Module

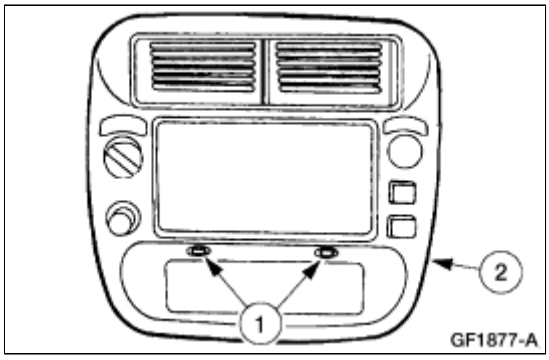
Removal

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

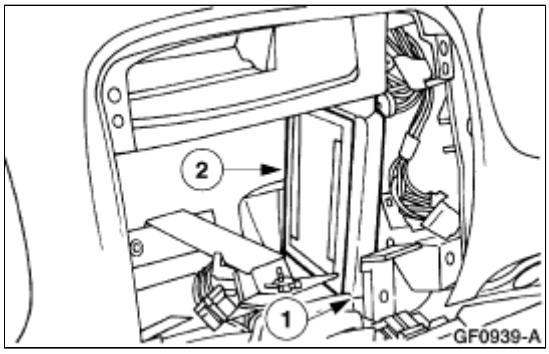
   NOTE: Ride heights must be reset for the air suspension module whenever the air suspension module is replaced.

   Disconnect the battery negative ground cable.

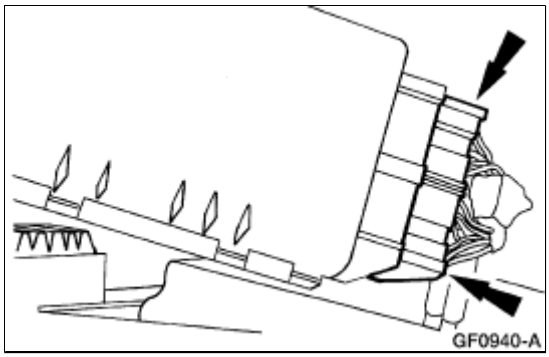
2. Remove the center instrument panel finish panel.
   1. Remove the center instrument panel finish panel screws.
   2. Disconnect the electrical connectors and remove the center panel finish panel.



3. Remove the air suspension control module.
   1. Remove the air suspension control module screws.
   2. Slide the air suspension control module down and out of the support bracket.



4. Disconnect the air suspension control module electrical connectors and remove the air suspension control module.

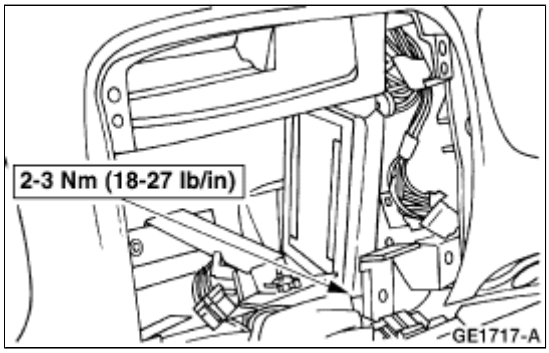


Installation

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 mi) or more to relearn the strategy.

   NOTE: When installing a new air suspension control module, ride height adjustment must be performed. Ride Height Adjustments

   To install, reverse the removal procedure.



General Specifications

Item	Specification
Front Axle	
Motorcraft SAE 80W90 Thermally Stable 4x4 Axle Lubricant	WSP-M2C197-A
Rear Axle	
Friction Modifier C8AZ-19B546-A	EST-M2C118-A
Explorer and Mountaineer with 8.8-inch ring gear, 5.0L engine and Traction-Lok® differential: High Performance Synthetic 75-W140 Rear Axle Lubricant F1TZ-19580-B	WSL-M2C192-A
Explorer with 8.8-inch ring gear and conventional 4.0L engine: Thermally Stable XY-80W90-QL	WSP-M2C197-A
Driveshaft Slip-Yoke	
Premium Long-Life Grease XG-1-C	ESA-M1C75-B
Capacities	
Front axle	1.54 liters (2.7 pints) (9.56 mm [0.38 in] below the bottom of the filler hole)
Rear axle	2.60 liters (5.5 pints) (6-14 mm [1/4-9/16 in] below the bottom of the filler hole)
Traction-Lok® [1]	118.29 ml (4 oz)
Sealants	
Pipe Sealant with Teflon® D8AZ-19554-A	WSK-M2G350-A2
Epoxy Sealer	M-3D35A (E)
Stud and Bearing Mount EOAZ-19554-BA	WSK-M2G349-A1
Engine Angle (Degrees)	
All	4.75

[1] Friction modifier

Explorer 4x2 Rear Driveline Angles @ Curb Specifications

Model	Trans.	Engine	Ride Height mm (In.)	Rear DS Angle (deg.)	Pinion Angle (deg.)
2-door	Manual	4.0	123 (4.84)	8.0	5.35
2-door	Auto	4.0	123 (4.84)	8.3	5.35
4-door	Manual	4.0	143 (5.63)	7.7	5.1
4-door	Auto	4.0	143 (5.63)	7.9	5.1

4-door	Auto	5.0	140 (5.51)	6.6	5.0

Explorer, Mountaineer 4x4 Rear Driveline Angles @ Curb Specifications

Model	Trans.	Engine	Ride Height mm (In.)	Rear DS Angle (deg.)	Pinion Angle (deg.)
2-door	Auto/Manual	4.0	118 (4.65)	9.9	5.4
4-door without air suspension	Auto/Manual	4.0	143 (5.63)	8.4	5.1
4-door with air suspension	Auto	4.0	118 (4.65)	9.1	5.4
4-door without air suspension	Auto	5.0	140 (5.51)	6.9	5.1
4-door with air suspension	Auto	5.0	118 (4.65)	7.4	5.4

Driveline System

The source of the drivetrain's power is generated by the engine and delivered to the transmission. The driveline transfers the engine torque through the driveshaft to the axle.

- On 2-wheel drive vehicles, power is transmitted through the transmission to the driveshaft and then to the rear axle.
- On 4-wheel drive vehicles, power is transmitted through the transmission and the transfer case. The transfer case directs the power to the rear driveshaft and then to the rear axle. When engaged, it also transmits power through the front driveshaft to the front axle.
- On all wheel drive vehicles, power is transmitted through the transmission and continuously proportioned to the front and rear axles through the transfer case.

The rear driveshaft is connected to the output shaft of the transmission and to the rear axle. The front driveshaft is connected to the transfer case and to the front axle. Universal joints and CV joints are used at both ends of the driveshaft to allow for angular motions. Slip yokes are used to allow for any changes to the length of the driveshaft. The engine torque enters the axle through the drive pinion, which rotates the ring gear. The ring gear is mounted to the differential case, which contains the gears that transmit power to the rear axle shafts or front halfshafts. These shafts rotate the drive wheels.

Vehicles have the following types of driveshafts:

- One-piece rear driveshaft with two U-joints and a front slip yoke.
- One-piece front driveshaft with one front U-joint, a slip yoke and a rear CV joint.

For additional information on the front axle assembly, refer to Section 205-03 .

For additional information on the halfshaft, refer to Section 205-04 .

For additional information on the driveshaft, refer to Section 205-01 .

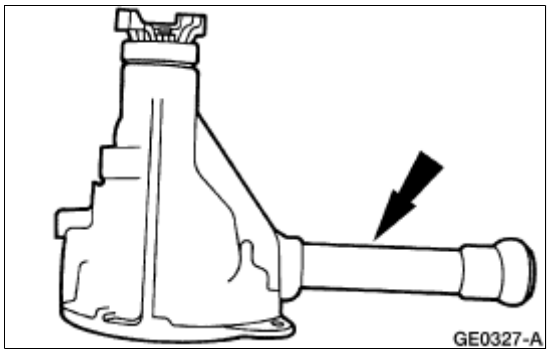
For additional information on the rear axle, refer to Section 205-02 .

The engine angle is built into the engine mounts. If the engine angle is out of specification, the engine mounts must be inspected for damage.

Vehicle Certification (VC) Label Example

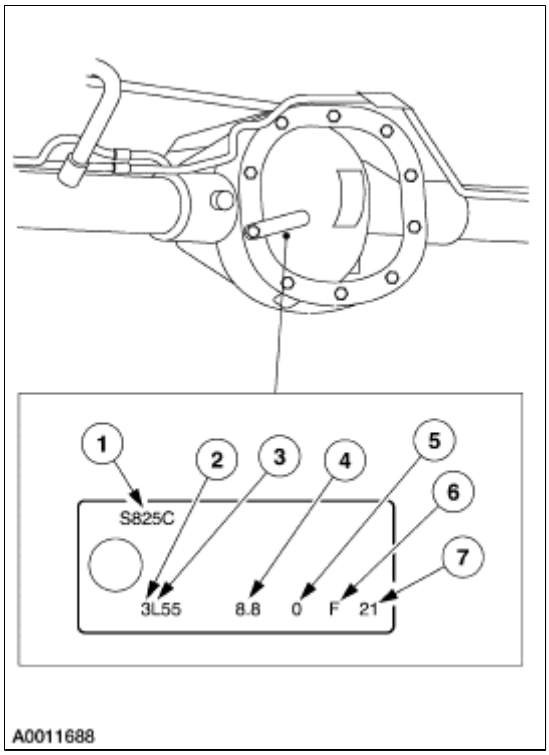
The vehicle certification (VC) label is located in the driver door jamb. The first two digits of the axle code indicate the rear axle and the third digit refers to the front axle, if so equipped. For additional information on the VC label, refer to Section 100-01 .

Front Axle Identification Tag



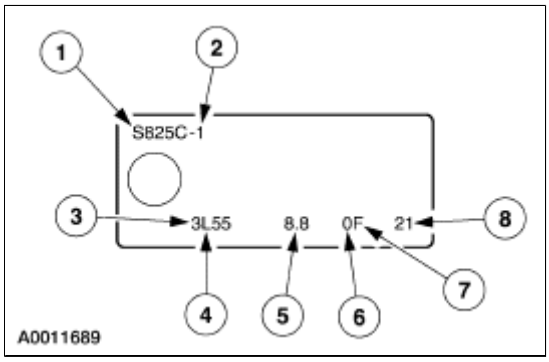
A manufacturing date code and a complete part number is stamped on the left carrier arm between the fill plug and axle end. A metal axle identification tag is attached to the differential by a housing cover bolt.

Rear Axle Identification Tag



Item	Description
1	Plant code
2	Axle ratio
3	Denotes Traction-Lok®
4	Ring gear diameter (inch)
5	Build year
6	Build month
7	Build day

Axle Identification Tag Denoting Interchangeability Affected Internally



Item	Description
1	Plant code
2	Denotes interchangeability affected internally

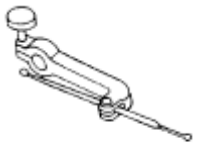
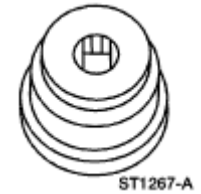
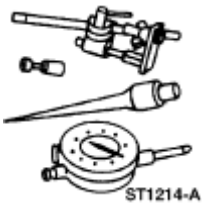
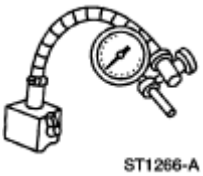
3	Axle ratio
4	Denotes Traction-Lok®
5	Ring gear diameter (inch)
6	Build year
7	Build month
8	Build day

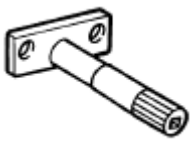
CAUTION: The axle identification tag is the official service identifier. Do not damage the tag. Always reinstall the tag after removing it for axle inspection/repair.

The axle identification tag identifies a particular axle design, a specific ratio, and if it is a conventional or limited slip (Traction-Lok®) type. In addition, the plant code will not change as long as that particular axle assembly never undergoes an external design change. If, however, an internal design change takes place during the production life of the axle and that internal change affects parts interchangeability, a dash and numerical suffix is added to the plant code. This means that as an assembly both axles are interchangeable; however, internally they are different. Therefore, each requires different internal parts at the time of repair.

Driveline System

Special Tool(s)

 ST1268-A	Clamp Plate 205-320 (T92L-4851-C)
 ST1348-A	Clutch Housing Alignment Adapter 308-021 (T75L-4201-A)
 ST1257-A	Companion Flange Holding Tool 205-126 (T78P-4851-A)
 ST1267-A	Companion Flange Runout Gauge 205-319 (T92L-4851-B)
 ST1214-A	Dial Indicator with Bracketry 100-002 (TOOL-4201-C) or Equivalent
 ST1266-A	Dial Indicator/Magnetic Base 100-D002 (D78P-4201-B) or Equivalent
 ST2207-A	Vibration Analyzer 100-F027 (014-00344)

 ST2040-A	Traction-Lok® Torque Tool 205-022 (T66L-4204-A)

Inspection and Verification

Certain axle and driveline symptoms are also common to the engine (6007), transmission, wheel bearings, tires, and other parts of the vehicle. For this reason, be sure that the cause of the concern 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.

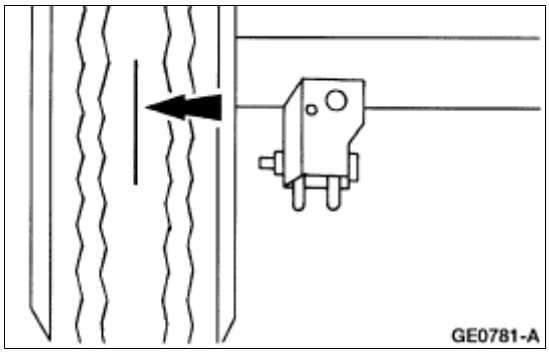
Universal Joint (U-Joint) Inspection

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. For additional information, refer to Section 205-01 .

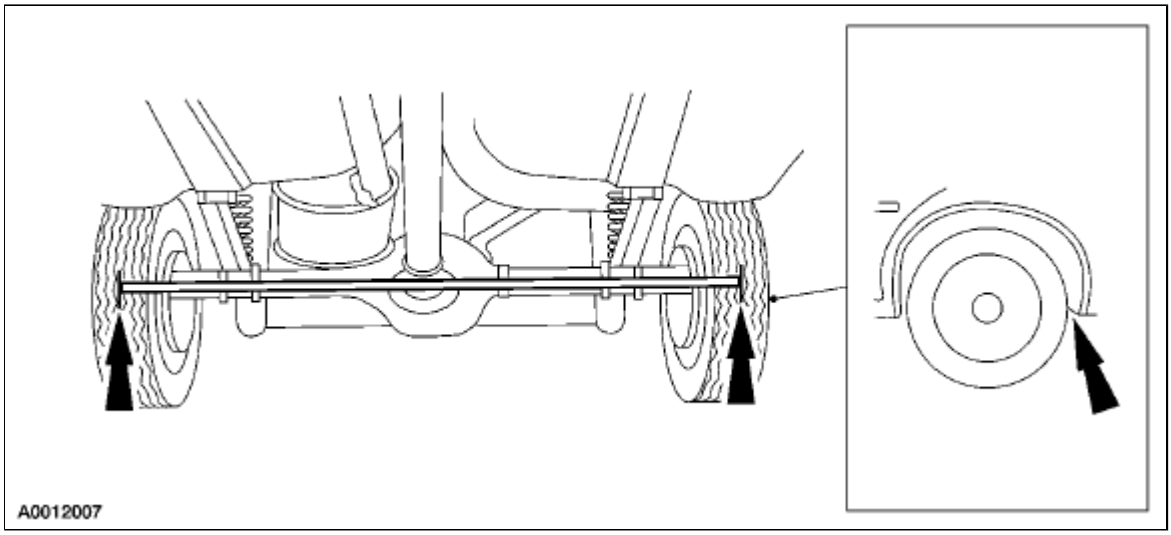
Inspection For Bent Rear Axle Housing

1. Raise and support the vehicle. For additional information, refer to Section 100-02 . Allow the rear axle (4001) to be freely suspended.

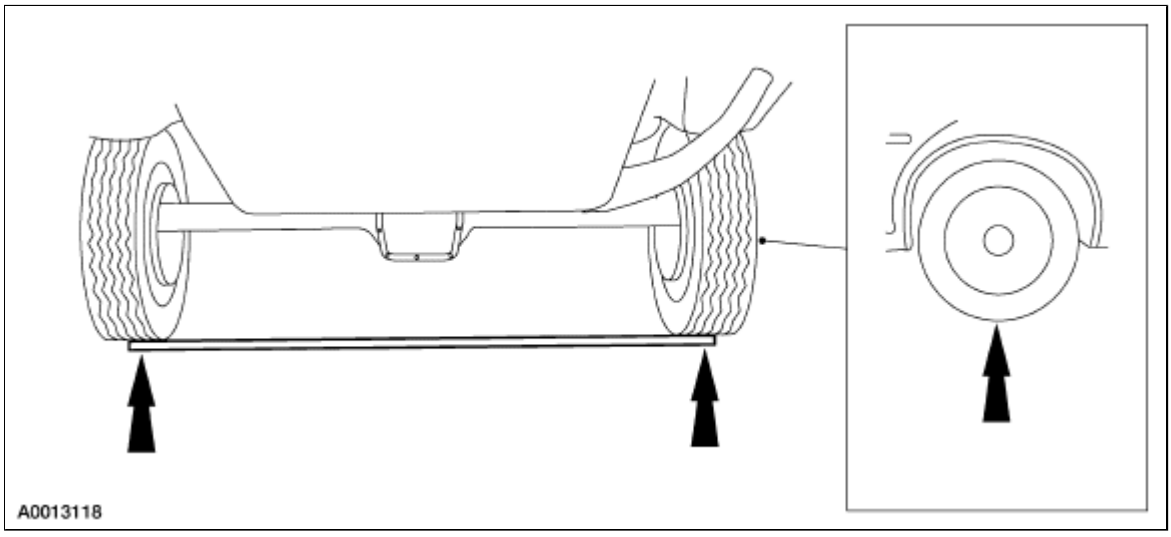
2. Use white chalk or paint to mark a vertical line on the center of each rear tire.



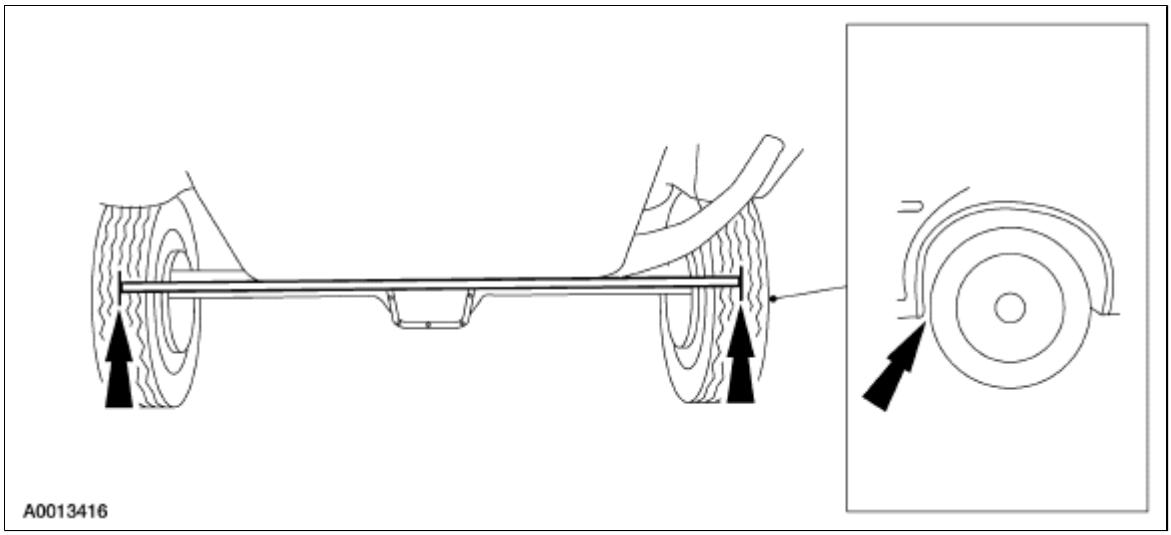
3. Adjust both wheels so that the markings face the front of the vehicle. With a tape measure, measure the distance between the marks and record this reading (front reading).



4. Rotate the rear wheels so the markings are directly underneath the vehicle. Measure the distance between the marks and record this reading (bottom reading).



5. Rotate the rear wheels so the markings face the rear of the vehicle. Measure and record the distance between the marks (rear reading).



6. Compare the front and the rear readings (Steps 3 and 5) to find the toe-in or toe-out condition.
   - Toe-in occurs when the front measurement is less than the rear measurement.
   - Toe-out occurs when the rear measurement is less than the front measurement.

7. To determine camber, find the average of the front and the rear measurements (Steps 3 and 5). Subtract the bottom reading (Step 4) from this number.
   Positive (+) camber is when the bottom reading is less than the average of the front and rear readings. Negative (-) camber is when the bottom reading is greater than the average of the front and rear readings.

8. The results of the calculations in Steps 6 and 7 must conform to the following specifications:
   Toe-in: 0 - 1/16 inch.
   Toe-out: 0 - 3/16 inch.
   Camber: 0 ± 5/32 inch.
   If the axle housing does not meet these specifications, it must be installed new. Refer to Section 205-02 .

9. After the axle housing has been installed, repeat Steps 2 through 7.

Analysis of Leakage

Clean up the leaking area enough to identify the exact source.

A plugged axle housing vent can cause excessive pinion seal lip wear due to internal pressure buildup.

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 or a small diameter Allen wrench 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.

The pinion flange must be installed new if any of these conditions exist.

Metal chips or sand trapped at the sealing lip can also cause oil leaks. This can cause a wear groove on the pinion flange and heavy pinion seal wear.

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

For additional information on differential seals, refer to Section 205-02 for the rear axle or Section 205-03 for the front axle.

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.

WARNING: An all-wheel drive (AWD) vehicle will always have all wheels on both axles driving. If only one wheel/axle is raised off the floor and the axle is driven by the engine, the wheel/axle on the floor could drive the vehicle off the stand or jack. Be sure all wheels are off the floor.

Few vibration conditions are caused by the front or 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 is caused by tires, driveline angle or driveline imbalance.

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. For additional information, refer to Section 204-04 .

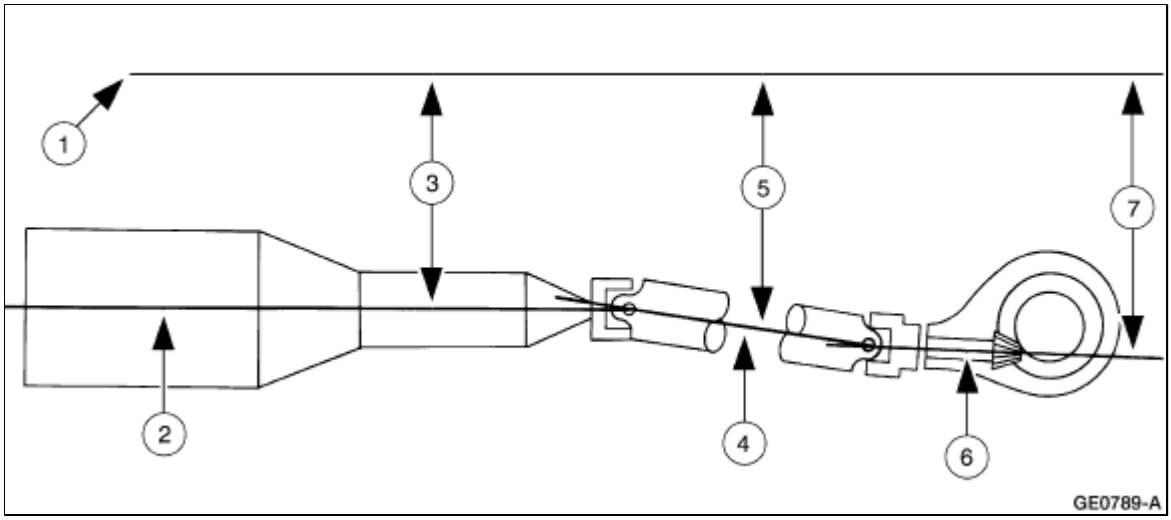
Driveline Imbalance

Driveline imbalance can be caused by excessive looseness in the driveshaft, damaged driveshaft tubing, looseness or high runout at the driveshaft attachments (axle and transfer case flanges). Excessive looseness in the driveshaft can be caused by CV joint or universal joint wear as well as loose fitting slip-yoke splines. Inspect and install new driveshaft and halfshaft components as necessary. For additional information, refer to Section 205-01 and Section 205-04 .

Driveline Angle

Driveline angularity is the angular relationship between the engine crankshaft (6303), the driveshaft, and the rear axle pinion. Some of the 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 .

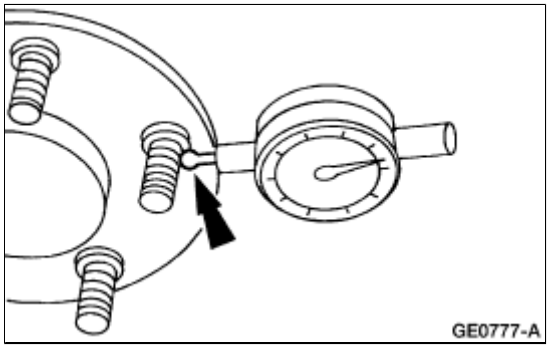
Universal Joint (U-Joint) Wear

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. For additional information, 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.

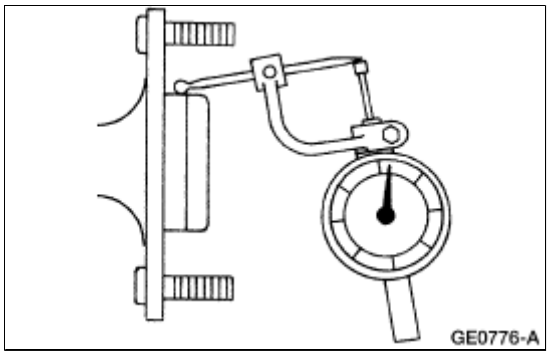
1. Position the Dial Indicator with Bracketry perpendicular to the wheel hub or axle flange bolt, as close to the hub or flange face as possible. Zero the indicator to allow the pointer to deflect either way.



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 Dial Indicator with Bracketry with the Clutch Housing Alignment Adapter to the pilot, as close to the hub or axle flange face as possible. Zero the indicator to allow the pointer to deflect either way.

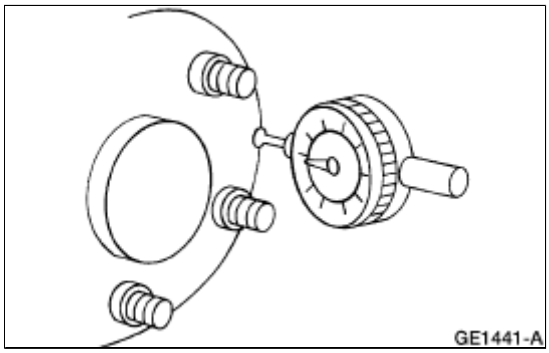


2. Rotate the hub or flange one full turn and note the maximum and minimum readings. The difference between the maximum and minimum readings will be the total pilot runout. Pilot runout must not exceed 0.15 mm (0.006 inch).

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 Dial Indicator with Bracketry 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 a new ring gear and pinion.

Halfshafts, Front Wheel

NOTE: Constant velocity (CV) joints must not be installed unless disassembly and inspection reveals unusual wear. For additional information, refer to Section 205-04 .

NOTE: While inspecting the boots, watch for indentations ("dimples") in the boot convolutions. Indentations must be removed.

- Inspect the boots for evidence of cracks, tears, or splits.
- Inspect the underbody for any indication of grease splatter near the boots outboard and inboard locations. This is an indication of boot/clamp damage.

Axle Noise

NOTE: Before disassembling the axle to diagnose and correct gear noise, eliminate the tires, exhaust, trim items, roof racks, axle shafts (4234) 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.

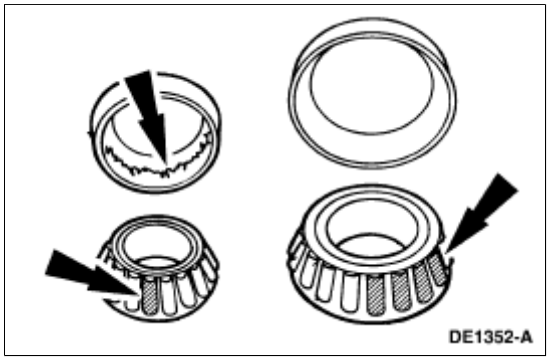
Bearing Whine

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.

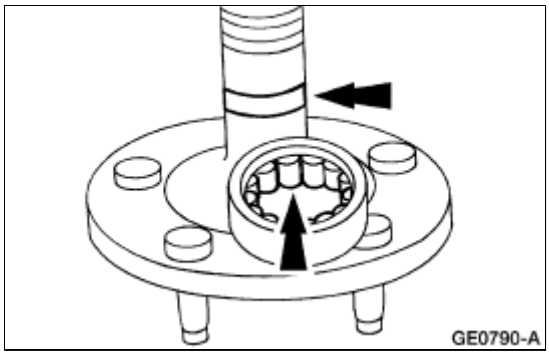
As noted, pinion bearings make a high-pitched, whistling noise, usually at all speeds. If however there is only one pinion bearing that is worn/damaged, the noise may vary in different driving phases. Pinion bearings must not be installed new unless they are scored or damaged or there is a specific pinion bearing noise. 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, the pinion bearing must be installed new.

NOTE: A low-pitched rumble normally associated with a worn/damaged wheel bearing can be caused by the exterior luggage rack or tires.

A wheel bearing noise can be mistaken for a pinion bearing noise. On 4x2 vehicles, check the wheel bearing for a spalled cup, and spalled/damaged rollers. 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.



On 4x4 vehicles, check the wheel bearing for rotating smoothness and end play. Install new as required.

Chuckle

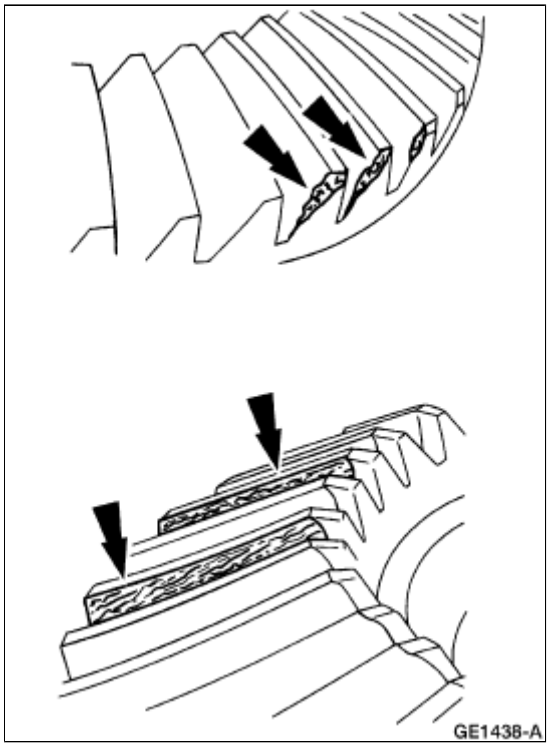
Chuckle that occurs on the coast driving phase is usually caused by excessive clearance between the differential gear hub and the differential case bore.

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.

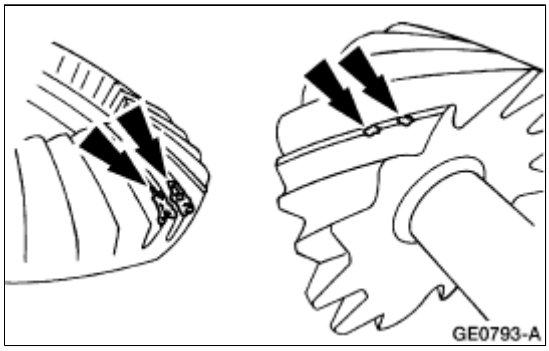
If either gear is scored or damaged badly, the ring gear and pinion must be installed new.



If metal has broken loose, the axle housing must be cleaned to remove particles that will cause damage. At this time, any other damaged parts in the axle housing must also be installed new.

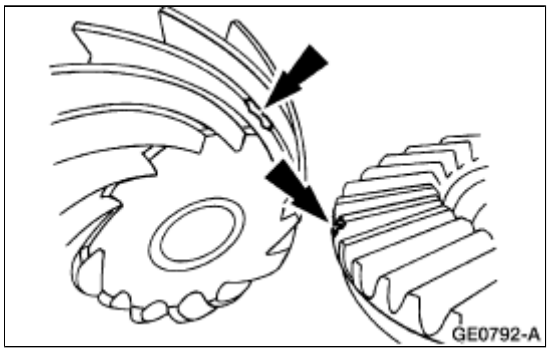
Knock

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.

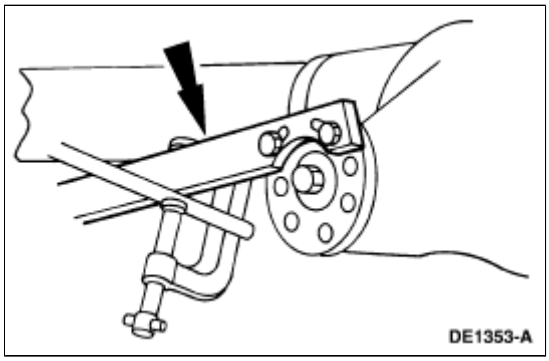
Clunk

Clunk is a metallic noise heard when the automatic transmission is engaged in REVERSE or DRIVE. The noise can 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. For additional information, refer to Section 205-01 .

Total Backlash Check

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Remove the driveshaft. For additional information, refer to Section 205-01 .
3. Install the Companion Flange Holding 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 shaft bearing 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.

Analysis of Inoperative Conditions

If the axle does not operate, one of the following may be the cause.

Broken Welds

If axle housing welds are completely broken, install a new axle housing.

Wheel Bearing Wear/Damage

Because of the severe loads they must handle, wheel bearings can require replacement at high mileage. If a wheel bearing fails at low mileage, it is often caused by overloading.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• Traction-Lok® Does Not Work in Snow, Mud or on Ice	• Differential.	• CARRY OUT the Traction-Lok® Differential Operation Check in this section. REPAIR as necessary. REFER to Section 205-02 .
• Lubricant Leaking from the Pinion Seal, Axle Shaft Oil Seals or Support Arm to the Housing	• Vent. • Damage in the seal contact area or dust slinger on the pinion flange dust shield.	• CLEAN the axle housing vent. • INSTALL a new pinion flange and the pinion seal if damage is found.
• Front Axle Will Not Engage	• Switches. • Wiring. • GEM. • Shift motor.	• REFER to Section 308-07A .
• Front Axle Will Not Disengage	• Switches. • Wiring. • GEM. • Shift motor.	• REFER to Section 308-07A .

Component Tests

Driveshaft Vibration Diagnosis

1. **NOTE:** When carrying out the following procedure steps on four-wheel drive vehicles, raise and support the vehicle so that all four wheels do not touch the ground.

   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.

Driveline Vibration

NOTE: An analysis of driveline vibration can also be conducted using the Vibration Analyzer; following 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 speeds. 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.

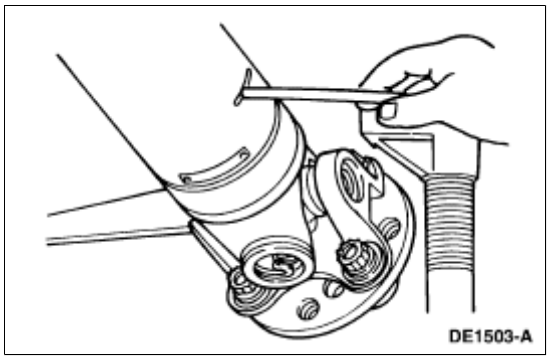
1. **NOTE:** When carrying out the following procedure steps on four-wheel drive vehicles, raise and support the vehicle so that all four wheels do not touch the ground.

   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 lugs. Remove the wheels. Install all the lug 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.

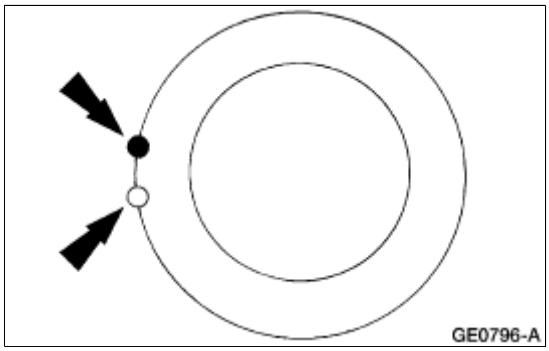
3. Inspect the driveshaft(s) for signs of physical damage, missing balance weight, undercoating, incorrect seating, wear and binding universal joints. Check the index marks (paint spots) on the rear of the driveshaft and axle pinion flange. If these marks are more than 90 degrees apart, disconnect the 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 driveshafts by turning the axle and measure the runout at the front, the center, and the rear of the driveshafts with the indicator. If the runout exceeds 0.89 mm (0.035 inch) at the center, the driveshaft must be installed new. If the center is within limit, but the front or rear runout is not, mark the runout high points and proceed to Step 5. If the runout is within the limits at all points, proceed to Step 7.

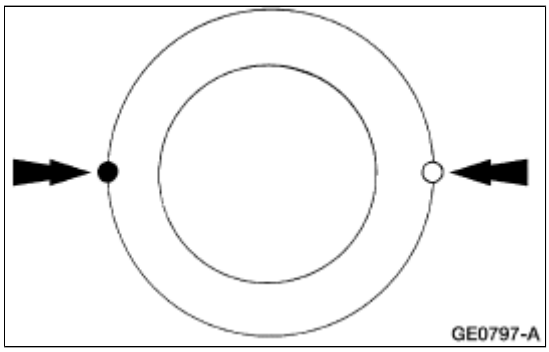


5. Scribe alignment marks on the driveshaft and the pinion flanges. Disconnect the driveshaft, rotate it one-half turn, and reconnect it. Circular axle pinion flanges can be turned in one-quarter increments to fine tune the runout condition; half-round axle pinion flanges are limited to two positions. Recheck the runout. 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 the vibration persists, proceed to Step 7.

6. Excessive driveshaft runout may originate in the driveshaft itself or in the pinion flanges. 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), the shaft must be installed new and the vehicle road tested.



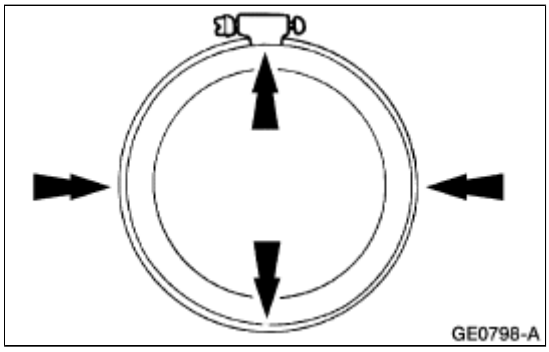
If the marks are on opposite sides of the driveshaft, the pinion flange is responsible for the vibration.



When installing or adjusting a pinion flange, the driveshaft runout must not exceed 0.064 mm (0.025 inch). When runout is within limits, recheck for vibration at road speed. If vibration persists, balance the driveshaft.

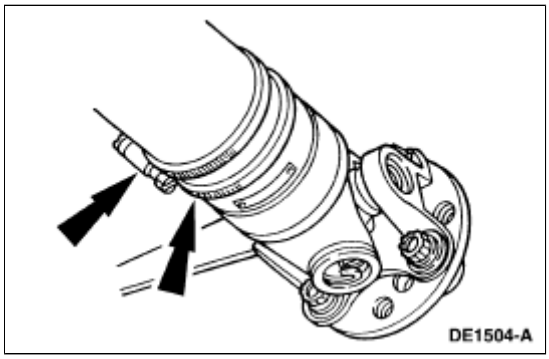
7. To balance the driveshaft, install one or two hose clamps on the driveshaft, near the ends. Position of the hose clamp head(s) can be determined by trial-and-error.

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.

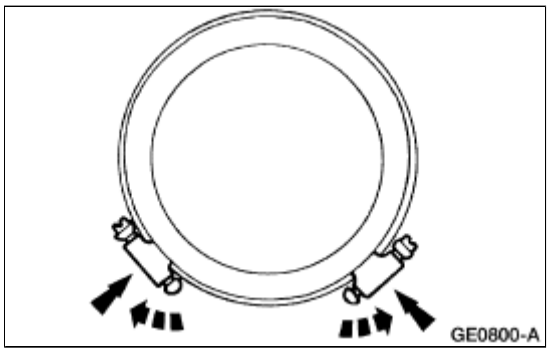


Check for vibration at road speed. Recheck with the clamp at each of the other positions to find the position that shows minimum vibration. If two adjacent positions show equal improvement, position the clamp head between them.

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 driveshaft. If the vibration is still not acceptable, refer to Section 205-02 for differential case and ring gear runout checks.

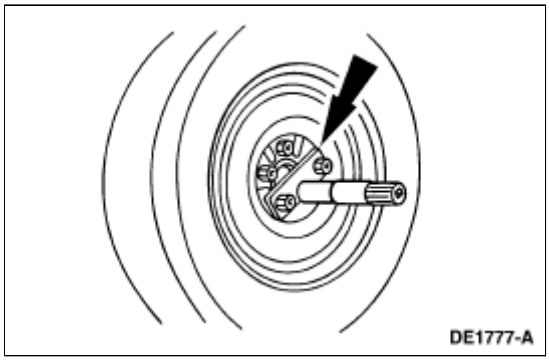
Traction-Lok® Differential Operation Check

A Traction-Lok® differential can be checked for correct operation without removing it from the rear axle housing (4010).

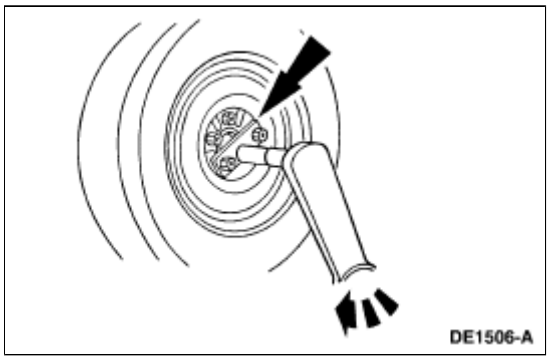
WARNING: A vehicle equipped with a Traction-Lok® differential will always have both wheels driving. If only one wheel is raised off the floor and the rear axle is driven by the engine, the wheel on the floor could drive the vehicle off the stand or jack. Be sure both rear wheels are off the floor.

WARNING: An all-wheel drive (AWD) vehicle will always have all wheels on both axles driving. If only one wheel/axle is raised off the floor and the axle is driven by the engine, the wheel/axle on the floor could drive the vehicle off the stand or jack. Be sure all wheels are off the floor.

Raise only one rear wheel. Install the Traction-Lok® Torque Tool on the wheel lugs.



Use a torque wrench with the 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. For additional information, refer to Section 205-02 .

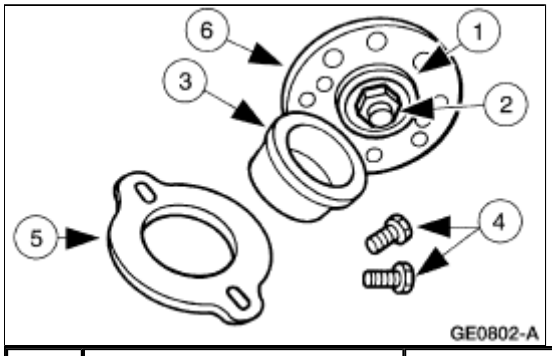
Traction-Lok® Differential Check Road Test

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 (4006).
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.

Pinion Flange Runout Check — Circular

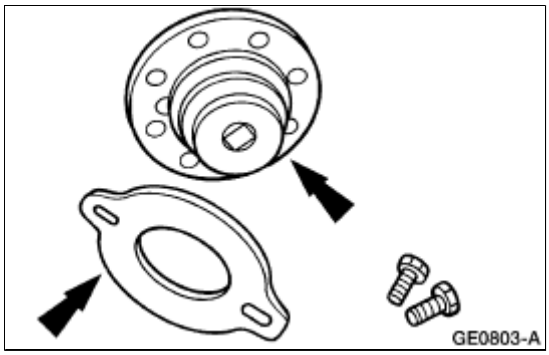
CAUTION: Pinion bearing preload must be reset if the pinion nut has been loosened or removed for pinion flange reindexing or installation.

1. Raise the vehicle on a twin-post hoist that supports the vehicle. For additional information, refer to Section 100-02 .
2. Remove the driveshaft. For additional information, refer to Section 205-01 .
3. Check the pinion flange for damage.
4. Position the Companion Flange Runout Gauge on the pinion flange.

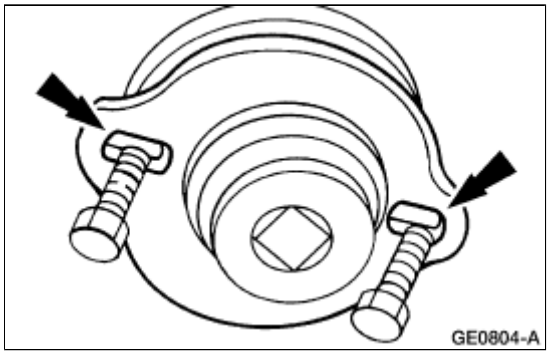


Item	Part Number	Description
1	—	Pilot (part of 205-319 (T92L-4851-B))
2	354845	Pinion nut
3	205-319 (T92L-4851-B)	Companion Flange Runout Gauge
4	—	Bolts (2 req'd) (part of 205-320 (T92L-4851-C))
5	205-320 (T92L-4851-C)	Clamp Plate
6	4851	Pinion flange

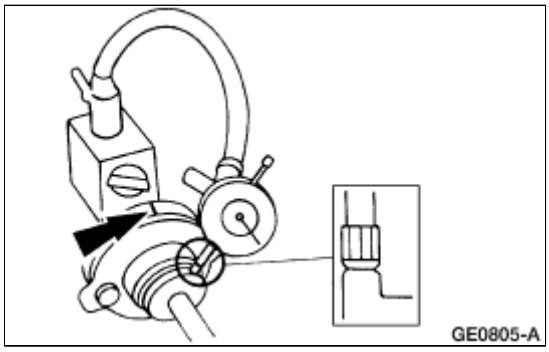
5. Position the Clamp Plate onto the Companion Flange Runout Gauge.



6. Align the holes on the clamp plate with the holes in the pinion flange and install the bolts. Snug the bolts evenly.

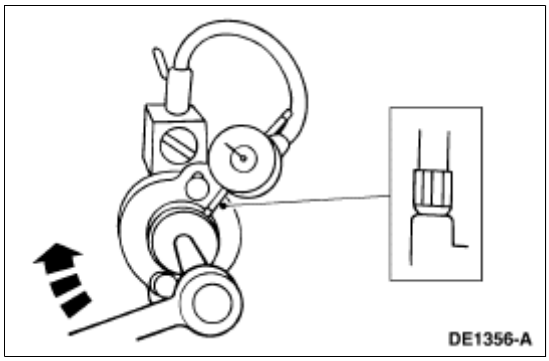


7. Position the Dial Indicator/Magnetic Base as shown. Turn the Companion Flange Runout Gauge, and locate and mark the high spot on the pinion flange with yellow paint.



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. For additional information, refer to Section 205-02 or Section 205-03 for the flange removal and installation procedures.

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. For the rear axle, if excessive runout is still evident after installation of the pinion flange, install a new ring and pinion. Repeat the above checks until the runout is within specifications.

10. Install the driveshaft. For additional information, 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.

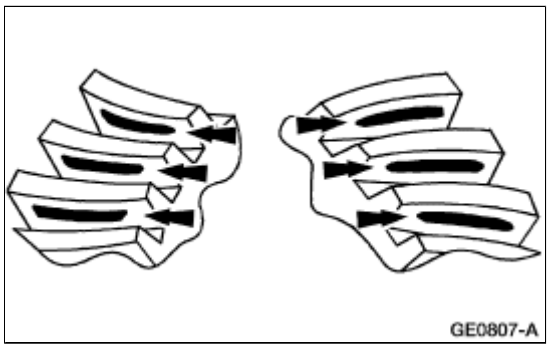
3. Certain types of gear tooth contact patterns on the ring gear indicate incorrect adjustment. Incorrect adjustment can be corrected by readjusting the ring gear or the pinion.

Contact Pattern Location

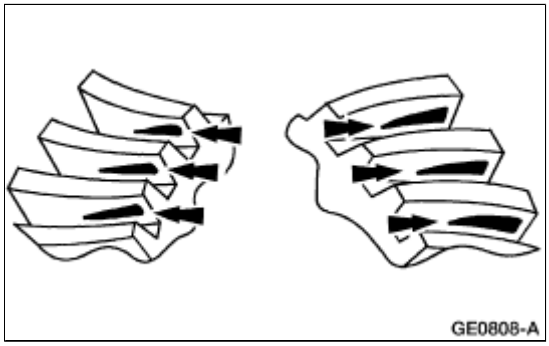
In general, desirable ring gear tooth patterns must have the following characteristics:

- 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.

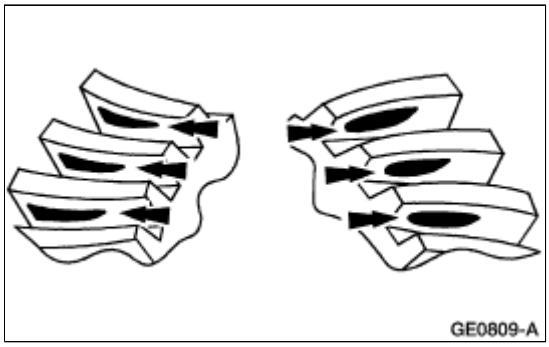
Acceptable ring gear tooth patterns for all axles.



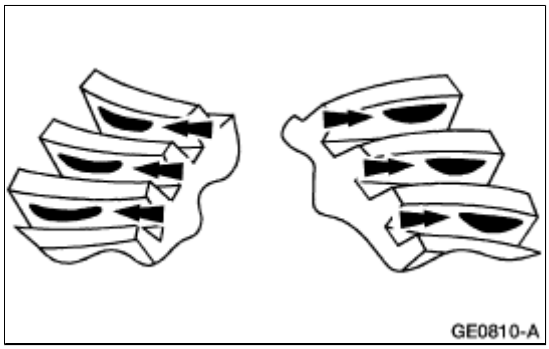
Correct backlash with a thinner pinion position shim required.



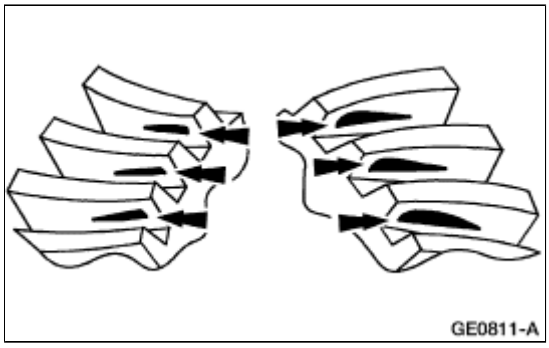
Correct backlash with a thicker pinion position shim required.



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)

 ST1622-A	Anglemaster II Driveline Inclinometer 164-R2402 or equivalent

CAUTION: Prior to checking driveline angularity, inspect the U-joints for correct operation.

NOTE: An incorrect driveline angle can cause a vibration or shudder. For additional information, refer to Section 100-04 .

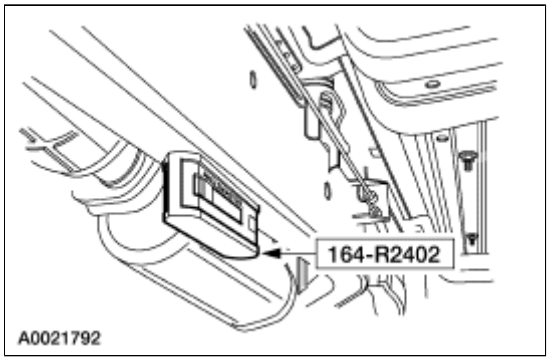
1. Check the vehicle for evidence of overload or sagging. Check for specified air pressures in all four tires.

2. Normalize the suspension.

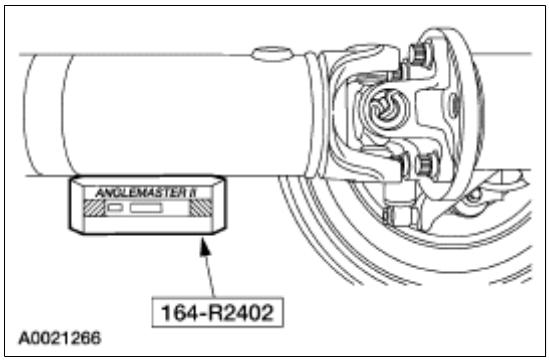
3. Drive the vehicle onto a drive-on hoist or back onto a front-end alignment rack.

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 fluid full.

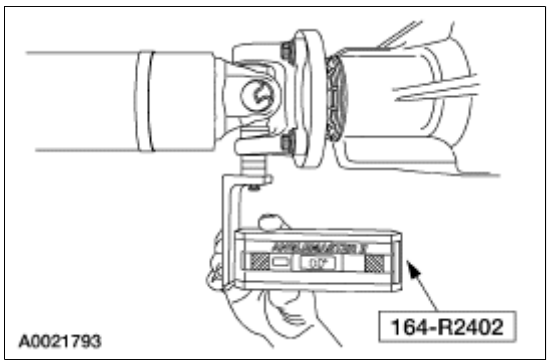
5. Place the special tool on a clean, flat level section on the bottom of the frame rail. Press the ALT ZERO button to calibrate the inclinometer to the vehicle.



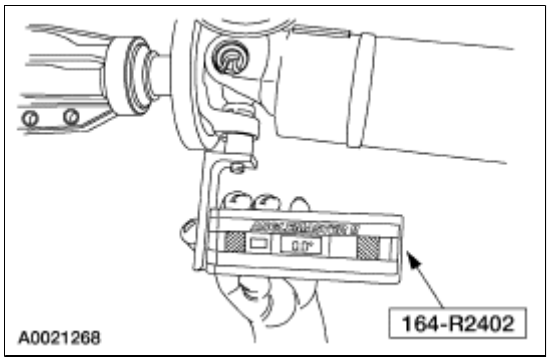
6. For the driveshaft angle reading, place the special tool flush against the bottom of the driveshaft. Check and record the reading. Compare the results with the correct angles. Refer to Specifications in this section.



7. 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 specifications, repair or adjust to obtain the correct angle . Inspect the rear suspension, rear axle, rear axle mounting or the frame for wear or damage.



8. 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.

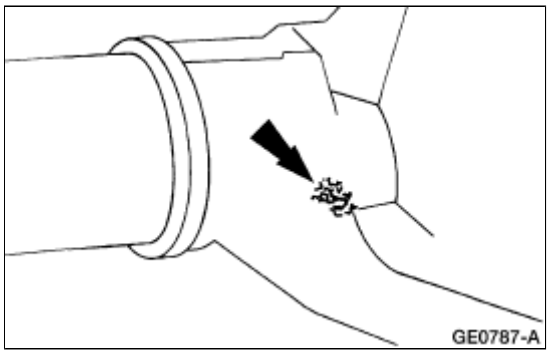


Axle Housing Casting Porosity (Holes in Casting) Repair

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 Devcon Aluminum Liquid F2 or equivalent 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 Devcon Aluminum Liquid F2 or equivalent meeting Ford specification M-3D35A(E).

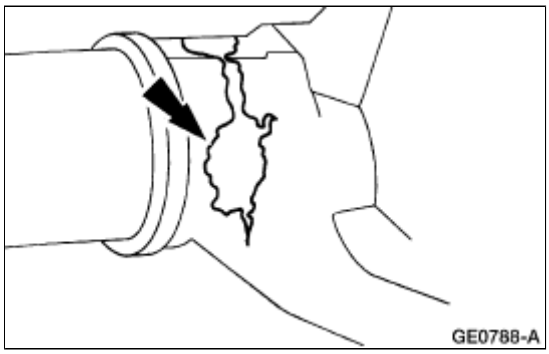
Axle Housing Weld Leaks Repair

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).



General Specifications

Item	Specification
Premium Long-Life Grease XG-1-C, -K or -T	ESA-M1C75-B
Threadlock and Sealer EOAZ-19554-AA	WSK-M2G351-A5

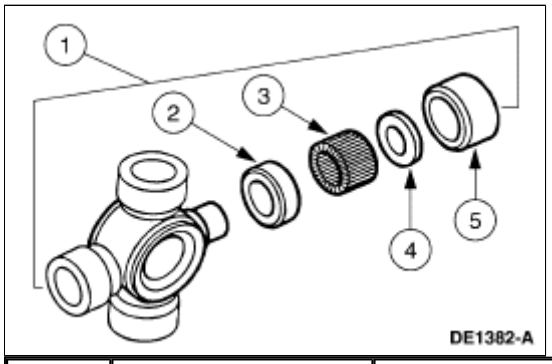
Torque Specifications

Description	Nm	lb-ft
Rear driveshaft flange yoke to transfer case bolts	112	83
Driveshaft to driveshaft rear axle pinion flange bolts	112	83
Front driveshaft to front axle bolts	15-20	11-15
Driveshaft constant velocity joint to transfer case bolts	30	22

Universal Joints

The universal joints are:

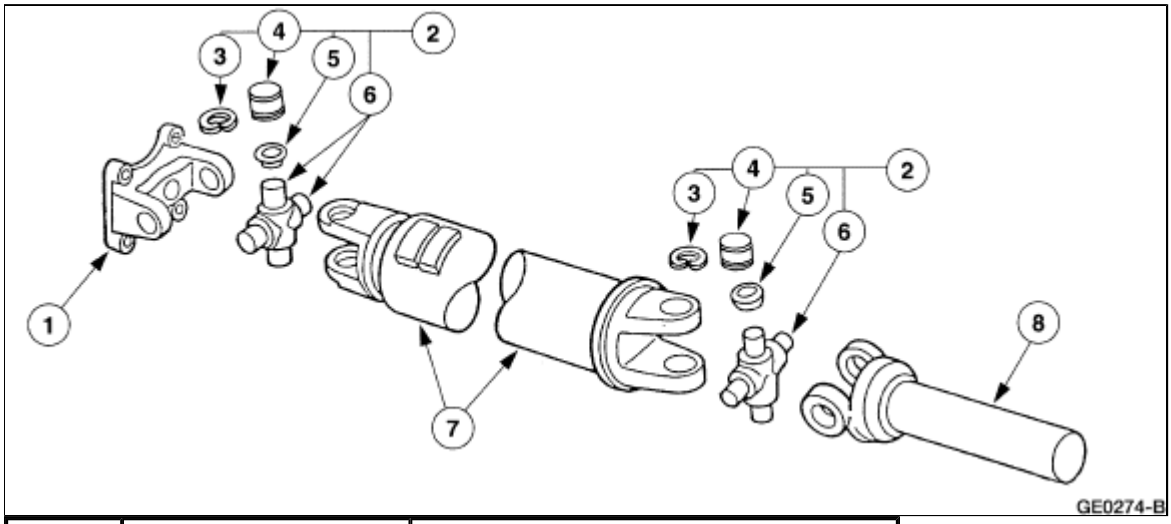
- lubed-for-life design and require no lubrication.
- equipped with nylon thrust washers, located at each base of the bearing cup, which control end play, position the needle bearing and improve grease movement.



Item	Part Number	Description
1	4635	Universal joint
2	—	Grease seal (part of 4635)
3	—	Needle rollers (part of 4635)
4	—	Thrust washer (part of 4635)
5	—	Bearing cup (part of 4635)

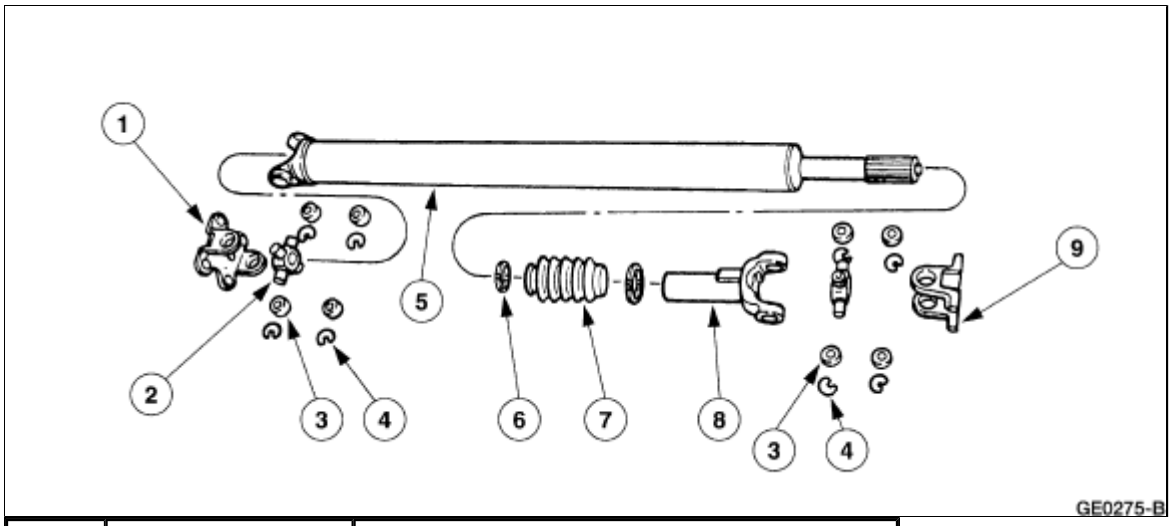
Driveshaft

Driveshaft — Rear, 4x2



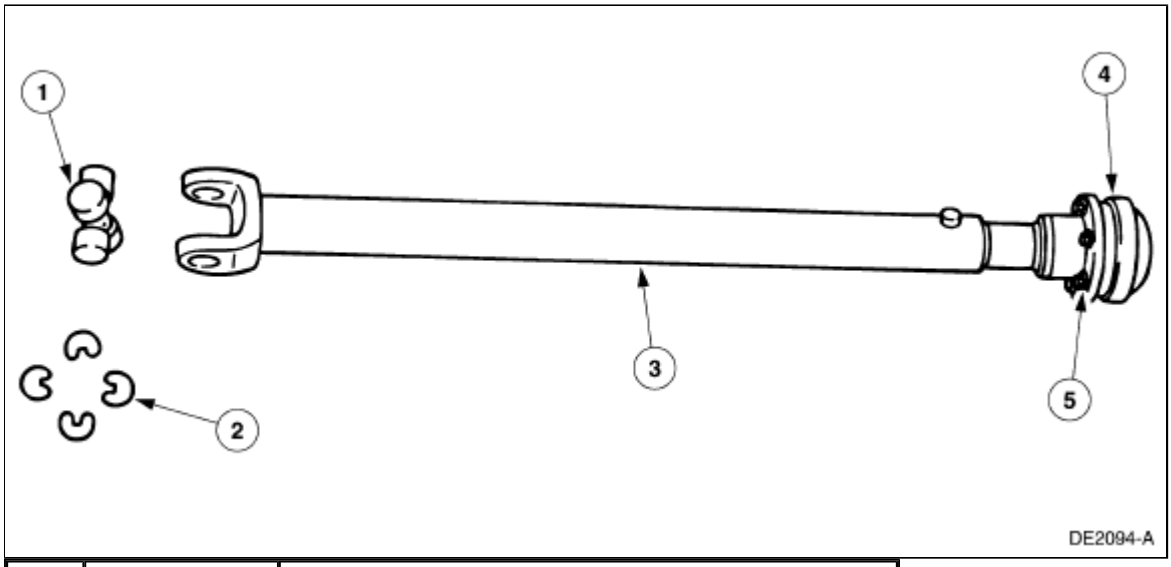
Item	Part Number	Description
1	4782	Flange
2	4635	Universal joint
3	—	Snap ring (part of 4635)
4	—	Bearing (part of 4635)
5	—	Seal (part of 4635)
6	—	Spider (part of 4635)
7	4602	Driveshaft
8	4841	Driveshaft slip yoke

Driveshaft — Rear, 4x4



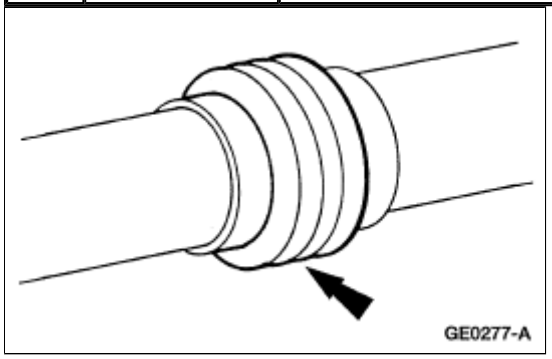
Item	Part Number	Description
1	4A378	Rear flange
2	—	Spider (part of 4635)
3	—	Bearing cup (part of 4635)
4	—	Snap ring (part of 4635)
5	4602	Driveshaft
6	3B478	Driveshaft slip-yoke boot clamp
7	4421	Universal joint slip-yoke boot
8	—	Driveshaft slip-yoke (part of 4602)
9	4A378	Front flange

Driveshaft — Front



Item	Part Number	Description
1	—	Universal joint

2	—	Snap rings
3	4A376	Front driveshaft
4	—	Constant velocity (CV) joint
5	—	Constant velocity (CV) joint bolts and washers



NOTE: Whenever the vehicle is raised on a hoist, inspect the universal joint slip yoke boot (4421) for rips or holes. Install new if required.

NOTE: All driveshafts are balanced. If undercoating the vehicle, protect the driveshaft (4602) and universal joints to prevent application of any undercoating material.

NOTE: The constant velocity (CV) joint on the front driveshaft is not serviceable.

The front driveshaft is connected to the transfer case and the front drive axle by a driveshaft flange yoke (4866).

Driveshaft

Refer to Section 205-00 .

Indexing

For additional information, refer to Section 205-00 .

Runout and Balance

For additional information, refer to Section 205-00 .

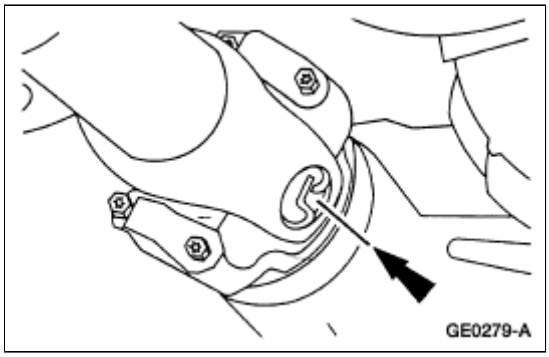
Driveshaft —Front

Material

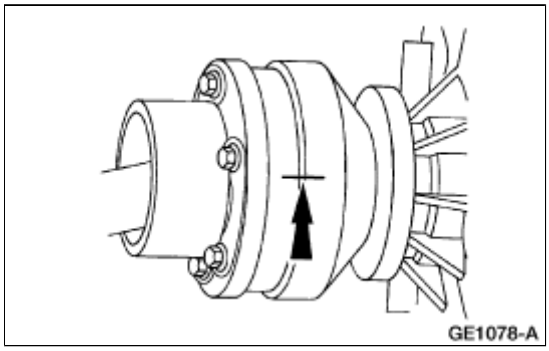
Item	Specification
Threadlock and Sealer EOAZ-19554-AA or equivalent	WSK-M2G351-A5

Removal

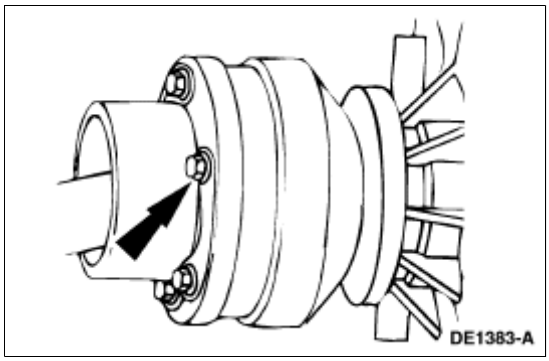
1. With the vehicle in NEUTRAL, raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Index-mark the front axle pinion flange and the front driveshaft.



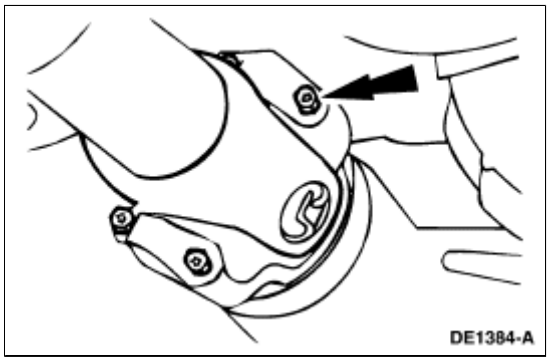
3. Index-mark the front output shaft assembly and the front driveshaft constant velocity (CV) joint.



4. Remove and discard the bolts and washers.



5. Remove and discard the bolts and universal joint retainers.

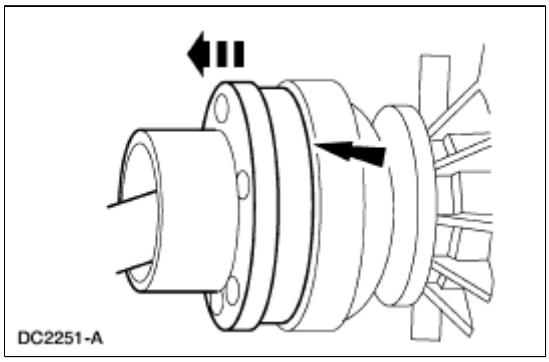


6. **CAUTION: Always disconnect the front driveshaft from the axle first. Carefully pull the driveshaft out of the CV joint housing. Otherwise the weight of the driveshaft can pinch the boot between the shaft and the boot can and cause the boot to tear.**

   CAUTION: Tape the bearing cups to the driveshaft to prevent them from falling off of the spider.

   NOTE: The front driveshaft CV joint is not repairable.

   Remove the driveshaft.

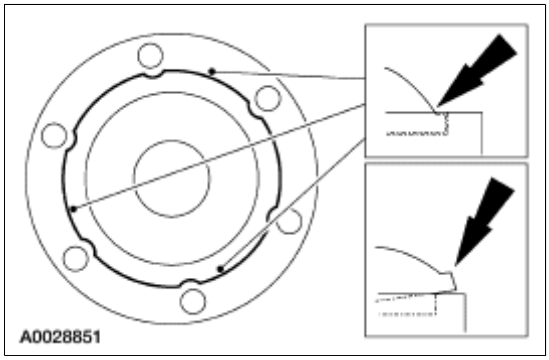


Installation

1. **CAUTION: The can (domed CV joint housing cover) is pressed into the CV joint housing**

at the factory. When housed correctly, the can will appear as shown in the cut-away illustration, top box. Do not reseat the can in the CV joint housing if the can's flange is above the CV joint housings shown in the cut-away illustration, bottom box. Install a new driveshaft.

Verify that the can flange is housed correctly in the CV joint housing as shown in the cut-away illustration, top box. Install a new driveshaft if the can flange is not housed correctly.



2. **CAUTION: Always connect the front driveshaft to the transfer case first. Otherwise the weight of the driveshaft can pinch the boot between the shaft and the boot can and cause the boot to tear.**

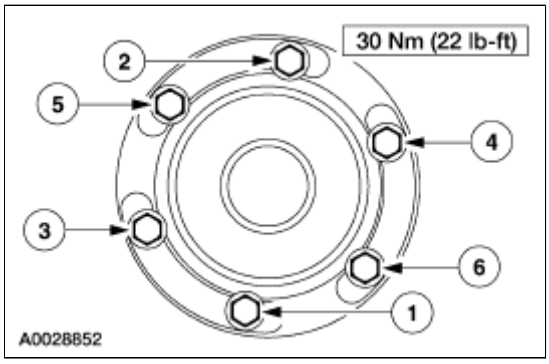
   NOTE: Align the index marks.

   Install the driveshaft.

3. **CAUTION: Tighten the bolts evenly in a cross pattern or damage will occur to the CV joint.**

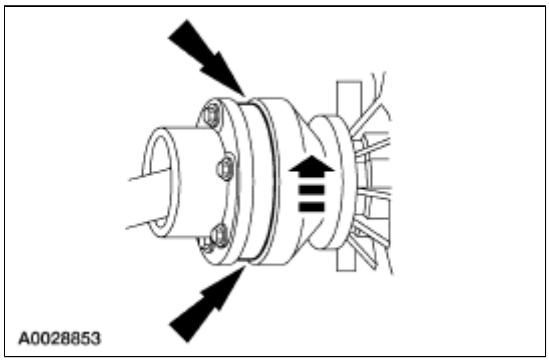
   NOTE: Install new washers and bolts. If new bolts are not available, coat the threads of the original bolts with threadlock and sealer.

   Install the new washers and bolts. Tighten the bolts evenly in a cross pattern as shown.



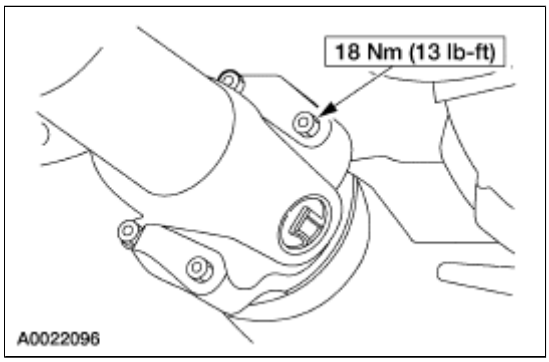
4. Verify that the CV joint has seated squarely in the transfer case flange.
   - Check that the space between the end of the CV joint cap and the end of the transfer case flange is equal from the top to the bottom of the two components.
   - Rotate the driveshaft 1/4 turn.
   - Check that the space between the end of the CV joint cap and the end of the transfer case flange is equal from the top of the bottom of the two components.

- Repeat this procedure several times.
- If the space is not equal at any point in the attachment, remove and reinstall the driveshaft as described in this procedure.



5. **NOTE:** Install new universal joint retainers and bolts. If new bolts are not available, coat the threads of the original bolts with threadlock and sealer.

   Install the new universal joint retainer and bolts.



6. Lower the vehicle.

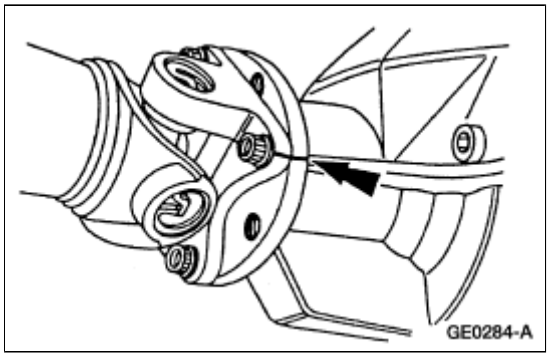
Driveshaft —Rear, 4x2

Removal

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 located in the rear jack storage area. 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.**

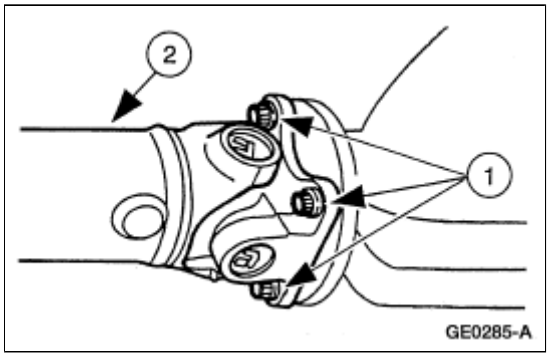
   With the vehicle in neutral, raise and support the vehicle; for additional information, refer to Section 100-02 .

2. Index-mark the driveshaft (4602) to driveshaft rear axle pinion flange.



3. **NOTE:** Index-mark the driveshaft slip yoke to the transmission output shaft.

   Remove the driveshaft.
   1. Remove and discard the four bolts, and disconnect the driveshaft.
   2. Lower the driveshaft, and slide the driveshaft rearward out of the transmission.
      - Plug the extension housing to prevent fluid loss.

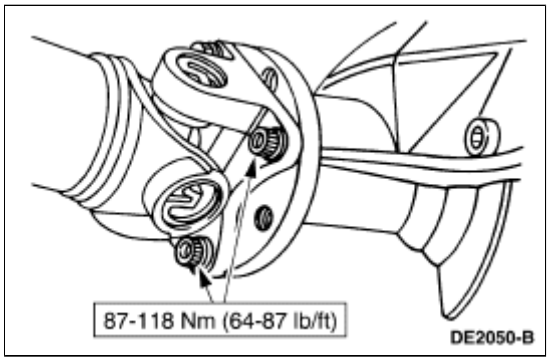


Installation

1. **NOTE:** Install new rear driveshaft-to-driveshaft rear axle pinion flange bolts. If new bolts are not available, coat the threads of the original bolts with Threadlock and Sealer EOAZ-19554-AA or

equivalent meeting Ford specification WSK-M2G351-A5.

To install, follow the removal procedure in reverse order.



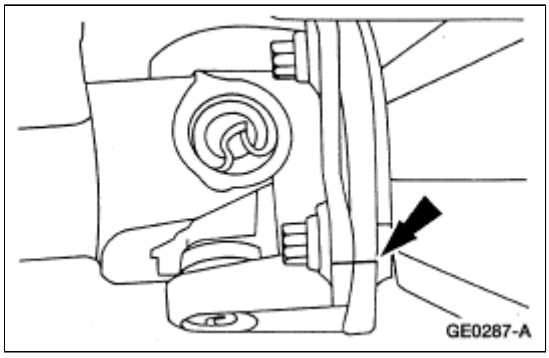
Driveshaft —Rear, 4x4

Removal

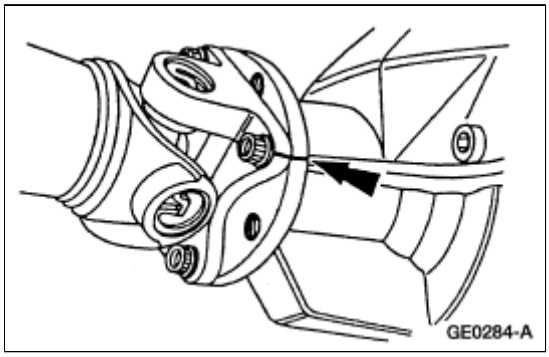
1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation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

   With the vehicle in NEUTRAL, raise and support the vehicle. For additional information, refer to Section 100-02 .

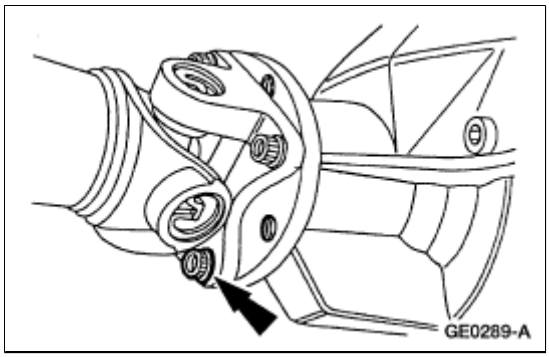
2. Index-mark the driveshaft yoke to the transfer case pinion flange.



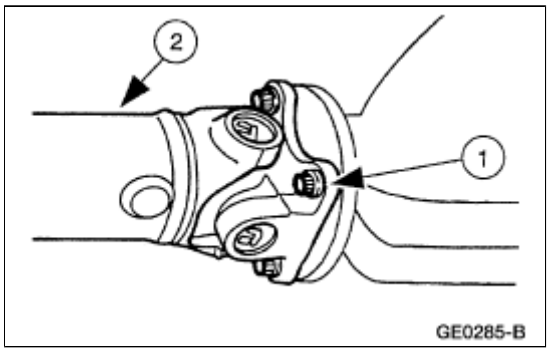
3. Index-mark the driveshaft (4602) to driveshaft rear axle pinion flange.



4. Remove the four rear bolts, and disconnect the rear driveshaft.



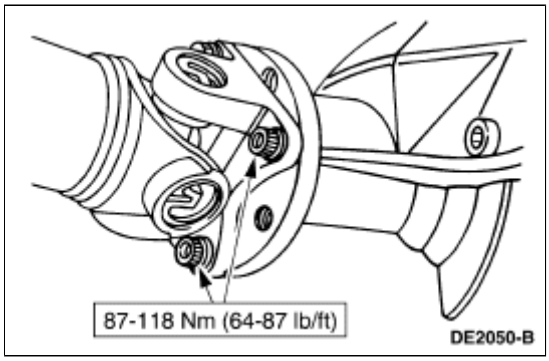
5. Separate the driveshaft from the transfer case.
    1. Remove the four bolts.
    2. Carefully remove the driveshaft.

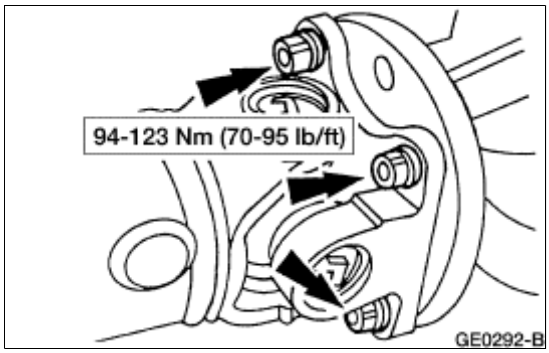


Installation

1. **NOTE:** Install new rear driveshaft-to-driveshaft rear axle pinion flange bolts and driveshaft flange yoke-to-transfer case bolts. If new bolts are not available, coat the threads of the original bolts with Threadlock and Sealer EOAZ-19554-AA or equivalent meeting Ford specification WSK-M2G351-A5.

   To install, follow the removal procedure in reverse order.




94-123 Nm (70-95 lb/ft)
GE0292-B

Driveshaft Slip Yoke

Special Tool(s)

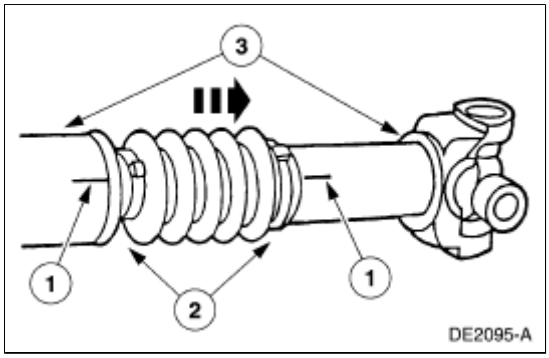
 ST1173-A	Installer, Keystone Clamp 211-002 (T63P-9171-A)

Disassembly

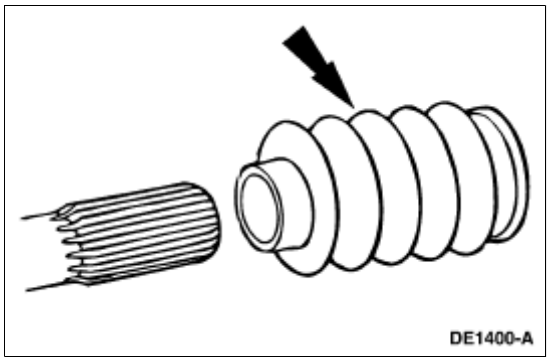
1. **CAUTION: Do not, under any circumstance, clamp the driveshaft (4602) in the jaws of a vise or similar holding fixture. Denting or localizing fracture can result, causing driveshaft failure during vehicle operation.**

   Place the driveshaft on a suitable workbench. Do not damage the tube.

2. Remove the driveshaft slip-yoke from the driveshaft.
   1. Index-mark the driveshaft and driveshaft slip-yoke.
   2. Cut and discard the driveshaft slip-yoke boot clamps (4K227).
   3. Remove the driveshaft slip-yoke from the driveshaft.



3. Remove the slip-yoke boot (4421) from the driveshaft.
   - Inspect the boot for damage. Discard the boot as necessary.

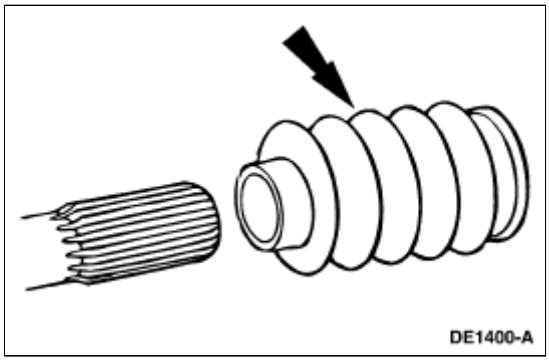


4. Inspect the lubricant on the driveshaft splines and in the driveshaft slip-yoke for contamination. If contaminated, inspect the driveshaft splines and the driveshaft slip-yoke for wear. Install new components as necessary.

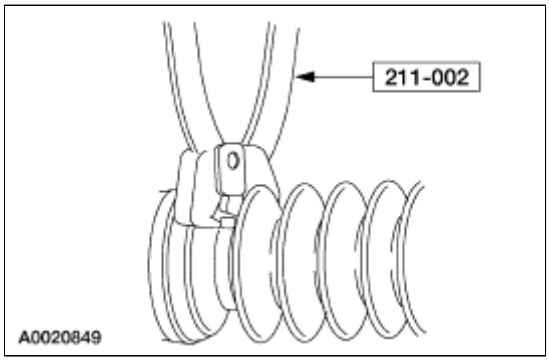
Assembly

1. Position the new small driveshaft slip-yoke boot clamp on the driveshaft stub shaft.

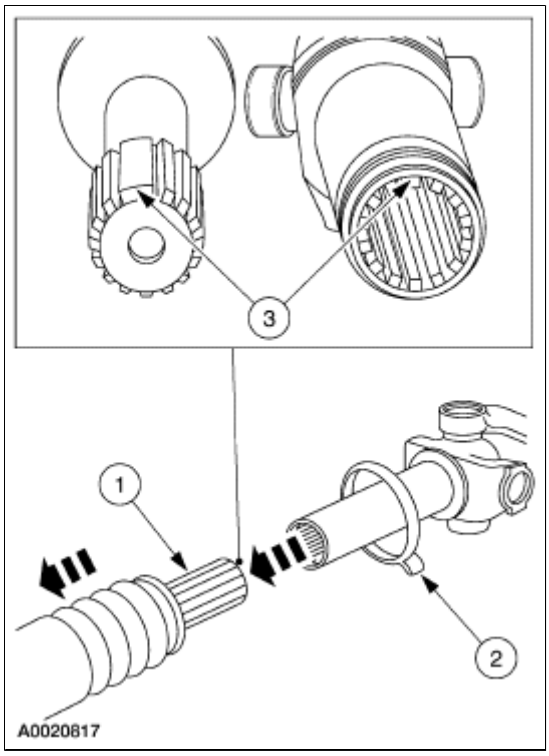
2. Slide the small opening end of the slip-yoke boot on the driveshaft stub shaft, as far as it will travel.



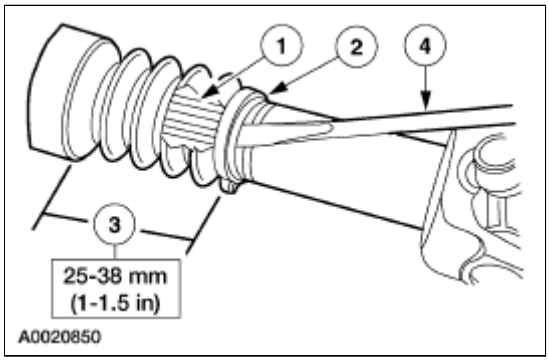
3. Using the special tool, crimp the driveshaft slip-yoke boot clamp.



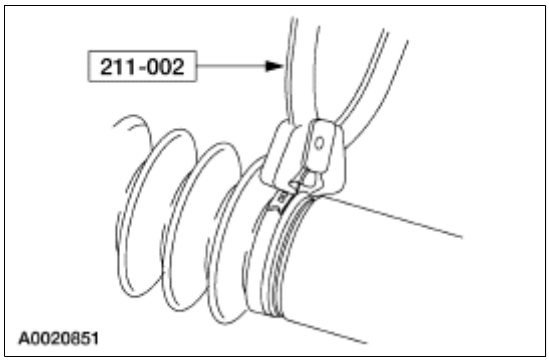
4. Install the driveshaft slip-yoke on the driveshaft.
    1. Pull the slip-yoke boot toward the driveshaft. Lubricate the driveshaft splines with approximately 10 grams (0.24 oz) of lubricant.
        - Use Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B.
    2. Position the new large slip-yoke boot clamp.
    3. Align the index-marks, and install the driveshaft slip-yoke on the driveshaft.



5. Set the driveshaft assembled length to specification.
    1. Remove any excess grease from the slip-yoke boot and driveshaft slip-yoke surfaces.
    2. Position the slip-yoke boot in the slip-yoke boot groove.
    3. Set the driveshaft assembled length to specification.
        - Measure from the stub shaft weld to the end of the driveshaft slip-yoke.
    4. Bleed the air from the slip-yoke boot.

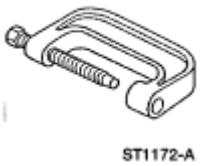


6. Using the special tool, crimp the large driveshaft slip-yoke boot clamp.


211-002
A0020851

Universal Joint —Single Cardan/Driveshaft

Special Tool(s)

 ST1172-A	C Frame & Screw 205-086 (T74P-4635-C)

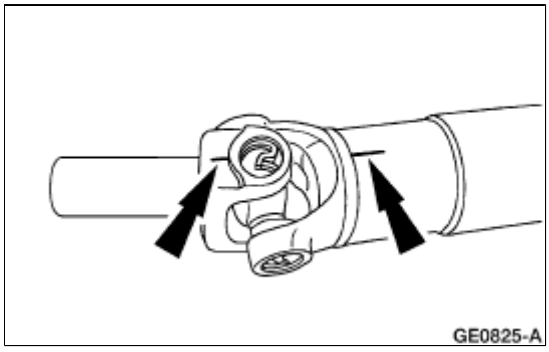
Disassembly

1. **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.**

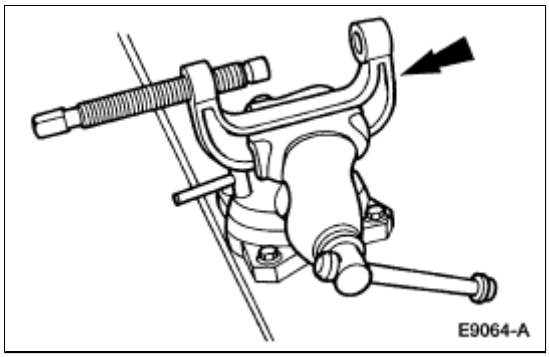
   Place the driveshaft (4602) on a suitable workbench. Be careful not to damage the tube.

2. **NOTE:** If components are not marked and therefore installed incorrectly, driveline imbalance can occur.

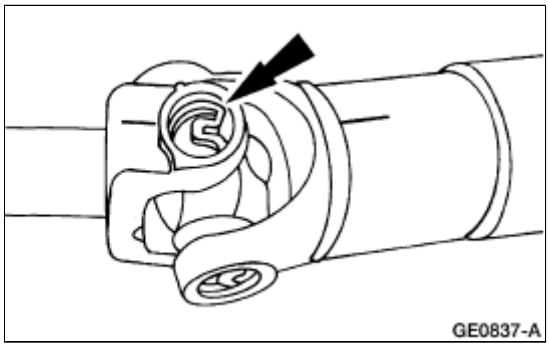
   Index-mark the driveshaft components.


GE0825-A

3. Clamp U-joint tool in a vise.

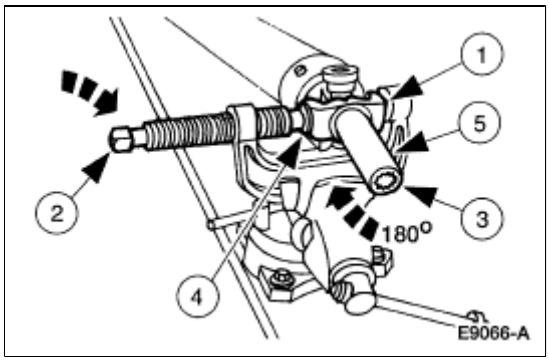


4. Remove all four of the snap rings.

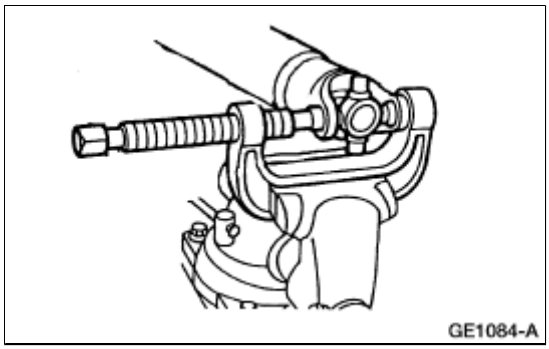


5. **NOTE:** If necessary, use a pair of pliers to remove a bearing cup if it cannot be pressed out all the way.

   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.



6. Repeat Step 5 to remove the remaining bearing cups and spider from the driveshaft.

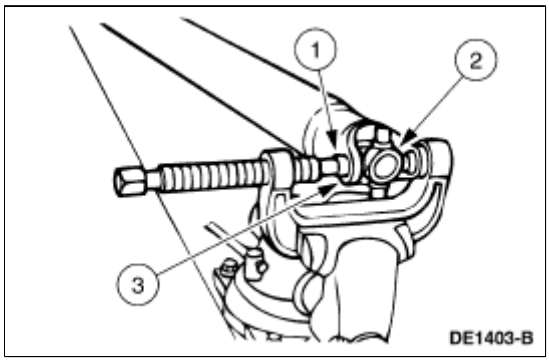


7. Clean the yoke area at each end of the driveshaft.

Assembly

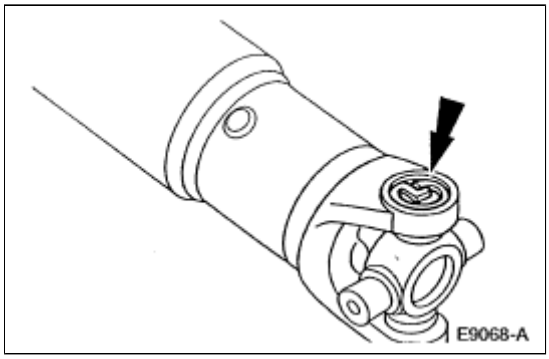
1. **NOTE:** Universal Joint Service Kits are to be installed as complete assemblies only. Do not mix components from other U-Joint Kits.

   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 U-joint 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.

   Remove the driveshaft from the U-joint tool, and install the snap ring.



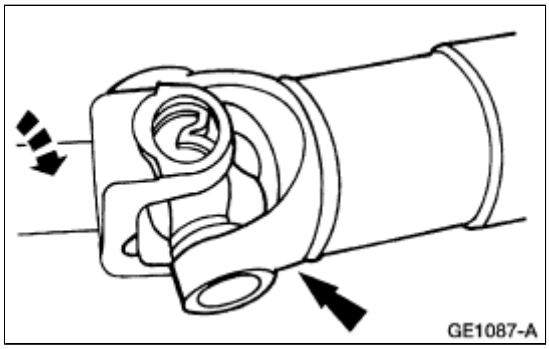
3. Repeat Steps 1 and 2 to install the opposite side of the driveshaft yoke.

4. Inspect the driveshaft slip-yoke. Install a new yoke, 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.

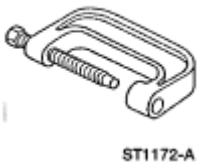
   Check the U-joints for freedom of movement.
   - If binding, strike the yoke with a brass or plastic hammer.



7. Install the driveshaft. For additional information, refer to the procedure in this section.

Universal Joint —Single Cardan/Flange Yoke

Special Tool(s)

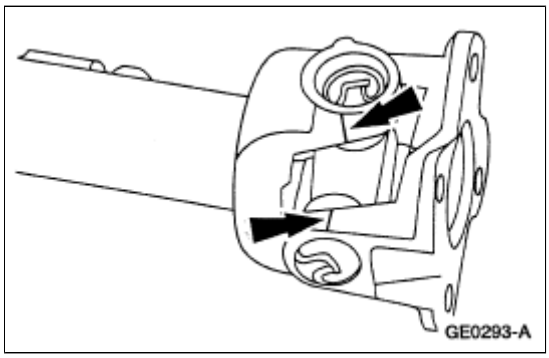
 ST1172-A	Installer/Remover, C Frame & Screw 205-086 (T74P-4635-C)

Disassembly

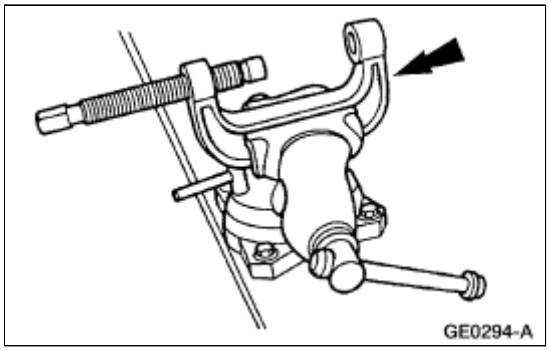
1. Remove the driveshaft. For additional information, refer to the procedure in this section.
2. **CAUTION: Do not clamp the driveshaft in a vise or similar holding fixture.**

   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.

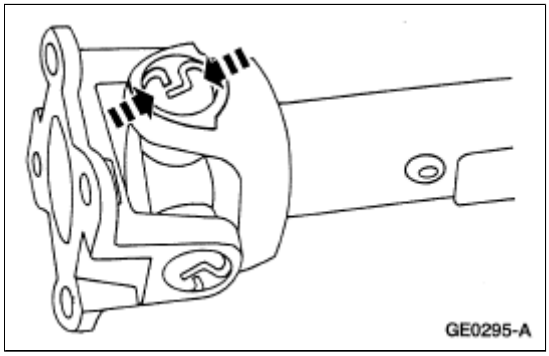
   Index-mark the positions of the driveshaft components.


GE0293-A

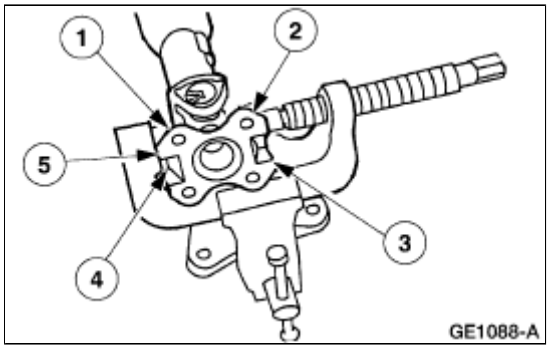
4. Clamp the U-joint tool in a vise.


GE0294-A

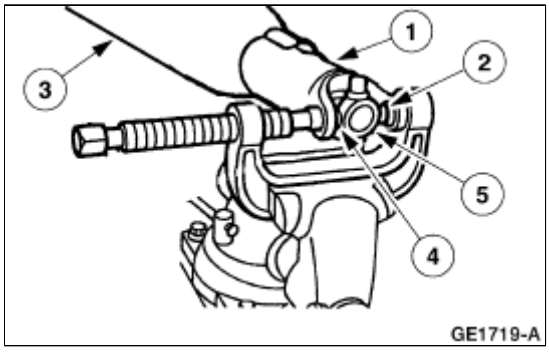
5. Remove all four of the snap rings.



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.

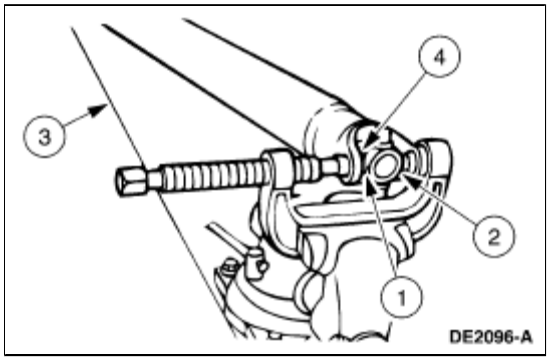


8. Clean the yoke area at the end of the driveshaft.

Assembly

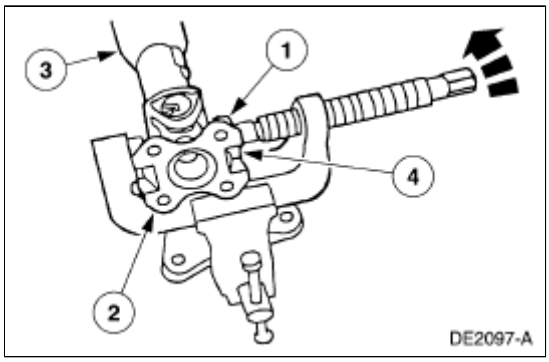
1. **NOTE:** Universal joint kits are to be installed as complete assemblies only. Do not mix components from other U-joint kits.

   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.



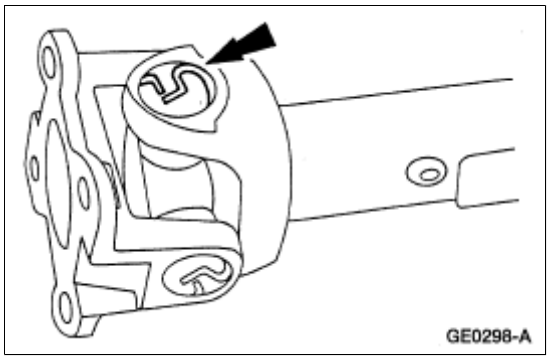
2. Inspect the driveshaft flange yoke. Install new if necessary.

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.



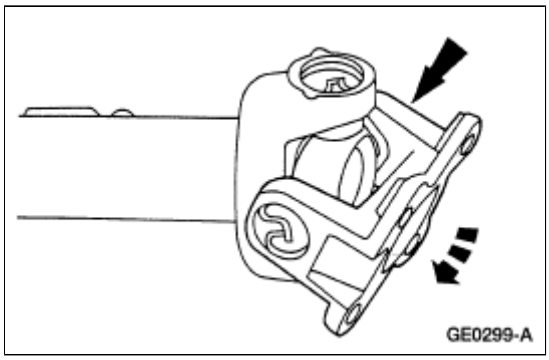
4. **NOTE:** Use the yellow snap rings supplied in the kit to assemble the universal joint (U-joint). If difficulty is encountered with the yellow snap rings, install the black snap rings.

   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.

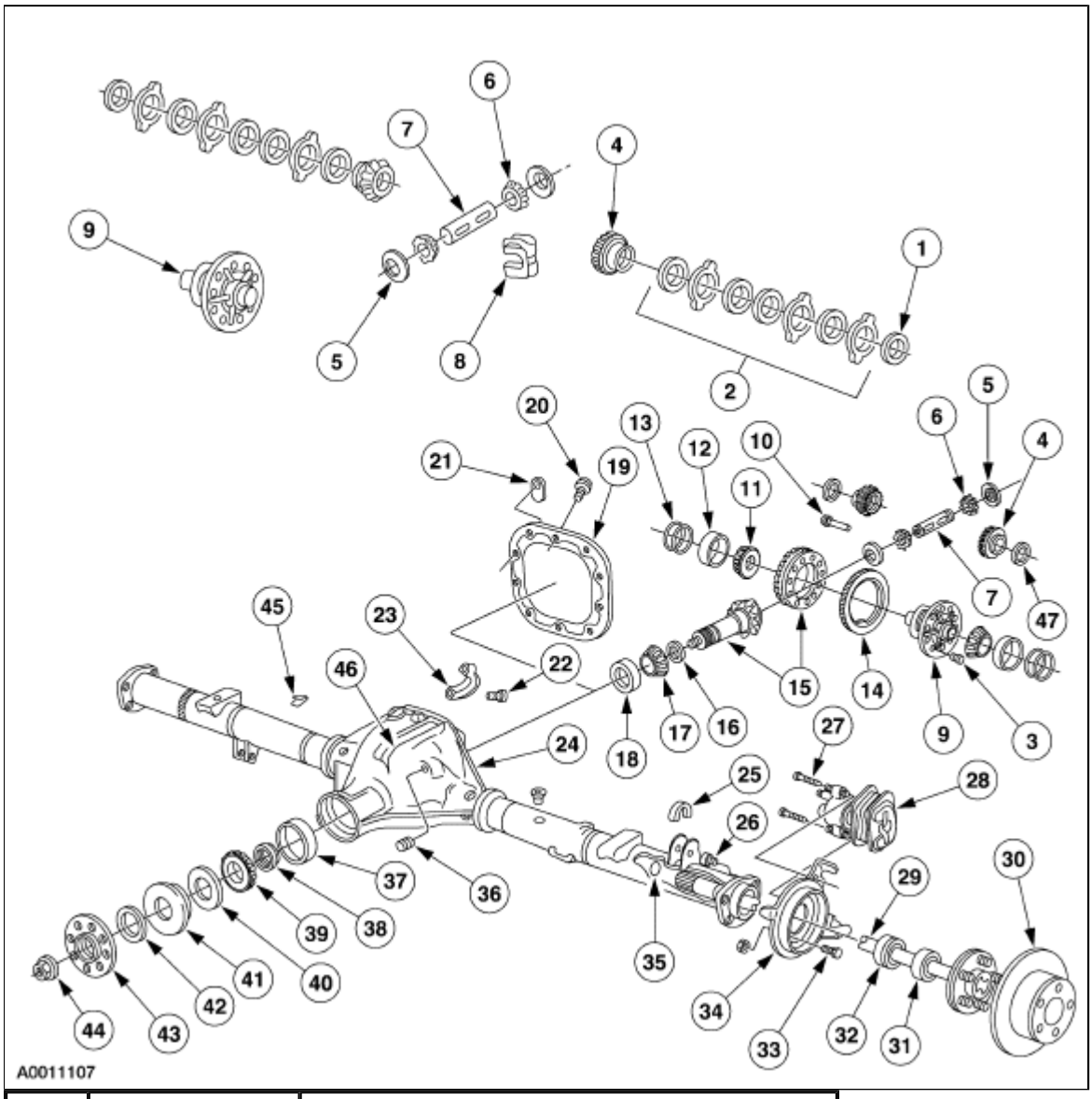
General Specifications

Item	Specification
Lubricants	
SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B (All with limited slip differential, and 5.0L)	WSL-M2C192-A
SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL (4.0L SOHC and EI with conventional differential)	WSP-M2C197-A
Ford Additive Friction Modifier C8AZ-19B546-A	EST-M2C118-A
Premium Long-Life Grease XG-1-C	ESA-M1C75-B
Capacity	
Approximate axle fill capacity	2.4L (5.5 pints) 6.4 mm (0.25 in)- 14.2 mm (0.56 in) below the fill hole
Sealants	
Clear Silicone Rubber D6AZ-19562-AA	ESB-M4G92-A
Threadlock and Sealer EOAZ-19554-AA	WSK-M2G351-A5
Adhesive	
Stud and Bearing Mount EOAZ-19554-BA	WSK-M2G349-A1
Clearance, Tolerance and Adjustments	
Maximum ring gear backface runout	0.102 mm (0.004 in)
Maximum differential case runout	0.076 mm (0.003 in)
Maximum axle shaft end play	0.762 mm (0.03 in)
Backlash between ring gear and pinion teeth	0.203 mm (0.008 in)- 0.381 mm (0.015 in) [0.305 mm (0.012 in)- 0.381 mm (0.015 in) preferred]
Maximum ring gear backlash variation between teeth	0.102 mm (0.004 in)
Maximum pinion runout	0.25 (0.010 T.I.R.)
RABS sensor air gap	0.127 mm (0.005 in)- 1.143 mm (0.045 in)

Torque Specifications

Description	Nm	lb-ft	lb-in
Differential bearing cap bolt	105	77	—
Differential pinion shaft lock bolt	30	22	—
Filler plug	30	22	—
Rear axle housing vent	11-24	8-18	—
Differential housing cover bolts	45	33	—
Rear spring plate nuts	115	85	—
Ring gear bolts	95-115	70-85	—
Differential clutch gauge nut	6.7	—	60
Pinion bearing preload (used pinion bearings)	0.9-1.5	—	8-14
Pinion bearing preload (new pinion bearings)	1.8-3.3	—	16-29
Brake hose junction block retaining bolt	7	—	62
Handle (pinion bearing preload simulation)	2.2	—	20
Initial minimum breakaway torque, Traction-Lok®	27	20	—

Rear Drive Axle and Differential



Item	Part Number	Description
1	4A324	Rear axle differential clutch shim
2	4947	Differential clutch pack
3	4216	Rear axle differential gear case bolt
4	4236	Differential side gear
5	4230	Differential pinion thrust washer
6	4215	Differential pinion gear
7	4211	Differential pinion shaft

8	4214	Differential clutch spring
9	4204	Differential case
10	4241	Differential pinion shaft lock bolt
11	4221	Differential bearing
12	4222	Differential bearing cup
13	4067	Differential bearing shim
14	4B409	Anti-lock speed sensor ring
15	4209	Ring gear and pinion
16	4663	Drive pinion bearing adjustment shim
17	4630	Pinion bearing (inner)
18	4628	Rear axle pinion bearing cup
19	4033	Differential housing cover
20	4346	Differential housing cover bolt
21	—	Rear axle identification tag
22	—	Bearing cap bolt (part of 4010)
23	—	Bearing cap (part of 4010)
24	4141	Rear axle differential carrier
25	4N237	U-washer
26	390317-S190	Bolt
27	N606046-S60	Bolt
28	2552	Rear disc brake caliper
29	4234	Axle shaft
30	2C026	Rear brake disc
31	1177	Wheel bearing oil seal
32	1225	Rear wheel bearing
33	—	Bolt (part of 2C220)
34	2C220	Rear disc brake adapter
35	4A332	Rear axle shaft O-ring
36	390943-S100	Filler plug
37	4616	Pinion bearing cup (outer)
38	4662	Collapsible spacer
39	4621	Pinion bearing (outer)
40	4670	Rear axle drive pinion shaft oil slinger
41	4676	Rear axle drive pinion seal
42	4859	Drive pinion oil seal deflector
43	4851	Pinion flange
44	389546-S100	Pinion nut
45	2251	Rear axle brake line clip

46	9E731	Vehicle speed sensor
47	4228	Differential side gear thrust washer

The rear axle assembly has the following features:

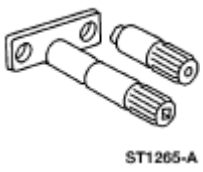
- An integral-type housing hypoid gear design (center of the pinion set below the centerline of the ring gear).
- The hypoid differential ring gear and pinion consists of a ring gear and an overhung drive pinion which is supported by two opposed tapered roller bearings.
- Pinion bearing preload is maintained by a collapsible spacer on the differential pinion shaft (4211) and adjusted by the pinion nut.
- The rear axle housing (4010) 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 differential pinion shaft is retained by a threaded differential pinion shaft lock bolt assembled to the differential case (4204)
- The differential case is mounted in the rear axle housing between two opposing differential bearings (4221) that are retained in the rear axle housing by removable bearing caps
- Use SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL or equivalent meeting Ford specification WSP-M2C197-A for 4.0L SOHC and 4.0L EI with a conventional differential.
- Use SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A for 4.0L SOHC and 4.0L EI with a limited slip differential and 5.0L.
- Differential bearing preload and ring gear backlash are adjusted by differential bearing shims located between the differential bearing cups and the rear axle housing.
- Rear axle identification is on an embossed metal tag bolted to the axle housing cover. For additional information, refer to Section 205-00 .

Rear Drive Axle and Differential

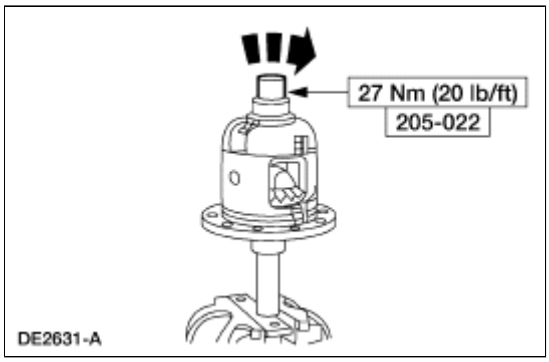
Refer to Section 205-00 .

Differential Bench Torque Test

Special Tool(s)

 ST1265-A	Traction-Lok® Torque Tool 205-022 (T66L-4204-A)

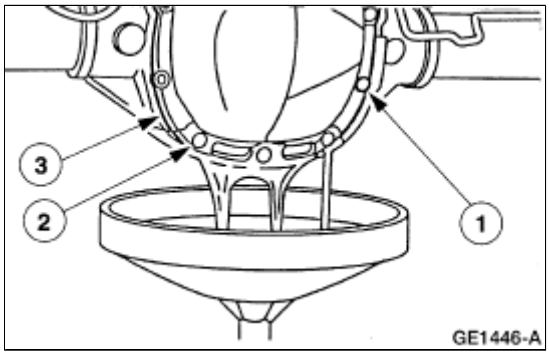
1. Check the torque required to rotate one differential side gear.
   - Mount the differential case and Traction-Lok® Torque Tool in a vise.
   - The initial minimum break-away torque, if original clutch plates are used, must be no less than the specification. The minimum rotating torque required to keep the differential side gear turning with new clutch plates may vary.
   - Refer to Section 205-00 .



Axle Shaft

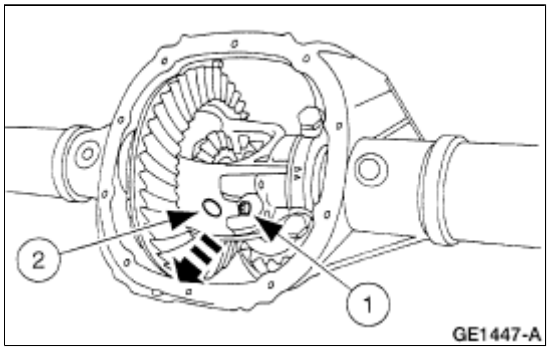
Removal

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 differential housing cover (4033).
   1. Loosen the bolts and drain the lubricant from the rear axle housing (4010).
   2. Remove the bolts.
   3. Remove the differential housing cover.



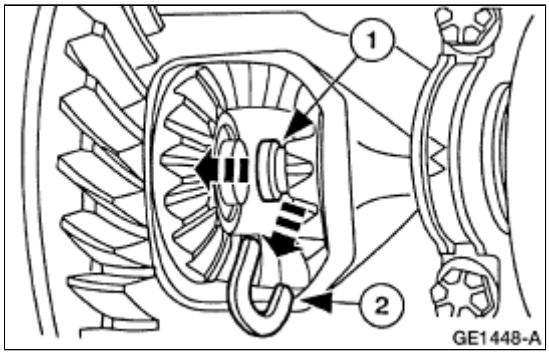
4. Remove the rear brake disc (2C026). For additional information, refer to Section 206-04 .
5. **CAUTION: Turning the differential case (4204) or an axle shaft (4234) with the differential pinion shaft (4211) removed will cause the differential pinion gears (4215) to fall out of the assembly and damage the components.**

   Remove the differential pinion shaft.
   1. Remove the differential pinion shaft lock bolt.
   2. Remove the differential pinion shaft.

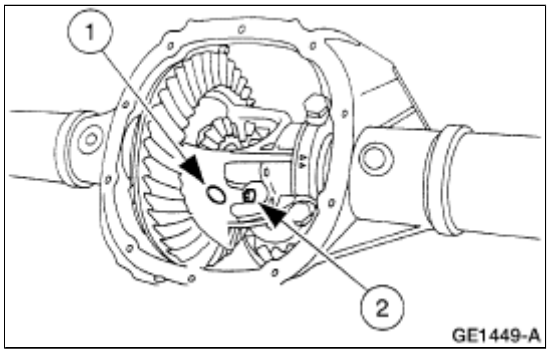


6. **CAUTION: Do not damage the rubber O-ring in the U-washer groove.**

Remove the U-washer (4N237).
1. Push the axle shaft inboard.
2. Remove the U-washer.

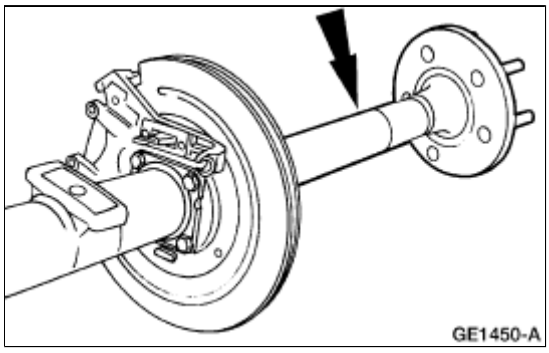


7. Reinstall the differential pinion shaft.
   1. Install the differential pinion shaft.
   2. Install the differential pinion shaft lock bolt finger-tight.



8. **CAUTION: Do not damage the wheel bearing oil seal (1177).**

   Remove the axle shaft.

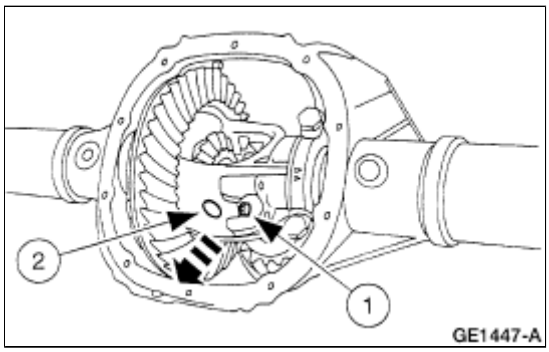


Installation

1. Lubricate the lip of the wheel bearing oil seal (1177).
   - Use Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B.

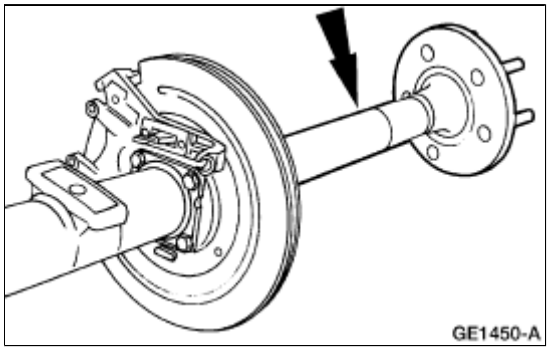
2. **CAUTION: Turning the differential case or an axle shaft with the differential pinion shaft removed will cause the differential pinion gears to fall out of the assembly and damage the components.**

   Remove the differential pinion shaft.
   1. Remove the differential pinion shaft lock bolt.
   2. Remove the differential pinion shaft.



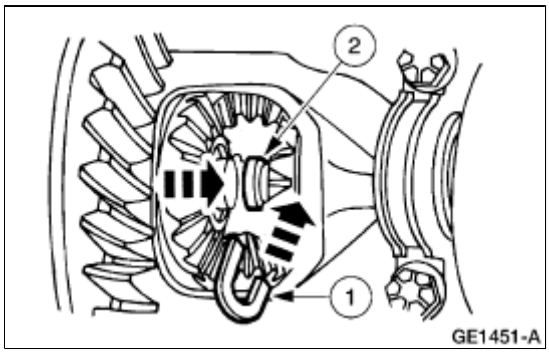
3. **CAUTION: Do not damage the wheel bearing oil seal.**

   Install the axle shaft.



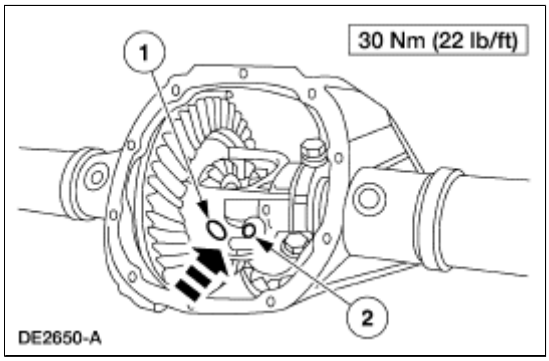
4. **CAUTION: Do not damage the rubber O-ring in the U-washer groove.**

   Install the U-washer.
   1. Position the U-washer on the button end of the axle shaft.
   2. Pull the axle shaft outward.



5. **CAUTION: 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.**

   Install the differential pinion shaft.
   1. Align the hole in the differential pinion shaft with the differential pinion shaft lock bolt hole.
   2. Install a new differential pinion shaft lock bolt.



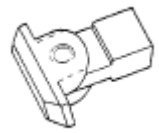
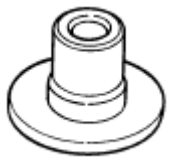
6. Install the rear brake disc. For additional information, refer to Section 206-04 .

7. Install the differential housing cover, and fill the rear axle housing (4010) with the specified lubricant type and quantity. For additional information, refer to Differential Housing Cover in this section.

