

2004 BRAKES

Disc Brakes - Vue

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Brake Caliper Bleeder Valve	13 N.m	115 lb in
Brake Caliper Guide Pin Bolt	44 N.m	32 lb ft
Brake Caliper Mounting Bracket Bolt	185 N.m	136 lb ft
Brake Hose-to-Brake Caliper Bolt	44 N.m	32 lb ft

DISC BRAKE COMPONENT SPECIFICATIONS

Disc Brake Component Specifications

Application	Specification	
	Metric	English
Brake Pad Lining Minimum Thickness	2.0 mm	0.080 in
Brake Pad Lining Thickness - New	9.6 mm	0.380 in
Brake Rotor Diameter	296.00 mm	11.654 in
Brake Rotor Discard Thickness*	24.5 mm	0.960 in
Brake Rotor Maximum Allowable Assembled Lateral Runout	0.06 mm	0.002 in
Brake Rotor Maximum Allowable Scoring	1.50 mm	0.059 in
Brake Rotor Maximum Allowable Thickness Variation	0.025 mm	0.001 in
Brake Rotor Minimum Allowable Thickness After Refinish	24.5 mm	0.960 in
Brake Rotor Thickness - New	26.0 mm	1.024 in

* All brake rotors have a discard dimension cast into them. Replace any rotor that does not meet this specification. After refinishing the rotor, replace any rotor that does not meet the minimum thickness specification.

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - DISC BRAKES

Begin the disc brake system diagnosis with **Diagnostic Starting Point - Hydraulic Brakes** in Hydraulic Brakes. The use of the Diagnostic Starting Point will lead to the identification of the correct procedure for diagnosing the system and where the procedure is located.

BRAKE ROTOR THICKNESS MEASUREMENT

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

1. If the inboard friction surface of the brake rotor is not accessible, reposition and support the caliper with the brake pads. Refer to **Brake Pads Replacement** .
2. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.

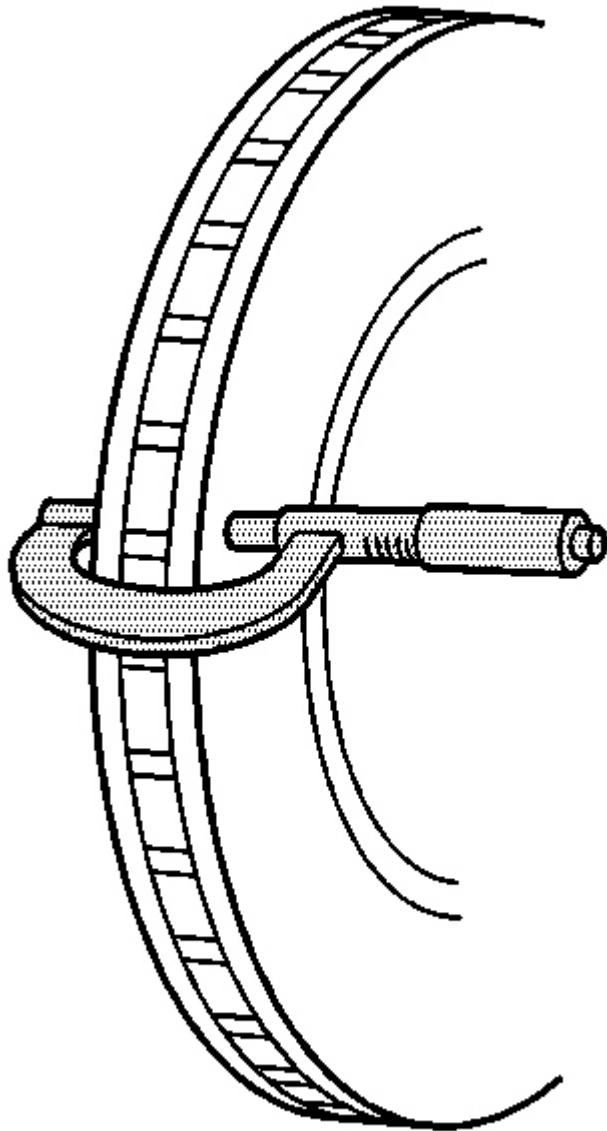


Fig. 1: Measuring Brake Rotor
Courtesy of GENERAL MOTORS CORP.

3. Using a micrometer calibrated in thousandths-of-a-millimeter, or ten-thousandths-of-an-inch, measure and record the thickness of the brake rotor at 4 or more points, evenly spaced around the rotor.

Ensure that the measurements are only taken within the friction surfaces and that the micrometer is

positioned the same distance from the outer edge of the rotor, about 13 mm (1/2 in), for each measurement.

4. Compare the lowest thickness measurement recorded to the following specification:

Specification: Brake rotor minimum allowable thickness after refinishing: 24.5 mm (0.960 in)

5. 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.
6. 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.
7. If the lowest thickness measurement of the brake rotor is at or below the discard thickness specification, the rotor requires replacement.

BRAKE ROTOR THICKNESS VARIATION MEASUREMENT

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

IMPORTANT: Any disc brake rotor that exhibits thickness variation exceeding the maximum acceptable level must be refinished or replaced. Thickness variation exceeding the maximum acceptable level can cause brake pulsation.

1. If the inboard friction surface of the brake rotor is not accessible, reposition and support the caliper with the brake pads. Refer to Brake Pads Replacement .
2. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.

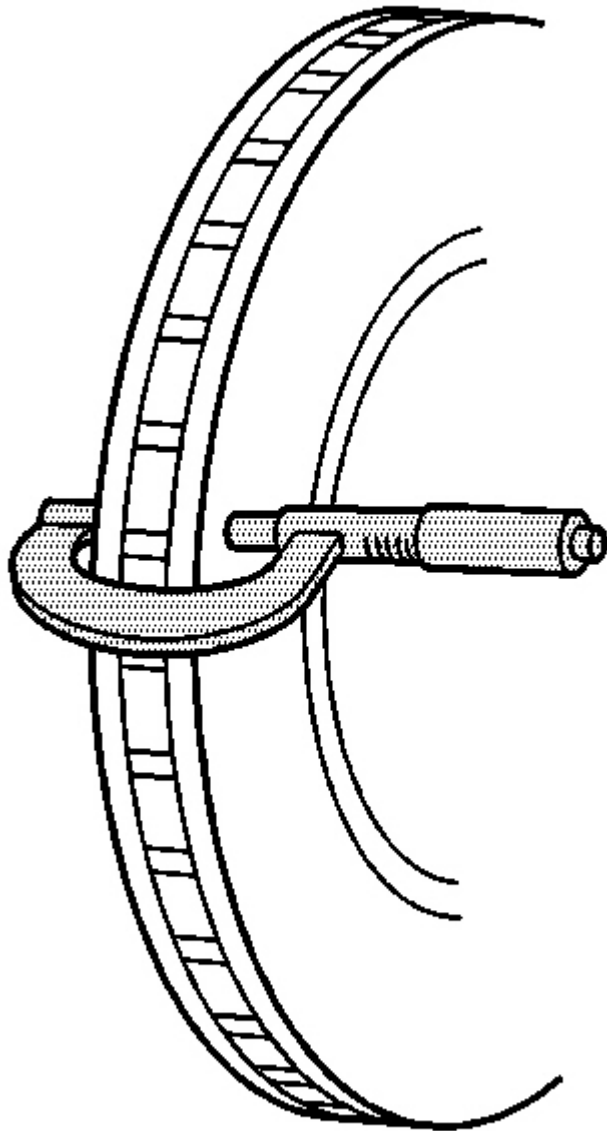


Fig. 2: Measuring Brake Rotor
Courtesy of GENERAL MOTORS CORP.

3. Using a micrometer calibrated in thousandths-of-a-millimeter, or ten-thousandths-of-an-inch, measure and record the thickness of the brake rotor at four or more points, evenly spaced around the rotor.

Ensure that the measurements are only taken within the friction surfaces and that the micrometer is

positioned the same distance from the outer edge of the rotor, about 13 mm (1/2 in), for each measurement.

4. Calculate the difference between the highest and lowest thickness measurements recorded to obtain the amount of thickness variation.
5. Compare the thickness variation measurement to the following specification:

Specification: Brake rotor maximum allowable thickness variation: 0.009 mm (0.000 in)

IMPORTANT: Whenever a brake rotor is refinished or replaced, the assembled lateral runout (LRO) of the rotor must be measured to ensure optimum performance of the disc brakes.

6. If the brake rotor thickness variation measurement exceeds the specification, the rotor requires refinishing or replacement.

BRAKE ROTOR SURFACE AND WEAR INSPECTION

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

1. If the inboard friction surface of the brake rotor is not accessible, reposition and support the caliper with the brake pads. Refer to **Brake Pads Replacement**.
2. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.
3. Inspect the friction 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
4. If the friction surfaces of the brake rotor exhibit one or more of the braking surface conditions listed, the rotor requires refinishing or replacement.

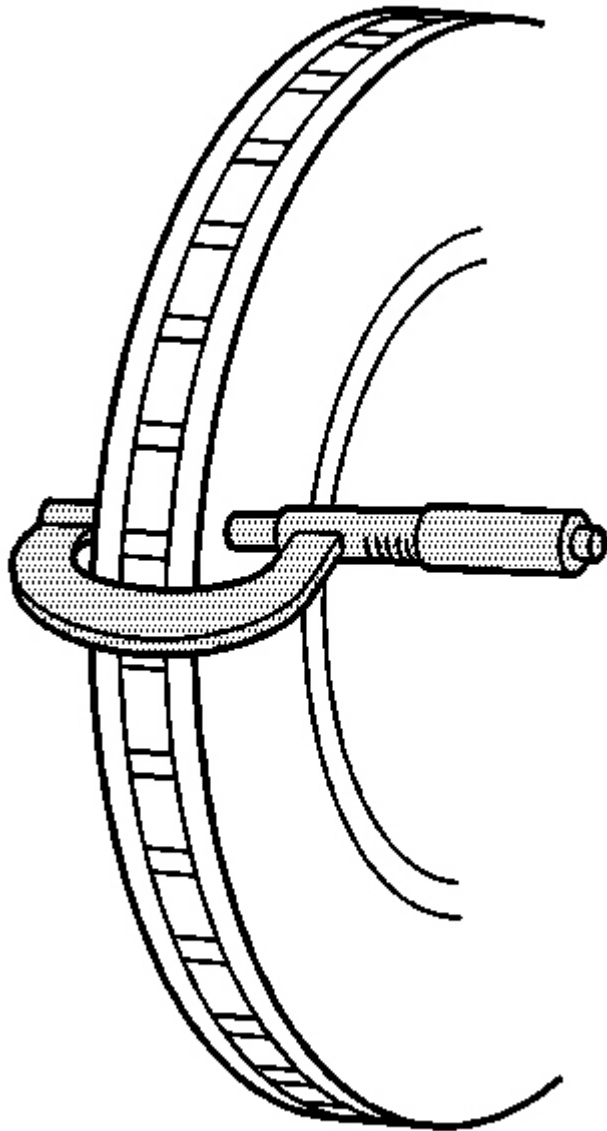


Fig. 3: Measuring Brake Rotor
Courtesy of GENERAL MOTORS CORP.

5. Using a micrometer calibrated in thousandths-of-a-millimeter, or ten-thousandths-of-an-inch, measure and record the scoring depth of any grooves present on the rotor friction surfaces.
6. Compare the groove scoring depth recorded to the following specification:

Specification: Brake rotor maximum allowable scoring: 1.50 mm (0.059 in)

7. If the brake rotor scoring depth exceeds the specification, or if an excessive amount of scoring is present, the rotor requires refinishing or replacement.

BRAKE ROTOR ASSEMBLED LATERAL RUNOUT (LRO) MEASUREMENT

Tools Required

- **J 39544-KIT** Torque-Limiting Socket Set, or equivalent. See **Special Tools and Equipment** .
- **J 41013** Rotor Resurfacing Kit. See **Special Tools and Equipment** .
- **J 42450-A** Wheel Hub Resurfacing Kit. See **Special Tools and Equipment** .
- **J 45101** Hub and Wheel Runout Gage, or equivalent. See **Special Tools and Equipment** .
- **J 45101-100** Conical Brake Rotor Washers. See **Special Tools and Equipment** .

CAUTION: Refer to **Brake Dust Caution** in Cautions and Notices.

IMPORTANT:

- Brake rotor assembled lateral runout (LRO) exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4 800-11 300 km (3,000-7,000 mi).
- Brake rotor thickness variation **MUST** be checked **BEFORE** checking for assembled LRO. Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to **Brake Rotor Thickness Variation Measurement** .

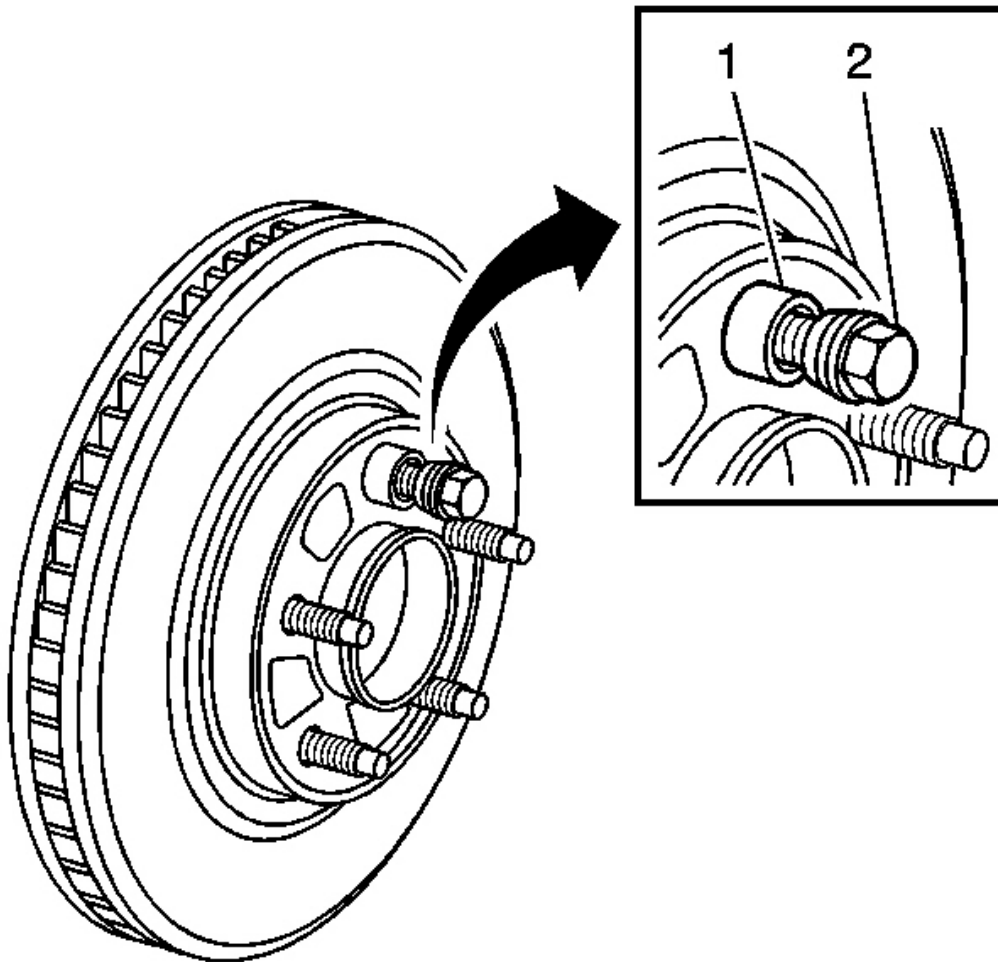


Fig. 4: Identifying J 45101-100
Courtesy of GENERAL MOTORS CORP.

1. Matchmark the position of the brake rotor to the wheel studs if this has not been done already.

IMPORTANT: Whenever the brake rotor has been separated from the hub/axle flange, any rust or contaminants should be cleaned from the hub/axle flange and the brake rotor mating surfaces. Failure to do this may result in excessive assembled LRO of the brake rotor, which could lead to brake pulsation.

2. Inspect the mating surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles, corrosion, rust, or debris remaining. If the wheel hub/axle flange and/or if the brake rotor mating surfaces exhibit these conditions, perform the following steps:

1. Remove the brake rotor from the vehicle. Refer to **Brake Rotor Replacement** .
 2. Using the **J 42450-A** , thoroughly clean any rust or corrosion from the mating surface of the hub/axle flange. See **Special Tools and Equipment** .
 3. Using the **J 41013** , thoroughly clean any rust or corrosion from the mating surface of the brake rotor. See **Special Tools and Equipment** .
 4. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.
3. Install the rotor to the hub/axle flange using the matchmark made prior to removal.
 4. Hold the rotor firmly in place against the hub/axle flange and install one of the **J 45101-100** (1), and one lug nut (2) onto the upper-most wheel stud. See **Special Tools and Equipment** .
 5. Continue to hold the rotor secure and tighten the lug nut firmly by hand.

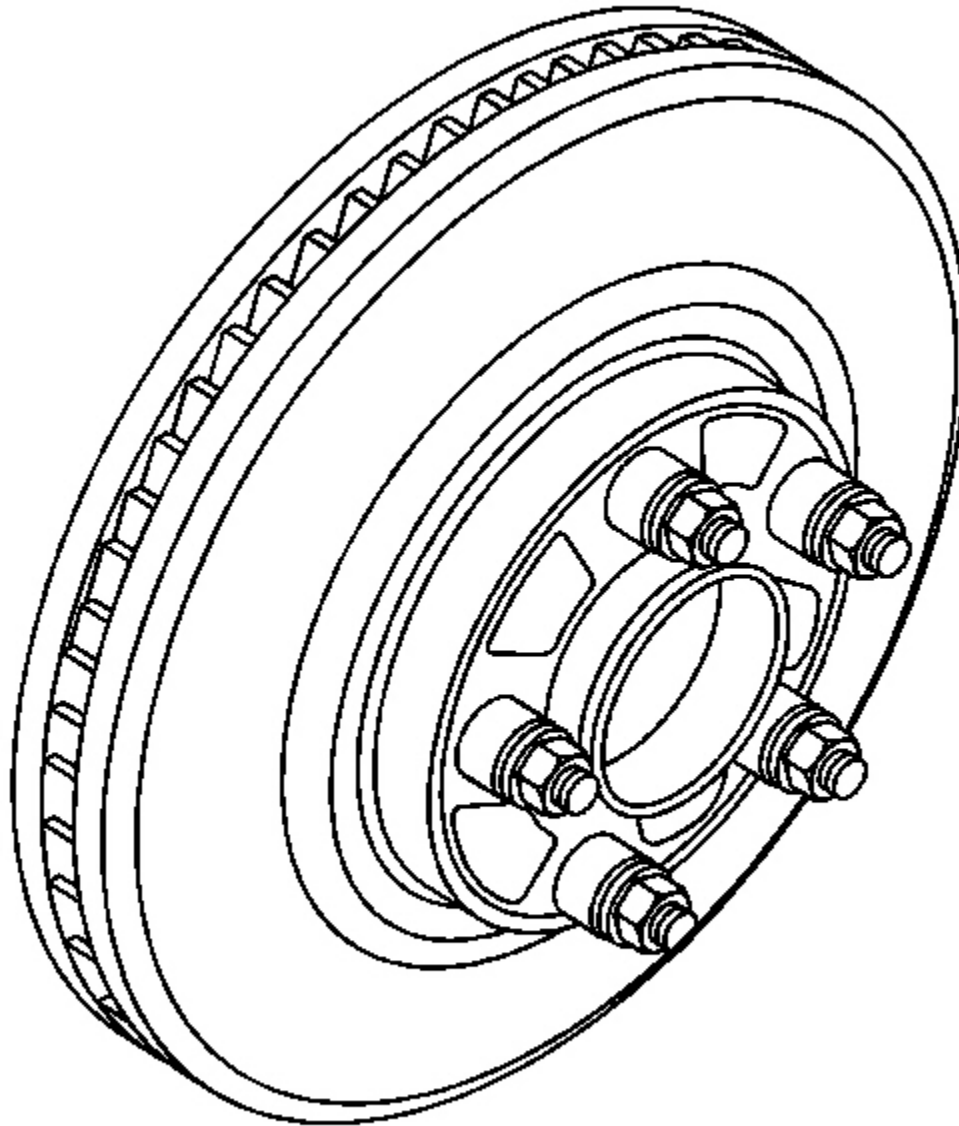


Fig. 5: Identifying Brake Rotor
Courtesy of GENERAL MOTORS CORP.

6. Install the remaining **J 45101-100** and lug nuts onto the wheel studs and tighten the nuts firmly by hand in a star-pattern. See **Special Tools and Equipment** .
7. Using the **J 39544-KIT** , or equivalent, tighten the lug nuts in a star-pattern to specification, in order to properly secure the rotor. See **Special Tools and Equipment** . Refer to **Tire and Wheel Removal and**

Installation in Tires and Wheels.

8. If the brake rotor has been REFINISHED or REPLACED with a new rotor, proceed to step 14.
9. If the brake rotor meets the following criteria, proceed to step 10.
 - The rotor is within specifications and is being REUSED.
 - The rotor has NOT been refinished.
 - The rotor does NOT exhibit thickness variation exceeding the maximum allowable level.

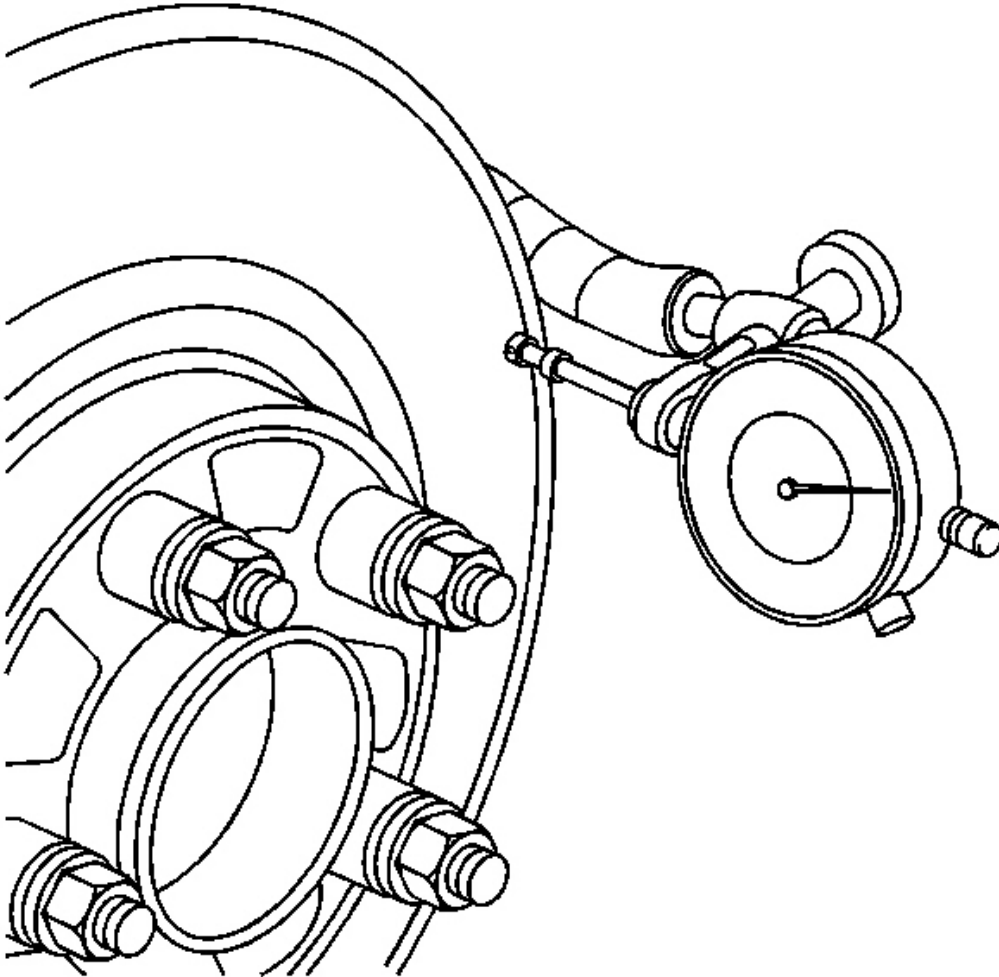


Fig. 6: Using Dial Indicator To Measure Lateral Runout
Courtesy of GENERAL MOTORS CORP.

10. Mount a dial indicator, **J 45101** , or equivalent, to the steering knuckle and position the indicator button

so it contacts the brake rotor friction surface at a 90 degree angle, approximately 13 mm (0.5 in) from the outer edge of the rotor. See **Special Tools and Equipment** .

11. Measure and record the assembled LRO of the brake rotor.
 1. Rotate the rotor until the lowest reading is displayed on the indicator dial, then set the dial to zero.
 2. Rotate the rotor until the highest reading is displayed on the dial.
 3. Mark the location of the high spot relative to the nearest wheel stud, or studs.
 4. Measure and record the amount of LRO.

12. Compare the brake rotor assembled LRO to the following specification:

Specification: Brake rotor maximum allowable assembled lateral runout: 0.06 mm (0.002 in).

13. If the brake rotor assembled LRO is within specifications, proceed to step 18.

If the brake rotor assembled LRO exceeds the specification, refinish the rotor to ensure true parallelism, refer to **Brake Rotor Refinishing** . After refinishing the rotor, proceed to step 14.

14. Mount a dial indicator, **J 45101** , or equivalent, to the steering knuckle and position the indicator button so it contacts the brake rotor friction surface at a 90 degree angle, approximately 13 mm (0.5 in) from the outer edge of the rotor. See **Special Tools and Equipment** .

15. Measure and record the assembled LRO of the brake rotor.
 1. Rotate the rotor until the lowest reading is displayed on the indicator dial, then set the dial to zero.
 2. Rotate the rotor until the highest reading is displayed on the dial.
 3. Mark the location of the high spot relative to the nearest wheel stud, or studs.
 4. Measure and record the amount of LRO.

16. Compare the brake rotor assembled LRO to the following specification:

Specification: Brake rotor maximum allowable assembled lateral runout: 0.06 mm (0.002 in)

17. If the brake rotor assembled LRO measurement exceeds the specification, bring the LRO to within specifications. Refer to **Brake Rotor Assembled Lateral Runout (LRO) Correction** .
18. If the brake rotor assembled LRO measurement is within specification, install the brake caliper and depress the brake pedal several times to secure the rotor in place before removing the **J 45101-100** and the lug nuts. See **Special Tools and Equipment** .

BRAKE PAD INSPECTION

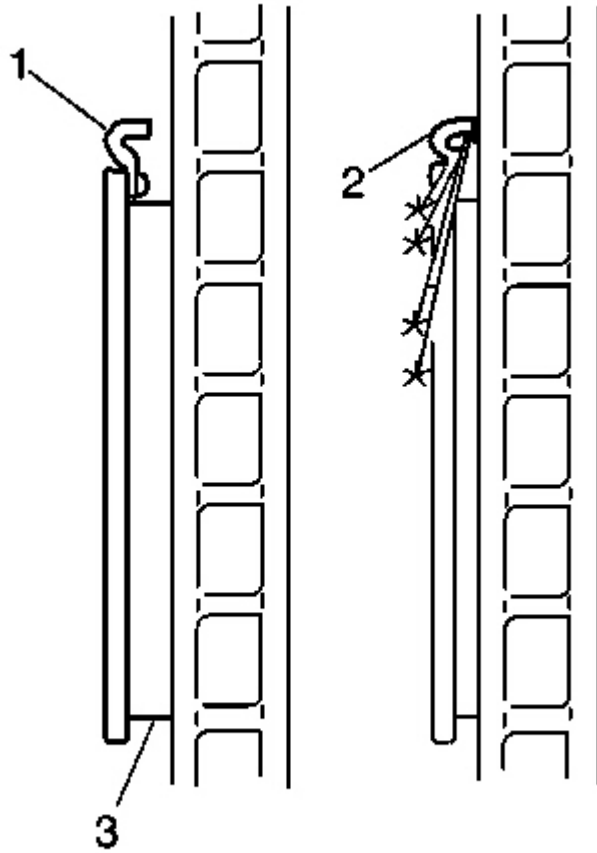


Fig. 7: View Of Brake Pads & Audible Wear Sensors
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

- 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 (3). The highest rate of wear normally occurs at the trailing edge of the disc brake pads.
- Inspect the thickness of the disc brake pads (3) in order to ensure that they have not worn excessively. The disc brake pad wear should be approximately even per axle set.

- Both front and rear disc brake pads have integral, audible wear sensors (1). When the disc brake pad wear reaches the minimum allowable thickness, the wear sensor contacts the disc brake rotor (2). The wear indicator will then produce an audible, high-pitched warning noise during wheel rotation.
- Replace the disc brake pads when the friction surface (3) is worn to within 2 mm (0.080 in) 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 0.5 mm (0.020 in) 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.
- Inspect the noise insulators on the brake pad mounting plate. Replace the brake pads if the noise insulators have separated from the brake pad mounting plate.

BRAKE CALIPER INSPECTION

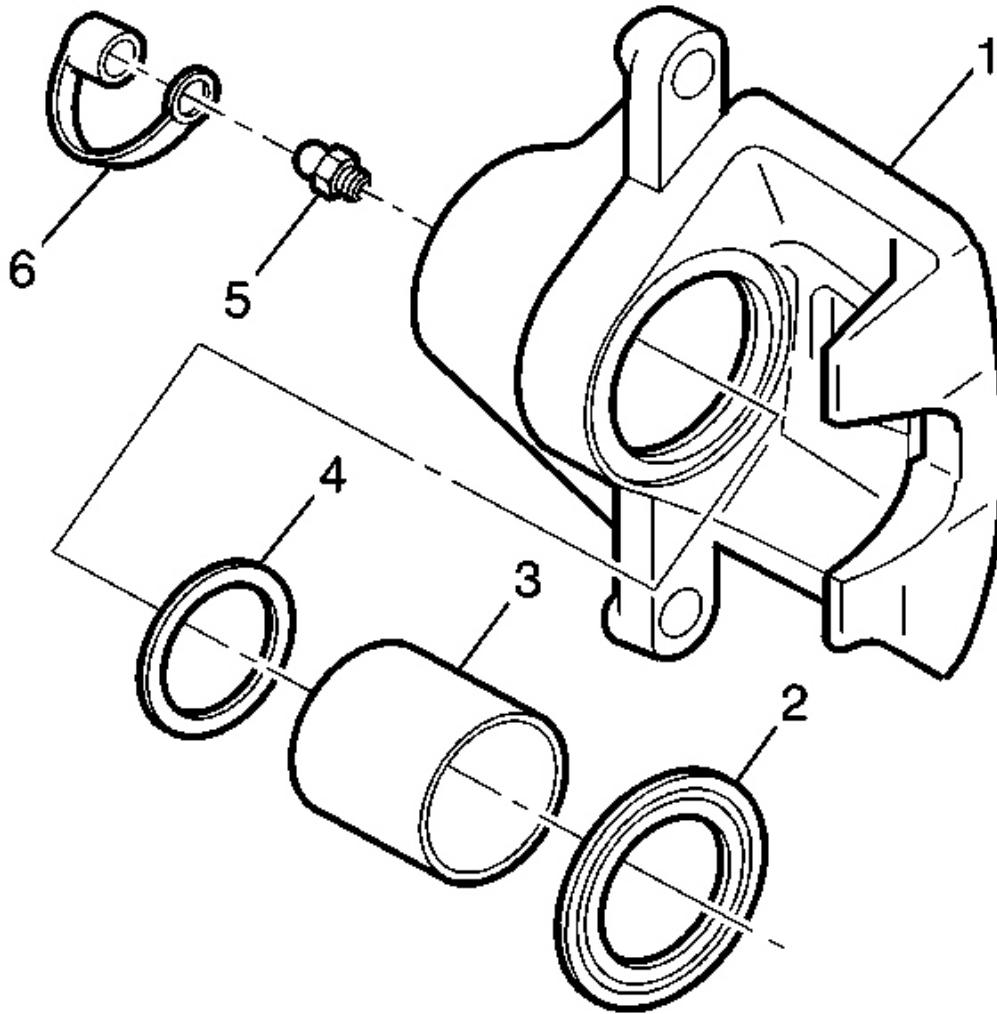


Fig. 8: Exploded View Of Brake Caliper
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

1. Inspect the brake caliper housing (1) 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 (2) 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.
3. Inspect for brake fluid leakage around the caliper piston dust boot seal (2) and on the disc brake pads. If there is any evidence of brake fluid leakage, the brake caliper requires overhaul or replacement.

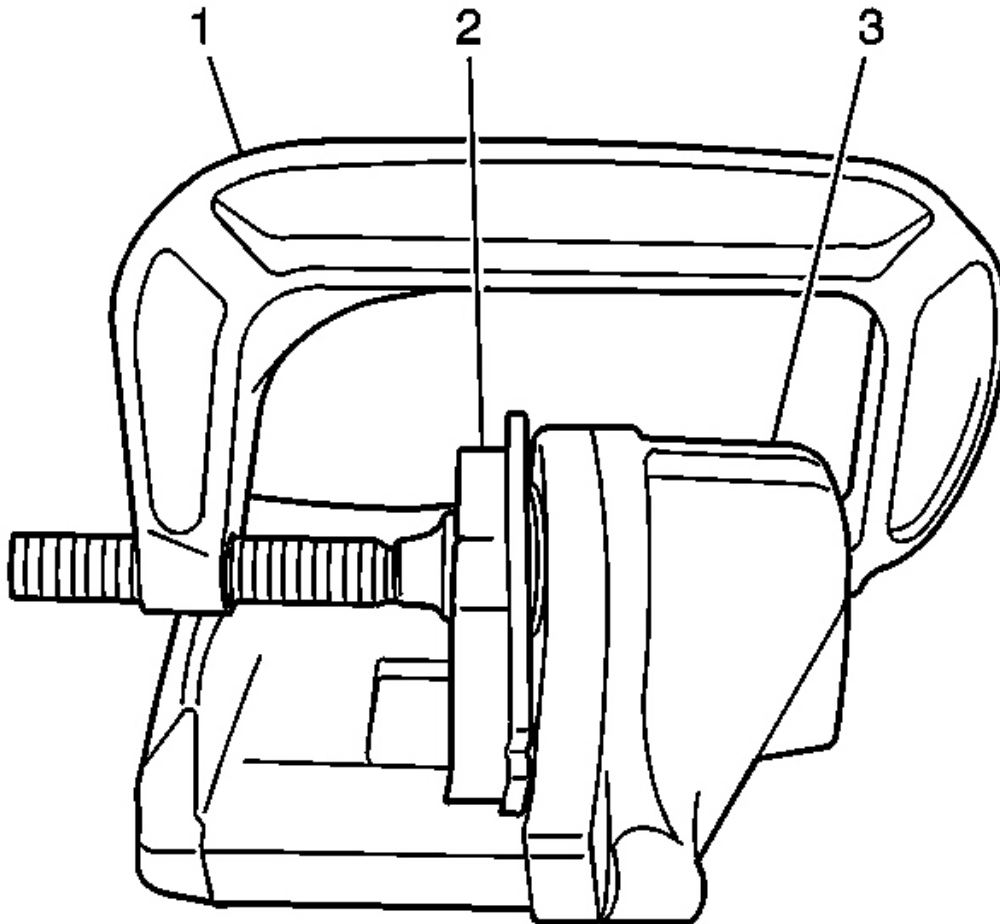


Fig. 9: Compressing Caliper Pistons
Courtesy of GENERAL MOTORS CORP.

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 (2) or block of wood in front of the piston. Using a large C-clamp (1) installed over the body of the caliper (3) and against the brake pad or block of wood, slowly bottom the piston in the bore.
- For dual piston caliper applications, insert a discarded inner brake pad (2) or block of wood in front of the pistons. Using 2 large C-clamps (1) installed over the body of the caliper (3) and against the brake pad or block of wood, slowly bottom the pistons evenly into the bores.

DISC BRAKE MOUNTING AND HARDWARE INSPECTION

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

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

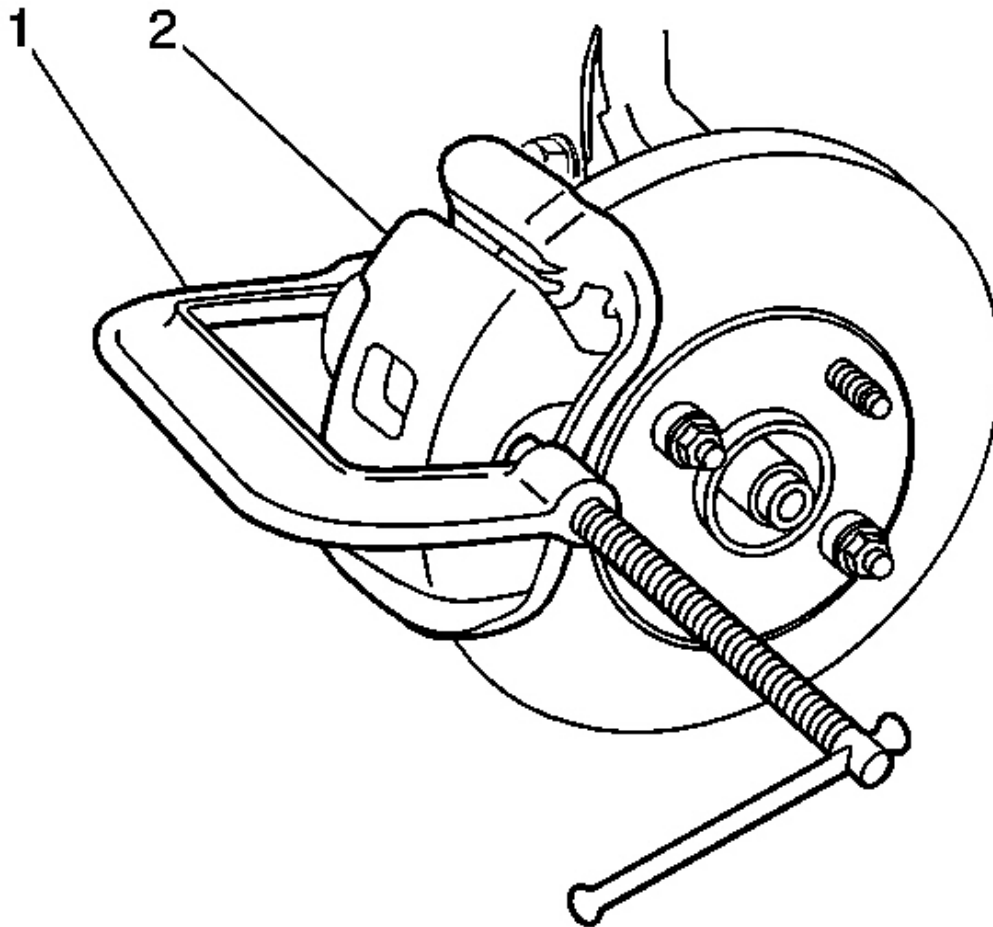


Fig. 10: Removing/Installing C-clamp From Caliper
Courtesy of GENERAL MOTORS CORP.

4. Install a large C-clamp (1), over the body of the brake caliper (2) with the C-clamp ends against the rear of the caliper body and against the outer brake pad.
5. Tighten the C-clamp (1) until the caliper piston is compressed into the caliper bore leaving a gap of approximately 10 mm (0.38 in) between the disc brake pads and the brake rotor.
6. Remove the C-clamp (1) from the caliper (2).
7. Grasp the brake caliper and attempt to move the brake caliper vertically. The brake caliper should not exhibit excessive looseness.
8. Grasp the brake caliper and move the brake caliper inboard and outboard. The brake caliper should slide smoothly with minimal force.

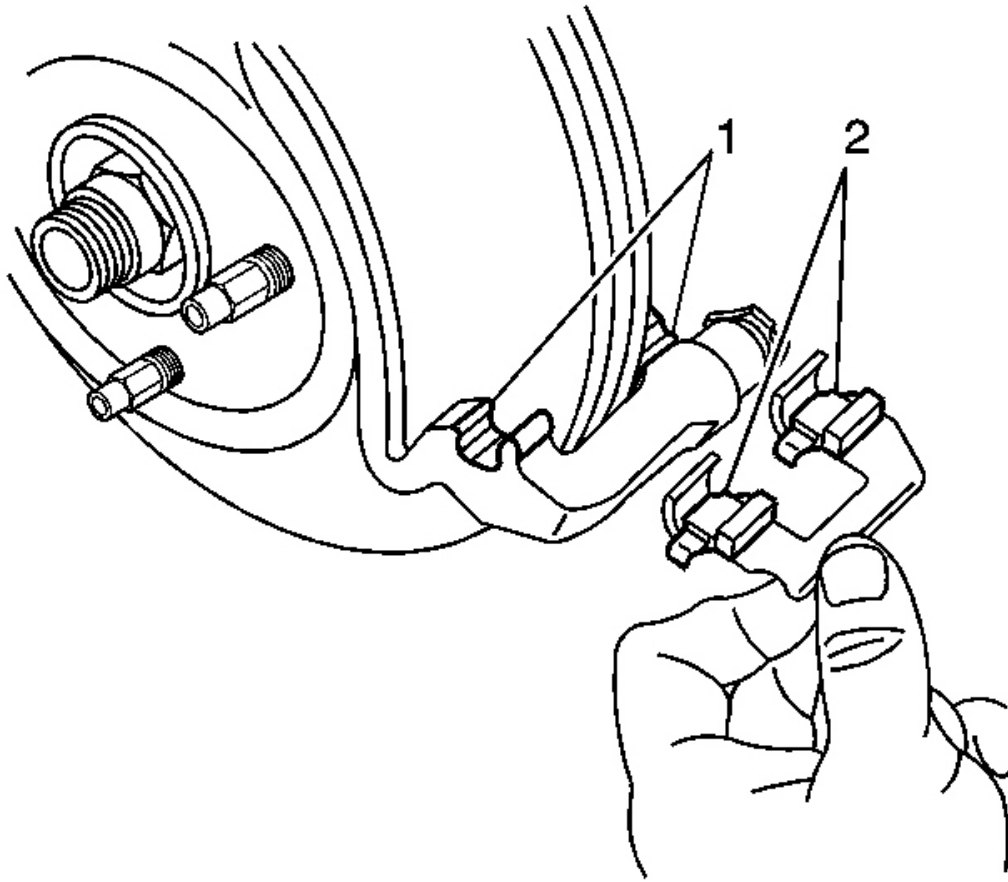


Fig. 11: Removing/Installing Brake Pad Retainers
Courtesy of GENERAL MOTORS CORP.

9. Ensure the disc brake pads are held firmly in place on the brake caliper mounting bracket (1), yet slide easily on the mounting hardware without binding.
10. Inspect the disc brake pad mounting hardware, pad retainers (2), for the following:
 - Bent mounting tabs
 - Excessive corrosion
 - Looseness at the brake caliper mounting bracket
 - Excessive wear and/or looseness at the disc brake pads
 - Missing mounting hardware
11. If any of the conditions listed are found, the disc brake pad mounting hardware requires replacement.

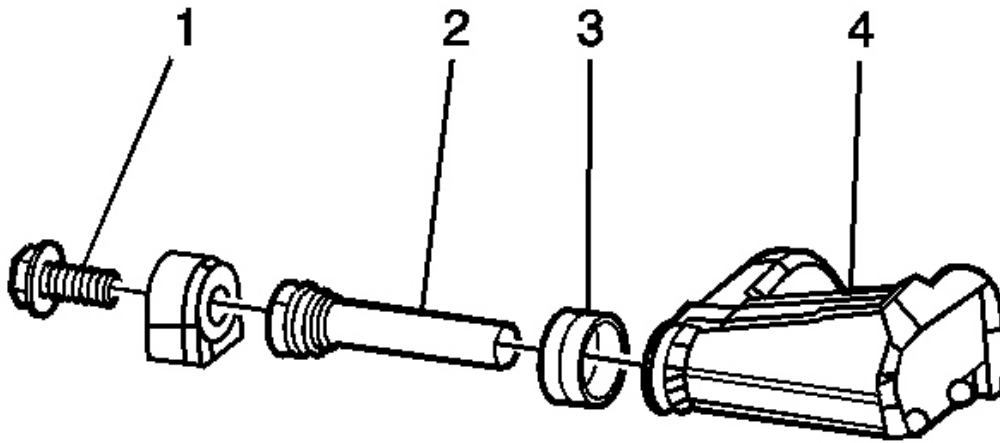


Fig. 12: Inspecting Brake Caliper Components
Courtesy of GENERAL MOTORS CORP.

12. Inspect the brake caliper guide pins (2) by gently pushing inward, without disengaging the slides from the boots, then pull outward, and observe for the following:
 - Bent or damaged brake caliper bolts (1)
 - Restricted caliper guide pin movement
 - Corrosion
 - Split or torn boots (3)
 - Missing boots
 - Looseness in the brake caliper mounting bracket
 - Seized or binding caliper guide pins
13. If any of the conditions listed are found, the brake caliper mounting hardware requires replacement.
14. Inspect the brake caliper mounting bracket (4) for being bent, cracked, or damaged.
15. If any of the conditions listed are found, the brake caliper mounting bracket requires replacement.

REPAIR INSTRUCTIONS

BRAKE PADS REPLACEMENT

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

Removal Procedure

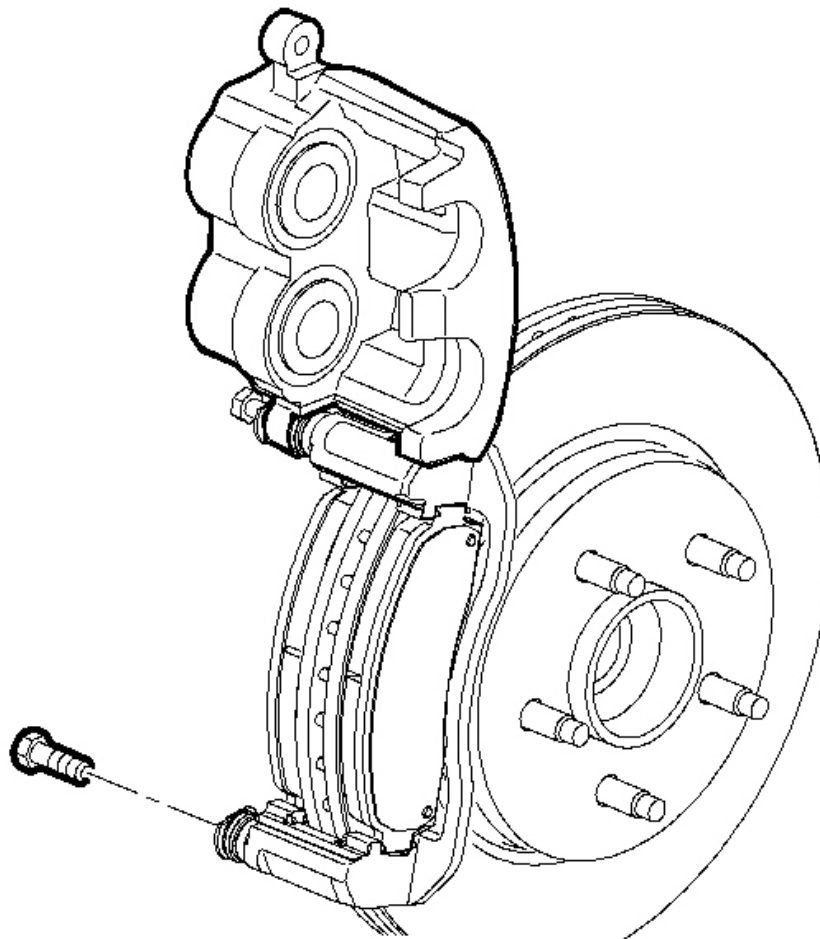


Fig. 13: View Of Brake Pads
Courtesy of GENERAL MOTORS CORP.

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

4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
5. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
6. Install and firmly hand tighten 2 wheel nuts to opposite wheel studs in order to retain the rotor to the hub.
7. Install a large C-clamp over the body of the brake caliper with the C-clamp ends against the rear of the caliper body and against the outboard brake pad.
8. Tighten the C-clamp evenly until the caliper piston is compressed into the caliper bore enough to allow the caliper to slide past the brake rotor.
9. Remove the C-clamp from the caliper.
10. Remove the brake caliper lower guide pin bolt.

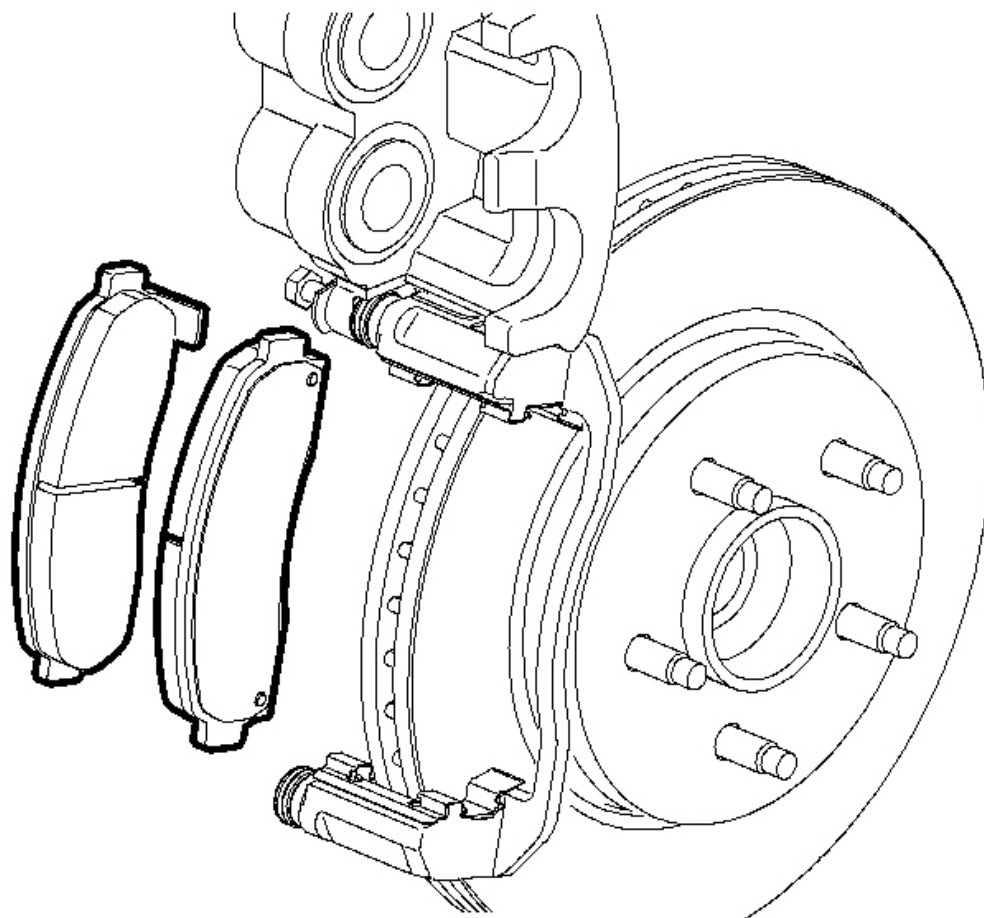


Fig. 14: Removing/Installing Brake Pads From Brake Caliper Bracket
Courtesy of GENERAL MOTORS CORP.

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. Without disconnecting the hydraulic brake flexible hose, pivot the caliper upward and secure the caliper with heavy mechanics wire, or equivalent.
12. Remove the brake pads from the caliper mounting bracket.

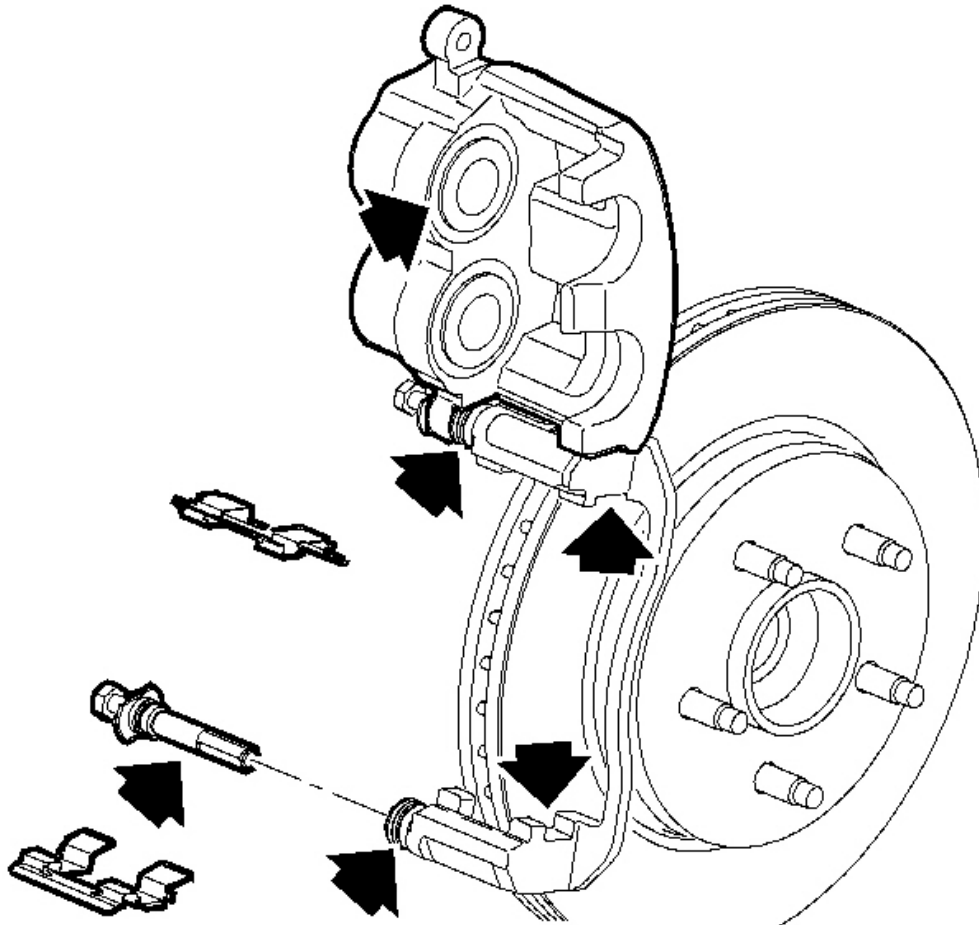


Fig. 15: Removing/Installing Brake Pad Retainers From Caliper Bracket
Courtesy of GENERAL MOTORS CORP.

13. Remove the brake pad retainers from the caliper bracket.
14. Thoroughly clean the brake pad hardware mating surfaces of the caliper bracket, of any debris and corrosion.
15. Inspect the brake caliper guide pins for freedom of movement, and inspect the condition of the guide pin boots. Move the guide pins inboard and outboard within the bracket bores, without disengaging the slides from the boots, and observe for the following:
 - Restricted caliper guide pin movement
 - Looseness in the brake caliper mounting bracket
 - Seized or binding caliper guide pins
 - Split or torn boots
16. If any of the conditions listed are found, the brake caliper guide pins and/or boots require replacement.

Installation Procedure

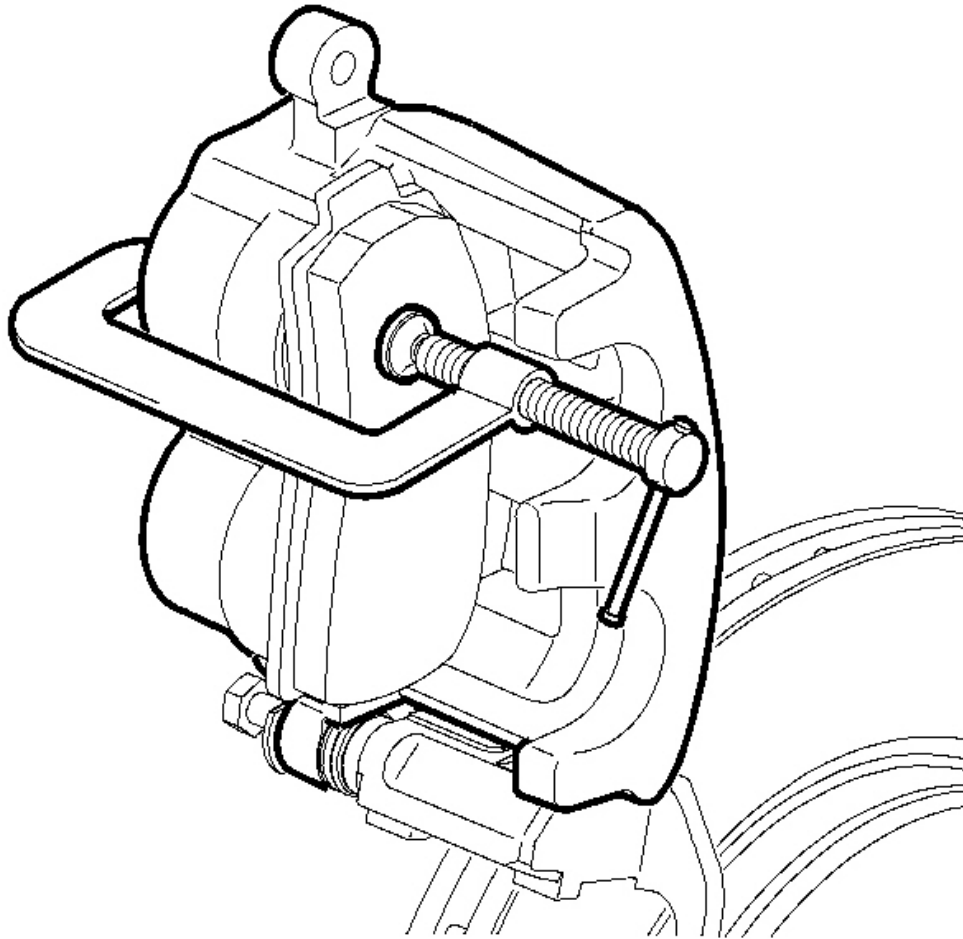


Fig. 16: Installing C-Clamp Of Brake Caliper
Courtesy of GENERAL MOTORS CORP.

1. Install a 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.
2. Tighten the C-clamp evenly until the caliper piston is compressed completely into the caliper bore.
3. Remove the C-clamp and the old brake pad or wood block from the caliper.

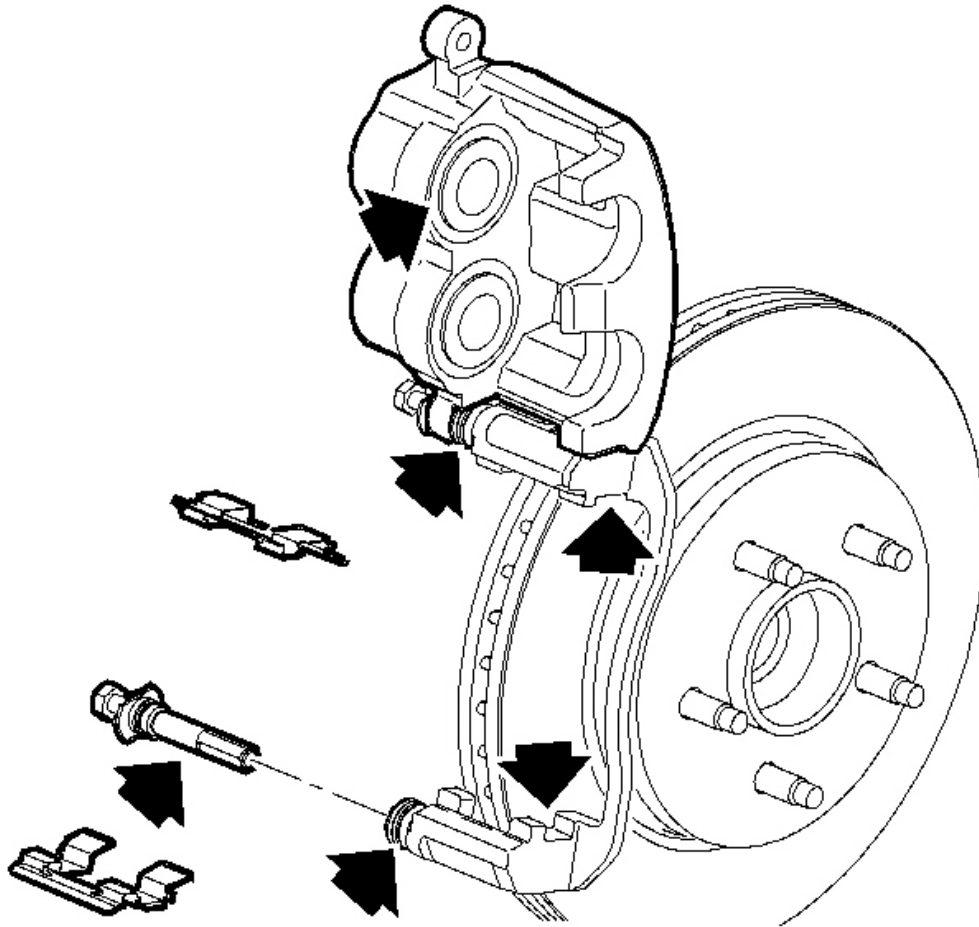


Fig. 17: Removing/Installing Brake Pad Retainers From Caliper Bracket
Courtesy of GENERAL MOTORS CORP.

4. Apply a very thin coating of high temperature silicone brake lubricant to the pad hardware mating surfaces of the caliper bracket only.
5. Install the brake pad retainers to the brake caliper bracket.

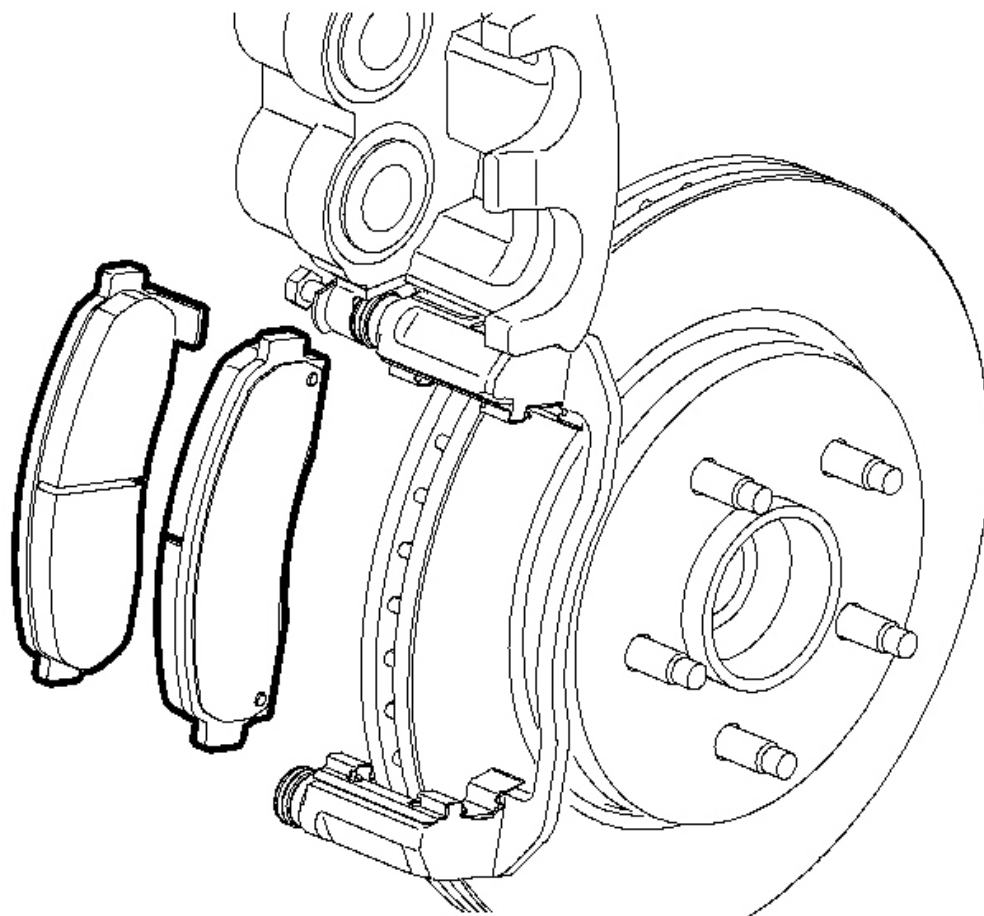


Fig. 18: Removing/Installing Brake Pads From Brake Caliper Bracket
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The wear sensor equipped disc brake pad must be mounted inboard of the rotor with the leading edge of the sensor facing the brake rotor during forward wheel rotation, or at the top of the pad when installed in vehicle position.

6. Install the brake pads to the caliper bracket.
7. Remove the support, and rotate the brake caliper into position over the disc brake pads and to the caliper mounting bracket.

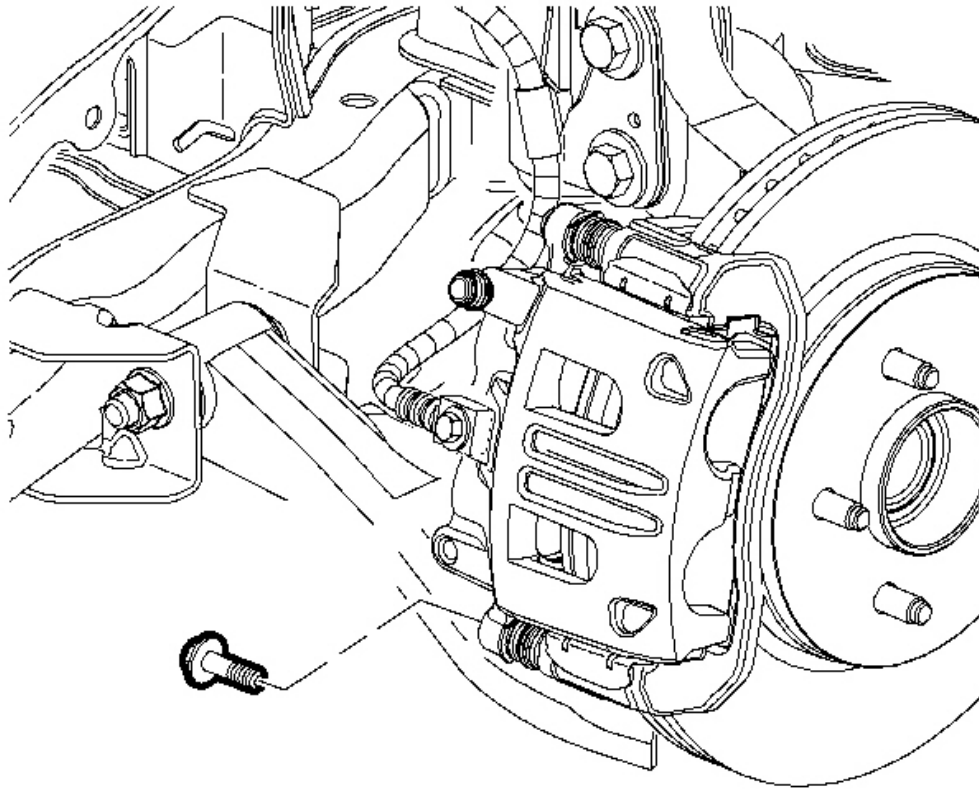


Fig. 19: Removing/Installing Brake Rotor To Hub/Axle Flange
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

8. Install the lower brake caliper guide pin bolt.

Tighten: Tighten the bolt to 44 N.m (32 lb ft).

9. Remove the wheel nuts retaining the brake rotor to the hub.
10. Install the tire and wheel assembly. Refer to Tire and Wheel Removal and Installation in Tires and Wheels.

11. Lower the vehicle.
12. With the engine OFF, gradually apply the brake pedal approximately 2/3 of its travel distance.
13. Slowly release the brake pedal.
14. Wait 15 seconds, then gradually apply the brake pedal approximately 2/3 of its travel distance again until a firm brake pedal apply is obtained. This will properly seat the brake caliper pistons and brake pads.
15. Fill the master cylinder auxiliary reservoir to the proper level. Refer to **Master Cylinder Reservoir Filling** in Hydraulic Brakes.
16. Burnish the pads and rotors. Refer to **Burnishing Pads and Rotors** .

BURNISHING PADS AND ROTORS

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.

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

Burnishing the brake pads and brake rotors is necessary in order to ensure that the braking surfaces are properly prepared after service has been performed on the disc brake system.

This procedure should be performed whenever the disc brake rotors have been refinished or replaced, and/or whenever the disc brake pads have been replaced.

1. Select a smooth road with little or no traffic.
2. Accelerate the vehicle to 48 km/h (30 mph).

IMPORTANT: Use care to avoid overheating the brakes while performing this step.

3. Using moderate to firm pressure, apply the brakes to bring the vehicle to a stop. Do not allow the brakes to lock.
4. Repeat steps 2 and 3 until approximately 20 stops have been completed. Allow sufficient cooling periods between stops in order to properly burnish the brake pads and rotors.

BRAKE CALIPER REPLACEMENT

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

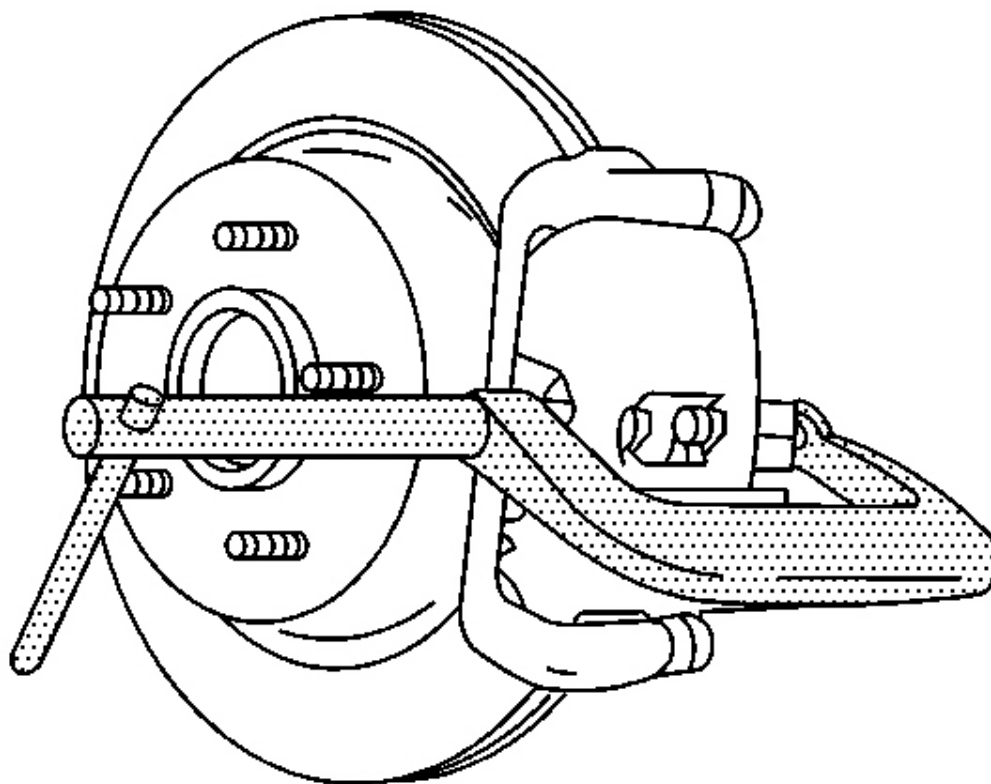


Fig. 20: View Of Brake Caliper
Courtesy of GENERAL MOTORS CORP.

1. Inspect the fluid level in the brake master cylinder reservoir.
2. If the brake fluid level is midway between the maximum-full point and the minimum allowable level, no brake fluid needs to be removed from the reservoir before proceeding.
3. If the brake fluid level is higher than midway between the maximum-full point and the minimum allowable level, remove brake fluid to the midway point before proceeding.
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
5. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
6. Install and firmly hand tighten 2 wheel nuts to opposite wheel studs in order to retain the rotor to the hub.
7. Install a large C-clamp over the body of the brake caliper with the C-clamp ends against the rear of the caliper body and against the outer brake pad.

8. 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.
9. Remove the C-clamp from the caliper.

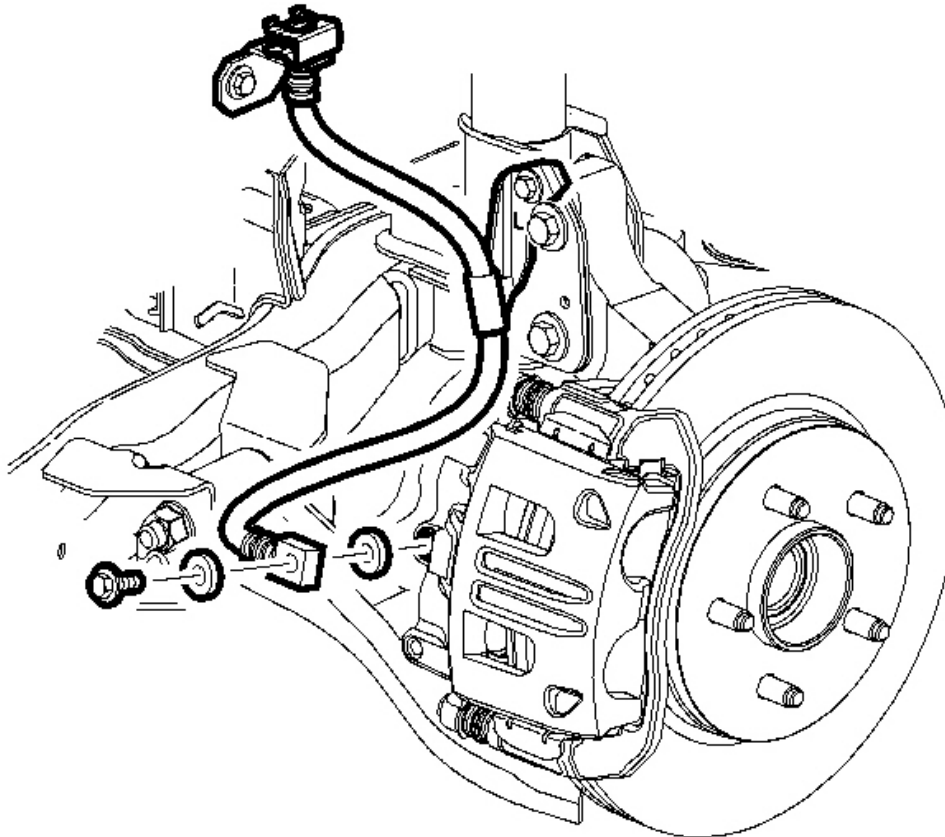


Fig. 21: Removing/Installing Copper Brake Hose Gaskets
Courtesy of GENERAL MOTORS CORP.

10. Remove the brake hose-to-caliper bolt from the brake caliper.
11. Remove the brake hose from the brake caliper.
12. Remove and discard the 2 copper brake hose gaskets. These gaskets may be stuck to the brake caliper and/or the brake hose end.
13. Cap or plug the opening in the brake caliper and the brake hose to prevent fluid loss and contamination.

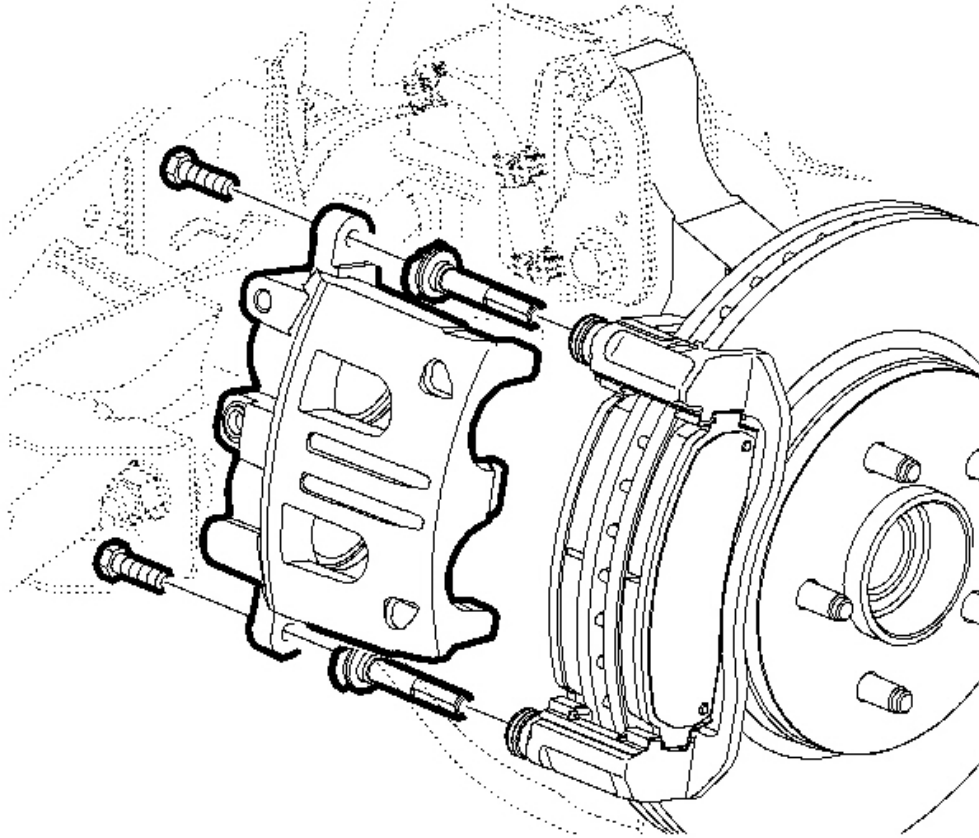


Fig. 22: Removing/Installing Brake Caliper Guide Pins
Courtesy of GENERAL MOTORS CORP.

14. Remove the brake caliper guide pin bolts.
15. Remove the brake caliper from the caliper bracket.
16. Inspect the brake caliper guide pins for freedom of movement, and inspect the condition of the guide pin boots. Move the guide pins inboard and outboard within the bracket bores, without disengaging the slides from the boots, and observe for the following:
 - Restricted caliper guide pin movement
 - Looseness in the brake caliper mounting bracket
 - Seized or binding caliper guide pins
 - Split or torn boots

17. If any of the conditions listed are found, the brake caliper guide pins and/or boots require replacement.

Installation Procedure

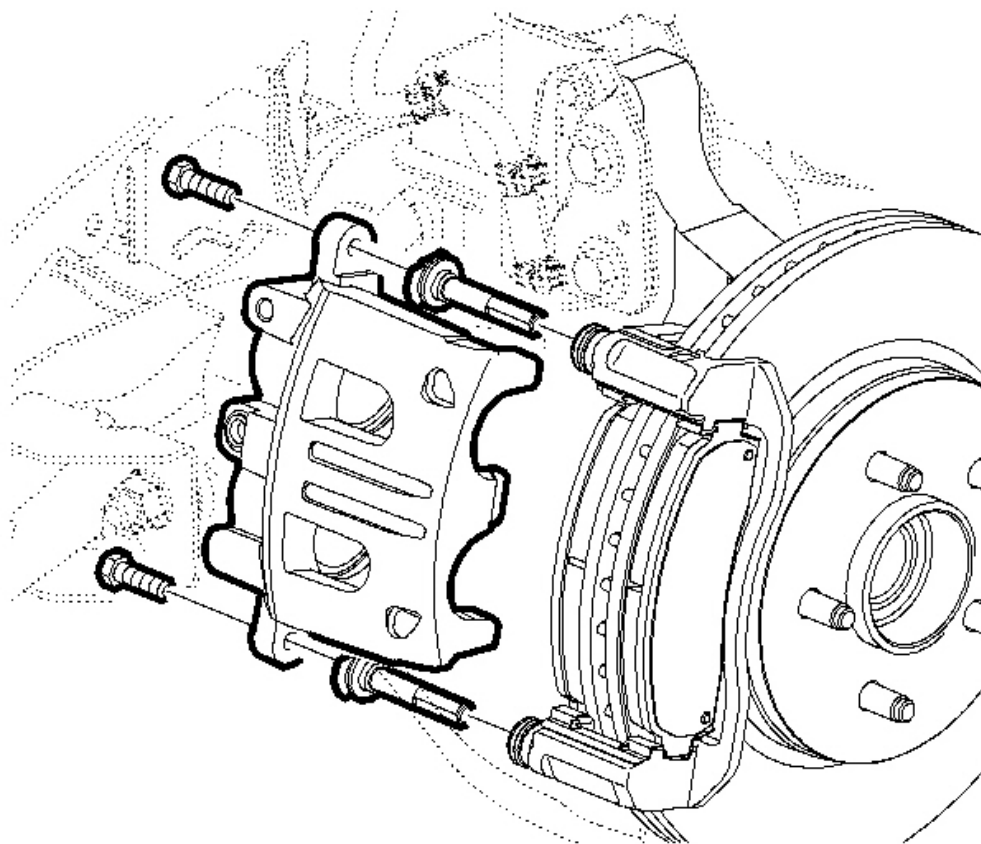


Fig. 23: Removing/Installing Brake Caliper Guide Pins
Courtesy of GENERAL MOTORS CORP.

1. Apply a light, thin coat of high temperature silicone brake lubricant to the caliper guide pins.
2. Install the guide pins to the brake caliper bracket.
3. Install the brake caliper to the brake caliper bracket.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the brake caliper guide pin bolts.

Tighten: Tighten the bolts to 44 N.m (32 lb ft).

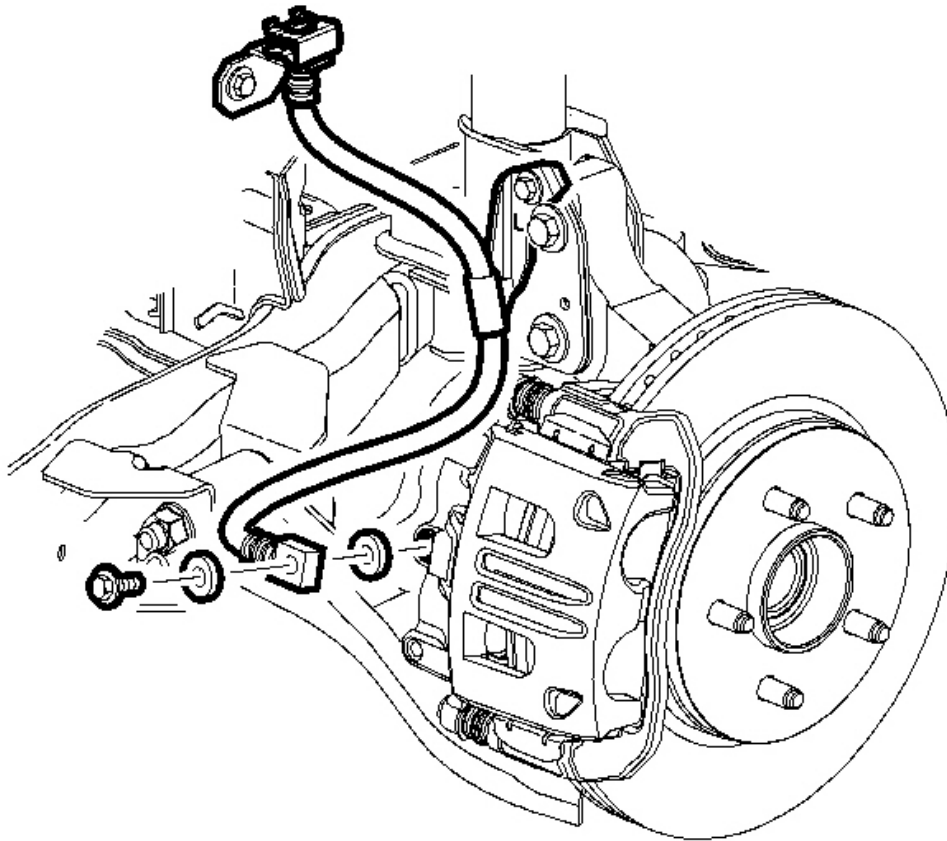


Fig. 24: Removing/Installing Copper Brake Hose Gaskets
Courtesy of GENERAL MOTORS CORP.

5. Remove the caps or plugs from the brake caliper opening and the brake hose.

IMPORTANT: Do not reuse the copper brake hose gaskets.

6. Install NEW copper brake hose gaskets to the brake hose-to-caliper bolt and to the brake hose.

7. Install the brake hose and the brake hose-to-brake caliper bolt to the brake caliper.

Tighten: Tighten the bolt to 44 N.m (32 lb ft).

8. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)** in Hydraulic Brakes.
9. Remove the wheel nuts retaining the brake rotor to the wheel hub.
10. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
11. Lower the vehicle.
12. With the engine OFF, gradually apply the brake pedal to approximately 2/3 of its travel distance.
13. Slowly release the brake pedal.
14. Wait 15 seconds, then gradually apply the brake pedal approximately 2/3 of its travel distance again until a firm brake pedal apply is obtained. This will properly seat the brake caliper pistons and brake pads.

DISC BRAKE HARDWARE REPLACEMENT

CAUTION: Refer to **Brake Dust Caution** in Cautions and Notices.

Removal Procedure

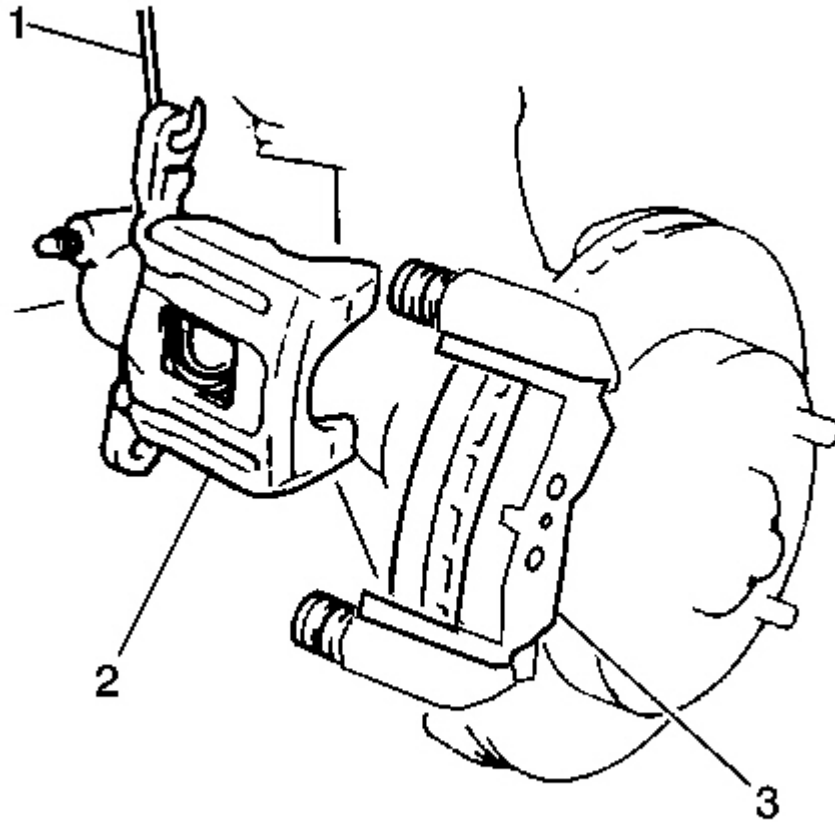


Fig. 25: Identifying Front Brake Caliper
Courtesy of GENERAL MOTORS CORP.

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. Remove the brake caliper (2) from the brake caliper mounting bracket and support the brake caliper with heavy mechanic's wire (1), or equivalent. Do NOT disconnect the hydraulic brake flexible hose from the caliper. Refer to [Brake Caliper Replacement](#) .

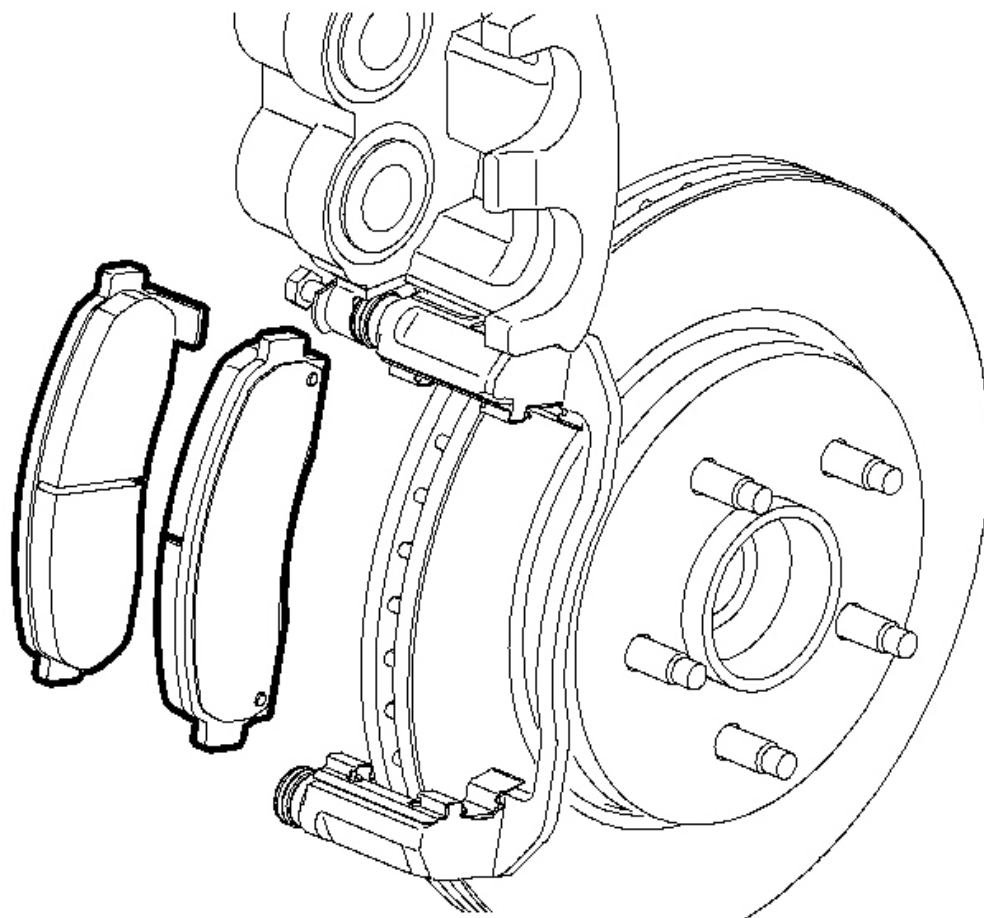


Fig. 26: Removing/Installing Brake Pads From Brake Caliper Bracket
Courtesy of GENERAL MOTORS CORP.

