vehicle operation. The self test should always be run after any repair to verify that the repair was successful.

To run the On-Demand Self Test, follow these steps:

6. Connect a scan tool to the data link connector (DLC).
7. Turn the ignition switch to the RUN position.
8. Follow manufacturer's instructions for the scan tool being used.
9. The RCM will run the On-Demand Self Test and display on-demand DTCs (reflecting hard system concerns) on the screen.

PID/Data Monitor and Record

The PID/Data Monitor and Record option allows the scan tool operator to read the state of several parameter IDs (PIDs) to aid in diagnosing the system. PIDs are real time measurements of parameters such as voltages, resistances, etc., calculated by the restraints control module (RCM) and sent to the scan tool for display. Many of the PIDs supported by the RCM are calculated periodically and are, therefore, not true real time readings.

To retrieve PIDs, follow these steps:

1. Connect the scan tool to data link connector (DLC).

2. Turn the ignition switch to the RUN position.
3. Follow manufacturer's instructions for the scan tool being used.
4. PIDs are continuously updated on the display.

Active Commands

This command allows the technician to verify operation of the air bag indicator and chime. When the air bag output command is executed, the indicator and the chime are activated simultaneously for approximately four seconds. Both devices are deactivated automatically.

Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table

DTC ^a	LFC ^b	LFC Priority	Description	Action To Take
—	—	1	The Air Bag Indicator is Illuminated Continuously — RCM Disconnected, Inoperative, or Lost/Low Ignition Feed	Go To Pinpoint Test A.
B1342	24	2	RCM Is Faulted	INSTALL a new RCM.
B1231	19	3	RCM Crash Data Memory Full	INSTALL a new RCM.
B1921	21	4	RCM Bracket Ground Resistance High	Go To Pinpoint Test B.
C1414	29	5	Incorrect Vehicle Identification Code	Go To Pinpoint Test C.
B1887	15	6	Driver Air Bag Circuit Shorted to Ground	Go To Pinpoint Test D.
B1916	15	7	Driver Air Bag Circuit Shorted to Battery or Ignition	Go To Pinpoint Test E.
B1888	16	8	Passenger Air Bag Circuit Shorted to Ground	Go To Pinpoint Test F.
B1925	16	9	Passenger Air Bag Circuit Shorted to Battery or Ignition	Go To Pinpoint Test G.
B1932	32	10	Driver Air Bag Circuit Resistance High	Go To Pinpoint Test H.
B1933	33	11	Passenger Air Bag Circuit Resistance High	Go To Pinpoint Test I.
B1934	34	12	Driver Air Bag Circuit Resistance Low	Go To Pinpoint Test J.
B1935	35	13	Passenger Air Bag Circuit Resistance Low	Go To Pinpoint Test K.
B1892	—	17	Air Bag Tone Warning Indicator Circuit Shorted to Ground or Open	Go To Pinpoint Test L.
B1891	—	18	Air Bag Tone Warning Indicator Circuit Shorted to Battery or Ignition	Go To Pinpoint Test M.
B1869	Tone _c	19	Air Bag Indicator Inoperative	Go To Pinpoint Test N.
B1870	Tone _c	20	Air Bag Indicator Shorted to Battery	Go To Pinpoint Test O.

—	—	—	No Communication with the Restraints Control Module	Go To Pinpoint Test P.
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^a DTC: Diagnostic Trouble Code, retrieved using a scan tool.

^b LFC: Lamp fault code, flashed on air bag indicator.


^c Tone will sound only if additional DTCs are present.

Inspection and Verification

1. Verify the customer concern by checking the air bag indicator in the instrument cluster. Refer to Prove Out the System in this section.
2. Visually inspect for obvious signs of mechanical and electrical damage using the following chart:

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> ● Damaged restraints control module (RCM) bracket 	<ul style="list-style-type: none"> ● Open fuse(s) ● Damaged wiring harness ● Loose or corroded connectors ● Circuitry open/shorted

3. If the concern is not visually evident, use the scan tool to retrieve diagnostic trouble codes (DTCs) and perform the on-demand self test.
4.  **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

If the on-demand self test is passed and no DTCs are retrieved, GO to [Symptom Chart](#).

5. If DTCs are retrieved, proceed to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table.

Symptom Chart

Symptom Chart


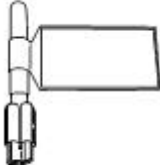

Condition	Possible Sources	Action
<ul style="list-style-type: none"> ● Air bag warning indicator is illuminated continuously 	<ul style="list-style-type: none"> ● Circuitry. ● Worn or damaged connector component. ● RCM. ● Instrument cluster. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test A.
<ul style="list-style-type: none"> ● Air bag indicator flashing 	<ul style="list-style-type: none"> ● Air bag SRS system fault. 	<ul style="list-style-type: none"> ● REFER to DTC Priority Table.
<ul style="list-style-type: none"> ● Audible tone — DTCs retrieved 	<ul style="list-style-type: none"> ● Air bag SRS system fault. 	<ul style="list-style-type: none"> ● Go To Pinpoint Test N. ● Go To Pinpoint Test O.
<ul style="list-style-type: none"> ● No communication with the 	<ul style="list-style-type: none"> ● Scan Tool. 	<ul style="list-style-type: none"> ● Go To Pinpoint

restraints control module	<ul style="list-style-type: none">● Data Link Connector (DLC).● RCM.● Circuitry.	Test P.
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Pinpoint Tests — Air Bag Supplemental Restraint System (SRS)

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2506-A	Diagnostic Tool, Restraint System 418-F088 (105-R0012)
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

Restraint System Diagnostic Tool Warning

 **WARNING:** This tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

Pinpoint Test Note

Do not carry out any pinpoint test unless directed by the Symptom Chart.

Pinpoint Test A: The Air Bag Warning Indicator Is Illuminated Continuously — RCM Disconnected, Inoperative or Lost/Low Ignition Feed

Normal Operation

NOTE: During normal operation the air bag indicator will be lit continuously for 6 seconds after the ignition switch is placed in the RUN position and after five cycles of a lamp fault code (LFC) if a fault exists. Be sure to cycle the ignition switch and look for a 6 second indicator prove-out without LFCs.


The restraints control module (RCM) will communicate diagnostic trouble codes (DTCs) to the scan tool through the data link connector (DLC). If the scan tool displays NO COMMUNICATION when retrieving continuous DTCs, [Go To Pinpoint Test P](#) to troubleshoot the system.

Possible Causes

An air bag indicator that is illuminated continuously can be caused by one of the following:

- worn or damaged shorting bar or camming beam.
- the ignition circuit damaged.
- the RCM disconnected from the vehicle harness.
- a loss of RCM ground circuits.
- the RCM inoperative.
- circuitry.

PINPOINT TEST A: THE AIR BAG WARNING INDICATOR IS ILLUMINATED CONTINUOUSLY — RCM DISCONNECTED, INOPERATIVE, OR LOST/LOW IGNITION FEED

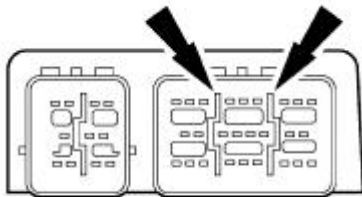
Test Step	Result / Action to Take
<p>A1 CHECK FOR CONTINUOUS OR ON-DEMAND SELF TEST DTCs</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Connect the diagnostic tool. Scan Tool ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Retrieve/Clear Continuous DTCs. ● Retrieve and record any continuous DTCs for use later in this pinpoint test. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Were any continuous or on-demand self test DTCs retrieved? 	<p>Yes If continuous DTCs were retrieved, GO to A3. If on-demand DTCs were retrieved, GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction.</p> <p>No GO to A2.</p>
<p>A2 CHECK THE RCM CONNECTION</p> <p> WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag Supplemental Restraint System (SRS) in this section.</p> <p>The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE: After diagnosing or</p>	<p>Yes GO to A3.</p> <p>No CONNECT C2041 and engage the locking tabs. GO to A7.</p>

repairing an SRS, the restraint system diagnostic tools must be removed before operating the vehicle over the road. **NOTE:** After diagnosing or repairing a seat system, the restraint system diagnostic tools must be removed before operating the vehicle over the road. **NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

- Key in OFF position.
- Deactivate the system. Refer to [Air Bag Supplemental Restraint System \(SRS\)](#) in this section.
- Key in OFF position.
- Connect: RCM C2041.
- Make sure RCM C2041 is fully connected and the red locking tab is engaged.
- **Is RCM C2041 fully connected and are the red locking tabs engaged?**

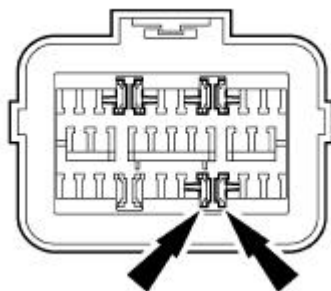
A3 CHECK THE RCM CONNECTOR

- Key in OFF position.
- Disconnect: RCM C2041.
- Inspect C2041 component side for a worn, or damaged camming beam. Inspect for foreign material.



DR1540-A

- **NOTE:** The shorting bars can be accessed by prying out the blue cover from the harness side of the connector.
- Inspect C2041 harness side for worn, damaged, or dislodged shorting bar at pins 20 and 21. Inspect for foreign material.



DR1541-A

- **Were any connector concerns found?**

Yes
CORRECT
connector
concerns. GO to
[A7](#).

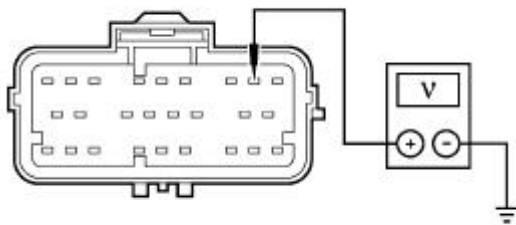
No
GO to [A4](#).

A4 CHECK THE IGNITION CIRCUIT 611 (WH/OG) FOR AN OPEN

- Key in ON position.
- Measure the voltage between RCM C2041 pin 2, circuit 611 (WH/OG), harness side and ground.

Yes
GO to [A5](#).

No
REPAIR the
circuit. GO to [A7](#).

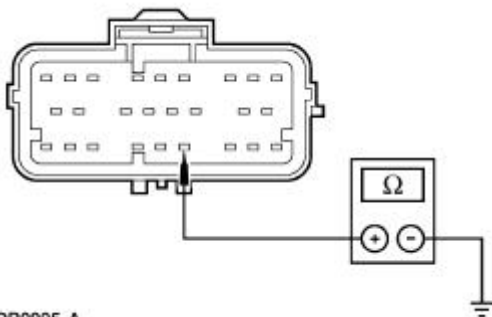


DR0994-A

- Is the voltage between 9 and 16 volts?

A5 CHECK THE GROUND CIRCUIT 397 (BK/WH) FOR AN OPEN

- Key in OFF position.
- Measure the resistance between RCM C2041 pin 21, circuit 397 (BK/WH), harness side and a sheet metal ground near the RCM.



DR0995-A

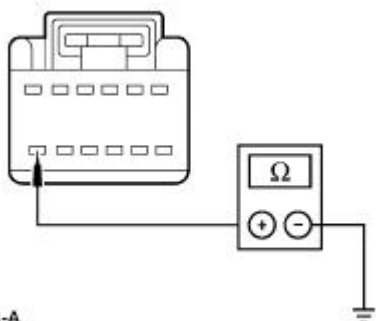
- Is the resistance less than 10 ohms?

Yes
GO to [A6](#).

No
REPAIR the circuit. GO to [A7](#).

A6 CHECK CIRCUIT 608 (BK/YE) FOR A SHORT TO GROUND

- Connect: RCM C2041.
- Disconnect: Instrument Cluster C220a.
- Measure the resistance to ground at instrument cluster C220a pin 12, circuit 608 (BK/YE), harness side.



DR1614-A

- Is the resistance less than 10,000 ohms?

Yes
REPAIR the circuit. GO to [A7](#).

No
INSTALL a new RCM. GO to [A7](#).

A7 CHECK FOR ADDITIONAL DTCs

- Refer to the continuous DTCs recorded during Step A1.
- Were any continuous DTCs retrieved during Step A1?

Yes
Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this

section for pinpoint test direction.

No
 RECONNECT the system.
 REACTIVATE the system. PROVE OUT the system.
 REFER to [Air Bag Supplemental Restraint System \(SRS\)](#) in this section. CLEAR all DTCs.

Pinpoint Test B: LFC 21/DTC B1921 — RCM Bracket Ground Resistance High

Normal Operation



WARNING: The tightening torque of the restraints control module (RCM) retaining bolts is critical for proper air bag supplemental restraint system (SRS) operation. Refer to [Restraints Control Module \(RCM\)](#) in this section for correct torque values.

The restraints control module (RCM) monitors the resistance between the ground connections at its housing and the reference ground at pin 21. If the RCM detects a resistance greater than 100 ohms, it will store a diagnostic trouble code (DTC) B1921 in memory and flash a lamp fault code (LFC) 21 (or higher priority code if one exists) on the air bag indicator.

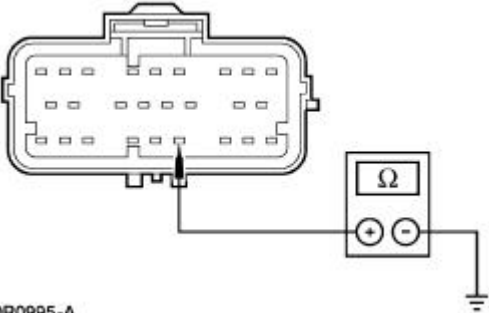
Possible Causes

High resistance between the RCM housing ground and pin ground can be caused by:

- incorrect seating of the RCM retaining bolts.
- incorrect tightening torque of the RCM retaining bolts.
- high resistance on RCM logic ground circuit 397 (BK/WH).

PINPOINT TEST B: LFC 21/DTC B1921 — RCM BRACKET GROUND RESISTANCE HIGH

Test Step	Result / Action to Take
B1 CHECK FOR A HARD OR INTERMITTENT DTC	
<ul style="list-style-type: none"> ● Key in OFF position. ● Connect the diagnostic tool. Scan Tool ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Retrieve/Clear Continuous DTCs. ● Retrieve and record any continuous DTCs for use later in this pinpoint test. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Was DTC B1921 retrieved during the on-demand self 	<p>Yes This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to B2.</p> <p>No</p>

<p>test?</p>	<p>This is an intermittent fault. The fault condition is not present at this time. GO to B6.</p>
<p>B2 INSPECT THE RCM MOUNTING, MOUNTING BRACKET AND MOUNTING SURFACE</p>	
<ul style="list-style-type: none"> ● Remove the RCM. Refer to Restraints Control Module (RCM) in the Removal and Installation portion of this section. ● Visually inspect the RCM, mounting bracket and mounting surface for damage, corrosion or dirt. ● Inspect the RCM mounting and make sure that the retaining bolts are fully seated and tightened correctly. Refer to Restraints Control Module (RCM) in the Removal and Installation portion of this section for correct tightening torque. ● Was a significant amount of corrosion or dirt found, the RCM mounting bracket attached to the mounting surface incorrectly or were the three RCM retaining bolts not fully seated and tightened correctly? 	<p>Yes Make sure the RCM, mounting bracket and mounting surface are free of damage, corrosion or dirt and the three retaining bolts are fully seated and correctly tightened. Reattach the RCM and mounting bracket to the mounting surface. GO to B7.</p> <p>No GO to B3.</p>
<p>B3 CHECK THE RCM HARNESS CONNECTION</p>	
<ul style="list-style-type: none"> ● Check the RCM harness connection. ● Is the RCM harness connector connected to the RCM correctly? 	<p>Yes GO to B4.</p> <p>No ATTACH the RCM harness connector correctly. GO to B7.</p>
<p>B4 CHECK THE VEHICLE CHASSIS GROUND</p>	
<ul style="list-style-type: none"> ● Measure the resistance between a known good chassis ground and the mounting surface of the RCM. ● Is the resistance greater than 100 ohms? 	<p>Yes REPAIR the chassis grounding system. GO to B7.</p> <p>No GO to B5.</p>
<p>B5 CHECK THE GROUND CIRCUIT 397 (BK/WH) FOR AN OPEN</p>	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: RCM C2041. ● Measure the resistance between RCM C2041 pin 21, circuit 397 (BK/WH), harness side and a sheet metal ground near the RCM.  <p>DR0995-A</p> <ul style="list-style-type: none"> ● Is the resistance greater than 100 ohms? 	<p>Yes REPAIR the circuit. GO to B7.</p> <p>No INSTALL a new RCM. GO to B7.</p>
<p>B6 CHECK FOR AN INTERMITTENT FAULT</p>	
<ul style="list-style-type: none"> ● Refer to the continuous DTCs recorded during Step B1. 	<p>Yes</p>

<ul style="list-style-type: none"> ● Was the continuous DTC retrieved during Step B1 an intermittent fault? 	<p>CHECK for causes or intermittent high resistance on circuit 397 (BK/WH). Attempt to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to B7.</p> <p>No GO to B7.</p>
<p>B7 CHECK FOR ADDITIONAL DTCs</p>	<p>Yes Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction.</p> <p>No RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag Supplemental Restraint System (SRS) in this section. CLEAR all DTCs.</p>
<ul style="list-style-type: none"> ● Refer to the continuous DTCs recorded during Step B1. ● Were any continuous DTCs retrieved during Step B1? 	

Pinpoint Test C: LFC 29/DTC C1414 — Incorrect Vehicle Identification Code

Normal Operation

The restraints control module (RCM) monitors the electrical state of pins 10, 13 and 14 to determine if it is installed on the correct vehicle. If the RCM detects an incorrect condition on any of these pins, it will store a diagnostic trouble code (DTC) C1414 in memory and flash a lamp fault code (LFC) 29 (or higher priority code if one exists) on the air bag indicator.


Possible Causes

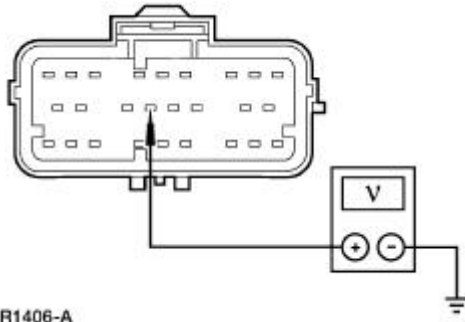
An incorrect vehicle identification code can be caused by:

- an RCM installed on the wrong vehicle.
- an incorrectly programmed RCM.
- vehicle ID pins not connected as expected.

PINPOINT TEST C: LFC 29/DTC C1414 — INCORRECT VEHICLE IDENTIFICATION CODE

Test Step	Result / Action to Take
C1 CHECK FOR A HARD OR INTERMITTENT DTC	

<ul style="list-style-type: none"> ● Key in OFF position. ● Connect the diagnostic tool. Scan Tool ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Retrieve/Clear Continuous DTCs. ● Retrieve and record any continuous DTCs for use later in this pinpoint test. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Was DTC C1414 retrieved during the on-demand self test? 	<p>Yes This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to C2.</p> <p>No This is an intermittent fault. The fault condition is not present at this time. GO to C5.</p>
C2 CHECK THE VEHICLE IDENTIFICATION PINS NO. 1 AND NO. 2	
<p> WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag Supplemental Restraint System (SRS) in this section.</p> <p>The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE: After diagnosing or repairing an SRS, the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE: After diagnosing or repairing a seat system, the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer. NOTE: For this vehicle application, RCM C2041 pins 10 and 13 should be open circuited.</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Deactivate the system. Refer to Air Bag Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● Key in OFF position. ● Disconnect: RCM C2041. ● Make sure the RCM C2041 pin 10 and pin 13 connector slots are empty and no connection is made when connected to the RCM. ● Are the RCM C2041 pin 10 and pin 13 connector slots empty? 	<p>Yes GO to C3.</p> <p>No REPAIR any concern found at the RCM C2041 pin 10 and pin 13 connector slots. GO to C6.</p>
C3 CHECK THE VEHICLE IDENTIFICATION PIN NO. 3	
<p>NOTE: For this vehicle application, RCM C2041 pin 14, circuit 611 (WH/OG) should be connected to ignition voltage.</p> <ul style="list-style-type: none"> ● Measure the voltage at RCM C2041 pin 14, circuit 611 (WH/OG), harness side and ground. 	<p>Yes GO to C4.</p> <p>No REPAIR the circuit. GO to C6.</p>



DR1406-A

- Is the voltage greater than 10 volts?

C4 CHECK THE RCM PROGRAMMED VEHICLE ID

- Enter the following diagnostic mode on the diagnostic tool: PID/Data Monitor and Record.
- Select PID VID No. 1, VID No. 2, and VID No. 3.
- Was vehicle ID No. 1 and vehicle ID No. 2 no connect and vehicle ID No. 3 ignition?

Yes
GO to [C5](#).

No
INSTALL a new RCM. GO to [C6](#).

C5 CHECK FOR AN INTERMITTENT FAULT

- Refer to the continuous DTCs recorded during Step C1.
- Was the continuous DTC retrieved during Step C1 an intermittent fault or were you directed to this step from Step C4?

Yes
CHECK for causes of an intermittent open on circuit 611 (WH/OG). Attempt to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to [C6](#).

No
GO to [C6](#).

C6 CHECK FOR ADDITIONAL DTCs

- Refer to continuous DTCs recorded during Step C1.
- Were any continuous DTCs retrieved during Step C1?

Yes
Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction.

No
RECONNECT the system.
REACTIVATE the

system. PROVE OUT the system. REFER to [Air Bag Supplemental Restraint System \(SRS\)](#) in this section. CLEAR all DTCs.

Pinpoint Test D: LFC 15/DTC B 1887— Driver Air Bag Circuit Shorted to Ground

Normal Operation

The restraints control module (RCM) checks for driver air bag circuit shorts to ground by monitoring the voltage of circuits 614 (GY/OG) and 615 (GY/WH) at pins 3 and 4. If the RCM detects a short to ground on either of these pins, it will store a diagnostic trouble code (DTC) B1887 in memory and flash a lamp fault code (LFC) 15 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

A driver air bag circuit short to ground can be caused by:

- a short to ground on circuit 614 (GY/OG).
- a short to ground on circuit 615 (GY/WH).
- a short to ground on the clockspring (14A664).
- a short to ground on the driver air bag module.
- an RCM internal concern.

PINPOINT TEST D: LFC 15/DTC B1887 — DRIVER AIR BAG CIRCUIT SHORTED TO GROUND

Test Step	Result / Action to Take
D1 CHECK FOR A HARD OR INTERMITTENT DTC	
<ul style="list-style-type: none"> ● Key in OFF position. ● Connect the diagnostic tool. Scan Tool ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Retrieve/Clear Continuous DTCs. ● Retrieve and record any continuous DTCs for use later in this pinpoint test. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Was DTC B1887 retrieved during the on-demand self test? 	<p>Yes This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to D2.</p> <p>No This is an intermittent fault. The fault condition is not present at this time. GO to D5.</p>

D2 CHECK THE DRIVER AIR BAG MODULE



WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to [Air Bag Supplemental Restraint System \(SRS\)](#) in this section.

The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. **NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, the restraint system diagnostic tools must be removed before operating the vehicle over the road. **NOTE:** After diagnosing or repairing a seat system, the restraint system diagnostic tools must be removed before operating the vehicle over the road. **NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

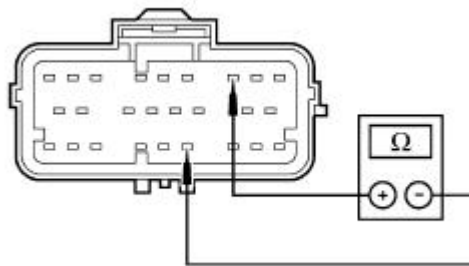
- Key in OFF position.
- Deactivate the system. Refer to [Air Bag Supplemental Restraint System \(SRS\)](#) in the Diagnosis and Testing portion of this section.
- Key in OFF position.
- Key in ON position.
- Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test.
- **Was DTC B1887 retrieved?**

Yes
GO to [D3](#).

No
INSTALL a new driver air bag module. GO to [D6](#).

D3 CHECK THE DRIVER AIR BAG MODULE CIRCUIT

- Key in OFF position.
- Disconnect: RCM C2041.
- **NOTE:** Do not separate or remove shorting bars from RCM C2041.
- Measure the resistance between RCM C2041 pin 3, circuit 614 (GY/OG), harness side and RCM C2041 pin 21, circuit 397 (BK/WH), harness side.



DR0999-B

- **Is the resistance less than 10,000 ohms?**

Yes
GO to [D4](#).

No
INSTALL a new RCM. GO to [D6](#).

D4 CHECK THE DRIVER AIR BAG MODULE WIRING AND THE CLOCKSPRING

- Disconnect: Driver Air Bag Module C216.
- Disconnect: Clockspring C218b.
- Inspect all crimps, terminals, wires and connectors in circuit 614 (GY/OG) feeding the RCM pin 3, circuit 615 (GY/WH) feeding pin 4, the clockspring C218b. Check for pinched wires and damaged connector pin terminals.
- **Was any damage found?**

Yes
REPAIR as necessary. GO to [D6](#).

No
GO to [D6](#).

D5 CHECK FOR AN INTERMITTENT FAULT	
<ul style="list-style-type: none"> ● Refer to the continuous DTCs recorded during Step D1. ● Was the continuous DTC retrieved during Step D1 an intermittent fault? 	<p>Yes CHECK for causes of intermittent short to ground on circuit 614 (GY/OG), circuit 615 (GY/WH), and the clockspring assembly. Attempt to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to D6.</p> <p>No GO to D6.</p>
D6 CHECK FOR ADDITIONAL DTCs	
<ul style="list-style-type: none"> ● Refer to continuous DTCs recorded during Step D1. ● Were any continuous DTCs retrieved during Step D1? 	<p>Yes Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction.</p> <p>No RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag Supplemental Restraint System (SRS) in this section. CLEAR all DTCs.</p>

Pinpoint Test E: LFC 15/DTC B1916 — Driver Air Bag Circuit Shorted to Battery or Ignition

Normal Operation


The restraints control module (RCM) checks for driver air bag circuit shorts to battery or ignition by monitoring the voltage of circuit 614 (GY/OG) and 615 (GY/WH) at pins 3 and 4. If the RCM detects a short to battery or ignition on either of these pins, it will store a diagnostic trouble code (DTC) B1916 in memory and flash a lamp fault code (LFC) 15 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

A driver air bag circuit short to battery or ignition can be caused by:

- a short to battery or ignition on circuit 614 (GY/OG).
- a short to battery or ignition on circuit 615 (GY/WH).
- a short to battery or ignition on the clockspring.
- a short to battery or ignition on the driver air bag module.
- an RCM internal concern.

PINPOINT TEST E: LFC 15/DTC B1916 — DRIVER AIR BAG CIRCUIT SHORTED TO BATTERY OR IGNITION

Test Step	Result / Action to Take
<p>E1 CHECK FOR A HARD OR INTERMITTENT DTC</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Connect the diagnostic tool. Scan Tool ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Retrieve/Clear Continuous DTCs. ● Retrieve and record any continuous DTCs for use later in this pinpoint test. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Was DTC B1916 retrieved during the on-demand self test? 	<p>Yes This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to E2.</p> <p>No This is an intermittent fault. The fault condition is not present at this time. GO to E5.</p>
<p>E2 CHECK THE DRIVER AIR BAG MODULE</p> <p> WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag Supplemental Restraint System (SRS) in this section.</p> <p>The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE: After diagnosing or repairing an SRS, the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE: After diagnosing or repairing a seat system, the restraint system diagnostic tools must be removed before operating the vehicle</p>	<p>Yes GO to E3.</p> <p>No INSTALL a new driver air bag module. GO to E6.</p>

<p>over the road. NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Deactivate the system. Refer to Air Bag Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● Key in OFF position. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Was DTC B1916 retrieved? 	
E3 CHECK THE DRIVER AIR BAG MODULE CIRCUIT	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Driver Air Bag Module Restraint System Diagnostic Tool. ● Disconnect: RCM C2041. ● Key in ON position. ● NOTE: Do not separate or remove shorting bars from RCM C2041. ● Measure the voltage between RCM C2041 pin 3, circuit 614 (GY/OG), harness side and ground; and between RCM C2041 pin 4, circuit 615 (GY/WH), harness side. <div style="text-align: center;"> </div> <ul style="list-style-type: none"> ● Are the voltages less than 0.2 volt? 	<p>Yes INSTALL a new RCM. GO to E6.</p> <p>No GO to E4.</p>
E4 CHECK THE DRIVER AIR BAG MODULE WIRING AND THE CLOCKSPRING	
<ul style="list-style-type: none"> ● Disconnect: Clockspring C218b. ● Inspect all crimps, terminals, wires and connectors in circuit 614 (GY/OG) feeding the RCM pin 3, circuit 615 (GY/WH) feeding pin 4, and the clockspring C218b. Check for pinched wires and damaged connector pin terminals. ● Was any damage found? 	<p>Yes REPAIR as necessary. GO to E6.</p> <p>No GO to E6.</p>
E5 CHECK FOR AN INTERMITTENT FAULT	
<ul style="list-style-type: none"> ● Refer to the continuous DTCs recorded during Step E1. ● Was the continuous DTC retrieved during Step E1 an intermittent fault? 	<p>Yes CHECK for causes of intermittent short to battery or ignition on circuit 614 (GY/OG), circuit 615 (GY/WH), and the clockspring assembly. Attempt to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO</p>

	to E6 . No GO to E6 .
E6 CHECK FOR ADDITIONAL DTCs	
<ul style="list-style-type: none"> ● Refer to continuous DTCs recorded during Step E1. ● Were any continuous DTCs retrieved during Step E1? 	<p>Yes Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction.</p> <p>No RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag Supplemental Restraint System (SRS) in this section. CLEAR all DTCs.</p>

Pinpoint Test F: LFC 16/DTC B1888 — Passenger Air Bag Circuit Shorted to Ground

Normal Operation

The restraints control module (RCM) checks for passenger air bag circuit shorts to ground by monitoring the voltage of circuits 607 (LB/OG) and 616 (PK/BK) at pins 6 and 7. If the RCM detects a short to ground on either of these pins, it will store a diagnostic trouble code (DTC) B1888 in memory and flash a lamp fault code (LFC) 16 (or higher priority code if one exists) on the air bag indicator.


Possible Causes

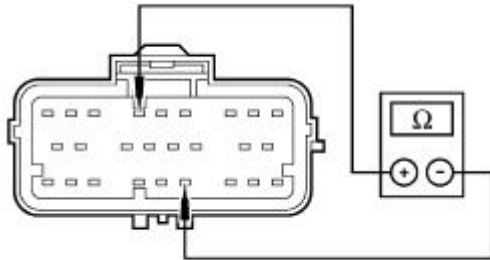
A passenger air bag circuit short to ground can be caused by:

- a short to ground on circuit 607 (LB/OG).
- a short to ground on circuit 616 (PK/BK).
- a short to ground on the passenger air bag module.
- an RCM internal concern.

PINPOINT TEST F: LFC 16/DTC B1888 — PASSENGER AIR BAG CIRCUIT SHORTED TO GROUND

Test Step	Result / Action to Take
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F1 CHECK FOR A HARD OR INTERMITTENT DTC	
<ul style="list-style-type: none"> ● Key in OFF position. ● Connect the diagnostic tool. Scan Tool ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Retrieve/Clear Continuous DTCs. ● Retrieve and record any continuous DTCs for use later in this pinpoint test. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Was DTC B1888 retrieved during the on-demand self test? 	<p>Yes This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to F2.</p> <p>No This is an intermittent fault. The fault condition is not present at this time. GO to F5.</p>
F2 CHECK THE PASSENGER AIR BAG MODULE	
<p> WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag Supplemental Restraint System (SRS) in this section.</p> <p>The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE: After diagnosing or repairing an SRS, the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE: After diagnosing or repairing a seat system, the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Deactivate the system. Refer to Air Bag Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● Key in OFF position. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Was DTC B1888 retrieved? 	<p>Yes GO to F3.</p> <p>No INSTALL a new passenger air bag module. GO to F6.</p>
F3 CHECK THE PASSENGER AIR BAG MODULE CIRCUIT	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: RCM C2041. ● NOTE: Do not separate or remove shorting bars from RCM C2041. ● Measure the resistance between RCM C2041 pin 6, circuit 607 (LB/OG), harness side and RCM C2041 pin 21, circuit 397 (BK/WH), harness side. 	<p>Yes GO to F4.</p> <p>No INSTALL a new RCM. GO to F6.</p>



DR1000-B

- Is the resistance less than 10,000 ohms?

F4 CHECK THE PASSENGER AIR BAG MODULE WIRING

- Disconnect: Passenger Air Bag Module C256.
- Inspect all crimps, terminals, wires and connectors in circuit 607 (LB/OG) feeding the RCM pin 6, circuit 616 (PK/BK) feeding pin 7. Check for pinched wires and damaged connector pin terminals.
- Was any damage found?

Yes
REPAIR as necessary. GO to [F6](#).

No
GO to [F6](#).

F5 CHECK FOR AN INTERMITTENT FAULT

- Refer to the continuous DTCs recorded during Step F1.
- Was the continuous DTC retrieved during Step F1 an intermittent fault?

Yes
CHECK for causes of intermittent short to ground on circuit 607 (LB/OG) and circuit 616 (PK/BK). Attempt to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to [F6](#).

No
GO to [F6](#).

F6 CHECK FOR ADDITIONAL DTCs

- Refer to the continuous DTCs recorded during Step F1.
- Were any continuous DTCs retrieved during Step F1?

Yes
Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction.

No
RECONNECT the system.

REACTIVATE the system. PROVE OUT the system. REFER to [Air Bag Supplemental Restraint System \(SRS\)](#) in this section. CLEAR all DTCs.

Pinpoint Test G: LFC 16/DTC B1925 — Passenger Air Bag Circuit Shorted to Battery or Ignition

Normal Operation

The restraints control module (RCM) checks for passenger air bag circuit shorts to battery or ignition by monitoring the voltage of circuits 607 (LB/OG) and 616 (PK/BK) at pins 6 and 7. If the RCM detects a short to battery or ignition on either of these pins, it will store a diagnostic trouble code (DTC) B1925 in memory and flash a lamp fault code (LFC) 16 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

A passenger air bag circuit short to battery or ignition can be caused by:

- a short to battery or ignition on circuit 607 (LB/OG).
- a short to battery or ignition on circuit 616 (PK/BK).
- a short to battery or ignition on the passenger air bag module.
- an RCM internal concern.

PINPOINT TEST G: LFC 16/DTC B1925 — PASSENGER AIR BAG CIRCUIT SHORTED TO BATTERY OR IGNITION

Test Step	Result / Action to Take
G1 CHECK FOR A HARD OR INTERMITTENT DTC	
<ul style="list-style-type: none"> ● Key in OFF position. ● Connect the diagnostic tool. Scan Tool ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Retrieve/Clear Continuous DTCs. ● Retrieve and record any continuous DTCs for use later in this pinpoint test. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Was DTC B1925 retrieved during the on-demand self test? 	<p>Yes This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to G2.</p> <p>No This is an intermittent fault. The fault condition is not present at this time. GO to G5.</p>

G2 CHECK THE PASSENGER AIR BAG MODULE



WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to [Air Bag Supplemental Restraint System \(SRS\)](#) in this section.

The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. **NOTE:** Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, the restraint system diagnostic tools must be removed before operating the vehicle over the road. **NOTE:** After diagnosing or repairing a seat system, the restraint system diagnostic tools must be removed before operating the vehicle over the road. **NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

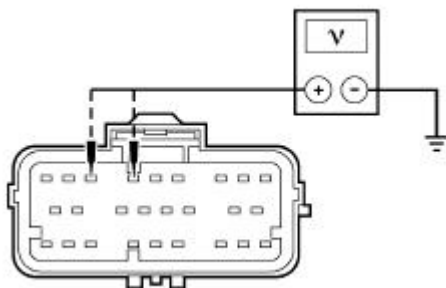
- Key in OFF position.
- Deactivate the system. Refer to [Air Bag Supplemental Restraint System \(SRS\)](#) in the Diagnosis and Testing portion of this section.
- Key in OFF position.
- Key in ON position.
- Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test.
- **Was DTC B1925 retrieved?**

Yes
GO to [G3](#).

No
INSTALL a new passenger air bag module. GO to [G6](#).

G3 CHECK THE PASSENGER AIR BAG MODULE CIRCUIT

- Key in OFF position.
- Disconnect: Passenger Air Bag Module Restraint System Diagnostic Tool.
- Disconnect: RCM C2041.
- Key in ON position.
- **NOTE:** Do not separate or remove shorting bars from RCM C2041.
- Measure the voltage between RCM C2041 pin 6, circuit 607 (LB/OG), harness side and ground; and between RCM C2041 pin 7, circuit 616 (PK/BK), harness side and ground.



A0042187

- **Are the voltages less than 0.2 volt?**

Yes
INSTALL a new RCM. GO to [G6](#).

No
GO to [G4](#).

G4 CHECK THE PASSENGER AIR BAG MODULE WIRING

- Inspect all crimps, terminals, wires and connectors in circuit 607 (LB/OG) feeding the RCM pin 6, circuit 616 (PK/BK) feeding pin 7. Check for pinched wires and damaged connector pin terminals.
- **Was any damage found?**

Yes
REPAIR as necessary. GO to [G6](#).

	<p>No GO to G6.</p>
G5 CHECK FOR AN INTERMITTENT FAULT	
<ul style="list-style-type: none"> ● Refer to the continuous DTCs recorded during Step G1. ● Was the continuous DTC retrieved during Step G1 an intermittent fault? 	<p>Yes CHECK for causes of intermittent short to battery or ignition on circuit 607 (LB/OG) and circuit 616 (PK/BK). Attempt to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to G6.</p> <p>No GO to G6.</p>
G6 CHECK FOR ADDITIONAL DTCs	
<ul style="list-style-type: none"> ● Refer to the continuous DTCs recorded during Step G1. ● Were any continuous DTCs retrieved during Step G1? 	<p>Yes Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction.</p> <p>No RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag Supplemental Restraint System (SRS) in this section. CLEAR all DTCs.</p>

Pinpoint Test H: LFC 32/DTC B1932 — Driver Air Bag Circuit Resistance High

Normal Operation


The restraints control module (RCM) monitors the resistance for the driver air bag ignitor by measuring the resistance between pins 3 and 4. If the RCM detects high resistance between these pins, it will store a diagnostic trouble code (DTC) B1932 in memory and flash a lamp fault code (LFC) 32 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

Driver air bag high resistance can be caused by:

- a poor connection or corrosion in the driver air bag module circuits or the clockspring.
- an open circuit or high resistance in the clockspring windings.
- an open circuit or high resistance in the wiring harness.
- an open circuit or high resistance in the driver air bag module.
- an RCM internal concern.

PINPOINT TEST H: LFC 32/DTC B1932 — DRIVER AIR BAG CIRCUIT RESISTANCE HIGH

Test Step	Result / Action to Take
<p>H1 CHECK FOR A HARD OR INTERMITTENT DTC</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Connect the diagnostic tool. Scan Tool ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Retrieve/Clear Continuous DTCs. ● Retrieve and record any continuous DTCs for use later in this pinpoint test. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Was DTC B1932 retrieved during the on-demand self test? 	<p>Yes This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to H2.</p> <p>No This is an intermittent fault. The fault condition is not present at this time. GO to H5.</p>
<p>H2 CHECK THE DRIVER AIR BAG MODULE</p> <p> WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag Supplemental Restraint System (SRS) in this section.</p> <p>The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE: After diagnosing or repairing an SRS, the restraint system diagnostic tools must be</p>	<p>Yes GO to H3.</p> <p>No INSTALL a new driver air bag module. GO to H6.</p>

<p>removed before operating the vehicle over the road. NOTE: After diagnosing or repairing a seat system, the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Deactivate the system. Refer to Air Bag Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● Key in OFF position. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Was DTC B1932 retrieved? 	
H3 CHECK THE DRIVER AIR BAG MODULE CIRCUIT	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: RCM C2041. ● Disconnect: Driver Air Bag Restraint System Diagnostic Tool. ● NOTE: By disconnecting the RCM connector, circuit 614 (GY/OG) and circuit 615 (GY/WH) of the RCM connector are shorted together with a shorting bar. Do not remove the shorting bar. ● NOTE: Zero the multimeter prior to taking the measurement. ● Measure the resistance between driver air bag C216, circuit 614 (GY/OG), harness side and driver air bag C216, circuit 615 (GY/WH), harness side. <div style="text-align: center;"> <p>DR0292-B</p> </div> <ul style="list-style-type: none"> ● Is the resistance greater than 0.5 ohm? 	<p>Yes GO to H4.</p> <p>No INSTALL a new RCM. GO to H6.</p>
H4 CHECK THE CLOCKSPrING	
<ul style="list-style-type: none"> ● Disconnect: Clockspring C218b. ● NOTE: By disconnecting the clockspring connector, the connector pins are shorted together with a shorting bar. Do not remove the shorting bar. ● NOTE: Zero the multimeter prior to taking the measurement. ● Measure the resistance between clockspring C218b, circuit 614 (GY/OG), and circuit 615 (GY/WH), harness side. <div style="text-align: center;"> <p>DR0292-B</p> </div> <ul style="list-style-type: none"> ● Is the resistance greater than 0.5 ohm? 	<p>Yes INSTALL a new clockspring. GO to H6.</p> <p>No REPAIR the circuit (s) as necessary. GO to H6.</p>
H5 CHECK FOR AN INTERMITTENT FAULT	
<ul style="list-style-type: none"> ● Refer to the continuous DTCs recorded during Step H1. 	<p>Yes</p>

<ul style="list-style-type: none"> ● Was the continuous DTC retrieved during Step H1 an intermittent fault? 	<p>CHECK for causes of intermittent high resistance on circuit 614 (GY/OG), circuit 615 (GY/WH), and the clockspring assembly. Attempt to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to H6.</p> <p>No GO to H6.</p>
<p>H6 CHECK FOR ADDITIONAL DTCs</p>	
<ul style="list-style-type: none"> ● Refer to the continuous DTCs recorded during Step H1. ● Were any continuous DTCs retrieved during Step H1. 	<p>Yes Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction.</p> <p>No RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag Supplemental Restraint System (SRS) in this section. CLEAR all DTCs.</p>

Pinpoint Test I: LFC 33/DTC B1933 — Passenger Air Bag Circuit Resistance High

Normal Operation


The restraints control module (RCM) monitors the resistance of the passenger air bag ignitor by measuring the resistance between pins 6 and 7. If the RCM detects high resistance between these pins, it will store a diagnostic trouble code (DTC) B1933 in memory and flash a lamp fault code (LFC) 33 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

A passenger air bag high resistance can be caused by:

- a poor connection or corrosion in the passenger air bag module circuits.
- an open circuit or high resistance in the wiring harness.
- an open circuit or high resistance in the passenger air bag module.
- an RCM internal concern.

PINPOINT TEST I: LFC 33/DTC B1933 — PASSENGER AIR BAG CIRCUIT RESISTANCE HIGH

Test Step	Result / Action to Take
<p>I1 CHECK FOR A HARD OR INTERMITTENT DTC</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Connect the diagnostic tool. Scan Tool ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Retrieve/Clear Continuous DTCs. ● Retrieve and record any continuous DTCs for use later in this pinpoint test. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Was DTC B1933 retrieved during the on-demand self test? 	<p>Yes This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to I2.</p> <p>No This is an intermittent fault. The fault condition is not present at this time. GO to I4.</p>
<p>I2 CHECK THE PASSENGER AIR BAG MODULE</p> <p> WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag Supplemental Restraint System (SRS) in this section.</p> <p>The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE: After diagnosing or repairing an SRS, the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE: After diagnosing or repairing a seat system, the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Deactivate the system. Refer to Air Bag Supplemental Restraint 	<p>Yes GO to I3.</p> <p>No INSTALL a new passenger air bag module. GO to I5.</p>

<p>System (SRS) in the Diagnosis and Testing portion of this section.</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Was DTC B1933 retrieved? 	
I3 CHECK THE PASSENGER AIR BAG MODULE CIRCUIT	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: RCM C2041. ● Disconnect: Passenger Air Bag Restraint System Diagnostic Tool. ● NOTE: By disconnecting the RCM connector, circuit 607 (LB/OG) and circuit 616 (PK/BK) of the RCM connector are shorted together with a shorting bar. Do not remove the shorting bar. ● NOTE: Zero the multimeter prior to taking the measurement. ● Measure the resistance between passenger air bag C256, circuit 607 (LB/OG), harness side and passenger air bag C256, circuit 616 (PK/BK), harness side. <div style="text-align: center;"> <p>DR0292-B</p> </div> <ul style="list-style-type: none"> ● Is the resistance greater than 0.5 ohm? 	<p>Yes REPAIR the circuit (s) as necessary. GO to I5.</p> <p>No INSTALL a new RCM. GO to I5.</p>
I4 CHECK FOR AN INTERMITTENT FAULT	
<ul style="list-style-type: none"> ● Refer to the continuous DTCs recorded during Step I1. ● Was the continuous DTC retrieved during Step I1 an intermittent fault? 	<p>Yes CHECK for causes of intermittent high resistance on circuit 607 (LB/OG) and circuit 616 (PK/BK). Attempt to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to I5.</p> <p>No GO to I5.</p>
I5 CHECK FOR ADDITIONAL DTCs	
<ul style="list-style-type: none"> ● Refer to the continuous DTCs recorded during Step I1. ● Were any continuous DTCs retrieved during Step I1? 	<p>Yes Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic</p>

	<p>Trouble Code (DTC) Priority Table in this section for pinpoint test direction.</p> <p>No RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag Supplemental Restraint System (SRS) in this section. CLEAR all DTCs.</p>
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Pinpoint Test J: LFC 34/DTC B1934 — Driver Air Bag Circuit Resistance Low

Normal Operation

The restraints control module (RCM) monitors the resistance of the driver air bag ignitor by measuring the resistance between pins 3 and 4. If the RCM detects low resistance between these pins, it will store a diagnostic trouble code (DTC) B1934 in memory and flash a lamp fault code (LFC) 34 (or higher priority code if one exists) on the air bag indicator.


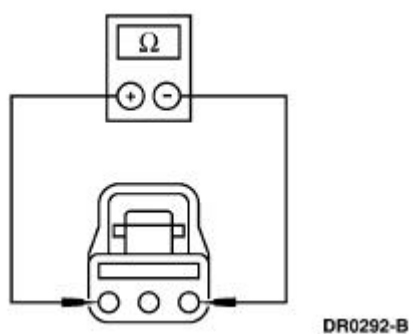
Possible Causes

Driver air bag low resistance can be caused by:

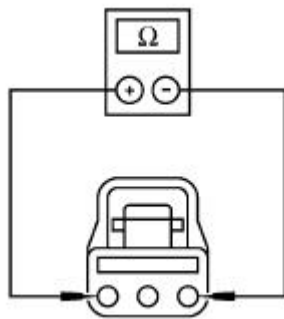
- a short in the clockspring windings.
- a short in the wiring harness.
- a low resistance in the driver air bag module.
- an RCM internal concern.
- worn or damaged short bar or camming beam.

PINPOINT TEST J: LFC 34/DTC B1934 — DRIVER AIR BAG CIRCUIT RESISTANCE LOW

Test Step	Result / Action to Take
<p>J1 CHECK FOR A HARD OR INTERMITTENT DTC</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Connect the diagnostic tool. Scan Tool ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Retrieve/Clear Continuous DTCs. ● Retrieve and record any continuous DTCs for use later in this pinpoint test. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. 	<p>Yes This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the</p>

<ul style="list-style-type: none"> ● Was DTC B1934 retrieved during the on-demand self test? 	<p>on-demand self test. GO to J2.</p> <p>No This is an intermittent fault. The fault condition is not present at this time. GO to J5.</p>
J2 CHECK THE DRIVER AIR BAG MODULE	
<p> WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag Supplemental Restraint System (SRS) in this section.</p> <p>The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE: After diagnosing or repairing an SRS, the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE: After diagnosing or repairing a seat system, the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Deactivate the system. Refer to Air Bag Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● Key in OFF position. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Was DTC B1934 retrieved? 	<p>Yes GO to J3.</p> <p>No INSTALL a new driver air bag module. GO to J6.</p>
J3 CHECK THE DRIVER AIR BAG MODULE CIRCUIT	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Driver Air Bag Restraint System Diagnostic Tool. ● Measure the resistance between driver air bag C216, circuit 614 (GY/OG), harness side and between driver air bag C216, circuit 615 (GY/WH), harness side.  <p style="text-align: center;">DR0292-B</p> <ul style="list-style-type: none"> ● Is the resistance greater than 10,000 ohms? 	<p>Yes INSTALL a new RCM. GO to J6.</p> <p>No GO to J4.</p>
J4 CHECK THE CLOCKSPRING	

- Disconnect: Clockspring C218b.
- Measure the resistance between clockspring C218b, circuit 614 (GY/OG) and circuit 615 (GY/WH), harness side.



DR0292-B

- Is the resistance greater than 10,000 ohms?

Yes

INSTALL a new clockspring. GO to [J6](#).

No

REPAIR the circuit (s) as necessary. GO to [J6](#).

J5 CHECK FOR AN INTERMITTENT FAULT

- Refer to the continuous DTCs recorded during Step J1.
- Was the continuous DTC retrieved during Step J1 an intermittent fault?

Yes

CHECK for causes of intermittent low resistance on circuit 614 (GY/OG), circuit 615 (GY/WH), and the clockspring assembly. Attempt to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to [J6](#).

No

GO to [J6](#).

J6 CHECK FOR ADDITIONAL DTCs

- Refer to the continuous DTCs recorded during Step J1.
- Were any continuous DTCs retrieved during Step J1?

Yes

Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction.

No

RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to [Air Bag Supplemental Restraint System](#)

[\(SRS\)](#) in this section. CLEAR all DTCs.

Pinpoint Test K: LFC 35/DTC B1935 — Passenger Air Bag Circuit Resistance Low

Normal Operation


The restraints control module (RCM) monitors the resistance of the passenger air bag ignitor by measuring the resistance between pins 6 and 7. If the RCM detects low resistance between these pins, it will store a diagnostic trouble code (DTC) B1935 in memory and flash a lamp fault code (LFC) 35 (or higher priority code if one exists) on the air bag indicator.

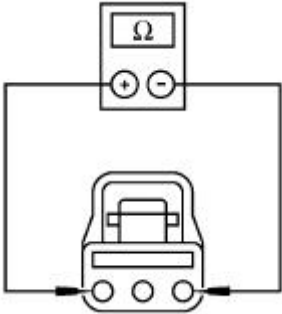
Possible Causes

Passenger air bag low resistance can be caused by:

- a short in the wiring harness.
- a low resistance in the passenger air bag module.
- an RCM internal concern.
- a worn or damaged connector shorting bar or camming beam.

PINPOINT TEST K: LFC 35/DTC B1935 — PASSENGER AIR BAG CIRCUIT RESISTANCE LOW

Test Step	Result / Action to Take
K1 CHECK FOR A HARD OR INTERMITTENT DTC	
<ul style="list-style-type: none"> ● Key in OFF position. ● Connect the diagnostic tool. Scan Tool ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Retrieve/Clear Continuous DTCs. ● Retrieve and record any continuous DTCs for use later in this pinpoint test. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Was DTC B1935 retrieved during the on-demand self test? 	<p>Yes This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to K2.</p> <p>No This is an intermittent fault. The fault condition is not present at this time. GO to K4.</p>
K2 CHECK THE PASSENGER AIR BAG MODULE	
<p> WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag Supplemental Restraint System (SRS) in this section.</p>	<p>Yes GO to K3.</p> <p>No INSTALL a new</p>

<p>The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE: After diagnosing or repairing an SRS, the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE: After diagnosing or repairing a seat system, the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Deactivate the system. Refer to Air Bag Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● Key in OFF position. ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Was DTC B1935 retrieved? 	<p>passenger air bag module. GO to K5.</p>
<p>K3 CHECK THE PASSENGER AIR BAG MODULE CIRCUIT</p>	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: Passenger Air Bag Restraint System Diagnostic Tool. ● Measure the resistance between passenger air bag C256, circuit 607 (LB/OG), harness side and passenger air bag C256, circuit 616 (PK/BK), harness side.  <p style="text-align: center;">DR0292-B</p> <ul style="list-style-type: none"> ● Is the resistance greater than 10,000 ohm? 	<p>Yes INSTALL a new RCM. GO to K5.</p> <p>No REPAIR the circuit (s) as necessary. GO to K5.</p>
<p>K4 CHECK FOR AN INTERMITTENT FAULT</p>	
<ul style="list-style-type: none"> ● Refer to the continuous DTCs recorded during Step K1. ● Was the continuous DTC retrieved during Step K1 an intermittent fault? 	<p>Yes CHECK for causes of intermittent low resistance on circuit 607 (LB/OG) and circuit 616 (PK/BK). Attempt to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent</p>

	<p>concerns found. GO to K5.</p> <p>No GO to K5.</p>
K5 CHECK FOR ADDITIONAL DTCs	
<ul style="list-style-type: none"> ● Refer to the continuous DTCs recorded during Step K1. ● Were any continuous DTCs retrieved during Step K1? 	<p>Yes Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction.</p> <p>No RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag Supplemental Restraint System (SRS) in this section. CLEAR all DTCs.</p>

Pinpoint Test L: B1892 — Air Bag Tone Warning Indicator Circuit Shorted to Ground or Open

Normal Operation

The restraints control module (RCM) monitors its connection to the generic electronic module (GEM) at C201e pin 10. This connection is used to signal a chime if the air bag indicator is inoperative and another SRS fault exists. If the RCM detects a short to ground or open on the connection to the GEM, it will store a diagnostic trouble code (DTC) B1892 in memory.

Possible Causes

An air bag tone warning indicator circuit short to ground or open can be caused by:

- a short to ground or open on circuit 1083 (LB/BK).
- a damaged or inoperative GEM.

PINPOINT TEST L: DTC B1892 — AIR BAG TONE WARNING INDICATOR CIRCUIT SHORTED TO GROUND OR OPEN

Test Step	Result / Action to Take
L1 CHECK FOR A HARD OR INTERMITTENT DTC	

- Key in OFF position.
- Connect the diagnostic tool. Scan Tool
- Key in ON position.
- Enter the following diagnostic mode on the diagnostic tool: Retrieve/Clear Continuous DTCs.
- Retrieve and record any continuous DTCs for use later in this pinpoint test.
- Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test.
- **Was DTC B1892 retrieved during the on-demand self test?**

Yes

This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to [L2](#).

No

This is an intermittent fault. The fault condition is not present at this time. GO to [L5](#).

L2 CHECK THE AIR BAG TONE WARNING INDICATOR CIRCUIT



WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to [Air Bag Supplemental Restraint System \(SRS\)](#) in this section.

The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE:** After diagnosing or repairing an SRS, the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE: After diagnosing or repairing a seat system, the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

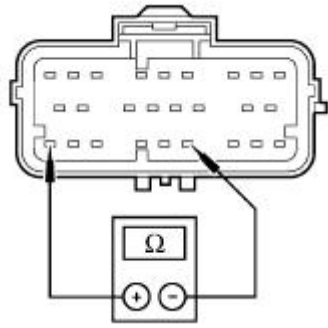
- Key in OFF position.
- Deactivate the system. Refer to [Air Bag Supplemental Restraint System \(SRS\)](#) in the Diagnosis and Testing portion of this section.
- Key in OFF position.
- Disconnect: RCM C2041.
- Disconnect: GEM C201e.
- Measure the resistance between RCM C2041 pin 26, circuit 1083 (LB/BK), harness side and RCM C2041 pin 21, circuit 397 (BK/WH), harness side.

Yes

REPAIR the circuit. GO to [L6](#).

No

GO to [L3](#).

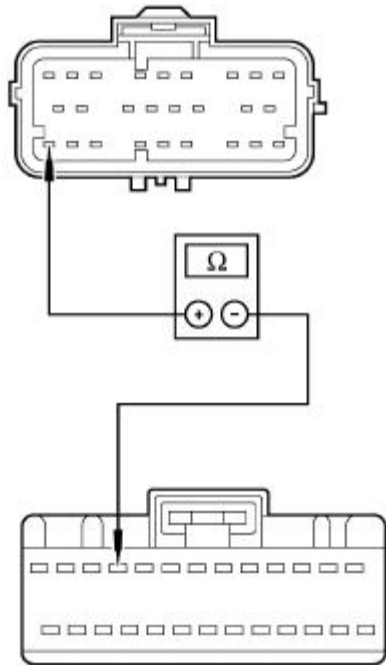


DR1013-A

- Is the resistance less than 10,000 ohms?

L3 CHECK THE AIR BAG TONE WARNING INDICATOR MODULE CIRCUIT

- Measure the resistance between RCM C2041 pin 26, circuit 1083 (LB/BK), harness side and GEM C201e pin 10, circuit 1083 (LB/BK), harness side.



DR1407-A

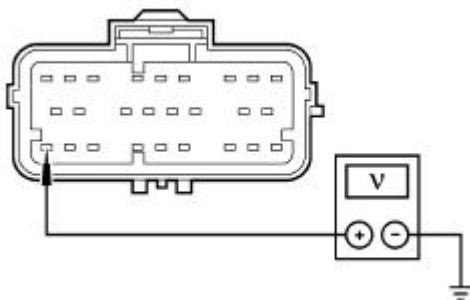
- Is the resistance greater than 10 ohms?

Yes
REPAIR the circuit. GO to [L6](#).

No
GO to [L4](#).

L4 CHECK THE AIR BAG TONE WARNING INDICATOR

- Disconnect: GEM C201e.
- Key in ON position.
- Measure the voltage between RCM C2041 pin 26, circuit 1083 (LB/BK), harness side and ground.



DR1042-A

Yes
INSTALL a new GEM. GO to [L6](#).

No
INSTALL a new RCM. GO to [L6](#).

<ul style="list-style-type: none"> ● Is the voltage less than 1.0 volt? 	
L5 CHECK FOR AN INTERMITTENT FAULT	
<ul style="list-style-type: none"> ● Refer to the continuous DTCs recorded during Step L1. ● Was the continuous DTC retrieved during Step L1 an intermittent fault? 	<p>Yes CHECK for causes of intermittent short to ground or open on circuit 1083 (LB/BK). Attempt to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to L6.</p> <p>No GO to L6.</p>
L6 CHECK FOR ADDITIONAL DTCs	
<ul style="list-style-type: none"> ● Refer to the continuous DTCs recorded during Step L1. ● Were any continuous DTCs retrieved during Step L1? 	<p>Yes Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction.</p> <p>No RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag Supplemental Restraint System (SRS) in this section. CLEAR all DTCs.</p>

Pinpoint Test M: DTC B1891 — Air Bag Tone Warning Indicator Circuit Shorted to Battery or Ignition

Normal Operation


The restraints control module (RCM) monitors its connection to the generic electronic module (GEM) at pin 10. This connection is used to signal a chime if the air bag indicator is inoperative and another SRS fault exists. If the RCM detects a short to battery or ignition on the connection to the GEM, it will store a diagnostic trouble code (DTC) B1891 in memory.

Possible Causes

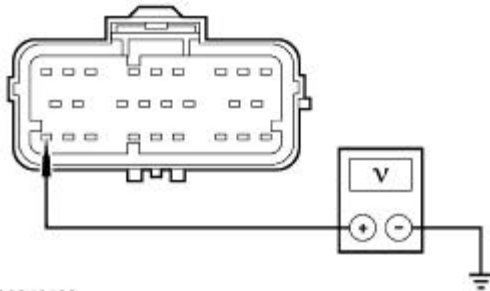
An air bag tone warning indicator circuit short to battery or ignition can be caused by:

- a short to battery or ignition on circuit 1083 (LB/BK).
- a damaged or inoperative GEM.
- an RCM internal concern.

PINPOINT TEST M: DTC B1891 — AIR BAG TONE WARNING INDICATOR CIRCUIT SHORTED TO BATTERY OR IGNITION

Test Step	Result / Action to Take
<p>M1 CHECK FOR A HARD OR INTERMITTENT DTC</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Connect the diagnostic tool. Scan Tool ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Retrieve/Clear Continuous DTCs. ● Retrieve and record any continuous DTCs for use later in this pinpoint test. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Was DTC B1891 retrieved during the on-demand self test? 	<p>Yes This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to M2.</p> <p>No This is an intermittent fault. The fault condition is not present at this time. GO to M4.</p>
<p>M2 CHECK THE AIR BAG TONE WARNING INDICATOR CIRCUIT</p> <p> WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag Supplemental Restraint System (SRS) in this section.</p> <p>The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE: After diagnosing or repairing an SRS, the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE: After diagnosing or repairing a seat system, the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.</p>	<p>Yes GO to M3.</p> <p>No REPAIR the circuit. GO to M5.</p>

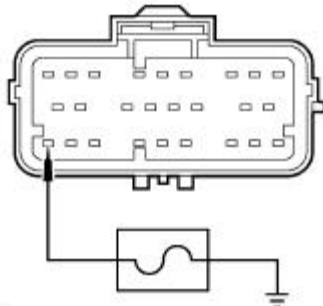
- Key in OFF position.
- Deactivate the system. Refer to [Air Bag Supplemental Restraint System \(SRS\)](#) in the Diagnosis and Testing portion of this section.
- Key in OFF position.
- Disconnect: RCM C2041.
- Disconnect: GEM C201e.
- Key in ON position.
- Measure the voltage between RCM C2041 pin 26, circuit 1083 (LB/BK), harness side and ground.



- Is the voltage less than 0.2 volt?

M3 CHECK THE AIR BAG TONE WARNING INDICATOR

- Key in OFF position.
- Connect: GEM C201e.
- Key in ON position.
- Jumper RCM C2041 pin 26, circuit 1083 (LB/BK), harness side to ground.



- Does the GEM generate a tone?

Yes
INSTALL a new RCM. GO to [M5](#).

No
INSTALL a new GEM. GO to [M5](#).

M4 CHECK FOR AN INTERMITTENT FAULT

- Refer to continuous DTCs recorded during Step M1.
- Was the continuous DTC retrieved during step M1 an intermittent fault?

Yes
Check for causes of intermittent short to ground or open on circuit 1083 (LB/BK). Attempt to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to [M5](#).

No
GO to [M5](#).

M5 CHECK FOR ADDITIONAL DTCs	
<ul style="list-style-type: none"> ● Refer to the continuous DTCs recorded during Step M1. ● Were any continuous DTCs retrieved during Step M1? 	<p>Yes Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction.</p> <p>No RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag Supplemental Restraint System (SRS) in this section. CLEAR all DTCs.</p>

Pinpoint Test N: DTC B1869 — Air Bag Indicator Inoperative

Normal Operation

The air bag indicator is designed to illuminate for 6 (+/-2) seconds when the ignition switch is turned to the RUN position. This initial 6 seconds of illumination is considered normal operation and is called proveout of the air bag indicator. The air bag indicator is then used to warn the driver that there is a fault in the air bag supplemental restraint system (SRS).

The restraints control module (RCM) monitors the air bag indicator for open and short to ground conditions. If the RCM detects an open or short to ground condition on the air bag indicator circuit, it will store a diagnostic trouble code (DTC) B1869 in memory.


If the RCM detects an air bag indicator failure in addition to another SRS failure, the RCM will send a signal to the generic electronic module (GEM) to produce five sets of five tone bursts.

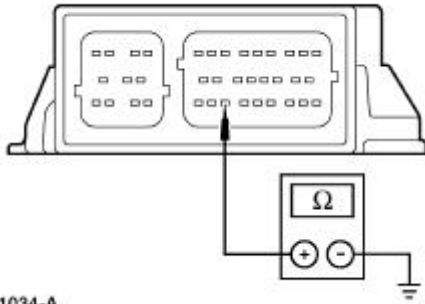
Possible Causes

An air bag indicator inoperative condition can be caused by:

- a damaged wiring on circuit 608 (BK/YE).
- a damaged or burned out air bag indicator.
- worn or damaged instrument cluster.
- an RCM internal concern.

PINPOINT TEST N: DTC B1869 — AIR BAG INDICATOR INOPERATIVE

Test Step	Result / Action to Take
<p>N1 CHECK FOR A HARD OR INTERMITTENT DTC</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Connect the diagnostic tool. Scan Tool ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Retrieve/Clear Continuous DTCs. ● Retrieve and record any continuous DTCs for use later in this pinpoint test. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Was DTC B1869 retrieved during the on-demand self test? 	<p>Yes This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to N2.</p> <p>No This is an intermittent fault. The fault conditions not present at this time. GO to N5.</p>
<p>N2 CHECK THE RCM</p> <p> WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag Supplemental Restraint System (SRS) in this section.</p> <p>The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE: After diagnosing or repairing an SRS, the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE: After diagnosing or repairing a seat system, the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Deactivate the system. Refer to Air Bag Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● Key in OFF position. ● Disconnect: RCM C2041. ● Measure the resistance between RCM C2041 pin 20, component side and a known good chassis ground. 	<p>Yes INSTALL a new RCM. GO to N6.</p> <p>No GO to N3.</p>

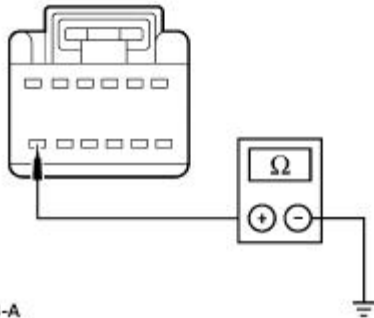


DR1034-A

- Is the resistance less than 10 ohms?

N3 CHECK CIRCUIT 608 (BK/YE) FOR A SHORT TO GROUND

- Key in OFF position.
- Disconnect: Instrument Cluster C220a.
- Measure the resistance to ground at instrument cluster C220a pin 12, circuit 608 (BK/YE).

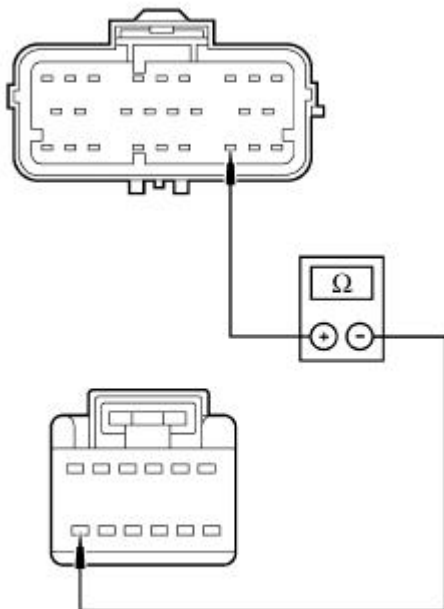


DR1614-A

- Is the resistance less than 100 ohms?

N4 CHECK CIRCUIT 608 (BK/YE) FOR AN OPEN

- Disconnect: Instrument Cluster C220a.
- Measure the resistance between RCM C2041 pin 20, circuit 608 (BK/YE), harness side and instrument cluster C220a pin 12, circuit 608 (BK/YE), harness side.



DR1408-A

Yes
REPAIR the circuit. GO to [N6](#).

No
GO to [N4](#).

Yes
REPAIR the circuit. GO to [N6](#).

No
REPAIR the instrument cluster. GO to [N6](#).

<ul style="list-style-type: none"> ● Is the resistance greater than 10 ohms? 	
N5 CHECK FOR AN INTERMITTENT FAULT	
<ul style="list-style-type: none"> ● Refer to the continuous DTCs recorded during Step N1. ● Was the continuous DTC retrieved during Step N1 an intermittent fault? 	<p>Yes CHECK for causes of intermittent short to ground or open on circuit 608 (BK/YE). Attempt to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to N6.</p> <p>No GO to N6.</p>
N6 CHECK FOR ADDITIONAL DTCs	
<ul style="list-style-type: none"> ● Refer to the continuous DTCs recorded during Step N1. ● Were any continuous DTCs retrieved during Step N1? 	<p>Yes Do not clear any DTCs until all DTCs have been resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction.</p> <p>No RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag Supplemental Restraint System (SRS) in this section. CLEAR all DTCs.</p>

Pinpoint Test O: DTC B1870 — Air Bag Indicator Shorted to Battery

Normal Operation

The air bag indicator is designed to illuminate for 6 (+/-2) seconds when the ignition switch is turned to the RUN position. This initial 6 seconds of illumination is considered normal operation and is called proveout of the air bag indicator. The air bag indicator is then used to warn the driver that there is a fault in the air bag supplemental restraint system (SRS).

While the air bag indicator is lit, the restraints control module (RCM) monitors the air bag indicator for short to battery conditions. If the RCM detects a short to battery condition on the air bag indicator

circuit, it will store a diagnostic trouble code (DTC) B1870 in memory.


If the RCM detects an air bag indicator failure in addition to another SRS failure, the RCM will send a signal to the generic electronic module (GEM) to produce five sets of five tone bursts.

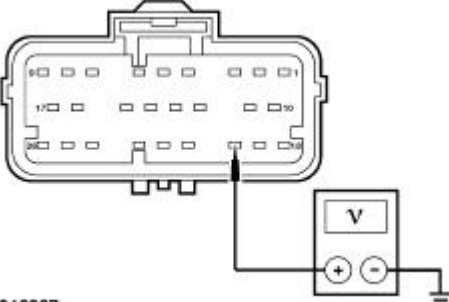
Possible Causes

An air bag indicator short to battery condition can be caused by:

- damaged wiring on circuit 608 (BK/YE).
- an instrument cluster malfunction.
- an RCM internal concern.

PINPOINT TEST O: DTC B1870 — AIR BAG INDICATOR SHORTED TO BATTERY

Test Step	Result / Action to Take
<p>O1 CHECK FOR A HARD OR INTERMITTENT DTC</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Connect the diagnostic tool. Scan Tool ● Key in ON position. ● Enter the following diagnostic mode on the diagnostic tool: Retrieve/Clear Continuous DTCs. ● Retrieve and record any continuous DTCs for use later in this pinpoint test. ● Enter the following diagnostic mode on the diagnostic tool: On-Demand Self Test. ● Was DTC B1870 retrieved during the on-demand self test? 	<p>Yes This is a hard fault. The fault condition is still present. This fault cannot be cleared until it is corrected and the DTC is no longer retrieved during the on-demand self test. GO to O2.</p> <p>No This is an intermittent fault. The fault condition is not present at this time. GO to O4.</p>
<p>O2 CHECK THE AIR BAG INDICATOR CIRCUIT</p> <p> WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag Supplemental Restraint System (SRS) in this section.</p> <p>The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury. NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. The</p>	<p>Yes INSTALL a new RCM. GO to O5.</p> <p>No GO to O3.</p>

<p>restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE: After diagnosing or repairing an SRS, the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE: After diagnosing or repairing a seat system, the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Deactivate the system. Refer to Air Bag Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● Key in OFF position. ● Disconnect: RCM C2041. ● Key in ON position. ● Is the air bag indicator illuminated? 	
<p>O3 CHECK AIR BAG INDICATOR CIRCUIT FOR SHORT TO BATTERY</p>	
<ul style="list-style-type: none"> ● Key in OFF position. ● Disconnect: RCM C2041. ● Disconnect: Instrument Cluster C220a. ● Key in ON position. ● Measure the voltage between RCM C2041 pin 20, circuit 608 (BK/YE), harness side and ground.  <p>A0042327</p> <ul style="list-style-type: none"> ● Is the voltage less than 0.2 volt? 	<p>Yes REPAIR the instrument cluster. GO to O5.</p> <p>No REPAIR the circuit. GO to O5.</p>
<p>O4 CHECK FOR AN INTERMITTENT FAULT</p>	
<ul style="list-style-type: none"> ● Refer to the continuous DTCs recorded during Step O1. ● Was the continuous DTC retrieved during Step O1 an intermittent fault? 	<p>Yes CHECK for causes of intermittent short to battery on circuit 608 (BK/YE). Attempt to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. REPAIR any intermittent concerns found. GO to O5.</p> <p>No GO to O5.</p>
<p>O5 CHECK FOR ADDITIONAL DTCs</p>	
<ul style="list-style-type: none"> ● Refer to the continuous DTCs recorded during Step O1. ● Were any continuous DTCs retrieved during Step O1? 	<p>Yes Do not clear any DTCs until all DTCs have been</p>

	<p>resolved. GO to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table in this section for pinpoint test direction.</p> <p>No RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag Supplemental Restraint System (SRS) in this section. CLEAR all DTCs.</p>
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Pinpoint Test P: No Communication With The Restraints Control Module

Normal Operation


The RCM communicates with the scan tool using ISO 9141 communication mode through the data link connector (DLC).

Possible Causes

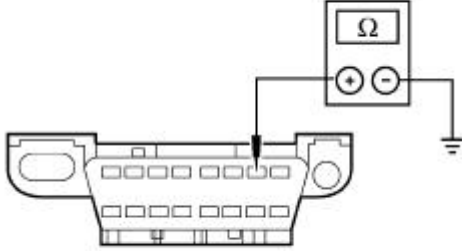
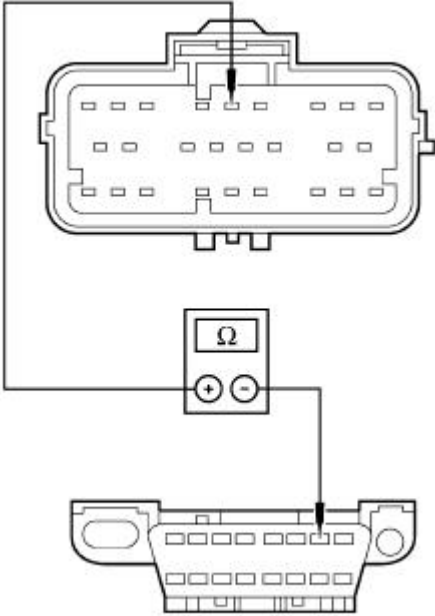
A no communication condition can be caused by:

- damage to circuit 70 (LB/WH).
- a damaged DLC.
- a damaged scan tool.
- an RCM internal concern.

PINPOINT TEST P: NO COMMUNICATION WITH THE RESTRAINTS CONTROL MODULE

Test Step	Result / Action to Take
<p>P1 CHECK THE RCM CONNECTOR C2041 AND CONNECTOR PIN 5 FOR DAMAGE</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;">  <p>WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag Supplemental Restraint System (SRS) in this section.</p> <p>The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is</p> </div>	<p>Yes GO to P2.</p> <p>No REPAIR RCM C2041 or RCM C2041 pin 5 as necessary.</p>

<p>reactivated to avoid non-deployment in a collision, resulting in possible personal injury. NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. The restraint system diagnostic tools must be removed prior to operating the vehicle over the road. NOTE: After diagnosing or repairing an SRS, the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE: After diagnosing or repairing a seat system, the restraint system diagnostic tools must be removed before operating the vehicle over the road. NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.</p> <ul style="list-style-type: none"> ● Key in OFF position. ● Deactivate the system. Refer to Air Bag Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section. ● Key in OFF position. ● Disconnect: RCM C2041. ● Inspect RCM C2041, harness side and RCM C2041, component side, pin 5 for damage. ● Are RCM C2041 and RCM C2041 pin 5 OK? 	<p>REACTIVATE the system.</p>
<p>P2 CHECK THE DLC CONNECTOR C251 AND CONNECTOR PIN 7 FOR DAMAGE</p> <ul style="list-style-type: none"> ● Inspect DLC C251 and DLC C251 pin 7 for damage. ● Are DLC C251 and DLC C251 pin 7 OK? 	<p>Yes GO to P3.</p> <p>No REPAIR DLC C251 or DLC C251 pin 7 as necessary. RETEST the communication to RCM. RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag Supplemental Restraint System (SRS) in this section.</p>
<p>P3 CHECK CIRCUIT 70 (LB/WH) FOR SHORT TO BATTERY</p> <ul style="list-style-type: none"> ● Measure the voltage to ground at DLC C251 pin 7, circuit 70 (LB/WH). <div> </div> <p>DR1546-A</p> <ul style="list-style-type: none"> ● Can any voltage be measured? 	<p>Yes REPAIR the battery short. RETEST the communication to RCM. RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag Supplemental Restraint System (SRS) in this section.</p>

	<p>No GO to P4.</p>
<p>P4 CHECK CIRCUIT 70 (LB/WH) FOR SHORT TO GROUND</p> <ul style="list-style-type: none"> ● Measure the resistance to ground at DLC C251 pin 7, circuit 70 (LB/WH).  <p>DR1547-A</p> <ul style="list-style-type: none"> ● Is the resistance less than 10,000 ohms? 	<p>Yes REPAIR the circuit. RETEST the communication to RCM. RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag Supplemental Restraint System (SRS) in this section.</p> <p>No GO to P5.</p>
<p>P5 CHECK CIRCUIT 70 (LB/WH) FOR AN OPEN</p> <ul style="list-style-type: none"> ● Measure the resistance between RCM C2041 pin 5, circuit 70 (LB/WH), harness side and DLC C251 pin 7, circuit 70 (LB/WH), harness side.  <p>DR1019-A</p> <ul style="list-style-type: none"> ● Is the resistance less than 5 ohms? 	<p>Yes INSTALL a new RCM. RETEST the communication to RCM. RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag Supplemental Restraint System (SRS) in this section.</p> <p>No REPAIR the circuit. RETEST the communication to RCM. RECONNECT the system. REACTIVATE the system. PROVE OUT the system. REFER to Air Bag Supplemental Restraint System (SRS) in this section.</p>

Inspection and Repair After a Supplemental Restraint System (SRS) Deployment



WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to [Air Bag Supplemental Restraint System \(SRS\)](#) in this section.

The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury.

NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road.**


NOTE: After diagnosing or repairing a SRS the restraint system diagnostic tools must be removed before operating the vehicle over the road.

NOTE: After diagnosing or repairing a seat system the restraint system diagnostic tools must be removed before operating the vehicle over the road.

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.


1. When any deployable device (driver air bag, passenger air bag, seat side air bag, safety belt pretensioner, etc.) or combination of devices are deployed and/or the RCM has the DTC B1231 (Crash Data Memory Full) in memory, the repair of the vehicle's supplemental restraint system (SRS) is to include the removal of all deployed devices and installation of new deployable devices, the removal and installation of new impact sensors, and the removal and installation of a new RCM.
2. When any damage to the impact sensor mounting points or mounting hardware has occurred, repair or install new mounting points and mounting hardware as needed.
3. When the driver air bag module has deployed a new clockspring must be installed.
4. Inspect the entire vehicle for damage, including the following components:
 - steering column.
 - instrument panel knee bolsters and mounting points.
 - instrument panel braces and brackets.
 - instrument panel and mounting points.
 - seats and seat mounting points.
 - safety belts, safety belt buckles, and safety belt retractors. For additional information, refer to [Section 501-20A](#).
 - supplemental restraint system (SRS) wiring, wiring harnesses, and connectors.
5. After carrying out the review and inspection of the entire vehicle for damage, repair or install new components as needed.

Air Bag Disposal —Deployed Air Bag


1.  **WARNING:** Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

Dispose of the deployed air bag modules and safety belt pretensioners in the same manner as any other part to be scrapped.

Air Bag Disposal —Undeployed Inoperative

 **WARNING:** Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

 **WARNING:** Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

 **WARNING:** Carry a live air bag module with the air bag and trim cover or deployment door pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

NOTE: All inoperative air bag modules and safety belt pretensioners have been placed on the Mandatory Return List. All discolored or damaged air bag modules must be treated the same as any inoperative live air bag being returned.

1. Remove the inoperative component from the vehicle. For additional information, refer to the appropriate air bag procedure in this section.

AIR BAG MODULE VERIFICATION


VEHICLE SERIAL NO.

This 17 digit number can be found (1) on your vehicle registration (2) on the dash panel at left side close to lower edge of windshield.

ATTENTION INSTALLER

Please complete and mail this postcard with your New Air Bag Module Serial Number (see sample below) and the Vehicle Identification Number (VIN) of the vehicle in which you are installing this module.

LOOK FOR YOUR REPLACEMENT AIR BAG MODULE SERIAL NUMBER (SN) AT THE LOCATION SHOWN IN THIS SAMPLE AND ENTER IT IN THE SPACE PROVIDED BELOW



SAMPLE

REPLACEMENT AIR BAG MODULE SERIAL NO.


A0005406


2. **NOTE:** When installing a new air bag module, a prepaid return postcard is provided with the replacement air bag module. The serial number for the new part and the vehicle identification number (VIN) must be recorded and sent to Ford Motor Company.


If installing a new air bag module, record the necessary information and return the inoperative air bag module to Ford Motor Company.


Air Bag Disposal —Driver, Undeployed, Scrapped Vehicle

Remote Deployment

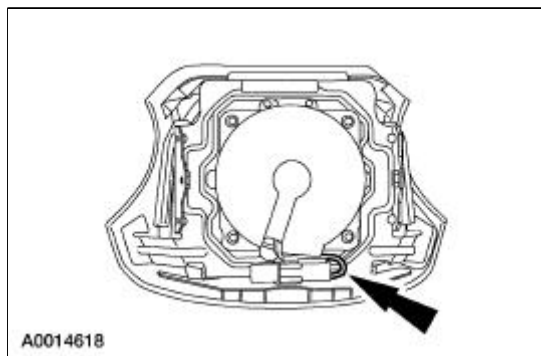
 **WARNING:** Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module or safety belt retractor/pretensioner assembly. This will reduce the risk of injury in the event of an accidental deployment.

 **WARNING:** Carry a live air bag module with the air bag and trim cover or deployment door pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

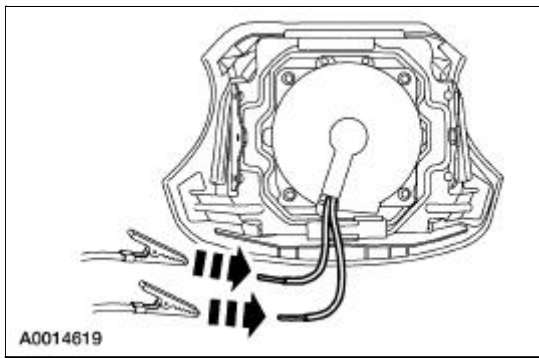
 **WARNING:** Remote deployment is to be performed outdoors with all personnel at least 6.1 meters (20 feet) away to ensure personal safety. Due to the loud report which occurs when the air bag is deployed, hearing protection is required.

 **WARNING:** Do not place the driver or passenger air bag module with the trim cover or deployment door facing down, as the forces of the deploying air bag can cause it to ricochet and cause personal injury.

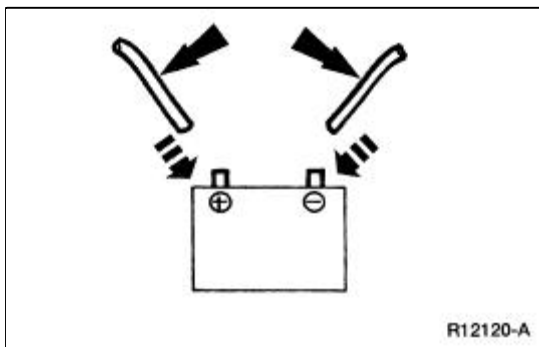
1. Remove the driver air bag from the vehicle. For additional information, refer to [Driver Air Bag Module](#) in this section.
2. Cut and strip the wires at the driver air bag electrical connector.



3. Obtain two wires (20 gauge minimum) at least 6.1 meters (20 feet) long and attach one end of each wire to the stripped ends of the driver air bag module wires.




4. Place the air bag module on a flat surface in an open outdoor area with the trim cover facing upward.
5. Remain at least 6.1 meters (20 feet) away from the air bag module.
6. Deploy the air bag module by touching the other ends of the two wires to the terminals of a 12-volt battery.





7. To allow for cooling, wait at least ten minutes before approaching the deployed air bag.
 8. Dispose of the deployed air bag module in the same manner as any other part to be scrapped.
-


Air Bag Disposal —Passenger, Undeployed, Scrapped Vehicle

Remote Deployment

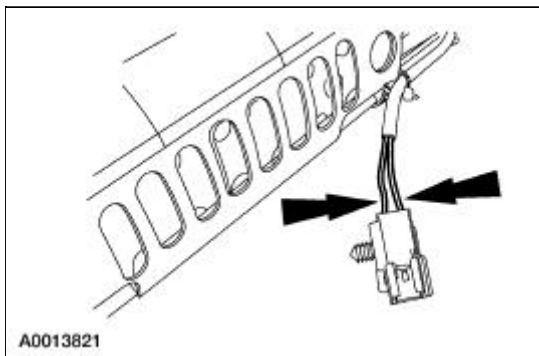
 **WARNING:** Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module or safety belt retractor/pretensioner assembly. This will reduce the risk of injury in the event of an accidental deployment.

 **WARNING:** Carry a live air bag module with the air bag and trim cover or deployment door pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

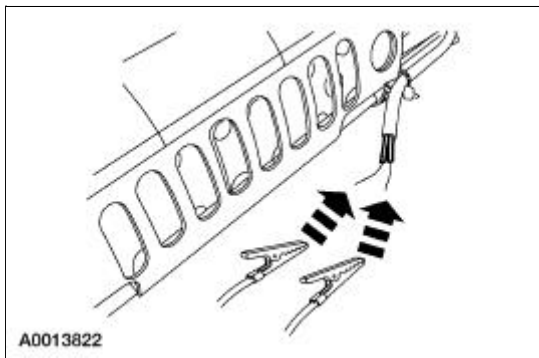
 **WARNING:** Remote deployment is to be performed outdoors with all personnel at least 6.1 meters (20 feet) away to ensure personal safety. Due to the loud report which occurs when the air bag is deployed, hearing protection is required.

 **WARNING:** Do not place the driver or passenger air bag module with the trim cover or deployment door facing down, as the forces of the deploying air bag can cause it to ricochet and cause personal injury.

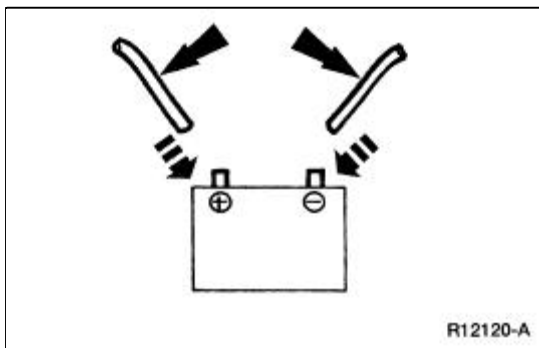
1. Remove the passenger air bag from the vehicle. For additional information, refer to [Passenger Air Bag Module](#) in this section.
2. Cut and strip the wires near the passenger air bag electrical connector.



3. Obtain two wires (20 gauge minimum) at least 6.1 meters (20 feet) long and attach one end of each wire to the stripped ends of the passenger air bag module wires.




4. Place the air bag module on a flat surface in an open outdoor area with the deflector can facing downward.
5. Remain at least 6.1 meters (20 feet) away from the air bag module.
6. Deploy the air bag module by touching the other ends of the two wires to the terminals of a 12-volt battery.




7. To allow for cooling, wait at least ten minutes before approaching the deployed air bag.
 8. Dispose of the deployed air bag module in the same manner as any other part to be scrapped.
-


Supplemental Restraint System (SRS) Deactivation and Reactivation

Special Tool(s)


 ST2506-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-R0012)
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Deactivation


 **WARNING:** Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.


 **WARNING:** Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.


 **WARNING:** Do not set a live air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.

 **WARNING:** After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

 **WARNING:** Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

 **WARNING:** The safety belt buckle pretensioner and safety belt retractor pretensioner are pyrotechnic devices. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

 **WARNING:** Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

 **WARNING:** The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side air bag and/or a safety belt pretensioner (if equipped) system is being serviced, **the air bag system must be deactivated.**


NOTE: Restraint system diagnostic tools **MUST** be installed under the seats in the seat side air bag (if equipped) and safety belt pretensioner (if equipped) to floor connectors.

NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road.**

NOTE: After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

1.  **WARNING:** To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

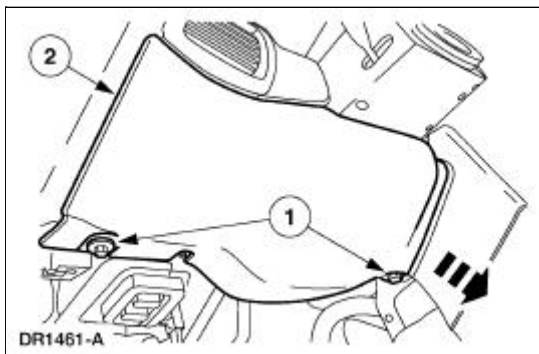
Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

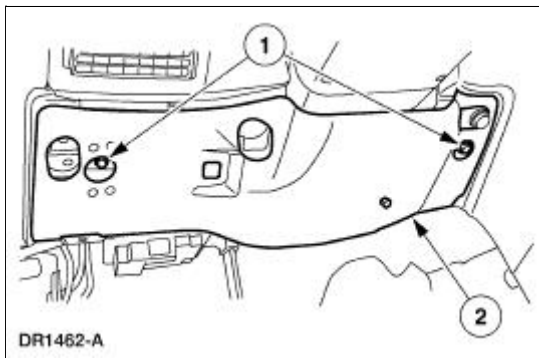
To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable and wait at least one minute. For additional information, refer to [Section 414-01](#).

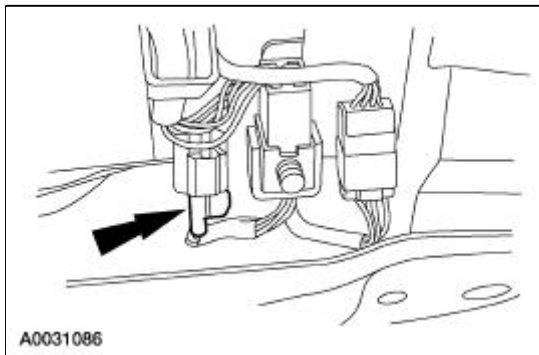
2. Remove the steering column opening lower finish panel.
 1. Remove the screws.
 2. Pull out to release the retaining clips and remove the steering column opening lower finish panel.



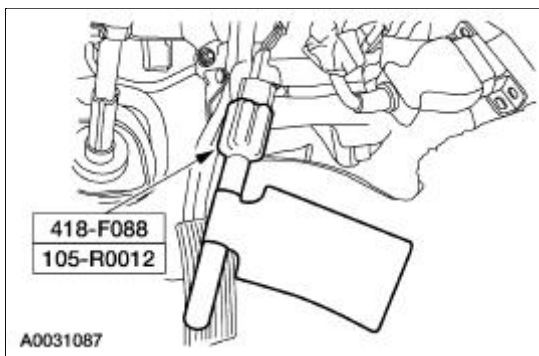
3. Remove the steering column opening lower reinforcement.
 1. Remove the bolts.
 2. Remove the steering column opening lower reinforcement.



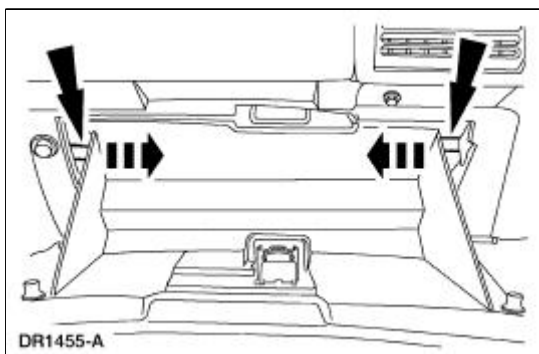
4. Pushing in on the release tab, disconnect the clockspring electrical connector at the base of the steering column.



5. Attach the restraint system diagnostic tool to the vehicle harness side of the clockspring electrical connector.



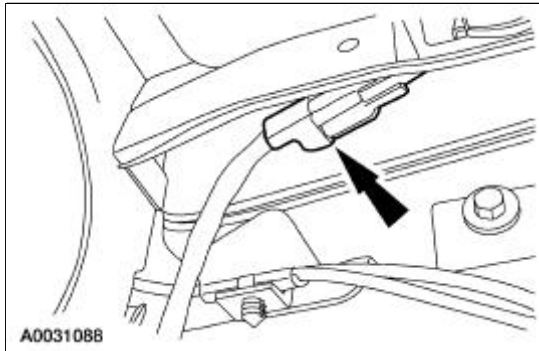
6. Open the glove compartment, push in on the tabs and open the glove compartment door to its fullest extent.



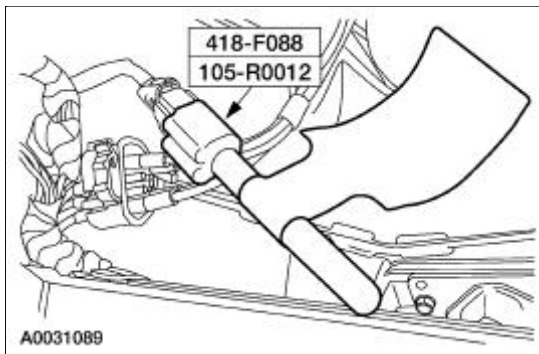
7. Remove the right hand A/C register duct.

- Remove the two screws retaining the duct to the A/C register.
- Separate the A/C duct at the air plenum and remove the duct.

8. Disconnect the passenger air bag module.



9. Attach the restraint system diagnostic tool to the vehicle harness side of the passenger air bag electrical connector.



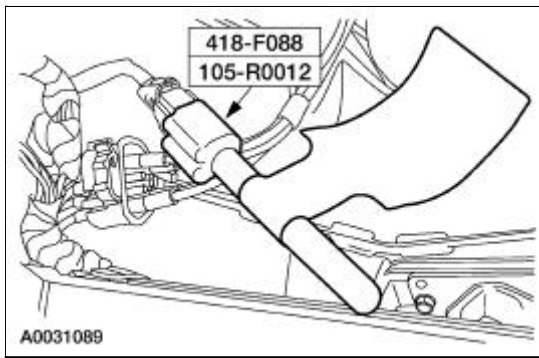
10. Connect the battery ground cable. For additional information, refer to [Section 414-01](#).
11. With the restraint system diagnostic tools installed at all deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to [Air Bag Supplemental Restraint System \(SRS\)](#) in the Diagnosis and Testing portion of this section.
12. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to [Section 414-01](#).

Reactivation

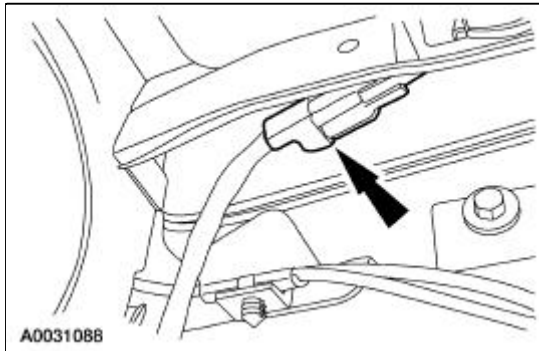


WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the deactivation procedure.

1. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to [Section 414-01](#).
2. Remove the restraint system diagnostic tool from the passenger air bag module electrical connector.



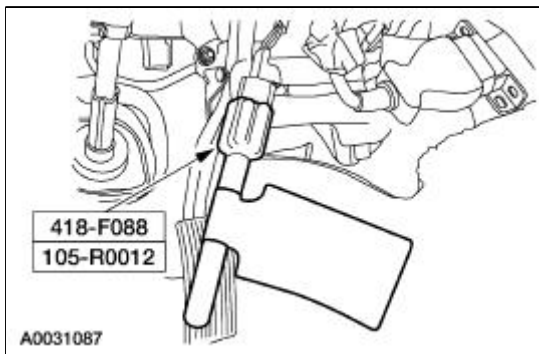
3. Connect the passenger air bag module electrical connector.



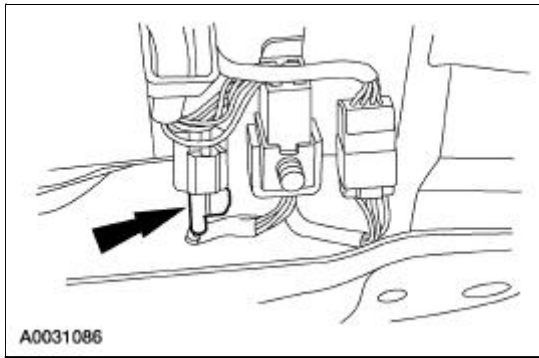
4. Install the right hand A/C register duct.
 - Connect the A/C duct at the air plenum.
 - Install the duct at the A/C register and install the two screws.

5. Close the glove compartment.

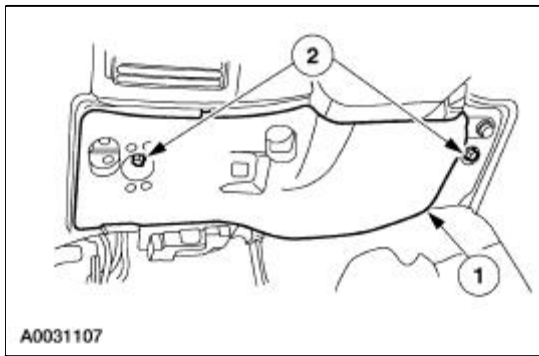
6. Remove the restraint system diagnostic tool from the clockspring electrical connector.



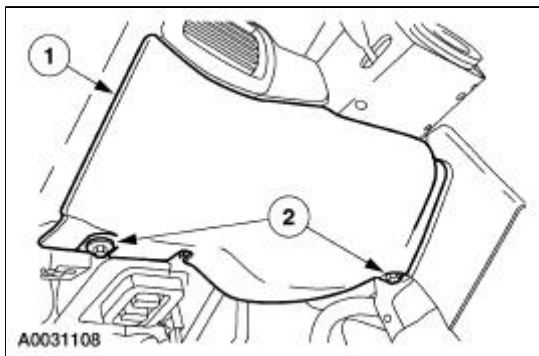
7. Connect the clockspring electrical connector at the base of the steering column.




8. Install the steering column opening lower reinforcement.
 1. Position the steering column opening lower reinforcement.
 2. Install the bolts.



9. Install the steering column opening lower finish panel.
 1. Align the steering column opening lower finish panel and push in, seating the retaining clips.
 2. Install the screws.



10. Connect the battery ground cable. For additional information, refer to [Section 414-01](#).
11.  **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to [Air Bag Supplemental Restraint System \(SRS\)](#) in the Diagnosis and Testing portion of this section.

Weld Nut Repair — "J" Nut, Restraints Control Module (RCM)



WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

NOTE: There are two procedures to repair a vehicle having missing restraints control module attaching weld nut(s). Read both procedures before proceeding with the repair.

NOTE: If two or more weld nuts are missing, do not install the "J" nuts as outlined in this procedure. Weld nuts must be installed as outlined in Weld Nut Repair — Missing Weld Nut, Restraints Control Module (RCM).

NOTE: The following procedure applies to vehicles that have a rectangular hole in the sheet metal that is in close proximity to the missing weld nut.

1. Obtain a "J" nut (part number N623332-S301) or any of the following optional "J" nuts (part numbers: N623342-S101, N800854-S100, N800925-S100).
2. Obtain a 6 mm (0.24 in) grounding screw (part number N806327-S190) or equivalent.
3. Install the "J" nut through the rectangular hole in the sheet metal.
4. **NOTE:** Be sure the threaded portion of the "J" nut is aligned with the clearance hole in the sheet metal.

Install the crash sensor.

5. Tighten the attaching screws to specification. For additional information, refer to Torque Specifications in this section.
-

Weld Nut Repair —Missing Weld Nut, Restraints Control Module (RCM)

! **WARNING:** To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

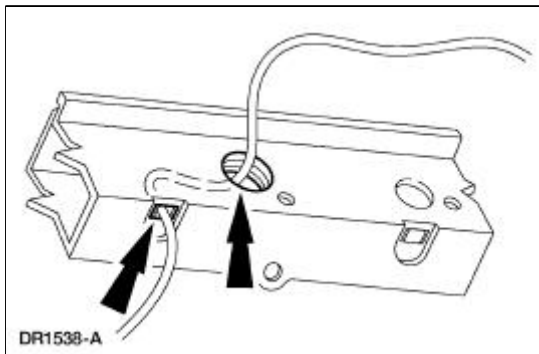
To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

NOTE: There are two procedures to repair a vehicle having missing restraints control module attaching weld nut(s). Read both procedures before proceeding with the repair.

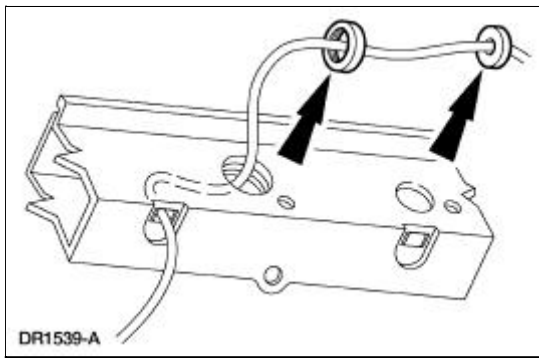
NOTE: If two or more weld nuts are missing, do not install the "J" nuts as outlined in Weld Nut Repair — "J" Nut, Restraints Control Module (RCM). Weld nuts must be installed as outlined in this procedure.

NOTE: Radiator support repair shown, others are similar.

1. Obtain a 6 mm (0.24 in) weld nut (part number N806285-S190).
2. Obtain a 6 mm (0.24 in) grounding screw (part number N806327-S190).
3. Route a sufficient length of copper welding wire through the weld nut clearance hole and back out an adjacent access hole.




4. Feed the copper welding wire through the weld nut, then through a standard flatwasher.



5. Secure the flatwasher so that it cannot be pulled off the end of the copper welding wire.
 6. Pull the copper welding wire back through the clearance hole, allowing the weld nut and flatwasher to follow the copper welding wire through.
 7. Position the weld nut to the weld nut clearance hole, firmly pulling on the copper welding wire allowing the secured flatwasher to hold the weld nut in position.
 8. Holding the weld nut securely in place and using a MIG welder, weld in four places around the edge of the weld nut.
 9. Metal finish as required.
 10. Verify the nut is securely in place.
 11. Install the crash sensor.
 12. Tighten the attaching screws to specification. For additional information, refer to Torque Specifications in this section.
-

Weld Nut Repair —Stripped Weld Nut, Restraints Control Module (RCM)

 **WARNING:** To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

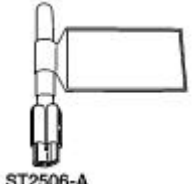
The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).


1. Obtain an 8 mm (0.32 in) grounding screw (part number N802455-S190).
 2. Drill out the internal threads of the stripped-out weld nut to 7.37 mm (0.29 in) using a letter "L" size drill bit.
 3. Position the crash sensor to the vehicle.
 4. Install the 8 mm (0.32 in) grounding screw into the drilled-out weld nut.
 5. Install the remaining attaching screws.
 6. Tighten the attaching screws to specification. For additional information, refer to Torque Specifications in this section.
-


Restraints Control Module (RCM)


Special Tool(s)

 ST2506-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-R0012)
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Removal

 **WARNING:** The restraints control module (RCM) orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) has been involved in a collision in which the center tunnel area has been damaged, inspect the mounting and bracket for deformation. If damaged, the RCM must be replaced whether or not the air bags have deployed. In addition, make sure the area of the RCM mounting is restored to its original condition.


 **WARNING:** Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

 **WARNING:** The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

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

NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

1. Prepare the vehicle for restraints control module (RCM) removal.

-  **WARNING:** To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.


Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable

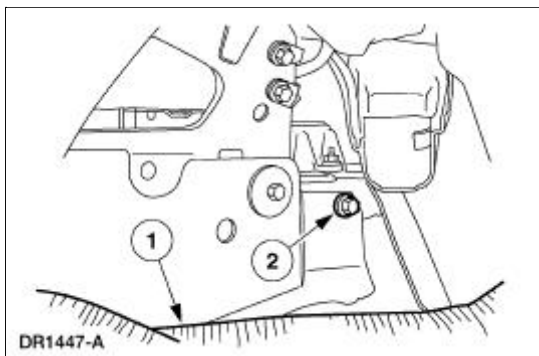
and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to [Section 414-01](#).

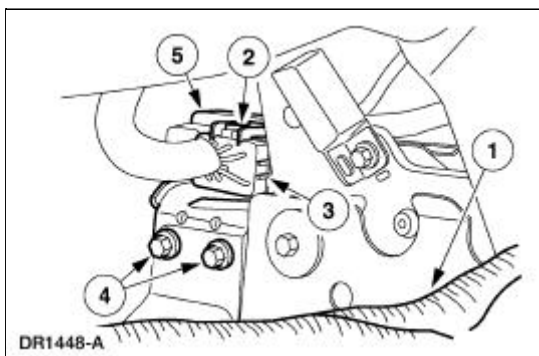
2.  **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

Deactivate the supplemental restraint system (SRS). For additional information, refer to [Supplemental Restraint System \(SRS\) Deactivation and Reactivation](#) in the General Procedures portion of this section.


2. Remove the right hand restraints control module (RCM) bracket retaining bolt.
 1. Position the carpet back at the right hand side of the instrument panel (I/P) center support bracket.
 2. Remove the RCM bracket retaining bolt.




3. Remove the RCM with bracket.
 1. Position the carpet back at the left hand side of the I/P center support bracket.
 2. Disengage the RCM electrical connector locking clip.
 3. Disconnect the RCM electrical connector.
 4. Remove the two retaining bolts.
 5. Remove the RCM with bracket.



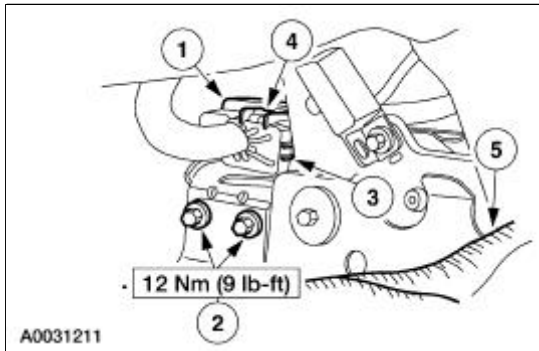
Installation

 **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions and notes at the beginning of the removal procedure.**

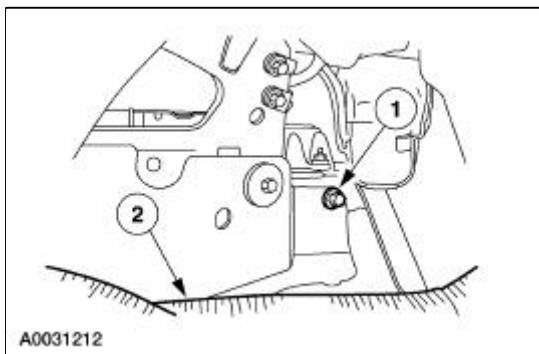
1.  **WARNING: The tightening torque of the air bag restraints control module (RCM) retaining bolts is critical for correct system operation.**

Connect the RCM.

1. Position the RCM.
2. Install the bolts.
3. Connect the RCM electrical connector.
4. Slide and engage the RCM electrical connector locking clip.
5. Reposition the carpet.



2. Install the RCM.
 1. Install the bolt.
 2. Reposition the carpet.



3. Connect the battery ground cable. For additional information, refer to [Section 414-01](#).
4. With the restraint system diagnostic tools installed at all deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to [Air Bag Supplemental Restraint System \(SRS\)](#) in the Diagnosis and Testing portion of this section.
5. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to [Section 414-01](#).
6. Restore the vehicle to operating condition.
 1. **⚠️ WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

Reactivate the supplemental restraint system (SRS). For additional information, refer to [Supplemental Restraint System \(SRS\) Deactivation and Reactivation](#) in the General Procedures portion of this section.

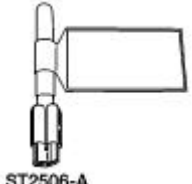
2. **⚠️ WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to [Air Bag Supplemental](#)


[Restraint System \(SRS\)](#) in the Diagnosis and Testing portion of this section.


Driver Air Bag Module

Special Tool(s)


 ST2506-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-R0012)
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Removal

 **WARNING:** Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.


 **WARNING:** Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

 **WARNING:** Do not set a live air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.

 **WARNING:** After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.


 **WARNING:** Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

 **WARNING:** Air bag modules with discolored or damaged trim covers must be replaced, not repainted.

 **WARNING:** The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

1. Prepare the vehicle for driver air bag module removal.


1.  **WARNING:** To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

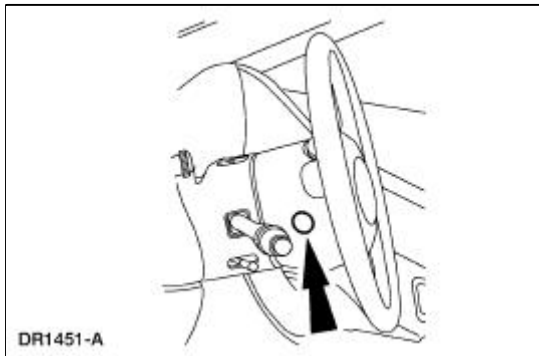
To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to [Section 414-01](#).

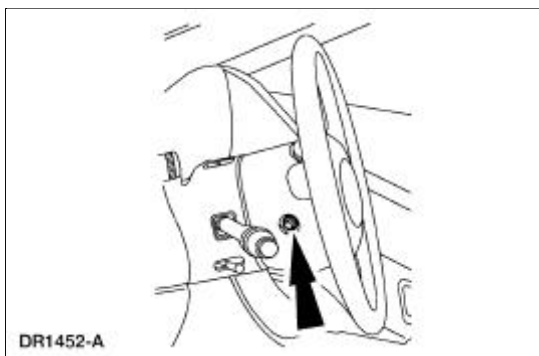
2.  **WARNING:** To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.

Deactivate the supplemental restraint system (SRS). For additional information, refer to [Supplemental Restraint System \(SRS\) Deactivation and Reactivation](#) in the General Procedures portion of this section.

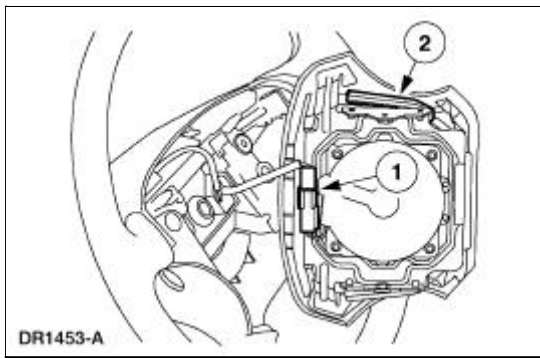
2. Remove the two steering wheel plugs.



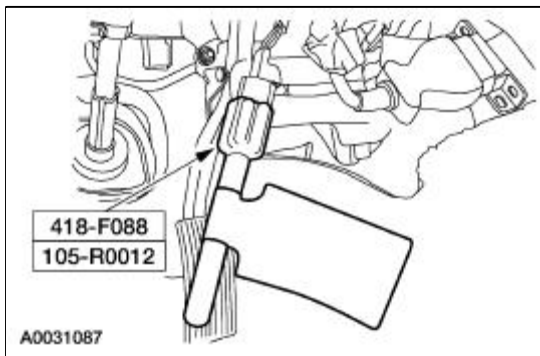
3. Remove the two driver air bag module retaining bolts (one shown).



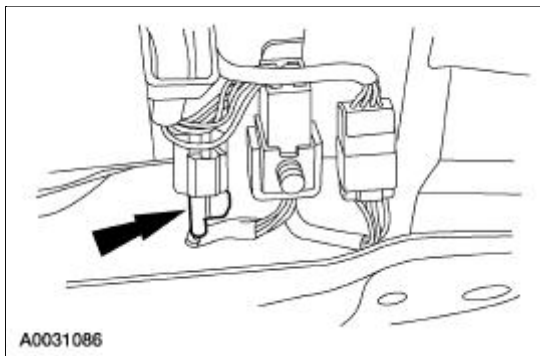
4. Remove the driver air bag module.
 1. Disconnect the driver air bag module electrical connector.
 2. Remove the driver air bag module.



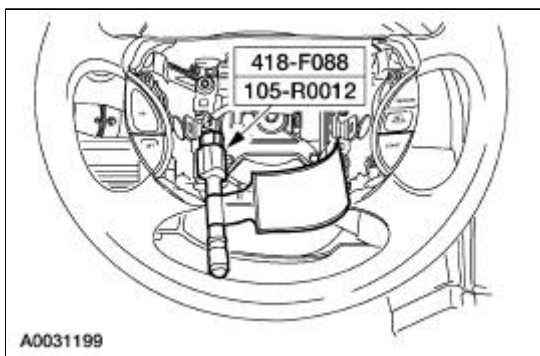
5. Remove the restraint system diagnostic tool from the vehicle harness side of the clockspring electrical connector at the base of the steering column.



6. Connect the clockspring electrical connector at the base of the steering column.




7. Attach the restraint system diagnostic tool to the clockspring electrical connector at the top of the steering column.



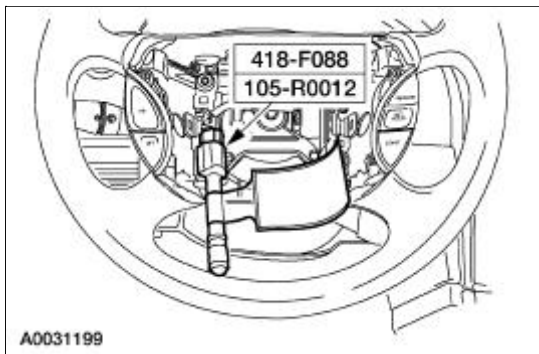
8. Connect the battery ground cable. For additional information, refer to [Section 414-01](#).

9. With the restraint system diagnostic tools installed at all deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to [Air Bag Supplemental Restraint System \(SRS\)](#) in the Diagnosis and Testing portion of this section.
10. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to [Section 414-01](#).

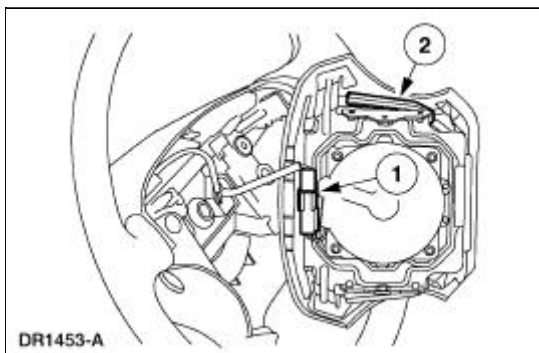
Installation

 **WARNING:** To reduce the risk of serious personal injury, read and follow all warnings, cautions and notes at the beginning of the removal procedure.

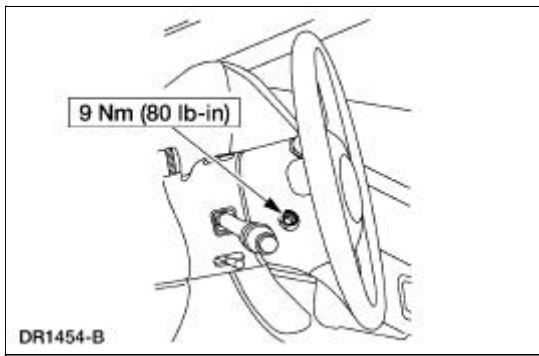
1. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to [Section 414-01](#).
2. Remove the restraint system diagnostic tool from the clockspring electrical connector at the top of the steering column.



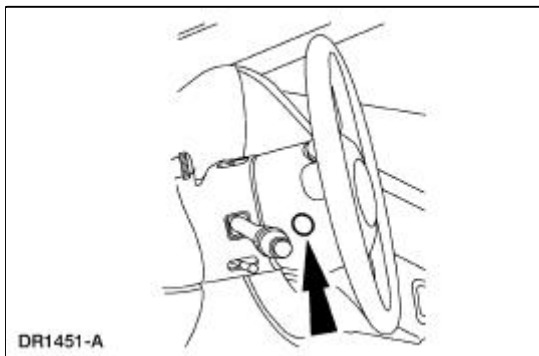
3. Connect the driver air bag module.
 1. Connect the driver air bag module electrical connector.
 2. Position the driver air bag module to the steering wheel.




4. Install the two driver air bag module bolts.



5. Install the two steering wheel back cover plugs.



6. Connect the battery ground cable. For additional information, refer to [Section 414-01](#).
7. With the restraint system diagnostic tools still installed at the remaining deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to [Air Bag Supplemental Restraint System \(SRS\)](#) in the Diagnosis and Testing portion of this section.


8.  **WARNING:** To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.


The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable and wait at least one minute. For additional information, refer to [Section 414-01](#).

9. Restore the vehicle to operating condition.
 1.  **WARNING:** To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.

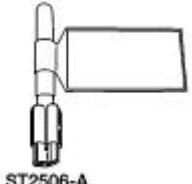
Reactivate the supplemental restraint system (SRS). For additional information, refer to [Supplemental Restraint System \(SRS\) Deactivation and Reactivation](#) in the General Procedures portion of this section.

2.  **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**


With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to [Air Bag Supplemental Restraint System \(SRS\)](#) in the Diagnosis and Testing portion of this section.


Passenger Air Bag Module


Special Tool(s)


 ST2506-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-R0012)
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Removal

 **WARNING:** Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.


 **WARNING:** Carry a live air bag module with the air bag and deployment door pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

 **WARNING:** Do not set a live air bag module down with the deployment door face down. This will reduce the risk of injury in the event of an accidental deployment.

 **WARNING:** After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.


 **WARNING:** Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

 **WARNING:** Air bag modules with discolored or damaged trim covers must be replaced, not repainted.

 **WARNING:** The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

1. Prepare the vehicle for passenger air bag module removal.


1.  **WARNING:** To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to [Section 414-01](#).

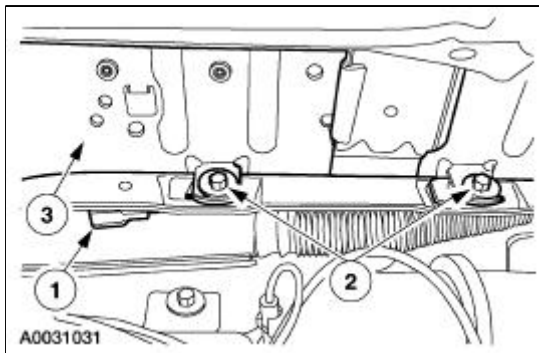
2.  **WARNING:** To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.

Deactivate the supplemental restraint system (SRS). For additional information, refer to [Supplemental Restraint System \(SRS\) Deactivation and Reactivation](#) in the General Procedures portion of this section.


2.  **CAUTION:** Do not handle the passenger air bag module by grabbing the edges of the deployment doors.

Remove the passenger air bag module.

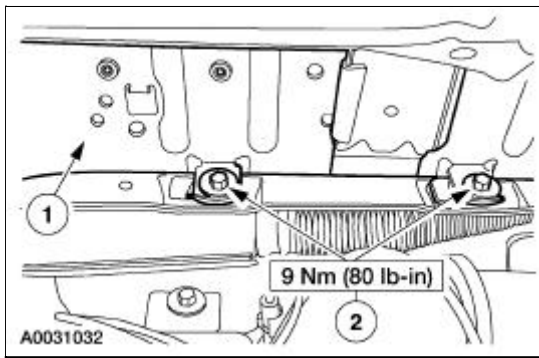
1. Remove the passenger air bag module electrical connector from the instrument panel bracket.
2. Remove the passenger air bag module bolts.
3. Placing one hand in the glove compartment opening, push the passenger air bag module out and remove it.



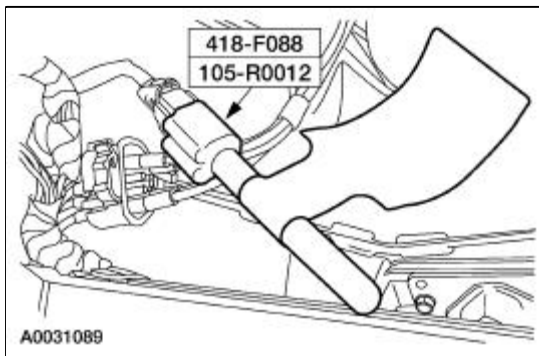
Installation

 **WARNING:** To reduce the risk of serious personal injury, read and follow all warnings, cautions and notes at the beginning of the removal procedure.

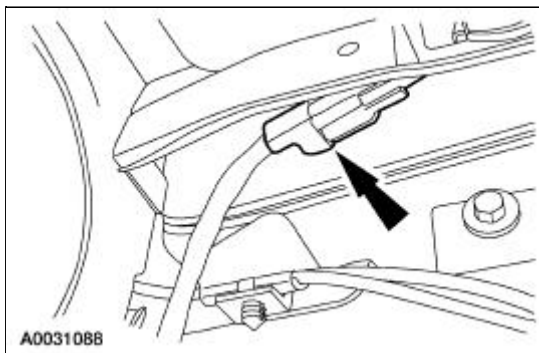
1. Install the passenger air bag module.
 1. Position the passenger air bag module into the instrument panel.
 2. Install the bolts.



2. Remove the restraint system diagnostic tool from the vehicle harness side of the passenger air bag electrical connector.



3. Connect the passenger air bag module electrical connector. Install the passenger air bag module electrical connector and pin-type retainer to the instrument panel frame.



4. Close the glove compartment.
5. Connect the battery ground cable. For additional information, refer to [Section 414-01](#).
6. With the restraint system diagnostic tools still installed at the remaining deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to [Air Bag Supplemental Restraint System \(SRS\)](#) in the Diagnosis and Testing portion of this section.

7. **⚠️ WARNING:** To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.


Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.


To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable and wait at least one minute. For additional information, refer to [Section 414-01](#).

8. Restore the vehicle to operating condition.

1.  **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

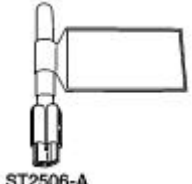
Reactivate the supplemental restraint system (SRS). For additional information, refer to [Supplemental Restraint System \(SRS\) Deactivation and Reactivation](#) in the General Procedures portion of this section.

2.  **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**


With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to [Air Bag Supplemental Restraint System \(SRS\)](#) in the Diagnosis and Testing portion of this section.


Clockspring

Special Tool(s)


 <p>ST2506-A</p>	Diagnostic Tool, Restraint System (2 Req'd) 418-F088 (105-R0012)
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Removal

 **WARNING:** Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.


 **WARNING:** Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

 **WARNING:** Do not set a live air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.

 **WARNING:** After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.


 **WARNING:** Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

 **WARNING:** Air bag modules with discolored or damaged trim covers must be replaced, not repainted.

 **WARNING:** The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

1. Prepare the vehicle for clockspring removal.


1.  **WARNING:** To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

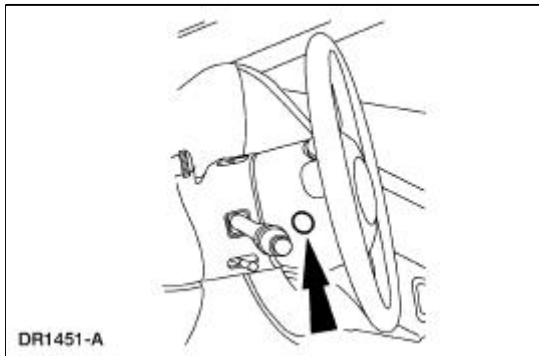
To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to [Section 414-01](#).

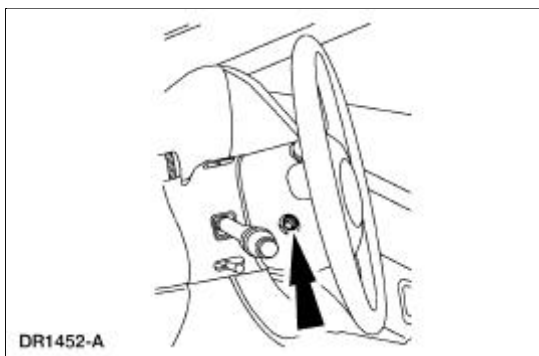
2.  **WARNING:** To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.

Deactivate the supplemental restraint system (SRS). For additional information, refer to [Supplemental Restraint System \(SRS\) Deactivation and Reactivation](#) in the General Procedures portion of this section.

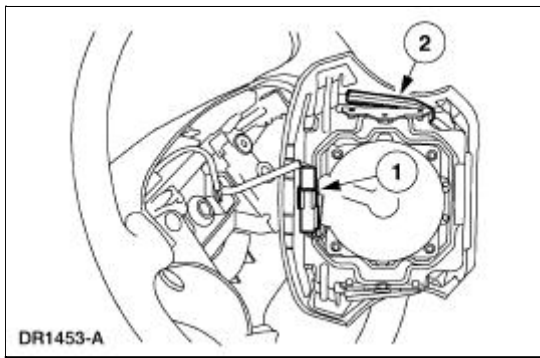
2. Remove the two steering wheel back cover plugs.



3. Remove the two driver air bag module retaining bolts.



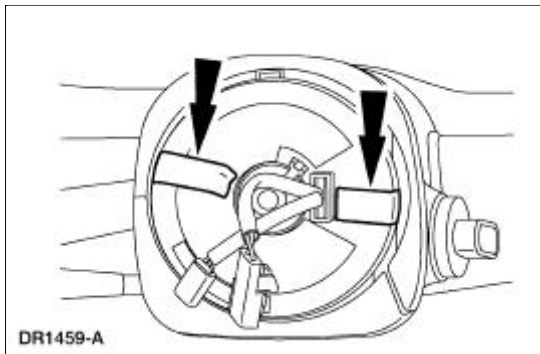
4. Remove the driver air bag module.
 1. Disconnect the driver air bag module electrical connector.
 2. Remove the driver air bag module.



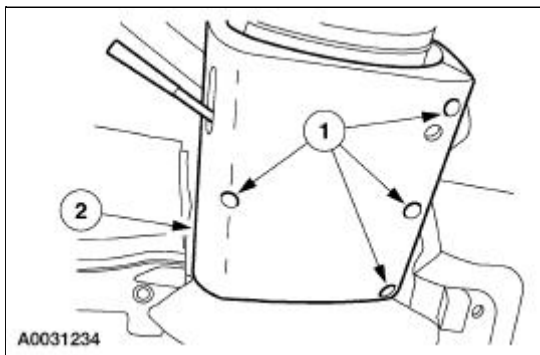
5. **NOTE:** Make sure the wheels (1007) are in the straight-ahead position.

Remove the steering wheel (3600). For additional information, refer to [Section 211-04](#).

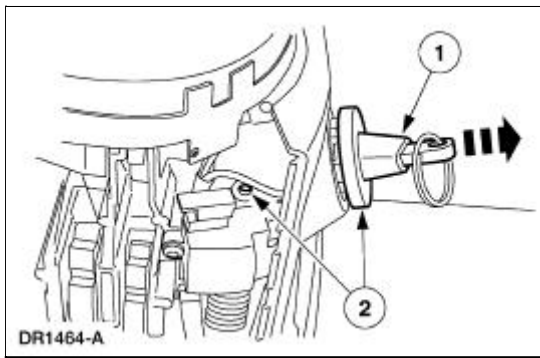
6. Apply two strips of masking tape across the clockspring (14A664) to prevent accidental rotation when the clockspring is removed.



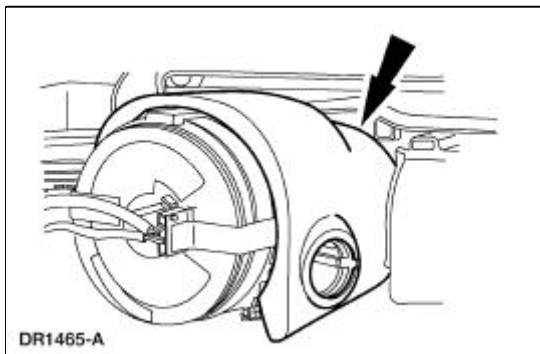
7. Remove the lower steering column shroud (3530).
 1. Remove the tilt wheel handle and shank (3F609).
 2. Remove the four screws.
 3. Remove the lower steering column shroud.



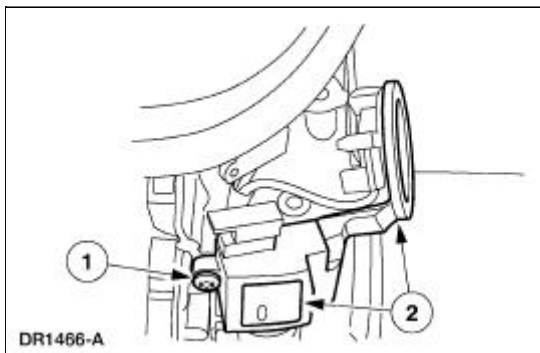
8. Remove the ignition switch lock cylinder (11582).
 1. Position the ignition switch lock cylinder to the RUN position.
 2. Using the suitable tool, push upward on the cylinder release tab while pulling the ignition switch lock cylinder outward.



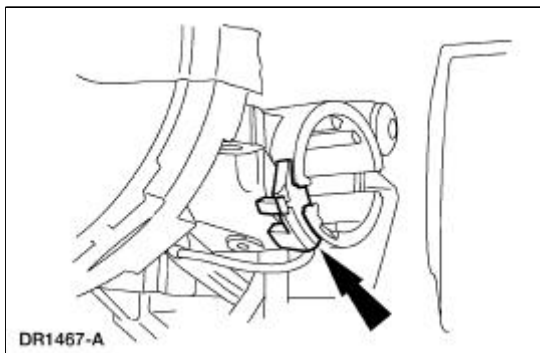
9. Raise the upper steering column shroud.



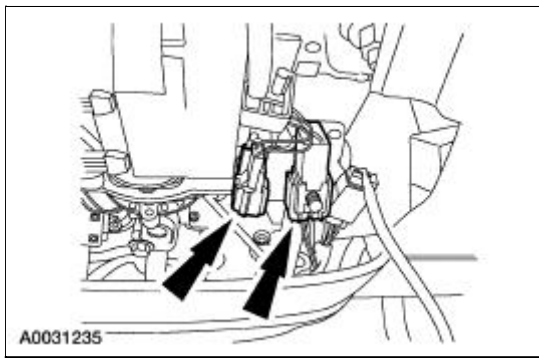
10. Remove the passive anti-theft system (PATS) transmitter.
1. Remove the PATS transmitter retaining screw.
2. Position the PATS transmitter out of the way.