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

Rear Wheel Bearing and Axle Shaft Oil Seal

Special Tool(s)

 ST1283-A	Axle Bearing Remover 205-193 (T83T-1225-A)
 ST2027-A	Axle Seal Replacer 205-190 (T83T-1175-A)
 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST1185-A	Impact Slide Hammer 100-001 (T50T-100-A)
 ST1322-A	Rear Axle Bearing Replacer 205-194 (T83T-1225-B)

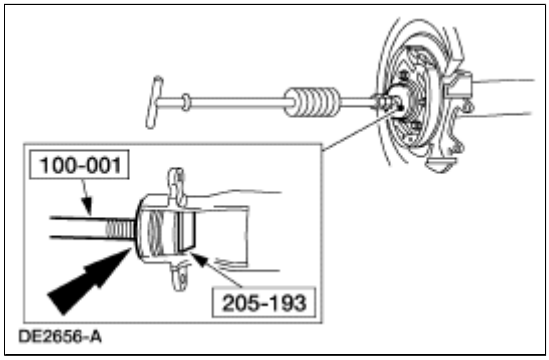
Removal

1. Remove the axle shaft (4334). For additional information, refer to Axle Shaft in this section.

2. **CAUTION: Never remove the wheel bearing oil seal (1177) by itself. Always remove the rear wheel bearing (1225) and the inner wheel bearing oil seal at the same time.**

   NOTE: If the wheel bearing oil seal is leaking, the axle housing vent may be plugged with foreign material.

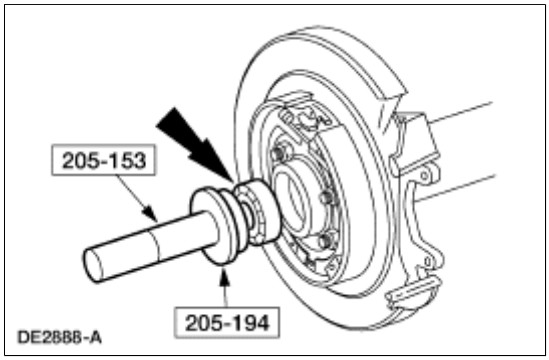
Using the special tools, remove the rear wheel bearing and wheel bearing oil seal together.



Installation

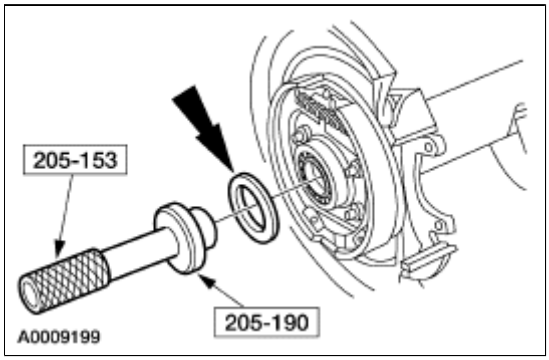
1. Lubricate the new rear wheel bearing.
   - For 4.0L SOHC and 4.0L EI with limited slip rear axles and 5.0L vehicles, use SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A.
   - For 4.0L SOHC and 4.0L EI with conventional rear axles, use SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL or equivalent meeting Ford specification WSP-M2C197-A.

2. Using the special tools, install the 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 wheel bearing oil seal.



5. Install the axle shaft. For additional information, refer to Axle Shaft in this section.

Drive Pinion Flange

Special Tool(s)

 ST2026-A	2-Jaw Puller 205-D072 (D97L-4221-A) or Equivalent
 ST1257-A	Companion Flange Holding Tool 205-126 (T78P-4851-A)
 ST1862-A	Companion Flange Replacer 205-002 (TOOL-4858-E) or Equivalent

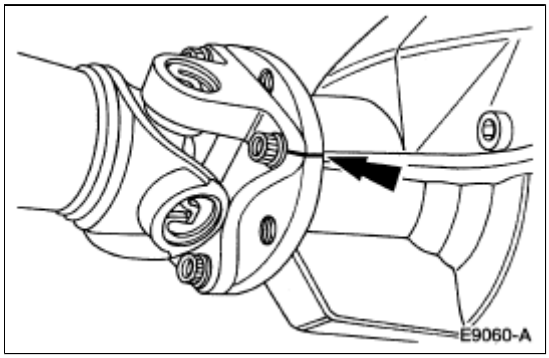
Removal

1. **CAUTION: Do not allow the calipers to hang from the brake hoses.**

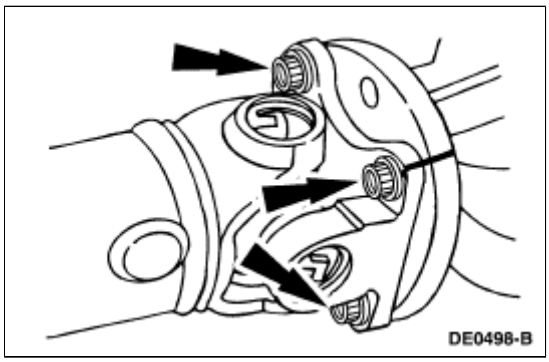
   NOTE: Remove the rear wheels and the rear disc brake calipers (2552) to prevent brake drag during the drive pinion bearing preload adjustment.

   Remove the rear disc brake calipers. For additional information, refer to Section 206-04 .

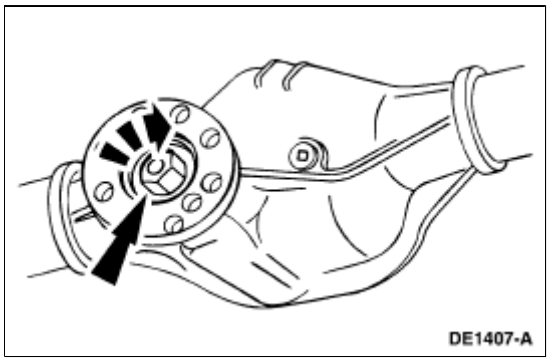
2. Index-mark the driveshaft flange and pinion flange (4851) to maintain initial balance during installation.



3. Remove the four bolts and disconnect the driveshaft.
   - Position the driveshaft aside.

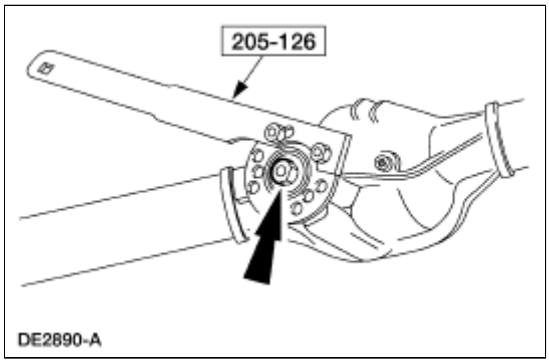


4. Install a Nm (inch-pound) torque wrench on the pinion nut, and record the torque necessary to maintain rotation of the pinion through several revolutions.

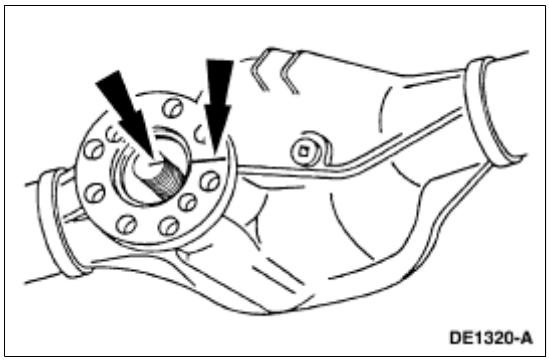


5. **CAUTION: After removing the pinion nut, discard it. Use a new nut for installation.**

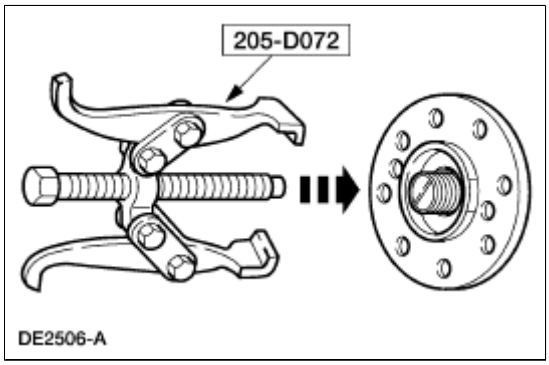
   Use the special tool to hold the pinion flange while removing the pinion nut.



6. Index-mark the pinion flange and the drive pinion stem to maintain initial balance during installation.



7. Using the special tool, remove the pinion flange.

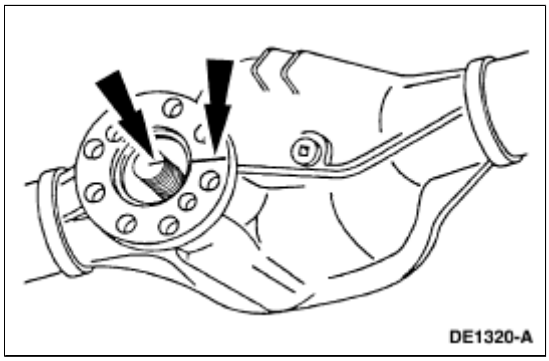


Installation

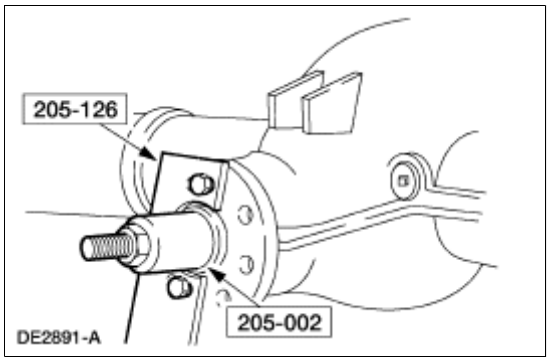
1. Lubricate the pinion flange splines.
   - For vehicles with 4.0L SOHC and 4.0L EI with Traction-Lok ® differentials and 5.0L, use Motorcraft Synthetic 75W140 Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A.
   - For vehicles with 4.0L SOHC and 4.0L EI with conventional differentials, use Thermally Stable Rear Axle Lubricant XY-80W90-QL or equivalent meeting Ford specification WSP-M2C197-A.

2. **NOTE:** Disregard the scribe marks if installing a new pinion flange.

   Align the pinion flange with the drive pinion shaft.



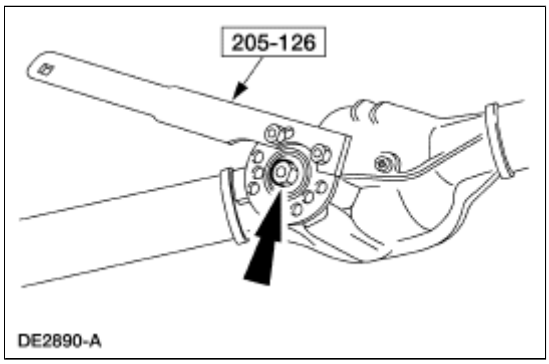
3. Using the special tools, install the pinion flange.



4. **CAUTION: Do not under any circumstance loosen the pinion nut to reduce preload. If it is necessary to reduce preload, install a new collapsible spacer (4662) and pinion nut.**

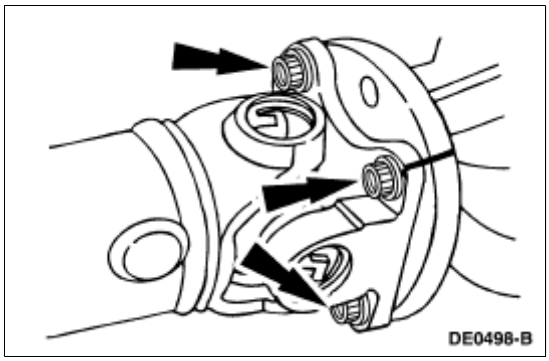
   CAUTION: Remove the special tool when taking preload readings with the Nm (inch-pound) torque wrench.

   Use the special tool to hold the pinion flange while tightening the pinion nut.
   - Rotate the pinion occasionally to make sure the pinion bearings (4630) (4621) seat correctly. Take frequent pinion bearing torque preload readings by rotating the 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 pinion nut to specification. If the preload recorded prior to disassembly is higher than the specification for used bearings, then tighten the pinion nut to the original reading as recorded.
   - Refer to the torque specification for used pinion bearings in the Specifications portion of this section.



5. **CAUTION: Be sure to align the index-marks.**

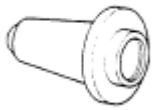
   Connect the driveshaft. For additional information, refer to Section 205-01 .



6. Install the rear disc brake calipers. For additional information, refer to Section 206-04 .
7. Install the rear wheel and tire assemblies. For additional information, refer to Section 204-04 .
8. Refer to Differential Housing Cover in this section for the specified axle lubricant type and fill capacity.

Drive Pinion Seal

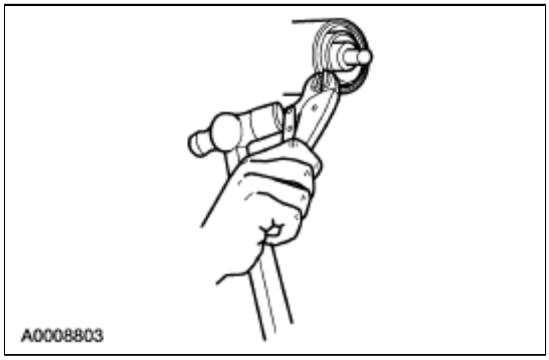
Special Tool(s)

 ST1325-A	Pinion Seal Replacer 205-208 (T83T-4676-A)

Removal

1. Remove the pinion flange (4851). For additional information, refer to Pinion Flange in this section.

2. Force up on the metal flange of the rear axle drive pinion seal (4676). Install gripping pliers and strike with a hammer until the rear axle drive pinion seal is removed.

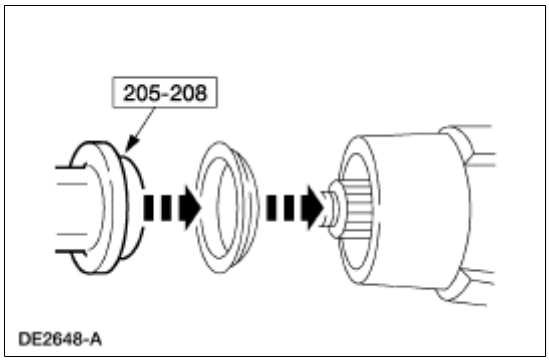


Installation

1. Lubricate the new rear drive pinion seal.
   - Use Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B.

2. **CAUTION: If the rear axle drive pinion seal becomes misaligned during installation, remove the rear axle drive pinion seal and install a new seal.**

   Using the special tool, install the rear axle drive pinion seal.

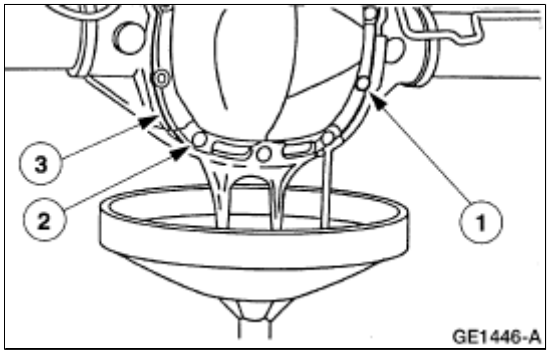


3. Install the pinion flange. For additional information, refer to Pinion Flange in this section.

Differential Housing Cover

Removal

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Remove the differential housing cover (4033).
    1. Loosen the bolts and drain the lubricant from the rear axle housing (4010).
    2. Remove the bolts.
    3. Remove the differential housing cover.



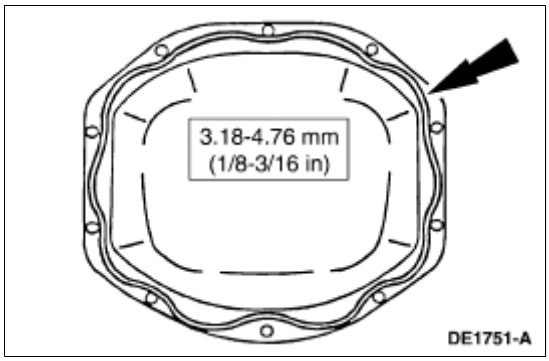
Installation

1. **CAUTION: Make sure the machined surface on the rear axle 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 rear axle housing and the differential housing cover gasket mating surfaces.

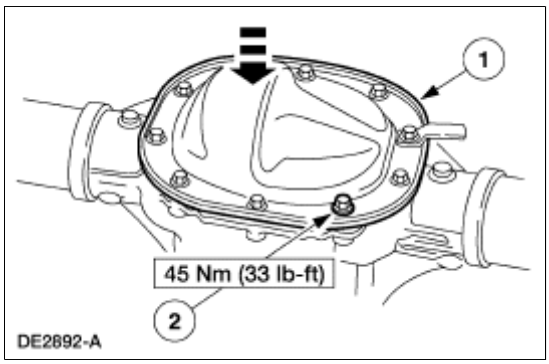
2. **CAUTION: Install the differential housing cover within 15 minutes of applying the silicone, or it will be necessary to remove and reapply new sealant.**

   Apply a new continuous bead of sealant to the differential housing cover.
    - Use 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.

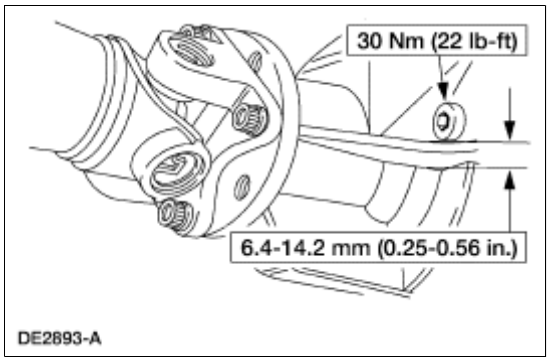
   Install the differential housing cover.
   1. Install the differential housing cover.
   2. Install the bolts.



4. **CAUTION: For Traction-Lok® axles, first fill the rear axle with 118 ml (4 oz) of Ford Additive Friction Modifier C8AZ-19B546-A or equivalent meeting Ford specification EST-M2C118-A.**

   NOTE: In-vehicle repair refill capacities are determined by filling the rear axle to the level shown.

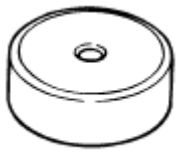
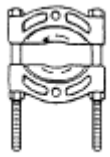
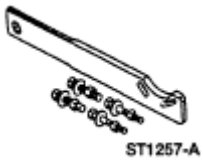
   Fill the rear axle.
   - For vehicles with 4.0L SOHC and 4.0L EI with Traction-Lok® rear axles and 5.0L, use 2.4 liters (5.5 pints) of SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A, and install the filler plug.
   - For vehicles with 4.0L SOHC and 4.0L EI with conventional rear axles, use 2.4 liters (5.5 pints) of SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL or equivalent meeting Ford specification WSP-M2C197-A.

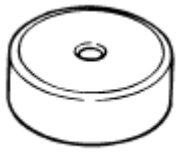
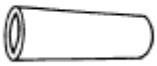
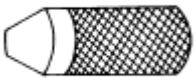
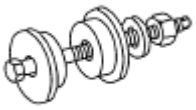
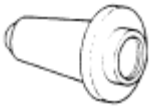


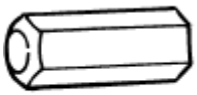
5. Lower the vehicle.

Drive Pinion

Special Tool(s)

 ST1743-A	Aligning Adapter 205-105 (T76P-4020-A3)
 ST1368-A	Bearing Puller 205-D064 (D84L-1123-A) or Equivalent
 ST1254-A	Bearing/Seal Service Plate 205-090 (T75L-1165-B)
 ST1257-A	Companion Flange Holding Tool 205-126 (T78P-4851-A)
 ST1862-A	Companion Flange Replacer 205-002 (TOOL-4858-E) or Equivalent
 ST1431-A	Gauge Block 205-110 (T76P-4020-A10)
	Gauge Disc 205-129 (T79P-4020-A18)

 ST1743-A	
 ST1434-A	Gauge Tube 205-130 (T79P-4020-A19)
 ST1432-A	Handle 205-111 (T76P-4020-A11)
 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST1653-A	Handle 205-D055 (D81L-4000-A) or Equivalent
 ST1367-A	Pinion Bearing Cone Replacer 205-005 (T53T-4621-C)
 ST1678-A	Pinion Bearing Cup Replacer 205-024 (T67P-4616-A)
 ST1325-A	Pinion Seal Replacer 205-208 (T83T-4676-A)
	Pinion Thread Protector 205-460

 ST1882-A	
 ST1429-A	Screw 205-109 (T76P-4020-A9)

Removal

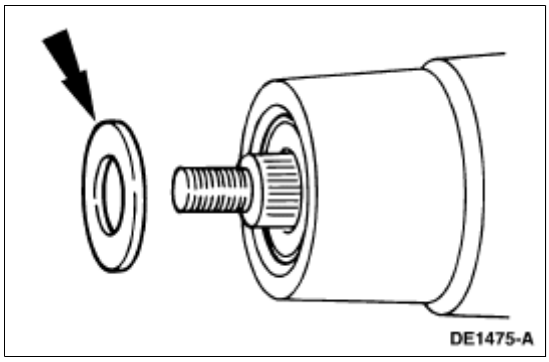
1. Remove the differential case (4204). For additional information, refer to Differential Case in this section.

2. **CAUTION: Record the torque necessary to maintain rotation of the pinion through several revolutions prior to removing the pinion flange (4851).**

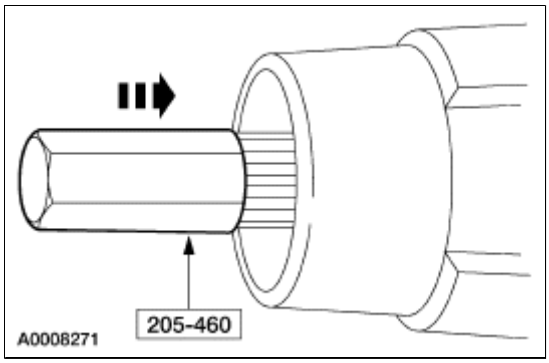
   Remove the pinion flange. For additional information, refer to Drive Pinion Flange in this section.

3. Remove the rear axle drive pinion seal (4676). For additional information, refer to Drive Pinion Seal in this section.

4. Remove the rear axle drive pinion shaft oil slinger (4670).

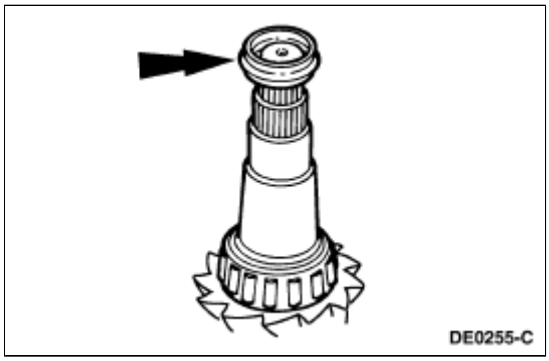


5. Using the special tool and a soft-faced hammer, drive the pinion assembly out of the outer pinion bearing (4621), and remove the pinion through the rear of the housing.

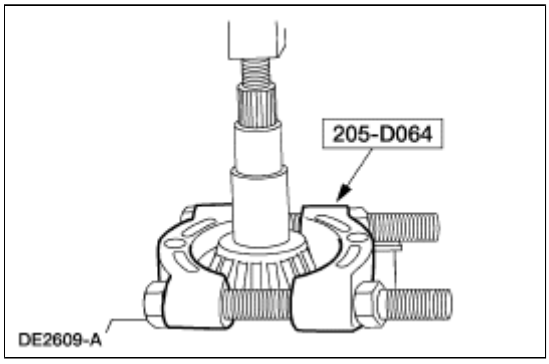


6. Remove the outer pinion bearing.

7. Remove and discard the collapsible spacer (4662).

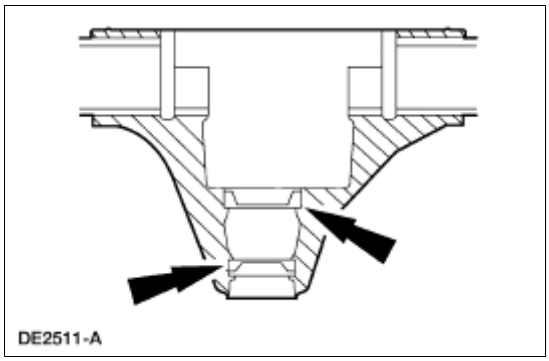


8. Using the special tool and a suitable press, remove the inner pinion bearing (4630).



9. **NOTE:** Do not remove the pinion bearing cups from the axle housing (4010) unless the cups are damaged.

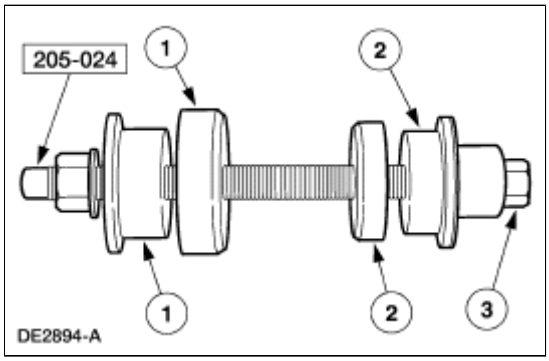
   To remove the bearing cups, tap alternately (with a brass drift of suitable length) on opposite sides of the cup to prevent the cup from cocking in the casting.



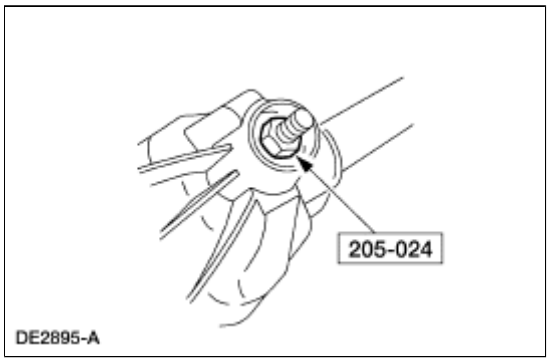
Installation

Using 205-024

1. Position the special tools and the inner and outer bearing cups in their respective axle housing bores.
    1. After placing the inner and outer bearing cups in their bores, place the special tool (inner) on the inner pinion bearing cup.
    2. Place the special tool (outer) on the outer pinion bearing cup.
    3. Install the special tool.

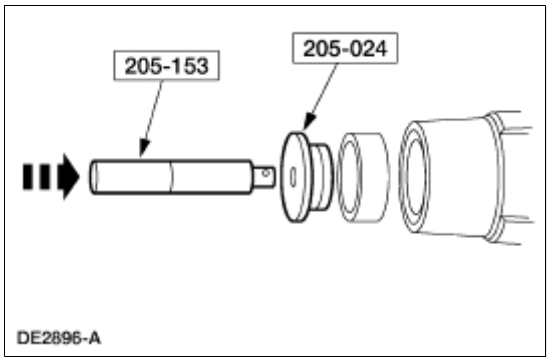


2. Tighten the special tool to seat the pinion bearing cups in their bores.

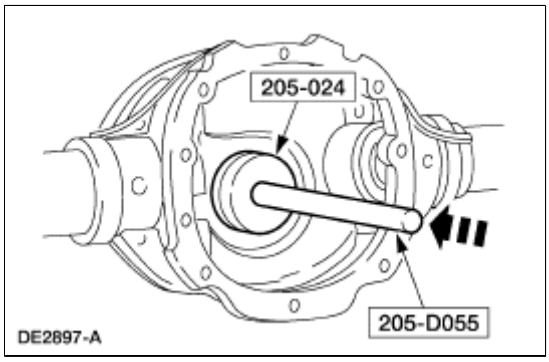


Using 205-153 and 205-D055

3. Using the special tools, drive the outer pinion bearing cup into the axle housing.



4. Using the special tools, drive the inner pinion bearing cup into the axle housing.

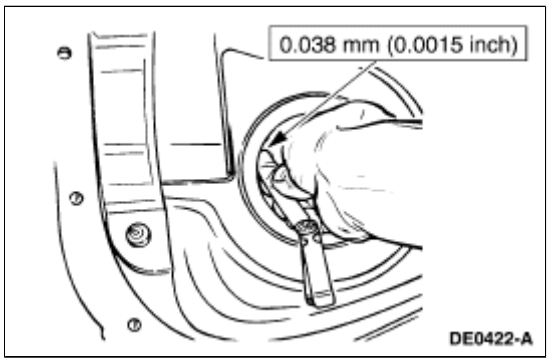


Setting pinion depth

5. **CAUTION: Always install new pinion bearings when installing new 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.

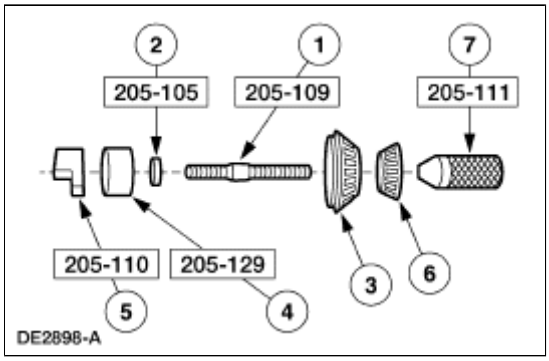
   Check that the cups have seated correctly in their bores.



6. **NOTE:** Apply only a light oil film on the pinion bearings before assembling the tools.

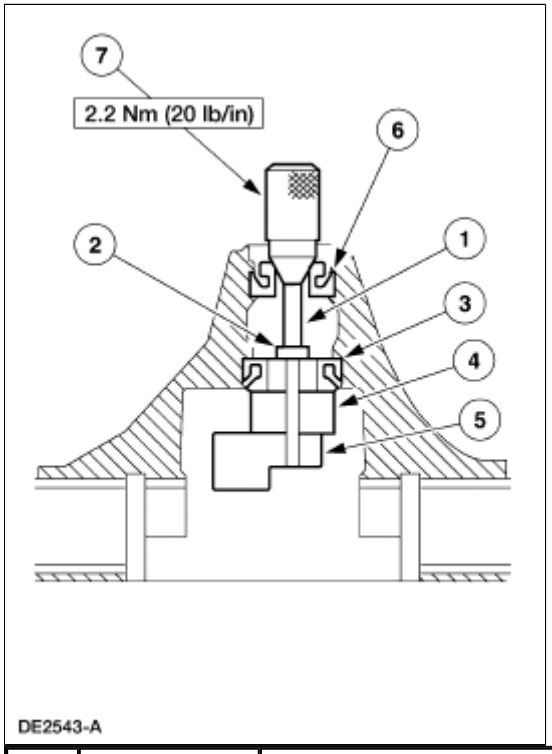
   Assemble and position the special tools and pinion bearings in the axle housing.
   1. Position the Screw.
   2. Position the Aligning Adapter.
   3. Position the inner pinion bearing.
   4. Position the Gauge Disc.

5. Position the Gauge Block.
6. Position the outer pinion bearing.
7. Thread on the Handle.



7. **NOTE:** This step simulates pinion bearing preload.

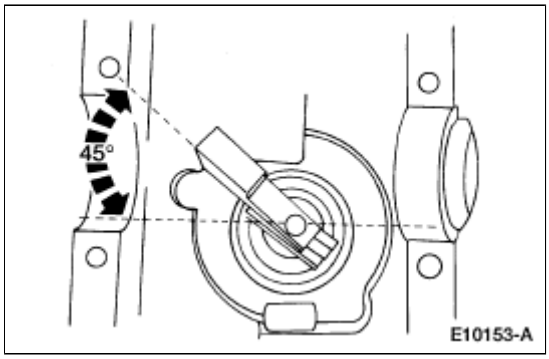
   Using a Nm (inch-pound) torque wrench, tighten the Handle to the specification.



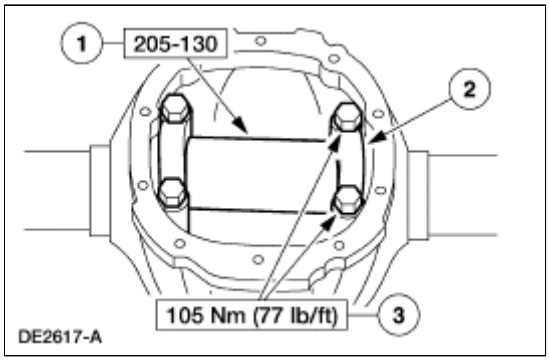
Item	Part Number	Description
1	205-109	Screw (T76P-4020-A9)
2	205-105	Aligning Adapter (1.612 inch O.D.) (T76P-4020-A3)
3	4630	Rear (inner) pinion bearing
4	205-129	Gauge Disc (1.1884 inch thick) (T79P-4020-A18)
5	205-110	Gauge Block (1.7 inch thick) (T76P-4020-A10)
6	4621	Front (outer) pinion bearing
7	205-111	Handle (T76P-4020-A11)

8. **NOTE:** Offset the Gauge Block to obtain an accurate reading.

   Rotate the Gauge Block several half-turns to make sure of correct seating of the pinion bearings and position the Gauge Block.



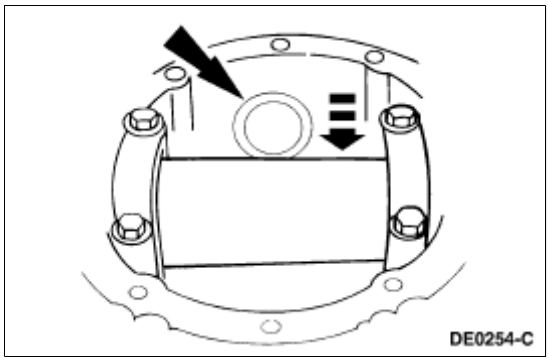
9. Install the special tool.
   1. Position the special tool.
   2. Install the bearing caps (4010).
   3. Install the four bolts.



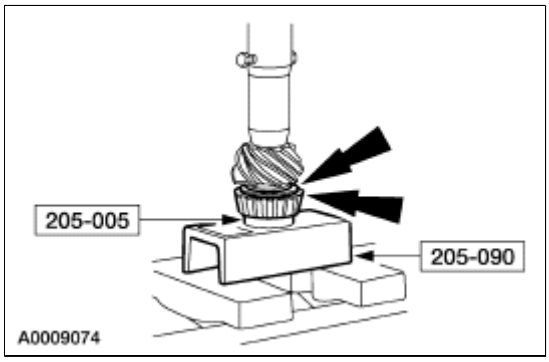
10. **NOTE:** Use only flat, clean drive pinion bearing adjustment shims.

    NOTE: Selection of too thick a pinion shim results in a deep tooth contact at final assembly of integral rear axle assemblies. Do not attempt to force the pinion shim between the Gauge Block and the Gauge Tube. A slight drag indicates correct shim selection.

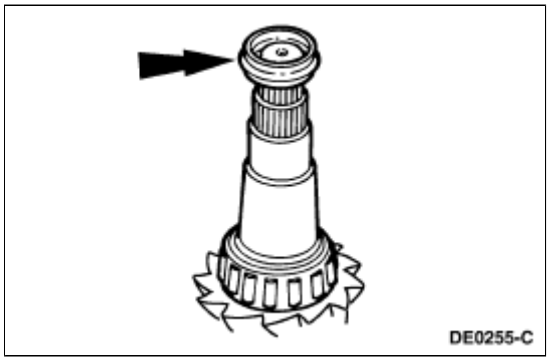
    Use a drive pinion bearing adjustment shim as a gauge for shim selection.
    - Check the pinion bearing adjustment shim thickness between the Gauge Block and the Gauge Tube.
    - After determining the correct shim thickness, remove the special tools.



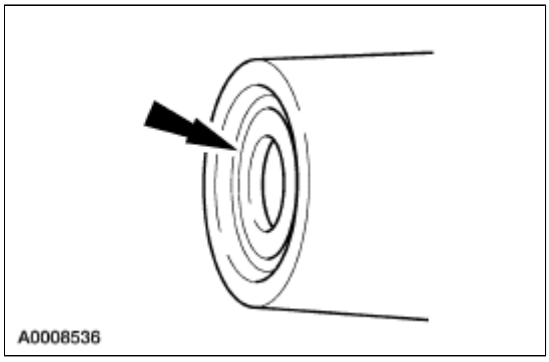
11. Using the special tool and a suitable press, seat the pinion bearing firmly against the pinion gear.



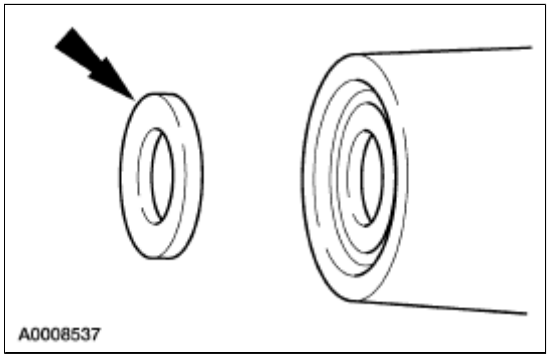
12. Place a new collapsible spacer on the pinion shaft against the pinion stem shoulder.



13. Install the outer pinion bearing.



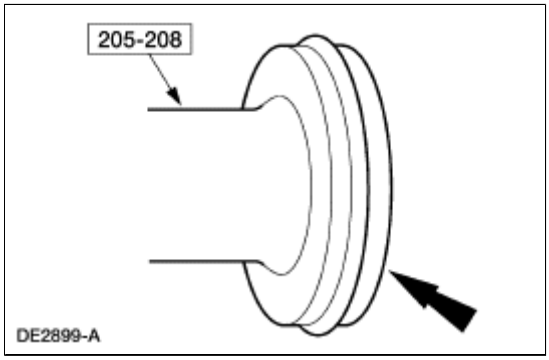
14. Install the rear axle drive pinion shaft oil slinger.



15. **CAUTION: Installation without the correct tool can result in early seal failure.**

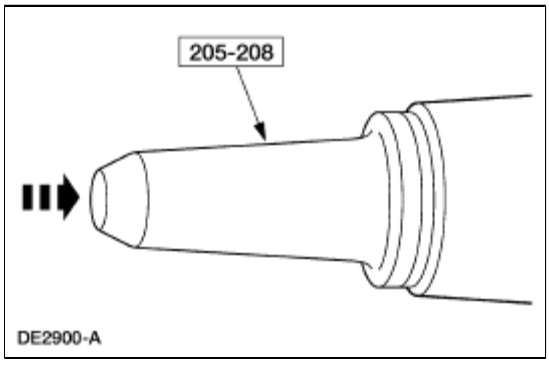
NOTE: Coat the lips of the rear axle drive pinion seal with Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B.

Place the rear axle drive pinion seal on the special tool.

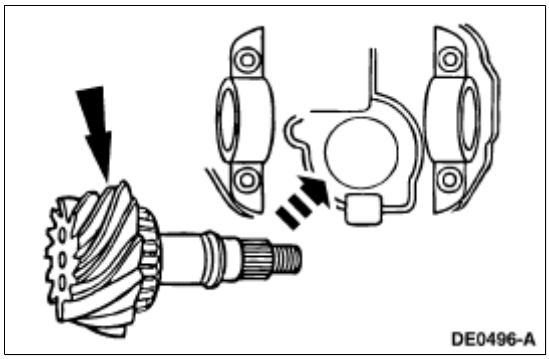


16. **CAUTION: If the rear axle drive pinion seal becomes cocked during installation, remove it and install a new one.**

Place the special tool and seal in the pinion seal bore and drive the rear axle drive pinion seal into place.



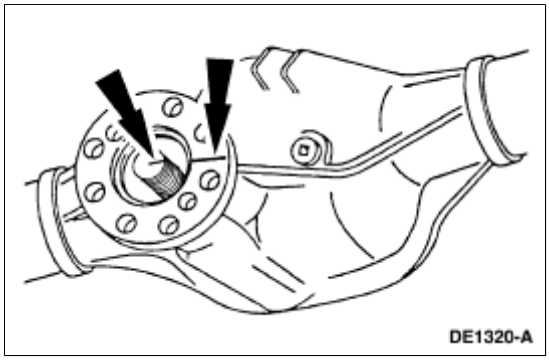
17. Install the pinion assembly (pinion, shims, inner pinion bearing, and collapsible spacer) into the rear axle housing bore.



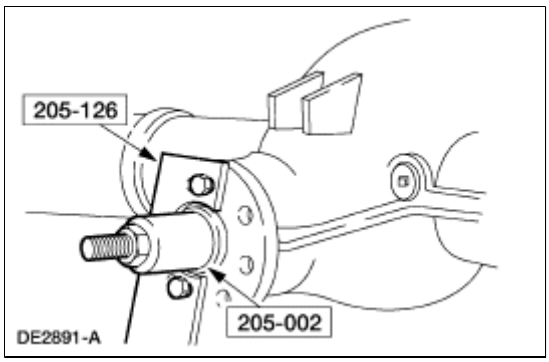
18. Lubricate the pinion flange splines.
    - Vehicles with 4.0L SOHC and 4.0L EI with a conventional differential, use SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL or equivalent meeting Ford specification WSP-M2C197-A.
    - Vehicles with 4.0L SOHC and 4.0L EI with Limited Slip differential and 5.0L, use SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A.

19. **NOTE:** Disregard the alignment marks if installing a new pinion flange.

    Align the pinion flange with the drive pinion shaft.



20. Using the special tools, install the pinion flange.

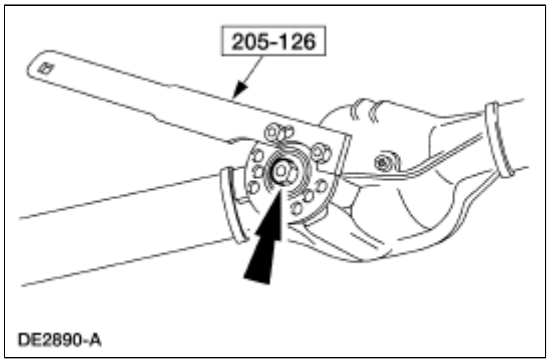


21. **CAUTION: Do not under any circumstance loosen the pinion nut to reduce preload. If it is necessary to reduce preload, install a new collapsible spacer and pinion nut.**

CAUTION: Remove the special tool when taking preload readings with the Nm (inch-pound) torque wrench.

Use the special tool to hold the pinion flange while tightening the pinion nut.

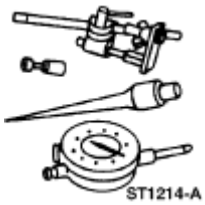
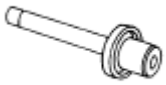
- Rotate the pinion occasionally to make sure the cone and roller bearings are seating correctly.
- Install a Nm (inch-pound) torque wrench on the pinion nut.
- Rotating the the pinion through several revolutions, take frequent cone and roller bearing torque preload readings until the original recorded preload reading is obtained.
- If the original recorded preload is lower than specifications, tighten to the appropriate specifications for used bearings. If the preload is higher than specification, tighten the nut to the original reading as recorded. Refer to the torque specification for new pinion bearings in the Specifications portion of this section.



22. Install differential case and the remaining components. For additional information, refer to Differential Case in this section.

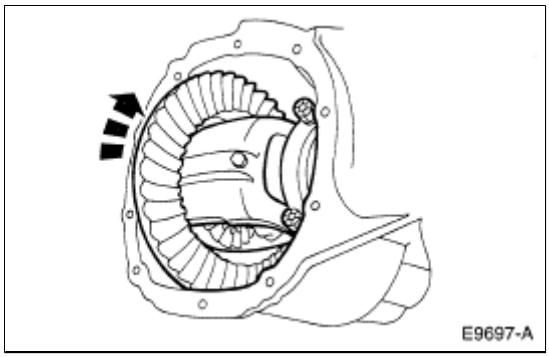
Differential Case

Special Tool(s)

 ST2026-A	2-Jaw Puller 205-D072 (D97L-4221-A) or Equivalent
 ST1214-A	Dial Indicator with Bracketry 100-002 (TOOL-4201-C) or Equivalent
 ST1375-A	Differential Side Bearing Replacer 205-010 (T57L-4221-A2)
 ST1485-A	Shim Driver 205-220 (T85L-4067-AH)
 ST1543-A	Step Plate 205-D016 (D80L-630-5) or Equivalent

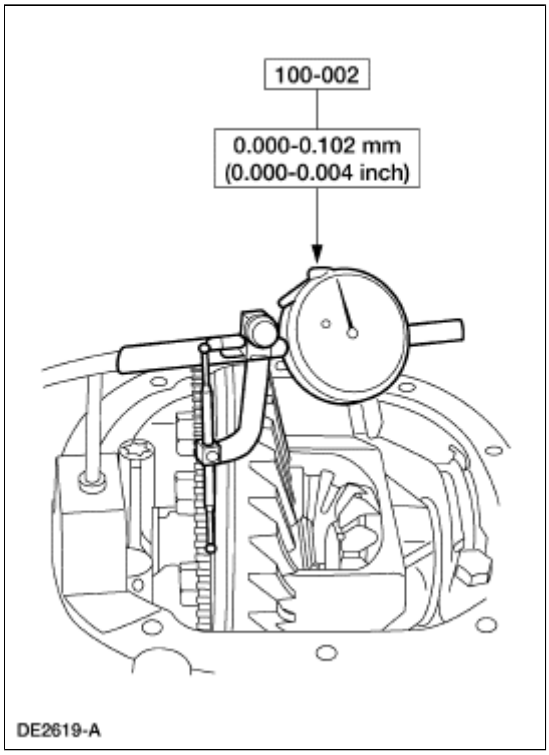
Removal

1. Remove the axle shafts (4234). For additional information, refer to Axle Shaft in this section.
2. Wipe the lubricant from the internal working parts and visually inspect the parts for wear and damage.
3. Rotate the differential case (4204) to see if there is any roughness which would indicate damaged bearings or gears.



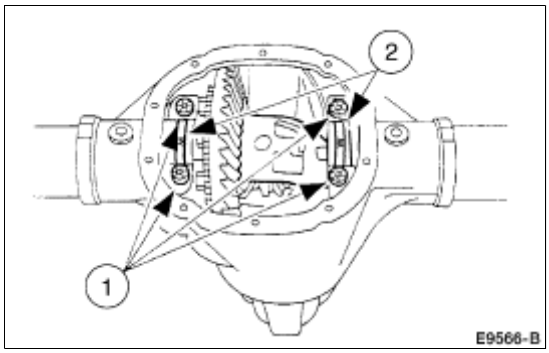
4. **NOTE:** There is a space between the anti-lock speed sensor ring and the ring gear for measuring ring gear backface runout.

   Position the special tool and check the ring gear backlash and ring gear backface runout.



5. **CAUTION: Mark the position of the bearing caps, as the arrows may not be visible. The bearing caps must be installed in their identical locations and positions.**

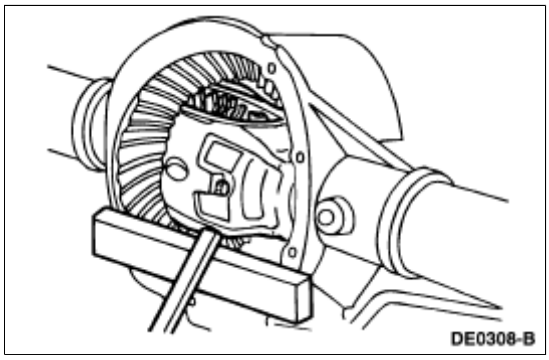
   Loosen the differential case.
   1. Remove the four bearing cap bolts.
   2. Remove the two bearing caps.



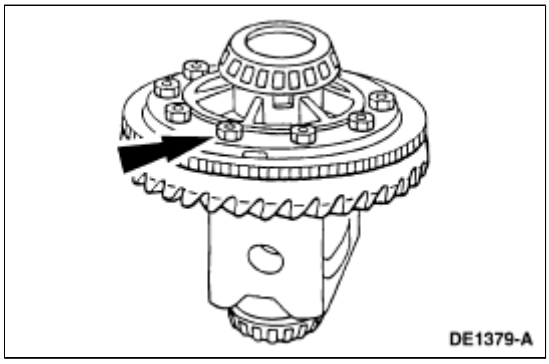
6. **WARNING: Be careful not to allow the differential case to fall.**

   CAUTION: Place a wood block between the pry bar and the rear axle housing (4010) to protect the machined surface from damage.

   Use the pry bar and the wood block to remove the differential case from the rear axle housing.



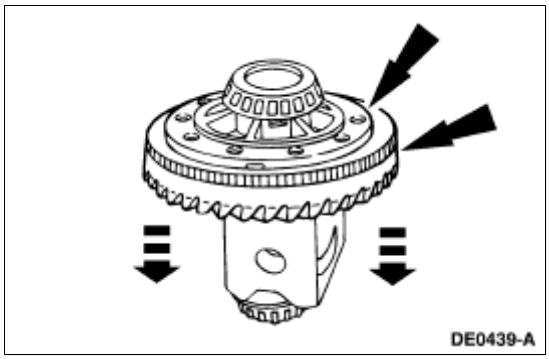
7. Remove the 10 ring gear bolts.



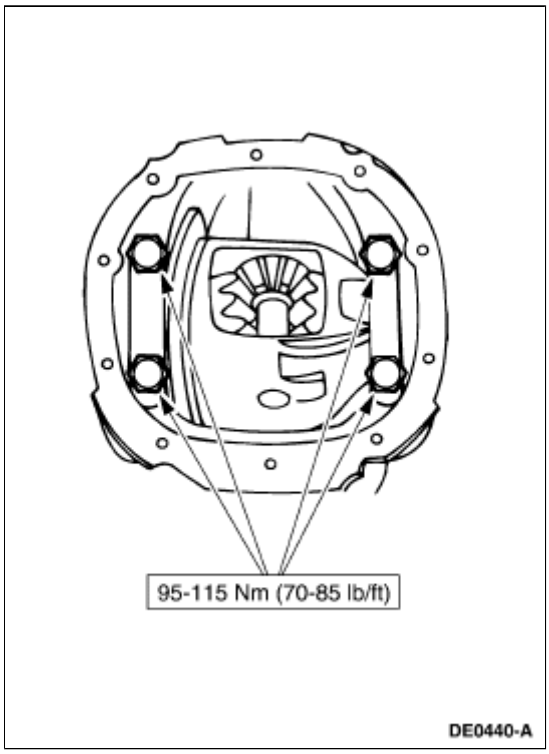
8. **CAUTION: Care should be taken not to damage the ring bolt hole threads.**

   CAUTION: The anti-lock speed sensor ring cannot be reused once removed.

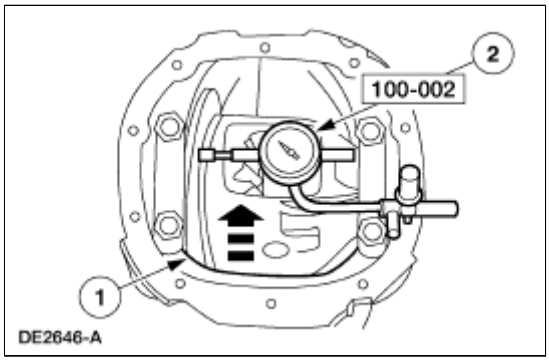
   Insert a punch in the bolt holes and drive off the ring gear and, if necessary, the anti-lock speed sensor ring.



9. Install the differential case.
   - Position the differential case assembly, including the bearing cups and shims, in the rear axle housing. Install the differential bearing caps and the differential bearing cap bolts.

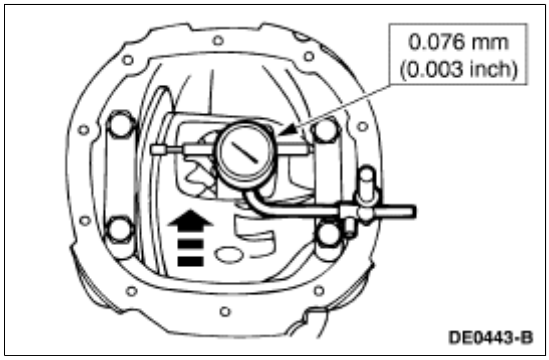


10. Position the special tool.
    1. Rotate the differential case to make sure the differential bearings (4221) are correctly seated.
    2. Position the special tool.

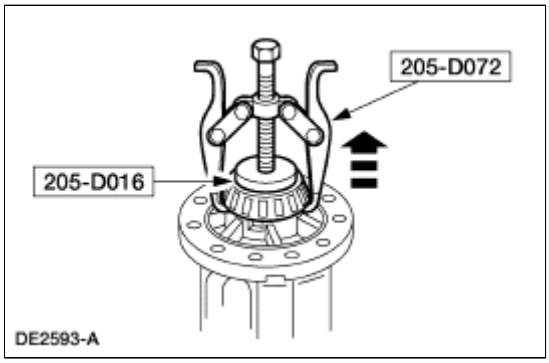


11. **NOTE:** If runout is less than the specification, install a new ring gear and pinion. If runout exceeds the specification, the ring gear is true and the concern is due to either a damaged differential case or differential bearings. Inspect the differential bearings. If the differential bearings are not damaged, install a new differential case and differential bearings.

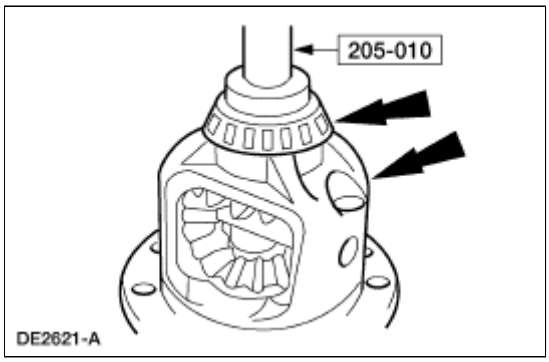
    Measure the differential case runout without the ring gear.



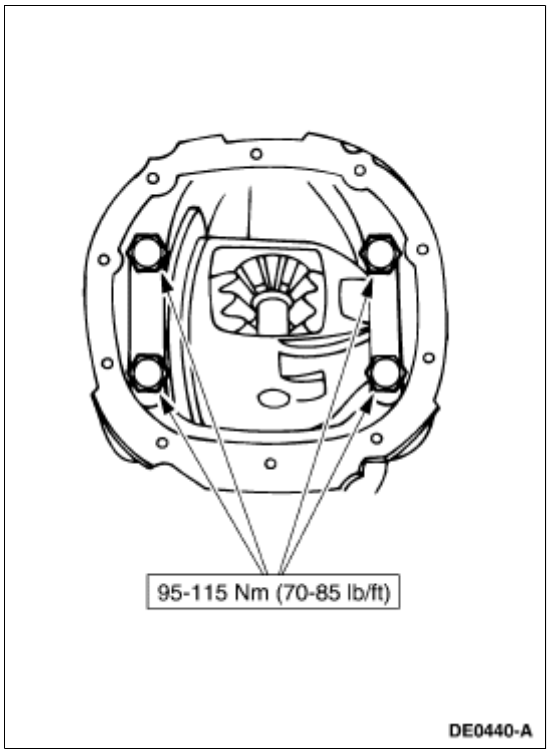
12. Remove the differential case from the rear axle housing and remove the differential bearings using the special tools.



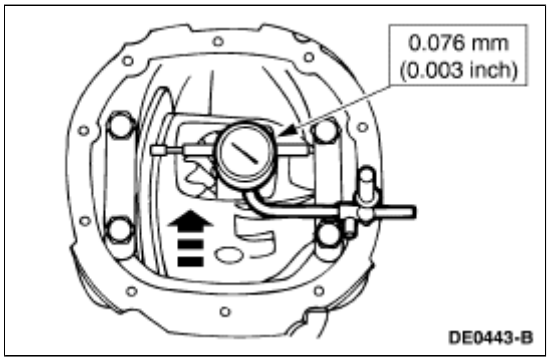
13. Use the special tool to install the new differential bearings on the differential case.



14. Install the differential case. Position the differential case assembly, including the bearing cups and shims in the rear axle housing. Tighten bearing caps to specifications.



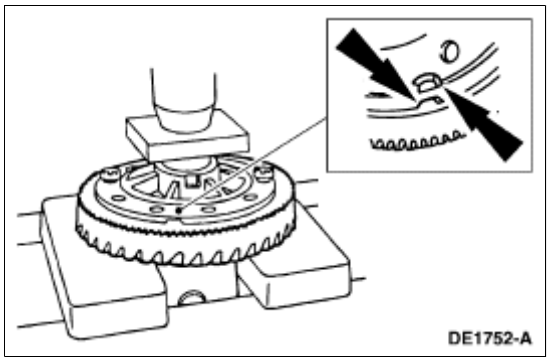
15. Measure the differential case runout without the ring gear, and check the case runout again with the new differential bearings.
    - If the runout is now less than the specification shown, use the new differential bearings for assembly.
    - If the runout is still excessive, the differential case is damaged and a new differential case must be installed.



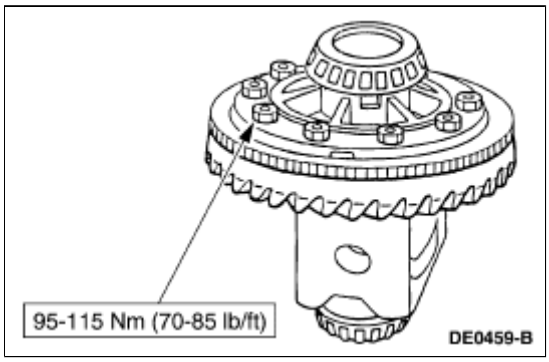
Installation

All vehicles

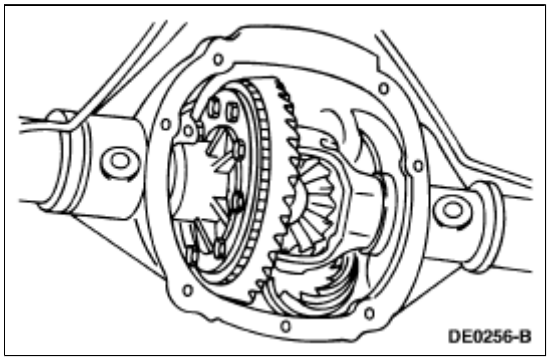
1. Press a new anti-lock speed sensor ring, if removed, and the ring gear on the differential case.
    - Align the notch on the differential case flange with the notch on the anti-lock speed sensor ring.



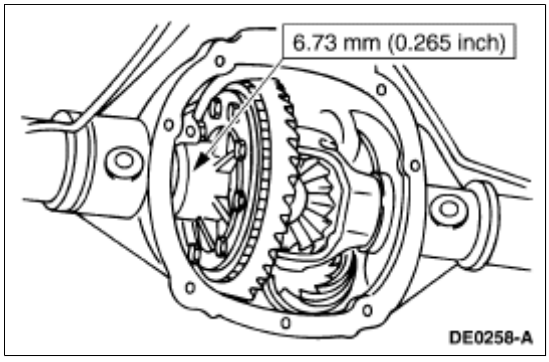
2. Install the ring gear bolts.
    - Apply Stud and Bearing Mount EOAZ-19554-BA or equivalent meeting Ford specification WSK-M2G349-A1 to ring gear bolts.



3. With pinion depth set and pinion installed, place the differential case in the rear axle housing.



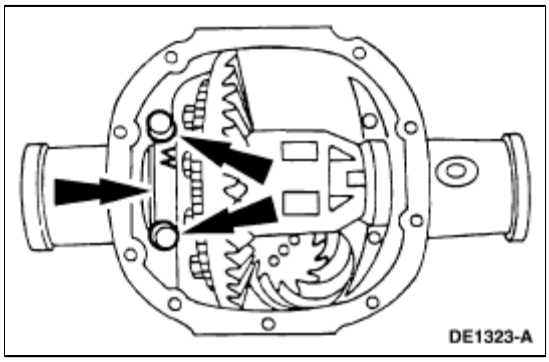
4. Install a shim on the left side.



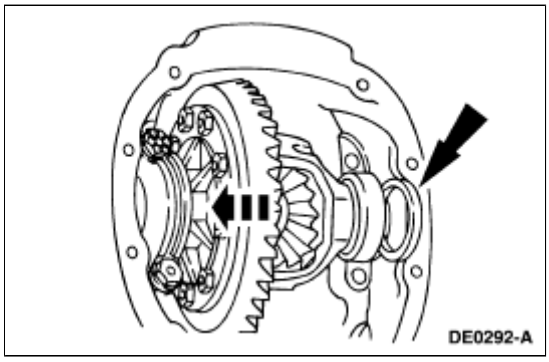
5. **CAUTION: Mark the position of the bearing caps as the arrows may not be visible. The bearing caps must be installed in their identical locations and positions.**

   NOTE: Apply pressure toward the left side to make sure the left bearing cap is seated.

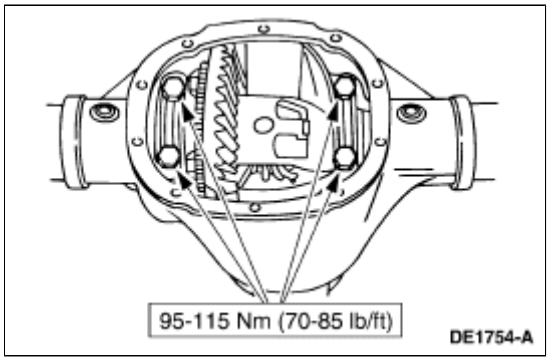
   Install the left bearing cap and loosely install the bearing cap bolts.



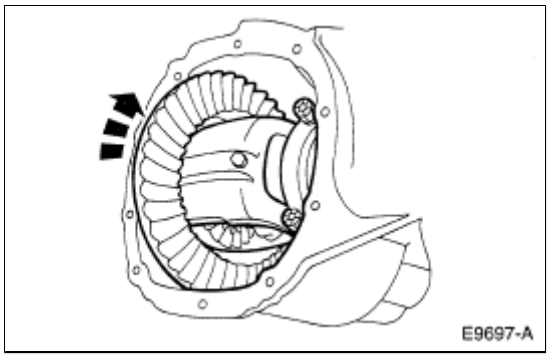
6. Install progressively larger shims on the right side until the largest shim selected can be assembled by hand.



7. Install the right side bearing cap and tighten the left side and right side bolts to specification.



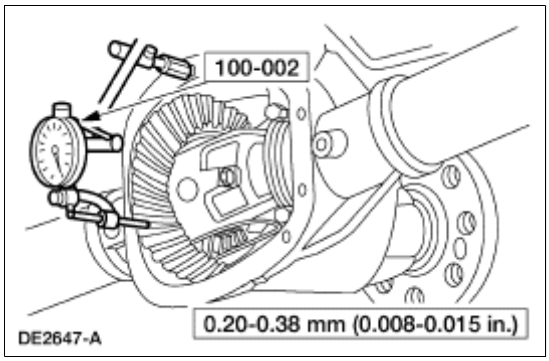
8. Rotate the differential case to make sure it rotates freely.



Measuring backlash

9. Use the special tool to measure the ring gear backlash.
    - If the backlash is within specification, go to Backlash within specification in this procedure.
    - If a zero backlash condition occurs, go to Zero backlash in this procedure.
    - If the backlash is not within specification, go 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

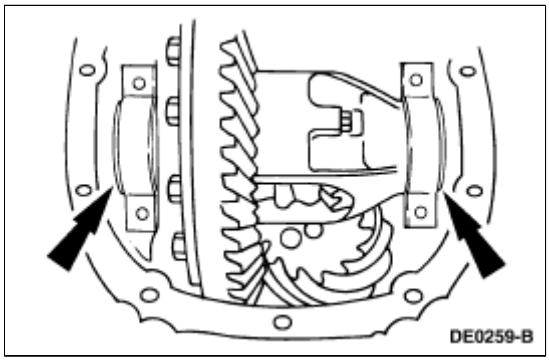


Zero backlash

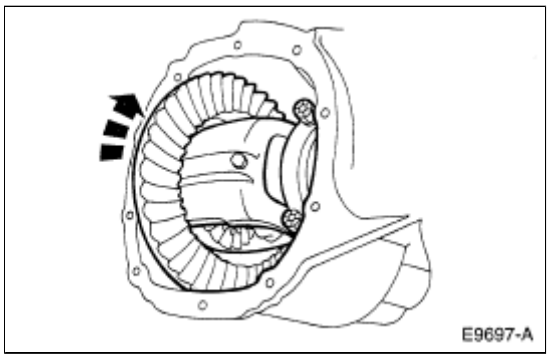
10. If a zero backlash condition occurs, add 0.51 mm (0.020 inch) to the RH side and subtract 0.51 mm (0.020 inch) from the LH side to allow backlash indication. Check the backlash. Repeat Measuring backlash in this procedure.

Backlash not within specification

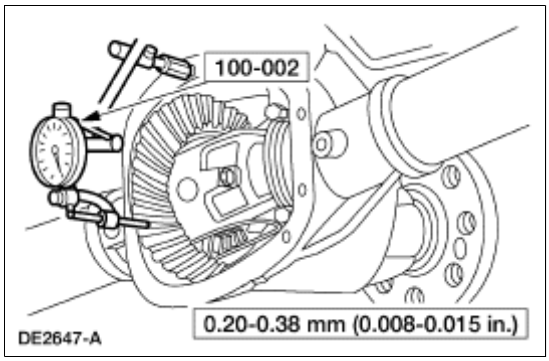
11. To increase or decrease the backlash, remove the bearing caps and install a thicker shim or a thinner shim as shown.
    - If the backlash is not within specification, correct by increasing the thickness of one differential bearing shim and decreasing the thickness of the other differential bearing shim by the same amount.



12. Rotate the differential several times to make sure the differential bearings are correctly seated.

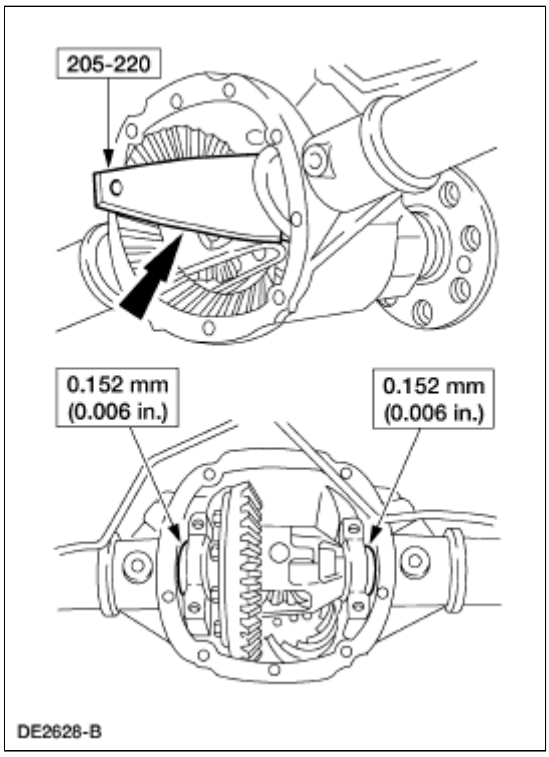


13. Using the special tool, recheck the backlash.
    - If the backlash is within specification, go to Backlash within specification in this procedure. If the backlash is not within specification, repeat Measuring backlash in this procedure.

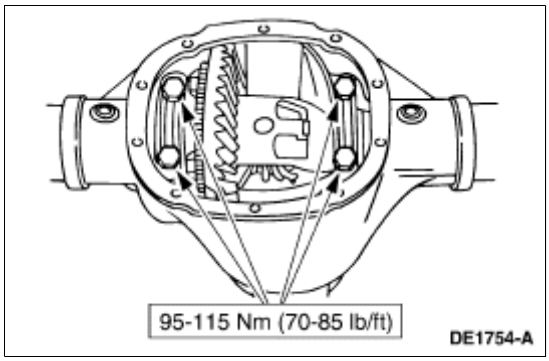


Backlash within specification

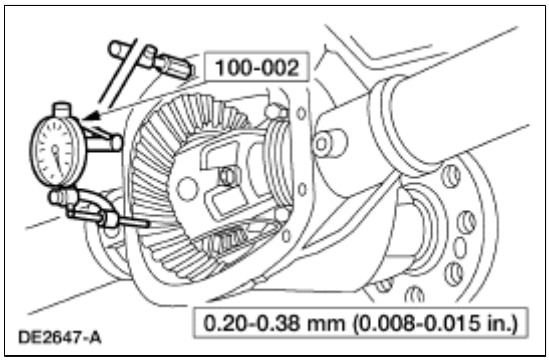
14. Remove the bearing caps and bolts.
    - To establish differential bearing preload, increase both left and right shim sizes by the specification shown in the illustration.
    - Using the special tool, make sure that the differential bearing shims are fully seated and the assembly turns freely.



15. Install the bearing caps and bearing cap bolts.



16. Using the special tool, recheck the backlash.



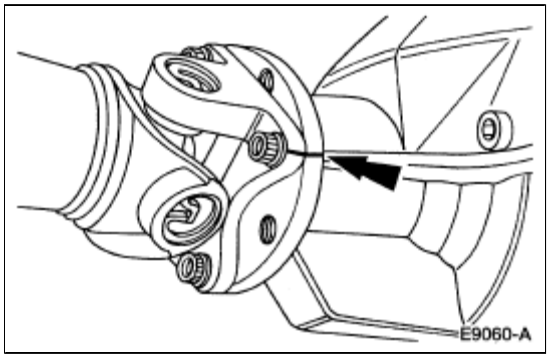
17. Install the axle shafts. For additional information, refer to Axle Shaft in this section.

18. Install the differential housing cover and refill the rear axle with specified lubricant. For additional information, refer to Differential Housing Cover in this section.

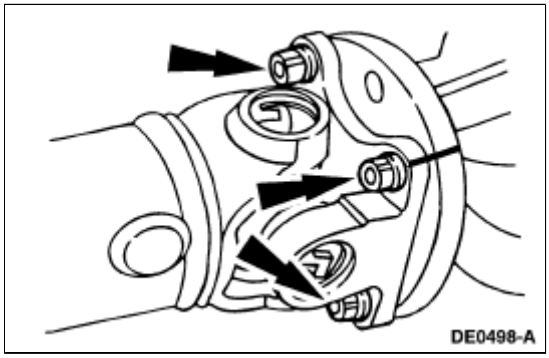
Axle Assembly

Removal

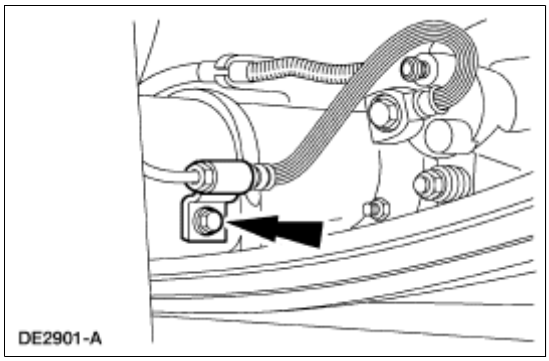
1. Release the tension on the parking brake cable. For additional information, refer to Section 206-05 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Remove the rear wheel and tire assemblies. For additional information, refer to Section 204-04 .
4. Index-mark the driveshaft flange and the pinion flange (4851) to maintain initial balance during installation.



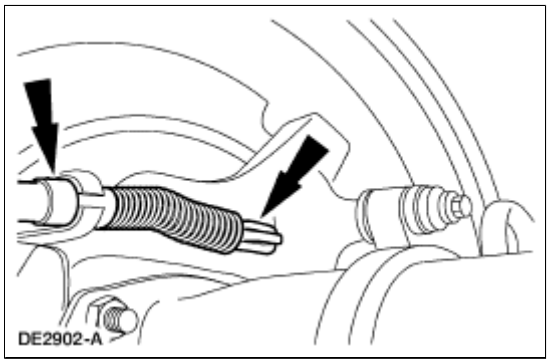
5. Remove the four bolts and position the driveshaft (4602) aside.



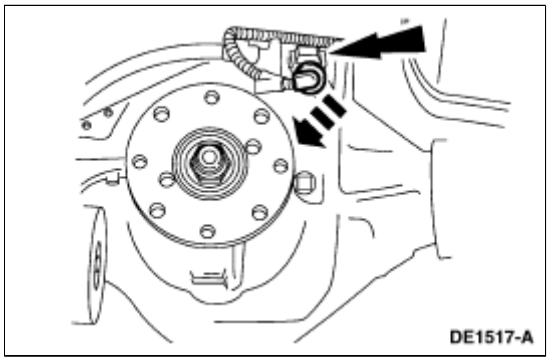
6. Remove the bolt, and position the brake hose junction block aside.



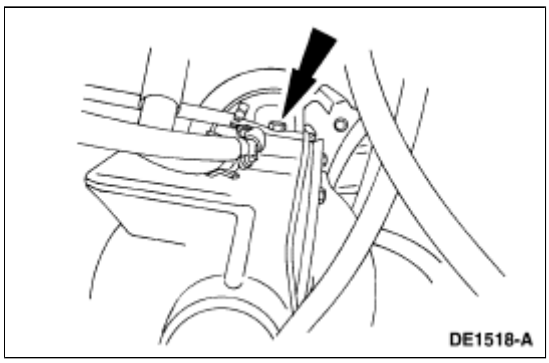
7. Disconnect the parking cable and conduit at the parking brake lever.



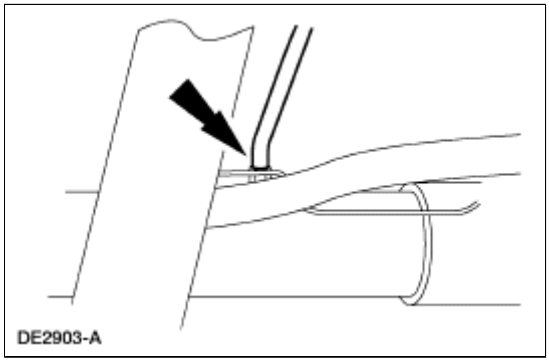
8. Disconnect the vehicle speed sensor.



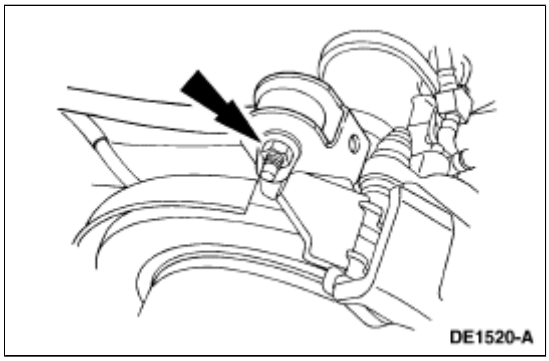
9. Remove the bolt, and reroute the parking brake cables and the vehicle speed sensor wiring.



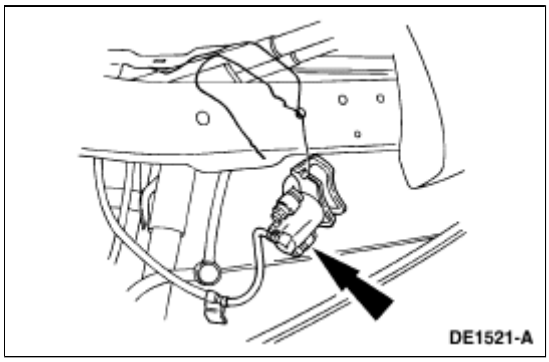
10. Disconnect the vent hose.



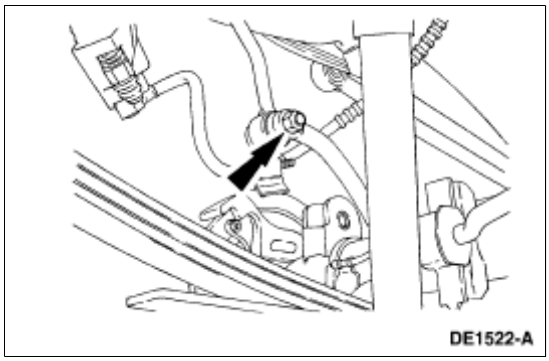
11. Disconnect the anti-windup bar, if so equipped.



12. Remove, and wire the rear disc brake calipers (2552) aside. For additional information, refer to Section 206-04 .

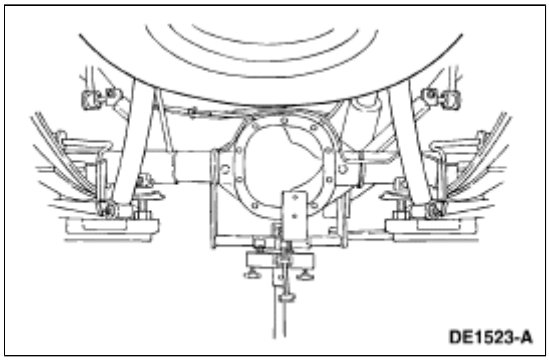


13. Disconnect the rear stabilizer bar (5A772) at the links.

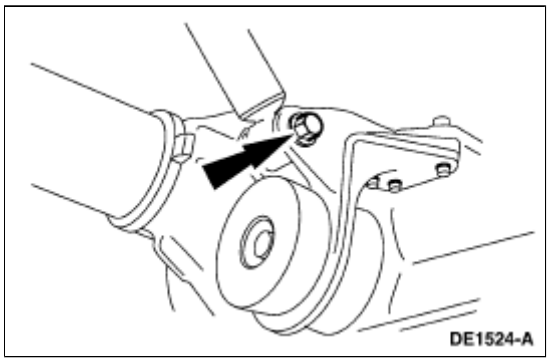


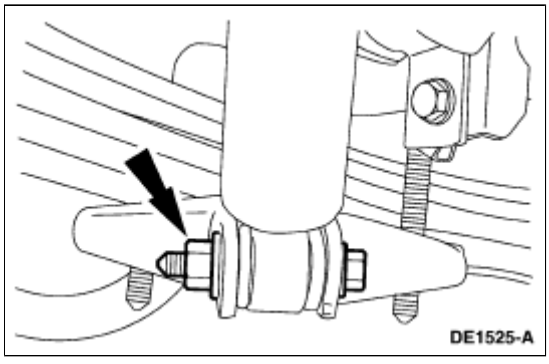
14. **WARNING: Use an extra support strap to secure the rear axle to the jack.**

    Use a suitable jack to support the rear axle assembly.

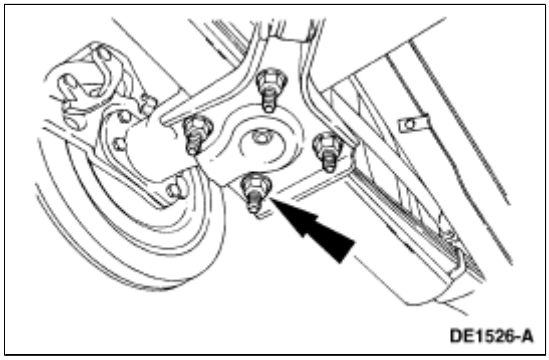


15. Remove the lower nuts and bolts from all three shock absorbers.





16. Remove the nuts and the U-bolt.



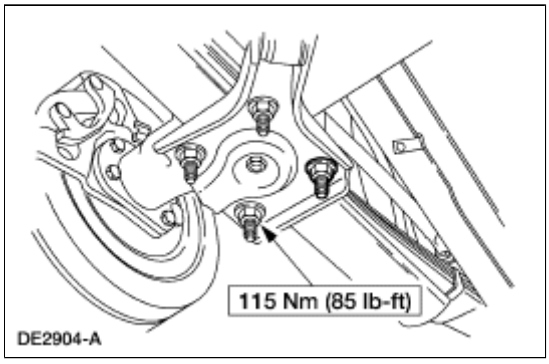
17. **CAUTION: Be careful of obstructions and of causing damage to vehicle components when performing this step.**

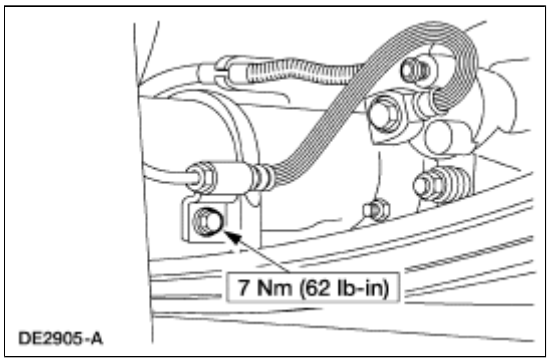
    Raise the rear axle off the rear springs and manipulate the rear axle from the vehicle.

Installation

1. To install, reverse the removal procedure.
   - Refer to Section 204-02 for the shock absorber, stabilizer bar and anti-windup bar fastener tightening specifications.
   - **CAUTION: Be sure to align the driveshaft flange and the pinion flange index-marks.**

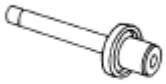
     Refer to Section 205-01 for driveshaft fastener tightening specifications.
   - For wheel and tire torques, refer to Section 204-04 .





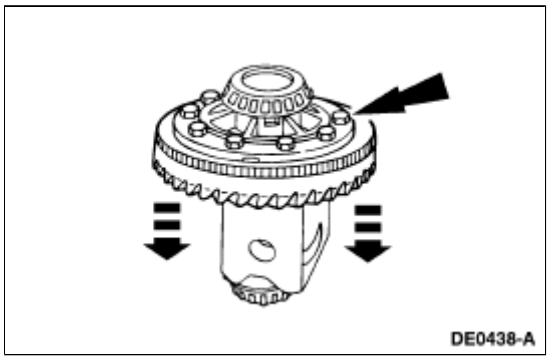
Differential Case and Ring Gear —Conventional

Special Tool(s)

 ST2026-A	2-Jaw Puller 205-D072 (D97L-4221-A) or Equivalent
 ST1375-A	Differential Side Bearing Replacer 205-010 (T57L-4221-A2)
 ST1543-A	Step Plate 205-D016 (D80L-630-5) or Equivalent

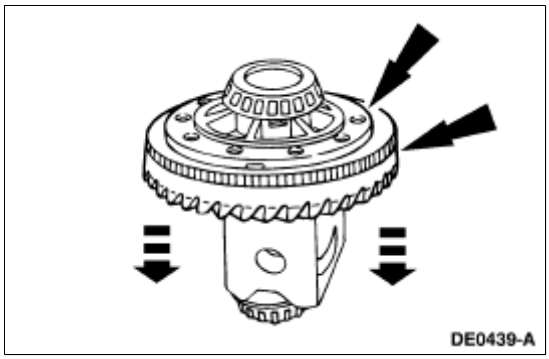
Disassembly

1. Remove the differential case. For additional information, refer to Differential Case in this section.
2. Remove the 10 ring gear bolts.


DE0438-A

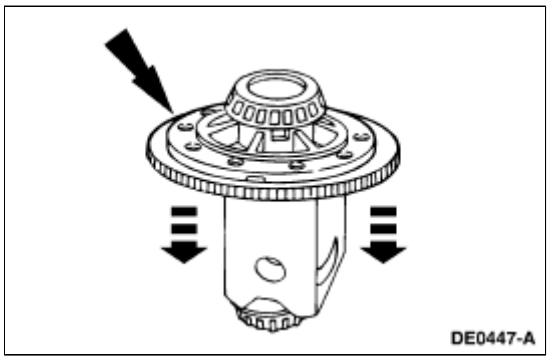
3. **CAUTION: Care should be taken not to damage the bolt hole threads.**

   Insert a punch in the bolt holes and drive the ring gear off.

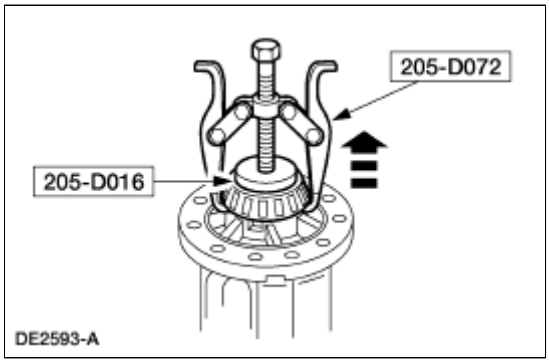


4. **NOTE:** The speed sensor ring cannot be reused once removed.

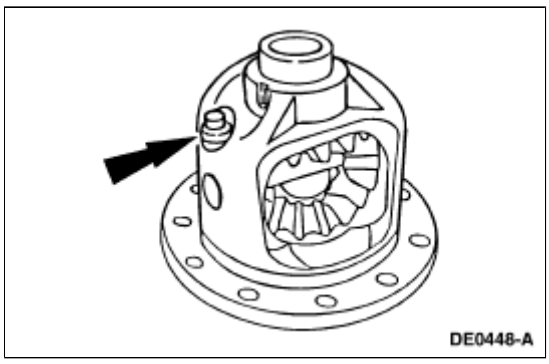
   Remove the speed sensor ring if required.



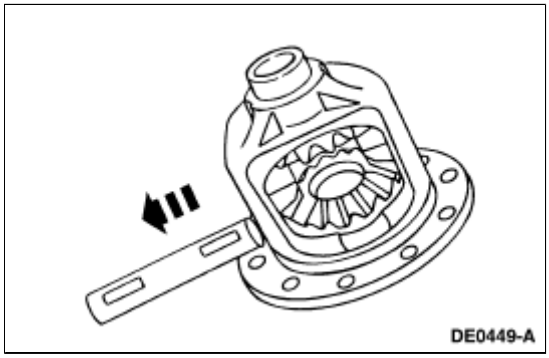
5. If required, use the special tools to remove the differential bearings.



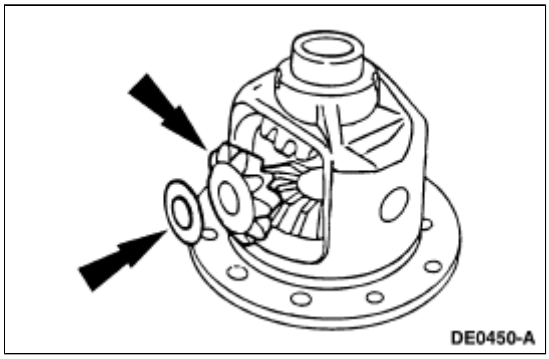
6. Remove the differential pinion shaft lock bolt.



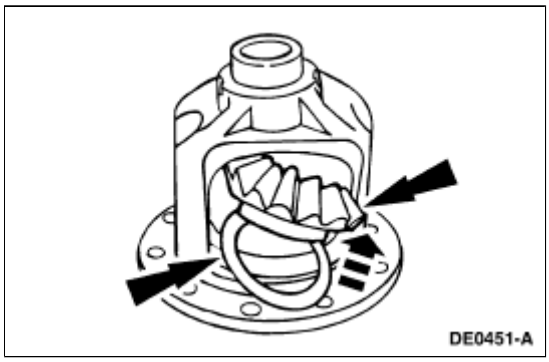
7. Remove the differential pinion shaft (4211).



8. Rotate and remove the differential pinion gears (4215) and the differential pinion thrust washers (4230).

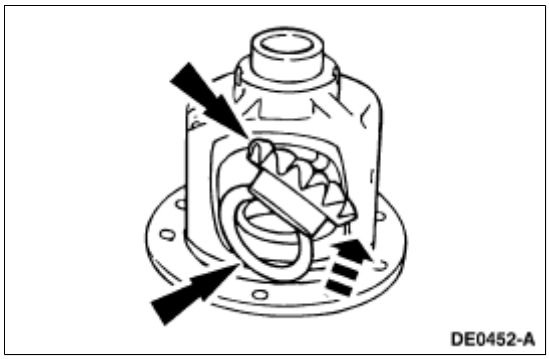


9. Remove the differential side gears (4236) and the differential side gear thrust washers.

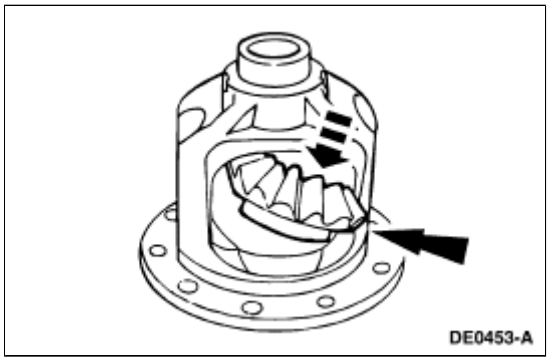


Assembly

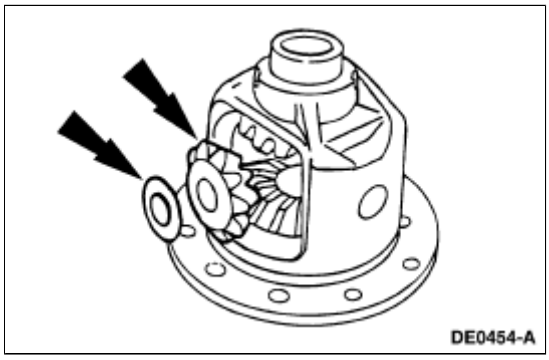
1. Lubricate the differential side gear thrust washers (4228) and the differential side gear journals.
   - For vehicles with 5.0L engines, use SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B meeting Ford specification WSL-M2C192-A.
   - For vehicles with 4.0L engines, use SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL meeting Ford specification WSP-M2C197-A.
   - Position the differential side gear thrust washers on the differential side gears.



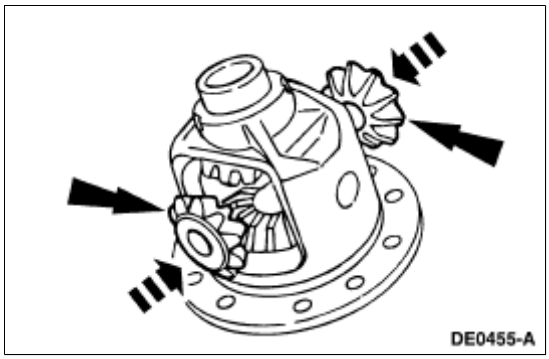
2. Position the differential side gears.



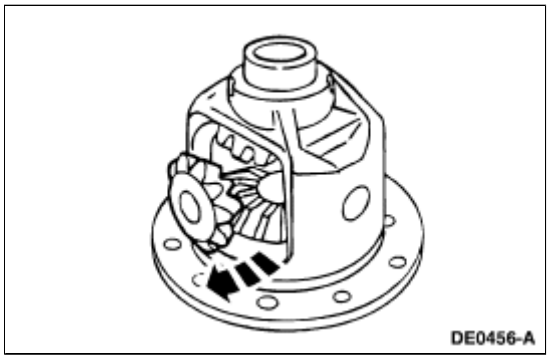
3. Lubricate the differential pinion thrust washers and the differential pinion gears and assemble.
   - For vehicles with 5.0L engines, use SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B meeting Ford specification WSL-M2C192-A.
   - For vehicles with 4.0L engines, use SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL meeting Ford specification WSP-M2C197-A.



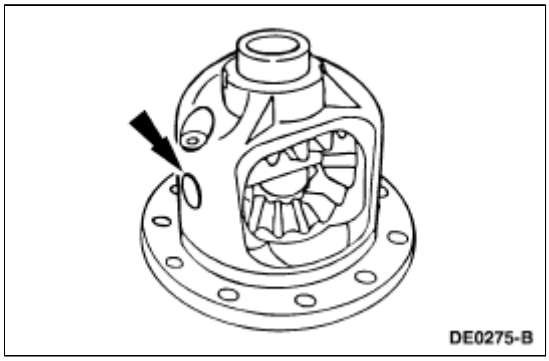
4. Engage the differential pinion gears opposite the differential side gears.



5. Rotate the differential pinion gears to align with the differential pinion shaft bore.

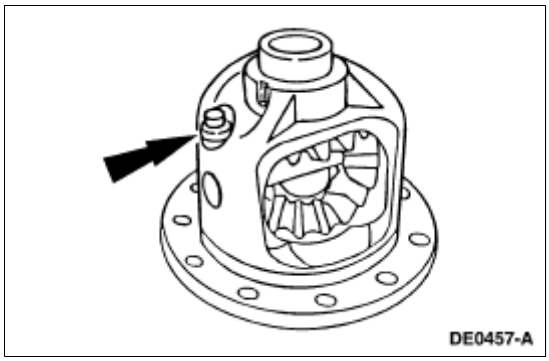


6. Insert the differential pinion shaft.
   - Align the hole in the differential pinion shaft with the hole in the differential case (4204).

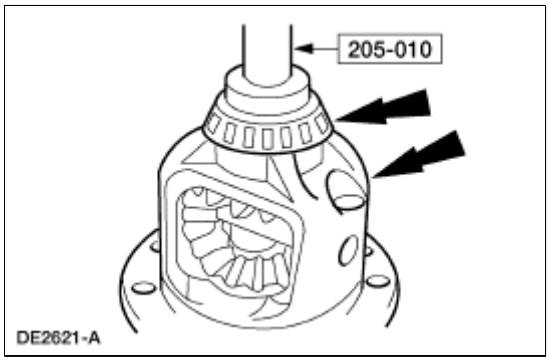


7. **CAUTION: If a new pinion shaft lock bolt is unavailable, coat the threads with Threadlock and Sealer EOAZ-19554-AA or equivalent meeting Ford specifications WSK-M2G351-A5 prior to installation.**

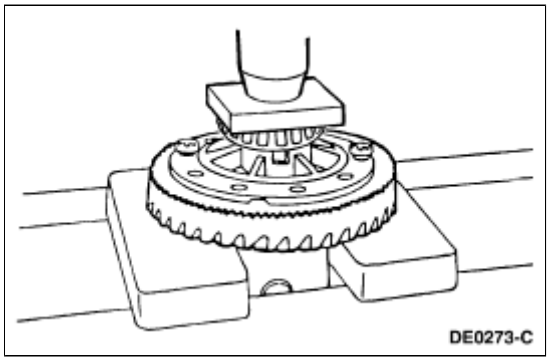
   Install a new differential pinion shaft lock bolt and tighten finger-tight.



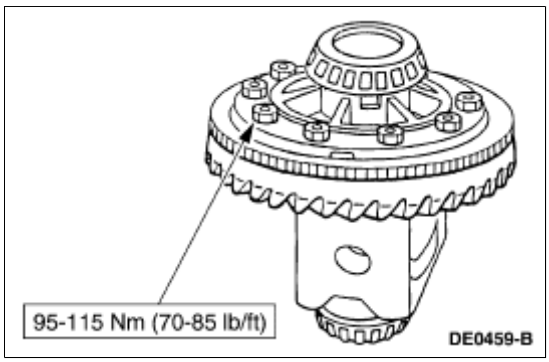
8. Using the special tool, install the new differential bearings (4221) on the differential case.



9. Press the new anti-lock speed sensor ring and the ring gear on the differential case.



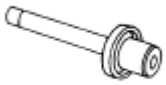
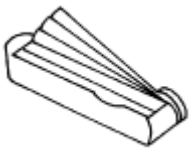
10. Install the ring gear bolts.
    - Apply Stud and Bearing Mount EOAZ-19554-BA or equivalent meeting Ford specification WSK-M2G349-A1 to ring gear bolts.



11. Install the differential case. For additional information, refer to Differential Case in this section.

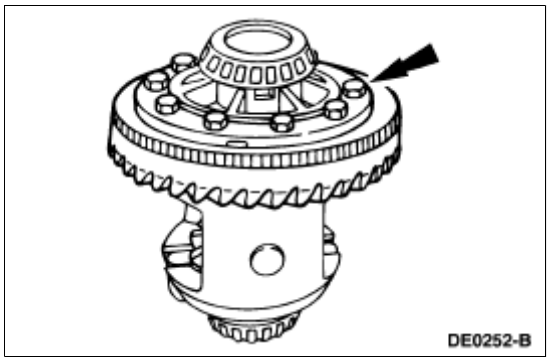
Differential Case and Ring Gear —Traction-Lok®

Special Tool(s)

 ST2026-A	2-Jaw Puller 205-D072 (D97L-4221-A) or Equivalent
 ST1374-A	Differential Clutch Gauge 205-135 (T80P-4946-A)
 ST1375-A	Differential Side Bearing Replacer 205-010 (T57L-4221-A2)
 ST1271-A	Feeler Gauge Set 303-D027 (D81L-4201-A) or Equivalent
 ST1543-A	Step Plate 205-D016 (D80L-630-5) or Equivalent

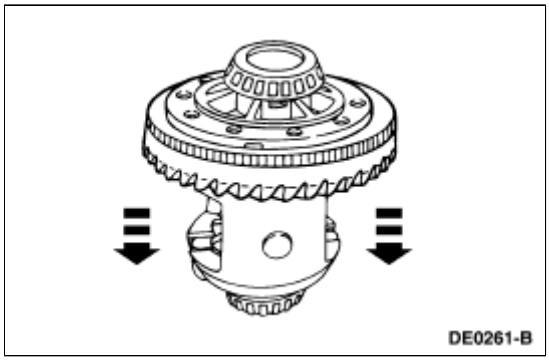
Disassembly

1. Remove the differential case (4204). For additional information, refer to Differential Case in this section.
2. Remove the 10 bolts.



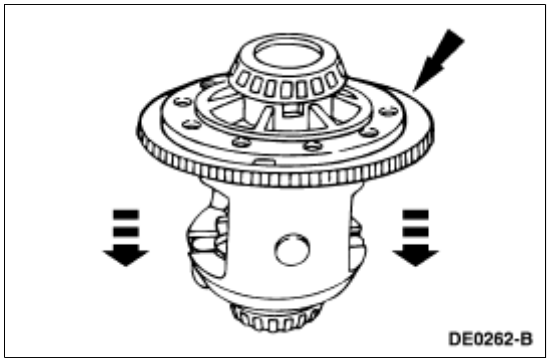
3. **CAUTION: Do not damage the bolt hole threads.**

   Insert a punch in the bolt holes, and drive the ring gear off.

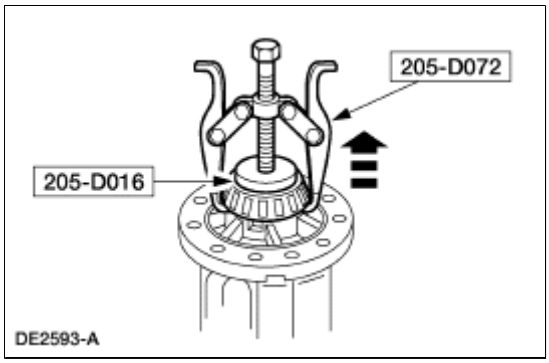


4. **CAUTION: Do not reuse the anti-lock speed sensor ring (4B409) after removing it.**

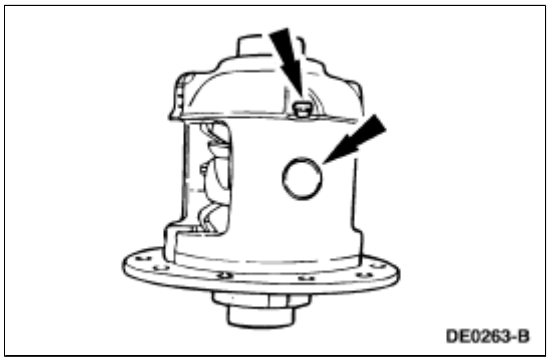
   If necessary, remove the anti-lock speed sensor ring and discard it.



5. Using the special tools, remove the differential bearings (4221).

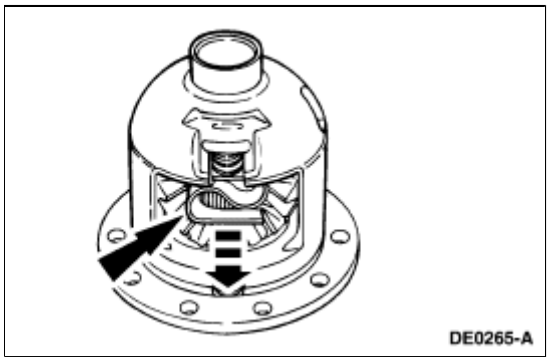


6. Remove the differential pinion shaft lock bolt, and remove the differential pinion shaft (4211).

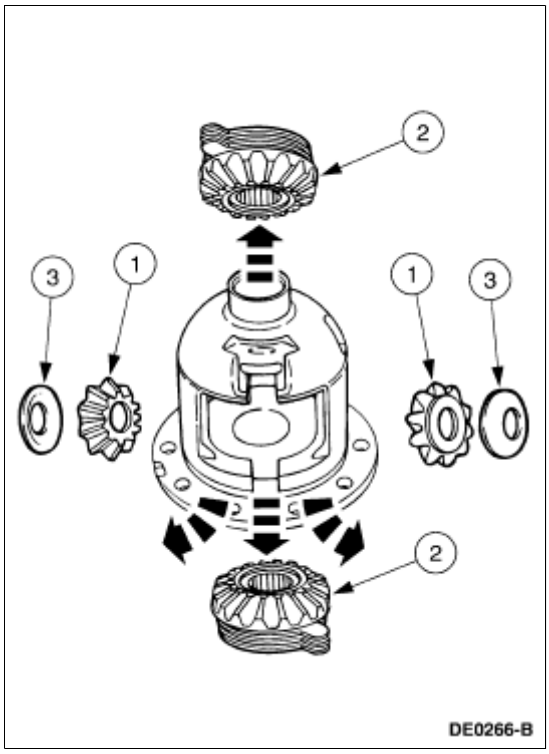


7. **WARNING: Due to the spring tension, take care when removing the differential clutch spring (4214).**

   Remove the differential clutch spring.

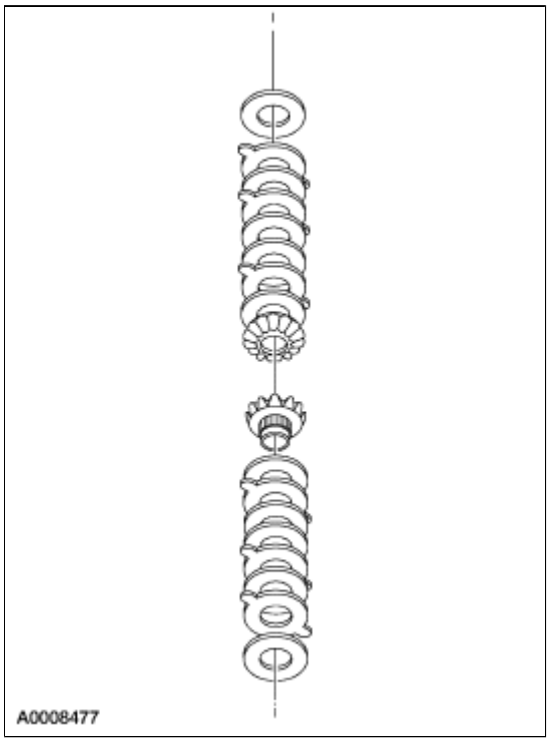


8. Remove the differential gears and washers.
   1. Remove the differential pinion gears (4215).
   2. Remove the differential side gears (4236).
   3. Remove the differential pinion thrust washers (4230).



9. **CAUTION: Keep the differential clutch packs (4947) in order. Do not mix them. Be sure to reassemble them in the same sequence.**

   Remove and tag the differential clutch packs, shims and differential side gears "right" and "left".



10. **CAUTION: Do not use acids or solvents to clean the differential clutch packs. Wipe the components with a clean, lint-free cloth only.**

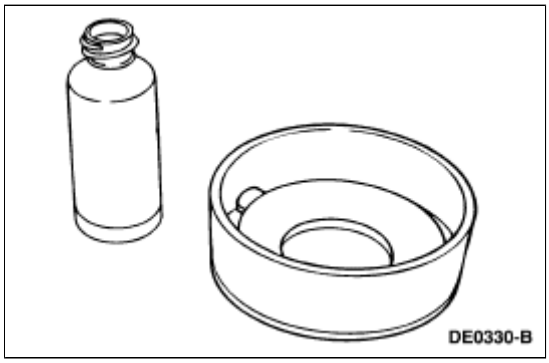
    Clean and inspect the differential clutch packs for wear and damage. Install new parts as necessary.

11. Clean and inspect the remaining differential case components for wear and damage. Install new components as necessary.

Assembly

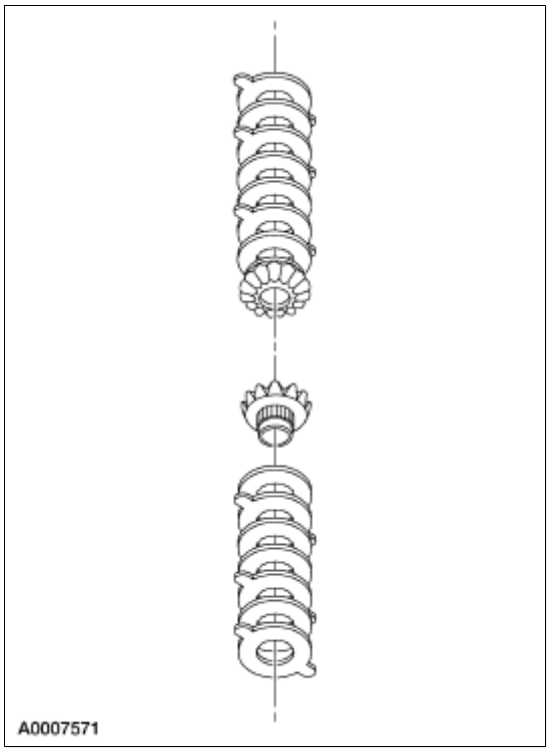
1. **CAUTION: Use 118 ml (4 oz) of Ford Additive Friction Modifier C8AZ-19B546-A or equivalent meeting Ford specification EST-M2C118-A in the axle.**

   Prelubricate each steel clutch plate and soak all of the friction plates in Ford Additive Friction Modifier C8AZ-19B546-A or equivalent meeting Ford specification EST-M2C118-A for at least 15 minutes.



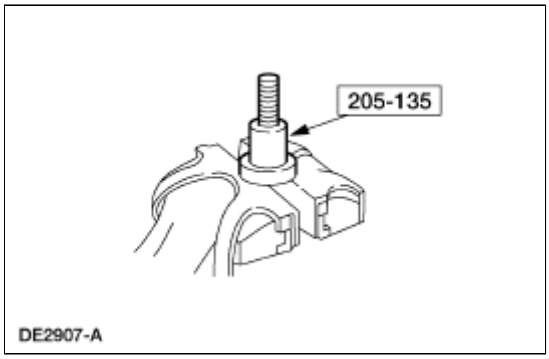
2. **CAUTION: Do not mix the left and right side differential clutch packs and shims.**

   Assemble the left and right differential clutch packs (without the shims) and differential side gears.

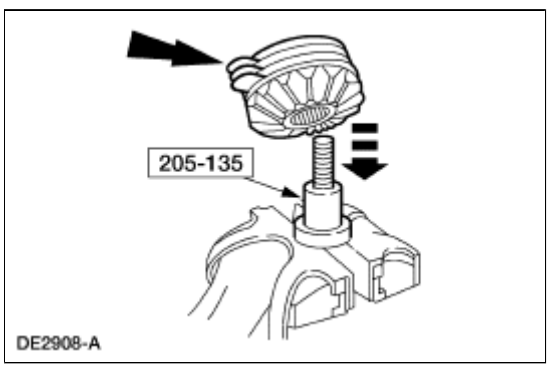


3. **CAUTION: Use the correct mandrel with the Differential Clutch Gauge.**

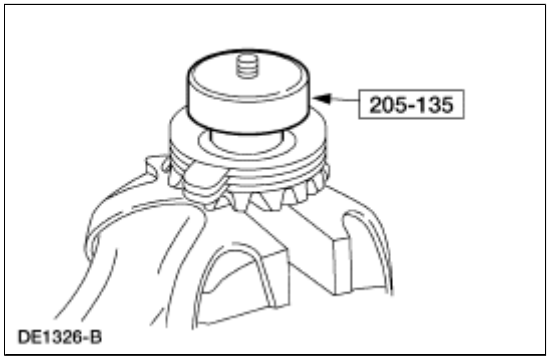
   Place the special tool in a vise.



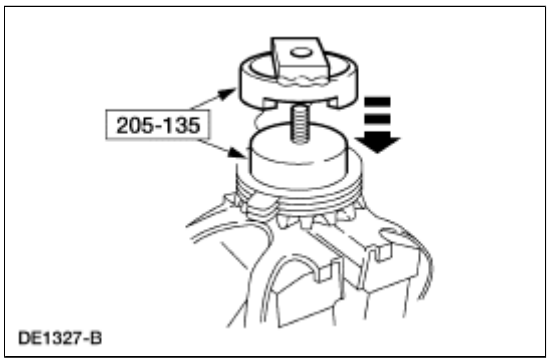
4. Install the differential clutch pack and differential side gear (without the shim) on the special tool.



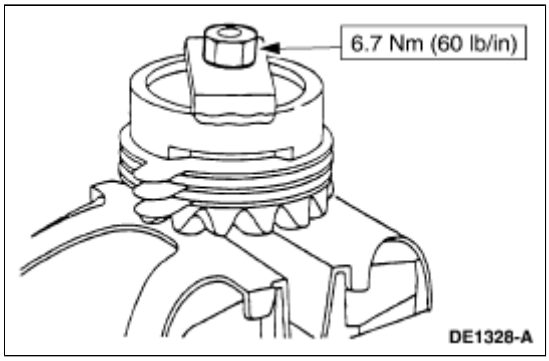
5. Position the special tool hand-tight on top of the differential clutch pack.



6. Install the special tool over the disc and differential clutch pack.



7. Install the nut.



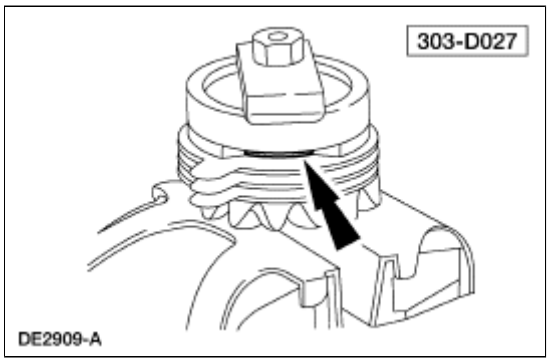
8. **NOTE:** Clutch Pack Kit F5AZ-4947-BA is available to rebuild the 8.8-inch ring gear Traction-Lok® differential.

   Using the special tool, determine the thickness of the new clutch shim.
   - Insert the thickest blade that will enter between the tool and the differential clutch pack.

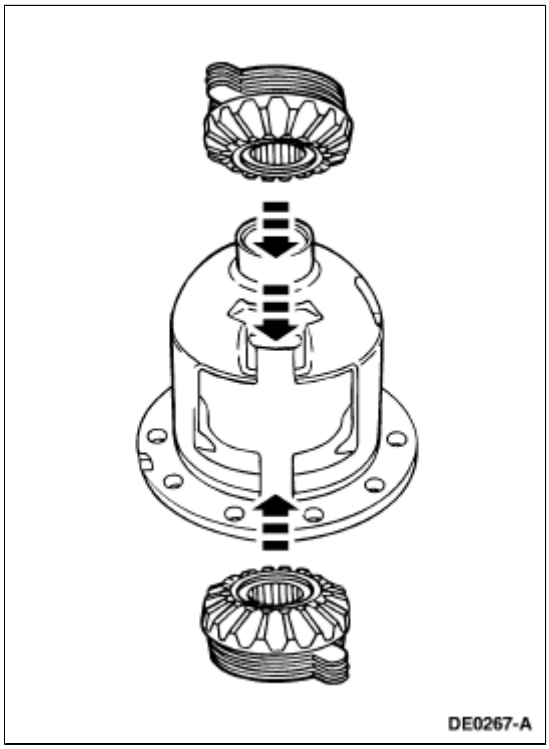
Selective Shims

Part Number	Description
EOAZ-4A324-G	0.025 Inch
EOAZ-4A324-H	0.030 Inch

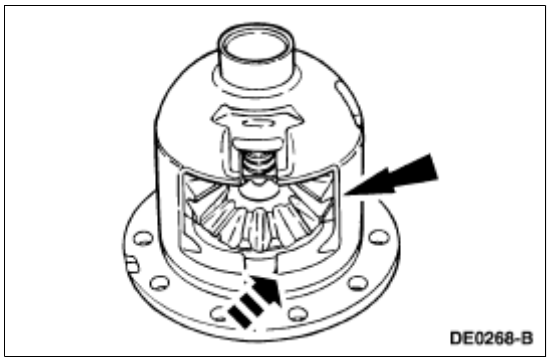
EOAZ-4A324-C	0.035 Inch
EOAZ-4A324-D	0.040 Inch
EOAZ-4A324-F	0.045 Inch



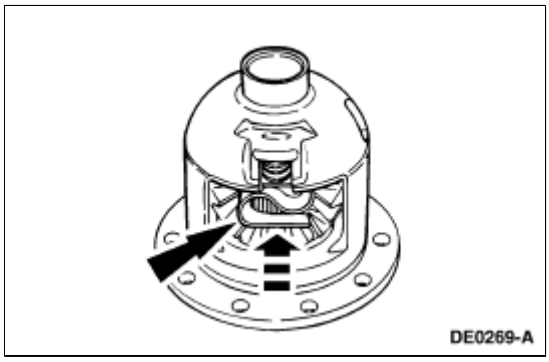
9. Remove the special tool from the clutch pack and side gear assembly.
10. Install the shims on the clutch pack and side gear assembly.
11. Install the differential side gear assemblies in the differential case.



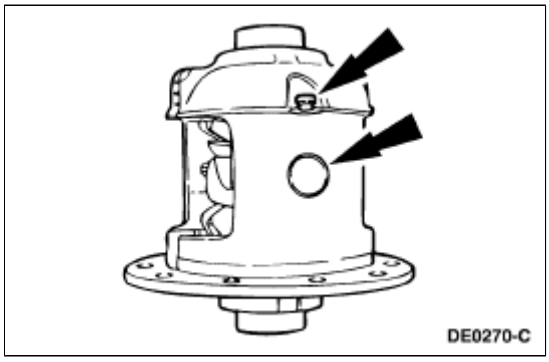
12. Install the differential pinion gears with the differential pinion thrust washers in the differential case.



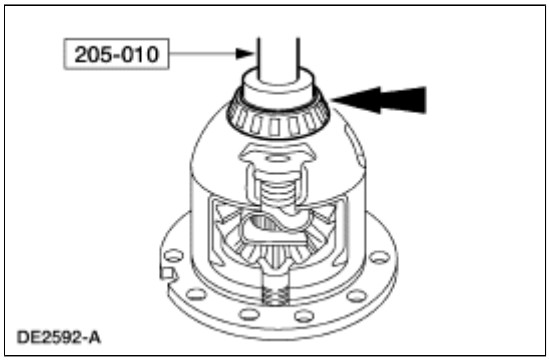
13. Using a soft-faced hammer, install the differential clutch spring.



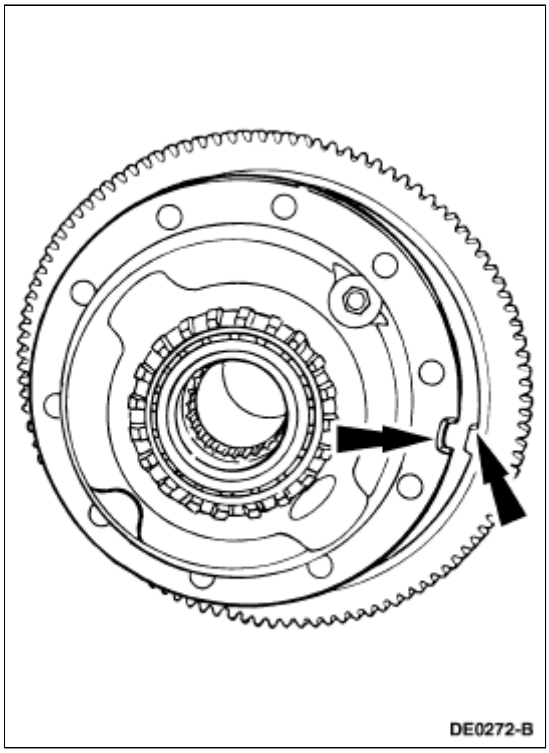
14. Install the differential pinion shaft, and install a new differential pinion shaft lock bolt finger-tight.



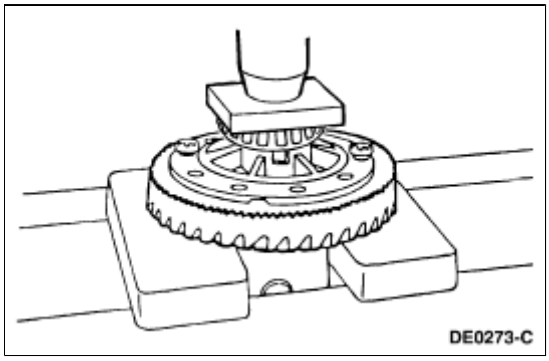
15. Using the special tool, install the differential bearings.



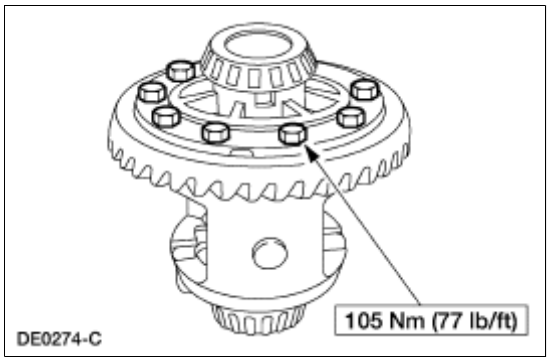
16. Install the anti-lock speed sensor ring by aligning the tab with the slot.
    - Start two bolts through the differential case and into the ring gear to make sure the ring gear bolt holes align with the differential case bolt holes.



17. Press the new anti-lock speed sensor ring and the ring gear on the differential case.



18. Install the bolts.
    - Apply Stud and Bearing Mount EOAZ-19554-BA or equivalent meeting Ford specification WSK-M2G349-A1 to the bolt threads.



19. Install the differential case. For additional information, refer to Differential Case in this section.

General Specifications

Item	Specification
Housing Spreader Adapter bolt thread engagement mm (inch)	12.7 (0.500)
Maximum spread of differential housing mm (inch)	0.381 (0.015)
Ring gear backlash mm (inch)	0.13-0.20 (0.005-0.008)
Maximum backlash variation between points checked mm (inch)	0.05 (0.002)
Sealant	
Ford Black Silicone Rubber F4AZ-19562-B	WSE-M4G323-A1
Lubricant	
Motorcraft SAE 80W90 XL-80W90-QL Thermally Stable 4x4 Axle Lubricant	WSP-M2C197-A
Capacity	
Front axle L (Pint)	1.54 (3.25)
Lubricant level mm (in)	9.56 (0.38) below bottom of axle cover filler hole

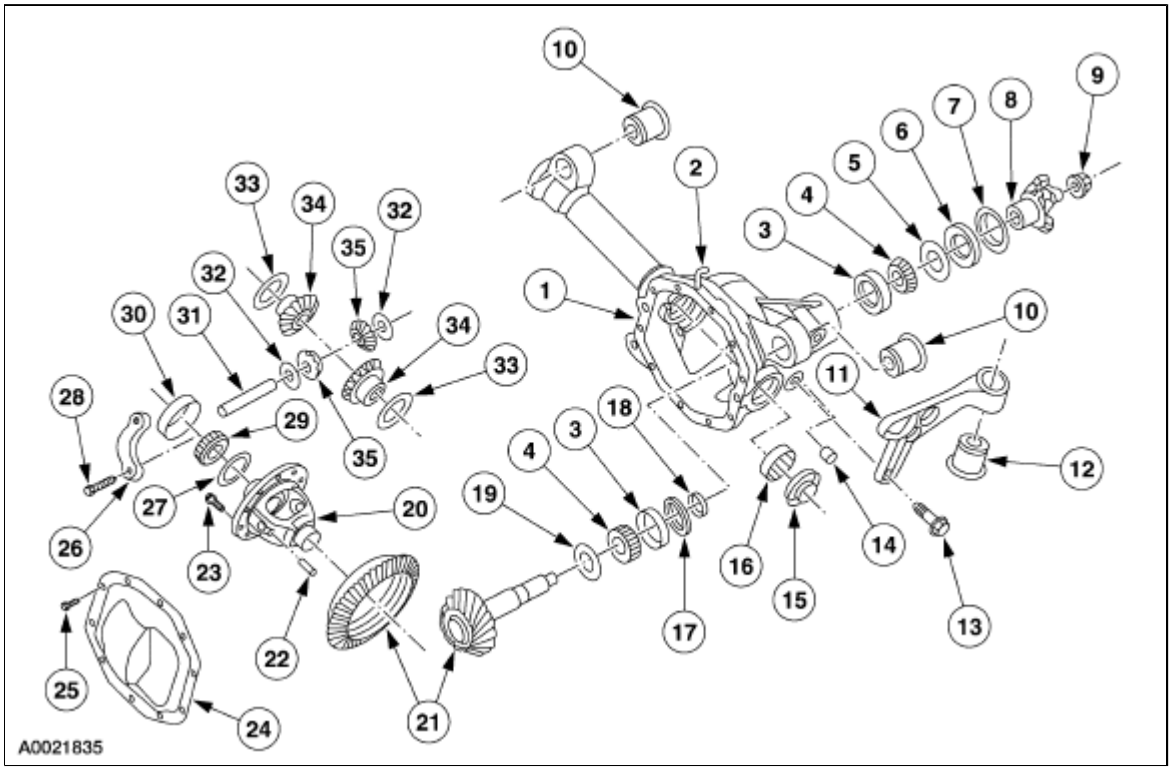
Torque Specifications

Description	Nm	lb-ft	lb-in
Front axle retainer bracket bolt	106	78	—
Ring gear bolt	109	80	—
Differential bearing cap bolt	61	45	—
Differential housing cover bolt	22	16	—
Axle to frame bolt	66	49	—
Pinion bearing preload (new pinion bearings)	1.7-3.4	—	15-30
Pinion bearing preload (original pinion bearings)	[a]	—	[a]
Universal joint spider retainer bolt	19	14	—
Brake caliper guide pin bolt	33	24	—
Tie-rod nut	91	67	—
Upper ball joint pinch bolt	48	35	—

[a] The reading must be 0.56 Nm (5 lb-in) more than the initial reading taken during disassembly.

