Fastener Tightening Specifications

Application	Specification	
	Metric	English
Brake Hose Bracket Bolt - Front	9 N·m	80 lb in
Brake Hose Bracket Bolt - Rear	12 N·m	106 lb in
Brake Hose Fitting Bolt - Front	40 N·m	30 lb ft
Brake Hose Fitting Bolt - Rear	50 N·m	37 lb ft
Brake Pedal Bracket Bolts	22 N·m	16 lb ft
Brake Pipe Fittings - Master Cylinder Outlet	20 N·m	15 lb ft
Brake Pipe Fittings - Front and Rear at Brake Hose	17 N·m	13 lb ft
Brake Pipe Fittings - Rear Crossover Brake Pipe Union	20 N·m	15 lb ft
Brake Pressure Modulator Valve (BPMV) Assembly Bracket Nuts	20 N·m	15 lb ft
Master Cylinder Nuts	20 N·m	15 lb ft
Power Brake Booster Auxiliary Pump Bracket Bolts	10 N·m	89 lb in
Power Brake Booster Auxiliary Pump Nuts	10 N·m	89 lb in
Vacuum Booster Nuts	25 N·m	18 lb ft

Brake System Specifications

Application	Specification	
	Metric	English
Brake Pedal Travel - Maximum specification with 445 N (100 lbs) of force applied to the brake pedal with the ignition OFF and the booster power reserve depleted.	45 mm	1.77 in

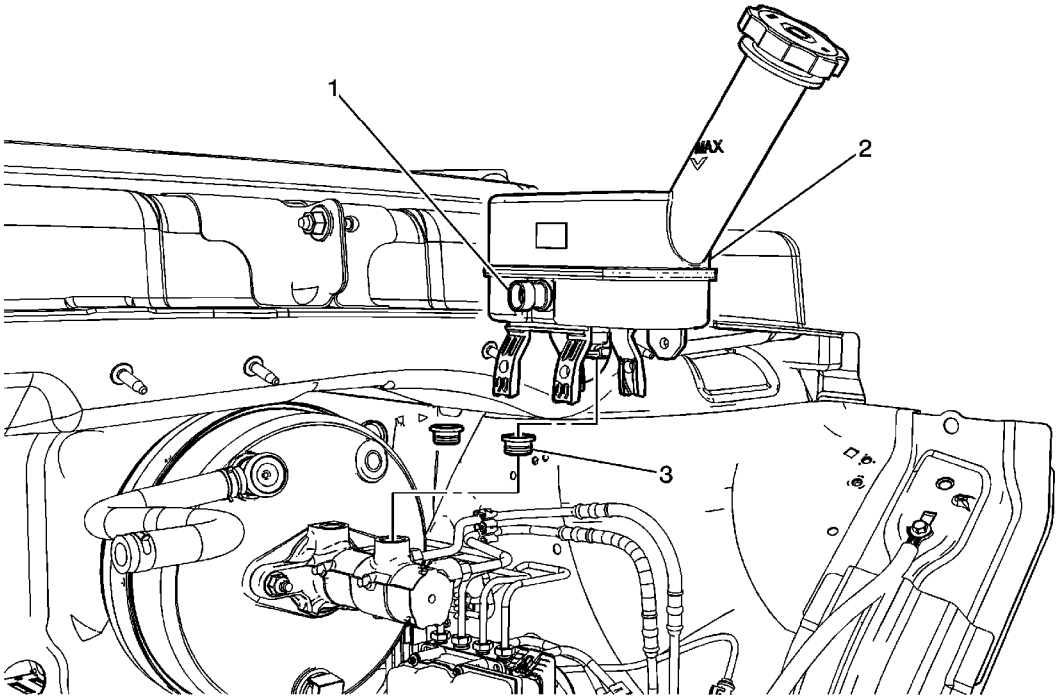
Master Cylinder Reservoir Filling

Warning: Refer to Brake Fluid Irritant Warning in the Preface section.

Caution: Refer to Brake Fluid Effects on Paint and Electrical Components Caution in the Preface section.

1. Visually inspect the brake fluid level through the brake master cylinder 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 reservoir, clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm. Use only GM approved brake fluid from a clean, sealed brake fluid container.

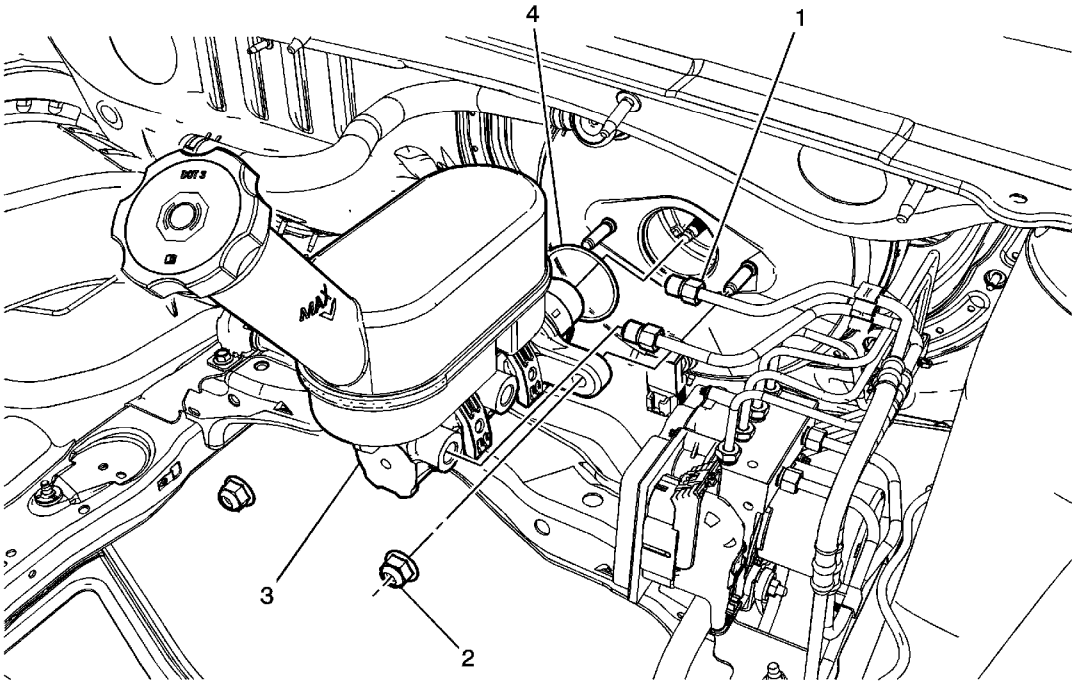
Master Cylinder Reservoir Replacement



Callout	Component Name
Warning: Refer to Brake Fluid Irritant Warning in the Preface section. **Caution:** Refer to Brake Fluid Effects on Paint and Electrical Components Caution in the Preface section. **Preliminary Procedures** 1. Using a suitable tool, remove the brake fluid from the brake master cylinder reservoir. 2. Discard the brake fluid into an approved container. 3. Remove the air cleaner element. Refer to Air Cleaner Element Replacement. 4. Remove the windshield washer solvent heater, if equipped. Refer to Windshield Washer Solvent Heater Replacement.	
1	Master Cylinder Fluid Level Sensor Electrical Connector **Procedure** Disconnect the electrical connector.
	Master Cylinder Reservoir

2	**Procedure** Carefully spread the 4 locking tabs and lift the master cylinder reservoir upward.
3	Master Cylinder Reservoir Seals (Qty: 2) **Procedure** 1. Lubricate the seals and the outer surface area of the reservoir-to-housing barrels with GM approved brake fluid from a clean, sealed brake fluid container. Refer to Fluid and Lubricant Recommendations. 2. Place the new lubricated seals on the reservoir-to-housing barrels before installing the reservoir to the master cylinder housing. 3. Fill the brake master cylinder reservoir. Refer to Master Cylinder Reservoir Filling.

Master Cylinder Replacement



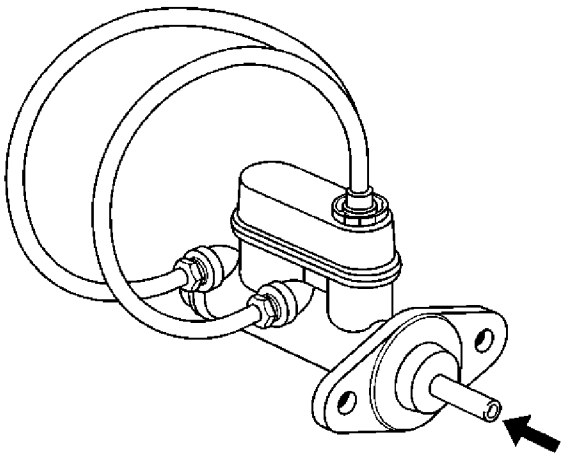
Callout	Component Name
	Warning: Refer to Brake Fluid Irritant Warning in the Preface section. **Caution:** Refer to Brake Fluid Effects on Paint and Electrical Components Caution in the Preface section. **Preliminary Procedures** 1. Turn the ignition switch to the OFF position. 2. Apply the brake pedal several times until the brake pedal becomes firm to deplete the power brake booster vacuum reserve. 3. Remove the air cleaner element. Refer to Air Cleaner Element Replacement. 4. Using a suitable tool, remove the brake fluid from the brake master cylinder reservoir. 5. Discard the brake fluid into an approved container. 6. Disconnect the master cylinder fluid level sensor electrical connector. 7. Remove the windshield washer solvent heater, if equipped. Refer to Windshield Washer Solvent Heater Replacement.
	Brake Pipe Fitting (Qty: 2) **Caution:** Refer to Fastener Caution in the Preface section.

1	**Procedure** 1. Remove any dirt or debris from the brake pipe fitting. 2. Cap the brake pipe fittings to prevent brake fluid loss and contamination. **Tighten** 20 N·m (15 lb ft)
2	Brake Master Cylinder Nut (Qty: 2) **Tighten** 20 N·m (15 lb ft)
3	Brake Master Cylinder Assembly **Procedure** After the installation is complete, bleed the hydraulic brake system. Refer to Hydraulic Brake System Bleeding.
4	Brake Master Cylinder to Vacuum Booster Seal **Procedure** 1. Inspect the brake master cylinder to vacuum booster seal for damage and replace if necessary. 2. Ensure the brake master cylinder to vacuum booster seal is seated properly against the face of the flange on the brake master cylinder housing.

Master Cylinder Bench Bleeding

Warning: Refer to Brake Fluid Irritant Warning in the Preface section.

Caution: Refer to Brake Fluid Effects on Paint and Electrical Components Caution in the Preface section.