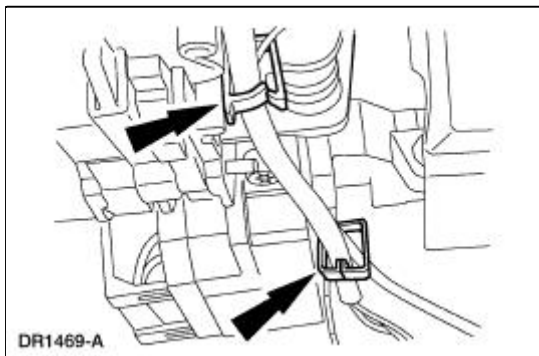
11. Remove the key-in-ignition warning indicator switch.



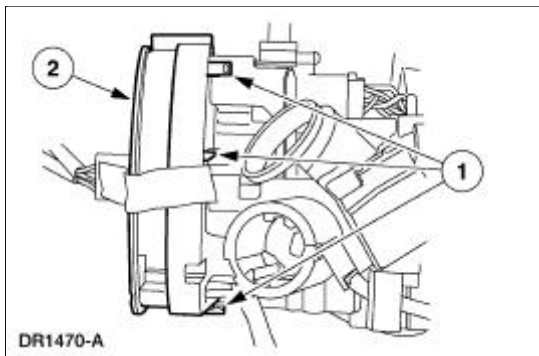
12. Remove the two clockspring electrical connectors from the bracket. Disconnect the remaining electrical connector.




13. Remove the wire harness from its holders.



14. Remove the clockspring.
 1. Pry the clockspring retaining clips loose.
 2. Remove the clockspring.



Installation

 **WARNING:** To reduce the risk of serious personal injury, read and follow all warnings, cautions and notes at the beginning of the removal procedure.


Vehicles receiving a new clockspring

1. **NOTE:** A new clockspring is supplied in a centralized position and held there with a key.

Remove the key from the clockspring, holding the rotor in its centralized position.

- Do not allow the clockspring rotor to turn.


Vehicles needing clockspring recentering

2.  **WARNING: Incorrect centralization may result in premature component failure. If in doubt when centralizing the clockspring, repeat the centralizing procedure. Failure to follow this instruction may result in personal injury.**

 **CAUTION: Make sure the road wheels are in the straight ahead position.**

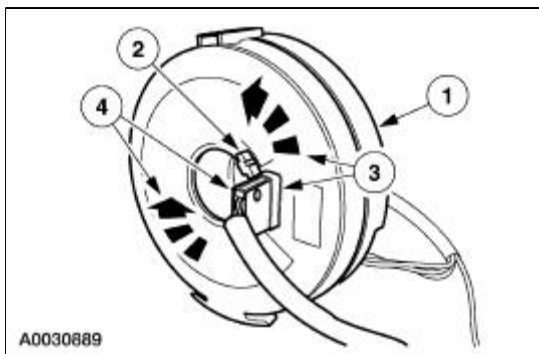
NOTE: If a clockspring has rotated out of center, follow through with this step.

Centralize the clockspring.

1. Hold the clockspring outer housing stationary.
2. Depress the clockspring locking tab to release the rotor.
3.  **CAUTION: Overturning will destroy the clockspring. The internal ribbon wire acts as the stop and can be broken from its internal connection.**

While holding the clockspring locking tab in the released position, turn the rotor counterclockwise, carefully feeling for the ribbon wire to run out of length, and a slight resistance is felt. Stop turning at this point.

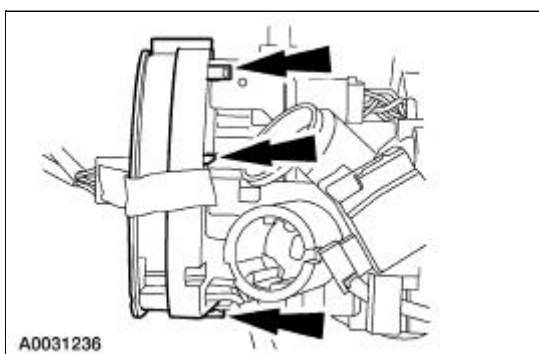
4. While holding the clockspring locking tab in the released position, turn the clockspring clockwise approximately three turns. This is the center point of the clockspring.
 - Release the clockspring locking tab. Do not allow the rotor to turn from this position.



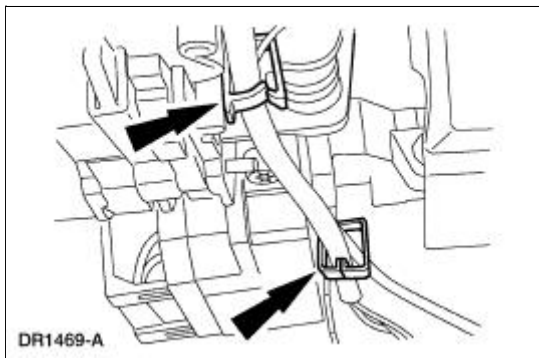
All vehicles

3. **NOTE:** Slight turning of the clockspring rotor is allowable for alignment purposes to the steering column.

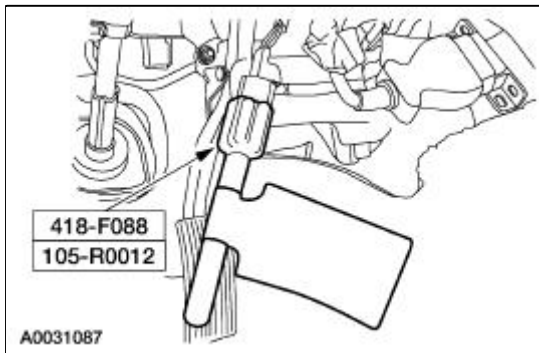
With the flats of the clockspring aligned to the flats of the steering column, slide the clockspring onto the steering column engaging the retaining tabs.



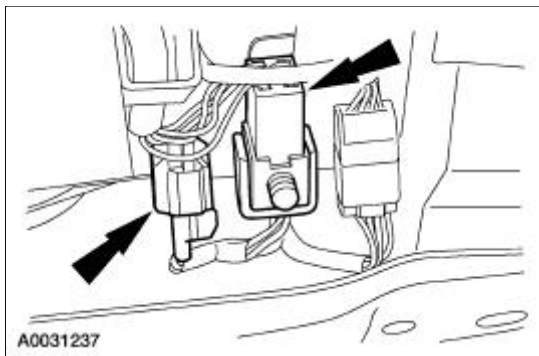
4. Route the clockspring wire harness down the side of the steering column and into the holders.



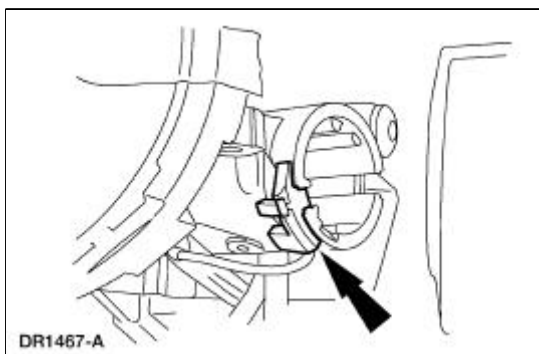
5. Remove the restraint system diagnostic tool from the vehicle harness side of the clockspring electrical connector.



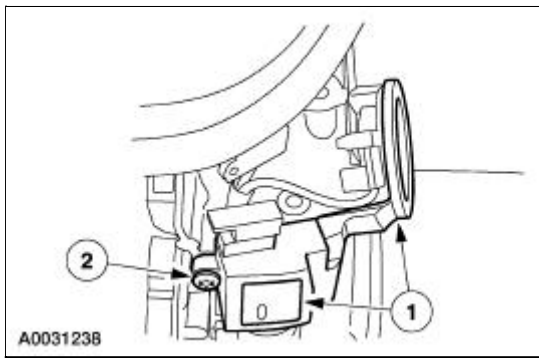
6. Connect the two clockspring electrical connectors. Position the clockspring electrical connectors onto the bracket.



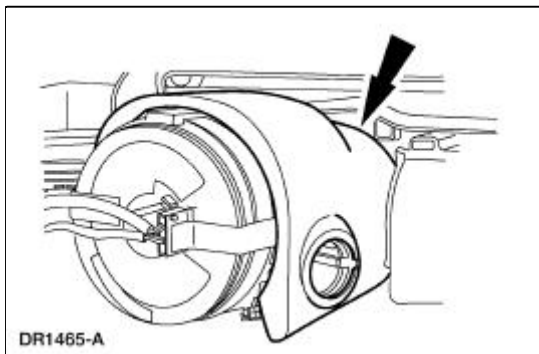
7. Install the key-in-ignition warning indicator switch.



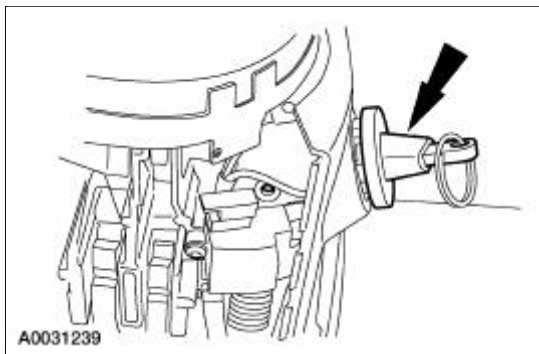
8. Install the passive anti-theft system (PATS) transmitter.
 1. Position the PATS transmitter to the steering column.
 2. Install the screw.



9. Reposition the upper steering column shroud.



10. Install the ignition switch lock cylinder.

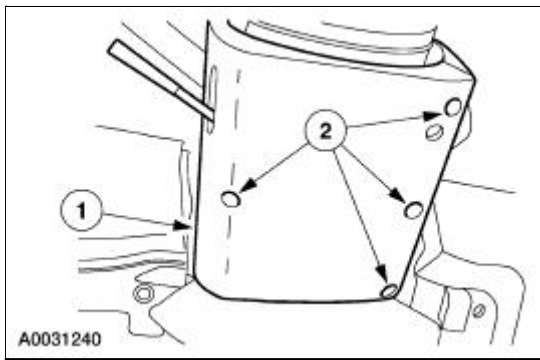


Vehicle repairs reusing the same clockspring

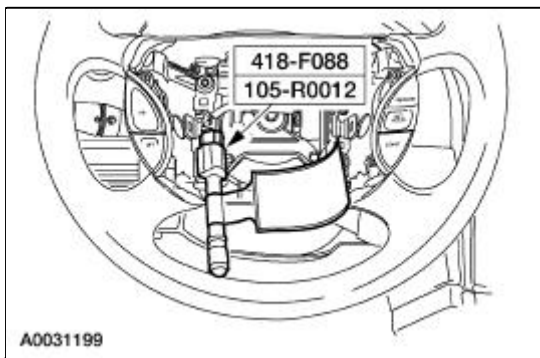
11. Remove the tape applied during clockspring removal.

All vehicles

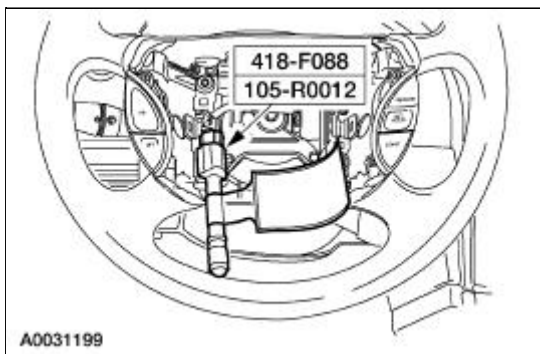
12. Install the lower steering column shroud.
 1. Position the lower steering column shroud.
 2. Install the screws.



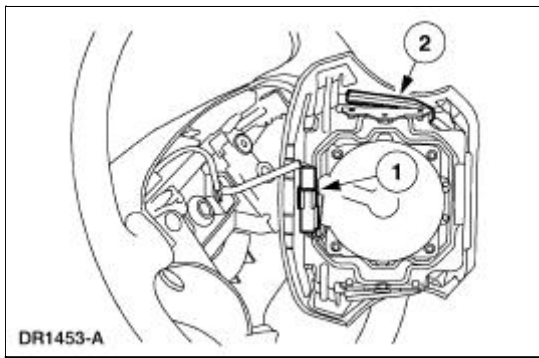
13. Install the steering wheel. Do not install the driver air bag module at this time. For additional information, refer to [Section 211-04](#).
14. Attach the restraint system diagnostic tool to the clockspring electrical connector at the top of the steering column.



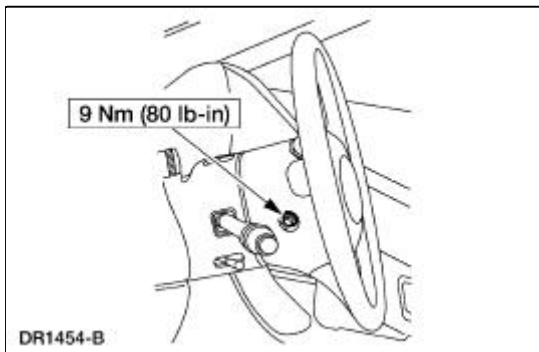
15. Connect the battery ground cable. For additional information, refer to [Section 414-01](#).
16. With the restraint system diagnostic tools installed at all deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to [Air Bag Supplemental Restraint System \(SRS\)](#), in the Diagnosis and Testing portion of this section.
17. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to [Section 414-01](#).
18. Remove the restraint system diagnostic tool from the clockspring electrical connector at the top of the steering column.



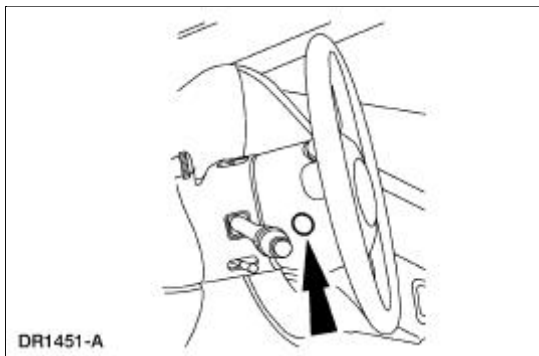
19. Connect and position the driver air bag module to the steering wheel.
 1. Connect the driver air bag module electrical connector.
 2. Position the driver air bag module to the steering wheel.




20. Install the two driver air bag module bolts.




21. Install the two steering wheel back cover plugs.



22. Restore the vehicle to operating condition.

1.  **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

Reactivate the supplemental restraint system (SRS). For additional information, refer to [Supplemental Restraint System \(SRS\) Deactivation and Reactivation](#) in the General Procedures portion of this section.

2.  **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to [Air Bag Supplemental Restraint System \(SRS\)](#) in the Diagnosis and Testing portion of this section.

Torque Specifications


Description	Nm	lb-ft
Engine mount nuts (3.8L engine)	115	85
Engine mount nuts (4.6L engine)	150	111
Front subframe lower bolts	90	66
Front subframe upper bolts	115	85
Front subframe brace bolts	41	30
Front subframe support, front and rear outboard bolts (convertible vehicles only)	63	46
Front subframe support, rear inboard bolts (convertible vehicles only)	30	22
HEGO connector bracket nut	47	35
Rear subframe bolts	103	76
Transmission support insulator to transmission extension housing bolts	70	52
Transmission support insulator-to-rear engine support nut	70	52
Transmission support crossmember to transmission support member through bolts and nuts	63	46

Frame Assembly

Underbody misalignment can affect front and rear wheel alignment, the operation of the suspension parts and drivetrain operation. Window glass cracks, door and window opening concerns, and air or water leaks at the doors are often caused by improperly tightened bolts and body misalignment.

Every structural member and outer panel is designed to offer the maximum protection in the event of a collision.

Body Misalignment Check

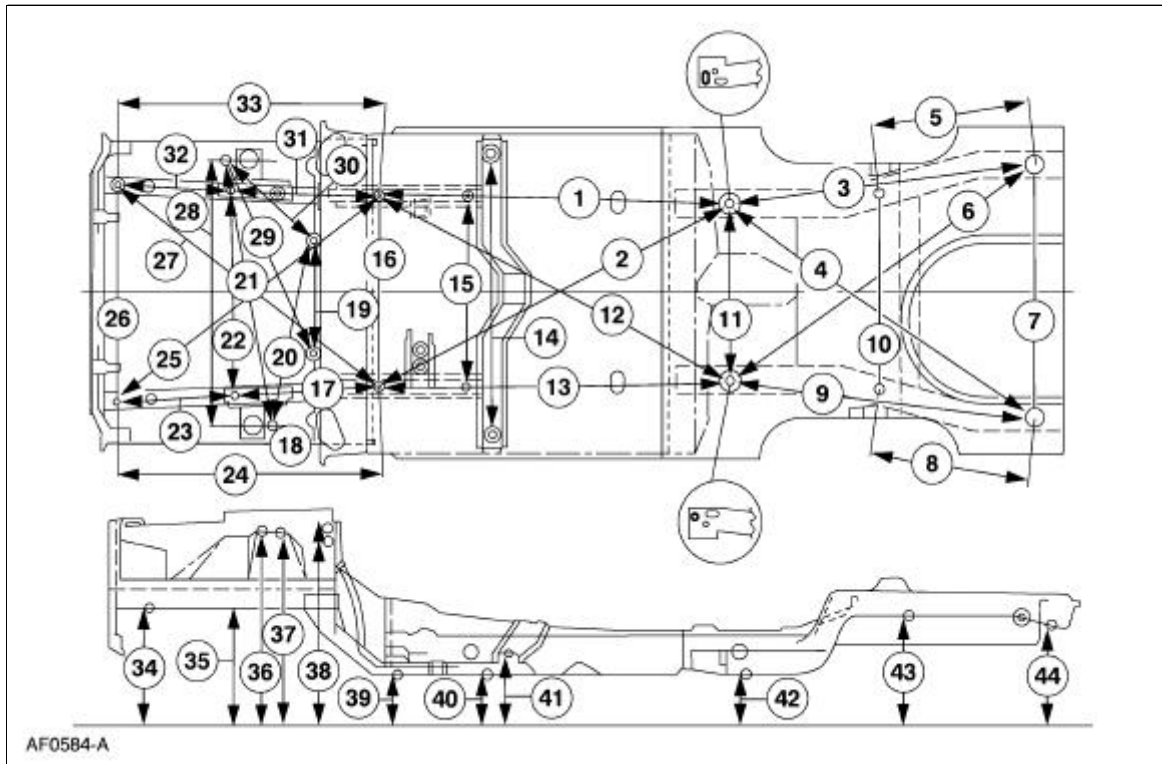
1.  **CAUTION: Do not attempt to correct any serious misalignment with one pulling/pushing operation. Damage to structure may occur.**

NOTE: All body alignment measurements are made without trim and from metal to metal.

To check the body alignment, take two opposite diagonal measurements between the front, center or rear pillars. Take the measurements between reference points, such as crease lines or weld joints which are diagonally opposite each other on the two pillars being measured.

Underbody Misalignment Check

Underbody Dimensions





Item	Part Number	Description
1	—	1390.65 mm (54.750 in)
2	—	1535.75 mm (61.43 in)
3	—	1123.25 mm (44.93 in)
4	—	1450.97 mm (57.125 in)
5	—	420.68 mm (16.5622 in)
6	—	1450.97 mm (57.125 in)
7	—	1065.28 mm (41.9400 in)
8	—	420.68 mm (16.5622 in)
9	—	1141.41 mm (44.9373 in)
10	—	857.00 mm (33.740 in)
11	—	751.84 mm (29.600 in)
12	—	1670.05 mm (62.750 in)
13	—	1352.55 mm (53.250 in)
14	—	1212.00 mm (47.716 in)
15	—	802.40 mm (31.5905 in)
16	—	802.40 mm (31.5905 in)
17	—	717.55 mm (28.250 in)

18	—	325.43 mm (12.8122 in)
19	—	520.70 mm (20.500 in)
20	—	792.16 mm (31.1873 in)
21	—	992.18 mm (39.0621 in)
22	—	863.60 mm (34.00 in)
23	—	522.28 mm (20.5622 in)
24	—	1219.20 mm (48.00 in)
25	—	1454.15 mm (57.250)
26	—	893.76 mm (35.1873 in)
27	—	1484.31 mm (58.4373 in)
28	—	792.16 mm (31.1873 in)
29	—	819.15 mm (32.250 in)
30	—	404.81 mm (15.9374 in)
31	—	684.21 mm (26.9374 in)
32	—	522.28 mm (20.5622 in)
33	—	1181.10 mm (46.500 in)
34	—	385.76 mm (15.1874 in)
35	—	385.76 mm (15.1874 in)
36	—	746.12 mm (29.375 in)
37	—	713.83 mm (28.1035 in)
38	—	RH 758.82 mm RH (29.875 in)
38	—	LH 755.65 mm LH (29.750 in)
39	—	114.30 mm (4.500 in)
40	—	127.00 mm (5.00 in)
41	—	152.40 mm (6.00 in)
42	—	96.93 mm (3.8122 in)
43	—	373.06 mm (14.6874 in)
44	—	369.88 mm (14.5622 in)

1. Underbody dimensions tolerances are ± 3.175 mm (0.125 in). Reference dimensions are not controlled dimensions. Reference points are ± 4.76 mm (0.1875 in). All underbody dimensions are detailed to the centerline of existing holes in the underbody assembly.
 2. Inspect all unibody structural members for cracks, twists or bends. Check all welded connections for cracks. Inspect support brackets for looseness.
-

Front Subframe —3.8L Engine

Special Tool(s)

 <p>ST2333-A</p>	3-Bar Engine Support Kit 303-F072
 <p>ST2375-A</p>	Lifting Bracket Set, Engine 303-D095 (D94L-6001-A) (014- 00792)

Removal and Installation

All vehicles

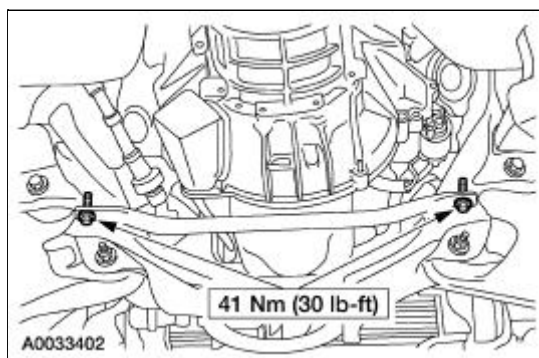
1. Remove the steering gear. For additional information, refer to [Section 211-02](#).
2. Remove the lower control arms. For additional information, refer to [Section 204-01](#).

Vehicles with convertible top

3. Remove the front subframe support. For additional information, refer to [Subframe Support—Convertible](#) in this section.

Vehicles with hard top

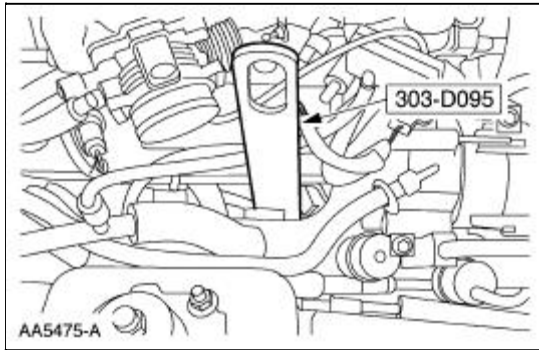
4. Remove the front subframe brace.
 - Remove the bolts.



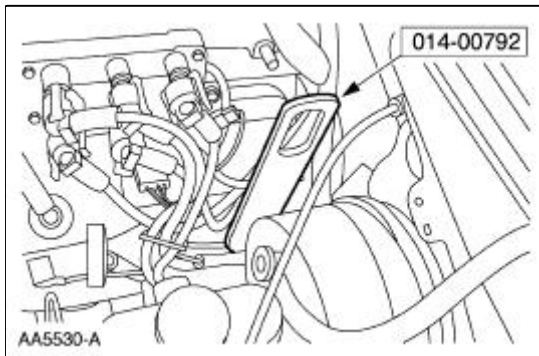
All vehicles

5. Lower the vehicle.

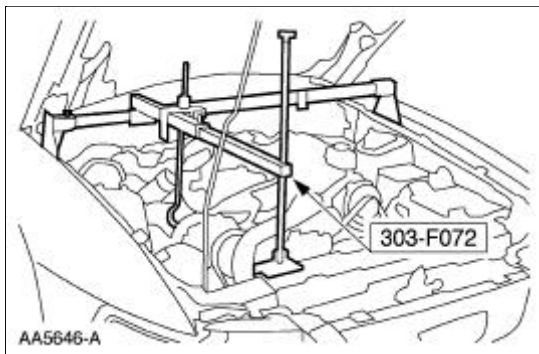
6. Install the special tool.



7. Install the special tool.

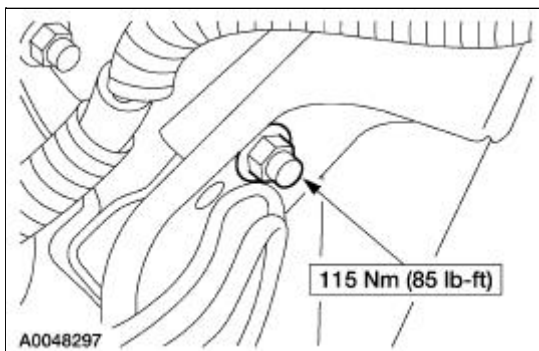


8. Install the special tool.

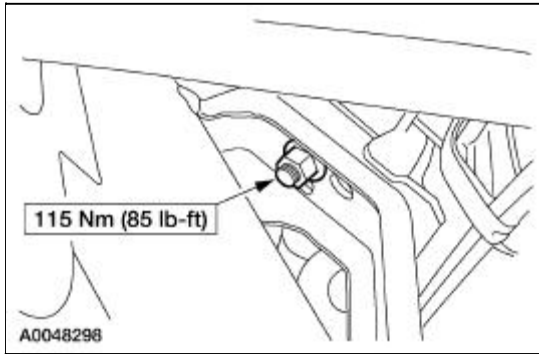


9. Raise and support the vehicle.

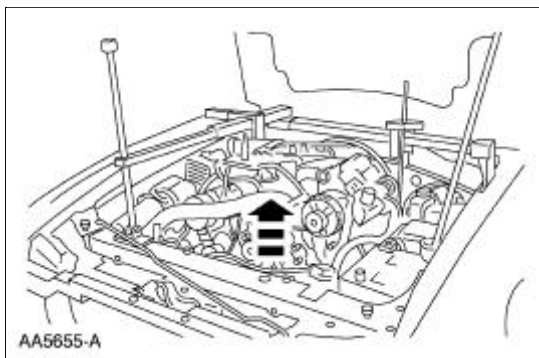
10. Remove the LH engine mount nut.



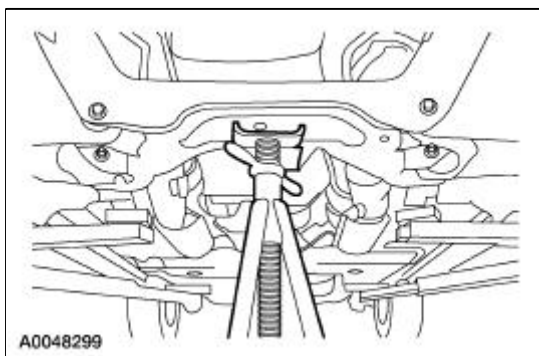
11. Remove the RH engine mount nut.



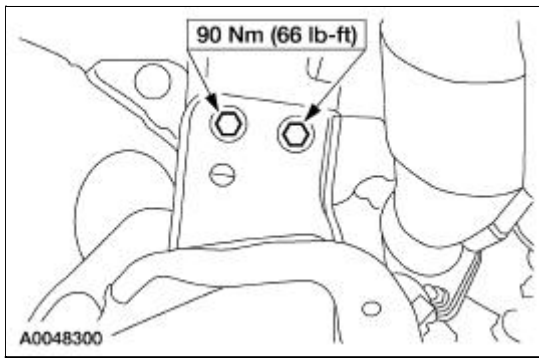
12. Lower the vehicle.
13. Using the special tool, raise and support the engine.



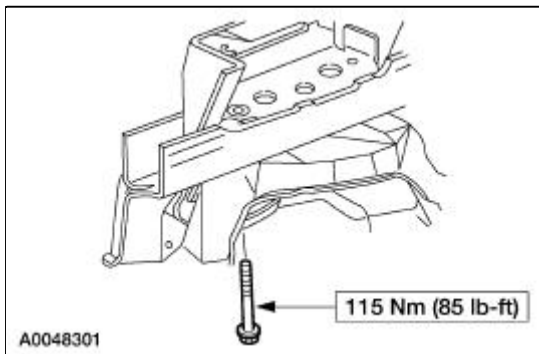
14. Raise the vehicle.
15. Support the front subframe.



16. Remove the four front subframe lower bolts.

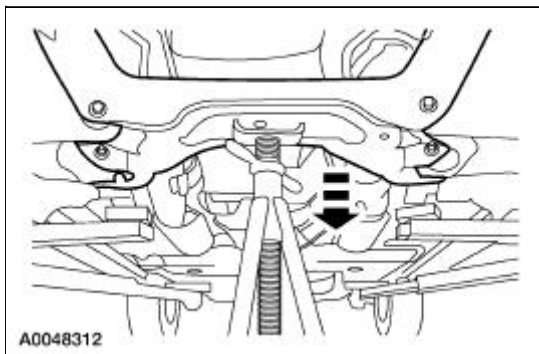


17. Remove the four front subframe upper bolts.



18. **NOTE:** Two technicians are needed to carry out this step.

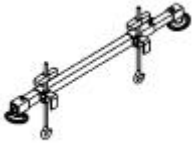

Lower and remove the front subframe.



19. To install, reverse the removal procedure.
-

Front Subframe —4.6L (2V) Engine

Special Tool(s)

 ST2363-A	Support Bar, Engine 303-290-A
 ST1603-A	Lifting Bracket, Engine 303-D088 (D93P-6001-A2)

Removal and Installation

All vehicles

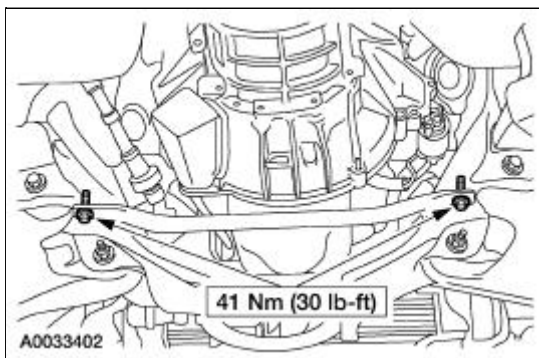
1. Remove the steering gear. For additional information, refer to [Section 211-02](#).
2. Remove the lower control arms. For additional information, refer to [Section 204-01](#).

Vehicles with convertible top

3. Remove the front subframe support. For additional information, refer to Subframe Support — Convertible in this section

Vehicles with hard top

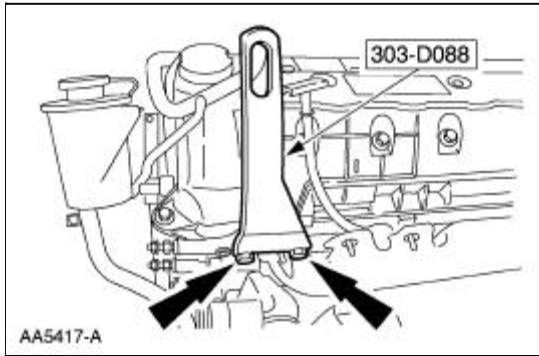
4. Remove the front subframe brace.
 - Remove the bolts



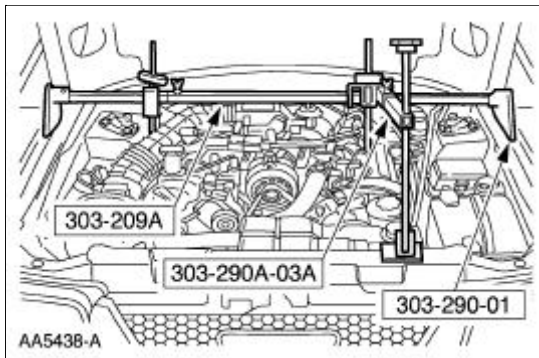
All vehicles

5. Lower the vehicle.

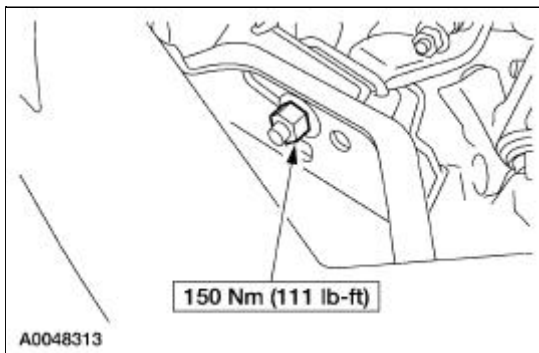
6. Install the special tool.



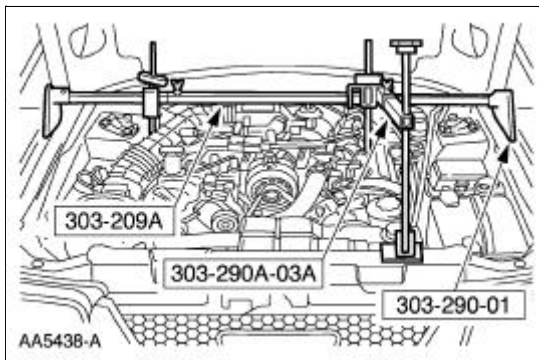
7. Install the special tool.



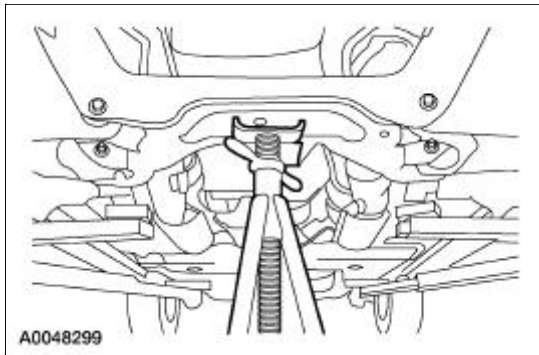
8. Raise and support the vehicle.
9. Remove the two engine mount nuts.



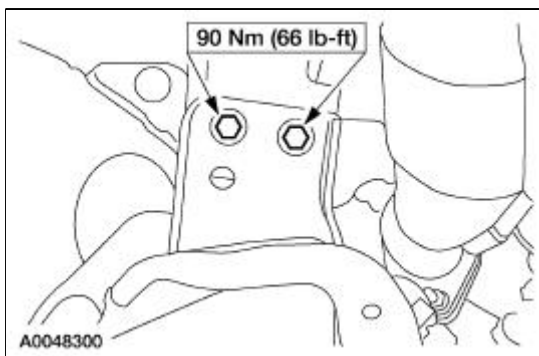
10. Lower the vehicle.
11. Using the special tool, raise and support the engine.



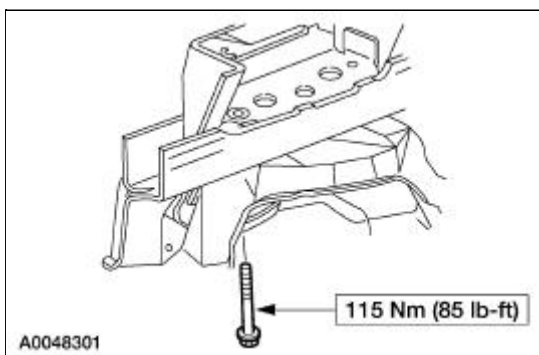
12. Raise the vehicle.
13. Support the front subframe.



14. Remove the four front subframe lower bolts.

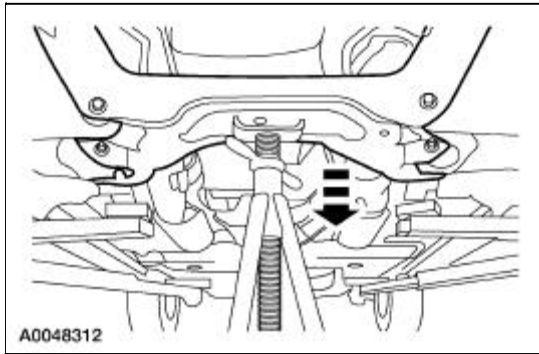


15. Remove the four front subframe upper bolts.



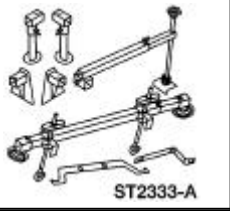

16. **NOTE:** Two technicians are needed to carry out this step.

Lower and remove the front subframe.



Front Subframe —4.6L (4V) Engine

Special Tool(s)

 <p>ST2333-A</p>	3-Bar Engine Support Kit 303-F072
 <p>ST2375-A</p>	Lifting Bracket, Engine 303-D088 (D93P-6001-A2)

Removal and Installation

All vehicles

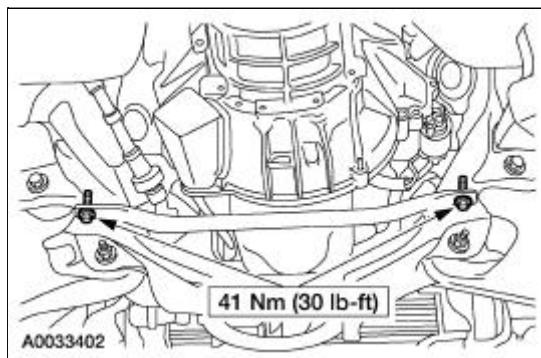
1. Remove the steering gear. For additional information, refer to [Section 211-02](#).
2. Remove the lower control arms. For additional information, refer to [Section 204-01](#).

Vehicles with convertible top

3. Remove the front subframe support. For additional information, refer to [Subframe Support—Convertible](#) in this section.

Vehicles with hard top

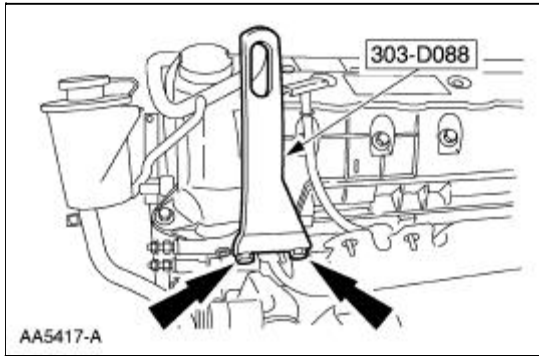
4. Remove the front subframe brace.
 - Remove the bolts.



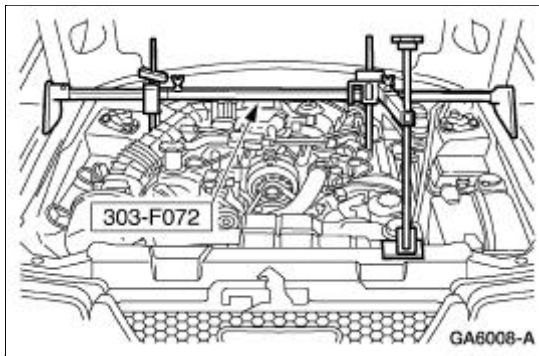
All vehicles

5. Lower the vehicle.

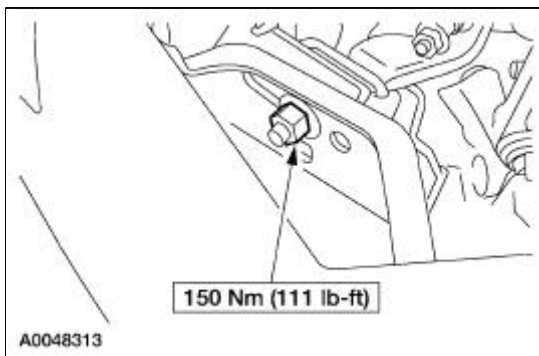
6. Install the special tool.



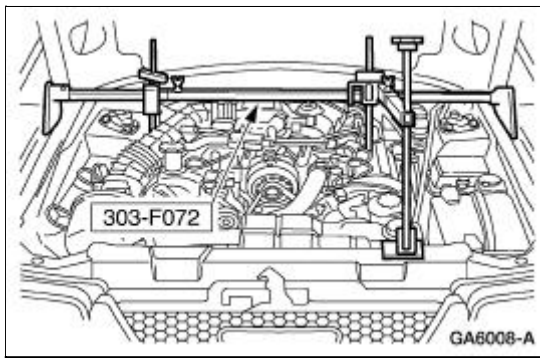
7. Install the special tool.



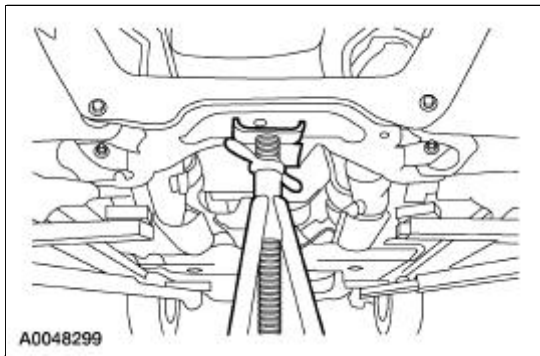
8. Raise and support the vehicle.
9. Remove the two engine mount nuts.



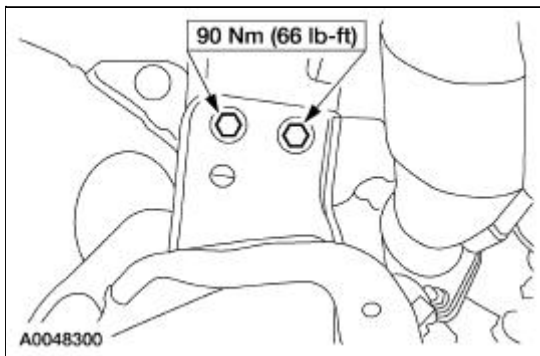
10. Lower the vehicle.
11. Using the special tool, raise and support the engine.



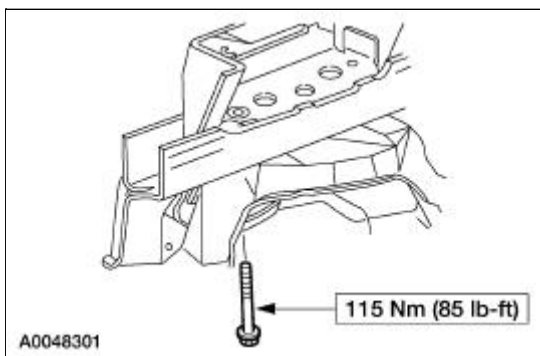
- 12. Raise the vehicle.
- 13. Support the front subframe.



- 14. Remove the four front subframe lower bolts.

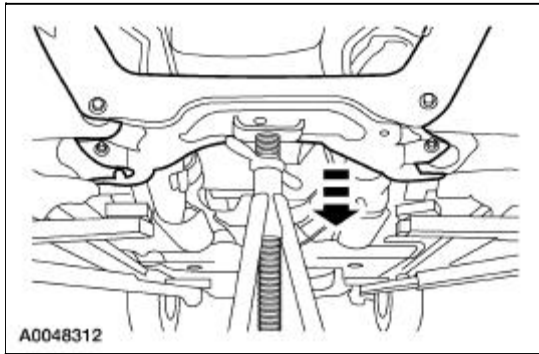


- 15. Remove the four front subframe upper bolts.



- 16. **NOTE:** Two technicians are needed to carry out this step.


Lower and remove the front subframe.



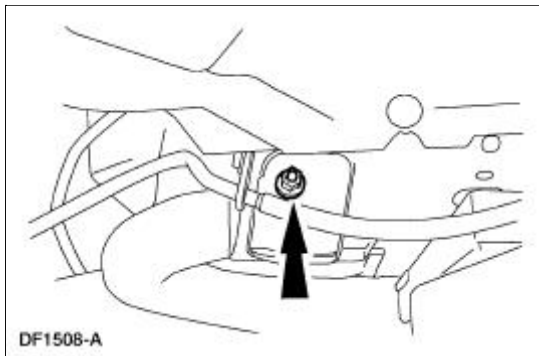
17. To install, reverse the removal procedure.

Rear Subframe

Removal and Installation

 **CAUTION:** Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation becomes necessary. Torque values must be used as specified during reassembly.

1. Remove the rear coil springs. For additional information, refer to [Section 204-02](#).
2. Using the special tool, raise the rear subframe.
3. Remove and discard the rear subframe front bolts.



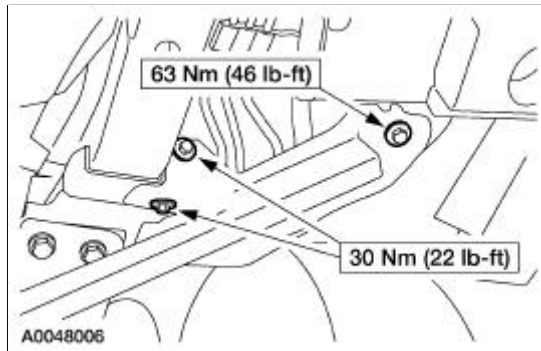
4. Using the special tool, lower and remove the rear subframe.
5. **NOTE:** Discard the old bolts and nuts. Do not reuse, install new bolts and nuts.

To install, reverse the removal procedure.

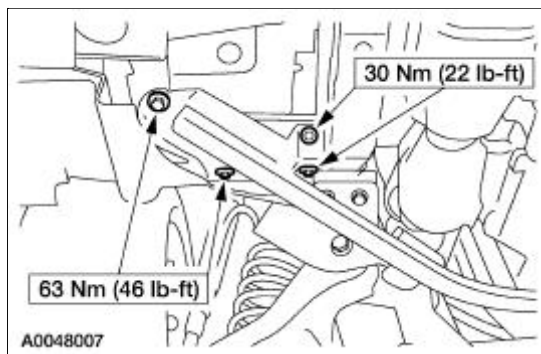
Subframe Support —Convertible

Removal and Installation

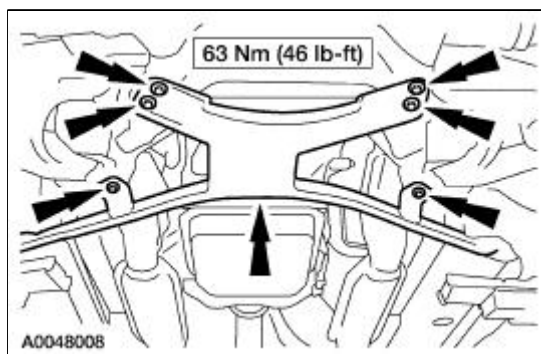
1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Support the front subframe support.
3. Remove the RH front subframe support bolts.



4. Remove the LH front subframe support bolts.



5. Remove the front subframe support.
 - Remove the bolts and lower the front subframe support.



6. To install, reverse the removal procedure.

GENERAL INFORMATION

INTRODUCTION

In the past, when cars were simpler, diagrams were simpler. All components were connected by wires, and diagrams seldom exceeded 4 pages in length. Today, some wiring diagrams require more than 16 pages. It would be impractical to expect a service technician to trace a wire from page 1 across every page to page 16.

Components shown with a dashed line instead of a solid line indicate not all circuits are shown in this particular diagram (circuits shown in system diagrams are typically applicable to that system only). The remaining circuits connected to that component will be shown in the appropriate system that they apply to.

Today, the wiring diagram necessary to support a given repair procedure is included within that article or a link is provided to the appropriate SYSTEM WIRING DIAGRAM article. For example, the wiring diagram for a Ford EEC-IV system may be included in ENGINE PERFORMANCE and WIRING DIAGRAMS articles for Ford Motor Co. The wiring diagram for a cruise control system may be included in ACCESSORIES & EQUIPMENT section for the specific vehicle manufacturer, and the wiring diagram for an anti-lock brake system may be included in BRAKES and WIRING DIAGRAMS for the specific manufacturer.

WIRING DIAGRAMS contains all wiring diagrams not included in STARTING & CHARGING SYSTEMS and ACCESSORIES & EQUIPMENT. This includes: Data Link Connectors, Ground Distribution, Power Distribution, Engine Performance, Electric Cooling Fans, Anti-Lock Brakes, Electronic Suspension and Electronic Steering wiring diagrams. The Data Link Connectors wiring diagrams show the circuits by which the various on-board computers exchange information, and the diagnostic connectors used for diagnosis and their location. The Ground Distribution wiring diagrams show all vehicle ground points, their location, and the components common to those ground points. The Power Distribution wiring diagrams show the power feed circuits and the components common to those power feeds.

Wiring diagrams used to support the information in ACCESSORIES & EQUIPMENT are drawn in a "top-down" format. The diagrams are drawn with the power source at the top of the diagram and the ground point at the bottom of the diagram. Component locations are identified on the wiring diagrams. Any wires that do not connect directly to a component are identified on the diagram to indicate where they go.

WIRING DIAGRAM COLOR ABBREVIATIONS

COLOR ABBREVIATIONS

Color

Normal

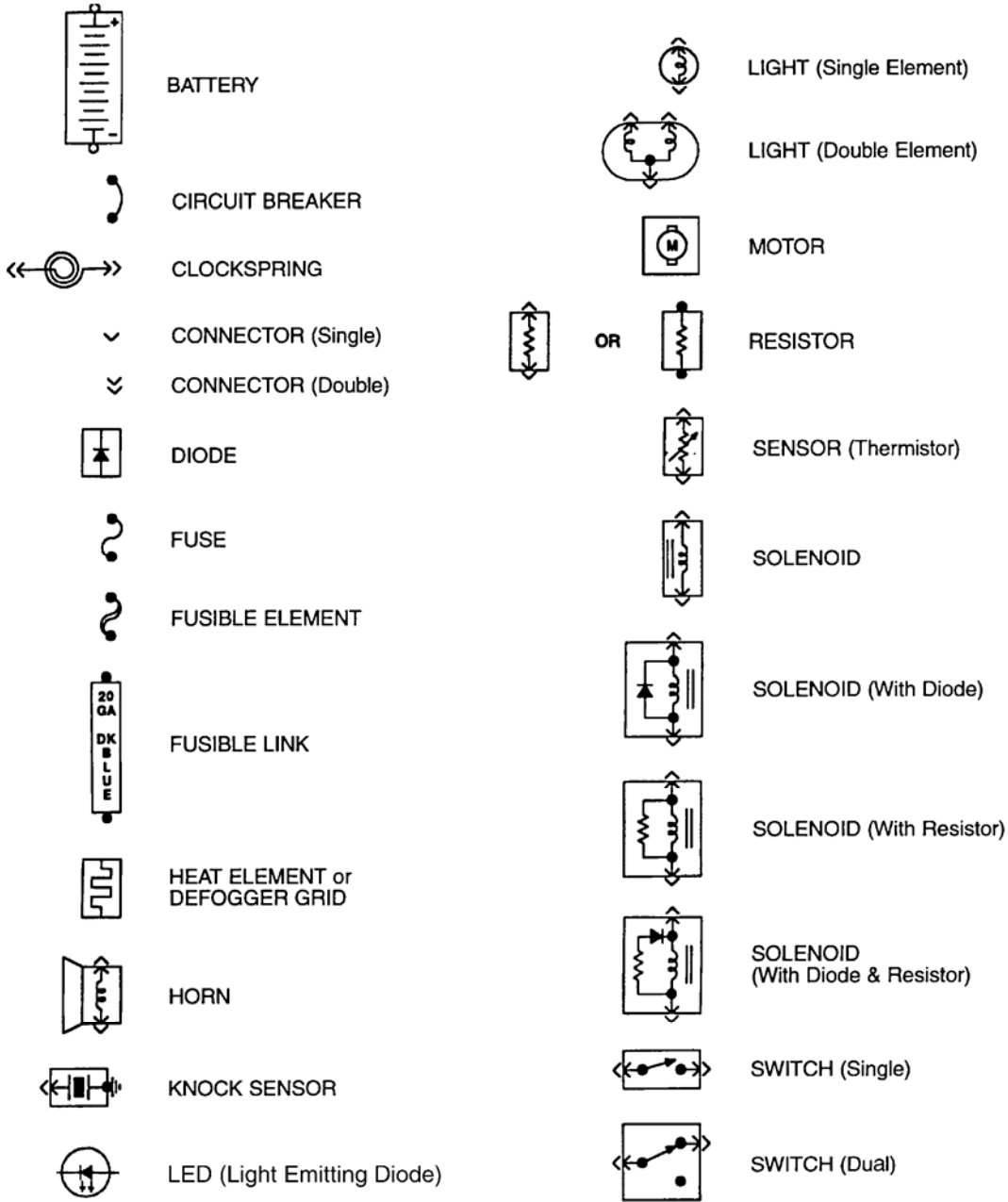
Optional

Color	Normal	Optional

Black	BLK	BK
Blue	BLU	BU
Brown	BRN	BN
Clear	CLR	CR
Dark Blue	DK BLU	DK BU
Dark Green	DK GRN	DK GN
Green	GRN	GN
Gray	GRY	GY
Light Blue	LT BLU	LT BU
Light Green	LT GRN	LT GN
Orange	ORG	OG
Pink	PNK	PK
Purple	PPL	PL
Red	RED	RD
Tan	TAN	TN
Violet	VIO	VI
White	WHT	WT
Yellow	YEL	YL

WIRING DIAGRAM SYMBOLS

NOTE: Standard wiring symbols are used on all wiring diagrams. The list below will help clarify any symbols that are not easily understood at a glance. Most components are labeled "Motor", "Switch" or "Relay" in addition to being drawn with the standard symbol.



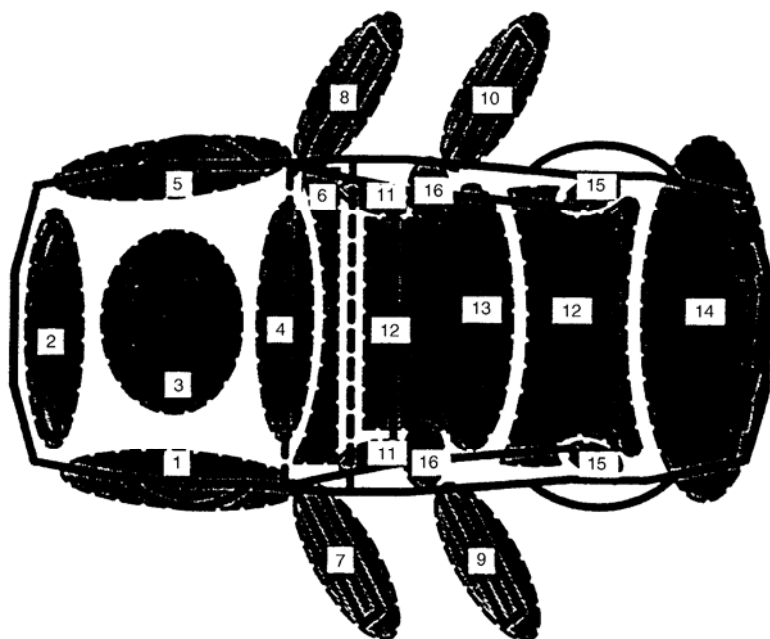
G50E03637

Fig. 1: Identifying Standard Wiring Diagram Symbols

WIRING DIAGRAM GROUND NUMBER LOCATIONS

NOTE: The following illustration depicts standardized ground numbers and locations to be used in conjunction with wiring diagrams applying to 2001 and prior model years only. See [Fig. 2](#) . Wiring diagrams applying to newer model years depict manufacturer-specified ground numbers and locations. Do not utilize the illustration with 2002 and newer

model year wiring diagrams.



- | | | |
|---|---|--|
| <p>1) Left Fender
 G100 Front Of Fender
 G102 On Shock Tower
 G104 Rear Of Fender</p> <p>2) Front of Vehicle
 G106 Behind Left Headlight
 G107 Behind Right Headlight
 G108 Left Radiator Support
 G109 Right Radiator Support</p> <p>3) Engine
 G110 Left Front Of Engine
 G111 Left Front Behind Battery
 G112 Left Side Of Engine
 G114 Left Rear Of Engine
 G115 Rear Of Engine
 G117 Right Rear Of Engine
 G119 Right Front Of Engine
 G120 Right Side Of Engine
 G125 Front Of Engine
 G127 Left Underside Of Hood
 G128 Right Underside Of Hood
 G129 Top Center Of Transaxle</p> <p>4) Safety Wall
 G116 Left Side Of Safety Wall
 G121 Center Of Safety Wall
 G123 Right Side Of Safety Wall</p> <p>5) Right Fender
 G101 Front Of Fender
 G103 On Shock Tower
 G105 Rear Of Fender</p> | <p>6) Instrument Panel
 G200 Left Kick Panel
 G201 Right Side Of I/P
 G202 Left Side Of I/P
 G203 Right Kick Panel
 G204 Left Rear Of Steering Support
 G205 Right Rear Of Steering Support
 G206 Center Of I/P
 G207 Top Of Steering Column</p> <p>7) Left Front Door
 G500 Left Front Door</p> <p>8) Right Front Door
 G600 Right Front Door</p> <p>9) Left Rear Door
 G700 Left Rear Door</p> <p>10) Right Rear Door
 G800 Right Rear Door</p> <p>11) "A" Pillars
 G900 Left "A" Pillar
 G901 Right "A" Pillar</p> <p>12) Passenger Compartment
 G300 Below Left Front Seat
 G301 Below Right Front Seat
 G302 Below Center Console
 G303 Below Right Rear Seat
 G304 Below Left Rear Seat
 G306 Below Center Of Rear Seat
 G307 Below Right Rear Window
 G309 Left Front Door Sill
 G310 Behind Right Rear Seat
 G311 Center Of Rear Shelf
 G312 Behind Left Rear Seat</p> | <p>13) Roof
 G902 Left Front Of Roof
 G903 Right Front Of Roof
 G906 Left Rear Of Roof
 G907 Right Rear Of Roof
 G908 Center Front Of Roof
 G909 Center Rear Of Roof</p> <p>14) Rear Of Vehicle
 G400 Left Front Side Of Trunk
 G401 Right Front Side Of Trunk
 G402 Left Rear Wheelwell
 G403 Right Rear Wheelwell
 G404 Left Rear Side Of Trunk
 G405 Right Rear Side Of Trunk
 G406 Center Rear Of Trunk Lid
 G407 Center Rear Of Trunk
 G408 Center Front Of Trunk
 G409 Rear Of Cargo Bed</p> <p>15) "C" Pillars
 G904 Left "C" Pillar
 G905 Right "C" Pillar</p> <p>16) "B" Pillars
 G305 Right "B" Pillar
 G308 Left "B" Pillar</p> |
|---|---|--|

G00027307

Fig. 2: Ground Numbers & Locations (2001 & Prior Model Years)

WIRING DIAGRAM COMPONENT LOCATIONS

When trying to locate a component in a wiring diagram and you don't know the specific system where it is located, use this handy component locator to find the system wiring diagram in which the component is located. Then, go to that system and locate the component within the wiring diagram.

2002 Ford Focus ZX5

For example, if you don't know the specific system in which the ignition switch is located, look up ignition switch in the wiring diagram component location tables and go to the appropriate wiring diagram(s) which contain either full or partial views of the ignition switch. The full view of the ignition switch is located in Power Distribution.

The first listing for the component will be the full or most complete view of the component. Additional listings will be partial views of the component. Not all components are used on all models.

All components will have a partial view in Ground Distribution and Power Distribution. Data Link Connectors show connecting circuits between modules. Alternate names for components may be listed in wiring diagram component locations tables.

WIRING DIAGRAM COMPONENT LOCATIONS

Component	Wiring Diagram
ABS Electronic Control Unit	Anti-Lock Brakes; Data Link Connectors
ABS Hydraulic Unit	Anti-Lock Brakes
Acceleration Sensor	Anti-Lock Brakes
Accessory Delay Relay	Power Windows
A/C Compressor Clutch Relay	Engine Performance
A/C Sensor	Engine Performance
A/C Pressure Switch	Engine Performance
Adaptive Lamp Control Module	Exterior Lights
Air Bag(s)	Air Bag Restraint System
Air Bag Module	Air Bag Restraint System
Air Bag Sensor(s)	Air Bag Restraint System
Air Injection Pump Relay	Engine Performance
Air Temperature Sensor	Overhead Console
Alternator (Generator)	Generators & Regulators
Anti-Theft Control Module	Anti-Theft System; Starters
Autolamp Control Relay	Headlight Systems; Daytime Running Lights
Automatic Shutdown (ASD) Relay	Engine Performance; Generators & Regulators
Autostick Switch	Engine Performance
Auxiliary Battery Relay	Generators & Regulators
Back-Up Lights	Back-Up Lights; Exterior Lights
Barometric (BARO) Pressure Sensor	Engine Performance
Battery	Power Distribution
Battery Temperature Sensor	Engine Performance
Body Control Module	Body Control Computer; Anti-Theft System; Daytime Running Lights; Engine Performance; Headlight Systems; Warning Systems
Boost Control Solenoid	Engine Performance
Boost Sensor	Engine Performance
Brake Fluid Level Switch	Analog Instrument Panels
Brake On/Off (BOO) Switch	Cruise Control Systems; Engine Performance; Shift Interlock Systems
Buzzer Module	Warning Systems

Camshaft Position (CMP) Sensor	Engine Performance
Central Control Module	Anti-Theft System
Clockspring	Air Bag Restraint System; Cruise Control Systems; Steering Column Switches
Clutch Pedal Position Switch	Starters
Clutch Start Switch	Starters
Combination Meter	Analog Instrument Panels
Constant Control Relay Module (CCRM)	Engine Performance; Electric Cooling Fans
Convenience Center	Power Distribution; Illumination/Interior Lights
Convertible Top Motor	Power Convertible Top
Convertible Top Switch	Power Convertible Top
Crankshaft Position (CKP) Sensor	Engine Performance
Cruise Control Module	Cruise Control Systems
Cruise Control Switch	Cruise Control Systems
Condenser Fan Relay(s)	Electric Cooling Fans
Data Link Connector (DLC)	Engine Performance
Daytime Running Lights Module	Daytime Running Lights; Exterior Lights
Defogger Relay	Rear Window Defogger
Diagnostic Energy Reserve Module (DERM)	Air Bag Restraint System
Discriminating Sensor (Air Bag)	Air Bag Restraint System
Distributor	Engine Performance
Door Lock Actuators	Power Door Locks; Remote Keyless Entry
Door Lock Relay(s)	Power Door Locks
Electrochromic Mirror	Power Mirrors
Electronic Level Control (ELC) Height Sensor	Electronic Suspension
Electronic Level Control (ELC) Module	Electronic Suspension
Engine Coolant Temperature (ECT) Sending Unit	Analog Instrument Panels
Engine Coolant Temperature (ECT) Sensor	Engine Performance
Engine Control Module	Engine Performance; Generators & Regulators; Starters
ETACS ECU	Warning Systems; Power Windows; Remote Keyless Entry
Evaporative (EVAP) Emissions Canister	Engine Performance
EVAP Canister Purge Solenoid	Engine Performance
EVAP Canister Vent Solenoid	Engine Performance
Exhaust Gas Recirculation (EGR) Valve	Engine Performance
Fuel Tank Vacuum Sensor	Engine Performance
Fog Lights	Headlight Systems; Daytime Running Lights
Fog Light Relay	Headlight Systems; Daytime Running Lights
Fuel Door Release Solenoid	Power Fuel Door Release
Fuel Gauge Sending Unit	Analog Instrument Panels
Fuel Injectors	Engine Performance
Fuel Pump	Engine Performance
Fuel Pump Relay	Engine Performance; Power Distribution

Fuse/Relay Block	Power Distribution
Fusible Links	Power Distribution; Generators & Regulators; Starters
Generator	Generators & Regulators; Engine Performance; Power Distribution
Generic Electronic Module (GEM)	Body Control Modules; Electronic Suspension
Glow Plug Relay	Engine Performance
Glow Plugs	Engine Performance
Grounds	Ground Distribution
Headlight Door Module	Headlight Doors
Headlight Relay	Headlight Systems; Daytime Running Lights
Headlights	Headlight Systems; Daytime Running Lights
Heated Oxygen Sensor(s) (HO2S)	Engine Performance
Heated Windshield Control Module	Heated Windshields
Height Sensor	Electronic Suspension
Horns	Steering Column Switches
Horn Relay	Steering Column Switches
Idle Air Control (IAC) Motor/Valve	Engine Performance
Ignition Coil(s)	Engine Performance
Ignition Key Lock Cylinder	Anti-Theft System
Ignition Module	Engine Performance
Ignition Switch	Power Distribution; Engine Performance; Generators & Regulators; Starters
Illuminated Entry Module	Illumination/Interior Lights
Illumination Lights	Illumination/Interior Lights
Impact Sensor	Air Bag Restraint System
Inertia Fuel Shutoff Switch	Engine Performance
Inhibit Relay	Starters
Instrument Cluster	Analog Instrument Panels
Intake Air Temperature (IAT) Sensor	Engine Performance
Interior Lights	Illumination/Interior Lights
Interlock Switch	Starters
Junction Block	Power Distribution
Keyless Entry Receiver	Remote Keyless Entry
Key Reminder Switch	Starters
Knock Sensor	Engine Performance
Lamp Control Module	Exterior Lights
License Plate Lamp	Exterior Lights
Lighting Control Module	Lighting Control Modules; Anti-Theft System; Daytime Running Lights; Headlight Systems
Lower Relay	Power Convertible Top
Malfunction Indicator Light (MIL)	Engine Performance; Instrument Panels
Manifold Absolute Pressure (MAP) Sensor	Engine Performance
Mass Airflow (MAF) Sensor	Engine Performance

Mega Fuse	Generators & Regulators
Memory Seat/Mirror Module	Memory Systems
Mirror Defogger	Rear Window Defogger
Moon Roof Motor	Power Moon Roof
Moon Roof Relay	Power Moon Roof
Multi-Function Control Module	Warning Systems
Neutral Safety Switch	Starters
Oil Level Switch	Engine Performance
Oil Pressure Switch/Sending Unit	Analog Instrument Panels; Engine Performance
Overhead Console	Overhead Console
Oxygen Sensor(s) (O2S)	Engine Performance
Parking Brake Switch	Analog Instrument Panels
Park Lights	Exterior Lights
Park/Neutral Position Switch	Starters; Engine Performance; Anti-Theft System; Body Control Module
Perimeter Lighting Control Relay	Exterior Lights
Power Amplifier	Power Antennas
Power Antenna Module	Power Antennas
Power Antenna Motor	Power Antennas
Power Distribution Center	Power Distribution; Generators & Regulators; Starters
Power Door Lock Motors	Power Door Locks
Power Mirror Motors	Power Mirrors; Memory Systems
Power Sliding Door Controller	Power Sliding Side Door
Power Seat Motors	Power Seats; Memory Systems
Power Steering Pressure Switch	Engine Performance
Power Top Motor	Power Convertible Top
Power Top Relay(s)	Power Convertible Top
Powertrain Control Module	Engine Performance; Analog Instrument Panels; Cruise Control Systems; Data Link Connectors; Generators & Regulators; Starters
Power Window Motors	Power Windows
Power Window Relay(s)	Power Windows
Radiator Fan Motor(s)	Electric Cooling Fans
Radiator Fan Relay(s)	Engine Performance; Electric Cooling Fans;
Rainsense Module	Wiper/Washer Systems
Raise Relay	Power Convertible Top
Remote Anti-Theft Personality (RAP) Module	Anti-Theft System; Starters; Warning Systems
Seat Belt Pretensioners	Air Bag Restraint System
Seat Belt Retractor Solenoid	Passive Restraints
Seat Belt Switch	Air Bag Restraint System; Passive Restraints
Shift Interlock Solenoid	Shift Interlock Systems
Shift Lock Actuator	Shift Interlock Systems
Side Marker Lights	Exterior Lights

SIR Coil Assembly (Clockspring)	Air Bag Restraint System
Slip Ring (Clockspring)	Air Bag Restraint System; Steering Column Switches
SRS Control Module	Air Bag Restraint System
Starter Motor	Starters
Starter Interrupt Relay	Starters
Starter Solenoid	Starters
Starter Relay	Starters
Steering Wheel Position Sensor	Anti-Lock Brakes
Stoplights	Exterior Lights
Stoplight Switch	Engine Performance; Cruise Control Systems; Anti-Lock Brakes
Sun Roof ECU	Power Sun Roof
Sun Roof Motor	Power Sun Roof
Sun Roof Position Sensor	Power Sun Roof
Taillights	Exterior Lights
Throttle Position (TP) Sensor	Engine Performance
Torque Converter Clutch Solenoid/Switch	Engine Performance
Traction Control Switch	Anti-Lock Brakes
Trailer Tow Connector	Exterior Lights
Trailer Tow Relay	Exterior Lights
Transmission/Transaxle	Engine Performance
Transmission Control Module (TCM)	Engine Performance; Starters
Transmission Range Sensor	Starters; Back-Up Lights; Engine Performance
Transmission Range Switch	Back-Up Lights; Engine Performance; Anti-Theft System
Turn Signal Flasher	Exterior Lights
Turn Signal Lights	Exterior Lights
Twilight Sentinel Switch	Headlight Systems; Daytime Running Lights
Vapor Canister Leak Detection Pump	Engine Performance
Vehicle Control Module (VCM)	Engine Performance
Vehicle Dynamic Module	Electronic Suspension
Vehicle Speed Control Servo	Cruise Control Systems
Vehicle Speed Sensor	Data Link Connectors; Analog Instrument Panels; Cruise Control Systems; Electronic Suspension
Voltage Regulator	Generators & Regulators
Water-In-Fuel Sensor	Engine Performance; Analog Instrument Panels
Wheel Speed Sensors	Anti-Lock Brakes
Window Timer Module	Power Convertible Top
Windshield Intermittent Wiper Relay	Wiper/Washer Systems
Windshield Washer Motor	Wiper/Washer Systems
Wiper Motor	Wiper/Washer Systems

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

2003 SYSTEM WIRING DIAGRAMS

Ford - Mustang

AIR CONDITIONING

3.8L



2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

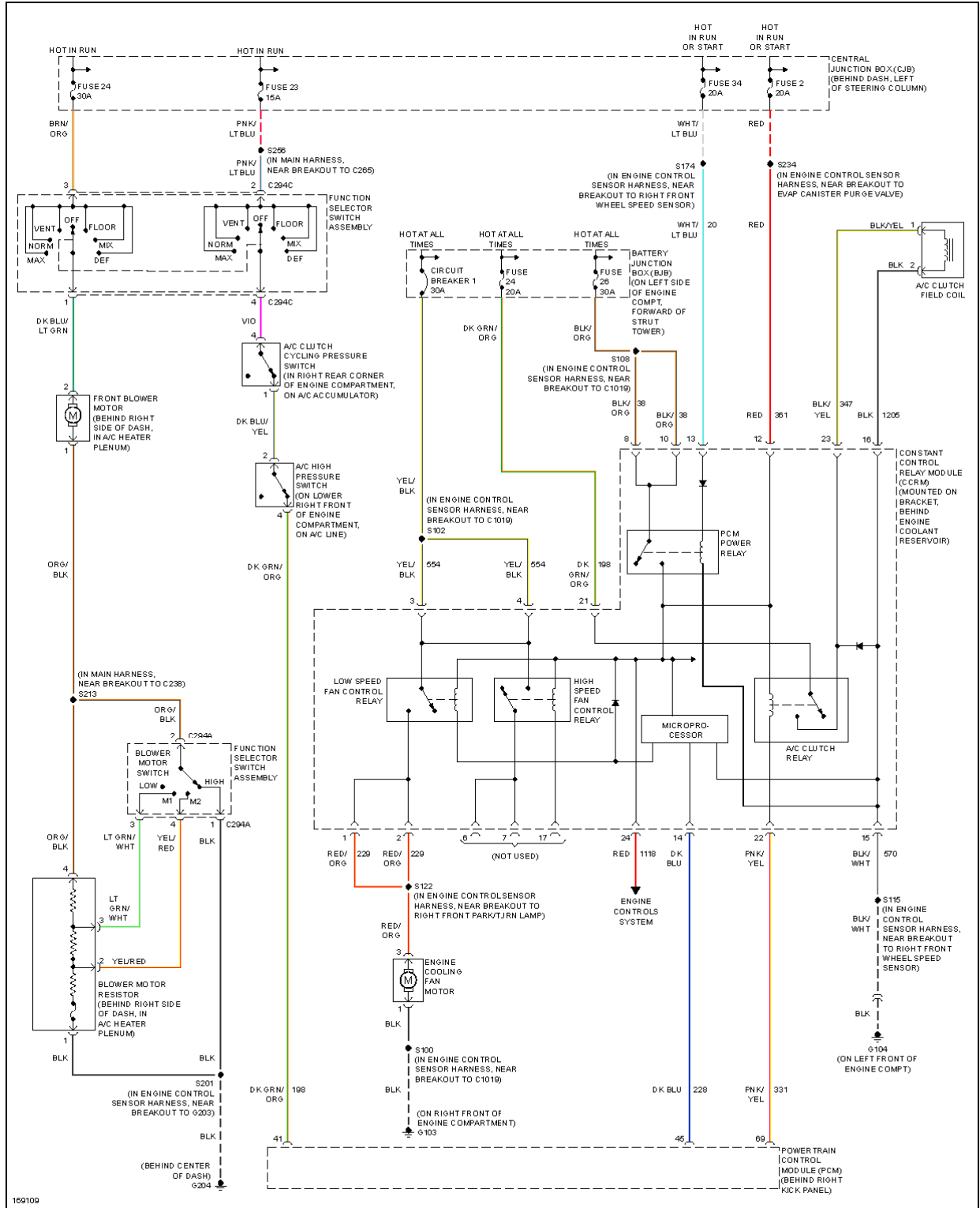


Fig. 1: 3.8L, Air Conditioning Circuit

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

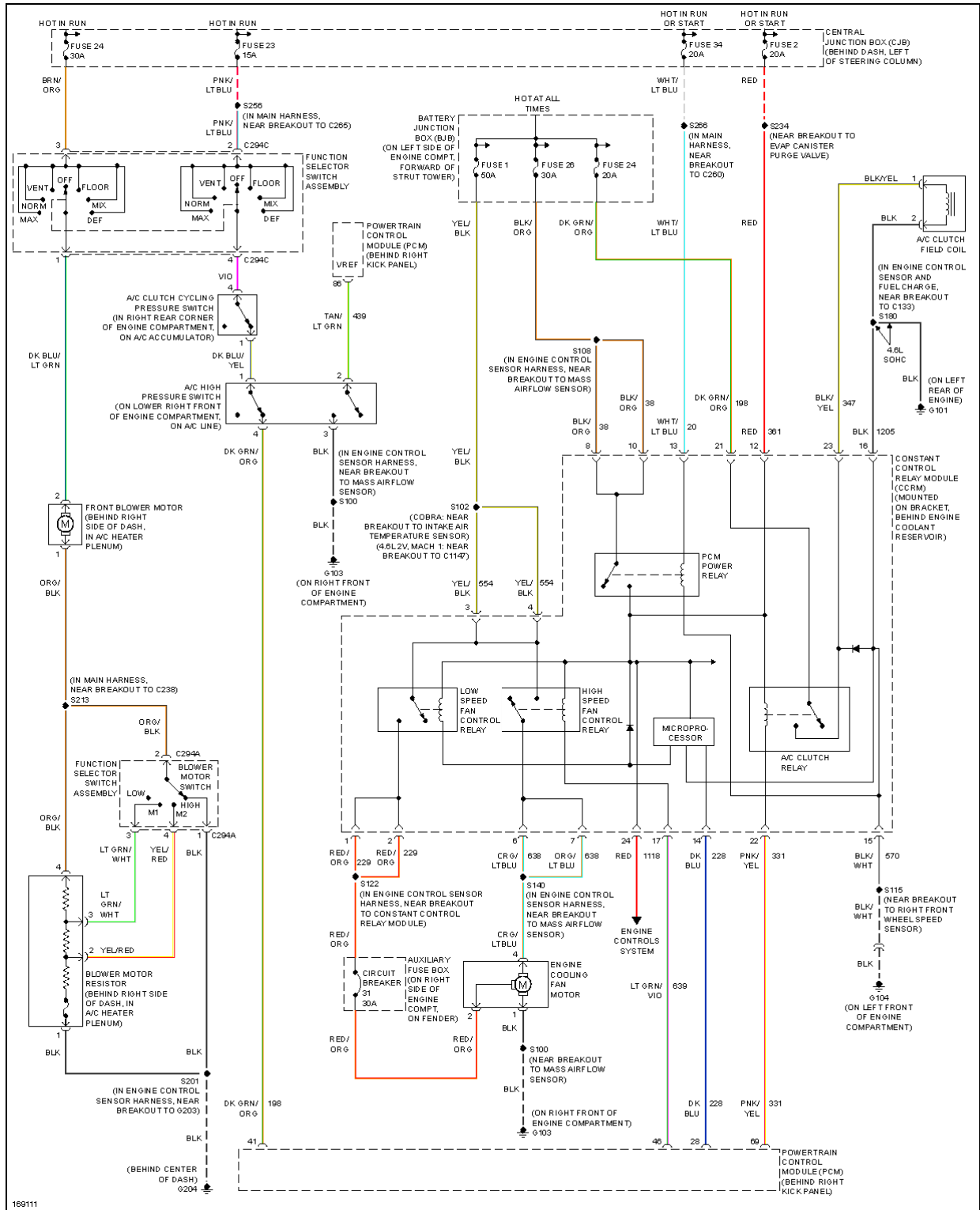
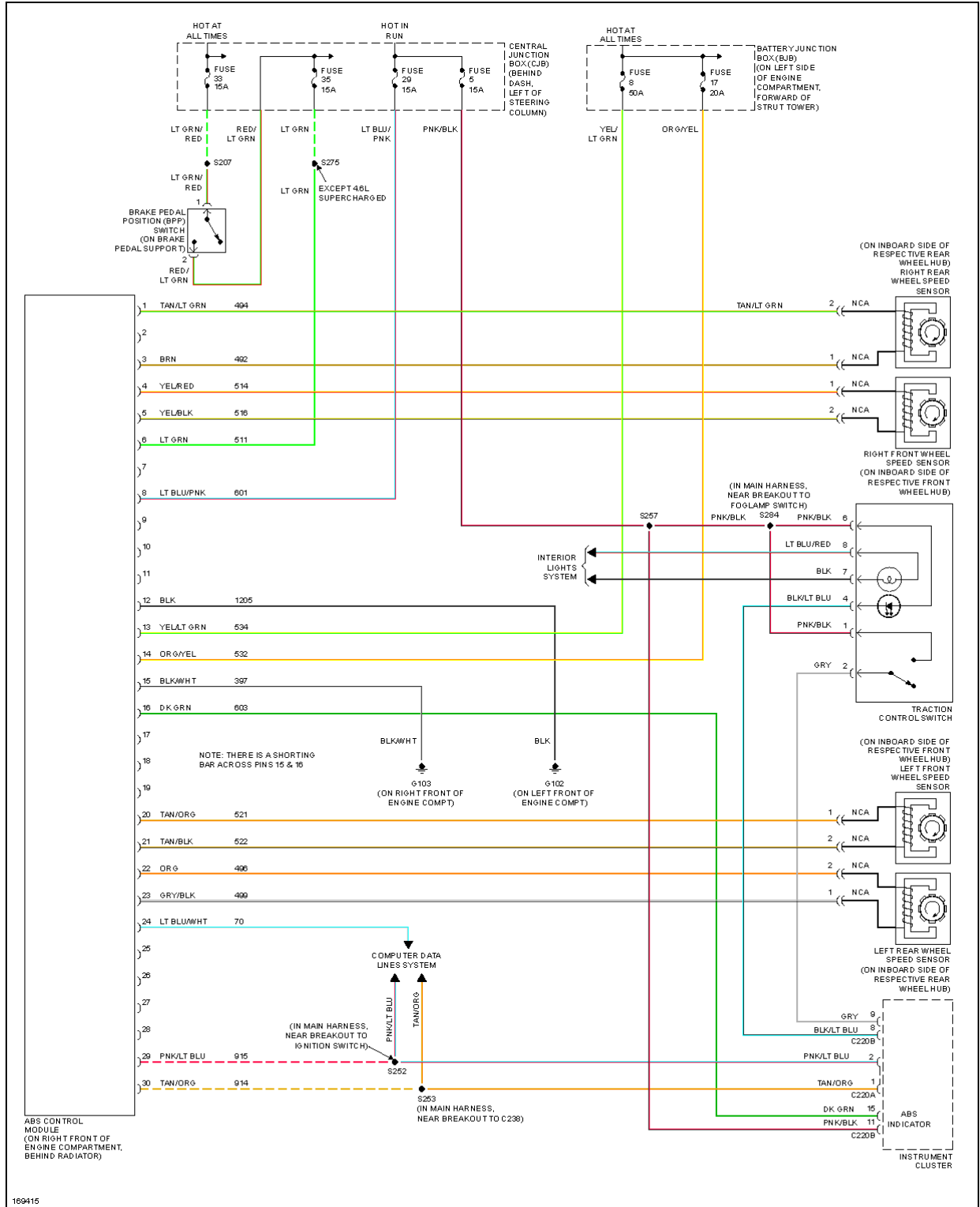


Fig. 2: 4.6L, Air Conditioning Circuit

ANTI-LOCK BRAKES

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang



169415

Fig. 3: Anti-lock Brakes Circuit

ANTI-THEFT

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

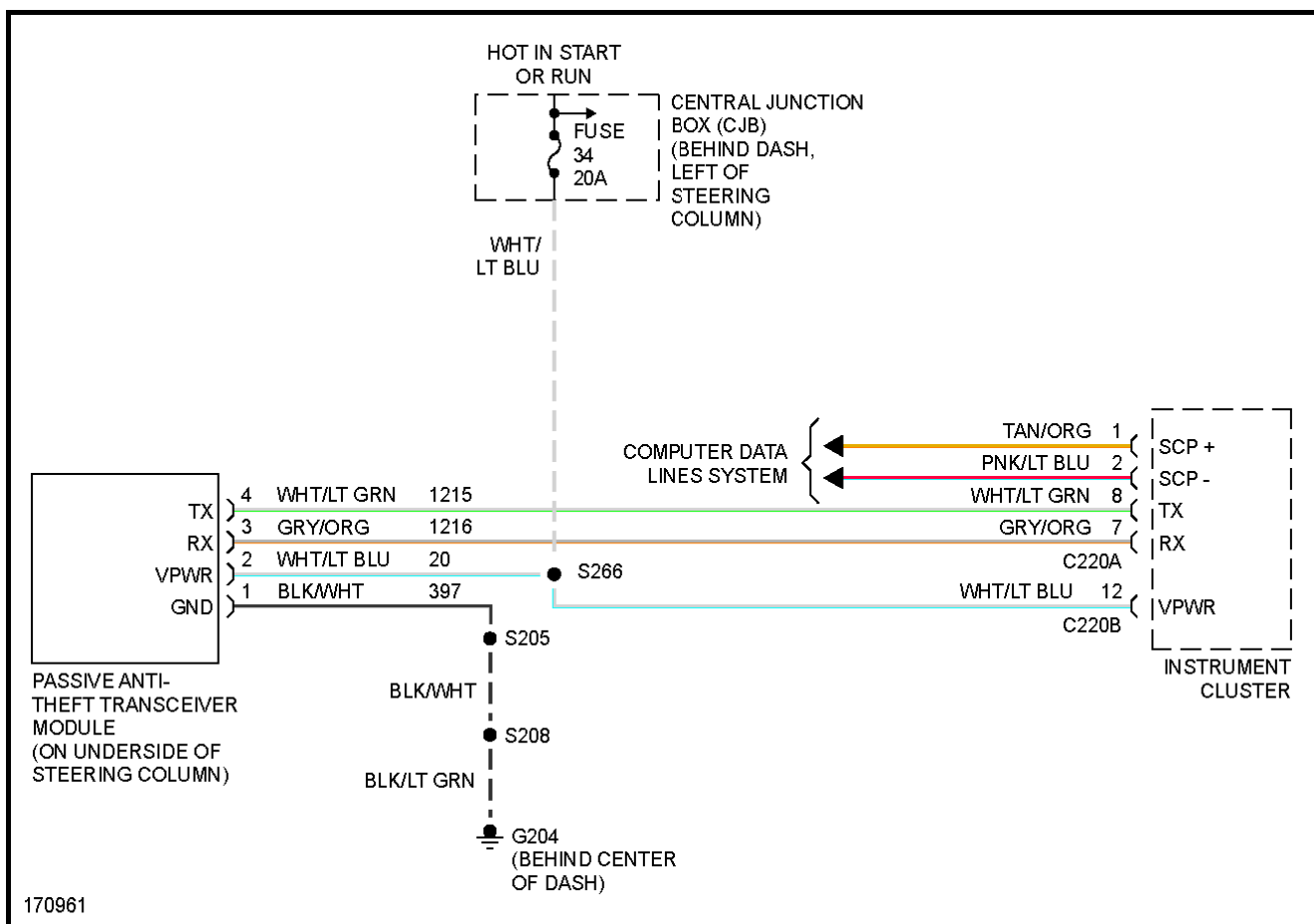


Fig. 4: Passive Anti-theft Circuit

BODY CONTROL MODULES

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

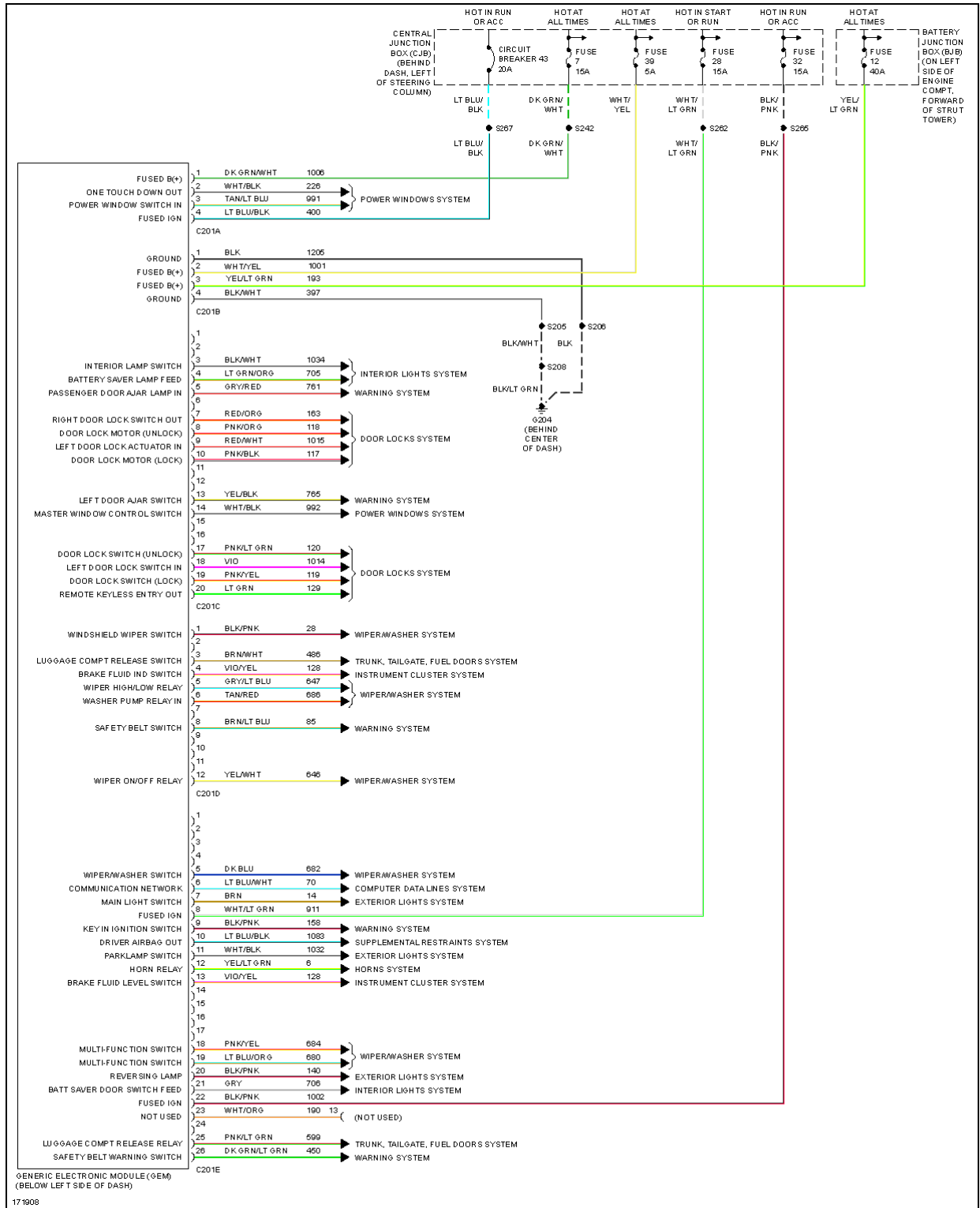


Fig. 5: Body Control Modules Circuit

COMPUTER DATA LINES

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

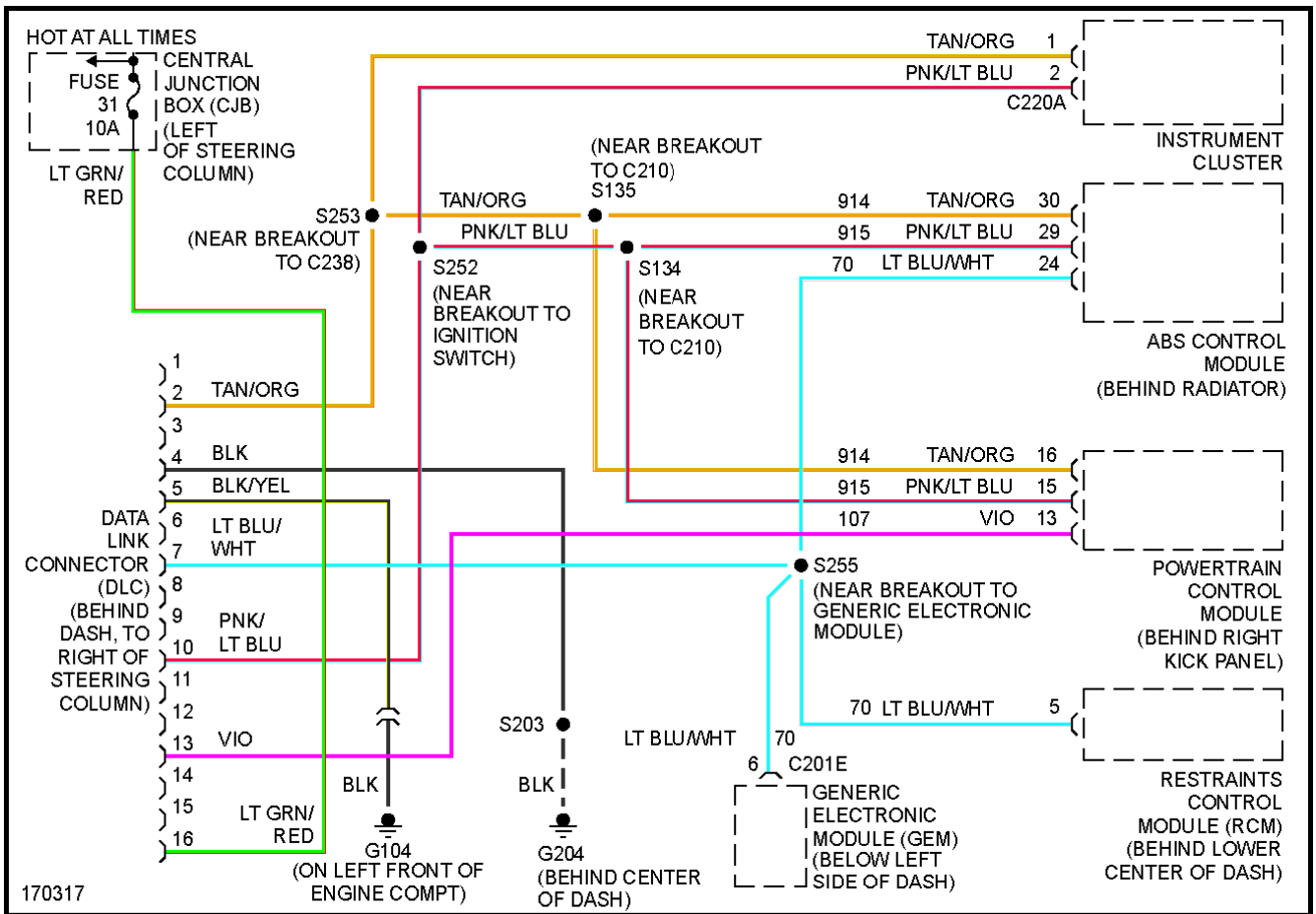


Fig. 6: Computer Data Lines Circuit

COOLING FAN

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

3.8L

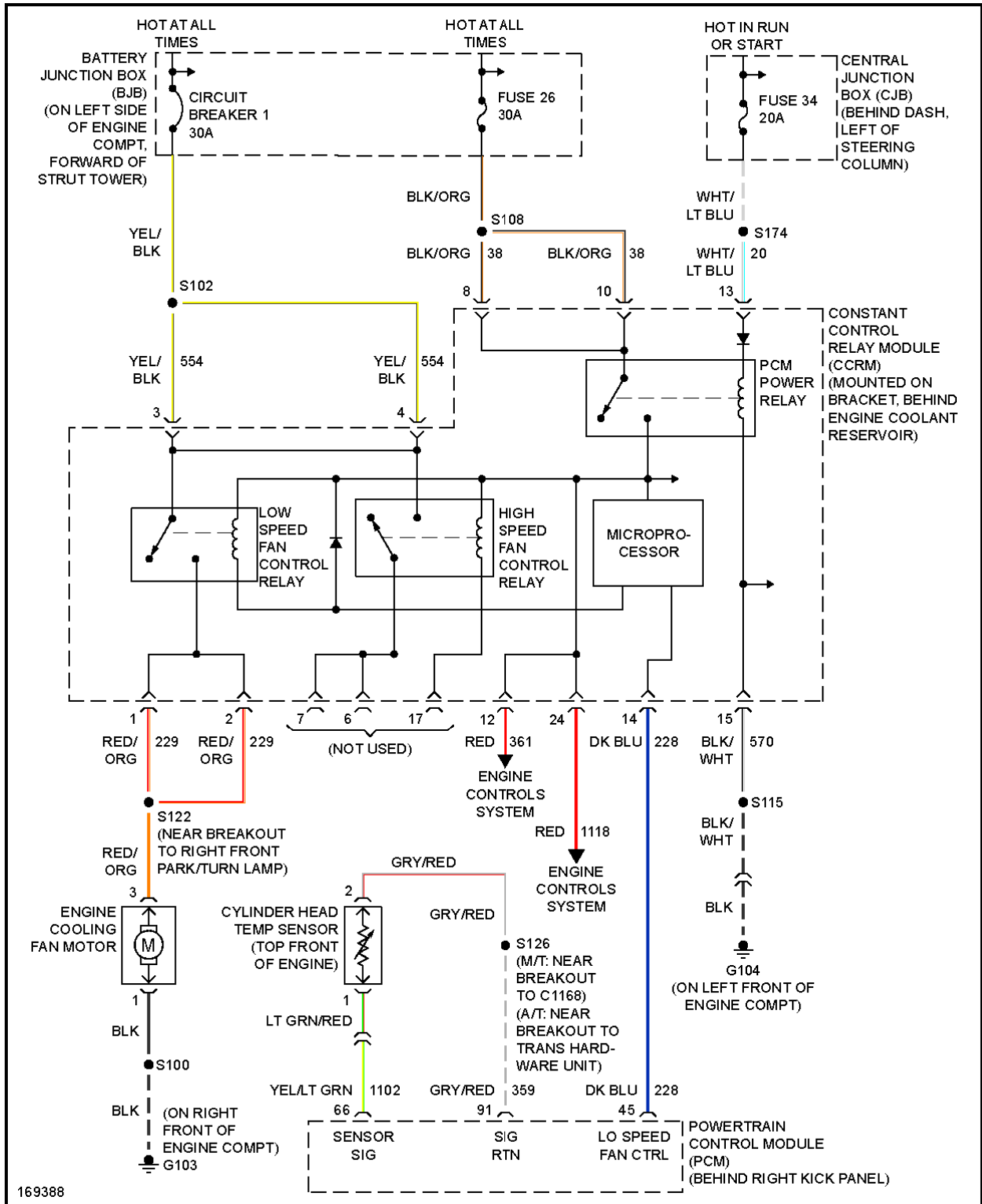


Fig. 7: 3.8L, Cooling Fan Circuit

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

4.6L

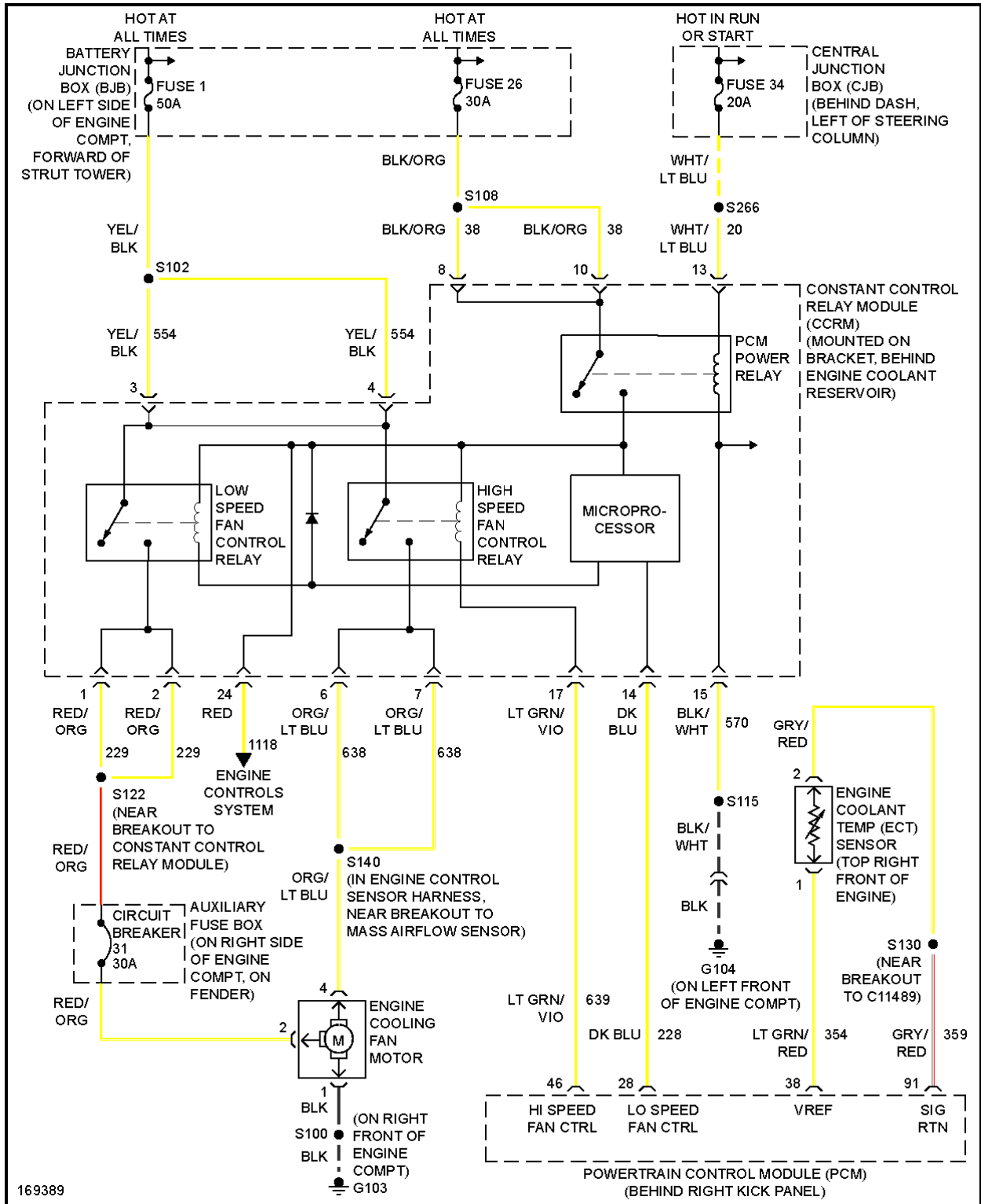
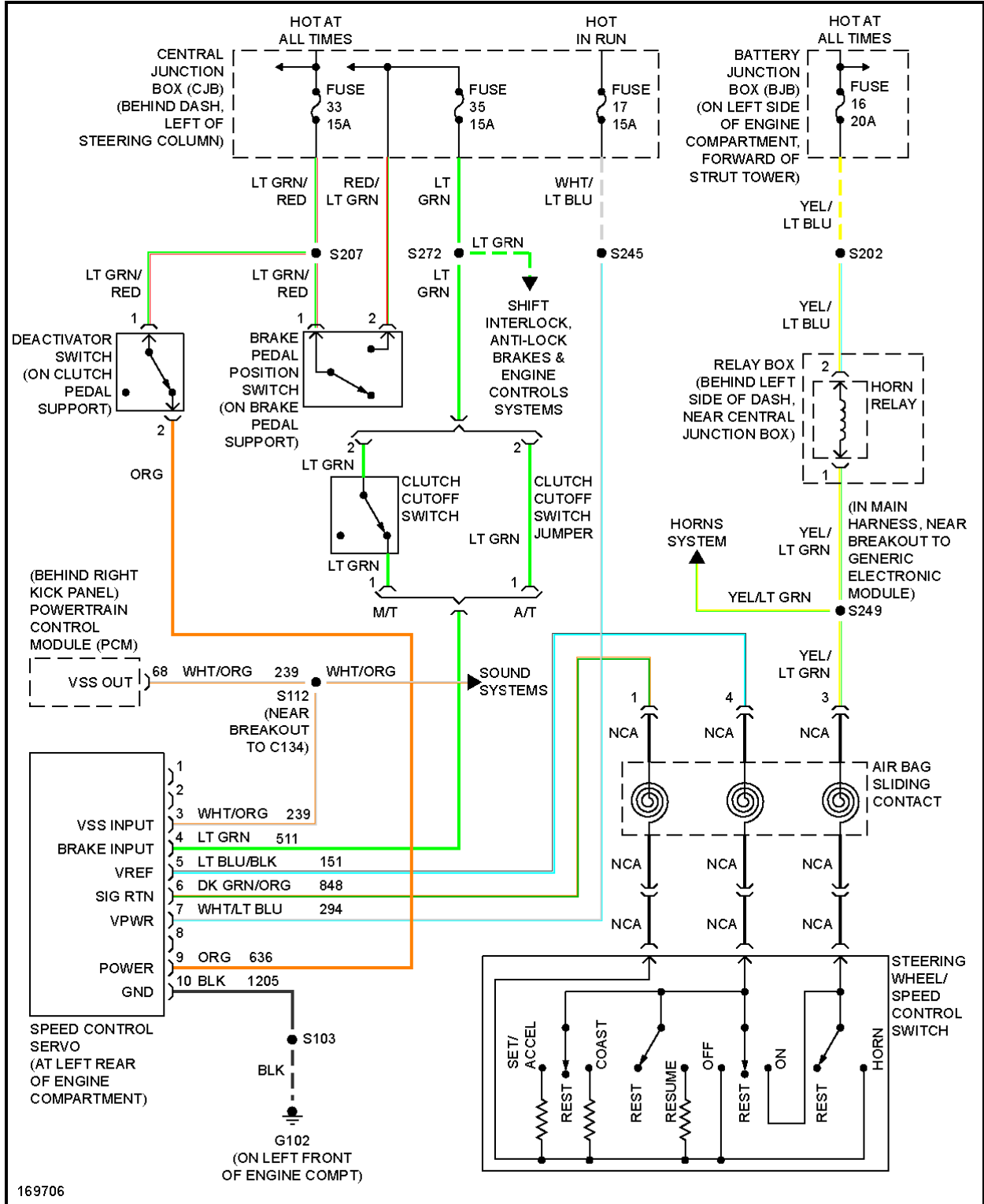


Fig. 8: 4.6L, Cooling Fan Circuit

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

CRUISE CONTROL



169706

Fig. 9: Cruise Control Circuit

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

DEFOGGERS

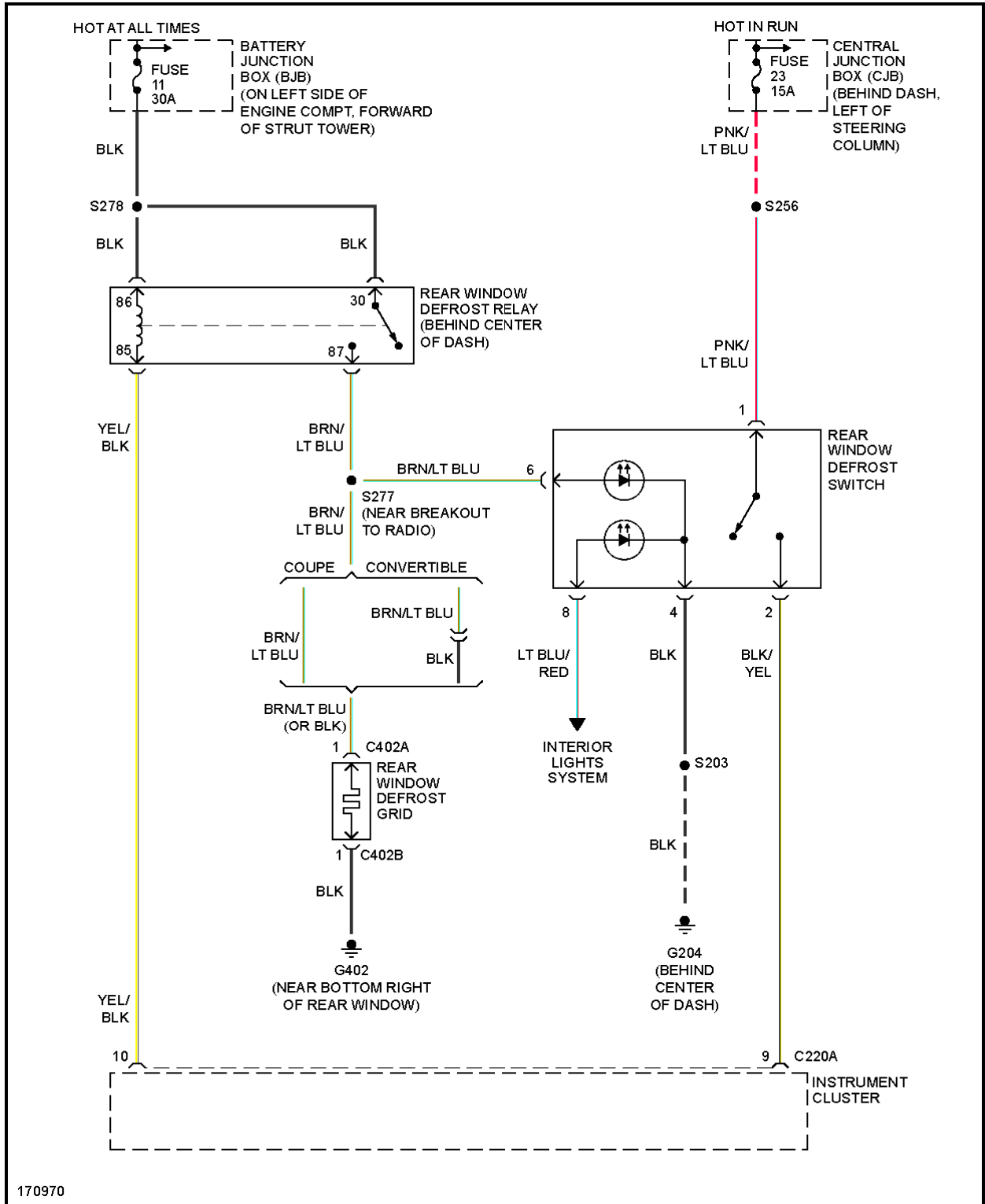


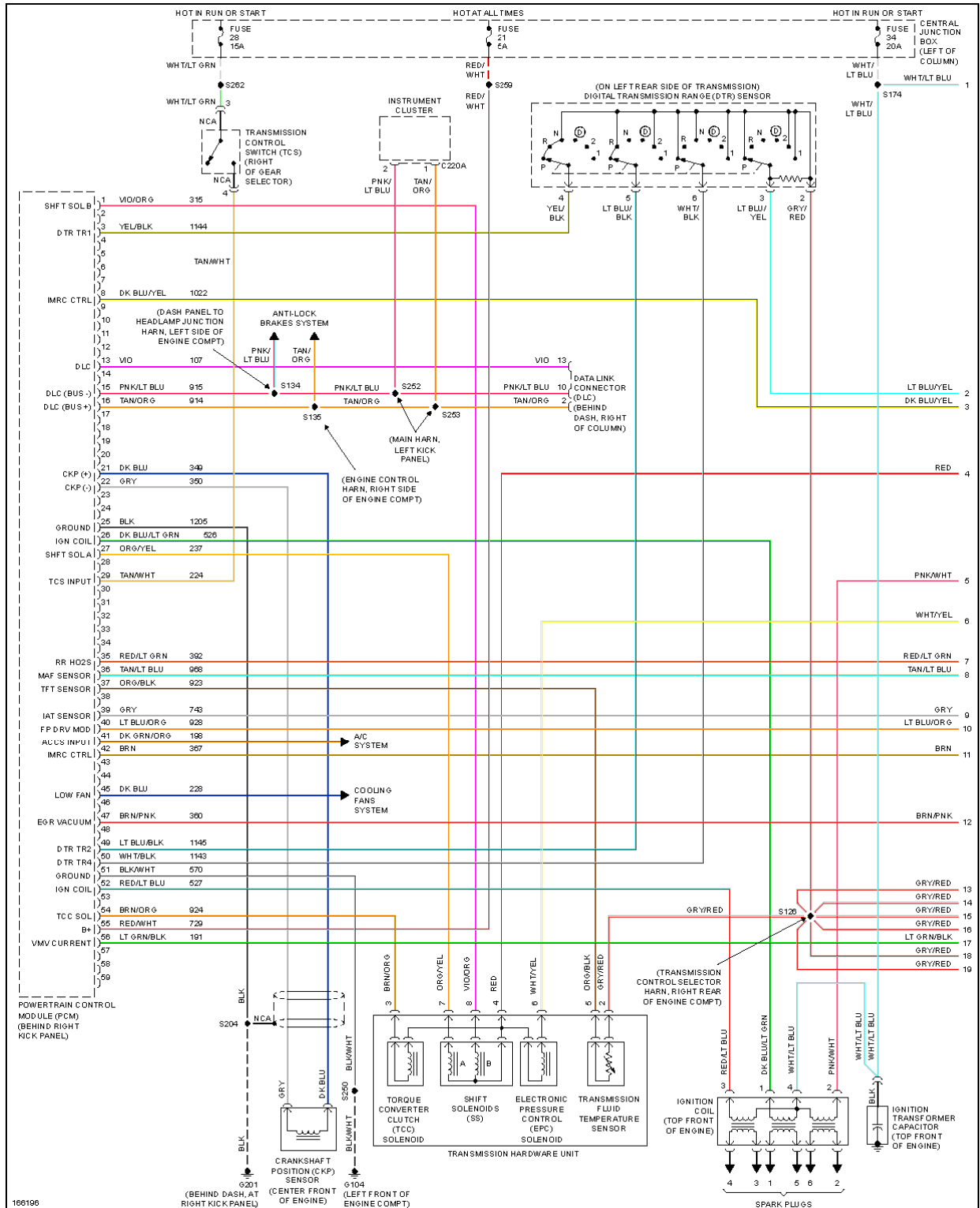
Fig. 10: Defoggers Circuit

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

ENGINE PERFORMANCE

3.8L



2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

Fig. 11: 3.8L, Engine Performance Circuit (1 of 3)

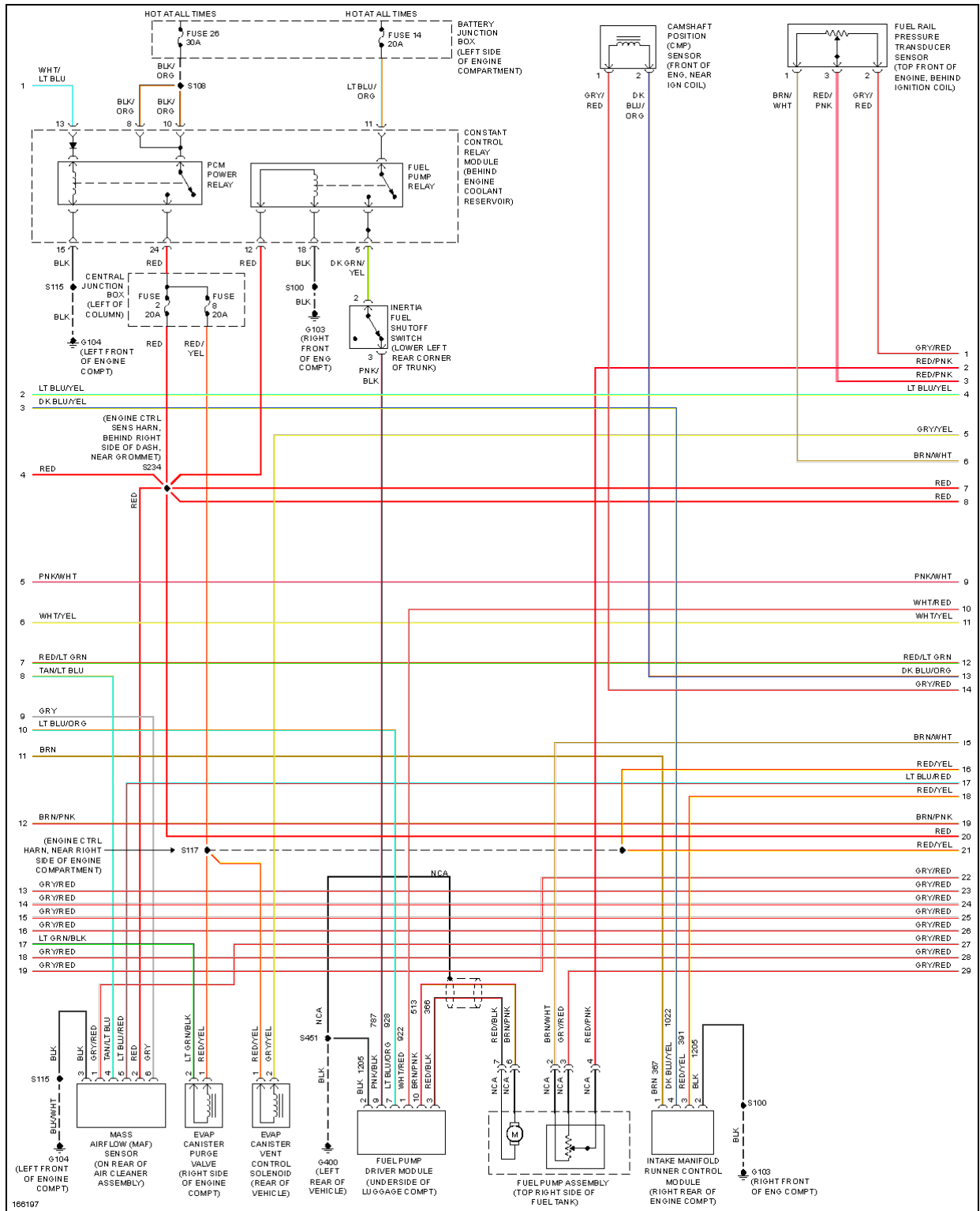


Fig. 12: 3.8L, Engine Performance Circuit (2 of 3)

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

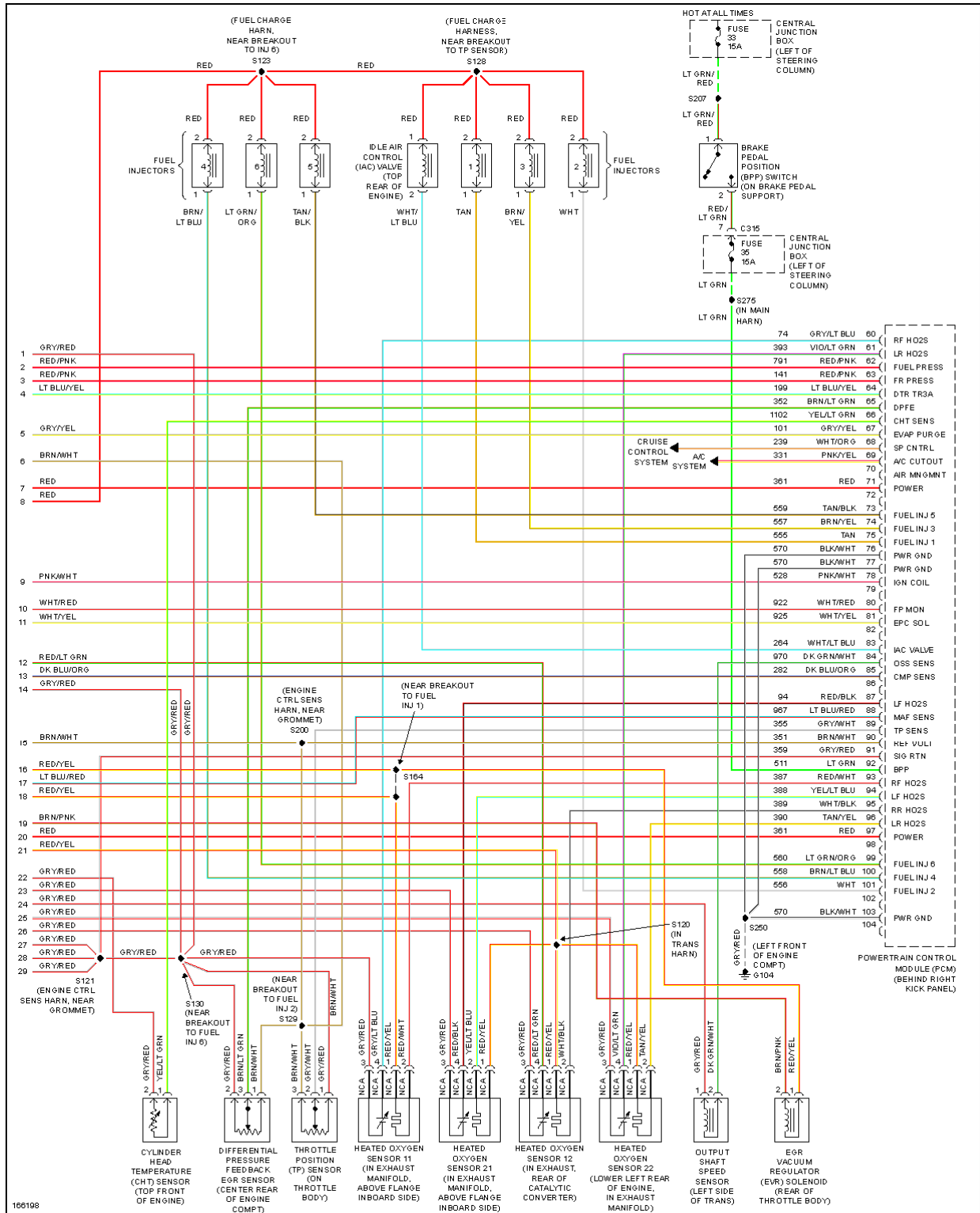


Fig. 13: 3.8L, Engine Performance Circuit (3 of 3)

4.6L DOHC

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

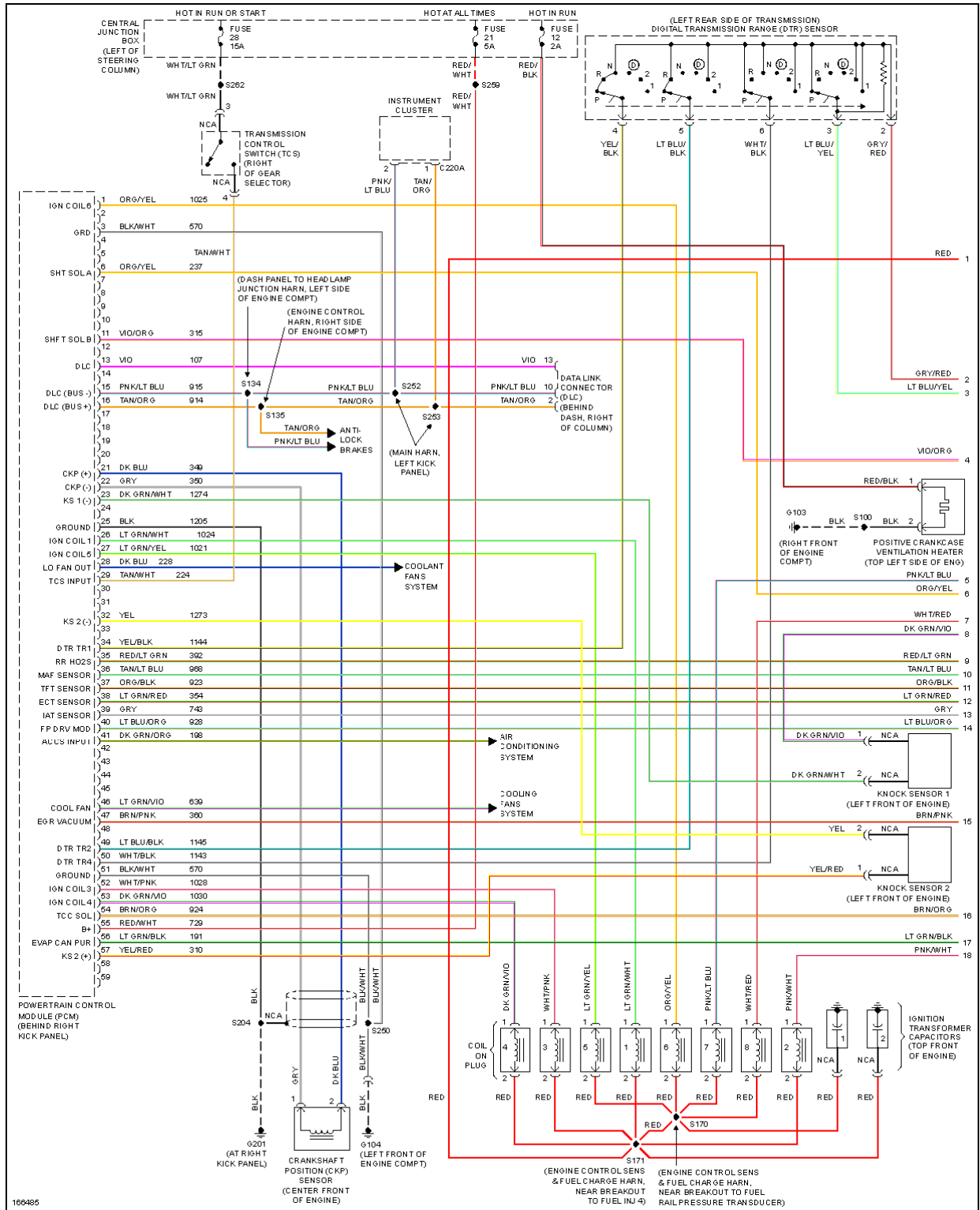


Fig. 14: 4.6L DOHC, Engine Performance Circuit (1 of 3)

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

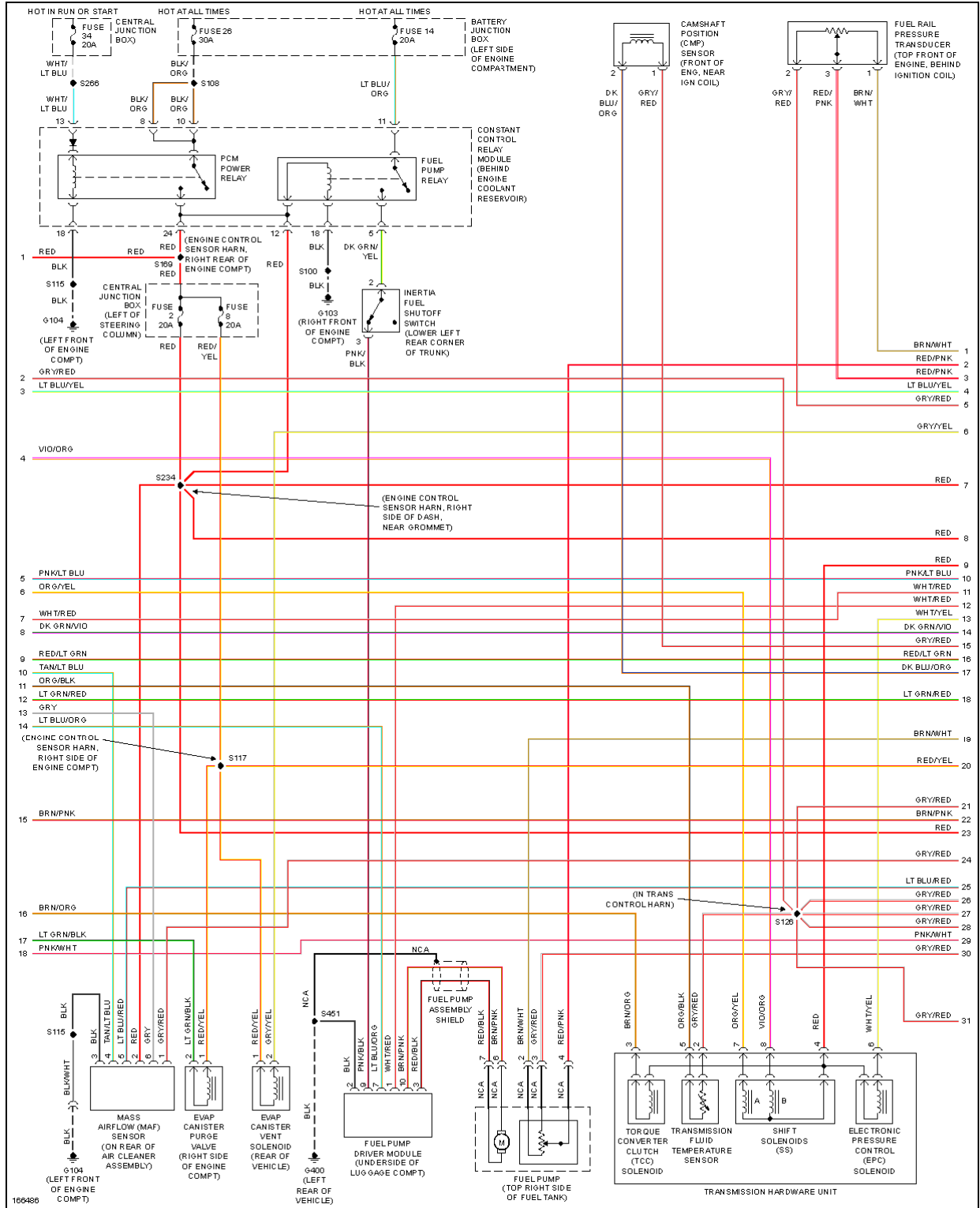


Fig. 15: 4.6L DOHC, Engine Performance Circuit (2 of 3)

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

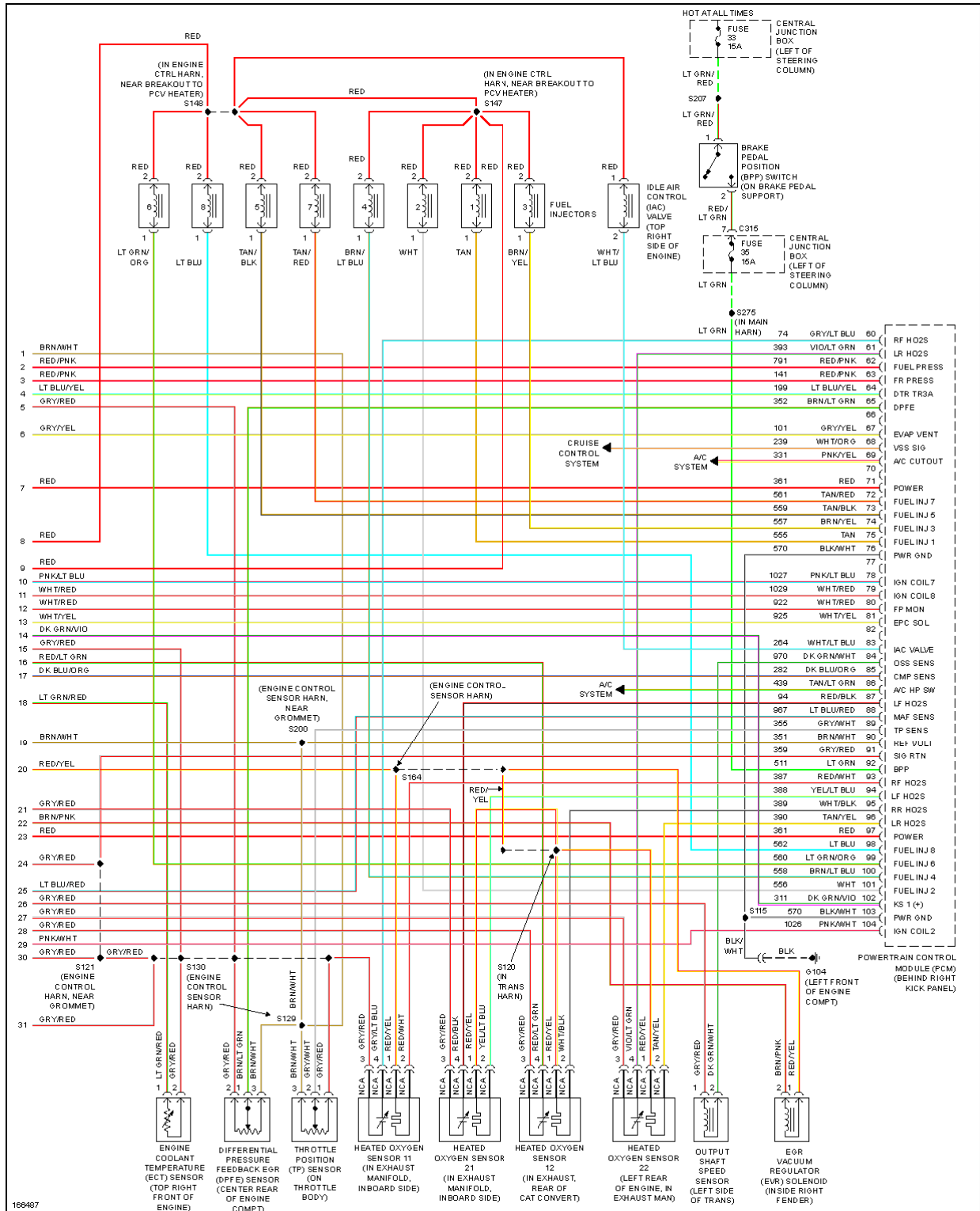


Fig. 16: 4.6L DOHC, Engine Performance Circuit (3 of 3)