Front Drive Axle and Differential

AWD Dana 35 Exploded View



Item	Description
1	Differential Housing
2	Vent tube
3	Differential drive pinion bearing cup (2 req'd)
4	Differential pinion bearing (2 req'd)
5	Front axle drive pinion shaft oil slinger
6	Pinion seal
7	Drive pinion oil seal deflector
8	Pinion flange
9	Pinion nut
10	Bushing (2 req'd)
11	Axle to frame bracket
12	Bushing
13	Axle bracket to housing bolt (3 req'd)

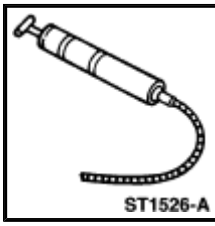
14	Fill plug
15	Axle shaft oil seal (LH)
16	Axle shaft bearing
17	Oil restrictor plate (baffle)
18	Collapsible spacer
19	Pinion position shim
20	Differential case
21	Differential ring gear and pinion
22	Differential pinion shaft roll pin
23	Differential ring gear bolt (8 req'd)
24	Differential housing cover
25	Differential cover bolts (10 req'd)
26	Differential bearing cap (part of 3010)
27	Differential preload/backlash shim
28	Differential bearing cap bolt (4 req'd)
29	Differential bearing
30	Differential bearing race
31	Differential pinion shaft
32	Differential pinion thrust washer (2 req'd)
33	Differential side gear thrust washer (2 req'd)
34	Differential side gear (2 req'd)
35	Differential pinion gear (2 req'd)

Front Drive Axle

Refer to Section 205-00 .

Axle and Differential Drain and Refill

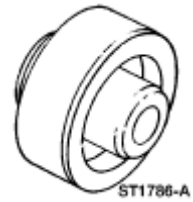
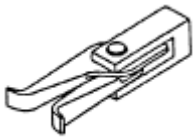
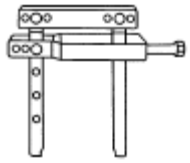
Special Tool(s)

 ST1526-A	Oil Suction Gun 303-D104 (D94T-9000-A)

1. Raise the vehicle on a hoist.
2. Remove the differential fill plug.
3. Use the oil suction gun and remove the axle lubricant through the fill opening.
4. If necessary, a cleaning solvent can be injected to remove any contaminants.
5. Repeat Step 3 to remove the cleaning solvent.
6. Refill the differential with Motorcraft SAE 80W90 Thermally Stable 4x4 Axle Lubricant meeting Ford specification WSP-M2C197-A.
7. Install the fill plug and tighten.

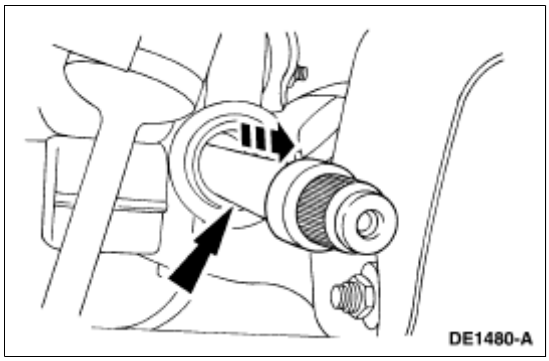
Axle Tube Bearing

Special Tool(s)

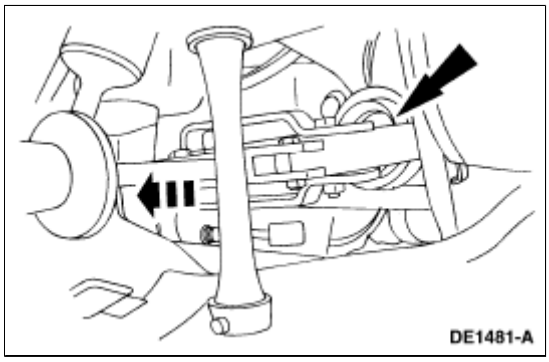
 ST2472-A	Axle Bearing Replacer 205-345 (T95T-1175-B)
 ST1786-A	Axle Seal Replacer 205-350 (T95T-3010-A)
 ST1362-A	Bearing Remover 307-318 (T94P-77001-KH)
 ST1609-A	Converter Oil Seal Remover 307-309 (T94P-77001-BH)
 ST1255-A	Handle 205-153 (T80T-4000-W)

Removal

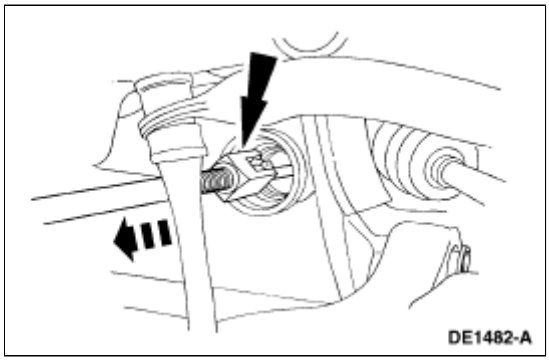
1. Remove the right-hand halfshaft. For additional information, refer to Section 205-04 .
2. Remove the right-hand axle shaft.



3. Use a converter oil seal remover and a slide hammer to remove the axle seal.



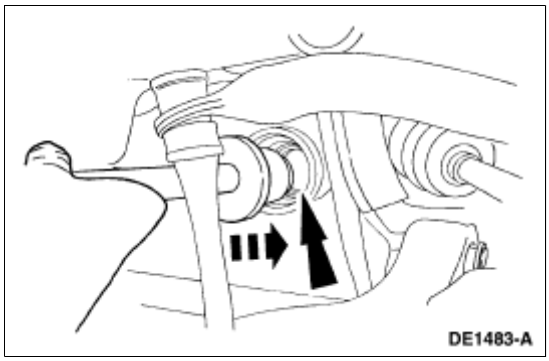
4. Use an axle bearing remover and a slide hammer to remove the axle tube bearing.



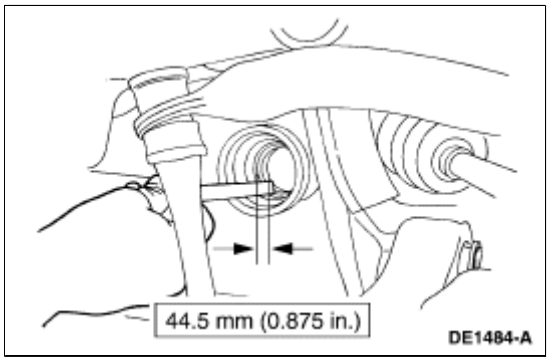
5. Clean the bearing and seal surfaces of any foreign debris.

Installation

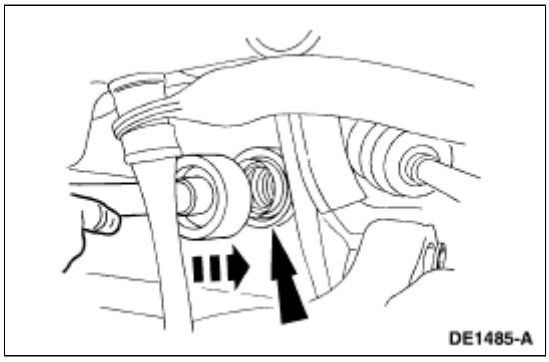
1. Use the Axle Bearing Replacer and the Handle to replace the RH axle tube bearing.



2. Check the bearing depth as shown.

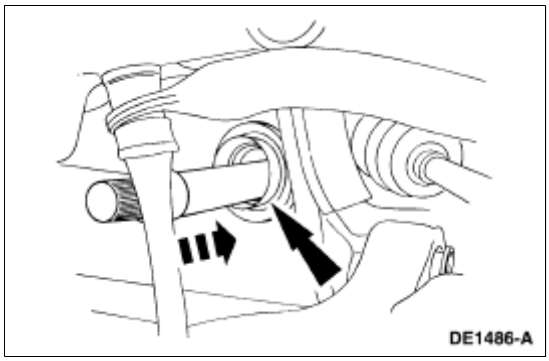


3. Use the Axle Seal Replacer and the Handle to replace the axle tube seal.



4. **CAUTION: Care should be taken not to damage the axle seal surface.**

   Install the axle shaft.

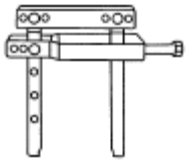
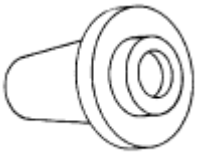


5. Refill the front drive axle to proper level using Motorcraft SAE 80W90 Thermally Stable 4x4 Axle Lubricant meeting Ford specification WSP-M2C197-A.

6. Install the RH halfshaft. For additional information, refer to Section 205-04 .

Drive Pinion Seal

Special Tool(s)

 ST2026-A	2-Jaw Puller 205-D072 (D97L-4221-A) or Equivalent
 ST1257-A	Companion Flange Holding Tool 205-126 (T78P-4851-A)
 ST1609-A	Converter Oil Seal Remover 307-309 (T94P-77001-BH)
 ST1358-A	Pinion Seal Replacer 205-133 (T79P-4676-A)

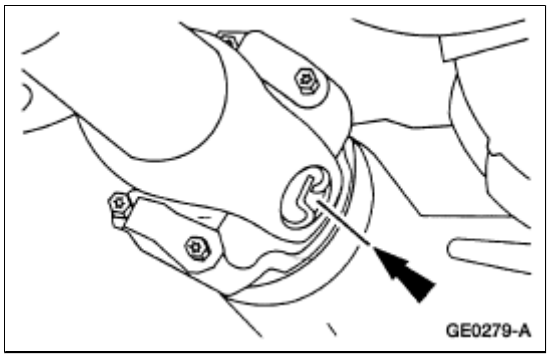
Removal

CAUTION: This operation disturbs the differential pinion bearing preload. Carefully reset the preload during assembly.

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 located in the rear jack storage area. 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.**

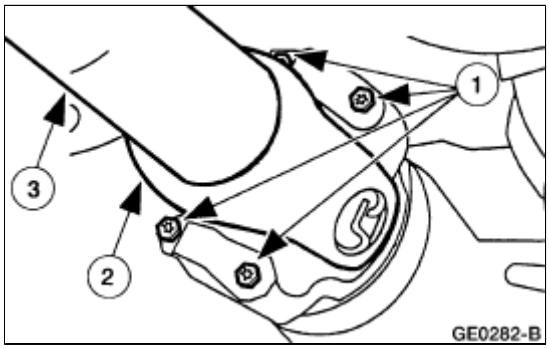
   Raise and support the vehicle. For additional information, refer to Section 100-02 .

2. Index-mark the front driveshaft and pinion flange.

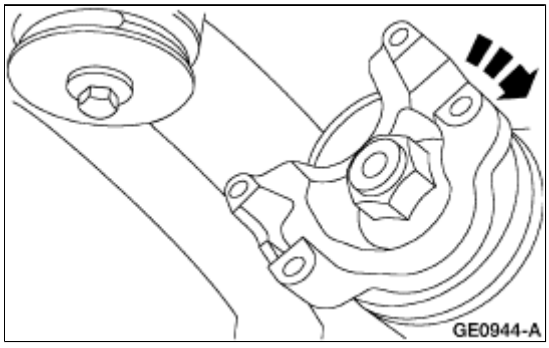


3. **CAUTION: Do not allow the driveshaft to hang unsupported.**

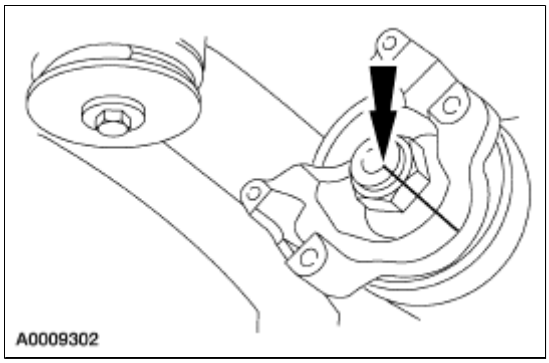
   Disconnect the front driveshaft from the pinion flange, and position it aside.
   1. Remove the bolts and the universal joint spider retainers.
   2. Disconnect the front driveshaft from the pinion flange.
   3. Position the front driveshaft aside.



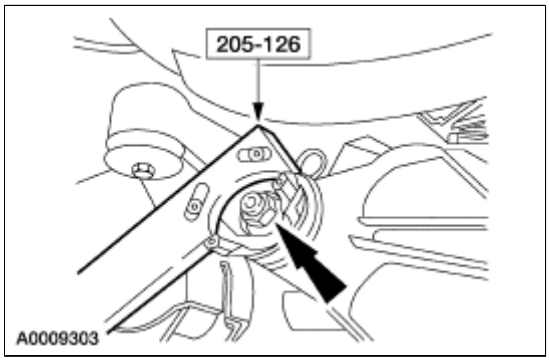
4. Measure the pinion bearing preload.
   - Using a Nm (inch-pound) torque wrench, measure the torque required to maintain pinion rotation. Record the measurement.



5. Index-mark the pinion flange and the pinion stem.

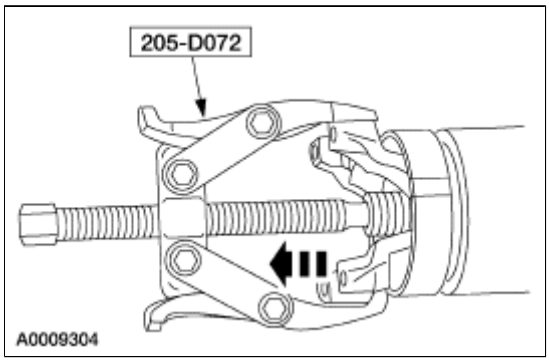


6. Use the special tool to hold the pinion flange while removing the nut.



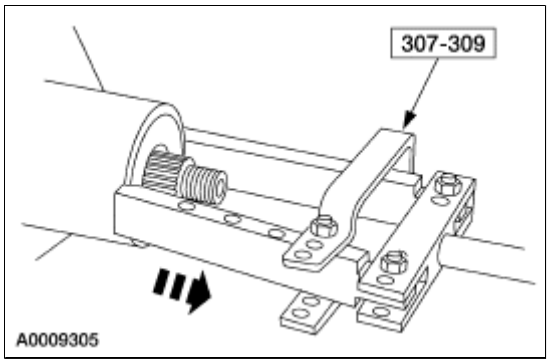
7. **CAUTION: Place a drain pan under the differential housing.**

   Using the special tool, remove the pinion flange.

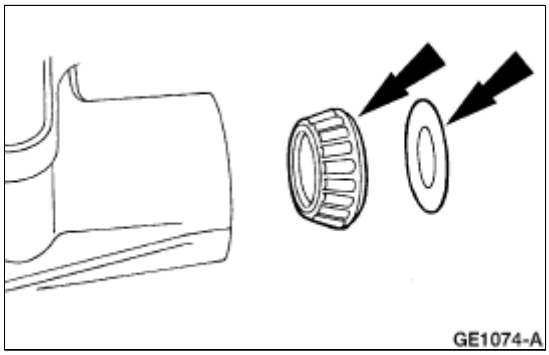


8. Inspect the pinion flange for burrs and damage. Inspect the end of the pinion flange that contacts the bearing cone, the nut counterbore, and the seal surface for nicks. Discard the pinion flange as necessary.

9. Using the special tool and a suitable impact slide hammer, remove the pinion seal.



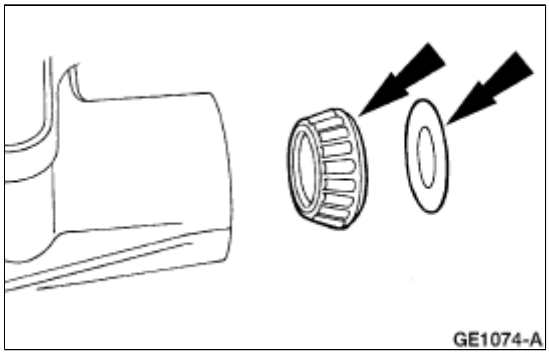
10. Remove the front axle drive pinion shaft oil slinger and the differential pinion bearing.



11. Remove and discard the collapsible spacer.

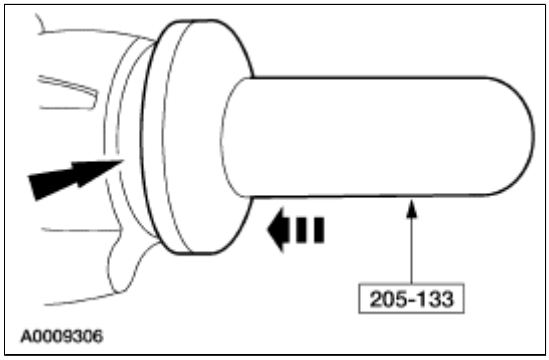
Installation

1. Verify that the splines on the pinion stem are free of burrs. If burrs are evident, remove them with a fine crocus cloth. Work in a rotating motion to wipe the pinion clean.
2. Clean the pinion seal bore.
3. Install a new collapsible spacer.
4. Install the original differential pinion bearing and the front axle drive pinion shaft oil slinger.



5. Lubricate the pinion seal.
   - Use Motorcraft SAE 80W90 Thermally Stable 4x4 Axle Lubricant meeting Ford specification WSP-M2C197-A.

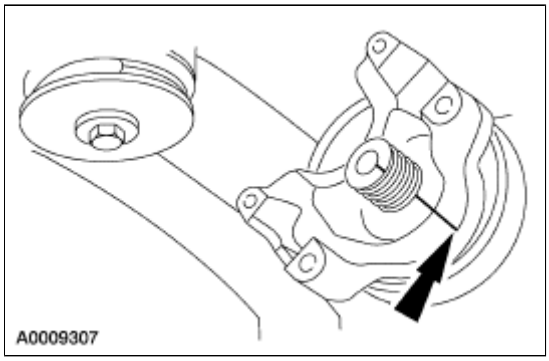
6. Using the special tool, install the pinion seal.



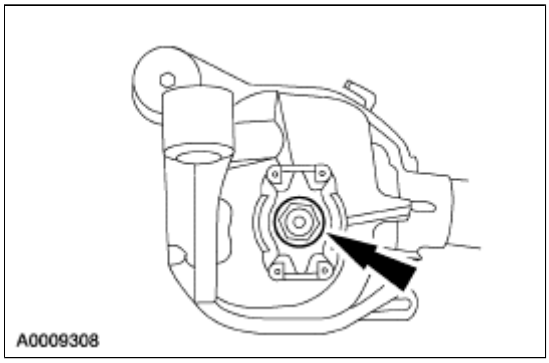
7. Lubricate the pinion flange splines.
   - Use Motorcraft SAE 80W90 Thermally Stable 4x4 Axle Lubricant meeting Ford specification WSP-M2C197-A.

8. **CAUTION: Never use a metal hammer on the pinion flange or install the flange with power tools. If necessary, use a plastic hammer to tap on a tight fitting flange.**

   Align the index marks and install the pinion flange.



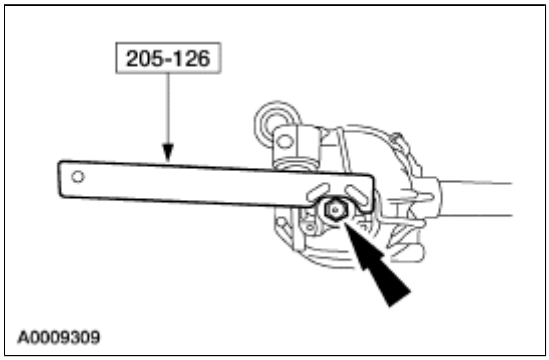
9. Install the new nut hand-tight.



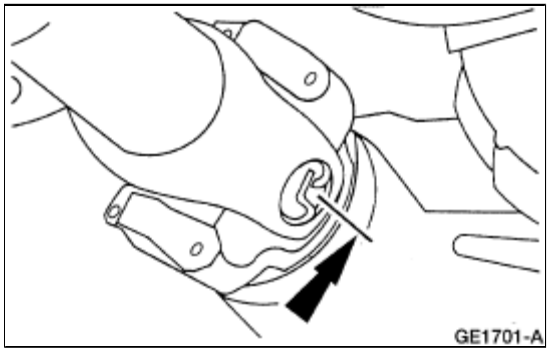
10. **CAUTION: Do not loosen the nut to reduce preload. Install a new collapsible spacer and nut if preload reduction is necessary.**

    Use the special tool to hold the pinion flange while tightening the nut to set the preload.

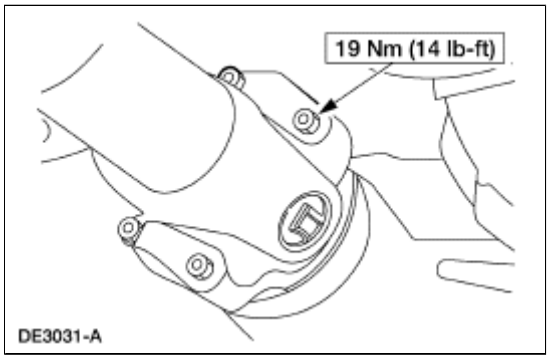
- Tighten the nut, rotating the pinion occasionally to ensure the differential pinion bearings are seating correctly. Take frequent differential pinion bearing preload readings by rotating the pinion with a Nm (inch-pound) torque wrench. The final reading must be 0.56 Nm (5 lb-in) more than the initial reading taken during removal.



11. Align the index marks and position the front driveshaft.



12. Install the universal joint spider retainers and bolts.



13. Check the fluid level and, if necessary, fill the axle to specification.
    - Use Motorcraft SAE 80W90 Thermally Stable 4x4 Axle Lubricant meeting Ford specification WSP-M2C197-A.

14. Lower the vehicle.

15. If so equipped, reactivate the air suspension.

Axle Assembly —Front

Special Tool(s)

 ST2453-A	Axle Service Plugs Set 205-S358 (T95T-4850-A)
 ST1106-A	Tie Rod End Remover 211-001 (TOOL-3290-D) or equivalent

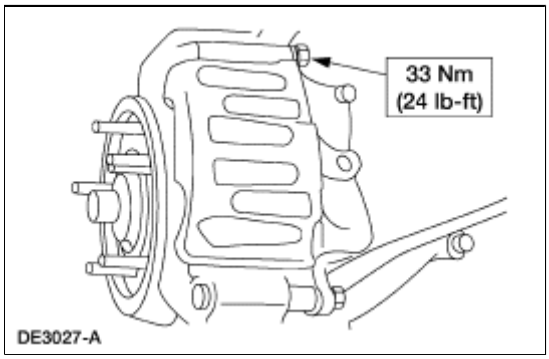
Removal

1. Raise the vehicle on a hoist. For additional information, refer to Section 100-02 .
2. Remove the front wheel and tire assemblies. For additional information, refer to Section 204-04 .
3. **WARNING: Remove or tape the brake pads, to prevent them from falling out of the caliper guides.**

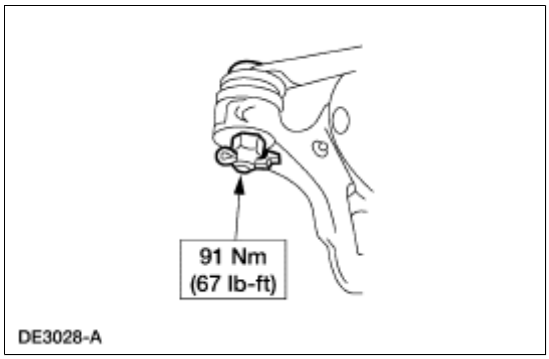
   CAUTION: Do not allow the calipers to hang by the hoses.

   NOTE: Install a wheel nut to secure each brake disc in place.

   Remove the bolts and position both calipers aside.

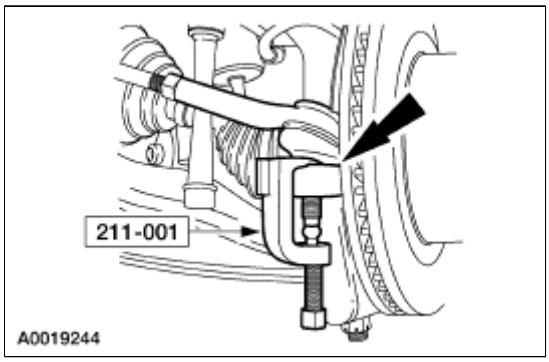


4. Remove the cotter pins and nuts from both outer tie-rods.



5. **NOTE:** Do not damage the tie-rod dust boots when installing the special tool. Apply a small amount of grease to the tie-rod stud.

   Using the special tool, separate the tie-rod ends from the knuckles.

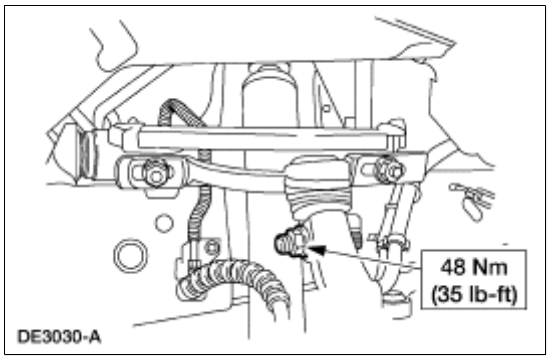


6. Unclip the left and right wheel anti-lock sensor wiring harnesses from the locators on the vehicle chassis, located above the stabilizer bar brackets.

7. **WARNING: Do not allow the wheel knuckle to hang freely. It is possible to overextend and internally separate the inner CV joint. Separate both axle halfshafts from the front axle.**

   CAUTION: Take necessary precautions to protect the machined sealing surfaces on each axle.

   Remove both pinch bolts and disconnect the upper ball joints.
   - Pull the RH axle halfshaft, with the wheel knuckle, away from the axle until the axle halfshaft is out of the axle.
   - Pull the LH axle halfshaft, with the wheel knuckle, away from the axle. The LH axle cannot be removed from the axle at this time.



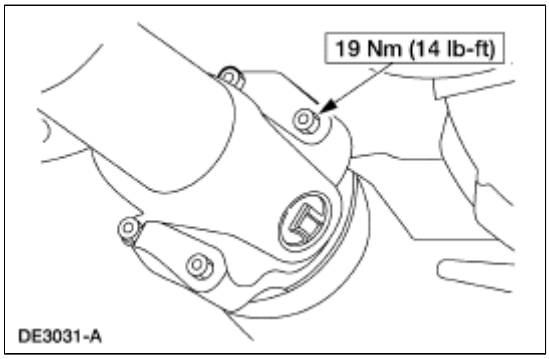
8. Raise the vehicle.

9. Remove the lower engine splash shield, if equipped.

10. **WARNING: Tape the U-joint bearing caps to prevent them from falling off the U-joint.**

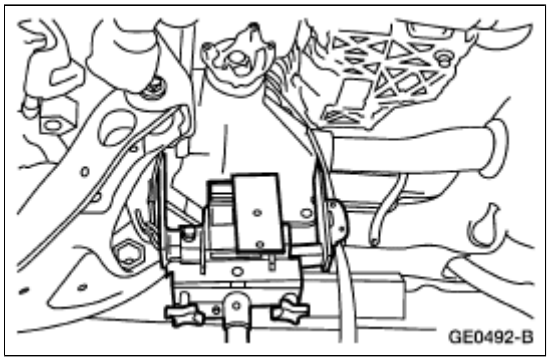
    WARNING: Index-mark the front axle pinion flange to the front driveshaft.

    Remove and discard the bolts and straps. Secure the driveshaft out of the way.

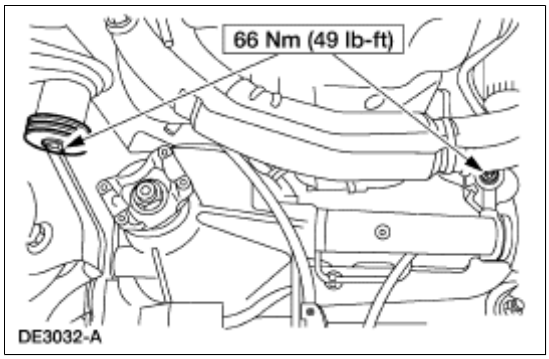


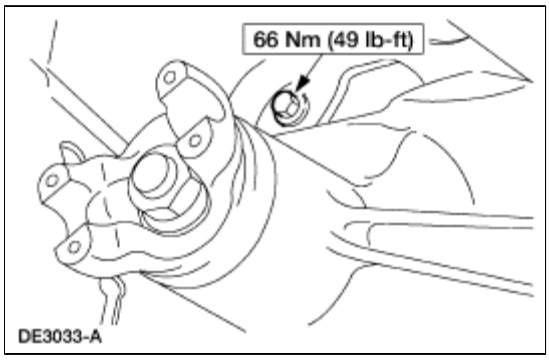
11. **NOTE:** Use the Axle Service Plugs Set T95T-4850-A to plug the axle openings.

    Secure the axle housing to a suitable lift.



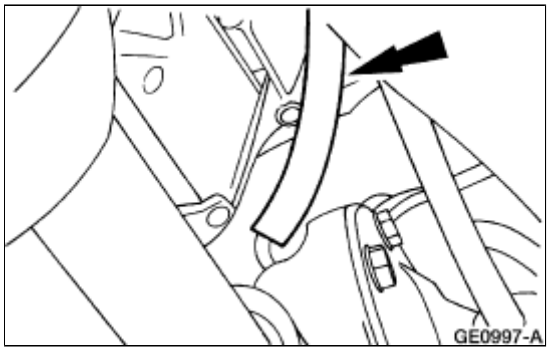
12. Remove and discard the bolts.





13. Lower the axle 25 mm (1 inch) and move to the right 19 mm (0.75 inch), guiding the LH axle halfshaft out of the axle.

14. Disconnect the vent hose from the front axle housing.



15. Lower the axle from the vehicle.

Installation

1. **CAUTION: Install a new retainer circlip on the left inboard CV joint housing. If reinstalling the original axle housing, install a new retainer circlip on the right side.**

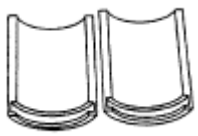
   CAUTION: Make sure the halfshaft circlips fully seat.

   To install, reverse the removal procedure.
   - Fill the front axle with the correct type and quantity of lubricant.
   - Install new driveshaft bolts and straps.

- Install new axle mounting bolts.

Bushing

Special Tool(s)

 ST1160-A	Bushing Collet Replacer 205-372 (T96T-5638-F)
 ST1159-A	Bushing Cup Remover/Replacer 205-371 (T96T-5638-E)
 ST1155-A	Bushing Remover 205-376 (T96T-5638-K)
 ST1156-A	Bushing Replacer 205-370 (T96T-5638-B)
 ST1162-A	Drawbolt 205-374 (T96T-5638-H)
 ST1158-A	Ring Gauge (0.225) 204-206 (T96T-5638-D)

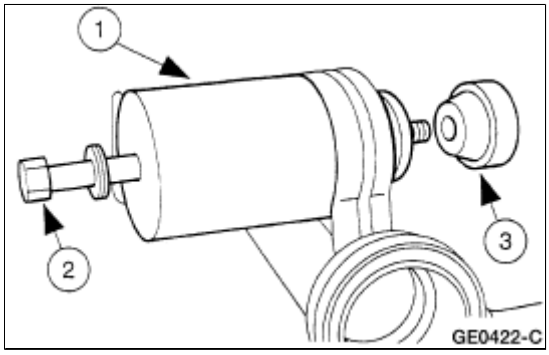
Removal

1. **NOTE:** Axle tube bushing removal shown, axle housing bushing is a similar procedure.

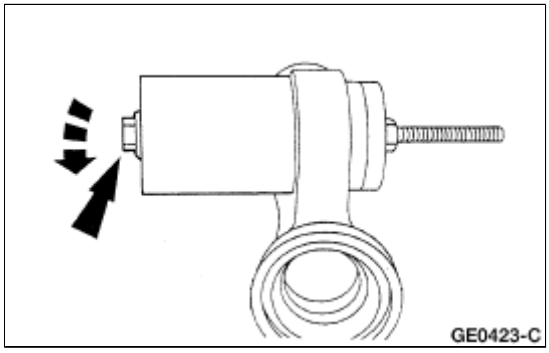
   Remove the front axle assembly. For additional information, refer to Axle Assembly—Front in this

section.

2. Position the tube bushing removal tools.
    1. Position the Bushing Cup Remover/Replacer.
    2. Position the Drawbolt.
    3. Thread the Bushing Remover on the Drawbolt.



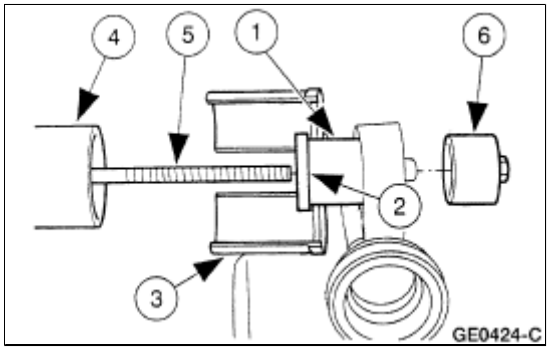
3. Tighten the Drawbolt to remove the tube bushing.



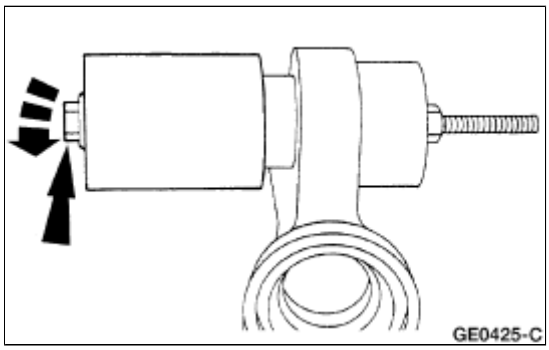
Installation

1. **NOTE:** Axle tube bushing installation shown, axle housing bushing is a similar procedure.

    Position the tube bushing and the tube bushing installation tools.
    1. Position the tube bushing.
    2. Position the Ring Gauge.
    3. Position the Bushing Collet Replacer.
    4. Position the Bushing Cup Remover/Replacer.
    5. Position the Drawbolt.
    6. Thread the Bushing Replacer on the Drawbolt.



2. Tighten the Drawbolt to install the tube bushing.
    - Remove the tools.



3. Install the front axle assembly. For additional information, refer to Axle Assembly—Front in this section.

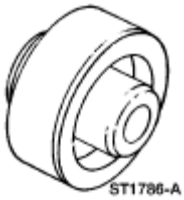
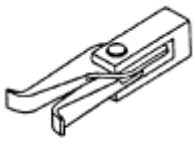
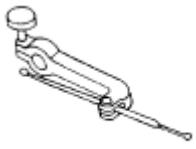
4. Check the fluid level and fill the axle to specification.
    - Use Motorcraft SAE 80W90 Thermally Stable 4x4 Axle Lubricant meeting Ford specification WSP-M2C197-A.

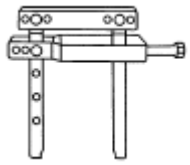
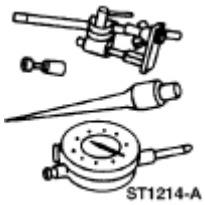
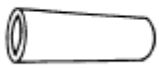
5. Lower the vehicle.

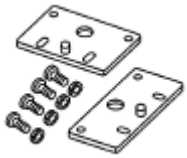
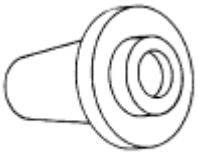
6. If equipped with air suspension , reactivate the system by turning on the air suspension switch.

Axle

Special Tool(s)

 ST2026-A	2-Jaw Puller 205-D072 (D97L-4221-A) or Equivalent
 ST2472-A	Axle Bearing Replacer 205-345 (T95T-1175-B)
 ST1768-A	Axle Bearing Replacer 205-347 (T95T-1175-D)
 ST1786-A	Axle Seal Replacer 205-350 (T95T-3010-A)
 ST1200-A	Bearing Cup Remover 308-047 (T77F-1102-A)
 ST1362-A	Bearing Remover 307-318 (T94P-77001-KH)
 ST1348-A	Clutch Housing Alignment Adapter 308-021 (T75L-4201-A)

 ST1257-A	Companion Flange Holding Tool 205-126 (T78P-4851-A)
 ST1609-A	Converter Oil Seal Remover 307-309 (T94P-77001-BH)
 ST1361-A	Cup Replacer (Outer) (use with 205-098) 205-054 (T71P-4616-A)
 ST1544-A	Dana Pinion Depth Gauge 205-S156 (T80T-4020-A)
 ST1214-A	Dial Indicator with Bracketry 100-002 (TOOL-4201-C) or Equivalent
 ST1259-A	Differential Carrier Spreader 205-001 (TOOL-4000-E) or Equivalent
 ST1548-A	Dummy Bearing, Differential Bearing 205-247 (T86T-4222-AH)
 ST1434-A	Gauge Tube 205-D034 (D80T-4020-F49) or equivalent
	Handle 205-153 (T80T-4000-W)

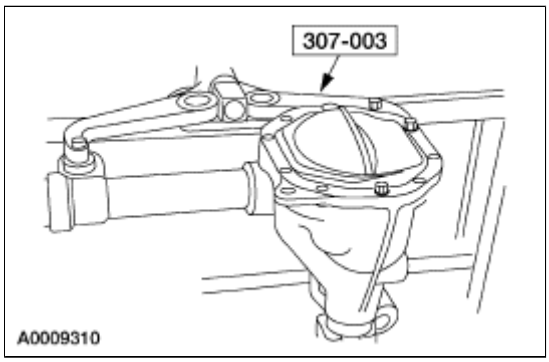
 ST1255-A	
 ST1186-A	Holding Fixture 307-003 (T57L-500-B)
 ST1610-A	Housing Spreader Adapter Set 205-356 (T95T-4000-A)
 ST1484-A	Pinion Bearing Cone Replacer 205-005 (T53T-4621-C)
 ST1361-A	Pinion Bearing Cup Replacer (Inner) (use with 205-098) 205-014 (T60K-4616-A)
 ST1358-A	Pinion Seal Replacer 205-133 (T79P-4676-A)
 ST1869-A	Rear Axle Draw Bar 205-098 (T75T-1176-A)
 ST1310-A	Universal Bearing Puller 205-055 (T71P-4621-B)

Disassembly

CAUTION: Many components and surfaces in the axle are precision machined. Careful handling during disassembly, cleaning, inspection, and assembly will prevent unnecessary damage to machined surfaces.

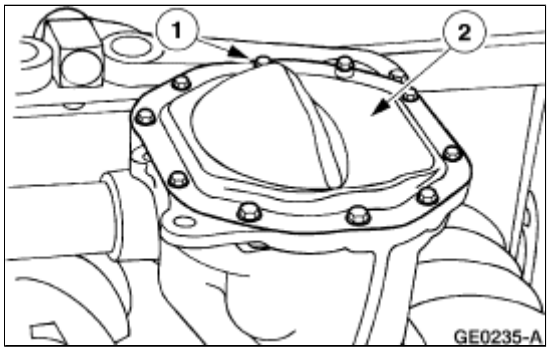
1. Remove the front drive axle assembly from the vehicle. For additional information, refer to Axle Assembly—Front in this section.

2. Attach the axle assembly to the special tool.



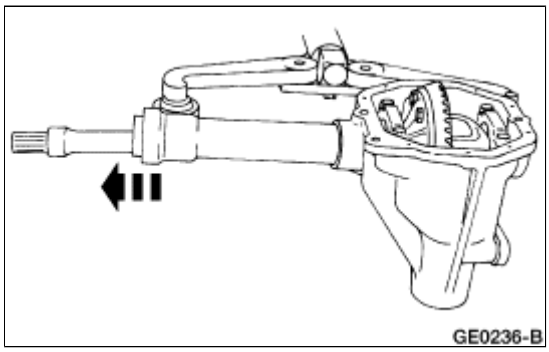
3. **NOTE:** Place a suitable drain pan under the axle.

   Remove the differential housing cover.
   1. Remove the bolts.
   2. Remove the differential housing cover.

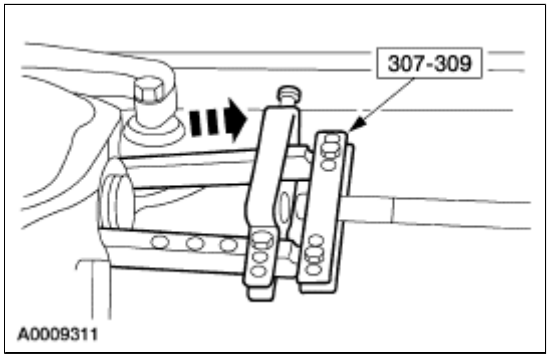


4. Drain the axle lubricant from the differential housing.

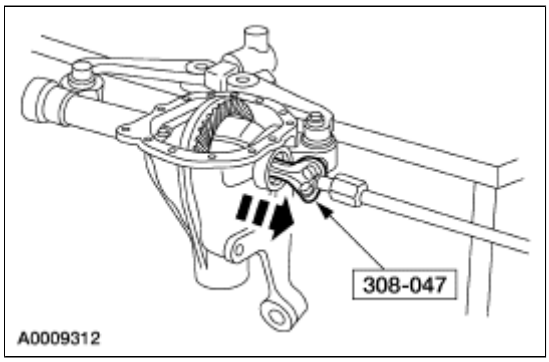
5. Remove the axle shaft using a jerking motion.



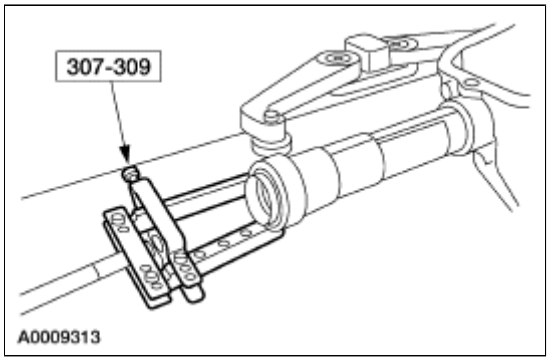
6. Using the special tool and a suitable impact slide hammer, remove the axle shaft oil seal.



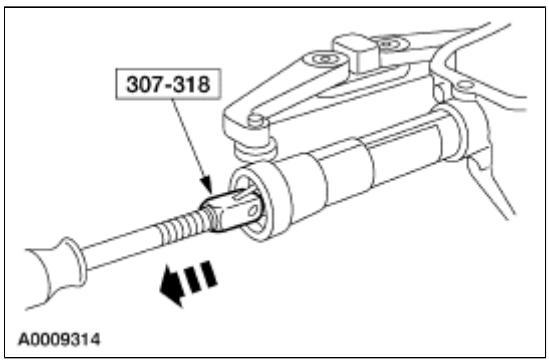
7. Using the special tool and a suitable impact slide hammer, remove the axle shaft bearing.



8. Using the special tool and a suitable impact slide hammer, remove the axle shaft oil seal.

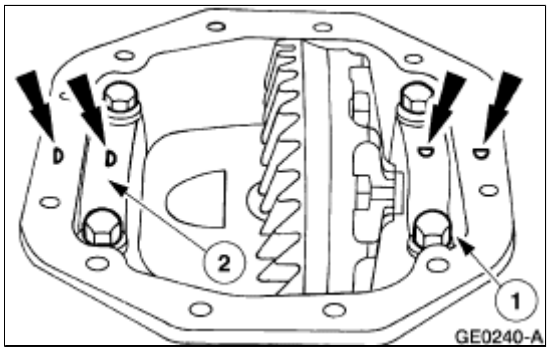


9. Using the special tool and a suitable impact slide hammer, remove the axle tube bearing.



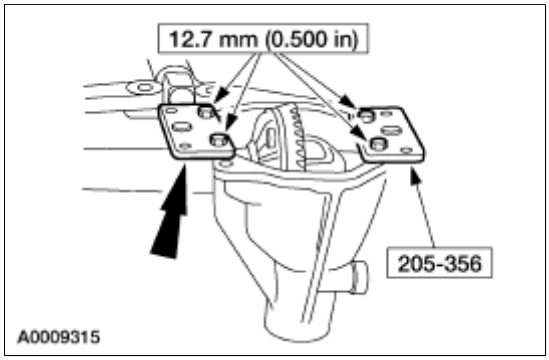
10. **CAUTION: The matched numbers or letters stamped on both of the differential bearing caps and the differential housing must correspond during assembly.**

    Remove the differential bearing caps.
    1. Remove the bolts.
    2. Remove the differential bearing caps.

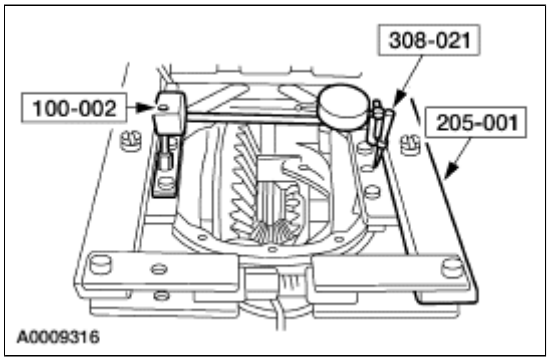


11. **CAUTION: The Housing Spreader Adapter bolts have a minimum thread engagement as specified.**

    Install the special tool.



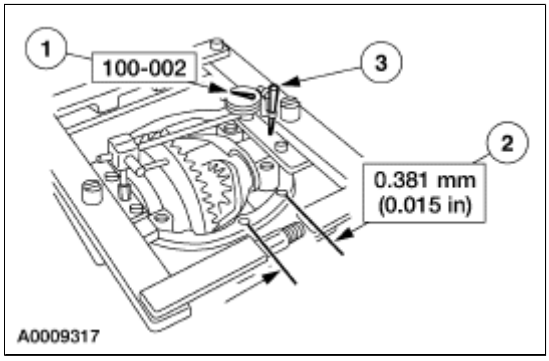
12. Install the special tools.
    - Position the Clutch Housing Alignment Adapter needle in the Housing Spreader Adapter hole.



13. **CAUTION: Over spreading can damage the differential housing.**

Spread the differential housing to the specification.

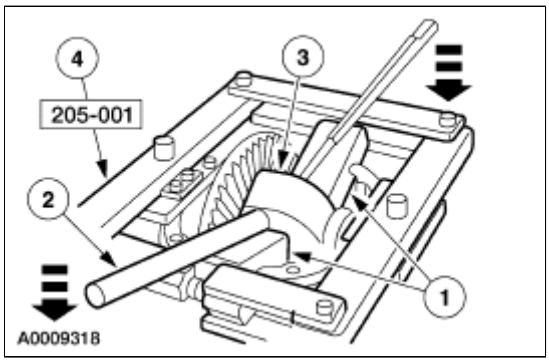
1. Adjust the special tool to zero.
2. Tighten the Differential Carrier Spreader screw to spread the differential housing to the specification.
3. Remove the Dial Indicator with Bracketry and the Clutch Housing Alignment Adapter.



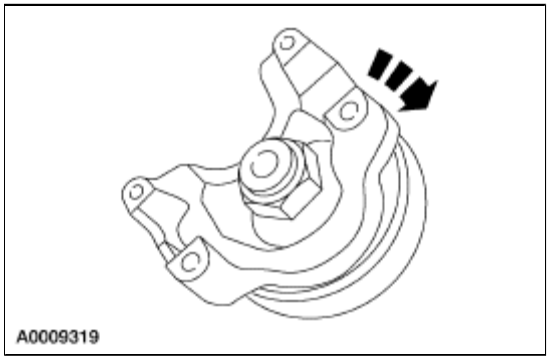
14. **CAUTION: Use wood blocks to avoid damaging the differential housing.**

Remove the differential assembly from the differential housing.

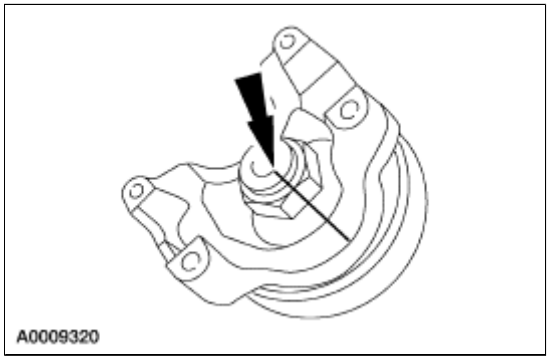
1. Position the wood blocks.
2. Push downward on the pry bars.
3. Remove the differential assembly.
4. Remove the special tool.



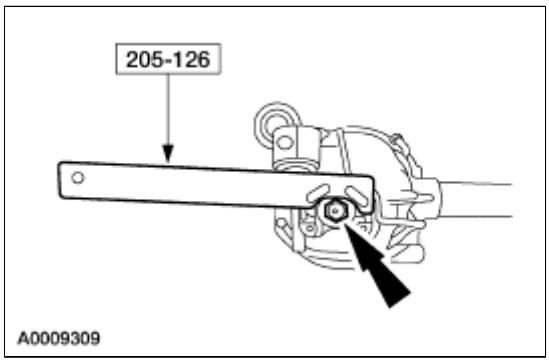
15. Measure the pinion bearing preload.
    - Using a Nm (pound-inch) torque wrench, measure the torque required to maintain pinion rotation. Record the measurement.



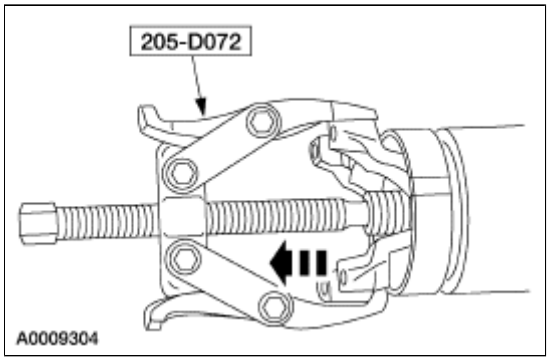
16. Index-mark the pinion flange and the pinion stem.



17. Use the special tool to hold the flange while removing the nut.



18. Using the special tool, remove the pinion flange.

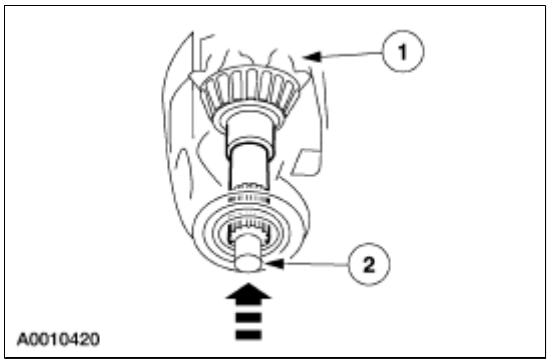


19. **WARNING: The gear teeth have sharp edges. Handle the gear with care to avoid personal injury.**

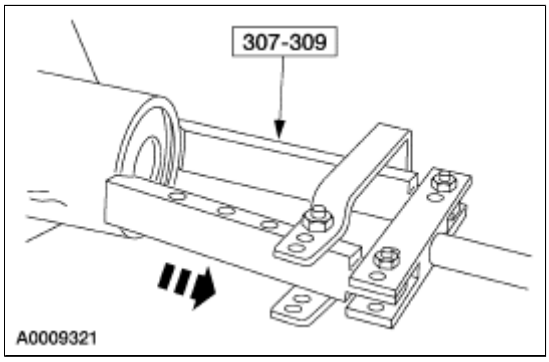
CAUTION: Never use a metal hammer on the pinion. Use a soft mallet to drive the pinion out of the differential housing.

Using a soft-face hammer, remove the pinion from the differential housing.

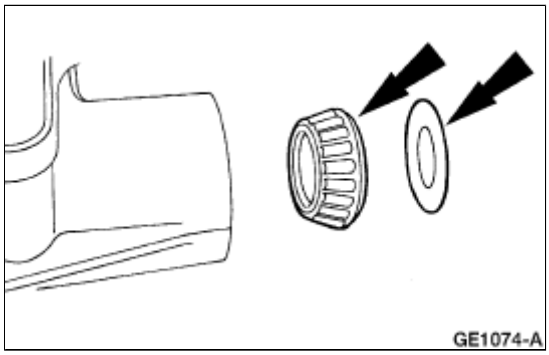
1. Hold the pinion inside the differential housing.
2. Use a soft-face hammer to remove the pinion from the differential housing.



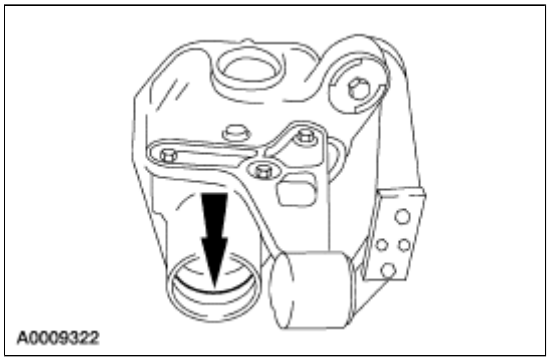
20. Using the special tool and a suitable impact slide hammer, remove the pinion seal.



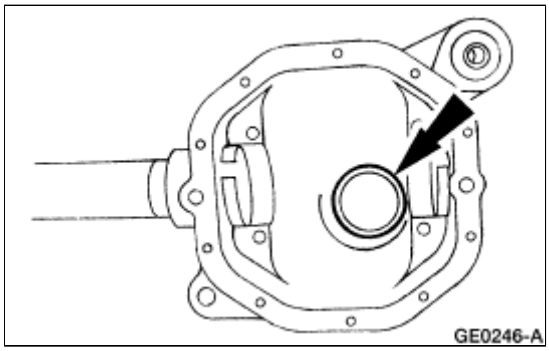
21. Remove the front axle drive pinion shaft oil slinger and the differential pinion bearing.



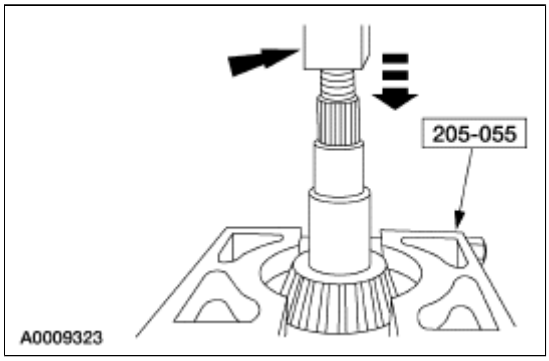
22. Remove the outer differential drive pinion bearing cup by tapping alternately on each side of the cup to prevent it from cocking in the bore.



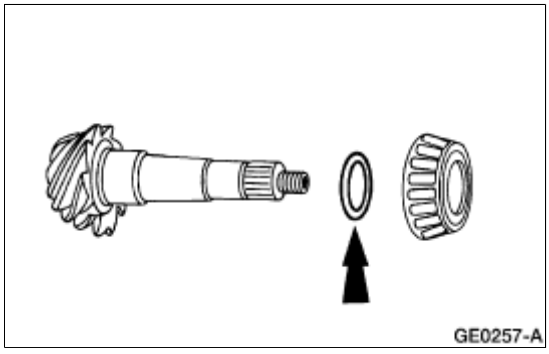
23. Remove the inner differential drive pinion bearing cup by tapping alternately on each side of the cup to prevent it from cocking in the bore.



24. Using the special tool and a suitable press, remove the differential pinion bearing.



25. Remove the pinion position shim from the differential pinion gear. Measure the pinion position shim thickness with a micrometer. Record the measurement.



26. Remove the differential ring gear, the differential bearings, and if necessary, disassemble the differential case. For additional information, refer to Differential Case in this section.

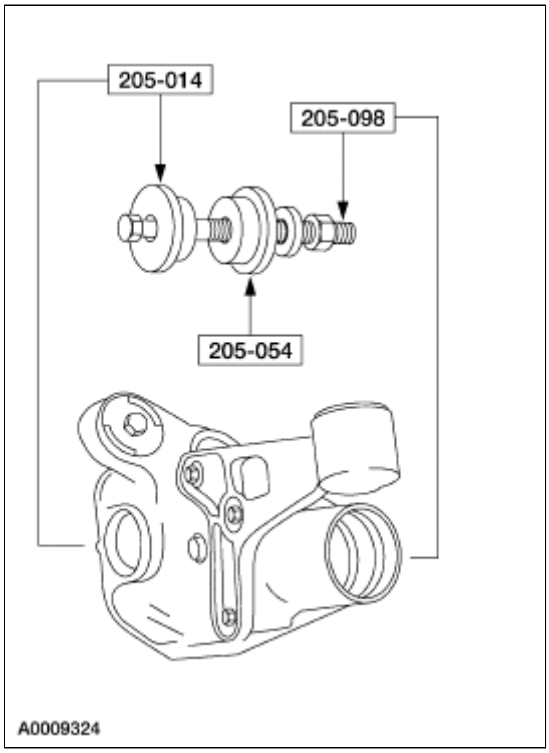
Assembly

CAUTION: Always install new gaskets and seals when assembling the axle. When building the subassembly, lubricate each component with clean Motorcraft SAE 80W90 Thermally Stable 4x4 Axle Lubricant meeting Ford specification WSP-M2C197-A. Also, lubricate the subassembly when installing it into the differential housing. Tighten all fasteners to specification.

1. **CAUTION: Always install new differential pinion bearings when installing new differential drive pinion bearing cups.**

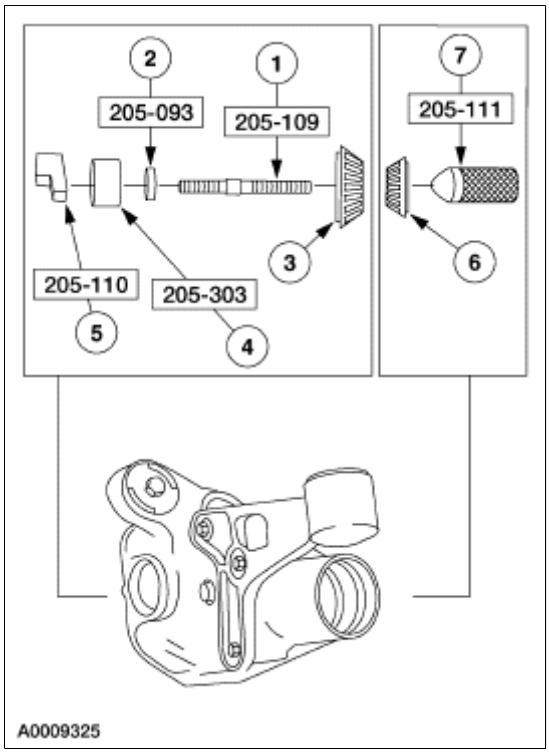
   Lubricate the new differential drive pinion bearing cups.
   - Use Motorcraft SAE 80W90 Thermally Stable 4x4 Axle Lubricant meeting Ford specification WSP-M2C197-A.

2. Using the special tools, install the differential drive pinion bearing cups.

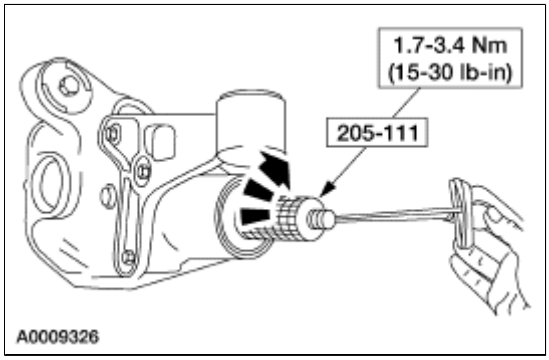


3. **NOTE:** Apply a light film of oil to the differential pinion bearings before installing them.

   Assemble and position the following in the differential housing.
   1. Position the Screw.
   2. Position the Aligning Adapter.
   3. Position the inner differential pinion bearing.
   4. Position the Gauge Disc.
   5. Position the Gauge Block.
   6. Position the outer differential pinion bearing.
   7. Thread on the Handle.

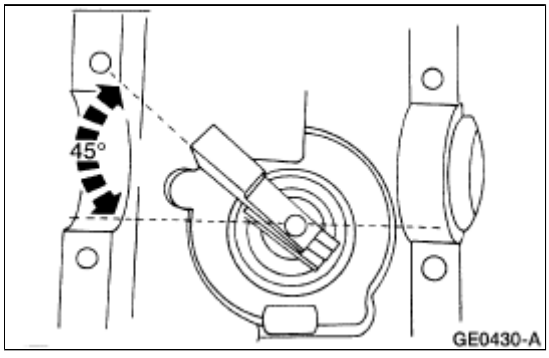


4. Using a Nm (pound-inch) torque wrench, tighten the Handle.

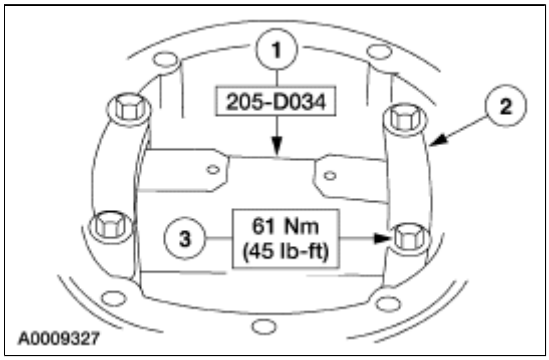


5. **NOTE:** Offset the Gauge Block to obtain an accurate reading.

   Rotate the Gauge Block several half turns to ensure the differential pinion bearings seat correctly, and position the Gauge Block as shown.



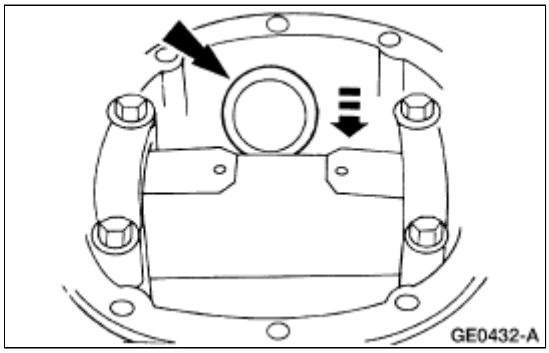
6. Install the special tool and the paper shipping tags.
    1. Position the special tool and the paper shipping tags.
    2. Install the differential bearing caps.
    3. Install the bolts.



7. **NOTE:** Use a feeler gauge, or flat, clean drive pinion position shims as a measuring device.

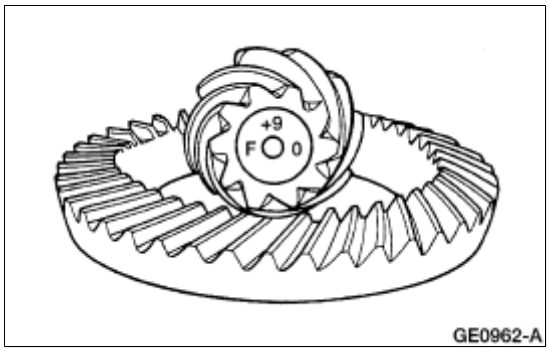
    NOTE: Selection of a shim that is too thick results in deep tooth contact at final assembly. Do not attempt to force the gauge or shim between the Gauge Block and the Gauge Tube. A slight drag indicates a correct selection.

    Using a feeler gauge, or a flat, clean drive pinion position shim, measure between the Gauge Block and the Gauge Tube. Record the measurement.
    - Remove the special tools after determining the correct shim thickness.

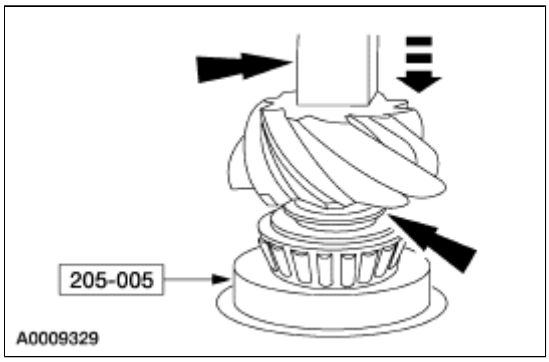


8. Select the correct thickness drive pinion position shim.
    - New drive pinion position shims are available in 0.762 mm (0.030 in), 0.8128 mm (0.032 in), 0.8636 mm (0.034 in), 0.9144 mm (0.036 in), 0.9652 mm (0.038 in), 1.016 mm (0.040 in), 1.0668 mm (0.042 in), 1.1176 mm (0.044 in), 1.1684 mm (0.046 in), 1.2192 mm (0.048 in), 1.27 mm (0.050 in), and 1.3208 mm (0.052 in) thickness.

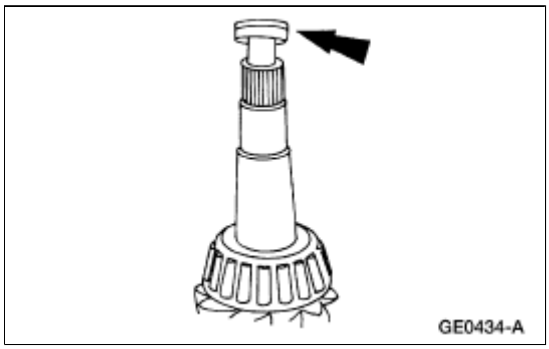
9. The shim selection tool steps identify the correct shim for a ring and pinion with an "O" etching. Optimum depth for each gearset is determined at the factory and the number is etched, + or -, on the pinion button. If the etched number is positive, subtract that number from the shim thickness identified by the selection tool steps. If the number is negative, add that number to the selected shim thickness.



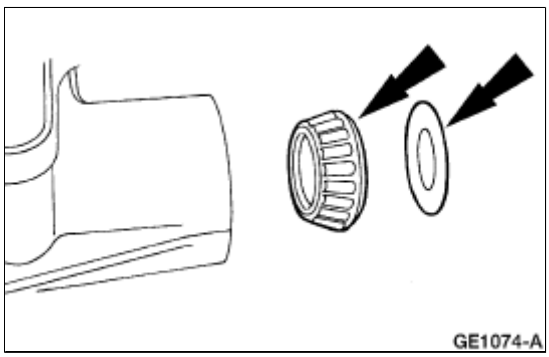
10. Install the pinion position shim and the differential pinion bearing.
    - Using the special tool and a suitable press, seat the differential pinion bearing firmly against the pinion position shim.



11. Install a new collapsible spacer.



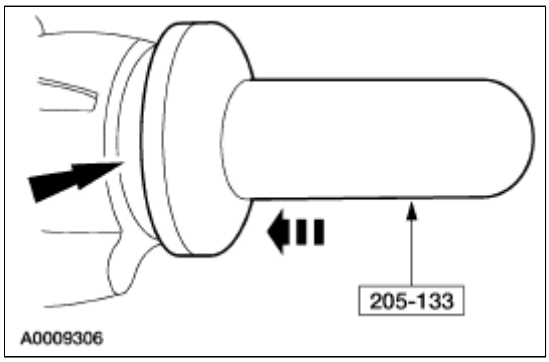
12. Install the differential pinion bearing and the front axle drive pinion shaft oil slinger.



13. **CAUTION: Installing the pinion seal without the correct tool can result in early seal failure.**

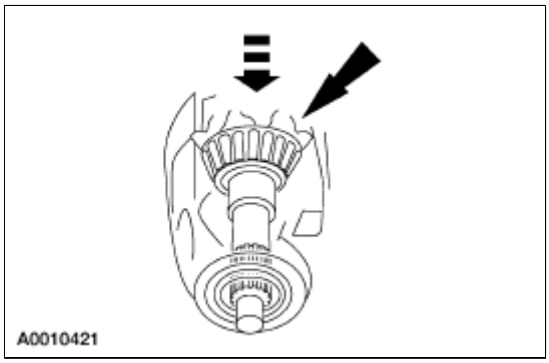
    CAUTION: If the pinion seal becomes cocked during installation, remove it and install a new one.

    Using the special tool, install the pinion seal.



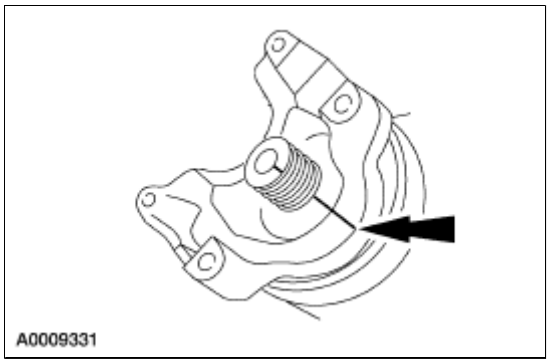
14. Lightly lubricate the pinion gear splines.
    - Use Motorcraft SAE 80W90 Thermally Stable 4x4 Axle Lubricant meeting Ford specification WSP-M2C197-A.

15. Position the pinion gear in the differential housing.

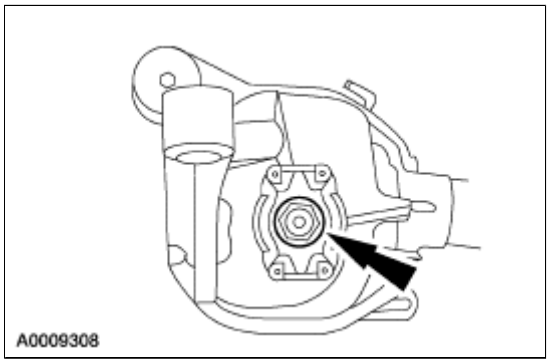


16. **CAUTION: Never use a metal hammer on the pinion flange or install the flange with power tools. If necessary, use a plastic hammer to tap on a tight fitting flange.**

    Align the index marks and install the pinion flange.



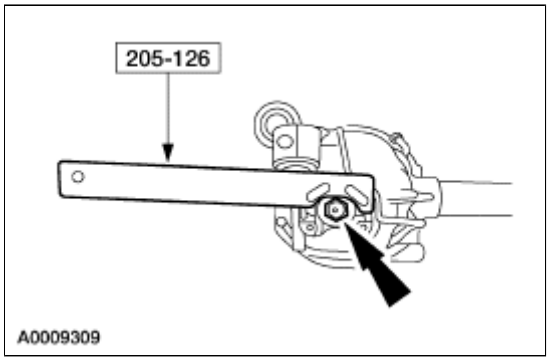
17. Install the new nut hand-tight.



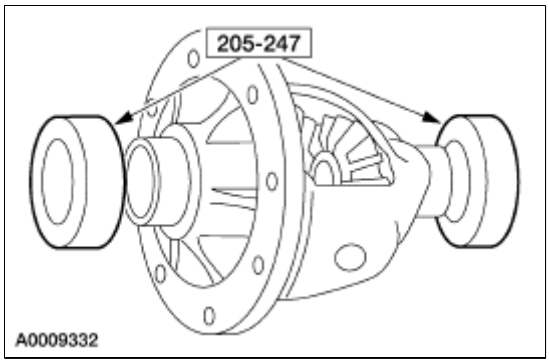
18. **CAUTION: Do not loosen the nut to reduce preload. Install a new collapsible spacer and nut if preload reduction is necessary.**

Use the special tool to hold the pinion flange while tightening the nut to set the preload.

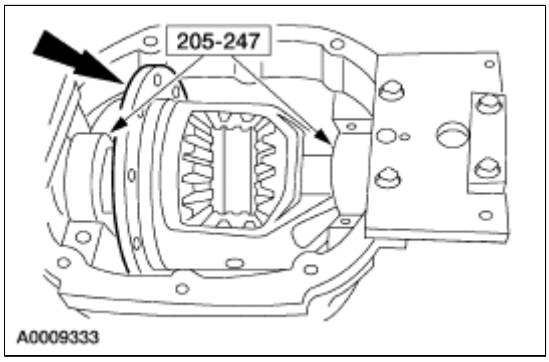
- Rotate the pinion occasionally to ensure the differential pinion bearings are seating correctly. Take frequent differential pinion bearing preload readings by rotating the pinion with a Nm (inch-pound) torque wrench.
  - If installing new differential pinion bearings, tighten the nut to specification. Refer to Specifications in this section.
  - If installing the original differential pinion bearings, the final reading must be 0.56 Nm (5 lb-in) more than the initial reading taken during disassembly.



19. Install the special tool.

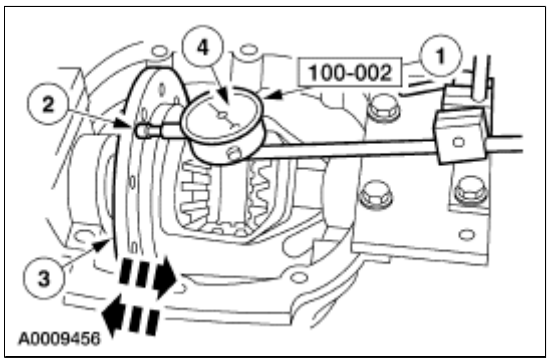


20. Install the differential case in the differential housing.

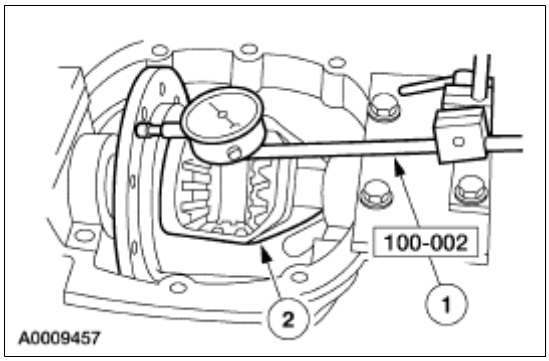


21. **NOTE:** Repeat this step until obtaining a consistent reading.

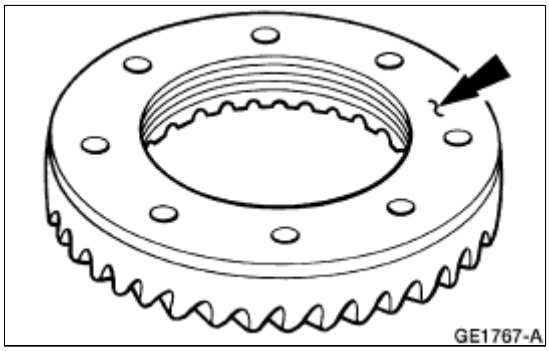
    Measure the total end play.
    1. Install the special tool.
    2. Force the differential case as far as possible away from the indicator. Position the indicator tip on the machined surface and adjust it to measure full travel. With force still applied, set the indicator to zero.
    3. Force the differential case as far as possible in the opposite direction.
    4. Record the total end play reading on the Differential Bearing Shim Selection Procedure Worksheet, Line A in this procedure.



22. Remove the special tool, and remove the differential case.
    1. Remove the special tool.
    2. Remove the differential case.



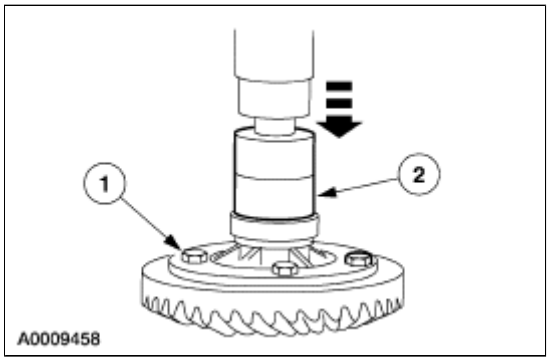
23. Use a fine flat file to remove any burrs and nicks found on the differential ring gear mounting surface.



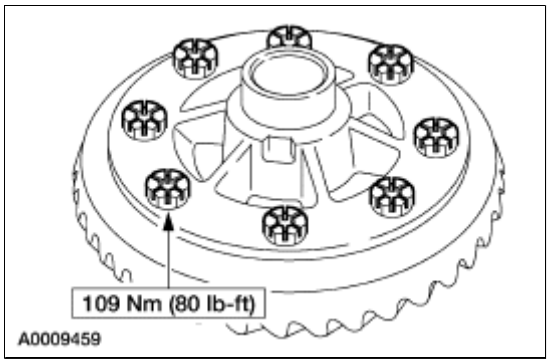
24. **CAUTION: Do not reuse the original bolts.**

Using a suitable press, install the differential ring gear.

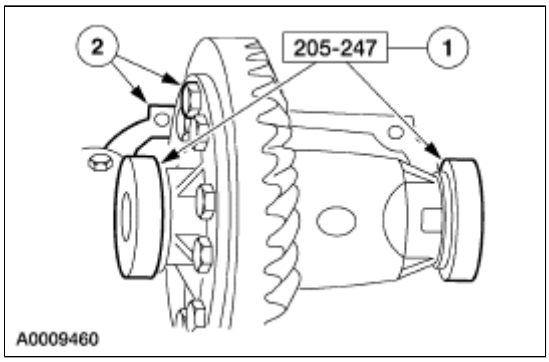
1. Position the differential ring gear and the differential case. Start two or three new bolts to align the holes in the ring gear and the differential case.
2. Using a suitable press, install the differential ring gear.



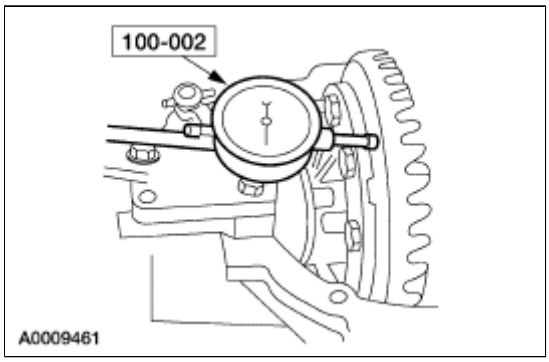
25. Install the remaining new bolts. Tighten all of the bolts to specification.



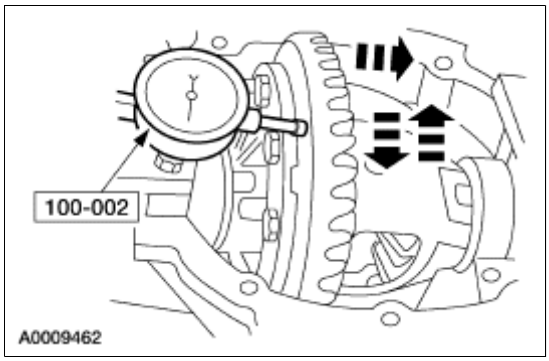
26. Install the special tool, and position the assembly in the differential housing.
    1. Install the special tool.
    2. Position the assembly in the differential housing.



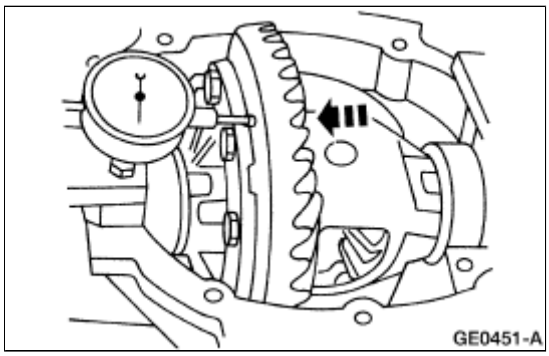
27. Position the special tool.



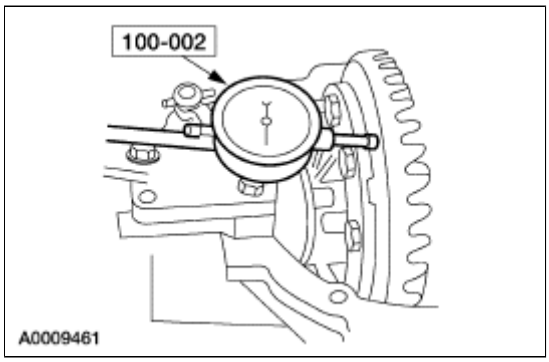
28. Force the differential ring gear into mesh with the pinion gear (zero backlash). With force still applied, set the special tool to zero.



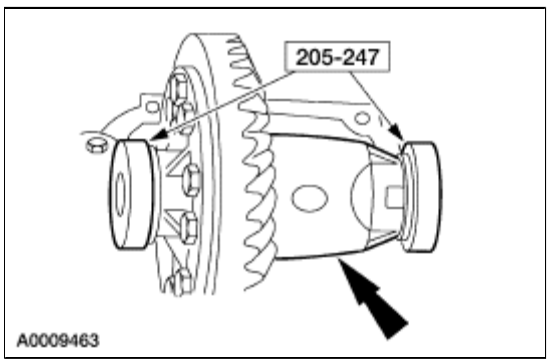
29. Force the differential ring gear away from the pinion gear as far as possible. Record the reading on the Differential Bearing Shim Selection Procedure Worksheet, Line D in this procedure.



30. Remove the special tool.



31. Remove the differential case from the differential housing. Remove the special tool from the differential case hubs.

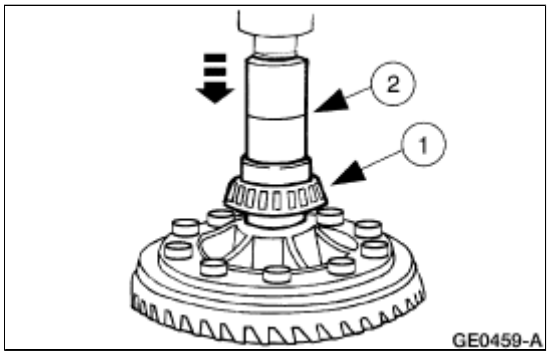


32. Complete the worksheet, and select the appropriate thickness differential shims. New differential shims are available in 0.0762 mm (0.003 in), 0.127 mm (0.005 in), 0.254 mm (0.010 in), and 0.762 mm (0.030 in) thickness.

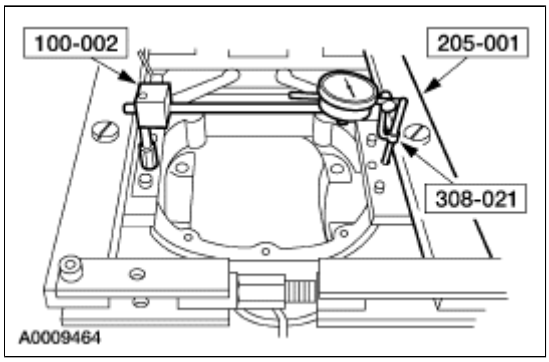
Differential Bearing Shim Selection Procedure Worksheet

Line	Item	Result (actual) mm (in)	Result (example) mm (in)
A	Total end play reading (without gears)		2.032 (0.080)
B	Add preload	+0.2032 (+0.008)	+0.2032 (+0.008)
C	Total (add A and B)		2.2352 (0.088)
D	End play measurement (with gears)		1.0414 (0.041)
E	Subtract the shim thickness on the ring gear side	-0.0762 (-0.003)	-0.0762 (-0.003)
F	Total (subtract E from D) (thickness of shims to place on the ring gear side)		0.9652 (0.038)
G	Total (subtract F from C) (thickness of shims to place on the drive pinion side)		1.27 (0.050)

33. Install the differential shims and the differential bearing.
    1. Position the differential shims and the differential bearing.
    2. Using a suitable press, install the differential bearing.
    - Repeat this step for opposite side of the differential case.

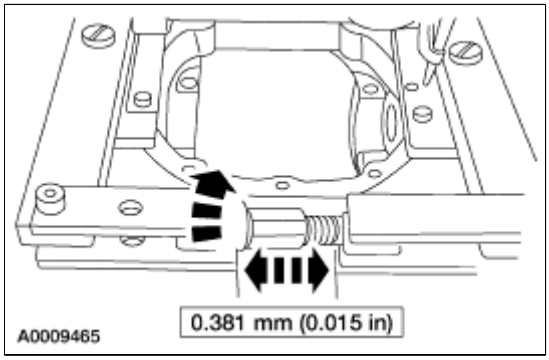


34. Install the special tools.
    - Position the Clutch Housing Alignment Adapter needle in the Housing Spreader Adapter hole.

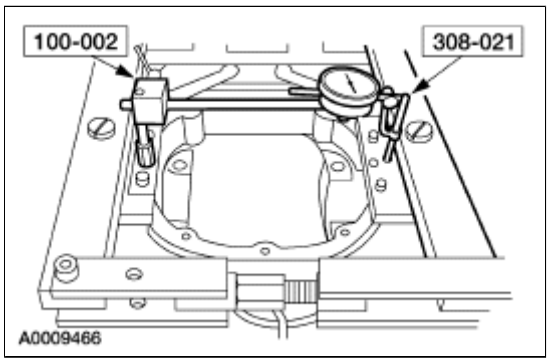


35. **CAUTION: Over spreading can damage the differential housing.**

Spread the differential housing to the specification.

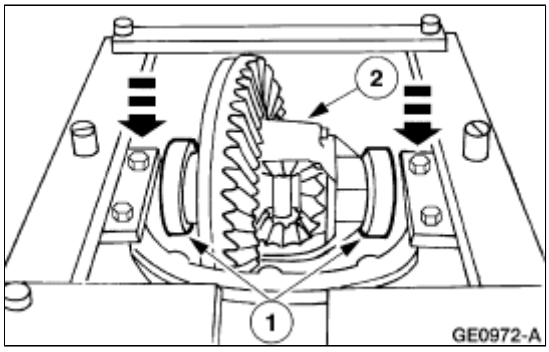


36. Remove the special tools.



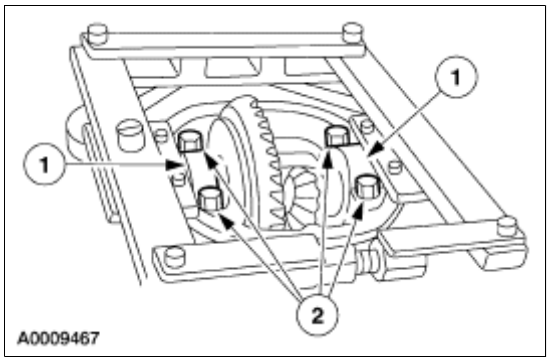
37. **NOTE:** Push the differential case downward to fully seat the differential bearing cups in the differential housing.

Install the differential bearing cups and the differential case in the differential housing.
1. Position the differential bearing cups on the differential bearings.
2. Lower the differential case in place.

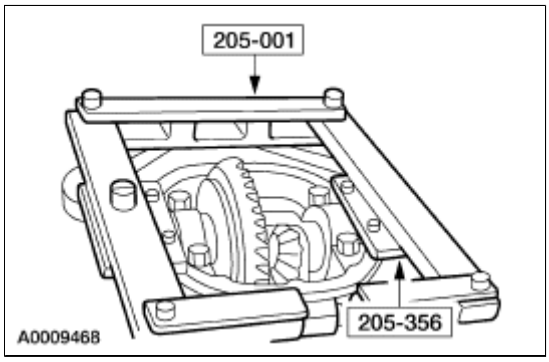


38. **CAUTION: Do not tighten the bolts to specification at this time.**

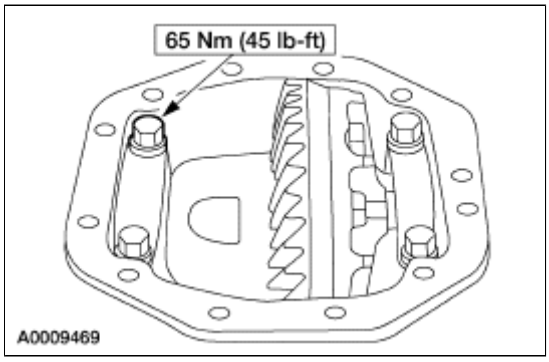
Install the differential bearing caps in their original positions.
1. Position the differential bearing caps.
2. Install the bolts hand-tight.



39. Remove the special tools.

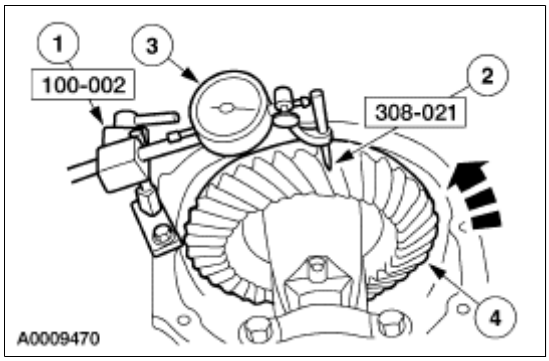


40. Tighten the bolts.

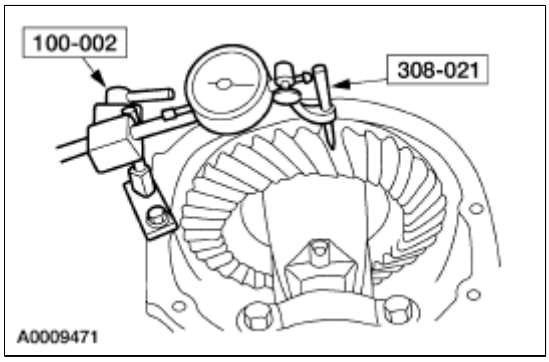


41. Verify that the differential case rotates freely.

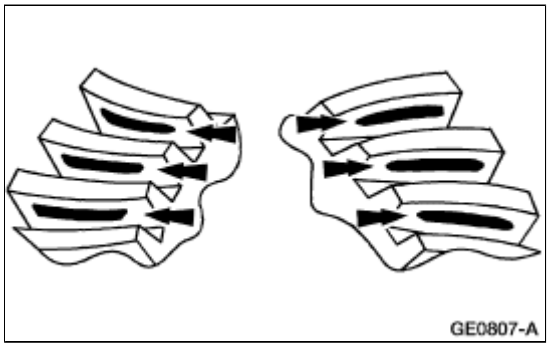
42. Using the special tools, measure the backlash at three equally spaced points on the differential ring gear.
    1. Mount the special tool.
    2. Position the special tool.
    3. Zero the indicator.
    4. Turn the differential ring gear without turning the pinion gear. Record the measurement.
    - The backlash tolerance is 0.13 mm (0.005 in) to 0.20 mm (0.008 in) and cannot vary more than 0.05 mm (0.002 in) between points checked. A backlash variation of more than 0.005 mm (0.002 in) indicates gear/case runout.
    - If the backlash is not within specification, correct by increasing the thickness of one differential bearing shim and decreasing the thickness of the other differential bearing shim by the same amount.



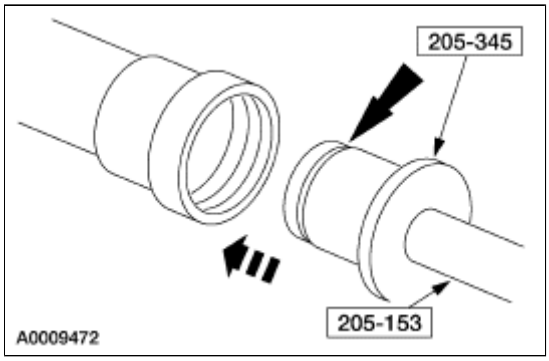
43. Remove the special tools.



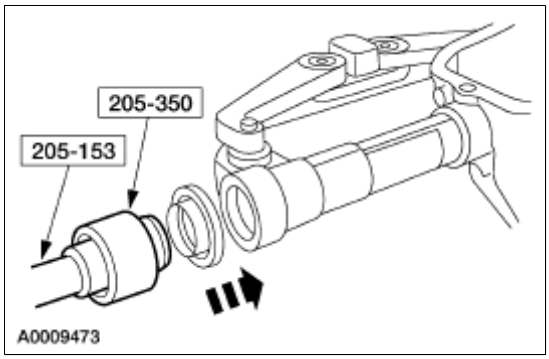
44. Check the gear tooth contact pattern. For additional information, refer to Section 205-00 .



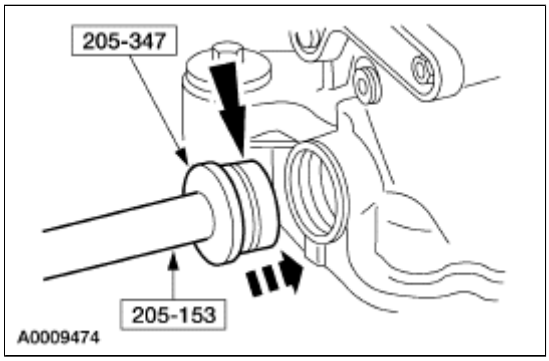
45. Using the special tools, install the axle tube bearing.



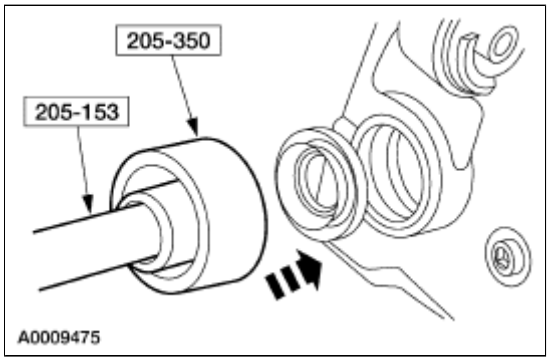
46. Using the special tools, install the axle shaft oil seal.



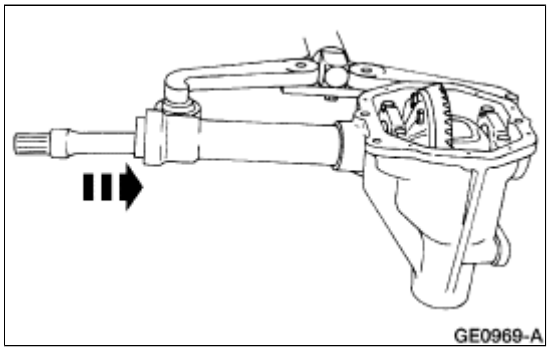
47. Using the special tools, install the axle shaft bearing.



48. Using the special tools, install the axle shaft oil seal.



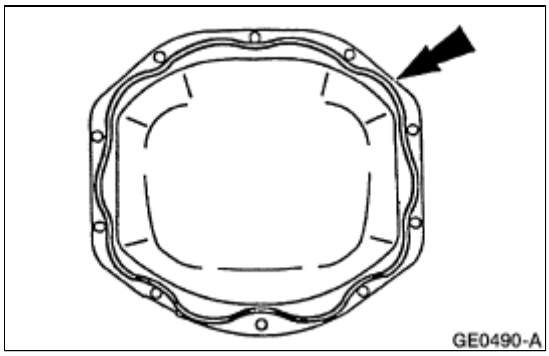
49. Install the axle shaft.



50. **CAUTION: The machined mating surfaces on the differential housing and the differential housing cover must be clean and free of lubricant before applying the new silicone sealant. Cover the inside of the differential housing before cleaning the machined surface to prevent contamination.**

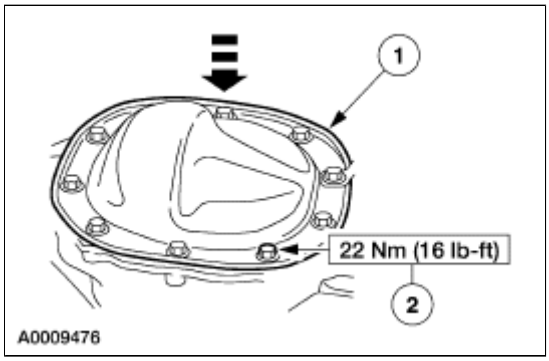
    Clean the differential housing and the differential housing cover mating surfaces.

51. Apply a continuous bead of sealant to the differential housing cover.
    - Use Ford Black Silicone Rubber F4AZ-19562-B or equivalent meeting Ford specification WSE-M4G323-A1.



52. **CAUTION: Install the differential housing cover within 15 minutes of applying the silicone or it will be necessary to apply new sealant. 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. Position the differential housing cover.
    2. Install the bolts.



53. Install the front axle assembly. For additional information, refer to Axle Assembly—Front in this section.

54. Fill the axle with 1.54 Liter (2.25 pints) of lubricant.
    - Use Motorcraft SAE 80W90 Thermally Stable 4x4 Axle Lubricant meeting Ford specification WSP-M2C197-A.

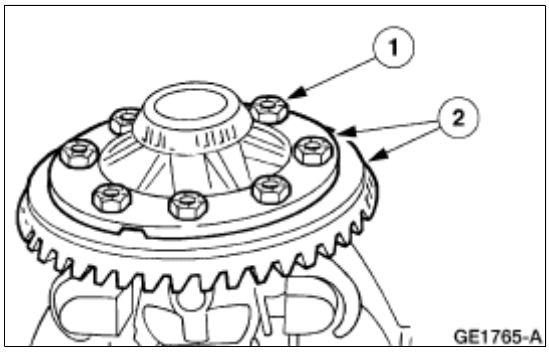
Differential Case

Special Tool(s)

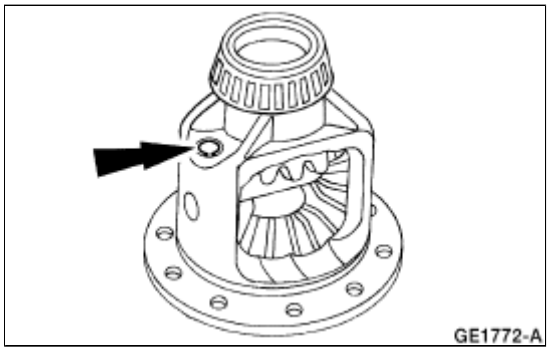
 ST1347-A	Pinion and Carrier Puller 205-D036 (D81L-4220-A) or Equivalent

Disassembly

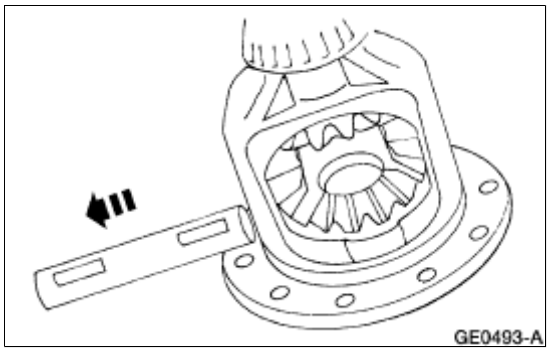
1. Remove the differential ring gear.
    1. Remove and discard the bolts.
    2. Using a drift that will bottom out in the bolt holes, separate the differential ring gear from the differential case.



2. Drive out the differential pinion shaft roll pin.

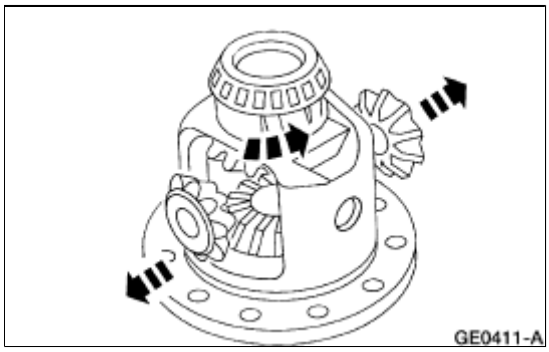


3. Remove the differential pinion shaft.

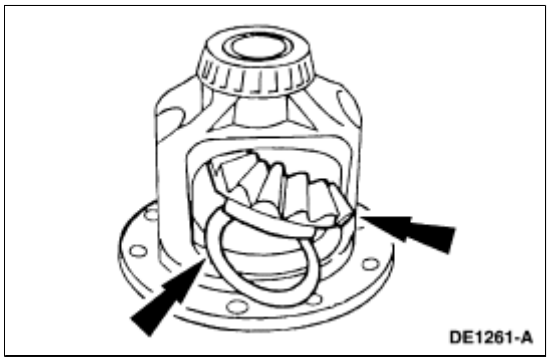


4. **CAUTION: The upper differential side gear may fall out of the case bore after removing the differential pinion gears.**

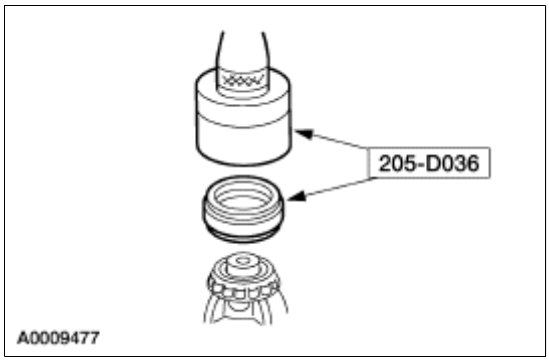
   Rotate the differential pinion gears to the differential case window and remove them and the differential pinion thrust washers.



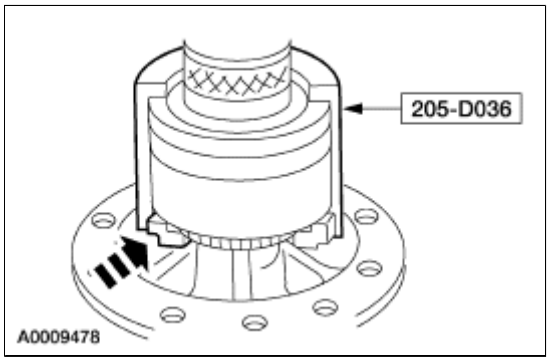
5. Remove the differential side gears and the differential side gear thrust washers.



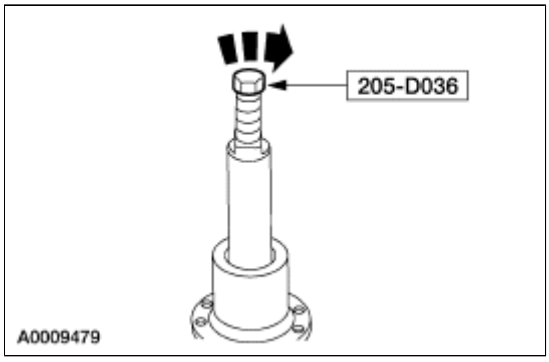
6. Assemble the special tool.



7. Position the special tool on the differential bearing.

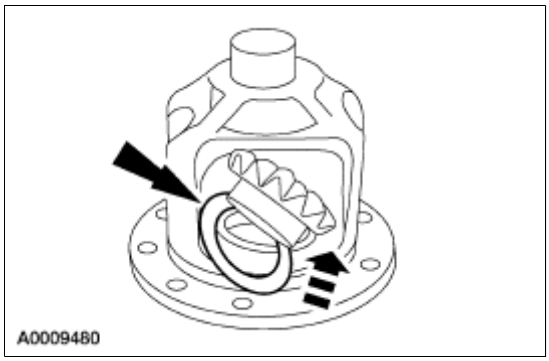


8. Using the special tool, remove the differential bearing.
    - Repeat the procedure for the other bearing.

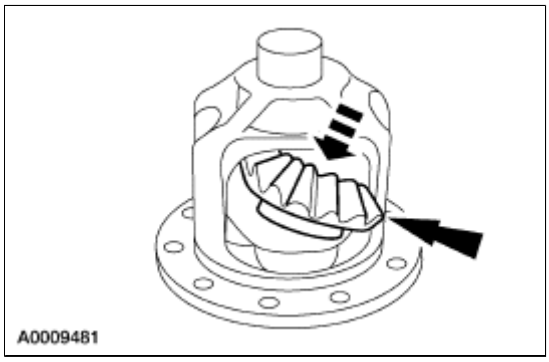


Assembly

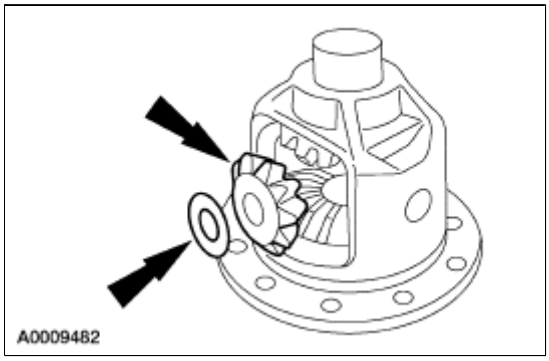
1. Lubricate the differential side gear thrust washers and the differential side gears, and assemble them.
    - Use Motorcraft SAE 80W90 Thermally Stable 4x4 Axle Lubricant meeting Ford specification WSP-M2C197-A.



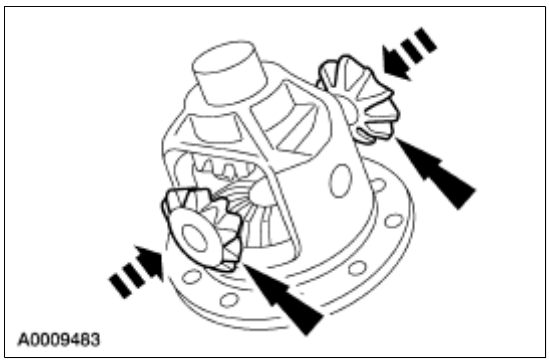
2. Position the differential side gear and thrust washer assemblies in the differential case.



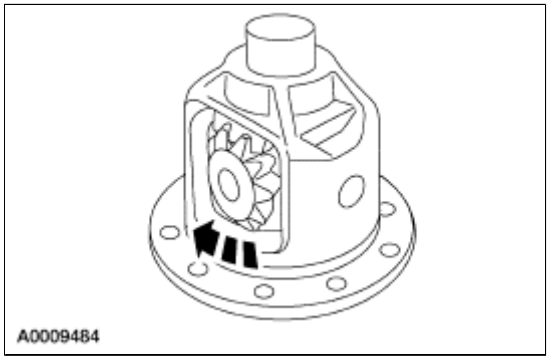
3. Lubricate the differential pinion thrust washers and the differential pinion gears, and assemble them.
    - Use Motorcraft SAE 80W90 Thermally Stable 4x4 Axle Lubricant meeting Ford specification WSP-M2C197-A.



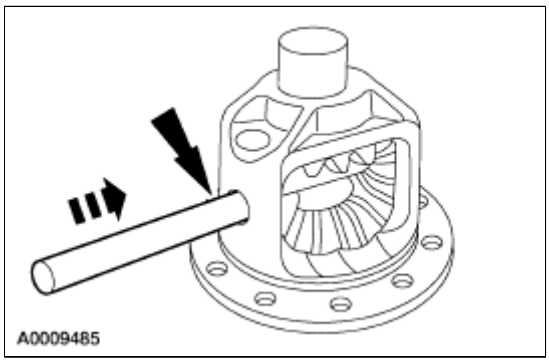
4. Engage the differential pinion gears between the differential side gears.



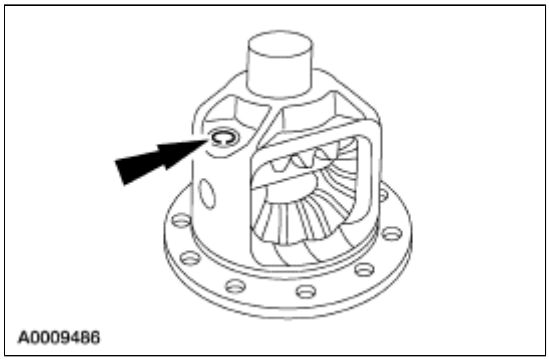
5. Rotate the differential pinion gears and align them with the differential pinion shaft bore.



6. Insert the differential pinion shaft.



7. Install the differential pinion shaft roll pin.



8. Install the differential bearing shims, the differential bearings, and the differential ring gear. For additional information, refer to Axle in this section.

General Specifications

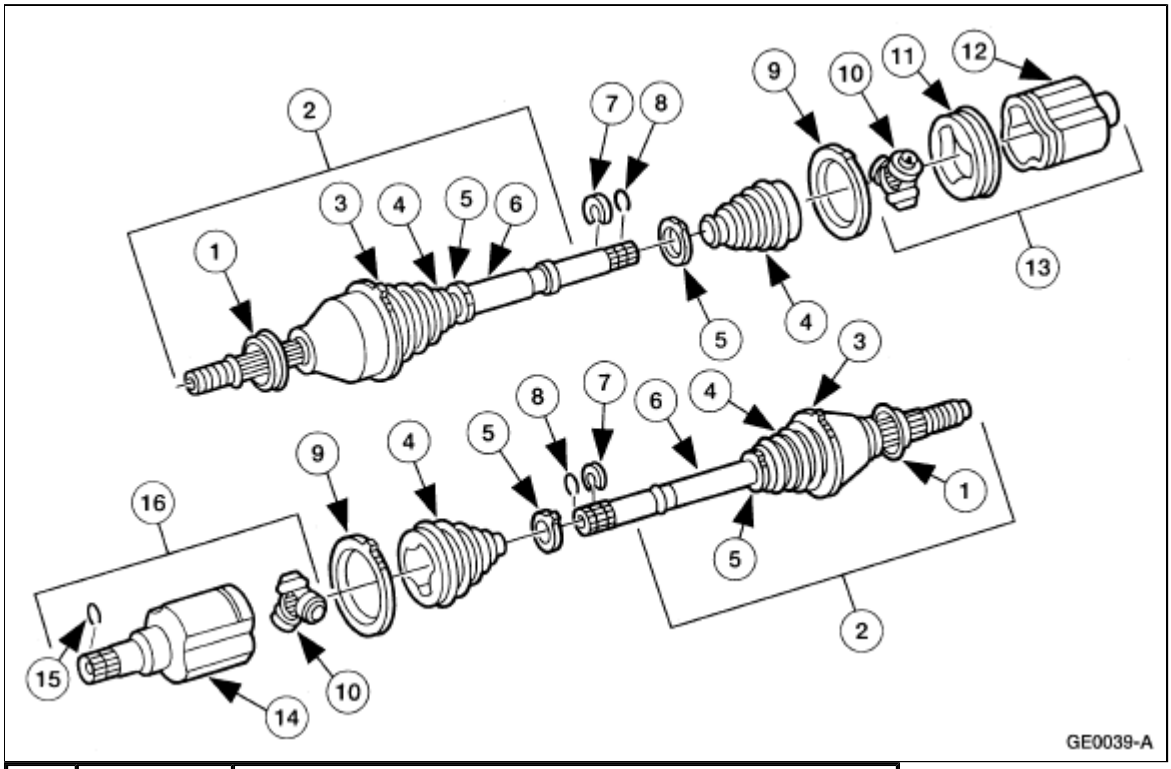
Item	Specification
Ford High Temp Constant Velocity Joint Grease Motorcraft XG-2 or equivalent	ESP-M1C207-A

Torque Specifications

Description	Nm	lb-ft
Disc brake caliper bolts	33	24
Upper ball joint nut	69	51
Front axle wheel hub retainer	250	184
Tie-rod end nut	70	52
Stabilizer bar link nut	25	18

Front Drive Halfshafts

Front Drive Halfshaft and Joint Assembly



Item	Part Number	Description
1	3K070	Front Wheel Excluder Seal
2	3B436	Side Shaft Assembly
3	3B478	Front Wheel Halfshaft Joint Boot Clamp (Part of 3A331, 3B436)
4	3A331	Front Wheel Halfshaft Joint Boot
5	3B478	Front Wheel Halfshaft Joint Boot Clamp (Part of 3A331, 3B436)
6	—	Interconnecting Shaft (Part of 3B436)
7	—	Stop Ring (Part of 3A331, 3B436 and 3B414)
8	3Z498	Retainer Circlip (Part of 3A331, 3B436 and 3B414)
9	3B478	Front Wheel Halfshaft Joint Boot Clamp (Part of 3A331, 3B436 and 3B414)
10	—	Inboard CV Joint (Part of 3B414)
11	—	Tri-Lobe Insert (Part of 3B414)

12	—	Housing (Part of RH 3B414)
13	3B414	Front Wheel Halfshaft Joint (Plunge Type, RH) (Inboard)
14	—	Housing (Part of LH 3B414)
15	—	Retainer Circlip (Part of 3A331 and 3B414)
16	3B414	Front Wheel Halfshaft Joint (Plunge Type, LH) (Inboard)

The front wheel driveshaft joints:

- transmit equal engine torque from the axle to both front wheels.
- use a constant velocity (CV) joint, at both the inboard and outboard ends, for operating smoothness.
- rotate at approximately one-third the speed of a driveshaft and do not normally contribute to any rotational vibration that may occur.

The only replaceable components of the front wheel driveshaft and joints are:

- Wheel driveshaft and joint boots (inboard and outboard). The replacement kit includes wheel driveshaft and joint boots and clamps, snap rings, retainer ring and grease.
- Inboard CV joint (plunge type).
- Side shaft. Replacement includes the outboard front wheel halfshaft joint (fixed type), outboard boot and clamps, front wheel excluder seal (assembled on the interconnecting shaft).

Front Drive Halfshafts

Halfshafts, Front Wheel

NOTE: Constant velocity (CV) joints must not be replaced unless disassembly and inspection reveals unusual wear.

NOTE: While inspecting the boots, watch for indentations ("dimples") in the boot convolutions. Indentations must be removed.

- Inspect the boots for evidence of cracks, tears, or splits.
- Inspect the underbody for any indication of grease splatter near the boots outboard and inboard locations. This is an indication of boot/clamp damage.

Symptom Chart

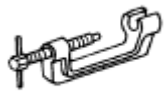
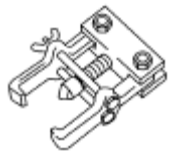
Symptom Chart

Condition	Possible Sources	Action
• Clicking, Popping, or Grinding Noises While Turning	• Inadequate or contaminated lubrication in the constant velocity (CV) joint.	• INSPECT, CLEAN and LUBRICATE as necessary.
	• Another component contacting the halfshaft.	• INSPECT and REPAIR as necessary.
	• Wheel bearings.	• REFER to Section 204-00 .
	• Brake components.	• REFER to Section 206-00 .
	• Suspension components.	• REFER to Section 204-00 .
	• Steering components.	• REFER to Section 211-04 .
• Shudder, Vibration During Acceleration	• High constant velocity (CV) joint operating angles caused by improper ride height.	• CHECK the ride height and VERIFY the proper spring rate. REPAIR as necessary.
	• Constant velocity (CV) joint.	• INSPECT and REPLACE as necessary.
	• Front suspension components.	• CHECK for worn suspension bushings and damaged components. REPAIR as necessary.
• Vibration at Speeds Greater Than 35 mph	• Out-of-balance wheels or tires.	• BALANCE wheels or tires, REPLACE as necessary.

	• Improperly seated constant velocity (CV) joint in the front wheel hub.	• REFER to Halfshaft in this section.
	• Lateral and radial tire and wheel runout.	• REFER to Section 204-04 .
	• CV joint worn.	• REPLACE the halfshaft.

Halfshaft

Special Tool(s)

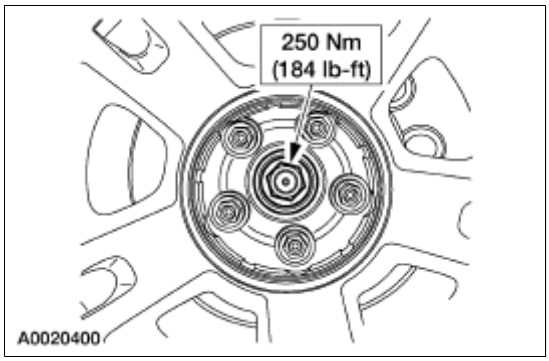
 ST1494-A	Installer/Remover, C-Frame and Screw 211-023 (T74P-3044-A1)
 ST2272-A	Remover, Front Wheel Hub 205-D070 (D93P-1175-B) or equivalent
 ST2517-A	Remover, Halfshaft 205-291 (T89P-3514-A)
 ST2273-A	Remover, Steering Arm 211-003 (T64P-3590-F)

Removal and Installation

NOTE: Except where noted, this procedure applies to both front halfshaft assemblies. Use only the procedure steps necessary for the halfshaft requiring removal/installation.

LH/RH halfshaft

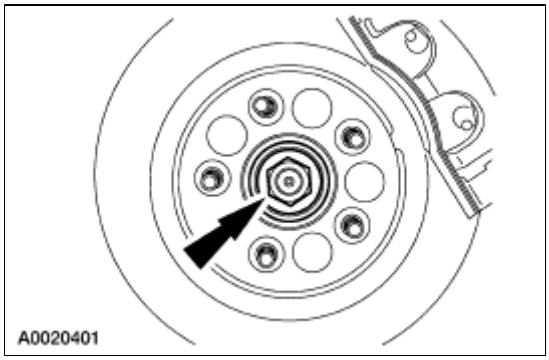
1. Remove the center cap from the front wheel.
2. Loosen the front axle wheel hub retainer.



3. With the vehicle in NEUTRAL, raise and support the vehicle. For additional information, refer to Section 100-02 .

4. Remove the front wheel and tire assembly. For additional information, refer to Section 204-04 .

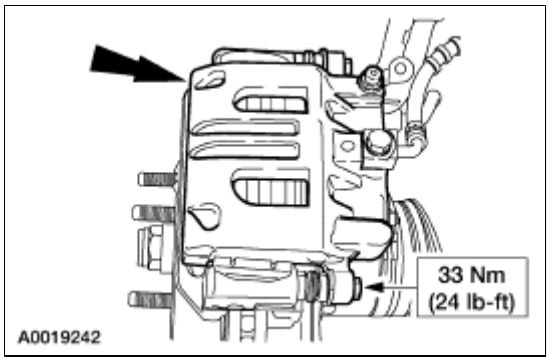
5. Remove the front axle wheel hub retainer and the washer. Discard the front axle wheel hub retainer.



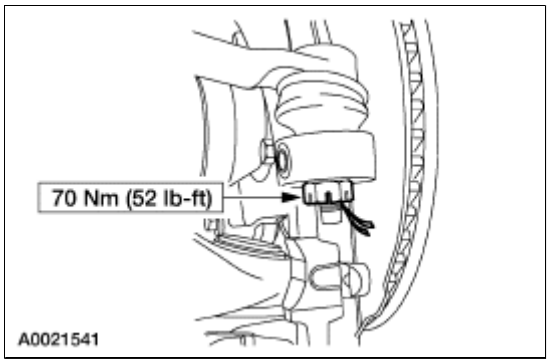
6. **WARNING: Remove or tape the brake pads to prevent them from falling out of the anchor plate. Failure to follow these instructions may result in personal injury or component damage.**

   CAUTION: To prevent damage to the brake hose, do not allow the disc brake caliper to hang suspended from the hose.

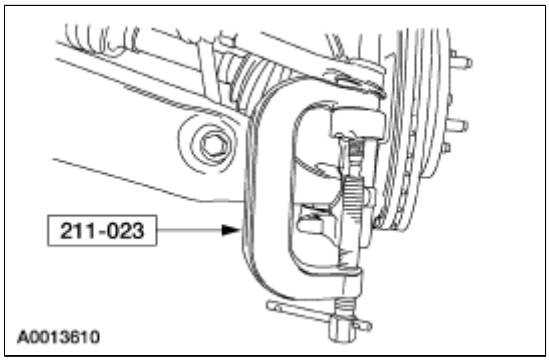
   Remove the two bolts and position the disc brake caliper aside.



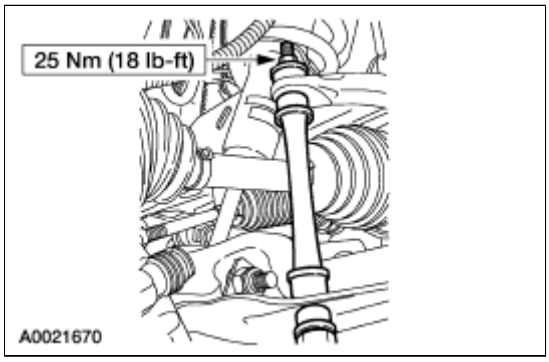
7. Remove and discard the cotter pin and the nut.



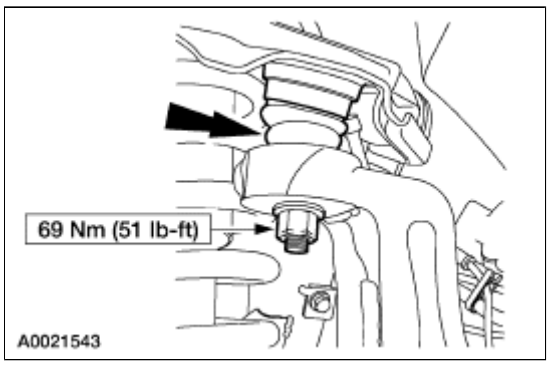
8. Using the special tool, separate the tie-rod end from the knuckle.



