# SPECIFICATIONS

### Material

| Item | Specification | Fill Capacity |
|---|---|---|
| High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada) | WSS-M6C62-A or WSS-M6C65-A1 | 714 ml (1.5 pt) |
| Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada) | — | — |
| Silicone Brake Caliper Grease and Dielectric Compound XG-3-A | ESE-M1C171-A | — |

### General Specifications

| Item | Specification |
|---|---|
| **Brake Disc — 4.0L SOHC and 4.6L (3V)** | |
| Front brake disc minimum thickness | 28.4 mm (1.118 in) |
| Rear brake disc minimum thickness | 17.4 mm (0.685 in) |
| **Brake Pads — 4.0L SOHC and 4.6L (3V)** | |
| Brake pad maximum taper wear (in any direction) | 3.0 mm (0.118 in) |

### General Specifications (Continued)

| Item | Specification |
|---|---|
| Brake pad minimum thickness | 3.0 mm (0.118 in) |
| **Brake Disc — 5.4L** | |
| Front brake disc minimum thickness | 30.0 mm (1.181 in) |
| **Brake Pads — 5.4L** | |
| Front brake pad minimum thickness | 1.8 mm (0.071 in) |
| Rear brake pad minimum thickness | 3.0 mm (0.118 in) |

### Torque Specifications

| Description | Nm | lb-ft | lb-in |
|---|---|---|---|
| Brake caliper bolts[a] | 33 | 24 | — |
| Front brake caliper bleeder screw — 4.0L SOHC and 4.6L (3V) | 10 | — | 89 |
| Front brake caliper bleeder screws — 5.4L | 18 | — | 159 |
| Master cylinder brake tube fittings | 17 | — | 150 |
| Rear brake caliper bleeder screw — all vehicles | 10 | — | 89 |

a The bolts retaining the front caliper halves together on 5.4L equipped vehicles are not serviceable.

# DESCRIPTION AND OPERATION

## Brake System

The brake system consists of the following components:

- Front and rear disc brakes
- Cable/caliper actuated parking brake
- Front-to-rear split hydraulic system
- Four wheel ABS
- Red brake warning indicator
- Vacuum-assisted power brake booster

The brake pedal is connected to the power brake booster, which is connected to the brake master cylinder. When the brake pedal is pressed, brake fluid is pushed through the double-walled steel tubes and flexible hoses to the front and rear disc brake calipers. The brake fluid enters the disc brake calipers, forcing the caliper pistons and brake pads outward against the brake disc friction surface, slowing or stopping rotation. When the brake pedal is released, brake fluid pressure is relieved, returning the front and rear disc brake caliper pistons and brake pads to the unapplied position.

For information on the following components:

- Front disc brakes, refer to Section 206-03.
- Rear disc brakes, refer to Section 206-04.
- Parking brake actuation, refer to Section 206-05.
- Hydraulic brake actuation, refer to Section 206-06.
- Vacuum-assisted power brake booster, refer to Section 206-07.
- ABS, refer to Section 206-09.

# DIAGNOSIS AND TESTING

## Brake System

### Material

| Item | Specification |
|---|---|
| High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada) | WSS-M6C62-A |
| Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada) | — |
| Silicone Brake Caliper Grease and Dielectric Compound XG-3-A | ESE-M1C171-A |

## Principles of Operation

### Brake System

Applying the brake pedal uses lever action to push a rod into the brake booster, which through the use of vacuum, boosts the force of the rod and then transmits this force into the master cylinder. This produces hydraulic pressure in the master cylinder. On vehicles not equipped with ABS, the hydraulic pressure is transmitted by brake fluid through the brake tubes to the individual brake calipers. On vehicles equipped with ABS, the hydraulic pressure is transmitted by brake fluid through the brake tubes to the ABS hydraulic control unit (HCU), which then distributes that pressure to the individual brake calipers. The brake calipers use hydraulic pressure to apply the pads. The application of the brake pads will cause the rotation of the wheels to slow or stop, depending on how much brake pressure is applied. The parking brakes carry out the same function except that they are mechanically actuated by a cable that connects only to the rear brakes.

### Red Brake Warning Indicator

The red brake warning indicator alerts the driver to certain conditions that exist in the brake system. The instrument cluster performs a bulb check when the ignition key is turned to the RUN position. The conditions that cause the indicator to illuminate are low brake fluid level, the parking brake is applied or there is a fault in the ABS (if the yellow ABS warning indicator is also illuminated). To diagnose a red brake warning indicator concern, refer to Section 413-01.

## Inspection and Verification

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

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

**⚠ CAUTION: Blistering or swelling of rubber brake components can indicate contamination of the brake fluid by a petroleum-based substance. Contaminated rubber components in the hydraulic brake system must be replaced and the entire hydraulic brake system must be flushed with clean, specified brake fluid to prevent recontamination.**

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

**NOTE:** Always check the fluid level in the brake master cylinder reservoir before carrying out any test procedures. If the fluid level is not at the correct level, clean the reservoir cap before removing, then add clean, specified brake fluid.

**NOTE:** Prior to carrying out any diagnosis, make sure the red brake warning indicator is functional. Refer to Section 413-01.

The first indication that something may be wrong in the brake system is a change in the feeling through the brake pedal. 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.

## DIAGNOSIS AND TESTING (Continued)

If a wheel 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 concern. If this does not relieve the locked wheel condition, repair the locked components before proceeding.

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

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

### Visual Inspection Chart

| Mechanical | Electrical |
|---|---|
| • Brake master cylinder<br>• Brake master cylinder reservoir<br>• Brake booster<br>• Brake booster check valve<br>• Brake booster vacuum hose<br>• Brake hoses and tubes<br>• Brake caliper<br>• Brake caliper piston seals<br>• Brake caliper guide pins<br>• Brake disc<br>• Brake pads<br>• Brake pedal linkage<br>• Wheel bearings<br>• Tires | • Parking brake switch<br>• Brake fluid level switch<br>• Wiring, terminals and connectors |

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, GO to Symptom Chart — Brake System or GO to Symptom Chart — Noise, Vibration and Harshness (NVH).

For low or spongy brake pedal concerns:

- check for fluid leaks. Repair as necessary.
- check and, if necessary, refill the brake master cylinder reservoir with clean, specified brake fluid.
- bleed the brake system and retest the brake pedal feel.
- if the brake pedal is still low or feels spongy, check the brake pedal mounting for looseness and correct installation. Check the power brake booster and the master cylinder for loose mounting. Correct as necessary and retest the system for normal operation.

For a slow or incomplete brake pedal return concern:

- inspect for binding, damage, correct installation or interference at the brake pedal.
- check the power brake booster for binding, damage and correct installation.

### Road Test

The technician should have a thorough knowledge of the brake system operation and accepted general braking guidelines in order to detect any problems.

Select a road that is reasonably smooth and level. Gravel or bumpy roads are not suitable because the surface does not allow the tires to grip the road equally. Avoid crowned roads.

A key factor in evaluating brake concerns is the deceleration rate. This varies from vehicle to vehicle and with changes in operating conditions. It is evident how well the brakes are working after just a few applications.

### Brake Pads

**NOTE:** It is not required to install new brake pads if the friction material thickness is within specifications. It is also not required to install new brake pads when the brake discs are machined.

- Remove the brake pads. Refer to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.

## DIAGNOSIS AND TESTING (Continued)

- Inspect and measure the thickness of the brake pad friction material. Refer to Specifications in this section.
  - — If there are missing chunks or cracks in the lining through to the backing plate, install new brake pads. Refer to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.
  - — If the thickness of the friction material is less than the specified thickness, install new brake pads, Refer to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.
  - — If the friction material shows taper wear that is not within specifications, verify the caliper guide pins are functioning correctly. Refer to Brake Caliper Guide Pins in this section.

### Brake Discs

**⚠ CAUTION: Using an impact tool without a torque socket will lead to unevenly tightened wheel nuts. This causes brake disc on-vehicle lateral runout and brake roughness.**

**NOTE:** It is generally not required to install new brake discs to address noise issues.

- Remove the brake disc. Refer to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.
- Inspect the brake discs and measure the brake disc thickness in a minimum of 4 places around the circumference of the brake disc. Record the measurements, refer to Specifications in this section.
  - — If the brake disc is cracked or otherwise damaged, install new a brake disc. Refer to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.
  - — If any thickness measurement is less than the minimum specification, install a new brake disc. Refer to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.
  - — If the diagnosis has revealed vibration in the steering wheel, seat or pedal while braking that varies with vehicle speed, machine the brake disc. Heavily scored brake discs, similar to that caused by pads worn down to the backing plate, should also be machined. In order to machine, discs must be above the minimum thickness specification. Refer to Specifications and Brake Disc Machining in this section.

### Brake Calipers

Inspect the brake calipers for the following:

- Brake fluid leaks
- Boots and seals for tears or cracks
- Caliper pistons for binding and corrosion
- Guide pins for correct operation. Refer to Brake Caliper Guide Pins in this section

### Brake Caliper Guide Pins

**⚠ CAUTION: Do not use power tools for caliper guide pin bore cleaning. Damage to the bore may result.**

**NOTE:** The guide pins are part of the anchor plate.

The guide pins should slide with a reasonable amount of hand force. If the brake pads show taper wear or the guide pins are difficult to move, install a new brake caliper anchor plate. Refer to Section 206-03 for the front brake caliper anchor plate or Section 206-04 for the rear brake caliper anchor plate.

If the lining is not within specifications, install new brake pads. Refer to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.

## DIAGNOSIS AND TESTING (Continued)

### Brake Hoses and Tubes

⚠ **CAUTION: Never use copper tubing. It is subject to fatigue, cracking and corrosion, which may result in brake tube failure.**

- Double-wall steel tubing is used throughout the brake hydraulic system. All brake tube fittings must be correctly double flared to provide strong, leakproof connections. When bending tubing to fit the underbody or rear axle contours, be careful not to kink or crack the tube.
- If a section of the brake tube is damaged, the entire section must be installed with a new tube of the same type, size, shape and length.
- When installing the hydraulic brake tubing, hoses or connectors, tighten all connections to specifications. After installation, bleed the brake system. Refer to Brake System Bleeding in this section.

Install a new brake flexible hose if the hose shows signs of softening, cracking or other damage.

When installing a new brake hose, position the hose to avoid contact with other vehicle components.

### Non-Pressure Leaks

Two parts of the brake system that may have a brake fluid loss that does not appear when the system is under pressure are the brake master cylinder reservoir and the brake caliper, under the following conditions:

### Reservoir

- Missing or poorly-fitted brake master cylinder filler cap
- Missing or damaged brake master cylinder filler cap gasket
- Punctured or otherwise damaged brake master cylinder reservoir
- Missing, damaged or poorly-fitted sealing grommets between the brake master cylinder and the brake master cylinder reservoir

The brake master cylinder reservoir grommets are not serviceable and must be installed new as part of a new brake master cylinder and reservoir assembly. Refer to brake master cylinder in Section 206-06.

### Caliper

- Foreign material in the caliper piston seal groove
- Punctured or otherwise damaged caliper piston seal

The brake caliper piston seals are not serviceable and must be installed new as part of a new brake caliper. Refer to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.

### 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 fall during brake application and rise during release. The net fluid level (such as after brake application and release) will remain unchanged.

**Condition 2:** A trace of brake fluid will exist on the booster shell below the master cylinder mounting flange. This results from the normal lubricating action of the master cylinder bore and seal.

**Condition 3:** Fluid level will decrease with pad wear.

### Brake Master Cylinder — Abnormal Conditions

Changes in brake pedal feel or travel are indicators that something may be wrong in the brake system. GO to Symptom Chart — Brake System for abnormal condition diagnosis.

### Brake Booster

Inspect the brake booster:

- for excessive corrosion or damage.
- vacuum connections for leakage.
- vacuum hoses for kinks or leakage.
- check valve for correct operation.

### Parking Brake

Check the operation of the parking brake system with the vehicle on a hoist and the parking brake control fully released. Carry out the parking brake system diagnosis, refer to Section 206-05.

## DIAGNOSIS AND TESTING (Continued)

## Symptom Chart — Brake System

### Symptom Chart — Brake System

| Condition | Possible Sources | Action |
|---|---|---|
| • The red brake warning indicator and the yellow ABS warning indicator are illuminated | • DTCs in the ABS module | • REFER to Section 206-09 to diagnose the ABS module. |
| • The red brake warning indicator is always/never on | • Brake fluid level switch<br>• Parking brake switch<br>• Wiring, terminals or connectors<br>• Instrument cluster<br>• Smart junction box (SJB) | • REFER to Section 413-01 to diagnose the red brake warning indicator. |
| • The brakes pull or drift | • Tires | • INSPECT the tires for uneven or excessive wear, and correct inflation. REFER to Section 204-04. |
| | • Brake pads | • INSPECT the brake pads for contamination, uneven taper or excessive wear. REFER to Brake Pads in this section. |
| | • Brake discs | • INSPECT the brake discs and the hubs for contamination or damage, INSTALL new as necessary. |
| | • Brake calipers and/or guide pins | • INSPECT the brake calipers and guide pins, REFER to Brake Calipers and Brake Caliper Guide Pins in this section. |
| | • Suspension component and/or wheel alignment | • INSPECT the suspension and CHECK the wheel alignment. REFER to Section 204-00. |
| • Brake pedal goes down fast | • Brake fluid leaks and/or air in the system | • INSPECT the system for leaks. REPAIR as necessary. FILL the brake master cylinder reservoir. BLEED the system. REFER to Brake System Bleeding in this section. |
| | • Brake master cylinder | • CARRY OUT the Brake Master Cylinder Component Test in this section. |
| | • Hydraulic control unit (HCU) | • INSPECT the HCU. REFER to Section 206-09. |
| • The brake pedal eases down slowly | • Air in the system | • BLEED the system. REFER to Brake System Bleeding in this section. |
| | • Brake master cylinder | • CARRY OUT the Brake Master Cylinder Component Test in this section. |
| | • HCU | • INSPECT the HCU. REFER to Section 206-09. |

## DIAGNOSIS AND TESTING (Continued)

### Symptom Chart — Brake System (Continued)

| Condition | Possible Sources | Action |
|---|---|---|
| • Brakes lock up under light brake pedal force | • Brake pads | • INSPECT the brake pads for uneven taper or excessive wear, REFER to Brake Pads in this section. |
| | • Brake calipers and/or guide pins | • INSPECT the brake calipers and guide pins, REFER to Brake Calipers and Brake Caliper Guide Pins in this section. |
| | • Anti-lock brake control system | • CHECK the anti-lock brake control system. REFER to Section 206-09. |
| • Excessive/erratic brake pedal travel | • Brake fluid leaks and/or air in the system | • INSPECT the system for leaks. REPAIR as necessary. BLEED the system. REFER to Brake System Bleeding in this section. |
| | • Brake calipers and/or guide pins | • INSPECT the brake calipers and guide pins, REFER to Brake Calipers and Brake Caliper Guide Pins in this section. |
| | • Brake flexible hose | • INSPECT the brake flexible hoses for swelling and damage. INSTALL new as necessary. REFER to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes. |
| | • Brake master cylinder | • CARRY OUT the Brake Master Cylinder Component Test in this section. |
| | • Brake pads | • INSPECT the brake pads for taper wear, REFER to Brake Pads in this section. |
| | • Brake pedal | • INSPECT the brake pedal for binding, obstructions and correct installation. REPAIR as necessary. CHECK the brake pedal fasteners for correct torque. REFER to Specifications in Section 206-06. |
| | • Anti-lock brake control system | • CHECK the anti-lock brake control system. REFER to Section 206-09. |

## DIAGNOSIS AND TESTING (Continued)

### Symptom Chart — Brake System (Continued)

| Condition | Possible Sources | Action |
|---|---|---|
| • Brakes drag | • Parking brake component | • REPAIR or INSTALL new components as necessary. REFER to Section 206-05. |
| | • Brake caliper guide pins | • INSPECT the caliper guide pins for correct operation. INSTALL new components as necessary. REFER to Brake Caliper Guide Pins in this section. |
| | • Disc brake caliper(s) | • REPAIR or INSTALL new brake calipers as necessary. REFER to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes. |
| | • Brake booster | • CARRY OUT the Brake Booster Component Test in this section. |
| | • Brake master cylinder | • CARRY OUT the Brake Master Cylinder Component Test in this section. |
| • Excessive brake pedal effort | • Insufficient engine vacuum for brake booster operation | • CHECK engine vacuum. REFER to the Intake Manifold Vacuum Test in Section 303-00. |
| | • Brake booster manifold vacuum hose | • VERIFY engine vacuum at the booster. REROUTE, REPAIR or INSTALL new components as necessary. |
| | • Brake booster | • VERIFY engine vacuum at the booster. CARRY OUT the Brake Booster Component Test in this section. |
| | • Brake booster check valve | • VERIFY engine vacuum at the booster. CARRY OUT the Check Valve Component Test in this section. |

## DIAGNOSIS AND TESTING (Continued)

## Symptom Chart — Noise, Vibration and Harshness (NVH)

### Symptom Chart — Noise, Vibration and Harshness (NVH)

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

| Condition | Possible Sources | Action |
|---|---|---|
| • Vibration when the brakes are applied | • Tires | • CORRECT any wheel and tire concern before diagnosing the brake or suspension systems. REFER to Section 204-04 to diagnose the tires. |
| | • Uneven brake pad wear<br>• Brake disc pad transfer<br>• Uneven brake disc wear<br>• Suspension components | • COMPLETE the brake system inspection described in Inspection and Verification in this section. If the condition still exists, GO to Pinpoint Test A. |
| • Brake vibration/shudder — occurs when the brake pedal is released | • Brake caliper guide pins | • INSPECT the brake caliper guide pins for correct operation. REFER to Brake Caliper Guide Pins in this section. |
| | • Brake drag | • GO to Symptom Chart — Brake System. |
| • Rattling noise | • Caliper mounting bolts loose | • CHECK the caliper bolts. TIGHTEN to specifications. REFER to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes. |
| | • Damaged or worn caliper guide pins or retainers | • CHECK the caliper guide pins and retainers for correct operation. REFER to Brake Caliper Guide Pins in this section. INSTALL new components as necessary. |
| | • Missing or damaged anti-rattle clips or springs | • CHECK the brake pads for missing clips or broken springs. INSTALL new components as necessary. REFER to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes. |
| | • Loose brake disc shield | • TIGHTEN the brake disc shield bolts to specification. REFER to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes. |
| • Clicking noise — with brakes applied on vehicles equipped with ABS brakes | • ABS hydraulic control unit | • Acceptable condition during an ABS event. |
| • Squealing noise — occurs on first (morning) brake application | • Brake pads | • Acceptable condition. Caused by humidity and low brake pad temperature. |

## DIAGNOSIS AND TESTING (Continued)

### Symptom Chart — Noise, Vibration and Harshness (NVH) (Continued)

| Condition | Possible Sources | Action |
|---|---|---|
| • Squealing noise — a continuous squeal | • Brake pads worn below minimum thickness | • INSPECT brake pads for excessive wear, taper wear or uneven wear. VERIFY brake pads are within minimum specifications. REFER to Brake Pads in this section. |
| • Squealing noise — an intermittent squeal brought on by cold, heat, water, mud or snow | • Brake pads | • Acceptable condition. |
| • Groaning noise — occurs at low speeds with brake lightly applied (creeping) | • Brake pads | • Acceptable condition. |
| • Grinding noise — continuous | • Brake pads worn below minimum thickness | • INSPECT the brake pads, brake discs and attaching hardware for damage. VERIFY brake components are within specifications. REFER to Specifications in this section. |
| • Moaning noise | • Brake pads contaminated with grease or oil | • INSPECT the brake pads for contamination. REPAIR or INSTALL new components as necessary. REFER to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes. |

## Pinpoint Tests

### Pinpoint Test A: Vibration When the Brakes are Applied

#### Normal Operation

During moderate to heavy braking, noise from the hydraulic control unit (HCU) and pulsation in the brake pedal can be observed. Pedal pulsation coupled with noise during heavy braking or on loose gravel, bumps, wet or snowy surfaces is acceptable and indicates correct functioning of the ABS. Pedal pulsation or steering wheel nibble when the brakes are applied (frequency is proportioned to the vehicle speed) indicates a concern with a brake or suspension component.

**PINPOINT TEST A: VIBRATION WHEN THE BRAKES ARE APPLIED**

| Test Step | | Result / Action to Take |
|---|---|---|
| A1 | **ROAD TEST THE VEHICLE — LIGHT BRAKING** | |
| | • Road test the vehicle. Warm the brakes by slowing the vehicle from 80 to 32 km/h (50 to 20 mph) using light brake force. At highway speeds of 89-97 km/h (55-60 mph), apply the brake using light pedal force.<br>• **Is there a vibration/shudder felt in the steering wheel, seat or brake pedal?** | **Yes**<br>GO to A4.<br>**No**<br>GO to A2. |

(Continued)

## DIAGNOSIS AND TESTING (Continued)

**PINPOINT TEST A: VIBRATION WHEN THE BRAKES ARE APPLIED (Continued)**

| Test Step | | Result / Action to Take |
|---|---|---|
| **A2** | **ROAD TEST THE VEHICLE — MODERATE TO HEAVY BRAKING** | |
| | • Road test the vehicle. At highway speeds of 89-97 km/h (55-60 mph), apply the brake using a moderate to heavy pedal force.<br>• **Is there a vibration/shudder?** | **Yes**<br>GO to **A3**.<br>**No**<br>The concern is not present at this time. |
| **A3** | **CHECK ABS OPERATION** | |
| | • Road test the vehicle and apply the brakes on a dry, firm surface, then apply the brakes on a wet, snowy or loose surface (such as gravel).<br>• **Is the vibration/shudder only present on a wet, snowy or loose surface?** | **Yes**<br>This is a normal operating condition of the ABS.<br>**No**<br>GO to **A5**. |
| **A4** | **CHECK THE PARKING BRAKE OPERATION** | |
| | • This test is not applicable to vehicles with drum-in-hat type parking brakes. For vehicles with drum-in-hat parking brakes, proceed to the next test step. For all other vehicles, apply the parking brake to identify if the problem is in the front or rear brake. At highway speeds of 89-97 km/h (55-60 mph), lightly apply the parking brake until the vehicle slows down. Release the parking brake immediately after the test.<br>• **Is there a vibration/shudder?** | **Yes**<br>GO to **A7**.<br>**No**<br>GO to **A5**. |
| **A5** | **CHECK THE FRONT SUSPENSION** | |
| | • Check the front suspension. Refer to Section 204-00.<br>• **Are all the suspension components in satisfactory condition?** | **Yes**<br>GO to **A6**.<br>**No**<br>REPAIR or INSTALL new components as necessary. TEST the system for normal operation. |
| **A6** | **RESURFACE THE FRONT BRAKE DISCS** | |
| | • ⚠ **CAUTION: Do not use a bench lathe to machine the brake discs. A bench lathe may cause brake disc on-vehicle lateral runout and brake roughness.**<br>**NOTE:** Follow the brake lathe manufacturer's instructions to machine the brake discs. After machining, make sure the brake disc meets the thickness specification.<br>Resurface the front brake discs. Refer to Brake Disc Machining in this section.<br>• Road test the vehicle.<br>• **Is the vibration/shudder present?** | **Yes**<br>GO to **A7**.<br>**No**<br>The concern has been repaired. |
| **A7** | **CHECK THE REAR SUSPENSION** | |
| | • Check the rear suspension. Refer to Section 204-00.<br>• **Are all the suspension components in satisfactory condition?** | **Yes**<br>RESURFACE the rear brake discs. REFER to Brake Disc Machining in this section.<br>**No**<br>REPAIR or INSTALL new components as necessary. TEST the system for normal operation. |

## Component Tests

### Brake Booster

1. Disconnect the check valve from the brake booster.
2. Apply the parking brake, start the engine and place the transmission in NEUTRAL.
3. Verify that manifold vacuum is available at the check valve with the engine at idle speed and the transmission in NEUTRAL.
   - If manifold vacuum is available, stop the engine, connect the check valve and continue with Step 5.
   - If manifold vacuum is not available, continue with Step 4.

## DIAGNOSIS AND TESTING (Continued)

4. Disconnect the check valve from the vacuum hose and verify that manifold vacuum is available at the hose with the engine at idle speed and the transmission in NEUTRAL.
   - If manifold vacuum is available, stop the engine, install a new check valve and continue with Step 5.
   - If manifold vacuum is not available, stop the engine, connect the vacuum hose to the check valve and refer to Section 303-00 to diagnose the no vacuum condition.
5. Apply the brake pedal several times to exhaust all vacuum from the system.
6. Apply the brake pedal and hold it in the applied position. Start the engine and verify that the brake pedal moves downward after the engine starts.
   - If the brake pedal moves, the brake booster is operating correctly.
   - If the brake pedal does not move, install a new brake booster. Refer to Section 206-07.
7. Operate the engine a minimum of 10 seconds at fast idle. Stop the engine, and let the vehicle stand for 10 minutes. Then apply the brake pedal with approximately 89 N (20 lb) of force. The brake pedal feel should be the same as that noted with the engine operating. If the brake pedal feels hard (no power assist), install a new brake booster check valve and retest. If the brake pedal feels spongy, bleed the hydraulic system to remove air. Refer to Brake System Bleeding in this section.

### Brake Booster Check Valve

The function of the brake booster check valve is to allow manifold vacuum to enter the brake booster and prevent the escape of vacuum in case manifold vacuum is lost during sustained full throttle operation.

1. Disconnect the vacuum booster hose from the check valve.
2. Apply the parking brake, start the engine and place the transmission in NEUTRAL.
3. Verify that manifold vacuum is available at the check valve end of the vacuum hose with the engine at idle speed and the transmission in NEUTRAL.
   - If manifold vacuum is available, stop the engine, connect the vacuum hose to the check valve and continue this test.
   - If manifold vacuum is not available, stop the engine, connect the vacuum hose to the check valve and refer to Section 303-00 to diagnose the no vacuum condition.
4. Connect the vacuum hose to the check valve and run the engine for at least 10 seconds.
5. Operate the brake pedal to check for power assist.
   - If power assist is present, continue with this test.
   - If power assist is not present, refer to Brake Booster Component Test in this section.
6. **NOTE:** Do not remove the brake booster check valve from the brake booster in this step.

   Stop the engine and disconnect the vacuum booster hose from the brake booster check valve.
7. Apply the brake and verify that there is enough vacuum retained in the brake booster for at least one power-assisted brake application.
   - If there is enough vacuum for at least one power-asssisted brake application, the check valve is functioning correctly.
   - If there is not enough vacuum for at least one power-asssisted brake application, continue with this test.
8. Inspect the brake booster for any signs of damage that may cause a leak.
   - If any damage is found, install a new brake booster and repeat this test.
   - If no damage is found, install a new check valve.

### Brake Master Cylinder — Bypass Condition

1. Disconnect the brake tubes from the master cylinder.
2. Plug the outlet ports of the master cylinder.

## DIAGNOSIS AND TESTING (Continued)

3. Apply the brakes. If brake pedal height cannot be maintained, the brake master cylinder has an internal leak and a new brake master cylinder must be installed.

### Brake Master Cylinder — Compensator Port

The purpose of the compensator ports in the brake master cylinder is to:

- supply additional brake fluid from the brake master cylinder reservoir needed by the brake system due to brake lining wear.
- allow brake fluid to return to the brake master cylinder reservoir when the brakes are released. The returning brake fluid creates a slight turbulence in the brake master cylinder reservoir. This is a normal condition and indicates that the compensator ports are not clogged.

Clogged compensator ports may cause the brakes to hang up or not fully release. If clogged compensator ports are suspected, proceed as follows:

1. With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02.
2. With the brakes released, attempt to rotate each wheel and check for any brake drag.
   - If an excessive amount of brake drag exists at all 4 wheels, continue with the test.
   - If an excessive amount of brake drag exists at only one wheel, it indicates a possible seized brake caliper, brake wheel cylinder or parking brake component. Repair or install new components as necessary.
3. Check the brake stoplamp switch and the brake pedal free play to verify that the brake pedal is not partially applied.
4. Loosen the brake master cylinder nuts and position the brake master cylinder away from the brake booster.
5. With the brakes released, attempt to rotate each wheel and check for any brake drag.
   - If the brake drag is no longer present, install a new brake booster. Refer to Section 206-07.
   - If the brake drag is still present, install a new master cylinder. Refer to Section 206-06.

# GENERAL PROCEDURES

## Brake Disc Machining

**NOTE:** Do not use a bench lathe to machine the brake discs. Use an on-vehicle brake lathe only. Read the entire operating manual and/or view the video shipped with the lathe before installing, operating or repairing the lathe.

**NOTE:** An on-vehicle brake lathe with an automatic runout adjustment feature is preferred. However, if the lathe is not self adjusting, the lathe oscillation must be adjusted using a dial indicator. The total indicated runout target is 0.000 mm (0.000 in). The maximum indicated runout should be no more than 0.050 mm (0.002 in). If the runout adjustment (automatic or manual) is carried out correctly prior to machining, then the final brake disc runout will be within specification and a runout measurement is not necessary after machining.

**NOTE:** Lateral runout and disc thickness variation measurements are not required because correct adjustment of the on-vehicle brake lathe will make sure that these dimensions are within specification.

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

2. *NOTICE:* **Do not allow the caliper to hang from the brake hose or damage to the hose may occur.**

   Remove the bolts and position the brake caliper or brake caliper and anchor plate assembly aside, as required.
   - Support the brake caliper using mechanic's wire.

3. Install the hub adapter using:
   - four wheel nuts on a 4-stud wheel hub.
   - five wheel nuts on a 5-stud wheel hub.
   - six wheel nuts on a 6-stud wheel hub.
   - four wheel nuts on a 7- or 8-stud wheel hub.
   - five wheel nuts on a 10-stud wheel hub.

4. Install the cutting lathe.

5. If the lathe is not self adjusting, adjust the lathe oscillation using a dial indicator. The total indicated runout target is 0.000 mm (0.000 in). The maximum indicated runout should be no more than 0.050 mm (0.002 in).

6. Center the cutting head, adjust the cutting bits and install the chip deflector/silencer.

7. **NOTE:** The depth of the cut should be between 0.10 and 0.40 mm (0.004 and 0.015 in). Lighter cuts will cause the bit to heat up and wear faster. Heavier cuts will cause poor brake disc surface finish.

   Machine the brake disc.

8. Remove the lathe and the silencer.

9. Remove the wheel nuts and hub adapter.

10. Remove the metal shavings.

11. **NOTE:** It is not required to install new brake pads if friction material is within specifications. For additional information, refer to Specifications in this section.

    Position the brake caliper or brake caliper and anchor plate assembly.
    - Install the bolts.
    - For fastener torque specifications, refer to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.

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

# GENERAL PROCEDURES

## Brake System Bleeding

**Material**

| Item | Specification |
|---|---|
| High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada) | WSS-M6C62-A or WSS-M6C65-A1 |

### Manual Bleeding

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

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

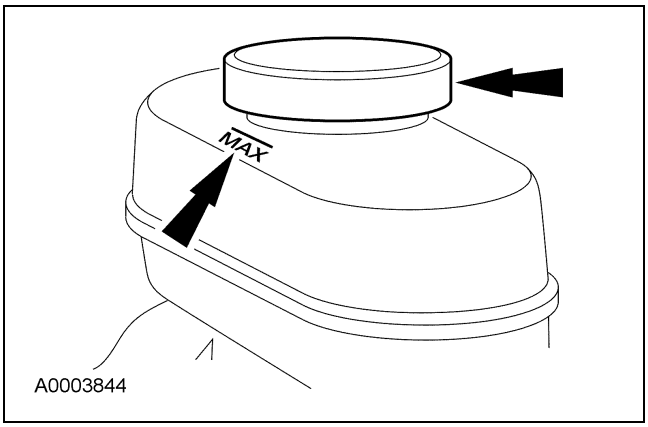
**⚠ WARNING: Do not allow the brake master cylinder to run dry during the bleeding operation. Master cylinder may be damaged if operated without fluid, resulting in degraded braking performance. Failure to follow this instruction may result in serious personal injury.**

*NOTICE:* **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

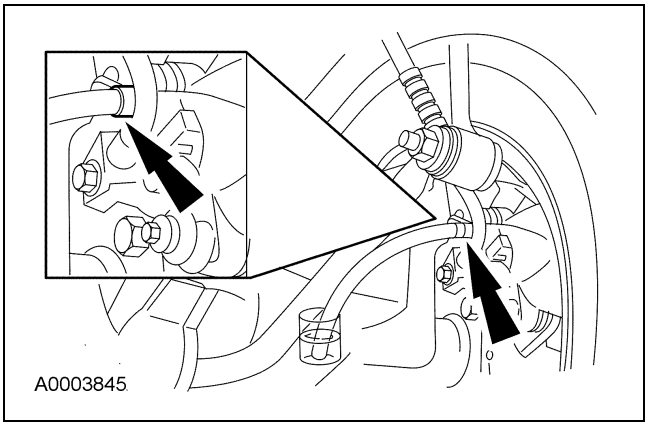
#### All vehicles

1. **NOTE:** Pressure bleeding the brake system is preferred to manual bleeding.

   Clean all dirt from and remove the brake master cylinder filler cap and fill the brake master cylinder reservoir with clean, specified brake fluid.




2. Remove the RH rear brake caliper bleeder screw cap and place a box-end wrench on the bleeder screw. Attach a rubber drain hose to the bleeder screw and submerge the free end of the hose in a container partially filled with clean, specified brake fluid.




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

4. Loosen the RH rear brake caliper 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 with clean, specified brake fluid as necessary.

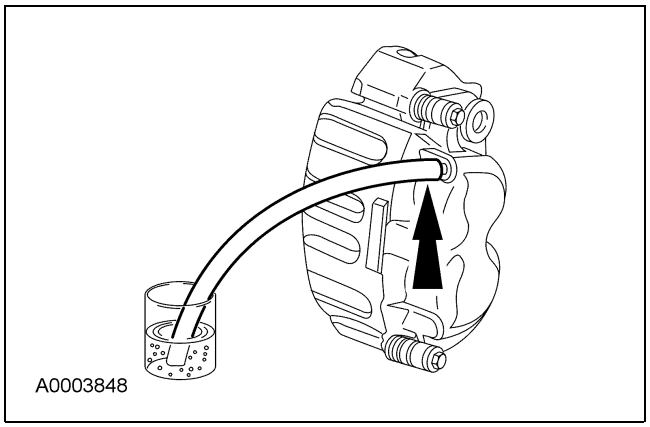
5. Tighten the RH rear brake caliper bleeder screw to specifications. Refer to Specifications in this section. Remove the rubber hose and install the bleeder screw cap.

