

**2002 BRAKES****Disc - Corvette****DESCRIPTION & OPERATION****BRAKE WARNING SYSTEM****BRAKE**

The Instrument Panel Cluster (IPC) illuminates the BRAKE indicator when the following occurs:

- The IPC detects a low brake fluid condition (signal circuit is low).
- The IPC detects the park brake is engaged (signal circuit low).
- The IPC performs the displays test at the start of each ignition cycle.
- The indicator illuminates for approximately 3 seconds.
- There is a Dynamic Rear Proportioning (DRP) failure.

**LOW BRAKE FLUID**

The IPC illuminates the LOW BRAKE FLUID indicator in the message center when the IPC receives a hardwire input from the brake fluid level sensor (signal is low).

**DISC BRAKE SYSTEM DESCRIPTION**

The disc brake system consists of the following components:

**Disc Brake Pads**

Applies mechanical output force from the hydraulic brake calipers to friction surfaces of brake rotors.

**Disc Brake Pad Hardware**

Secures disc brake pads firmly in proper relationship to the hydraulic brake calipers. Enables a sliding motion of brake pads when mechanical output force is applied.

**Disc Brake Caliper Hardware**

Provides mounting for hydraulic brake caliper and secures the caliper firmly in proper relationship to caliper bracket. Enables a sliding motion of the brake caliper to the brake pads when mechanical output force is applied.

**Disc Brake Rotors**

Uses mechanical output force applied to friction surfaces from the disc brake pads to slow

speed of tire and wheel assembly rotation.

## **DISC BRAKE SYSTEM OPERATION**

Mechanical output force is applied from the hydraulic brake caliper pistons to the inner brake pads. As the pistons press the inner brake pads outward, the caliper housings draw the outer brake pads inward. This allows the output force to be equally distributed. The brake pads apply the output force to the friction surfaces on both sides of the brake rotors, which slows the rotation of the tire and wheel assemblies. The correct function of both the brake pad and brake caliper hardware is essential for even distribution of braking force.

## **HYDRAULIC BRAKE SYSTEM DESCRIPTION**

The hydraulic brake system consists of the following:

### **Hydraulic Brake Master Cylinder Fluid Reservoir**

Contains supply of brake fluid for the hydraulic brake system.

Regulates brake fluid pressure delivered to hydraulic brake wheel circuits, in order to control the distribution of braking force. Pressure balance control is achieved through Dynamic Rear Proportioning (DRP), which is a function of the ABS modulator. Refer to **DESCRIPTION AND OPERATION** for specific information on the operation of DRP. Hydraulic Brake Pipes and Flexible Brake Hoses Carries brake fluid to and from hydraulic brake system components. Hydraulic Brake Wheel Apply Components Converts hydraulic input pressure into mechanical output force.

### **Hydraulic Brake Master Cylinder**

- Converts mechanical input force into hydraulic output pressure.
- Hydraulic output pressure is distributed from the master cylinder through 2 hydraulic circuits, supplying diagonally-opposed wheel apply circuits.

### **Hydraulic Brake Pressure Balance Control System**

1. Regulates brake fluid pressure delivered to hydraulic brake wheel circuits, in order to control the distribution of braking force.
2. Pressure balance control is achieved through Dynamic Rear Proportioning (DRP), which is a function of the ABS modulator.

### **Hydraulic Brake Pipes and Flexible Brake Hoses**

Carries brake fluid to and from hydraulic brake system components.

### **Hydraulic Brake Wheel Apply Components**

Converts hydraulic input pressure into mechanical output force.

**HYDRAULIC BRAKE SYSTEM OPERATION**

Mechanical force is converted into hydraulic pressure by the master cylinder, regulated to meet braking system demands by the pressure balance control system, and delivered to the hydraulic brake wheel circuits by the pipes and flexible hoses. The wheel apply components then convert the hydraulic pressure back into mechanical force which presses linings against rotating brake system components.

**BRAKE ASSIST SYSTEM DESCRIPTION**

The brake assist system consists of the following:

**Brake Pedal**

Receives, multiplies and transfers brake system input force from driver.

**Brake Pedal Pushrod**

Transfers multiplied input force received from brake pedal to brake booster.

**Vacuum Brake Booster**

1. Uses source vacuum to decrease effort required by driver when applying brake system input force.
2. When brake system input force is applied, air at atmospheric pressure is admitted to the rear of both vacuum diaphragms, providing a decrease in brake pedal effort required. When input force is removed, vacuum replaces atmospheric pressure within the booster.

**Vacuum Source**

Supplies force used by vacuum brake booster to decrease brake pedal effort.

**Vacuum Source Delivery System**

Enables delivery and retention of source vacuum for vacuum brake booster.

**BRAKE ASSIST SYSTEM OPERATION**

Brake system input force is multiplied by the brake pedal and transferred by the pedal pushrod to the hydraulic brake master cylinder. Effort required to apply the brake system is reduced by the vacuum brake booster.

**PARK BRAKE SYSTEM DESCRIPTION**

The park brake system consists of the following:

**Park Brake Actuator/Adjuster**

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Uses multiplied input force from apply lever via the cables to expand park brake shoe toward the friction surface of the drum-in-hat portion of the rear brake rotor.

Threaded park brake actuators/adjusters are also used to control clearance between the park brake shoe and the friction surface of the drum-in-hat portion of the rear brake rotor.

#### **Park Brake Cable Equalizer**

Evenly distributes input force to both the left and right park brake units. An auto adjust spring is used to remove the slack in the park brake cables.

#### **Park Brake Cables**

Transfers input force received from park brake lever, through park brake cable equalizer, to park brake apply lever.

#### **Park Brake Lever Assembly**

Receives and transfers park brake system apply input force from driver to park brake cable system. Releases applied park brake system when the lever is returned to the at-rest position.

#### **Park Brake Shoe (Rear Disc, Drum-In-Hat System)**

Applies mechanical output force from park brake actuator/adjuster to friction surface of the drum-in-hat portion of the rear brake rotor.

### **PARK BRAKE SYSTEM OPERATION**

Park brake apply input force is received by the park brake lever assembly being raised, transferred and evenly distributed, through the park brake cables and the park brake cable equalizer, to the left and right park brake apply levers. The park brake apply levers multiply and transfer the apply input force to the park brake actuators/adjusters which expand the park brake shoe toward the friction surface of the drum-in-hat portion of the rear brake rotor in order to prevent the rotation of the rear tire and wheel assemblies. The park brake lever assembly releases an applied park brake system when the lever is returned to the at-rest position.

### **BLEEDING BRAKE SYSTEM**

**WARNING:** Avoid spilling brake fluid onto painted surfaces, electrical connections, wiring, or cables. Brake fluid will damage painted surfaces and cause corrosion to electrical components. If any brake fluid comes in contact with painted surfaces, immediately flush the area with water. If any brake fluid comes in contact with electrical connections, wiring, or cables, use a clean shop cloth to



wipe away the fluid.

**CAUTION:** When adding fluid to the brake master cylinder reservoir, use only Delco Supreme 11(R) (GM P/N 12377967 US; 992667 Canada), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container. The use of any type of fluid other than the recommended type of brake fluid, may cause contamination which could result in damage to the internal rubber seals and/or rubber linings of hydraulic brake system components.

## BRAKE BLEEDING SEQUENCE

### BRAKE BLEEDING SEQUENCE

Application	Sequence
Corvette	RR, LF, LR, RF

## MANUAL BLEEDING

**NOTE:** Ensure master cylinder reservoir is at least half full during entire bleeding procedure.

1. Place a clean shop cloth beneath the brake master cylinder to prevent brake fluid spills.
2. With the ignition OFF and the brakes cool, apply the brakes 3-5 times, or until the brake pedal effort increases significantly, in order to deplete the brake booster power reserve.
3. If you have performed a brake master cylinder bench bleeding on this vehicle, or if you disconnected the brake pipes from the master cylinder, you must perform the following steps:
  - A. Ensure that the brake master cylinder reservoir is full to the maximum-fill level. If necessary, add Delco Supreme 11(R) (GM P/N 12377967 US; 992667 Canada), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container. If removal of the reservoir cap and diaphragm is necessary, clean the outside of the reservoir on and around the cap prior to removal.
  - B. With the rear brake pipe installed securely to the master cylinder, loosen and separate the front brake pipe from the front port of the brake master cylinder.
  - C. Allow a small amount of brake fluid to gravity bleed from the open port of the master cylinder.
  - D. Reconnect the brake pipe to the master cylinder port and tighten securely.
  - E. Have an assistant slowly depress the brake pedal fully and maintain steady pressure on the pedal.
  - F. Loosen the same brake pipe to purge air from the open port of the master cylinder.

- G. Tighten the brake pipe, then have the assistant slowly release the brake pedal.
  - H. Wait 15 seconds, then repeat steps D -G until all air is purged from the same port of the master cylinder.
  - I. With the front brake pipe installed securely to the master cylinder, after all air has been purged from the front port of the master cylinder, loosen and separate the rear brake pipe from the master cylinder, then repeat steps B -G .
  - J. After completing the final master cylinder port bleeding procedure, ensure that both of the brake pipe-to-master cylinder fittings are tightened to specification. See **TORQUE SPECIFICATIONS** .
4. Fill the brake master cylinder reservoir with Delco Supreme 11(R) (GM P/N 12377967 US; 992667 Canada), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container. Ensure that the brake master cylinder reservoir remains at least half-full during this bleeding procedure. Add fluid as needed to maintain the proper level. Clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm.
  5. Install a proper box-end wrench onto the right rear wheel hydraulic circuit bleeder valve.
  6. Install a transparent hose over the end of the bleeder valve.
  7. Submerge the open end of the transparent hose into a transparent container partially filled with Delco Supreme 11(R) (GM P/N 12377967 US; 992667 Canada), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container.
  8. Have an assistant slowly depress the brake pedal fully and maintain steady pressure on the pedal.
  9. Loosen the bleeder valve to purge air from the wheel hydraulic circuit.
  10. Tighten the bleeder valve, then have the assistant slowly release the brake pedal.
  11. Wait 15 seconds, then repeat steps 8 -10 until all air is purged from the same wheel hydraulic circuit.
  12. With the right rear wheel hydraulic circuit bleeder valve tightened securely, after all air has been purged from the right rear hydraulic circuit, install a proper box-end wrench onto the left front wheel hydraulic circuit bleeder valve.
  13. Install a transparent hose over the end of the bleeder valve, then repeat steps 7 -11 .
  14. With the left front wheel hydraulic circuit bleeder valve tightened securely, after all air has been purged from the left front hydraulic circuit, install a proper box-end wrench onto the left rear wheel hydraulic circuit bleeder valve.
  15. Install a transparent hose over the end of the bleeder valve, then repeat steps 7 -11 .
  16. With the left rear wheel hydraulic circuit bleeder valve tightened securely, after all air has been purged from the left rear hydraulic circuit, install a proper box-end wrench onto the right front wheel hydraulic circuit bleeder valve.
  17. Install a transparent hose over the end of the bleeder valve, then repeat steps 7 -11 .

18. After completing the final wheel hydraulic circuit bleeding procedure, ensure that each of the 4 wheel hydraulic circuit bleeder valves are properly tightened.
19. Fill the brake master cylinder reservoir to the maximum-fill level with Delco Supreme 11(R) (GM P/N 12377967 US; 992667 Canada), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container.
20. Slowly depress and release the brake pedal. Observe the feel of the brake pedal.

**NOTE:** If it is determined that air was induced into the system upstream of the ABS modulator prior to servicing, the ABS Automated Bleed Procedure must be performed using a scan tool. See appropriate ANTI-LOCK article.

21. If the brake pedal feels spongy, repeat the bleeding procedure again. If the brake pedal still feels spongy after repeating the bleeding procedure, perform the following steps:
  - Inspect the brake system for external leaks. See **BRAKE SYSTEM EXTERNAL LEAK INSPECTION**.
  - Pressure bleed the hydraulic brake system in order to purge any air that may still be trapped in the system. See **PRESSURE BLEEDING**.
22. Turn the ignition key ON, with the engine OFF. Check to see if the brake system warning lamp remains illuminated.

**CAUTION: DO NOT allow the vehicle to be driven until it is diagnosed and repaired.**

23. If the BRAKE system warning indicator remains illuminated, see **BRAKE WARNING INDICATOR ALWAYS ON**.

#### **PRESSURE BLEEDING**

1. Place a clean shop cloth beneath the brake master cylinder to prevent brake fluid spills.
2. With the ignition OFF and the brakes cool, apply the brakes 3-5 times, or until the brake pedal effort increases significantly, in order to deplete the brake booster power reserve.
3. If you have performed a brake master cylinder bench bleeding on this vehicle, or if you disconnected the brake pipes from the master cylinder, you must perform the following steps:
  - A. Ensure that the brake master cylinder reservoir is full to the maximum-fill level. If necessary, add Delco Supreme 11(R) (GM P/N 12377967 US; 992667 Canada), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container. If removal of the reservoir cap and diaphragm is necessary, clean the outside of the reservoir on and around the cap prior to removal.
  - B. With the rear brake pipe installed securely to the master cylinder, loosen and

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separate the front brake pipe from the front port of the brake master cylinder.

- C. Allow a small amount of brake fluid to gravity bleed from the open port of the master cylinder.
- D. Reconnect the brake pipe to the master cylinder port and tighten securely.
- E. Have an assistant slowly depress the brake pedal fully and maintain steady pressure on the pedal.
- F. Loosen the same brake pipe to purge air from the open port of the master cylinder.
- G. Tighten the brake pipe, then have the assistant slowly release the brake pedal.
- H. Wait 15 seconds, then repeat steps D -G until all air is purged from the same port of the master cylinder.
- I. With the front brake pipe installed securely to the master cylinder, after all air has been purged from the front port of the master cylinder, loosen and separate the rear brake pipe from the master cylinder, then repeat steps B -G .
- J. After completing the final master cylinder port bleeding procedure, ensure that both of the brake pipe-to-master cylinder fittings are tightened to specification. See **TORQUE SPECIFICATIONS** .

- 4. Fill the brake master cylinder reservoir with Delco Supreme 11(R) (GM P/N 12377967 US; 992667 Canada), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container. Ensure that the brake master cylinder reservoir remains at least half-full during this bleeding procedure. Add fluid as needed to maintain the proper level. Clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm.
- 5. Install the Master Cylinder Bleeder Adapter (J-35589-A) to the brake master cylinder reservoir.
- 6. Check the brake fluid level in the Diaphragm Type Brake Pressure Bleeder (J-29532), or equivalent. Add Delco Supreme 11(R) (GM P/N 12377967 US; 992667 Canada), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container as necessary to bring the level to approximately the half-full point.
- 7. Connect the Diaphragm Type Brake Pressure Bleeder, or equivalent, to the Master Cylinder Bleeder Adapter.
- 8. Charge the Diaphragm Type Brake Pressure Bleeder, or equivalent, air tank to 25-30 psi (175-205 kPa).
- 9. Open the Diaphragm Type Brake Pressure Bleeder, or equivalent, fluid tank valve to allow pressurized brake fluid to enter the brake system.
- 10. Wait approximately 30 seconds, then inspect the entire hydraulic brake system in order to ensure that there are no existing external brake fluid leaks. Any brake fluid leaks identified require repair prior to completing this procedure.
- 11. Install a proper box-end wrench onto the right rear wheel hydraulic circuit bleeder valve.
- 12. Install a transparent hose over the end of the bleeder valve.

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13. Submerge the open end of the transparent hose into a transparent container partially filled with Delco Supreme 11(R) (GM P/N 12377967 US; 992667 Canada), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container.
14. Loosen the bleeder valve to purge air from the wheel hydraulic circuit. Allow fluid to flow until air bubbles stop flowing from the bleeder, then tighten the bleeder valve.
15. With the right rear wheel hydraulic circuit bleeder valve tightened securely, after all air has been purged from the right rear hydraulic circuit, install a proper box-end wrench onto the left front wheel hydraulic circuit bleeder valve.
16. Install a transparent hose over the end of the bleeder valve, then repeat steps 13 -14 .
17. With the left front wheel hydraulic circuit bleeder valve tightened securely, after all air has been purged from the left front hydraulic circuit, install a proper box-end wrench onto the left rear wheel hydraulic circuit bleeder valve.
18. Install a transparent hose over the end of the bleeder valve, then repeat steps 13 -14 .
19. With the left rear wheel hydraulic circuit bleeder valve tightened securely, after all air has been purged from the left rear hydraulic circuit, install a proper box-end wrench onto the right front wheel hydraulic circuit bleeder valve.
20. Install a transparent hose over the end of the bleeder valve, then repeat steps 13 -14 .
21. After completing the final wheel hydraulic circuit bleeding procedure, ensure that each of the 4 wheel hydraulic circuit bleeder valves are properly tightened.
22. Close the Diaphragm Type Brake Pressure Bleeder, or equivalent, fluid tank valve, then disconnect the Diaphragm Type Brake Pressure Bleeder, or equivalent, from the Master Cylinder Bleeder Adapter.
23. Remove the Master Cylinder Bleeder Adapter from the brake master cylinder reservoir.
24. Fill the brake master cylinder reservoir to the maximum-fill level with Delco Supreme 11(R), (GM P/N 12377967 US; 992667 Canada), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container.
25. Slowly depress and release the brake pedal. Observe the feel of the brake pedal.
26. If the brake pedal feels spongy, perform the following steps:
  - A. Inspect the brake system for external leaks. See **BRAKE SYSTEM EXTERNAL LEAK INSPECTION** .
  - B. Using a scan tool, perform the anti-lock brake system automated bleeding procedure to remove any air that may have been trapped in the Brake Pressure Modulator Valve (BPMV). See **ANTILOCK BRAKE SYSTEM** .
27. Turn the ignition key ON, with the engine OFF. Check to see if the brake system warning lamp remains illuminated.

**CAUTION: DO NOT allow the vehicle to be driven until it is diagnosed and repaired.**

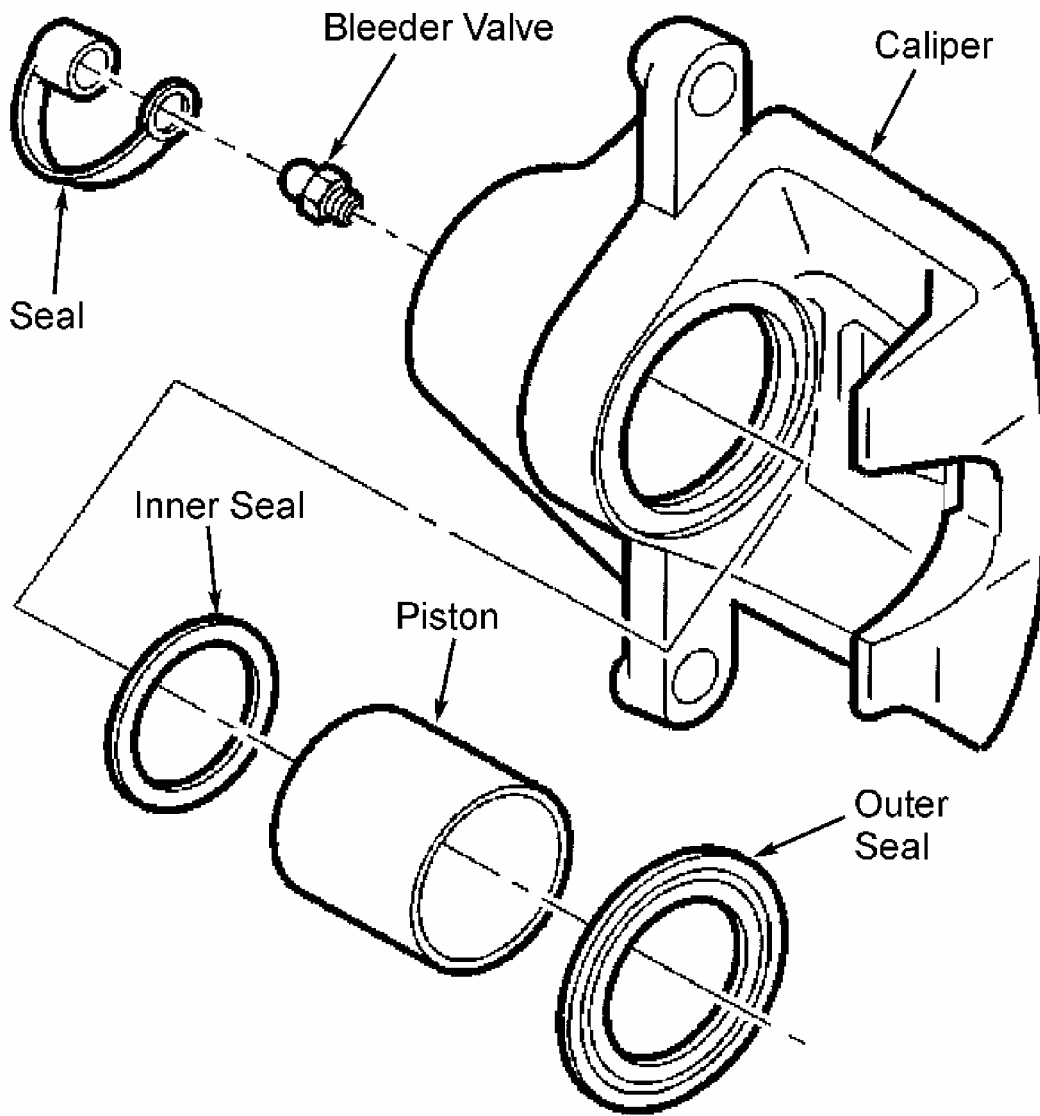
28. If the BRAKE system warning indicator remains illuminated, see **BRAKE**

**WARNING INDICATOR ALWAYS ON .**

**ADJUSTMENTS & INSPECTIONS**

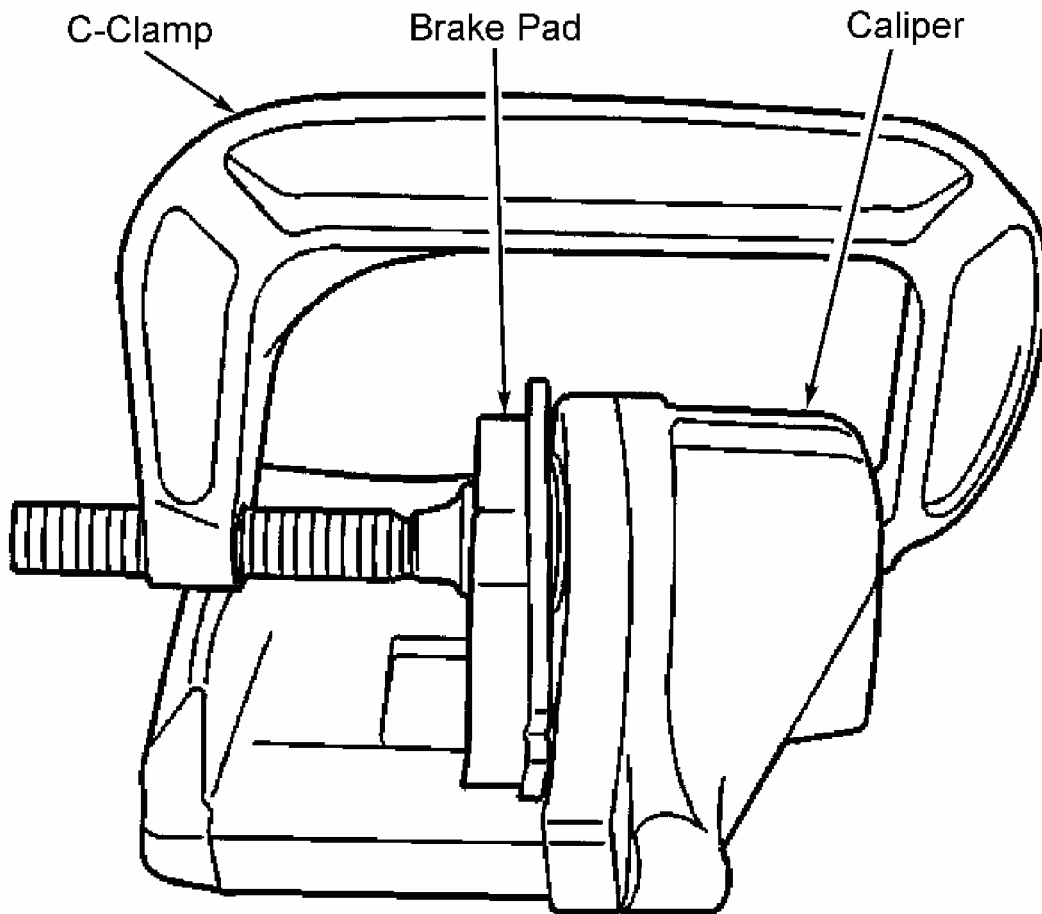
**BRAKE CALIPER INSPECTION**

1. Inspect the brake caliper housing for cracks, excess wear, and/or damage. If any of these conditions are present, the brake caliper requires replacement.
2. Inspect the caliper piston dust boot seal for cracks, tears, cuts, deterioration and/or improper seating in the caliper body. If any of these conditions are present, the brake caliper requires overhaul or replacement. See [Fig. 1](#) .
3. Inspect for brake fluid leakage around the caliper piston dust boot seal and on the disc brake pads. If there is any evidence of brake fluid leakage, the brake caliper requires overhaul or replacement.
4. Inspect for smooth and complete travel of the caliper piston, or pistons, into the caliper bore, or bores: The movement of a caliper piston into a caliper bore should be smooth and even. If a caliper piston is frozen or difficult to bottom, the caliper requires overhaul or replacement:
  - For single piston caliper applications, insert a discarded inner brake pad or block of wood in front of the piston. Using a large C-clamp installed over the body of the caliper and against the brake pad or block of wood, slowly bottom the piston in the bore. See [Fig. 2](#) .
  - For dual piston caliper applications, insert a discarded inner brake pad or block of wood in front of the pistons. Using 2 large C-clamps installed over the body of the caliper and against the brake pad or block of wood, slowly bottom the pistons evenly into the bores.