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

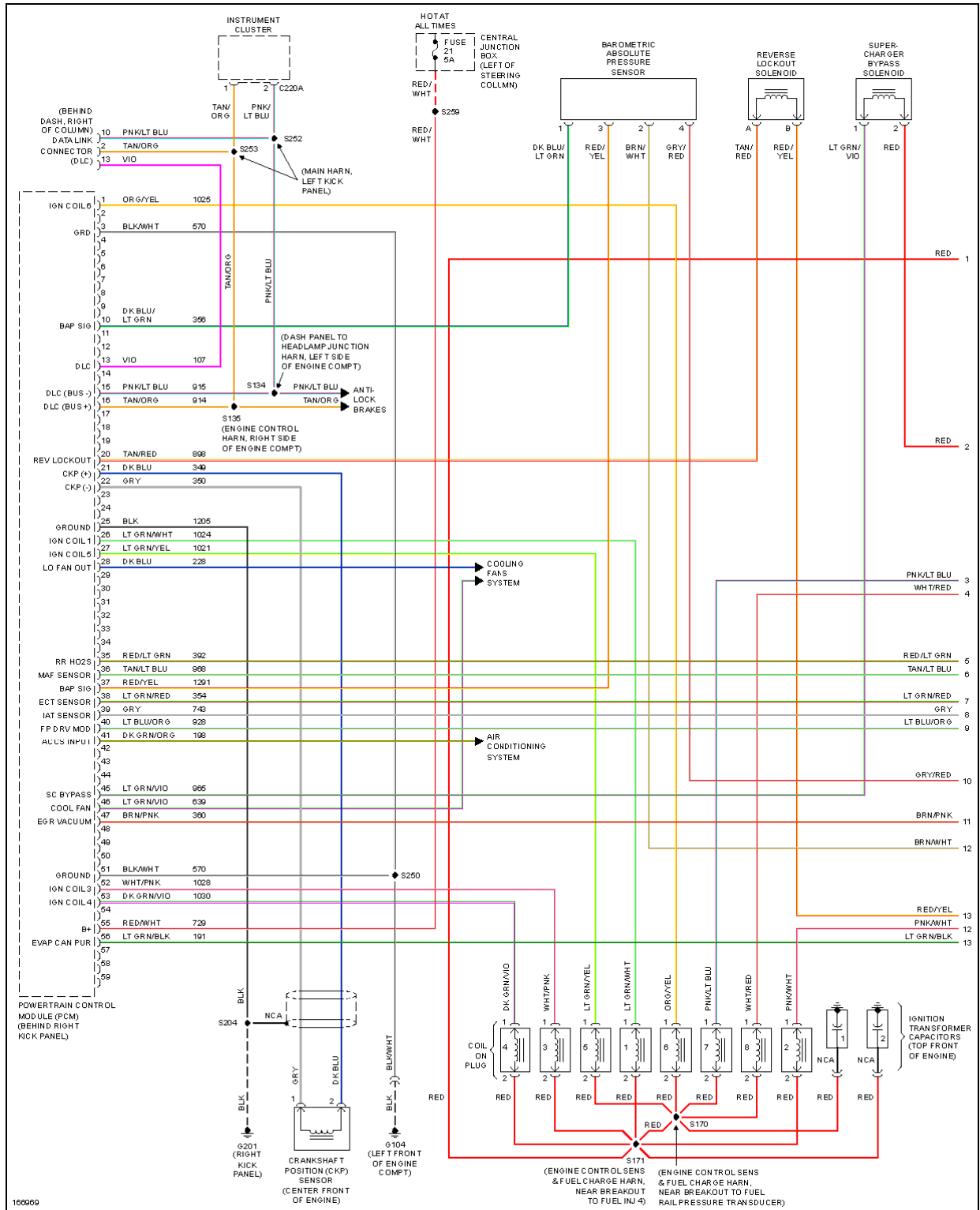


Fig. 17: 4.6L SC, Engine Performance Circuit (1 of 3)

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

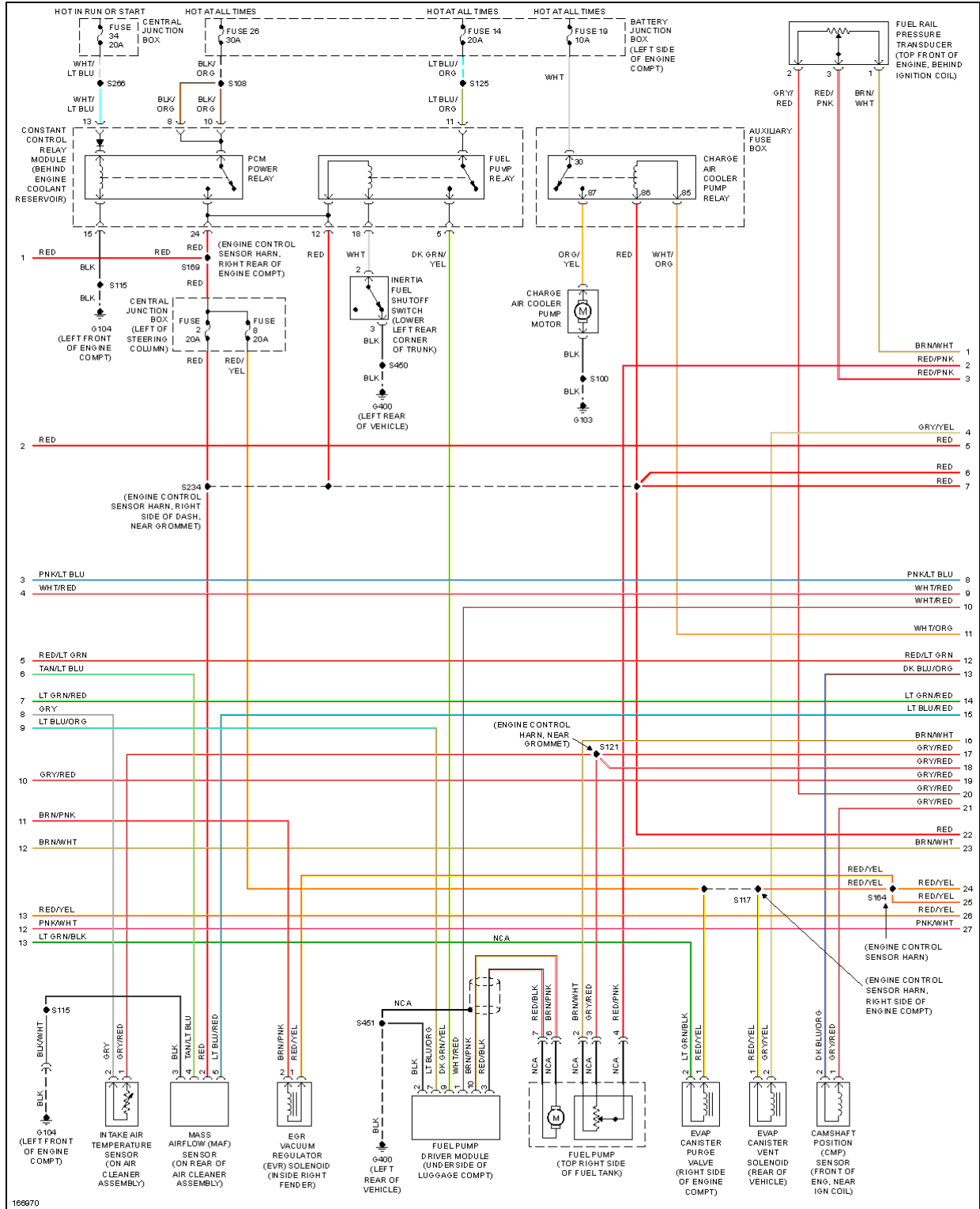


Fig. 18: 4.6L SC, Engine Performance Circuit (2 of 3)

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

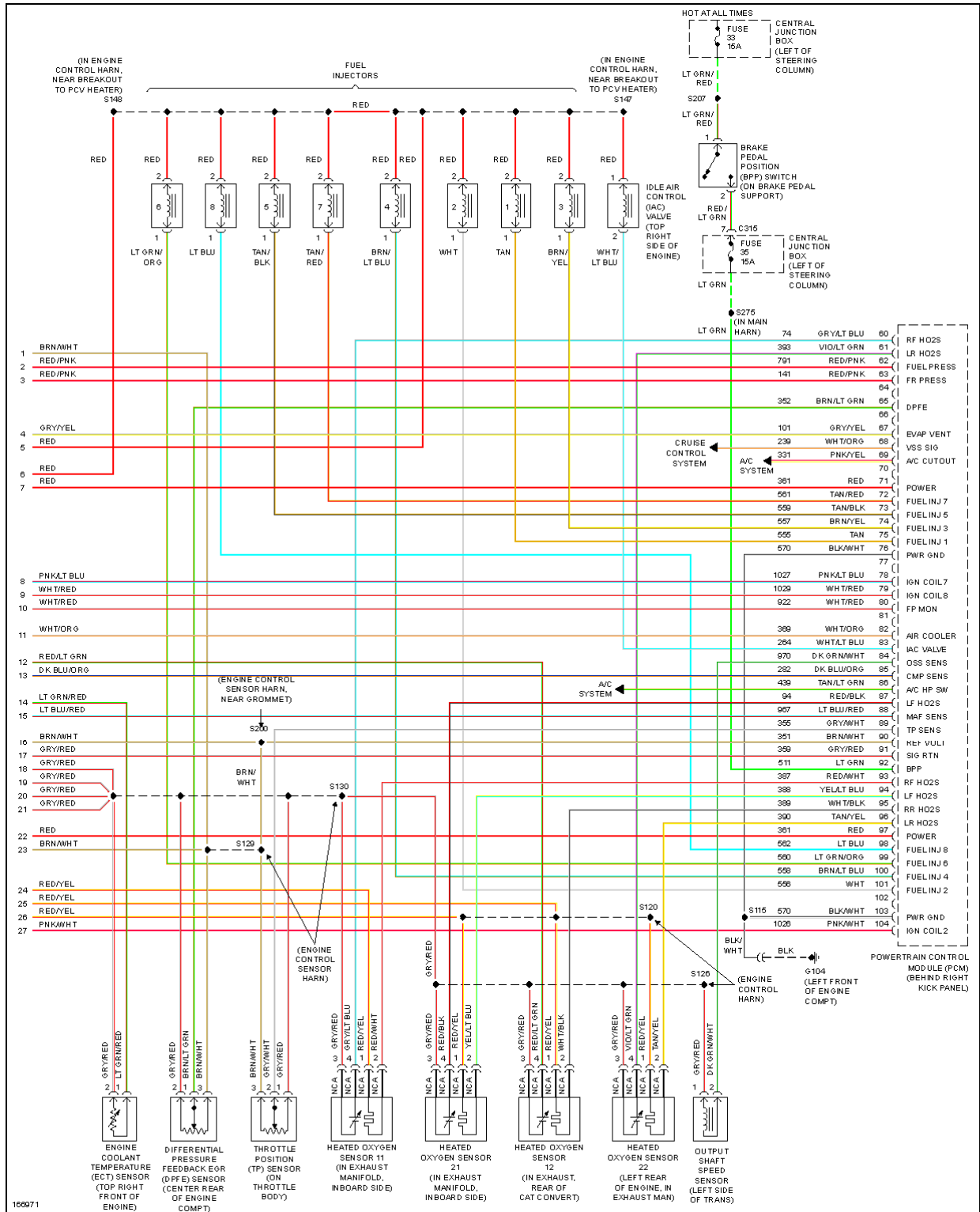


Fig. 19: 4.6L SC, Engine Performance Circuit (3 of 3)

4.6L SOHC

2003 Ford Mustang

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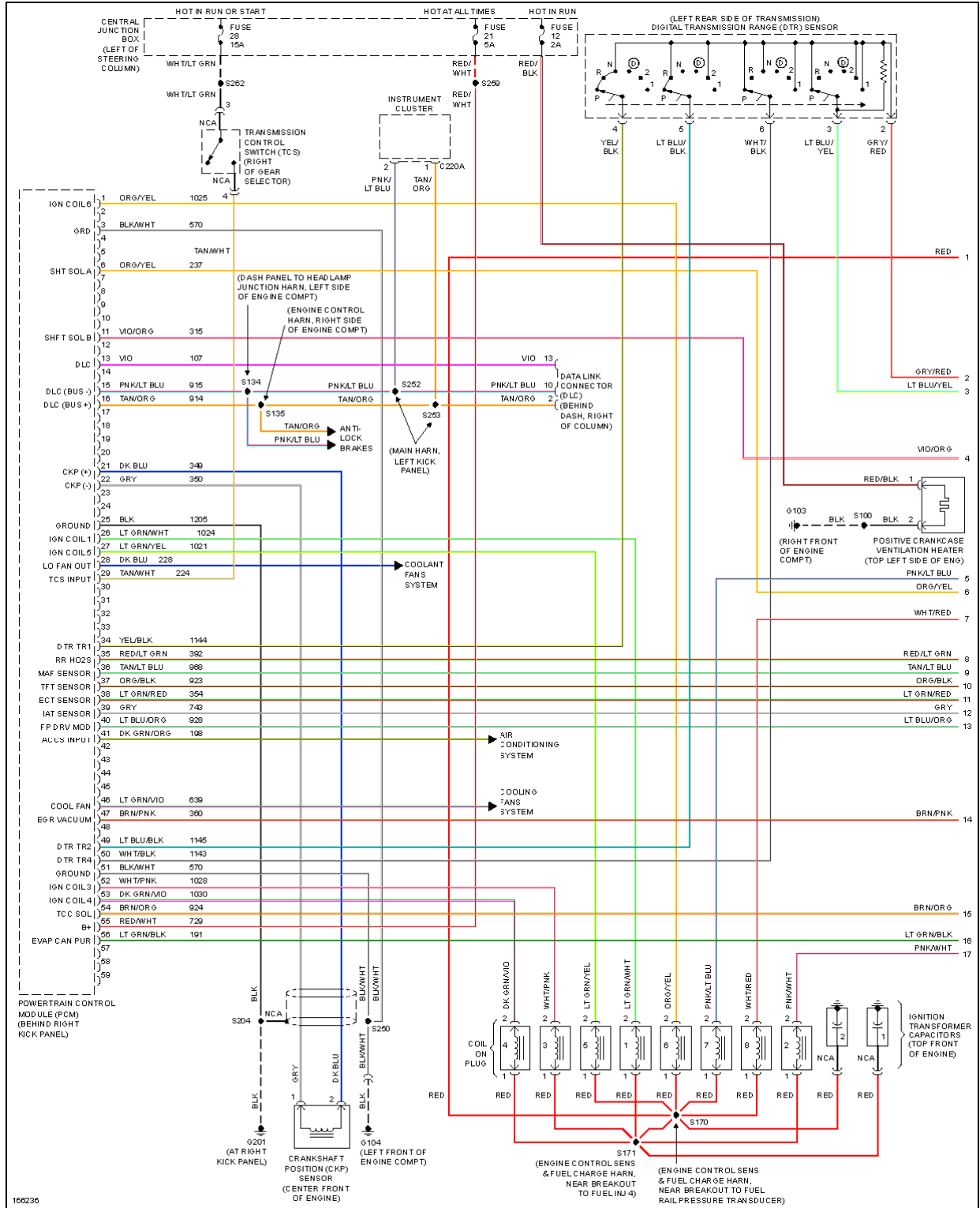


Fig. 20: 4.6L SOHC, Engine Performance Circuit (1 of 3)

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

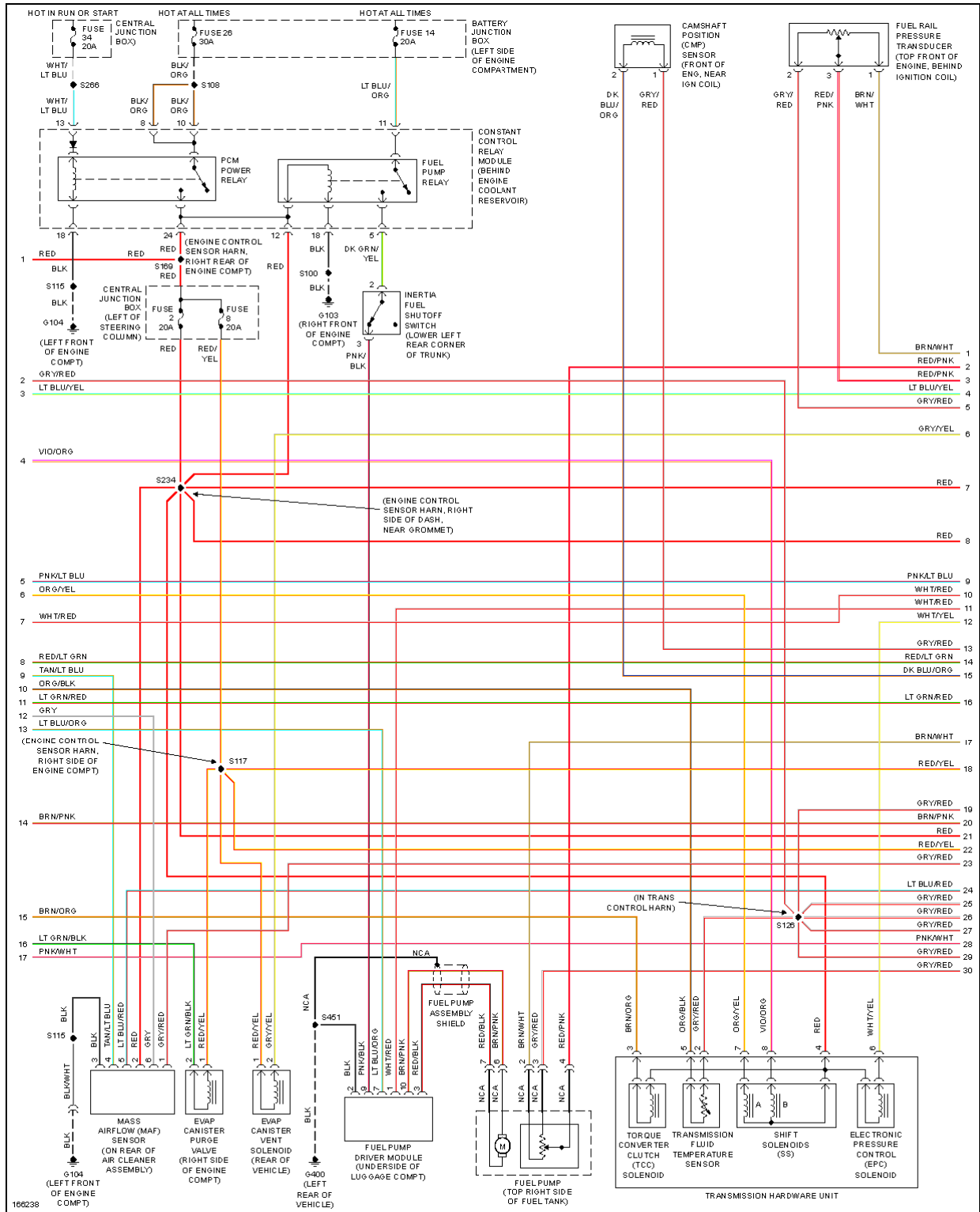


Fig. 21: 4.6L SOHC, Engine Performance Circuit (2 of 3)

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

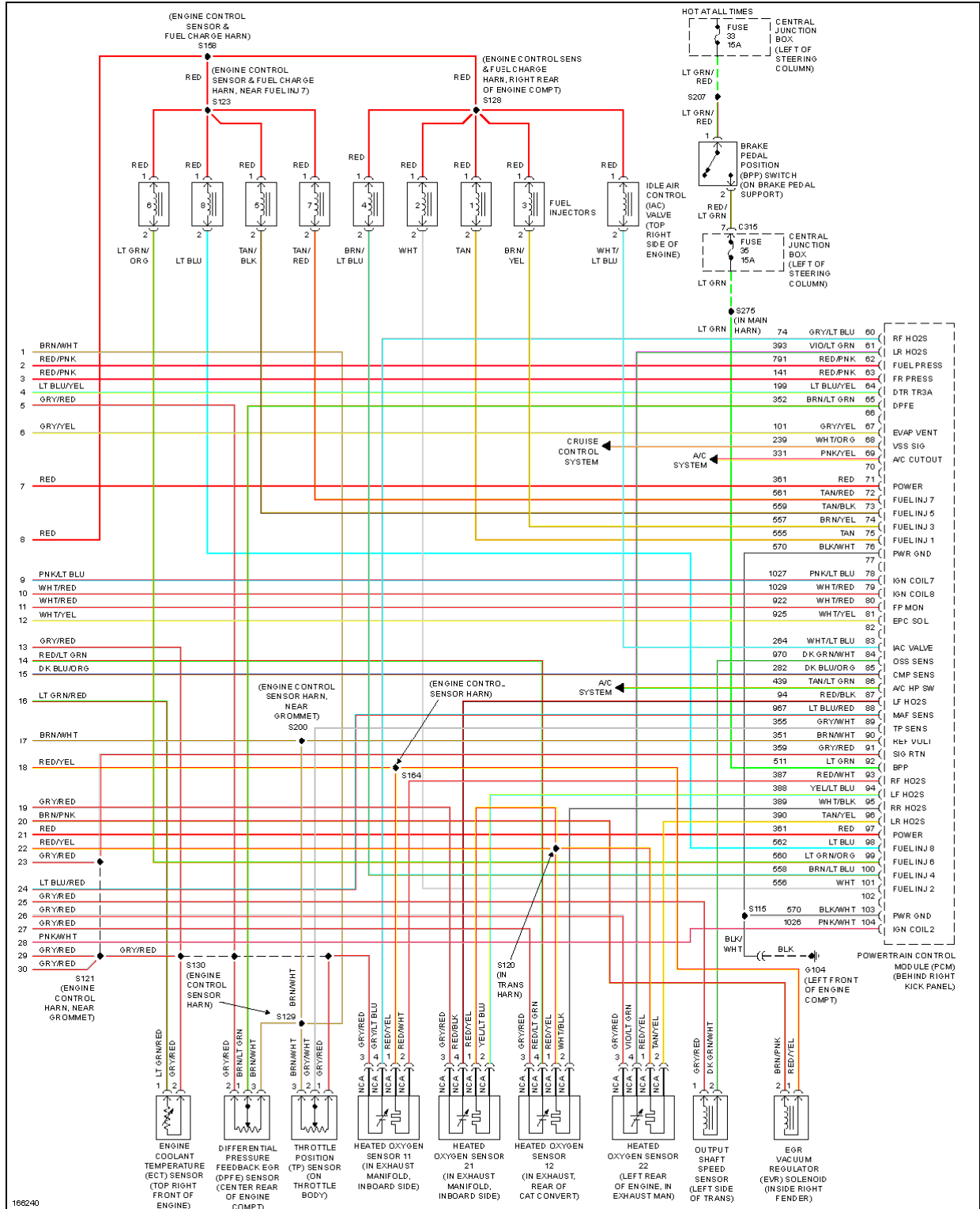


Fig. 22: 4.6L SOHC, Engine Performance Circuit (3 of 3)

EXTERIOR LIGHTS

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

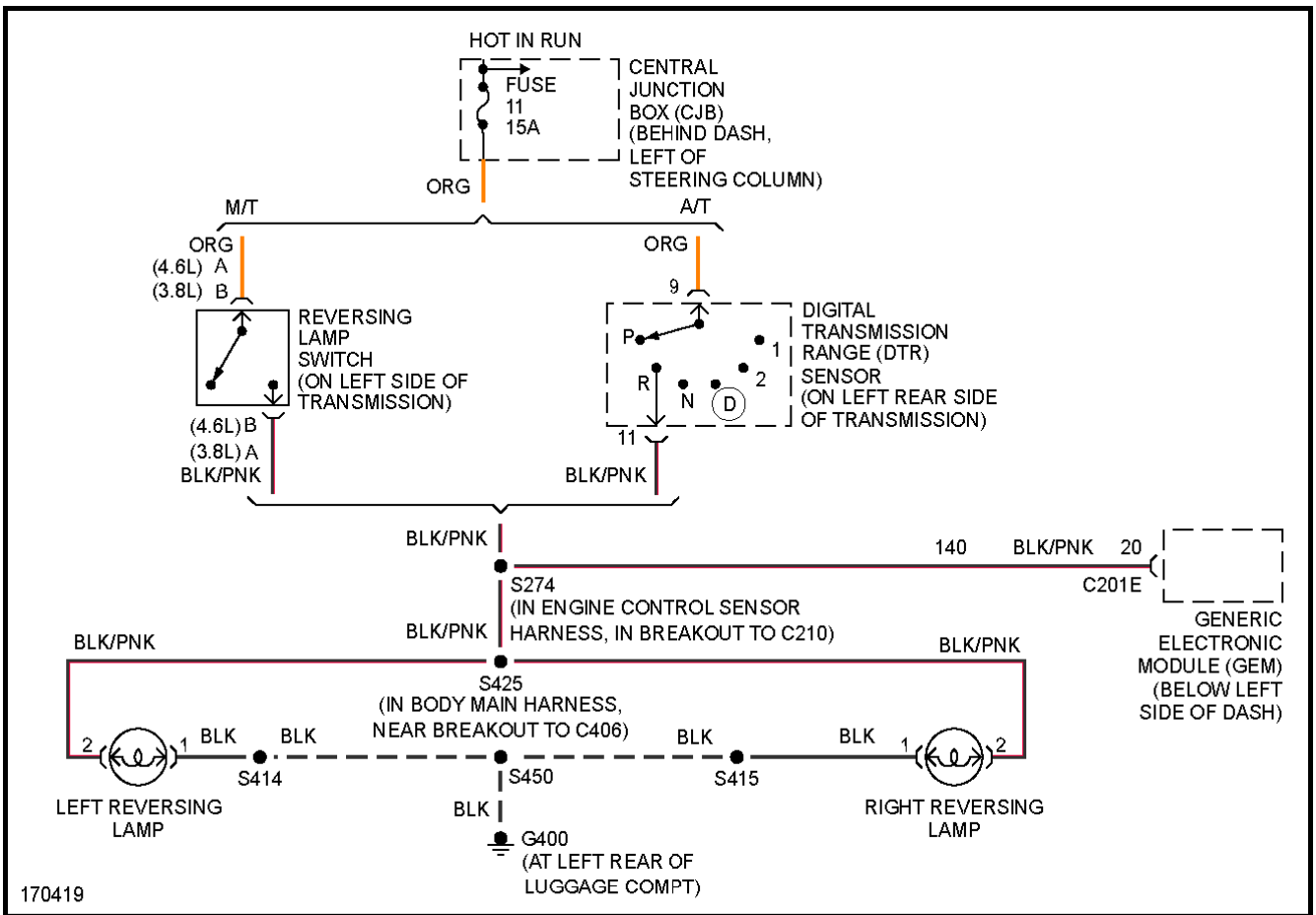


Fig. 23: Back-up Lamps Circuit

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

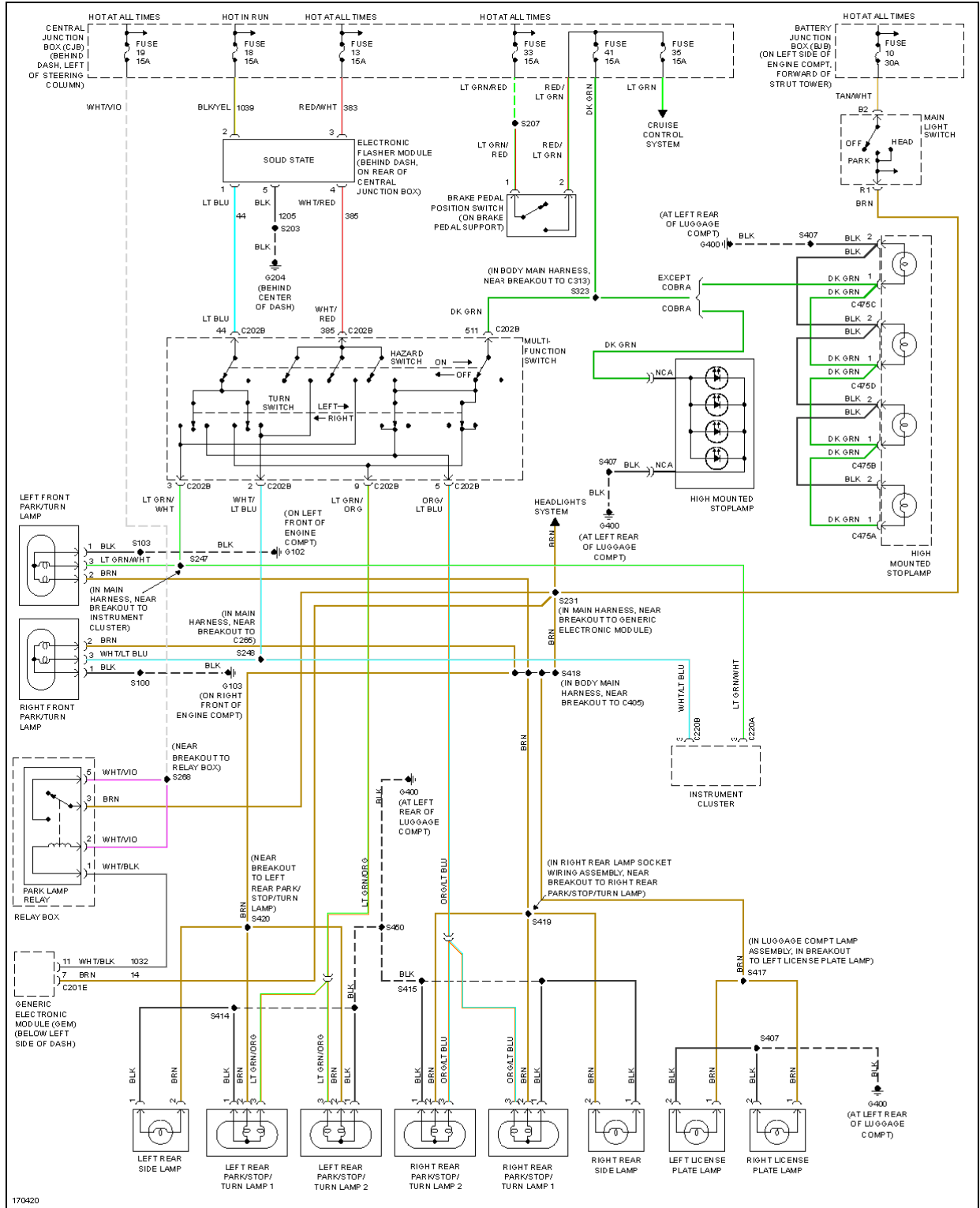


Fig. 24: Exterior Lamps Circuit

GROUND DISTRIBUTION

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

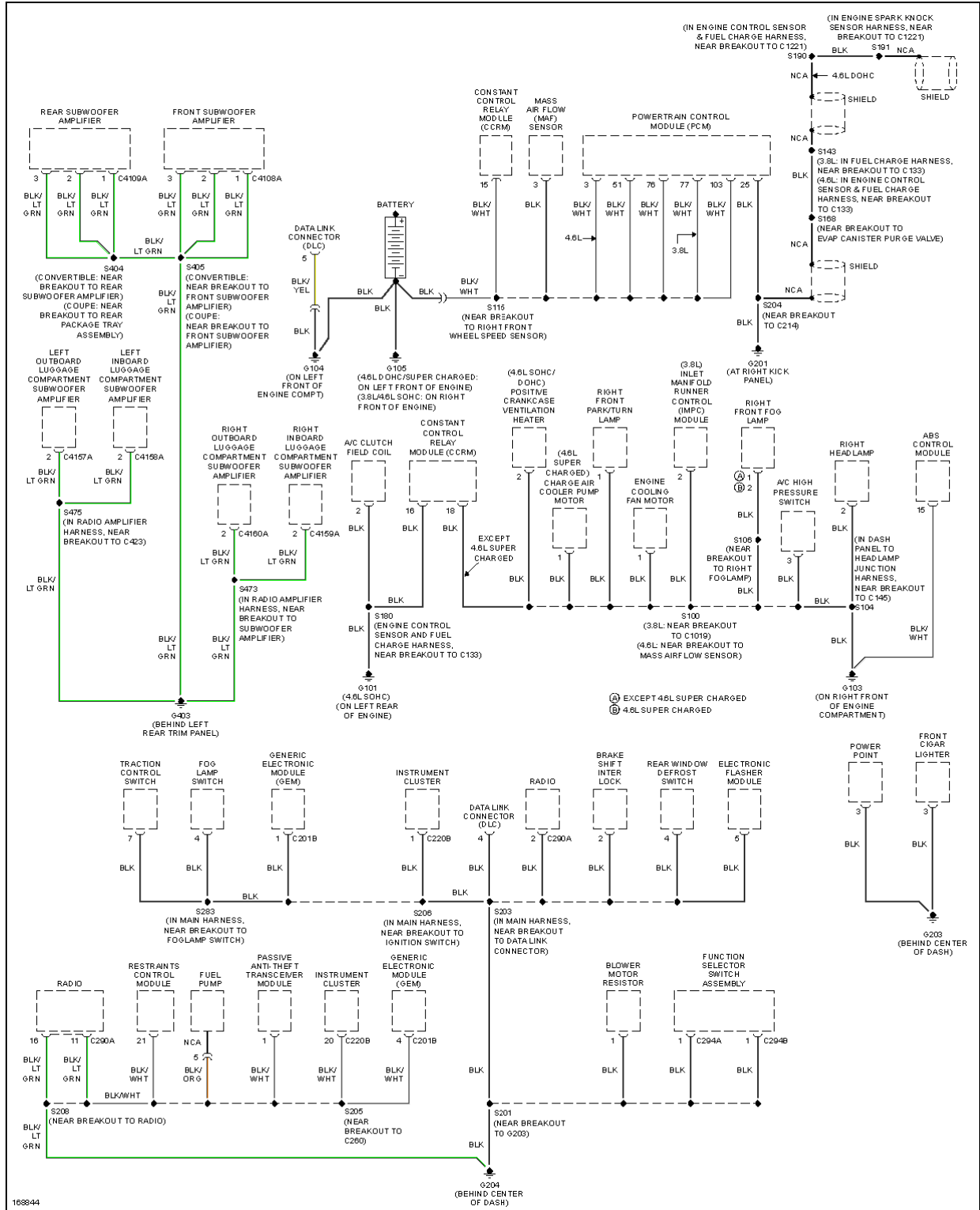


Fig. 25: Ground Distribution Circuit (1 of 2)

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

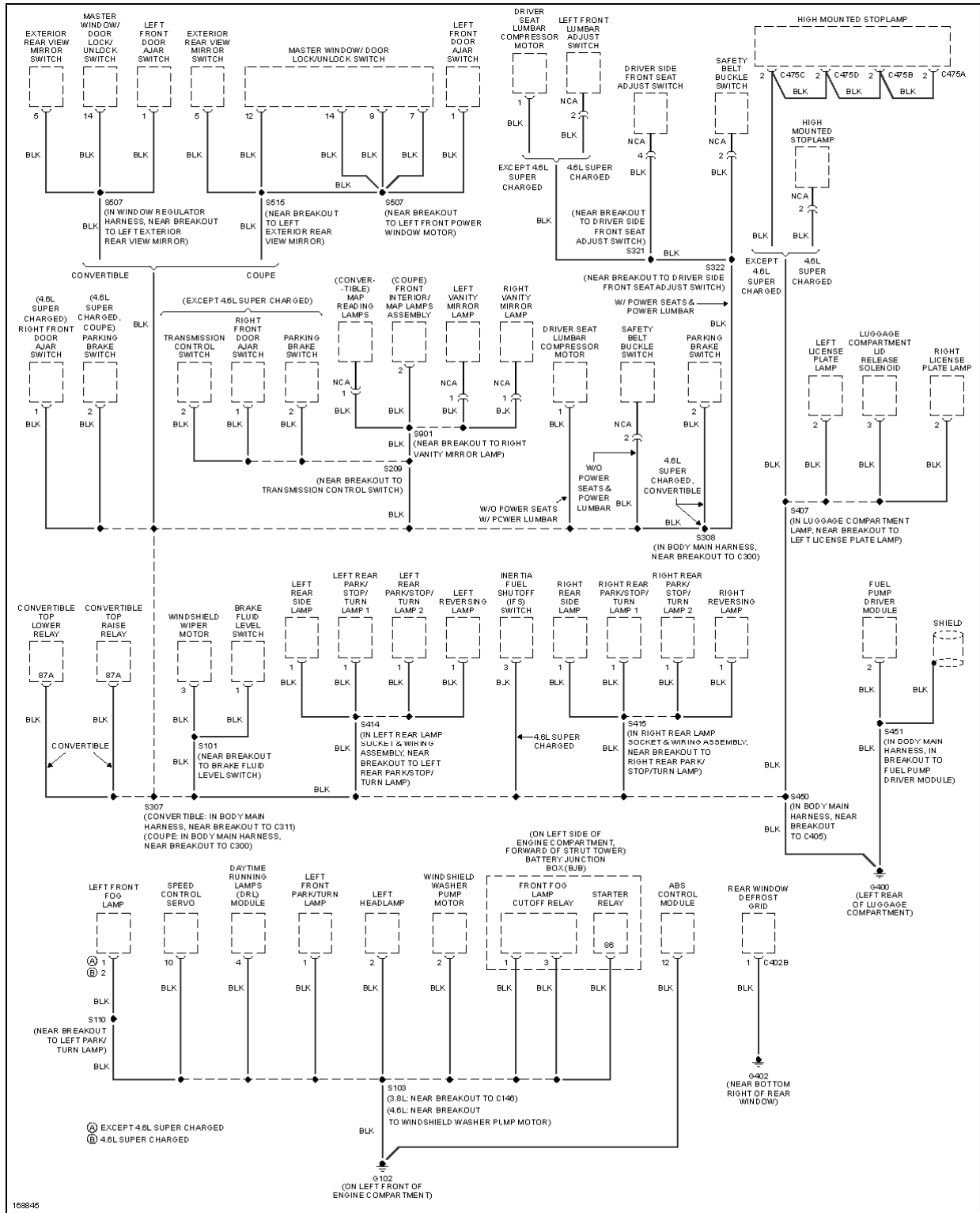


Fig. 26: Ground Distribution Circuit (2 of 2)

HEADLIGHTS

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

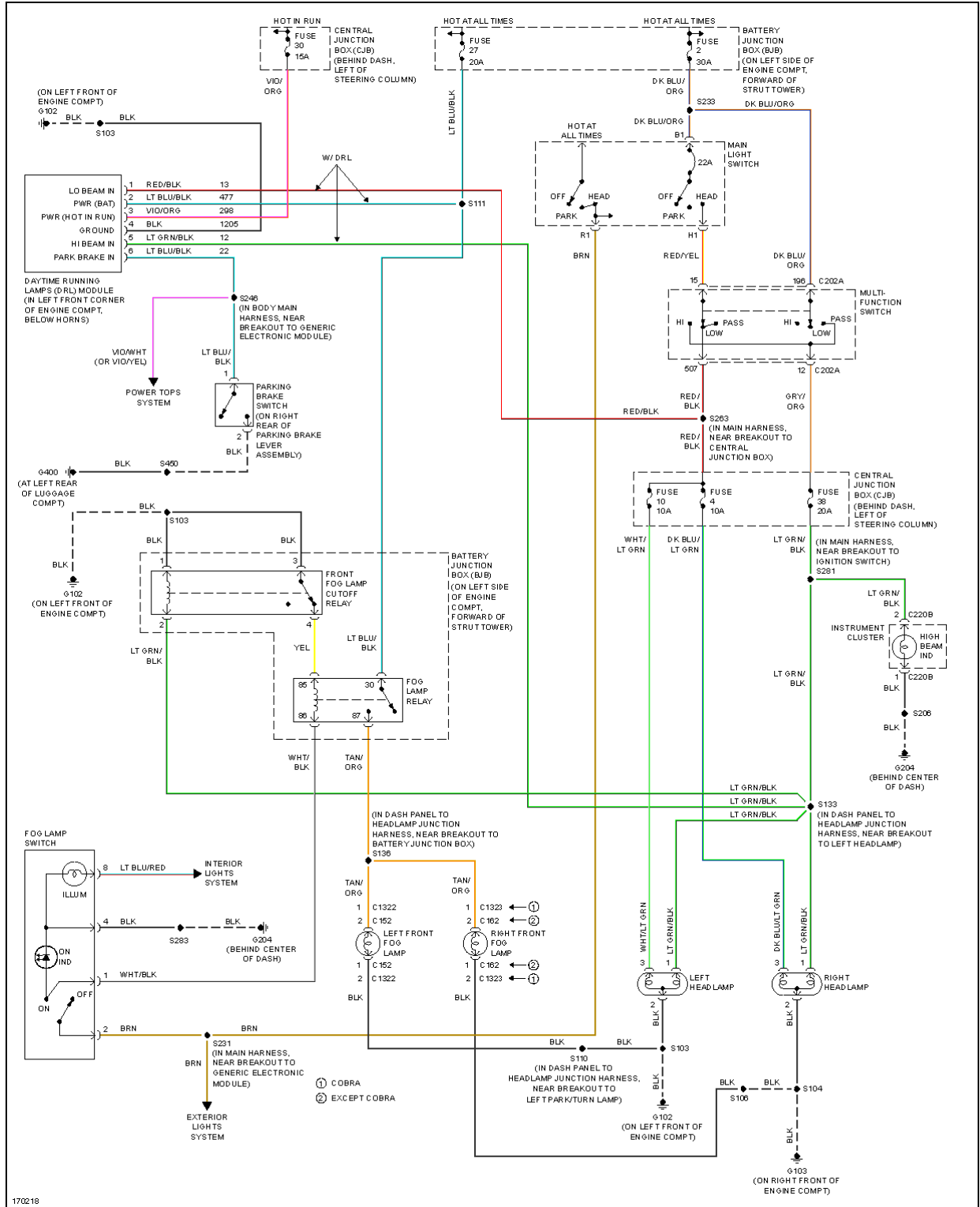


Fig. 27: Headlights Circuit

HORN

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

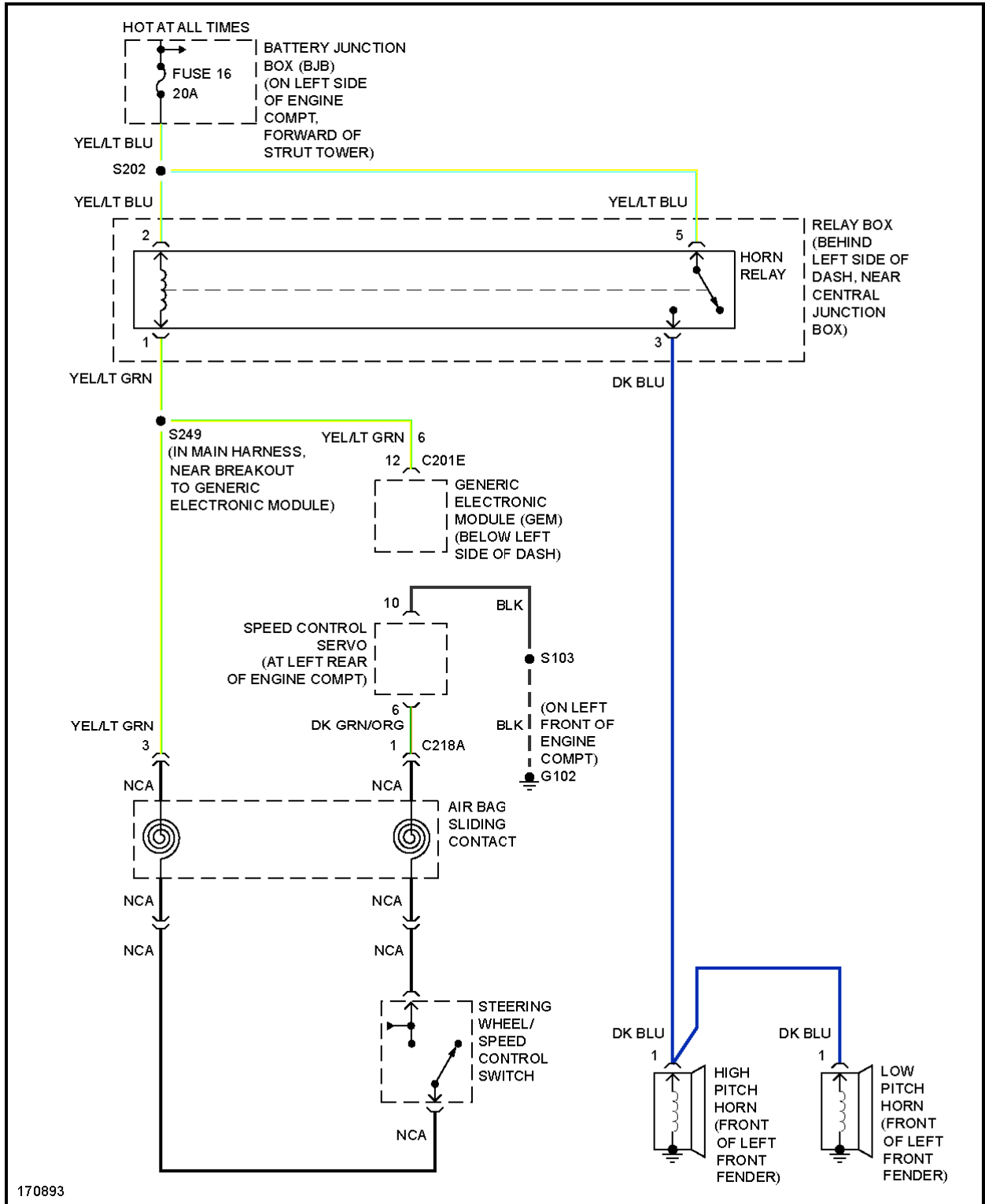


Fig. 28: Horn Circuit

INSTRUMENT CLUSTER

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

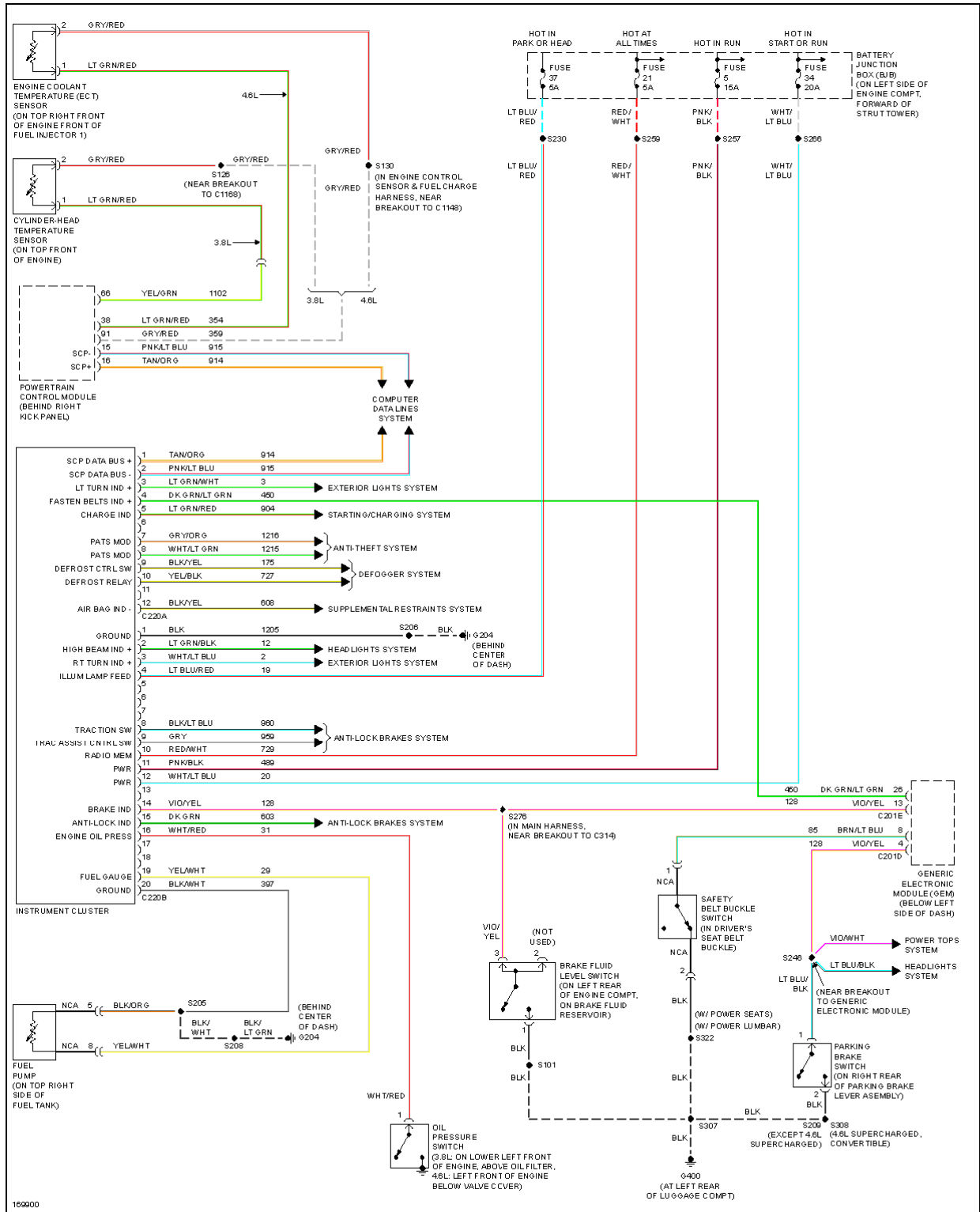


Fig. 29: Instrument Cluster Circuit

INTERIOR LIGHTS

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

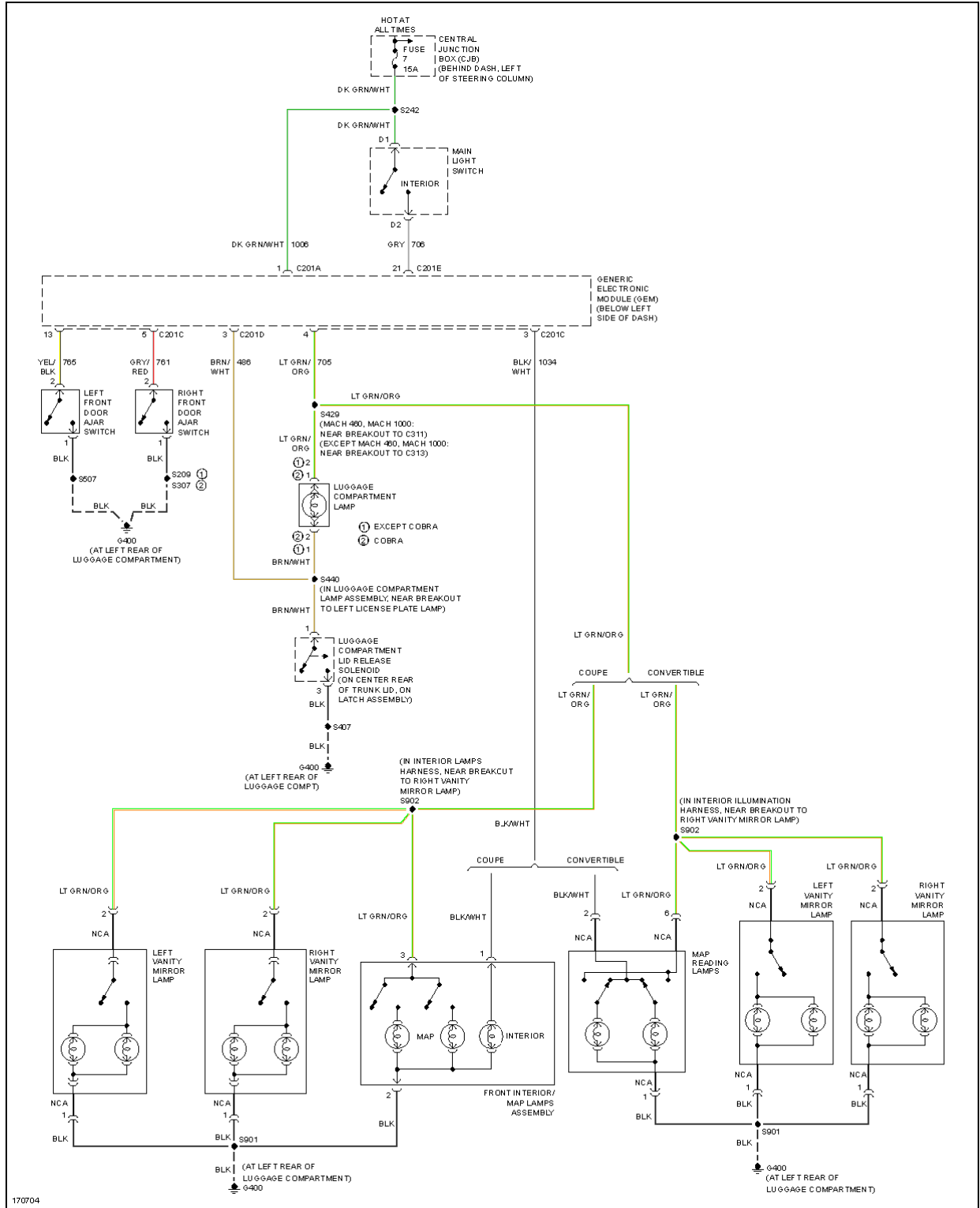


Fig. 30: Courtesy Lamps Circuit

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

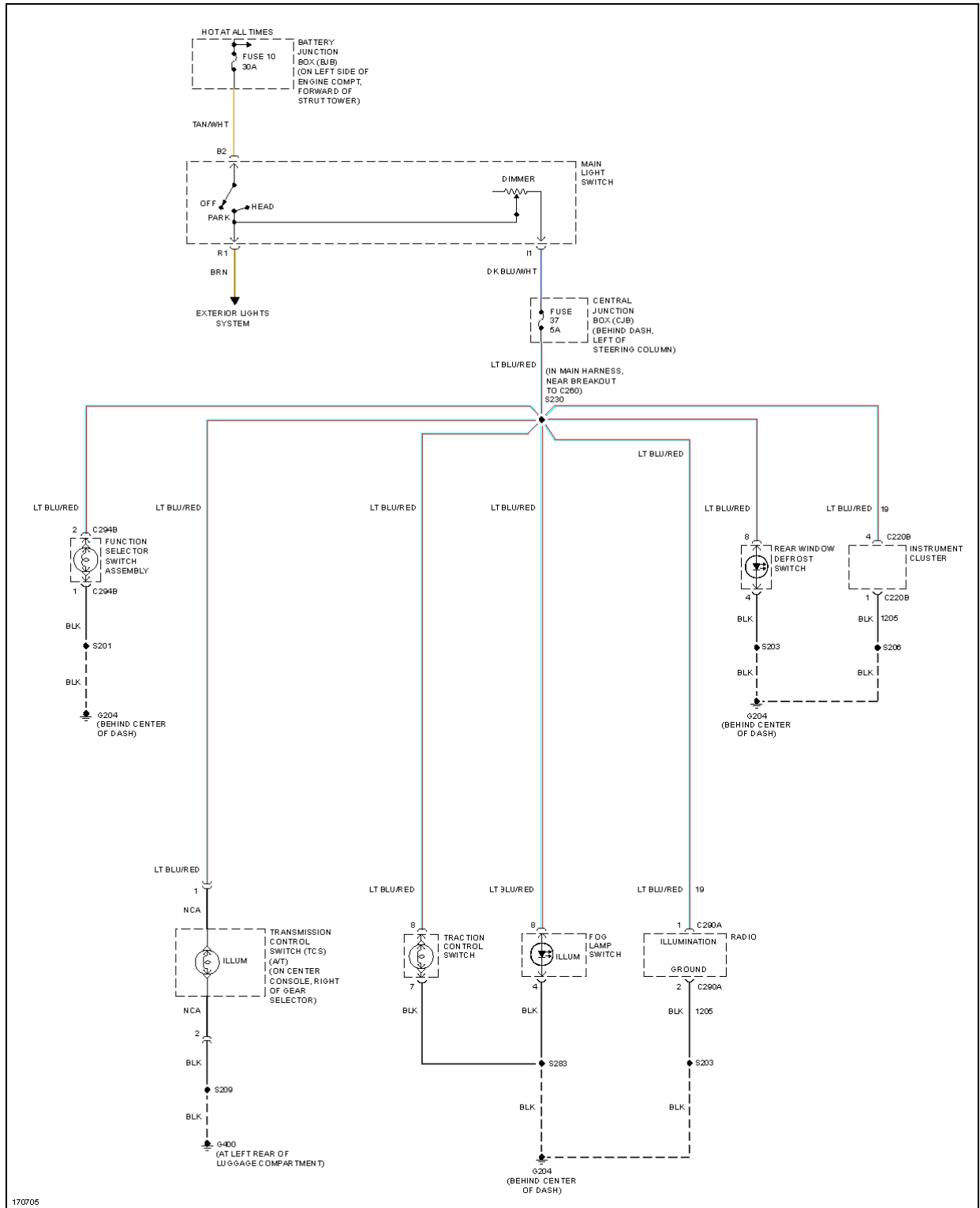


Fig. 31: Instrument Illumination Circuit

POWER DISTRIBUTION

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

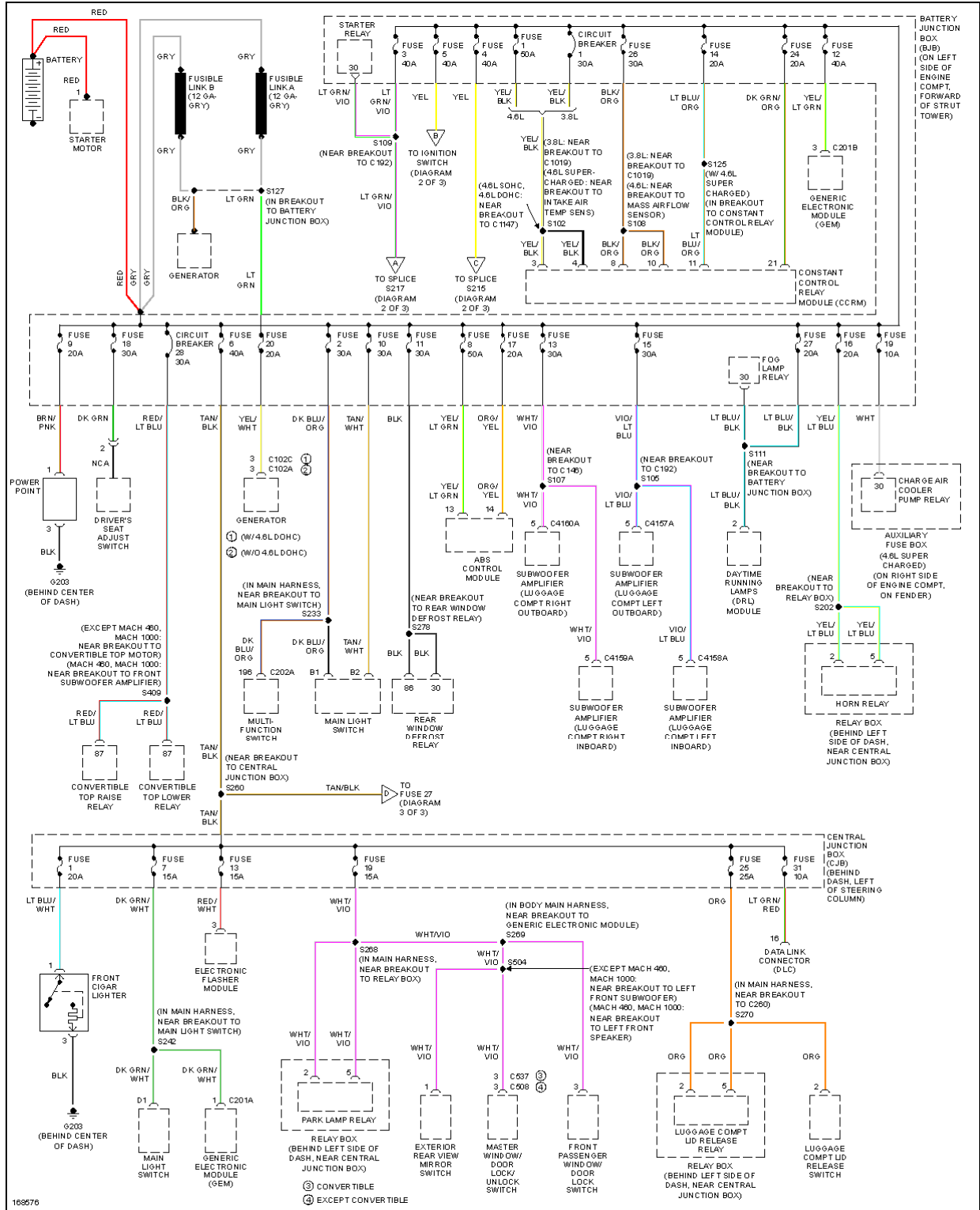


Fig. 32: Power Distribution Circuit (1 of 3)

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

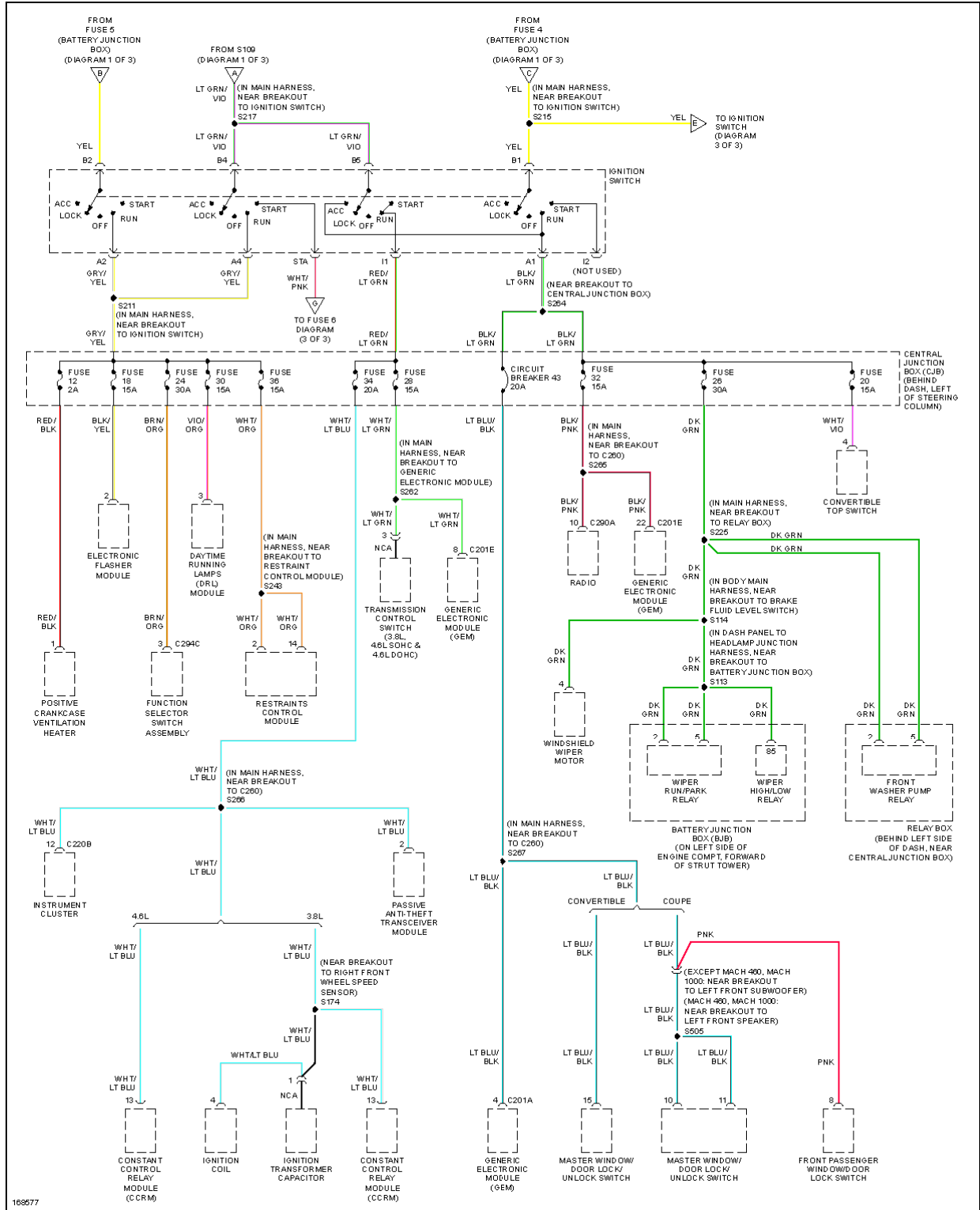


Fig. 33: Power Distribution Circuit (2 of 3)

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

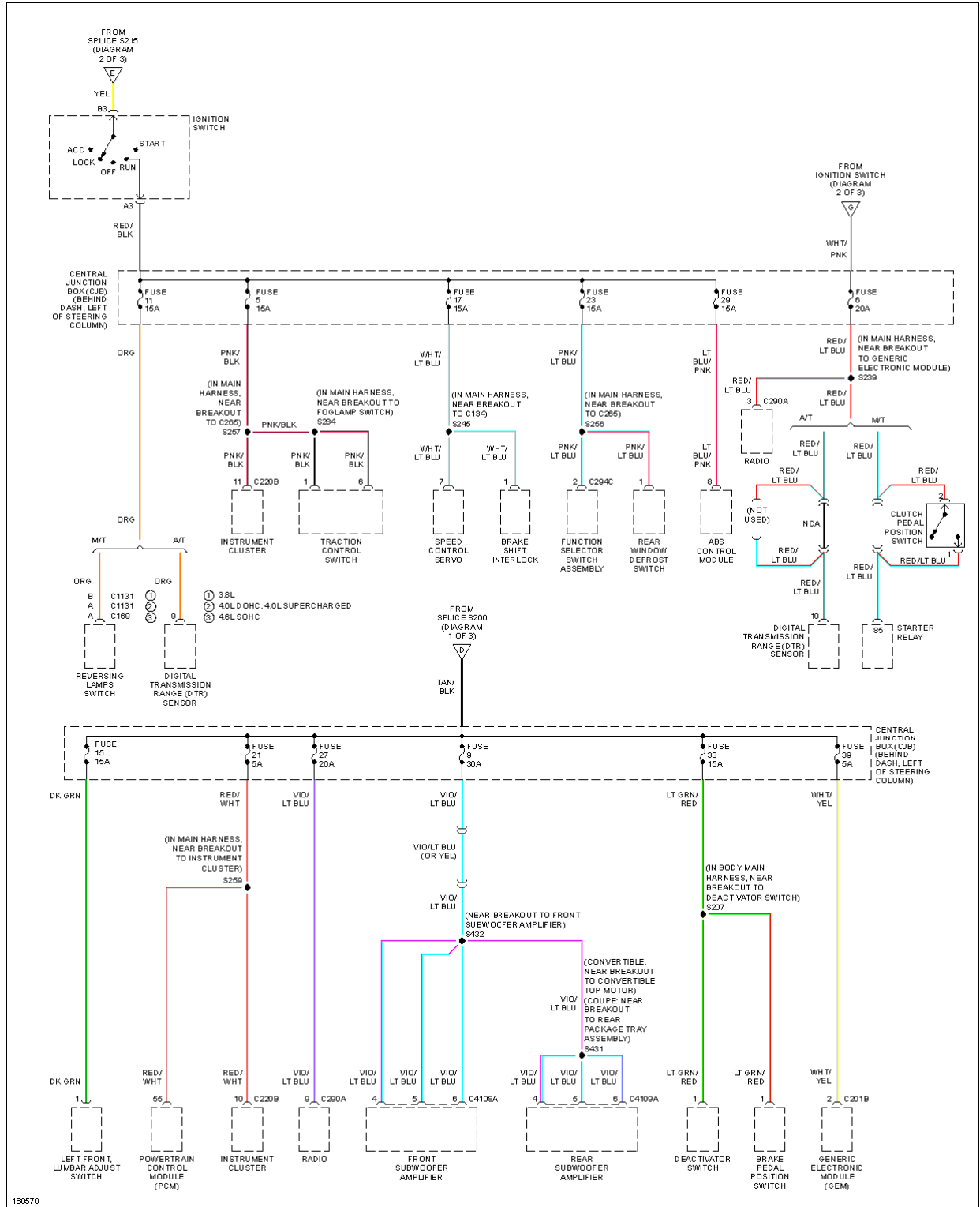


Fig. 34: Power Distribution Circuit (3 of 3)

POWER DOOR LOCKS

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

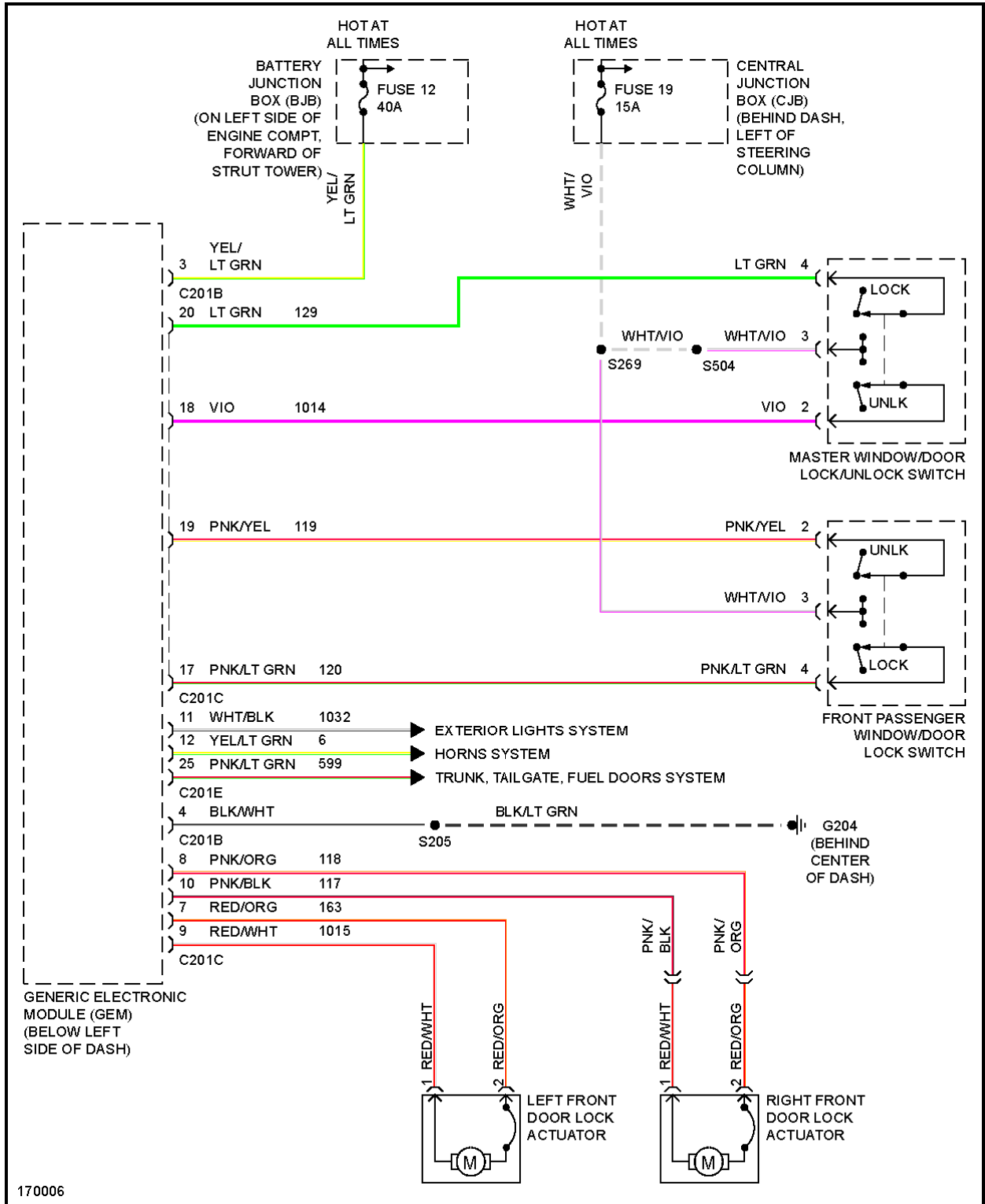


Fig. 35: Power Door Locks Circuit

POWER MIRRORS

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

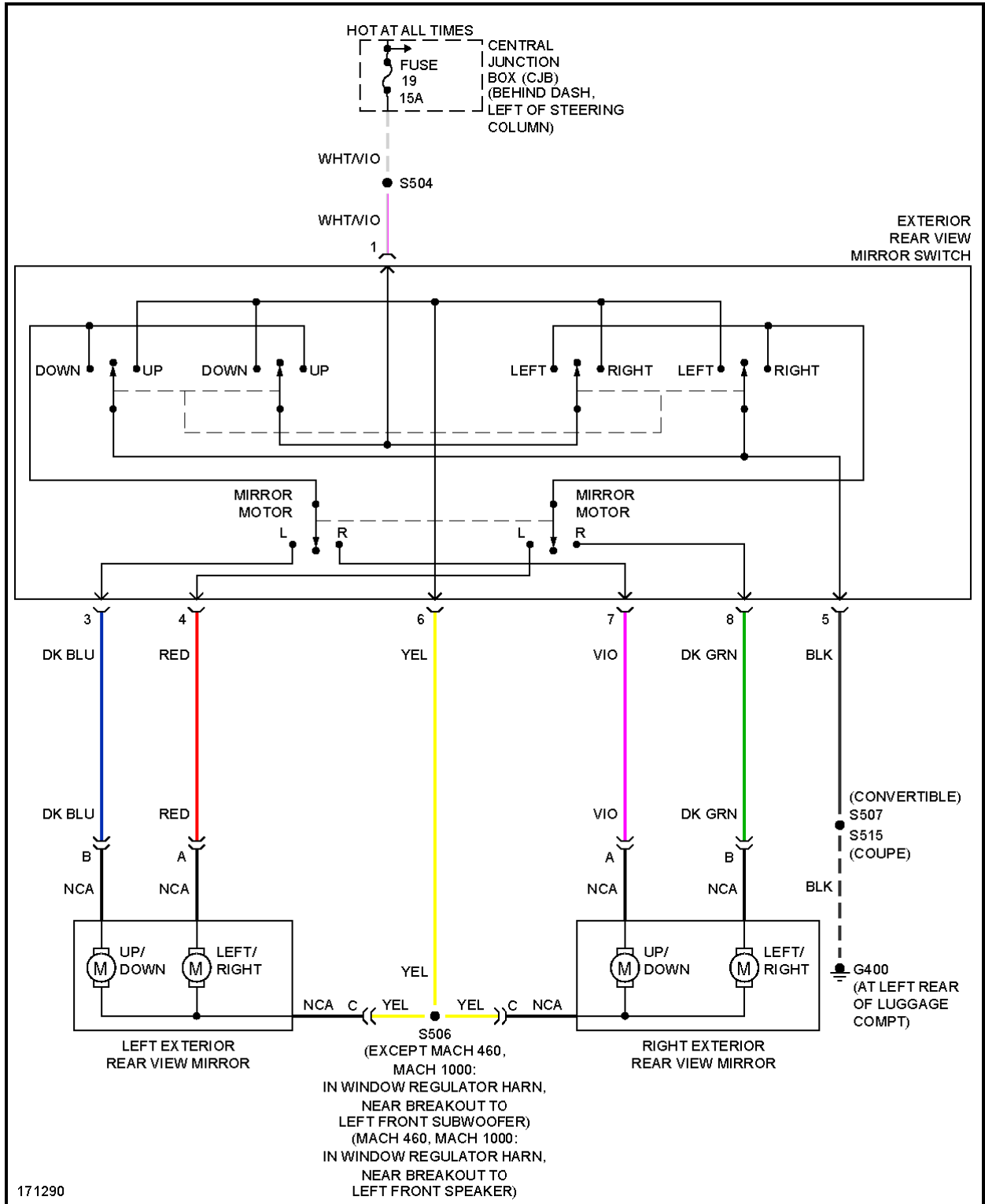


Fig. 36: Power Mirrors Circuit

POWER SEATS

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

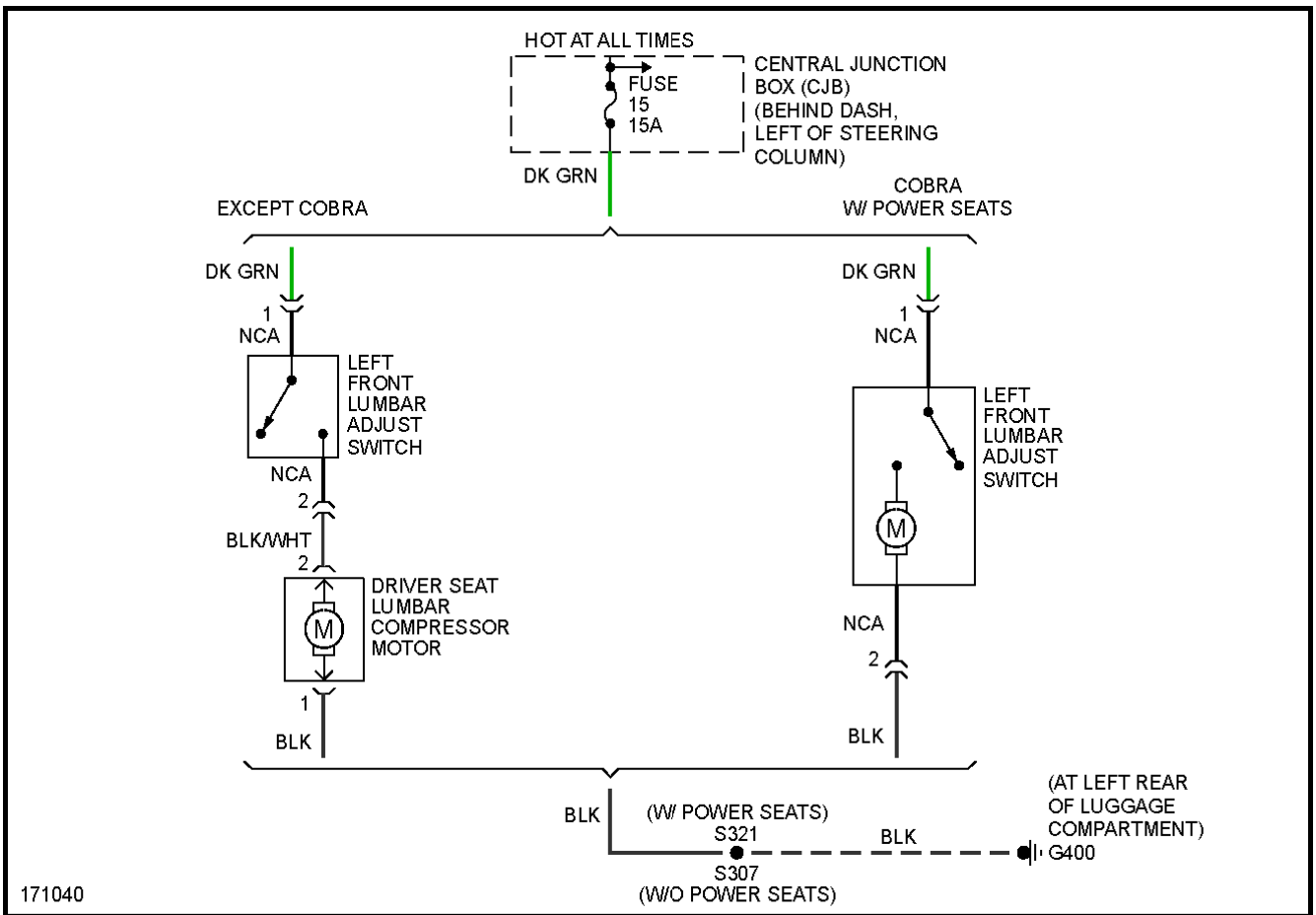


Fig. 37: Lumbar Circuit

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

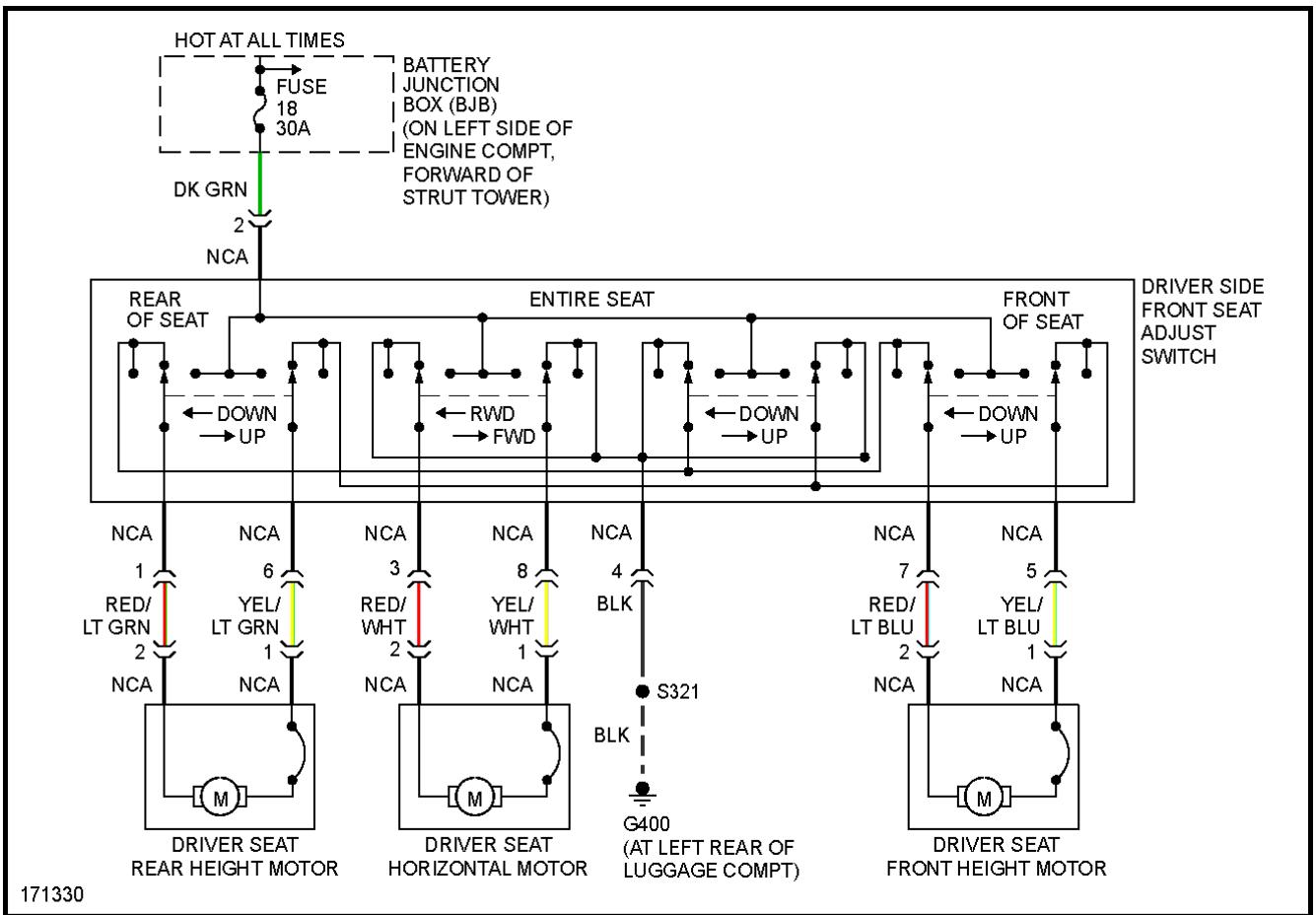


Fig. 38: Power Seat Circuit

POWER TOP/SUNROOF

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

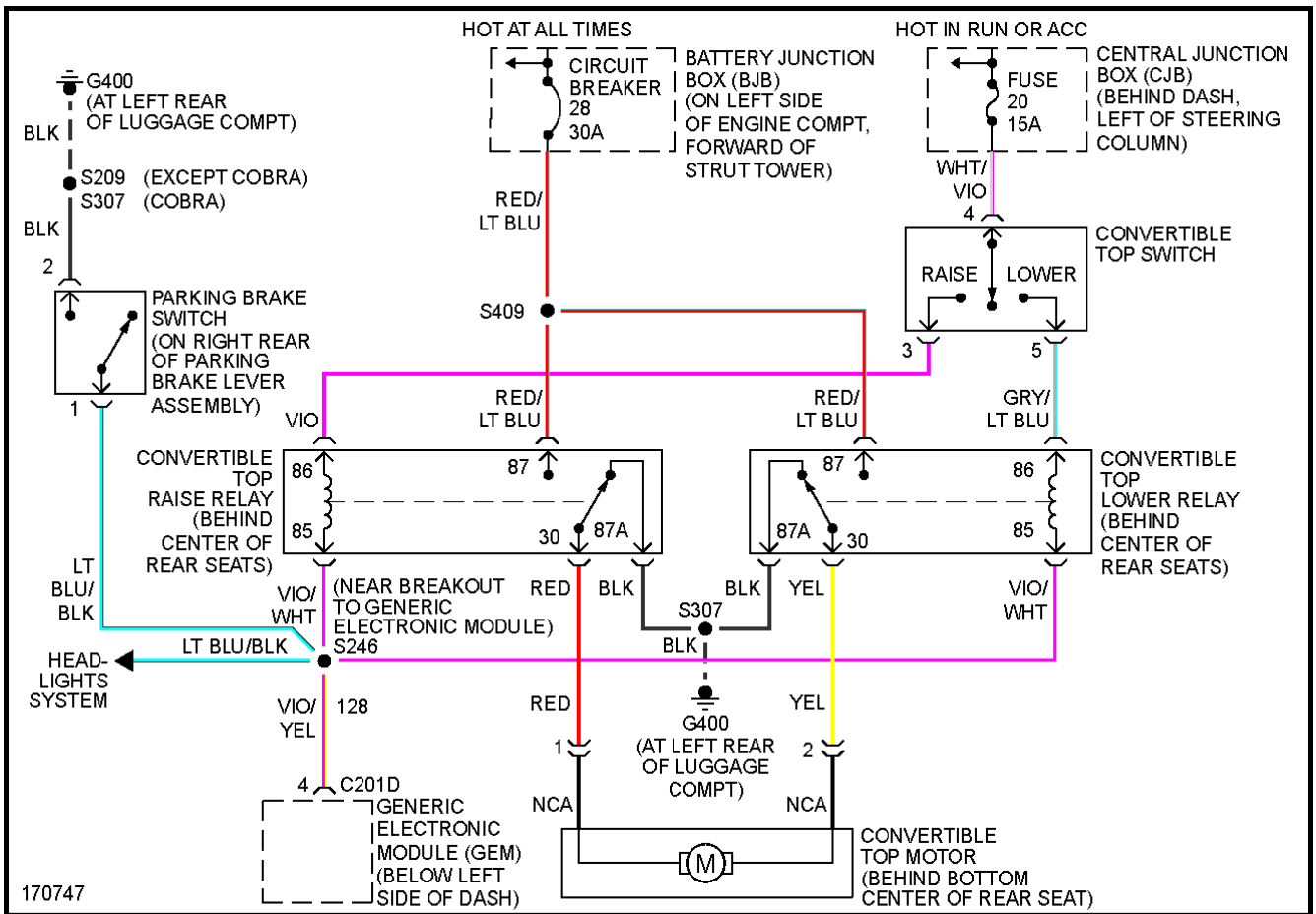


Fig. 39: Power Top/Sunroof Circuit

POWER WINDOWS

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

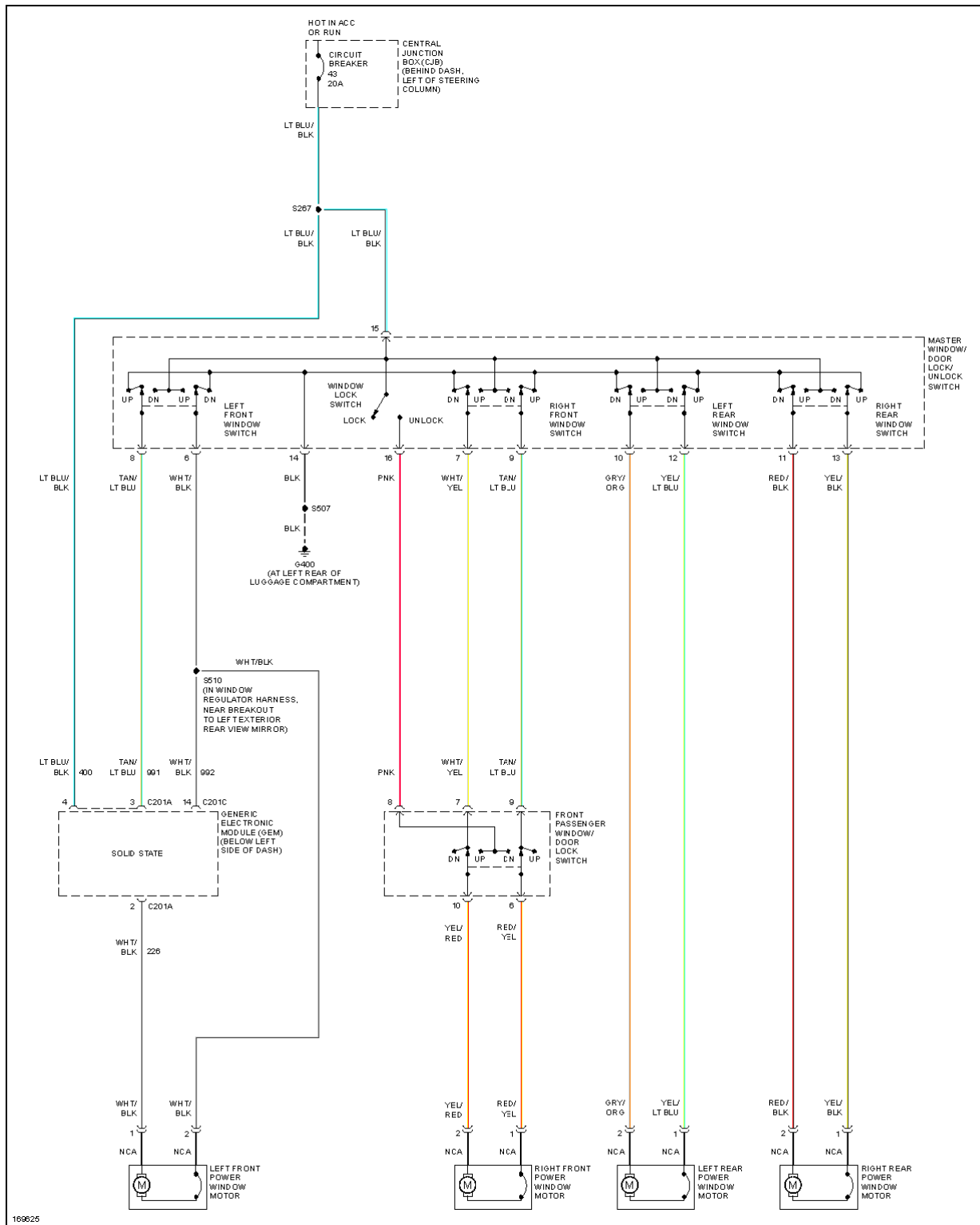


Fig. 40: Power Windows Circuit, Convertible

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

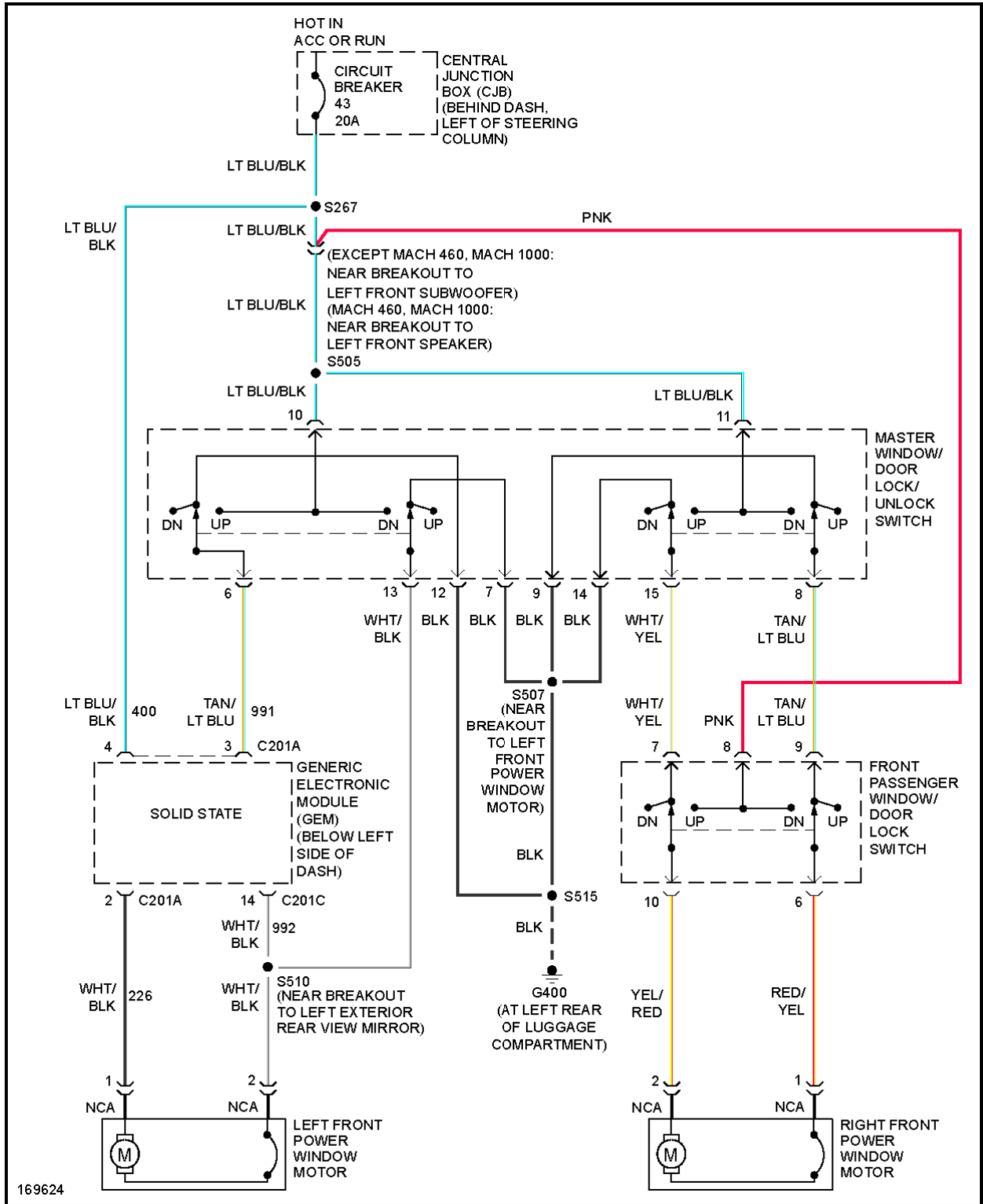


Fig. 41: Power Windows Circuit, Coupe

RADIO

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

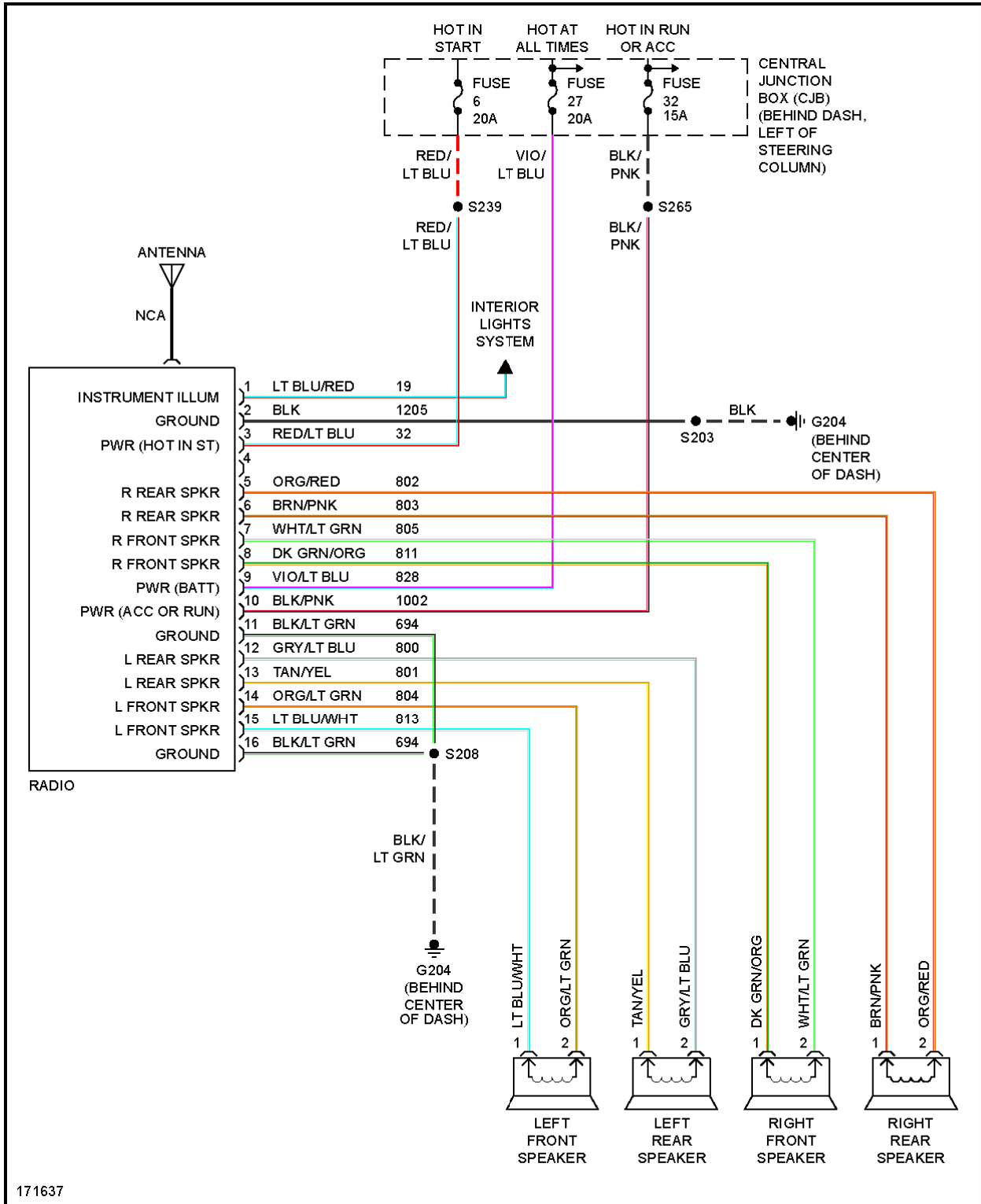


Fig. 42: Base Radio Circuit

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

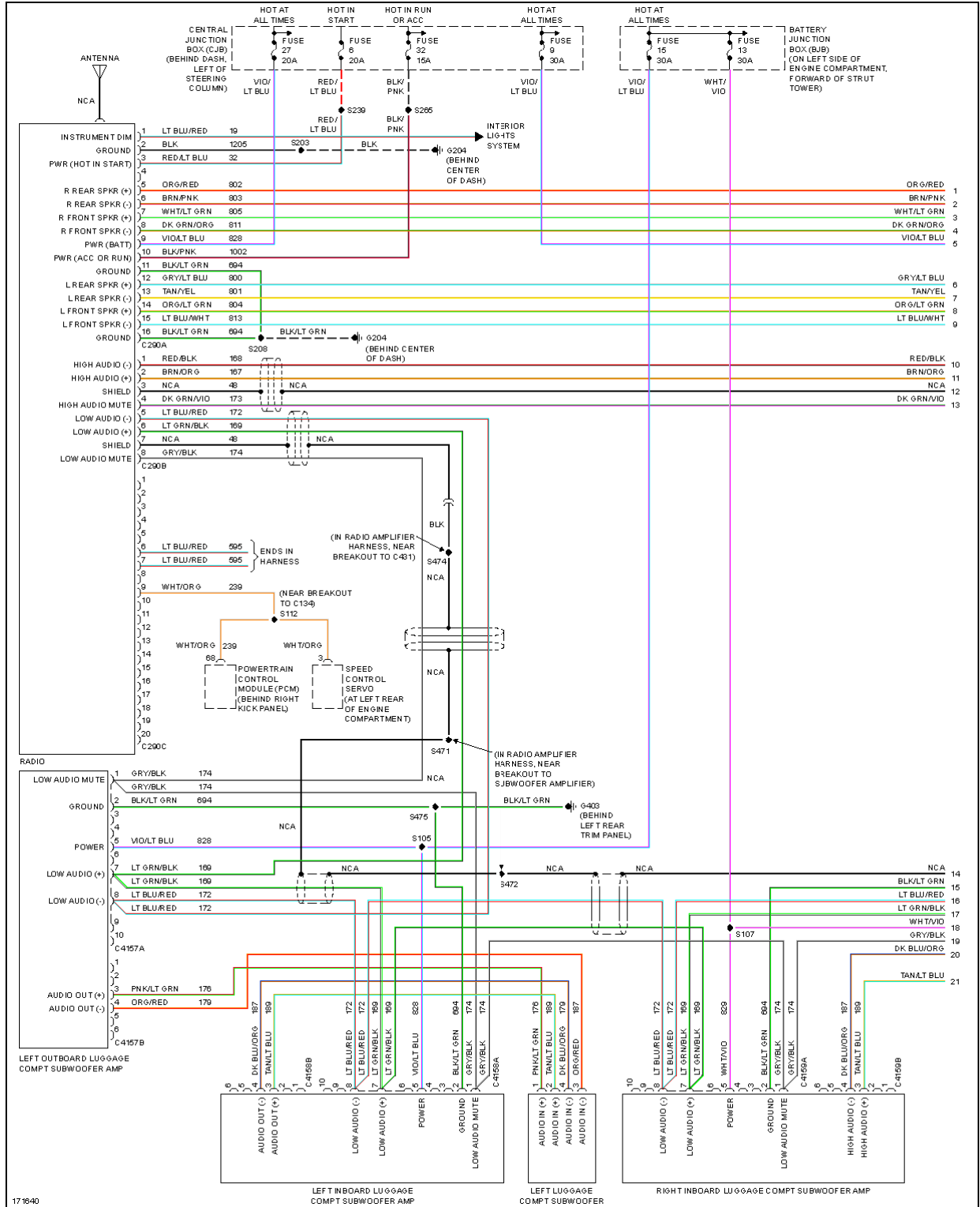


Fig. 43: Premium Sound Radio Circuit, Convertible W/ Mach 1000 Sound System (1 of 2)

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

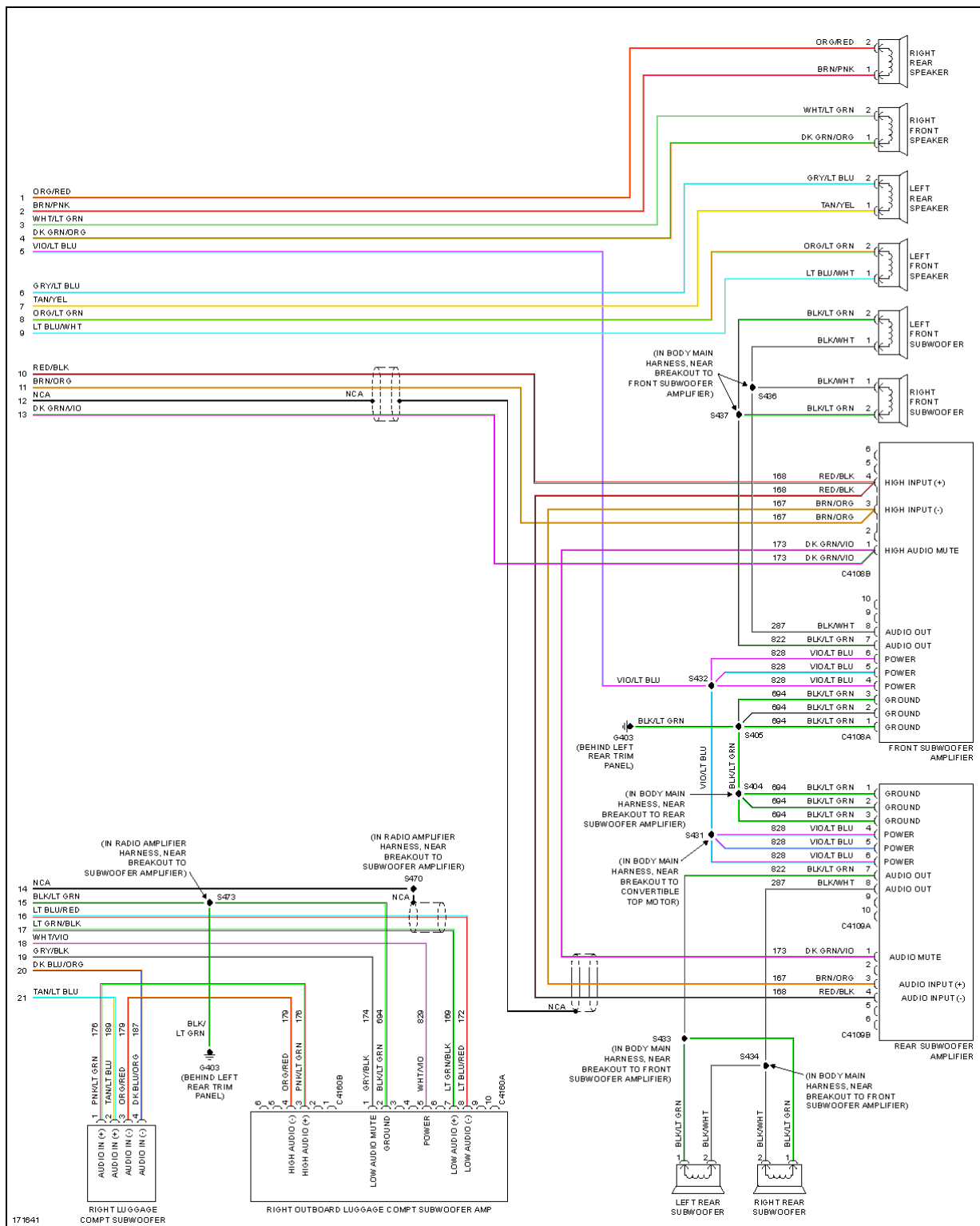


Fig. 44: Premium Sound Radio Circuit, Convertible W/ Mach 1000 Sound System (2 of 2)

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

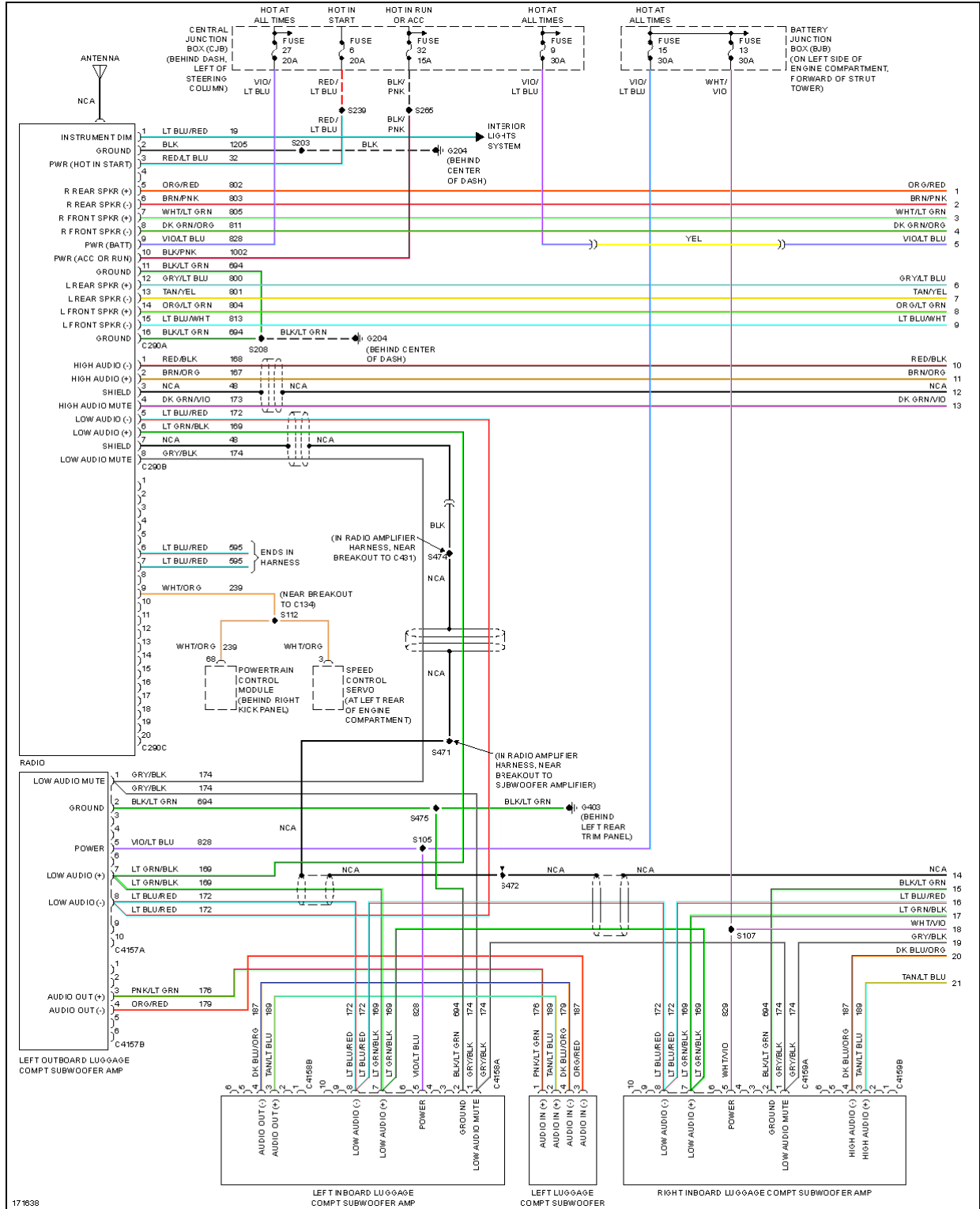


Fig. 45: Premium Sound Radio Circuit, Coupe W/ Mach 1000 Sound System (1 of 2)

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

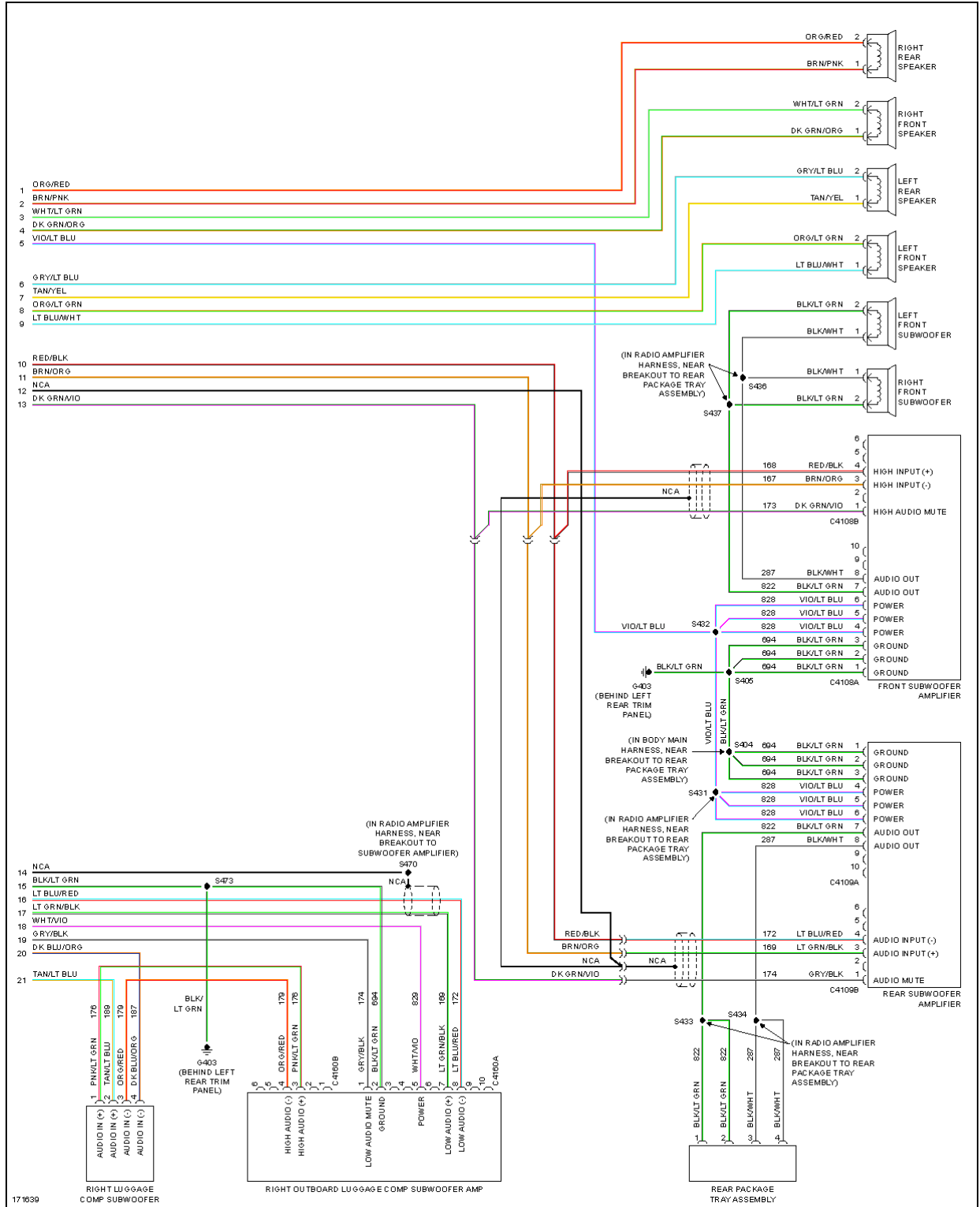


Fig. 46: Premium Sound Radio Circuit, Coupe W/ Mach 1000 Sound System (2 of 2)