2. Remove the brake pads from the brake caliper bracket.

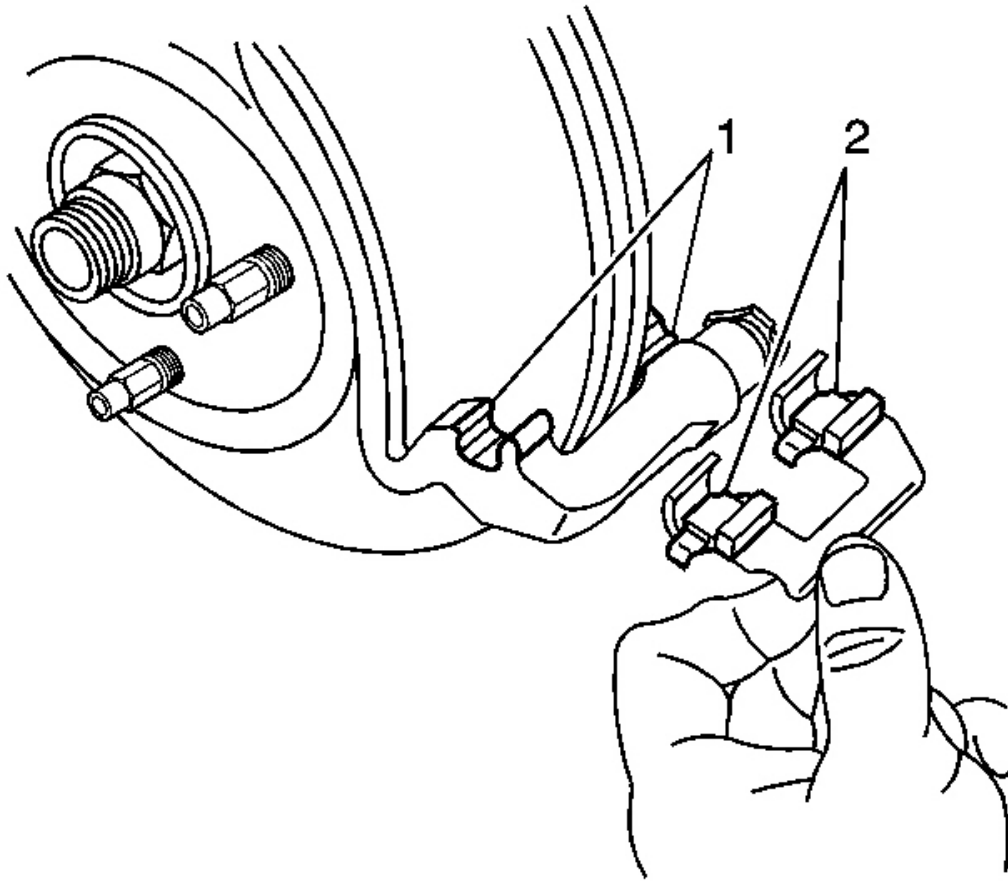


Fig. 27: Removing/Installing Brake Pad Retainers
Courtesy of GENERAL MOTORS CORP.

3. Remove the disc brake pad retainers (2) from the brake caliper bracket.
4. Thoroughly clean the brake pad hardware mating surfaces of the caliper bracket, of any debris and corrosion.
5. Inspect the disc brake pad retainers for the following:
 - Bent mounting tabs
 - Excessive corrosion
 - Looseness at the brake caliper mounting bracket
 - Looseness at the disc brake pads
6. If any of the conditions listed are found, the disc brake pad retainers require replacement.

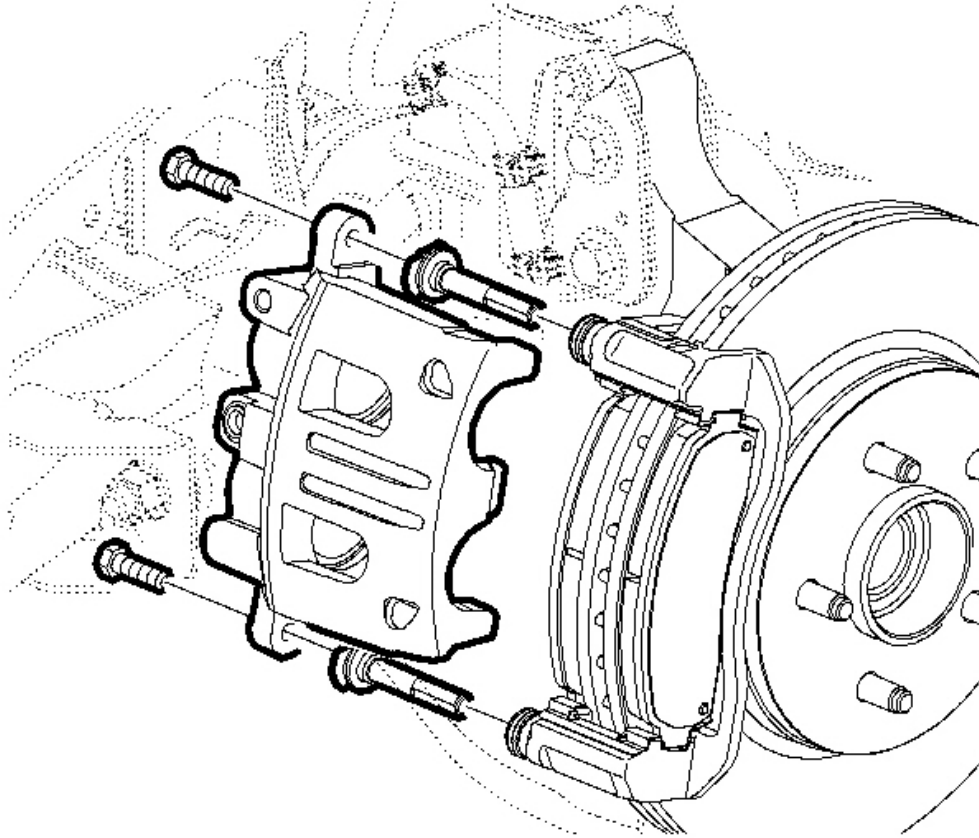


Fig. 28: Removing/Installing Brake Caliper Guide Pins
Courtesy of GENERAL MOTORS CORP.

7. Remove the brake caliper guide pins from the brake caliper bracket.

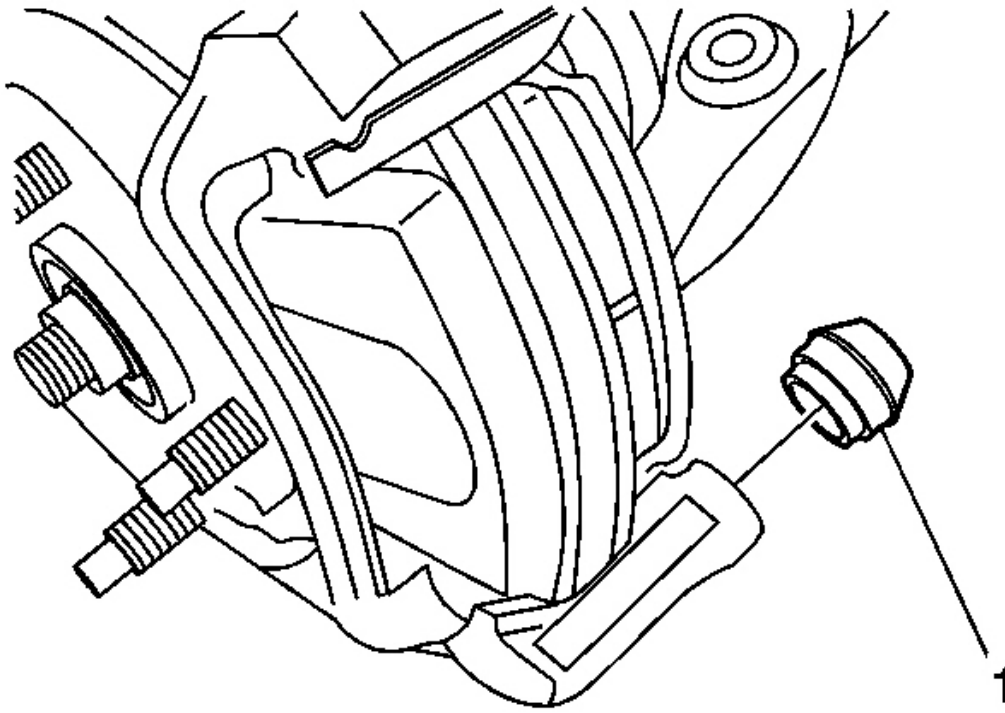


Fig. 29: Removing/Installing Caliper Guide Pin Boots From Caliper Bracket
Courtesy of GENERAL MOTORS CORP.

8. Remove the caliper guide pin boots (1) from the caliper bracket.
9. Inspect the caliper guide pin bores in the caliper bracket. Carefully remove any debris or corrosion from the bores.
10. Inspect the guide pin boots (1). If the boots are damaged, they require replacement.
11. Inspect the caliper guide pins. If either of the guide pin assemblies is damaged or corroded, the guide pins require replacement.

Installation Procedure

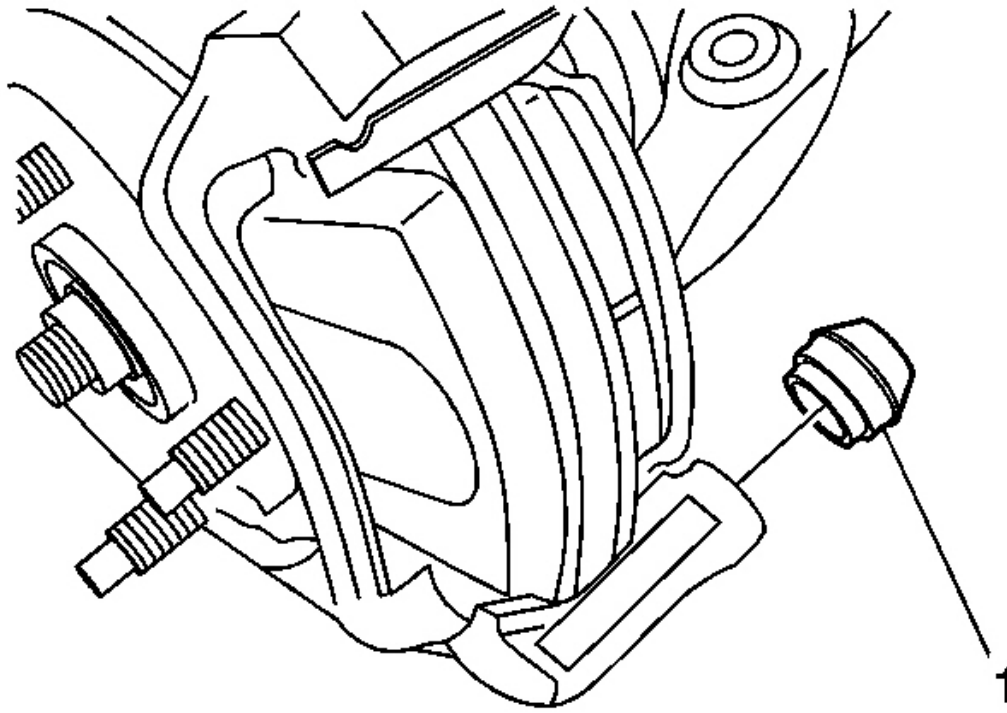


Fig. 30: Removing/Installing Caliper Guide Pin Boots From Caliper Bracket
Courtesy of GENERAL MOTORS CORP.

1. Apply a thin, light coating of high temperature silicone brake lubricant to the brake caliper guide pin boots (1).
2. Fully install the guide pin boots (1) to the brake caliper mounting bracket.

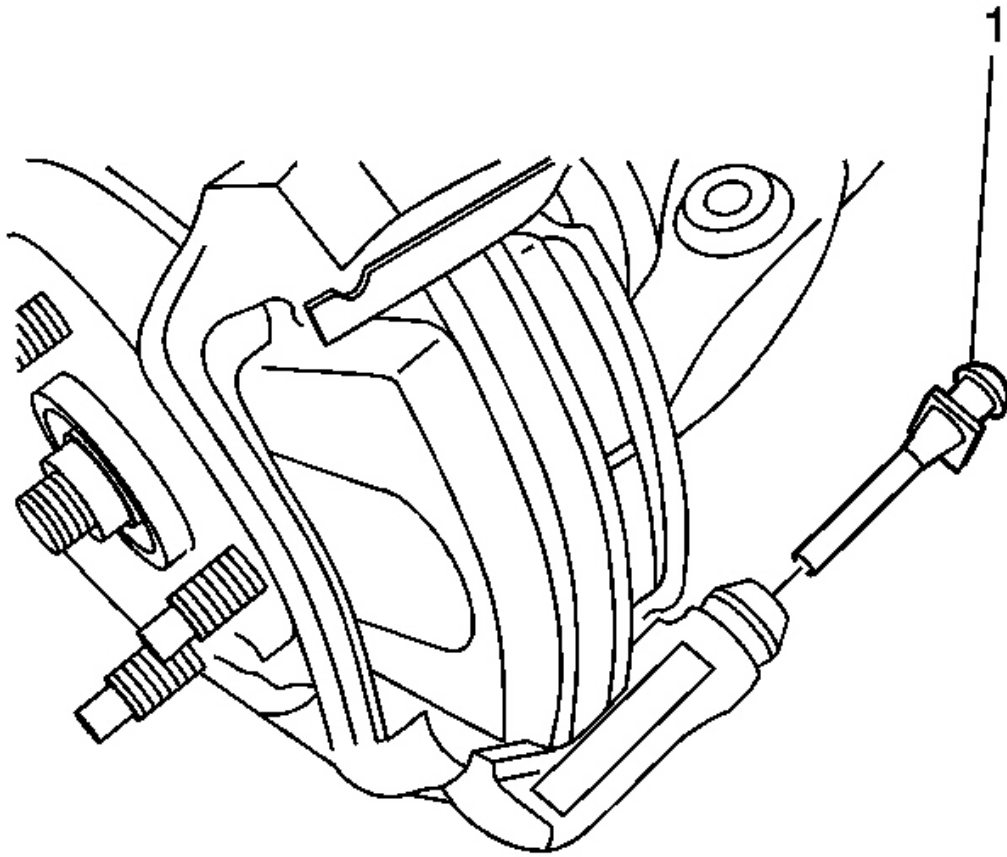


Fig. 31: Installing Brake Caliper Guide Pins To Caliper Mounting Bracket
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure that there is not a build up of lubricant at the end of the upper guide pin, ahead of the bushing.

3. Apply a light coating of high temperature silicone brake lubricant to the brake caliper guide pins.
4. Install the brake caliper guide pins (1) to the caliper mounting bracket. Ensure that the rim of the guide pin boots is fully seated in the groove on the guide pins.

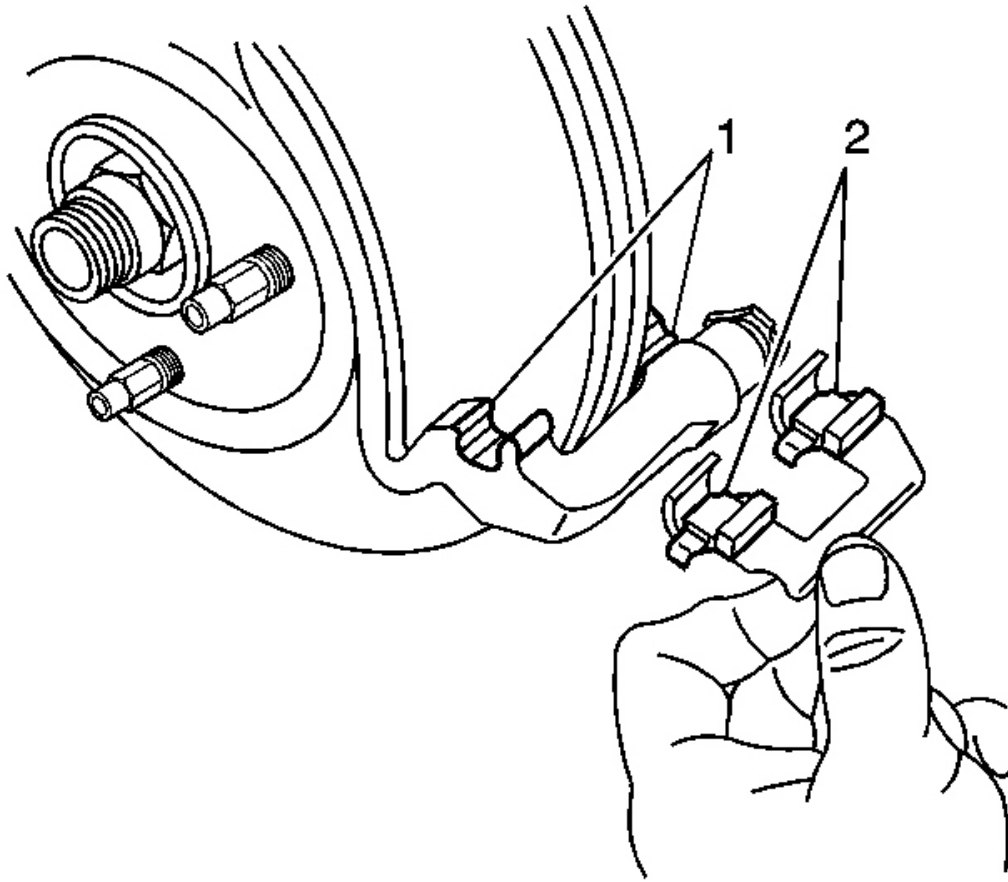


Fig. 32: Removing/Installing Brake Pad Retainers
Courtesy of GENERAL MOTORS CORP.

5. Apply a very thin coating of high temperature silicone brake lubricant to the pad hardware mating surfaces (1) of the caliper bracket only.
6. If reusing the brake pad retainers, clean the brake pad mating surfaces of the brake pad retainers (2).
7. Install the brake pad retainers (2) to the brake caliper bracket.

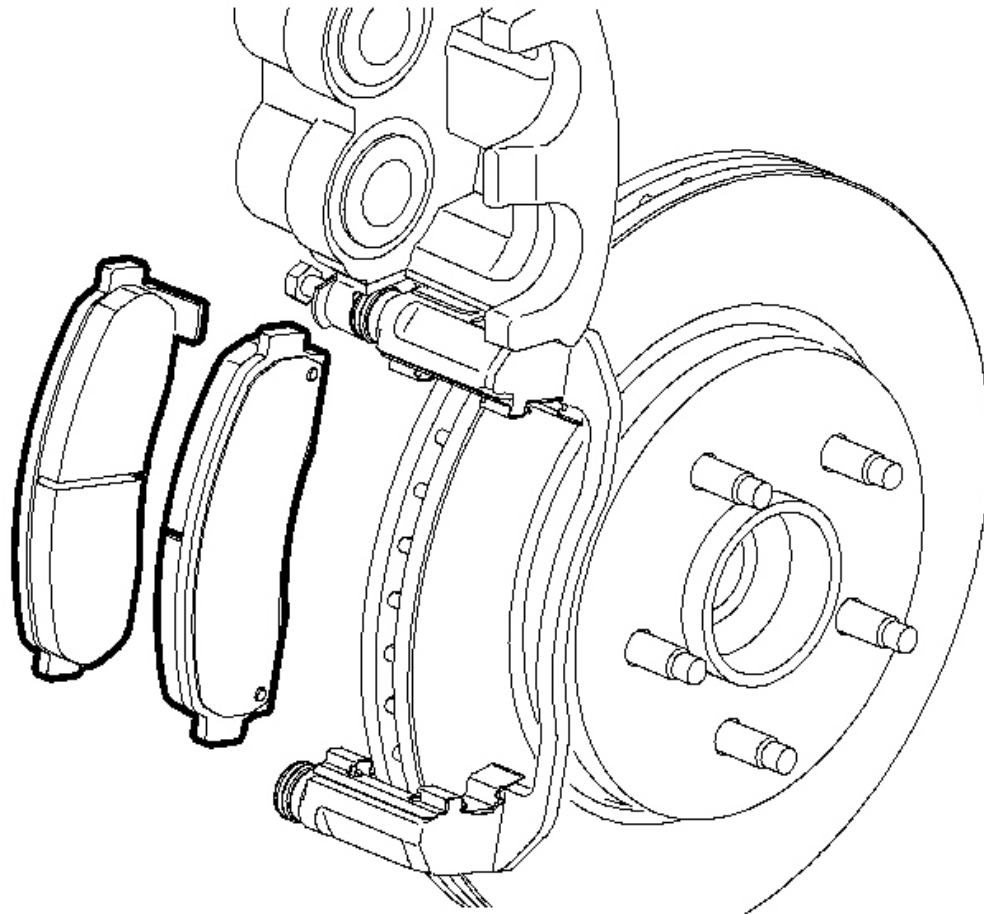


Fig. 33: Removing/Installing Brake Pads From Brake Caliper Bracket
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The wear sensor equipped disc brake pad must be mounted inboard of the rotor with the leading edge of the sensor facing the brake rotor during forward wheel rotation, or at the top of the pad when installed in vehicle position.

8. Install the brake pads to the brake caliper bracket.
9. Remove the support and reposition the brake caliper over the brake pads and to the mounting bracket. Refer to **Brake Caliper Replacement** .

BRAKE CALIPER BRACKET REPLACEMENT

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

Removal Procedure

CAUTION: Do not move the vehicle until a firm brake pedal is obtained. Failure to obtain a firm pedal before moving vehicle may result in personal injury.

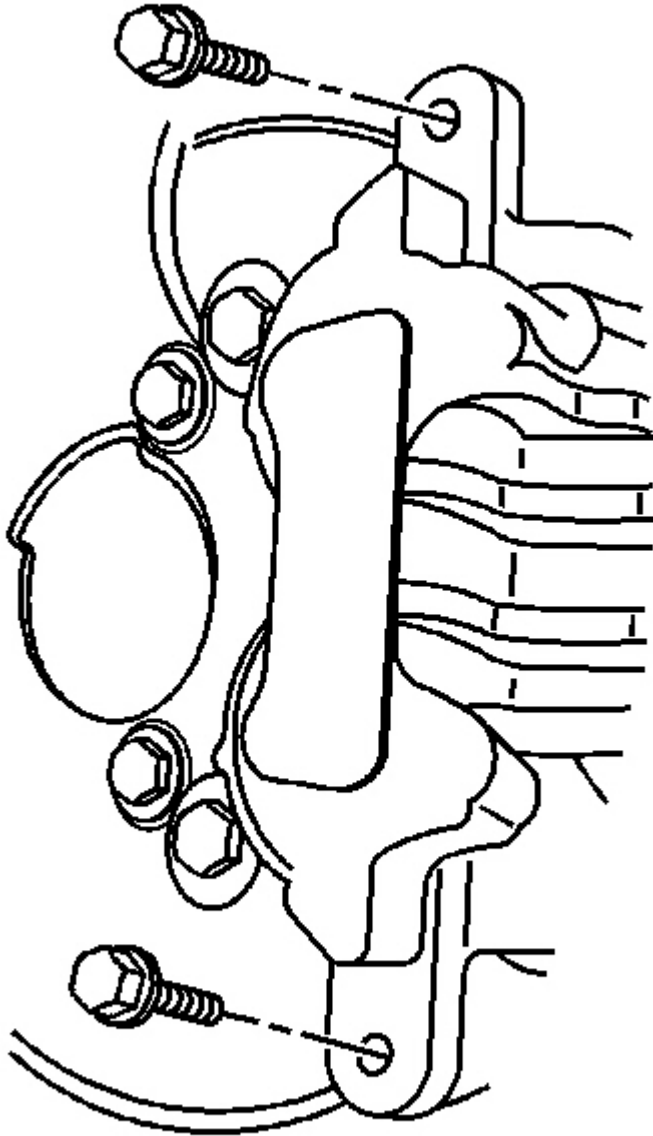


Fig. 34: View Of Brake Caliper Bracket
Courtesy of GENERAL MOTORS CORP.

1. Remove the brake caliper from the brake caliper bracket. Refer to **Brake Caliper Replacement** .

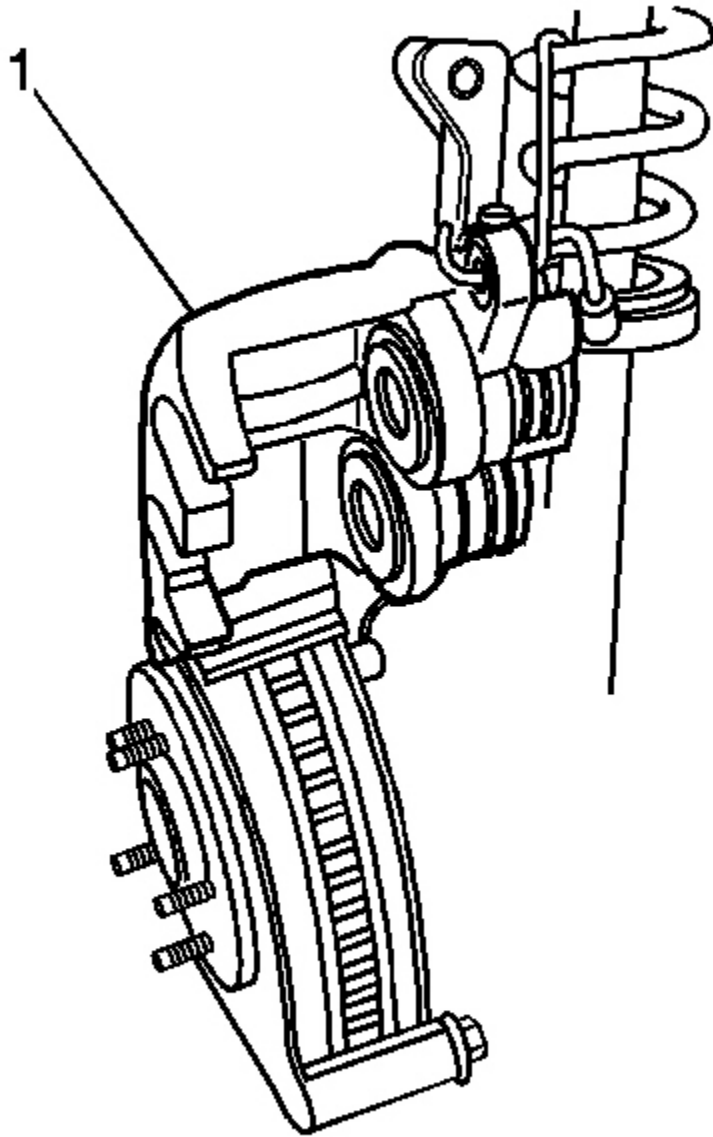


Fig. 35: Supporting Brake Caliper With Heavy Mechanic's Wire
Courtesy of GENERAL MOTORS CORP.

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.

2. Support the brake caliper (1) with heavy mechanic's wire, or equivalent; do NOT disconnect the hydraulic brake flexible hose from the caliper.

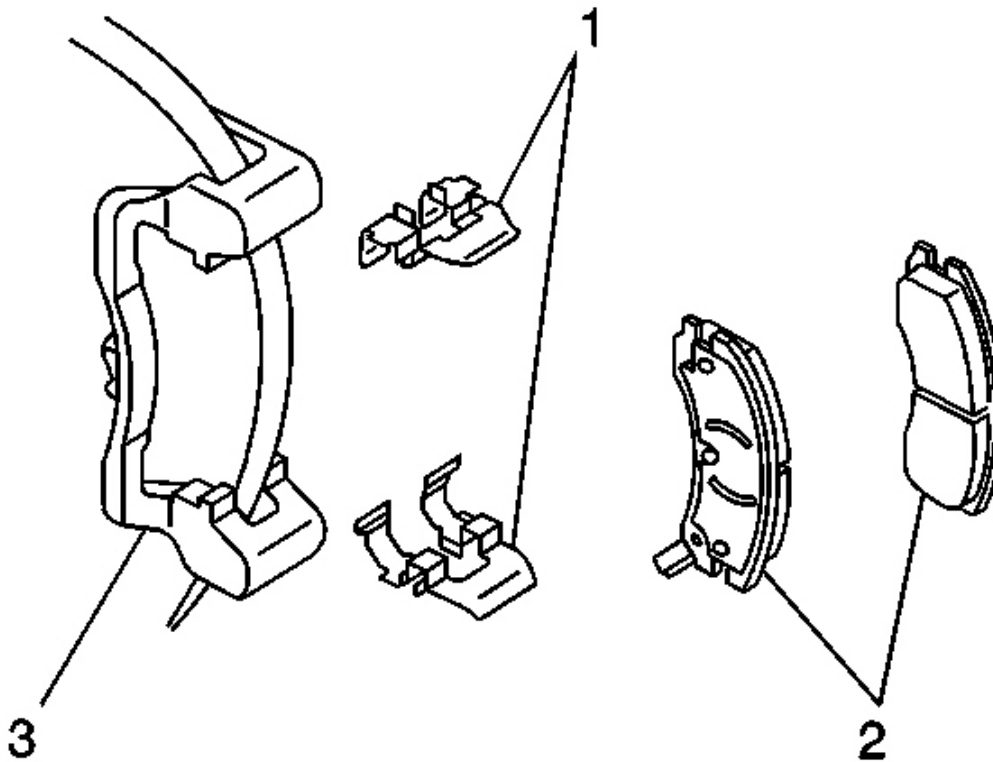


Fig. 36: Identifying Brake Components
Courtesy of GENERAL MOTORS CORP.

3. Remove the brake pads (2) from the brake caliper bracket (3).
4. Remove the brake pad retainers (1) from the brake caliper bracket (3).

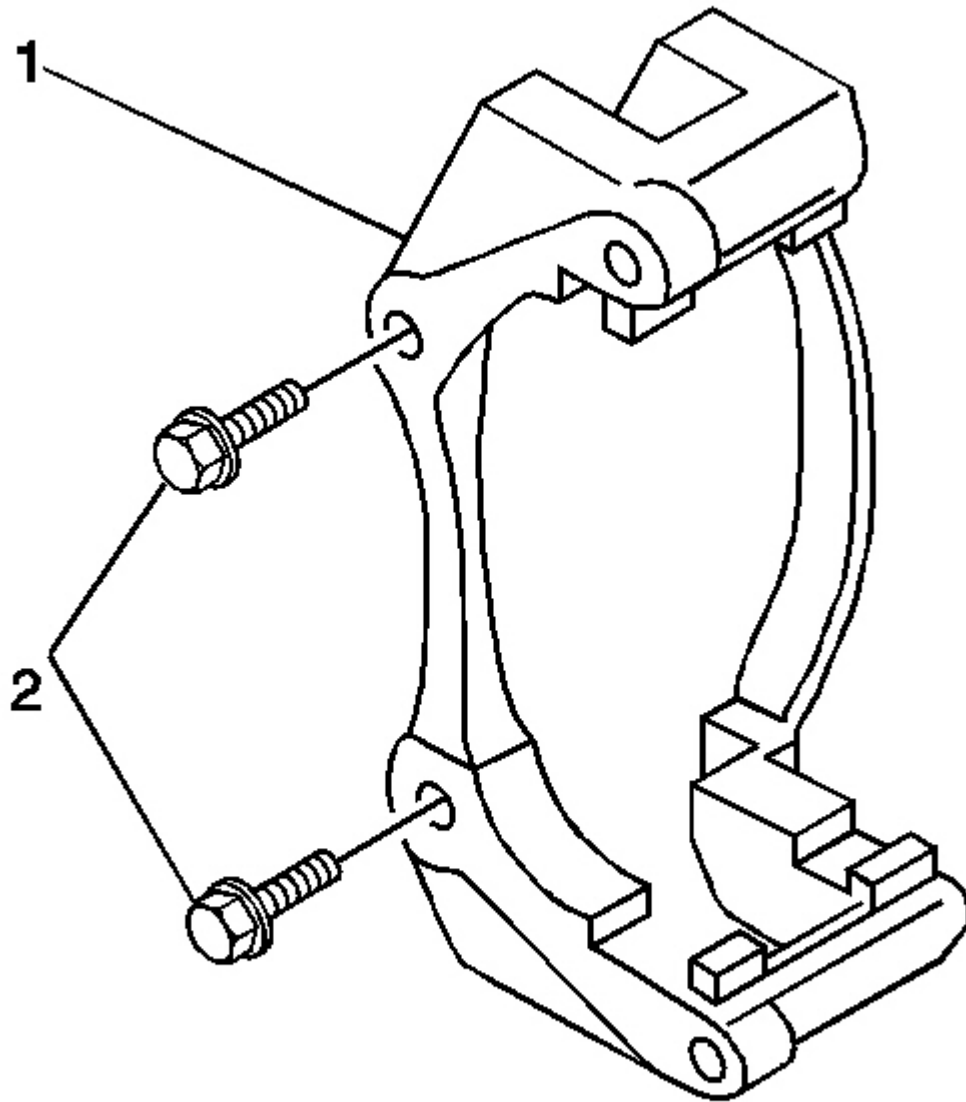


Fig. 37: Removing/Installing Brake Caliper Bracket
Courtesy of GENERAL MOTORS CORP.

5. Remove the brake caliper bracket bolts (2).
6. Remove the brake caliper bracket (1) from the knuckle.

Installation Procedure

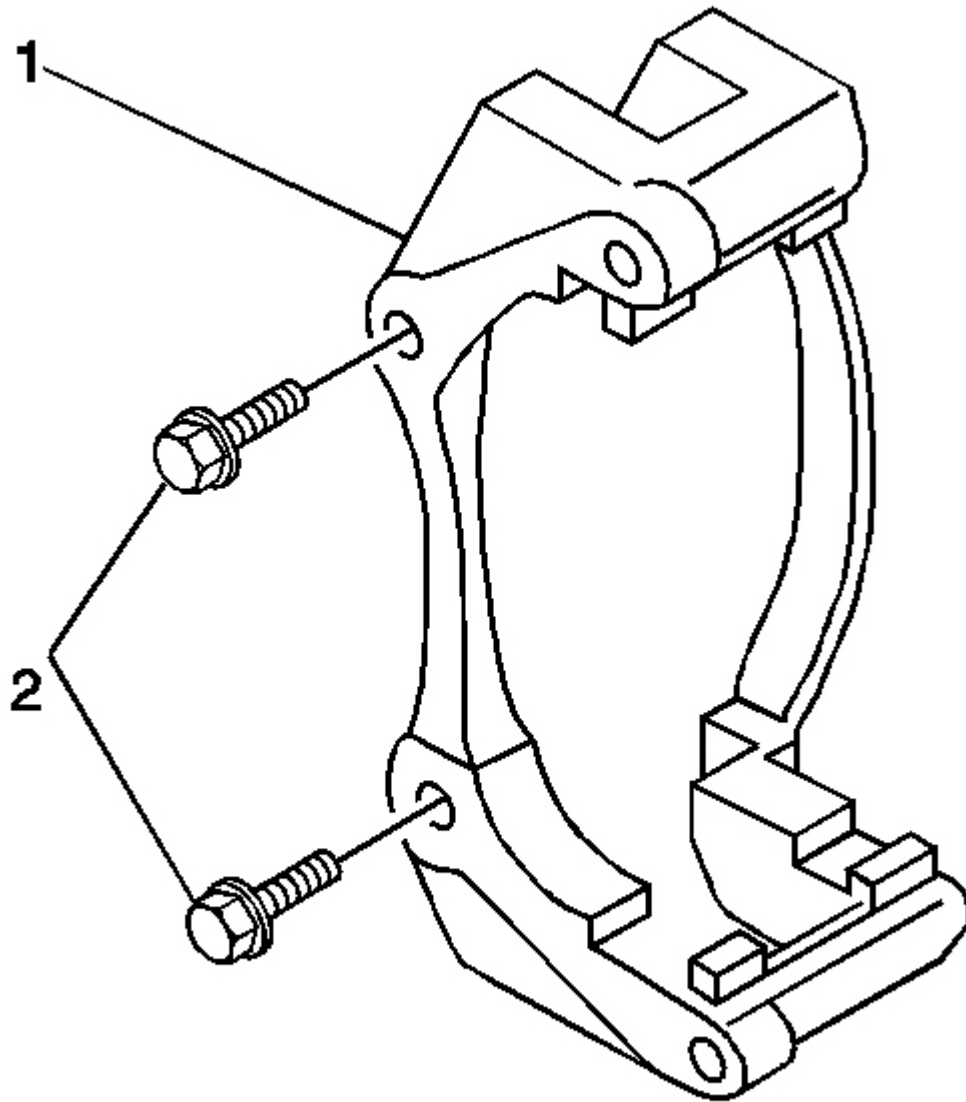


Fig. 38: Removing/Installing Brake Caliper Bracket
Courtesy of GENERAL MOTORS CORP.

1. Install the brake caliper bracket (1) to the knuckle.

IMPORTANT: If reusing the caliper bracket bolts, the threads of the caliper bracket bolts and the threads of the knuckle mounting holes must be thoroughly cleaned and free of debris prior to the application of threadlocker.

2. Prepare the bolts and the threaded holes for assembly:
 1. Thoroughly clean the residue from the bolt threads by using denatured alcohol or equivalent and allow to dry.
 2. Thoroughly clean the residue from the threaded holes by using denatured alcohol or equivalent and allow to dry.
 3. Apply threadlocker Saturn P/N 21005994, or equivalent to two-thirds of the threaded length of the lower caliper bracket bolts.
 4. Allow the threadlocker to cure approximately 10 minutes before installation.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the 2 brake caliper bracket bolts (2).

Tighten: Tighten the front brake caliper bracket bolts to 185 N.m (136 lb ft).

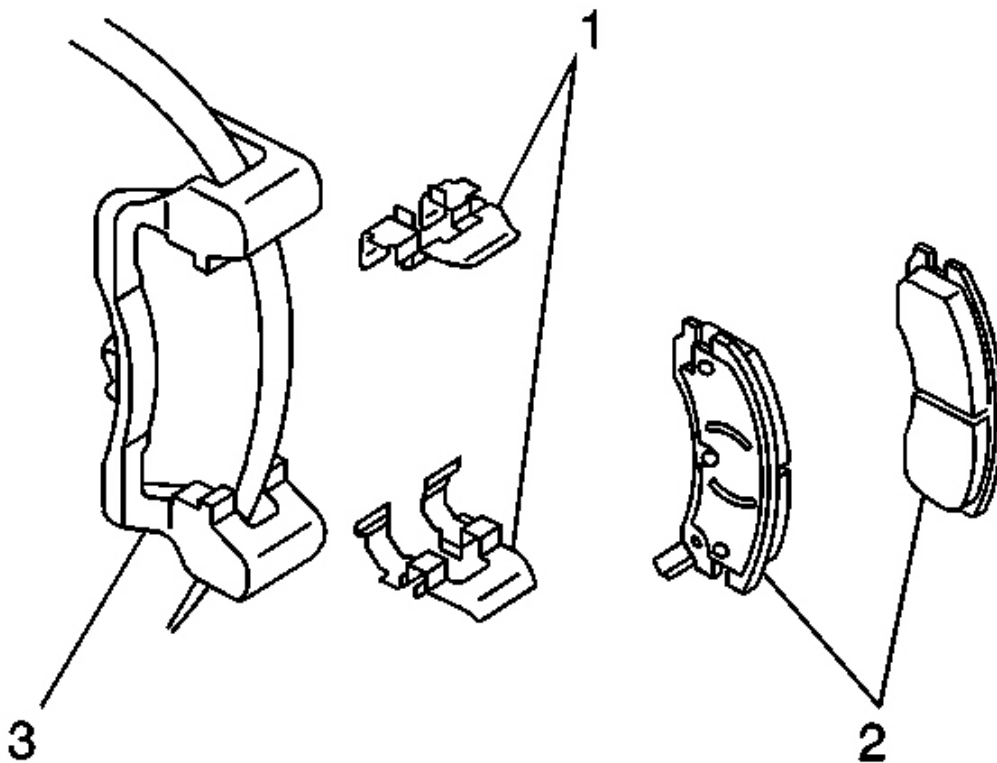


Fig. 39: Identifying Brake Components
Courtesy of GENERAL MOTORS CORP.

4. Install the brake pad retainers (1) to the brake caliper bracket (3).
5. Install the brake pads (2) to the brake caliper bracket (3).
6. Install the brake caliper (1) to the front brake caliper bracket (2). Refer to **Brake Caliper Replacement** .

BRAKE ROTOR REPLACEMENT

Tools Required

- **J 41013** Rotor Resurfacing Kit. See **Special Tools and Equipment** .
- **J 42450-A** Wheel Hub Resurfacing Kit. See **Special Tools and Equipment** .

CAUTION: Refer to **Brake Dust Caution** in Cautions and Notices.

Removal Procedure

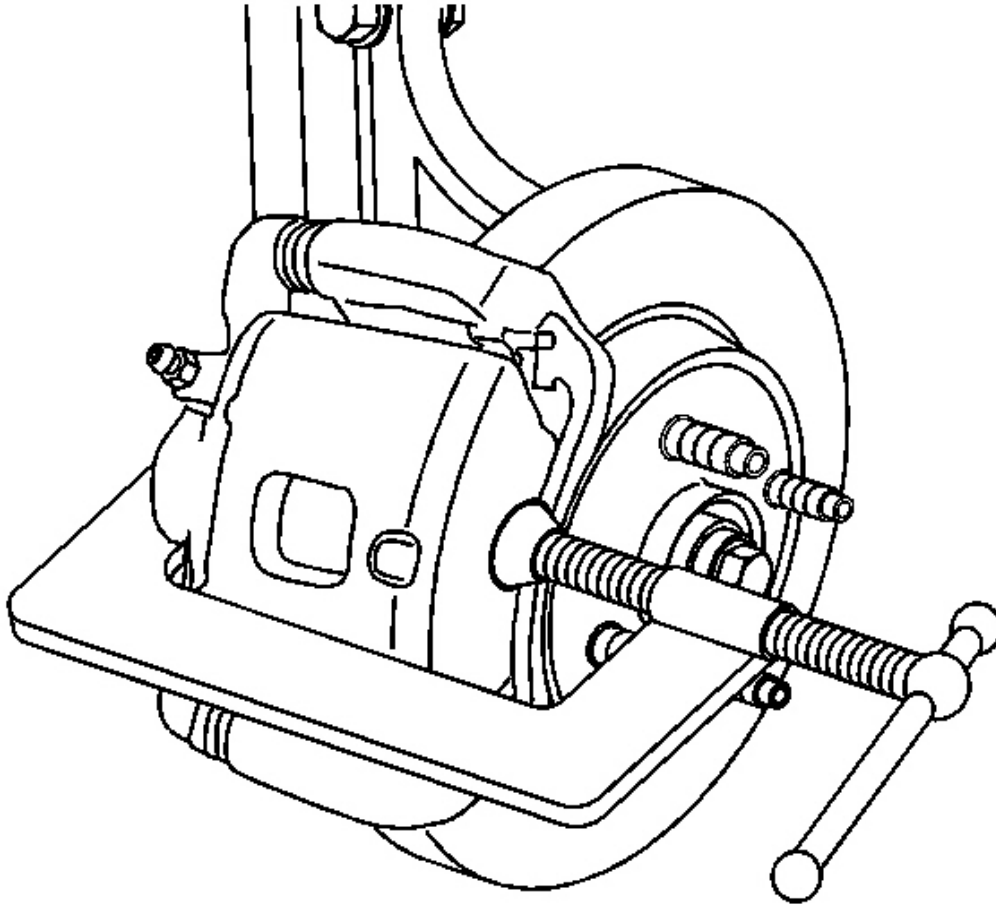


Fig. 40: Installing C-Clamp Over Body Of Brake Caliper
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
3. Install a C-clamp over the body of the brake caliper, with the C-clamp ends against the rear of the caliper body and the outboard disc brake pad.
4. 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.
5. Remove the C-clamp.

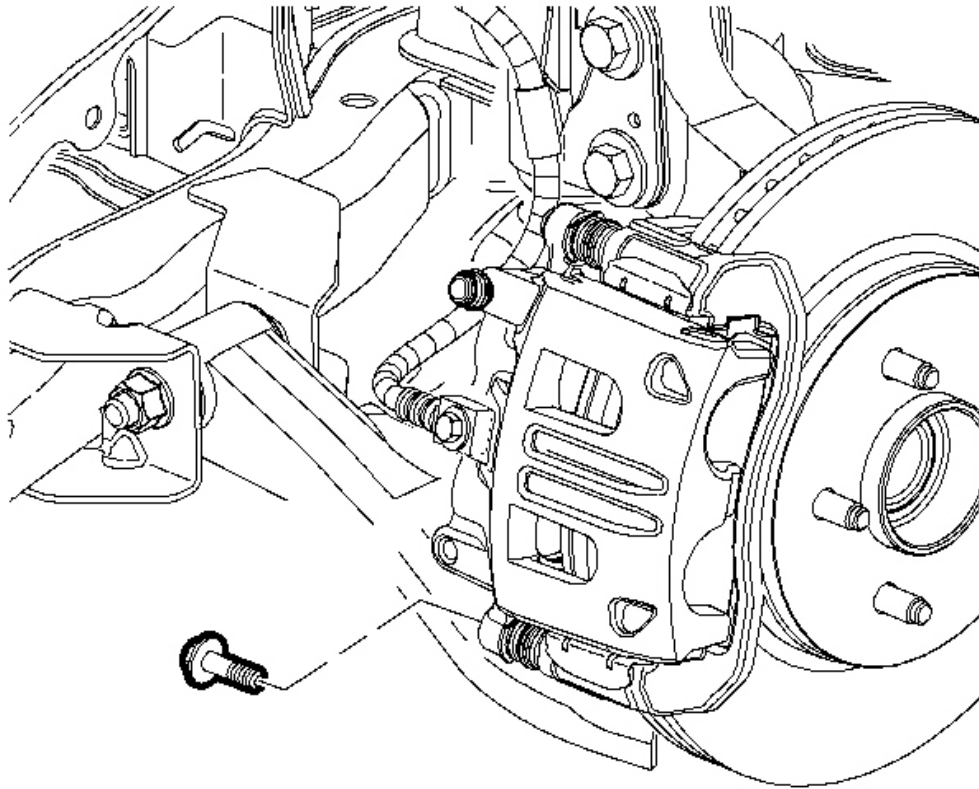


Fig. 41: Removing/Installing Brake Rotor To Hub/Axle Flange
Courtesy of GENERAL MOTORS CORP.

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.

IMPORTANT: Do NOT disconnect the hydraulic brake flexible hose from the caliper.

6. Remove the brake caliper and the caliper mounting bracket as an assembly from the steering knuckle and

support the assembly with heavy mechanic's wire, or equivalent. Ensure that there is no tension on the hydraulic brake flexible hose. Refer to **Brake Caliper Bracket Replacement** .

7. Matchmark the position of the brake rotor to the wheel studs.
8. Remove the brake rotor.

Installation Procedure

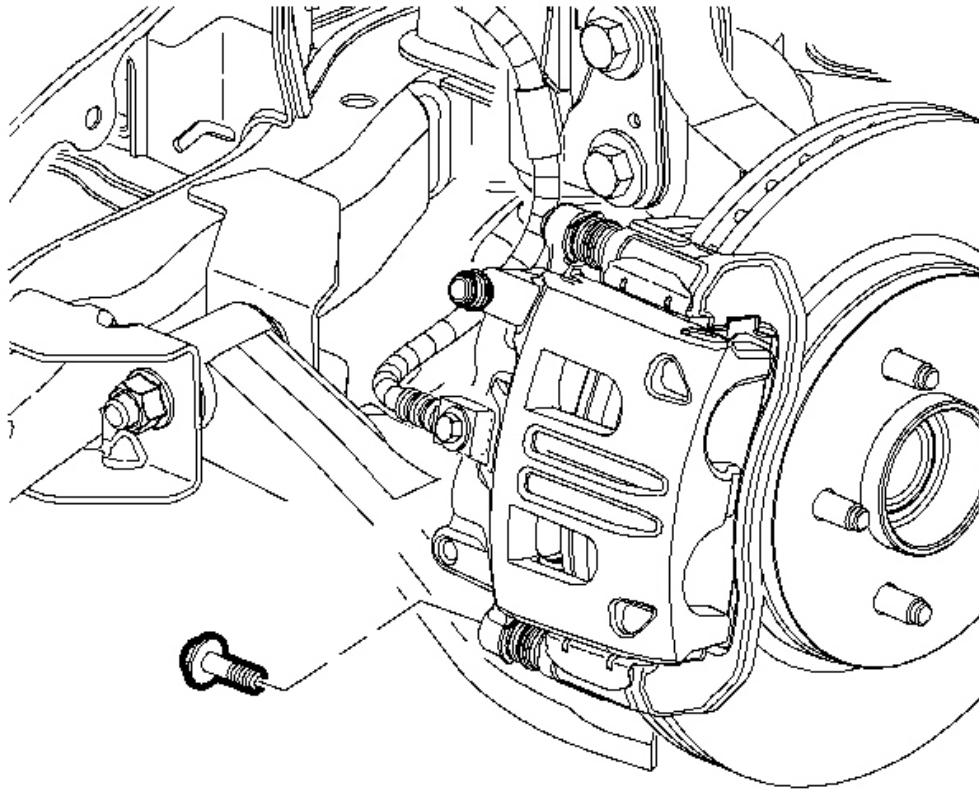


Fig. 42: Removing/Installing Brake Rotor To Hub/Axle Flange
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Whenever the brake rotor has been separated from the hub/axle flange, any rust or contaminants should be cleaned from the hub/axle flange and

the brake rotor mating surfaces. Failure to do this may result in excessive assembled lateral runout (LRO) of the brake rotor, which could lead to brake pulsation.

1. Using the **J 42450-A** , thoroughly clean any rust or corrosion from the mating surface of the hub/axle flange. See **Special Tools and Equipment** .
2. Using the **J 41013** , thoroughly clean any rust or corrosion from the mating surface and mounting surface of the brake rotor. See **Special Tools and Equipment** .
3. Inspect the mating surfaces of the hub/axle flange and the rotor to ensure that there are no foreign particles or debris remaining.
4. Install the brake rotor to the hub/axle flange. Use the matchmark made prior to removal for proper orientation to the flange.
5. If the brake rotor was removed and installed as part of a brake system repair, measure the assembled LRO of the brake rotor to ensure optimum performance of the disc brakes. Refer to **Brake Rotor Assembled Lateral Runout (LRO) Measurement** .
6. If the brake rotor assembled LRO measurement exceeds the specification, bring the LRO to within specifications. Refer to **Brake Rotor Assembled Lateral Runout (LRO) Correction** .
7. Remove the support, and install the brake caliper and the brake caliper bracket as an assembly to the steering knuckle. Refer to **Brake Caliper Bracket Replacement** .
8. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
9. Lower the vehicle.
10. If the brake rotor was refinished or replaced, or if new brake pads were installed, burnish the pads and rotors. Refer to **Burnishing Pads and Rotors** .

BRAKE ROTOR ASSEMBLED LATERAL RUNOUT (LRO) CORRECTION

IMPORTANT:

- **Brake rotor thickness variation MUST be checked BEFORE checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to Brake Rotor Thickness Variation Measurement .**
- **Brake rotor assembled lateral runout (LRO) exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4 800-11 300 km (3,000-7,000 mi). Refer to Brake Rotor Assembled Lateral Runout (LRO) Measurement .**

Review the following acceptable methods for bringing the brake rotor assembled LRO to within specifications. Determine which method to use for the specific vehicle being repaired.

- The indexing method of correcting assembled LRO is most effective when the LRO specification is only exceeded by a relatively small amount: 0.025-0.127 mm (0.001-0.005 in). Indexing is used to achieve the best possible match of high spots to low spots between related components. Refer to **Brake Rotor Assembled Lateral Runout (LRO) Correction - Indexing** .

- The correction plate method of correcting assembled LRO involves the addition of a tapered plate between the brake rotor and the hub/axle flange. The correction plate method can be used to correct LRO that exceeds the specification by up to 0.23 mm (0.009 in). Refer to **Brake Rotor Assembled Lateral Runout (LRO) Correction - Correction Plates** .
- The on-vehicle brake lathe method is used to bring the LRO to within specifications through compensating for LRO while refinishing the brake rotor. Refer to **Brake Rotor Assembled Lateral Runout (LRO) Correction - On-Vehicle Lathe** .

If the assembled LRO cannot be corrected using these methods, then other components must be suspected as causing and/or contributing to the LRO concern.

BRAKE ROTOR ASSEMBLED LATERAL RUNOUT (LRO) CORRECTION - INDEXING

Tools Required

- **J 39544-KIT** Torque-Limiting Socket Set, or equivalent. See **Special Tools and Equipment** .
- **J 45101-100** Conical Brake Rotor Washers. See **Special Tools and Equipment** .

CAUTION: Refer to **Brake Dust Caution** in Cautions and Notices.

IMPORTANT:

- Brake rotor thickness variation **MUST** be checked **BEFORE** checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to **Brake Rotor Thickness Variation Measurement** .
- Brake rotor assembled lateral runout (LRO) exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4 800-11 300 km (3,000-7,000 mi). Refer to **Brake Rotor Assembled Lateral Runout (LRO) Measurement** .

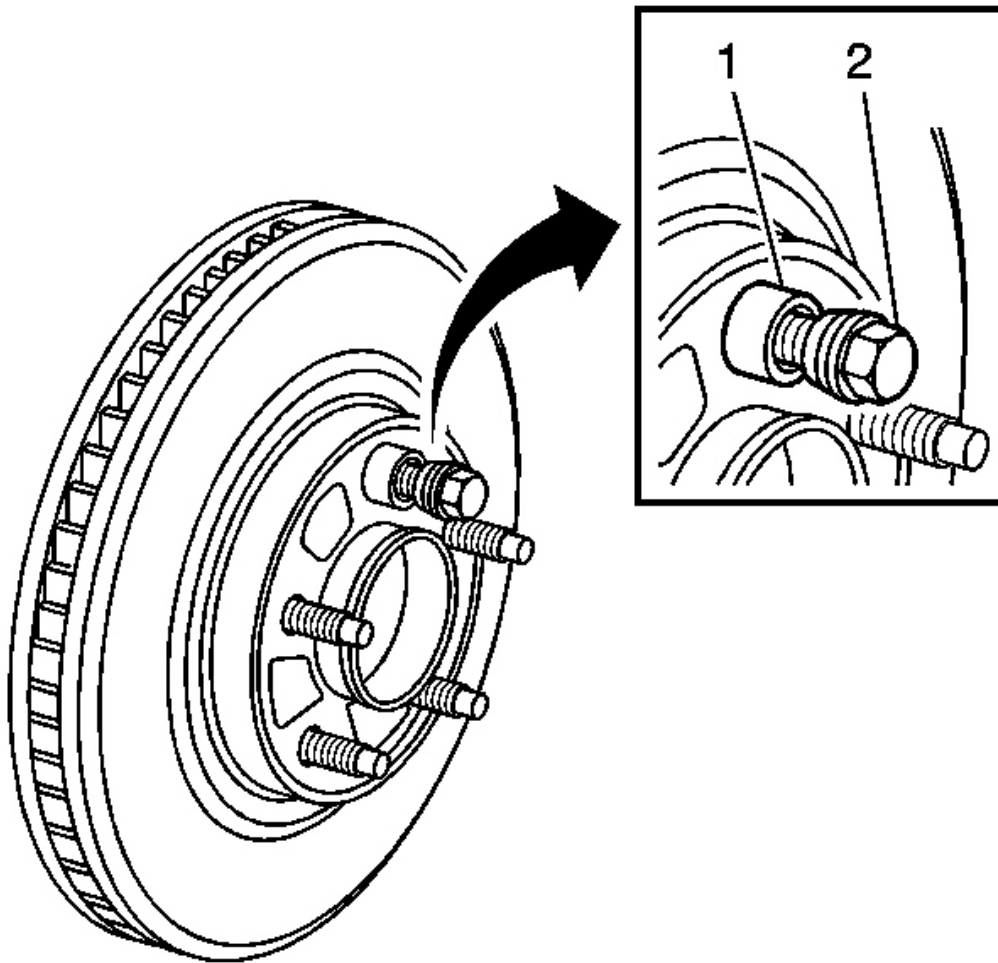


Fig. 43: Identifying J 45101-100
Courtesy of GENERAL MOTORS CORP.

1. Remove the **J 45101-100** and the lug nuts that were installed during the assembled LRO measurement procedure. See **Special Tools and Equipment** .
2. Inspect the mating surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles or debris remaining.
3. Index the brake rotor in a different orientation to the hub/axle flange.
4. Hold the rotor firmly in place against the hub/axle flange and install one of the **J 45101-100** (1) and one lug nut (2) onto the upper-most wheel stud. See **Special Tools and Equipment** .
5. Continue to hold the rotor secure and tighten the lug nut firmly by hand.

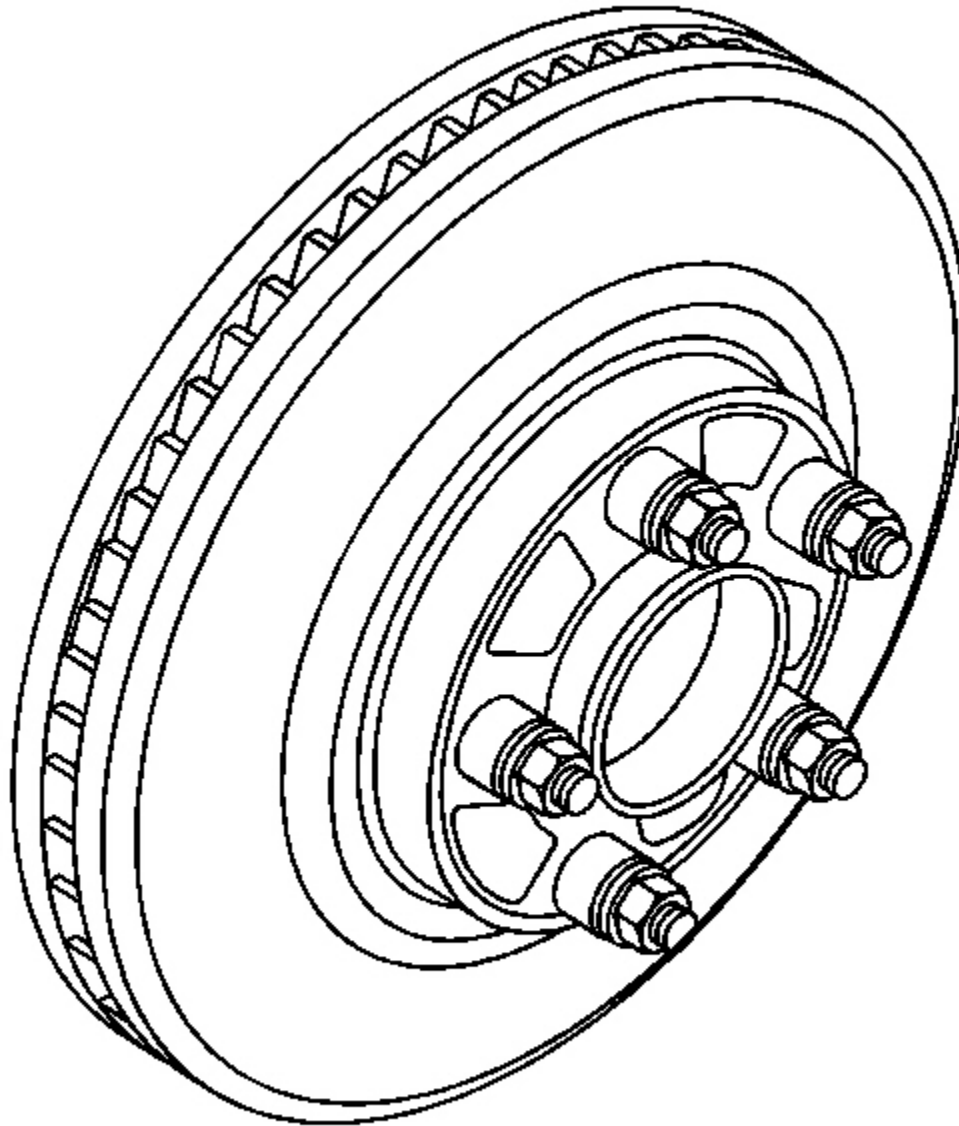


Fig. 44: Identifying Brake Rotor
Courtesy of GENERAL MOTORS CORP.

6. Install the remaining **J 45101-100** and lug nuts onto the wheel studs and tighten the nuts firmly by hand in a star-pattern. See **Special Tools and Equipment** .
7. Using the **J 39544-KIT** , or equivalent, tighten the lug nuts in a star-pattern to specification, in order to properly secure the rotor. See **Special Tools and Equipment** . Refer to **Tire and Wheel Removal and**

Installation in Tires and Wheels.

8. Measure the assembled LRO of the brake rotor. Refer to **Brake Rotor Assembled Lateral Runout (LRO) Measurement** .
9. Compare the amount of change between this measurement and the original measurement.
10. If this measurement is within specifications, proceed to step 14.
11. If this measurement still exceeds specifications, repeat steps 1-9 until the best assembled LRO measurement is obtained.
12. Matchmark the final location of the rotor to the wheel studs if the orientation is different than it was originally.
13. If the brake rotor assembled LRO measurement still exceeds the maximum allowable specification, refer to **Brake Rotor Assembled Lateral Runout (LRO) Correction** .
14. If the brake rotor assembled LRO is within specification, install the brake caliper and depress the brake pedal several times to secure the rotor in place before removing the **J 45101-100** and the lug nuts. See **Special Tools and Equipment** .

BRAKE ROTOR ASSEMBLED LATERAL RUNOUT (LRO) CORRECTION - CORRECTION PLATES

Tools Required

- **J 39544-KIT** Torque-Limiting Socket Set, or equivalent. See **Special Tools and Equipment** .
- **J 45101-100** Conical Brake Rotor Washers. See **Special Tools and Equipment** .

CAUTION: Refer to **Brake Dust Caution** in Cautions and Notices.

IMPORTANT:

- **Brake rotor thickness variation MUST be checked BEFORE checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to Brake Rotor Thickness Variation Measurement .**
- **Brake rotor assembled lateral runout (LRO) exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4 800-11 300 km (3,000-7,000 mi). Refer to Brake Rotor Assembled Lateral Runout (LRO) Measurement .**

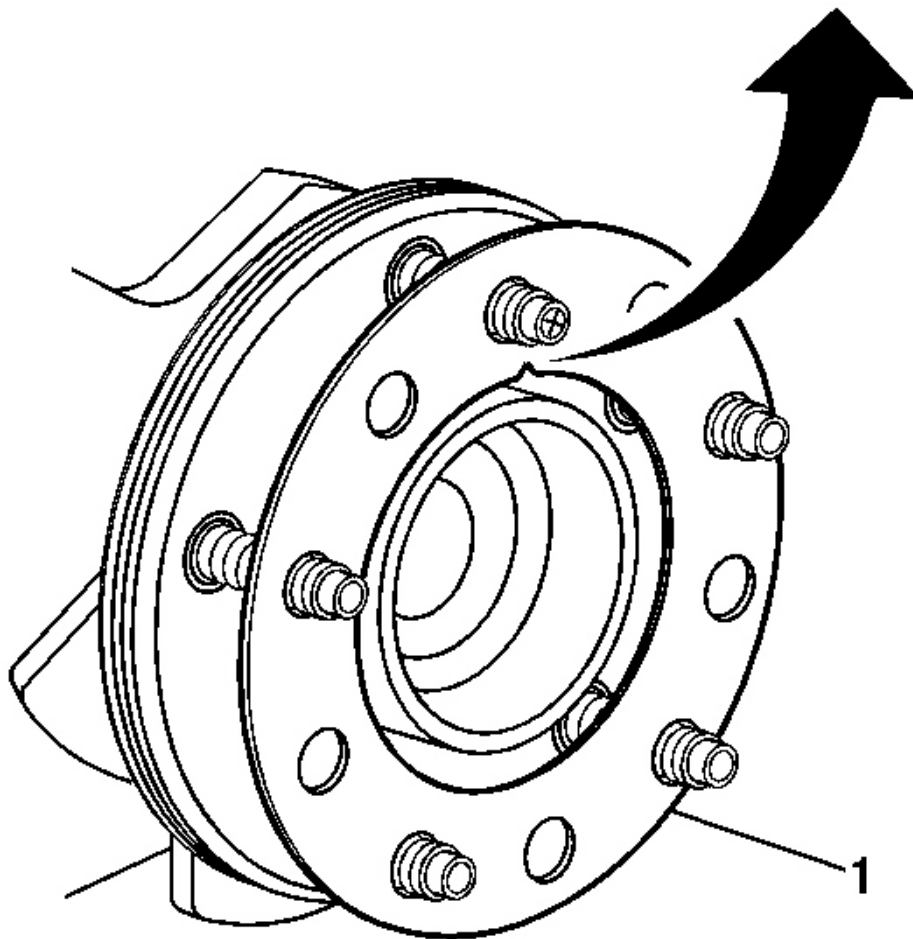
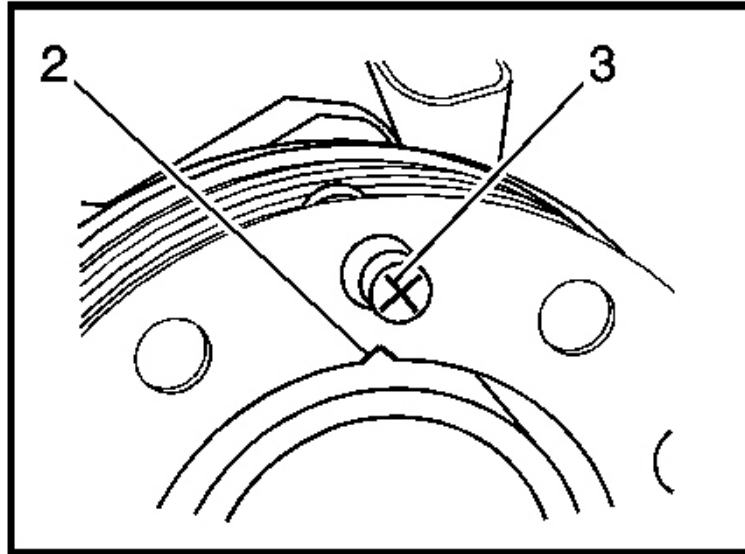


Fig. 45: Installing Correction Plate, High Spot Mark & V-Shaped Notch
Courtesy of GENERAL MOTORS CORP.

1. Rotate the brake rotor to position the high spot, identified and marked during the brake rotor assembled LRO measurement procedure, to face upward.
2. Remove the **J 45101-100** and the lug nuts that were installed during the assembled LRO measurement procedure and/or the indexing correction procedure. See **Special Tools and Equipment** .
3. Inspect the mounting surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles or debris remaining.
4. Select the correction plate, following the manufacturer's instructions, which has a specification closest to the assembled LRO measurement.

For example: If the assembled LRO measurement was 0.076 mm (0.003 in), the 0.076 mm (0.003 in) correction plate would be used. If the measurement was 0.127 mm (0.005 in), the 0.152 mm (0.006 in) correction plate would be used.

5. Determine the positioning for the correction plate (1) using the high spot mark (3) made during the brake rotor assembled LRO measurement procedure.

IMPORTANT:

- **Do NOT install used correction plates in an attempt to correct brake rotor assembled lateral runout (LRO).**
- **Do NOT stack up, or install more than one correction plate onto one hub/axle flange location, in an attempt to correct brake rotor assembled LRO.**

6. Install the correction plate (1) onto the hub/axle flange, with the V-shaped notch (2) orientated to align with the high spot mark (3), that was positioned to face upward.

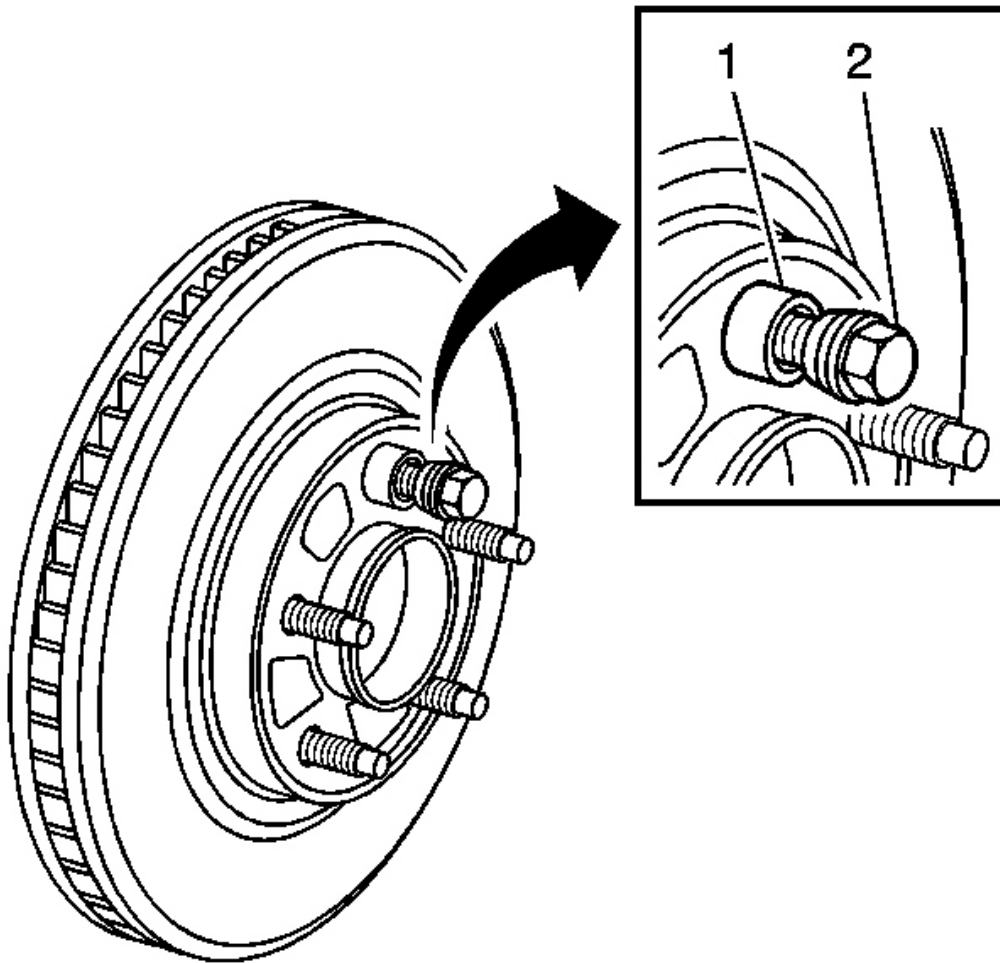


Fig. 46: Identifying J 45101-100
Courtesy of GENERAL MOTORS CORP.

7. Install the brake rotor to the hub/axle flange. Use the matchmark made prior to removal for proper orientation to the flange.
8. Hold the rotor firmly in place against the hub/axle flange and install one of the **J 45101-100** (1) and one lug nut (2) onto the upper-most wheel stud. See **Special Tools and Equipment** .
9. Continue to hold the rotor secure and tighten the lug nut firmly by hand.

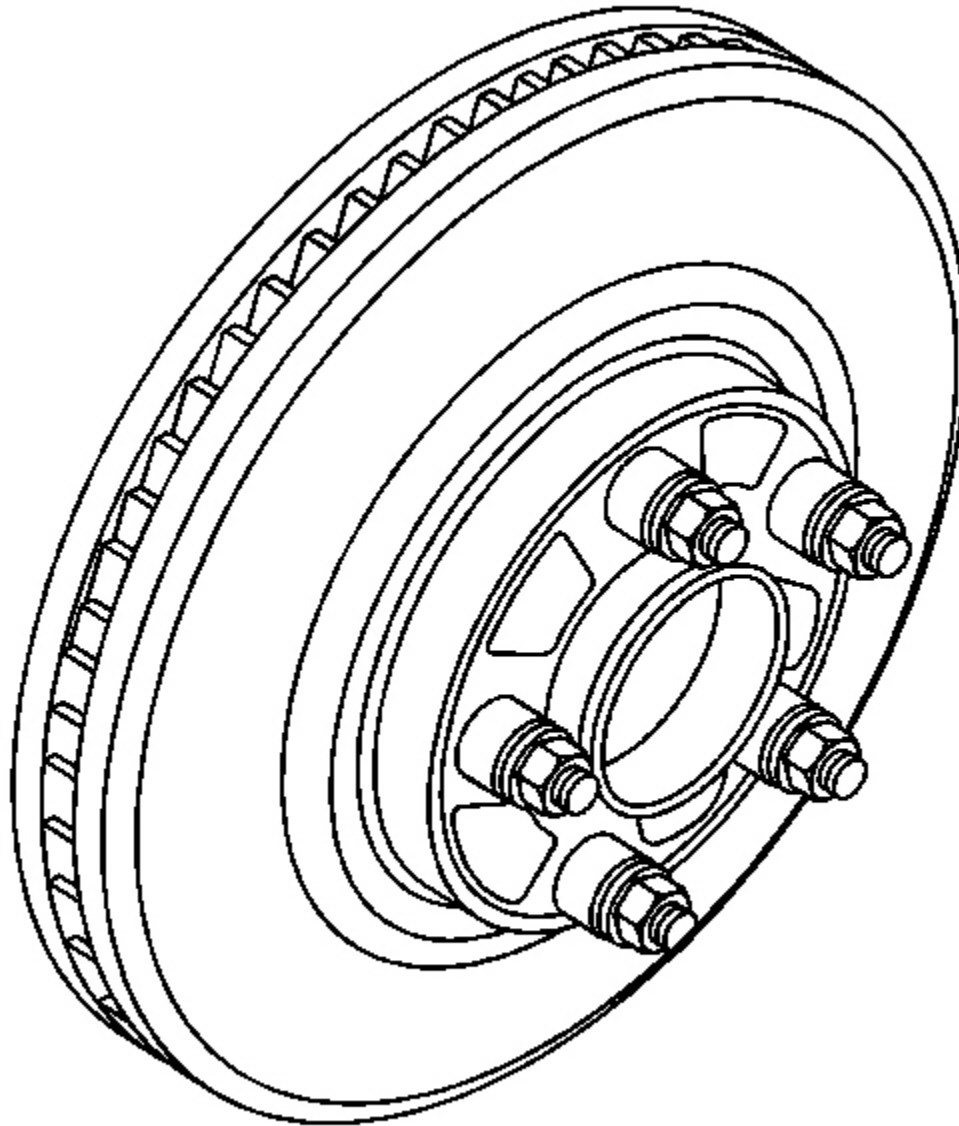


Fig. 47: Identifying Brake Rotor
Courtesy of GENERAL MOTORS CORP.

10. Install the remaining **J 45101-100** and lug nuts onto the wheel studs and tighten the nuts firmly by hand in a star-pattern. See **Special Tools and Equipment** .
11. Using the **J 39544-KIT** , or equivalent, tighten the lug nuts in a star-pattern to specification, in order to properly secure the rotor. See **Special Tools and Equipment** . Refer to **Tire and Wheel Removal and**

Installation in Tires and Wheels.

12. Measure the assembled LRO of the brake rotor. Refer to **Brake Rotor Assembled Lateral Runout (LRO) Measurement** .
13. If the brake rotor assembled LRO measurement still exceeds the maximum allowable specification, refer to **Brake Rotor Assembled Lateral Runout (LRO) Correction** .
14. If the brake rotor assembled LRO measurement is within specification, install the brake caliper and depress the brake pedal several times to secure the rotor in place before removing the **J 45101-100** and the lug nuts. See **Special Tools and Equipment** .

BRAKE ROTOR ASSEMBLED LATERAL RUNOUT (LRO) CORRECTION - ON-VEHICLE LATHE

Tools Required

J 45101-100 Conical Brake Rotor Washers. See **Special Tools and Equipment** .

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

IMPORTANT:

- **Brake rotor thickness variation MUST be checked BEFORE checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to Brake Rotor Thickness Variation Measurement .**
- **Brake rotor assembled lateral runout (LRO) exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4 800-11 300 km (3,000-7,000 mi). Refer to Brake Rotor Assembled Lateral Runout (LRO) Measurement .**

1. Ensure that the caliper and caliper bracket that are already being supported, are clear from contacting any rotating components, such as the brake rotor.
2. Remove the **J 45101-100** and the lug nuts that were installed during the assembled LRO measurement procedure and/or the indexing correction procedure. See **Special Tools and Equipment** .
3. Inspect the mounting surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles or debris remaining.
4. Set up the lathe, following the manufacturer's instructions.
5. Refinish the brake rotor, following the brake lathe manufacturer's instructions.
6. After each successive cut, inspect the brake rotor thickness. Refer to **Brake Rotor Thickness Measurement** .
7. If at any time the brake rotor exceeds the minimum allowable thickness after refinish specification, the brake rotor must be replaced. After replacing the rotor, proceed to step 10.
8. After refinishing the brake rotor, use the following procedure in order to obtain the desired non-directional finish:
 1. Follow the brake lathe manufacturer's recommended speed setting for applying a non-directional

finish

2. Using moderate pressure, apply the non-directional finish:
 - If the lathe is equipped with a non-directional finishing tool, apply the finish with 120 grit aluminum oxide sandpaper
 - If the lathe is not equipped with a non-directional finishing tool, apply the finish with a sanding block and 150 grit aluminum oxide sandpaper
3. After applying a non-directional finish, clean each friction surface of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner
9. Remove the lathe from the vehicle.
10. Measure the assembled LRO of the brake rotor. Refer to **Brake Rotor Assembled Lateral Runout (LRO) Measurement** .
11. If the brake rotor assembled LRO measurement still exceeds the maximum allowable specification, refer to **Brake Rotor Assembled Lateral Runout (LRO) Correction** .
12. If the brake rotor assembled LRO is within specification, install the brake caliper and depress the brake pedal several times to secure the rotor in place before removing the **J 45101-100** and the lug nuts. See **Special Tools and Equipment** .

BRAKE ROTOR REFINISHING

Tools Required

- **J 41013** Rotor Resurfacing Kit. See **Special Tools and Equipment** .
- **J 42450-A** Wheel Hub Resurfacing Kit. See **Special Tools and Equipment** .

CAUTION: Refer to **Brake Dust Caution** in Cautions and Notices.

IMPORTANT:

- **The disc brake rotors do not require refinishing as part of routine brake system service. New disc brake rotors do not require refinishing.**

Do not refinish disc brake rotors in an attempt to correct the following conditions:

- **Brake system noise - squeal, growl, groan**
- **Uneven and/or premature disc brake pad wear**
- **Superficial or cosmetic corrosion/rust of the disc brake rotor friction surface**
- **Scoring of the disc brake rotor friction surface less than the maximum allowable specification**
- **Before refinishing a brake rotor, the rotor MUST first be checked for adequate thickness to allow the rotor to be refinished and remain above the minimum allowable thickness after refinish specification. Refer to**

Brake Rotor Thickness Measurement .

Disc brake rotors should only be refinished if they have adequate thickness to be refinished and if one or more of the following conditions exist:

- **Thickness variation in excess of the maximum allowable specification**
- **Excessive corrosion/rust and/or pitting**
- **Cracks and/or heat spots**
- **Excessive blueing discoloration**
- **Scoring of the disc brake rotor surface in excess of the maximum allowable specification**
- **Disc brake rotors may need to be refinished as part of the process for correcting brake rotor assembled lateral runout (LRO) that exceeds the maximum allowable specification.**

IMPORTANT: Whenever the brake rotor has been separated from the hub/axle flange, clean any rust or contaminants from the hub/axle flange and the brake rotor mating surfaces. Failure to do this may result in increased assembled lateral runout (LRO) of the brake rotor, which could lead to brake pulsation.

1. Using the **J 42450-A** , thoroughly clean any rust or corrosion from the mating surface of the hub/axle flange. See **Special Tools and Equipment** .
2. Using the **J 41013** , thoroughly clean any rust or corrosion from the mating surface and mounting surface of the brake rotor. See **Special Tools and Equipment** .
3. Inspect the mating surfaces of the hub/axle flange and the rotor to ensure that there are no foreign particles or debris remaining.
4. Mount the brake rotor to the brake lathe according to the lathe manufacturer's instructions, ensuring that all mounting attachments and adapters are clean and free of debris.
5. Ensure that any vibration dampening attachments are securely in place.
6. With the brake lathe running, slowly bring in the cutting tools until they just contact the brake rotor friction surfaces.
7. Observe the witness mark on the brake rotor. If the witness mark extends approximately three-quarters or more of the way around the brake rotor friction surface on each side, the brake rotor is properly mounted to the lathe.
8. If the witness mark does not extend three-quarters or more of the way around the brake rotor, re-mount the rotor to the lathe.
9. Following the brake lathe manufacturer's instructions, refinish the brake rotor.
10. After each successive cut, inspect the brake rotor thickness. Refer to **Brake Rotor Thickness Measurement** .

11. If at any time the brake rotor exceeds the minimum allowable thickness after refinish specification, the brake rotor must be replaced.
12. After refinishing the brake rotor, use the following procedure in order to obtain the desired non-directional finish:
 1. Follow the brake lathe manufacturer's recommended speed setting for applying a non-directional finish
 2. Using moderate pressure, apply the non-directional finish:
 - If the lathe is equipped with a non-directional finishing tool, apply the finish with 120 grit aluminum oxide sandpaper
 - If the lathe is not equipped with a non-directional finishing tool, apply the finish with a sanding block and 150 grit aluminum oxide sandpaper
 3. After applying a non-directional finish, clean each friction surface of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner
13. Remove the brake rotor from the brake lathe.
14. Measure the assembled lateral runout (LRO) of the brake rotor to ensure optimum performance of the disc brakes. Refer to **Brake Rotor Assembled Lateral Runout (LRO) Measurement** .
15. If the brake rotor assembled LRO measurement exceeds the specification, bring the LRO to within specifications. Refer to **Brake Rotor Assembled Lateral Runout (LRO) Correction** .

DESCRIPTION AND OPERATION

DISC BRAKE SYSTEM DESCRIPTION AND OPERATION

System Component 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 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 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.

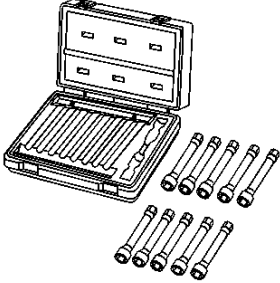
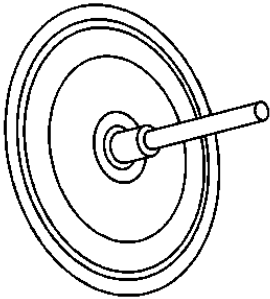
System Operation

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.

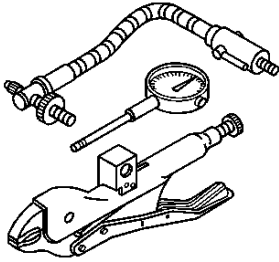
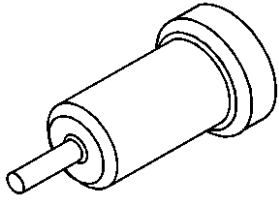
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

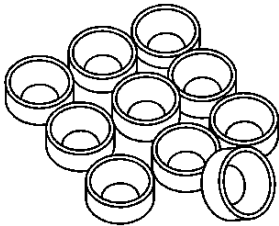
Special Tools

Illustration	Tool Number/ Description
	J 39544-KIT Torque Limiting Socket Set
	J 41013 Rotor Resurfacing Kit
	J 42450-A

Wheel Hub Resurfacing Kit



J 45101
Hub and Wheel Runout Gage



J 45101-100
Conical Brake Rotor Washers

2004 BRAKES

Drum Brakes - Vue

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Brake Pipe Fitting at the Wheel Cylinder	19 N.m	14 lb ft
Wheel Cylinder Bleeder Valve	8 N.m	71 lb in
Wheel Cylinder Mounting Bolts	15 N.m	11 lb ft

DRUM BRAKE COMPONENT SPECIFICATIONS

Drum Brake Component Specifications

Application	Specification	
	Metric	English
Brake Drum Diameter - New	250.0 mm	9.84 in
Brake Drum Discard Diameter	251.5 mm	9.90 in
Brake Drum Maximum Allowable Radial Runout	0.03 mm	0.001 in
Brake Drum Maximum Allowable Scoring	1.5 mm	0.059 in
Brake Drum Maximum Diameter After Refinish	251.5 mm	9.90 in
Brake Shoe Lining Minimum Thickness	1.0 mm	0.04 in
Brake Shoe Lining Thickness - New	6.0 mm	0.24 in
Brake Shoe Lining-to-Drum Clearance	0.50 mm	0.020 in

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - DRUM BRAKES

Begin the drum brake system diagnosis with **Diagnostic Starting Point - Hydraulic Brakes** in Hydraulic Brakes. The use of the Diagnostic Starting Point leads to the identification of the correct procedure for diagnosing the system and where the procedure is located.

BRAKE DRUM DIAMETER MEASUREMENT

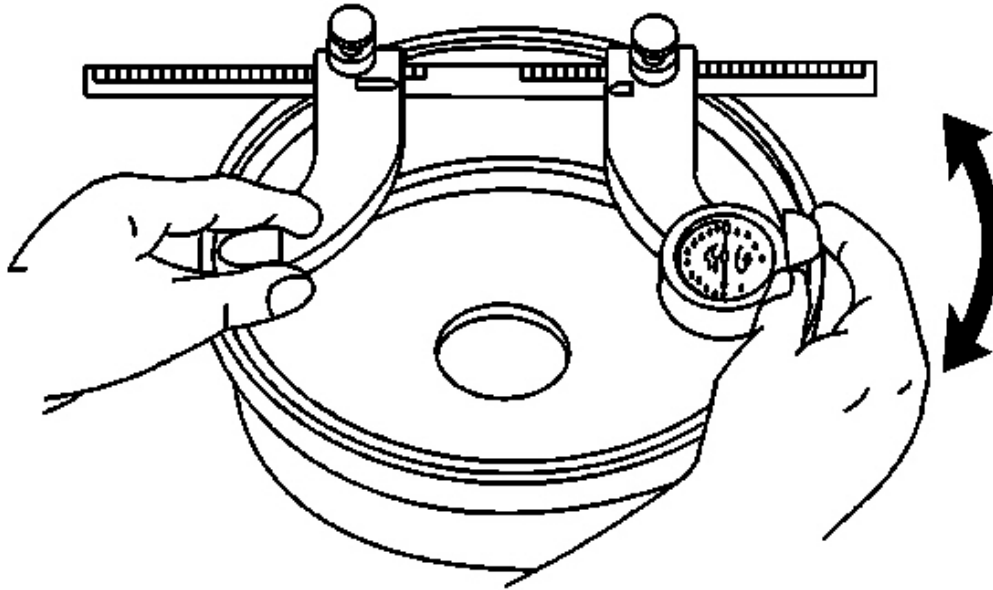


Fig. 1: Measuring Brake Drum
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

1. Clean the brake shoe lining contact surface of the brake drum with denatured alcohol or an equivalent approved brake cleaner.
2. Using a brake drum micrometer calibrated in thousandths of an inch, measure and record the largest diameter of the brake drum at 4 or more points, equally spaced around the drum.

Ensure the measurements are only taken within the brake shoe lining contact area. The micrometer must be positioned the same distance from the outside edge of the drum for each measurement.

3. Compare the largest diameter measurement recorded to the following specifications:

Specification:

- Brake drum maximum allowable diameter after refinish: 251.5 mm (9.90 in)
- Brake drum discard diameter: 251.5 mm (9.90 in)

4. If the largest diameter measurement of the brake drum is less than the maximum allowable inside

diameter after refinishing specification, the drum may be refinished, depending upon surface and wear conditions.

5. If the largest diameter measurement of the brake drum is equal to the maximum allowable diameter after refinishing specification, the drum may not be refinished.
6. If the largest diameter measurement of the brake drum is greater than the discard diameter specification, the drum requires replacement.

BRAKE DRUM SURFACE AND WEAR INSPECTION

Tools Required

J 8001 Dial Indicator, or equivalent. See **Special Tools and Equipment** .

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

1. With the brake drum removed, clean the brake shoe lining contact surface of the brake drum with denatured alcohol or an equivalent approved brake cleaner.
2. Inspect the braking surface of the brake drum 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 drum.