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**Fig. 1: Identifying Caliper Components**  
**Courtesy of GENERAL MOTORS CORP.**



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**Fig. 2: Collapsing Caliper Piston**  
Courtesy of GENERAL MOTORS CORP.

### **BRAKE PAD INSPECTION**

Inspect the disc brake pads at regular intervals, or whenever the tire and wheel assemblies are removed from the vehicle:

- If replacement is necessary, always replace disc brake pads in axle sets. Inspect both edges of the disc brake pad friction surfaces.
- The highest rate of wear normally occurs at the trailing edge of the disc brake pads.
- Inspect the thickness of the disc brake pads in order to ensure that they have not worn prematurely.
- The disc brake pad wear should be approximately even per axle set.
- Both front and rear disc brake pads have integral, audible wear sensors.
- When the disc brake pad wear reaches the minimum allowable thickness, the wear



sensor contacts the disc brake rotor.

- The wear indicator will then produce an audible, high-pitched warning noise during wheel rotation.
- Replace the disc brake pads when the friction surface is worn to within 0.030 in (0.76 mm) of the mounting plates.
- Remove the brake calipers and inspect the friction surfaces of the inner and outer disc brake pads to ensure that they are level. Place the disc brake pad friction surfaces together and measure the gap between the surfaces. If more than 0.005 in (0.13 mm) gap exists midway between the length of the disc brake pads, replace the disc brake pads.
- Verify that any disc brake pad shims that may be required are in place and not damaged or excessively corroded. Replace any missing or damaged shims in order to preserve proper disc brake performance.
- Replace the disc brake pads if any have separated from the mounting plates.
- Inspect the disc brake pads friction surfaces for cracks, fractures, or damage which may cause noise or otherwise impair disc brake performance.

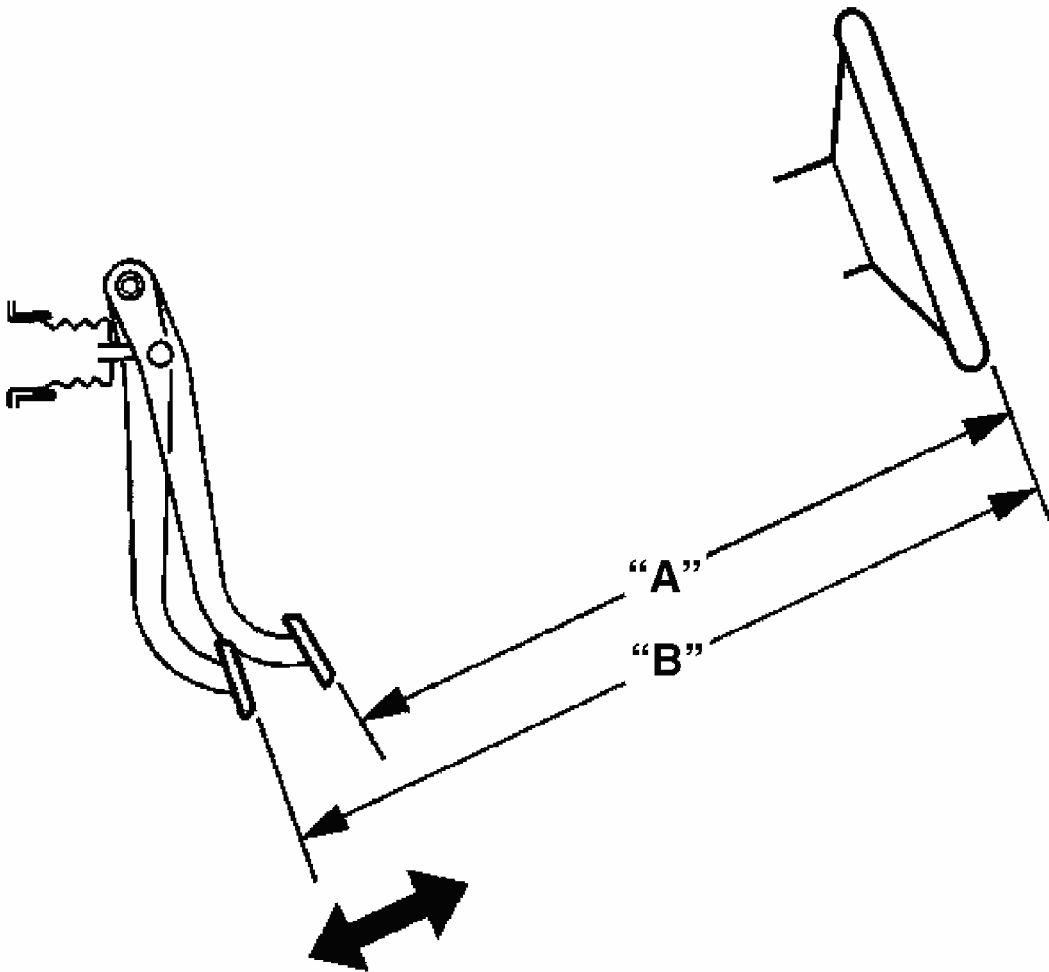
### **BRAKE PEDAL PUSHROD INSPECTION**

Disconnect the brake pedal pushrod from the brake pedal. Inspect the brake pedal pushrod eyelet bushing for cracks and/or excessive wear. Reposition the pedal pushrod boot toward the front of the vehicle to expose as much of the pedal pushrod as possible. Inspect the brake pedal pushrod for straightness. If the brake pedal pushrod eyelet bushing exhibited cracks and/or excessive wear, then the bushing requires replacement. If the brake pedal pushrod is not straight, then the pushrod requires replacement. Return the pedal pushrod boot to its original position on the pedal pushrod. Connect the brake pedal pushrod to the brake pedal.

### **BRAKE PEDAL TRAVEL MEASUREMENT & INSPECTION**

1. With the ignition OFF and the brakes cool, apply the brakes 3-5 times, or until the brake pedal effort increases significantly, in order to deplete the brake booster power reserve.
2. Install the Brake Pedal Effort Gauge (J-28662) to the brake pedal.
3. Measure and record the distance from the brake pedal to the rim of the steering wheel (measurement "A"). See **Fig. 3** .
4. Apply and maintain the brakes with 70 lbs. (310 N) of force to the brake pedal, as indicated on the Brake Pedal Effort Gauge.
5. While maintaining 70 lbs. (310 N) of force to the brake pedal, measure and record the distance from the same point on the brake pedal to the same point on the rim of the steering wheel (measurement "B"). See **Fig. 3** .
6. Release the brakes and repeat steps 4 and 5 to obtain a second measurement. After obtaining a second measurement, go to next step.

7. Average the first and second measurements recorded during the 2 applies of the brakes.
8. Subtract the initial measurement, unapplied (measurement "A"), from the averaged, applied measurement (measurement "B") to obtain the brake pedal travel distance.
9. Measure brake pedal travel with the ignition OFF, brake booster power assist depleted, and the brakes cool. Maximum brake pedal travel should be 2.75" (70 mm). Adjust brake pedal travel as necessary.



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**Fig. 3: Measuring Brake Pedal Travel**  
Courtesy of GENERAL MOTORS CORP.

#### **BRAKE PIPE AND HOSE INSPECTION**

1. Visually inspect all of the brake pipes for kinks, improper routing, missing or damaged retainers, leaking fittings, and excessive corrosion.
2. If any of the brake pipes exhibited any of the conditions listed, then the identified pipe,

or pipes, require replacement. Ensure that the vehicle axles are properly supported at ride height in order to maintain the proper relationship of the flexible brake hoses to the chassis.

3. Visually inspect all of the flexible brake hoses for kinks, improper routing, twists, chafing, missing or damaged retainers, leaking connections, cracking, dry-rot, blisters, and bulges.
4. If any of the flexible brake hoses exhibited any of the conditions listed, then the identified flexible brake hose, or hoses require replacement. Squeeze the flexible brake hoses with firm finger pressure to check for soft spots, indicating an internal restriction. Check the entire length of each flexible brake hose. If any of the flexible brake hoses were found to have soft spots, then the identified flexible brake hose, or hoses require replacement.

### **BRAKE SYSTEM EXTERNAL LEAK INSPECTION**

1. In order to inspect for external brake fluid leaks, first check the fluid level in the master cylinder. While a slight brake fluid level drop can be considered a normal condition due to brake lining wear, a very low level may indicate a brake fluid leak in the hydraulic system.
2. If the fluid level is abnormally low, adjust the brake fluid level.
3. Start the engine and allow it to idle.
4. Apply constant, moderate foot pressure to the brake pedal. If the brake pedal gradually falls away while under foot pressure, there may be a brake fluid leak.
5. Turn OFF the ignition.
6. Visually inspect the following brake system components for brake fluid leaks, excessive corrosion, and damage. Give particular attention to all brake pipe and flexible hose connections to ensure that there are not any slight brake fluid leaks, even though the brake pedal may feel firm and hold steady:
  - Master cylinder brake pipe fittings.
  - All brake pipe connections.
  - Brake pipes.
  - Brake hoses and connections.
  - Brake calipers and/or wheel cylinders, if equipped.
7. While slight dampness around the master cylinder reservoir can be considered acceptable, brake fluid leaking from any of the brake system components requires immediate attention. If any of these components exhibit signs of brake fluid leakage, repair or replace those components. After the repair or replacement, reinspect the hydraulic brake system to assure proper function.

### **DISC BRAKE MOUNTING & HARDWARE INSPECTION**

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1. Inspect the disc brake pad mounting hardware for the following:
  - A. Missing mounting hardware.
  - B. Excessive corrosion.
  - C. Bent mounting tabs.
  - D. Looseness at the caliper mounting bracket.
  - E. Looseness at the disc brake pads.
2. If any of the conditions listed are found, the disc brake pad mounting hardware requires replacement.
3. Ensure the disc brake pads are held firmly in place on the caliper mounting bracket, yet slide easily on the mounting hardware without binding.
4. Inspect the caliper slide pins by gently pulling outward, without disengaging the slides from the boots, then pushing inward, and observe for the following:
  - A. Binding.
  - B. Seizing.
  - C. Looseness.
  - D. Bent or damaged slide pins.
  - E. Cracked or torn slide pin boots.
  - F. Missing slide pin boots.
  - G. Bent or damaged caliper mounting bracket.
5. If any of the conditions listed are found, the caliper mounting hardware requires replacement.

#### Rear

1. Remove the disc brake caliper from the caliper mounting bracket.
2. Remove the disc brake pads from the caliper mounting bracket.
3. Inspect the disc brake pad mounting hardware for the following:
  - Missing mounting hardware.
  - Excessive corrosion.
  - Bent mounting tabs.
  - Looseness at the caliper mounting bracket.
  - Looseness at the disc brake pads.
4. If any of the conditions listed are found, the disc brake pad mounting hardware requires replacement.
5. Ensure the disc brake pads are held firmly in place on the caliper mounting bracket, yet slide easily on the mounting hardware without binding.
6. Inspect the caliper slide pins by gently pulling outward (without disengaging the slides from the boots), then pushing inward, and observe for the following:

- Binding.
  - Seizing.
  - Looseness.
  - Bent or damaged slide pins.
  - Cracked or torn slide pin boots.
  - Missing slide pin boots.
  - Bent or damaged caliper mounting bracket.
7. If any of the conditions listed are found, the caliper mounting hardware requires replacement.
  8. Install the disc brake pads to the caliper mounting bracket.
  9. Install the disc brake caliper to the mounting bracket.

**BRAKE ROTOR THICKNESS MEASUREMENT**

1. Clean the brake pad lining contact surface of the brake rotor with denatured alcohol or an equivalent brake cleaner.
2. Using a micrometer calibrated in ten-thousands of an inch, measure and record the lowest thickness of the brake rotor at four or more points, equally spaced around the rotor. Ensure that the measurements are only taken within the brake pad lining contact area and that the micrometer is positioned the same distance (approximately 0.5") from the outside edge of the rotor for each measurement.
3. Compare the lowest thickness measurement recorded to the vehicle specifications. See **DISC BRAKE SPECIFICATIONS** .
4. If the lowest thickness measurement of the brake rotor is above the minimum allowable thickness after refinishing specification, the rotor may be able to be refinished, depending upon surface and wear conditions which may be present.
5. If the lowest thickness measurement of the brake rotor is at or below the minimum allowable thickness after refinishing specification, the rotor may not be refinished.
6. If the lowest thickness measurement of the brake rotor is at or below the discard thickness specification, the rotor requires replacement.

**BRAKE ROTOR SURFACE AND WEAR INSPECTION**

1. With the tire and wheel assemblies removed and the brake rotors retained by wheel lug nuts, clean the braking (friction) surfaces of the brake rotor with denatured alcohol or an equivalent approved brake cleaner.
2. Inspect the braking surfaces of the brake rotor for the following braking surface conditions:
  - Heavy rust and/or pitting. Light surface rust can be removed with an abrasive disc; heavy surface rust and/or pitting must be removed by refinishing the rotor.

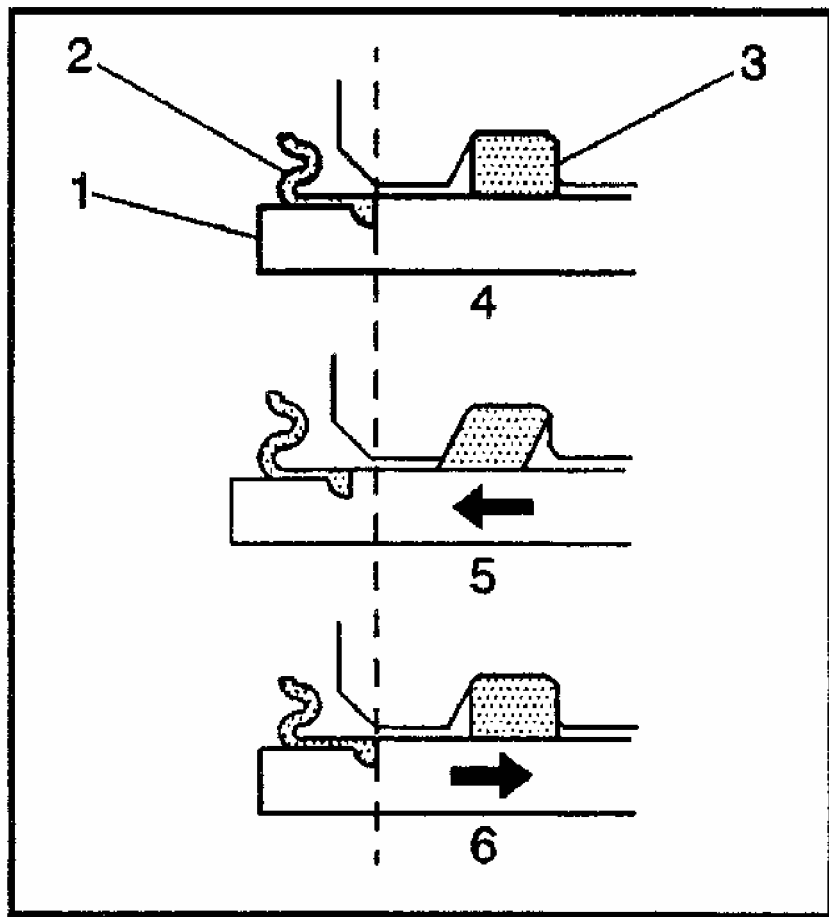
- Cracks and/or heat spots.
  - Excessive blueing discoloration.
3. If the braking surfaces of the brake rotor exhibits one or more of the Braking Surface Conditions, the rotor requires refinishing or replacement.
  4. Using a micrometer calibrated in ten-thousands of an inch, measure and record the thickness variation of the brake rotor at four or more points, around the rotor. Ensure that the measurements are only taken within the brake pad lining contact area and that the micrometer is positioned the same distance from the outside edge of the rotor for each measurement.
  5. Compare the maximum thickness variation (parallelism) measurement recorded to the vehicle specifications. See **DISC BRAKE SPECIFICATIONS** .
  6. If the brake rotor thickness variation exceeds the specification, the rotor requires refinishing or replacement.
  7. Using the micrometer, measure and record any grooves present on the rotor braking surface.
  8. Compare the groove (scoring) depth measurement recorded to the vehicle specifications. See **DISC BRAKE SPECIFICATIONS** .
  9. If the brake rotor scoring depth exceeds the specification, or if an excessive amount of scoring is present, the rotor requires refinishing or replacement.
  10. Mount a Dial Indicator (J-8001) or equivalent, and position the indicator button so it contacts the brake rotor at a 90 degree angle, approximately 0.5" (13 mm) from the rotor's outer edge.
  11. Measure and record the lateral runout of the brake rotor.
    - A. Rotate the rotor until the lowest reading is displayed on the indicator dial, then zero the dial.
    - B. Rotate the rotor until the highest reading is displayed on the dial.
    - C. Measure and record the amount of sealed wheel bearing play, then subtract the bearing play from the lateral runout recorded to obtain the true amount of lateral runout.
  12. Compare the brake rotor lateral runout measurement recorded to the vehicle specifications. See **DISC BRAKE SPECIFICATIONS** .
  13. If the brake rotor lateral runout exceeds the specification, the rotor requires refinishing or replacement.

#### **HYDRAULIC BRAKE COMPONENT OPERATION VISUAL INSPECTION**

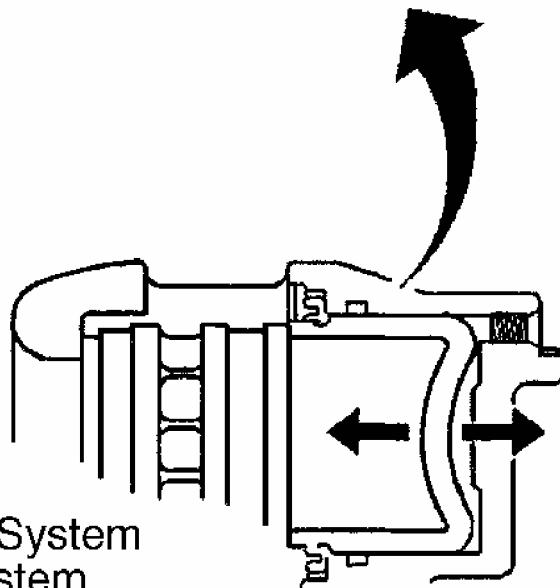
1. With the tire and wheel assemblies removed and the brake rotors retained by wheel lug nuts, visually inspect the caliper piston dust boot sealing area to ensure that there are no brake fluid leaks.
2. If any evidence of a brake fluid leak is present, the brake caliper requires overhaul or

replacement.

3. While the brake system is at rest, observe the position of the caliper piston in relation to the caliper housing. See **Fig. 4** .
4. Have an assistant apply and release the brake pedal several times while you observe the operation of the hydraulic brake caliper. Observe the caliper piston for unrestricted and even movement during each apply of the brake system. Observe the caliper piston for an unrestricted and even return motion during each release of the brake system.
5. If the caliper piston did not exhibit unrestricted and even movement during brake system apply and/or release, the piston square seal may be worn or damaged and the caliper may require overhaul or replacement.



1. Caliper Piston
2. Dust Boot
3. Piston Square Seal
4. System At Rest
5. Application Of Brake System
6. Release Of Brake System



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**Fig. 4: Hydraulic Brake Component Operation Visual Inspection**



Courtesy of GENERAL MOTORS CORP.

## PARKING BRAKE ADJUSTMENT

**NOTE:** Park brake adjustment is not necessary after replacing the park brake lever or park brake cables. The park brake cables are tensioned automatically by cycling the park brake lever three times.

1. Apply and fully release the parking brake three times.
2. Verify that the parking brake lever releases completely.
3. Turn ON the ignition. Verify that the Red BRAKE warning indicator light is off.
4. Turn OFF the ignition.
5. Raise and support the vehicle.
6. Remove the rear tire and wheel assemblies.