## GENERAL PROCEDURES (Continued)

6. Repeat Steps 2 through 5 for the LH rear brake caliper bleeder screw.

### Vehicles equipped with a 4.0L SOHC or 4.6L (3V) engine

7. Remove the RH front brake caliper bleeder screw cap and place a box-end wrench on the bleeder screw. Attach a rubber drain hose to the bleeder screw and submerge the free end of the hose in a container partially filled with clean, specified brake fluid.




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

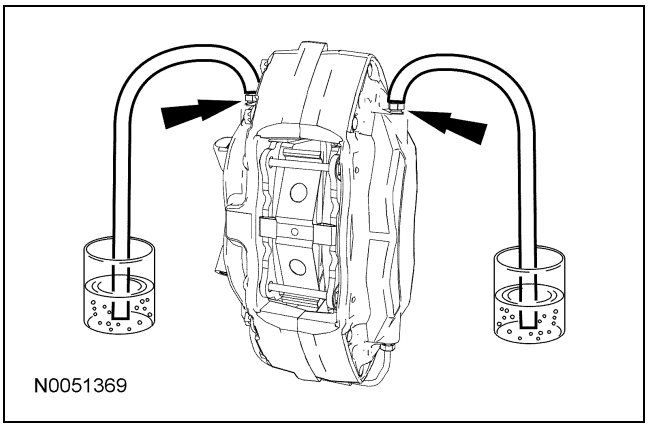
9. Loosen the RH front brake caliper bleeder screw until a stream of brake fluid comes out. While the assistant maintains pressure on the brake pedal, tighten the bleeder screw.
   - Repeat until clear, bubble-free fluid comes out.
   - Refill the brake master cylinder reservoir with clean, specified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

10. Tighten the RH front brake caliper bleeder screw to specifications. Refer to Specifications in this section. Remove the rubber hose and install the bleeder screw cap.

11. Repeat Steps 7 through 10 for the LH front brake caliper bleeder screw.

### Vehicles equipped with a 5.4L engine

12. Remove the RH front brake caliper inner bleeder screw cap and place a box-end wrench on the bleeder screw. Attach a rubber drain hose to the bleeder screw and submerge the free end of the hose in a container partially filled with clean, specified brake fluid.




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

14. Loosen the RH front brake caliper inner 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 with clean, specified brake fluid as necessary.

15. Tighten the RH front brake caliper inner bleeder screw to specifications. Refer to Specifications in this section. Remove the rubber hose and install the bleeder screw cap.

16. Repeat Steps 12 through 15 for the RH front brake caliper outer bleeder screw.

17. Repeat Steps 12 through 15 for the RH front brake caliper inner bleeder screw.

18. Repeat Steps 12 through 15 for the LH front brake caliper inner bleeder screw.

19. Repeat Steps 12 through 15 for the LH front brake caliper outer bleeder screw.

## GENERAL PROCEDURES (Continued)

20. Repeat Steps 12 through 15 for the LH front brake caliper inner bleeder screw.

### Pressure Bleeding

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

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

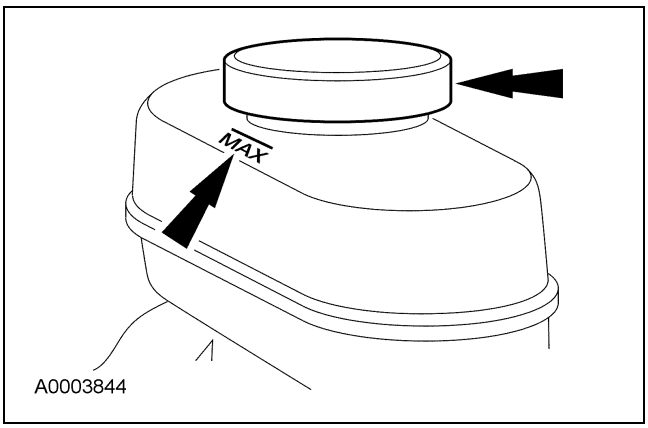
**⚠ WARNING: Do not allow the brake master cylinder to run dry during the bleeding operation. Master cylinder may be damaged if operated without fluid, resulting in degraded braking performance. Failure to follow this instruction may result in serious personal injury.**

*NOTICE:* **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

**NOTE:** When any part of the hydraulic system is 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 is correctly connected. The hydraulic system can be bled manually or with pressure bleeding equipment.

### All vehicles

1. Clean all dirt from and remove the brake master cylinder filler cap and fill the brake master cylinder reservoir with clean, specified brake fluid.



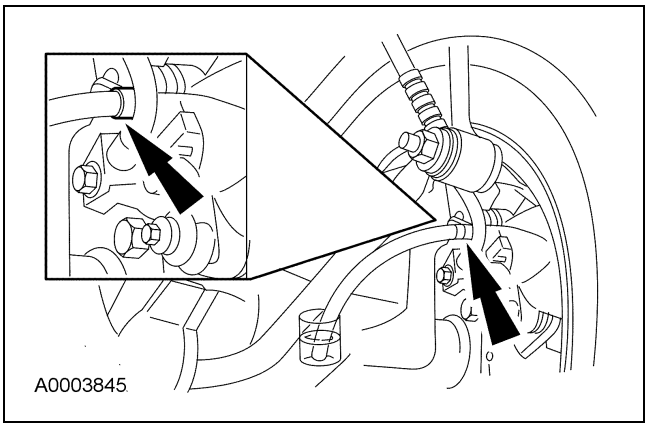

2. **NOTE:** Master cylinder pressure bleeder adapter tools are available from various manufacturers of pressure bleeding equipment. Follow the instructions of the manufacturer when installing the adapter.

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

   - Pressure bleed the brake system at 207-345 kPa (30-50 psi).

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

   Remove the RH rear brake caliper bleeder screw cap and place a box-end wrench on the bleeder screw. Attach a rubber drain hose to the bleeder screw, and submerge the free end of the hose in a container partially filled with clean, specified brake fluid.




4. Open the valve on the bleeder tank.

## GENERAL PROCEDURES (Continued)

5. Loosen the RH rear bleeder screw and leave open until clear, bubble-free brake fluid flows into the container. Wait 15 seconds after clear, bubble-free fluid flows through the rubber hose.

6. Tighten the RH rear bleeder screw to specifications. Refer to Specifications in this section. Remove the rubber hose and install the bleeder screw cap.

### Vehicles equipped with a 4.0L SOHC or 4.6L (3V) engine

7. Continue bleeding the system in the following sequence:
   1 LH rear brake caliper bleeder screw
      - Tighten to specifications. Refer to Specifications in this section.
   2 RH front brake caliper bleeder screw
      - Tighten to specifications. Refer to Specifications in this section.
   3 LH front brake caliper bleeder screw
      - Tighten to specifications. Refer to Specifications in this section.

### Vehicles equipped with a 5.4L engine

8. Continue bleeding the system in the following sequence:
   1 LH rear brake caliper bleeder screw
      - Tighten to specifications. Refer to Specifications in this section.
   2 RH front brake caliper inner bleeder screw
      - Tighten to specifications. Refer to Specifications in this section.
   3 RH front brake caliper outer bleeder screw
      - Tighten to specifications. Refer to Specifications in this section.
   4 RH front brake caliper inner bleeder screw
      - Tighten to specifications. Refer to Specifications in this section.
   5 LH front brake caliper inner bleeder screw
      - Tighten to specifications. Refer to Specifications in this section.
   6 LH front brake caliper outer bleeder screw
      - Tighten to specifications. Refer to Specifications in this section.
   7 LH front brake caliper inner bleeder screw
      - Tighten to specifications. Refer to Specifications in this section.

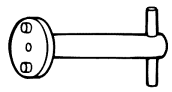
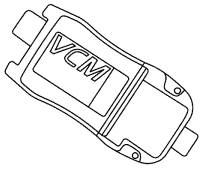
### All vehicles

9. Close the bleeder tank valve and release the pressure. Remove the tank hose from the adapter and remove the adapter. Fill the brake master cylinder reservoir with clean, specified brake fluid if necessary. Install the brake master cylinder filler cap.

# GENERAL PROCEDURES

## Component Bleeding

### Special Tool(s)

| | |
|---|---|
|  ST1112-A | Adapter for Adjuster, Rear Brake Caliper Piston 206-026 (T87P-2588-A) |
|   ST2834-A | Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool |

### Material

| Item | Specification |
|---|---|
| High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada) | WSS-M6C62-A or WSS-M6C65-A1 |

## Master Cylinder

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

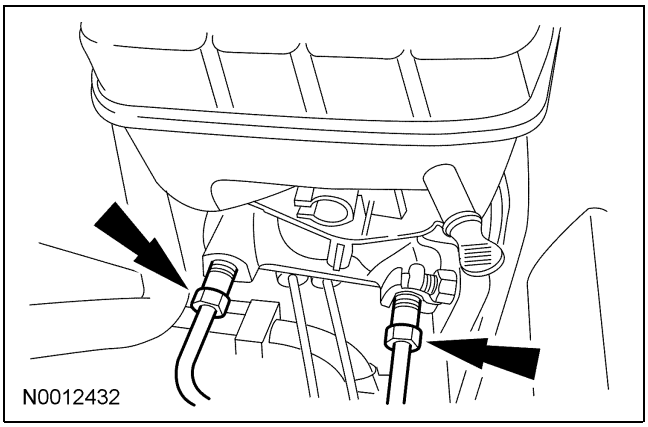
**⚠ WARNING: Carefully read cautionary information on product label. For EMERGENCY MEDICAL INFORMATION seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to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

**⚠ WARNING: Do not allow the brake master cylinder to run dry during the bleeding operation. Master cylinder may be damaged if operated without fluid, resulting in degraded braking performance. Failure to follow this instruction may result in serious personal injury.**

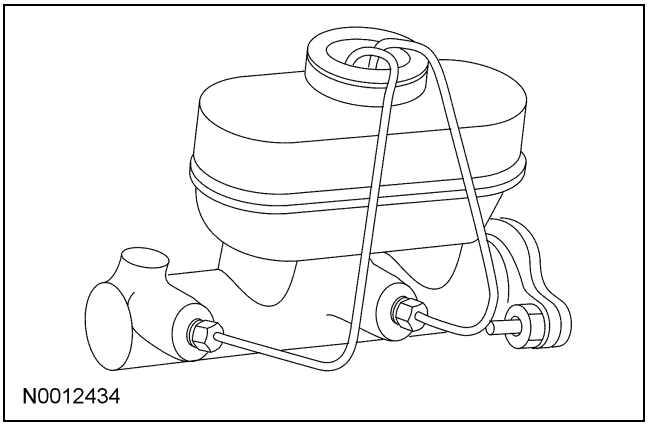
***NOTICE:* Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

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

1. Disconnect the brake tubes.




2. Install short brake tubes onto the primary and secondary ports with the ends submerged in the brake master cylinder reservoir.




3. Fill the brake master cylinder reservoir with clean, specified brake fluid.

## GENERAL PROCEDURES (Continued)

4. Have an assistant pump the brake pedal until clear fluid flows from the brake tubes, without air bubbles.

5. Remove the short brake tubes and install the master cylinder brake tube fittings.
   - Tighten to specifications. Refer to Specifications in this section.

6. Follow the pressure bleeding or manual bleeding procedure steps to bleed the system.

### Rear Brake Caliper

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

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

**⚠ WARNING: Do not allow the brake master cylinder to run dry during the bleeding operation. Master cylinder may be damaged if operated without fluid, resulting in degraded braking performance. Failure to follow this instruction may result in serious personal injury.**

*NOTICE:* **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

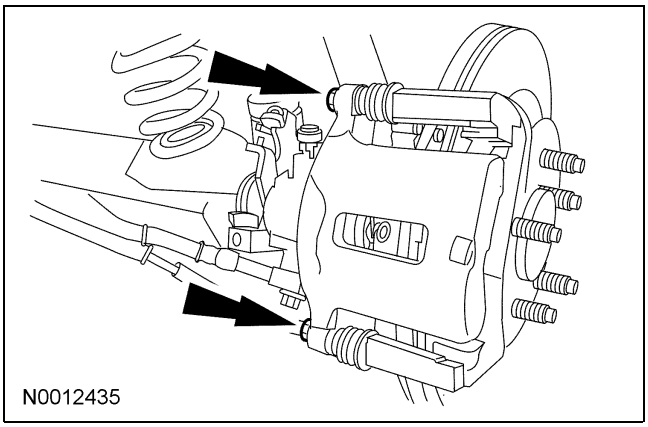
**NOTE:** When any part of the hydraulic system is disconnected for repair or installation of new components, air can get into the system and cause spongy brake pedal action. This requires bleeding of the hydraulic system after it is correctly connected. The hydraulic system can be bled manually or with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

**NOTE:** Due to the complexity of the fluid path within the rear integral parking brake calipers, it may be necessary to follow this procedure when new calipers are installed.

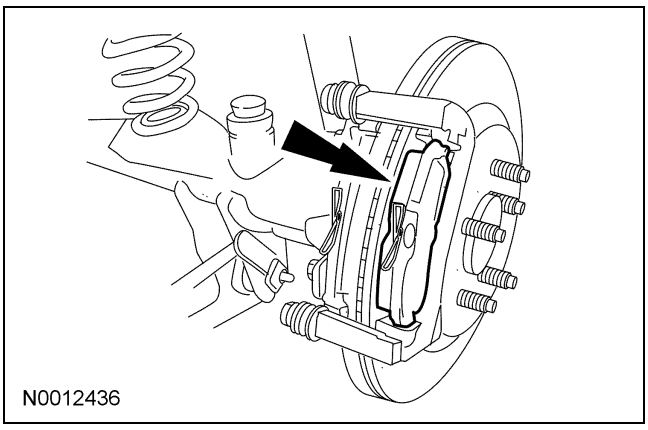
1. **NOTE:** This procedure is necessary only when installing a new rear brake caliper. To bleed the brake system, refer to Brake System Bleeding in this section.

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

2. Remove the 2 brake caliper bolts and position the brake caliper aside.




3. Remove the outer brake pad.

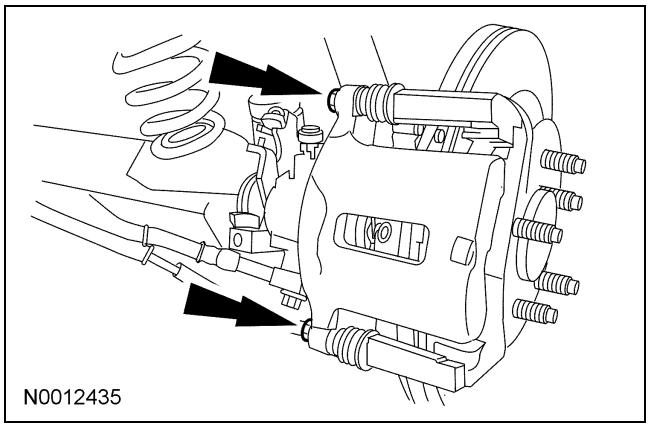


## GENERAL PROCEDURES (Continued)

4. **NOTE:** Place a shop towel between the caliper and the brake disc.

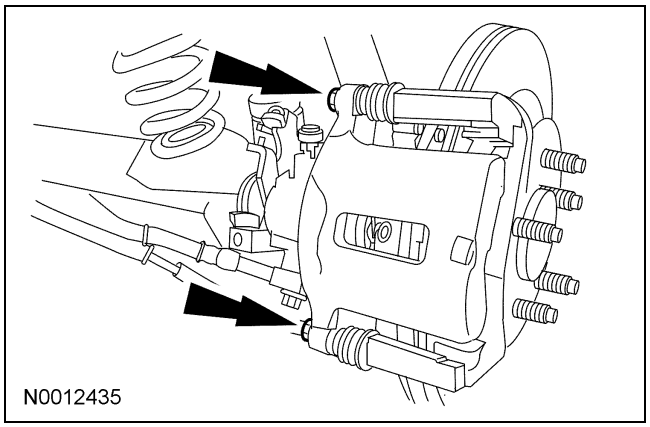
   Install the brake caliper using the 2 brake caliper bolts.

   - Tighten to specifications. Refer to Specifications in this section.

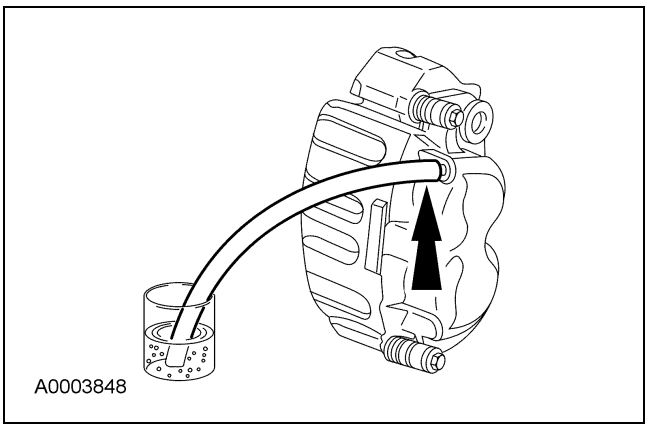



5. Slowly apply the brake pedal to extend the brake caliper piston outward.

6. Remove the 2 brake caliper bolts and position the brake caliper aside.

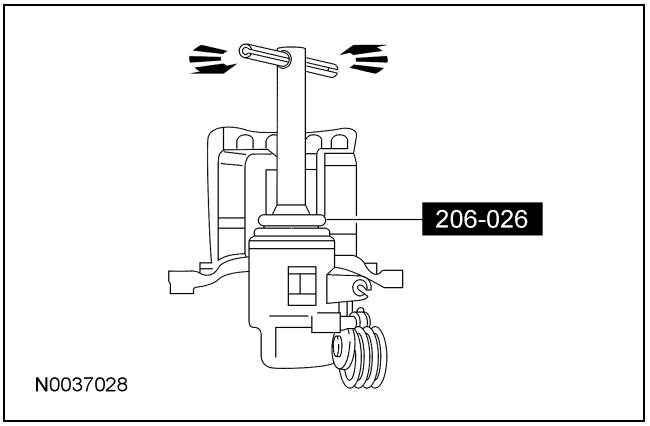



7. Remove the brake caliper bleeder screw cap and place a box-end wrench on the bleeder screw. Attach a rubber drain hose to the bleeder screw and submerge the free end of the hose in a container partially filled with clean, specified brake fluid.




8. Loosen the brake caliper bleeder screw.

9. Using the Rear Brake Caliper Piston Adjuster Adapter, fully retract the brake caliper piston and tighten the bleeder screw to specifications. Refer to Specifications in this section.



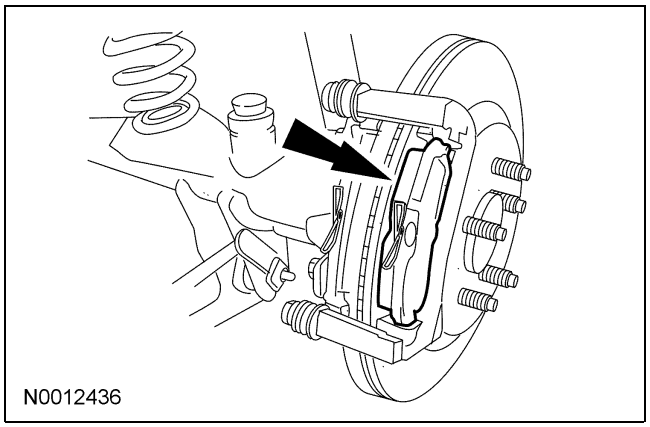

10. Repeat Steps 4 through 9 until clear, bubble free fluid comes out.

    - Refill the brake master cylinder reservoir as necessary.
    - Install the bleeder screw cap.

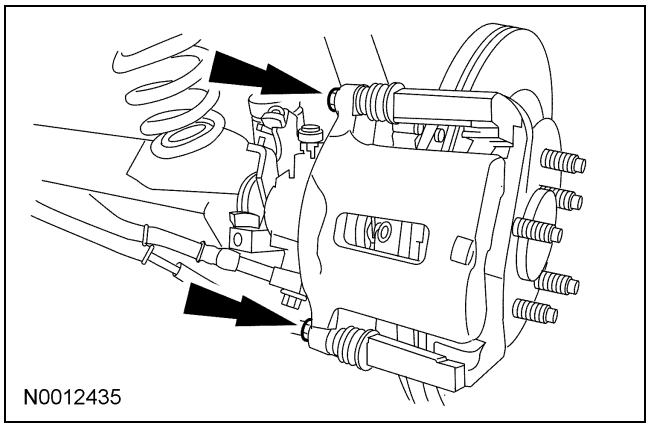
11. Remove the 2 brake caliper bolts and the shop towel.

## GENERAL PROCEDURES (Continued)

12. Install the outer brake pad.




13. Position the brake caliper and install the 2 brake caliper bolts.
    - Tighten to specifications. Refer to Specifications in this section.




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

### ABS Hydraulic Control Unit (HCU) Bleeding

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

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

**⚠ WARNING: Do not allow the brake master cylinder to run dry during the bleeding operation. Master cylinder may be damaged if operated without fluid, resulting in degraded braking performance. Failure to follow this instruction may result in serious personal injury.**

***NOTICE:*** **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

**NOTE:** This procedure is only required when a new Hydraulic Control Unit (HCU) is installed.

**NOTE:** When any part of the hydraulic system is 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 is correctly connected. The hydraulic system can be bled manually or with pressure bleeding equipment.

1. Connect the scan tool and follow the ABS HCU bleeding instructions.

2. Use the pressure or manual bleeding procedure to bleed the system, refer to Brake System Bleeding in this section.

# SPECIFICATIONS

### Material

| Item | Specification | Fill Capacity |
|---|---|---|
| High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada) | WSS-M6C62-A | 714 ml (1.5 pt) |
| High Temperature Nickel Anti-Seize Lubricant XL-2 (US); CXG-2-B (Canada) | ESE-M12A4-A | — |
| Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada) | — | — |
| Silicone Brake Caliper Grease and Dielectric Compound XG-3-A | ESE-M1C171-A | — |

### General Specifications

| Item | Specification |
|---|---|
| **Brake Disc — 4.0L SOHC and 4.6L (3V)** | |
| Brake disc minimum thickness | 28.4 mm (1.118 in) |
| **Brake Disc — 5.4L** | |

### General Specifications (Continued)

| Item | Specification |
|---|---|
| Brake disc minimum thickness | 30.0 mm (1.181 in) |
| **Brake Pads — 4.0L SOHC and 4.6L (3V)** | |
| Brake pad maximum taper wear (in any direction) | 3.0 mm (0.118 in) |
| Brake pad minimum thickness | 3.0 mm (0.118 in) |
| **Brake Pads — 5.4L** | |
| Brake pad minimum thickness | 1.8 mm (0.071 in) |

### Torque Specifications

| Description | Nm | lb-ft | lb-in |
|---|---|---|---|
| Bleeder screw | 10 | — | 89 |
| Brake caliper anchor plate bolts | 115 | 85 | — |
| Brake caliper bolt — 5.4L | 115 | 85 | — |
| Brake caliper flow bolt | 40 | 30 | — |
| Brake caliper guide pin bolts | 34 | 25 | — |
| Brake disc shield bolts | 20 | 15 | — |
| Brake flexible hose bracket bolts | 20 | 15 | — |
| Brake tube fittings | 17 | 13 | — |

# DESCRIPTION AND OPERATION

## Front Disc Brake

The front brake disc system consists of the following components:

- Brake caliper anchor plate
- Brake caliper
- Brake disc
- Brake disc shield
- Brake flexible hose

When mechanical force is applied by the driver to the brake pedal, the force is converted into hydraulic pressure by the master cylinder. The hydraulic force is directed to the disc brake calipers and transferred to the brake pads. The brake pads are then forced against the brake friction surfaces by the brake caliper pistons. The friction of the brake pads on the brake disc causes the slowing of wheel rotation and the vehicle.

# DIAGNOSIS AND TESTING

## Front Disc Brake

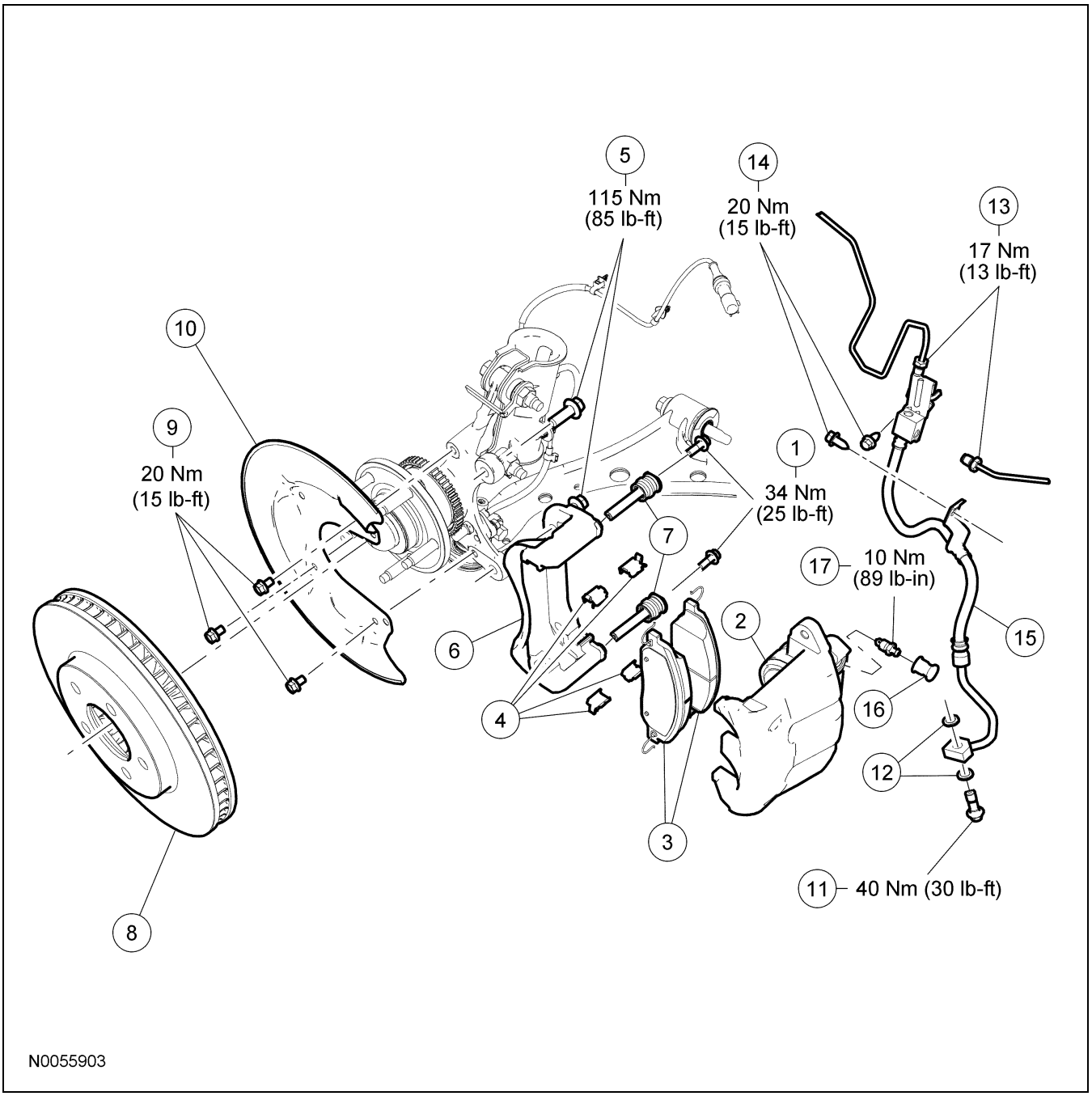
Refer to Section 206-00.

# REMOVAL AND INSTALLATION

## Disc Brake System — Exploded View

**4.0L SOHC and 4.6L (3V)**

**NOTE:** LH shown, RH similar.




| Item | Part Number | Description |
|---|---|---|
| 1 | — | Brake caliper guide pin bolts (2 required) (part of 2B134, also part of 2001) |
| 2 | 2C357 RH/ 2C358 LH | Brake caliper |

(Continued)

| Item | Part Number | Description |
|---|---|---|
| 3 | 2001 | Brake pads kit |
| 4 | — | Spring clips (4 required) (part of 2001) |
| 5 | W710233 | Brake caliper anchor plate bolts (2 required) |

(Continued)

## REMOVAL AND INSTALLATION (Continued)

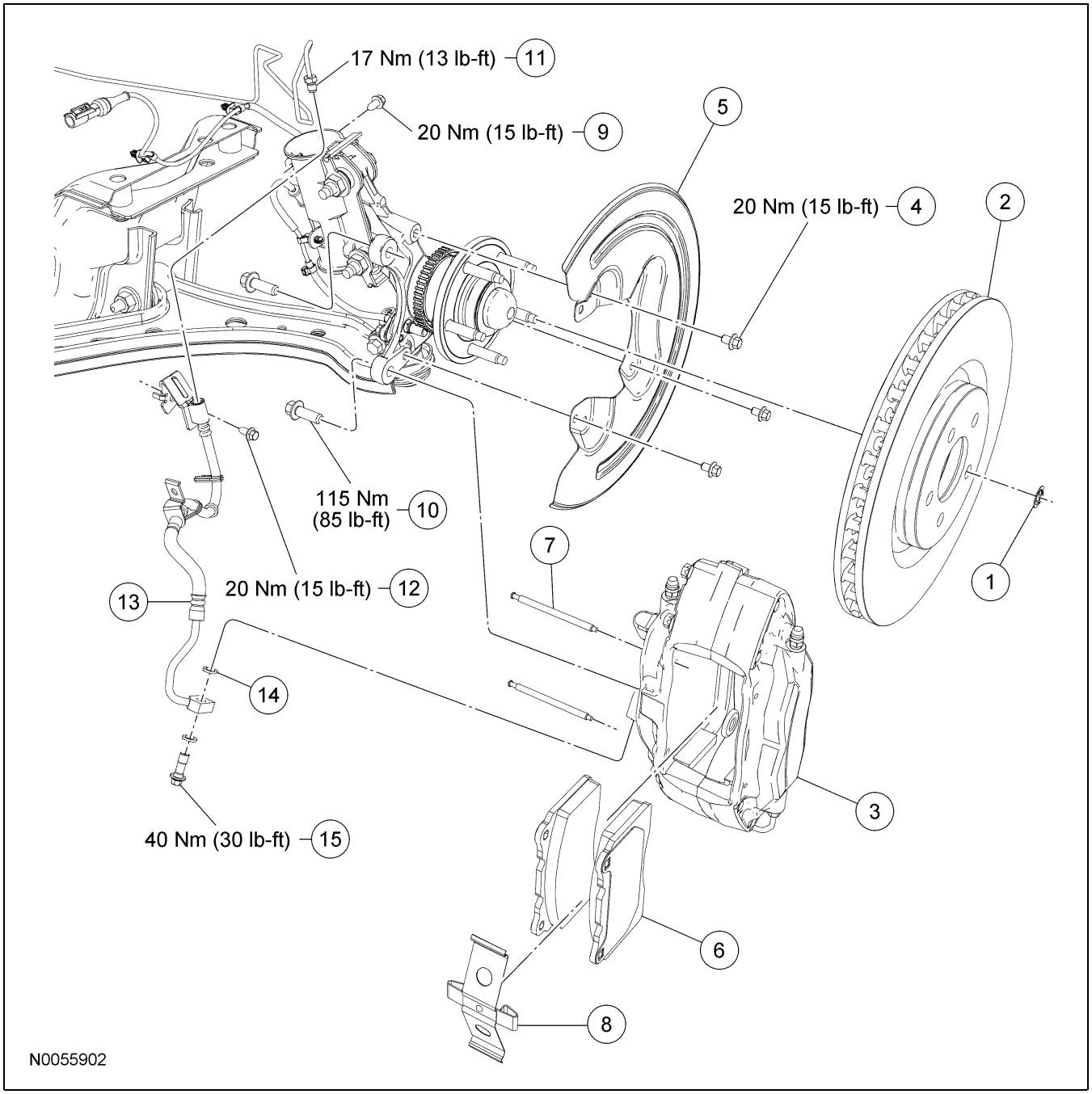
| Item | Part Number | Description |
|---|---|---|
| 6 | 2B134 | Brake caliper anchor plate |
| 7 | — | Guide pins (part of 2B134) |
| 8 | 1125 | Brake disc |
| 9 | W500020 | Brake disc shield bolts (3 required) |
| 10 | 2K004 | Brake disc shield |
| 11 | W712275 | Brake caliper flow bolt |
| 12 | W712362 | Copper washers (2 required) |
| 13 | — | Brake tube fittings (part of 2C296) |
| 14 | N802191 | Brake flexible hose bracket bolts |
| 15 | 2078 RH/ 2B557 LH | Brake flexible hose |
| 16 | — | Bleeder screw cap (part of 2208) |
| 17 | 2208 | Bleeder screw |

(Continued)

## REMOVAL AND INSTALLATION (Continued)

**5.4L**

**NOTE:** RH shown, LH similar




| Item | Part Number | Description |
|---|---|---|
| 1 | 383609 | Retaining nut |
| 2 | 1125 | Brake disc |
| 3 | 2B220 RH/ 2B221 LH | Brake caliper |
| 4 | W500020 | Brake disc shield bolt (3 required) |
| 5 | 2K004 | Brake disc shield |
| 6 | 2001 | Brake pad (2 required) |

(Continued)

| Item | Part Number | Description |
|---|---|---|
| 7 | — | Brake pad mounting pin (2 required) (part of 2B164) |
| 8 | — | Spring retainer clip (part of 2K583) |
| 9 | N802191 | Brake hose-to-strut bolt |
| 10 | W710233 | Brake caliper bolt (2 required) |

(Continued)

## REMOVAL AND INSTALLATION (Continued)

| Item | Part Number | Description |
|---|---|---|
| 11 | — | Brake tube fitting (part of 2C296) |
| 12 | N802191 | Brake flexible hose bracket bolt |
| 13 | 2078 RH/ 2B557 LH | Brake flexible hose |
| 14 | W712362 | Copper washer (2 required) |
| 15 | W712275 | Brake caliper flow bolt |

1. **NOTE:** A revised part, with the same base part number, has been released for the RH brake hose. When installing a new RH brake hose, position the anti-rotation tab on the mounting bracket toward the front of the vehicle and install the bolt with the head toward the rear of the vehicle.