- Cracks and/or heat spots
 - Excessive blueing discoloration
 - Missing balance weights
3. If the braking surface of the brake drum exhibits one or more of the Braking Surface Conditions listed, the drum requires refinishing or replacement.

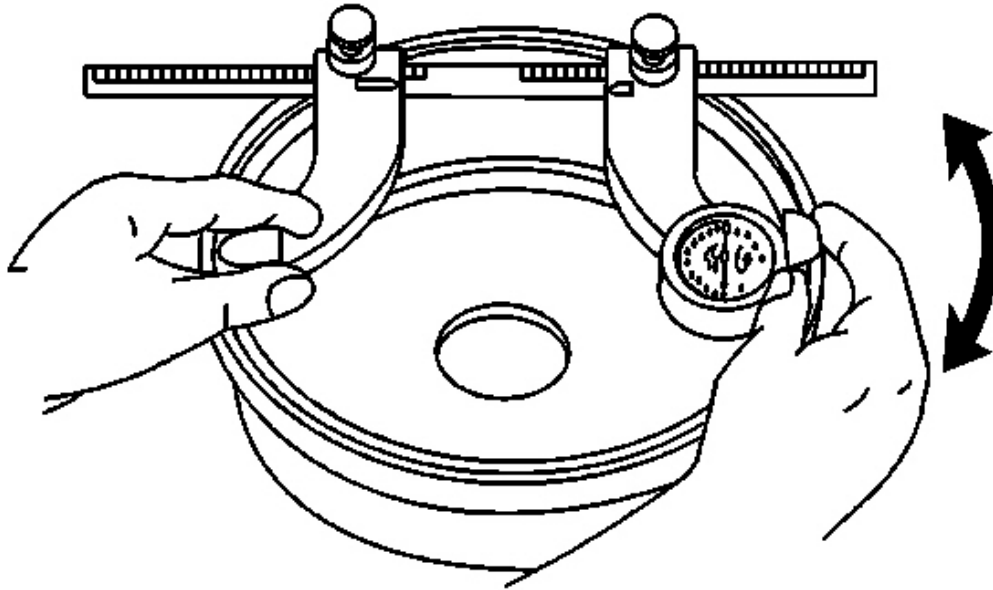


Fig. 2: Measuring Brake Drum
Courtesy of GENERAL MOTORS CORP.

4. Using a brake drum micrometer calibrated in thousandths-of-an-inch, measure and record any grooves present on the drum braking surface.

Ensure that the measurements are only taken within the brake shoe lining contact area.

5. Compare the groove, or scoring depth recorded to the following specification:

Specification: Brake drum maximum allowable scoring: 1.5 mm (0.059 in)

6. If the brake drum scoring depth exceeds the specification, or if an excessive amount of scoring is present, the drum requires refinishing or replacement.
7. Mount the brake drum on a brake lathe.
8. Mount a dial indicator, **J 8001** or equivalent, and position the indicator button so it contacts the braking surface of the brake drum at a 90 degree angle, approximately 19 mm (0.75 in) from the outer edge of the drum. See **Special Tools and Equipment**.
9. Measure and record the radial runout of the brake drum.
 1. Rotate the drum until the lowest reading is displayed on the indicator dial, then zero the dial.
 2. Rotate the drum until the highest reading is displayed on the dial.

10. Compare the radial runout of the brake drum to the following specification:

Specification: Brake drum maximum allowable radial runout: 0.03 mm (0.001 in)

11. If the brake drum radial runout exceeds the specification, the drum requires refinishing or replacement.

DRUM BRAKE HARDWARE INSPECTION

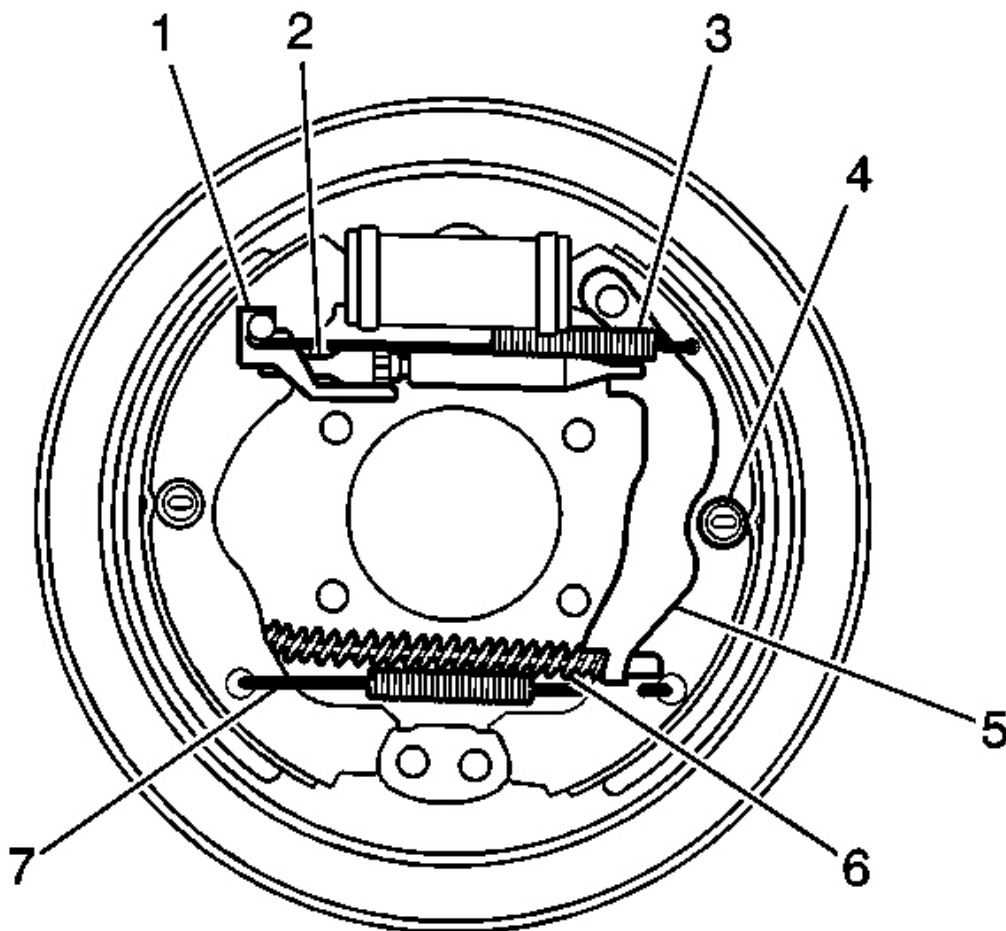


Fig. 3: View Of Brake Components
Courtesy of GENERAL MOTORS CORP.

1. Visually inspect the drum brake system hold-down springs (4) for the following:

- Excessive corrosion

- Damaged or bent locating pins
 - Broken spring coils
 - Damaged retaining cups
2. Visually inspect the lower return spring (7) and the upper return/adjuster actuator spring (3) for the following:
 - Excessive corrosion
 - Excessive stretching
 - Broken hook ends
 - Twisting or binding
 3. If any of the conditions listed were found, the drum brake system hardware requires replacement.
 4. Visually inspect the park brake lever (5) for the following:
 - Bent
 - Broken pivot
 - Broken at park brake cable attachment
 5. If any of the conditions listed were found, the park brake lever and/or attaching hardware requires replacement.

DRUM BRAKE ADJUSTING HARDWARE INSPECTION

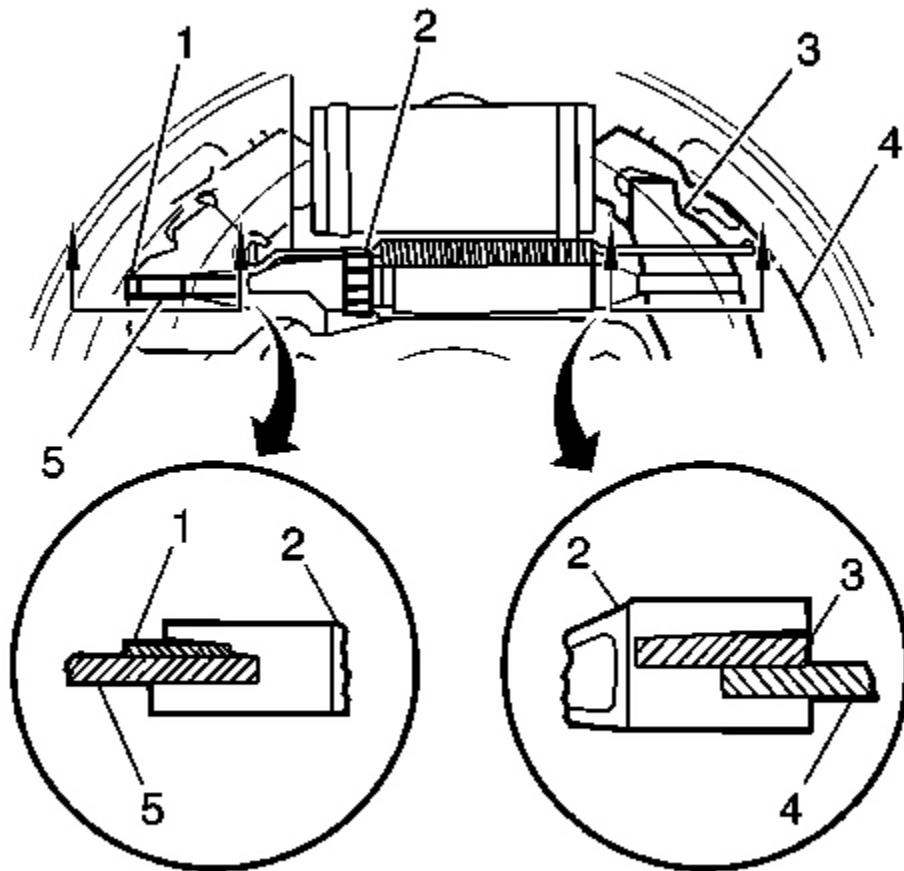


Fig. 4: Locating Adjuster Actuator Components
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

1. Visually inspect the adjuster actuator spring (2) for the following:
 - Excessive corrosion
 - Excessive stretching
 - Broken hook ends
 - Twisting or binding
 - Missing

2. If any of the conditions listed were found, the drum brake system adjuster hardware requires replacement.
3. Visually inspect the adjuster actuator lever (1) for the following conditions:
 - Bent
 - Broken
 - Missing
 - Broken spring attachment tab
4. If any of the conditions listed were found, the adjuster actuator lever and/or attaching hardware requires replacement.

REPAIR INSTRUCTIONS

BRAKE DRUM REPLACEMENT

Tools Required

- **J 41013** Rotor Resurfacing Kit
- **J 42450-A** Wheel Hub Resurfacing Kit

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

Removal Procedure

1. Check to ensure that the park brake is fully released.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
3. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.

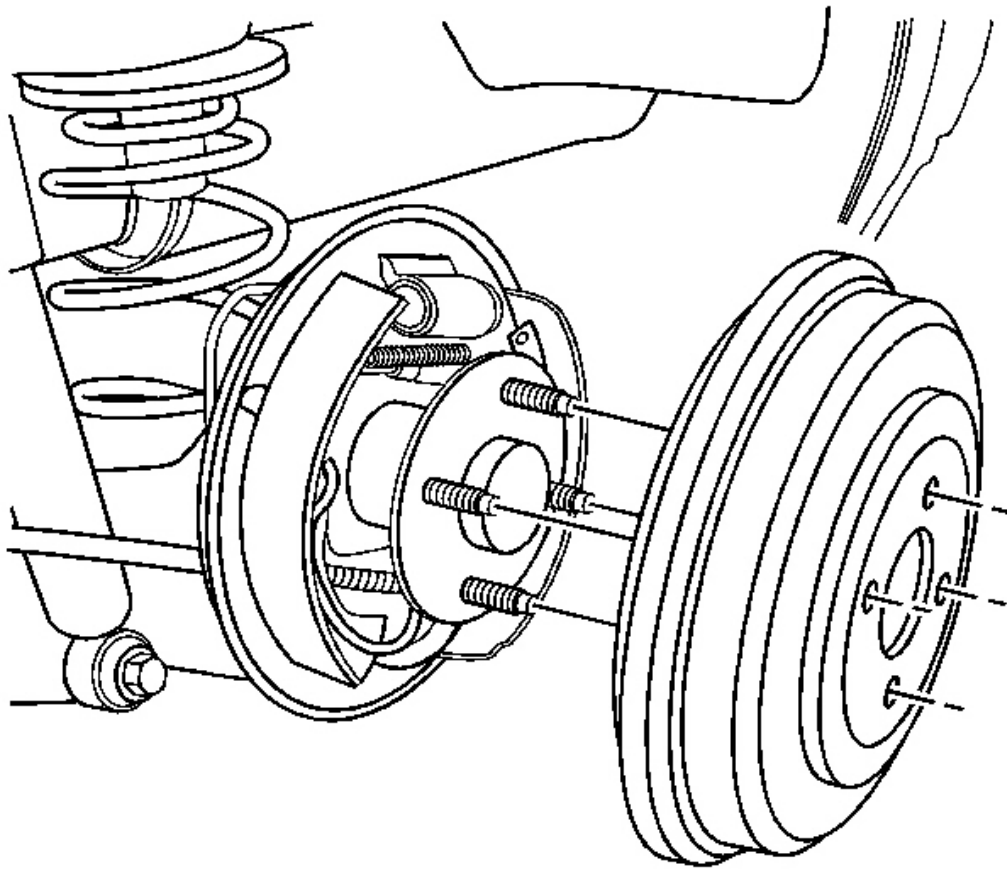


Fig. 5: Removing/Installing Brake Drum
Courtesy of GENERAL MOTORS CORP.

4. Remove the brake drum.
5. If the brake drum is to be reinstalled to the vehicle, use the **J 41013** to clean any rust or corrosion from the hub/flange mating surface of the brake drum.

If necessary, carefully remove any corrosion from the edge of the drum braking surface in order to ease installation.

6. Use the **J 42450-A** to clean the wheel hub flange.

Installation Procedure

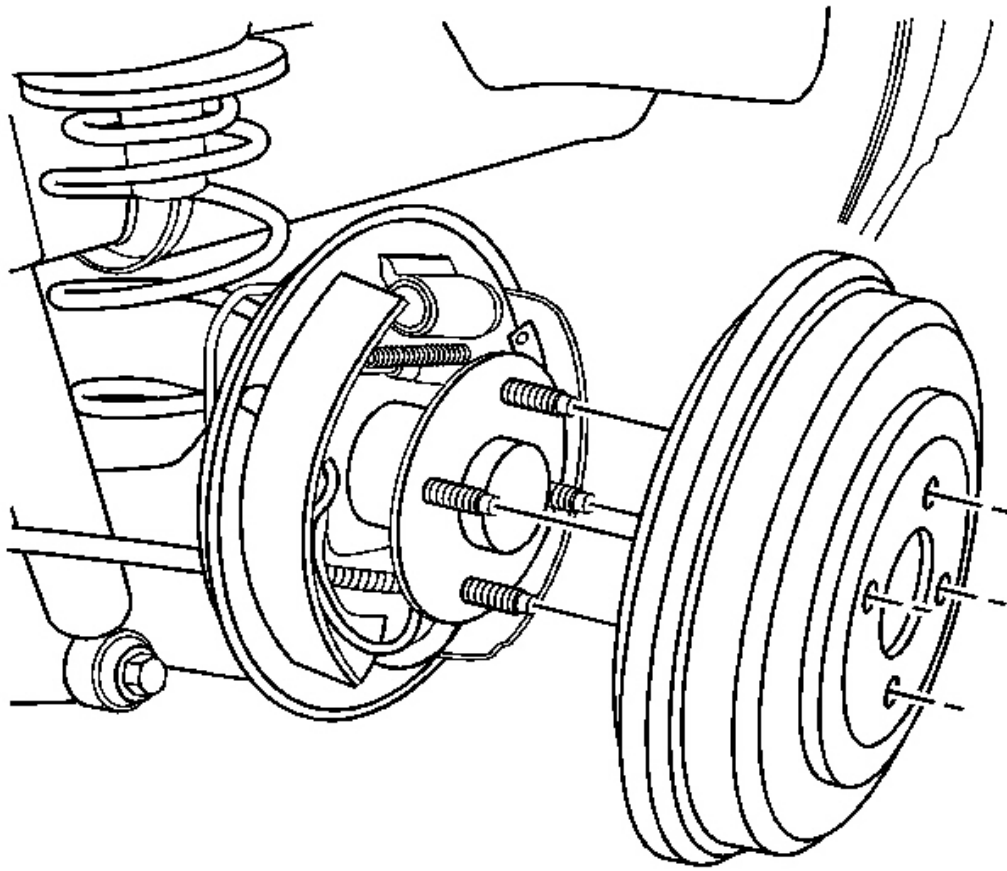


Fig. 6: Removing/Installing Brake Drum
Courtesy of GENERAL MOTORS CORP.

1. Adjust the drum brakes. Refer to **Drum Brake Adjustment** .
2. Install the brake drum.
3. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
4. Apply the brakes approximately three times in order to seat and center the brake shoes within the drum.
5. Lower the vehicle.

BRAKE DRUM REFINISHING

Tools Required

- **J 41013** Rotor/Drum Flange Resurfacing Kit

- **J 42450-A** Hub Cleaning Kit

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

1. The brake drums do not require refinishing as part of routine brake system service. Do not refinish brake drums in an attempt to correct the following conditions:
 - Brake system noise (squeal, growl, groan)
 - Uneven and/or premature brake lining wear
 - Superficial or cosmetic corrosion/rust of the brake drum surface
 - Scoring of the brake drum surface (less than the maximum allowable specification)
2. Brake drums should only be refinished if the following conditions exist:
 - Excessive corrosion/rust and/or pitting
 - Cracks and/or heat spots
 - Excessive blueing discoloration
 - Scoring of the brake drum surface (in excess of the maximum allowable specification)
 - Radial runout in excess of the maximum allowable specification
3. Inspect each of the brake drums and determine if the brake drums can be refinished and remain within the maximum allowable diameter after refinish specification:
 1. With the tire and wheel assemblies removed, measure the diameter of each of the brake drums. Refer to **Brake Drum Diameter Measurement** .
 2. Inspect each of the brake drums for excessive surface wear and/or radial runout. Refer to **Brake Drum Surface and Wear Inspection** .
4. If the brake drums can be refinished, proceed with the rotor refinishing procedure.
5. If necessary, use the **J 41013** in order to thoroughly clean any corrosion/rust from the brake drum flange.
6. Mount the brake drum to the brake lathe according to the lathe manufacturer's instructions.
7. Ensure that any vibration dampening attachments are securely in place.
8. With the brake lathe running, slowly bring in the cutting tool until it just contacts the brake drum friction surface.
9. Observe the witness mark on the brake drum. If the witness mark extends approximately three-quarters or more of the way around the brake drum surface, the brake drum is properly mounted to the lathe.
10. If the witness mark does not extend three-quarters or more of the way around the brake drum, re-mount the brake drum to the lathe.
11. Following the brake lathe manufacturer's instructions, refinish the brake drum.
12. After each successive cut, inspect the brake drum diameter. Refer to **Brake Drum Diameter Measurement** .
13. If at any time the brake drum exceeds the maximum allowable diameter after refinish specification, the brake drum must be replaced.
14. After refinishing the brake drum, use the following procedure in order to obtain the desired non-directional finish:

1. Follow the brake lathe manufacturer's recommended speed setting for applying a non-directional finish
 2. Using moderate pressure, apply the non-directional finish:
 - If the lathe is equipped with a non-directional finishing tool, apply the finish with 120 grit aluminum oxide sandpaper.
 - If the lathe is not equipped with a non-directional finishing tool, apply the finish with a sanding block and 150 grit aluminum oxide sandpaper.
 3. After applying a non-directional finish, clean each friction surface of the brake drum with denatured alcohol or an equivalent brake cleaner
15. Remove the brake drum from the brake lathe.

IMPORTANT: Failure to clean the corrosion from the wheel bearing flange may result in increased lateral runout of the brake drum and brake system pulsation.

16. If necessary, use the **J 42450-A** in order to thoroughly clean any corrosion from the wheel bearing flange.

BRAKE SHOE REPLACEMENT

Removal Procedure

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

CAUTION: Keep fingers away from rear brake shoe springs to prevent fingers from being pinched between spring and shoe web or spring and backing plate.

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle in General Information.
2. Remove the brake drum. Refer to Brake Drum Replacement .

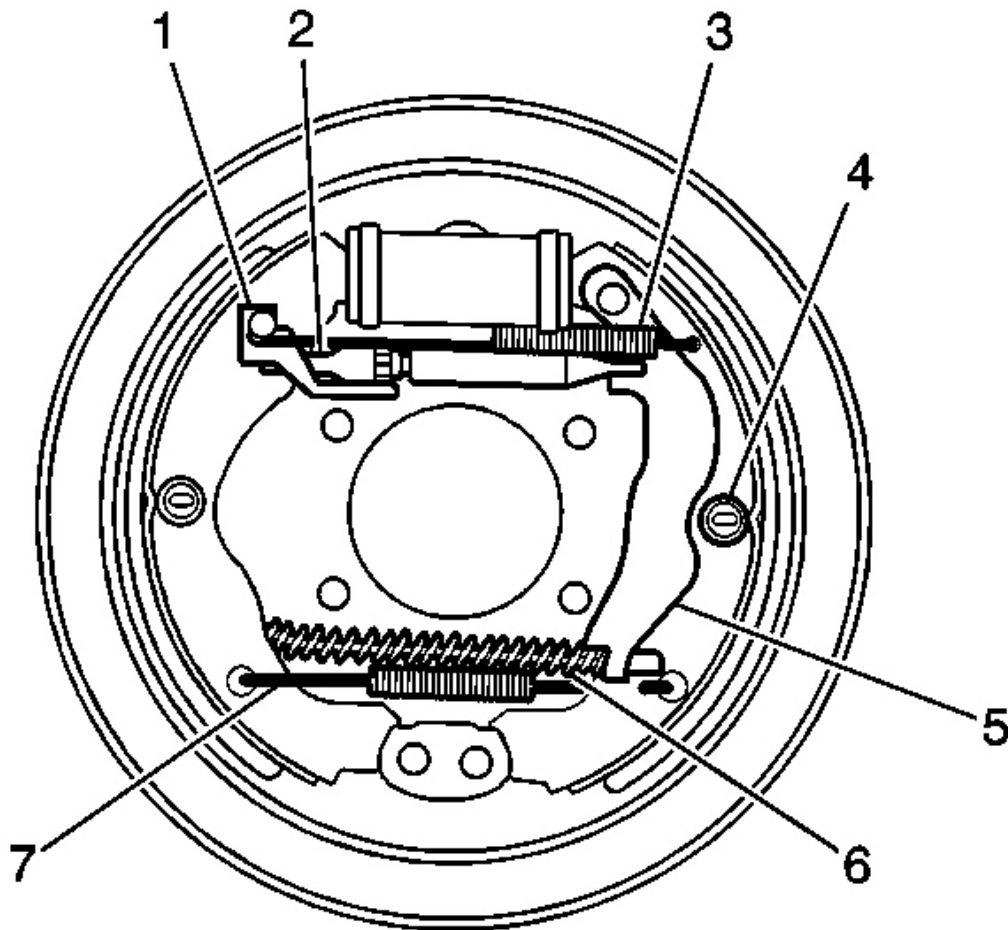


Fig. 7: View Of Brake Components
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not over stretch the adjuster spring. Damage can occur if the spring is over stretched.

3. Disengage the adjuster spring hook end from the tab on the adjuster actuator (1).
4. Remove the straight end of the adjuster spring from the brake shoe.
5. Remove the adjuster actuator from the brake shoe.
6. Remove the return spring (7) from the brake shoes.
7. Remove the park brake cable (6) from the park brake actuator lever (5).
8. Remove the brake shoe hold-down springs and retainers (4) from the brake shoes.

9. Remove the adjuster from the brake shoes and the park brake actuator lever (2).
10. Remove the horseshoe clip retaining the park brake actuator lever to the brake shoe.
11. Remove the park brake actuator lever and wave washer from the brake shoe.
12. Clean all of the drum brake system components with denatured alcohol.
13. Inspect all of the drum brake system components. Refer to **Drum Brake Hardware Inspection** and **Drum Brake Adjusting Hardware Inspection** .
14. Replace drum brake system components as necessary.
15. Inspect the wheel cylinder for the following conditions:
 - Brake fluid leakage
 - Worn or damaged dust boots
16. Replace damaged or leaking wheel cylinders as necessary. Refer to **Wheel Cylinder Replacement** .

Installation Procedure

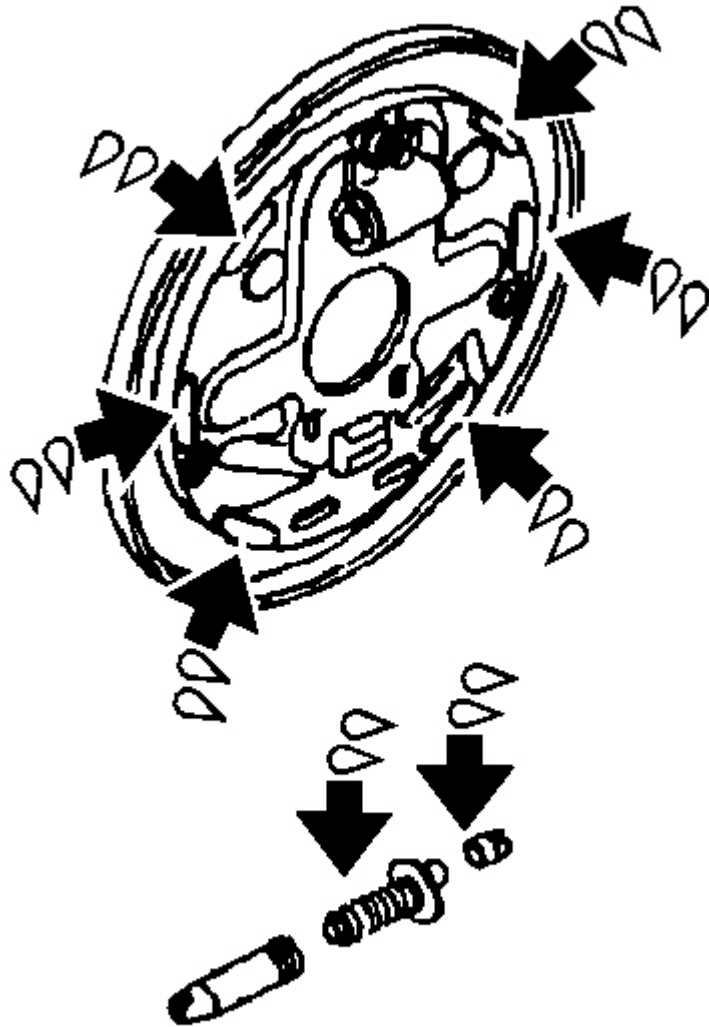


Fig. 8: Applying Silicone Brake Lubricant
Courtesy of GENERAL MOTORS CORP.

1. Apply a thin, light coat of high temperature, silicone brake lubricant to the following areas:
 - The brake shoe contact points on the backing plate
 - The adjuster screw threads
 - The inside diameter of the adjuster socket

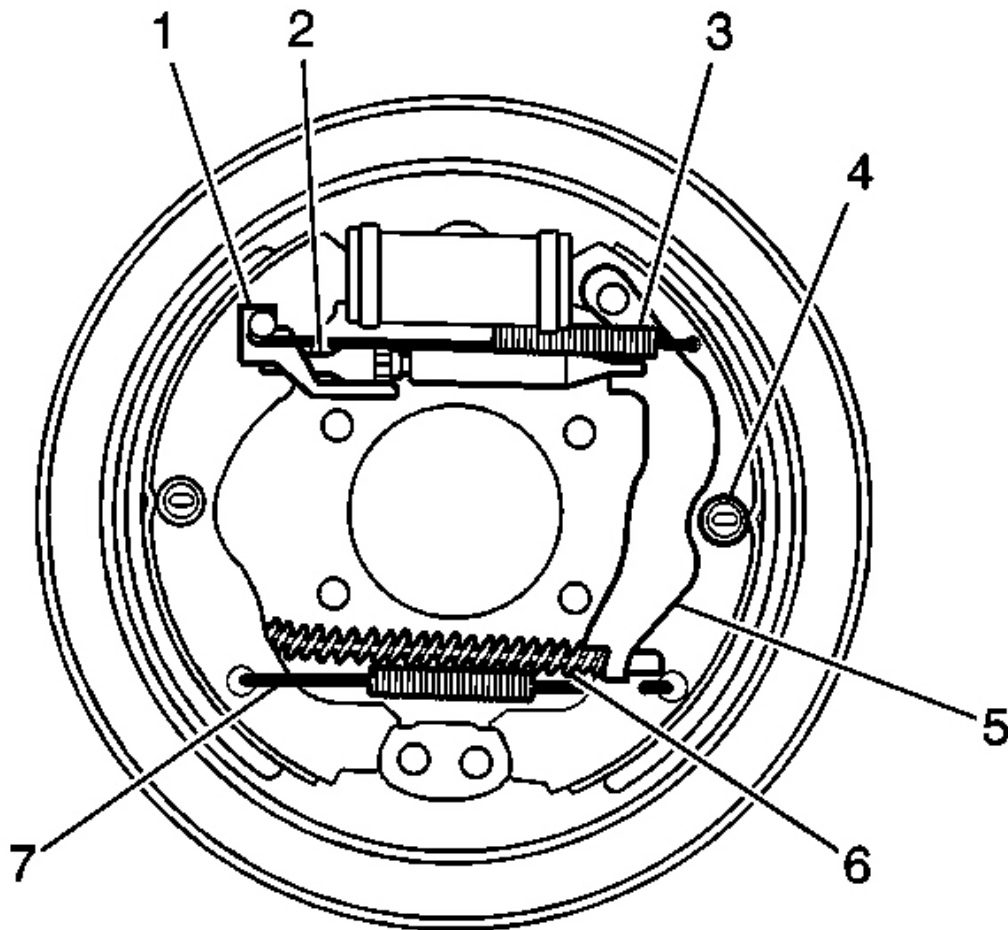


Fig. 9: View Of Brake Components
Courtesy of GENERAL MOTORS CORP.

2. Install the park brake actuator lever (5) to the lever pivot pin.
3. Install the horseshoe clip to the park brake actuator lever pivot pin.
4. Install the brake shoes to the brake backing plate.
5. Install the brake shoe hold-down pins, springs and retainers (4) to the brake shoes.
6. Install the park brake cable (6) to the park brake actuator lever.

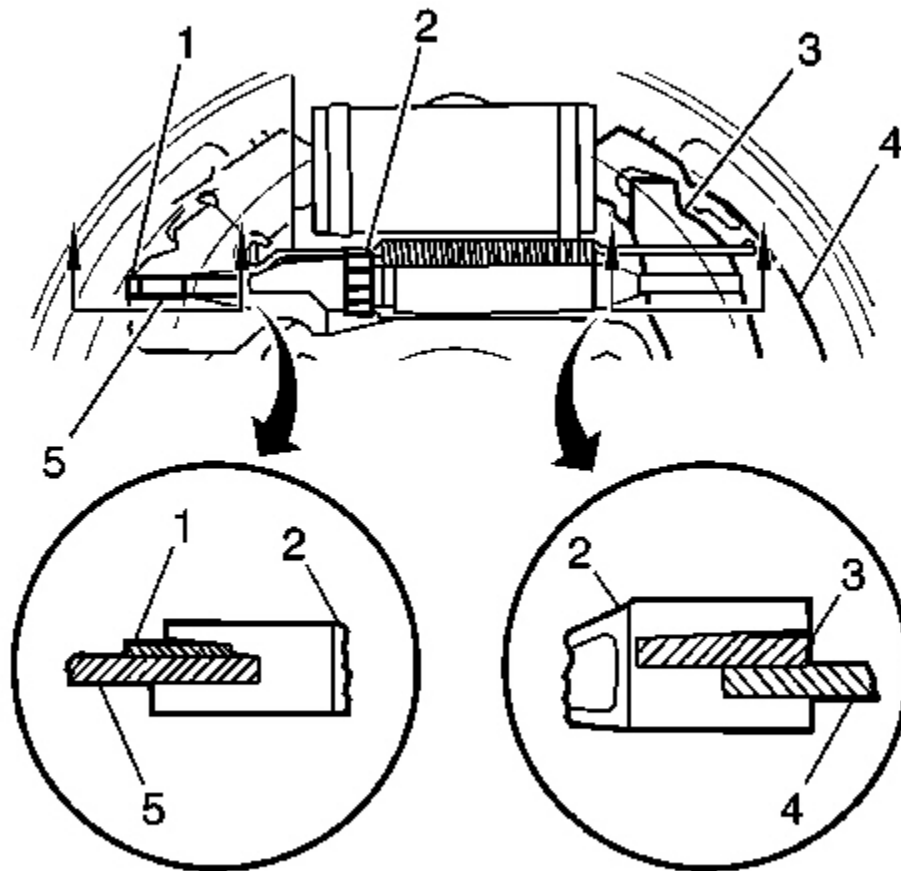


Fig. 10: Locating Adjuster Actuator Components
 Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure that the adjuster (2) engages the brake shoe (4) and the park brake actuator (3) properly.

7. Install the adjuster screw to the brake shoe and the park brake actuator.
8. Apply a thin, light coat of high temperature, silicone brake lubricant to the adjuster actuator/brake shoe interface.
9. Install the adjuster actuator (1) to the brake shoe.

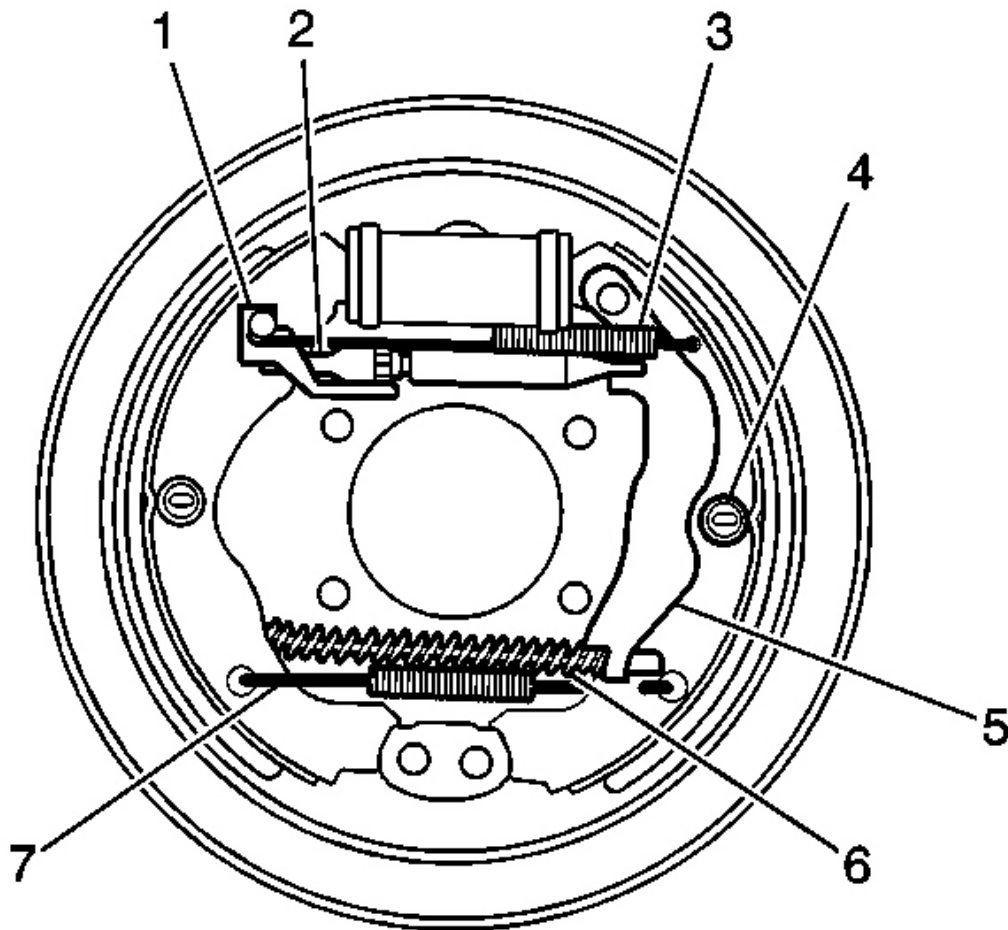


Fig. 11: View Of Brake Components
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not over stretch the adjuster spring. Damage can occur if the spring is over stretched.

10. Install the straight end of the adjuster spring (3) to the brake shoe.
11. Install the adjuster spring hook end to the tab on the adjuster actuator (1).
12. Install the return spring (7) to the brake shoes.

IMPORTANT: Ensure that the adjuster operates properly.

13. Move the park brake actuator lever (5) in order to spread the brake shoes apart. The adjuster actuator lever should move downward, then upward as the park brake actuator lever is released, forcing the adjuster wheel to rotate.

If the adjuster does not operate properly, remove then reinstall the adjuster.

14. Adjust the brake shoes. Refer to **Drum Brake Adjustment** .
15. Adjust the park brake cable. Refer to **Park Brake Adjustment** in Park Brake.
16. Install the brake drum. Refer to **Brake Drum Replacement** .
17. Lower the vehicle.

DRUM BRAKE BACKING PLATE REPLACEMENT

Removal Procedure

CAUTION: Refer to **Brake Dust Caution** in Cautions and Notices.

NOTE: Do not pry against the splash shield or backing plate in attempt to free the drum. This will bend the splash shield or backing plate. A bent backing plate may cause brake chatter and/or pulsation.

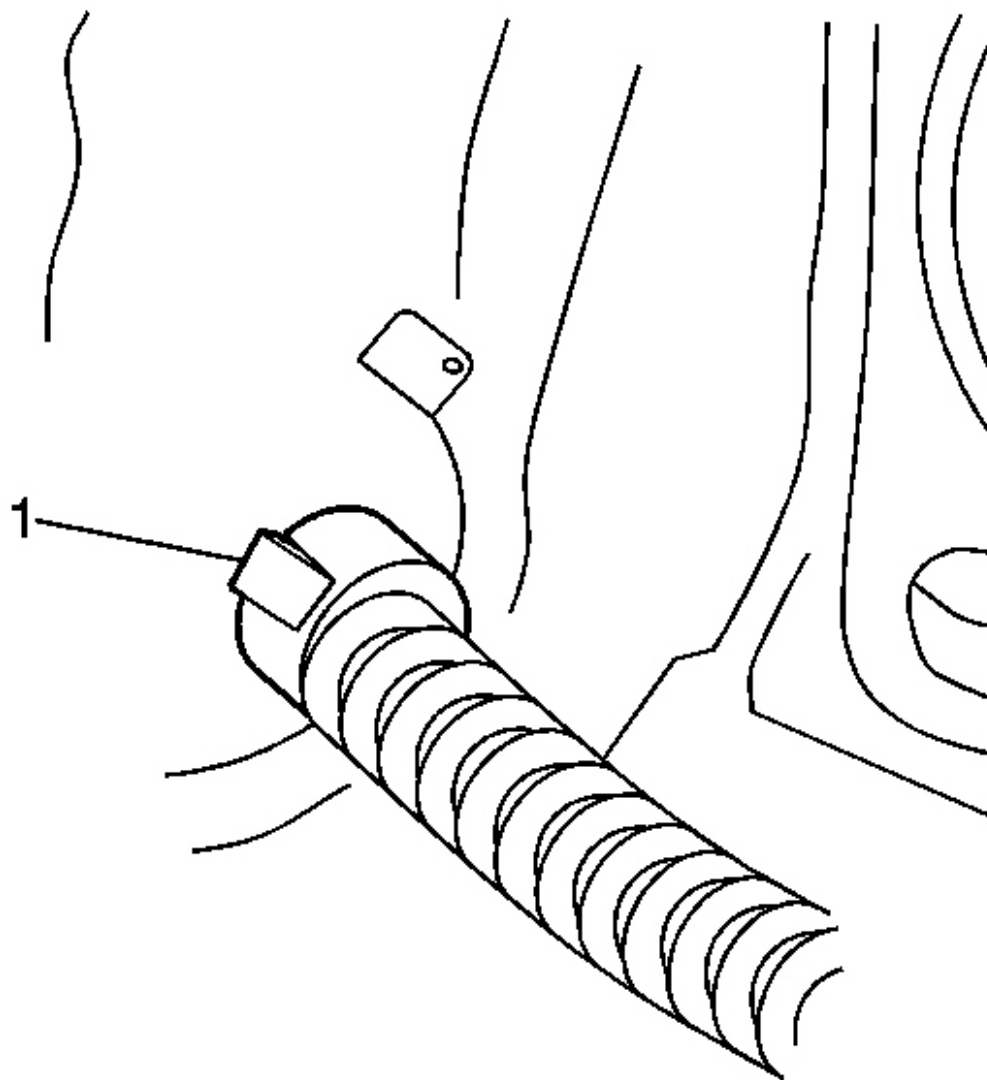


Fig. 12: Identifying Park Brake Cable Fitting Retaining Tab
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the tire and wheel. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
3. Remove the brake drum. Refer to **Brake Drum Replacement** .
4. Remove the brake shoes. Refer to **Brake Shoe Replacement** .
5. Remove the park brake cable from the park brake actuator lever.

6. Depress the retaining fingers on the park brake cable (1) and remove the park brake cable from the backing plate.

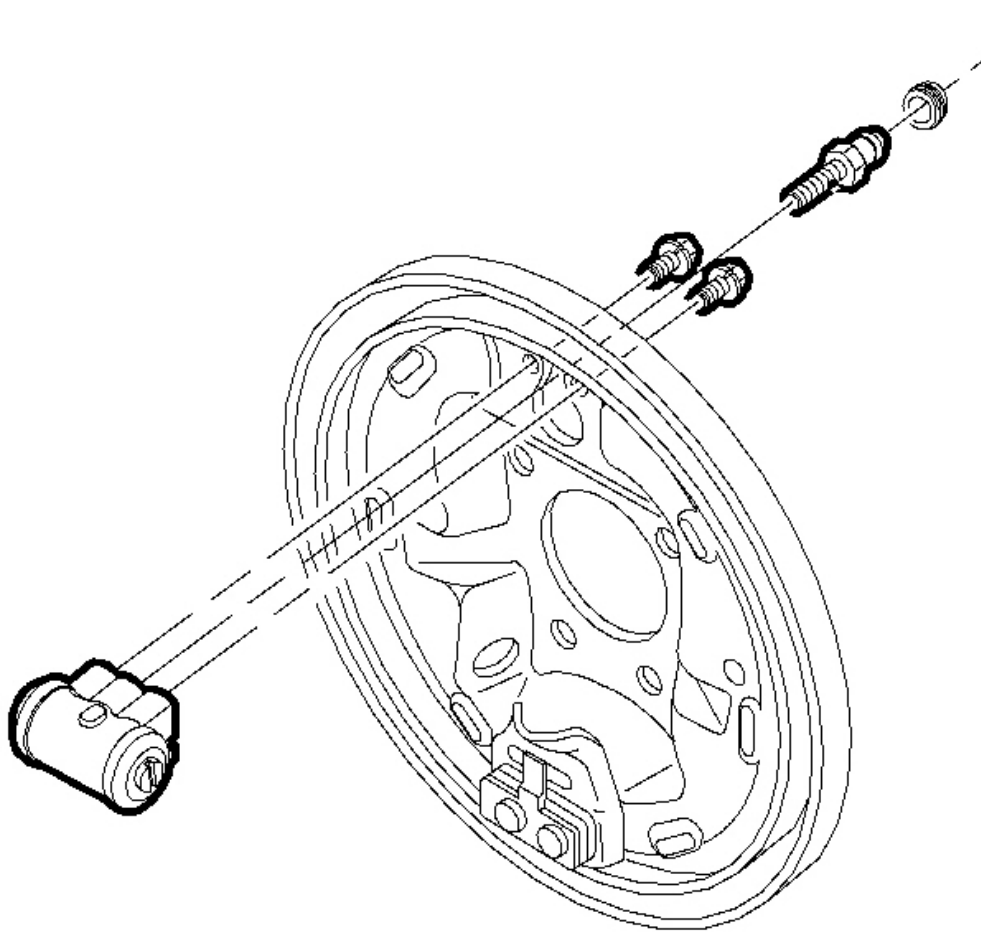


Fig. 13: Removing/Installing Wheel Cylinder
Courtesy of GENERAL MOTORS CORP.

7. Remove the wheel cylinder. Refer to **Wheel Cylinder Replacement** .

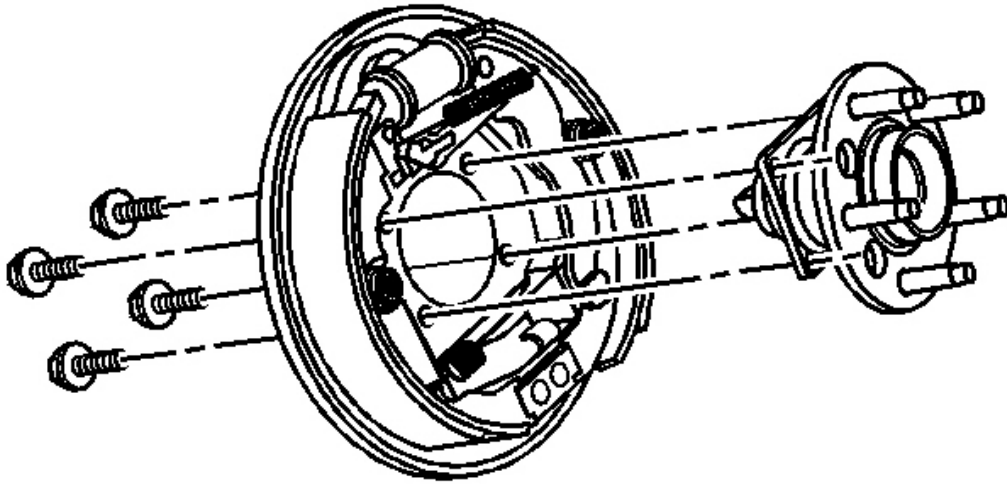


Fig. 14: Removing/Installing Wheel Bearing/Hub Assembly
Courtesy of GENERAL MOTORS CORP.

8. Remove the wheel bearing/hub assembly. Refer to **Wheel Bearing/Hub Replacement - Rear** in Rear Suspension.
9. Remove the backing plate.

Installation Procedure

1. Install the backing plate.

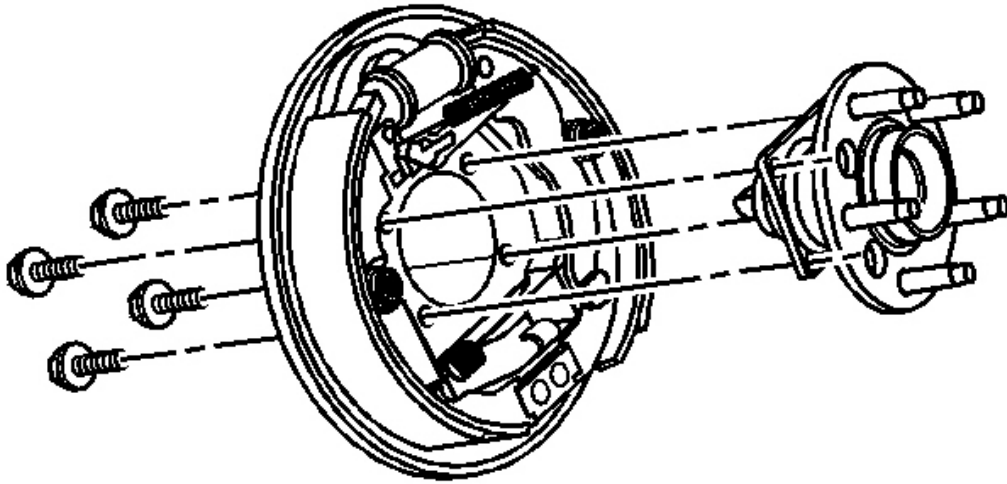


Fig. 15: Removing/Installing Wheel Bearing/Hub Assembly
Courtesy of GENERAL MOTORS CORP.

2. Install the wheel bearing/hub assembly. Refer to **Wheel Bearing/Hub Replacement - Rear** in Rear Suspension.

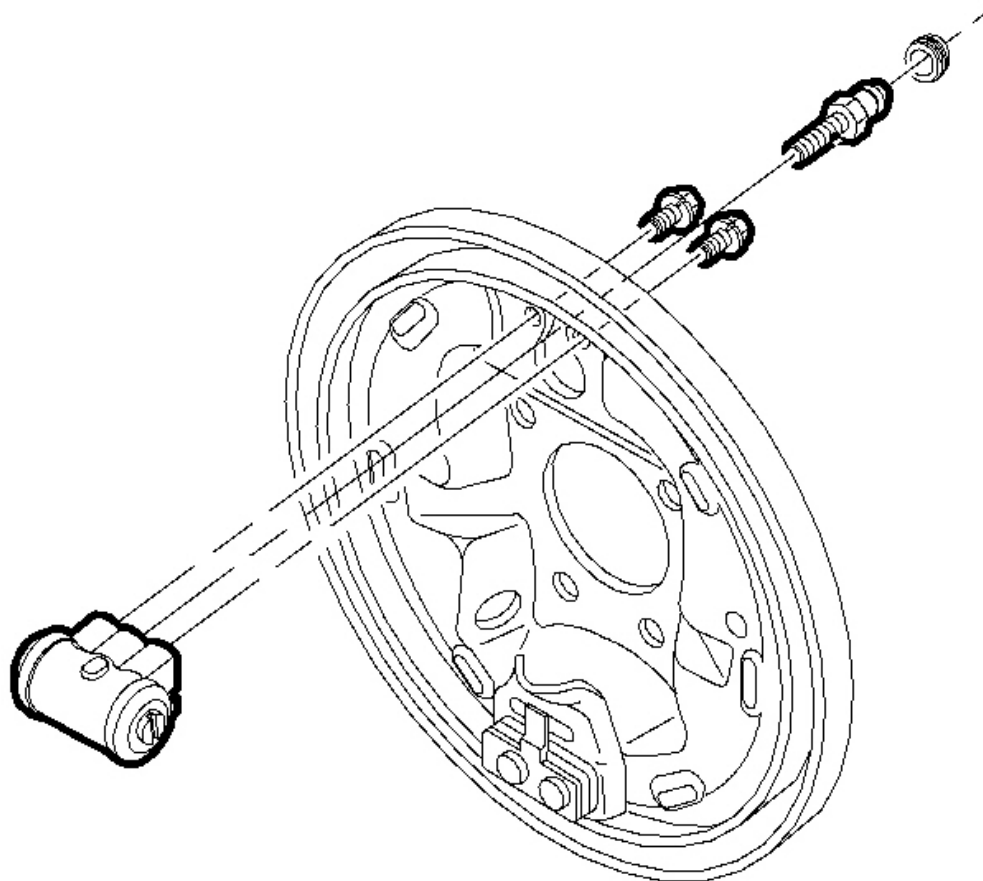


Fig. 16: Removing/Installing Wheel Cylinder
Courtesy of GENERAL MOTORS CORP.

3. Install the wheel cylinder. Refer to **Wheel Cylinder Replacement** .

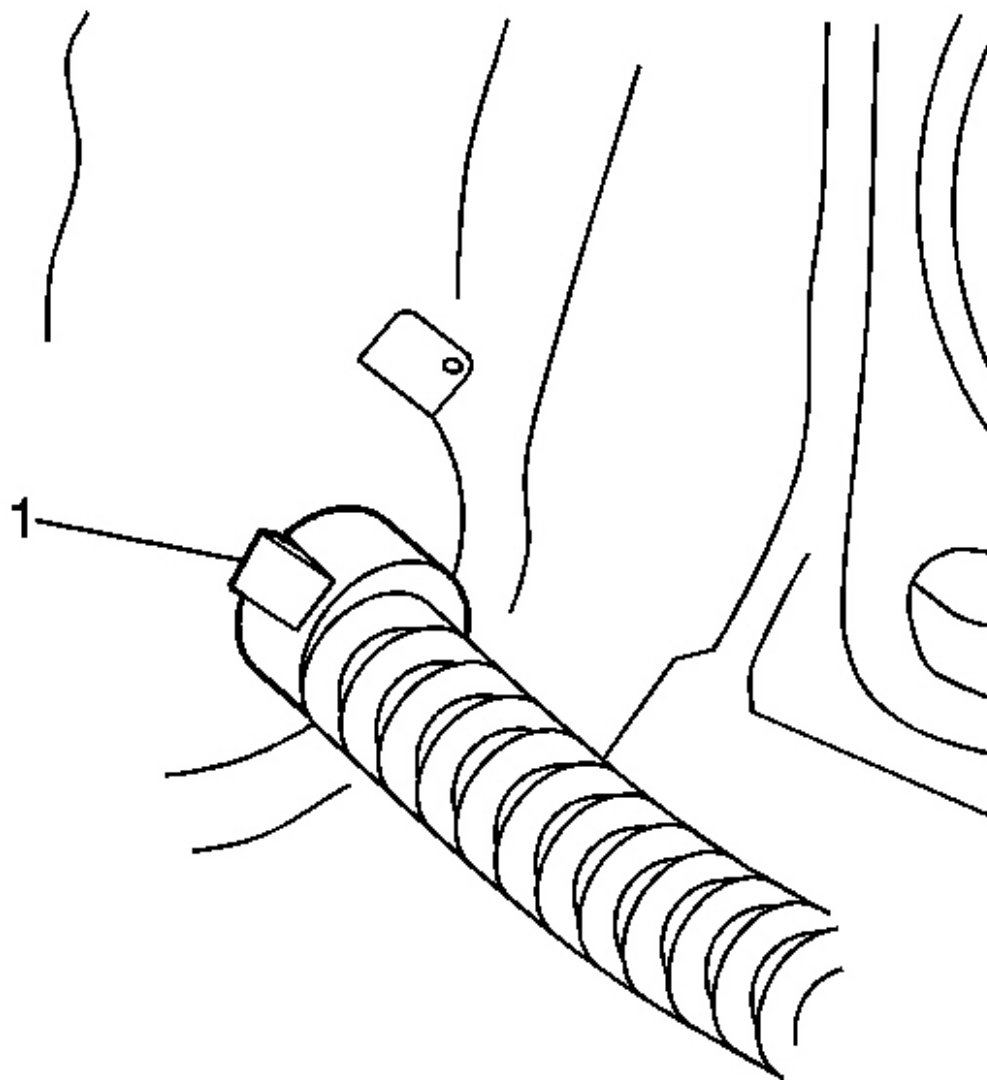


Fig. 17: Identifying Park Brake Cable Fitting Retaining Tab
Courtesy of GENERAL MOTORS CORP.

4. Install the park brake cable (1) to the backing plate.

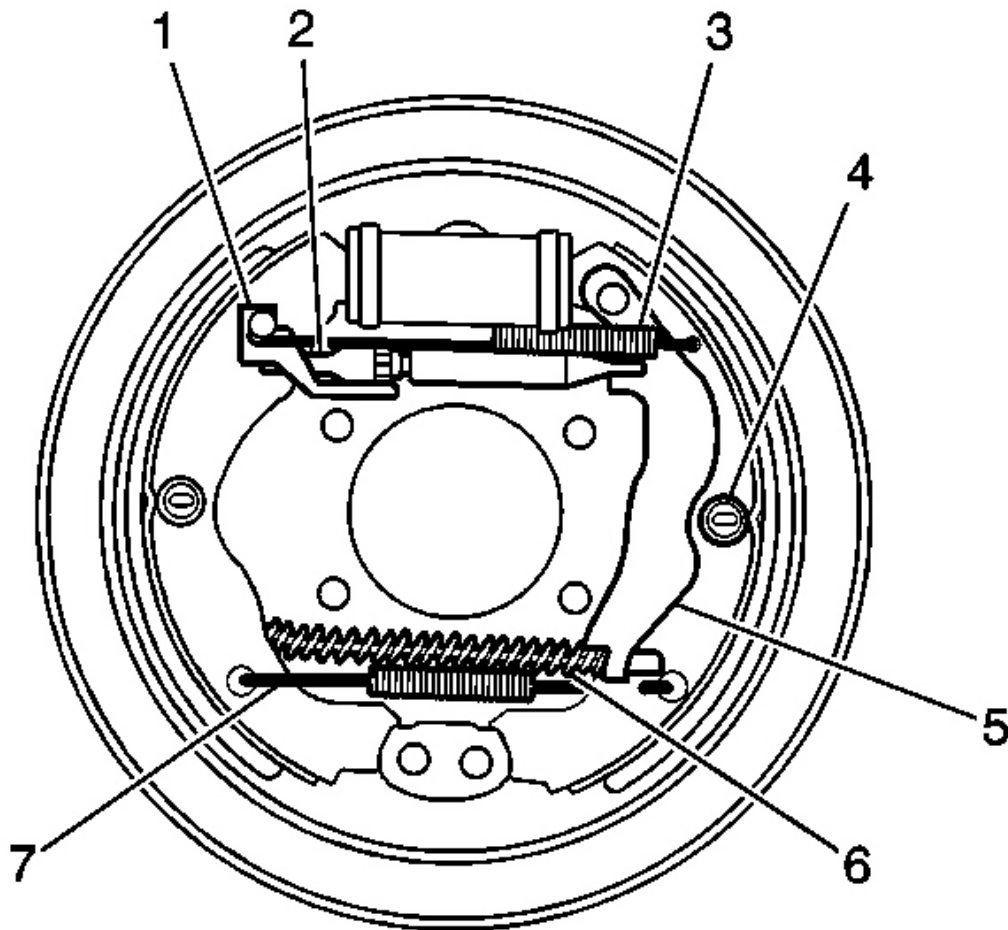


Fig. 18: View Of Brake Components
Courtesy of GENERAL MOTORS CORP.

5. Install the park brake cable to the park brake actuator (5).
6. Install the brake shoes. Refer to **Brake Shoe Replacement** .
7. Adjust the brake shoes. Refer to **Drum Brake Adjustment** .
8. Adjust the park brake cable. Refer to **Park Brake Adjustment** in Park Brake.
9. Install the brake drum. Refer to **Brake Drum Replacement** .
10. Install the tire and wheel. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
11. Lower the vehicle.

DRUM BRAKE HARDWARE REPLACEMENT

Removal Procedure

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle in General Information.
2. Remove the brake drum. Refer to Brake Drum Replacement.

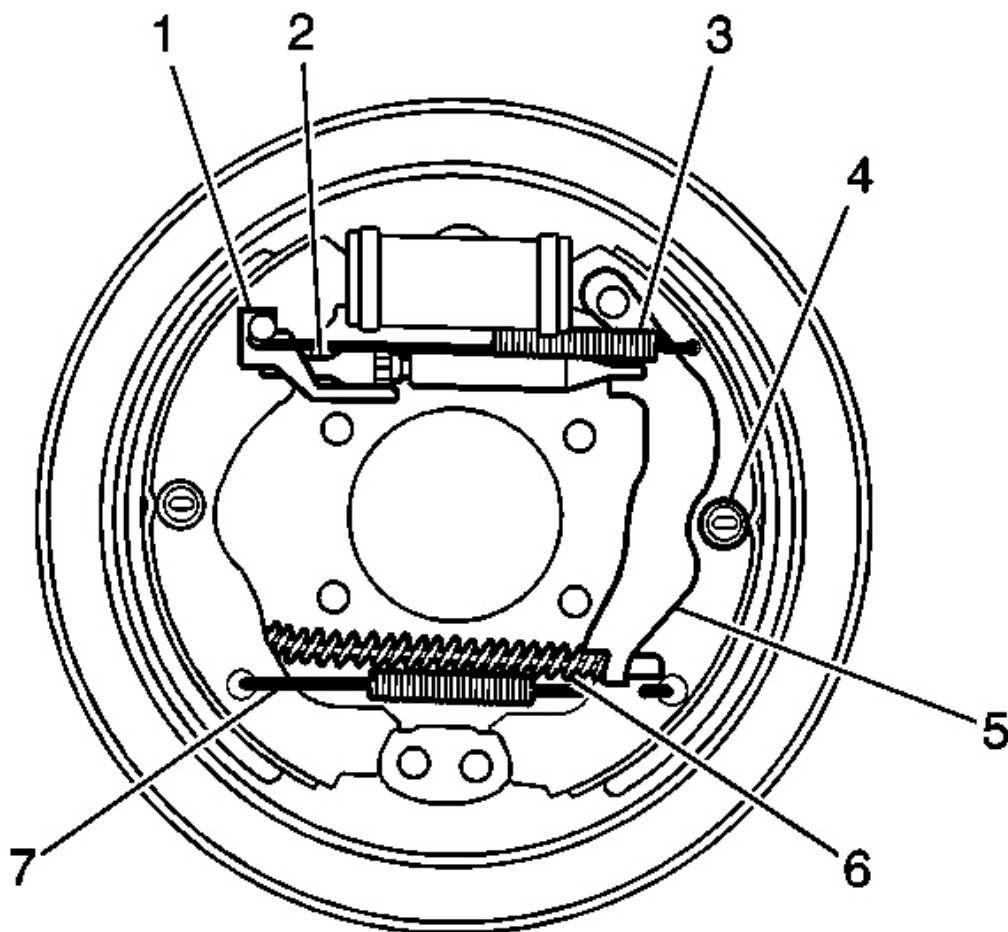


Fig. 19: View Of Brake Components
Courtesy of GENERAL MOTORS CORP.

3. Disengage the adjuster spring hook end from the tab on the adjuster actuator (1).

4. Remove the straight end of the adjuster spring from the brake shoe.
5. Remove the return spring (7) from the brake shoes.
6. Remove the brake shoe hold-down springs and retainers (4) from the brake shoes.
7. Remove the park brake actuator lever and wave washer from the brake shoe.
8. Clean all of the drum brake system components with denatured alcohol.
9. Inspect all of the drum brake system components. Refer to **Drum Brake Hardware Inspection** and **Drum Brake Adjusting Hardware Inspection** .

Installation Procedure

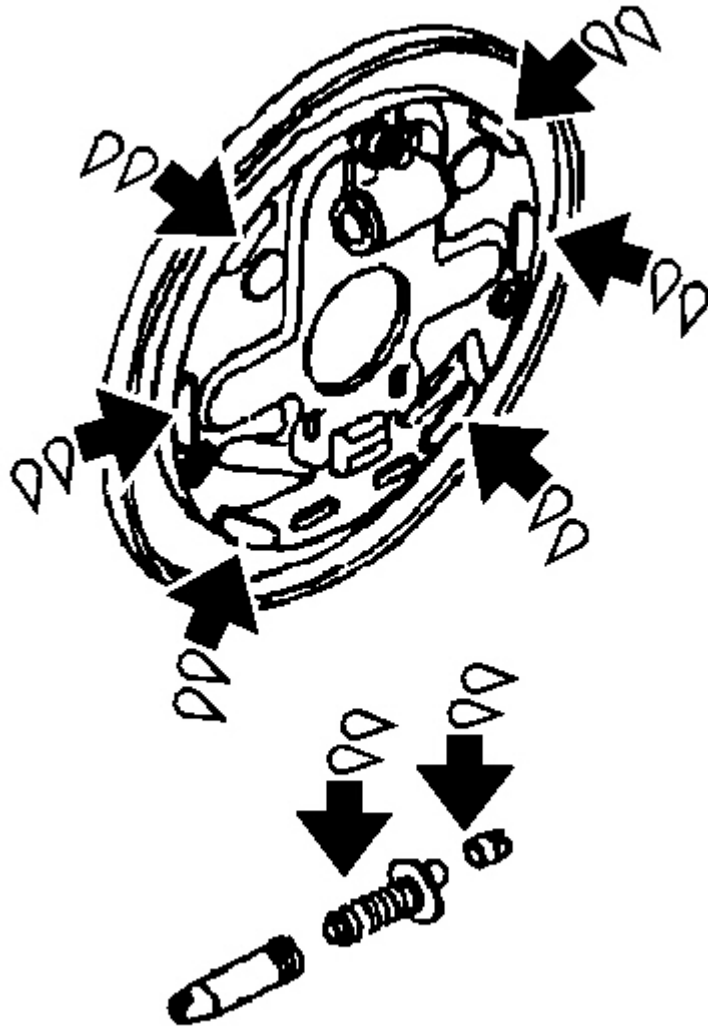


Fig. 20: Applying Silicone Brake Lubricant
Courtesy of GENERAL MOTORS CORP.

1. Apply GM P/N 1052196 (Canadian P/N 5264008) brake lubricant or equivalent to the backing plate in the following areas:
 - The brake shoe contact points on the backing plate
 - The adjuster screw threads and inside diameter of the adjuster socket

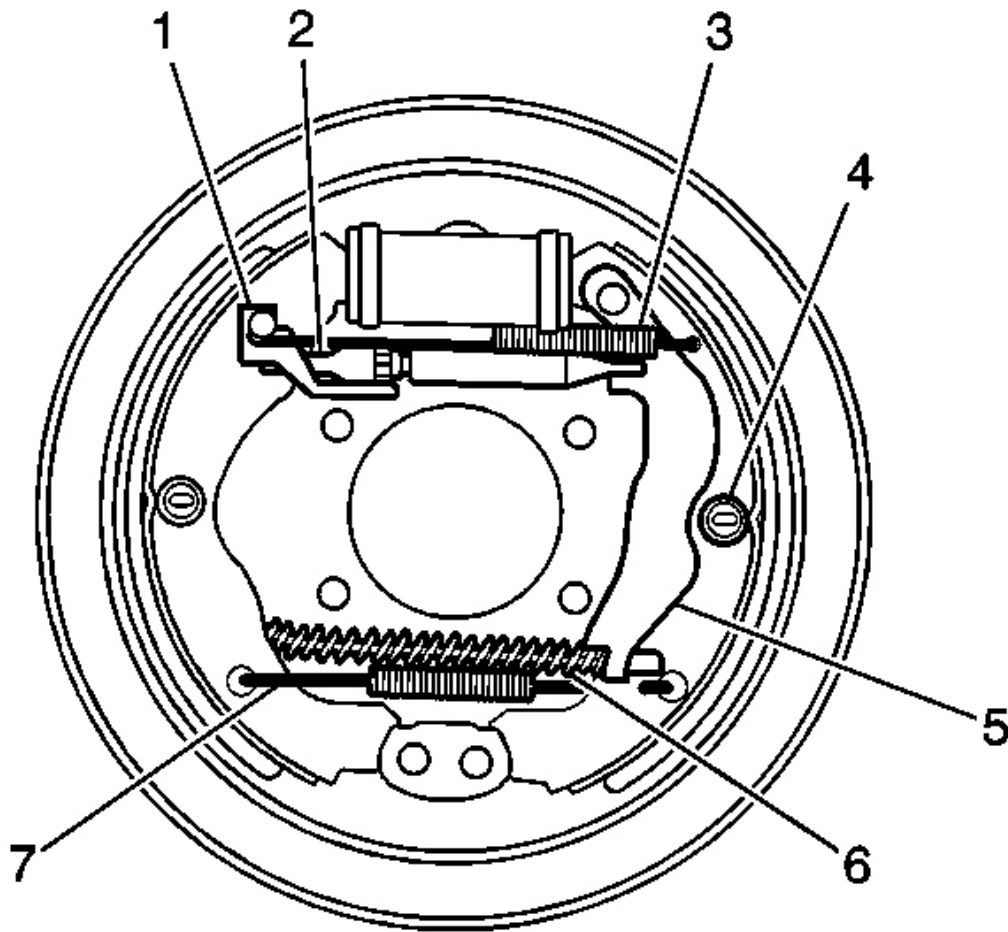


Fig. 21: View Of Brake Components
Courtesy of GENERAL MOTORS CORP.

2. Install the brake shoe hold-down pins, springs and retainers (4) to the brake shoes.

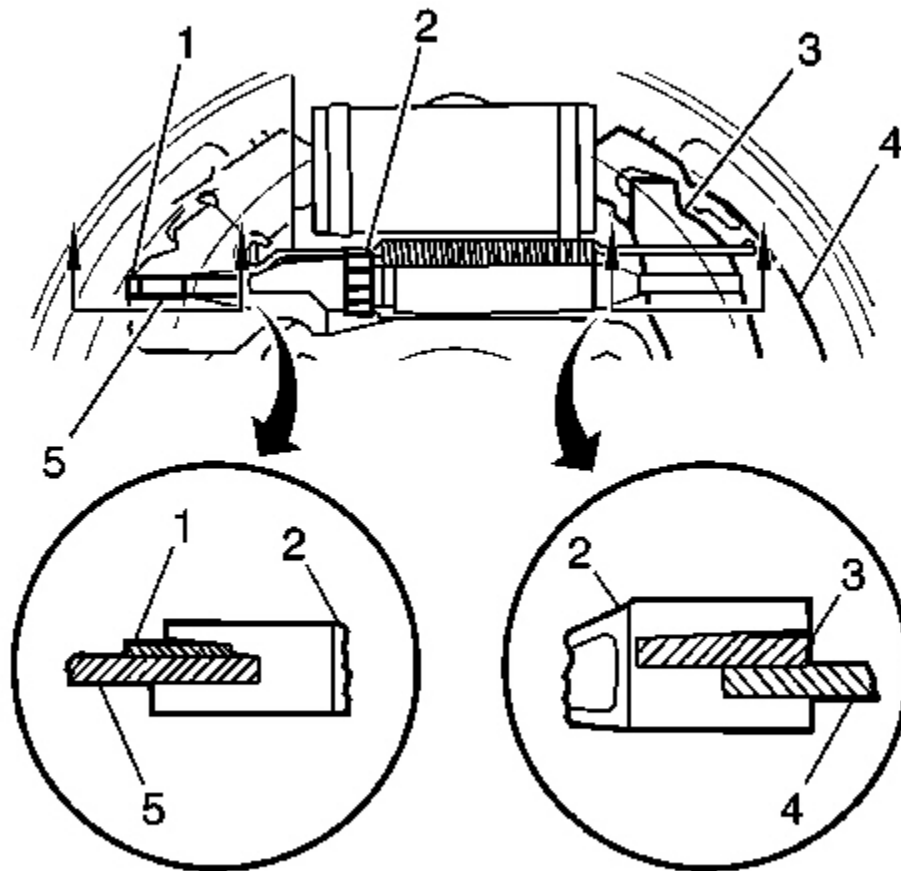


Fig. 22: Locating Adjuster Actuator Components
Courtesy of GENERAL MOTORS CORP.

3. Install the adjuster spring (2) to the brake shoe.

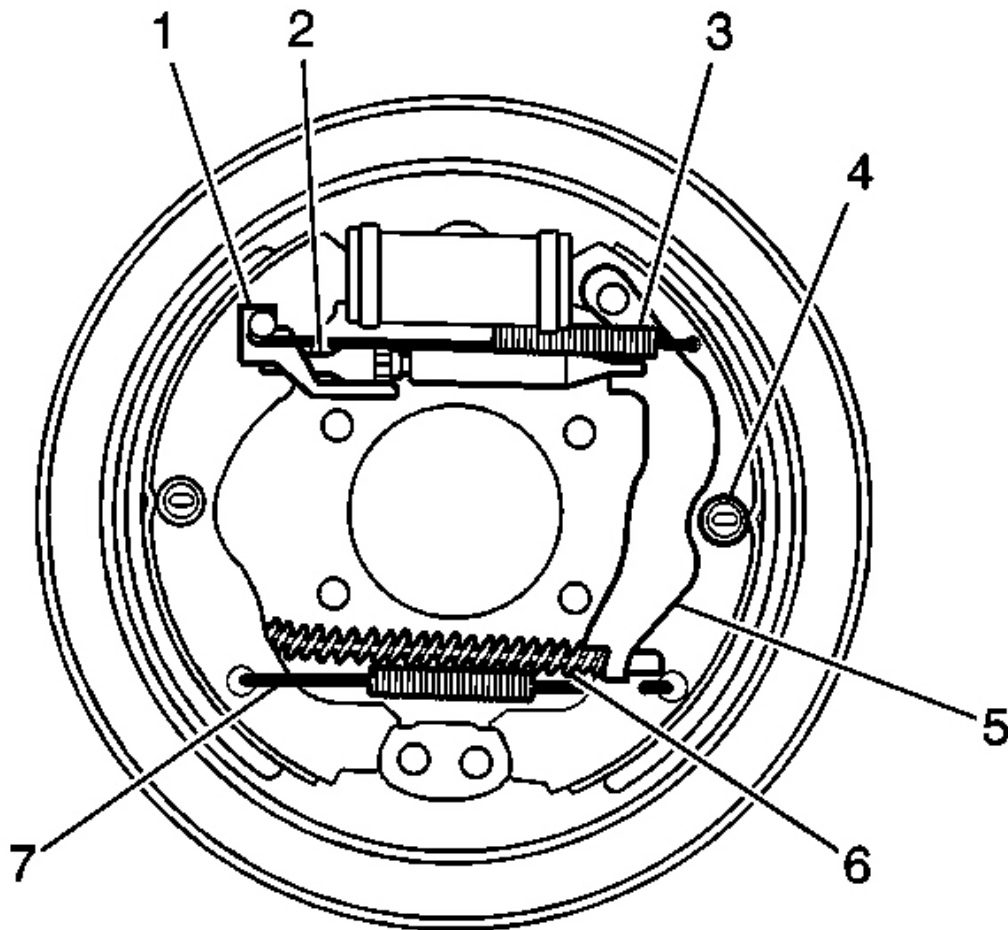


Fig. 23: View Of Brake Components
Courtesy of GENERAL MOTORS CORP.

4. Install the adjuster spring hook end to the tab on the adjuster actuator (1).
5. Install the return spring (7) to the brake shoes.
6. Adjust the brake shoes. Refer to **Drum Brake Adjustment** .
7. Check for proper park brake cable Adjustment. Refer to **Park Brake Adjustment** in Park Brake.
8. Install the brake drum. Refer to **Brake Drum Replacement** .
9. Lower the vehicle.

DRUM BRAKE ADJUSTING HARDWARE REPLACEMENT

Tools Required

J 38400 Brake Shoe Spanner and Spring Remover. See Special Tools and Equipment .

Removal Procedure

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

1. Remove the brake drum. Refer to Brake Drum Replacement .

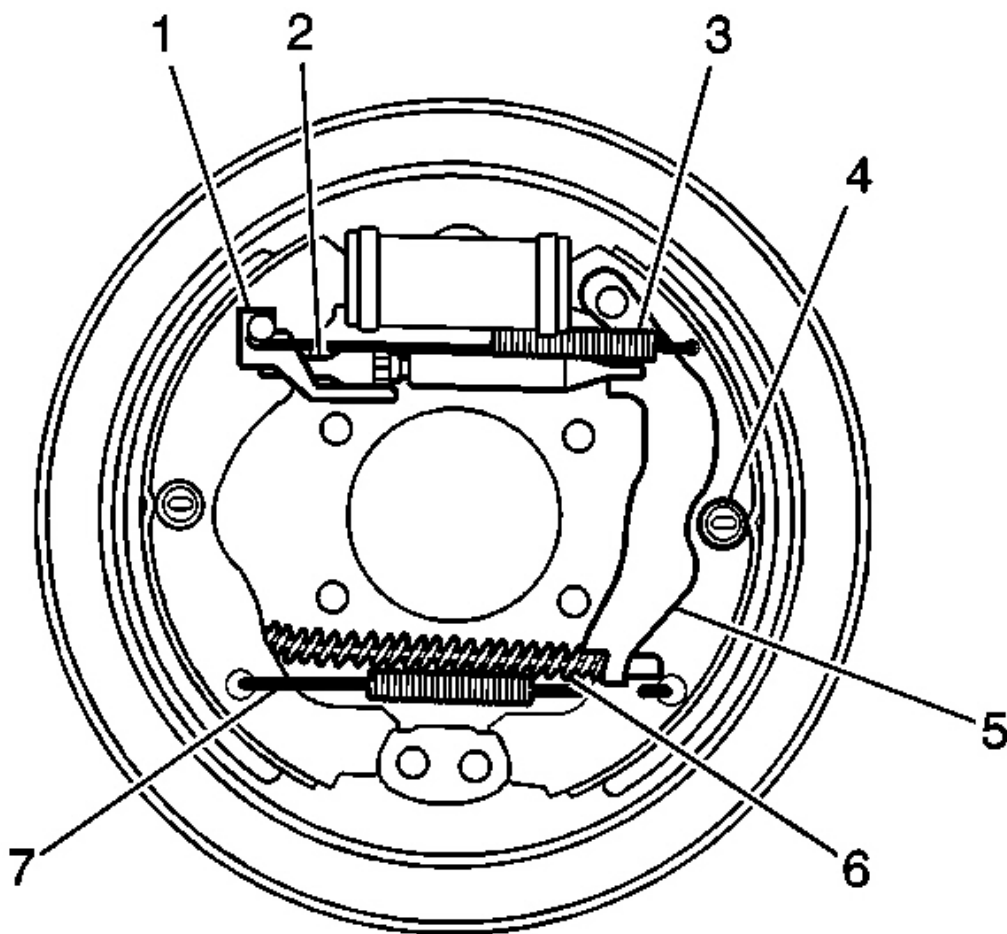


Fig. 24: View Of Brake Components
Courtesy of GENERAL MOTORS CORP.

2. Remove the adjuster spring (3). Disengage the adjuster spring hook end from the tab on the adjuster actuator (1).

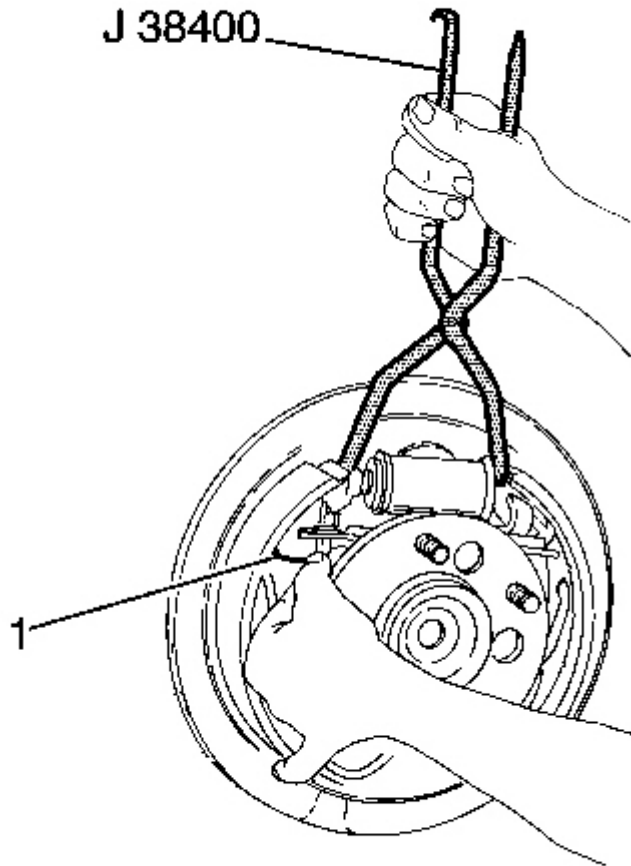


Fig. 25: Using J38400
Courtesy of GENERAL MOTORS CORP.

3. Use the **J 38400** in order to spread the brake shoes (1) apart. See **Special Tools and Equipment** .
4. Remove the adjuster.

Installation Procedure

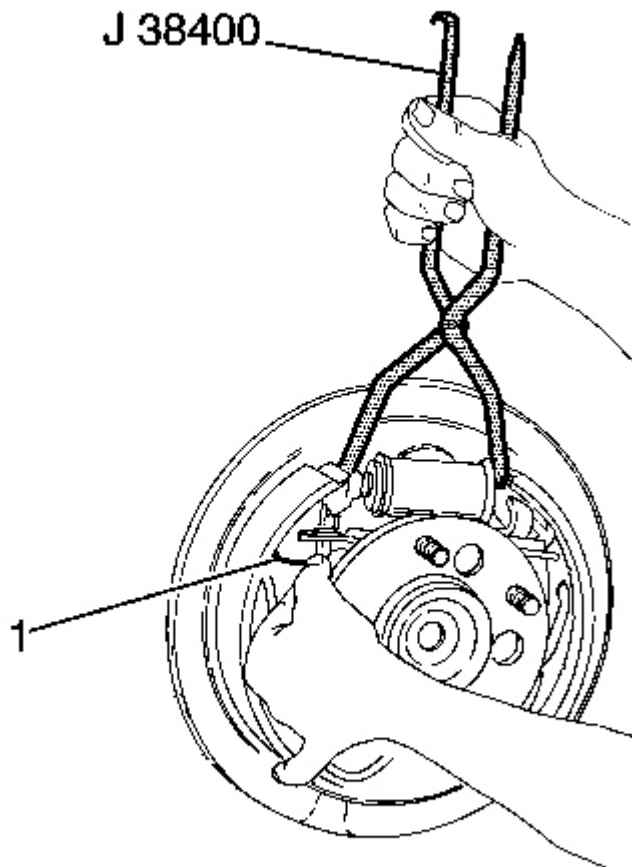


Fig. 26: Using J38400
Courtesy of GENERAL MOTORS CORP.

1. Use the **J 38400** in order to spread the brake shoes (1) apart. See **Special Tools and Equipment** .

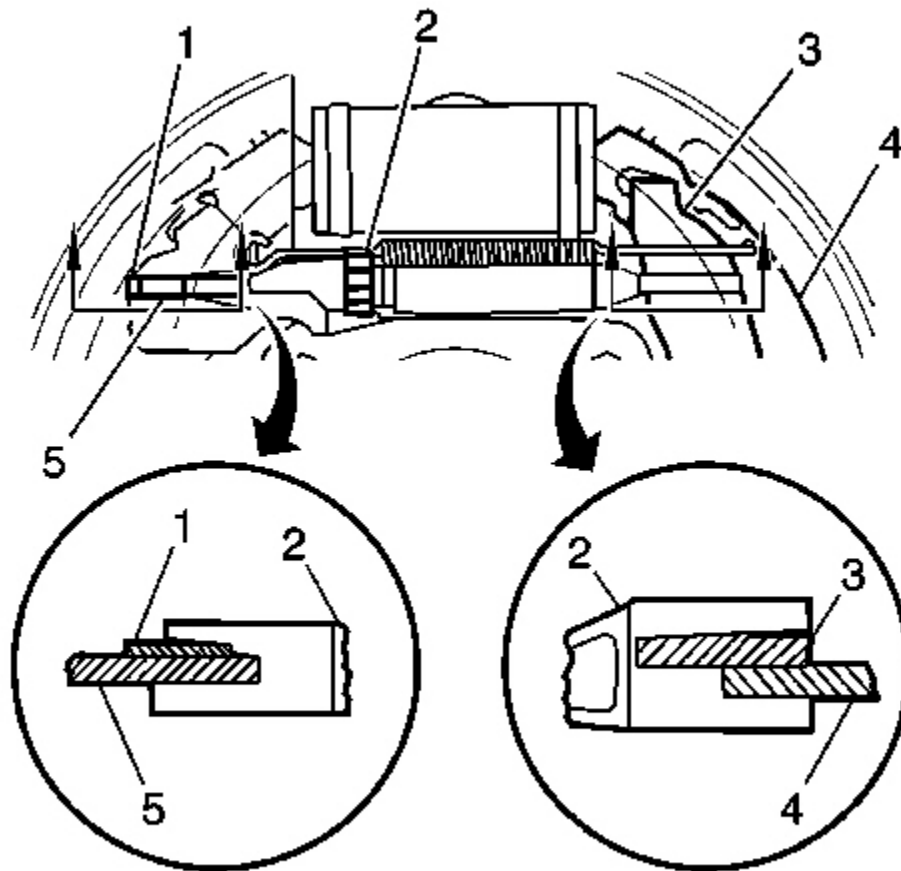


Fig. 27: Locating Adjuster Actuator Components
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure that the adjuster (2) engages the brake shoes (4 and 5), the park brake actuator (3), and the adjuster actuator (1) properly.

2. Install the adjuster.

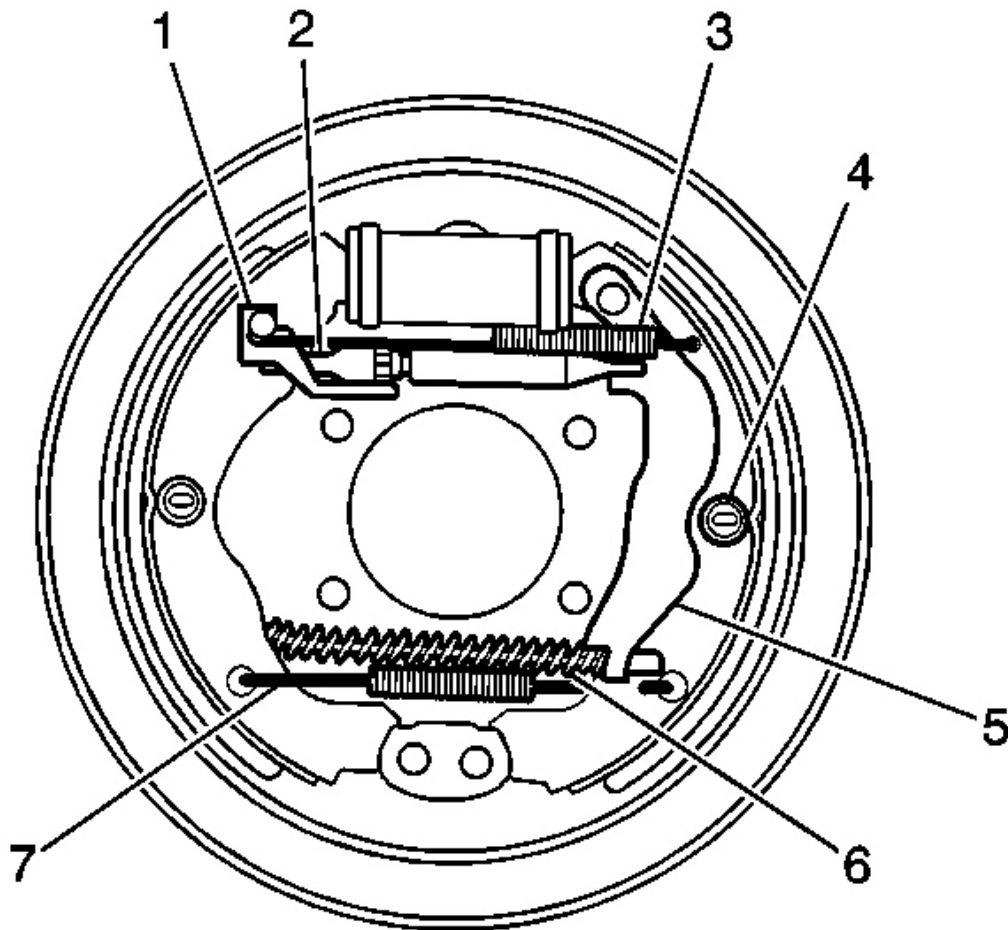


Fig. 28: View Of Brake Components
Courtesy of GENERAL MOTORS CORP.

3. Install the adjuster spring (3).
 1. Install the straight end of the adjuster spring into the brake shoe.
 2. Install the hook end of the adjuster spring to the adjuster actuator (1).
4. Adjust the brake shoes. Refer to **Drum Brake Adjustment** .
5. Install the brake drum. Refer to **Brake Drum Replacement** .
6. Lower the vehicle.

WHEEL CYLINDER REPLACEMENT

Tools Required

J 38400 Brake Shoe Spanner and Spring Remover. See Special Tools and Equipment .

Removal Procedure

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle in General Information.
2. Remove the tire and wheel. Refer to Tire and Wheel Removal and Installation in Tires and Wheels.
3. Clean all dirt and foreign material from the wheel cylinder brake pipe fitting and the bleeder valve.

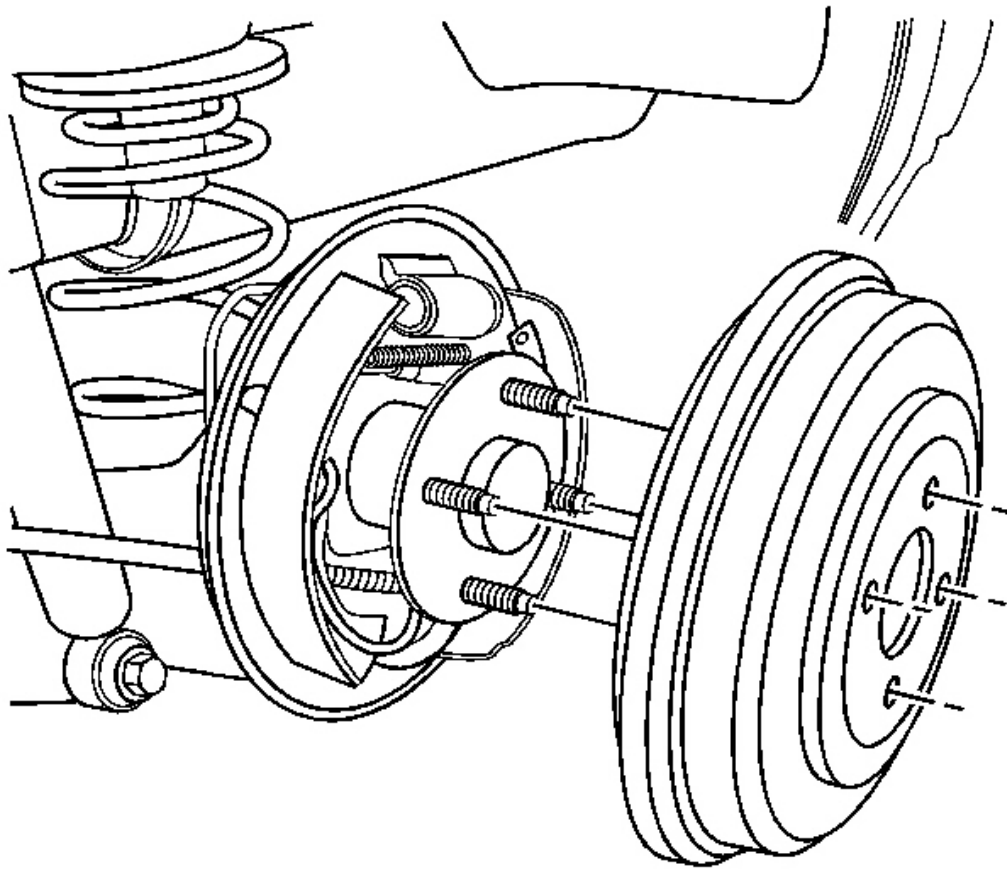


Fig. 29: Removing/Installing Brake Drum
Courtesy of GENERAL MOTORS CORP.

