

2017 BRAKES**Hydraulic Brakes - Encore, Trax****SPECIFICATIONS****FASTENER SPECIFICATIONS****Single Use Non-Threaded Fasteners/Components****NOTE:**

All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application
Brake Hose Fitting Gasket

Reusable Threaded Fastener Tightening Specifications**NOTE:**

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Brake Hose Fitting Bolt	40 N.m (30 lb ft)
Brake Pedal Assembly Upper Bolt	9 N.m (80 lb in)
Brake Pedal Bracket Nut	9 N.m (80 lb in)
Brake Pedal Nut	19 N.m (14 lb ft)
Brake Pedal Release Bracket Bolt	22 N.m (16 lb ft)
Brake Pipe Fitting	18 N.m (13 lb ft)
Master Cylinder Nut	19 N.m (14 lb ft)
Power Brake Booster Pump Bracket Nut - M4P	58 N.m (43 lb ft)
Power Brake Booster Pump Bracket Nut - MNH, MNK, MR5	22 N.m (16 lb ft)
Power Brake Booster Pump Nut	7 N.m (62 lb in)
Power Vacuum Brake Booster Bolt	19 N.m (14 lb ft)

APPROXIMATE FLUID CAPACITIES

Application	Specification	
	Metric	English
Hydraulic Brake System	0.67 L	1.416 pt

BRAKE COMPONENT SPECIFICATIONS

Application	Specification	
	Metric	English
Brake Caliper Bleeder Valve	17 N.m	13 lb ft
Rear Brake Cylinder Bleeder Valve	9 N.m	80 lb in

BRAKE SYSTEM SPECIFICATIONS

Application	Specification	
	Metric	English

Application	Specification	
	Metric	English
Brake Pedal Travel Maximum specification with 450 N (101 lbs) of force applied to the pedal with the ignition OFF and the booster power reserve depleted.	48-58 mm	1.9-2.3 in

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Application	Type of Material	GM Part Number	
		United States	Canada
Hydraulic Brake System	DOT 3 Motor Vehicle Brake Fluid	19299818	19299819
Hydraulic Brake System	DOT 4 Motor Vehicle Brake Fluid	19299570	19299571

SCHEMATIC WIRING DIAGRAMS

HYDRAULIC BRAKE WIRING SCHEMATICS (BUICK WITH LE2)

Hydraulic Brakes (Buick with LE2)

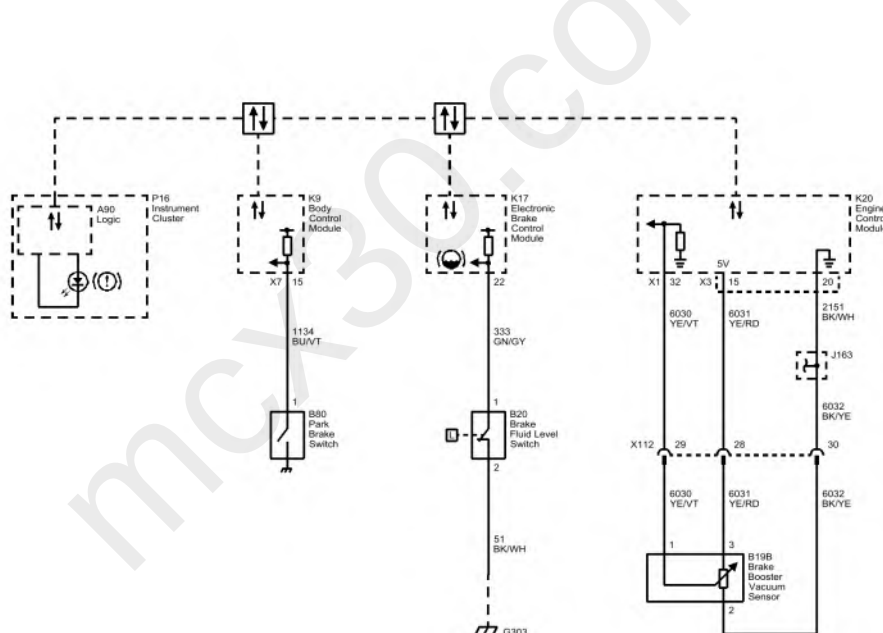


Fig. 1: Hydraulic Brakes (Buick with LE2)

Courtesy of GENERAL MOTORS COMPANY

HYDRAULIC BRAKE WIRING SCHEMATICS (BUICK WITH LUV)

Hydraulic Brakes (Buick with LUV)

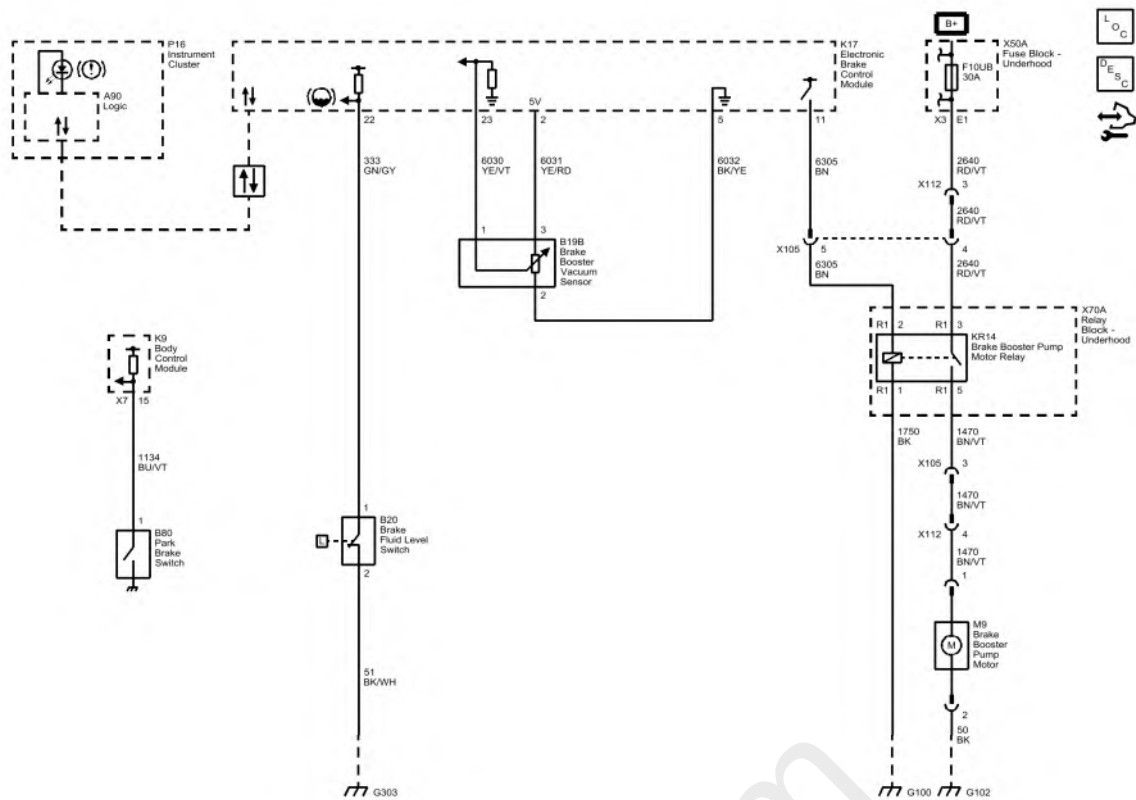


Fig. 2: Hydraulic Brakes (Buick with LUV)
Courtesy of GENERAL MOTORS COMPANY

HYDRAULIC BRAKE WIRING SCHEMATICS (CHEVROLET)

Hydraulic Brakes (Chevrolet)

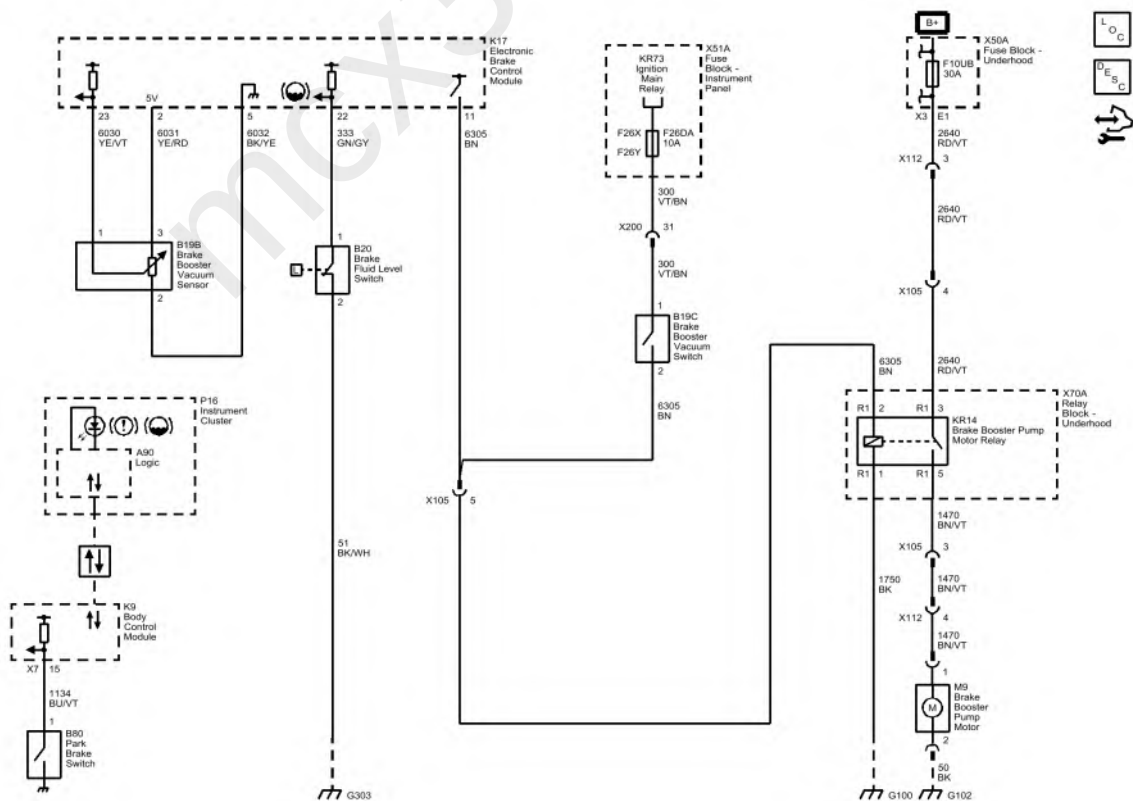


Fig. 3: Hydraulic Brakes (Chevrolet)
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC C025E: BRAKE BOOSTER

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC C025E

Brake Booster Vacuum Sensor Circuit

DTC C027B

Brake Booster Electric Vacuum Pump

For symptom byte information refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5V Reference	C025E 1A	C025E 04	C025E 1A	-
Signal	C025E 04	C025E 01	C025E 01	C025E 5A
Low Reference	-	C025E 01	-	-
Brake Booster Pump Motor Relay B+ Terminal 3	1	1	-	-
Brake Booster Pump Motor Switch Control Terminal 5	1	1	2	-
Brake Booster Pump Motor Relay Coil Control Terminal 2	C025E 04, C027B 04	C025E 04, C027B 04	C025E 01, C027B 01	-
Brake Booster Pump Motor Relay Ground Terminal 1	-	1	-	-
Brake Booster Pump Motor B+ Terminal 1	1	1	2	-
Brake Booster Pump Motor Ground Terminal 2	-	1	1	-
1. Brake Booster Pump Motor Always Off 2. Brake Booster Pump Motor Always ON				

Circuit/System Description

The brake booster vacuum sensor measures the vacuum in the brake booster. The electronic brake control module supplies a 5 v reference and a low reference circuit to the brake booster vacuum sensor. The vacuum sensor supplies a voltage signal in relation to the pressure in the brake booster to the electronic brake control module. When the vacuum within the system becomes low, the electronic brake control module turns on the brake booster pump motor by providing battery voltage to the brake booster pump motor relay. The relay activates and supplies the voltage to the brake booster pump motor.