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

# REMOVAL AND INSTALLATION

## Brake Caliper — 4.0L SOHC and 4.6L (3V)

### Material

| Item | Specification |
|---|---|
| High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada) | WSS-M6C62-A |

### Removal

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

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

**⚠ 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.**

1. Remove the wheel and tire. For additional information, refer to Section 204-04.
2. Remove the brake caliper flow bolt and discard the 2 copper washers.
3. **⚠ CAUTION: Do not use the caliper sight hole to retract pistons as this may damage the pistons and boots.**

   Remove and discard the 2 brake caliper guide pin bolts and remove the brake caliper.
4. Inspect the brake caliper.
   - If leaks or damaged boots are found, install a new brake caliper.

### Installation

1. Position the brake caliper and install 2 new guide pin bolts.
   - Tighten to 34 Nm (25 lb-ft).
2. Using 2 new copper washers, position the brake flexible hose on the brake caliper and install the brake caliper flow bolt.
   - Tighten to 40 Nm (30 lb-ft).
3. Bleed the brake system. For additional information, refer to Section 206-00.
4. Install the wheel and tire. For additional information, refer to Section 204-04.

# REMOVAL AND INSTALLATION

## Brake Caliper — 5.4L

**Material**

| Item | Specification |
|---|---|
| High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada) | WSS-M6C62-A |

### Removal and Installation

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

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

**⚠ 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.**

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

2. Remove the brake pads. For additional information, refer to Brake Caliper — 5.4L in this section.

3. Remove the brake caliper flow bolt and discard the 2 copper washers.
   - To install, tighten to 48 Nm (35 lb-ft).
   - Install new copper washers.

4. **⚠ CAUTION: Do not remove the bolts securing the 2 caliper halves together. Do not attempt to separate the 2 caliper halves or damage to components may occur.**

   Remove the 2 brake caliper anchor plate bolts and the brake caliper.
   - To install, tighten to 40 Nm (30 lb-ft).

5. To install, reverse the removal procedure.
   - Bleed the brakes. For additional information, refer to Section 206-00.

# REMOVAL AND INSTALLATION

## Brake Pads — 4.0L SOHC and 4.6L (3V)

### Material

| Item | Specification |
|---|---|
| High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada) | WSS-M6C62-A |
| Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada) | — |
| Silicone Brake Caliper Grease and Dielectric Compound XG-3-A | ESE-M1C171-A |

### Removal

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

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

**⚠ 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.**

1. Check the brake fluid level in the brake fluid reservoir.
   - If required, remove fluid until the brake master cylinder reservoir is half full.
2. Remove the wheel and tire. For additional information, refer to Section 204-04.
3. **⚠ CAUTION: Do not use the caliper sight hole to retract pistons as this may damage the pistons and boots.**

   **⚠ CAUTION: Do not allow the brake caliper, brake pads and anchor plate assembly to hang from the brake hose or damage to the hose may occur.**

   Remove and discard the 2 brake caliper guide pin bolts and position the brake caliper aside.
   - Support the brake caliper using mechanic's wire.
4. **⚠ CAUTION: Install new brake pads if they are worn past the specified thickness above the metal backing plates. Install new brake pads in axle sets or brake drag/brake pull may occur.**

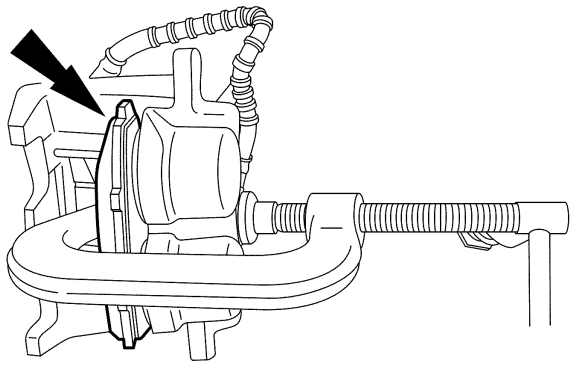
   Remove the brake pads and discard the 4 spring clips.
5. Inspect the brake caliper.
   - If leaks or damaged boots are found, install a new brake caliper. For additional information, refer to Brake Caliper — 4.0L SOHC and 4.6L (3V) in this section.
6. Inspect the brake caliper anchor plate assembly.
   - Check the guide pins and boots for binding or damage.
   - Lubricate the guide pins with the specified grease.
   - Install a new brake caliper anchor plate if it is worn or damaged. For additional information, refer to Brake Caliper — 4.0L SOHC and 4.6L (3V) in this section.

## REMOVAL AND INSTALLATION (Continued)

### Installation

1. **CAUTION: Protect the piston and boots when pushing the caliper piston into the caliper piston bores or damage to the piston or boots may occur.**

   If installing new brake pads, using a C-clamp and a worn brake pad, compress the brake caliper pistons into the caliper.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2. **CAUTION: Do not allow grease, oil, brake fluid or other contaminants to contact the pad lining material or damage to components may occur. Do not install contaminated pads.**

   **NOTE:** Install all the hardware supplied with the brake pad kits.

   Install 4 new spring clips and the 2 brake pads.

3. Position the brake caliper on the anchor plate and install 2 new guide pin bolts.
   - Tighten to 34 Nm (25 lb-ft).

4. If necessary, fill the brake fluid reservoir with clean, specified brake fluid.

5. Apply the brakes several times to verify correct brake operation.

# REMOVAL AND INSTALLATION

## Brake Pads — 5.4L

### Removal and Installation

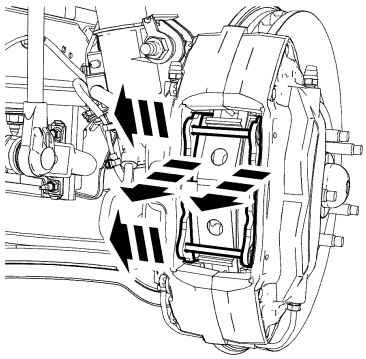
⚠ **WARNING: Always install new brake shoes or pads at both ends of an axle to reduce the possibility of brakes pulling vehicle to one side. Failure to follow this instruction may result in uneven braking and serious personal injury.**

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

2. **NOTE:** Inspect and install new brake pad mounting hardware as necessary.

   Remove the brake pad mounting pins and spring retainer clip.

   - Remove the brake pads from the caliper assembly.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3. ⚠ **CAUTION: Do not allow the brake caliper to hang from the brake hose or damage to the hose may occur.**

   Remove and discard the 2 brake caliper bolts and position the brake caliper aside.

   - Support the brake caliper using mechanic's wire.
   - To install, tighten new caliper bolts to 115 Nm (85 lb-ft).

4. ⚠ **CAUTION: Protect the piston and boots when pushing the caliper piston into the caliper piston bores or damage to the piston or boots may occur.**

   If installing new brake pads, using a C-clamp and a worn brake pad, compress the brake caliper pistons into the caliper.

5. To install, reverse the removal procedure.

6. Apply the brake pedal several times to verify correct brake operation.

# REMOVAL AND INSTALLATION

## Brake Caliper Anchor Plate — 4.0L SOHC and 4.6L (3V)

### Material

| Item | Specification |
|---|---|
| Silicone Brake Caliper Grease and Dielectric Compound XG-3-A | ESE-M1C171-A |

### Removal and Installation

1. Remove the brake pads. For additional information, refer to Brake Pads — 4.0L SOHC and 4.6L (3V) in this section.
2. **NOTE:** Clean any residual threadlock compound from the anchor plate threads before installing the bolts.

   Remove and discard the 2 anchor plate bolts and remove the brake caliper anchor plate.

   - To install, tighten new anchor plate bolts to 115 Nm (85 lb-ft).
3. Inspect the brake caliper anchor plate assembly.
   - Check the guide pins and boots for binding and damage.
   - Replace worn or damaged pins. Lubricate the pins with the specified grease.
   - Install a new brake caliper anchor plate if it is worn or damaged.
4. To install, reverse the removal procedure.

# REMOVAL AND INSTALLATION

## Brake Disc

### Material

| Item | Specification |
|---|---|
| High Temperature Nickel Anti-Seize Lubricant XL-2 (US); CXG-2-B (Canada) | ESE-M12A4-A |
| Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada) | — |

## Removal

### 4.0L SOHC and 4.6L (3V) equipped vehicles

1. **CAUTION: Do not allow the brake caliper, brake pads and anchor plate assembly to hang from the brake hose or damage to the hose may occur.**

   Remove and discard the 2 brake caliper anchor plate bolts and position the brake caliper, brake pads and anchor plate aside as an assembly.

   - Support the brake caliper, brake pads and anchor plate assembly using mechanic's wire.

### 5.4L equipped vehicles

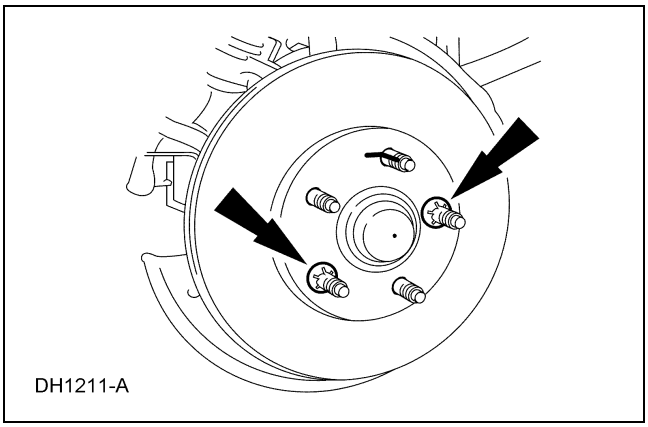
2. **CAUTION: Do not allow the brake caliper assembly to hang from the brake hose or damage to the hose may occur.**

   Remove and discard the 2 brake caliper bolts and position the caliper assembly aside.

   - Support the caliper assembly using mechanic's wire.

### All vehicles

3. If equipped, remove and discard the retainer nuts.




4. Remove the brake disc.

## Installation

### All vehicles

1. **CAUTION: Do not use an abrasive sanding disc since it will remove paint or other protective finishes from the wheel or metal from the mounting surfaces, adversely affecting corrosion protection and brake disc lateral runout.**

   Remove corrosion from the wheel mounting surfaces, both disc mounting surfaces and hub mounting surfaces.

   - Use brake parts cleaner to clean the brake disc and hub surfaces.
   - Apply anti-seize lubricant to the hub mounting surfaces to prevent future corrosion.

2. Install the brake disc.

### 4.0L SOHC and 4.6L (3V) equipped vehicles

3. **NOTE:** Clean any residual threadlock compound from the anchor plate threads before installing the bolts.

   Position the brake caliper, brake pads and anchor plate assembly.

   - Install 2 new brake caliper anchor plate bolts and tighten to 115 Nm (85 lb-ft).

## REMOVAL AND INSTALLATION (Continued)

### 5.4L equipped vehicles

4. Position the brake caliper assembly and install 2 new caliper bolts.
   - Tighten the bolts to 115 Nm (85 lb-ft).

# REMOVAL AND INSTALLATION

## Brake Disc Shield

### Removal and Installation

1. Remove the brake disc. For additional information, refer to Brake Disc in this section.
2. Remove the 3 bolts and the brake disc shield.
   - To install, tighten to 20 Nm (15 lb-ft).
3. To install, reverse the removal procedure.

# REMOVAL AND INSTALLATION

## Brake Flexible Hose

### Material

| Item | Specification |
|---|---|
| High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada) | WSS-M6C62-A |

### Removal and Installation

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

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

**⚠ 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.**

1. Remove the brake caliper flow bolt and discard the 2 copper washers.
   - To install, tighten to 40 Nm (30 lb-ft).
2. Disconnect the brake tube fitting from the brake flexible hose.
   - To install, tighten to 17 Nm (13 lb-ft).
3. Remove the 2 brake flexible hose bracket bolts and the brake flexible hose.
   - To install, tighten to 20 Nm (15 lb-ft).
4. To install, reverse the removal procedure.
   - Bleed the brake system. For additional information, refer to Section 206-00.

# SPECIFICATIONS

### Material

| Item | Specification | Fill Capacity |
|---|---|---|
| High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada) | WSS-M6C62-A | 714 ml (1.5 pt) |
| High Temperature Nickel Anti-Seize Lubricant XL-2 (US); CXG-2-B (Canada) | ESE-M12A4-A | — |
| Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada) | — | — |
| Silicone Brake Caliper Grease and Dielectric Compound XG-3-A | ESE-M1C171-A | — |

### General Specifications

| Item | Specification |
|---|---|
| **Brake Disc** | |
| Brake disc minimum thickness | 17.4 mm (0.685 in) |

### General Specifications (Continued)

| Item | Specification |
|---|---|
| **Brake Pads** | |
| Brake pad maximum taper wear (in any direction) | 3.0 mm (0.118 in) |
| Brake pad minimum thickness | 3.0 mm (0.118 in) |

### Torque Specifications

| Description | Nm | lb-ft | lb-in |
|---|---|---|---|
| Anti-moan bracket U-bolt nuts | 35 | 26 | — |
| Bleeder screw | 10 | — | 89 |
| Brake caliper anchor plate bolts | 103 | 76 | — |
| Brake caliper flow bolt | 40 | 30 | — |
| Brake caliper guide pin bolts[a] | — | — | — |
| Brake caliper support bracket bolts | 68 | 50 | — |
| Brake disc shield bolts | 20 | 15 | — |
| Brake hose bracket bolts | 15 | 11 | — |
| Brake tube fitting | 17 | 13 | — |

a Refer to the procedure for the correct tightening sequence and torque specifications.

# DESCRIPTION AND OPERATION

## Rear Disc Brake

The rear disc brake system consists of the following components:

- Brake caliper anchor plate
- Brake caliper
- Brake disc
- Brake flexible hose
- Brake pads

When mechanical force is applied by the driver to the brake pedal, the force is converted into hydraulic pressure by the master cylinder. The hydraulic force is directed to the disc brake calipers and transferred to the brake pads. The brake pads are then forced against the brake friction surfaces by the brake caliper pistons. The friction of the brake pads on the brake disc causes the slowing or stopping of wheel rotation and the vehicle.

# DIAGNOSIS AND TESTING

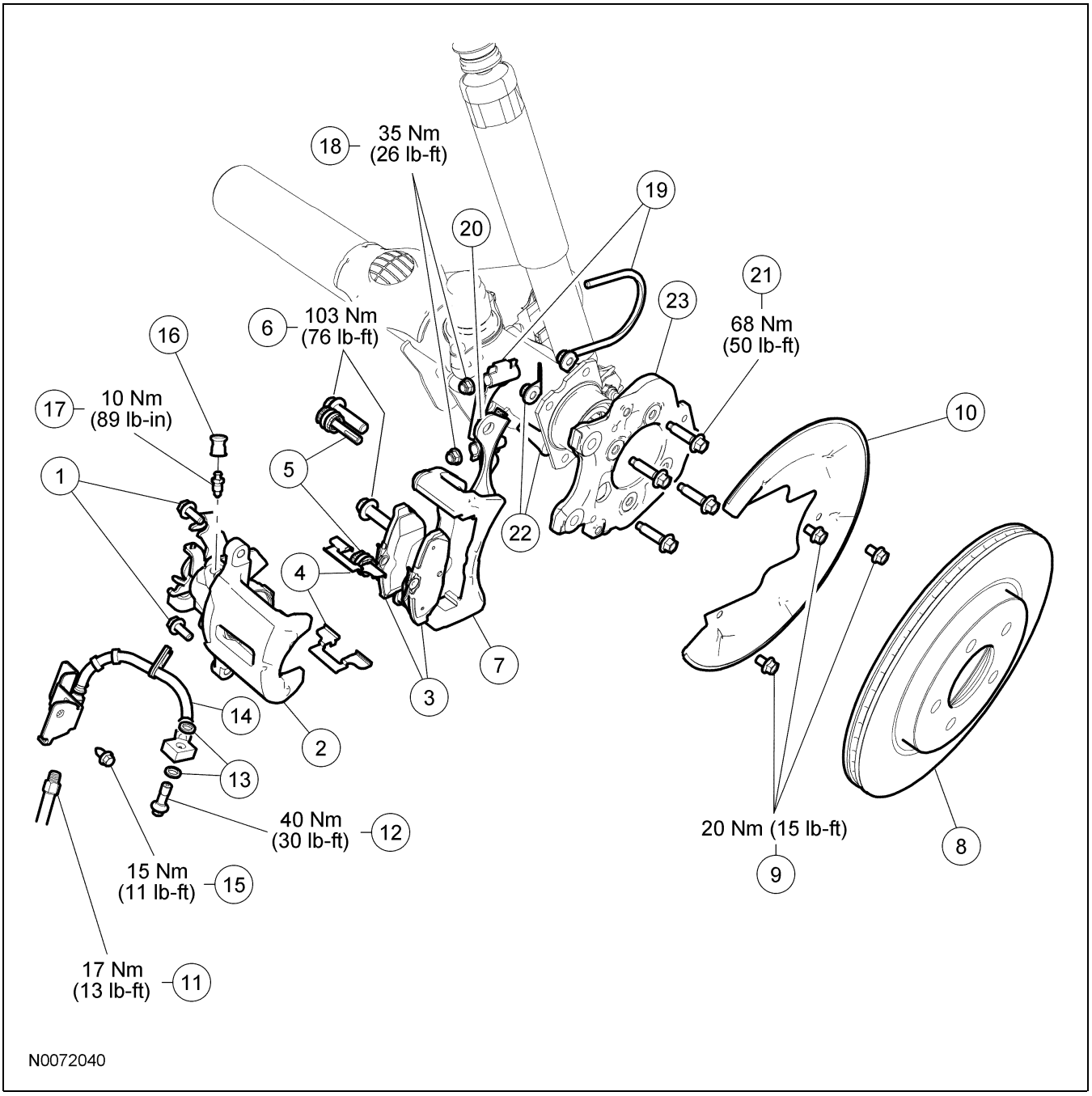
## Rear Disc Brake

Refer to Section 206-00.

# REMOVAL AND INSTALLATION

## Disc Brake System — Exploded View

**NOTE:** 4.0L SOHC and 4.6L (3L) shown, 5.4L similar.




| Item | Part Number | Description |
|---|---|---|
| 1 | 2N386 | Brake caliper guide pin bolts |
| 2 | 2552 RH/ 2553 LH | Brake caliper |
| 3 | 2218 | Brake pads (kit) |
| 4 | — | Spring clips (part of kit 2200) |

(Continued)

| Item | Part Number | Description |
|---|---|---|
| 5 | — | Guide pin and boot (part of kit 2B296) |
| 6 | W705821 | Brake caliper anchor plate bolt kits (2 bolts each side) |
| 7 | 2B511 | Brake caliper anchor plate |
| 8 | 2C026 | Brake disc |

(Continued)

## REMOVAL AND INSTALLATION (Continued)

| Item | Part Number | Description |
|---|---|---|
| 9 | W500020 | Brake disc shield bolts (3 required) (part of 2C029) |
| 10 | 2C029 | Brake disc shield |
| 11 | — | Brake tube fitting (part of 2268) |
| 12 | W712275 | Brake caliper flow bolt |
| 13 | W712362 | Copper washers (2 required) |
| 14 | 2A442 RH/ 2A478 LH | Brake hose |
| 15 | N802191 | Brake hose bracket bolt |
| 16 | — | Bleeder screw cap (part of 2N033) |
| 17 | 2N033 | Bleeder screw |
| 18 | W520112 | Anti-moan bracket U-bolt nuts (2 required) |
| 19 | — | Anti-moan bracket U-bolt and clamp (part of 2C371) |
| 20 | 2C371 | Anti-moan bracket (4.0L SOHC and 4.6L [3V] only) |
| 21 | — | Brake caliper support bracket bolts (4 required) (part of 4001) |
| 22 | — | Brake caliper support bracket flag nuts (4 required) (part of 4001) |
| 23 | — | Brake caliper support bracket (part of 4001) |

(Continued)

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

# REMOVAL AND INSTALLATION

## Brake Caliper

### Material

| Item | Specification |
|---|---|
| High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada) | WSS-M6C62-A |

## Removal

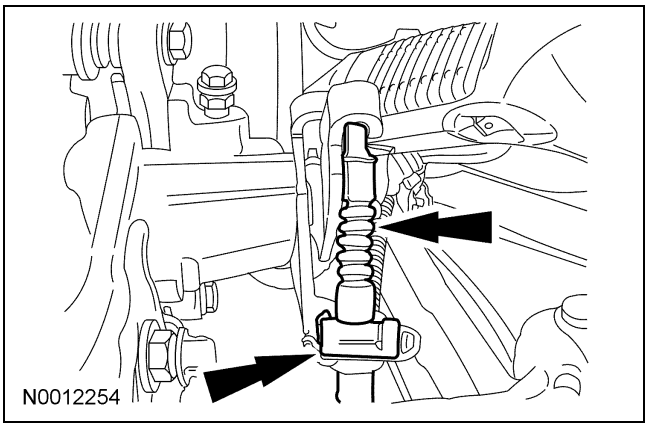
**⚠ WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.**

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

**⚠ 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.**

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

2. Remove the retaining clip and the parking brake cable and conduit from the brake caliper.




3. Remove the brake caliper flow bolt and discard the 2 copper washers.

4. Remove the 2 brake caliper guide pin bolts and the brake caliper.

5. Inspect the brake caliper.
   - If leaks or a damaged piston boot are found, install a new brake caliper.

### Installation

1. Position the brake caliper and install the 2 brake caliper guide pin bolts until snug.
   - Tighten the RH caliper guide pin bolts in the following sequence:
     - Tighten the top bolt to 33 Nm (24 lb-ft).
     - Tighten the bottom bolt to 33 Nm (24 lb-ft).
   - Tighten the LH caliper guide pin bolts in the following sequence:
     - Tighten the bottom bolt to 33 Nm (24 lb-ft).
     - Tighten the top bolt to 33 Nm (24 lb-ft).

2. Using 2 new copper washers, position the front brake hose on the brake caliper and install the flow bolt.
   - Tighten to 40 Nm (30 lb-ft).

3. Connect the parking brake cable and conduit to the brake caliper.
   - Install the retaining clip.

4. Bleed the caliper. For additional information, refer to Section 206-00 for component bleeding.

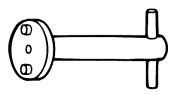
## REMOVAL AND INSTALLATION (Continued)

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

# REMOVAL AND INSTALLATION

## Brake Pads

### Special Tool(s)

| | |
|---|---|
|  ST1112-A | Adapter, Rear Brake Caliper Piston Adjuster 206-026 (T87P-2588-A) or equivalent |

### Material

| Item | Specification |
|---|---|
| High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada) | WSS-M6C62-A |
| Silicone Brake Caliper Grease and Dielectric Compound XG-3-A | ESE-M1C171-A |

## Removal

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

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

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

**⚠ 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.**

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

2. **⚠ CAUTION: Care must be used when servicing rear brake components without disconnecting the parking brake cable from the brake caliper lever. Carefully position the caliper aside using a suitable support or damage to the parking brake cable end fittings may occur.**

   **⚠ CAUTION: Do not use caliper sight hole to retract pistons as this may damage the pistons and boots.**

   **⚠ CAUTION: Do not allow the caliper to hang from the brake hose or damage to the hose may occur.**

   Remove the 2 brake caliper guide pin bolts and position the brake caliper aside.

   - Support the caliper using mechanic's wire.

3. Remove the brake pads and discard the spring clips.

4. Measure the brake disc thickness.
   - Install a new brake disc if not within specification. For additional information, refer to Brake Disc in this section.

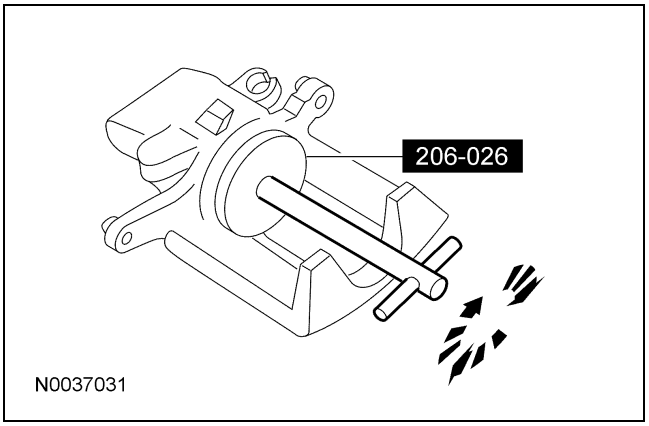
5. Inspect the brake caliper.
   - If leaks or damaged boots are found, install a new brake caliper. For additional information, refer to Brake Caliper in this section.

6. Inspect the brake caliper anchor plate assembly.
   - Check the guide pins and boots for binding and damage.
   - Replace worn or damaged pins. Lubricate the pins with the specified grease.
   - Install a new brake caliper anchor plate if it is worn or damaged.

## REMOVAL AND INSTALLATION (Continued)

### Installation

1. Using the special tool, compress the brake caliper piston into the brake caliper bore.




2. Position the notch in the caliper piston up and down to align with the alignment pin on the brake pad.

3. **CAUTION: Do not allow grease, oil, brake fluid or other contaminants to contact the pad lining material, or damage to components may occur. Do not install contaminated pads.**

   **NOTE:** Install all hardware supplied with the pad kit.

   Install the 2 new spring clips and the brake pads.

4. Position the brake caliper on the anchor plate and install the 2 brake caliper guide pin bolts until snug.
   - Tighten the RH caliper guide pin bolts in the following sequence:
     - Tighten the top bolt to 33 Nm (24 lb-ft).
     - Tighten the bottom bolt to 33 Nm (24 lb-ft).
   - Tighten the LH caliper guide pin bolts in the following sequence:
     - Tighten the bottom bolt to 33 Nm (24 lb-ft).
     - Tighten the top bolt to 33 Nm (24 lb-ft).

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

6. Apply brakes several times to verify correct brake operation.

# REMOVAL AND INSTALLATION

## Brake Caliper Anchor Plate

### Material

| Item | Specification |
|---|---|
| Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada) | — |

### Removal

1. Remove the brake pads. For additional information, refer to Brake Pads in this section.
2. Remove the 2 brake caliper anchor plate bolts and the brake caliper.
   - Discard the bolts.

### Installation

1. **CAUTION: In order for the brake caliper anchor plate bolts to attain the proper clamp load when installed, the residual thread lock compound must be cleaned out of the bolt threads of the anchor plate.**

   Clean any residual thread lock compound, and any other foreign material, from the threads of the brake caliper anchor plate.
2. Position the brake caliper anchor plate and install 2 new anchor plate bolts.
   - Tighten to 103 Nm (76 lb-ft).
3. Install the brake pads. For additional information, refer to Brake Pads in this section.

# REMOVAL AND INSTALLATION

## Brake Disc

### Material

| Item | Specification |
|---|---|
| High Temperature Nickel Anti-Seize Lubricant XL-2 (US); CXG-2-B (Canada) | ESE-M12A4-A |
| Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada) | — |

## Removal

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

2. **CAUTION: Care must be used when servicing rear brake components without disconnecting the parking brake cable from the brake caliper lever. Carefully position the caliper aside using a suitable support or damage to the parking brake cable end fittings may occur.**

   **CAUTION: Do not allow the brake caliper and anchor plate assembly to hang from the brake hose or damage to the hose may occur.**

   Remove and discard the 2 anchor plate bolts and position the brake caliper anchor plate and brake caliper assembly aside.

   - Support the caliper using mechanic's wire.

3. Remove the brake disc.

## Installation

1. Clean any rust or foreign material from the brake disc and the wheel hub.

   - Use brake parts cleaner to clean the brake disc and hub surfaces.

2. **CAUTION: In order for the brake caliper anchor plate bolts to attain the proper clamp load when installed, the residual thread lock compound must be cleaned out of the bolt threads of the anchor plate.**

   Clean any residual thread lock compound, and any other foreign material, from the threads of the brake caliper anchor plate.

3. **CAUTION: Do not allow the lubricant to make contact with the wheel studs, brake pads or brake disc or damage to components may occur.**

   Apply a thin coat of anti-seize lubricant to the hub flange.

4. Position the brake disc onto the wheel hub.

5. Position the brake caliper anchor plate and install 2 new anchor plate bolts.

   - Tighten to 103 Nm (76 lb-ft).

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

7. Apply brakes several times to verify correct brake operation.

# REMOVAL AND INSTALLATION

## Brake Disc Shield

### Removal and Installation

1. Remove the brake disc. For additional information, refer to Brake Disc in this section.
2. Remove the 3 bolts and the brake disc shield.
   - To install, tighten to 20 Nm (15 lb-ft).
3. To install, reverse the removal procedure.

# REMOVAL AND INSTALLATION

## Brake Caliper Support Bracket

### Removal and Installation

1. Remove the rear axle shaft. For additional information, refer to Section 205-02A or Section 205-02B.
2. Remove the 3 bolts and the brake disc shield.
   - To install, tighten to 20 Nm (15 lb-ft).
3. **NOTE:** Make sure the anti-moan bracket holes, the brake caliper support bracket and the brake caliper anchor plate holes line up during installation.

   Remove the anti-moan bracket.
   - To install, tighten to 35 Nm (26 lb-ft).
4. Remove the 4 brake caliper support bracket nuts, bolts and the bracket.
   - To install, tighten to 68 Nm (50 lb-ft).
5. To install, reverse the removal procedure.

# REMOVAL AND INSTALLATION

## Brake Flexible Hose

### Material

| Item | Specification |
|---|---|
| High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada) | WSS-M6C62-A |

### Removal and Installation

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

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

**⚠ 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.**

1. Remove the wheel and tire. For additional information, refer to Section 204-04.
2. Remove the brake caliper flow bolt and discard the 2 copper washers.
   - To install, tighten to 40 Nm (30 lb-ft).
3. Disconnect the brake tube fitting from the brake flexible hose.
   - To install, tighten to 17 Nm (13 lb-ft).
4. Remove the brake hose bracket bolt and the brake hose.
   - To install, tighten to 15 Nm (11 lb-ft).
5. To install, reverse the removal procedure.
   - Bleed the brake caliper. For additional information, refer to Section 206-00 for component bleeding.

# SPECIFICATIONS

### Material

| Item | Specification | Fill Capacity |
|---|---|---|
| Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada) | — | — |

### Torque Specifications

| Description | Nm | lb-ft |
|---|---|---|
| Parking brake cable bracket bolts | 27 | 20 |
| Parking brake cable crossmember bracket bolt | 20 | 15 |

### Torque Specifications (Continued)

| Description | Nm | lb-ft |
|---|---|---|
| Parking brake control bolts | 30 | 22 |
| Parking brake control nuts | 17 | 13 |
| Support brace bolts | 63 | 46 |

# DESCRIPTION AND OPERATION

## Parking Brake

### Parking Brake

The parking brake system consists of the following components:

- Parking brake control
- Rear parking brake cables

The parking brake system is a mechanical system that activates a self-adjusting brake system within the rear brake caliper.

The parking brake system is cable-actuated and controlled by an independent hand-operated parking brake control. The parking brake system is actuated when the parking brake control is pulled up and released by pressing the release button on the end of the parking brake control handle. The parking brake control applies tension to rear brake pads through the front parking brake cable and conduit and the LH and RH rear parking brake cables. The respective rear parking brake assemblies are then applied.

# DIAGNOSIS AND TESTING

## Parking Brake

### Material

| Item | Specification |
|---|---|
| Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada) | — |

## Principles of Operation

### Parking Brake System

The parking brake system is cable-actuated and controlled by an independent hand-operated parking brake control that is not self adjusting, The parking brake system is actuated when the parking brake control is pulled up. When the parking brake control is pulled, tension is applied to the front parking brake cable. This tension pulls on both rear parking brake cables, which are attached to the brake caliper parking brake actuators and apply the brake pads. When the parking brake release button is pressed and the brake control is released, the return springs on the brake calipers and the parking brake control return the system to the released position.

## Inspection and Verification

**NOTE:** Prior to carrying out any diagnosis, make sure the red brake warning indicator is functional. Refer to Section 413-01.

The first indication that something may be wrong in the brake system is a change in the feeling through the parking brake control. The parking brake not holding on an incline or dragging after being released are also indicators of system concerns.

Check the operation of the parking brake system with the vehicle on a hoist and the parking brake control fully released. Check for any damaged cables and install new components as necessary. Carry out the brake system diagnosis.

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical damage.

### Visual Inspection Chart

| Mechanical |
|---|
| • Front parking brake cable and conduit<br>• Parking brake control<br>• Parking brake equalizer<br>• Rear brake calipers<br>• Rear parking brake cables and conduits |

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and GO to Symptom Chart.

## DIAGNOSIS AND TESTING (Continued)

### Symptom Chart

#### Symptom Chart

| Condition | Possible Sources | Action |
|---|---|---|
| • The red brake warning indicator is always/never on | • Brake fluid level switch<br>• Parking brake switch<br>• Wiring, terminals or connectors<br>• Instrument cluster<br>• Smart junction box (SJB) | • REFER to Section 413-01 to diagnose the red brake warning indicator. |
| • Rear brakes drag | • Parking brake component(s) | • INSPECT the parking brake system for corrosion, rust or kinked cables. REPAIR or INSTALL new parking brake components as necessary. |
| | • Rear brake caliper guide pins | • INSPECT the brake caliper guide pins, REFER to Brake Caliper Guide Pins in Section 206-00. |
| | • Brake caliper | • INSPECT the brake caliper guide pins, REFER to Brake Caliper in Section 206-00. |
| | • Brake booster | • CARRY OUT the Brake Booster Component Test. REFER to Section 206-00. |
| | • Brake master cylinder | • CARRY OUT the Brake Master Cylinder Component Test. REFER to Section 206-00. |
| • The parking brake will not apply | • Parking brake control<br>• Parking brake cables<br>• Parking brake rear wheel components | • GO to Pinpoint Test A. |
| • The parking brake will not release | • Parking brake cables<br>• Parking brake control<br>• Parking brake rear wheel components | • GO to Pinpoint Test B. |

### Pinpoint Tests

#### Pinpoint Test A: The Parking Brake Will Not Apply

#### Normal Operation

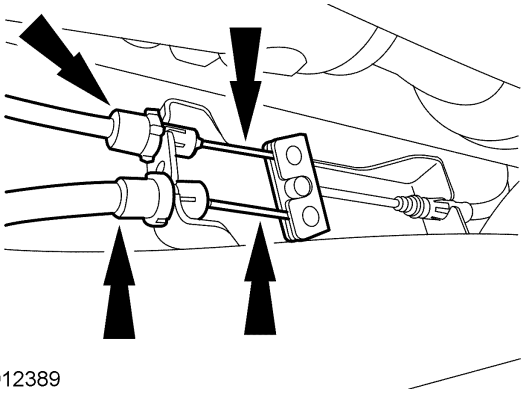
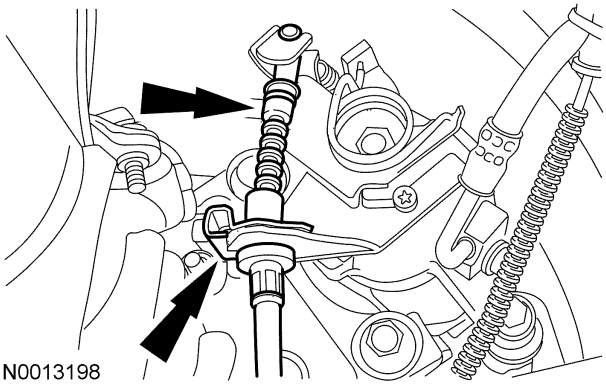
The parking brake system is cable-actuated and controlled by an independent hand-operated parking brake control that is not self adjusting, The parking brake system is actuated when the parking brake control is pulled up. When the parking brake control is pulled, tension is applied to the front parking brake cable. This tension pulls on both rear parking brake cables, which are attached to the brake caliper parking brake actuators and apply the brake pads.