4. Remove the brake drum. Refer to **Brake Drum Replacement** .
5. Remove the brake pipe nut.
6. Install a cap over the end of the brake pipe in order to prevent brake fluid loss and/or brake fluid contamination.

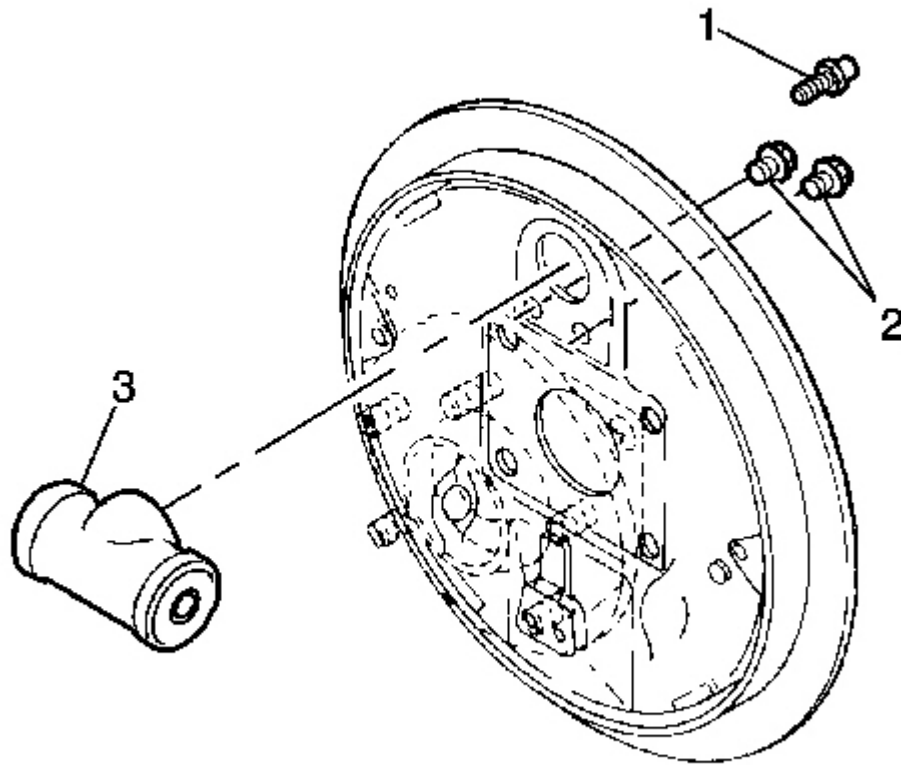


Fig. 30: Exploded View Of Wheel Cylinder
Courtesy of GENERAL MOTORS CORP.

7. Remove the wheel cylinder bolts (2).

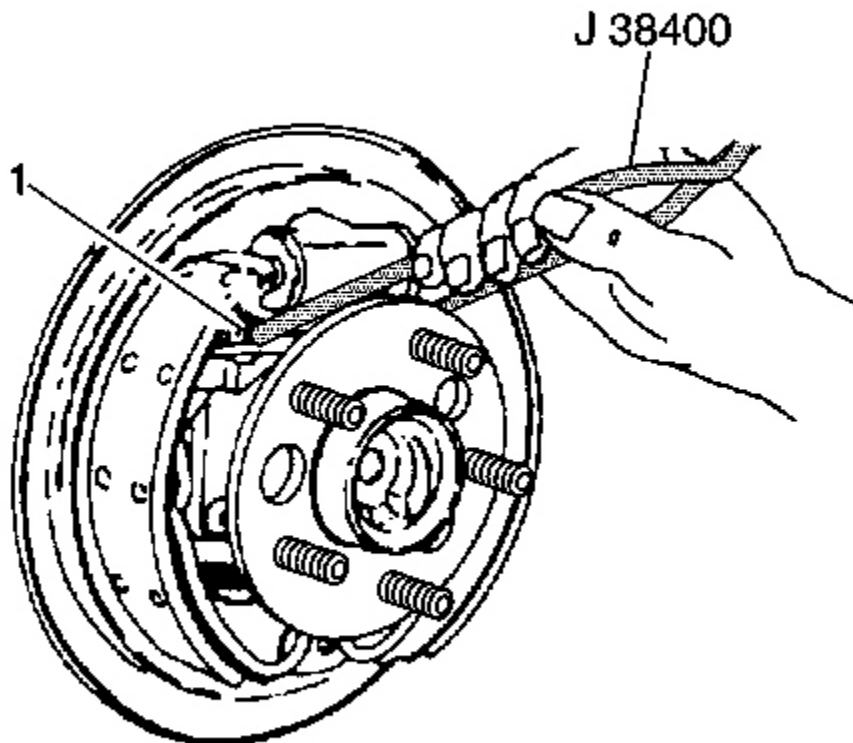


Fig. 31: Using J 38400
Courtesy of GENERAL MOTORS CORP.

8. Use the **J 38400** in order to spread the brake shoes apart (1). See **Special Tools and Equipment** .
9. Remove the wheel cylinder.
10. Clean the old sealant from the backing plate where the wheel cylinder was installed. Clean the sealant from the wheel cylinder if you are reusing the wheel cylinder.

Installation Procedure

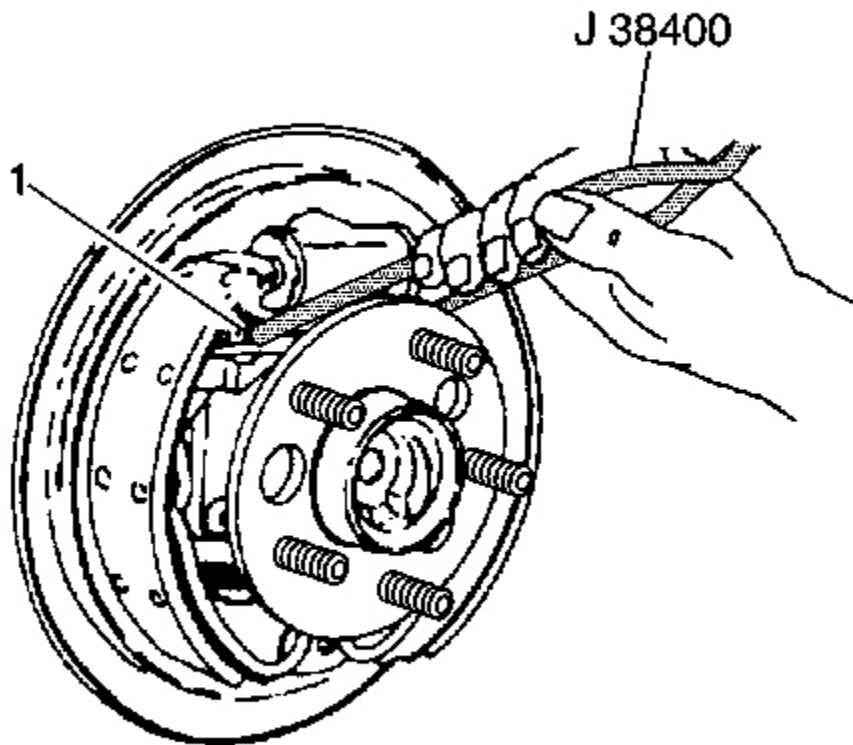


Fig. 32: Using J 38400
Courtesy of GENERAL MOTORS CORP.

1. Use the **J 38400** in order to spread the brake shoes apart (1). See **Special Tools and Equipment** .

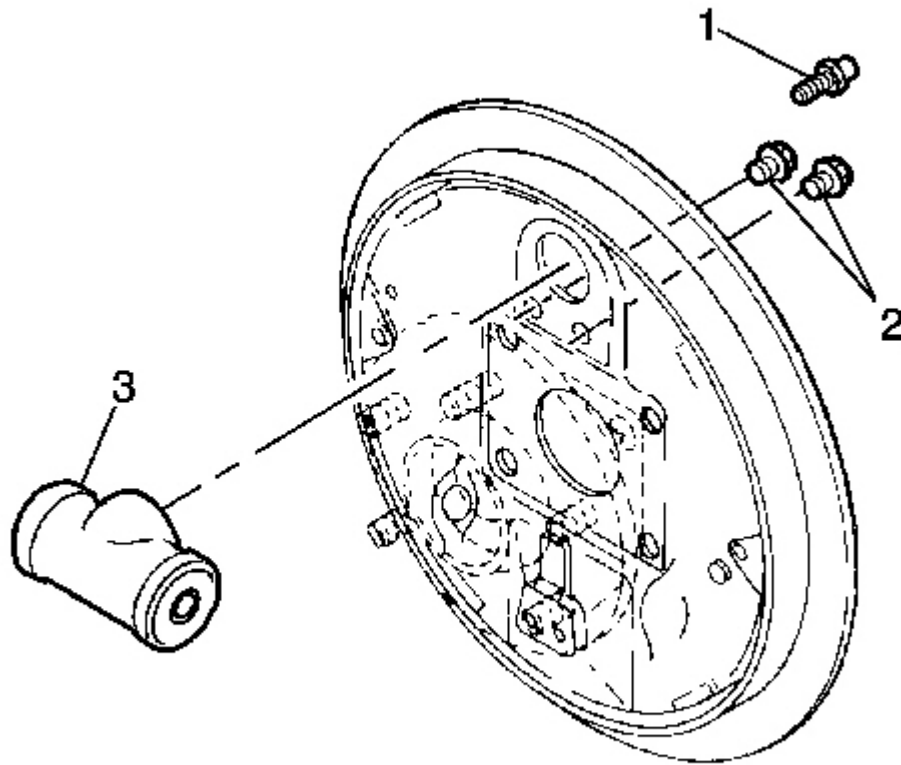


Fig. 33: Exploded View Of Wheel Cylinder
Courtesy of GENERAL MOTORS CORP.

2. Install the wheel cylinder.

NOTE: Refer to **Fastener Notice in Cautions and Notices.**

3. Install the wheel cylinder bolts (2).

Tighten: Tighten the bolts to 15 N.m (11 lb ft).

4. Remove the cap from the brake pipe and install the brake pipe to the wheel cylinder.

Tighten: Tighten the nut to 19 N.m (14 lb ft).

5. Install the brake drum. Refer to **Brake Drum Replacement** .

6. Bleed the hydraulic brake system at the wheel cylinder. Refer to **Hydraulic Brake System Bleeding**

(Manual) or **Hydraulic Brake System Bleeding (Pressure)** in Hydraulic Brakes.

7. Install the tire and wheel. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
8. Lower the vehicle.

DRUM BRAKE ADJUSTMENT

Tools Required

J 21177-A Drum-to-Brake Shoe Clearance Gage. See **Special Tools and Equipment** .

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the rear wheels and tires. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
3. Relieve cable tension from the park brake system at the equalizer. There should be no tension on the park brake cables, so that the brake shoes are positioned only by the adjuster strut.

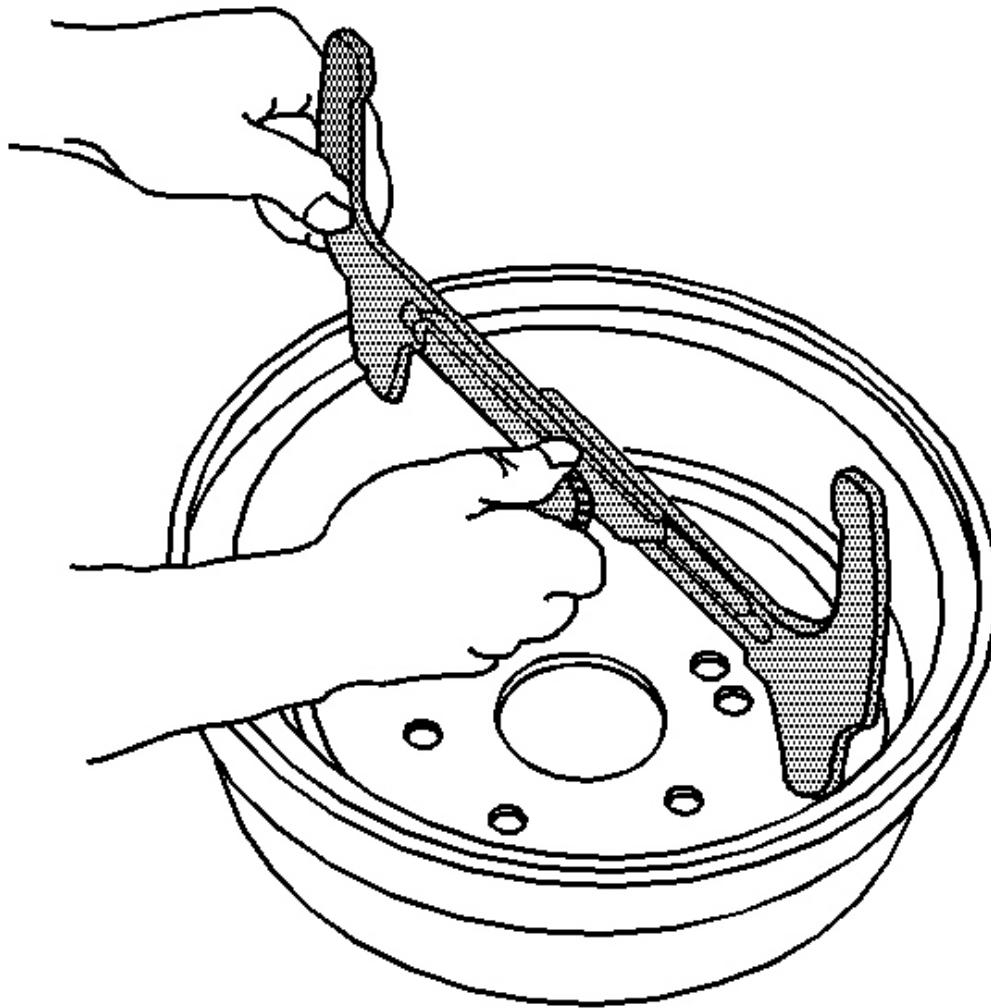


Fig. 34: Removing Rear Drums
Courtesy of GENERAL MOTORS CORP.

4. Remove the rear drums. Refer to **Brake Drum Replacement** .
5. Set the **J 21177-A** so that the **J 21177-A** contacts the inside diameter of the drum at the widest point. See **Special Tools and Equipment** .

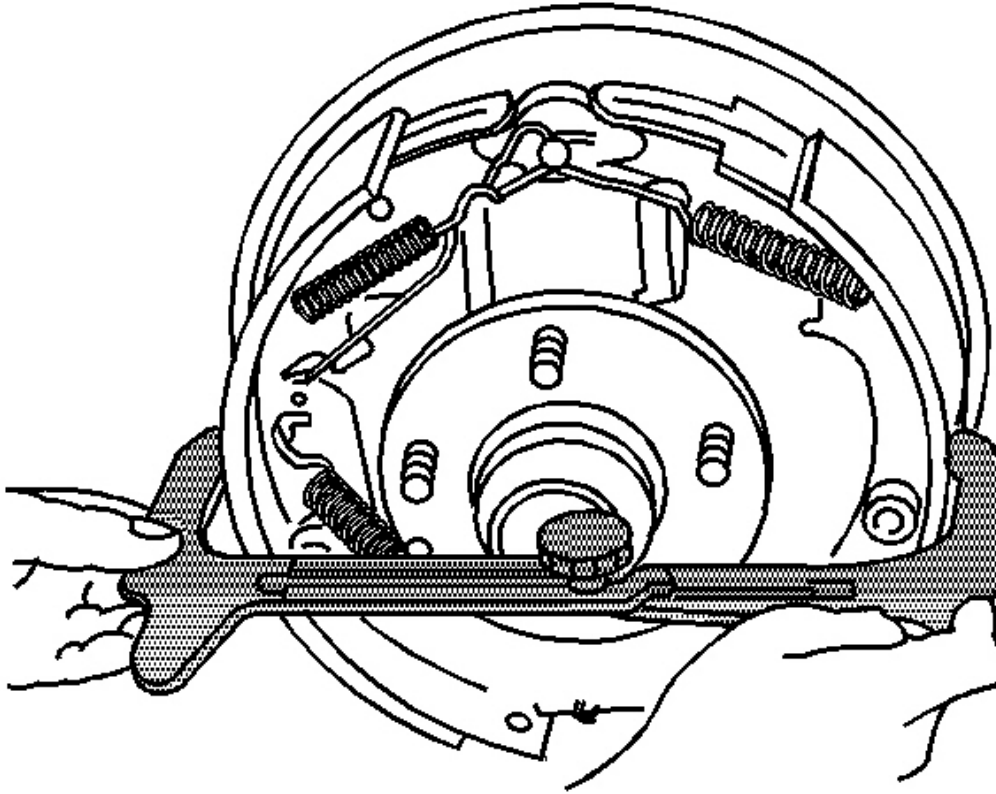


Fig. 35: Positioning J21177-A
Courtesy of GENERAL MOTORS CORP.

6. Position the **J 21177-A** over the shoes at the widest point. See **Special Tools and Equipment** .
7. Turn the adjuster nut until the shoes just contact the **J 21177-A** . See **Special Tools and Equipment** .
8. Repeat steps 2-7 for the other rear brake assembly.
9. Install the rear drums. Refer to **Brake Drum Replacement** .
10. Install the rear wheels and tires. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
11. Adjust the park brake cable system. Refer to **Park Brake Adjustment** in Park Brake.
12. Lower the vehicle.

DESCRIPTION AND OPERATION

DRUM BRAKE SYSTEM DESCRIPTION AND OPERATION

System Component Description

The drum brake system consists of the following:

Drum Brake Shoes

Applies mechanical output force, from hydraulic brake wheel cylinders, to friction surface of brake drums.

Brake Drums

Uses mechanical output force applied to friction surface from drum brake shoes to slow speed of tire and wheel assembly rotation.

Drum Brake Hardware

Secures drum brake shoes firmly in proper relationship to hydraulic brake wheel cylinders. Enables sliding motion of brake shoes needed to expand toward friction surface of drums when mechanical output force is applied. Provides return of brake shoes when mechanical output force is relieved.

Drum Brake Adjusting Hardware

Provides automatic adjustment of brake shoes to brake drum friction surface whenever brake apply occurs.

System Operation

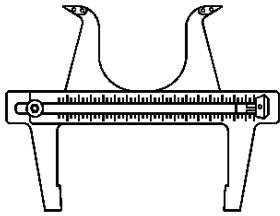
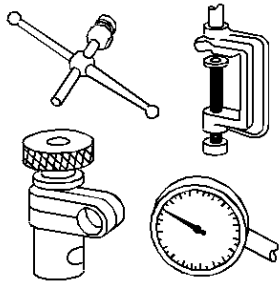
Mechanical output force is applied from the hydraulic brake wheel cylinder pistons to the top of the drum brake shoes. The output force is then distributed between the primary and secondary brake shoes as the shoes expand toward the friction surface of the brake drums. The brake shoes apply the output force to the friction surface of the brake drums, which slows the rotation of the tire and wheel assemblies. The proper function of both the drum brake hardware and adjusting hardware is essential to the proper distribution of braking force.

SPECIAL TOOLS AND EQUIPMENT

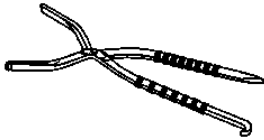
SPECIAL TOOLS

Special Tools

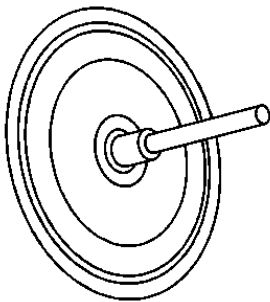
Illustration	Tool Number/ Description
	J 8001 Dial Indicator Set



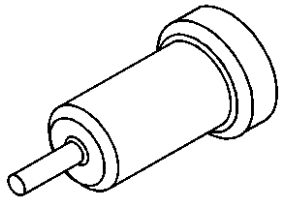
J 21177-A
Drum to Brake Shoe Clearance Gage



J 38400
Brake Shoe Spanner and Spring Remover



J 41013
Rotor/Drum Flange Resurfacing Kit



J 42450-A
Wheel Hub/Flange Resurfacing Kit

2004 BRAKES

Hydraulic Brakes - Vue

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Brake Hose-to-Brake Caliper Bolt	44 N.m	32 lb ft
Brake Master Cylinder Mounting Nuts	25 N.m	18 lb ft
Brake Pedal Bracket-to-Cross Car Beam Bolt	25 N.m	18 lb ft
Brake Pipe Fitting at the Front Brake Hose	18 N.m	13 lb ft
Brake Pipe Fittings at the Master Cylinder	18 N.m	13 lb ft
Brake Pipe Fittings at the Proportioning Valve Assembly	18 N.m	13 lb ft
Brake Pipe Fittings at the Rear Brake Crossover Pipe	25 N.m	18 lb ft
Brake Pipe Fittings at the Rear Brake Hose	18 N.m	13 lb ft
Front and Rear Brake Hose Bracket Retaining Bolt	12 N.m	106 lb in
Proportioning Valve-to-Body Bolt	12 N.m	106 lb in
Proportioning Valve Assembly Bracket Mounting Nut	25 N.m	18 lb ft
Vacuum Brake Booster Mounting Nuts	25 N.m	18 lb ft

BRAKE COMPONENT SPECIFICATIONS

Brake Component Specifications

Application	Specification	
	Metric	English
Brake Caliper Bleeder Valve	13 N.m	115 lb in
Drum Brake Wheel Cylinder Bleeder Valve	13 N.m	115 lb in

BRAKE SYSTEM SPECIFICATIONS

Brake System Specifications

Application	Specification	
	Metric	English
Brake Pedal Travel <ul style="list-style-type: none">Maximum specification with 445 N (100 lbs) of force applied to the brake pedal with the ignition OFF and the booster power reserve depleted.	57 mm	2.25 in

SCHEMATIC AND ROUTING DIAGRAMS

BRAKE WARNING SYSTEM SCHEMATICS

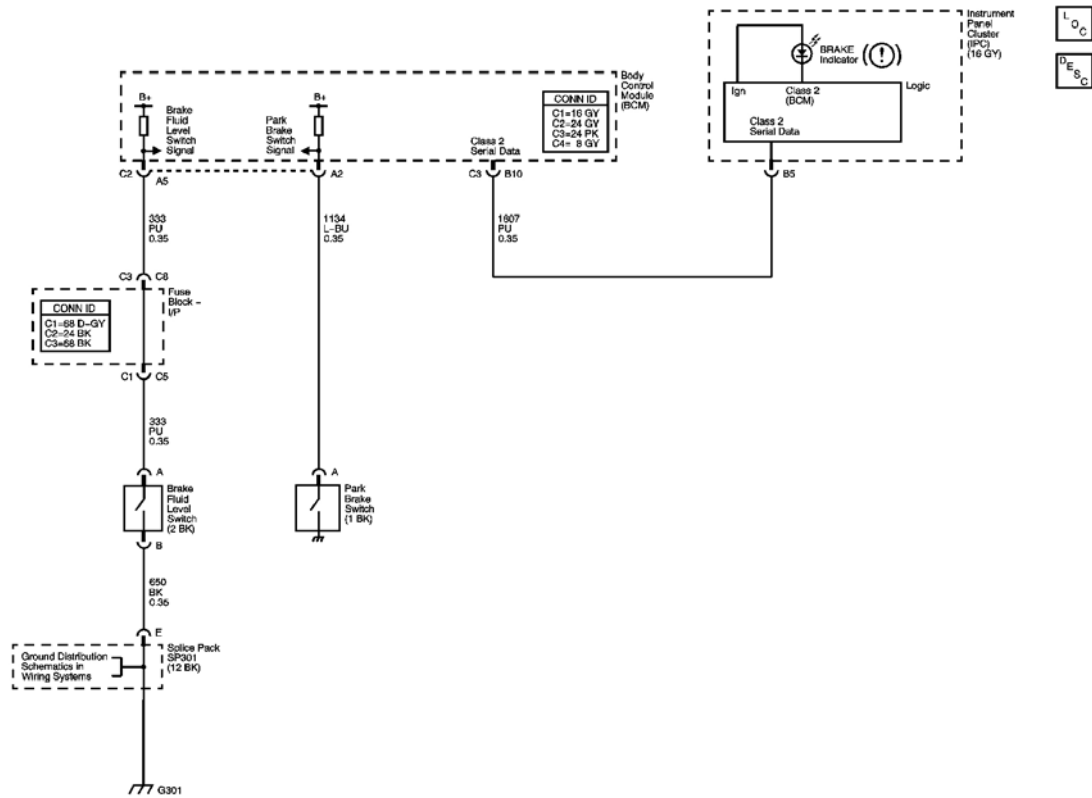


Fig. 1: Brake Warning System Schematics
Courtesy of GENERAL MOTORS CORP.

HYDRAULIC BRAKE PIPE ROUTING - MASTER CYLINDER TO ABS

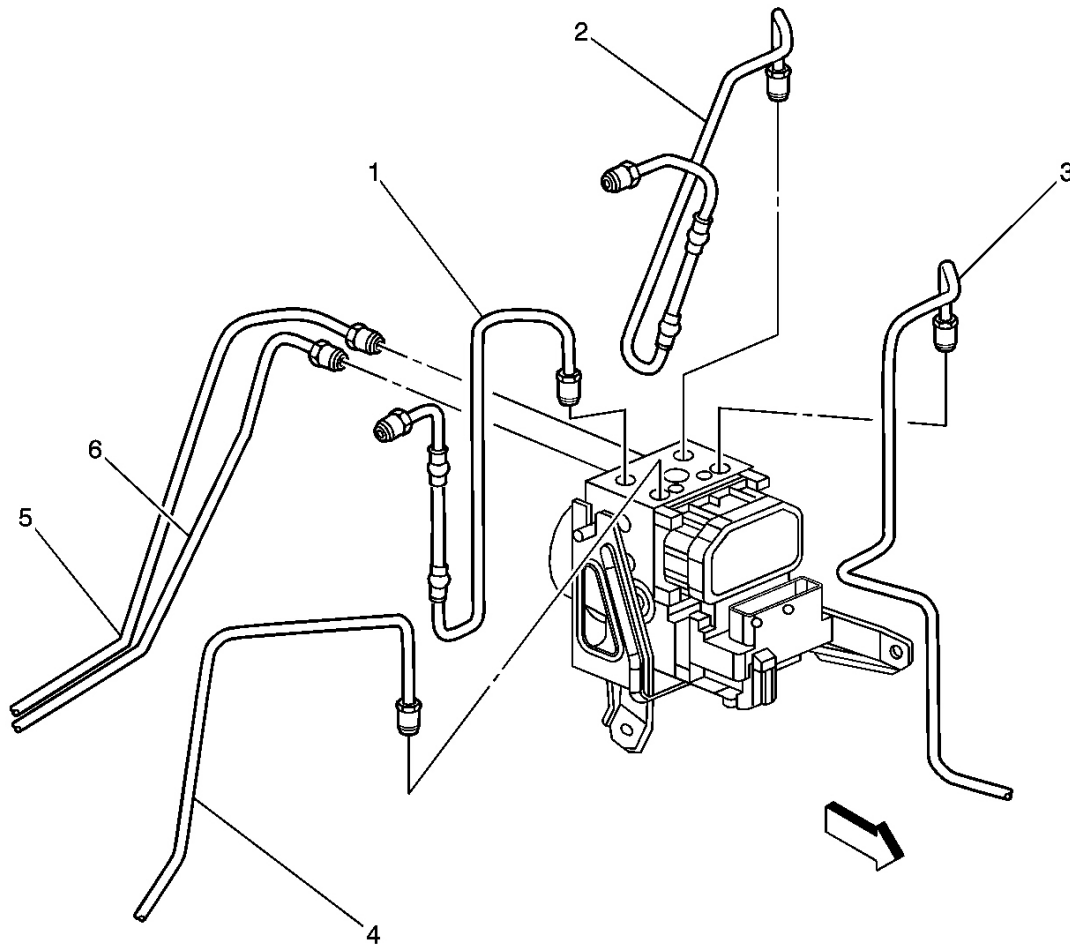


Fig. 2: View Of Master Cylinder Brake Pipe
 Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 2 Hydraulic Brake Pipe Routing - Master Cylinder To ABS

Callout	Component Name
1	Master Cylinder Primary Brake Pipe
2	Master Cylinder Secondary Brake Pipe
3	BPMV Brake Pipe to LF Brake Corner
4	BPMV Brake Pipe to RF Brake Corner
5	BPMV Brake Pipe to RR Brake Corner
6	BPMV Brake Pipe to LR Brake Corner

HYDRAULIC BRAKE PIPE ROUTING - MASTER CYLINDER TO PROPORTIONING VALVE ASSEMBLY

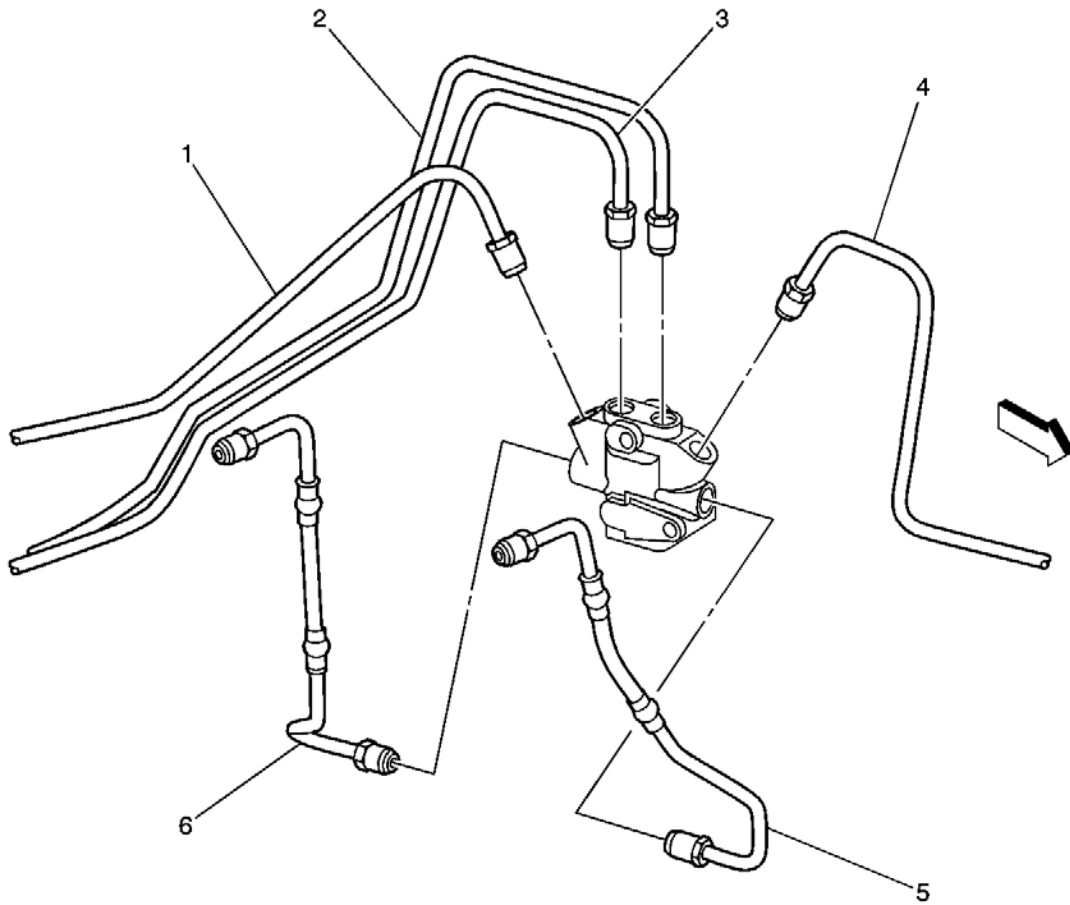


Fig. 3: View Of Master Cylinder Proportioning Brake Pipe
 Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 3 Hydraulic Pipe Routing - Master Cylinder To Proportioning Valve Assembly

Callout	Component Name
1	Proportioning Valve Brake Pipe to RF Brake Corner
2	Proportioning Valve Brake Pipe to RR Brake Corner
3	Proportioning Valve Brake Pipe to LR Brake Corner
4	Proportioning Valve Brake Pipe to LF Brake Corner
5	Master Cylinder Secondary Brake Pipe
6	Master Cylinder Primary Brake Pipe

COMPONENT LOCATOR

HYDRAULIC BRAKES COMPONENT VIEWS

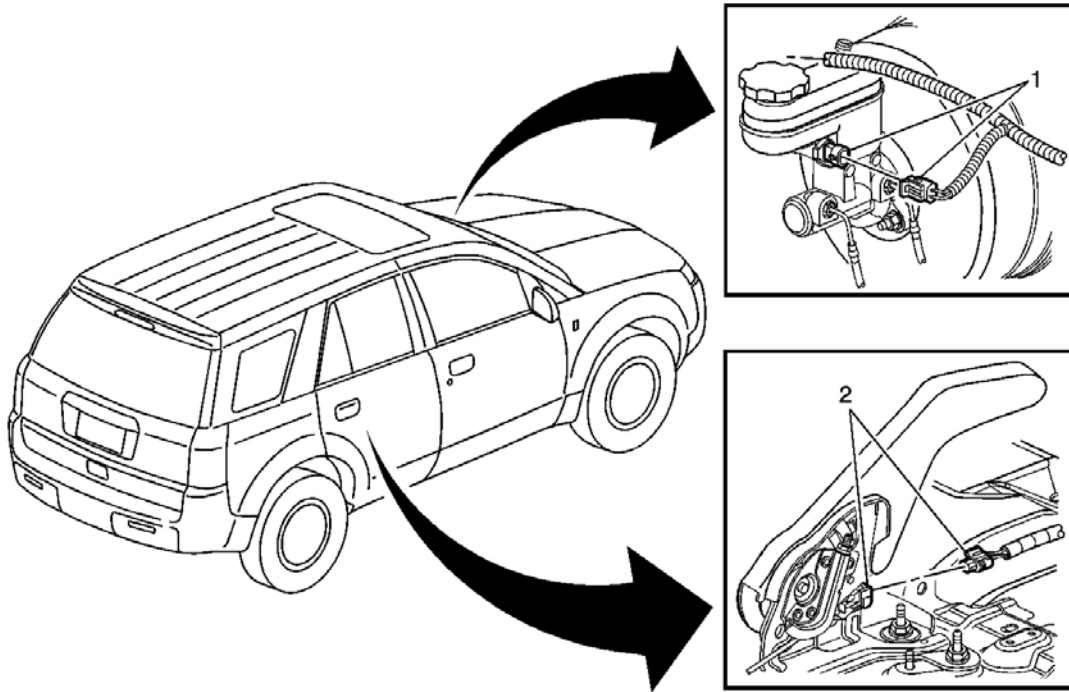


Fig. 4: Hydraulic Brakes Components
 Courtesy of GENERAL MOTORS CORP.

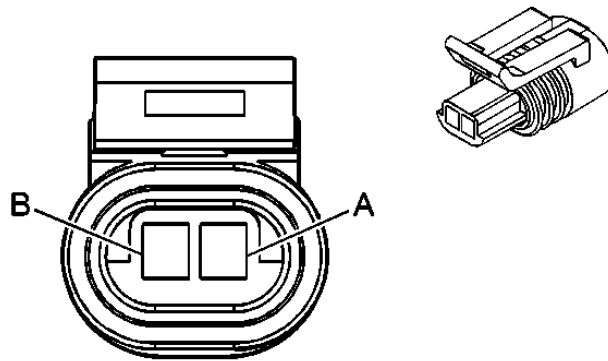
Callouts For Fig. 4 Component View

Callout	Component Name
1	Brake Fluid Level Switch (2 BK)
2	Park Brake Switch (1 BK)

HYDRAULIC BRAKES CONNECTOR END VIEWS

Brake Fluid Level Switch Connector End View



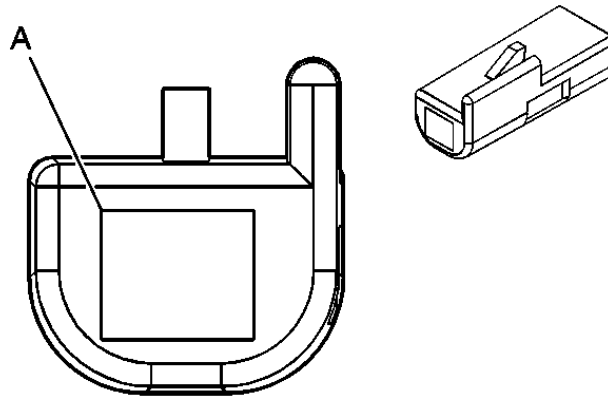


Connector Part Information

- 12162195
- 2-Way F Metri-Pack 150-Z Series, Sealed, Pull to Seat (BK)

Pin	Wire Color	Circuit Number	Function
A	PU	333	Brake Fluid Level Switch Signal
B	BK	650	Ground

Park Brake Switch Connector End View



Connector Part Information

- 12047682
- 1-Way F Metri-Pack 150 Series (BK)

Pin	Wire Color	Circuit Number	Function
A	L-BU	1134	Park Brake Switch Signal

DIAGNOSTIC STARTING POINT - HYDRAULIC BRAKES

Begin the system diagnosis by reviewing the system Description and 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. Refer to **Symptoms - Hydraulic Brakes** in order to identify the correct procedure for diagnosing the system and where the procedure is located.

DIAGNOSTIC SYSTEM CHECK - HYDRAULIC BRAKES

Test Description

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.

Diagnostic System Check - Hydraulic Brakes

Step	Action	Yes	No
1	Install a scan tool. Does the scan tool power up?	Go to Step 2	Go to Scan Tool Does Not Power Up in Data Link Communications
2	1. Turn ON the ignition, with the engine OFF. 2. Attempt to establish communication with the following control modules: <ul style="list-style-type: none">• Electronic brake control module (EBCM)• Body control module (BCM) Does the scan tool communicate with all control modules?	Go to Step 3	Go to Scan Tool Does Not Communicate with Class 2 Device in Data Link Communications
3	Select the display DTCs function on the scan tool for the following control modules: <ul style="list-style-type: none">• Electronic brake control module (EBCM)• Body control module (BCM)		

	Does the scan tool display any DTCs?	Go to Step 4	Go to Symptoms - Hydraulic Brakes
4	Does the scan tool display any DTCs which begin with a "U"?	Go to Scan Tool Does Not Communicate with Class 2 Device in Data Link Communications	Go to Step 5
5	Does the scan tool display DTC B1000?	Go to Diagnostic Trouble Code (DTC) List in Body Control System	Go to Step 6
6	Does the scan tool display DTC P0562, or P0621?	Go to Diagnostic Trouble Code (DTC) List in Engine Electrical	Go to Diagnostic Trouble Code (DTC) List

SCAN TOOL OUTPUT CONTROLS

Scan Tool Output Controls

Scan Tool Output Control	Additional Menu Selection(s)	Description
Automated Bleed Procedure	-	Used in order to bleed the ABS hydraulics. Refer to ABS Automated Bleed Procedure .
ABS Warning Lamp	-	Commands the ABS indicator ON and OFF
Left Front Solenoid	-	Commands the solenoid ON and OFF
Left Rear Solenoid	-	Commands the solenoid ON and OFF
Pump Motor	-	Commands the pump motor ON and OFF
LF Inlet Solenoid	Solenoid Test	Commands the solenoid ON and OFF
LF Outlet Solenoid	Solenoid Test	Commands the solenoid ON and OFF
LR Inlet Solenoid	Solenoid Test	Commands the solenoid ON and OFF
LR Outlet Solenoid	Solenoid Test	Commands the solenoid ON and OFF
LF Master Cylinder Isolation Solenoid	Solenoid Test	Commands the solenoid ON and OFF
LF Prime Solenoid	Solenoid Test	Commands the solenoid ON and OFF
TCS On/Off test	-	Commands the traction control system ON and OFF. Performs the same function as the traction control switch.

SCAN TOOL DATA LIST

Instrument Cluster (IPC) Scan Tool Data List

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition ON, engine OFF, brake fluid level normal, and park brake released			
Low Brake Fluid Level	-	Volts	2.5
Park Brake Switch	Inputs for Analog Dash	Off/On	Off

SCAN TOOL DATA DEFINITIONS

Brake Fluid Level

Scan tool displays OK or Low. The status of the brake fluid level sensor signal.

Park Brake Switch

Scan tool displays Applied/Released - Display indicates the state of the brake switch.

Red Brake Warning Indicator

Scan tool displays Off/On - Display indicates if the red BRAKE warning indicator is currently ON.

DIAGNOSTIC TROUBLE CODE (DTC) LIST

Diagnostic Trouble Code (DTC) List

DTC	Diagnostic Procedure	Module(s)
B0005	<u>DTC B0005</u>	BCM
C0267	<u>DTC C0267</u>	BCM

DTC B0005

Circuit Description

The park brake switch monitors if the park brake is engaged. When the body control module (BCM) sees the park brake switch input grounded, it sends a serial data message to the instrument panel cluster (IPC) requesting illumination of the red brake indicator.

Conditions for Running the DTC

The vehicle speed is greater than 8 km/h (5 mph).

Conditions for Setting the DTC

The BCM detects a ground on the park brake switch signal circuit for longer than 2 seconds.

Action Taken When the DTC Sets

Conditions for Clearing the DTC

- The condition for the DTC is no longer present and the DTC is cleared with a scan tool.
- The electronic brake control module (EBCM) automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

DTC B0005 Circuit

Step	Action	Yes	No
Schematic Reference: Brake Warning System Schematics			
Connector End View Reference: Hydraulic Brakes Connector End Views			
1	Did you perform the Hydraulic Brake Diagnostic System Check?	Go to Step 2	Go to Diagnostic System Check - Hydraulic Brakes
2	<ol style="list-style-type: none"> 1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, observe the Park Brake Switch parameter in the brake control module (BCM) data list. <p>Does the scan tool indicate that the Park Brake Switch parameter is OK?</p>	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems	Go to Step 3
3	<ol style="list-style-type: none"> 1. Turn OFF the ignition. 2. Disconnect the park brake switch. 3. Turn ON the ignition, with the engine OFF. 4. With a scan tool, observe the Park Brake Switch parameter. <p>Does the scan tool indicate that the Park Brake Switch parameter is OK?</p>	Go to Step 5	Go to Step 4
4	Test the signal circuit of the park brake switch for a short to ground. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 7	Go to Step 6
5	Replace the park brake switch. Refer to Park Brake Warning Lamp Switch Replacement . Did you complete the repair?	Go to Step 7	-
6	Replace the BCM. Refer to Body Control Module Replacement in Body Control System. Did you complete the repair?	Go to Step 7	-
7	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 2

DTC C0267

Circuit Description

The body control module (BCM) monitors the brake fluid level in the master cylinder reservoir via the brake fluid level switch.

Conditions for Running the DTC

The ignition switch is in the ON position for 60 seconds or more.

Conditions for Setting the DTC

- The BCM detects a low brake fluid level condition for more then 60 seconds.
- The BCM detects a short to voltage in the brake fluid level signal circuit.
- The BCM detects an open in the brake fluid level signal circuit.

Action Taken When the DTC Sets

The red brake warning indicator turns ON.

Conditions for Clearing the DTC

The conditions for setting the DTC are no longer present and you use the scan tool Clear DTCs function.

Diagnostic Aids

A lower than normal brake fluid level in the master cylinder may cause the brake fluid level switch to close when the vehicle makes sharp turns or sudden stops. Low brake fluid level may be caused by a brake fluid leak or worn disc brake pads.

Thoroughly inspect connections or circuitry that may cause an intermittent malfunction. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems.

DTC C0267 Circuit

Step	Action	Yes	No
Schematic Reference: Brake Warning System Schematics Connector End View Reference: Body Control System Connector End Views in Body Control System			
1	Did you perform the hydraulic brake Diagnostic System Check?	Go to Step 2	Go to Diagnostic System Check - Hydraulic Brakes
2	1. Use a scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC C0129 or C0267 set as current?	Go to Step 3	Go to Diagnostic Aids
3	Inspect the brake fluid level in the master cylinder reservoir. Refer to Master Cylinder Reservoir Filling .	Go to	

	Did you find and correct the condition?	Step 8	Go to Step 4
4	<ol style="list-style-type: none"> 1. Disconnect the brake fluid level switch harness connector. 2. Use the scan tool to observe the brake fluid level status. <p>Does the scan tool display Low?</p>	Go to Step 6	Go to Step 5
5	<p>Replace the brake fluid level switch. Refer to Master Cylinder Fluid Level Sensor Replacement.</p> <p>Did you complete the replacement?</p>	Go to Step 8	-
6	<ol style="list-style-type: none"> 1. Turn OFF the ignition. 2. Disconnect the body control module (BCM) harness connector. 3. Test the brake warning indicator supply voltage circuit for a short to ground, short to voltage, or open. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. <p>Did you find and correct the condition?</p>	Go to Step 8	Go to Step 7
7	<p>Replace the BCM. Refer to Body Control Module Replacement in Anti-lock Brake System.</p> <p>Did you complete the replacement?</p>	Go to Step 8	-
8	<ol style="list-style-type: none"> 1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. <p>Does the DTC reset?</p>	Go to Step 3	System OK

SYMPTOMS - HYDRAULIC BRAKES

IMPORTANT: The following steps must be completed before using the symptom tables.

1. Perform the **Brake System Vehicle Road Test** before using the hydraulic brake symptom tables in order to duplicate the customer concern.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to the following:
 - **Brake Warning System Description and Operation**
 - **Hydraulic Brake System Description and Operation**
 - **Brake Assist System Description and Operation**
 - **Disc Brake System Description and Operation in Disc Brakes**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the hydraulic brake system. Refer to **Checking Aftermarket Accessories** in Wiring Systems.

- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Brake Warning Indicator Always On**
- **Brake Warning Indicator Inoperative**
- **Brake Pulsation**
- **Braking Action Uneven - Pulls to One Side**
- **Braking Action Uneven - Front to Rear**
- **Brake Pedal Excessive Travel**
- **Brake Pedal Excessive Effort**
- **Brake System Slow Release**
- **Brake Fluid Loss**

BRAKE WARNING INDICATOR ALWAYS ON

Brake Warning Indicator Always On

Step	Action	Yes	No
Schematic Reference: Brake Warning System Schematics Connector End View Reference: Body Control System Connector End Views in Body Control System			
1	Did you perform the Hydraulic Brake Diagnostic System Check?	Go to Step 2	Go to Diagnostic System Check - Hydraulic Brakes
2	1. Turn ON the ignition, with the engine OFF. 2. Release the park brake. 3. With a scan tool, observe the Park Brake Switch parameter in the Body Control Module data list. Does the scan tool indicate that the Park Brake Switch parameter is OFF?	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems	Go to Step 3
	1. Turn OFF the ignition. 2. Disconnect the park brake switch.		

3	<p>3. Turn ON the ignition, with the engine OFF.</p> <p>4. With a scan tool, observe the Park Brake Switch parameter.</p> <p>Does the scan tool indicate that the Park Brake Switch parameter is OFF?</p>	Go to Step 5	Go to Step 4
4	<p>Test the signal circuit of the park brake switch for a short to ground. Refer to Circuit Testing and Wiring Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 9	Go to Step 6
5	<p>Inspect for poor connections at the harness connector of the park brake switch. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 9	Go to Step 7
6	<p>Inspect for poor connections at the harness connector of the body control module (BCM). Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 9	Go to Step 8
7	<p>Replace the park brake switch. Refer to Park Brake Warning Lamp Switch Replacement in Park Brake.</p> <p>Did you complete the repair?</p>	Go to Step 9	-
8	<p>Replace the BCM. Refer to Body Control Module Replacement in Body Control System.</p> <p>Did you complete the repair?</p>	Go to Step 9	-
9	<p>Operate the system in order to verify the repair.</p> <p>Did you correct the condition?</p>	System OK	Go to Step 2

BRAKE WARNING INDICATOR INOPERATIVE

Brake Warning Indicator Inoperative

Step	Action	Yes	No
<p>Schematic Reference: Brake Warning System Schematics</p> <p>Connector End View Reference: Body Control System Connector End Views in Body Control System</p>			
1	<p>Did you perform the Hydraulic Brake Diagnostic System Check?</p>	Go to Step 2	Go to Diagnostic System Check - Hydraulic Brakes
	<p>1. Turn ON the ignition, with the engine OFF.</p> <p>2. Apply the park brake.</p>		

2	<p>3. With a scan tool, observe the Park Brake Switch parameter in the Body Control Module data list.</p> <p>Does the scan tool indicate that the Park Brake Switch parameter is ON?</p>	<p>Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems</p>	<p>Go to Step 3</p>
3	<p>1. Turn OFF the ignition.</p> <p>2. Disconnect the park brake switch.</p> <p>3. Connect a 3A fused jumper wire between the signal circuit of the park brake warning lamp switch and ground.</p> <p>4. Turn ON the ignition, with the engine OFF.</p> <p>5. With a scan tool, observe the Park Brake Switch parameter.</p> <p>Does the scan tool indicate that the Park Brake Switch parameter is ON?</p>	<p>Go to Step 5</p>	<p>Go to Step 4</p>
4	<p>Test the signal circuit of the park brake switch for an open circuit. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	<p>Go to Step 9</p>	<p>Go to Step 6</p>
5	<p>Inspect for poor connections at the harness connector of the park brake switch. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	<p>Go to Step 9</p>	<p>Go to Step 7</p>
6	<p>Inspect for poor connections at the harness connector of the body control module (BCM). Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	<p>Go to Step 9</p>	<p>Go to Step 8</p>
7	<p>Replace the park brake switch. Refer to Park Brake Warning Lamp Switch Replacement in Park Brake.</p> <p>Did you complete the repair?</p>	<p>Go to Step 9</p>	<p>-</p>
8	<p>Replace the BCM. Refer to Body Control Module Replacement in Body Control System.</p> <p>Did you complete the repair?</p>	<p>Go to Step 9</p>	<p>-</p>
9	<p>Operate the system in order to verify the repair.</p> <p>Did you correct the condition?</p>	<p>System OK</p>	<p>Go to Step 2</p>

BRAKE PULSATION

Test Description

The numbers below refers to the step numbers on the diagnostic table:

2: Suspension components that are not operating properly may cause a disturbance to the vehicle during application of the brake system.

3: Anti-lock brake system operation could produce feedback through the brake pedal during application of the brake system.

Brake Pulsation

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to Diagnostic Starting Point - Hydraulic Brakes
2	Inspect the suspension system for proper operation. Refer to Diagnostic Starting Point - Suspension General Diagnosis in Suspension General Diagnosis. Did you find and correct a condition?	Go to Step 7	Go to Step 3
3	Inspect the anti-lock brake system, if equipped, for proper operation. Refer to Diagnostic Starting Point - Anti-lock Brake System in Anti-lock Brake System. Did you find and correct a condition?	Go to Step 7	Go to Step 4
4	Inspect the disc brake system for proper operation. Refer to Disc Brake System Diagnosis . Did you find and correct a condition?	Go to Step 7	Go to Step 5
5	Inspect the drum brake system for proper operation. Refer to Drum Brake System Diagnosis . Did you find and correct a condition?	Go to Step 7	Go to Step 6
6	Inspect the hydraulic brake system for proper operation. Refer to Hydraulic Brake System Diagnosis . Did you find and correct a condition?	Go to Step 7	Go to Diagnostic Starting Point - Hydraulic Brakes
7	Road test the vehicle in order to confirm proper operation. Refer to Brake System Vehicle Road Test . Is the condition still present?	Go to Step 2	System OK

BRAKE SYSTEM NOISE

Brake System Noise

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom Table?	Go to Step 2	Go to Diagnostic Starting Point - Hydraulic Brakes
2	Inspect the disc brake system for proper operation. Refer to Disc Brake System Diagnosis .	Go to	

	Did you find and correct a condition?	Step 7	Go to Step 3
3	Inspect the drum brake system for proper operation. Refer to Drum Brake System Diagnosis . Did you find and correct a condition?	Go to Step 7	Go to Step 4
4	Inspect the brake assist system for proper operation. Refer to Brake Assist System Diagnosis . Did you find and correct a condition?	Go to Step 7	Go to Step 5
5	Inspect the hydraulic brake system for proper operation. Refer to Hydraulic Brake System Diagnosis . Did you find and correct a condition?	Go to Step 7	Go to Step 6
6	Inspect the park brake system for proper operation. Refer to Park Brake System Diagnosis in Park Brake. Did you find and correct a condition?	Go to Step 7	Go to Diagnostic Starting Point - Hydraulic Brakes
7	Road test the vehicle in order to confirm proper operation. Refer to Brake System Vehicle Road Test . Is the condition still present?	Go to Step 2	System OK

BRAKING ACTION UNEVEN - PULLS TO ONE SIDE

Test Description

The numbers below refers to the step numbers on the diagnostic table:

2: Suspension components that are not operating properly may cause a disturbance to the vehicle during application of the brake system.

3: Steering components that are not operating properly may cause a disturbance to the vehicle during application of the brake system.

Braking Action Uneven - Pulls to One Side

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom Table?	Go to Step 2	Go to Diagnostic Starting Point - Hydraulic Brakes
2	Inspect the suspension system for proper operation. Refer to Diagnostic Starting Point - Suspension General Diagnosis in Suspension General Diagnosis. Did you find and correct a condition?	Go to Step 7	Go to Step 3
3	Inspect the steering system for proper operation. Refer to Diagnostic Starting Point - Power Steering System in Power Steering System. Did you find and correct a condition?	Go to Step 7	Go to Step 4
4	Inspect the hydraulic brake system for proper operation. Refer to Hydraulic Brake System Diagnosis . Did you find and correct a condition?	Go to Step 7	Go to Step 5
	Inspect the disc brake system for proper operation. Refer to		

5	Disc Brake System Diagnosis . Did you find and correct a condition?	Go to Step 7	Go to Step 6
6	Inspect the drum brake system for proper operation. Refer to Drum Brake System Diagnosis . Did you find and correct a condition?	Go to Step 7	Go to Diagnostic Starting Point - Hydraulic Brakes
7	Road test the vehicle in order to confirm proper operation. Refer to Brake System Vehicle Road Test . Is the condition still present?	Go to Step 2	System OK

BRAKING ACTION UNEVEN - FRONT TO REAR

Test Description

The number below refers to the step number on the diagnostic table:

2: Suspension components that are not operating properly may cause a disturbance to the vehicle during application of the brake system.

Braking Action Uneven - Front to Rear

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom Table?	Go to Step 2	Go to Diagnostic Starting Point - Hydraulic Brakes
2	Inspect the suspension system for proper operation. Refer to Diagnostic Starting Point - Suspension General Diagnosis in Suspension General Diagnosis. Did you find and correct a condition?	Go to Step 7	Go to Step 3
3	Inspect the hydraulic brake system for proper operation. Refer to Hydraulic Brake System Diagnosis . Did you find and correct a condition?	Go to Step 7	Go to Step 4
4	Inspect the disc brake system for proper operation. Refer to Disc Brake System Diagnosis . Did you find and correct a condition?	Go to Step 7	Go to Step 5
5	Inspect the drum brake system for proper operation. Refer to Drum Brake System Diagnosis . Did you find and correct a condition?	Go to Step 7	Go to Step 6
6	Inspect the brake assist system for proper operation. Refer to Brake Assist System Diagnosis . Did you find and correct a condition?	Go to Step 7	Go to Diagnostic Starting Point - Hydraulic Brakes
7	Road test the vehicle in order to confirm proper operation. Refer to Brake System Vehicle Road Test . Is the condition still present?	Go to Step 2	System OK

BRAKE PEDAL EXCESSIVE TRAVEL

Brake Pedal Excessive Travel

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom Table?	Go to Step 2	Go to Diagnostic Starting Point - Hydraulic Brakes
2	Inspect for proper brake pedal travel. Refer to Brake Pedal Travel Measurement and Inspection . Is the brake pedal travel distance within the acceptable level?	Go to Step 5	Go to Step 3
3	<ol style="list-style-type: none"> 1. Inspect for worn, missing or damaged brake pedal system components. 2. Replace the brake pedal system components that are worn, missing or damaged, refer to the following as necessary. <ul style="list-style-type: none"> • Brake Pedal Assembly Replacement • Vacuum Brake Booster Replacement (for pedal pushrod replacement) <p>Did you find and replace any worn, missing or damaged brake pedal system components?</p>	Go to Step 4	Go to Step 5
4	Reinspect for proper brake pedal travel. Refer to Brake Pedal Travel Measurement and Inspection . Is the brake pedal travel distance within the acceptable level?	Go to Step 9	Go to Step 5
5	Inspect the hydraulic brake system for proper operation. Refer to Hydraulic Brake System Diagnosis . Did you find and correct a condition?	Go to Step 9	Go to Step 6
6	Inspect the drum brake system for proper operation. Refer to Drum Brake System Diagnosis . Did you find and correct a condition?	Go to Step 9	Go to Step 7
7	Inspect the disc brake system for proper operation. Refer to Disc Brake System Diagnosis . Did you find and correct a condition?	Go to Step 9	Go to Step 8
8	Inspect the brake assist system for proper operation. Refer to Brake Assist System Diagnosis . Did you find and correct a condition?	Go to Step 9	Go to Diagnostic Starting Point - Hydraulic Brakes
9	Road test the vehicle to confirm proper operation. Refer to Brake System Vehicle Road Test . Is the condition still present?	Go to Step 2	System OK

BRAKE PEDAL EXCESSIVE EFFORT

Brake Pedal Excessive Effort

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom Table?	Go to Step 2	Go to Diagnostic Starting Point - Hydraulic Brakes
	Inspect the brake assist system for proper operation.		

2	Refer to Brake Assist System Diagnosis . Did you find and correct a condition?	Go to Step 6	Go to Step 3
3	Inspect the hydraulic brake system for proper operation. Refer to Hydraulic Brake System Diagnosis . Did you find and correct a condition?	Go to Step 6	Go to Step 4
4	Inspect the disc brake system for proper operation. Refer to Disc Brake System Diagnosis . Did you find and correct a condition?	Go to Step 6	Go to Step 5
5	Inspect the drum brake system for proper operation. Refer to Drum Brake System Diagnosis . Did you find and correct a condition?	Go to Step 6	Go to Diagnostic Starting Point - Hydraulic Brakes
6	Road test the vehicle to confirm proper operation. Refer to Brake System Vehicle Road Test . Is the condition still present?	Go to Step 2	System OK

BRAKES DRAG

Brakes Drag

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to Diagnostic Starting Point - Hydraulic Brakes
2	<ol style="list-style-type: none"> Inspect the stop lamp switch for proper adjustment to ensure that the brake pedal is fully releasing. Refer to Stop Lamp Switch Adjustment in Lighting Systems. Inspect the cruise control release switch, if equipped, for proper adjustment to ensure that the brake pedal is fully releasing. Refer to Cruise Release Switch Adjustment in Cruise Control. Did you find and correct a condition?	Go to Step 11	Go to Step 3
3	Inspect the drum brake system for proper operation. Refer to Drum Brake System Diagnosis . Did you find and correct a condition?	Go to Step 11	Go to Step 4
4	Inspect the park brake system for proper operation. Refer to Park Brake System Diagnosis in Park Brake. Did you find and correct a condition?	Go to Step 11	Go to Step 5
5	Inspect the disc brake system for proper operation. Refer to Disc Brake System Diagnosis . Did you find and correct a condition?	Go to Step 11	Go to Step 6
6	<ol style="list-style-type: none"> Separate the brake booster pushrod from the brake pedal. Refer to Brake Pedal Assembly Replacement . Inspect the brake corners to determine if the brake drag condition is still present. 		

	Do the brake corners still exhibit the brake drag condition?	Go to Step 8	Go to Step 7
7	Replace the brake pedal assembly. Refer to <u>Brake Pedal Assembly Replacement</u> . Did you complete the replacement?	Go to Step 11	-
8	1. Separate the master cylinder from the brake booster. Do not disconnect any brake pipes. Refer to <u>Master Cylinder Replacement</u> . 2. Inspect the brake corners to determine if the brake drag condition is still present. Do the brake corners still exhibit the brake drag condition?	Go to Step 10	Go to Step 9
9	Replace the brake booster assembly. Refer to <u>Vacuum Brake Booster Replacement</u> . Did you complete the replacement?	Go to Step 11	-
10	Inspect the hydraulic brake system for proper operation. Refer to <u>Hydraulic Brake System Diagnosis</u> . Did you find and correct a condition?	Go to Step 11	Go to <u>Diagnostic Starting Point - Hydraulic Brakes</u>
11	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle to confirm proper operation. Refer to <u>Brake System Vehicle Road Test</u> . Is the condition still present?	Go to Step 2	System OK

BRAKE SYSTEM SLOW RELEASE

Brake System Slow Release

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom Table?	Go to Step 2	Go to <u>Diagnostic Starting Point - Hydraulic Brakes</u>
2	Inspect the hydraulic brake system for proper operation. Refer to <u>Hydraulic Brake System Diagnosis</u> . Did you find and correct a condition?	Go to Step 6	Go to Step 3
3	Inspect the brake assist system for proper operation. Refer to <u>Brake Assist System Diagnosis</u> . Did you find and correct a condition?	Go to Step 6	Go to Step 4
4	Inspect the drum brake system for proper operation. Refer to <u>Drum Brake System Diagnosis</u> . Did you find and correct a condition?	Go to Step 6	Go to Step 5
5	Inspect the disc brake system for proper operation. Refer to <u>Disc Brake System Diagnosis</u> . Did you find and correct a condition?	Go to Step 6	Go to <u>Diagnostic Starting Point - Hydraulic Brakes</u>
	Road test the vehicle to confirm proper operation. Refer		

6	to Brake System Vehicle Road Test . Is the condition still present?	Go to Step 2	System OK
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BRAKE FLUID LOSS

Brake Fluid Loss

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to Diagnostic Starting Point - Hydraulic Brakes
2	Inspect the hydraulic brake system for proper operation. Refer to Hydraulic Brake System Diagnosis . Did you find and correct a condition?	Go to Step 7	Go to Step 3
3	Inspect the disc brake system for proper operation. Refer to Disc Brake System Diagnosis . Did you find and correct a condition?	Go to Step 7	Go to Step 4
4	Inspect the drum brake system for proper operation. Refer to Drum Brake System Diagnosis . Did you find and correct a condition?	Go to Step 7	Go to Step 5
5	<ol style="list-style-type: none"> 1. Separate the master cylinder from the vacuum brake booster. Do not disconnect any brake pipes. Refer to Master Cylinder Replacement . 2. Inspect the rear of the master cylinder for a brake fluid leak. 3. Inspect for brake fluid in the vacuum brake booster. Did you find a brake fluid leak?	Go to Step 6	Go to Diagnostic Starting Point - Hydraulic Brakes
6	Replace the brake master cylinder and the vacuum brake booster. Refer to Master Cylinder Replacement and Vacuum Brake Booster Replacement . Did you complete the replacement?	Go to Step 7	-
7	<ol style="list-style-type: none"> 1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle to confirm proper operation. Refer to Brake System Vehicle Road Test . Is the condition still present?	Go to Step 2	System OK

DISC BRAKE SYSTEM DIAGNOSIS

Test Description

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

9: Lubricant leaks from non-brake system components may come in contact with and contaminate brake system components.

10: Lubricant leaks from non-brake system components may come in contact with and contaminate brake system components.

13: Disc brake rotor thickness variation that exceeds the maximum acceptable level can cause brake pulsation.

17: Disc brake rotor thickness variation that exceeds the maximum acceptable level can cause brake pulsation.

20: Disc brake rotor assembled lateral runout (LRO) that exceeds the maximum acceptable level can lead to thickness variation.

Disc Brake System Diagnosis

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the DISC brake system in order to determine if the DISC brake system is operating properly. You will be directed by the appropriate Symptom table to go to other brake system diagnostic tables as appropriate.			
1	Were you sent here from a Brake Symptom table?	Go to Step 2	Go to Diagnostic Starting Point - Hydraulic Brakes
2	<p>Visually inspect the disc brake pads for the following conditions: Refer to Brake Pad Inspection in Disc Brakes.</p> <ul style="list-style-type: none"> • Lining thickness below specifications • Uneven and/or abnormal wear-Edge-to-edge and/or side-to-side • Looseness or damage, including pad hardware • Evidence of contamination from an external substance <p>Did you find any conditions to indicate a concern with any of the disc brake pads?</p>	Go to Step 3	Go to Step 12
3	Are any of the disc brake pads contaminated?	Go to Step 8	Go to Step 4
4	Are any of the disc brake pads worn unevenly?	Go to Step 7	Go to Step 5
5	Are any of the disc brake pads and/or pad hardware loose or damaged?	Go to Step 7	Go to Step 6
	1. Remove and inspect the worn disc brake pads for glazing, looseness, heat spots or damage.		

6	<p>2. Replace the worn disc brake pads as a complete axle set. Refer to <u>Brake Pads Replacement</u> in Disc Brakes.</p> <p>Did you complete the inspection and replacement?</p>	Go to Step 12	-
7	<p>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.</p> <p>IMPORTANT: Do NOT disconnect the hydraulic brake flex hoses from the calipers.</p> <p>1. Remove the disc brake calipers from the mounting brackets and support the calipers. Refer to <u>Brake Caliper Replacement</u> in Disc Brakes.</p> <p>2. Inspect the disc brake caliper mounting bracket and the mounting/sliding hardware for the following conditions:</p> <p>Refer to <u>Disc Brake Mounting and Hardware Inspection</u> in Disc Brakes.</p> <ul style="list-style-type: none"> • Binding or seized hardware • Worn, damaged or missing hardware components • Loose, bent, cracked, or damaged caliper mounting bracket <p>3. Replace components as required. Refer to the following procedures in Disc Brakes, as required:</p> <ul style="list-style-type: none"> • <u>Brake Caliper Bracket Replacement</u> • <u>Disc Brake Hardware Replacement</u> <p>4. Replace the unevenly-worn, loose or damaged disc brake pads as a complete axle set. Refer to <u>Brake Pads Replacement</u> in Disc Brakes.</p> <p>Did you complete the inspection and replacement?</p>	Go to Step 12	-
	<p>1. Inspect the disc brake calipers, brake hoses and brake pipes for evidence of an external brake fluid leak.</p> <p>2. Replace any components found to be leaking brake fluid. Refer to the following procedures as required:</p> <ul style="list-style-type: none"> • <u>Brake Caliper Replacement</u> in Disc Brakes 		

8	<ul style="list-style-type: none"> • <u>Brake Hose Replacement - Front</u> • <u>Brake Pipe Replacement</u> <p>Did you find and correct the source of the leak causing contamination of the pads?</p>	Go to Step 11	Go to Step 9
9	<ol style="list-style-type: none"> 1. Inspect the wheel drive shaft outer seals for damage and evidence of a grease leak. 2. Replace any wheel drive shaft seal that is found to be leaking grease which may be the source of the contamination to the pads. Refer to <u>Wheel Drive Shaft Outer Joint and Seal Replacement - Front</u> in Wheel Drive Shafts. <p>Did you find and correct the source of the leak causing contamination of the pads?</p>	Go to Step 11	Go to Step 10
10	<ol style="list-style-type: none"> 1. Inspect the automatic transmission cooling system lines, if equipped, for damage and evidence of an external fluid leak which may be the source of the contamination to the pads. 2. Replace any components found to be leaking fluid which may be the source of the contamination to the pads. <p>Did you find and correct the source of the leak causing contamination of the pads?</p>	Go to Step 11	-
11	<ol style="list-style-type: none"> 1. Clean the remaining disc brake system components to remove any traces of the contaminant. <p>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.</p> <p>IMPORTANT: Do NOT disconnect the hydraulic brake flex hoses from the calipers.</p> <ol style="list-style-type: none"> 2. Remove the disc brake calipers from the mounting brackets and support the calipers. Refer to <u>Brake Caliper Replacement</u> in Disc Brakes. 3. Inspect the disc brake caliper mounting/sliding hardware for the following conditions: 		-

	<p>Refer to <u>Disc Brake Mounting and Hardware Inspection</u> in Disc Brakes.</p> <ul style="list-style-type: none"> • Binding or seized hardware • Distorted, worn, damaged or missing hardware components <p>4. Replace the caliper mounting/sliding hardware components as required. Refer to <u>Disc Brake Hardware Replacement</u> in Disc Brakes.</p> <p>5. Replace the contaminated disc brake pads as a complete axle set. Refer to <u>Brake Pads Replacement</u> in Disc Brakes.</p> <p>Did you complete the cleaning, inspection and replacement?</p>	<p>Go to Step 12</p>	
<p>12</p>	<p>1. Check the thickness of each of the disc brake rotors.</p> <p>IMPORTANT: Make the following determination AND ANSWER the question INDIVIDUALLY for EACH rotor.</p> <p>2. Make a determination for each brake rotor if the rotor can be REFINISHED and REMAIN ABOVE the minimum requirements.</p> <p>Refer to <u>Brake Rotor Thickness Measurement</u> in Disc Brakes. Does the disc brake rotor meet the minimum requirements for REFINISHING?</p>	<p>Go to Step 13</p>	<p>Go to Step 16</p>
<p>13</p>	<p>IMPORTANT: Perform the following inspection AND ANSWER the question INDIVIDUALLY for EACH rotor.</p> <p>Inspect each of the disc brake rotors for thickness variation that exceeds the maximum acceptable level. Refer to <u>Brake Rotor Thickness Variation Measurement</u> in Disc Brakes. Does the brake rotor exhibit thickness variation that exceeds the maximum acceptable level?</p>	<p>Go to Step 15</p>	<p>Go to Step 14</p>
	<p>1. Inspect each of the disc brake rotors for the following surface and wear conditions:</p> <p>Refer to <u>Brake Rotor Surface and Wear Inspection</u> in Disc Brakes.</p> <ul style="list-style-type: none"> • Heavy rust and/or pitting • Cracks and/or heat spots • Excessive blueing discoloration 		

14	<ul style="list-style-type: none"> • Deep or excessive scoring beyond maximum acceptable level <p>IMPORTANT: Make the following determination AND ANSWER the question INDIVIDUALLY for EACH rotor.</p> <p>2. Make a determination for each brake rotor if the rotor requires refinishing based upon the results of the inspection.</p> <p>If the brake rotor exhibits any of the conditions listed previously, it requires refinishing.</p> <p>Does the brake rotor require REFINISHING?</p>	Go to Step 15	Go to Step 20
15	<ol style="list-style-type: none"> 1. Refinish the brake rotor. Refer to <u>Brake Rotor Refinishing</u> in Disc Brakes. 2. Inspect the brake rotor thickness. Refer to <u>Brake Rotor Thickness Measurement</u> in Disc Brakes. <p>Were you able to REFINISH the brake rotor within the minimum requirements?</p>	Go to Step 20	Go to Step 19
16	Is the brake rotor at or below the DISCARD requirements?	Go to Step 19	Go to Step 17
17	<p>IMPORTANT: Perform the following inspection AND ANSWER the question INDIVIDUALLY for EACH rotor.</p> <p>Inspect each of the disc brake rotors for thickness variation that exceeds the maximum acceptable level. Refer to <u>Brake Rotor Thickness Variation Measurement</u> in Disc Brakes. Does the brake rotor exhibit thickness variation that exceeds the maximum acceptable level?</p>	Go to Step 19	Go to Step 18
18	<ol style="list-style-type: none"> 1. Inspect each of the disc brake rotors for the following surface and wear conditions: <p>Refer to <u>Brake Rotor Surface and Wear Inspection</u> in Disc Brakes.</p> <ul style="list-style-type: none"> • Heavy rust and/or pitting • Cracks and/or heat spots • Excessive blueing discoloration • Deep or excessive scoring beyond maximum acceptable level 		

	<p>IMPORTANT: Make the following determination AND ANSWER the question INDIVIDUALLY for EACH rotor.</p> <p>2. Make a determination for each brake rotor if the rotor requires replacement based upon the results of the inspection.</p> <p>If the brake rotor exhibits any of the conditions listed previously, it requires replacement.</p> <p>Does the brake rotor require REPLACEMENT?</p>	Go to Step 19	Go to Step 20
19	<p>IMPORTANT: Whenever a brake rotor is replaced, the assembled lateral runout (LRO) of the rotor must be measured to ensure optimum performance of the disc brakes.</p> <p>Replace the brake rotor. Refer to Brake Rotor Replacement in Disc Brakes. Did you complete the replacement?</p>	Go to Step 22	-
20	<p>IMPORTANT: Perform the following inspection AND ANSWER the question INDIVIDUALLY for EACH rotor.</p> <p>Inspect each of the disc brake rotors for assembled lateral runout (LRO) that exceeds the maximum acceptable level. Refer to Brake Rotor Assembled Lateral Runout (LRO) Measurement in Disc Brakes. Does the brake rotor exhibit assembled LRO that exceeds the maximum acceptable level?</p>	Go to Step 21	Go to Step 22
21	<p>Correct the LRO for each brake rotor that was determined to have LRO exceeding the maximum acceptable level. Refer to Brake Rotor Assembled Lateral Runout (LRO) Correction in Disc Brakes. Did you complete the operation?</p>	Go to Step 22	-
22	<p>Install or connect components that were removed or disconnected during diagnosis. Did you complete the operation?</p>	Disc Brake System OK Return to Symptom Table	-

DRUM BRAKE SYSTEM DIAGNOSIS

Test Description

The number below refers to the step number on the diagnostic table:

18: Drum brake backing plates that come in contact with brake drums may cause brake system noise.

Drum Brake System Diagnosis

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the DRUM brake system in order to determine if the DRUM brake system is operating properly. You will be directed by the appropriate Symptom table to go to other brake system diagnostic tables as appropriate.			
1	Were you sent here from a Brake Symptom table?	Go to Step 2	Go to Diagnostic Starting Point - Hydraulic Brakes
2	<ol style="list-style-type: none"> 1. Remove the brake drums. Refer to Brake Drum Replacement in Drum Brakes. 2. Inspect the drum brake shoes for the following conditions: <ul style="list-style-type: none"> • Lining thickness below specifications • Uneven and/or abnormal wear - edge-to-edge and/or side-to-side • Contamination from an external substance • Looseness, damage, glazing, or incorrect lining material <p>Did you find any conditions to indicate a concern with any of the drum brake shoes?</p>	Go to Step 3	Go to Step 7
3	Are any of the brake shoes contaminated?	Go to Step 4	Go to Step 5
4	<ol style="list-style-type: none"> 1. Inspect the wheel cylinders for evidence of an external brake fluid leak. 2. Replace any wheel cylinder that is found to be leaking brake fluid. Refer to Wheel Cylinder Replacement in Drum Brakes. <p>Did you complete the inspection and replacement?</p>	Go to Step 6	-
5	<ol style="list-style-type: none"> 1. Inspect the drum brake hardware for any components which are worn, damaged, discolored due to stress, broken or missing. Refer to Drum Brake Hardware Inspection in Drum Brakes. 2. Replace components as required. Refer to Drum Brake Hardware Replacement in Drum Brakes. 3. Replace the drum brake shoes. Refer to Brake Shoe Replacement in Drum Brakes. <p>Did you complete the inspection and replacement?</p>	Go to Step 8	-
	<ol style="list-style-type: none"> 1. Clean the remaining drum brake system components to remove any traces of the contaminant. 2. Inspect the drum brake hardware for any components which are worn, damaged, discolored due to stress, broken 		

6	<p>or missing. Refer to <u>Drum Brake Hardware Inspection</u> in Drum Brakes.</p> <p>3. Replace the drum brake hardware components as required. Refer to <u>Drum Brake Hardware Replacement</u> in Drum Brakes.</p> <p>4. Replace the contaminated brake shoes. Refer to <u>Brake Shoe Replacement</u> in Drum Brakes.</p>		-
	<p>Did you complete the cleaning, inspection and replacement?</p>	Go to Step 8	
7	<p>1. Inspect the drum brake hardware for any components which are worn, damaged, discolored due to stress, broken or missing. Refer to <u>Drum Brake Hardware Inspection</u> in Drum Brakes.</p> <p>2. Replace components as required. Refer to <u>Drum Brake Hardware Replacement</u> in Drum Brakes.</p>		-
	<p>Did you complete the inspection and, if necessary, the replacement?</p>	Go to Step 8	
8	<p>1. Check the diameter of each of the brake drums.</p> <p>IMPORTANT: Make the following determination AND ANSWER the question INDIVIDUALLY for EACH drum.</p> <p>2. Make a determination for each brake drum if the drum can be REFINISHED and REMAIN ABOVE the minimum requirements.</p>		
	<p>Refer to <u>Brake Drum Diameter Measurement</u> in Drum Brakes. Does the brake drum meet the minimum requirements for REFINISHING?</p>	Go to Step 9	Go to Step 11
	<p>1. Inspect each of the brake drums for the following surface and wear conditions:</p> <p>Refer to <u>Brake Drum Surface and Wear Inspection</u> in Drum Brakes.</p> <ul style="list-style-type: none"> • Braking Surface Conditions <ul style="list-style-type: none"> ▪ Heavy rust and/or pitting ▪ Cracks and/or heat spots ▪ Excessive blueing discoloration ▪ Missing balance weights • Braking Surface Wear Conditions 		

9	<ul style="list-style-type: none"> ■ Deep or excessive scoring beyond maximum acceptable level ■ Radial runout beyond maximum acceptable level <p>IMPORTANT: Make the following determination AND ANSWER the question INDIVIDUALLY for EACH drum.</p> <p>2. Make a determination for each brake drum if the drum requires refinishing based upon the results of the inspection.</p> <p>If the brake drum exhibits any of the following conditions, it requires refinishing.</p> <ul style="list-style-type: none"> ● Drum exhibits one or more of the Braking Surface Conditions listed previously ● Drum is beyond the acceptable level in one or more of the Braking Surface Wear Conditions listed previously <p>Does the brake drum require REFINISHING?</p>	Go to Step 10	Go to Step 14
10	<ol style="list-style-type: none"> 1. Refinish the brake drum. Refer to <u>Brake Drum Refinishing</u> in Drum Brakes. 2. Inspect the brake drum diameter. Refer to <u>Brake Drum Diameter Measurement</u> in Drum Brakes. <p>Were you able to REFINISH the brake drum within the minimum requirements?</p>	Go to Step 14	Go to Step 13
11	<p>Is the brake drum at or below the DISCARD requirements?</p>	Go to Step 13	Go to Step 12
	<ol style="list-style-type: none"> 1. Inspect each of the brake drums for the following surface and wear conditions: <p>Refer to <u>Brake Drum Surface and Wear Inspection</u> in Drum Brakes.</p> <ul style="list-style-type: none"> ● Braking Surface Conditions <ul style="list-style-type: none"> ■ Heavy rust and/or pitting ■ Cracks and/or heat spots ■ Excessive blueing discoloration ■ Missing balance weights 		

12	<ul style="list-style-type: none"> • Braking Surface Wear Conditions <ul style="list-style-type: none"> ▪ Deep or excessive scoring beyond maximum acceptable level ▪ Radial runout beyond maximum acceptable level <p>IMPORTANT: Make the following determination AND ANSWER the question INDIVIDUALLY for EACH drum.</p> <p>2. Make a determination for each brake drum if the drum requires replacement based upon the results of the inspection.</p> <p>If a brake drum exhibits any of the following conditions, it requires replacement.</p> <ul style="list-style-type: none"> • Drum exhibits one or more of the Braking Surface Conditions listed previously • Drum is beyond the acceptable level in one or more of the Braking Surface Wear Conditions listed previously <p>Does the brake drum require REPLACEMENT?</p>	Go to Step 13	Go to Step 14
13	<p>Replace the brake drum. Refer to Brake Drum Replacement in Drum Brakes.</p> <p>Did you complete the replacement?</p>	Go to Step 14	-
14	<p>Inspect the brake shoes for proper adjustment. Refer to Drum Brake Adjustment in Drum Brakes.</p> <p>Are the brake shoes adjusted properly?</p>	Go to Step 18	Go to Step 15
15	<p>Inspect the components of the brake drum adjustment hardware system for free movement and correct operation. Refer to Drum Brake Adjusting Hardware Inspection in Drum Brakes.</p> <p>Do the drum brake adjusting hardware components operate freely and correctly?</p>	Go to Step 17	Go to Step 16
16	<p>Replace the drum brake adjusting hardware components as necessary. Refer to Drum Brake Adjusting Hardware Replacement in Drum Brakes.</p> <p>Is the replacement complete?</p>	Go to Step 17	-
17	<p>Adjust the drum brake shoes. Refer to Drum Brake Adjustment in Drum Brakes.</p> <p>Were you able to complete the adjustment?</p>	Go to Step 20	Return to Symptom Table
	<p>Inspect the drum brake backing plate for the following:</p> <ul style="list-style-type: none"> • Excessive wear or rust 		

18	<ul style="list-style-type: none"> • Damage and/or evidence of contact with the brake drum <p>Does the drum brake backing plate exhibit any of these conditions?</p>	Go to Step 19	Go to Step 20
19	<p>Repair or replace the drum brake backing plate as necessary. Refer to Drum Brake Backing Plate Replacement in Drum Brakes.</p> <p>Did you complete the repair or replacement?</p>	Go to Step 20	-
20	<p>Install or connect components that were removed or disconnected during diagnosis.</p> <p>Did you complete the operation?</p>	Drum Brake System OK Return to Symptom Table	-

HYDRAULIC BRAKE SYSTEM DIAGNOSIS

Hydraulic Brake System Diagnosis

Step	Action	Yes	No
<p>DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the HYDRAULIC brake system in order to determine if the HYDRAULIC brake system is operating properly. You will be directed by the appropriate Symptom table to go to other brake system diagnostic tables as appropriate.</p>			
1	Were you sent here from a Brake Symptom table?	Go to Step 2	Go to Diagnostic Starting Point - Hydraulic Brakes
2	Inspect and adjust the brake fluid level in the brake master cylinder. Refer to Master Cylinder Reservoir Filling . Was the brake fluid level low?	Go to Step 3	Go to Step 4
3	<ol style="list-style-type: none"> Inspect the brake fluid for the following conditions, indicating brake fluid contamination: <ul style="list-style-type: none"> • Fluid separation, indicating two types of fluid are present <ul style="list-style-type: none"> ■ Swirled appearance-Oil-based substance ■ Layered appearance-Silicone-based substance • Fluid discoloration <ul style="list-style-type: none"> ■ Cloudy appearance-Moisture ■ Dark appearance/suspended particles in fluid-Dirt, rust, corrosion, brake dust 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?	Go to Step 5	Go to Step 6
4	<ol style="list-style-type: none"> 1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination: <ul style="list-style-type: none"> • Fluid separation, indicating two types of fluid are present <ul style="list-style-type: none"> ▪ Swirled appearance-Oil-based substance ▪ Layered appearance-Silicone-based substance • Fluid discoloration <ul style="list-style-type: none"> ▪ Cloudy appearance-Moisture ▪ Dark appearance/suspended particles in fluid-Dirt, rust, corrosion, brake dust 2. Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating fluid contamination. 	Go to Step 5	Go to Step 12
5	<p>Do any of the above conditions exist?</p> <ol style="list-style-type: none"> 1. Flush the hydraulic brake system. Refer to <u>Hydraulic Brake System Flushing</u> . 2. 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. Refer to the procedures indicated. <ol style="list-style-type: none"> 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. <ul style="list-style-type: none"> • <u>Master Cylinder Reservoir Replacement</u> • Replace the brake master cylinder reservoir cap diaphragm. • <u>Master Cylinder Replacement</u> • Brake master cylinder reservoir-Clean the brake master cylinder reservoir using denatured alcohol, or equivalent, then dry the reservoir using non-lubricated, filtered air, or if necessary, replace the brake master cylinder reservoir. • <u>Brake Hose Replacement - Front</u> 		-

- **Brake Hose Replacement - Rear**
- **Brake Caliper Replacement** in Disc Brakes
- **Wheel Cylinder Replacement** in Drum Brakes
- **Proportioning Valve Replacement** , if equipped
- **Brake Modulator Assembly Replacement** , if equipped, in Anti-lock Brake System

3. 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.
4. Refill and bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)Hydraulic Brake System Bleeding (Pressure)** .

Did you complete the operation and any required repairs and/or replacements?