Conditions for Running the DTC

Engine running

Conditions for Setting the DTC

C025E 01

- A short to voltage is detected on the signal circuit.
- A short to voltage is detected on the 5 V reference circuit.
- A short to voltage is detected on the relay control circuit.

C025E 04

- A open/high resistance is detected on the vacuum sensor signal circuit.
- A open/high resistance is detected on the relay control circuit.

C025E 5A

The Electronic Brake Control Module detected an erratic Vacuum Sensor Signal that is not plausible.

C025E 71

The electronic brake control module receives an invalid serial data message from the engine control module.

C027B 01

The electronic brake control module receives an invalid serial data message from the engine control module.

C027B 04

The electronic brake control module receives an invalid serial data message from the engine control module.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The red Brake warning indicator turns ON.
- The Electronic Brake Control Module disables the ABS, the traction control, and the electronic stability control for the duration of the ignition cycle.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Reference Information

Schematic Reference

[Hydraulic Brake Schematics \(Buick with LE2\)](#)[Hydraulic Brake Schematics \(Buick with LUV\)](#)[Hydraulic Brake Schematics \(Chevrolet\)](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#), [COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

Description and Operation

Brake Assist System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Testing

C025E 71

1. Ignition ON.

2. Verify that no other DTCs are set.

- **If any other DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).

- **If no other DTCs are set**

3. Replace the K20 Engine Control Module.

4. Verify the DTC C025E does not set while operating the vehicle under the conditions for Running the DTC.

- **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

- **If the DTC does not set**

5. All OK.

C025E 01, C025E 04, C025E 5A, C027B 01, or C027B 04

1. Ignition OFF and all vehicle systems OFF, disconnect the KR14 Brake Booster Pump Motor Relay. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between the ground circuit terminal 1 (86) and ground.

- **If 10 Ω or greater**

1. Ignition OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Ignition ON.

4. Verify a test lamp illuminates between the B+ circuit terminal 3 (30) and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition OFF.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Ignition OFF.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for infinite resistance between the control circuit terminal 5 (87) and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the KR14 Brake Booster Pump Motor Relay.

- **If the test lamp illuminates**

5. Connect a test lamp between the control circuit terminal 2 (85) and the ground circuit terminal 1 (86). Clear EBCM DTCs.

6. Verify the test lamp turns ON and OFF when commanding the Brake Booster Electric Vacuum Pump ON and OFF with a scan tool.

- **If the test lamp is always OFF**

1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the K17 Electronic Brake Control Module.

- **If the test lamp is always ON**

1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, ignition ON.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K17 Electronic Brake Control Module.

- **If the test lamp turns ON and OFF**

7. Verify that a test lamp does not illuminate between the control circuit terminal 5 (87) and ground.

- **If the test lamp illuminates**

Repair the short to voltage on the control circuit

- **If the test lamp does not illuminate**

8. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the M9 Brake Booster Pump Motor. It may take up to 2 min for all vehicle systems to power down.
9. Test for less than 10 Ω between the M9 Brake Booster Pump Motor ground circuit terminal 2 and ground.

- **If 10 Ω or greater**

1. Ignition OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

10. Connect the harness connector at the M9 Brake Booster Pump Motor.
11. Ignition ON, connect a 30 A fused jumper wire between the B+ circuit terminal 3 (30) and the control circuit terminal 5 (87).
12. Verify the M9 Brake Booster Pump Motor is activated.

- **If the M9 Brake Booster Pump Motor does not activate**

1. Ignition OFF, disconnect the harness connector at the M9 Brake Booster Pump Motor.
2. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the M9 Brake Booster Pump Motor.

- **If the M9 Brake Booster Pump Motor activates**

13. Test for 60-180 Ω between terminals 85 and 86 on the relay.

- **If less than 60 or greater than 180 Ω**

Replace the relay.

- **If between 60-180 Ω**

14. Test for infinite resistance between the terminals listed below:

- 30 and 86
- 30 and 85
- 30 and 87
- 85 and 87

- **If less than infinite resistance**

Replace the relay.

- **If infinite resistance**

15. Install a 20 A fused jumper wire between relay terminal 85 and 12 V. Install a jumper wire between relay terminal 86 and ground.
16. Test for less than 2 Ω between terminals 30 and 87.
 - **If 2 Ω or greater**

Replace the relay.

- **If less than 2 Ω**

17. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B19B Brake Booster Vacuum Sensor. It may take up to 2 min for all vehicle systems to power down.

18. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.

- **If 10 Ω or greater**

1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the K17 Electronic Brake Control Module.

- **If less than 10 Ω**

19. Ignition ON.

20. Test for 4.8-5.2 V between the 5 V reference circuit terminal 3 and ground.

- **If less than 4.8 V**

1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.

2. Test for infinite resistance between the 5 V reference circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance

3. Test for less than 2 Ω in the 5 V reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the K17 Electronic Brake Control Module.

- **If greater than 5.2 V**

1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, ignition ON.

2. Test for less than 1 V between the 5 V reference circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.

- If less than 1 V, replace the K17 Electronic Brake Control Module.

- **If between 4.8-5.2 V**

21. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, Ignition ON.

22. Test for less than 1 V between the B19B Brake Booster Vacuum Sensor signal circuit terminal 1 and ground.

- **If greater than 1 V**

Repair the short to voltage on the circuit.

- **If less than 1 V**

23. Ignition OFF.

24. Test for infinite resistance between the B19B Brake Booster Vacuum Sensor signal circuit terminal 1 and ground.

- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

25. Test for less than 2 Ω in the B19B Brake Booster Vacuum Sensor signal circuit end to end.

- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

26. Replace the B19B Brake Booster Vacuum Sensor.

27. Verify the DTC does not set while operating the vehicle under Conditions for Running the DTC.

- **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

- If the DTC does not set

28. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Power Brake Booster Vacuum Hose Replacement \(LUV\)](#)[Power Brake Booster Vacuum Hose Replacement \(LE2\)](#)[Power Brake Booster Vacuum Hose Replacement \(2H0\)](#) for brake booster vacuum sensor replacement
- Refer to [Control Module References](#) for control module replacement, programming and setup.

DTC C0267: LOW BRAKE FLUID INDICATED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC C0267

Low Brake Fluid Indicated

For symptom byte information refer to [Symptom Byte List](#).

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	C0267 00	C0267 00	-	-
Ground	-	C0267 00	-	-

Circuit/System Description

The brake fluid level switch monitors the level of the brake fluid in the brake fluid reservoir. When the electronic brake control module sees low brake fluid level, the DTC is set.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

Low brake fluid level is detected for 8 s.

Action Taken When the DTC Sets

- The electronic brake control module disables the traction control and stability control for the duration of the ignition cycle.
- The traction control/stability control-active indicator turns ON.
- The brake warning indicator turns ON.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#) [COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

Description and Operation

[Brake Warning System Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Verify that the brake is above minimum level.
 - **If low**
Refer to [Brake Fluid Loss](#).
 - **If above minimum level**
2. Ignition ON.
3. Verify the scan tool Brake Fluid Level Sensor parameter is Ok.
 - **If the parameter is Low**
Refer to Circuit/System Testing.
 - **If the parameter is Ok**
4. All OK.

[Circuit/System Testing](#)

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B20 Brake Fluid Level Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.
 - **If 10 Ω or greater**
 1. Ignition OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Ignition ON.
4. Verify the scan tool Brake Fluid Level Sensor parameter is Low.
 - **If the parameter is not Low**
 1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.
 2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K17 Electronic Brake Control Module.
 - **If the parameter is Low**

5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and ground.

6. Verify the scan tool Brake Fluid Level Sensor parameter is Ok.

- **If the parameter is not Ok**

1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V.
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K17 Electronic Brake Control Module.

- **If the parameter is Ok**

7. Test or replace the B20 Brake Fluid Level Switch.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Brake Fluid Level Indicator Switch Replacement](#)
- Refer to [Control Module References](#) for electronic brake control module replacement, programming and setup.

DTC C027B: BRAKE BOOSTER

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC C025E

Brake Booster Vacuum Sensor Circuit

DTC C027B

Brake Booster Electric Vacuum Pump

For symptom byte information refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5V Reference	C025E 1A	C025E 04	C025E 1A	-
Signal	C025E 04	C025E 01	C025E 01	C025E 5A
Low Reference	-	C025E 01	-	-
Brake Booster Pump Motor Relay B+ Terminal 3	1	1	-	-
Brake Booster Pump Motor Switch Control Terminal 5	1	1	2	-
Brake Booster Pump Motor Relay Coil Control Terminal 2	C025E 04, C027B 04	C025E 04, C027B 04	C025E 01, C027B 01	-
Brake Booster Pump Motor Relay Ground Terminal 1	-	1	-	-
Brake Booster Pump Motor B+ Terminal 1	1	1	2	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Brake Booster Pump Motor Ground Terminal 2	-	1	1	-
1. Brake Booster Pump Motor Always Off 2. Brake Booster Pump Motor Always ON				

Circuit/System Description

The brake booster vacuum sensor measures the vacuum in the brake booster. The electronic brake control module supplies a 5 v reference and a low reference circuit to the brake booster vacuum sensor. The vacuum sensor supplies a voltage signal in relation to the pressure in the brake booster to the electronic brake control module. When the vacuum within the system becomes low, the electronic brake control module turns on the brake booster pump motor by providing battery voltage to the brake booster pump motor relay. The relay activates and supplies the voltage to the brake booster pump motor.

Conditions for Running the DTC

Engine running

Conditions for Setting the DTC

C025E 01

- A short to voltage is detected on the signal circuit.
- A short to voltage is detected on the 5 V reference circuit.
- A short to voltage is detected on the relay control circuit.

C025E 04

- A open/high resistance is detected on the vacuum sensor signal circuit.
- A open/high resistance is detected on the relay control circuit.

C025E 5A

The Electronic Brake Control Module detected an erratic Vacuum Sensor Signal that is not plausible.

C025E 71

The electronic brake control module receives an invalid serial data message from the engine control module.

C027B 01

The electronic brake control module receives an invalid serial data message from the engine control module.

C027B 04

The electronic brake control module receives an invalid serial data message from the engine control module.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The red Brake warning indicator turns ON.
- The Electronic Brake Control Module disables the ABS, the traction control, and the electronic stability control for the duration of the ignition cycle.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Reference Information

Schematic Reference

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE) **COMPONENT CONNECTOR END VIEWS - INDEX (TRAX)**

Description and Operation

Brake Assist System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

C025E 71

1. Ignition ON.
2. Verify that no other DTCs are set.
 - **If any other DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If no other DTCs are set**
3. Replace the K20 Engine Control Module.
4. Verify the DTC C025E does not set while operating the vehicle under the conditions for Running the DTC.
 - **If the DTC sets**

Replace the K17 Electronic Brake Control Module.
 - **If the DTC does not set**
5. All OK.