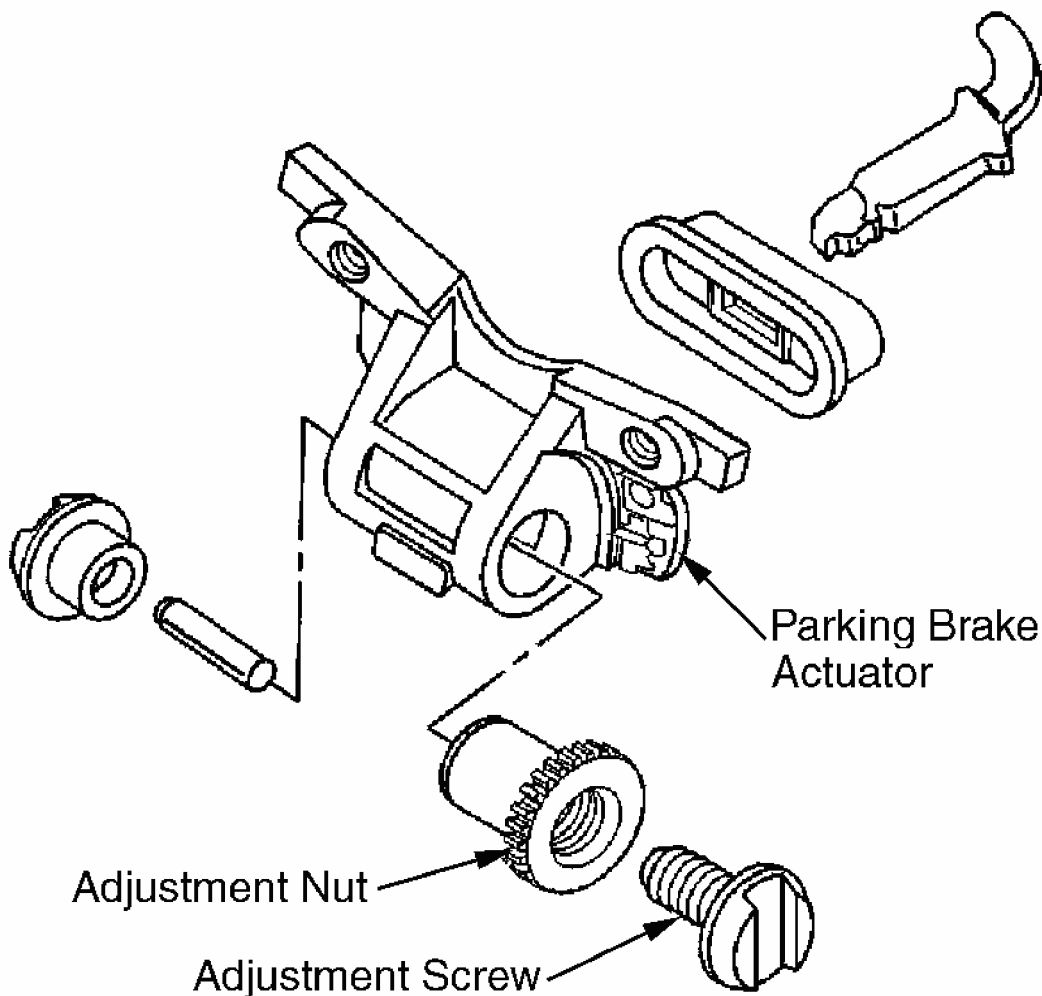
**CAUTION: DO NOT operate the park brake lever with the rear disc brake rotors removed.**

7. Remove the rear disc brake rotors. See **REAR BRAKE ROTOR**.
8. Place the inside measurement contacts of the Drum to Brake Shoe Clearance Gauge (J-21177-A) at the widest point of the drum portion of the brake rotor.
9. Tighten the set screw on the Drum to Brake Shoe Clearance Gauge in order to ensure the proper measurement when removing the tool from the drum.
10. Position the outside measurement contacts of the Drum to Brake Shoe Clearance Gauge over the park brake shoe at the widest point.

**NOTE:** If the gap between the adjustment nut and the adjustment screw of the parking brake actuator exceeds 0.25" (5 mm) during the adjustment procedure, the park brake shoe must be replaced.

11. Adjust the park brake shoe-to-drum clearance by rotating the adjustment nut on the parking brake actuator. See **Fig. 5**. Park brake shoe-to-drum clearance should be adjusted to 0.015" (.38 mm).
12. Install the rear brake rotors. See **REAR BRAKE ROTOR**.
13. Install the rear tire and wheel assemblies. Tighten wheel lug nuts to specification. See **TORQUE SPECIFICATIONS**.
14. Apply and release the park brake lever three times.
15. Apply the park brake lever. Inspect the rotation of the rear wheels:
  - The wheels should not rotate forward.

- The wheels should drag or not rotate rearward.
16. If the rear tire and wheel assemblies rotate forward or do not exhibit drag rearward, repeat the adjustment procedure.
  17. Release the parking lever. Verify that the wheels rotate freely.
  18. Lower the vehicle.



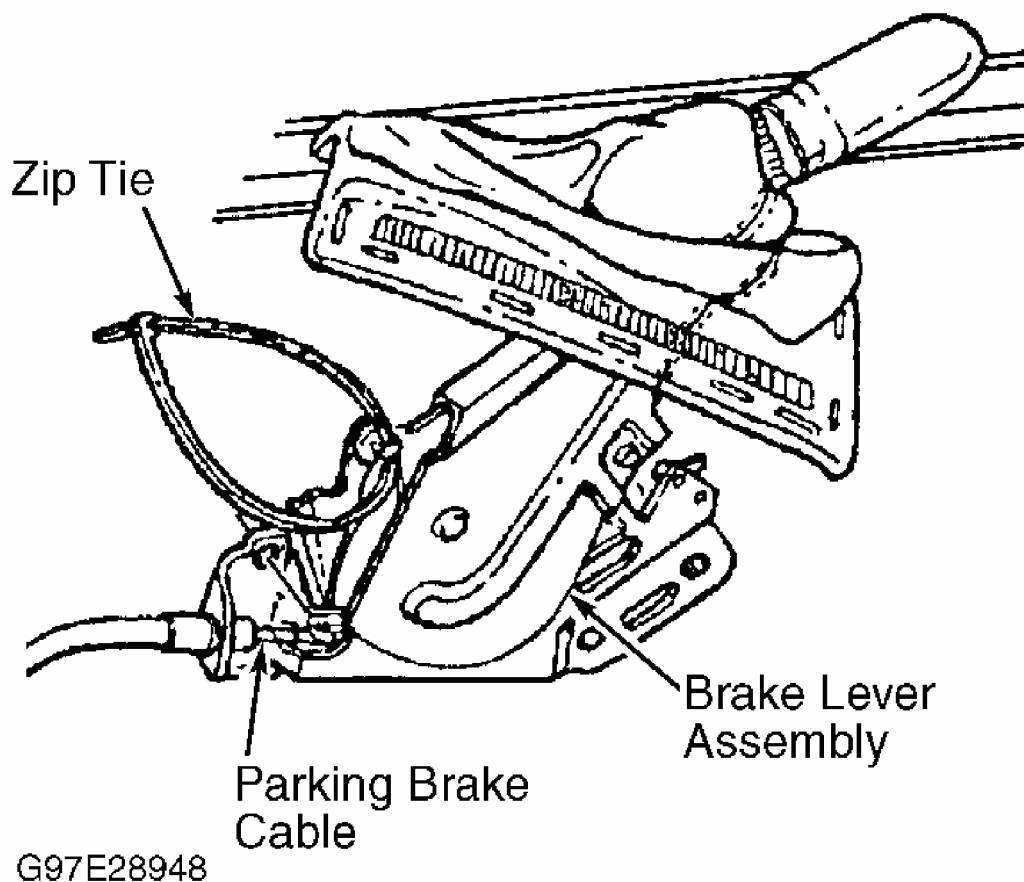
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**Fig. 5: Exploded View Of Parking Brake Actuator Assembly**  
 Courtesy of GENERAL MOTORS CORP.

#### DISABLING PARKING BRAKE AUTOMATIC ADJUSTER

Raise and support vehicle. Remove rear wheels. Disconnect parking brake cable from apply lever. Carefully peel carpet away from parking brake lever. With assistance of another technician, pull disconnected parking brake cable downward until fully extended, and install

a zip tie or cotter pin through lined up holes in parking brake lever. See **Fig. 6** . DO NOT over-extend parking brake cable.



**Fig. 6: Disabling & Enabling Parking Brake Cable Automatic Adjuster**  
Courtesy of GENERAL MOTORS CORP.

#### ENABLING PARKING BRAKE AUTOMATIC ADJUSTER

Connect parking brake cable to apply lever. Remove zip tie or cotter pin from parking brake lever. Reposition carpet into position. Install rear wheels. Lower vehicle. Apply and release parking brake 3 times to auto adjust.

#### BRAKELIGHT/CRUISE CONTROL SWITCH ADJUSTMENT

1. With the brake pedal depressed, insert the stoplamp/cruise control switch into the retainer until the switch body seats in the retainer.
2. Note that "CLICKS" can be heard as the threaded portion of the switch is pushed through the retainer.

3. Slowly pull the brake pedal fully rearward against the stop until the "CLICK" sound can no longer be heard. The switch will be moved in the retainer providing proper adjustment.

## TROUBLE SHOOTING

### BRAKE ASSIST SYSTEM DIAGNOSIS

**NOTE:** This diagnostic table is designed to diagnose **ONLY** the components of the brake **ASSIST** system in order to determine if the brake **ASSIST** system is operating properly. You will be directed by the appropriate Symptom table to go to other brake system diagnostic tables as appropriate.

1. Perform **HYDRAULIC BRAKE SYSTEM DIAGNOSTIC STARTING POINT** .
2. Inspect for proper brake pedal travel. See **BRAKE PEDAL TRAVEL MEASUREMENT & INSPECTION** . Is the brake pedal travel distance within the acceptable limits? If so, go to step 5 . If not, go to next step.
3.
  - A. Inspect for worn, missing, misaligned, bent or damaged brake pedal system components.
    - For the brake pedal pushrod component inspection, see **BRAKE PEDAL PUSHROD INSPECTION** .
    - Inspect the brake pedal bushings for excessive wear and/or damage and inspect the brake pedal for a misaligned, bent and/or damaged condition.
  - B. Replace the brake pedal system components that are worn, missing, misaligned, bent or damaged. Refer to the following procedures as necessary.
    - See **BRAKE PEDAL** .
    - For a bent or damaged pedal pushrod, replace power brake booster. See **POWER BRAKE BOOSTER** .

Did you find and replace any worn, missing, misaligned, bent or damaged brake pedal system components? If so, go to next step. If not, go to step 5 .

4. Reinspect for proper brake pedal travel. See **BRAKE PEDAL TRAVEL MEASUREMENT & INSPECTION** . Is the brake pedal travel distance within the acceptable limits? If so, go to step 8 . If not, go to next step.
5. Check the engine vacuum source that supplies vacuum to the vacuum brake booster. See **BRAKE SYSTEM VACUUM SOURCE TEST** . Is the vacuum reading within the acceptable limits? If so, go to next step. If not, go to BASIC DIAGNOSTIC PROCEDURES - 5.7L .
6. During the vacuum source inspection in step 5 , did the vacuum booster check valve operate properly? If so, go to step 8 . If not, go to next step.

7. Replace the vacuum booster check valve. After replacement, go to next step.

8.

A. Pump the brake pedal several times until the brake pedal effort increases significantly.

B. Maintain moderate foot pressure on the brake pedal and start the engine. Observe pedal operation.

Did the brake pedal drop slightly, then remain firm after the engine was started? If so, go to next step. If not, go to step 12 .

9.

- Release the brake pedal.
- Turn the ignition OFF, then wait 15 seconds.
- Pump the brake pedal 2 times to check for vacuum booster available vacuum reserve. Observe pedal effort. If operating properly, the vacuum brake booster should maintain assist for at least 2 pedal applications.

Did the brake pedal effort increase significantly? If so, go to step 12 . If not, go to next step.

10. Inspect the brake pedal pushrod and the brake pedal for misalignment, a bent condition and/or damage. See **BRAKE PEDAL PUSHROD INSPECTION** . Is the brake pedal pushrod and/or the brake pedal misaligned, bent or damaged? If so, go to next step. If not, go to step 13 .

11. If brake pedal pushrod is bent or damaged, see **POWER BRAKE BOOSTER** . If brake pedal is bent or damaged, see **BRAKE PEDAL** .

12. Replace power brake booster. See **POWER BRAKE BOOSTER** . After repairs are complete, go to next step.

13. Install or connect any components that were removed or disconnected during diagnosis

#### **HYDRAULIC BRAKE SYSTEM DIAGNOSTIC STARTING POINT**

Begin the hydraulic brake system diagnosis with the **HYDRAULIC BRAKE SYSTEM DIAGNOSTIC SYSTEM CHECK** . The Hydraulic Brake System Diagnostic System Check will provide the following information:

1. The identification of the control module(s) which command the system.
2. The ability of the control module(s) to communicate through the serial data circuit.
3. The identification of any stored Diagnostic Trouble Codes (DTCs) and their status.

#### **PARK BRAKE SYSTEM DIAGNOSTIC STARTING POINT**

Begin the system diagnosis by reviewing park brake system description and operation. See **PARK BRAKE SYSTEM DESCRIPTION** and **PARK BRAKE SYSTEM**

**OPERATION** . Reviewing the description and operation information will help you determine the correct symptom diagnostic procedure when a malfunction exists. Reviewing the description and operation information will also help you determine if the condition described by the customer is normal operation. See **SYMPTOM TESTS** in order to identify the correct procedure for diagnosing the system.

## **ROAD TEST**

### **Preliminary Inspections**

1. Visually inspect easily accessible brake system components for obvious damage and/or leaks which may indicate that the vehicle should not be driven until further inspections have been completed.
2. Inspect the brake master cylinder reservoir fluid level and adjust only if necessary for brake system road testing.
3. Inspect the tire inflation pressures and adjust as necessary.
4. Inspect the tire tread patterns to ensure that they are the same or very similar, especially per axle.
5. Ensure that the vehicle is not loaded unevenly prior to brake system road testing.

### **Road Testing Procedure**

**CAUTION: Road test a vehicle under safe conditions and while obeying all traffic laws. DO NOT attempt any maneuvers that could jeopardize vehicle control. Failure to adhere to these precautions could lead to serious personal injury and vehicle damage.**

1. Start the engine and allow it to idle.
2. Check to see if the BRAKE system warning lamp remains illuminated.
3. If the BRAKE system warning lamp remains illuminated, DO NOT proceed to test drive the vehicle until it is diagnosed and repaired.
4. Select a smooth, dry, clean and level road or large lot that is as free of traffic and obstacles as possible for brake system low speed road testing.
5. With the transmission in Park, lightly apply the brake pedal. Observe both the pedal feel and the pedal travel.
6. If the brake pedal apply felt spongy, or the pedal travel was excessive, DO NOT drive the vehicle until it is repaired.
7. If the brake pedal apply did not feel spongy and the pedal travel was not excessive, proceed to next step.
8. Release and apply the brakes.
9. While continuing to apply the brakes, shift the transmission into DRIVE, release the

## 2002 Chevrolet Corvette

### 2002 BRAKES Disc - Corvette

brakes and allow the engine to idle the vehicle away from the stopped position. Observe for a slow release of the brake system.

10. With the aid of an assistant to observe the vehicle's performance from outside of the vehicle, drive the vehicle at a low speed and lightly apply the brakes while driving past the assistant. Have the assistant observe for brake system noise from the side of the vehicle closest to them, while you observe both the pedal effort and the pedal travel.
11. If the brake pedal apply effort was excessive, or the pedal travel was excessive, DO NOT continue to test drive the vehicle until it is repaired.
12. If the brake pedal apply effort was not excessive and the pedal travel was not excessive, proceed to next step.
13. Drive the vehicle in the opposite direction, at the same low speed and lightly apply the brakes while driving past the assistant. Have the assistant observe for brake system noise from the side of the vehicle closest to him.
14. Drive the vehicle at a low speed and shift the transmission into NEUTRAL without applying the brakes. Observe for a rapid deceleration in vehicle speed, indicating possible brake drag.
15. Select a smooth, dry, clean and level road that is as free of heavy traffic as possible for brake system moderate speed road testing.
16. Drive the vehicle at a moderate speed. Observe for a pull and/or incorrect tracking of the vehicle without the brakes applied.
17. While continuing to drive the vehicle at a moderate speed, perform several light applies of the brakes. Observe the pedal effort and the pedal travel, observe for brake system noise, pulsation and/or brake drag.
18. If the brake pedal apply effort was excessive, or the pedal travel was excessive, DO NOT continue to test drive the vehicle until it is repaired.
19. If the brake pedal apply effort was not excessive and the pedal travel was not excessive, proceed to next step.
20. While continuing to drive the vehicle at a moderate speed, perform several moderate applies of the brakes. Observe the pedal effort and the pedal travel, observe for brake system pulsation and/or uneven braking action - either side to side, or front to rear. A small amount of vehicle front end dip is expected during a moderate apply of the brakes.
21. If the brake pedal apply effort was excessive, or the pedal travel was excessive, DO NOT continue to test drive the vehicle until it is repaired.

## SELF-DIAGNOSTIC SYSTEM

**NOTE:** For more information on scan tool usage and data lists, see **BODY CONTROL MODULES** .

### SCAN TOOL DATA LIST (HYDRAULIC BRAKES)

## 2002 Chevrolet Corvette

### 2002 BRAKES Disc - Corvette

All readings taken with ignition ON, engine OFF, brake fluid level normal, and park brake released.

#### SCAN TOOL DATA LIST (HYDRAULIC BRAKES)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Brake Fluid Level	Inputs	OK/Low	OK
Park Brake Switch	Inputs	On/Off	Off

#### HYDRAULIC BRAKE SYSTEM DIAGNOSTIC SYSTEM CHECK

The numbers below refer to the step numbers on the diagnostic table.

**2** - Lack of communication may be due to a partial malfunction of the serial data circuit or due to a total malfunction of the serial data circuit. The specified procedure will determine the particular condition.

**4** - The presence of DTCs which begin with "U" indicate some other module is not communicating. The specified procedure will compile the available information before tests are performed.

1. Turn ignition switch to OFF. Connect scan tool to Data Link Connector (DLC). Attempt to power up scan tool. If scan tool powers up, go to next step. If scan tool does not power up, see **SCAN TOOL DOES NOT POWER UP**.
2. Turn ignition switch to ON. Using scan tool attempt to establish communications with Electronic Brake Control Module (EBCM) and Instrument Panel Cluster (IPC). If communications are successfully established with specified modules, go to next step. If communications cannot be established, see **SCAN TOOL DOES NOT COMMUNICATE WITH CLASS 2 DEVICE**.
3. Select DISPLAY DTCs function on scan tool for EBCM and IPC. If scan tool displays DTCs, go to next step. If scan tool does not display DTCs, repair brake system by symptom. Investigate suspected faulty components for leaking or physical damage. Repair as necessary.
4. If DTC C1247 is retrieved, perform **DTC C1247: BRAKE FLUID SWITCH INPUT GROUNDED**. If DTC(s) other than C1247 are displayed, see **DIAGNOSTIC TROUBLE CODE (DTC) LIST**.

#### DISC BRAKE SYSTEM DIAGNOSIS

1. Were you sent here from a symptom test? If so, go to next step. If not, go to **HYDRAULIC BRAKE SYSTEM DIAGNOSTIC STARTING POINT**.
2. Visually inspect the disc brake pads for the following conditions:
  - Lining thickness below specifications.
  - Uneven and/or abnormal wear, edge-to-edge and/or side-to-side.



- Evidence of contamination from an external substance.
- Looseness or damage, including pad hardware.

Did you find any conditions to indicate a concern with any of the front and/or rear disc brake pads? If so, go to next step. If not, go to step 12 .

3. Are any of the front and/or rear disc brake pads contaminated? If so, go to step 8 . If not, go to next step.
4. Are any of the front and/or rear disc brake pads worn unevenly? If so, go to step 7 . If not, go to next step.
5. Are any of the front and/or rear disc brake pads and/or pad hardware loose or damaged? If so, go to step 7 . If not, go to next step.
6.
  - Remove and inspect the worn disc brake pads for glazing, looseness, heat spots or damage.
  - Replace the worn disc brake pads as a complete axle set. See **FRONT BRAKE PADS** or **REAR BRAKE PADS** .

After completing the inspection and/or replacement, go to step 12 .

**NOTE:**      **Support the brake caliper with heavy mechanic's wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.**

7.
  - A. Remove the front and/or rear disc brake calipers, as appropriate, from the mounting brackets and support the calipers. Do NOT disconnect the hydraulic brake flex hoses from the calipers. See **FRONT BRAKE CALIPER** or **REAR BRAKE CALIPER** .
  - B. Inspect the disc brake caliper mounting bracket and the mounting/sliding hardware for a loose, bent, cracked or damaged caliper mounting bracket, binding or seized hardware, or worn, damaged or missing hardware components. See **DISC BRAKE HARDWARE** .
  - C. Replace components as required.
  - D. Replace the unevenly-worn, loose or damaged disc brake pads as a complete axle set. See **FRONT BRAKE PADS** or **REAR BRAKE PADS** .

After completing the inspection and/or replacement, go to step 12 .

8. Inspect the disc brake calipers, brake hoses and brake pipes for evidence of an external brake fluid leak. Replace component(s) as necessary. See appropriate procedure in **REMOVAL & INSTALLATION**. Did you find and correct the source of the leak causing contamination of the pads? If so, go to step 11 . If not, go to next step.
9. Inspect the axle shaft outer seals for damage and evidence of a grease leak. Replace any axle shaft seal that is found to be leaking grease which may be the source of the contamination to the pads. See **DIFFERENTIALS & AXLE SHAFTS - CORVETTE** . Did you find and correct the source of the leak causing contamination of the pads? If so, go to step 11 . If not, go to next step.
10. Repair/replace any components found to be leaking fluid which may be the source of the contamination to the pads. After repairs are complete, go to next step.

**NOTE:**      **Support the brake caliper with heavy mechanic's wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.**

11.
  - A. Clean the remaining disc brake system components to remove any traces of the contaminants.
  - B. Remove the front and/or rear disc brake calipers, as appropriate, from the mounting brackets and support the calipers. Do NOT disconnect the hydraulic brake flex hoses from the calipers. See **FRONT BRAKE CALIPER** or **REAR BRAKE CALIPER** .
  - C. Inspect the disc brake caliper mounting/sliding hardware for binding or seized hardware, or distorted, worn, damaged or missing hardware components. See **DISC BRAKE MOUNTING & HARDWARE INSPECTION** .
  - D. Replace the caliper mounting/sliding hardware components as required. See **DISC BRAKE HARDWARE** .
  - E. Replace the contaminated disc brake pads as a complete axle set. See **FRONT BRAKE PADS** or **REAR BRAKE PADS** . After repairs are complete, go to next step.
12. Check the thickness of each of the disc brake rotors. Make a determination for each brake rotor if the rotor can be refinished and remain above the minimum requirements. See **DISC BRAKE SPECIFICATIONS** . If the rotor can be refinished and remain above the minimum requirements, go to next step. If the rotor cannot be refinished and remain above the minimum requirements, go to step 15 .

13.

- A. Inspect each of the disc brake rotors for the following surface and wear conditions:
- Heavy rust and/or pitting.
  - Cracks and/or heat spots.
  - Excessive blueing discoloration.
  - Deep or excessive scoring beyond maximum acceptable level.
  - Lateral runout beyond maximum acceptable level.
  - Thickness variation beyond maximum acceptable level.
- B. Make a determination for each brake rotor if the rotor requires refinishing based upon the results of the inspection. If the brake rotor exhibits any of the listed conditions, it requires refinishing. If the brake rotor requires refinishing, go to next step. If the brake rotor does not require refinishing, go to step 18 .
14. Refinish the brake rotor. Inspect the brake rotor thickness. See **DISC BRAKE SPECIFICATIONS** . Were you able to refinish the brake rotor within the minimum requirements? If so, go to step 18 . If not, go to step 17 .
15. Is the brake rotor at or below the discard requirements? If so, go to step 17 . If not, go to next step.
- 16.
- A. Inspect each of the disc brake rotors for the following surface and wear conditions:
- Heavy rust and/or pitting.
  - Cracks and/or heat spots.
  - Excessive blueing discoloration.
  - Deep or excessive scoring beyond maximum acceptable level.
  - Lateral runout beyond maximum acceptable level.
  - Thickness variation beyond maximum acceptable level.
- B. Make a determination for each brake rotor if the rotor requires replacing based upon the results of the inspection. If the brake rotor exhibits any of the listed conditions, it requires refinishing. If the brake rotor requires replacing, go to next step. If the brake rotor does not require replacing, go to step 18 .
17. Replace the brake rotor. See **FRONT BRAKE ROTOR** or **REAR BRAKE ROTOR** . After repairs are complete, go to next step.
18. Install or connect components that were removed or disconnected during diagnosis.