Go to **Step 9**

6

1. Inspect the following hydraulic brake system components for external fluid leaks. Repair or replace any of the components found to be leaking brake fluid. Refer to the appropriate procedures:
 - **Master Cylinder Reservoir Replacement**
Brake master cylinder reservoir cap diaphragm
 - **Master Cylinder Replacement**
 - **Brake Hose Replacement - Front**
 - **Brake Hose Replacement - Rear**
 - **Brake Pipe Replacement**
 - **Brake Caliper Replacement** in Disc Brakes
 - **Wheel Cylinder Replacement** in Drum Brakes
 - **Proportioning Valve Replacement** , if equipped
 - **Brake Modulator Assembly Replacement** , if equipped, in Anti-lock Brake System
2. If you repaired or replaced any of the brake system components listed, bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)Hydraulic Brake System Bleeding (Pressure)** . 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, and/or the proportioning valve

	<p>assembly, was replaced</p> <ul style="list-style-type: none"> An unrestricted and even flow of brake fluid per axle during the bleeding procedure 	Go to Step 7	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, and/or the proportioning valve assembly, was replaced?	Go to Step 19	Go to Step 8
8	Was the flow of brake fluid unrestricted and even per axle during the bleeding procedure?	Go to Step 9	Go to Step 10
9	<p>Inspect the hydraulic function of the brake calipers/wheel cylinders for proper operation. Refer to Hydraulic Brake Component Operation Visual Inspection .</p> <p>Was the hydraulic function of the brake calipers/wheel cylinders operating properly?</p>	Go to Step 21	Go to Step 14
10	Was the flow of brake fluid restricted or uneven through front axle hydraulic components during the bleeding procedure?	Go to Step 13	Go to Step 11
11	Was the flow of brake fluid restricted or uneven through rear axle hydraulic components during the bleeding procedure?	Go to Step 17	-
12	<p>Inspect the hydraulic function of the brake calipers/wheel cylinders for proper operation. Refer to Hydraulic Brake Component Operation Visual Inspection .</p> <p>Was the hydraulic function of the brake calipers/wheel cylinders operating properly?</p>	Go to Step 15	Go to Step 13
13	<p>Determine if the brake caliper is restricting the flow of brake fluid and/or not operating properly:</p> <ol style="list-style-type: none"> Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle in General Information. Remove the tire and wheel assemblies. Refer to Tire and Wheel Removal and Installation in Tires and Wheels. 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. <p>Was the flow of brake fluid unrestricted and did the caliper piston move freely?</p>	Go to Step 17	Go to Step 14
14	<p>Repair or replace any brake caliper/wheel cylinder that was not operating properly. Refer to the appropriate procedure.</p> <ul style="list-style-type: none"> Brake Caliper Replacement in Disc Brakes 		-

	<ul style="list-style-type: none"> • <u>Wheel Cylinder Replacement</u> in Drum Brakes 		
	Did you complete the repair and/or replacement?	Go to Step 21	
15	<p>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. Refer to <u>Hydraulic Brake System Bleeding (Manual)Hydraulic Brake System Bleeding (Pressure)</u> .</p> <p>Was there air in the system?</p>	Go to Step 19	Go to Step 16
16	Was the flow of brake fluid unrestricted and even per axle during the bleeding procedure?	Go to Step 21	Go to Step 17
17	<ol style="list-style-type: none"> 1. Inspect the hydraulic brake pipes and flexible brake hoses for signs of a fluid restriction; such as being bent, kinked, pinched or damaged. Refer to <u>Brake Pipe and Hose Inspection</u> . 2. Replace any of the hydraulic brake pipes and/or flexible brake hoses found to be bent, kinked, pinched, or damaged. Refer to the following procedures as necessary: <ul style="list-style-type: none"> • <u>Brake Hose Replacement - Front</u> • <u>Brake Hose Replacement - Rear</u> • <u>Brake Pipe Replacement</u> 3. 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. <p>Did you find and correct a condition?</p>	Go to Step 21	Go to Step 18
18	<ul style="list-style-type: none"> • If equipped with non-ABS, replace the proportioning valve assembly. Refer to <u>Proportioning Valve Replacement</u> . • If equipped with ABS, replace the brake modulator assembly, in order to correct the hydraulic brake dynamic rear proportioning mechanical operation. Refer to <u>Brake Modulator Assembly Replacement</u> in Anti-lock Brake System. <p>Did you complete the replacement?</p>	Go to Step 21	-
19	<ol style="list-style-type: none"> 1. 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. 2. Inspect the hydraulic brake system components for evidence of a recent repair, which may have introduced air into the system. 3. Repair or replace any of the components found to be installed incorrectly or seeping brake fluid. 	Go to Step	

	Did you find and correct a condition?	21	Go to Step 20
20	<ol style="list-style-type: none"> 1. Inspect the brake master cylinder for internal fluid leaks. Refer to Brake System Internal Leak Test . 2. Repair or replace the brake master cylinder if it is found to be leaking brake fluid internally. Refer to Master Cylinder Replacement . 	Go to Step 21	Return to Symptom Table
	Did you find and correct a condition?		
21	<p>Install or connect components that were removed or disconnected during diagnosis.</p> <p>Did you complete the operation?</p>	Hydraulic Brake System OK Return to Symptom Table	-

BRAKE ASSIST SYSTEM DIAGNOSIS

Brake Assist System Diagnosis

Step	Action	Yes	No
DEFINITION: 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	Were you sent here from a Brake Symptom table?	Go to Step 2	Go to Diagnostic Starting Point - Hydraulic Brakes
2	<p>Inspect for proper brake pedal travel. Refer to Brake Pedal Travel Measurement and Inspection .</p> <p>Is the brake pedal travel distance within the acceptable limits?</p>	Go to Step 5	Go to Step 3
3	<ol style="list-style-type: none"> 1. Inspect for worn, missing, misaligned, bent or damaged brake pedal system components. <ul style="list-style-type: none"> • For the brake pedal pushrod component inspection, refer to 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. 2. Replace the brake pedal system components that are worn, missing, misaligned, bent or damaged. Refer to the following procedures as necessary. <ul style="list-style-type: none"> • Brake Pedal Assembly Replacement • Vacuum Brake Booster Replacement - for a bent or damaged pedal pushrod replacement 		

	Did you find and replace any worn, missing, misaligned, bent or damaged brake pedal system components?	Go to Step 4	Go to Step 5
4	Reinspect for proper brake pedal travel. Refer to <u>Brake Pedal Travel Measurement and Inspection</u> . Is the brake pedal travel distance within the acceptable limits?	Go to Step 8	Go to Step 5
5	Check the engine vacuum source that supplies vacuum to the vacuum brake booster. Refer to <u>Brake System Vacuum Source Test</u> . Is the vacuum reading within the acceptable limits?	Go to Step 6	Go to <u>Diagnostic Starting Point - Engine Mechanical</u> in Engine Mechanical - 2.2L
6	During the vacuum source inspection, did the vacuum booster check valve operate properly?	Go to Step 8	Go to Step 7
7	Replace the vacuum booster check valve. Refer to <u>Vacuum Brake Booster Check Valve and/or Hose Replacement</u> . Did you complete the replacement?	Go to Step 8	-
8	<ol style="list-style-type: none"> 1. Pump the brake pedal several times until the brake pedal becomes hard. 2. 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?	Go to Step 9	Go to Step 12
9	<ol style="list-style-type: none"> 1. Release the brake pedal. 2. Turn the ignition OFF, then wait 15 seconds. 3. Pump the brake pedal two 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 two pedal applications. Did the brake pedal effort increase significantly?	Go to Step 12	Go to Step 10
10	Inspect the brake pedal pushrod and the brake pedal for misalignment, a bent condition and/or damage. Is the brake pedal pushrod and/or the brake pedal misaligned, bent or damaged?	Go to Step 11	Go to Step 13
	Replace the brake pedal pushrod and/or the brake pedal, as necessary. Refer to the following procedures:		

11	<ul style="list-style-type: none"> • <u>Brake Pedal Assembly Replacement</u> • <u>Vacuum Brake Booster Replacement</u> - for a bent or damaged pedal pushrod replacement 		
	Did you complete the replacement?	Go to Step 13	-
12	Replace the vacuum brake booster. Refer to <u>Vacuum Brake Booster Replacement</u> . Did you complete the replacement?	Go to Step 13	-
13	Install or connect any components that were removed or disconnected during diagnosis. Did you complete the operation?	Brake Assist System OK Return to Symptom Table	-

BRAKE SYSTEM VEHICLE 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. Refer to **Master Cylinder Reservoir Filling** .
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. Refer to **Symptoms - Hydraulic Brakes** .
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 step 8.
8. Release and apply the brakes.
9. While continuing to apply the brakes, shift the transmission into DRIVE, release the 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 step 13.
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 step 20.
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.

BRAKE PEDAL TRAVEL MEASUREMENT AND INSPECTION

Tools Required

J 28662 Brake Pedal Effort Gage, or equivalent. See **Special Tools and Equipment** .

1. With the ignition OFF and the brakes cool, apply the brakes 3-5 times, or until the brake pedal becomes firm, in order to deplete the brake booster power reserve.
2. Install the **J 28662** , or equivalent to the brake pedal. See **Special Tools and Equipment** .

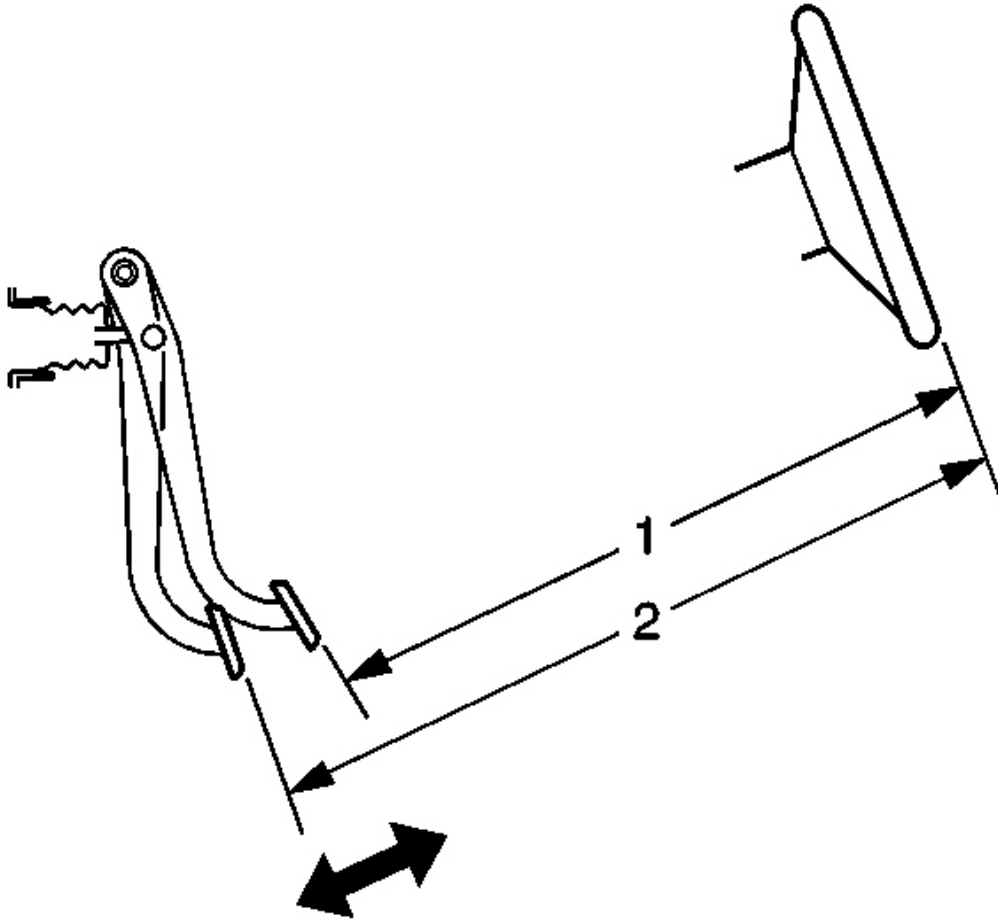


Fig. 5: Measuring Brake Pedal Travel
Courtesy of GENERAL MOTORS CORP.

3. Measure and record the distance (1) from the brake pedal to the rim of the steering wheel. Note the points of measurement.
4. Apply and maintain the brakes with 445 N (100 lb) of force to the brake pedal, as indicated on the **J 28662** , or equivalent. See **Special Tools and Equipment** .
5. While maintaining 445 N (100 lb) of force to the brake pedal, measure and record the distance (2) from the same point on the brake pedal to the same point on the rim of the steering wheel.

6. Release the brakes and repeat steps 4 and 5 to obtain a second measurement. After obtaining a second measurement, proceed to step 7.
7. Average the first and second measurements recorded during the two applies of the brakes.
8. Subtract the initial measurement, unapplied (1), from the averaged, applied measurement (2) to obtain the brake pedal travel distance.

Specification: Maximum brake pedal travel-Measured with the ignition OFF, brake booster power assist depleted, and the brakes cool: 57 mm (2.25 in).

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.

Specification: 47-68 kPa (14-20 in Hg)

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 the following conditions.
 - Tight connection to the engine
 - Collapse, deformation or contamination
 - Cracks, cuts, 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: 47-68 kPa (14-20 in Hg)

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 the following conditions:
 - Firm connection to the vacuum brake booster
 - Deformation or contamination
 - Cracks, cuts, dry-rot
19. If any of these conditions were found with the check valve grommet, replace the grommet.

BRAKE SYSTEM EXTERNAL LEAK INSPECTION

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

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. Refer to **Master Cylinder Reservoir Filling**.
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.

BRAKE SYSTEM INTERNAL LEAK TEST

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

1. Start the engine and allow it to idle.
2. Apply light, steady pressure to the brake pedal. Observe both the brake pedal feel and travel.
3. Release the brakes and turn OFF the ignition.
4. If the brake pedal apply felt spongy, but the brake pedal travel was not excessive, perform the following steps:
 1. Inspect the brake system for external leaks. Refer to **Brake System External Leak Inspection** .
 2. Pressure bleed the brake system in order to purge any air that may be trapped in the system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)** .

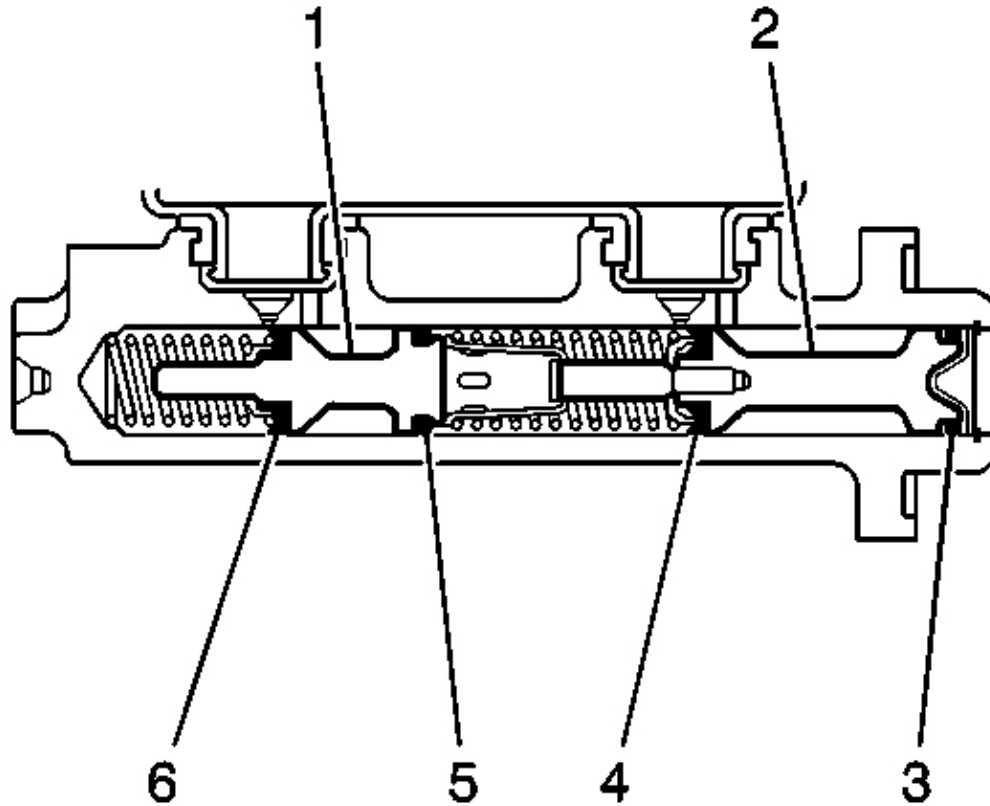


Fig. 6: Identifying Master Cylinder Components
Courtesy of GENERAL MOTORS CORP.

5. If the brake pedal apply did not feel spongy, but the brake pedal travel was excessive, perform the following steps:
 1. Loosen the master cylinder-to-brake power booster mounting nuts.
 2. Carefully pull the master cylinder away from the brake power booster just enough to inspect the mounting surface of the master cylinder.
 3. Inspect the master cylinder mounting surface at the primary piston (2) for brake fluid leaks.
6. If the master cylinder exhibits any leakage around the primary piston (2), then the primary piston primary seal (4) and/or secondary seal (3) is leaking and the master cylinder requires overhaul or replacement.
7. If the master cylinder primary piston (2) does not exhibit any leakage, pressure bleed the brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.
8. 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 (1) from the secondary piston primary seal (6) or secondary seal (5).

9. 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.

HYDRAULIC BRAKE COMPONENT OPERATION VISUAL INSPECTION

Disc Brake

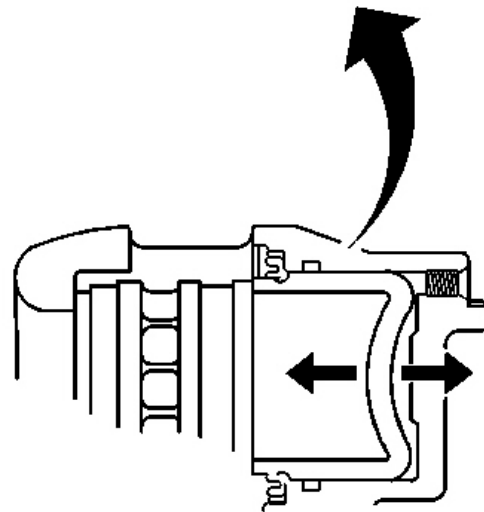
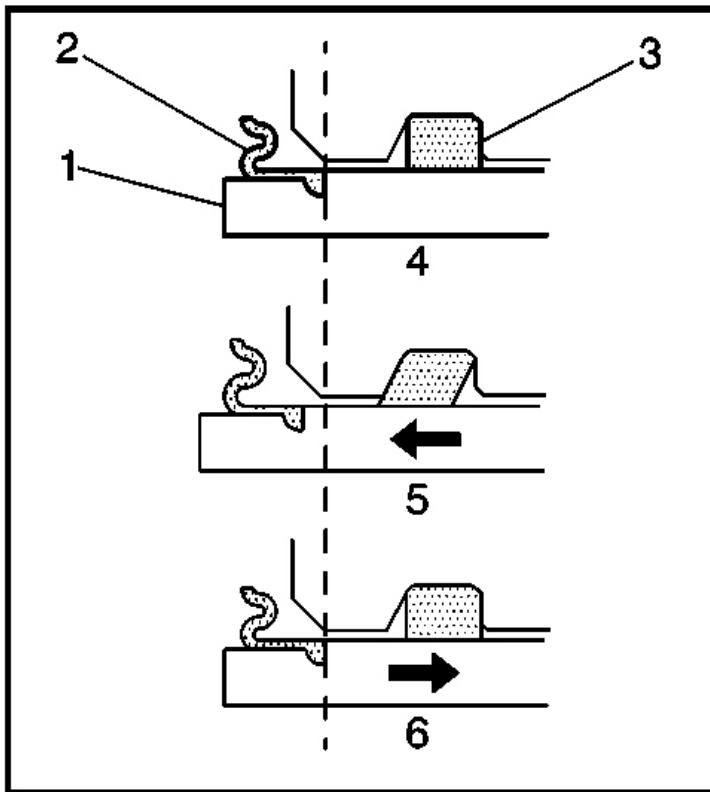


Fig. 7: Exploded View Of Caliper Piston
 Courtesy of GENERAL MOTORS CORP.

1. With the tire and wheel assemblies removed and the brake rotors retained by wheel lug nuts, visually

- inspect the caliper piston dust boot (2) 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 (4), observe the position of the caliper piston (1) in relation to the caliper housing.
 4. Have an assistant apply and release the brake pedal several times while you observe the operation of the hydraulic brake caliper.
 1. Observe the caliper piston (1) for unrestricted and even movement during each apply of the brake system (5).
 2. Observe the caliper piston (1) for an unrestricted and even return motion during each release of the brake system (6).
 5. If the caliper piston (1) did not exhibit unrestricted and even movement during brake system apply and/or release, the piston square seal (3) may be worn or damaged and the caliper may require overhaul or replacement.

Drum Brake

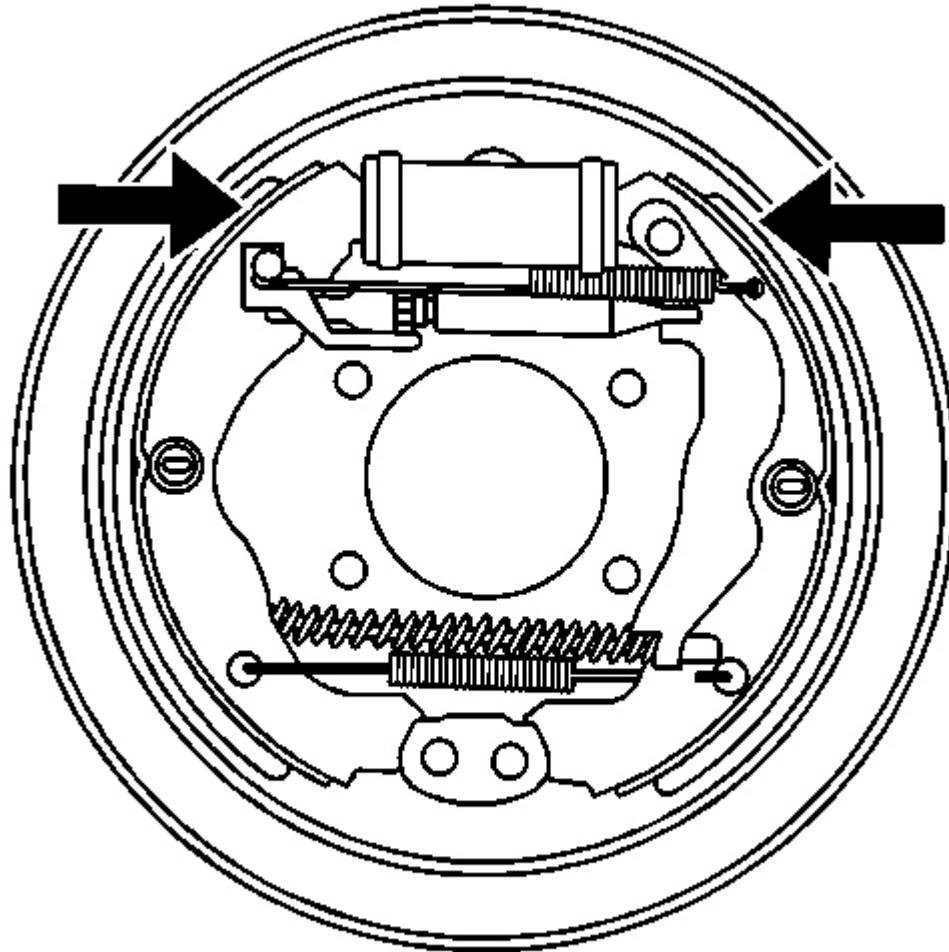


Fig. 8: View Of Brake Drums
Courtesy of GENERAL MOTORS CORP.

1. With the rear tire and wheel assemblies and the brake drums removed, visually inspect the wheel cylinder pistons boot sealing areas to ensure that there are no brake fluid leaks.
2. If any evidence of a brake fluid leak is present, the brake wheel cylinder requires replacement.
3. Using firm hand pressure, simultaneously and evenly apply force on both brake shoes in order to compress the wheel cylinder pistons into their bore.
4. Evenly release the force from both brake shoes to allow the wheel cylinder pistons to return.
5. If one or both of the wheel cylinder pistons did not exhibit unrestricted and even movement during apply and/or release of force, the wheel cylinder may require replacement.

BRAKE PIPE AND HOSE INSPECTION

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

1. Visually inspect all of the brake pipes for the following conditions:
 - Kinks, improper routing, missing or damaged retainers
 - Leaking fittings, excessive corrosion
2. If any of the brake pipes exhibited any of the conditions listed, then the identified pipe, or pipes, require replacement.
3. 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.

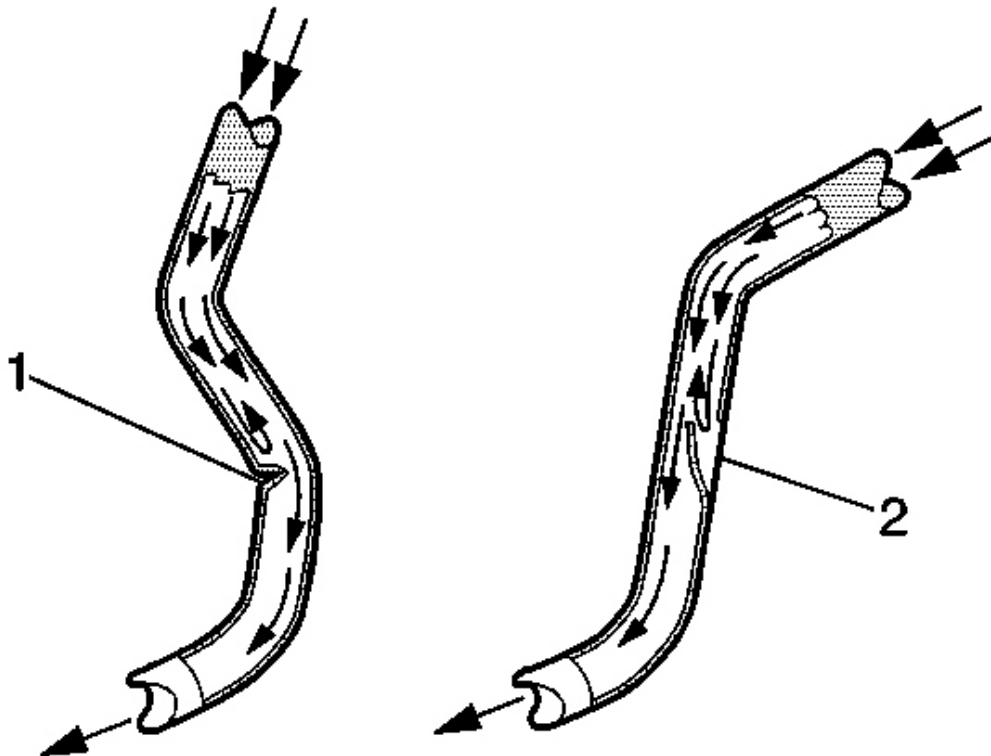


Fig. 9: Inspecting Brake Hoses
Courtesy of GENERAL MOTORS CORP.

4. Visually inspect all of the flexible brake hoses for the following conditions:
 - Kinks (1), improper routing, twists, chafing, missing or damaged retainers
 - Leaking connections, cracking, dry-rot, blisters, bulges
5. If any of the flexible brake hoses exhibited any of the conditions listed, then the identified flexible brake hose, or hoses require replacement.
6. Squeeze the flexible brake hoses with firm finger pressure to check for soft spots (2), indicating an internal restriction. Check the entire length of each flexible brake hose.
7. If any of the flexible brake hoses were found to have soft spots (2), then the identified flexible brake hose, or hoses require replacement.

BRAKE PEDAL PUSHROD INSPECTION

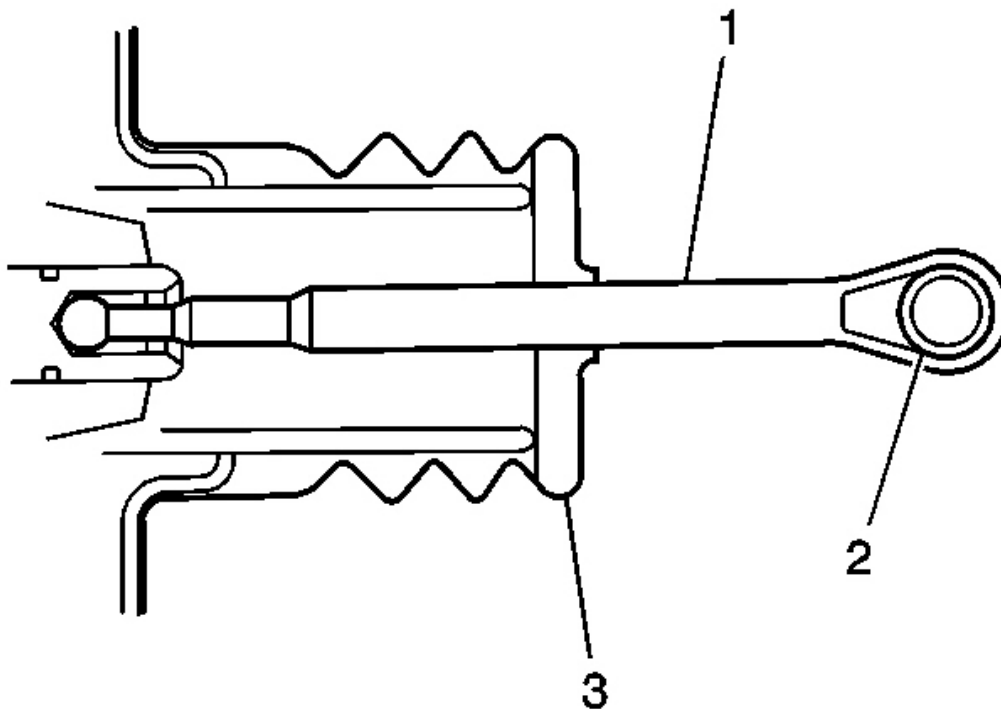


Fig. 10: Inspecting Brake Pedal Pushrod
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the brake pedal pushrod (1) from the brake pedal.

2. Inspect the brake pedal pushrod eyelet bushing (2), if equipped, for cracks and/or excessive wear.
3. Reposition the pedal pushrod boot (3) toward the front of the vehicle to expose as much of the pedal pushrod (1) as possible.
4. Inspect the brake pedal pushrod (1) for straightness.
5. If the brake pedal pushrod eyelet bushing (2) exhibited cracks and/or excessive wear, then the bushing requires replacement.
6. If the brake pedal pushrod (1) is not straight, then the pushrod requires replacement.
7. Return the pedal pushrod boot (3) to its original position on the pedal pushrod (1).
8. Connect the brake pedal pushrod (1) to the brake pedal.

REPAIR INSTRUCTIONS

MASTER CYLINDER RESERVOIR FILLING

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: When adding fluid to the brake master cylinder reservoir, use only GM approved 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.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

1. Visually inspect the brake fluid level through the brake master cylinder auxiliary reservoir.
2. If the brake fluid level is at or below the half-full point during routine fluid checks, the brake system should be inspected for wear and possible brake fluid leaks.
3. If the brake fluid level is at or below the half-full point during routine fluid checks, and an inspection of the brake system did not reveal wear or brake fluid leaks, the brake fluid may be topped-off up to the maximum-fill level.
4. If brake system service was just completed, the brake fluid may be topped-off up to the maximum-fill level.
5. If the brake fluid level is above the half-full point, adding brake fluid is not recommended under normal conditions.
6. If brake fluid is to be added to the master cylinder auxiliary reservoir, clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm.

MASTER CYLINDER RESERVOIR REPLACEMENT

Removal Procedure

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: When adding fluid to the brake master cylinder reservoir, use only GM approved 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.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

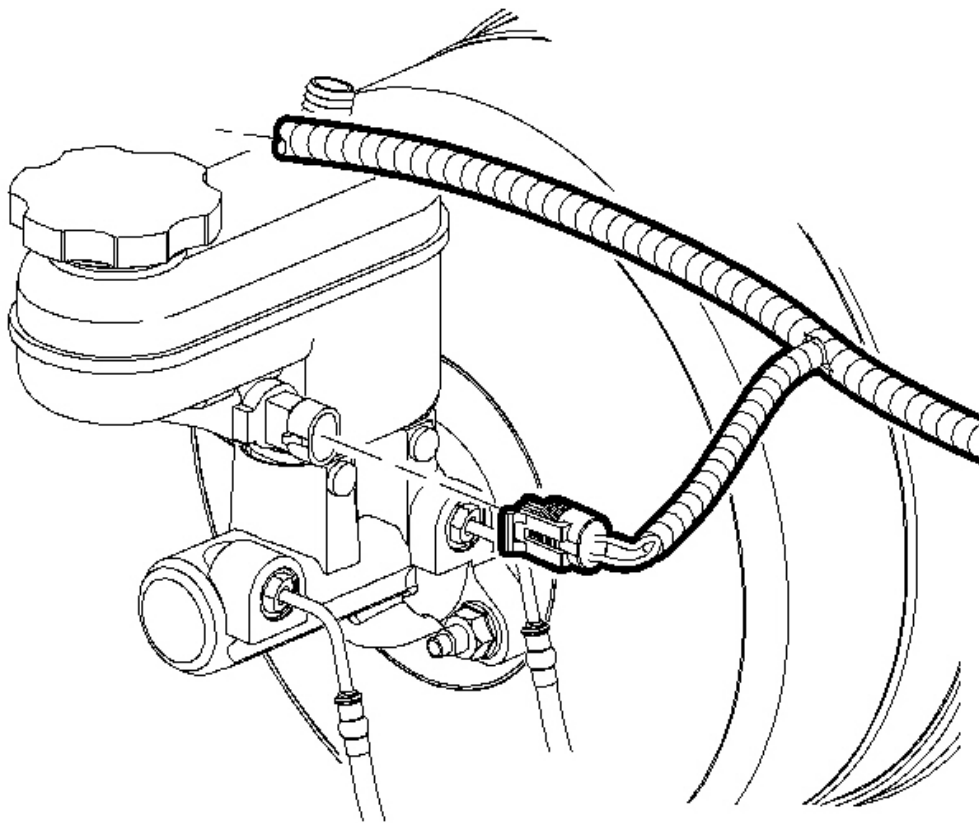


Fig. 11: Disconnecting/Connecting Brake Fluid Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Remove the brake fluid from the reservoir. Discard the fluid into an approved container.
2. Disconnect the brake fluid level sensor electrical connector.

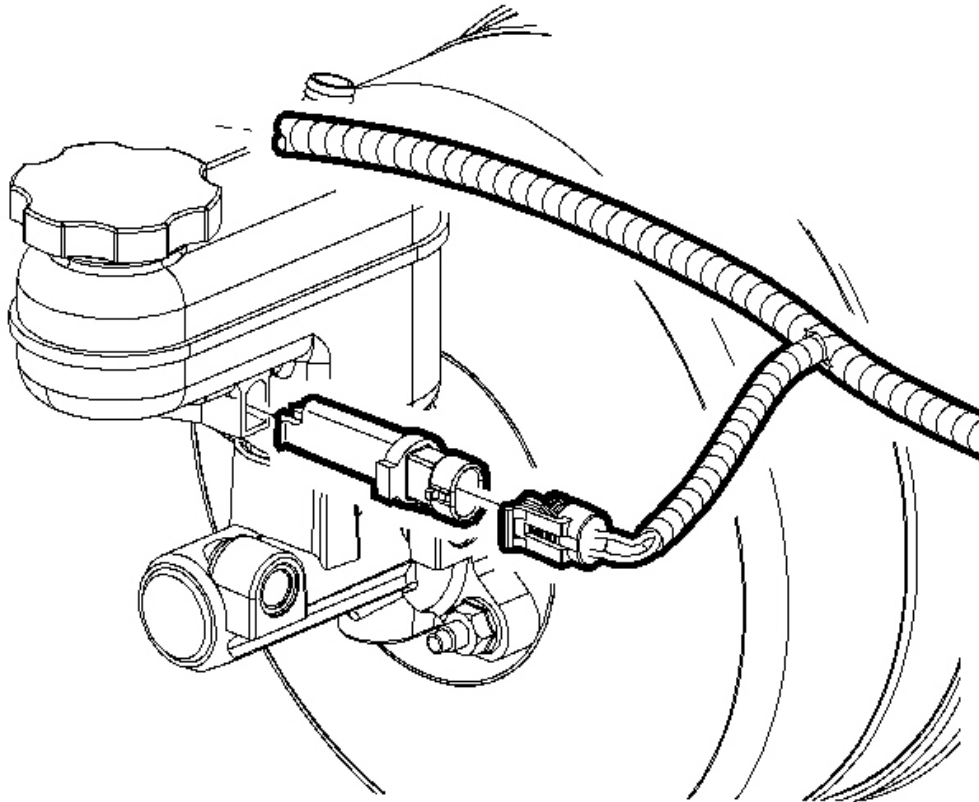


Fig. 12: Removing/Installing Brake Fluid Level Sensor
Courtesy of GENERAL MOTORS CORP.

3. Remove the brake fluid level sensor. Refer to **Master Cylinder Fluid Level Sensor Replacement** .

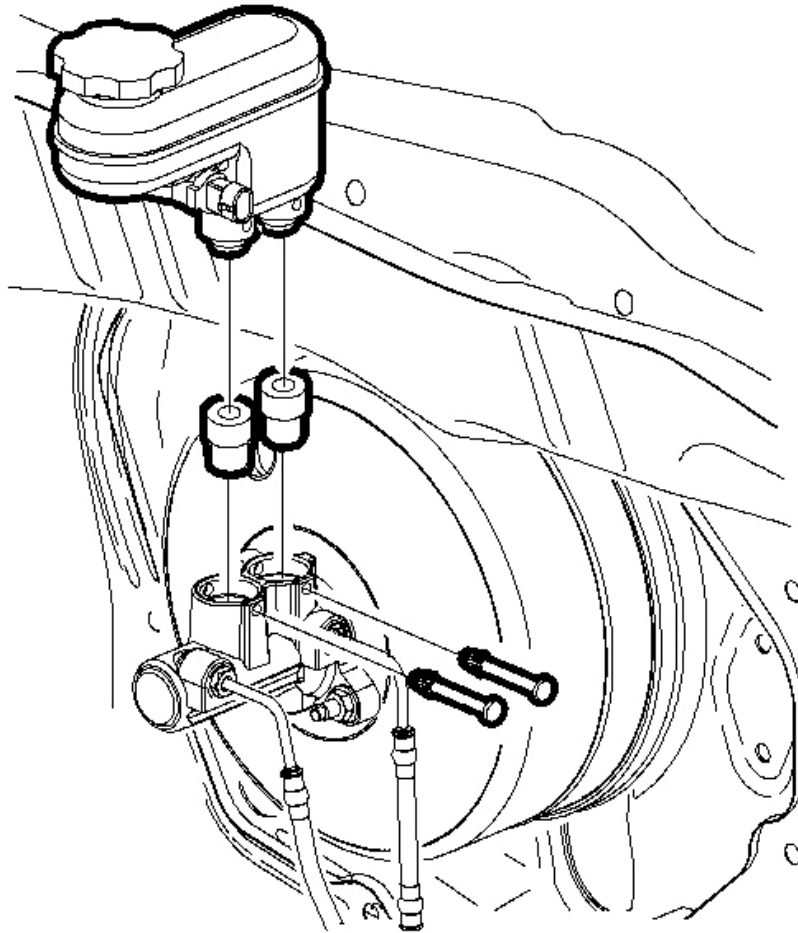


Fig. 13: Removing/Installing Master Cylinder Reservoir
Courtesy of GENERAL MOTORS CORP.

4. Remove the master cylinder reservoir attachment pins and discard the pins.
5. Release the reservoir from the master cylinder by carefully pulling reservoir straight up.
6. Remove the reservoir seals from the master cylinder body.

Installation Procedure

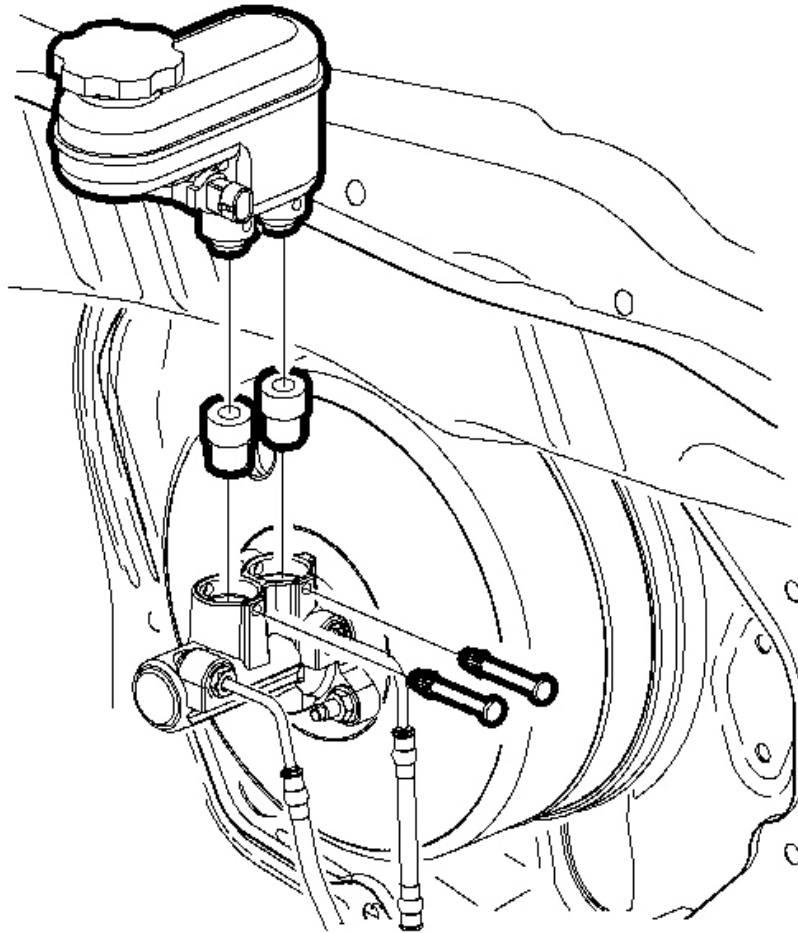


Fig. 14: Removing/Installing Master Cylinder Reservoir
Courtesy of GENERAL MOTORS CORP.

1. Install the reservoir seals to the master cylinder body.
2. Install the reservoir to the master cylinder body by pushing the reservoir bayonets straight down into the seals in the master cylinder body.
3. Install NEW reservoir attachment pins. Ensure that the attachment pins are fully and firmly seated.

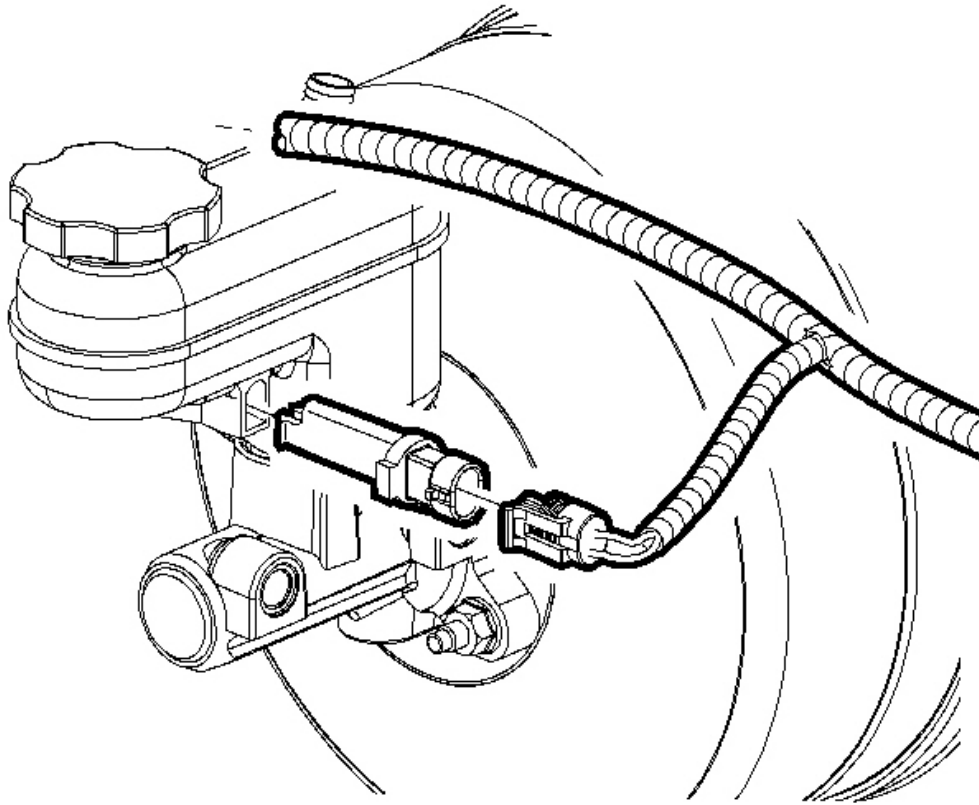


Fig. 15: Removing/Installing Brake Fluid Level Sensor
Courtesy of GENERAL MOTORS CORP.

4. Install the brake fluid level sensor. Refer to **Master Cylinder Fluid Level Sensor Replacement** .

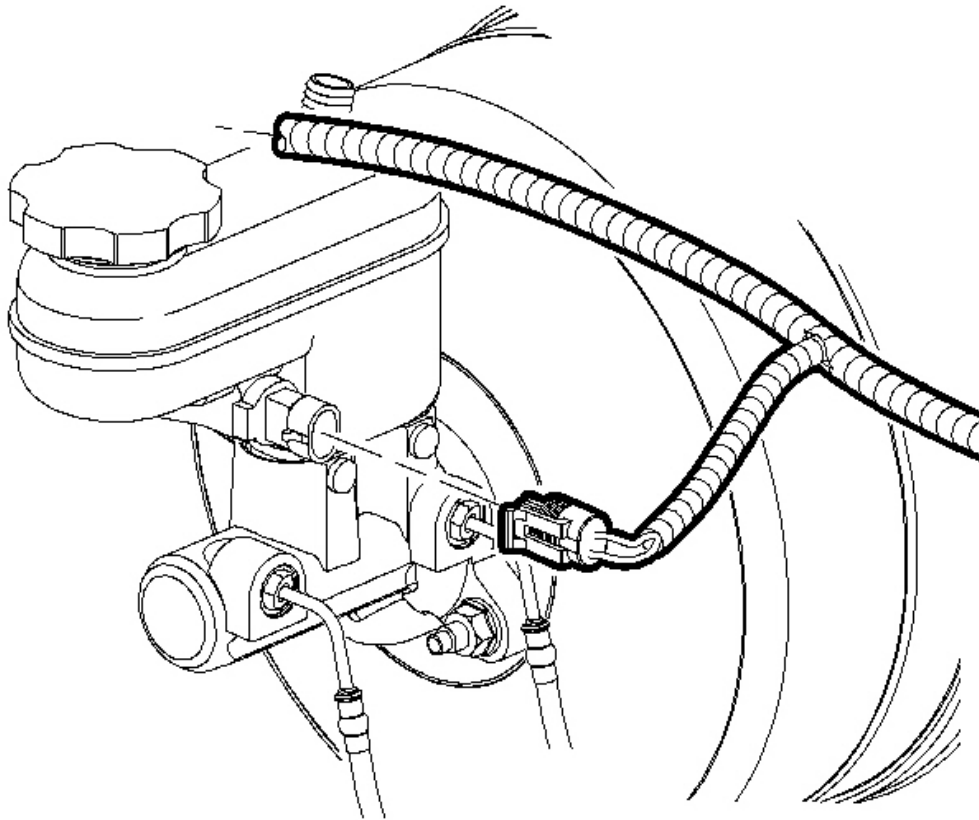


Fig. 16: Disconnecting/Connecting Brake Fluid Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

5. Connect the low brake fluid level sensor electrical connector.
6. Fill the master cylinder reservoir. Refer to **Master Cylinder Reservoir Filling** .
7. Bleed the brake system. Refer to **Hydraulic Brake System Bleeding (Manual)Hydraulic Brake System Bleeding (Pressure)** .

MASTER CYLINDER REPLACEMENT

Removal Procedure

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

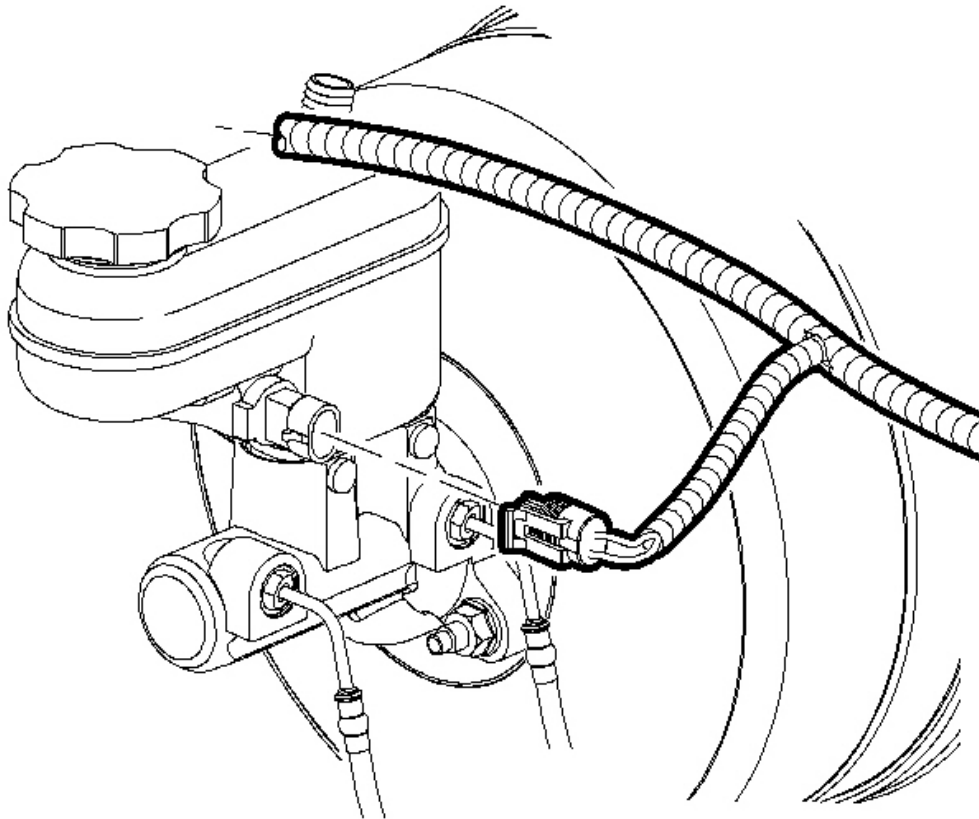


Fig. 17: Disconnecting/Connecting Brake Fluid Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the electrical connector from the brake fluid level sensor.

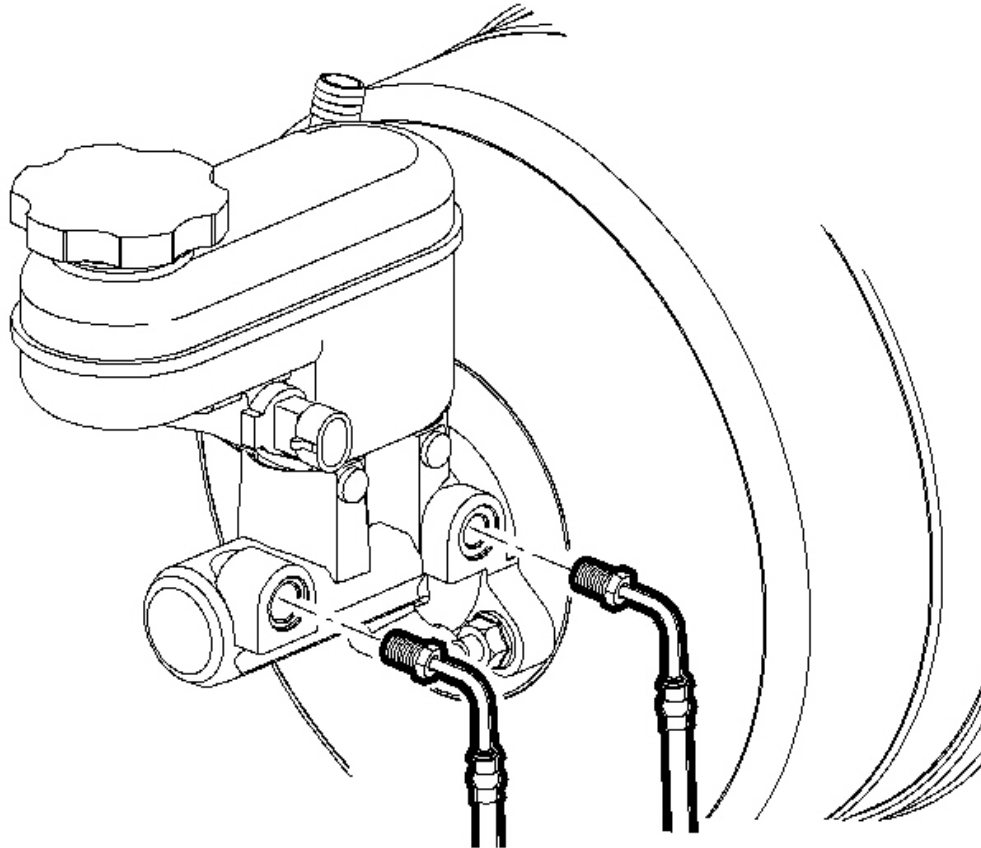


Fig. 18: Disconnecting/Connecting Brake Pipes From Master Cylinder
Courtesy of GENERAL MOTORS CORP.

2. Disconnect the brake pipes from the master cylinder.

IMPORTANT: Install a rubber cap or plug to the exposed brake pipe fitting ends in order to prevent brake fluid loss and contamination.

3. Plug the open brake pipe ends.

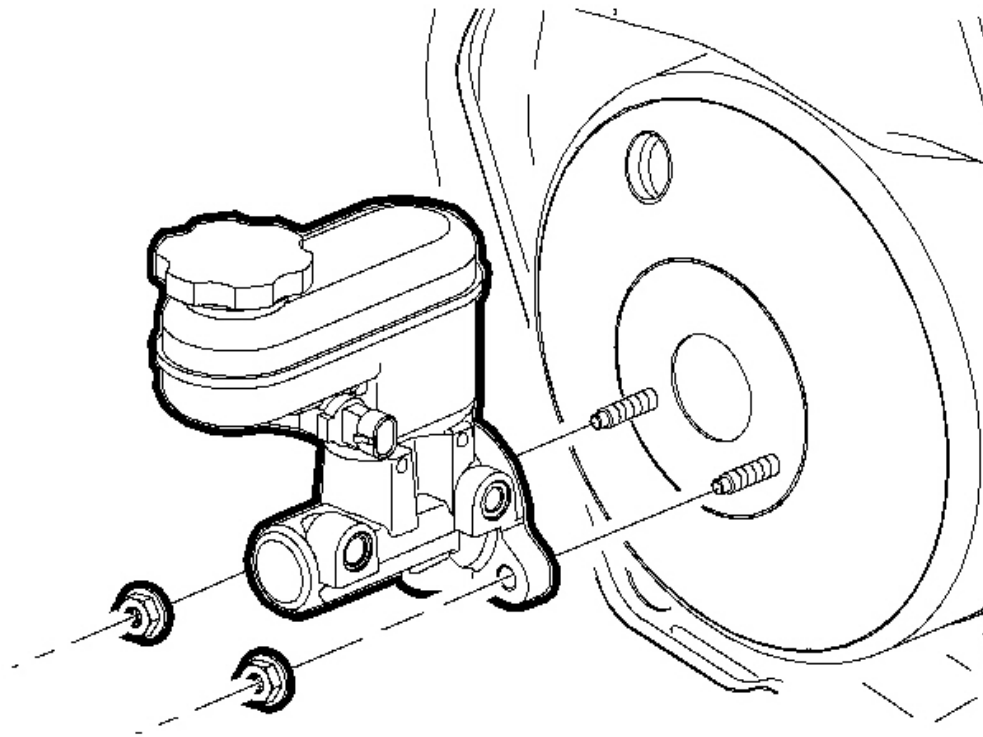


Fig. 19: Removing/Installing Master Cylinder
Courtesy of GENERAL MOTORS CORP.

4. Remove master cylinder mounting nuts.
5. Remove the master cylinder from the vehicle.
6. Drain the master cylinder reservoir of all brake fluid.

Installation Procedure

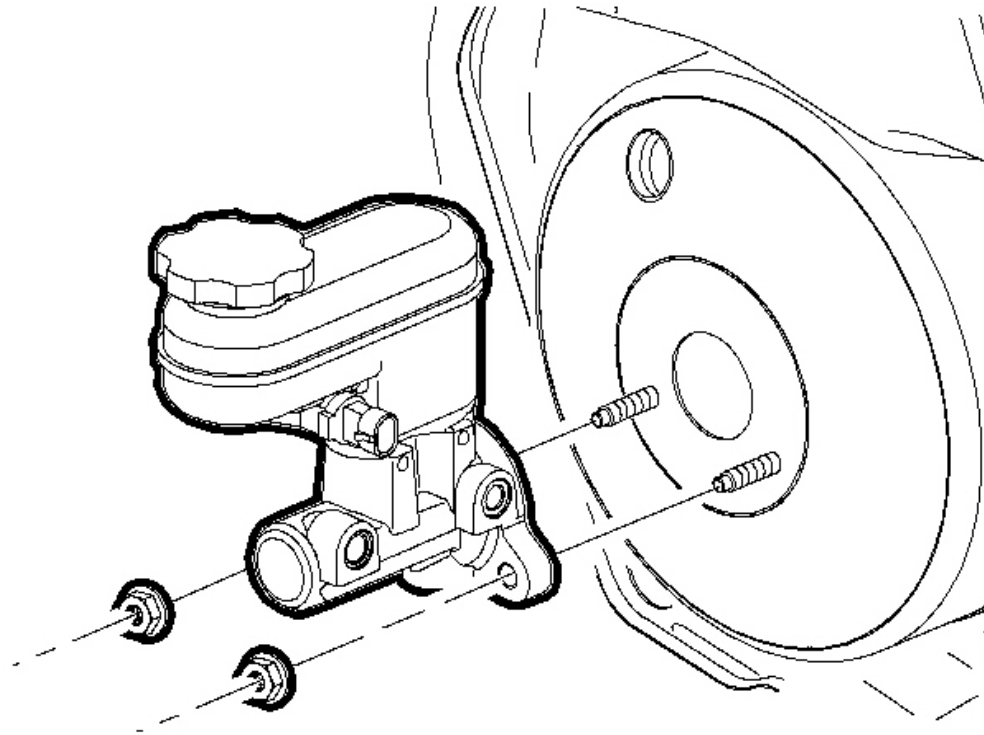


Fig. 20: Removing/Installing Master Cylinder
Courtesy of GENERAL MOTORS CORP.

1. Bench bleed the master cylinder. Refer to **Master Cylinder Bench Bleeding** .
2. Install the master cylinder to the brake booster.

NOTE: Refer to **Fastener Notice** in **Cautions and Notices**.

3. Install the master cylinder mounting nuts.

Tighten: Tighten the master cylinder mounting nuts to 25 N.m (18 lb ft).

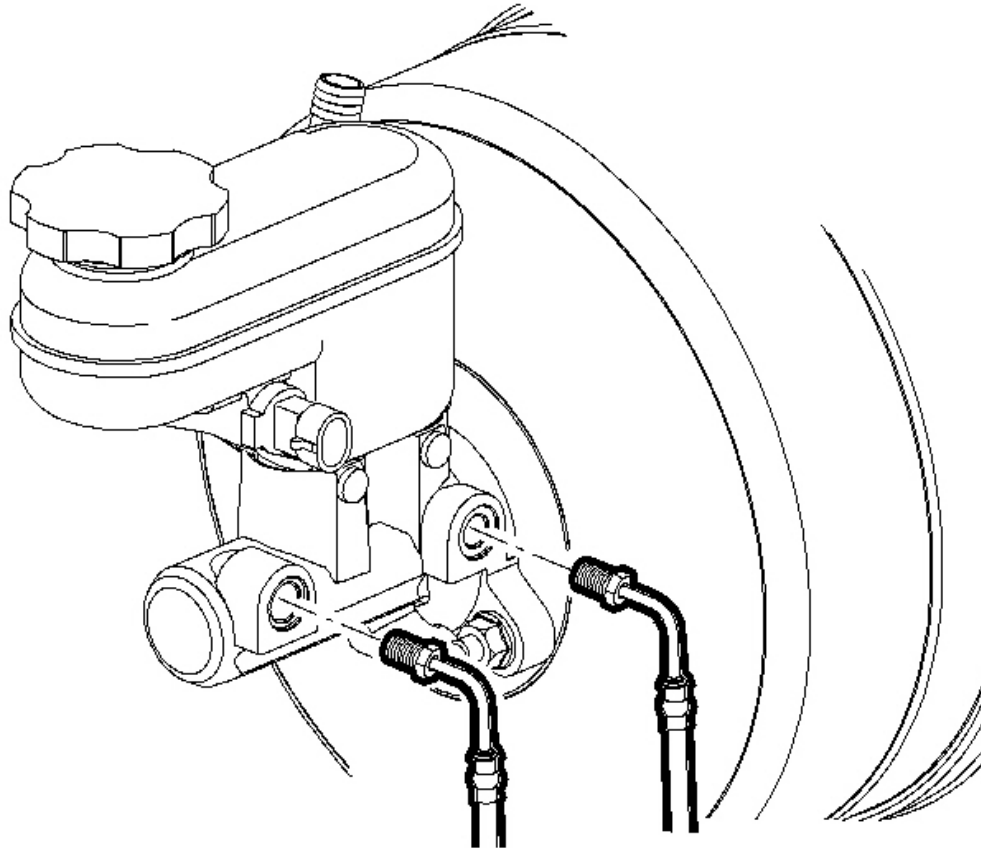


Fig. 21: Disconnecting/Connecting Brake Pipes From Master Cylinder
Courtesy of GENERAL MOTORS CORP.

4. Remove the plugs from the brake pipes.
5. Connect the brake pipes to the master cylinder.

Tighten: Tighten the brake pipe fittings at the master cylinder to 18 N.m (13 lb ft).

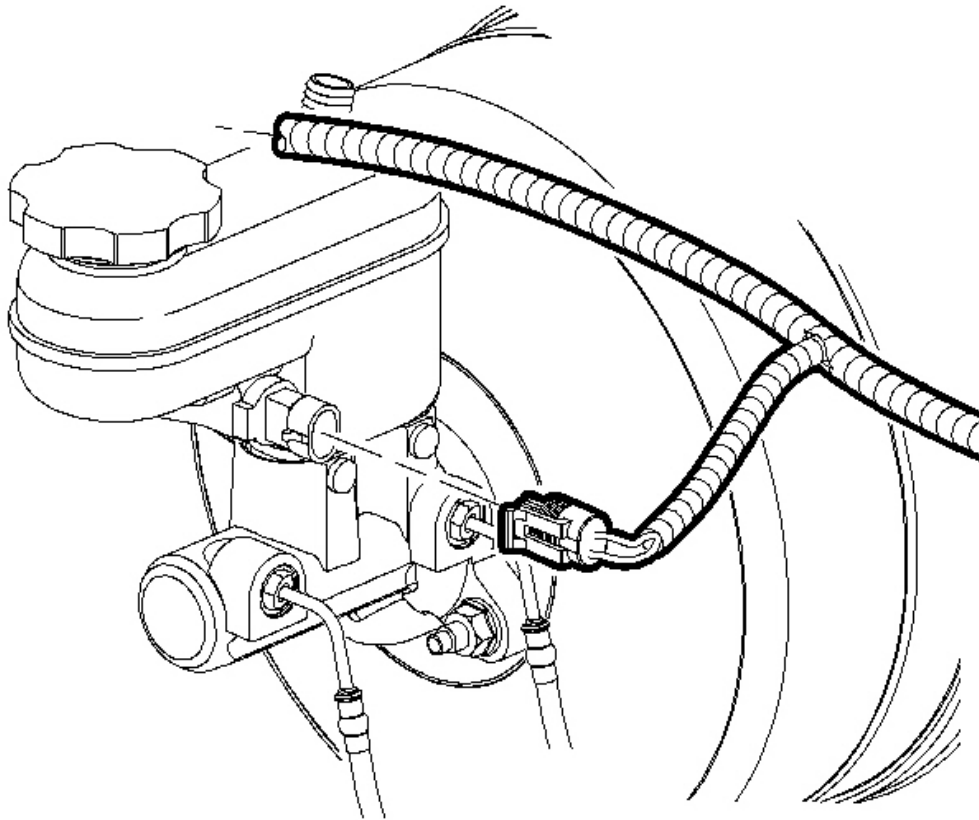


Fig. 22: Disconnecting/Connecting Brake Fluid Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

6. Connect the electrical connector to the brake fluid level sensor.
7. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)****Hydraulic Brake System Bleeding (Pressure)** .

MASTER CYLINDER BENCH BLEEDING

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: When adding fluid to the brake master cylinder reservoir, use only GM approved 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.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

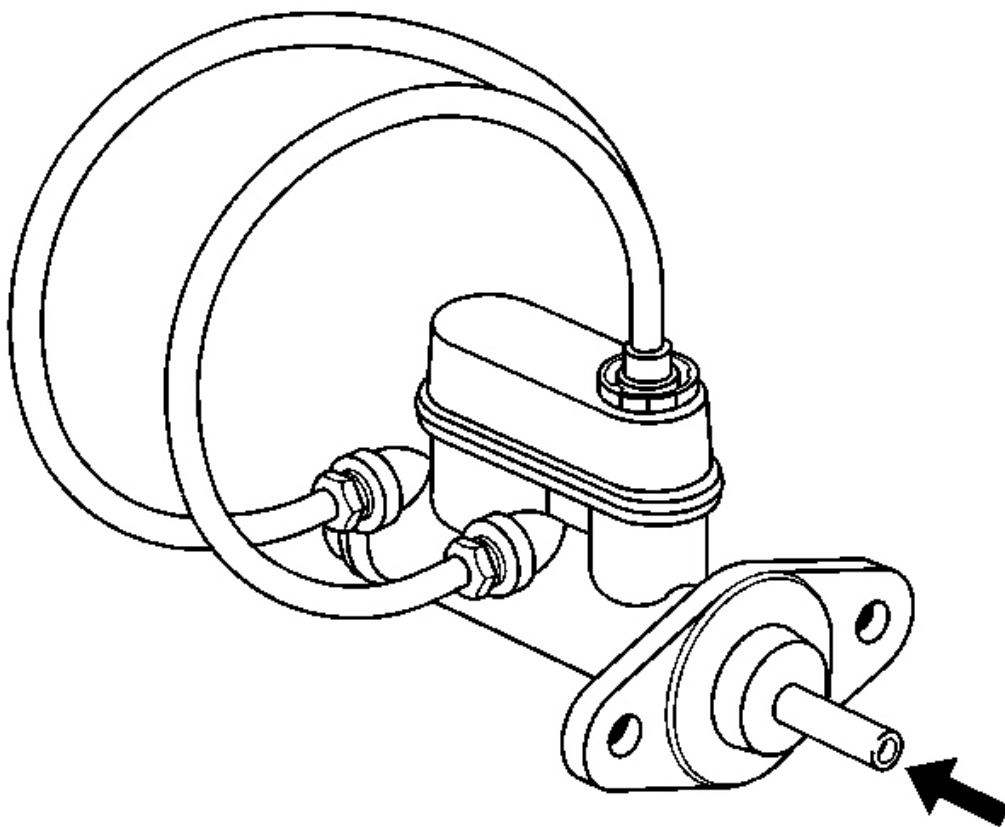


Fig. 23: Bleeding Master Cylinder
Courtesy of GENERAL MOTORS CORP.

1. Secure the mounting flange of the brake master cylinder in a bench vise so that the rear of the primary piston is accessible.
2. Remove the cap from the hose nipple on the master cylinder reservoir.
3. Install suitable fittings to the master cylinder ports that match the type of flare seat required and also

provide for hose attachment.

4. Install transparent hoses to the fittings, then route the hoses into the master cylinder reservoir.
5. Ensure that the ends of the transparent hoses running into the reservoir are fully submerged in the brake fluid.
6. Using a smooth, round-ended tool, depress and release the primary piston as far as it will travel, a depth of about 25 mm (1 in), several times. Observe the flow of fluid coming from the ports.

As air is bled from the primary and secondary pistons, the effort required to depress the primary piston will increase and the amount of travel will decrease.

7. Continue to depress and release the primary piston until fluid flows freely from the ports with no evidence of air bubbles.
8. Remove the transparent hoses from the reservoir.
9. Install the cap to the hose nipple on the reservoir, to prevent fluid loss and contamination.
10. Remove the fittings with the transparent hoses from the master cylinder ports. Wrap the master cylinder with a clean shop cloth to prevent brake fluid spills.
11. Remove the master cylinder from the vise.

MASTER CYLINDER FLUID LEVEL SENSOR REPLACEMENT

Removal Procedure

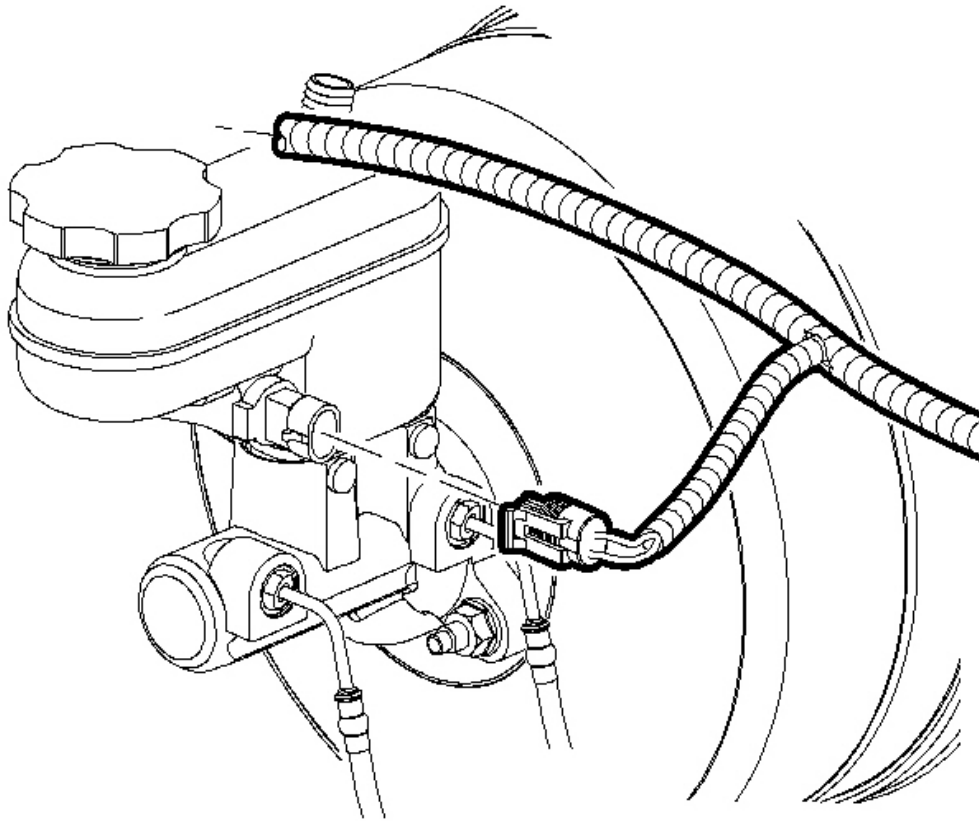


Fig. 24: Disconnecting/Connecting Brake Fluid Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the brake fluid level sensor electrical connector.

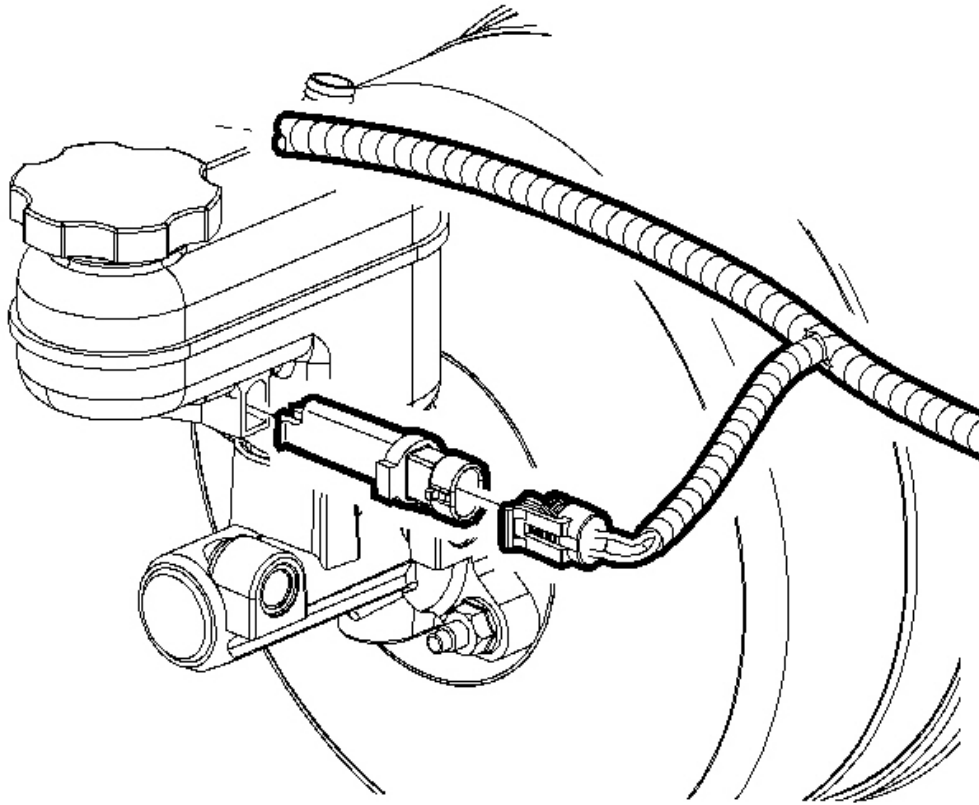


Fig. 25: Removing/Installing Brake Fluid Level Sensor
Courtesy of GENERAL MOTORS CORP.

2. While simultaneously depressing the retaining tabs on the opposite side of the sensor electrical connection, carefully pull the sensor from the master cylinder reservoir.
3. Remove the low brake fluid level sensor.

Installation Procedure

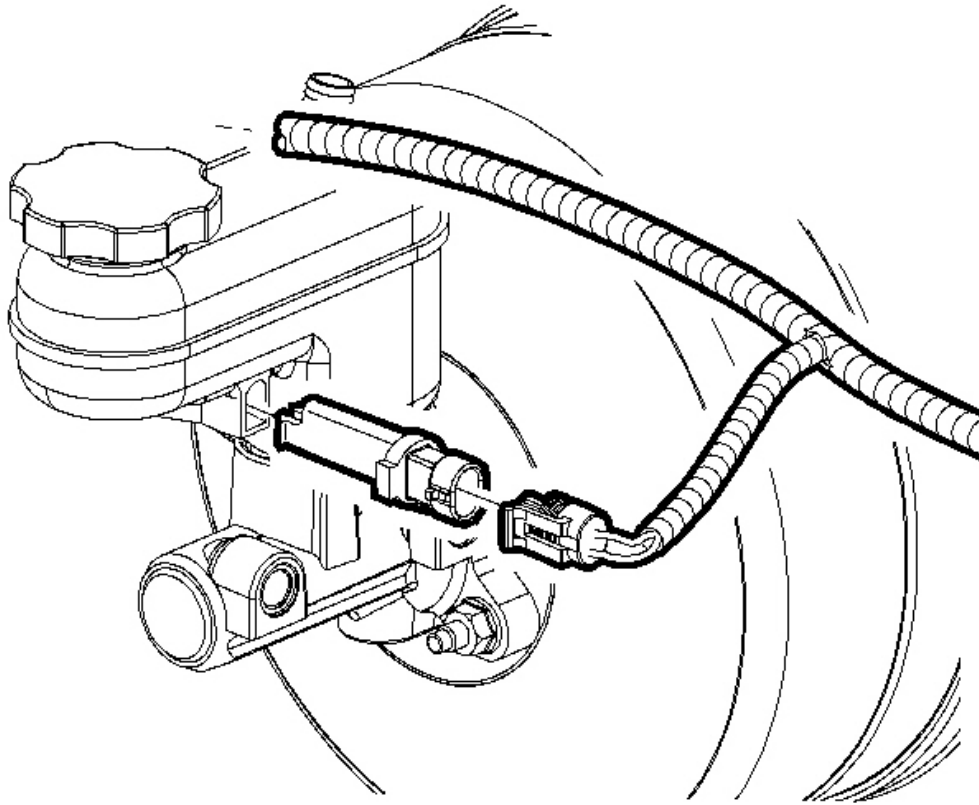


Fig. 26: Removing/Installing Brake Fluid Level Sensor
Courtesy of GENERAL MOTORS CORP.

1. While noting the proper orientation, install the brake fluid level sensor to the master cylinder.
2. Press the brake fluid level sensor firmly into the master cylinder reservoir, ensuring that the retaining tabs are fully engaged.

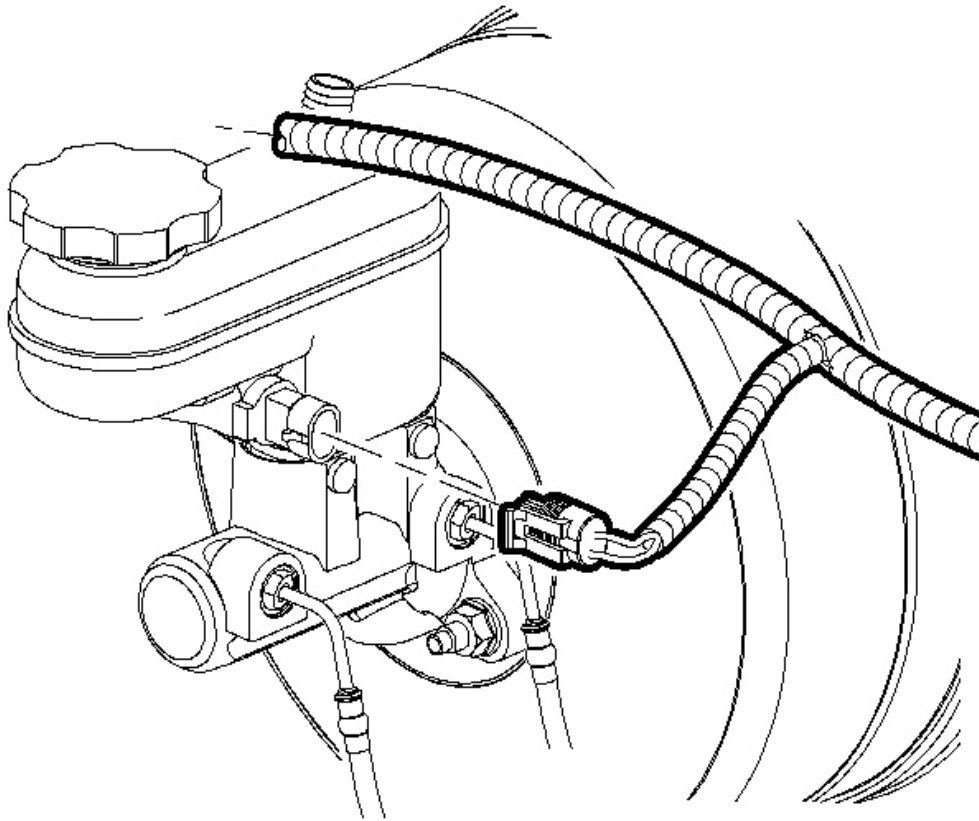


Fig. 27: Disconnecting/Connecting Brake Fluid Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. Connect the brake fluid level sensor electrical connector.

BRAKE PEDAL ASSEMBLY REPLACEMENT

Removal Procedure

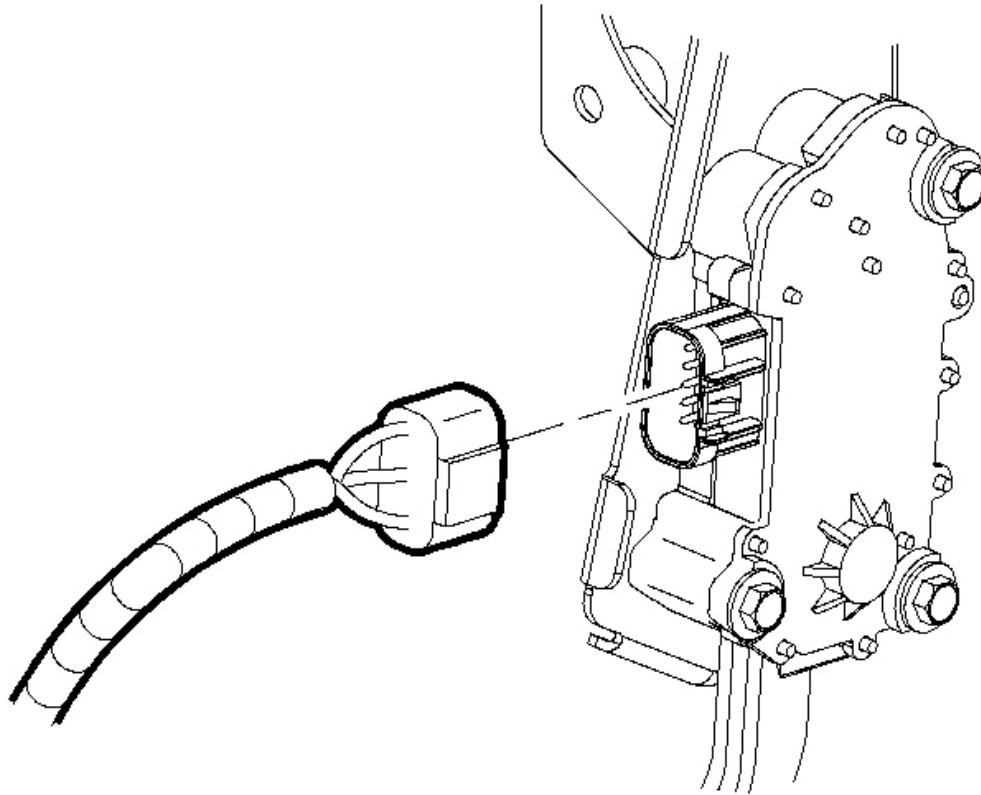


Fig. 28: Disconnecting/Connecting Accelerator Pedal Assembly Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the accelerator pedal assembly electrical connector.

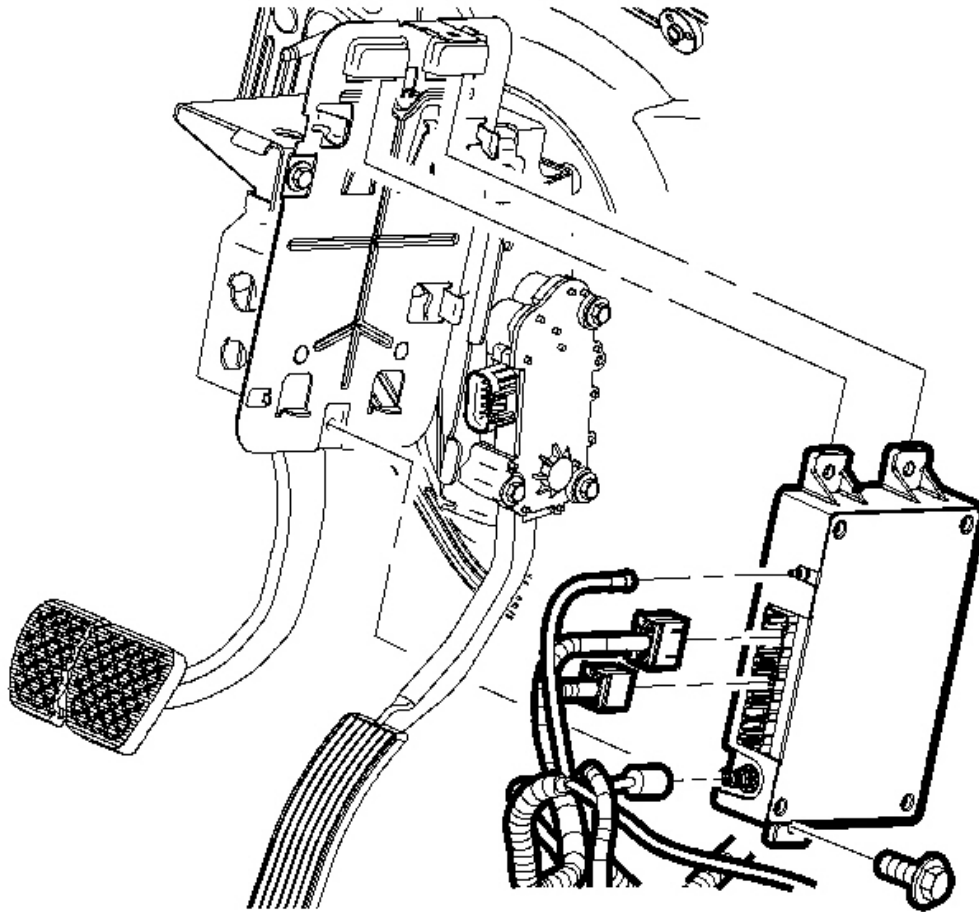


Fig. 29: Removing Mounting Bolts & Reposition OnStar Module
Courtesy of GENERAL MOTORS CORP.

2. Remove the mounting bolts and reposition the OnStar(R) module aside, if equipped. Refer to **Communication Interface Module Replacement** in Cellular Communication.

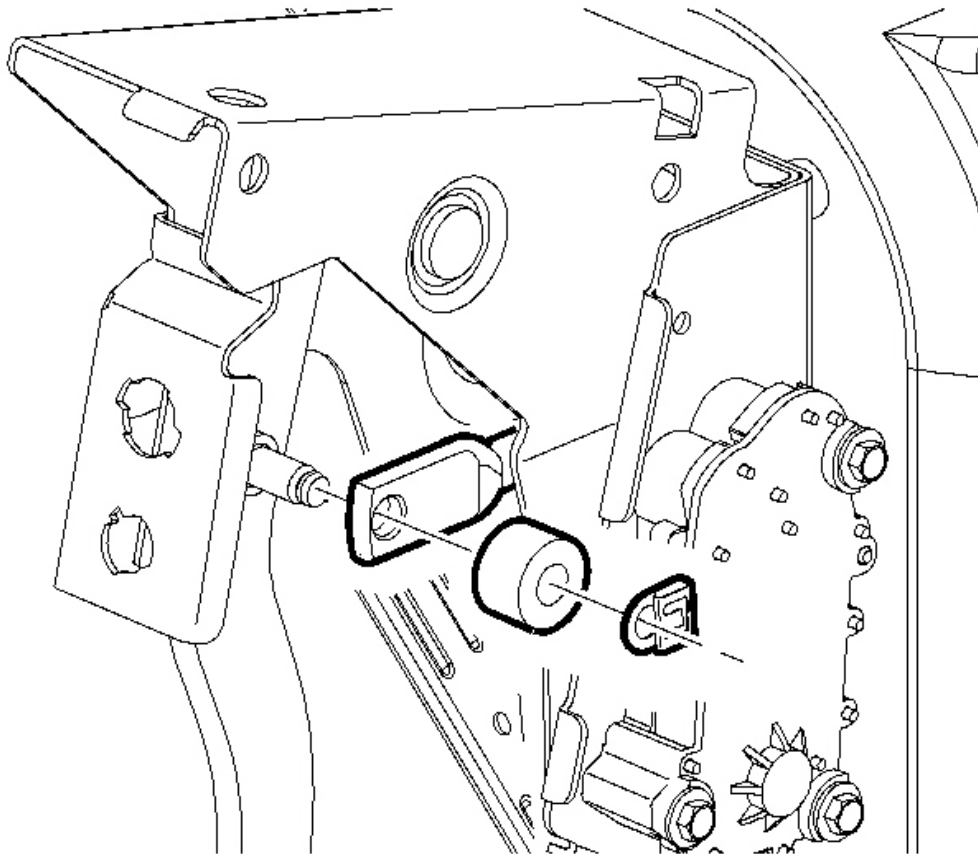


Fig. 30: Removing/Installing Washer & Retaining Clip To Brake Pedal
Courtesy of GENERAL MOTORS CORP.

3. Remove the retaining clip and washer from the brake pedal.
4. Release the brake booster pushrod from the brake pedal.

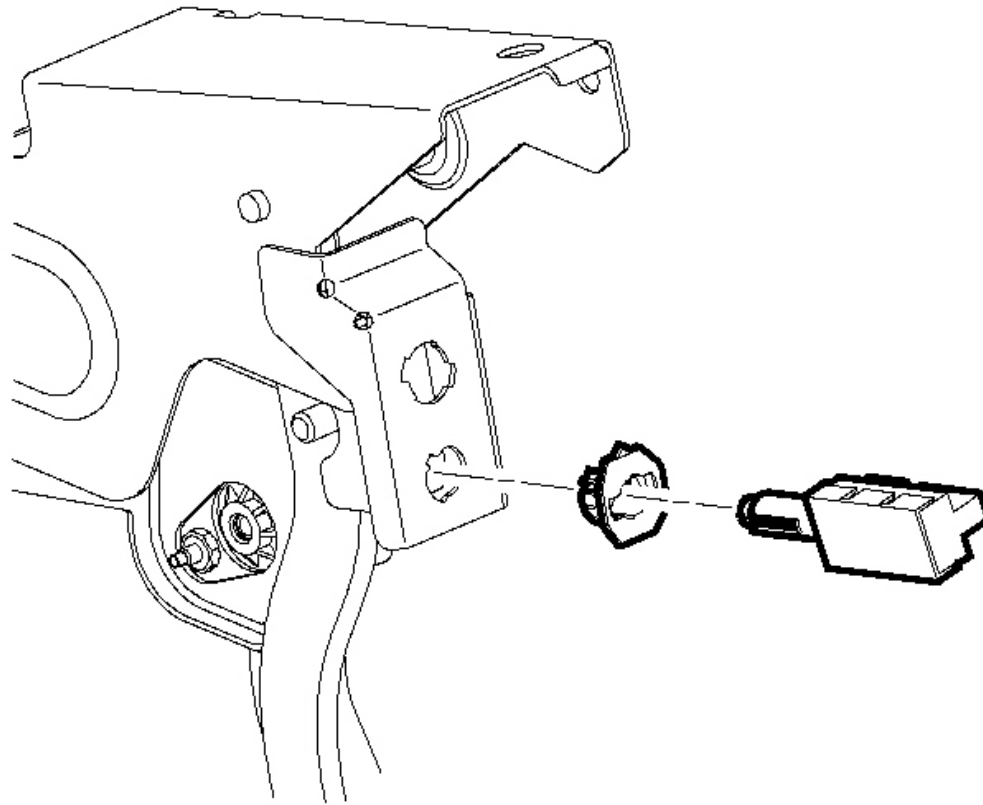


Fig. 31: Removing/Installing Stop Lamp Switch
Courtesy of GENERAL MOTORS CORP.

5. Remove the stop lamp switch from the pedal bracket. Refer to **Stop Lamp Switch Replacement** in Lighting Systems.

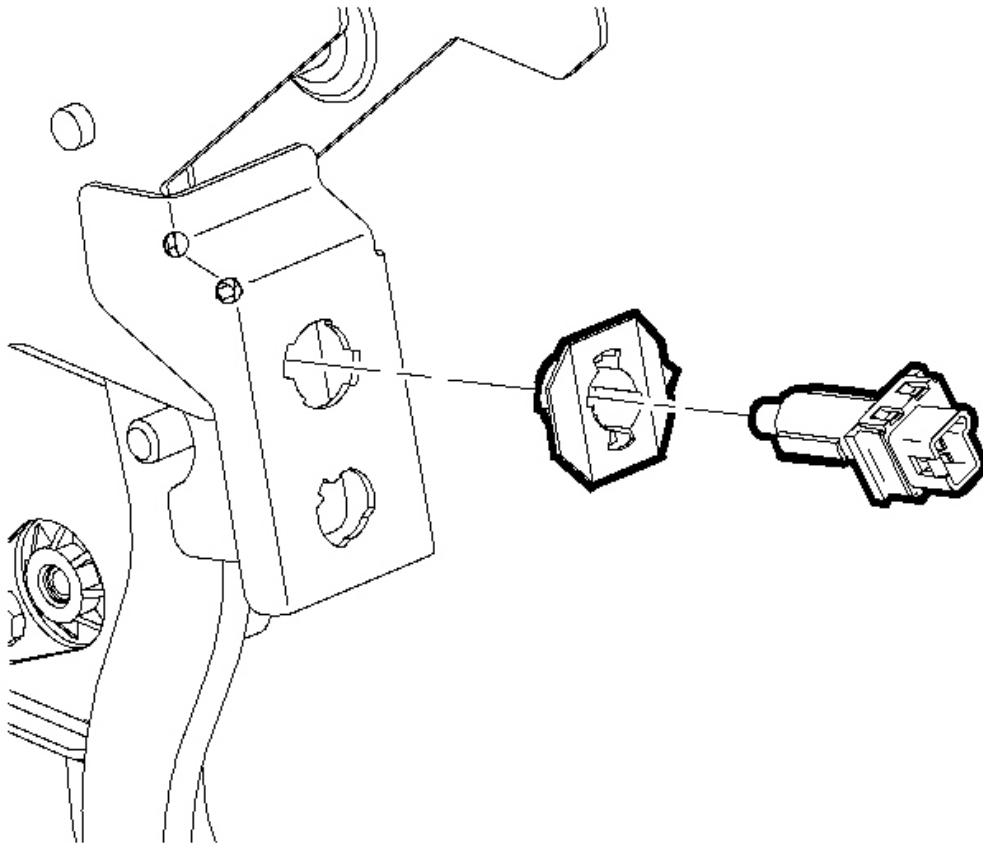


Fig. 32: Removing/Installing Cruise Control Release Switch
Courtesy of GENERAL MOTORS CORP.