C025E 01, C025E 04, C025E 5A, C027B 01, or C027B 04

1. Ignition OFF and all vehicle systems OFF, disconnect the KR14 Brake Booster Pump Motor Relay. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 1 (86) and ground.
 - **If 10 Ω or greater**
 1. Ignition OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Ignition ON.
4. Verify a test lamp illuminates between the B+ circuit terminal 3 (30) and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
- **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for infinite resistance between the control circuit terminal 5 (87) and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the KR14 Brake Booster Pump Motor Relay.
- **If the test lamp illuminates**
- 5. Connect a test lamp between the control circuit terminal 2 (85) and the ground circuit terminal 1 (86). Clear EBCM DTCs.
- 6. Verify the test lamp turns ON and OFF when commanding the Brake Booster Electric Vacuum Pump ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K17 Electronic Brake Control Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K17 Electronic Brake Control Module.
 - **If the test lamp turns ON and OFF**
- 7. Verify that a test lamp does not illuminate between the control circuit terminal 5 (87) and ground.
 - **If the test lamp illuminates**

Repair the short to voltage on the control circuit
 - **If the test lamp does not illuminate**
- 8. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the M9 Brake Booster Pump Motor. It may take up to 2 min for all vehicle systems to power down.
- 9. Test for less than 10 Ω between the M9 Brake Booster Pump Motor ground circuit terminal 2 and ground.
 - **If 10 Ω or greater**
 1. Ignition OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
- 10. Connect the harness connector at the M9 Brake Booster Pump Motor.
- 11. Ignition ON, connect a 30 A fused jumper wire between the B+ circuit terminal 3 (30) and the control circuit terminal 5 (87).
- 12. Verify the M9 Brake Booster Pump Motor is activated.
 - **If the M9 Brake Booster Pump Motor does not activate**
 1. Ignition OFF, disconnect the harness connector at the M9 Brake Booster Pump Motor.
 2. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the M9 Brake Booster Pump Motor.

- **If the M9 Brake Booster Pump Motor activates**

13. Test for 60-180 Ω between terminals 85 and 86 on the relay.

- **If less than 60 or greater than 180 Ω**

Replace the relay.

- **If between 60-180 Ω**

14. Test for infinite resistance between the terminals listed below:

- 30 and 86
- 30 and 85
- 30 and 87
- 85 and 87
- **If less than infinite resistance**

Replace the relay.

- **If infinite resistance**

15. Install a 20 A fused jumper wire between relay terminal 85 and 12 V. Install a jumper wire between relay terminal 86 and ground.

16. Test for less than 2 Ω between terminals 30 and 87.

- **If 2 Ω or greater**

Replace the relay.

- **If less than 2 Ω**

17. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B19B Brake Booster Vacuum Sensor. It may take up to 2 min for all vehicle systems to power down.

18. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.

- **If 10 Ω or greater**

1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.
2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K17 Electronic Brake Control Module.

- **If less than 10 Ω**

19. Ignition ON.

20. Test for 4.8-5.2 V between the 5 V reference circuit terminal 3 and ground.

- **If less than 4.8 V**

1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.
2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K17 Electronic Brake Control Module.

- **If greater than 5.2 V**

1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, ignition ON.
2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K17 Electronic Brake Control Module.

- **If between 4.8-5.2 V**

21. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, Ignition ON.
22. Test for less than 1 V between the B19B Brake Booster Vacuum Sensor signal circuit terminal 1 and ground.
- **If greater than 1 V**
- Repair the short to voltage on the circuit.
- **If less than 1 V**
23. Ignition OFF.
24. Test for infinite resistance between the B19B Brake Booster Vacuum Sensor signal circuit terminal 1 and ground.
- **If less than infinite resistance**
- Repair the short to ground on the circuit.
- **If infinite resistance**
25. Test for less than 2 Ω in the B19B Brake Booster Vacuum Sensor signal circuit end to end.
- **If 2 Ω or greater**
- Repair the open/high resistance in the circuit.
- **If less than 2 Ω**
26. Replace the B19B Brake Booster Vacuum Sensor.
27. Verify the DTC does not set while operating the vehicle under Conditions for Running the DTC.
- **If the DTC sets**
- Replace the K17 Electronic Brake Control Module.
- **If the DTC does not set**
28. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Power Brake Booster Vacuum Hose Replacement \(LUV\)](#)[Power Brake Booster Vacuum Hose Replacement \(LE2\)](#)[Power Brake Booster Vacuum Hose Replacement \(2H0\)](#) for brake booster vacuum sensor replacement
- Refer to [Control Module References](#) for control module replacement, programming and setup.

DTC P050F: BRAKE BOOSTER WEAK VACUUM

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P050F

Brake Booster Weak Vacuum

For symptom byte information refer to [Symptom Byte List](#).

Circuit/System Description

The brake booster vacuum sensor measures the vacuum in the brake booster assembly. The engine control module supplies a 5 V reference and a low reference circuit to the brake booster vacuum sensor. The vacuum sensor supplies a voltage signal in relation to the pressure in the brake booster to the engine control module.

Conditions for Running the DTC

- The vehicle is in an Autostop.
- No MAP sensor DTCs set.
- No TP sensor DTCs set.

Conditions for Setting the DTC

The engine control module detected a weak vacuum in the brake booster assembly.

Action Taken When the DTC Sets

DTC P050F is a Type B DTC.

Conditions for Clearing the DTC

DTC P050F is a Type B DTC.

Reference Information

Schematic Reference

[Hydraulic Brake Schematics \(Buick with LE2\)](#)[Hydraulic Brake Schematics \(Buick with LUV\)](#)[Hydraulic Brake Schematics \(Chevrolet\)](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#) [COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

Description and Operation

[Brake Assist System Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify that DTCs P0556, P0557, or P0558 are not set.
 - **If the DTC is set**
Refer to [DTC P0556, P0557, or P0558](#).
 - **If the DTC is not set**
3. Verify that the brake booster vacuum system has no damage, leakage or incorrect installation.
 - **If damage, leakage or incorrect installation is found**
Refer to [Brake Assist System Diagnosis](#).
 - **If the inspection is OK**
4. Test or replace the B19B Brake Booster Vacuum Sensor.

5. Verify the DTC does not set while operating the vehicle under the Conditions for Running the DTC.

- **If the DTC sets**

Replace the K20 Engine Control Module.

- **If the DTC does not set**

6. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Power Brake Booster Vacuum Hose Replacement \(LUV\)](#)[Power Brake Booster Vacuum Hose Replacement \(LE2\)](#)[Power Brake Booster Vacuum Hose Replacement \(2H0\)](#) for B19B Brake Booster Vacuum Sensor replacement
- Refer to [Control Module References](#) for K20 Engine Control Module replacement, programming and setup.

DTC P0556, P0557, OR P0558: BRAKE BOOSTER PRESSURE SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0556

Brake Booster Pressure Sensor Performance

DTC P0557

Brake Booster Pressure Sensor Circuit Low Voltage

DTC P0558

Brake Booster Pressure Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5V Reference	P0557	P0557	-	P0556
Sensor Signal	P0557	P0557	P0558	P0556
Low Reference	-	P0557	-	P0556

Circuit/System Description

The brake booster vacuum sensor monitors the pressure in the brake booster. The engine control module supplies a 5 V reference and a low reference circuit to the brake booster vacuum sensor. The vacuum sensor supplies a voltage signal in relation to the pressure in the brake booster to the engine control module.

Conditions for Running the DTC

P0556

Engine Running.

P0557 or P0558

Ignition ON.

Conditions for Setting the DTC

P0556

The engine control module detects brake booster vacuum as being less than the intake manifold vacuum for more than 100 ms.

P0557

The engine control module detects less than 0.01 V on the brake booster sensor signal circuit for more than 12.5 ms.

P0558

The engine control module detects greater than 4.9 V on the brake booster sensor signal circuit for more than 12.5 ms.

Action Taken When the DTC Sets

DTCs P0556, P0557 or P0558 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0556, P0557 or P0558 are Type B DTCs.

Reference Information

Schematic Reference

[Hydraulic Brake Schematics \(Buick with LE2\)](#)[Hydraulic Brake Schematics \(Buick with LUV\)](#)[Hydraulic Brake Schematics \(Chevrolet\)](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#) [COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

Description and Operation

Brake Assist System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B19B Brake Booster Vacuum Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 2 (or B) and ground.
 - **If 10 Ω or greater**
 1. Disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If less than 10 Ω**

3. Ignition ON.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 3 (or C) and ground.
 - **If less than 4.8 V**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If greater than 5.2 V**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If between 4.8-5.2 V**
5. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, Ignition ON.
6. Test for less than 1 V between the B19B Brake Booster Vacuum Sensor signal circuit terminal 1 (or A) and ground.
 - **If greater than 1 V**

Repair the short to voltage on the circuit.
 - **If less than 1 V**
7. Ignition OFF.
8. Test for infinite resistance between the B19B Brake Booster Vacuum Sensor signal circuit terminal 1 (or A) and ground.
 - **If less than infinite resistance**

Repair the short to ground on the circuit.
 - **If infinite resistance**
9. Test for less than 2 Ω in the B19B Brake Booster Vacuum Sensor signal circuit end to end.
 - **If 2 Ω or greater**

Repair the open/high resistance in the circuit.
 - **If less than 2 Ω**
10. Replace the B19B Brake Booster Vacuum Sensor.
11. Verify the DTC does not set while operating the vehicle under Conditions for Running the DTC.
 - **If the DTC sets**

Replace the K20 Engine Control Module.
 - **If the DTC does not set**
12. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Power Brake Booster Vacuum Sensor Replacement](#)
- Refer to [Control Module References](#) for Engine Control Module replacement, programming and setup.

SYMPTOMS - HYDRAULIC BRAKES

NOTE: 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 customers 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 Booster Vacuum Assist Description and Operation](#)
 - [Brake Assist System Description and Operation](#)
 - [ABS Description and Operation](#)

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the hydraulic brake system. Refer to [Checking Aftermarket Accessories](#) .
- 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](#) .

Symptom List

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

- [Brake Booster Pump Motor Malfunction](#)
- [Brake Warning Indicator Malfunction \(Buick\)](#)[Brake Warning Indicator Malfunction \(Chevrolet\)](#)
- [Brake Pulsation](#)
- [Brake System Noise](#)
- [Braking Action Uneven - Pulls to One Side](#)
- [Braking Action Uneven - Front to Rear](#)
- [Brake Pedal Excessive Travel](#)
- [Brake Pedal Excessive Effort](#)
- [Brakes Drag](#)
- [Brake System Slow Release](#)
- [Brake Fluid Loss](#)

BRAKE BOOSTER PUMP MOTOR MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Brake Booster Pump Motor Relay B+ Terminal 3	1	1	-	-
Brake Booster Pump Motor Switch Control Terminal 5	1	1	2	-
Brake Booster Pump Motor Relay Coil Control Terminal 2	1	1	2	-
Brake Booster Pump Motor Relay Ground Terminal 1	-	1	-	-
Brake Booster Pump Motor B+ Terminal 1	1	1	2	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Brake Booster Pump Motor Ground Terminal 2	-	1	1	-
1. Brake Booster Pump Motor Always Off 2. Brake Booster Pump Motor Always ON				

Circuit/System Description

The brake booster vacuum sensor measures the vacuum in the brake booster. The electronic brake control module supplies a 5 v reference and a low reference circuit to the brake booster vacuum sensor. The vacuum sensor supplies a voltage signal in relation to the pressure in the brake booster to the electronic brake control module. When the vacuum within the system becomes low, the electronic brake control module turns on the brake booster pump motor by providing battery voltage to the brake booster pump motor relay. The relay activates and supplies the voltage to the brake booster pump motor.