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

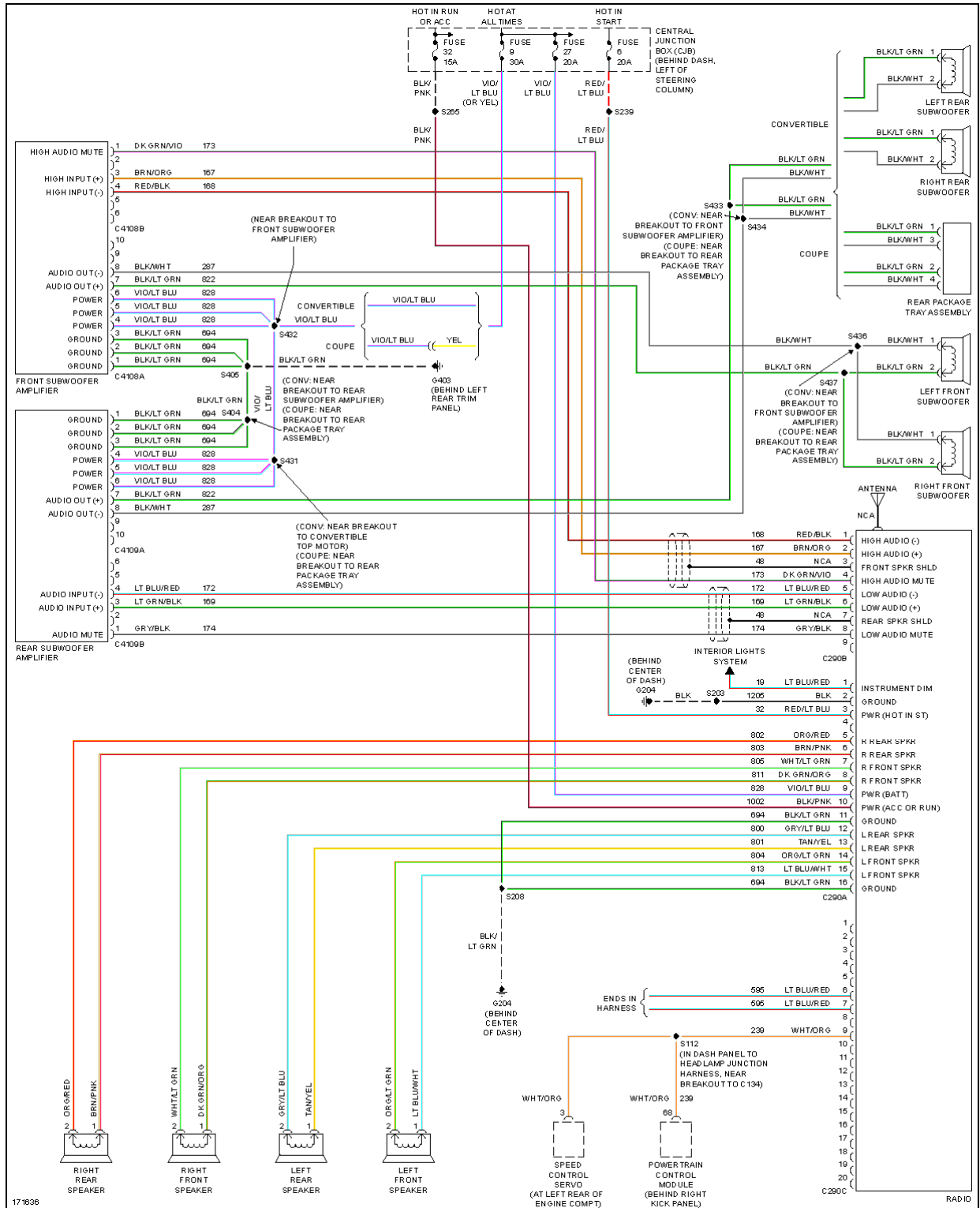


Fig. 47: Premium Sound Radio Circuit, W/ Mach 460 Sound System

SHIFT INTERLOCK

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

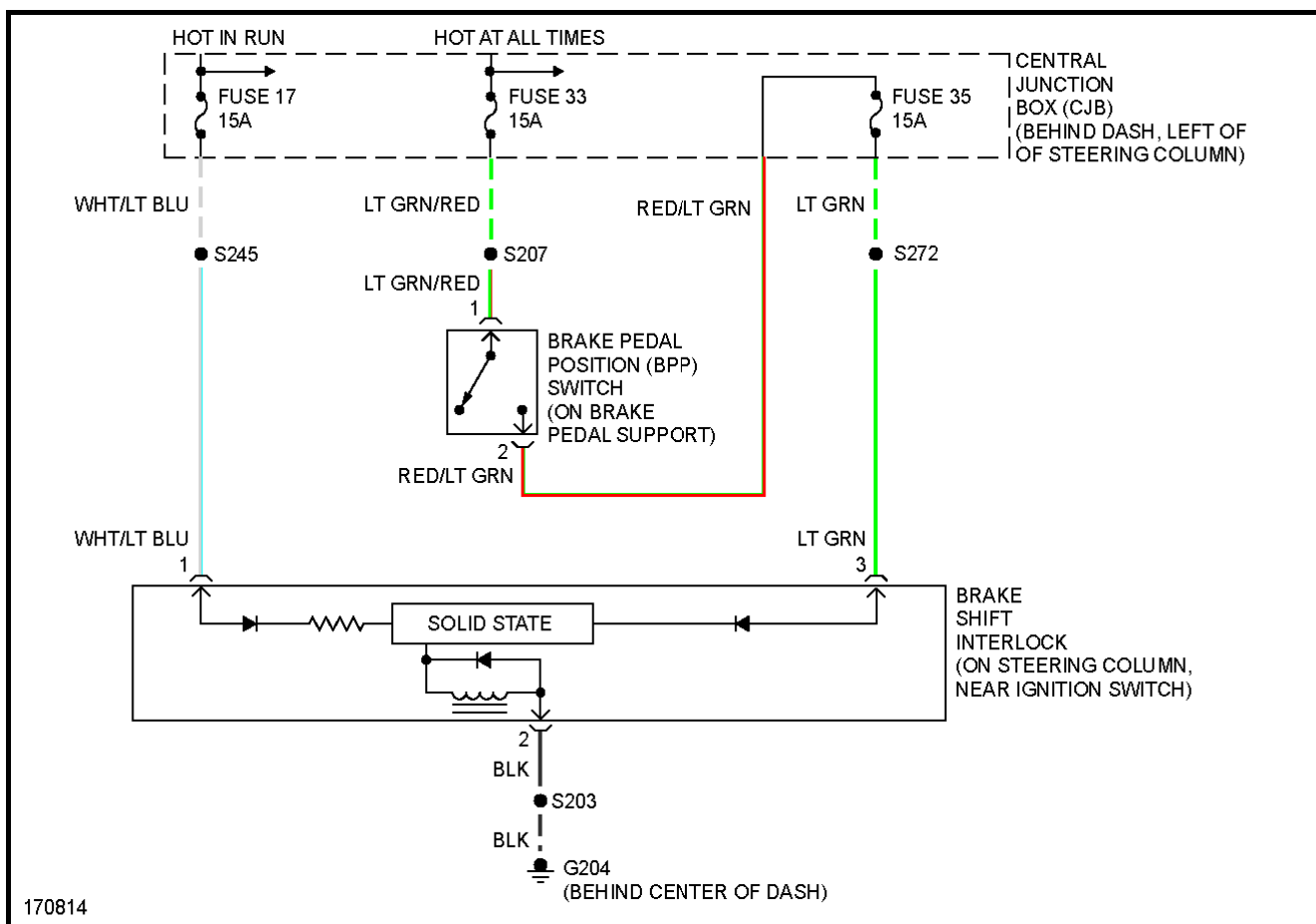


Fig. 48: Shift Interlock Circuit

STARTING/CHARGING

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

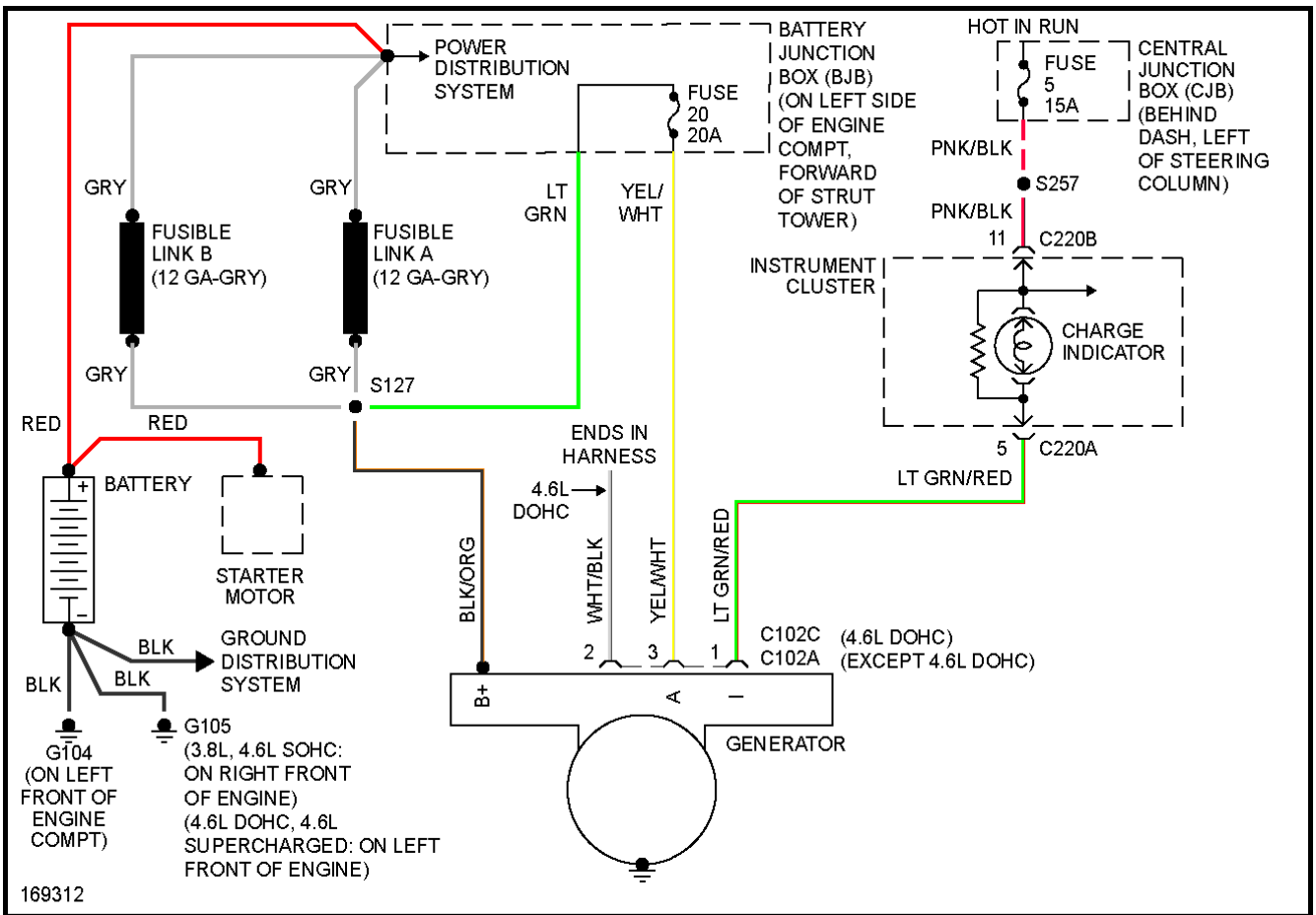


Fig. 49: Charging Circuit

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

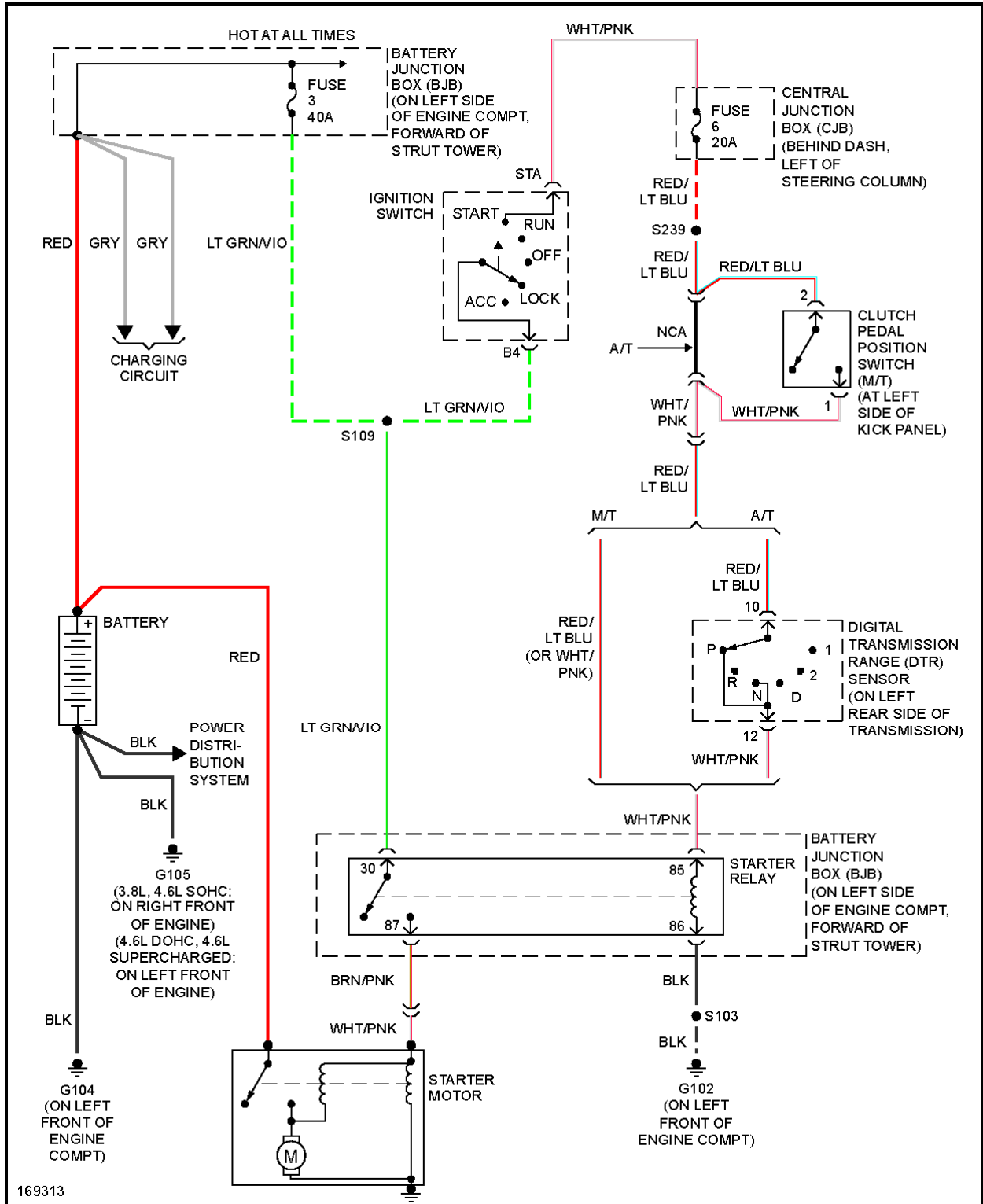


Fig. 50: Starting Circuit

SUPPLEMENTAL RESTRAINTS

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

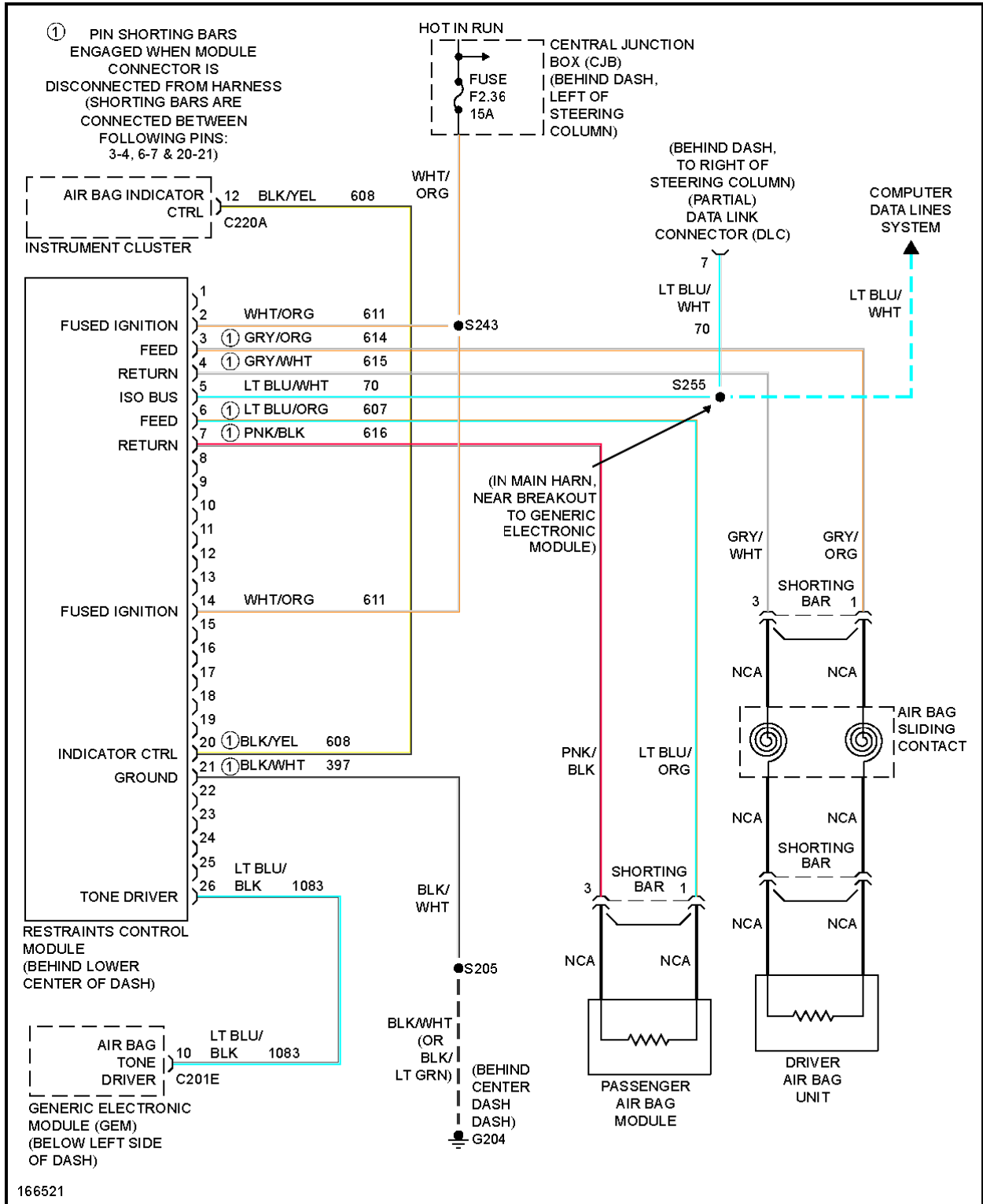


Fig. 51: Supplemental Restraints Circuit

TRANSMISSION

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

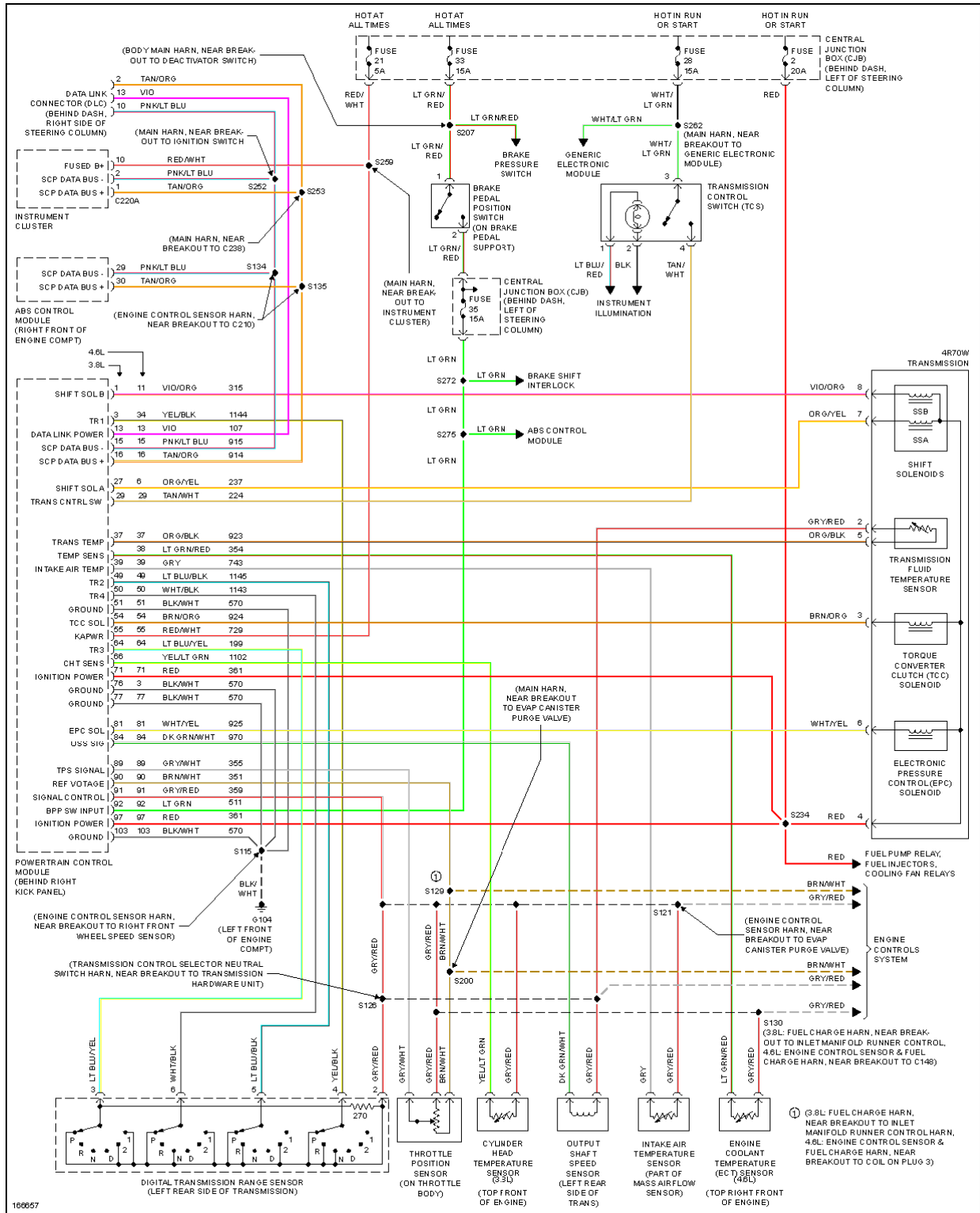


Fig. 52: A/T Circuit

TRUNK, TAILGATE, FUEL DOOR

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

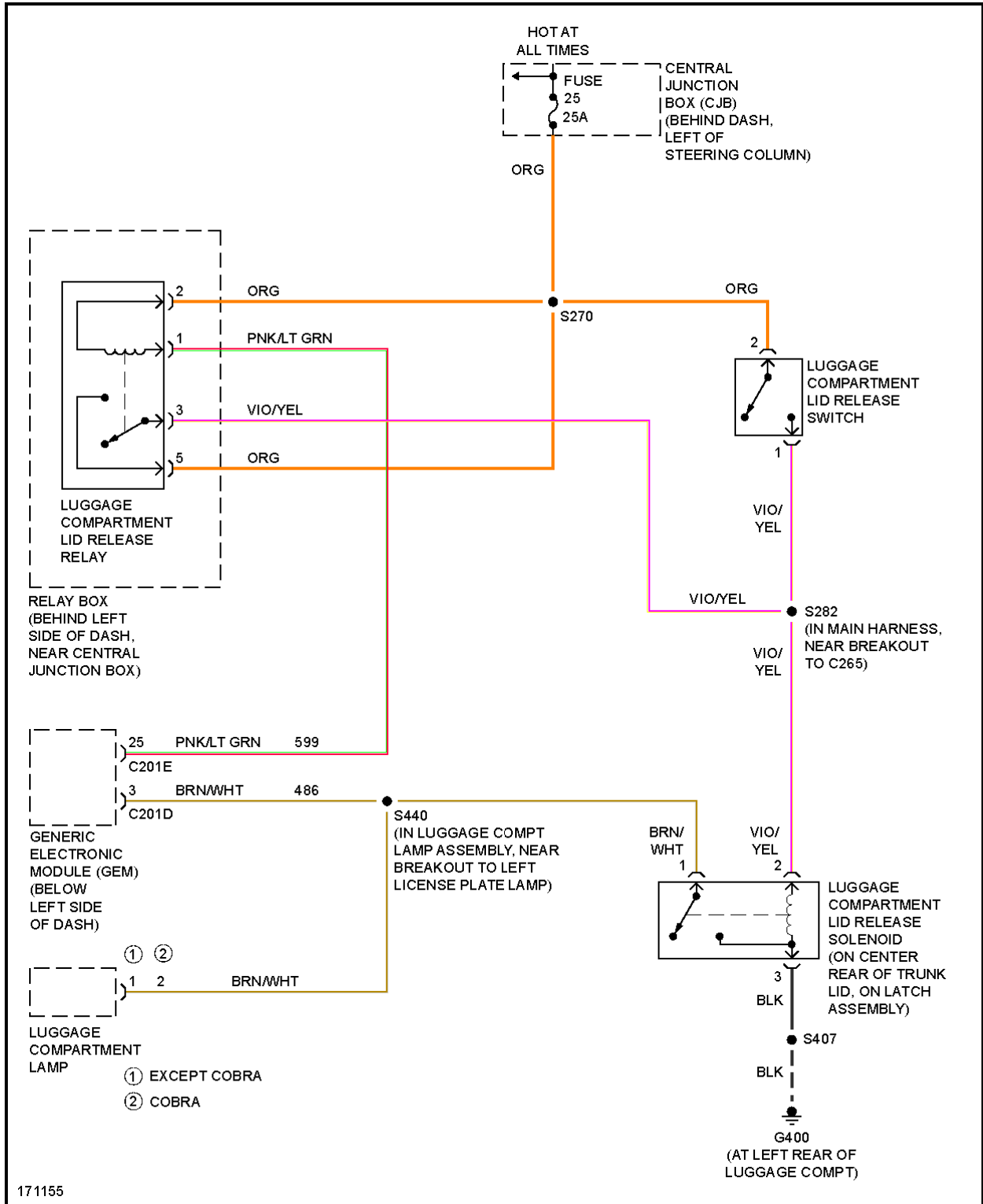


Fig. 53: Trunk, Tailgate, Fuel Door Circuit

WARNING SYSTEMS

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

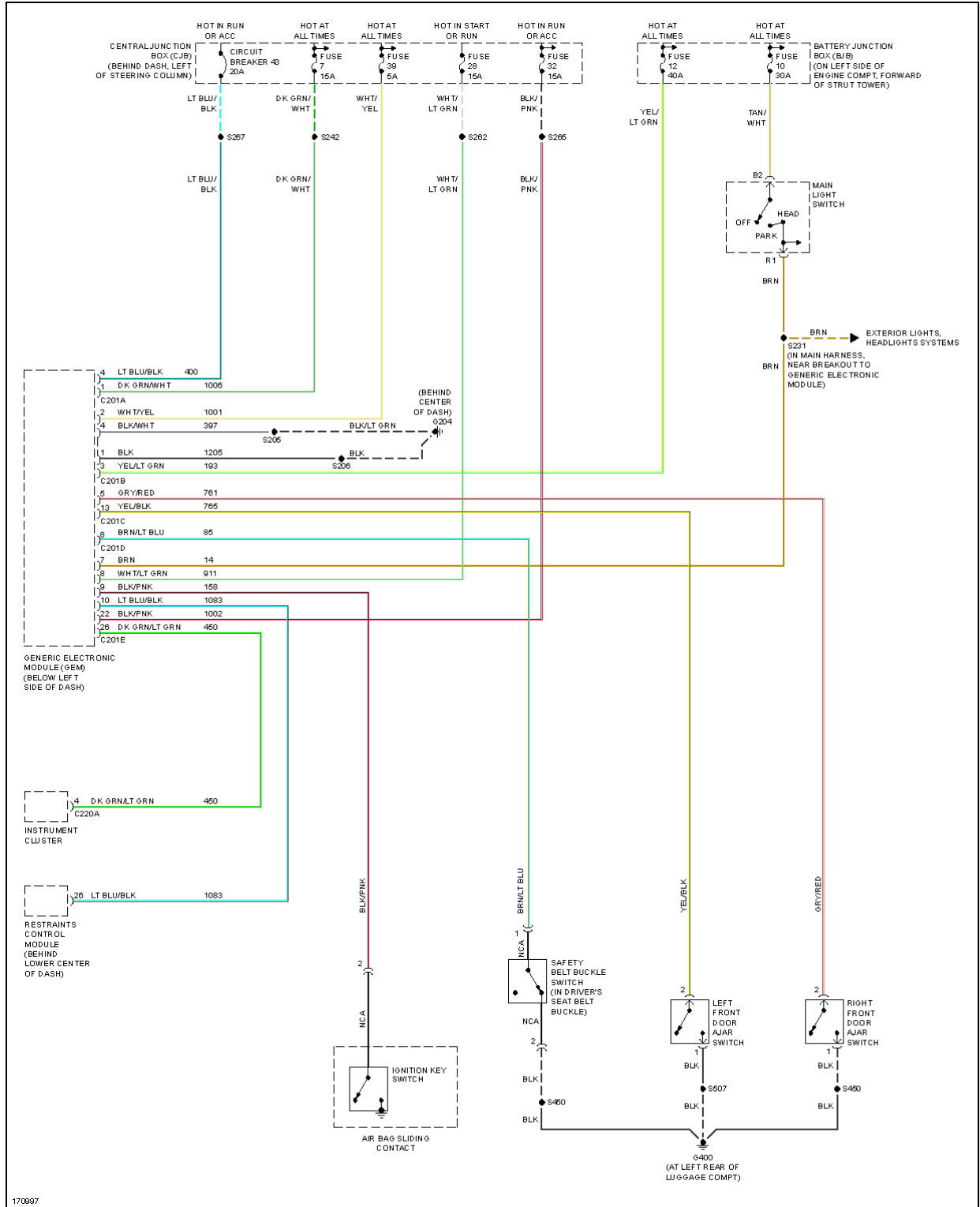


Fig. 54: Warning Systems Circuit

WIPER/WASHER

2003 Ford Mustang

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

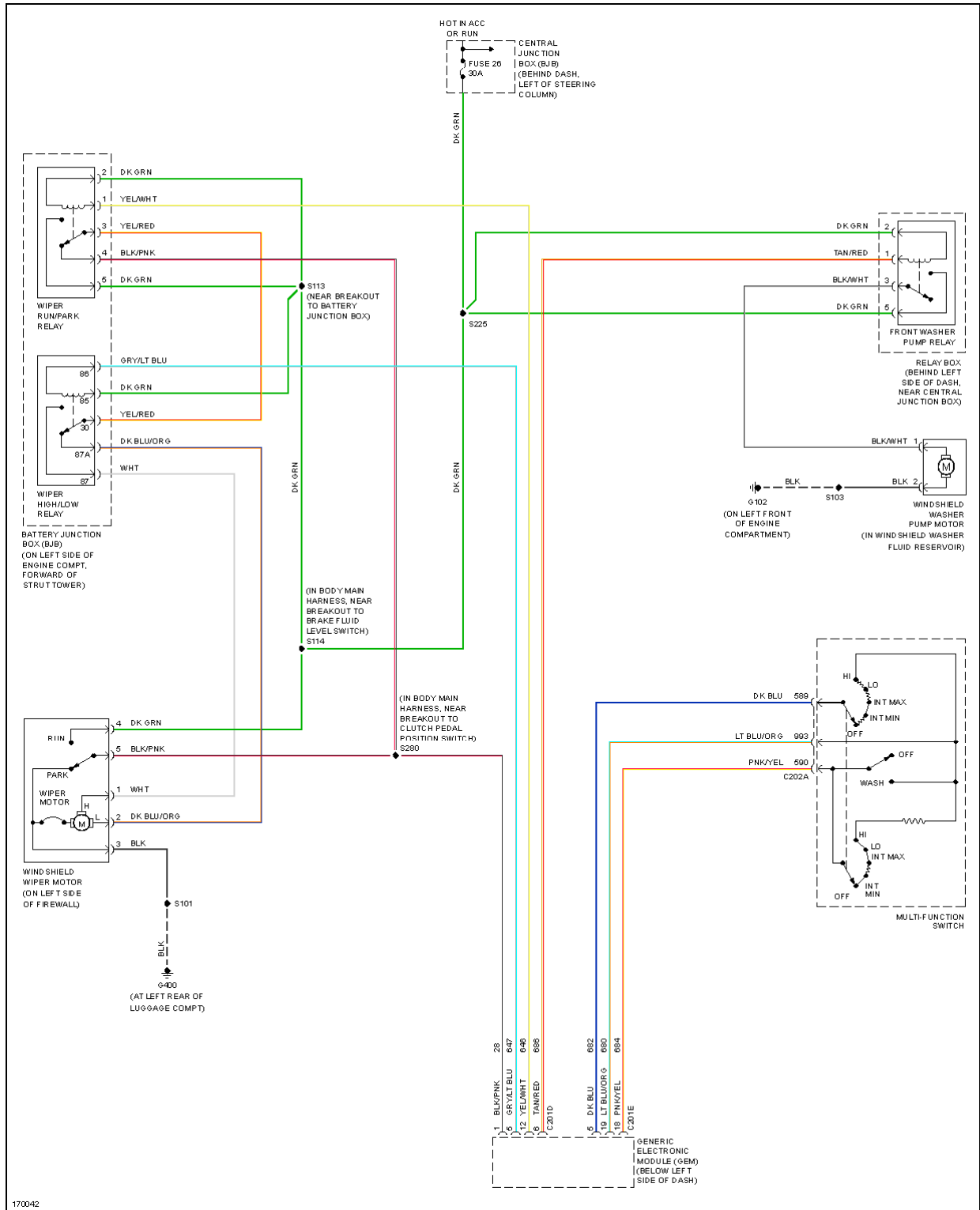


Fig. 55: Wiper/Washer Circuit

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

2003 SYSTEM WIRING DIAGRAMS

Ford - Mustang

USING WIRING DIAGRAMS

For information on using these wiring diagrams, see USING SYSTEM WIRING DIAGRAMS article.

AIR CONDITIONING

3.8L

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

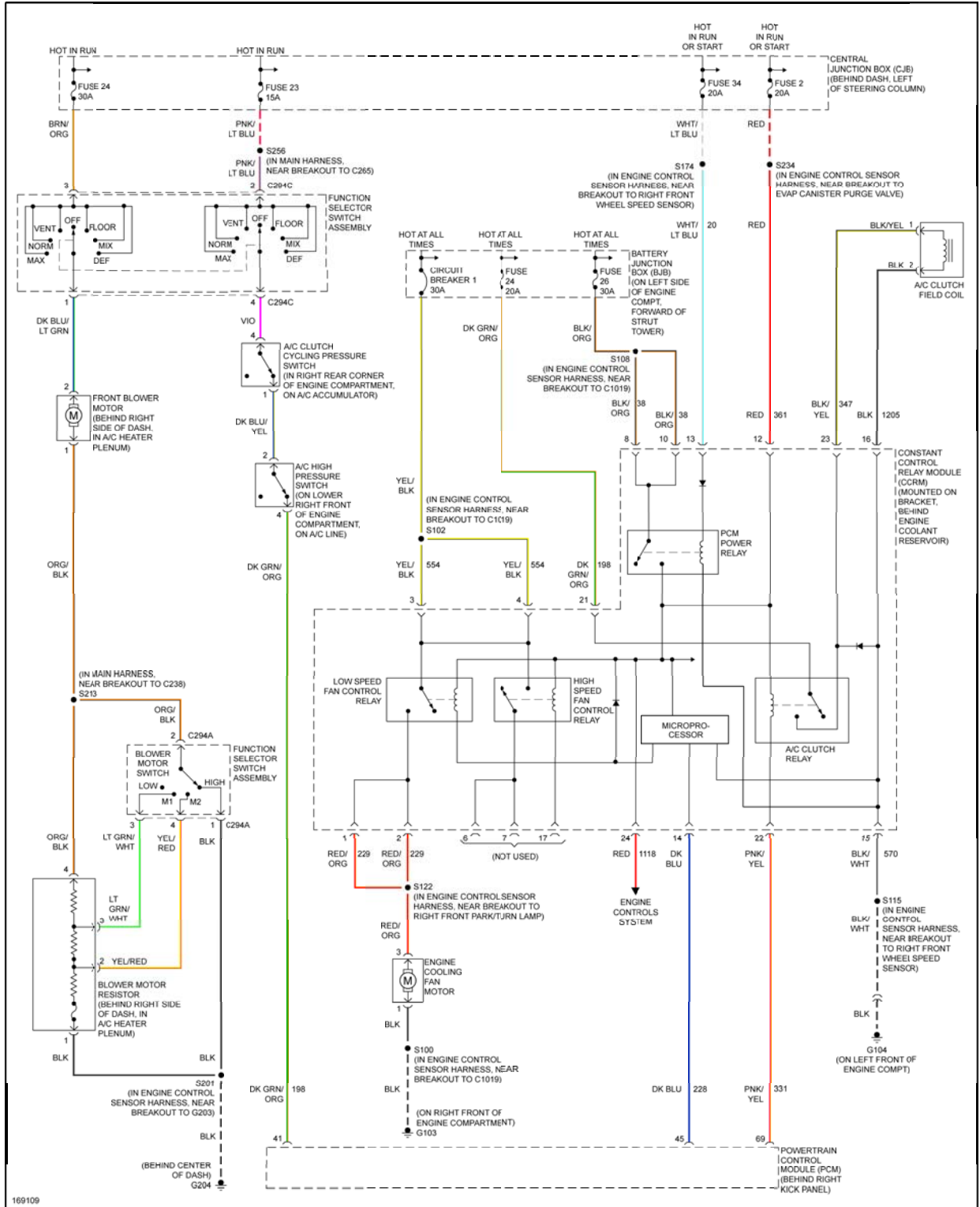


Fig. 1: 3.8L, Air Conditioning Circuit

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

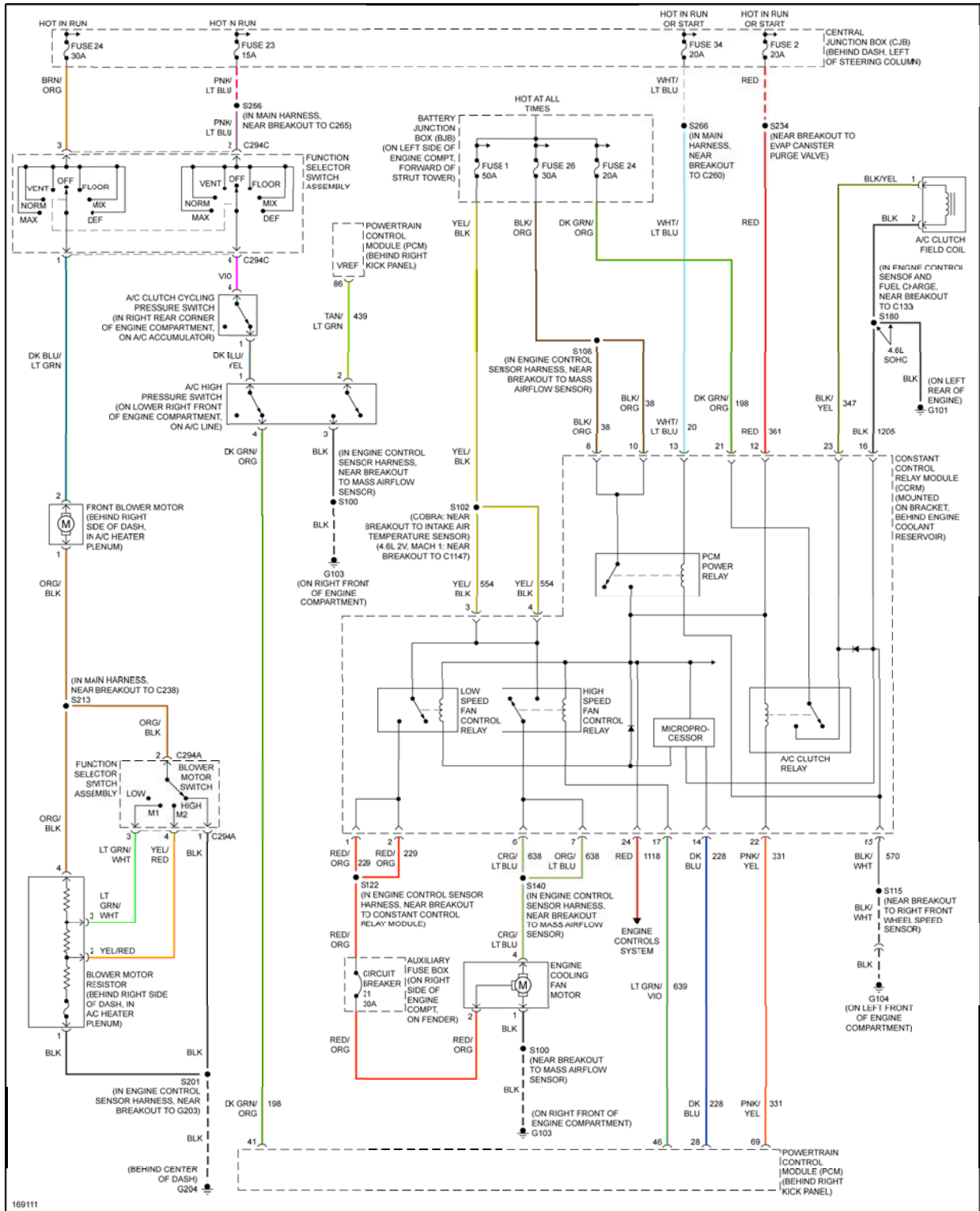


Fig. 2: 4.6L, Air Conditioning Circuit

ANTI-LOCK BRAKES

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

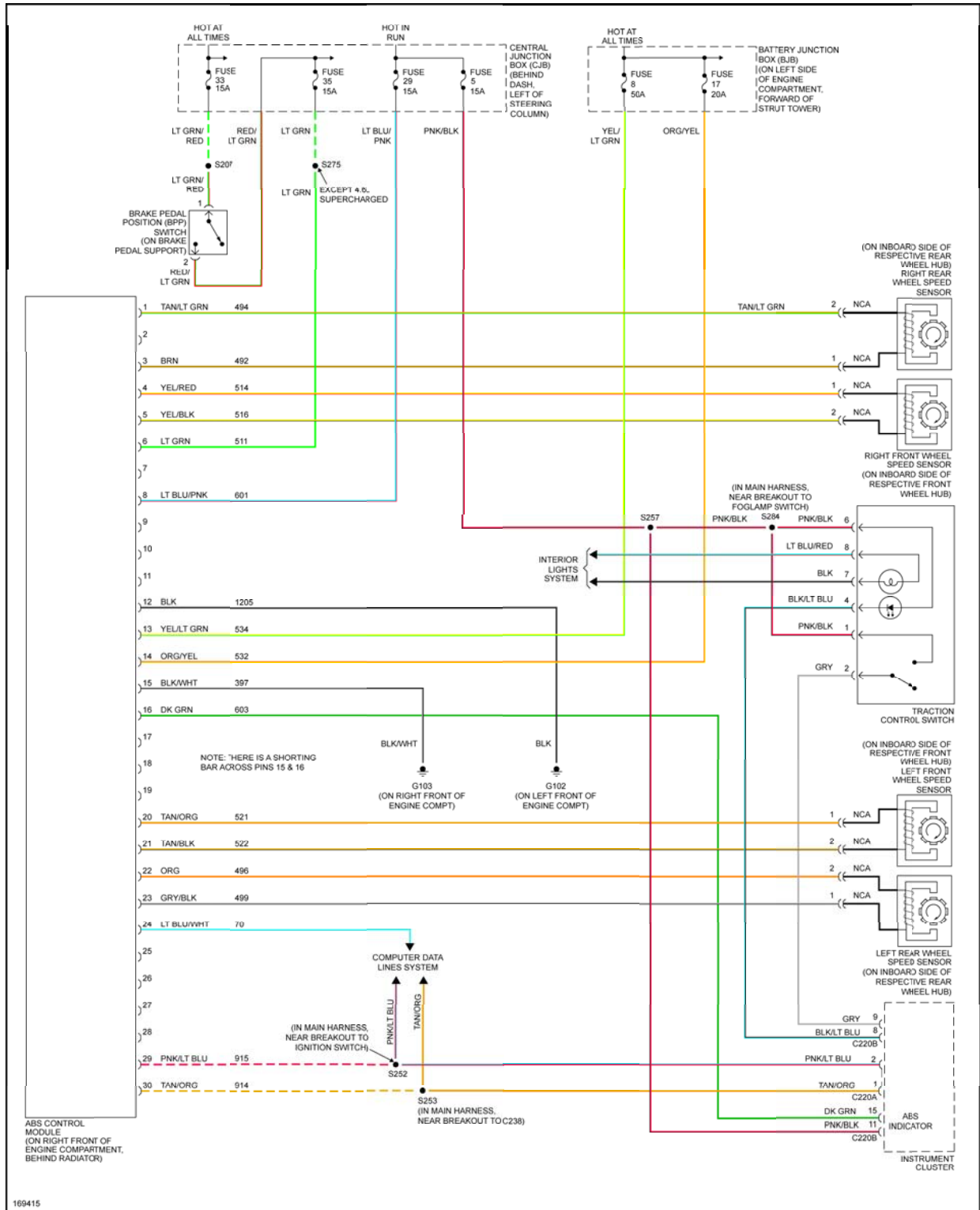


Fig. 3: Anti-lock Brakes Circuit

ANTI-THEFT

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

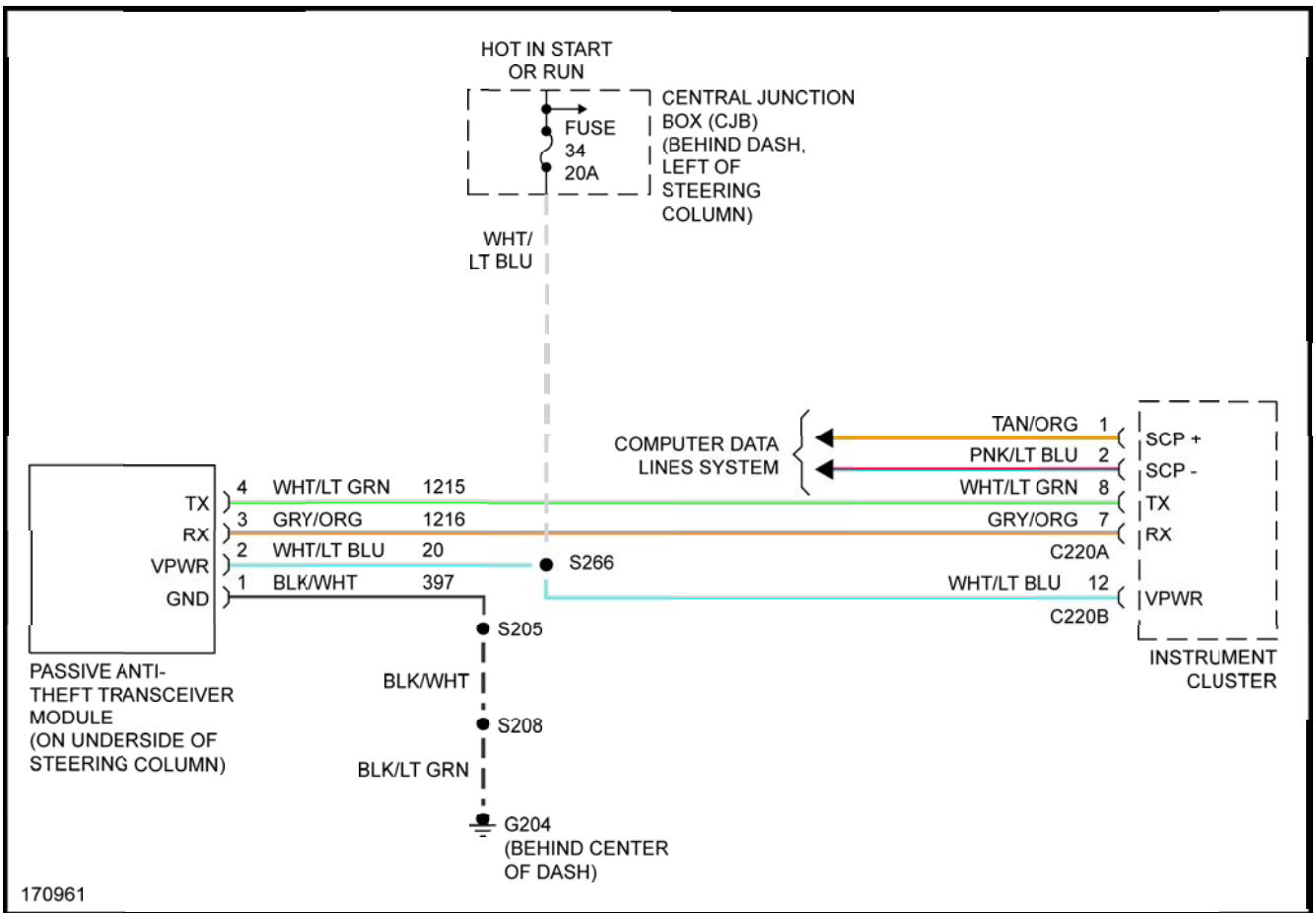


Fig. 4: Passive Anti-theft Circuit

BODY CONTROL MODULES

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

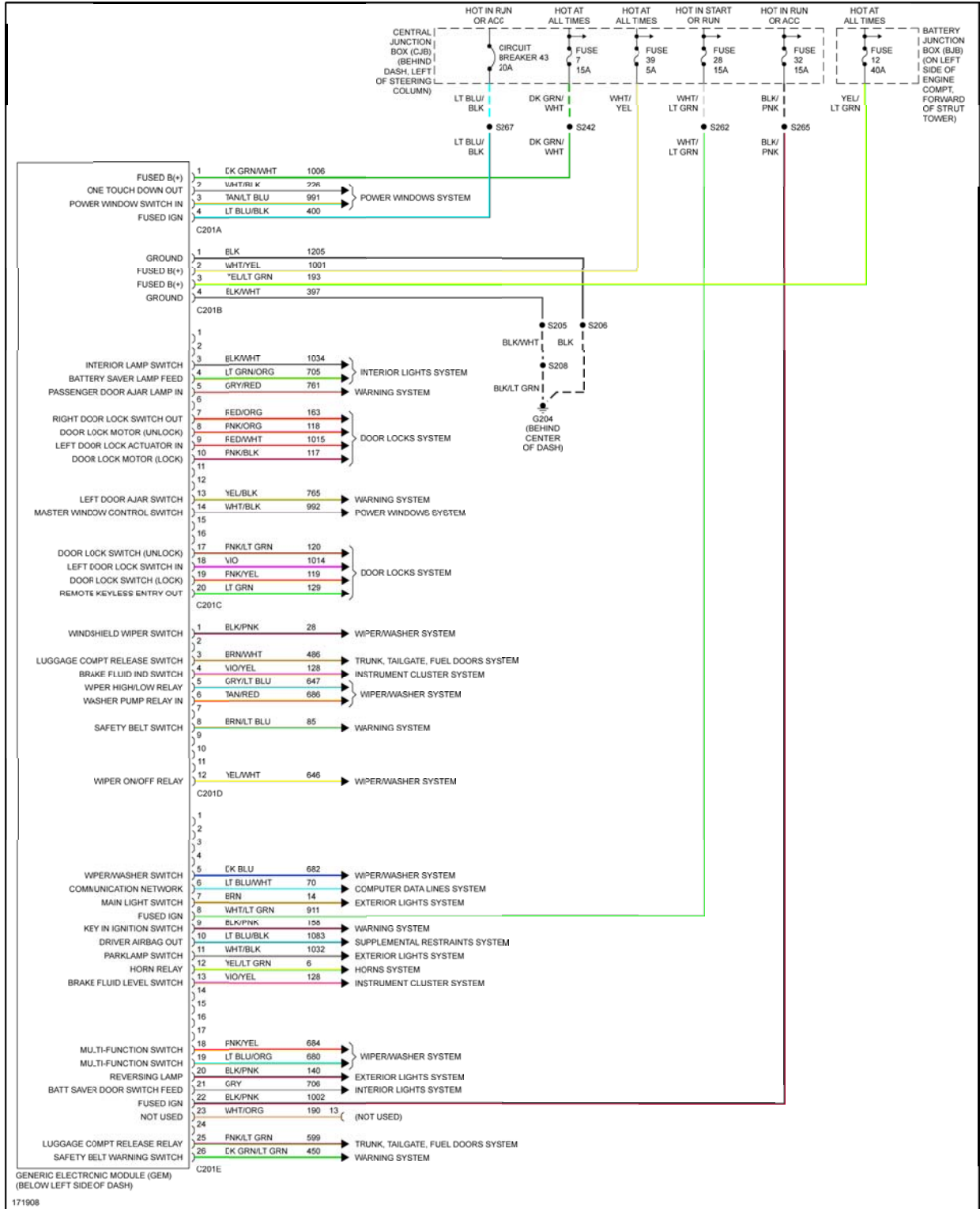


Fig. 5: Body Control Modules Circuit

COMPUTER DATA LINES

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

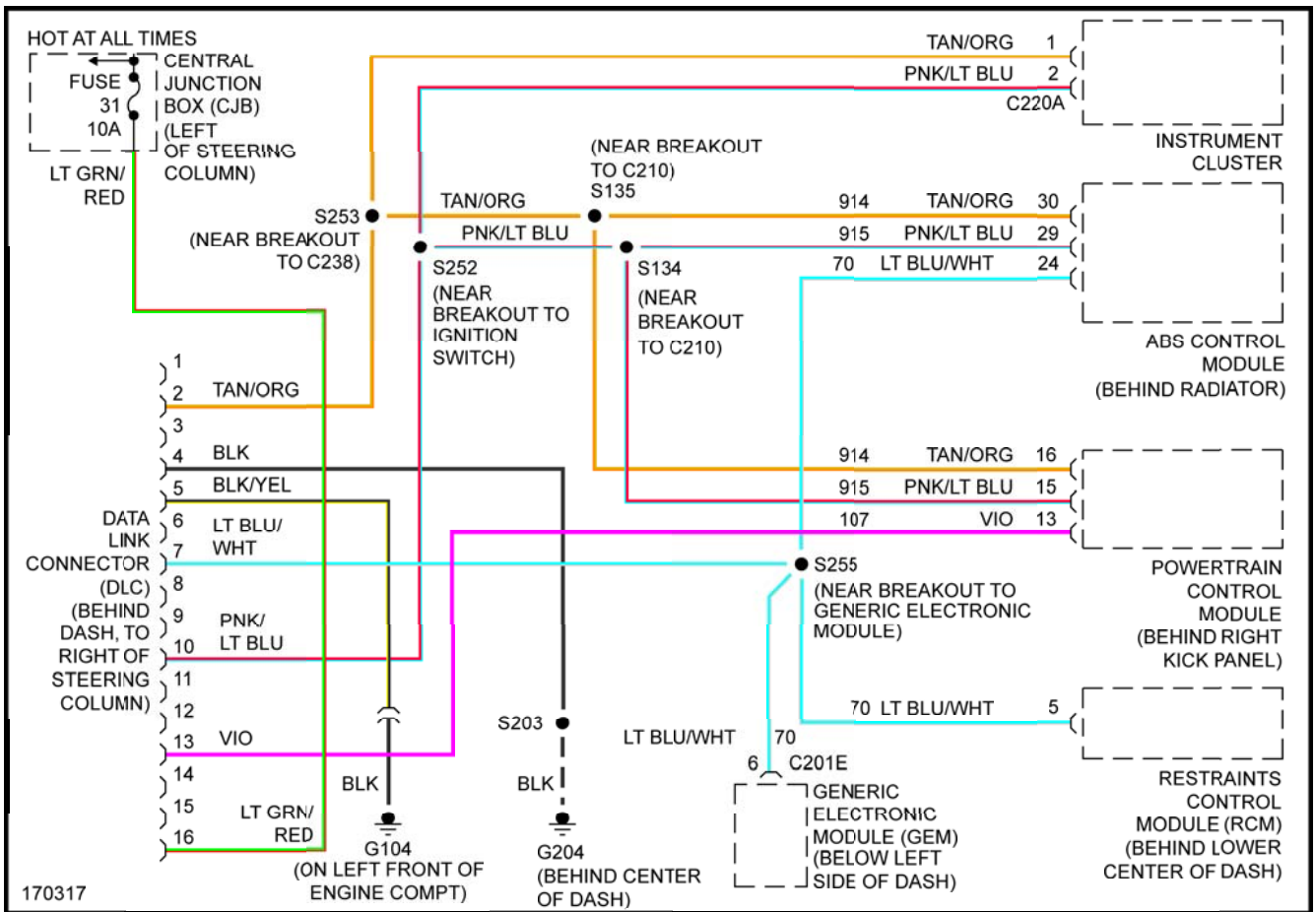


Fig. 6: Computer Data Lines Circuit

COOLING FAN

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

3.8L

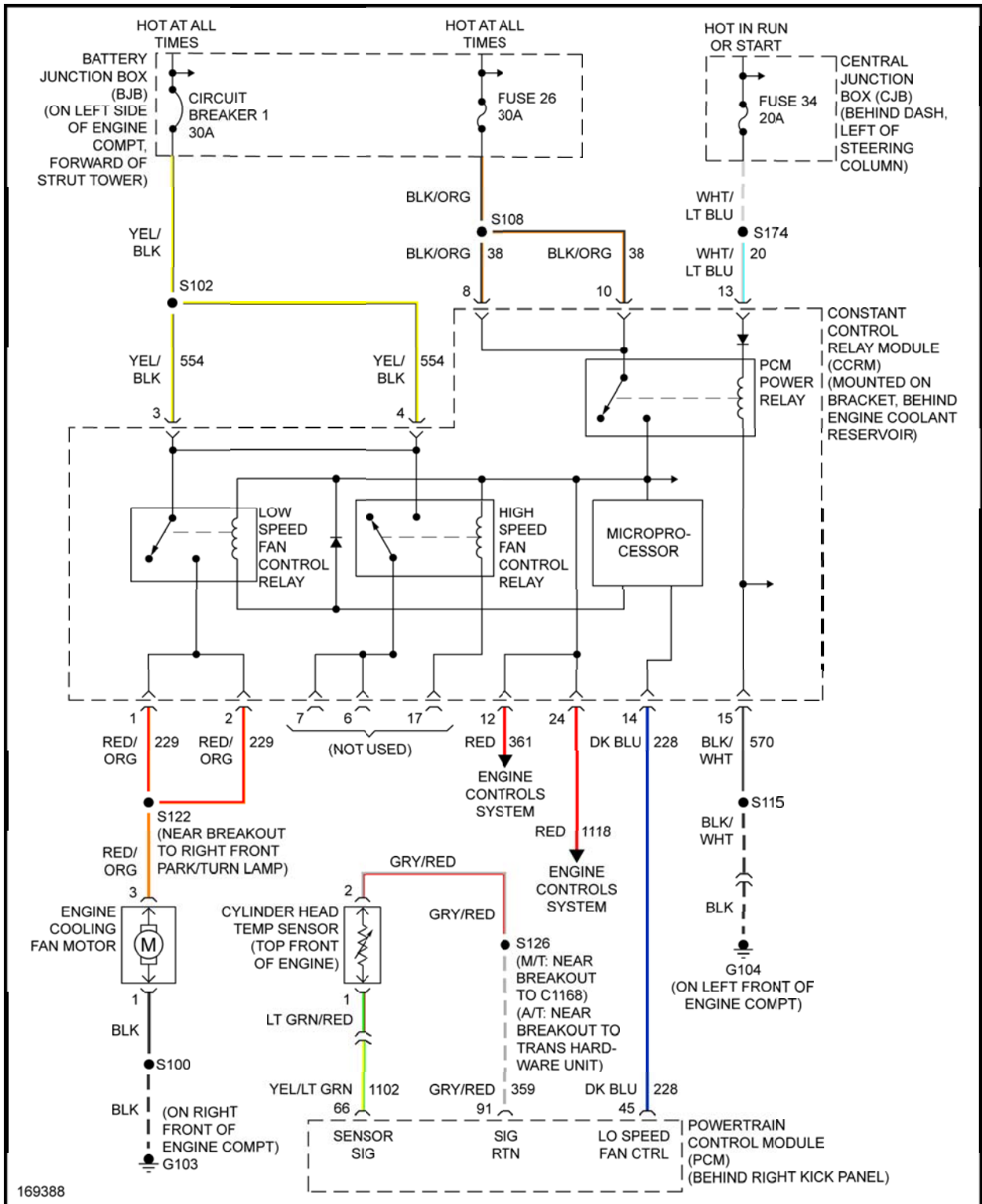


Fig. 7: 3.8L, Cooling Fan Circuit

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

4.6L

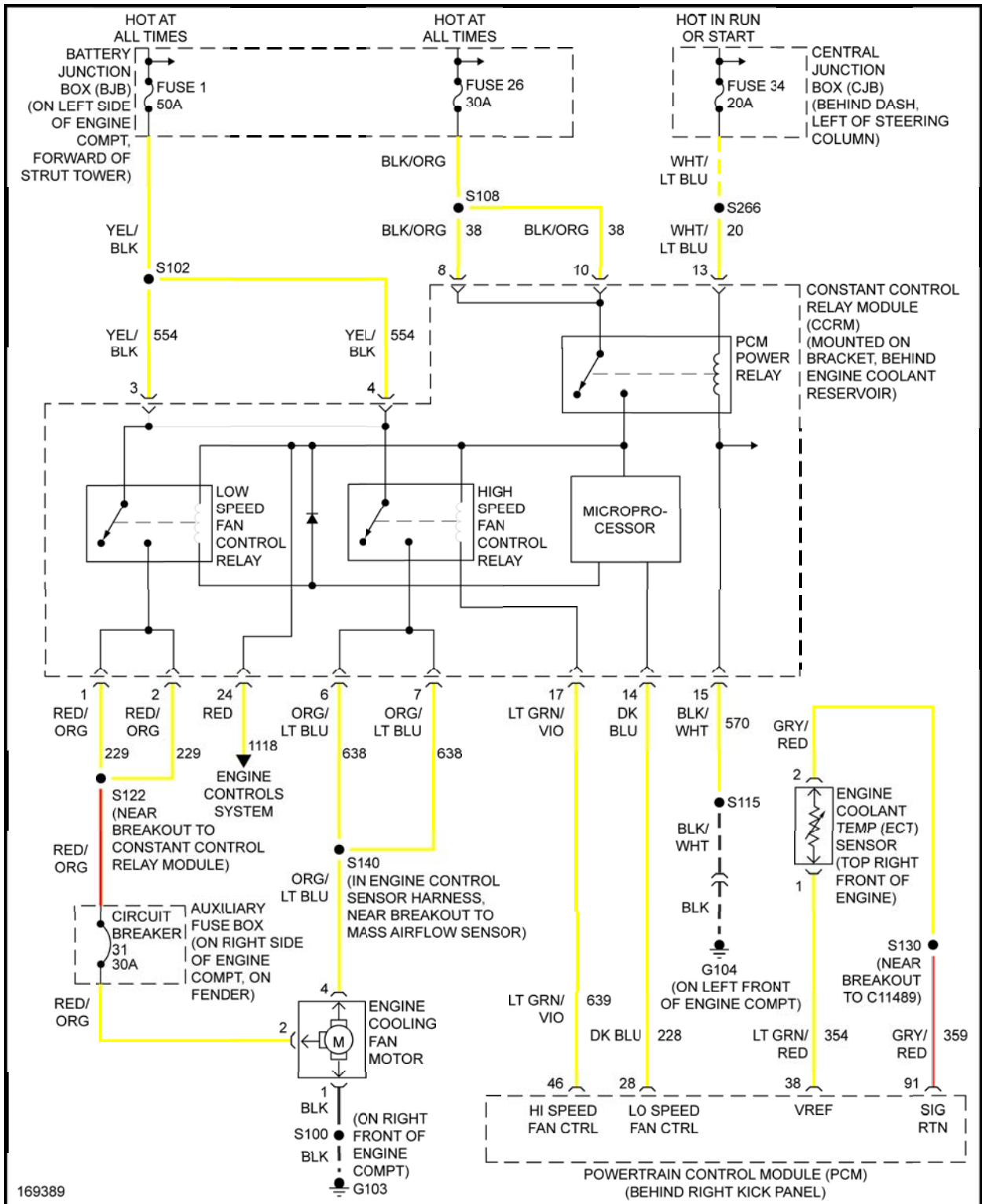
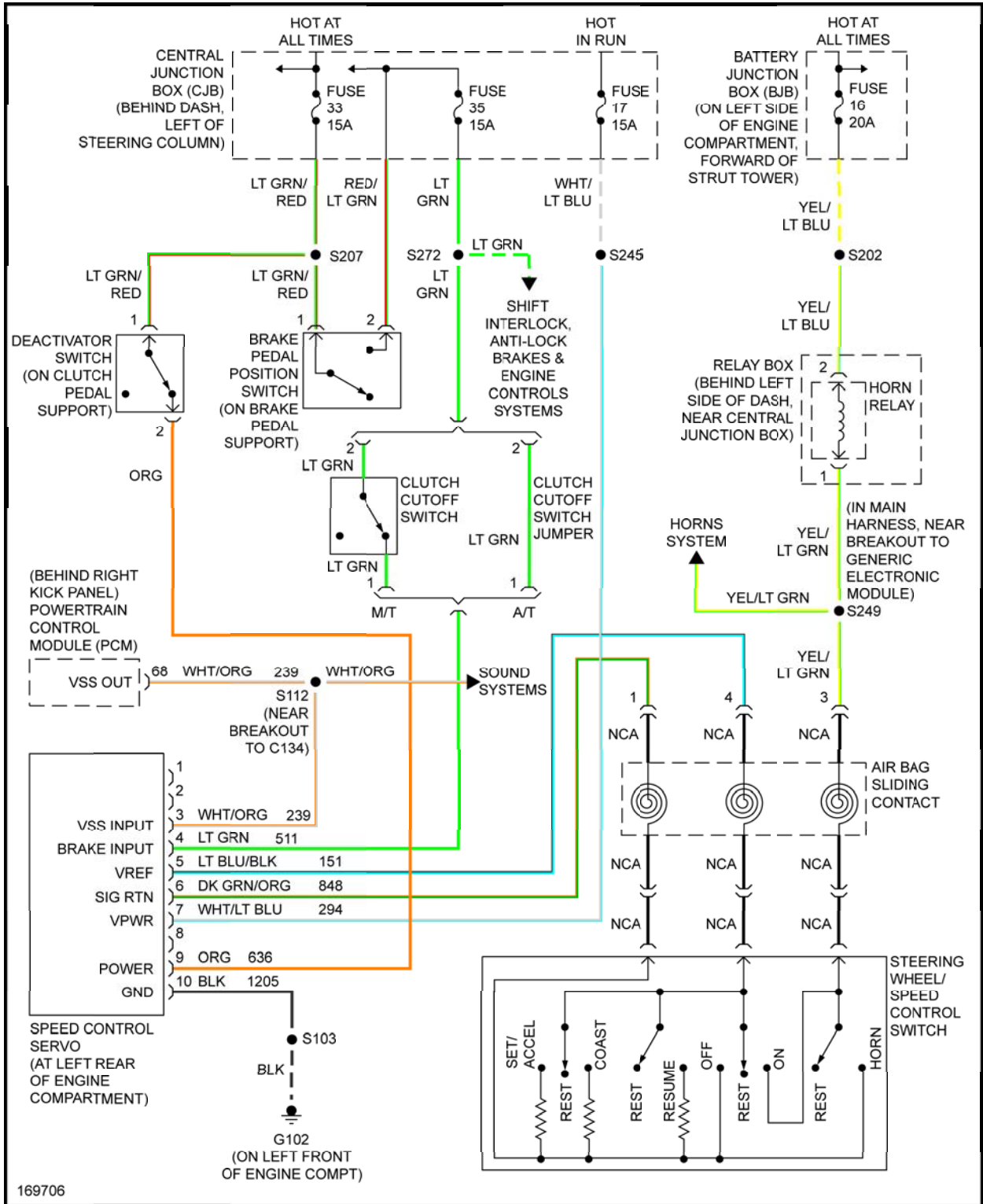


Fig. 8: 4.6L, Cooling Fan Circuit

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

CRUISE CONTROL



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Fig. 9: Cruise Control Circuit

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

DEFOGGERS

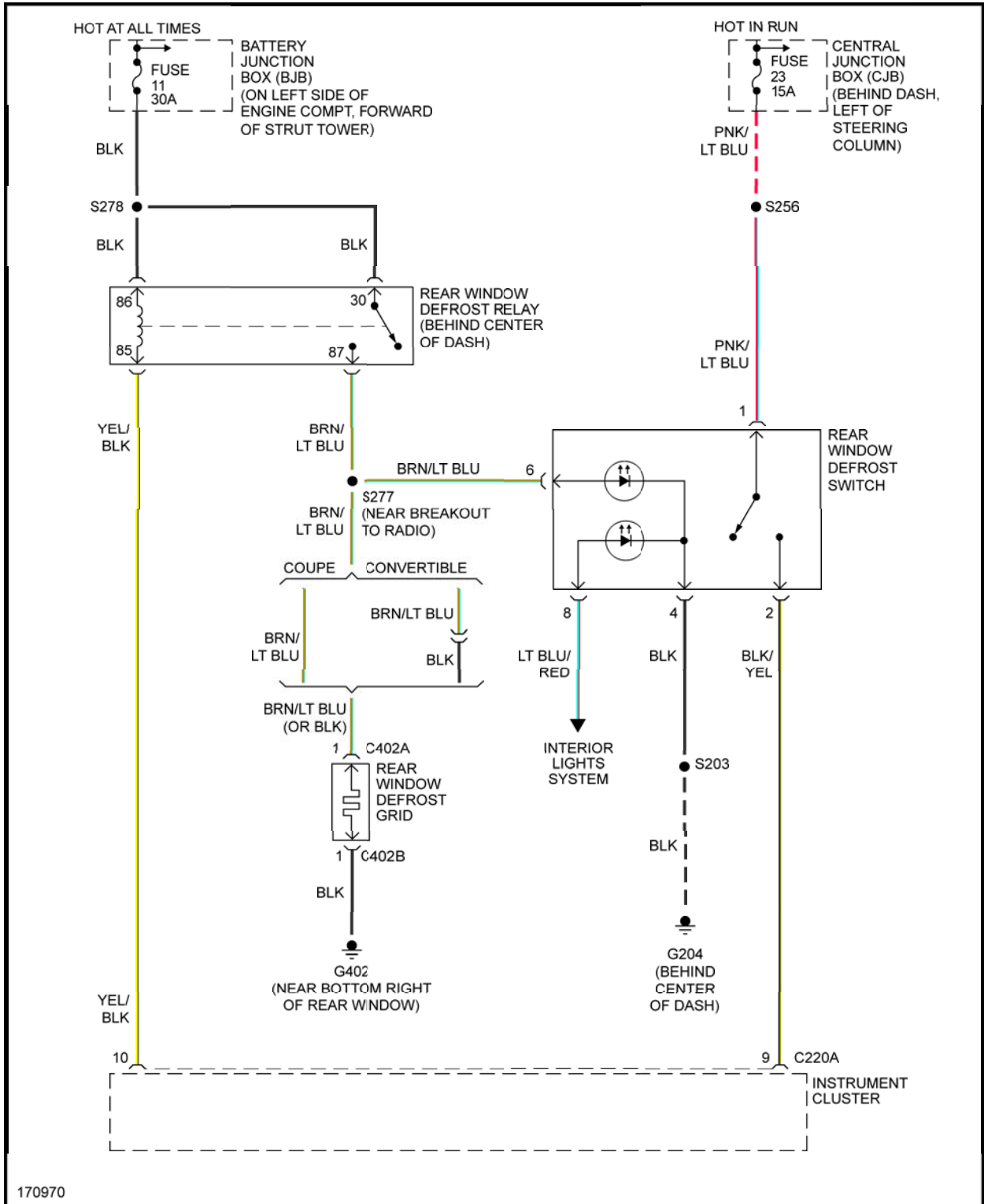


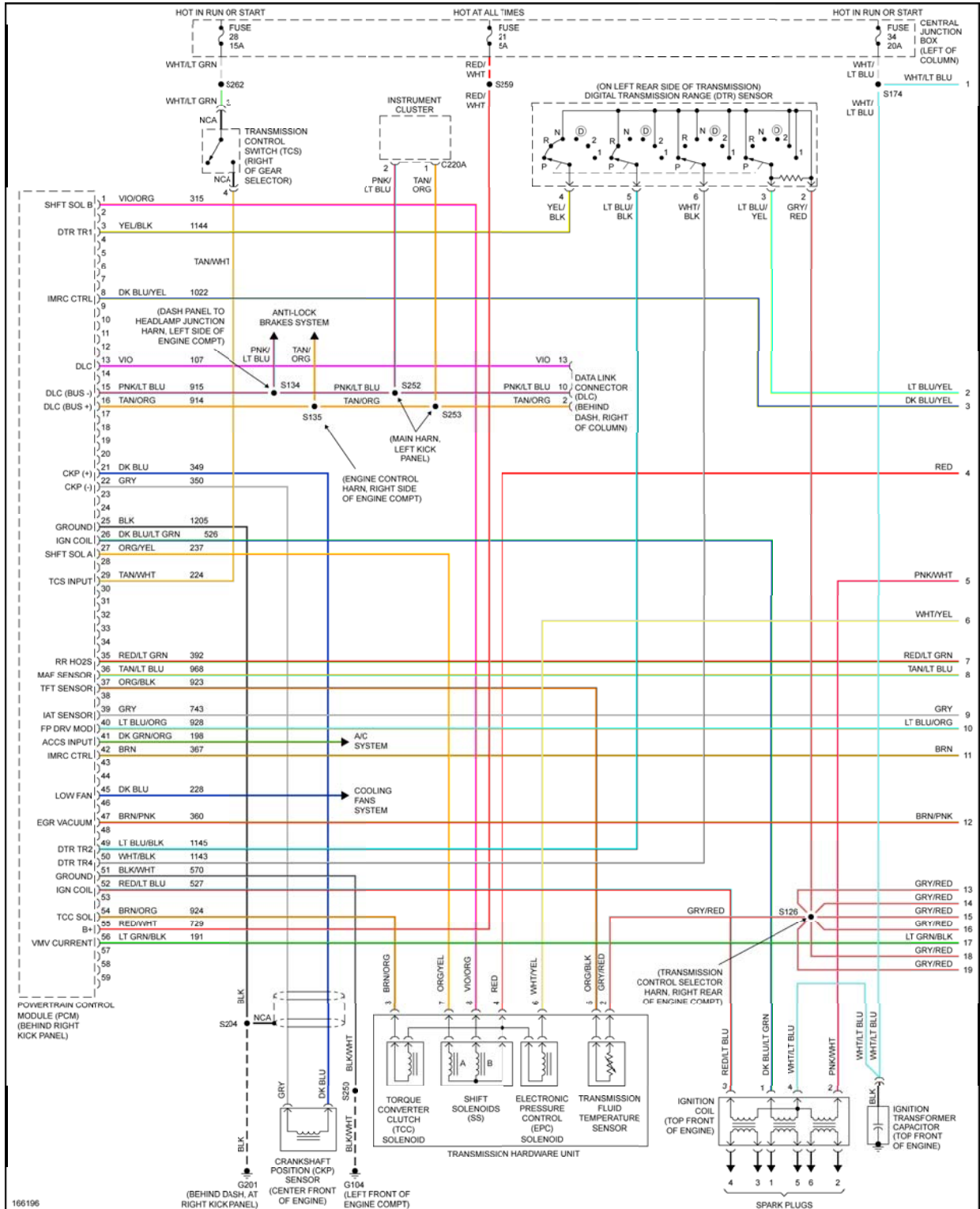
Fig. 10: Defoggers Circuit

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

ENGINE PERFORMANCE

3.8L



2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

Fig. 11: 3.8L, Engine Performance Circuit (1 of 3)

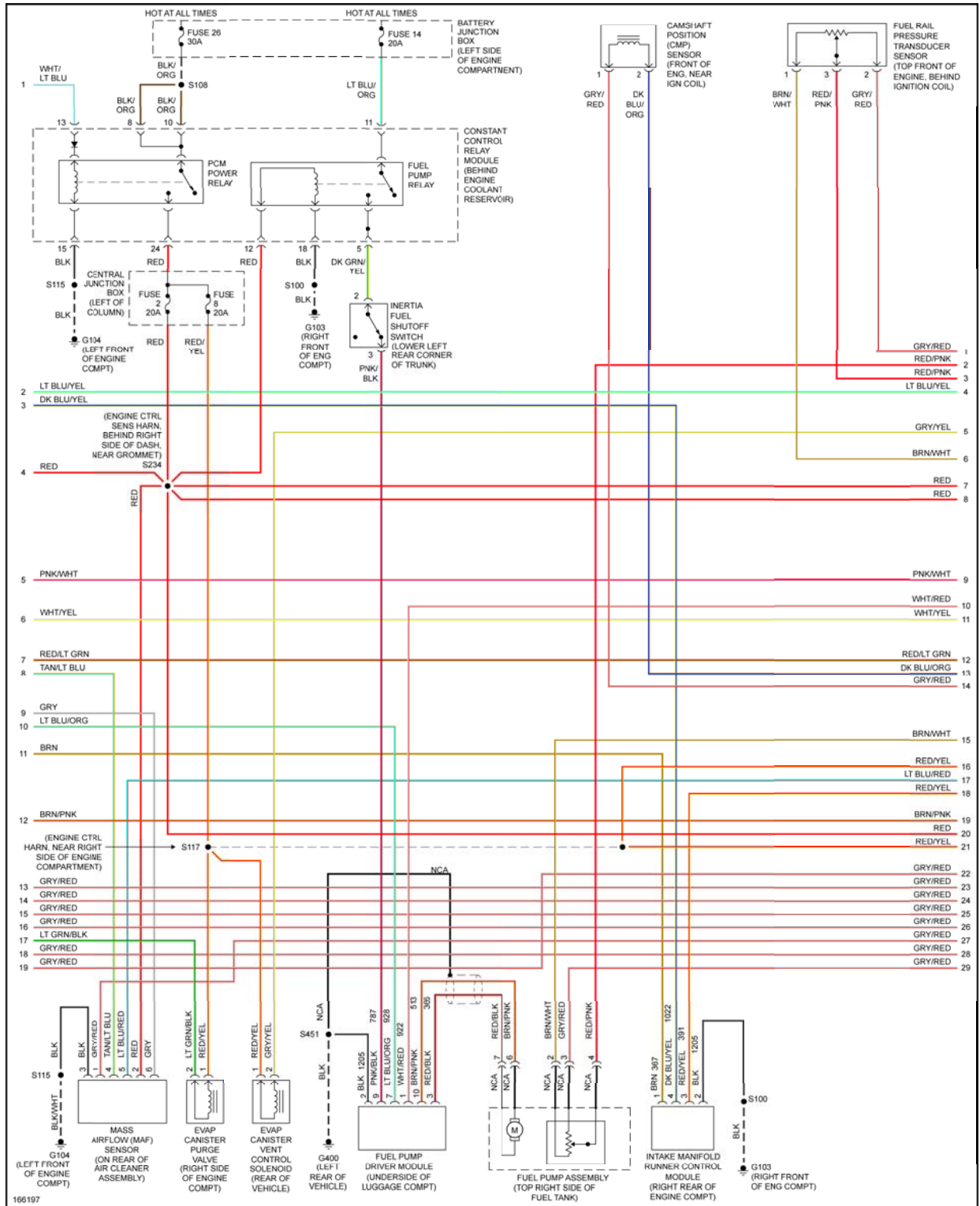


Fig. 12: 3.8L, Engine Performance Circuit (2 of 3)

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

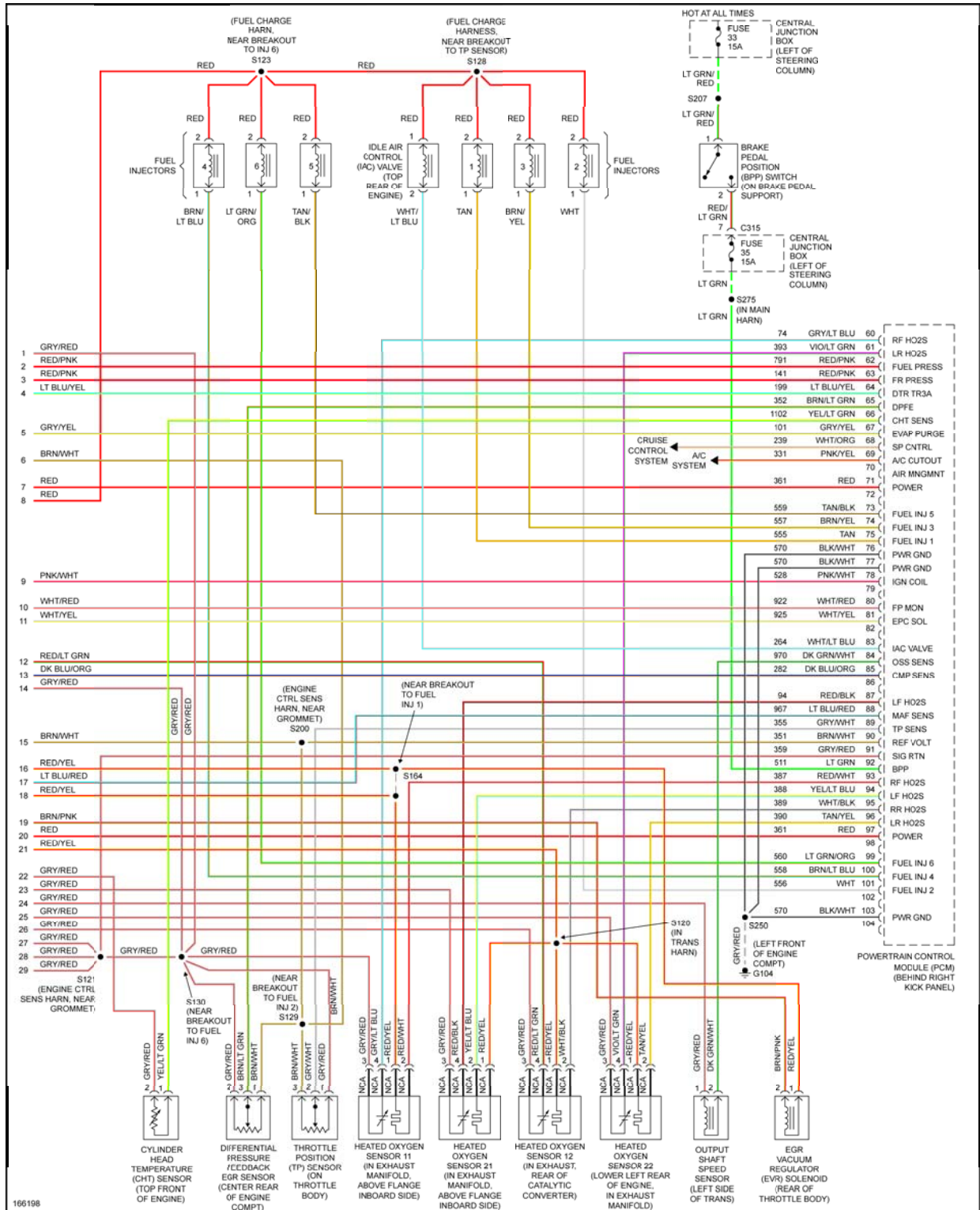


Fig. 13: 3.8L, Engine Performance Circuit (3 of 3)

4.6L DOHC

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

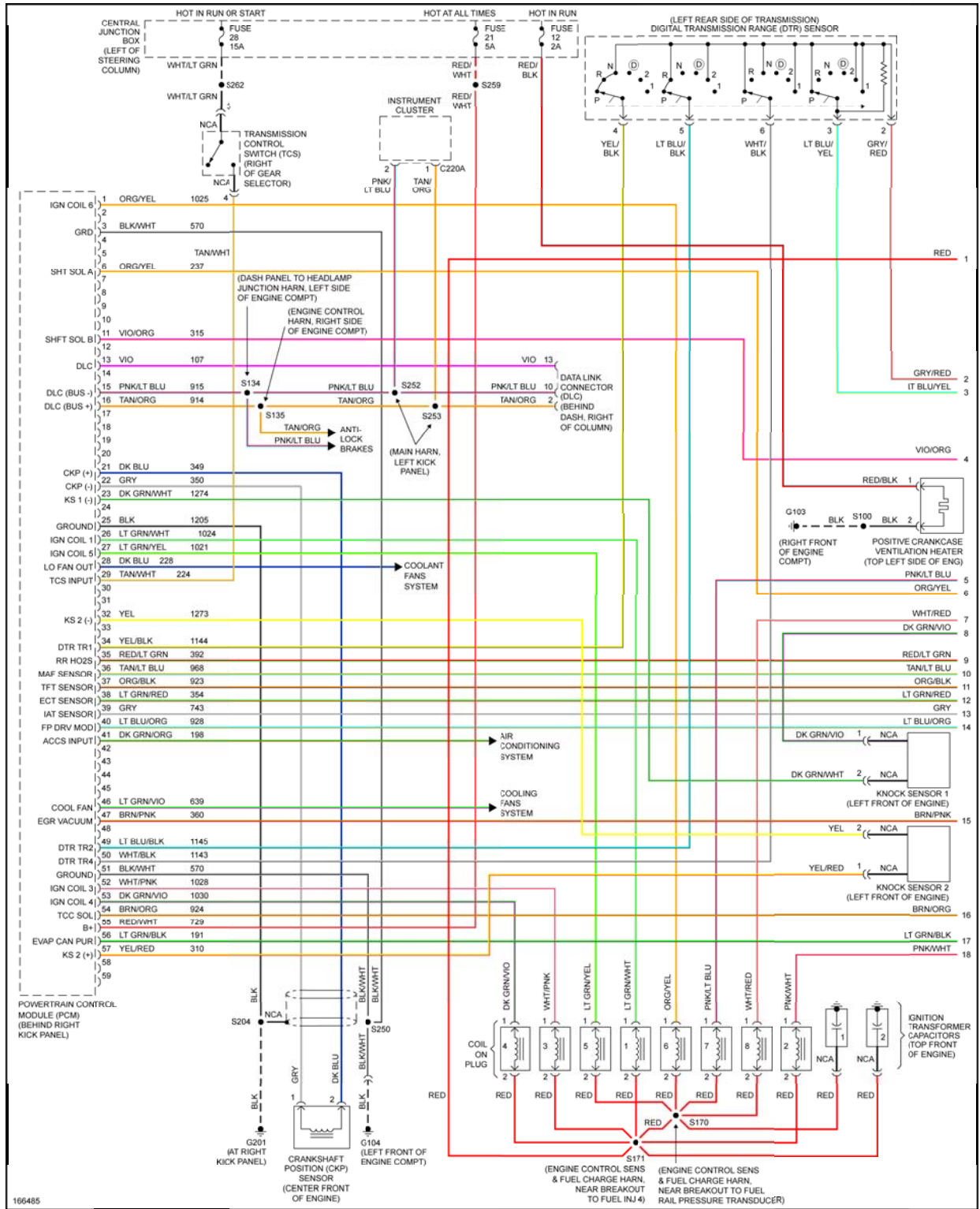


Fig. 14: 4.6L DOHC, Engine Performance Circuit (1 of 3)

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

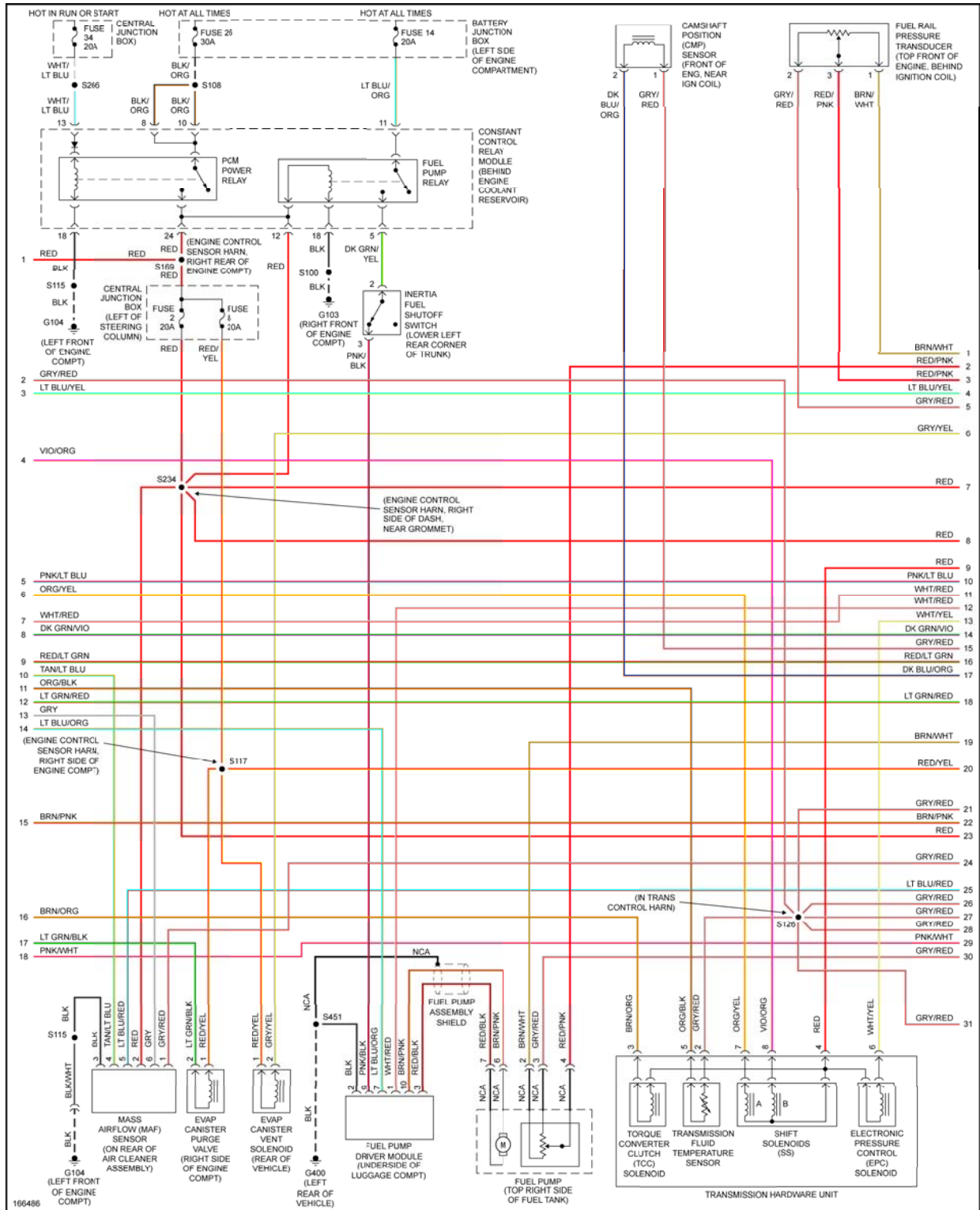


Fig. 15: 4.6L DOHC, Engine Performance Circuit (2 of 3)

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

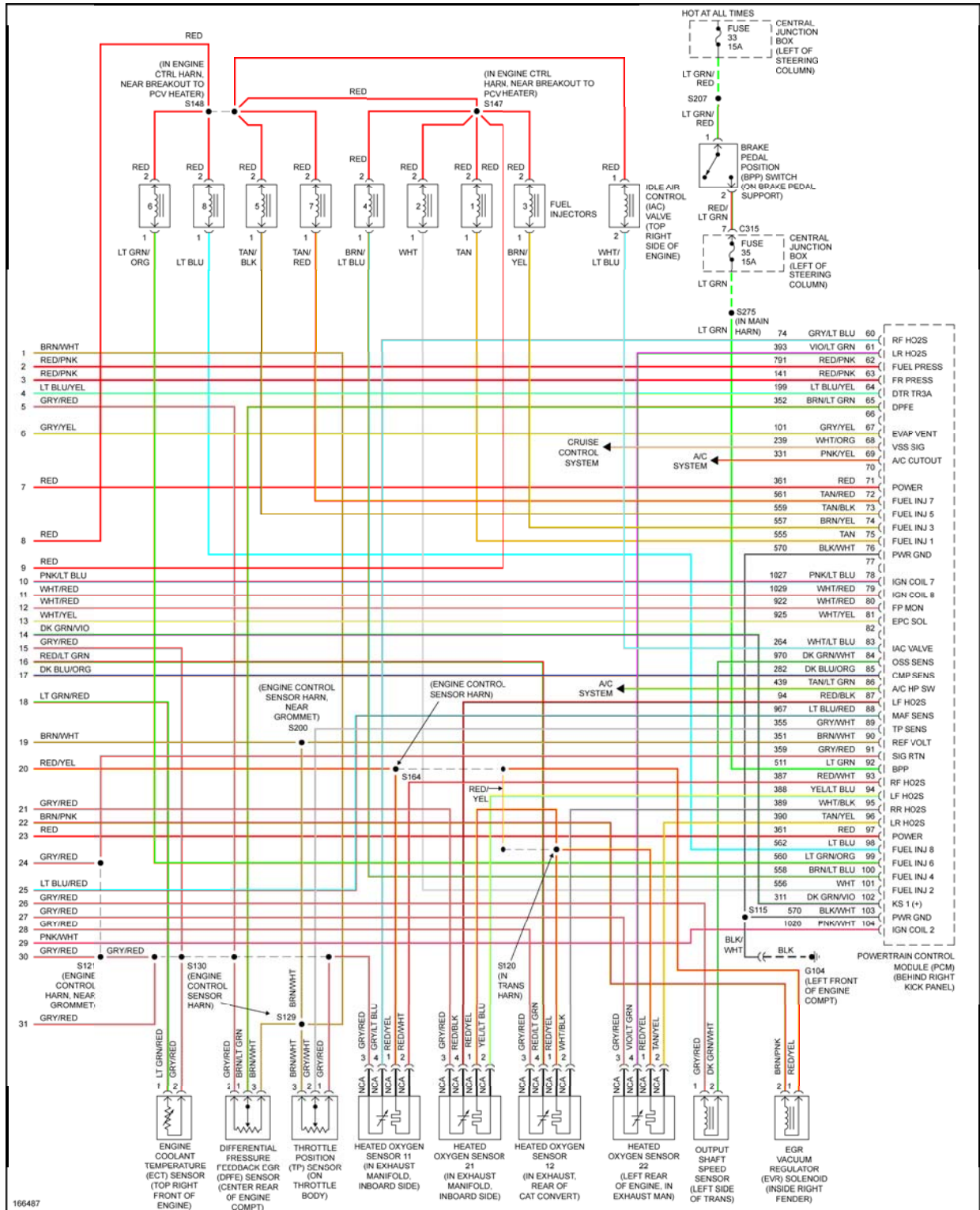


Fig. 16: 4.6L DOHC, Engine Performance Circuit (3 of 3)

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

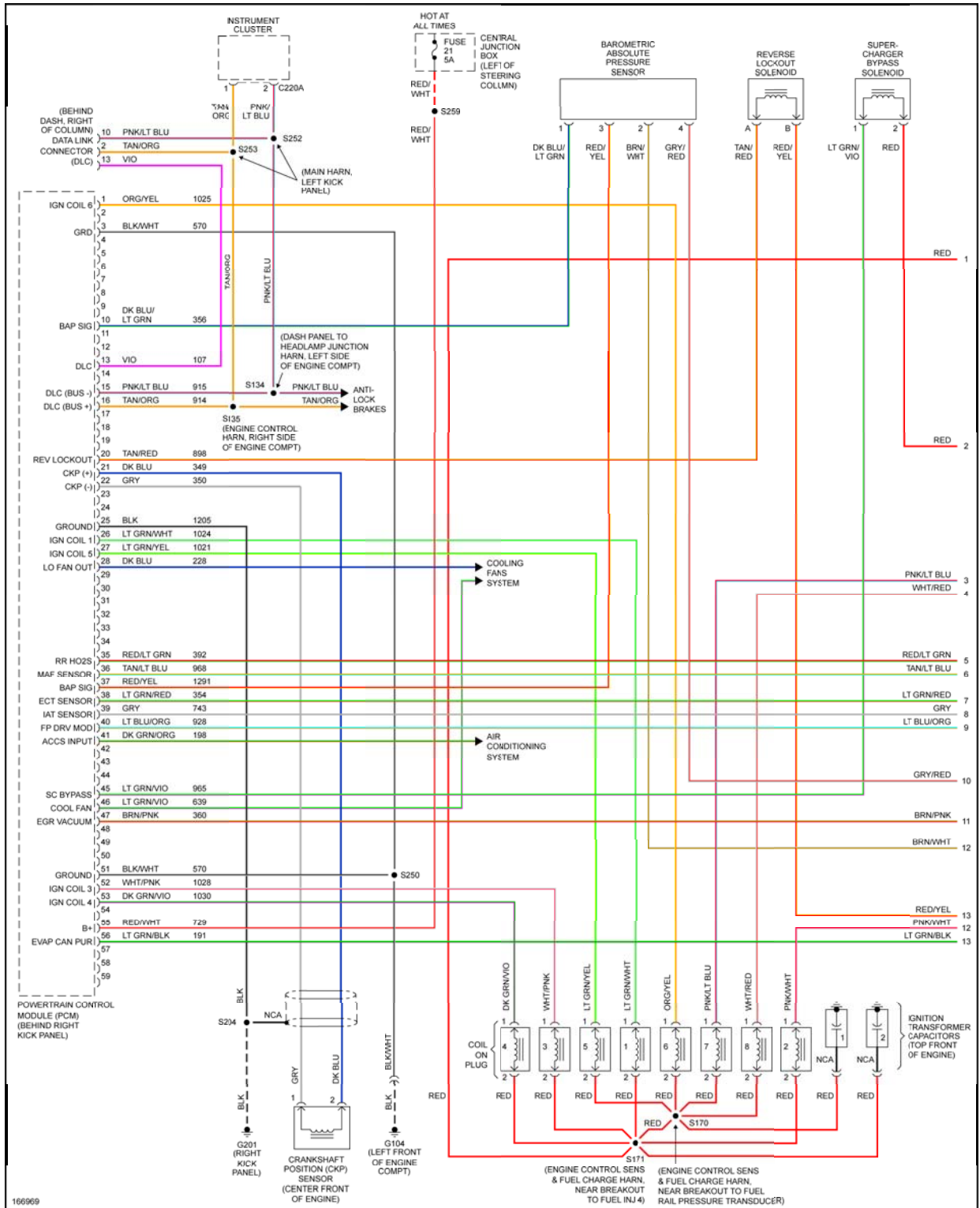


Fig. 17: 4.6L SC, Engine Performance Circuit (1 of 3)

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

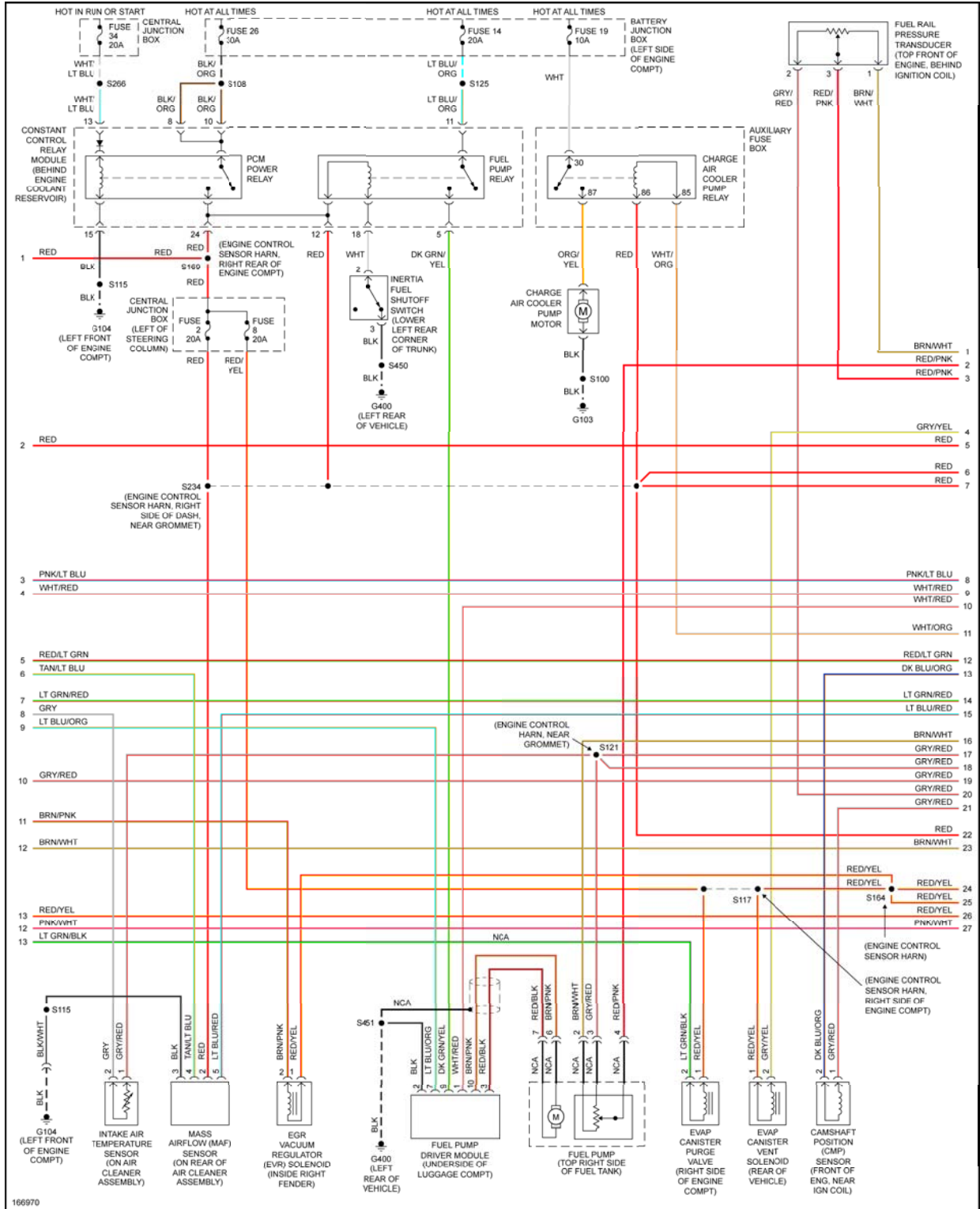


Fig. 18: 4.6L SC, Engine Performance Circuit (2 of 3)

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

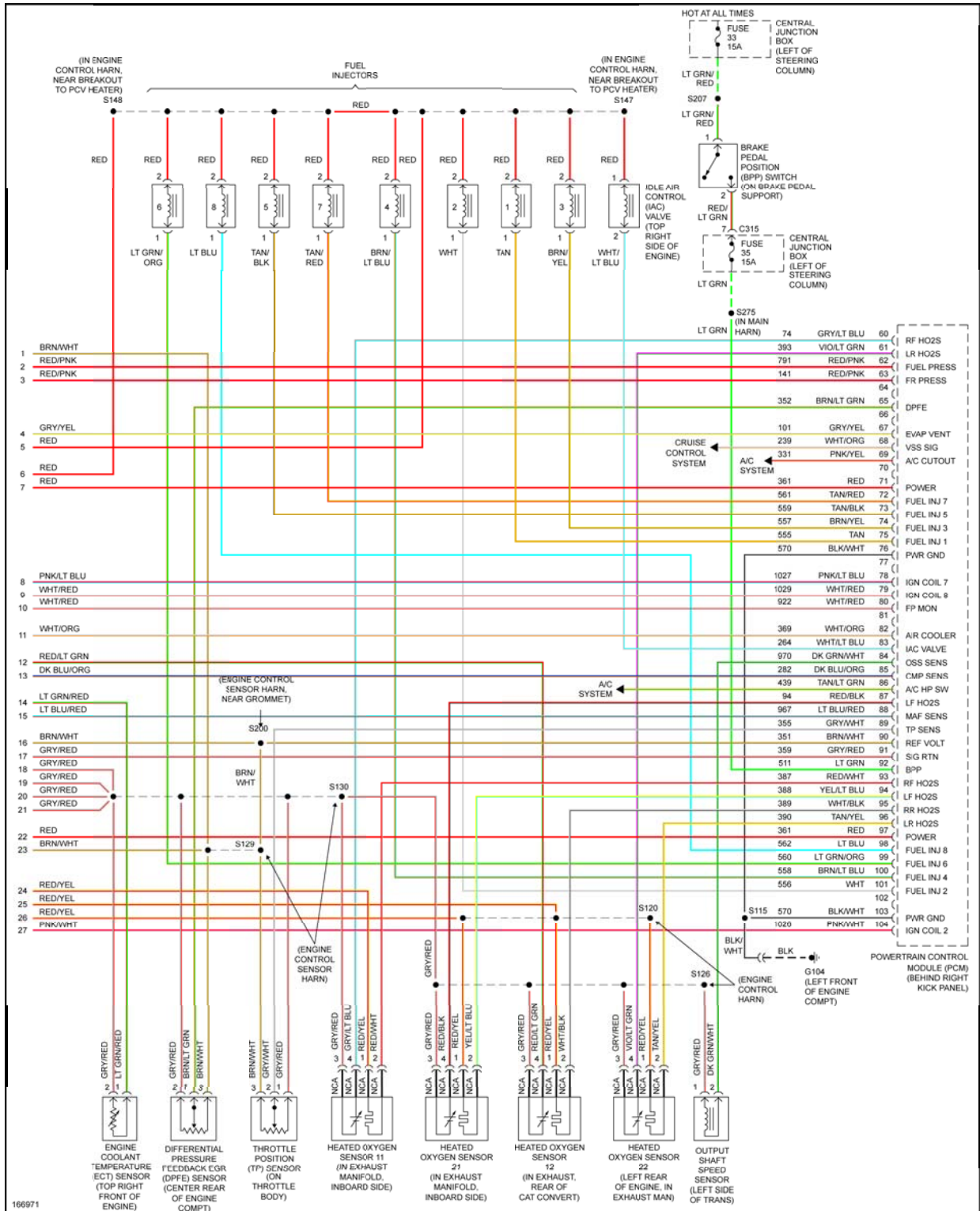


Fig. 19: 4.6L SC, Engine Performance Circuit (3 of 3)

4.6L SOHC

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

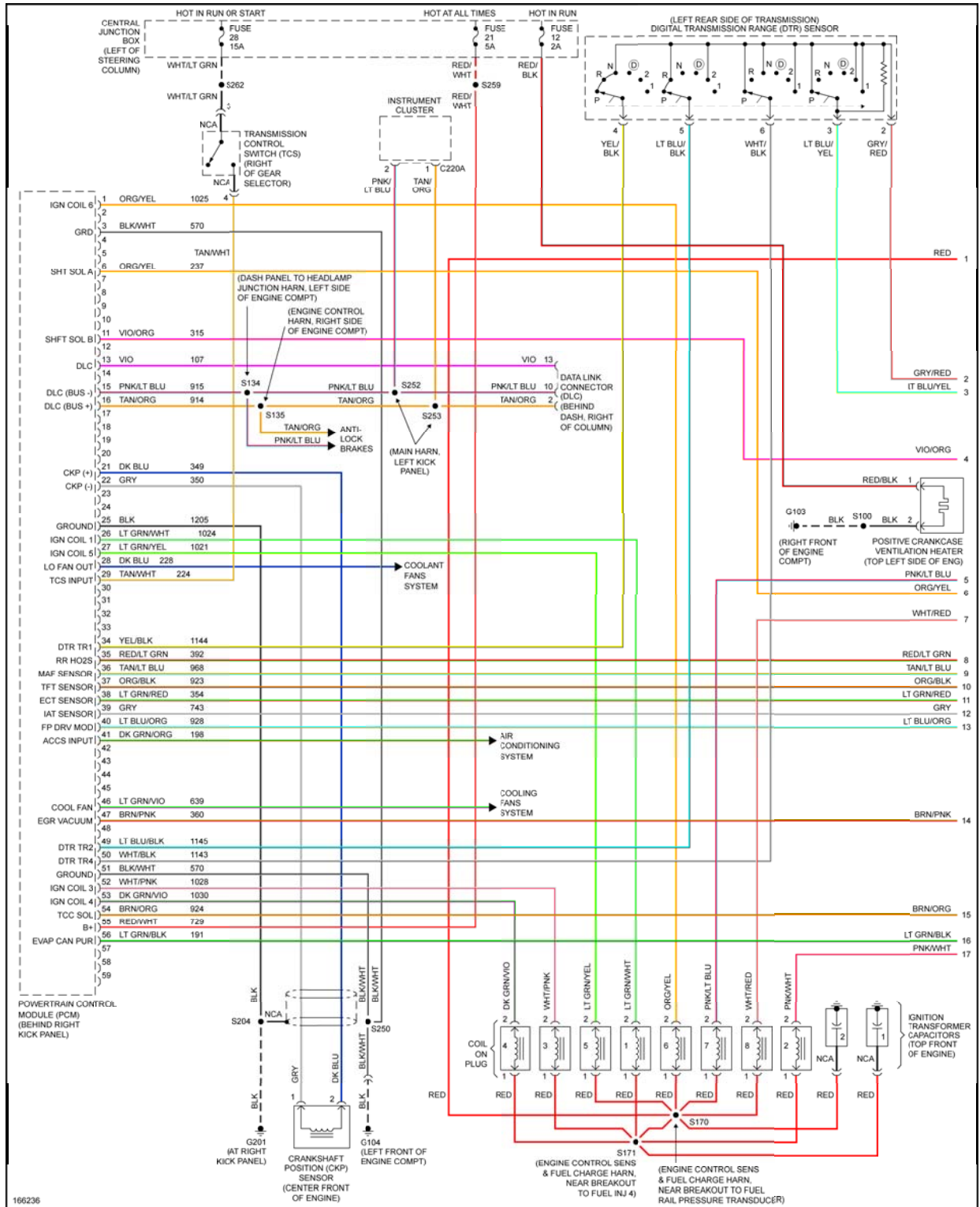


Fig. 20: 4.6L SOHC, Engine Performance Circuit (1 of 3)

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

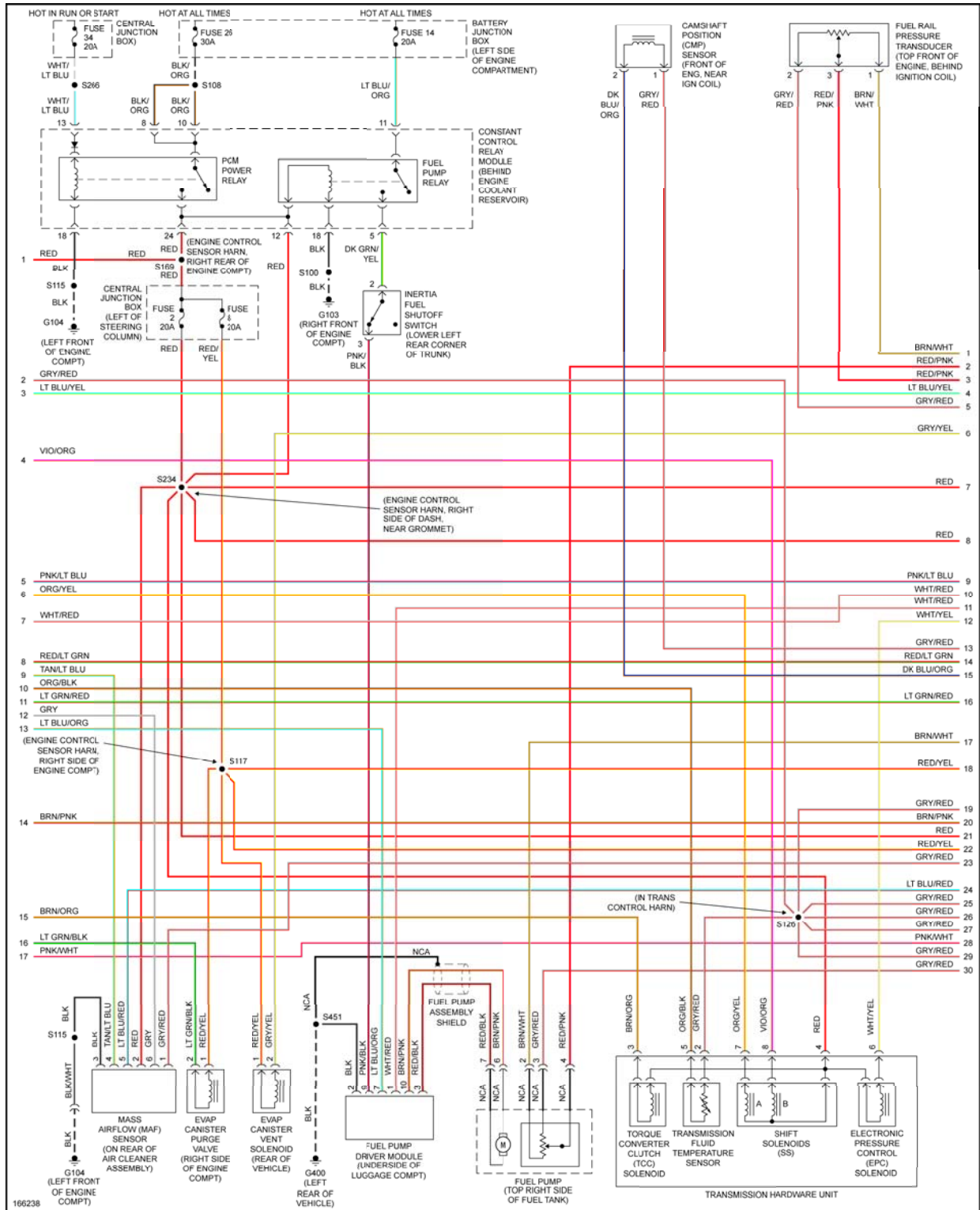


Fig. 21: 4.6L SOHC, Engine Performance Circuit (2 of 3)

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

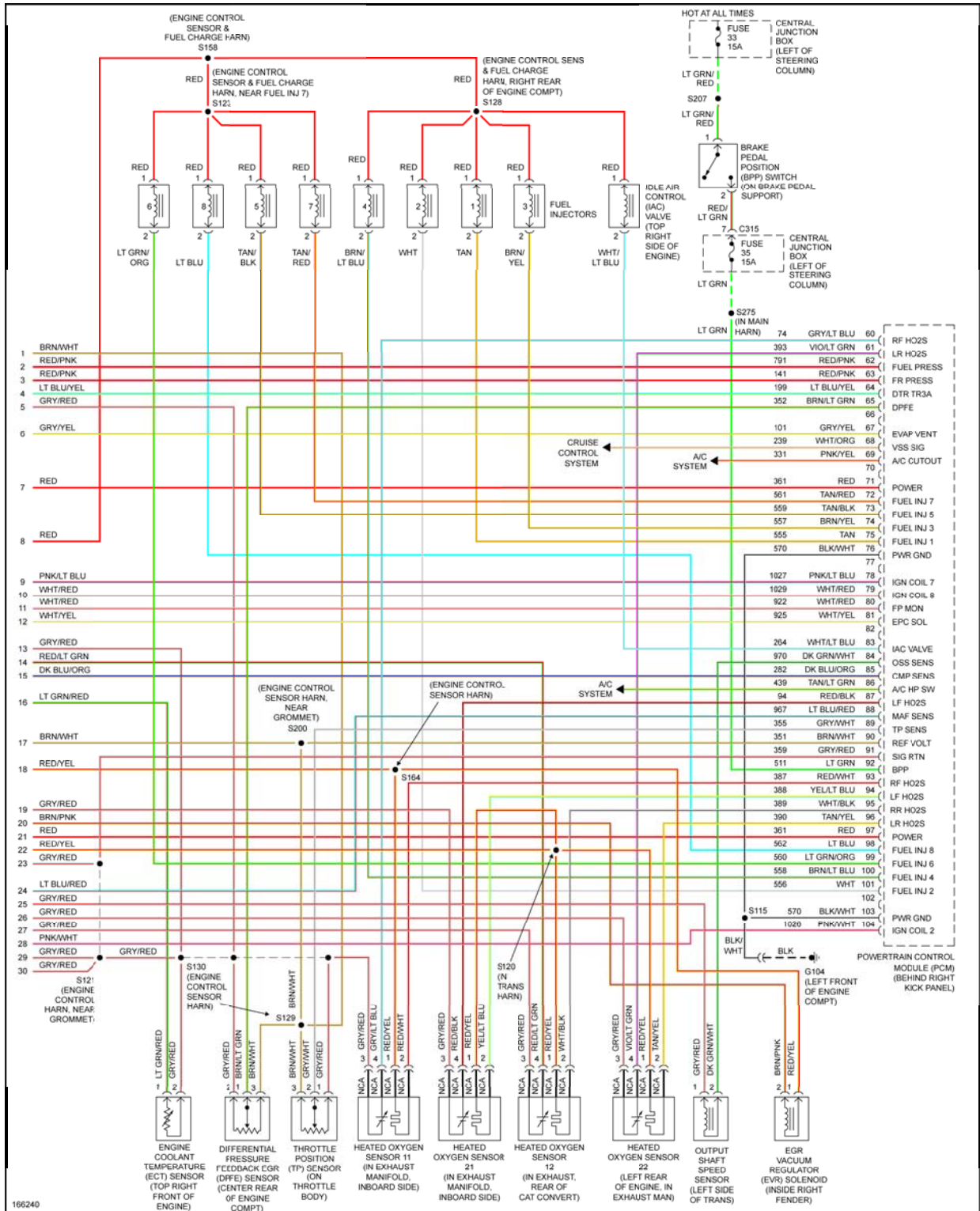


Fig. 22: 4.6L SOHC, Engine Performance Circuit (3 of 3)

EXTERIOR LIGHTS

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

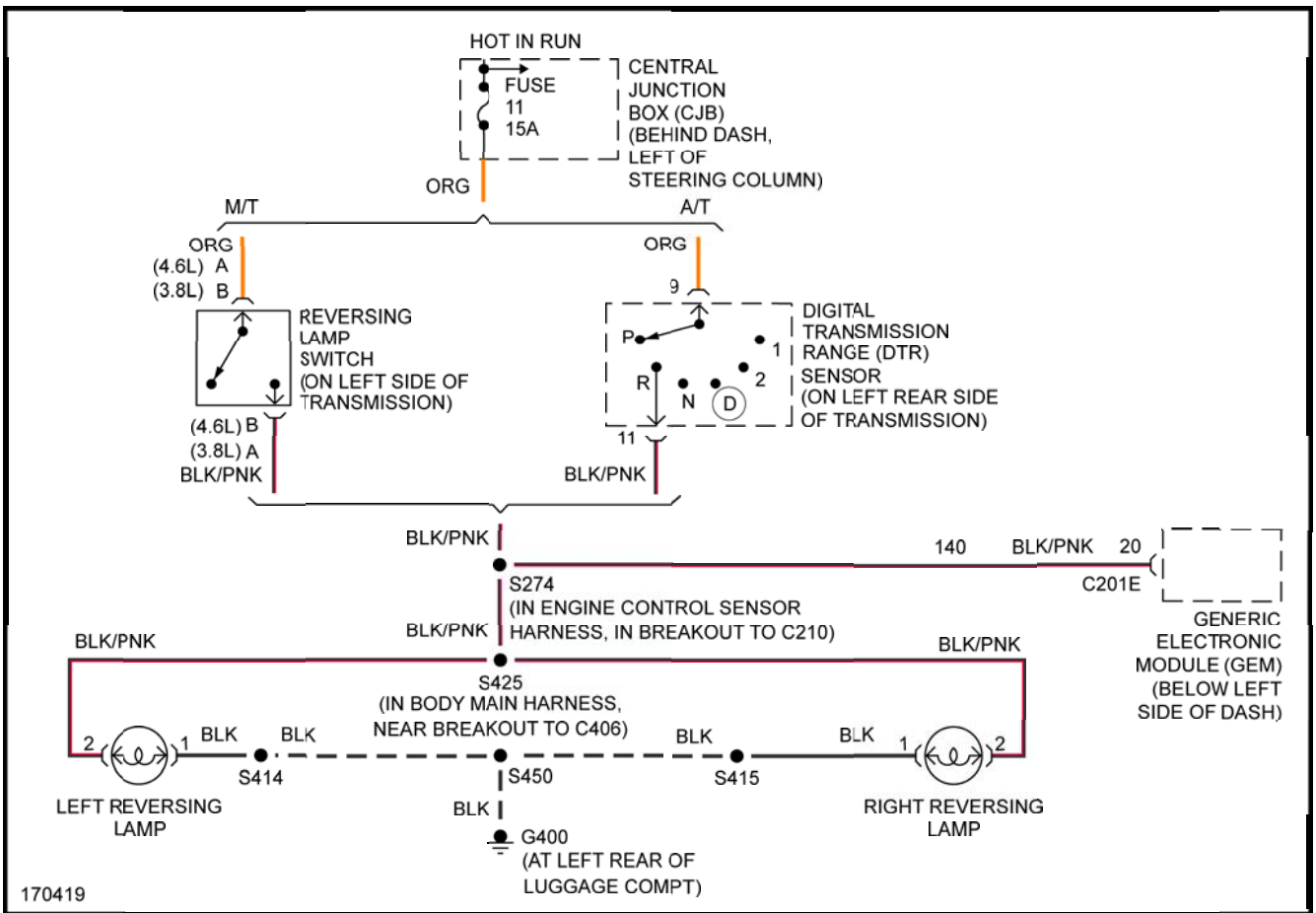


Fig. 23: Back-up Lamps Circuit

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

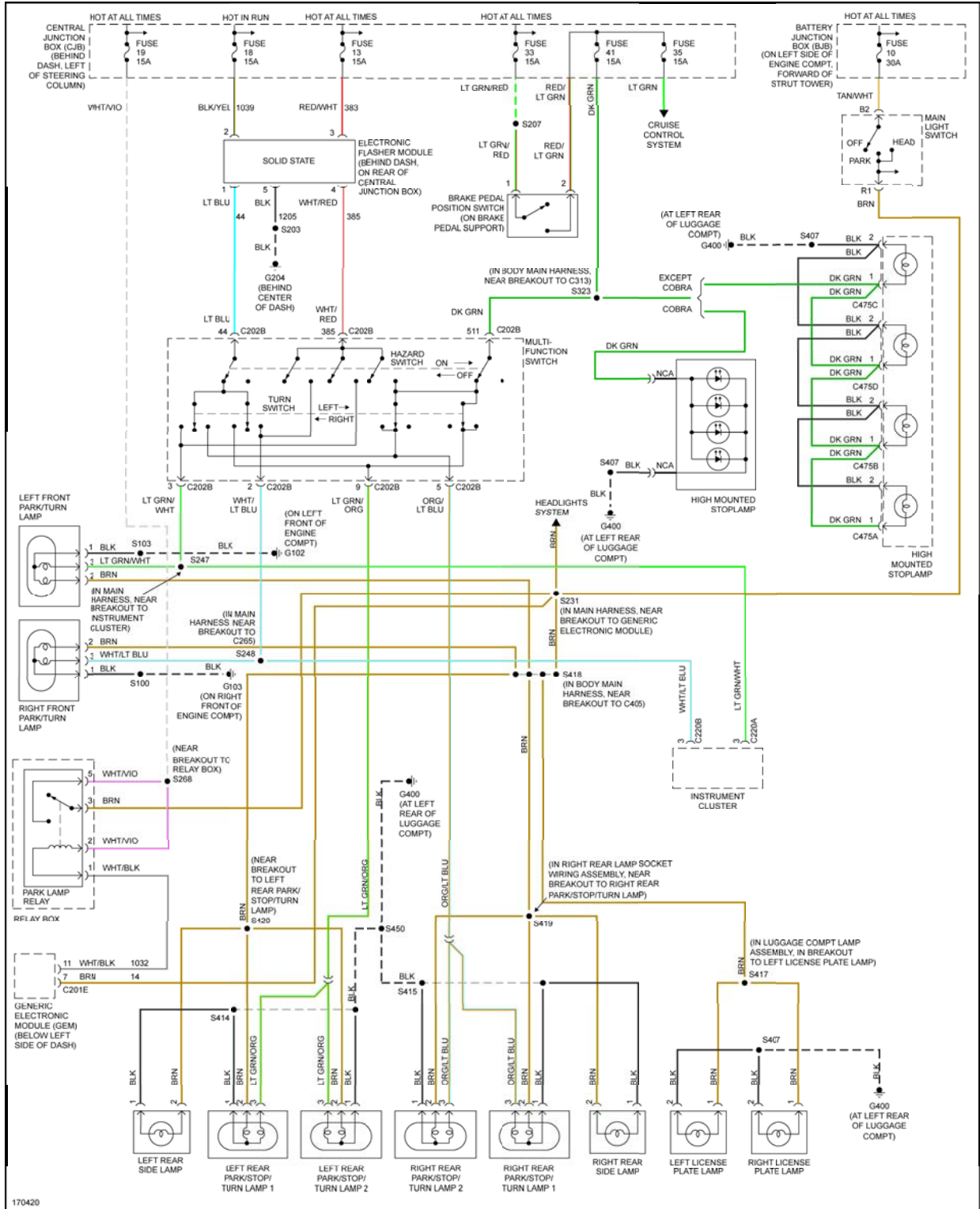


Fig. 24: Exterior Lamps Circuit

GROUND DISTRIBUTION

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

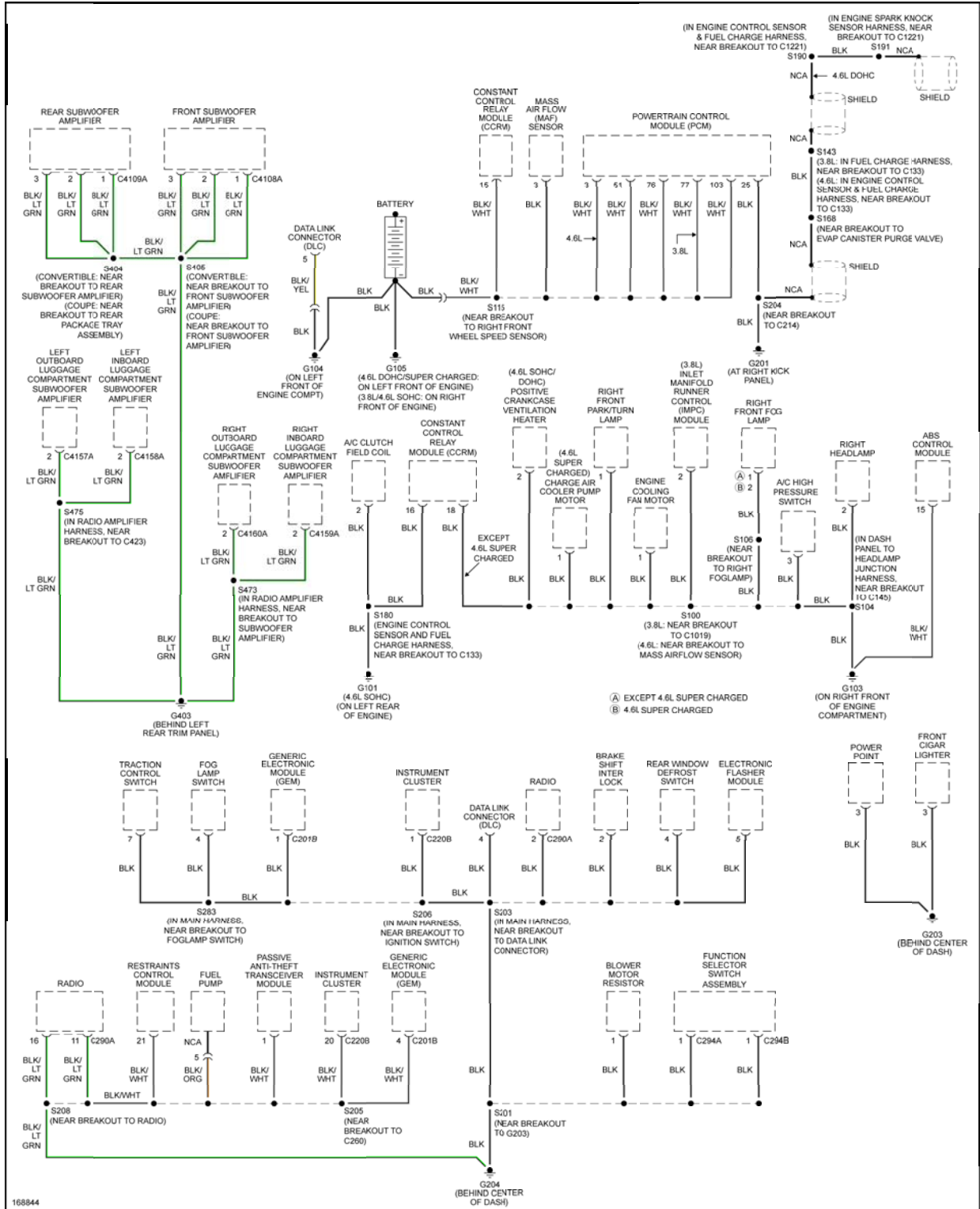


Fig. 25: Ground Distribution Circuit (1 of 2)

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

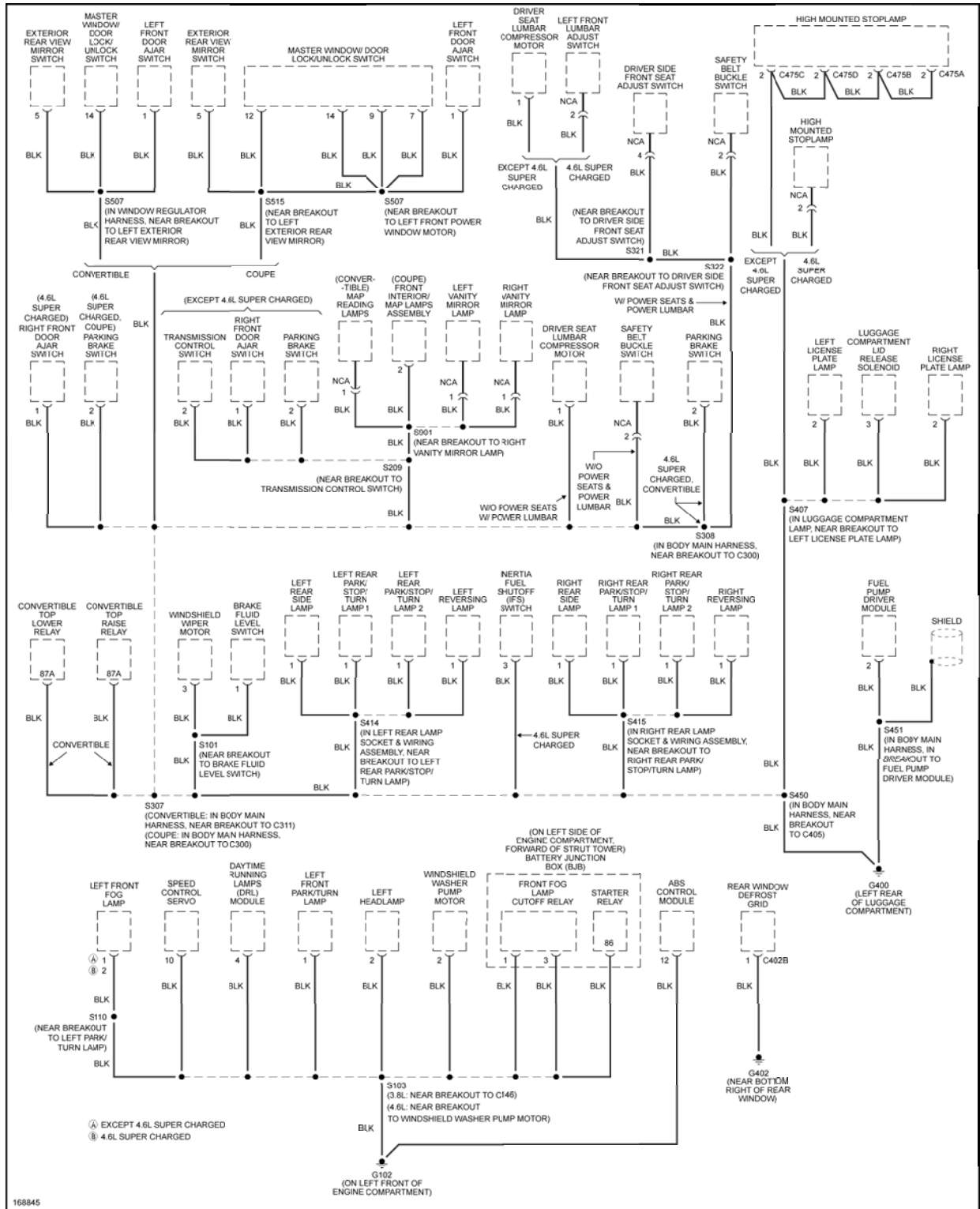


Fig. 26: Ground Distribution Circuit (2 of 2)