9. Remove the stabilizer bar link.

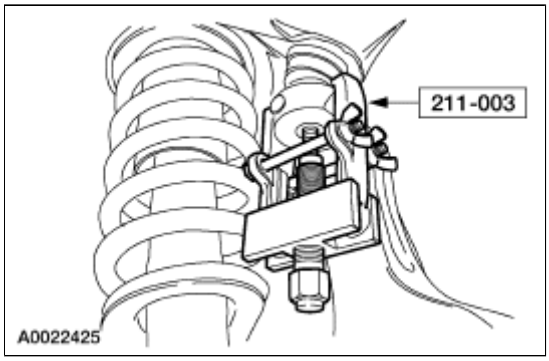


10. Remove and discard the nut.



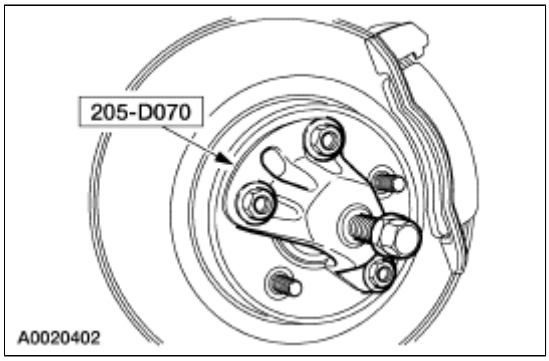
11. **CAUTION: Do not allow the knuckle to hang freely. It is possible to overextend and internally separate each inner CV joint from its housing.**

    Using the special tool, disconnect the upper ball joint from the knuckle.

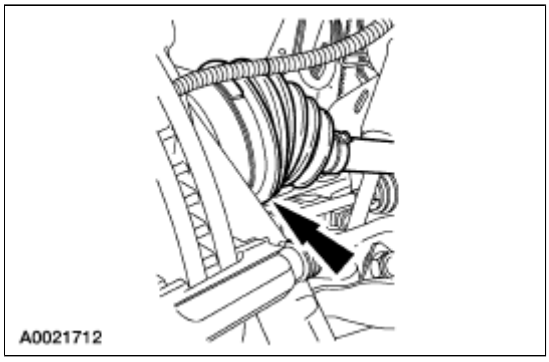


12. **CAUTION: Do not use a hammer to separate the outboard CV joint from the hub. Damage to the threads and internal CV joint components may result.**

    Using the special tool, press the outboard CV joint until it is loose in the hub.



13. Remove the outboard CV joint from the hub.

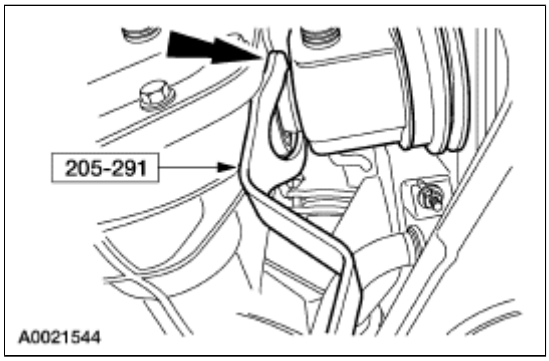


LH halfshaft only

14. **CAUTION: Do not damage the axle shaft oil seal or the machined sealing surface on the inboard CV joint housing.**

NOTE: A circlip retains the inboard CV joint housing to the differential side gear in the axle.

Using the special tool, disengage the LH inboard CV joint housing from the differential side gear.

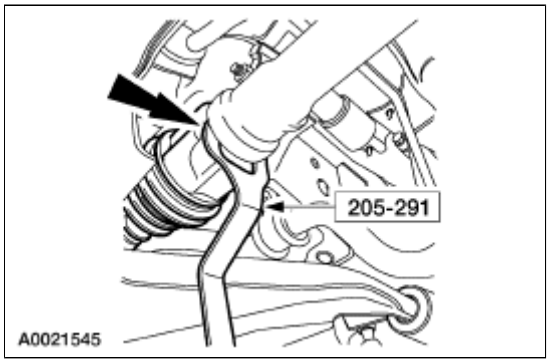


RH halfshaft only

15. **CAUTION: Do not damage the axle shaft oil seal or the machined sealing surface on the inboard CV joint housing.**

    NOTE: A circlip retains the inboard CV joint housing to the axle shaft in the axle tube.

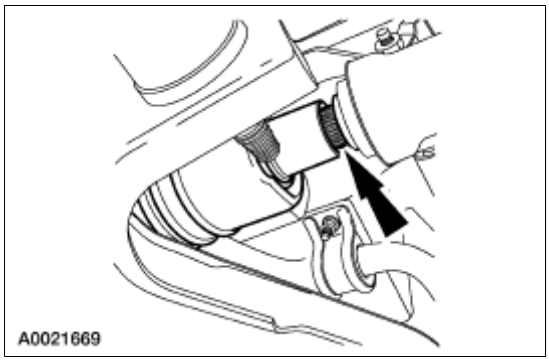
    Using the special tool, disengage the RH inboard CV joint housing from the axle tube.



16. **CAUTION: Do not damage the axle shaft oil seal, the machined sealing surface on the inboard CV joint housing, or the axle shaft splines.**

    CAUTION: Install a new retainer circlip on the outboard splines end of the axle shaft before reseating the axle shaft in the differential side gear.

    Pull the halfshaft and the axle shaft away from the axle tube, and separate the inboard CV joint housing from the axle shaft.



LH/RH halfshaft

17. Remove the halfshaft assembly from the vehicle.

18. **CAUTION: Always install the halfshaft with a new retainer circlip and a new front axle wheel hub retainer.**

    CAUTION: On the RH side, check the retainer circlip engagement after reseating the axle shaft and after installing the halfshaft in the axle. On the LH side, check the retainer circlip engagement after installing the halfshaft in the axle. When seated, the retainer circlip will lock the axle shaft and the inboard CV joint housing to the axle.

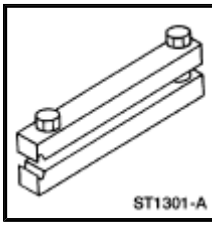
    CAUTION: Never use power tools to tighten the front axle wheel hub retainer.

    NOTE: It may be necessary to support the front suspension lower arm to be able to connect the upper ball joint to the knuckle.

    To install, reverse the removal procedure.

Halfshaft

Special Tool(s)

 ST1301-A	Installer, Constant Velocity Joint Boot Clamp 205-343 (T95P-3514-A)

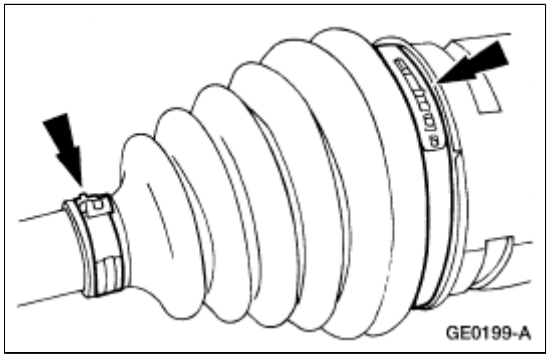
Material

Item	Specification
Ford High Temp Constant Velocity Joint Grease Motorcraft XG-2 or equivalent	ESP-M1C207-A

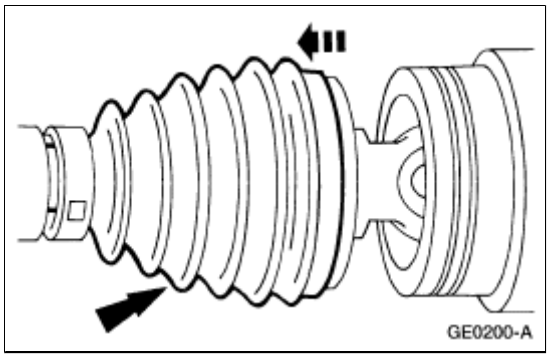
Disassembly

1. Remove the front wheel halfshaft. For additional information, refer to Halfshaft in this section.
2. **CAUTION: Be careful not to damage the halfshaft boot.**

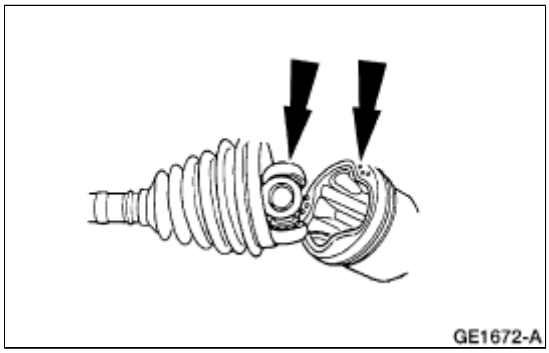
   Remove the two inboard boot clamps.



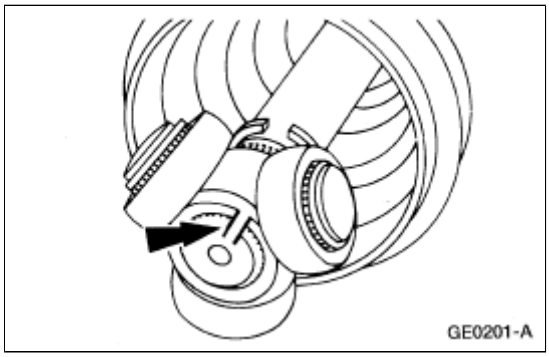
3. Slide the inboard halfshaft boot off the inboard CV joint housing.



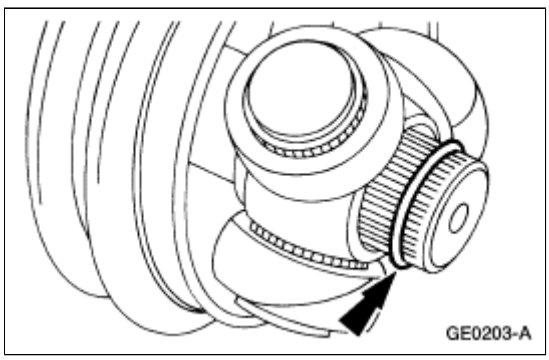
4. Separate the CV joint from the CV joint housing.



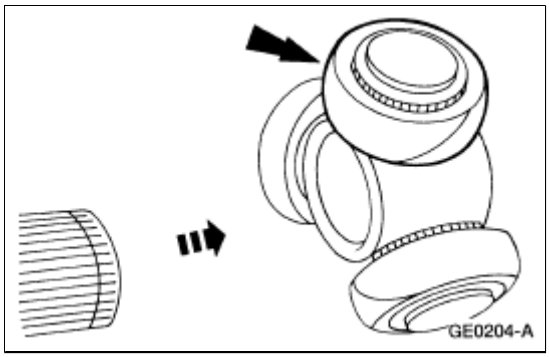
5. Mark the shaft and the inboard CV joint to ease alignment during assembly.



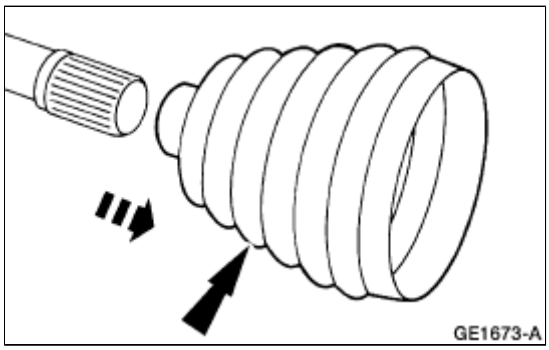
6. Remove the snap ring.



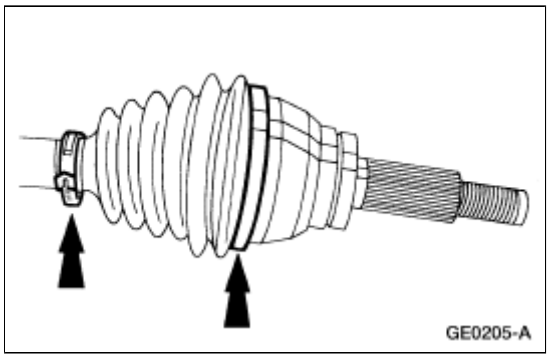
7. Remove the CV joint.



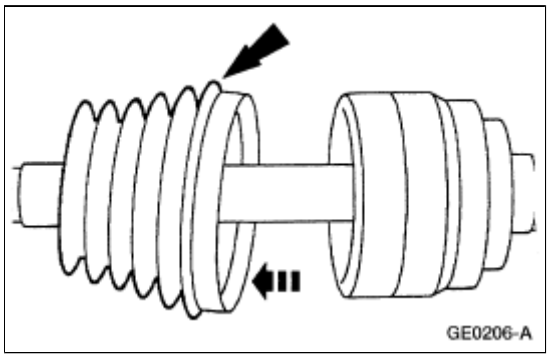
8. Inspect the stop ring for wear or damage. Install a new stop ring as necessary.
9. Remove the inboard halfshaft boot from the shaft assembly.



10. Remove the two outboard boot clamps.



11. Remove the outboard halfshaft boot.

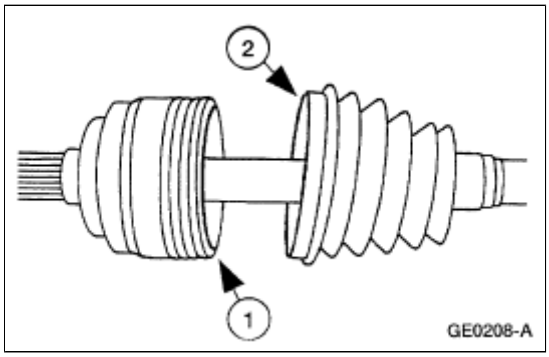


12. **NOTE:** If grease is contaminated, clean and inspect the joint for wear. If worn or damaged, install a new outboard CV joint and shaft assembly.

    Inspect for contaminated grease.

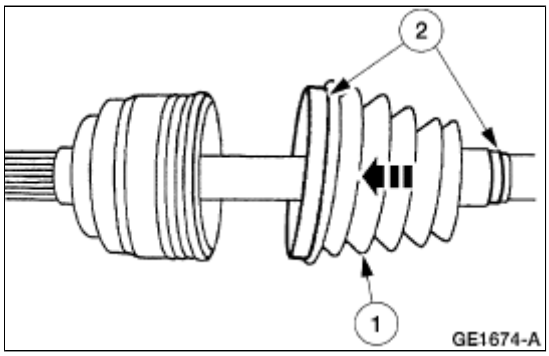
Assembly

1. Pack the outboard CV joint with grease.
    1. Use Ford High Temp Constant Velocity Joint Grease to fill the outboard CV joint.
    2. Spread any remaining grease from the service kit evenly inside the outboard halfshaft boot.



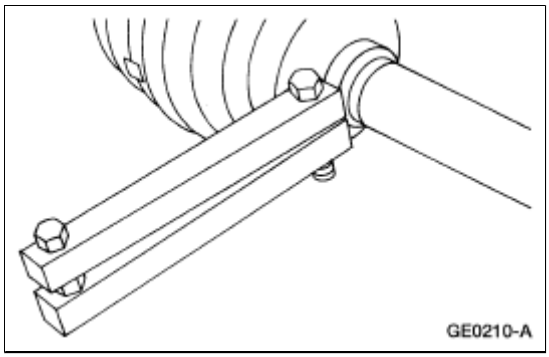
2. **NOTE:** Clean the halfshaft boot mounting surfaces of access grease before positioning the halfshaft boot into place.

    Position the outboard halfshaft boot and outboard boot clamps.
    1. Position the outboard halfshaft boot.
    2. Position the boot clamps on the outboard halfshaft boot.

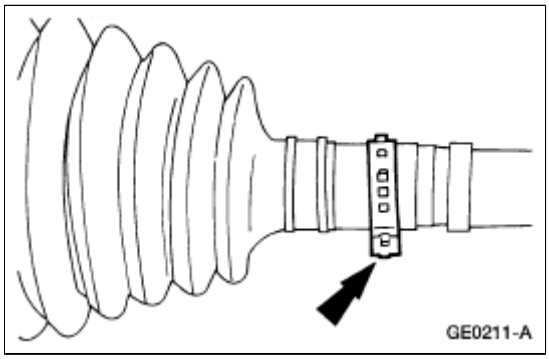


3. **NOTE:** Tighten the through-bolt until the installer is in the closed position.

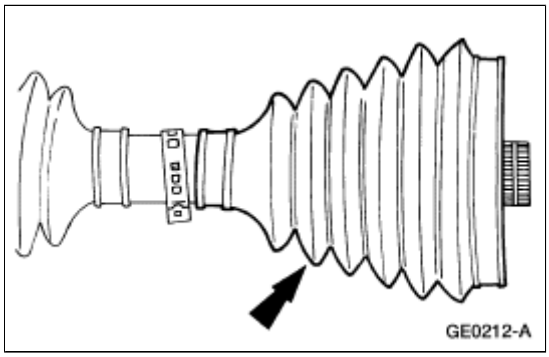
    Use the CV Boot Clamp Installer to install the outboard CV joint boot clamps.



4. Position the boot clamp on the halfshaft.

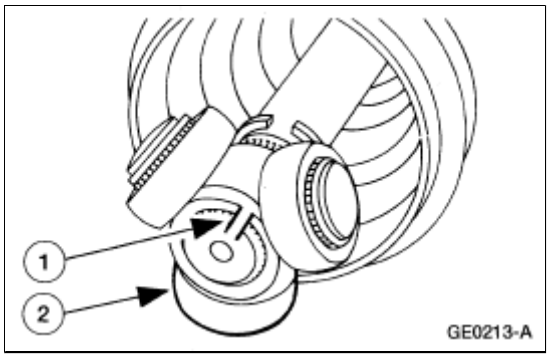


5. Position the inboard halfshaft boot.

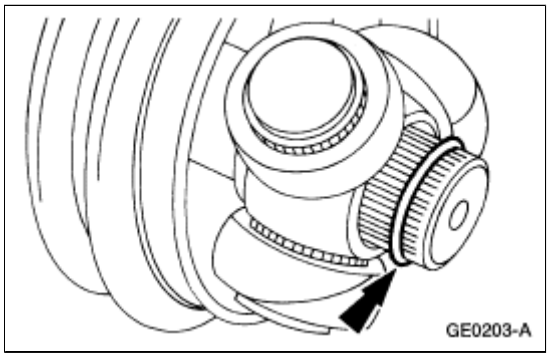


6. Install a new stop ring, if necessary.

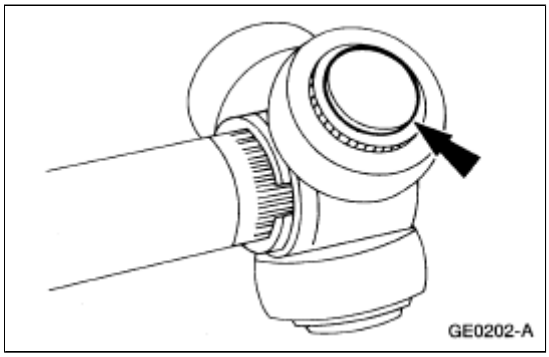
7. Install the CV joint on the halfshaft.
    1. Line up the marks on the halfshaft and the CV joint.
    2. Install the CV joint on the halfshaft.



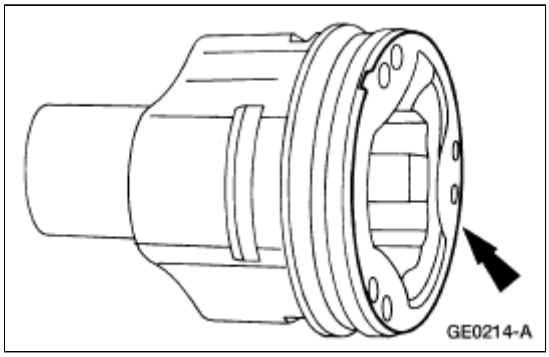
8. Install the snap ring.



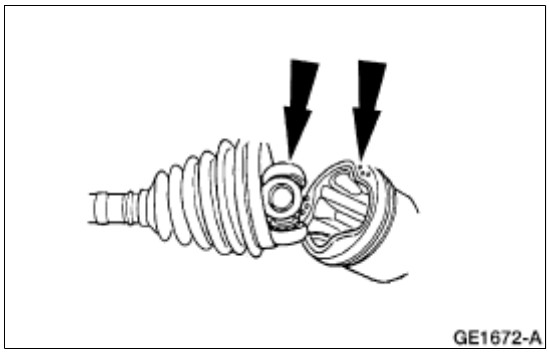
9. Lubricate the three CV joint needle bearings with grease.



10. Fill the inboard CV joint housing with 235 grams of grease.

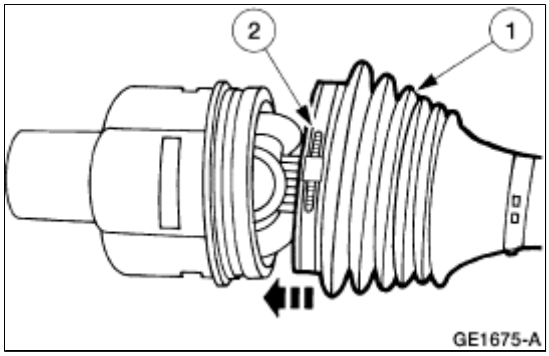


11. Position the CV joint housing onto the CV joint.

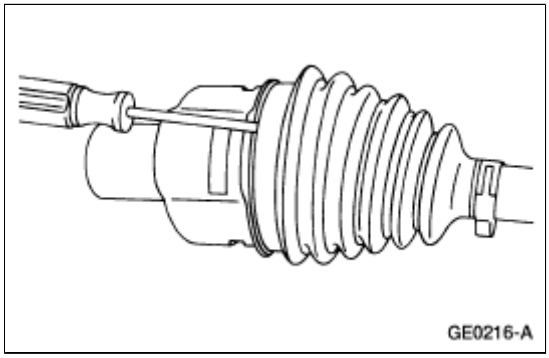


12. **NOTE:** Remove any excess grease from the inboard halfshaft boot mating surface before positioning into place.

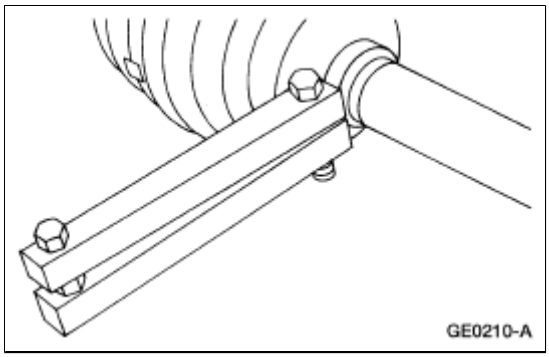
    Position the inboard halfshaft boot and boot clamp.
    1. Position the inboard halfshaft boot into place.
    2. Position the boot clamp.



13. Insert a dulled screwdriver blade to relieve built-up air pressure in the halfshaft boot.



14. Use the CV Boot Clamp Installer to install the inboard boot clamps.



15. Install the front wheel halfshaft. For additional information, refer to Halfshaft in this section.

General Specifications

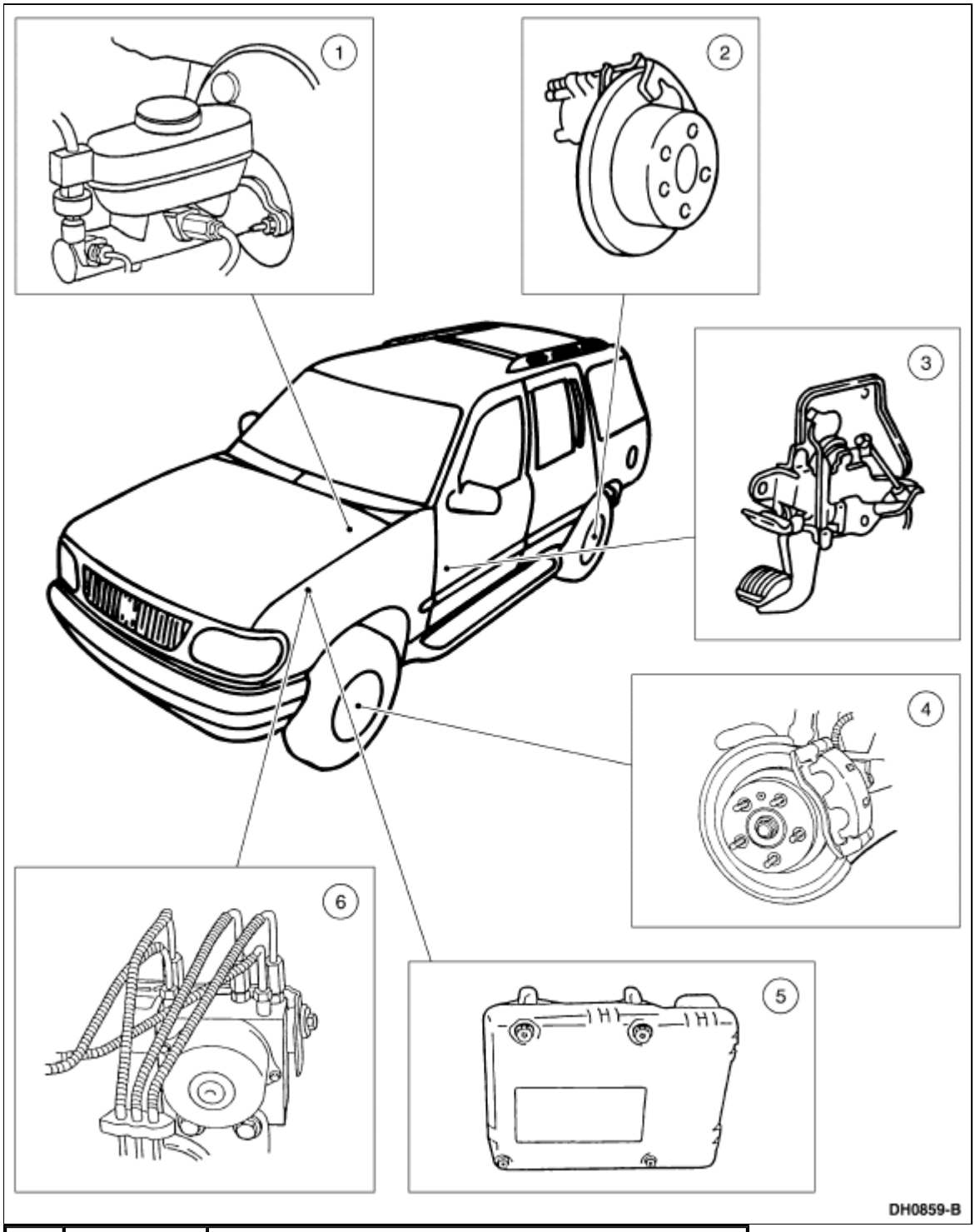
Item	Specification
Lining wear limit (above backing plate or rivets)	1.0 mm (0.040 Inch)
Lubricants	
High Performance DOT 3 Brake Fluid C6AZ-19542-AB	ESA-M6C25-A DOT 3
High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA	ESE-M12A4-A
Disc Brakes	
Brake disc minimum thickness	Molded into the brake disc
Brake disc maximum runout	0.013 mm (0.0005 Inch)
Brake disc maximum thickness variation	0.0051 mm (0.0002 Inch)

Torque Specifications

Description	Nm	lb-ft	lb-in
Brake master cylinder tube fitting, front	15-20	11-14	—
Brake master cylinder tube fitting, rear	15-20	11-14	—
Caliper bleeder screw, rear	20	15	—
Caliper bleeder screw, front	20	15	—
Master cylinder bleeder screw	8-18	—	70-159
Cruise control switch	14-20	10-14	—

Brake System

Component Locator



Item	Part Number	Description
1	2140	Brake master cylinder (fluid control valve on 2-door only)
2	—	Rear disc brake assy
3	2780	Parking brake control
4	—	Front disc brake assy
5	2C219	Anti-lock electronic control module
6	2C215	Anti-lock hydraulic control unit

The vehicle is equipped with a vacuum-assisted 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 brakes utilize a dual-piston brake caliper and disc brake system. Refer to Section 206-03 .

The rear brakes utilize a single piston caliper and disc brake system with the parking brake assembly located inside the drum and hat-type brake disc. Refer to Section 206-04 .

The parking brake system is a shoe and drum system that is located inside the drum and hat-type rear brake discs. Refer to Section 206-05 .

A 4-wheel anti-lock brake system (4WABS) is standard. Refer to Section 206-09 .

A fluid control valve, mounted at the rear port of the brake master cylinder, is used on 2-door models only.

Brake System

Refer to Wiring Diagrams Cell 62 , Instrument Cluster for schematic and connector information.

Refer to Wiring Diagrams Cell 97 , Daytime Running Lamps for schematic and connector information.

Inspection and Verification

Preliminary Checks

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 DOT 3 equivalent meeting Ford specification ESA-M6C25-A.

NOTE: Prior to performing any diagnosis, make certain that the brake warning indicator is functional. Refer to Section 413-01 .

A change in brake pedal feel is usually the first indicator of a brake system concern. The change may only be normal ABS function, but is sufficient cause for further investigation. 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 (1007) is locked and the vehicle must be moved, open a bleeder screw at the locked wheel 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.

Brake Booster

Inspect all hoses and connections. All unused vacuum connectors should be capped. Hoses and their connections should be correctly secured and in good condition with no holes, soft or collapsed areas.

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, except to demonstrate ABS function, are not suitable. 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.

Visual Inspection Chart

Mechanical	Electrical
• Brake master cylinder • Brake caliper piston • Brake discs • Wheel bearings • Brake pads • Power brake booster • Brake pedal linkage • Booster vacuum hose • Tires	• Parking brake switch • Damaged or corroded wiring harness • Brake master cylinder fluid level switch • Stoplight switch

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 (2455) is still low or feels spongy, check the wheel bearings. Refer to Section 206-03 (4x2) or Section 204-01B (4x4) for front wheel bearings and Section 205-02 for rear wheel bearings.

For 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:

- The condition and pressure.
- Suspension bushings and ball joints.

Correct as necessary.

1. Verify and isolate the concern. Brake roughness can be felt in:
    1. the steering wheel.
    2. the seat.
    3. the brake pedal.

2. After verifying the concern, check for related concerns in the:
    1. On-Line Automotive Service Information System (OASIS).
    2. 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 brake disc and hub assembly:
    1. Match-mark before disassembly.
    2. Remove the brake disc.
    3. Using a die grinder with a mild abrasive (Scotch Brite® type), remove any rust or corrosion from the hub and brake disc mounting surfaces.
    4. 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 in). Lighter cuts will cause heat and wear. Heavier cuts will cause poor brake disc surface finish.

    Using the special tool, 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 special tool 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 brake disc and a non drum-in-hat hub assembly:
    - Remove the brake disc from the hub.
    - Remove any remaining metal chips from brake disc and hub mounting surfaces and from the ABS sensor.
    - Apply High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA or equivalent meeting Ford specification ESE-M12A4-A 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

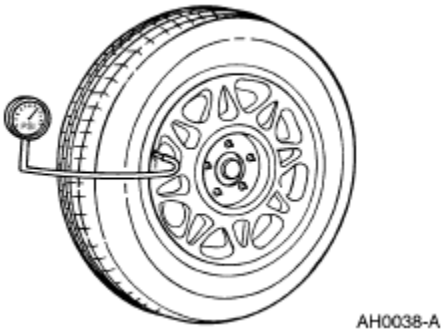
Symptom Chart

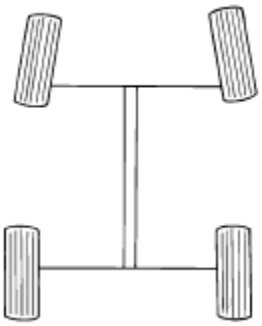
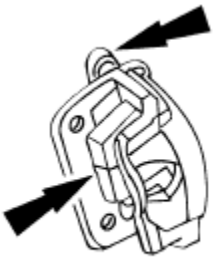
Condition	Possible Sources	Action
• Brakes Pull or Drift	• Tire air pressure. • Wheel alignment. • Brake pads. • Brake components. • Suspension component.	• GO to Pinpoint Test A .
• Red Brake Warning Indicator Always On	• Instrument cluster. • Circuit. • Parking brake. • Brake fluid level.	• GO to Pinpoint Test B .
• Vibration When Brakes Are Applied	• Rear disc brakes. • Front disc brakes.	• REFER to Section 100-04 .
• Brake Pedal Goes Down Fast	• Brake fluid level. • Air in system. • Brake master cylinder. • Normal ABS operation.	• FILL the brake master cylinder reservoir. BLEED the system. • BLEED the system. • PERFORM the brake master cylinder component test in this section. • No action required.
• The Brake Pedal Eases Down Slowly	• Air in system. • Brake master cylinder. • Normal ABS operation.	• BLEED the system. REFER to Bleeding—System in this section. • PERFORM the brake master cylinder component test in this section. • No action required.
• Brakes Lock Up During Light Brake Pedal Force	• Road conditions. • Disc brake component. • Parking brake component. • Anti-lock brake control system. • Fluid control valve.	• TEST on smooth road. • GO to Pinpoint Test C .
• Excessive/Erratic Brake Pedal Travel	• Leak in hydraulic system. • Air in system. • Disc brake caliper. • Brake booster-to-brake master cylinder push rod adjustment. • Brake master cylinder. • Normal ABS operation.	• GO to Pinpoint Test D . • No action required.

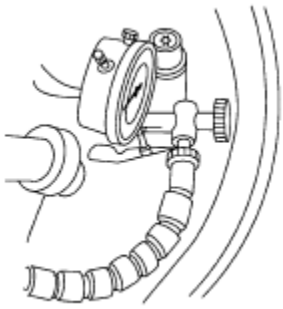
• Brakes Drag	• Parking brake component. • Disc brake caliper. • Brake booster-to-brake master cylinder push rod adjustment. • Brake master cylinder.	• REPAIR or INSTALL new components as necessary. REFER to Section 206-05 . • REPAIR or INSTALL new as necessary. REFER to Section 206-03 . • ADJUST the push rod. REFER to Section 206-07 . • PERFORM the brake master cylinder component test in this section.
• Excessive Brake Pedal Effort	• Power brake booster. • Power brake booster check valve. • Power brake booster hose.	• PERFORM the brake booster component test in this section.
• Red Brake Warning Indicator Inoperative	• Circuit. • Bulb.	• REFER to Section 413-01 .
• Brake Noise	• Disc brake component.	• MACHINE or INSTALL new as necessary. REFER to Section 206-03 or Section 206-04 .

Pinpoint Tests

PINPOINT TEST A: BRAKES PULL OR DRIFT

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK THE TIRE PRESSURE	
1  AH0038-A	1 Check for excessive wear and measure the air pressure in all four tires. • **Are the tires good and the tire pressure within specifications?** → **Yes**

	GO to A2 . → **No** ADJUST the tire pressure. ROTATE the tires front to rear. INSTALL new tires if excessively worn.
A2 CHECK THE ALIGNMENT	
1  AH0061-A	1 Check for correct camber, caster and toe-in settings. Refer to Section 204-00 . • **Is the alignment set to specification?** → **Yes** INSTALL new disc brake caliper at the affected wheel. TEST the system for normal operation. → **No** GO to A3 .
A3 CHECK THE CALIPER PISTON AND PINS	
1  AH0041-A	1 Check the disc brake caliper pistons and pins for binding or sticking. • **Do the disc brake caliper pistons or pins bind or stick?** → **Yes** REPAIR or INSTALL new components as necessary. → **No** GO to A4 .
A4 INSPECT THE BRAKE PADS	

1  AH0048-A	1 Inspect the brake pads for contamination and wear concerns. • **Are the brake pads OK?** → **Yes** GO to A5 . → **No** INSTALL new brake pads. REFER to Section 206-03 (front) or Section 206-04 (rear).
A5 INSPECT THE BRAKE DISCS AND HUBS	
1  AH0300-A	1 Inspect the brake discs and hubs for excessive runout thickness variation or damage. • **Are the brake discs within specification?** → **Yes** Have the customer duplicate the concern. → **No** REPAIR and INSTALL new brake discs and hubs as necessary.

PINPOINT TEST B: RED BRAKE WARNING INDICATOR ALWAYS ON

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK THE BRAKE MASTER CYLINDER FLUID LEVEL SWITCH	
1	

2

Brake Master Cylinder Fluid Level Switch

3

- **Does the brake warning indicator turn on?**

→ **Yes**
GO to B2.

→ **No**
INSTALL new brake master cylinder fluid level switch. TEST the system for normal operation.

B2 CHECK THE PARKING BRAKE SWITCH

1

2

Parking Brake Switch

3

- **Does the red brake warning indicator turn on?**

→ **Yes**
For vehicles without daytime running lamps (DRL), GO to B3. For vehicles equipped with DRL, GO to B4.

→ **No**
INSTALL a new parking brake switch. TEST the system for normal operation.

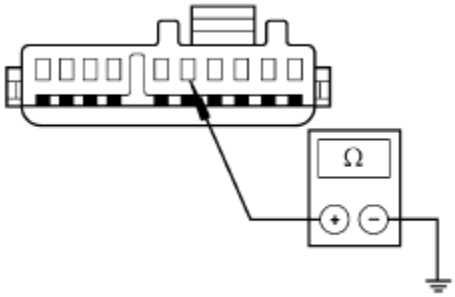
B3 CHECK CIRCUITS 977 (P/W) and 162 (LG/R)

1

2

Instrument Cluster C288

3



3 Measure the resistance between Pin C288-5, Circuit 977 (P/W), and ground.

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
REPAIR the instrument cluster. TEST the system for normal operation.

→ **No**
REPAIR Circuit 977 (P/W) or 162 (LG/R). TEST the system for normal operation.

B4 CHECK CIRCUIT 977 (P/W)

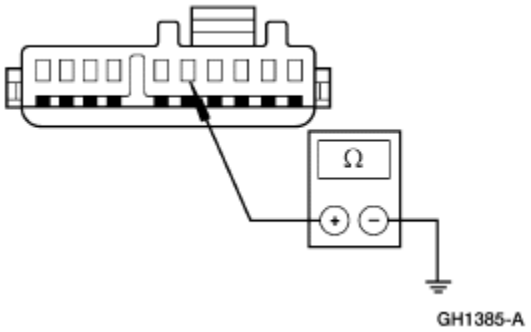
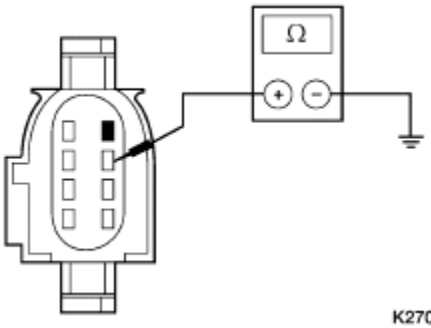
1

2

Instrument Cluster

3

DRL Module

4  GH1385-A	4 Measure the resistance between Pin C288-5, Circuit 977 (P/W), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to B5 . → **No** REPAIR Circuit 977 (P/W). TEST the system for normal operation.
B5 CHECK PARKING BRAKE CIRCUIT 162 (LG/R)	
1  K27006-A	1 Measure the resistance between Pin C134-4, Circuit 162 (LG/R), and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** INSTALL a new DRL module. REFER to Section 417-04 . TEST the system for normal operation. → **No** REPAIR Circuit 162 (LG/R). TEST the system for normal operation.

PINPOINT TEST C: BRAKES LOCK UP DURING LIGHT BRAKE PEDAL FORCE

CONDITIONS	DETAILS/RESULTS/ACTIONS

C1 CHECK FOR BINDING OR STICKING BRAKE COMPONENTS

1

2 Check for binding, damage and correct installation at each wheel brake component.

- **Do any of the components bind or stick?**

→ **Yes**
REPAIR or INSTALL new components as necessary. TEST the system for normal operation.

→ **No**
GO to C2 .

C2 CHECK THE PARKING BRAKE COMPONENTS

1 Check parking brake components for damage, seized condition, and correct adjustment. Refer to Section 206-05 .

- **Are the parking brake components OK?**

→ **Yes**
GO to C3 .

→ **No**
REPAIR or INSTALL new components as necessary. REFER to Section 206-05 . TEST the system for normal operation.

C3 INSPECT THE BRAKE PADS

1 Inspect brake pads for contamination, excessive wear or damage. Refer to Section 206-03 for front disc brake. Refer to Section 206-04 for rear disc brake.

- **Are the brake pads OK?**

→ **Yes**
GO to C4 .

→ **No**
INSTALL new brake pads as necessary. TEST the system for normal operation.

C4 CHECK FOR LOOSE BRAKE COMPONENT MOUNTINGS

1 Check for loose or damaged caliper mounting bolts.

- **Are the component mountings OK?**

→ **Yes**
With fluid control valve, GO to C5 . Without fluid control valve, CHECK the 4-wheel anti-lock brake system (4WABS). REFER to Section 206-09 .

	→ **No** REPAIR as necessary. TEST the system for normal operation.
C5 CHECK THE FLUID CONTROL VALVE	
	1 Replace the fluid control valve with a known good valve. 2 Test the system for normal operation. • **Does the system operate OK now?** → **Yes** Discard the original fluid control valve. → **No** CHECK the four-wheel anti-lock brake system (4WABS). REFER to Section 206-09 .

PINPOINT TEST D: EXCESSIVE/ERRATIC BRAKE PEDAL TRAVEL

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CHECK FOR SPONGY PEDAL	
1  2 	3 Operate the brake pedal and note pedal feel. • **Does the brake pedal feel spongy?** → **Yes** BLEED the system. REFER to Bleeding—System in this section. TEST the system for normal operation. → **No** GO to D2 .
D2 CHECK THE BRAKE PEDAL	
	1 Inspect the brake pedal for binding, obstruction or damage. • **Is the brake pedal OK?** → **Yes** GO to D3 .

	→ **No** REPAIR or INSTALL new as necessary. TEST the system for normal operation.
D3 CHECK THE BRAKE COMPONENTS	
	1 Inspect the disc brake components for binding, damage, correct installation and contamination. • **Are the disc brake components OK?** → **Yes** GO to D4 . → **No** REPAIR or INSTALL new as necessary. TEST the system for normal operation.
D4 CHECK ABS SYSTEM FOR CORRECT FUNCTION	
	1 Check the ABS system. REFER to Section 206-09 . • **Are the disc brake components OK?** → **Yes** INSTALL a new power brake booster. TEST the system for normal operation. → **No** REPAIR or INSTALL new as necessary. TEST the system for normal operation.

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 the test with the following steps.
4. Remove the vacuum booster hose (2A047) from 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 (2365) and repeat Steps 2 and 3 above.
5. Check and 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 lbs) 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 check valve and retest. If the brake pedal feels spongy, bleed the hydraulic system to remove air. 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. Do not remove the power brake booster check valve from the power brake booster.
- There should be enough vacuum retained in the power 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 (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.

Abnormal Conditions

Changes in brake pedal feel or travel are indicators that something could be wrong in the brake system. Refer to the 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 installed new.

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 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.

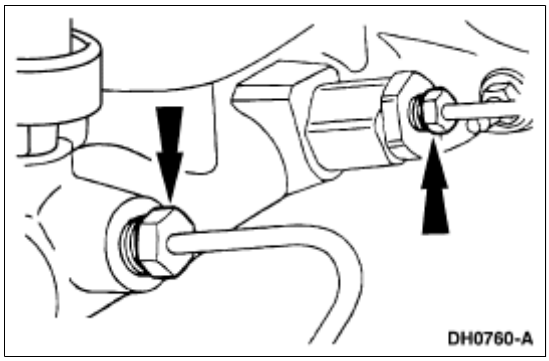
CAUTION: Do not allow the brake master cylinder reservoir to run dry during the bleeding operation. Keep the brake master cylinder reservoir filled with the specified brake fluid. Never reuse the brake fluid that has been drained from the hydraulic system.

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.

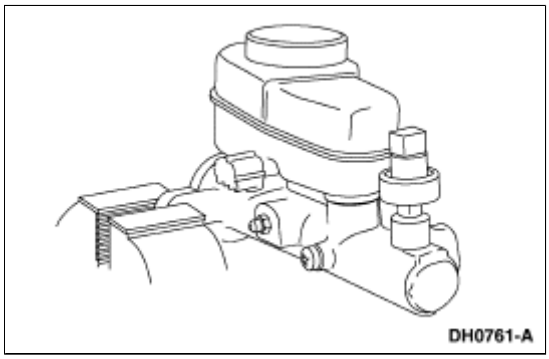
NOTE: When any part of the hydraulic system has been disconnected for repair or installation, air can get into the system and cause spongy brake pedal action. This requires bleeding of the hydraulic system after it has been correctly connected. The hydraulic system can be bled manually or with pressure bleeding equipment.

NOTE: When the brake master cylinder has been installed new or the system has been emptied or partially emptied, it must be primed to prevent air from entering the system.

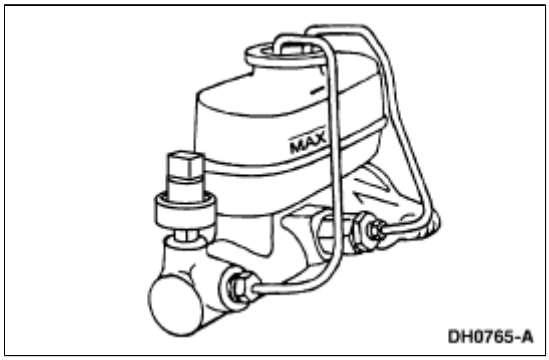
1. For in-vehicle priming, disconnect the brake lines from the brake master cylinder.



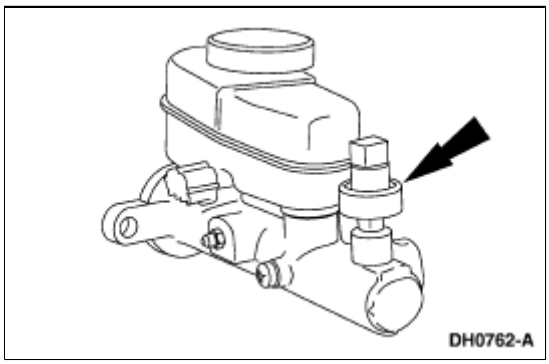
2. For bench priming, mount the brake master cylinder in a vise.



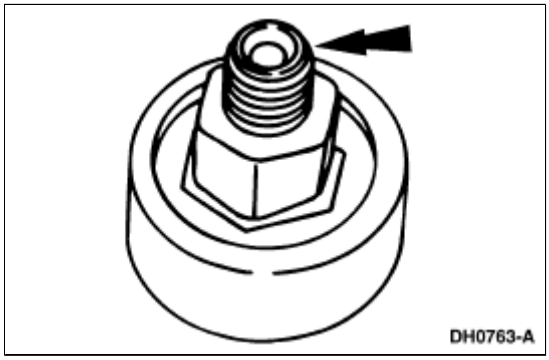
3. Install short brake tubes with the ends bent into the brake master cylinder reservoir.
   - Fill the brake master cylinder reservoir with High Performance DOT 3 Brake Fluid C6AZ-19542-AB or DOT 3 equivalent meeting Ford specification ESA-M6C25-A.



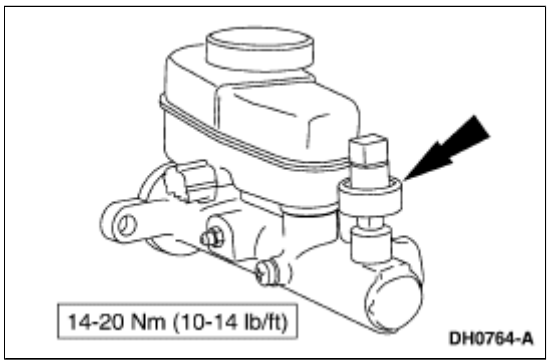
4. For a new brake master cylinder, remove the cruise switch.



5. Fill the cruise switch with the specified brake fluid.



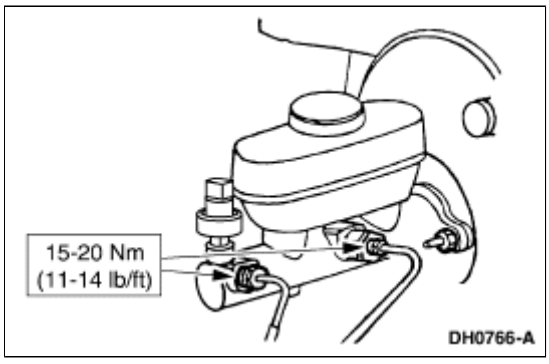
6. Install the cruise switch.



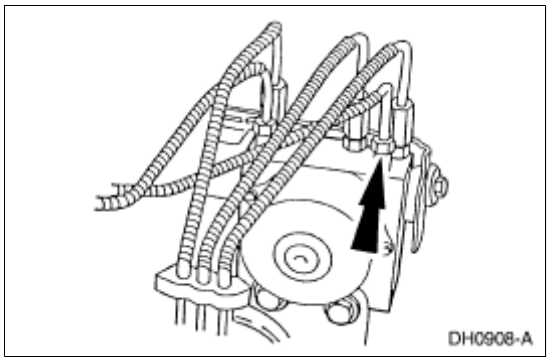
7. Slowly depress the primary piston or, for in-vehicle priming, have an assistant slowly pump the brake pedal until clear brake fluid flows from both brake tubes with no air bubbles.

8. If necessary, install the brake master cylinder into the vehicle. For additional information, refer to Section 206-06 .

9. Remove the short brake tubes and install the master cylinder outlet tubes.



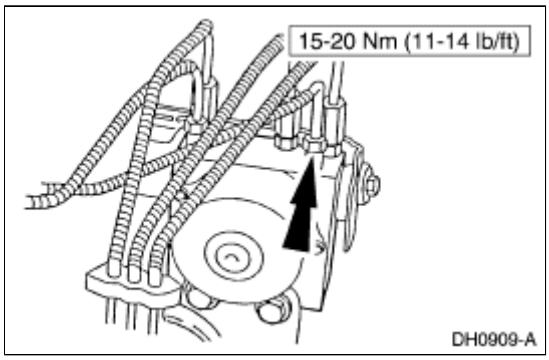
10. Loosen a brake outlet tube at the 4WABS hydraulic control unit (HCU).



11. **NOTE:** Refill the brake master cylinder reservoir as necessary.

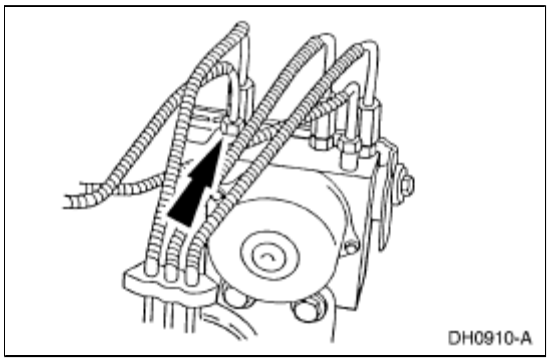
    Have an assistant depress and hold the brake pedal.

12. Tighten the outlet tube fitting at the HCU.

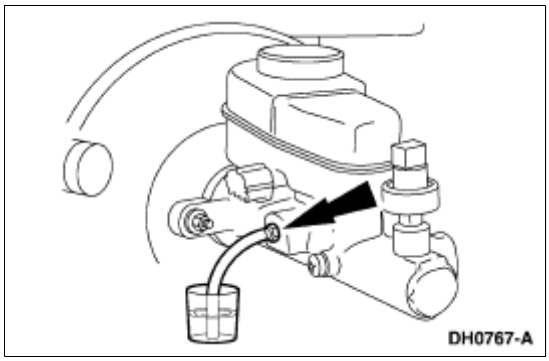


13. Repeat the above three steps until no air bubbles are seen in the expelled brake fluid.

14. Repeat the above four steps for the remaining master cylinder outlet tube.



15. Connect one end of a flexible tube to the master cylinder bleeder screw. Submerge the other end in a container partially filled with the specified brake fluid.

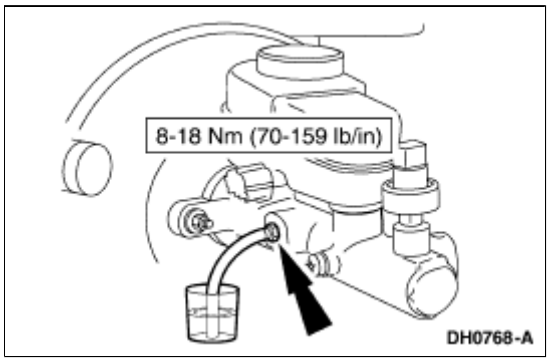


16. Have an assistant pump and then hold firm pressure on the brake pedal.

17. **NOTE:** Refill the brake master cylinder reservoir as necessary.

    Loosen the master cylinder bleeder screw until brake fluid flows out of the drain tube.

18. Tighten the master cylinder bleeder screw.



19. Repeat the above three steps until there are no air bubbles in the expelled brake fluid.

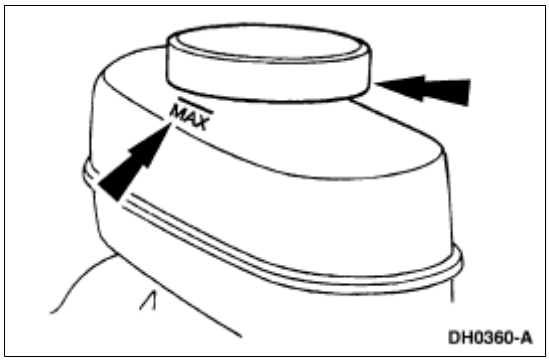
20. Bleed the brake system. For additional information, refer to Bleeding — System in this section.

Four Wheel Anti-Lock Brake System (4WABS) Hydraulic Control Unit (HCU)

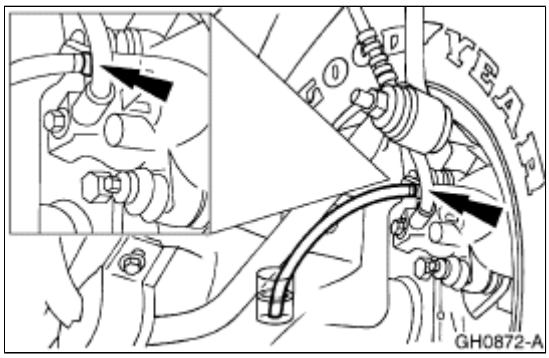
NOTE: This procedure only needs to be performed if the 4-wheel anti-lock brake (4WABS) hydraulic control unit (HCU) has been installed new.

1. Connect the scan tool DCL cable adapter into the vehicle data link connector (DLC) under the dash, and follow the scan tool instructions for bleeding.

2. Clean all dirt from and remove the brake master cylinder filler cap (2162), and fill the brake master cylinder reservoir with the specified brake fluid.



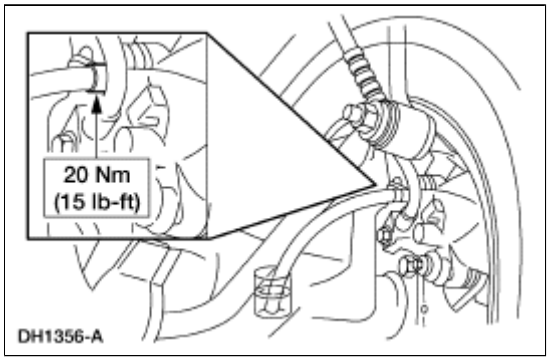
3. Connect a clear drain tube to the RH rear bleeder screw and the other end in a container partially filled with recommended brake fluid.



4. Have an assistant pump the brake pedal and then hold firm pressure on the brake pedal.

5. 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 bleeder screw.
   - Repeat until clear, bubble-free fluid comes out.
   - Refill the brake master cylinder reservoir as necessary.

6. Tighten the bleeder screw.



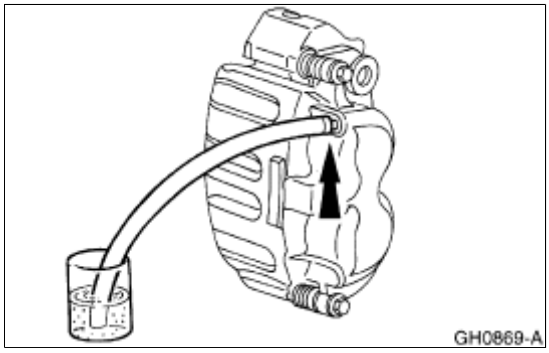
7. Repeat Steps 3-6 for the LH rear bleeder screw, the RH front bleeder screw and the LH front bleeder screw, in that order.

8. Repeat the conventional bleed procedure as outlined in Steps 3-7.

Caliper

1. **NOTE:** It is not necessary to do a complete brake system bleed if only the disc brake caliper was disconnected.

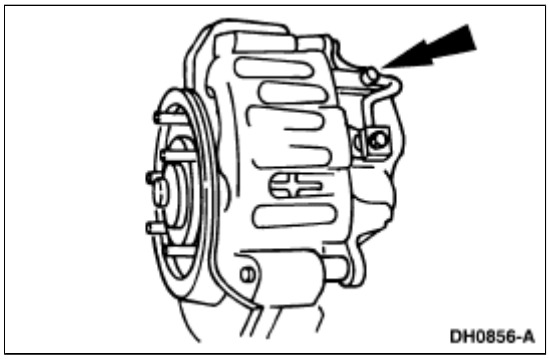
   Place a box end wrench on the disc brake caliper bleeder screw. Attach a rubber drain tube to the disc brake caliper bleeder screw, and submerge the free end of the tube in a container partially filled with clean brake fluid.



2. Have an assistant pump the brake pedal 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 as necessary.

4. Tighten the disc brake caliper bleeder screw. Refer to Specifications in this section.



Bleeding —System

Manual

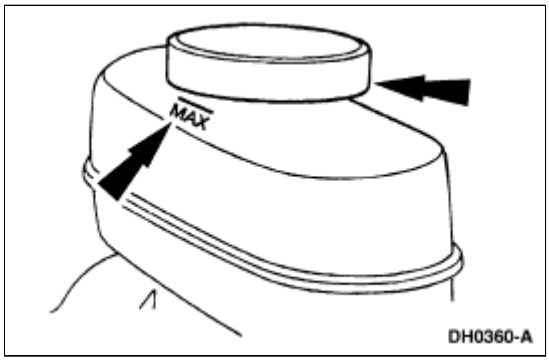
WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. 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.

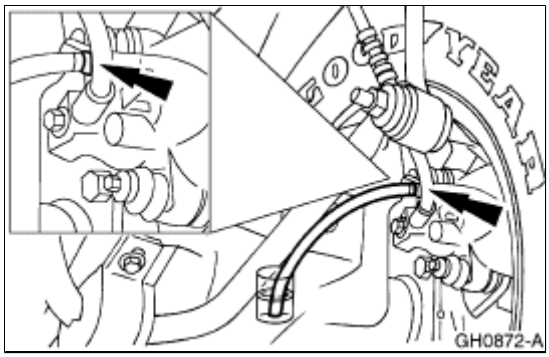
CAUTION: Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

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.



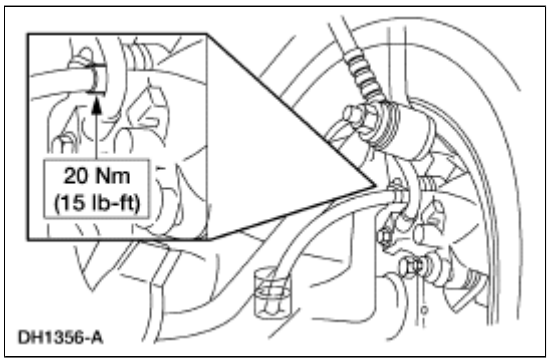
2. Place a box end wrench on the RH rear bleeder screw. Attach a rubber drain tube to the RH rear bleeder screw and submerge the free end of the tube in a container partially filled with clean brake fluid.



3. Have an assistant pump the brake pedal and then hold firm pressure on the brake pedal.

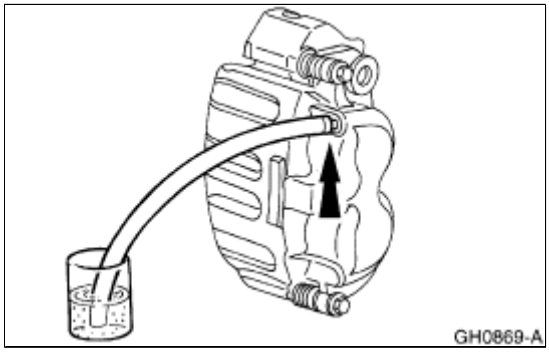
4. Loosen the RH rear bleeder screw until a stream of brake fluid comes out. While the assistant maintains pressure on the brake pedal, tighten the RH rear bleeder screw.
   - Repeat until clear, bubble-free fluid comes out.
   - Refill the brake master cylinder reservoir as necessary.

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.



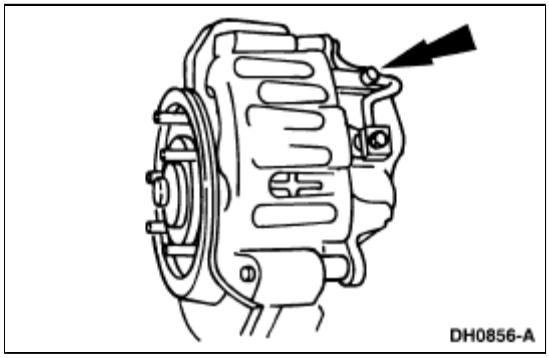
8. Have an assistant pump the brake pedal and then hold firm pressure on the brake pedal.

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.

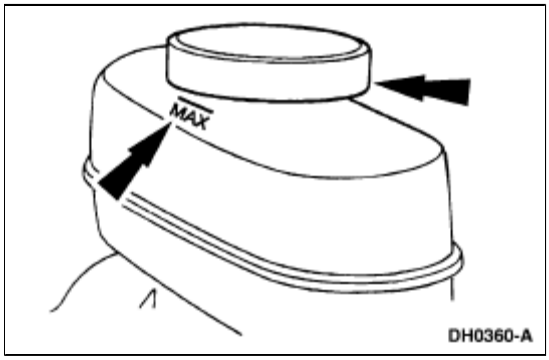
10. Tighten the RH front disc brake caliper bleeder screw. For additional information, refer to Specifications in this section.



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.

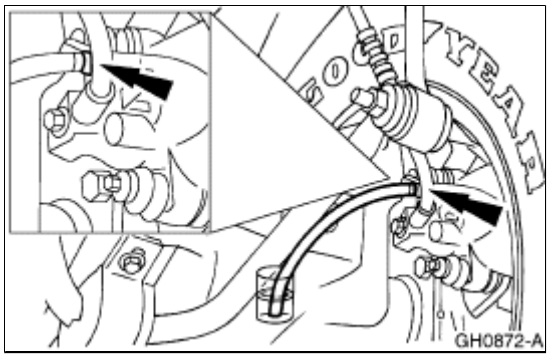


2. **NOTE:** Master cylinder pressure bleeder adapter tools are available from various manufacturers of pressure bleeding equipment. Follow the instructions of the manufacturer when installing the adapter.

   Install the bleeder adapter to the brake master cylinder reservoir, and attach the bleeder tank hose to the fitting on the adapter.

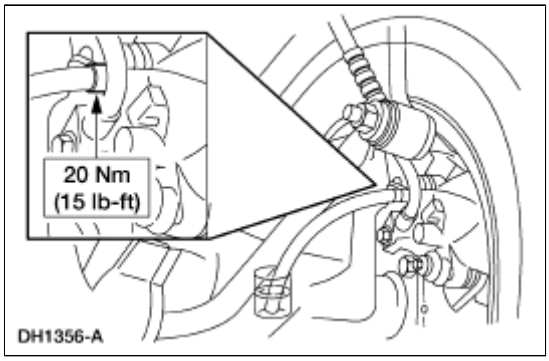
3. **NOTE:** Bleed the longest line first. Make sure the bleeder tank contains enough specified brake fluid to complete the bleeding operation.

   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. Verify that the reservoir level is dropping.

4. If the reservoir level is dropping, inspect the brake components, fittings and lines to locate the source of the leak.

General Specifications

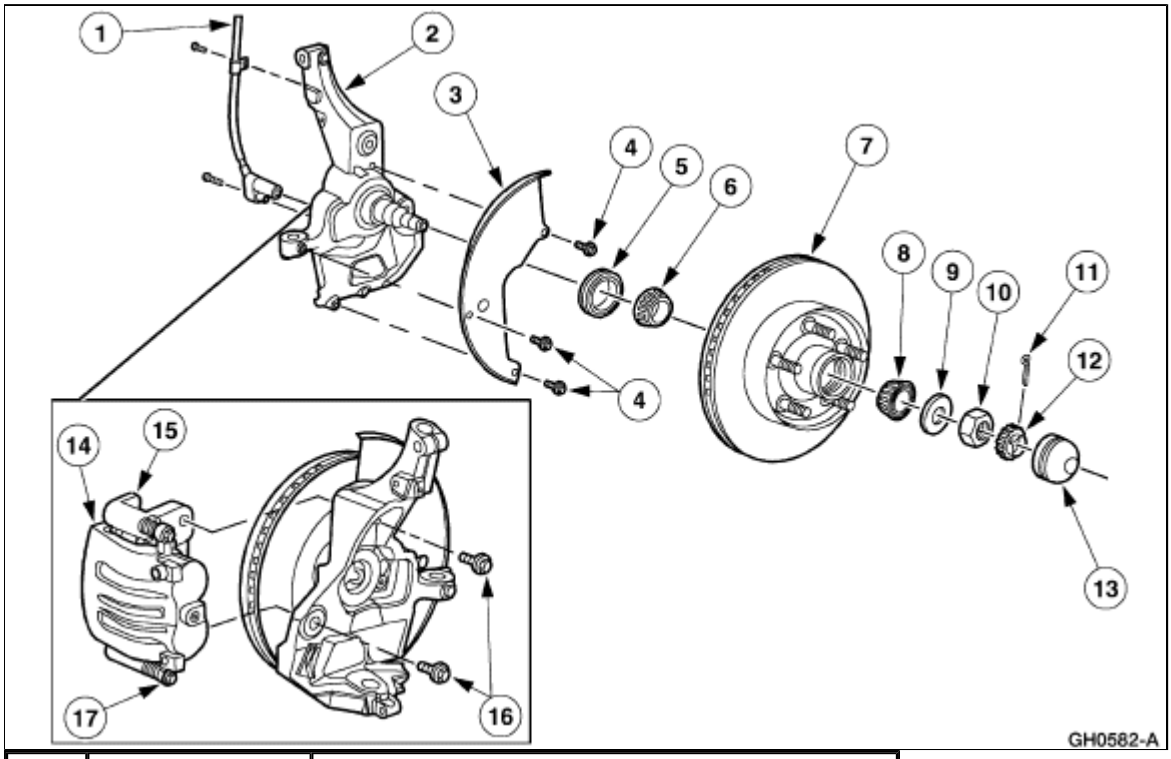
Item	Specification
Disc brake lining wear limit	2.5 mm (0.10 in)
Disc minimum thickness	24.5 mm (0.98 in)

Torque Specifications

Description	Nm	lb-ft
Brake hose bolt	30-40	23-29
Front disc brake caliper anchor plate bolts	98-132	72-97
Disc brake caliper bolts	28-36	21-26
Brake disc shield bolts	10-14	7-10

Front Disc Brake

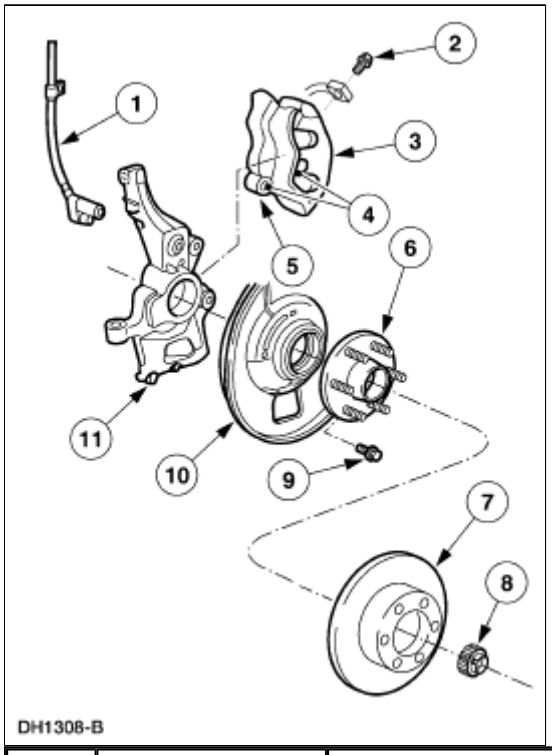
Front Disc Brake Components — 4x2



Item	Part Number	Description
1	2C204	Front brake anti-lock sensor
2	3105	Front wheel spindle
3	2K004	Brake disc shield
4	N611171-S2	Bolt
5	1190	Grease seal
6	1216	Front wheel bearing
7	1102	Brake disc and hub
8	1216	Front wheel bearing
9	1195	Front wheel outer bearing retainer washer
10	374504-S36	Hub spindle nut
11	N642569-S	Cotter pin
12	390622-S	Nut retainer
13	1131	Hub grease cap
14	2B120	Disc brake caliper
15	2B292	Front disc brake caliper anchor plate

16	N805163-S190	Caliper anchor plate bolts
17	2N386	Disc brake caliper bolt

Front Disc Brake Components — 4x4



Item	Part Number	Description
1	2C204	Front brake anti-lock sensor
2	N808236-S36	Front brake hose bolt
3	2B120	Disc brake caliper
4	2001	Pads
5	2B292	Front disc brake caliper anchor plate
6	1104	Wheel hub
7	1125	Brake disc
8	3B477	Front axle wheel hub retainer
9	N611171-S2	Bolt (3 req'd)
10	2K005	Brake disc shield
11	3K186	Front wheel knuckle

On two-wheel drive vehicles:

- The disc brake caliper (2B120) bolts to the anchor plate (2B292).
- The brake disc and hub (1102) is an integrally cast assembly.

On AWD and 4x4 vehicles:

- The disc brake caliper bolts to the front wheel knuckle (3K186).
- A separate brake disc (1125) attaches to the wheel hub (1104).

The disc brake caliper:

- is a pin slider, dual piston type.
- has two caliper pistons (2196).

The caliper has a fluid inlet at the center of the housing. A square section seal fitted into an annular groove in the caliper bore seals against hydraulic pressure, while rubber boots seal the caliper pistons and caliper bore from contamination.

The brake disc shield (2K005):

- bolts to the front wheel knuckle
- protects the bearings and inboard surface of the brake disc.

The pads are:

- contained within the front disc brake caliper anchor plate (2B292).
- held to the front disc brake caliper anchor plate abutments by disc brake anti-rattle clips.

Front Disc Brake

Refer to Section 206-00 .

Pads

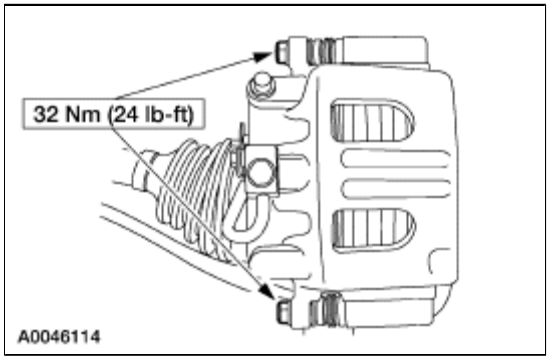
Removal and Installation

1. Remove the brake fluid in the master cylinder reservoir until the reservoir is half full.

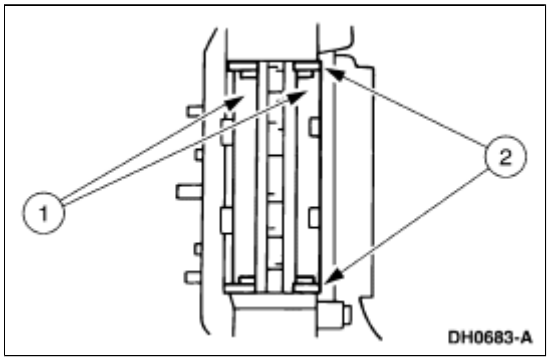
2. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation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

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

3. Position the brake caliper aside.
   - Remove the brake caliper bolts.
   - Position the brake caliper aside and support it.



4. Remove the pads and the stainless slippers.
   1. Remove the pads.
   2. Remove the stainless slippers.



5. Use a suitable suction device to remove the brake fluid from the master cylinder.

6. Clean the anchor plate.

7. The inboard pad has a wear indicator tab. The indicator tab must be oriented toward the brake disc surface.

8. Install the stainless slippers and the pads.
   - Install the new stainless slippers (included in service kit).
   - Install the pads.

9. **NOTE:** The caliper pistons must be compressed using a C-clamp and a wooden block.

   NOTE: Tighten the bottom caliper bolt on the LF side first. Tighten the top caliper bolt on the RF side first.

   Inspect the brake system operation.

10. To install, reverse the removal procedure.

Caliper

Removal

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 located in the rear jack storage area. 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.**

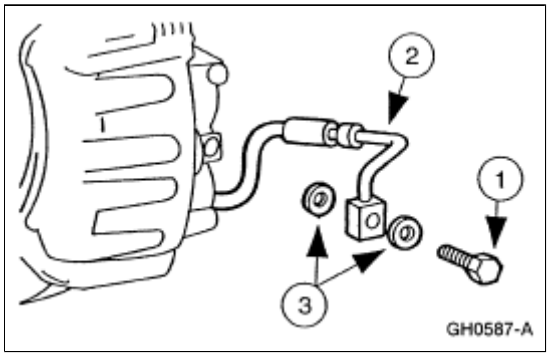
   Raise and support the vehicle. For additional information, refer to Section 100-02 .

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

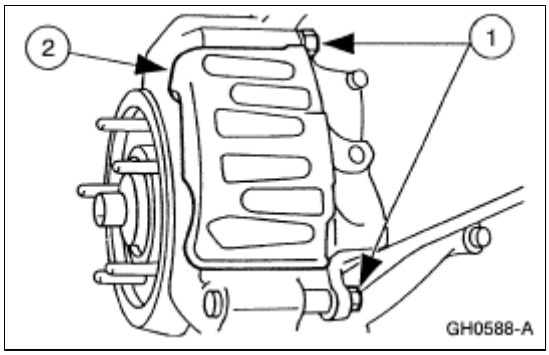
3. **WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. 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, immediately wash it with water.

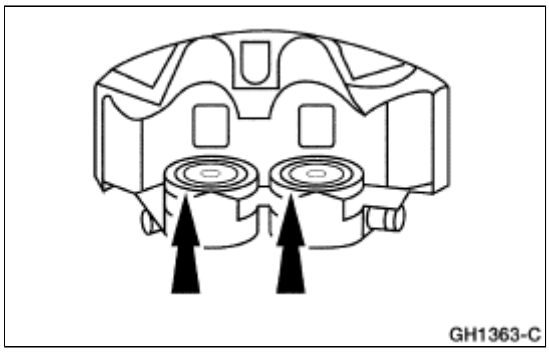
   Disconnect the front brake hose (2078).
   1. Remove the front brake hose bolt.
   2. Disconnect the front brake hose.
   3. Remove and discard the copper washers. Plug the front brake hose.



4. Remove the disc brake caliper (2B120).
   1. Remove the disc brake caliper bolts.
   2. Lift the disc brake caliper off the front disc brake caliper anchor plate (2B292).

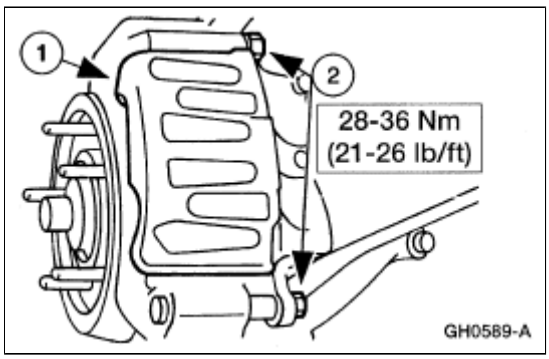


5. Inspect the disc brake caliper for leaks.
    - If leaks are found, disassembly is required. For additional information, refer to Caliper , Disassembly and Assembly in this section.

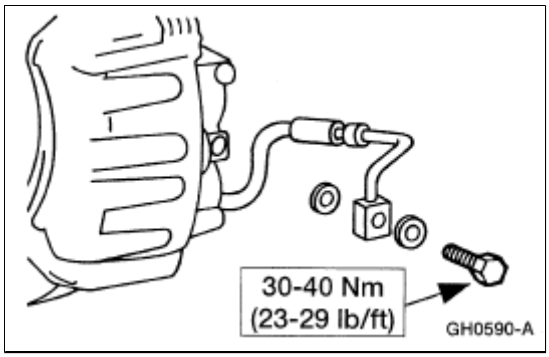


Installation

1. Install the disc brake caliper.
    1. Install the disc brake caliper.
    2. Install the disc brake caliper bolts.



2. Install the front brake hose.
    - Use new copper washers; connect the front brake hose.
    - Install the front brake hose bolt.



3. Bleed the disc brake caliper. For additional information, refer to Section 206-00 .
4. **NOTE:** If equipped with air suspension, reactivate the system by turning on the air suspension switch.

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

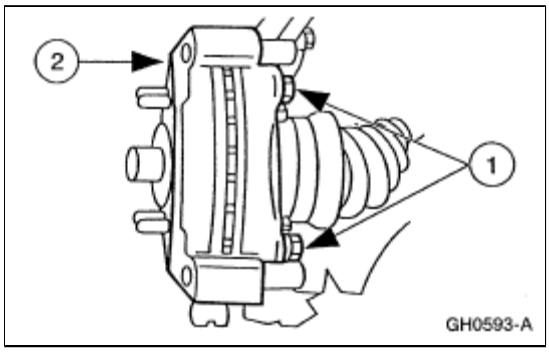
Brake Caliper Anchor Plate

Removal

1. **NOTE:** AWD and 4x4 shown, 4x2 similar.

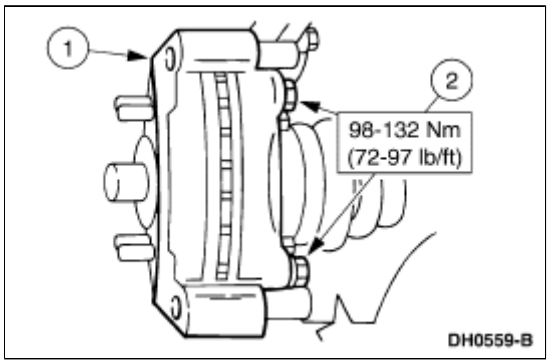
   Remove the pads. For additional information, refer to Pads in this section.

2. Remove the front disc brake caliper anchor plate (2B292).
   1. Remove the two front disc brake caliper anchor plate bolts.
   2. Remove the front disc brake caliper anchor plate.



Installation

1. Install the front disc brake caliper anchor plate.
   1. Position the front disc brake caliper anchor plate.
   2. Install the front disc brake caliper anchor plate bolts.



2. Install the pads. For additional information, refer to Pads in this section.

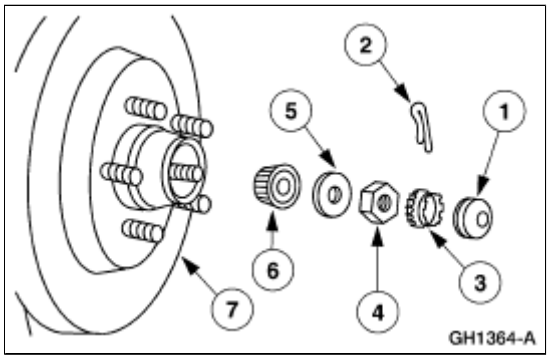
Disc

Removal

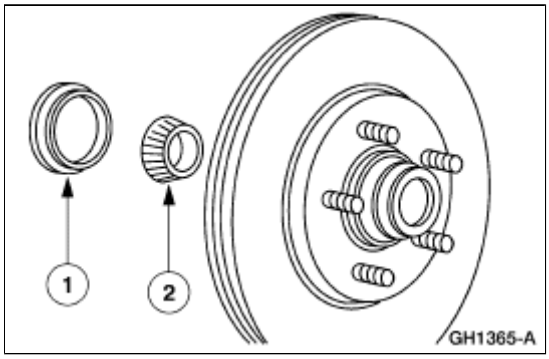
1. Remove the front disc brake caliper anchor plate (2B292). For additional information, refer to Brake Caliper Anchor Plate in this section.

2. On 4x4 vehicles, remove the brake disc (1125).

3. On 4x2 vehicles, remove the brake disc and hub (1102) as follows:
    1. Remove the hub grease cap (1131).
    2. Remove the cotter pin.
    3. Remove the nut retainer.
    4. Remove the spindle nut.
    5. Remove the front wheel outer bearing retainer washer (1195).
    6. Remove the outer front wheel bearing (1216).
    7. Remove the brake disc and hub.



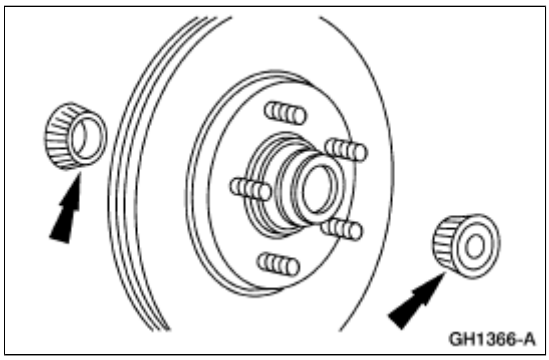
4. Remove the wheel hub grease seal (1190).
    1. Remove the wheel hub grease seal.
    2. Remove the inner front wheel bearing.



Installation

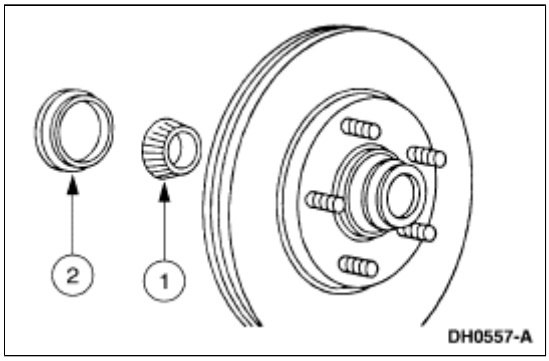
1. On AWD and 4x4 vehicles, position the brake disc to the wheel hub.
    - Use Metal Brake Parts Cleaner F3AZ-19579-SA or equivalent to clean the brake disc.

2. On 4x2 vehicles, thoroughly clean and inspect the front wheel bearings and the brake disc and hub.
    - Use Metal Brake Parts Cleaner F3AZ-19579-SA or equivalent.

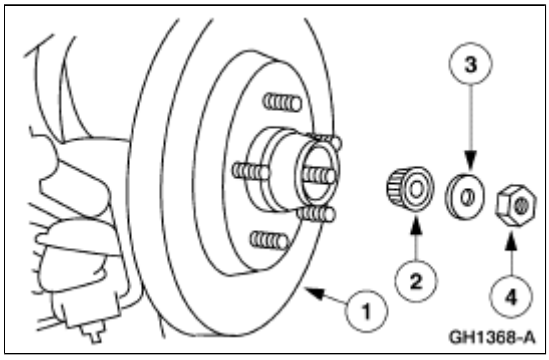


3. On 4x2 vehicles, lubricate the front wheel bearings.
    - Use Premium Long-Life Grease XG-1-C or -K or equivalent meeting Ford specification ESA-M1C75-B.

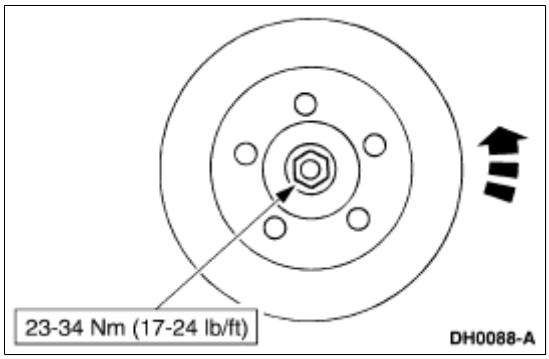
4. On 4x2 vehicles, install a new wheel hub grease seal.
    1. Install the inner front wheel bearing.
    2. Install a new wheel hub grease seal.



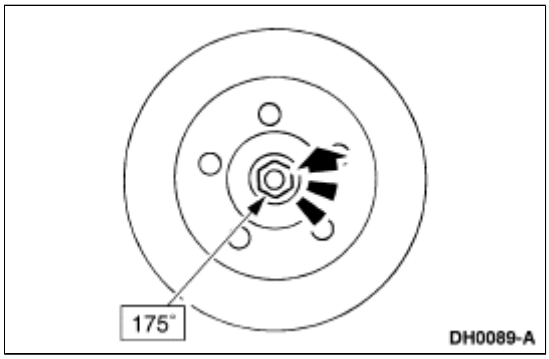
5. On 4x2 vehicles, install the brake disc and hub.
    1. Position the brake disc and hub.
    2. Install the outer front wheel bearing.
    3. Install the front wheel outer bearing retainer washer.
    4. Install the spindle nut.



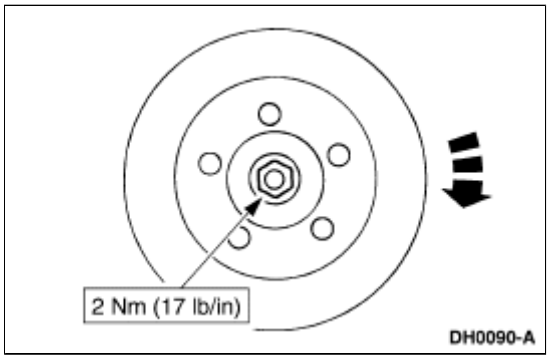
6. Tighten the spindle nut while rotating the brake disc and hub.



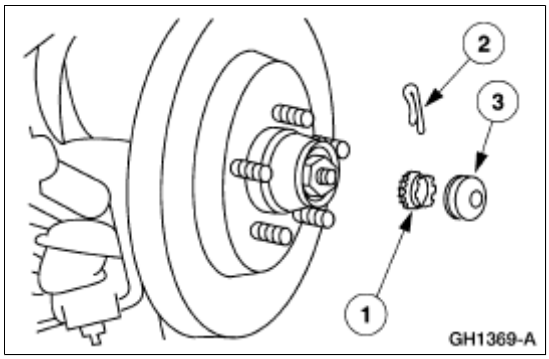
7. Loosen the spindle nut.



8. Tighten the spindle nut while rotating the brake disc and hub.



9. On 4x2 vehicles, install the following components:
    1. Install the nut retainer.
    2. Install the cotter pin.
    3. Install the hub grease cap.



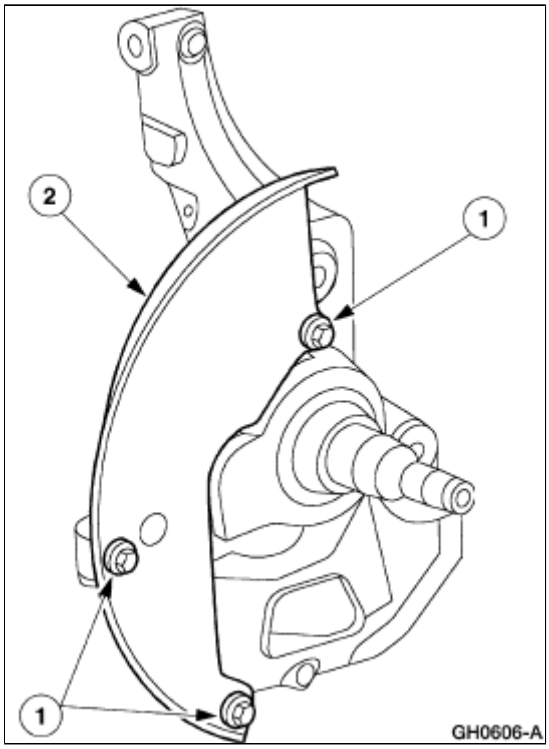
10. Install the front disc brake caliper anchor plate. For additional information, refer to Brake Caliper Anchor Plate in this section.

Shield —4x2

Removal

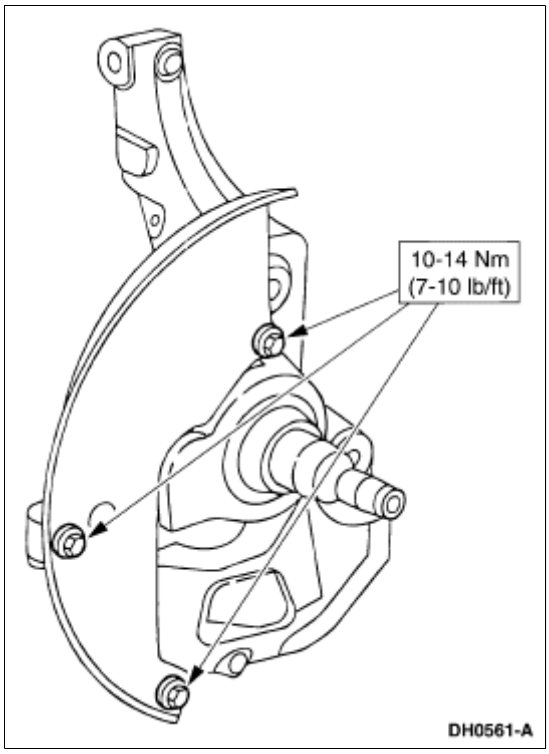
1. Remove the brake disc. For additional information, refer to Disc in this section.

2. Remove the brake disc shield (2K005).
    1. Remove the bolts.
    2. Remove the brake disc shield.



Installation

1. Follow the removal procedure in reverse order.

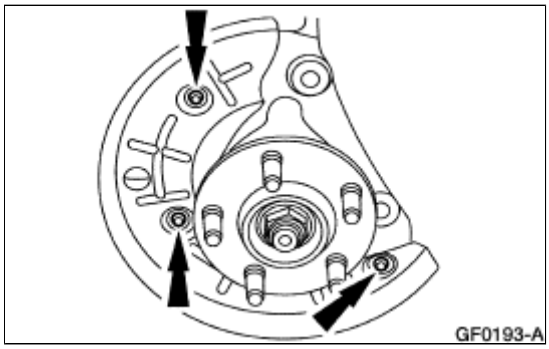

10-14 Nm
(7-10 lb/ft)
DH0561-A

Shield —AWD, 4x4

Removal

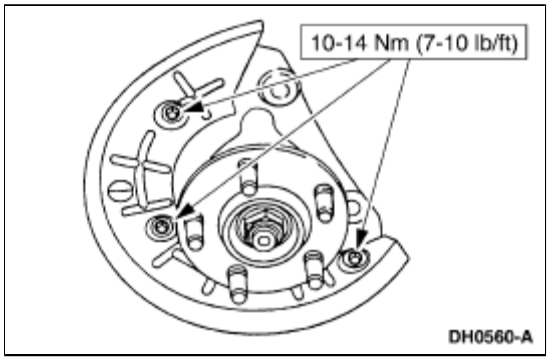
1. Remove the brake disc. For additional information, refer to Disc in this section.

2. Remove the brake disc shield (2K005).
   - Remove the three brake disc shield bolts and remove the brake disc shield.



Installation

1. Follow the removal procedure in reverse order.



Caliper

Disassembly

WARNING: Use of any brake fluid other than approved DOT 3 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 to 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.

NOTE: Use clean, fresh Ford High Performance DOT 3 Motor Vehicle Brake Fluid C6AZ-19542-AB or equivalent meeting Ford specification ESA-M6C25A.

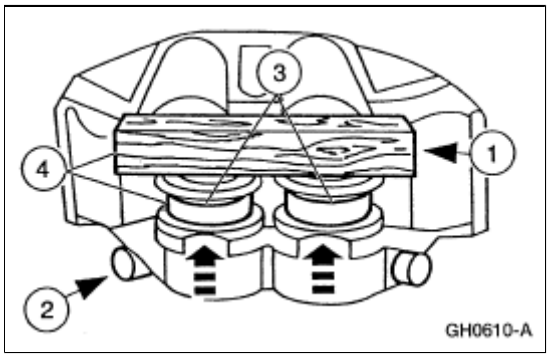
- Do not reuse brake fluid drained or bled from the system.
- Do not use brake fluid that has been stored in an open container.
- Do not use contaminated brake fluid.

1. Remove the disc brake caliper (2B120). For additional information, refer to Caliper in the Removal and Installation portion in this section.

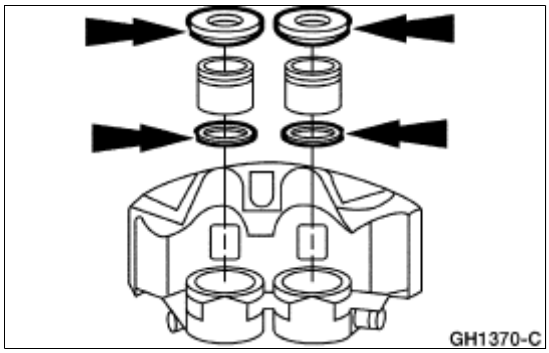
2. Drain remaining brake fluid from the disc brake caliper.

3. Secure the disc brake caliper in a vise.

4. Remove the caliper pistons (2196).
    1. Place a block of wood between the caliper bridge and the caliper pistons.
    2. Apply low air pressure to the fluid port in the disc brake caliper.
    3. Force out the caliper piston to the block of wood.
    4. Remove the block of wood and the caliper pistons.



5. Remove and discard the piston seals and boots.



6. **NOTE:** Do not hone the caliper bores. Pistons are not available for honed caliper bores.

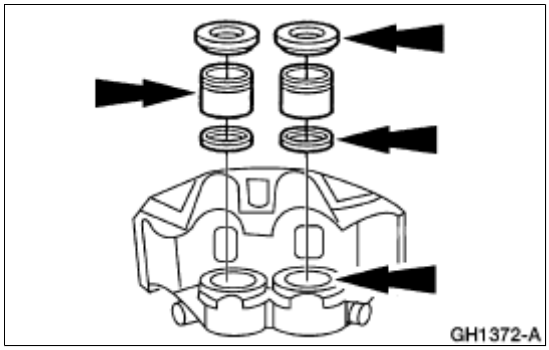
   If the caliper bores are excessively scored or corroded, install a new disc brake caliper.

Assembly

1. **CAUTION: Never reuse piston seals or dust boots.**

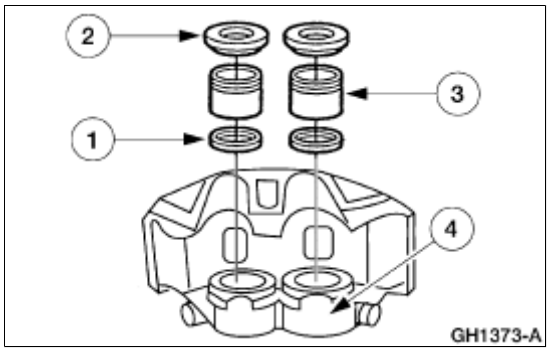
   NOTE: Never reuse brake fluid that has been drained from the hydraulic system or has been allowed to stand in an open container for an extended period of time.

   Lubricate the piston boot, caliper piston, piston seal, and cylinder bores with High Performance DOT 3 Motor Vehicle Brake Fluid C6AZ-19542-AB or DOT 3 equivalent meeting Ford specification ESA-M6C25-A.



2. Install the caliper pistons.
   1. Install the piston seal.
   2. Install the piston boot.
   3. **CAUTION: Be careful not to damage or dislodge the piston seal.**

      Insert the caliper piston.
   4. Press the caliper piston into the caliper bore, being careful not to cock the caliper piston.



3. Install the disc brake caliper. For additional information, refer to Caliper in the Removal and Installation portion in this section.

General Specifications

Item	Specification
Rear disc brake lining minimum thickness	1.0 mm (0.039 in)
Rear brake disc minimum thickness [a]	11 mm (0.44 in)
Rear brake disc maximum allowable runout	0.0051 mm (0.0002 in)
Rear brake disc maximum thickness variation	0.013 mm (0.0005 in)
Lubricants	
High Performance DOT 3 Brake Fluid C6AZ-19542-AB	ESA-M6C25-A
Silicone Rubber D6AZ-19562-AA	ESB-M4G92-A
Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A (Motorcraft WA-10)	ESE-M1C171-A

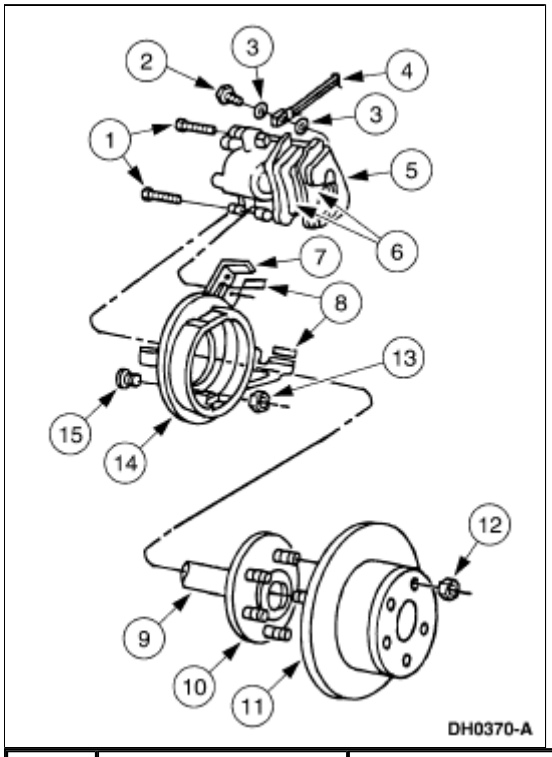
[a] Minimum brake disc thickness is molded into the brake disc.

Torque Specifications

Description	Nm	lb-ft
Brake caliper bolts	27	20
Caliper flow bolt	30-40	23-29
Rear wheel disc brake adapter bolts	108	80

Rear Disc Brake

Rear Disc Brake System Components



Item	Part Number	Description
1	N807146-S101	Brake caliper bolt
2	385116-S2	Flow bolt
3	388949-S	Copper washer (2 req'd)
4	2A442	Rear wheel brake hose
5	2552	Rear disc brake caliper
6	—	Brake pads
7	2C220	Adapter assy
8	2A648	Shoe slippers
9	4234	Axle shaft
10	1107	Wheel stud (5 req'd)
11	2C026	Brake disc
12	—	Keeper nut
13	—	Rear wheel disc brake adapter nut
14	2C220	Rear wheel disc brake adapter
15	—	Rear wheel disc brake adapter bolt

NOTE: The inboard and outboard brake pads are not interchangeable.

The brake disc (2C026) is a solid, full-cast, drum-in-hat type. The rear disc brake caliper (2552) is equipped with a riveted spring clip that secures it to either the rear disc brake caliper piston or the rear disc brake caliper housing.

Rear Disc Brake

Refer to Section 206-00 .

Caliper

Removal

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.**

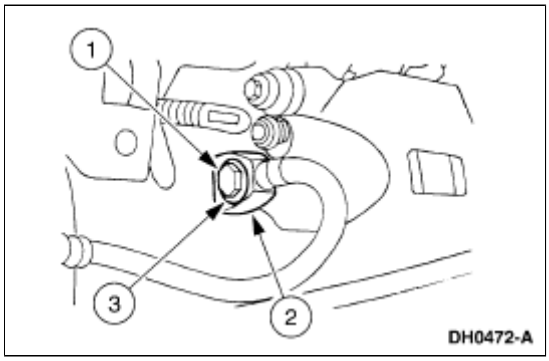
   Raise and support the vehicle. For additional information, refer to Section 100-02 .

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.**

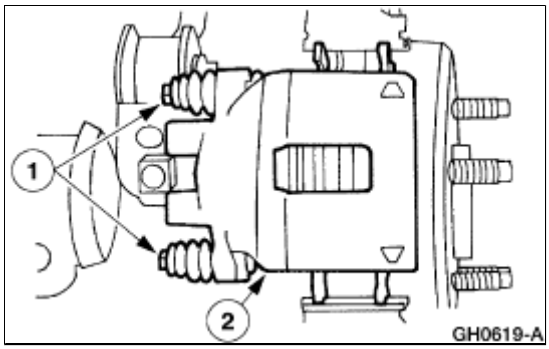
   CAUTION: Brake fluid is harmful to painted or plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

   Disconnect the brake hose.
   1. Remove bolt.
   2. Disconnect the rear wheel brake hose (2A442).
   3. Remove the copper washers and plug the brake hose.

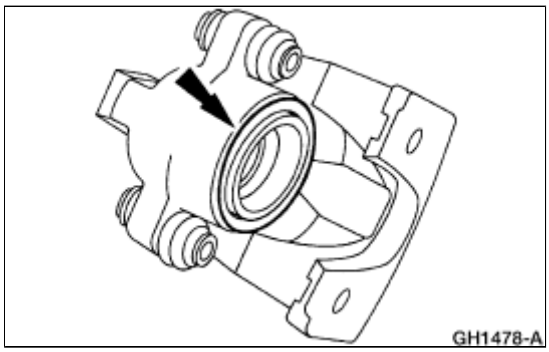


4. **CAUTION: Do not remove the guide pins or guide pin boots unless a problem is suspected. The guide pins are meant to be sealed for life and are not repairable. Use Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A (Motorcraft WA-10) or an equivalent silicone compound meeting Ford specification ESE-M1C171-A for re-lubing the caliper slide pins. Other greases can swell the guide pin boots, resulting in contamination and accelerated corrosion or wear of the caliper slide pin mechanism.**

   Remove the rear disc brake caliper (2552).
   1. Remove the brake caliper bolts (2W303).
   2. Lift the rear disc brake caliper off the rear disc brake caliper anchor plate (2C220).



5. Inspect the rear disc brake caliper for leaks.
   - If leaks are found, disassembly is required. Refer to Caliper in this section.



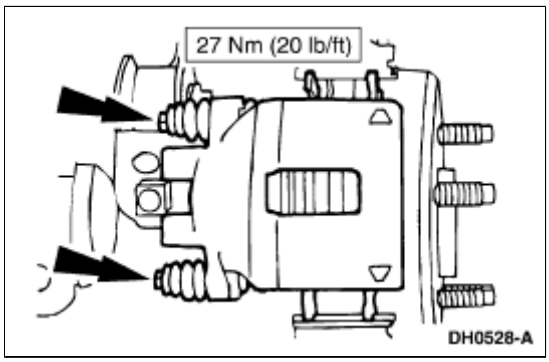
Installation

1. **CAUTION: To prevent interference with rear disc brake caliper operation, install only the correct caliper bolt.**

   NOTE: Make sure the stainless steel shoe slippers are correctly positioned. Install new slippers if worn or damaged.

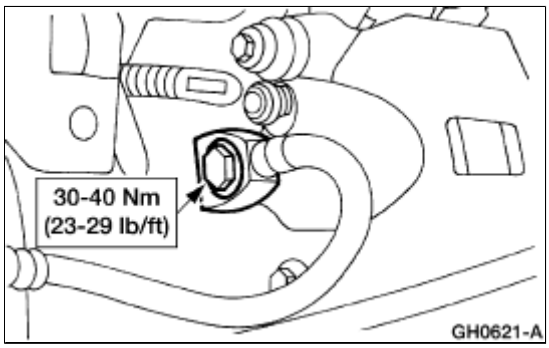
   NOTE: When installed, the locator notch on the brake pads will be located at the upper end of the rear disc brake caliper.

   Install the rear disc brake caliper.



2. Install the rear wheel brake hose.
   - Connect the brake hose and install the caliper flow bolt.

- Use new copper washers.



3. Bleed the disc brake caliper. For additional information, refer to Section 206-00 .
4. **NOTE:** If equipped with air suspension, reactivate the system by turning on the air suspension switch.

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

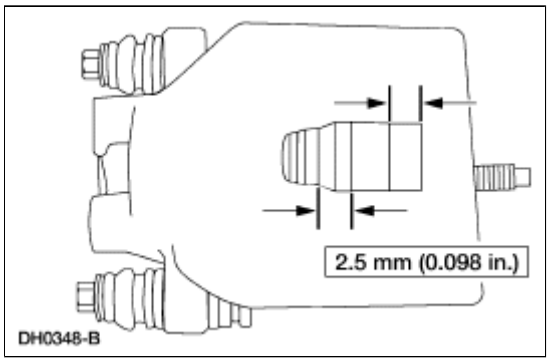
Pads

Removal

1. Remove brake fluid in the master cylinder reservoir until the reservoir is half full.

2. **CAUTION: Replace the 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 brake pads for wear or contamination. Install new pads if worn to or past specification.

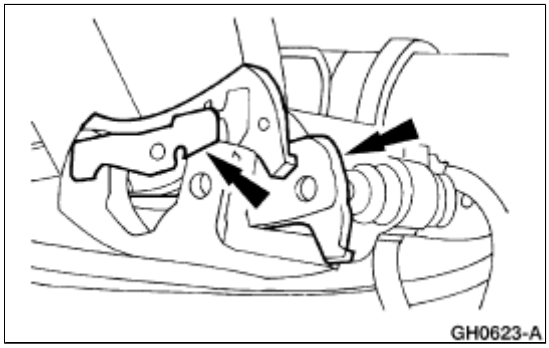


3. **NOTE:** It is not necessary to remove the rear wheel brake hose (2A442) when performing this procedure.

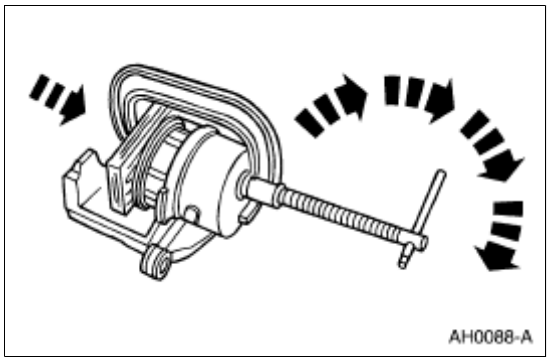
   Remove the rear disc brake caliper (2552). For additional information, refer to Caliper in this section.

4. **CAUTION: Do not allow grease, oil, brake fluid or other contaminants to contact the brake pads.**

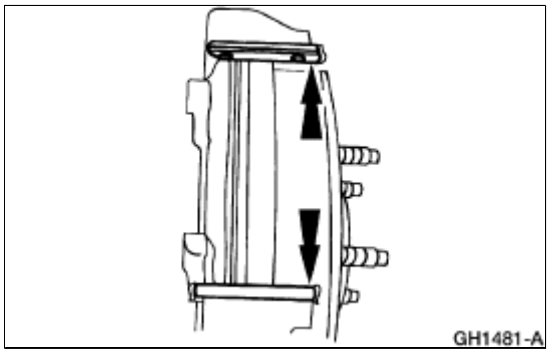
   Remove the brake pads.



5. Retract the caliper piston into the rear disc brake caliper.

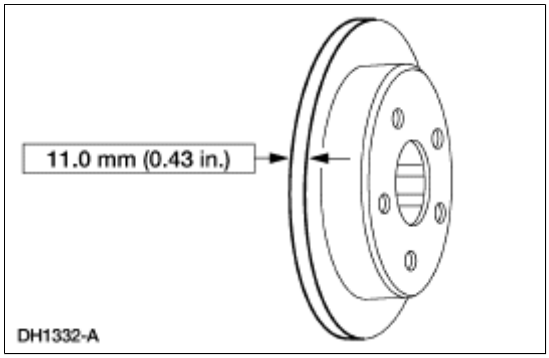


6. Remove the slippers.



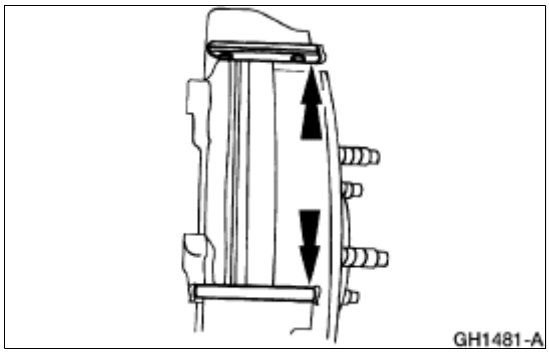
7. **CAUTION: Use a hub-mount brake lathe if necessary to machine the rear brake disc.**

   Measure the rear brake disc, and resurface as necessary. Install a new rear brake disc if beyond specification.



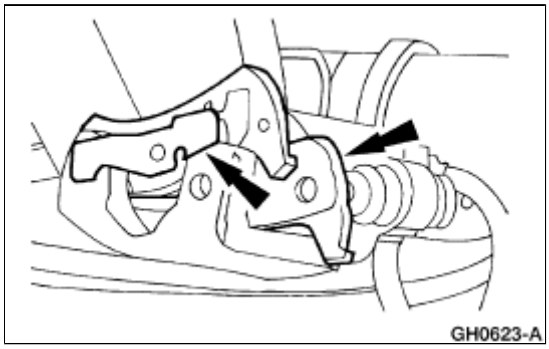
Installation

1. Clean the slipper mating surface, and install the slippers.



2. **CAUTION: Install new brake pads in full axle sets. Do not install new brake pads on only one side of vehicle.**

   Install the brake pads.



3. Install the rear disc brake caliper. For additional information, refer to Caliper in this section.
4. Verify correct brake operation.

Disc

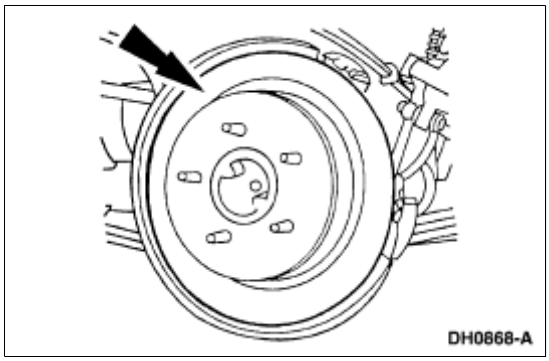
Removal

1. **NOTE:** When removing the rear brake disc (2C026) in this procedure it is not necessary to disconnect the hydraulic lines.

   Remove the rear disc brake caliper (2552). For additional information, refer to Caliper in this section.

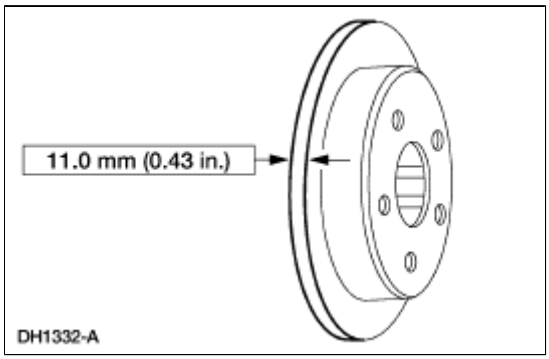
2. **NOTE:** If the rear brake disc binds on the rear parking brake shoe and linings, remove the adjustment hole access plug and contract the parking brake shoe and lining.

   Remove the rear brake disc.



3. **CAUTION: Use a hub-mount brake lathe if necessary to machine the rear brake disc.**

   Measure the rear brake disc, and resurface as necessary. Install a new rear brake disc if beyond specification.



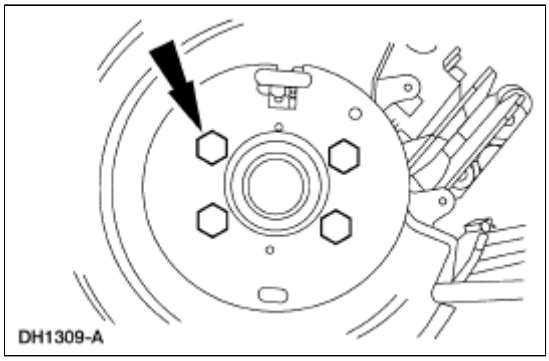
Installation

1. Follow the removal procedure in reverse order.

Adapter

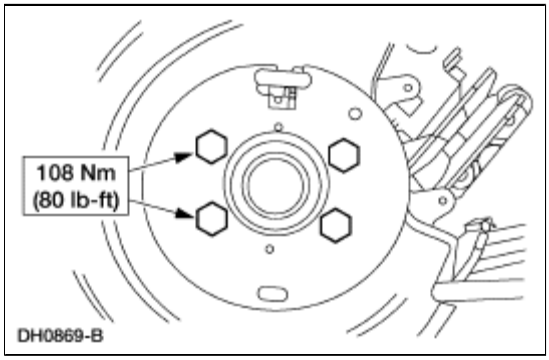
Removal

1. Disconnect the rear parking brake cable guide (2A697). For additional information, refer to Section 206-05 .
2. Remove the axle shaft (4234). For additional information, refer to Section 206-05 .
3. Remove the bolts and the rear wheel disc brake adapter (2C220).



Installation

1. Follow the removal procedure in reverse order.

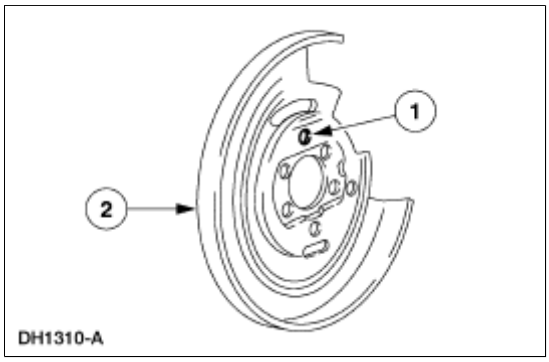


Shield

Removal

1. Remove the rear wheel disc brake adapter (2C220). For additional information, refer to Adapter in this section.

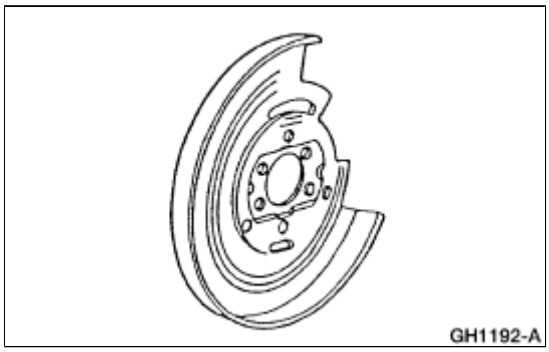
2. Remove the rear wheel disc brake shield (2C028).
    1. Drill out the rivet.
    2. Remove the rear wheel disc brake shield.



Installation

1. **NOTE:** Because the rear wheel disc brake shield is held in position by the four rear wheel disc brake adapter bolts, a new rivet is not required.

   Seal the rivet hole with Clear Silicone Rubber D6AZ-19562-AA or equivalent meeting Ford specification ESB-M4G92-A, and install the rear wheel disc brake shield.



2. Install the rear wheel disc brake adapter. For additional information, refer to Adapter in this section.

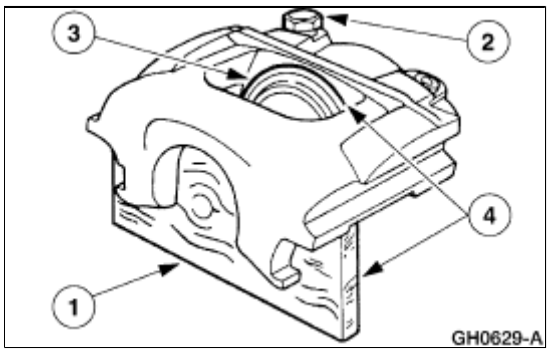
Caliper

Special Tool(s)

 ST1255-A	Handle 205-153 (T80T-4000-W)
 ST1588-A	Dust Seal Replacer 206-053 (T92P-2588-AH)

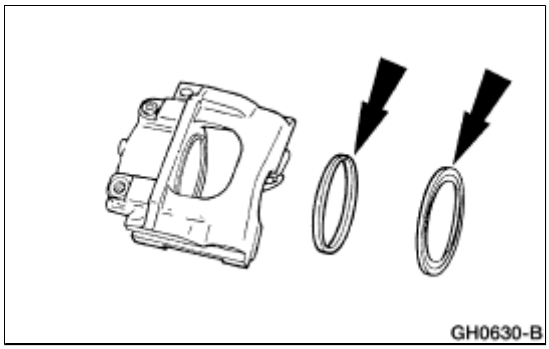
Disassembly

1. Remove the rear disc brake caliper (2552). For additional information, refer to Caliper in this section.
2. Drain the remaining brake fluid from the rear disc brake caliper.
3. Secure the rear disc brake caliper in a vise.
4. Remove the rear disc brake piston.
    1. Place a block of wood between the caliper bridge and the rear disc brake piston.
    2. Apply low air pressure to the fluid port in the rear disc brake caliper.
    3. Force the rear disc brake piston out to the block of wood.
    4. Remove the block of wood and the rear disc brake piston.



5. **NOTE:** Do not hone the cylinder bore. Pistons are not available for honed cylinder bores. If the rear disc brake caliper cylinder bore/piston is excessively scored or corroded, install a new rear disc brake caliper.

    Remove and discard the piston seal and dust boot.

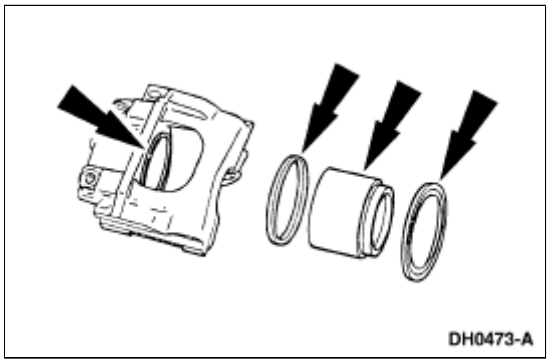


Assembly

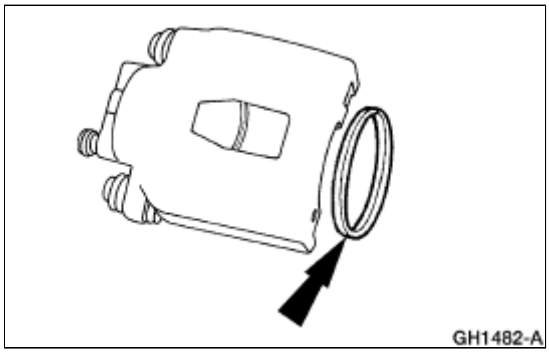
CAUTION: Never reuse the piston seal or dust boot.

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.

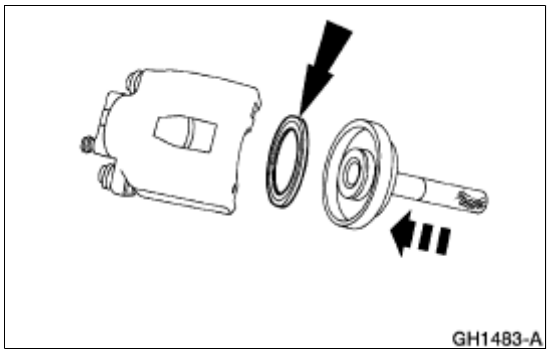
1. Lubricate the following with High Performance DOT 3 Motor Vehicle Brake Fluid C6AZ-19542-AB or equivalent DOT 3 fluid meeting Ford specification ESA-M6C25-A.
   - cylinder bore
   - piston seal
   - rear disc brake piston
   - dust boot



2. Install the piston seal.

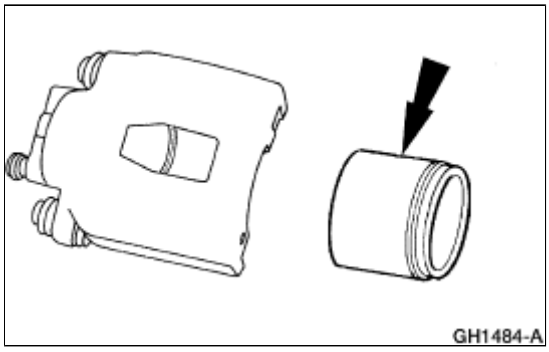


3. Install the dust boot.



4. **CAUTION: Be careful not to damage or dislodge the piston seal.**

   Install the rear disc brake piston.