Reference Information

Schematic Reference

[Hydraulic Brake Schematics \(Buick with LE2\)](#)[Hydraulic Brake Schematics \(Buick with LUV\)](#)[Hydraulic Brake Schematics \(Chevrolet\)](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#) [COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

Description and Operation

[Brake Booster Vacuum Assist Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#)

Circuit/System Verification

1. Ignition ON.
2. Verify the M9 Brake Booster Pump Motor turns ON and OFF when commanding the Brake Booster Electric Vacuum Pump ON and OFF with a scan tool.

- **If the M9 Brake Booster Pump Motor does not turn ON and OFF**

Refer to Circuit/System Testing.

- **If the M9 Brake Booster Pump Motor turn ON and OFF**

3. Verify that the brake booster vacuum system has no damage, leakage or incorrect installation.

- **If damage, leakage or incorrect installation is found**

Refer to [Brake Assist System Diagnosis](#).

- **If the inspection is OK**

4. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the KR14 Brake Booster Pump Motor Relay. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 1 (86) and ground.
 - **If 10 Ω or greater**
 1. Ignition OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Ignition ON.
4. Verify a test lamp illuminates between the B+ circuit terminal 3 (30) and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for infinite resistance between the control circuit terminal 5 (87) and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the KR14 Brake Booster Pump Motor Relay.
 - **If the test lamp illuminates**
5. Connect a test lamp between the control circuit terminal 2 (85) and the ground circuit terminal 1 (86).
6. Verify the test lamp turns ON and OFF when commanding the Brake Booster Electric Vacuum Pump ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K17 Electronic Brake Control Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K17 Electronic Brake Control Module.
 - **If the test lamp turns ON and OFF**
7. Verify that a test lamp does not illuminate between the control circuit terminal 5 (87) and ground.
 - **If the test lamp illuminates**

Repair the short to voltage on the control circuit
 - **If the test lamp does not illuminate**
8. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the M9 Brake Booster Pump Motor. It may take up to 2 min for all vehicle systems to power down.

9. Test for less than 10 Ω between the M9 Brake Booster Pump Motor ground circuit terminal 2 and ground.
- **If 10 Ω or greater**
 1. Ignition OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
10. Connect the harness connector at the M9 Brake Booster Pump Motor.
11. Ignition ON, connect a 30 A fused jumper wire between the B+ circuit terminal 3 (30) and the control circuit terminal 5 (87).
12. Verify the M9 Brake Booster Pump Motor is activated.
- **If the M9 Brake Booster Pump Motor does not activate**
 1. Ignition OFF, disconnect the harness connector at the M9 Brake Booster Pump Motor.
 2. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the M9 Brake Booster Pump Motor.
 - **If the M9 Brake Booster Pump Motor activates**
13. Test or replace the KR14 Brake Booster Pump Motor Relay.

Component Testing

Motor Test

1. Ignition OFF, disconnect the harness connector at the M9 Brake Booster Pump Motor. Install a 30 A fused jumper wire between the B+ circuit terminal 1 and B+. Install a jumper wire between the ground circuit terminal 2 and ground.
2. Verify the M9 Brake Booster Pump Motor activates.
 - **If the brake booster pump motor does not activate**

Replace the M9 Brake Booster Pump Motor.
 - **If the brake booster pump motor activates**
3. All OK.

Relay Test

1. Ignition OFF, disconnect the KR14 Brake Booster Pump Motor Relay.
2. Test for 60-180 Ω between terminals 1 and 2.
 - **If less than 60 or greater than 180 Ω**

Replace the relay.
 - **If between 60-180 Ω**
3. Test for infinite resistance between the terminals listed below:
 - 30 and 86
 - 30 and 85
 - 30 and 87
 - 85 and 87
 - **If less than infinite resistance**

Replace the relay.
 - **If infinite resistance**
4. Install a 20 A fused jumper wire between relay terminal 85 and 12 V. Install a jumper wire between relay terminal 86 and ground.
5. Test for less than 2 Ω between terminals 30 and 87.

- If 2 Ω or greater

Replace the relay.

- If less than 2 Ω

6. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Relay Replacement \(Attached to Wire Harness\)](#) [Relay Replacement \(Within an Electrical Center\)](#).
- Refer to [Power Brake Booster Pump Replacement](#).
- Refer to [Control Module References](#) for Electronic Brake Control Module replacement, programming and setup.

BRAKE WARNING INDICATOR MALFUNCTION (BUICK)

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Brake Fluid Level Signal	-	1	-	-
Park Brake Signal	1	1	1	-
Brake Fluid Level Ground	-	1	-	-
1. Brake Warning Indicator Malfunction				

Circuit/System Description

The instrument cluster turns ON the brake warning indicator for 5 s after ignition ON. When the electronic brake control module detects low brake fluid or body control module detects parking brake is applied a request is sent to the instrument cluster via serial data to turn the brake warning indicator ON.

Reference Information

Schematic Reference

[Hydraulic Brake Schematics \(Buick with LE2\)](#)[Hydraulic Brake Schematics \(Buick with LUV\)](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)

Description and Operation

Hydraulic Brake System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Circuit/System Verification

1. Verify that the brake fluid is above minimum level.

- **If low**

Refer to **Brake Fluid Loss**.

- **If above minimum level**

2. Ignition ON.

3. Verify the scan tool Brake Fluid Level Sensor is OK.

- **If the parameter is Low**

Refer to Circuit/System Testing - Brake Fluid Level Switch Malfunction.

- **If the parameter is OK**

4. Verify the scan tool Park Brake Switch parameter changes between Applied and Released while applying and releasing the parking brake.

- **If the parameter does not change**

Refer to Circuit/System Testing - Park Brake Switch Malfunction.

- **If the parameter changes**

5. Verify the brake warning indicator turns ON and OFF, when commanding the instrument cluster All Indicators On and Off with a scan tool.

- **If the brake warning indicator does not turn ON and OFF**

Replace the P16 Instrument Cluster.

- **If the brake warning indicator turns ON and OFF**

6. All OK.

Circuit/System Testing

NOTE: **Circuit/System Verification must be performed before Circuit/System Testing.**

Brake Fluid Level Sensor Malfunction

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B20 Brake Fluid Level Switch. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.

- **If 10 Ω or greater**

1. Ignition OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Ignition ON.

4. Verify the scan tool Brake Fluid Level Sensor parameter is Low.

- **If the parameter is not Low**

1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.

2. Test for infinite resistance between the signal circuit terminal 1 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance, replace the K17 Electronic Brake Control Module.

- **If the parameter is Low**

5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and ground.

6. Verify the scan tool Brake Fluid Level Sensor parameter is OK.

- **If the parameter is Low**

1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V.
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K17 Electronic Brake Control Module.

- **If the parameter is OK**

7. Test or replace the B20 Brake Fluid Level Switch.

Park Brake Switch Malfunction

1. Ignition OFF, disconnect the harness connector at the B80 Park Brake Switch.
2. Verify that the B80 Park Brake Switch has no physical damage or incorrect installation.

- **If physical damage or incorrect installation is found**

Test or replace the B80 Park Brake Switch.

- **If the inspection is OK**

3. Ignition ON.
4. Verify the scan tool Park Brake Switch parameter is Released.

- **If the parameter is Applied**

1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
2. Test for infinite resistance between the signal circuit terminal A and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.

- **If the parameter is Released**

5. Install a 3 A fused jumper wire between the signal circuit terminal A and ground.
6. Verify the scan tool Park Brake Switch parameter is Applied.

- **If the parameter is Released**

1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module, ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V.
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.

- **If the parameter is Applied**

7. Test or replace the B80 Park Brake Switch.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Brake Fluid Level Indicator Switch Replacement](#)
- Refer to [Parking Brake Indicator Switch Replacement](#)
- Refer to [Control Module References](#) for body control module replacement, programming and setup.

BRAKE WARNING INDICATOR MALFUNCTION (CHEVROLET)

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Brake Fluid Level Signal	-	1	-	-
Park Brake Signal	1	1	1	-
Brake Fluid Level Ground	-	1	-	-
1. Brake Warning Indicator Malfunction				

Circuit/System Description

The instrument cluster turns ON the brake warning indicator for 5 s after ignition ON. When the electronic brake control module detects low brake fluid or body control module detects parking brake is applied a request is sent to the instrument cluster via serial data to turn the brake warning indicator ON.

Reference Information

Schematic Reference

[Hydraulic Brake Schematics \(Chevrolet\)](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

Description and Operation

[Hydraulic Brake System Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Verify that the brake fluid is above minimum level.
 - **If low**
Refer to [Brake Fluid Loss](#).
 - **If above minimum level**
2. Refer to Circuit/System Testing - Brake Fluid Level Switch Malfunction.
3. Ignition ON.
4. Verify the scan tool Park Brake Switch parameter changes between Applied and Released while applying and releasing the parking brake.
 - **If the parameter does not change**
Refer to Circuit/System Testing - Park Brake Switch Malfunction.
 - **If the parameter changes**

5. Verify the brake warning indicator turns ON and OFF, when commanding the instrument cluster All Indicators On and Off with a scan tool.

- **If the brake warning indicator does not turn ON and OFF**

Replace the P16 Instrument Cluster.

- **If the brake warning indicator turns ON and OFF**

6. All OK.

Circuit/System Testing

NOTE: **Circuit/System Verification must be performed before Circuit/System Testing.**

Brake Fluid Level Sensor Malfunction

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B20 Brake Fluid Level Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.
 - **If 10 Ω or greater**
 1. Ignition OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Disconnect the harness connector at the K9 Body Control Module.
4. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 1. Test for less than 2 Ω in the signal circuit end to end
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the B20 Brake Fluid Level Switch.
5. Verify the Brake Warning Indicator is Off
 - **If the Brake Warning Indicator is On**

Replace the K9 Body Control Module
 - **If the Brake Warning Indicator is Off**
6. All OK.

Park Brake Switch Malfunction

1. Ignition OFF, disconnect the harness connector at the B80 Park Brake Switch.
2. Verify that the B80 Park Brake Switch has no physical damage or incorrect installation.
 - **If physical damage or incorrect installation is found**

Test or replace the B80 Park Brake Switch.
 - **If the inspection is OK**
3. Ignition ON.
4. Verify the scan tool Park Brake Switch parameter is Released.
 - **If the parameter is Applied**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal A and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If the parameter is Released**

5. Install a 3 A fused jumper wire between the signal circuit terminal A and ground.

6. Verify the scan tool Park Brake Switch parameter is Applied.

- **If the parameter is Released**

1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module, ignition ON.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V.

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If the parameter is Applied**

7. Test or replace the B80 Park Brake Switch.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Brake Fluid Level Indicator Switch Replacement](#)
- Refer to [Parking Brake Indicator Switch Replacement](#)
- Refer to [Control Module References](#) for body control module replacement, programming and setup.