#### This pinpoint test is intended to diagnose the following:

- Parking brake control
- Parking brake cables
- Rear brake calipers

## DIAGNOSIS AND TESTING (Continued)

### PINPOINT TEST A: THE PARKING BRAKE WILL NOT APPLY

| Test Step | | Result / Action to Take |
|---|---|---|
| **A1** | **CHECK THE PARKING BRAKE CONTROL** | |
| | • Apply the parking brake control.<br>• **Does the parking brake control move?** | **Yes**<br>GO to **A2**.<br>**No**<br>GO to **A3**. |
| **A2** | **CHECK FOR BROKEN CABLES** | |
| | • **NOTE:** Have an assistant apply and release the parking brake control to help isolate disconnected cables or cables that do not move.<br>Inspect the following items for damage and correct connections:<br>— Parking brake control<br>— Front cable<br>— Equalizer<br>— LH rear cable<br>— RH rear cable<br>— Rear brake caliper actuators<br>• **Is any damage found or are any components disconnected?** | **Yes**<br>CONNECT the component(s) or INSTALL a new parking brake component(s) as necessary. TEST the system for normal operation.<br>**No**<br>VERIFY that the rear pads are within thickness specifications. REFER to Specifications in Section 206-00. If the rear pads are OK, INSTALL new rear brake calipers. REFER to Section 206-04. |
| **A3** | **ISOLATE THE PARKING BRAKE CONTROL AND FRONT PARKING BRAKE CABLE** | |
| | • Disconnect the LH and RH rear cables from the equalizer and release the cables from the body bracket.<br>  <br>N0012389<br>• Apply the parking brake control.<br>• **Does the parking brake control move?** | **Yes**<br>GO to **A4**.<br>**No**<br>INSTALL a new parking brake control. REFER to Parking Brake Control in this section. TEST the system for normal operation. |
| **A4** | **ISOLATE THE REAR PARKING BRAKE CABLES** | |
| | • Disconnect the LH and RH parking brake cables from the subframe brackets and the brake calipers.<br>  <br>N0013198<br>• While holding the cable conduit, attempt to slide the cable inside the conduit.<br>• **Does the cable slide freely inside the conduit?** | **Yes**<br>INSTALL new rear brake calipers. REFER to Section 206-04.<br>**No**<br>INSTALL a new rear brake cable(s). REFER to Parking Brake Cable — Rear in this section. TEST the system for normal operation. |

## DIAGNOSIS AND TESTING (Continued)

### Pinpoint Test B: The Parking Brake Will Not Release

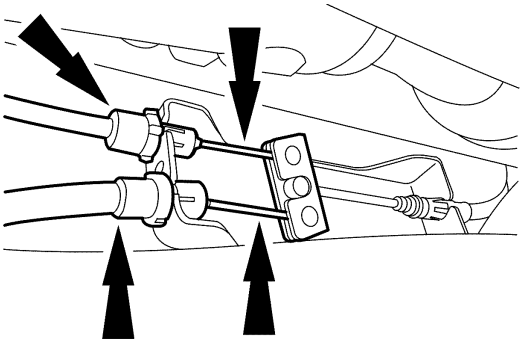
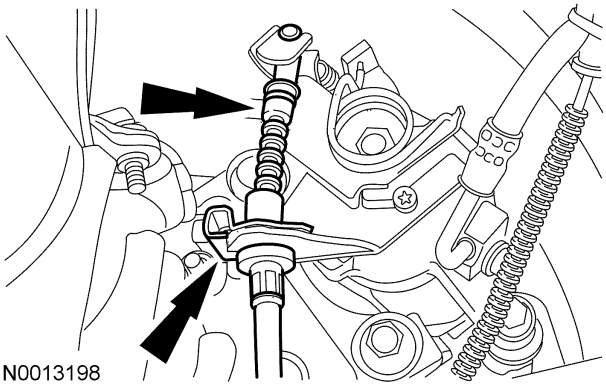
### Normal Operation

When the parking brake release button is pressed and the brake control is released, the return springs on the brake calipers and the parking brake control return the system to the released position.

### This pinpoint test is intended to diagnose the following:

- Parking brake cables
- Parking brake control
- Parking brake rear wheel components

**PINPOINT TEST B: THE PARKING BRAKE WILL NOT RELEASE**

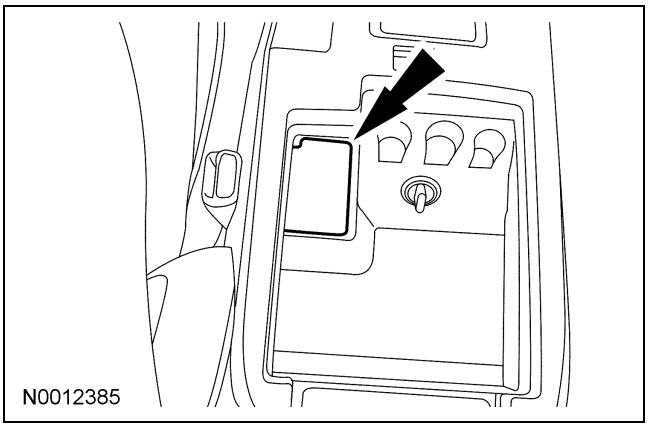
| Test Step | | Result / Action to Take |
|---|---|---|
| **B1** | **CHECK THE PARKING BRAKE CONTROL** | |
| | • Press the release button on the parking brake control and release the handle.<br>• **Does the parking brake control move?** | **Yes**<br>GO to **B2**.<br>**No**<br>INSTALL a new parking brake control. REFER to Parking Brake Control in this section. TEST the system for normal operation. |
| **B2** | **CHECK THE REAR PARKING BRAKE CABLES** | |
| | • Disconnect the LH and RH rear cables from the equalizer and release the cables from the body bracket.<br>  <br>N0012389<br>• Disconnect the LH and RH parking brake cables from the subframe brackets and the brake calipers.<br>  <br>N0013198<br>• While holding the rear cable conduit, attempt to slide the rear cable inside the conduit.<br>• **Does the cable slide freely inside the conduit?** | **Yes**<br>INSTALL new rear brake calipers. REFER to Section 206-04.<br>**No**<br>INSTALL new rear brake cable(s). REFER to Parking Brake Cable — Rear in this section. TEST the system for normal operation. |

# GENERAL PROCEDURES

## Parking Brake Cable Tension Release

⚠ **CAUTION: Do not overtighten the parking brake cable adjustment nut. Overtightening will cause the brakes to drag or lock up.**

1. Remove the access cover inside the floor console bin.




2. Position the parking brake control handle at the fourth notch to access the parking brake cable adjuster nut.
3. **NOTE:** The rod is staked to prevent the removal of the nut.

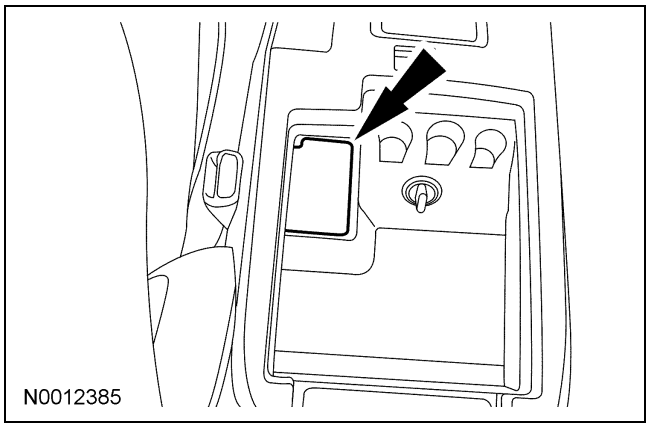
   Loosen, but do not remove, the parking brake cable adjuster nut.
4. Lower the parking brake control handle.
5. To adjust the parking brake cable tension, refer to Parking Brake Cable Adjustment in this section.

# GENERAL PROCEDURES

## Parking Brake Cable Adjustment

**⚠ CAUTION: Do not overtighten the parking brake cable adjustment nut. Overtightening will cause the brakes to drag or lock up.**

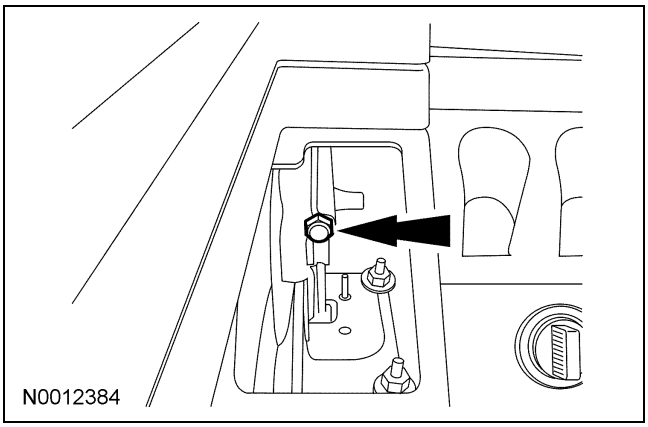
1. Remove the access cover inside the floor console bin.




2. Position the parking brake handle up at the fourth notch to access the adjuster nut.

3. **NOTE:** The rod is staked to prevent the removal of the nut.

   Loosen, but do not remove, the parking brake cable adjuster nut.




4. Apply the tension by tightening the parking brake cable adjustment nut until there is no lash in the system with the handle in the lowered position.

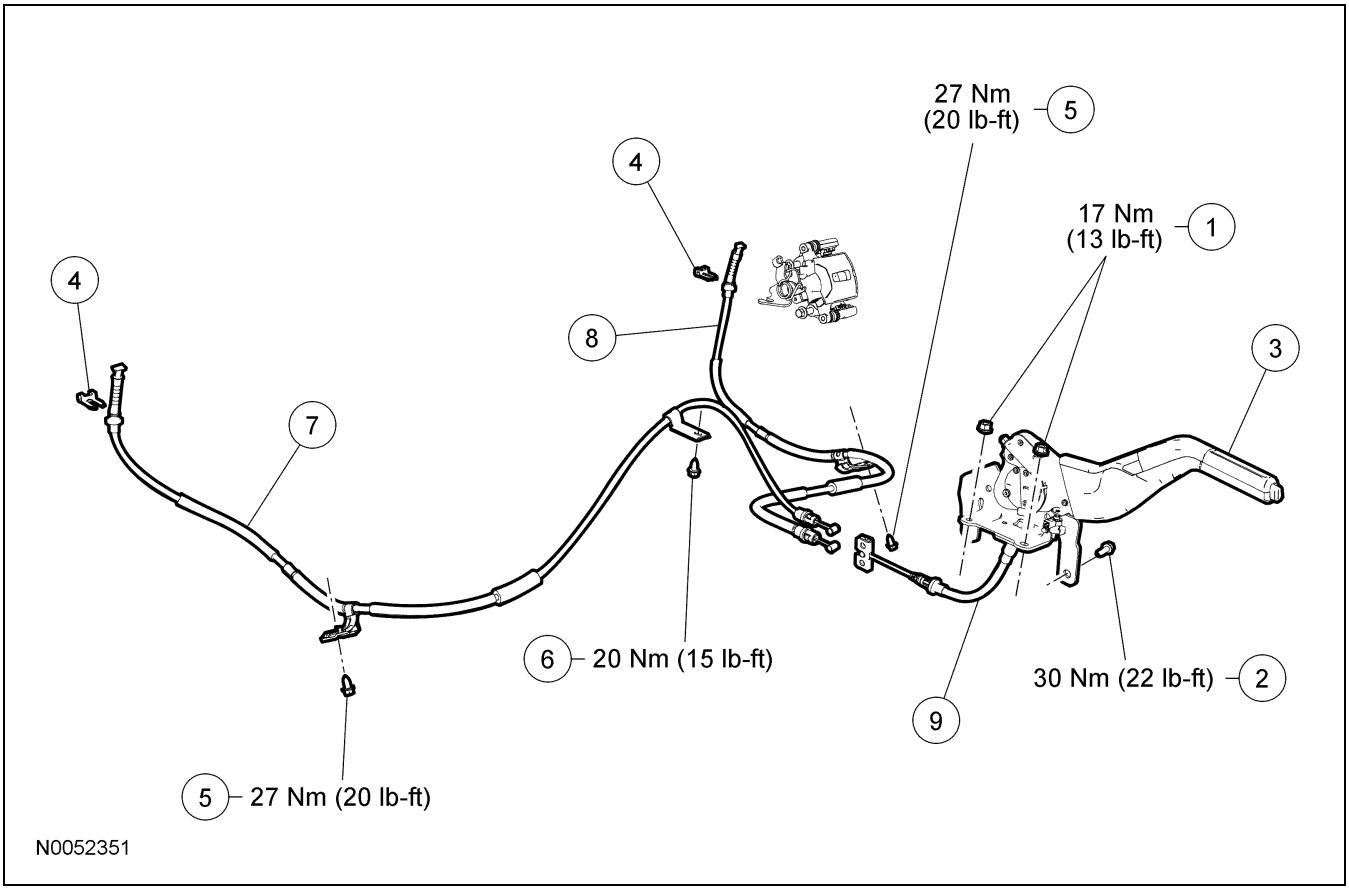
5. Cycle the parking brake control 4 times and adjust as necessary.

6. Lower the parking brake handle and install the access cover.

7. Test the parking brake system for proper operation.

# REMOVAL AND INSTALLATION

## Parking Brake — Exploded View




| Item | Part Number | Description |
|---|---|---|
| 1 | N804796 | Parking brake control nuts (2 required) |
| 2 | W704911 | Parking brake control bolt (2 required) |
| 3 | 2780 | Parking brake control |
| 4 | 2860 | Parking brake cable retaining clips (2 required) |
| 5 | W505263 | Parking brake cable bracket bolts |
| 6 | W704911 | Parking brake cable crossmember bracket bolt |

(Continued)

| Item | Part Number | Description |
|---|---|---|
| 7 | 2A635 | Rear parking brake cable (RH) |
| 8 | 2A823 | Rear parking brake cable (LH) |
| 9 | — | Front parking brake cable (part of 2780) |

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

# REMOVAL AND INSTALLATION

## Parking Brake Control

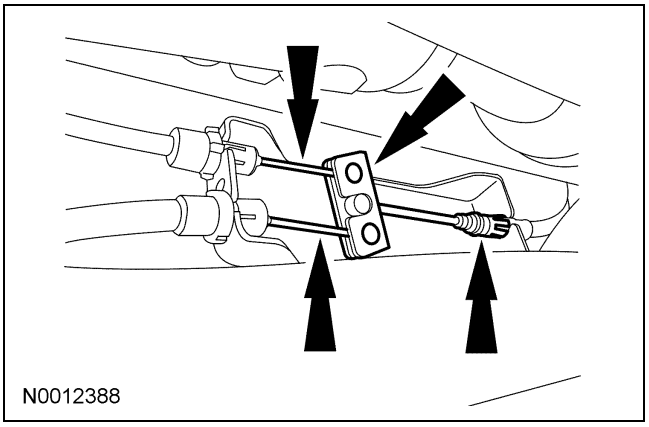
### Removal and Installation

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

2. Remove the floor console. For additional information, refer to Section 501-12.

3. Release the tension on the parking brake cable. For additional information, refer to Parking Brake Cable Tension Release in this section.

4. Disconnect the front parking brake cable from the 2 rear parking brake cables at the equalizer and release the front cable from the body bracket.




5. Disconnect the parking brake switch electrical connector.

6. Remove the 2 nuts from the parking brake control.
   - To install, tighten to 17 Nm (13 lb-ft).

7. Remove the 2 bolts from the parking brake control.
   - To install, tighten to 30 Nm (22 lb-ft).

8. Remove the parking brake control.
   - Position the cable and equalizer through the floorpan.

9. To install, reverse the removal procedure.
   - Adjust the parking brake cable tension. For additional information, refer to Parking Brake Cable Adjustment in this section.

# REMOVAL AND INSTALLATION

## Parking Brake Cable — Rear

### Removal and Installation

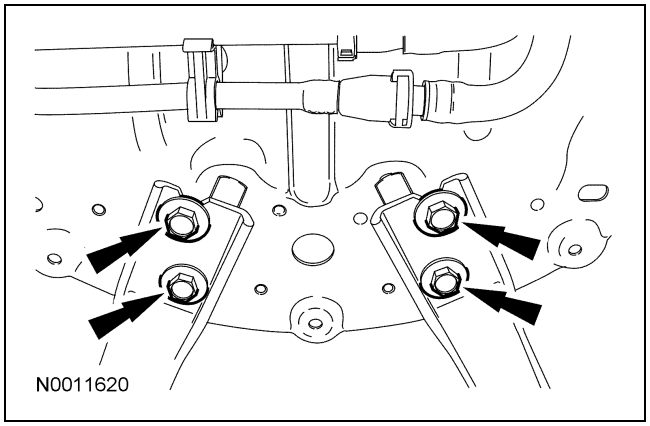
#### All vehicles

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

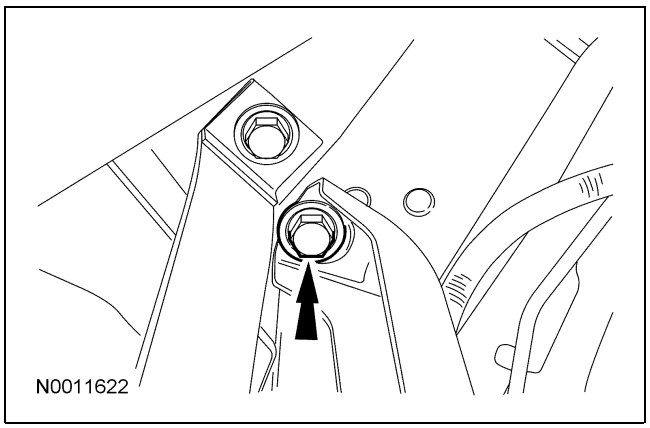
2. Release the tension on the parking brake cable. For additional information, refer to Parking Brake Cable Tension Release in this section.

#### Convertible vehicles

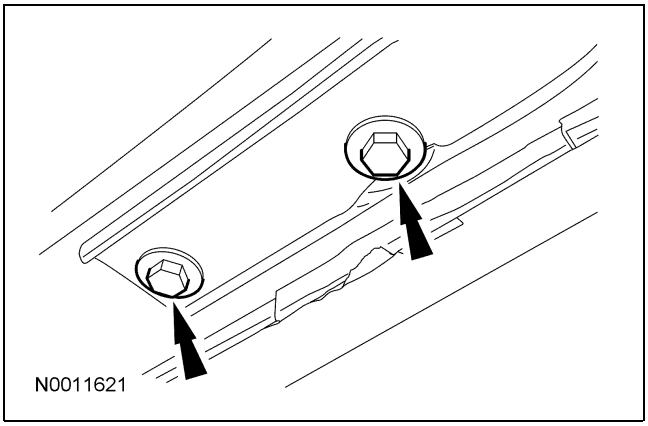
3. Remove and discard the appropriate support brace rear bolts.
   - To install, tighten to 63 Nm (46 lb-ft).




4. Remove and discard the appropriate support brace upper bolts.
   - To install, tighten to 63 Nm (46 lb-ft).

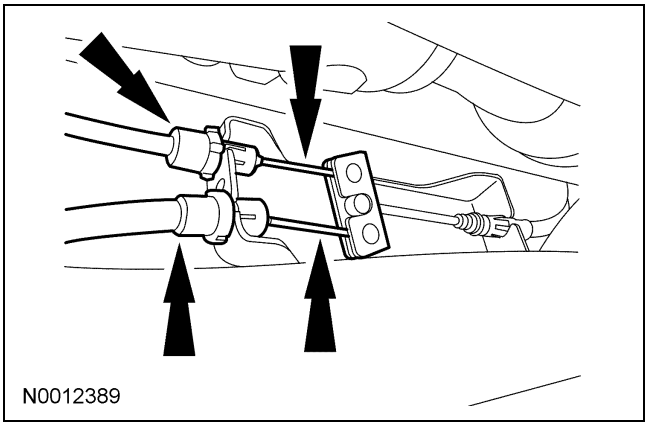



5. Remove and discard the appropriate support brace front bolts.
   - To install, tighten to 63 Nm (46 lb-ft).




#### All vehicles

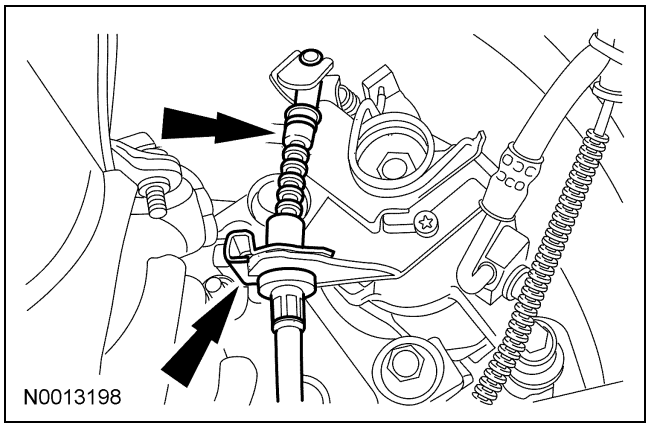
6. Disconnect the appropriate rear parking brake cable from the front parking brake cable at the equalizer, and release the cable from the body bracket.



## REMOVAL AND INSTALLATION (Continued)

7. **⚠ CAUTION: Verify that the boot is attached to the conduit end fitting and the strand end fitting. A clamp must be secured on the strand end fitting (t-end). There should be no exposed strand at the wheel end of the parking brake cable, brake drag or lock up may occur.**

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




8. Remove the parking brake cable bracket bolt.
   - To install, tighten to 27 Nm (20 lb-ft).
9. If removing the RH cable, remove the parking brake cable crossmember bracket bolt.
   - To install, tighten to 20 Nm (15 lb-ft).
10. To install, reverse the removal procedure.
    - Adjust the parking brake cable tension. For additional information, refer to the Parking Brake Cable Adjustment in this section.

# SPECIFICATIONS

### Material

| Item | Specification | Fill Capacity |
|---|---|---|
| High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada) | WSS-M6C62-A or WSS-M6C65-A1 | 714 ml (1.50 pt) |

### Torque Specifications

| Description | Nm | lb-ft | lb-in |
|---|---|---|---|
| Brake booster nuts | 25 | 18 | — |
| Brake fluid proportioning valve | 25 | 18 | — |

### Torque Specifications (Continued)

| Description | Nm | lb-ft | lb-in |
|---|---|---|---|
| Brake fluid reservoir pin | 8 | — | 71 |
| Brake master cylinder nuts | 23 | 17 | — |
| Brake pedal bracket bolts | 25 | 18 | — |
| Brake tube fittings | 17 | — | 150 |
| Pressure reducing valve (vehicles not equipped with ABS) | 17 | — | 150 |

# DESCRIPTION AND OPERATION

## Hydraulic Brake Actuation

The hydraulic brake actuation system consists of the following components:

- Brake master cylinder and fluid reservoir
- Brake pedal and bracket
- Brake tubes and hoses

The brake pedal is connected to the power brake booster, which is connected to the brake master cylinder. When the brake pedal is pressed, brake fluid is pushed through the double-walled steel tube and flexible hoses to the front and rear disc brake calipers. The brake fluid enters the disc brake calipers, forcing the caliper pistons and brake pads outward against the brake disc friction surface, slowing or stopping rotation. When the brake pedal is released, brake fluid pressure is relieved, returning the front and rear disc brake caliper pistons and brake pads to the unapplied position.

# DIAGNOSIS AND TESTING

## Hydraulic Brake Actuation

Refer to Section 206-00.

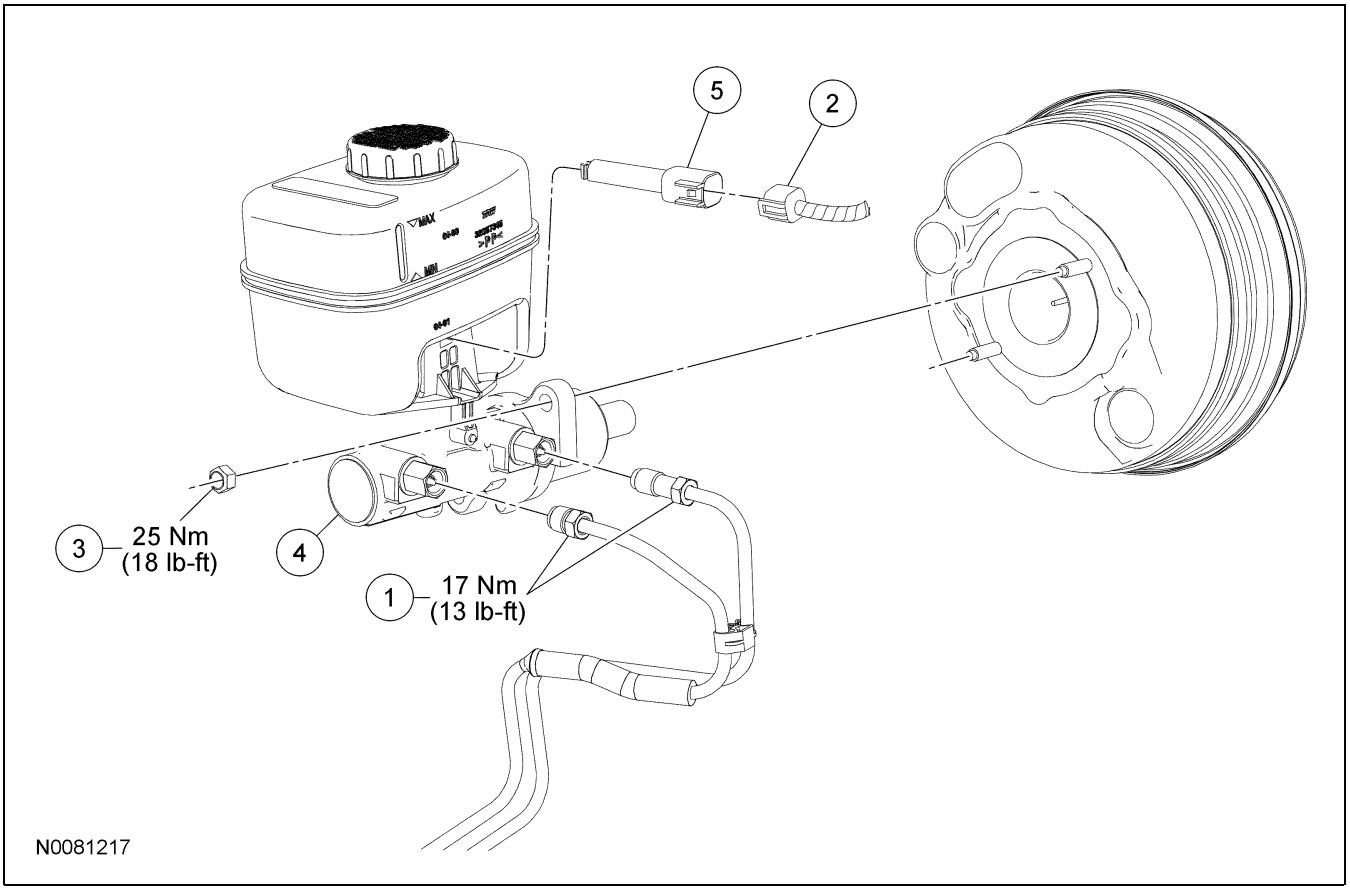
# REMOVAL AND INSTALLATION

## Brake Master Cylinder

**Material**

| Item | Specification |
|---|---|
| High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada) | WSS-M6C62-A |

**NOTE:** Automatic transmission and ABS shown, all others similar.




| Item | Part Number | Description |
|---|---|---|
| 1 | — | Brake tube fittings (part of 2269) |
| 2 | — | Brake fluid level sensor electrical connector (part of 12A581) |

| Item | Part Number | Description |
|---|---|---|
| 3 | W520011 | Brake master cylinder nut (2 required) |
| 4 | 2140 | Brake master cylinder |
| 5 | 2C251 | Brake fluid level sensor |

(Continued)

## REMOVAL AND INSTALLATION (Continued)

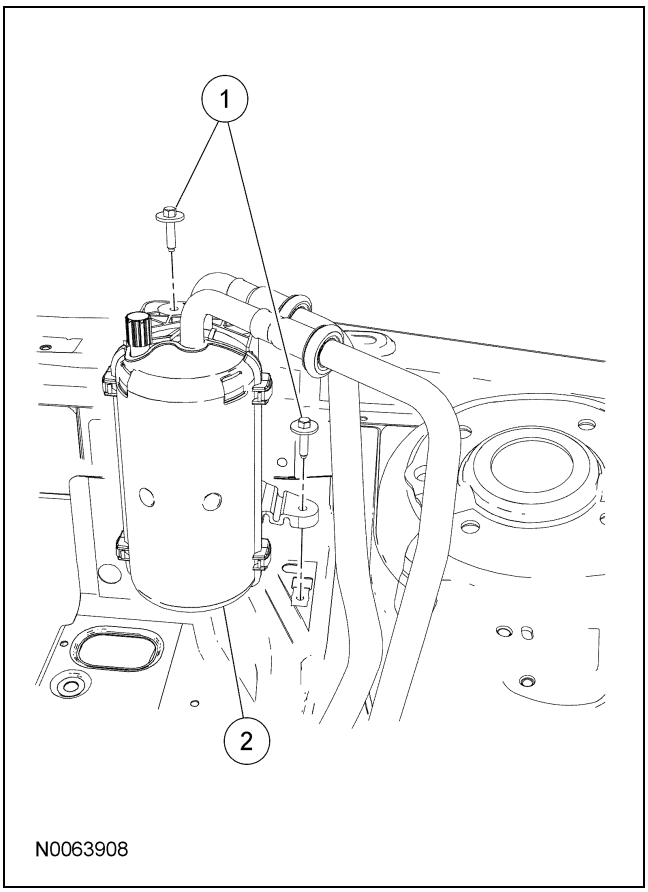
### Removal and Installation

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

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

**⚠ 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.**

1. Position the A/C suction accumulator aside.
   1 Remove the 2 bolts.
   2 Position the accumulator aside.




2. Disconnect the brake fluid sensor electrical connector.

3. If equipped with a manual transmission, remove the clutch hose clamp and disconnect the clutch hose from the brake fluid reservoir.

4. Disconnect the 2 brake tube fittings from the master cylinder.
   - To install, tighten to 17 Nm (13 lb-ft).
   - Cap the brake lines and plug the master cylinder ports.

5. Remove and discard the 2 nuts and remove the brake master cylinder.
   - To install, tighten the new nuts to 15 Nm (11 lb-ft).

## REMOVAL AND INSTALLATION (Continued)

6. To install, reverse the removal procedure.
   - Bleed the master cylinder. For additional information, refer to Section 206-00 for component bleeding.
   - If equipped with a manual transmission, bleed the clutch master cylinder. For additional information, refer to Section 308-00 for Clutch System Bleeding.

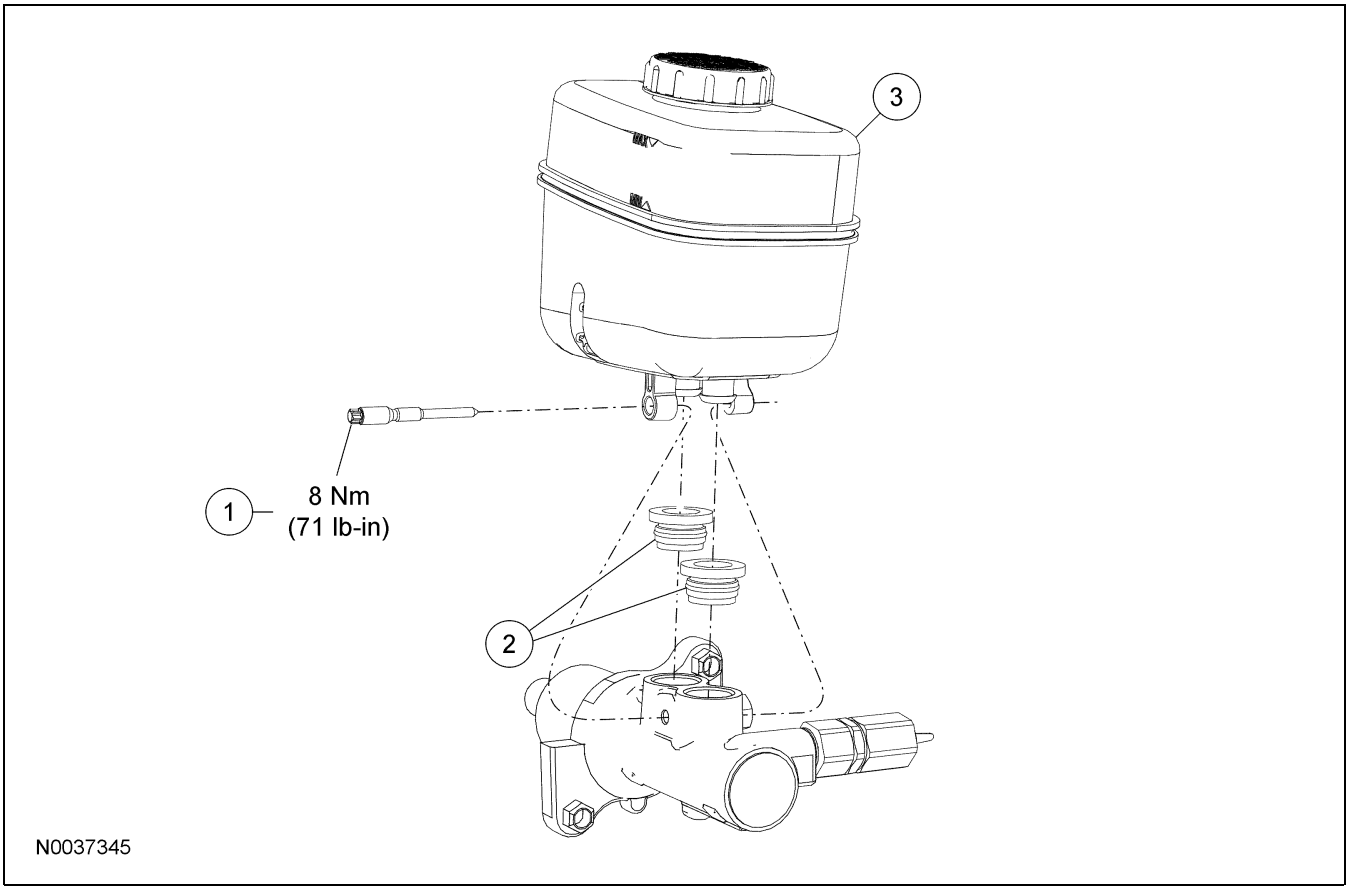
# REMOVAL AND INSTALLATION

## Brake Fluid Reservoir

**Material**

| Item | Specification |
|---|---|
| High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada) | WSS-M6C62-A |

**NOTE:** Automatic transmission shown, all others similar.




| Item | Part Number | Description |
|---|---|---|
| 1 | 2462 | Brake fluid reservoir pin |
| 2 | — | Brake fluid reservoir seals (2 required) (part of 2422) |
| 3 | 2422 | Brake fluid reservoir |

## REMOVAL AND INSTALLATION (Continued)

### Removal and Installation

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

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

**⚠ 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.**

1. Using a suitable tool, remove the brake fluid from the brake fluid reservoir.
2. If equipped with a manual transmission, release the clamp and disconnect the clutch hose from the brake fluid reservoir.
3. Remove the brake fluid reservoir pin.
   - To install, tighten to 8 Nm (71 lb-in).
4. **NOTE:** Use new seals provided with a new brake fluid reservoir.