HEADLIGHTS

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

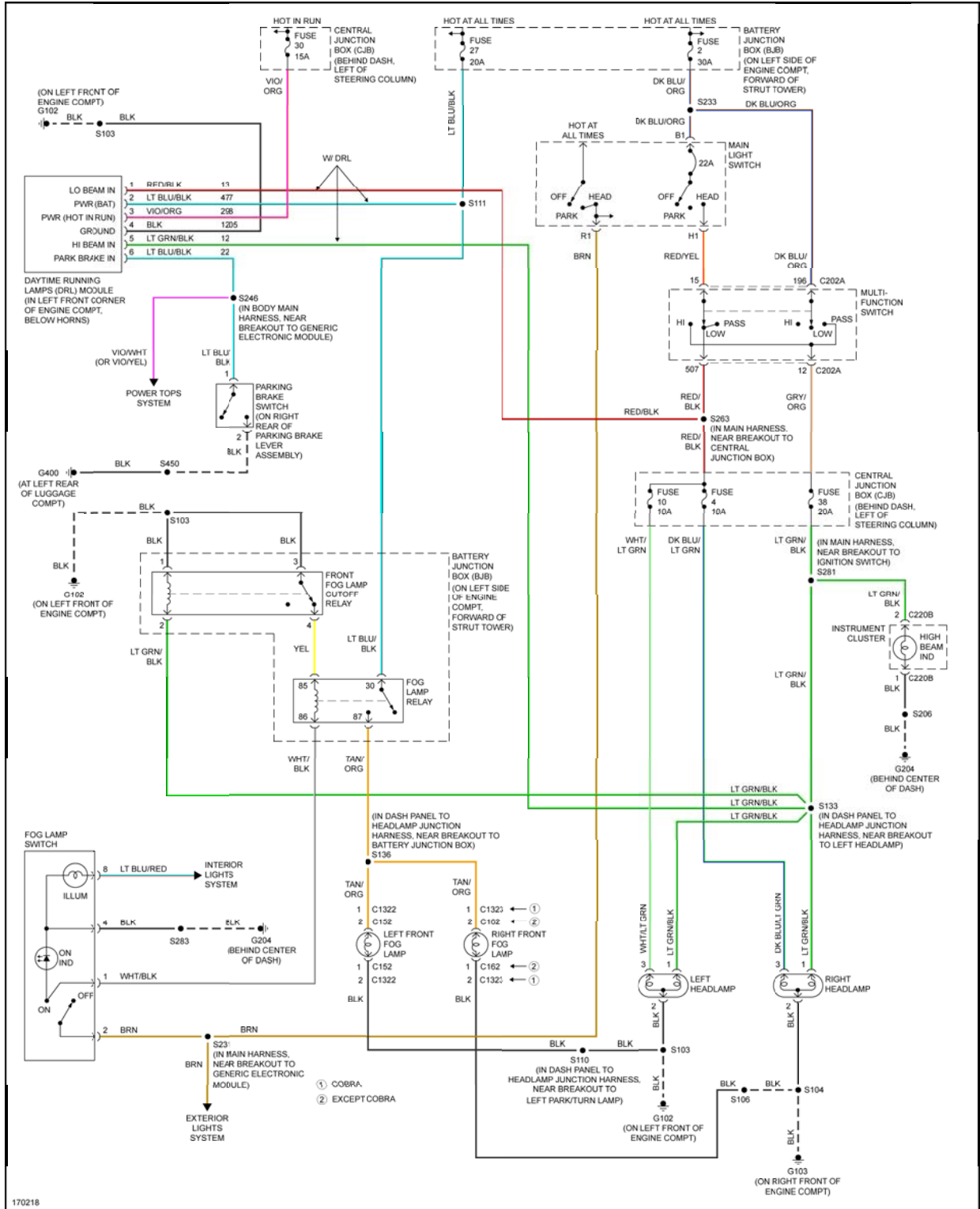


Fig. 27: Headlights Circuit

HORN

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

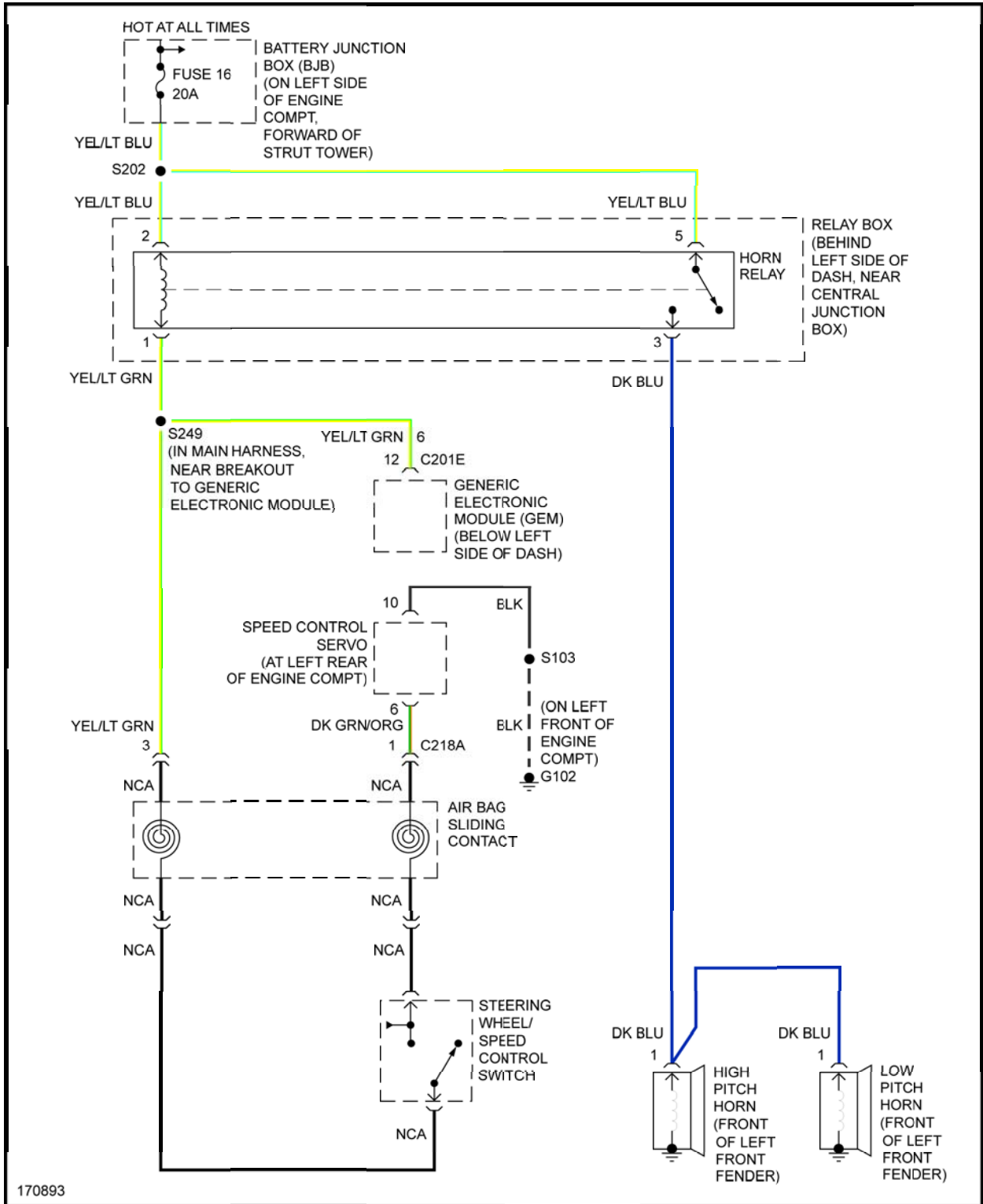


Fig. 28: Horn Circuit

INSTRUMENT CLUSTER

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

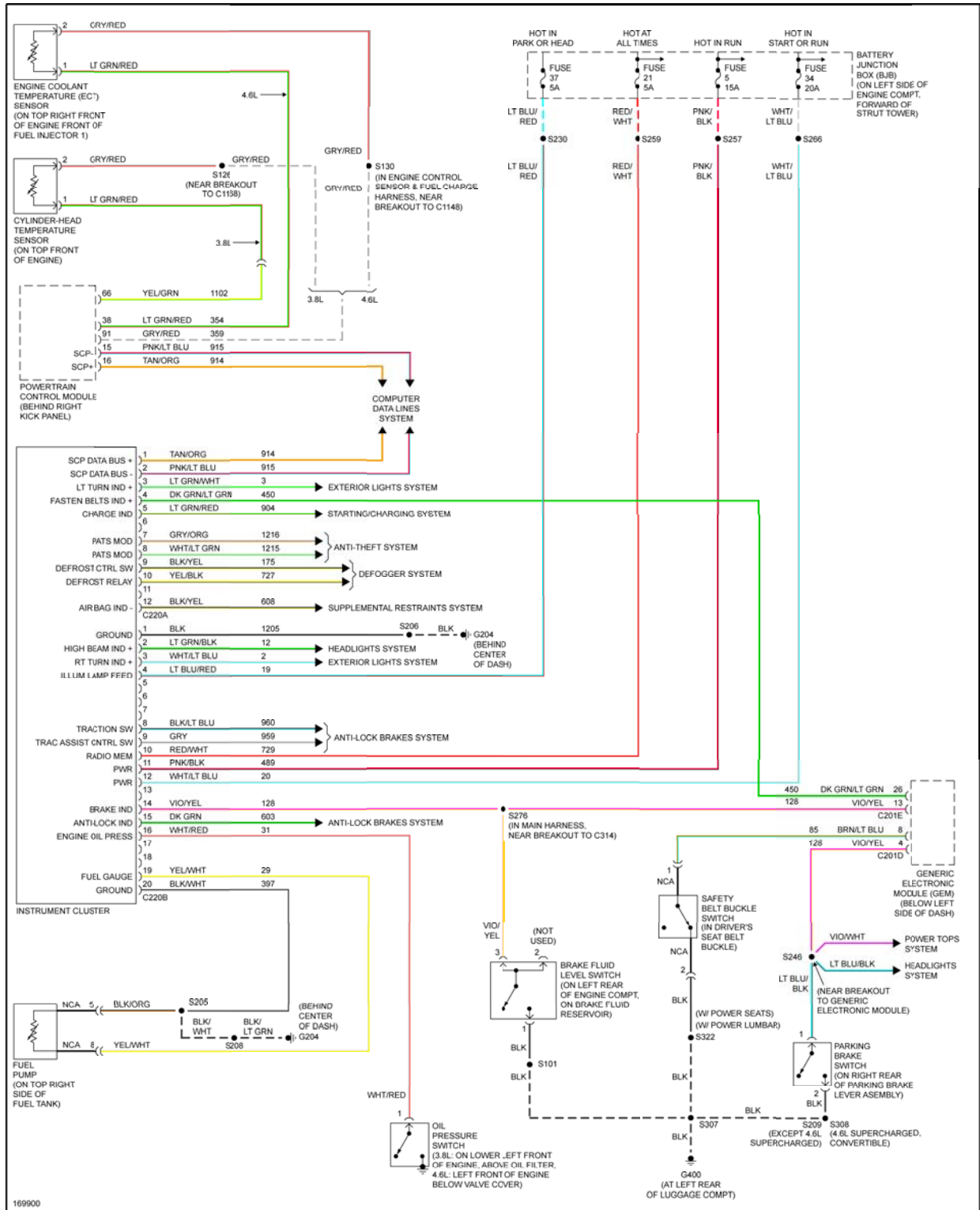


Fig. 29: Instrument Cluster Circuit

INTERIOR LIGHTS

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

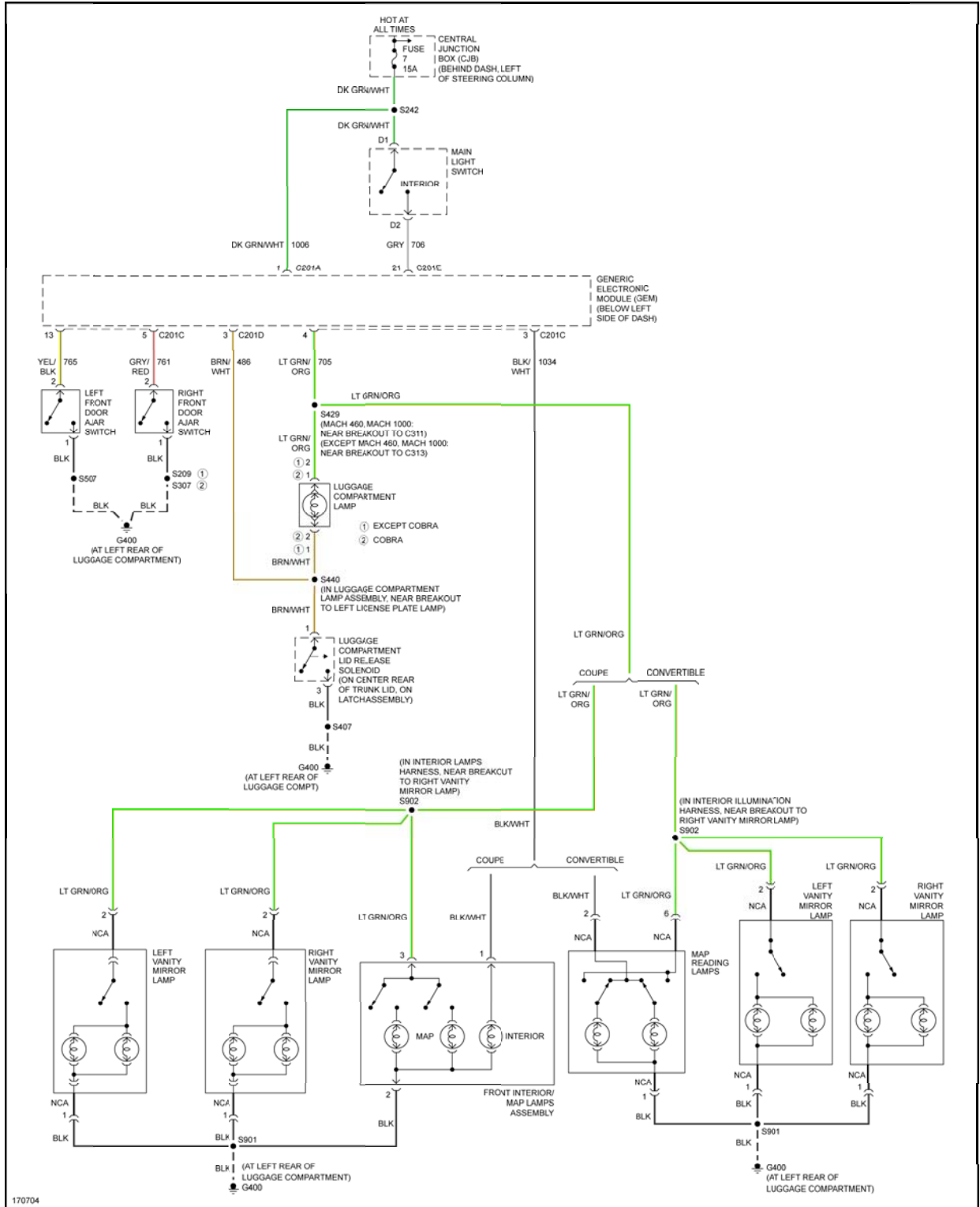


Fig. 30: Courtesy Lamps Circuit

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

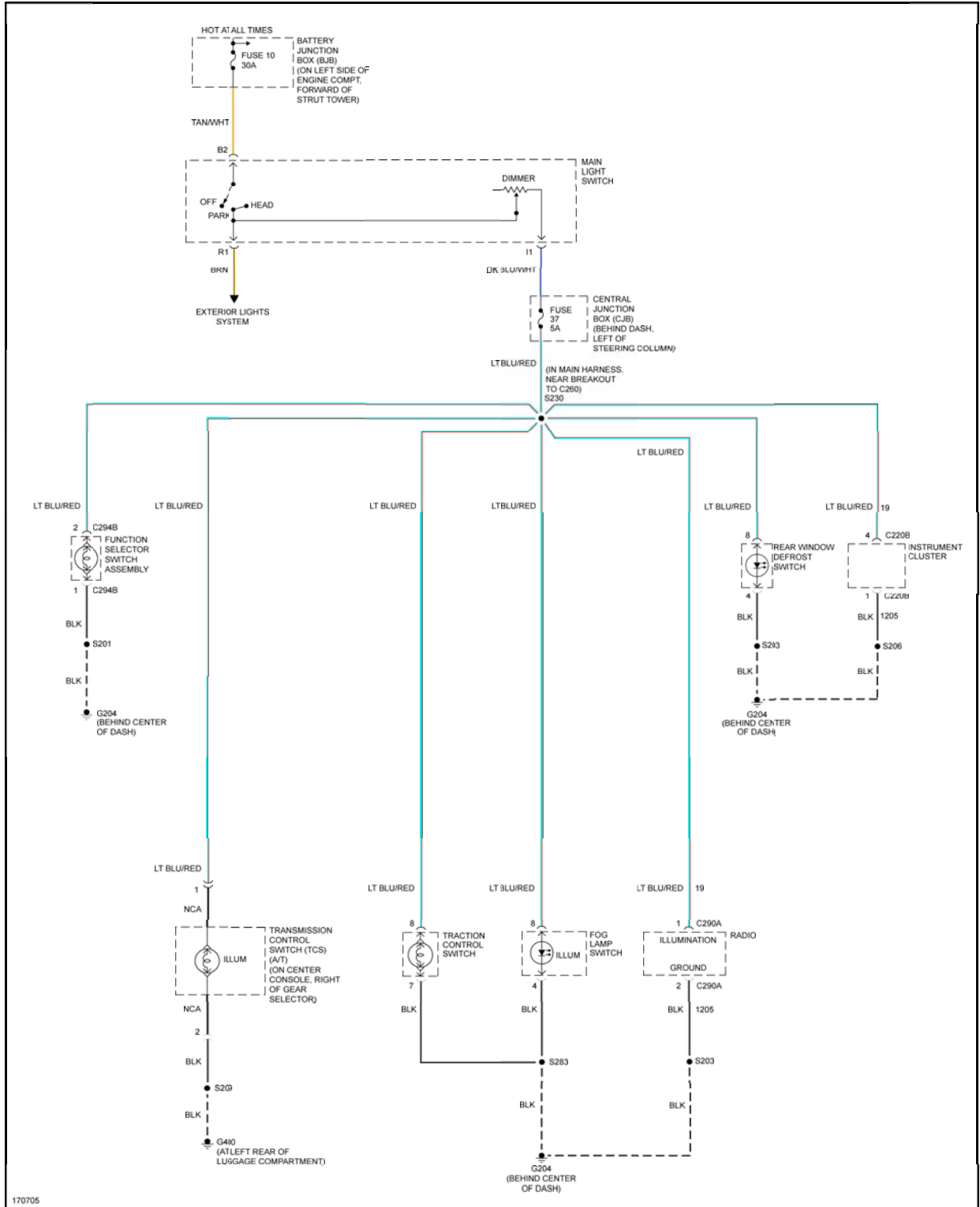


Fig. 31: Instrument Illumination Circuit

POWER DISTRIBUTION

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

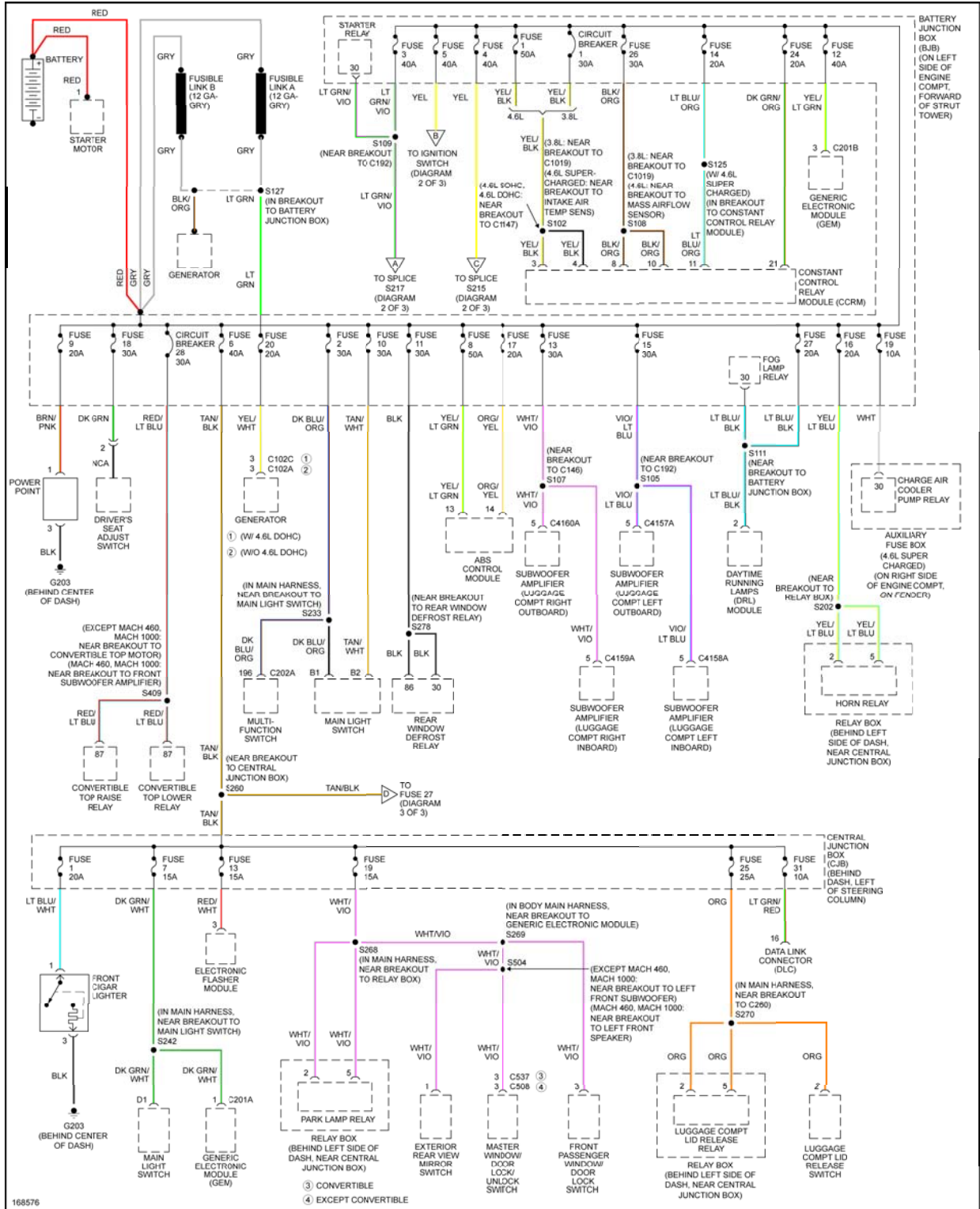


Fig. 32: Power Distribution Circuit (1 of 3)

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

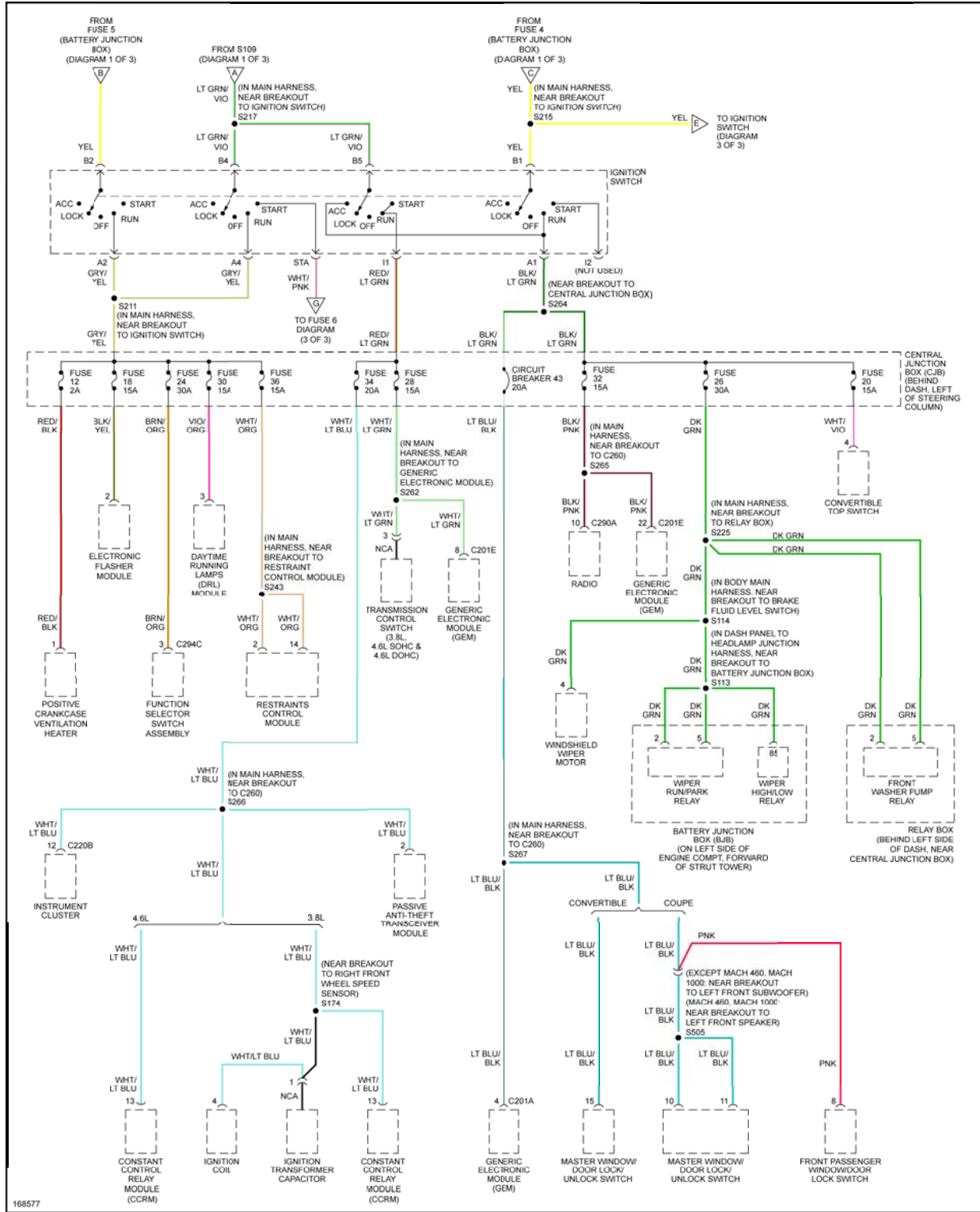
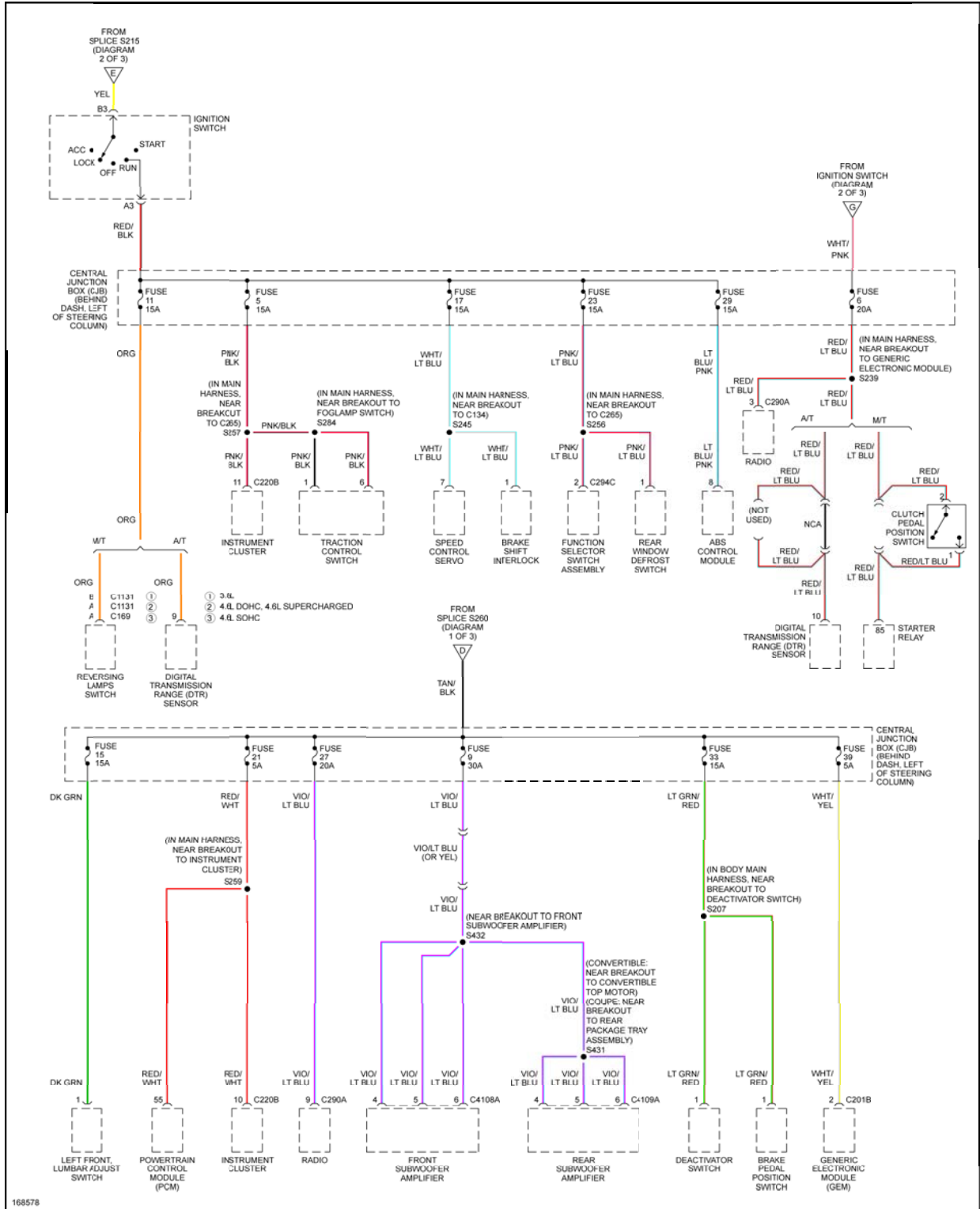


Fig. 33: Power Distribution Circuit (2 of 3)

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang



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Fig. 34: Power Distribution Circuit (3 of 3)

POWER DOOR LOCKS

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

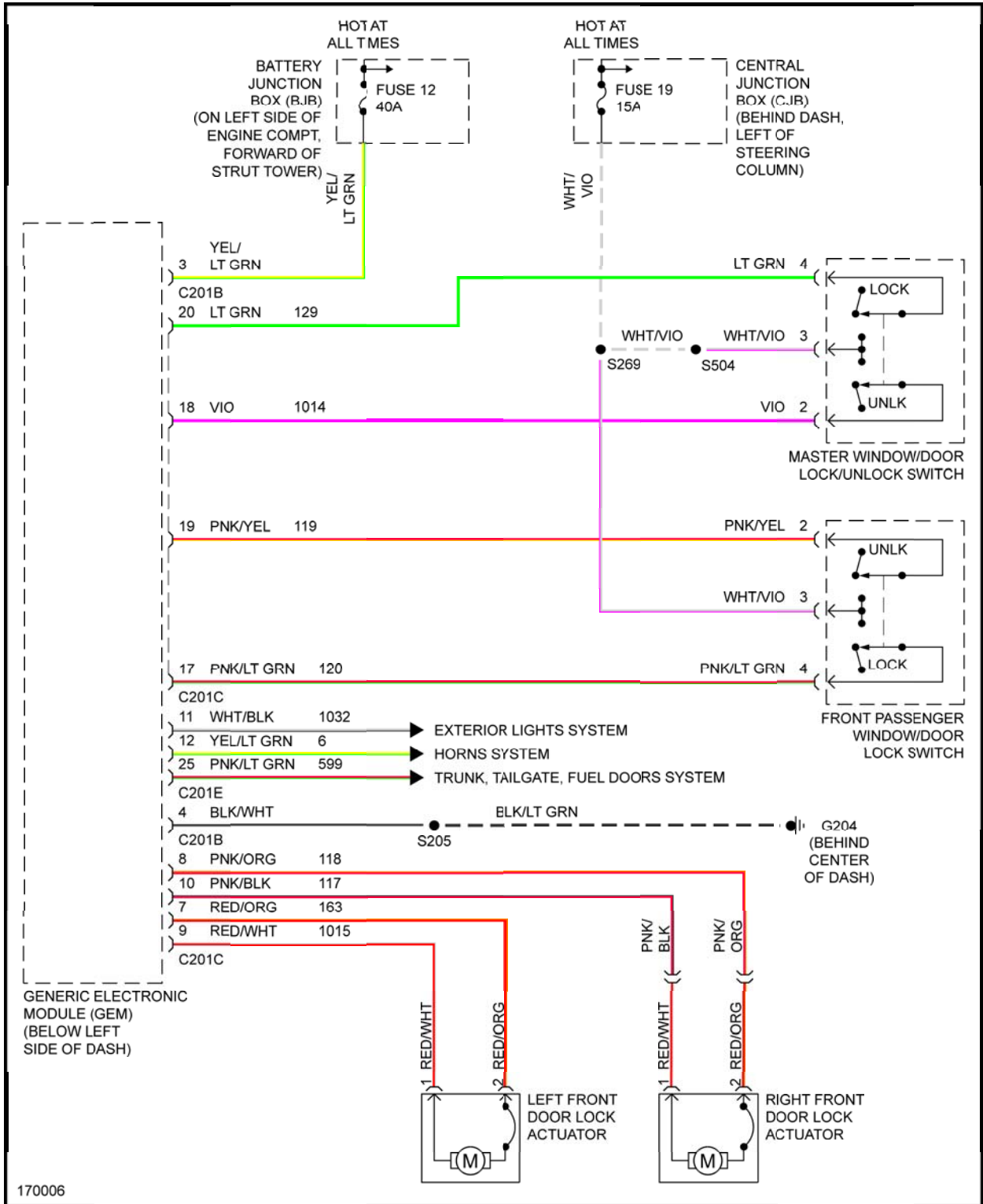


Fig. 35: Power Door Locks Circuit

POWER MIRRORS

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

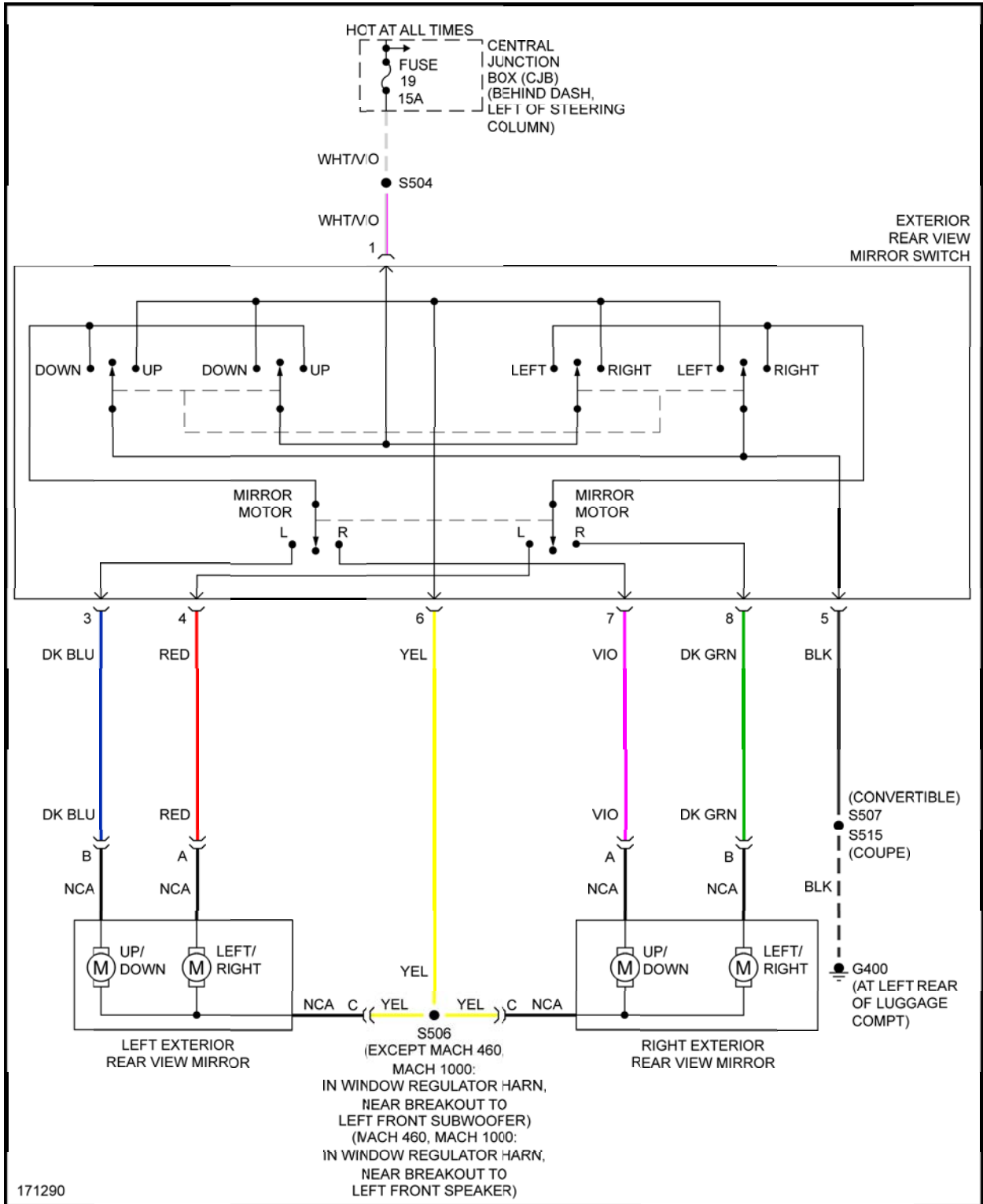


Fig. 36: Power Mirrors Circuit

POWER SEATS

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

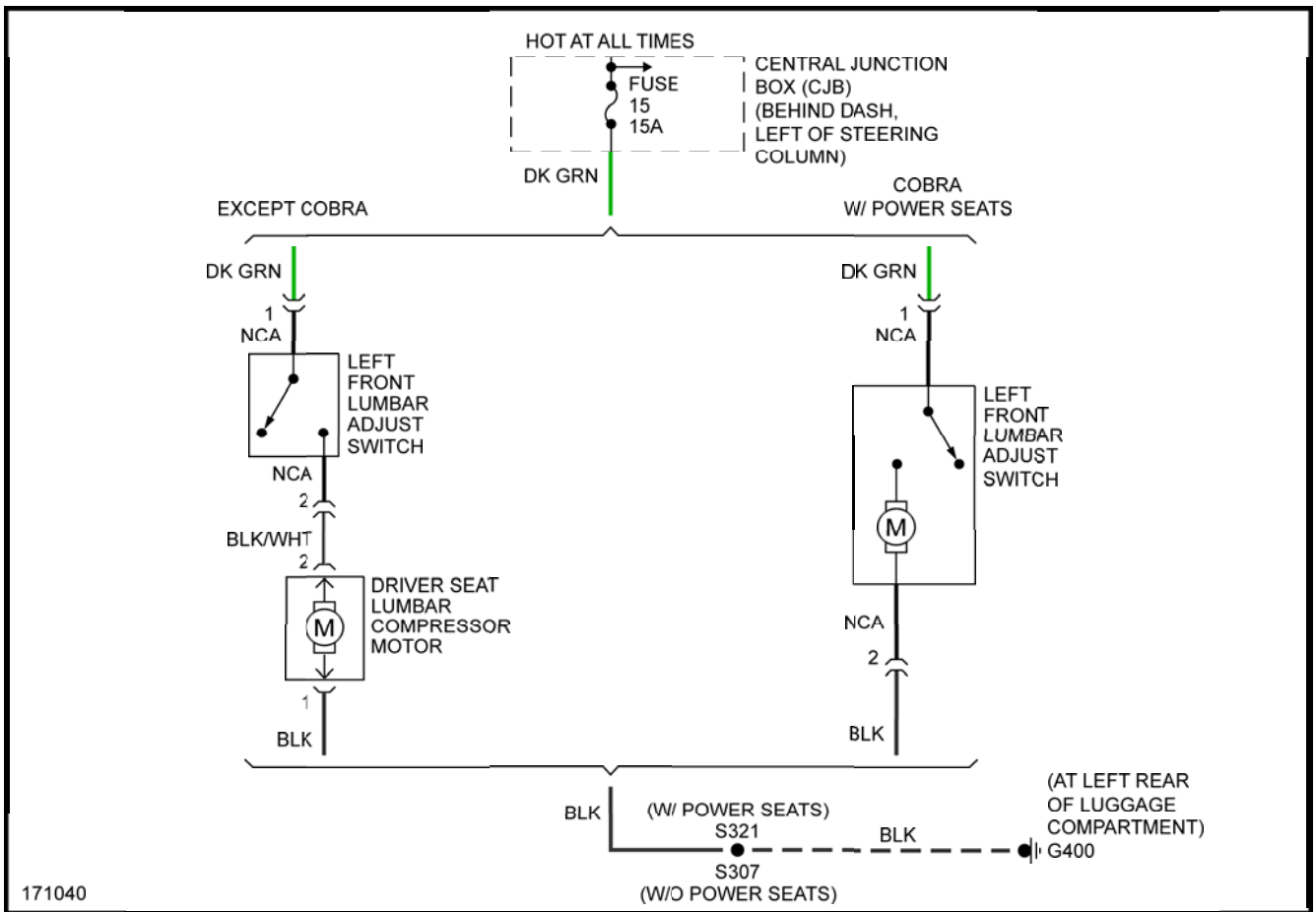


Fig. 37: Lumbar Circuit

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

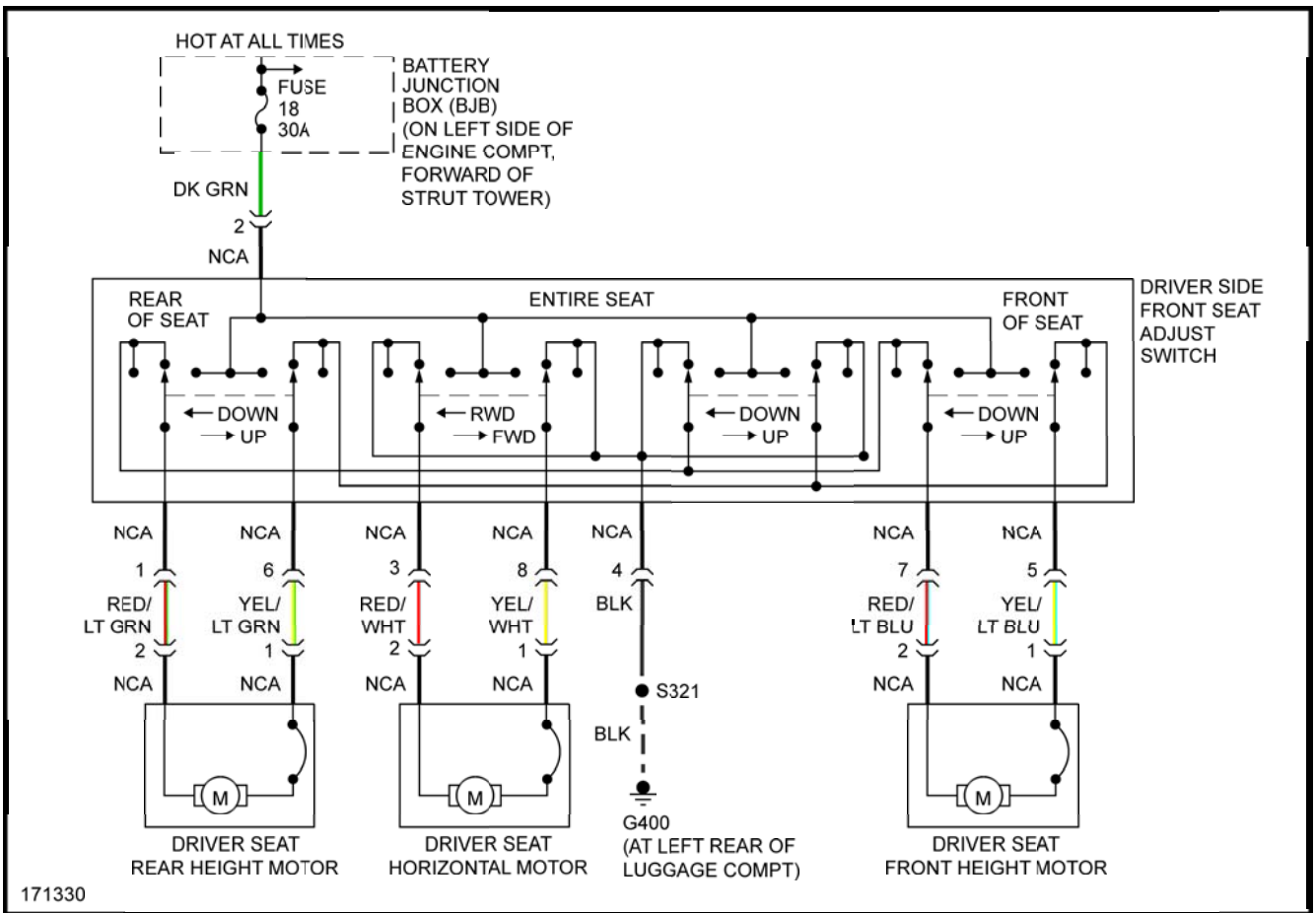


Fig. 38: Power Seat Circuit

POWER TOP/SUNROOF

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

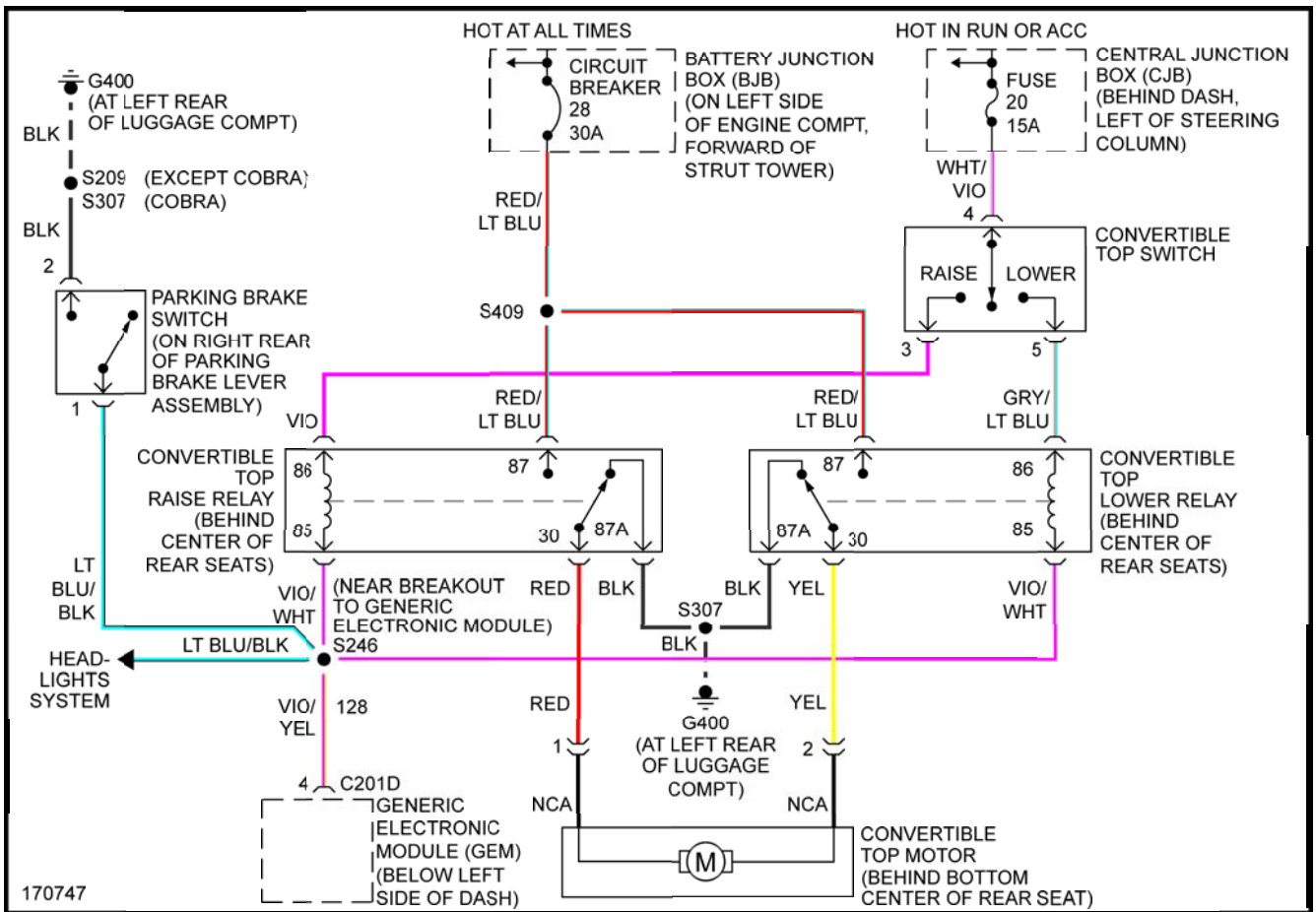


Fig. 39: Power Top/Sunroof Circuit

POWER WINDOWS

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

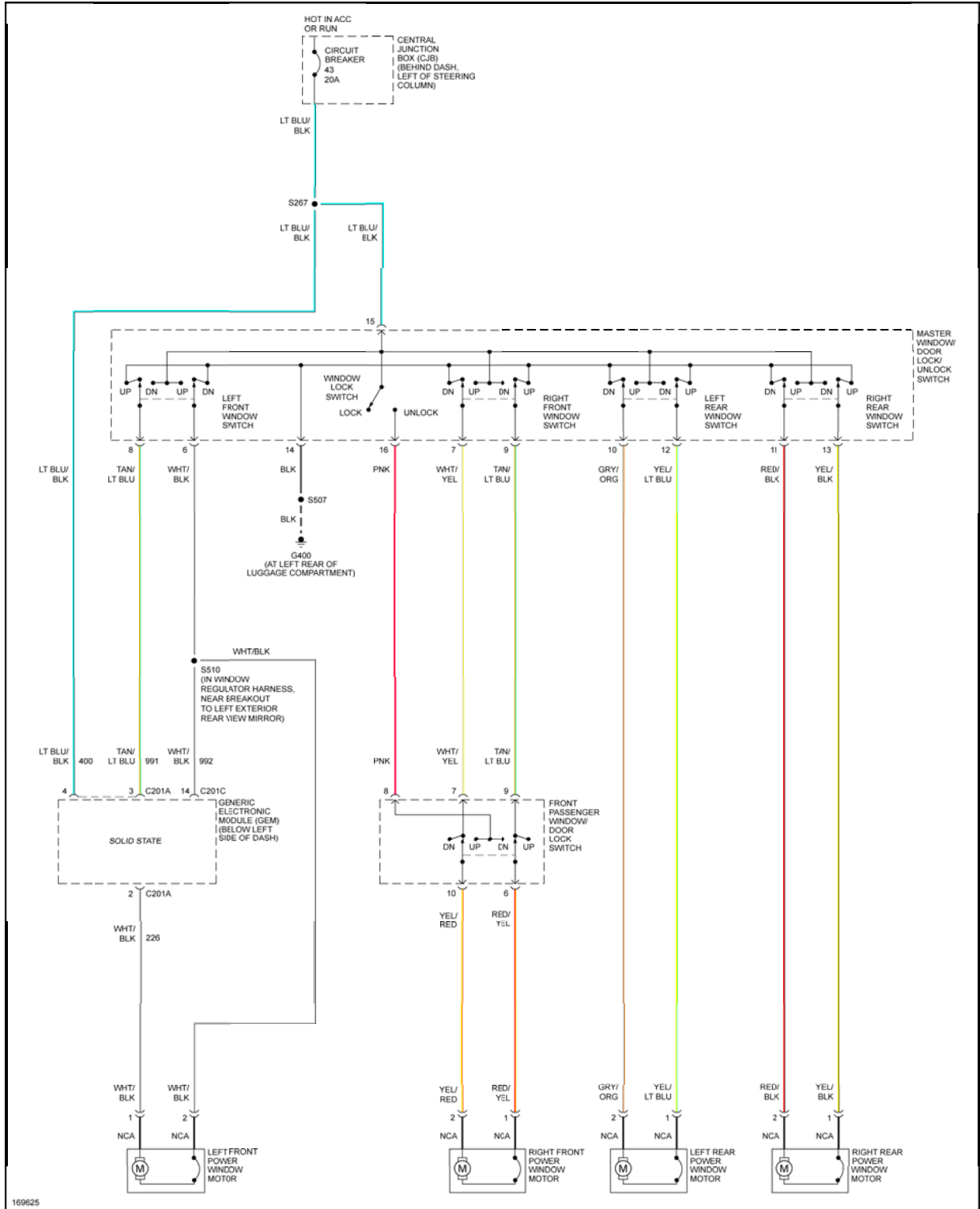


Fig. 40: Power Windows Circuit, Convertible

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

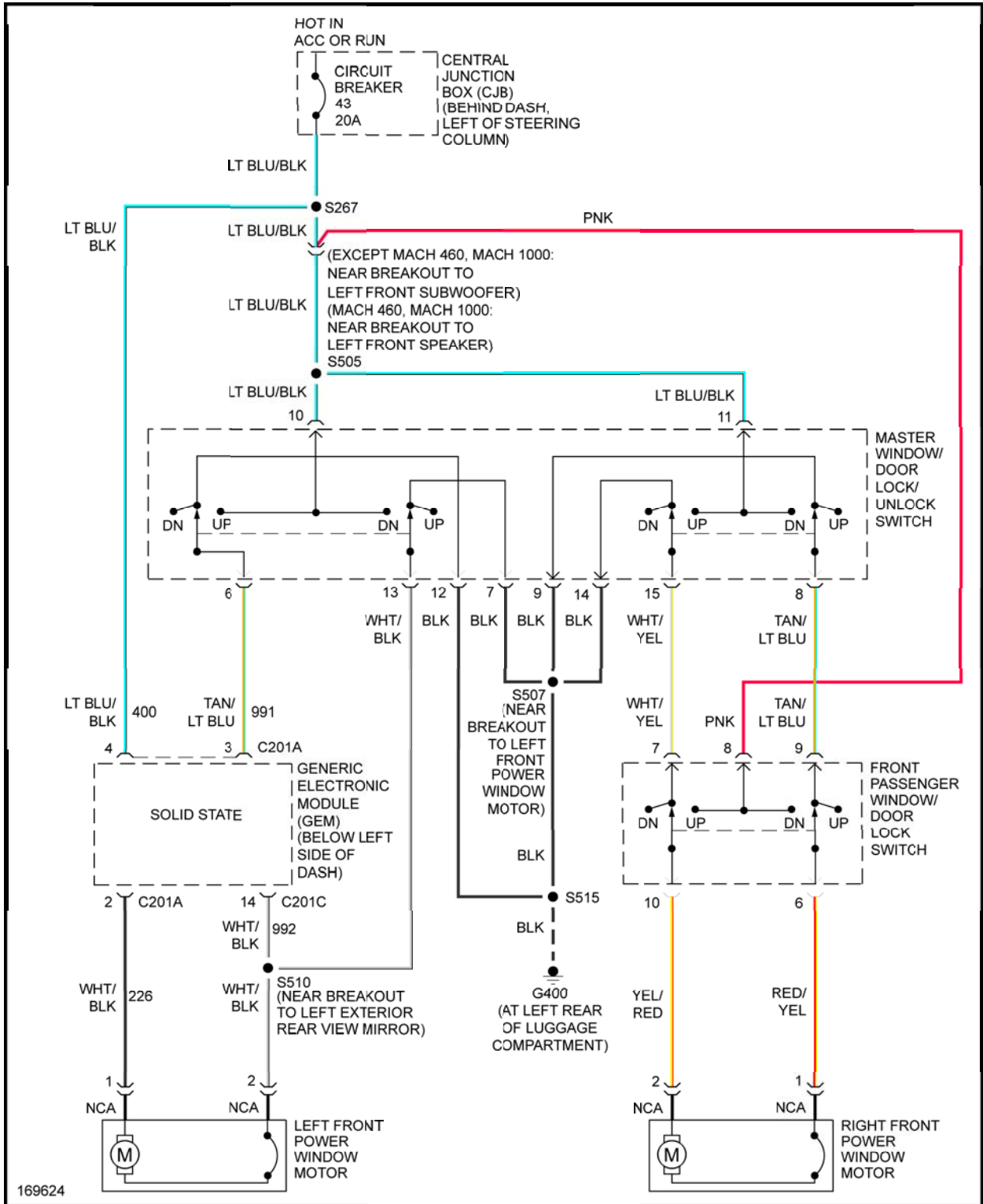


Fig. 41: Power Windows Circuit, Coupe

RADIO

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

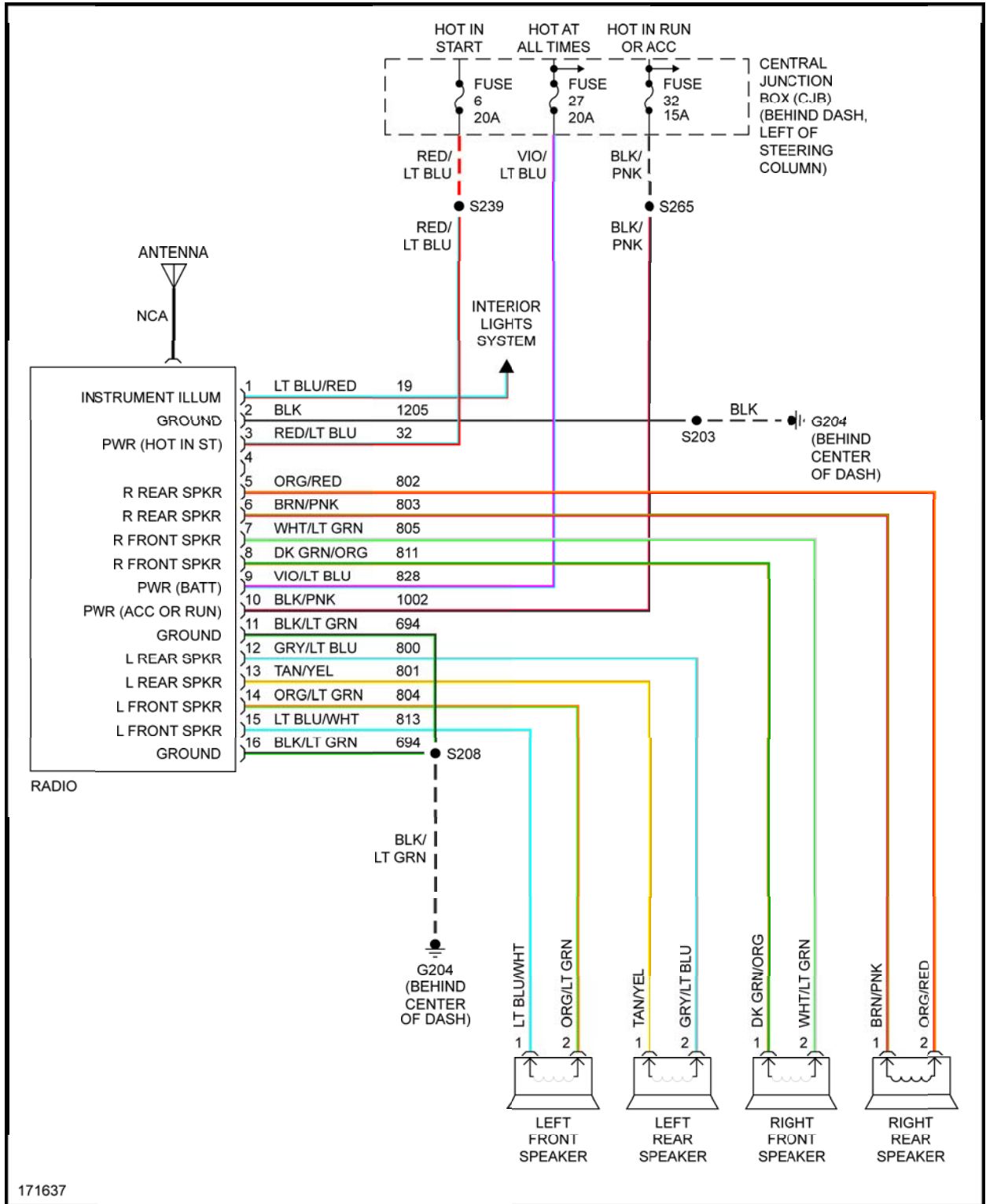


Fig. 42: Base Radio Circuit

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

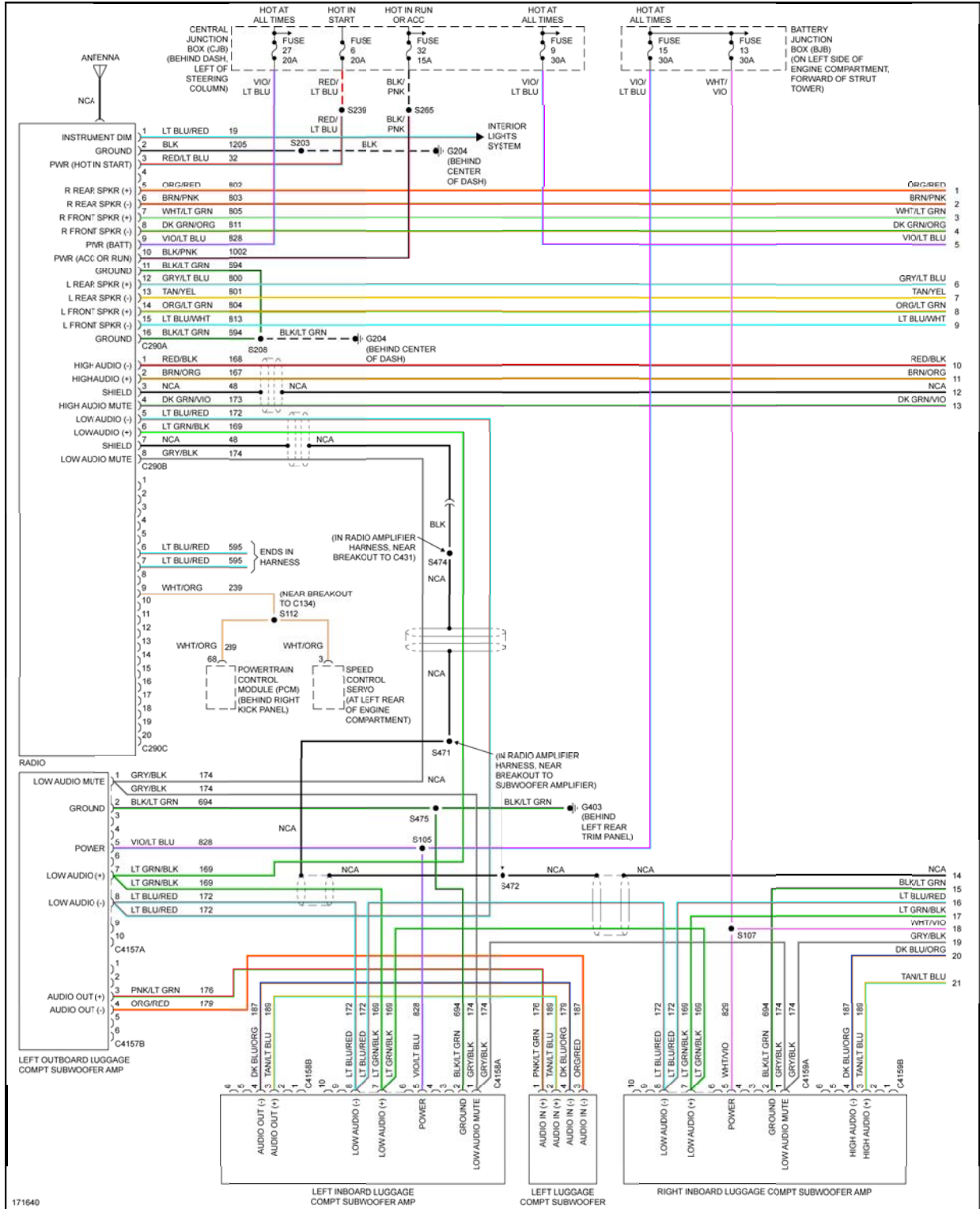


Fig. 43: Premium Sound Radio Circuit, Convertible W/ Mach 1000 Sound System (1 of 2)

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

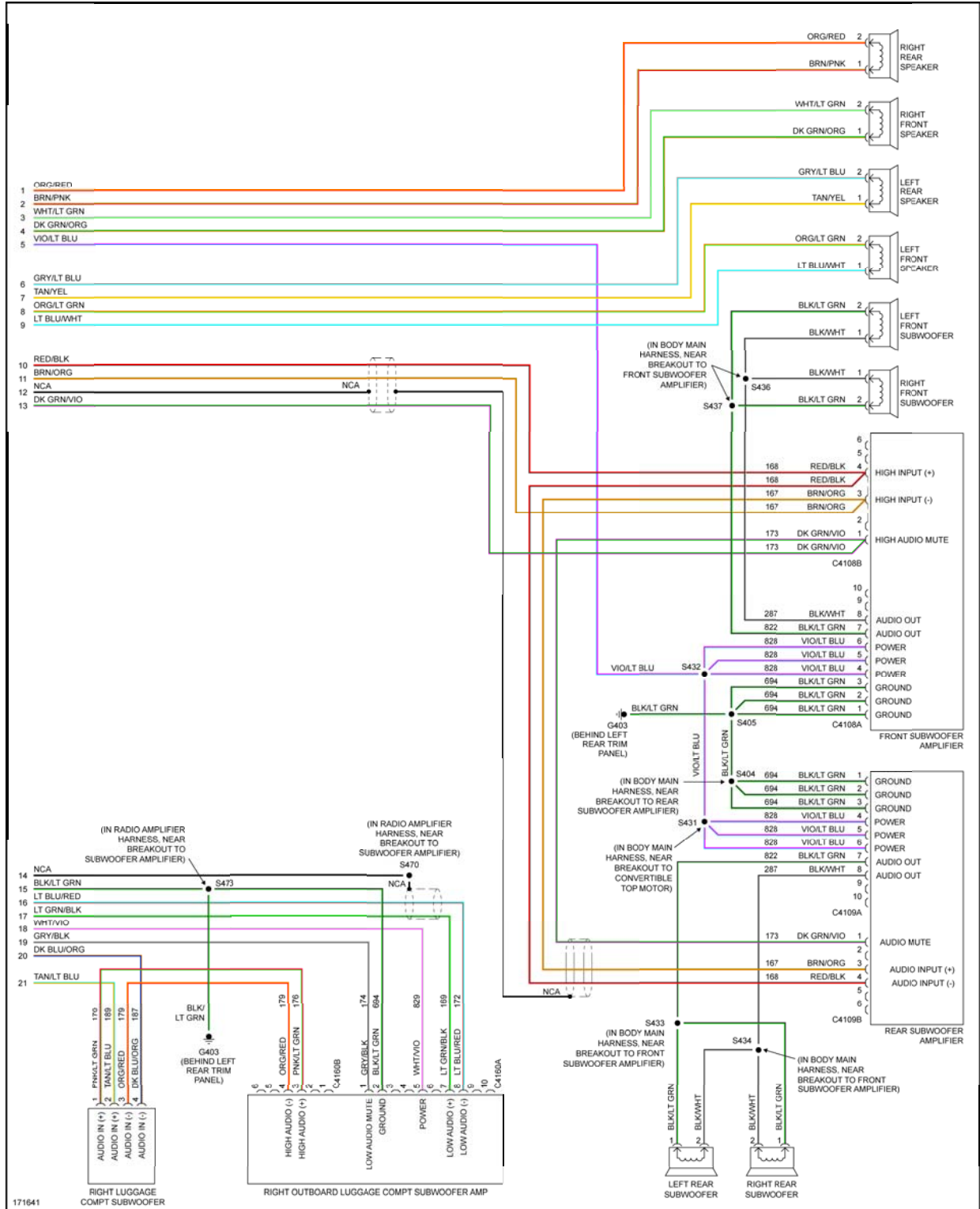


Fig. 44: Premium Sound Radio Circuit, Convertible W/ Mach 1000 Sound System (2 of 2)

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

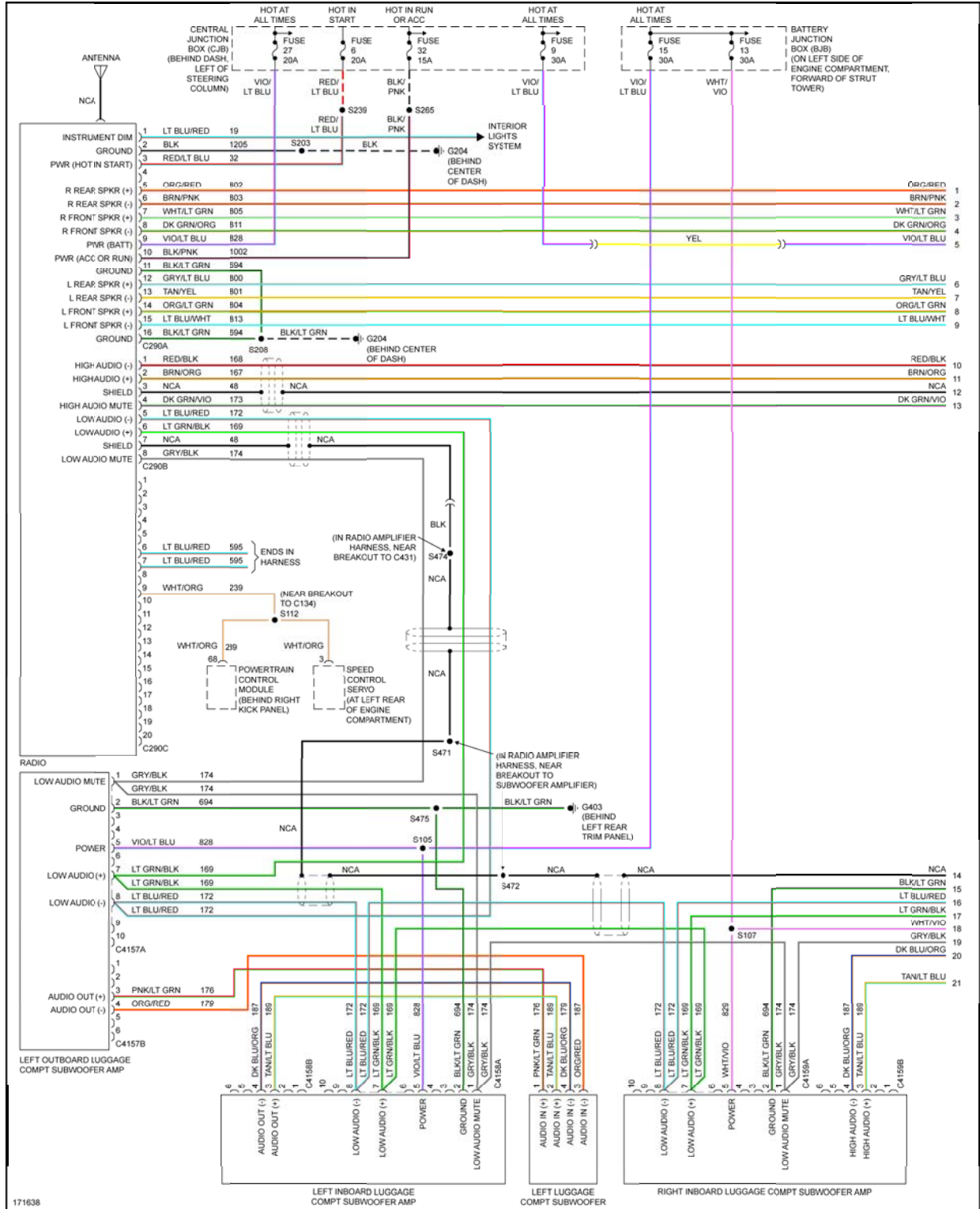


Fig. 45: Premium Sound Radio Circuit, Coupe W/ Mach 1000 Sound System (1 of 2)

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

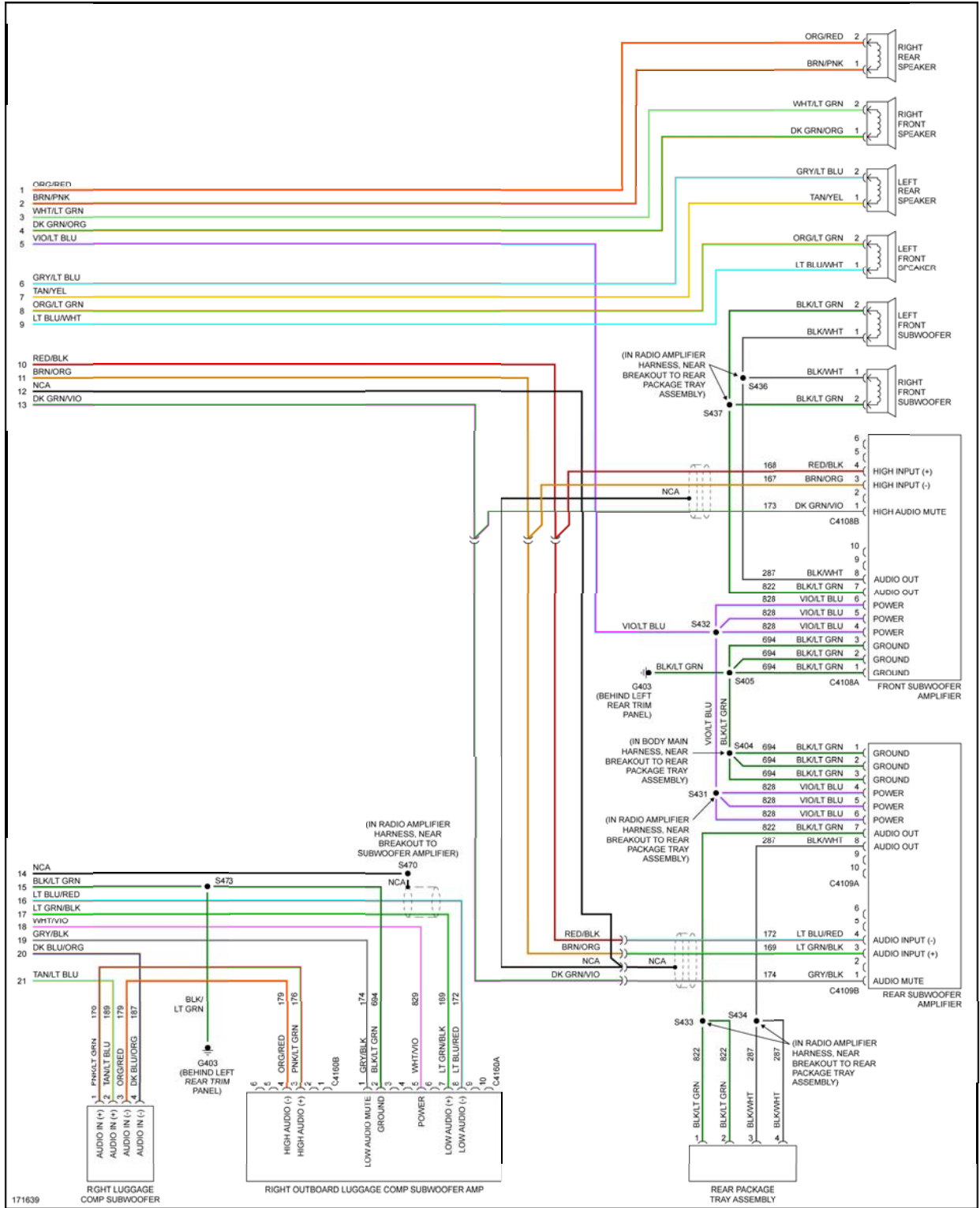


Fig. 46: Premium Sound Radio Circuit, Coupe W/ Mach 1000 Sound System (2 of 2)

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

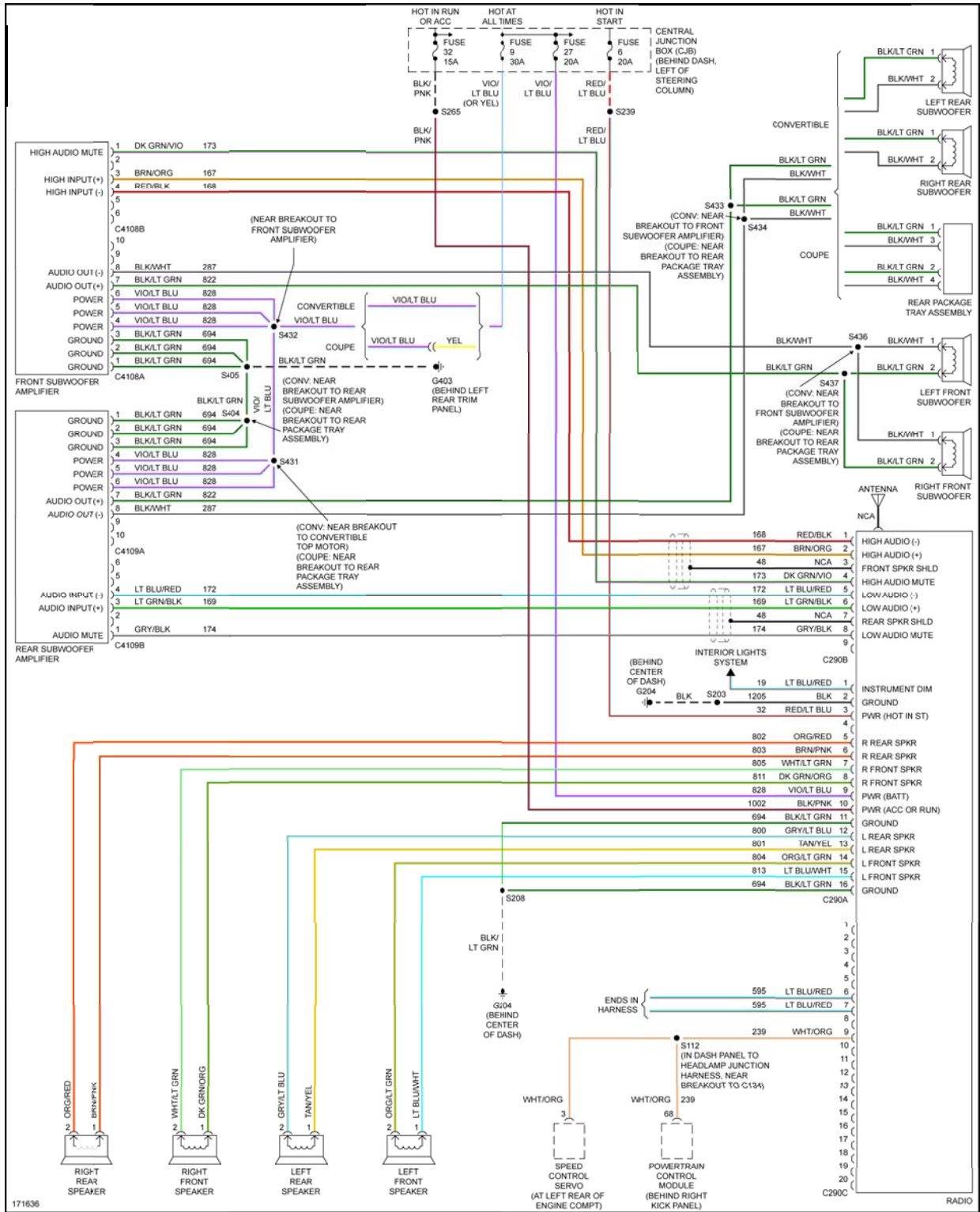


Fig. 47: Premium Sound Radio Circuit, W/ Mach 460 Sound System

SHIFT INTERLOCK

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

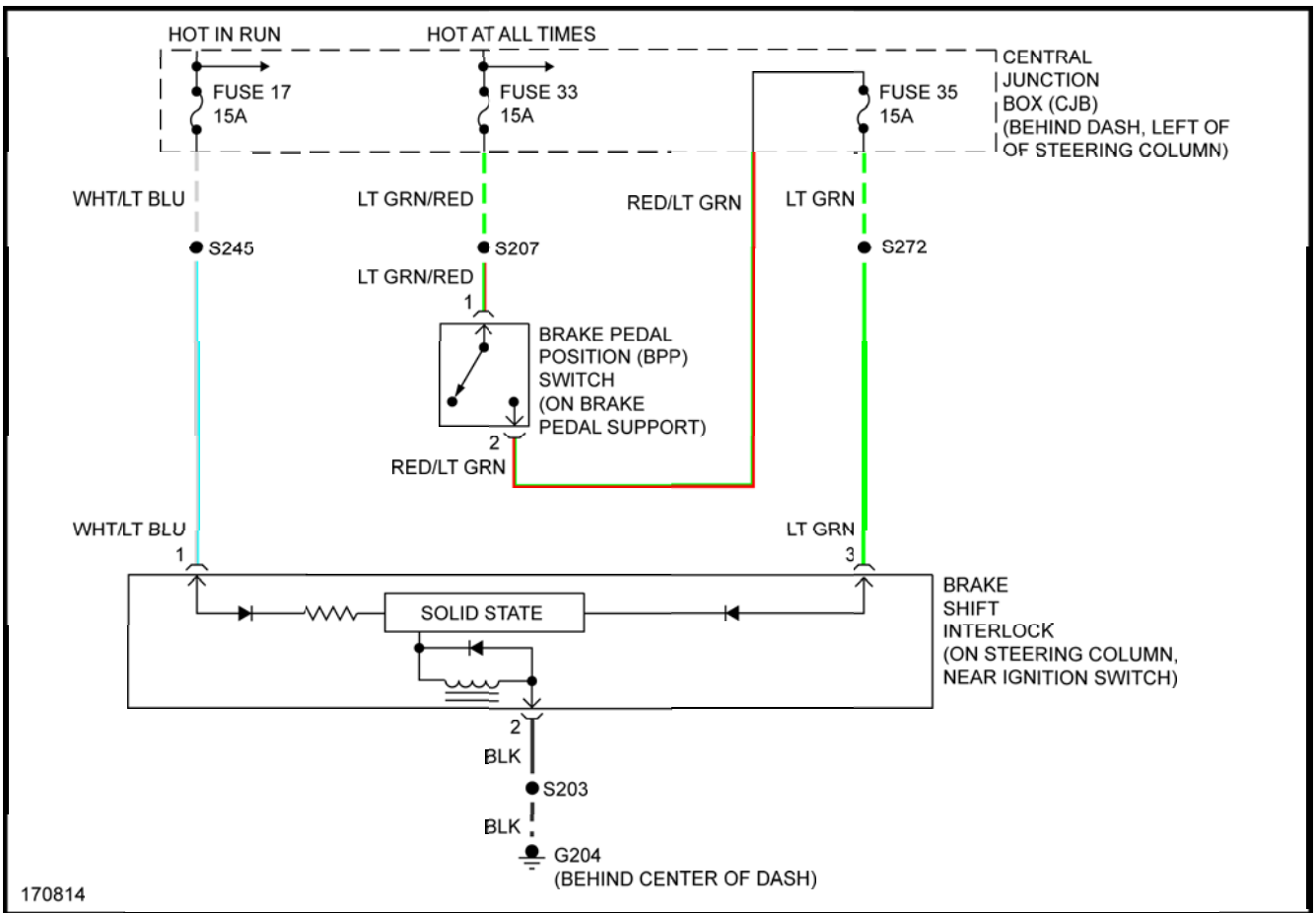


Fig. 48: Shift Interlock Circuit

STARTING/CHARGING

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

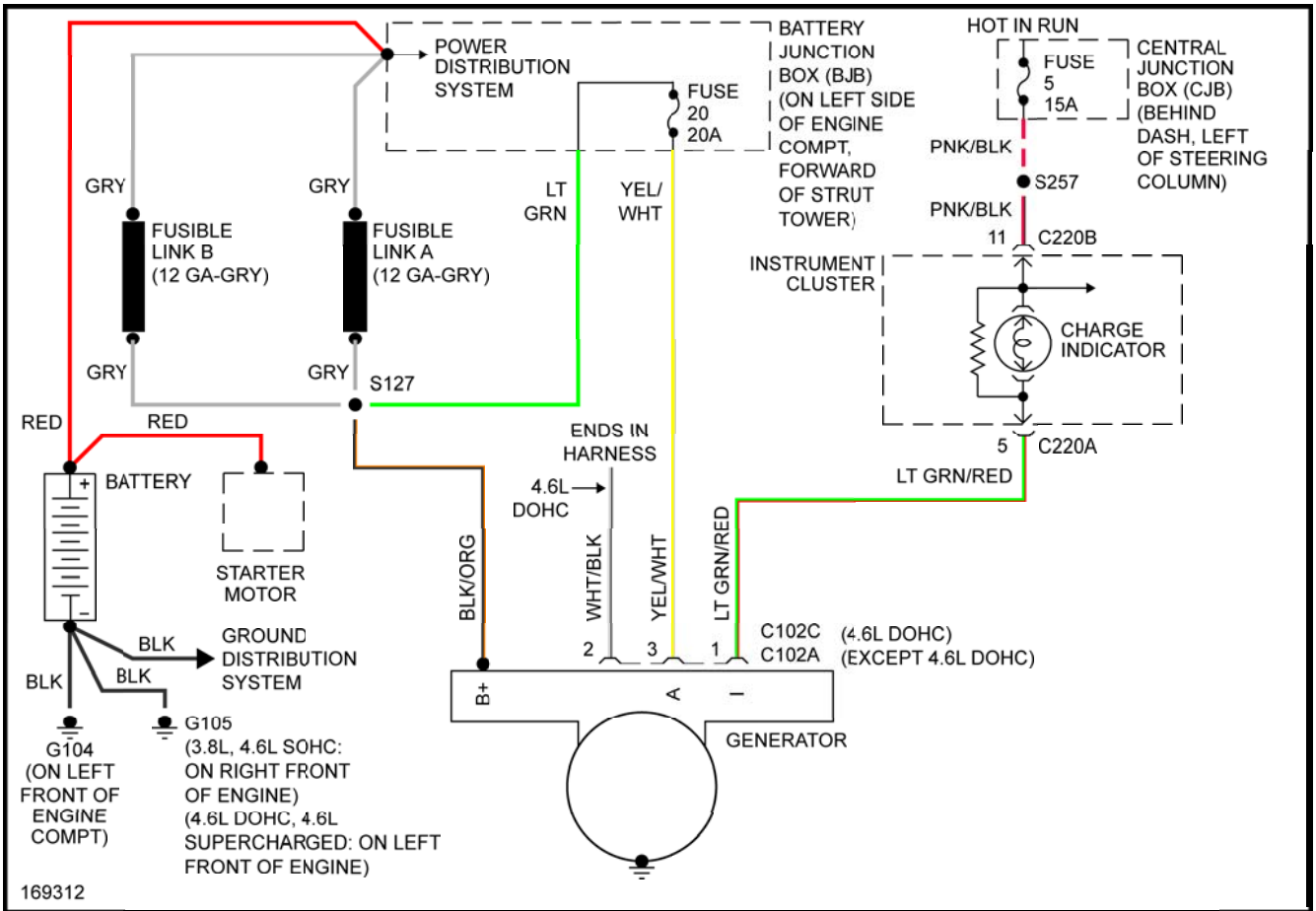


Fig. 49: Charging Circuit

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

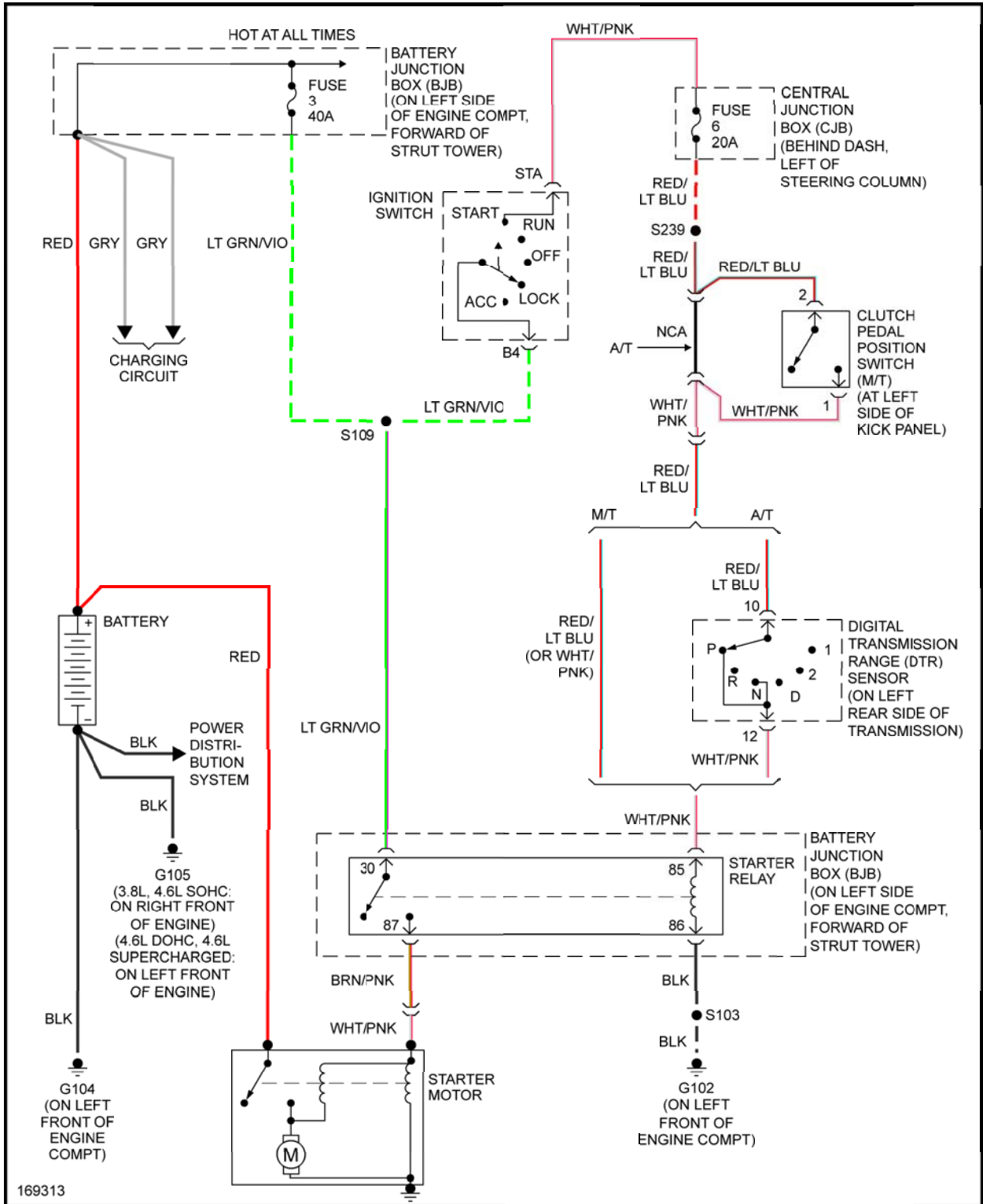


Fig. 50: Starting Circuit

SUPPLEMENTAL RESTRAINTS

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

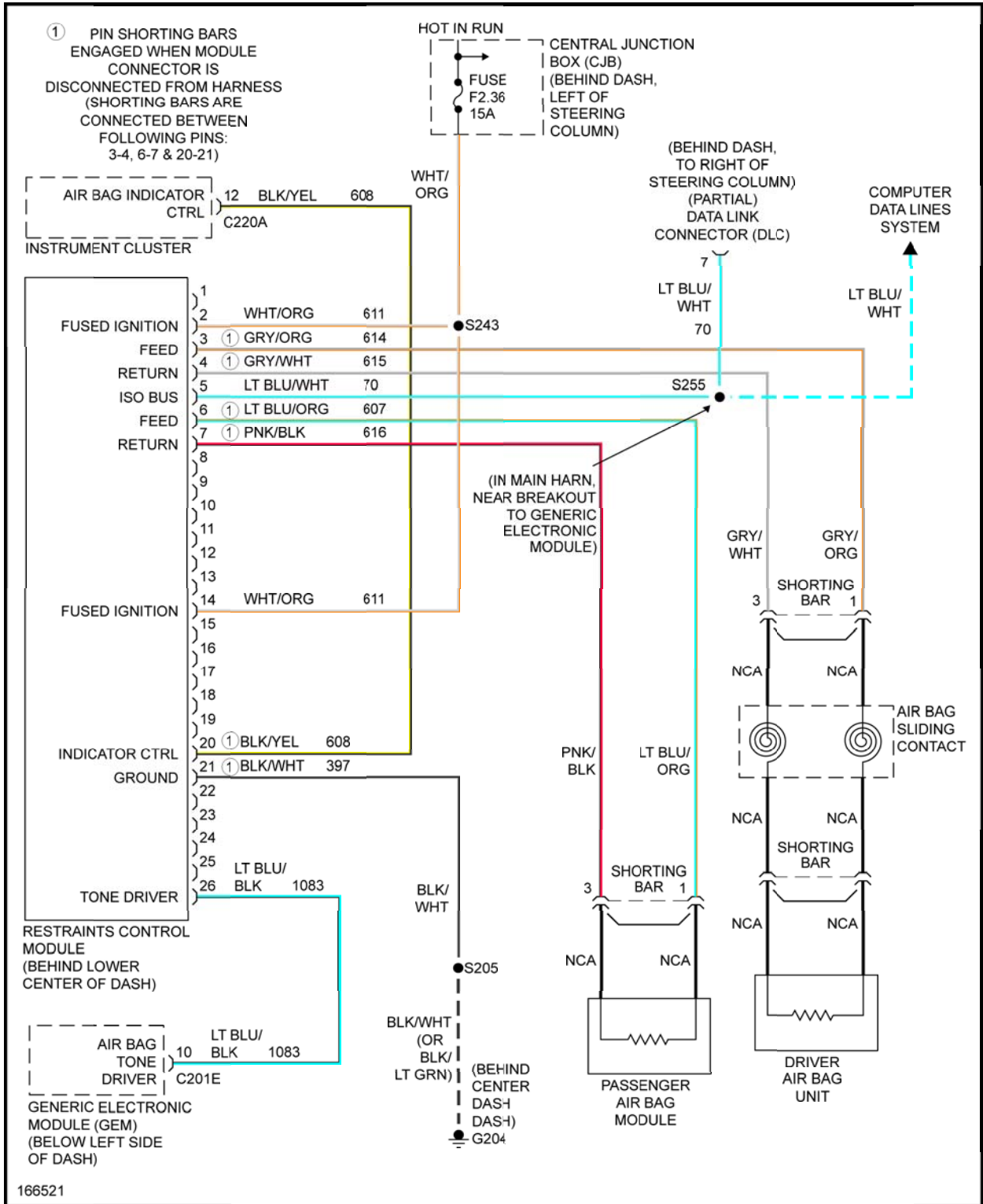


Fig. 51: Supplemental Restraints Circuit

TRANSMISSION

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

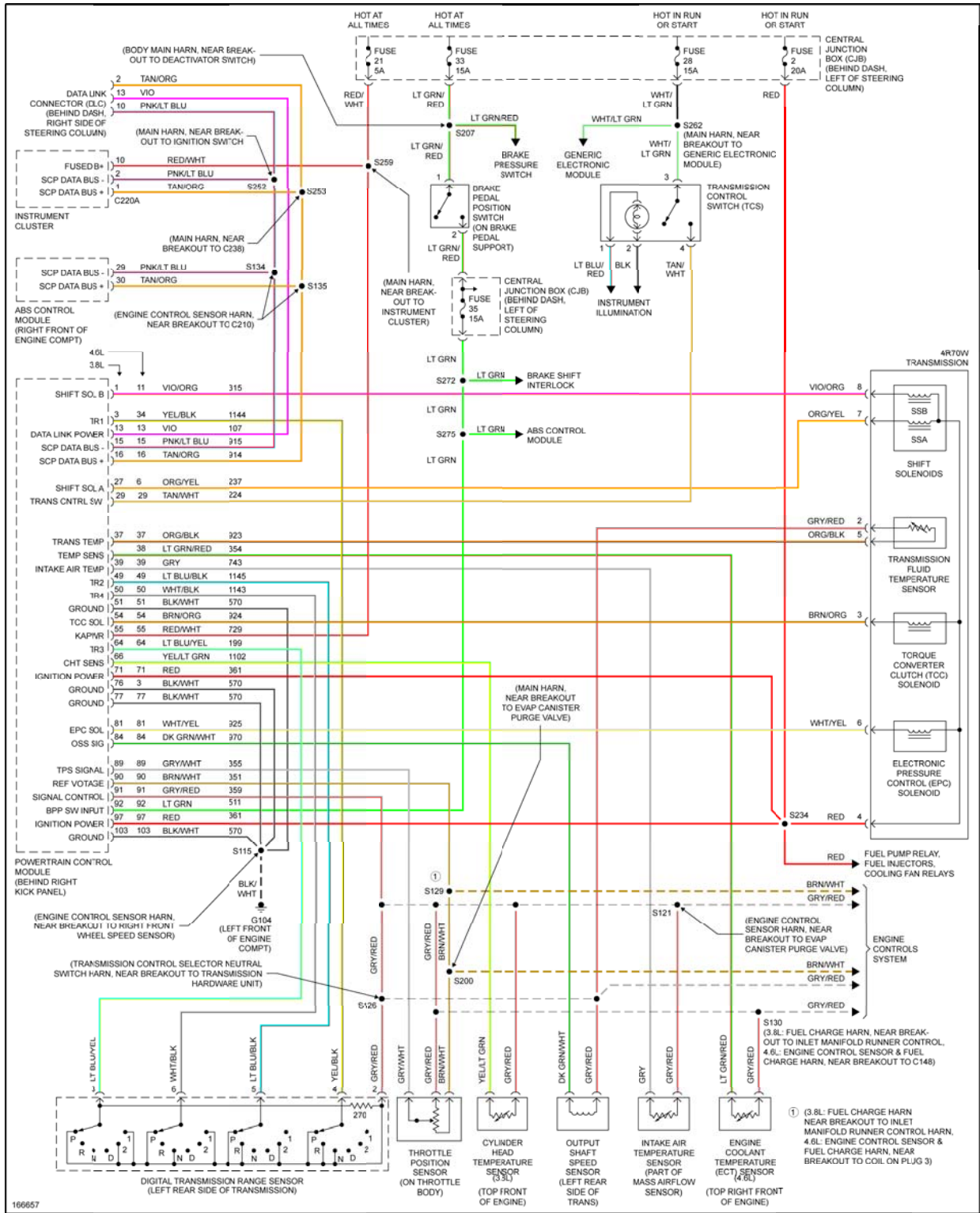


Fig. 52: A/T Circuit

TRUNK, TAILGATE, FUEL DOOR

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

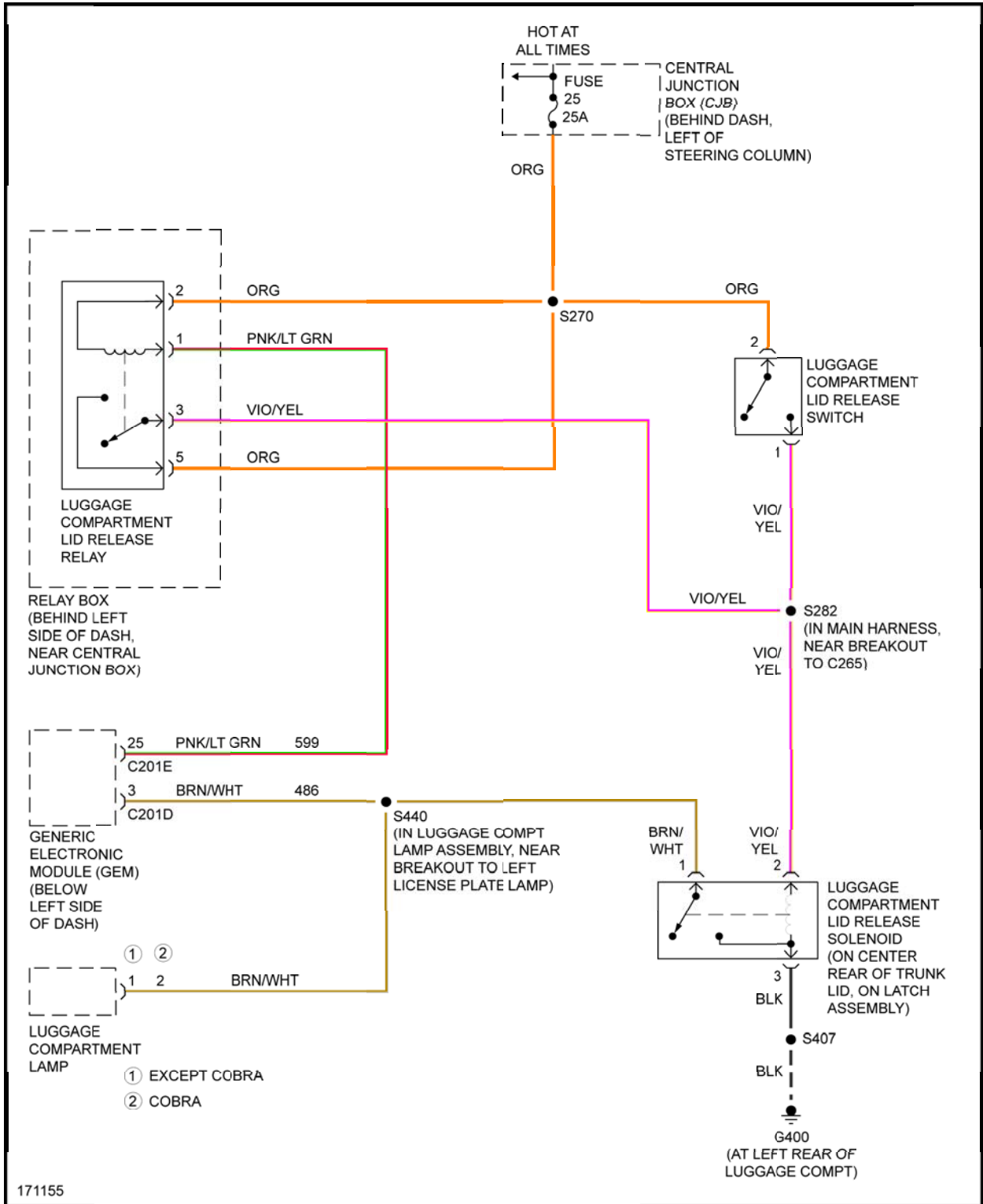


Fig. 53: Trunk, Tailgate, Fuel Door Circuit

WARNING SYSTEMS

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

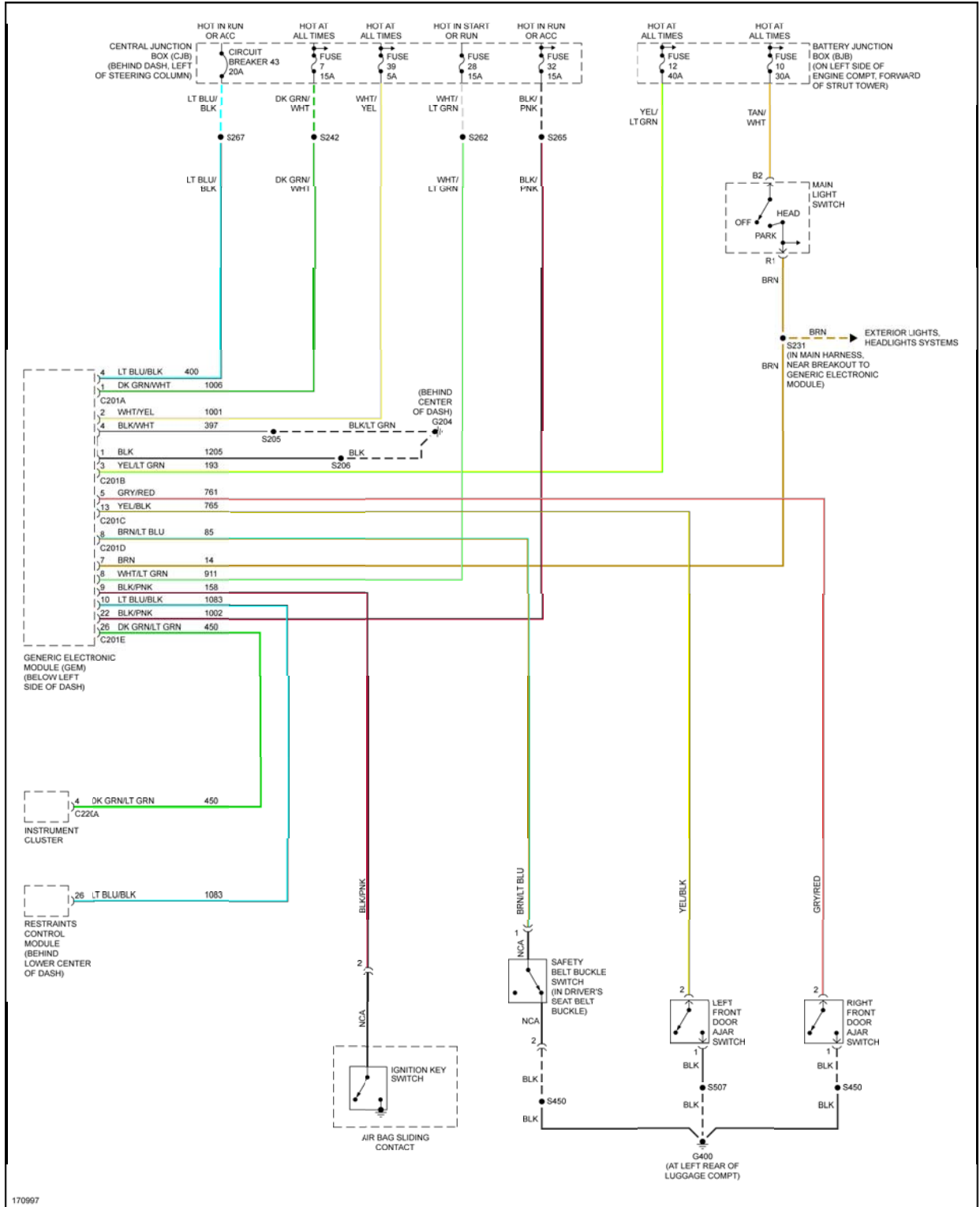


Fig. 54: Warning Systems Circuit

WIPER/WASHER

2003 Ford Mustang GT

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

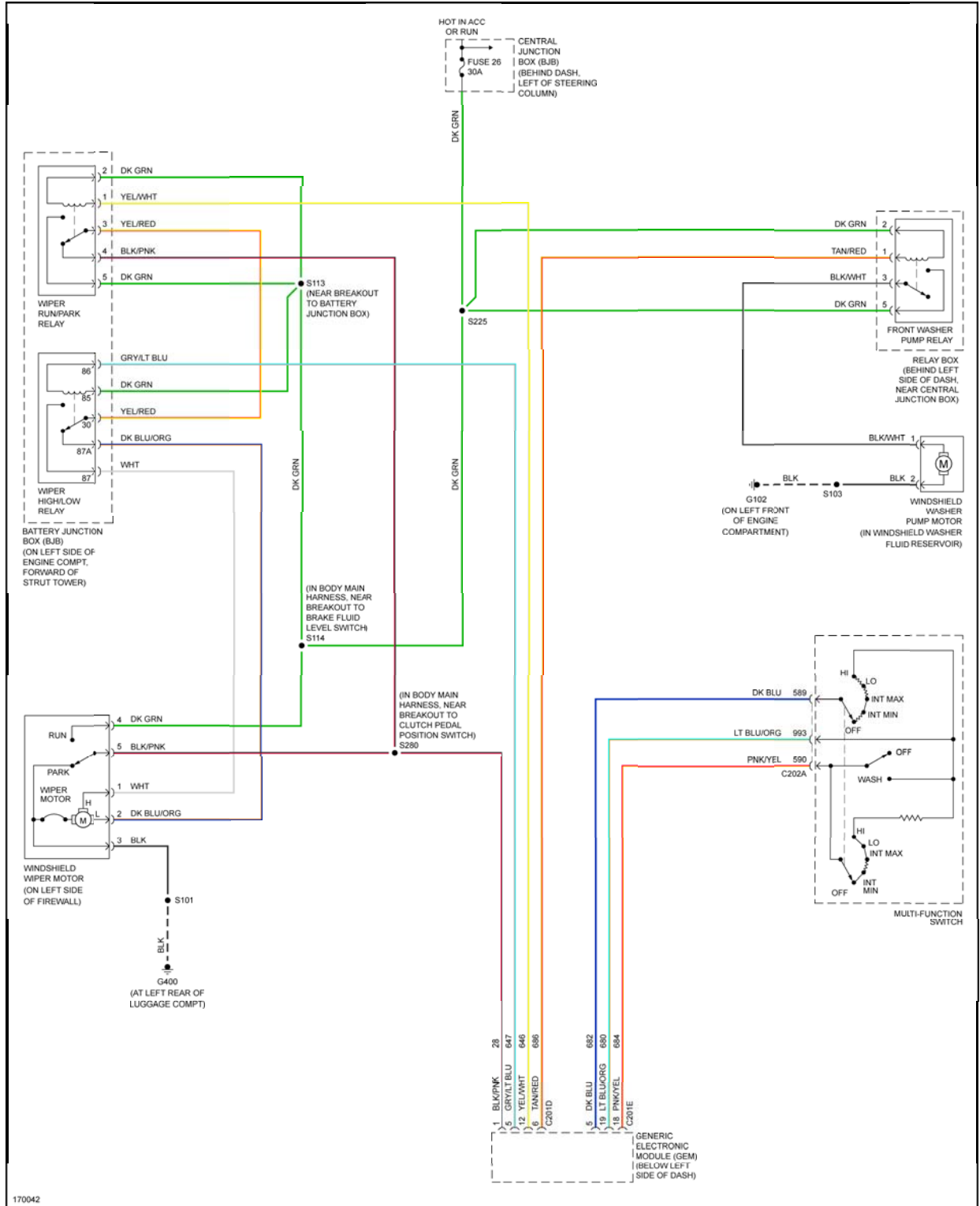


Fig. 55: Wiper/Washer Circuit

2003 SYSTEM WIRING DIAGRAMS

Ford - Mustang

USING WIRING DIAGRAMS

For information on using these wiring diagrams, see [USING SYSTEM WIRING DIAGRAMS](#) article.

AIR CONDITIONING

3.8L

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

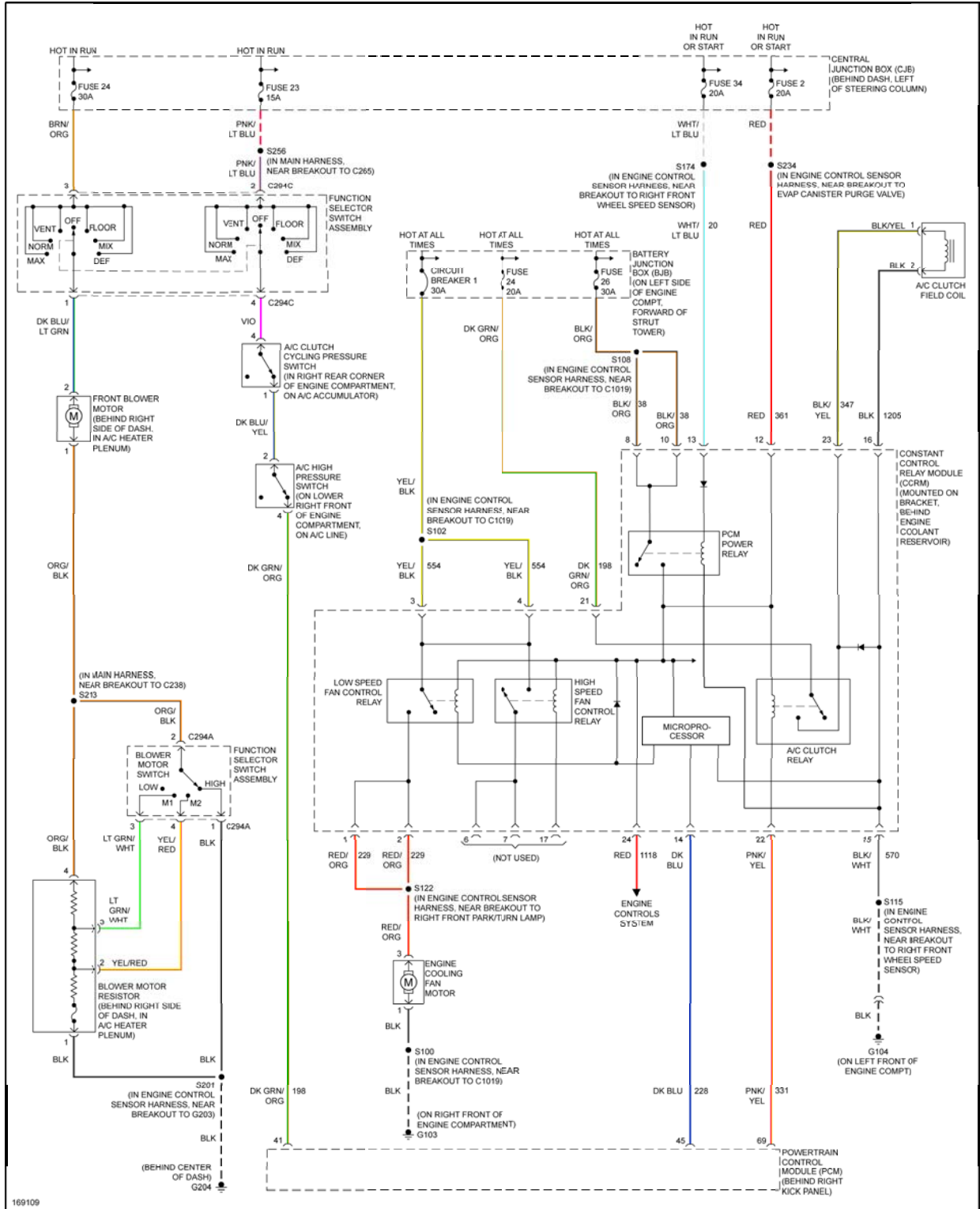


Fig. 1: 3.8L, Air Conditioning Circuit

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

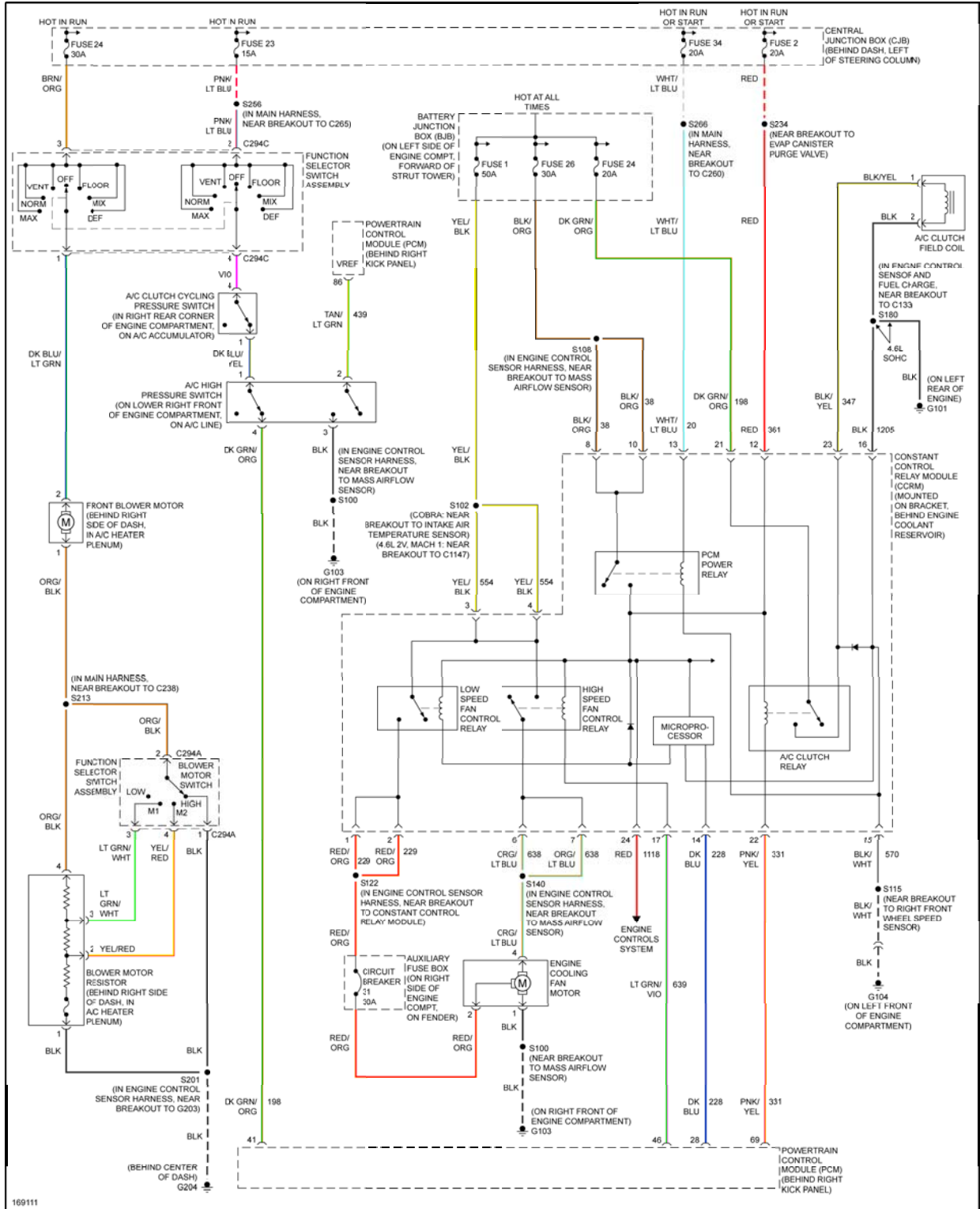
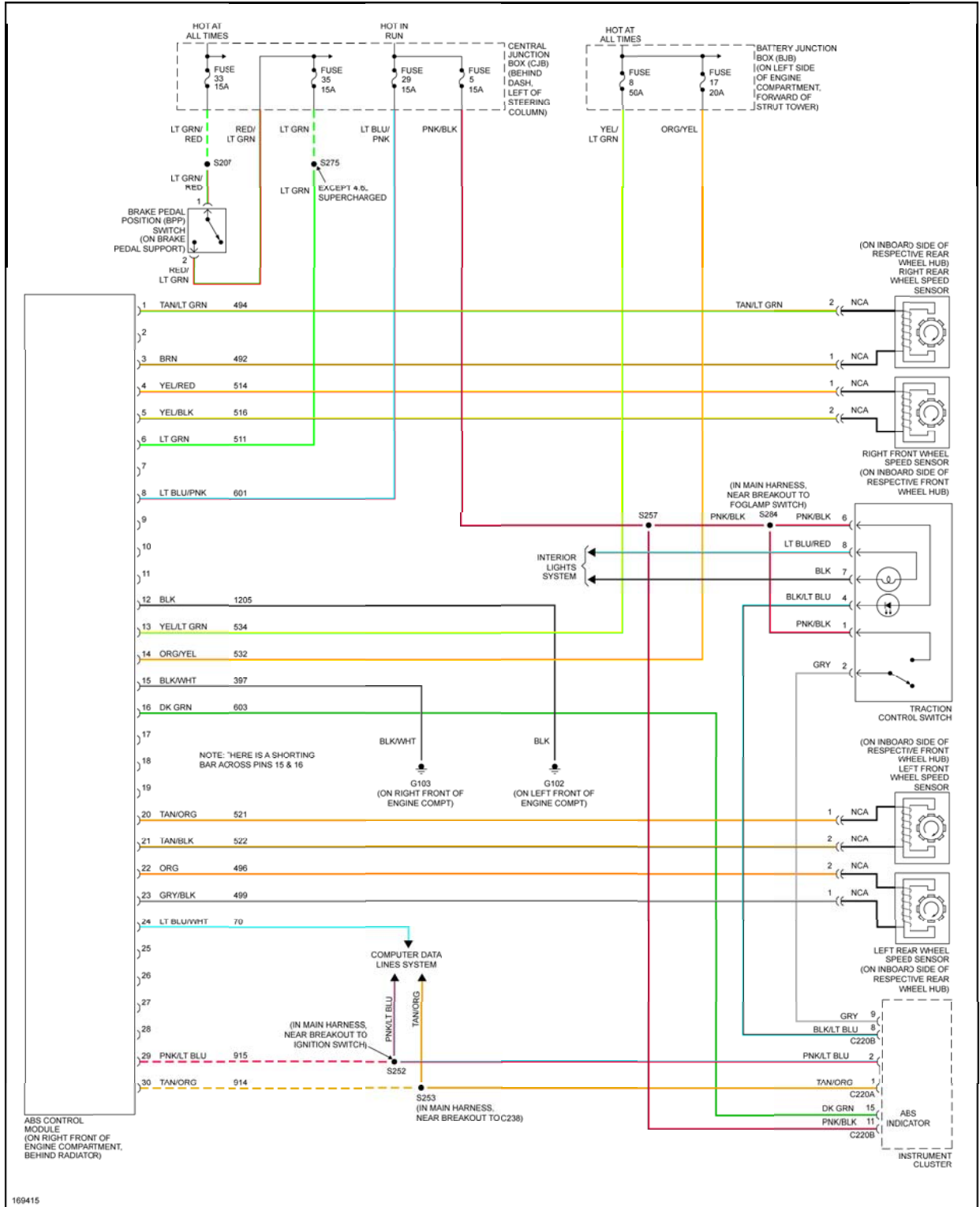


Fig. 2: 4.6L, Air Conditioning Circuit

ANTI-LOCK BRAKES

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang



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Fig. 3: Anti-lock Brakes Circuit

ANTI-THEFT

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

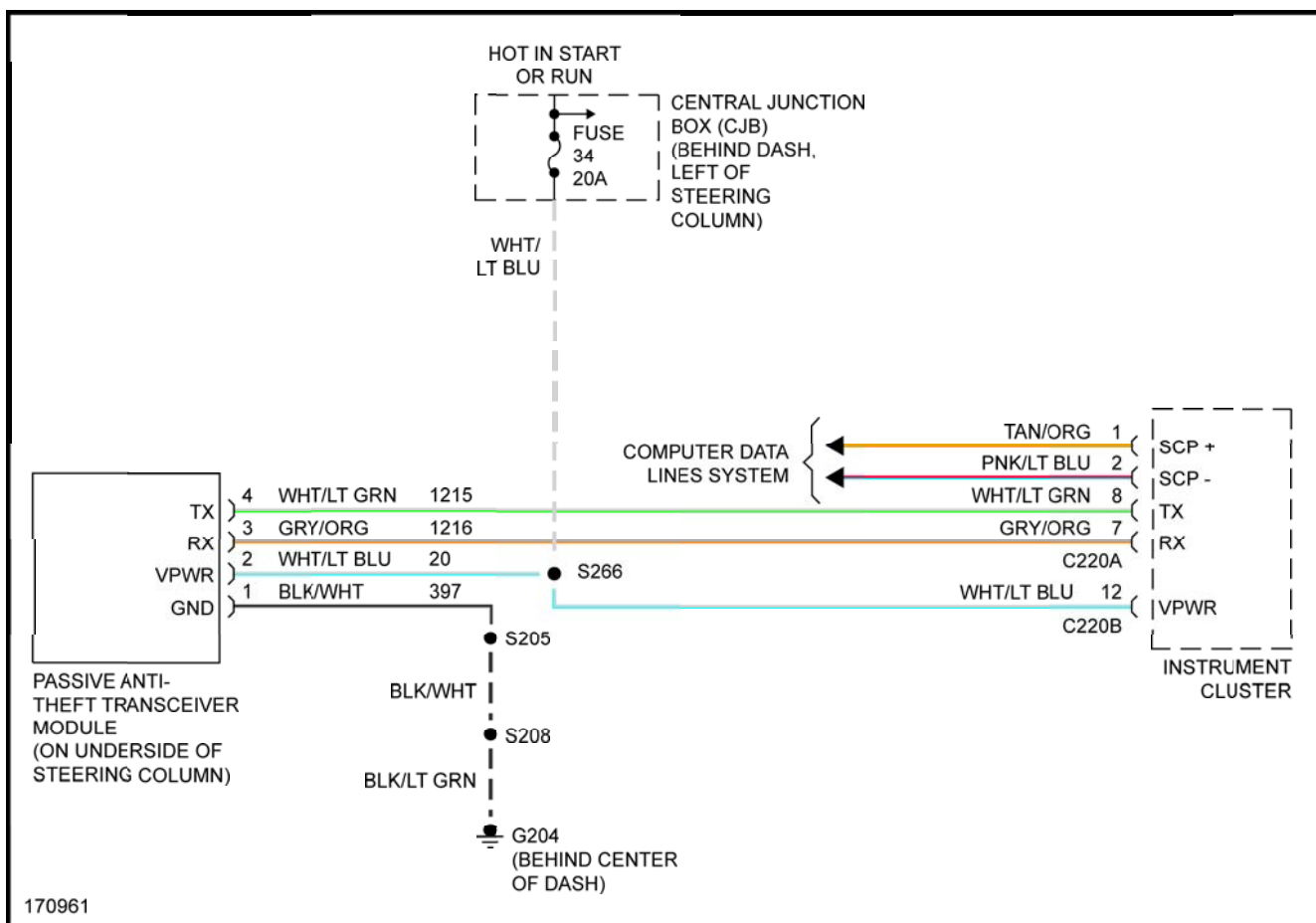


Fig. 4: Passive Anti-theft Circuit

BODY CONTROL MODULES

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

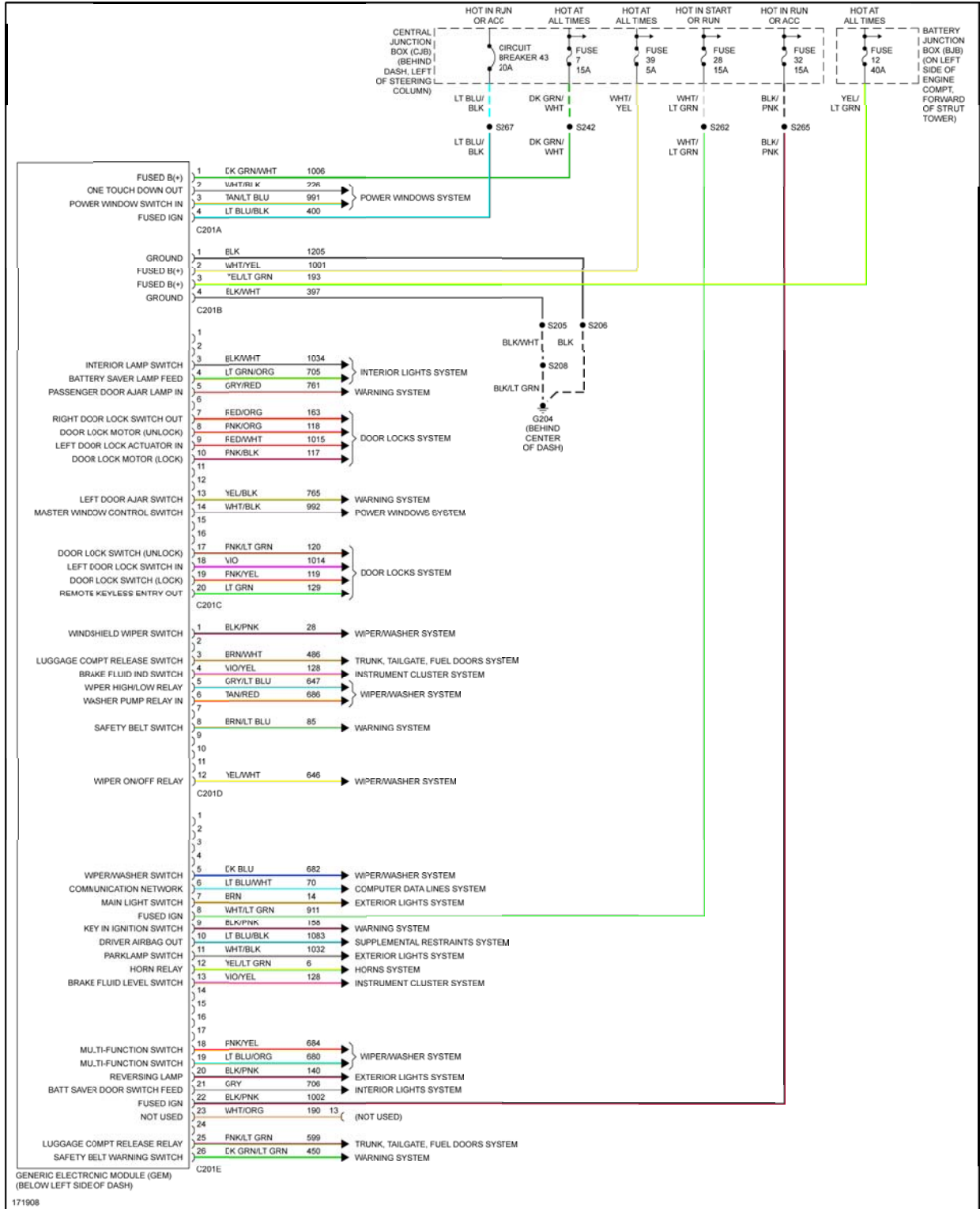


Fig. 5: Body Control Modules Circuit

COMPUTER DATA LINES

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

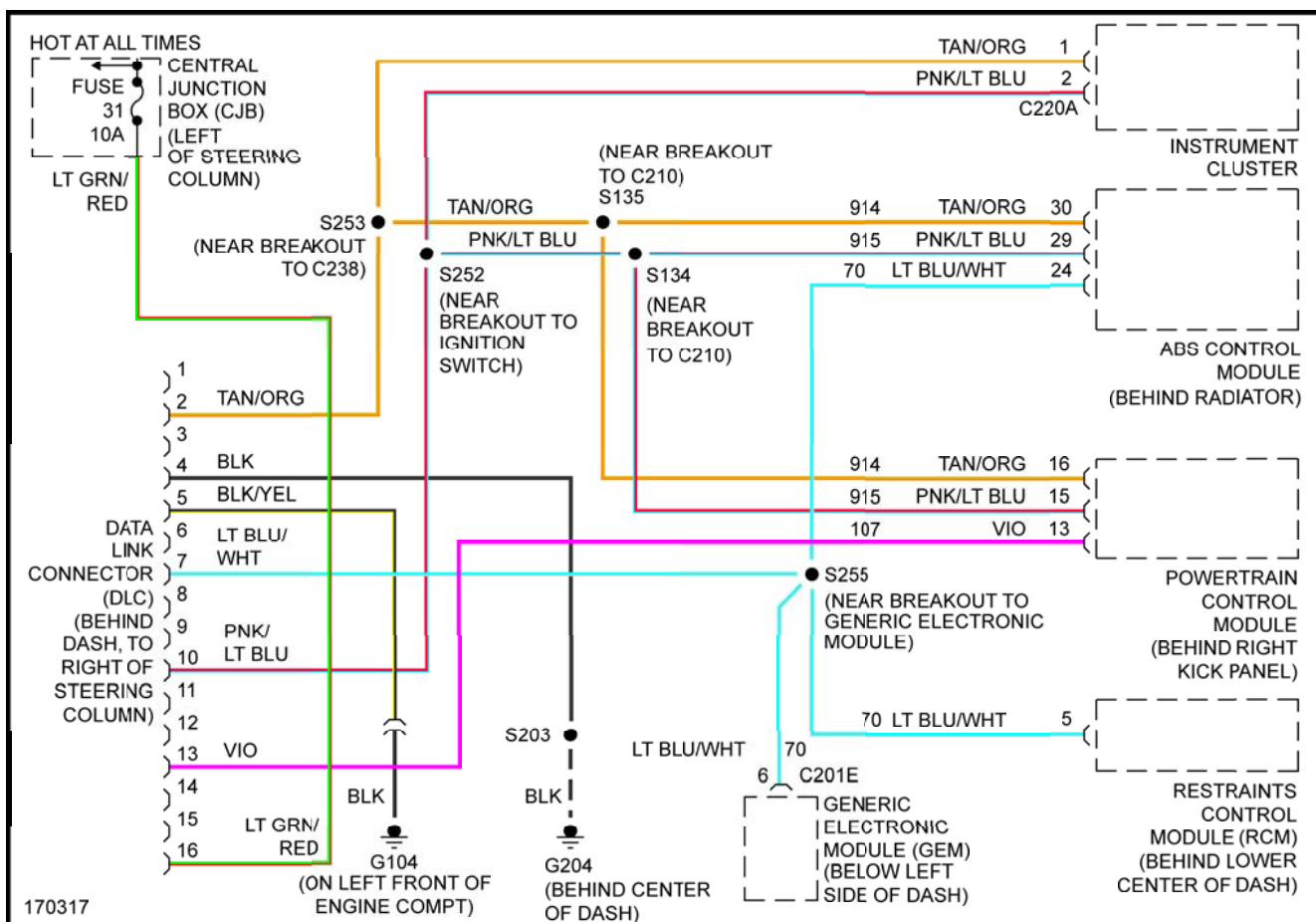


Fig. 6: Computer Data Lines Circuit

COOLING FAN

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

3.8L

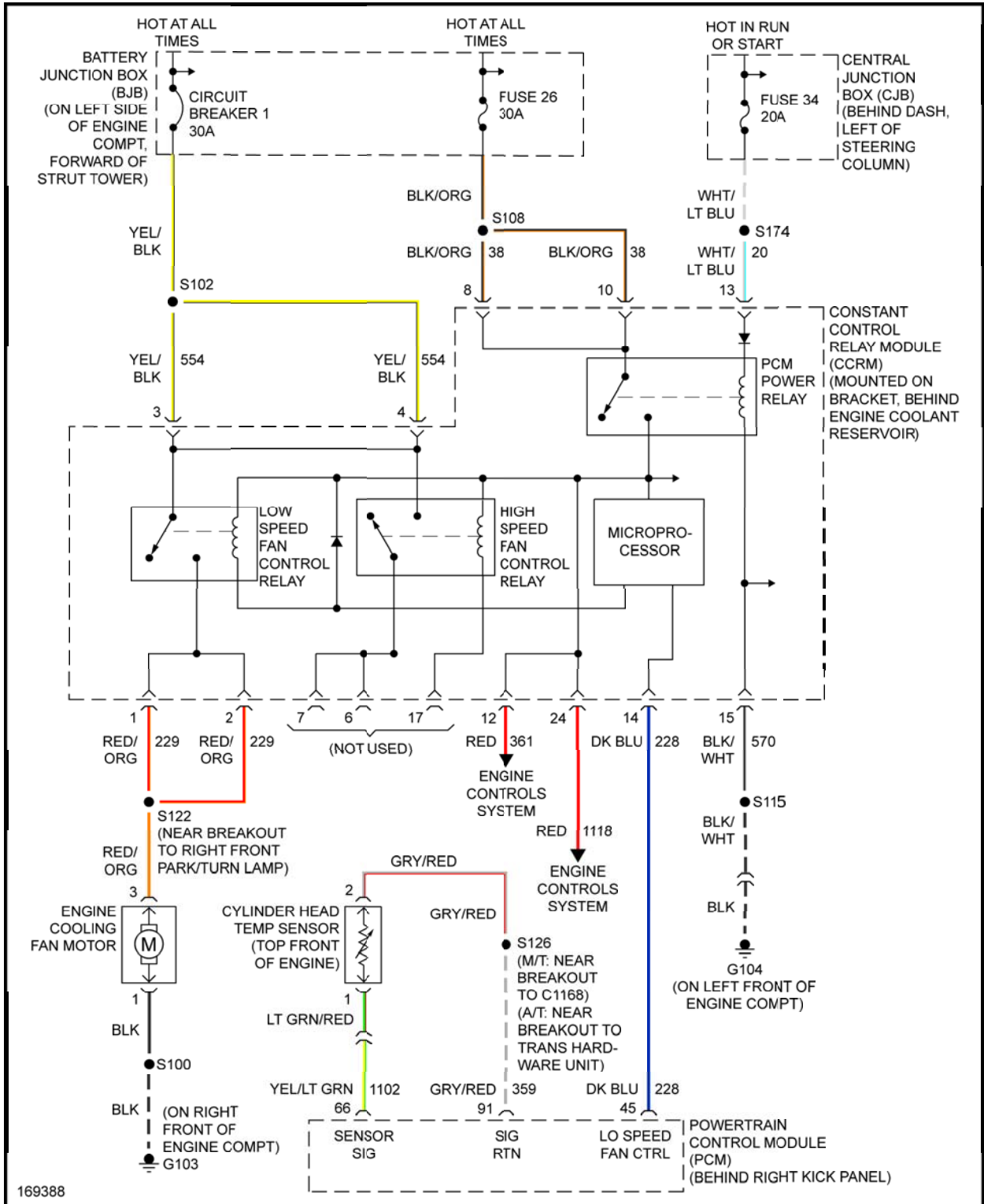


Fig. 7: 3.8L, Cooling Fan Circuit

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

4.6L

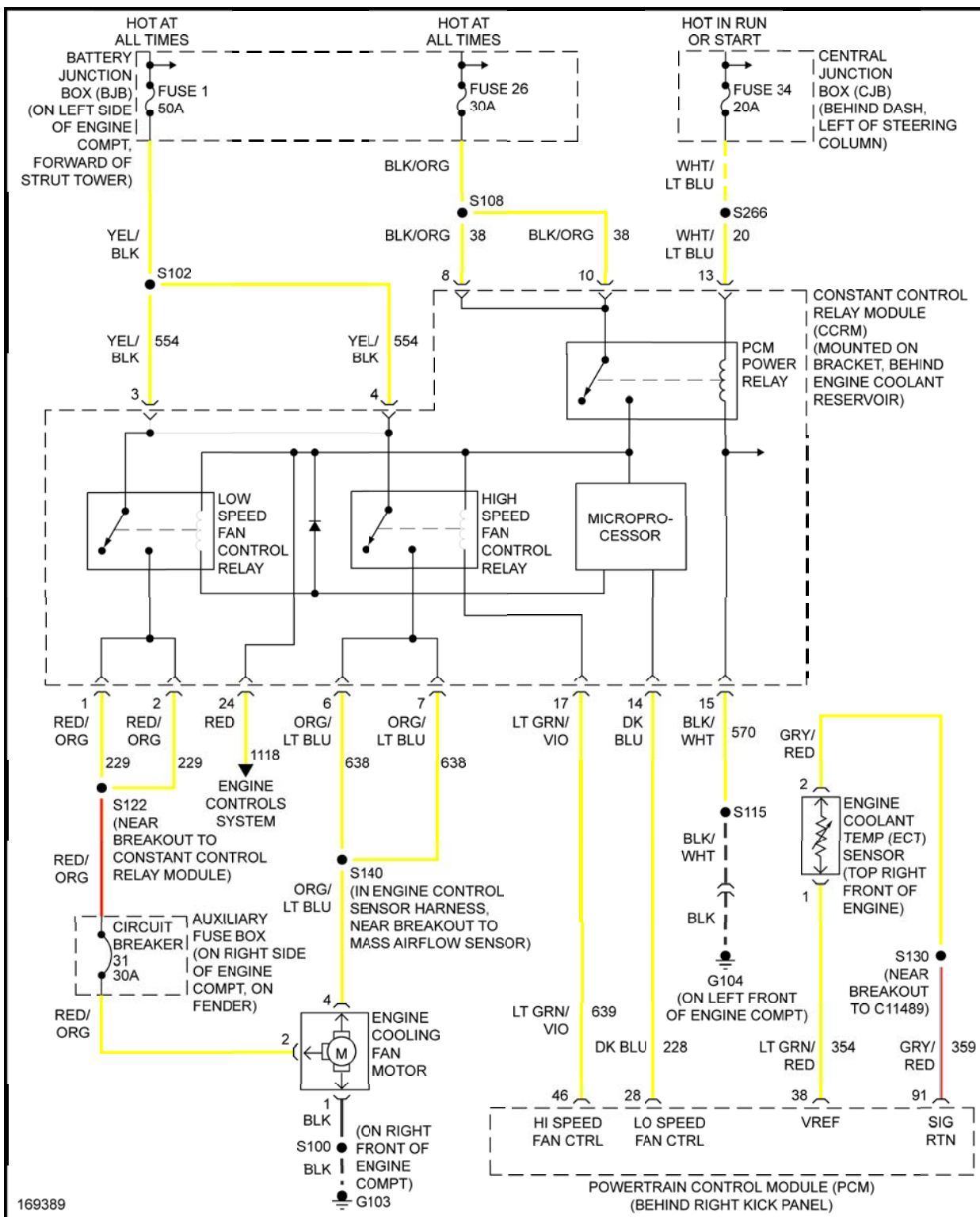
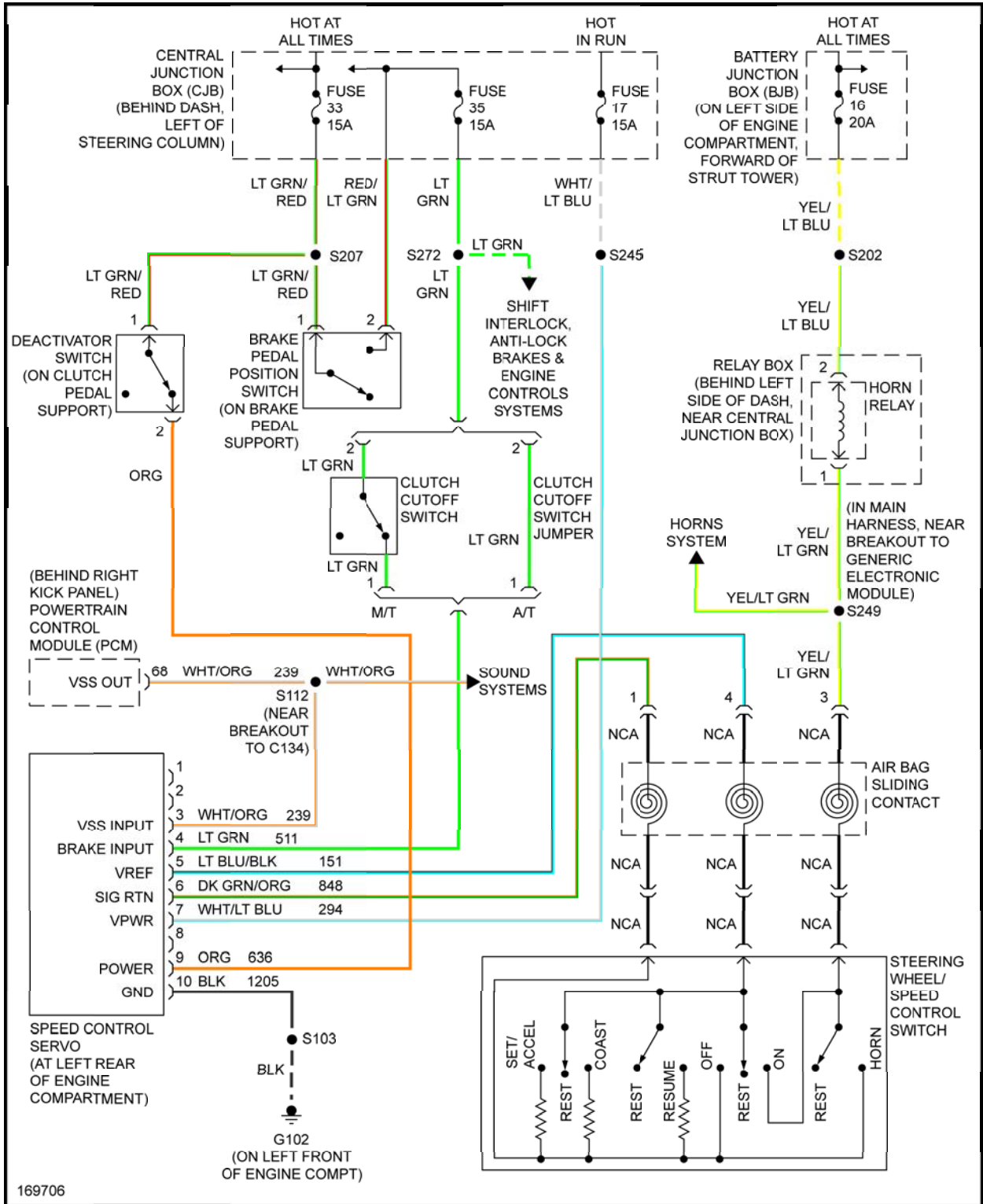