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 master cylinder reservoir cap and diaphragm.
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 installed to the master cylinder ports, then route the hoses into the master cylinder reservoir.
5. Fill the master cylinder reservoir to at least the half-way point with GM approved brake fluid from a clean, sealed brake fluid container. Refer to Master Cylinder Reservoir Filling.
6. Ensure that the ends of the transparent hoses running into the master cylinder reservoir are fully submerged in the brake fluid.
7. 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.

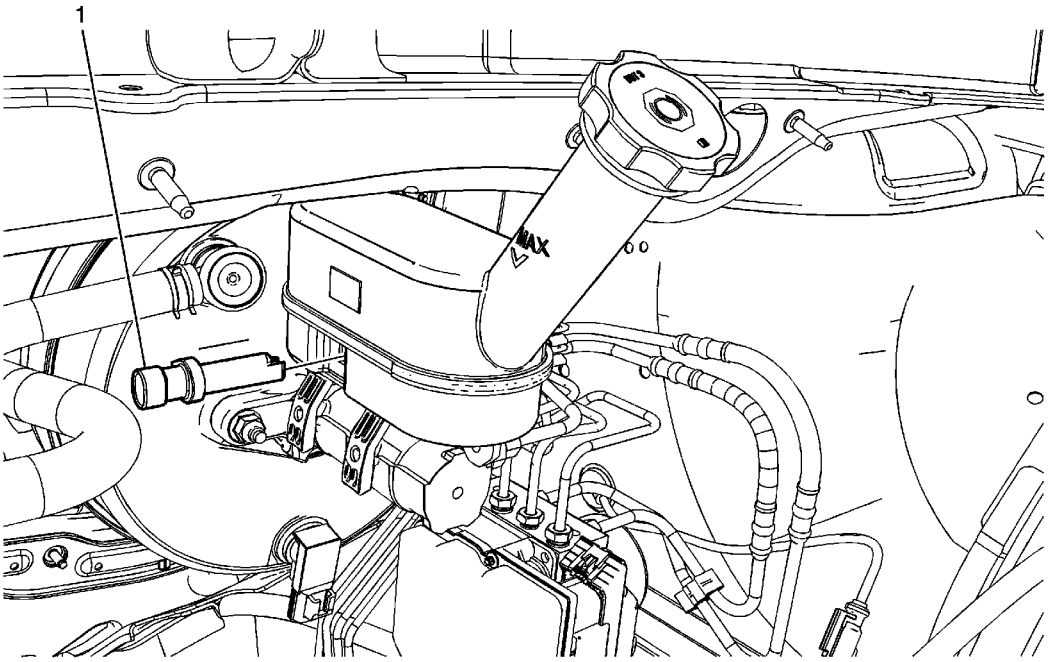
   As air is bled from the primary and secondary pistons, the effort required to depress the primary piston will increase and the amount of travel will decrease.

8. Continue to depress and release the primary piston until fluid flows freely from the ports with no evidence of air bubbles.
9. Remove the transparent hoses from the master cylinder reservoir.
10. Install the master cylinder reservoir cap and diaphragm.
11. 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.

12. Remove the master cylinder from the vise.

Brake Fluid Level Indicator Switch Replacement

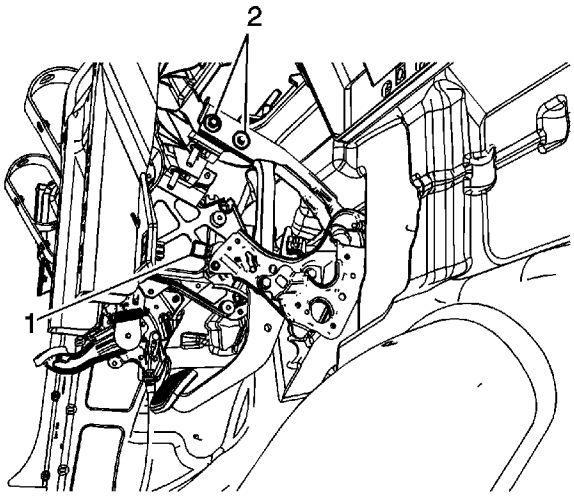


Callout	Component Name
Preliminary Procedures 1. Remove the air cleaner element. Refer to Air Cleaner Element Replacement . 2. Remove the windshield washer solvent heater. Refer to Windshield Washer Solvent Heater Replacement .	
1	Master Cylinder Fluid Level Sensor **Procedure** 1. Disconnect the electrical connector. 2. Compress the locking tabs on the sensor to release the sensor from the brake master cylinder reservoir.

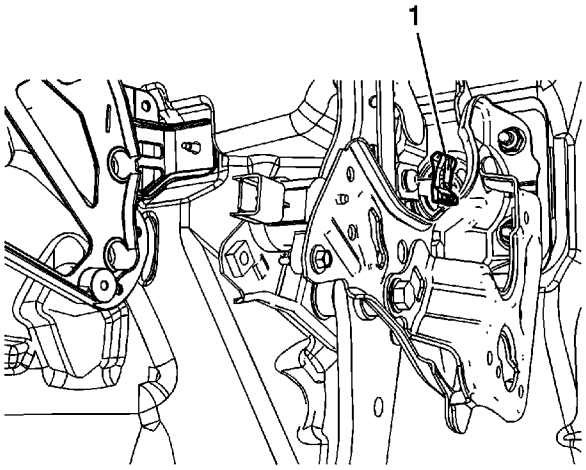
Brake Pedal Assembly Replacement

Removal Procedure

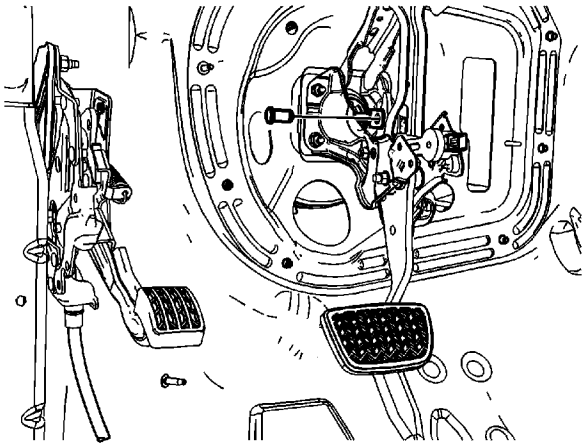
1. Remove the left side instrument panel (I/P) insulator panel. Refer to Instrument Panel Insulator Panel Replacement - Left Side.
2. Remove the driver knee bolster. Refer to Driver Knee Bolster Replacement.
3. Remove the accelerator pedal position sensor. Refer to Accelerator Pedal Position Sensor Replacement.



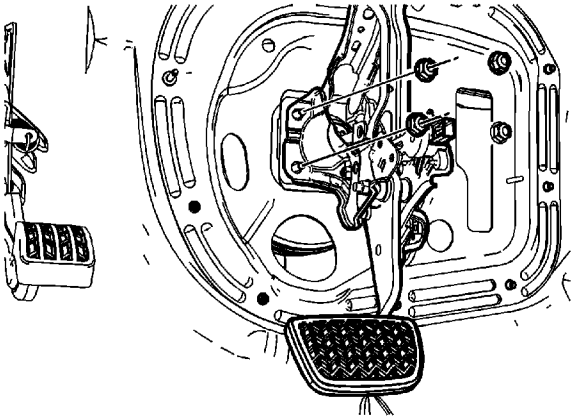
4. Disconnect the brake pedal position sensor electrical connector (1).
5. Remove the 2 brake pedal bracket bolts (2).



6. Remove the brake pedal pushrod retainer (1).

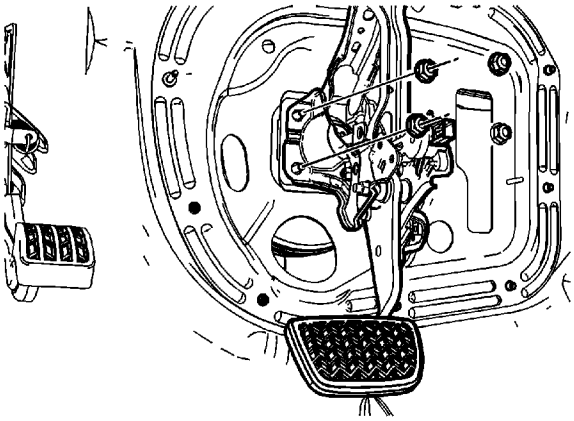


7. Remove the brake pedal pushrod clevis pin.
8. Remove the intermediate steering shaft. Refer to Intermediate Steering Shaft Replacement.



9. Remove the 4 vacuum booster nuts.
10. Position the vacuum brake booster and master cylinder assembly forward slightly to allow the brake pedal and bracket assembly to clear the booster studs.
11. Remove the brake pedal assembly.

Installation Procedure

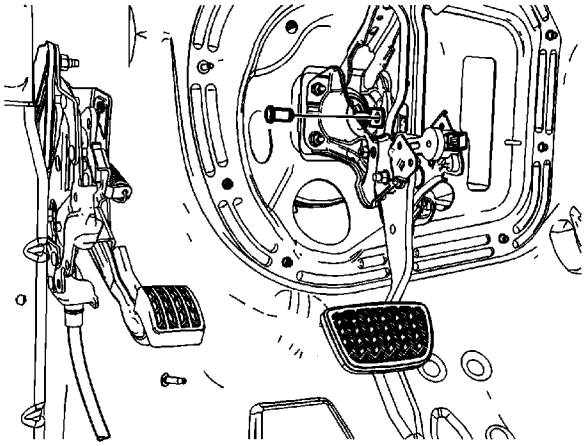


1. Position the brake pedal assembly to the dash panel.
2. Position the vacuum brake booster and master cylinder assembly to the dash panel.

Caution: Refer to Fastener Caution in the Preface section.

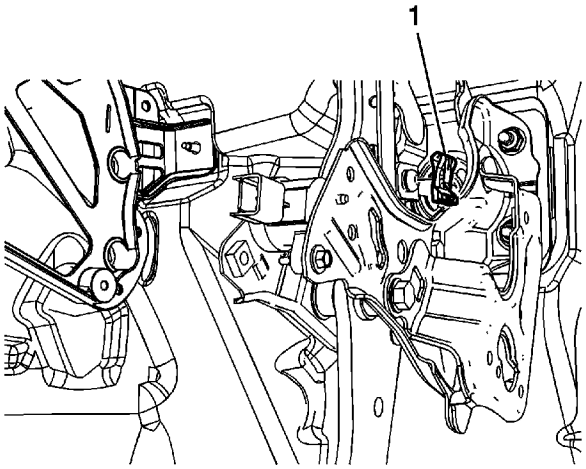
3. Install the 4 vacuum booster nuts.