5. Install the rear disc brake caliper. For additional information, refer to Caliper in this section.

General Specifications

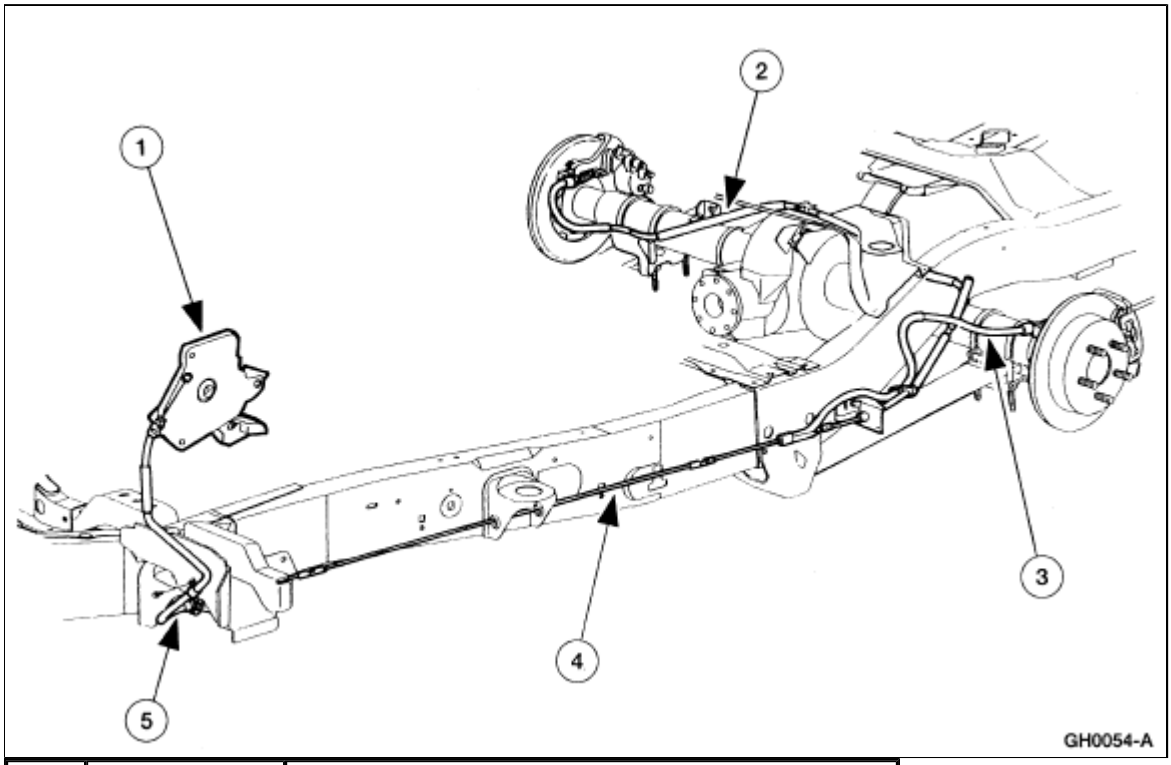
Item	Specification
Parking brake shoes and lining minimum thickness	1.0 mm (0.04 in)
Lubricant	
Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A (Motorcraft WA-10)	ESE-M1C171-A

Torque Specifications

Description	Nm	lb-ft	lb-in
Wheel nuts	135	100	—
Parking brake control bolts	17-23	13-17	—
Parking brake cable and conduit clip bolt	15-20	11-14	—
Parking brake cable retainer clip bolt	6-8	—	54-70
Parking brake remote release to instrument panel	2.1-2.9	—	19-25
Rear disc brake caliper to rear disc brake caliper anchor plate bolts	27	20	—
Parking brake cable retainer screws	20	15	—

Parking Brake

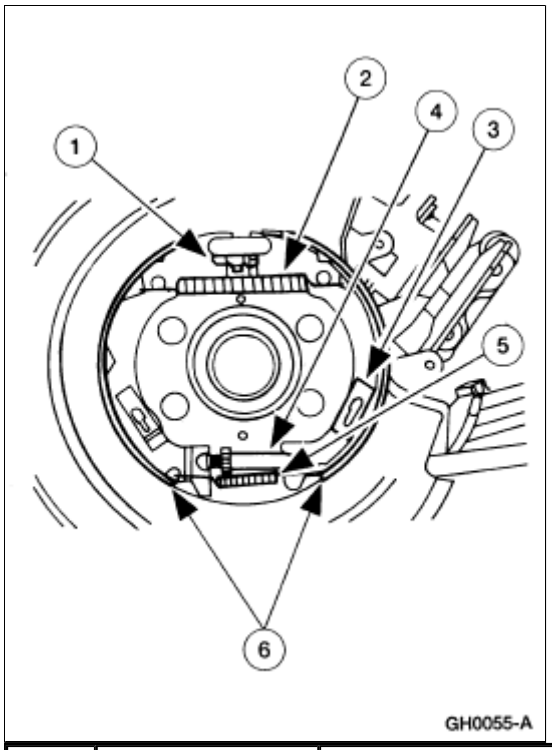
Parking Brake System Components



Item	Part Number	Description
1	2780	Parking brake control
2	2A635	Parking brake rear cable and conduit— (RH)
3	2A809	Parking brake rear cable and conduit— (LH)
4	2A793	Parking brake intermediate cable
5	2853	Front parking brake cable and conduit

The parking brake system is actuated when the parking brake control (2780) is depressed. The parking brake control applies tension to the front parking brake cable and conduit (2853), the parking brake intermediate cable (2A620), and the parking brake cable equalizer (2A602). The parking brake cable equalizer is coupled to the RH parking brake rear cable and conduit (2A635), and the LH parking brake rear cable and conduit. The respective rear brake assemblies are then applied.

Parking Brake Components



Item	Part Number	Description
1	2A637	Parking brake lever (RH)
1	2A638	Parking brake lever (LH)
2	2296	Brake shoe retracting spring
3	2A094	Brake shoe hold-down spring and pin
4	2041	Brake adjuster screw
5	2049	Brake shoe adjusting screw spring
6	2648	Rear brake shoe and lining

The rear wheel disc brake assembly contains a cable actuated parking brake assembly.

If the parking brake control is not fully released, the parking brake signal switch will illuminate the brake warning light.

The parking brake signal switch is mounted on the parking brake control. The switch is held in place by a self-tapping screw and aligned with a locater pin.

Parking Brake

Inspection and Verification

Check the operation of the parking brake system with the vehicle on a hoist and the parking brake control (2780) fully released. Check for any damaged cables and install new as necessary. Check the rear brake adjustment or perform brake system diagnosis.

Check the parking brake by depressing the parking brake control pedal. The parking brake must hold the vehicle on an incline by applying pressure to the pedal before it reaches full pedal travel to the floor. If not as specified, check the parking brake system for correct rear brake adjustment, cable operation and parking brake control operation.

Symptom Chart

Parking Brake System

Condition	Possible Sources	Action
• Parking brake will not apply	• Parking brake cable. • Rear shoes and linings. • Parking brake control.	• Go To Pinpoint Test A .
• Parking brake will not release	• Parking brake cable. • Parking brake control. • Rear shoes and linings.	• Go To Pinpoint Test B .

Pinpoint Tests

PINPOINT TEST A: PARKING BRAKE WILL NOT APPLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK THE PARKING BRAKE CABLE	
	1 Raise and support the vehicle. 2 Inspect for broken or binding parking brake cables. • **Is there a parking brake cable concern?** → **Yes** REPAIR or INSTALL a new parking brake cable as necessary.

	→ **No** GO to A2 .
A2 CHECK THE PARKING BRAKE CONTROL	
	1 Operate the parking brake control. • **Does the parking brake control operate smoothly?** → **Yes** GO to A3 . → **No** REPAIR the binding condition in the parking brake control. TEST the system for normal operation.
A3 CHECK THE PARKING BRAKE COMPONENTS	
	1 Remove the rear brake discs (2C026). Refer to Section 206-04 . 2 Operate the parking brake control and observe the parking brake components. • **Do the parking brake components operate?** → **Yes** CHECK the parking brake shoe and lining clearance to the drum of the brake disc. The minimum thickness on the shoes and lining is 1.0 mm (0.04 in). REFER to Parking Brake Shoes in this section. → **No** REPAIR the worn or damaged parts. TEST the system for normal operation.

PINPOINT TEST B: PARKING BRAKE WILL NOT RELEASE

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK THE PARKING BRAKE CABLE	
	1 Release the parking brake control. 2 If the vehicle cannot be moved, raise and support it. 3 Release the parking brake cable tension. 4 Remove the rear brake disc and disconnect the parking brake rear cable and conduit (2A635). • **Does the parking brake release?** → **Yes** INSPECT the parking brake cable for binding. INSPECT the parking brake control. INSTALL new components as necessary. TEST the system for normal operation. → **No**

	REPAIR the worn or damaged rear brake component. TEST the system for normal operation.

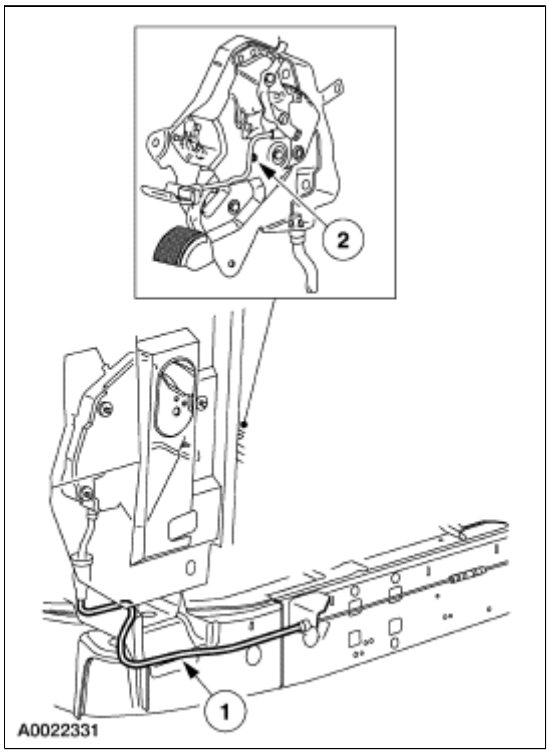
Control

Removal and Installation

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

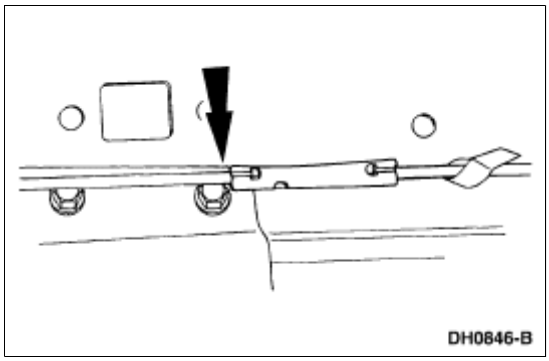
2. **NOTE:** Verify that the parking brake control (2780) is fully released.

   Relieve the tension on the parking brake system.
   1. Pull down on the parking brake intermediate cable (2A793).
   2. Insert a 4 mm (5/32-inch) drill bit or equivalent retainer in the parking brake control.

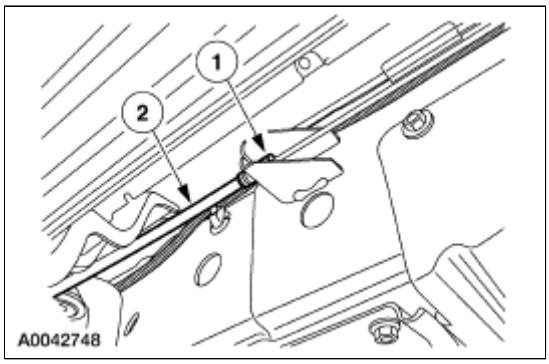


3. Raise and support the vehicle. For additional information, refer to Section 100-02 .

4. Disconnect the front parking brake cable and conduit (2853) at the locating hole end of the connector.

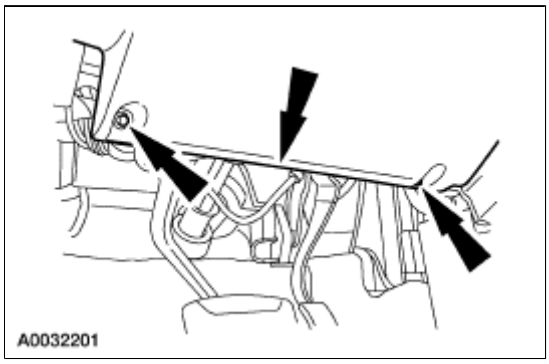


5. Remove the front parking brake cable and conduit from the bracket.
    1. Compress the retainer from the front parking brake cable and conduit from the bracket.
    2. Remove the front parking brake cable and conduit from the bracket.

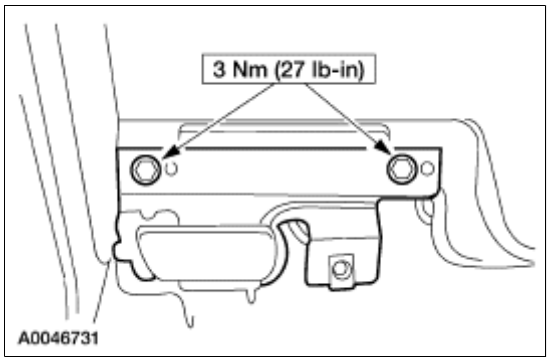


6. Lower the vehicle.

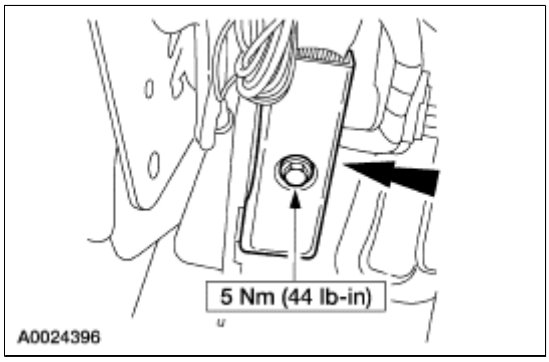
7. Remove the screws and the instrument panel steering column cover.



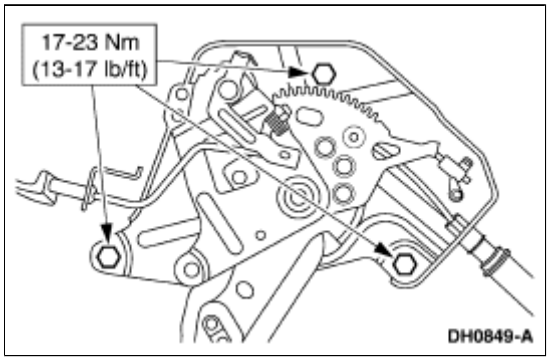
8. Remove the parking brake release mounting bolts.



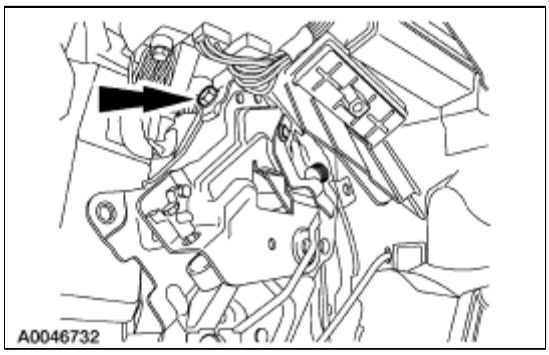
9. Loosen the bolt and disconnect the instrument panel-to-body harness electrical connector.



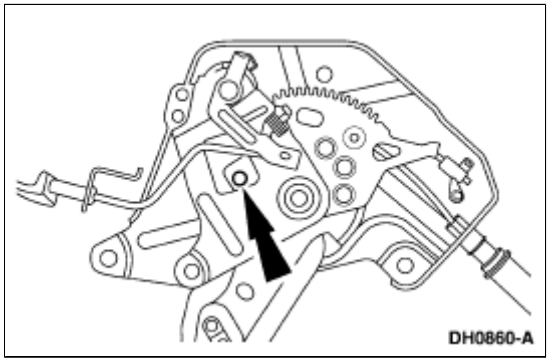
10. Remove the parking brake control and front parking brake cable and conduit.
    - Disconnect the parking brake signal switch electrical connector.
    - Remove the three parking brake control bolts.



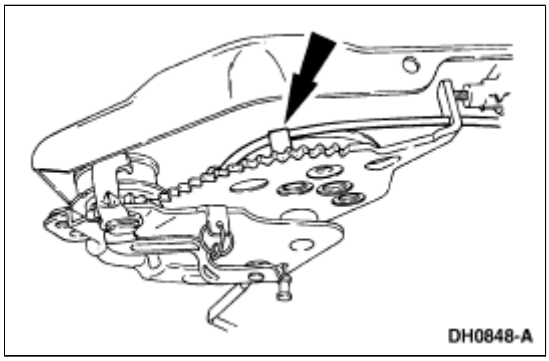
11. Remove the screw and position the bracket and wiring connector aside.



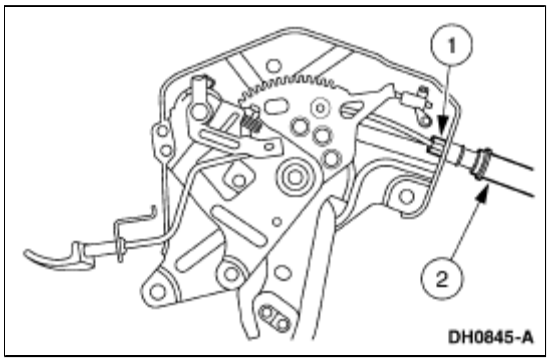
12. Remove the parking brake anchor pin from the parking brake control (2780).



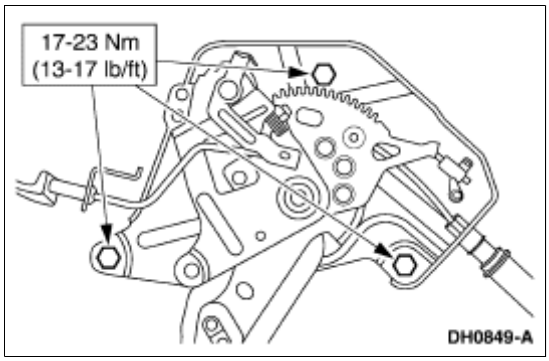
13. Bend the takeup spool tab up.



14. Remove the front parking brake cable and conduit housing.
    1. Compress the front parking brake cable and conduit-to-parking brake control clip.
    2. Remove the front parking brake cable and conduit housing.



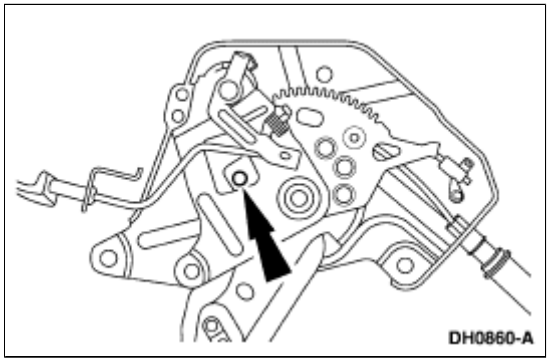
15. To install, reverse the removal procedure.


17-23 Nm
(13-17 lb/ft)
DH0849-A

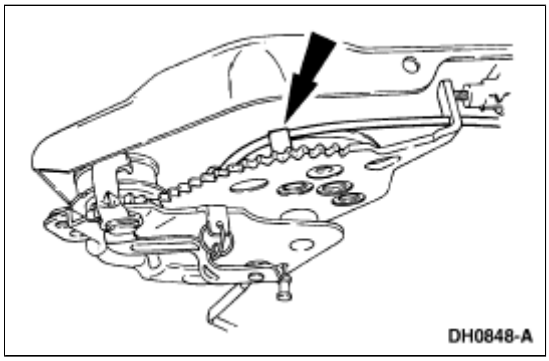
Cable and Conduit —Front

Removal and Installation

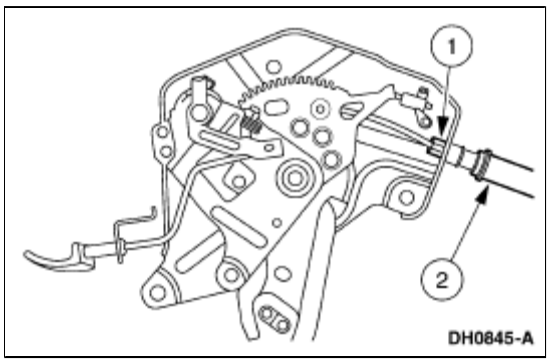
1. Remove the parking brake control. For additional information, refer to Control in this section.
2. Remove the parking brake anchor pin from the parking brake control (2780).



3. Bend the takeup spool tab up.



4. Remove the front parking brake cable and conduit housing.
    1. Compress the front parking brake cable and conduit-to-parking brake control clip.
    2. Remove the front parking brake cable and conduit housing.



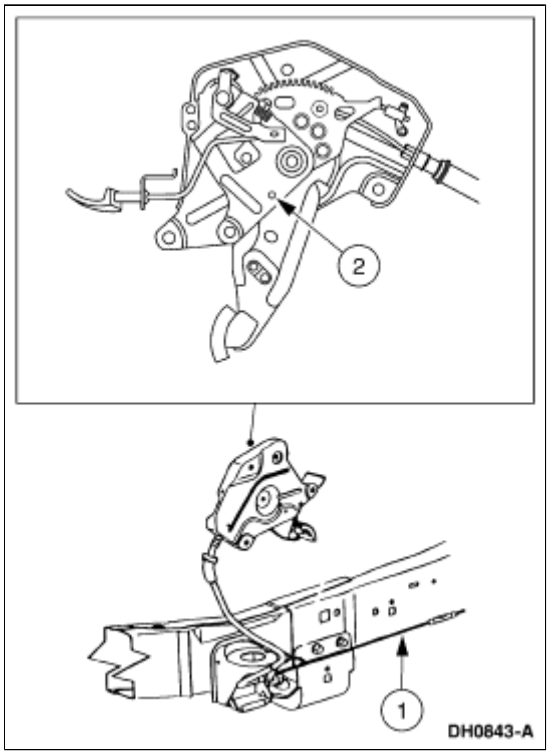
5. To install, reverse the removal procedure.
    - Make sure cable is routed through loop on takeup spool.

Cable and Conduit —Rear

Removal

1. **NOTE:** Make sure the parking brake control (2780) is fully released.

   Relieve the tension on the parking brake system.
   1. Pull the front parking brake cable and conduit (2853).
   2. Insert a 4 mm (5/32-inch) drill bit or equivalent retainer.



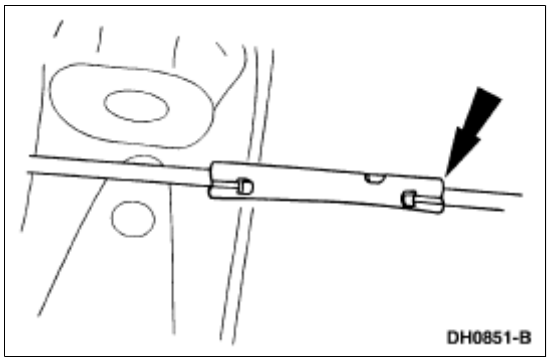
2. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in rear jack storage area. Failure to do so can result in unexpected inflation or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

   Raise and support the vehicle. For additional information, refer to Section 100-02 .

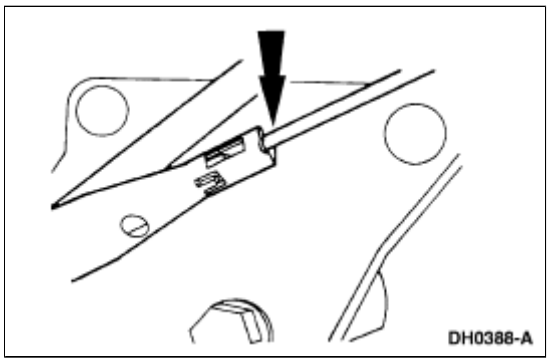
3. Remove the tire and wheel assembly. For additional information, refer to Section 204-04 .

4. **NOTE:** Disconnect the parking brake intermediate cable (2A620) from the locating hole end of the connector.

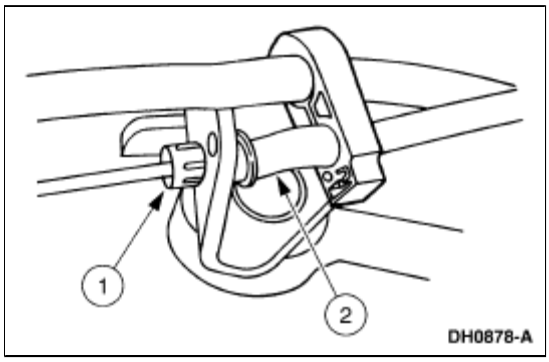
   Disconnect the parking brake intermediate cable from the LH parking brake rear cable and conduit (2A635).



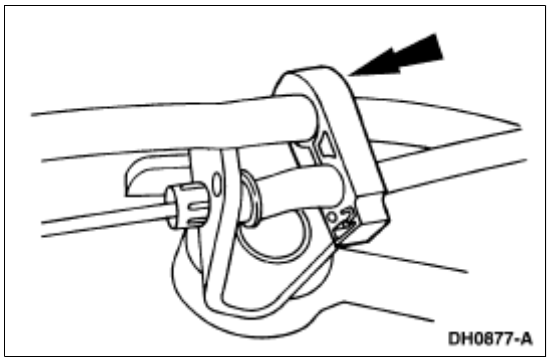
5. Separate the RH parking brake rear cable and conduit from the LH parking brake rear cable and conduit at the parking brake cable equalizer (2A602).



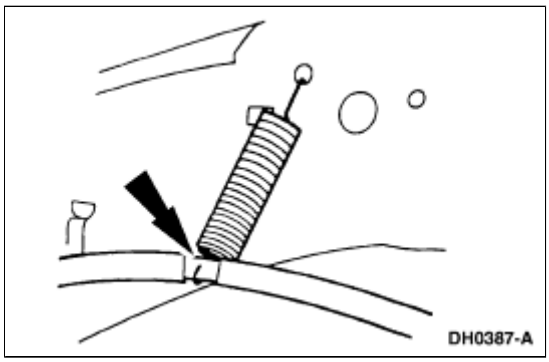
6. Remove the RH parking brake rear cable and conduit from the parking brake cable bracket (2530).
    1. Compress the parking brake cable clip.
    2. Remove the RH parking brake rear cable and conduit from the parking brake cable bracket.



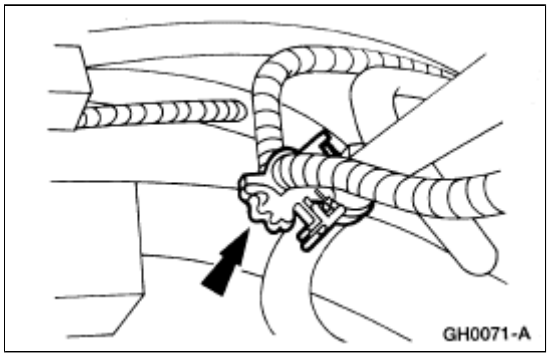
7. Remove the RH parking brake rear cable and conduit to LH parking brake rear cable and conduit clip.



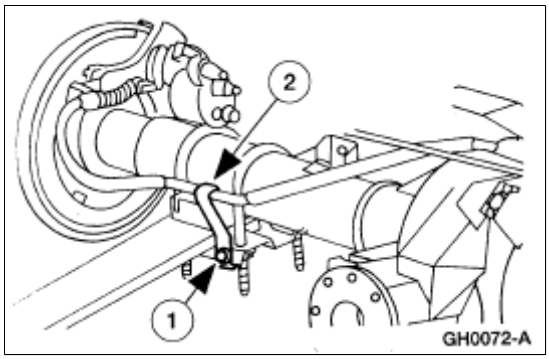
8. Remove the RH parking brake rear cable and conduit from the rear parking brake cable retainer (2A709).



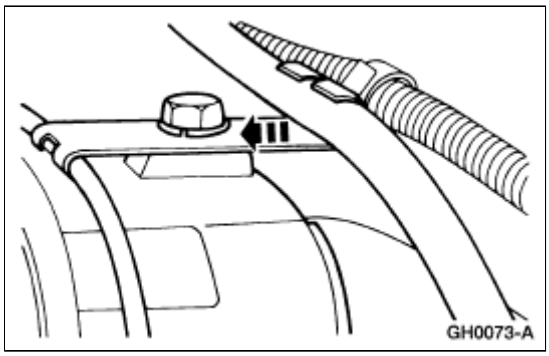
9. Remove the RH parking brake rear cable and conduit to the RH hydraulic brake line clip.



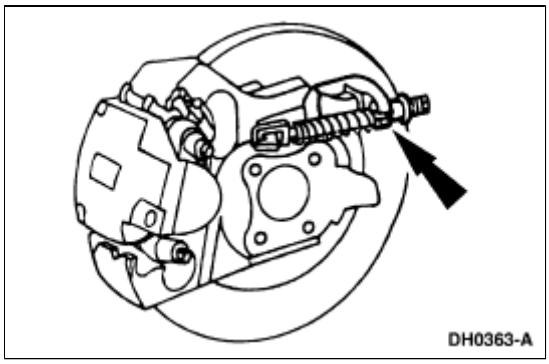
10. Remove the parking brake cable retainer clip (2A826).
    1. Remove the parking brake cable retainer clip bolt.
    2. Remove the parking brake cable retainer clip.



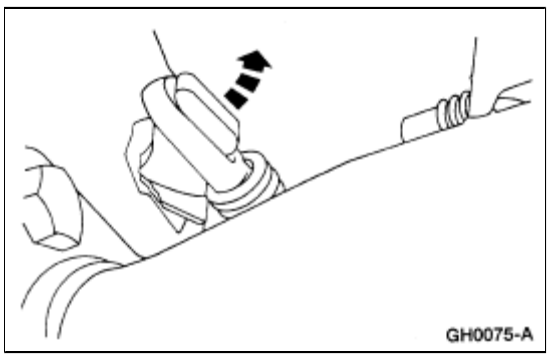
11. Unclip the parking brake rear cable and conduit from the brake line clip on top of the rear axle housing.



12. Compress the retainer and release the parking brake rear cable and conduit from the rear disc brake caliper anchor plate (2C220).

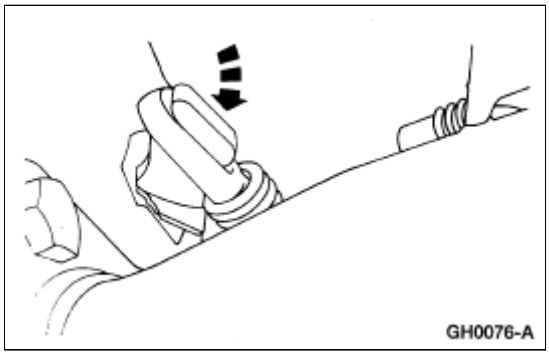


13. Unclip the parking brake rear cable and conduit from the parking brake lever (2A637).

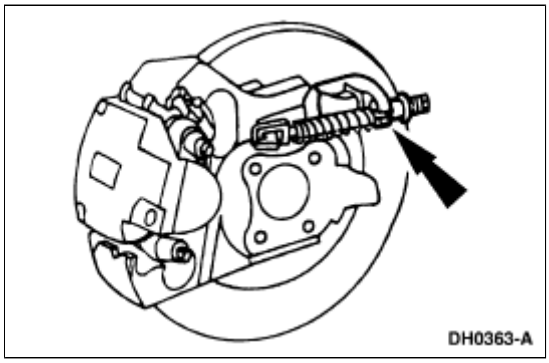


Installation

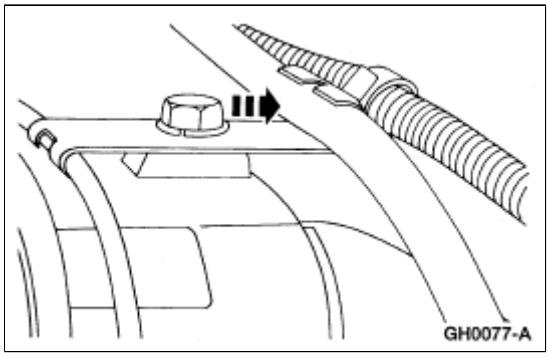
1. Clip the parking brake rear cable and conduit to the parking brake lever.



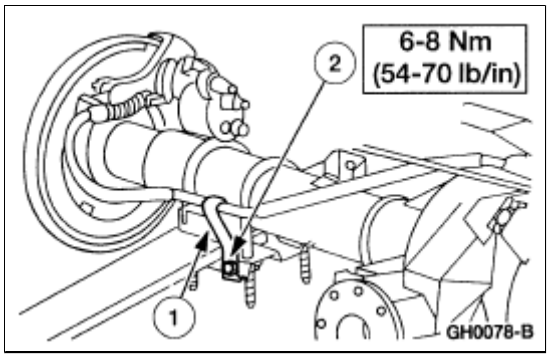
2. Connect the parking brake rear cable and conduit to the rear disc brake caliper anchor plate.



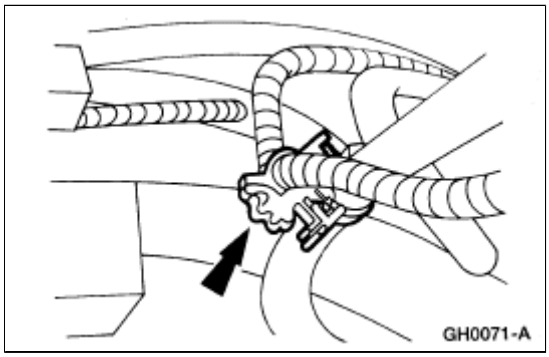
3. Clip the parking brake rear cable and conduit to the brake line clip on top of the rear axle housing.



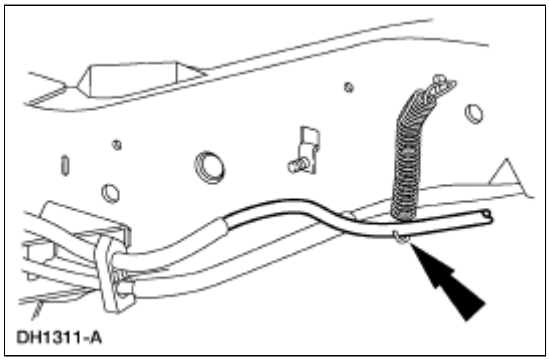
4. Install the parking brake cable retainer clip.
    1. Position the parking brake cable retainer clip.
    2. Install the parking brake cable retainer clip bolt.



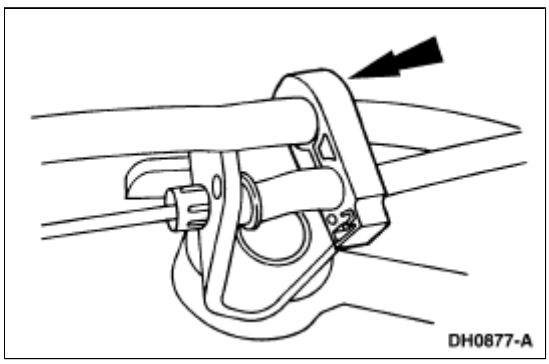
5. Install the RH parking brake rear cable and conduit to the RH hydraulic brake line clip.



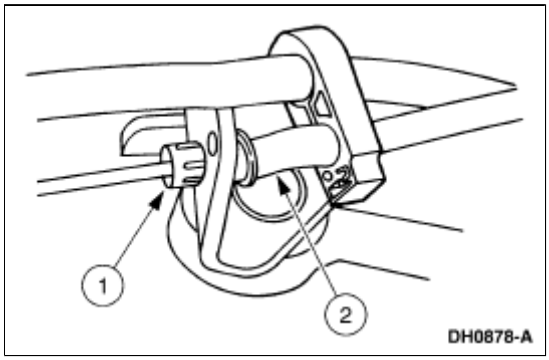
6. Hook the RH parking brake rear cable and conduit to the rear parking brake cable retainer.



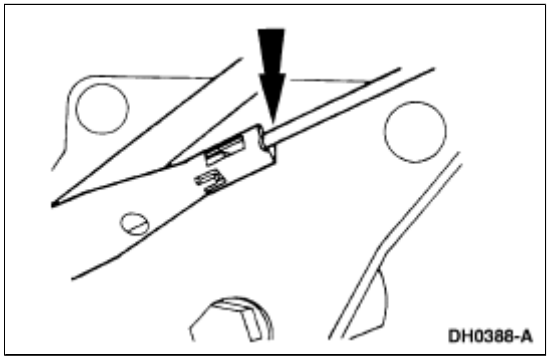
7. Install the RH parking brake rear cable and conduit to the LH parking brake rear cable and conduit clip.



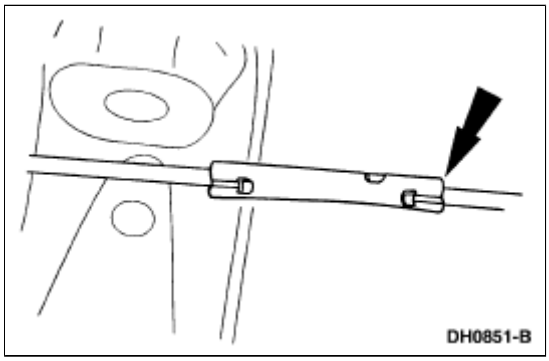
8. Connect the RH parking brake rear cable and conduit to the parking brake cable bracket.
    1. Install the RH parking brake rear cable and conduit to the parking brake cable bracket.
    2. Push the RH parking brake rear cable and conduit into the parking brake cable bracket until the parking brake cable and conduit clip is seated.



9. Connect the RH parking brake rear cable and conduit to the LH parking brake rear cable and conduit at the parking brake cable equalizer.



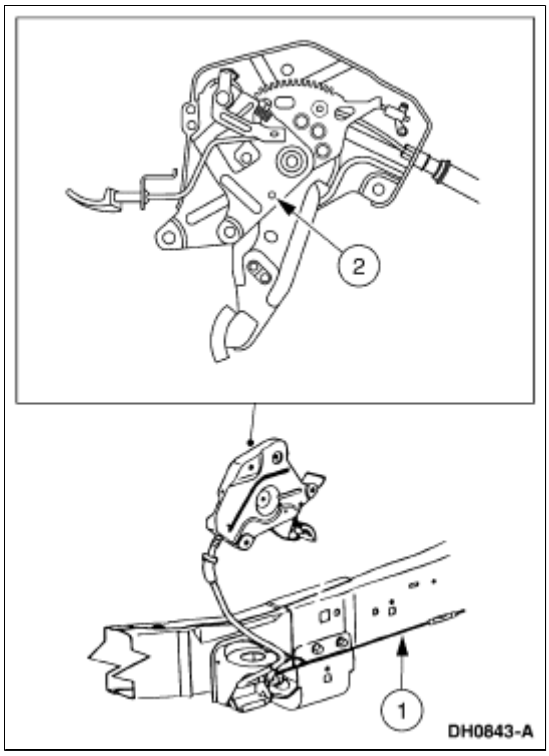
10. Connect the parking brake intermediate cable to the LH parking brake rear cable and conduit.



11. **NOTE:** If equipped with air suspension, reactivate the system by turning on the air suspension switch.

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

12. Apply tension to the parking brake system.
    1. Pull down on the front parking brake cable and conduit.
    2. Remove the retainer.


2
1
DH0843-A

Parking Brake Shoes

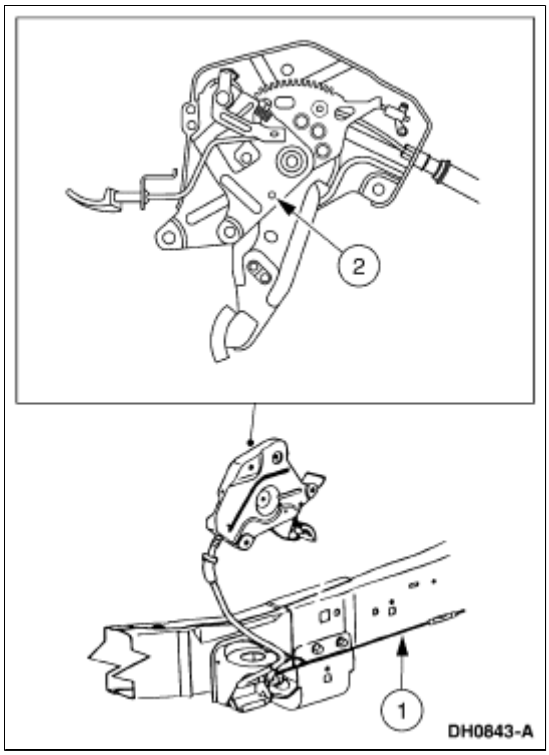
Special Tool(s)

 ST1468-A	Brake Adjusting Gauge 206-D002 (D81L-1103-A) or Equivalent

Removal

1. **NOTE:** Make sure the parking brake control (2780) is fully released.

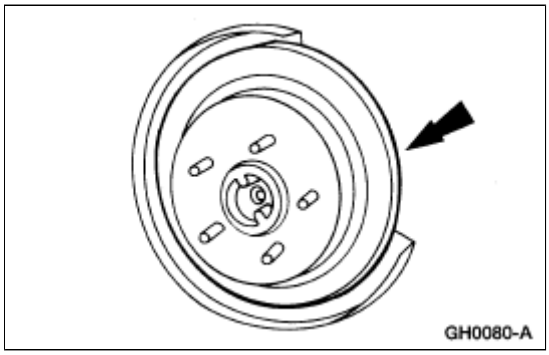
   Relieve the tension on the parking brake system.
   1. Pull the front parking brake cable and conduit (2853).
   2. Insert a 4 mm (5/32-inch) drill bit or equivalent retainer.



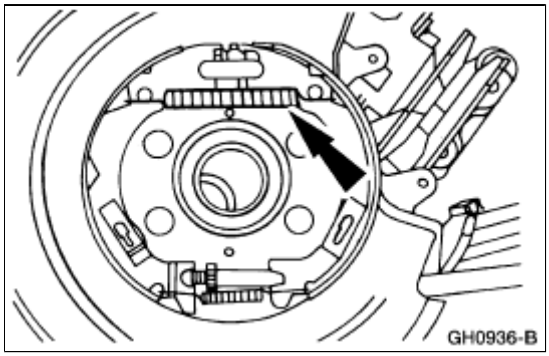
2. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in rear jack storage area. Failure to do so can result in unexpected inflation or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

Raise and support the vehicle. For additional information, refer to Section 100-02 .

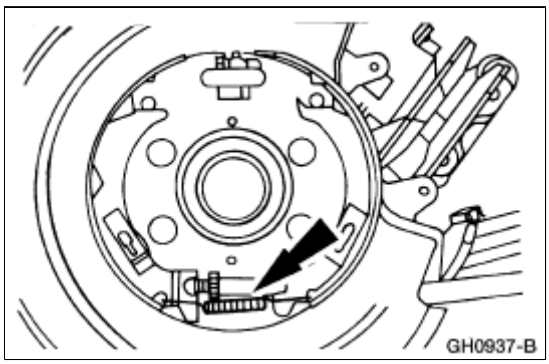
3. Remove the tire and wheel assembly. For additional information, refer to Section 204-04 .
4. Remove the rear brake disc (2C026). For additional information, refer to Section 206-04 .



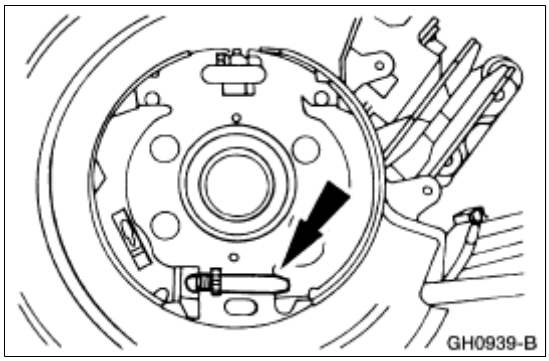
5. Remove the brake shoe retracting spring (2296).



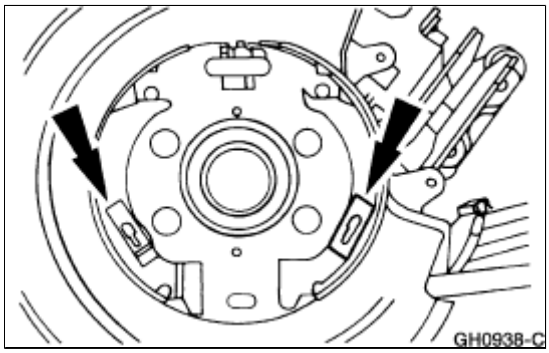
6. Remove the brake shoe adjusting screw spring (2049).



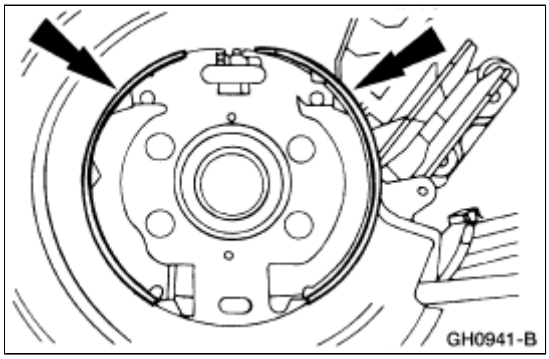
7. Remove the brake adjuster screw (2041).



8. Remove the rear brake shoe hold-down springs (2068).



9. Remove the rear brake shoes and linings (2200) along with the inboard brake shoe retracting spring.

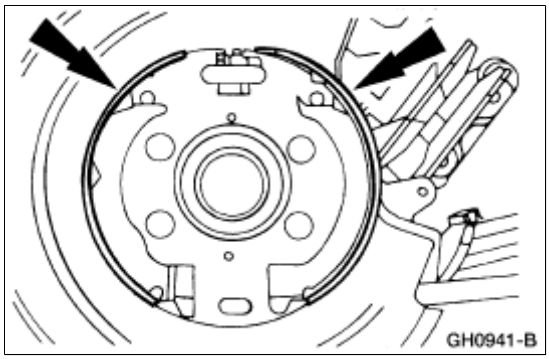


10. Inspect the components for excessive wear or damage and install new as required.

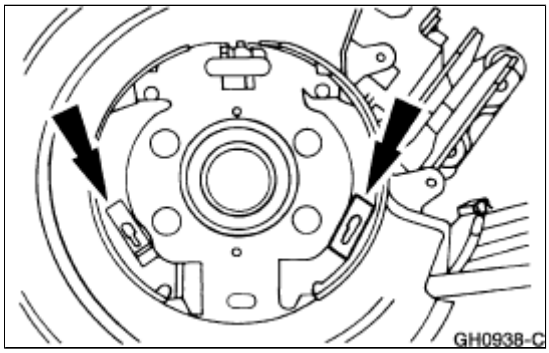
Installation

1. **NOTE:** Lubricate the brake shoe contact point before installation of rear shoes using Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A (Motorcraft WA-10) or an equivalent silicone compound meeting Ford Specification ESE-M1C171-A.

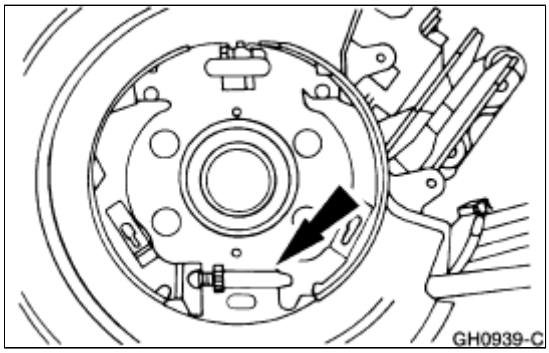
   Install the rear brake shoes and linings along with the inboard brake shoe retracting spring.



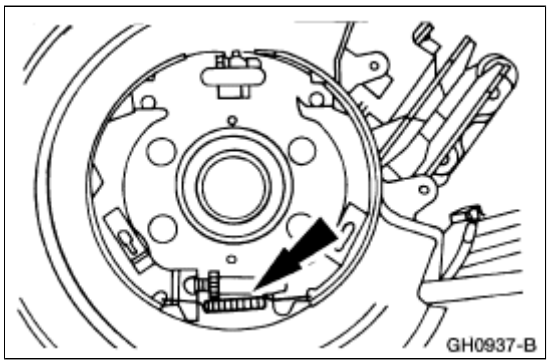
2. Install the brake shoe hold-down springs.



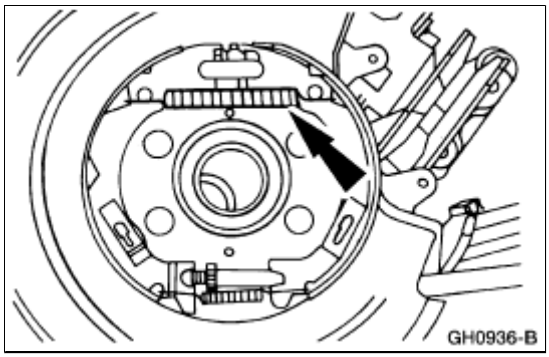
3. Install the brake adjuster screw.



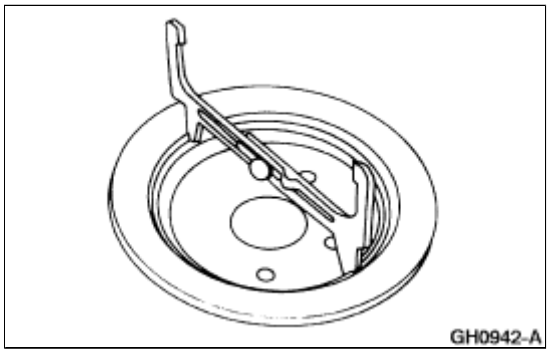
4. Install the brake shoe adjusting screw spring.



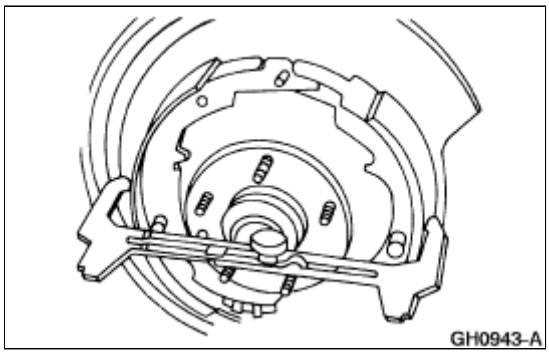
5. Install the outboard brake shoe retracting spring.



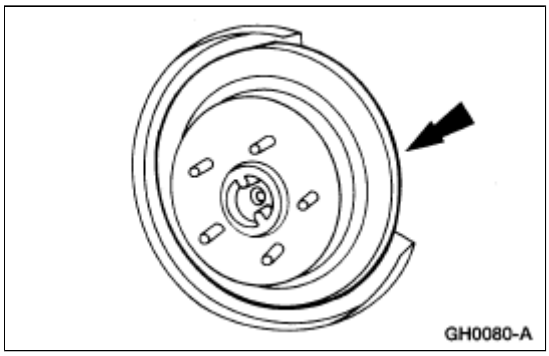
6. Use Brake Adjusting Gauge to measure the inside diameter of the drum portion of the rear brake disc.



7. Use Brake Adjusting Gauge to set the rear brake shoe and lining diameter to 0.5 mm (0.020 in) less than the inside diameter of the drum portion of the rear brake disc.



8. Install the rear brake disc. For additional information, refer to Section 206-04 .



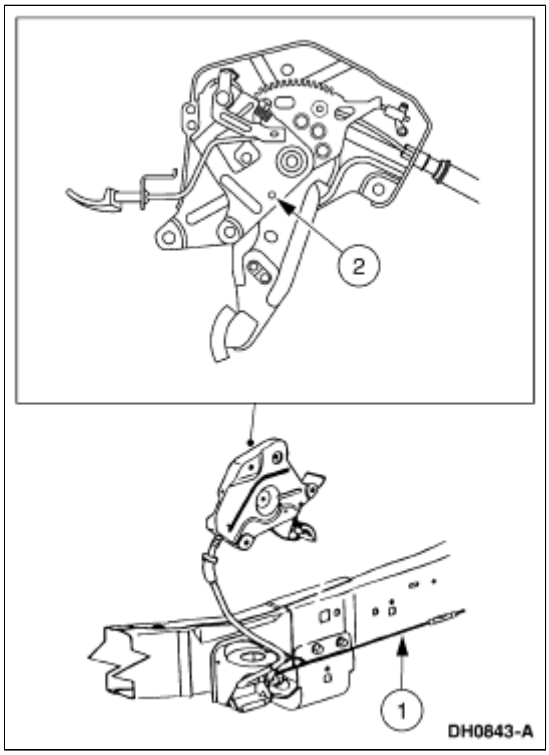
9. **WARNING: Always remove any corrosion, dirt or foreign material present on the mounting surfaces of the wheel or the surface of the wheel hub, brake drum or brake disc that contacts the wheel. Installing wheels without correct metal to metal contact at the wheel mounting surfaces can cause the lug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

   Clean the wheel hub mounting surface.

10. **NOTE:** If equipped with air suspension, reactivate the system by turning on the air suspension switch.

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

11. Apply tension to the parking brake cable system.
    1. Hold the front parking brake cable and conduit taut.
    2. Remove the retainer from the parking brake control.



12. Check the operation of the parking brake.

Bulb —Brake System Warning Indicator

Removal and Installation

For additional information, refer to Section 413-01 .

General Specifications

Item	Specification
Lubricant	
High Performance DOT 3 Brake Fluid C6AZ-19542-AB	ESA-M6C25-A

Torque Specifications

Description	Nm	lb-ft	lb-in
Brake master cylinder nut	18-27	14-19	—
Master cylinder brake tube nuts	15-20	12-14	—
Brake pedal bracket bolts and nuts	21-29	16-21	—
Brake pedal bracket nuts	21-29	16-21	—
Front brake hose bolt	30-40	23-29	—
Front brake hose bracket	13-17	10-12	—
Front brake tube	15-20	12-14	—
Disc brake caliper bleeder screw	17-24	13-17	—
Rear brake tube fitting	15-20	12-14	—
Brake pressure switch	14-20	11-14	—
Rear brake hose to caliper bolt	30-40	23-29	—
Brake hose bracket to rear axle bolt	13-17	10-12	—
Rear disc brake caliper bleeder screw	17-24	13-17	—
Brake pedal pivot bolt and nut	20-34	15-25	—
Battery ground cable bolt	7-10	—	62-88
Brake pressure control valve	13-22	10-16	—
Master cylinder bleeder screw	8-18	6-13	—

Hydraulic Brake Actuation

This vehicle is equipped with a brake pedal actuated dual brake system. The system consists of the following:

- brake pedal (2455)
- power brake booster (2005)
- brake master cylinder (2140)
- brake pressure control valve (2B091) (2-door vehicles)
- 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 one circuit and the rear wheel brakes, the other circuit.

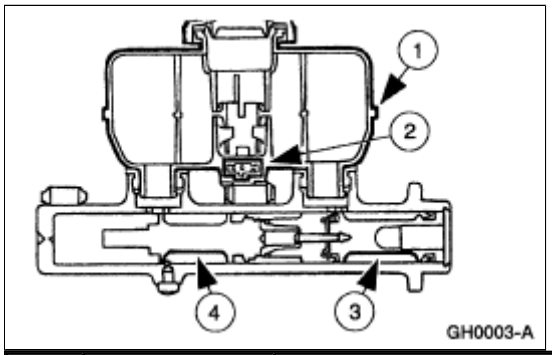
Brake Fluid

WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush 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.

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 use contaminated brake fluid.
- Do not mix different types of brake fluid.

Brake Master Cylinder



Item	Part Number	Description
1	2K478	Brake master cylinder reservoir

2	—	Brake master cylinder fluid level warning switch (part of 2K478)
3	—	Primary piston (part of 2140)
4	—	Secondary piston (part of 2140)

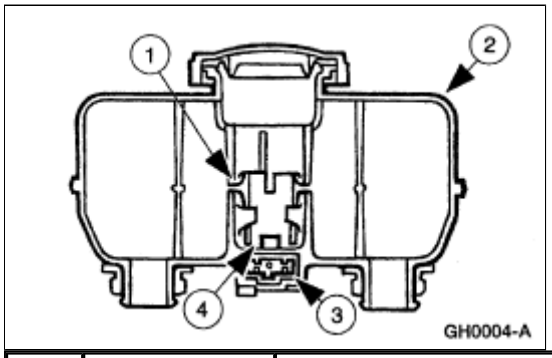
The brake master cylinder is a dual-piston type.

The brake master cylinder is assisted by a power brake booster. For additional information, refer to Section 206-07 .

The following conditions are considered normal and not indications that the brake master cylinder is in need of repair or replacement:

- Low brake fluid level detected without signs of leakage. This condition is caused by displacement of brake fluid from the brake master cylinder reservoir (2K478) into the disc brake calipers/rear disc brake calipers to compensate for normal brake wear. 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.
- A momentary or slight squirt of brake fluid inside the brake master cylinder reservoir upon application of the brake pedal.
- A trace of brake fluid found on the outside of the power brake booster below the brake master cylinder mounting flange. This condition results from the lubricating action of the brake master cylinder wiping seal.

Warning Switch, Brake Fluid Level



Item	Part Number	Description
1	—	Float (part of 2K478)
2	2K478	Brake master cylinder reservoir
3	—	Brake fluid level warning switch (part of 2K478)
4	—	Magnet (part of 2K478)

The brake master cylinder fluid level warning switch is an integral part of the brake master cylinder reservoir. It consists of a float containing a magnet and a reed switch mounted in the bottom of the brake master cylinder reservoir.

When the brake fluid in the brake master cylinder reservoir gets to a predetermined level, the floating magnet actuates the reed switch, causing the red brake warning indicator to illuminate. Loss of brake fluid will cause this system to activate.

Brake Tubes and Hoses

CAUTION: Never use copper tubing. It is subject to fatigue, cracking and corrosion, which could result in brake tube failure.

If a section of brake tube is damaged, the entire section must be installed new with a tube of the same type, size, shape and length.

When installing hydraulic brake tubing, hoses, or connectors, tighten all connections to specifications. After installation, bleed the brake system. For additional information, refer to Section 206-00 .

Hydraulic Brake Actuation

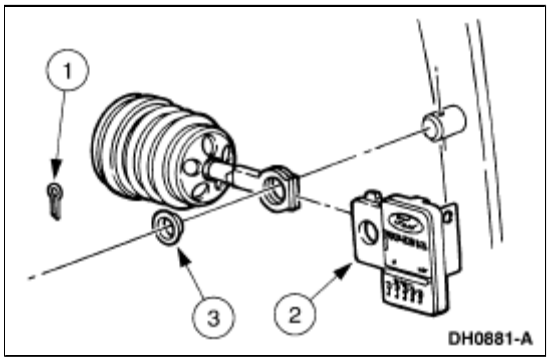
Refer to Section 206-00 .

Pedal and Bracket

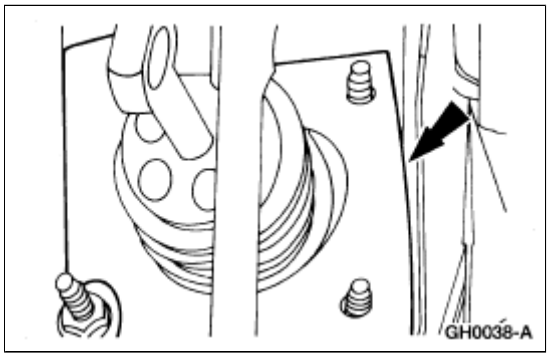
Removal

1. **NOTE:** When removing the stoplight switch (13480), retain the bushing and hairpin clip. They will be required for installation.

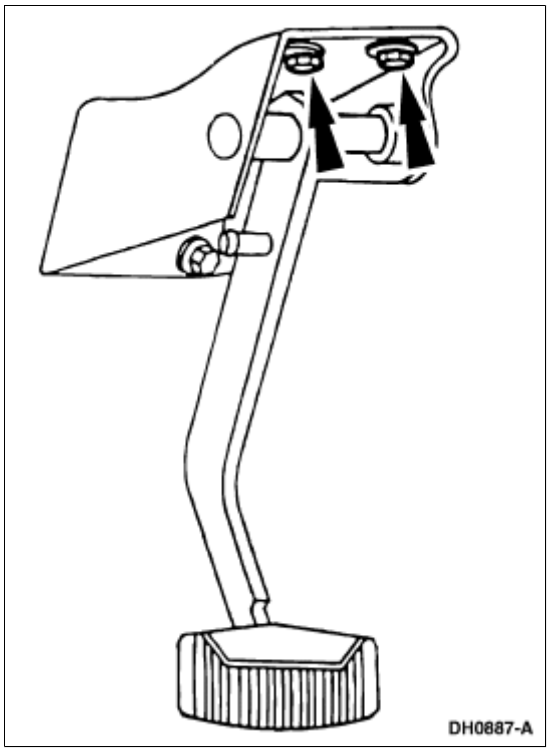
   Disconnect the brake booster push rod.
   1. Remove the hairpin clip.
   2. Separate the stoplight switch and the brake booster push rod from the brake pedal pin.
   3. Remove the brake booster push rod bushing.



2. Remove the bulkhead sound insulator.

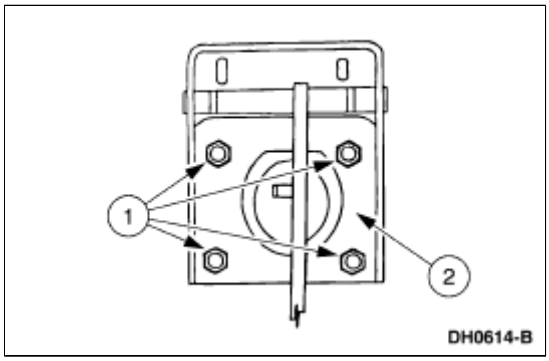


3. Remove the bolts.



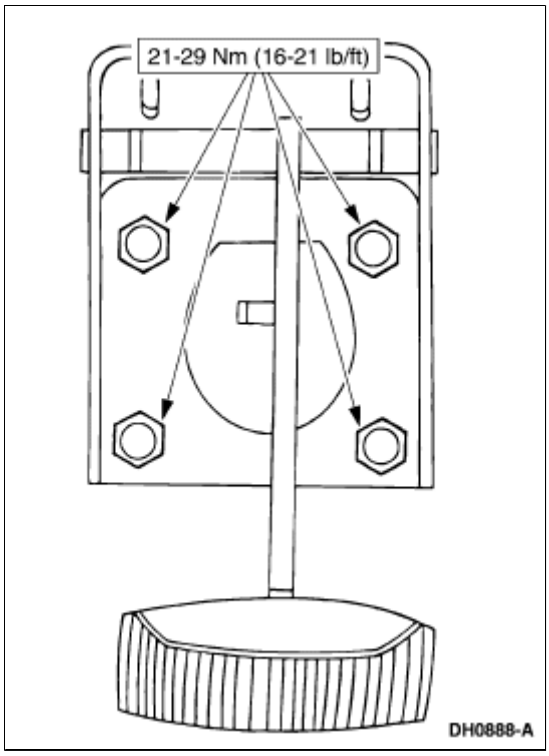
4. **CAUTION: Support the brake master cylinder and power brake booster in the engine compartment.**

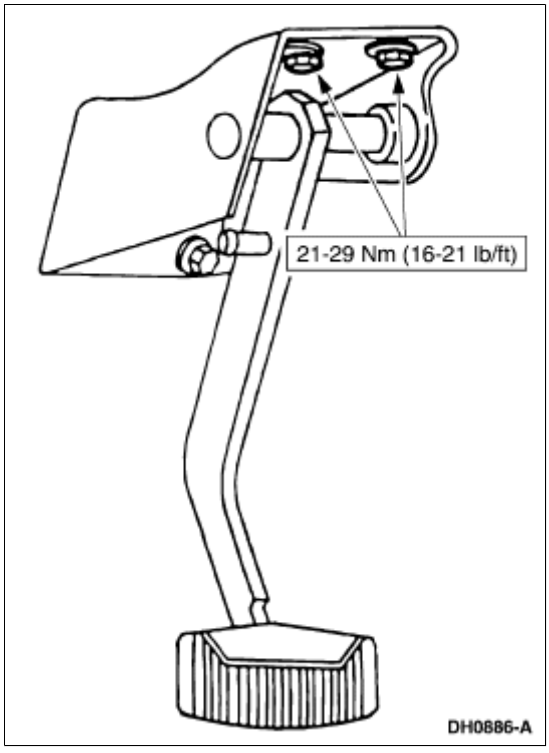
   Remove the brake pedal assembly.
   1. Remove the nuts.
   2. Remove the brake pedal assembly.



Installation

1. Follow the removal procedure in reverse order.


21-29 Nm (16-21 lb/ft)
DH0888-A

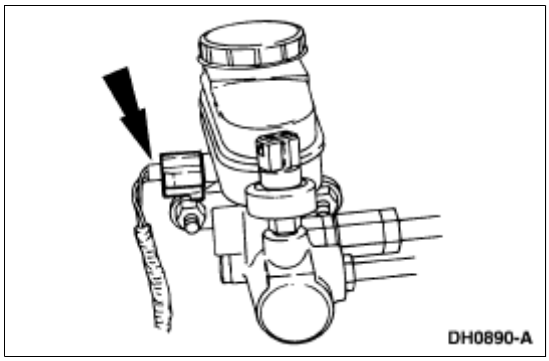

21-29 Nm (16-21 lb/ft)
DH0886-A

Master Cylinder

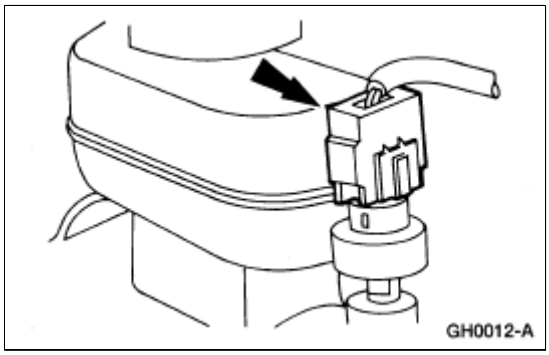
Removal

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.

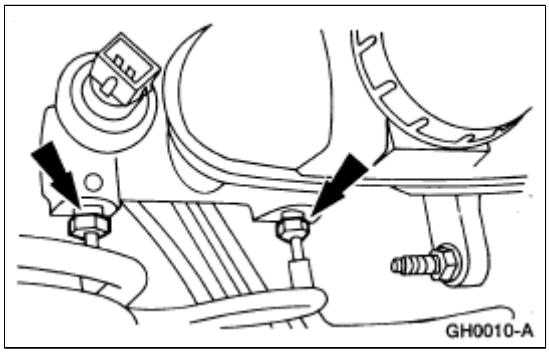
1. Disconnect the brake fluid level warning switch.



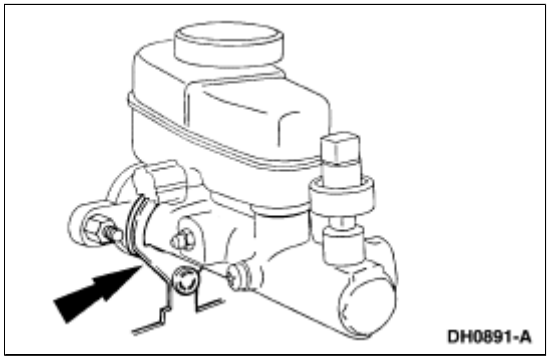
2. On cruise control equipped vehicles, disconnect the brake pressure switch.



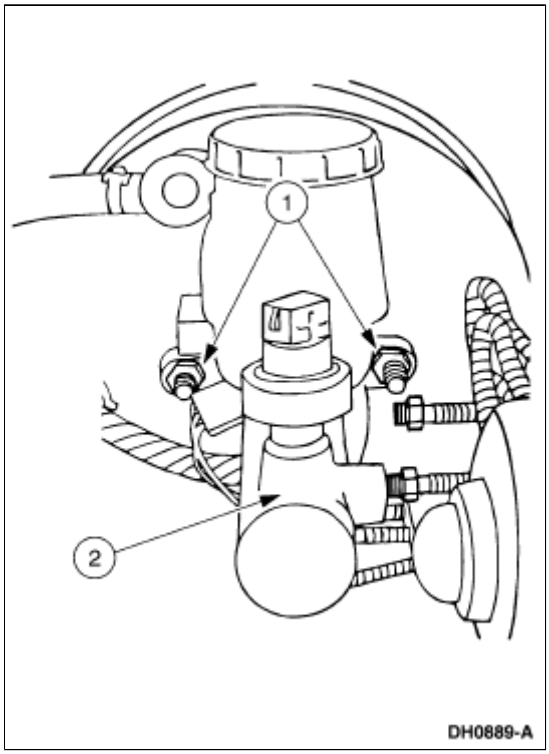
3. Disconnect the two brake lines, and plug the lines and the brake master cylinder ports.



4. On vehicles with 4.0L engine, remove the wiring retainer clip from the master cylinder.

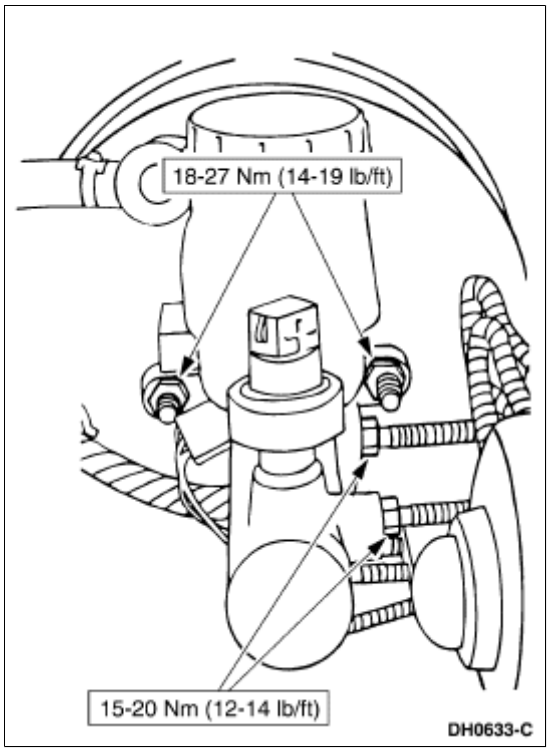


5. Remove the brake master cylinder (2140).
    1. Remove the nuts.
    2. Remove the brake master cylinder.



Installation

1. Follow the removal procedure in reverse order.
    - Bleed the brake master cylinder before installation. For additional information, refer to Section 206-00 .
    - Bleed the brake system. For additional information, refer to Section 206-00 .

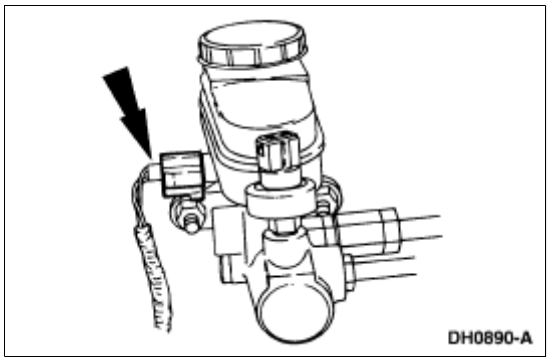

18-27 Nm (14-19 lb/ft)
15-20 Nm (12-14 lb/ft)
DH0633-C

Reservoir

Removal

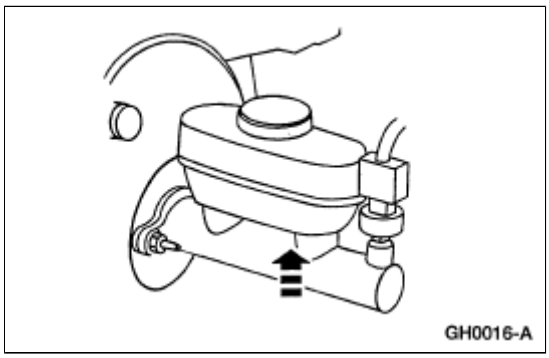
WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

1. Disconnect the brake master cylinder fluid level warning 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 to remove.

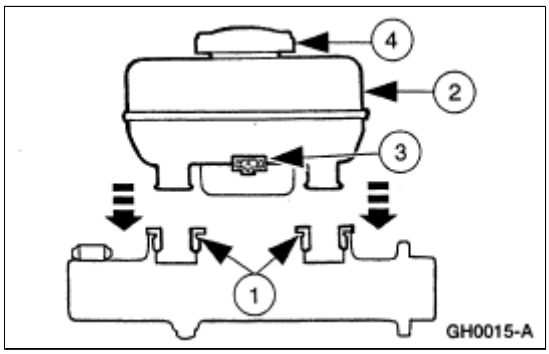


Installation

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 DOT 3 fluid meeting Ford specification ESA-M6C25-A, and insert the grommets in the brake master cylinder (2140).
   2. Press the brake master cylinder reservoir into the grommets until it snaps.
   3. Connect the brake master cylinder fluid level warning switch.
   4. 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.



General Specifications

Item	Specification
Power brake booster push rod length	24.89 mm (0.99 in) - 25.37 mm (1.01 in)

Torque Specifications

Description	Nm	lb-ft
Power brake booster nuts	21-29	15-20

Brake Booster

The power brake booster (2005):

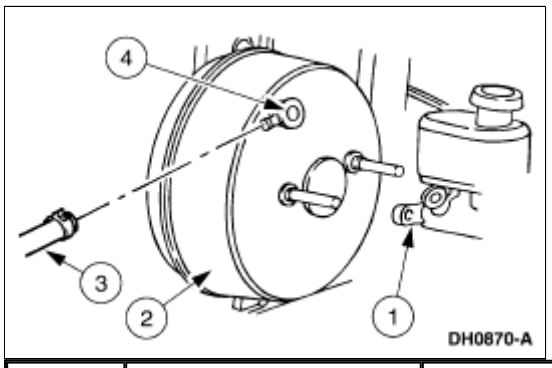
- is a dual diaphragm, vacuum assisted power brake booster.
- is located on the LH side of the bulkhead in the engine compartment, between the brake pedal and brake master cylinder (2140).
- is divided into separate chambers by the diaphragm.
- will not operate if vacuum is restricted or if any of the 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:

- is located on the front of the power brake booster.
- 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	Brake vacuum booster
3	381298	Vacuum hose
4	2365	Check valve

Power Brake System

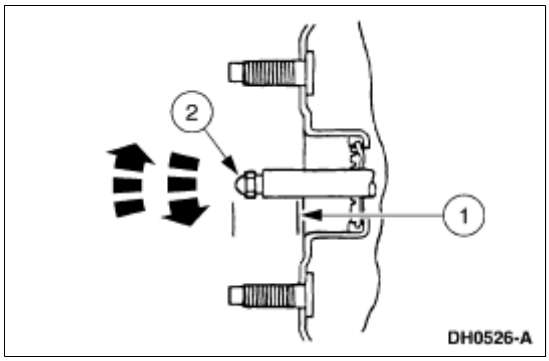
Refer to Section 206-00 .

Push Rod Adjustment

1. Remove the brake master cylinder (2140). For additional information, refer to Section 206-06 .

2. **CAUTION: Do not apply the brake pedal with the master cylinder removed from the booster.**

   Adjust the power brake booster to brake master cylinder push rod, vacuum applied.
   1. Measure the power brake booster to brake master cylinder push rod.
   2. If necessary, adjust the screw to the correct length. Refer to Specifications in this section.



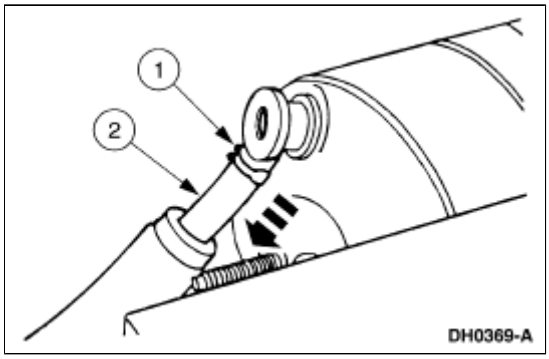
3. Install the brake master cylinder. For additional information, refer to Section 206-06 .

Brake Booster

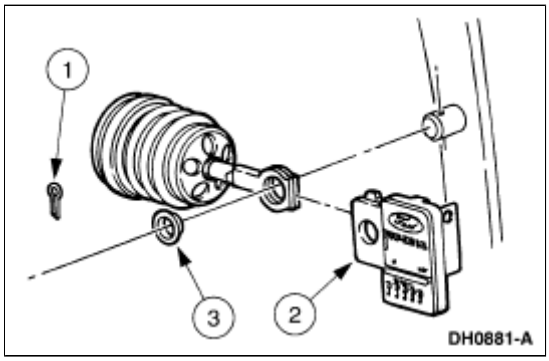
Removal

1. Remove the brake master cylinder (2140). For additional information, refer to Section 206-06 .

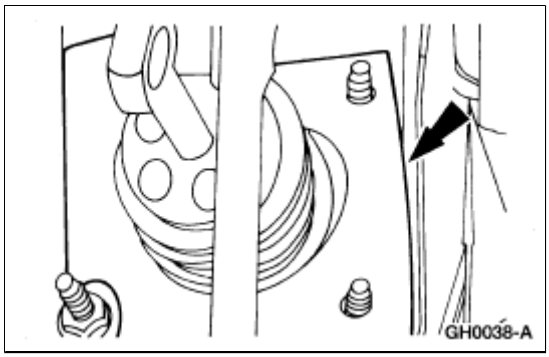
2. Disconnect the power brake booster hose.
    1. Compress the clamp.
    2. Disconnect the power brake booster hose.



3. Disconnect the brake pedal to power brake booster push rod.
    1. Remove the self-locking pin.
    2. Remove the stoplight switch (13480) and the brake booster push rod from the brake pedal pin.
    3. Remove the brake booster push rod bushing.

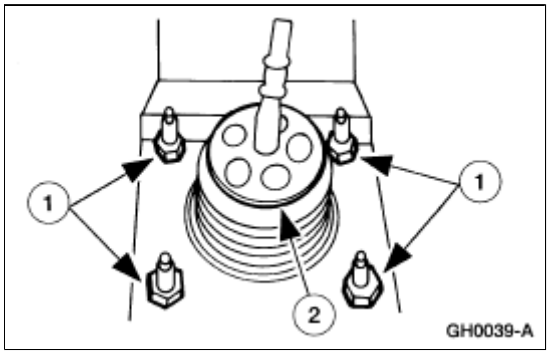


4. Remove the bulkhead sound insulator.



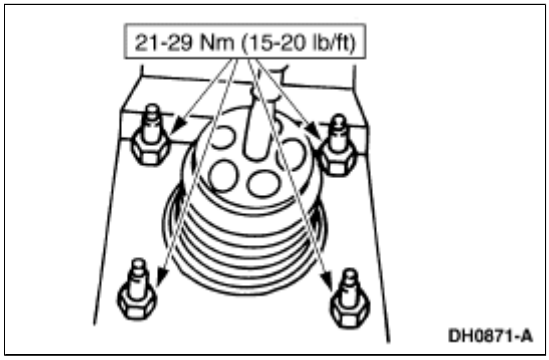
5. **NOTE:** Support the power brake booster (2005).

   Remove the power brake booster.
   1. Remove the nuts.
   2. Remove the power brake booster.



Installation

1. Follow the removal procedure in reverse order.



General Specifications

Item	Specification
High performance rear axle lubricant F1TZ-19580-B	WSL-M2C192-A
High temperature 4x4 front axle and wheel bearing grease E8TZ-19590-A	ESA-M1C198-A

Torque Specifications

Description	Nm	lb-ft	lb-in
Anti-lock brake control module bolts	1.8-1.9	—	—
Brake line to (EHCU) nuts (M10-1)	12-16	—	—
Brake line to (EHCU) nuts (M12-1)	15-18	—	—
Electronic hydraulic control unit bolts	9-13	—	—
Front anti-lock brake sensor bolt (4x2)	8-10	—	71-88
Front anti-lock brake sensor wire retaining bolt (4x4)	7-9	—	62-80
Front anti-lock brake sensor bolt (4x4)	7-9	—	62-80
G-switch nuts	19.1-25.9	—	—
Rear anti-lock brake sensor bolt	27	20	—

Anti-Lock Control —(4WABS)

The anti-lock control system consists of the following components:

- hydraulic control unit (HCU) (2C215)
- anti-lock brake control module (2B373)
- rear anti-lock brake sensor (2C190)
- rear anti-lock brake sensor indicator (4B409)
- G-switch (4x4) (2C341)
- front anti-lock brake sensor (2C204)
- front anti-lock brake sensor indicator (2C182)
- yellow ABS warning indicator (10849)

Anti-Lock Control

Refer to Wiring Diagrams Cell 42 , Anti-Lock Brake System (ABS) for schematic and connector information.

Special Tool(s)

 ST1137-A	73 Digital Multimeter or equivalent 105-R0051
 ST1177-A	88 Digital Multimeter or equivalent 105-R0053
 ST1449-A	EEC-IV 60-Pin Breakout Box or equivalent 418-005 (014-00322)
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool
 ST1450-A	Anti-Lock Brake Adapter T97P-50-ALA

Principles of Operation

The anti-lock brake system (ABS) operates as follows:

- When the brakes are applied, fluid is forced from the brake master cylinder outlet ports to the hydraulic control unit (HCU) inlet ports. This pressure is transmitted through three normally open solenoid valves contained inside the HCU through the outlet ports of the HCU to each wheel.
- If the anti-lock brake control module senses a wheel is about to lock, based on anti-lock brake sensor

data, it closes the normally open solenoid valve for that circuit. This prevents any more fluid from entering that circuit.
- The anti-lock brake control module then looks at the anti-lock brake sensor signal from the affected wheel(s) again.
- If that wheel(s) is still decelerating, it opens the closed solenoid valve for that circuit to further reduce hydraulic pressure trapped in the line.
- Once the affected wheel comes back up to speed, the anti-lock brake control module returns the solenoid valves to their normal condition allowing fluid flow to the affected brake.
- The anti-lock brake control module monitors the electromechanical components of the system.
- A malfunction in the anti-lock brake system will cause the anti-lock brake control module to shut off or inhibit the system. However, normal power-assisted braking remains.
- Malfunctions are indicated by the yellow ABS warning indicator in the instrument cluster (10849).
- The anti-lock brake system is self-monitoring. When the ignition switch is turned to the RUN position, the anit-lock brake control module will carry out a preliminary self-check on the anti-lock electrical system indicated by a three-second illumination of the yellow ABS warning indicator in the instrument cluster.
- During vehicle operation, including normal and anti-lock braking, the anti-lock brake control module monitors all electrical anti-lock functions and some hydraulic operations.
- Each time the vehicle is driven, as soon as vehicle speed reaches approximately 20 km/h (12mph), the anti-lock brake control module turns on the pump motor for approximately one-half second. At this time, a mechanical noise may be heard. This is a normal function of the self-check by the anti-lock brake control module.
- Pedal pulsation coupled with noise while braking on loose gravel, bumps, wet or snowy roads is normal and indicates correct functioning of the anti-lock brake system.

Anti-Lock Brake Control Module

NOTE: The anti-lock brake control module must be reconfigured upon replacement. Refer to Section 418-01 .

The anti-lock brake control module is an on-board, diagnostic, non-repairable unit consisting of two microprocessors and the necessary circuitry for their operation. The anti-lock brake control module monitors system operation during normal driving as well as during anti-lock braking.

Anti-lock brake module operation is as follows:

- Under normal driving conditions, the microprocessor produces short test pulses to the solenoid valves that check the electrical system without any mechanical reaction.
- Impending wheel lock conditions trigger signals from the anti-lock brake control module that open and close the appropriate solenoid valves. This results in moderate pulsations in the brake pedal (2455).

During normal braking, the brake pedal feel will be identical to a standard brake system.

Most faults which occur to the anti-lock brake system will be stored as a diagnostic trouble code (DTC) in the keep-alive memory of the anti-lock brake control module. The DTCs can be retrieved by following the on-board diagnostic procedures.

Anti-Lock Brake Sensor

NOTE: Any time an anti-lock brake sensor is removed, thoroughly clean the mounting surfaces. On front anti-lock brake sensors, apply High Temperature 4x4 Front Axle and Wheel Bearing Grease E8TZ-19590A or equivalent meeting Ford specification ESA-M1C198-A.

The anti-lock brake system uses three variable-reluctance sensors to determine vehicle speed. The anti-lock

brake sensors operate on magnetic induction principle. As the teeth on the anti-lock brake sensor indicator rotate past the stationary sensor, a signal proportional to the speed of the rotation is generated and sent to the anti-lock brake control module through a twisted cable and shielded wiring harness.

G-Switch

The G-switch is used on 4x4 vehicles only. When driven in the 4-wheel drive mode, all four wheels are mechanically linked and a situation could arise in which one wheel locks up and causes all four wheels to lock up and skid. The speed sensors would indicate the vehicle speed as zero. Without the G-switch, the anti-lock brake control module would have no data to compare and would react as if the vehicle were stopped when in fact it is moving.

The G-switch detects and signals the anti-lock brake control module that the vehicle is moving.

Inspection and Verification

NOTE: The anti-lock brake control module must be reconfigured upon replacement. Refer to Section 418-01 .

1. Verify the customer concern by applying the brakes under different conditions.

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

Visual Inspection Chart

Mechanical	Electrical

• Parking brake cable
• Tire pressure
• Tire size or mismatched tires
	• Blown fuse:
	  ▪ Central junction box (CJB) Fuse 11 (7.5A), Fuse 14 (10A)
	  ▪ Battery junction box (BJB) Maxi-Fuse 3 (50A)
	  ▪ BJB Mini-Fuse 7 (30A)
	• Connectors or connections
	• Harness routing
	• Wire chafing
	• Circuitry open/shorted
	• Indicator bulb

3. If the fault is not visually evident, 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 anti-lock brake control module, 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 anti-lock brake control module.

6. If the DTCs retrieved are related to the concern, go to Anti-Lock Brake Control Module Diagnostic Trouble Code (DTC) Index to continue diagnostics.

7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart.

Warning Lamp Indicator

The anti-lock brake system (ABS) uses the yellow ABS warning indicator to alert the driver of a malfunctions in the ABS.

The yellow ABS warning indicator will come on to warn the driver that the ABS has been turned off due to a symptom that exists in the ABS. Normal power assist braking remains but wheels can lock during a panic stop while the yellow ABS warning indicator is illuminated.

The diagnostic procedures must be followed step-by-step in order to correct the condition.

Anti-Lock Brake Control Module Diagnostic Trouble Code (DTC) Index

Anti-Lock Brake Control Module Diagnostic Trouble Code (DTC) Index

DTCs	Description	Source	Action
B1342	Anti-Lock Brake Control Module Failure	Anti-Lock Brake Control Module	INSTALL a new Anti-lock brake control module; refer to Anti-Lock Brake System (ABS) Module . REPEAT the self-test.
B1485	Brake Pedal Position (BPP) Switch Circuit Failure	Anti-Lock Brake Control Module	IGNORE the DTC. This DTC Applies Only to Traction Control Vehicle.
B1676	Battery Voltage Out Of Range	Anti-Lock Brake Control Module	GO to Pinpoint Test B .
B2141	Vehicle Speed Calibration Data Not Programmed Into Module	Anti-Lock Brake Control Module	CARRY OUT the Calibration Procedure Using the Scan Tool. REPEAT the self-test.
C1095	Hydraulic Pump Motor Circuit Failure	Anti-Lock Brake Control Module	GO to Pinpoint Test E .
C1102	G-Switch Circuit Failure	Anti-Lock Brake Control Module	GO to Pinpoint Test F .
C1145	RF Anti-Lock Brake Sensor Circuit Failure	Anti-Lock Brake Control Module	GO to Pinpoint Test C .
C1155	LF Anti-Lock Brake Sensor Circuit Failure	Anti-Lock Brake Control Module	GO to Pinpoint Test C .
C1230	Rear Anti-Lock Brake Sensor Circuit Failure	Anti-Lock Brake Control Module	GO to Pinpoint Test C .
C1233	LF Anti-Lock Brake Sensor Output Failure	Anti-Lock Brake Control Module	GO to Pinpoint Test D .
C1234	RF Anti-Lock Brake Sensor Output Failure	Anti-Lock Brake Control Module	GO to Pinpoint Test D .
C1237	Rear Anti-Lock Brake Sensor	Anti-Lock Brake	GO to Pinpoint Test D .

	Output Failure	Control Module	

Anti-Lock Brake Control Module Parameter Identification (PID) Index

Anti-Lock Brake Control Module Parameter Identification (PID) Index

PID	Description	Expected Values
CONTABS	Number of Continuous DTCs on ABS	one count per bit
BOO_ABS	Brake Pedal Position (BPP) Switch Input	ON, OFF
ACCLSW1	Acceleration Switch Position 1 Input	ACT, notACT
ACCLSW2	Acceleration Switch Position 2 Input	ACT, notACT
ABSR_O	Rear ABS Outlet Valve	ON, OFF
ABSLF_O	LF ABS Outlet Valve	ON, OFF
ABSRF_O	RF ABS Outlet Valve	ON, OFF
ABSR_I	Rear ABS Inlet Valve	ON, OFF
ABSLF_I	LF ABS Inlet Valve	ON, OFF
ABSRF_I	RF ABS Inlet Valve	ON, OFF
LF_WSPD	LF Wheel Speed	0-255 MPH
RF_WSPD	RF Wheel Speed	0-255 MPH
R_WSPD	Rear Wheel Speed	0-255 MPH
4WDLOW	4WD Low Input	ON, OFF

Anti-Lock Brake Control Module Active Command Index

Anti-Lock Brake Control Module Active Command Index

Active Command	Display	Action
ABS Output Control	PMP MOTOR	ON, OFF
	LF INLET	ON, OFF
	RF INLET	ON, OFF
	R INLET	ON, OFF
	LF OUTLET	ON, OFF
	RF OUTLET	ON, OFF
	R OUTLET	ON, OFF
	ABS POWER	ON, OFF
ABS OUTPUT CONTROL II	ABS ACTIVE	ON, OFF

Symptom Chart

NOTE: Refer to the Wiring Diagrams for connector numbers stated in the Pinpoint Tests.

Symptom Chart

Condition	Possible Sources	Action
• No communication with the anti-lock brake control module	• BJB Fuse 7 (30A). • CJB Fuse 14 (10A). • Circuitry. • Anti-lock brake control module.	• GO to Pinpoint Test A .
• Loss of sensor signal during vehicle deceleration or sensor signal drops out at low speed	• Anti-lock brake sensor indicator. • Sensor output is weak. • Air gap.	• GO to Pinpoint Test D .
• Unwarranted ABS activity	• Circuitry. • Anti-lock brake sensor.	• GO to Pinpoint Test D .
• Maladjusted rear brakes or "grabby" brake shoe or linings	• Rear brake adjustment. • Linings.	• REFER to Section 206-00 .
• Base brake mechanical concern for wheels lock up	• Rear brakes. • Parking brake. • Rear axle seal.	• REFER to Section 206-00 . • REFER to Section 206-05 . • REFER to Section 205-00 .
• Base brake hydraulic concern (soft pedal)	• Brake line or hose, fitting, master cylinder, or brake caliper. • Air in brake system.	• REFER to Section 206-00 .
• Base brake mechanical concern (hard pedal)	• Vacuum boost. • Brake caliper. • Brake line or hose.	• REFER to Section 206-00 .
• Base brake hydraulic concern during medium/hard brake application	• Brake line or hose, fitting, master cylinder, wheel cylinder, or caliper. • Air in brake system.	• REFER to Section 206-00 .
• Base brake mechanical concern during medium/hard brake application	• Vacuum boost. • Wheel cylinder or caliper. • Brake line or hose. • Brake shoe or pad linings.	• REFER to Section 206-00 .
• Base brake mechanical concern for vehicle pulls	• Rear brake. • Caliper. • Brake pad or shoe	• REFER to Section 206-00 .

	wear.	
• Base brake hydraulic concern for vehicle pulls	• Brake line or hose. • Caliper. • Wheel cylinder.	• REFER to Section 206-00 .
• Intermittent loss of voltage to anti-lock brake control module	• Circuitry.	• INSPECT Circuit 601 from ignition switch to anti-lock brake control module harness connector for opens or shorts. REPAIR as necessary.
	• Anti-lock brake control module.	• INSPECT anti-lock brake control module grounds for looseness, corrosion or excessive dirt. REPAIR as necessary.
	• BJB.	• CORRECT condition.
• One wheel locks up; no DTCs recorded	• Base brake.	• REFER to Section 206-00 .
	• Dump valve. • ISO valve.	• INSTALL a new hydraulic control unit.
• The yellow ABS warning indicator does not self-check	• Bulb. • Circuitry. • Instrument cluster. • Anti-lock brake control module.	• GO to Pinpoint Test G .
• Soft or excessive brake pedal	• Brake line or hose, fitting, master cylinder, wheel cylinder, or caliper. • Air in brake system.	• REFER to Section 206-00 .

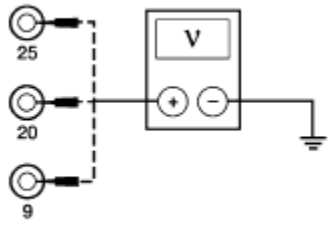
Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE ANTI-LOCK BRAKE CONTROL MODULE

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK CIRCUIT 601 (LB/PK), 534 (YE/LG), AND 483 (RD)	
1  2  Anti-Lock Brake Control Module C186	

4

5



GH2470-A

3 Connect EEC-IV 60-Pin Breakout Box.

5 Measure the voltage between EEC-IV 60-Pin Breakout Box pins, and ground as follows:

EEC-IV 60-Pin Breakout Box Pin	Circuit
20	601 (LB/PK)
25	483 (RD)
9	534 (YE/BK)

- **Are the voltages greater than 10 volts?**

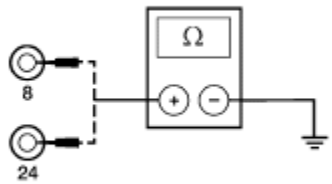
→ **Yes**
GO to A2.

→ **No**
REPAIR circuit(s) in question. TEST the system for normal operation.

A2 CHECK CIRCUIT 57 (BK) FOR AN OPEN

1

2



GH1805-A

2 Measure the resistance between EEC-IV 60-Pin Breakout Box Pin 8, Circuit 57 (BK), and ground; and between EEC-IV 60-Pin Breakout Box Pin 24, Circuit 57 (BK), and ground.

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

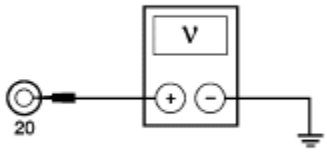
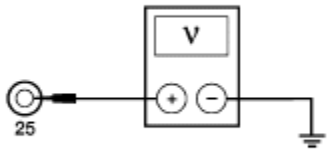
→ **Yes**
REFER to Section 418-00.

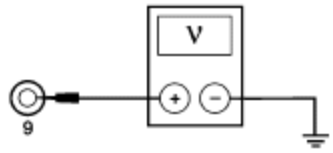
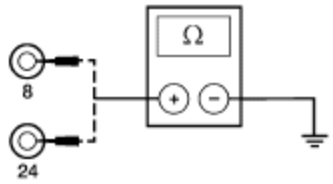
→ **No**

	REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST B: DTC B1676, BATTERY VOLTAGE OUT OF RANGE

CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: DTC B1676 is generated when the anti-lock brake control module detects system voltage is less than 9 volts or greater than 19 volts for more than 8 seconds.	
B1 CHECK RECENT VEHICLE HISTORY	
	1 Check recent vehicle history. • **Has the vehicle been jump-started by a tow truck within the past two weeks?** → **Yes** The system is OK. CLEAR the DTCs. REPEAT the self-test. → **No** GO to B2.
B2 CHECK THE BATTERY VOLTAGE	
	1 Measure the voltage between the positive and negative battery posts. • **Is the voltage between 9 and 19 volts?** → **Yes** GO to B3. → **No** REFER to Section 414-00.
B3 CHECK CIRCUIT 601 (LB/PK) FOR PROPER VOLTAGE	
1  2  Anti-Lock Brake Control Module C186 4	3 Connect EEC-IV 60-Pin Breakout Box.

 5  GH2462-A	5 Measure the voltage between EEC-IV 60-Pin Breakout Box Pin 20, Circuit 601 (LB/PK), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to B4 . → **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B4 CHECK CIRCUIT 483 (RD) FOR AN OPEN	
1  2  GH1804-A	2 Measure the voltage between EEC-IV 60-Pin Breakout Box Pin 25, Circuit 483 (RD), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to B5 . → **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B5 CHECK CIRCUIT 534 (YE/LG) FOR AN OPEN	

1  GH1803-A	1 Measure the voltage between EEC-IV 60-Pin Breakout Box Pin 9, Circuit 534 (YE/LG), and ground. • **Is the voltage greater than 10 volts?** → **Yes** GO to B6 . → **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
B6 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
1  GH1805-A	1 Measure the resistance between EEC-IV 60-Pin Breakout Box Pin 8, Circuit 57 (BK), and ground; and between EEC-IV 60-Pin Breakout Box Pin 24, Circuit 57 (BK), and ground. • **Are the resistances less than 5 ohms?** → **Yes** INSTALL a new anti-lock brake control module; REFER to Anti-Lock Brake System (ABS) Module . REPEAT the self-test. → **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

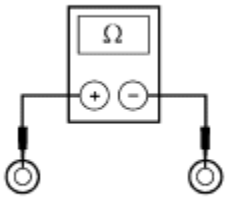
PINPOINT TEST C: DTCs C1145, C1155, AND C1230, ANTI-LOCK BRAKE SENSOR CIRCUIT FAILURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK THE ANTI-LOCK BRAKE SENSOR RESISTANCE AT BREAKOUT BOX	
1	

2

Anti-Lock Brake Control Module C186

4



GH1062-A

3 Connect EEC-IV 60-Pin Breakout Box.

4 Measure the resistance between EEC-IV 60-Pin Breakout Box pins for the suspect anti-lock brake sensor as follows:

Anti-Lock Brake Sensor	EEC-IV 60-Pin Breakout Box	
	Positive Probe	Negative Probe
LF	17	18
RF	3	4
Rear	22	21

- **Is the resistance between 800 and 1400 ohms (front 4x2), 800 and 2500 ohms (rear), or 380 and 480 ohms (front 4x4)?**

→ **Yes**
GO to C5 .

→ **No**
GO to C2 .

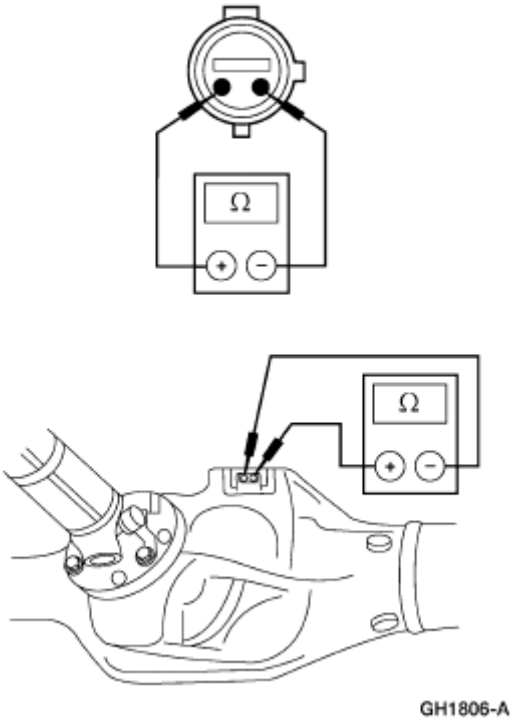
C2 CHECK ANTI-LOCK BRAKE SENSOR RESISTANCE

1

Disconnect Suspect Anti-Lock Brake Sensor

2

2 Measure the resistance between suspect anti-lock brake sensor terminals.



- **Is the resistance between 800 and 1400 ohms (front 4x2), 800 and 3500 ohms (rear), or 380 and 480 ohms (front 4x4)?**

→ **Yes**
GO to C3.

→ **No**
REPLACE suspect anti-lock brake sensor. If front anti-lock brake sensor (4x4), REFER to Sensor—Front 4x4.

If front anti-lock brake sensor (4x2), REFER to Sensor—Front 4x2.

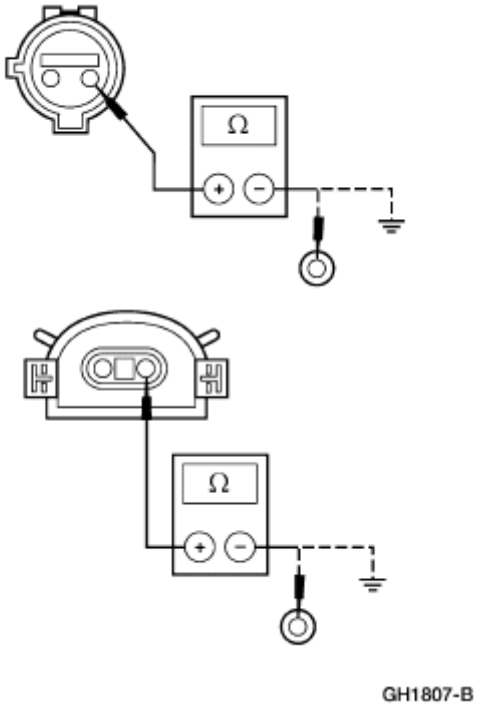
If rear anti-lock brake sensor, REFER to Sensor—Rear. CLEAR the DTCs. REPEAT the self-test.

C3 CHECK CIRCUIT 521 (TN/OG), 514 (YE/RD), OR 523 (RD/PK)

1

1 Measure the resistance between suspect anti-lock brake sensor and EEC-IV 60-Pin Breakout Box; and between suspect anti-lock brake sensor and ground as follows:

Anti-Lock Brake Sensor	Sensor Connector and Circuit	EEC-IV 60-Pin Break-out Box
LF	C188 Pin 2, Circuit 521	17



	(TN/OG)	
RF	C187 Pin 2, Circuit 514 (YE/RD)	3
Rear	C422 Pin 2, Circuit 523 (RD/PK)	21

- **Is the resistance between suspect anti-lock brake sensor, and EEC-IV 60-Pin Breakout Box less than 5 ohms; and between suspect anti-lock brake sensor, and ground greater than 10,000 ohms?**

→ **Yes**
GO to C4 .

→ **No**
REPAIR the circuit in question. REPEAT the self-test.

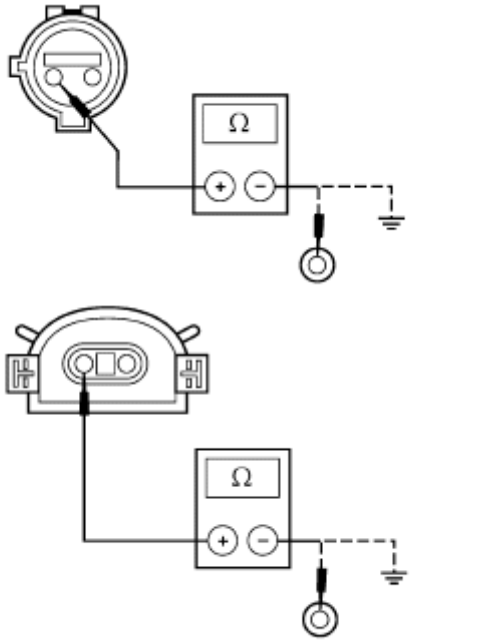
C4 CHECK CIRCUIT 522 (TN/BK), 516 (YE/BK), OR 519 (LG/BK)

1

1 Measure the resistance between suspect anti-lock brake sensor, and EEC-IV 60-Pin Breakout Box; and between suspect anti-lock brake sensor and ground as follows:

Anti-Lock Brake Sensor	Sensor Connector and Circuit	EEC-IV 60-Pin Break-out Box
LF	C188 Pin 1, Circuit 522 (TN/BK)	18
RF	C187 Pin 1, Circuit 516 (YE/BK)	4
Rear	C422 Pin 1,	22

	Circuit 519 (LG/BK)	



GH1808-B

- **Is the resistance between suspect anti-lock brake sensor, and EEC-IV 60-Pin Breakout Box less than 5 ohms; and between suspect anti-lock brake sensor, and ground greater than 10,000 ohms?**

→ **Yes**
GO to C8 .

→ **No**
REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.

C5 CHECK THE SUSPECT ANTI-LOCK BRAKE SENSOR CIRCUIT FOR SHORT TO POWER

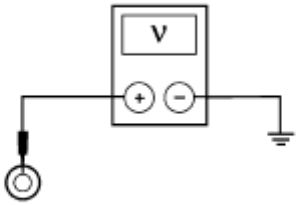
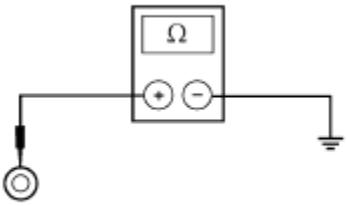
1

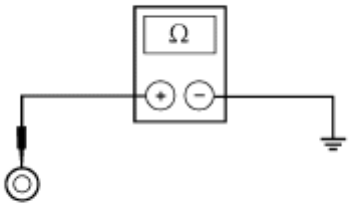
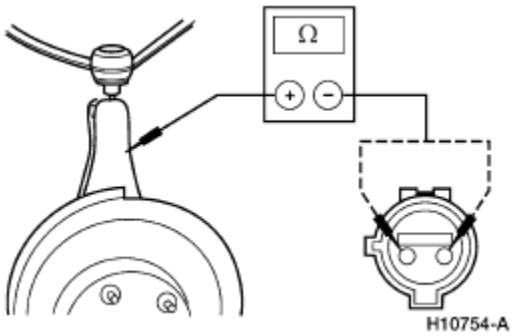
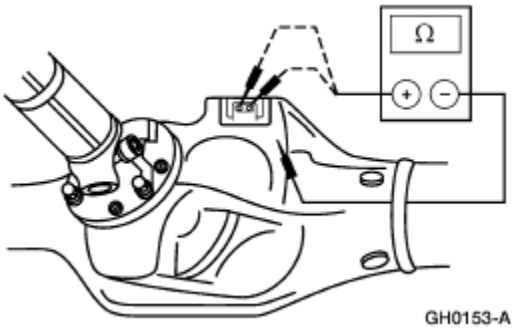

Suspect Anti-Lock Brake Sensor

2

2 Measure the voltage between suspect EEC-IV 60-Pin Breakout Box pins, and ground as follows:

Anti-Lock Brake Sensor	EEC-IV 60-Pin Breakout Box
LF	17
RF	3

 GH2094-A	Rear 21 • **Is voltage present?** → **Yes** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test. → **No** GO to C6 .
C6 CHECK CIRCUIT 521 (TN/OG), 514 (YE/RD), OR 523 (RD/PK), FOR SHORT TO GROUND	
1  GH1066-A	1 Measure the resistance between EEC-IV 60-Pin Breakout Box, and ground for the suspect anti-lock brake sensor as follows: **Anti-Lock Brake Sensor** / **EEC-IV 60-Pin Breakout Box** LF 17 RF 3 Rear 21 • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to C7 . → **No** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.
C7 CHECK CIRCUIT 522 (TN/BK), 516 (YE/BK), OR 519 (LG/BK) FOR SHORT TO GROUND	
1	1 Measure the resistance between EEC-IV 60-Pin Breakout Box, and ground as follows: **Anti-Lock Brake Sensor** / **EEC-IV 60-Pin Breakout Box** LF 18 RF 4

 GH1066-A	Rear | 22 • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to C8 . → **No** REPAIR the circuit in question. CLEAR the DTCs. REPEAT the self-test.
C8 CHECK FOR SHORT TO SPINDLE	
1  H10754-A	1 If the front anti-lock brake sensor is suspected, measure the resistance between the spindle near the sensor, and both terminals of the anti-lock brake sensor.
2  GH0153-A	2 If the rear anti-lock brake sensor is suspected, measure the resistance between the rear axle housing near the sensor, and both terminals of the anti-lock brake sensor. • **Is the resistance greater than 10,000 ohms?** → **Yes** GO to C9 .

	→ **No** REPLACE suspect anti-lock brake sensor. If front anti-lock brake sensor (4x4), REFER to Sensor—Front 4x4 . If front anti-lock brake sensor (4x2), REFER to Sensor—Front 4x2 . If rear anti-lock brake sensor, REFER to Sensor—Rear . CLEAR the DTCs. REPEAT the self-test.
C9 CHECK WHEEL END ROUTING FOR DAMAGE	
	1 Inspect the anti-lock brake sensor cable at the affected wheel end for chafing or other wiring damage. • **Is damage found?** → **Yes** INSTALL a new anti-lock brake sensor. If front anti-lock brake sensor (4x4), REFER to Sensor—Front 4x4 . CLEAR the DTCs. REPEAT the self-test. If front anti-lock brake sensor (4x2), REFER to Sensor—Front 4x2 . CLEAR the DTCs. REPEAT the self-test. → **No** INSTALL a new anti-lock brake control module; REFER to Anti-Lock Brake System (ABS) Module . REPEAT the self-test.

PINPOINT TEST D: DTCS C1233, C1234, AND C1237 ANTI-LOCK BRAKE SENSOR OUTPUT FAILURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
NOTE: Any time an anti-lock brake sensor is removed, thoroughly clean the mounting surfaces. On front anti-lock brake sensors, apply High Temperature 4x4 Front Axle and Wheel Bearing Grease E8TZ-19590A or equivalent meeting Ford specification ESA-M1C198-A.	
D1 CHECK THE ANTI-LOCK BRAKE SENSOR PIDS	
1 	
2 	2 Monitor the anti-lock brake control module PIDS LF_WSPD, RF_WSPD, and R_WSPD, while driving the vehicle at a constant speed below 20 km/h (12 mph).

	• **Are the anti-lock brake sensor PIDS consistent?** → **Yes** CLEAR the DTCs. If the DTC is received again, INSTALL a new anti-lock brake control module; REFER to Anti-Lock Brake System (ABS) Module . REPEAT the self-test. → **No** GO to D2 .
D2 CHECK FOR ANTI-LOCK BRAKE SENSOR DAMAGE AND LOOSENESS	
NOTE: Any time an anti-lock brake sensor is removed, thoroughly clean the mounting surfaces. On front anti-lock brake sensors, apply High Temperature 4x4 Front Axle and Wheel Bearing Grease E8TZ-19590-A or equivalent meeting Ford specification ESA-M1C198-A.	
1 	2 Raise and support the vehicle. Refer to Section 100-02 . 3 **CAUTION: Examine the anti-lock brake sensor wire carefully with a good light. Failure to verify damage to the anti-lock brake sensor wire will lead to unnecessary component replacement.** Inspect the anti-lock brake sensor mounting for looseness. If the anti-lock brake sensor is suspected, inspect the sensor for corrosion on the rear axle housing boss, or on the front anti-lock brake mounting flange. Clean as necessary. • **Is the anti-lock brake sensor OK?** → **Yes** GO to D3 . → **No** If the anti-lock brake sensor mounting is loose or corroded, REMOVE the anti-lock brake sensor, plug the opening, and thoroughly clean the mounting surfaces. On front anti-lock brake sensors, apply High Temperature 4x4 Front Axle and Wheel Bearing Grease E8TZ-19590-A or equivalent meeting Ford specification ESA-M1C198-A.CLEAR the DTCs. REPEAT the self-test. If the anti-lock brake sensor is damaged, INSTALL a new the anti-lock brake sensor.

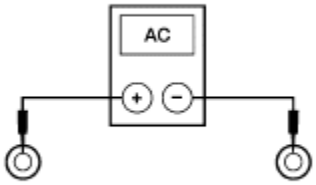
	If front anti-lock brake sensor (4x4), REFER to Sensor—Front 4x4 . CLEAR the DTCs. REPEAT the self-test. If front anti-lock brake sensor (4x2), REFER to Sensor—Front 4x2 . CLEAR the DTCs. REPEAT the self-test. If rear anti-lock brake sensor, REFER to Sensor—Rear . CLEAR the DTCs. REPEAT the self-test.
D3 CHECK FOR ANTI-LOCK BRAKE SENSOR INDICATOR DAMAGE	
NOTE: Any time an anti-lock brake sensor is removed, thoroughly clean the mounting surfaces. On front anti-lock brake sensors, apply High Temperature 4x4 Front Axle and Wheel Bearing Grease E8TZ-19590-A or equivalent meeting Ford specification ESA-M1C198-A.	
	1 Remove the anti-lock brake sensor. 2 **CAUTION: Examine the anti-lock brake sensor indicator carefully with a good light. Failure to verify damage to the anti-lock brake sensor indicator will lead to unnecessary component replacement.** Inspect the anti-lock brake sensor indicator for damaged or missing teeth. Rotate the wheel to verify that no teeth are missing. • **Is the anti-lock brake sensor indicator OK?** → **Yes** GO to D4 . → **No** INSTALL a new anti-lock brake sensor indicator. If front anti-lock brake sensor indicator (4x4), REFER to Sensor Indicator—Front 4x4 . CLEAR the DTCs. REPEAT the self-test. If front anti-lock brake sensor indicator (4x2), REFER to Sensor Indicator—Front 4x2 . CLEAR the DTCs. REPEAT the self-test. If rear anti-lock brake sensor indicator, REFER to Sensor Indicator—Rear . CLEAR the DTCs. REPEAT the self-test
D4 CHECK ANTI-LOCK BRAKE SENSOR OUTPUT AT EEC-IV 60-PIN BREAKOUT BOX	
2	1 Lower the vehicle so that all wheels are free to spin.

Anti-Lock Brake Control Module C186

3 Connect EEC-IV 60-Pin Breakout Box.

4

5



GH1952-B

5 While spinning the suspect wheel at a constant speed, measure the AC voltage of the suspect anti-lock brake sensor between EEC-IV 60-Pin Breakout Box pins as follows:

Anti-Lock Brake Sensor	EEC-IV 60-Pin Breakout Box	
	Positive Probe	Negative Probe
LF	17	18
RF	3	4
Rear	22	21

- **Is the anti-lock brake sensor output between 100 and 3500 mVolts?**

→ **Yes**
INSTALL a new anti-lock brake control module: REFER to Anti-Lock Brake System (ABS) Module . REPEAT the self-test.

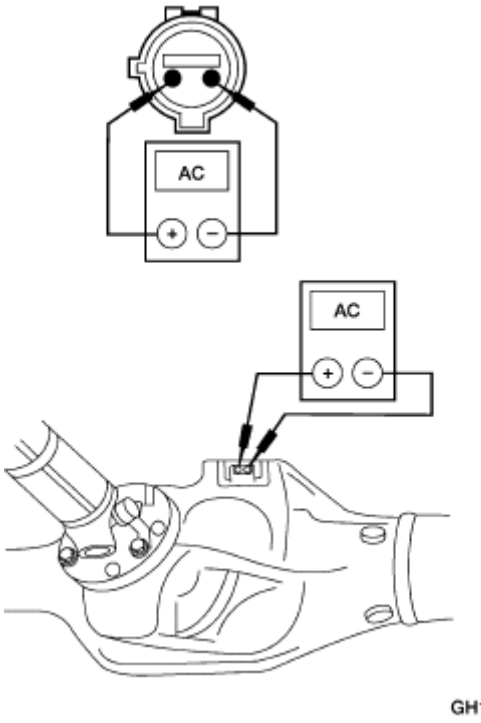
→ **No**
GO to D5 .

D5 CHECK THE ANTI-LOCK BRAKE SENSOR OUTPUT

1

Suspect Anti-Lock Brake Sensor

2 While spinning the suspect wheel at a constant speed, measure the AC voltage between the suspect anti-lock brake sensor terminals.



- **Is the anti-lock brake sensor output between 100 and 3500 mVolts?**

→ **Yes**
REPAIR the suspect anti-lock brake sensor circuit(s) in question. CLEAR the DTCs. REPEAT the self-test.

→ **No**
INSTALL a new anti-lock brake sensor.

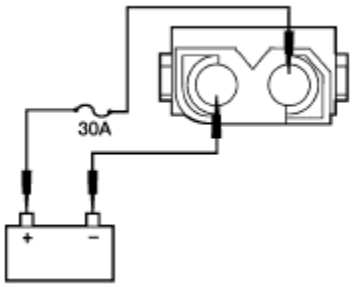
If front anti-lock brake sensor (4x4), REFER to Sensor—Front 4x4 . CLEAR the DTCs. REPEAT the self-test.

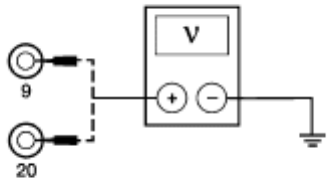
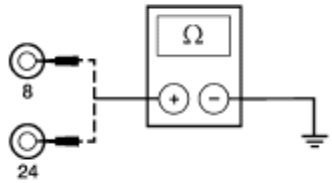
If front anti-lock brake sensor (4x2), REFER to Sensor—Front 4x2 . CLEAR the DTC's. REPEAT the self-test. If rear anti-lock brake sensor; REFER to Sensor—Rear .

PINPOINT TEST E: DTC C1095, HYDRAULIC PUMP MOTOR CIRCUIT FAILURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 CHECK THE ABS PUMP MOTOR	
1	

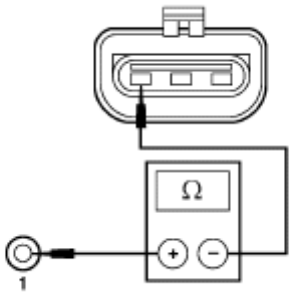
	• **Is the pump motor on constantly?** → **Yes** INSTALL a new anti-lock brake control module; REFER to Anti-Lock Brake System (ABS) Module . CLEAR the DTCs. REPEAT the self-test. → **No** GO to E2 .
E2 CHECK THE PUMP MOTOR OPERATION	
1  Scan Tool 2  3 	3 Trigger the anti-lock brake control module active command PMP MOTOR ON. • **Does the pump motor operate?** → **Yes** CLEAR the DTC. CHECK the yellow ABS warning indicator while driving the vehicle 32 km/h (20 mph) without brakes applied until the vehicle exceeds 32 km/h (20 mph). If the yellow ABS warning indicator illuminates, INSTALL a new anti-lock brake control module; REFER to Anti-Lock Brake System (ABS) Module . CLEAR the DTCs. REPEAT the self-test. If the yellow ABS warning indicator does not illuminate, CLEAR the DTCs. REPEAT the self-test. → **No** GO to E3 .
E3 CHECK THE PUMP MOTOR	
1	

 2  Pump Motor Connector 3  GH1811-A	3 Connect a fused (30A) jumper wire between positive battery terminal and red ABS pump motor terminal. Connect a jumper wire between the negative battery terminal and brown ABS pump motor terminal. • **Is the ABS pump motor running?** → **Yes** GO to E4 . → **No** INSTALL a new HCU; REFER to Hydraulic Control Unit . CLEAR the DTCs. REPEAT the self-test.
E4 CHECK CIRCUIT 534 (YE/LG) AND CIRCUIT 601 (LB/PK) FOR AN OPEN	
1  2  Anti-Lock Brake Control Module C186 4  5	3 Connect EEC-IV 60-Pin Breakout Box. 5 Measure the voltage between EEC-IV 60-Pin Breakout Box Pin 9, Circuit 534 (YE/LG), and ground; and between EEC-IV 60-Pin Breakout

 GH2463-A	Box Pin 20, Circuit 601 (LB/PK), and ground. • **Are the voltages greater than 10 volts?** → **Yes** GO to E5 . → **No** REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the self-test.
E5 CHECK CIRCUIT 57 (BK) FOR AN OPEN	
1  2  GH1805-A	2 Measure the resistance between EEC-IV 60-Pin Breakout Box Pin 8, Circuit 57 (BK), and ground; and between EEC-IV 60-Pin Breakout Box Pin 24, Circuit 57 (BK), and ground. • **Are the resistances less 5 ohms ?** → **Yes** INSTALL a new anti-lock brake control module. REFER to Anti-Lock Brake System (ABS) Module . REPEAT the self-test. → **No** REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST F: DTC C1102 — G-SWITCH CIRCUIT FAILURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
F1 CHECK THE G-SWITCH	
1  2  3 	2 Monitor and record the anti-lock brake control module PIDS ACCLSW1, and ACCLSW2, while driving the vehicle. 3 Check the table after recording the anti-lock brake control module PIDS ACCLSW1, and ACCLSW2. • **Do the G-switch PIDS toggle between ACT and notACT?** → **Yes** INSTALL a new anti-lock brake control module; REFER to Anti-Lock Brake System (ABS) Module . REPEAT the self-test. → **No** GO to F2 .
F2 CHECK CIRCUIT 836 (OG/WH) FOR AN OPEN	
1  2  Anti-Lock Brake Control Module C186 3  G-switch C312 4	4 Measure the resistance between EEC-IV 60-Pin Breakout Box Pin 1, Circuit 836 (OG/WH), and G-switch C312 Pin 3, Circuit 836 (OG/WH), harness side.



GH2464-A

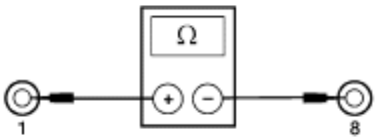
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to F3 .

→ **No**
REPAIR the circuit . CLEAR the DTCs. REPEAT the self-test.