Fig. 8: 4.6L, Cooling Fan Circuit

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

CRUISE CONTROL



169706

Fig. 9: Cruise Control Circuit

DEFOGGERS

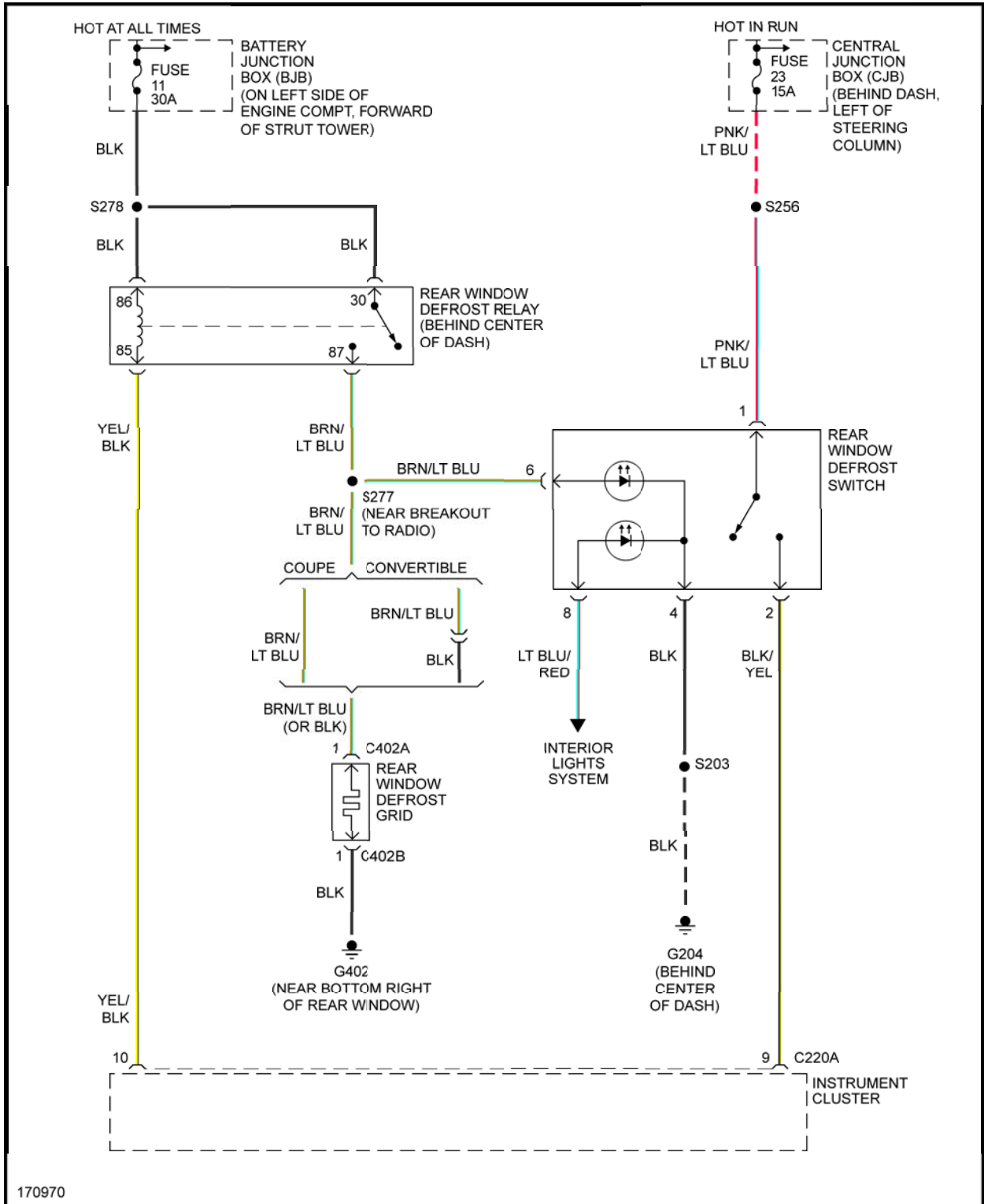


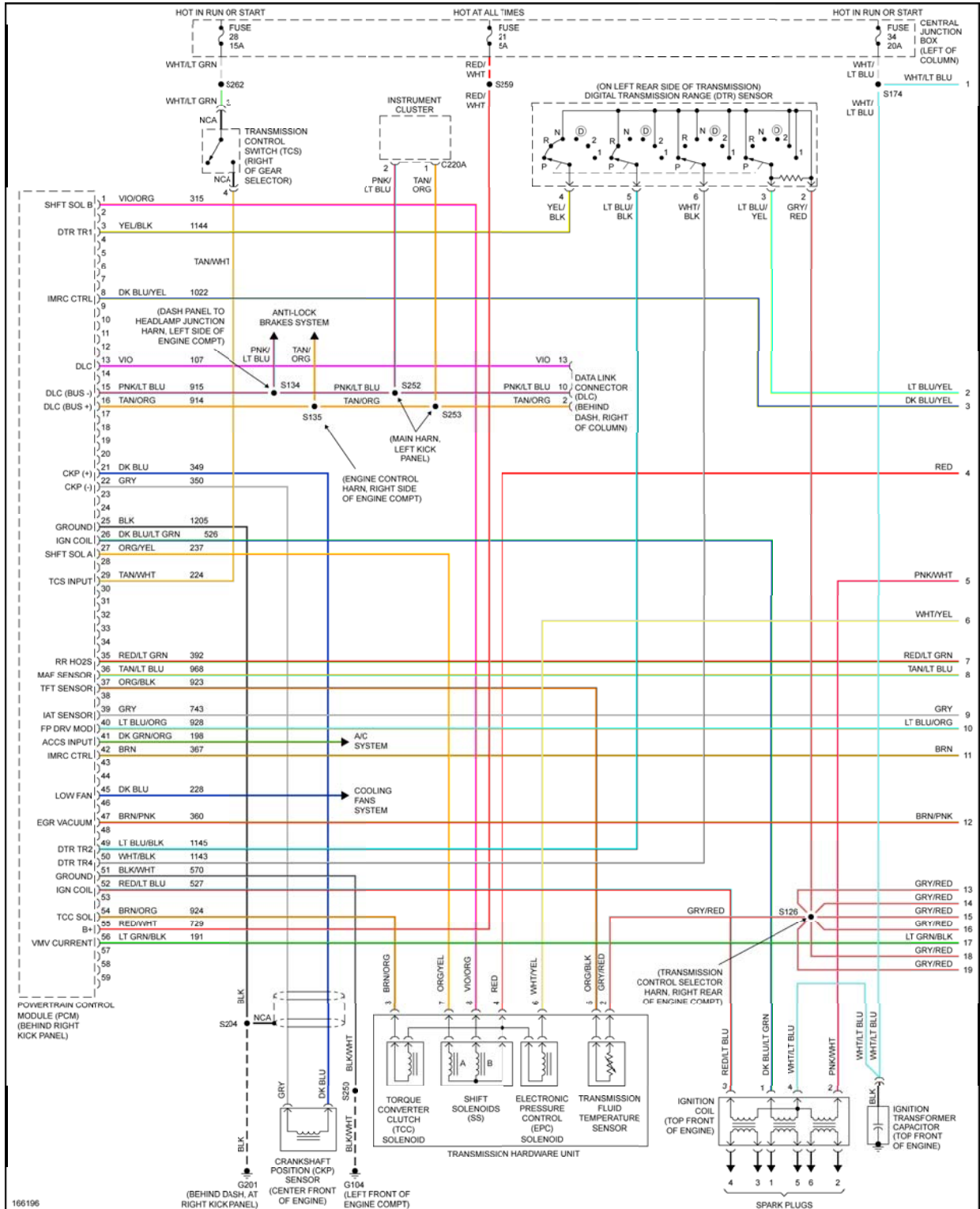
Fig. 10: Defoggers Circuit

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

ENGINE PERFORMANCE

3.8L



2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

Fig. 11: 3.8L, Engine Performance Circuit (1 of 3)

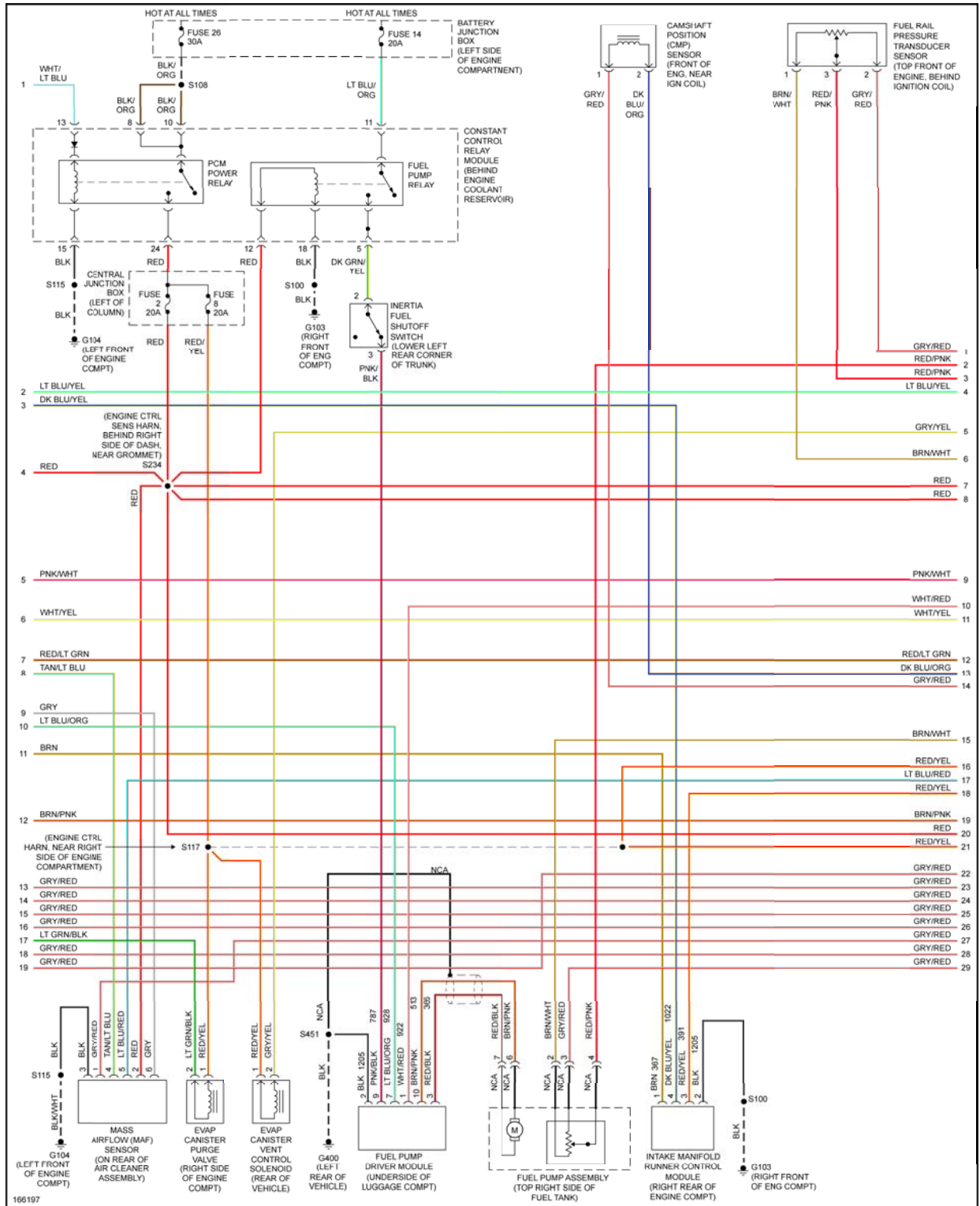


Fig. 12: 3.8L, Engine Performance Circuit (2 of 3)

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

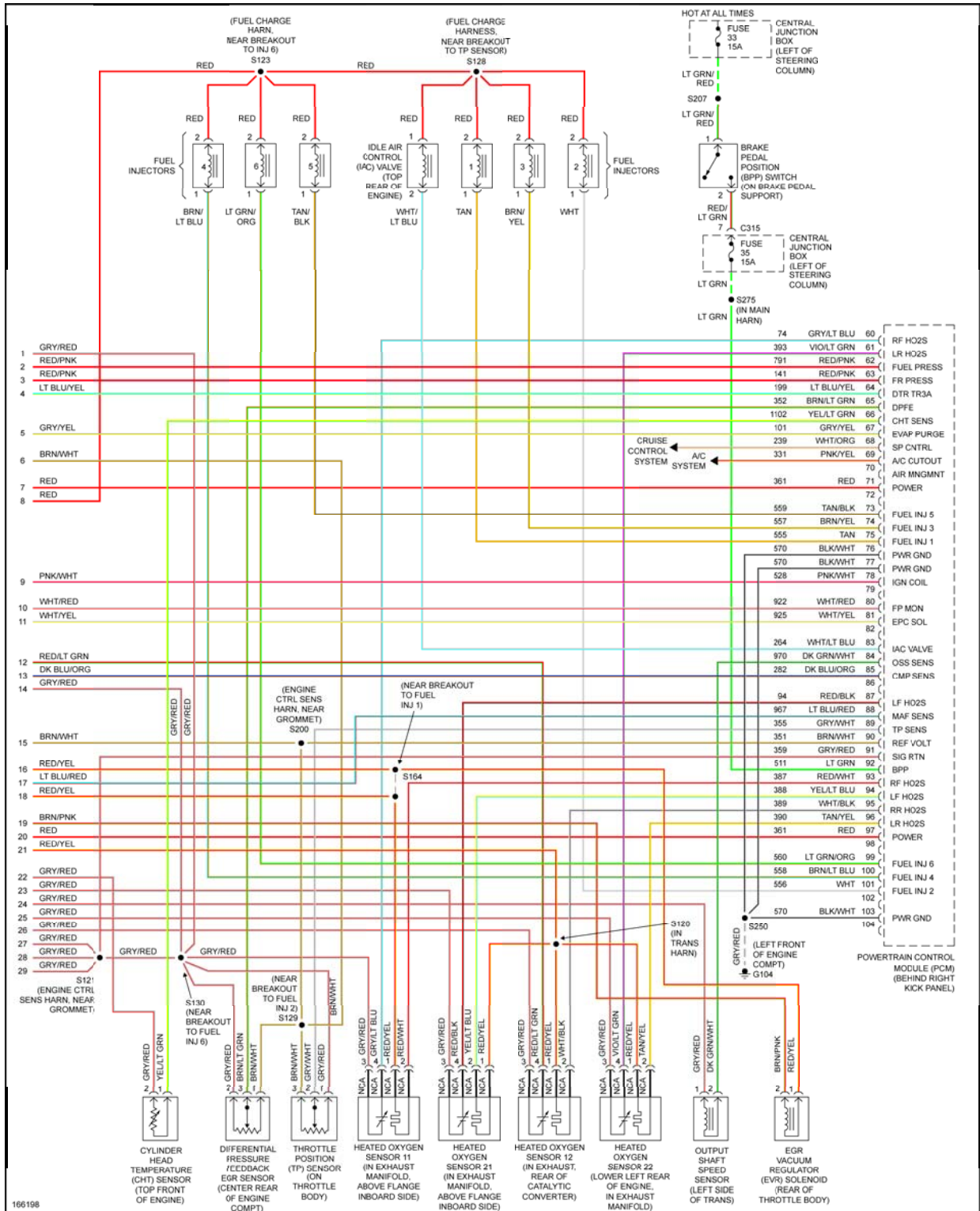


Fig. 13: 3.8L, Engine Performance Circuit (3 of 3)

4.6L DOHC

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

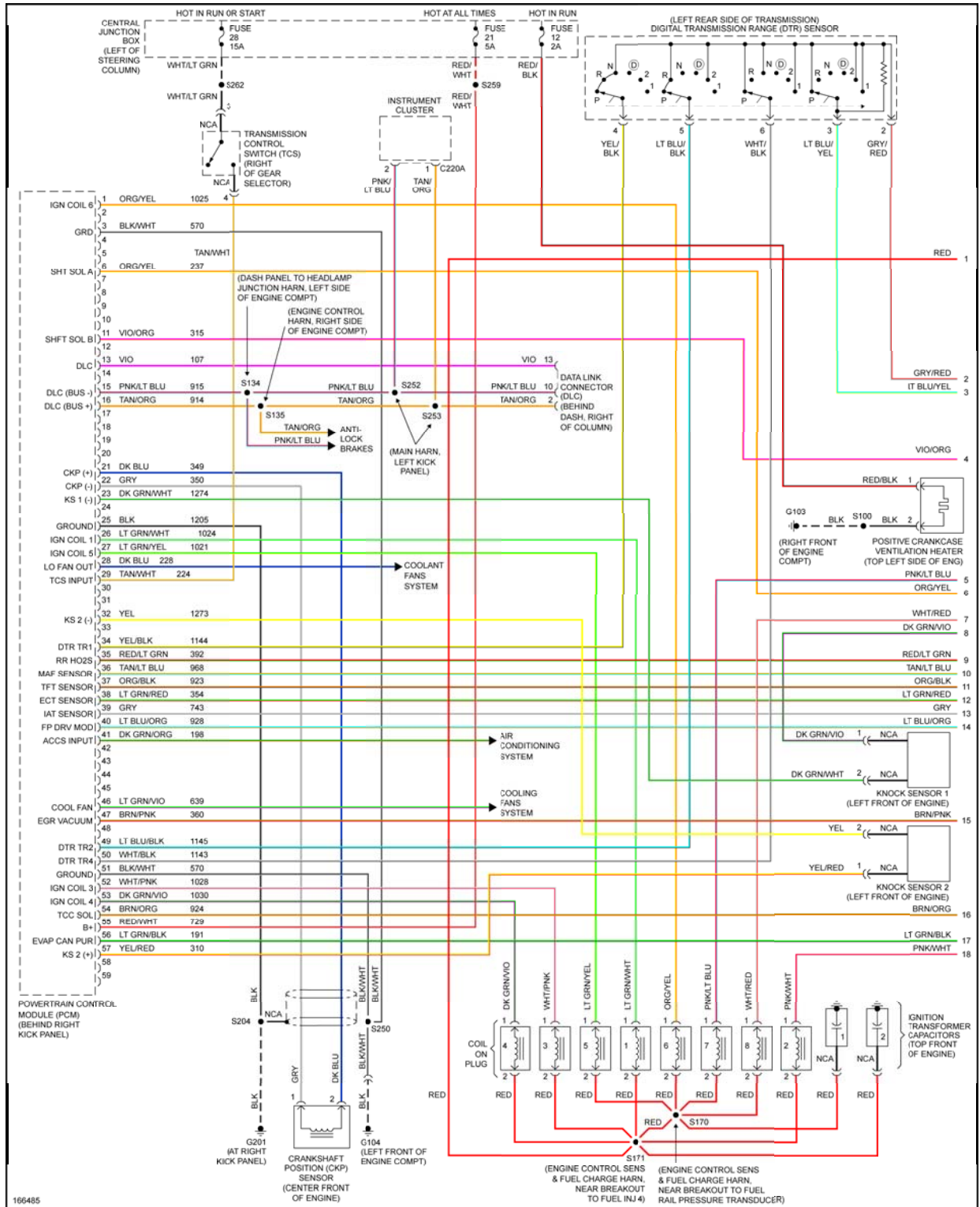


Fig. 14: 4.6L DOHC, Engine Performance Circuit (1 of 3)

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

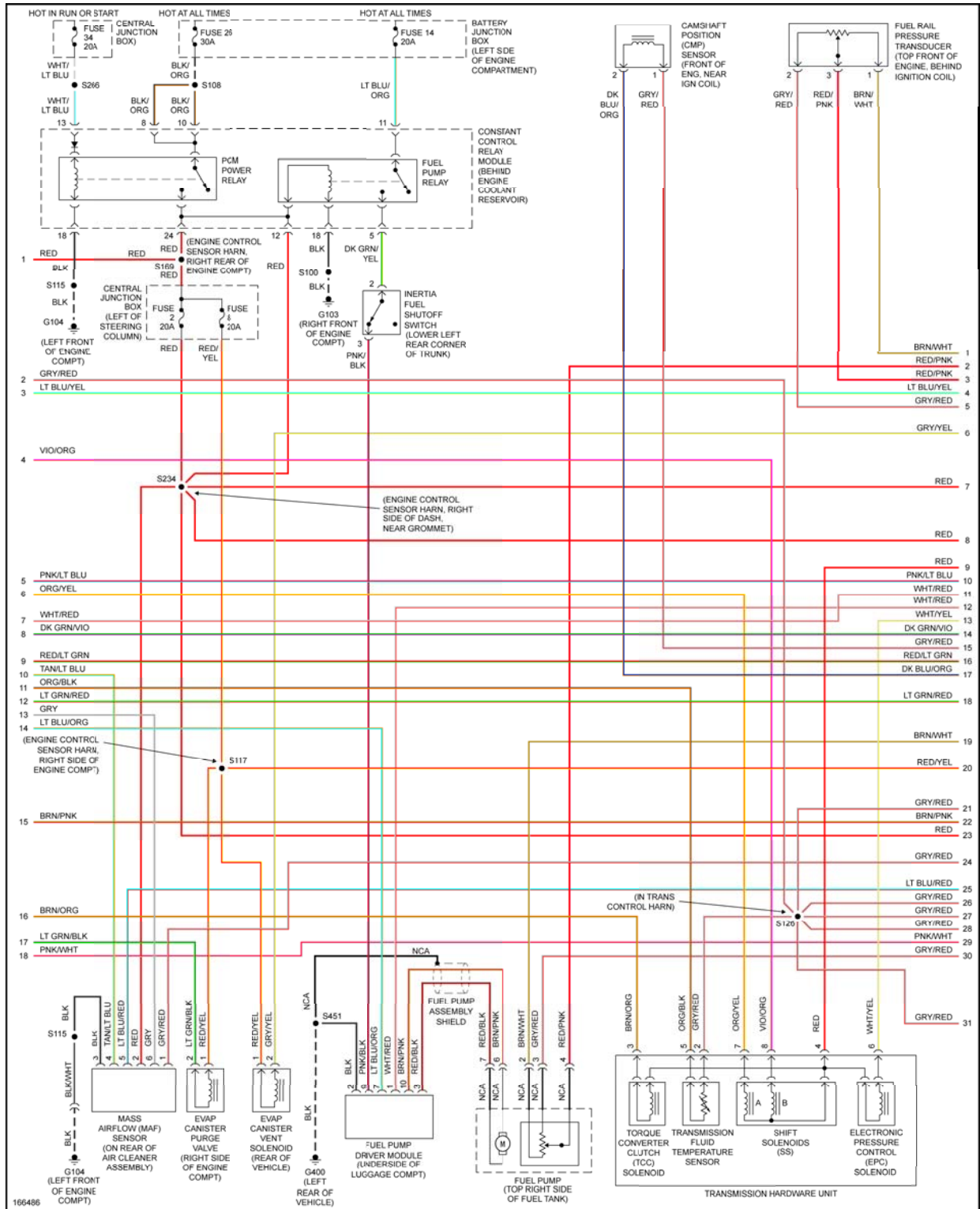


Fig. 15: 4.6L DOHC, Engine Performance Circuit (2 of 3)

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

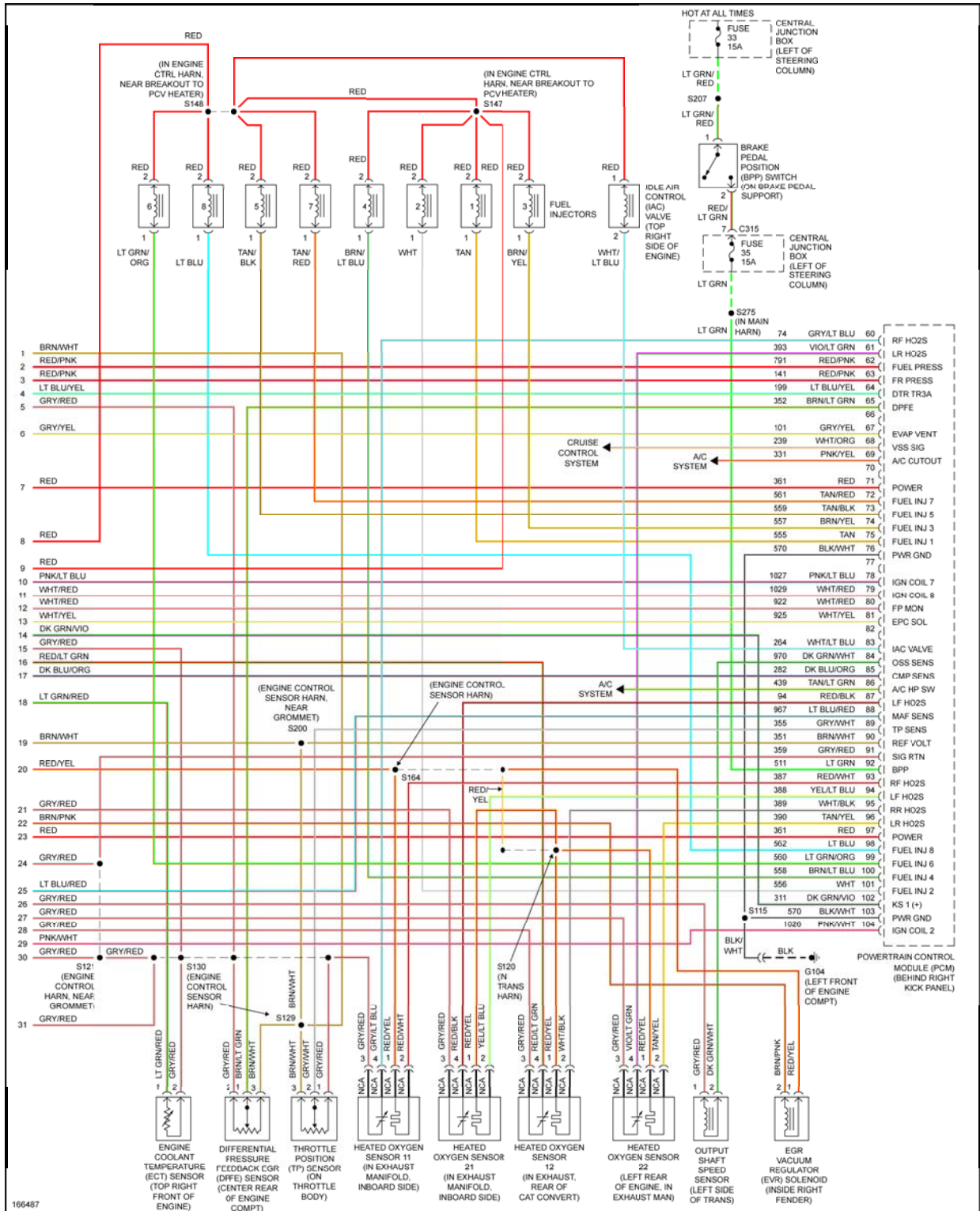


Fig. 16: 4.6L DOHC, Engine Performance Circuit (3 of 3)

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

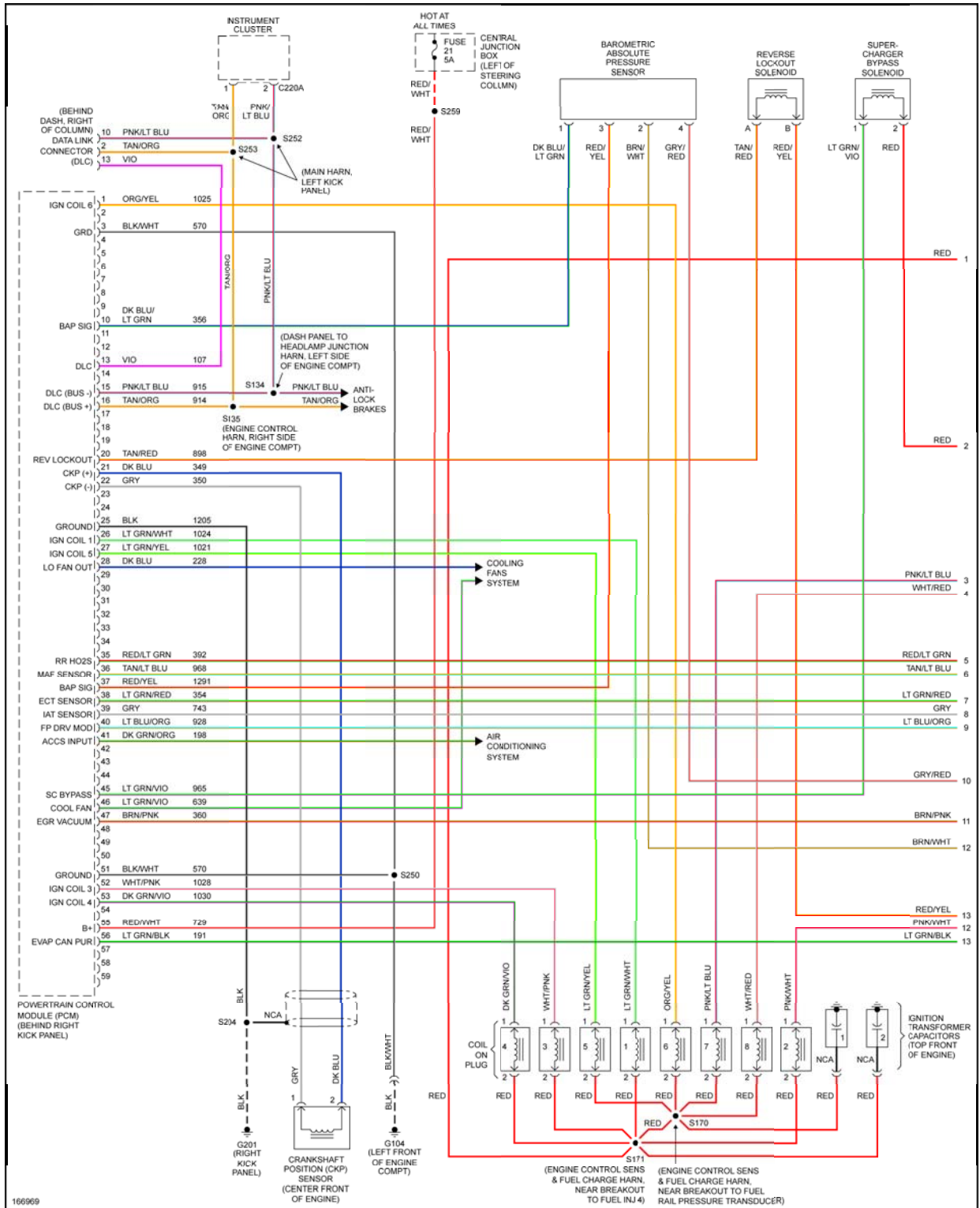


Fig. 17: 4.6L SC, Engine Performance Circuit (1 of 3)

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

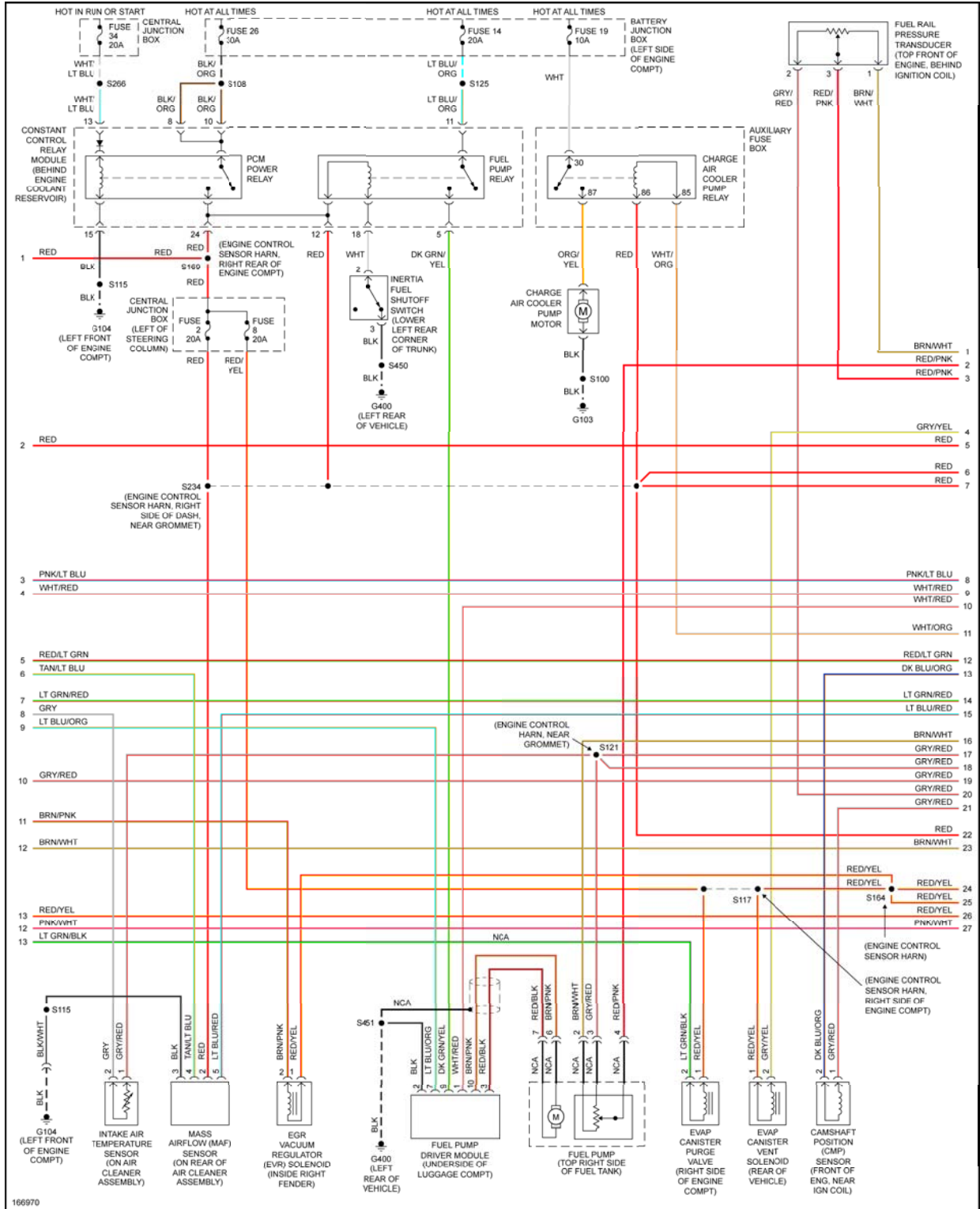


Fig. 18: 4.6L SC, Engine Performance Circuit (2 of 3)

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

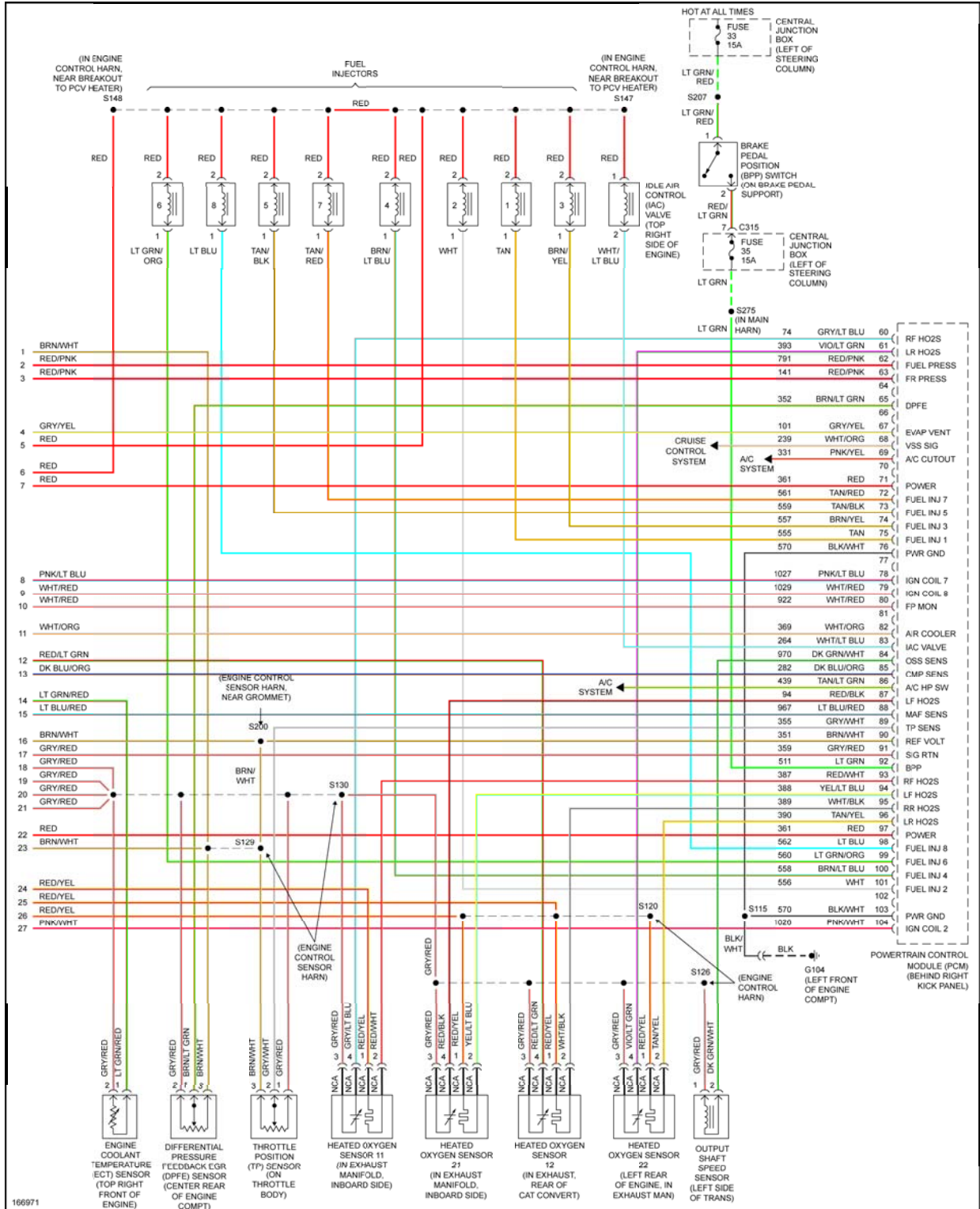


Fig. 19: 4.6L SC, Engine Performance Circuit (3 of 3)

4.6L SOHC

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

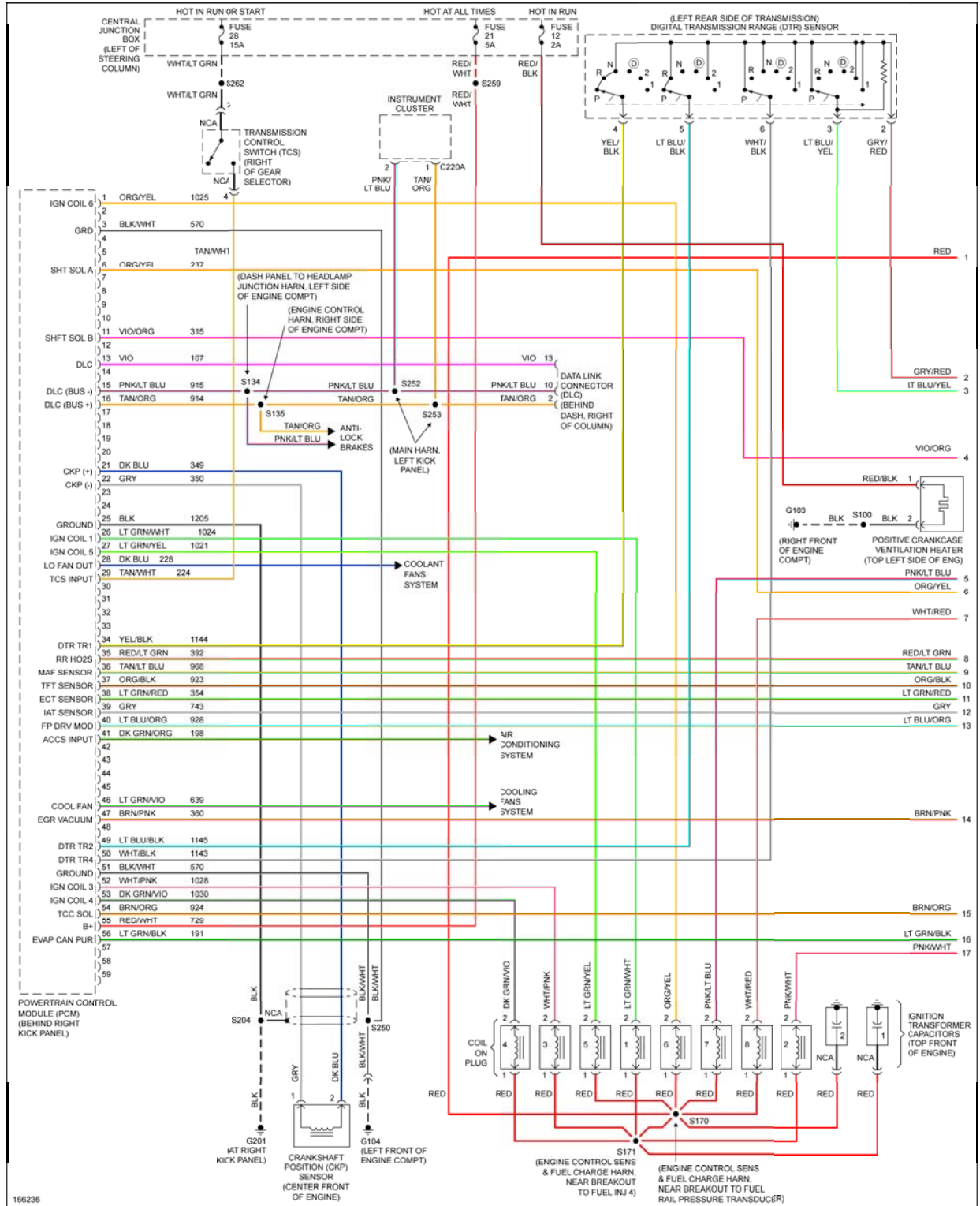


Fig. 20: 4.6L SOHC, Engine Performance Circuit (1 of 3)

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

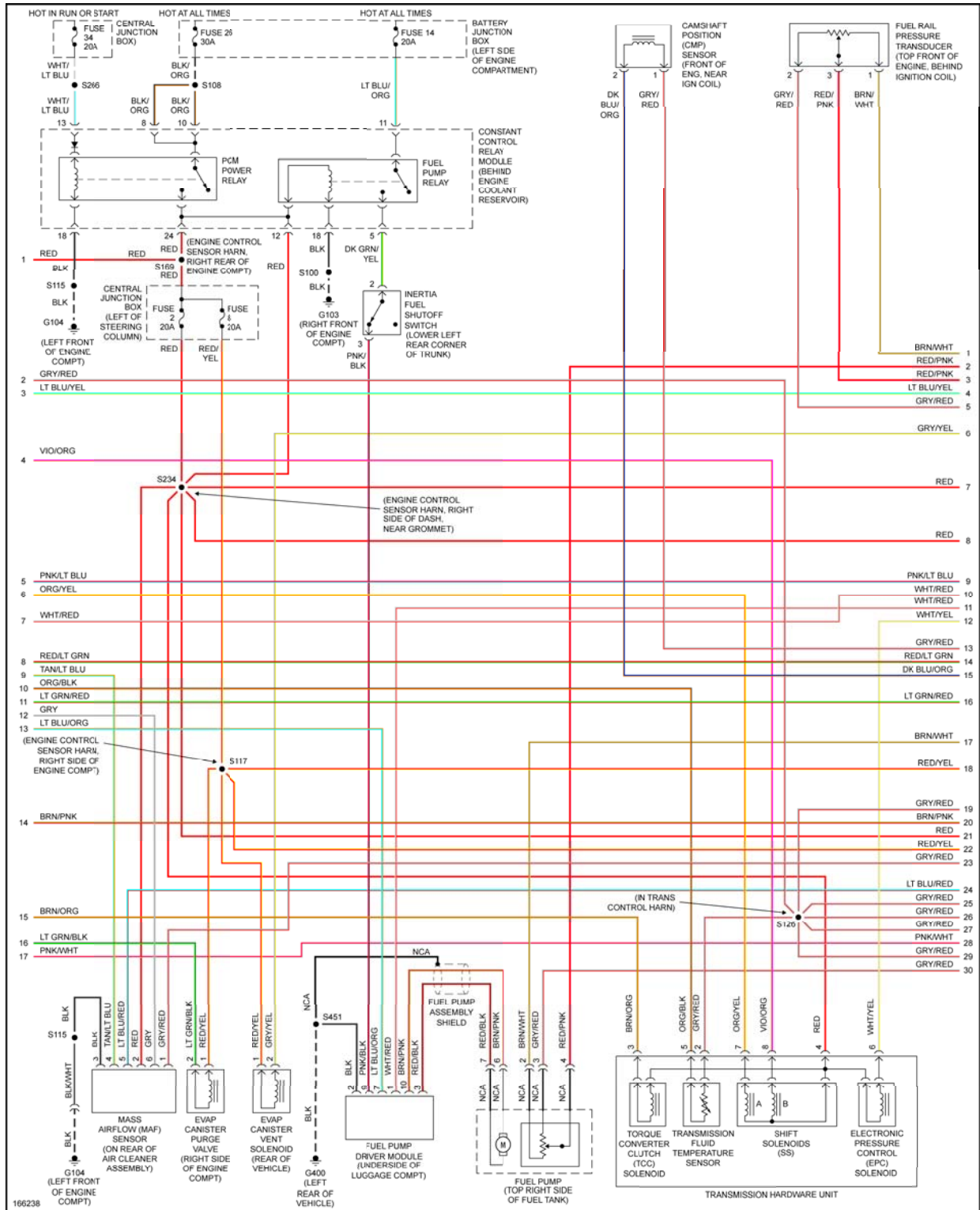


Fig. 21: 4.6L SOHC, Engine Performance Circuit (2 of 3)

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

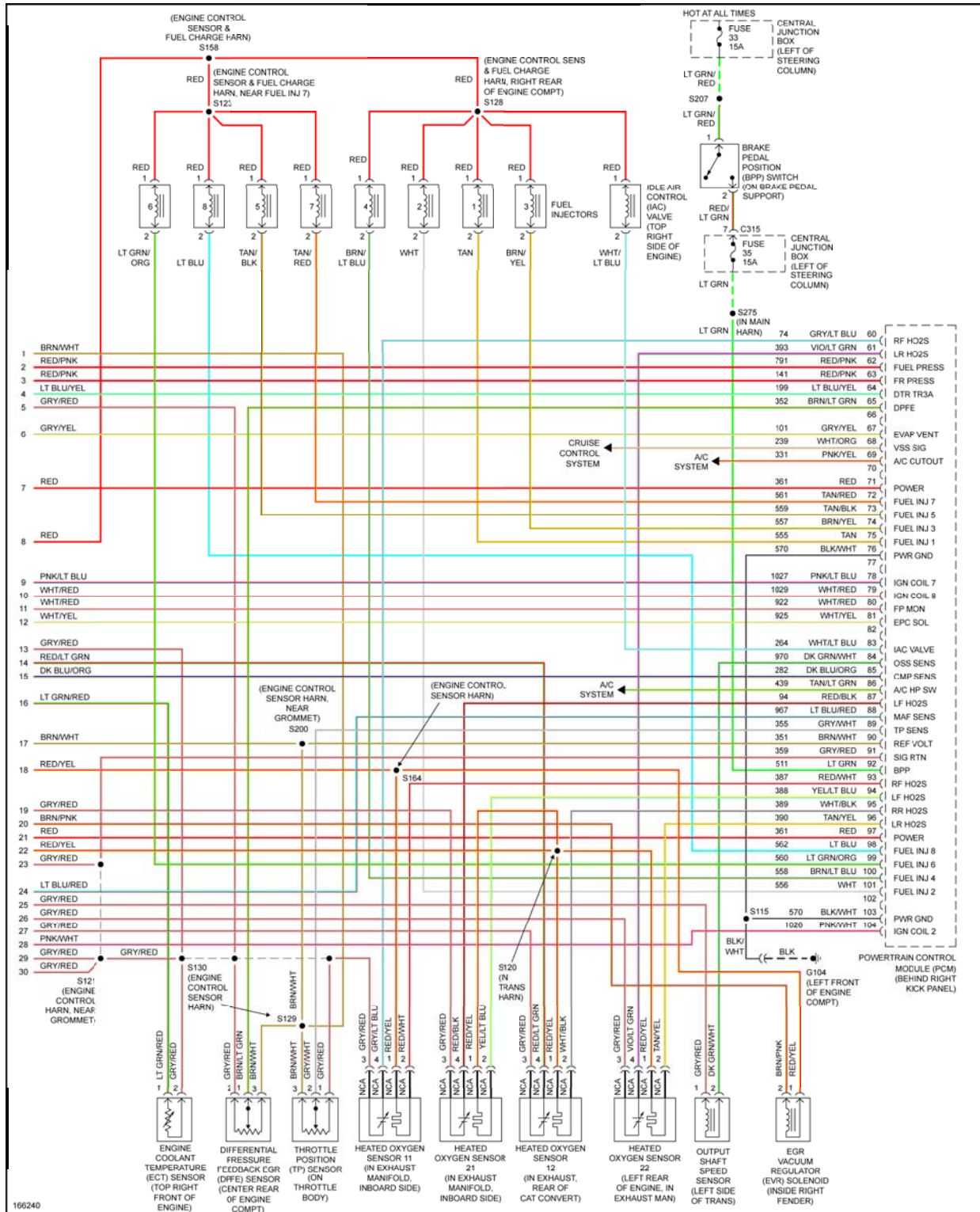


Fig. 22: 4.6L SOHC, Engine Performance Circuit (3 of 3)

EXTERIOR LIGHTS

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

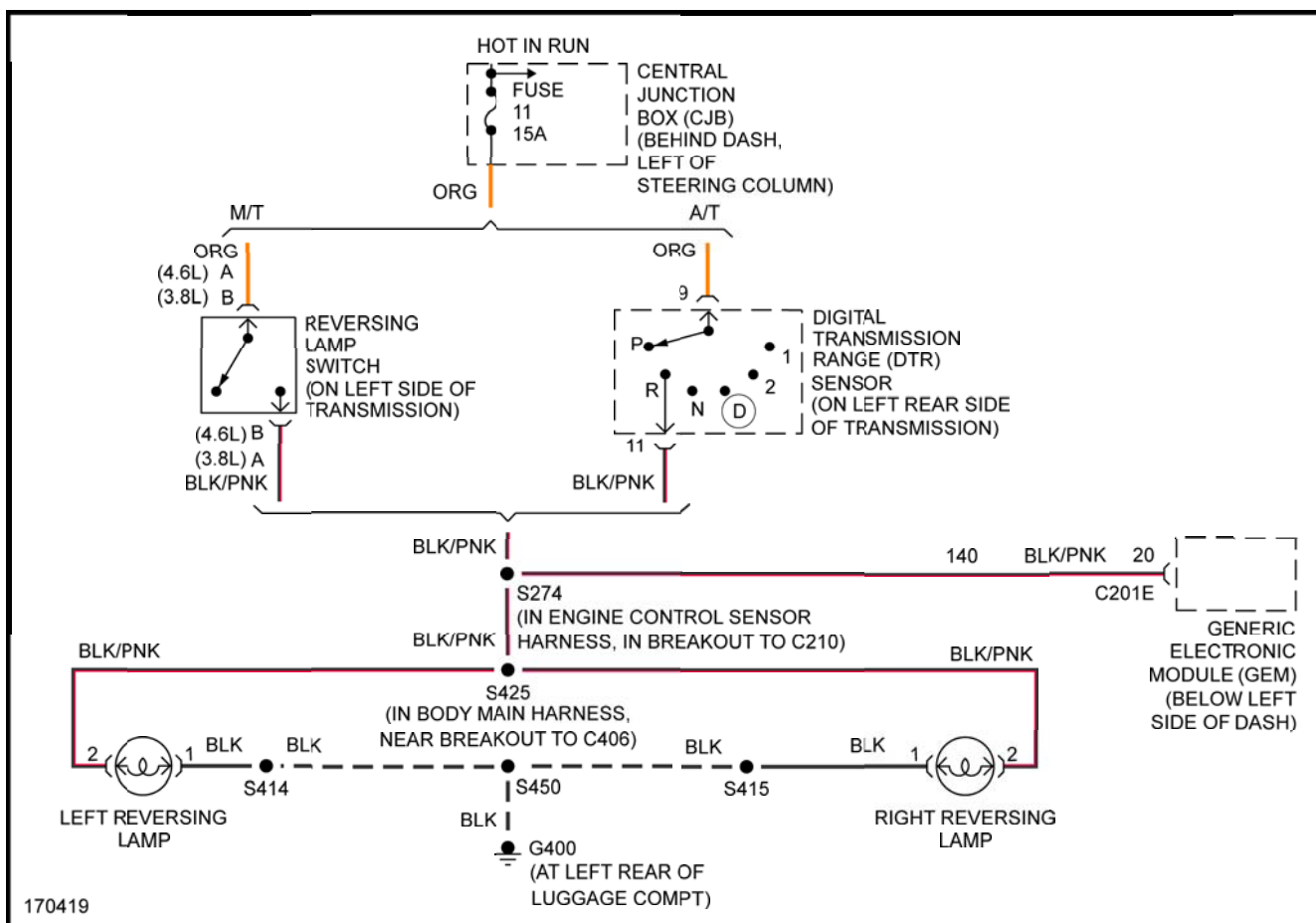


Fig. 23: Back-up Lamps Circuit

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

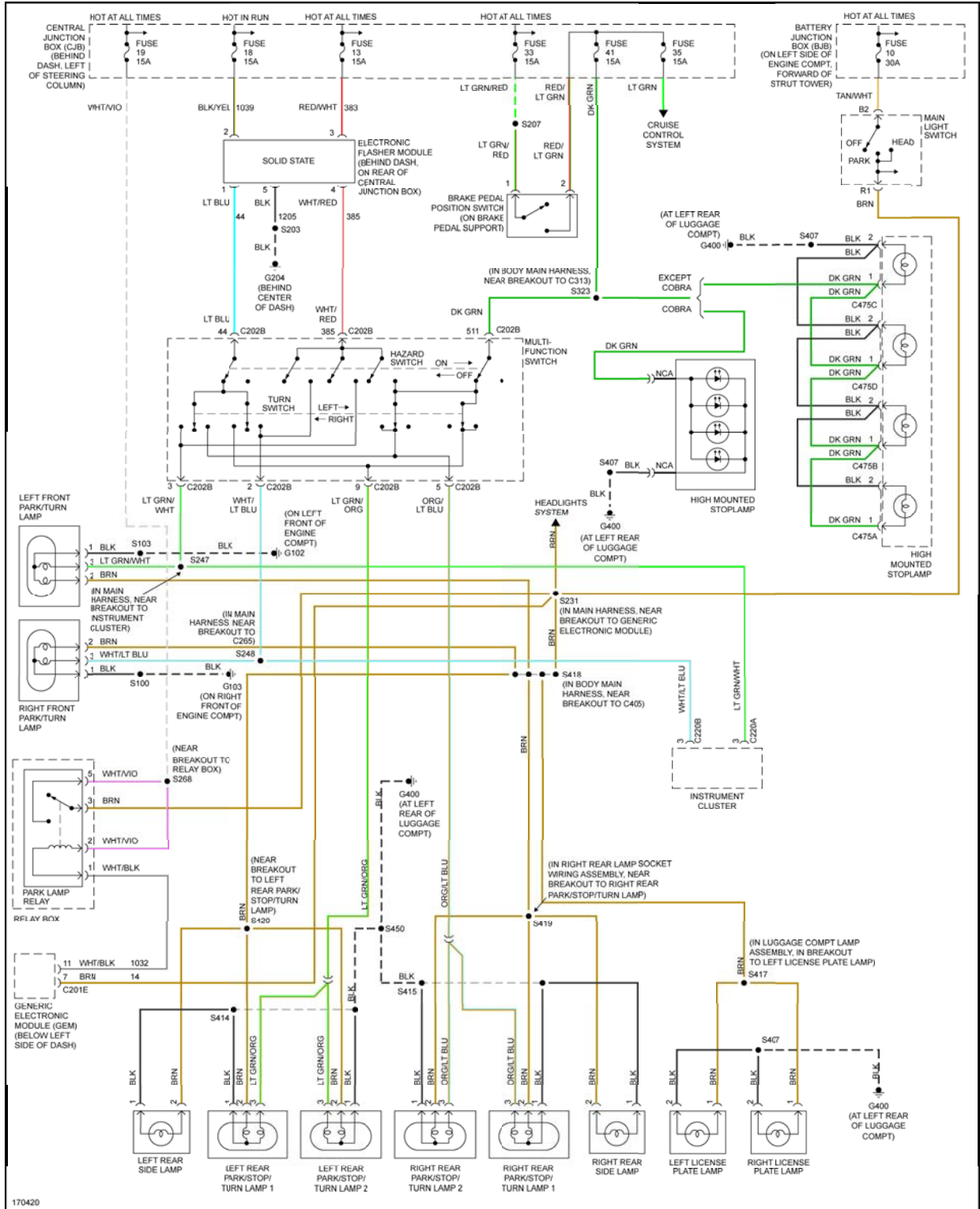


Fig. 24: Exterior Lamps Circuit

GROUND DISTRIBUTION

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

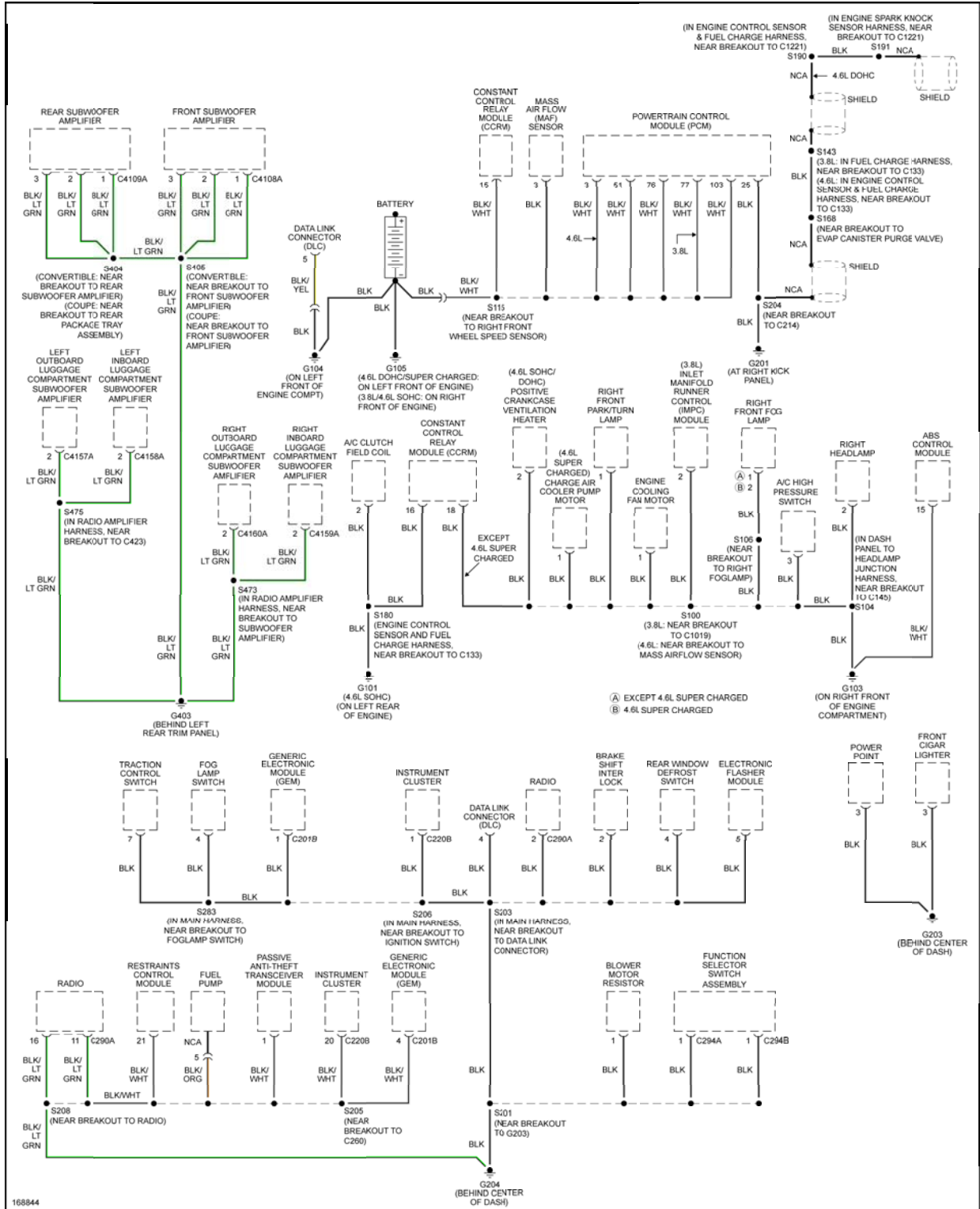


Fig. 25: Ground Distribution Circuit (1 of 2)

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

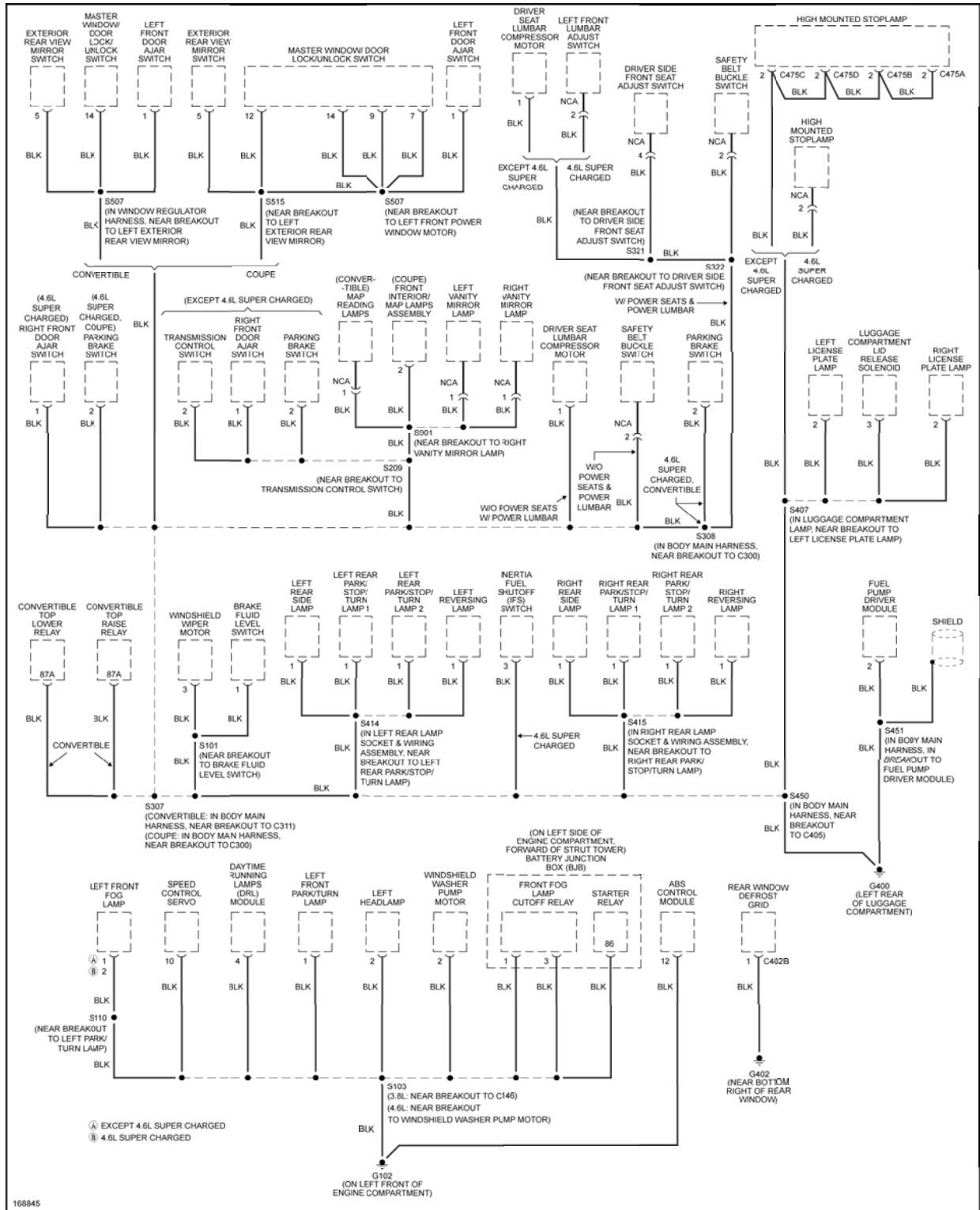


Fig. 26: Ground Distribution Circuit (2 of 2)

HEADLIGHTS

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

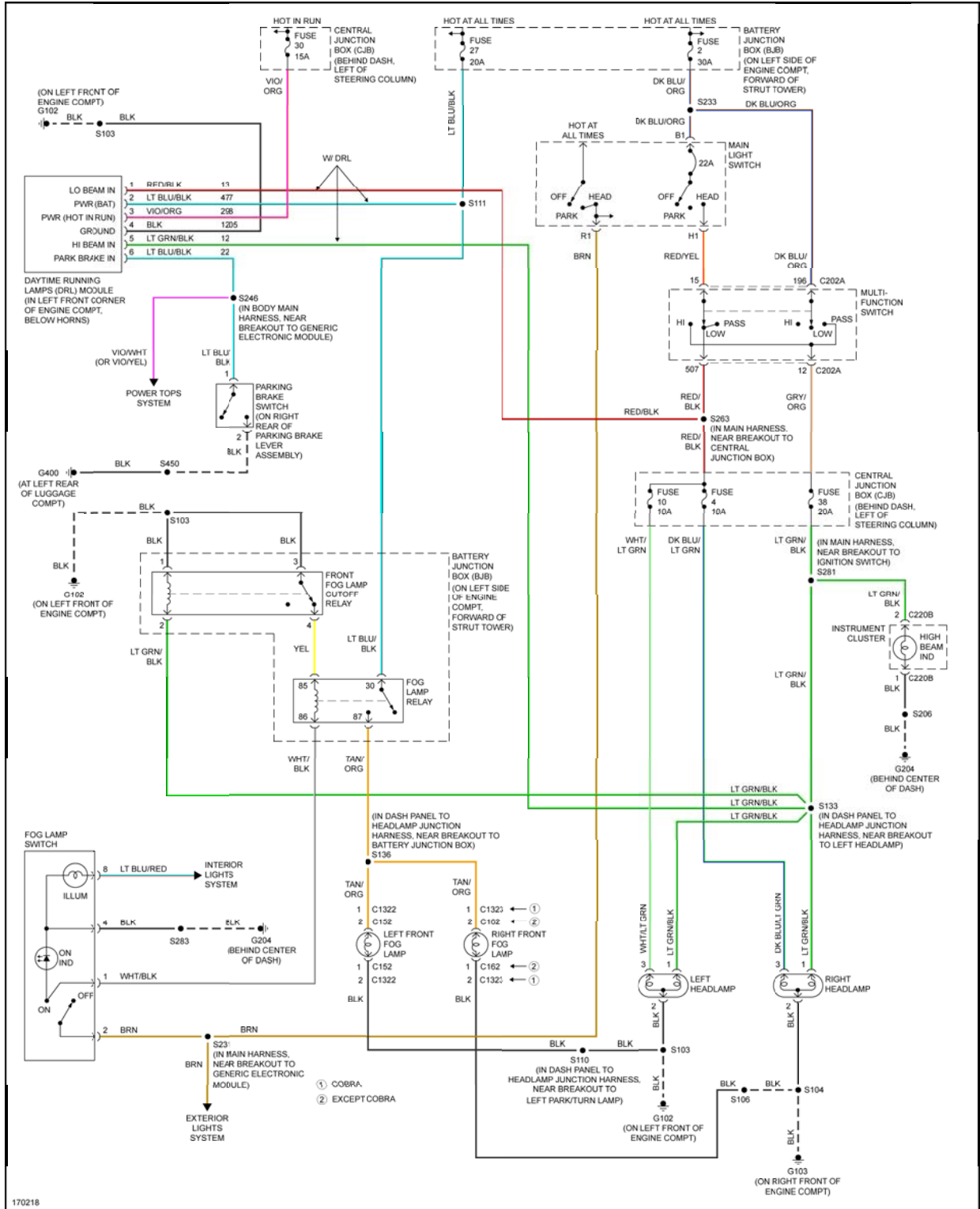


Fig. 27: Headlights Circuit

HORN

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

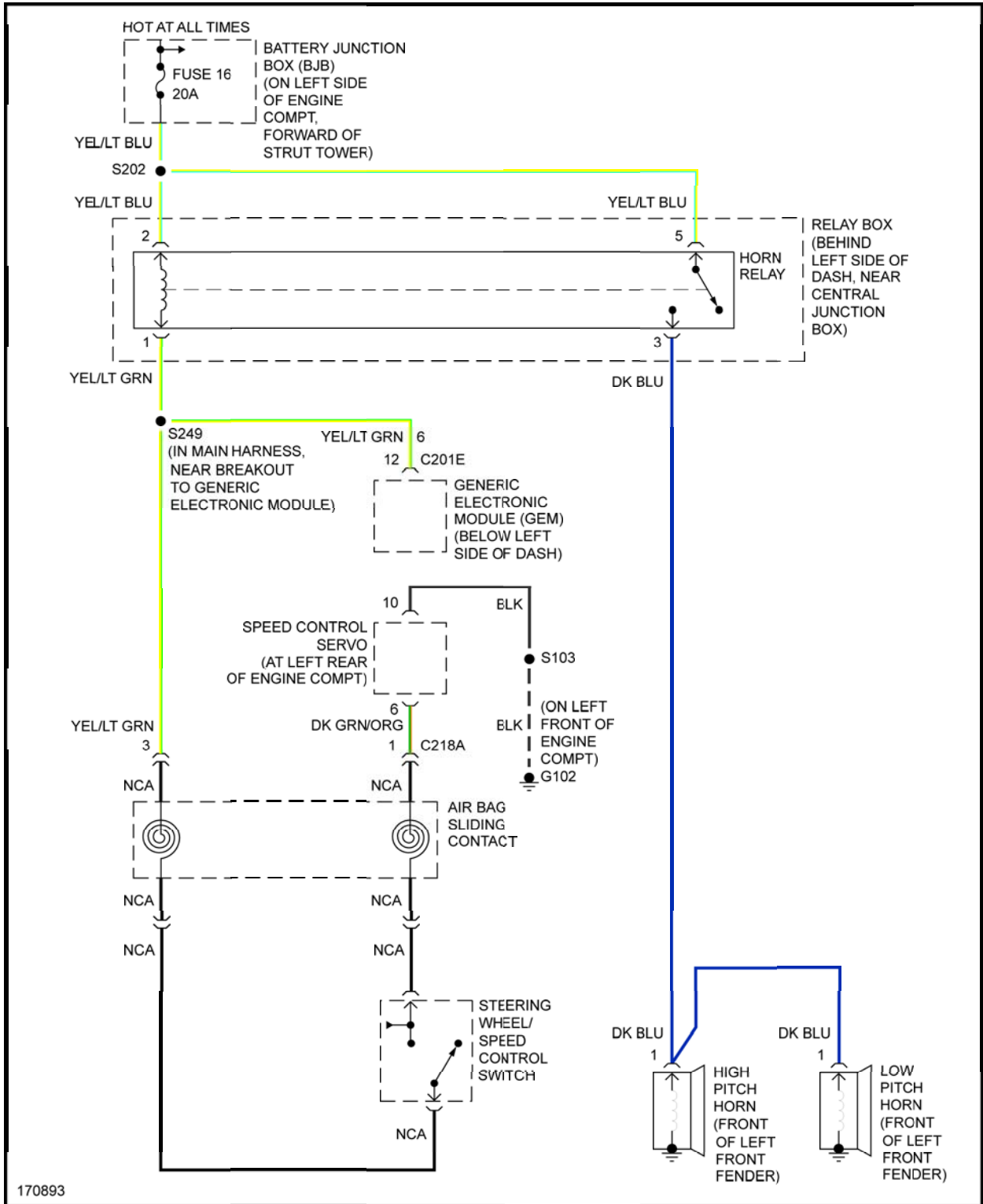


Fig. 28: Horn Circuit

INSTRUMENT CLUSTER

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

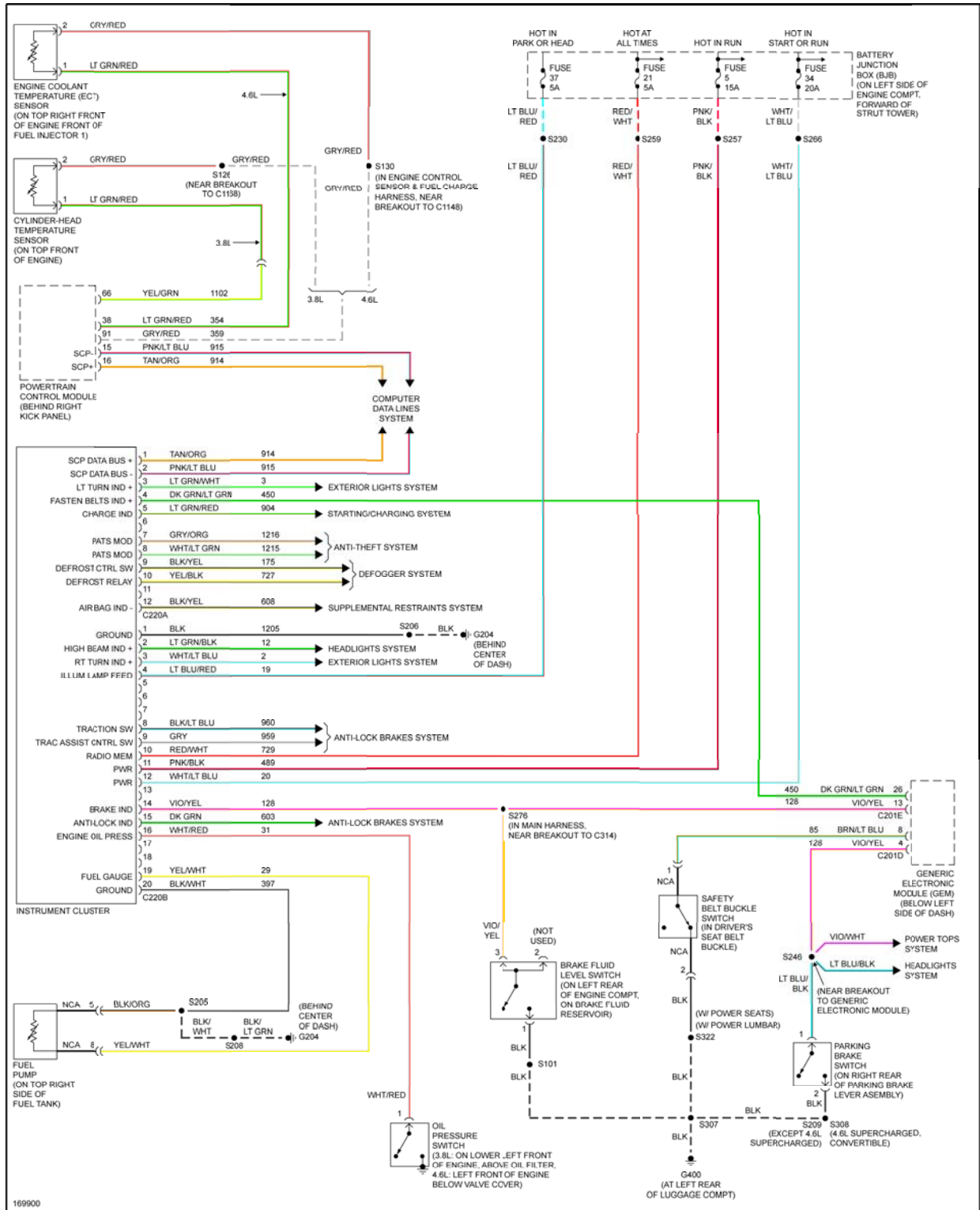


Fig. 29: Instrument Cluster Circuit

INTERIOR LIGHTS

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

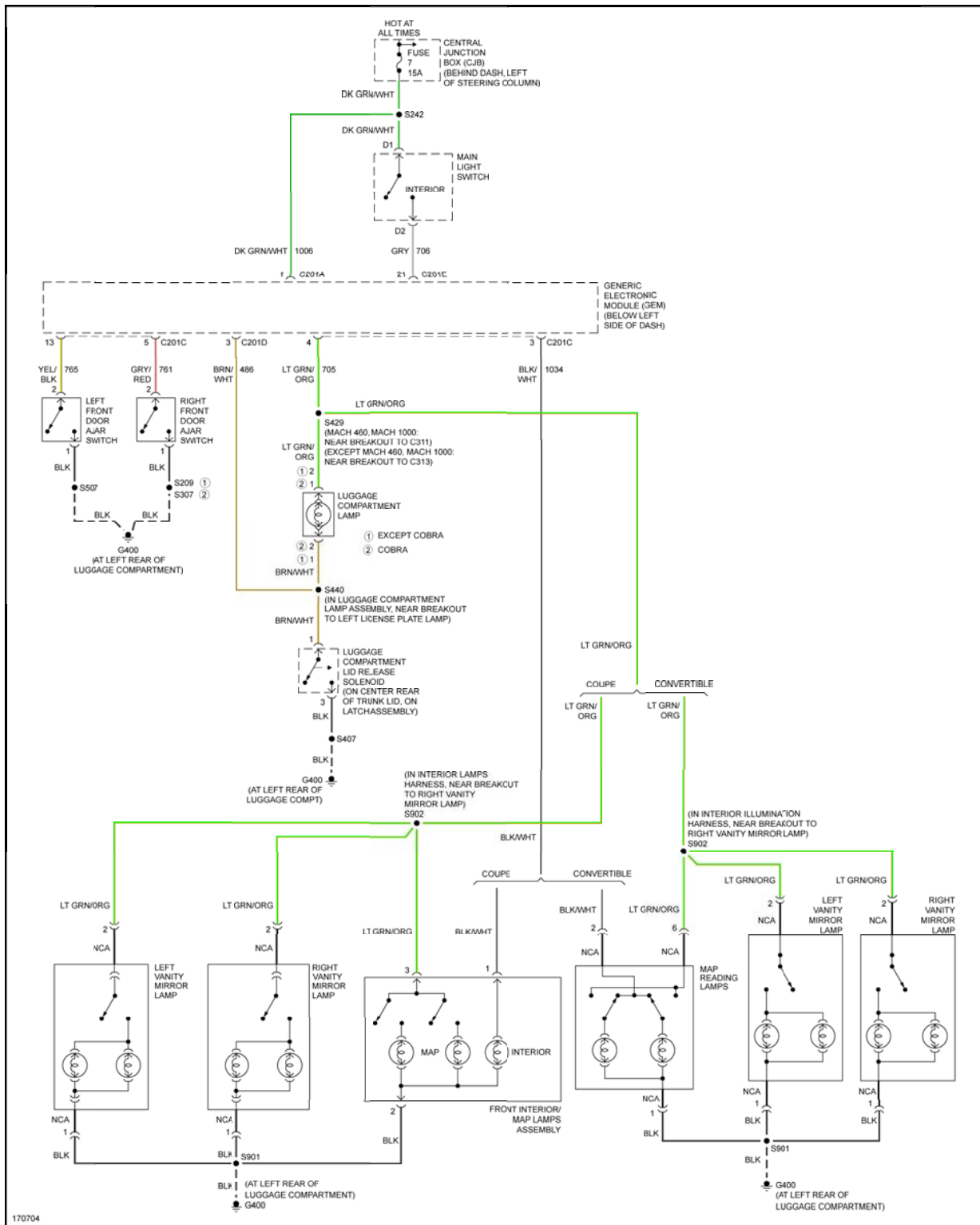


Fig. 30: Courtesy Lamps Circuit

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

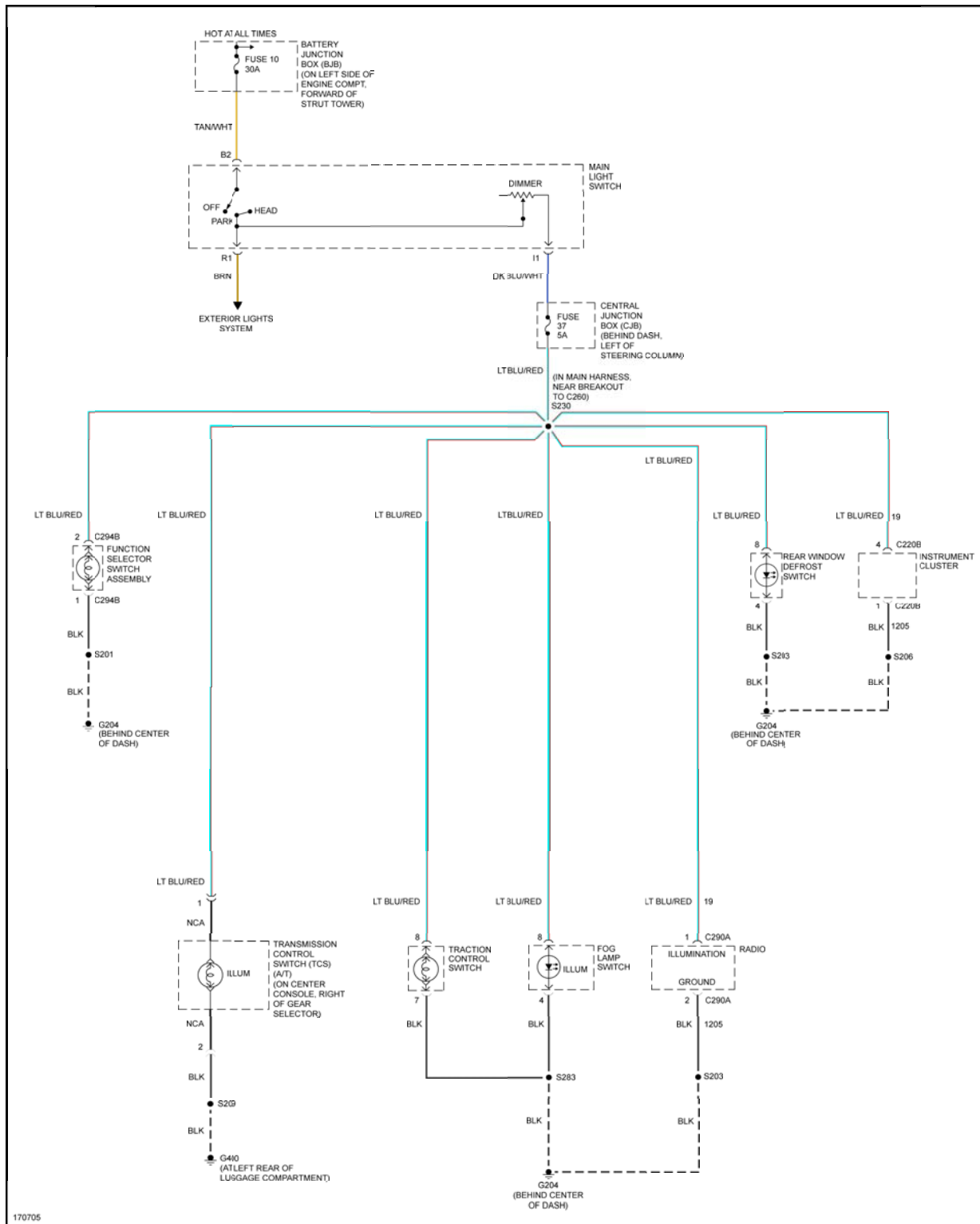


Fig. 31: Instrument Illumination Circuit

POWER DISTRIBUTION

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

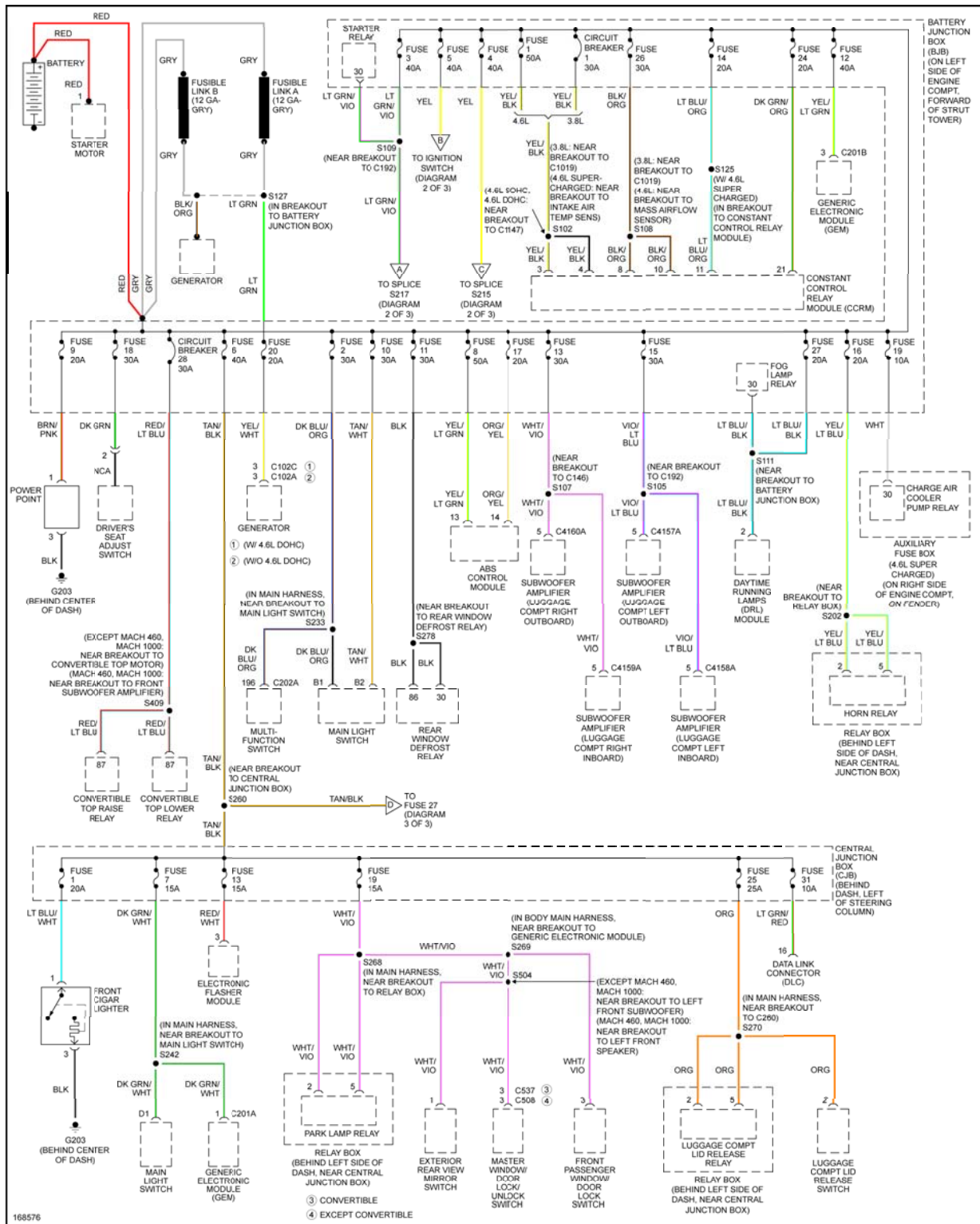


Fig. 32: Power Distribution Circuit (1 of 3)

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

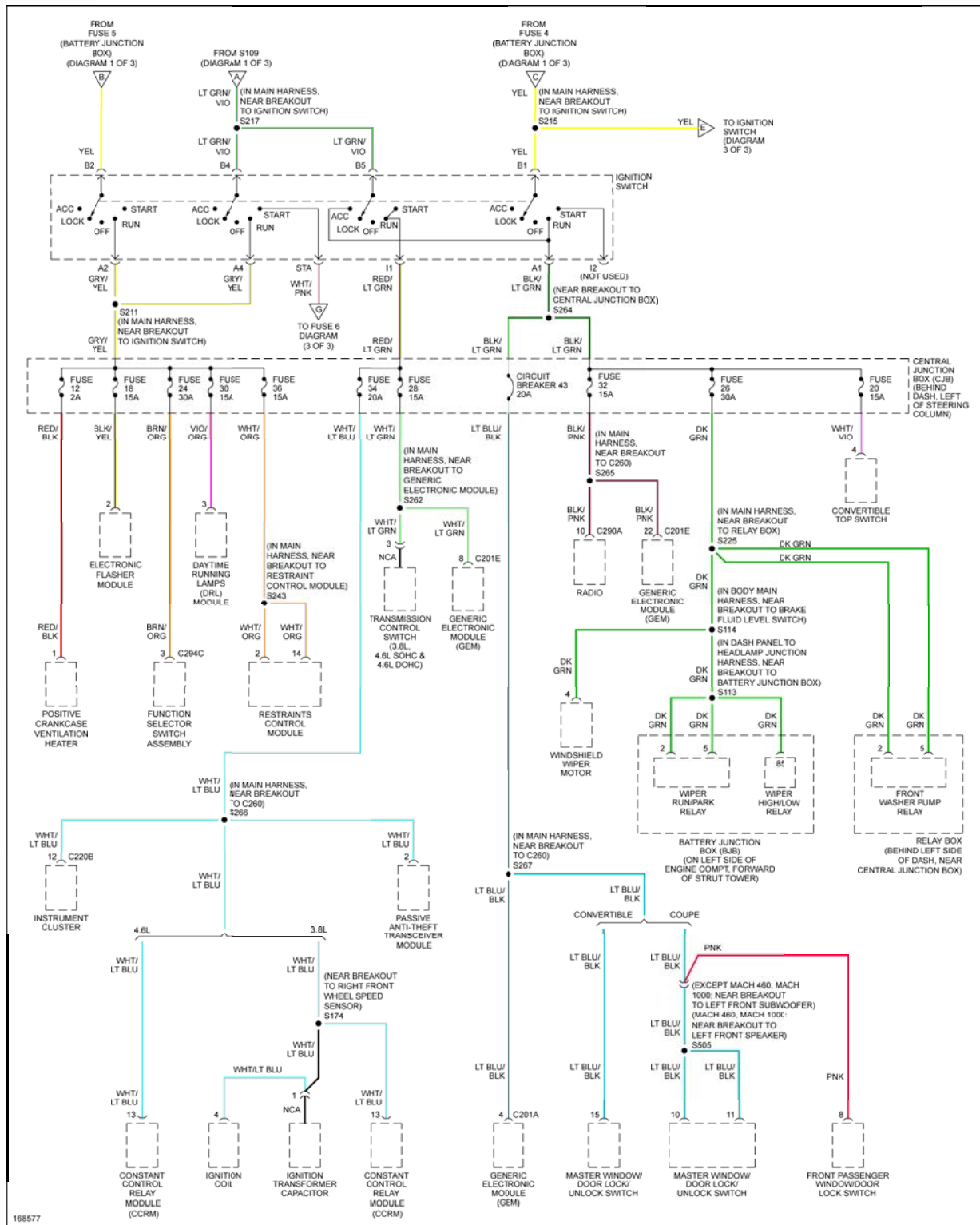


Fig. 33: Power Distribution Circuit (2 of 3)

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

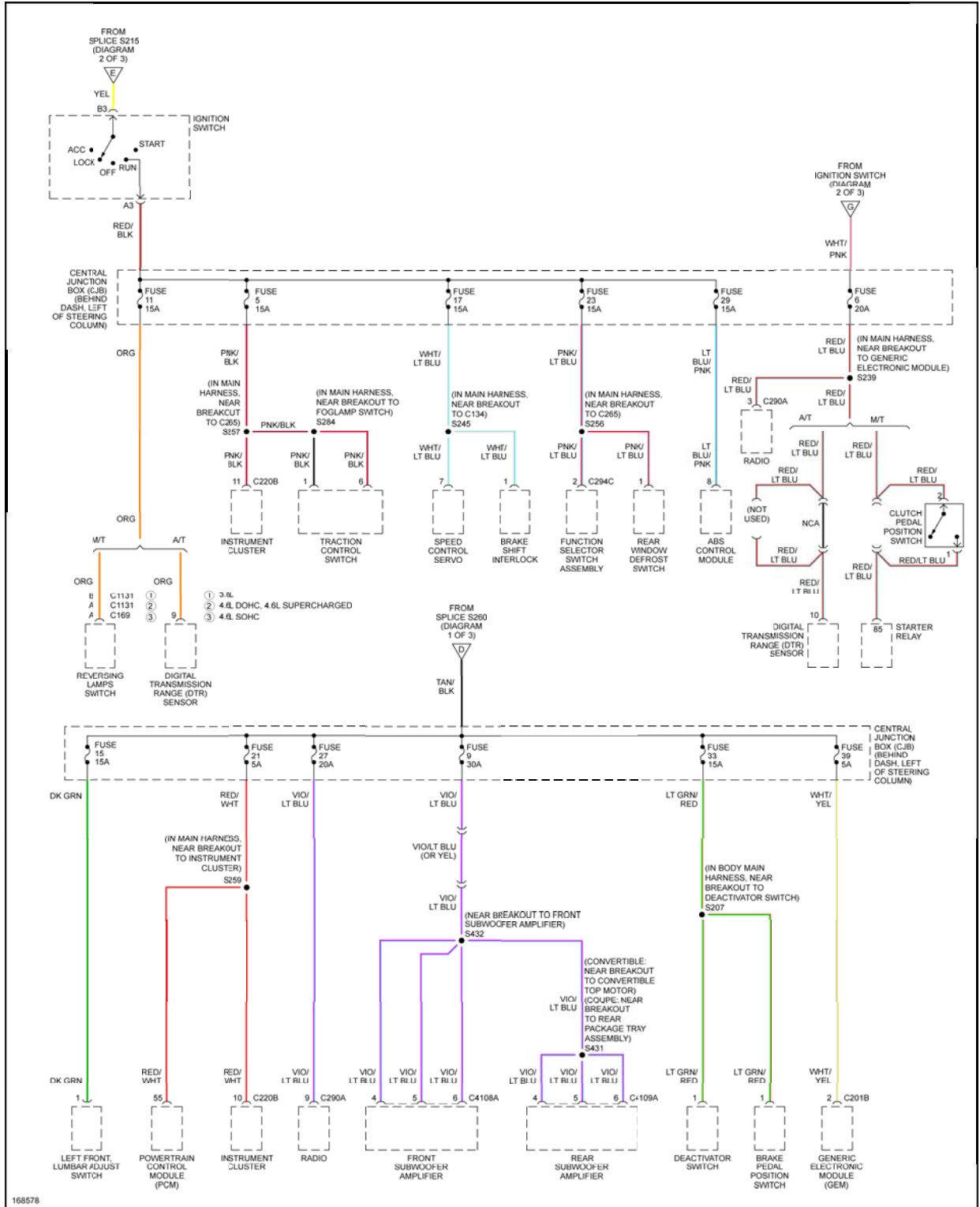


Fig. 34: Power Distribution Circuit (3 of 3)

POWER DOOR LOCKS

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

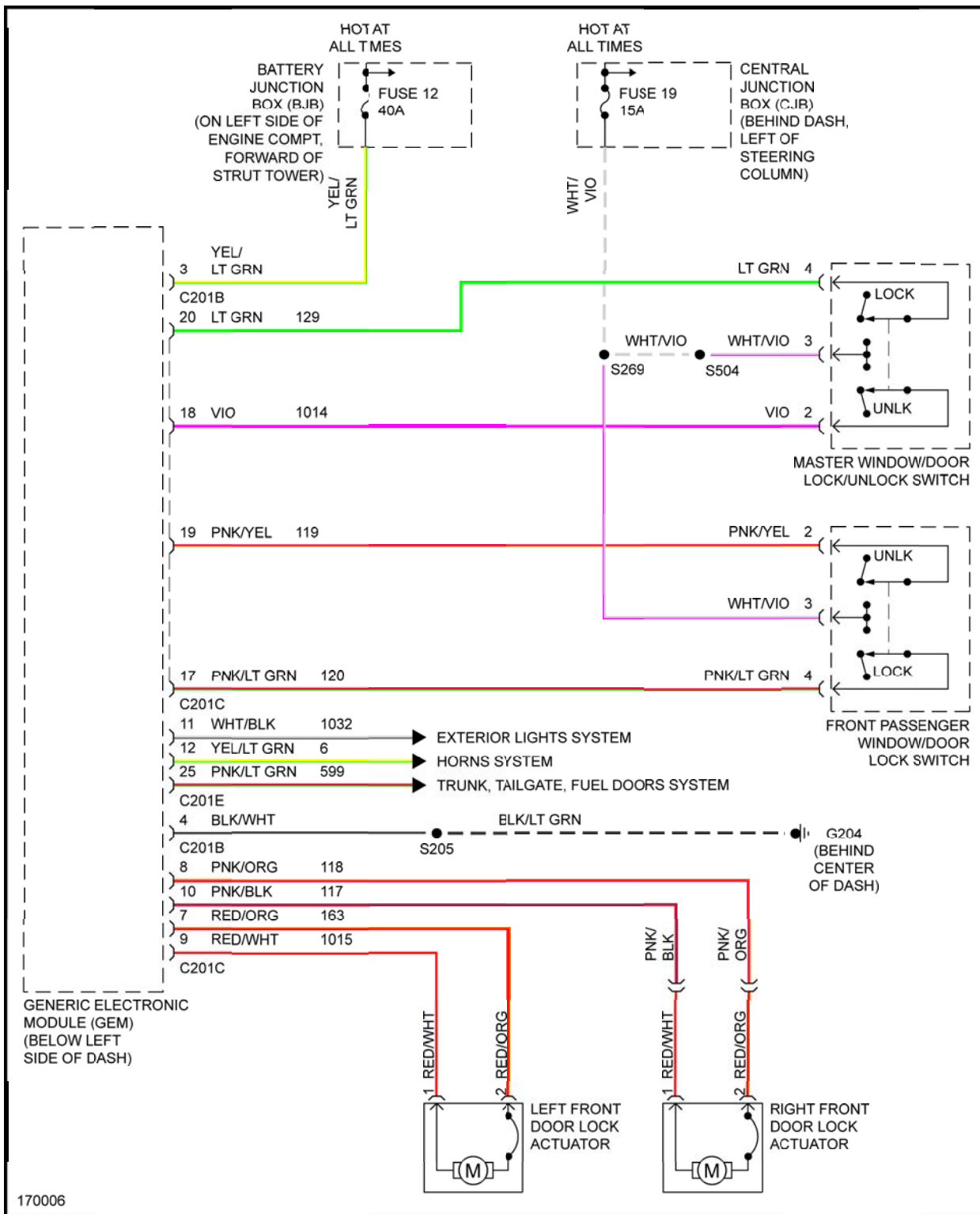


Fig. 35: Power Door Locks Circuit

POWER MIRRORS

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

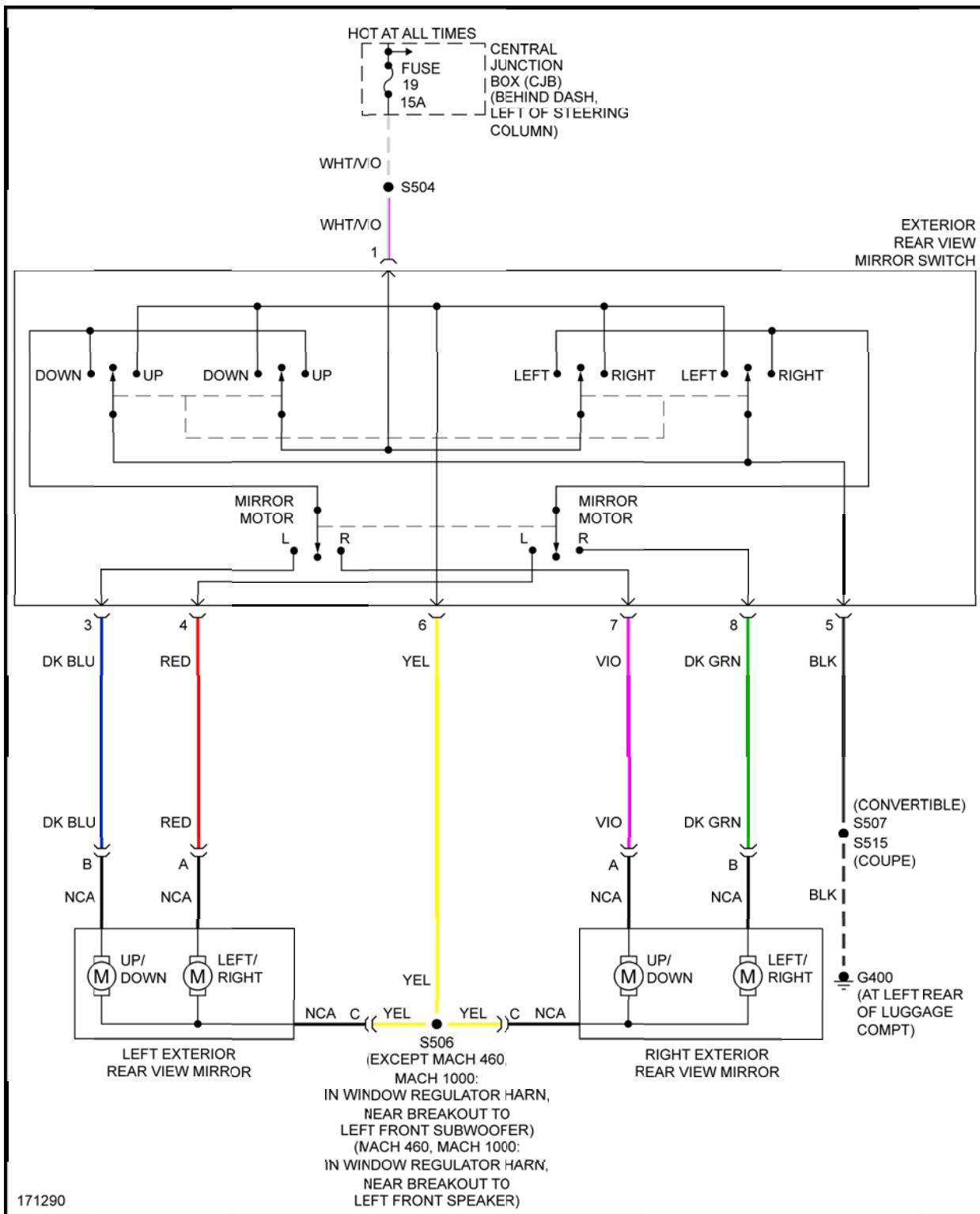


Fig. 36: Power Mirrors Circuit

POWER SEATS

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

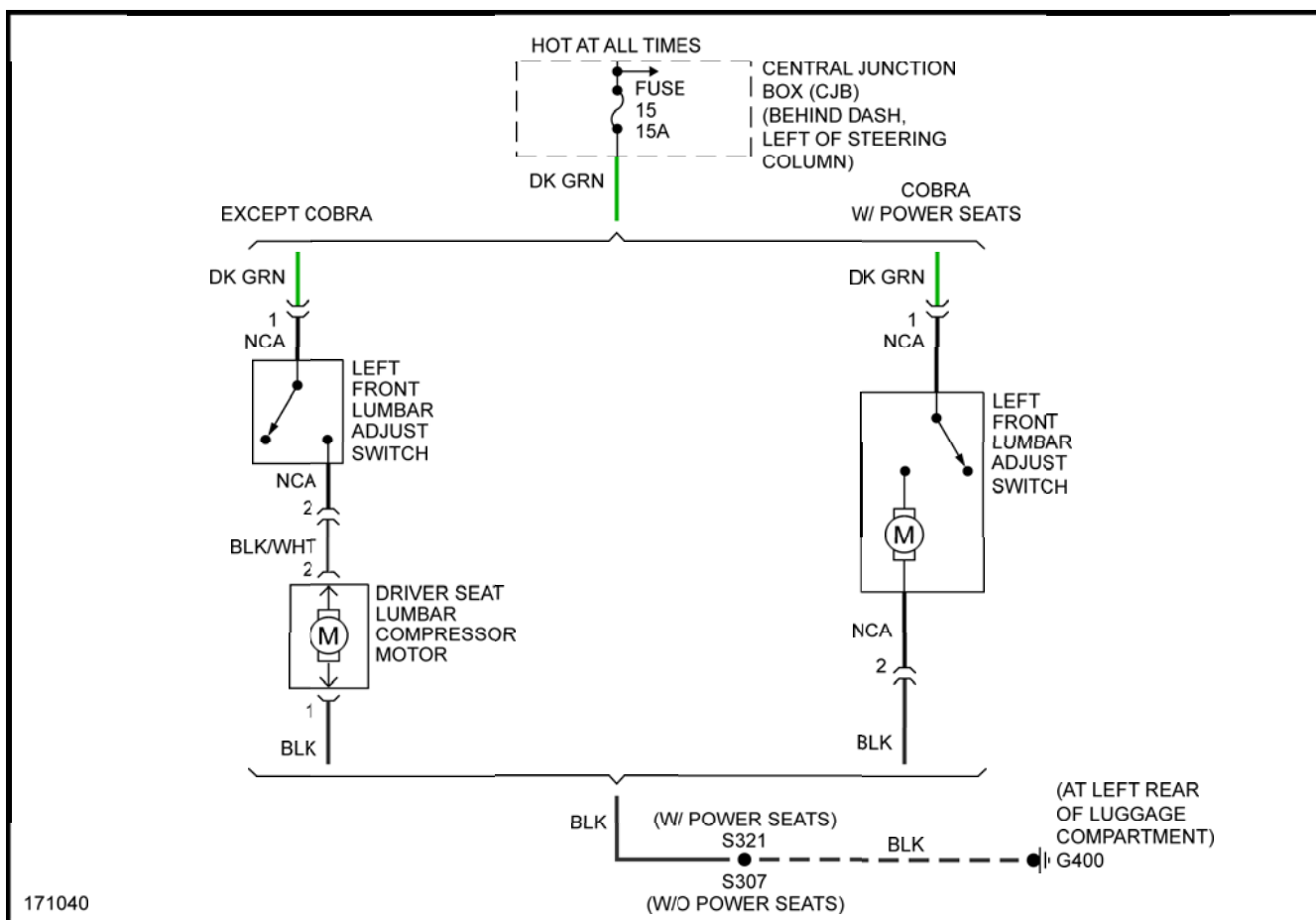


Fig. 37: Lumbar Circuit

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

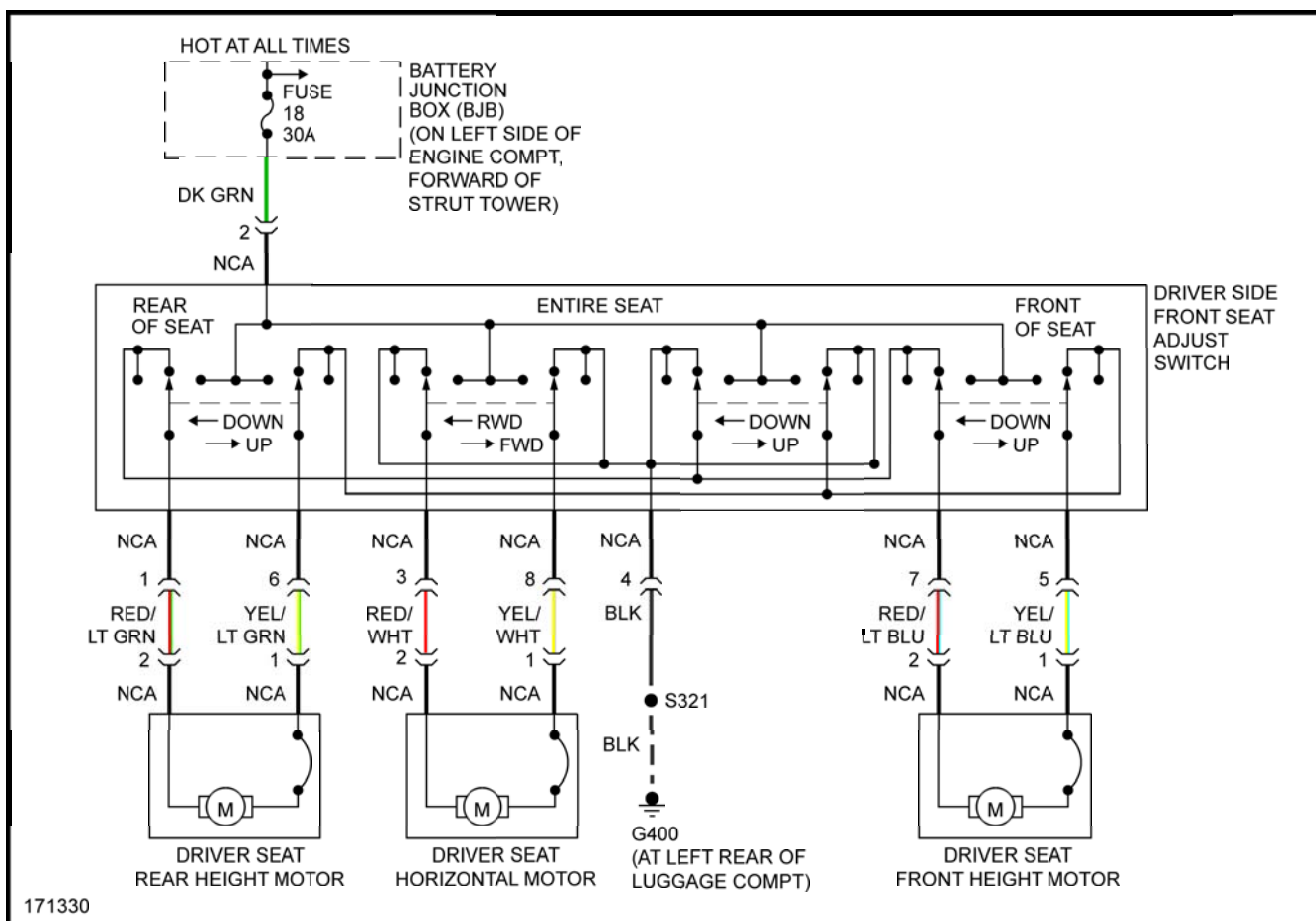


Fig. 38: Power Seat Circuit

POWER TOP/SUNROOF

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

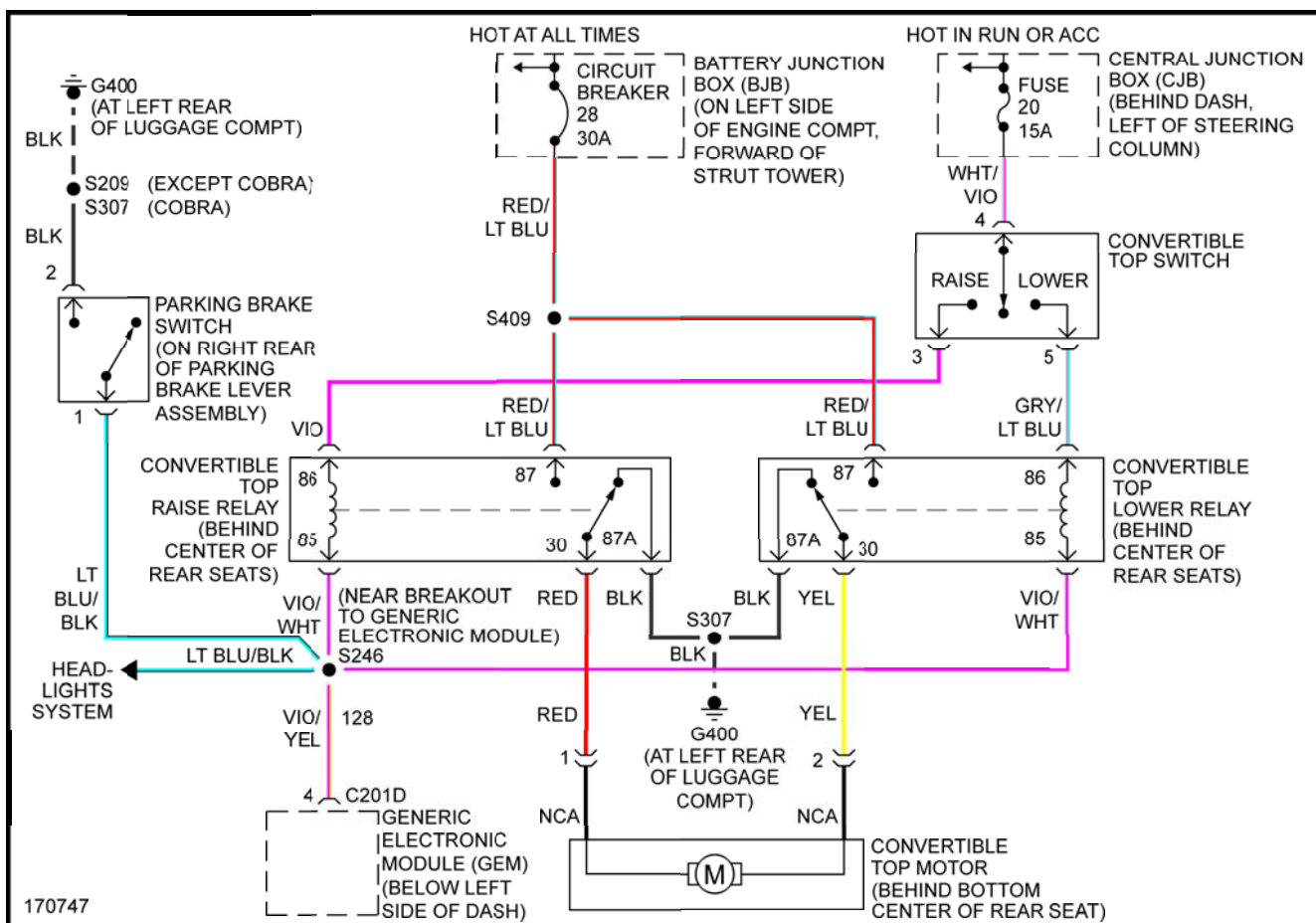


Fig. 39: Power Top/Sunroof Circuit

POWER WINDOWS

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

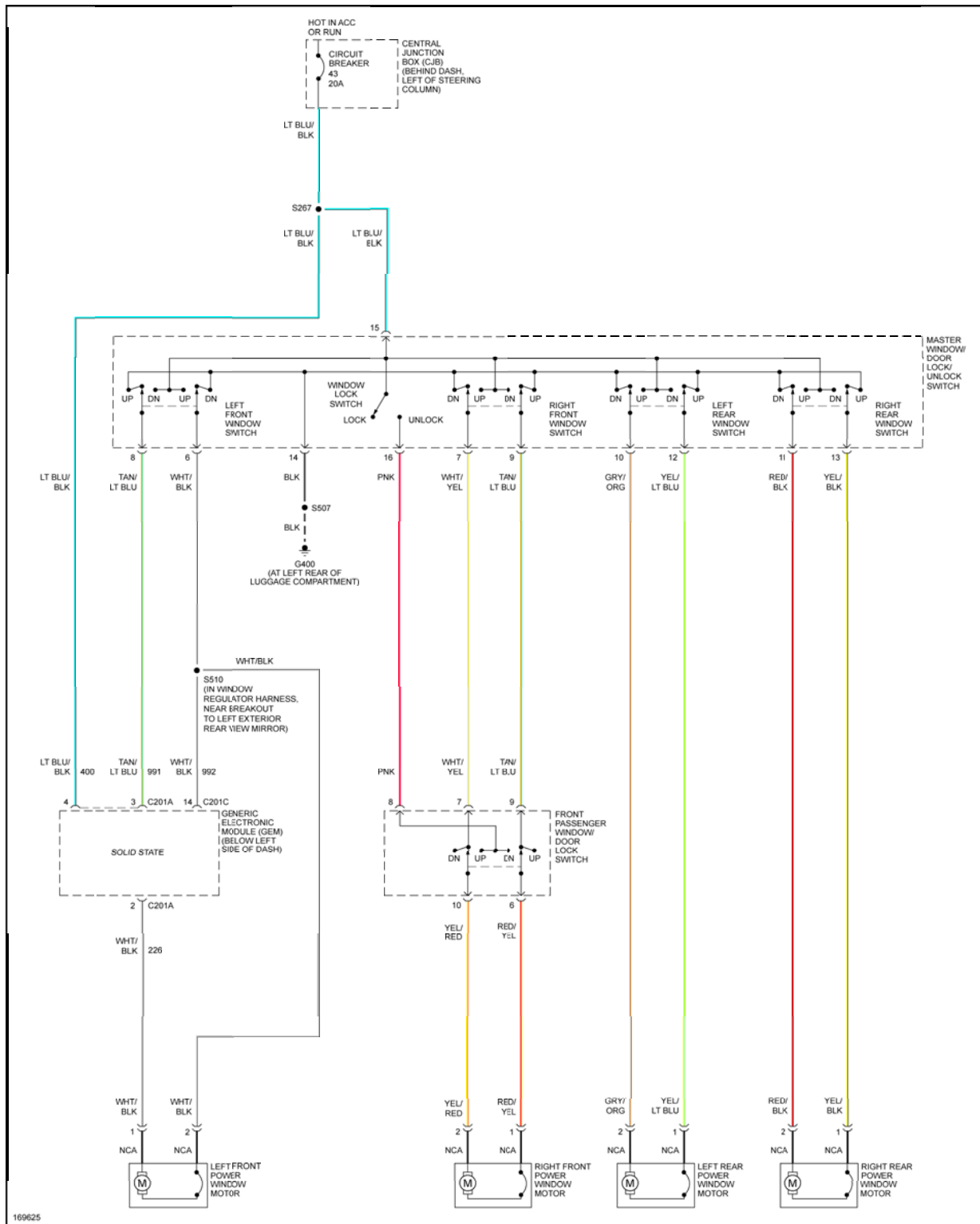


Fig. 40: Power Windows Circuit, Convertible

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

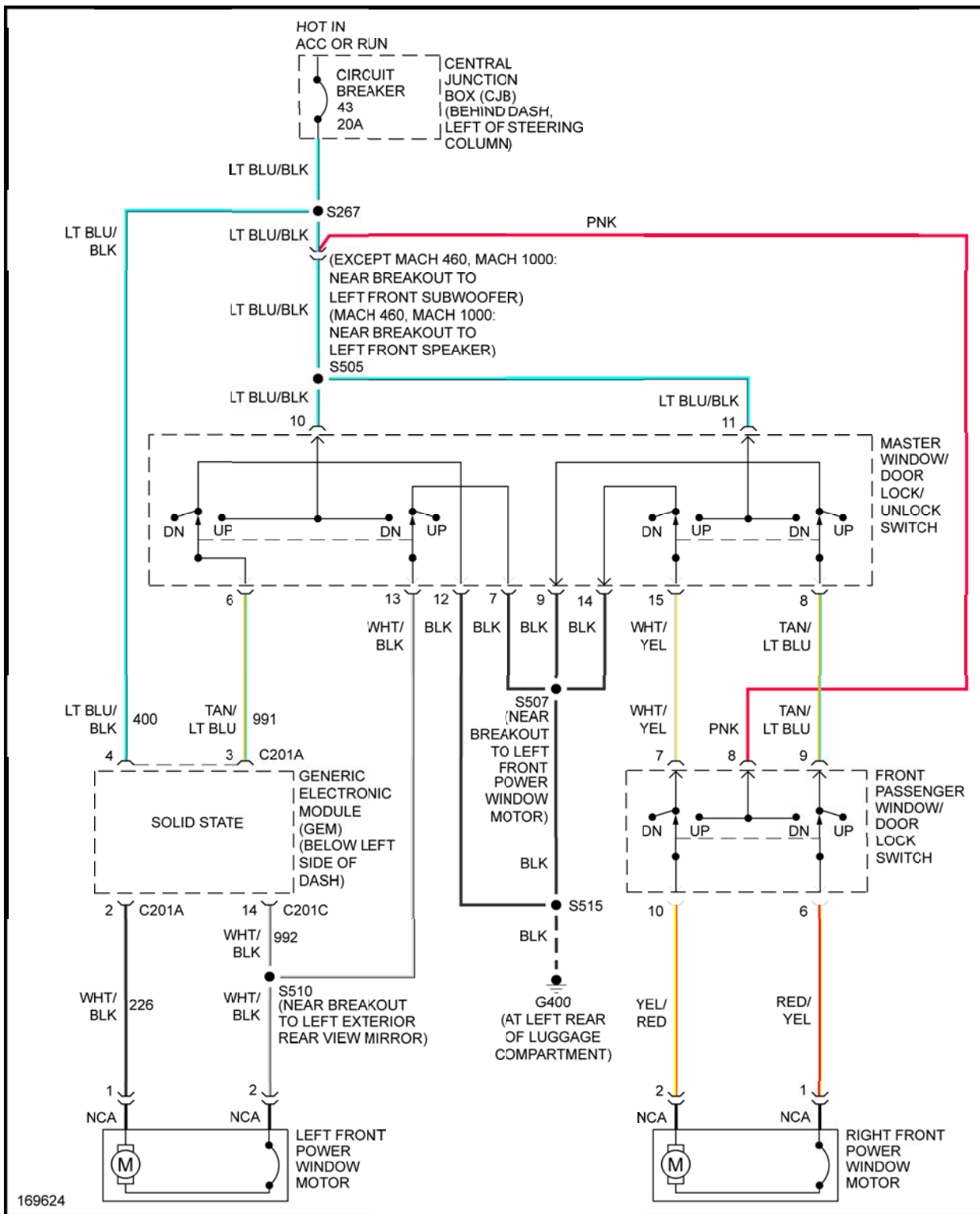


Fig. 41: Power Windows Circuit, Coupe

RADIO

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

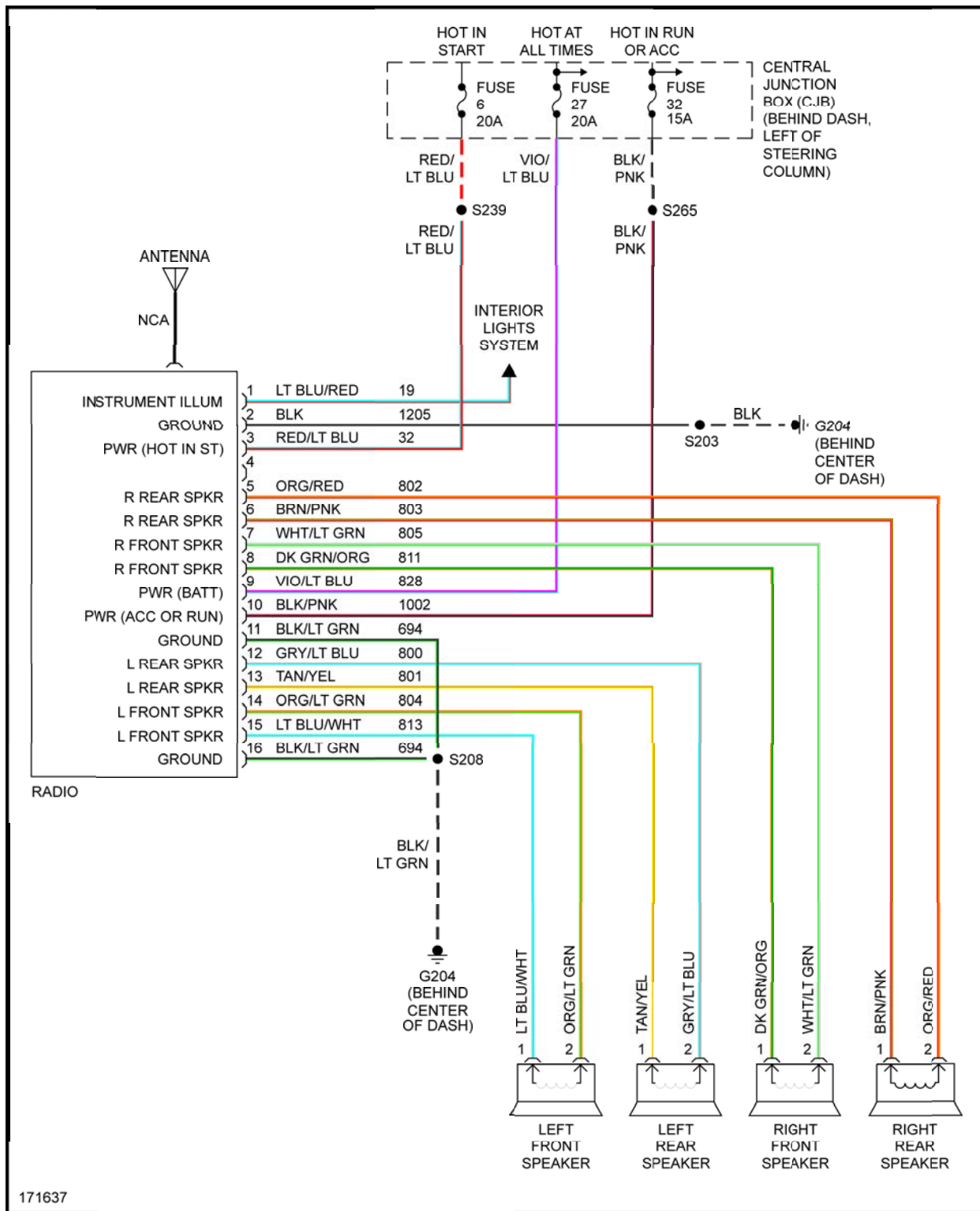


Fig. 42: Base Radio Circuit

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

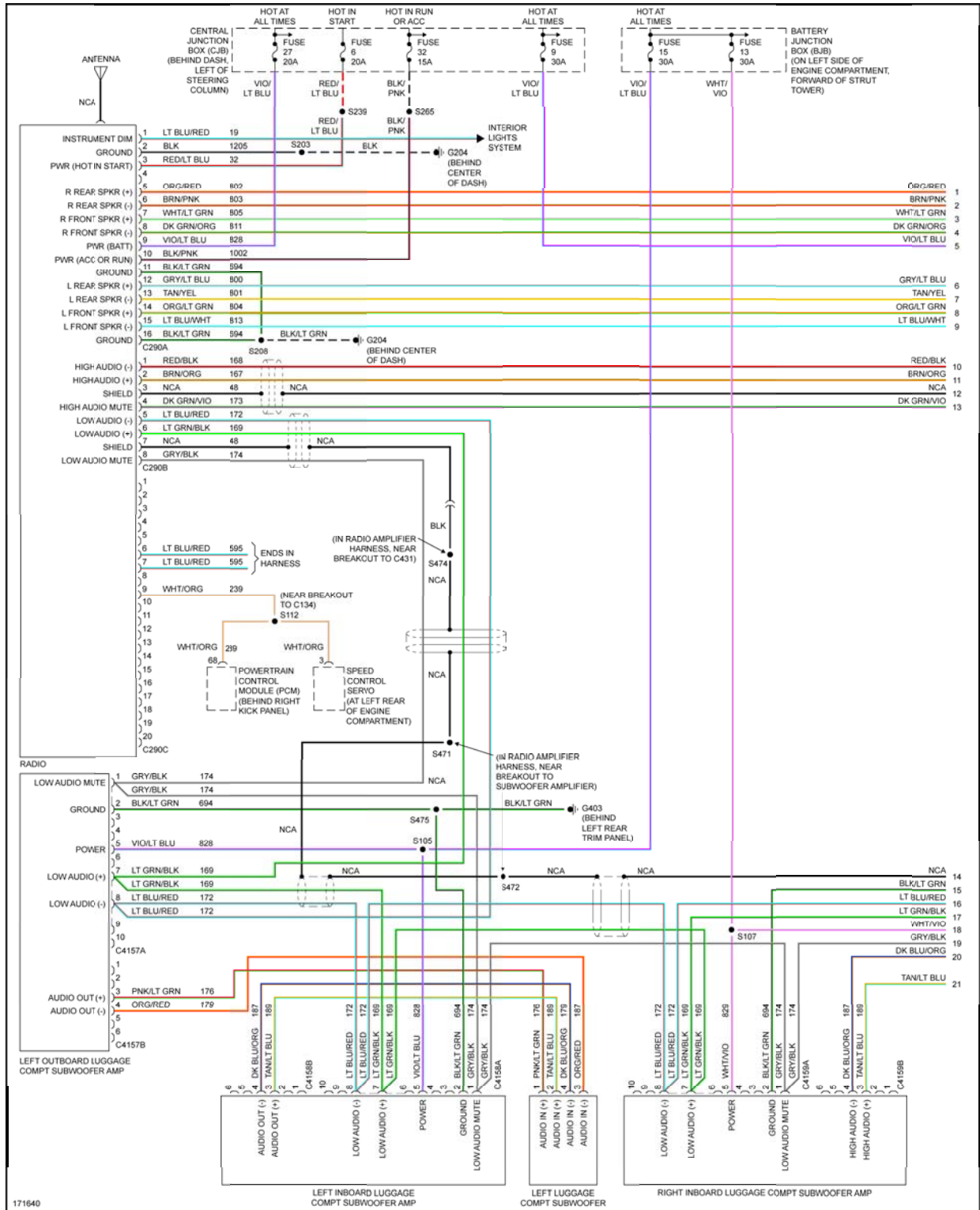


Fig. 43: Premium Sound Radio Circuit, Convertible W/ Mach 1000 Sound System (1 of 2)