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

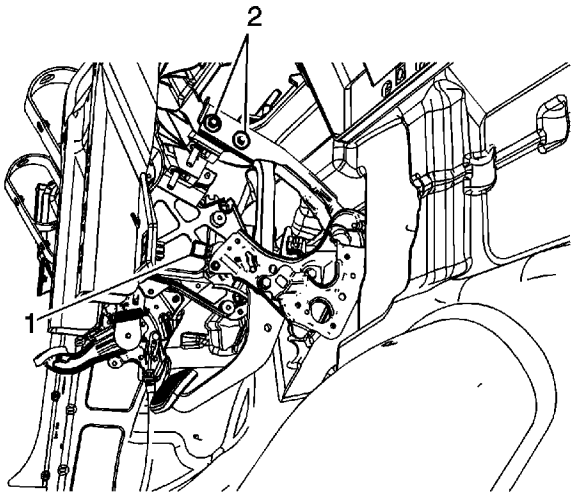


4. Position the brake pedal pushrod to the brake pedal.

5. Install the brake pedal pushrod clevis pin.



6. Install the brake pedal pushrod retainer (1).
7. Install the intermediate steering shaft. Refer to Intermediate Steering Shaft Replacement.



8. Install the 2 brake pedal bracket bolts (2).

Tighten
Tighten the bolts to 22 N·m (16 lb ft).

9. Connect the brake pedal position sensor electrical connector (1).
10. Connect the brake pedal position sensor electrical connector.
11. Install the accelerator pedal position sensor. Refer to Accelerator Pedal Position Sensor Replacement.
12. Install the driver knee bolster. Refer to Driver Knee Bolster Replacement.

13. Install the left side I/P insulator panel. Refer to Instrument Panel Insulator Panel Replacement - Left Side.
14. Calibrate the brake pedal position sensor. Refer to Brake Pedal Position Sensor Calibration.

Brake Pipe Replacement

Special Tools

J 45405 Pipe Flaring Tool Kit

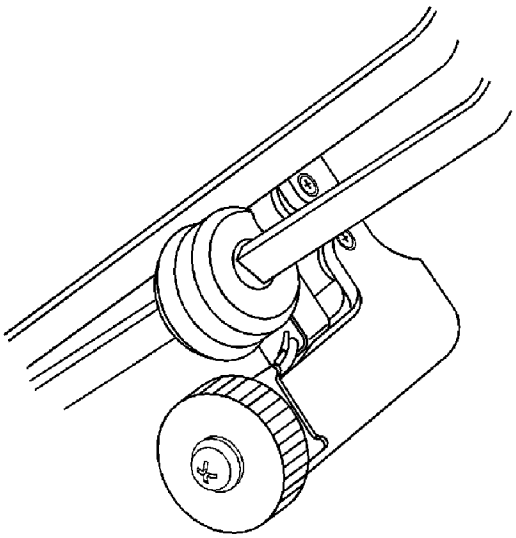
Warning: Refer to Brake Fluid Irritant Warning in the Preface section.

Warning: 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.

Caution: Refer to Brake Fluid Effects on Paint and Electrical Components Caution in the Preface section.

Note: 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.



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 .
   - 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.

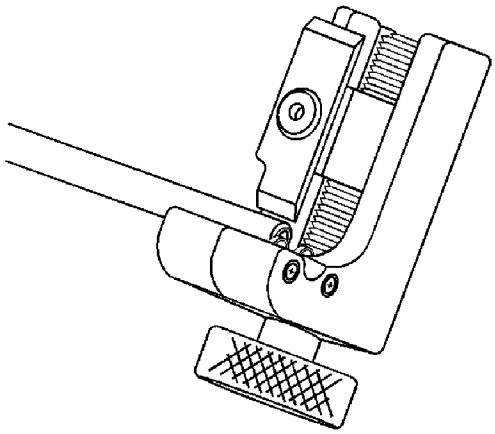
5. Add to the measurement taken the appropriate additional length required for each flare to be created.

   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
   - 12.67 mm (0.499 in) for 7.94 mm (5/16 in) diameter pipe

   Note: 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.
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.



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.

   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) and 7.94 mm (5/16 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.

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

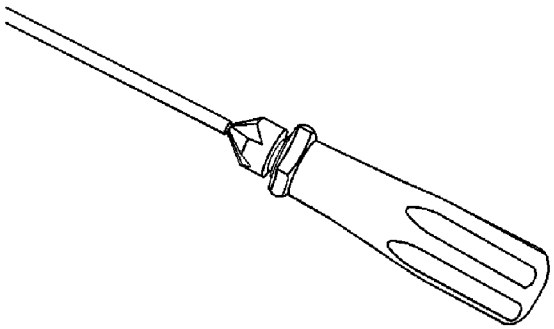
- Rotate the stripping tool in a clockwise direction, ensuring that the brake pipe end remains against the tool roller ledges.
- After each successive revolution of the stripping tool, carefully rotate the thumbwheel of the tool clockwise, in order to continue stripping the coating from the brake pipe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

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

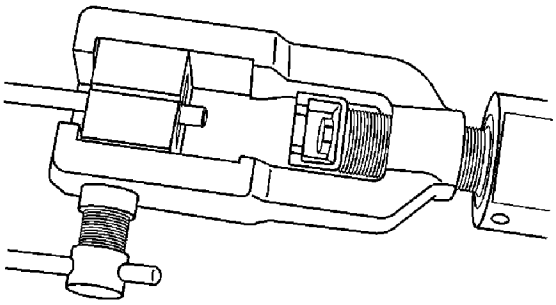
- Inspect the stripped end of the brake pipe to ensure that the proper amount of coating has been removed.

Specification

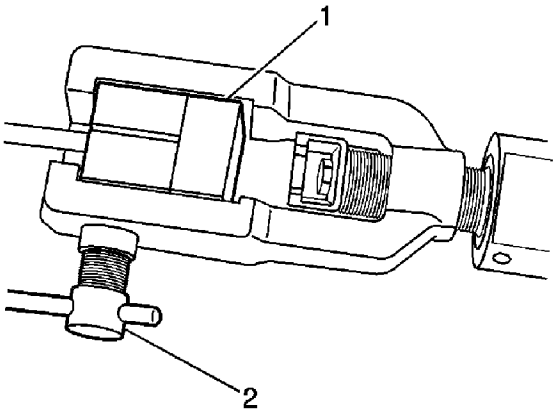
- 6.35 mm (0.250 in) for 4.76 mm (3/16 in) diameter pipe
- 9.50 mm (0.374 in) for 6.35 mm (1/4 in) and 7.94 mm (5/16 in) diameter pipe



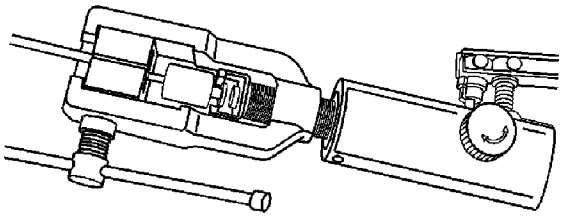
10. Chamfer the inside and outside diameter of the pipe with the de-burring tool included in the J 45405 .
11. Install the tube nuts on the brake pipe, noting their orientation.
12. Clean the brake pipe and the J 45405 of lubricant, contaminants, and debris.



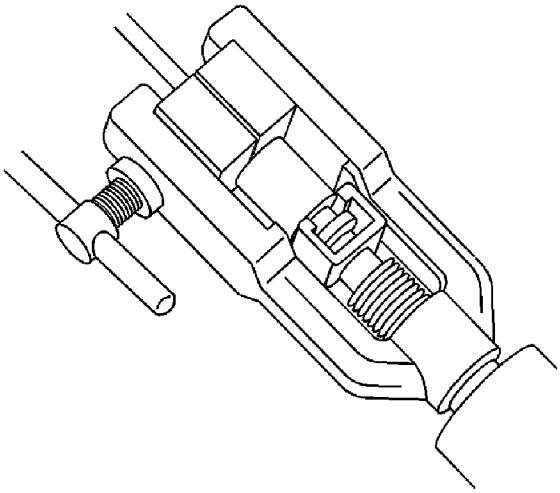
13. Loosen the die clamping screw of the J 45405 .
14. Select the corresponding die set and install the die halves into the die cage with the full, flat face of one die facing the clamping screw, and the counterbores of both dies facing the forming ram.



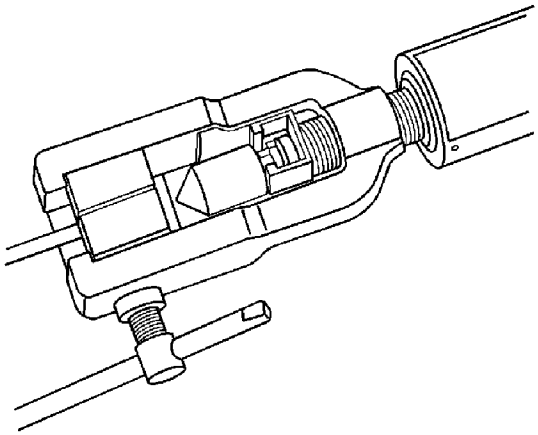
15. Place the flat face of an unused die (1) against the die halves in the clamping cage and hold firmly against the counterbored face of the dies.
16. Insert the prepared end of the pipe to be flared through the back of the dies until the pipe is seated against the flat surface of the unused die (1).
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.



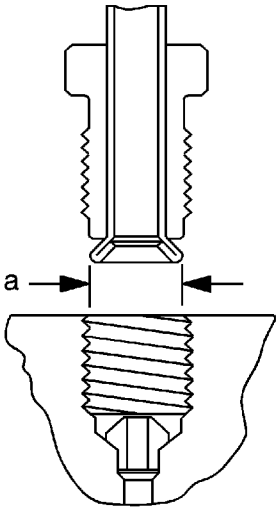
20. Select the appropriate forming mandrel and place into the forming ram.
21. Rotate the hydraulic fluid control valve clockwise to the closed position.
22. Rotate the body of the J 45405 until it bottoms against the die cage.



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.
24. Rotate the hydraulic fluid control valve counterclockwise to the open position to allow the hydraulic forming ram to retract.



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.
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.
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.