**HYDRAULIC BRAKE SYSTEM DIAGNOSIS**

1. Were you sent here from a symptom test? If so, go to next step. If not, go to **HYDRAULIC BRAKE SYSTEM DIAGNOSTIC STARTING POINT** .
2. Inspect and adjust the brake fluid level in the brake master cylinder. If the brake fluid

level was low, go to next step. If the brake fluid level was not low, go to step 4 .

3.

- A. Inspect the brake fluid for fluid separation, indicating 2 types of fluid are present and brake fluid is contaminated:
  - Swirled appearance - oil-based substance.
  - Layered appearance - silicone-based substance.
- B. Inspect the brake fluid for fluid discoloration, indicating 2 types of fluid are present and brake fluid is contaminated:
  - Cloudy appearance - moisture.
  - Dark appearance/suspended particles in fluid - dirt, rust, corrosion, brake dust.
- C. Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating fluid contamination.

Do any of the above conditions exist? If so, go to step 5 . If not, go to step 6 .

4.

- A. Inspect the brake fluid for fluid separation, indicating 2 types of fluid are present and brake fluid is contaminated:
  - Swirled appearance - oil-based substance.
  - Layered appearance - silicone-based substance.
- B. Inspect the brake fluid for fluid discoloration, indicating 2 types of fluid are present and brake fluid is contaminated:
  - Cloudy appearance - moisture.
  - Dark appearance/suspended particles in fluid - dirt, rust, corrosion, brake dust.
- C. Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating fluid contamination.

Do any of the above conditions exist? If so, go to next step. If not, go to step 12 .

5.

- A. Flush the hydraulic brake system.
- B. If the brake fluid was contaminated with an oil-based or a silicone-based fluid, indicated by fluid separation and/or a swollen master cylinder reservoir cap diaphragm and/or swollen reservoir-to-master cylinder grommets, perform the following steps:
  - 1. Remove all of the following components listed. Each component contains internal rubber seals/linings which have been contaminated.
  - 2. Clean out the hydraulic brake pipes using denatured alcohol, or equivalent.
  - 3. Dry the brake pipes using non-lubricated, filtered air.

4. Repair or replace all of the following components listed. Each component contains internal rubber seals/linings which have been contaminated.
- **Master Cylinder** - Overhaul or replace master cylinder. For master cylinder overhaul, see **OVERHAUL** . For master cylinder replacement, see **MASTER CYLINDER** .
  - **Brake Master Cylinder Reservoir** - Clean the brake master cylinder reservoir using denatured alcohol, or equivalent. Dry the master cylinder reservoir using non-lubricated, filtered air. If necessary, replace the brake master cylinder reservoir.
  - **Brake Master Cylinder Reservoir Cap Diaphragm** - Replace the brake master cylinder reservoir cap diaphragm.
  - **Brake Hoses** - For brake hose replacement, see **BRAKE HOSE** .
  - **Brake Calipers** - For brake caliper overhaul, see **OVERHAUL** . For brake caliper replacement, see **FRONT BRAKE CALIPER** or **REAR BRAKE CALIPER** .
  - **Brake Pressure Modulator Valve** - See **ANTILOCK BRAKE SYSTEM** .
- C. If the brake fluid was not contaminated with an oil-based fluid, but was contaminated with water or dirt, rust, corrosion, and/or brake dust, replace the brake master cylinder reservoir cap diaphragm which may have allowed moisture or dirt to enter the system.
- D. Refill and bleed the hydraulic brake system. See **BLEEDING BRAKE SYSTEM** .

After repairs are complete, go to step 9 .

6.

- A. Inspect the following hydraulic brake system components for external fluid leaks. Repair or replace any of the components found to be leaking brake fluid.
- **Master Cylinder** - Overhaul or replace master cylinder. For master cylinder overhaul, see **OVERHAUL** . For master cylinder replacement, see **MASTER CYLINDER** .
  - **Brake Hoses** - For brake hose replacement, see **BRAKE HOSE** .
  - **Brake Calipers** - For brake caliper overhaul, see **OVERHAUL** . For brake caliper replacement, see **FRONT BRAKE CALIPER** or **REAR BRAKE CALIPER** .
  - **Brake Pressure Modulator Valve** - See **ANTILOCK BRAKE SYSTEM** .
- B. If you repaired or replaced any of the brake system components listed, bleed the hydraulic brake system. See **BLEEDING BRAKE SYSTEM** . While bleeding the hydraulic brake system, observe for the following conditions:
- The presence of air in the system at a bleeder valve location other than at the repair location, except if the brake master cylinder was replaced.

- An unrestricted and even flow of brake fluid per axle during the bleeding procedure.

Did you find and correct a condition? If so, go to next step. If not, go to step 12 .

7. Was there air in the system at a bleeder valve location other than at the repair location, except if the brake master cylinder was replaced? If so, go to step 19 . If not, go to next step.
8. Was the flow of brake fluid unrestricted and even per axle during the bleeding procedure? If so, go to next step. If not, go to step 10 .
9. Inspect the hydraulic function of the brake calipers for proper operation. See **HYDRAULIC BRAKE COMPONENT OPERATION VISUAL INSPECTION** . Was the hydraulic function of the brake calipers operating properly? If so, go to step 21 . If not, go to step 14 .
10. Was the flow of brake fluid restricted or uneven through front axle hydraulic components during the bleeding procedure? If so, go to step 13 . If not, go to next step.
11. Was the flow of brake fluid restricted or uneven through rear axle hydraulic components during the bleeding procedure? If so, go to step 17 .
12. Inspect the hydraulic function of the brake calipers for proper operation. See **HYDRAULIC BRAKE COMPONENT OPERATION VISUAL INSPECTION** . Was the hydraulic function of the brake calipers operating properly? If so, go to step 15 . If not, go to next step.
13. Determine if the brake caliper is restricting the flow of brake fluid and/or not operating properly:
  - Raise and support the vehicle.
  - Remove the tire and wheel assemblies.
  - Open the suspected caliper bleeder valve.
  - Using a large "C" clamp, compress the caliper piston and observe for an unrestricted flow of brake fluid and for free movement of the caliper piston.
  - Close the caliper bleeder valve.

Was the flow of brake fluid unrestricted and did the caliper piston move freely? If so, go to step 17 . If not, go to next step.

14. Repair or replace any brake caliper that was not operating properly. For brake caliper overhaul, see **OVERHAUL** . For brake caliper replacement, see **FRONT BRAKE CALIPER** or **REAR BRAKE CALIPER** . After repairs are complete, go to step 21 .
15. Bleed the hydraulic brake system to observe for the presence of air in the system and to observe for an unrestricted and even flow of brake fluid per axle during the bleeding procedure. See **BLEEDING BRAKE SYSTEM** . Was there air in the system? If so, go to step 19 . If not, go to next step.
16. Was the flow of brake fluid unrestricted and even per axle during the bleeding

procedure? If so, go to step 21 . If not, go to next step.

17.

- Inspect the hydraulic brake pipes and flexible brake hoses for signs of a fluid restriction; such as being bent, kinked, pinched or damaged.
- Replace any of the hydraulic brake pipes and/or flexible brake hoses found to be bent, kinked, pinched, or damaged.
- If none of the hydraulic brake pipes or flexible brake hoses were visibly bent, kinked, pinched, or damaged, replace the hydraulic brake flex hose at the restricted location.

Did you find and correct a condition? If so, go to step 21 . If not, go to next step.

18. Replace the Brake Pressure Modulator Valve (BPMV), in order to correct the hydraulic brake dynamic rear proportioning mechanical operation. See **ANTILOCK BRAKE SYSTEM** . After repairs are complete, go to step 21 .

19.

- Inspect the hydraulic brake system components for brake fluid seepage at a seal and/or fitting location, which may have drawn air into the system.
- Inspect the hydraulic brake system components for evidence of a recent repair, which may have introduced air into the system.
- Repair or replace any of the components found to be installed incorrectly or seeping brake fluid.

Did you find and correct a condition? If so, go to step 21 . If not, go to next step.

20. Inspect the brake master cylinder for internal fluid leaks. See **BRAKE SYSTEM INTERNAL LEAK TEST** . Repair or replace the brake master cylinder if it is found to be leaking brake fluid internally. For master cylinder overhaul, see **OVERHAUL** . To replace master cylinder, see **MASTER CYLINDER** . After repairs are complete, go to next step.

21. Install or connect components that were removed or disconnected during diagnosis.

## **PARK BRAKE SYSTEM DIAGNOSIS**

**NOTE:**      **This test is designed to diagnose only the components of the park brake system in order to determine if the park brake system is operating properly.**

1. Were you sent here from **HYDRAULIC BRAKE SYSTEM TEST** ? If so, go to step 4 . If not, go to next step.
2. Were you sent here from **PARK BRAKE WILL NOT HOLD OR RELEASE** ? If so, go to step 4 . If not, go to next step.
3. Is the symptom related to the ability of the park brake system to hold and/or release? If so, see **PARK BRAKE SYSTEM DIAGNOSTIC STARTING POINT** . If not, see **HYDRAULIC BRAKE SYSTEM DIAGNOSTIC STARTING POINT** .

4.

- Raise and support the vehicle with the rear axle supported by jack stands.
- Shift the transmission into Neutral.
- With the park brake released, attempt to rotate the rear wheels to check the rear brakes for a significant amount of drag.

Do the rear brakes have a significant amount of drag? If so, go to step 11 . If not, go to next step.

5.

- Shift the transmission into Neutral.
- Apply the park brake.
- Attempt to rotate the rear wheels to check the rear brakes for a significant amount of drag.

Do the rear brakes have a significant amount of drag? If so, go to next step. If not, go to step 7 .

6. Release the park brake. Rotate the rear wheels to check the rear brakes for a significant reduction in the amount of drag. Did the rear brakes exhibit a significant reduction in the amount of drag? If so, go to step 21 . If not, go to step 11 .
7. Visually inspect the park brake cable connections and the cables that are accessible on the underside of the vehicle for disconnections and/or damage. Were any of the park brake cables disconnected and/or damaged? If so, go to next step. If not, go to step 9 .
8. Reconnect or replace the park brake cables as necessary. See **PARK BRAKE CABLE** . After repairs are complete, go to next step.
9. Check the adjustment of the park brake. See **PARKING BRAKE ADJUSTMENT** . Was the park brake adjusted properly? If so, go to step 11 . If not, go to next step.
10. Adjust the park brake. See **PARKING BRAKE ADJUSTMENT** . Were you able to adjust the park brake? If so, go to step 16 . If not, go to next step.

**NOTE:**      **DO NOT depress the brake pedal with the brake rotors removed, or with the brake calipers repositioned away from the brake rotors, or damage to the brake system may result.**

11.

- Remove the rear brake rotors. See **REAR BRAKE ROTOR** .
- Inspect the park brake shoe hardware for looseness, damaged, broken or missing components.
- Check the park brake actuators for a seized condition.

Does the park brake hardware and/or the park brake actuators require replacement? If so, go to next step. If not, go to step 13 .

12.



- Replace park brake hardware components as necessary. See **PARK BRAKE SHOE** .
  - Replace the park brake actuators as necessary. See **PARK BRAKE SHOE ACTUATOR** . After repairs are complete, go to next step.
13. Have an assistant apply and release the park brake, while you observe the park brake cables for free movement. Did the park brake cables move freely? If so, go to next step. If not, go to step 17 .
  14. Check the adjustment of the park brake. See **PARKING BRAKE ADJUSTMENT** . Was the park brake adjusted properly? If so, go to step 16 . If not, go to next step.
  15. Adjust the park brake. See **PARKING BRAKE ADJUSTMENT** . Were you able to adjust the park brake? If so, go to next step. If not, go to step 26 .
  16.
    - With the transmission still in Neutral, apply the park brake.
    - Attempt to rotate the rear wheels to check the rear brakes for a significant amount of drag.
    - Release the park brake.
    - Rotate the rear wheels to check the rear brakes for a significant reduction of drag.Did the park brake apply and release properly? If so, go to step 28 . If not, go to **PARK BRAKE WILL NOT HOLD OR RELEASE** .
  17. Disconnect the park brake cable connections that are accessible on the underside of the vehicle one at a time and check each cable for free movement. Do any of the park brake cables accessible on the underside of the vehicle require replacement? If so, go to next step. If not, go to step 19 .
  18. Replace any of the park brake cables that do not have free movement or are not releasing properly. See **PARK BRAKE CABLE** . After repairs are complete, go to next step.
  19. Disconnect the front park brake cable connection accessible inside the vehicle at the park brake lever assembly and check for free movement. Replace the front park brake cable if it does not have free movement. See **PARK BRAKE CABLE** . Did you find and correct a condition? If so, go to step 24 . If not, go to next step.
  20. Replace the park brake lever assembly for not releasing properly. See **PARK BRAKE LEVER ASSEMBLY** .
  21. Check the adjustment of the park brake. See **PARKING BRAKE ADJUSTMENT** . Was the park brake adjusted properly? If so, go to step 28 . If not, go to next step.
  22. Adjust the park brake. See **PARKING BRAKE ADJUSTMENT** . Were you able to adjust the park brake? If so, go to step 27 . If not, go to next step.
  23.
    - Remove the rear brake rotors, if they have not yet been removed. See **REAR BRAKE ROTOR** .

- Inspect the park brake actuators for a seized condition.
  - Replace the park brake actuators as necessary. See **PARK BRAKE SHOE ACTUATOR** . Did you find and correct a condition? If so, go to next step. If not, go to step 26 .
24. Adjust the park brake. See **PARKING BRAKE ADJUSTMENT** . Were you able to adjust the park brake? If so, go to step 27 . If not, go to step 26 .
25. Adjust the park brake. See **PARKING BRAKE ADJUSTMENT** . Were you able to adjust the park brake? If so, go to step 27 . If not, go to **SYMPTOM TESTS** .
26. Replace the component that is used to adjust the park brake system. See **PARK BRAKE LEVER ASSEMBLY** . Adjust the park brake. See **PARKING BRAKE ADJUSTMENT** . Did you complete the replacement and adjustment? If so, go to next step. If not, go to **SYMPTOM TESTS** .
- 27.
- With the transmission still in Neutral, apply the park brake.
  - Attempt to rotate the rear wheels to check the rear brakes for a significant amount of drag.
  - Release the park brake.
  - Rotate the rear wheels to check the rear brakes for a significant reduction of drag.
- Did the park brake apply and release properly? If so, go to next step. If not, go to **SYMPTOM TESTS** .
28. Install or connect any components that were removed or disconnected during diagnosis.

## **SYMPTOM TESTS**

Inspect for aftermarket devices which could affect the operation of the park brake system. Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom. Refer to a specific symptom diagnostic procedure in order to diagnose the symptom.

### **BRAKE WARNING INDICATOR ALWAYS ON**

1. If hydraulic brake system diagnostic system check has been performed, go to next step. If hydraulic brake system diagnostic system check has not been performed, see **HYDRAULIC BRAKE SYSTEM DIAGNOSTIC SYSTEM CHECK** .
2. Turn ON the ignition, with the engine OFF. Release the parking brake. Using a scan tool, observe the Park Brake Switch parameter in the Instrument Panel Cluster data list. Does the scan tool indicate that the Park Brake Switch parameter is Off? If so, problem is intermittent. If not, go to next step.
3. Turn OFF the ignition. Disconnect the parking brake switch. See **PARKING BRAKE SWITCH** as necessary to access parking brake switch electrical connector. Turn ON the ignition, with the engine OFF. Using a scan tool, observe the Park Brake Switch

parameter. Does the scan tool indicate that the Park Brake Switch parameter is Off? If so, go to step 5 . If not, go to next step.

4. Test the signal circuit of the park brake switch for a short to ground. For wiring, see **INSTRUMENT CLUSTER** . Did you find and correct the condition? If so, go to step 9 . If not, go to step 6 .
5. Inspect for poor connections at the harness connector of the parking brake switch. Did you find and correct the condition? If so, go to step 9 . If not, go to step 7 .
6. Inspect for poor connections at the harness connector of the Instrument Panel Cluster (IPC). Did you find and correct the condition? If so, go to step 9 . If not, go to step 8 .
7. Replace the parking brake switch. See **PARKING BRAKE SWITCH** . After repairs are complete, go to step 9 .
8. Replace the Instrument Panel Cluster (IPC). See **INSTRUMENT PANEL CLUSTER** . After repairs are complete, go to next step.
9. Operate the system in order to verify the repair. Did you correct the condition? If so, repair is complete. If not, go to step 2 .

#### **BRAKE WARNING INDICATOR INOPERATIVE**

1. If hydraulic brake system diagnostic system check has been performed, go to next step. If hydraulic brake system diagnostic system check has not been performed, see **HYDRAULIC BRAKE SYSTEM DIAGNOSTIC SYSTEM CHECK** .
2. Turn OFF the ignition. Turn ON the ignition, with the engine OFF. Observe the red BRAKE indicator. Does the Red BRAKE indicator illuminate briefly during the displays test? If so, go to next step. If not, go to step 11 .
3. Apply the parking brake. Does the Red BRAKE indicator illuminate? If so, go to next step. If not, go to step 5 .
4. Turn OFF the ignition. Release the parking brake. Disconnect the brake fluid level switch, located on side of master cylinder reservoir. Connect a 3-amp fused jumper wire between the signal circuit of the brake fluid level switch and the ground circuit of the brake fluid level switch. Turn ON the ignition, with the engine OFF. Does the Red BRAKE indicator illuminate? If so, go to step 10 . If not, go to step 7 .
5. Turn OFF the ignition. Disconnect the parking brake switch. See **PARKING BRAKE SWITCH** as necessary to access parking brake switch electrical connector. Connect a 3-amp fused jumper wire between the signal circuit of the parking brake switch and a good ground. Turn ON the ignition, with the engine OFF. Does the Red BRAKE indicator illuminate? If so, go to step 9 . If not, go to next step.
6. Test the signal circuit of the park brake switch for a high resistance or an open. For wiring, see **INSTRUMENT CLUSTER** . Did you find and correct the condition? If so, go to step 15 . If not, go to step 11 .
7. Test the signal circuit of the brake fluid level switch for a high resistance or an open. For wiring, see **INSTRUMENT CLUSTER** . Did you find and correct the condition?

If so, go to step 15 . If not, go to next step.

8. Test the ground circuit of the brake fluid level switch for a high resistance or an open. For wiring, see **INSTRUMENT CLUSTER** . Did you find and correct the condition? If so, go to step 15 . If not, go to step 11 .
9. Inspect for poor case ground or poor connections at the harness connector of the parking brake switch. For wiring, see **INSTRUMENT CLUSTER** . Did you find and correct the condition? If so, go to step 15 . If not, go to step 12 .
10. Inspect for poor connections at the harness connector of the brake fluid level switch. For wiring, see **INSTRUMENT CLUSTER** . Did you find and correct the condition? If so, go to step 15 . If not, go to step 13 .
11. Inspect for poor connections at the harness connector of the Instrument Panel Cluster (IPC). For wiring, see **INSTRUMENT CLUSTER** . Did you find and correct the condition? If so, go to step 15 . If not, go to step 14 .
12. Replace the parking brake switch. See **PARKING BRAKE SWITCH** . After repairs are complete, go to step 15 .
13. Replace the brake fluid level switch. See **BRAKE FLUID LEVEL SWITCH** . After repairs are complete, go to step 15 .
14. Replace the Instrument Panel Cluster (IPC). See **INSTRUMENT PANEL CLUSTER** . After repairs are complete, go to next step.
15. Operate the vehicle in order to verify the repair. Did you correct the condition? If so, repair is complete. If not, go to step [2](#) .

#### **PARK BRAKE WILL NOT HOLD OR RELEASE**

1. Were you sent here from PARK BRAKE SYSTEM DIAGNOSTIC STARTING POINT? If so, go to next step. If not, go to **PARK BRAKE SYSTEM DIAGNOSTIC STARTING POINT** .
2. Inspect the park brake system for proper operation. See **PARK BRAKE SYSTEM TEST** . Did you find and correct a condition? If so, go to step 5 . If not, go to next step.
3. Inspect the disc brake system for proper operation. See **DISC BRAKE SYSTEM TEST** . Did you find and correct a condition? If so, go to step 5 . If not, go to next step.
4. Inspect the hydraulic brake system for proper operation. See **HYDRAULIC BRAKE SYSTEM TEST** . Did you find and correct a condition? If so, go to next step. If not, go to **PARK BRAKE SYSTEM DIAGNOSTIC STARTING POINT** .
5. Road test the vehicle in order to confirm proper operation. See **ROAD TEST** . If condition still exists, go to step 2 .

## **DIAGNOSTIC TESTS**

### **DTC C1247: BRAKE FLUID SWITCH INPUT GROUNDED**

#### **Circuit Description**

Brake fluid level switch monitors level of brake fluid in master cylinder. When Instrument Panel Cluster (IPC) sees brake fluid level switch input grounded, it turns ON red Brake indicator and sends a serial data message to the Electronic Brake Control Module (EBCM) that tells the EBCM that the brake fluid level is low. When DTC is in effect, the following action occur:

- EBCM disables traction control and vehicle stability control until DTC becomes a history DTC.
- Brake warning indicator is illuminated.
- Traction control and active handling indicators illuminate.
- Driver Information Center (DIC) displays LOW BRAKE FLUID, SERVICE TRACTION SYSTEM and SERVICE ACTIVE HANDLING messages.

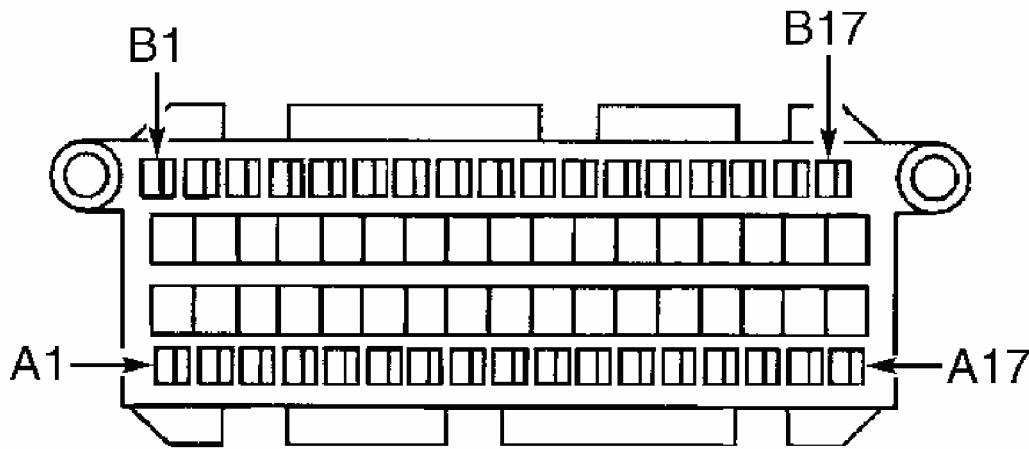
ABS system will remain operational while DTC is in effect.