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

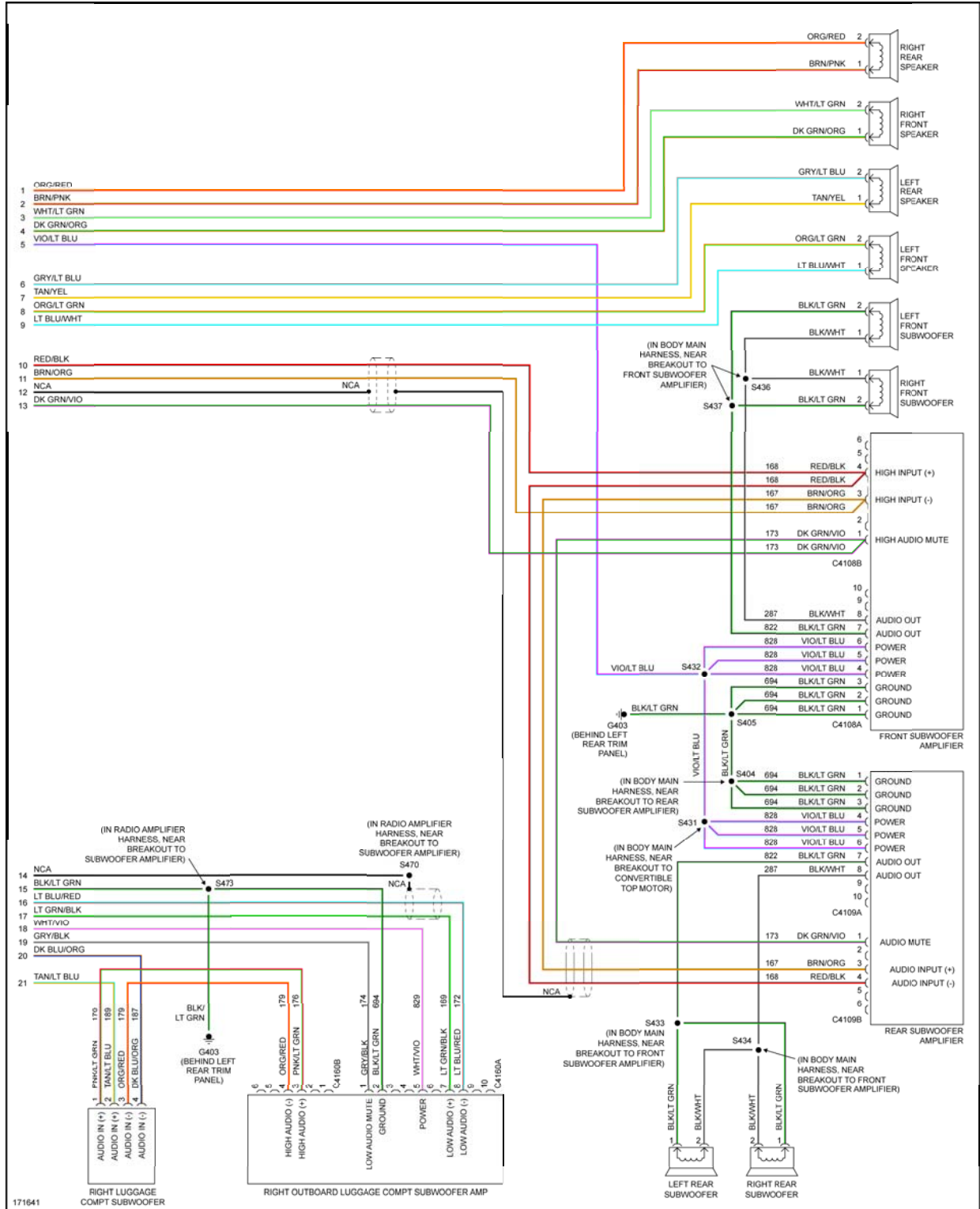


Fig. 44: Premium Sound Radio Circuit, Convertible W/ Mach 1000 Sound System (2 of 2)

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

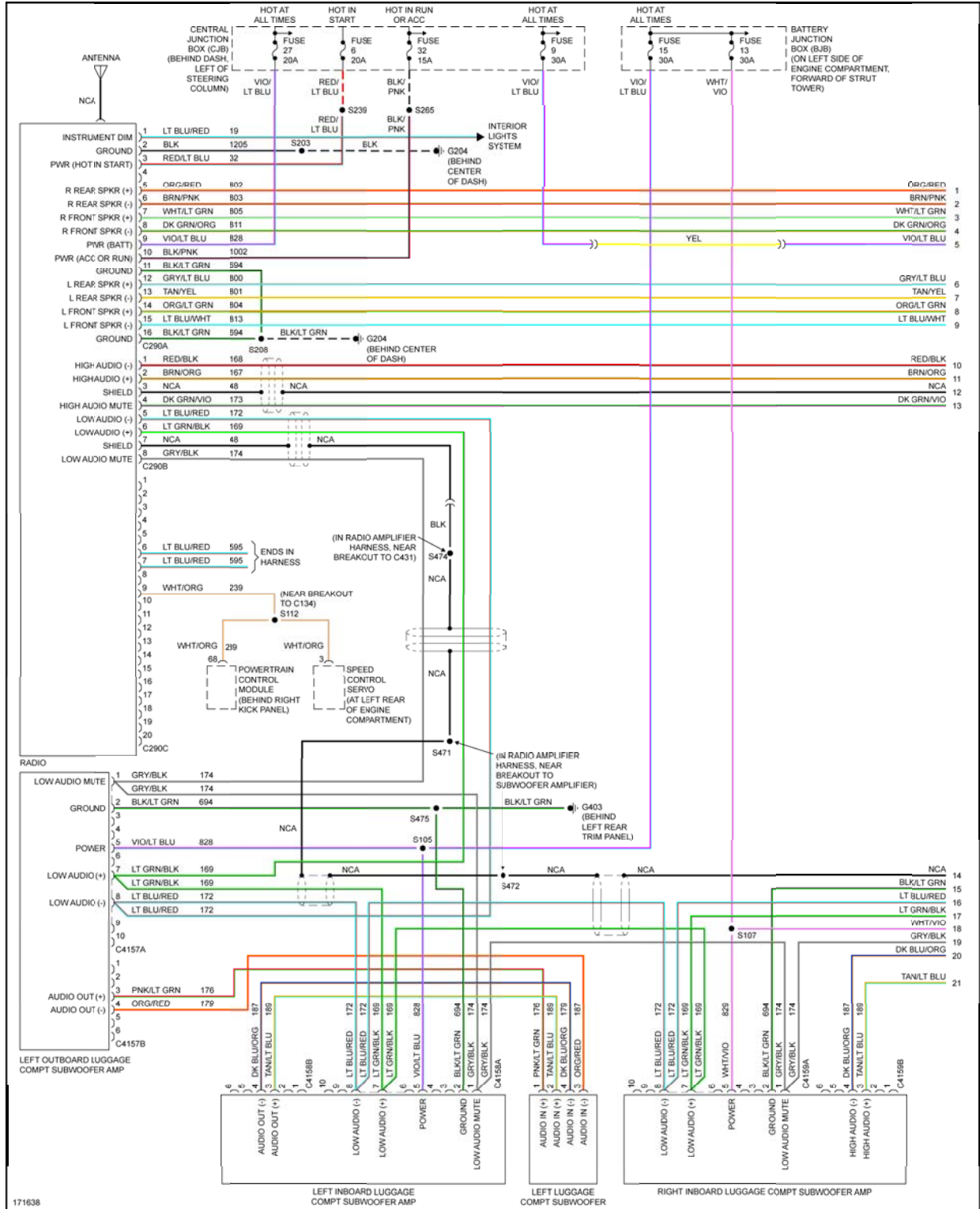


Fig. 45: Premium Sound Radio Circuit, Coupe W/ Mach 1000 Sound System (1 of 2)

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

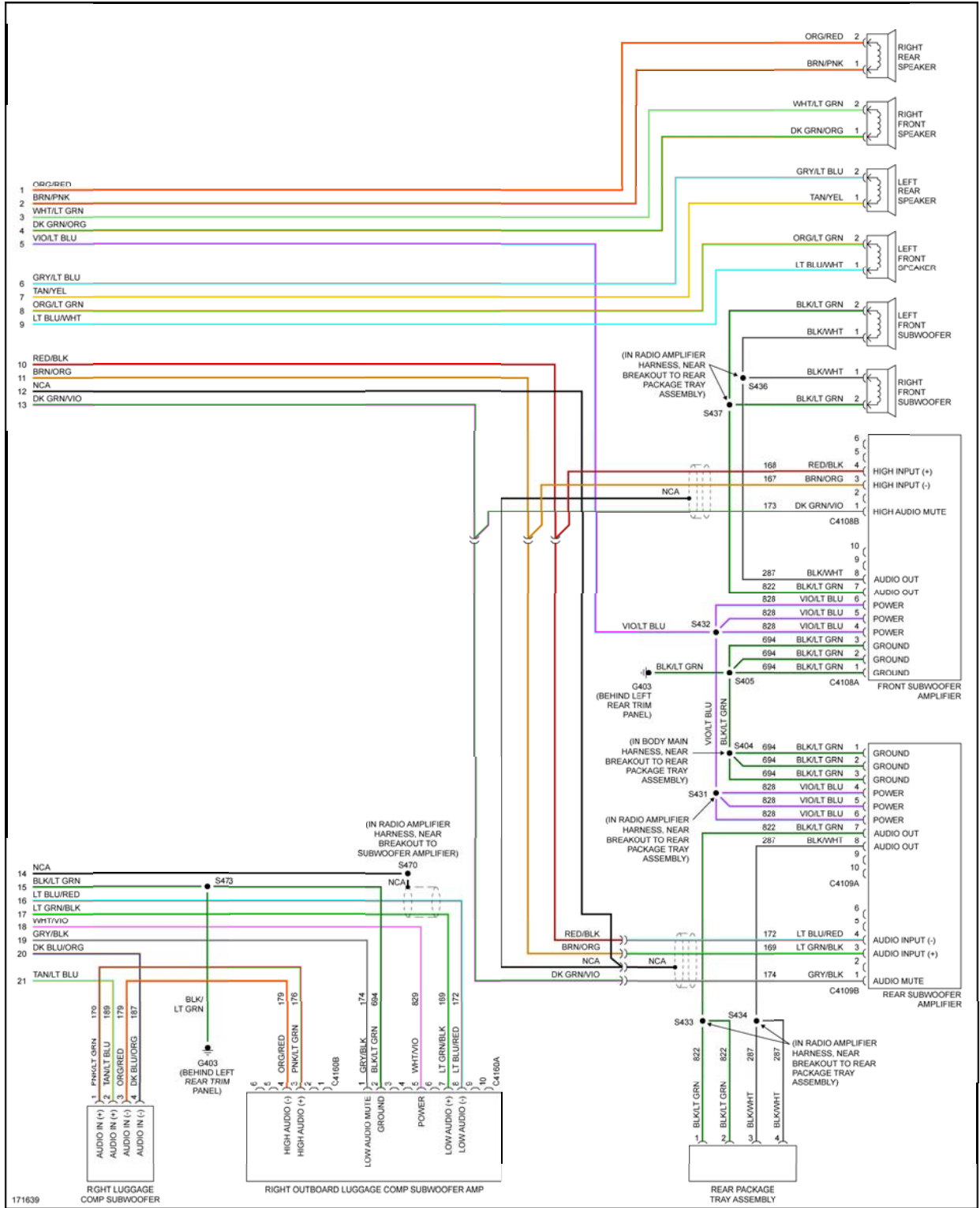


Fig. 46: Premium Sound Radio Circuit, Coupe W/ Mach 1000 Sound System (2 of 2)

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

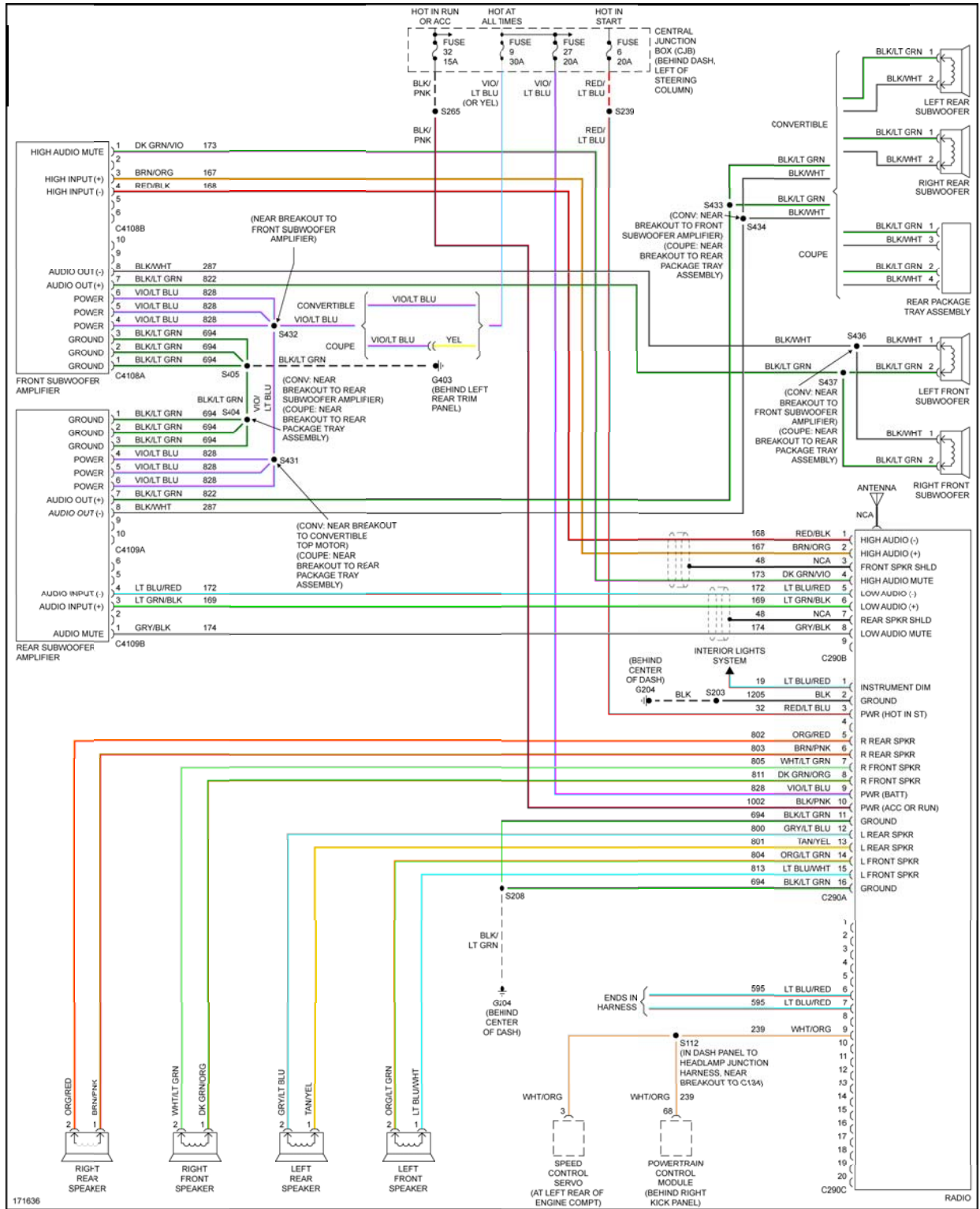


Fig. 47: Premium Sound Radio Circuit, W/ Mach 460 Sound System

SHIFT INTERLOCK

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

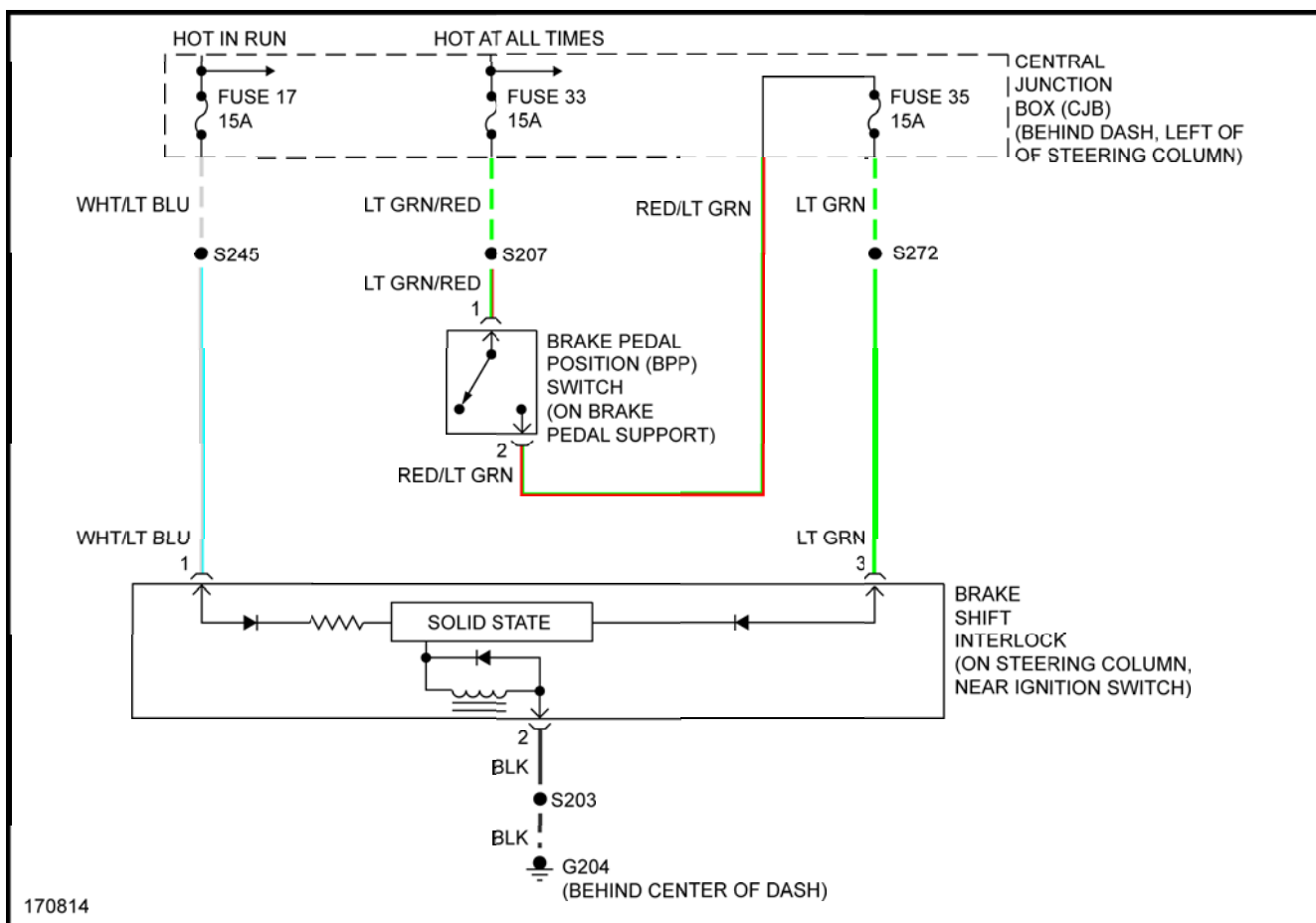


Fig. 48: Shift Interlock Circuit

STARTING/CHARGING

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

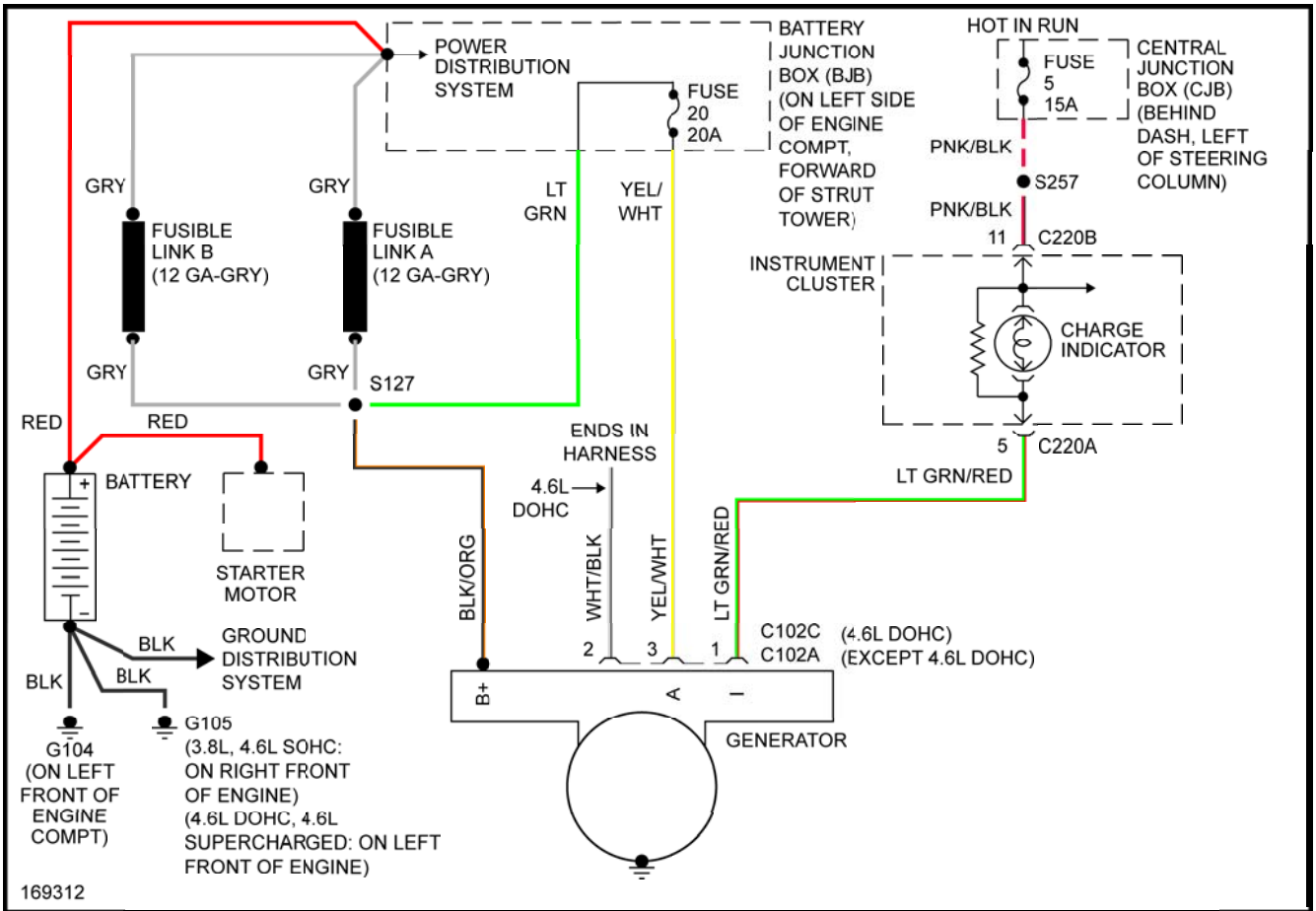


Fig. 49: Charging Circuit

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

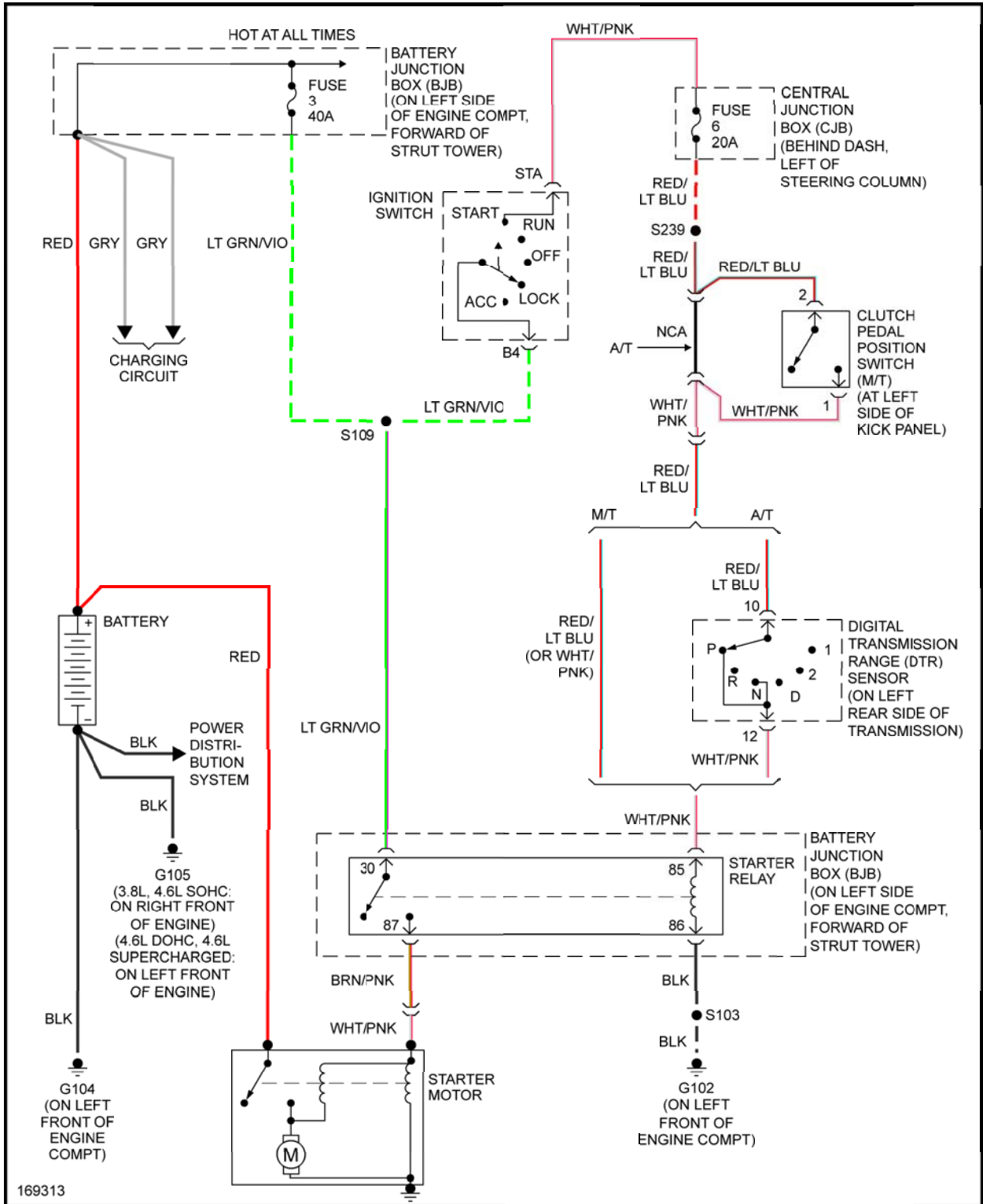


Fig. 50: Starting Circuit

SUPPLEMENTAL RESTRAINTS

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

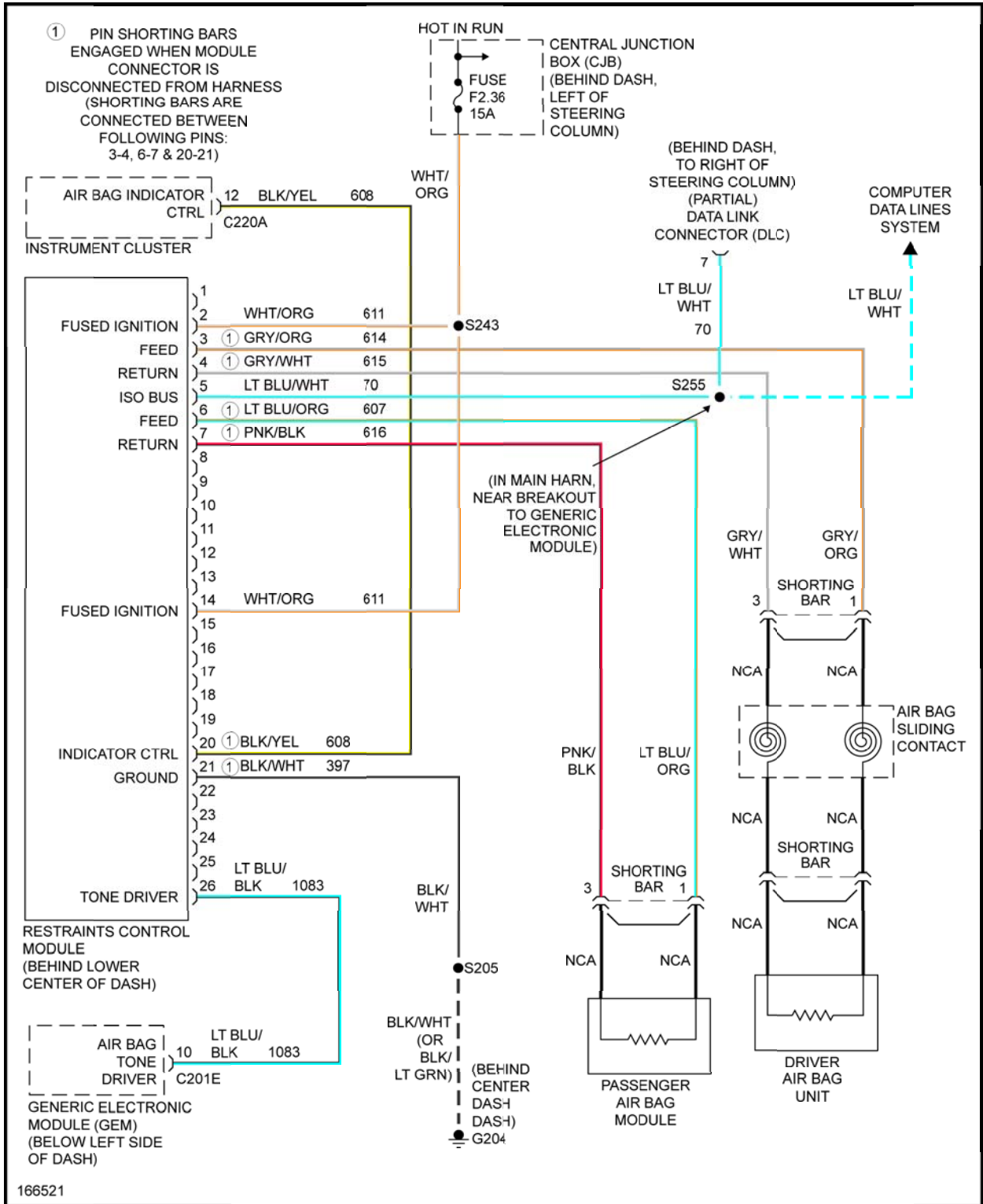


Fig. 51: Supplemental Restraints Circuit

TRANSMISSION

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

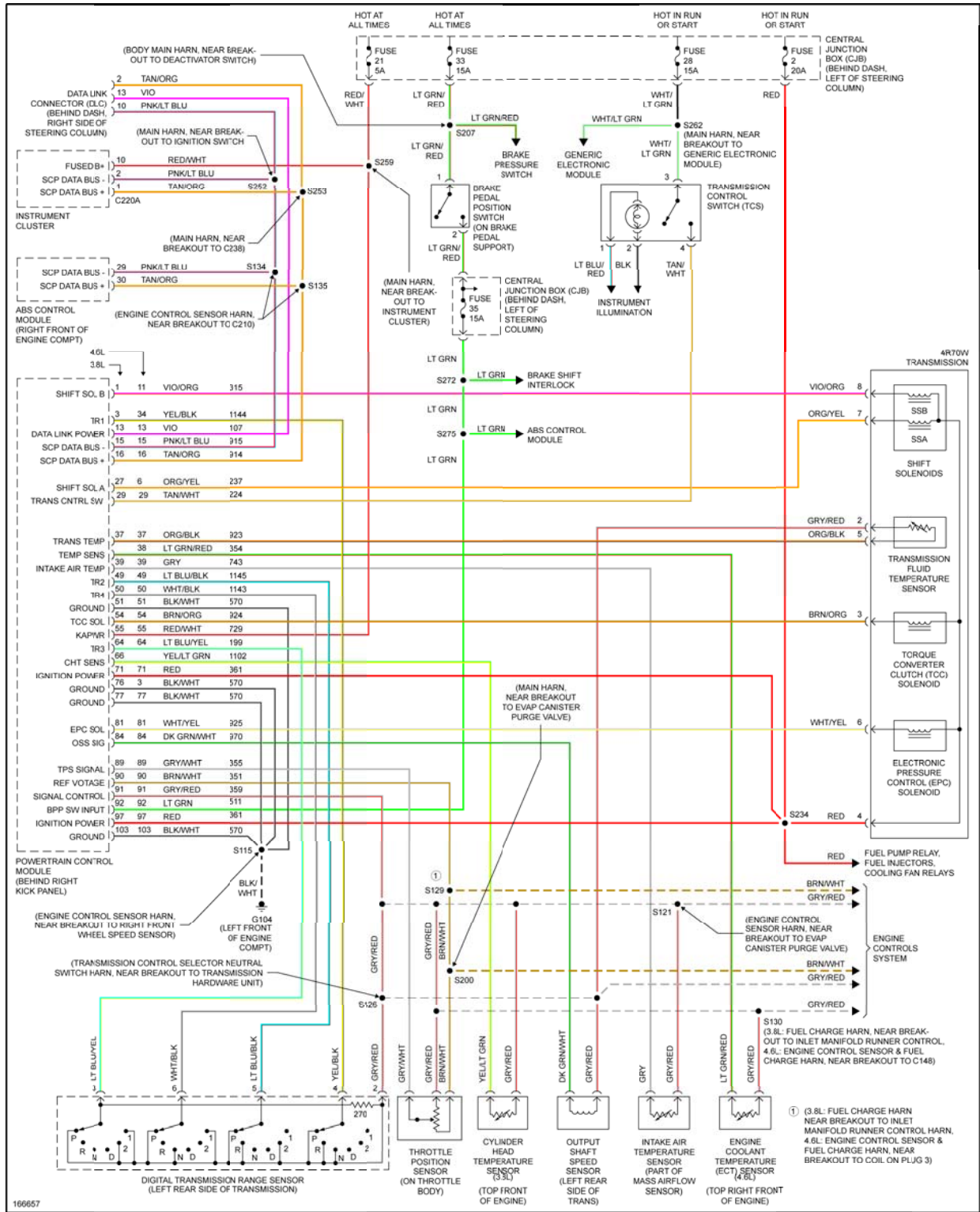


Fig. 52: A/T Circuit

TRUNK, TAILGATE, FUEL DOOR

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

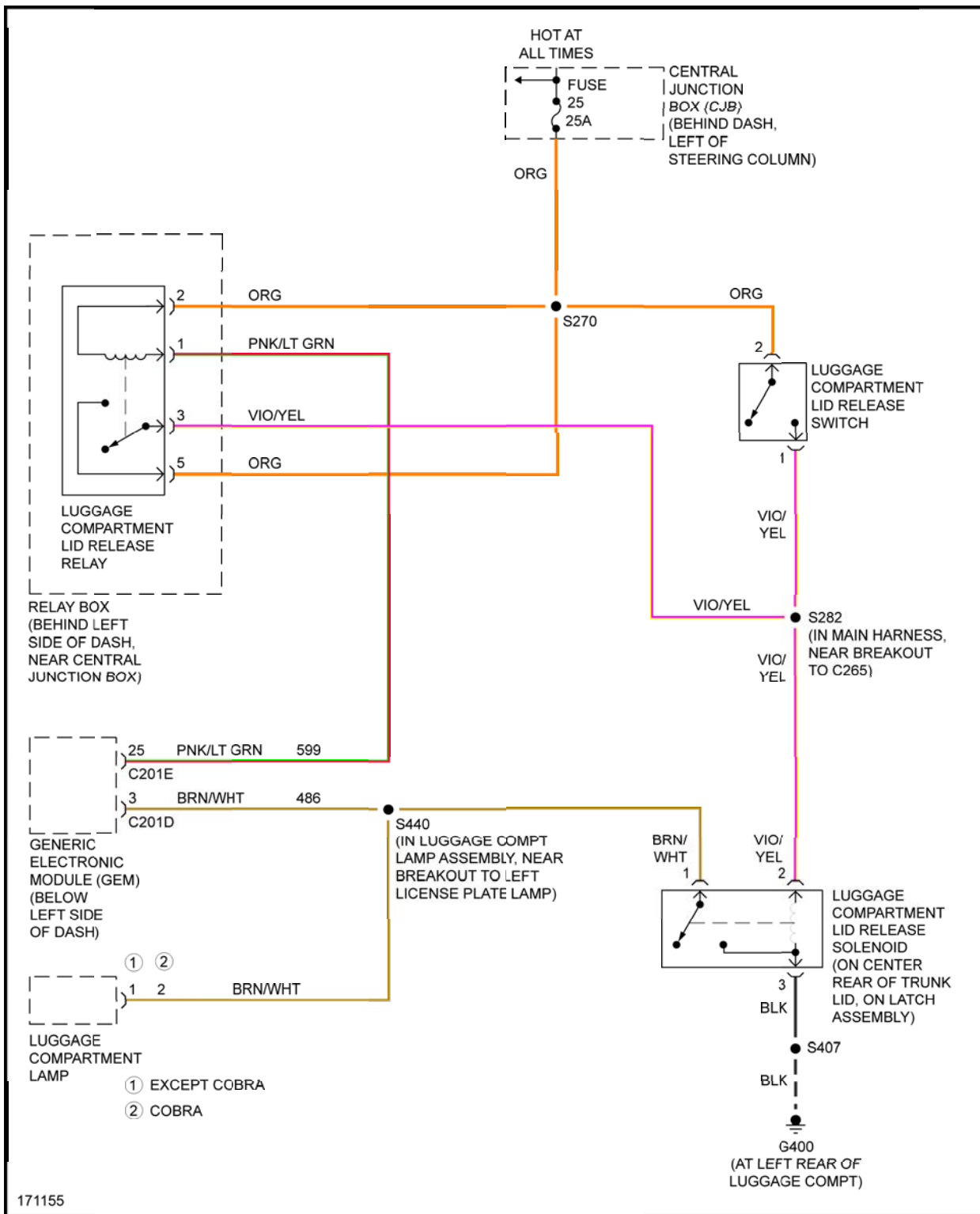


Fig. 53: Trunk, Tailgate, Fuel Door Circuit

WARNING SYSTEMS

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

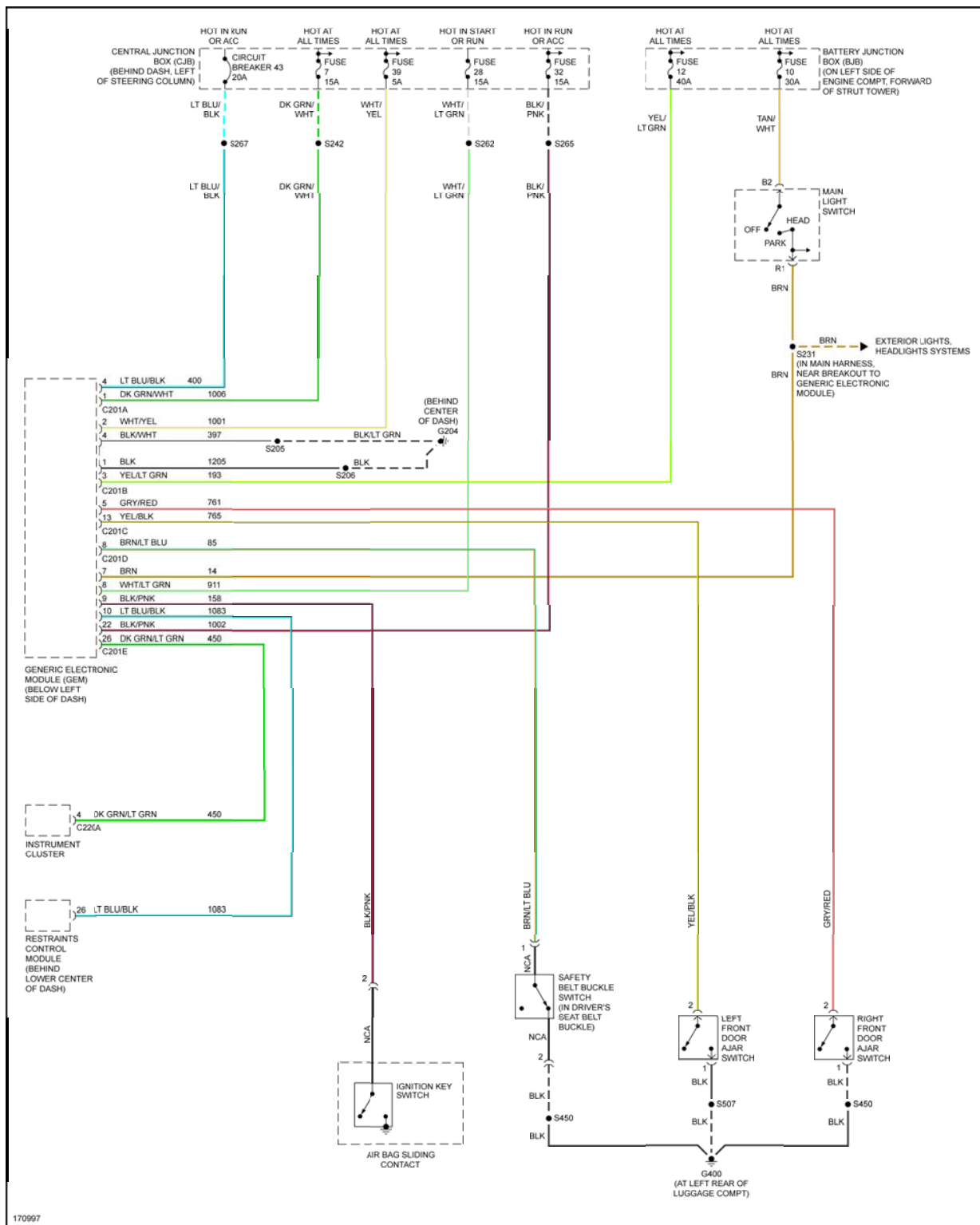


Fig. 54: Warning Systems Circuit

WIPER/WASHER

2003 Ford Mustang Cobra

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

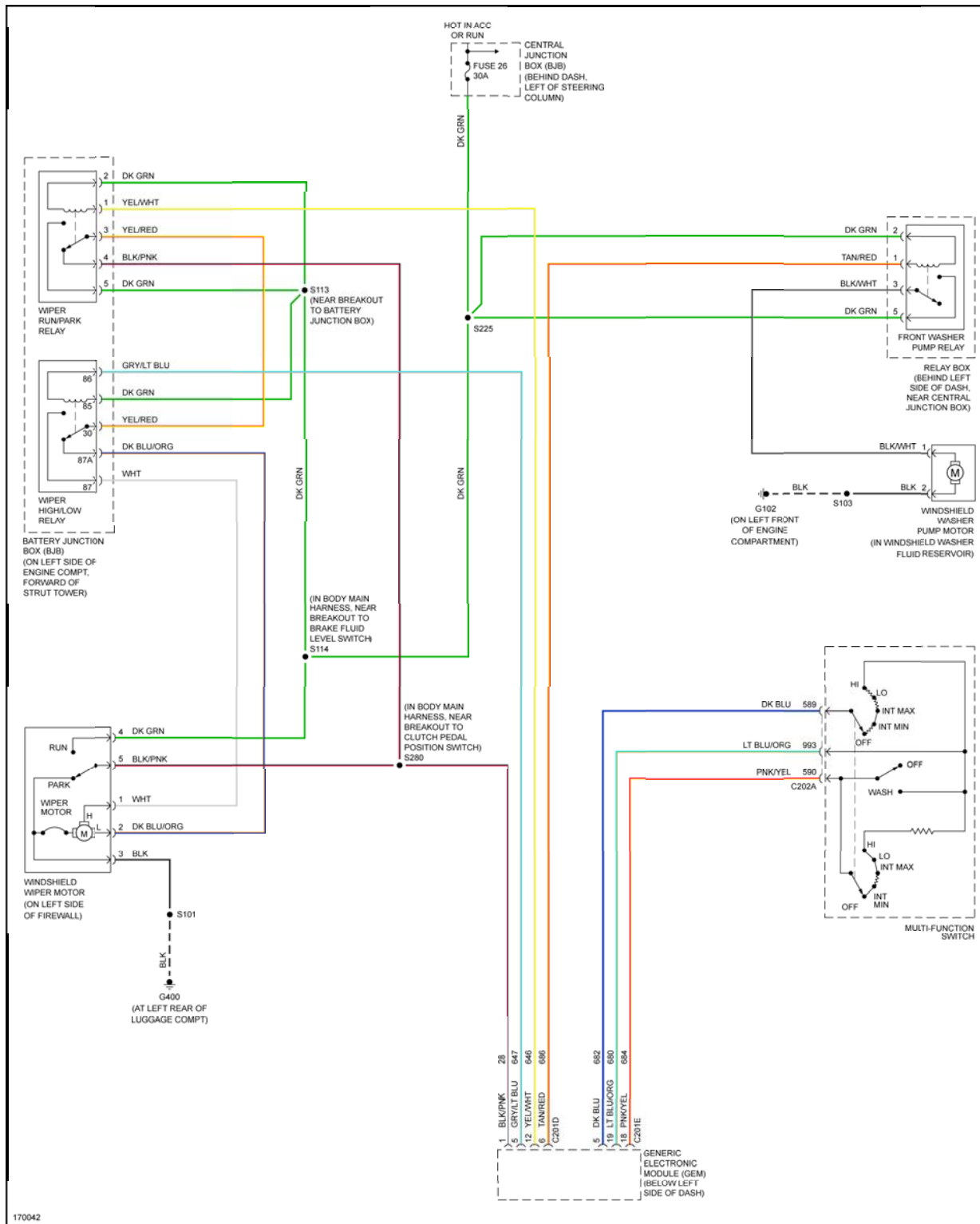


Fig. 55: Wiper/Washer Circuit

2003 SYSTEM WIRING DIAGRAMS

Ford - Mustang

USING WIRING DIAGRAMS

For information on using these wiring diagrams, see [USING SYSTEM WIRING DIAGRAMS](#) article.

AIR CONDITIONING

3.8L

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

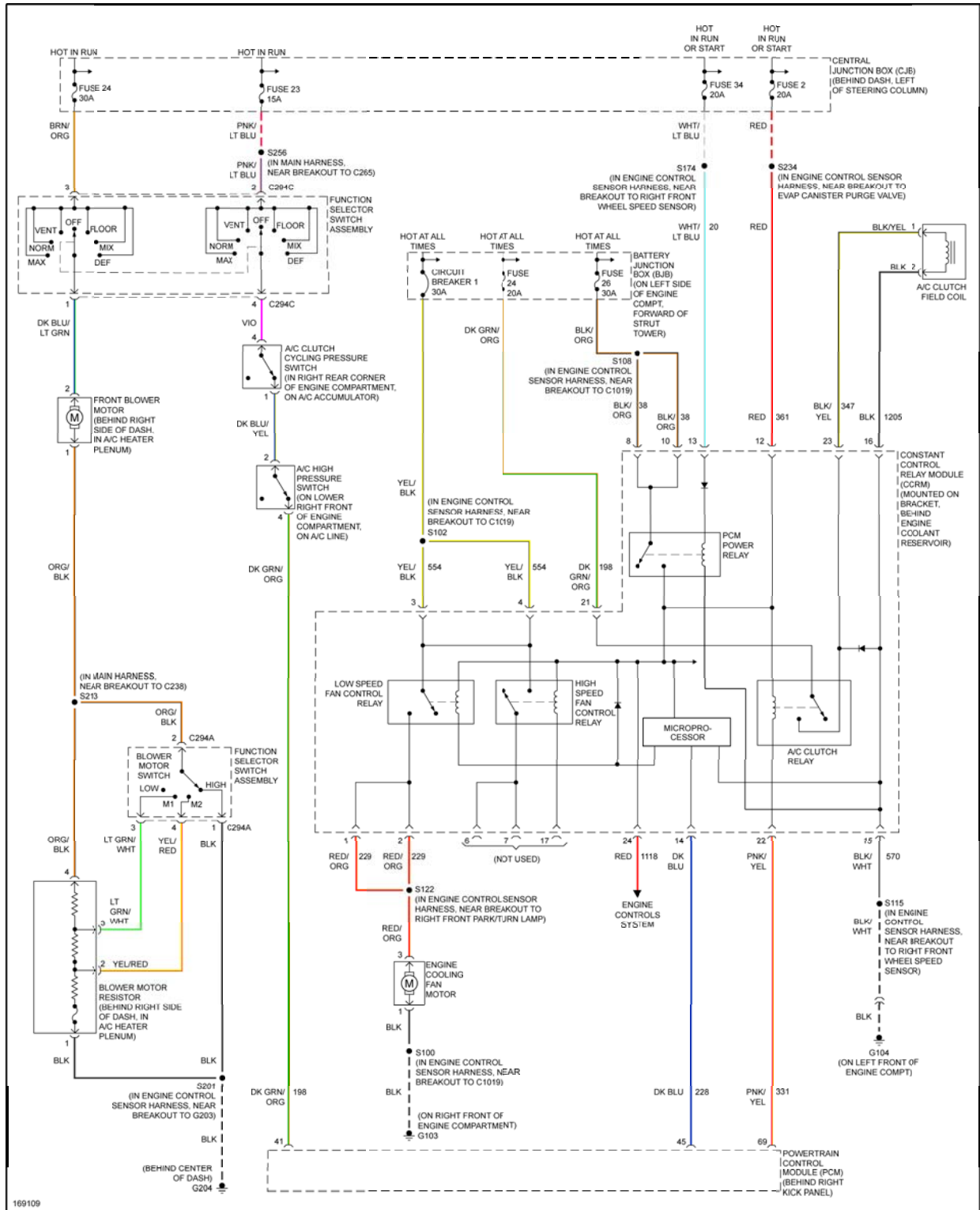


Fig. 1: 3.8L, Air Conditioning Circuit

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

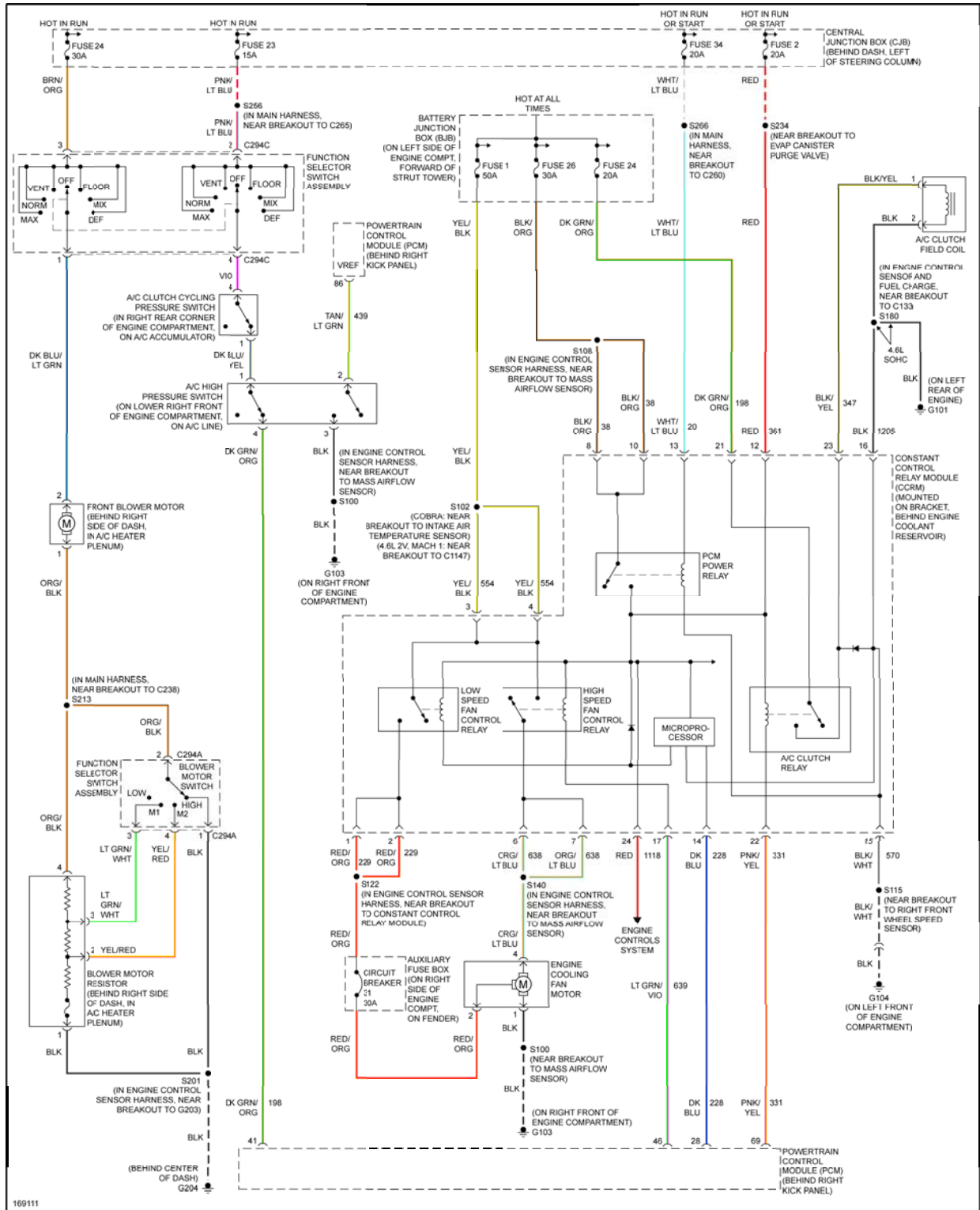


Fig. 2: 4.6L, Air Conditioning Circuit

ANTI-LOCK BRAKES

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

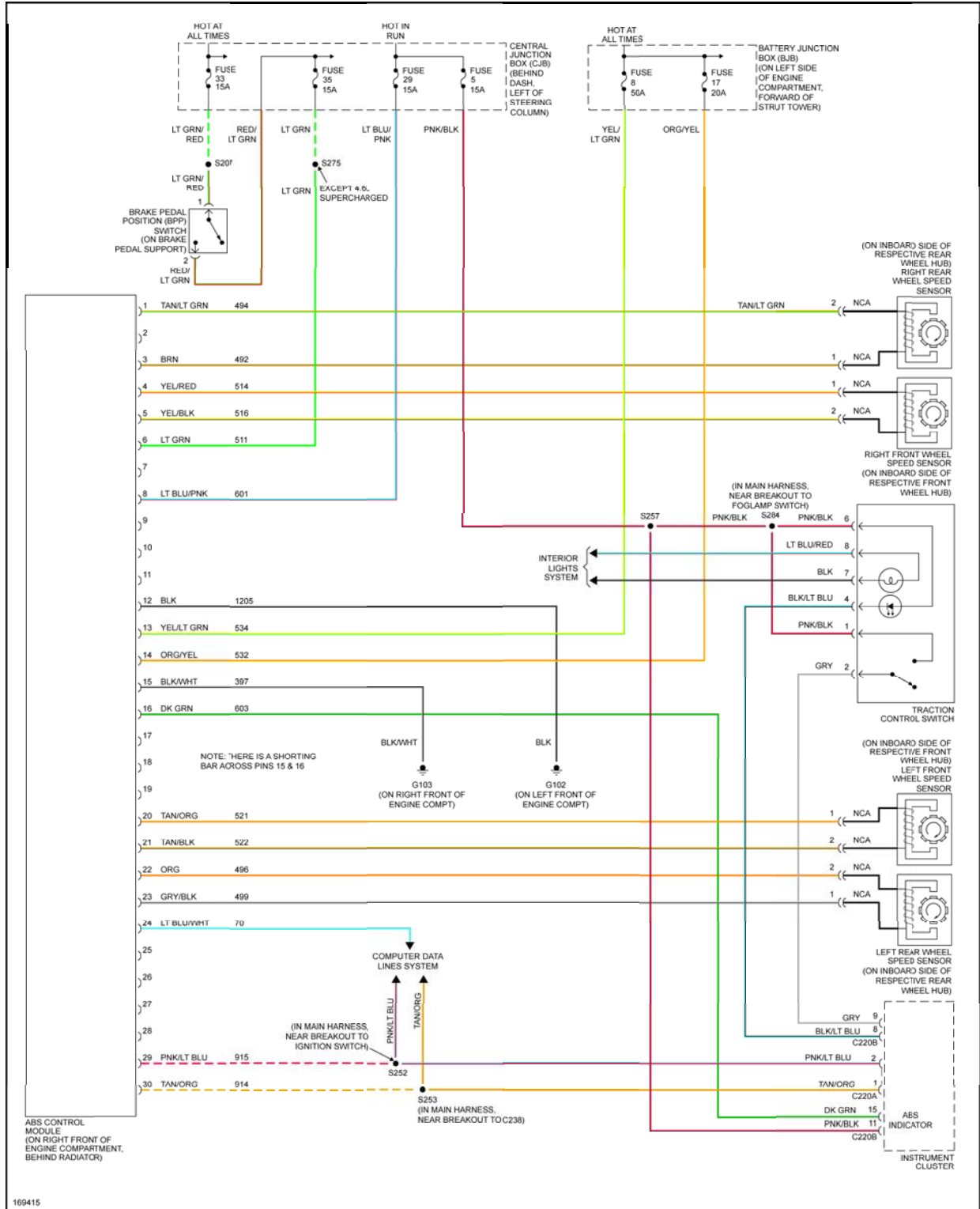


Fig. 3: Anti-lock Brakes Circuit

ANTI-THEFT

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

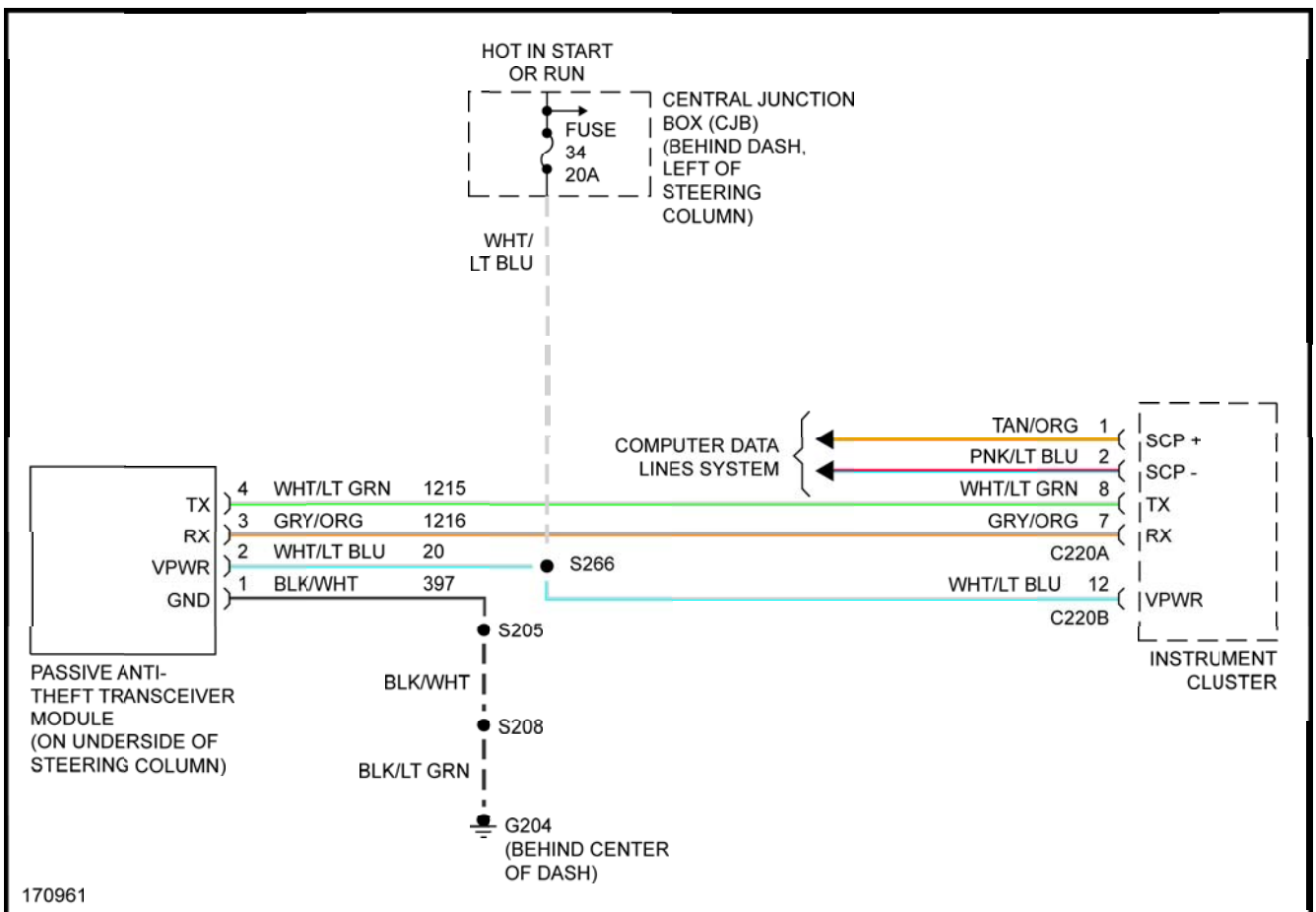


Fig. 4: Passive Anti-theft Circuit

BODY CONTROL MODULES

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

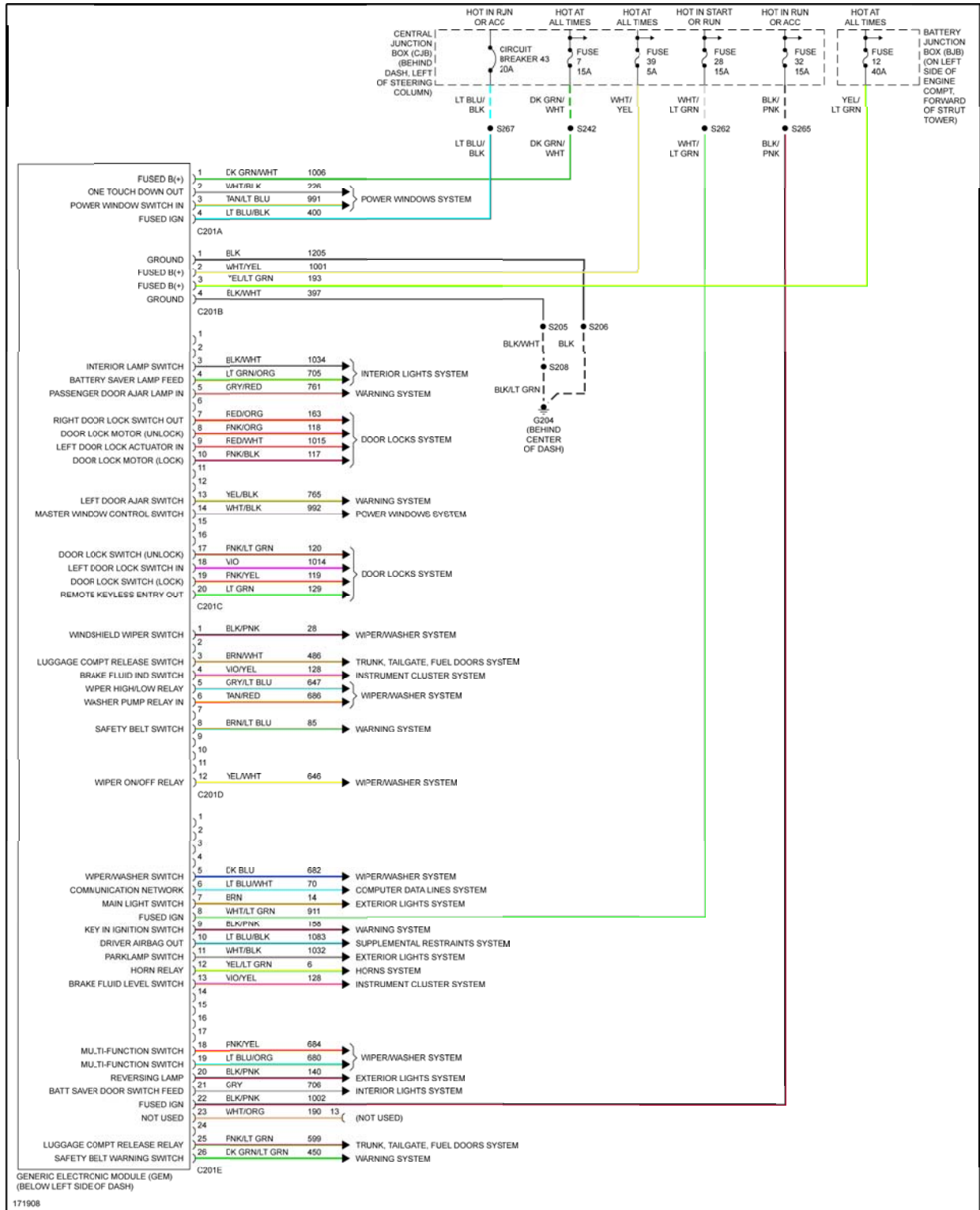


Fig. 5: Body Control Modules Circuit

COMPUTER DATA LINES

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

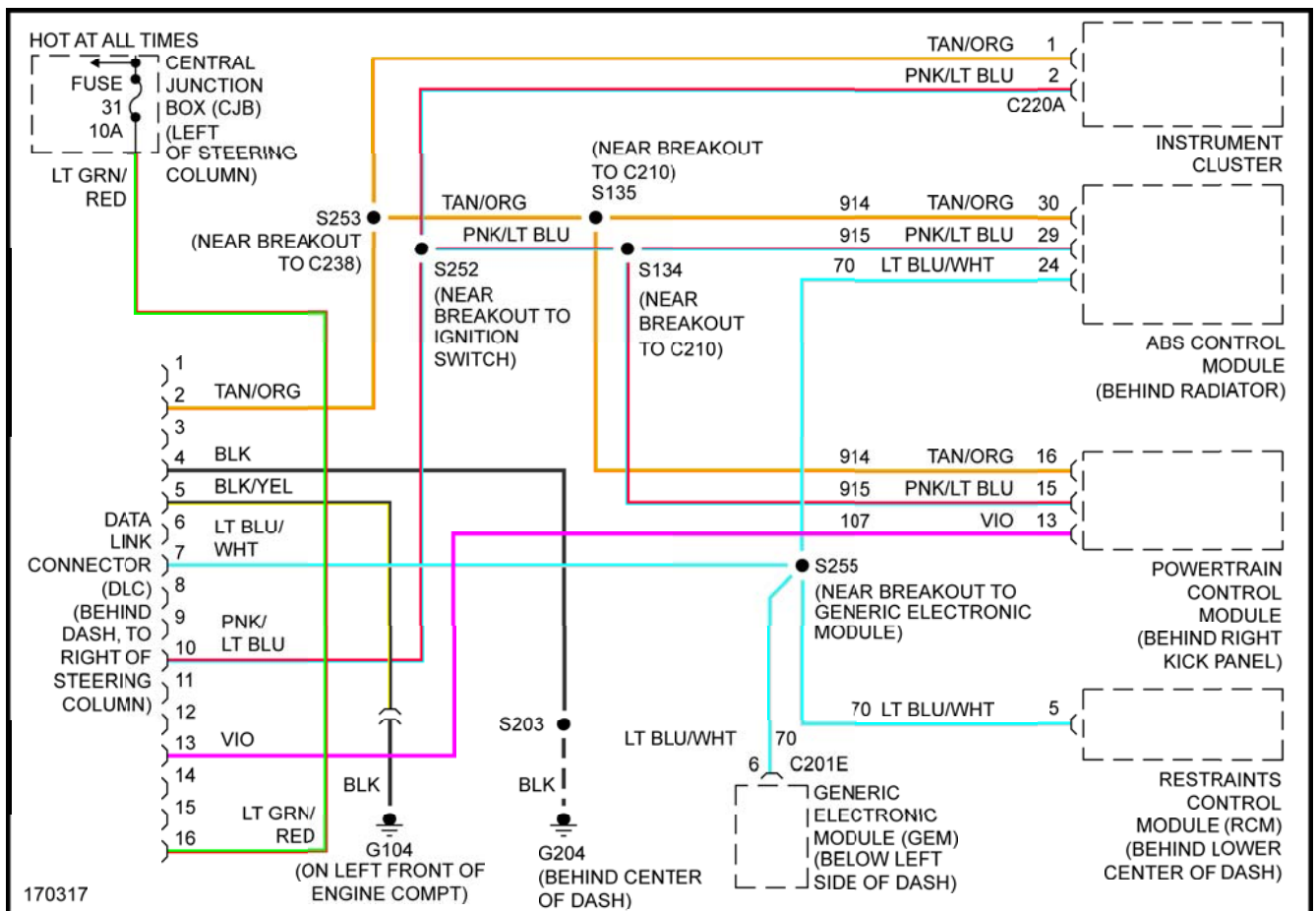


Fig. 6: Computer Data Lines Circuit

COOLING FAN

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

3.8L

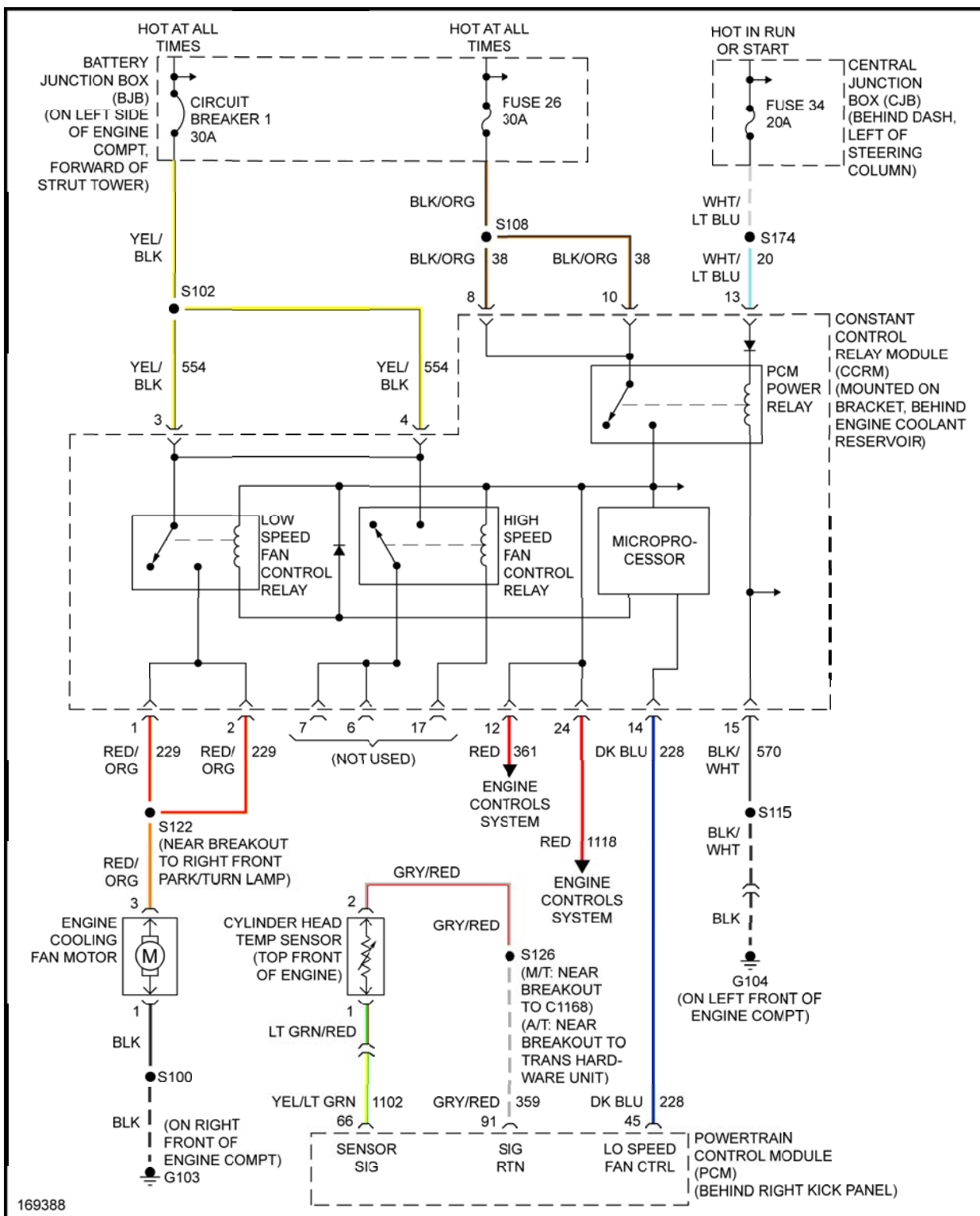


Fig. 7: 3.8L, Cooling Fan Circuit

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

4.6L

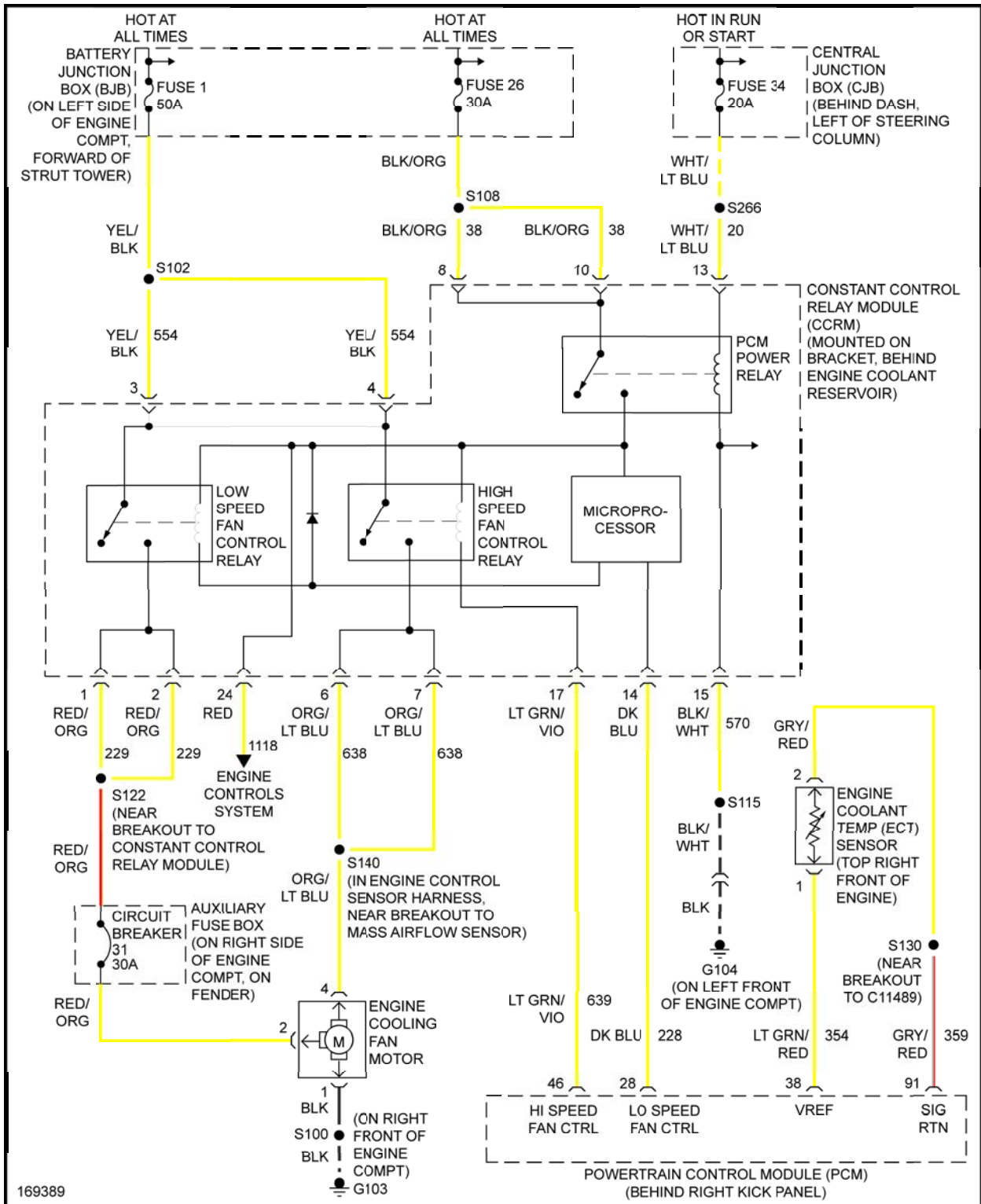
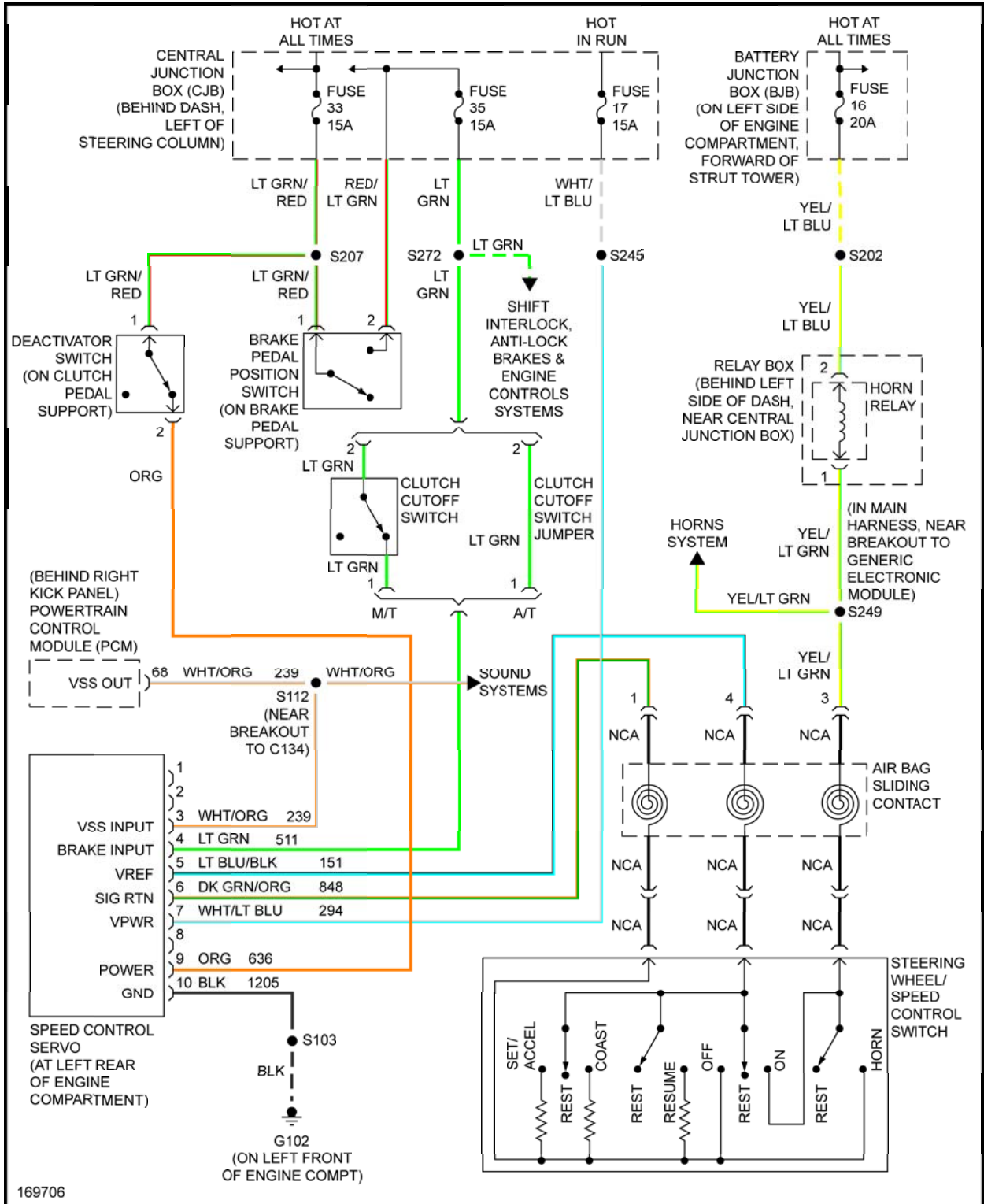


Fig. 8: 4.6L, Cooling Fan Circuit

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

CRUISE CONTROL



169706

Fig. 9: Cruise Control Circuit

DEFOGGERS

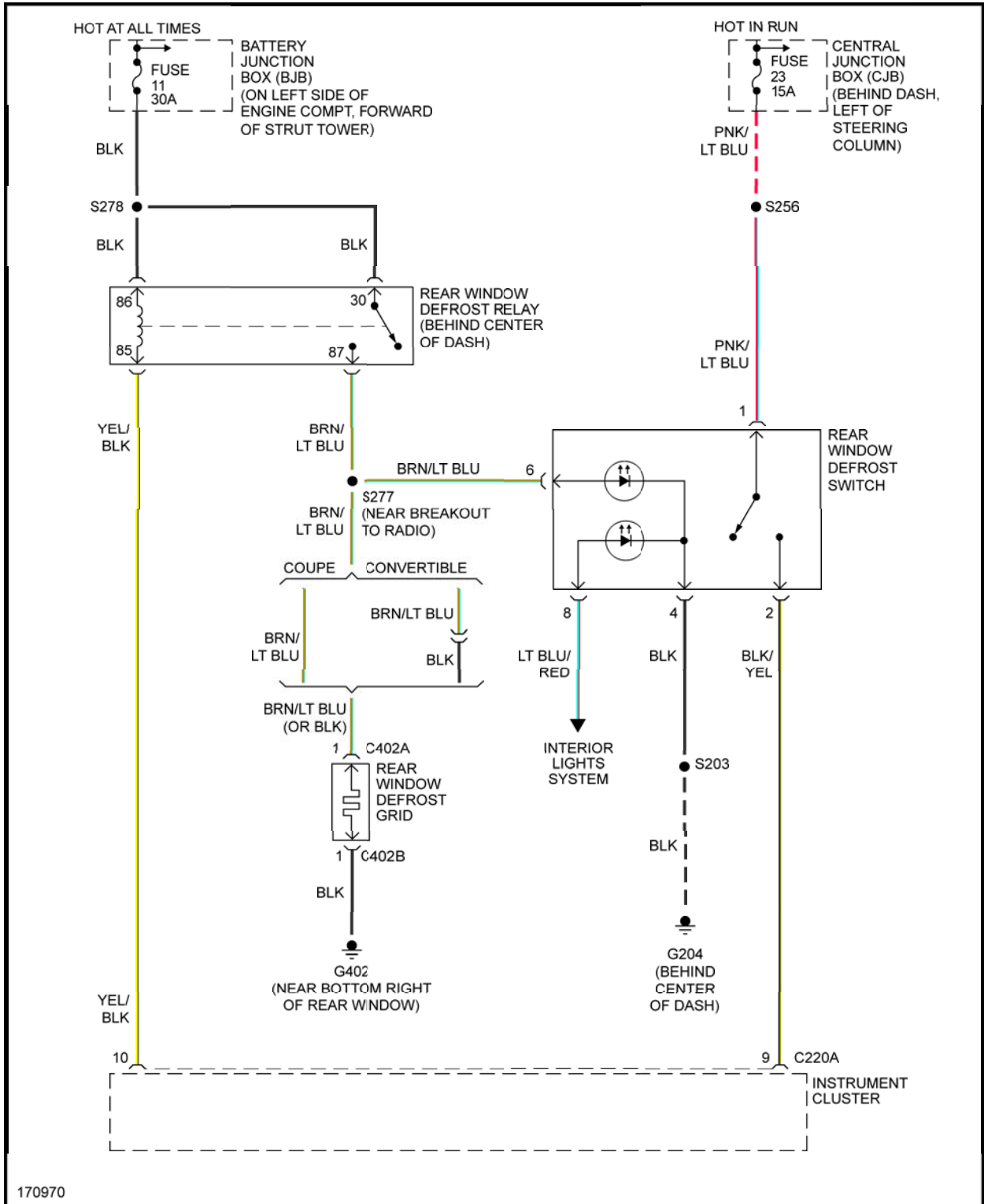


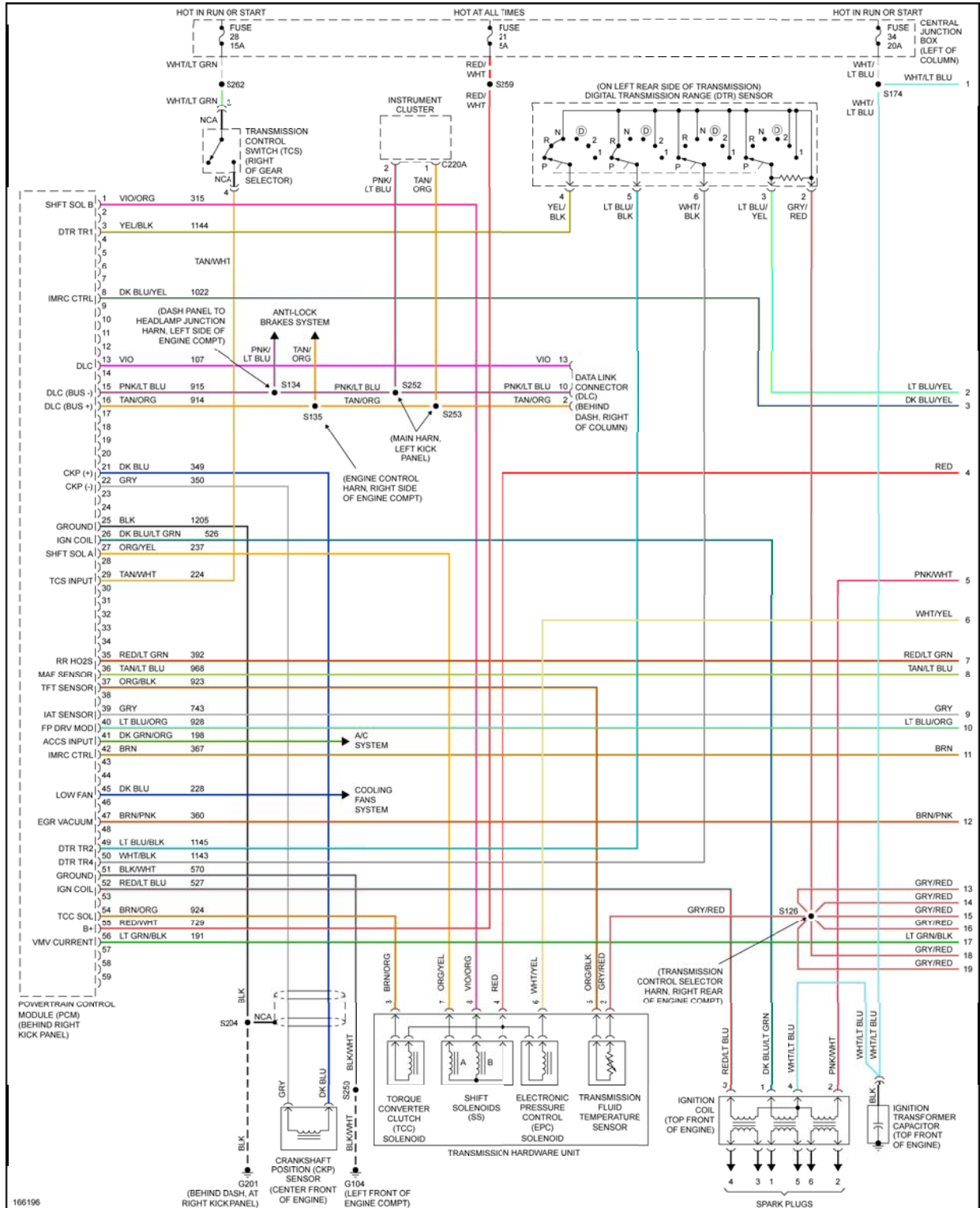
Fig. 10: Defoggers Circuit

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

ENGINE PERFORMANCE

3.8L



2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

Fig. 11: 3.8L, Engine Performance Circuit (1 of 3)

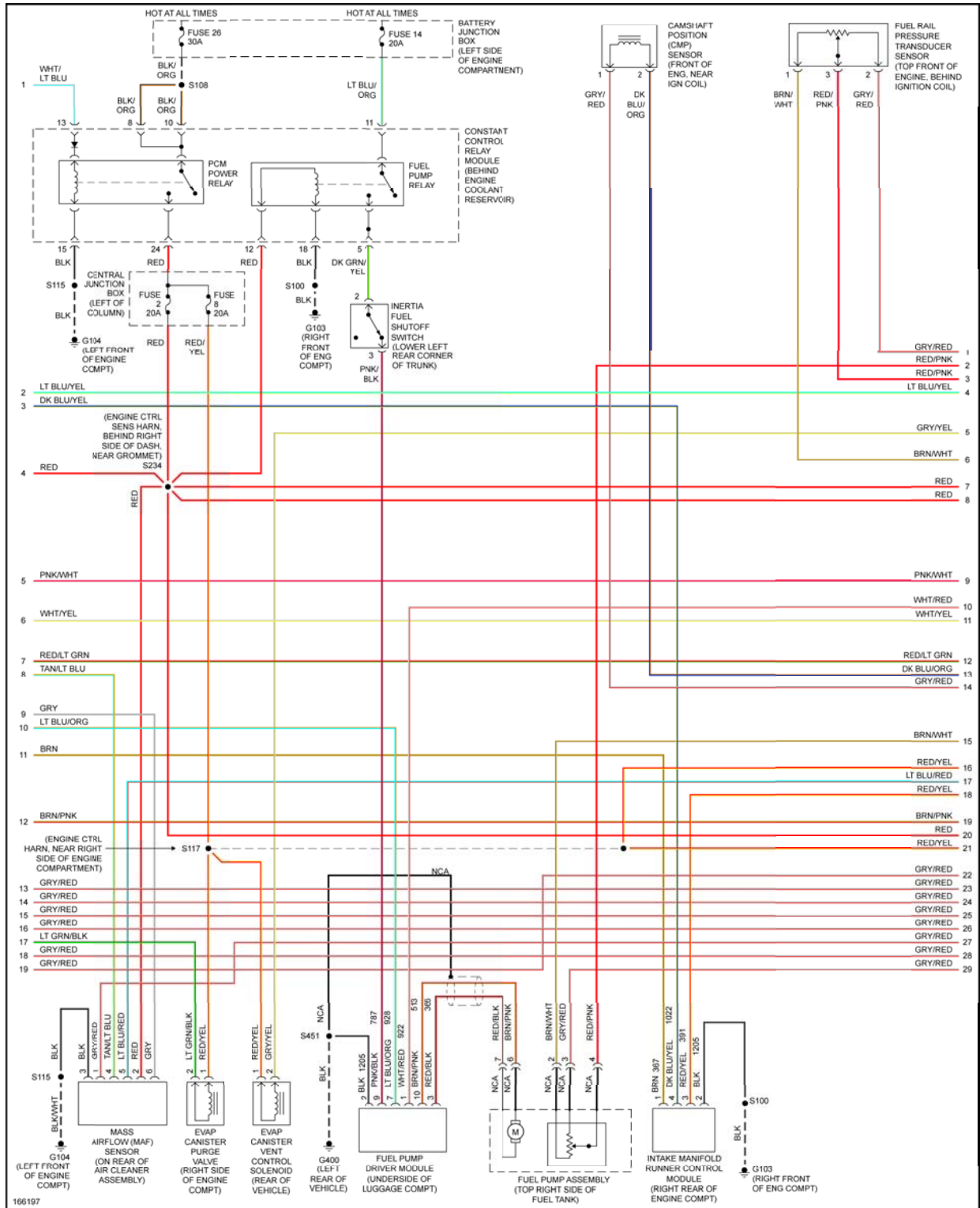


Fig. 12: 3.8L, Engine Performance Circuit (2 of 3)

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

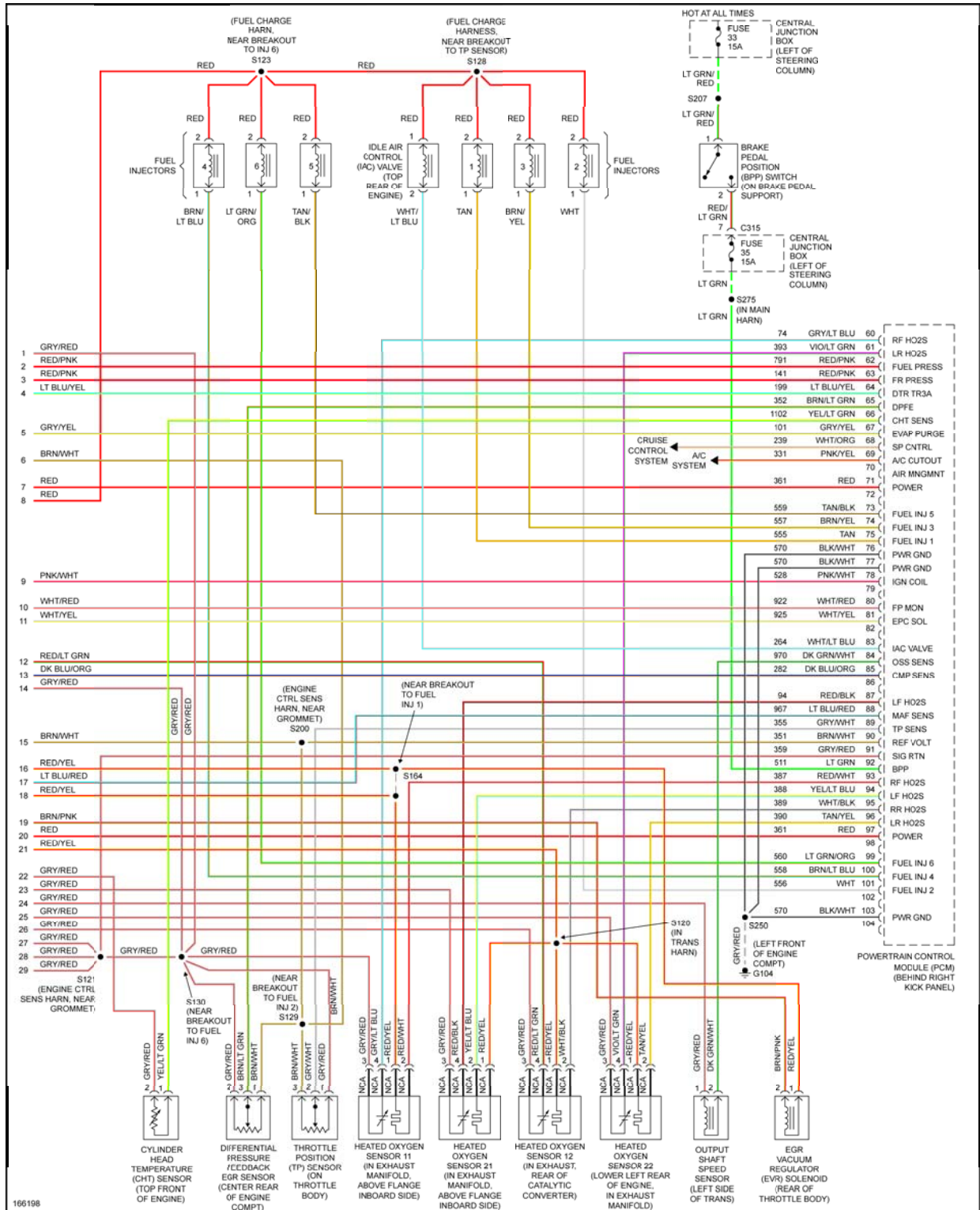


Fig. 13: 3.8L, Engine Performance Circuit (3 of 3)

4.6L DOHC

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

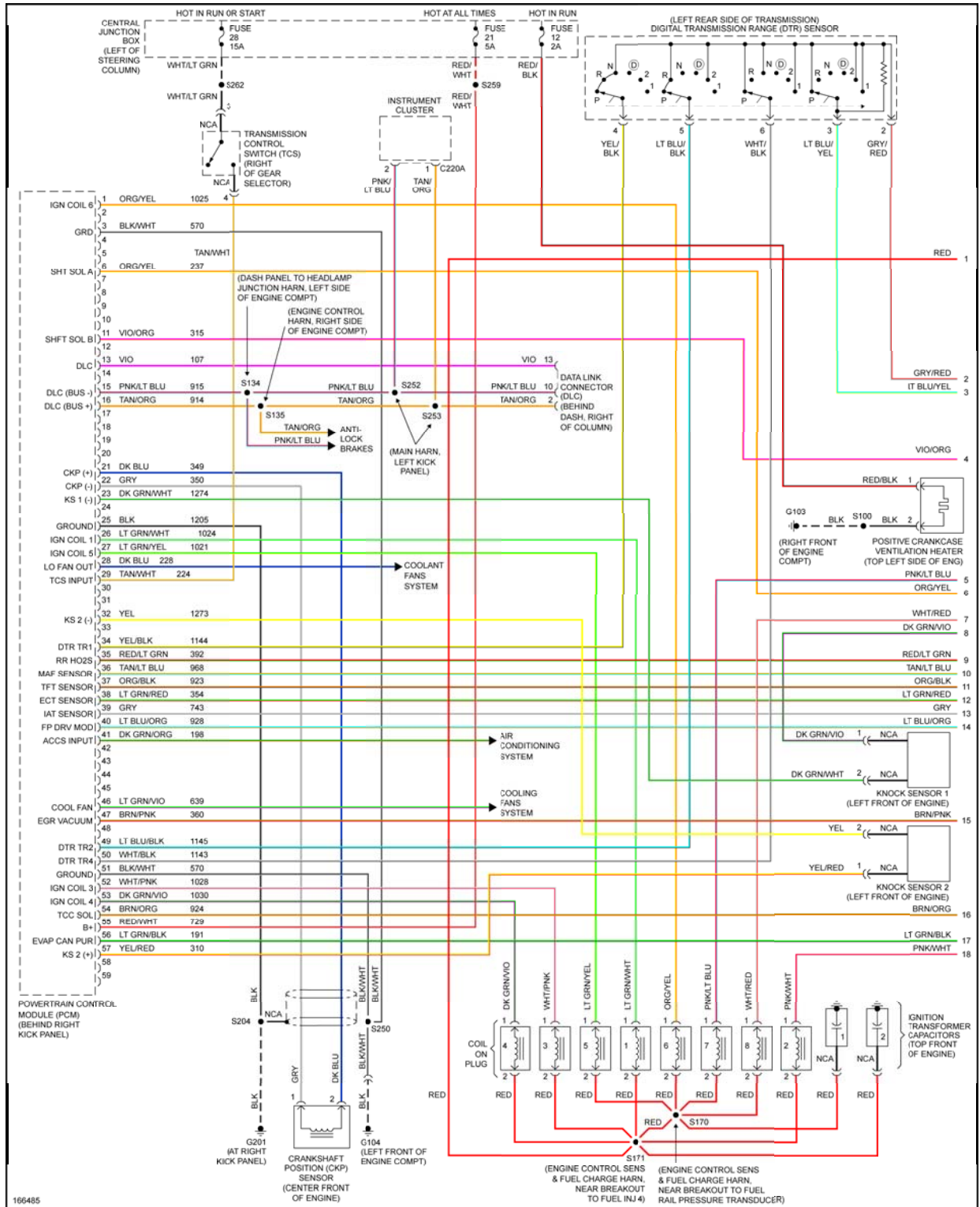


Fig. 14: 4.6L DOHC, Engine Performance Circuit (1 of 3)

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

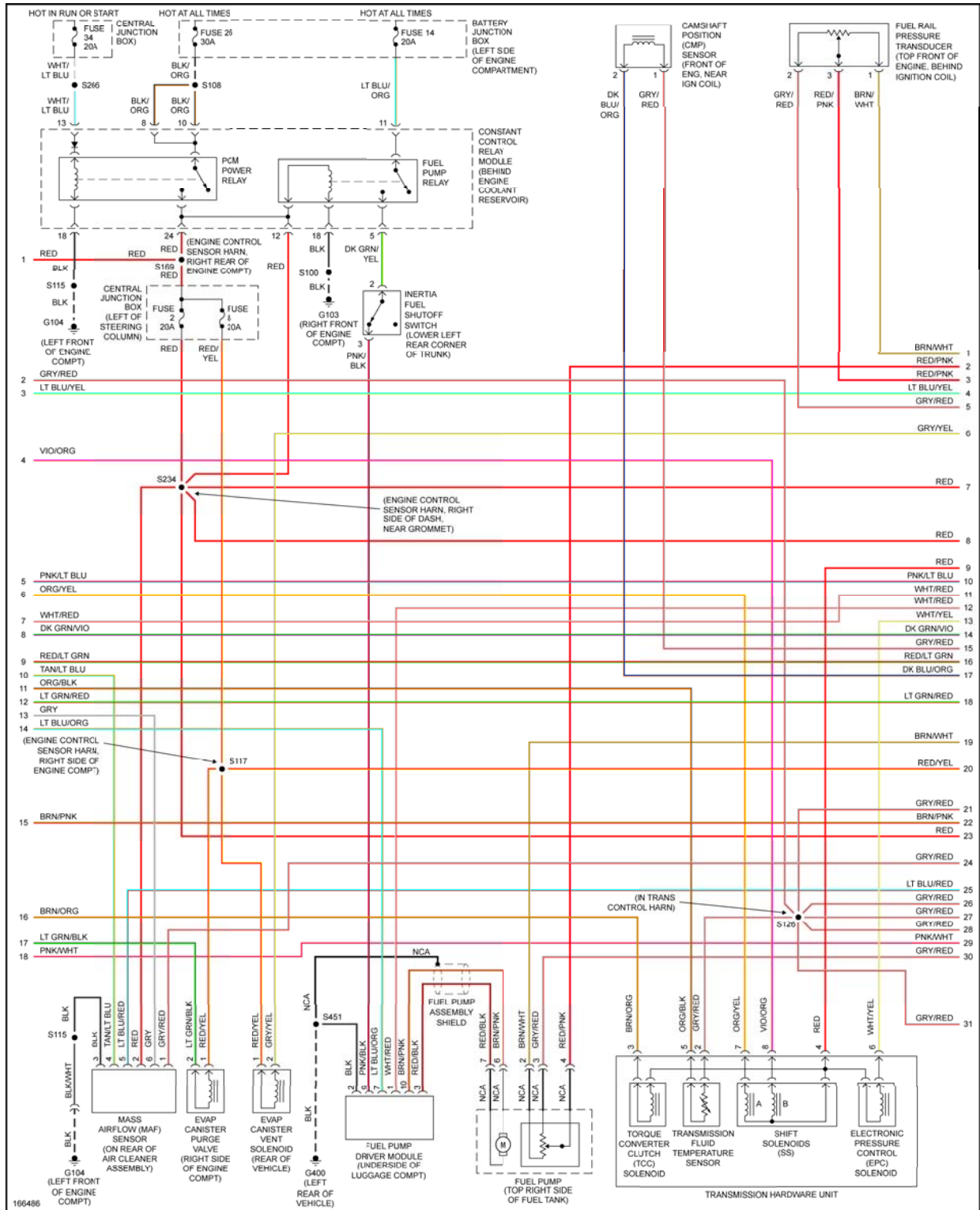


Fig. 15: 4.6L DOHC, Engine Performance Circuit (2 of 3)

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

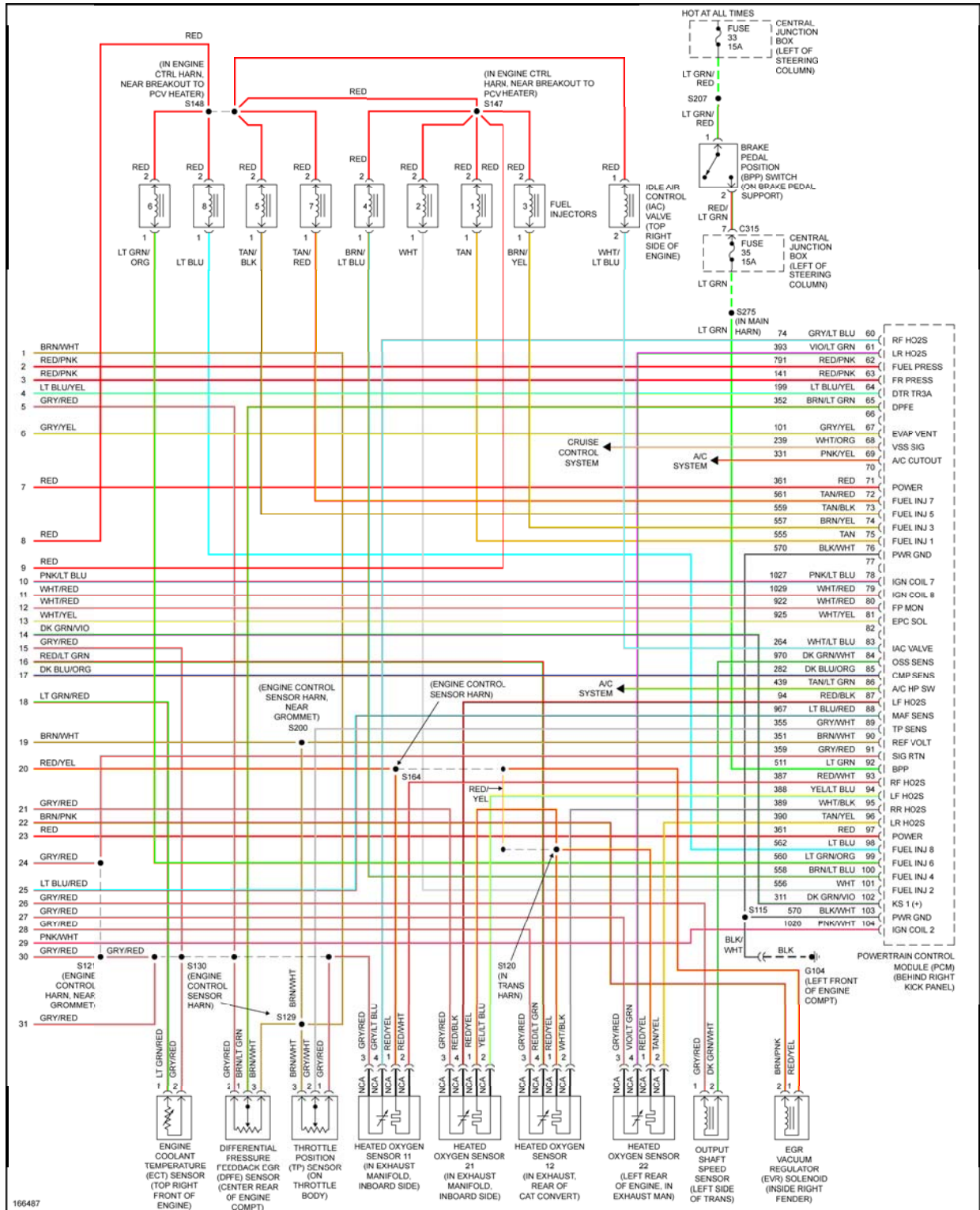


Fig. 16: 4.6L DOHC, Engine Performance Circuit (3 of 3)

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

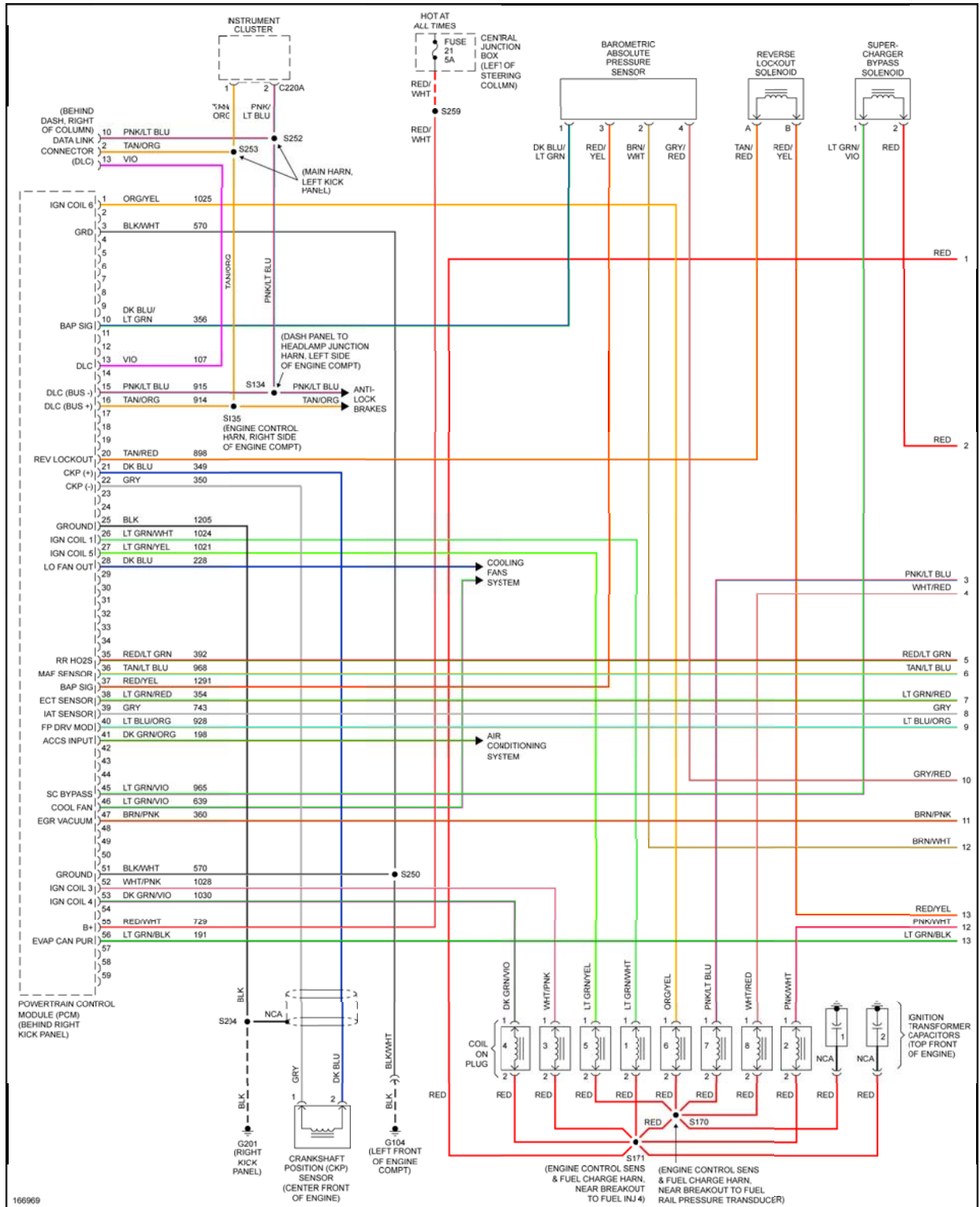


Fig. 17: 4.6L SC, Engine Performance Circuit (1 of 3)

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

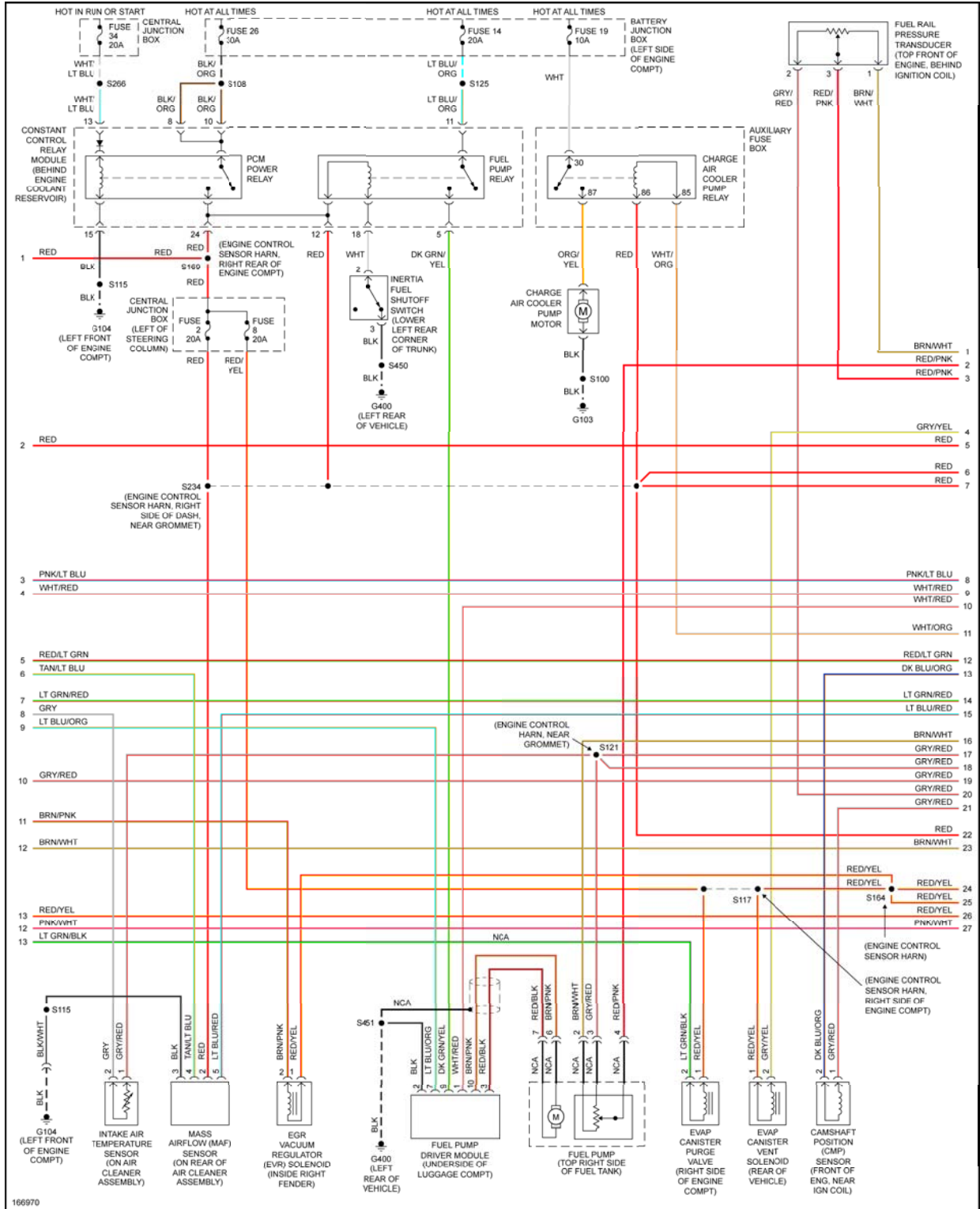


Fig. 18: 4.6L SC, Engine Performance Circuit (2 of 3)

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

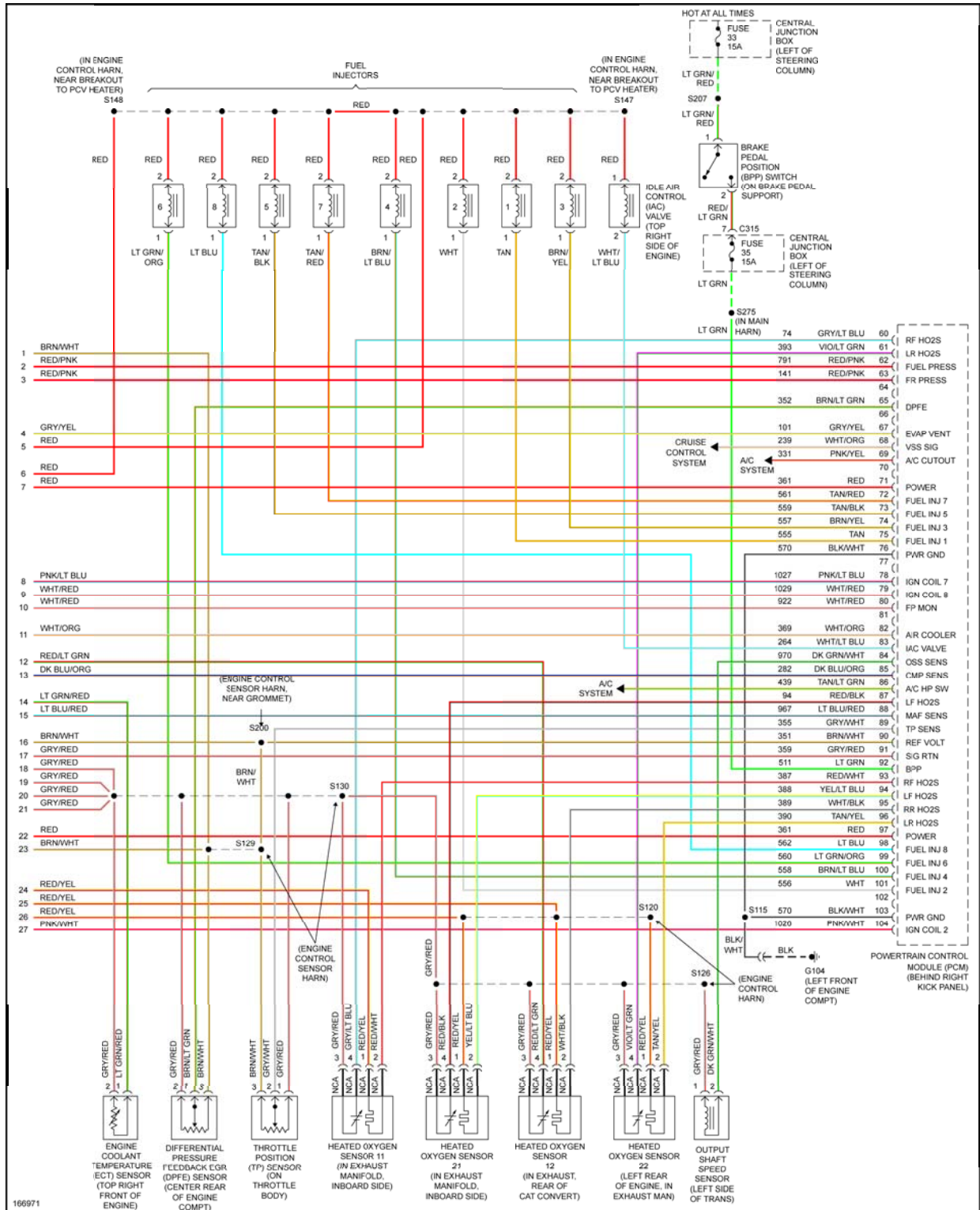


Fig. 19: 4.6L SC, Engine Performance Circuit (3 of 3)

4.6L SOHC

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

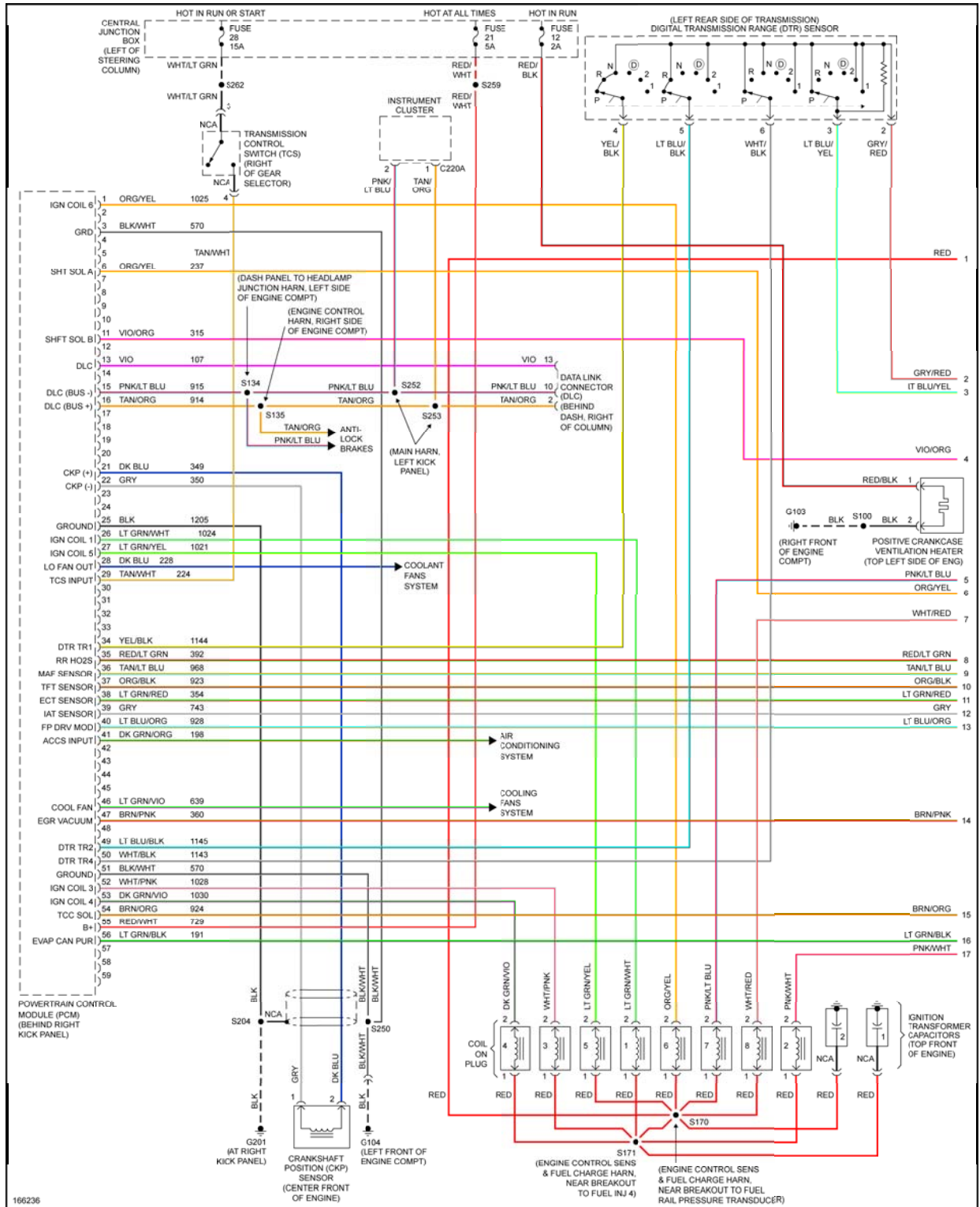


Fig. 20: 4.6L SOHC, Engine Performance Circuit (1 of 3)

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

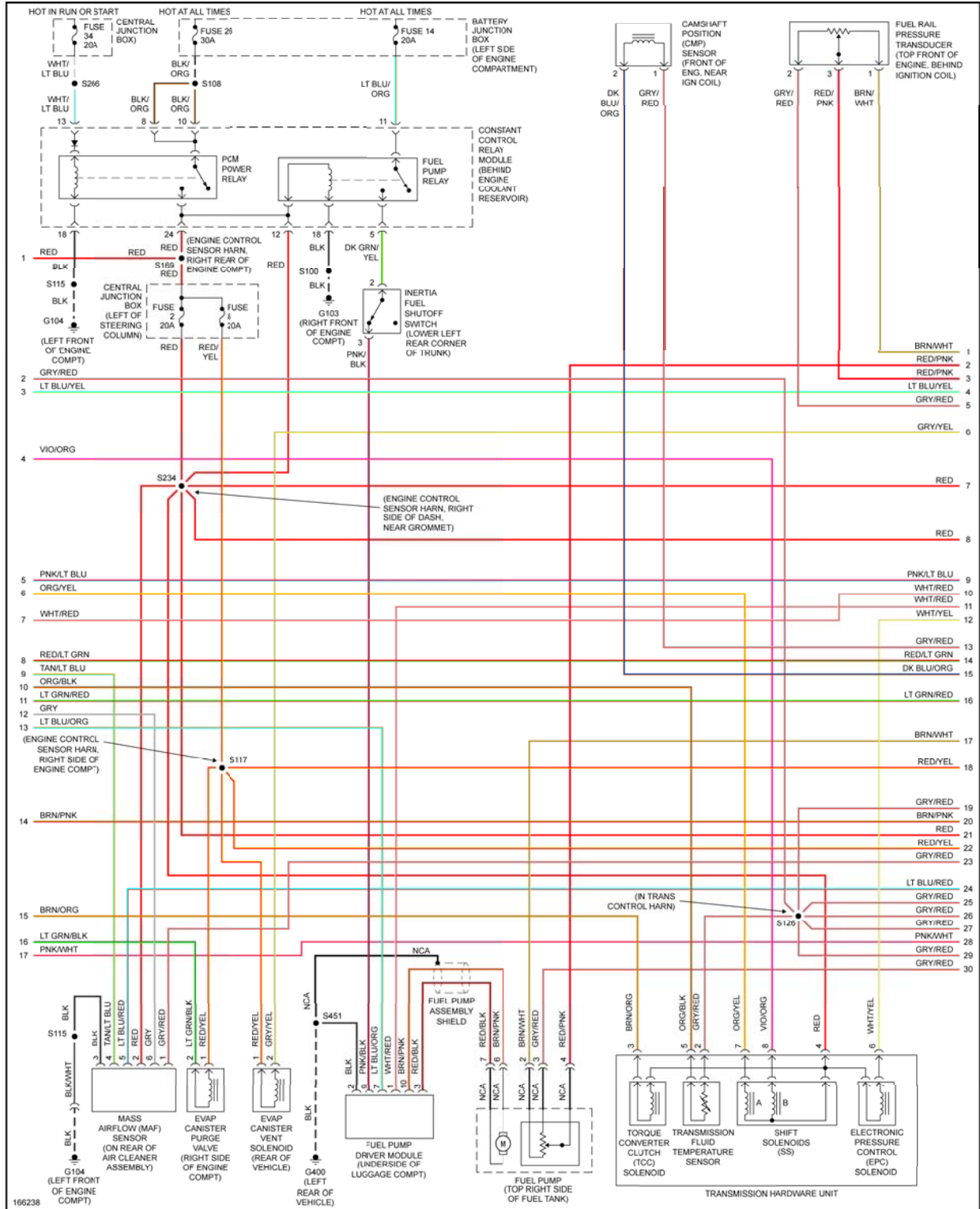


Fig. 21: 4.6L SOHC, Engine Performance Circuit (2 of 3)