6. Remove the cruise control release switch, if equipped, from the pedal bracket. Refer to **Cruise Release Switch Replacement** in Cruise Control.

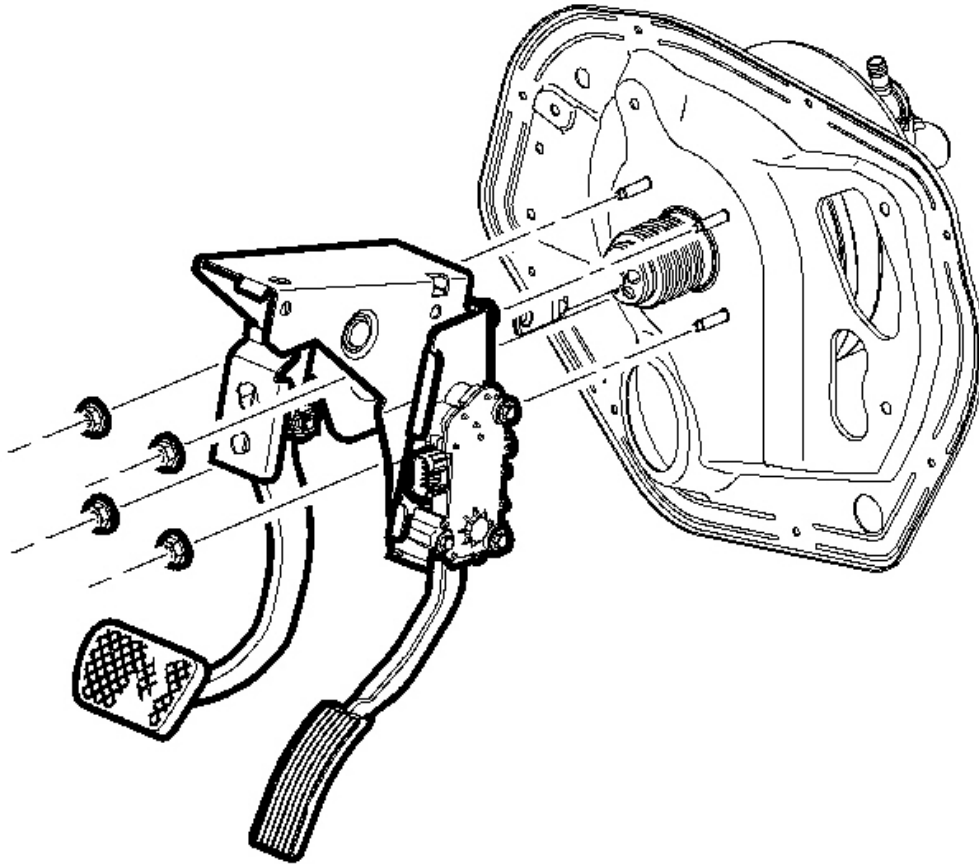


Fig. 33: Removing/Installing Brake Pedal Assembly
Courtesy of GENERAL MOTORS CORP.

7. Remove the brake booster mounting nuts.

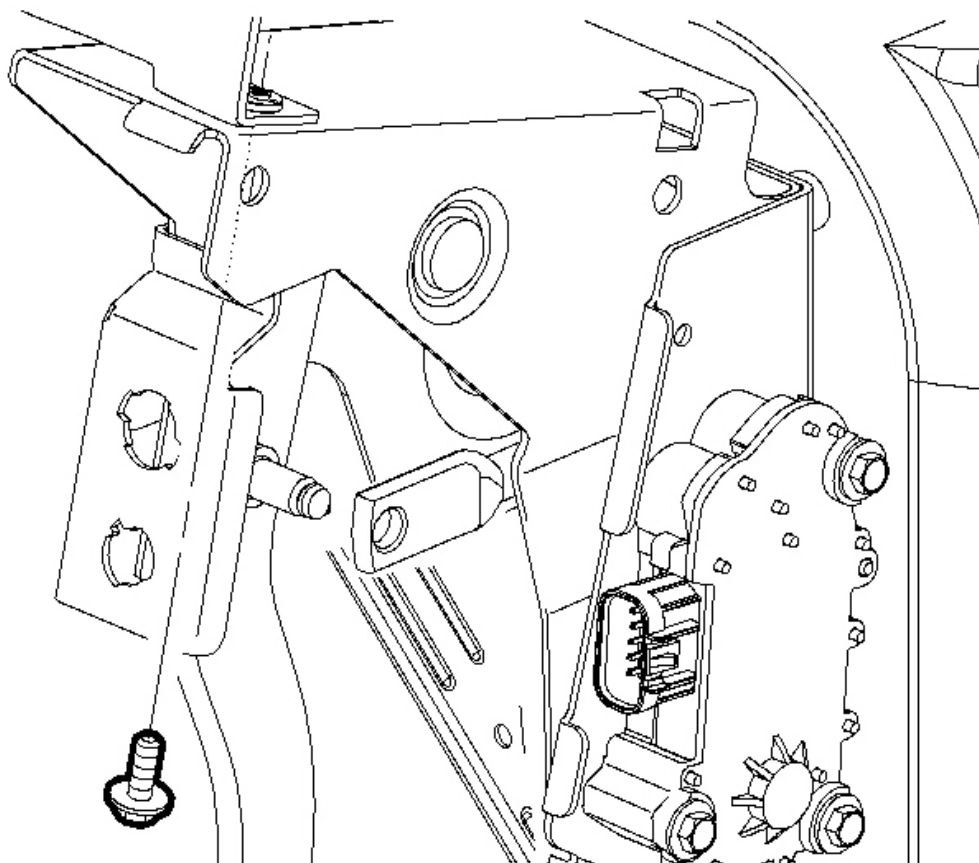


Fig. 34: Removing/Installing Brake Pedal Bracket
Courtesy of GENERAL MOTORS CORP.

8. Remove the brake pedal bracket-to-steering column bracket bolt.

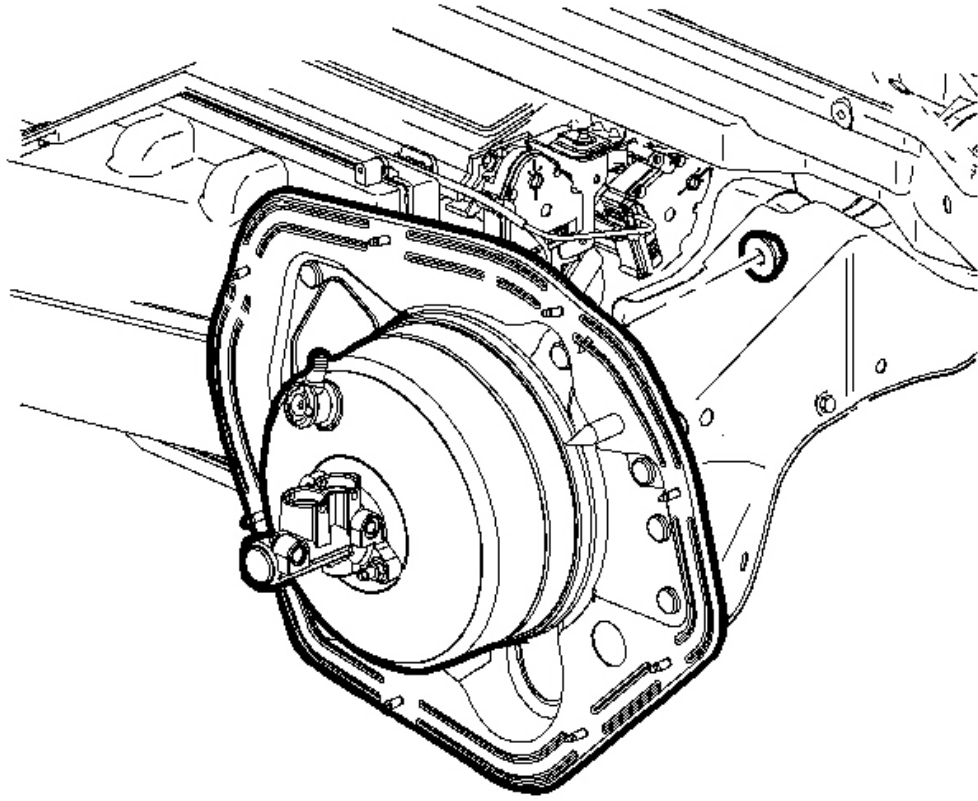


Fig. 35: Installing Steering Column Bracket
Courtesy of GENERAL MOTORS CORP.

9. Loosen, but do not remove, the steering column bracket to cowl nut.
10. While simultaneously disengaging the brake pedal bracket pilot bushings from the foam insulation panel, pull the brake pedal assembly back and toward the center of the vehicle.
11. Remove the brake pedal assembly from the vehicle.

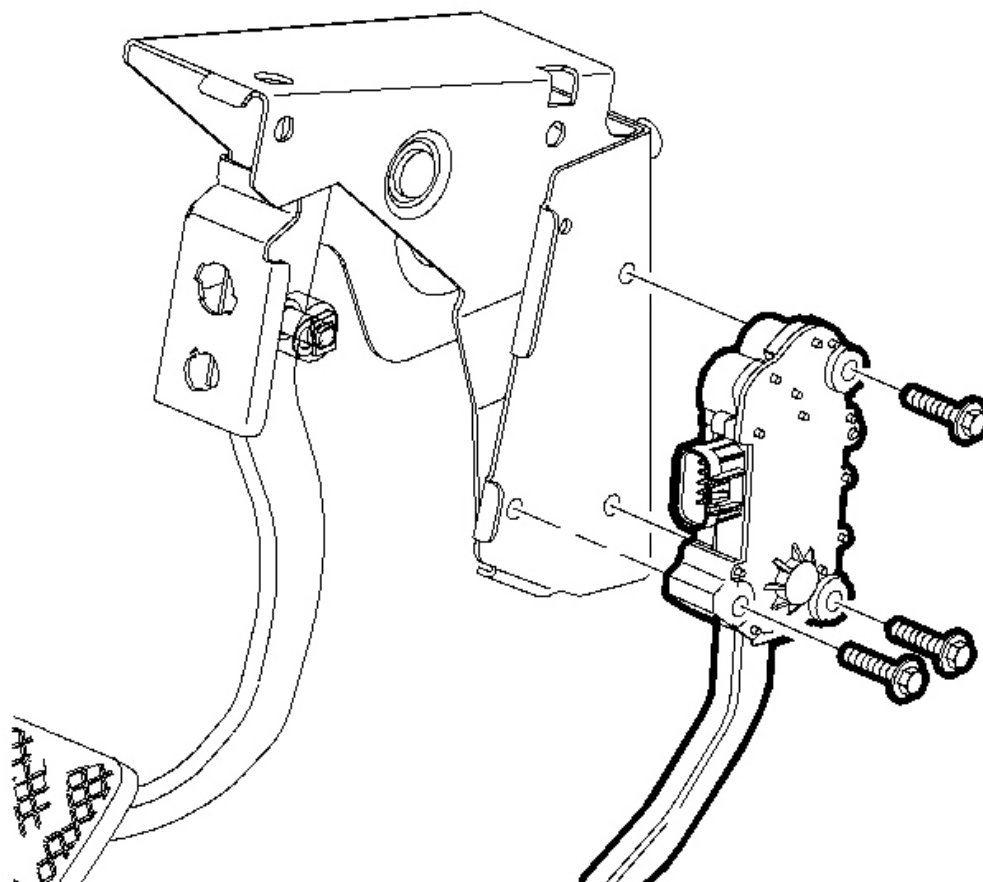


Fig. 36: Removing/Installing Accelerator Pedal Assembly
Courtesy of GENERAL MOTORS CORP.

12. Remove the accelerator pedal assembly from the brake pedal bracket. Refer to **Accelerator Pedal Position Assembly Replacement** in Engine Controls - 2.2L (L61) or **Accelerator Pedal Position (APP) Sensor Replacement** in Engine Controls - 3.5L (L66).

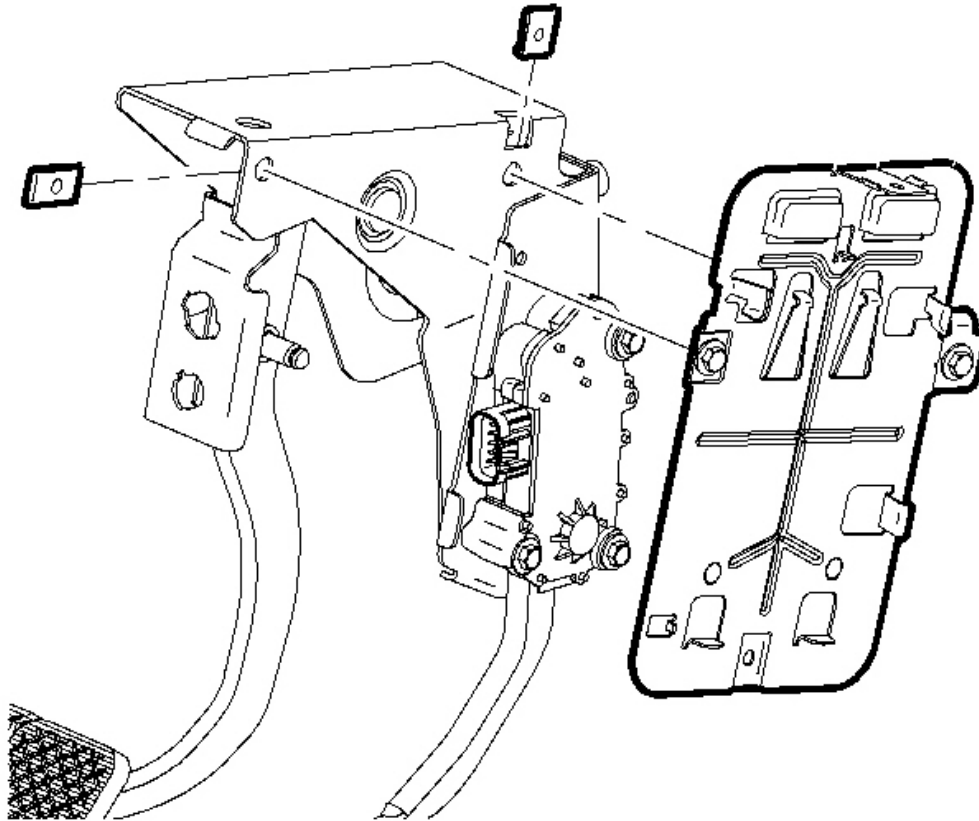


Fig. 37: Removing/Installing OnStar J-Nuts & Mounting Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

13. Remove the OnStar(R) mounting bracket bolts and J-nuts from the brake pedal assembly, if equipped.

Installation Procedure

NOTE: Refer to Fastener Notice in Cautions and Notices.

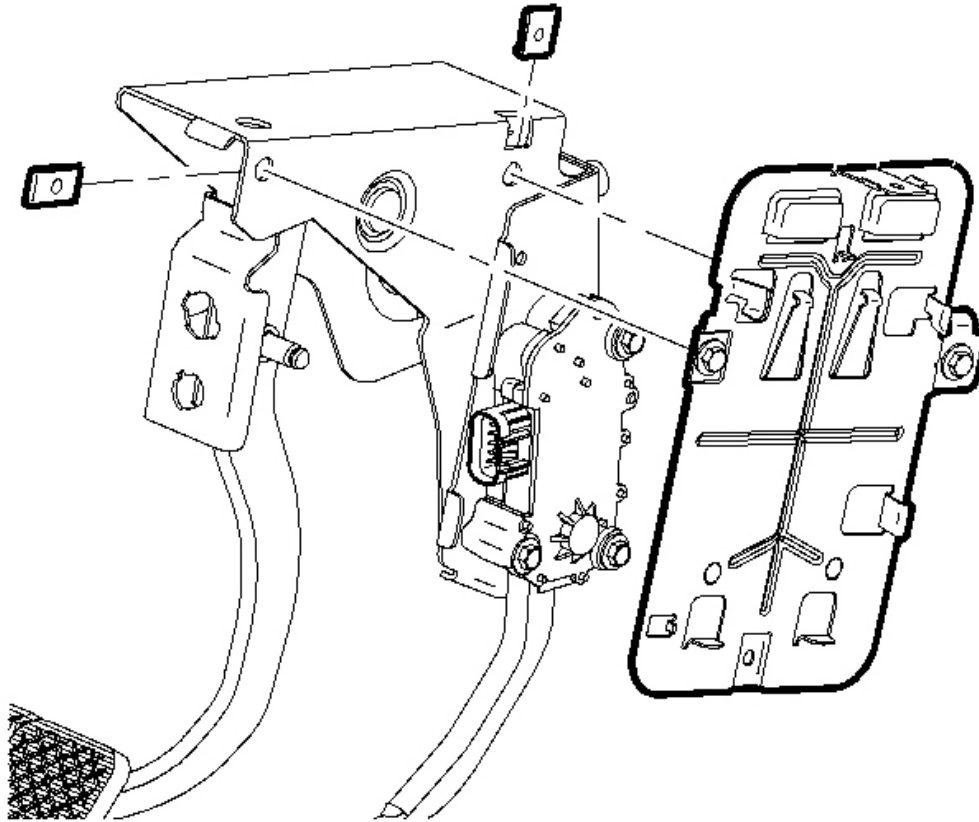


Fig. 38: Removing/Installing OnStar J-Nuts & Mounting Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the OnStar(R) J-nuts and mounting bracket bolts to the brake pedal assembly, if equipped.

Tighten: Tighten the bolts to 10 N.m (89 lb in).

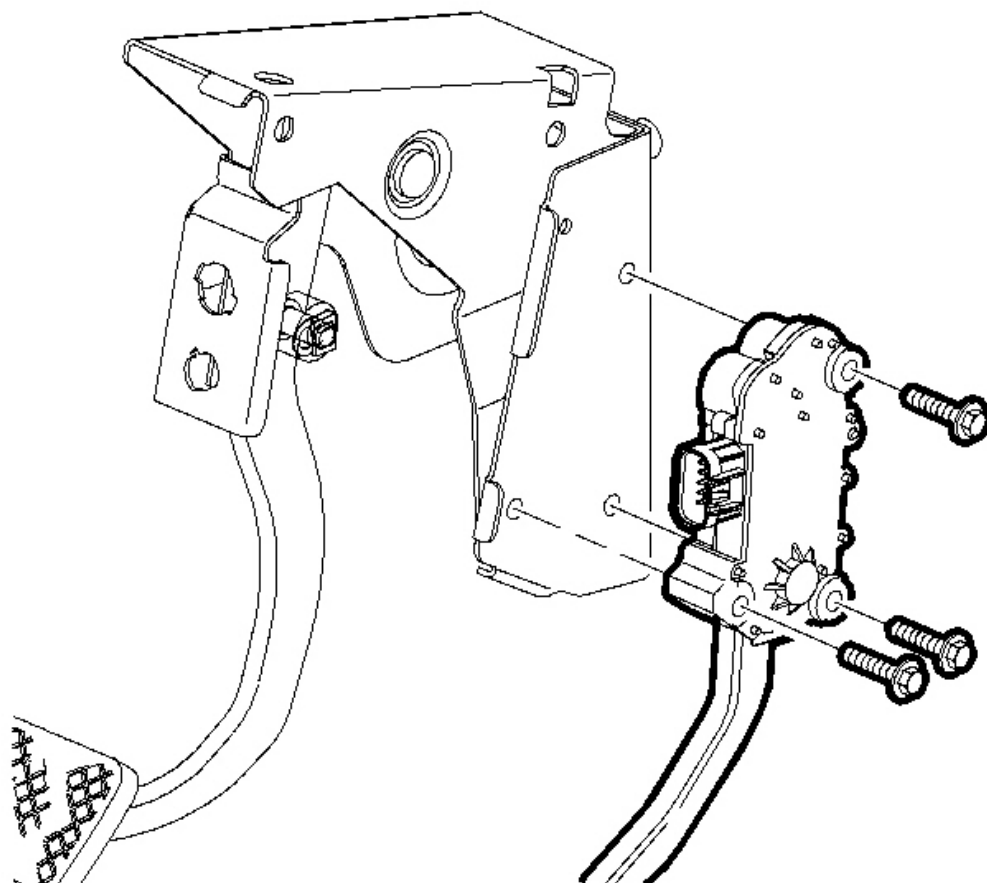


Fig. 39: Removing/Installing Accelerator Pedal Assembly
Courtesy of GENERAL MOTORS CORP.

2. Install the accelerator pedal assembly to the brake pedal bracket. Refer to **Accelerator Pedal Position Assembly Replacement** in Engine Controls - 2.2L (L61) or **Accelerator Pedal Position (APP) Sensor Replacement** in Engine Controls - 3.5L (L66).

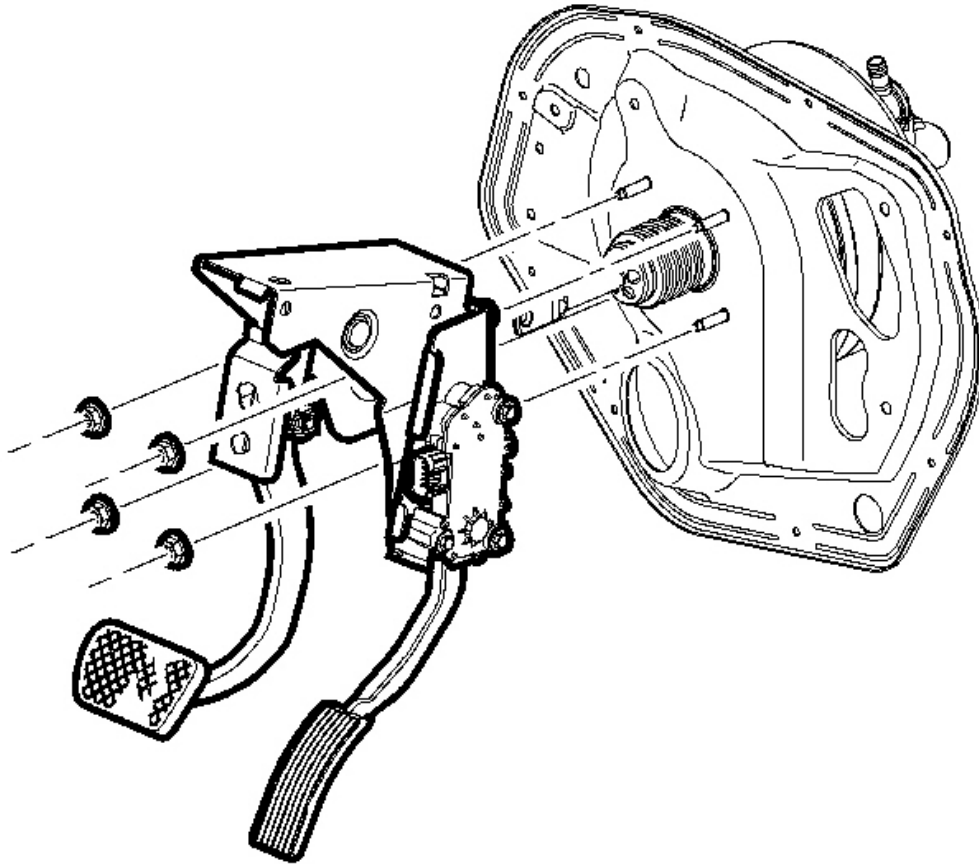


Fig. 40: Removing/Installing Brake Pedal Assembly
Courtesy of GENERAL MOTORS CORP.

3. Install the brake pedal assembly into the vehicle, while guiding the brake pedal bracket pilot bushings into the foam insulator panel.

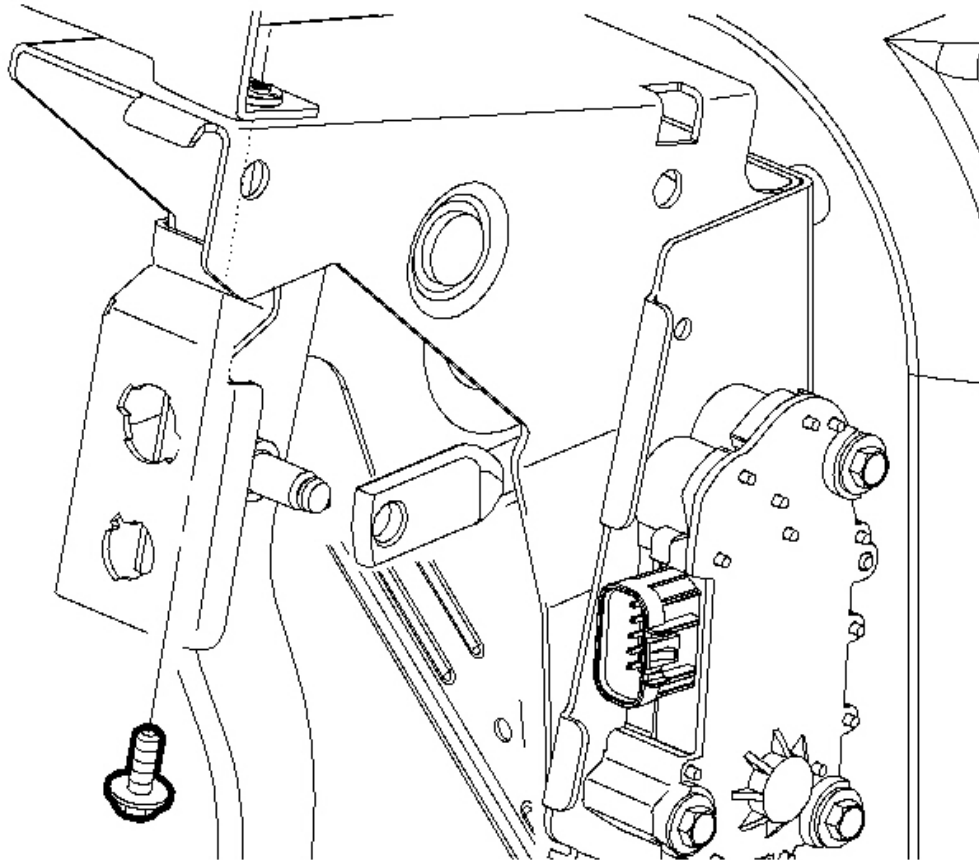


Fig. 41: Removing/Installing Brake Pedal Bracket
Courtesy of GENERAL MOTORS CORP.

4. Install the brake pedal bracket-to-steering column bracket bolt.

Tighten: Tighten the bolt to 25 N.m (18 lb ft).

5. Loosely install the brake booster mounting nuts.
6. Apply a thin coating of lithium grease to the pushrod pin on the brake pedal.

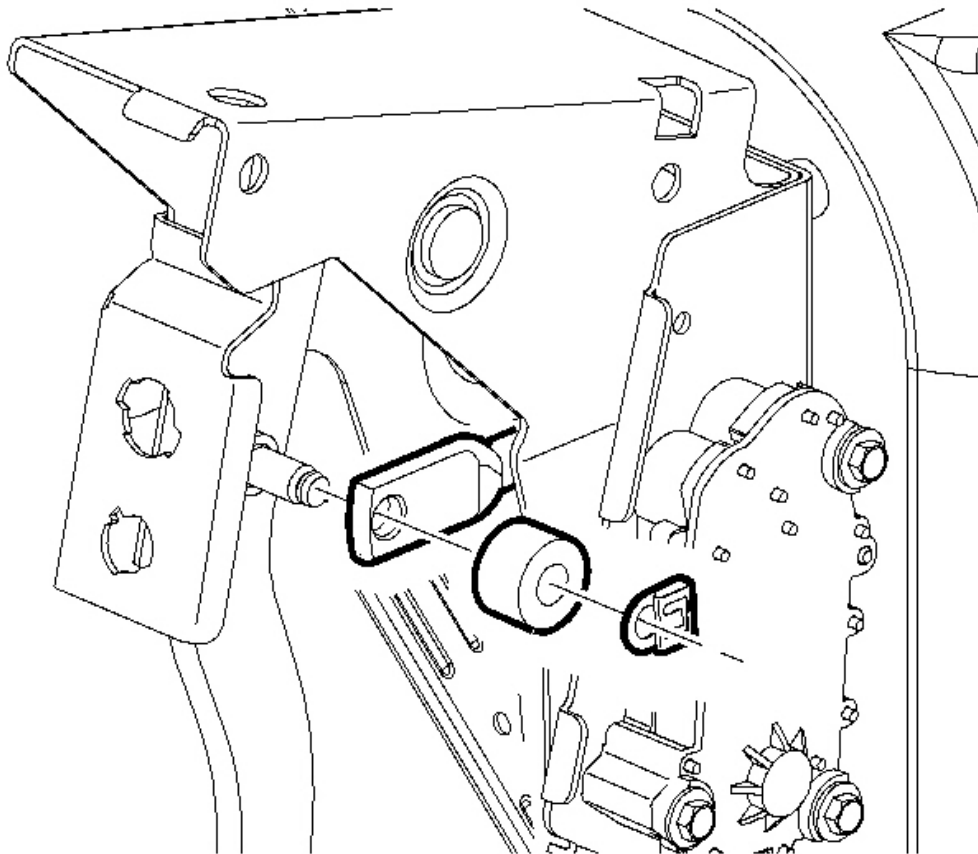


Fig. 42: Removing/Installing Washer & Retaining Clip To Brake Pedal
Courtesy of GENERAL MOTORS CORP.

7. Connect the brake booster pushrod to the brake pedal.
8. Install the washer and retaining clip to the brake pedal.

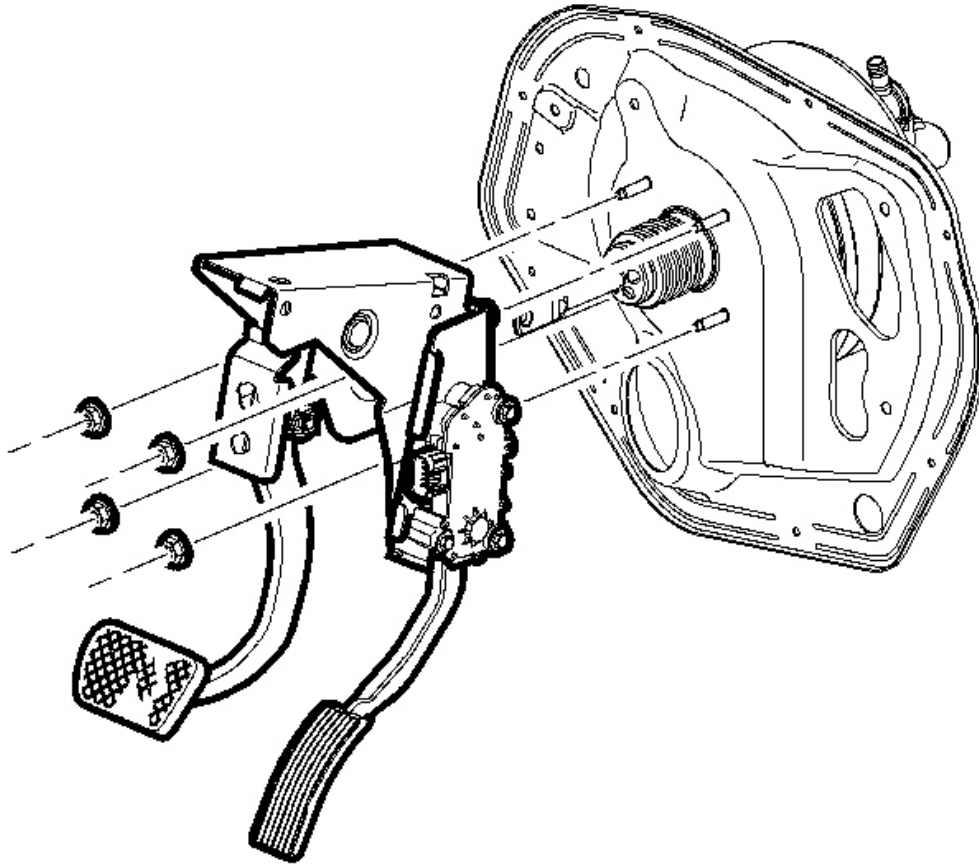


Fig. 43: Removing/Installing Brake Pedal Assembly
Courtesy of GENERAL MOTORS CORP.

9. Tighten the vacuum brake booster mounting nuts.

Tighten: Tighten the nuts to 25 N.m (18 lb ft).

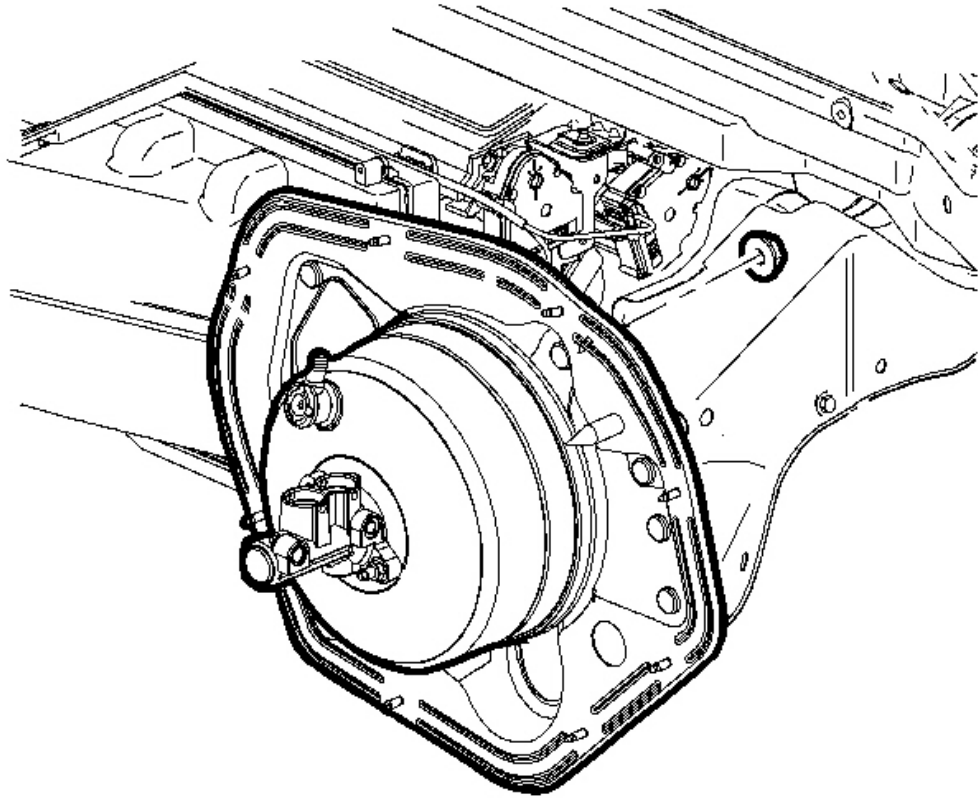


Fig. 44: Installing Steering Column Bracket
Courtesy of GENERAL MOTORS CORP.

10. Install the steering column bracket to cowl nut.

Tighten: Tighten the nuts to 25 N.m (18 lb ft).

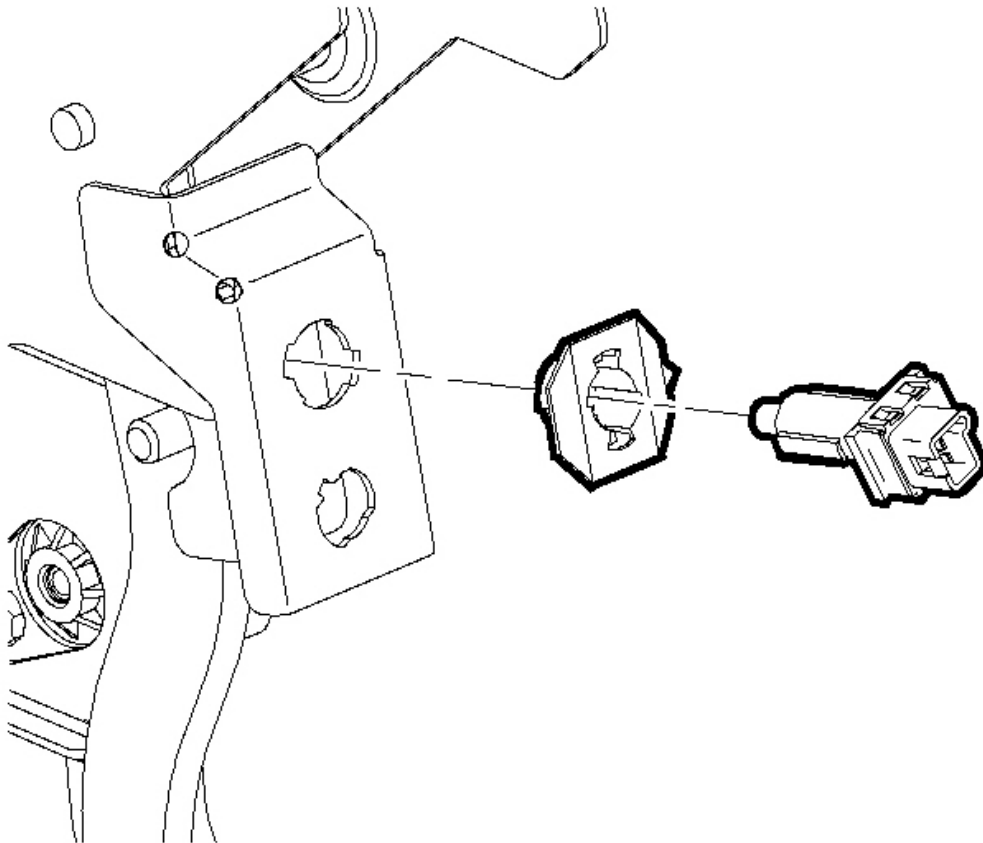


Fig. 45: Removing/Installing Cruise Control Release Switch
Courtesy of GENERAL MOTORS CORP.

11. Install the cruise control release switch and retainer, if equipped, to the pedal bracket. Refer to **Cruise Release Switch Replacement** in Cruise Control.

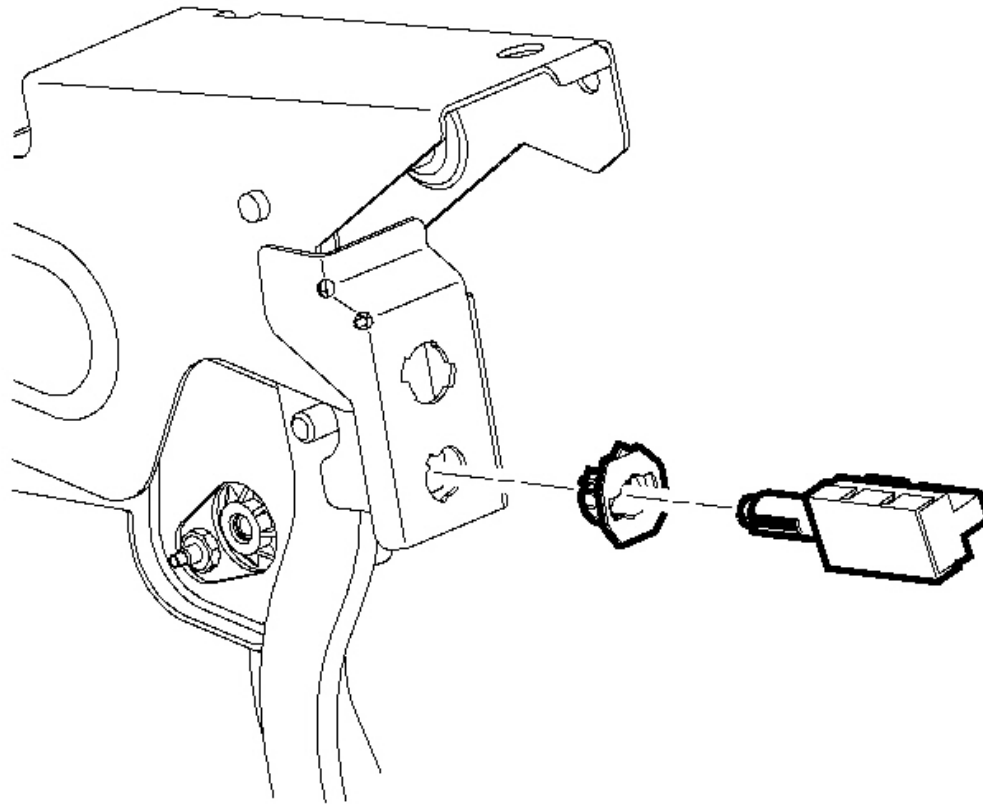


Fig. 46: Removing/Installing Stop Lamp Switch
Courtesy of GENERAL MOTORS CORP.

12. Install the stop lamp switch and retainer to the pedal bracket. Refer to **Stop Lamp Switch Replacement** in Lighting Systems.
13. Adjust the stop lamp switch. Refer to **Stop Lamp Switch Adjustment** in Lighting Systems.
14. Adjust the cruise release switch, if equipped. Refer to **Cruise Release Switch Adjustment** in Cruise Control.

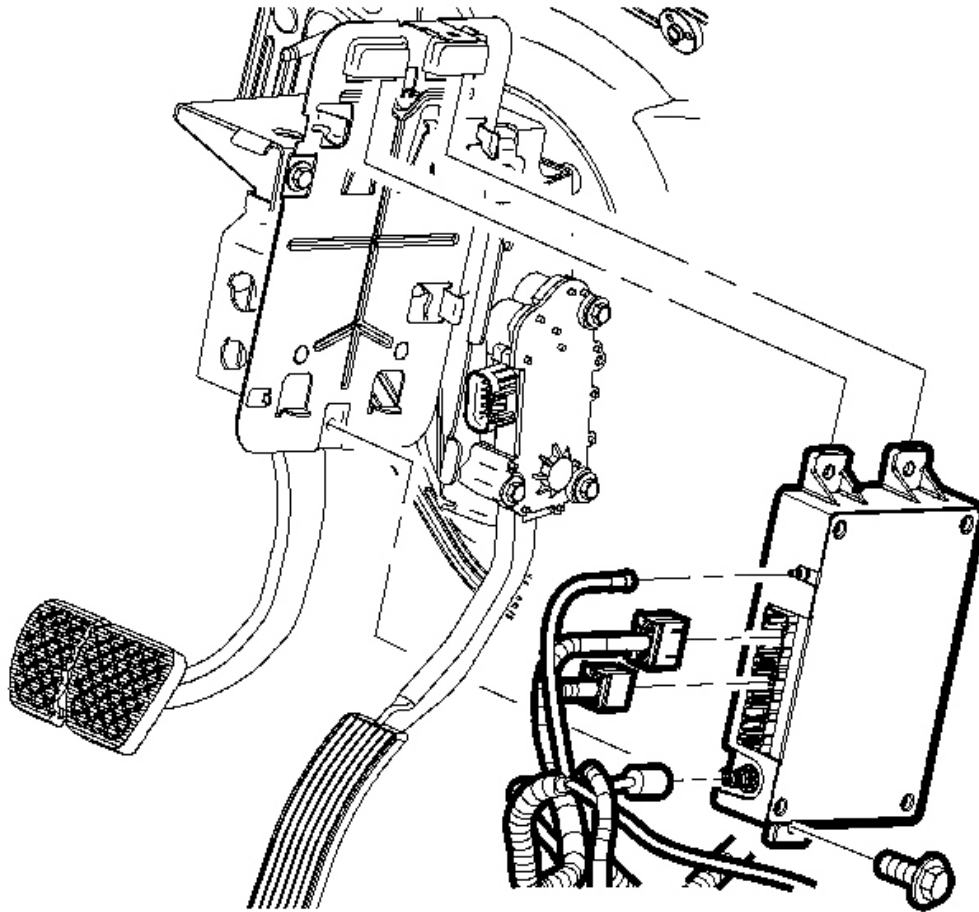


Fig. 47: Removing Mounting Bolts & Reposition OnStar Module
Courtesy of GENERAL MOTORS CORP.

15. Reposition the OnStar(R) module to the mounting bracket, if equipped. Refer to **Communication Interface Module Replacement** in Cellular Communication.

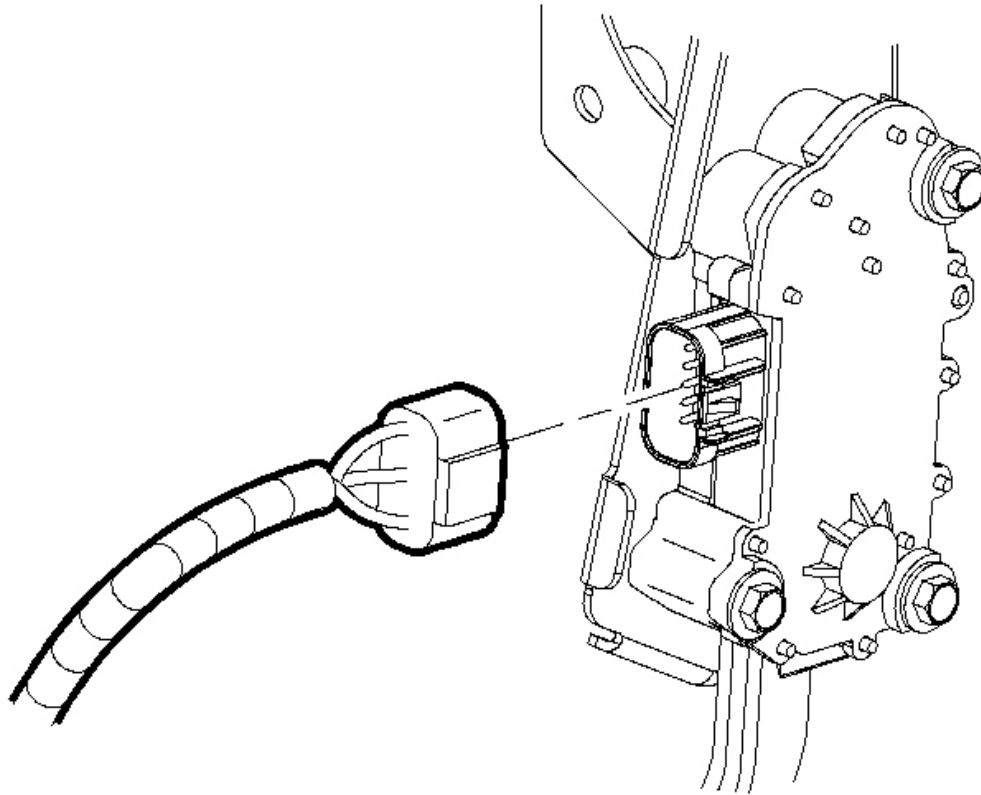


Fig. 48: Disconnecting/Connecting Accelerator Pedal Assembly Electrical Connector
Courtesy of GENERAL MOTORS CORP.

16. Connect the accelerator pedal assembly electrical connector.

PROPORTIONING VALVE REPLACEMENT

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

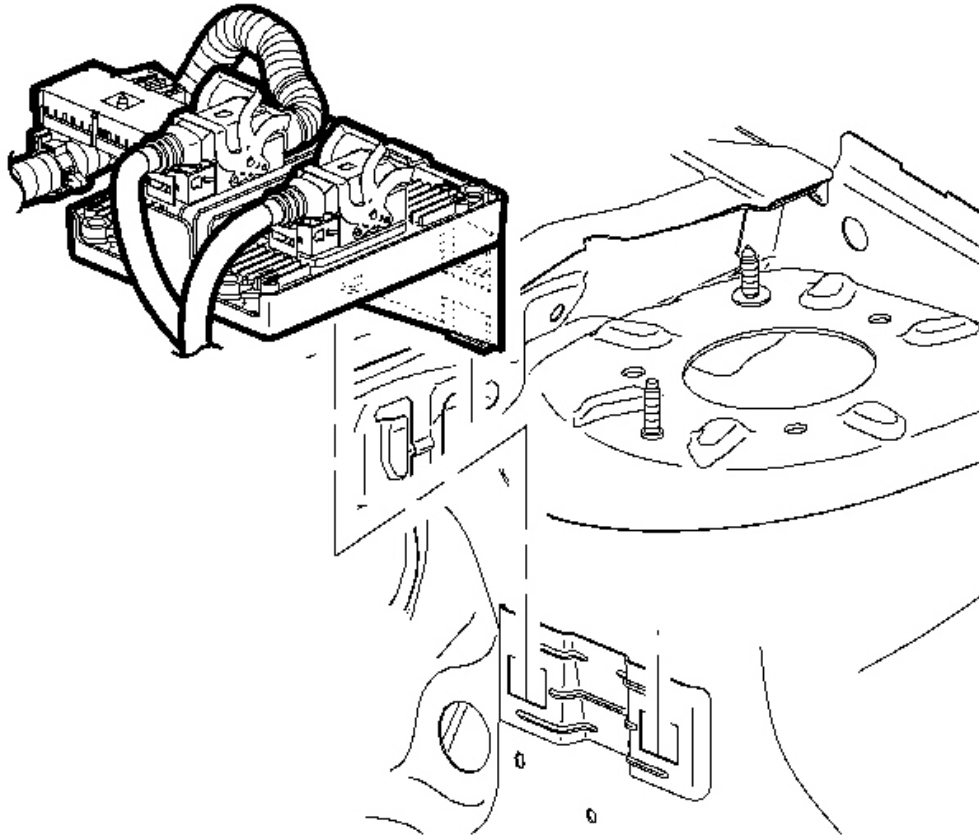


Fig. 49: Removing/Installing Transaxle Control Module (TCM)
Courtesy of GENERAL MOTORS CORP.

1. Without disconnecting the electrical connectors, remove the transmission control module (TCM) if equipped from the bracket and position aside on top of the engine. Refer to **Transmission Control Module (TCM) Replacement** in Automatic Transmission - VT25-E.

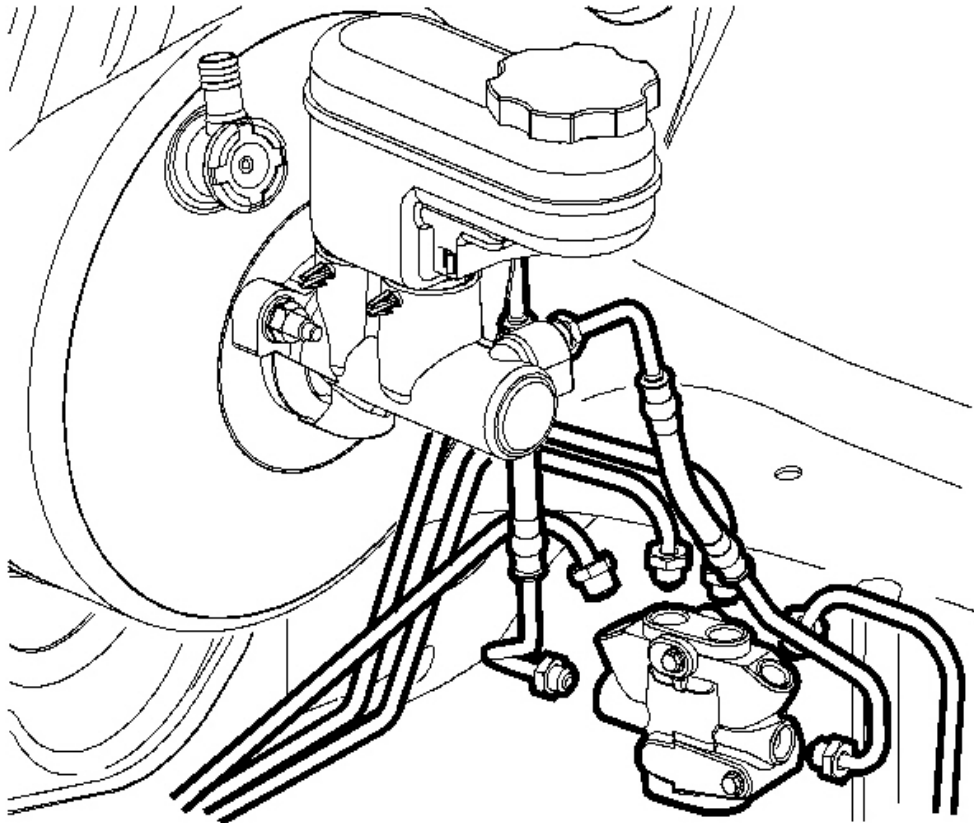


Fig. 50: Removing Plugs From Proportioning Valve Assembly
Courtesy of GENERAL MOTORS CORP.

2. Place a shop towel under the proportioning valve assembly to catch any brake fluid loss.

IMPORTANT: Prior to disconnecting the brake pipes from the proportioning valve assembly, note the locations of the brake pipes to the valve assembly, to aid during installation.

3. Disconnect the caliper and wheel cylinder brake pipes from the proportioning valve assembly.
4. Cap or plug the brake pipe ends to prevent brake fluid loss and contamination.
5. Disconnect the master cylinder brake pipes from the proportioning valve assembly.

6. Cap or plug the brake pipe ends to prevent brake fluid loss and contamination.
7. If the proportioning valve is to be reused, plug the ports to prevent brake fluid loss and contamination.

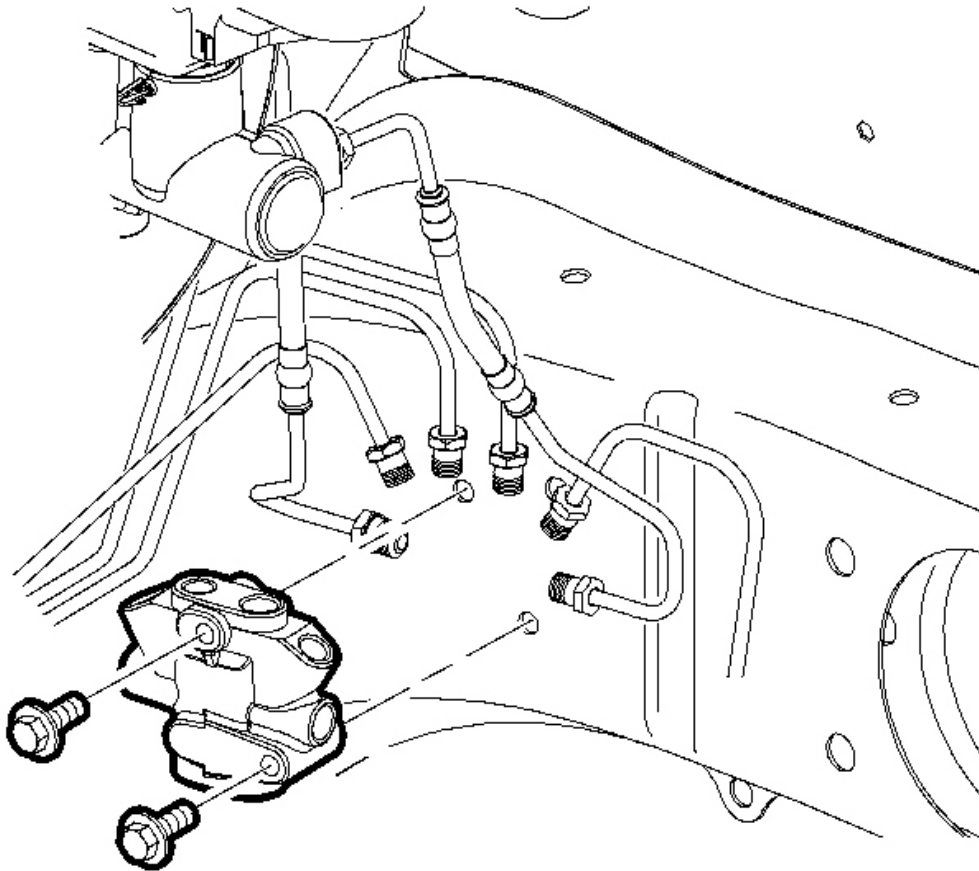


Fig. 51: Removing/Installing Proportioning Valve Assembly
Courtesy of GENERAL MOTORS CORP.

8. Remove the proportioning valve mounting bolts.

IMPORTANT: Do not exert excessive force on the brake pipes.

9. Remove the proportioning valve from the vehicle while carefully repositioning the brake pipes.

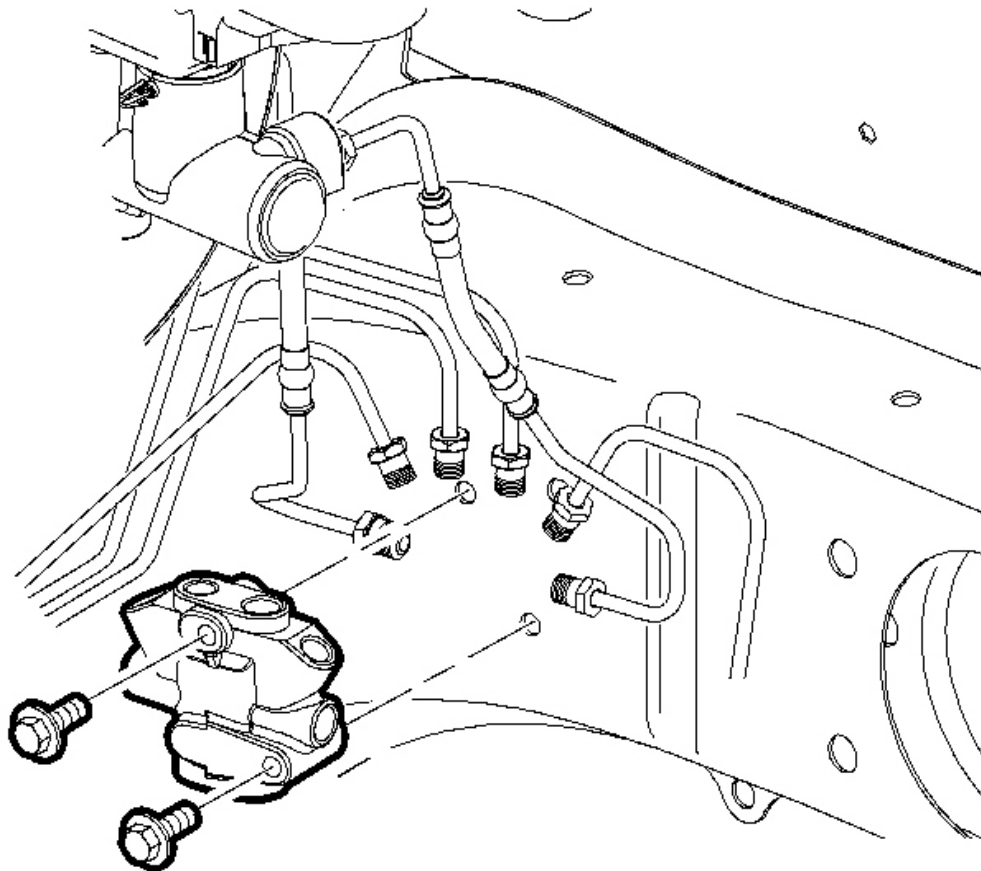


Fig. 52: Removing/Installing Proportioning Valve Assembly
Courtesy of GENERAL MOTORS CORP.

1. Install the proportioning valve assembly to the vehicle.

NOTE: Refer to **Fastener Notice** in **Cautions and Notices**.

2. Install the proportioning valve assembly bracket mounting bolts.

Tighten: Tighten the bolts to 12 N.m (9 lb ft).

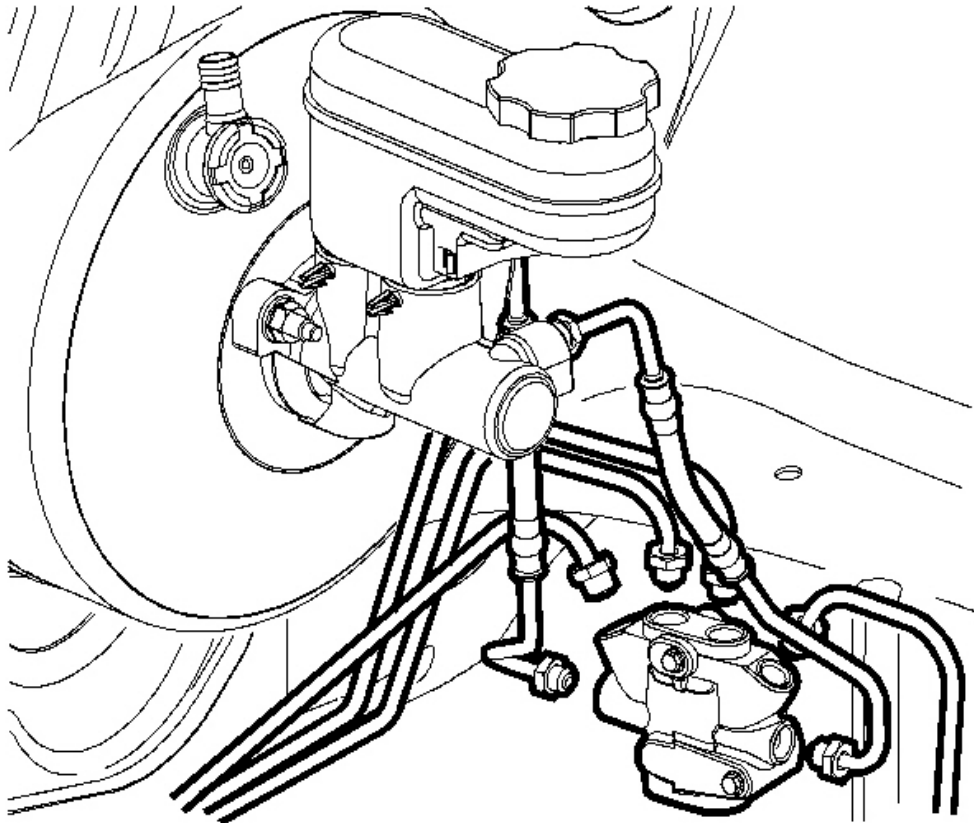


Fig. 53: Removing Plugs From Proportioning Valve Assembly
Courtesy of GENERAL MOTORS CORP.

3. Remove the plugs from the proportioning valve assembly ports.
4. Remove the caps or plugs from the master cylinder brake pipe ends.
5. Connect the master cylinder brake pipes to the proportioning valve assembly.
6. Tighten the brake pipe fittings at the proportioning valve assembly.

Tighten: Tighten the fittings to 18 N.m (13 lb ft).

7. Remove the caps or plugs from the caliper and wheel cylinder brake pipe ends.
8. Connect the caliper and wheel cylinder brake pipes to the proportioning valve assembly.

9. Tighten the brake pipe fittings at the proportioning valve assembly.

Tighten: Tighten the fittings to 18 N.m (13 lb ft).

10. Remove the shop towel and discard into an approved container.

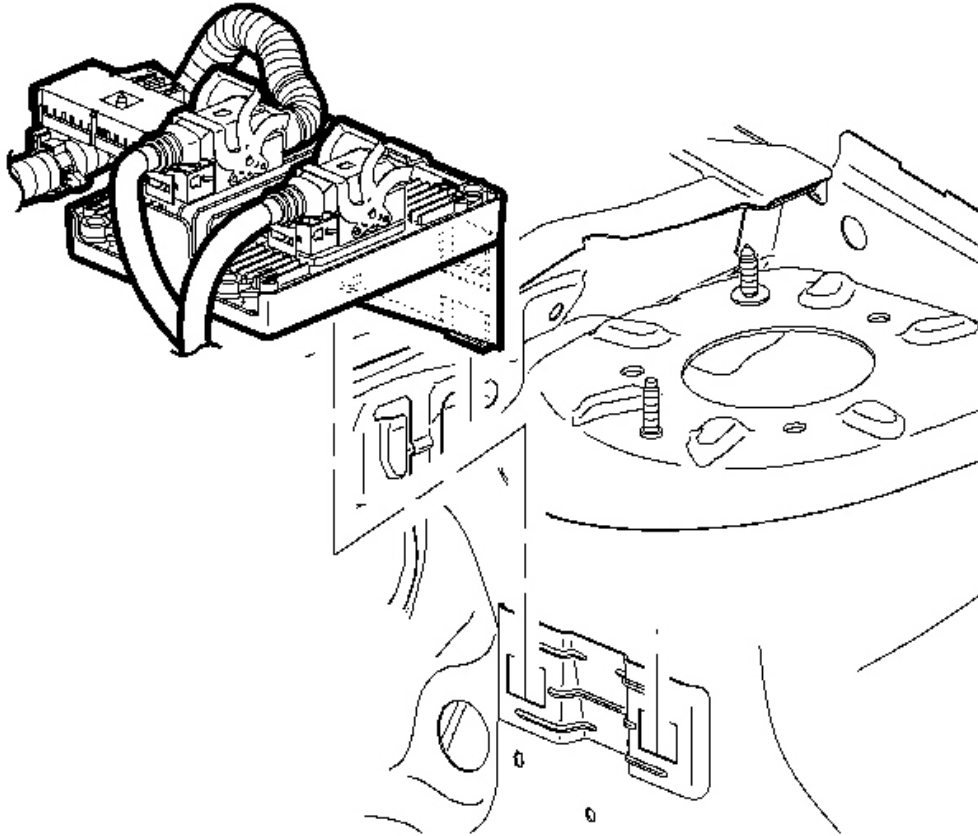


Fig. 54: Removing/Installing Transaxle Control Module (TCM)
Courtesy of GENERAL MOTORS CORP.

11. Reposition the TCM if equipped to the bracket. Refer to **Transmission Control Module (TCM) Replacement** in Automatic Transmission - VT25-E.
12. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual) Hydraulic Brake System Bleeding (Pressure)**.

BRAKE PIPE REPLACEMENT

Tools Required

J 45405 Brake Pipe Flaring Kit. See Special Tools and Equipment .

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

CAUTION: Always use double walled steel brake pipe when replacing brake pipes. The use of any other pipe is not recommended and may cause brake system failure. Carefully route and retain replacement brake pipes. Always use the correct fasteners and the original location for replacement brake pipes. Failure to properly route and retain brake pipes may cause damage to the brake pipes and cause brake system failure.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

IMPORTANT: When servicing the brake pipes, note the following:

- If sectioning the brake pipe, use replacement pipe of the same type and outside diameter.
- Use fittings of the appropriate size and type.
- Only create flares of the same type or design as originally equipped on the vehicle.

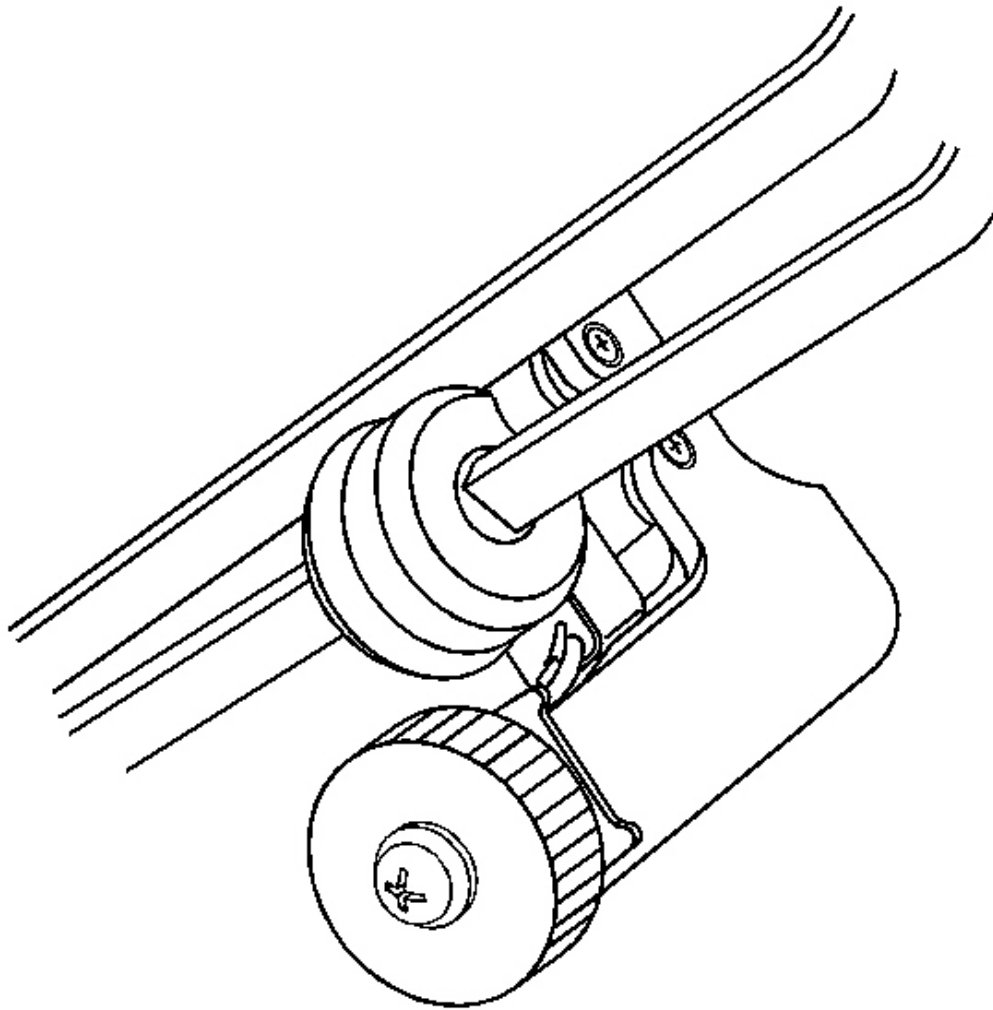


Fig. 55: Sectioning Brake Pipe Using Pipe Cutter
Courtesy of GENERAL MOTORS CORP.

1. Inspect the area of brake pipe to be repaired or replaced.
2. Release the brake pipe to be replaced from the retainers, as required.
3. Select an appropriate location to section the brake pipe, if necessary.
 - Allow adequate clearance in order to maneuver the **J 45405** . See **Special Tools and Equipment** .
 - Avoid sectioning the brake pipe at bends or mounting points.
4. Using a string or wire, measure the length of the pipe to be replaced including all pipe bends.
5. Add to the measurement taken the appropriate additional length required for each flare to be created.

Specification:

- 6.35 mm (0.250 in) for 4.76 mm (3/16 in) diameter pipe
- 9.50 mm (0.374 in) for 6.35 mm (1/4 in) diameter pipe

IMPORTANT: Ensure that the brake pipe end to be flared is cut at a square, 90 degree angle to the pipe length.

6. Using the pipe cutter included in the **J 45405** , carefully cut the brake pipe squarely to the measured length. See **Special Tools and Equipment** .
7. Remove the sectioned brake pipe from the vehicle.
8. Select the appropriate size of brake pipe and tube nuts, as necessary. The brake pipe outside diameter determines brake pipe size.

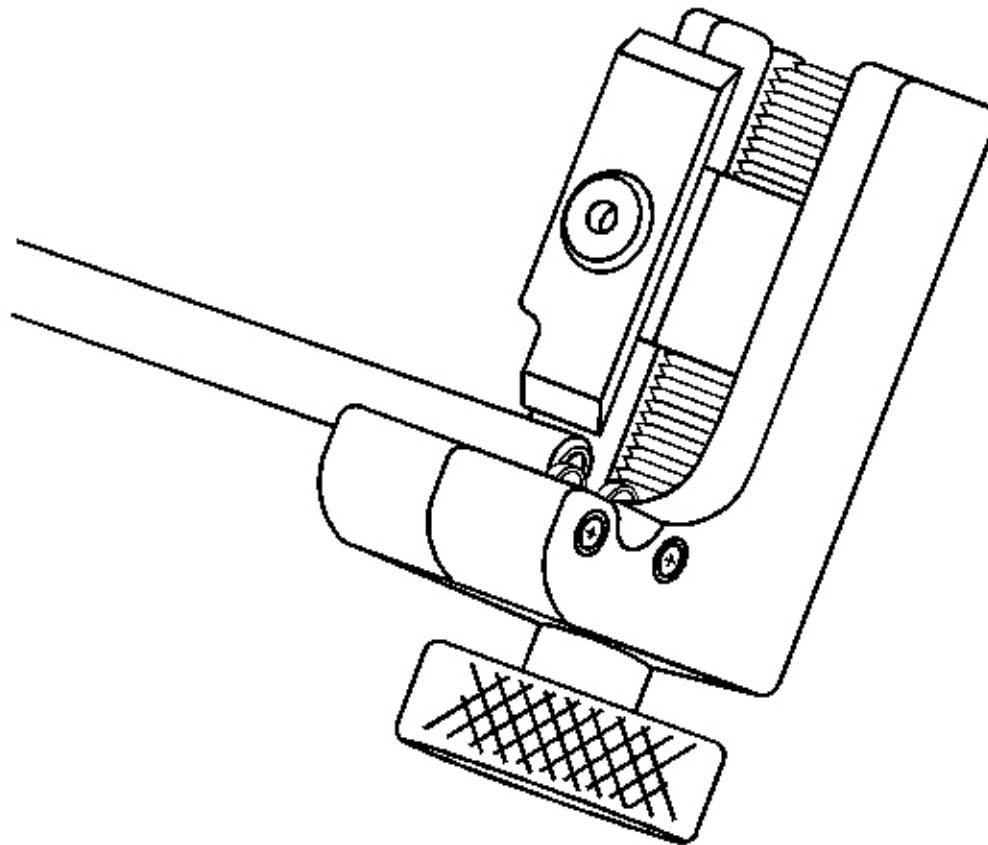


Fig. 56: Stripping Nylon Coating From Brake Pipe Ends

Courtesy of **GENERAL MOTORS CORP.**

9. Strip the nylon coating from the brake pipe end to be flared, if necessary.
- Select the appropriate blade on the coating stripping tool included in the **J 45405** , by unthreading the blade block from the stripping tool and installing the block with the desired blade facing the tool rollers. See **Special Tools and Equipment** .

Specification:

- 6.35 mm (0.250 in) blade for 4.76 mm (3/16 in) diameter pipe
 - 9.50 mm (0.374 in) blade for 6.35 mm (1/4 in) diameter pipe
- Insert the brake pipe end to be flared into the stripping tool to the depth of the ledge on the tool rollers.
 - While holding the brake pipe firmly against the stripping tool roller ledges, rotate the thumbwheel of the tool until the blade contacts the brake pipe coated surface.

IMPORTANT: Do not gouge the metal surface of the brake pipe.

- Rotate the stripping tool in a clockwise direction, ensuring that the brake pipe end remains against the tool roller ledges.
- After each successive revolution of the stripping tool, carefully rotate the thumbwheel of the tool clockwise, in order to continue stripping the coating from the brake pipe until the metal pipe surface is exposed.
- Loosen the thumbwheel of the tool and remove the brake pipe.

IMPORTANT: Ensure that all loose remnants of the nylon coating have been removed from the brake pipe.

- Inspect the stripped end of the brake pipe to ensure that the proper amount of coating has been removed.

Specification:

- 6.35 mm (0.250 in) for 4.76 mm (3/16 in) diameter pipe
- 9.50 mm (0.374 in) for 6.35 mm (1/4 in) diameter pipe

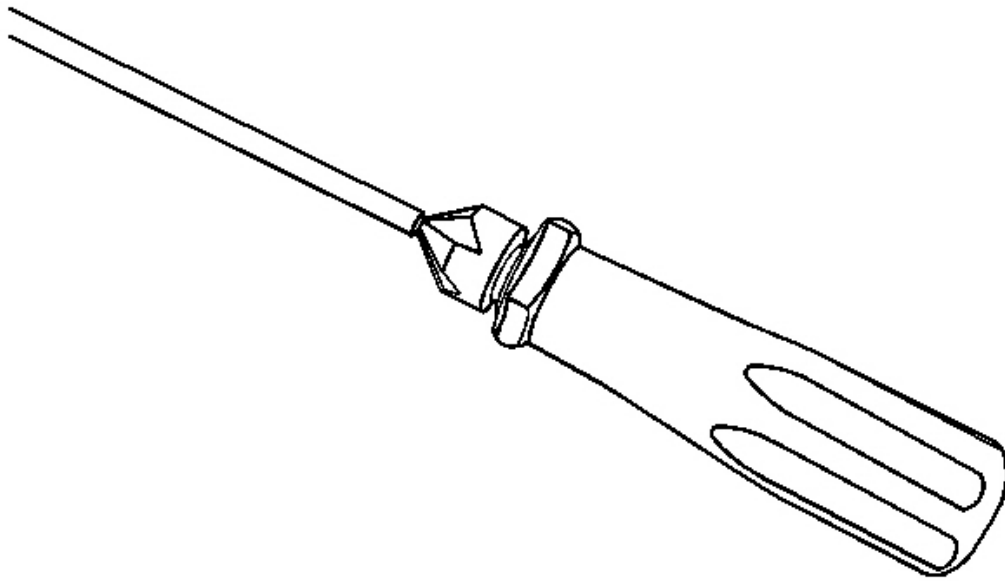


Fig. 57: Chamfering Pipe Using De-Burring Tool
Courtesy of GENERAL MOTORS CORP.

10. Chamfer the inside and outside diameter of the pipe with the de-burring tool included in the **J 45405** . See **Special Tools and Equipment** .
11. Install the tube nuts on the brake pipe, noting their orientation.
12. Clean the brake pipe and the **J 45405** of lubricant, contaminants, and debris. See **Special Tools and Equipment** .

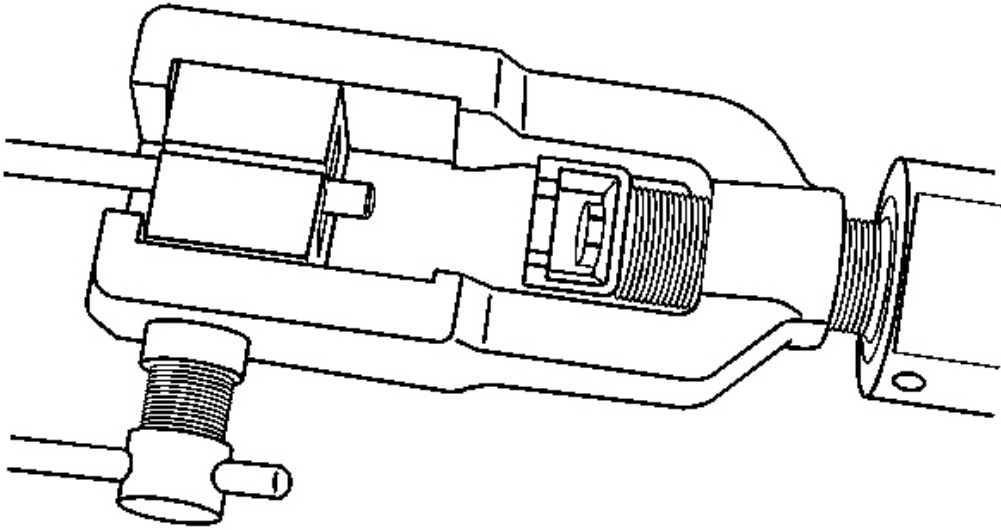


Fig. 58: View Of Pipe Flaring Tool
Courtesy of GENERAL MOTORS CORP.

13. Loosen the die clamping screw of the **J 45405** . See **Special Tools and Equipment** .
14. Select the corresponding die set and install the die halves into the die cage with the full, flat face of one die facing the clamping screw, and the counterbores of both dies facing the forming ram.

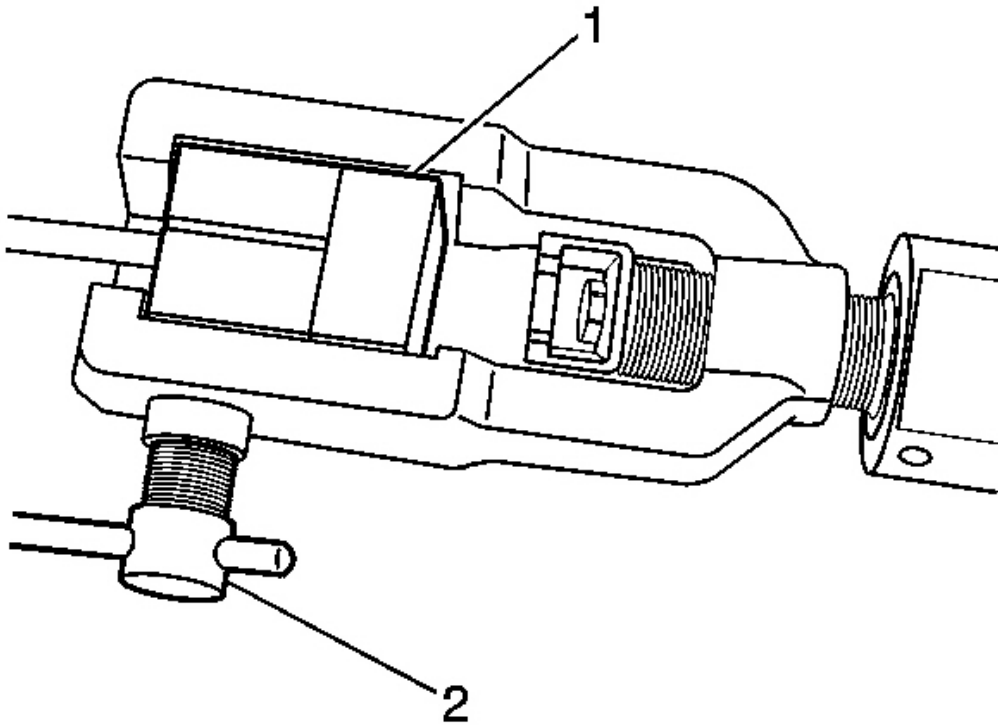


Fig. 59: View Of Pipe Flaring Tool J 45405
Courtesy of GENERAL MOTORS CORP.

15. Place the flat face of an unused die (1) against the die halves in the clamping cage and hold firmly against the counterbored face of the dies.
16. Insert the prepared end of the pipe to be flared through the back of the dies until the pipe is seated against the flat surface of the unused die (1).
17. Remove the unused die (1).
18. Ensure that the rear of both dies are seated firmly against the enclosed end of the die cage.
19. Firmly hand tighten the clamping screw (2) against the dies.

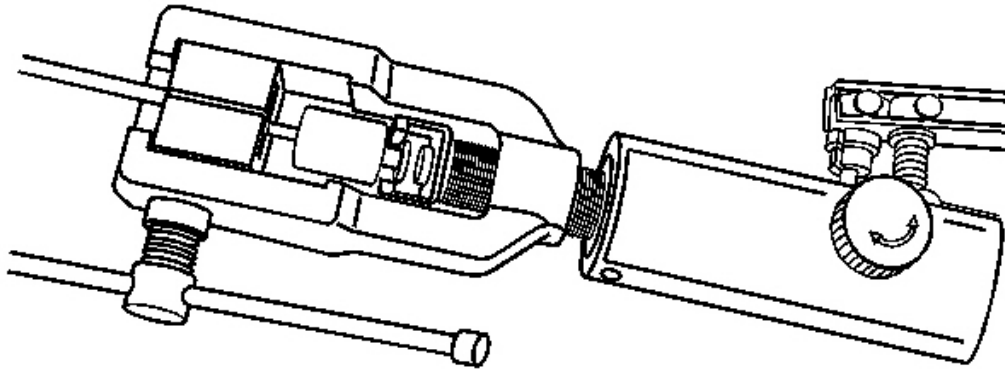


Fig. 60: Rotating J 45405 To Bottom Against Die Cage
Courtesy of GENERAL MOTORS CORP.

20. Select the appropriate forming mandrel and place into the forming ram.
21. Rotate the hydraulic fluid control valve clockwise to the closed position.
22. Rotate the body of the **J 45405** until it bottoms against the die cage. See **Special Tools and Equipment** .

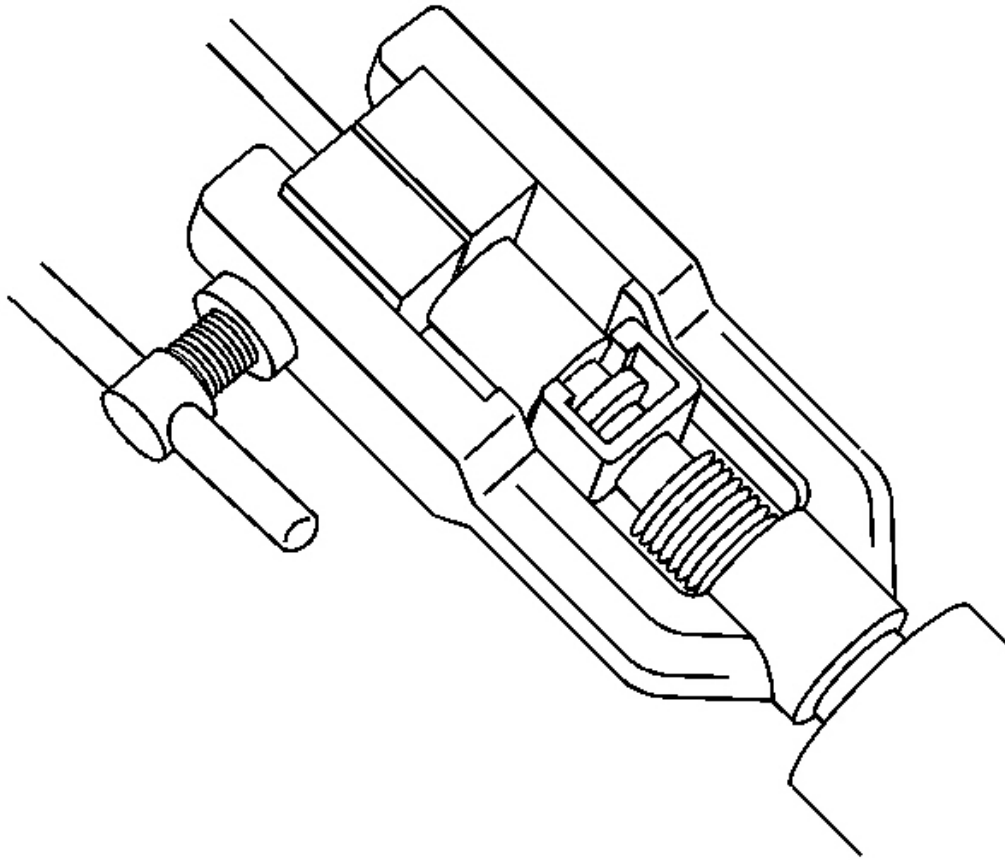


Fig. 61: View Of Pipe Flaring Tool
Courtesy of GENERAL MOTORS CORP.

23. While guiding the forming mandrel into the exposed end of pipe to be flared, operate the lever of the **J 45405** until the forming mandrel bottoms against the clamping dies. See **Special Tools and Equipment** .
24. Rotate the hydraulic fluid control valve counterclockwise to the open position to allow the hydraulic forming ram to retract.

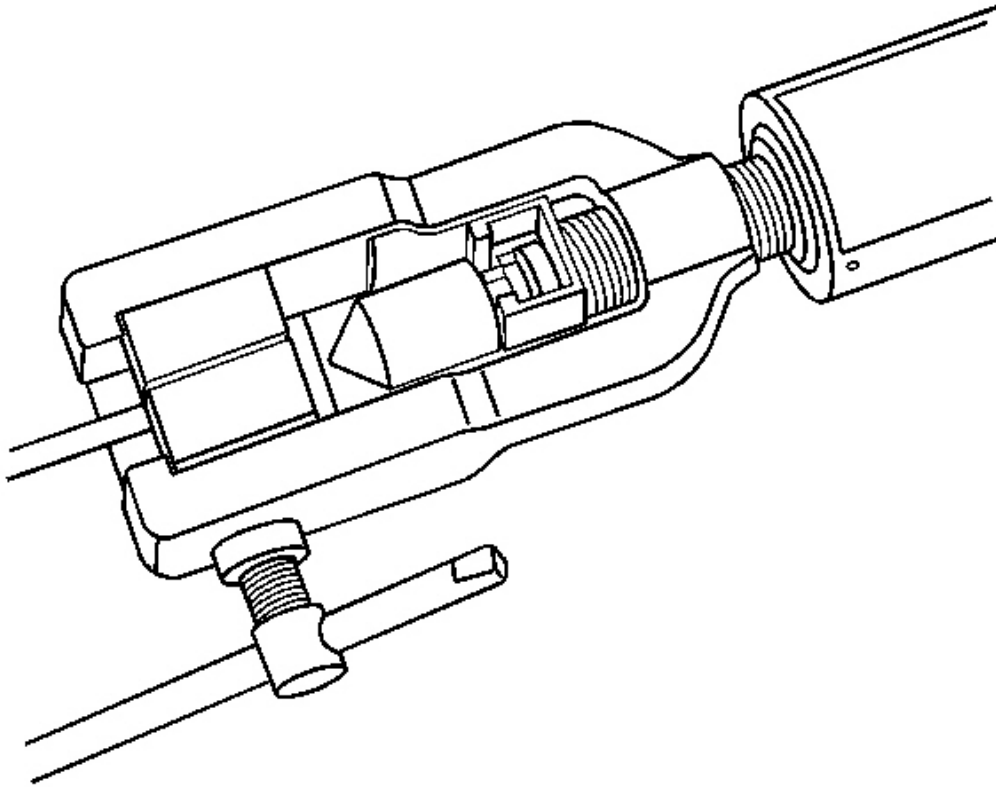


Fig. 62: Using Pipe Flaring Tool
Courtesy of GENERAL MOTORS CORP.