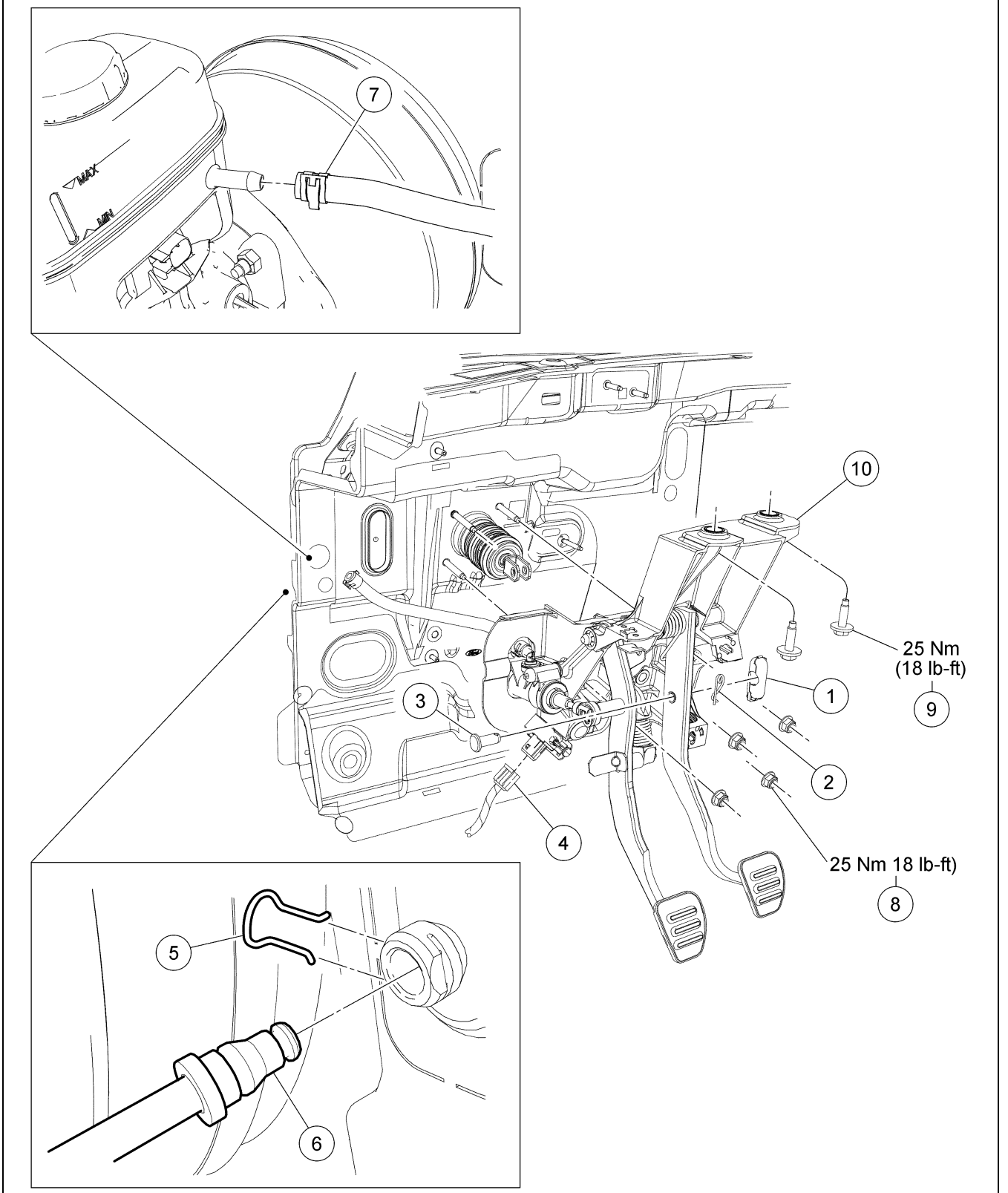
   Remove the brake fluid reservoir.
   - When installing the brake fluid reservoir, lubricate the new seals with brake fluid.
5. To install, reverse the removal procedure.
   - Bleed the brake system. For additional information, refer to Section 206-00.
   - If equipped with a manual transmission, bleed the clutch master cylinder. For additional information, refer to Section 308-00 for Clutch System Bleeding.

# REMOVAL AND INSTALLATION

## REMOVAL AND INSTALLATION (Continued)

### Brake Pedal and Bracket

**NOTE:** Manual transmission pedal assembly shown, automatic transmission pedal assembly similar.



## REMOVAL AND INSTALLATION (Continued)

| Item | Part Number | Description |
|---|---|---|
| 1 | 2475 | Redundant self-locking clip cover |
| 2 | 380699 | Self-locking clip |
| 3 | 2N513 | Brake booster rod pin |
| 4 | — | Clutch Pedal Position (CPP) switch connector (part of 12638) |
| 5 | — | Harpin clip (part of 7A543) |
| 6 | — | Clutch pedal high-pressure hydraulic hose (part of 7A512) |
| 7 | — | Clutch low-pressure hydraulic hose (part of 7A543) |
| 8 | W520112 | Brake booster nut (4 required) |
| 9 | W701834 | Brake pedal bracket bolt (2 required) |
| 10 | 2450 | Brake pedal and bracket |

### Removal and Installation

### All vehicles

1. *NOTICE:* **Do not service the brake pedal or brake booster without first removing the stoplamp switch and speed control deactivator switch. These switches must be removed with the brake pedal in the at-rest position. Switch plungers must be compressed for the switch to rotate in the bracket. Attempting to remove the switch when the plunger is extended (during pedal apply) will result in damage to the switch.**

   Remove the stoplamp switch. For additional information, refer to Section 417-01.

2. Remove the brake pedal speed control deactivation switch. For additional information, refer to Section 310-03.

3. Remove the redundant self-locking pin cover and the self-locking pin.

4. Remove the booster rod pin from the brake pedal.

### Manual transmission vehicles

5. *NOTICE:* **The clutch pedal must be connected to the clutch master cylinder actuation rod and in the at-rest position before removing or installing the speed control deactivator switch. Failure to follow this instruction will damage the switch.**

   Remove the clutch pedal speed control deactivator switch. For additional information, refer to Section 310-03.

6. Disconnect the Clutch Pedal Position (CPP) switch electrical connector.

7. Disconnect the clutch pedal low pressure hydraulic hose from the master cylinder reservoir.

8. **NOTE:** The clutch master cylinder is self-bleeding. Pump the clutch pedal until all the air is forced back into the brake master cylinder reservoir.

   Remove the hairpin clip and disconnect the clutch pedal high pressure hydraulic hose from the clutch master cylinder.

   - Install the hairpin clip into the clutch master cylinder.

### All vehicles

9. Remove the 4 brake booster nuts.
   - To install, tighten to 25 Nm (18 lb-ft).

10. Remove the top 2 bolts from the brake pedal bracket assembly.
    - To install, tighten to 25 Nm (18 lb-ft).

11. Remove the brake pedal bracket assembly from the vehicle.

## REMOVAL AND INSTALLATION (Continued)

12. ***NOTICE:*** **Do not press, pull or otherwise move the brake pedal while installing the stoplamp switch or the speed control deactivator switch. These switches must be installed with the booster push rod attached to the brake pedal and with the brake pedal in the at-rest position. Installing these switches with the brake pedal in any other position will result in incorrect adjustment and may damage the switches.**

    To install, reverse the removal procedure.

# SPECIFICATIONS

### Torque Specifications

| Description | Nm | lb-ft |
|---|---|---|
| Brake booster nuts | 25 | 18 |

# DESCRIPTION AND OPERATION

## Brake Booster

The power brake actuation system consists of the following components:

- Brake booster
- Brake booster check valve
- Brake booster vacuum supply hose

The brake booster uses engine vacuum from the intake manifold to create a partial vacuum inside the vacuum booster on both sides of the diaphragm. When the brake pedal is pressed, the booster rod opens a valve, allowing air to enter the booster on one side of the diaphragm while sealing off the opposite side. This increases pressure on that side of the diaphragm so that it helps push the rod, which in turn pushes the piston in the master cylinder. As the brake pedal is released, the valve seals off the outside air supply while opening the vacuum valve. This restores vacuum to both sides of the diaphragm, allowing everything to return to its original position.

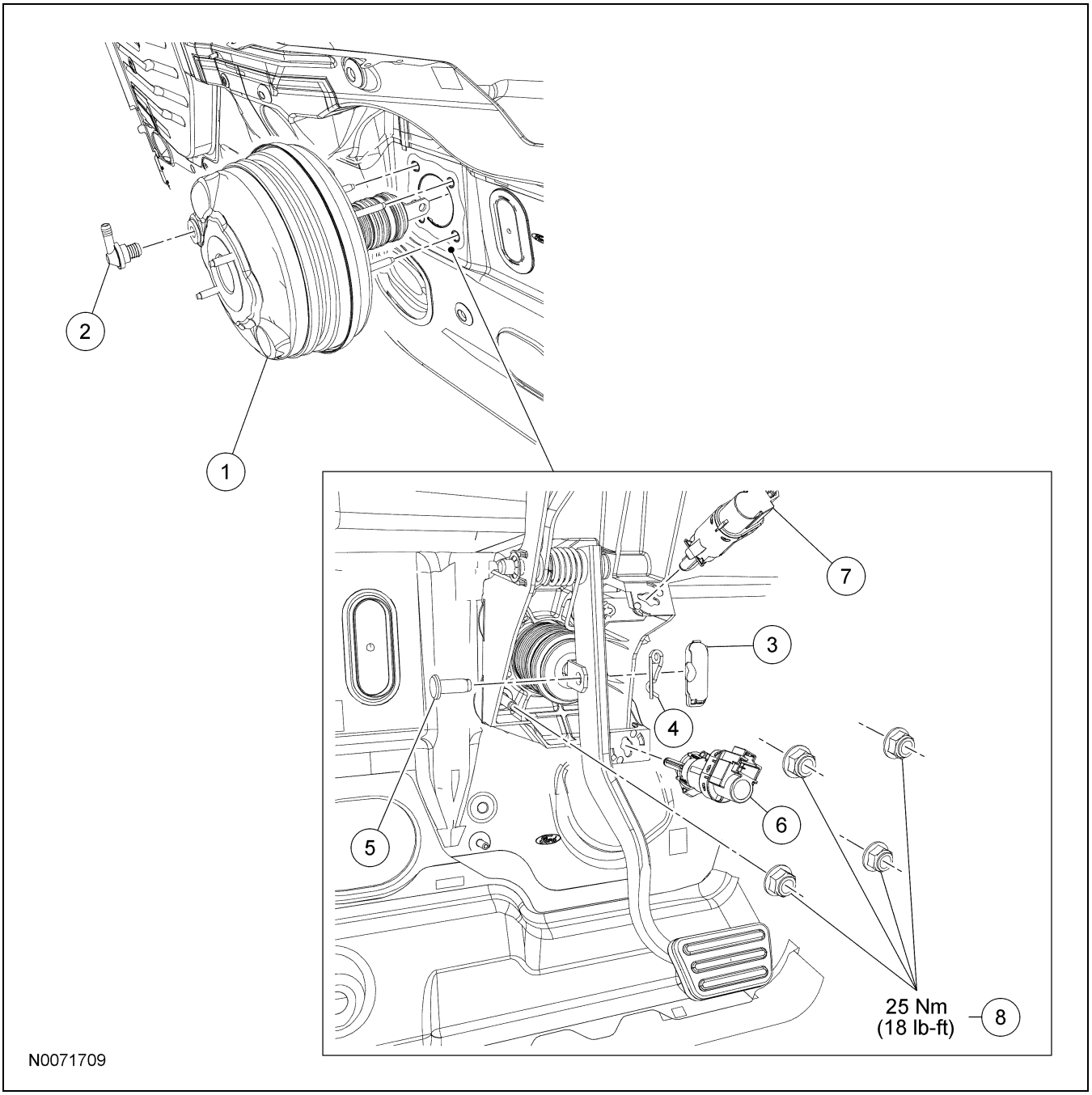
# DIAGNOSIS AND TESTING

## Power Brake System

Refer to Section 206-00.

# REMOVAL AND INSTALLATION

## Brake Booster




| Item | Part Number | Description |
|---|---|---|
| 1 | 2B195 | Brake booster |
| 2 | 2365 | Brake booster vacuum check valve |
| 3 | 2475 | Redundant self-locking clip cover |
| 4 | 380699 | Self-locking clip |

(Continued)

| Item | Part Number | Description |
|---|---|---|
| 5 | 2N513 | Brake booster rod pin |
| 6 | 13480 | Stop lamp switch |
| 7 | 9C872 | Speed deactivation switch |
| 8 | W520112 | Brake booster nuts (4 required) |

## REMOVAL AND INSTALLATION (Continued)

### Removal and Installation

### Vehicles equipped with 5.4L engines

1. Remove the suction accumulator. For additional information, refer to Section 412-01.

### All vehicles

2. **CAUTION: The brake booster check valve must be disconnected from the brake booster prior to removing the master cylinder or the master cylinder seal may be drawn into the brake booster.**

   Disconnect the brake booster check valve from the brake booster to deplete the residual vacuum in the brake booster.

3. Remove the brake master cylinder. For additional information, refer to Section 206-06.

4. **CAUTION: Do not service the brake pedal or brake booster without first removing the stoplamp switch and speed control deactivator switch. These switches must be removed with the brake pedal in the at-rest position. Switch plungers must be compressed for the switch to rotate in the bracket. Attempting to remove the switch when the plunger is extended (during pedal apply) will result in damage to the switch.**

   Remove the stoplamp switch. For additional information, refer to Section 417-01.

5. If equipped, remove the speed control deactivator switch. For additional information, refer to Section 310-03.

6. Remove the redundant self-locking pin cover, self-locking pin and the booster rod pin.

7. Remove the 4 brake booster nuts.
   - To install, tighten to 25 Nm (18 lb-ft).

8. Remove the brake booster assembly from the vehicle.

9. **CAUTION: Do not press, pull or otherwise move the brake pedal while installing the stoplamp switch or the speed control deactivator switch. These switches must be installed with the booster push rod attached to the brake pedal and with the brake pedal in the at-rest position. Installing these switches with the brake pedal in any other position will result in incorrect adjustment and may damage the switches.**

   To install, reverse the removal procedure.

# SPECIFICATIONS

### Material

| Item | Specification | Fill Capacity |
|---|---|---|
| High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada) | WSS-M6C62-A or WSS-M6C65-A1 | 714 ml (1.5 pt) |

### Torque Specifications

| Description | Nm | lb-ft | lb-in |
|---|---|---|---|
| ABS module screws | 3 | — | 27 |
| Brake tube-to-Hydraulic Control Unit (HCU) fittings | 17 | — | 150 |

### Torque Specifications (Continued)

| Description | Nm | lb-ft | lb-in |
|---|---|---|---|
| HCU bracket-to-frame bolts | 25 | 18 | — |
| HCU bracket-to-HCU bolt | 11 | — | 97 |
| Wheel speed sensor bolt | 15 | — | 133 |

# DESCRIPTION AND OPERATION

## Anti-Lock Control

### Anti-Lock Brake System (ABS) with Traction Control

The ABS consists of the following components:

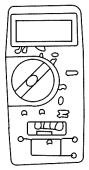
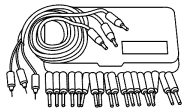
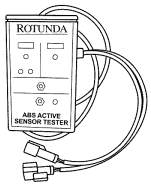
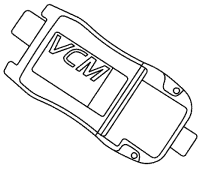
- Hydraulic Control Unit (HCU)
- ABS module
- Front wheel speed sensors
- Front wheel speed sensor rings
- Rear wheel speed sensors
- Rear wheel speed sensor rings
- Traction control switch

The ABS prevents wheel lock-up by monitoring the wheel speed sensors and actuating the HCU modulating the brake pressure to prevent wheel lockup. By preventing the wheels from locking up, the driver is able to maintain steering control and stop in the shortest possible distance under most conditions. The traction control system utilizes the same components as the ABS to prevent wheel spin and help maintain vehicle control during acceleration.

# DIAGNOSIS AND TESTING

## Anti-Lock Control

### Special Tool(s)

| | |
|---|---|
|  ST1137-A | 73III Digital Multi-meter 105-R0057 or equivalent |
|  ST1138-A | Flex Probe Kit 105-R025C or equivalent |
|   ST3030-A | Rotunda Active Wheel Speed Sensor Tester 105-R0110 |
|   ST2834-A | Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool |

## Principles of Operation

### Anti-Lock Braking

The standard ABS module manages anti-lock braking to maintain vehicle control during deceleration.

The ABS module monitors and compares the rotational speed of each wheel. Wheel speeds are measured by the wheel speed sensor, which electrically senses each tooth of the sensor ring as it passes through the magnetic field of the sensor. When the ABS module detects an impending wheel lock, the ABS module commands the hydraulic pump motor on and commands the Hydraulic Control Unit (HCU) to open and close the appropriate solenoid valves to modulate the brake pressure to the individual brake caliper(s). Once the affected wheel(s) return to the desired speed, the ABS module commands the HCU to return the solenoid valves to their normal position and normal base brake operation is restored.

The ABS module is self-monitoring. When the ignition switch is in the RUN position, the ABS module does a preliminary electrical check and, at approximately 12 km/h (8 mph), the hydraulic pump motor is turned on for approximately one-half second. During this time a buzzing or humming noise may be heard and a vibration maybe felt in the brake pedal. This is a normal condition. If a malfunction is detected in the system, the module disables the ABS system and illuminates the yellow ABS warning indicator. However, the base power-assist braking system functions normally.

### Traction Control

Traction control utilizes ABS components to detect and control excessive rear wheel spin on low-traction surfaces.

## DIAGNOSIS AND TESTING (Continued)

When the drive wheels lose traction on a low-traction surface, with vehicle speed under 100 km/h (62 mph), the ABS module commands the hydraulic pump motor on and commands the HCU to open and close the appropriate solenoid valves to modulate the brake pressure to the rear brake caliper(s) while simultaneously sending a request to the PCM over the High Speed Controller Area Network (HS-CAN) bus to reduce engine torque to maintain vehicle traction. The PCM accomplishes this by minor incremental timing changes and fewer fuel injector pulses until the ABS module ends the request. The request ends when the driven wheel speed returns to the desired speed. After the vehicle speed exceeds 100 km/h (62 mph), the traction control is accomplished only through the PCM torque control. During a traction control event, the traction control indicator in the instrument cluster will flash.

The intention of traction control is to detect and control excessive rear wheel spin on low-traction surfaces. On high-traction surfaces, a controlled amount of rear wheel spin will be allowed in the interest of quick acceleration. In order to avoid unnecessary traction control activation, the traction control strategy uses several inputs to determine when traction control activation is beneficial to the driver. The PCM relays throttle position information to the ABS module over the HS-CAN bus. The throttle position is utilized to determine if the driver intends to accelerate quickly. If this is the case, traction control will allow a controlled amount of rear wheel spin. If rear wheel spin is permitted, input from the front wheel speed sensors will be used to calculate vehicle acceleration. If the vehicle is accelerating while wheel spin is occurring, the ABS module will check for a difference between the left front and right front wheel speeds to determine if the vehicle is accelerating in a straight line. If the vehicle is not accelerating (rear wheels spinning on a slippery surface) or if the vehicle is turning, traction control will activate to help make better use of the available traction.

### Traction Control Switch

The traction control switch allows the driver to control use of the traction control system. This is independent of the standard ABS function, which cannot be switched off by the driver. The traction control system status is indicated by a light in the traction control switch and an indicator in the instrument cluster. When the traction control system is switched off, the indicator in the switch will illuminate. When the traction control system is turned off, the standard ABS functions continue to operate as designed unless the yellow ABS warning indicator is also illuminated. Normal braking function always occurs, unless the red brake warning indicator is illuminated.

## Inspection and Verification

1. Verify the customer concern.
2. Verify the stoplamps operate correctly by applying and releasing the brake pedal with the ignition switch in the OFF position. If the stoplamps do not operate correctly, refer to Section 417-01. If the stoplamps operate correctly, proceed to the next step.
3. Visually inspect for obvious signs of mechanical or electrical damage:

**Visual Inspection Chart**

| Mechanical | Electrical |
|---|---|
| • Base brake system<br>• Hydraulic Control Unit (HCU)<br>• Suspension components<br>• Tire pressure<br>• Tire size or mismatched tires<br>• Wheel speed sensor ring | • ABS module<br>• Brake Pedal Position (BPP) switch<br>• Bussed Electrical Center (BEC) fuse(s):<br>— 8 (40A)<br>— 47 (15A)<br>— 65 (30A)<br>• Smart Junction Box (SJB) fuse 18 (10A)<br>• Traction control switch<br>• Wheel speed sensors<br>• Wiring, terminals or connectors |

4. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
5. **NOTE:** Make sure to use the latest scan tool software release.

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

## DIAGNOSIS AND TESTING (Continued)

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

   If the scan tool does not communicate with the VCM:

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

7. If the scan tool does not communicate with the vehicle:

   - verify the ignition key is in the ON position.
   - verify the scan tool operation with a known good vehicle.
   - refer to Section 418-00 to diagnose no response from the PCM.

8. Carry out the network test.

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

9. Clear the continuous DTCs and carry out the self-test diagnostics for the ABS module and the instrument cluster.
10. If the DTCs retrieved are related to the concern, go to the ABS Module DTC Chart and/or the Instrument Cluster DTC Chart. For all other DTCs, refer to the Master DTC Chart in Section 419-10.
11. If no DTCs related to the concern are retrieved, GO to Symptom Chart.

## DTC Charts

### ABS Module DTC Chart

| DTC | Description | Source | Action |
|---|---|---|---|
| B1317 | Battery Voltage High | ABS Module | GO to Pinpoint Test A. |
| B1318 | Battery Voltage Low | ABS Module | GO to Pinpoint Test A. |
| B1342 | ECU is Faulted | ABS Module | **NOTE:** If other DTCs are present, repair them before installing a new module. CLEAR the DTCs. RETRIEVE the DTCs. If DTC B1342 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. REPEAT the self-test. |
| C1095 | ABS Hydraulic Pump Motor Circuit Failure | ABS Module | GO to Pinpoint Test B. |
| C1096 | ABS Hydraulic Pump Motor Circuit Open | ABS Module | GO to Pinpoint Test B. |
| C1115 | ABS Power Relay Output Short Circuit to Battery | ABS Module | CLEAR all DTCs. DRIVE the vehicle. If DTC C1115 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CARRY OUT the self-test with the brake pedal not applied. |
| C1145 | Wheel Speed Sensor RF Input Circuit Failure | ABS Module | GO to Pinpoint Test C. |
| C1155 | Wheel Speed Sensor LF Input Circuit Failure | ABS Module | GO to Pinpoint Test C. |

## DIAGNOSIS AND TESTING (Continued)

### ABS Module DTC Chart (Continued)

| DTC | Description | Source | Action |
|---|---|---|---|
| C1165 | Wheel Speed Sensor RR Input Circuit Failure | ABS Module | GO to Pinpoint Test C. |
| C1175 | Wheel Speed Sensor LR Input Circuit Failure | ABS Module | GO to Pinpoint Test C. |
| C1185 | ABS Power Relay Output Circuit Failure | ABS Module | CLEAR all DTCs. If DTC C1185 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CARRY OUT the self-test with the brake pedal not applied. |
| C1194 | ABS Outlet Valve Coil LF Circuit Failure | ABS Module | CLEAR all DTCs. DRIVE the vehicle. If DTC C1194 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CARRY OUT the self-test with the brake pedal not applied. |
| C1198 | ABS Inlet Valve Coil LF Circuit Failure | ABS Module | CLEAR all DTCs. DRIVE the vehicle. If DTC C1198 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CARRY OUT the self-test with the brake pedal not applied. |
| C1210 | ABS Outlet Valve Coil RF Circuit Failure | ABS Module | CLEAR all DTCs. DRIVE the vehicle. If DTC C1210 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CARRY OUT the self-test with the brake pedal not applied. |
| C1214 | ABS Inlet Valve Coil RF Circuit Failure | ABS Module | CLEAR all DTCs. DRIVE the vehicle. If DTC C1214 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CARRY OUT the self-test with the brake pedal not applied. |
| C1222 | Wheel Speed Mismatch | ABS Module | GO to Pinpoint Test D. |
| C1233 | Wheel Speed LF Input Signal Missing | ABS Module | GO to Pinpoint Test D. |
| C1234 | Wheel Speed RF Input Signal Missing | ABS Module | GO to Pinpoint Test D. |
| C1235 | Wheel Speed RR Input Signal Missing | ABS Module | GO to Pinpoint Test D. |
| C1236 | Wheel Speed LR Input Signal Missing | ABS Module | GO to Pinpoint Test D. |
| C1242 | ABS Outlet Valve Coil LR Circuit Failure | ABS Module | CLEAR all DTCs. DRIVE the vehicle. If DTC C1242 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CARRY OUT the self-test with the brake pedal not applied. |

## DIAGNOSIS AND TESTING (Continued)

### ABS Module DTC Chart (Continued)

| DTC | Description | Source | Action |
|---|---|---|---|
| C1246 | ABS Outlet Valve Coil RR Circuit Failure | ABS Module | CLEAR all DTCs. DRIVE the vehicle. If DTC C1246 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CARRY OUT the self-test with the brake pedal not applied. |
| C1250 | ABS Inlet Valve Coil LR Circuit Failure | ABS Module | CLEAR all DTCs. DRIVE the vehicle. If DTC C1250 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CARRY OUT the self-test with the brake pedal not applied. |
| C1254 | ABS Inlet Valve Coil RR Circuit Failure | ABS Module | CLEAR all DTCs. DRIVE the vehicle. If DTC C1254 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CARRY OUT the self-test with the brake pedal not applied. |
| C1329 | ABS Outlet Valve Coil RF Circuit Excessive Temperature | ABS Module | CLEAR all DTCs. DRIVE the vehicle. If DTC C1329 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CARRY OUT the self-test with the brake pedal not applied. |
| C1330 | ABS Outlet Valve Coil LR Circuit Excessive Temperature | ABS Module | CLEAR all DTCs. DRIVE the vehicle. If DTC C1330 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CARRY OUT the self-test with the brake pedal not applied. |
| C1331 | ABS Outlet Valve Coil RR Circuit Excessive Temperature | ABS Module | CLEAR all DTCs. DRIVE the vehicle. If DTC C1331 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CARRY OUT the self-test with the brake pedal not applied. |
| C1332 | ABS Outlet Valve Coil LF Circuit Excessive Temperature | ABS Module | CLEAR all DTCs. DRIVE the vehicle. If DTC C1332 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CARRY OUT the self-test with the brake pedal not applied. |

## DIAGNOSIS AND TESTING (Continued)

### ABS Module DTC Chart (Continued)

| DTC | Description | Source | Action |
|---|---|---|---|
| C1333 | ABS Inlet Valve Coil LR Circuit Excessive Temperature | ABS Module | CLEAR all DTCs. DRIVE the vehicle. If DTC C1333 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CARRY OUT the self-test with the brake pedal not applied. |
| C1334 | ABS Inlet Valve Coil LF Circuit Excessive Temperature | ABS Module | CLEAR all DTCs. DRIVE the vehicle. If DTC C1334 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CARRY OUT the self-test with the brake pedal not applied. |
| C1335 | ABS Inlet Valve Coil RF Circuit Excessive Temperature | ABS Module | CLEAR all DTCs. DRIVE the vehicle. If DTC C1335 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CARRY OUT the self-test with the brake pedal not applied. |
| C1336 | ABS Inlet Valve Coil RR Circuit Excessive Temperature | ABS Module | CLEAR all DTCs. DRIVE the vehicle. If DTC C1336 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CARRY OUT the self-test with the brake pedal not applied. |
| C1404 | Traction Control Valve Rear Circuit Failure | ABS Module | CLEAR all DTCs. DRIVE the vehicle. If DTC C1404 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CARRY OUT the self-test with the brake pedal not applied. |
| C1446 | Brake Switch Circuit Failure | ABS Module | GO to Pinpoint Test E. |
| C1527 | Traction Control Rear Valve Circuit Excessive Temperature | ABS Module | CLEAR all DTCs. DRIVE the vehicle. If DTC C1527 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CARRY OUT the self-test with the brake pedal not applied. |
| C1531 | Dynamic Stability Control LF Valve Circuit Excessive Temperature | ABS Module | CLEAR all DTCs. DRIVE the vehicle. If DTC C1531 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CARRY OUT the self-test with the brake pedal not applied. |

## DIAGNOSIS AND TESTING (Continued)

### ABS Module DTC Chart (Continued)

| DTC | Description | Source | Action |
|---|---|---|---|
| C1730 | Reference Voltage Out of Range (+5 V) | ABS Module | If any other DTCs are present, DIAGNOSE those DTCs first. CLEAR all DTCs. DRIVE the vehicle. If the DTC is still present, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CARRY OUT the self-test with the brake pedal not applied. |
| C1958 | Dynamic Stability Control Valve LF circuit Failure | ABS Module | CLEAR all DTCs. DRIVE the vehicle. If DTC C1958 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CARRY OUT the self-test with the brake pedal not applied. |
| U0073 | Control Module Communication Bus Off | ABS Module | REFER to Section 418-00 to diagnose the Hydraulic Control Unit (HCU) bus. |
| U1900 | CAN Communication Bus Fault — Receive Error | ABS Module | REFER to Section 418-00 to diagnose the HCU bus. |
| U2011 | Module Transmitted Invalid Data (Non-SCP) | ABS Module | VERIFY PCM configuration, REFER to Programmable Module Installation (PMI) in Section 418-01. If the PCM is not correctly configured, CONFIGURE the PCM. If the PCM is correctly configured, REFER to Section 418-00 to diagnose the HCU bus. |
| U2050 | No Application Present | ABS Module | CONFIGURE the ABS module. REFER to Programmable Module Installation (PMI) in Section 418-01. CLEAR the DTCs. RETRIEVE the DTCs and VERIFY successful module configuration. If DTC U2050 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CLEAR the DTC. REPEAT the self-test. |
| U2051 | One or More Calibration Files Missing/Corrupt | ABS Module | CONFIGURE the ABS module, REFER to Programmable Module Installation (PMI) in Section 418-01. CLEAR the DTCs. CARRY OUT the ABS module self-test. RETRIEVE and RECORD any DTCs. If DTC U2051 is retrieved again, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CLEAR the DTC. REPEAT the self-test. |

### Instrument Cluster DTC Chart

| DTC | Description | Source | Action |
|---|---|---|---|
| C1093 | Traction Control Disable Switch Circuit Failure | Instrument Cluster | GO to Pinpoint Test H. |
| — | All Other Instrument Cluster DTCs | Instrument Cluster | REFER to the Master DTC Chart in Section 419-10. |

## DIAGNOSIS AND TESTING (Continued)

### Symptom Chart

#### Symptom Chart

| Condition | Possible Sources | Action |
|---|---|---|
| • No communication with the ABS module | • Wiring, terminals or connectors<br>• ABS module | • REFER to Section 418-00 to diagnose the no communications concern. |
| • No communication with the instrument cluster | • Wiring, terminals or connectors<br>• Instrument cluster | • REFER to Section 418-00 to diagnose the no communication concern. |
| • The yellow ABS warning indicator is illuminated | • DTCs in the ABS module | • RETRIEVE and RECORD any ABS module DTCs. GO to the ABS Module DTC Chart. |
| • The yellow ABS warning indicator is never on | • Wiring, terminals or connectors<br>• Instrument cluster | • REFER to Section 413-01 to continue diagnosis of the yellow brake warning indicator. |
| • Spongy/soft/low brake pedal with no warning indicator | • Air in brake hydraulic system<br>• Base brake system<br>• Hydraulic Control Unit (HCU) | • GO to Pinpoint Test F. |
| • Poor vehicle tracking during anti-lock function | • Air in the brake system<br>• Base brake system<br>• HCU | • GO to Pinpoint Test G. |
| • The traction control system is inoperative | • Wiring, terminals or connectors<br>• Traction control switch<br>• Instrument cluster<br>• ABS module | • GO to Pinpoint Test I. |
| • The traction control system cannot be disabled | • Wiring, terminals or connectors<br>• Traction control switch<br>• Instrument cluster<br>• ABS module | • GO to Pinpoint Test H. |
| • The traction control switch indicator is never/always on | • Circuitry<br>• Traction control switch<br>• Instrument cluster | • REFER to Diagnosis and Testing in Section 413-01 to diagnose the traction control indicator. |

### Pinpoint Tests

#### Pinpoint Test A: DTCs B1317 and B1318 — Battery Voltage High/Low

Refer to Wiring Diagrams Cell 42, Vehicle Dynamic Systems for schematic and connector information.

#### Normal Operation

The operating voltage required to operate the ABS module, hydraulic pump and isolation valves is in a range between 10 and 16 volts.