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

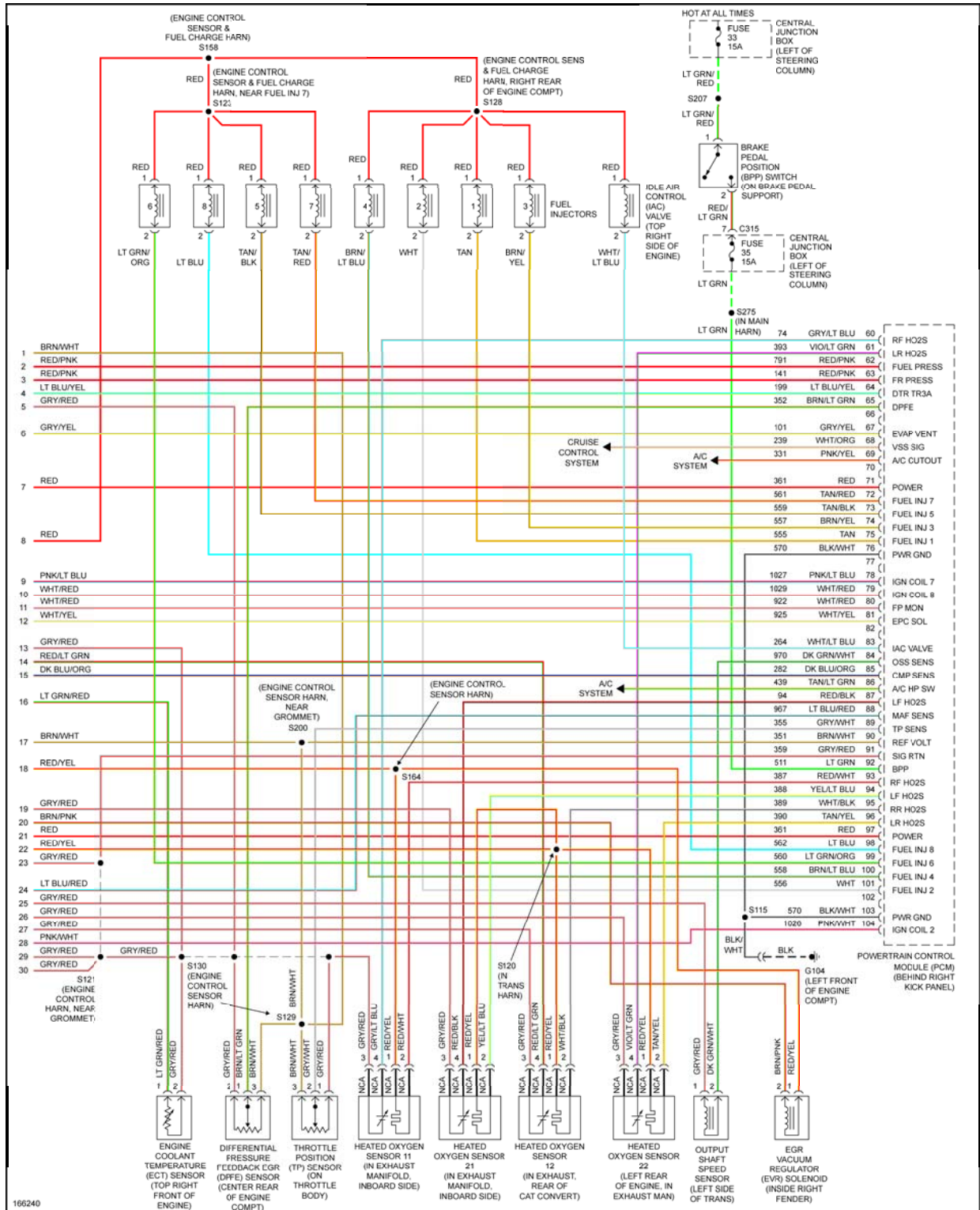


Fig. 22: 4.6L SOHC, Engine Performance Circuit (3 of 3)

EXTERIOR LIGHTS

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

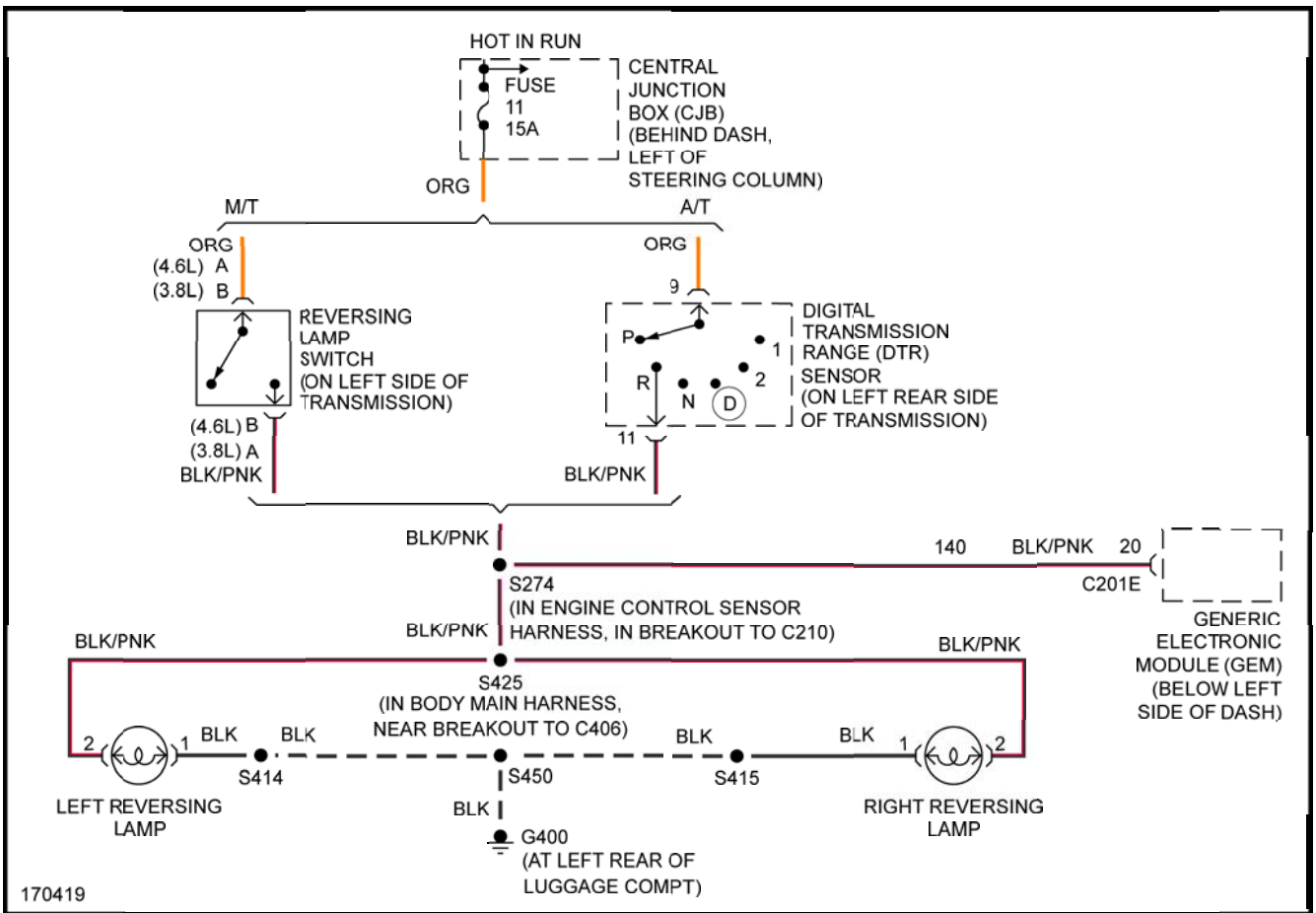


Fig. 23: Back-up Lamps Circuit

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

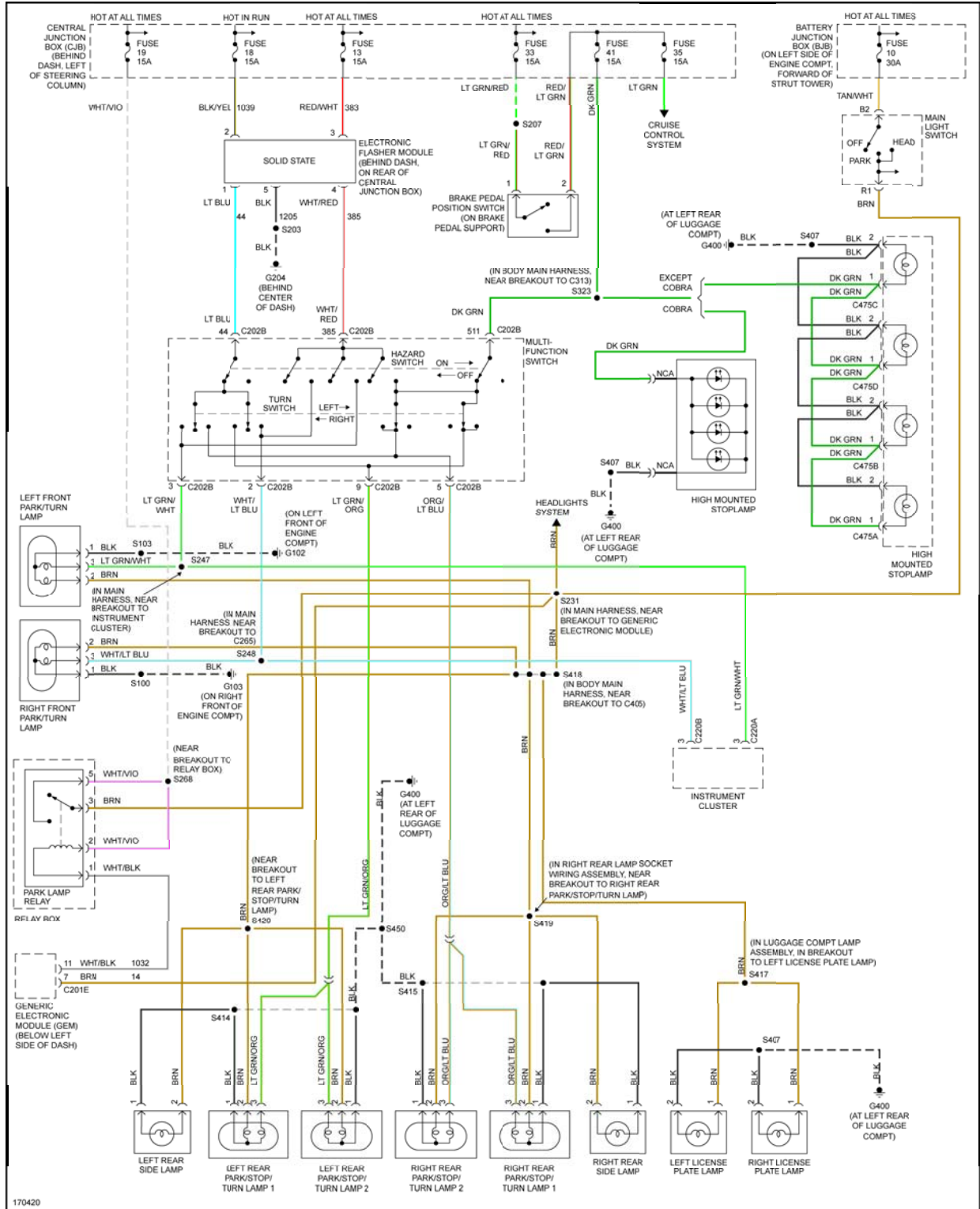


Fig. 24: Exterior Lamps Circuit

GROUND DISTRIBUTION

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

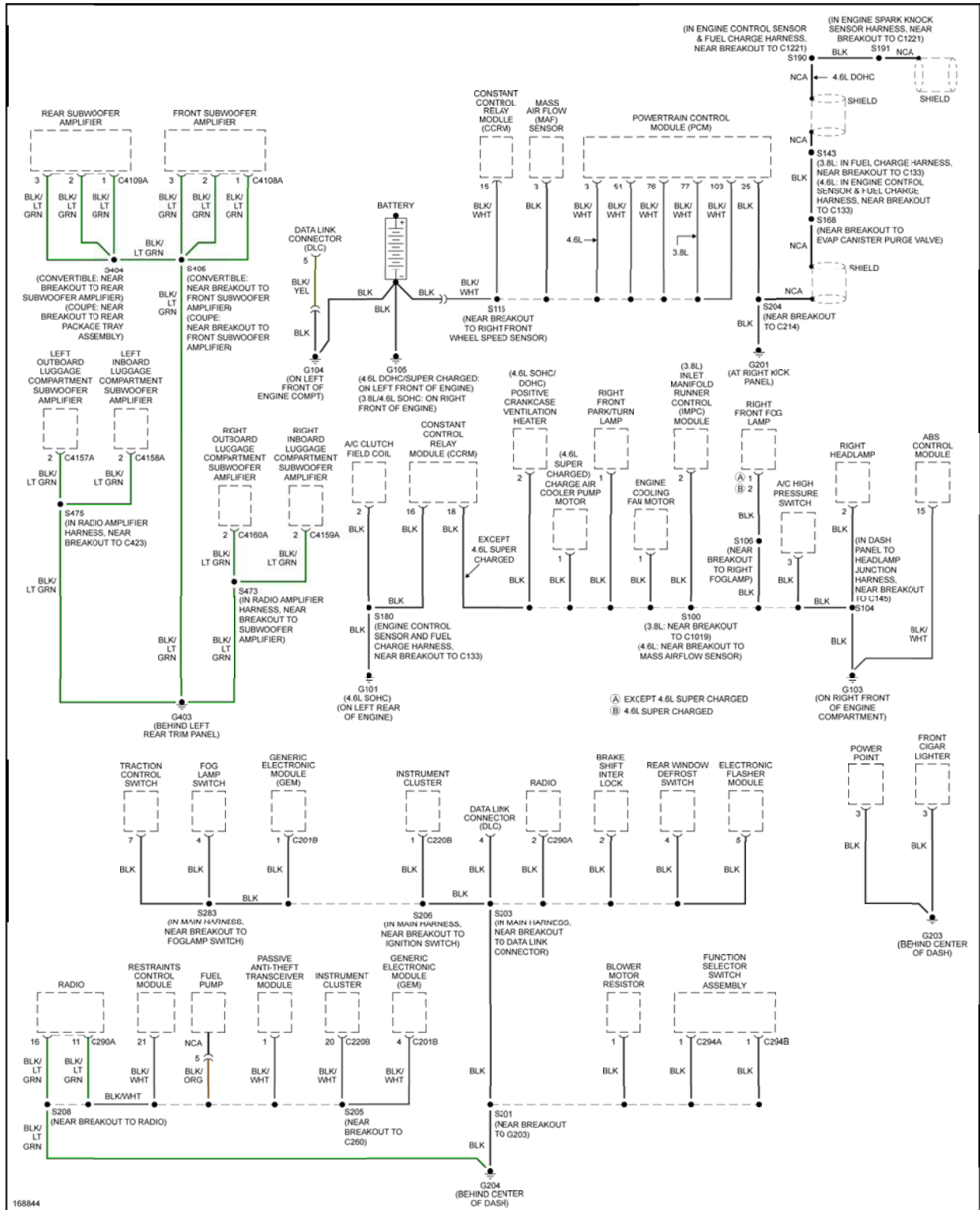


Fig. 25: Ground Distribution Circuit (1 of 2)

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

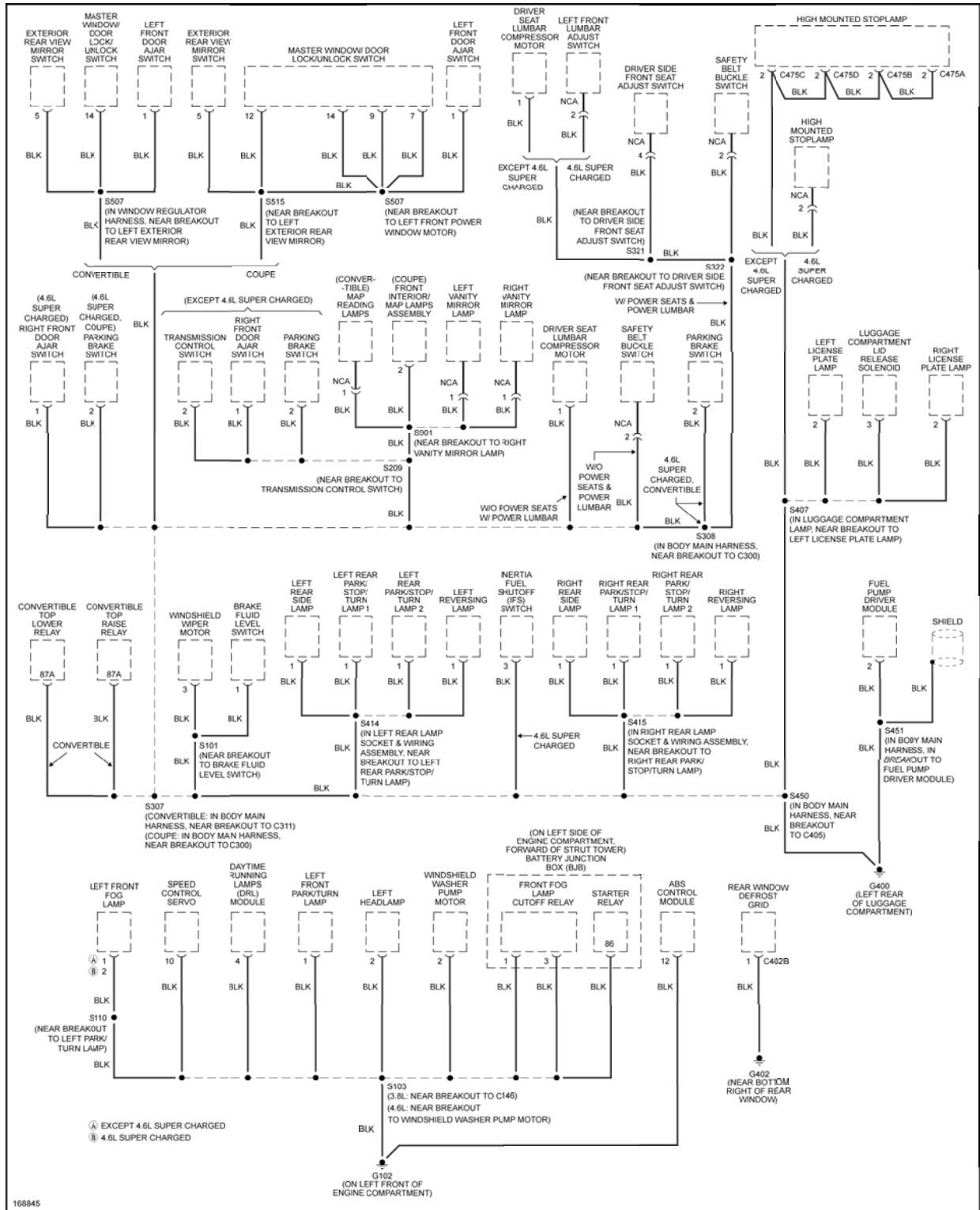


Fig. 26: Ground Distribution Circuit (2 of 2)

HEADLIGHTS

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

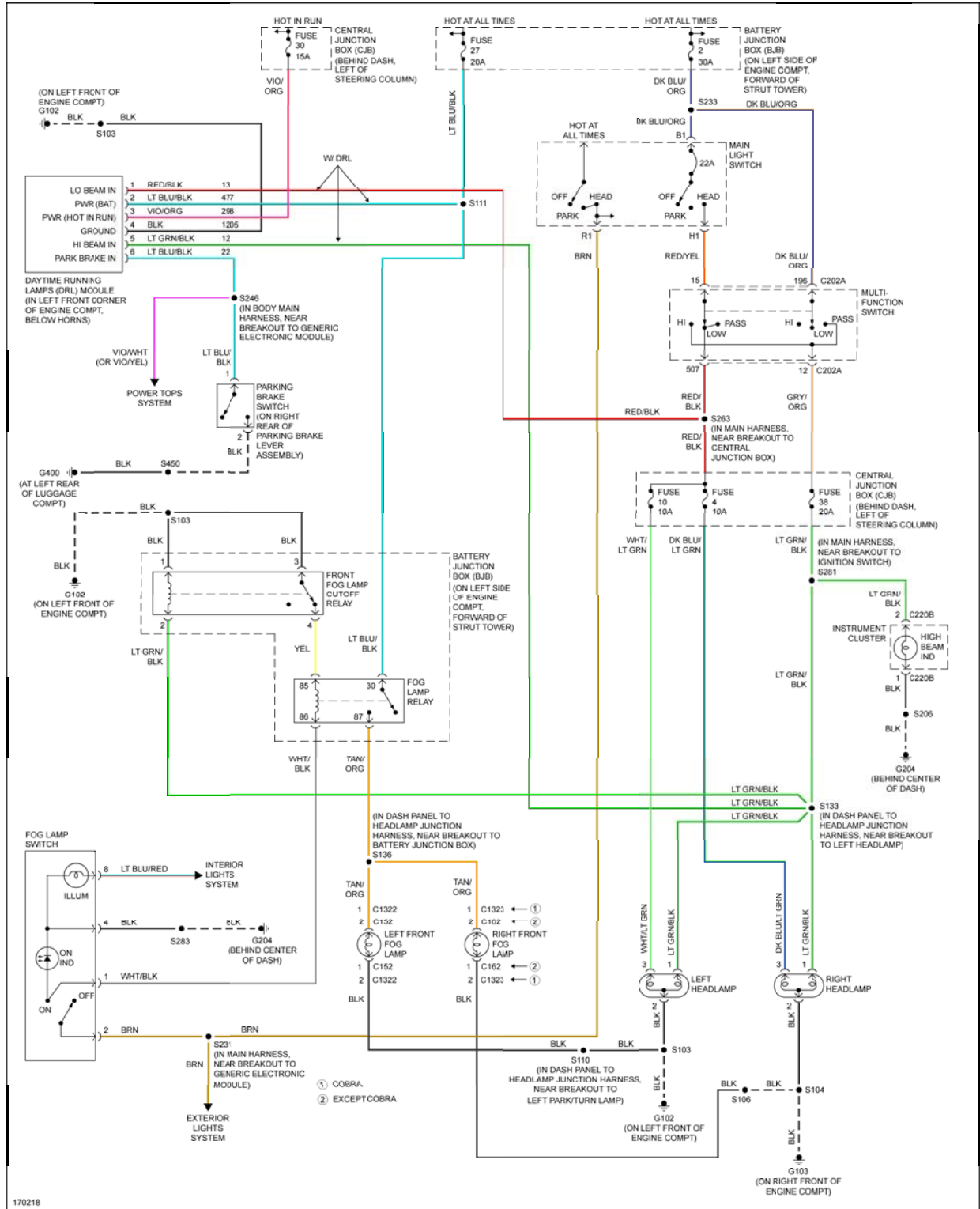


Fig. 27: Headlights Circuit

HORN

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

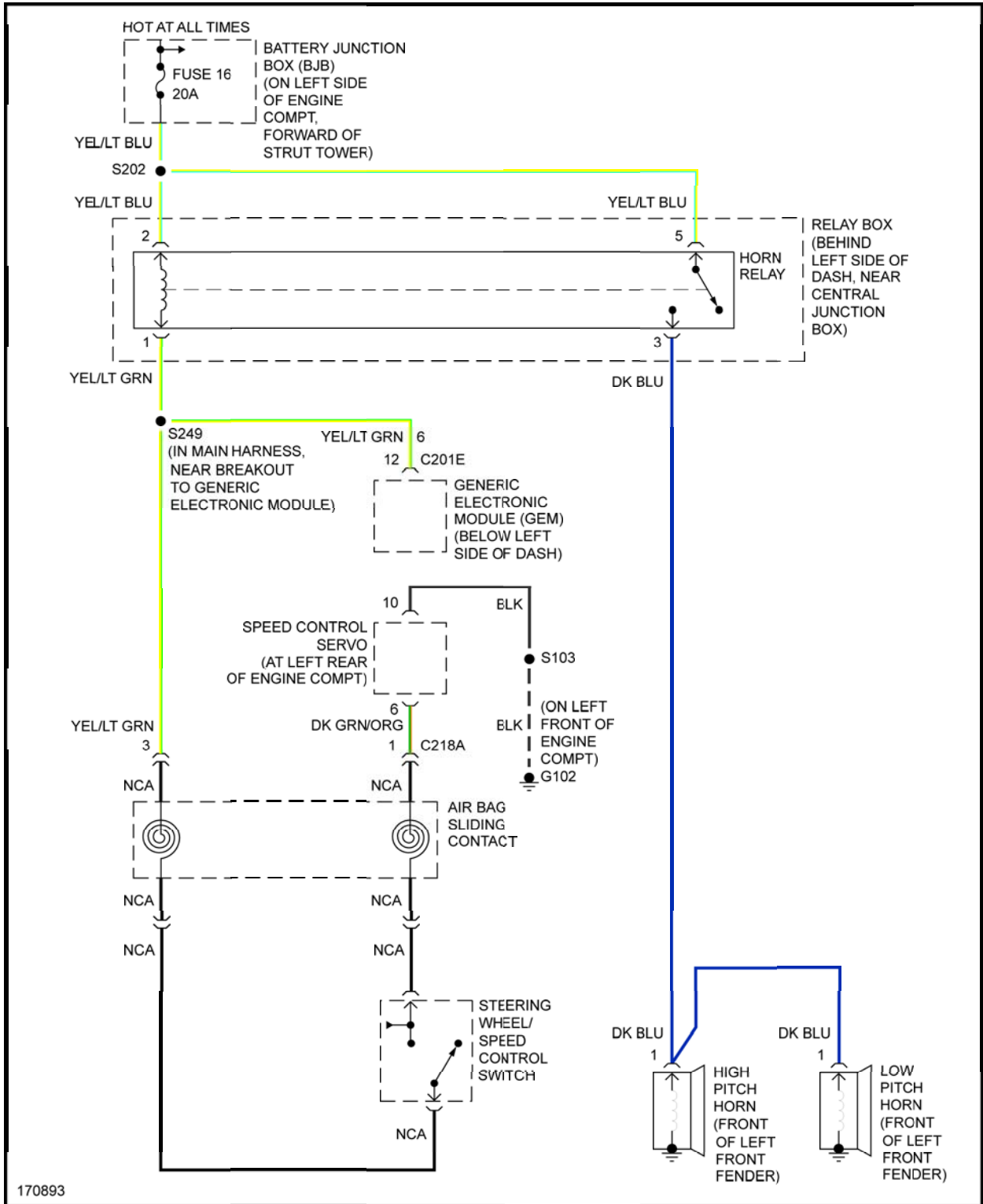


Fig. 28: Horn Circuit

INSTRUMENT CLUSTER

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

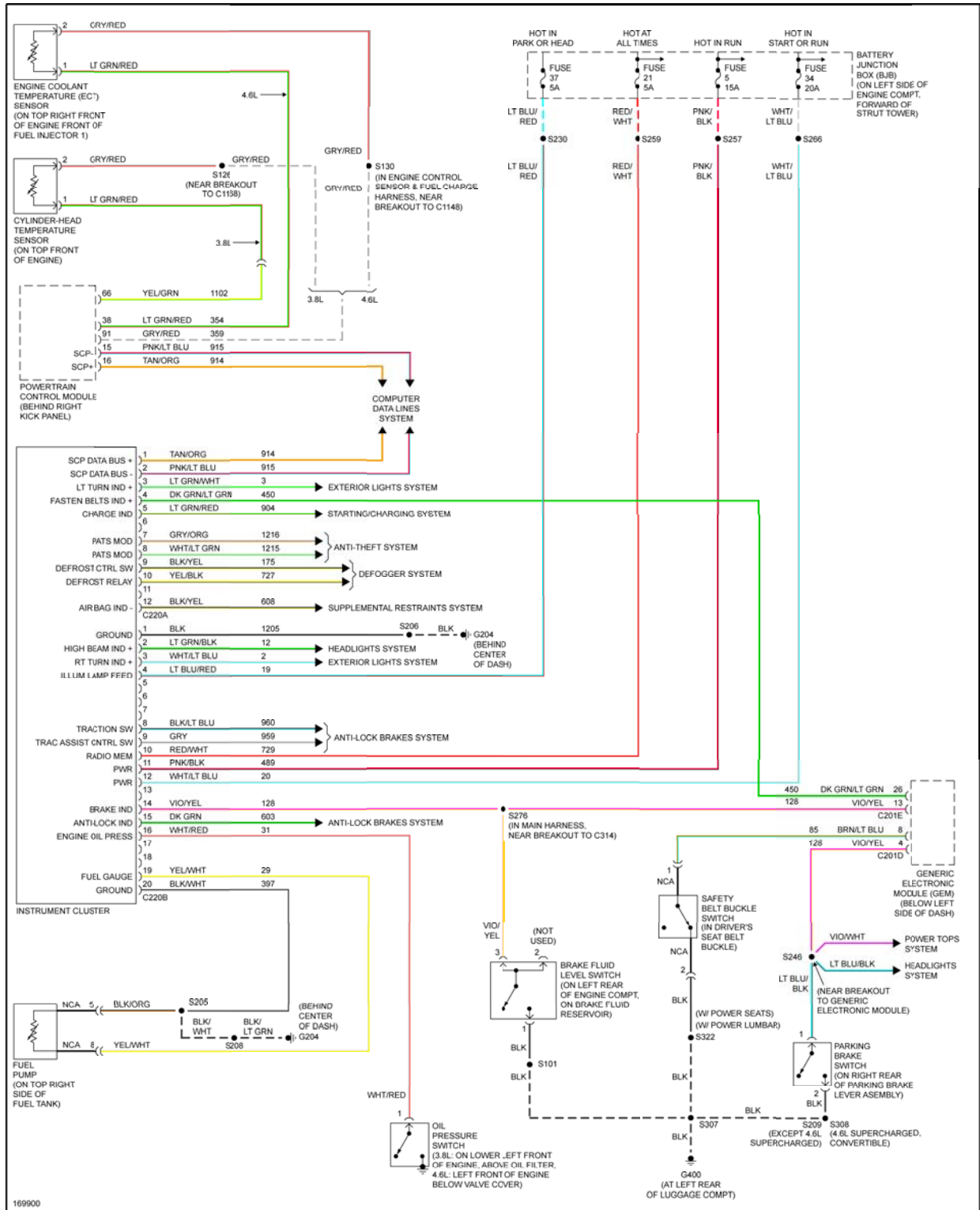


Fig. 29: Instrument Cluster Circuit

INTERIOR LIGHTS

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

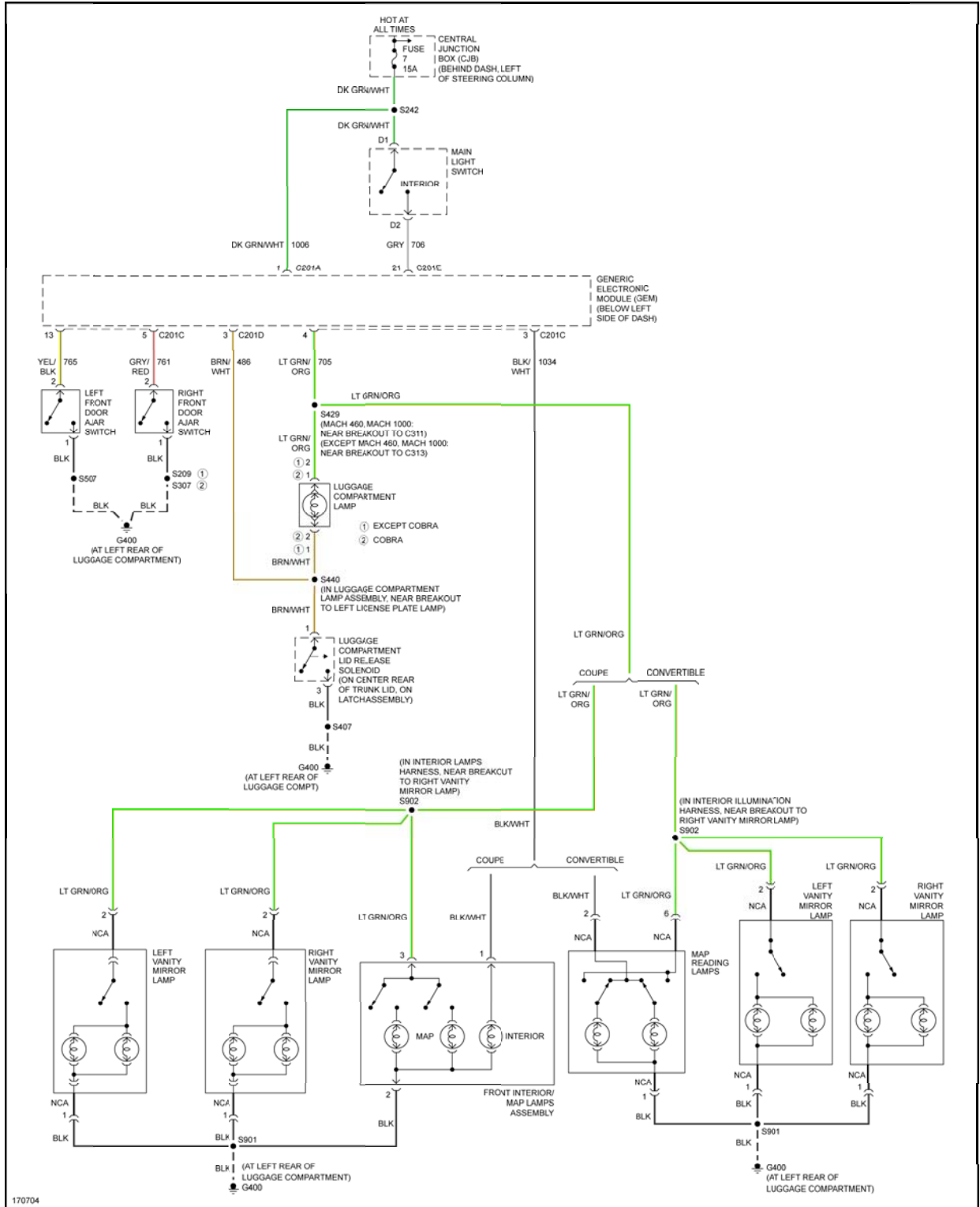


Fig. 30: Courtesy Lamps Circuit

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

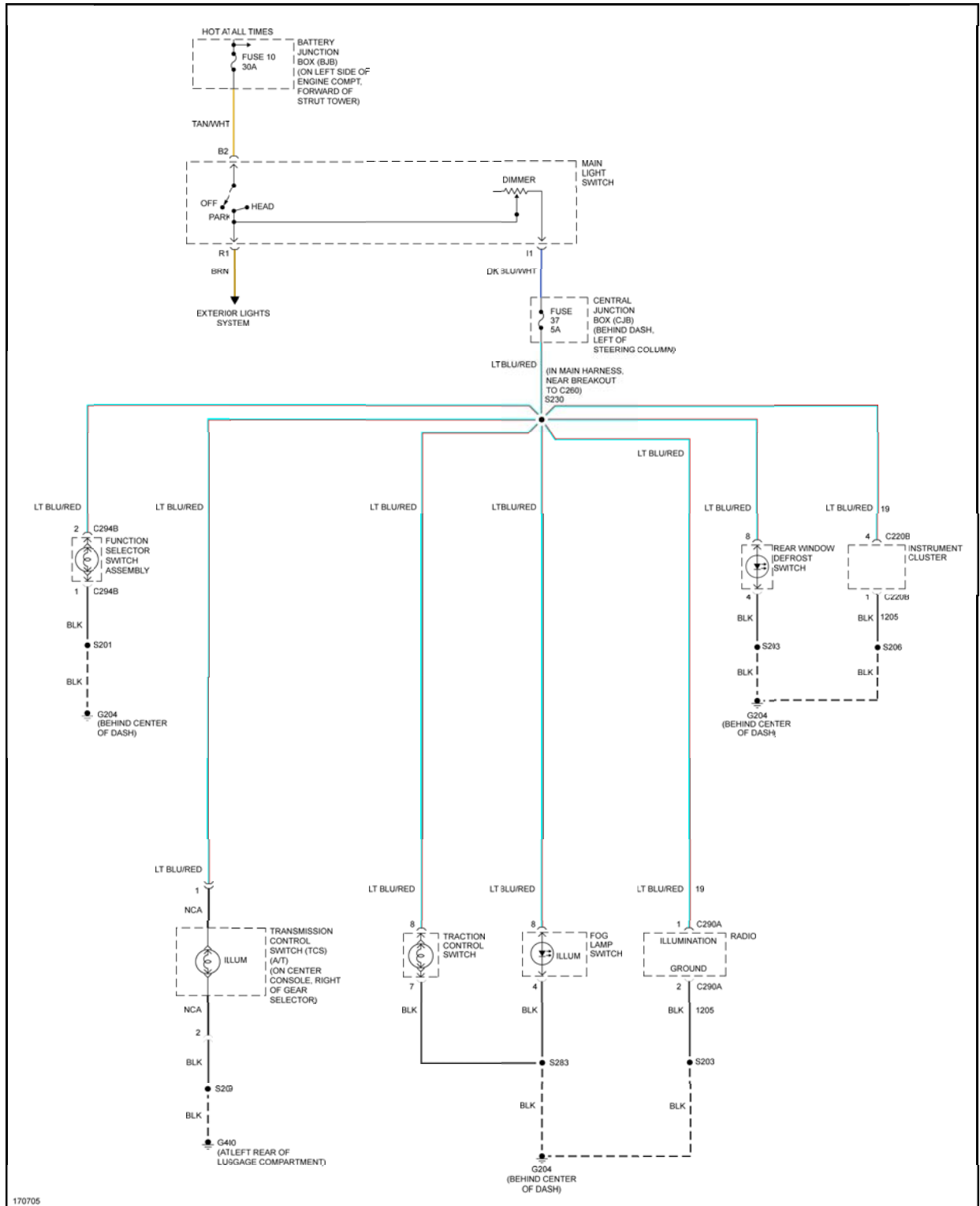


Fig. 31: Instrument Illumination Circuit

POWER DISTRIBUTION

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

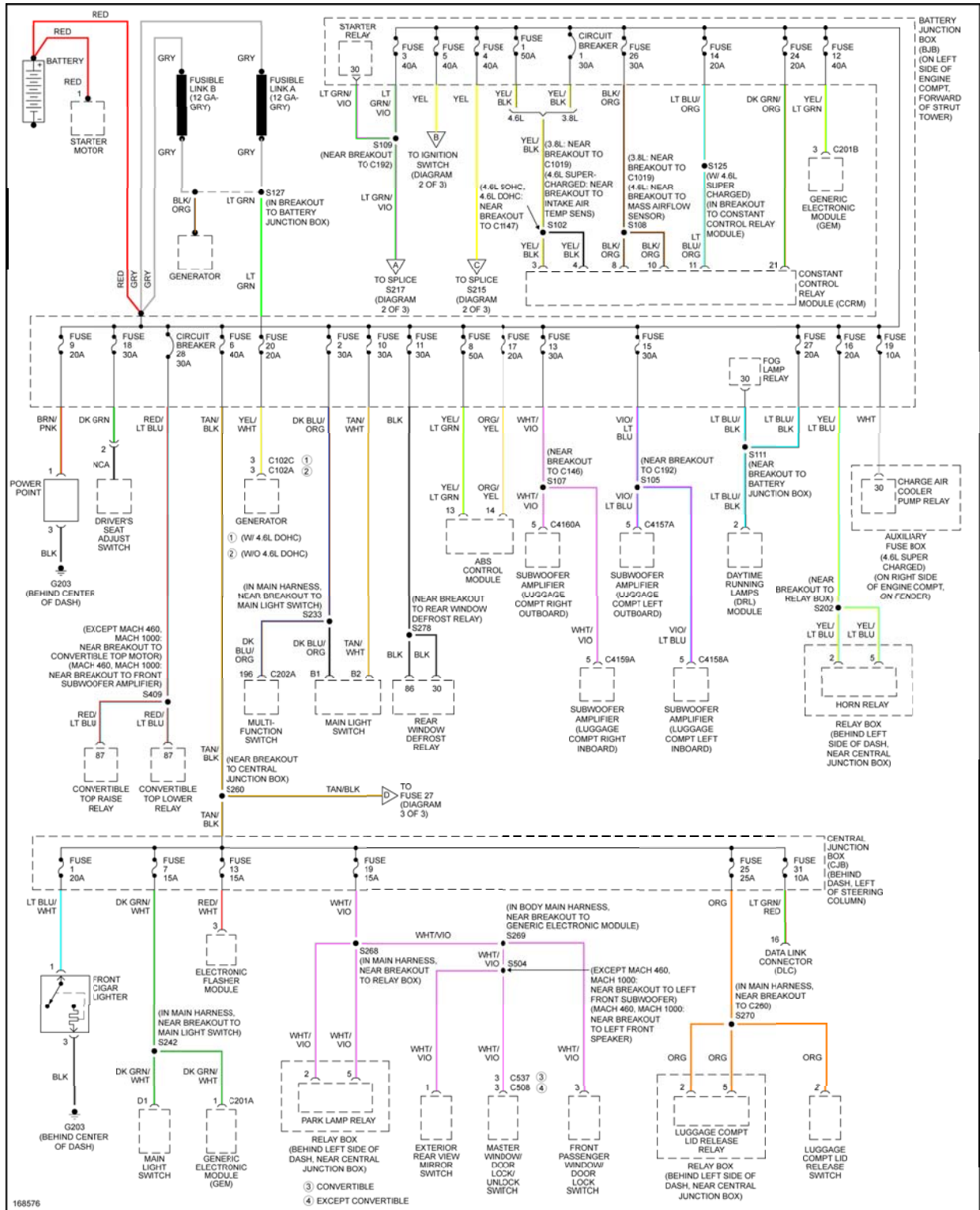


Fig. 32: Power Distribution Circuit (1 of 3)

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

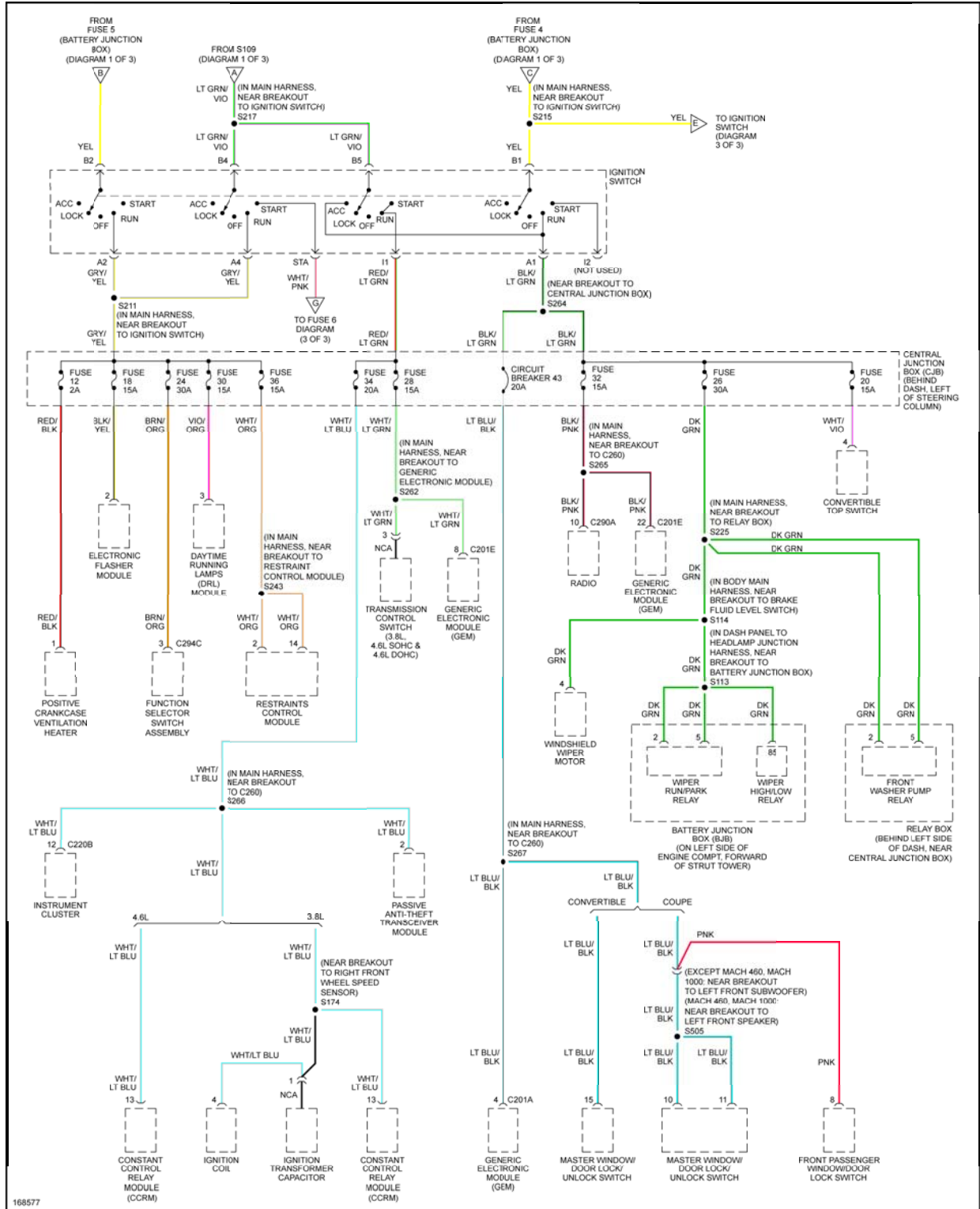


Fig. 33: Power Distribution Circuit (2 of 3)

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

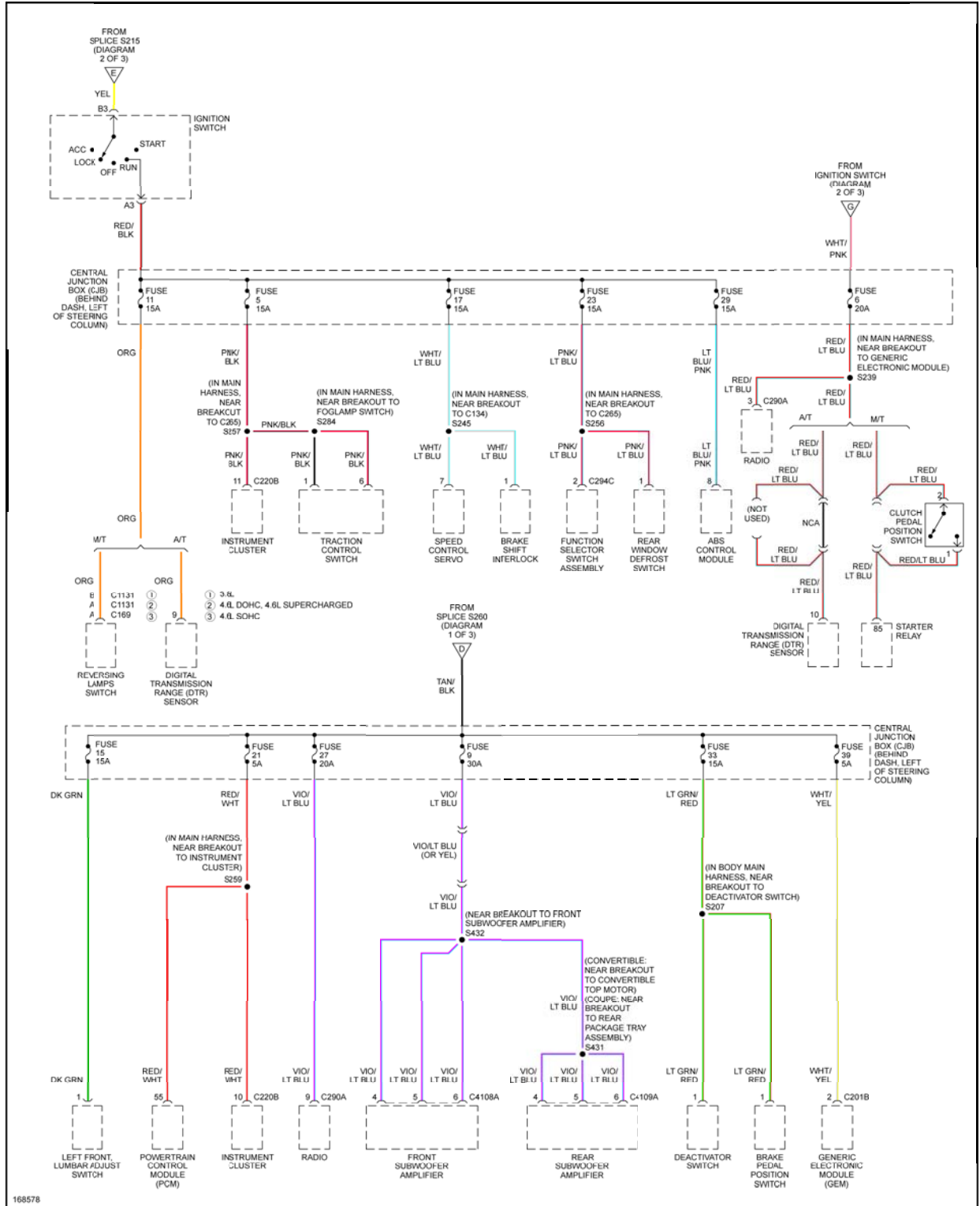


Fig. 34: Power Distribution Circuit (3 of 3)

POWER DOOR LOCKS

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

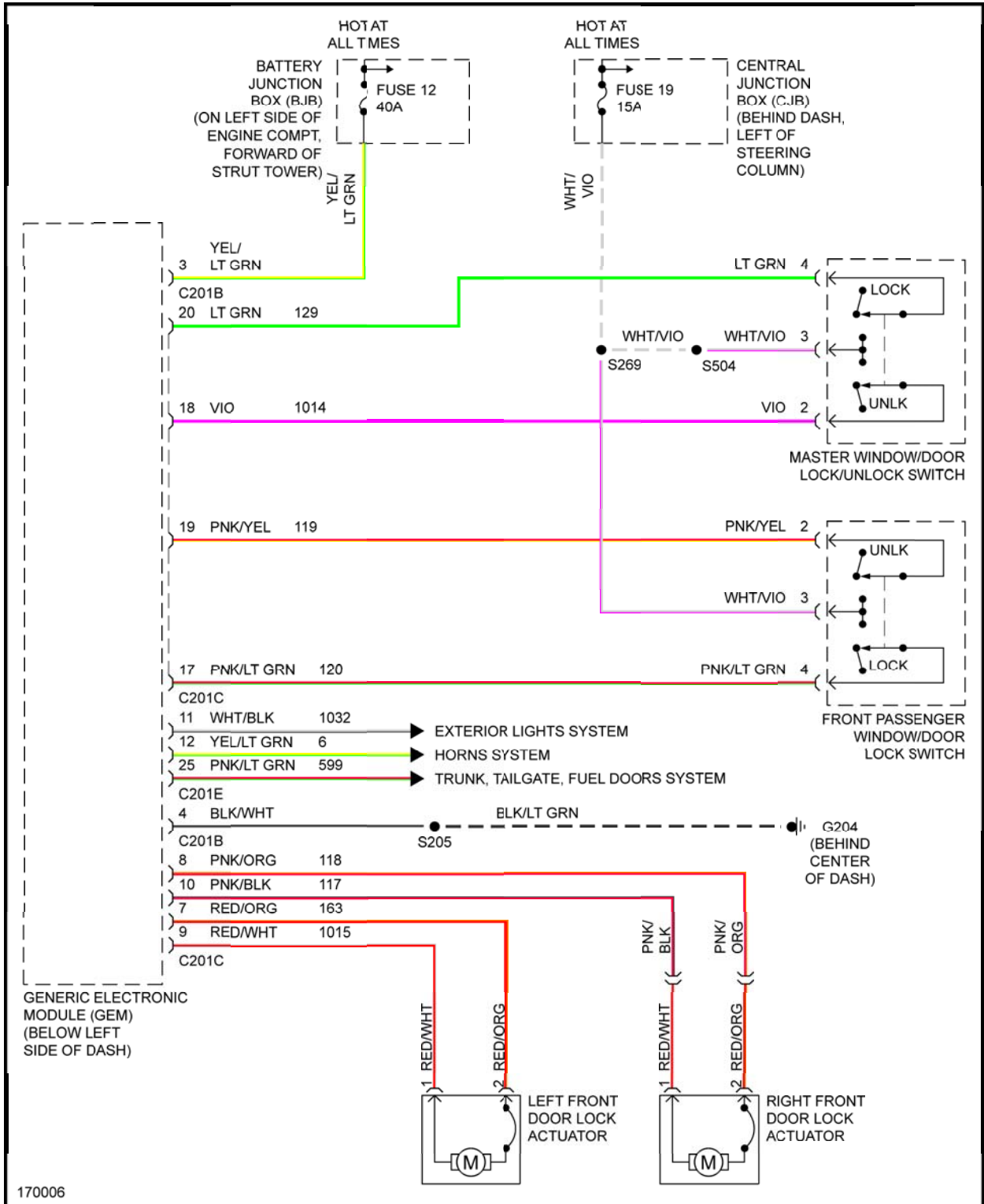


Fig. 35: Power Door Locks Circuit

POWER MIRRORS

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

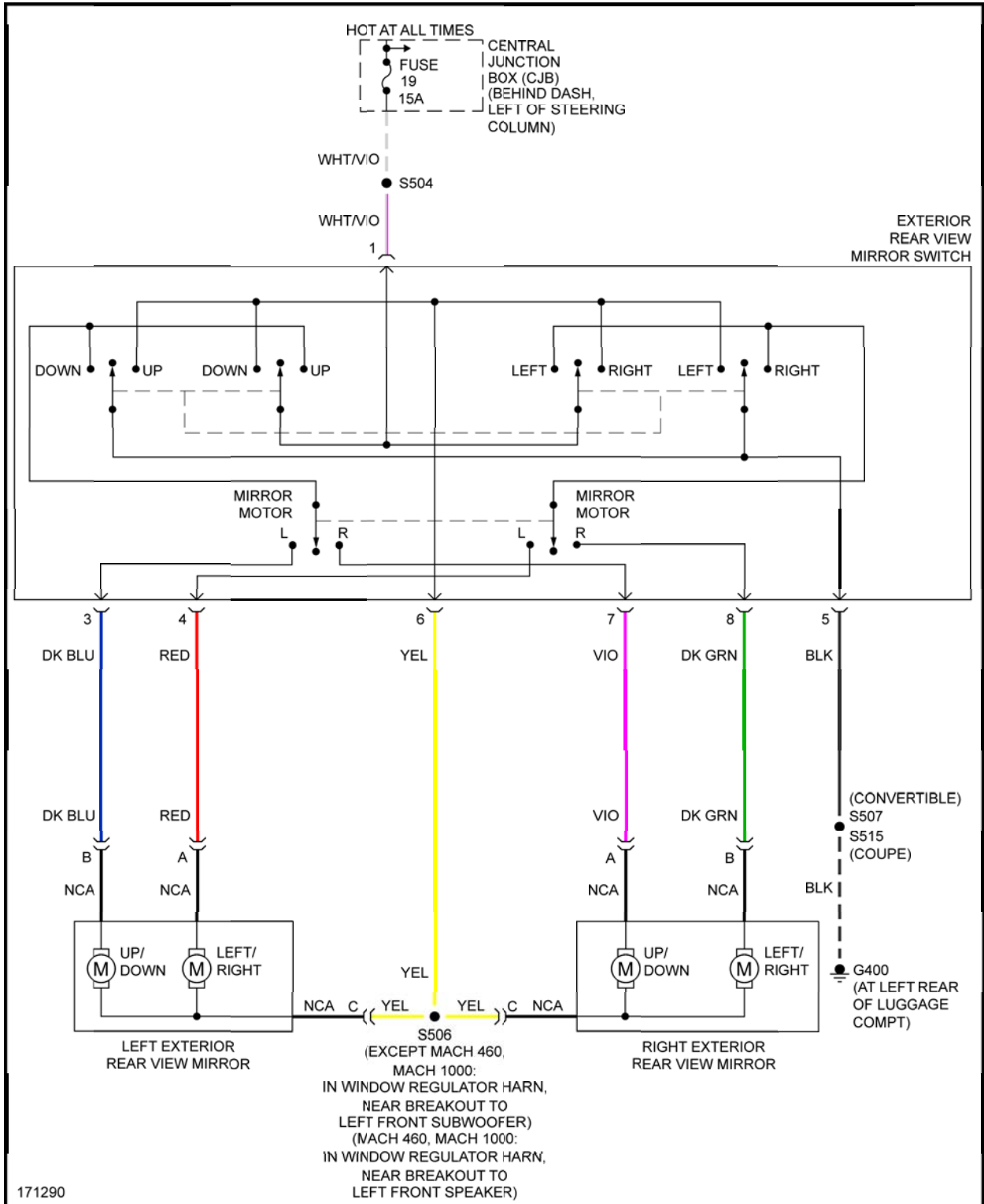


Fig. 36: Power Mirrors Circuit

POWER SEATS

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

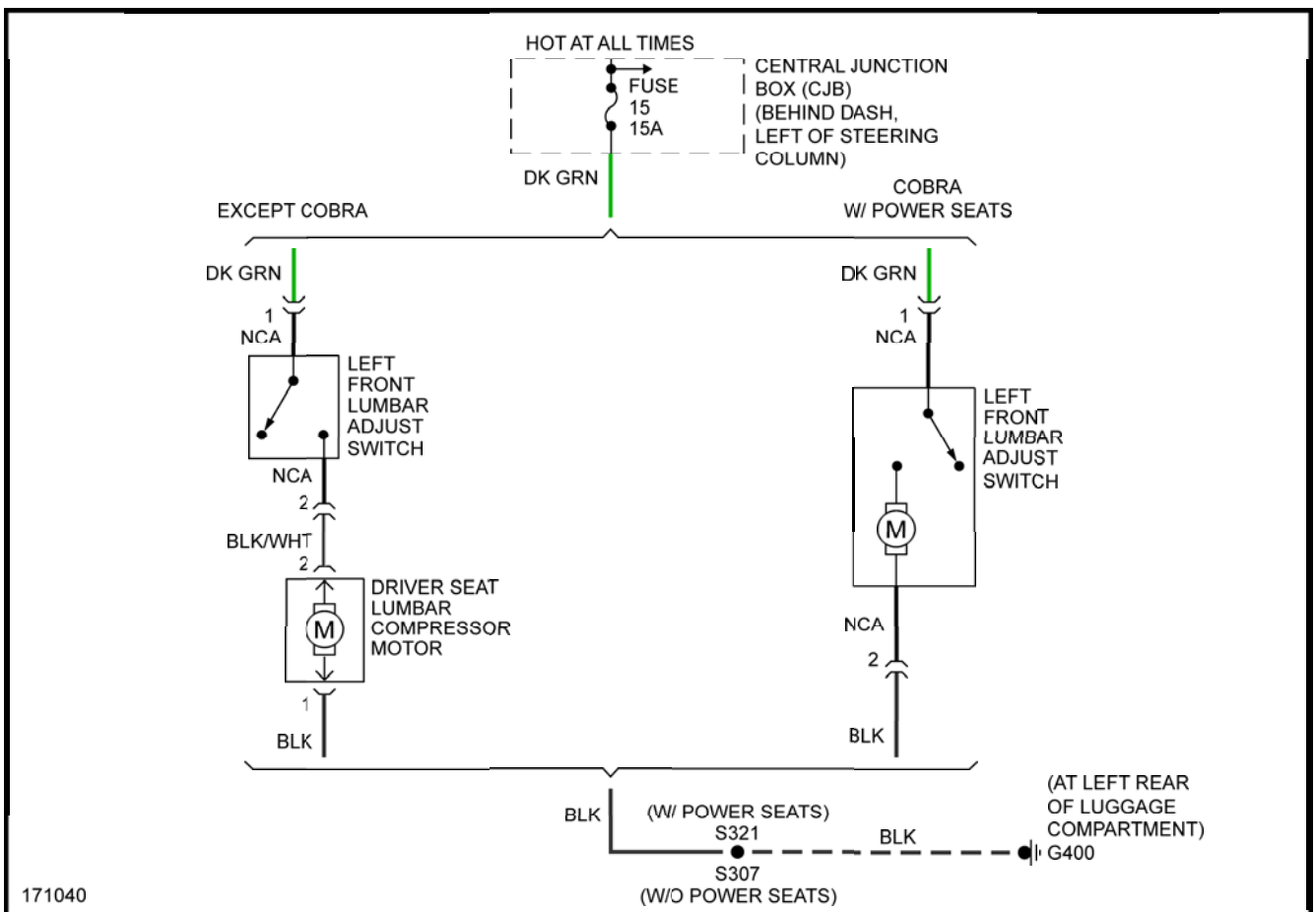


Fig. 37: Lumbar Circuit

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

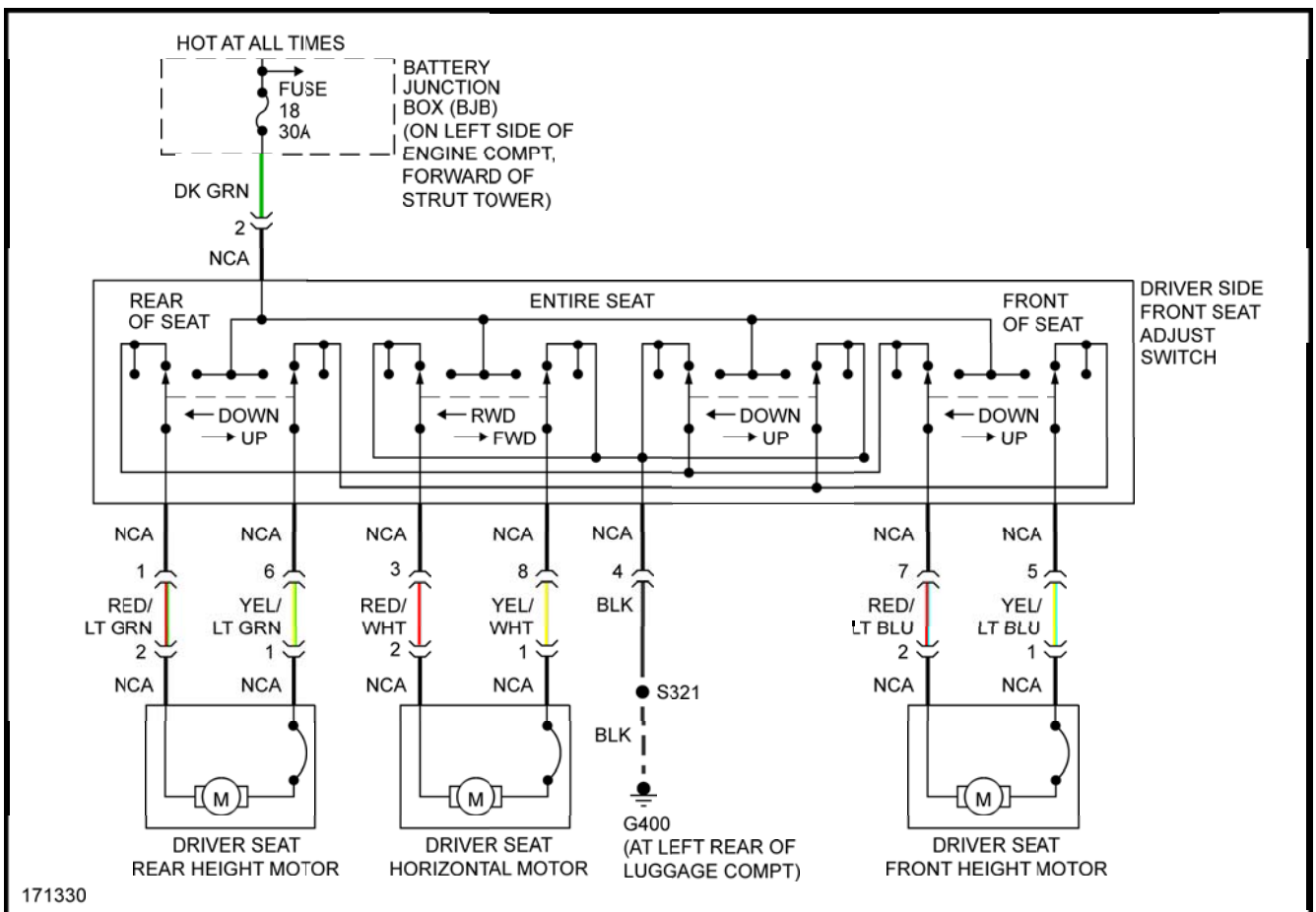


Fig. 38: Power Seat Circuit

POWER TOP/SUNROOF

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

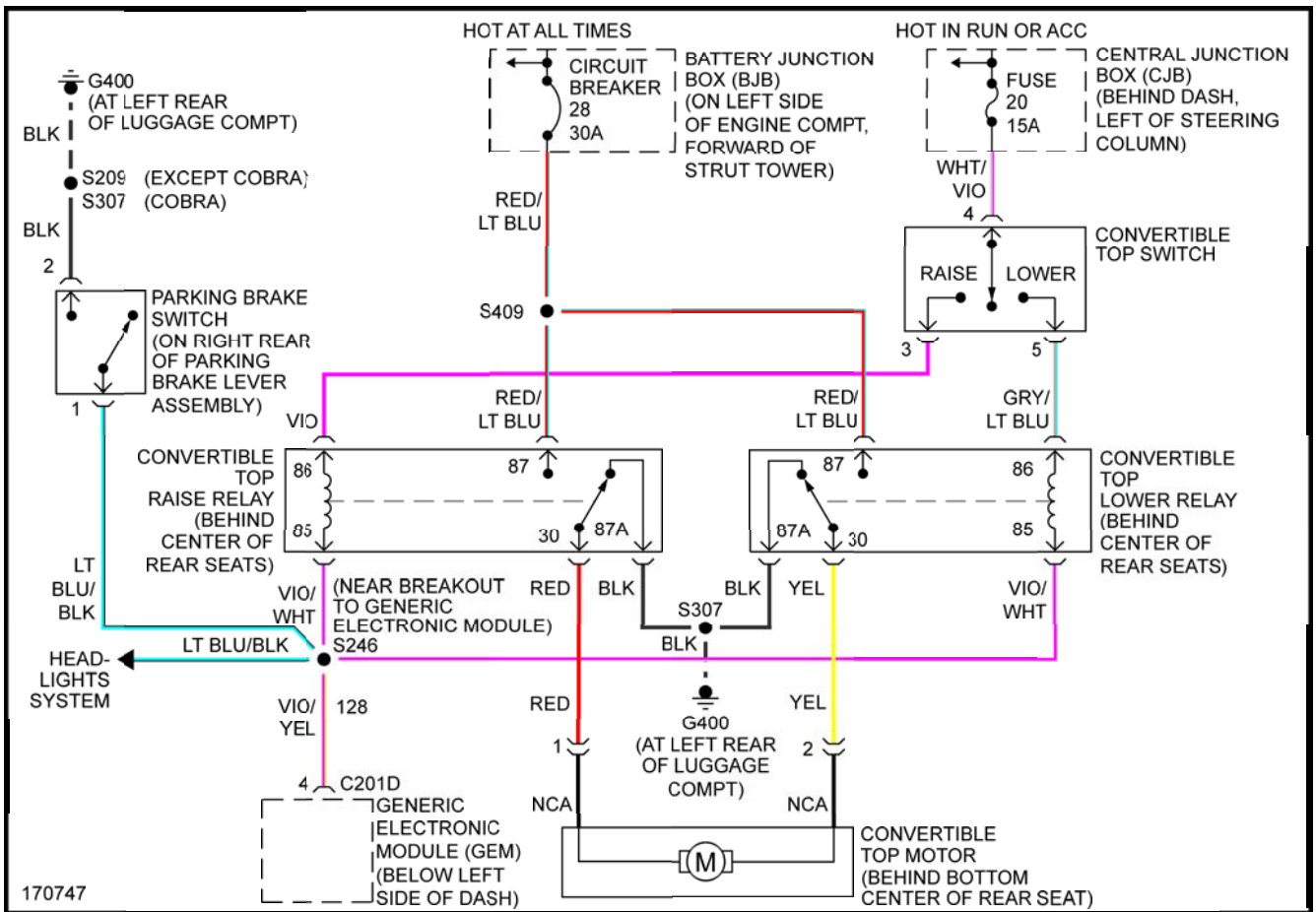


Fig. 39: Power Top/Sunroof Circuit

POWER WINDOWS

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

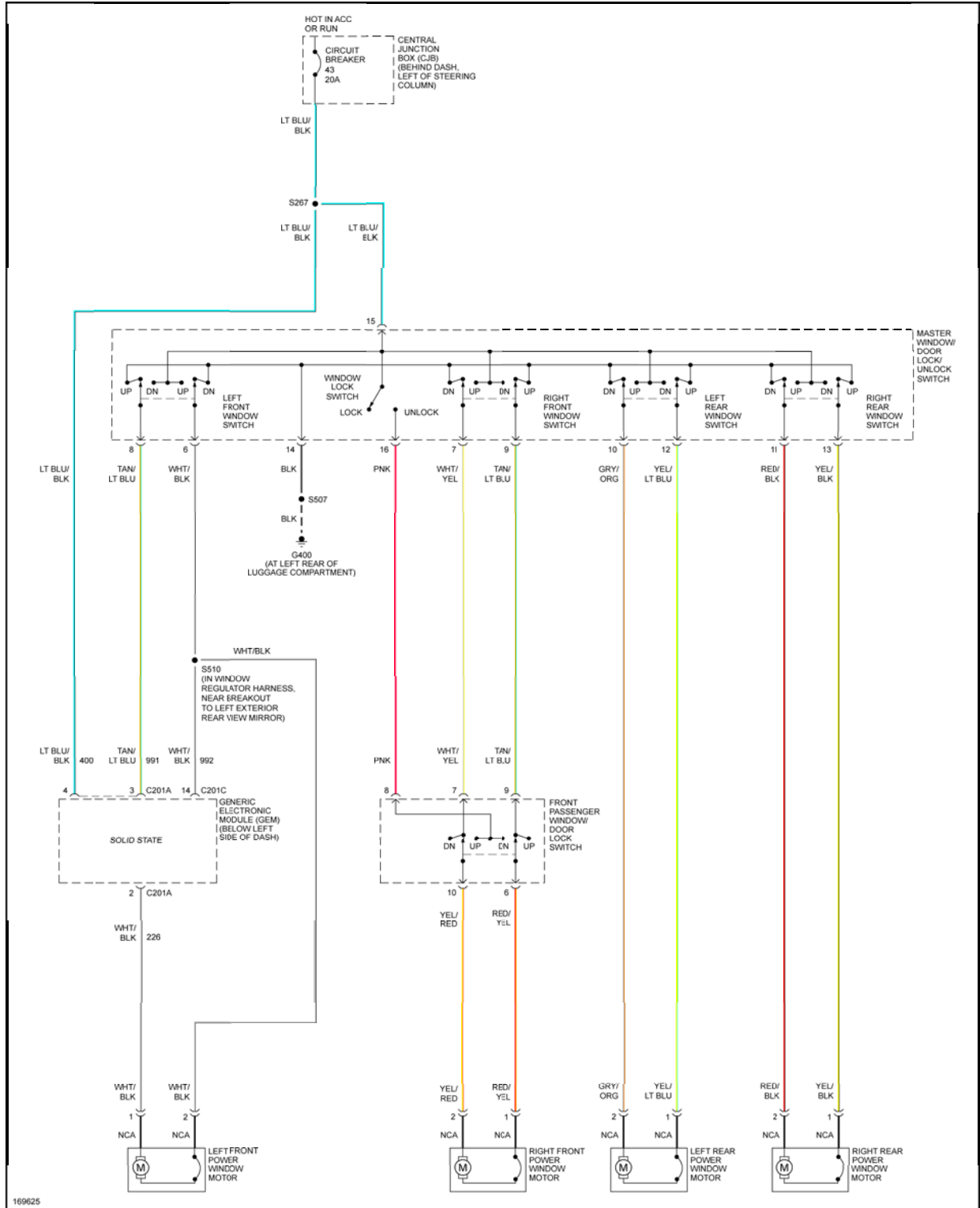


Fig. 40: Power Windows Circuit, Convertible

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

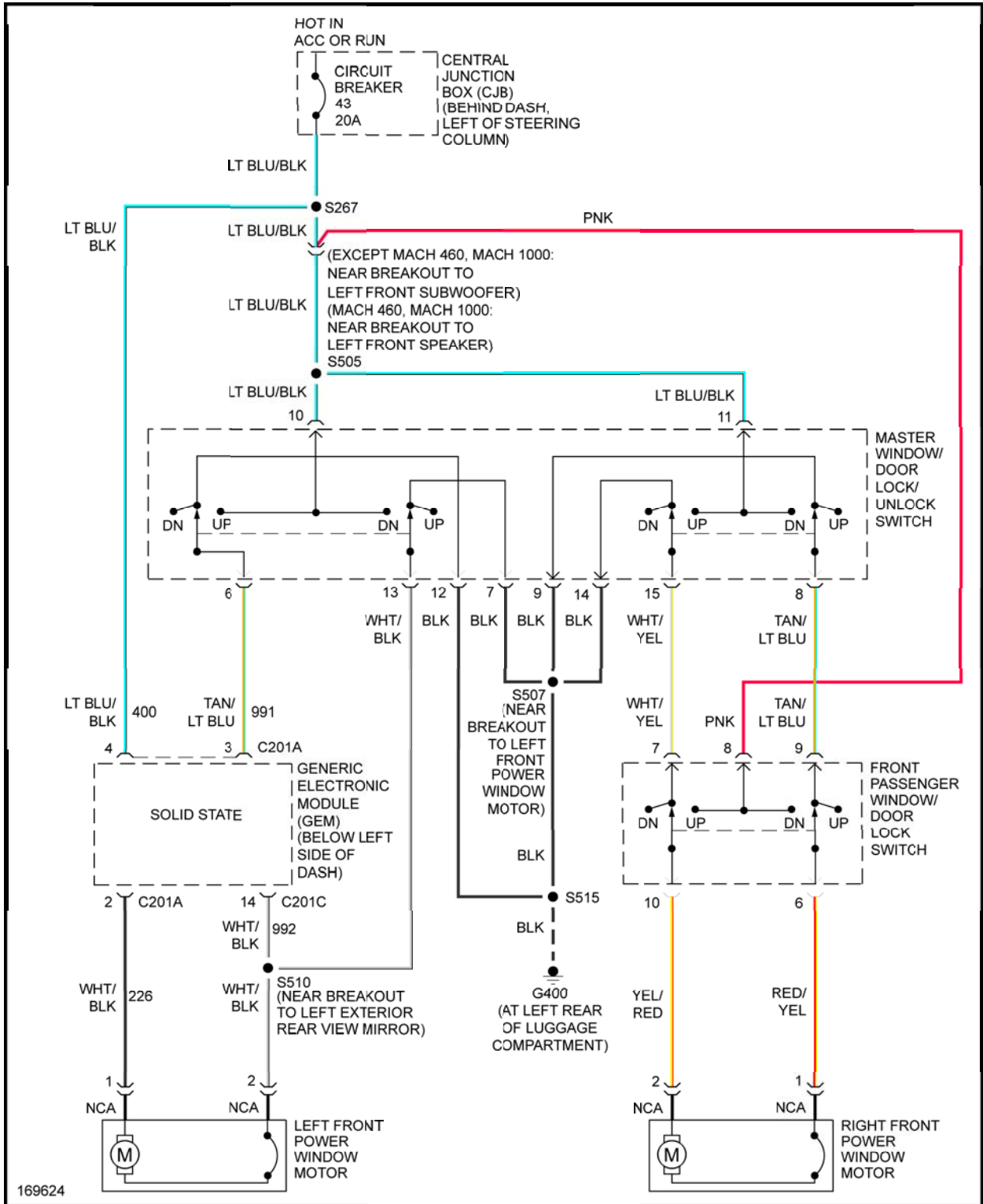


Fig. 41: Power Windows Circuit, Coupe

RADIO

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

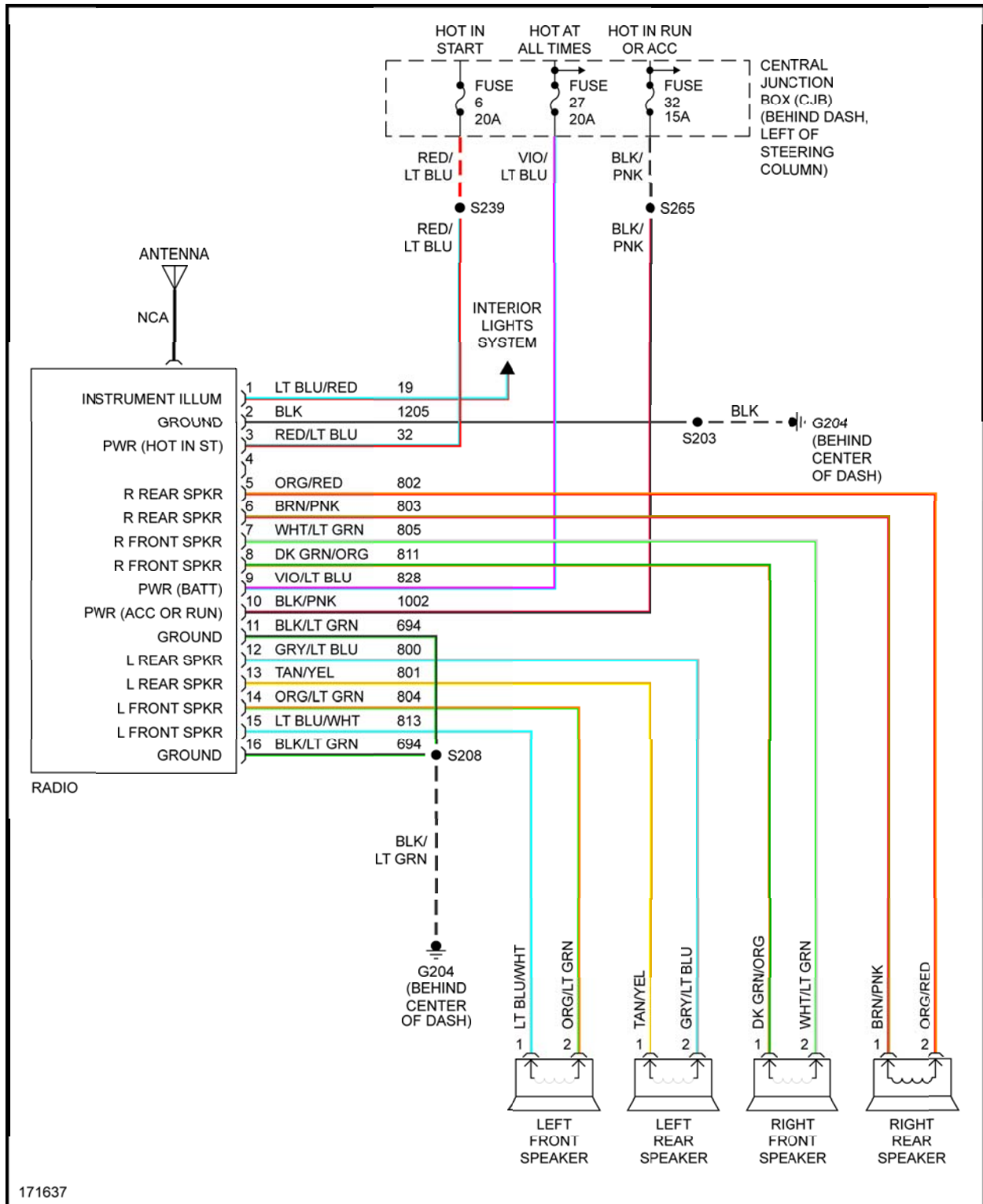


Fig. 42: Base Radio Circuit

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

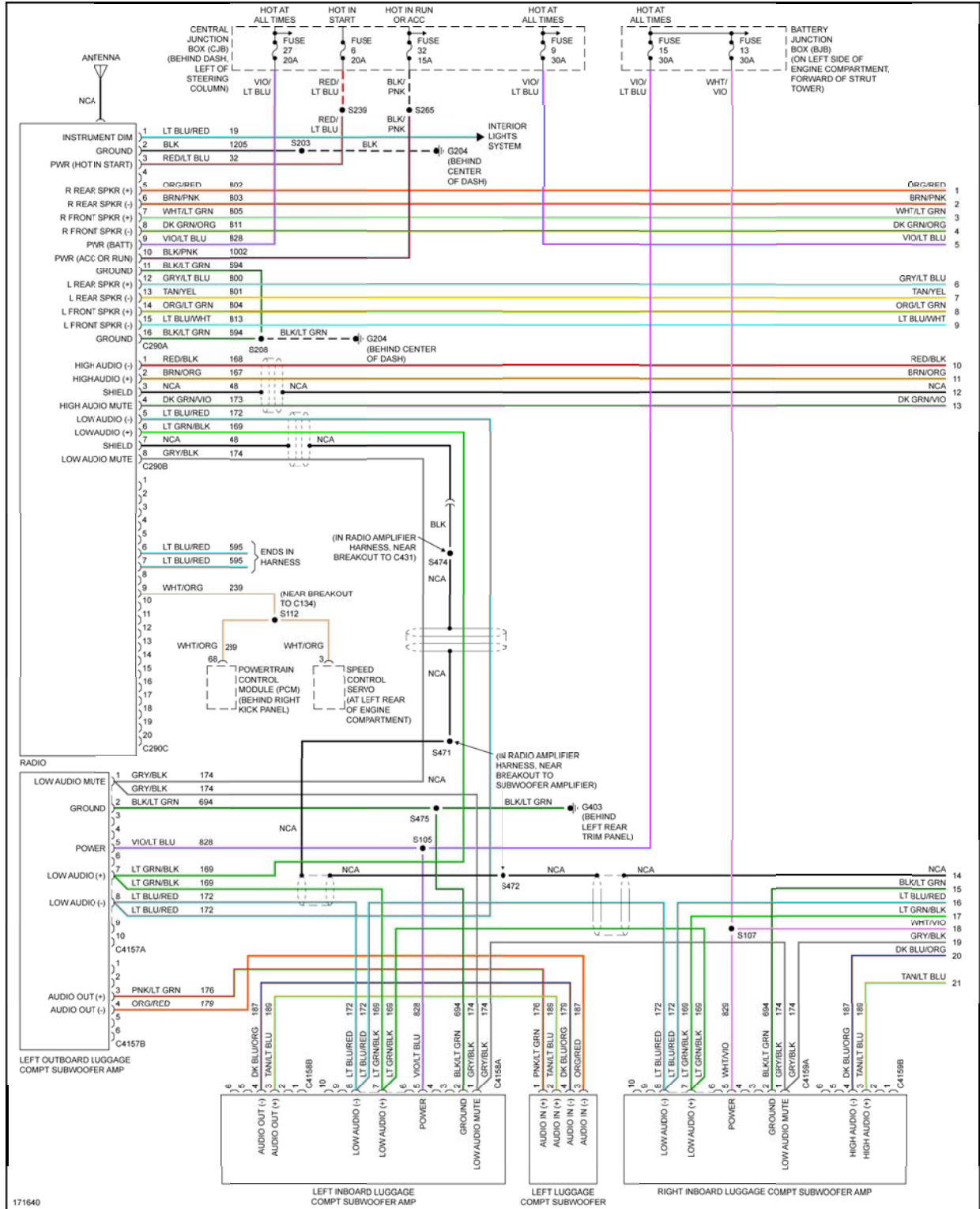


Fig. 43: Premium Sound Radio Circuit, Convertible W/ Mach 1000 Sound System (1 of 2)

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

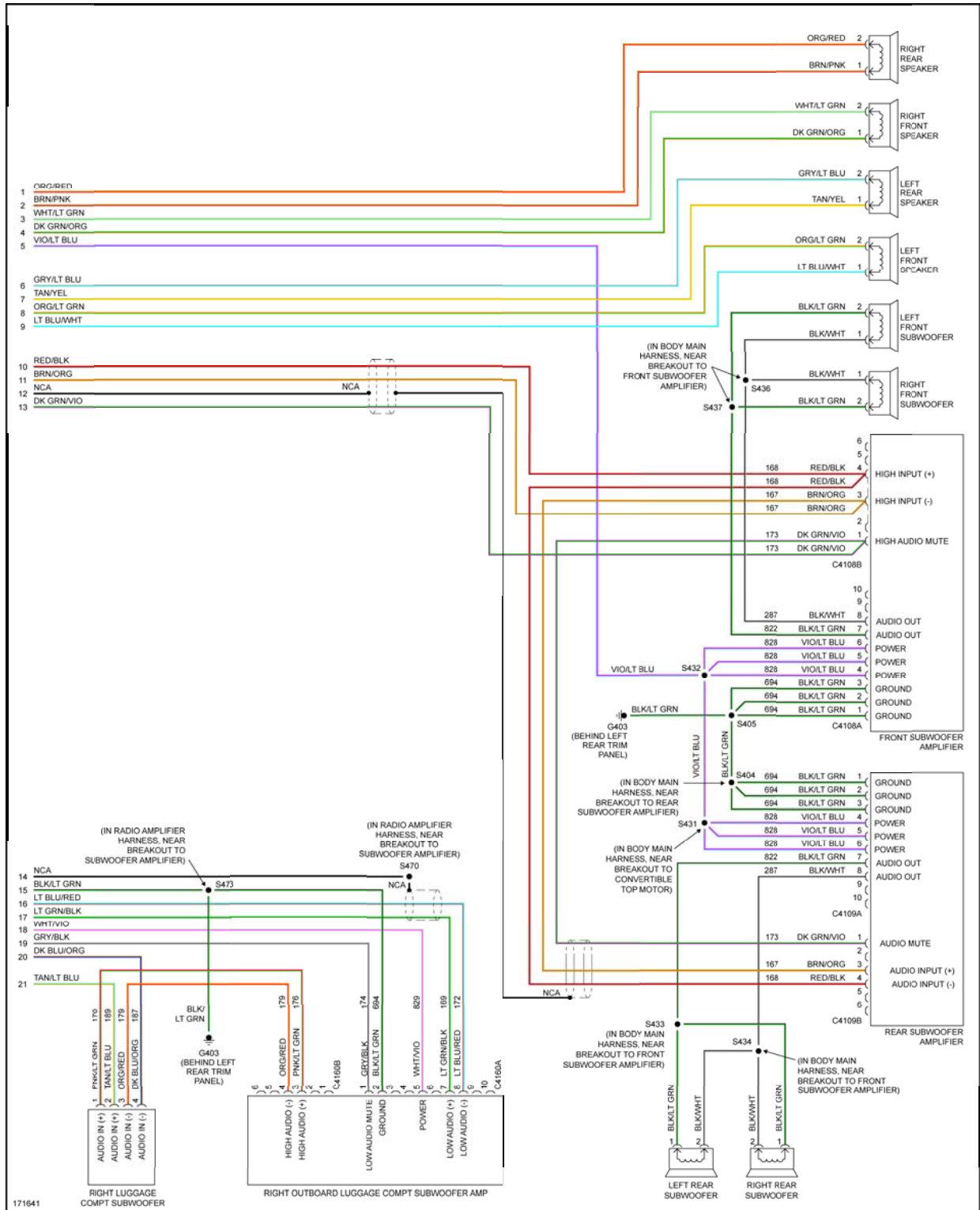


Fig. 44: Premium Sound Radio Circuit, Convertible W/ Mach 1000 Sound System (2 of 2)

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

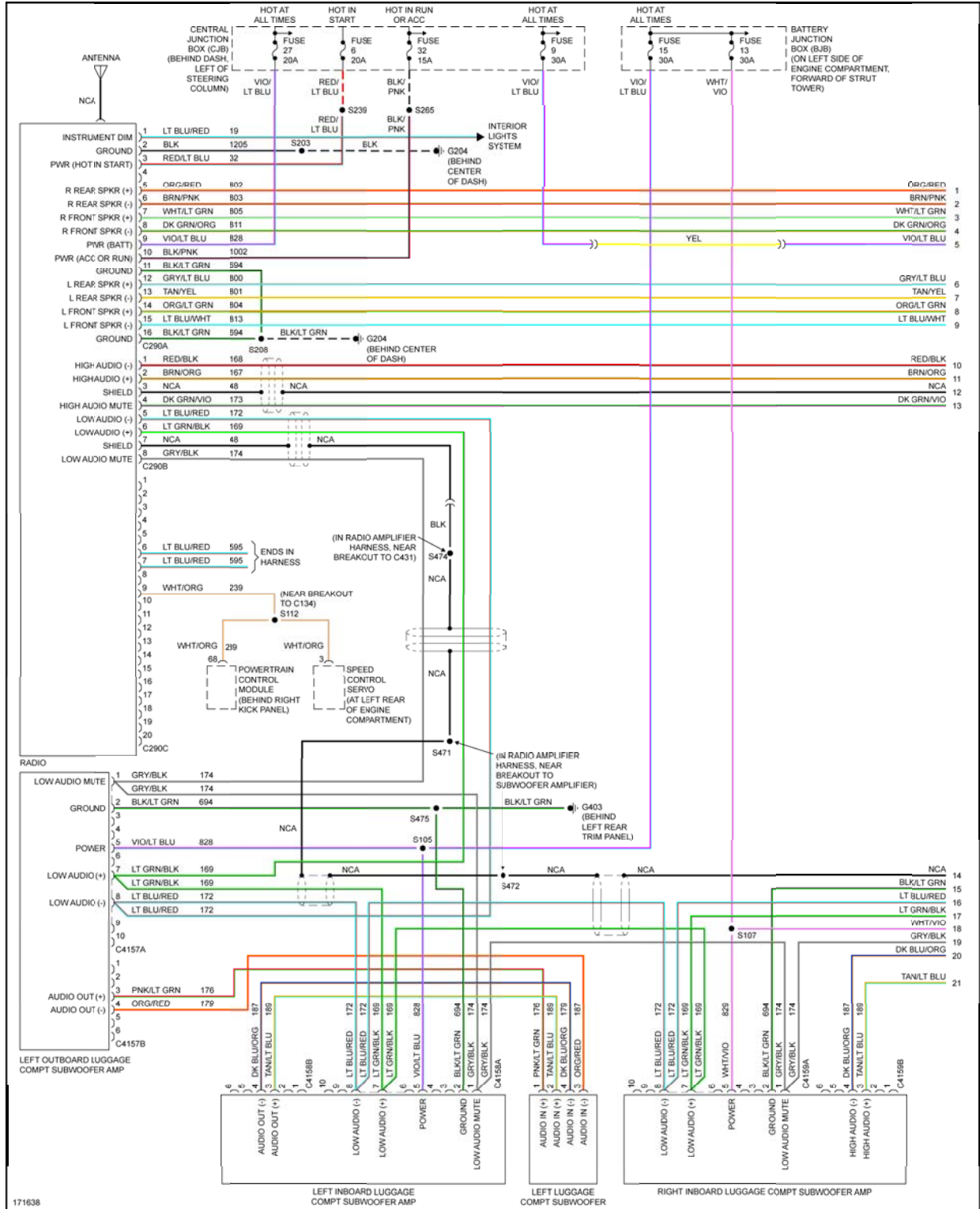


Fig. 45: Premium Sound Radio Circuit, Coupe W/ Mach 1000 Sound System (1 of 2)

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

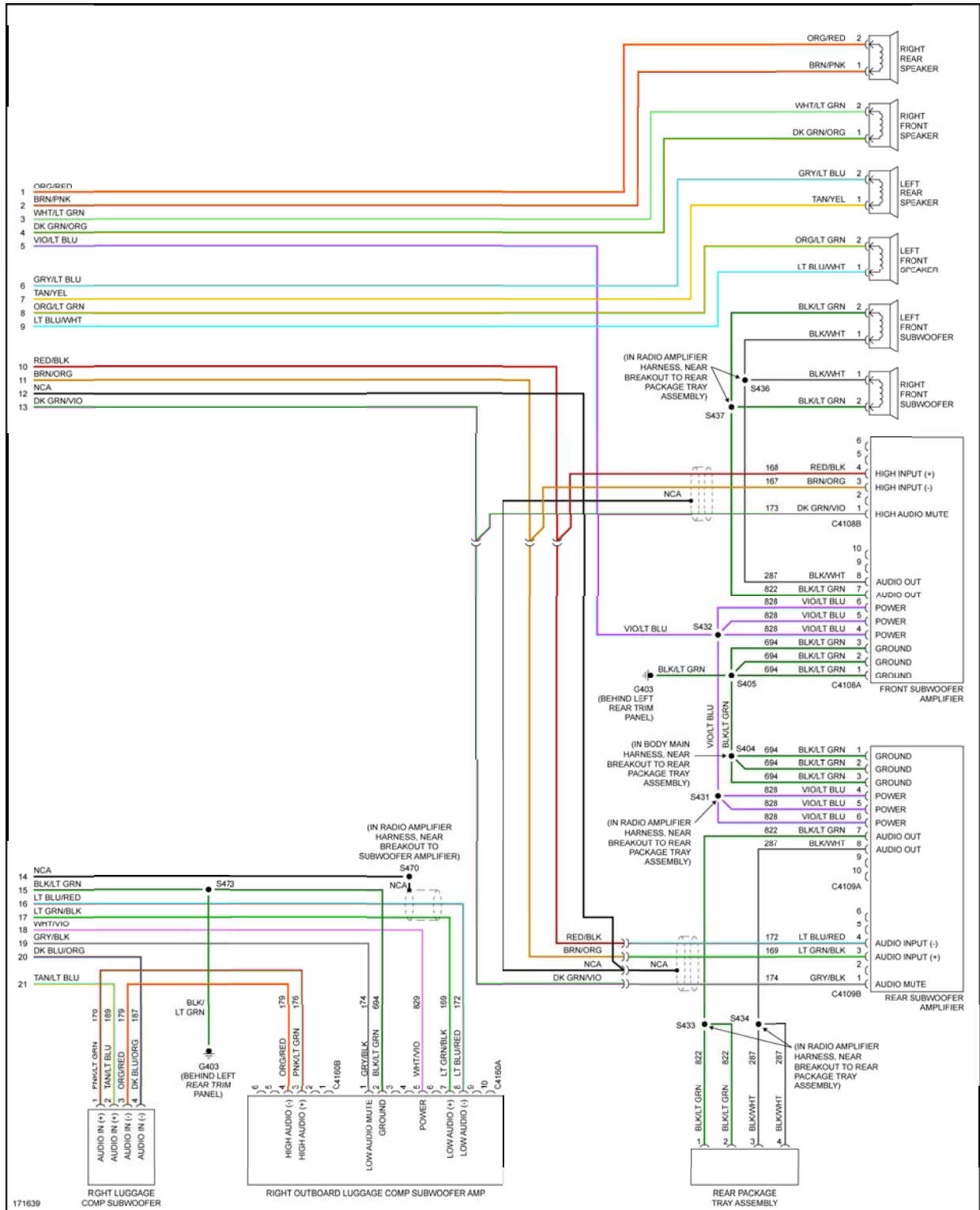


Fig. 46: Premium Sound Radio Circuit, Coupe W/ Mach 1000 Sound System (2 of 2)

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

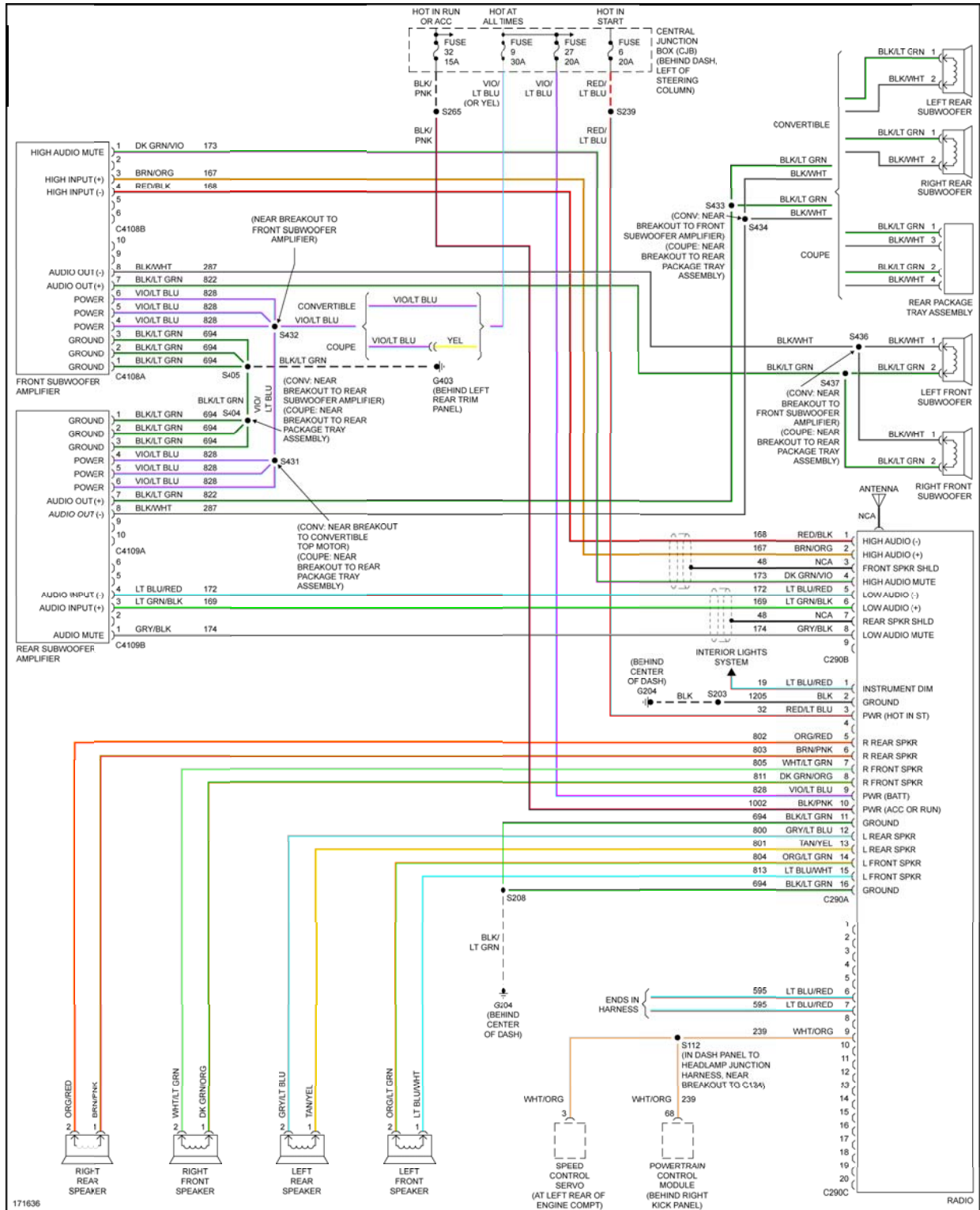


Fig. 47: Premium Sound Radio Circuit, W/ Mach 460 Sound System

SHIFT INTERLOCK

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

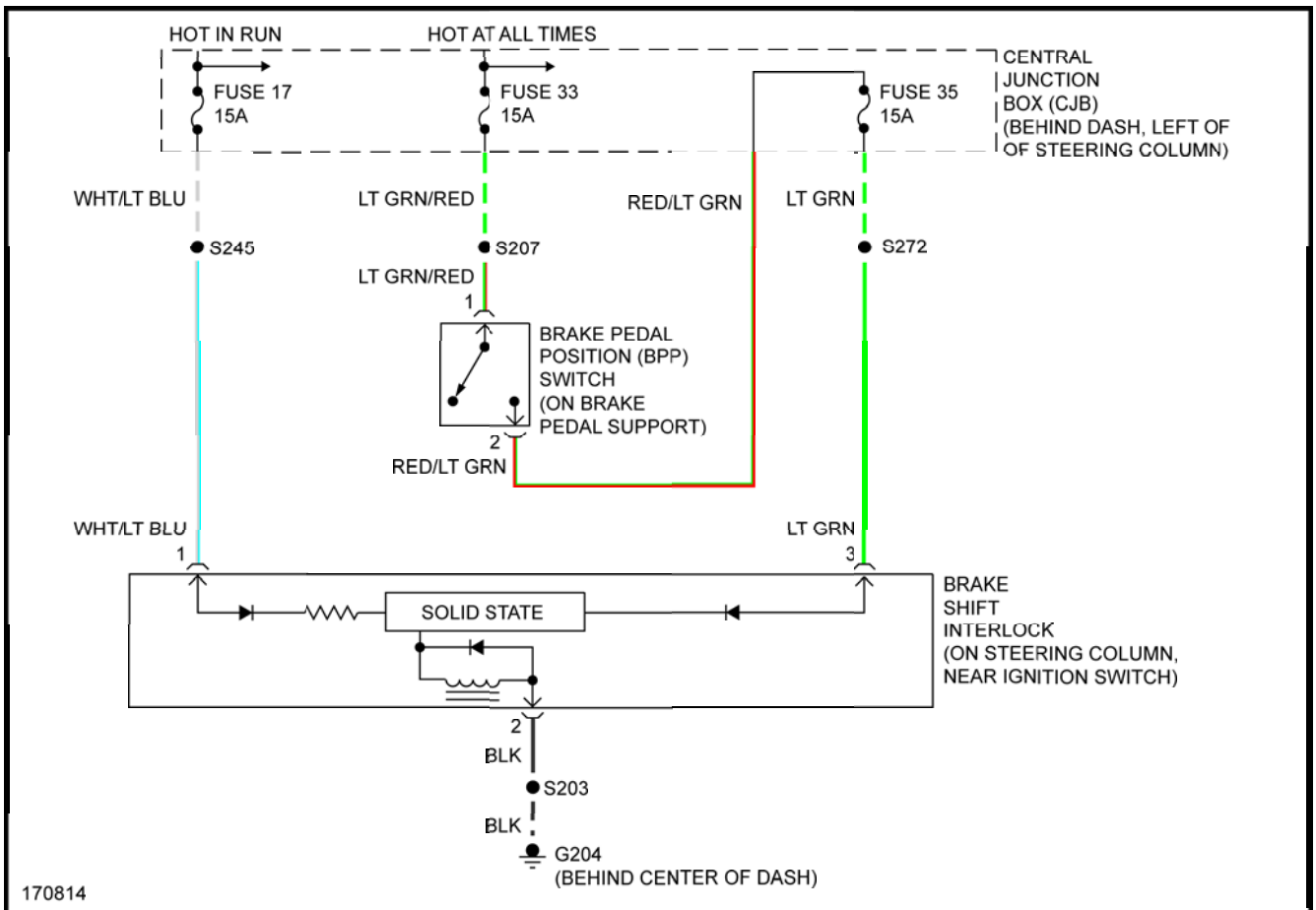
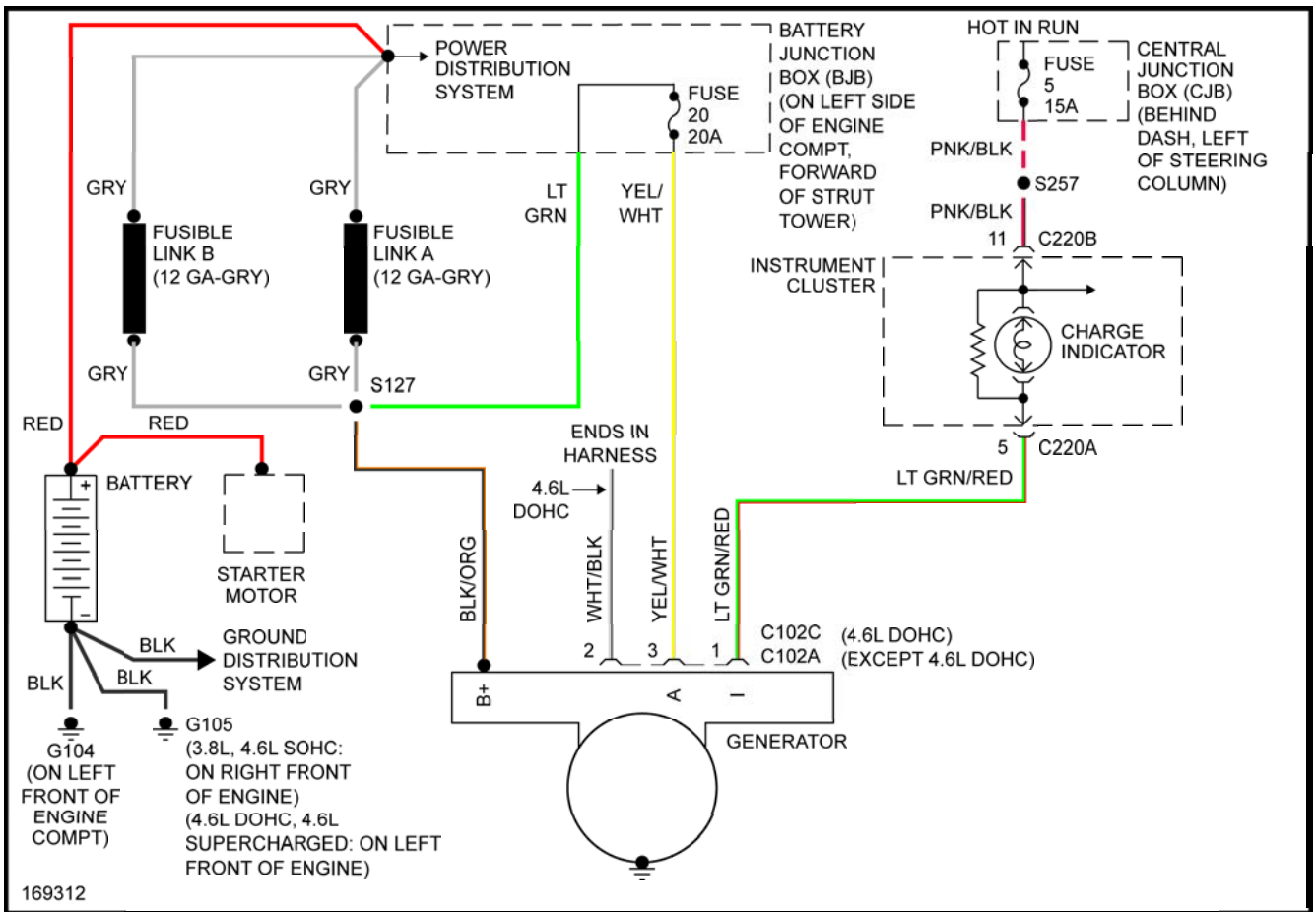


Fig. 48: Shift Interlock Circuit

STARTING/CHARGING

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang



169312

Fig. 49: Charging Circuit

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

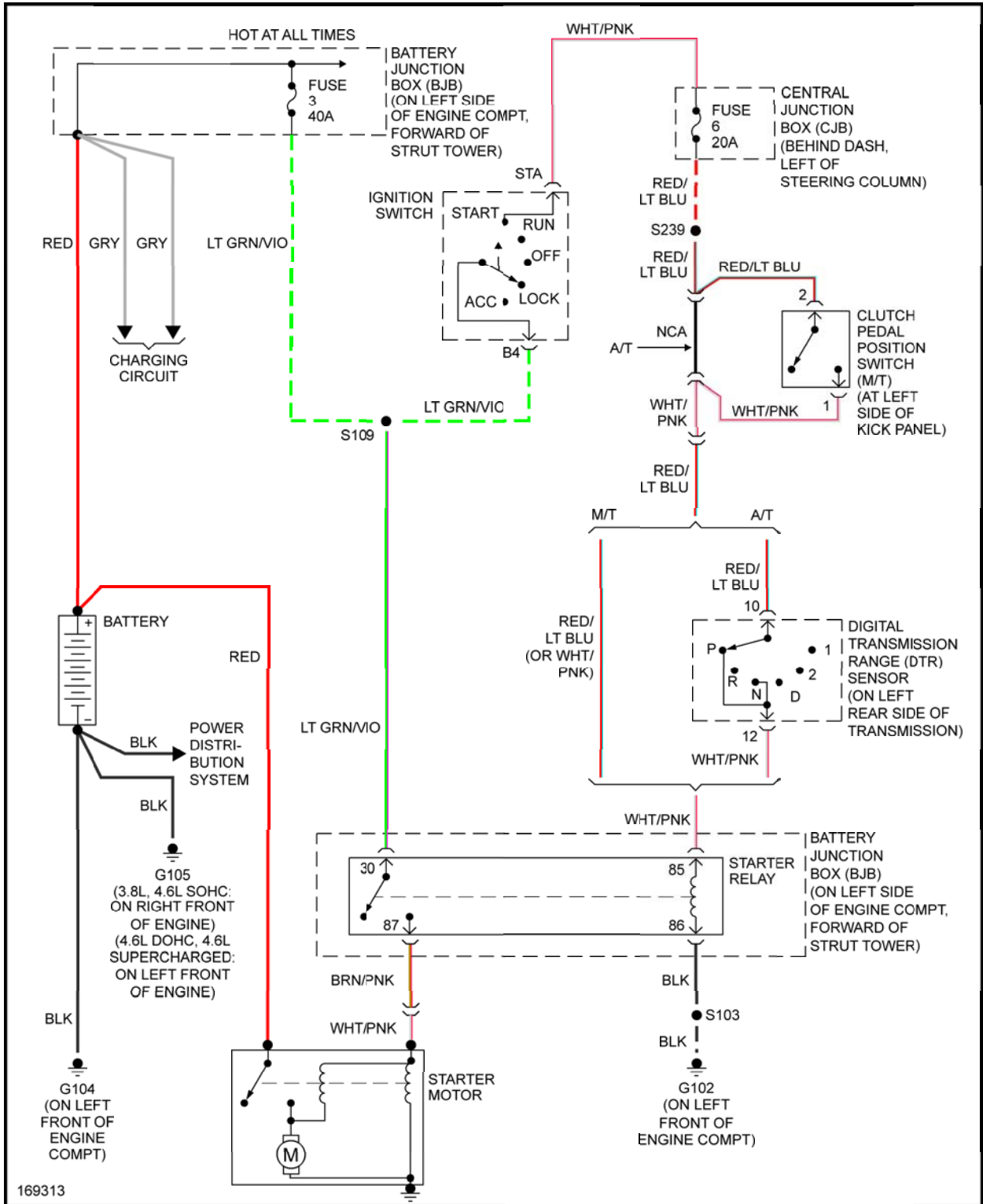


Fig. 50: Starting Circuit

SUPPLEMENTAL RESTRAINTS

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

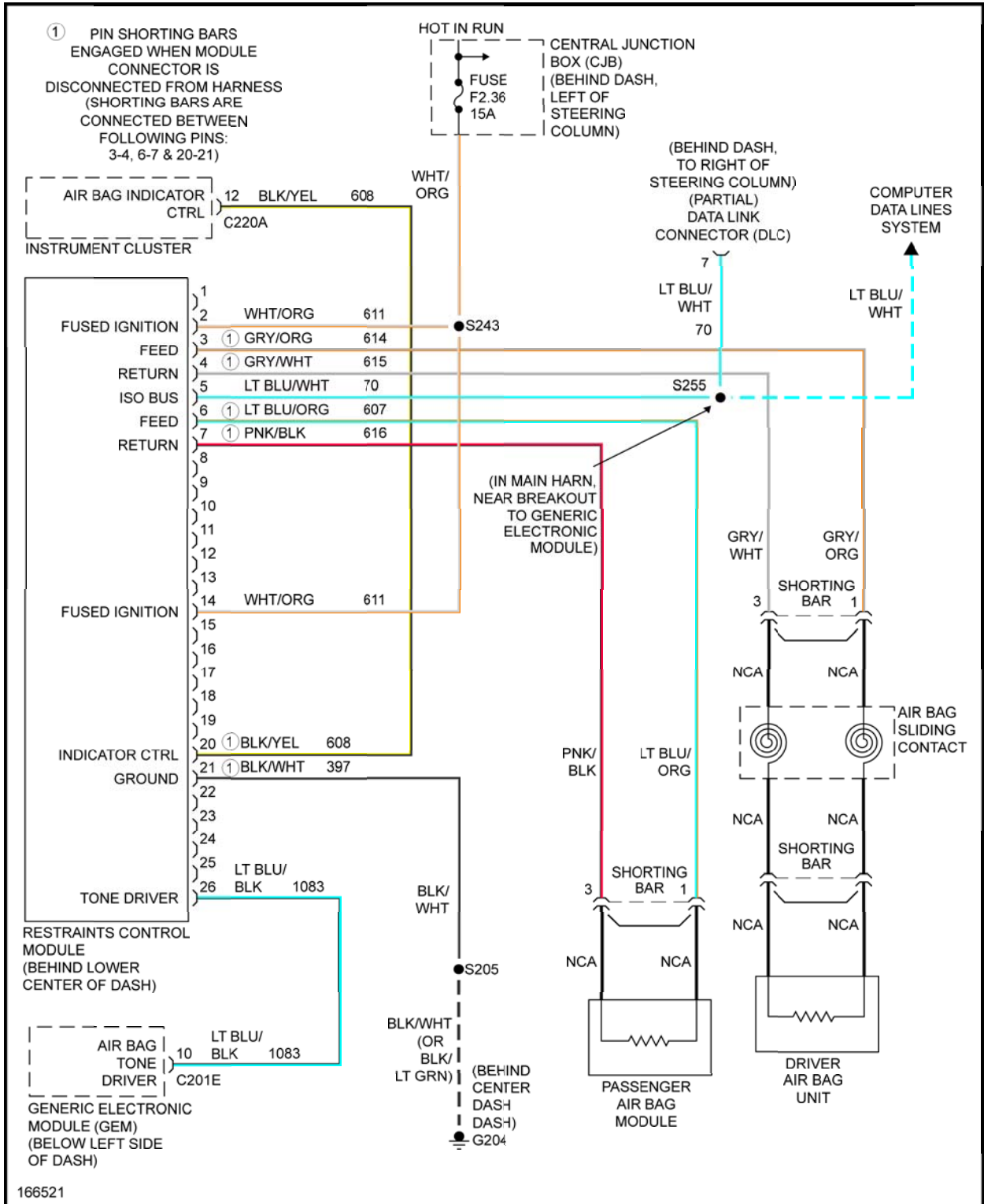


Fig. 51: Supplemental Restraints Circuit

TRANSMISSION

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

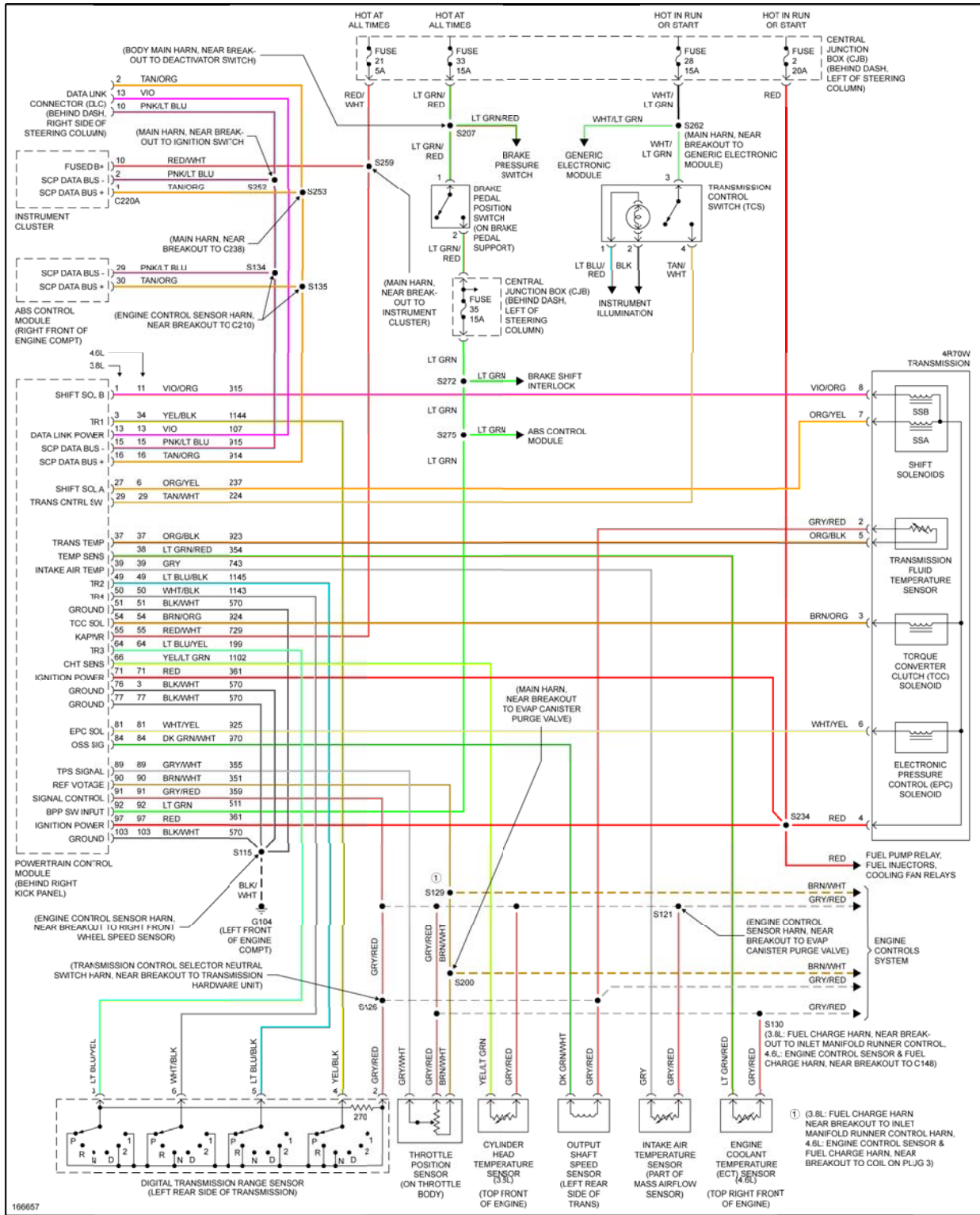


Fig. 52: A/T Circuit

TRUNK, TAILGATE, FUEL DOOR

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

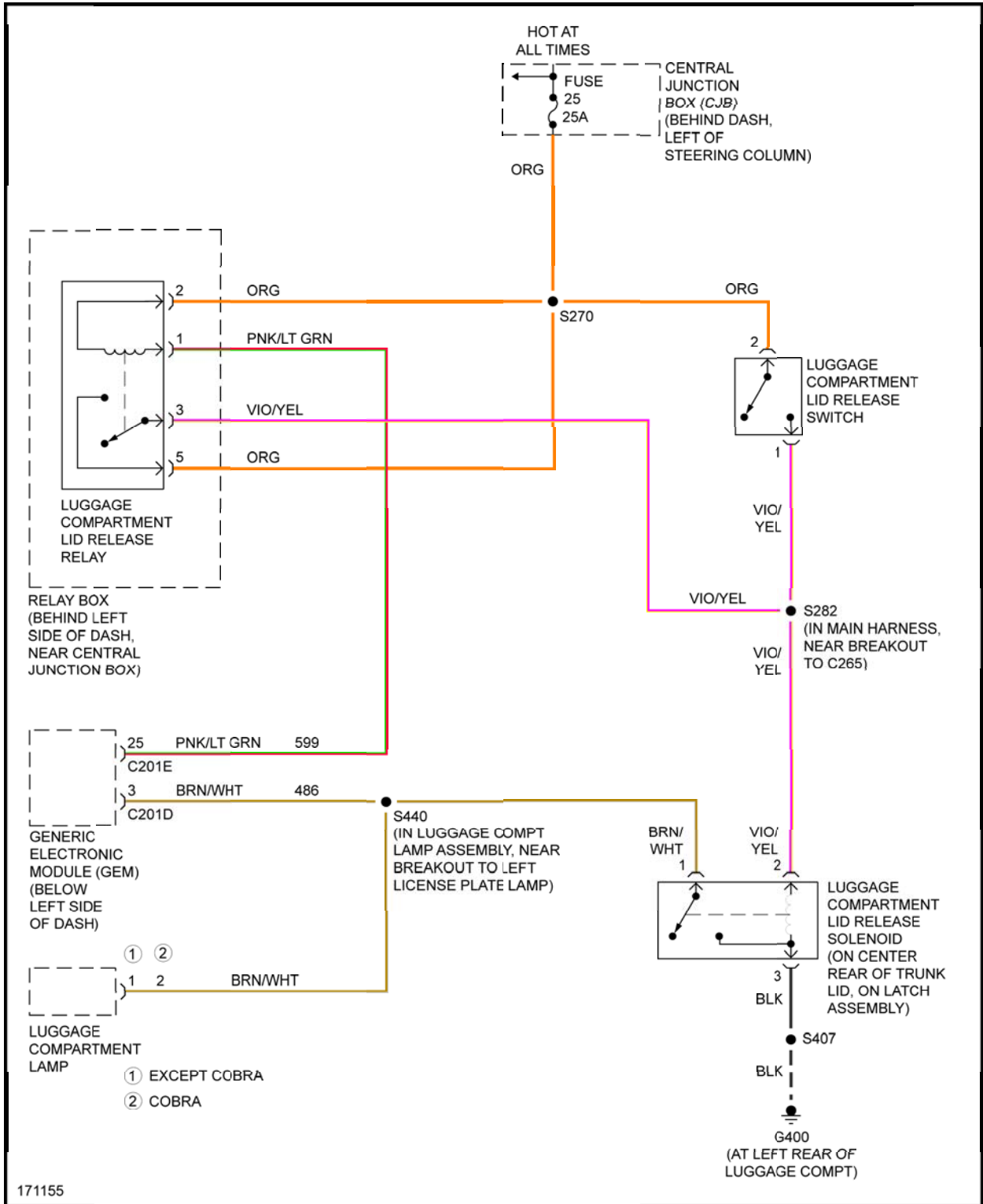


Fig. 53: Trunk, Tailgate, Fuel Door Circuit

WARNING SYSTEMS

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

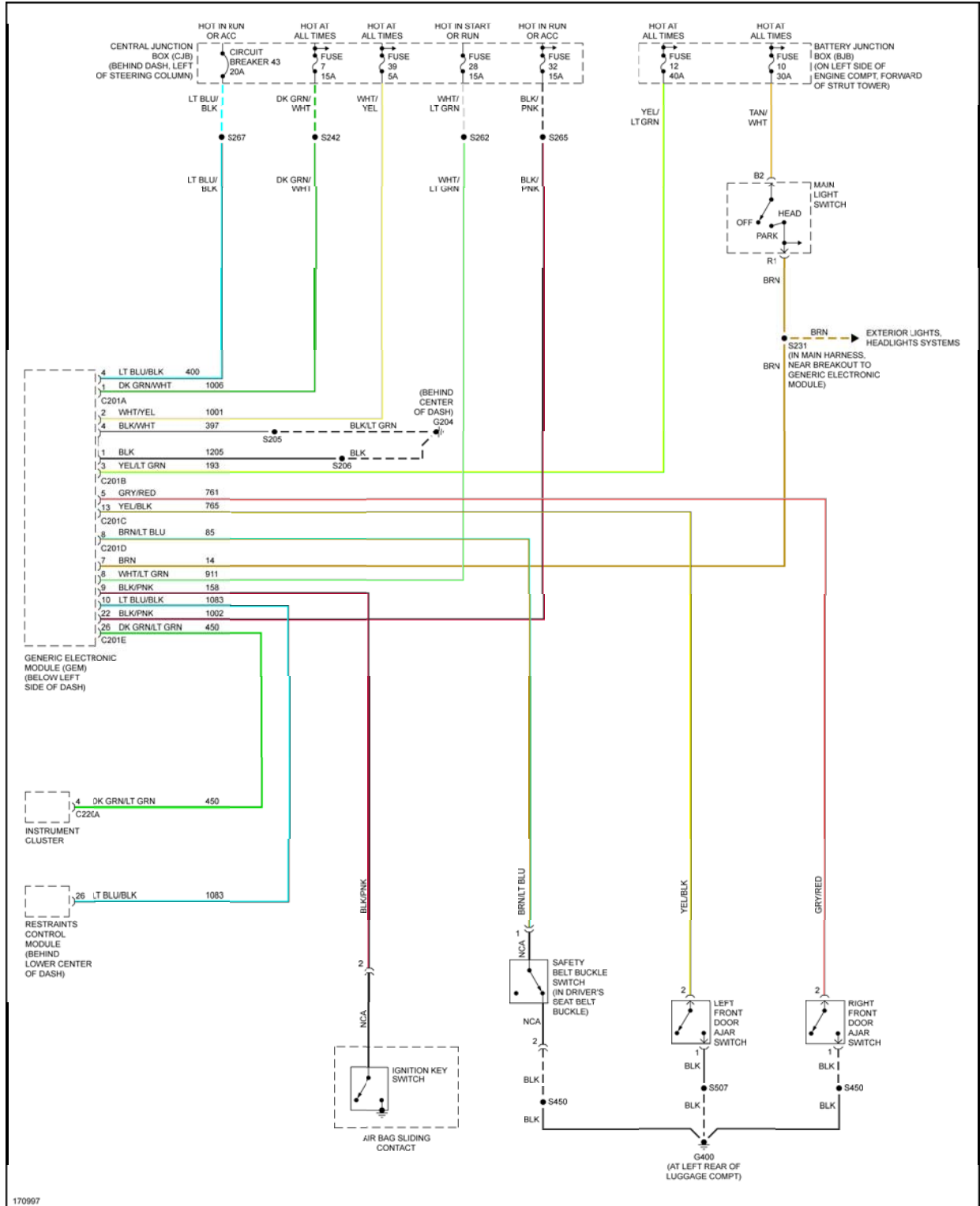


Fig. 54: Warning Systems Circuit

WIPER/WASHER

2003 Ford Mustang Mach 1

2003 SYSTEM WIRING DIAGRAMS Ford - Mustang

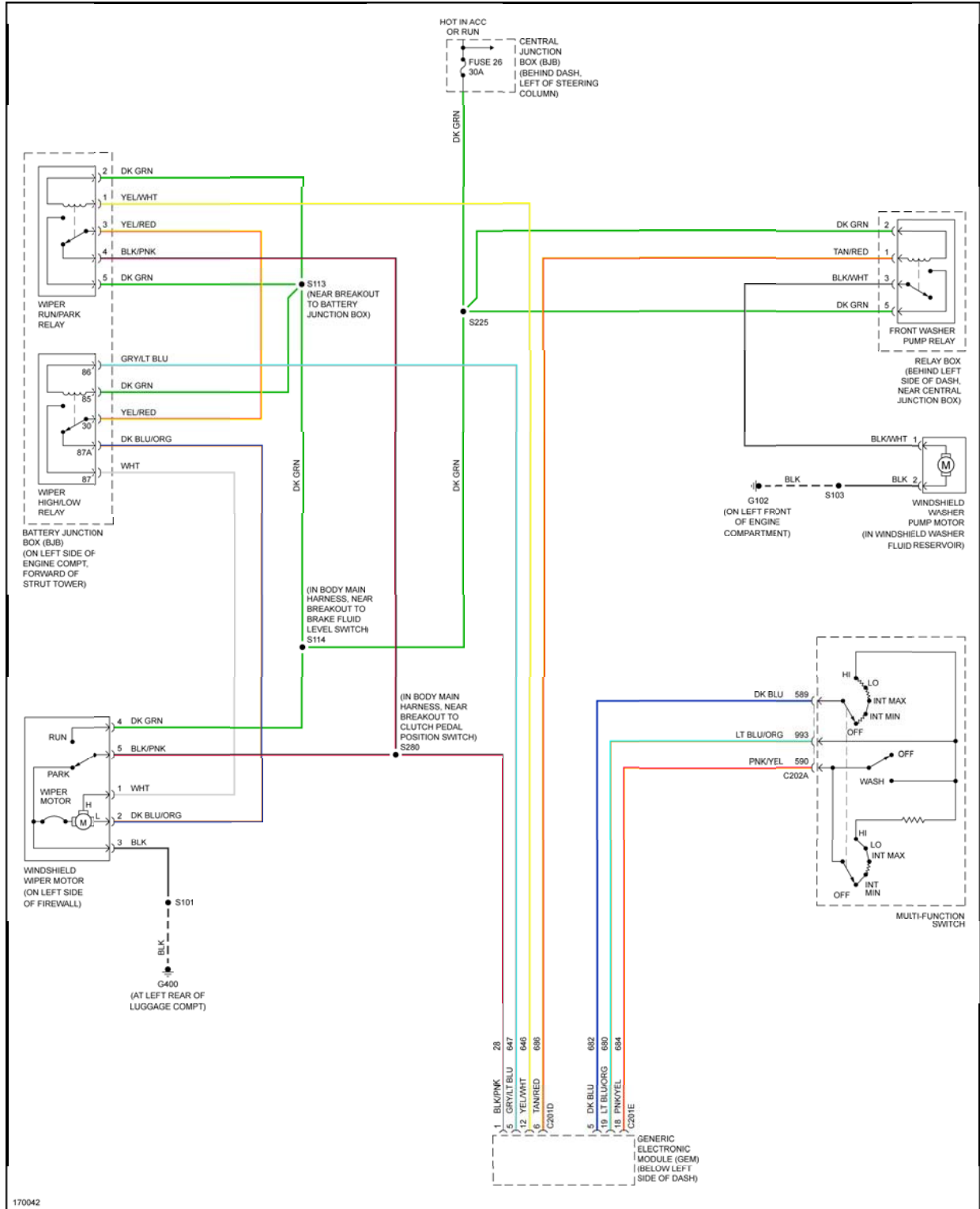


Fig. 55: Wiper/Washer Circuit