25. Insert the finishing cone into the forming ram.
26. Rotate the hydraulic fluid control valve clockwise to the closed position.
27. Rotate the body of the **J 45405** until it bottoms against the die cage. See **Special Tools and Equipment** .
28. While guiding the finishing cone into the exposed end of pipe to be flared, operate the lever of the **J 45405** until the finishing cone bottoms against the dies. See **Special Tools and Equipment** .
29. Rotate the hydraulic fluid control valve counterclockwise to the open position to allow the hydraulic forming ram to retract.
30. Loosen the die clamping screw and remove the dies and pipe.
31. If necessary, lightly tap the dies until the die halves separate.

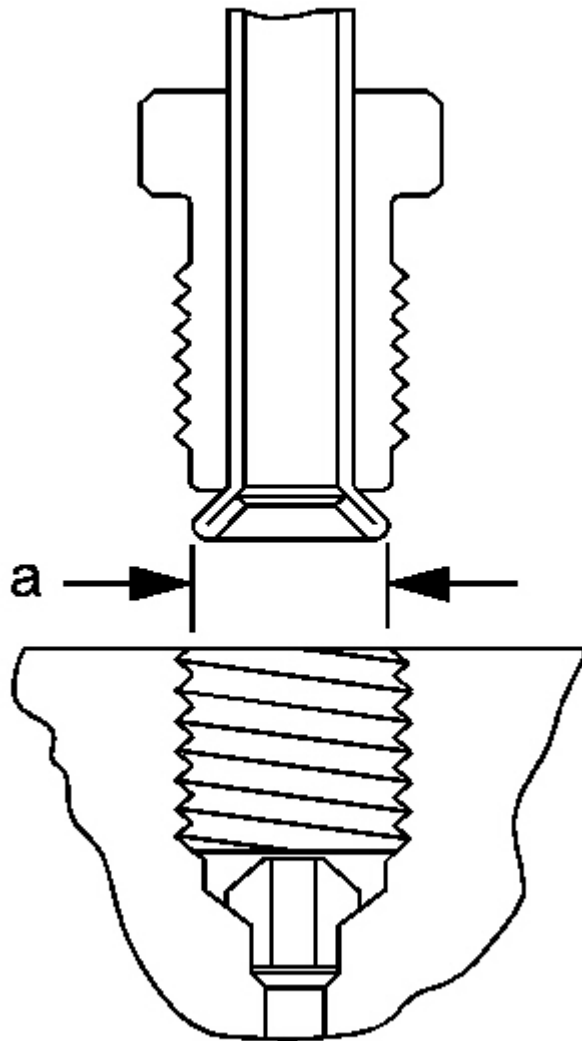


Fig. 63: Identifying Correct Brake Pipe Flare Shape & Diameter
Courtesy of GENERAL MOTORS CORP.

32. Inspect the brake pipe flare for correct shape and diameter (a).

Specification:

- 6.92 mm (0.272 in) +/- 0.18 mm (0.007 in) flare diameter for 4.76 mm (3/16 in) diameter pipe
- 8.92 mm (0.351 in) +/- 0.18 mm (0.007 in) flare diameter for 6.35 mm (1/4 in) diameter pipe

33. If necessary, using the removed section of brake pipe as a template, shape the new pipe with a suitable brake pipe bending tool.

IMPORTANT: When installing the pipe, maintain a clearance of 19 mm (3/4 in) from all moving or vibrating components.

34. Install the pipe to the vehicle with the appropriate brake pipe unions, as required.
35. If previously released, secure the brake pipe to the retainers.
36. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual) Hydraulic Brake System Bleeding (Pressure)** .
37. With the aid of an assistant, inspect the brake pipe flares for leaks by starting the engine and applying the brakes.

BRAKE HOSE REPLACEMENT - FRONT

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

Removal Procedure

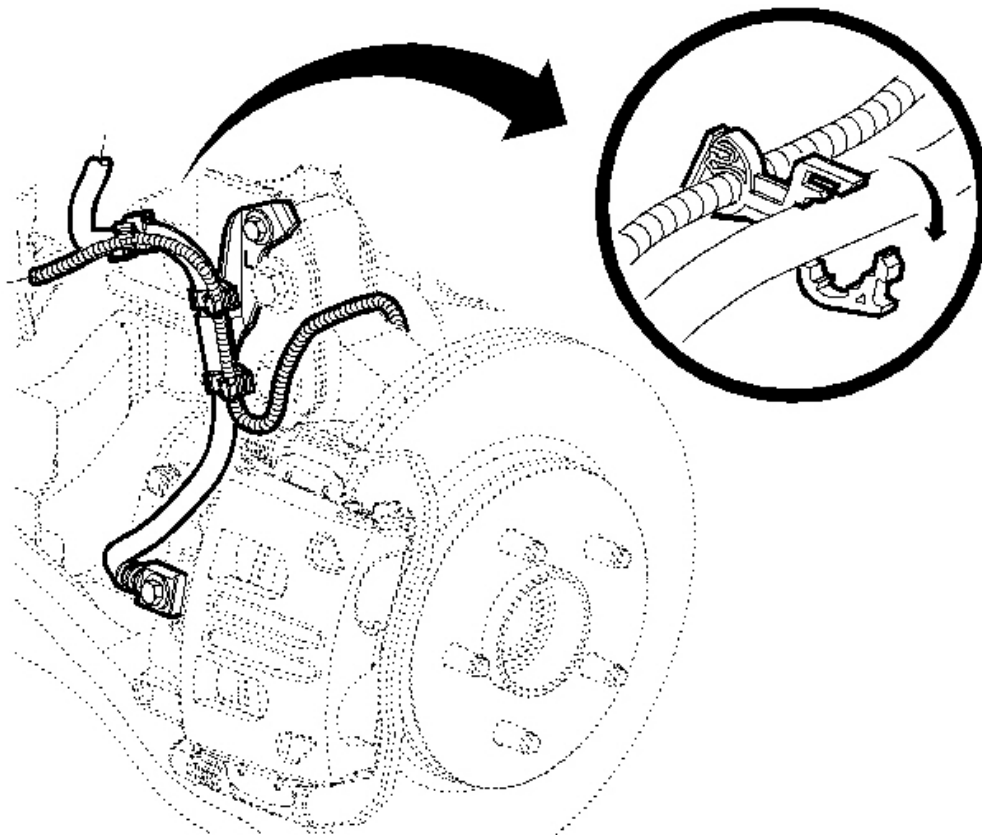


Fig. 64: View Of Front Brake Hose
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
3. Release the wheel speed sensor wire harness retainers and harness from the front brake hose.

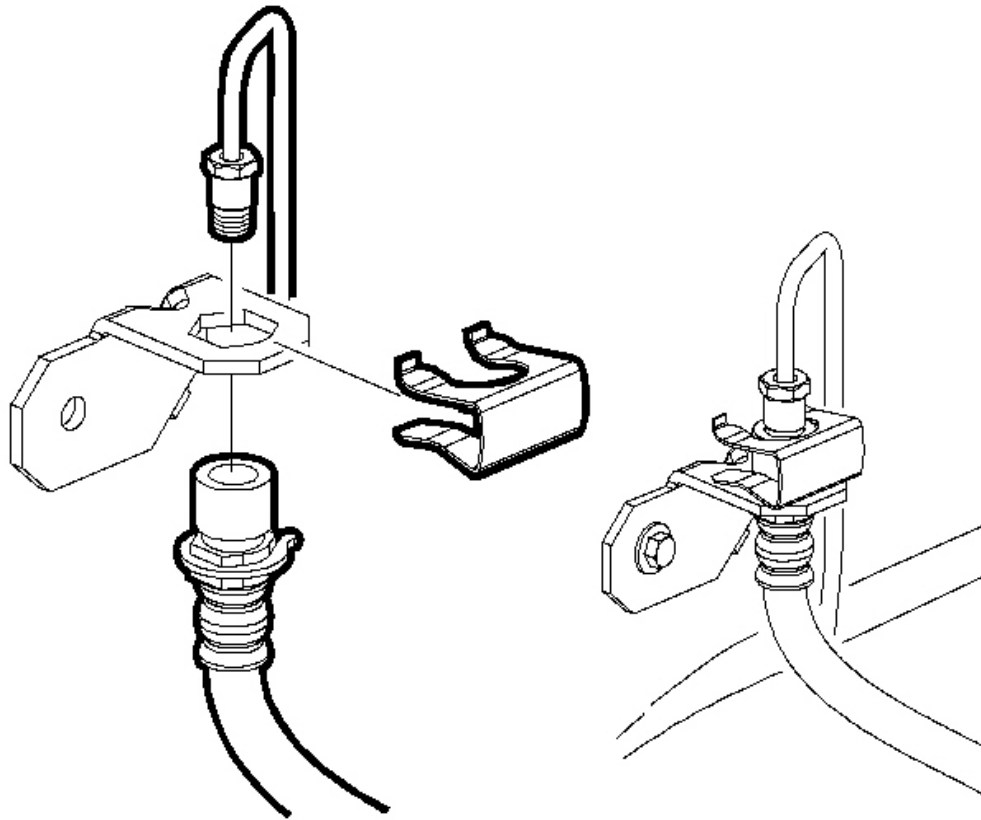


Fig. 65: Removing/Installing Brake Hose
Courtesy of GENERAL MOTORS CORP.

4. Clean all dirt and foreign material from the brake hose ends and the brake pipe fitting.
5. Using a backup wrench on the hose fitting, disconnect the brake pipe fitting from the brake hose. Cap or plug the brake pipe fitting end and the brake hose end to prevent fluid loss and contamination.
6. Release the retaining clip from the brake hose mounting bracket and the brake hose.

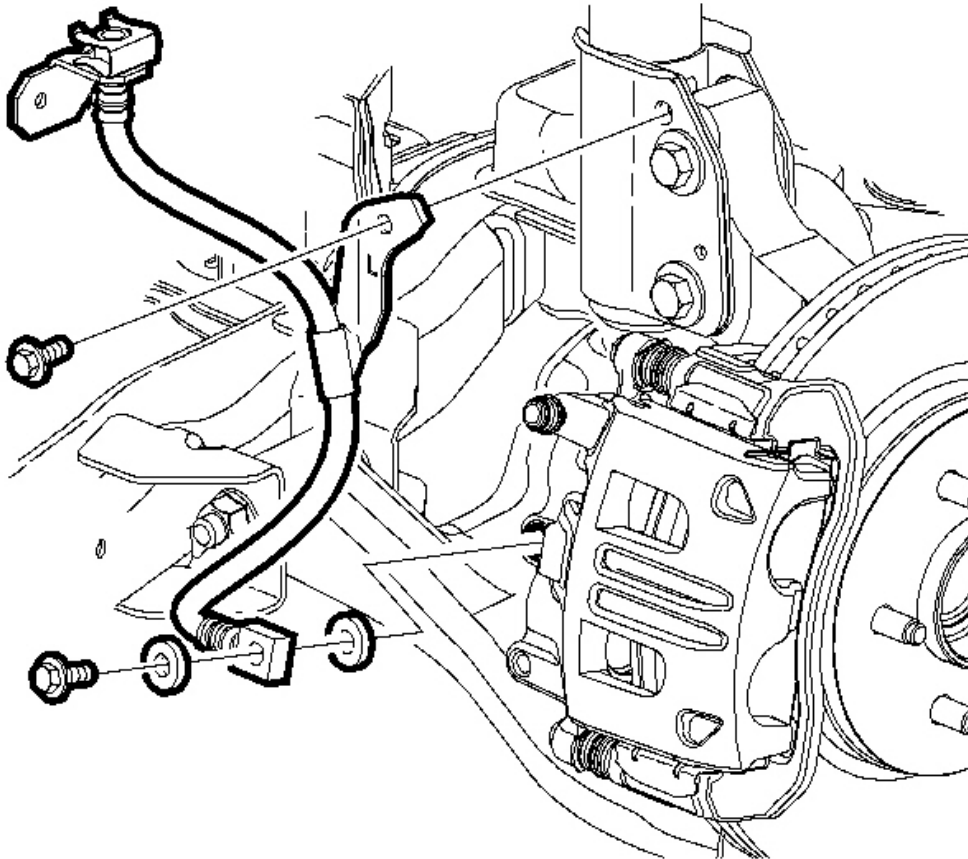


Fig. 66: Removing/Installing Front Brake Hose Bracket Retaining Bolt
Courtesy of GENERAL MOTORS CORP.

7. Remove the brake hose-to-caliper bolt from the brake caliper.
8. Remove the brake hose bracket retaining bolt.
9. Remove the brake hose from the brake caliper.
10. Remove and discard the copper brake hose gaskets. These gaskets may be stuck to the brake caliper and/or the brake hose end.
11. Cap or plug the opening in the brake caliper and the brake hose to prevent fluid loss and contamination.

Installation Procedure

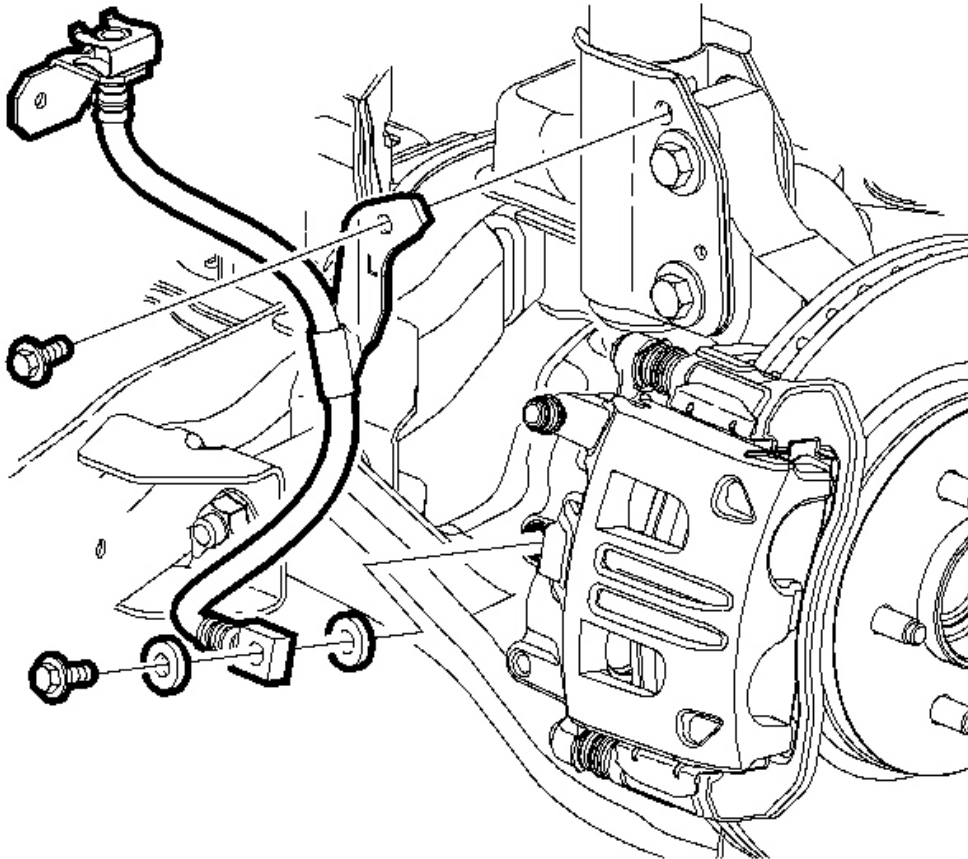


Fig. 67: Removing/Installing Front Brake Hose Bracket Retaining Bolt
Courtesy of GENERAL MOTORS CORP.

1. Remove the caps or plugs from the opening in the brake caliper and the brake hose.

IMPORTANT: Install NEW copper brake hose gaskets.

2. Assemble the NEW copper brake hose gaskets, and the brake hose bolt, to the brake hose.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the brake hose-to-brake caliper bolt to the brake caliper.

Tighten: Tighten the bolt to 44 N.m (32 lb ft).

4. Install the front brake hose bracket retaining bolt.

Tighten: Tighten the bolt to 12 N.m (106 lb in).

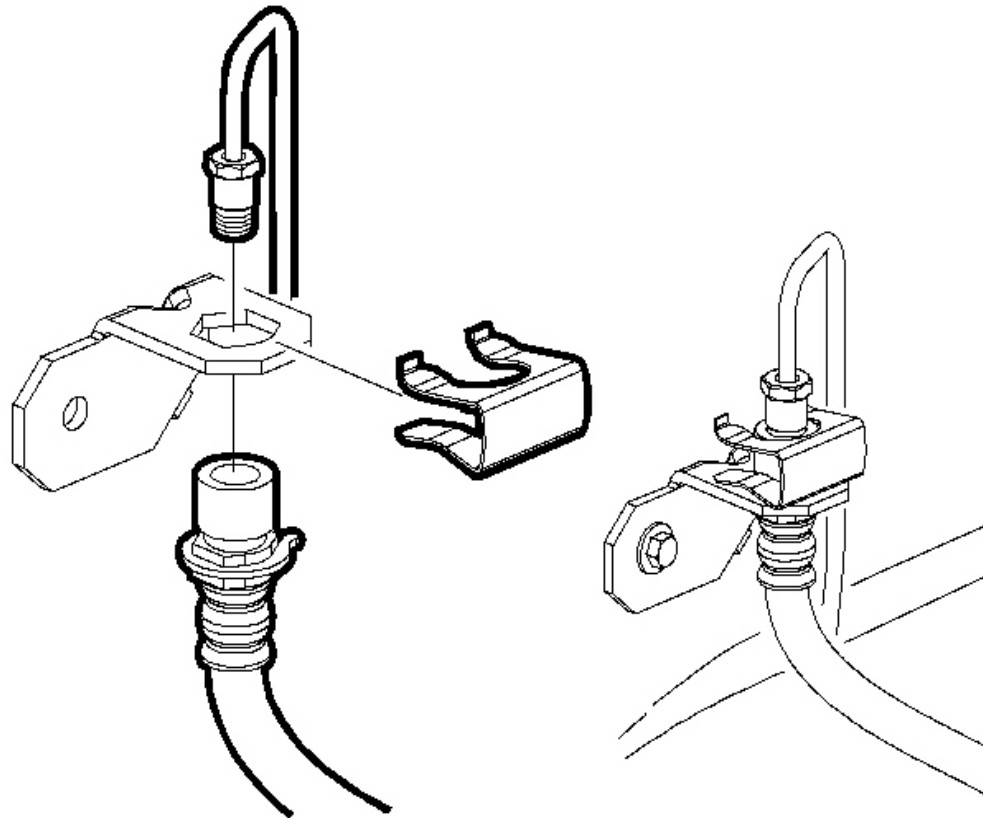


Fig. 68: Removing/Installing Brake Hose
Courtesy of GENERAL MOTORS CORP.

5. Remove the caps or plugs from the brake pipe fitting end and the brake hose end.
6. Using a backup wrench on the hose fitting, connect the brake pipe fitting at the front brake hose.

Tighten: Tighten the fitting to 18 N.m (13 lb ft).

7. Install the brake hose retaining clip to the brake hose and the brake hose mounting bracket.
8. Connect the wheel speed sensor wire harness and harness retainers to the front brake hose.
9. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
10. Ensure that the hose does not make contact with any part of the suspension. Check the hose in extreme right and extreme left turn conditions. If the hose makes contact, remove the hose and correct the condition.
11. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)** .
12. Lower the vehicle.

BRAKE HOSE REPLACEMENT - REAR

CAUTION: Refer to **Brake Fluid Irritant Caution** in Cautions and Notices.

NOTE: Refer to **Brake Fluid Effects on Paint and Electrical Components Notice** in Cautions and Notices.

Removal Procedure

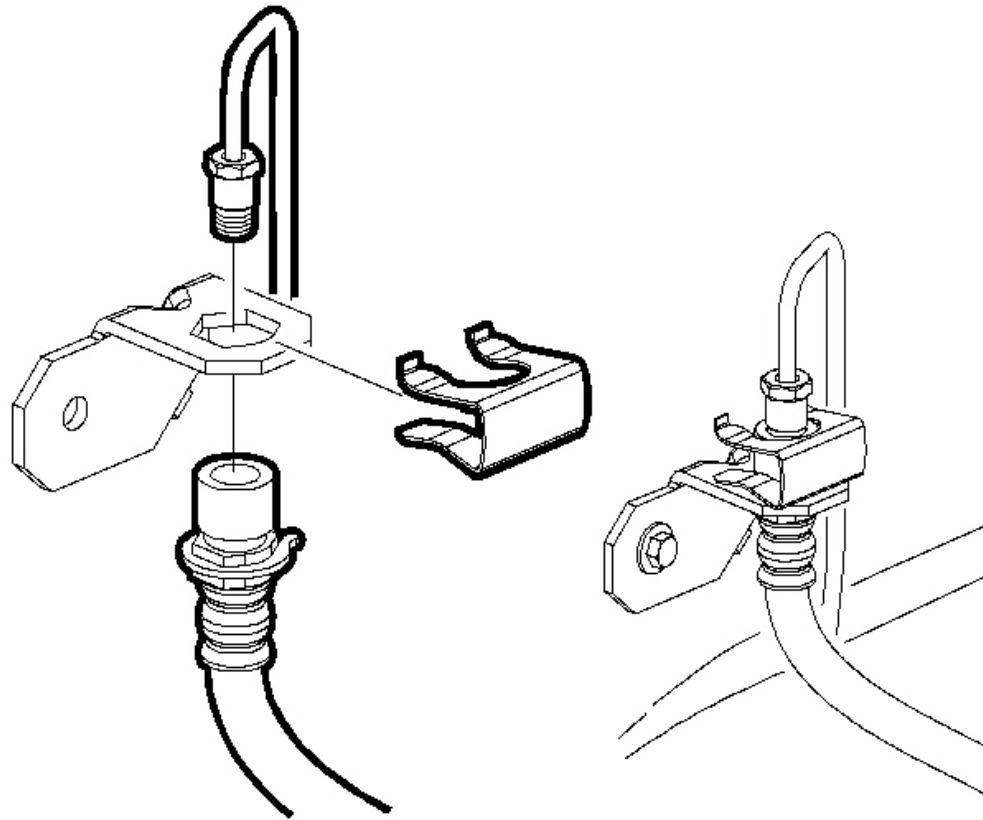


Fig. 69: Removing/Installing Brake Hose
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
3. Clean all dirt and foreign material from the brake hose ends and brake pipe fittings.
4. Using a backup wrench on the hose fitting, disconnect the brake pipe fittings from the brake hose. Cap or plug the brake pipe fitting ends and the brake hose ends to prevent fluid loss and contamination.
5. Remove the brake hose retaining clips from the hose mounting brackets.
6. Remove the hose from the mounting brackets.

Installation Procedure

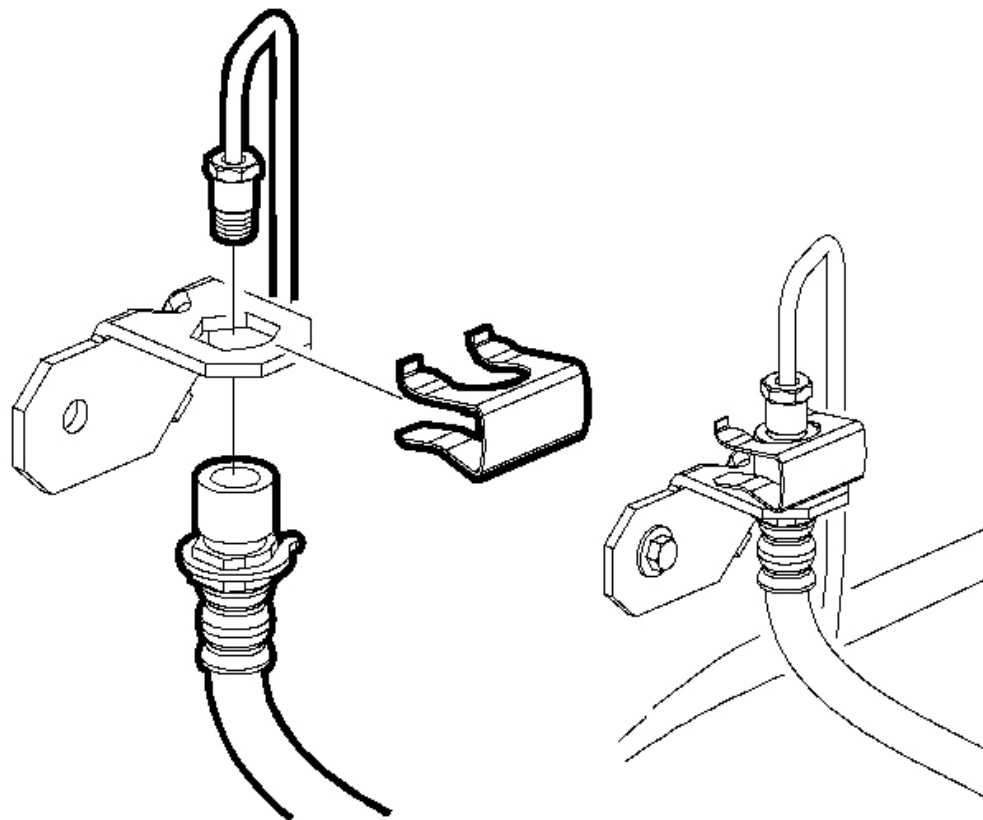


Fig. 70: Removing/Installing Brake Hose
Courtesy of GENERAL MOTORS CORP.

1. Install the brake hose to the brake hose mounting brackets. Align the hose fittings with the notch in the brackets.
2. Install the hose retaining clips onto the hose fittings at the hose brackets.

NOTE: Refer to Fastener Notice in **Cautions and Notices**.

3. Using a backup wrench on the hose fitting, connect the brake pipe fittings at the rear brake hose.

Tighten: Tighten the fittings to 18 N.m (13 lb ft).

4. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
5. Ensure that the hose does not make contact with any part of the suspension. If the hose makes contact, remove the hose and correct the condition.
6. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)** .
7. Lower the vehicle.

HYDRAULIC BRAKE SYSTEM BLEEDING (MANUAL)

CAUTION: Refer to **Brake Fluid Irritant Caution** in Cautions and Notices.

NOTE: When adding fluid to the brake master cylinder reservoir, use only GM approved 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.

NOTE: Refer to **Brake Fluid Effects on Paint and Electrical Components Notice** in Cautions and Notices.

1. Place a clean shop cloth beneath the brake master cylinder to catch 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, or if you have disconnected the brake pipes from the proportioning valve assembly or the brake modulator assembly, you must perform the following steps to bleed air at the ports of the hydraulic component:
 1. If removal of the reservoir cap and diaphragm is necessary, clean the outside of the reservoir on and around the cap prior to removal.
 2. With the brake pipes installed securely to the master cylinder, proportioning valve assembly, or brake modulator assembly, loosen and separate one of the brake pipes from the port of the component.

For the proportioning valve assembly or the brake modulator assembly, perform these steps in the sequence of system flow; begin with the fluid feed pipes from the master cylinder.

3. Allow a small amount of brake fluid to gravity bleed from the open port of the component.
4. Reconnect the brake pipe to the component and tighten securely.
5. Have an assistant slowly depress the brake pedal fully and maintain steady pressure on the pedal.

6. Loosen the same brake pipe to purge air from the open port of the component.
 7. Tighten the brake pipe, then have the assistant slowly release the brake pedal.
 8. Wait 15 seconds, then repeat steps 3.3-3.7 until all air is purged from the same port of the component.
 9. With the brake pipe installed securely to the master cylinder, proportioning valve assembly, or brake modulator assembly, and after all air has been purged from the first port of the component that was bled, loosen and separate the next brake pipe from the component, then repeat steps 3.3-3.8 until each of the ports on the component has been bled.
 10. After completing the final component port bleeding procedure, ensure that each of the brake pipe-to-component fittings is properly tightened.
4. Ensure 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. Have an assistant slowly depress the brake pedal fully and maintain steady pressure on the pedal.
8. Loosen the bleeder valve to purge air from the wheel hydraulic circuit.
9. Tighten the bleeder valve, then have the assistant slowly release the brake pedal.
10. Wait 15 seconds, then repeat steps 8-10 until all air is purged from the same wheel hydraulic circuit.
11. With the right rear wheel hydraulic circuit bleeder valve tightened securely, and 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.
12. Install a transparent hose over the end of the bleeder valve, then repeat steps 7-11.
13. With the left front wheel hydraulic circuit bleeder valve tightened securely, and 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.
14. Install a transparent hose over the end of the bleeder valve, then repeat steps 7-11.
15. With the left rear wheel hydraulic circuit bleeder valve tightened securely, and 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.
16. Install a transparent hose over the end of the bleeder valve, then repeat steps 7-11.
17. After completing the final wheel hydraulic circuit bleeding procedure, ensure that each of the 4 wheel hydraulic circuit bleeder valves is properly tightened.
18. Slowly depress and release the brake pedal. Observe the feel of the brake pedal.
19. 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:
 1. Inspect the brake system for external leaks. Refer to **Brake System External Leak Inspection**.
 2. Pressure bleed the hydraulic brake system in order to purge any air that may still be trapped in the

system.

20. Turn the ignition key ON, with the engine OFF. Check to see if the brake system warning lamp remains illuminated.

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

21. If the brake system warning lamp remains illuminated. Refer to Symptoms - Hydraulic Brakes .

HYDRAULIC BRAKE SYSTEM BLEEDING (PRESSURE)

Tools Required

- **J 29532** Diaphragm Type Brake Pressure Bleeder, or equivalent. See Special Tools and Equipment .
- **J 44894-A** Brake Pressure Bleeder Adapter. See Special Tools and Equipment .

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: When adding fluid to the brake master cylinder reservoir, use only GM approved 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.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

1. Place a clean shop cloth beneath the brake master cylinder to catch brake fluid spills.
2. With the ignition OFF and the brakes cool, apply the brakes 3-5 times, or until the brake pedal becomes firm, 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, or if you have disconnected the brake pipes from the proportioning valve assembly or the brake modulator assembly, you must perform the following steps to bleed air at the ports of the hydraulic component:
 1. If removal of the reservoir cap and diaphragm is necessary, clean the outside of the reservoir on and around the cap prior to removal.
 2. With the brake pipes installed securely to the master cylinder, proportioning valve assembly, or brake modulator assembly, loosen and separate one of the brake pipes from the port of the component.

For the proportioning valve assembly or the brake modulator assembly, perform these steps in the sequence of system flow; begin with the fluid feed pipes from the master cylinder.

3. Allow a small amount of brake fluid to gravity bleed from the open port of the component.
 4. Reconnect the brake pipe to the component and tighten securely.
 5. Have an assistant slowly depress the brake pedal fully and maintain steady pressure on the pedal.
 6. Loosen the same brake pipe to purge air from the open port of the component.
 7. Tighten the brake pipe, then have the assistant slowly release the brake pedal.
 8. Wait 15 seconds, then repeat steps 3.3-3.7 until all air is purged from the same port of the component.
 9. With the brake pipe installed securely to the master cylinder, proportioning valve assembly, or brake modulator assembly, and after all air has been purged from the first port of the component that was bled, loosen and separate the next brake pipe from the component, then repeat steps 3.3-3.8 until each of the ports on the component has been bled.
 10. After completing the final component port bleeding procedure, ensure that each of the brake pipe-to-component fittings is properly tightened.
4. Clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm.
 5. Install the **J 44894-A** to the brake master cylinder reservoir. See **Special Tools and Equipment** .
 6. Connect the **J 29532** , or equivalent, to the **J 44894-A** . See **Special Tools and Equipment** .
 7. Charge the **J 29532** , or equivalent, air tank to 175-205 kPa (25-30 psi). See **Special Tools and Equipment** .
 8. Open the **J 29532** , or equivalent, fluid tank valve to allow pressurized brake fluid to enter the brake system. See **Special Tools and Equipment** .
 9. 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.

10. Install a proper box-end wrench onto the RIGHT REAR wheel hydraulic circuit bleeder valve.
11. Install a transparent hose over the end of the bleeder valve.
12. 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.
13. With the right rear wheel hydraulic circuit bleeder valve tightened securely, and 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.
14. Install a transparent hose over the end of the bleeder valve, then repeat steps 13-14.
15. With the left front wheel hydraulic circuit bleeder valve tightened securely, and 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.
16. Install a transparent hose over the end of the bleeder valve, then repeat steps 13-14.
17. With the left rear wheel hydraulic circuit bleeder valve tightened securely, and 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.

18. Install a transparent hose over the end of the bleeder valve, then repeat steps 13-14.
19. After completing the final wheel hydraulic circuit bleeding procedure, ensure that each of the 4 wheel hydraulic circuit bleeder valves is properly tightened.
20. Close the **J 29532** , or equivalent, fluid tank valve, then disconnect the **J 29532** , or equivalent, from the **J 44894-A** . See **Special Tools and Equipment** .
21. Remove the **J 44894-A** from the brake master cylinder reservoir. See **Special Tools and Equipment** .
22. Slowly depress and release the brake pedal. Observe the feel of the brake pedal.
23. If the brake pedal feels spongy perform the following steps:
 1. Inspect the brake system for external leaks. Refer to **Brake System External Leak Inspection** .
 2. If equipped with anti-lock brakes, 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). Refer to **ABS Automated Bleed Procedure** in Anti-lock Brake System.
24. Turn the ignition key ON, with the engine OFF. Check to see if the brake system warning lamp remains illuminated.

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

25. If the brake system warning lamp remains illuminated. Refer to **Symptoms - Hydraulic Brakes** .

HYDRAULIC BRAKE SYSTEM FLUSHING

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: When adding fluid to the brake master cylinder reservoir, use only GM approved 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.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination:
 - Fluid separation, indicating two types of fluid are present; a substance other than the recommended brake fluid has been introduced into the brake hydraulic system
 - Swirled appearance-Oil-based substance
 - Layered appearance-Silicone-based substance
 - Fluid discoloration, indicating the presence of moisture or particles that have been introduced into the brake hydraulic system
 - Cloudy appearance-Moisture

- Dark appearance/suspended particles in fluid-Dirt, rust, corrosion, brake dust
- 2. Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating brake fluid contamination.
- 3. If the brake fluid WAS contaminated with an oil-based or a silicone-based substance, indicated by fluid separation and/or a swollen master cylinder reservoir cap diaphragm and/or swollen reservoir-to-master cylinder grommets, perform the following:
 1. Remove ALL of the following components listed from the vehicle. Each component contains internal rubber seals/linings which have been contaminated by the contaminated brake fluid in the brake hydraulic system.

Refer to the procedures indicated:

- **Master Cylinder Reservoir Replacement**
 - **Master Cylinder Replacement**
 - **Brake Hose Replacement - Front**
 - **Brake Hose Replacement - Rear**
 - **Brake Caliper Replacement** in Disc Brakes
 - **Wheel Cylinder Replacement** in Drum Brakes
 - **Proportioning Valve Replacement** , if equipped
 - **Brake Modulator Assembly Replacement** , if equipped, in Antilock Brake System
2. Clean out all 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 and install them to the vehicle. Each component contains internal rubber seals/linings which have been contaminated by the contaminated brake fluid in the brake hydraulic system.

Refer to the procedures indicated:

- **Master Cylinder Reservoir Replacement**

Replace the brake master cylinder reservoir cap diaphragm.

- **Master Cylinder Replacement** ; also perform the following:

Clean the brake master cylinder reservoir using denatured alcohol, or equivalent, then dry the reservoir using non-lubricated, filtered air. Inspect the reservoir for cracks and/or damage and replace if necessary. Refer to **Master Cylinder Reservoir Replacement** .

- **Brake Hose Replacement - Front**
- **Brake Hose Replacement - Rear**
- **Brake Caliper Replacement** in Disc Brakes
- **Wheel Cylinder Replacement** in Drum Brakes

- **Proportioning Valve Replacement** , if equipped
 - **Brake Modulator Assembly Replacement** , if equipped, in Antilock Brake System
4. If the brake fluid was NOT contaminated with an oil-based or a silicone-based substance, 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 the moisture or particles to enter the hydraulic system.
 5. Pressure bleed the hydraulic brake system; begin the procedure with the pressure bleeder reservoir filled to the maximum-fill level with the correct brake fluid as indicated. Refer to **Hydraulic Brake System Bleeding (Manual)Hydraulic Brake System Bleeding (Pressure)** .

VACUUM BRAKE BOOSTER REPLACEMENT

Removal Procedure

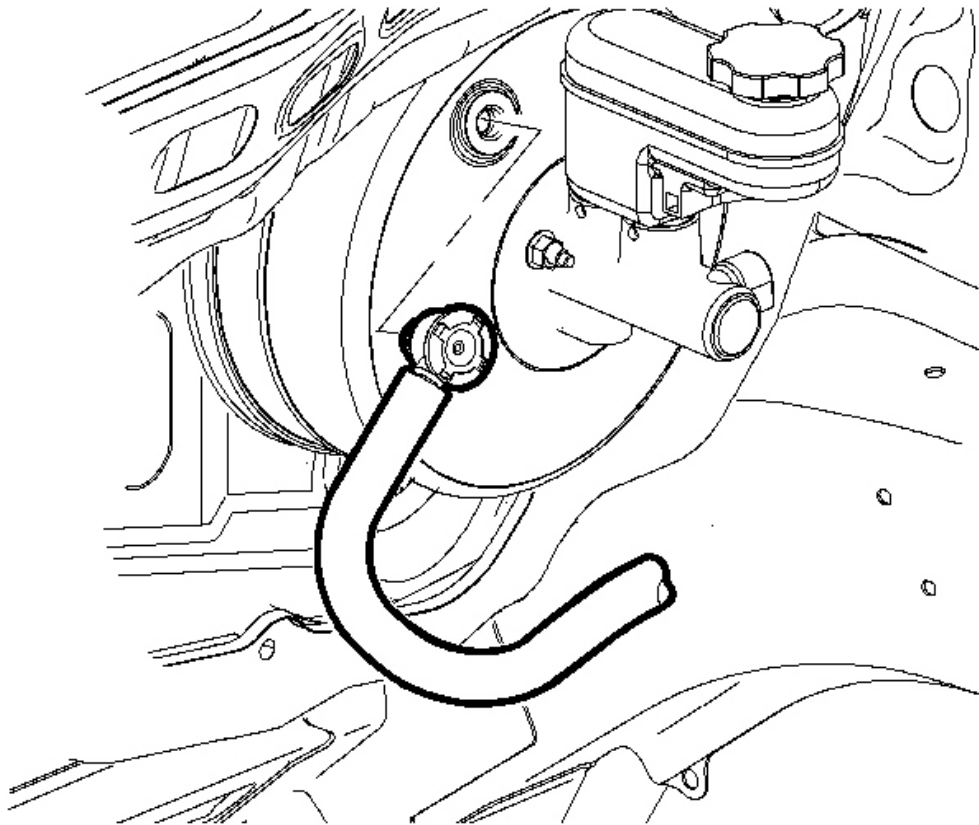


Fig. 71: Removing/Installing Vacuum Booster Check Valve & Hose Assembly
Courtesy of GENERAL MOTORS CORP.

1. Disconnect and remove the battery. Refer to **Battery Replacement** in Engine Electrical.
2. Remove and position aside the underhood electrical center. Refer to **Underhood Electrical Center or Junction Block Replacement** in Wiring Systems.
3. Remove the battery tray. Refer to **Battery Tray Replacement (L61)** or **Battery Tray Replacement (L66)** in Engine Electrical.
4. Disconnect the coolant surge hose from the surge tank and position aside.
5. Remove the master cylinder mounting nuts. Do NOT disconnect the brake pipes from the master cylinder.
6. Carefully pull the master cylinder away from the vacuum booster and position aside.
7. Disconnect the vacuum booster check valve and hose assembly from the booster. Refer to **Vacuum**

Brake Booster Check Valve and/or Hose Replacement .

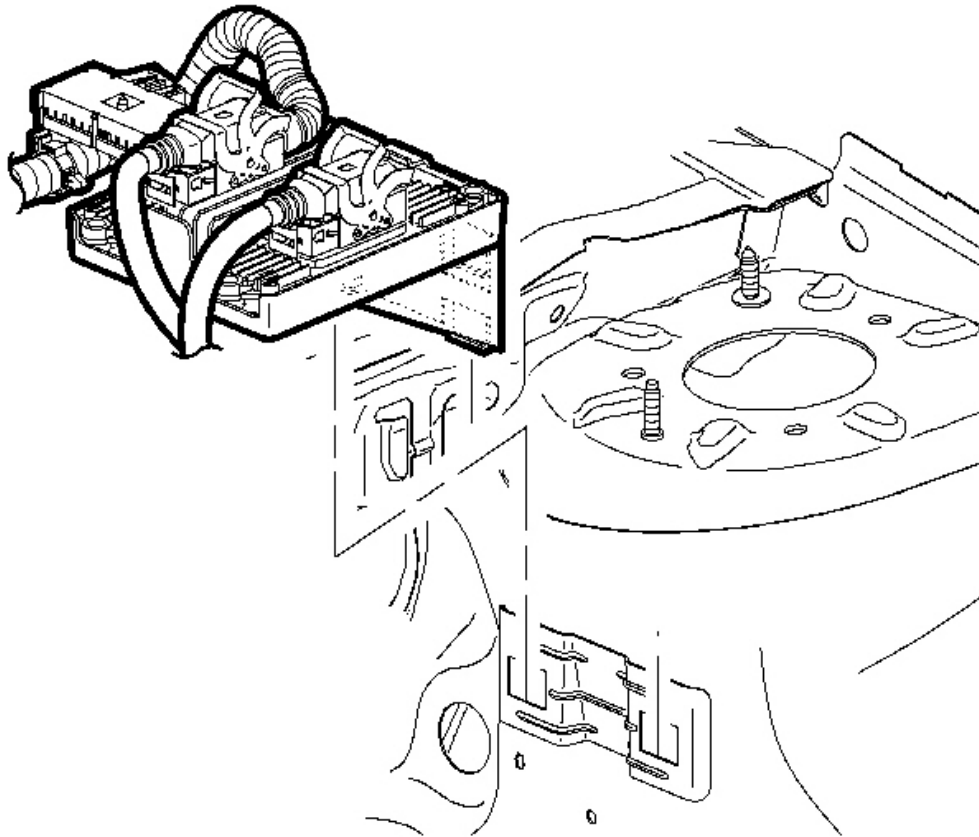


Fig. 72: Removing/Installing Transaxle Control Module (TCM)
Courtesy of GENERAL MOTORS CORP.

8. Remove the transaxle control module (TCM) and position over engine.
9. Remove the brake modulator assembly, if equipped. Refer to **Brake Modulator Assembly Replacement** in Anti-lock Brake System.

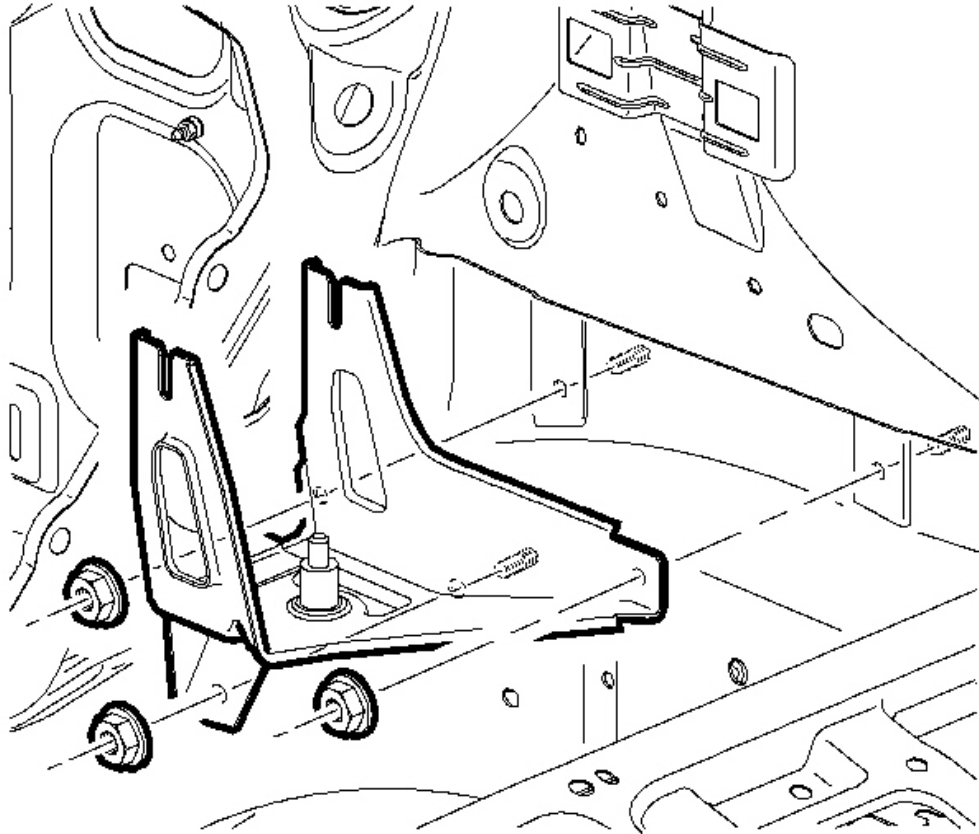


Fig. 73: Removing/Installing Brake Modulator Valve Bracket
Courtesy of GENERAL MOTORS CORP.

10. Remove the brake modulator valve bracket, if equipped. Refer to **Brake Pressure Modulator Valve (BPMV) Bracket Replacement** in Anti-lock Brake System.

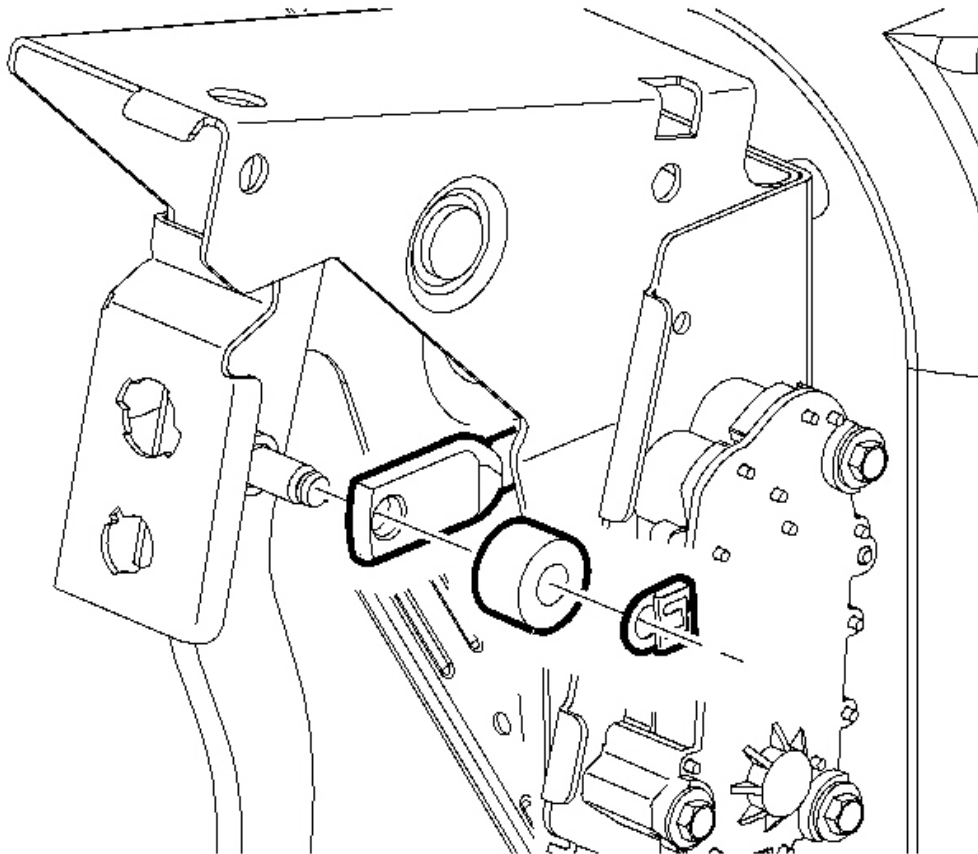


Fig. 74: Removing/Installing Washer & Retaining Clip To Brake Pedal
Courtesy of GENERAL MOTORS CORP.

11. Remove the brake booster push rod-to-brake pedal retaining clip.
12. Remove the foam washer from the brake pedal assembly.

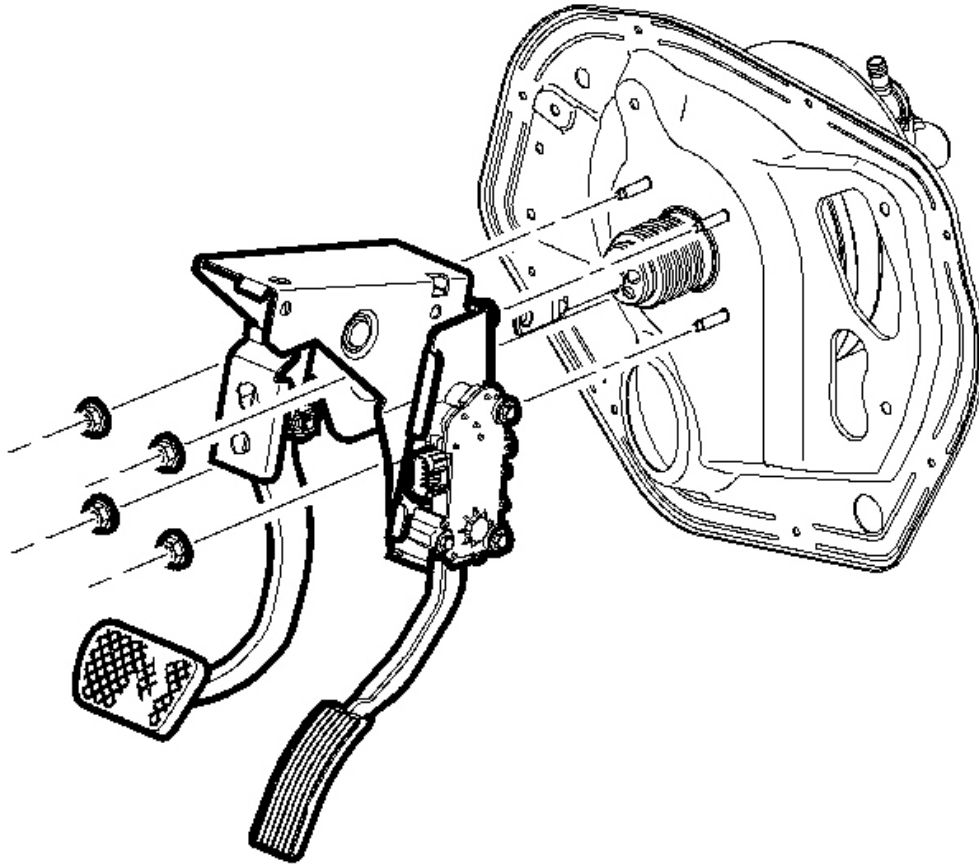


Fig. 75: Removing/Installing Brake Pedal Assembly
Courtesy of GENERAL MOTORS CORP.

13. Remove the brake booster mounting nuts.

IMPORTANT: Ensure that the foam insulator on the mounting surface of the brake booster withdraws with the booster.

14. Disengage the brake booster from the front of dash and the brake pedal bracket. Maneuver the booster toward the center of the vehicle in order to ease removal.

Installation Procedure

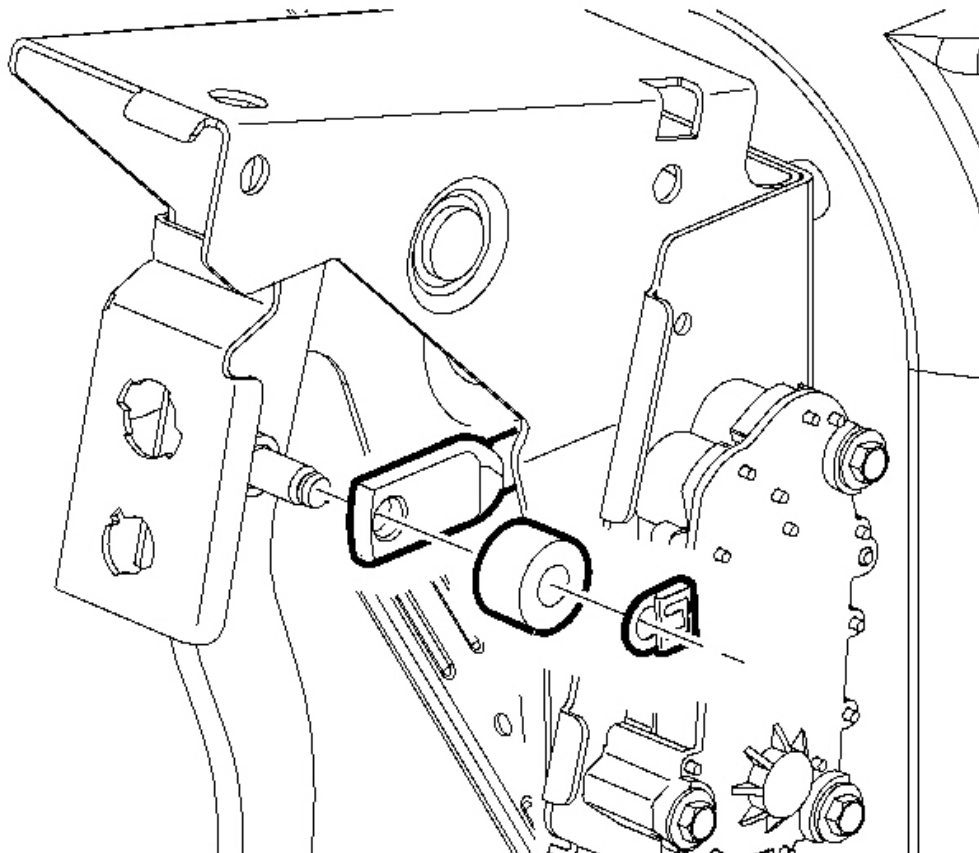


Fig. 76: Removing/Installing Washer & Retaining Clip To Brake Pedal
Courtesy of GENERAL MOTORS CORP.

1. Install the foam insulator the vacuum brake booster.
2. Install the brake booster to the vehicle.
3. Install, but do not tighten, the booster mounting nuts.
4. Lightly lubricate the booster push rod pivot pin on the brake pedal with silicone lubricant.
5. Install the booster push rod to the pivot pin on the brake pedal.
6. Install the foam washer to the pivot pin.
7. Install the brake booster push rod retaining clip.

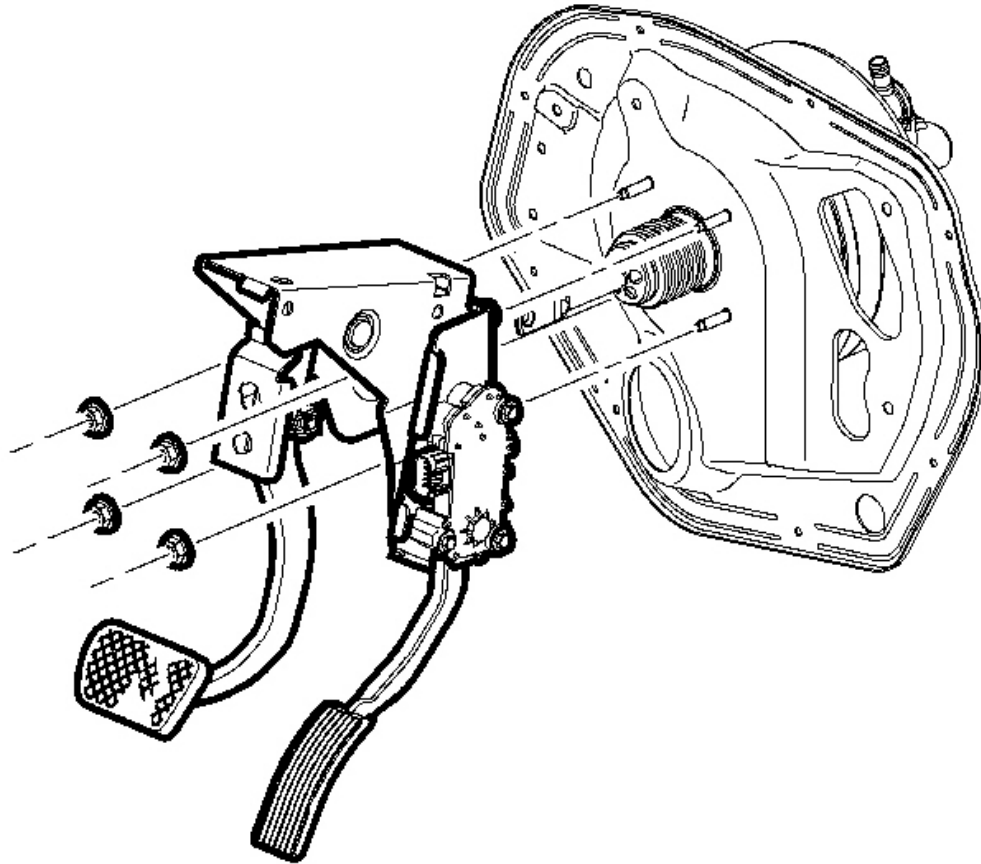


Fig. 77: Removing/Installing Brake Pedal Assembly
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

8. Fully seat the brake booster to the front of dash and the brake pedal assembly.
9. Tighten the vacuum brake booster mounting nuts.

Tighten: Tighten the nuts to 25 N.m (18 lb ft).

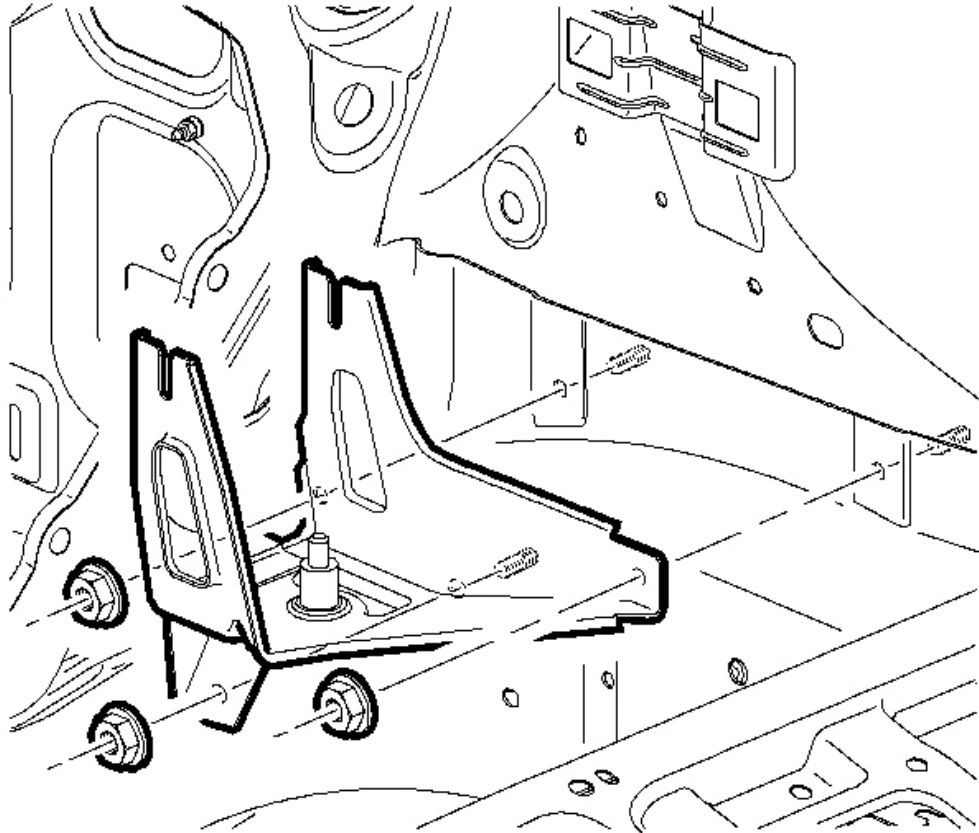


Fig. 78: Removing/Installing Brake Modulator Valve Bracket
Courtesy of GENERAL MOTORS CORP.

10. Install the brake modulator valve bracket, if equipped. Refer to **Brake Pressure Modulator Valve (BPMV) Bracket Replacement** in Anti-lock Brake System.
11. Install the brake modulator assembly, if equipped. Refer to **Brake Modulator Assembly Replacement** in Anti-lock Brake System.

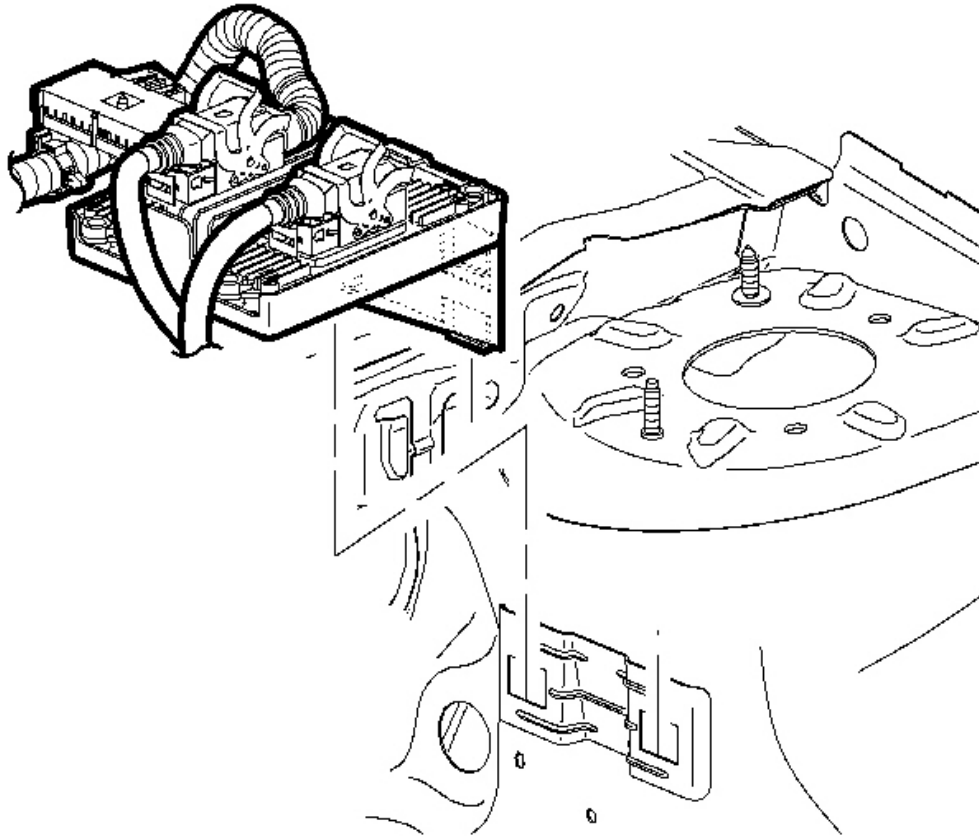


Fig. 79: Removing/Installing Transaxle Control Module (TCM)
Courtesy of GENERAL MOTORS CORP.

12. Install the transaxle control module (TCM) to the bracket.

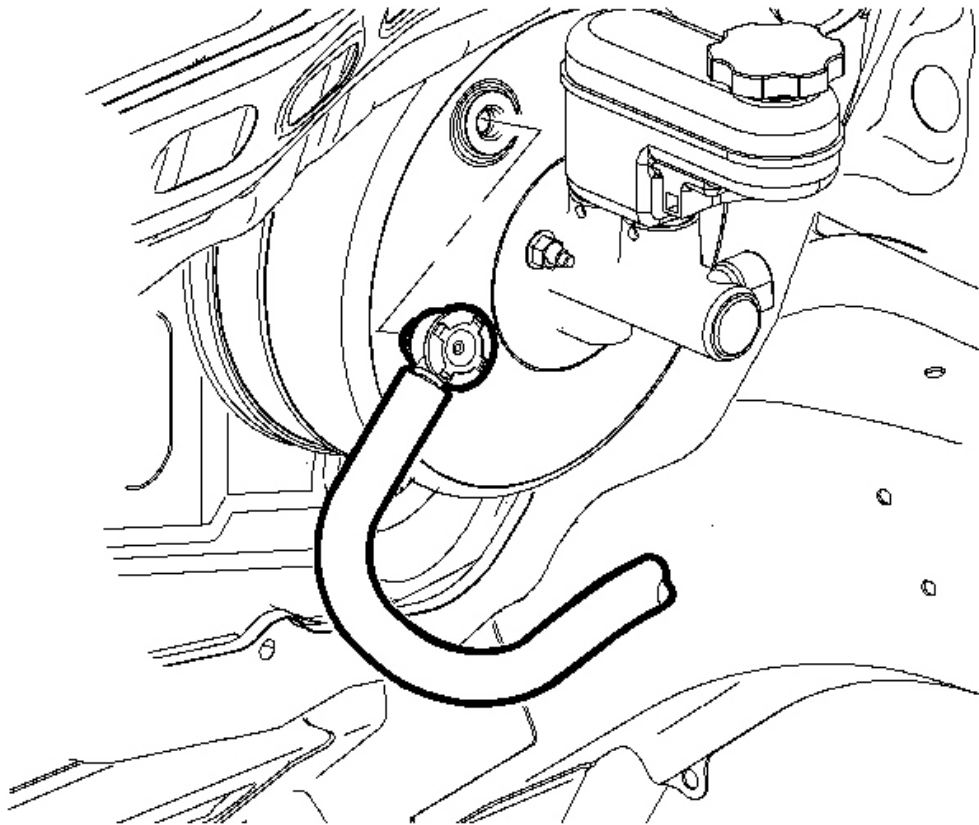


Fig. 80: Removing/Installing Vacuum Booster Check Valve & Hose Assembly
Courtesy of GENERAL MOTORS CORP.

13. Install the vacuum booster check valve and hose assembly to the booster.
14. Reposition and install the master cylinder to the booster. Refer to **Master Cylinder Replacement** .

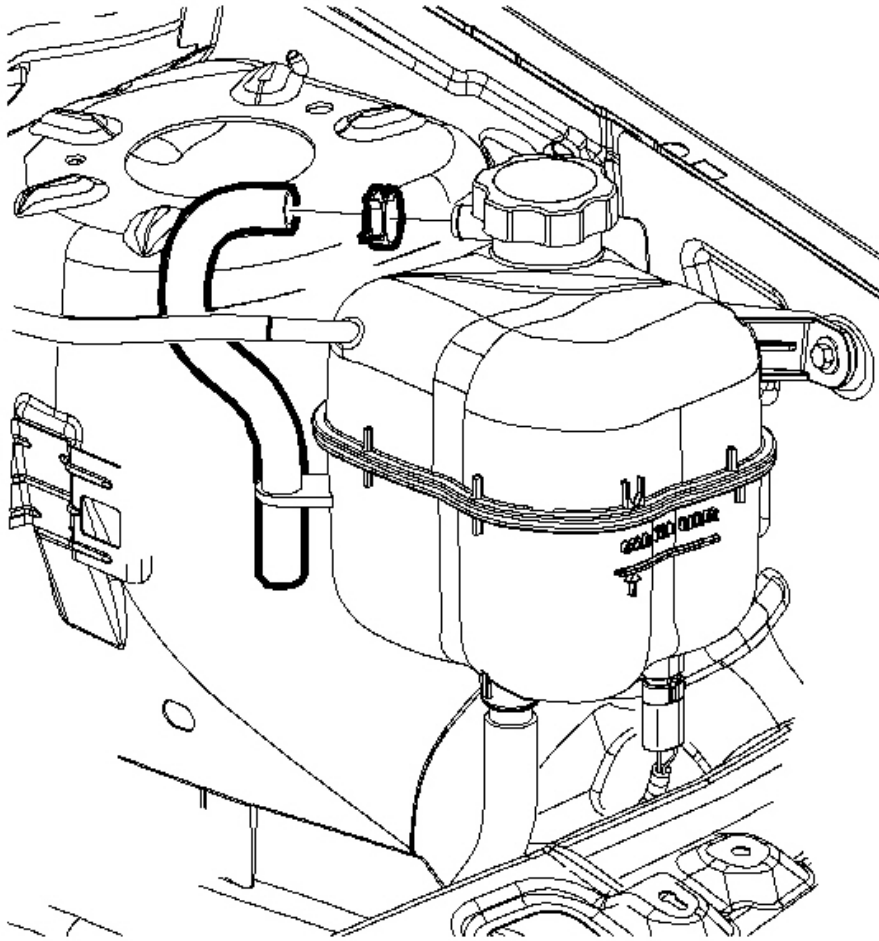


Fig. 81: Installing Coolant Surge Hose & Clamp
Courtesy of GENERAL MOTORS CORP.

15. Install the coolant surge hose and clamp to the surge tank.
16. Install the battery tray. Refer to **Battery Tray Replacement (L61)** or **Battery Tray Replacement (L66)** in Engine Electrical.
17. Install the underhood electrical center. Refer to **Underhood Electrical Center or Junction Block Replacement** in Wiring Systems.
18. Install and connect the battery. Refer to **Battery Replacement** in Engine Electrical.
19. If necessary, bleed the brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)** .

VACUUM BRAKE BOOSTER CHECK VALVE AND/OR HOSE REPLACEMENT

Removal Procedure

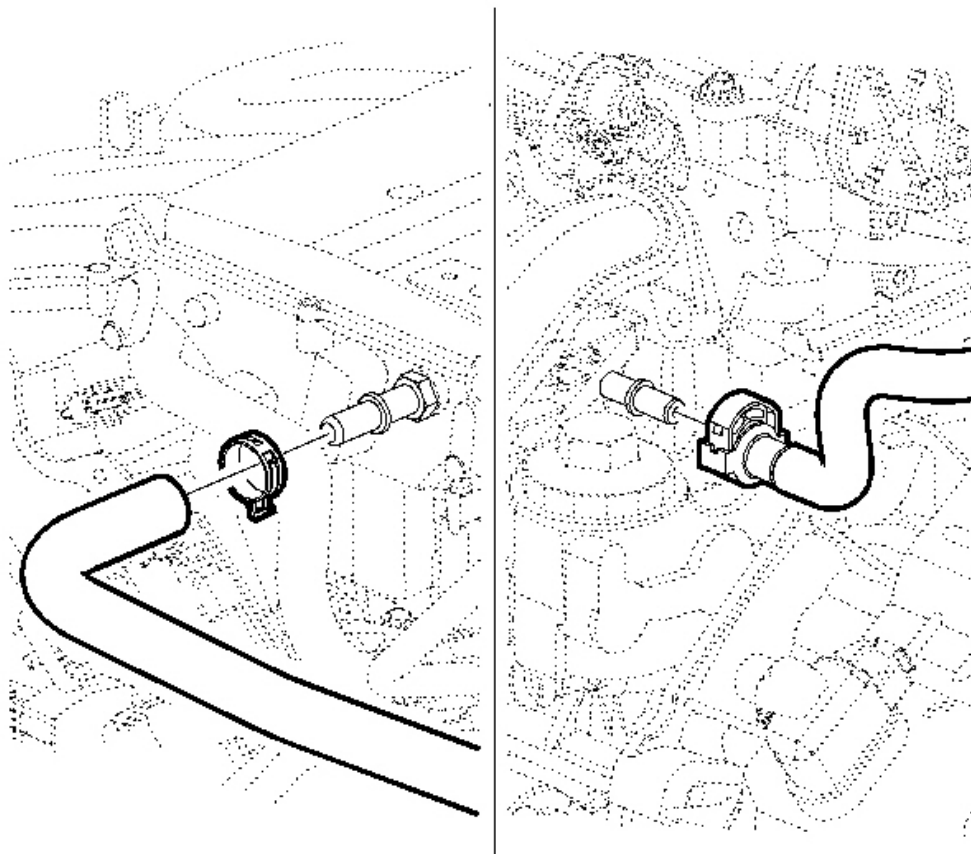


Fig. 82: View Of Vacuum Brake Booster Check Valve & Hose
Courtesy of GENERAL MOTORS CORP.

1. Release the retaining clamp and remove the vacuum hose from the vacuum port on the engine.

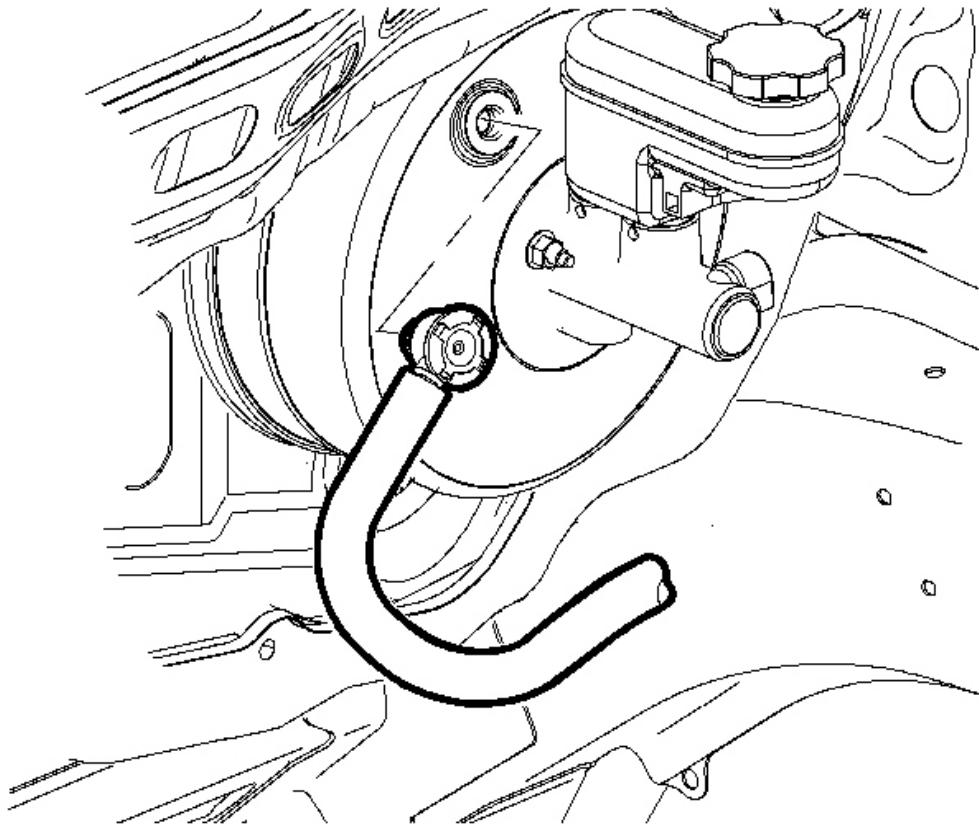


Fig. 83: Removing/Installing Vacuum Booster Check Valve & Hose Assembly
Courtesy of GENERAL MOTORS CORP.

2. Remove the check valve and hose from the brake booster by gently turning the check valve right then left while pulling straight out from the grommet.
3. Remove the vacuum hose from the check valve.

Installation Procedure

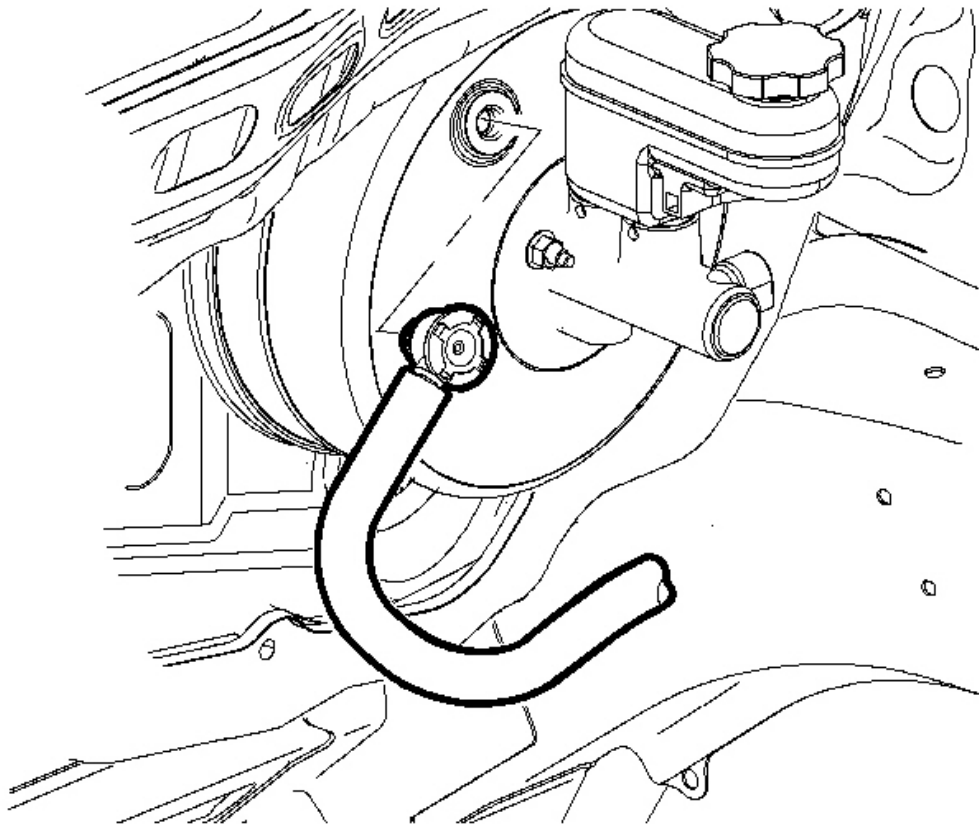


Fig. 84: Removing/Installing Vacuum Booster Check Valve & Hose Assembly
Courtesy of GENERAL MOTORS CORP.

1. Install the vacuum hose to the check valve.
2. Install the brake booster check valve and hose assembly to the booster.

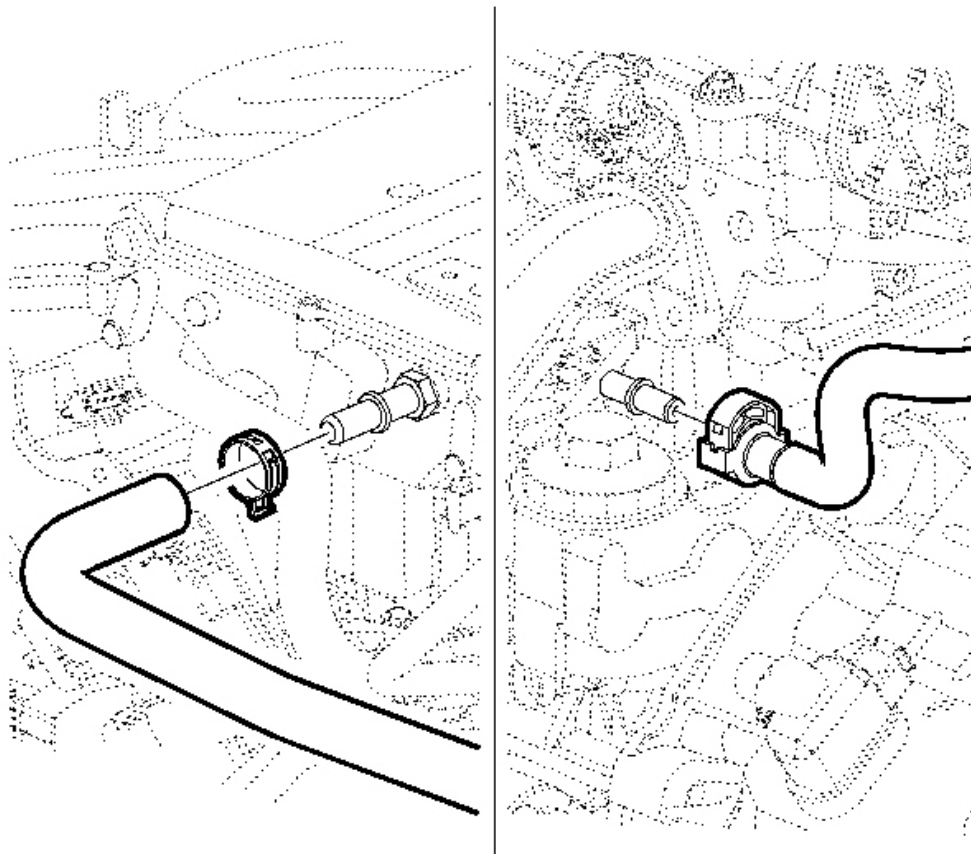


Fig. 85: View Of Vacuum Brake Booster Check Valve & Hose
Courtesy of GENERAL MOTORS CORP.

3. Install the vacuum hose to the engine vacuum port.
4. Install the vacuum hose clamp.

DESCRIPTION AND OPERATION

BRAKE WARNING SYSTEM DESCRIPTION AND OPERATION

Brake System Indicator

The IPC illuminates the brake indicator when the following occurs:

- The body control module (BCM) detects that the park brake is engaged. The IPC receives a class 2 message from the BCM requesting illumination. If the vehicle is shifted out of park with the park brake engaged, the BCM activates an audible warning.
- The body control module (BCM) detects a low brake fluid condition (signal circuit is low). The IPC receives a class 2 message from the BCM requesting illumination.
- The IPC performs the displays test at the start of each ignition cycle. The indicator illuminates for approximately 3 seconds.

HYDRAULIC BRAKE SYSTEM DESCRIPTION AND OPERATION

System Component 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.

Hydraulic Brake Master Cylinder

Converts mechanical input force into hydraulic output pressure.

Hydraulic output pressure is distributed from the master cylinder through two hydraulic circuits, supplying diagonally-opposed wheel apply circuits.

Hydraulic Brake Pressure Balance Control System

Regulates brake fluid pressure delivered to hydraulic brake wheel circuits, in order to control the distribution of braking force.

Pressure balance control on non-ABS equipped vehicles, is achieved through a proportioning valve assembly.

Pressure balance control on ABS equipped vehicles, is achieved through dynamic rear proportioning (DRP), which is a function of the ABS modulator. Refer to **ABS Description and Operation** in Anti-lock Brake System 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.

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 AND OPERATION

System Component 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

Uses source vacuum to decrease effort required by driver when applying brake system input force. 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.

System Operation

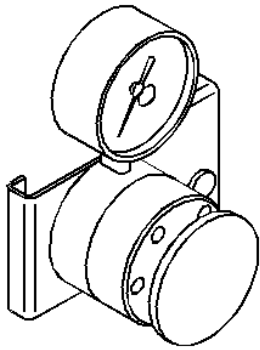
Brake system input force is multiplied by the brake pedal and transferred by the pedal pushrod to the hydraulic brake master cylinder. Effort required to apply the brake system is reduced by the vacuum brake booster.

SPECIAL TOOLS AND EQUIPMENT

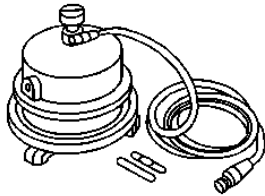
SPECIAL TOOLS

Special Tools

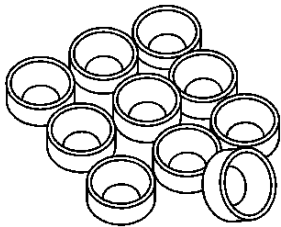
Illustration	Tool Number/ Description



J 28662
Brake Pedal Effort Gage

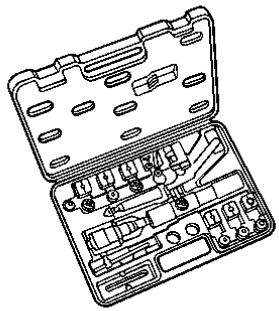


J 29532
Diaphragm Type Brake Pressure Bleeder



J 44894-A
Brake Pressure Bleeder Adapter

J 45405
Brake Pipe Flaring Kit



2004 BRAKES

Park Brake - Vue

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Park Brake Cable Bracket-to-Trailing Arm Bolt and Nut	12 N.m	106 lb in
Park Brake Cable Bracket-to-Underbody Bolt	25 N.m	18 lb ft
Park Brake Lever Assembly Mounting Nuts	25 N.m	18 lb ft
Park Brake Lever Cover Screw	4 N.m	35 lb in
Park Brake Warning Lamp Switch Mounting Screw	3 N.m	27 lb in

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - PARK BRAKE

Begin the system diagnosis by reviewing the system description and 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. Refer to **Symptoms - Park Brake** in order to identify the correct procedure for diagnosing the system and where the procedure is located.

SYMPTOMS - PARK BRAKE

IMPORTANT: Review the system operation in order to familiarize yourself with the system functions.

Refer to **Park Brake System Description and Operation** .