BRAKE PULSATION

Step	Action	Yes	No
DEFINITION: Fluctuation or pulsation is felt through the brake pedal, steering wheel, seat, floor, and/or in the vehicle ONLY when braking.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to Symptoms - Hydraulic Brakes
2	1. Inspect the disc brake system for the following conditions: • Excessive thickness variation of rotor friction surfaces • Excessive assembled lateral runout (LRO) of rotor friction surfaces • Hard spots, heat checks, blueing discoloration of rotor friction surfaces; possibly due to brake drag • Excessive corrosion of rotor friction surfaces; including red, gray or black oxidation • Loose, damaged or missing caliper or lining hardware • Bent or damaged caliper or mounting component • Excessive LRO of wheel hub/axle flange; due to damage and/or loose or excessively worn bearings 2. Adjust, repair or replace components as necessary. Refer to Disc Brake System Diagnosis. Did you find and correct a condition?	Go to Step 4	Go to Step 3

Step	Action	Yes	No
3	1. Inspect the drum brake system for the following conditions: • Out of round or damaged drum • Excessive radial runout of drum friction surface • Hard spots, heat checks, blueing discoloration of drum friction surface; possibly due to brake drag • Bent of damaged drum • Excessive radial runout of wheel hub/axle flange; due to damage and/or loose or excessively worn bearings 2. Adjust, repair or replace components as necessary. Refer to Drum Brake System Diagnosis. Did you find and correct a condition?	Go to Step 4	Go to Symptoms - Hydraulic Brakes
4	1. Install or connect components that were removed or disconnected during diagnosis. 2. 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

Step	Action	Yes	No
DEFINITION: Vehicle exhibits abnormal noise when braking; vehicle may exhibit abnormal noise during motion just after brake pedal release.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to Symptoms - Hydraulic Brakes

Step	Action	Yes	No
2	1. Inspect the disc brake system for the following conditions: • Lining wear indicator contact with rotor • Debris trapped between rotor and splash shield or backing plate; and/or debris trapped between rotor and linings • Contaminated linings • Aftermarket linings • Glazed linings • Distorted, cracked or damaged linings • Excessively worn linings • Damaged or excessively worn caliper hardware and/or lining hardware • Incorrectly installed, loose or missing caliper hardware and/or lining hardware • Lack of lubrication or excessive corrosion on metal to metal contact surfaces • Bent or damaged splash shield or backing plate • Hard spots, heat checks, blueing discoloration of rotor friction surfaces • Glazed rotor friction surfaces • Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. Refer to Disc Brake System Diagnosis. Did you find and correct a condition?	Go to Step 10	Go to Step 3
3	1. Inspect the drum brake system for the following conditions: • Glazed linings • Contaminated linings • Aftermarket linings • Distorted, damaged or excessively worn linings • Improper adjustment • Weak or damaged return spring or springs • Weak or damaged hold down spring or springs • Cracked, scored, excessively worn or damaged drum • Out of round or damaged drum • Hard spots, heat checks, blueing discoloration of drum friction surface • Threaded or spiral grooves in drum friction surface • Distorted or damaged backing plate • Lack of lubrication on backing plate • Excessive dust or foreign matter in drum 2. Adjust, repair or replace components as necessary. Refer to Drum Brake System Diagnosis. Did you find and correct a condition?	Go to Step 10	Go to Step 4

Step	Action	Yes	No
4	1. Inspect the brake assist system for the following conditions: • Lack of lubrication or excessively worn pushrod or pedal pivots or pivot bushings • Bent or damaged pedal pushrod, pedal, or pedal bracket • Damaged or improperly operating vacuum booster and/or check valve, if equipped • Low power steering fluid level, if equipped with hydraulic boost • Improperly tensioned, excessively worn or damaged power steering belt, if equipped with hydraulic boost • Restricted return hose from hydraulic booster, if equipped • Improperly operating hydraulic booster, if equipped • Improperly functioning power steering system, if equipped with a hydraulic booster assembly • Contaminated power steering fluid, if equipped with hydraulic boost 2. Adjust, repair or replace components as necessary. Refer to Brake Assist System Diagnosis. Did you find and correct a condition?	Go to Step 10	Go to Step 5
5	1. Inspect the hydraulic brake system for the following conditions. • Improper operation of wheel cylinder pistons, if equipped • Improper operation of caliper pistons • Contaminated brake fluid 2. Adjust, repair or replace components as necessary. Refer to Hydraulic Brake System Diagnosis. Did you find and correct a condition?	Go to Step 10	Go to Step 6
6	Is the vehicle equipped with a drum-in-rotor type of park brake system?	Go to Step 7	Go to Step 9
7	Ensure the park brake shoes are not adjusted too tightly, possibly causing a noise under certain conditions. Are the park brake shoes adjusted too tightly?	Go to Step 8	Go to Step 9
8	1. Clean and inspect the park brake shoes for excessive wear and/or damage. 2. Inspect the drum portion of the rotors for excessive wear, blueing discoloration, heat spots, and excessive radial runout. 3. If any of these conditions are present, replace the affected components. 4. Adjust the park brake system. Did you find and correct a condition?	Go to Step 10	Go to Step 9
9	Inspect the park brake system for proper operation. Refer to Park Brake System Diagnosis (Disc Brake). Park Brake System Diagnosis (Drum Brake). Did you find and correct a condition?	Go to Step 10	Go to Symptoms - Hydraulic Brakes

Step	Action	Yes	No
10	1. Install or connect components that were removed or disconnected during diagnosis. 2. 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 number below refer to the step number on the diagnostic table:

5

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

6

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

Step	Action	Yes	No
DEFINITION: Vehicle pulls to one side only when braking.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to Symptoms - Hydraulic Brakes
2	1. Inspect the hydraulic brake system for the following conditions: • Kinked, pinched or damaged brake pipe or flexible brake hose • Sticking or improperly operating caliper piston • Sticking or improperly operating wheel cylinder pistons • Brake fluid leak 2. Adjust, repair or replace components as necessary. Refer to Hydraulic Brake System Diagnosis . Did you find and correct a condition?	Go to Step 7	Go to Step 3

Step	Action	Yes	No
3	1. Inspect the disc brake system for the following conditions: • Contaminated linings • Glazed linings • Distorted, cracked or damaged linings on one side • Loose, damaged or missing caliper hardware and/or lining hardware • Incorrect linings on one side • Hard spots, heat checks, blueing discoloration of rotor friction surfaces; possibly due to brake drag • Glazed rotor friction surfaces • Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. Refer to Disc Brake System Diagnosis. Did you find and correct a condition?	Go to Step 7	Go to Step 4
4	1. Inspect the drum brake system for the following conditions: • Improper adjustment or improper adjuster operation • Weak or damaged return spring or springs • Glazed linings • Contaminated linings • Distorted or damaged linings • Incorrect linings on one side • Excessively worn or damaged drum on one side 2. Adjust, repair or replace components as necessary. Refer to Drum Brake System Diagnosis. Did you find and correct a condition?	Go to Step 7	Go to Step 5
5	1. Inspect the suspension system for the following conditions: • Incorrect tire pressure • Loose suspension component connections • Excessively worn or damaged suspension components 2. Adjust, repair or replace components as necessary. Refer to Symptoms - Suspension General Diagnosis. Did you find and correct a condition?	Go to Step 7	Go to Step 6

Step	Action	Yes	No
6	1. Inspect the steering system for the following conditions: • Loose steering component connections • Excessively worn or damaged steering components 2. Adjust, repair or replace components as necessary. Refer to Symptoms - Power Steering System . Did you find and correct a condition?	Go to Step 7	Go to Symptoms - Hydraulic Brakes
7	1. Install or connect components that were removed or disconnected during diagnosis. 2. 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:

5

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

Step	Action	Yes	No
DEFINITION: Braking action or stopping force sensitive or grabbing and/or more pronounced at the front or at the rear axle. Sensitive or grabbing brakes: Excessive brake jump-in force relative to brake pedal input.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to Symptoms - Hydraulic Brakes
2	1. Inspect the hydraulic brake system for the following conditions: • Improper operation of wheel cylinder pistons, if equipped • Improper operation of caliper pistons • Kinked, pinched or damaged brake pipe or flexible brake hose • Brake fluid leak • Improperly functioning proportioning valve, if equipped • Improper operation of dynamic rear proportioning (DRP) system, if equipped 2. Adjust, repair or replace components as necessary. Refer to Hydraulic Brake System Diagnosis . Did you find and correct a condition?	Go to Step 7	Go to Step 3

Step	Action	Yes	No
3	1. Inspect the disc brake system for the following conditions: • Contaminated linings • Glazed linings • Distorted, cracked or damaged linings • Excessively worn linings • Aftermarket linings • Damaged or excessively worn caliper hardware and/or lining hardware • Hard spots, heat checks, blueing discoloration of rotor friction surfaces • Glazed rotor friction surfaces 2. Adjust, repair or replace components as necessary. Refer to Disc Brake System Diagnosis. Did you find and correct a condition?	Go to Step 7	Go to Step 4
4	1. Inspect the drum brake system for the following conditions. • Contaminated linings • Improper adjustment • Excessively worn or damaged linings • Weak or damaged return spring or springs • Excessively worn or damaged drums • Hard spots, heat checks, blueing discoloration of drum friction surface • Distorted or damaged backing plate 2. Adjust, repair or replace components as necessary. Refer to Drum Brake System Diagnosis. Did you find and correct a condition?	Go to Step 7	Go to Step 5
5	1. Inspect the suspension system for the following conditions: • Loose suspension component connections • Excessively worn or damaged suspension components 2. Adjust, repair or replace components as necessary. Refer to Symptoms - Suspension General Diagnosis. Did you find and correct a condition?	Go to Step 7	Go to Step 6

Step	Action	Yes	No
6	- Inspect the brake assist system for the following conditions: - Binding, bent or damaged pedal pushrod, pedal, or pedal bracket - Damaged or improperly operating vacuum booster, if equipped - Damaged or improperly operating hydraulic booster, if equipped - Adjust, repair or replace components as necessary. Refer to Brake Assist System Diagnosis. Did you find and correct a condition?	Go to Step 7	Go to Symptoms - Hydraulic Brakes
7	- Install or connect components that were removed or disconnected during diagnosis. - 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

Step	Action	Yes	No
DEFINITION: Brake pedal travels further than expected to obtain firm pedal and/or firm pedal cannot be obtained, pedal fades away, or pedal is spongy.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to Symptoms - Hydraulic Brakes
2	Inspect the travel and feel of brake pedal applies. Perform the following: - Apply the brake pedal several times to fully deplete the power reserve. - With power reserve depleted, apply the brake pedal with light, steady pressure and hold for 15 seconds. Observe pedal travel and feel. - Apply the brake pedal with light, steady pressure, then without pumping the pedal, reduce pressure and reapply pressure several times. Observe pedal travel and feel for each apply. - Apply the brake pedal slowly, then release and apply the pedal quickly. Observe pedal travel and feel for each apply. Did you complete the brake pedal travel and feel inspections?	Go to Step 3	-

Step	Action	Yes	No
3	1. Inspect the hydraulic brake system for the conditions listed, based on the following symptoms observed during the pedal travel and feel inspections. • Pedal feel was spongy. • Air in hydraulic system • External brake fluid leaks • Soft, weak or damaged hydraulic hoses; expanding under pressure • Pedal fell away and/or traveled to or almost to floor. • External brake fluid leaks • Poor brake fluid quality; low boiling point • Internal brake fluid leaks; improperly functioning master cylinder • Pedal was somewhat firm then dropped slightly, or pedal rose with successive applies, or pedal travel was different between slow and quick applies. • Internal brake fluid leaks; improperly functioning master cylinder • Poor brake fluid quality; low boiling point • Binding wheel cylinder pistons, if equipped • Pedal returned to rest slowly after any of the applies. • Internally damaged flexible brake hoses; hindering fluid return • Binding caliper pistons • Binding wheel cylinder pistons, if equipped • Internal brake fluid leaks; improperly functioning master cylinder 2. Repair or replace components as necessary. Refer to Hydraulic Brake System Diagnosis. 3. Re-inspect brake pedal apply travel and feel. Did you find and correct a condition?	Go to Step 9	Go to Step 4
4	1. Inspect the drum brake system, if equipped, for the following conditions: • Improper adjustment or improper adjuster operation • Glazed or excessively worn linings • Cracked, distorted or damaged linings • Cracked, excessively worn, distorted or damaged drums • Bell-mouth or barrel-shaped drum friction surface • Hard spots, heat checks, blueing discoloration of drum friction surface 2. Adjust, repair or replace components as necessary. Refer to Drum Brake System Diagnosis. 3. Re-inspect brake pedal apply travel and feel. Did you find and correct a condition?	Go to Step 9	Go to Step 5