## DIAGNOSIS AND TESTING (Continued)

Fused ignition voltage is supplied to the ABS module from Smart Junction Box (SJB) fuse 18 (10A) along circuit 1844 (LG/RD). Fused battery voltage is supplied to the ABS module from Bussed Electrical Center (BEC) fuse 65 (30A) along circuit 601 (LB/BK) and BEC fuse 8 (40A) along circuit 534 (YE/LG). Ground is provided to the ABS module along circuit 1205 (BK). There are 2 ground circuits (one for the ABS module and one for the hydraulic pump motor) both share the same circuit number and wire color.

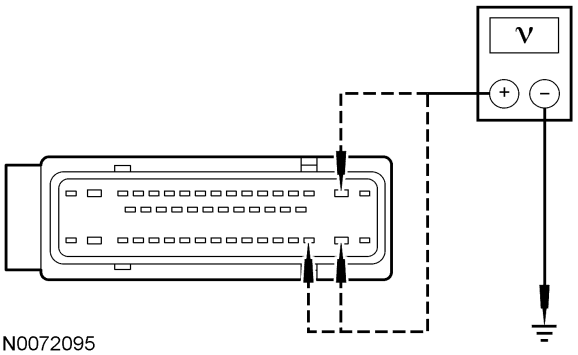
- DTC B1317 Battery Voltage High — If during an ABS module self-test or normal operation, the battery or charging system voltage exceeds 16 volts, DTC B1317 will be set.
- DTC B1318 Battery Voltage Low — If during an ABS module self-test or normal operation, the battery or charging system voltage drops below 10 volts, DTC B1318 will be set.

### This pinpoint test is intended to diagnose the following:

- Fuse(s)
- Wiring, terminals or connectors
- Charging system
- Vehicle battery
- ABS module

### PINPOINT TEST A: DTCs B1317 AND B1318 — BATTERY VOLTAGE HIGH/LOW

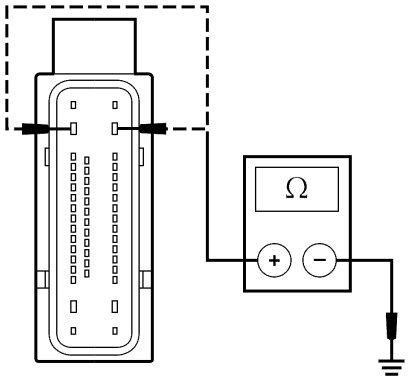
***NOTICE:*** **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

| Test Step | | Result / Action to Take |
|---|---|---|
| **A1** | **CHECK THE BATTERY VOLTAGE** | |
| | • Measure the battery voltage between the positive and negative battery posts with the Key ON Engine OFF (KOEO), and with the engine running.<br>• **Is the battery voltage between 10 and 13 volts with KOEO, and between 13 and 17 volts with the engine running?** | **Yes**<br>GO to **A2**.<br>**No**<br>REFER to Section 414-00 to continue diagnosis of the charging system and vehicle battery. |
| **A2** | **CHECK THE VOLTAGE TO THE ABS MODULE** | |
| | • Ignition OFF.<br>• Disconnect: ABS Module C135.<br>• Ignition ON.<br>• Measure the voltage between ground and:<br>— ABS module C135-2, circuit 601 (LB/PK), harness side.<br>— ABS module C135-31, circuit 534 (YE/LG), harness side.<br>— ABS module C135-32, circuit 1844 (LG/RD), harness side.<br>  <br><br>N0072095<br>• **Are the voltages greater than 10 volts?** | **Yes**<br>GO to **A3**.<br>**No**<br>VERIFY SJB fuse 18 (10A) is OK. If OK, REPAIR circuit 1844 (LG/RD).<br>VERIFY BEC fuse 8 (40A) is OK. If OK, REPAIR circuit 534 (YE/LG).<br>VERIFY BEC fuse 65 (30A) is OK. If OK, REPAIR circuit 601 (LB/PK).<br>CLEAR the DTCs. CARRY OUT the self-test with the brake pedal not applied. |
| **A3** | **CHECK THE CIRCUIT 1205 (BK) FOR AN OPEN** | |
| | • Ignition OFF. | |

(Continued)

## DIAGNOSIS AND TESTING (Continued)

**PINPOINT TEST A: DTCs B1317 AND B1318 — BATTERY VOLTAGE HIGH/LOW (Continued)**

| Test Step | | Result / Action to Take |
|---|---|---|
| **A3** | **CHECK THE CIRCUIT 1205 (BK) FOR AN OPEN (Continued)** | |
| | • Measure the resistance between ground and:<br>— ABS module C135-45, circuit 1205 (BK), harness side.<br>— ABS module C135-16, circuit 1205 (BK), harness side.<br>  <br><br>N0009314<br>• **Are the resistances less than 5 ohms?** | **Yes**<br>GO to **A4**.<br>**No**<br>REPAIR the affected circuit(s). REPEAT the self-test. |
| **A4** | **CHECK FOR CORRECT ABS MODULE OPERATION** | |
| | • Check ABS C135 for:<br>— corrosion.<br>— spread terminals.<br>— pushed-out pins.<br>• Connect: ABS Module C135.<br>• Make sure the connector seats properly, then operate the system and verify the concern is still present.<br>• **Is the concern still present?** | **Yes**<br>INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CLEAR the DTCs. REPEAT the self-test.<br>**No**<br>The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. CARRY OUT the self-test with the brake pedal not applied. |

### Pinpoint Test B: DTCs C1095 and C1096 — ABS Hydraulic Pump Motor Circuit Failure/Open

Refer to Wiring Diagrams Cell 42, Vehicle Dynamic Systems for schematic and connector information.

### Normal Operation

Fused battery voltage for ABS pump motor operation is supplied to the ABS module from the Bussed Electrical Center (BEC) fuse 8 (40A) along circuit 534 (YE/LG). Ground for the pump motor is provided along circuit 1205 (BK).

When the ignition key is turned to the ON position, the ABS module commands the Hydraulic Control Unit (HCU) pump on for 100 ms (±6 ms) and is then commanded off. After 6 ms, the ABS module will read the voltage that is being generated by the HCU pump. If the voltage indicates the motor is spinning at less than 500 rpm, there may be a locked motor. If this condition is detected 4 times, DTC C1095 is set. The pump motor is checked for an open circuit 2 seconds after the most recent successful pump motor off command. If the pump motor feedback remains greater than 0.75 volt for more than 50 ms (±6 ms) after these conditions have been met, DTC C1096 is set.

- DTC C1095 ABS Hydraulic Pump Motor Circuit Failure — If a short to voltage or ground is detected, if a locked up pump motor is detected or if there is an internal failure of the ABS module, DTC C1095 will be set.

## DIAGNOSIS AND TESTING (Continued)

- DTC C1096 ABS Hydraulic Pump Motor Circuit Open — If a short to voltage, a short to ground or an open is detected, if a locked up pump motor is detected or if there is an internal failure of the ABS module, DTC C1095 will be set.

**This pinpoint test is intended to diagnose the following:**

- Fuse
- Wiring, terminals or connectors
- Hydraulic pump motor
- ABS module

### PINPOINT TEST B: DTCs C1095 AND C1096 — ABS HYDRAULIC PUMP MOTOR CIRCUIT FAILURE/OPEN

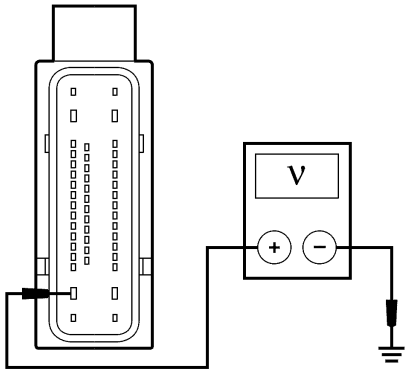
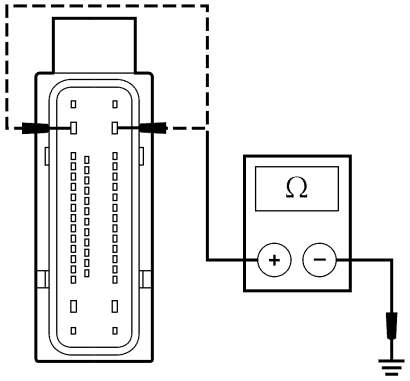
***NOTICE:*** **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

| Test Step | | Result / Action to Take |
|---|---|---|
| **B1** | **CHECK THE ABS PUMP MOTOR** | |
| | • Ignition ON.<br>• **Is the ABS pump motor running all the time?** | **Yes**<br>INSTALL a new ABS module and HCU. REFER to Anti-Lock Brake System (ABS) Module and Hydraulic Control Unit (HCU) in this section. CLEAR the DTCs. REPEAT the ABS self-test.<br>**No**<br>GO to **B2**. |
| **B2** | **CHECK THE PUMP MOTOR OUTPUT COMMAND (ABS__MTR)** | |
| | • Connect the scan tool.<br>• Enter the following diagnostic mode on the scan tool: ABS DataLogger.<br>• Toggle the ABS__MTR output command ON.<br>• **Does the ABS pump motor run for approximately 2 seconds?** | **Yes**<br>TOGGLE the output command OFF.<br>CLEAR the DTCs. CHECK the yellow ABS warning indicator while driving the vehicle (brakes must not be applied) above 32 km/h (20 mph). If the yellow ABS warning indicator illuminates, RETRIEVE the DTCs.<br>**If DTC C1096** is retrieved, GO to **B5**.<br>**If DTC C1095** is retrieved, INSTALL a new HCU. REFER to Hydraulic Control Unit (HCU) in this section.<br>**For all other ABS module DTCs**, GO to the ABS Module DTC Chart in this section.<br>CLEAR the DTCs. REPEAT the self-test.<br>**No**<br>TOGGLE the output command OFF and GO to **B3**. |
| **B3** | **CHECK THE VOLTAGE TO THE ABS MODULE** | |
| | • Ignition OFF.<br>• Disconnect: ABS Module C135. | |

(Continued)

## DIAGNOSIS AND TESTING (Continued)

### PINPOINT TEST B: DTCs C1095 AND C1096 — ABS HYDRAULIC PUMP MOTOR CIRCUIT FAILURE/OPEN (Continued)

| Test Step | | Result / Action to Take |
|---|---|---|
| B3 | **CHECK THE VOLTAGE TO THE ABS MODULE (Continued)** | |
| | • Measure the voltage between ABS module C135-31, circuit 534 (YE/LG), harness side and ground.<br>  <br><br>N0009315<br>• **Is the voltage greater than 10 volts?** | **Yes**<br>GO to **B4**.<br>**No**<br>VERIFY BEC fuse 8 (40A) is OK. If OK, REPAIR circuit 534 (YE/LG). CLEAR the DTCs. REPEAT the self-test. |
| B4 | **CHECK CIRCUIT 1205 (BK) FOR AN OPEN** | |
| | • Measure the resistance between ground and:<br>— ABS module C135-45, circuit 1205 (BK), harness side.<br>— ABS module C135-16, circuit 1205 (BK), harness side.<br>  <br><br>N0009314<br>• **Are the resistances less than 5 ohms?** | **Yes**<br>INSTALL a new HCU. REFER to Hydraulic Control Unit (HCU) in this section. CLEAR the DTCs. REPEAT the self-test.<br>**No**<br>REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. |
| B5 | **CHECK FOR CORRECT ABS MODULE OPERATION** | |
| | • Ignition OFF.<br>• Disconnect: ABS Module C135.<br>• Check the connector for:<br>— corrosion.<br>— spread terminals.<br>— pushed-out pins.<br>• Connect: ABS Module C135.<br>• Make sure the connector seats properly, then operate the system and verify the concern is still present.<br>• **Is the concern still present?** | **Yes**<br>INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CLEAR the DTCs. REPEAT the self-test.<br>**No**<br>The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. CARRY OUT the self-test with the brake pedal not applied. |

## Pinpoint Test C: DTCs C1145, C1155, C1165 and C1175 — Wheel Speed Sensor Input Circuit Failure

Refer to Wiring Diagrams Cell 42, Vehicle Dynamic Systems for schematic and connector information.

## DIAGNOSIS AND TESTING (Continued)

### Normal Operation

The active wheel speed sensors generate a square wave signal that is sent to the ABS module. The wheel speed sensor circuitry connects to the ABS module through 2 wires and a connector at each wheel speed sensor. When the ignition is turned to the RUN position, the ABS module carries out a self-test by sending a reference voltage to all of the wheel speed sensors and their circuitry to determine if they are functional. Voltage and ground signals are supplied to the wheel speed sensors from the ABS module.

| DTC Description | Fault Trigger Condition |
|---|---|
| • DTC C1145 RF Wheel Speed Sensor Input Circuit Failure<br>• DTC C1155 LF Wheel Speed Sensor Input Circuit Failure<br>• DTC C1165 RR Wheel Speed Sensor Input Circuit Failure<br>• DTC C1175 LR Wheel Speed Sensor Input Circuit Failure | When the vehicle speed exceeds 5 km/h (3 mph), if the ABS module detects an open, short to ground or voltage or a defective wheel speed sensor input circuit, the appropriate DTC will be set. |

**This pinpoint test is intended to diagnose the following:**

- Wiring, terminals or connectors
- Wheel speed sensors
- Wheel speed sensor rings
- ABS module

**PINPOINT TEST C: DTCs C1145, C1155, C1165 AND C1175 — WHEEL SPEED SENSOR INPUT CIRCUIT FAILURE**

***NOTICE:*** **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

| Test Step | | Result / Action to Take |
|---|---|---|
| C1 | **CHECK FOR FAULT REPEATABILITY** | |
| | • Connect the scan tool.<br>• Ignition ON.<br>• Enter the following diagnostic mode on the scan tool: ABS Clear Continuous DTCs.<br>• Drive the vehicle at least 16 km/h (10 mph).<br>• Retrieve and document continuous DTCs.<br>• **Is DTC C1145, C1155, C1165 or C1175 retrieved?** | **Yes**<br>If the active wheel speed sensor tool is available, GO to C2. If the active wheel speed sensor tool is not available, GO to C4.<br>**No**<br>INSPECT the wheel speed sensors, wheel speed sensor wiring and wheel speed sensor tone rings. REPAIR or INSTALL new as necessary. If any other DTCs are retrieved, GO to the ABS Module DTC Chart. |
| C2 | **CHECK THE ABS MODULE OUTPUT USING THE SPECIAL TOOL** | |
| | • Ignition OFF.<br>• Disconnect: Suspect Wheel Speed Sensor.<br>• Connect the active wheel speed sensor tester to the wheel speed sensor connectors.<br>• Ignition ON.<br>• Select the correct system polarity on the special tool and turn the active wheel speed sensor power switch to the ON position.<br>• **Is the module output LED illuminated?** | **Yes**<br>GO to C3.<br>**No**<br>GO to C6. |

(Continued)

## DIAGNOSIS AND TESTING (Continued)

### PINPOINT TEST C: DTCs C1145, C1155, C1165 AND C1175 — WHEEL SPEED SENSOR INPUT CIRCUIT FAILURE (Continued)

| Test Step | | Result / Action to Take |
|---|---|---|
| C3 | **CHECK THE WHEEL SPEED SENSOR OUTPUT WITH THE SPECIAL TOOL** | |
| | • Raise the suspect wheel until it can spin freely. Refer to Section 100-02.<br>• While monitoring the active wheel speed sensor tester, slowly spin the suspect wheel.<br>• **Do the sensor output LEDs illuminate and flash and is the current overload LED not illuminated?** | **Yes**<br>The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.<br>**No**<br>If the current level LED is not illuminated and the sensor output LEDs do not illuminate or if the current level LED is illuminated red, INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor — Front or Wheel Speed Sensor — Rear in this section. CLEAR the DTCs. REPEAT the self-test.<br>If the current level LED is not illuminated and the sensor output LEDs illuminate green but do not flash, INSPECT the wheel speed sensor tone rings and INSTALL new tone ring as necessary. REFER to Wheel Speed Sensor Ring — Front or Wheel Speed Sensor Ring — Rear in this section. If the tone ring is OK, INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor — Front or Wheel Speed Sensor — Rear in this section. CLEAR the DTCs. REPEAT the self-test. |
| C4 | **CHECK THE WHEEL SPEED SENSOR CIRCUITS FOR A SHORT TO VOLTAGE** | |
| | **NOTE:** Both circuits must be checked for each DTC.<br>• Ignition OFF.<br>• Disconnect: ABS Module C135.<br>• Disconnect: Suspect Wheel Speed Sensor.<br>• Ignition ON.<br>• **For DTC C1145**, measure the voltage between:<br>— ABS module C135-26, circuit 514 (YE/RD), harness side and ground.<br>— ABS module C135-27, circuit 516 (YE/BK), harness side and ground.<br>• **For DTC C1155**, measure the voltage between:<br>— ABS module C135-13, circuit 522 (TN/BK), harness side and ground.<br>— ABS module C135-12, circuit 521 (TN/OG), harness side and ground.<br>• **For DTC C1165**, measure the voltage between:<br>— ABS module C135-44, circuit 524 (PK/BK), harness side and ground.<br>— ABS module C135-43, circuit 523 (RD/PK), harness side and ground.<br>• **For DTC C1175**, measure the voltage between:<br>— ABS module C135-42, circuit 518 (LG/RD), harness side and ground.<br>— ABS module C135-41, circuit 519 (LG/BK), harness side and ground.<br>• **Is any voltage present?** | **Yes**<br>REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.<br>**No**<br>GO to **C5**. |
| C5 | **CHECK THE WHEEL SPEED SENSOR CIRCUITS FOR A SHORT TO GROUND** | |
| | **NOTE:** Both circuits must be checked for each DTC.<br>• Ignition OFF.<br>• **For DTC C1145**, measure the resistance between:<br>— ABS module C135-26, circuit 514 (YE/RD), harness side and ground.<br>— ABS module C135-27, circuit 516 (YE/BK), harness side and ground. | |

(Continued)

## DIAGNOSIS AND TESTING (Continued)

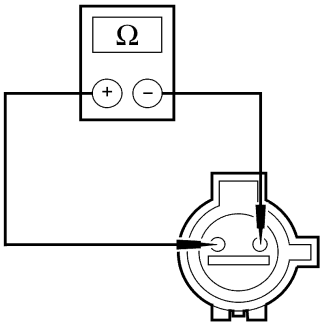
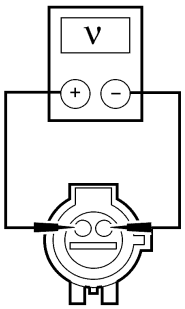
### PINPOINT TEST C: DTCs C1145, C1155, C1165 AND C1175 — WHEEL SPEED SENSOR INPUT CIRCUIT FAILURE (Continued)

| Test Step | | Result / Action to Take |
|---|---|---|
| C5 | **CHECK THE WHEEL SPEED SENSOR CIRCUITS FOR A SHORT TO GROUND (Continued)** | |
| | • **For DTC C1155**, measure the resistance between:<br>— ABS module C135-13, circuit 522 (TN/BK), harness side and ground.<br>— ABS module C135-12, circuit 521 (TN/OG), harness side and ground.<br>• **For DTC C1165**, measure the resistance between:<br>— ABS module C135-44, circuit 524 (PK/BK), harness side and ground.<br>— ABS module C135-43, circuit 523 (RD/PK), harness side and ground.<br>• **For DTC C1175**, measure the resistance between:<br>— ABS module C135-42, circuit 518 (LG/RD), harness side and ground.<br>— ABS module C135-41, circuit 519 (LG/BK), harness side and ground.<br>• **Are the resistances greater than 10,000 ohms?** | **Yes**<br>GO to **C6**.<br>**No**<br>REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. |
| C6 | **CHECK THE WHEEL SPEED SENSOR CIRCUITS FOR AN OPEN** | |
| | **NOTE:** Both circuits must be checked for each DTC.<br>• Disconnect: ABS Module C135.<br>• Disconnect: Suspect Wheel Speed Sensor.<br>• **For DTC C1145**, measure the resistance between:<br>— ABS module C135-26, circuit 514 (YE/RD), harness side and RH front wheel speed sensor C160-1, circuit 514 (YE/RD), harness side.<br>— ABS module C135-27, circuit 516 (YE/BK), harness side and RH front wheel speed sensor C160-2, circuit 516 (YE/BK), harness side.<br>• **For DTC C1155**, measure the resistance between:<br>— ABS module C135-13, circuit 522 (TN/BK), harness side and LH front wheel speed sensor C150-2, circuit 522 (TN/BK), harness side.<br>— ABS module C135-12, circuit 521 (TN/OG), harness side and LH front wheel speed sensor C150-1, circuit 521 (TN/OG), harness side.<br>• **For DTC C1165**, measure the resistance between:<br>— ABS module C135-44, circuit 524 (PK/BK), harness side and RH rear wheel speed sensor C3117-2, circuit 524 (PK/BK), harness side.<br>— ABS module C135-43, circuit 523 (RD/PK), harness side and RH rear wheel speed sensor C3117-1, circuit 523 (RD/PK), harness side.<br>• **For DTC C1175**, measure the resistance between:<br>— ABS module C135-42, circuit 518 (LG/RD), harness side and LH rear wheel speed sensor C3116-1, circuit 518 (LG/RD), harness side.<br>— ABS module C135-41, circuit 519 (LG/BK), harness side and LH rear wheel speed sensor C3116-2, circuit 519 (LG/BK), harness side.<br>• **Are the resistances less than 5 ohms?** | **Yes**<br>GO to **C7**.<br>**No**<br>REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. |

(Continued)

## DIAGNOSIS AND TESTING (Continued)

### PINPOINT TEST C: DTCs C1145, C1155, C1165 AND C1175 — WHEEL SPEED SENSOR INPUT CIRCUIT FAILURE (Continued)

| Test Step | | Result / Action to Take |
|---|---|---|
| C7 | **CHECK FOR SHORTED WHEEL SPEED SENSOR CIRCUITS** | |
| | • Measure the resistance between the suspect wheel speed sensor pins, harness side with the meter in the 10 mega ohm range.<br>  <br><br>A0057968<br>• **Is the resistance greater than 10,000 ohms?** | **Yes**<br>GO to **C8**.<br>**No**<br>REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. |
| C8 | **CHECK THE ABS MODULE OUTPUT** | |
| | • Connect: ABS Module C135.<br>• Ignition ON.<br>• Measure the voltage between the suspect wheel speed sensor pins, harness side.<br>  <br><br>A0057374<br>• **Is the voltage greater than 10 volts?** | **Yes**<br>INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor — Front or Wheel Speed Sensor — Rear in this section. CLEAR the DTCs. REPEAT the self-test.<br>**No**<br>GO to **C9**. |
| C9 | **CHECK FOR CORRECT ABS MODULE OPERATION** | |
| | • Ignition OFF.<br>• Disconnect: ABS Module C135.<br>• Check the connector for:<br>— corrosion.<br>— spread terminals.<br>— pushed-out pins.<br>• Connect: ABS Module C135.<br>• Make sure the connector seats properly, then operate the system and verify the concern is still present.<br>• **Is the concern still present?** | **Yes**<br>INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CLEAR the DTCs. REPEAT the self-test.<br>**No**<br>The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. |

### Pinpoint Test D: DTCs C1222, C1233, C1234, C1235 and C1236 — Wheel Speed Sensor Input Signal Missing/Mismatch

Refer to Wiring Diagrams Cell 42, Vehicle Dynamic Systems for schematic and connector information.

### Normal Operation

The wheel speed sensor and sensor ring generate a square wave signal to the ABS module that is proportional to wheel speed. The ABS module compares wheel speed inputs from all wheel speed sensors to determine an impending wheel lockup. Incorrect tire size can set these DTCs as well.

## DIAGNOSIS AND TESTING (Continued)

| DTC Description | Fault Trigger Condition |
|---|---|
| • DTC C1222 Wheel Speed Mismatch | When the vehicle speed exceeds 20 km/h (12 mph), if the ABS module detects a difference between wheel speed sensor signals, DTC C1222 will be set. DTC C1222 can also be set by damaged tone rings, mismatched wheel and/or tire sizes or driving the vehicle on one or more deflated tires. |
| • DTC C1233 LF Wheel Speed Sensor Signal Fault<br>• DTC C1234 RF Wheel Speed Sensor Signal Fault<br>• DTC C1235 RR Wheel Speed Sensor Signal Fault<br>• DTC C1236 LR Wheel Speed Sensor Signal Fault | When the vehicle speed exceeds 20 km/h (12 mph), if the ABS module does not receive a signal from the wheel speed sensor, the appropriate DTC will be set. These DTCs can also be set by an excessive wheel speed sensor-to-tone ring air gap or a damaged tone ring. |

**This pinpoint test is intended to diagnose the following:**

- Wheel speed sensor
- Wheel speed sensor ring
- ABS module

### PINPOINT TEST D: DTCs C1222, C1233, C1234, C1235 AND C1236 — WHEEL SPEED SENSOR INPUT SIGNAL MISSING/MISMATCH

***NOTICE:*** **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

| Test Step | | Result / Action to Take |
|---|---|---|
| D1 | **CHECK THE DTCs FROM THE SELF-TEST** | |
| | • Retrieve the recorded results from the ABS module continuous and on-demand self tests.<br>• **Are DTCs C1145, C1155, C1165 or C1175 present?** | **Yes**<br>GO to Pinpoint Test C.<br>**No**<br>**For DTC C1222**, GO to D7. **For DTCs C1233, C1234, C1235 and C1236**, if the active wheel speed sensor tool is available, GO to D3. If the active wheel speed sensor tool is not available, GO to D6. **For all other DTCs**, GO to the ABS Module DTC Chart.<br>If no DTCs are present, GO to D2. |
| D2 | **MONITOR THE WHEEL SPEED SENSOR PIDs** | |
| | • Enter the following diagnostic mode on the scan tool: ABS DataLogger.<br>• Drive the vehicle at a constant speed and monitor the following wheel speed PIDs:<br>— Left Front Wheel Speed Sensor (LF__WSPD)<br>— Right Front Wheel Speed Sensor (RF__WSPD)<br>— Left Rear Wheel Speed Sensor (LR__WSPD)<br>— Right Rear Wheel Speed Sensor (RR__WSPD)<br>• **Are the wheel speed PIDs consistent with the vehicle speed and each other?** | **Yes**<br>The system is operating correctly at this time. DRIVE the vehicle and CARRY OUT at least one ABS stop. If the ABS warning indicator illuminates, REFER to Inspection and Verification in this section. If the ABS warning indicator does not illuminate, RETURN the vehicle to the customer.<br>**No**<br>If the wheel speed PIDs are not consistent between each other, GO to D7.<br>If the wheel speed PIDs are consistent between each other but do not match the vehicle speed and the active wheel speed sensor tool is available, GO to D3. If the active wheel speed sensor tool is not available, GO to D6. |
| D3 | **CHECK THE ABS MODULE OUTPUT USING THE ACTIVE WHEEL SPEED SENSOR TESTER** | |
| | • Ignition OFF.<br>• Disconnect: Suspect Wheel Speed Sensor.<br>• Connect the active wheel speed sensor tester to the wheel speed sensor connectors. | |

(Continued)

## DIAGNOSIS AND TESTING (Continued)

### PINPOINT TEST D: DTCs C1222, C1233, C1234, C1235 AND C1236 — WHEEL SPEED SENSOR INPUT SIGNAL MISSING/MISMATCH (Continued)

| Test Step | | Result / Action to Take |
|---|---|---|
| D3 | **CHECK THE ABS MODULE OUTPUT USING THE ACTIVE WHEEL SPEED SENSOR TESTER (Continued)** | |
| | • Ignition ON.<br>• Select the correct system polarity on the active wheel speed sensor tester and turn the active wheel speed sensor tester power switch to the ON position.<br>• **Is the module output LED illuminated?** | **Yes**<br>GO to **D5**.<br>**No**<br>GO to **D4**. |
| D4 | **CHECK THE WHEEL SPEED SENSOR CIRCUITS FOR AN OPEN** | |
| | **NOTE:** Both circuits must be checked for each DTC.<br>• Ignition OFF.<br>• **For DTC C1233**: measure the resistance between:<br>— ABS module C135-13, circuit 522 (TN/BK), harness side and LF wheel speed sensor C150-2, circuit 522 (TN/BK), harness side.<br>— ABS module C135-12, circuit 521 (TN/OG), harness side and LF wheel speed sensor C150-1, circuit 521 (TN/OG), harness side.<br>• **For DTC C1234**: measure the resistance between:<br>— ABS module C135-26, circuit 514 (YE/RD), harness side and RF wheel speed sensor C160-1, circuit 514 (YE/RD), harness side.<br>— ABS module C135-27, circuit 516 (YE/BK), harness side and RF wheel speed sensor C160-2, circuit 516 (YE/BK), harness side.<br>• **For DTC C1235**: measure the resistance between:<br>— ABS module C135-44, circuit 524 (PK/BK), harness side and RR wheel speed sensor C3117-2, circuit 524 (PK/BK), harness side.<br>— ABS module C135-43, circuit 523 (RD/PK), harness side and RR wheel speed sensor C3117-1, circuit 523 (RD/PK), harness side.<br>• **For DTC C1236**: measure the resistance between:<br>— ABS module C135-42, circuit 518 (LG/RD), harness side and LR wheel speed sensor C3116-1, circuit 518 (LG/RD), harness side.<br>— ABS module C135-41, circuit 519 (LG/BK), harness side and LR wheel speed sensor C3116-2, circuit 519 (LG/BK), harness side.<br>• **Are the resistances less than 5 ohms?** | **Yes**<br>GO to **D10**.<br>**No**<br>REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. |

(Continued)

## DIAGNOSIS AND TESTING (Continued)

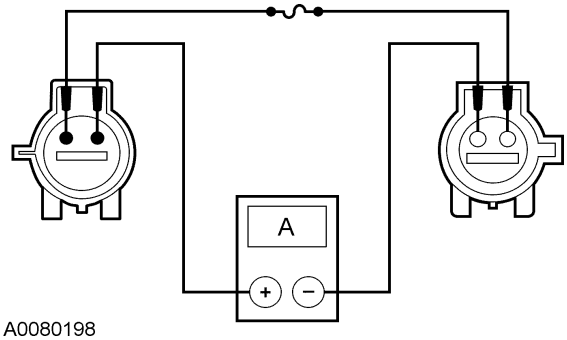
### PINPOINT TEST D: DTCs C1222, C1233, C1234, C1235 AND C1236 — WHEEL SPEED SENSOR INPUT SIGNAL MISSING/MISMATCH (Continued)

| Test Step | | Result / Action to Take |
|---|---|---|
| **D5** | **CHECK THE WHEEL SPEED SENSOR OUTPUT WITH THE SPECIAL TOOL** | |
| | • Raise the suspect wheel until it can spin freely. Refer to Section 100-02.<br>• While monitoring the active wheel speed sensor tester, slowly spin the suspect wheel.<br>• **Do the sensor output LEDs illuminate and flash and is the current overload LED not illuminated?** | **Yes**<br>INSPECT the wheel speed sensor tone ring for damage and looseness. INSTALL new components as necessary. If the tone ring is OK, the concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.<br>**No**<br>If the current level LED is not illuminated and the sensor output LEDs do not illuminate or if the current level LED is illuminated red, INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor — Front or Wheel Speed Sensor — Rear in this section. CLEAR the DTCs. REPEAT the self-test.<br>If the current level LED is not illuminated and the sensor output LEDs illuminate green but do not flash, INSPECT the wheel speed sensor tone ring and INSTALL a new tone ring as necessary. REFER to Wheel Speed Sensor Ring — Front or Wheel Speed Sensor Ring — Rear in this section. If the tone ring is OK, INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor — Front or Wheel Speed Sensor — Rear in this section. CLEAR the DTCs. REPEAT the self-test. |
| **D6** | **CHECK THE WHEEL SPEED SENSOR OUTPUT** | |
| | **NOTE:** The ignition switch must be in the OFF position until the connections are made or a DTC will set and the ABS warning indicator will illuminate and the ABS module will no longer supply voltage to the wheel speed sensors. If this happens, turn the ignition switch to the OFF position and make sure that no jumper connections are shorted to ground or shorted together. Turn the ignition switch to the ON position and wait for the ABS warning indicator to prove out.<br>• Disconnect: Suspect Wheel Speed Sensor. | |

(Continued)

## DIAGNOSIS AND TESTING (Continued)

### PINPOINT TEST D: DTCs C1222, C1233, C1234, C1235 AND C1236 — WHEEL SPEED SENSOR INPUT SIGNAL MISSING/MISMATCH (Continued)

| Test Step | | Result / Action to Take |
|---|---|---|
| D6 | CHECK THE WHEEL SPEED SENSOR OUTPUT (Continued) | |
| | • Connect a fused (5A) jumper wire between the suspect wheel speed sensor, component side, and the wheel speed sensor, harness side, as follows:<br>— **For DTC C1233**: LH front wheel speed sensor C150-1, circuit 521 (TN/OG), harness side and LH front wheel speed sensor C150 pin 1, circuit 521 (TN/OG), component side.<br>— **For DTC C1234**: RH front wheel speed sensor C160-1, circuit 514 (YE/RD), harness side and RH front wheel speed sensor C160 pin 1, circuit 514 (YE/RD), component side.<br>— **For DTC C1235**: RH rear wheel speed sensor C3117-1, circuit 523 (RD/PK), harness side and RH rear wheel speed sensor C3117 pin 1, circuit 523 (RD/PK), component side.<br>— **For DTC C1236**: LH rear wheel speed sensor C3116-1, circuit 518 (LG/RD), harness side and LH rear wheel speed sensor C3116 pin 1, circuit 518 (LG/RD), component side.<br>  <br><br>A0080198<br>• Connect a digital multi-meter between the suspect wheel speed sensor, component side, and the wheel speed sensor, harness side, as follows:<br>— **For DTC C1233**: LH front wheel speed sensor C150-2, circuit 522 (TN/BK), harness side and LH front wheel speed sensor C150 pin 2, circuit 522 (TN/BK), component side.<br>— **For DTC C1234**: RH front wheel speed sensor C160-2, circuit 516 (YE/BK), harness side and RH front wheel speed sensor C160 pin 2, circuit 516 (YE/BK), component side.<br>— **For DTC C1235**: RH rear wheel speed sensor C3117-2, circuit 524 (PK/BK), harness side and RH rear wheel speed sensor C3117 pin 2, circuit 524 (PK/BK), component side.<br>— **For DTC C1236**: LH rear wheel speed sensor C3116-2, circuit 519 (LG/BK), harness side and LH rear wheel speed sensor C3116 pin 2, circuit 519 (LG/BK), component side.<br>• Ignition In ACC.<br>• **NOTE:** The wheel must be moved very slowly to allow the meter to read the high and low current as the sensor tone ring openings pass the sensor.<br>Measure the current while slightly rotating the wheel using incremental turns.<br>• **Does the digital multi-meter switch between the low state (5-8 mA) and the high state (11-18 mA)?** | **Yes**<br>GO to **D8**.<br>**No**<br>INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor — Front or Wheel Speed Sensor — Rear in this section. CLEAR the DTCs. REPEAT the self-test. |
| D7 | CHECK THE WHEEL SPEED SENSOR MOUNTING | |
| | • With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02.<br>• **NOTE:** Examine the wheel speed sensor wire carefully, using a good light source. Failure to verify damage in the wheel speed sensor wire can lead to unnecessary installation of a new component.<br>Inspect the wheel speed sensor for looseness.<br>• **Is the wheel speed sensor and mounting OK?** | **Yes**<br>GO to **D8**.<br>**No**<br>TIGHTEN the wheel speed sensor to specification, REFER to Specifications in this section. CLEAR the DTCs. REPEAT the self-test. |

(Continued)

## DIAGNOSIS AND TESTING (Continued)

**PINPOINT TEST D: DTCs C1222, C1233, C1234, C1235 AND C1236 — WHEEL SPEED SENSOR INPUT SIGNAL MISSING/MISMATCH (Continued)**

| Test Step | | Result / Action to Take |
|---|---|---|
| D8 | **CHECK THE WHEEL SPEED SENSOR AND HARNESS FOR DAMAGE** | |
| | • **NOTE:** Examine the wheel speed sensor wire carefully, using a good light source. Failure to verify damage in the wheel speed sensor wire can lead to unnecessary installation of a new component.<br>Inspect the wheel speed sensor and attached wire harness for general damage.<br>• **Is the wheel speed sensor and harness OK?** | **Yes**<br>GO to D9.<br>**No**<br>INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor — Front or Wheel Speed Sensor — Rear in this section. CLEAR the DTC. REPEAT the self-test. |
| D9 | **CHECK FOR WHEEL SPEED SENSOR TONE RING FOR DAMAGE** | |
| | • If necessary, remove the wheel speed sensor. Refer to Wheel Speed Sensor — Front or Wheel Speed Sensor — Rear in this section.<br>• Inspect the wheel speed sensor ring for damaged or missing teeth. Rotate the wheel to verify that no teeth are missing.<br>• **Is the wheel speed sensor ring OK?** | **Yes**<br>GO to D10.<br>**No**<br>INSTALL a new wheel speed sensor ring. REFER to Wheel Speed Sensor Ring — Front or Wheel Speed Sensor Ring — Rear in this section. CLEAR the DTCs. REPEAT the self-test. |
| D10 | **CHECK FOR CORRECT ABS MODULE OPERATION** | |
| | • Ignition OFF.<br>• Disconnect: ABS Module C135.<br>• Check the connector for:<br>— corrosion.<br>— spread terminals.<br>— pushed-out pins.<br>• Connect: ABS Module C135.<br>• Make sure the connector seats properly, then operate the system and verify the concern is still present.<br>• **Is the concern still present?** | **Yes**<br>INSPECT the wheel speed sensor tone ring for damage and looseness. INSTALL new components as necessary. If the tone ring is OK, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CLEAR the DTCs. REPEAT the self-test.<br>**No**<br>The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. |

### Pinpoint Test E: DTC C1446 — Brake Switch Circuit Failure

Refer to Wiring Diagrams Cell 42, Vehicle Dynamic Systems for schematic and connector information.