F3 CHECK CIRCUIT 836 (OG/WH) FOR SHORT TO GROUND

1



GH2465-A

1 Measure the resistance between EEC-IV 60-Pin Breakout Box Pin 1, Circuit 836 (OG/WH), and G-switch C312 Pin 8, Circuit 57 (BK), harness side.

- **Is the resistance greater than 10,000 ohms?**

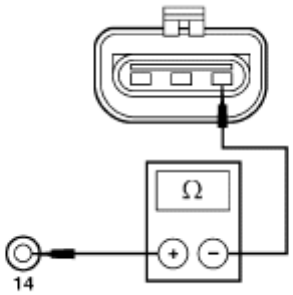
→ **Yes**
GO to F4 .

→ **No**
REPAIR Circuit 836 (OG/WH). CLEAR the DTCs. REPEAT the self-test.

F4 CHECK CIRCUIT 886 (OG/BK) FOR AN OPEN

1

1 Measure the resistance between EEC-IV 60-Pin Breakout Box Pin 14, Circuit 886 (OG/BK), and G-switch C312 Pin 1, Circuit 886 (OG/BK).



GH2466-A

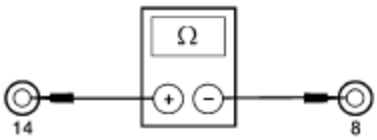
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to F5 .

→ **No**
REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.

F5 CHECK CIRCUIT 886 (OG/BK) FOR SHORT TO GROUND

1



GH2467-A

1 Measure the resistance between EEC-IV 60-Pin Breakout Box Pin 14, Circuit 886 (OG/BK), and EEC-IV 60-Pin Breakout Box Pin 8, Circuit 57 (BK).

- **Is the resistance greater than 10,000 ohms?**

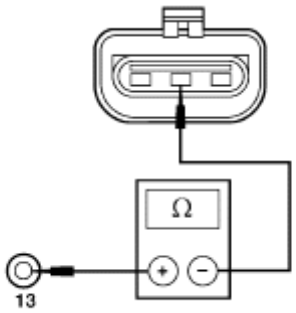
→ **Yes**
GO to F6 .

→ **No**
REPAIR Circuit 886 (OG/BK). CLEAR the DTCs. REPEAT the self-test.

F6 CHECK CIRCUIT 887 (YE) FOR AN OPEN

1

1 Measure the resistance between EEC-IV 60-Pin Breakout Box Pin 13, Circuit 887 (YE), and G-switch C312 Pin 2, Circuit 887 (YE), harness side.



GH2468-B

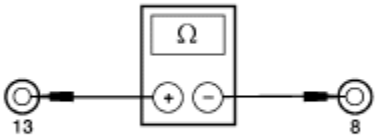
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to F7 .

→ **No**
REPAIR the circuit. CLEAR the DTCs.
REPEAT the self-test.

F7 CHECK CIRCUIT 887 (YE) FOR SHORT TO GROUND

1



GH2469-A

1 Measure the resistance between EEC-IV 60-Pin Breakout Box Pin 13, Circuit 887 (YE), and EEC-IV 60-Pin Breakout Box Pin 8, Circuit 57 (BK).

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
GO to F8 .

→ **No**
REPAIR Circuit 887 (YE). CLEAR the DTCs.
REPEAT the self-test.

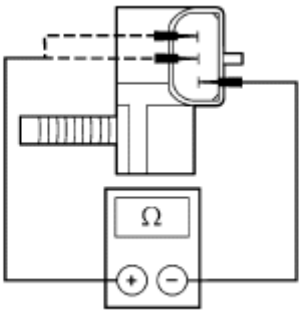
F8 CHECK G-SWITCH, DEFAULT G-SWITCH POSITION

2

1 Place the G-switch on a level surface.

2 **NOTE:** The G-switch must be in the same position it would be in the vehicle.

Measure the resistance between G-switch Pin 1, and Pin 3; and between G-switch Pin 1, and Pin 2 (component side).



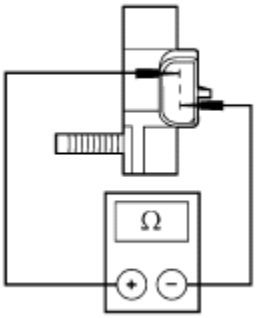
- **Are the resistances less than 5 ohms?**

→ **Yes**
GO to F9 .

→ **No**
INSTALL a new G-switch; REFER to Switch—G . CLEAR the DTCs. REPEAT the self-test.

F9 CHECK G-SWITCH, FRONT OF G-SWITCH RAISED 38.0 MM (1.5 IN)

2



1 **NOTE:** The arrow on the G-switch points toward the front.

Raise the front of the G-switch 38.0mm (1.5 in).

2 Measure the resistance between G-switch Pin 1, and Pin 3 (component side).

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
GO to F10 .

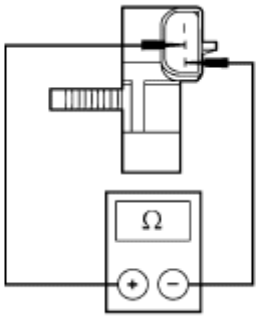
→ **No**
INSTALL a new G-switch; REFER to Switch—G . CLEAR the DTCs. REPEAT the self-test.

F10 CHECK G-SWITCH, REAR OF G-SWITCH RAISED 25.4 MM (1 IN)

2

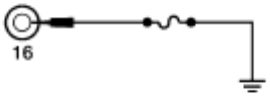
1 Raise the rear of the G-switch 25.4mm (1in).

2 Measure the resistance between G-switch Pin

 GH1923-A	2, and Pin 1 (component side). • **Is the resistance greater than 10,000 ohms?** → **Yes** INSTALL a new anti-lock brake control module; REFER to Anti-Lock Brake System (ABS) Module . REPEAT the self-test. → **No** INSTALL a new G-switch; REFER to Switch—G . CLEAR the DTCs. REPEAT the self-test.

PINPOINT TEST G: THE YELLOW ABS WARNING INDICATOR DOES NOT SELF-CHECK

CONDITIONS	DETAILS/RESULTS/ACTIONS
G1 CHECK THE ANTI-LOCK BRAKE CONTROL MODULE	
1 	
2  Anti-lock Brake Control Module C186	
	3 Connect EEC-IV 60-Pin Breakout Box.
4 	
5	5 Connect a fused (10A) jumper between EEC-IV 60-Pin Breakout Box Pin 16, Circuit 603 (DG), and ground.



GH2471-A

- **Does the yellow ABS warning indicator illuminate?**

→ **Yes**
VERIFY that all repair procedures have been carried out and DTCs have been repaired. INSTALL a new anti-lock brake control module; REFER to Anti-Lock Brake System (ABS) Module . TEST the system for normal operation.

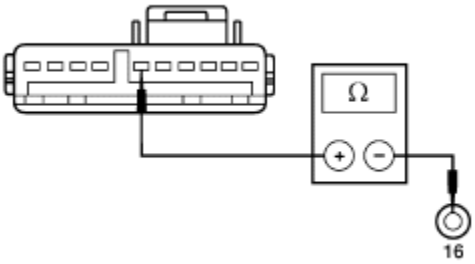
→ **No**
GO to G2 .

G2 CHECK CIRCUIT 603 (DG) FOR AN OPEN

1

Instrument Cluster C288

2



GH1819-A

2 Measure the resistance between EEC-IV 60-Pin Breakout Box Pin 16, Circuit 603 (DG), and instrument cluster C288 Pin 6, Circuit 603 (DG), harness side.

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

→ **Yes**
INSTALL a new instrument cluster printed circuit; REFER to Section 413-01 . TEST the system for normal operation.

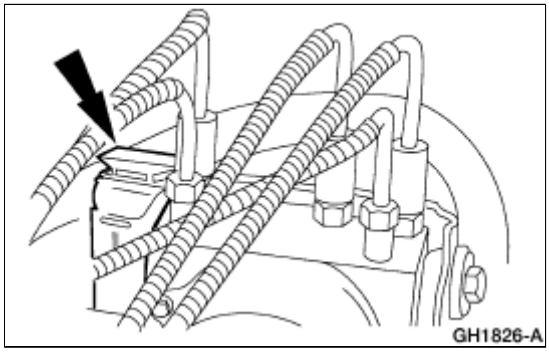
→ **No**
REPAIR the circuit. TEST the system for

	normal operation.

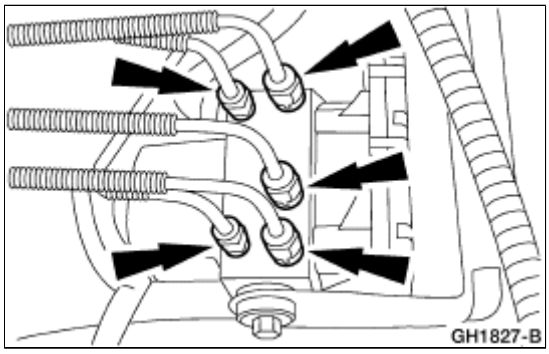
Hydraulic Control Unit

Removal

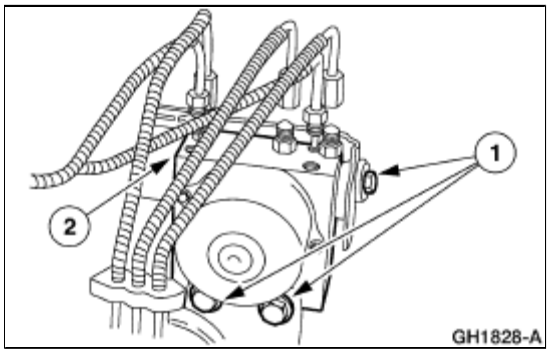
1. Disconnect the battery ground cable.
2. Disconnect the electrical connector by lifting up on the release tab.



3. Disconnect the brake lines from the hydraulic control unit (HCU).



4. Remove the HCU.
    1. Remove the bolts.
    2. Remove the HCU.



5. Remove the anti-lock brake control module.

Installation

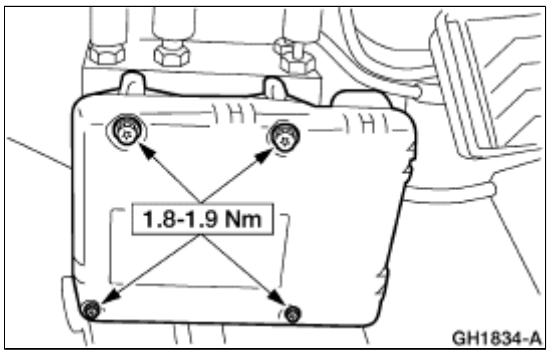
1. **WARNING: Brake fluid contains polyglycol ethers and polyclycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.**

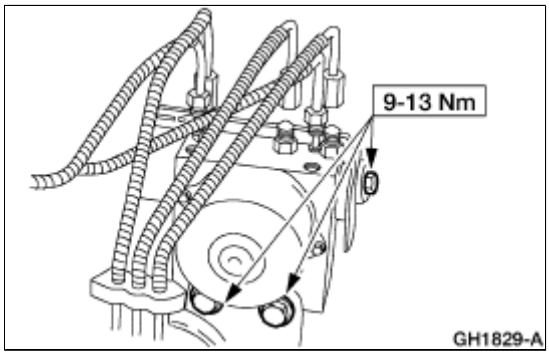
   CAUTION: Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

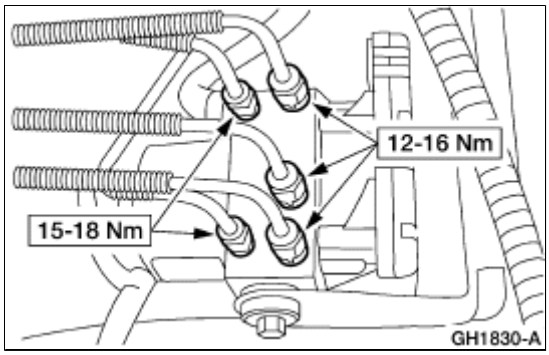
   CAUTION: After the HCU is installed, it is necessary to bleed the hydraulic brake system; refer to Section 206-00 .

   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.



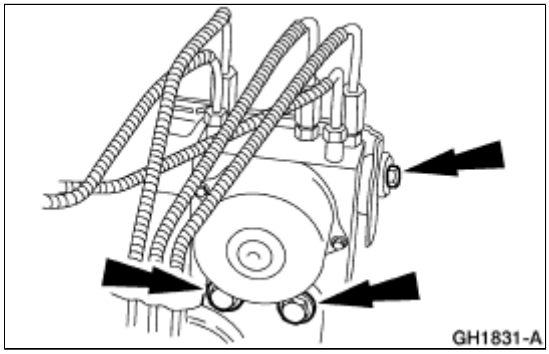



12-16 Nm
15-18 Nm
GH1830-A

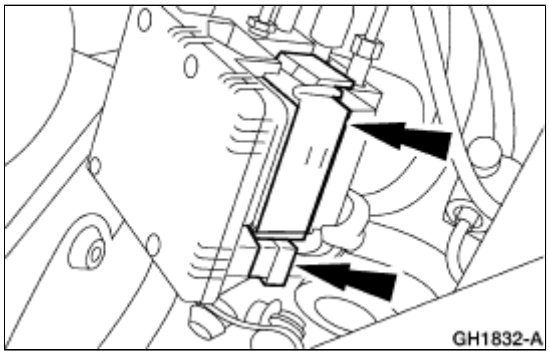
Anti-Lock Brake System (ABS) Module

Removal

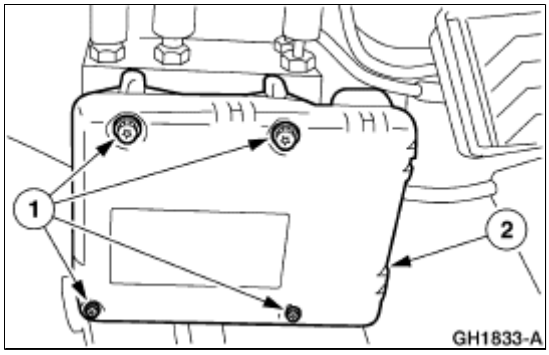
1. Disconnect the battery ground cable.
2. Remove the hydraulic control unit bolts.



3. Disconnect the anti-lock brake control module electrical connectors.



4. Remove the anti-lock brake control module.
    1. Remove the bolts.
    2. Remove the control module.

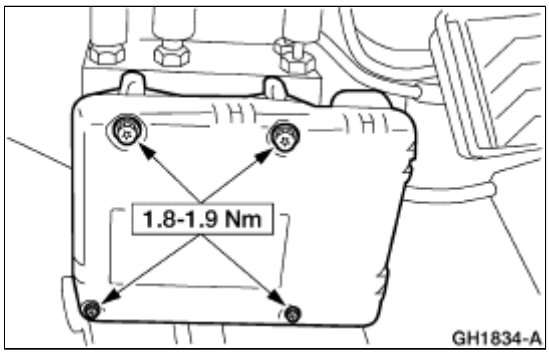


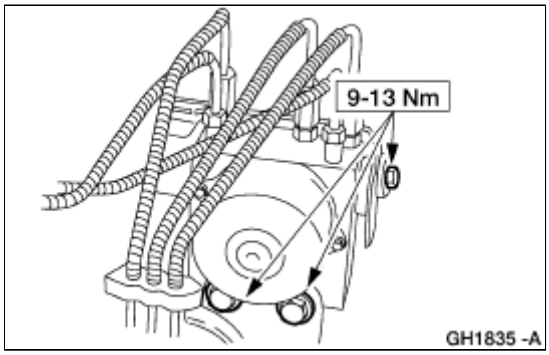
Installation

1. **CAUTION: Once the new module is installed, it is necessary to configure it using the scan tool.**

   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.



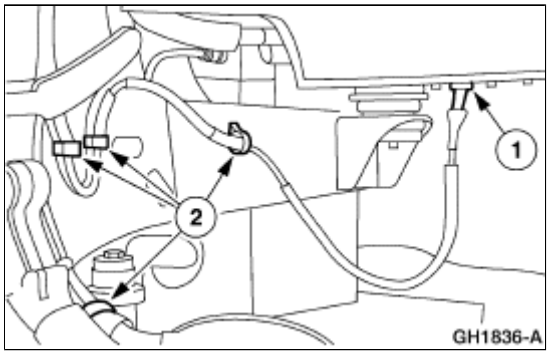


Sensor —Front 4x2

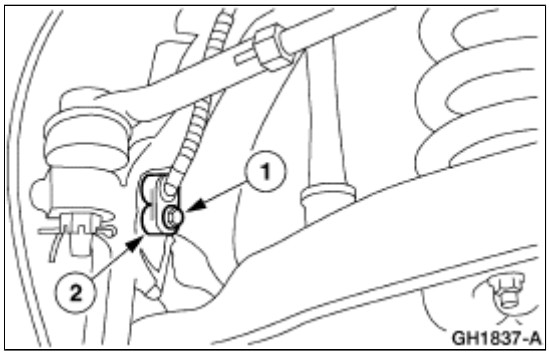
Removal and Installation

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .

2. Disconnect the front anti-lock brake sensor wire from the vehicle frame.
    1. Disconnect the electrical connector.
    2. Unclip the front anti-lock brake sensor wire from the vehicle frame.

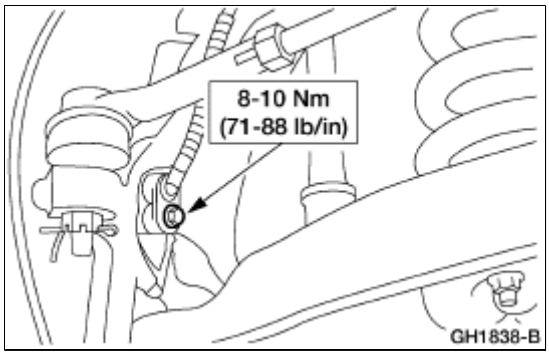


3. Remove the front anti-lock brake sensor.
    1. Remove the bolt.
    2. Remove the front anti-lock brake sensor.



4. **NOTE:** Plug the sensor mount opening and thoroughly clean the mounting surface. Apply High Temperature 4x4 Front Axle and Wheel Bearing Grease E8TZ-19590-A meeting Ford specification ESA-M1C198-A.

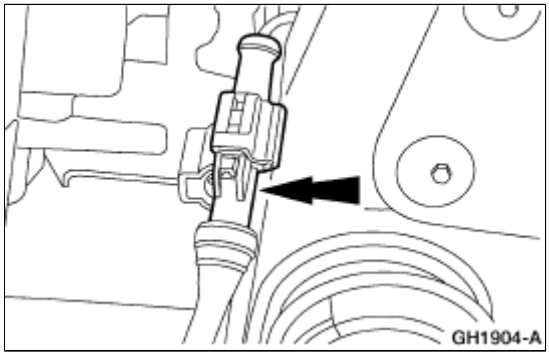
   To install, reverse the removal procedure.


8-10 Nm
(71-88 lb/in)
GH1838-B

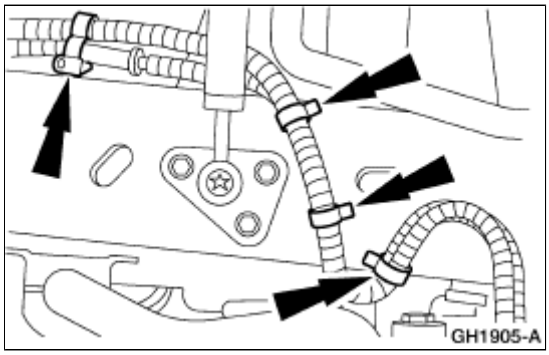
Sensor —Front 4x4

Removal

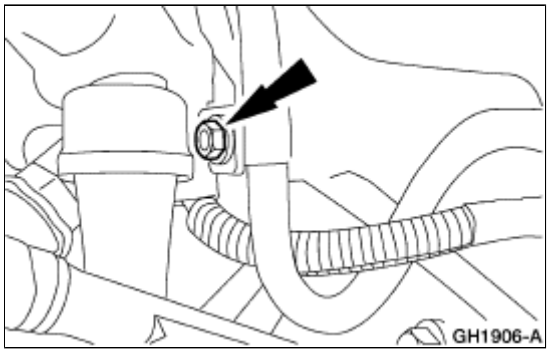
1. Remove the rotor shield; refer to Section 206-03 .
2. Disconnect the front anti-lock brake sensor electrical connector.



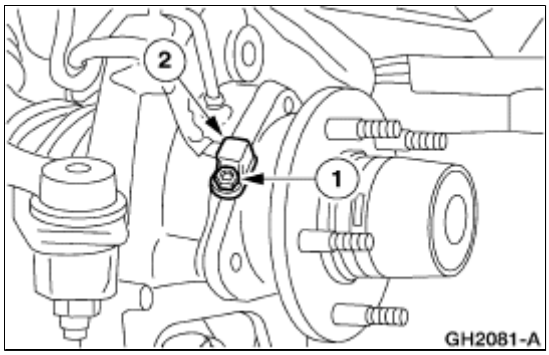
3. Unclip the front anti-lock brake sensor wire from the vehicle frame.



4. Remove the bolt.



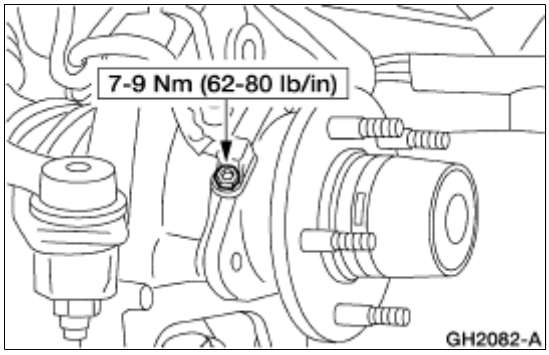
5. Remove the front anti-lock brake sensor.
    1. Remove the bolt.
    2. Remove the front anti-lock brake sensor.

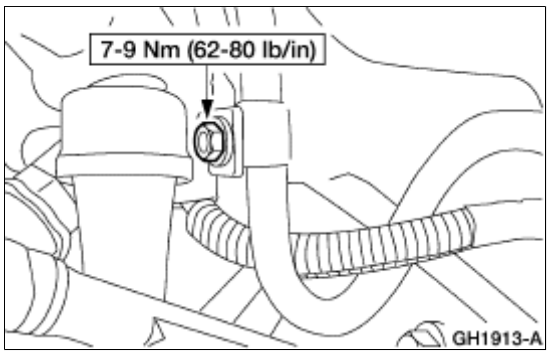


Installation

1. **NOTE:** Plug the sensor mount opening and thoroughly clean the mounting surface. Apply High Temperature 4x4 Front Axle and Wheel Bearing Grease E8TZ-19590-A meeting Ford specification ESA-M1C198-A.

   To install, reverse the removal procedure.





Sensor —Rear

Material

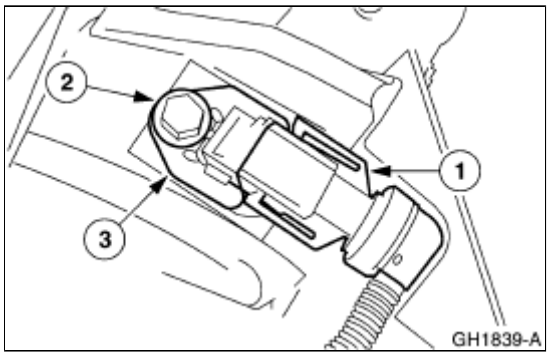
Item	Specification
SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent	WSL-M2C192-A

Removal and Installation

1. Raise and support vehicle. For additional information, refer to Section 100-02 .

2. **NOTE:** Clean off dirt and foreign material that may have collected around the rear anti-lock brake sensor before removal.

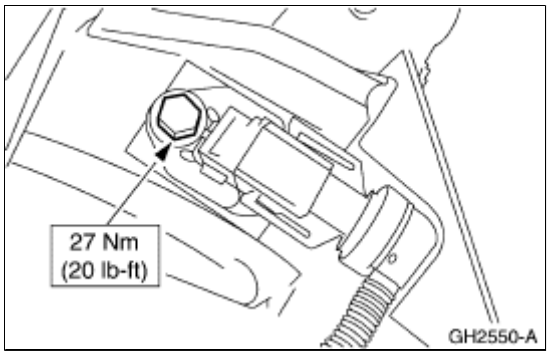
   Remove the rear anti-lock brake sensor.
   1. Disconnect the rear anti-lock brake sensor electrical connector.
   2. Remove the bolt.
   3. Remove the rear anti-lock brake sensor.



3. **NOTE:** Thoroughly clean the mounting surface.

   NOTE: Inspect the anti-lock brake sensor O-ring for damage; lightly lubricate the O-ring with axle lubricant.

   To install, reverse the removal procedure.


27 Nm
(20 lb-ft)
GH2550-A

Sensor Indicator —Front 4x2

Removal and Installation

For additional information, refer to Section 206-03 .

Sensor Indicator —Front 4x4

Removal and Installation

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

Sensor Indicator —Rear

Removal and Installation

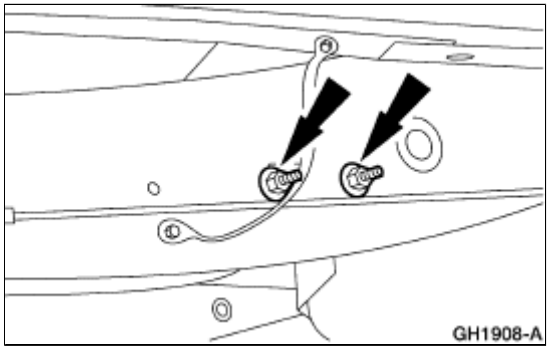
NOTE: The rear anti-lock brake sensor indicator is attached to the differential case.

For additional information, refer to Section 205-02 .

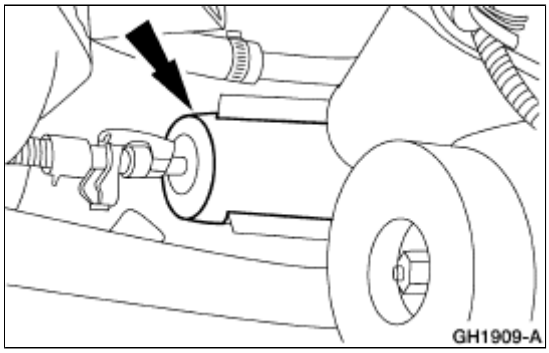
Switch —G

Removal

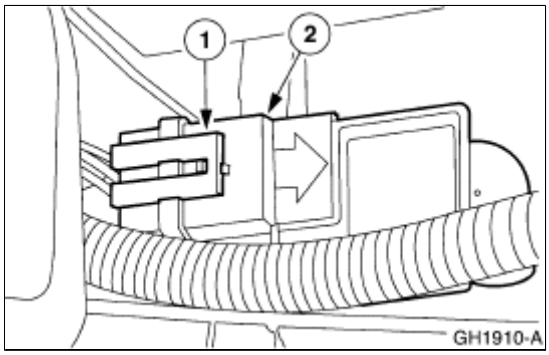
1. Raise and support the vehicle; refer to Section 100-02 .
2. Remove the nuts.



3. Unclip the fuel filter from the vehicle frame.

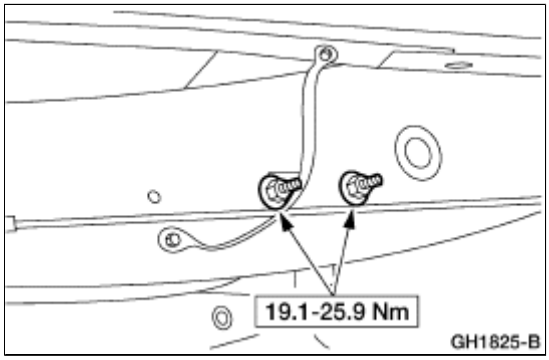


4. Remove the G-switch.
    1. Disconnect the G-switch electrical connector.
    2. Remove the G-switch.



Installation

1. To install, reverse the removal procedure.



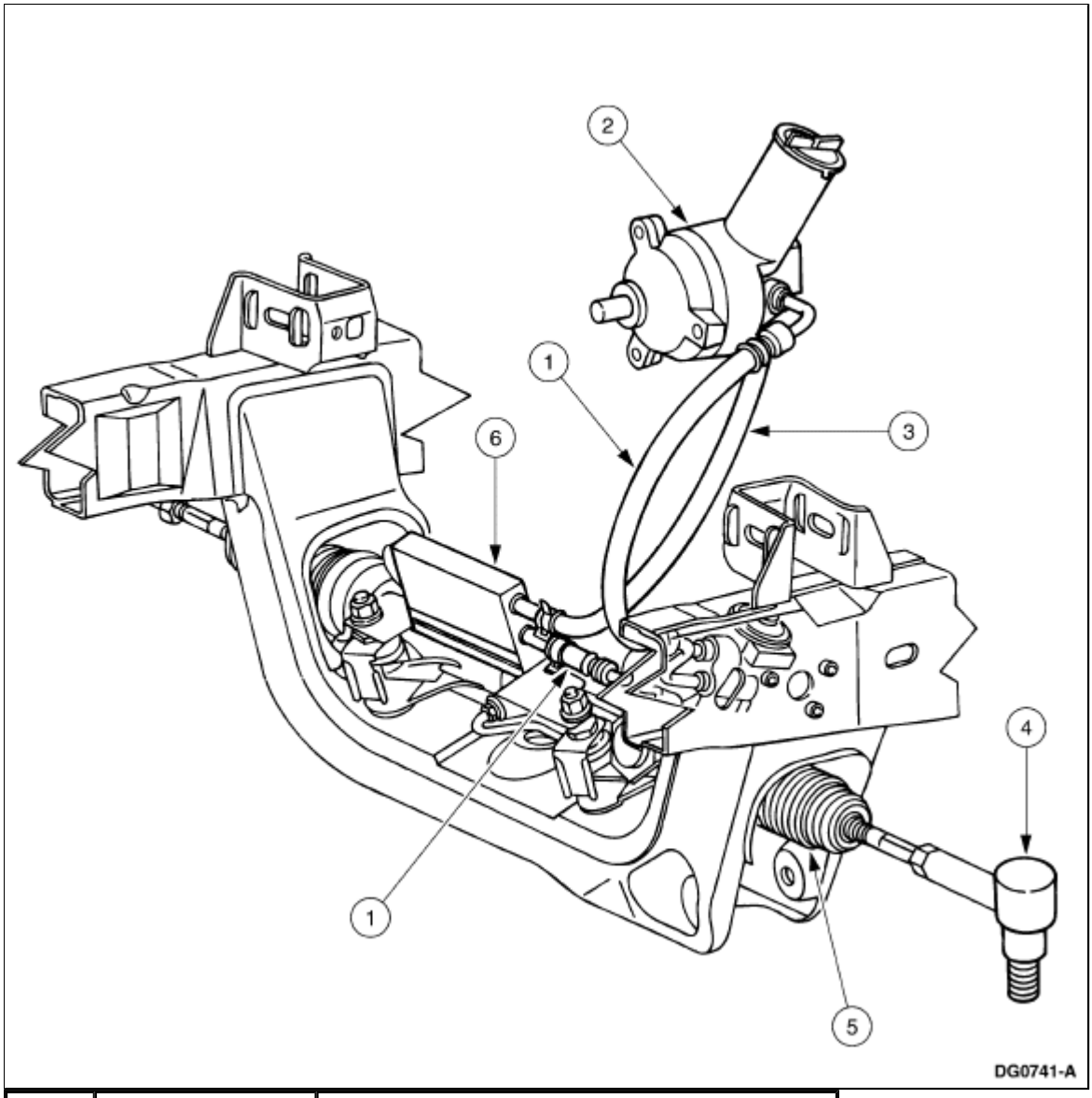
General Specifications

Item	Specification
Steering Wheel Turning Effort	4.5 Kg (10 Lb)
Power Steering Gear	
Type	Rack and Pinion
Steering Gear Turns (Stop to Stop)	3.2/4.0
Tie Rod Articulation Torque	7.25 Kg (16 Lb)
Power Steering Pump	
Type	CII
Flow Rate @ 74°-80°C (165°-175°F) and Engine Speed Set at 1500 RPM	7.9-9.5 Liters/Minute (2.1-2.5 gpm)
Maximum Pressure @ 74°-80°C (165°-175°F) and Engine Speed Set at 1500 RPM	1034 kPa (150 psi)
Minimum Flow Rate @ 74°-80°C (165°-175°F), Power Steering Analyzer Set at 5,102 kPa (750 psi) and Engine Speed Set at Idle	3.6 Liters/Minute (0.95 gpm)
Relief Pressure	8,946-10,205 kPa (1,300-1,480 psi)
Type	CIII
Flow Rate @ 74°-80°C (165°-175°F) and Engine Speed Set at 1500 RPM	8.3-9.8 Liters/Minute (2.2-2.6 gpm)
Maximum Pressure @ 74°-80°C (165°-175°F) and Engine Speed Set at 1500 RPM	1034 kPa (150 psi)
Minimum Flow Rate @ 74°-80°C (165°-175°F), Power Steering Analyzer Set at 5,102 kPa (750 psi) and Engine Speed Set at Idle	4.35 Liters/Minute (1.15 gpm)
Relief Pressure	8,946-10,205 kPa (1,300-1,480 psi)
Lubricants	
MERCON® Multi-Purpose ATF XT-2-QDX	MERCON®

Steering System

The power steering system has a typical rack-and-pinion design consisting of the following components:

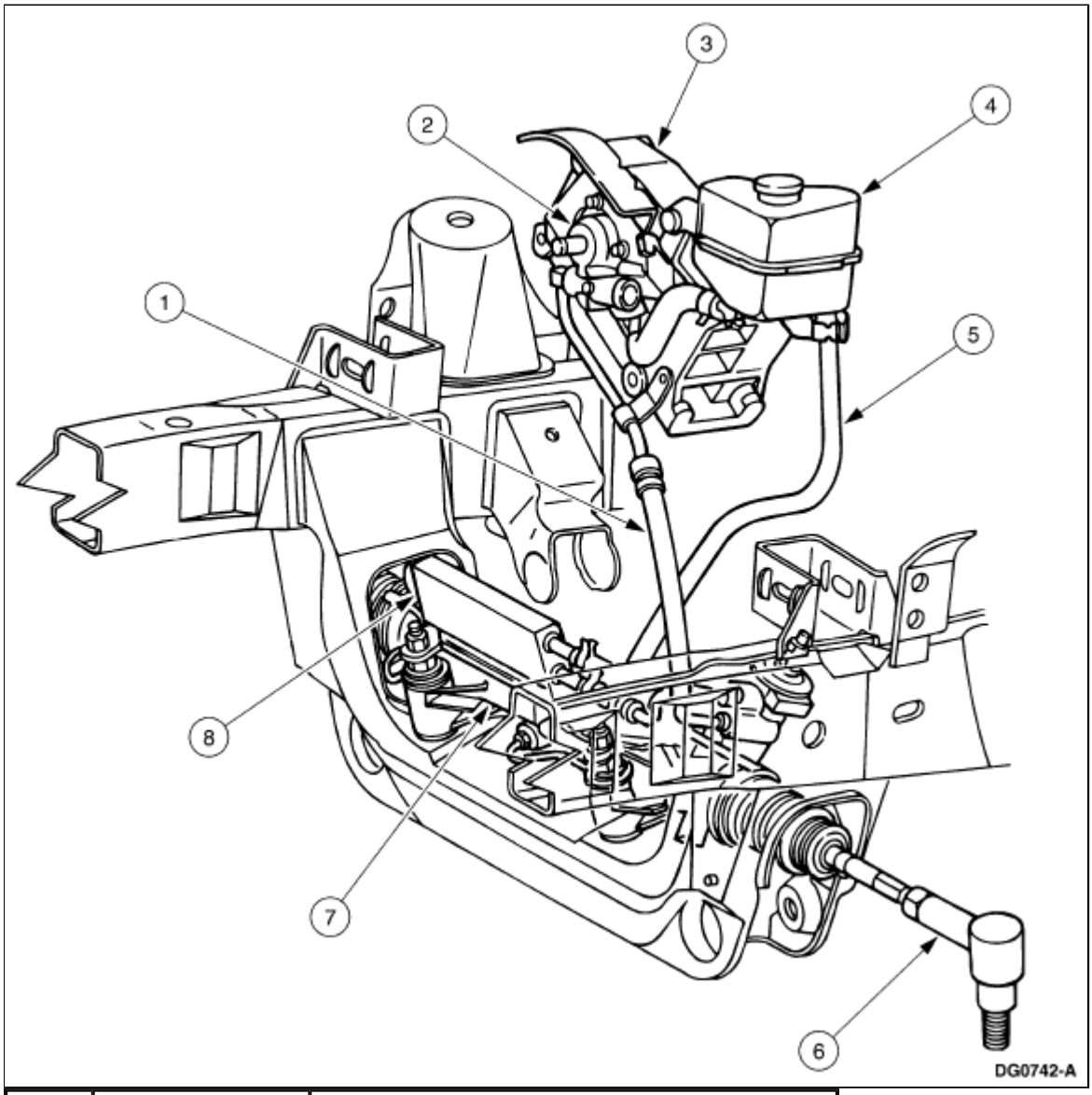
Steering System Components — 4.0 Liter (Push Rod)



Item	Part Number	Description
1	3A719	Power Steering Pressure Hose
2	3A674	Power Steering Pump
3	3A005	Power Steering Return Line Hose
4	3A130	Tie Rod End
5	3504	Steering Gear

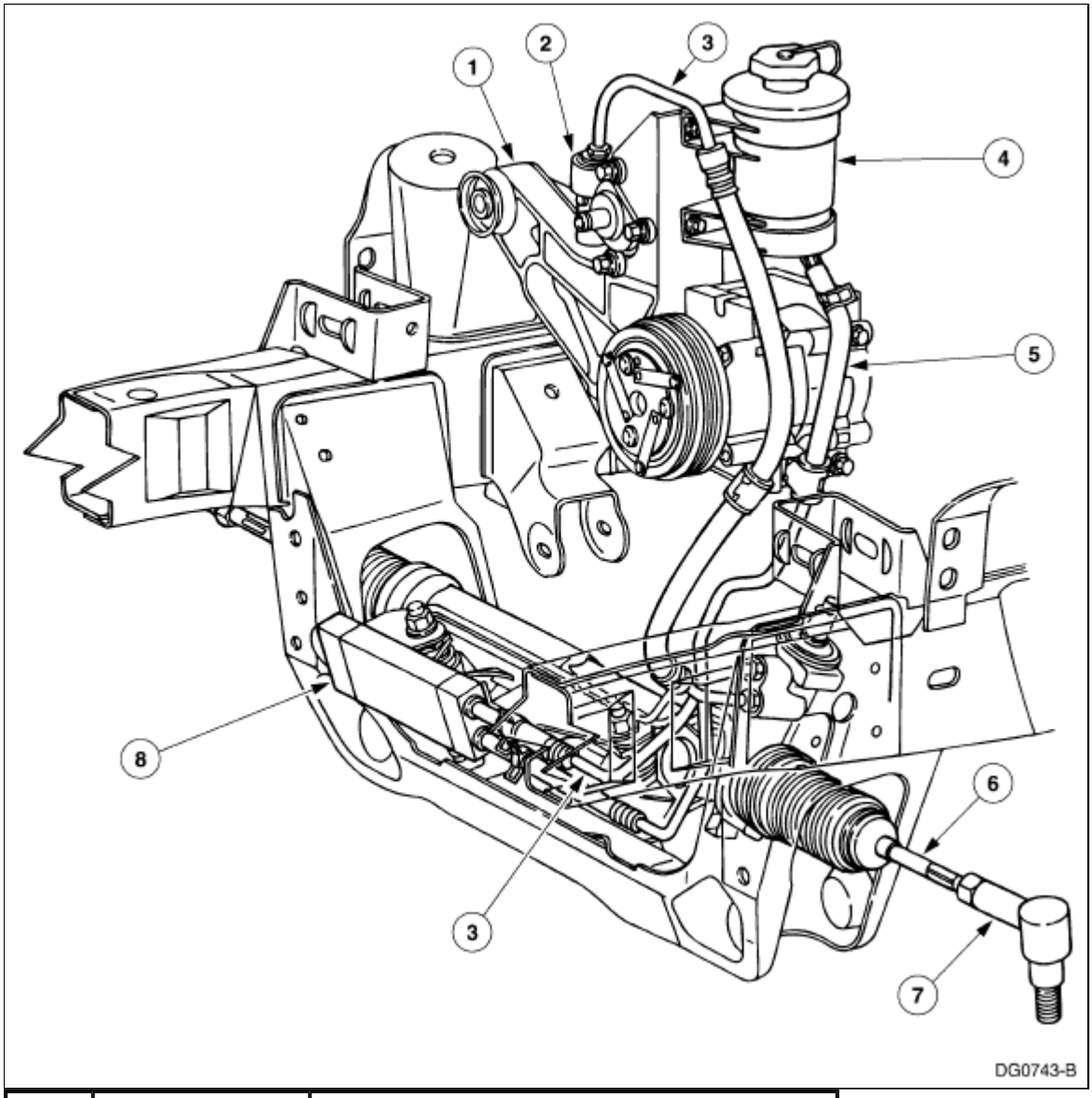
6	3D746	Power Steering Fluid Cooler

Steering System Components — 4.0 Liter SOHC



Item	Part Number	Description
1	3A719	Power Steering Pressure Hose
2	3A674	Power Steering Pump
3	2882	A/C Compressor Mounting Bracket
4	3A697	Power Steering Oil Reservoir
5	3A005	Power Steering Return Line Hose
6	3A130	Tie Rod End
7	3504	Steering Gear
8	3D746	Power Steering Fluid Cooler

Steering System Components — 5.0 Liter



Item	Part Number	Description
1	2882	A/C Compressor Mounting Bracket
2	3A674	Power Steering Pump
3	3A719	Power Steering Pressure Hose
4	3A697	Power Steering Oil Reservoir
5	3A005	Power Steering Return Line Hose
6	3504	Steering Gear
7	3A130	Tie Rod End
8	3D746	Power Steering Fluid Cooler

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 fluid lines, refer to Section 211-02 .

For information on the front wheel spindles (4x2), refer to Section 204-01A .

For information on the power steering fluid cooler (3D746), refer to Section 211-02 .

For information on the power steering pump (3A674), refer to Section 211-02 .

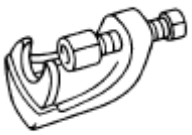
For information on the steering gear (3504), refer to Section 211-02 .

For information on the tie rod end (3A130), refer to Section 211-02 .

For information on the wheel hubs (4x4 or AWD), refer to Section 204-01B .

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.

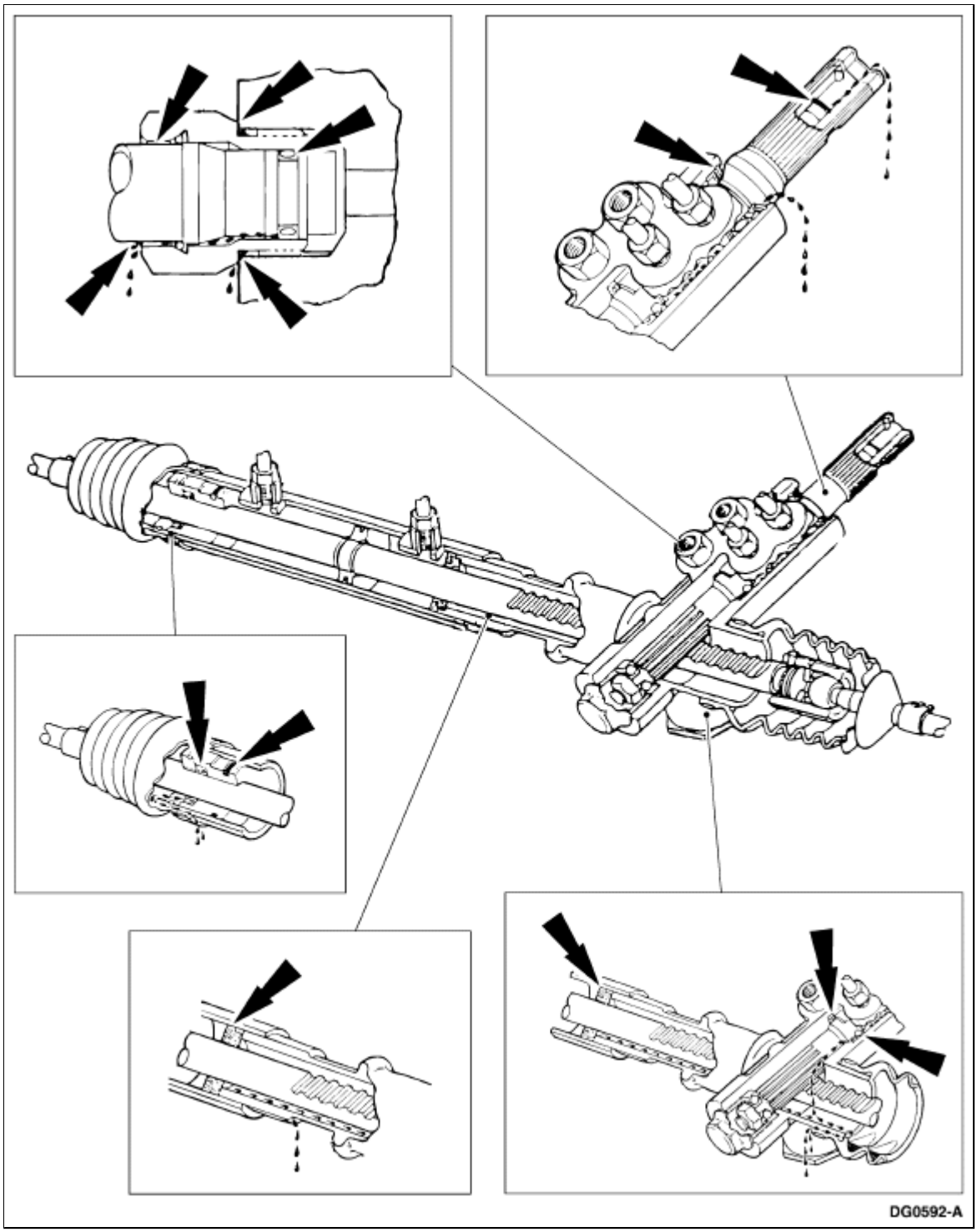
2. Inspect Tires
   - Check the tire pressure; refer to the Vehicle Certification (VC) label.
   - Verify that all tires are sized to specification; refer to Section 204-04 .
   - Check the tires for damage or uneven wear; refer to Section 204-04 .

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 hot or cold range on the dipstick. 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 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 pressure hose (3A719), power steering return hose (3A713), power steering fluid cooler and hose assembly 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
• 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
• Hard Steering or Lack of Assist	• Seized lower steering column shaft U-joints.	• REPLACE the lower steering column shaft; REFER to Section 211-04 .
	• Damaged, fractured steering column bearing (s).	• REPAIR the steering column; REFER to Section 211-04 .
	• Power steering pump.	• GO to Pump Flow and Pressure Test Component Test in this section.
	• Suspension components.	• REFER to Section 204-00 for suspension system diagnosis and testing.
	• Steering gear internal leakage.	• GO to Pump Flow and Pressure Test Component Test in this section.
• Excessive Steering Pump Noise	• Power steering pump.	• GO to Pump Flow and Pressure Test Component Test in this section.
• Excessive Steering Wheel Play	• Damaged, loose, or worn tie rod end (3A130).	• GO to the Steering Linkage Component Test.

	• Loose, worn or damaged front wheel spindle tie rod (3280). • Damaged/worn steering gear. • Loose, worn or damaged steering column bearing (s). • Loose, worn or damaged lower steering column shaft U-joint(s).	• GO to the Tie Rod Articulation Torque Component Test. • REPLACE the steering gear; REFER to Section 211-02 . • REPLACE any unserviceable steering column bearing(s); REFER to Section 211-04 . • REPLACE the lower steering column shaft; REFER to Section 211-04 .
• Wander	• 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.	• INFORM the customer of improper vehicle loading. • GO to the Tie Rod Articulation Torque Component Test. • GO to the Steering Linkage Component Test. • REPLACE or TIGHTEN the bolts; REFER to Section 211-02 . • TIGHTEN the bolts; REFER to Section 211-04 . • REPLACE the lower steering column shaft; REFER to Section 211-04 . • REPLACE any unserviceable steering column bearings; REFER to Section 211-04 . • REFER to Section 204-00 for suspension system diagnosis and testing.
• Drift/Pull	• 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.	• INFORM the customer of improper vehicle loading. • 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.

	• The steering gear valve effort out of balance. • Check the brake system for proper operation. • Improper frame/underbody alignment.	• GO to Steering Gear Valve Component Test in this section. • REFER to Section 206-00 . • CORRECT as required; REFER to Frame Dimension Manual.
• Feedback	• 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).	• GO to the Tie Rod Articulation Torque Component Test. • GO to the Steering Linkage Component Test. • REPLACE or TIGHTEN the retaining bolts; REFER to Section 211-02 . • TIGHTEN the bolts; REFER to Section 211-04 . • REPLACE as necessary; REFER to Section 204-01A or Section 204-01B . • REPLACE any unserviceable steering column bearing(s); REFER to Section 211-04 .
• Poor Returnability/Sticky Steering	• 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).	• REPLACE the 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. • REPLACE any unserviceable steering column bearing(s); REFER to Section 211-04 .
• Shimmy	• Loose, worn or damaged tie rod end. • Loose, worn or damaged front wheel spindle tie rod. • Suspension components.	• 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 steering linkage 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. Replace or tighten any worn, damaged, or loose steering components. 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 oil reservoir (3A697).

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 Spring Scale 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 the Power Steering Analyzer 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 power steering analyzer 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, the power steering pump may require repair. 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 replace the power steering pump.

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, then replace the power steering pump.

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, then replace the power steering pump.

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. Repair or replace the steering gear as necessary; 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; refer to Section 211-02 .

2. Move the front wheel spindle tie rod back and forth three times.

3. Hook Spring Scale 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, replace the front wheel spindle tie rod; 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, repair or replace the steering gear; refer to Section 211-02 .

2. If the vehicle pulls with the engine OFF, cross-switch the front wheels.

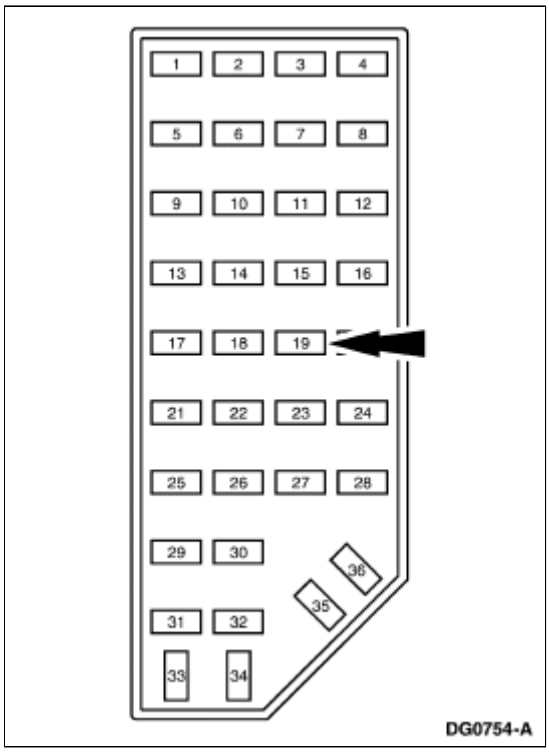
3. If the vehicle pulls to the opposite side, cross-switch the front and rear wheels on the same side.

4. If the vehicle pull direction does not change, check the front suspension components, wheel alignment and frame alignment; refer to Section 204-00 or an appropriate frame dimensions manual.

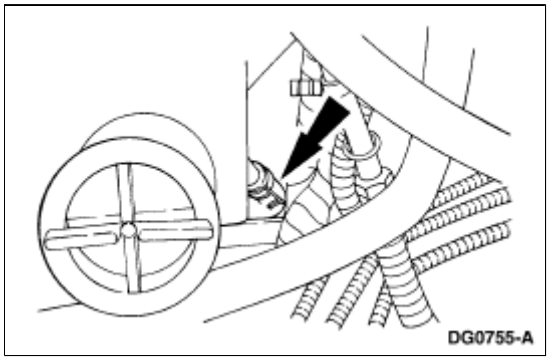
System Flushing

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 ignition coil fuse to disable the vehicle.



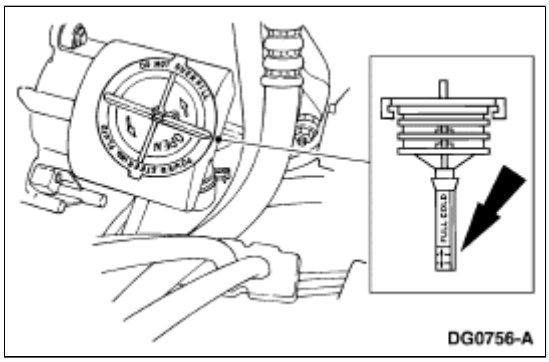
2. Disconnect the power steering return hose. Plug the reservoir.



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 .

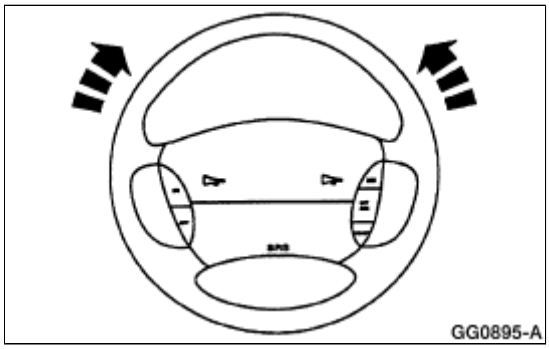
5. Fill the reservoir.
   - Use Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent.



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.**

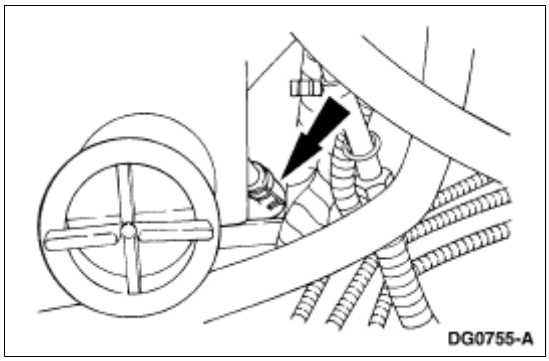
   CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump could occur.

   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 debris.
   - Add Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent as needed.



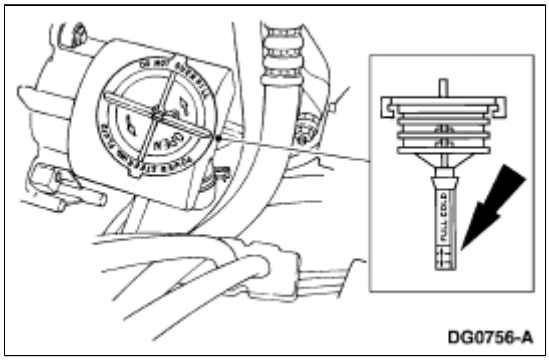
7. Lower the vehicle.

8. Disconnect the extension hose from the power steering return hose. Remove the plug. Attach the power steering return hose to the reservoir.

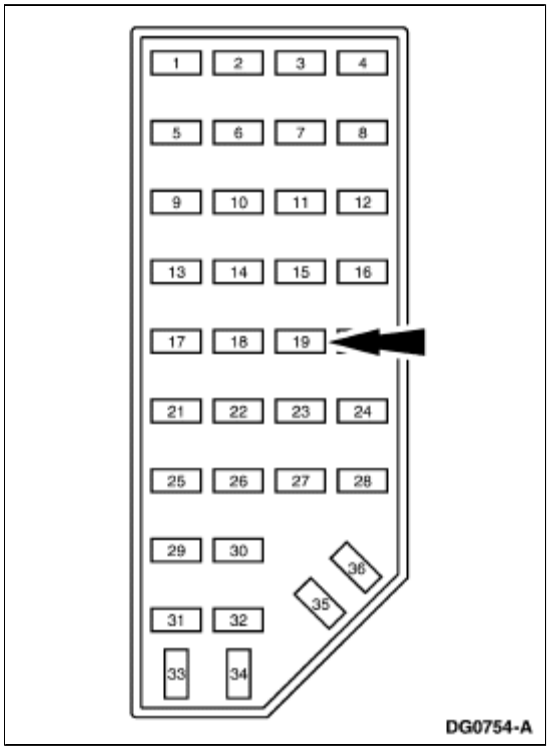


9. **CAUTION: Do not overfill the reservoir.**

   Fill the reservoir.
   - Use Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent.

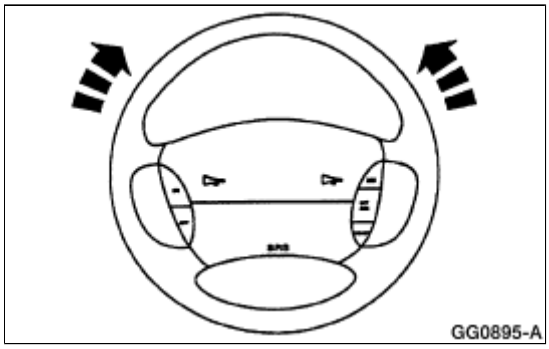


10. Install the ignition coil fuse.



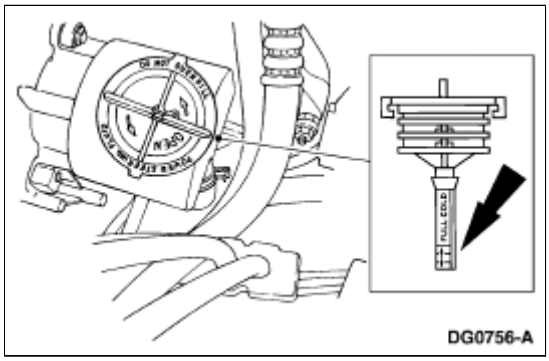
11. **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump could occur.**

    Start the engine and turn the steering wheel from stop-to-stop.



12. **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 power steering fluid level.



Purging

Special Tool(s)

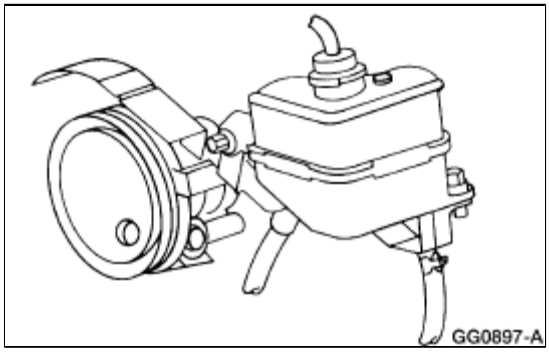
 ST1176-A	Vacuum Pump 416-D002 (D95L-7559-A) or Equivalent

CAUTION: If the air is not purged from the power steering system correctly, premature power steering pump failure could result. The 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.
   - Use Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent.

2. Tightly insert the stopper of the vacuum pump into the reservoir.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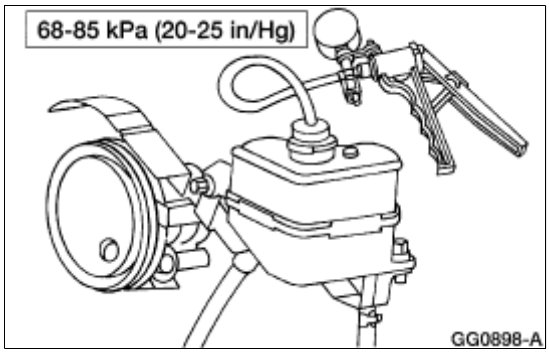
3. Start the vehicle.

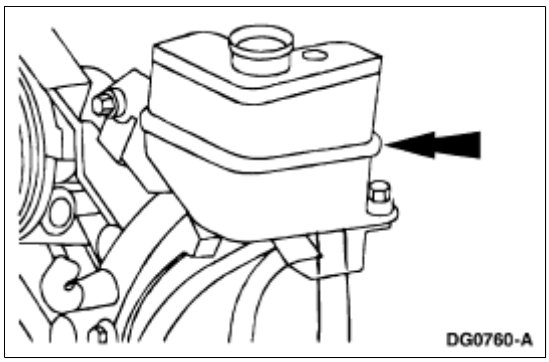
4. Apply maximum vacuum and maintain it for a minimum of three minutes with the engine speed set at idle.



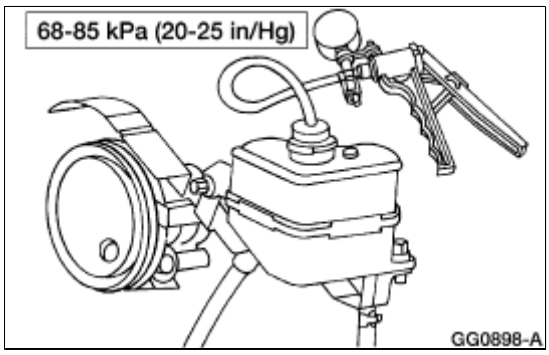
5. Release the vacuum and remove the vacuum pump.

6. **CAUTION: Do not overfill the power steering pump reservoir (3E764).**

   Fill the reservoir.
   - Use Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or MERCON® equivalent.

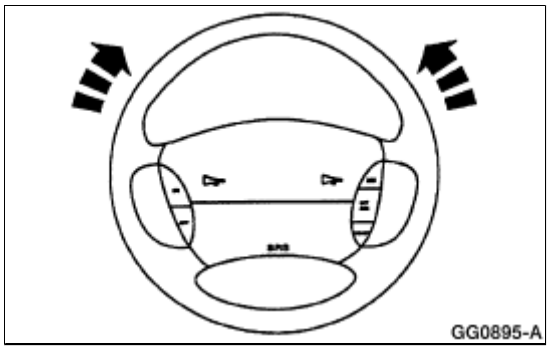


7. Reinstall the vacuum pump. Apply and maintain maximum vacuum.



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 could occur.**

   Cycle the steering wheel fully to the left and right every 30 seconds for approximately five minutes.

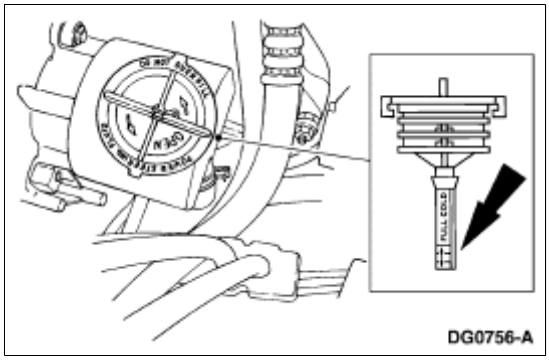


9. Stop the engine, release the vacuum, and remove the vacuum pump.
10. Install the reservoir cap.
11. Check for fluid leaks at all of the connections. If the power steering fluid shows signs of air, repeat this procedure.

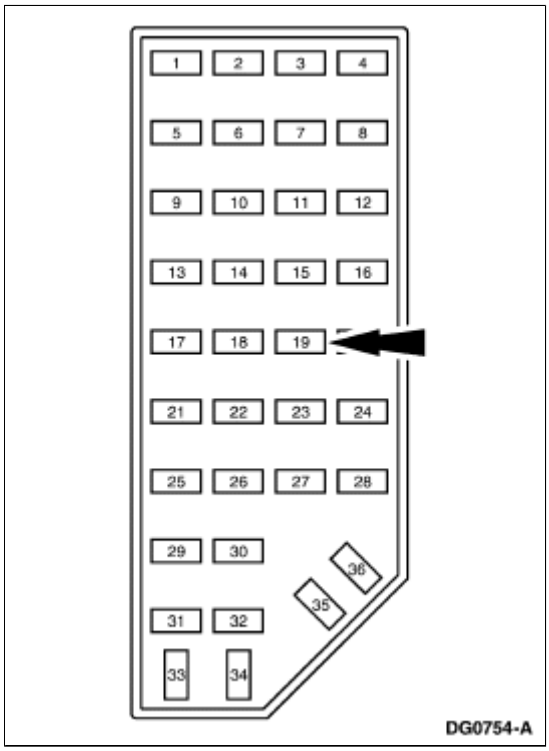
Fill

1. **WARNING: Do not mix oil types, any mixture or any unapproved oil could lead to seal deterioration and leaks. A leak could ultimately cause loss of fluid, which could result in a loss of power steering assist.**

   Fill the reservoir.
   - Use Motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or equivalent meeting Ford Specification MERCON®.



2. Remove the ignition coil fuse to disable the vehicle.

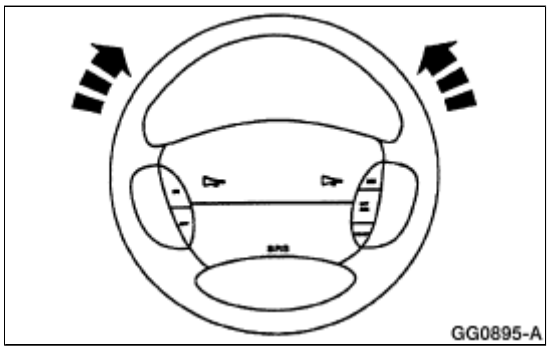


3. Raise the front wheels off the floor; for additional information, refer to Section 100-02 .

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 could occur.

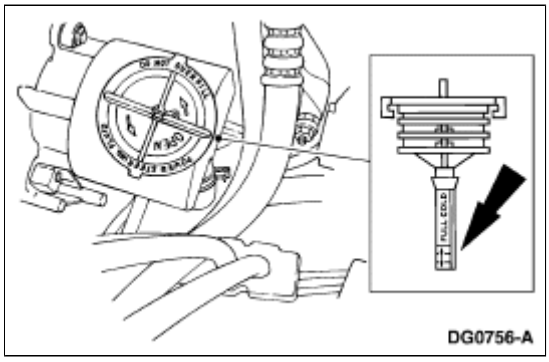
   Turn the steering wheel from stop-to-stop while cranking the engine.



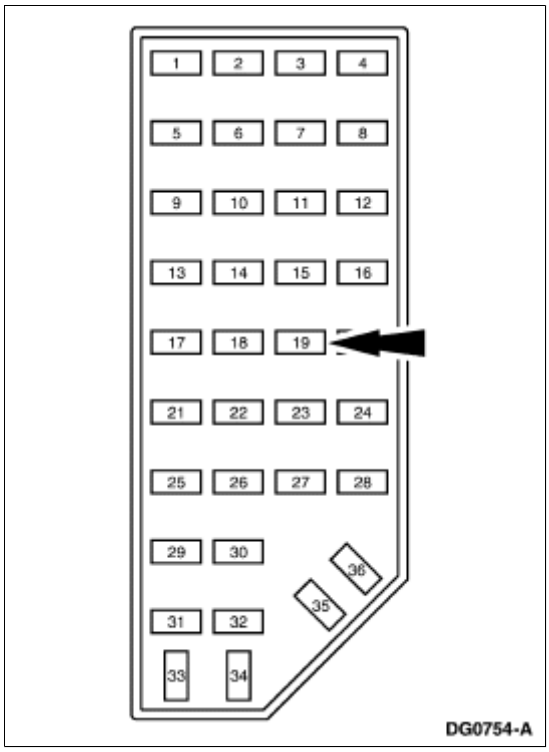
5. Lower the vehicle.

6. **CAUTION: Do not overfill the reservoir.**

   Fill the reservoir.
   - Use motorcraft MERCON® Multi-Purpose ATF XT-2-QDX or equivalent meeting Ford Specification MERCON®.



7. Install the ignition coil fuse.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DG0754-A

General Specifications

Item	Specification
Motorcraft MERCON® ATF	MERCON®

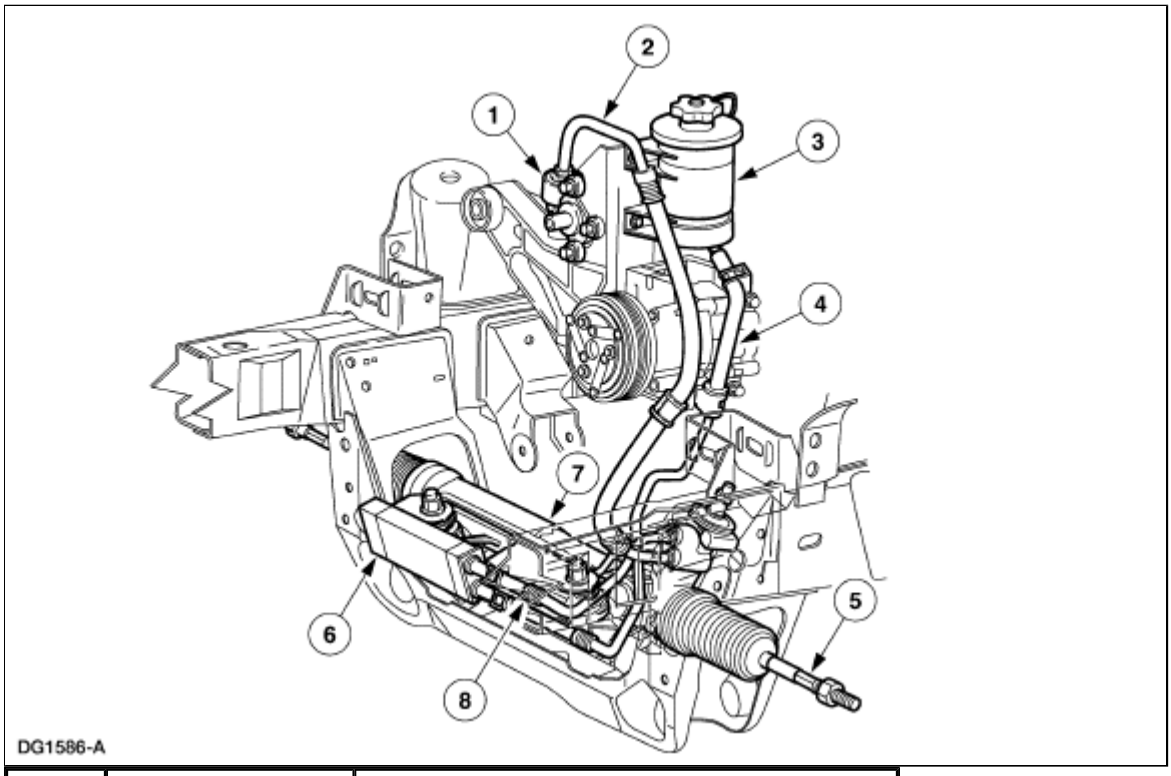
Torque Specifications

Description	Nm	lb-ft
Engine mount nuts (5.0L)	150	111
Front wheel spindle tie-rod ball socket	120	89
Lower intermediate shaft pinch bolt	49	36
Power steering fluid cooler nuts	80	59
Power steering pressure hose to power steering pump (4.0L push rod)	48	35
Power steering pressure hose to power steering pump (5.0L and 4.0L SOHC)	65	48
Power steering pump bolts (4.0L push rod)	48	35
Power steering pump bolts (5.0L and 4.0L SOHC)	25	18
Power steering pump pulley bolts (5.0L and 4.0L SOHC)	25	18
Radiator air deflector bolts	27	20
Steering gear pressure fittings	36	22
Steering gear to crossmember stud bolts and nuts	150	111
Tie-rod end to spindle castellated nuts	90	66
Tie-rod jam nut	80	59

Power Steering

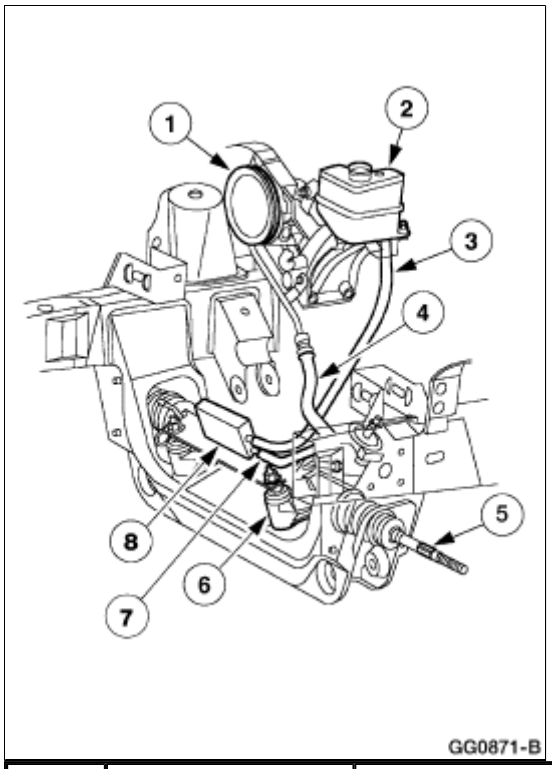
The power steering system is a hydraulic assisted system that reduces the amount of effort required to turn the wheels.

System View — 5.0L Engine



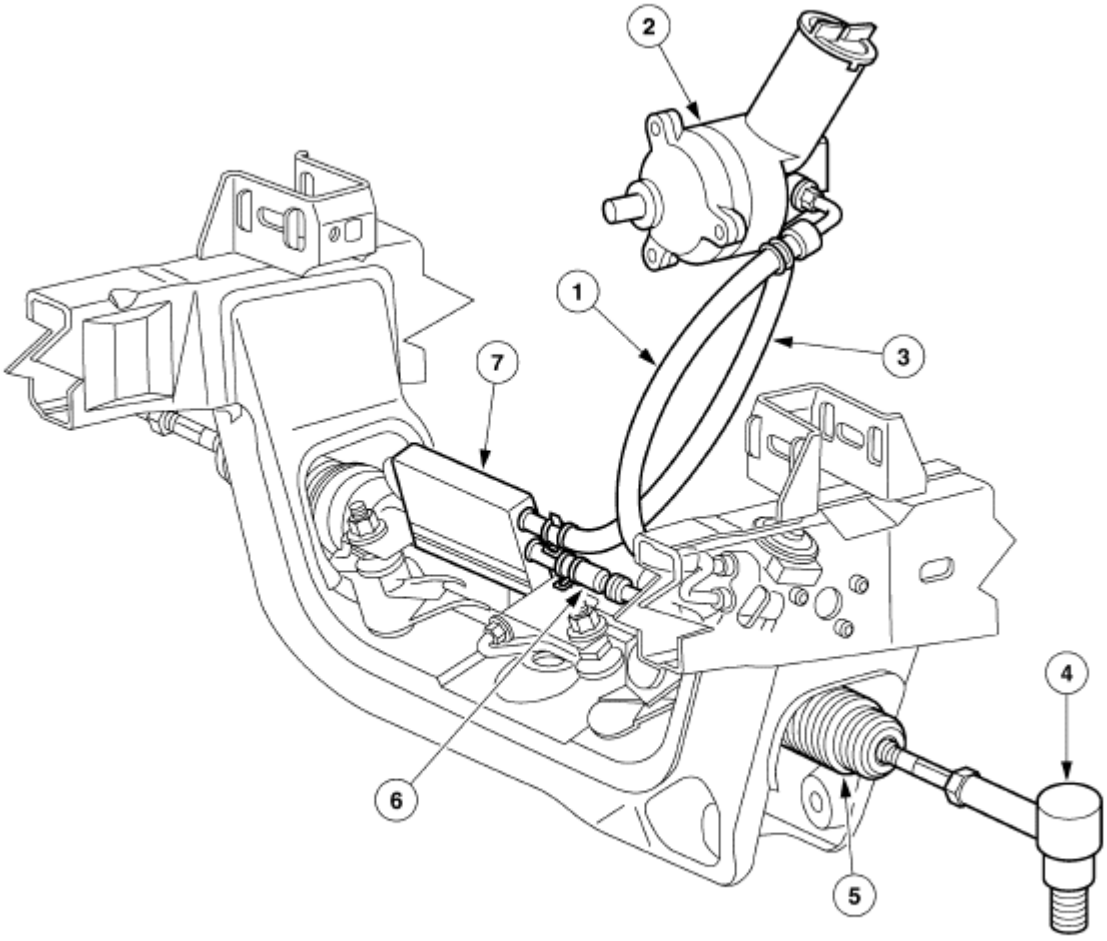
Item	Part Number	Description
1	3A733	Power steering pump pulley
2	3A719	Power steering pressure hose
3	3A697	Power steering oil reservoir
4	3A005	Power steering return line hose
5	3280	Front wheel spindle tie-rod
6	3F780	Power steering fluid cooler
7	3504	Steering gear
8	3A713	Power steering return hose

System View — 4.0L Engine SOHC



Item	Part Number	Description
1	3A733	Power steering pump pulley
2	3A697	Power steering fluid reservoir
3	3A005	Power steering return line hose
4	3A719	Power steering pressure hose
5	3280	Front wheel spindle tie-rod
6	3504	Steering gear
7	3A713	Power steering return hose
8	3F780	Power steering fluid cooler

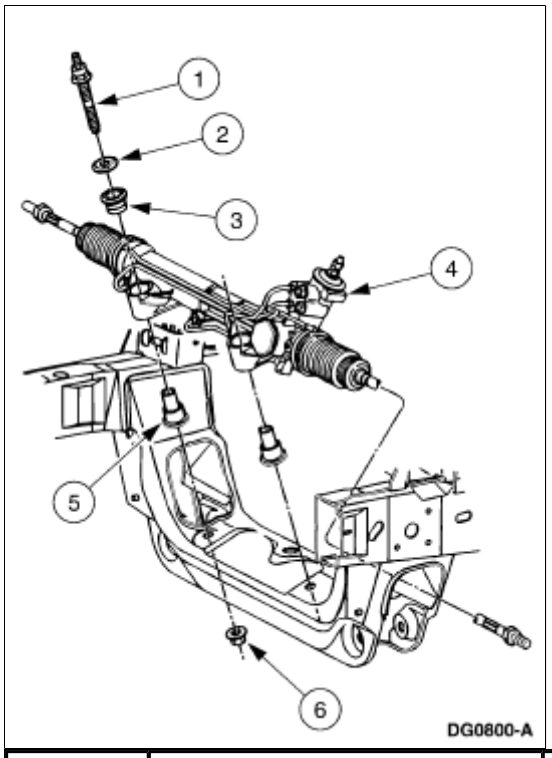
System View — 4.0L Engine (Push Rod)



DG1634-A

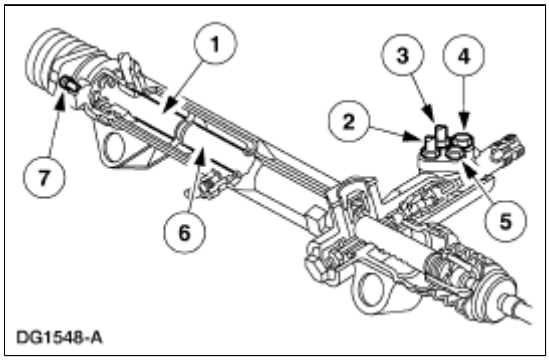
Item	Part Number	Description
1	3A719	Power steering pressure hose
2	3A674	Power steering pump
3	3A005	Power steering return line hose
4	3A130	Tie-rod end
5	3504	Steering gear
6	3A713	Power steering return hose
7	3F780	Power steering fluid cooler

Steering Gear Mounting



Item	Part Number	Description
1	N811762-S60	Stud
2	385935-S36	Washer
3	3K576	Insulator
4	3504	Steering gear
5	3F638	Insulator
6	N8086255-S60	Nut

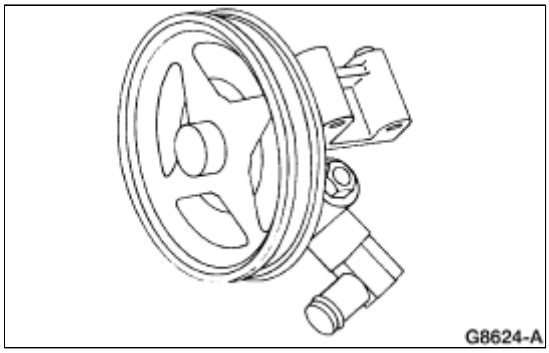
Steering Gear



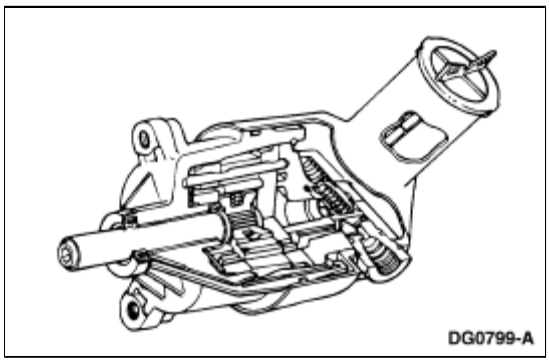
Item	Description
1	Oil flow — left turn
2	To left turn port
3	To right turn port

4	Return port (out)
5	Pressure port (in)
6	Oil flow — right turn
7	Air transfer tube (between bellows)

Power Steering Pump — 4.0L (SOHC) and 5.0L Engines



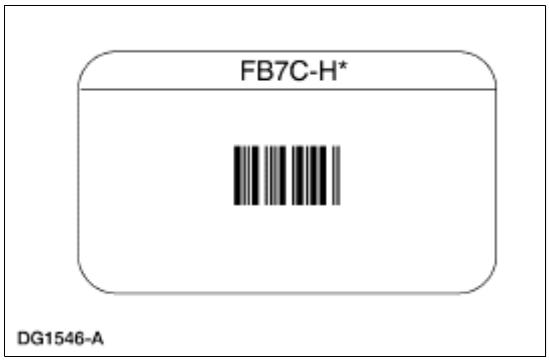
Power Steering Pump — 4.0L Engine (Push Rod)



Steering Gear Identification

CAUTION: Always use the ID code when ordering service parts.

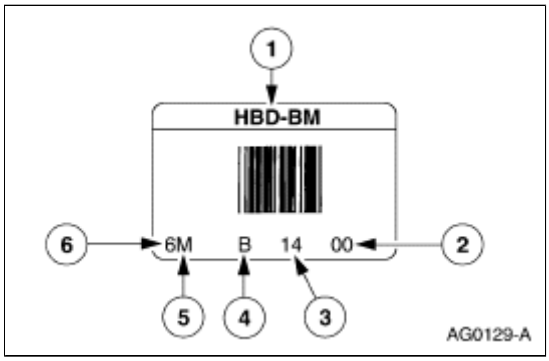
The steering gear identification code is located on a tag attached to the steering gear.



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.



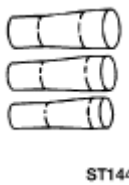
Item	Description
1	Model code
2	For manufacturing purposes only
3	Day of the month
4	Shift
5	Month
6	Year

Power Steering

Refer to Section 211-00 .

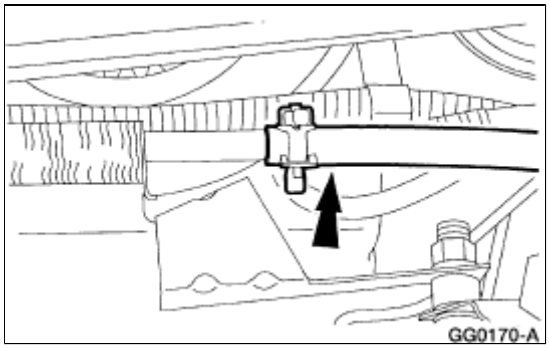
Pump —5.0L Engine

Special Tool(s)

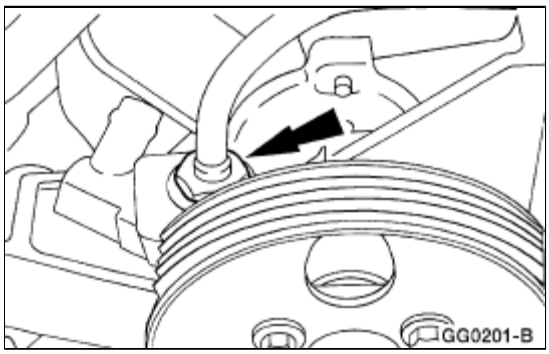
 ST1444-A	Teflon Seal Replacer Set 211-D027 (D90P-3517-A) or Equivalent

Removal

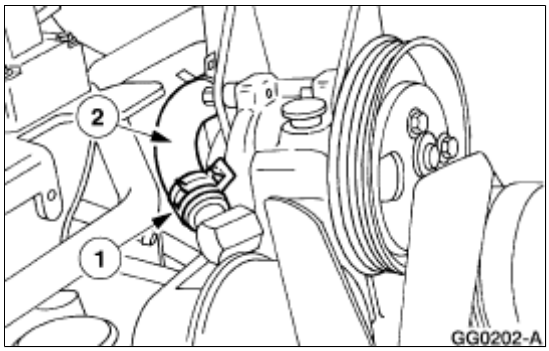
1. Remove the drive belt (8620). For additional information, refer to Section 303-05 .
2. Disconnect the power steering return line hose at the power steering fluid cooler (3F780).
   - Drain the power steering oil reservoir (3A697).



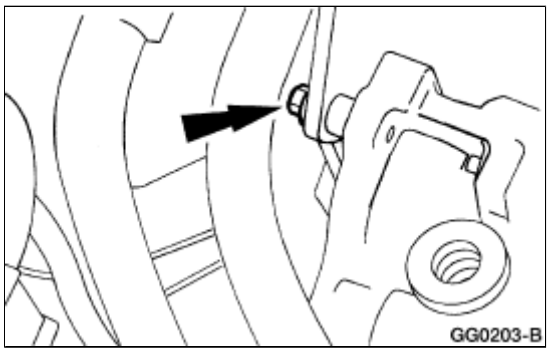
3. Disconnect the power steering pressure hose (3A719) from the power steering pump (3A674).



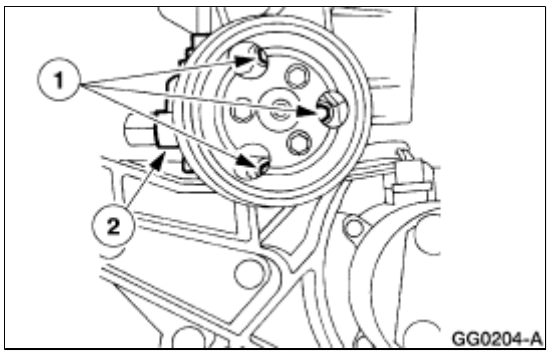
4. Disconnect the power steering oil reservoir outlet hose from the power steering pump.
   1. Compress and move the power steering oil reservoir outlet hose clamp.
   2. Disconnect the power steering oil reservoir outlet hose from the power steering pump.



5. Remove the rear bolt.

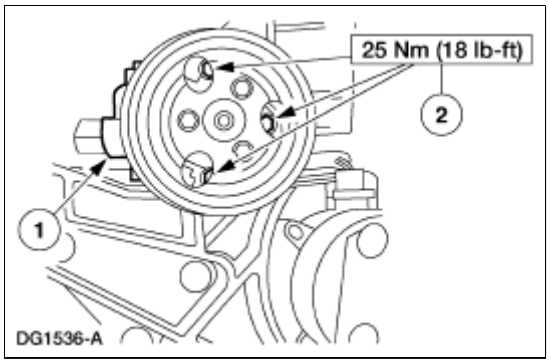


6. Remove the power steering pump.
    1. Remove the three front bolts.
        - Rotate the pulley to access each bolt.
    2. Remove the power steering pump.

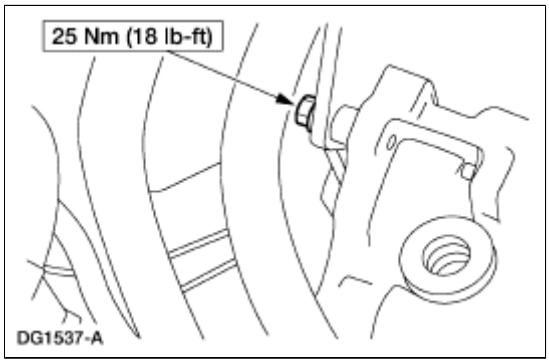


Installation

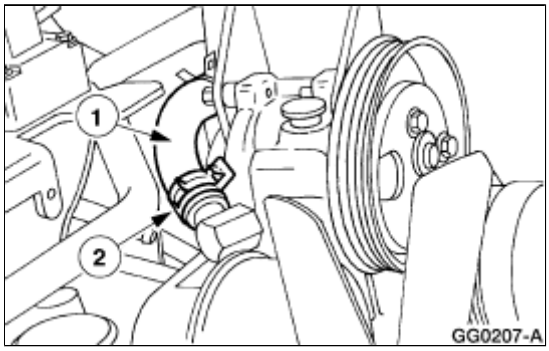
1. Install the power steering pump.
    1. Position the power steering pump.
    2. Install the three front bolts.
        - Rotate the pulley to access each bolt.



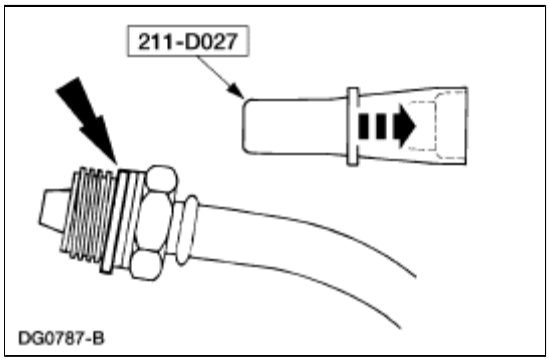
2. Install the rear bolt.



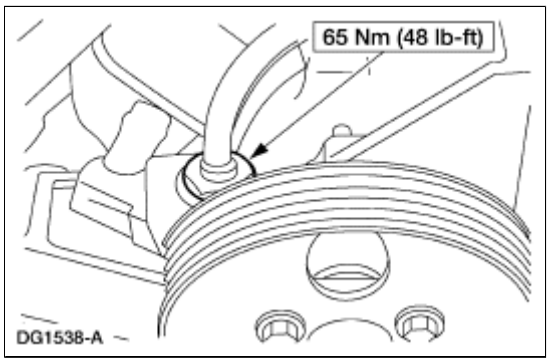
3. Connect the power steering oil reservoir outlet hose to the power steering pump.
    1. Connect the power steering oil reservoir outlet hose to the power steering pump.
    2. Compress and move the power steering oil reservoir outlet hose clamp.



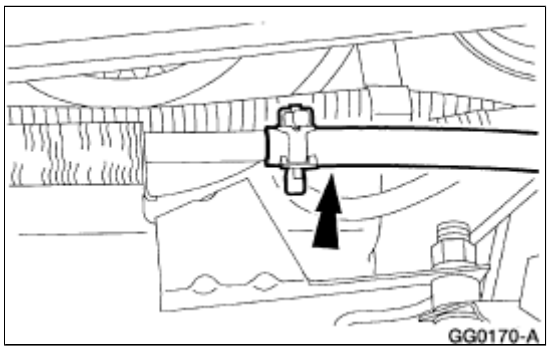
4. Using the special tool, install a new seal on the power steering pressure hose.



5. Connect the power steering pressure hose to the power steering pump.



6. Connect the power steering return line hose to the power steering fluid cooler.

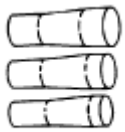


7. Install the drive belt. For additional information, refer Section 303-05 .

8. Fill, and leak check the system. For additional information, refer to Section 211-00 .

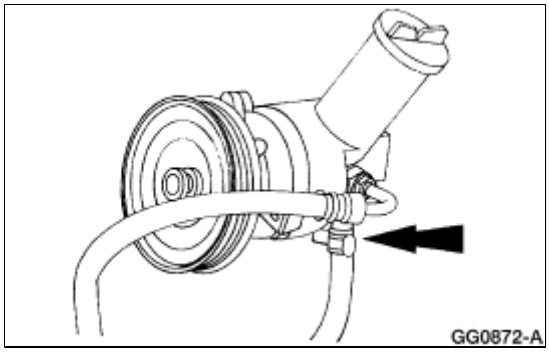
Pump —4.0L Engine (Push Rod)

Special Tool(s)

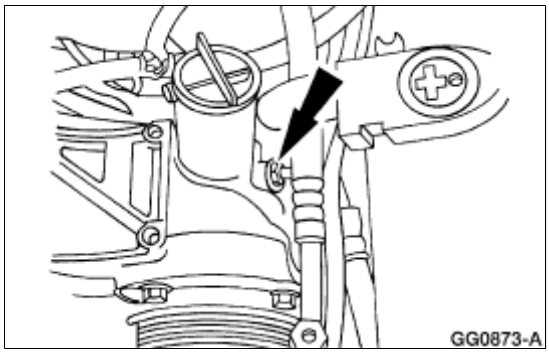
	Steering Pump Pulley Remover 211-016 (T69L-10300-B)
	Steering Pump Pulley Replacer 211-009 (T65P-3A733-C)
 ST1444-A	Teflon Seal Replacer Set 211-D027 (D90P-3517-A) or Equivalent

Removal

1. Remove the drive belt (8620). For additional information, refer to Section 303-05 .
2. Remove the engine cooling fan. For additional information, refer to Section 303-03 .
3. Disconnect the power steering return line hose at the power steering pump (3A674).
   - Allow the system to drain.

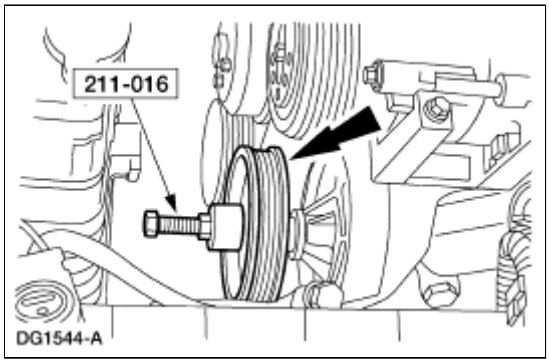


4. Disconnect the power steering pressure hose (3A719) from the power steering pump.

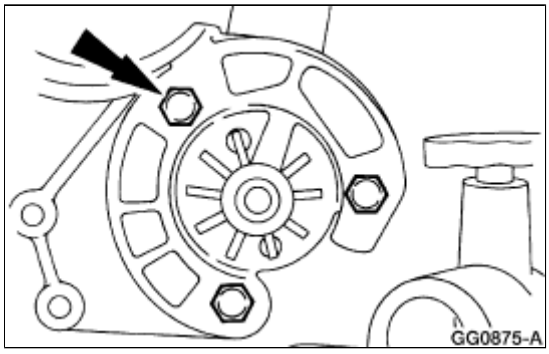


5. **CAUTION: Do not apply pressure on the power steering pump rotor shaft. Pressure will damage internal thrust areas of the power steering pump.**

   Using the special tool, remove the power steering pump pulley (3A733).
   - Inspect the pulley for paint marks in the web area near the hub. If there are two paint marks, discard the 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.

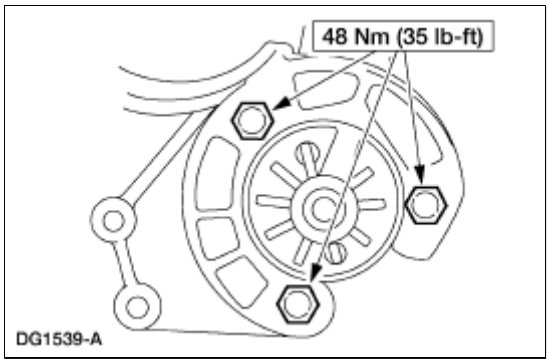


6. Remove the bolts and the power steering pump.



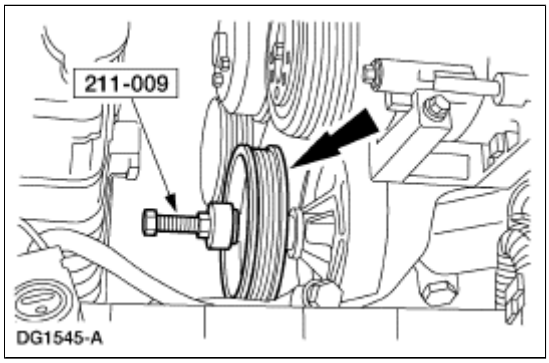
Installation

1. Position the power steering pump and install the bolts.

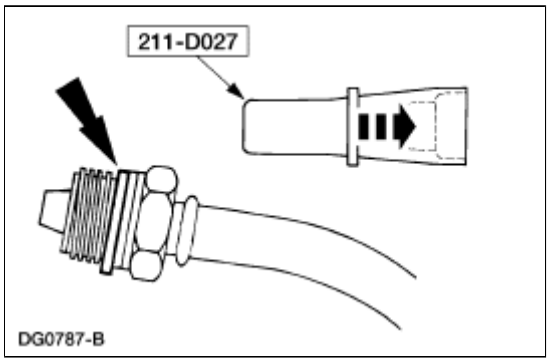


2. **CAUTION: Install a new power steering pump pulley after it has been removed and installed two times.**

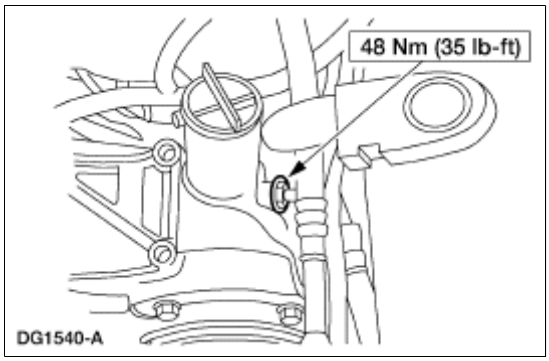
   Using the special tool, install the power steering pump pulley.
   - Inspect the pulley for paint marks in the web area near the hub. If there are two paint marks, discard the pulley. If there is no paint or one paint mark, use a paint pencil to mark the web area of the pulley near the hub.



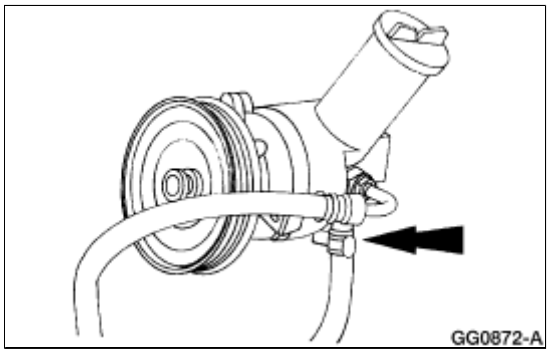
3. Using the special tool, install a new seal on the power steering pressure hose.



4. Connect the power steering pressure hose to the power steering pump.



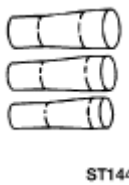
5. Connect the power steering return line hose at the power steering pump.



6. Install the engine cooling fan. For additional information, refer to Section 303-03 .
7. Install the drive belt. For additional information, refer to Section 303-05 .
8. Fill and leak check the system. For additional information, refer to Section 211-00 .

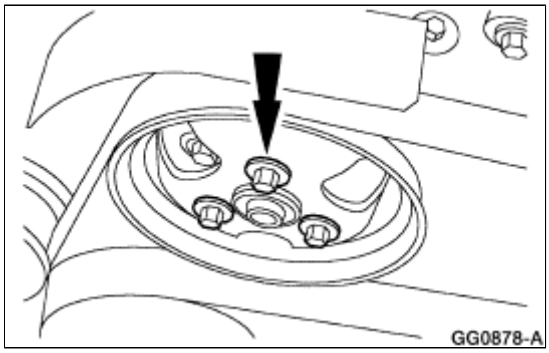
Pump —4.0L Engine (SOHC)

Special Tool(s)

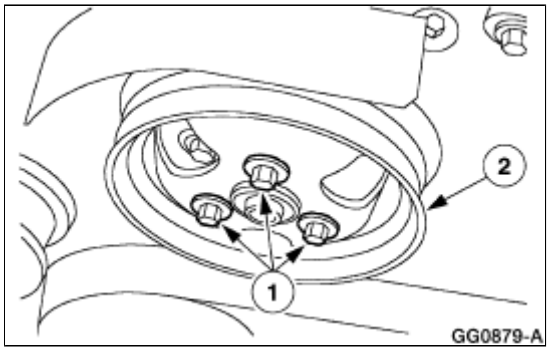
 ST1444-A	Teflon Seal Replacer Set 211-D027 (D90P-3517-A) or Equivalent

Removal

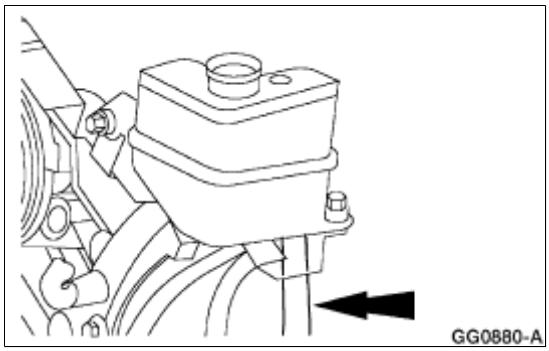
1. Remove the engine cooling fan. For additional information, refer to Section 303-03 .
2. Loosen the power steering pump pulley bolts.



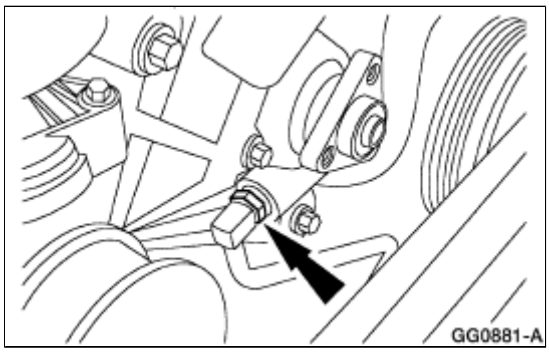
3. Remove the drive belt (8620). For additional information, refer to Section 303-05 .
4. Remove the power steering pump pulley (3A733).
    1. Remove the bolts.
    2. Remove the power steering pump pulley.



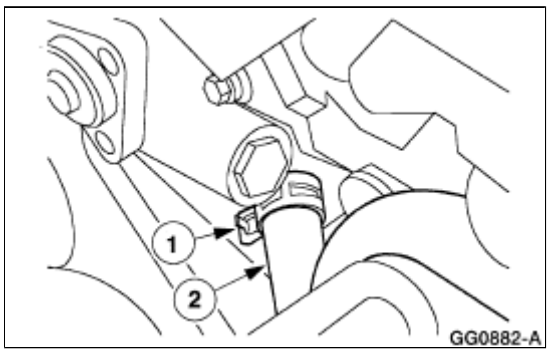
5. Disconnect the power steering return line hose at the power steering fluid reservoir.
    - Allow the system to drain.



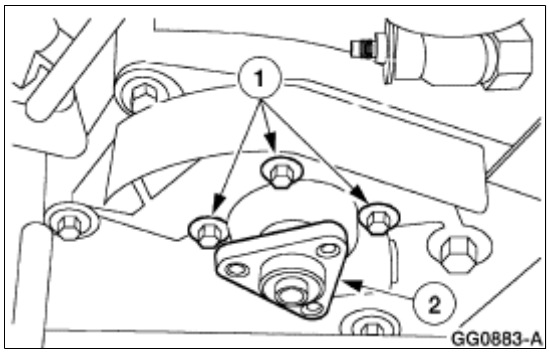
6. Disconnect the power steering pressure hose (3A719) from the power steering pump (3A674).



7. Disconnect the power steering fluid reservoir outlet hose from the power steering pump.
    1. Compress and move the power steering fluid reservoir outlet hose clamp.
    2. Disconnect the power steering fluid reservoir outlet hose from the power steering pump.

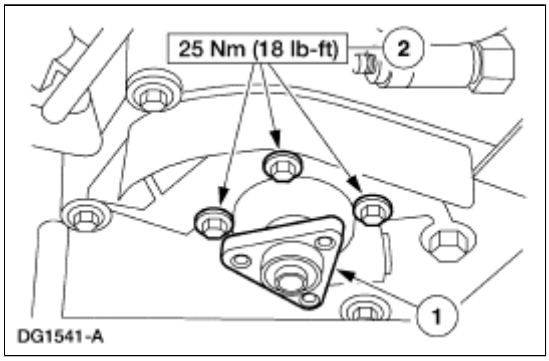


8. Remove the power steering pump.
    1. Remove the bolts.
    2. Remove the power steering pump.

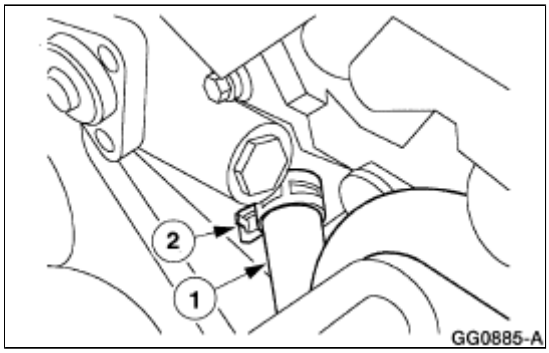


Installation

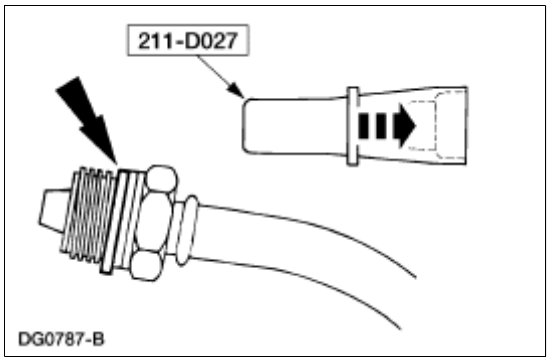
1. Install the power steering pump.
    1. Position the power steering pump.
    2. Install the bolts.



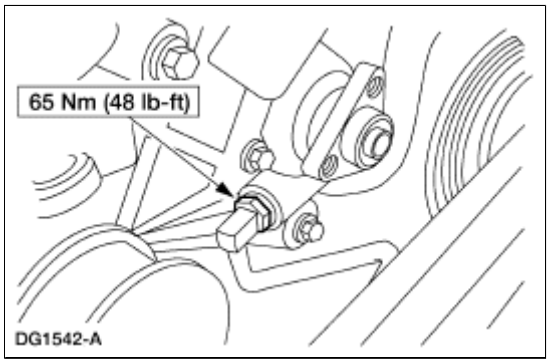
2. Connect the power steering fluid reservoir outlet hose to the power steering pump.
    1. Connect the power steering fluid reservoir outlet hose to the power steering pump.
    2. Compress and move the power steering fluid reservoir outlet hose clamp into place.



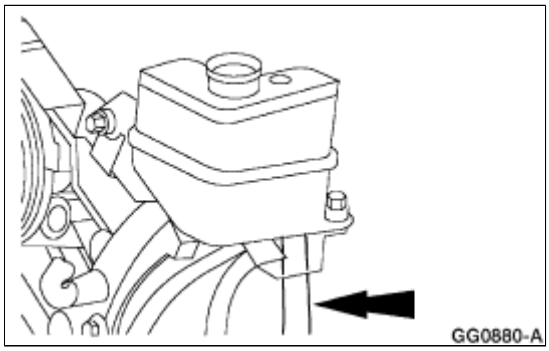
3. Using the special tool, install a new seal on the power steering pressure hose.



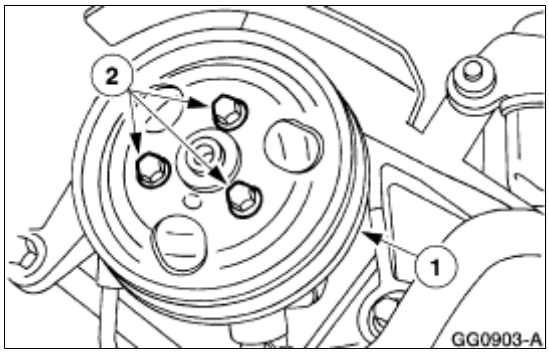
4. Connect the power steering pressure hose to the power steering pump.



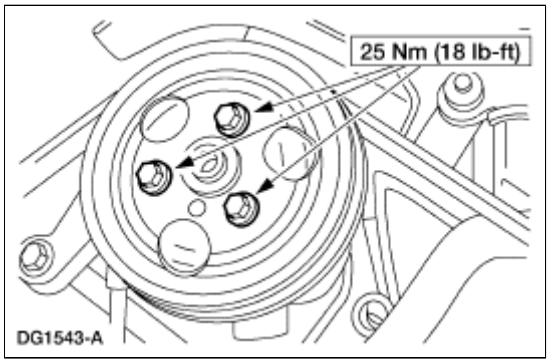
5. Connect the power steering return line hose to the power steering fluid reservoir.



6. Install the power steering pump pulley.
    1. Position the power steering pump pulley.
    2. Install the bolts.



7. Install the drive belt. For additional information, refer to Section 303-05 .
8. Tighten the power steering pump pulley bolts.

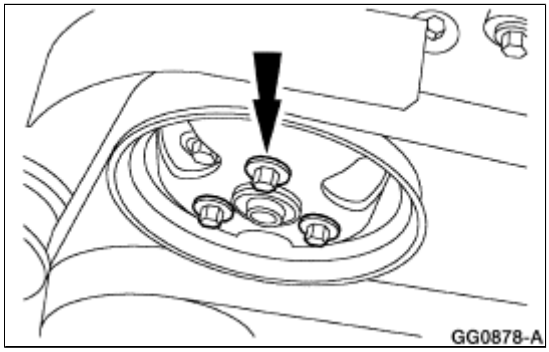


9. Install the engine cooling fan. For additional information, refer to Section 303-03 .
10. Fill, and leak check the system. For additional information, refer to Section 211-00 .

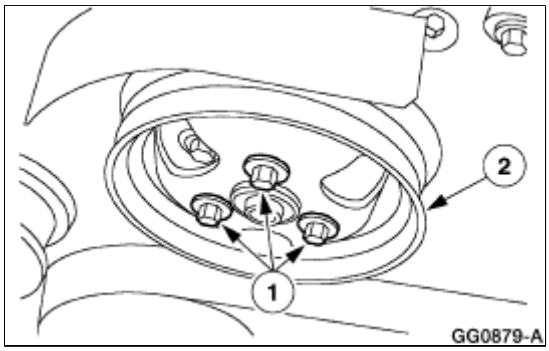
Pulley —Pump, 5.0L Engine and 4.0L Engine (SOHC)

Removal

1. Remove the engine cooling fan. For additional information, refer to Section 303-03 .
2. Loosen the power steering pump pulley bolts.

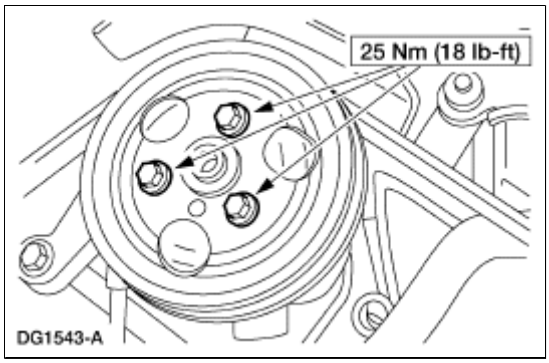


3. Remove the drive belt (8620). For additional information, refer to Section 303-05 .
4. Remove the power steering pump pulley (3A733).
    1. Remove the bolts.
    2. Remove the power steering pump pulley.



Installation

1. Follow the removal procedure in reverse order.


25 Nm (18 lb-ft)
DG1543-A

Hose

Special Tool(s)

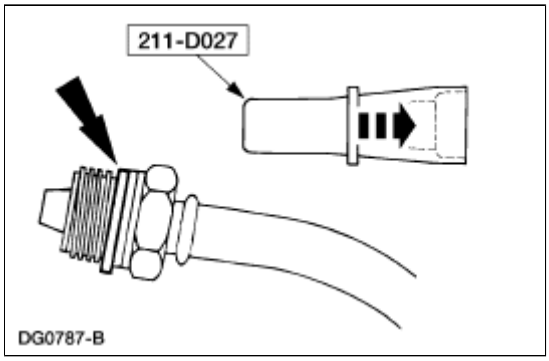
 ST1444-A	Teflon Seal Replacer Set 211-D027 (D90P-3517-A) or Equivalent

Removal

1. Refer to the System View illustration in Description and Operation for the hose routing and retention points.

Installation

1. 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.

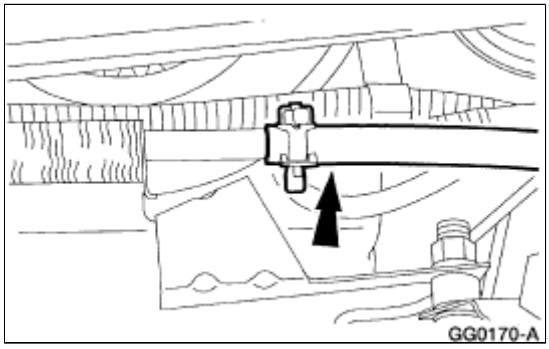


2. Fill and leak check the system. For additional information, refer to Section 211-00 .

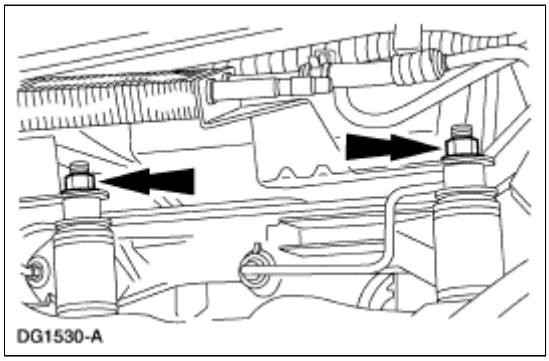
Cooler —Fluid

Removal

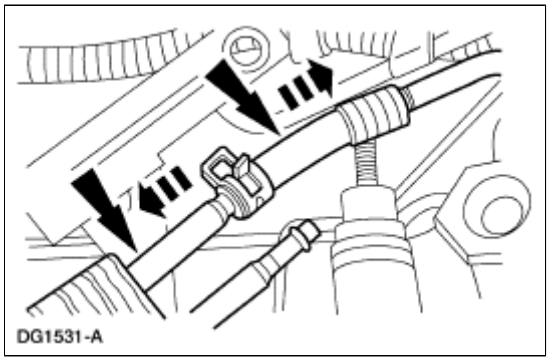
1. Disconnect the power steering return line hose (3A005) at the power steering fluid cooler (3F780).
   - Allow the system to drain.



2. Remove the power steering fluid cooler to crossmember nuts.

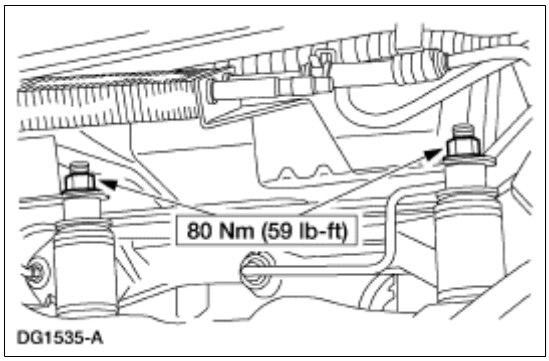


3. Disconnect the power steering return hose (3A713). Remove the power steering fluid cooler.



Installation

1. Follow the removal procedure in reverse order.



2. Fill, and leak check the system. For additional information, refer to Section 211-00 .

Gear —4.0L

Removal

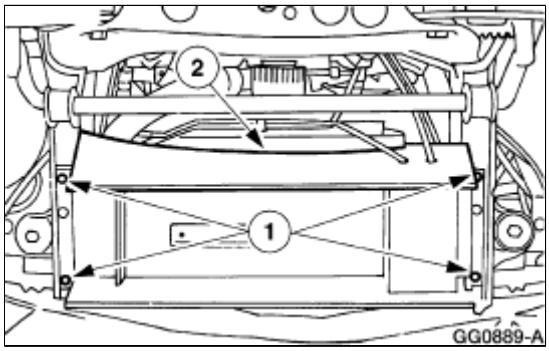
1. Place front wheels in the straight ahead position. Do not lock the steering column.

2. **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 located in the rear jack storage area. 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.**

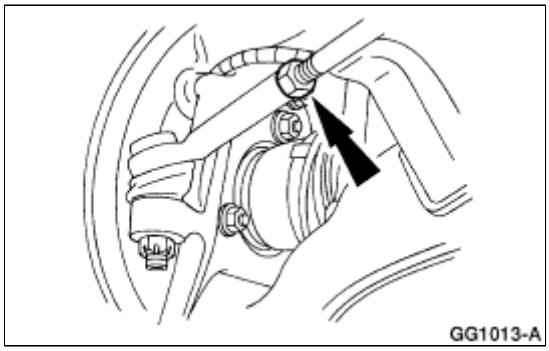
   Raise the vehicle. For additional information, refer to Section 100-02 .

3. Remove the front wheel and tire assemblies. For additional information, refer to Section 204-04 .

4. Remove the radiator air deflector (8327).
   1. Remove the bolts.
   2. Remove the radiator air deflector.

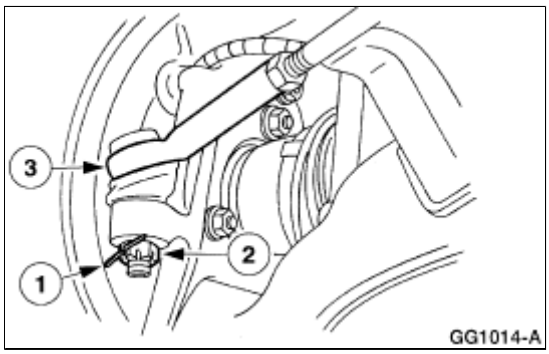


5. Loosen the LH tie-rod end jam nut.

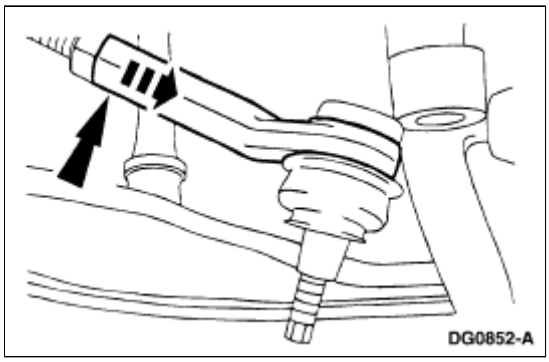


6. Disconnect the tie-rod ends (3A131).
   1. Remove and discard the cotter pins.
   2. Remove the castellated nuts.
   3. Disconnect the tie-rod ends from the steering knuckles.

- Do not damage the tie-rod end boots.

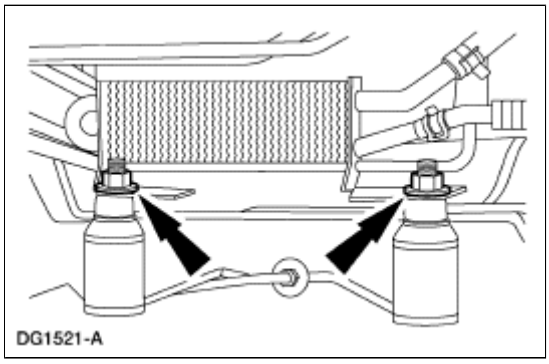


7. Remove the LH tie-rod end.
   - Count and record the number of turns required to remove the tie-rod end.

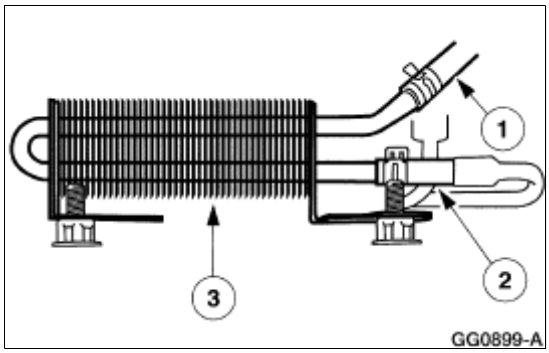


8. Remove the front stabilizer bar (5482). For additional information, refer to Section 204-01A .
   - Mark the driver side end of the stabilizer bar for correct installation.

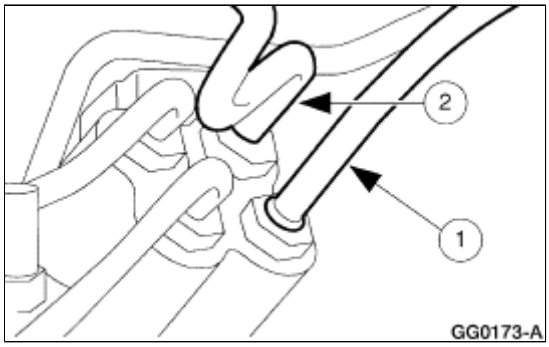
9. Remove the power steering cooler to crossmember nuts.