Step	Action	Yes	No
5	- Inspect the disc brake system for the following conditions: - Cracked, excessively worn or damaged linings - Cracked, excessively worn or damaged rotors - Improperly operating, binding or damaged caliper hardware and/or lining hardware - Loose or missing caliper hardware and/or lining hardware - Excessive assembled lateral runout (LRO) of rotor friction surfaces - Bent or damaged caliper or mounting component - Adjust, repair or replace components as necessary. Refer to Disc Brake System Diagnosis. - Re-inspect brake pedal apply travel and feel. Did you find and correct a condition?	Go to Step 9	Go to Step 6
6	Inspect for proper brake pedal travel. Refer to Brake Pedal Travel Measurement and Inspection. Is the brake pedal travel distance within the acceptable limits?	Go to Step 8	Go to Step 7
7	- Inspect for worn, missing, misaligned, bent or damaged brake pedal system components. - For the brake pedal pushrod component inspection, refer to Brake Pedal Pushrod Inspection. - Inspect the brake pedal bushings for binding, excessive wear and/or damage and inspect the brake pedal for a misaligned, bent, and/or damaged condition. - Replace the brake pedal system components that are worn, missing, misaligned, bent or damaged. Did you find and replace any worn, missing, misaligned, bent or damaged brake pedal system components?	Go to Step 9	Go to Step 8
8	- Inspect the brake assist system for the following conditions: - Vacuum leaks and/or improperly operating check valve, if equipped with vacuum assist - Power steering fluid leaks, if equipped with hydraulic power assist - Damaged or improperly operating brake booster assembly - Adjust, repair or replace components as necessary. Refer to Brake Assist System Diagnosis. Did you find and correct a condition?	Go to Step 9	Go to Symptoms - Hydraulic Brakes
9	- Install or connect components that were removed or disconnected during diagnosis. - 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 EFFORT

Step	Action	Yes	No
DEFINITION: Brake pedal requires an increased amount of input from the driver to obtain good braking action and/or stopping distance is increased.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to Symptoms - Hydraulic Brakes
2	1. Inspect the brake assist system for the following conditions: • Vacuum leaks, if equipped with vacuum power assist • Power steering fluid leaks, if equipped with hydraulic power assist • Lack of lubrication, binding or excessively worn pushrod or pedal pivots or pivot bushings • Bent or damaged pedal pushrod, pedal, or pedal bracket • Damaged or improperly operating brake booster assembly 2. Adjust, repair or replace components as necessary. Refer to Brake Assist System Diagnosis. Did you find and correct a condition?	Go to Step 6	Go to Step 3
3	1. Inspect the hydraulic brake system for the following conditions: • Binding caliper pistons • Binding wheel cylinder pistons, if equipped • Internally damaged flexible brake hoses; hindering fluid flow • External brake fluid leaks • Kinked or damaged flexible brake hoses and/or pipes • Internal brake fluid leaks; improperly operating master cylinder • Poor brake fluid quality; low boiling point 2. Adjust, repair or replace components as necessary. Refer to Hydraulic Brake System Diagnosis. Did you find and correct a condition?	Go to Step 6	Go to Step 4

Step	Action	Yes	No
4	1. Inspect the disc brake system for the following conditions: • Excessively worn linings • Glazed linings • Cracked, distorted or damaged linings • Contaminated linings • Binding, damaged or excessively worn caliper hardware and/or lining hardware • Lack of lubrication or excessive corrosion on metal to metal contact surfaces • Excessively worn or corroded rotor friction surfaces • Glazed rotor friction surfaces • Hard spots, heat checks, blueing discoloration of rotor friction surfaces 2. Adjust, repair or replace components as necessary. Refer to Disc Brake System Diagnosis. Did you find and correct a condition?	Go to Step 6	Go to Step 5
5	1. Inspect the drum brake system, if equipped, for the following conditions: • Excessively worn linings • Improper adjustment or improper adjuster operation • Glazed linings • Cracked, distorted or damaged linings • Contaminated linings • Out of round or damaged drum • Bell-mouth or barrel-shaped drum friction surface • Hard spots, heat checks, blueing discoloration of drum friction surface • Lack of lubrication on backing plate • Excessive dust or foreign matter in drum 2. Adjust, repair or replace components as necessary. Refer to Drum Brake System Diagnosis. Did you find and correct a condition?	Go to Step 6	Go to Symptoms - Hydraulic Brakes
6	1. Install or connect components that were removed or disconnected during diagnosis. 2. 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

BRAKES DRAG

Step	Action	Yes	No
DEFINITION: Brake system does not fully release or has delayed release; vehicle motion may be hindered by brake system without applying brakes.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to Symptoms - Hydraulic Brakes

Step	Action	Yes	No
2	Is the vehicle equipped with an adjustable stop lamp switch and/or an adjustable cruise control release switch?	Go to Step 3	Go to Step 4
3	1. Inspect the stop lamp switch for proper adjustment to ensure that the brake pedal is fully releasing. 2. Inspect the cruise control release switch, if equipped, for proper adjustment to ensure that the brake pedal is fully releasing. Did you find and correct a condition?	Go to Step 15	Go to Step 4
4	Is the vehicle equipped with a drum-in-rotor type of park brake system?	Go to Step 5	Go to Step 7
5	Ensure the park brake shoes are not adjusted too tightly, possibly causing drag under certain conditions. Are the park brake shoes adjusted too tightly?	Go to Step 6	Go to Step 8
6	1. Clean and inspect the park brake shoes for excessive wear and/or damage. 2. Inspect the drum portion of the rotors for excessive wear, blueing discoloration and heat spots. 3. If any of these conditions are present, replace the affected components. 4. Adjust the park brake system. Did you find and correct a condition?	Go to Step 15	Go to Step 8
7	1. Inspect the drum brake system, if equipped, for the following conditions: • Improper adjustment • Weak or damaged return spring or springs • Distorted or damaged linings • Out of round or damaged drum • Weak or damaged hold down spring or springs • Lack of lubrication on backing plate • Distorted or damaged backing plate 2. Adjust, repair or replace components as necessary. Refer to <u>Drum Brake System Diagnosis</u>. Did you find and correct a condition?	Go to Step 15	Go to Step 8
8	Inspect the park brake system for proper operation. Refer to <u>Park Brake System Diagnosis (Disc Brake)</u>, <u>Park Brake System Diagnosis (Drum Brake)</u>. Did you find and correct a condition?	Go to Step 15	Go to Step 9

Step	Action	Yes	No
9	- Inspect the disc brake system for the following conditions: - Binding, incorrectly installed or missing caliper hardware and/or lining hardware-Ensure free movement of linings and of caliper, if equipped with sliding type caliper. - Lack of lubrication or excessive corrosion on metal to metal contact surfaces - Distorted or damaged linings - Damaged or excessively worn caliper hardware and/or lining hardware - Bent or damaged caliper or mounting component - Adjust, repair or replace components as necessary. Refer to Disc Brake System Diagnosis. Did you find and correct a condition?	Go to Step 15	Go to Step 10
10	- Separate the brake booster pushrod from the brake pedal. - 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 12	Go to Step 11
11	- Inspect the pushrod for improper position and/or damage. Correctly position or replace the pushrod if necessary. - Inspect the brake pedal assembly for damage and replace if necessary. Did you complete the repair or replacement?	Go to Step 15	-
12	- For vacuum boost systems, disconnect the vacuum check valve from the booster to relieve vacuum reserve. - Separate the master cylinder from the brake booster. Do not disconnect any brake pipes. - 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 14	Go to Step 13
13	Replace the brake booster assembly. Did you complete the replacement?	Go to Step 15	-

Step	Action	Yes	No
14	- Inspect the hydraulic brake system for the following conditions: - Improper operation of wheel cylinder pistons, if equipped - Improper operation of caliper pistons - Contaminated brake fluid - Internally damaged flexible brake hoses; hindering brake release - Damaged or improperly operating master cylinder - Adjust, repair or replace components as necessary. Refer to Hydraulic Brake System Diagnosis. Did you find and correct a condition?	Go to Step 15	Go to Symptoms - Hydraulic Brakes
15	- Install or connect components that were removed or disconnected during diagnosis. - 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 SLOW RELEASE

Step	Action	Yes	No
DEFINITION: Brake system releases and returns to rest slowly; vehicle motion is hindered by brake system briefly after release of brake pedal.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to Symptoms - Hydraulic Brakes
2	- Inspect the hydraulic brake system for the following conditions: - Improper operation of wheel cylinder pistons, if equipped - Improper operation of caliper pistons - Internally damaged flexible brake hoses; hindering brake release - Contaminated brake fluid - Damaged or improperly operating master cylinder - Adjust, repair or replace components as necessary. Refer to Hydraulic Brake System Diagnosis. Did you find and correct a condition?	Go to Step 6	Go to Step 3

Step	Action	Yes	No
3	- Inspect the brake assist system for the following conditions: - Binding, bent or damaged pedal pushrod, pedal, or pedal bracket - Damaged or improperly operating vacuum booster, if equipped - Restricted return hose from hydraulic booster, if equipped - Damaged or improperly operating hydraulic booster, if equipped - Adjust, repair or replace components as necessary. Refer to Brake Assist System Diagnosis. Did you find and correct a condition?	Go to Step 6	Go to Step 4
4	- Inspect the drum brake system, if equipped, for the following conditions: - Weak or damaged return spring or springs - Distorted or damaged linings - Out of round or damaged drum - Lack of lubrication on backing plate - Distorted or damaged backing plate - Adjust, repair or replace components as necessary. Refer to Drum Brake System Diagnosis. Did you find and correct a condition?	Go to Step 6	Go to Step 5
5	- Inspect the disc brake system for the following conditions: - Damaged or excessively worn caliper hardware and/or lining hardware - Distorted or damaged linings - Lack of lubrication or excessive corrosion on metal to metal contact surfaces - Bent or damaged caliper or mounting component - Adjust, repair or replace components as necessary. Refer to Disc Brake System Diagnosis. Did you find and correct a condition?	Go to Step 6	Go to Symptoms - Hydraulic Brakes
6	- Install or connect components that were removed or disconnected during diagnosis. - 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 FLUID LOSS

Step	Action	Yes	No
DEFINITION: Brake fluid level is low not related to lining wear.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to Symptoms - Hydraulic Brakes

Step	Action	Yes	No
2	- Inspect the following hydraulic brake system components for brake fluid leaks: - Flexible brake hose connections; threaded and bolted - Flexible brake hose crimping joints - Brake pipe fittings - Caliper piston seals - Wheel cylinder piston seals, if equipped - Master cylinder reservoir - Master cylinder reservoir low pressure hose, if equipped - Brake pressure modulator valve (BPMV) assembly, if equipped - Repair or replace components as necessary. Refer to Hydraulic Brake System Diagnosis. Did you find and correct a condition?	Go to Step 5	Go to Step 3
3	- Disconnect the vacuum check valve from the booster to relieve vacuum reserve. - Separate the master cylinder from the vacuum brake booster. Do not disconnect any brake pipes. - Inspect the rear of the master cylinder for a brake fluid leak. - Inspect for brake fluid in the vacuum brake booster. Did you find the brake fluid leak?	Go to Step 4	Go to Symptoms - Hydraulic Brakes
4	Replace the brake master cylinder and the vacuum brake booster. Did you complete the replacement?	Go to Step 5	-
5	- Install or connect components that were removed or disconnected during diagnosis. - 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.