#### Normal Operation

The normally-closed Brake Pedal Position (BPP) switch (also known as the speed control deactivation switch) receives fused battery voltage from Bussed Electrical Center (BEC) fuse 47 (15A) along circuit 391 (RD/YE) when the ignition key is turned to the RUN position. This voltage is sent through the BPP switch to the ABS module and the PCM along circuit 535 (LB/RD). When the brake pedal is applied, the BPP opens and the voltage signal is no longer referenced by the ABS module and PCM.

When the fluid level in the brake master cylinder reservoir reaches a predetermined level, the brake fluid level switch closes and voltage is sent to the Smart Junction Box (SJB). The SJB then sends a message to the ABS module along the High Speed Controller Area Network (HS-CAN) bus network.

- DTC C1446 Brake Switch Circuit Failure — If during normal operation the ABS module determines that the BPP information is invalid when compared to other inputs (brake pressure transducer and wheel speed sensors) or if the brake pedal message is missing completely, DTC C1446 will be set. Also, a low brake fluid level in the master cylinder reservoir or an open, short to ground or short to voltage in the brake fluid level switch that the SJB interprets as a low fluid condition will cause DTC C1446 to be set.

#### This pinpoint test is intended to diagnose

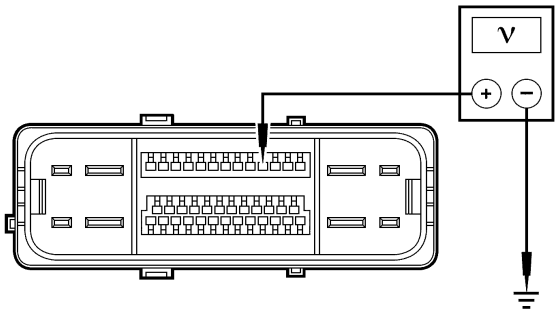
## DIAGNOSIS AND TESTING (Continued)

**the following:**

- Wiring, terminals or connectors
- BPP switch
- ABS module

### PINPOINT TEST E: DTC C1446 — BRAKE SWITCH CIRCUIT FAILURE

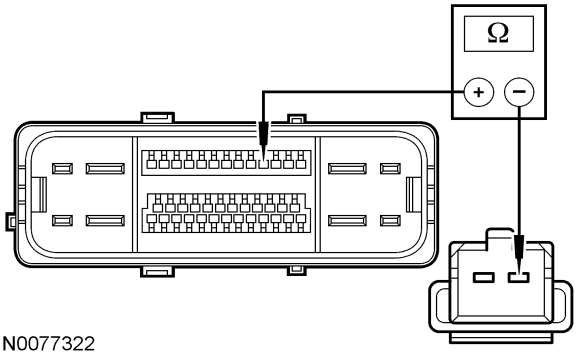
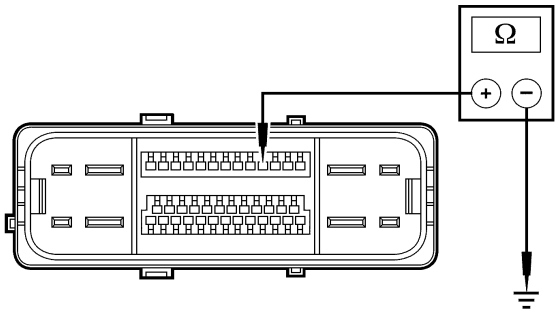
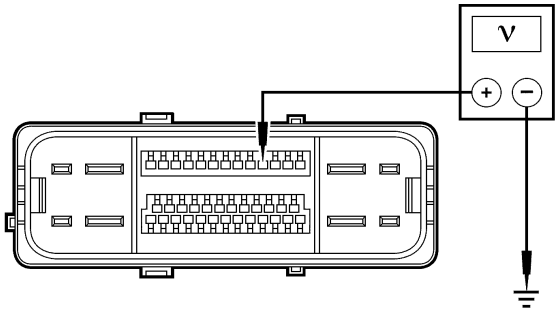
***NOTICE:*** **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

| Test Step | | Result / Action to Take |
|---|---|---|
| **E1** | **MONITOR THE RED BRAKE WARNING INDICATOR** | |
| | • Ignition ON.<br>• Observe the red brake warning indicator while turning the ignition switch from OFF to RUN.<br>• **Does the indicator illuminate for a brief period and then extinguish?** | **Yes**<br>GO to **E2**.<br>**No**<br>REFER to Section 413-01 to diagnose the red brake warning indicator. |
| **E2** | **CHECK THE ABS MODULE AND THE SJB FOR COMMUNICATION DTCs** | |
| | • Connect the scan tool.<br>• Enter the following diagnostic mode on the scan tool: Self Test ABS Module.<br>• Retrieve and record any ABS module communication DTCs.<br>• Enter the following diagnostic mode on the scan tool: Self Test SJB.<br>• Retrieve and record any SJB communication DTCs.<br>• **Are any communication DTCs present in the ABS module and/or the SJB?** | **Yes**<br>For ABS module communication DTCs, REFER to the ABS Module DTC Chart.<br>For SJB communication DTCs, REFER to the Master DTC Chart in Section 419-10.<br>**No**<br>GO to **E3**. |
| **E3** | **CHECK FOR BPP SWITCH VOLTAGE TO THE ABS MODULE** | |
| | • Ignition OFF.<br>• Disconnect: ABS Module C135.<br>• Ignition ON.<br>• While pressing and releasing the brake pedal, measure the voltage between ABS module C135-6, circuit 535 (LB/RD), harness side and ground.<br>  <br>N0077321<br>• **Is the voltage greater than 10 volts with the pedal released and 0 volt with the pedal pressed?** | **Yes**<br>GO to **E12**.<br>**No**<br>GO to **E4**. |
| **E4** | **ISOLATE THE BPP SWITCH** | |
| | • Ignition OFF.<br>• Disconnect: BPP Switch C278 (also known as the speed control deactivator switch).<br>• While pressing and releasing the brake pedal, measure the resistance between BPP switch connector C278 pin-1, component side, and BPP switch C278 pin-2, component side.<br>• **Is the resistance greater than 10,000 ohms with the pedal pressed and less than 5 ohms with the brake pedal released?** | **Yes**<br>GO to **E5**.<br>**No**<br>INSTALL a new BPP switch. REFER to Speed Control Deactivator Switch Removal and Installation in Section 310-03. CLEAR the DTC. REPEAT the self-test. |
| **E5** | **CHECK CIRCUIT 535 (LB/RD) FOR AN OPEN** | |
| | • Ignition OFF. | |

(Continued)

## DIAGNOSIS AND TESTING (Continued)

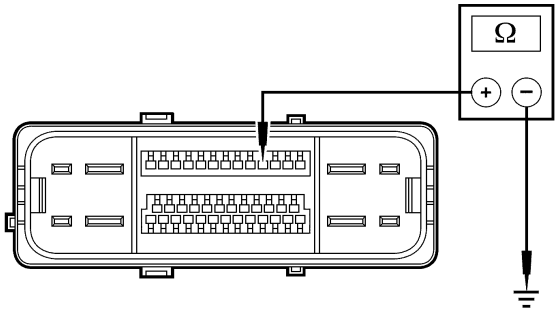
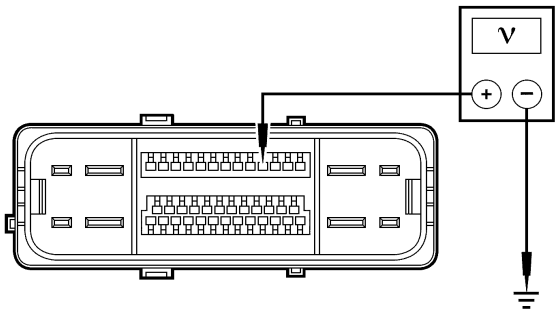
### PINPOINT TEST E: DTC C1446 — BRAKE SWITCH CIRCUIT FAILURE (Continued)

| Test Step | | Result / Action to Take |
|---|---|---|
| E5 | CHECK CIRCUIT 535 (LB/RD) FOR AN OPEN (Continued) | |
| | • Disconnect: PCM C175b.<br>• Measure the resistance between ABS module C135-6, circuit 535 (LB/RD), harness side and BPP switch C278-1, circuit 535 (LB/RD), harness side.<br>  <br><br>N0077322<br>• **Is the resistance less than 5 ohms?** | **Yes**<br>GO to **E6**.<br>**No**<br>REPAIR circuit 535 (LB/RD). CLEAR the DTC. REPEAT the self-test. |
| E6 | CHECK CIRCUIT 535 (LB/RD) FOR A SHORT TO GROUND | |
| | • Measure the resistance between ABS module C135-6, circuit 535 (LB/RD), harness side and ground.<br>  <br><br>N0077323<br>• **Is the resistance greater than 10,000 ohms?** | **Yes**<br>GO to **E7**.<br>**No**<br>REPAIR circuit 535 (LB/RD). CLEAR the DTC. REPEAT the self-test. |
| E7 | CHECK CIRCUIT 535 (LB/RD) FOR A SHORT TO VOLTAGE | |
| | • Ignition ON.<br>• Measure the voltage between ABS module C135-6, circuit 535 (LB/RD), harness side and ground.<br>  <br><br>N0078560<br>• **Is any voltage present?** | **Yes**<br>REPAIR circuit 535 (LB/RD). CLEAR the DTC. REPEAT the self-test.<br>**No**<br>GO to **E8**. |

(Continued)

## DIAGNOSIS AND TESTING (Continued)

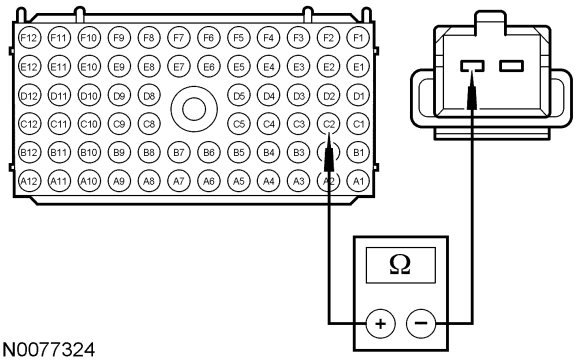
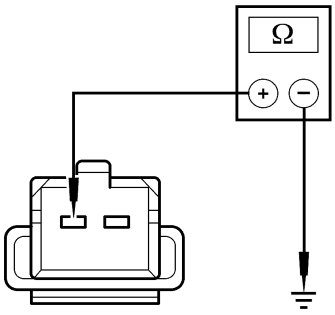
### PINPOINT TEST E: DTC C1446 — BRAKE SWITCH CIRCUIT FAILURE (Continued)

| Test Step | | Result / Action to Take |
|---|---|---|
| **E8** | **CHECK THE PCM FOR A SHORT TO GROUND** | |
| | • Ignition OFF.<br>• Connect: PCM C175b.<br>• Measure the resistance between ABS module C135-6, circuit 535 (LB/RD), harness side and ground.<br>  <br><br>N0077323<br>• **Is the resistance greater than 10,000 ohms?** | **Yes**<br>GO to **E9**.<br>**No**<br>INSTALL a new PCM. REFER to Section 303-14. CLEAR the DTC. REPEAT the self-test. |
| **E9** | **CHECK THE PCM FOR A SHORT TO VOLTAGE** | |
| | • Ignition ON.<br>• Measure the voltage between ABS module C135-6, circuit 535 (LB/RD), harness side and ground.<br>  <br><br>N0078560<br>• **Is any voltage present?** | **Yes**<br>INSTALL a new PCM. REFER to Section 303-14. CLEAR the DTC. REPEAT the self-test.<br>**No**<br>GO to **E10**. |
| **E10** | **CHECK CIRCUIT 391 (RD/YE) FOR AN OPEN** | |
| | • Ignition OFF.<br>• Disconnect: BEC C1035a. | |

(Continued)

## DIAGNOSIS AND TESTING (Continued)

### PINPOINT TEST E: DTC C1446 — BRAKE SWITCH CIRCUIT FAILURE (Continued)

| Test Step | | Result / Action to Take |
|---|---|---|
| E10 | **CHECK CIRCUIT 391 (RD/YE) FOR AN OPEN (Continued)** | |
| | • Measure the resistance between BPP switch C278-2, circuit 391 (RD/YE), harness side and BEC C1035a-C2, circuit 391 (RD/YE), harness side.<br>  <br><br>N0077324<br>• **Is the resistance less than 5 ohms?** | **Yes**<br>GO to **E11**.<br>**No**<br>VERIFY BEC fuse 47 (15A) is OK. If OK, REPAIR circuit 391 (RD/YE). CLEAR the DTC. REPEAT the self-test. |
| E11 | **CHECK CIRCUIT 391 (RD/YE) FOR A SHORT TO GROUND** | |
| | • Measure the resistance between BPP switch C278-2, circuit 391 (RD/YE), harness side and ground.<br>  <br><br>N0077325<br>• **Is the resistance greater than 10,000 ohms?** | **Yes**<br>INSTALL a new BPP switch. REFER to speed control deactivator switch in Section 310-03. CLEAR the DTCs. REPEAT the self-test.<br>**No**<br>REPAIR circuit 391 (RD/YE). CLEAR the DTC. REPEAT the self-test. |
| E12 | **CHECK FOR CORRECT ABS MODULE OPERATION** | |
| | • Ignition OFF.<br>• Disconnect: ABS Module C135.<br>• Check the ABS module connector for:<br>— corrosion.<br>— pushed-out pins.<br>— spread terminals.<br>• Connect: ABS Module C135.<br>• Make sure the ABS module connector seats correctly, then operate the system and verify if the concern is still present.<br>• **Is the concern still present?** | **Yes**<br>INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CLEAR the DTCs. REPEAT the self-test.<br>**No**<br>The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test with the brake pedal not applied. |

### Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator

#### Normal Operation

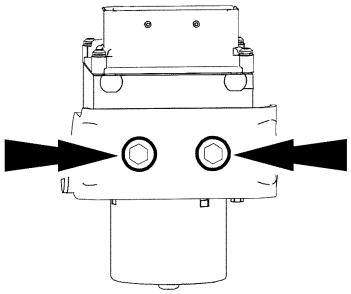
The brake pedal should be firm when applied.

#### This pinpoint test is intended to diagnose the following:

- Base brake system
- Hydraulic Control Unit (HCU)

## DIAGNOSIS AND TESTING (Continued)

**PINPOINT TEST F: SPONGY/SOFT/LOW BRAKE PEDAL WITH NO WARNING INDICATOR**

| Test Step | | Result / Action to Take |
|---|---|---|
| **F1** | **CHECK THE BASE BRAKE COMPONENTS** | |
| | • Visually inspect the brake hoses and tubes from the HCU to the brake calipers.<br>• Visually inspect the calipers and brake components.<br>• **Are any of these components damaged or leaking?** | **Yes**<br>REPAIR or INSTALL new components as necessary. TEST the system for normal operation.<br>**No**<br>GO to **F2**. |
| **F2** | **CHECK FOR A LEAKING DUMP VALVE** | |
| | • Ignition OFF.<br>• **NOTE:** The HCU is located under the air cleaner.<br>Remove the rubber boots from the 2 HCU low pressure accumulators and insert a clean steel implement (such as a paper clip or a small screwdriver) into each low pressure accumulator.<br>  <br>N0012765<br>• Ignition ON.<br>• **NOTE:** A leaking dump valve is similar to the master cylinder bypass condition. It is important that the pedal be quickly and forcefully applied to rule out master cylinder bypass as a condition.<br>Have an assistant press hard on the brake pedal while observing the steel implements.<br>• **Do either of the implements move out 6.35 mm (0.25 in) or more?** | **Yes**<br>INSTALL a new HCU. REFER to Hydraulic Control Unit (HCU) in this section.<br>**No**<br>REMOVE the steel implements. INSTALL the rubber boots on each low pressure accumulator. REFER to Section 206-00 to continue diagnosis of the base brake system. |

### Pinpoint Test G: Poor Vehicle Tracking During Anti-lock Function

#### Normal Operation

The operating voltage required to operate the ABS module, hydraulic pump and isolation valves is in a range between 10 and 16 volts.

Fused ignition voltage is supplied to the ABS module from Smart Junction Box (SJB) fuse 18 (10A) along circuit 1844 (LG/RD). Fused battery voltage is supplied to the ABS module from Bussed Electrical Center (BEC) fuse 65 (30A) along circuit 601 (LB/BK) and BEC fuse 8 (40A) along circuit 534 (YE/LG). Ground is provided to the ABS module along circuit 1205 (BK). There are 2 ground circuits (one for the ABS module and one for the hydraulic pump motor) both share the same circuit number and wire color.

#### This pinpoint test is intended to diagnose the following:

- Base brake system
- Hydraulic Control Unit (HCU)

## DIAGNOSIS AND TESTING (Continued)

### PINPOINT TEST G: POOR VEHICLE TRACKING DURING ANTI-LOCK FUNCTION

| Test Step | | Result / Action to Take |
|---|---|---|
| G1 | **CHECK THE BASE BRAKE COMPONENTS** | |
| | • Eliminate the base brake system as the cause of the concern.<br>• **Is the base brake system operating correctly?** | **Yes**<br>GO to G2.<br>**No**<br>REPAIR the base brake system. REFER to Section 206-00. TEST the system for normal operation. |
| G2 | **BLEED THE ABS HCU** | |
| | • Bleed the HCU. Refer to Component Bleeding in Section 206-00.<br>• Test drive the vehicle.<br>• **Does the vehicle track correctly?** | **Yes**<br>The brake system is operating correctly. The concern may have been caused by air in the hydraulic system or a sticky valve.<br>**No**<br>GO to G3. |
| G3 | **CHECK THE ABS INLET VALVE (CLOSED POSITION)** | |
| | • Ignition ON.<br>• With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02.<br>• Check all the wheels to make sure they spin freely (the transmission must be in NEUTRAL).<br>• Enter the following diagnostic mode on the scan tool: ABS DataLogger: Left Front Inlet Valve (ABSLF__I) Output Command.<br>• Toggle the ABSLF__I output command ON.<br>• Apply moderate brake pedal effort.<br>• Have an assistant attempt to rotate the LF wheel.<br>• **Does the LF wheel rotate?** | **Yes**<br>TOGGLE the ABSLF__I output command OFF. GO to G4.<br>**No**<br>TOGGLE the ABSLF__I output command OFF. INSTALL a new HCU. REFER to Hydraulic Control Unit (HCU) in this section. TEST the system for normal operation. |
| G4 | **CHECK THE ABS INLET VALVE (OPEN POSITION)** | |
| | • Apply moderate brake pedal effort.<br>• Have an assistant attempt to rotate the LF wheel.<br>• **Does the LF wheel rotate?** | **Yes**<br>INSTALL a new HCU. REFER to Hydraulic Control Unit (HCU) in this section. TEST the system for normal operation.<br>**No**<br>GO to G5. |
| G5 | **CHECK THE ABS OUTPUT VALVE (OPEN POSITION)** | |
| | • Apply moderate brake pedal effort.<br>• Enter the following diagnostic mode on the scan tool: ABS DataLogger.<br>— Left Front Inlet Valve (ABSLF__I) Output Command<br>— Pump Motor (ABS__MTR) Output Command<br>— Left Front Outlet Valve (ABSLF__O) Output Command<br>• Toggle the ABSLF__I output command ON.<br>• Toggle the ABS__MTR output command ON for 6 seconds. (The output command must be toggled ON 3 times. Each toggle runs the pump for 2 seconds.)<br>• Toggle the ABSLF__O output command ON.<br>• Toggle the ABSLF__O output command OFF. Repeat 3 times.<br>• While the output commands are toggled ON, have an assistant attempt to rotate the LF wheel.<br>• **Does the LF wheel rotate?** | **Yes**<br>TOGGLE all output commands OFF. GO to G6.<br>**No**<br>TOGGLE all output commands OFF. INSTALL a new HCU. REFER to Hydraulic Control Unit (HCU) in this section. TEST the system for normal operation. |
| G6 | **CHECK THE ABS INLET AND OUTLET VALVES (CLOSED POSITION)** | |
| | • Apply moderate brake pedal effort.<br>• Have an assistant attempt to rotate the LF wheel.<br>• **Does the LF wheel rotate?** | **Yes**<br>INSTALL a new HCU. REFER to Hydraulic Control Unit (HCU) in this section. TEST the system for normal operation.<br>**No**<br>REPEAT this procedure (beginning with Step G2) for the RF, LR and RR wheels using the appropriate output commands. If no failure occurs, the system is operating normally. |

## DIAGNOSIS AND TESTING (Continued)

### Pinpoint Test H: The Traction Control System Cannot be Disabled

Refer to Wiring Diagrams Cell 42, Vehicle Dynamic Systems for schematic and connector information.

### Normal Operation

The traction control system can be disabled by the driver pressing the traction control switch located in the instrument panel next to the hazard flasher switch. The traction control switch is a normally-open momentary contact switch and is hard-wired to the instrument cluster along circuit 1412 (WH/PK). The switch is grounded along circuit 1205 (BK). When the traction control switch is pressed, circuit 1412 (WH/PK) and circuit 1205 (BK) are momentarily connected together. The instrument cluster detects this ground and sends a voltage to the traction control switch through circuit 939 (VT) to illuminate the traction control switch at the same time the instrument cluster sends a message over the High Speed Controller Area Network (HS-CAN) bus to the ABS module to disable the traction control system. The system will remain disabled until the traction control switch is pressed again or when the ignition key is cycled from ON to OFF and then back to ON again.

- DTC C1093 Traction Control Disable Switch Circuit Failure — If during the instrument cluster on-demand self test the instrument cluster detects a short to ground on circuit 1412 (WH/PK), then DTC C1093 will be set. This is usually due to the traction control switch being pressed during the self-test.

### This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Traction control switch
- Instrument cluster
- ABS module

### PINPOINT TEST H: THE TRACTION CONTROL SYSTEM CANNOT BE DISABLED

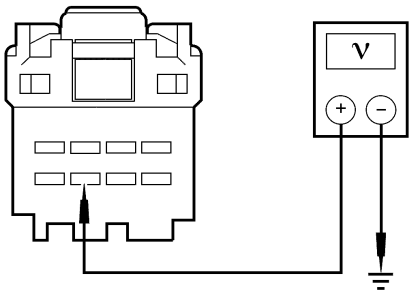
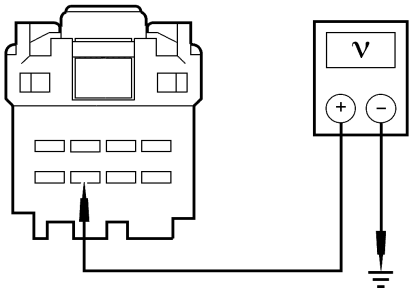
***NOTICE:*** **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

| Test Step | | Result / Action to Take |
|---|---|---|
| **H1** | **CHECK FOR INSTRUMENT CLUSTER DTCs** | |
| | • Connect the scan tool.<br>• Ignition ON.<br>• Enter the following diagnostic mode on the scan tool: Self Test Instrument Cluster.<br>• Using the scan tool, carry out the instrument cluster self-test. Retrieve and record any DTCs.<br>• **Is DTC C1093 present?** | **Yes**<br>GO to H7.<br>**No**<br>For all other instrument cluster DTCs, REFER to the Master DTC Chart in Section 419-10.<br>If no instrument cluster DTCs are present, GO to H2. |

(Continued)

## DIAGNOSIS AND TESTING (Continued)

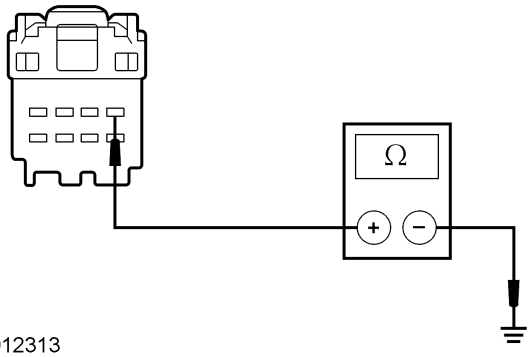
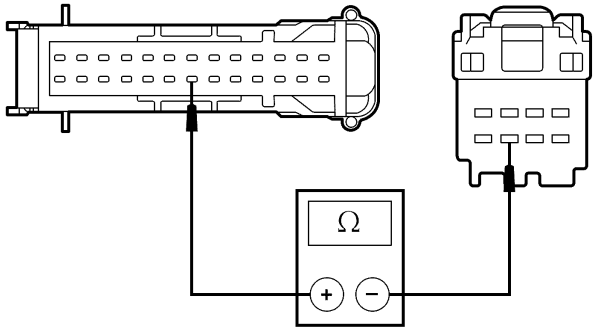
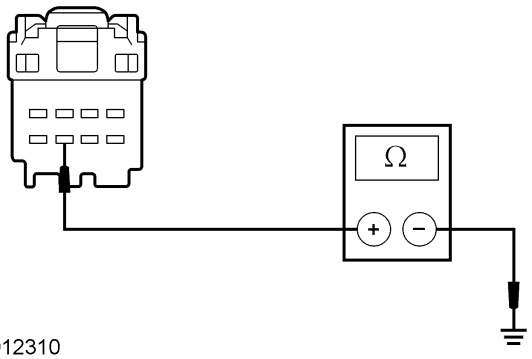
### PINPOINT TEST H: THE TRACTION CONTROL SYSTEM CANNOT BE DISABLED (Continued)

| Test Step | | Result / Action to Take |
|---|---|---|
| **H2** | **CHECK THE TRACTION CONTROL SWITCH** | |
| | • Disconnect: Traction Control Switch C2039.<br>• Measure the resistance between traction control switch C2039 pin-1 and pin-7, component side, while pressing and releasing the traction control switch.<br>• **Is the resistance less than 5 ohms with the switch pressed and greater than 10,000 ohms with the switch released?** | **Yes**<br>GO to **H3**.<br>**No**<br>INSTALL a new traction control switch. REFER to Traction Control Switch in this section. CLEAR the DTCs. REPEAT the self-test. |
| **H3** | **CHECK THE VOLTAGE TO THE TRACTION CONTROL SWITCH FROM THE INSTRUMENT CLUSTER** | |
| | • Ignition ON.<br>• Measure the voltage between traction control switch C2039-7, circuit 1412 (WH/PK), harness side and ground.<br>  <br>N0072094<br>• **Is the voltage greater than 9.5 volts?** | **Yes**<br>GO to **H4**.<br>**No**<br>GO to **H6**. |
| **H4** | **CHECK CIRCUIT 1412 (WH/PK) FOR A SHORT TO VOLTAGE** | |
| | • Ignition OFF.<br>• Disconnect: Instrument Cluster C220.<br>• Ignition ON.<br>• Measure the voltage between traction control switch C2039-7, circuit 1412 (WH/PK), harness side and ground.<br>  <br>N0072094<br>• **Is any voltage present?** | **Yes**<br>REPAIR circuit 1412 (WH/PK). CLEAR the DTCs. REPEAT the self-test.<br>**No**<br>GO to **H5**. |
| **H5** | **CHECK CIRCUIT 1205 (BK) FOR AN OPEN** | |
| | • Ignition OFF. | |

(Continued)

## DIAGNOSIS AND TESTING (Continued)

### PINPOINT TEST H: THE TRACTION CONTROL SYSTEM CANNOT BE DISABLED (Continued)

| Test Step | | Result / Action to Take |
|---|---|---|
| **H5** | **CHECK CIRCUIT 1205 (BK) FOR AN OPEN (Continued)** | |
| | • Measure the resistance between traction control switch C2039-1, circuit 1205 (BK), harness side and ground.<br>  <br>N0012313<br>• **Is the resistance less than 5 ohms?** | **Yes**<br>GO to **H8**.<br>**No**<br>REPAIR circuit 1205 (BK). CLEAR the DTCs. REPEAT the self-test. |
| **H6** | **CHECK CIRCUIT 1412 (WH/PK) FOR AN OPEN** | |
| | • Disconnect: Instrument Cluster C220.<br>• Measure the resistance between instrument cluster C220-20, circuit 1412 (WH/PK), harness side and traction control switch C2039-7, circuit 1412 (WH/PK), harness side.<br>  <br>N0012312<br>• **Is the resistance less than 5 ohms?** | **Yes**<br>GO to **H7**.<br>**No**<br>REPAIR circuit 1412 (WH/PK). CLEAR the DTCs. REPEAT the self-test. |
| **H7** | **CHECK CIRCUIT 1412 (WH/PK) FOR A SHORT TO GROUND** | |
| | • Ignition OFF.<br>• Measure the resistance between traction control switch C2039-7, circuit 1412 (WH/PK), harness side and ground.<br>  <br>N0012310<br>• **Is the resistance greater than 10,000 ohms?** | **Yes**<br>GO to **H8**.<br>**No**<br>REPAIR circuit 1412 (WH/PK). CLEAR the DTCs. REPEAT the self-test. |

(Continued)

## DIAGNOSIS AND TESTING (Continued)

**PINPOINT TEST H: THE TRACTION CONTROL SYSTEM CANNOT BE DISABLED (Continued)**

| Test Step | | Result / Action to Take |
|---|---|---|
| **H8** | **CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION** | |
| | • Disconnect: Instrument Cluster C220.<br>• Check the connector for:<br>— corrosion.<br>— spread terminals.<br>— pushed-out pins.<br>• Connect: Instrument Cluster C220.<br>• Make sure the connector seats correctly then operate the system and verify the concern is still present.<br>• **Is the concern still present?** | **Yes**<br>INSTALL a new instrument cluster. REFER to Section 413-01. CLEAR the DTCs. REPEAT the self-test.<br>**No**<br>The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. |

### Pinpoint Test I: The Traction Control System is Inoperative

Refer to Wiring Diagrams Cell 42, Vehicle Dynamic Systems for schematic and connector information.

### Normal Operation

Traction control utilizes ABS components to detect and control excessive rear wheel spin on low-traction surfaces. On high-traction surfaces, traction control will permit a controlled amount of rear wheel spin in the interest of quick acceleration. The traction control strategy will utilize throttle position information provided by the PCM over the High Speed Controller Area Network (HS-CAN) and front wheel speed sensor input to determine if it is necessary for traction control to intervene.

If the rear wheels begin to spin on a low-traction surface, the ABS module will use the Hydraulic Control Unit (HCU) to modulate brake fluid pressure to the rear brake calipers. At the same time, the ABS module sends a message to the PCM over the HS-CAN bus to modulate engine torque. Engine torque modulation is achieved by regulating fuel and spark to the cylinders. Once the rear wheels return to the desired speed, the ABS module stops modulating the brake fluid pressure and stops sending the message to the PCM.