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

Specification

- 6.74-7.10 mm (0.265-0.279 in) flare diameter for 4.76 mm (3/16 in) diameter pipe

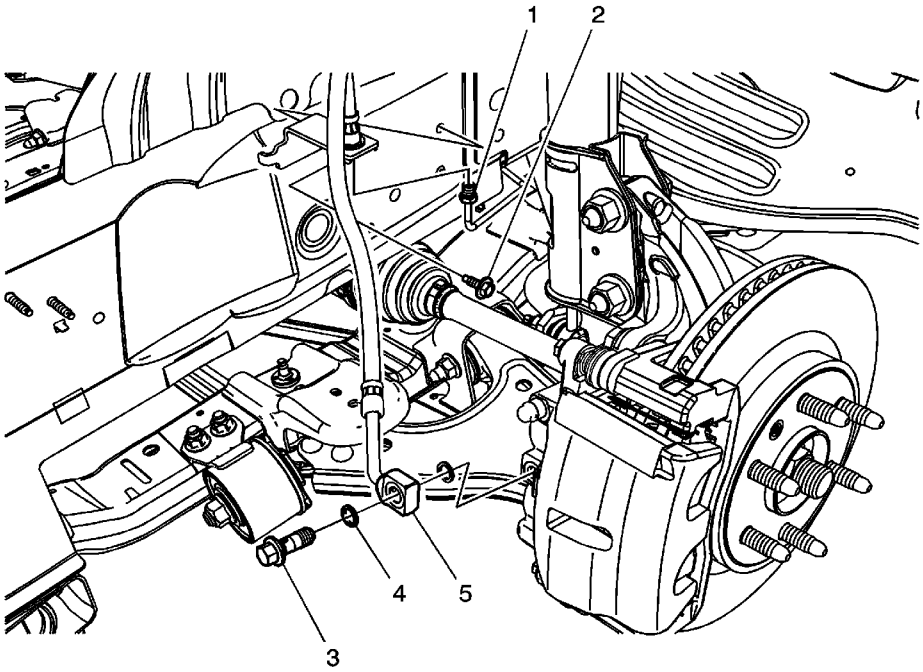
- 8.57-9.27 mm (0.344-0.358 in) flare diameter for 6.35 mm (1/4 in) diameter pipe
- 10.42-10.79 mm (0.410-0.425 in) flare diameter for 7.94 mm (5/16 in) diameter pipe

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

Note: 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.
37. With the aid of an assistant, inspect the brake pipe flares for leaks by starting the engine and applying the brakes.

Front Brake Hose Replacement



Callout	Component Name
	Warning: Refer to Brake Dust Warning in the Preface section. **Warning:** Refer to Brake Fluid Irritant Warning in the Preface section. **Preliminary Procedures** 1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle. 2. Remove the tire and wheel assembly. Refer to Tire and Wheel Removal and Installation.
1	Brake Pipe Fitting **Caution:** Refer to Fastener Caution in the Preface section. **Procedure** 1. Remove any dirt or debris from the brake pipe fitting. 2. Use a backup wrench on the brake hose fitting when disconnecting and connecting the brake pipe fitting. 3. Cap the brake pipe fitting to prevent brake fluid loss and contamination.

	Tighten 17 N·m (13 lb ft)
2	Brake Hose Bracket Bolt **Tighten** 9 N·m (80 lb in)
3	Brake Hose Fitting Bolt **Tighten** 40 N·m (30 lb ft)
4	Brake Hose Fitting Gasket (Qty: 2) **Procedure** 1. Discard the brake hose fitting gaskets. 2. Install 2 new brake hose fitting gaskets.
5	Brake Hose **Procedure** Bleed the hydraulic brake system. Refer to Hydraulic Brake System Bleeding.

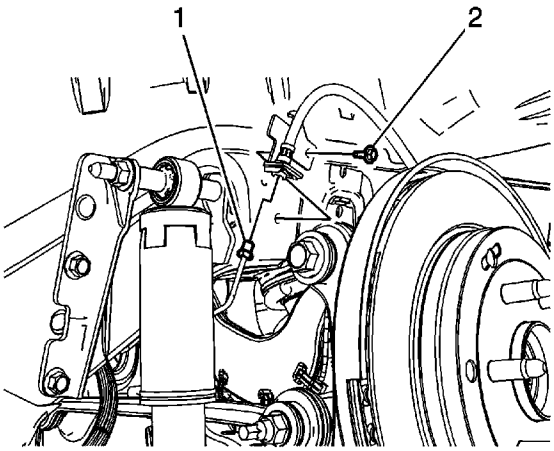
Rear Brake Hose Replacement

Removal Procedure

Warning: Refer to Brake Dust Warning in the Preface section.

Warning: Refer to Brake Fluid Irritant Warning in the Preface section.

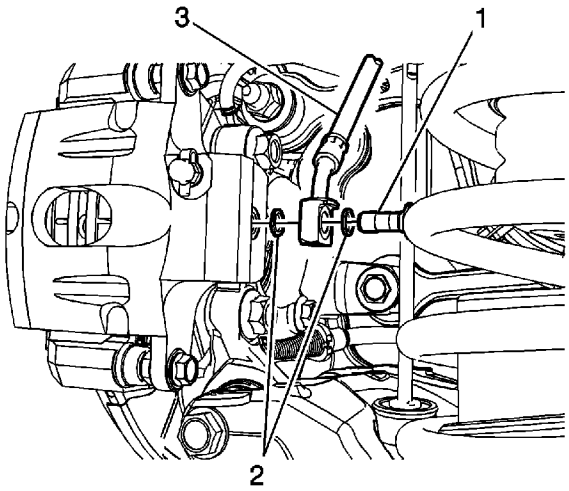
1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle.
2. Remove the tire and wheel assembly. Refer to Tire and Wheel Removal and Installation.



3. Remove any dirt or debris from the brake pipe fitting (1).
4. Using a backup wrench on the brake hose fitting, disconnect the brake pipe fitting.

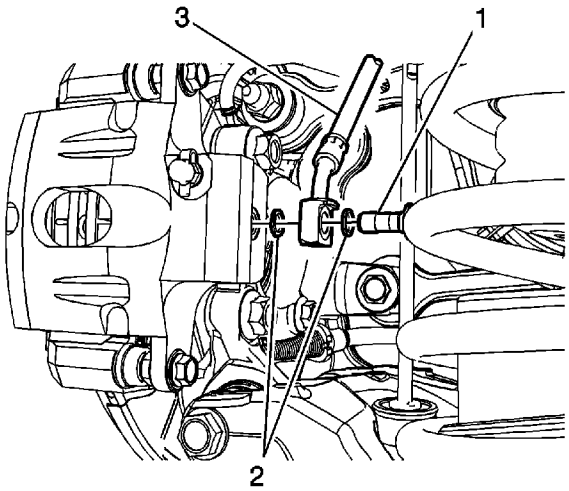
   Cap the brake pipe fitting to prevent brake fluid loss and contamination.

5. Remove the brake hose bracket bolt (2).



6. Remove the brake hose fitting bolt (1).
7. Remove and discard the 2 brake hose fitting gaskets (2).
8. Remove the brake hose (3).

Installation Procedure

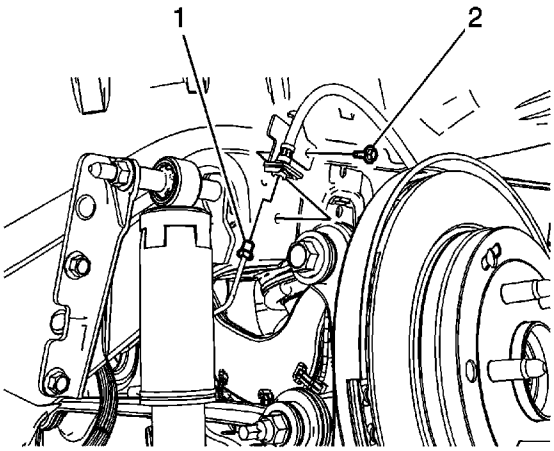


1. Assemble the brake hose fitting bolt (1) and 2 new brake hose fitting gaskets (2) to the brake hose (3).

   Caution: Refer to Fastener Caution in the Preface section.

2. Install the brake hose assembly to the caliper.

Tighten
Tighten the bolt to 50 N·m (37 lb ft).



3. Install the brake hose bracket bolt (2).

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

4. Using a backup wrench on the brake hose fitting, connect the brake pipe fitting (1).

   Tighten
   Tighten the fitting to 17 N·m (13 lb ft).

5. Bleed the hydraulic brake system. Refer to Hydraulic Brake System Bleeding.
6. Install the tire and wheel assembly. Refer to Tire and Wheel Removal and Installation.
7. Lower the vehicle.

Hydraulic Brake System Bleeding (Manual)

Warning: Refer to Brake Fluid Irritant Warning in the Preface section.

Caution: Refer to Brake Fluid Effects on Paint and Electrical Components Caution in the Preface section.

1. Place a clean shop cloth beneath the brake master cylinder to prevent brake fluid spills.
2. With the ignition OFF and the brakes cool, apply the brakes 3-5 times, or until the brake pedal effort increases significantly, in order to deplete the brake booster power reserve.
3. If you have performed a brake master cylinder bench bleeding on this vehicle, or if you disconnected the brake pipes from the master cylinder, you must perform the following steps:
   3.1. Ensure that the brake master cylinder reservoir is full to the maximum-fill level. If necessary add GM approved brake fluid from a clean, sealed brake fluid container. Refer to Fluid and Lubricant Recommendations.

   If removal of the reservoir cap and diaphragm is necessary, clean the outside of the reservoir on and around the cap prior to removal.

   3.2. With the rear brake pipe installed securely to the master cylinder, loosen and separate the front brake pipe from the front port of the brake master cylinder.
   3.3. Allow a small amount of brake fluid to gravity bleed from the open port of the master cylinder.
   3.4. Reconnect the brake pipe to the master cylinder port and tighten securely.
   3.5. Have an assistant slowly depress the brake pedal fully and maintain steady pressure on the pedal.
   3.6. Loosen the same brake pipe to purge air from the open port of the master cylinder.
   3.7. Tighten the brake pipe, then have the assistant slowly release the brake pedal.
   3.8. Wait 15 seconds, then repeat steps 3.3-3.7 until all air is purged from the same port of the master cylinder.
   3.9. With the front brake pipe installed securely to the master cylinder, after all air has been purged from the front port of the master cylinder, loosen and separate the rear brake pipe from the master cylinder, then repeat steps 3.3-3.8.
   3.10. After completing the final master cylinder port bleeding procedure, ensure that both of the brake pipe-to-master cylinder fittings are properly tightened.
4. Fill the brake master cylinder reservoir with GM approved brake fluid from a clean, sealed brake fluid container. Refer to Master Cylinder Reservoir Filling. Ensure that the brake master cylinder reservoir remains at least half-full during this bleeding procedure. Add fluid as needed to maintain the proper level.

   Clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm.