12

Disc brake rotor shields/backing plates that come in contact with disc brake rotors may cause brake system noise.

15

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

19

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

22

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

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 correctly. 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 Symptoms - Hydraulic Brakes
2	Visually inspect the disc brake pads for the following conditions: Refer to Brake Pad Inspection . • Lining thickness below specifications • Uneven and/or abnormal wear - edge-to-edge and/or side-to-side • Looseness or damage - including brake pad hardware • Evidence of contamination from an external substance Did you find any conditions to indicate a concern with any of the front and/or rear disc brake pads?	Go to Step 3	Go to Step 12
3	Are any of the front disc brake pads contaminated?	Go to Step 8	Go to Step 4
4	Are any of the front disc brake pads worn unevenly?	Go to Step 7	Go to Step 5
5	Are any of the front disc brake pads and/or brake pad hardware loose or damaged?	Go to Step 7	Go to Step 6
6	1. Remove and inspect the worn disc brake pads for glazing, looseness, heat spots or damage. 2. Replace the worn disc brake pads as a complete axle set. Refer to Front Disc Brake Pads Replacement . Did you complete the inspection and replacement?	Go to Step 12	-

Step	Action	Yes	No
7	CAUTION: Support the brake caliper with heavy mechanic 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. NOTE: Do NOT disconnect the hydraulic brake flex hoses from the calipers. 1. Remove the front brake caliper, as appropriate, from the mounting bracket and support the brake caliper. Refer to Front Brake Caliper Replacement. 2. Inspect the disc brake caliper mounting bracket and the mounting/sliding hardware for the following conditions: • Binding or seized hardware • Worn, damaged or missing hardware components • Loose, bent, cracked, or damaged brake caliper mounting bracket 3. Replace components as required. Refer to Front Brake Caliper Bracket Replacement. 4. Replace the unevenly-worn, loose or damaged disc brake pads as a complete axle set. Refer to Front Disc Brake Pads Replacement. Did you complete the inspection and replacement?	Go to Step 12	-
8	1. Inspect the disc brake calipers, brake hoses and brake pipes for evidence of an external brake fluid leak. 2. Replace any components found to be leaking brake fluid. Refer to the following procedures as required: • Front Brake Caliper Overhaul • Front Brake Caliper Replacement • Front Brake Hose Replacement • Brake Pipe Replacement Did you find and correct the source of the leak causing contamination of the brake pads?	Go to Step 11	Go to Step 9
9	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 brake pads. Refer to Front Wheel Drive Shaft Outer Joint and Boot Replacement. Did you find and correct the source of the leak causing contamination of the brake pads?	Go to Step 11	Go to Step 10

Step	Action	Yes	No
10	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 which may be the source of the contamination to the pads. Did you find and correct the source of the leak causing contamination of the pads?	Go to Step 11	-
11	1. Clean the remaining disc brake system components to remove any traces of the contaminant. CAUTION: Support the brake caliper with heavy mechanic 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. NOTE: Do NOT disconnect the hydraulic brake flex hoses from the calipers. 2. Remove the front disc brake caliper from the brake caliper mounting bracket and support the brake caliper. Refer to Front Brake Caliper Replacement. 3. Inspect the disc brake caliper mounting/sliding hardware for the following conditions: Refer to Front Disc Brake Mounting and Hardware Inspection. • Binding or seized hardware • Distorted, worn, damaged or missing hardware components 4. Replace the brake mounting/sliding hardware components as required. Refer to Front Disc Brake Mounting and Hardware Inspection. 5. Replace the contaminated brake pads as a complete axle set. Refer to Front Disc Brake Pads Replacement. Did you complete the cleaning, inspection and replacement?	Go to Step 12	-

Step	Action	Yes	No
12	1. Check the thickness of each of the disc brake rotors. NOTE: Make the following determination and answer the question individually for EACH rotor. 2. Make a determination for each brake rotor if the brake rotor can be REFINISHED and REMAIN ABOVE the minimum requirements. Refer to Brake Rotor Thickness Measurement .Does the brake rotor meet the minimum requirements for REFINISHING?	Go to Step 13	Go to Step 16
13	NOTE: Make the following determination and answer the question individually for EACH rotor. Inspect each of the brake rotors for thickness variation that exceeds the maximum acceptable level. Refer to Brake Rotor Thickness Variation Measurement .Does the brake rotor exhibit thickness variation that exceeds the maximum acceptable level?	Go to Step 15	Go to Step 14
14	1. Inspect each of the brake rotors for the following surface and wear conditions: Refer to Brake Rotor Surface and Wear Inspection . • Heavy rust and/or pitting • Cracks and/or heat spots • Excessive blueing discoloration • Deep or excessive scoring beyond maximum acceptable level NOTE: Make the following determination and answer the question individually for EACH rotor. 2. Make a determination for each brake rotor if the brake rotor requires refinishing based upon the results of the inspection. 3. If the brake rotor exhibits any of the conditions listed previously, it requires refinishing. Does the brake rotor require REFINISHING?	Go to Step 15	Go to Step 20
15	1. Refinish the brake rotor. Refer to Brake Rotor Refinishing . 2. Inspect the brake rotor thickness. Refer to Brake Rotor Thickness Measurement . Were you able to REFINISH the brake rotor within the minimum requirements?	Go to Step 20	Go to Step 19
16	Is the brake disc at or below the DISCARD requirements?	Go to Step 19	Go to Step 17

Step	Action	Yes	No
17	NOTE: Make the following determination and answer the question individually for EACH rotor. Inspect each of the brake rotors for thickness variation that exceeds the maximum acceptable level. Refer to Brake Rotor Thickness Variation Measurement .Does the brake rotor exhibit thickness variation that exceeds the maximum acceptable level?	Go to Step 19	Go to Step 18
18	1. Inspect each of the brake rotors for the following surface and wear conditions: Refer to Brake Rotor Surface and Wear Inspection . • Heavy rust and/or pitting • Cracks and/or heat spots • Excessive blueing discoloration • Deep or excessive scoring beyond maximum acceptable level NOTE: Make the following determination and answer the question individually for EACH rotor. 2. Make a determination for each brake rotor if the rotor requires replacement based upon the results of the inspection. If the brake rotor exhibits any of the conditions listed previously, it requires replacement. Does the brake rotor require REPLACEMENT?	Go to Step 19	Go to Step 20
19	NOTE: Whenever a brake rotor is replaced, the assembled lateral runout (LRO) of the brake rotor must be measured to ensure optimum performance of the disc brakes. Replace the brake rotor. Refer to Front Brake Rotor Replacement .Did you complete the replacement?	Go to Step 22	-
20	NOTE: Make the following determination and answer the question individually for EACH rotor. Inspect each of the brake rotors for assembled lateral runout (LRO) that exceeds the maximum acceptable level. Refer to Brake Rotor Assembled Lateral Runout Measurement .Does the brake rotor exhibit assembled LRO that exceeds the maximum acceptable level?	Go to Step 21	Go to Step 22
21	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 Correction . Did you complete the operation?	Go to Step 22	-

Step	Action	Yes	No
22	Install or connect components that were removed or disconnected during diagnosis. Did you complete the operation?	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.

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 Symptoms - Hydraulic Brakes
2	1. Remove the brake drums. Refer to Brake Drum Replacement. 2. Inspect the drum brake shoes for the following conditions: • Lining thickness below specifications • Uneven and/or abnormal wear - edge-to-edge and/or side-to-side • Looseness, damage, glazing, or incorrect lining material Did you find any conditions to indicate a concern with any of the drum brake shoes?	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	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 Rear Brake Cylinder Replacement. Did you complete the inspection and replacement?	Go to Step 6	-
5	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. 2. Replace components as required. Refer to Drum Brake Hardware Replacement. 3. Replace the drum brake shoes. Refer to Brake Shoe Replacement. Did you complete the inspection and replacement?	Go to Step 8	-

Step	Action	Yes	No
6	1. Clean the remaining drum brake system components to remove any traces of the contaminants. 2. 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 . 3. Replace the drum brake hardware components as required. Refer to Drum Brake Hardware Replacement . 4. Replace the contaminated brake shoes. Refer to Brake Shoe Replacement . Did you complete the cleaning, inspection and replacement?	Go to Step 8	-
7	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 . 2. Replace components as required. Refer to Drum Brake Hardware Replacement . Did you complete the inspection and, if necessary, the replacement?	Go to Step 8	-
8	1. Check the diameter of each of the brake drums. NOTE: Make the following determination and answer the question individually for EACH brake drum. 2. Make a determination for each brake drum if the drum can be REFINISHED and REMAIN ABOVE the minimum requirements. Refer to Brake Drum Diameter Measurement .Does the brake drum meet the minimum requirements for REFINISHING?	Go to Step 9	Go to Step 11

Step	Action	Yes	No
9	1. Inspect each of the brake drums for the following surface and wear conditions: Refer to <u>Brake Drum Surface and Wear Inspection</u> . - Braking surface conditions - Heavy rust and/or pitting - Cracks and/or heat spots - Excessive blueing discoloration - Missing balance weights - Braking surface wear conditions - Deep or excessive scoring beyond maximum acceptable level - Radial runout beyond maximum acceptable level NOTE: Make the following determination and answer the question individually for EACH brake drum. 2. Make a determination for each brake drum if the drum requires refinishing based upon the results of the inspection. If the brake drum exhibits any of the following conditions, it requires refinishing: - 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 Does the brake drum require REFINISHING?	Go to Step 10	Go to Step 14
10	1. Refinish the brake drum. Refer to <u>Brake Drum Refinishing</u> . 2. Inspect the brake drum diameter. Refer to <u>Brake Drum Diameter Measurement</u> . Were you able to REFINISH the brake drum within the minimum requirements?	Go to Step 14	Go to Step 13
11	Is the brake drum at or below the DISCARD requirements?	Go to Step 13	Go to Step 12

Step	Action	Yes	No
12	1. Inspect each of the brake drums for the following surface and wear conditions: Refer to Brake Drum Surface and Wear Inspection . - Braking surface conditions - Heavy rust and/or pitting - Cracks and/or heat spots - Excessive blueing discoloration - Missing balance weights - Braking surface wear conditions - Missing balance weights - Radial runout beyond maximum acceptable level NOTE: Make the following determination and answer the question individually for EACH brake drum. 2. Make a determination for each brake drum if the drum requires replacement based upon the results of the inspection. If a brake drum exhibits any of the following conditions, it requires replacement: - 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 Does the brake drum require REPLACEMENT?		
13	Replace the brake drum. Refer to Brake Drum Replacement . Did you complete the replacement?	Go to Step 13	Go to Step 14
14	Inspect the brake shoes for proper adjustment. Refer to Drum Brake Adjustment . Are the brake shoes adjusted properly?	Go to Step 14	-
15	Inspect the components of the brake drum adjustment hardware system for free movement and correct operation. Refer to Drum Brake Adjusting Hardware Inspection . Do the drum brake adjusting hardware components operate freely and correctly?	Go to Step 18	Go to Step 15
16	Replace the drum brake adjusting hardware components as necessary. Refer to Drum Brake Adjusting Hardware Replacement . Is the replacement complete?	Go to Step 17	Go to Step 16
17	Adjust the drum brake shoes. Refer to Drum Brake Adjustment . Were you able to complete the adjustment?	Go to Step 17	Go to Step 20
		Go to Step 20	Return to Symptom Table