10. Remove the power steering fluid cooler (3F780).
    1. Separate the power steering fluid return hose (3A713) from the power steering fluid cooler.
       - Allow the system to drain.
    2. Disconnect the power steering return line hose (3A005).
    3. Remove the power steering fluid cooler.

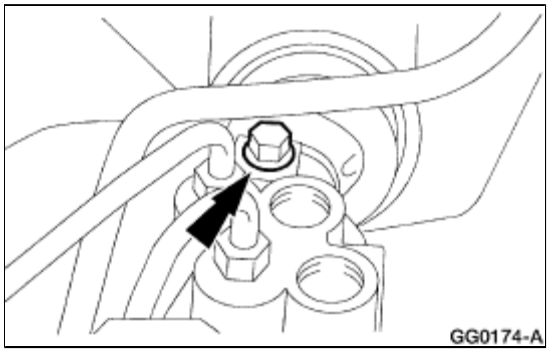


11. Disconnect the lines at the gear.
    1. Disconnect the power steering pressure hose (3A719).
    2. Disconnect the power steering return hose.



12. Plug ends of fluid lines and ports in steering gear to prevent damage and entry of dirt.

13. Rotate the steering column shaft to access the intermediate shaft pinch bolt. Remove the pinch bolt.



14. Lower the vehicle.

15. Turn the steering wheel back to the straight ahead position. Turn the ignition key to the locked position.

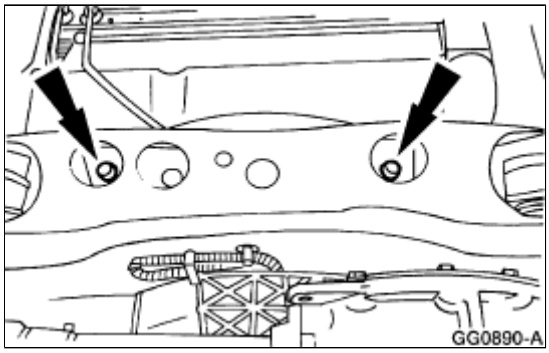
16. Raise the vehicle.

17. **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.**

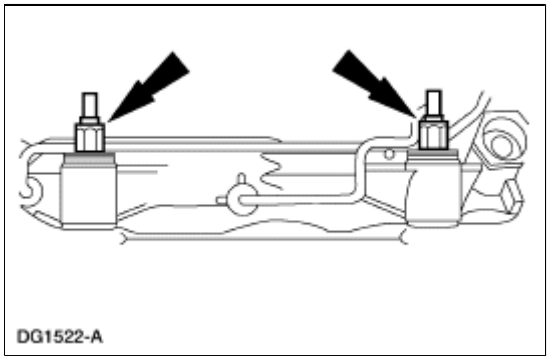
    Disconnect the intermediate shaft from the steering gear input shaft.

18. **CAUTION: Hold the tops of the steering gear to crossmember stud bolts to avoid damaging the steering gear fluid transfer tubes.**

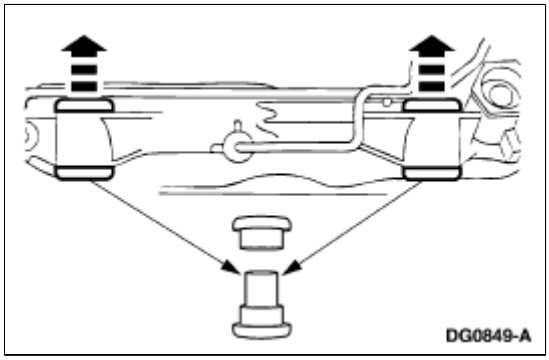
    Remove the nuts.



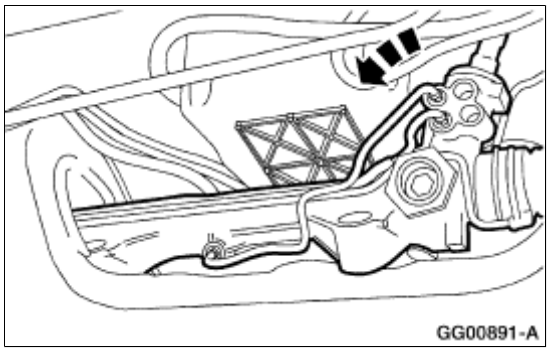
19. Remove the stud bolts and washers.



20. Remove the steering gear to crossmember insulator bushings.

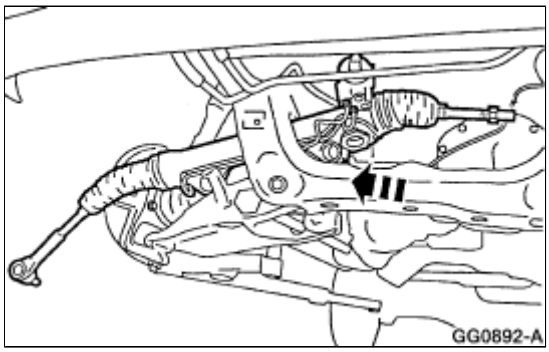


21. Rotate the steering gear control valve housing toward the front of the vehicle.

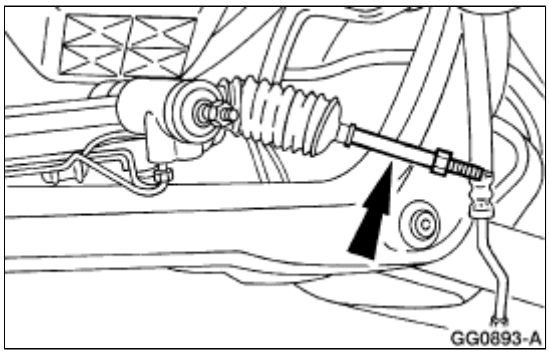


22. Turn the steering gear input shaft to the right until the stop is reached.

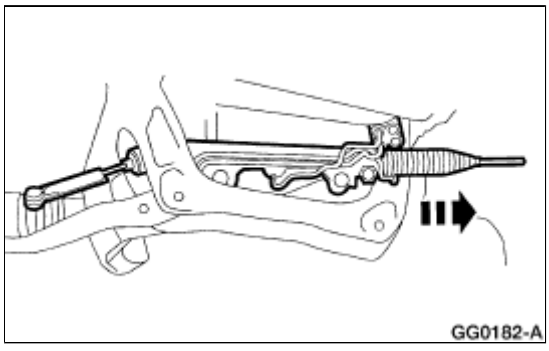
23. Move the steering gear (3504) as far to the RH side of the vehicle as possible.



24. Move the LH front wheel spindle tie-rod (3280) forward to clear the frame crossmember.

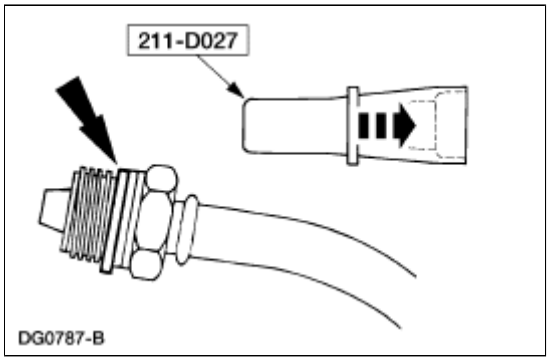


25. Remove the steering gear from the vehicle.



Installation

1. Using the special tool, install new seals on the power steering return hose and power steering pressure hose.



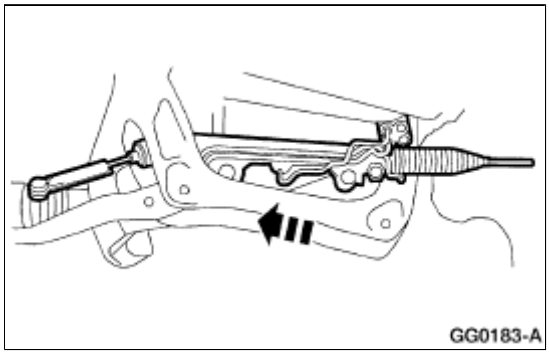
2. **NOTE:** Make sure the steering gear input shaft is turned to the left until the stop is reached.

   NOTE: Handle the steering gear with caution to avoid damage to the fluid transfer tubes and to avoid dimples in the tie-rod boots.

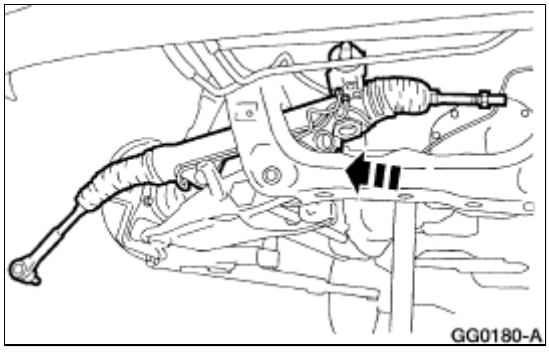
   Turn the steering gear input shaft to the right until the stop is reached. Note the number of turns.

3. **NOTE:** Make sure the steering gear control valve housing is turned toward the front of the vehicle.

   Install the steering gear into the RH opening of the crossmember.

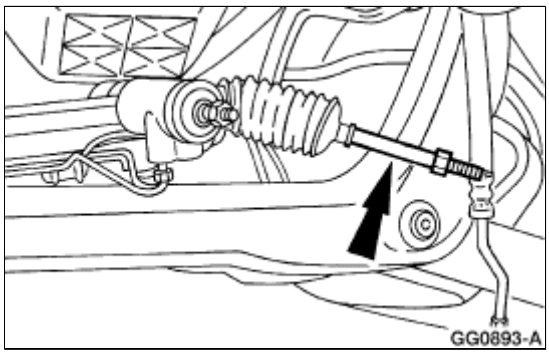


4. Move the steering gear as far to the RH side of the vehicle as possible.



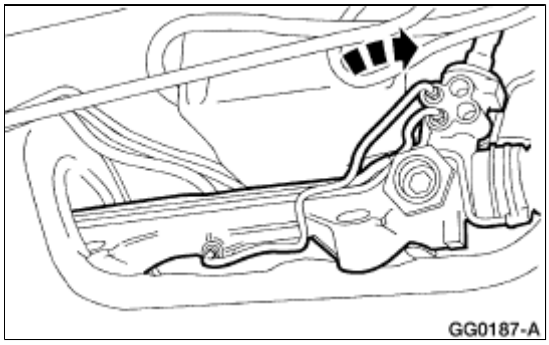
5. Move the LH front wheel spindle tie-rod into the opening in the crossmember and move the steering

gear into position.

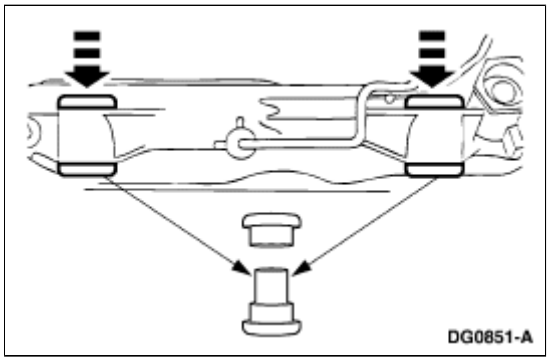


6. To place the steering gear in the straight ahead position, turn the steering gear input shaft to the left by half the number of turns recorded previously.

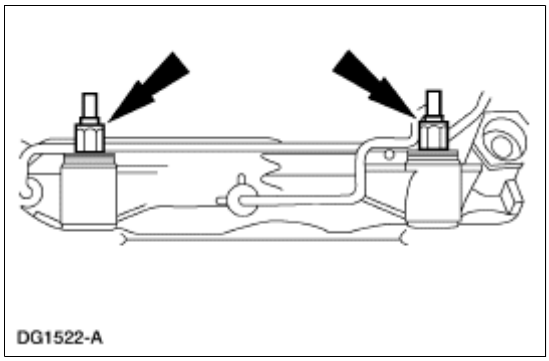
7. Rotate the steering gear control valve housing toward the rear of the vehicle.



8. Install the steering gear to crossmember insulator bushings as shown.
   - The large end of the metal sleeve must be positioned downward.
   - Check that the mounting surfaces on the crossmember are clean and free of debris.

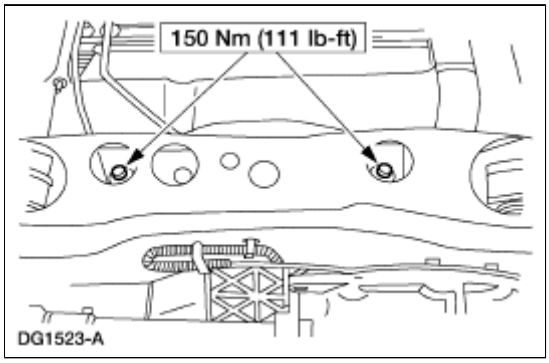


9. Install the steering gear to crossmember washers and stud bolts.
   - For additional information on correct mounting hardware orientation, refer to Power Steering in the Description and Operation portion of this section.
   - The dished side of the washers face down.



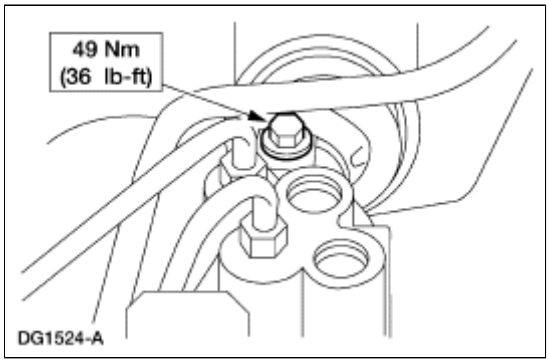
10. **CAUTION: Hold the tops of the steering gear to crossmember stud bolts to avoid damaging the steering gear fluid transfer tubes.**

    Install the nuts.

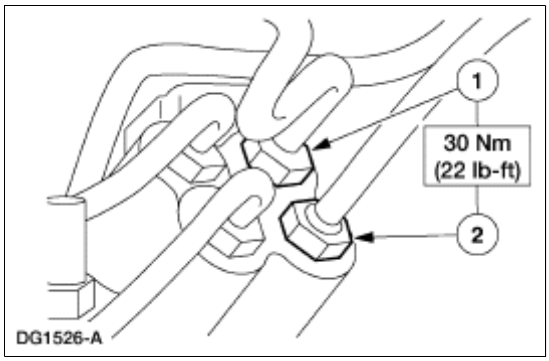


11. **CAUTION: Do not rotate the steering wheel when the lower steering column shaft is disconnected or damage to the air bag sliding contact will result.**

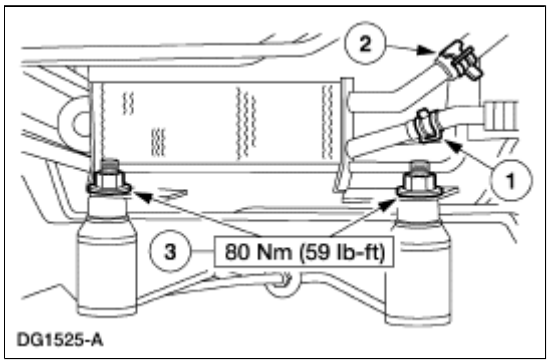
    Connect the intermediate shaft to the steering gear input shaft. Install the pinch bolt.



12. Install the steering gear fluid lines.
    1. Install the power steering return hose and then tighten tube nut.
    2. Install the power steering pressure hose and tighten the tube nut.

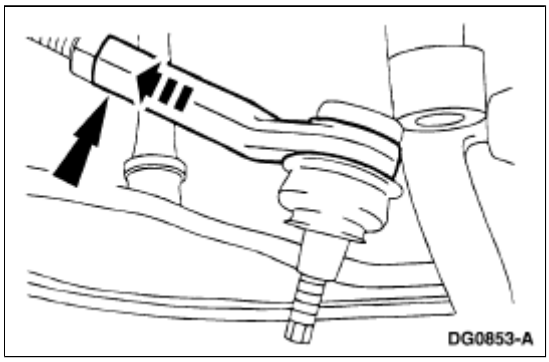


13. Install the power steering fluid cooler.
    1. Connect the power steering return line hose.
    2. Connect the power steering return hose.
    3. Position the power steering fluid cooler and install the nuts.

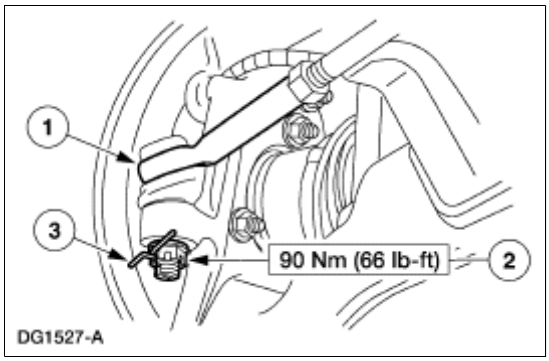


14. Install the front stabilizer bar. For additional information, refer to Section 204-01A .
    - Orientate the front stabilizer bar as noted during removal.

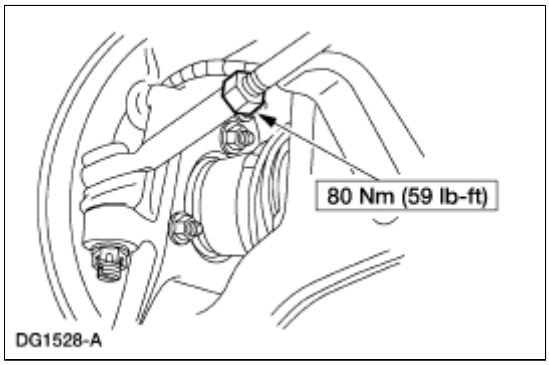
15. Install the LH tie-rod end on the front wheel spindle tie-rod.
    - Rotate the tie-rod end the number of turns recorded during removal.



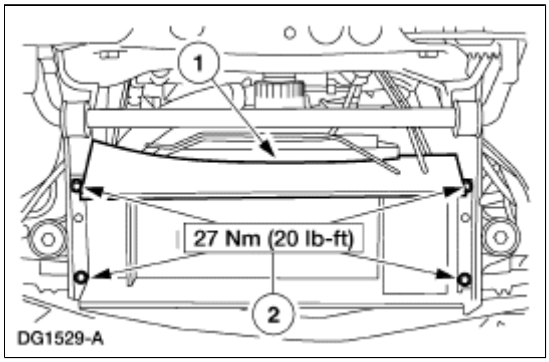
16. Connect the tie-rod ends to the steering knuckles.
    1. Position the tie-rod ends on the steering knuckles.
    2. Install the castellated nuts.
    3. Install the new cotter pins.
    - Check that the brake dust shields are not bent and are not in contact with the outer tie-rod boot seals.



17. Tighten the tie-rod jam nuts.



18. Install the radiator air deflector.
    1. Position the radiator air deflector.
    2. Install the bolts.



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

20. **NOTE:** If equipped with air suspension, reactivate the system by turning on the air suspension switch.

    Lower the vehicle.

21. Fill and leak check the power steering system. For additional information, refer to Section 211-00 .

22. Check the wheel alignment. For additional information, refer to Section 204-00 .

Gear —5.0L

Removal

1. Place the front wheels in the straight ahead position. Do not lock the steering column.

2. **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 located in the rear jack storage area. 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.**

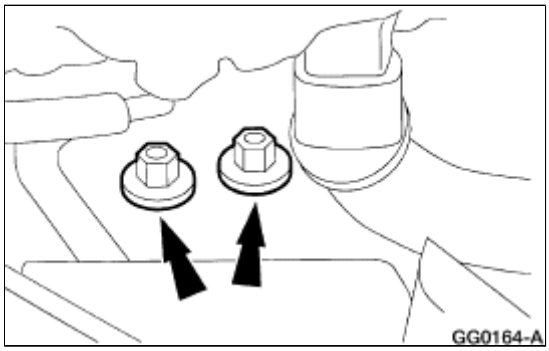
   Raise the vehicle. For additional information, refer to Section 100-02 .

3. Remove the engine oil cooler. For additional information, refer to Section 303-01C .

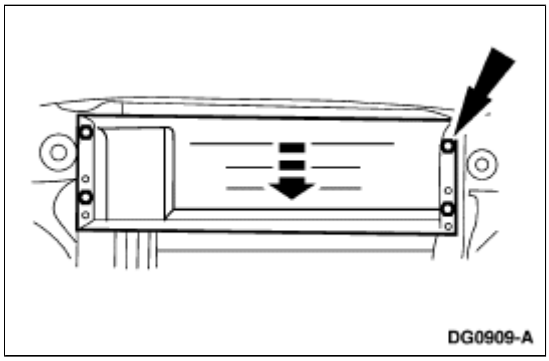
4. Remove the front wheel and tire assemblies. For additional information, refer to Section 204-04 .

5. Remove the inner fender splash shields.

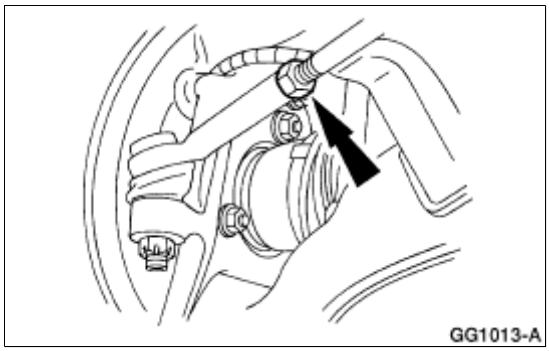
6. Remove the top motor mount nuts.



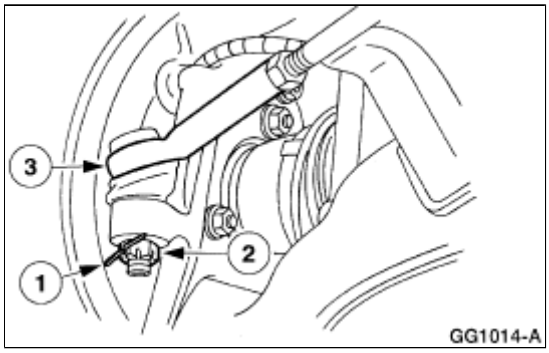
7. Remove the bolts and the radiator air deflector (8327).



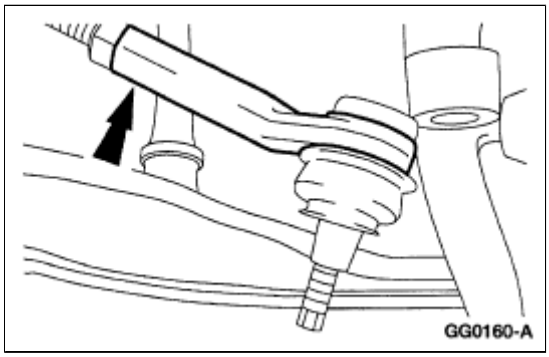
8. Loosen the LH tie-rod end jam nuts.



9. Disconnect the tie-rod ends (3A131).
    1. Remove and discard the cotter pins.
    2. Remove the castellated nuts.
    3. Separate the tie-rod ends from the steering knuckles. Do not damage the tie-rod end seals.

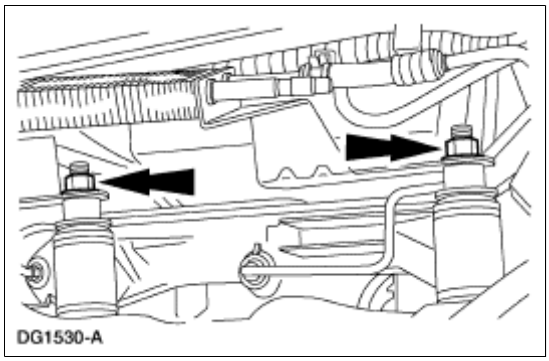


10. Remove the LH tie-rod end.
    - Count and record the number of turns required to remove the LH tie-rod end.

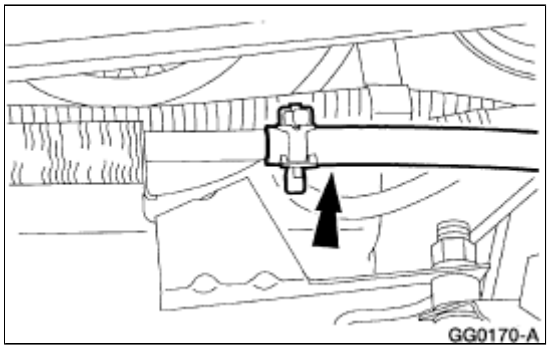


11. Remove the front stabilizer bar (5482). For additional information, refer to Section 204-01A .
    - Mark the driver side end of the stabilizer bar for correct installation.

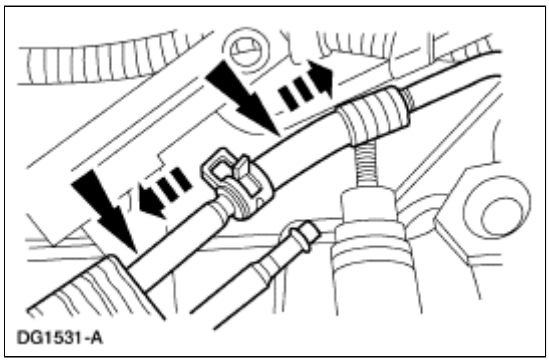
12. Remove the power steering fluid cooler to crossmember nuts.



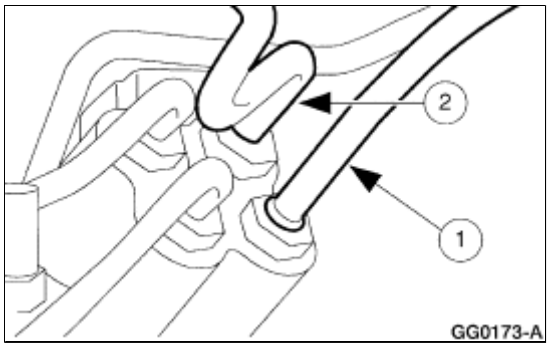
13. Disconnect the power steering return line hose (3A005) at the power steering fluid cooler (3F780).
    - Allow the system to drain.



14. Disconnect the power steering return hose (3A713) and remove the power steering fluid cooler.

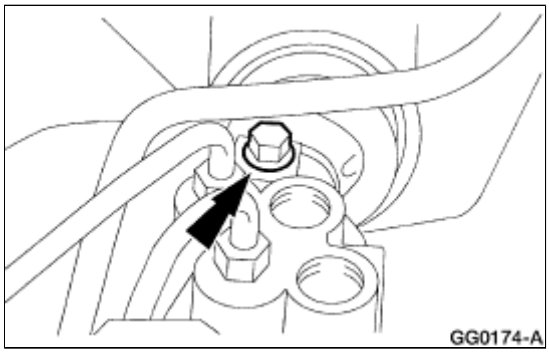


15. Disconnect the steering gear lines.
    1. Disconnect the power steering pressure hose (3A719).
    2. Disconnect the power steering return hose.



16. Plug the ends of all fluid lines removed and ports in steering gear to prevent damage and entry of dirt.

17. Rotate the steering column shaft to access the Intermediate shaft pinch bolt. Remove the pinch bolt.



18. Lower the vehicle.

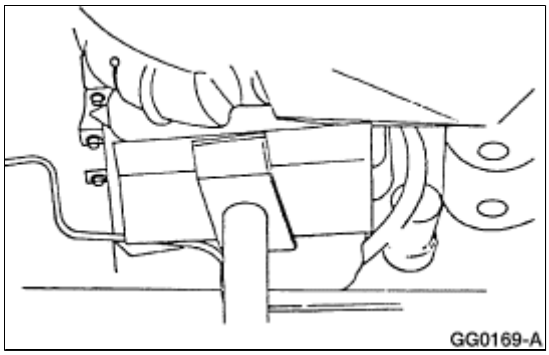
19. Turn the steering wheel back to the straight ahead position. Turn the ignition key to the locked position.

20. Raise the vehicle.

21. **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.**

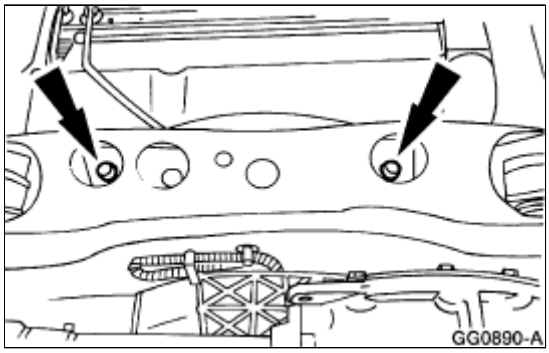
    Disconnect the intermediate shaft from the steering gear input shaft.

22. Raise the engine.
    - Position a block of wood between a screw jack and the bottom of the oil pan to avoid damaging the oil pan while raising the engine.

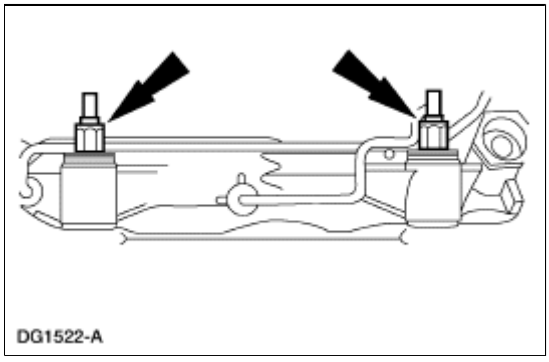


23. **CAUTION: Hold the tops of the steering gear to crossmember stud bolts to avoid damaging the steering gear fluid transfer tubes.**

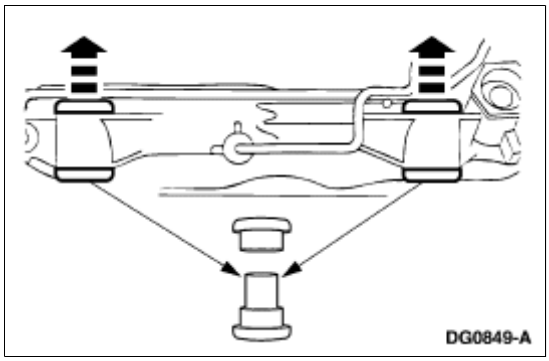
    Remove the nuts.



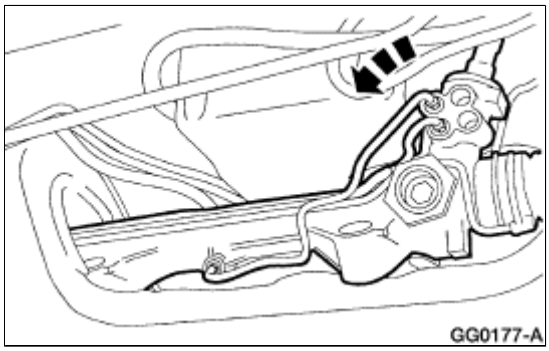
24. Remove the stud bolts and washers.



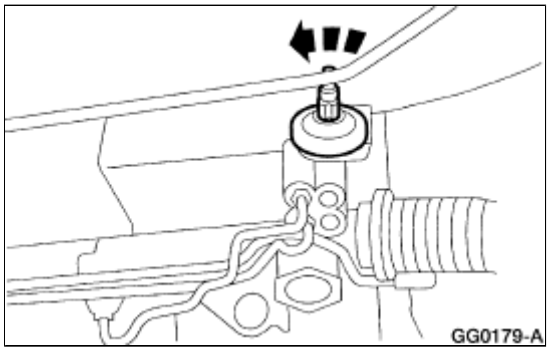
25. Remove the steering gear to crossmember insulator bushings.



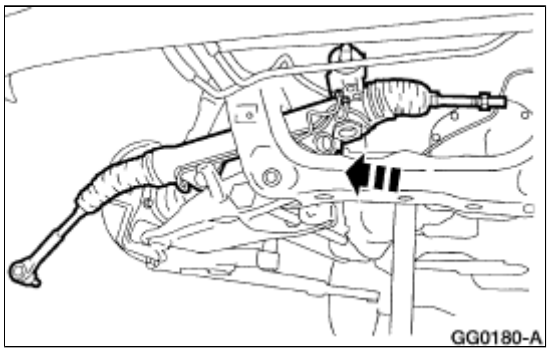
26. Rotate the steering gear control valve housing toward the front of the vehicle.



27. Turn the steering gear input shaft to the right until the stop is reached.

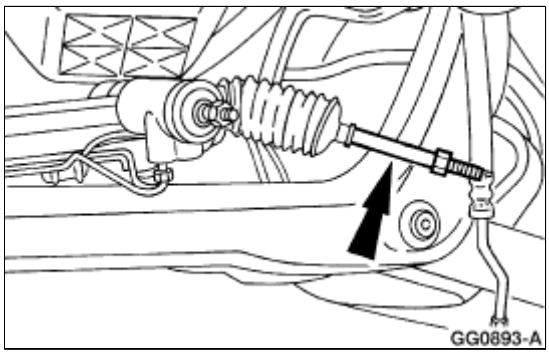


28. Move the steering gear (3504) as far to the RH side of the vehicle as possible.

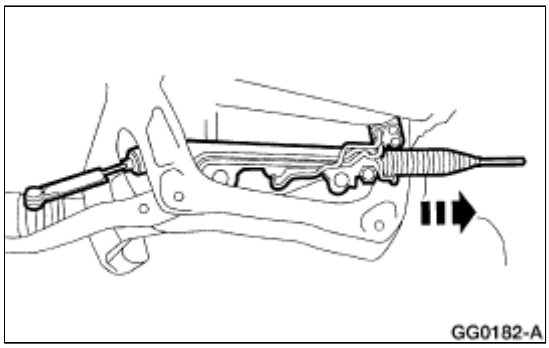


29. Move the LH front wheel spindle tie-rod (3280) forward to clear the crossmember. Turn the steering

gear input shaft to the left until the stop is reached.

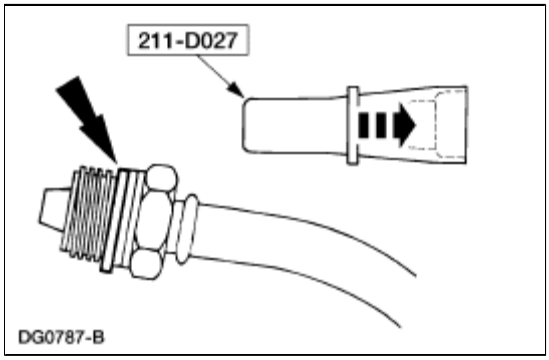


30. Remove the steering gear from the vehicle.



Installation

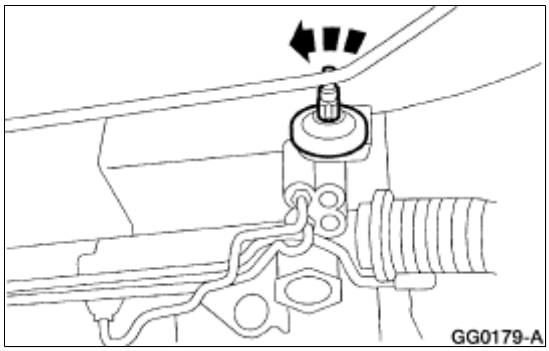
1. Using the special tool, install new seals on the power steering return hose and power steering pressure hose.



2. **NOTE:** Make sure the steering gear input shaft is turned to the left until the stop is reached.

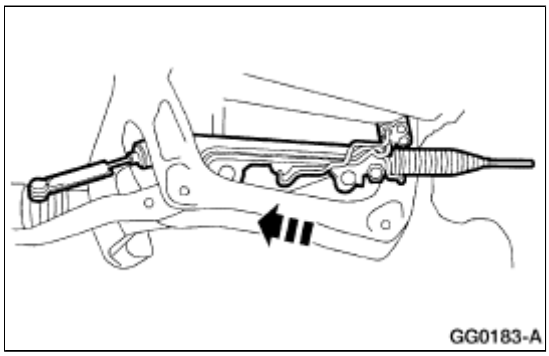
   NOTE: Handle the steering gear with caution to avoid damage to fluid transfer tubes and to avoid dimples in the tie-rod boots.

   Turn the steering gear input shaft to the right until the stop is reached. Note the number of turns required.

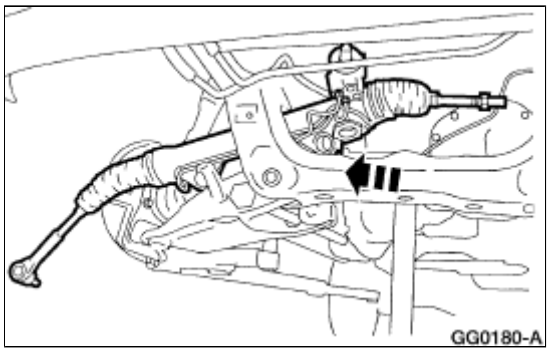


3. **NOTE:** Make sure the steering gear control valve housing is turned toward the front of the vehicle.

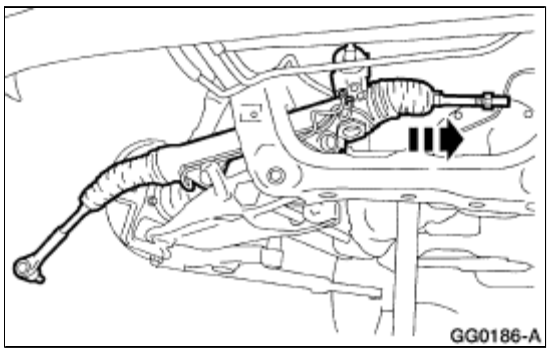
   Install the steering gear into the RH opening of the crossmember.



4. Move the steering gear as far to the RH side of the vehicle as possible.

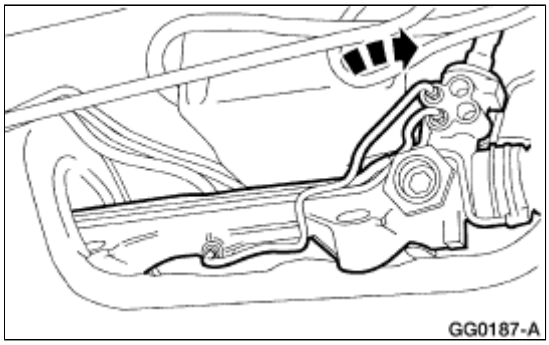


5. Move the LH front wheel spindle tie-rod into the opening in the crossmember and move the steering gear into position.

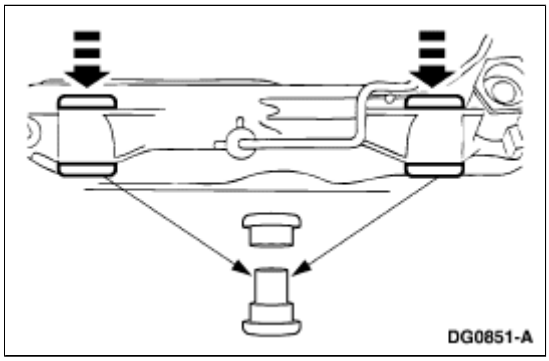


6. To place the steering gear in the straight ahead position, turn the steering gear input shaft to the left by half the number of turns recorded previously.

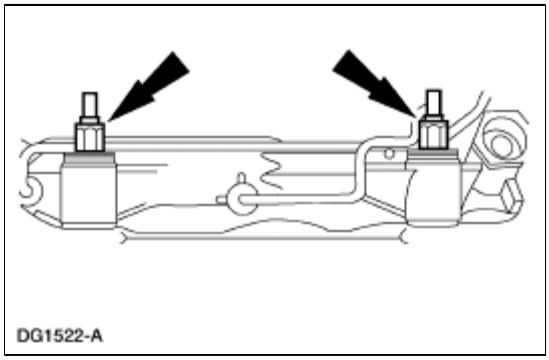
7. Rotate the steering gear control valve housing toward the rear of the vehicle.



8. Install the steering gear to crossmember insulator bushings as shown.
   - The large end of metal sleeve must be positioned downward.
   - Check that the mounting surfaces on the crossmember are clean and free of debris.

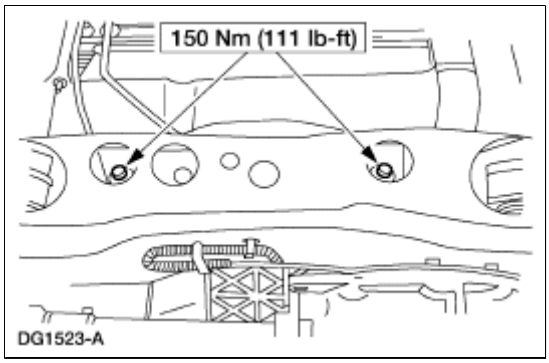


9. Install the steering gear to crossmember washers and stud bolts.
   - For additional information on correct mounting hardware orientation, refer to Power Steering in the Description and Operation portion of this section.



10. **CAUTION: Hold the tops of the steering gear to crossmember stud bolts to avoid damaging the steering gear fluid transfer tubes.**

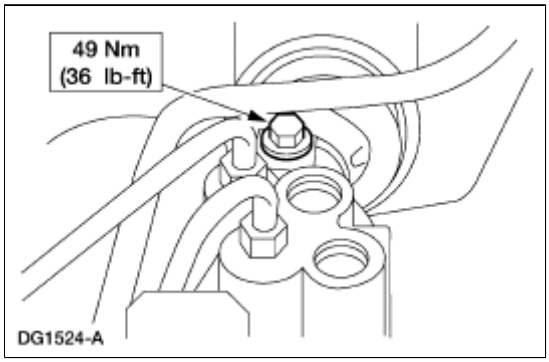
    Install the nuts.



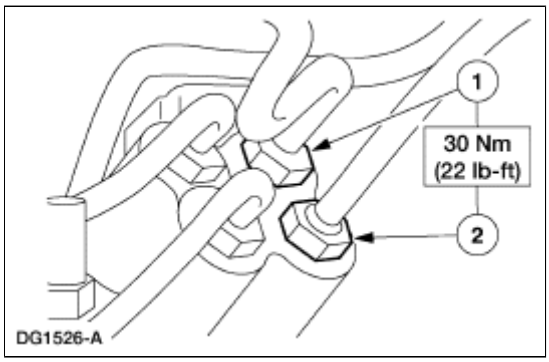
11. Lower the engine (6007).

12. **CAUTION: Do not rotate the steering wheel when the lower steering column shaft is disconnected, or damage to the air bag sliding contact (14A664) will result.**

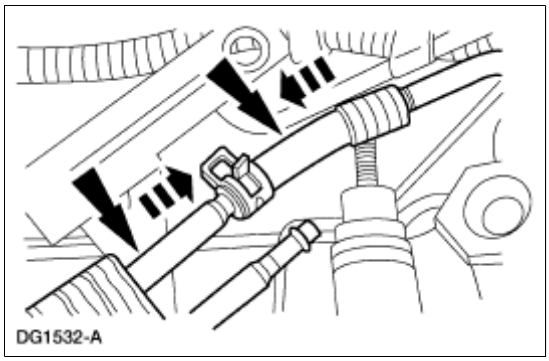
    Connect the intermediate shaft to the steering gear input shaft. Install the pinch bolt.



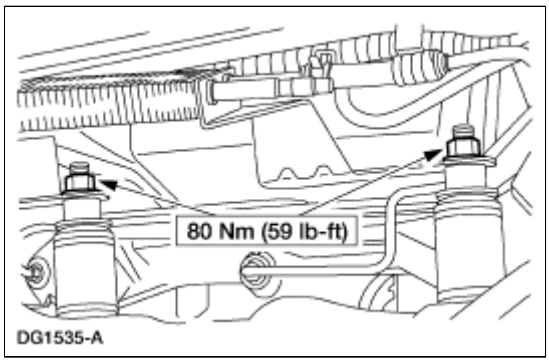
13. Connect the steering gear fluid lines.
    1. Connect the power steering return hose.
    2. Connect the power steering pressure hose.



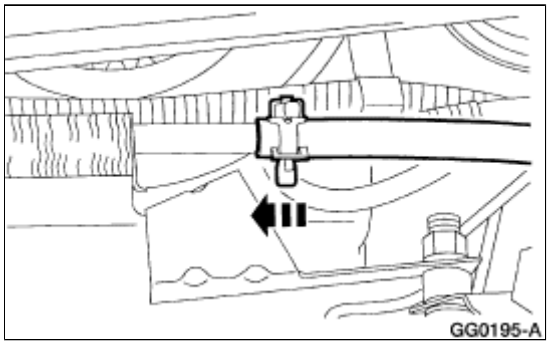
14. Connect the power steering return hose to the power steering fluid cooler.



15. Position the power steering fluid cooler and install the power steering fluid cooler to crossmember nuts.



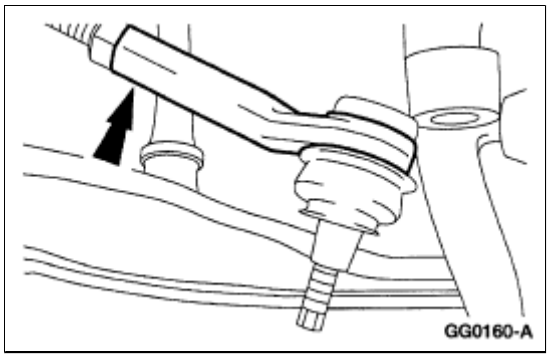
16. Connect the power steering return line hose to the power steering fluid cooler.



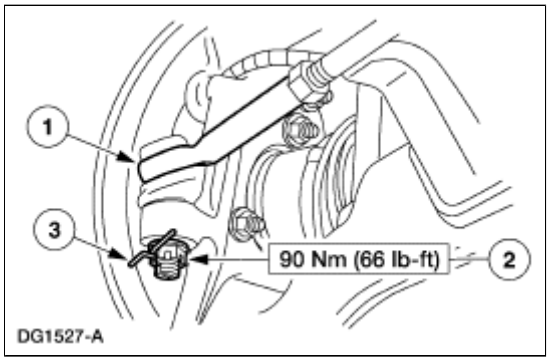
17. Install the engine oil cooler. For additional information, refer to Section 303-01C .

18. Install the front stabilizer bar. For additional information, refer to Section 204-01A .
    - Orientate the front stabilizer bar as noted during removal.

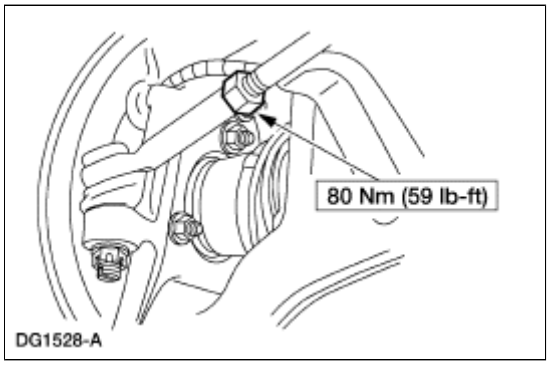
19. Install the tie-rod end.
    - Rotate the tie-rod end the number of turns recorded during removal.



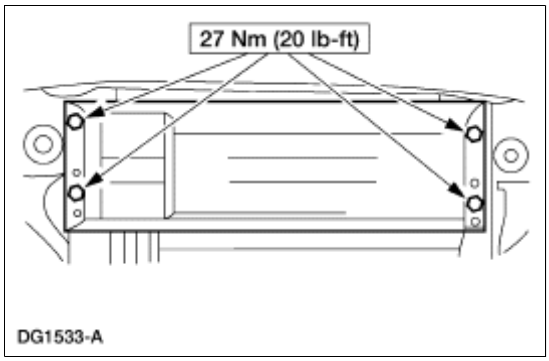
20. Connect the tie-rod ends to the steering knuckles.
    1. Position the tie-rod ends to the steering knuckles.
    2. Install the castellated nuts.
    3. Install the new cotter pins.
    - Check that brake dust shields are not bent and are not in contact with the outer tie-rod boot seals.



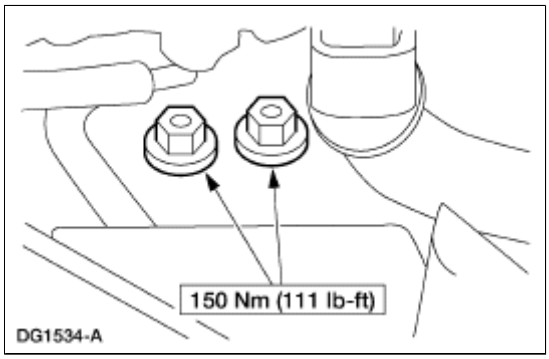
21. Tighten the LH tie-rod end jam nut.



22. Install the radiator air deflector.



23. Install the top engine mount nuts.



24. Install the inner fender splash shields.
25. Install the front wheel and tire assemblies. For additional information, refer to Section 204-04 .
26. **NOTE:** If equipped with air suspension, reactivate the system by turning on the air suspension switch.

    Lower the vehicle.
27. Refill and bleed the engine cooling system. For additional information, refer to Section 303-03 .
28. Fill and leak check the power steering system. For additional information, refer to Section 211-00 .
29. Check the wheel alignment. For additional information, refer to Section 204-00 .

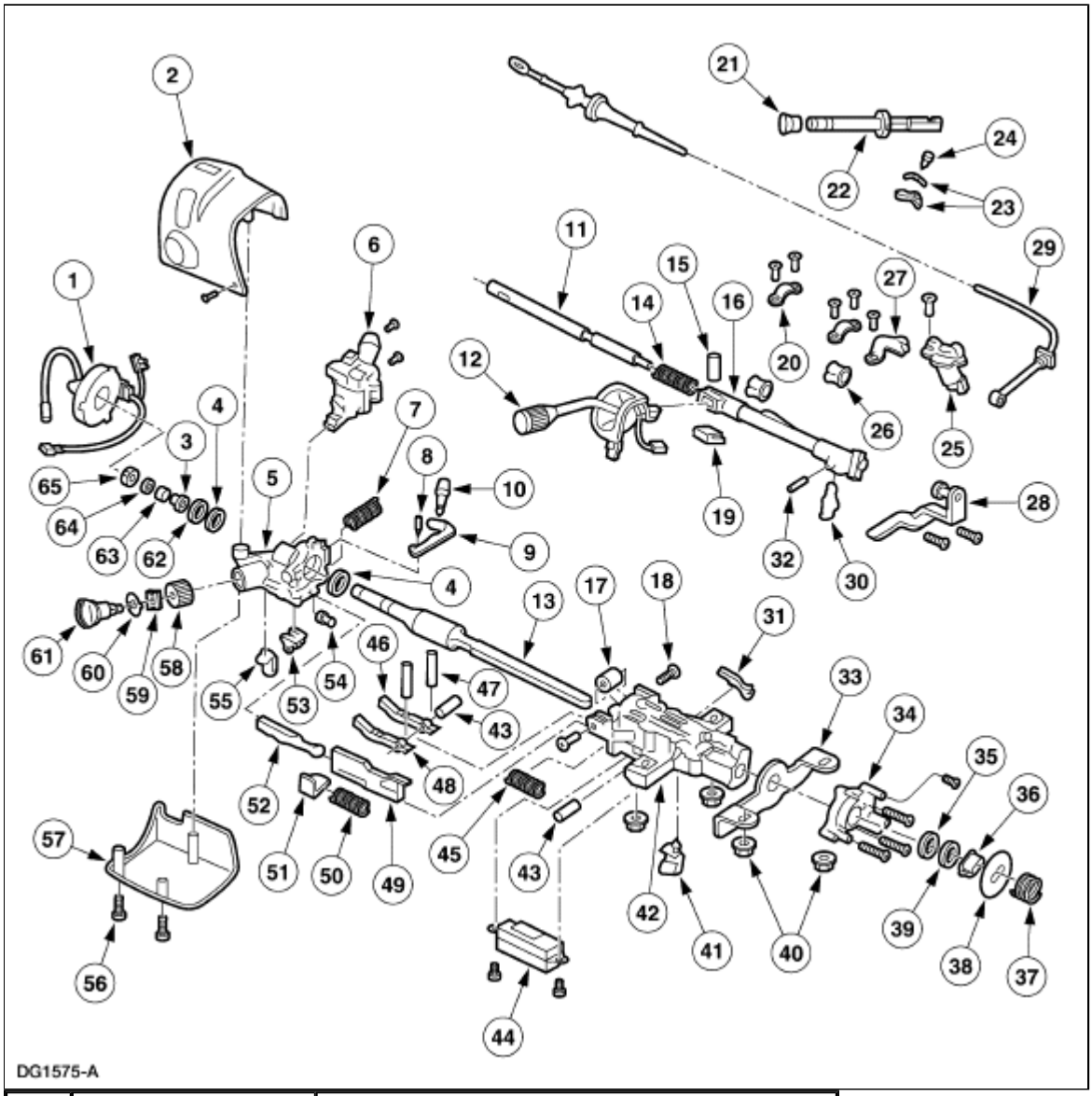
General Specifications

Item	Specification
Lubricants	
Steering Gear Grease C3AZ-19578-A	ESW-M1C87-A
Rust Penetrant and Inhibitor F2AZ-19A501-A	ESR-M99G56-A
Ignition Lock Grease FOAZ-19584-A	ESA-M1C232-A

Torque Specifications

Description	Nm	lb-ft	lb-in
Brake shift interlock solenoid bolts	9	—	80
Hood latch release handle screws	2.7-3.7	—	25-33
Ignition switch bolts	6	—	53
Instrument panel steering column cover screws	2.1-2.9	—	19-25
Instrument panel steering column opening cover reinforcement screws	7.6-10.4	—	67-92
Intermediate shaft to lower intermediate shaft bolt	41-55	30-40	—
Lock cylinder housing screws	22	16	—
Multi-function switch screws	2.1-2.9	—	19-25
Parking brake release handle screws	2.1-2.9	—	19-25
Shift tube bolts	9	—	80
Shock absorber electronic steering sensor bolts	1	—	10
Steering column lower bearing retainer bolts	9	—	80
Steering column retaining nuts	13-17	10-13	—
Steering wheel bolt	41-46	25-34	—
Transmission selector lever arm and support bolts	15	11	—
Upper intermediate shaft to steering column bolt	26-34	19-25	—

Steering Column



Item	Part Number	Description
1	14A664	Air bag sliding contact
2	3530	Upper steering column shroud
3	3518	Steering column bearing sleeve
4	3517	Steering column bearing
5	3511	Steering column lock cylinder housing
6	13K359	Multi-function switch
7	N808114	Pin
8	N805857	Steering column release lever pin

9	3D544	Steering column release lever
10	3F609	Tilt wheel handle and shank
11	7361	Column shift selector lever plunger
12	7210	Gearshift lever
13	3D657	Steering column shaft
14	7B071	Transmission control selector lever plunger spring
15	7G357	Gearshift lever pin
16	7212	Transmission column shift selector tube
17	3C549	Steering column spacer (fixed column)
18	N806582	Tilt column pivot screw
19	7C464	Transmission control selector lever spring clip
20	7E400	Gearshift tube bushing clamp
21	—	Spacer (fixed column)
22	3E729	Steering shaft (fixed column)
23	3F527	Lever assembly (manual transmission)
24	3F530	Pin (manual transmission)
25	3F752	Brake shift interlock solenoid
26	7335	Gearshift lever socket bushing
27	7A216	Transmission shift selector position insert
28	7302	Transmission selector lever arm and support
29	7E395	Shift cable and bracket
30	7210	Gearshift lever
31	3E691	Steering column lock pawl
32	7W441	Gearshift lever pin
33	3676	Steering column instrument panel bracket
34	3D681	Steering column lower bearing retainer
35	3518	Steering column bearing sleeve
36	3L539	Steering column bearing tolerance ring
37	3C674	Steering column lower bearing spring
38	3C131	Suspension height sensor control ring
39	3517	Steering column bearing
40	N806423-S56	Steering column retaining nuts
41	14A163	Wiring harness retainer
42	3F723	Steering actuator housing
43	3B663	Steering column lock lever pin
44	11572	Ignition switch
45	3D655	Steering column position spring
46	3D653-LH, 3B662-	Steering column lock lever

	RH	
47	3B768	Steering column position lock spring
48	3B661	Steering column locking lever
49	3E715	Lower steering column lock actuator
50	3E696	Steering column lock spring
51	3E691	Steering column lock pawl
52	3E723	Upper steering column lock lever actuator
53	3E695	Steering column lock cam
54	3D656	Steering column tilt flange bumper
55	14A163	Wiring harness retainer
56	391727-S304	Shroud screws
57	3530	Steering column shroud
58	3E717	Steering column lock gear
59	3E700	Steering column lock housing bearing
60	3C610	Bearing retainer
61	11582	Ignition switch lock cylinder
62	3L539	Steering column tolerance ring
63	3520	Steering column upper bearing spring
64	3C610	Snap ring
65	13318	Turn indicator cancel cam

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. New fasteners with the same part number must be installed if replacement becomes necessary. Do not use 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.

Steering Column

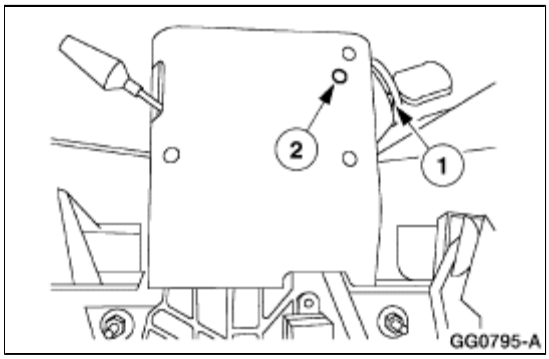
Refer to Section 211-00 .

Ignition Switch Lock Cylinder —Functional Lock Cylinder

Removal

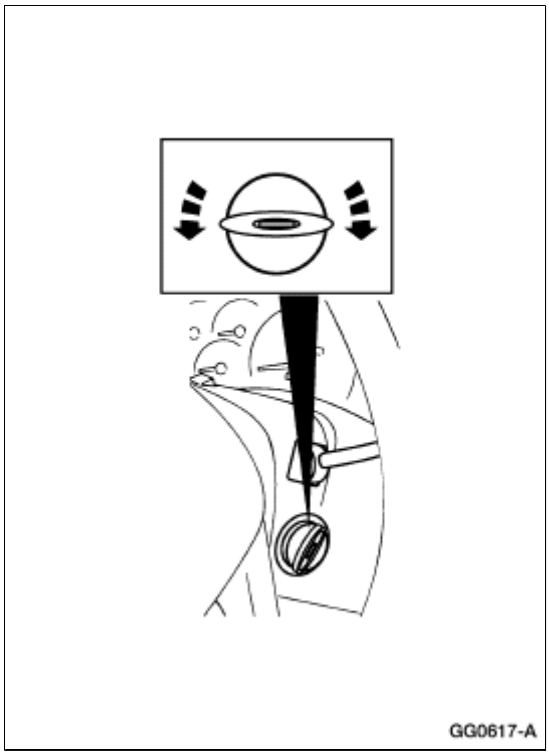
1. Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

2. Remove the ignition switch lock cylinder (11582).
    1. Insert the ignition key and turn to the RUN position.
    2. Press the ignition switch lock cylinder release pin while pulling out the ignition switch lock cylinder.



Installation

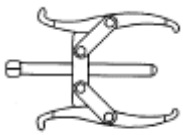
1. Follow the removal procedure in reverse order.
    - Verify ignition switch lock cylinder operation.



2. Prove out the air bag system. For additional information, refer to Section 501-20B .

Wheel

Special Tool(s)

 ST1321-A	2-Jaw Puller 205-116 (T77F-4220-B1)

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: 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: 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.

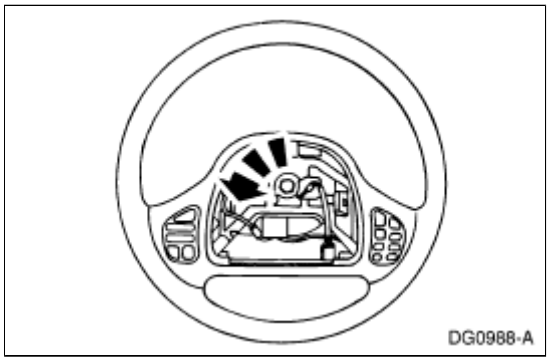
To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

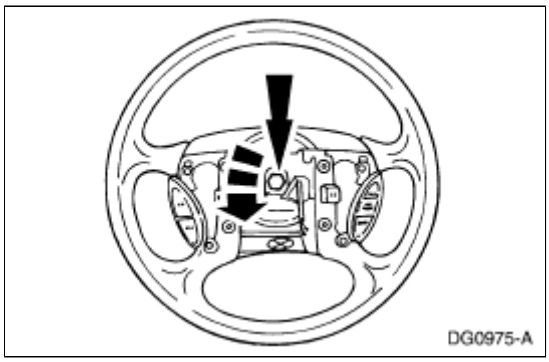
NOTE: Make sure the wheels (1007) are in the straight-ahead position.

1. Disconnect the battery cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .
   - Disconnect the battery ground cable.
   - Disconnect the battery to starter relay cable.

2. Remove the driver air bag module. For additional information, refer to Section 501-20B .

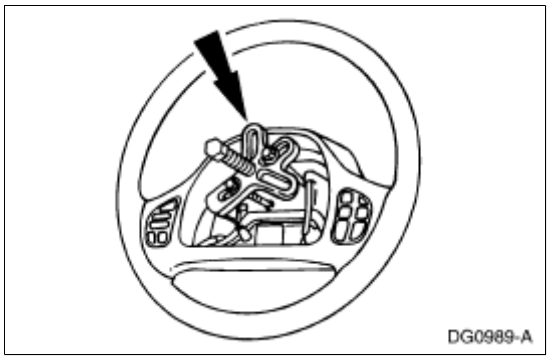
3. Remove the steering wheel bolt.

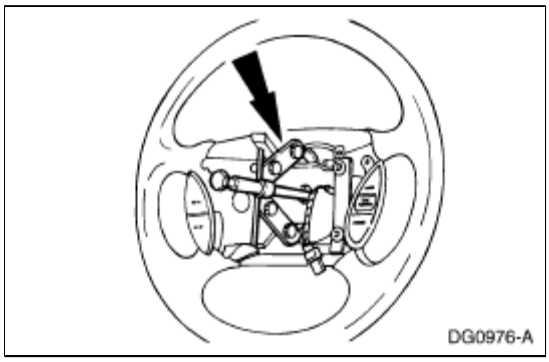




4. **CAUTION: Removing the steering wheel without using a puller can damage the column bearings.**

   Use the 2-Jaw Puller to remove the steering wheel (3600).





5. Remove and discard the original steering wheel bolt.

6. Remove the steering wheel while routing the wires from the air bag sliding contact through the steering wheel.

Installation

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: 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.

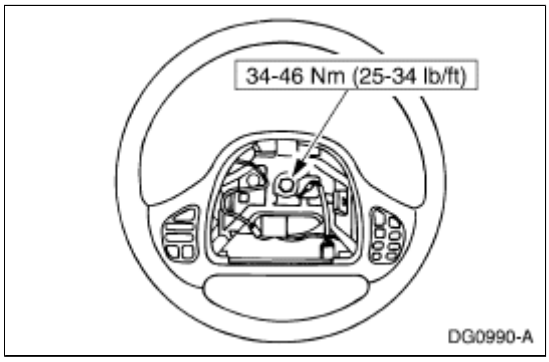
WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

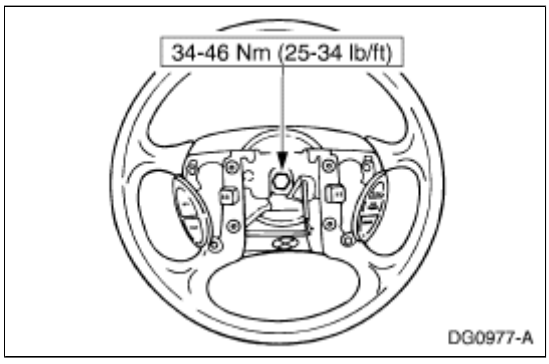
Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

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. Follow the removal procedure in reverse order.





2. Connect the battery cables. For additional information, refer to Section 414-01 .

3. Prove out the air bag system. For additional information, refer to Section 501-20B .

Air Bag Sliding Contact

Removal and Installation

For additional information, refer to Section 501-20B .

Column

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: 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: 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. Disconnect the battery cables (14301) and wait at least one minute. For additional information, refer

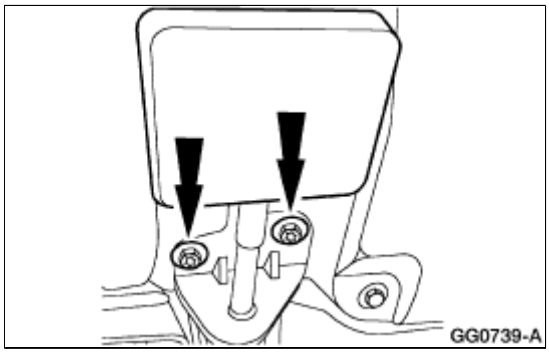
to Section 414-01 .

1. Remove the battery ground cable.
2. Remove the battery to starter relay cable.

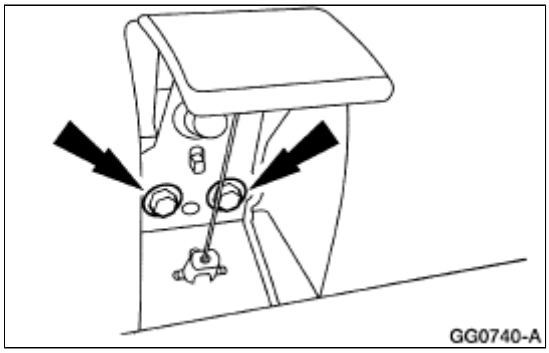
2. **NOTE:** Make sure the front wheels (1007) are in the straight-ahead position.

   Remove the steering wheel (3600). For additional information, refer to Wheel in this section.

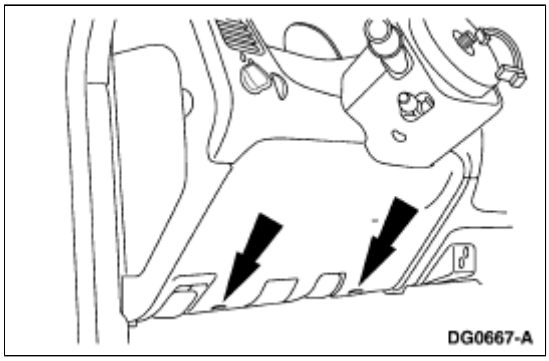
3. Remove the screws and position the parking brake release handle aside.



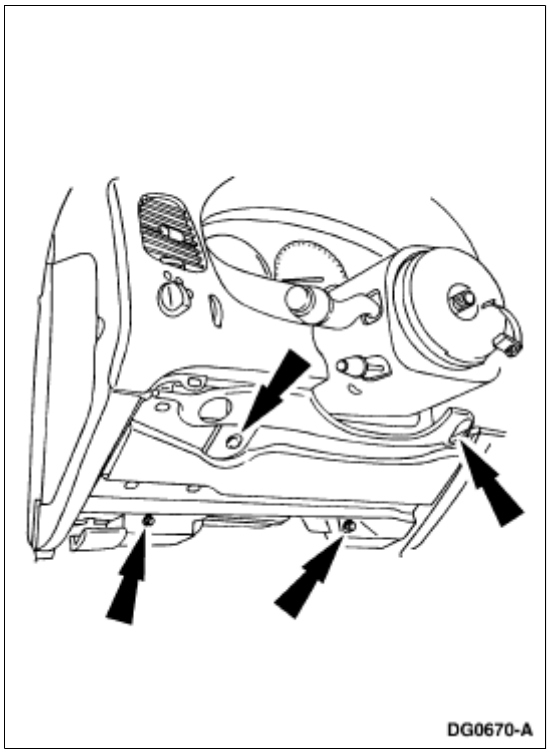
4. Remove the screws and position the hood release aside.



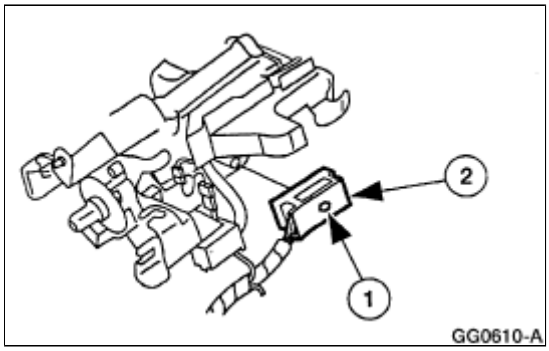
5. Remove two screws and the instrument panel steering column cover (04459).



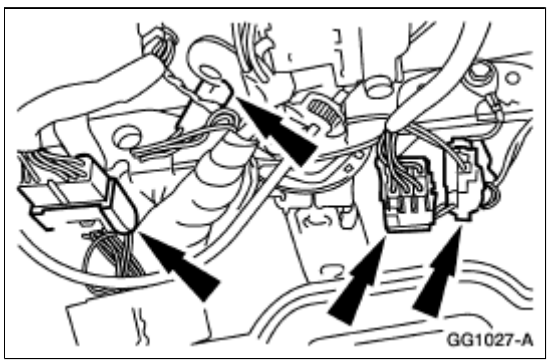
6. Remove the instrument panel steering column opening cover reinforcement (04502).



7. Disconnect the ignition switch electrical connector.
    1. Remove the bolt.
    2. Disconnect the electrical connector.

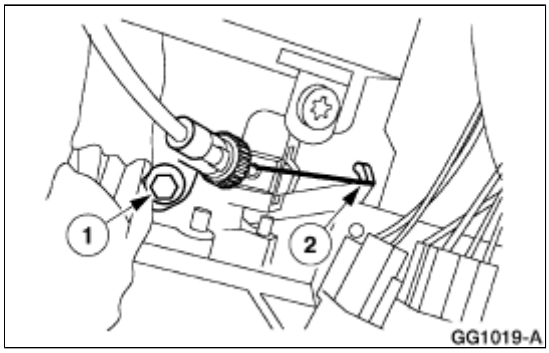


8. Disconnect the electrical connectors.

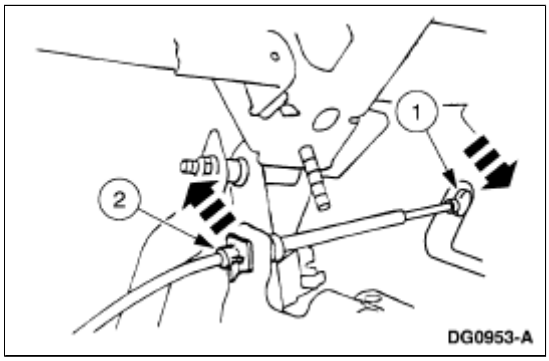


9. On automatic transmission vehicles, remove the transmission range indicator (PRND21) from the

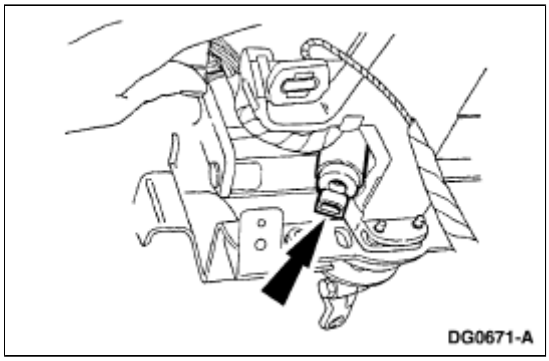
steering column (3C529).
1. Remove the bolt.
2. Remove the indicator cable.



10. On automatic transmission vehicles, disconnect the shift cable from the steering column.
    1. Disconnect the shift cable from the steering column shift tube lever.
    2. Disconnect the shift cable from the steering column bracket.

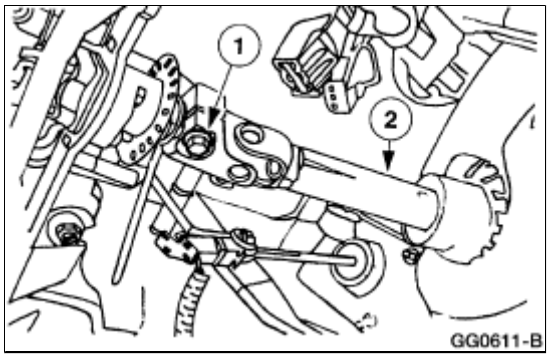


11. Disconnect the brake shift interlock solenoid electrical connector.

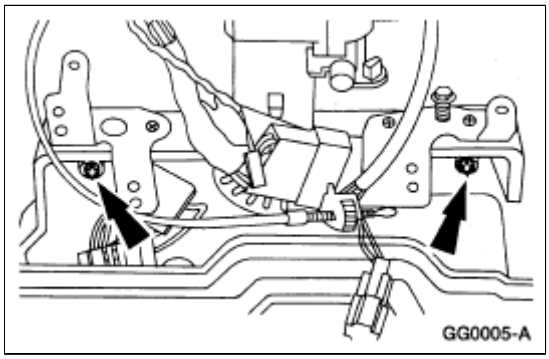


12. Remove the air bag sliding contact. For additional information, refer to Section 501-20B .

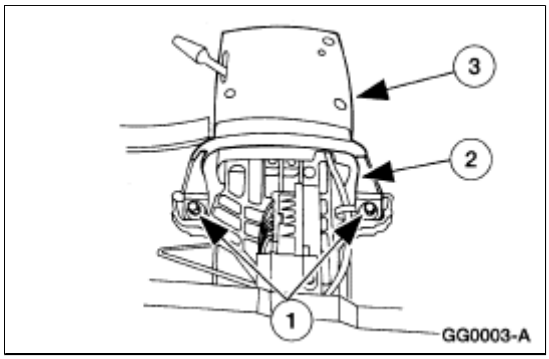
13. Remove the upper intermediate steering shaft to column shaft bolt.
    1. Remove and discard the steering column shaft pinch bolt.
    2. Slide the intermediate shaft yoke from the steering column.



14. Remove the lower steering column nuts.



15. Remove the steering column.
    1. Remove the nuts.
    2. Remove the steering column support.
    3. Remove the steering column.



Installation

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: 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.

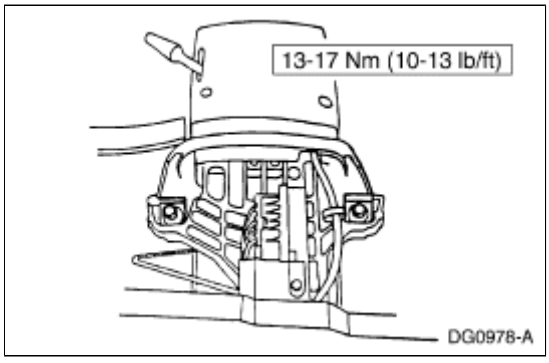
WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

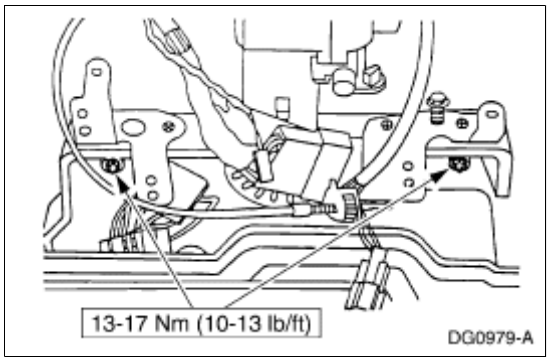
Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

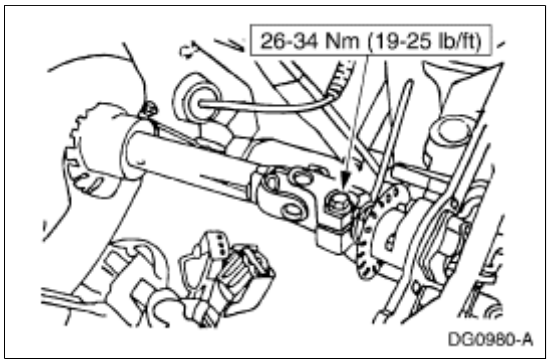
The side air bag sensors are located at or near the base of the B-pillar.

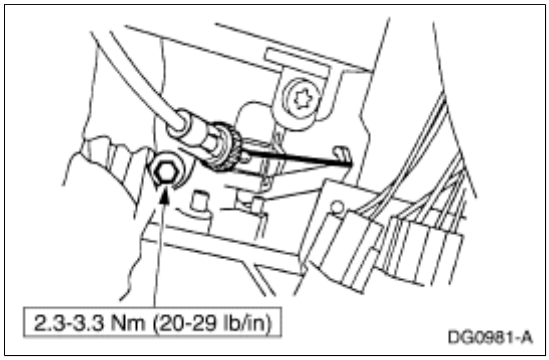
To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

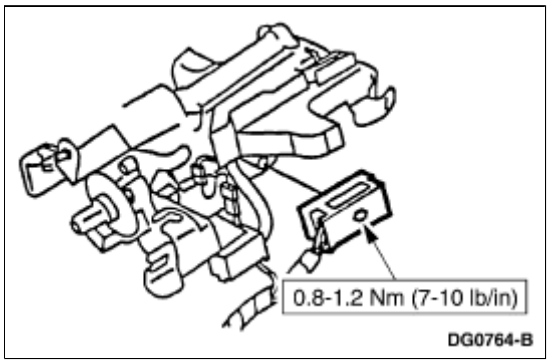
1. Follow the removal procedure in reverse order.
    - Use a new pinch bolt.

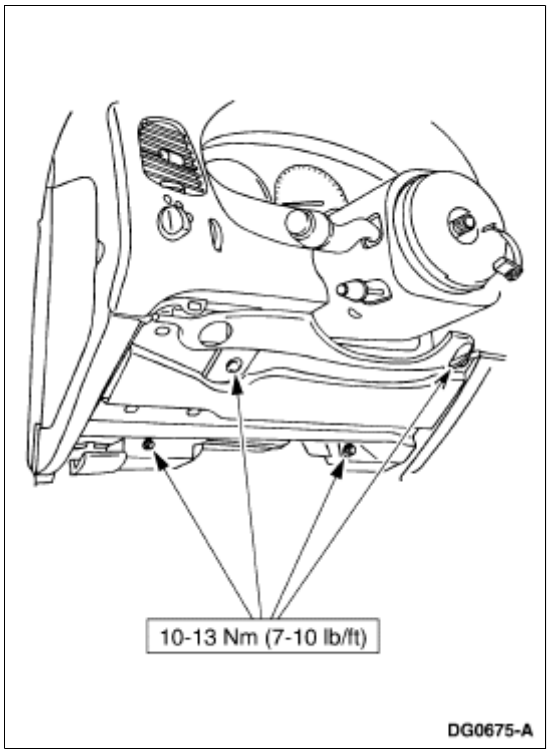


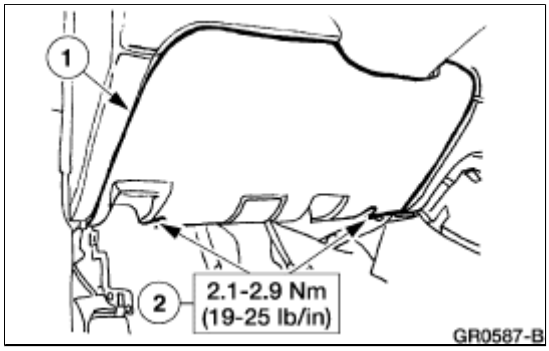

13-17 Nm (10-13 lb/ft)
DG0979-A

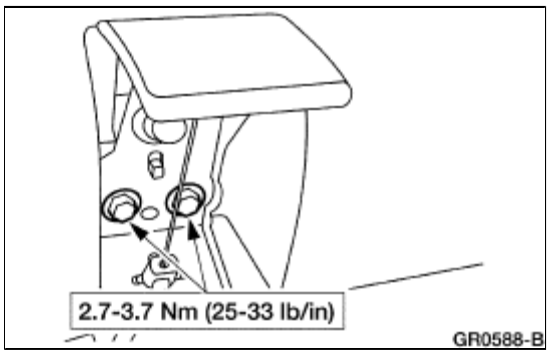

26-34 Nm (19-25 lb/ft)
DG0980-A

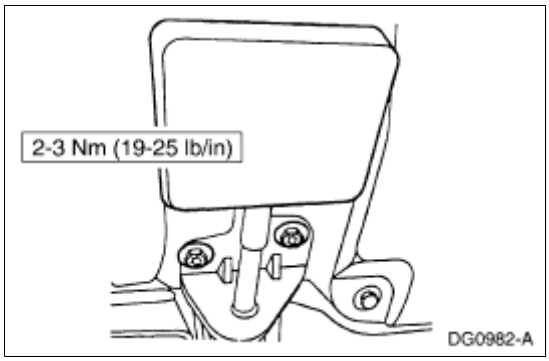

2.3-3.3 Nm (20-29 lb/in)
DG0981-A


0.8-1.2 Nm (7-10 lb/in)
DG0764-B


10-13 Nm (7-10 lb/ft)
DG0675-A


1
2
2.1-2.9 Nm
(19-25 lb/in)
GR0587-B


2.7-3.7 Nm (25-33 lb/in)
GR0588-B


2-3 Nm (19-25 lb/in)
DG0982-A

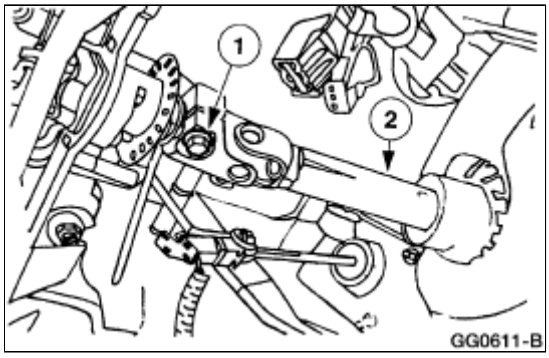
Steering Column Sensor Ring

Removal

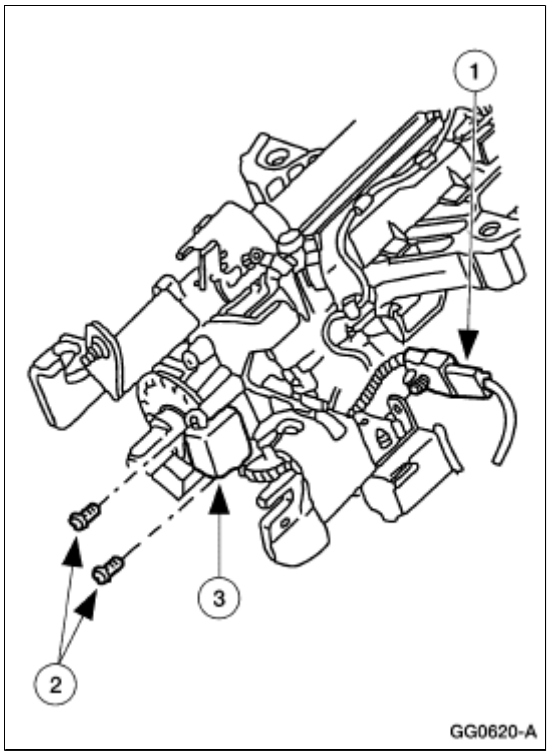
CAUTION: The steering column must be in the locked position, or the lower end of the column wired in such a way that the steering column does not rotate, resulting in damage to the air bag sliding contact (14A664).

NOTE: Discard the upper intermediate shaft to steering column shaft bolt upon removal. Do not reuse; install a new bolt.

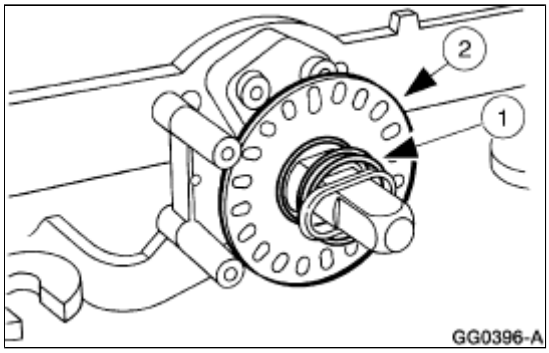
1. Remove the upper intermediate steering shaft to column shaft bolt.
    1. Remove and discard the steering column shaft pinch bolt.
    2. Slide the intermediate shaft yoke from the steering column.



2. Remove the shock absorber electronic steering sensor (18B015).
    1. Disconnect the electrical connector.
    2. Remove the screws.
    3. Remove the shock absorber electronic steering sensor.



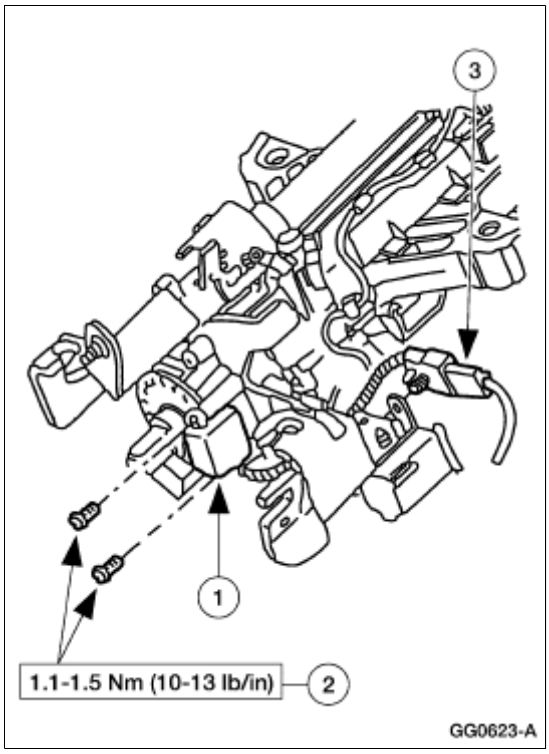
3. Remove the sensor ring.
    1. Remove the steering column lower bearing spring.
    2. Remove the sensor ring.



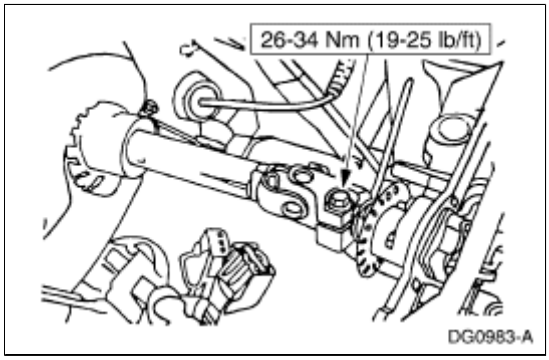
Installation

1. Follow the removal procedure in reverse order.

2. Install the shock absorber electronic steering sensor.
    1. Position the shock absorber electronic steering sensor.
    2. Install the screws.
    3. Connect the electrical connector.



3. Use a new pinch bolt.



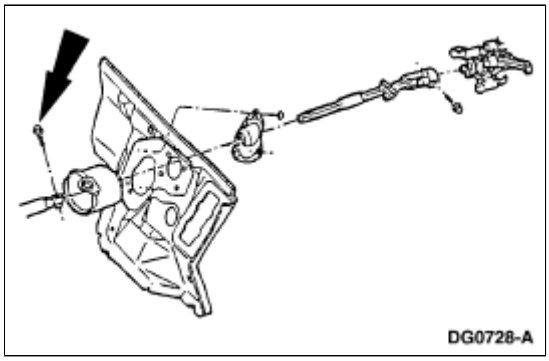
Steering Column Shaft

Removal

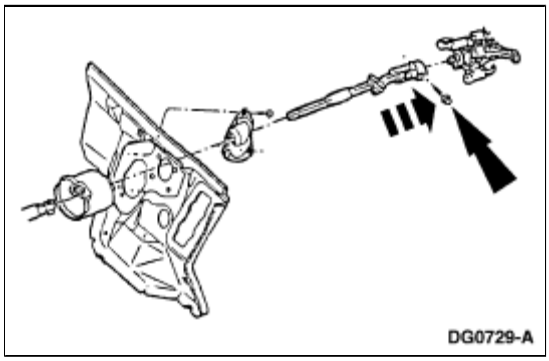
1. **CAUTION: The steering column must be in the locked position, or the lower end of the steering column is to be secured or wired in such a way as to prevent the steering column from rotating, resulting in damage to the air bag sliding contact (14A664).**

   NOTE: Discard the upper intermediate shaft to steering column shaft bolt and the upper intermediate shaft to lower steering column shaft bolt upon removal. Do not reuse; install new bolts.

   Remove the bolt securing the upper intermediate shaft to the lower intermediate shaft, at the midpoint connection. Collapse the lower shaft. Discard original bolt.
   - Use a new pinch bolt.

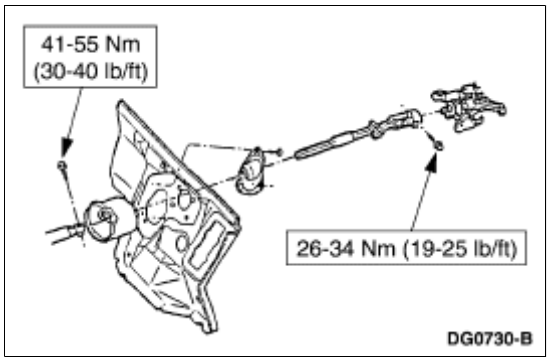


2. Remove the bolt securing the upper intermediate shaft to the steering column assembly. Remove the intermediate shaft from inside the vehicle. Discard the original bolt.



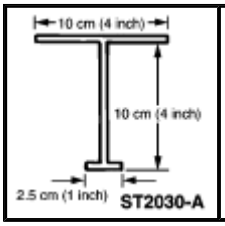
Installation

1. Follow the removal procedure in reverse order.


41-55 Nm
(30-40 lb/ft)
26-34 Nm (19-25 lb/ft)
DG0730-B

Steering Column —Manual Transmission

Special Tool(s)

	Steering Column Locking Lever Tool (Shop Fabricated)

Disassembly

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.

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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.

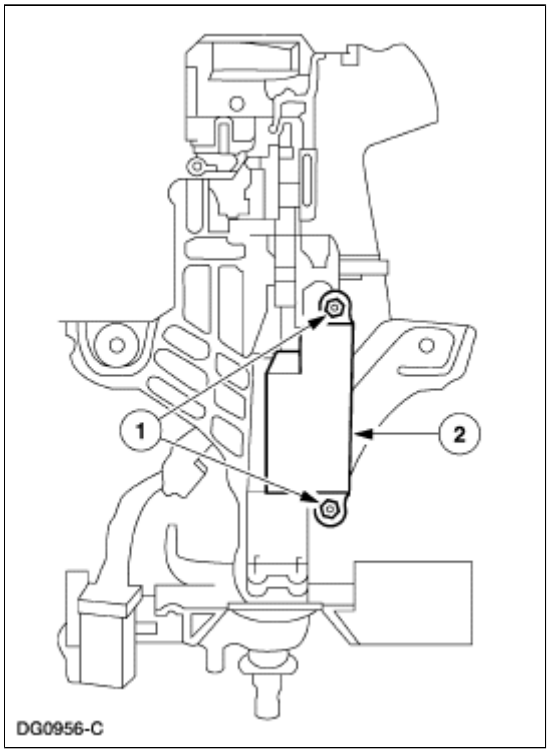
To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

All vehicles

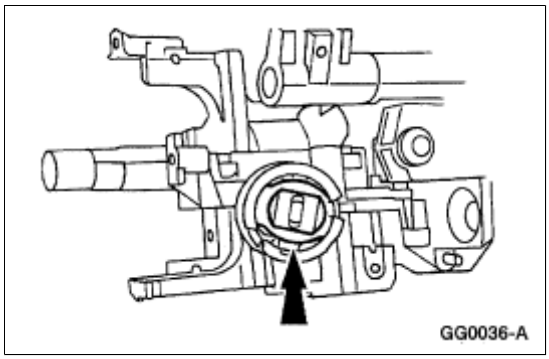
1. Remove the ignition switch lock cylinder. For additional information, refer to Ignition Switch Lock Cylinder—Functional Lock Cylinder or to Ignition Switch Lock Cylinder—Non-Functional Lock Cylinder in this section.

2. Remove the steering column (3C529). For additional information, refer to Column in this section.

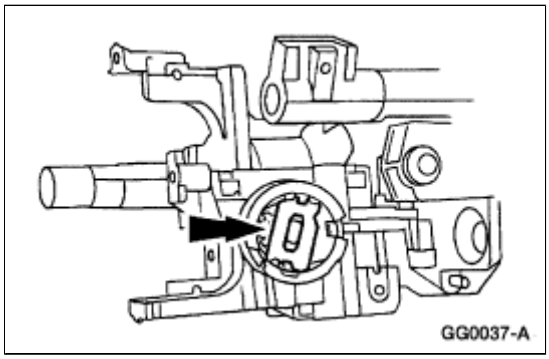
3. Remove the ignition switch (11572).
    1. Remove the ignition switch bolts.
    2. Remove the ignition switch.



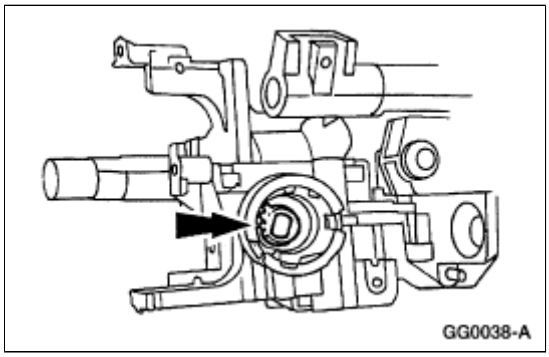
4. Remove the bearing retainer (3C610).



5. Remove the steering column lock housing bearing (3E700).

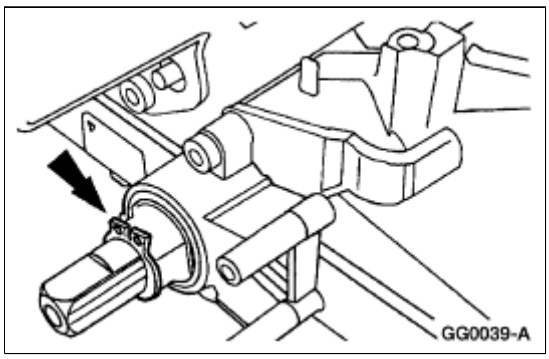


6. Remove the steering column lock gear (3E717).



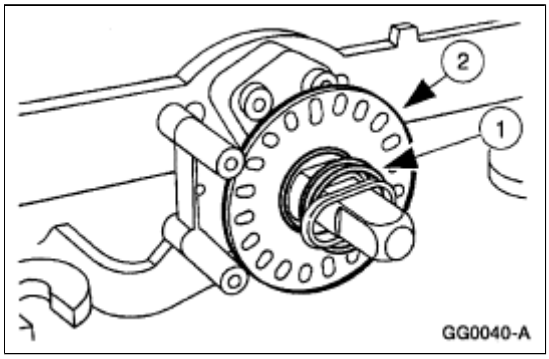
Vehicles with fixed steering columns

7. Remove the snap ring from the bottom of the steering column shaft.



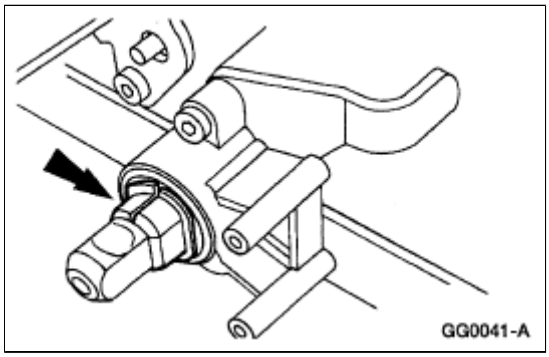
Vehicles with tilt steering columns

8. Remove the sensor ring.
    1. Remove the steering column lower bearing spring.
    2. Remove the sensor ring.



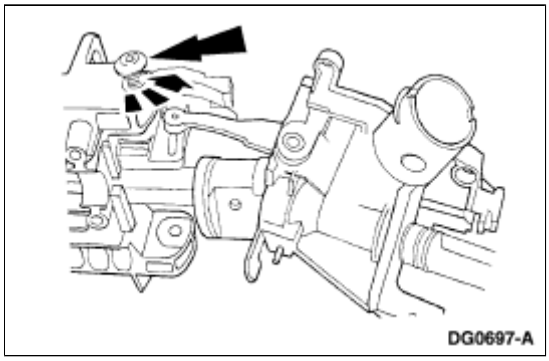
All vehicles

9. Remove the steering column bearing tolerance ring (3L539) from the steering column shaft.



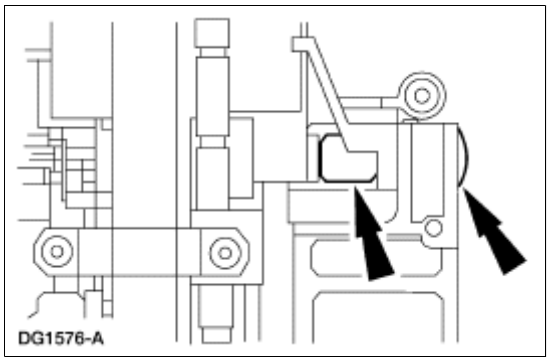
Vehicles with tilt steering columns

10. Remove the lock cylinder housing screws.



Vehicles with fixed steering columns

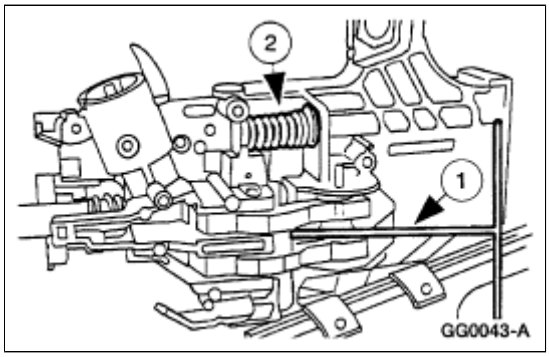
11. Remove the two lock cylinder housing screws and the steering column spacer (3C549).



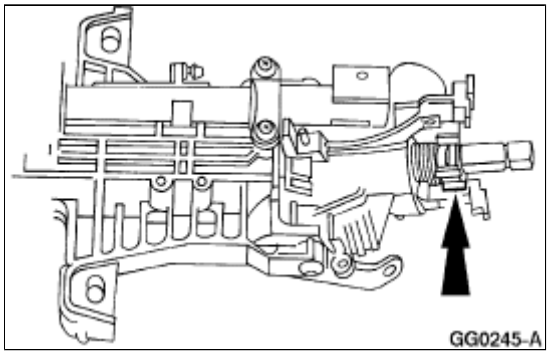
All vehicles

12. **WARNING: Steering column position spring is under tension and can come out with great force.**

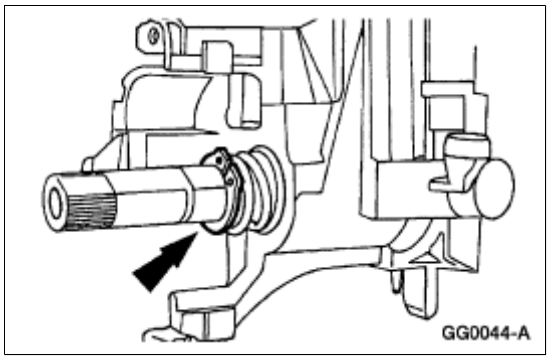
    Remove the lock cylinder housing and the steering column shaft from the steering actuator housing (3F723).
    1. Pry up on the steering column lock left hand levers (3D653) using a shop fabricated tool.
    2. On tilt steering columns, remove the steering column position spring (3D655).



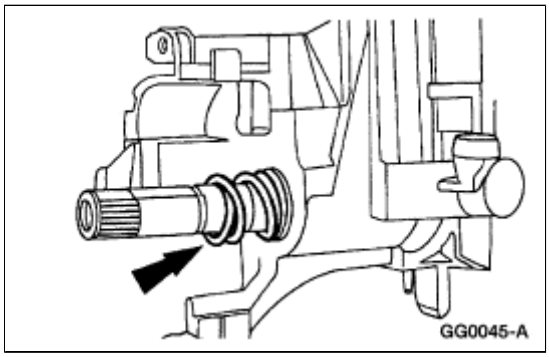
13. Remove the turn signal cancel cam.



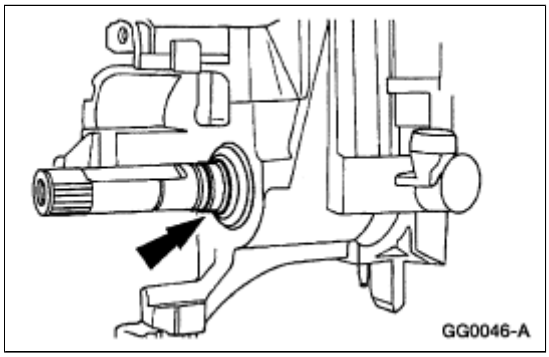
14. Remove the snap ring.



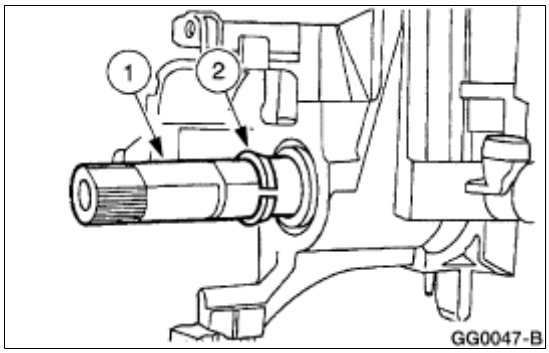
15. Remove the steering column upper bearing spring (3520).



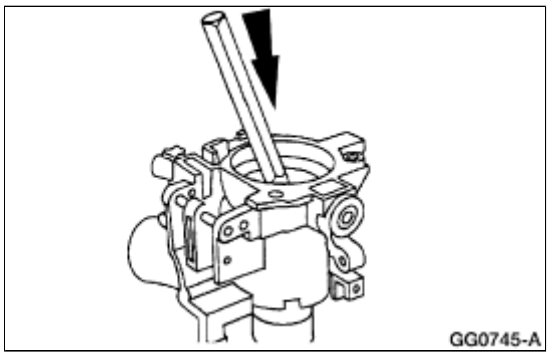
16. Remove the steering column bearing sleeve (3518).



17. Remove the steering column bearing tolerance ring.
    1. Slide the steering column shaft in toward the steering column lock cylinder housing (3511), then out.
    2. Slide the steering column bearing tolerance ring off the steering column shaft.

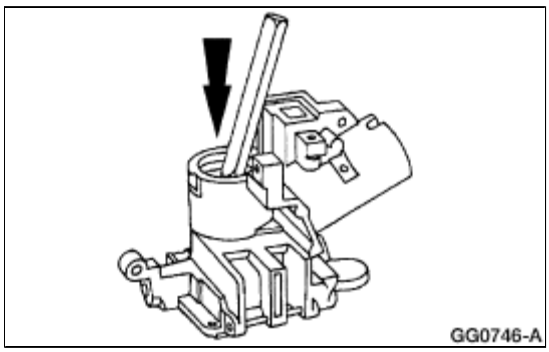


18. Using a suitable punch, remove the steering column bearing (3517) from the steering column lock cylinder housing.



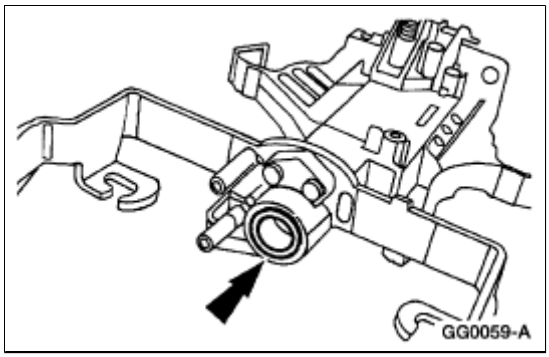
Vehicles with tilt steering columns

19. Use a suitable punch to remove the steering column bearing from the steering column lock cylinder housing.

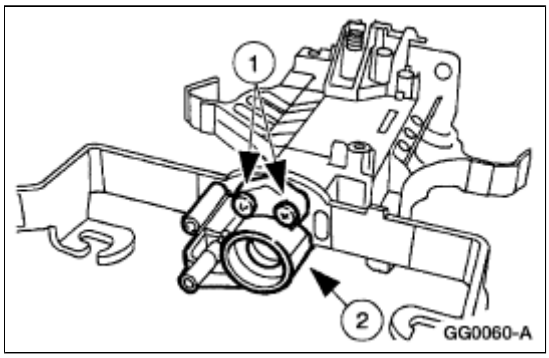


All vehicles

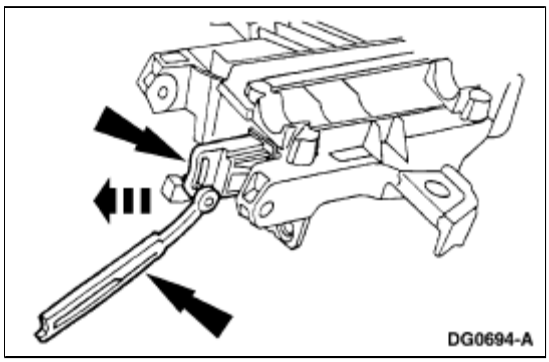
20. Remove the steering column bearing and sleeve.



21. Remove the steering column lower bearing retainer (3D681).
    1. Remove the three bolts.
    2. Remove the steering column lower bearing retainer.



22. Remove the upper steering column lock lever actuator (3E715) and the lower steering column lock lever actuator.



Assembly

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: 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: 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.

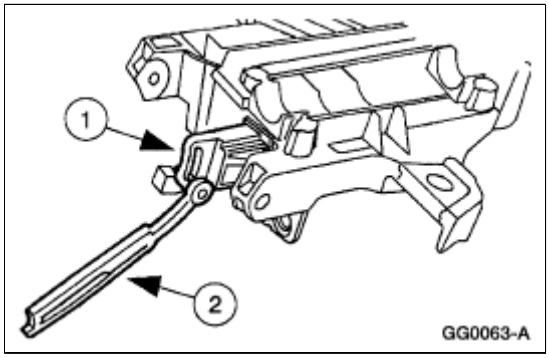
Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

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).

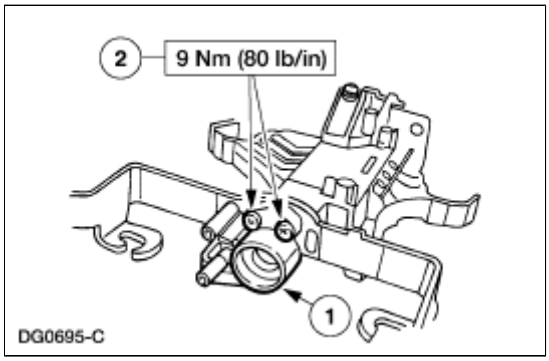
All vehicles

1. Install the steering column lock lever actuator.
    1. Lubricate the steering column lock lever actuator with Ignition Lock Grease FOAZ-19584-A or equivalent meeting Ford specification ESA-M1C232-A.
    2. Install the steering column lock lever actuator.



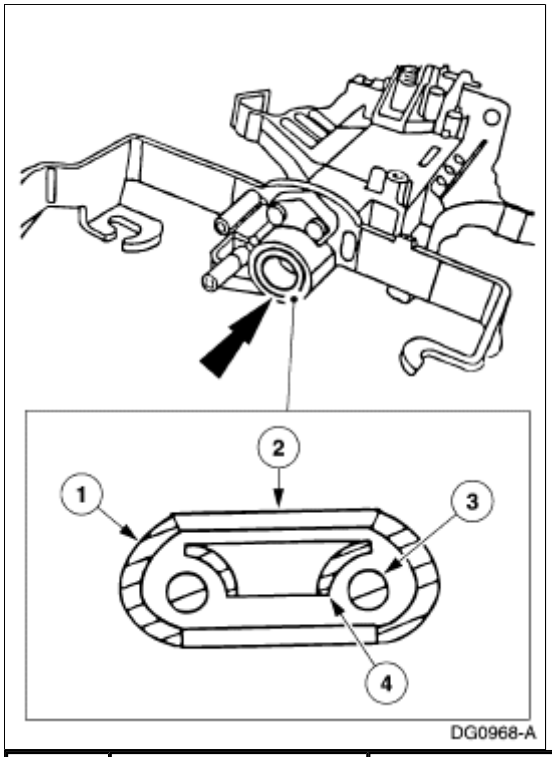
2. Install the steering column lower bearing retainer.

1. Position the steering column lower bearing retainer.
2. Install the three bolts.



3. **NOTE:** The "UP" position of the bearing must be facing forward, toward the engine.

   Install the steering column bearing and sleeve.



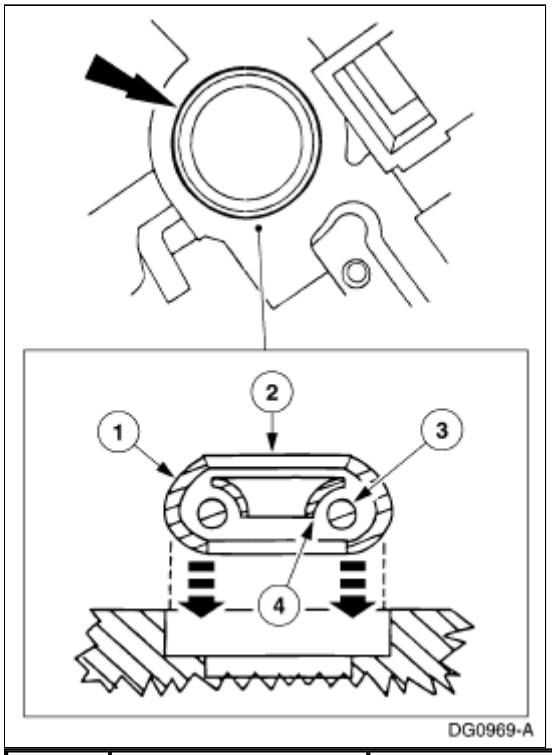
Item	Part Number	Description
1	—	Outer race
2	3517	Bearing (in the "UP" position)
3	—	Ball
4	—	Inner race

4. Install the steering column bearing and sleeve so that the inner race is visible when installed.

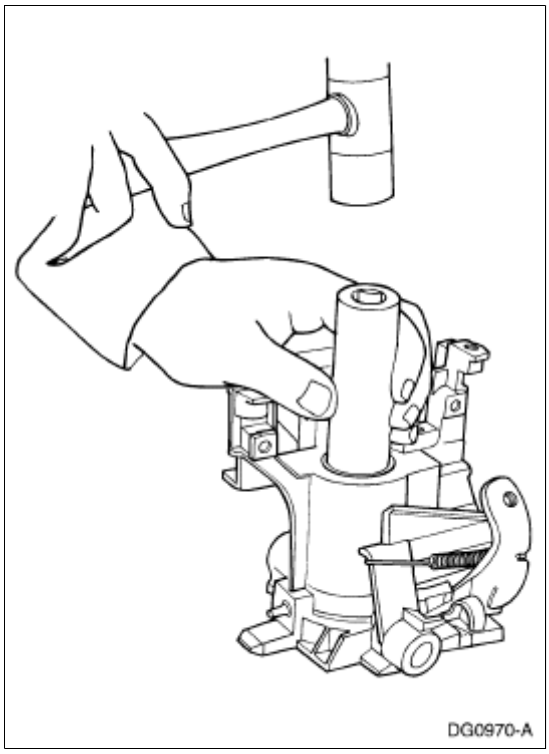
5. **CAUTION: Install the steering column bearing so that the inner race is visible when installed.**

NOTE: Use an appropriate bearing installer or socket.

Install the steering column bearing on the steering column lock cylinder housing.



Item	Part Number	Description
1	—	Outer race
2	—	Bearing (in the "UP" position)
3	—	Ball
4	—	Inner race

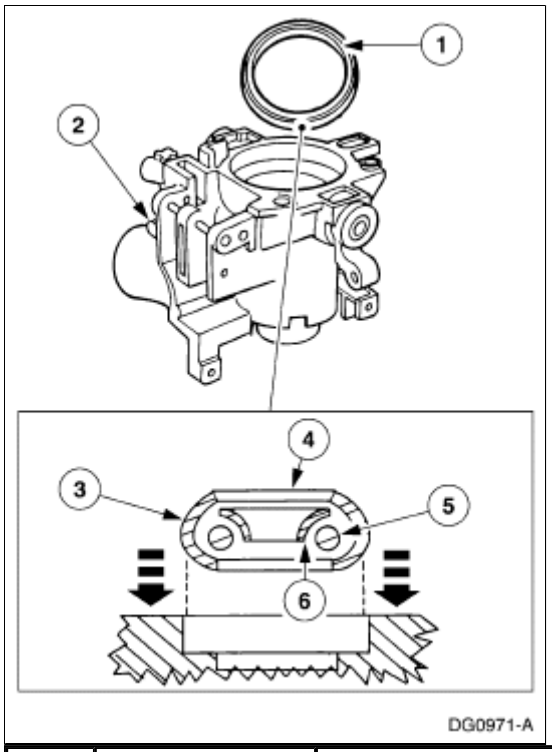


Vehicles with tilt steering columns

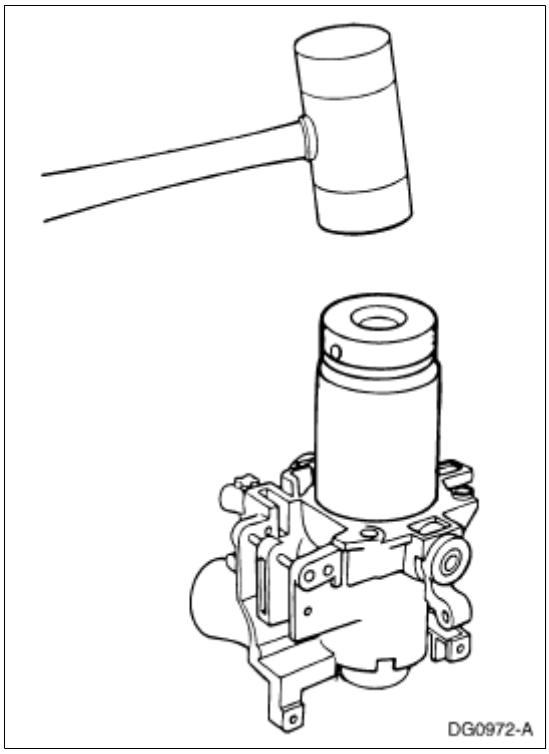
6. **CAUTION: Install the steering column bearing so that the inner race is visible when installed.**

   NOTE: Use an appropriate bearing installer or socket.

   Install the steering column bearing on the steering column lock cylinder housing.

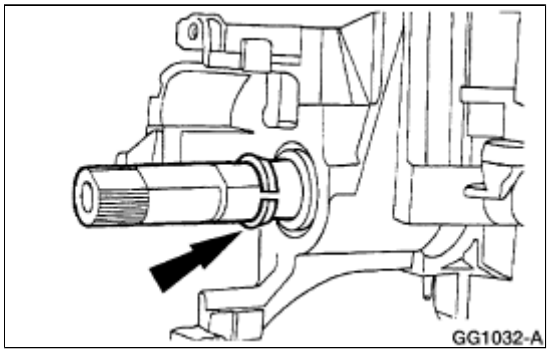


Item	Part Number	Description
1	—	Bearing slot
2	3511	Steering column lock cylinder housing
3	—	Outer race
4	—	Bearing (in the "UP" position)
5	—	Ball
6	—	Inner race

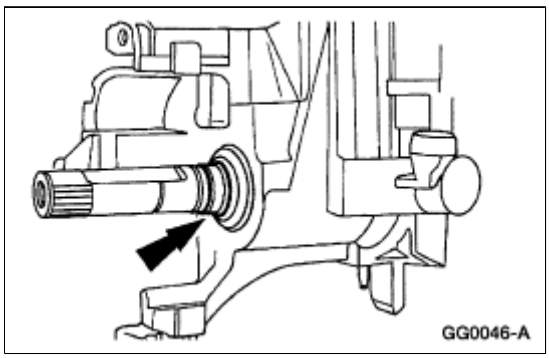


All vehicles

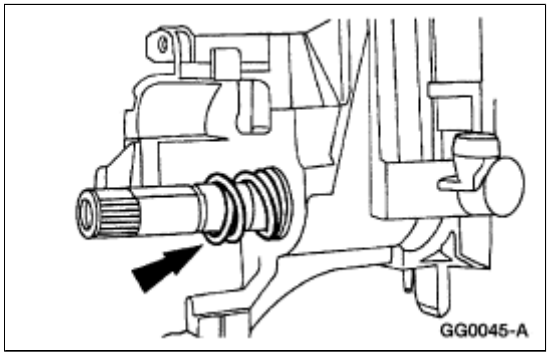
7. Position the steering column shaft in the steering column lock cylinder housing.
    - Install the steering column bearing tolerance ring on the steering column shaft.



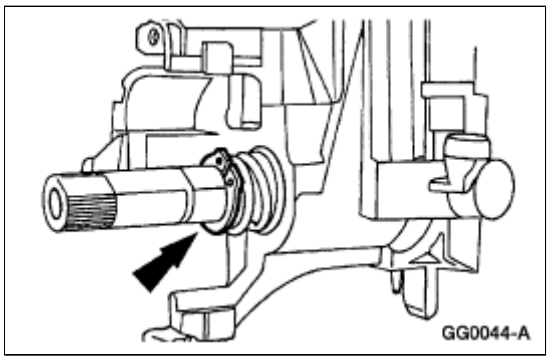
8. Install the steering column bearing sleeve.



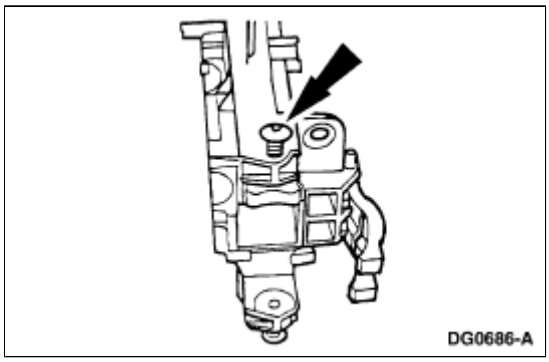
9. Install the steering column upper bearing spring.



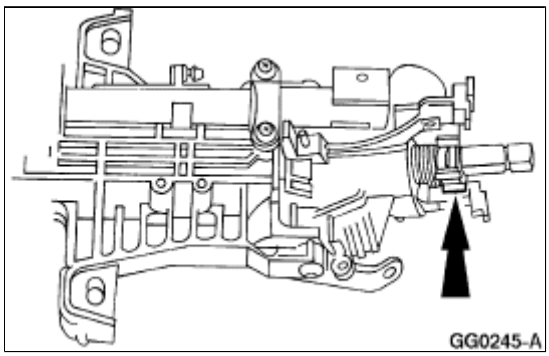
10. Install the snap ring.



11. Install the lock cylinder housing screws loosely and position the steering actuator housing in a vise.

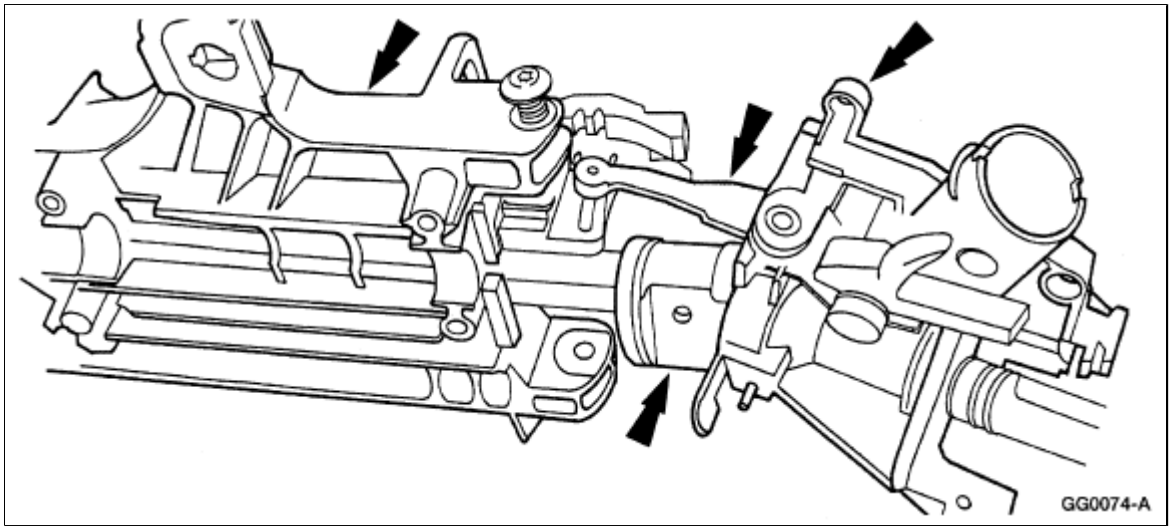


12. Install the turn signal cancel cam.

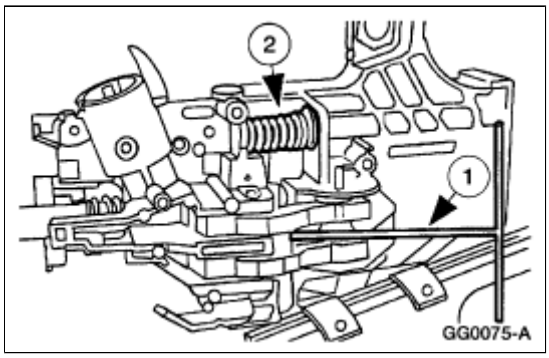


13. **NOTE:** Lubricate the lock cylinder housing bushings with Ignition Lock Grease FOAZ-19584-A or equivalent meeting Ford specification ESA-M1C232-A.