5. Install a proper box-end wrench onto the RIGHT REAR wheel hydraulic circuit bleeder valve.
6. Install a transparent hose over the end of the bleeder valve.
7. Submerge the open end of the transparent hose into a transparent container partially filled with GM approved brake fluid from a clean, sealed brake fluid container. Refer to Fluid and

Lubricant Recommendations.

8. Have an assistant slowly depress the brake pedal fully and maintain steady pressure on the pedal.
9. Loosen the bleeder valve to purge air from the wheel hydraulic circuit.
10. Tighten the bleeder valve, then have the assistant slowly release the brake pedal.
11. Wait 15 seconds, then repeat steps 8-10 until all air is purged from the same wheel hydraulic circuit.
12. With the right rear wheel hydraulic circuit bleeder valve tightened securely, after all air has been purged from the right rear hydraulic circuit install a proper box-end wrench onto the LEFT REAR wheel hydraulic circuit bleeder valve.
13. Install a transparent hose over the end of the bleeder valve, then repeat steps 7-11.
14. With the left rear wheel hydraulic circuit bleeder valve tightened securely, after all air purged from the left rear hydraulic circuit, install a proper box-end wrench onto the RIGHT FRONT wheel hydraulic circuit bleeder valve.
15. Install a transparent hose over the end of the bleeder valve, then repeat steps 7-11.
16. With the right front wheel hydraulic circuit bleeder valve tightened securely, after all air has been purged from the right front hydraulic circuit, install a proper box-end wrench onto the LEFT FRONT wheel hydraulic circuit bleeder valve.
17. Install a transparent hose over the end of the bleeder valve, then repeat steps 7-11.
18. After completing the final wheel hydraulic circuit bleeding procedure, ensure that each of the 4 wheel hydraulic circuit bleeder valves are properly tightened.
19. Fill the brake master cylinder reservoir to the maximum-fill level with GM approved brake fluid from a clean, sealed brake fluid container. Refer to Master Cylinder Reservoir Filling.
20. Slowly depress and release the brake pedal. Observe the feel of the brake pedal.
21. If the brake pedal feels spongy, repeat the bleeding procedure again. If the brake pedal still feels spongy after repeating the bleeding procedure, perform the following steps:
    21.1. Inspect the brake system for external leaks. Refer to Brake System External Leak Inspection.
    21.2. Pressure bleed the hydraulic brake system in order to purge any air that may still be trapped in the system.
22. Turn the ignition key ON, with the engine OFF. Check to see if the brake system warning lamp remains illuminated.

Note: If the brake system warning lamp remains illuminated, DO NOT allow the vehicle to be driven until it is diagnosed and repaired.

23. If the brake system warning lamp remains illuminated, refer to Symptoms - Hydraulic Brakes.

Hydraulic Brake System Bleeding (Pressure)

Special Tools

- *J-29532* Diaphragm Type Brake Pressure Bleeder, or equivalent
- *J-44894-A* Brake Pressure Bleeder Adapter

Warning: Refer to Brake Fluid Irritant Warning in the Preface section.

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:
   3.1. If removal of the reservoir cap and diaphragm is necessary, clean the outside of the reservoir on and around the cap prior to removal.
   3.2. 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.

   3.3. Allow a small amount of brake fluid to gravity bleed from the open port of the component.
   3.4. Reconnect the brake pipe to the component and tighten securely.
   3.5. Have an assistant slowly depress the brake pedal fully and maintain steady pressure on the pedal.
   3.6. Loosen the same brake pipe to purge air from the open port of the component.
   3.7. Tighten the brake pipe, then have the assistant slowly release the brake pedal.
   3.8. Wait 15 seconds, then repeat steps 3.3-3.7 until all air is purged from the same port of the component.
   3.9. 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.
   3.10. 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* Brake Pressure Bleeder Adapter to the brake master cylinder reservoir.
6. Connect the *J-29532* Diaphragm Type Brake Pressure Bleeder, or equivalent , to the J 44894-A .
7. Charge the *J-29532* Diaphragm Type Brake Pressure Bleeder, or equivalent , air tank to 175-

205 kPa (25-30 psi).

8. Open the *J-29532* Diaphragm Type Brake Pressure Bleeder, or equivalent , fluid tank valve to allow pressurized brake fluid to enter the brake system.
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* Diaphragm Type Brake Pressure Bleeder, or equivalent , fluid tank valve, then disconnect the *J-29532* Diaphragm Type Brake Pressure Bleeder, or equivalent , from the *J-44894-A* Brake Pressure Bleeder Adapter .
21. Remove the *J-44894-A* Brake Pressure Bleeder Adapter from the brake master cylinder reservoir.
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:
    23.1. Inspect the brake system for external leaks. Refer to Brake System External Leak Inspection.
    23.2. If equipped with antilock brakes, using a scan tool, perform the antilock brake system automated bleeding procedure to remove any air that may have been trapped in the brake pressure modulator valve (BPMV). Refer to Antilock Brake System Automated Bleed Procedure.
24. Turn the ignition key ON, with the engine OFF. Check to see if the brake system warning lamp remains illuminated.

    Note: 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

Warning: Refer to Brake Fluid Irritant Warning in the Preface section.

Caution: Refer to Brake Fluid Effects on Paint and Electrical Components Caution in the Preface section.

1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination:
   - Fluid separation, indicating 2 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:
   3.1. 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
   - Front Brake Hose Replacement
   - Rear Brake Hose Replacement
   - Front Brake Caliper Replacement
   - Rear Brake Caliper Replacement
   - Brake Pressure Modulator Valve Replacement

   3.2. Clean out all the hydraulic brake pipes using denatured alcohol, or equivalent.

   3.3. Dry the brake pipes using non-lubricated, filtered air.

   3.4. 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 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.

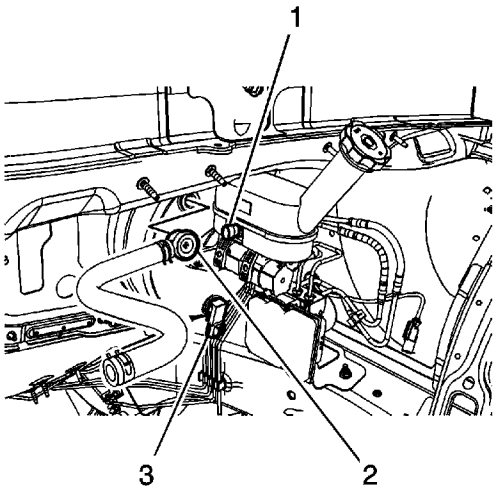
- Replace the brake master cylinder reservoir cap diaphragm.
- Front Brake Hose Replacement
- Rear Brake Hose Replacement
- Front Brake Caliper Replacement
- Rear Brake Caliper Replacement
- Brake Pressure Modulator Valve Replacement

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. The diaphragm may have allowed the moisture or particles to enter the hydraulic system.
5. Fill the brake master cylinder reservoir to the maximum-fill level with approved brake fluid from a clean, sealed brake fluid container as specified in the owners manual.
6. 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.

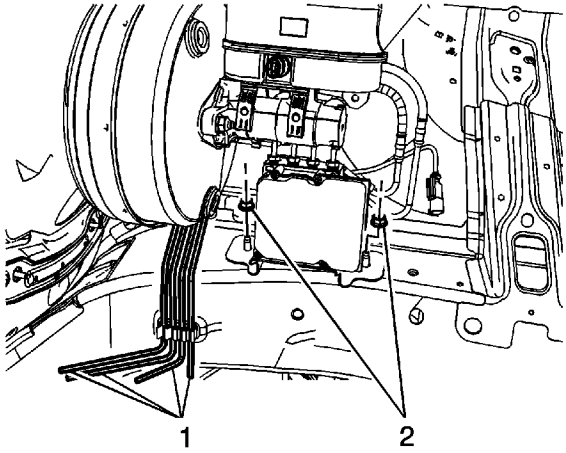
Power Vacuum Brake Booster Replacement

Removal Procedure

1. Place the vehicle on a level surface and apply the park brake.
2. With the engine OFF, apply and release the brake pedal several times until the brake pedal becomes firm to deplete the vacuum reserve in the vacuum brake booster.
3. Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement.
4. Remove the windshield washer solvent heater. Refer to Windshield Washer Solvent Heater Replacement.



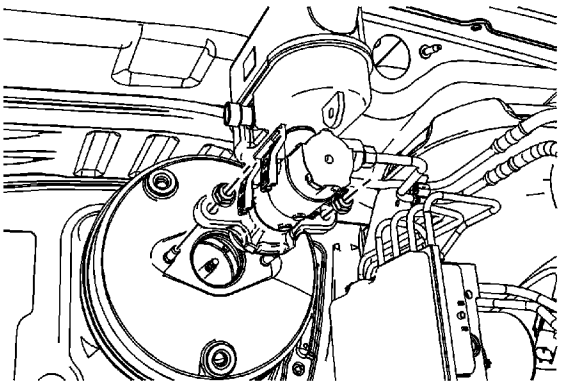
5. Disconnect the master cylinder fluid level sensor electrical connector (1).
6. Remove the vacuum brake booster check valve and hose assembly (2) from the vacuum brake booster and position aside.
7. Remove the vacuum brake booster vacuum sensor (3) and position aside.



8. Release the front and rear brake pipes (1) from the routing clip on the frame rail.
9. Remove the 2 nuts (2) from the brake pressure modulator valve (BPMV) assembly.

Note: It is not necessary to disconnect the brake pipes from the BPMV assembly.

10. Carefully lift the BPMV assembly over the studs and position forward slightly.

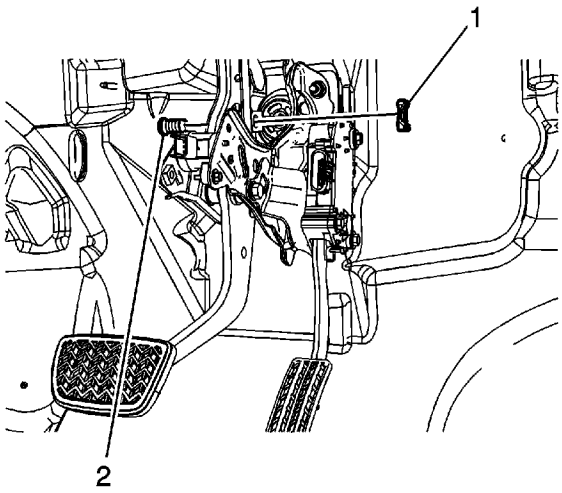


11. Remove the 2 brake master cylinder nuts.

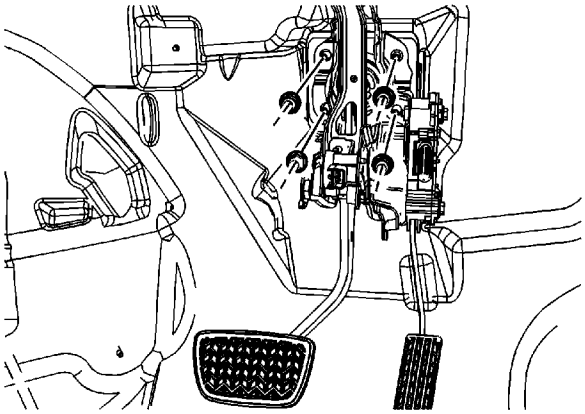
Note: It is not necessary to disconnect the brake pipes from the master cylinder.