#### Diagnostic Procedure

1. If hydraulic brake system diagnostic system check has been performed, go to next step. If hydraulic brake system diagnostic system check has not been performed, see **HYDRAULIC BRAKE SYSTEM DIAGNOSTIC SYSTEM CHECK**.
2. Inspect brake fluid level. If brake fluid level is below MIN mark on master cylinder, repair leak in brake system. If brake fluid level is above MIN mark on master cylinder, go to next step.
3. Turn ignition switch to OFF. Connect scan tool to Data Link Connector (DLC). Using scan tool observe BRAKE FLUID LEVEL parameter in Instrument Panel Cluster (IPC) data list. If scan tool indicates parameter is OK, system is functioning properly at this time. Check brake fluid level sensor connector for poor or intermittent connections. If scan tool indicates parameter is not okay, go to next step.
4. Turn ignition switch to OFF. Disconnect brake fluid level switch. Turn ignition switch to ON. Using scan tool, observe BRAKE FLUID LEVEL parameter in IPC data list. If scan tool indicates parameter is OK, go to step 6. If scan tool indicates parameter is not OK, go to next step.
5. Check purple wire between brake fluid level switch connector and IPC connector C1 terminal B4 for short to ground. See **Fig. 7**. Repair wiring as necessary, then go to step 10. If no problem is found, go to step 7.
6. Check brake fluid level switch connector for poor connection or corroded terminals. Repair connection as necessary, then go to step 10. If no problem is found, go to step 8.
7. Check IPC connector for poor connections or corroded terminals. Repair connection as necessary, then go to step 10. If no problem is found, go to step 9.
8. Replace brake fluid level switch. When repair is complete, go to step 10.
9. Replace IPC. See **INSTRUMENT PANEL CLUSTER**. When repair is complete, go

to next step.

10. Using scan tool, clear DTC. Scan for IPC/EBCM DTCs, If DTC C1247 resets, go to step 2 . If DTC does not reset, repair is complete.



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**Fig. 7: Identifying Instrument Cluster Connector Terminals**  
Courtesy of GENERAL MOTORS CORP.

#### Diagnostic Aids

Inspect master cylinder reservoir for proper brake fluid level

## SYSTEM TESTS

### BRAKE SYSTEM INTERNAL LEAK TEST

1. Start the engine and allow it to idle. Apply light, steady pressure to the brake pedal. Observe both the brake pedal feel and travel. Release the brakes and turn OFF the ignition.
2. If the brake pedal apply felt spongy, but the brake pedal travel was not excessive, inspect the brake system for external leaks. Pressure bleed the brake system in order to purge any air that may be trapped in the system. See [PRESSURE BLEEDING](#) .
3. If the brake pedal apply did not feel spongy, but the brake pedal travel was excessive, loosen the master cylinder-to-brake power booster mounting nuts. Carefully pull the master cylinder away from the brake power booster just enough to inspect the mounting surface of the master cylinder. Inspect the master cylinder mounting surface at the primary piston for brake fluid leaks.

4. If the master cylinder exhibits any leakage around the primary piston, then the primary piston primary seal and/or secondary seal is leaking and the master cylinder requires overhaul or replacement. If the master cylinder primary piston does not exhibit any leakage, pressure bleed the brake system. See **PRESSURE BLEEDING** .
5. If the brake pedal apply did not feel spongy, and the brake pedal travel was initially steady and not excessive, but then gradually fell, then the master cylinder requires overhaul or replacement due to an internal leak past the secondary piston from the secondary piston primary seal or secondary seal.
6. If the brake pedal apply did not feel spongy, and the brake pedal travel was initially steady and not excessive, then fell slightly, then became steady again, then the Brake Pressure Modulator Valve (BPMV) may be leaking internally, and may require replacement.

#### **BRAKE SYSTEM VACUUM SOURCE TEST**

1. Disconnect the engine vacuum hose from the vacuum brake booster check valve.
2. Install a vacuum gage to the engine vacuum hose.
3. Start the engine and allow the engine to idle until normal operating temperatures are reached.
4. Check to see if the engine vacuum reading is within the specified normal engine vacuum range of 14-20 in. Hg (47-68 kPa).
5. Turn the ignition OFF.
6. If the engine vacuum reading is within the specified normal range, proceed to step 10 .
7. If the engine vacuum reading is NOT within the specified normal range, inspect the engine vacuum hose for tight connection to the engine, collapse, deformation or contamination, cracks, cuts and dry-rot.
8. If any of these conditions were found with the engine vacuum hose, replace the hose, then repeat steps 2 -4 .
9. If none of these conditions were found with the engine vacuum hose, then there is an engine vacuum source problem, check the engine vacuum system.
10. Remove the vacuum brake booster check valve from the booster.
11. Install the check valve to the engine vacuum hose.
12. Install the vacuum gage to the check valve.
13. Start the engine and allow the engine to idle until normal operating temperatures are reached.
14. Turn the ignition OFF.
15. Check to see if the engine vacuum reading is maintained within the specified normal engine vacuum range. Specification 14-20 in. Hg (47-68 kPa).
16. If the engine vacuum reading is maintained within the specified normal range, proceed to step 18 .

17. If the engine vacuum reading is NOT maintained within the specified normal range, replace the brake booster check valve, then repeat steps 11 -15 .
18. Inspect the brake booster check valve grommet for a firm connection to the vacuum brake booster, deformation or contamination, cracks, cuts and dry-rot.
19. If any of these conditions were found with the check valve grommet, replace the grommet.

## **REMOVAL & INSTALLATION**

**CAUTION:** When battery is disconnected, vehicle computer and memory systems may lose memory data. Driveability problems may exist until computer systems have completed a relearn cycle. See COMPUTER RELEARN PROCEDURES before disconnecting battery.

### **BRAKE FLUID LEVEL SWITCH**

#### **Removal**

Remove brake fluid from master cylinder reservoir. Disconnect electrical connector from brake fluid level switch. Using needle nose pliers, carefully depress retaining tabs on end of brake fluid level switch while pressing switch through the reservoir to remove.

#### **Installation**

Place brake fluid level switch into reservoir and press into place to secure the retaining tabs. Connect brake fluid level switch connector. Fill and bleed brake system. See **BLEEDING BRAKE SYSTEM** .

### **BRAKE HOSES**

#### **Removal**

1. Raise and suitably support the vehicle.
2. Remove the tire and wheel assembly.
3. Clean all dirt and foreign material from the brake hose and brake pipe fitting.

**NOTE:**      **Install a rubber cap or plug to the exposed brake pipe fitting end to prevent brake fluid loss and contamination.**

4. Using a back-up wrench on the hose fitting, disconnect the brake pipe fitting from the brake hose, then cap or plug the brake pipe fitting end. DO NOT bend the brake pipe or the bracket.
5. Remove the brake hose retainer from the brake hose at the hose bracket.



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### 2002 BRAKES Disc - Corvette

6. Remove the brake hose from the hose bracket.
7. Remove the brake caliper inlet fitting bolt from the caliper.
8. Remove the brake hose from the brake caliper.
9. Remove and discard the 2 copper brake hose gaskets. These gaskets may be stuck to the brake caliper and/or the brake hose end.

#### Installation

To install, reverse removal procedure. Tighten fasteners to specification. See **TORQUE SPECIFICATIONS** . Fill and bleed brake system. See **BLEEDING BRAKE SYSTEM** .

#### BRAKE PEDAL

##### Removal

1. On convertible models, open the folding top stowage compartment lid. Remove the screws attaching the lower sides of the extension panel. Remove the screws attaching the top of the extension panel. Remove the extension panel upward from the bracket.
2. On all models, open the console door.
3. Pull up on the rear of the electronic traction control/ride control switch in order to release the retaining clips. If the switch does not release from the trim plate, carefully insert a screwdriver into the recess located at the rear of the switch and gently pull up the rear of the switch.
4. Disconnect the electrical connector from the electronic traction control/ride control switch.
5. Disconnect the LED connector from the wiring harness connector.
6. Remove the electronic traction control/ride control switch.
7. Using a small flat bladed screwdriver, carefully remove the console retaining nut covers.
8. Remove the nuts retaining the rear of the console.
9. Remove the nuts retaining the front of the console and the I/P accessory trim plate.
10. Lift the rear of the console slightly and pull rearward to release the front of the console from under the instrument panel accessory trim plate.
11. Disconnect the electrical connector from the electrical accessory plug.
12. Unscrew to remove the console electrical accessory plug retainer from the console electrical accessory plug housing.
13. Remove the electrical accessory plug housing from the console.
14. Disconnect the electrical connector from the fuel door release, rear lift window release (export) switch.
15. Remove the fuel door release, rear lift window release (export) switch from the console.

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16. Turn the console over and carefully insert a small flat bladed screwdriver to release the switch tabs. Remove the console from the vehicle.
17. Grasp the shift control boot (M/T) and apply light pressure in toward the shift control lever, to begin to release the shift boot retaining tabs from the Instrument Panel (I/P) accessory trim plate. Using light pressure, continue to release the remaining boot retaining tabs, then lift the boot away from the trim plate.
18. Open the cigar lighter door and remove the ashtray. Remove the I/P accessory trim plate grille. Pry gently at the side edge with a flat-bladed screwdriver to release the tab.
19. Remove the accessory trim plate retaining screws next to the cigar lighter and behind the ashtray. Remove the accessory trim plate retaining screw in the grille opening.
20. Grasp the sides of the accessory trim plate near the curve at the base. Pull the trim plate rearward to release the locking tabs. Lift the rear of the trim plate to clear the driveline tunnel studs. Disconnect the electrical connector from the cigar lighter.
21. Rotate the shift control boot (M/T) and reposition one end down into the shifter opening in the trim plate. Lift the accessory trim plate over the shifter (and shift control boot, M/T), and remove the trim plate.
22. Remove the fog lamp, rear compartment lid release switch. Pry carefully at the lower edge of the switch to release the locking tab. Disconnect the electrical connector from the switch.
23. Remove the driver knee bolster trim panel retaining screw behind the fog lamp, rear compartment lid release switch.
24. Remove the driver knee bolster trim panel lower retaining screws.
25. Grasp the driver knee bolster trim panel at the side edges.
26. Pull firmly rearward to release the locking tabs.
27. Disconnect the electrical connector from the inside air temperature sensor, if equipped.
28. Remove the driver knee bolster trim panel.
29. Disconnect the Accelerator Pedal Position (APP) sensor module electrical connector.
30. Disengage the front floor kick-up panel upper latches. Open the front floor kick-up panel. Lift the front floor kick-up panel's lower edge up out of the slots in the multi-use relay bracket. Remove the front floor kick-up panel.
31. Remove the cover from the Instrument Panel (I/P) electrical center.
32. Remove the RDO/ANT mini-fuse(R) No. 24 from the I/P electrical center.
33. Using a flat bladed tool, carefully pry the I/P courtesy lamp assembly from the left lower closeout panel. Remove the push-on retaining nut from the steering column bracket stud. Release the left lower closeout panel push-in retainers from the I/P lower support beam. Insert the I/P courtesy lamp assembly up through the opening in the closeout panel. Lower and remove the closeout panel. Release the notch in the right forward edge of the closeout panel from the tab on the accelerator pedal bracket.

**NOTE:** The signal processing module is only held in place by retaining bolts. Be sure to support the signal processor upon removal of the bolts.

34. Disconnect the electrical/audio connector from the Bose(R) signal processing module. Remove the bolts retaining the Bose(R) signal processing module to the steering column bracket. Remove the Bose(R) signal processing module.
35. Disconnect the stop light switch connector. Remove the retainer, washer, brake booster pushrod, and brake pedal pin from the brake pedal. Reposition the isolation mat by cutting a small slit in the mat.
36. Remove the brake pedal pivot bolt and nut. Remove the brake pedal from the mounting bracket.

#### Installation

1. Lubricate the bushings, pivot bolt, and all friction parts with high temperature silicone brake lubricant. Install the brake pedal to the mounting bracket.
2. Install the brake pedal pivot bolt and nut and tighten to specification. See **TORQUE SPECIFICATIONS**.
3. To complete installation, reverse removal procedure.

#### DISC BRAKE HARDWARE

**NOTE:** Support the brake caliper with heavy mechanic's wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

#### Removal - Front

1. Raise and support vehicle. Mark wheel in relation to hub. Remove wheel and tire assembly. Install and finger-tighten 2 lug nuts with flat side toward rotor to hold rotor when caliper is removed. Remove caliper guide pin bolts. Remove brake caliper from rotor and caliper mounting bracket. Wire caliper aside.
2. Remove the brake pads from the brake caliper bracket.
3. Remove the brake pad retainers from the brake caliper bracket.
4. Remove the caliper pins from the disc brake caliper mounting bracket.
5. Remove the caliper pin boots from the disc brake caliper mounting bracket.
6. Lightly wire brush all brake pad contact areas in order to remove any corrosion.

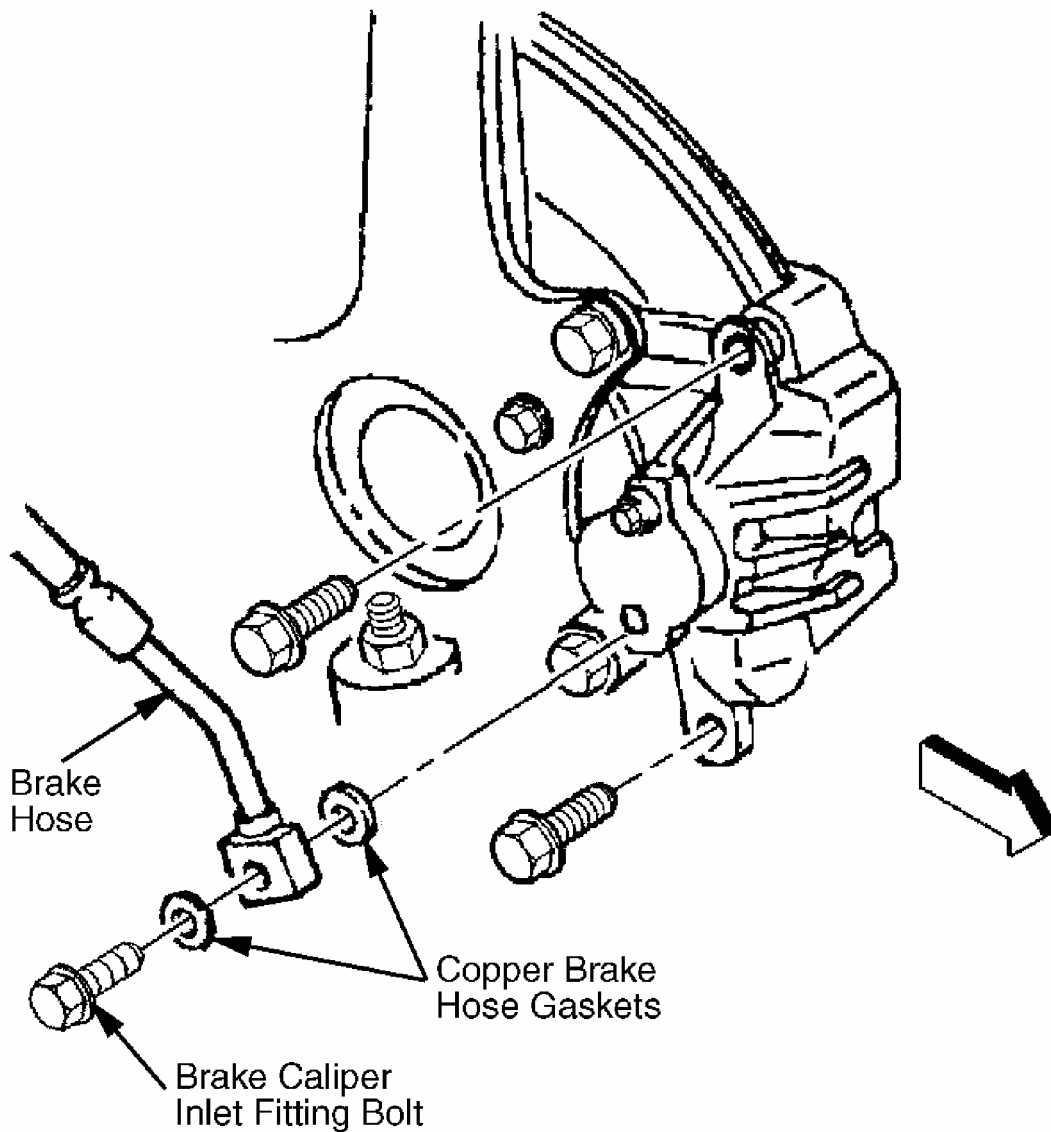
#### Installation

To install, reverse removal procedure. Lubricate the caliper guide pin bolts with high temperature silicone lubricant. Tighten fasteners to specification. See **TORQUE SPECIFICATIONS** .

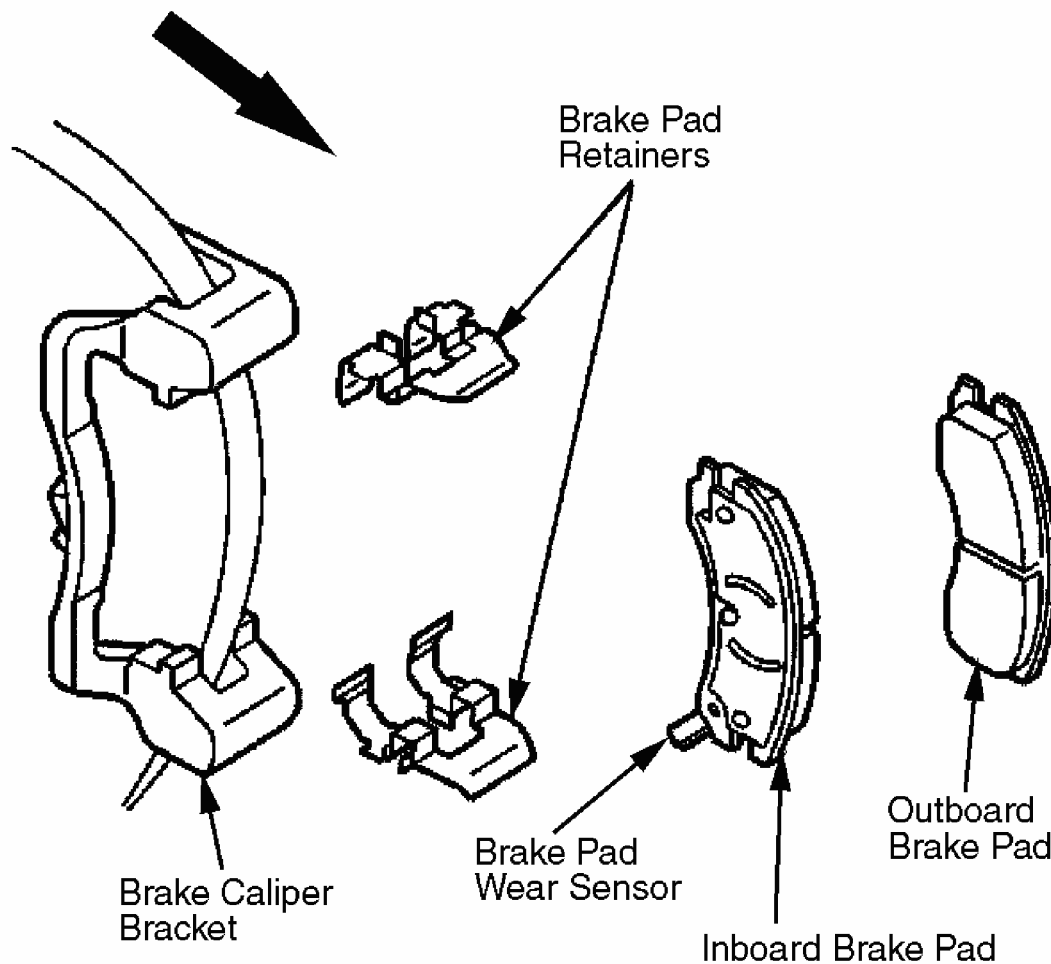
#### Removal - Rear

**NOTE:**      **Support the brake caliper with heavy mechanic's wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.**

1. Raise and support vehicle. Mark wheel in relation to hub. Remove wheel and tire assembly. Install and finger-tighten 2 lug nuts with flat side toward rotor to hold rotor when caliper is removed. Remove caliper guide pin bolts. See **Fig. 8** . Remove brake caliper from rotor and caliper mounting bracket. Wire caliper aside.
2. Remove the brake pads from the brake caliper bracket. See **Fig. 9** .
3. Remove the brake pad retainers from the brake caliper bracket.
4. Remove the caliper pins from the disc brake caliper mounting bracket.
5. Remove the caliper pin boots from the disc brake caliper mounting bracket.
6. Lightly wire brush all brake pad contact areas in order to remove any corrosion.



**Fig. 8: Identifying Rear Caliper Mounting Bolts & Brake Hose Connection (Left Side Shown; Right Side Is A Mirror Image)**  
**Courtesy of GENERAL MOTORS CORP.**



**Fig. 9: Identifying Rear Disc Brake Pad Orientation (Left Side Shown; Right Side Is A Mirror Image)**

Courtesy of GENERAL MOTORS CORP.

#### Installation

To install, reverse removal procedure. See **Fig. 8** and **Fig. 9** . Lubricate the caliper guide pin bolts with high temperature silicone lubricant. Tighten fasteners to specification. See **TORQUE SPECIFICATIONS** .

#### FRONT BRAKE CALIPER

##### Removal

1. Inspect fluid level in brake master cylinder.
2. If brake fluid level is midway between maximum-full point and minimum allowable level, no brake fluid needs to be removed from reservoir before proceeding.

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### 2002 BRAKES Disc - Corvette

3. If brake fluid level is higher than midway between maximum-full point and minimum allowable level, remove brake fluid to midway point before proceeding.
4. Raise and support vehicle.
5. Mark wheel in relation to hub. Remove wheel and tire assembly. Install and finger-tighten 2 lug nuts with flat side toward rotor to hold rotor when caliper is removed.
6. If not completely removing caliper, go to step 10 . If completely removing caliper, remove bolt securing brake hose to caliper.
7. Disconnect brake hose from caliper.
8. Remove and discard the 2 copper brake hose gaskets. Gaskets may be stuck to brake hose or brake caliper.
9. Plug opening in brake hose and brake caliper to prevent fluid loss and contamination.
10. Remove caliper guide pin bolts.
11. Remove brake caliper from rotor and caliper mounting bracket. If brake hose is still connected to caliper, wire caliper aside.

#### Installation

1. Inspect caliper slide boots for cuts, tears or deterioration. If damaged, replace the slides and boots.
2. Install caliper over rotor into caliper mounting bracket.
3. Install caliper guide pin bolts. Tighten caliper guide pin bolts to specification. See **TORQUE SPECIFICATIONS** .
4. If brake hose was not disconnected, go to step 8 . If brake hose was disconnected, remove caps sealing openings in brake caliper and brake hose.
5. Using 2 NEW copper gaskets, connect brake hose to caliper.
6. Tighten brake hose-to-caliper fitting bolt to specification. See **TORQUE SPECIFICATIONS** .
7. Bleed brake hydraulic system. See **BLEEDING BRAKE SYSTEM** .
8. Remove 2 lug nuts securing rotor and carefully align wheel-to-hub reference marks made during removal. Install wheel and tire assembly. Tighten wheel lug nuts to specification. See **TORQUE SPECIFICATIONS** .
9. Lower vehicle and ensure master cylinder fluid level is correct. Start engine and apply brakes slowly and firmly several times to seat pads. Recheck master cylinder fluid level and fill as necessary. Road-test vehicle.