### This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Instrument cluster
- ABS module

**PINPOINT TEST I: THE TRACTION CONTROL SYSTEM IS INOPERATIVE**

***NOTICE:*** **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

| Test Step | | Result / Action to Take |
|---|---|---|
| **I1** | **CHECK HS-CAN BUS** | |
| | • Connect the scan tool.<br>• Ignition ON.<br>• Enter the following diagnostic mode on the scan tool: Network Test.<br>• Using the scan tool, carry out the network test. Retrieve and record any DTCs.<br>• **Does the network test fail or are any communication DTCs present?** | **Yes**<br>REFER to Section 418-00 to diagnose the communication concern.<br>**No**<br>GO to I2. |
| **I2** | **CHECK FOR INSTRUMENT CLUSTER DTCs** | |
| | • Enter the following diagnostic mode on the scan tool: Self Test Instrument Cluster.<br>• Using the scan tool, carry out the instrument cluster self-test. Retrieve and record any instrument cluster DTCs.<br>• **Are any instrument cluster DTCs present?** | **Yes**<br>GO to the Instrument Cluster DTC Chart in this section.<br>**No**<br>GO to I3. |
| **I3** | **CHECK FOR ABS MODULE DTCs** | |
| | • Enter the following diagnostic mode on the scan tool: Self Test ABS.<br>• Using the scan tool, carry out the ABS module self-test. Retrieve and record any ABS module DTCs.<br>• **Are any ABS module DTCs present?** | **Yes**<br>GO to the ABS Module DTC Chart in this section.<br>**No**<br>GO to I4. |

(Continued)

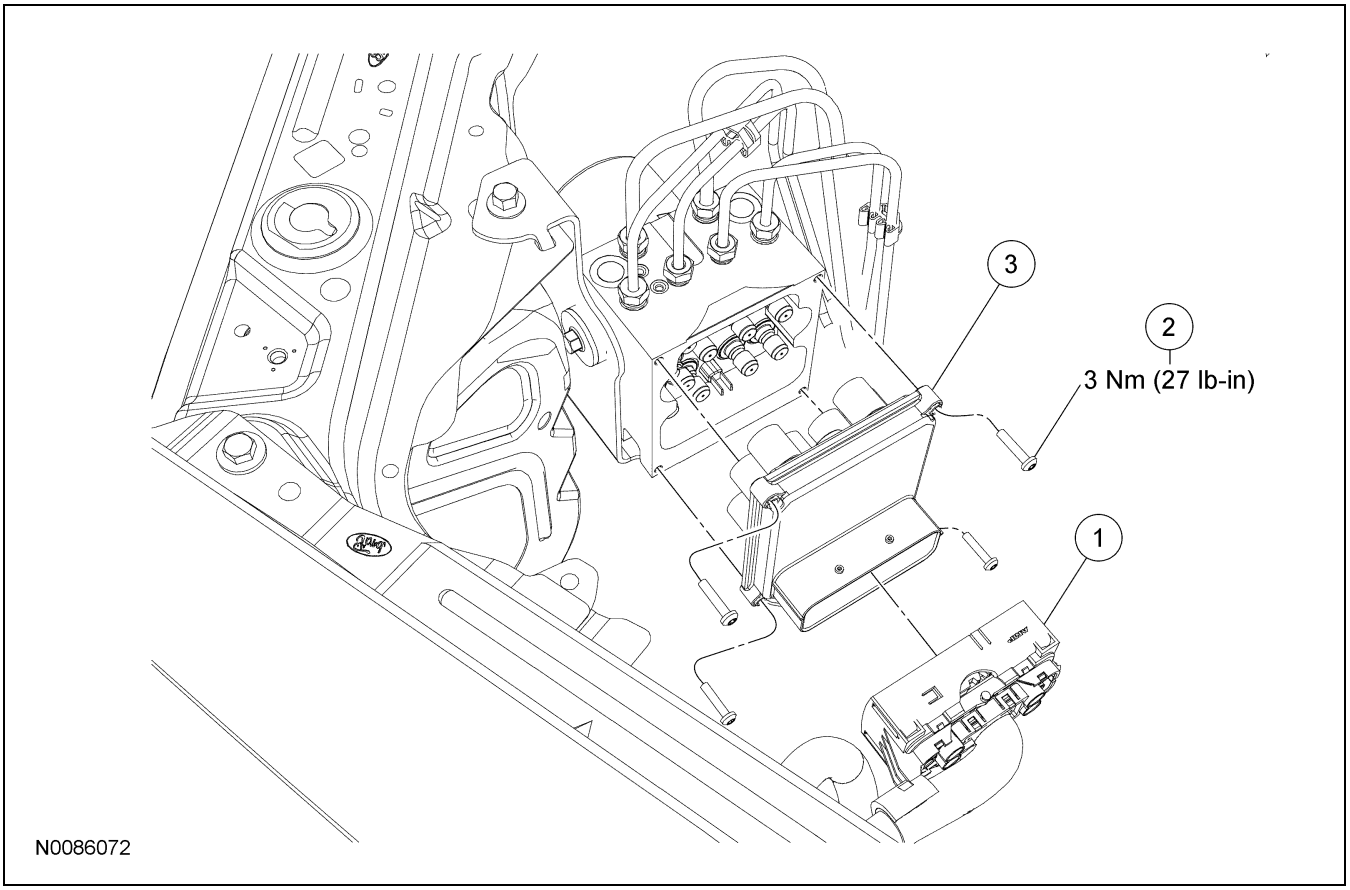
## DIAGNOSIS AND TESTING (Continued)

### PINPOINT TEST I: THE TRACTION CONTROL SYSTEM IS INOPERATIVE (Continued)

| Test Step | | Result / Action to Take |
|---|---|---|
| I4 | **CHECK FOR CORRECT ABS MODULE OPERATION** | |
| | • Ignition OFF.<br>• Disconnect: ABS Module C135.<br>• Check the connector for:<br>— corrosion.<br>— spread terminals.<br>— pushed-out pins.<br>• Connect: ABS Module C135.<br>• Make sure the connector seats properly, then operate the system and verify the concern is still present.<br>• **Is the concern still present?** | **Yes**<br>INSPECT the wheel speed sensor tone ring for damage and looseness. INSTALL new components as necessary. If the tone ring is OK, INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module in this section. CLEAR the DTCs. REPEAT the self-test.<br>**No**<br>The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. |

# REMOVAL AND INSTALLATION

## Anti-Lock Brake System (ABS) Module

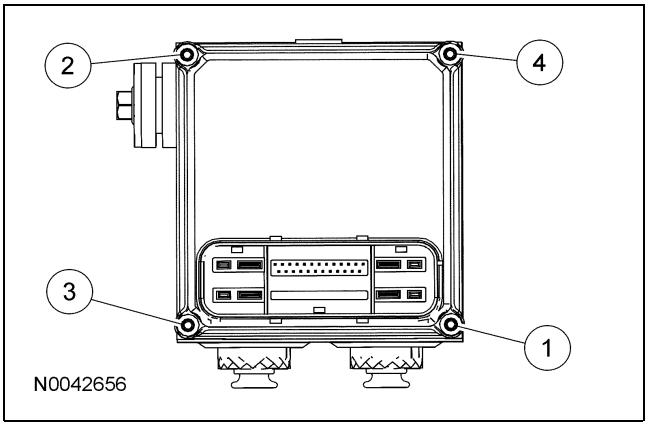



| Item | Part Number | Description |
|---|---|---|
| 1 | — | ABS module electrical connector (part of 14A005) |
| 2 | ZD061 | ABS module screw (4 required) |
| 3 | 2C219 | ABS module |

### Removal and Installation

***NOTICE:*** **Electronic modules are sensitive to electrical charges. The anti-lock brake system (ABS) module can be damaged if exposed to these charges.**

1. Remove the air cleaner assembly. For additional information, refer to Section 303-12.
2. Disconnect the ABS module electrical connector.
3. Remove the 4 screws and the ABS module.
   - To install, tighten to 3 Nm (27 lb-in) in the sequence shown.



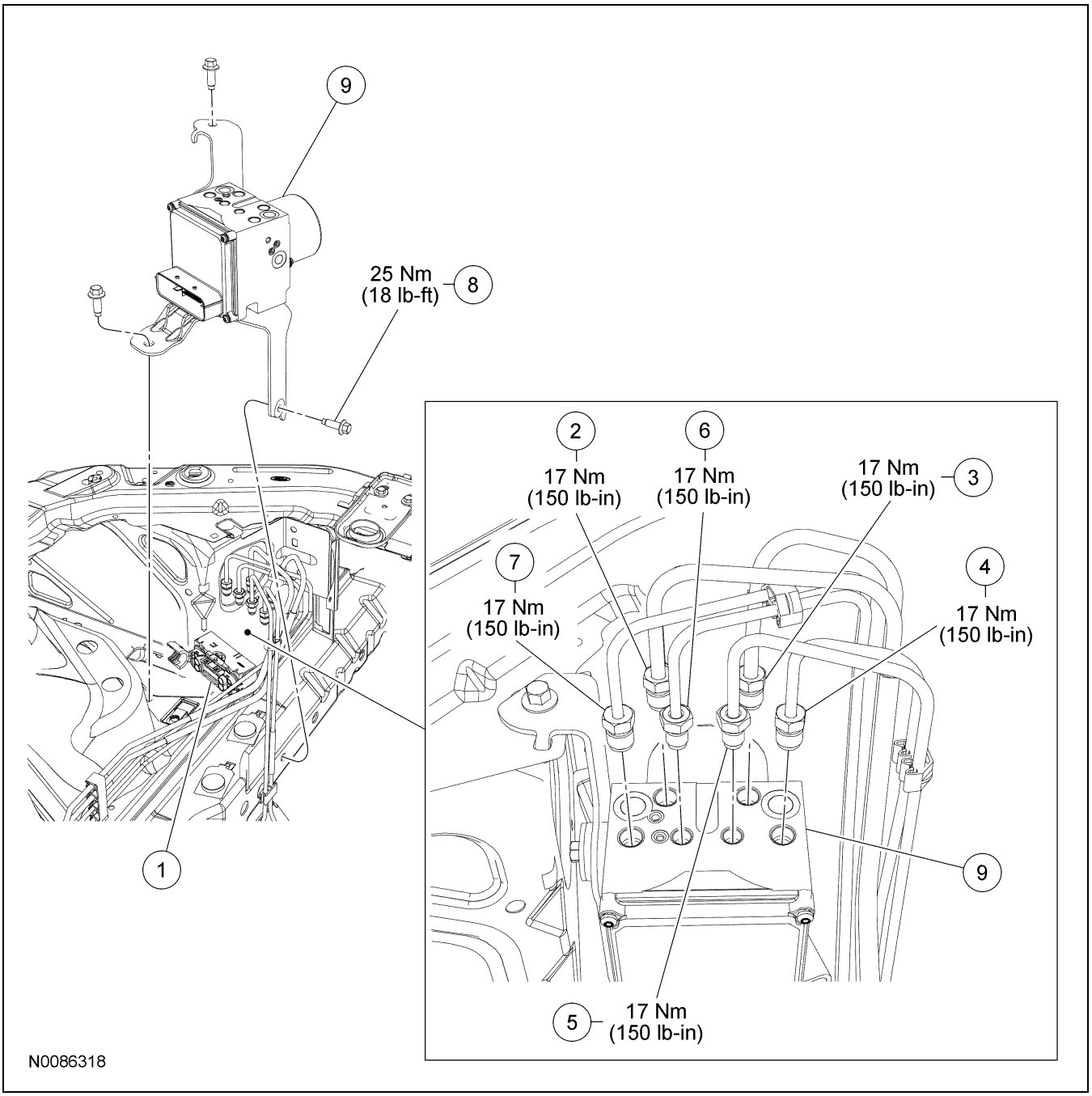

4. To install, reverse the removal procedure.

# REMOVAL AND INSTALLATION

## Hydraulic Control Unit (HCU)

**Material**

| Item | Specification |
|---|---|
| High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada) | WSS-M6C62-A or WSS-M6C65-A1 |



## REMOVAL AND INSTALLATION (Continued)

| Item | Part Number | Description |
|---|---|---|
| 1 | — | ABS module electrical connector (part of 14A005) |
| 2 | — | Master cylinder primary brake tube (part of 2269) |
| 3 | — | Master cylinder secondary brake tube (part of 2269) |
| 4 | — | RH front brake tube (part of 2C296B) |
| 5 | — | LH front brake tube (part of 2C296A) |
| 6 | — | RH rear brake tube fitting (part of 2C360) |
| 7 | — | LH rear brake tube fitting (part of 2C360) |
| 8 | W500223 | Hydraulic Control Unit (HCU) bracket-to-frame bolt (3 required) |
| 9 | 2C215 | HCU |

### Removal and Installation

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

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

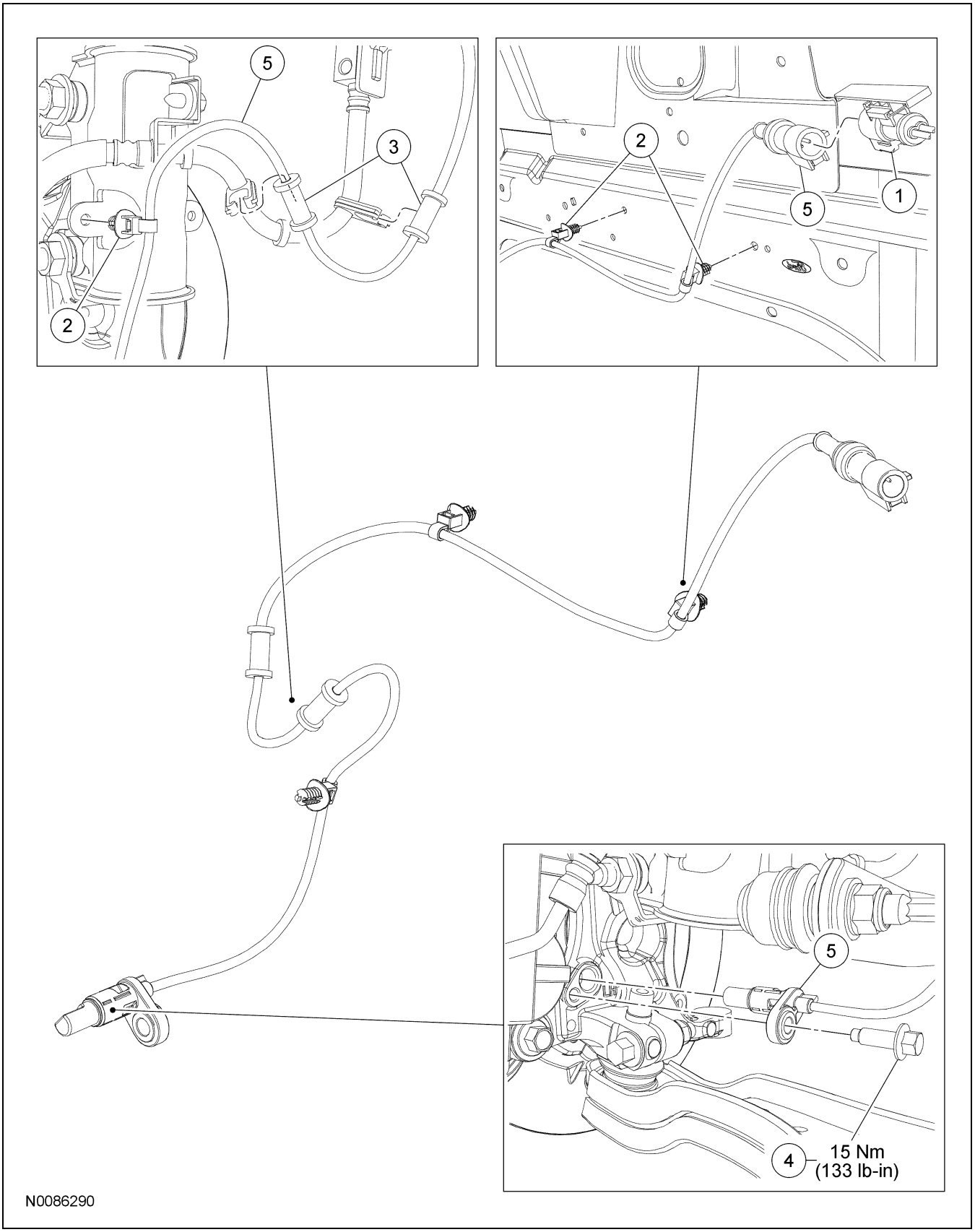
*NOTICE:* **Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.**

1. Remove the air cleaner assembly. For additional information, refer to Section 303-12.
2. Disconnect the ABS module electrical connector.
3. **NOTE:** Brake tubes must be installed in the same location as removed.

   Loosen the 6 brake tube-to-Hydraulic Control Unit (HCU) fittings, disconnect and position the brake tubes aside.
   - To install, tighten to 17 Nm (150 lb-in).
4. Remove the 3 HCU bracket-to-frame bolts.
   - To install, tighten to 25 Nm (18 lb-ft).
5. Remove the HCU assembly.
6. If necessary, remove the HCU bracket-to-HCU bolt and the bracket.
   - To install, tighten to 11 Nm (97 lb-in).
7. To install, reverse the removal procedure.
   - Bleed the brake system. For additional information, refer to Section 206-00.

# REMOVAL AND INSTALLATION

## Wheel Speed Sensor — Front



## REMOVAL AND INSTALLATION (Continued)

| Item | Part Number | Description |
|---|---|---|
| 1 | — | Wheel speed sensor electrical connector (part of 14407) |
| 2 | — | Wheel speed sensor harness pin-type retainers (part of 2C204) (3 required) |
| 3 | — | Wheel speed sensor grommet retainers (part of 2C204) (2 required) |
| 4 | W500223 | Wheel speed sensor bolt |
| 5 | 2C204 | Wheel speed sensor |

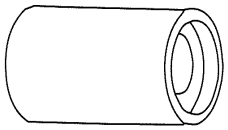
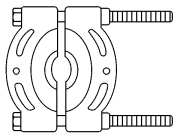
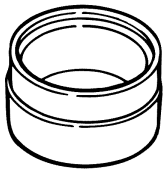
### Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02.
2. Disconnect the wheel speed sensor electrical connector.
3. Disconnect the 3 wheel speed sensor harness pin-type retainers.
4. Disconnect the 2 wheel speed sensor grommet retainers from the brake hose clips.
5. Remove the wheel speed sensor bolt.
   - To install, tighten to 15 Nm (133 lb-in).
6. Remove the wheel speed sensor and harness assembly.
7. To install, reverse the removal procedure.

# REMOVAL AND INSTALLATION

## Wheel Speed Sensor Ring — Front

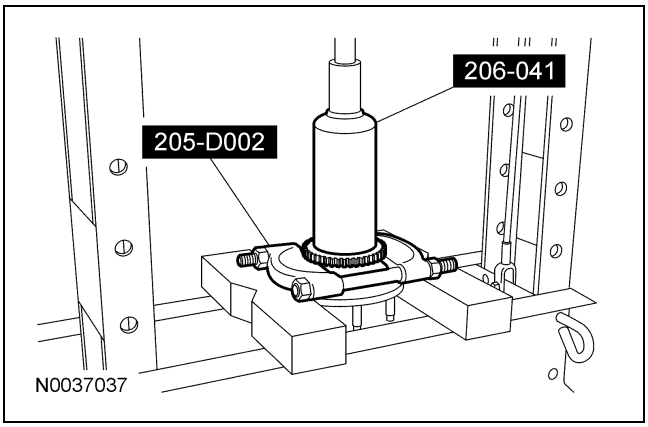
### Special Tool(s)

| | |
|---|---|
|  ST1713-A | Installer, Wheel Speed Sensor Ring 206-041 (T89P-20202-A) |
|  ST1895-A | Pinion Bearing Cone Remover 205-D002 (D79P-4621A) |
|  ST2039-A | Remover/Installer, Wheel Speed Sensor 206-033 (T88P-20202-A) |

### Removal

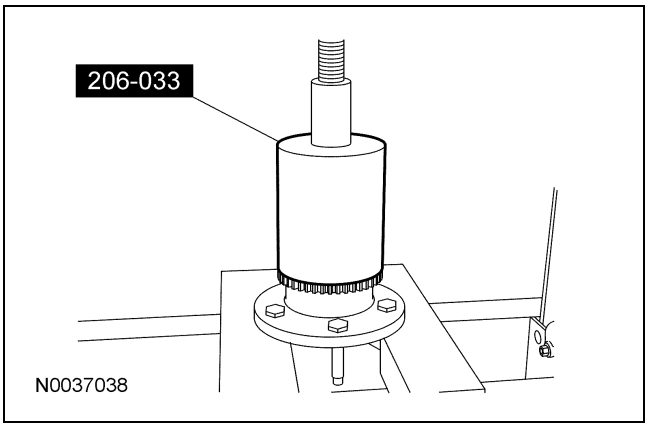
1. Remove the front hub and bearing assembly. For additional information, refer to Section 204-01.

2. Using the Pinion Bearing Cone Remover and the Wheel Speed Sensor Ring Installer, remove the front wheel speed sensor ring from the front hub.




### Installation

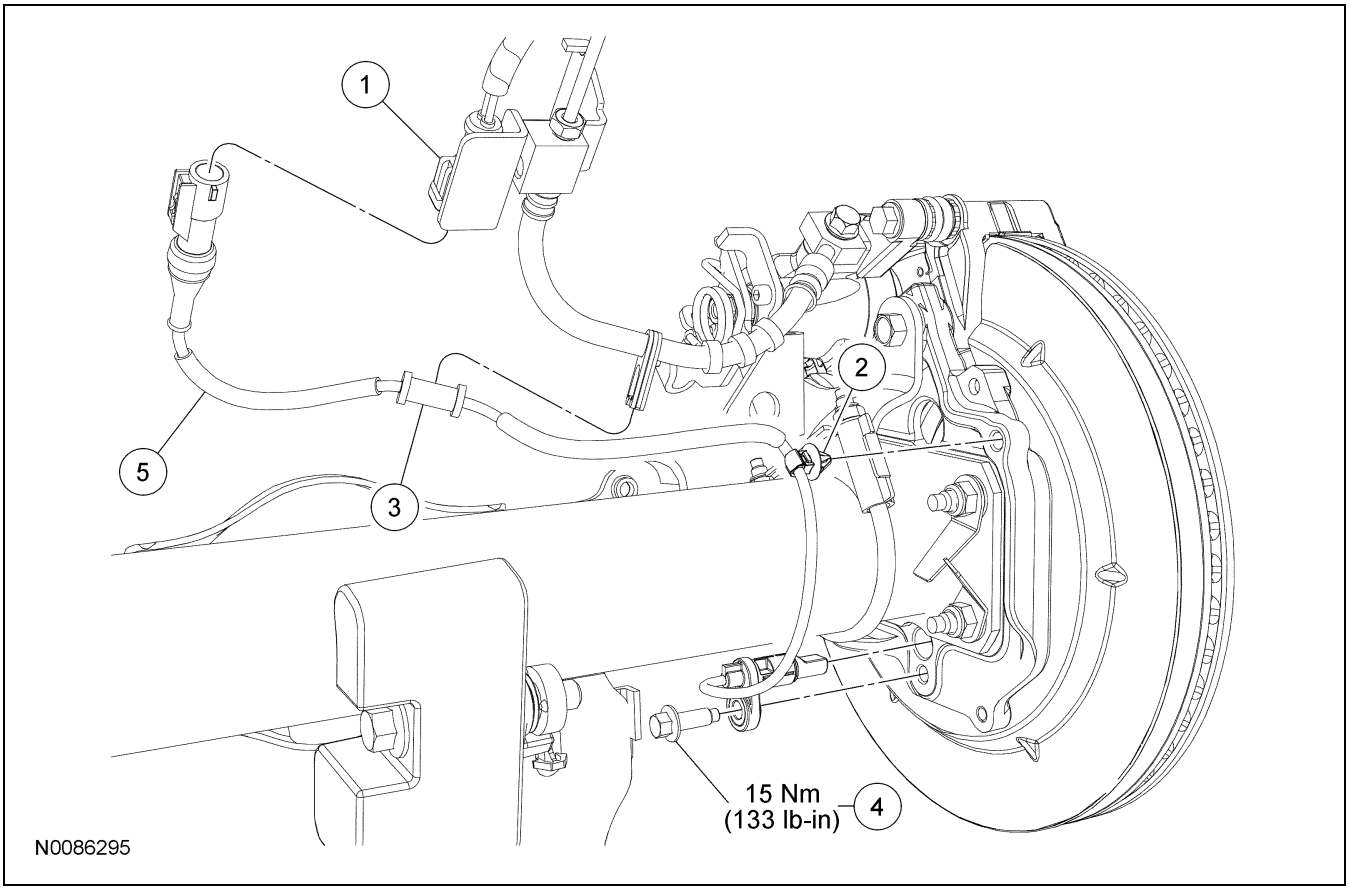
1. Using the Wheel Speed Sensor Remover/Installer, install the front wheel speed sensor ring to the front hub.




2. Install the front hub and bearing assembly. For additional information, refer to Section 204-01.

# REMOVAL AND INSTALLATION

## Wheel Speed Sensor — Rear




| Item | Part Number | Description |
|---|---|---|
| 1 | — | Wheel speed sensor electrical connector (part of 14407) |
| 2 | — | Wheel speed sensor harness pin-type retainer (part of 2C190) |
| 3 | — | Wheel speed sensor grommet retainer (part of 2C190) |
| 4 | W500223 | Wheel speed sensor bolt |
| 5 | 2C190 | Wheel speed sensor |

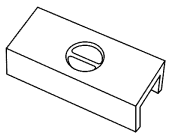
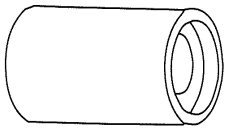
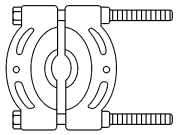
### Removal and Installation

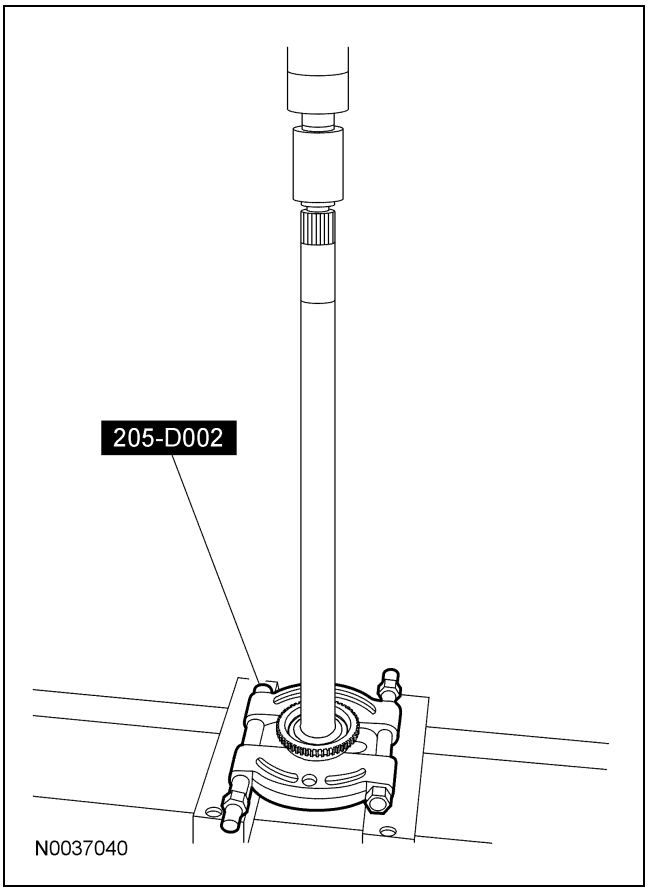
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to Section 100-02.
2. Disconnect the wheel speed sensor electrical connector.
3. Disconnect the 2 wheel speed sensor harness pin-type retainers.
4. Disconnect the wheel speed sensor grommet retainer from the brake hose clip.
5. Remove the wheel speed sensor bolt.
   - To install, tighten to 15 Nm (133 lb-in).
6. Remove the wheel speed sensor.
7. To install, reverse the removal procedure.

# REMOVAL AND INSTALLATION

## Wheel Speed Sensor Ring — Rear

**Special Tool(s)**

| | |
|---|---|
|  ST1254-A | Axle Bearing/Seal Plate 205-090 (T75L-1165-B) |
|  ST1713-A | Installer, Wheel Speed Sensor Ring 206-041 (T89P-20202-A) |
|  ST1895-A | Pinion Bearing Cone Remover 205-D002 (D79P-4621A) or equivalent |




### Removal

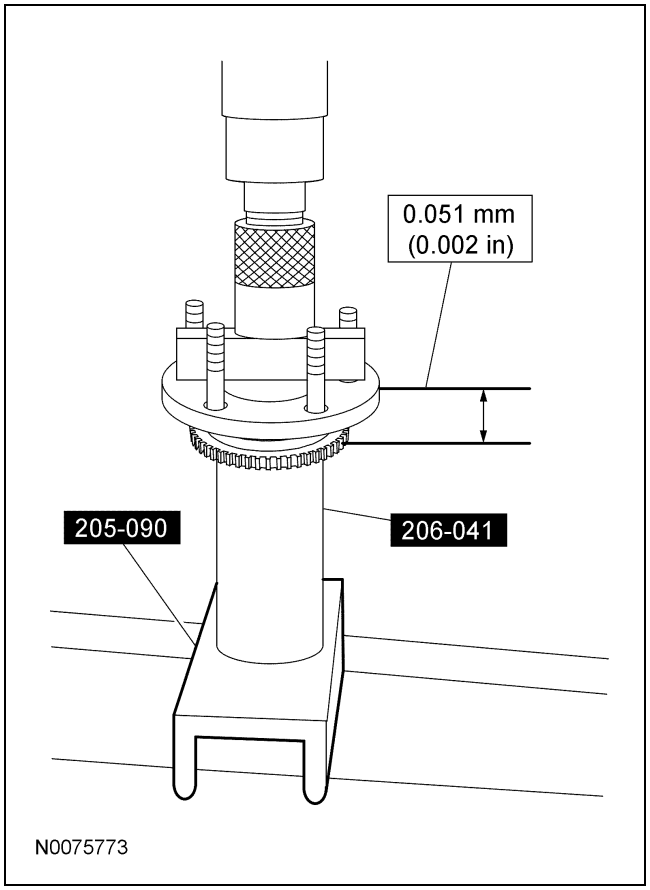
1. Remove the rear axle shaft. For additional information, refer to Section 205-02A or Section 205-02B.

2. Using the Pinion Bearing Cone Remover, remove the anti-lock brake sensor indicator from the axle shaft.

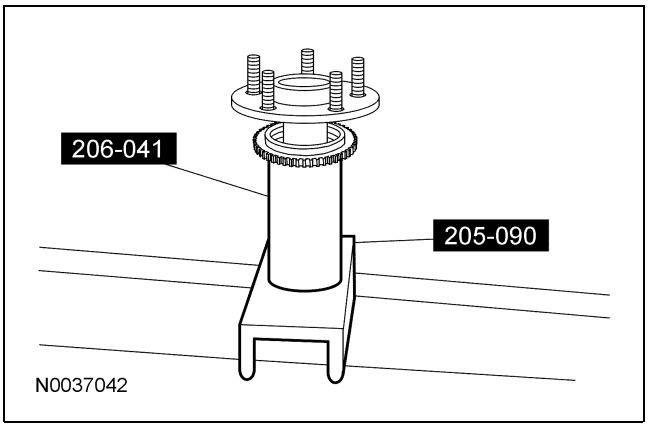
## REMOVAL AND INSTALLATION (Continued)

### Installation

1. Using the Axle Bearing/Seal Plate and the Wheel Speed Sensor Ring Installer, align the rear anti-lock brake sensor indicator to the rear axle shaft.



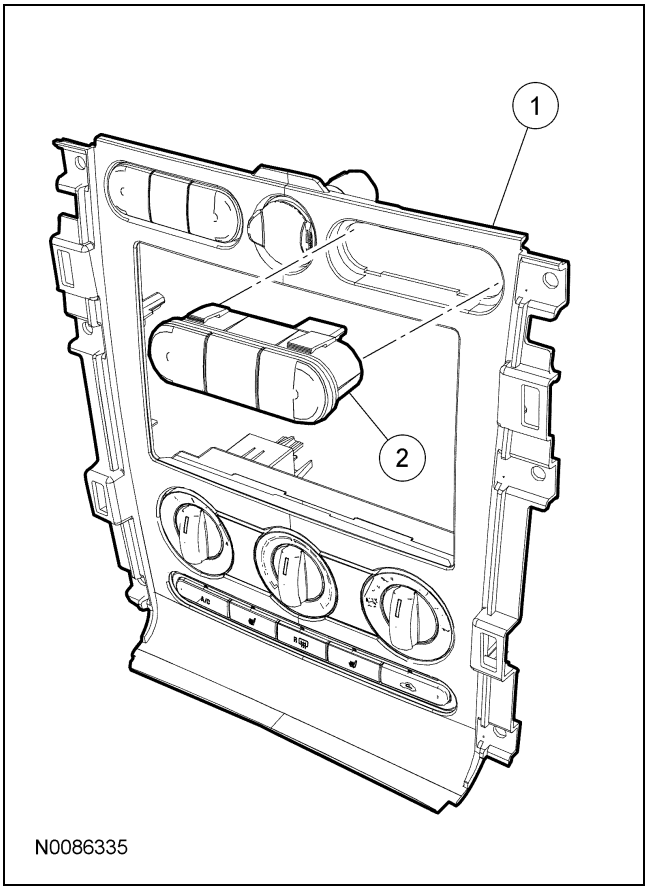

2. Using the Axle Bearing/Seal Plate and the Wheel Speed Sensor Ring Installer, press the rear anti-lock brake sensor on the rear axle shaft to specification.




3. Install the rear axle shaft. For additional information, refer to Section 205-02A.

# REMOVAL AND INSTALLATION

## Traction Control Switch



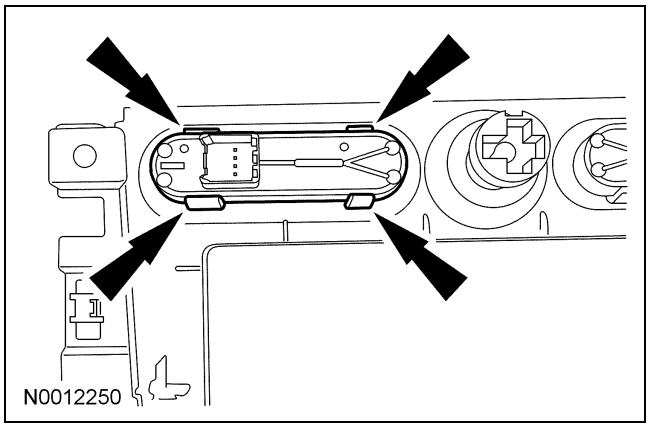

| Item | Part Number | Description |
|---|---|---|
| 1 | 6304302 | Instrument panel center finish panel |
| 2 | 13D730 | Traction control switch |

### Removal and Installation

1. Remove the instrument panel center finish panel. For additional information, refer to Section 501-12.

## REMOVAL AND INSTALLATION (Continued)

2. Press the retaining tabs and remove the switchblock.




3. To install, reverse the removal procedure.