12. Without disconnecting the brake pipes from the master cylinder, remove the master cylinder assembly and position aside.

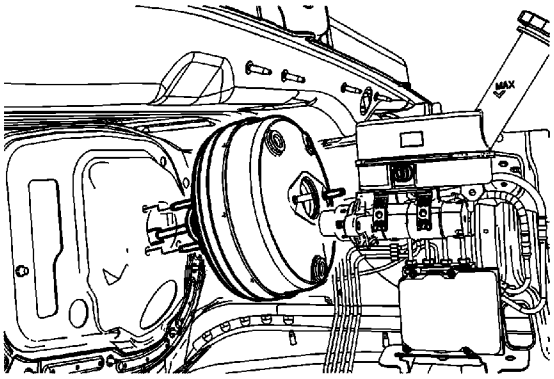
Place the brake master cylinder in an upright position and support with heavy mechanics wire or equivalent.



13. Remove the left side instrument panel insulator panel. Refer to Instrument Panel Insulator Panel Replacement - Left Side.
14. Remove the driver knee bolster. Refer to Driver Knee Bolster Replacement.
15. Remove the brake pedal pushrod retaining clip (1).
16. Remove the brake pedal pushrod clevis pin (2) and disconnect the pushrod from the brake pedal.
17. Remove the intermediate steering shaft. Refer to Intermediate Steering Shaft Replacement.



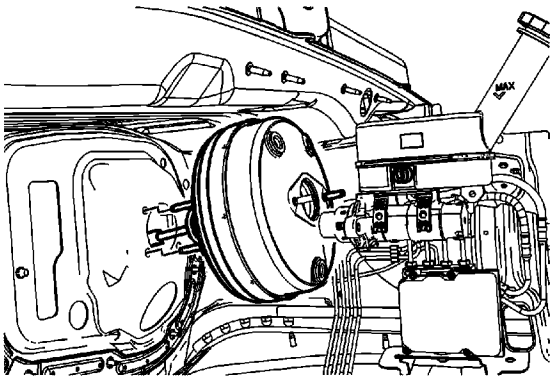
18. Remove the 4 vacuum brake booster nuts.



19. Pull the vacuum brake booster forward and tilt upward slightly until the mounting studs clear the dash panel.
20. Remove the vacuum brake booster.

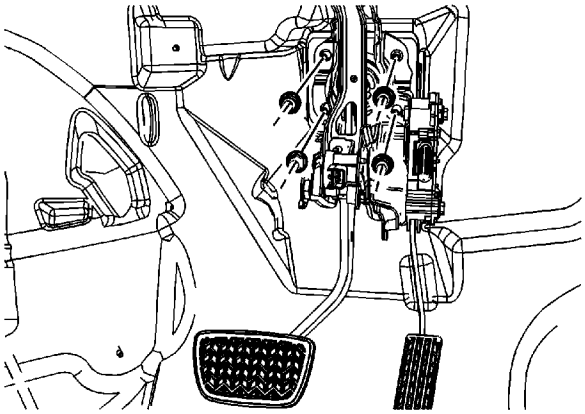
Installation Procedure

Note: Inspect the vacuum brake booster to dash panel gasket for damage and replace, if necessary.



1. Align the vacuum brake booster mounting studs to the dash panel.
2. Install the vacuum brake booster.

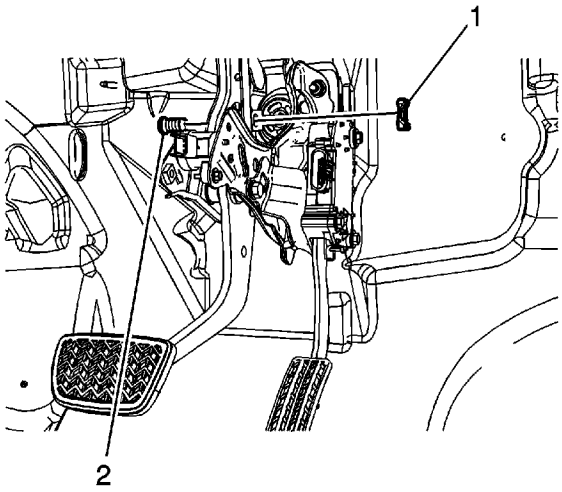
Caution: Refer to Fastener Caution in the Preface section.



3. Install the 4 vacuum brake booster nuts.

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

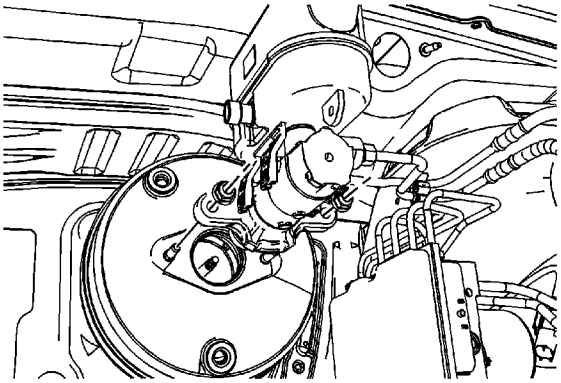
4. Install the intermediate steering shaft. Refer to Intermediate Steering Shaft Replacement.



5. Connect the brake pedal pushrod to the brake pedal and install the clevis pin (2).
6. Install the brake pedal pushrod retaining clip (1).
7. Install the driver knee bolster. Refer to Driver Knee Bolster Replacement.
8. Install the left side instrument panel insulator panel. Refer to Instrument Panel Insulator

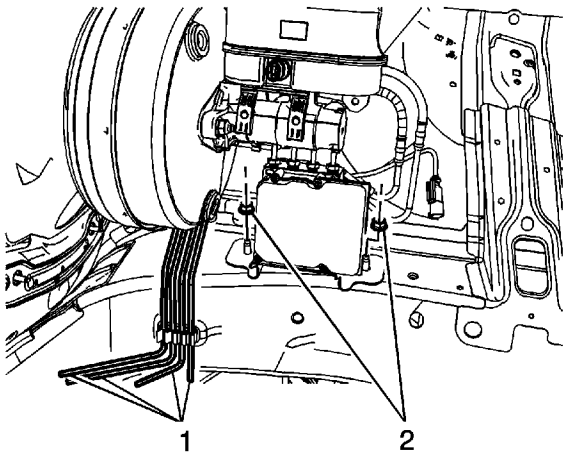
Panel Replacement - Left Side.

Note: Ensure the master cylinder to vacuum brake booster seal is properly installed on the back of the master cylinder housing and is not damaged.



9. Position the master cylinder to the vacuum booster. Inspect the master cylinder to vacuum brake booster seal for damage and replace, if necessary.
10. Install the 2 brake master cylinder nuts.

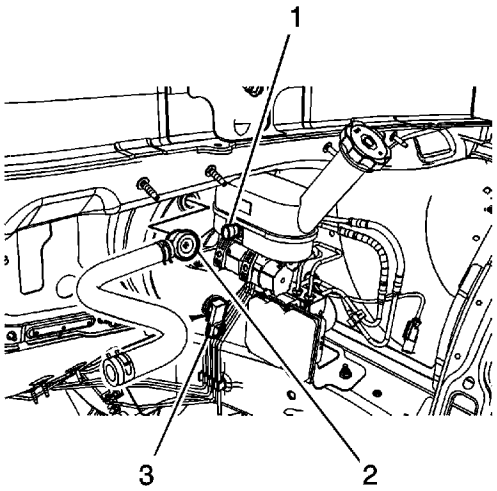
Tighten
Tighten the nuts to 20 N·m (15 lb ft).



11. Position the BPMV assembly over the studs.
12. Install the 2 nuts (2) to the BPMV and bracket assembly.

    Tighten
    Tighten the nuts to 20 N·m (15 lb ft).

13. Install the front and rear brake pipes (1) to the routing clip on the frame rail.



14. Connect the master cylinder fluid level sensor electrical connector (1).

    Note: If necessary, a small amount of denatured alcohol may be used to aid installation of the brake booster vacuum sensor. Do not use soap.

15. Install the vacuum brake booster vacuum sensor (3).

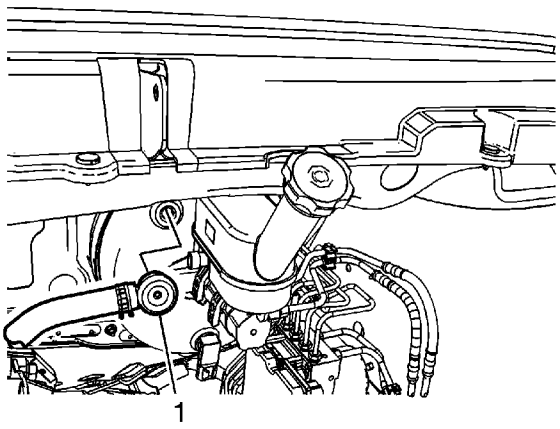
    Note: If necessary, a small amount of denatured alcohol may be used to aid installation of the brake booster check valve. Do not use soap.

16. Install the vacuum brake booster check valve and hose assembly (2) to the vacuum brake booster.
17. Install the windshield washer solvent heater. Refer to Windshield Washer Solvent Heater Replacement.
18. Install the air cleaner assembly. Refer to Air Cleaner Assembly Replacement.