#### FRONT BRAKE PADS

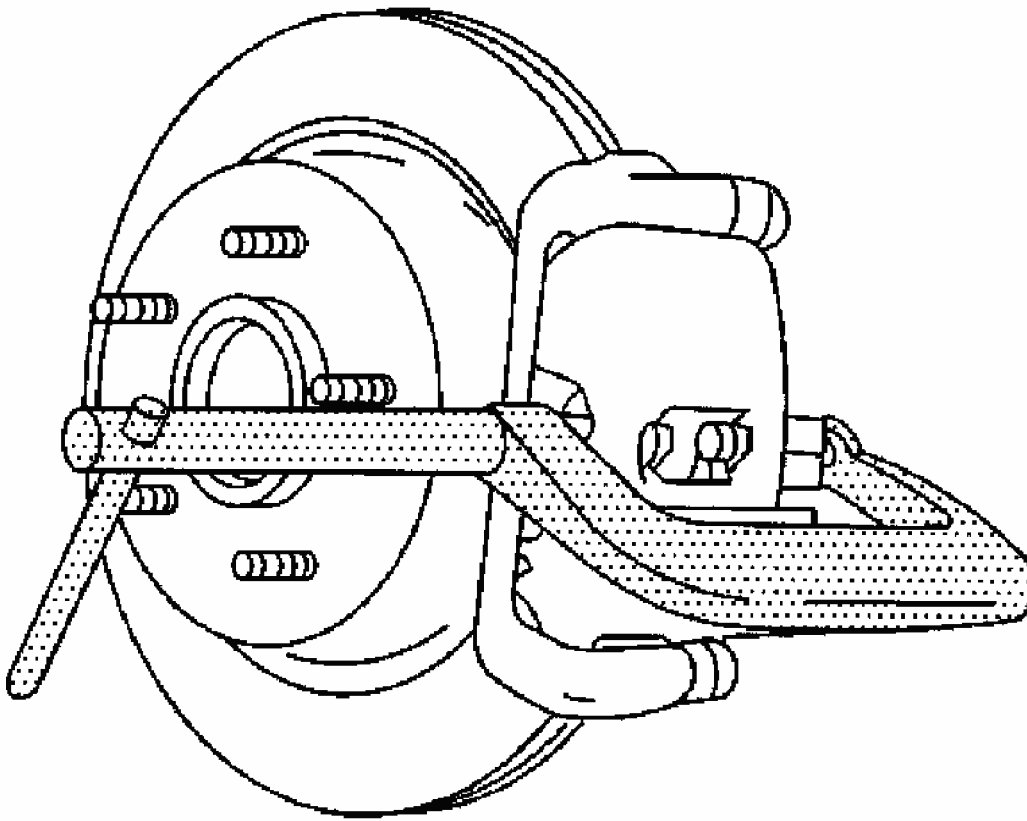
**NOTE:** After brake pads have been replaced and/or rotors have been resurfaced, it is recommended new braking surfaces be broken in or burnished. While test driving vehicle, perform 20 stops from 30

**MPH using medium to firm pedal pressure. DO NOT allow the brakes to lock. Ensure brakes do not overheat. Allow sufficient cooling periods between stops in order to properly burnish the brake pads and rotors.**

#### **Removal**

1. Inspect fluid level in brake master cylinder.
2. If brake fluid level is midway between maximum-full point and minimum allowable level, no brake fluid needs to be removed from reservoir before proceeding.
3. If brake fluid level is higher than midway between maximum-full point and minimum allowable level, remove brake fluid to midway point before proceeding.
4. Raise and support vehicle.
5. Mark wheel in relation to hub. Remove wheel and tire assembly.
6. Install and finger-tighten 2 lug nuts with flat side toward rotor to hold rotor when caliper is removed.
7. Install large "C" clamp over body of brake caliper with "C" clamp ends against rear of caliper body and against outboard brake pad. See **Fig. 10** .
8. Tighten the "C" clamp evenly until the caliper pistons are compressed into the caliper bores enough to allow the caliper to slide past the brake rotor.
9. Remove the "C" clamp from the caliper.
10. Remove upper brake caliper guide pin bolt.
11. Pivot brake caliper body downward and secure caliper out of way with heavy mechanic's wire or equivalent. Ensure that there is no tension on hydraulic brake flexible hose.
12. Remove brake pads from caliper bracket.
13. Remove and inspect brake pad retainers from caliper bracket.





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**Fig. 10: Retracting Disc Brake Caliper Piston (For Caliper Removal)**  
**Courtesy of GENERAL MOTORS CORP.**

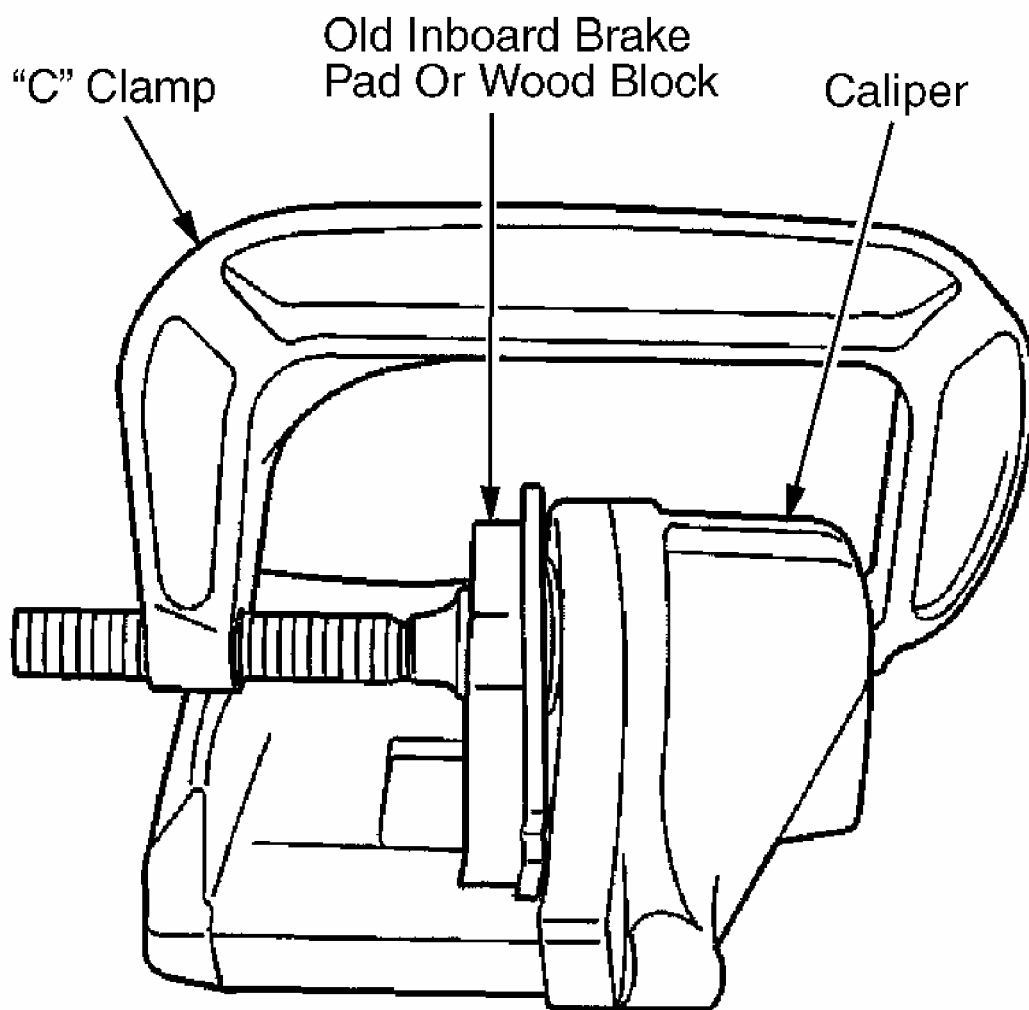
**Installation**

1. Inspect the caliper slide boots for cuts, tears, or deterioration. If damaged, replace the slides and the boots.
2. Install large "C" clamp over the body of the brake caliper with the "C" clamp ends against the rear of the caliper body and against an old inboard brake pad or a wood block installed against the caliper pistons. See **Fig. 11** .
3. Tighten the "C" clamp evenly until the caliper pistons are compressed completely into the caliper bores.
4. Remove the "C" clamp and the old brake pad or wood block from the caliper.
5. Install the brake pad retainers to the caliper bracket.
6. Install the brake pads to the caliper bracket. The brake pad wear sensor, mounted on the inboard brake pad, must be positioned so that it is in the trailing position during forward rotation of the brake rotor.

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### 2002 BRAKES Disc - Corvette

7. Pivot the brake caliper upward, over the brake pads and into the caliper bracket.
8. Install the upper brake caliper guide pin bolt and tighten to specification. See **TORQUE SPECIFICATIONS** .
9. Remove 2 lug nuts securing rotor. Install the tire and wheel assembly and tighten wheel lug nuts to specification.
10. Lower the vehicle.
11. With the engine OFF, gradually apply the brake pedal to approximately 2/3 of its travel distance.
12. Slowly release the brake pedal.
13. Wait 15 seconds, then repeat steps 11 -12 until a firm brake pedal apply is obtained. This will properly seat the brake caliper pistons and brake pads.
14. Fill the brake master cylinder reservoir to the proper level.
15. Burnish the brake pads and rotors. While test driving vehicle, perform 20 stops from 30 MPH using medium to firm pedal pressure. DO NOT allow the brakes to lock. Ensure brakes do not overheat. Allow sufficient cooling periods between stops in order to properly burnish the brake pads and rotors.



G00250006

**Fig. 11: Retracting Disc Brake Caliper Piston (For Installation Of New Brake Pads)**  
Courtesy of GENERAL MOTORS CORP.

#### FRONT BRAKE ROTOR

**NOTE:** After brake pads have been replaced and/or rotors have been resurfaced, it is recommended new braking surfaces be broken in or burnished. While test driving vehicle, perform 20 stops from 30 MPH using medium to firm pedal pressure. DO NOT allow the brakes to lock. Ensure brakes do not overheat. Allow sufficient cooling periods between stops in order to properly burnish the brake pads and rotors.

1. Raise and support vehicle.
2. Mark wheel in relation to hub. Remove wheel and tire assembly.
3. Install large "C" clamp over body of brake caliper with "C" clamp ends against rear of caliper body and against outboard brake pad. See **Fig. 10** .
4. Tighten the "C" clamp evenly until the caliper pistons are compressed into the caliper bores enough to allow the caliper to slide past the brake rotor.
5. Remove the "C" clamp from the caliper.
6. Remove the brake caliper bracket bolts. Remove the brake caliper and the caliper mounting bracket as an assembly from the suspension knuckle and support the assembly with heavy mechanic's wire, or equivalent. Ensure that there is no tension on the hydraulic brake flexible hose. Do NOT disconnect the hydraulic brake flexible hose from the caliper.
7. Mark rotor in relation to hub.
8. Remove rotor.

**Installation**

**NOTE:**      **Whenever the rotor has been separated from the wheel bearing flange, clean any rust or contaminants from the wheel bearing flange and the brake rotor mating surfaces. Failure to do this may result in increased lateral runout of the brake rotor, and brake pulsation.**

1. Clean any rust or corrosion from the wheel hub flange.
2. Clean any rust or corrosion from the mating surface and mounting surface of the brake rotor.
3. Install the brake rotor over the wheel studs onto the wheel bearing flange using reference mark made upon removal.
4. Install the brake caliper and the brake caliper bracket as an assembly to the suspension knuckle. Tighten fasteners to specification. See **TORQUE SPECIFICATIONS** .
5. Install the tire and wheel assembly and tighten wheel lug nuts to specification.
6. Lower the vehicle.
7. Burnish the brake pads and rotors. While test driving vehicle, perform 20 stops from 30 MPH using medium to firm pedal pressure. DO NOT allow the brakes to lock. Ensure brakes do not overheat. Allow sufficient cooling periods between stops in order to properly burnish the brake pads and rotors.

**MASTER CYLINDER****Removal**

Remove brake fluid from master cylinder reservoir. Disconnect electrical connector from

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brake fluid level switch. Disconnect brakelines from master cylinder. Plug openings. Remove nuts securing master cylinder to power brake booster. Remove master cylinder.

#### Installation

Bench bleed master cylinder. Install master cylinder to the power brake booster. Tighten master cylinder nuts and brakeline fittings to specification. See **TORQUE SPECIFICATIONS** . Connect brake fluid level switch connector. Fill and bleed brake system. See **BLEEDING BRAKE SYSTEM** .

#### PARK BRAKE CABLE

**CAUTION:** In order to avoid being burned, DO NOT service the exhaust system while it is still hot. Service the exhaust system when it is cool. Always wear protective goggles and gloves when removing exhaust parts as falling rust and sharp edges from worn exhaust components could result in serious personal injury.

#### Removal - Front

1. Remove the park brake lever. See **PARK BRAKE LEVER ASSEMBLY** .
2. Raise and support the vehicle.
3. Remove the rear stabilizer shaft bracket bolts and nuts. Remove the rear stabilizer shaft brackets and insulators. Position the stabilizer shaft downwards. Remove the left side exhaust muffler bolts. Remove the exhaust muffler gasket. Slide the muffler blade out from the hanger. Remove right muffler.
4. Disconnect the rear park brake cables from the equalizer.
5. Disconnect the front park brake cable from the cable retainer.
6. Remove the front park brake cable bracket from the tunnel.
7. Lower the vehicle.
8. Remove the front cable from the vehicle.
9. Remove the pass-through grommet and front bracket from the cable.

#### Installation

To install, reverse removal procedure. Use a NEW exhaust muffler gasket. Tighten fasteners to specification. See **TORQUE SPECIFICATIONS** . Install the park brake lever. See **PARK BRAKE LEVER ASSEMBLY** .

#### Removal - Rear

1. Disable the park brake automatic adjuster. See **DISABLING PARKING BRAKE AUTOMATIC ADJUSTER** .

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2. Raise and support the vehicle.
3. Remove the rear stabilizer shaft bracket bolts and nuts. Remove the rear stabilizer shaft brackets and insulators. Position the stabilizer shaft downwards. Remove the left side exhaust muffler bolts. Remove the exhaust muffler gasket. Slide the muffler blade out from the hanger. Remove right muffler.
4. Disconnect the rear park brake cable at the retainer and equalizer.
5. Remove the rear park brake cable from the rear suspension mounting bracket.
6. Remove the rear park brake cable retainer nut.
7. Remove the rear park brake cable from the vehicle.

#### Installation

To install, reverse removal procedure. Use a NEW exhaust muffler gasket. Tighten fasteners to specification. See **TORQUE SPECIFICATIONS** . Enable the park brake automatic adjuster. See **ENABLING PARKING BRAKE AUTOMATIC ADJUSTER** .

#### PARK BRAKE LEVER ASSEMBLY

##### Removal

1. On convertible models, open the folding top stowage compartment lid. Remove the screws attaching the lower sides of the extension panel. Remove the screws attaching the top of the extension panel. Remove the extension panel upward from the bracket.
2. On all models, open the console door.
3. Pull up on the rear of the electronic traction control/ride control switch in order to release the retaining clips. If the switch does not release from the trim plate, carefully insert a screwdriver into the recess located at the rear of the switch and gently pull up the rear of the switch.
4. Disconnect the electrical connector from the electronic traction control/ride control switch.
5. Disconnect the LED connector from the wiring harness connector.
6. Remove the electronic traction control/ride control switch.
7. Using a small flat bladed screwdriver, carefully remove the console retaining nut covers.
8. Remove the nuts retaining the rear of the console.
9. Remove the nuts retaining the front of the console and the I/P accessory trim plate.
10. Lift the rear of the console slightly and pull rearward to release the front of the console from under the instrument panel accessory trim plate.
11. Disconnect the electrical connector from the electrical accessory plug.
12. Unscrew to remove the console electrical accessory plug retainer from the console electrical accessory plug housing.

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### 2002 BRAKES Disc - Corvette

13. Remove the electrical accessory plug housing from the console.
14. Disconnect the electrical connector from the fuel door release, rear lift window release (export) switch.
15. Remove the fuel door release, rear lift window release (export) switch from the console.
16. Turn the console over and carefully insert a small flat bladed screwdriver to release the switch tabs. Remove the console from the vehicle.
17. Place a protective cover over the sill plate and door trim panel on the passenger side of the vehicle. Remove the roof lift-off panel (coupe), or lower the folding top (convertible), to provide additional space for passenger seat removal.
18. Position the passenger seat rearward.
19. Remove the push pins and covers from the front of the adjuster legs.
20. Remove the nuts from the front of the adjuster legs.
21. Position the passenger seat forward. Remove the nuts attaching the rear adjuster legs. Disconnect the seat electrical connector (if equipped). Remove the passenger seat.
22. Remove the park brake lever boot nuts.
23. Disconnect the parking brake switch electrical connector.
24. Disable the parking brake automatic adjuster. See **DISABLING PARKING BRAKE AUTOMATIC ADJUSTER** .
25. Remove the parking brake lever assembly mounting bolts.
26. Reposition the park brake lever.
27. Disconnect the front parking brake cable from the drive sector and park brake lever assembly.

#### Installation

To install, reverse removal procedure. Tighten fasteners to specification. See **TORQUE SPECIFICATIONS** . Enable the park brake automatic adjuster. See **ENABLING PARKING BRAKE AUTOMATIC ADJUSTER** .

#### PARK BRAKE SHOE

##### Removal

1. Remove the rear brake rotor. See **REAR BRAKE ROTOR** .
2. Remove the rear wheel bearing/hub. See **REAR WHEEL BEARING/HUB** .
3. Rotate the parking brake adjusting nut until all park brake shoe adjustment has been removed.
4. Remove the parking brake shoe retaining spring.
5. Remove the park brake shoe assembly by grasping the shoe and spreading slightly while pulling the shoe from the actuator assembly.

**Installation**

1. Install the park brake shoe assembly by grasping the shoe and spreading slightly while pulling the shoe over the actuator assembly.
2. Install the parking brake shoe retaining spring.
3. Adjust the parking brake shoe-to-drum clearance. See **PARKING BRAKE ADJUSTMENT** .
4. Install the wheel bearing/hub. See **REAR WHEEL BEARING/HUB** .
5. Install the rear brake rotor. See **REAR BRAKE ROTOR** . Tighten fasteners to specification. See **TORQUE SPECIFICATIONS** .

**PARK BRAKE SHOE ACTUATOR****Removal**

1. Remove the rear brake rotor. See **REAR BRAKE ROTOR** .
2. Rotate the park brake adjuster nut until the bolt is in the closed position.
3. Remove the park brake shoe retaining spring.
4. Remove the park brake shoe assembly by grasping the shoe and spreading slightly while pulling the shoe from the actuator assembly.
5. Remove the 2 actuator mounting bolts.
6. Remove the actuator assembly from the dust shield.

**Installation**

**NOTE:**      **DO NOT** apply lubricant to any of the bolt threads.

1. Apply high temperature, silicone lubricant to the moving parts of actuator, except for the bolt threads.
2. Install the actuator to the dust shield and tighten the mounting bolts to specification. See **TORQUE SPECIFICATIONS** .
3. Install the park brake shoe assembly by grasping the shoe and spreading slightly while pulling the shoe over the actuator assembly.
4. Install the park brake shoe retaining spring.
5. Adjust the park brake. See **PARKING BRAKE ADJUSTMENT** .
6. Install the rear brake rotor. See **REAR BRAKE ROTOR** . Tighten fasteners to specification. See **TORQUE SPECIFICATIONS** .

**PARKING BRAKE SWITCH****Removal**



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### 2002 BRAKES Disc - Corvette

1. On convertible models, open the folding top stowage compartment lid. Remove the screws attaching the lower sides of the extension panel. Remove the screws attaching the top of the extension panel. Remove the extension panel upward from the bracket.
2. On all models, open the console door.
3. Pull up on the rear of the electronic traction control/ride control switch in order to release the retaining clips. If the switch does not release from the trim plate, carefully insert a screwdriver into the recess located at the rear of the switch and gently pull up the rear of the switch.
4. Disconnect the electrical connector from the electronic traction control/ride control switch.
5. Disconnect the LED connector from the wiring harness connector.
6. Remove the electronic traction control/ride control switch.
7. Using a small flat bladed screwdriver, carefully remove the console retaining nut covers.
8. Remove the nuts retaining the rear of the console.
9. Remove the nuts retaining the front of the console and the I/P accessory trim plate.
10. Lift the rear of the console slightly and pull rearward to release the front of the console from under the instrument panel accessory trim plate.
11. Disconnect the electrical connector from the electrical accessory plug.
12. Unscrew to remove the console electrical accessory plug retainer from the console electrical accessory plug housing.
13. Remove the electrical accessory plug housing from the console.
14. Disconnect the electrical connector from the fuel door release, rear lift window release (export) switch.
15. Remove the fuel door release, rear lift window release (export) switch from the console.
16. Turn the console over and carefully insert a small flat bladed screwdriver to release the switch tabs. Remove the console from the vehicle.
17. Place a protective cover over the sill plate and door trim panel on the passenger side of the vehicle. Remove the roof lift-off panel (coupe), or lower the folding top (convertible), to provide additional space for passenger seat removal.
18. Position the passenger seat rearward.
19. Remove the push pins and covers from the front of the adjuster legs.
20. Remove the nuts from the front of the adjuster legs.
21. Position the passenger seat forward. Remove the nuts attaching the rear adjuster legs. Disconnect the seat electrical connector (if equipped). Remove the passenger seat.
22. Remove the park brake lever boot nuts.
23. Lift the park brake lever slightly until it engages the first stop.

24. Remove the park brake lever assembly mounting bolts.
25. Disconnect the parking brake switch electrical connector.
26. Position the park brake lever assembly toward the rear of the vehicle.
27. Remove the park brake switch.

### Installation

To install, reverse removal procedure. Tighten fasteners to specification. See **TORQUE SPECIFICATIONS** .