    Position the steering column lock cylinder housing and the steering column shaft on the steering actuator housing.
    - Make sure the upper and lower steering column lock actuators are aligned.

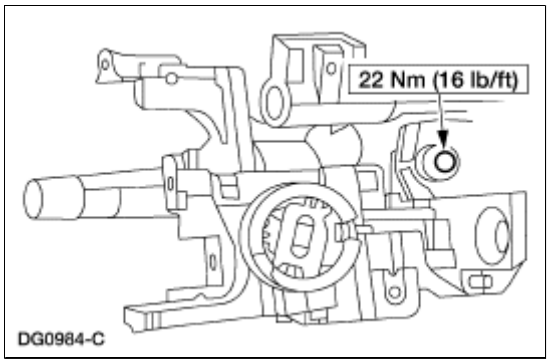


14. Position the steering column locking levers (3B661) on the steering actuator housing.
    1. Use a shop fabricated tool.
    2. On tilt steering columns, install and compress the steering column position spring.



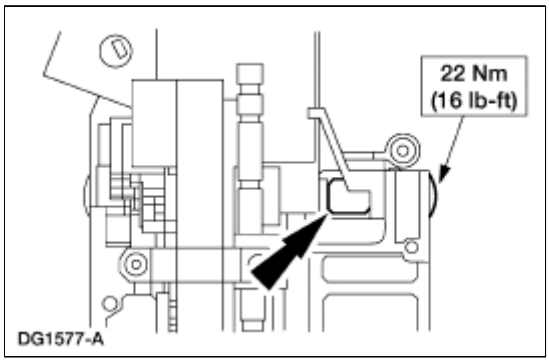
Vehicles with tilt steering columns

15. Tighten the lock cylinder housing screws.



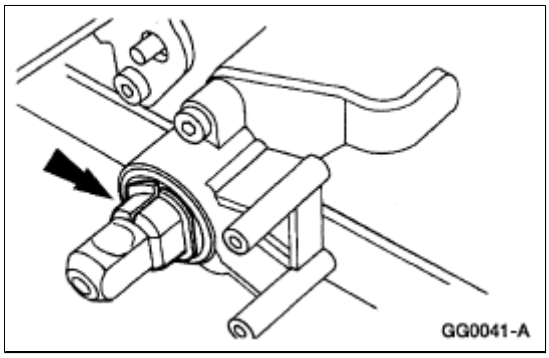
Vehicles with fixed steering columns

16. Install the steering column spacer (3C549). Tighten the two lock cylinder housing screws.
    - The steering column spacer is installed on the LH side of the steering column.



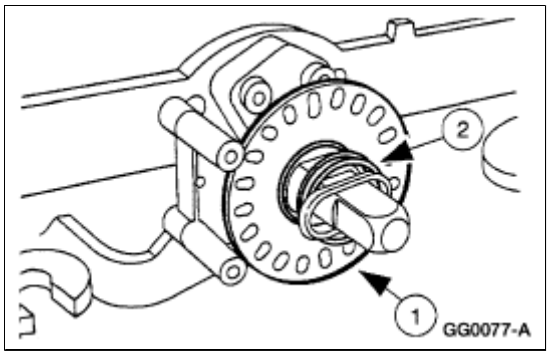
All vehicles

17. Install the steering column bearing tolerance ring.



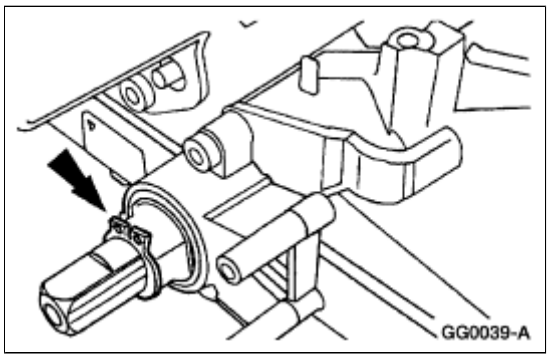
Vehicles with tilt steering columns

18. Install the sensor ring.
    1. Install the sensor ring.
    2. Install the steering column lower bearing spring.



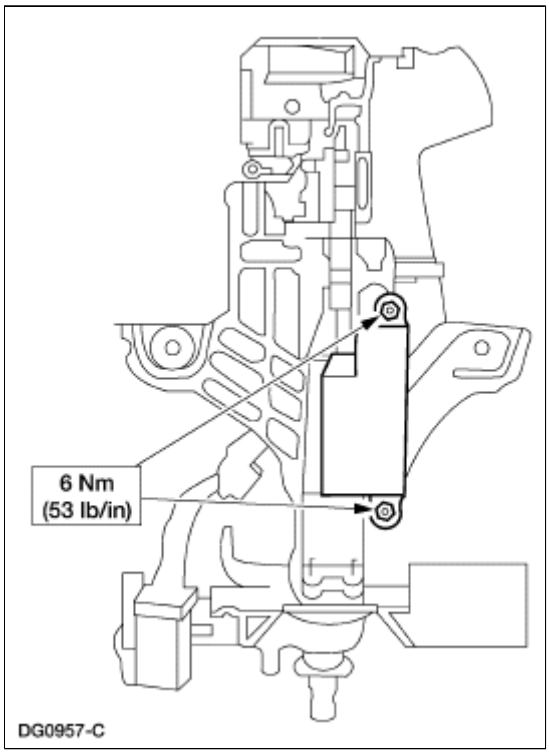
Vehicles with fixed steering columns

19. Install the snap ring.



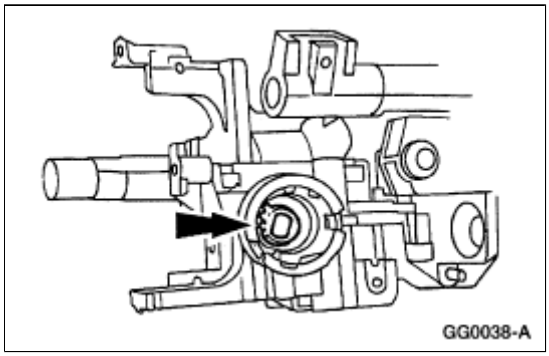
All vehicles

20. Install the ignition switch. Tighten bolts to specification.

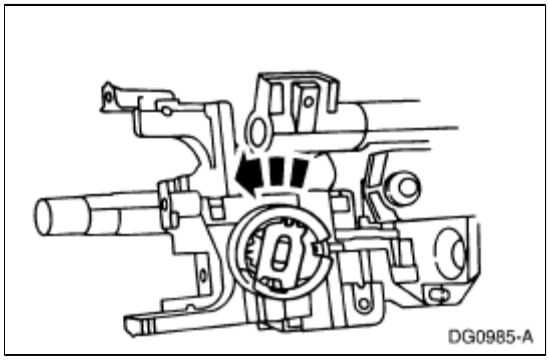


21. **NOTE:** The narrow section of the keyhole in the lock gear should be in the one o'clock position.

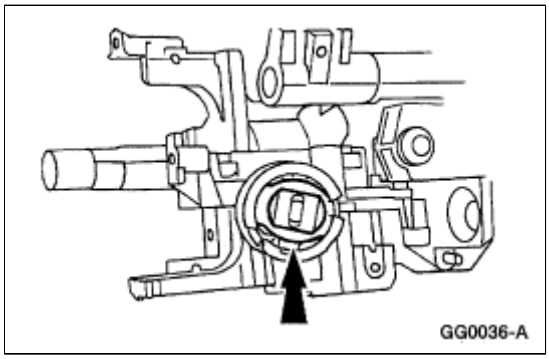
    Install the steering column lock gear.
    - Use Ignition Lock Grease FOAZ-19584-A or equivalent meeting Ford specification ESA-M1C232-A to coat the steering column lock gear.



22. Install the steering column 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 steering column lock housing bearing with Ignition Lock Grease FOAZ-19584-A or equivalent meeting Ford specification ESA-M1C232-A.



23. Install the steering column upper bearing retainer firmly to engage the four retention tabs into the lock housing.



24. Install the steering column. For additional information, refer to Column in this section.

25. Install the ignition switch lock cylinder. For additional information, refer to Ignition Switch Lock Cylinder—Functional Lock Cylinder or Ignition Switch Lock Cylinder—Non-Functional Lock Cylinder

in this section.

Steering Column —Automatic Transmission

Disassembly

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.

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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).

All vehicles

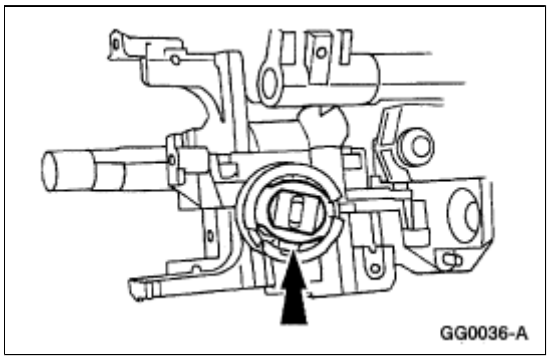
1. Remove the ignition switch lock cylinder. For additional information, refer to Ignition Switch Lock Cylinder—Functional Lock Cylinder or Ignition Switch Lock Cylinder—Non-Functional Lock Cylinder in this section.

2. Remove the air bag sliding contact. For additional information, refer to Section 501-20B .

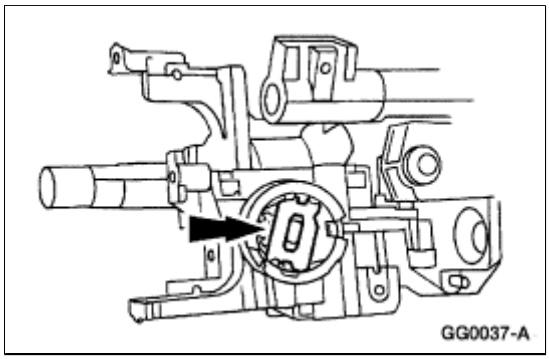
3. Remove the steering column (3C529). For additional information, refer to Column in this section.

4. **CAUTION: Carefully note the position of the steering column lock gear, bearing and retainer prior to removal.**

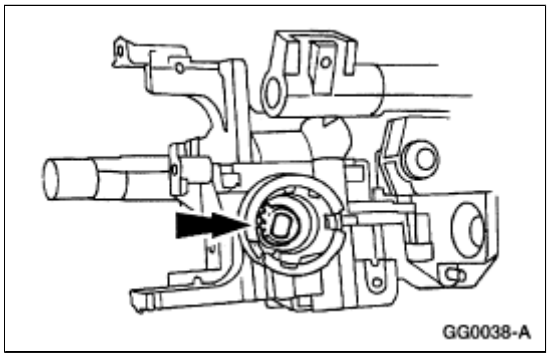
   Remove the bearing retainer (3C610).



5. Remove the steering column lock housing bearing (3E700).

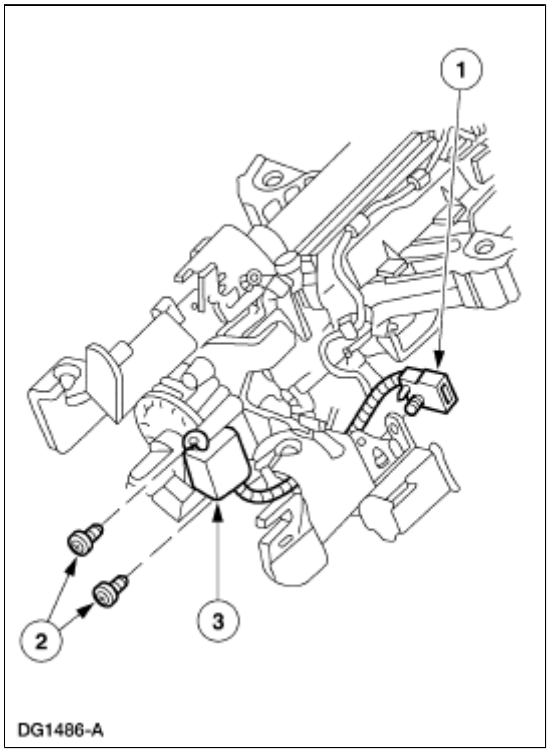


6. Remove the steering column lock gear (3E717).

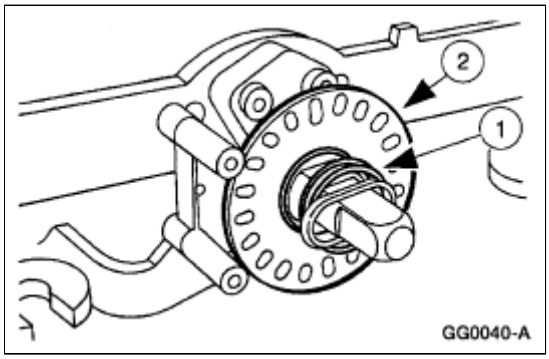


Vehicles with tilt steering columns

7. Remove the shock absorber electronic steering sensor (18B015).
    1. Disconnect the electrical connector.
    2. Remove the screws.
    3. Remove the shock absorber electronic steering sensor.

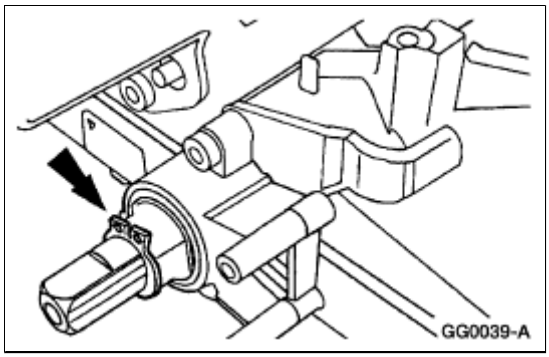


8. Remove the sensor ring.
    1. Remove the steering column lower bearing spring.
    2. Remove the sensor ring.



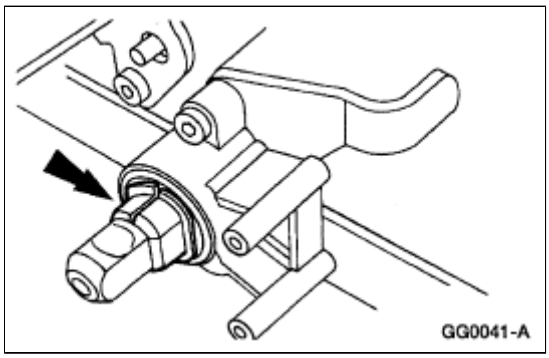
Vehicles with fixed steering columns

9. Remove the snap ring from the bottom of the steering column shaft.



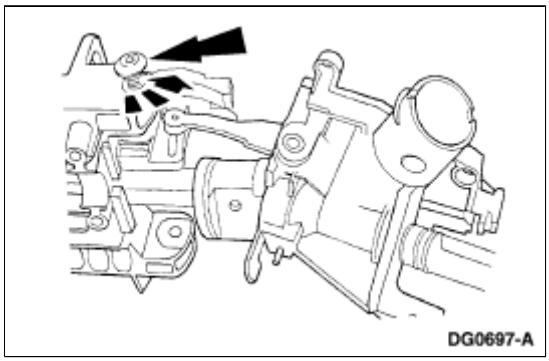
All vehicles

10. Remove the steering column bearing tolerance ring (3L539) from the steering column shaft.



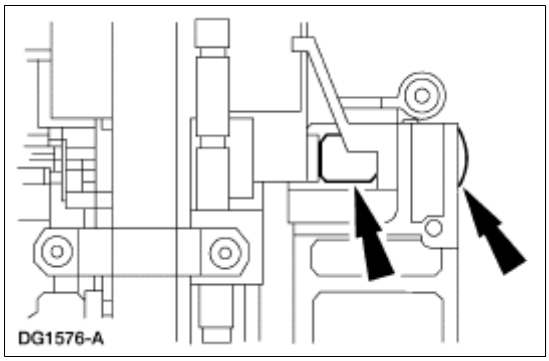
Vehicles with tilt steering columns

11. Remove the two lock cylinder housing pivot screws.



Vehicles with fixed steering columns

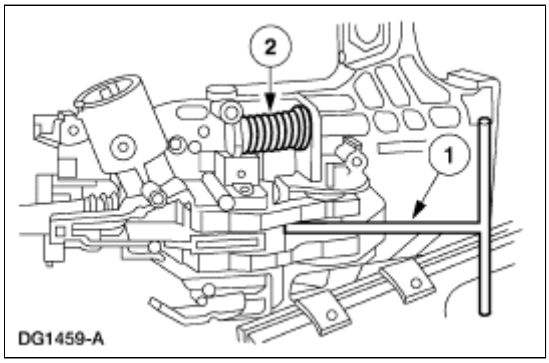
12. Remove the two lock cylinder housing screws and the steering column spacer (3C549).



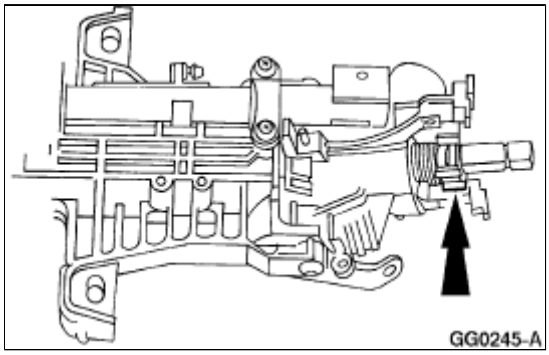
All vehicles

13. **WARNING: The steering column position spring is under tension and can come out with great force.**

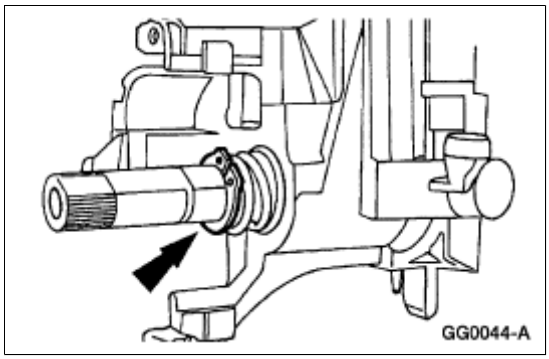
    Remove the steering column lock cylinder housing (3511) and the steering column shaft from the steering actuator housing (3F723).
    1. Pry up on the steering column locking levers (3B661) using a shop fabricated tool.
    2. On tilt steering columns, remove the steering column position spring (3D655).



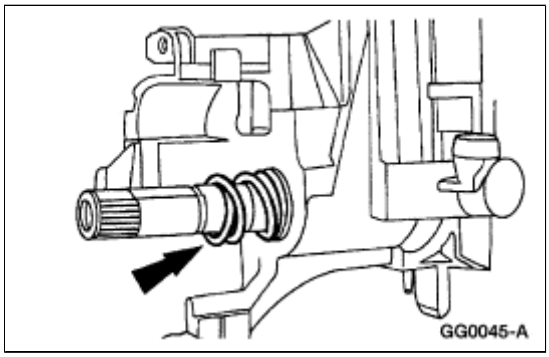
14. Remove the turn signal cancel cam.



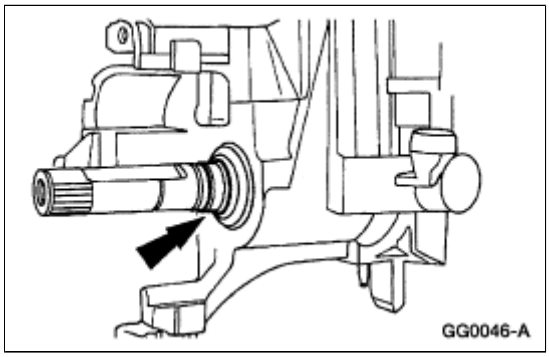
15. Remove the snap ring.



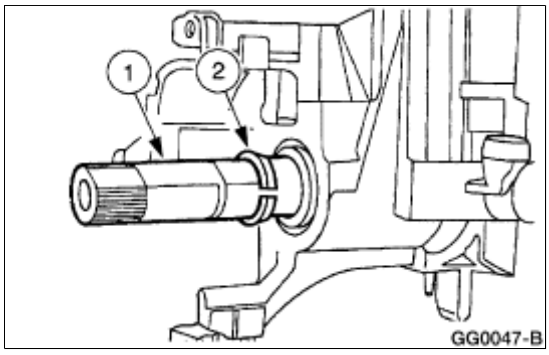
16. Remove the steering column upper bearing spring (3520).



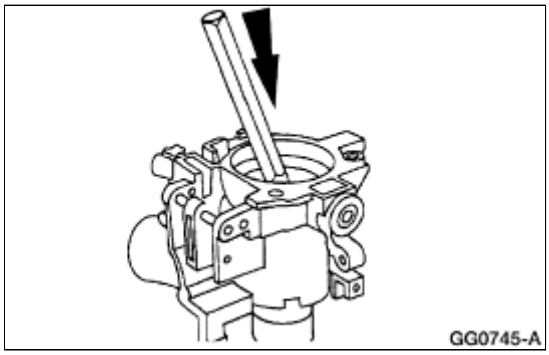
17. Remove the steering column bearing sleeve (3518).



18. Remove the steering column bearing tolerance ring.
    1. Slide the steering column shaft in toward the steering column lock cylinder housing, then out.
    2. Slide the steering column bearing tolerance ring off the steering column shaft.

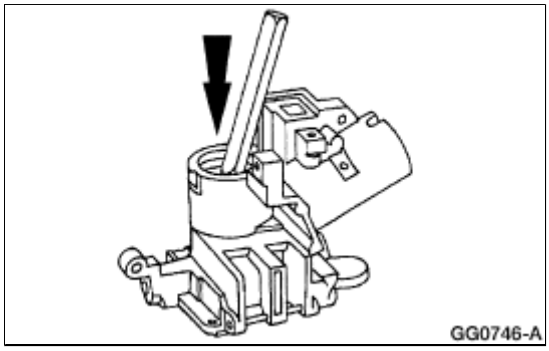


19. Using a suitable punch, remove the steering column bearing (3517) from the steering column lock cylinder housing.



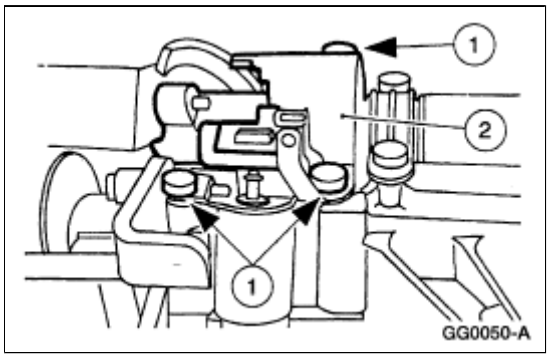
Vehicles with tilt steering columns

20. Use a suitable punch to remove the steering column bearing from the steering column lock cylinder housing.

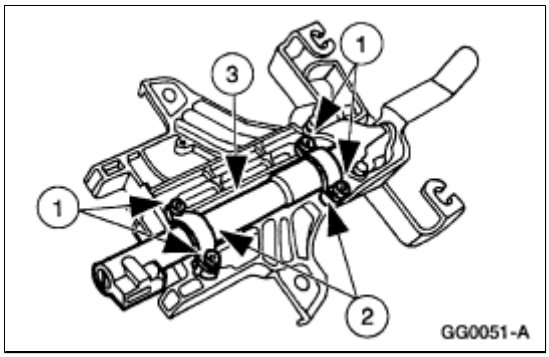


All vehicles

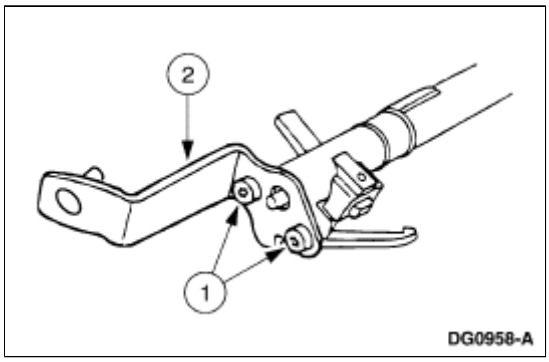
21. Remove the brake shift interlock solenoid.
    1. Remove the three bolts.
    2. Remove the brake shift interlock solenoid.



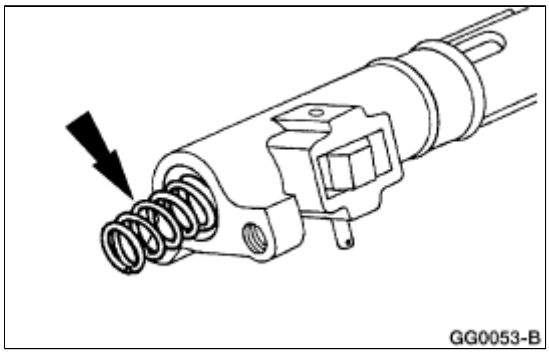
22. Remove the shift tube.
    1. Remove the four bolts.
    2. Remove the two shift tube clamps.
    3. Remove the shift tube.



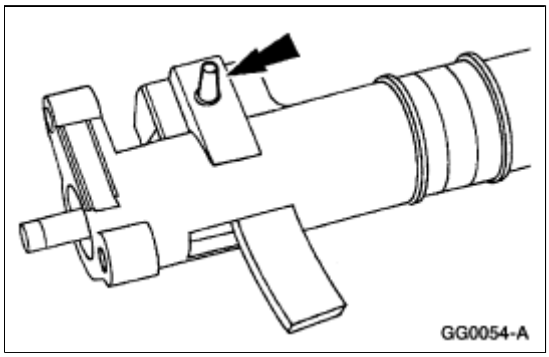
23. Remove the transmission selector lever arm and support (7302).
    1. Remove the two bolts.
    2. Remove the transmission selector lever arm and support.



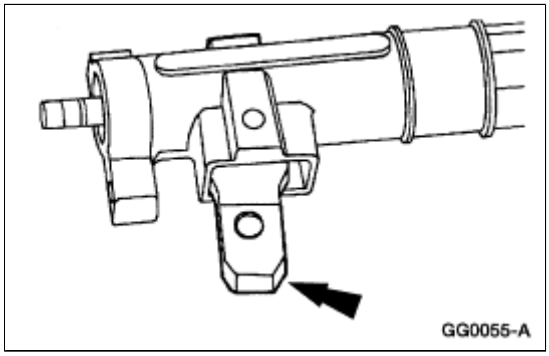
24. Remove the gearshift selector tube spring (7379).



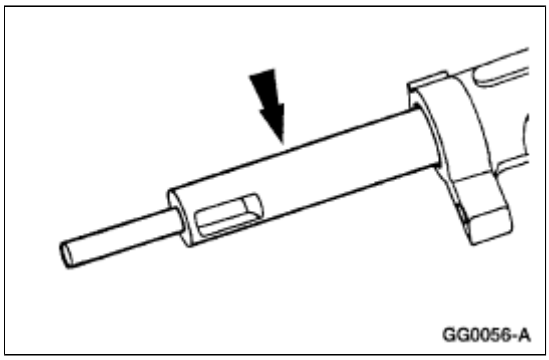
25. Drive out the gearshift lever pin (7W441) from the shift tube.



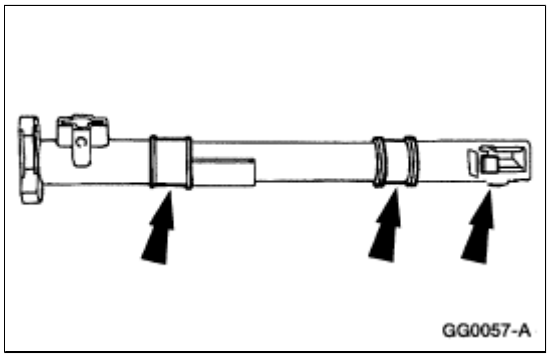
26. Remove the gearshift lever (7210).



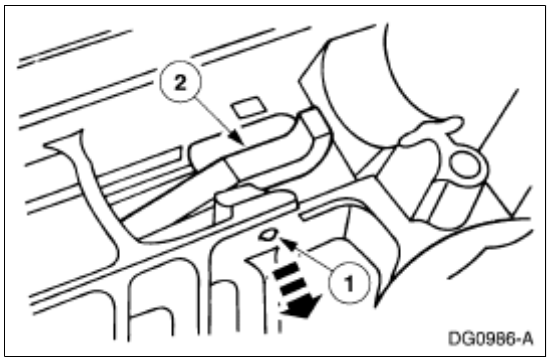
27. Remove the column shift selector lever plunger (7361).
    - If it is bent, install a new column shift selector lever plunger.



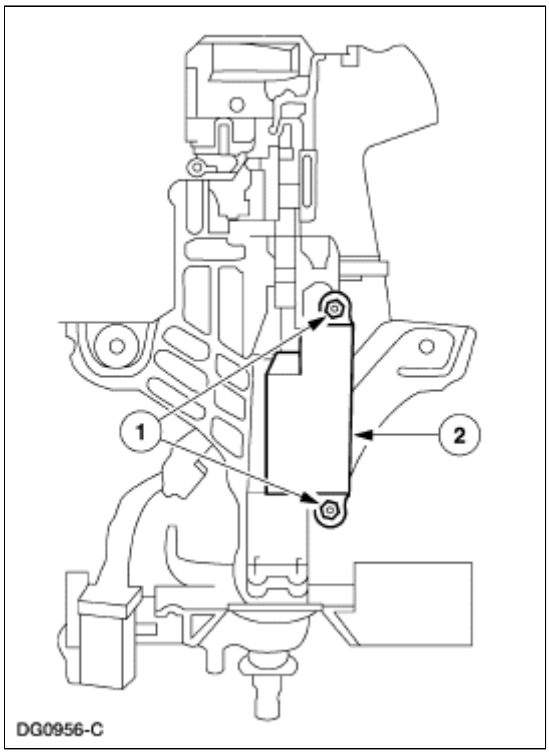
28. Remove the two gearshift lever socket bushings and the transmission control selector lever spring clip.



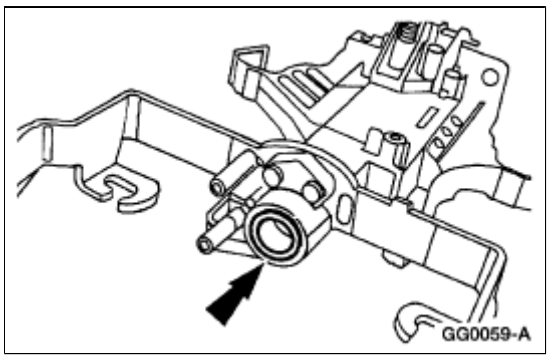
29. Remove the steering column lock pawl (3E691).
    1. Drive out the steering column lock lever pin.
    2. Remove the steering column lock pawl.



30. Remove the ignition switch (11572).
    1. Remove the bolts.
    2. Remove the ignition switch.

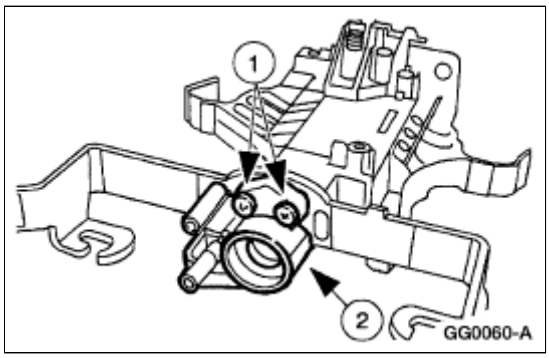


31. Remove the lower steering column bearing and sleeve.

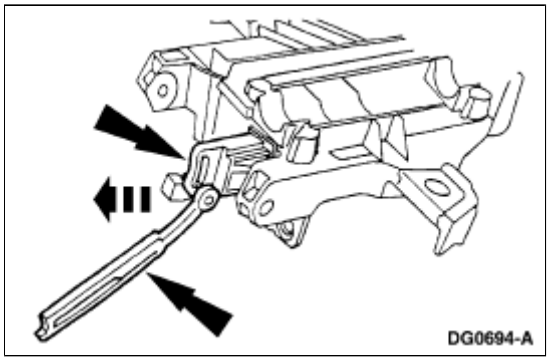


32. Remove the steering column lower bearing retainer.

1. Remove the three bolts.
2. Remove the steering column lower bearing retainer.



33. Remove the upper steering column lock actuator and the lower steering column lock actuator.



Assembly

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: 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: 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.

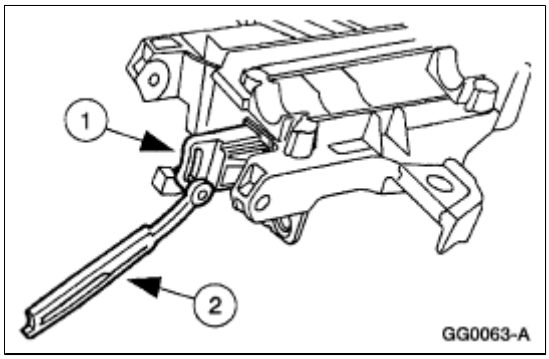
Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

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).

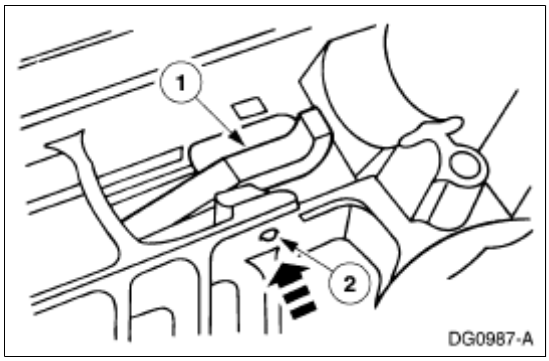
All vehicles

1. Install the steering column lock actuators.
    1. Use Ignition Lock Grease FOAZ-19584-A or equivalent meeting Ford specification ESA-M1C232-A to lubricate the steering column lock actuators.
    2. Install the steering column lock actuators.

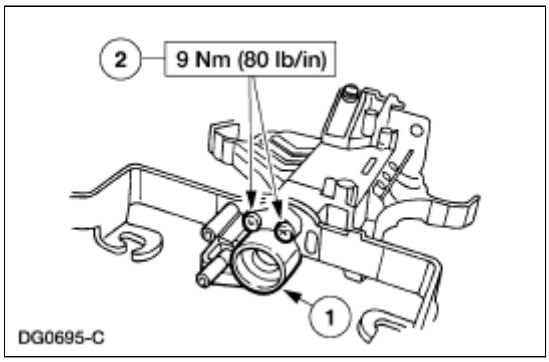


2. **NOTE:** Coat all surfaces with Ignition Lock Grease FOAZ-19584-A or equivalent meeting Ford specification ESA-M1C282-A.

    Install the steering column lock pawl.
    1. Position the steering column lock pawl.
    2. Drive in the steering column lock lever pin (3B663).



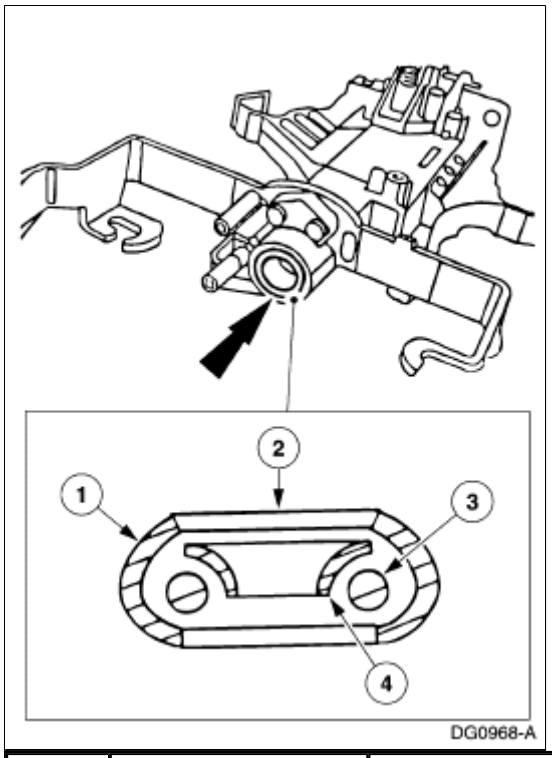
3. Install the steering column lower bearing retainer (3D681).
    1. Position the steering column lower bearing retainer.
    2. Install the three bolts.



4. **NOTE:** The "UP" position of the bearing must be facing forward, toward the engine.

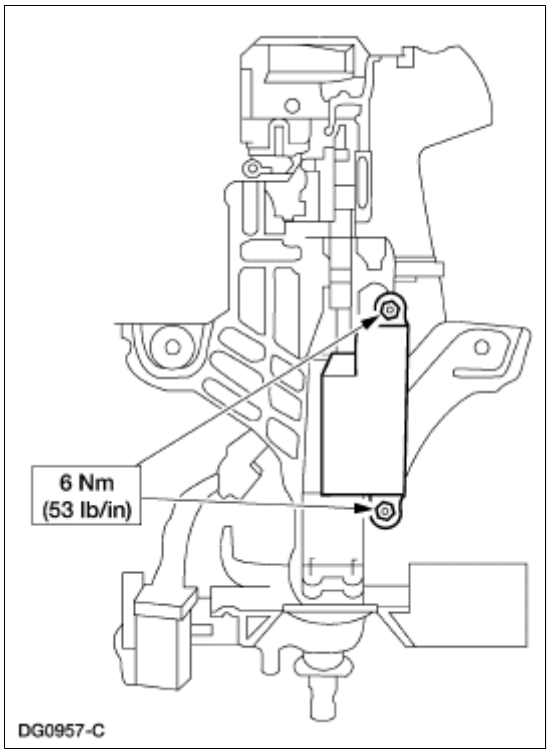
    NOTE: Install the steering column bearing and sleeve so that the inner race is visible when installed.

    Install the steering column bearing and sleeve.

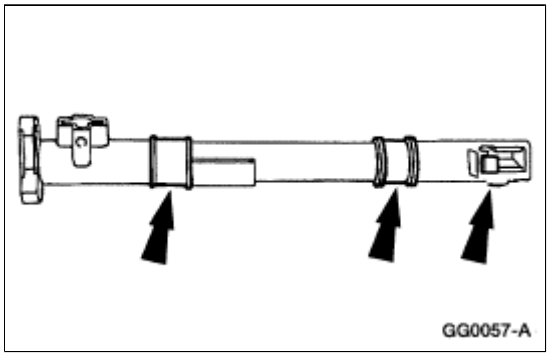


Item	Part Number	Description
1	—	Outer race
2	3517	Bearing (in the "UP" position)
3	—	Ball
4	—	Inner race

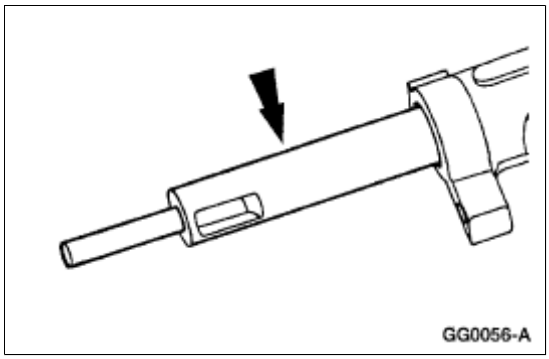
5. Install the ignition switch. Align the ignition switch with the slot and index mark on the steering column. Install the bolts.



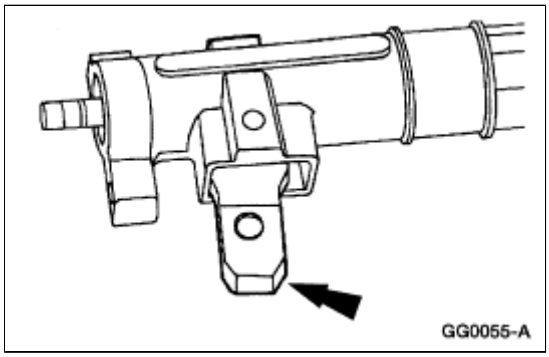
6. Install the transmission control selector lever spring clip and the gearshift lever socket bushings (7335) on the shift tube.
    - Coat the gearshift lever socket bushings with Steering Gear Grease C3AZ-19578-A or equivalent meeting Ford specification ESW-M1C87-A.



7. Install the column shift selector lever plunger.
    - Coat the column shift selector plunger with Steering Gear Grease C3AZ-19578-A or equivalent meeting Ford specification ESW-M1C87-A.

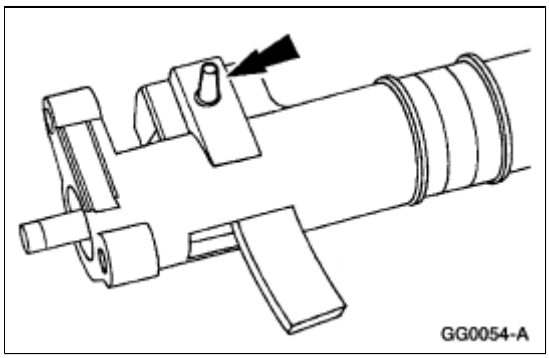


8. Position the gearshift lever in the shift tube.

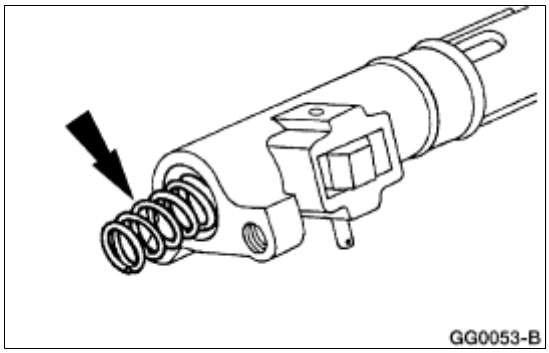


9. **CAUTION: Gearshift lever pin must be installed correctly or 1st gear position can be blocked.**

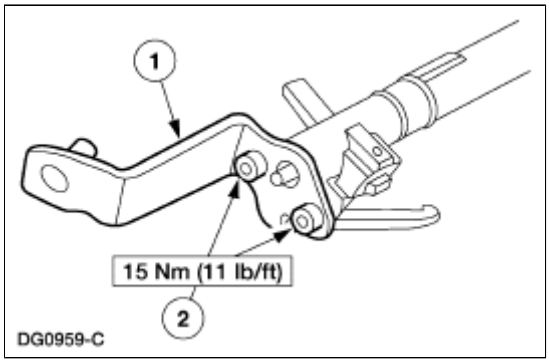
   Install the gearshift lever pin in the shift tube.



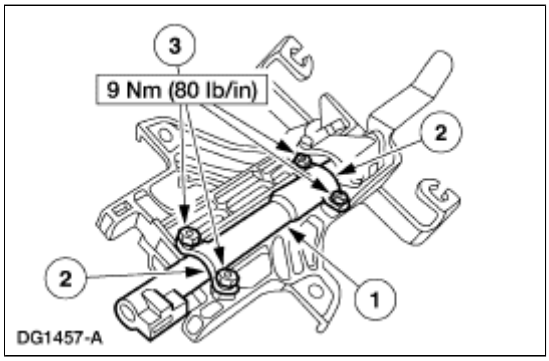
10. Install the gearshift selector tube spring in the shift tube.
    - Coat the end of the spring with Steering Gear Grease C3AZ-19578-A or equivalent meeting Ford specification ESW-M1C87-A.



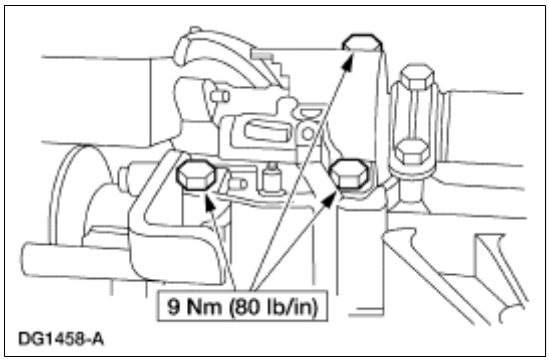
11. Install the transmission selector lever arm and support on the shift tube.
    1. Position the transmission selector lever arm and support.
    2. Install the bolts.



12. Install the shift tube.
    1. Position the shift tube.
    2. Position the shift tube clamps.
    3. Install the bolts.

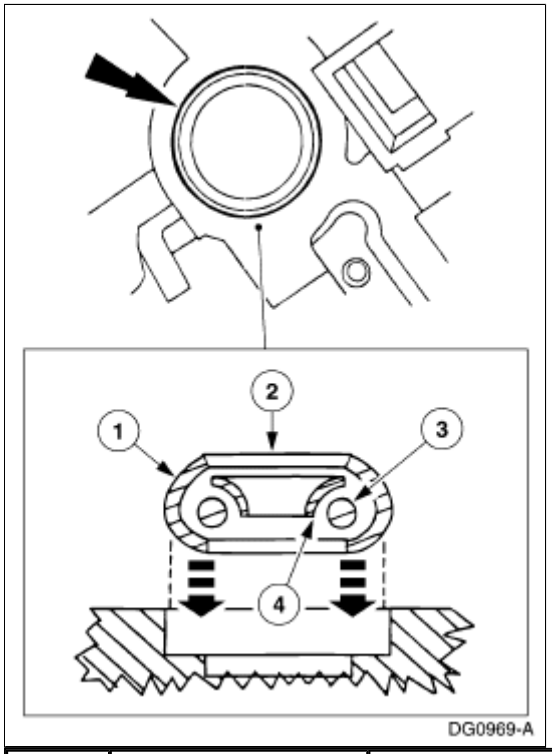


13. Position the brake shift interlock solenoid and install the bolts.

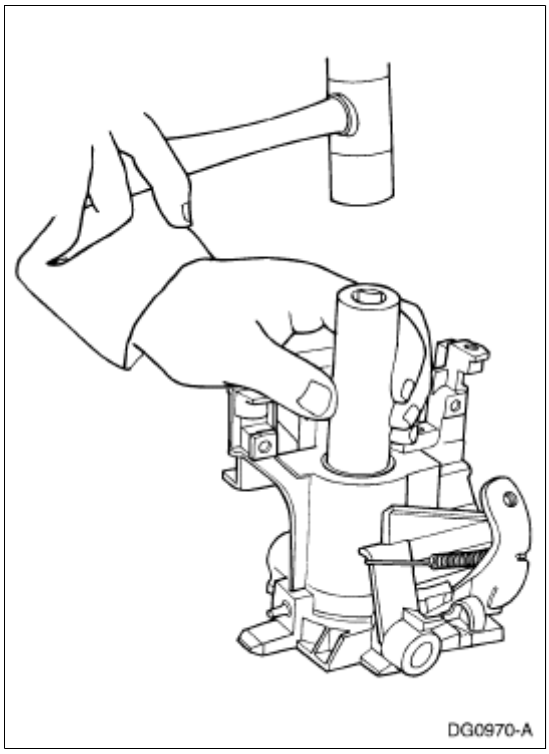


14. **CAUTION: Install the upper steering column bearing so that the inner race is visible when installed.**

Using an appropriate bearing installer or socket; install the upper steering column bearing on the steering column lock cylinder housing.



Item	Part Number	Description
1	—	Outer race
2	—	Bearing (in the "UP" position)
3	—	Ball
4	—	Inner race

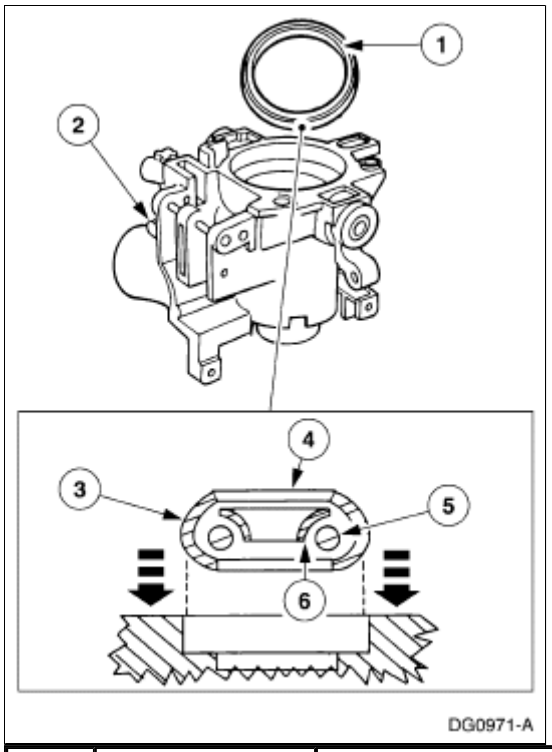


Vehicles with tilt steering columns

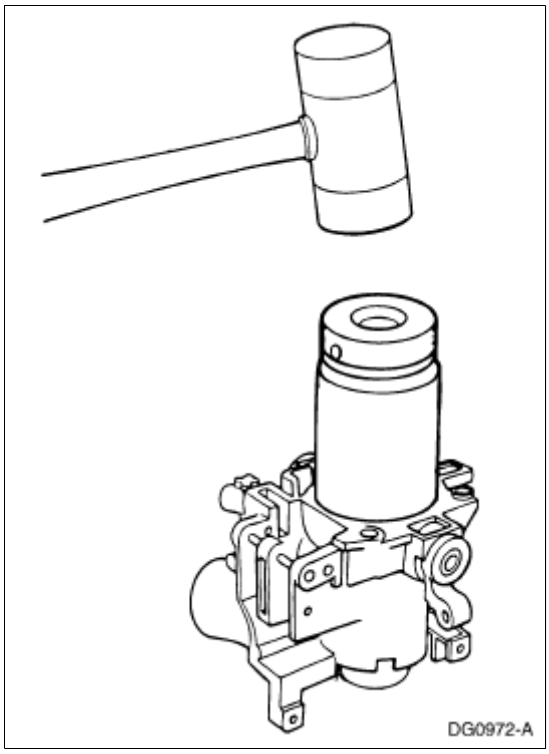
15. **CAUTION: Install the large steering column bearing so that the inner race is visible when installed.**

    NOTE: Use an appropriate bearing installer or socket.

    Install the large steering column bearing into the steering column lock cylinder housing.

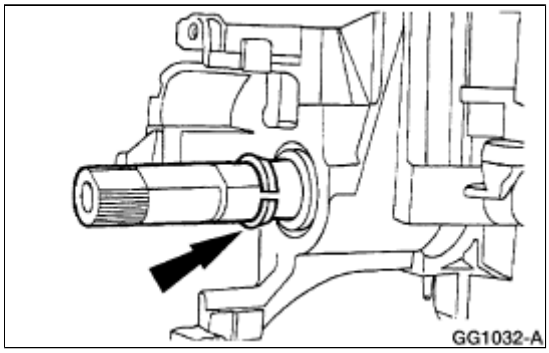


Item	Part Number	Description
1	—	Bearing slot
2	3511	Steering column lock cylinder housing
3	—	Outer race
4	—	Bearing (in the "UP" position)
5	—	Ball
6	—	Inner race

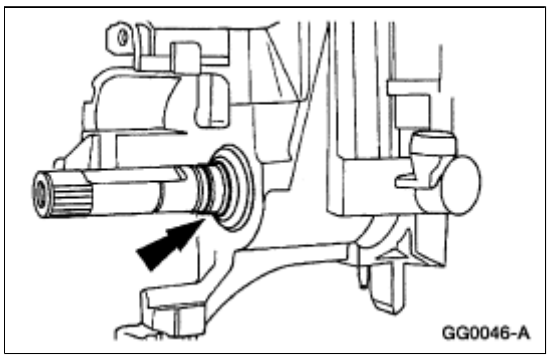


All vehicles

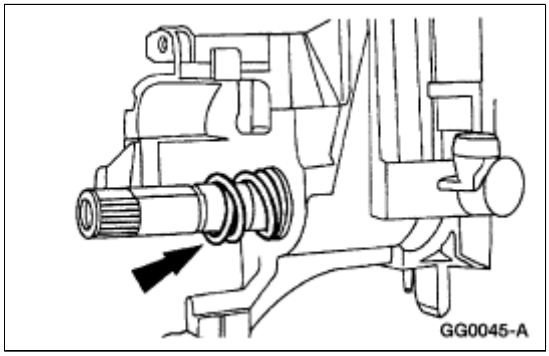
16. Position the steering column shaft in the steering column lock cylinder housing.
    - Install the steering column bearing tolerance ring on the steering column shaft.



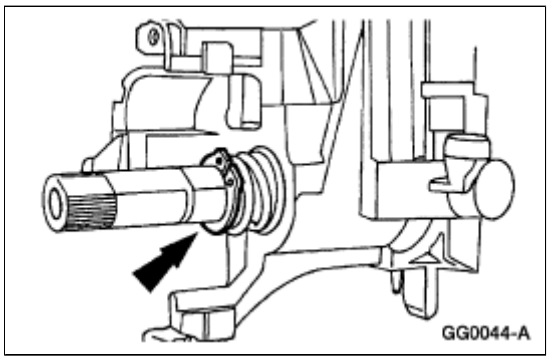
17. Install the steering column bearing sleeve.



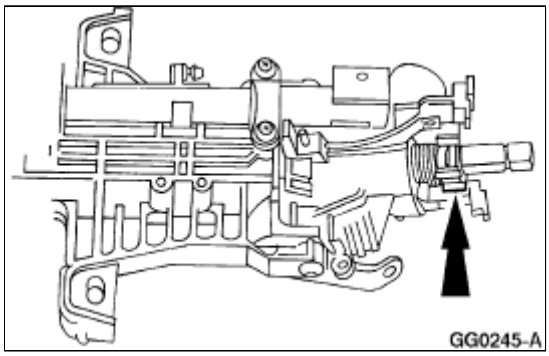
18. Install the steering column bearing spring (3C674).



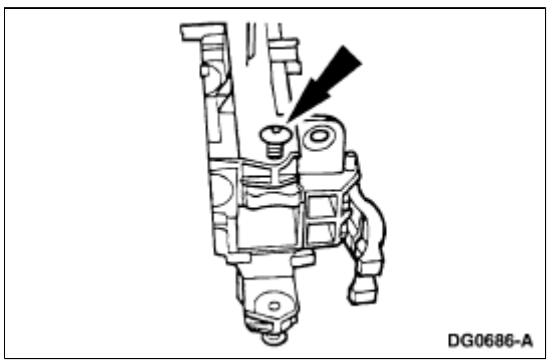
19. Install the snap ring.



20. Install the turn signal cancel cam.

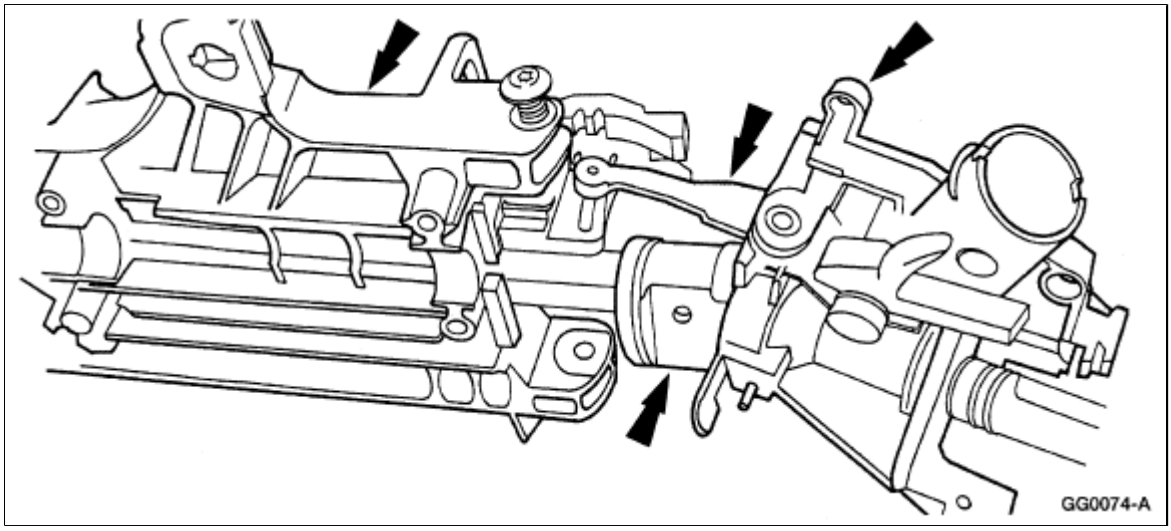


21. Install the lock cylinder housing screws loosely and position the steering actuator housing in a vise.

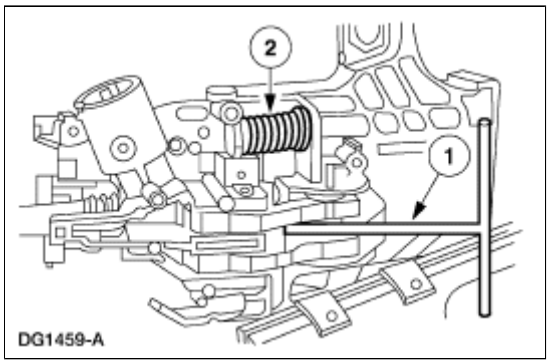


22. **NOTE:** Lubricate the lock cylinder housing bushings with Rust Penetrant and Inhibitor F2AZ-19A501-A or equivalent meeting Ford specification ESR-M99C56-A.

    Position the steering column lock cylinder housing and the steering column shaft on the steering actuator housing.
    - Make sure the upper and lower steering column lock actuators are aligned.

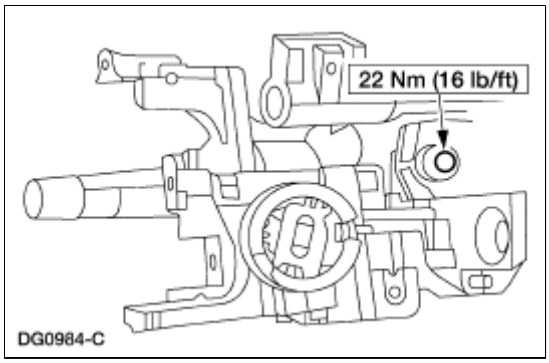


23. Position the steering column locking levers on the steering actuator housing.
    1. Use a shop fabricated tool.
    2. On tilt steering columns, install and compress the steering column position spring.



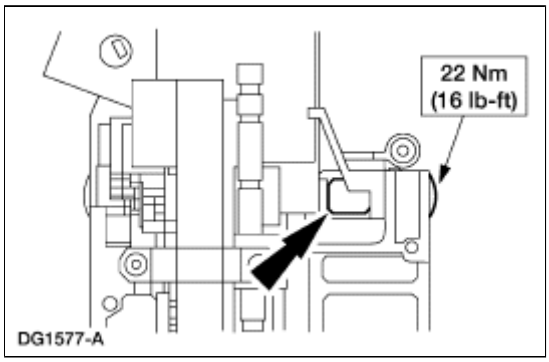
Vehicles with tilt steering columns

24. Position the lock cylinder housing and steering actuator housing, and tighten the lock cylinder housing screws.



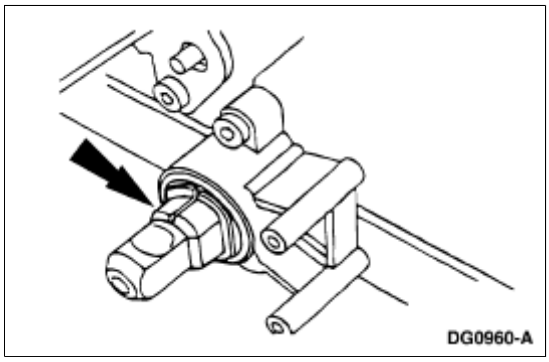
Vehicles with fixed steering columns

25. Install the steering column spacer (3C549). Tighten the two lock cylinder housing screws.
    - The steering column spacer is installed on the LH side of the steering column.



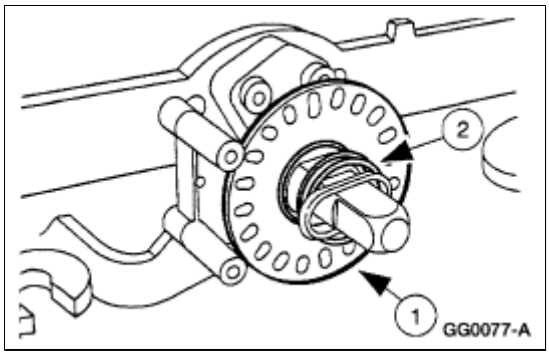
All vehicles

26. Install the steering column bearing tolerance ring.

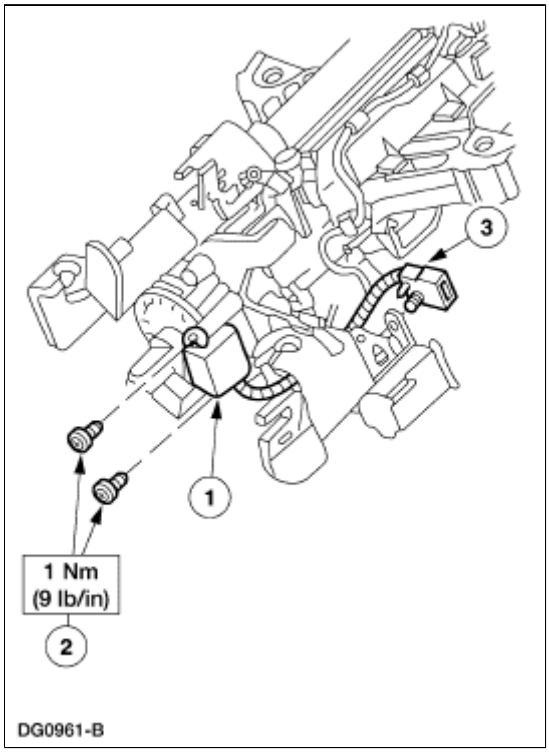


Vehicles with tilt steering columns

27. Install the sensor ring.
    1. Install the sensor ring.
    2. Install the steering column bearing spring.

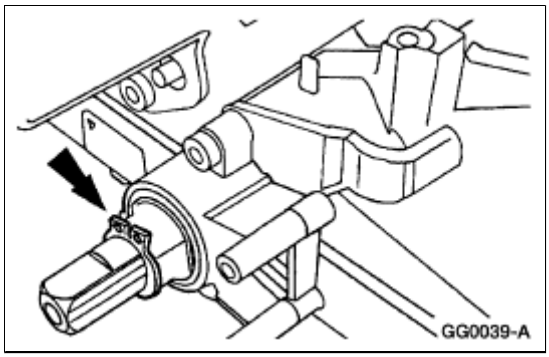


28. Install the shock absorber electronic steering sensor.
    1. Position the shock absorber electronic steering sensor.
    2. Install the screws.
    3. Connect the electrical connector.



Vehicles with fixed steering columns

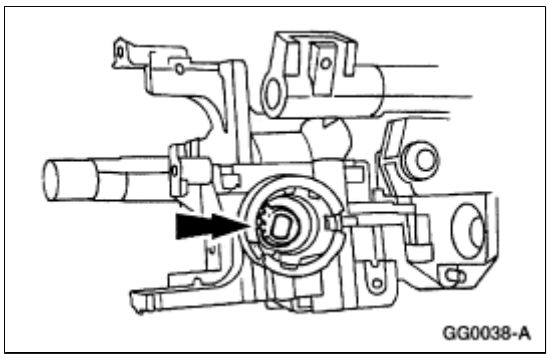
29. Install the snap ring.



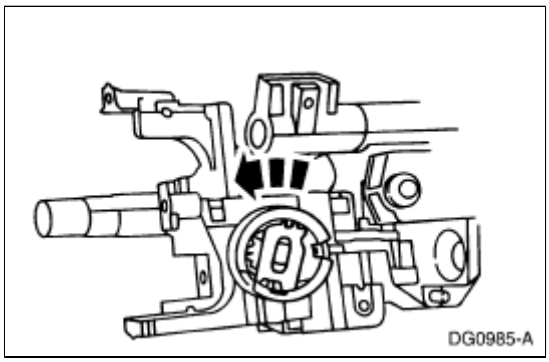
All vehicles

30. **NOTE:** The narrow section of the keyhole in the lock gear must be in the one o'clock position.

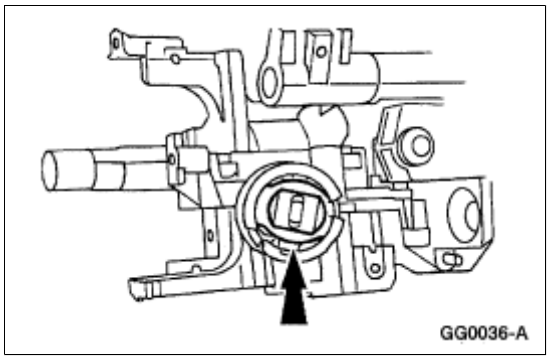
    Install the steering column lock gear.
    - Use Ignition Lock Grease FOAZ-19584-A or equivalent meeting Ford specification ESA-M1C232-A to coat the steering column lock gear.



31. Install the steering column 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 steering column lock housing bearing with Ignition Lock Grease FOAZ-19584-A or equivalent meeting Ford specification ESA-M1C232-A.



32. Install the steering column upper bearing retainer firmly to engage the four retention tabs into the lock housing.



33. Install the steering column. For additional information, refer to Column in this section.

34. Install the air bag sliding contact. For additional information, refer to Section 501-20B .

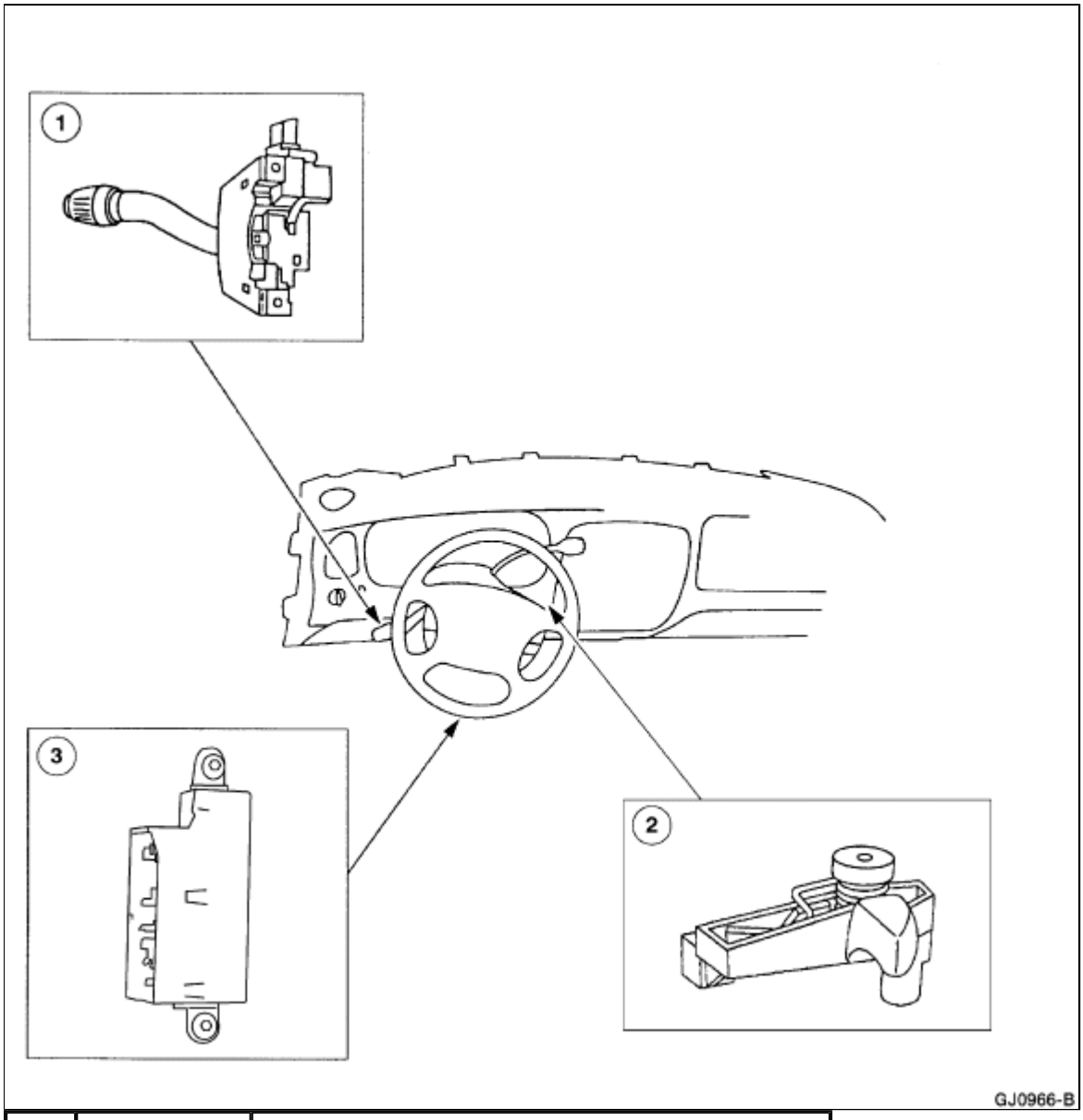
35. Install the ignition switch lock cylinder. For additional information, refer to Ignition Switch Lock Cylinder—Functional Lock Cylinder or Ignition Switch Lock Cylinder—Non-Functional Lock Cylinder in this section.

Torque Specifications

Description	Nm	lb-in
Battery Ground Cable Bolt	7-10	62-89
Hood Latch Release Handle Screws	2.7-3.7	25-33
Ignition Switch Electrical Connector Bolt	0.8-1.2	7.1-10.6
Ignition Switch Screws	5.3-7.2	47-64
Instrument Panel Steering Column Opening Cover Reinforcement Screws	7.6-10.4	—
Key Release Lever Bolt	4-6	36-53
Lower Instrument Panel Steering Column Cover Screws	2.7-3.7	25-33
Multi-Function Switch Screws	2-3	18-26
Parking Brake Release Handle Screws	2.7-3.7	25-33

Steering Column Switches

Steering Column Switches Component Location



Item	Part Number	Description
1	13K359	Multi-Function Switch
2	3F527	Key Release Lever (Manual Transmission Only)
3	11572	Ignition Switch

The integrated multi-function switch is mounted to the LH side of the steering column and controls the turn signals, hazard flasher, windshield wiper/washer control, headlamp dimmer/flash-to-pass.

The ignition switch is mounted below the steering column and is activated by rotating the key lock cylinder on the steering column.

The ignition key warning switch terminal and wire are secured to the steering column by integral locking fingers.

Steering Column Switches

Refer to Wiring Diagrams Cell 13 , Power Distribution 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.

Refer to Wiring Diagrams Cell 81 , Interval Wiper/Washer 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

Inspection and Verification

1. Verify the customer concern by operating the multi-function switch or ignition switch.
2. Visually inspect for the following obvious signs of mechanical and electrical damage:

Visual Inspection Chart

Mechanical	Electrical
• Damaged multi-function switch • Damaged ignition switch	• Failed fuse(s) • 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 properly 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. Perform 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/CTM, go to Pinpoint Test E.
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and perform self-test diagnostics for the GEM/CTM.

6. If the DTCs retrieved are related to the concern, go to the GEM/CTM 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/CTM Diagnostic Trouble Code (DTC) Index

GEM/CTM Diagnostic Trouble Code (DTC) Index

DTC	Description	DTC Caused By	Action
P0500	Vehicle Speed Signal Circuit Failure	GEM	REFER to Section 308-07A .
B1302	Accessory Delay Relay Coil Circuit Failure	GEM	REFER to Section 501-11 .
B1304	Accessory Delay Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1313	Battery Saver Relay Coil Circuit Failure	GEM/CTM	REFER to Section 417-02 .
B1315	Battery Saver Relay Coil Circuit Short to Battery	GEM/CTM	REFER to Section 417-02 .
B1317	Battery Voltage HIGH	GEM/CTM	REFER to Section 414-00 .
B1318	Battery Voltage LOW	GEM/CTM	REFER to Section 414-00 .
B1322	Door Ajar LF Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1323	Door Ajar Lamp Circuit Failure	GEM/CTM	REFER to Section 413-01 .
B1325	Door Ajar Lamp Circuit Short to Battery	GEM/CTM	REFER to Section 413-01 .
B1330	Door Ajar RF Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1334	Decklid Ajar Rear Door Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1338	RR Door Ajar Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1340	Chime Input Request Circuit Short to Ground	GEM/CTM	REFER to Section 413-09 .
B1342	GEM/CTM is Defective	GEM/CTM	CLEAR the DTCs. RETRIEVE the DTCs. If DTC B1342 is

			retrieved, REPLACE the GEM/CTM; REFER to Section 419-10 .
B1345	Heated Backlite Input Circuit Short to Ground	GEM	REFER to Section 501-11 .
B1347	Heated Backlite Relay Circuit Failure	GEM	REFER to Section 501-11 .
B1349	Heated Backlite Relay Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1352	Ignition Key-In Circuit Failure	GEM/CTM	REFER to Section 413-09 .
B1355	Ignition RUN Circuit Failure	GEM/CTM	REFER to Section 211-05 , Symptom Chart.
B1359	Ignition RUN/ACC Circuit Failure	GEM/CTM	REFER to Section 211-05 , Symptom Chart.
B1371	Illuminated Entry Relay Circuit Failure	GEM/CTM	REFER to Section 417-02 .
B1373	Interior Lamp Relay Coil Circuit Short to Battery	GEM/CTM	REFER to Section 417-02 .
B1398	Power Window LF One-Touch Window Relay Circuit Failure	GEM	REFER to Section 501-11 .
B1400	Power Window LF One-Touch Window Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-11 .
B1404	Power Window LF Down Circuit Open	GEM	REFER to Section 501-11 .
B1405	LF Power Window Down Circuit to Battery	GEM	REFER to Section 501-11 .
B1410	Power Window LF Motor Circuit Failure	GEM	REFER to Section 501-11 .
B1426	Seat Belt Lamp Circuit Short to Battery	GEM/CTM	REFER to Section 413-01 .
B1428	Seat Belt Lamp Circuit Failure	GEM/CTM	REFER to Section 413-01 .
B1431	Wiper Brake/Run Relay — Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1432	Wiper Brake/Run Relay Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1434	Wiper Hi/Lo Speed Relay — Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1436	Wiper Hi/Lo Speed Relay Circuit Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1438	Wiper Mode Select Switch Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1441	Wiper Mode Select	GEM/CTM	REFER to Section 501-16 .

	Switch Input Short to Ground		
B1446	Wiper Park Sense Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1450	Wiper/Washer Interval Delay Switch Input Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1453	Wiper/Washer Interval Delay Switch Input Short to Ground	GEM/CTM	REFER to Section 501-16 .
B1458	Wiper/Washer Pump Motor Relay Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1460	Wiper/Washer Pump Motor Relay Coil Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1462	Seat Belt Switch Circuit Failure	GEM/CTM	REFER to Section 413-09 .
B1466	Wiper Hi/Lo Speed Not Switching	GEM/CTM	REFER to Section 501-16 .
B1467	Wiper Hi/Lo Speed Circuit Motor Short to Battery	GEM/CTM	REFER to Section 501-16 .
B1473	Wiper Low Speed Circuit Motor Failure	GEM/CTM	REFER to Section 501-16 .
B1475	Accessory Delay Relay Contacts Short to Battery	GEM/CTM	REFER to Section 501-11 .
B1476	Wiper High Speed Circuit Motor Failure	GEM/CTM	REFER to Section 501-16 .
B1483	Brake Pedal Input Circuit Failure	GEM	REFER to Section 308-07A .
B1485	Brake Pedal Input Short Circuit to Battery	GEM	REFER to Section 308-07A .
B1574	LR Door Ajar Circuit Short to Ground	GEM/CTM	REFER to Section 417-02 .
B1577	Lamp Park Input Short Circuit to Battery	GEM/CTM	REFER to Section 413-09 .
B1610	Illuminated Entry Input (From RAP Module) Circuit Short to Ground	GEM	REFER to Section 417-02 .
B1611	Wiper Rear Mode Select Switch Circuit Failure	GEM	REFER to Section 501-16 .
B1614	Wiper Rear Mode Select Switch Circuit Short to Ground	GEM	REFER to Section 501-16 .
B1814	Wiper Rear Motor Down Relay Circuit	GEM	REFER to Section 501-16 .

	Failure		
B1816	Wiper Rear Motor Down Relay Coil Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1818	Wiper Rear Motor Up Relay Coil Circuit Failure	GEM	REFER to Section 501-16 .
B1820	Rear Wiper Motor Up Relay Circuit Short to Battery	GEM	REFER to Section 501-16 .
B1833	Door Unlock Switch Circuit Short to Ground	GEM	REFER to Section 501-14B .
B1834	Door Unlock Disarm Output Circuit Failure	GEM	REFER to Section 501-14B .
B1836	Door Unlock Disarm Output Circuit Short to Battery	GEM	REFER to Section 501-14B .
B1839	Wiper Rear Rear Motor Circuit Failure	GEM	REFER to Section 501-16 .
B1840	Wiper Front Power Circuit Failure	GEM/CTM	REFER to Section 501-16 .
B1894	Wiper Rear Motor Speed Sense Circuit Failure	GEM	REFER to Section 501-16 .
B2105	Throttle Position Input (TPI) Signal Out of Range Low	GEM	REFER to Section 308-07A .
B2106	Throttle Position Input (TPI) Signal Out of Range High	GEM	REFER to Section 308-07A .
B2141	NVM Configuration Failure	GEM/CTM	Vehicle speed calibration data is not programmed into the GEM/CTM. REFER to the scan tool help screen on the configuration card to program the tire size ratio. TEST the system for normal operation. If DTC B2141 is still present, REPLACE the GEM/CTM. REFER to Section 419-10 . TEST the system for normal operation.
P1763	Transmission Neutral InTow Indicator Circuit Short to Battery	GEM	REFER to Section 413-09 .
P1764	Transmission Neutral InTow Indicator Circuit Fault	GEM	REFER to Section 413-09 .
P1804	4WD High Indicator Circuit Failure	GEM	REFER to Section 308-07A .
P1806	4WD High Indicator Short Circuit to Battery	GEM	REFER to Section 308-07A .
P1808	4WD Low Indicator Circuit Failure	GEM	REFER to Section 308-07A .
P1810	4WD Low Indicator	GEM	REFER to Section 308-07A .

	Short Circuit to Battery		
P1812	4WD Mode Select Circuit Failure	GEM	REFER to Section 308-07A .
P1815	4WD Mode Select Short Circuit to Ground	GEM	REFER to Section 308-07A .
P1820	Transfer Case CW Shift Relay Coil Circuit Failure	GEM	REFER to Section 308-07A .
P1822	Transfer Case CW Shift Relay Coil Short to Power	GEM	REFER to Section 308-07A .
P1824	4WD Electric Clutch Relay Circuit Failure	GEM	REFER to Section 308-07A .
P1826	4WD Low Clutch Relay Short to Battery	GEM	REFER to Section 308-07A .
P1828	Transfer Case CCW Shift Relay Circuit Failure	GEM	REFER to Section 308-07A .
P1830	Transfer Case CCW Shift Relay Coil Short to Battery	GEM	REFER to Section 308-07A .
P1836	Transfer Case Front Shaft Speed Sensor Circuit Failure	GEM	REFER to Section 308-07A .
P1837	Transfer Case Rear Shaft Speed Sensor Circuit Failure	GEM	REFER to Section 308-07A .
P1838	Transfer Case Shift Motor Circuit Failure	GEM	REFER to Section 308-07A .
P1846	Transfer Case CONTACT PLATE "A" Circuit Failure	GEM	REFER to Section 308-07A .
P1850	Transfer Case CONTACT PLATE "B" Circuit Failure	GEM	REFER to Section 308-07A .
P1854	Transfer Case CONTACT PLATE "C" Circuit Failure	GEM	REFER to Section 308-07A .
P1858	Transfer Case CONTACT PLATE "D" Circuit Failure	GEM	REFER to Section 308-07A .
P1866	Transfer Case System Concern	GEM	REFER to Section 308-07A .
P1867	Transfer Case Contact Plate General Circuit Failure	GEM	REFER to Section 308-07A .
P1874	Automatic Hall Effect Sensor Power Circuit Failure	GEM	REFER to Section 308-07A .

P1875	Automatic Hall Effect Sensor Power Circuit Short to Battery	GEM	REFER to Section 308-07A .
P1891	Transfer Case Contact Plate Ground Return Open Circuit	GEM	REFER to Section 308-07A .

GEM/CTM Parameter Identification (PID) Index

GEM/CTM Parameter Identification (PID) Index

PID	Description	Expected Values
VSS_GEM	Vehicle Speed Input	0 - 255 KPH
PARK_SW	External Access Ajar Switch Status	OFF, ON
D_DR_SW	Left Front Door Ajar Switch Status	CLOSED, AJAR
DR_DSRM	Door Disarm Switch Status	L_DOOR, R_DOOR, LIFT_G, OFF
DR_UNLK	All Doors Unlock Output State	ON---, OFF---, ON-B-, OFFO-G
P_DR_SW	Right Passenger Door Ajar Switch Status	CLOSED, AJAR
IGN_KEY	Key-In-Ignition Status	IN, OUT
IGN_GEM	Ignition Switch Status	START, RUN, OFF, ACCY
BATSAV	Battery Saver Relay Circuit	ON---, OFF---, ON-B-, OFFO-G
VBATGEM	Battery Voltage	0.0 VDC - 14.3 VDC
LGATESW	Liftgate Ajar Switch Status	CLOSED - AJAR
LRDR_SW	Left Rear Door Ajar Switch Status	CLOSED - AJAR
RRDR_SW	Right Rear Door Ajar Switch Status	CLOSED - AJAR
INTLMP	Illuminated Entry Relay Circuit	ON---, OFF---, ON-B-, OFFO-G
CLTCHSW	Transmission Clutch Interlock Switch (GEM Only)	ENGAGED, NOT ENGAGED
NTRL_SW	Neutral Safety Switch Input (GEM Only)	NTRL, not NTRL
MTR_CCW	Transmission Transfer CCW Motor Output (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
MTR_CW	CW Shift Relay Coil Status (GEM Only)	OFF---, ON---, OFFO-G, ON-B-
4WD_SW	4WD Switch Status (GEM Only)	AUTO, 4WDLOW, 4WDHIGH
4WDELCL	4WD Electric Clutch	ON---, OFF---, ON-B-, OFFO-G
TRANSGR	Transmission Gear Status	REV, notREV
4WDCLCH	4WD Electronic Clutch Output Status (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
4WDLOW	4WD Low Indicator Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
4WDHIGH	4WD High Indicator Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
PLATE_A	Transfer Case Contact Plate Switch A (GEM Only)	OPEN, CLOSED
PLATE_B	Transfer Case Contact Plate Switch B (GEM Only)	OPEN, CLOSED
PLATE_C	Transfer Case Contact Plate Switch C (GEM Only)	OPEN, CLOSED
PLATE_D	Transfer Case Contact Plate Switch D (GEM Only)	OPEN, CLOSED

BOO_GEM	Brake Pedal Position (BPP) Switch Input (GEM Only)	ON, OFF
HALLPWR	Hall Effect Speed Sensor Power (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
4WDCLST	4WD Clutch PWM Output Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
TRA_RSP	Rear Shaft Speed (GEM Only)	0-255 mph
TRA_FSP	Front Shaft Speed (GEM Only)	0-225 mph
PLATEPW	Contact Plate Ground Output (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
PWR_RLY	ABS Active Input	ON, OFF
NTF	Neutral Tow Function (GEM Only)	ON, OFF
NTF_LMP	Neutral Tow Light (GEM Only)	ON, OFF
D_SBELT	Driver Seat Belt Status	OUT, IN
IPCHIME	External Chime Request	ON, OFF
SBLTMP	Seat Belt Indicator Status	OFF, ON, OFFO-G, ON-B-
DRAJR_L	Door Ajar Warning Lamp Circuit	OFF, ON
D_PWRLY	One Touch Down Relay Coil Circuit Status (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
D_ PWAMP	LF Power Window Regulator Electric Drive Current (GEM Only)	0.25 amp increments
D_PWPK	LF Power Window Regulator Electric Drive Peak Current (GEM Only)	0.25 amp increments
ACCDLY	Accessory Delay Relay Coil Circuit (GEM Only)	ON---, OFF---, ON-B-, OFFO-G
RDEF_ SW	Rear Defrost Control Switch Status	ON, OFF
RDEFRLY	Rear Window Defrost Relay Coil Circuit	ON---, OFF---, ON-B-, OFFO-G
WASHRLY	Washer Relay Status	ON---, OFF---, ON-B-, OFFO-G
WPPK_PK	Wiper Park-to-Park Time	0 - 65 Seconds
WPMODE	Wiper Control Mode Status	WASH, OPEN, INVLD, OFF, INTVL 1-7, LOW, HIGH
WPPRKSW	Wiper Motor Status	PARKED, notPRK
WPRUN	Wiper Mode Run Relay	ON---, OFF---, ON-B-, OFFO-G
WPHISP	Windshield Wiper HI/LO Relay Status	ON---, OFF---, ON-B-, OFFO-G
WASH_SW	Washer Pump Relay Switch Status	OFF, ON, ON-B-, OFFO-G
R_WP_UP	Rear Wiper Up Relay Status (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
R_WP_DN	Rear Wiper Down Relay Status (GEM Only)	ON---, OFF---, OFFO-G, ON-B-
R_WP_SW	Rear Wiper Input Switch Status (GEM Only)	WPLOW, OFF, WPHIGH
R_WP_MD	Rear Wiper Mode Switch Status (GEM Only)	OFF, INTVL 1-2, LOW WASH
R_WP_PK	Rear Wiper Park Status (GEM Only)	PARKED, notPRK

GEM/CTM Active Command Index

GEM/CTM Active Command Index

Active Command	Display	Action
PID LATCH	PID LATCH	ON, OFF
FRONT WIPER	WIPER RLY	ON, OFF
FRONT WIPER	SPEED RLY	ON, OFF
FRONT WIPER	WASH RLY	ON, OFF
WARNING LAMPS AND CHIME	SBLT LAMP	ON, OFF
WARNING LAMPS AND CHIME	CHIME	ON, OFF
WARNING LAMPS AND CHIME	AJAR LAMP	ON, OFF
BATTERY SAVER	BATT SAVR	ON, OFF
INTERIOR COURTESY LAMPS	INT LAMPS	ON, OFF
ONE TOUCH DOWN AND ACCY DELAY (GEM Only)	ACCY RLY	ON, OFF
ONE TOUCH DOWN AND ACCY DELAY (GEM Only)	ONE TOUCH	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	CW/CCW	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	HIGH LAMP	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	LOW LAMP	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	PLATE PWR	ON, OFF
4-WHEEL ELECTRONIC SHIFT (GEM Only)	SHFT CLCH	ON, OFF
SHIFT CLUTCH CONTROL	CLUTCH SOL	ANALOG %
NEUTRAL IN TOW LAMP	NTFLAMP	ON, OFF
REAR WIPER (GEM Only)	UP RELAY	ON, OFF
REAR WIPER (GEM Only)	DWN RELAY	ON, OFF
HEATED BACKLIGHT	RLY CNTRL	ON, OFF
DOOR LOCK CONTROL	DD UNLOCK	ON, OFF

GEM/CTM Wiggle Test Diagnostic Trouble Code (DTC) Index

GEM/CTM Wiggle Test Diagnostic Trouble Code (DTC) Index

DTC	Description	DTC Caused By
B1317	Battery Voltage HIGH	GEM/CTM
B1318	Battery Voltage Low	GEM/CTM
B1322	Driver Door Ajar Circuit Short to Ground	GEM/CTM
B1330	Passenger Door Ajar Short to Ground	GEM/CTM
B1352	Ignition Key-In Circuit Failure	GEM/CTM
B1410	Left Power Window Motor Circuit Failure	GEM
B1438	Wiper Mode Select Switch Circuit Failure	GEM/CTM
B1441	Wiper Mode Select Switch Short to Ground	GEM/CTM
B1446	Wiper Park Sense Circuit Failure	GEM/CTM

B1450	Wiper/Wash Interval Delay Switch Input Circuit Failure	GEM/CTM
B1453	Wiper/Wash Interval Delay Switch Input Short to Ground	GEM/CTM
B1462	Seat Belt Switch Circuit Failure	GEM/CTM
B1577	Park Lamp Input Circuit Short to Battery	GEM/CTM
B1610	Illuminated Entry Input (From RAP Module) Circuit Short to Ground	GEM/CTM
B1833	Door Unlock Disarm Switch Circuit Short to Ground	GEM

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• The Ignition Switch Is Inoperative	• Fuse(s). • Circuitry. • Ignition switch (11572).	• GO to Pinpoint Test A .
• No Power in ACC	• Ignition switch. • Circuitry.	• GO to Pinpoint Test B .
• No Power in RUN	• Ignition switch. • Circuitry.	• GO to Pinpoint Test C .
• No Power in START	• Ignition switch. • Circuitry.	• GO to Pinpoint Test D .
• No Communication With the Module — GEM/CTM	• Fuse. • Circuitry. • Module.	• GO to Pinpoint Test E .
• The Multi-Function Switch Hazard Switch Does Not Operate Properly	• Multi-function switch (13K359).	• GO to Component Test.
• High Key Efforts	• Ignition switch lock cylinder. • Steering column shrouds. • Casting/actuator binds, sticks, grabs with key rotation. • Ignition switch.	• GO to Component Test.

Pinpoint Tests

PINPOINT TEST A: THE IGNITION SWITCH IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK THE FUSE	
1	

2

Maxi-Fuse 1 (50A)

3 Check the power distribution box maxi-fuse 1 (50A).

- **Is the fuse OK?**

→ **Yes**
GO to A2 .

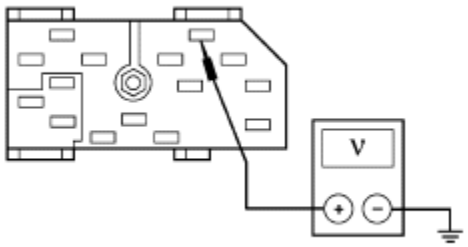
→ **No**
REPLACE maxi-fuse 1 (50A). TEST the system for normal operation. If the fuse fails again, CHECK for short to ground. REPAIR as necessary. TEST the system for normal operation.

A2 CHECK THE VOLTAGE SUPPLY TO THE IGNITION SWITCH

1

Ignition Switch C233

2



GJ0469-A

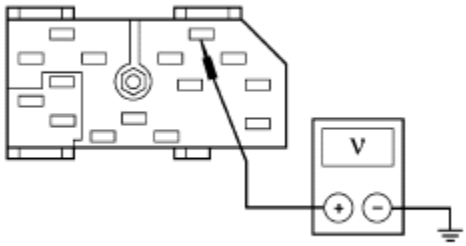
2 Measure the voltage between the ignition switch C233-B5, circuit 37 (Y), and ground.

- **Is the voltage greater than 10 volts?**

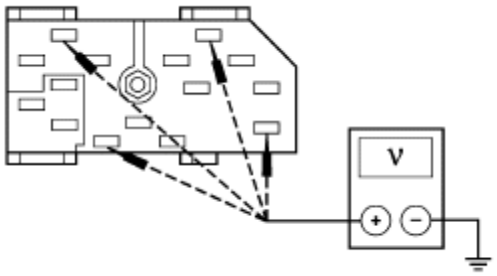
→ **Yes**
REPLACE the ignition switch. TEST the system for normal operation.

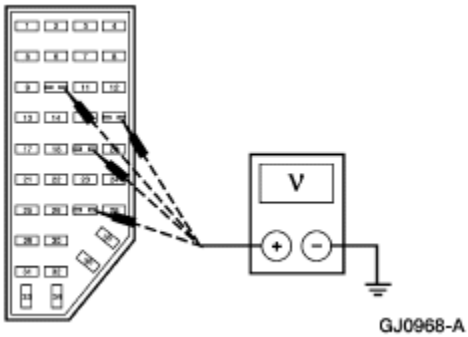
→ **No**
REPAIR circuit 37 (Y). TEST the system for normal operation.

PINPOINT TEST B: NO POWER IN ACC

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK THE RADIO OPERATION	
1 	2 Turn the radio on. • **Does the radio operate properly?** → **Yes** GO to B2 . → **No** GO to Pinpoint Test C .
B2 CHECK THE VOLTAGE SUPPLY TO THE IGNITION SWITCH	
1  Ignition Switch C233 2  GJ0469-A	2 Measure the voltage between the ignition switch C233 B-5, circuit 37 (Y), and ground. • **Is the voltage greater than 10 volts?** → **Yes** REPLACE the ignition switch. → **No** REPAIR circuit 37 (Y).

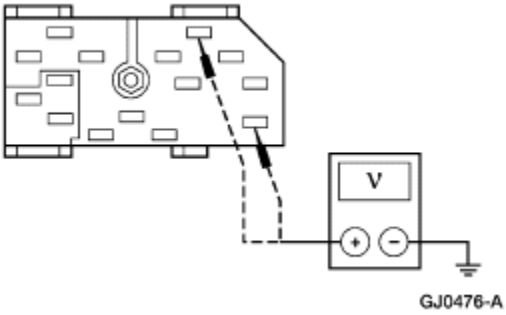
PINPOINT TEST C: NO POWER IN RUN

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK THE VOLTAGE SUPPLY TO THE IGNITION SWITCH	
1  2  Ignition Switch C233 3  GJ0967-A	3 Measure the voltage between ignition switch C233-B1, circuit 37 (Y), and ground; C233-B2, circuit 37 (Y), and ground; C233-B4, circuit 37 (Y), and ground; C233-B5, circuit 37 (Y), and ground. • **Are the voltages greater than 10 volts?** → **Yes** GO to C2 . → **No** REPAIR the circuit in question. TEST the system for normal operation.
C2 CHECK THE IGNITION SWITCH	
	1 Perform the ignition switch continuity test; refer to EVTM CELL 149. • **Does the ignition switch test OK?** → **Yes** GO to C3 . → **No** REPLACE the ignition switch. TEST the system for normal operation.
C3 CHECK THE VOLTAGE SUPPLY TO THE FUSE JUNCTION PANEL	
1	

 Ignition Switch C233 2  3  GJ0968-A	3 Measure the voltage between fuse junction panel fuse 16 (30A) and ground, fuse 10 (7.5A) and ground, fuse 19 (25A) and ground, and fuse 27 (15A) and ground. • **Are the voltages greater than 10 volts?** → **Yes** Reverify the concern. → **No** If fuse location 16 (30A), REPAIR circuit 297 (BK/LG). If fuse location 10 (7.5A), REPAIR circuit 687 (GY/Y). If fuse location 19 (25A), REPAIR circuit 1050 (LG/P). If fuse location 27 (15A), REPAIR circuit 687 (GY/Y). TEST the system for normal operation.

PINPOINT TEST D: NO POWER IN START

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CHECK THE VOLTAGE SUPPLY TO THE IGNITION SWITCH	
1 	

2  Ignition Switch C233 3  GJ0476-A	3 Measure the voltage between ignition switch C233-B4, circuit 37 (Y), C233-B5, circuit 37 (Y), and ground. • **Are the voltages greater than 10 volts?** → **Yes** GO to D2 . → **No** REPAIR circuit 37 (Y). TEST the system for normal operation.
D2 CHECK THE IGNITION SWITCH	
	1 Perform the ignition switch continuity test; refer to EVTM CELL 149. • **Does the ignition switch test OK?** → **Yes** GO to D3 . → **No** REPLACE the ignition switch. TEST the system for normal operation.
D3 CHECK CIRCUIT 1050 (LG/P) AND CIRCUIT 32 (R/LB) FOR VOLTAGE	
1  Ignition Switch C233 2 	

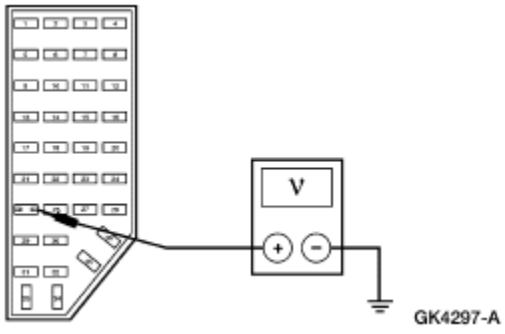
	3 Turn the key to the START position. • **Does the starter motor engage?** → **Yes** REPAIR circuit 1050 (LG/P). → **No** REPAIR circuit 32 (R/LB).

PINPOINT TEST E: NO COMMUNICATION WITH THE MODULE — GEM/CTM

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 CHECK POWER DISTRIBUTION BOX MAXI FUSE 5 (50A)	
1  Fuse 5 (50A)	• **Is the fuse OK?** → **Yes** GO to E2 . → **No** REPLACE the fuse. CLEAR the DTCs. TEST the system for normal operation. If the fuse fails again, CHECK circuit 1052 (T/BK) for a short to ground. REPAIR as necessary.
E2 CHECK FUSE JUNCTION PANEL FUSE 25 (7.5A)	
1  Fuse 25 (7.5A)	• **Is the fuse OK?** → **Yes** GO to E3 . → **No** REPLACE the fuse. CLEAR the DTCs. TEST the system for normal operation. If the fuse fails again, CHECK circuit 1001 (W/Y) for a short to ground. REPAIR as necessary.

E3 CHECK CIRCUIT 1052 (T/BK) FOR VOLTAGE

1



1 Measure the voltage between fuse junction panel fuse 25 (7.5A), pin 2, circuit 1052 (T/BK), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to E4 .

→ **No**
REPAIR circuit 1052 (T/BK). CLEAR the DTCs. TEST the system for normal operation.

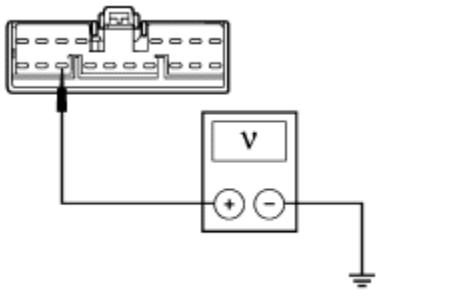
E4 CHECK THE VOLTAGE TO THE GEM/CTM — CIRCUIT 1001 (W/Y)

1

2

GEM/CTM C283

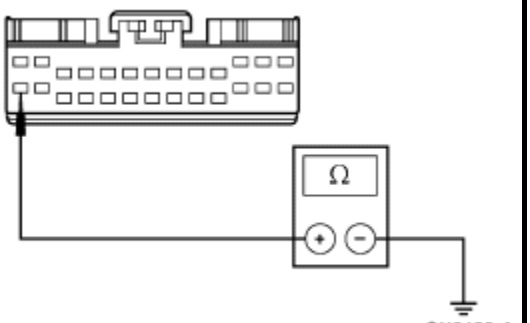
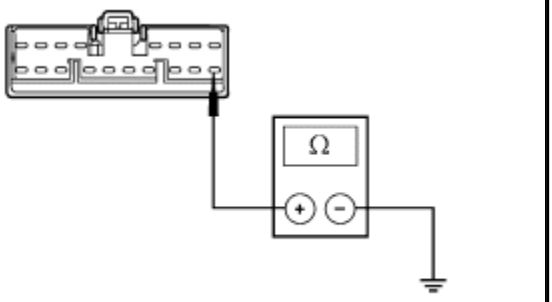
3



3 Measure the voltage between GEM/CTM C283-11, circuit 1001 (W/Y), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to E5 .

	→ **No** REPAIR circuit 1001 (W/Y). CLEAR the DTCs. TEST the system for normal operation.
E5 CHECK CIRCUIT 570 (BK/W) FOR OPEN	
1  GEM/CTM C280 2  GK6422-A	2 Measure the resistance between GEM/CTM C280-14, circuit 570 (BK/W), and ground. • **Are the resistances less than 5 ohms?** → **Yes** GO to E6 . → **No** REPAIR circuit 570 (BK/W). CLEAR the DTCs. TEST the system for normal operation.
E6 CHECK CIRCUIT 57 (BK) FOR OPEN	
1  GK6044-A	1 Measure the resistance between GEM/CTM C283-18, circuit 57 (BK), and ground. • **Is the resistance less than 5 ohms?** → **Yes** REFER to Section 418-00 . → **No** REPAIR circuit 57 (BK). CLEAR the DTCs.

	TEST the system for normal operation.

Component Test

Ignition Switch Mechanical Check

Test the mechanical operation of the ignition switch by rotating the lock cylinder through all switch positions. The movement should not stick or bind and should return from the START position back to the ON position without assistance (spring return). If sticking or binding is encountered, check for the following:

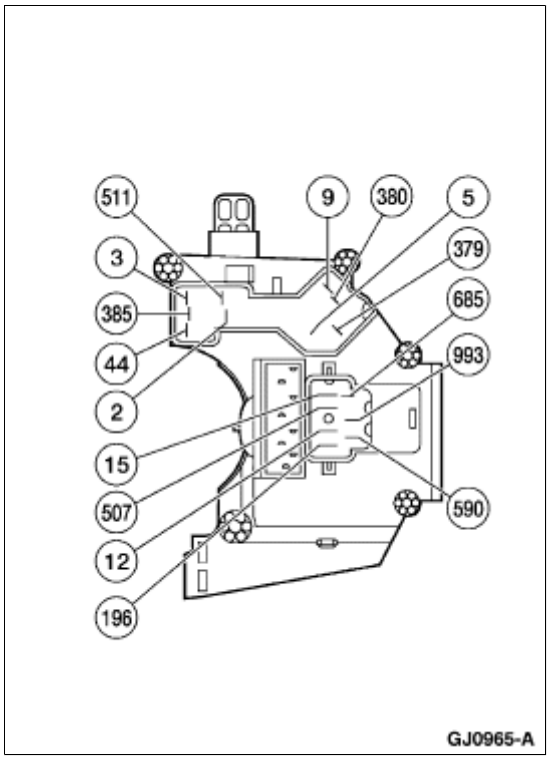
- Burrs on the lock cylinder key.
- Insufficient lube on lock cylinder.
- Bent or damaged ignition rod.
- Object rubbing against ignition rod.
- Excessive rubbing of actuator against transmission shift socket.
- Binding lock cylinder.
- Shroud rubbing against lock cylinder.
- Burrs or foreign material around the rack and pinion actuator in the lock cylinder housing.
- Insufficient lube on actuator. (Do not apply lubricant to the inside of the ignition switch.)
- Binding ignition switch.

If the steering wheel lock is engaged with the wheels loaded against a curb, there will be high effort required to turn the key from LOCK. Turn the steering wheel to either side of the lock to unload the system.

Ignition Switch Continuity Check

Refer to the Electrical Vacuum Troubleshooting Manual, Cell 149.

Multi-Function Switch



1. Measure the resistance between the multi-function switch terminals.
    1. If the resistances are as specified, multi-function switch is OK. RETURN the multi-function switch to the vehicle. TEST the system for normal operation.
    2. If the resistances are not as specified, REPLACE the multi-function switch. Refer to Multi-Function Switch. TEST the system for normal operation.

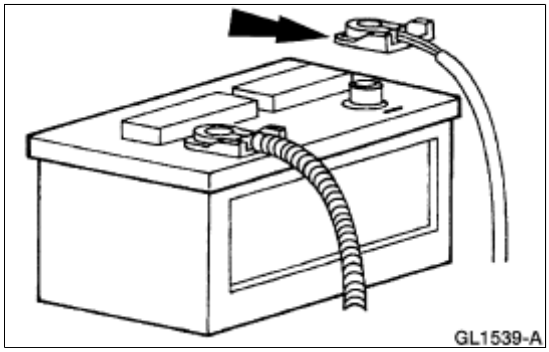
Function	Multi-Function Switch Position	Terminals	Resistance Values
Washer	ON	590 and 993	Less than 5 Ohms
	OFF	590 and 993	Greater than 10,000 Ohms
Wiper	OFF	685 and 993	Approximately 47,000 Ohms
	INT	685 and 993	Approximately 11,000 Ohms
	LO	685 and 993	Approximately 4,000 Ohms
	HI	685 and 993	Less than 5 ohms
Wiper	OFF	685 and 590	Approximately 150,000 Ohms
	INT	685 and 590	Between 14,000 Ohms and 11,000 Ohms
	LO	685 and 590	Approximately 7,200 Ohms
	HI	685 and 590	Approximately 3,200 Ohms

Wiper	OFF	590 and 993	Approximately 100,000 Ohms
	INT	590 and 993	Between 100,000 Ohms and 3,200 Ohms
	LO	590 and 993	Approximately 3,200 Ohms
	HI	590 and 993	Approximately 3,200 Ohms
Stoplamp Input	Center (no turn) Position	511 and 9, 511 and 5	Less Than 5 Ohms
Hazard	ON	385 and 5, 385 and 3, 385 and 9	Less than 5 Ohms
	OFF	385 and 5, 385 and 3, 385 and 9	Greater than 10,000 Ohms
Left Turn Signal	Place the Multi-Function Switch in the LEFT TURN Position	44 and 3, 44 and 9	Less than 5 Ohms
Right Turn Signal	Place the Multi-Function Switch in the RIGHT TURN Position	44 and 5, 44 and 2	Less than 5 Ohms
High Beam	Place the Multi-Function Switch in the HI BEAM Position	15 and 12	Less than 5 Ohms
Low Beam	Place the Multi-Function Switch in the LO BEAM Position	15 and 507	Less than 5 Ohms
Flash-To-Pass	Hold the Multi-Function Switch in the FLASH-TO-PASS Position	196 and 12, 15 and 507	Less than 5 Ohms

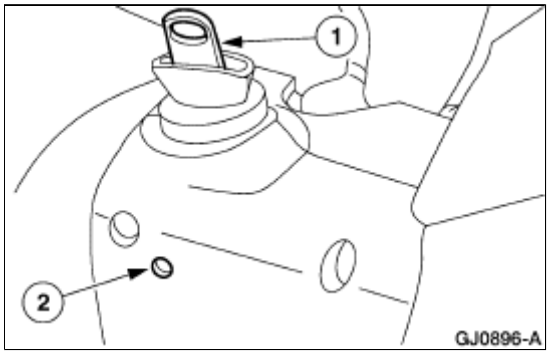
Multifunction Switch

Removal

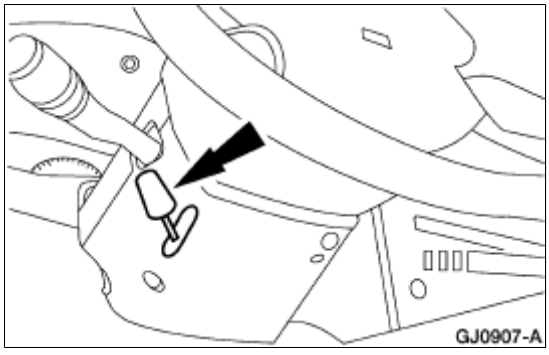
1. Disconnect the battery ground cable.



2. Remove the ignition switch lock cylinder.
    1. Insert the ignition key into the ignition switch lock cyliner 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.

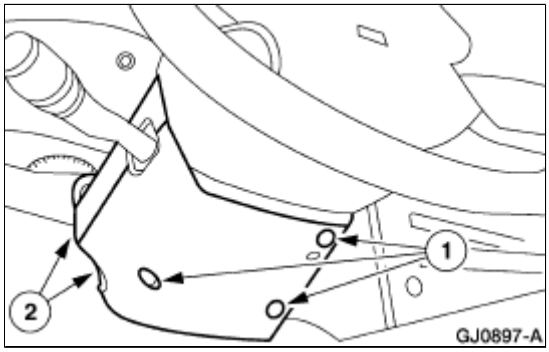


3. If equipped, twist the tilt wheel handle and shank counterclockwise and remove.

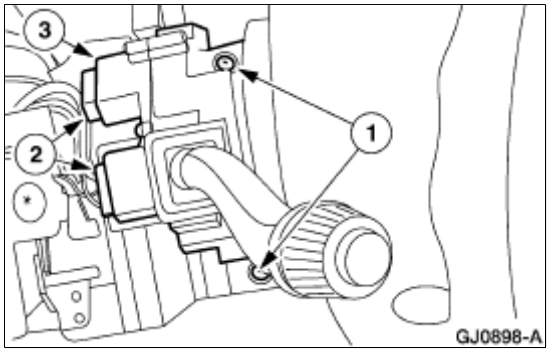


4. Remove the upper and lower steering column shrouds.
    1. Remove the screws.

2. Remove the upper and lower steering column shrouds.



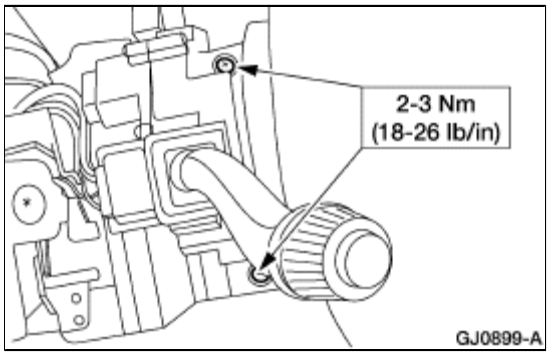
5. Remove the multi-function switch.
    1. Remove the screws.
    2. Disconnect the electrical connectors.
    3. Remove the multi-function switch.



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.

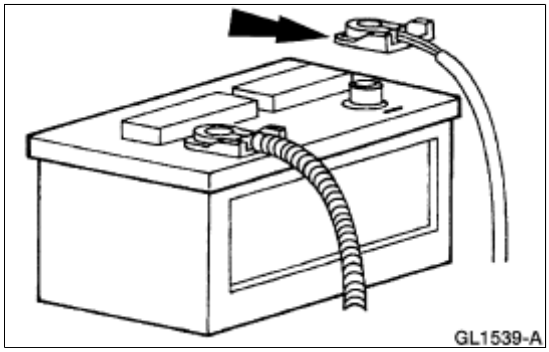
    To install, reverse the removal procedure.



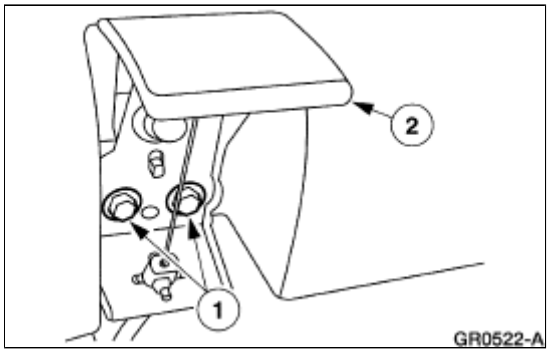
Ignition Switch

Removal

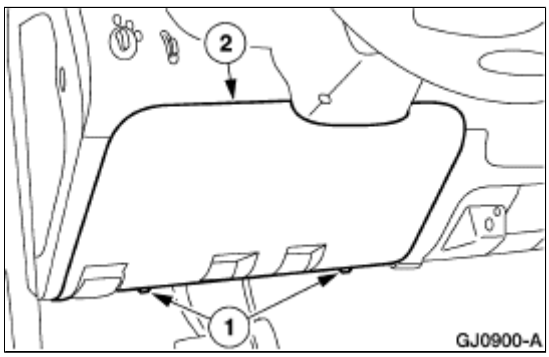
1. Disconnect the battery ground cable.



2. Detach the hood latch release handle and position aside.
    1. Remove the bolts.
    2. Position the hood latch release handle aside.

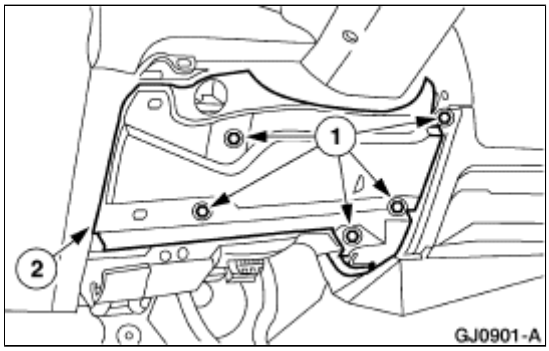


3. Remove the lower instrument panel steering column cover.
    1. Remove the screws.
    2. Remove the lower instrument panel steering column cover.

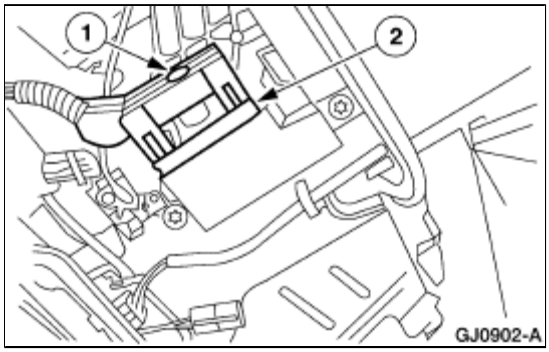


4. Remove the instrument panel steering column opening cover reinforcement.

1. Remove the bolts.
2. Remove the instrument panel steering column opening cover reinforcement.

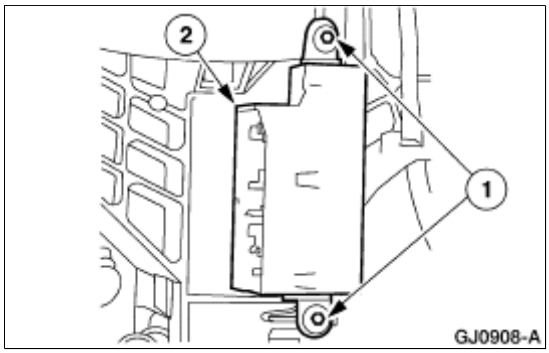


5. Disconnect the electrical connector.
   1. Loosen the bolt.
   2. Disconnect the electrical connector.



6. **NOTE:** The ignition key should be in the OFF position.

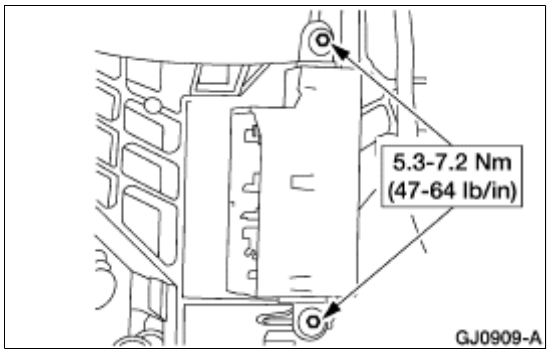
   Remove the ignition switch.
   1. Remove the screws.
   2. Remove the ignition switch.

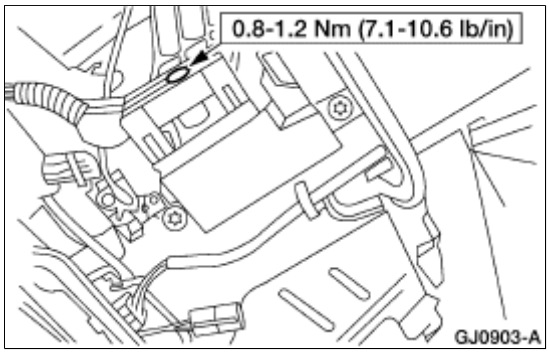


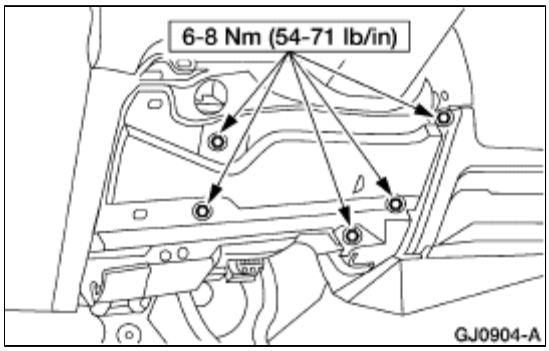
Installation

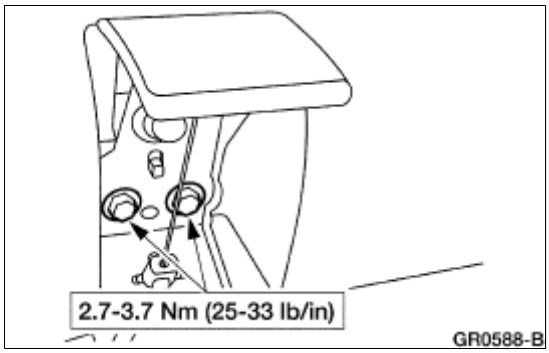
1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn its strategy.

   To install, reverse the removal procedure.


5.3-7.2 Nm
(47-64 lb/in)
GJ0909-A


0.8-1.2 Nm (7.1-10.6 lb/in)
GJ0903-A


6-8 Nm (54-71 lb/in)
GJ0904-A


2.7-3.7 Nm (25-33 lb/in)
GR0588-B

Key Release Interlock Actuator

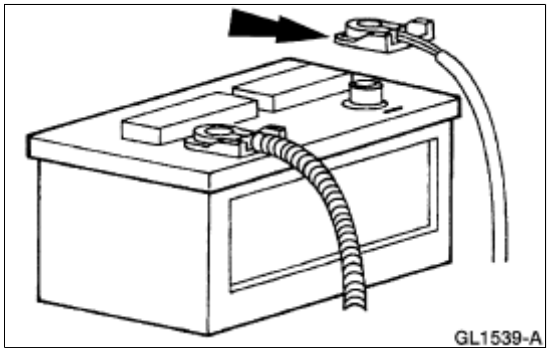
Removal and Installation

For additional information, refer to Section 211-04 .

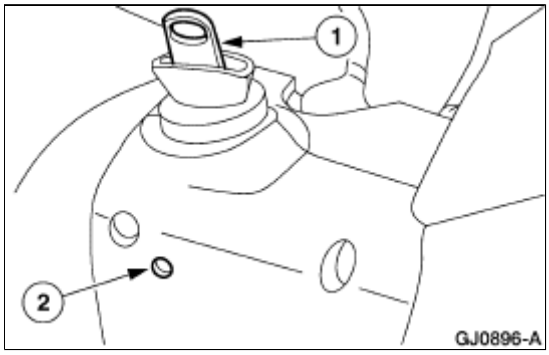
Key Release Button —Manual Transmission

Removal

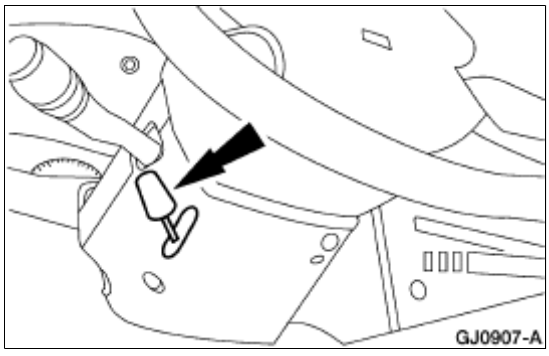
1. Disconnect the battery ground cable.



2. Remove the ignition switch lock cylinder (11582).
    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.

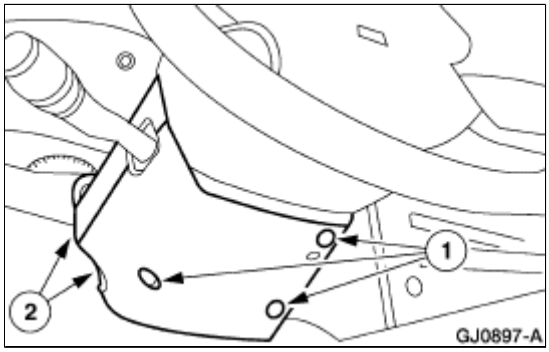


3. If equipped, remove the tilt wheel handle and shank.

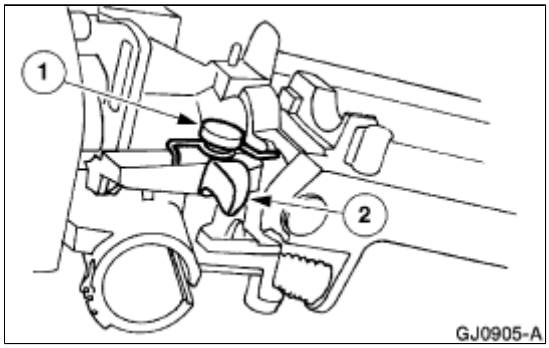


4. Remove the upper and lower steering column shrouds.
    1. Remove the screws.

2. Remove the upper and lower steering column shrouds.



5. Remove the key release lever.
   1. Remove the key release lever bolt.
   2. Remove the release lever handle and the spring.



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 16 km (10 mi) or more to relearn the strategy.

   To install, reverse the removal procedure.