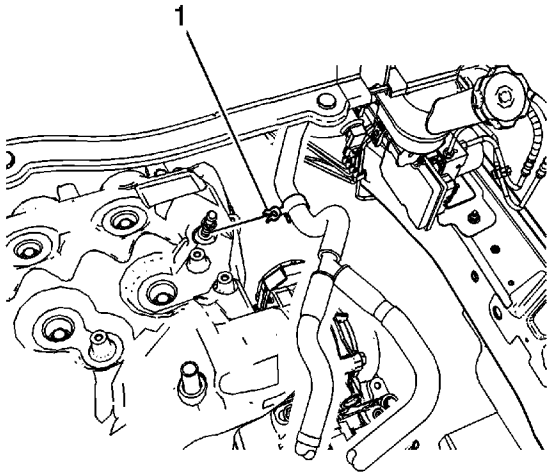
Power Brake Booster Vacuum Check Valve and Hose Replacement

Removal Procedure

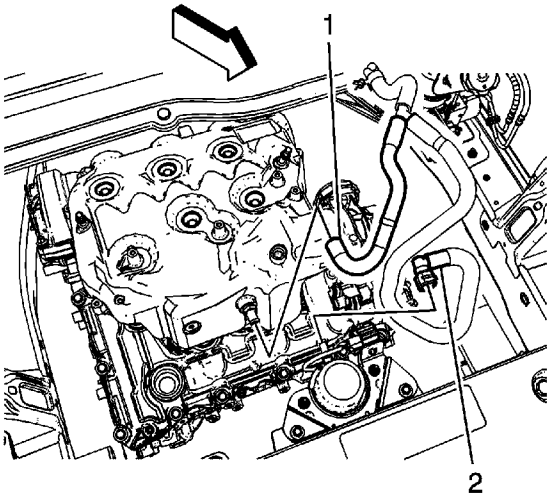
1. Turn the ignition switch to the OFF position.



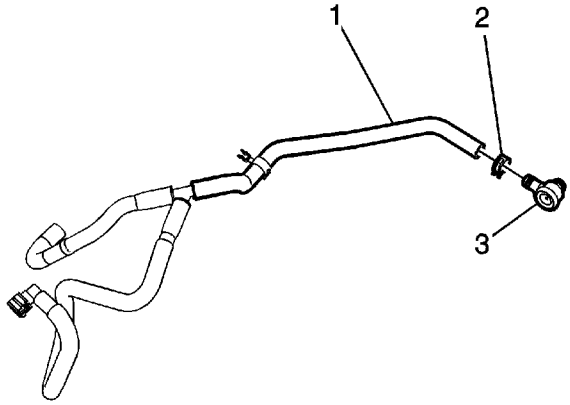
2. Apply and release the brake pedal several times until the brake pedal becomes firm to deplete the brake booster vacuum reserve.
3. Remove the windshield washer solvent heater, if equipped. Refer to Windshield Washer Solvent Heater Replacement.
4. Disconnect the power vacuum brake booster check valve and hose assembly (1) from the brake booster.



5. Remove the fuel injector sight shield. Refer to Fuel Injector Sight Shield Replacement.
6. Release the vacuum hose routing clip (1) from the intake manifold ball stud.

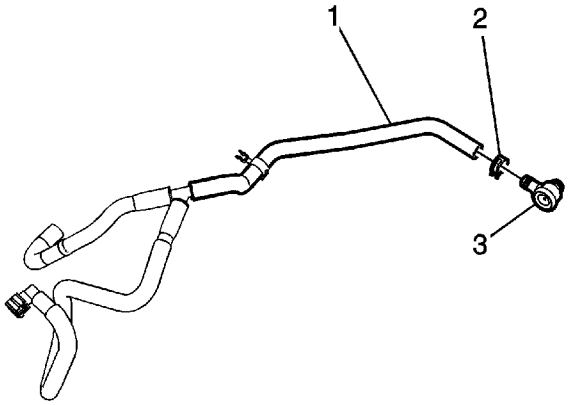


7. Disconnect the power vacuum brake booster hose (1) from the intake manifold vacuum port.
8. Release the quick connect (2) from the power brake booster auxiliary pump.
9. Remove the vacuum brake booster hose assembly from the vehicle.



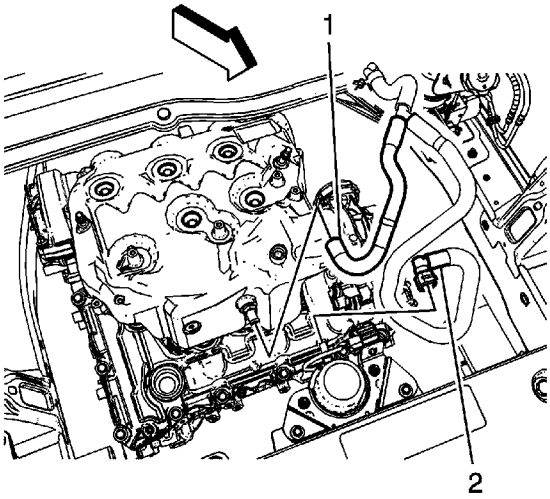
10. Remove the vacuum brake booster hose (1) and clamp (2) from the check valve (3).

Installation Procedure



1. Install the vacuum brake booster hose (1) and clamp (2) to the check valve (3).

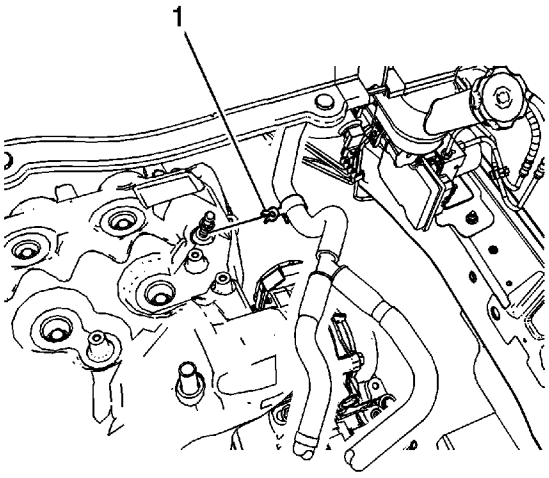
   If necessary, a small amount of denatured alcohol can be used as an assembly aid for installing the vacuum hose to the check valve. Do not use soap.



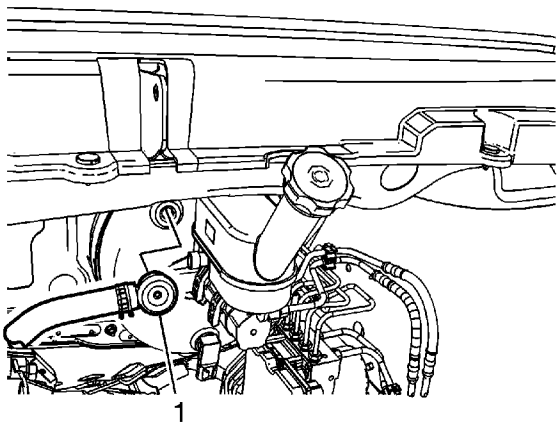
2. Install the vacuum brake booster hose assembly to the vehicle.
3. Connect the power vacuum brake booster hose (1) to the intake manifold vacuum port.

   If necessary, a small amount of denatured alcohol can be used as an assembly aid for installing the vacuum hose to the manifold vacuum port. Do not use soap.

4. Connect the quick connect (2) to the power brake booster auxiliary pump.



5. Connect the vacuum hose routing clip (1) to the intake manifold ball stud.
6. Install the fuel injector sight shield. Refer to Fuel Injector Sight Shield Replacement.

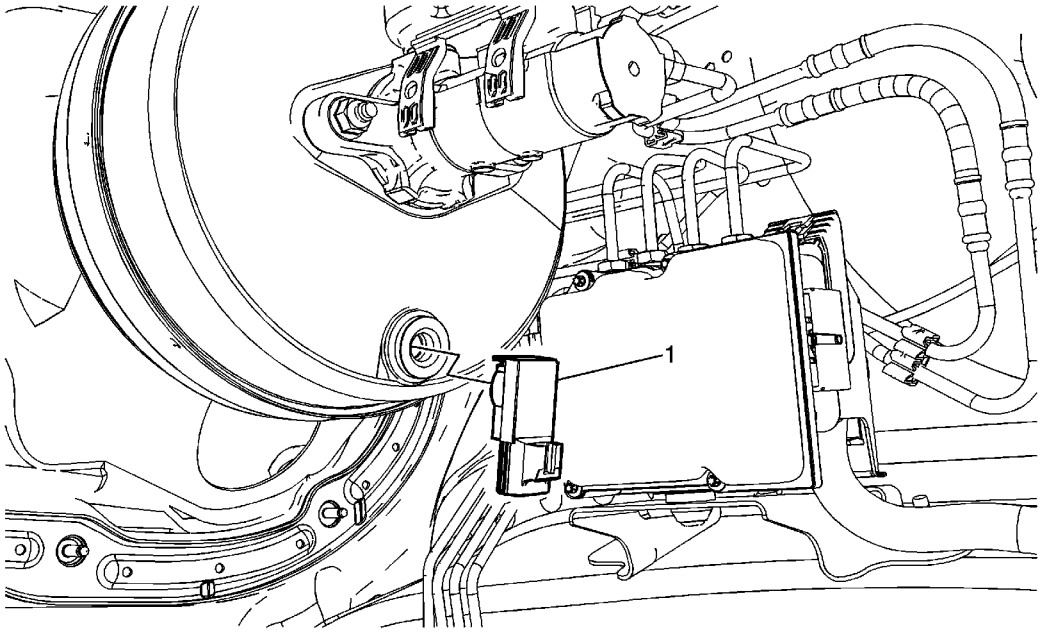


7. Connect the power vacuum brake booster check valve and hose assembly (1) to the brake booster.

   If necessary, a small amount of denatured alcohol can be used as an assembly aid for installing the check valve to the booster grommet. Do not use soap.

8. Install the windshield washer solvent heater, if equipped. Refer to Windshield Washer Solvent Heater Replacement.

Power Brake Booster Vacuum Sensor Replacement

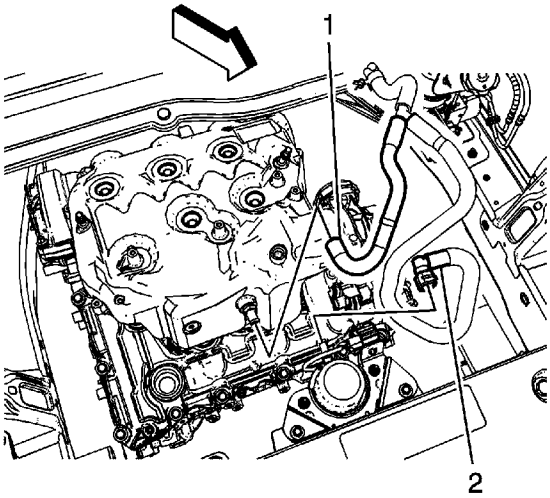


Callout	Component Name
Preliminary Procedures 1. Turn the ignition switch to the OFF position. 2. Apply the brake pedal several times until the brake pedal becomes firm to deplete the power brake booster vacuum reserve. 3. Disconnect the power brake booster vacuum sensor electrical connector.	
1	Power Brake Booster Vacuum Sensor **Tip** If necessary, a small amount of denatured alcohol can be used as an assembly aid for installing the power brake booster vacuum sensor to the brake booster. Do not use soap.