### POWER BRAKE BOOSTER

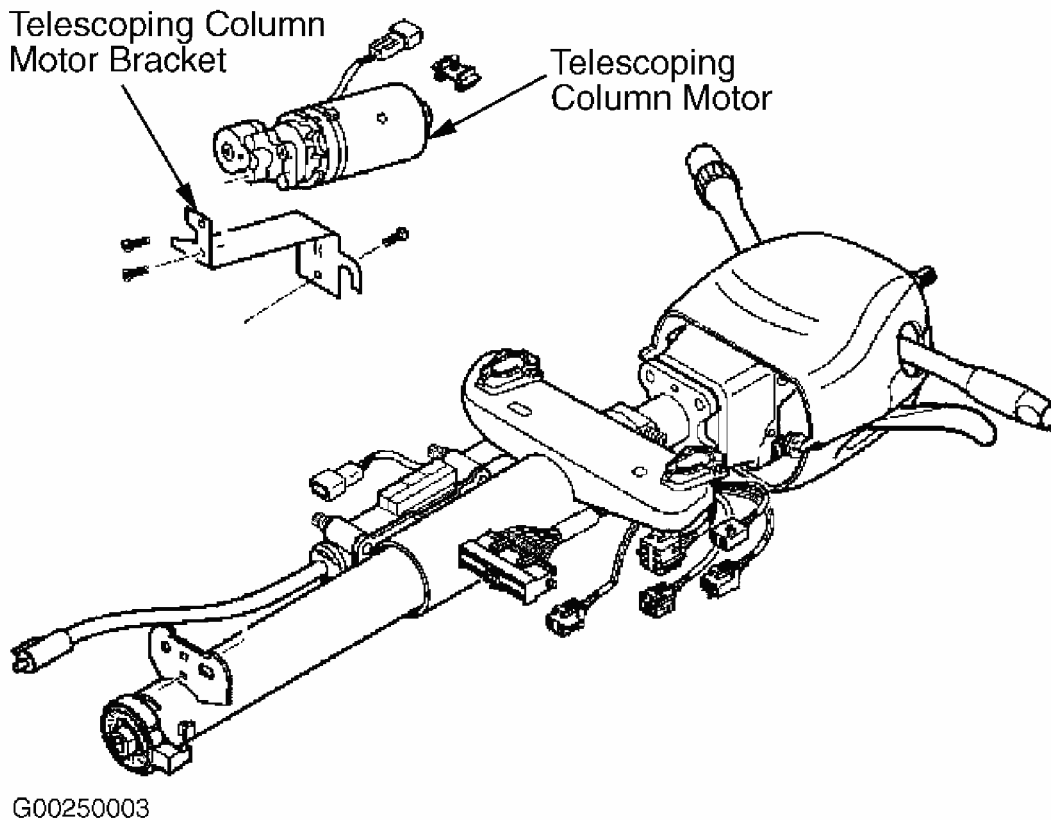
**NOTE:**      **Power brake booster can be removed without completely removing master cylinder. If master cylinder is to be completely removed from vehicle, see MASTER CYLINDER .**

### Removal

1. Disconnect negative battery cable. Remove windshield washer fluid reservoir. Disconnect electrical connector from master cylinder brake fluid level switch.
2. Remove nuts securing master cylinder to booster. Remove master cylinder from booster without disconnecting brakelines and position master cylinder aside. Disconnect brake booster vacuum hose from booster check valve. Remove left sound insulator under instrument panel. Remove master cylinder input push rod retaining clip and pin from brake pedal.
3. Remove the screw from the telescoping column motor mounting bracket and position the telescoping column motor assembly to the right of the steering column (if equipped). See **Fig. 12** . Remove booster mounting nuts and washers.

**NOTE:**      **The brake booster is retained to the cowl with push-on nuts.**

4. In order to release the booster mounting studs from the push-on nuts, move booster from side to side and pull the booster straight out.
5. Remove the brake booster and seal from the cowl. Inspect the booster seal and sealing surfaces for damage. Replace the seal if necessary.



**Fig. 12: Identifying Telescoping Steering Column Motor**  
Courtesy of GENERAL MOTORS CORP.

#### Installation

Install seal and booster to cowl. Install booster washers and stud nuts. Tighten nuts to specification. See **TORQUE SPECIFICATIONS** . To complete installation, reverse removal procedure. If master cylinder was removed, bleed brake system. See **BLEEDING BRAKE SYSTEM** .

#### REAR BRAKE CALIPER

##### Removal

1. Inspect fluid level in brake master cylinder.
2. If brake fluid level is midway between maximum-full point and minimum allowable level, no brake fluid needs to be removed from reservoir before proceeding.
3. If brake fluid level is higher than midway between maximum-full point and minimum allowable level, remove brake fluid to midway point before proceeding.
4. Raise and support vehicle.
5. Mark wheel in relation to hub. Remove wheel and tire assembly. Install and finger-

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### 2002 BRAKES Disc - Corvette

- tighten 2 lug nuts with flat side toward rotor to hold rotor when caliper is removed.
6. If not completely removing caliper, go to step 10 . If completely removing caliper, remove bolt securing brake hose to caliper. See **Fig. 8** .
  7. Disconnect brake hose from caliper.
  8. Remove and discard the 2 copper brake hose gaskets. Gaskets may be stuck to brake hose or brake caliper.
  9. Plug opening in brake hose and brake caliper to prevent fluid loss and contamination.
  10. Remove caliper guide pin bolts. See **Fig. 8** .
  11. Remove brake caliper from rotor and caliper mounting bracket. If brake hose is still connected to caliper, wire caliper aside.

#### Installation

1. Inspect the caliper slide boots for cuts, tears or deterioration. If damaged, replace the slides and the boots.
2. Install the brake caliper to the caliper mounting bracket.
3. Install the brake caliper guide pin bolts and tighten to specification. See **TORQUE SPECIFICATIONS** . See **Fig. 8** .
4. If brake hose was not disconnected, go to step 8 . If brake hose was disconnected, remove caps sealing openings in brake caliper and brake hose.
5. Assemble the 2 NEW copper brake hose gaskets, and the brake caliper inlet fitting bolt to the brake hose.
6. Install the brake hose and the brake caliper inlet fitting bolt to the brake caliper. Tighten brake caliper inlet fitting bolt to specification. See **TORQUE SPECIFICATIONS** .
7. Bleed the hydraulic brake system. See **BLEEDING BRAKE SYSTEM** .
8. Remove 2 lug nuts securing rotor. Install the tire and wheel assembly and tighten wheel lug nuts to specification.
9. Lower the vehicle.

#### REAR BRAKE PADS

##### Removal

**NOTE:** After brake pads have been replaced and/or rotors have been resurfaced, it is recommended new braking surfaces be broken in or burnished. While test driving vehicle, perform 20 stops from 30 MPH using medium to firm pedal pressure. DO NOT allow the brakes to lock. Ensure brakes do not overheat. Allow sufficient cooling periods between stops in order to properly burnish the brake pads and rotors.

1. Inspect fluid level in brake master cylinder.
2. If brake fluid level is midway between maximum-full point and minimum allowable level, no brake fluid needs to be removed from reservoir before proceeding. If brake fluid level is higher than midway between maximum-full point and minimum allowable level, remove brake fluid to midway point before proceeding.
3. Raise and support vehicle.
4. Mark wheel in relation to hub. Remove wheel and tire assembly.
5. Install and finger-tighten 2 lug nuts with flat side toward rotor to hold rotor when caliper is removed.
6. Install large "C" clamp over body of brake caliper with "C" clamp ends against rear of caliper body and against outboard brake pad. See **Fig. 10** .
7. Tighten the "C" clamp until the caliper piston is compressed into the caliper bore enough to allow the caliper to slide past the brake rotor.
8. Remove the "C" clamp from the caliper.
9. Remove caliper guide pin bolts.
10. Remove the brake caliper from the caliper bracket and support the caliper out of the way with heavy mechanic's wire or equivalent. Ensure that there is no tension on the hydraulic brake flexible hose. Do NOT disconnect the hydraulic brake flexible hose from the caliper.
11. Remove the brake pads from the caliper bracket.
12. Remove and inspect the brake pad retainers from the caliper bracket.

**Installation**

1. Inspect the caliper slide boots for cuts, tears or deterioration. If damaged, replace the slides and the boots.
2. Install large "C" clamp over the body of the brake caliper with the "C" clamp ends against the rear of the caliper body and against an old inboard brake pad or a wood block installed against the caliper piston. See **Fig. 11** .
3. Tighten the "C" clamp evenly until the caliper piston is compressed completely into the caliper bore.
4. Remove the "C" clamp and the old brake pad or wood block from the caliper.
5. Install the brake pad retainers to the caliper bracket. See **Fig. 9** .
6. Install the brake pads to the caliper bracket. The brake pad wear sensor, mounted on the inboard brake pad, must be positioned so that it is in the trailing position during forward rotation of the brake rotor. See **Fig. 9** .
7. Install the brake caliper to the caliper bracket.
8. Install the brake caliper guide pin bolts and tighten to specification. See **TORQUE SPECIFICATIONS** .
9. Install the tire and wheel assembly and tighten wheel lug nuts to specification.

10. Lower the vehicle.
11. With the engine OFF, gradually apply the brake pedal to approximately 2/3 of its travel distance.
12. Slowly release the brake pedal.
13. Wait 15 seconds, then repeat steps 11 -12 until a firm brake pedal apply is obtained. This will properly seat the brake caliper pistons and brake pads.
14. Fill the brake master cylinder reservoir to the proper level.
15. Burnish the brake pads and rotors. While test driving vehicle, perform 20 stops from 30 MPH using medium to firm pedal pressure. DO NOT allow the brakes to lock. Ensure brakes do not overheat. Allow sufficient cooling periods between stops in order to properly burnish the brake pads and rotors.

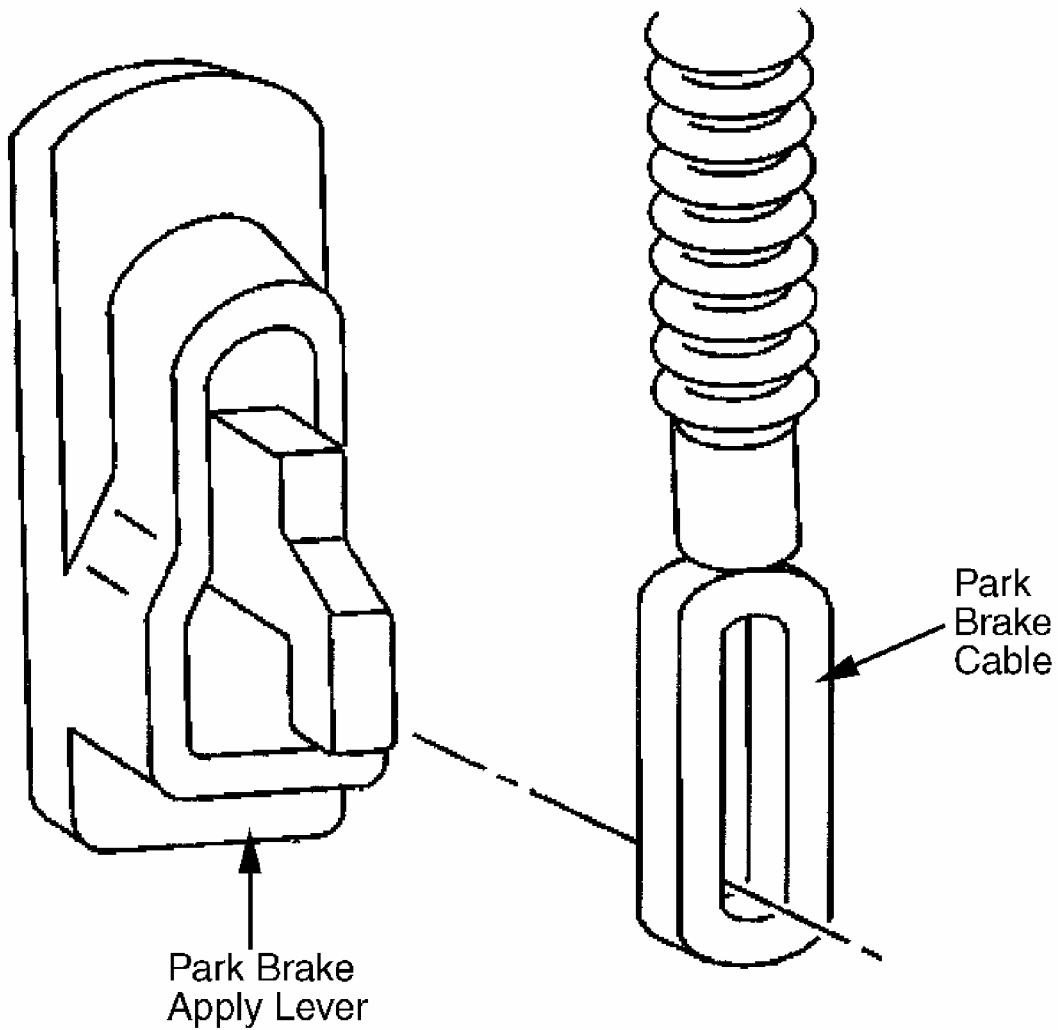
## REAR BRAKE ROTOR

**NOTE:** After brake pads have been replaced and/or rotors have been resurfaced, it is recommended new braking surfaces be broken in or burnished. While test driving vehicle, perform 20 stops from 30 MPH using medium to firm pedal pressure. DO NOT allow the brakes to lock. Ensure brakes do not overheat. Allow sufficient cooling periods between stops in order to properly burnish the brake pads and rotors.

## Removal

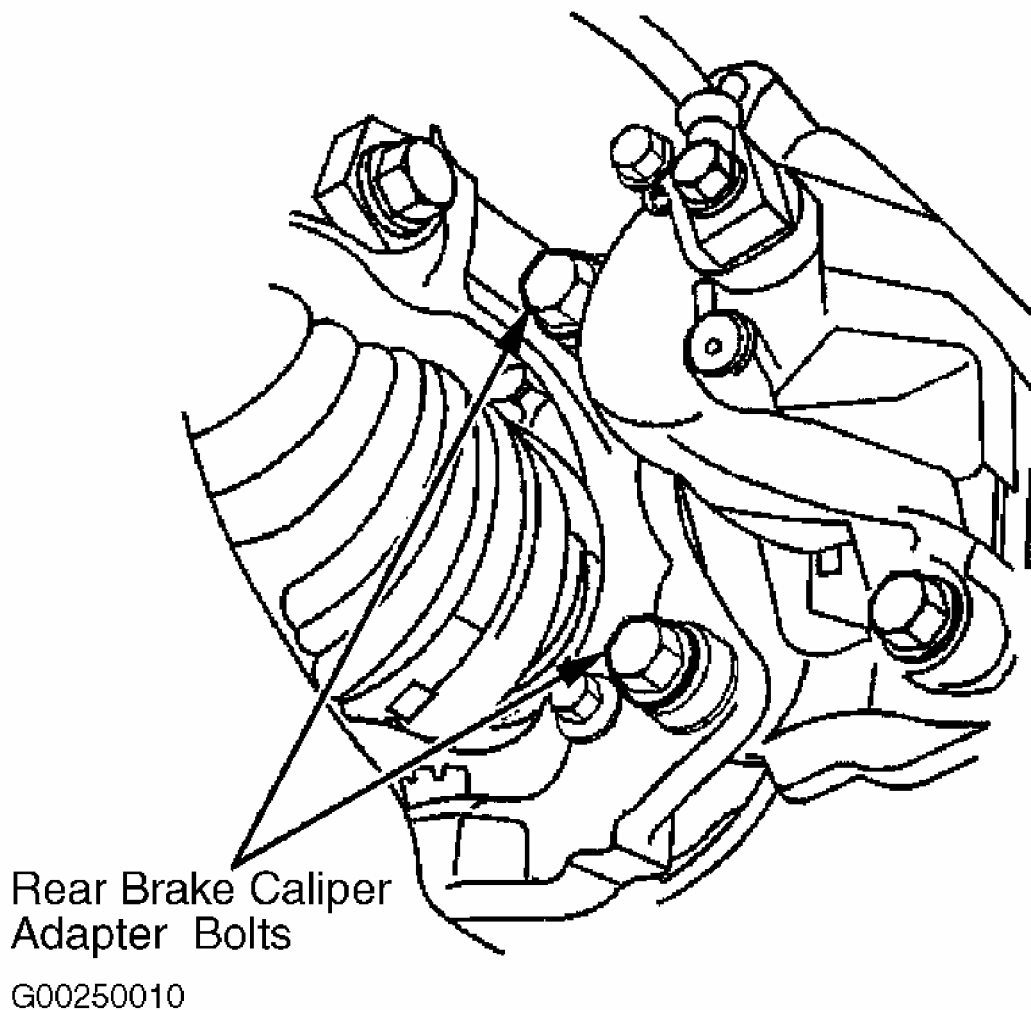
1. Check to be sure that the park brake is released.
2. Raise and suitably support the vehicle.
3. Mark wheel in relation to hub. Remove wheel and tire assembly.
4. Disconnect park brake cable from park brake apply lever. See **Fig. 13** .
5. Install large "C" clamp over body of brake caliper with "C" clamp ends against rear of caliper body and against outboard brake pad. See **Fig. 10** .
6. Tighten the "C" clamp until the caliper piston is compressed into the caliper bore enough to allow the caliper to slide past the brake rotor.
7. Remove the "C" clamp from the caliper.
8. Remove brake caliper adapter bolts. See **Fig. 14** . DO NOT disconnect brake flexible hose.
9. Remove the brake caliper and the caliper adapter as an assembly from the suspension knuckle and support the assembly with heavy mechanic's wire, or equivalent. Ensure that there is no tension on the hydraulic brake flexible hose. Do NOT disconnect the hydraulic brake flexible hose from the caliper.
10. Reference mark the position of the rotor to the wheel studs.
11. Remove the brake rotor. DO NOT force the rotor off. If the rotor is difficult to remove,

ease it off by gently rotating it as you pull outward.



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**Fig. 13: Removing/Installing Park Brake Cable From Park Brake Apply Lever**  
**Courtesy of GENERAL MOTORS CORP.**



**Fig. 14: Identifying Rear Brake Caliper Adapter Mounting Bolts**  
Courtesy of GENERAL MOTORS CORP.

**Installation**

**NOTE:** Whenever the rotor has been separated from the wheel bearing flange, clean any rust or contaminants from the wheel bearing flange and the brake rotor mating surfaces. Failure to do this may result in increased lateral runout of the brake rotor, and brake pulsation.

1. Clean any rust or corrosion from the wheel hub surface.
2. Clean any rust or corrosion from the rotor mating surface.
3. Connect the park brake cable to the park brake apply lever. See **Fig. 13** .



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### 2002 BRAKES Disc - Corvette

4. Adjust the clearance of the parking brake shoe to the drum-in-hat portion of the brake rotor. See **PARKING BRAKE** .
5. Install the brake rotor over the wheel studs onto the wheel bearing flange, aligning the reference mark made upon removal.
6. Install the brake caliper and the brake caliper bracket as an assembly to the suspension knuckle. Tighten brake caliper mounting bracket bolts to specification. See **TORQUE SPECIFICATIONS** .
7. Inspect the operation of the park brake. Adjust the park brake if necessary. See **PARKING BRAKE** .
8. Install the tire and wheel assembly and tighten wheel lug nuts to specification.
9. Lower the vehicle.
10. Burnish the brake pads and rotors. While test driving vehicle, perform 20 stops from 30 MPH using medium to firm pedal pressure. DO NOT allow the brakes to lock. Ensure brakes do not overheat. Allow sufficient cooling periods between stops in order to properly burnish the brake pads and rotors.

## REAR WHEEL BEARING/HUB

### Removal

1. Raise and support the vehicle.
2. Remove the tire and wheel assembly.
3. Disconnect the wheel speed sensor electrical connector.
4. Disconnect the Real Time Damping (RTD) position sensor link, if equipped.
5. Remove the brake caliper and rotor. See **REAR BRAKE ROTOR** .
6. Remove the shock absorber solenoid electrical connector, if equipped.
7. Separate the outer tie rod end from the suspension knuckle.
8. Remove the axle shaft spindle nut retainer, the axle shaft spindle nut and the washer.
9. Separate the upper control arm from the suspension knuckle.
10. Separate the suspension knuckle from the lower control arm ball joint stud.
11. Remove the suspension knuckle from the vehicle.
12. Remove the wheel hub mounting bolts.
13. Remove the hub and bearing assembly from the suspension knuckle.

### Installation

**NOTE:**     **The front and rear wheel hub/wheel speed sensors are not interchangeable. When you are replacing a wheel hub/wheel speed sensor be sure to use the correct wheel hub/wheel speed sensor part number. DO NOT mount the rear wheel hub/wheel**

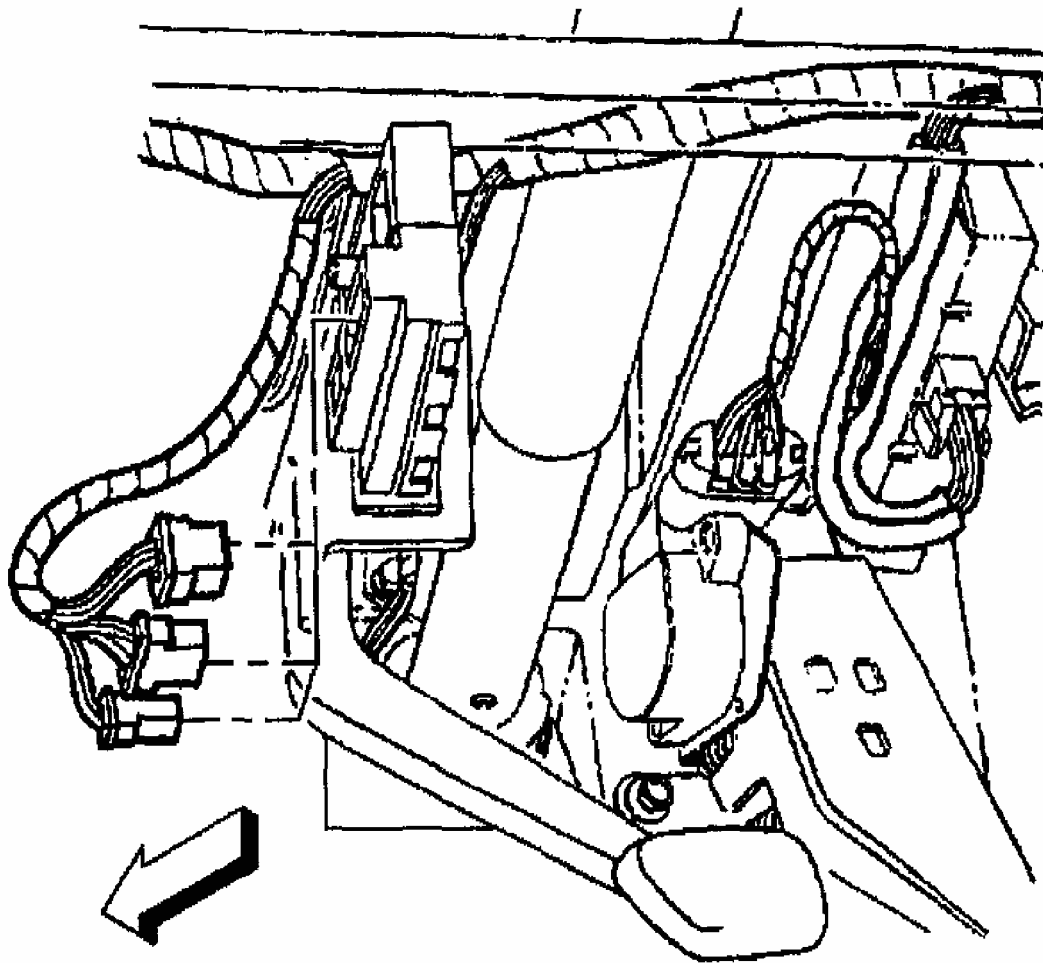
**speed sensor in the front steering knuckle. The rear wheel hub/wheel speed sensor features a splined hole through the center of the bearing which mates to the drive axle. The rear wheel hub/wheel speed sensor requires the support of the drive axle and the drive axle nut clamped joint to properly carry the vehicle loads. Mounting the rear wheel hub/wheel speed sensor in the front steering knuckle can cause bearing failure and possible damage to the vehicle.**

1. Install the wheel hub and bearing assembly to the suspension knuckle.
2. Install the wheel hub mounting bolts. Tighten the wheel hub mounting bolts to specification. See **TORQUE SPECIFICATIONS** .
3. Install the suspension knuckle to the upper control arm and to the lower control arm ball joint stud. To complete installation, reverse removal procedure. Tighten fasteners to specification. See **TORQUE SPECIFICATIONS** .