Visual/Physical Inspection

- 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.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

Park Brake Will Not Hold or Release

PARK BRAKE WILL NOT HOLD OR RELEASE

Park Brake Will Not Hold or Release

Step	Action	Yes	No
1	Were you sent here from the Park Brake Symptom Table?	Go to Step 2	Go to Diagnostic Starting Point - Park Brake
2	Inspect the park brake system for proper operation. Refer to Park Brake System Diagnosis . Did you find and correct a condition?	Go to Step 6	Go to Step 3
3	Inspect the drum brake system for proper operation. Refer to Drum Brake System Diagnosis in Hydraulic Brakes. Did you find and correct a condition?	Go to Step 6	Go to Step 4
4	Inspect the disc brake system for proper operation. Refer to Disc Brake System Diagnosis in Hydraulic Brakes. Did you find and correct a condition?	Go to Step 6	Go to Step 5
5	Inspect the hydraulic brake system for proper operation. Refer to Hydraulic Brake System Diagnosis in Hydraulic Brakes. Did you find and correct a condition?	Go to Step 6	Go to Diagnostic Starting Point - Park Brake
6	Road test the vehicle in order to confirm proper operation. Refer to Brake System Vehicle Road Test in Hydraulic Brakes. Is the condition still present?	Go to Step 2	System OK

PARK BRAKE SYSTEM DIAGNOSIS

Park Brake System Diagnosis

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the PARK brake system in order to determine if the PARK brake system is operating properly. You will be directed by the appropriate symptom table to go to other brake system diagnostic tables as appropriate.			
1	Were you sent here from a hydraulic brake symptom table?	Go to Step 4	Go to Step 2
2	Were you sent here from a park brake symptom table?	Go to Step 4	Go to Step 3
3	Is the symptom related to the ability of the park brake system to hold and/or release?	Go to Diagnostic Starting Point - Park Brake	Go to Diagnostic Starting Point - Hydraulic Brakes in Hydraulic Brakes
4	1. Raise and support the vehicle with the rear axle supported by jack stands. Refer to Lifting and Jacking the Vehicle in General Information. 2. 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?	Go to Step 11	Go to Step 5
5	<ol style="list-style-type: none"> 1. Apply the park brake. 2. 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?	Go to Step 6	Go to Step 7
6	<ol style="list-style-type: none"> 1. Release the park brake. 2. 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?	Go to Step 20	Go to Step 11
7	<ol style="list-style-type: none"> 1. Remove the brake drums. Refer to <u>Brake Drum Replacement</u> in Drum Brakes. 2. Visually check the park brake cable connections and the cables that are accessible on the UNDERSIDE of the vehicle for disconnections and/or damage. 		
	Were any or the park brake cables disconnected and/or damaged?	Go to Step 8	Go to Step 9
8	Reconnect or replace the park brake cables as necessary. Refer to <u>Park Brake Cable Replacement - Rear</u> . Did you complete the repair and/or replacement?	Go to Step 9	-
9	Check the adjustment of the park brake. Refer to <u>Park Brake Adjustment</u> . Was the park brake adjusted properly?	Go to Step 11	Go to Step 10
10	Adjust the park brake. Refer to <u>Park Brake Adjustment</u> . Were you able to attain adjustment of the park brake?	Go to Step 16	Go to Step 11
11	<p>NOTE: Do not depress the brake pedal with the brake rotors and/or the brake drums removed, or with the brake calipers repositioned away from the brake rotors, or damage to the brake system may result.</p> <ol style="list-style-type: none"> 1. Remove the brake drums. Refer to <u>Brake Drum Replacement</u> in Drum Brakes. 2. Inspect the park brake hardware for loose, damaged, broken or missing components. Refer to <u>Park Brake Hardware Inspection</u> . 3. Check the drum brake adjusters for a seized 		

	condition.		
	Does the park brake hardware and/or the park brake adjusters require replacement?	Go to Step 12	Go to Step 13
12	<ol style="list-style-type: none"> 1. Replace park brake hardware components as necessary. Refer to <u>Brake Shoe Replacement</u> in Drum Brakes. 2. Replace the drum brake adjusting hardware as necessary. Refer to <u>Drum Brake Adjusting Hardware Replacement</u> in Drum Brakes. 		-
	Did you complete the replacement?	Go to Step 13	
13	<p>Have an assistant apply and release the park brake, while you observe the park brake cables for free movement.</p> <p>Did the park brake cables move freely?</p>	Go to Step 14	Go to Step 17
14	<p>Check the adjustment of the park brake. Refer to <u>Park Brake Adjustment</u> .</p> <p>Was the park brake adjusted properly?</p>	Go to Step 16	Go to Step 15
15	<p>Adjust the park brake. Refer to <u>Park Brake Adjustment</u> .</p> <p>Were you able to attain adjustment of the park brake?</p>	Go to Step 16	Go to Step 25
16	<ol style="list-style-type: none"> 1. Apply the park brake. 2. Attempt to rotate the rear wheels to check the rear brakes for a significant amount of drag. 3. Release the park brake. 4. Rotate the rear wheels to check the rear brakes for a significant reduction of drag. 		
	Did the park brake apply and release properly?	Go to Step 27	Return to Symptom Table
17	<ol style="list-style-type: none"> 1. Remove the brake drums. Refer to <u>Brake Drum Replacement</u> in Drum Brakes. 2. 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?	Go to Step 18	Go to Step 19
18	<p>Replace any of the park brake cables that do not have free movement, not releasing properly. Refer to <u>Park Brake Cable Replacement - Rear</u> .</p> <p>Did you complete the replacement?</p>	Go to Step 23	-

19	<p>Replace the park brake lever assembly, not releasing properly. Refer to <u>Park Brake Lever Assembly Replacement</u> .</p> <p>Did you complete the replacement?</p>	Go to Step 24	-
20	<p>Check the adjustment of the park brake. Refer to <u>Park Brake Adjustment</u> .</p> <p>Was the park brake adjusted properly?</p>	Go to Step 27	Go to Step 21
21	<p>Adjust the park brake. Refer to <u>Park Brake Adjustment</u> .</p> <p>Were you able to attain adjustment of the park brake system?</p>	Go to Step 26	Go to Step 22
22	<ol style="list-style-type: none"> 1. Remove the brake drums. Refer to <u>Brake Drum Replacement</u> in Drum Brakes. 2. Check the drum brake adjusters for a seized condition. 3. Replace the drum brake adjusting hardware as necessary. <p>Refer to <u>Drum Brake Adjusting Hardware Replacement</u> in Drum Brakes. Did you find and correct a condition?</p>	Go to Step 23	Go to Step 25
23	<p>Adjust the park brake. Refer to <u>Park Brake Adjustment</u> .</p> <p>Were you able to attain adjustment of the park brake system?</p>	Go to Step 26	Go to Step 25
24	<p>Adjust the park brake. Refer to <u>Park Brake Adjustment</u> .</p> <p>Were you able to attain adjustment of the park brake system?</p>	Go to Step 26	Return to Symptom Table
25	<ol style="list-style-type: none"> 1. Replace the component that is used to adjust the park brake system. Refer to <u>Park Brake Cable Replacement - Front</u> . 2. Adjust the park brake. Refer to <u>Park Brake Adjustment</u> . <p>Did you complete the replacement and adjustment?</p>	Go to Step 26	Return to Symptom Table
26	<ol style="list-style-type: none"> 1. Apply the park brake. 2. Attempt to rotate the rear wheels to check the rear brakes for a significant amount of drag. 3. Release the park brake. 4. Rotate the rear wheels to check the rear brakes for a significant reduction of drag. 		Return to Symptom

	Did the park brake apply and release properly?	Go to Step 27	Table
27	Install or connect any components that were removed or disconnected during diagnosis. Did you complete the operation?	Park Brake System OK Return to Symptom Table	-

PARK BRAKE HARDWARE INSPECTION

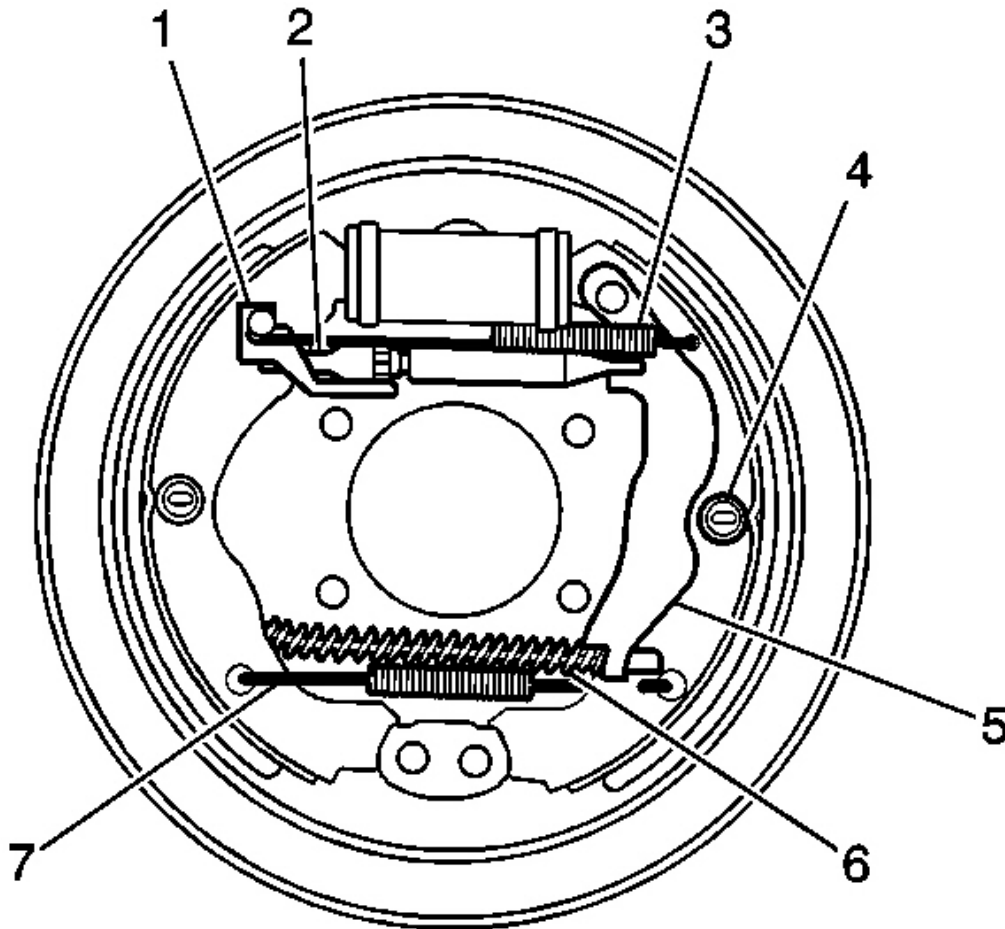


Fig. 1: View Of Brake Components
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

1. With the brake drums removed, visually inspect the upper return/adjuster actuator spring (3) and the lower return spring (7) for the following:
 - Excessive corrosion
 - Excessive stretching
 - Broken hook ends
 - Twisting or binding
2. If any of the conditions listed were found, which could lead to improper park brake apply and/or release, the adjuster hardware and/or return springs require replacement.
3. Visually inspect the adjuster (2) and the adjuster actuator lever (1) for the following:
 - Misalignment with the park brake lever (5)
 - Misalignment with the drum brake shoes
 - Broken or bent adjuster actuator lever (1)
 - Bent adjuster actuator lever pivot pin
4. If any of the conditions listed were found, which could lead to improper park brake apply and/or release, the adjuster hardware requires repair or replacement.
5. Inspect the park brake lever (5) for the following:
 - Bent
 - Broken pivot pin
 - Seized at the pivot pin
 - Broken at park brake cable attachment
 - Improper contact with the adjuster
6. If any of the conditions listed were found, which could lead to improper park brake apply and/or release, the park brake lever requires repair or replacement.
7. Visually inspect the park brake cable (6) for the following:
 - Improper mounting to the backing plate
 - Improper mounting at the park brake lever
 - Broken or missing cable end lug
8. If any of the conditions listed were found, which could lead to improper park brake apply and/or release, the park brake cable requires repair or replacement.
9. Apply the park brake lever/pedal three clicks.
10. Visually inspect the park brake cable for the following:
 - Unequal travel between the left and the right park brake systems
 - No travel on one or both of the park brake systems
11. If any of the conditions listed were found, which could lead to improper park brake apply and/or release, the park brake cable requires replacement and/or adjustment.
12. Release the park brake lever/pedal.
13. Visually inspect the park brake cable for the following:
 - Unequal release between the left and the right park brake systems

- No release at one or both of the park brake systems
14. If any of the conditions listed were found, which could lead to improper park brake apply and/or release, the park brake cable requires replacement and/or adjustment.

REPAIR INSTRUCTIONS

PARK BRAKE LEVER ASSEMBLY REPLACEMENT

Removal Procedure

1. Disable the SIR system. Refer to **SIR Disabling and Enabling Zone 8** in SIR.
2. Remove the front floor console. Refer to **Console Replacement - Front Floor** in Instrument Panel, Gages, and Console.
3. Ensure that the park brake lever is in the fully released position.

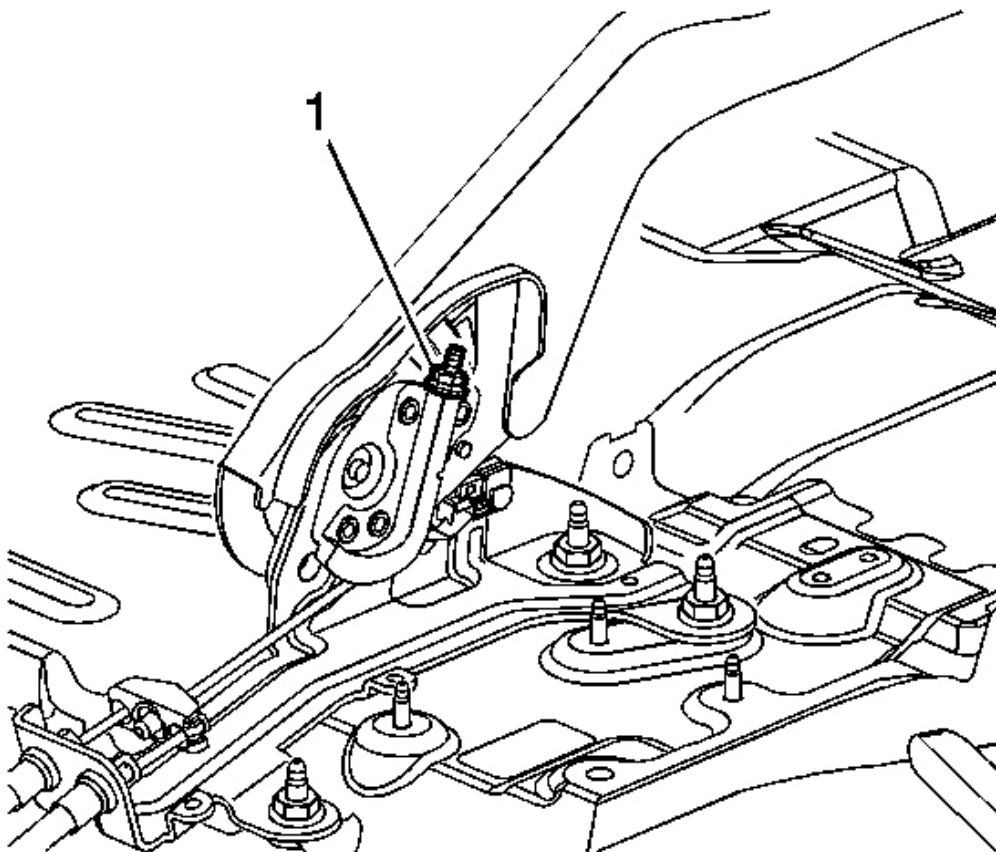


Fig. 2: Loosening Adjusting Nut (1) Completely To The End Of Front Cable Threaded Rod
Courtesy of GENERAL MOTORS CORP.

4. Release the tension from the park brake cable system at the front cable adjusting nut (1).
5. Using ONLY hand tools, loosen the adjusting nut (1) completely to the end of the front cable threaded rod.

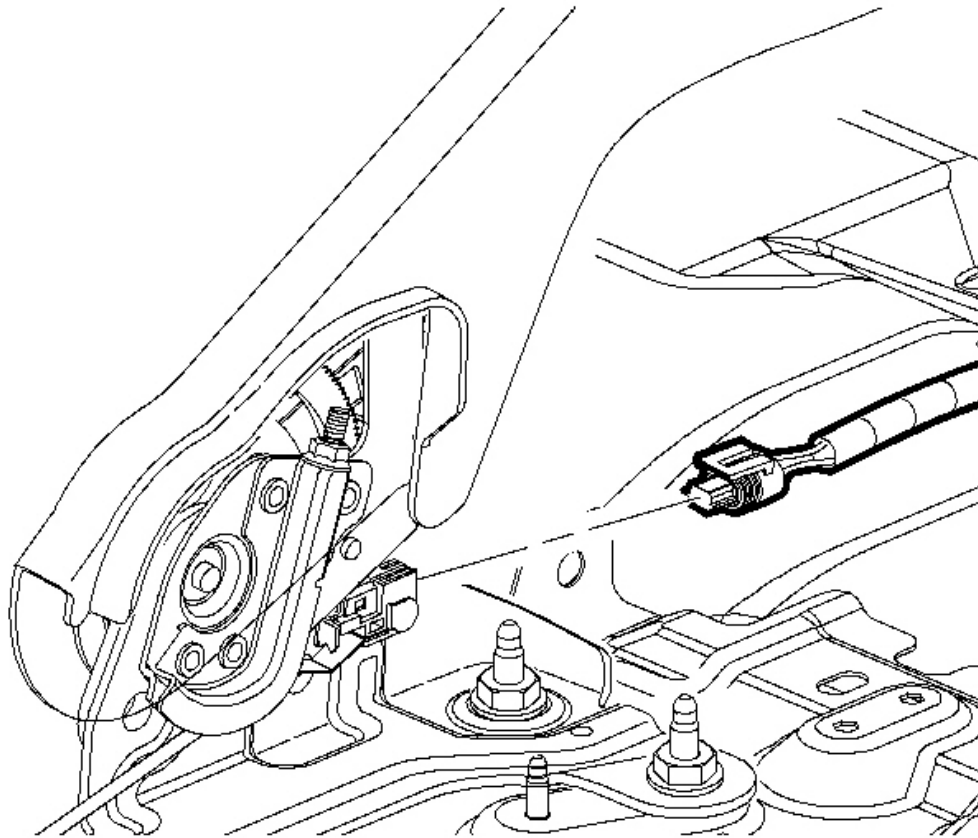


Fig. 3: Disconnecting/Connecting Electrical Connector From Park Brake Warning Lamp Switch
Courtesy of GENERAL MOTORS CORP.

6. Disconnect the electrical connector from the park brake warning lamp switch.

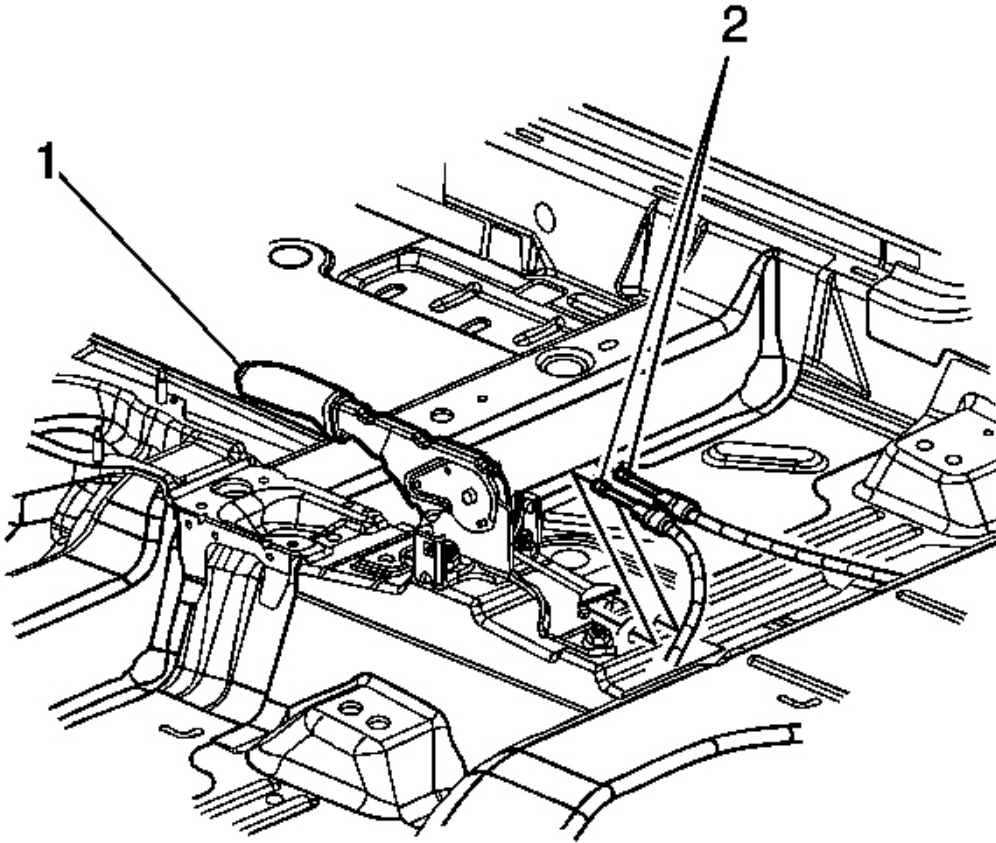


Fig. 4: Releasing Rear Park Brake Cable From Cable Equalizer
Courtesy of GENERAL MOTORS CORP.

7. With the park brake lever (1) in the released position, release the rear park brake cable (2) ends from the cable equalizer.
8. Release the rear cable fittings from the park brake lever bracket.

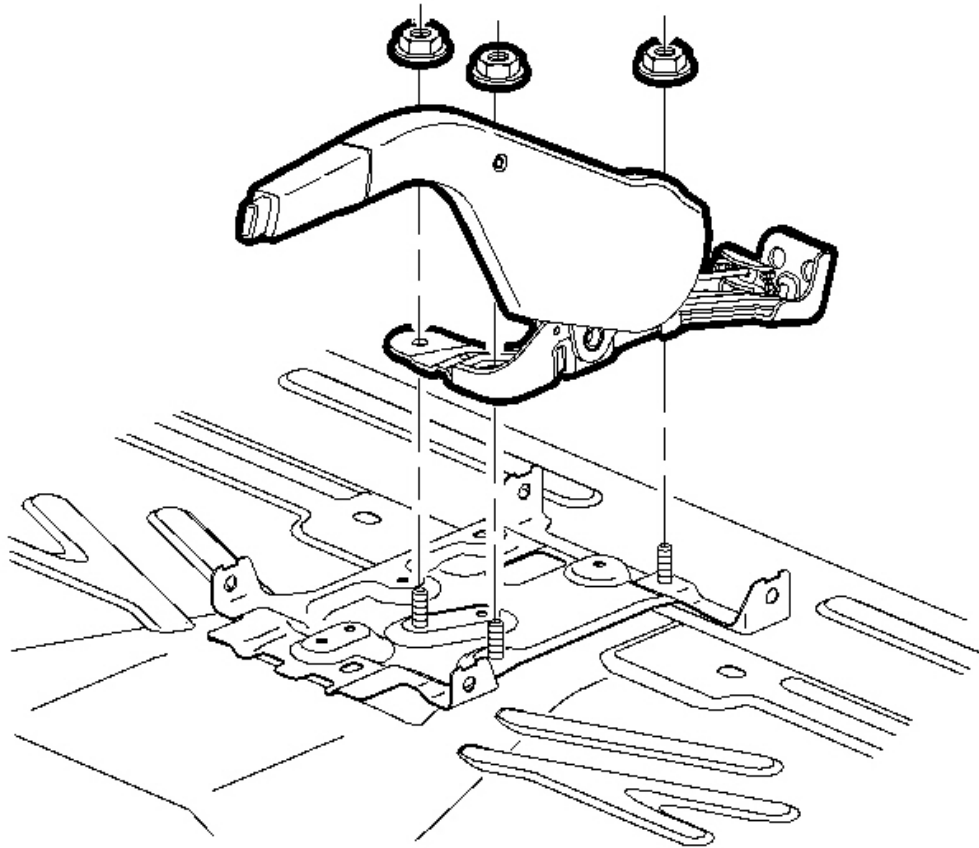


Fig. 5: Removing/Installing Park Brake Lever Assembly
Courtesy of GENERAL MOTORS CORP.

9. Remove the park brake lever mounting nuts.
10. Remove the park brake lever assembly from the vehicle.

Installation Procedure

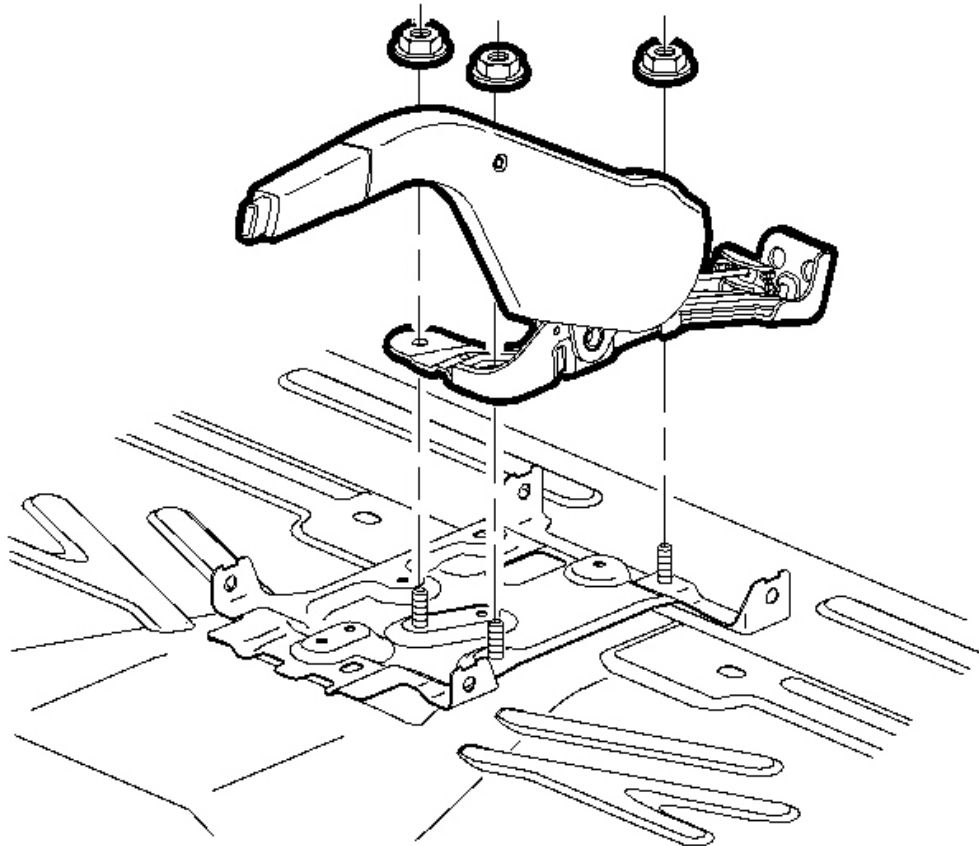


Fig. 6: Removing/Installing Park Brake Lever Assembly
Courtesy of GENERAL MOTORS CORP.

1. Install the park brake lever assembly to the vehicle.

NOTE: Refer to **Fastener Notice** in **Cautions and Notices**.

2. Install the park brake lever assembly mounting nuts.

Tighten: Tighten the nuts to 25 N.m (18 lb ft).

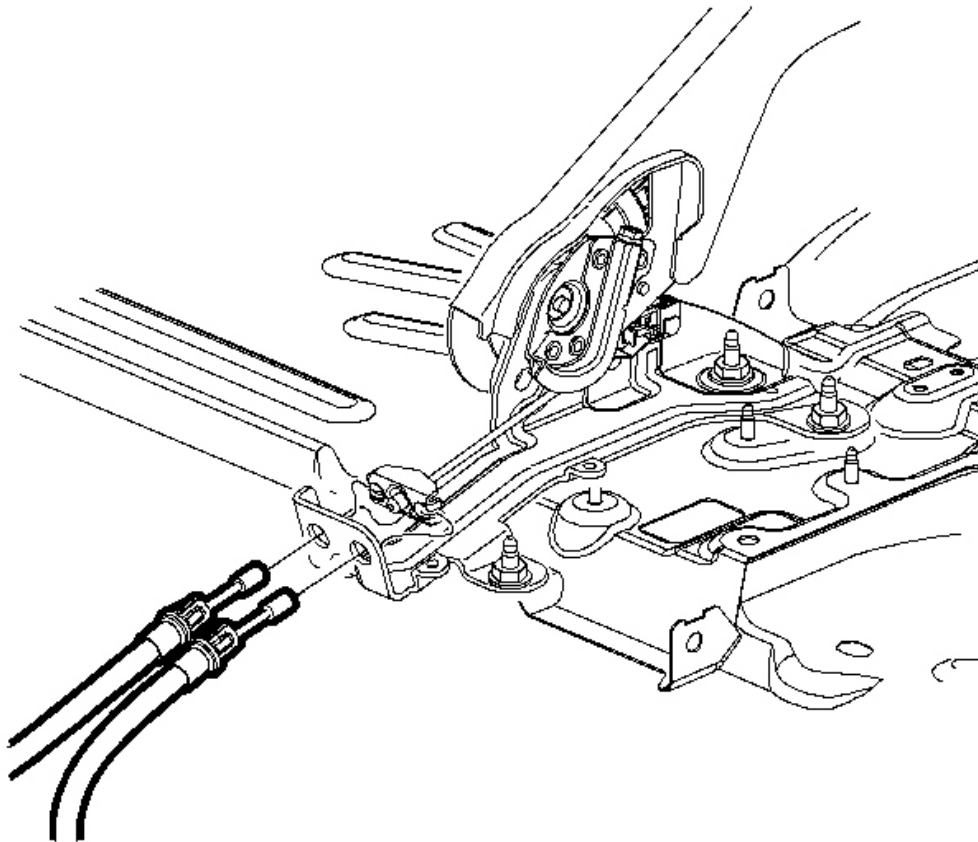


Fig. 7: Installing Cable Ends To Cable Equalizer
Courtesy of GENERAL MOTORS CORP.

3. Secure the rear cable fittings to the park brake lever bracket. Attempt to pull the park brake cables free of the lever bracket, to ensure that the retaining tabs on the fittings are properly secured.
4. Install the cable ends to the cable equalizer.

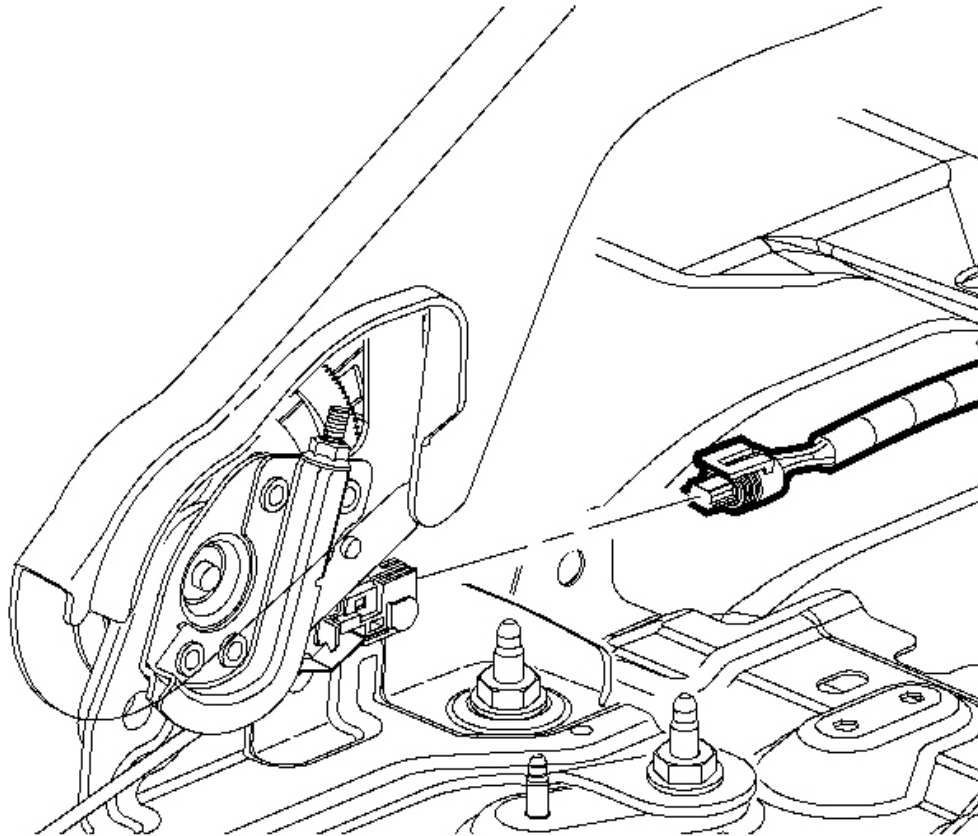


Fig. 8: Disconnecting/Connecting Electrical Connector From Park Brake Warning Lamp Switch
Courtesy of GENERAL MOTORS CORP.

5. Connect the electrical connector to the park brake warning lamp switch.
6. Adjust the park brake cable tension. Refer to **Park Brake Adjustment** .
7. Install the front floor console. Refer to **Console Replacement - Front Floor** in Instrument Panel, Gages, and Console.
8. Enable the SIR system. Refer to **SIR Disabling and Enabling Zone 8** in SIR.

PARK BRAKE WARNING LAMP SWITCH REPLACEMENT

Removal Procedure

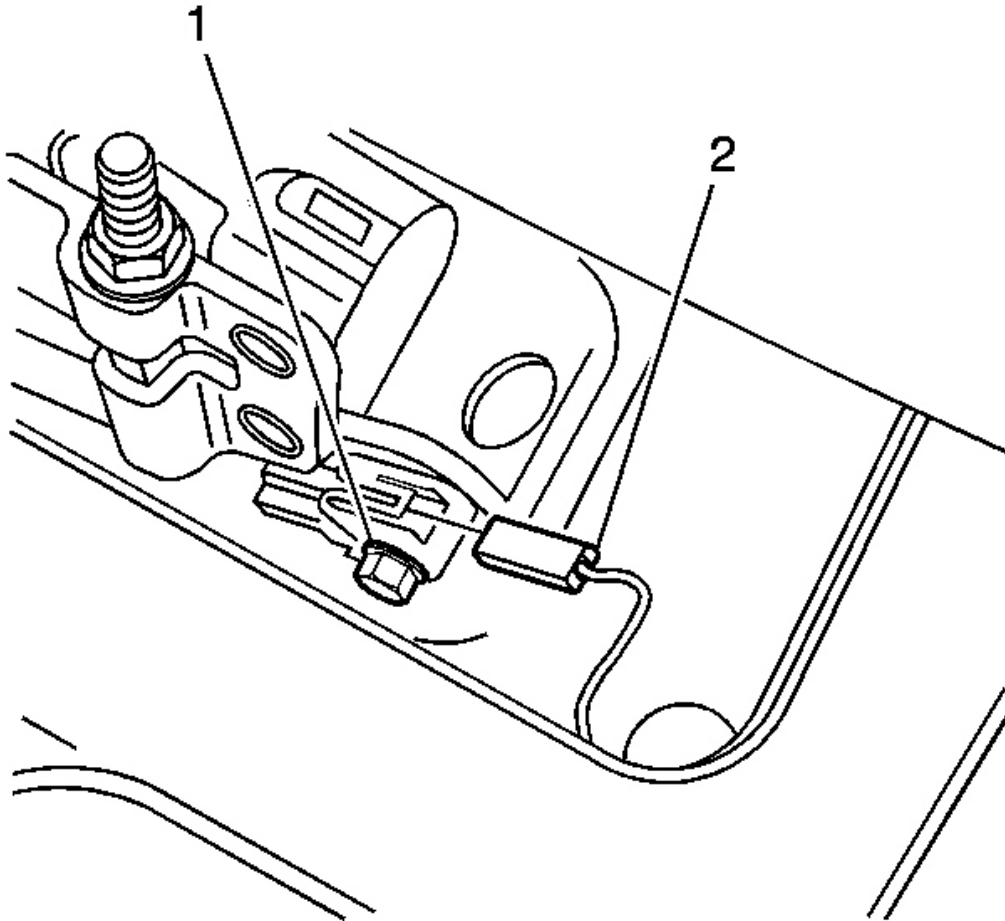


Fig. 9: View Of Park Brake Warning Lamp Switch
Courtesy of GENERAL MOTORS CORP.

1. Disable the SIR system. Refer to **SIR Disabling and Enabling Zone 8** in SIR.
2. Remove the front floor console. Refer to **Console Replacement - Front Floor** in Instrument Panel, Gages, and Console.
3. Disconnect the warning lamp switch electrical connector (2).
4. Remove the warning lamp switch mounting screw (1).
5. Remove the switch from the park brake lever assembly.

Installation Procedure

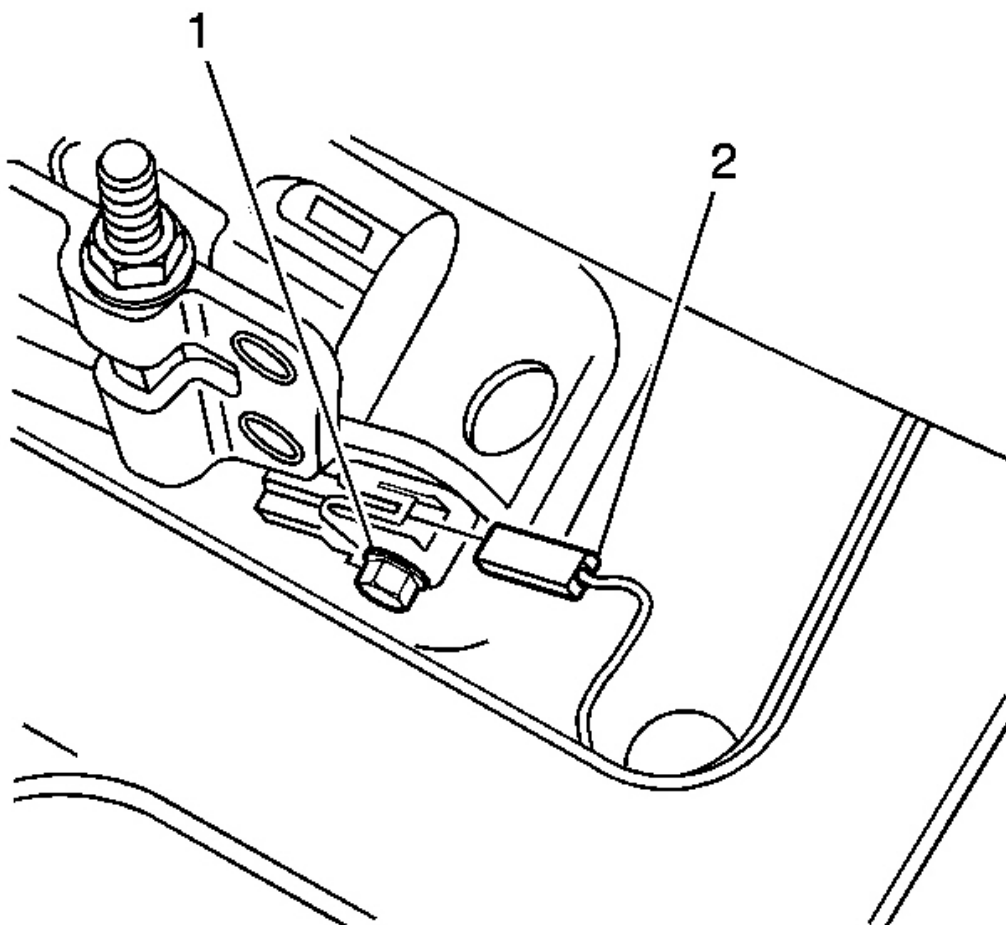


Fig. 10: View Of Park Brake Warning Lamp Switch
Courtesy of GENERAL MOTORS CORP.

1. Align the park brake warning lamp switch locating tab to the locating hole on the park brake lever assembly.
2. Install the switch to the park brake lever.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the park brake warning lamp switch mounting screw (1).

Tighten: Tighten the screw to 4 N.m (35 lb in).

4. Connect the park brake warning lamp switch electrical connector (2).

5. Install the front floor console. Refer to **Console Replacement - Front Floor** in Instrument Panel, Gages, and Console.
6. Enable the SIR system. Refer to **SIR Disabling and Enabling Zone 8** in SIR.
7. Verify correct park brake warning lamp operation.

PARK BRAKE CABLE REPLACEMENT - FRONT

Removal Procedure

1. Disable the SIR system. Refer to **SIR Disabling and Enabling Zone 8** in SIR.
2. Remove the front floor console. Refer to **Console Replacement - Front Floor** in Instrument Panel, Gages, and Console.

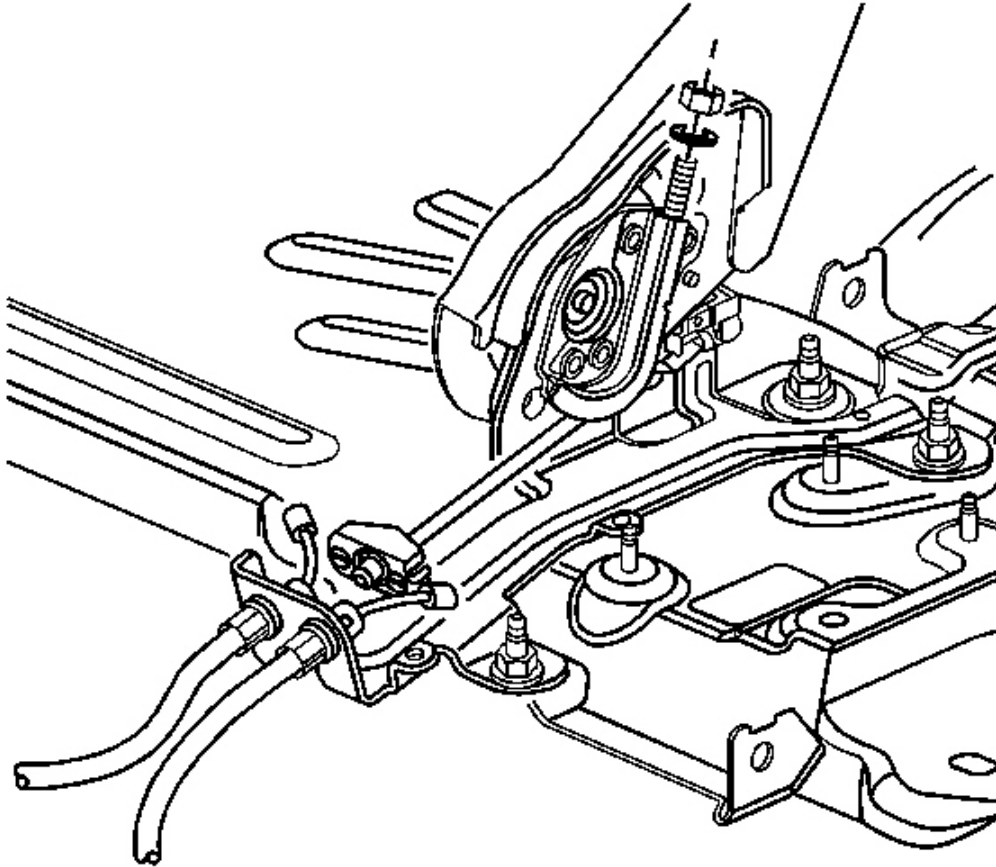


Fig. 11: View Of Front Park Brake Cable

Courtesy of GENERAL MOTORS CORP.

3. With park brake lever in the released position, using ONLY hand tools, remove the park brake cable adjusting nut and washer.
4. Release the rear park brake cable ends from the cable equalizer on the front cable.
5. Remove the front park brake cable from the park brake lever by pulling the cable rearward.

Installation Procedure

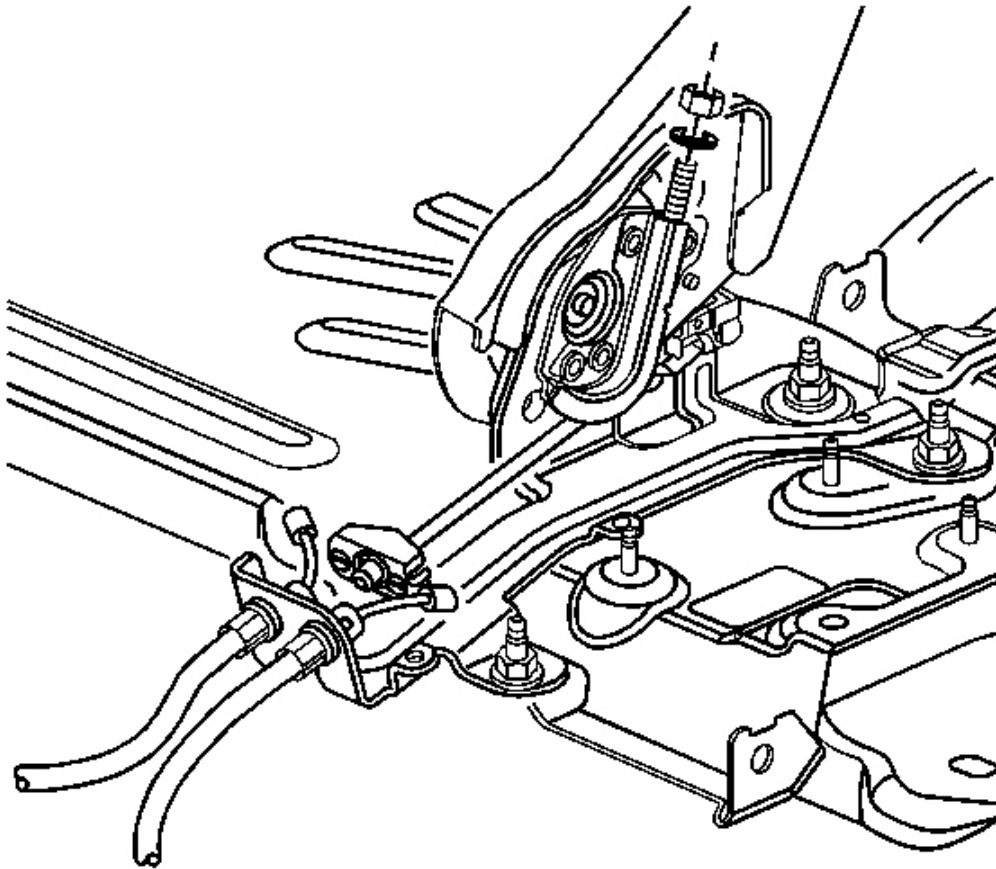


Fig. 12: View Of Front Park Brake Cable
Courtesy of GENERAL MOTORS CORP.

1. Install the front park brake cable to the park brake lever.
2. Install the rear cable ends to the cable equalizer.

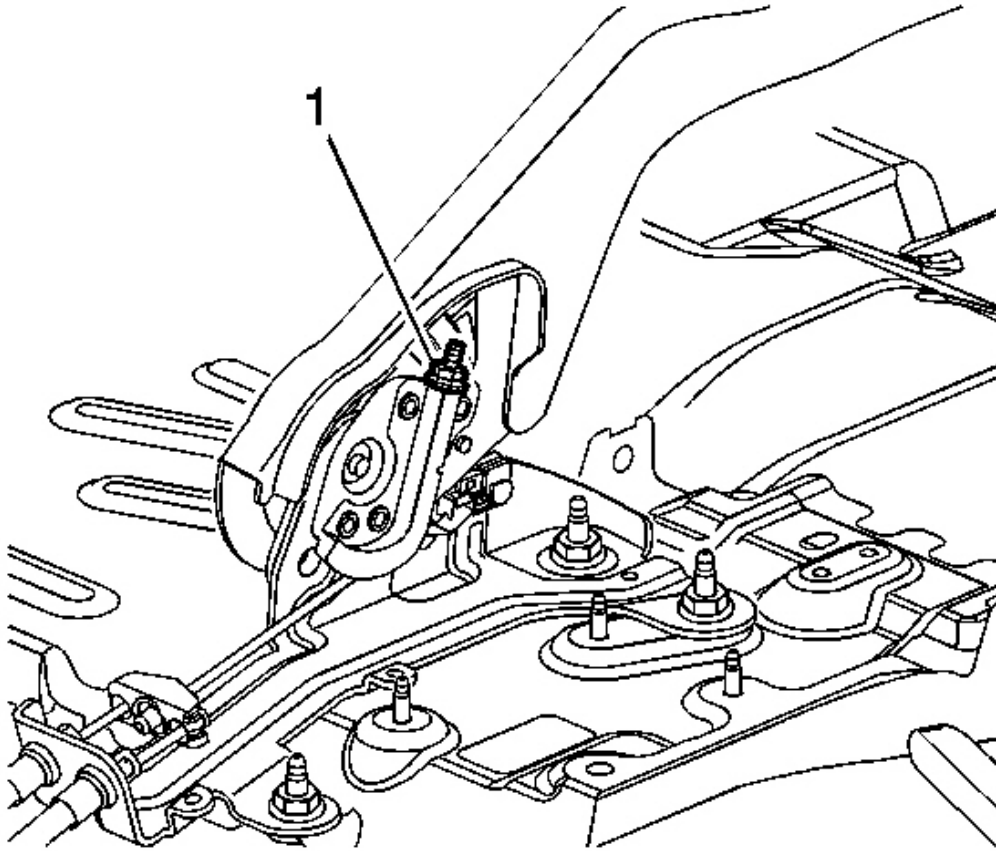


Fig. 13: Loosening Adjusting Nut (1) Completely To The End Of Front Cable Threaded Rod
Courtesy of GENERAL MOTORS CORP.

3. Using ONLY hand tools, install the washer and NEW adjusting nut (1) to the front park brake cable.
4. Adjust the park brake cable tension. Refer to **Park Brake Adjustment** .
5. Install the front floor console. Refer to **Console Replacement - Front Floor** in Instrument Panel, Gages, and Console.
6. Enable the SIR system. Refer to **SIR Disabling and Enabling Zone 8** in SIR.

PARK BRAKE CABLE REPLACEMENT - REAR

CAUTION: Refer to **Brake Dust Caution** in Cautions and Notices.

Removal Procedure

1. Disable the SIR system. Refer to **SIR Disabling and Enabling Zone 8** in SIR.
2. Remove the front floor console. Refer to **Console Replacement - Front Floor** in Instrument Panel, Gages, and Console.
3. Ensure that the park brake lever is in the fully released position.

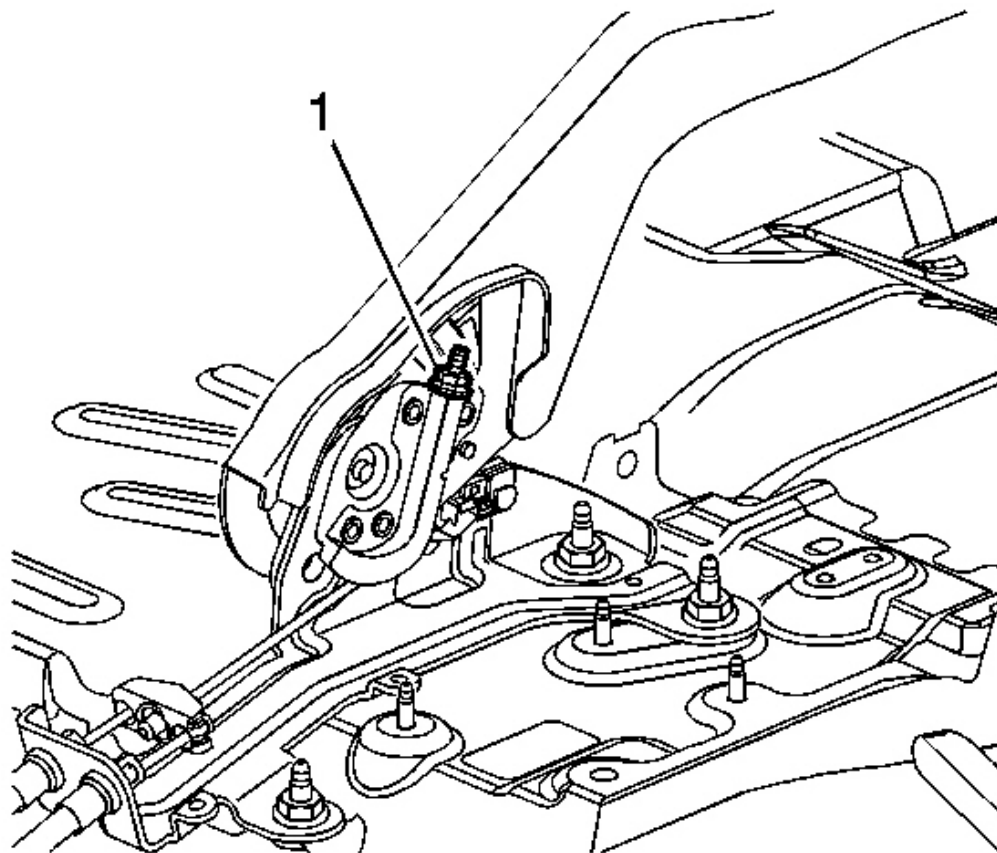


Fig. 14: Loosening Adjusting Nut (1) Completely To The End Of Front Cable Threaded Rod
Courtesy of GENERAL MOTORS CORP.

4. Release the tension from the park brake cable system at the front cable adjusting nut (1).

Using ONLY HAND TOOLS, loosen the adjusting nut (1) completely to the end of the front cable threaded rod.

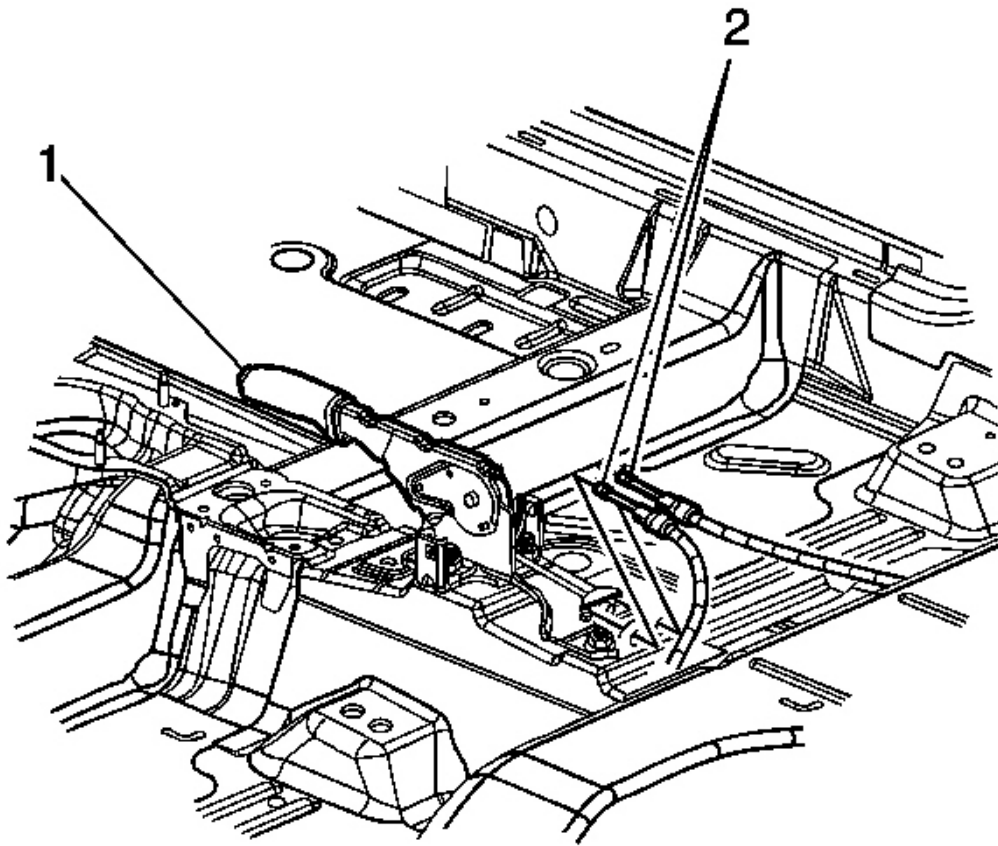


Fig. 15: Releasing Rear Park Brake Cable From Cable Equalizer
Courtesy of GENERAL MOTORS CORP.

5. Remove the rear carpet retainers. Refer to **Carpet Retainer Replacement - Rear** in Interior Trim.
6. Position the carpet forward in order to access the rear park brake cables and body pass-thru grommets.
7. With the park brake lever (1) in the released position, release the appropriate rear park brake cable (2) from the cable equalizer.
8. Release the rear cable fitting from the park brake lever bracket and remove the cable from the lever assembly.

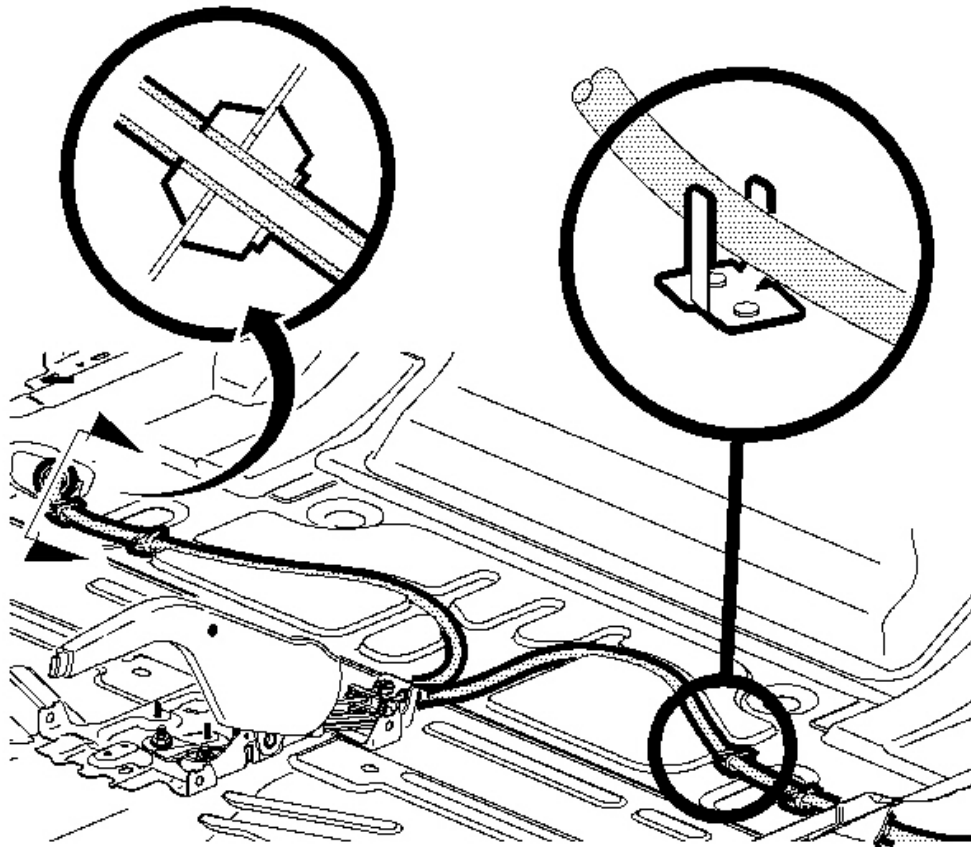


Fig. 16: Installing Rear Carpet Retainers
Courtesy of GENERAL MOTORS CORP.

9. Fold back the park brake cable routing tabs on the vehicle interior floor.
10. Release the rear park brake cable body pass-thru grommet.

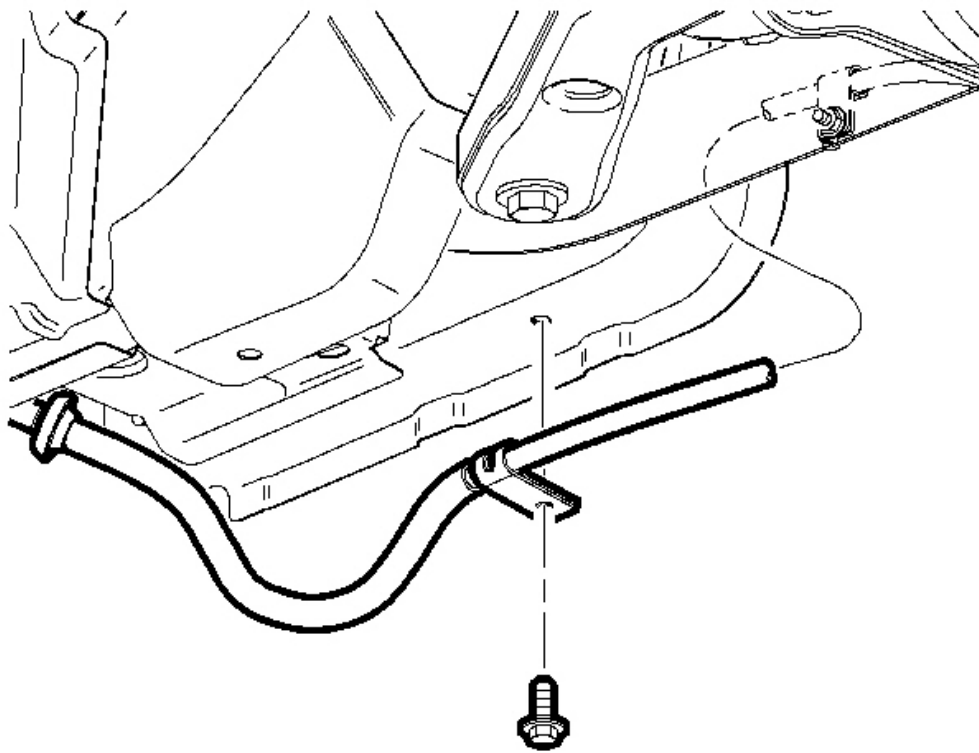


Fig. 17: Removing/Installing Bolt From Park Brake Cable Retainer & Vehicle Underbody
Courtesy of GENERAL MOTORS CORP.

11. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
12. Remove the bolt from the park brake cable-to-underbody retainer.

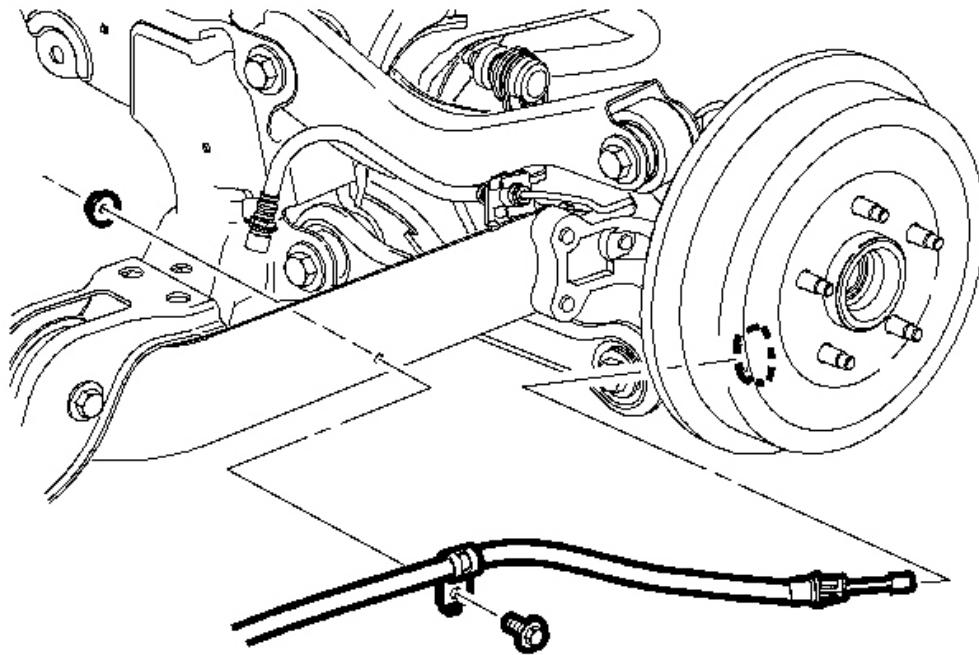


Fig. 18: Removing/Inserting Cable Through The Opening Of Vehicle Underbody
Courtesy of GENERAL MOTORS CORP.

13. Remove the bolt from the park brake cable retainer at the lower suspension trailing arm.
14. Remove the cable from the opening in the vehicle underbody.

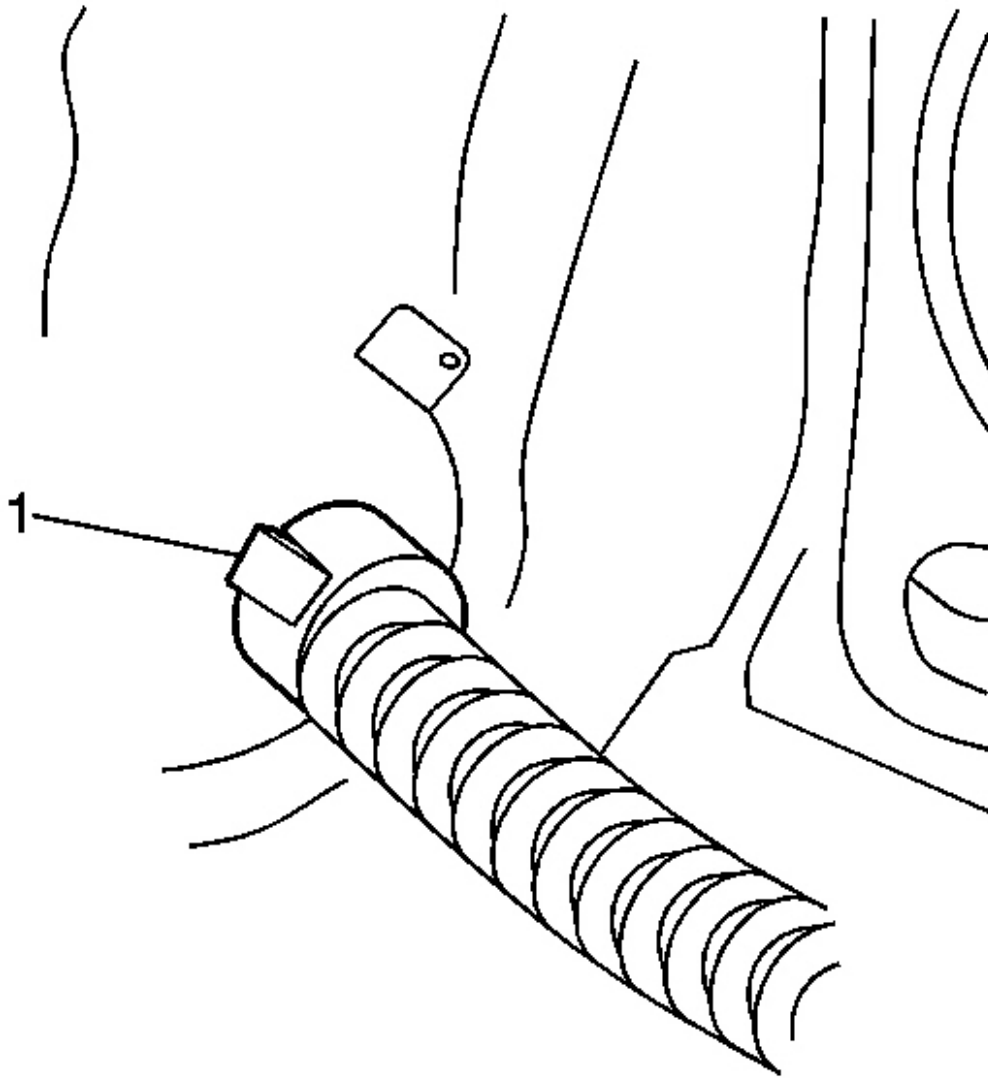


Fig. 19: Identifying Park Brake Cable Fitting Retaining Tab
Courtesy of GENERAL MOTORS CORP.

15. Remove the rear tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
16. Remove the brake drum. Refer to **Brake Drum Replacement** in Drum Brakes.
17. Using a flat-bladed screwdriver, depress the visible retaining tab (1) on the park brake cable fitting, then tilt the released side of the cable end back into the backing plate.

18. Rotate the park brake cable to expose the other retaining tab.
19. Using a flat-bladed screwdriver, depress the remaining retaining tab on the park brake cable fitting, and release the cable fitting from the backing plate.
20. Move the majority of the cable return spring back through the opening in the backing plate.
21. Push the cable toward the rear of the vehicle, just enough to clear the cable end from the slot on the park brake lever.
22. Using a flat-bladed screwdriver, lift the cable to fully release the cable from the lever, then remove the cable.

Installation Procedure

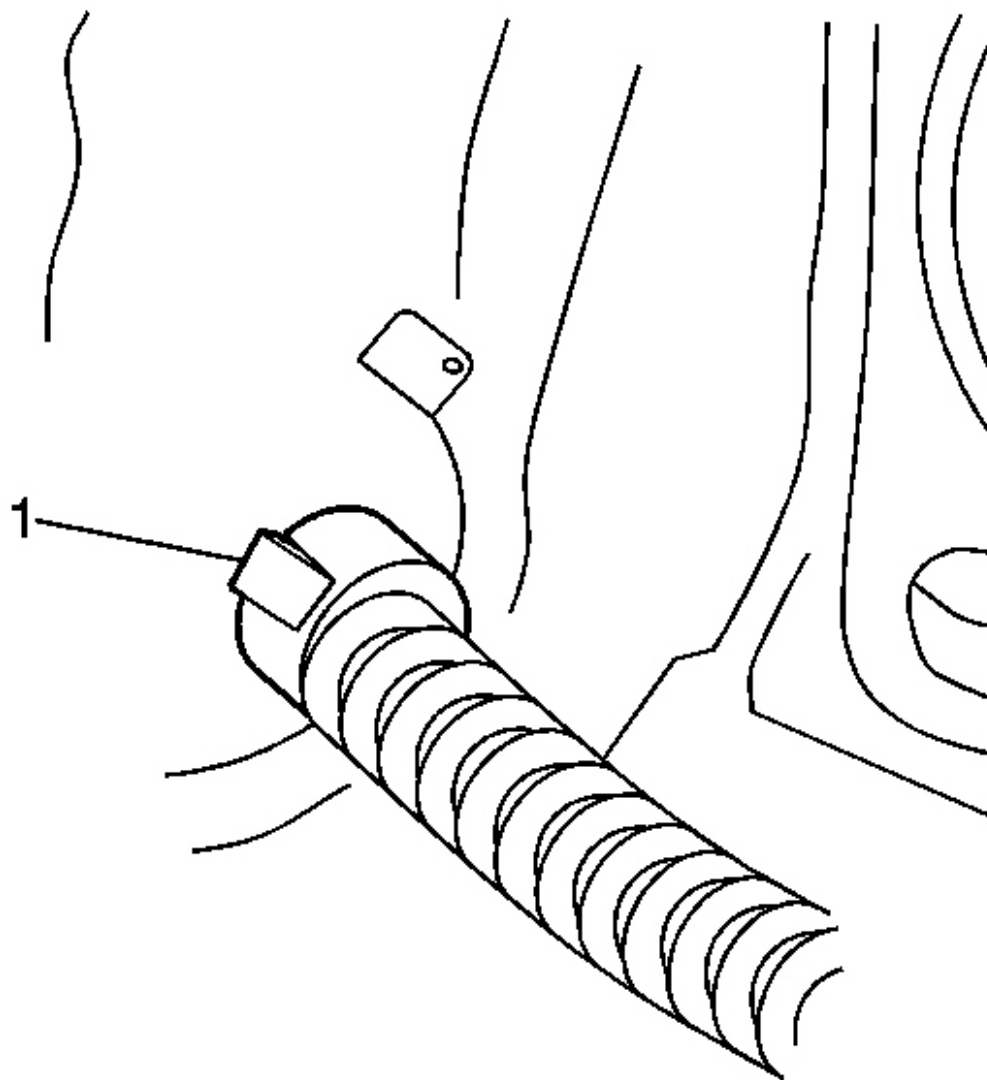


Fig. 20: Identifying Park Brake Cable Fitting Retaining Tab
Courtesy of GENERAL MOTORS CORP.

1. Insert the park brake cable through the opening in the backing plate. Only install the cable return spring to just rearward of the spring positioning tab on the backing plate.
2. Push the cable toward the rear of the vehicle, along the outside of the secondary brake shoe, until the cable end is positioned just past the slot on the park brake lever.
3. While holding the cable in position from front to rear, move the cable end to the back of the park brake

lever.

4. Press the cable down into the slot on the lever, then pull the cable toward the front of the vehicle to secure the cable end to the slot.
5. While continuing to pull the cable away from the lever, insert a flat-bladed screwdriver into the opening on the lever to prevent the cable from lifting out of the slot on the lever.
6. Move the cable return spring through the opening in the backing plate.
7. Secure the cable fitting to the backing plate. Attempt to pull the park brake cable free of the backing plate, to ensure that the retaining tabs (1) on the fitting are properly secured.
8. Adjust the rear drum brakes. Refer to **Drum Brake Adjustment** in Drum Brakes.
9. Install the brake drum. Refer to **Brake Drum Replacement** in Drum Brakes.
10. Install the rear tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.

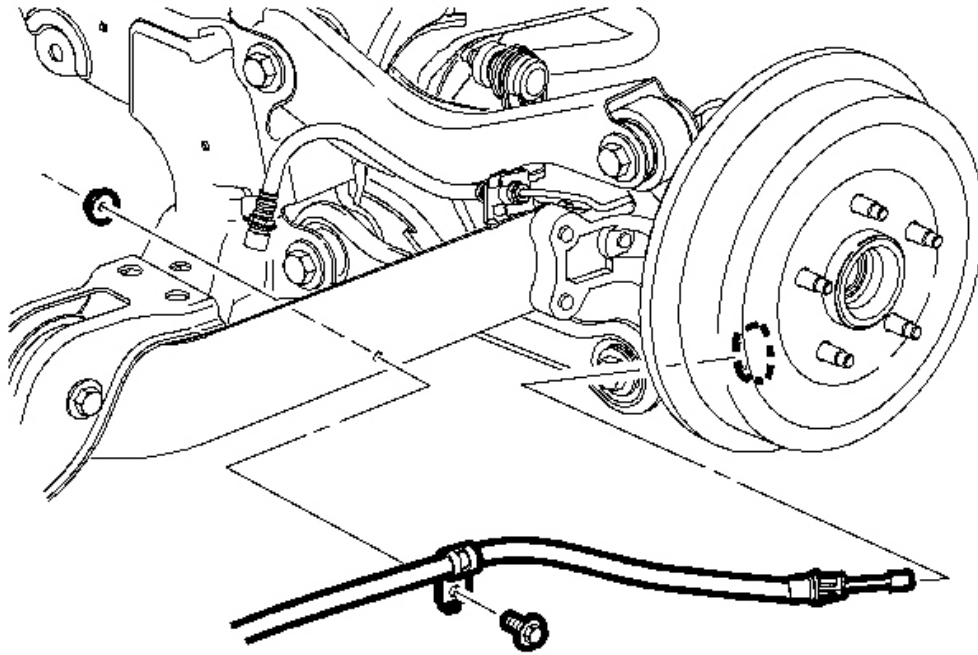


Fig. 21: Removing/Inserting Cable Through The Opening Of Vehicle Underbody
Courtesy of GENERAL MOTORS CORP.

11. Insert the cable through the opening in the vehicle underbody.
12. Install the park brake cable retaining bracket to the rear suspension lower trailing arm.

NOTE: Refer to Fastener Notice in Cautions and Notices.

13. Install the bolt and nut to the park brake cable retainer and lower trailing arm.

Tighten: Tighten the bolt and nut to 12 N.m (106 lb in).

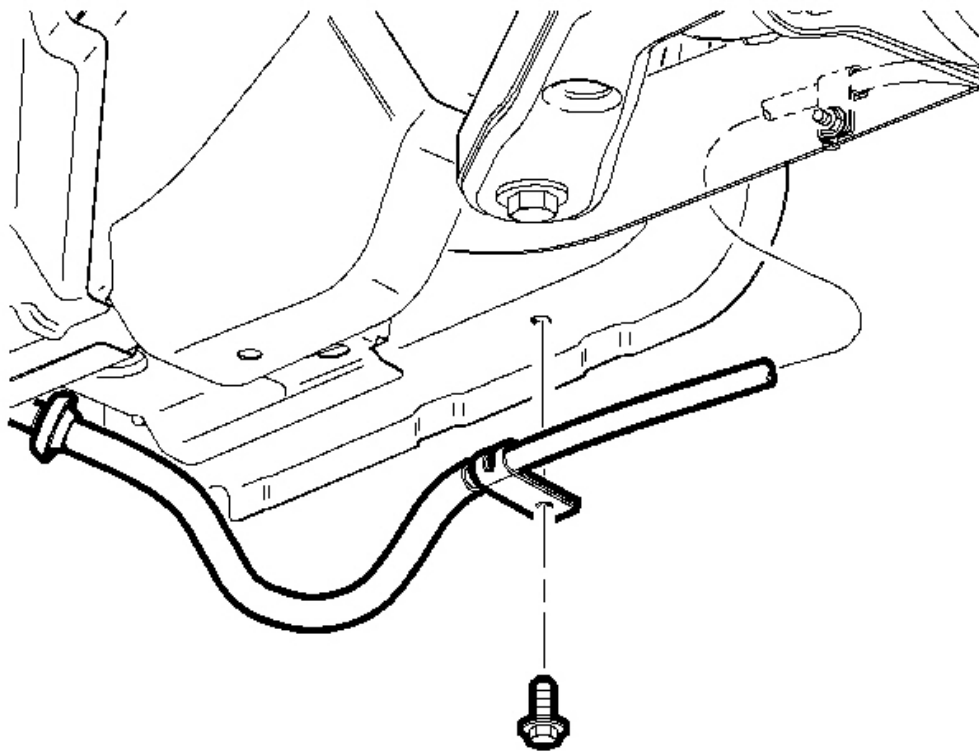


Fig. 22: Removing/Installing Bolt From Park Brake Cable Retainer & Vehicle Underbody
Courtesy of GENERAL MOTORS CORP.

14. Install and secure park brake cable pass-thru grommet to the opening in the vehicle underbody.
15. Install the park brake cable to the underbody retainer.
16. Install the bolt to the park brake cable retainer and the vehicle underbody.

Tighten: Tighten the bolt to 25 N.m (18 lb ft).

17. Lower the vehicle.

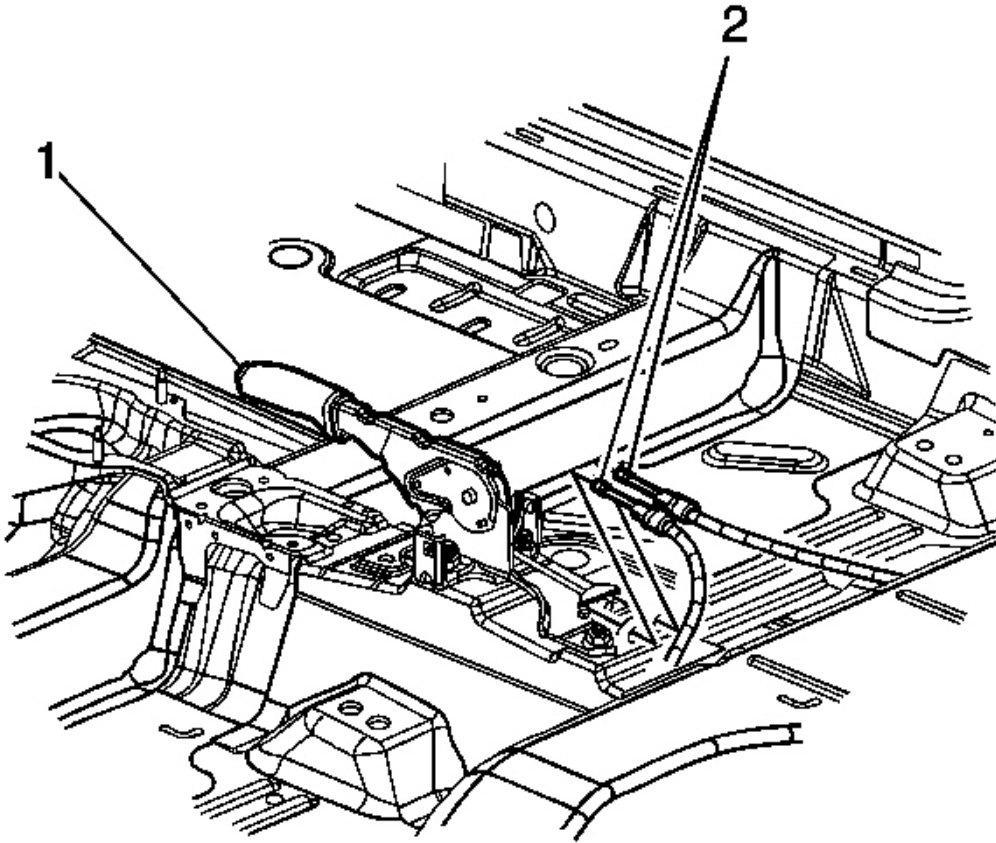


Fig. 23: Releasing Rear Park Brake Cable From Cable Equalizer
Courtesy of GENERAL MOTORS CORP.

18. Secure the cable fitting to the park brake lever bracket. Attempt to pull the park brake cable free of the lever bracket, to ensure that the retaining tabs on the fitting are properly secured.
19. Install the cable end (2) to the cable equalizer.

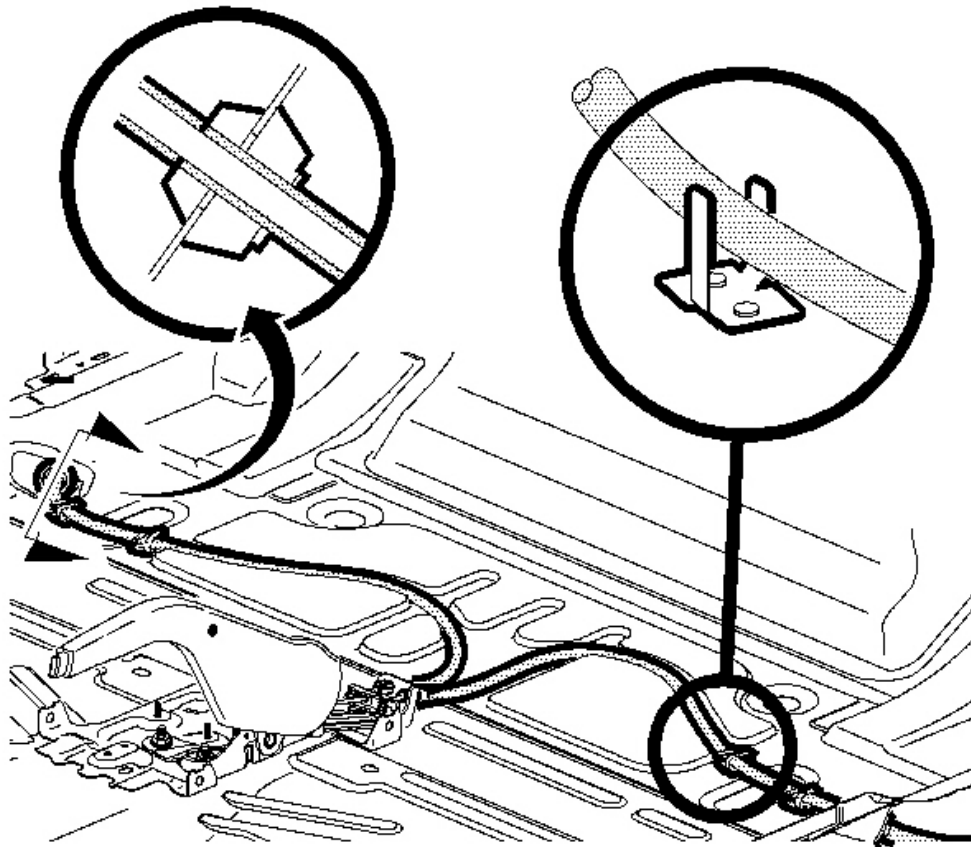


Fig. 24: Installing Rear Carpet Retainers
Courtesy of GENERAL MOTORS CORP.

20. Position park brake cable to routing tabs on vehicle interior floor.
21. Secure park brake cable to floor by folding routing tabs over park brake cable.
22. Reposition the carpet to the installed position.
23. Install the rear carpet retainers. Refer to **Carpet Retainer Replacement - Rear** in Interior Trim.
24. Adjust the park brake cable tension. Refer to **Park Brake Adjustment** .
25. Install the front floor console. Refer to **Console Replacement - Front Floor** in Instrument Panel, Gages, and Console.
26. Enable the SIR system. Refer to **SIR Disabling and Enabling Zone 8** in SIR.

PARK BRAKE ADJUSTMENT

CAUTION: Refer to Brake Dust Caution in Cautions and Notices.

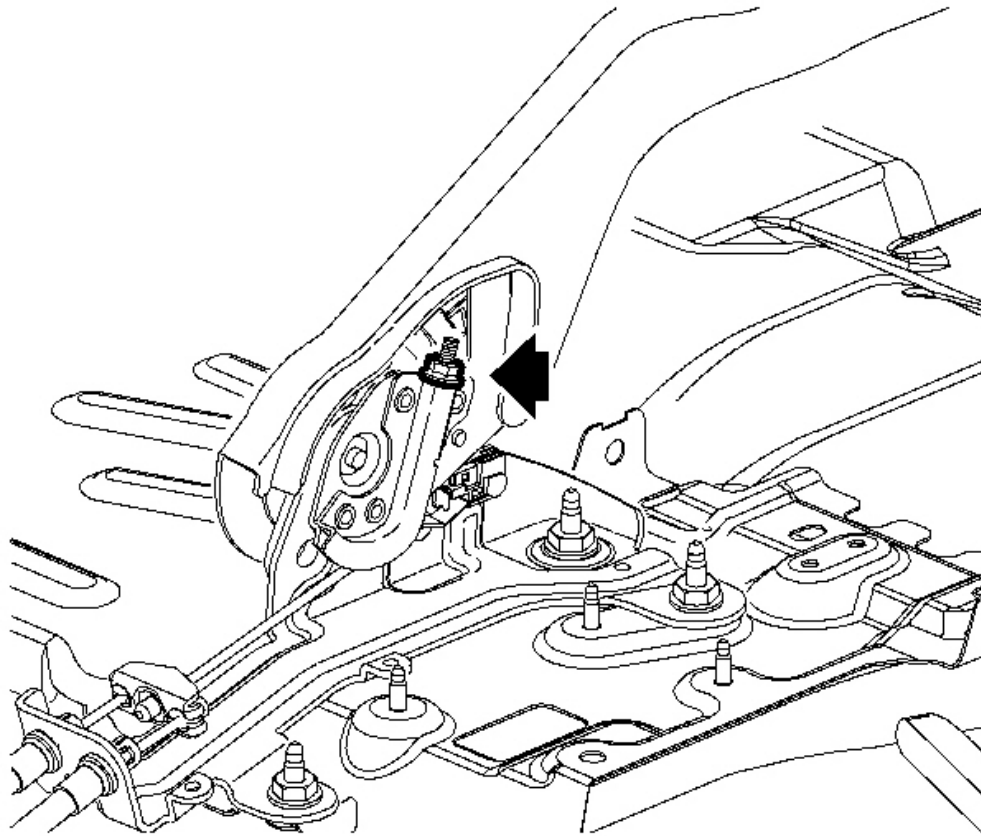


Fig. 25: View Of Park Brake
Courtesy of GENERAL MOTORS CORP.

1. Apply and fully release the park brake several times. Verify that the park brake lever releases completely.
2. Turn ON the ignition. Verify the red BRAKE warning lamp is not illuminated.
3. If the red BRAKE warning lamp is illuminated, verify the following:
 - The park brake lever is in the fully released position and against the stop.

- There is no slack in the park brake cable.
4. Turn OFF the ignition.
 5. Disable the SIR system. Refer to **SIR Disabling and Enabling Zone 8** in SIR.
 6. Remove the front floor console. Refer to **Console Replacement - Front Floor** in Instrument Panel, Gages, and Console.
 7. With the park brake lever in the released position, using ONLY hand tools, loosen the adjusting nut completely to the end of the front cable threaded rod.
 8. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
 9. Remove the rear tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
 10. Adjust the rear drum brakes. Refer to **Drum Brake Adjustment** in Drum Brakes.
 11. Ensure there is no brake shoe drag after adjustment by rotating the brake drums. If drag exists, re-center the brake shoes and perform the brake shoe adjustment again.
 12. Install 2 wheel nuts to the wheel studs and firmly hand tighten in order to retain the brake drums.
 13. Lower the vehicle to permit access to the park brake lever.
 14. Raise the park brake lever 1 detent position.

NOTE: Refer to **Fastener Notice** in Cautions and Notices.

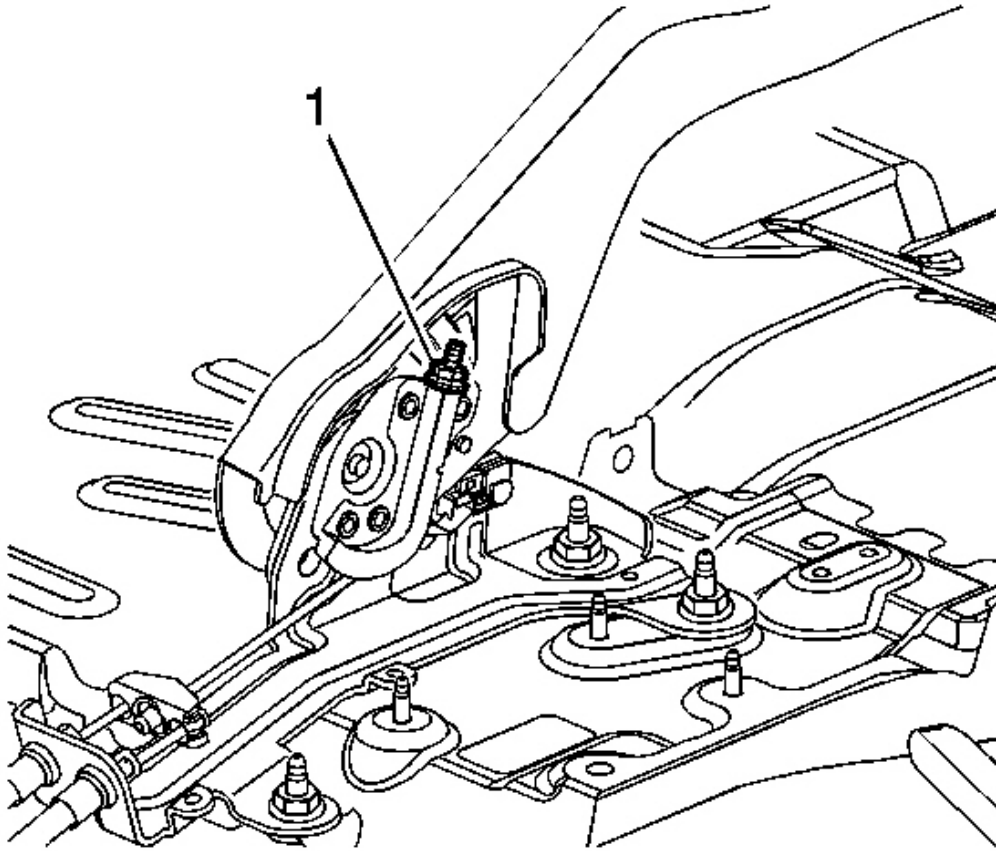


Fig. 26: Loosening Adjusting Nut (1) Completely To The End Of Front Cable Threaded Rod
Courtesy of GENERAL MOTORS CORP.

15. Using ONLY hand tools, tighten the park brake cable adjusting nut (1) until light to moderate drag is exhibited while rotating the rear brake drums.
16. Attempt to rotate the rear brake drums. There should be no rotation forward or rearward.
17. Fully release the park brake lever.
18. Verify the park brake is released by rotating the rear brake drums. The drums should rotate freely and exhibit no brake shoe drag.
19. If the drums do not rotate freely, repeat the park brake cable adjustment procedure.
20. Raise the park brake lever 3 detent positions and attempt to rotate the rear brake drums:
 - One of the brake drums should not rotate forward or rearward.
 - The other brake drum should not rotate forward or rearward, or should require substantial effort to rotate.

21. Raise the vehicle.
22. Remove the wheel nuts retaining the brake drums.
23. Install the rear tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
24. Lower the vehicle.
25. Install the front floor console. Refer to **Console Replacement - Front Floor** in Instrument Panel, Gages, and Console.
26. Release the park brake lever.
27. Enable the SIR system. Refer to **SIR Disabling and Enabling Zone 8** in SIR.

DESCRIPTION AND OPERATION

PARK BRAKE SYSTEM DESCRIPTION AND OPERATION

System Component Description

The park brake system consists of the following:

Park Brake Lever Assembly

Receives, multiplies, and transfers park brake system apply input force from driver to park brake cable system.

Releases applied park brake system when lever release button is depressed and lever is returned to the at rest position.

Park Brake Cables

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

Park Brake Cable Equalizer

Evenly distributes input force to both the left and right park brake units.

Threaded front park brake cable adjuster is also used to remove slack in park brake cables.

Park Brake Apply Lever

Multiplies and transfers input force to park brake actuator/adjuster.

Park Brake Actuator/Adjuster

Uses multiplied input force from apply lever to expand drum brake shoes toward the friction surface of the brake drum.

Threaded park brake actuators/adjusters are also used to control clearance between the drum brake shoes and the friction surface of the brake drum.

System Operation

Park brake apply input force is received by the park brake lever assembly being applied. The input force is multiplied by the lever assembly, 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 drum brake shoes toward the friction surface of the brake drum 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 it is released and returned to the at rest position.