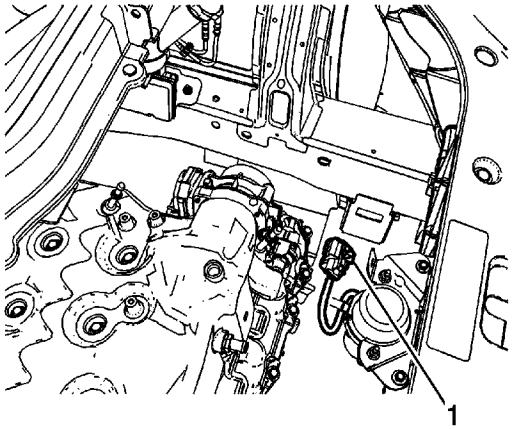
Power Brake Booster Auxiliary Pump Replacement

Removal Procedure

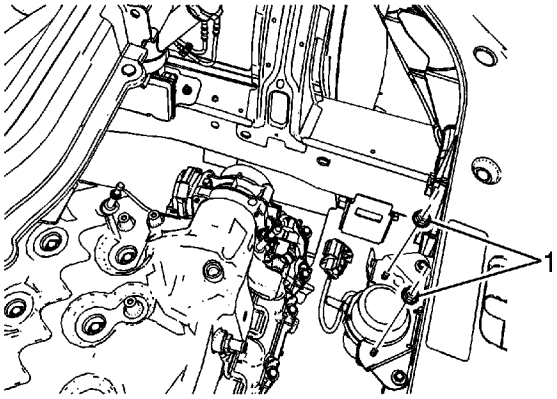
1. Turn the ignition switch to the OFF position.
2. Apply and release the brake pedal several times until the brake pedal becomes firm to deplete the brake booster vacuum reserve.
3. Remove the fuel injector sight shield. Refer to Fuel Injector Sight Shield Replacement.



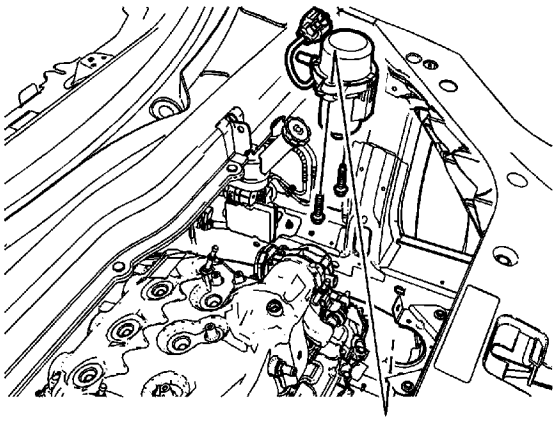
4. Release the quick connect (2) from the power brake booster auxiliary pump.
5. Position the vacuum brake booster hose assembly aside.



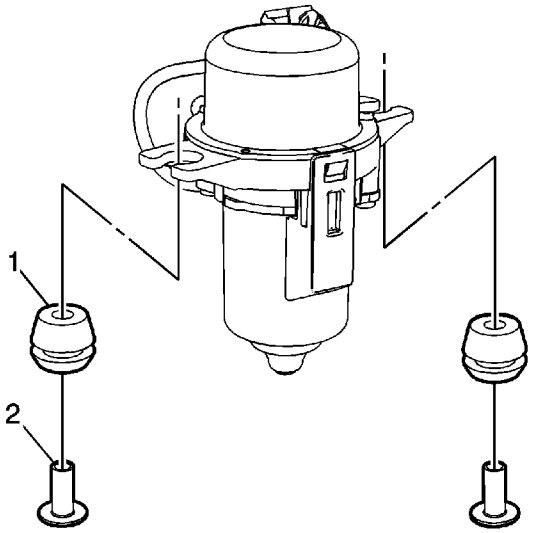
6. Disconnect the power brake booster auxiliary pump electrical connector.
7. Release the power brake booster auxiliary pump electrical connector (1) from the bracket.



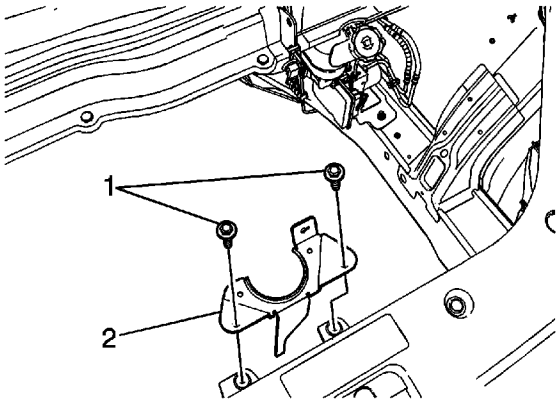
8. Remove the power brake booster auxiliary pump nuts (1).



9. Remove the power brake booster auxiliary pump bolts (1) and the pump (2).



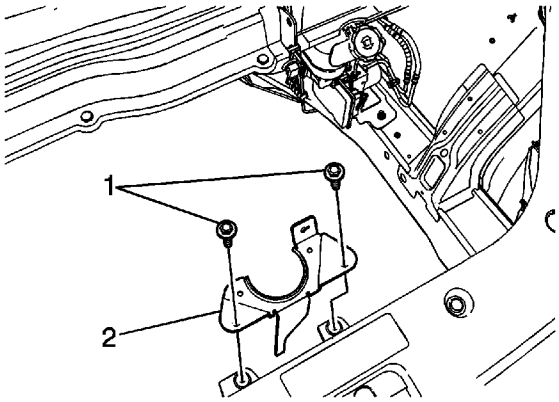
10. If necessary, remove the power brake booster auxiliary pump insulators (1) and sleeves (2).



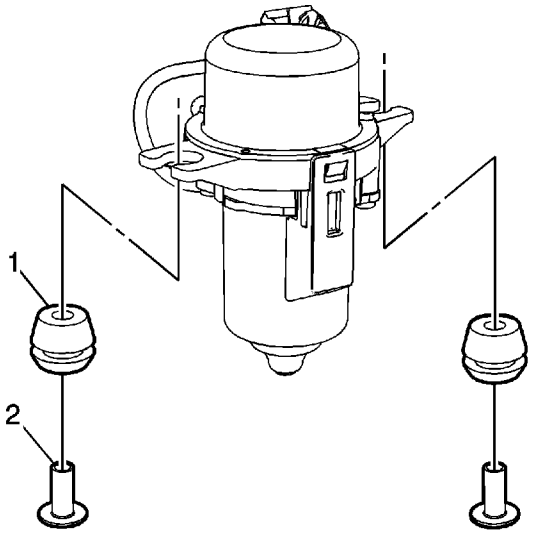
11. If necessary, remove the power brake booster auxiliary pump bracket bolts (1) and bracket (2).

Installation Procedure

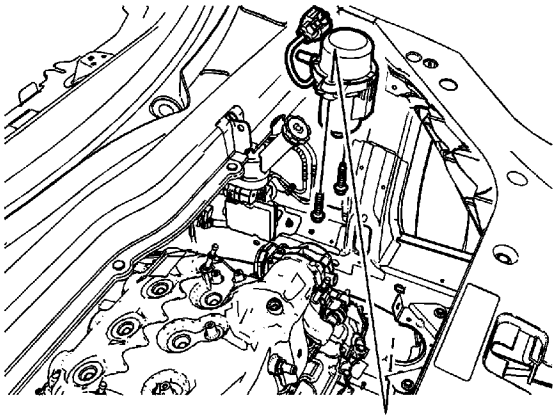
Caution: Refer to Fastener Caution in the Preface section.



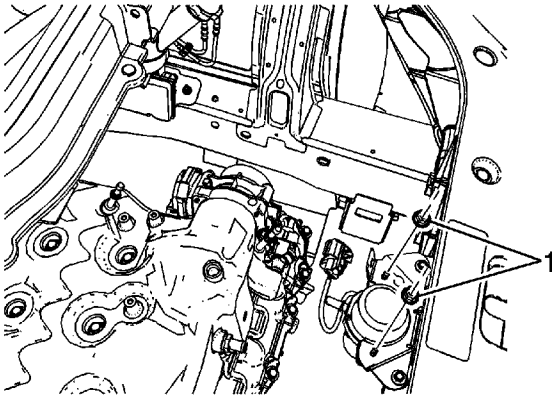
1. If removed, install the power brake booster auxiliary pump bracket bolts (1) and bracket (2) and tighten the bolts to **10 N·m (89 lb in)**.



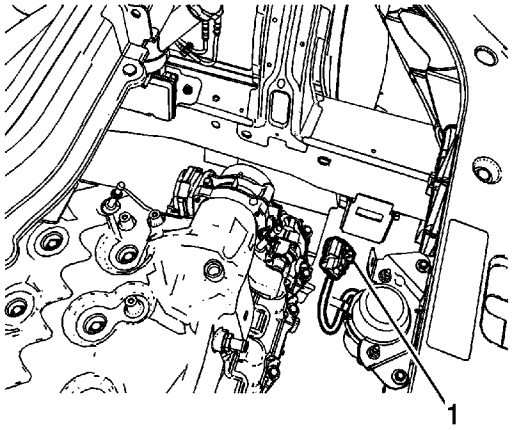
2. If removed, install the power brake booster auxiliary pump insulators (1) and sleeves (2).



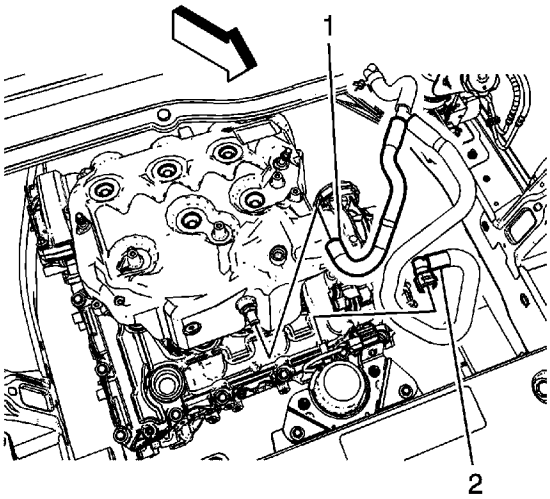
3. Install the power brake booster auxiliary pump bolts (1) and the pump (2) to the bracket.



4. Install the power brake booster auxiliary pump nuts (1) and tighten the nuts to **10 N·m (89 lb in)**.



5. Install the power brake booster auxiliary pump electrical connector (1) to the bracket.
6. Connect the power brake booster auxiliary pump electrical connector.



7. Connect the quick connect (2) to the power brake booster auxiliary pump.
8. Install the fuel injector sight shield. Refer to Fuel Injector Sight Shield Replacement.