## **STOP LAMP SWITCH REPLACEMENT**

### **Removal Procedure**

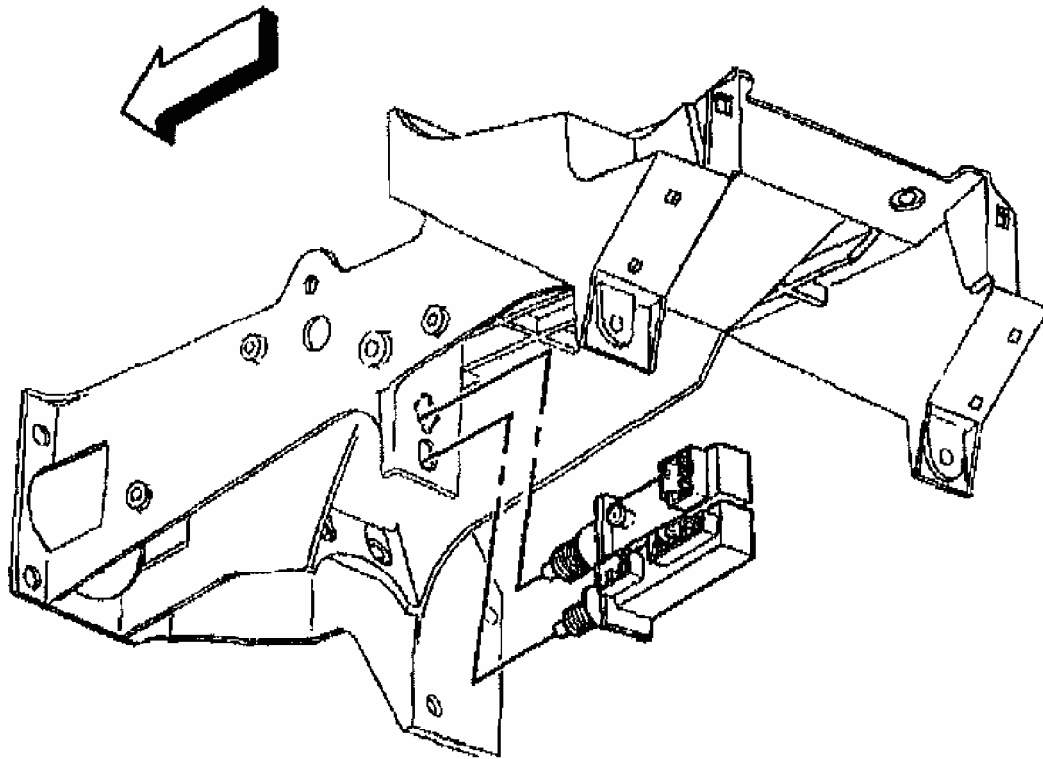
1. Remove the instrument panel (I/P) lower trim panel. Refer to **INSTRUMENT PANEL ACCESSORY TRIM PLATE & KNEE** .
2. Disconnect the stop lamp switch connectors.



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**Fig. 15: Removing Stop Lamp Switch Connectors**  
**Courtesy of GENERAL MOTORS CORP.**

3. 3. Remove the stop lamp switch.

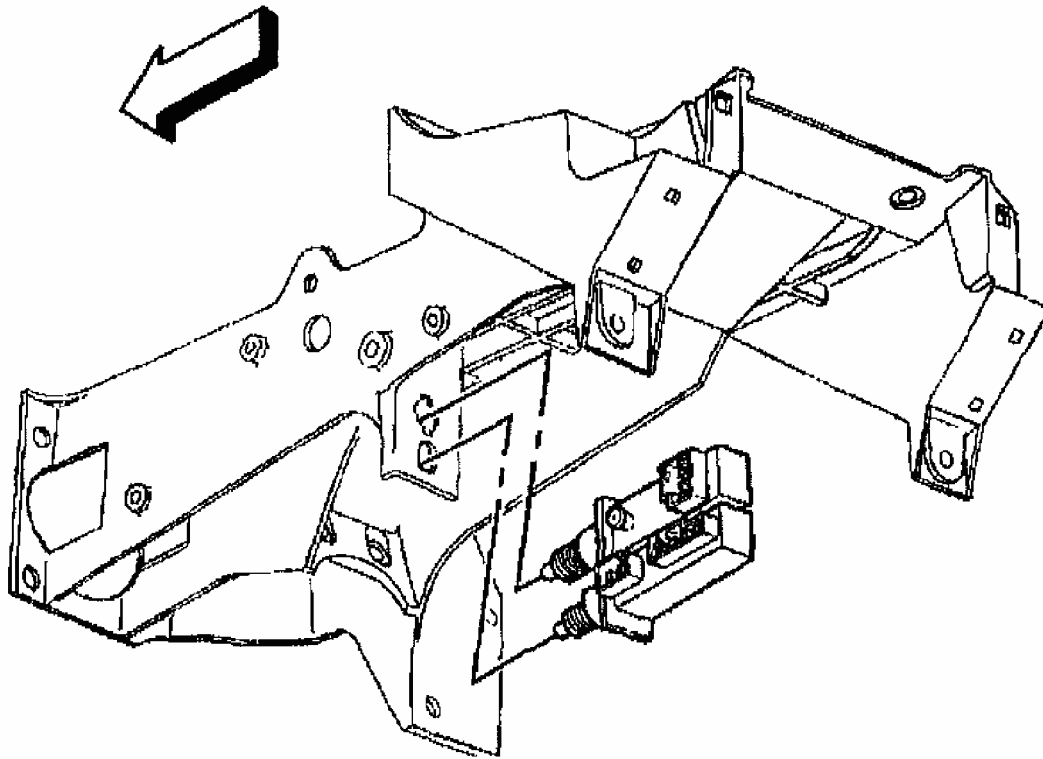


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**Fig. 16: Removing Stop Lamp Switch**  
**Courtesy of GENERAL MOTORS CORP.**

**Installation Procedure**

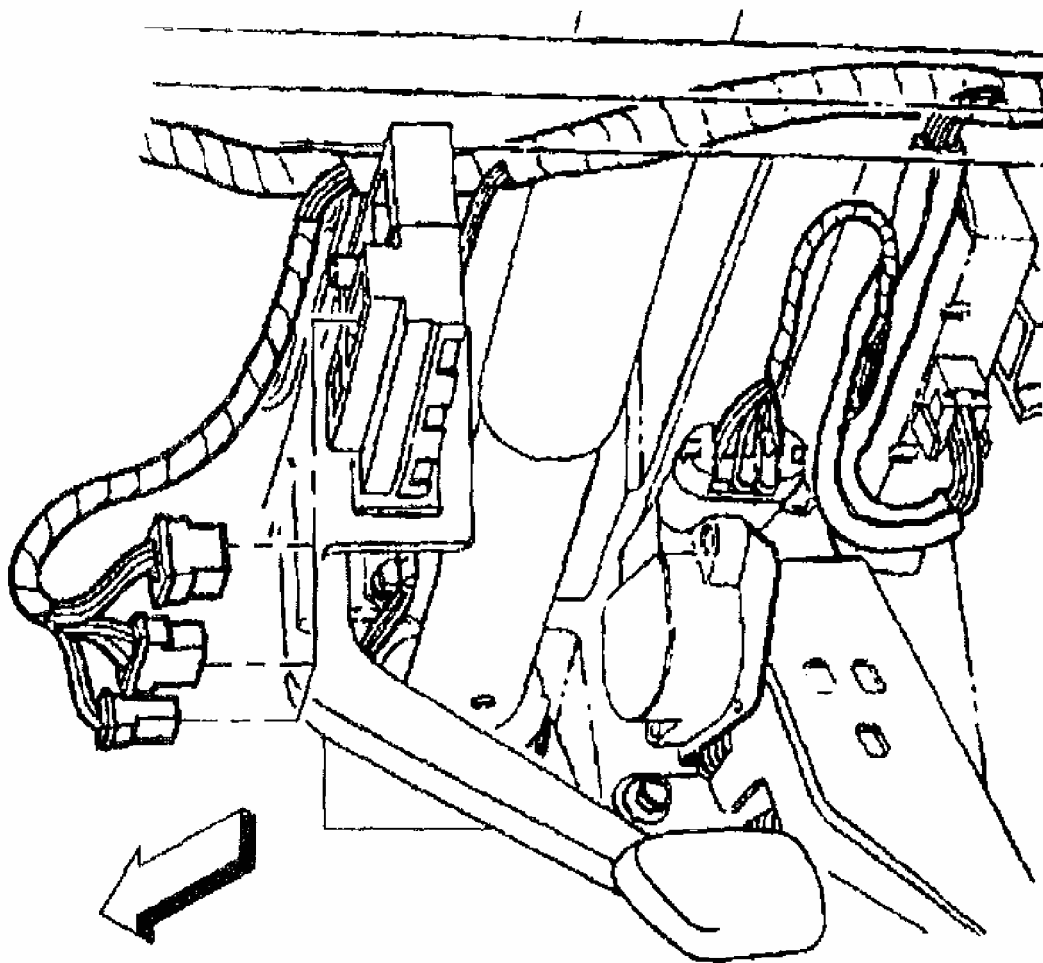
1. 1. Install the stop lamp switch.
2. 2. Adjust the stop lamp switch. Refer to **BRAKELIGHT/CRUISE CONTROL SWITCH ADJUSTMENT** . .



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**Fig. 17: Installing Stop Lamp Switch**  
**Courtesy of GENERAL MOTORS CORP.**

3. 3. Connect the stop lamp switch connectors.
4. 4. Install the instrument panel lower trim panel. Refer to **INSTRUMENT PANEL ACCESSORY TRIM PLATE & KNEE**

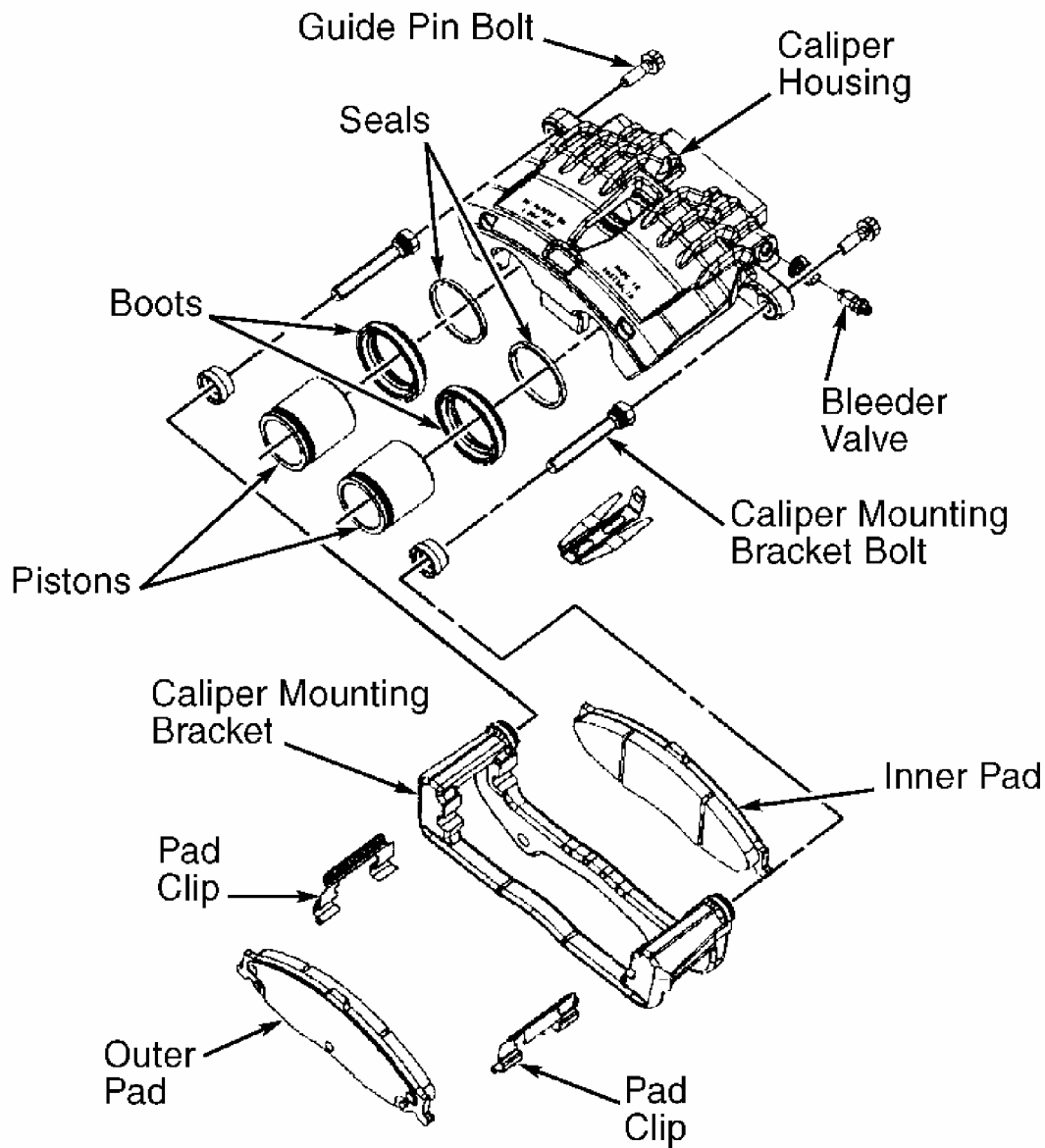


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**Fig. 18: Installing Stop Lamp Switch Connectors**  
Courtesy of GENERAL MOTORS CORP.

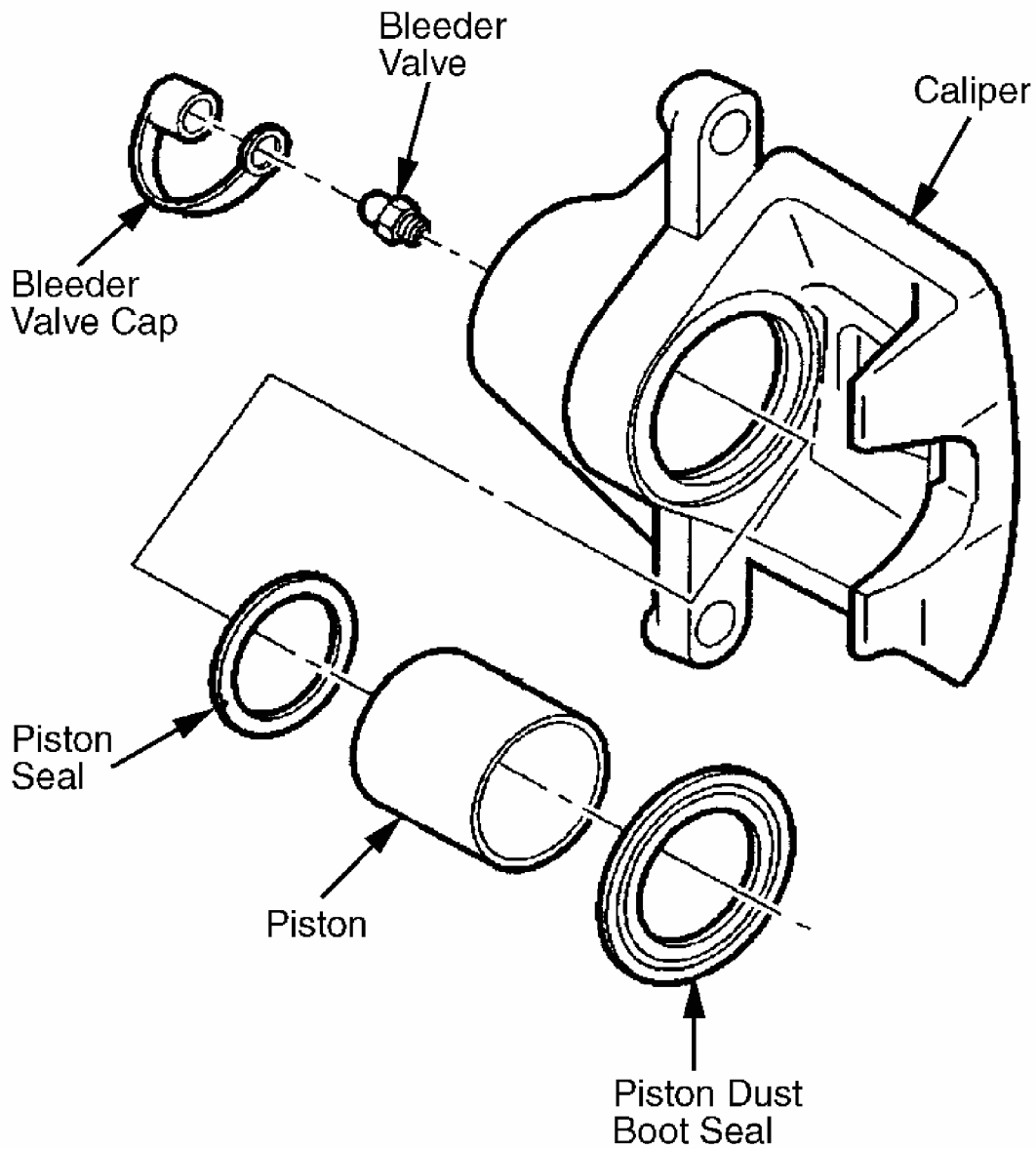
## OVERHAUL

**NOTE:** Use illustrations to aid in overhaul. See Fig. 19 -Fig. 21 .



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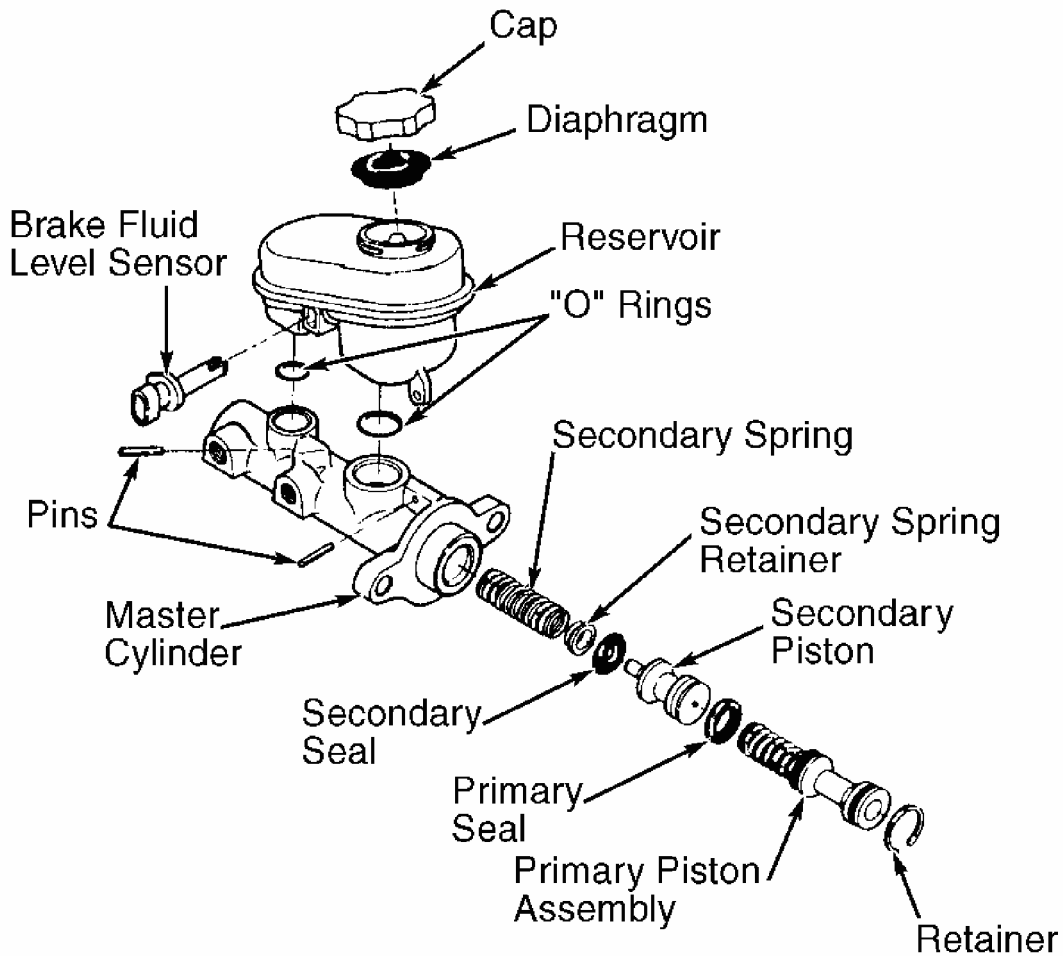
**Fig. 19: Exploded View Of Front Brake Caliper**  
Courtesy of GENERAL MOTORS CORP.



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**Fig. 20: Exploded View Of Rear Brake Caliper**  
Courtesy of GENERAL MOTORS CORP.





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**Fig. 21: Exploded View Of Master Cylinder**  
 Courtesy of GENERAL MOTORS CORP.

## DISC BRAKE SPECIFICATIONS

### DISC BRAKE SPECIFICATIONS

Application	In. (mm)
Disc Diameter <sup>(1)</sup>	
Lateral Runout	.002 (.06)
Parallelism	.001 (.03)
Minimum Refinish Thickness	
Front	1.205 (30.6)
Rear	.980 (24.9)
Discard Thickness	
Front	1.21 (30.6)

**2002 Chevrolet Corvette**

## 2002 BRAKES Disc - Corvette

Rear

.980 (24.9)

(1) Information is not available from manufacturer.

**TORQUE SPECIFICATIONS****TORQUE SPECIFICATIONS**

<b>Application</b>	<b>Ft. Lbs. (N.m)</b>
Axle Shaft Spindle Nut	118 (160)
Brake Hose-To-Caliper Inlet Fitting Bolt	33 (45)
Brake Hose-To-Brakeline Fitting	13 (18)
Brakeline-To-Master Cylinder Fitting	18 (24)
Brake Pedal Pivot Nut	21 (28)
Caliper Guide Pin Bolts	23 (31)
Caliper Mounting Bracket Bolts <sup>(1)</sup>	125 (170)
Exhaust Muffler Bolts	37 (50)
Master Cylinder-To-Booster Nut	21 (28)
Outer Tie Rod End Nut	
Step 1	15 (20)
Step 2	Additional 160 Degrees
Step 3	(2)
Parking Brake Lever Assembly Mounting Bolts	21 (28)
Parking Brake Shoe Actuator Assembly Mounting Bolts	52 (70)
Power Brake Booster-To-Firewall Nut	20 (27)
Rear Stabilizer Shaft Bracket	
Bolts	49 (65)
Nuts	70 (95)
Rear Suspension Knuckle Ball Joint Stud Nut	
Step 1	15 (20)
Step 2	Additional 250 Degrees
Step 3	(3)
Rear Wheel Hub Mounting Bolts	96 (130)
Seat Adjuster Leg Mounting Nuts	37 (50)
Seat Belt Buckle Side Mounting Nuts	37 (50)
Wheel Lug Nut	100 (136)
	<b>INCH Lbs. (N.m)</b>
Bose Signal Processing Module Retaining Bolts	22 (2.5)

**2002 Chevrolet Corvette**

## 2002 BRAKES Disc - Corvette

Caliper Bleeder Screw	106 (12)
Folding Top Storage Compartment Lid Extension Bolts (Convertible)	35 (4.0)
Parking Brake Lever Assembly Boot Nuts	89 (10)
Telescoping Steering Column Motor Screws	62 (7.0)
Windshield Washer Reservoir Retaining Nuts	66 (7.5)

(1) Clean mounting bracket and knuckle mating surface. Install NEW bolts, supplied with adhesive on threads.

(2) On final step, check for a minimum torque of 33 Ft. lbs. (45 N.m).

(3) On final step, check for a minimum torque of 41 Ft. lbs. (55 N.m).