Step	Action	Yes	No
18	Inspect the drum brake backing plate for the following: - Excessive wear or rust - Damage and/or evidence of contact with the brake drum Does the drum brake backing plate exhibit any of these conditions?	Go to Step 19	Go to Step 20
19	Repair or replace the drum brake backing plate as necessary. Refer to Rear Brake Backing Plate Replacement . Did you complete the repair or replacement?	Go to Step 20	-
20	Install or connect components that were removed or disconnected during diagnosis. Did you complete the operation?	Drum Brake System OK Return to Symptom Table	-

HYDRAULIC BRAKE SYSTEM DIAGNOSIS

Step	Action	Yes	No
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.			
1	Were you sent here from a Brake Symptom table?	Go to Step 2	Go to Symptoms - 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	1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination: - Fluid separation, indicating two types of fluid are present - Swirled appearance - oil-based substance - Layered appearance - silicone-based substance - Fluid discoloration - 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. Do any of the above conditions exist?	Go to Step 5	Go to Step 6

Step	Action	Yes	No
4	1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination: • Fluid separation, indicating two types of fluid are present • Swirled appearance - oil-based substance • Layered appearance - silicone-based substance • Fluid discoloration • 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. Do any of the above conditions exist?	Go to Step 5	Go to Step 12

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Step	Action	Yes	No
5	1. Flush the hydraulic brake system. Refer to Hydraulic Brake System Flushing. 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. 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. • Replace the brake master cylinder reservoir cap diaphragm. • Master Cylinder Replacement • 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. • Front Brake Hose Replacement • Rear Brake Hose Replacement (Drum Brake)Rear Brake Hose Replacement (Disc Brake) • Front Brake Caliper Overhaul • Front Brake Caliper Replacement • Rear Brake Cylinder Replacement • Brake Proportion Valve Replacement, if equipped • Brake Pressure Modulator Valve Replacement, if equipped 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	-

Step	Action	Yes	No
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: • Brake master cylinder reservoir cap diaphragm • Master Cylinder Replacement • Front Brake Hose Replacement • Rear Brake Hose Replacement (Drum Brake)Rear Brake Hose Replacement (Disc Brake) • Brake Pipe Replacement • Front Brake Caliper Overhaul • Front Brake Caliper Replacement • Rear Brake Cylinder Overhaul • Rear Brake Cylinder Replacement • Brake Proportion Valve Replacement, if equipped • Brake Pressure Modulator Valve Replacement, if equipped 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 assembly, was replaced • An unrestricted and even flow of brake fluid per axle during the bleeding procedure Did you find and correct a condition?	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	Inspect the hydraulic function of the brake calipers and/or wheel cylinders, if equipped for proper operation. Refer to Hydraulic Brake Component Operation Visual Inspection . Was the hydraulic function of the brake calipers/wheel cylinders operating properly?	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	Inspect the hydraulic function of the brake calipers/wheel cylinders for proper operation. Refer to Hydraulic Brake Component Operation Visual Inspection . Was the hydraulic function of the brake calipers/wheel cylinders operating properly?	Go to Step 15	Go to Step 13

Step	Action	Yes	No
13	Determine if the brake caliper is restricting the flow of brake fluid and/or not operating properly: 1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle . 2. Remove the tire and wheel assemblies. Refer to Tire and Wheel Removal and Installation . 3. Open the suspected brake caliper bleeder valve. 4. Using a large C-clamp, compress the brake caliper piston and observe for an unrestricted flow of brake fluid and for free movement of the brake caliper piston. 5. Close the caliper bleeder valve. Was the flow of brake fluid unrestricted and did the caliper piston move freely?	Go to Step 17	Go to Step 14
14	Repair or replace any brake caliper/wheel cylinder that was not operating properly. Refer to the appropriate procedure. • Front Brake Caliper Overhaul • Front Brake Caliper Replacement • Rear Brake Cylinder Replacement Did you complete the repair and/or replacement?	Go to Step 21	-
15	Bleed the hydraulic brake system to observe for the presence of air in the system and to observe for an unrestricted and even flow of brake fluid per axle during the bleeding procedure. Refer to Hydraulic Brake System Bleeding (Manual)Hydraulic Brake System Bleeding (Pressure). Was there air in the system?	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	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 Brake Pipe and Hose Inspection. 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: • Front Brake Hose Replacement • Rear Brake Hose Replacement (Drum Brake)Rear Brake Hose Replacement (Disc Brake). 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. Did you find and correct a condition?	Go to Step 21	Go to Step 18

Step	Action	Yes	No
18	1. If equipped with non-ABS, replace the proportioning valve assembly. Refer to <u>Brake Proportion Valve Replacement</u>. 2. 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 Pressure Modulator Valve Replacement</u>. Did you complete the replacement?	Go to Step 21	-
19	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. Did you find and correct a condition?	Go to Step 21	Go to Step 20
20	1. Inspect the brake master cylinder for internal fluid leaks. Refer to <u>Brake System Internal Leak Test</u>. 2. Repair or replace the brake master cylinder if it is found to be leaking brake fluid internally. Refer to <u>Master Cylinder Replacement</u>. Did you find and correct a condition?	Go to Step 21	Return to Symptom Table
21	Install or connect components that were removed or disconnected during diagnosis. Did you complete the operation?	Hydraulic Brake System OK Return to Symptom Table	-

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 3	Go to Step 2
2	Were you sent here directly from an electrical diagnostic to investigate vacuum as a possible concern?	Go to Step 5	Go to <u>Diagnostic Starting Point - Vehicle</u>
3	Inspect 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 5	Go to Step 4

Step	Action	Yes	No
4	- Inspect for worn, missing, misaligned, bent or damaged brake pedal system components. - Inspect the brake pedal for a misaligned, bent and/or damaged condition. - Inspect the brake pedal bushings for excessive wear and/or damage. - Replace the brake pedal system components that are worn, missing, misaligned, bent or damaged. Did you find and replace any worn, missing, misaligned, bent or damaged brake pedal system components?	Go to Step 5	Go to Hydraulic Brake System Diagnosis to check for internal and external fluid leaks and air in the hydraulic brake system
5	Check the engine vacuum source that supplies vacuum to the power brake booster. Refer to Brake System Vacuum Source Test. Is the vacuum reading within the acceptable limits?	Go to Step 6	Go to Engine Controls Diagnostics Information to check for vacuum issues, including vacuum pump operation, if equipped
6	Does the condition occur during cold start-up conditions?	Go to Step 7	Go to Step 8
7	Check engine vacuum, and vacuum pump operation, if equipped, under the same cold start-up conditions. Refer to Engine Controls Diagnostics. Did you find and correct a condition?	Go to Step 22	Go to Step 9
8	During the vacuum source test, did the power brake booster vacuum sensor operate properly?	Go to Step 10	Go to Step 9
9	Replace the power brake booster vacuum sensor. Refer to Power Brake Booster Vacuum Sensor Replacement. Did you complete the replacement?	Go to Step 10	-
10	If equipped with a booster mounted separate vacuum sensor, inspect the vacuum sensor grommet for cracks, cuts, dry-rot, or damage. Does the vacuum sensor grommet exhibit any of the conditions listed?	Go to Step 11	Go to Step 12
11	Replace the vacuum sensor grommet. Did you complete the replacement?	Go to Step 12	-
12	- If the vehicle is equipped with a vacuum sensor, install a scan tool. - Using the Data Display function, determine if brake booster vacuum sensor data is available within either the chassis brake controls area or the powertrain engine controls area. Is power brake booster vacuum sensor data available through the scan tool?	Go to Step 13	Go to Step 16

Step	Action	Yes	No
13	Perform the vacuum booster leak-down test using a scan tool: 1. Release the brake pedal. 2. Accelerate the engine to approximately 3000 RPM, then release the throttle. Wait 2-3 seconds and repeat once. 3. Turn the ignition OFF. 4. Turn the ignition ON. Do not start the engine. 5. Observe and record the power brake booster vacuum sensor reading on the scan tool over a period of 60 seconds. NOTE: Vacuum readings will decrease by approximately 2.7 kPa (0.8 Hg) for every 305 m (1000 ft) of elevation above sea level. 6. Determine the rate of vacuum leak. Specification Maximum allowable vacuum leak rate: 10 kPa (3 in Hg) in 60 seconds Was the rate of vacuum leak within the specified allowable range?	Go to Step 18	Go to Step 14
14	1. Deplete the vacuum reserve by applying the brake pedal several times, or by removing the power brake booster vacuum sensor. 2. Separate the master cylinder from the power brake booster. Do not disconnect any brake pipes. Refer to Master Cylinder Replacement. 3. If equipped with a vacuum seal on the rear of the master cylinder, inspect the seal for damage and correct positioning on the master cylinder. Replace the vacuum seal as necessary. 4. Carefully reinstall the master cylinder to the brake booster. Refer to Master Cylinder Replacement. Did you complete the operation?	Go to Step 15	-

Step	Action	Yes	No
15	Perform the power brake booster leak-down test using a scan tool: 1. Release the brake pedal. 2. Accelerate the engine to approximately 3000 RPM, then release the throttle. Wait 2-3 seconds and repeat once. 3. Turn the ignition OFF. 4. Turn the ignition ON. Do not start the engine. 5. Observe and record the power brake booster vacuum sensor reading on the scan tool over a period of 60 seconds. NOTE: Vacuum readings will decrease by approximately 2.7 kPa (0.8 Hg) for every 305 m (1000 ft) of elevation above sea level. 6. Determine the rate of vacuum leak. Specification Maximum allowable vacuum leak rate: 10 kPa (3 in Hg) in 60 seconds Was the rate of vacuum leak within the specified allowable range?	Go to Step 22	Go to Step 21
16	1. Separate the master cylinder from the power brake booster. Do not disconnect any brake pipes. Before removing the master cylinder, first deplete the vacuum by removing the power brake booster vacuum sensor or applying the brake pedal several times. Refer to Master Cylinder Replacement. 2. If equipped with a vacuum seal on the rear of the master cylinder, inspect the seal for damage and correct positioning on the master cylinder. 3. If equipped with a vacuum seal that is part of the booster, inspect the seal for damage. Does the vacuum seal exhibit any of the conditions listed?	Go to Step 17	Go to Step 18
17	1. If equipped with a vacuum seal on the rear of the master cylinder, replace the vacuum seal as necessary. Ensure the seal is positioned correctly during installation. 2. If equipped with a vacuum seal that requires replacement and which is part of the booster, the booster assembly must be replaced. 3. Carefully reinstall the master cylinder to the brake booster. Refer to Master Cylinder Replacement. Did you complete the replacement?	Go to Step 18	-

Step	Action	Yes	No
18	Perform the vacuum boost functional test: 1. If still separated, reinstall the master cylinder to the booster. Refer to Master Cylinder Replacement. 2. If the engine was started after reinstalling the master cylinder to the booster, perform the following: With the engine OFF, apply the brake pedal several times to deplete the vacuum reserve. 3. Apply and maintain moderate pressure on the brake pedal. 4. Start the engine and observe pedal operation. 5. Observe for audible vacuum leaks. The brake pedal should fall slightly, then hold. Is there an audible vacuum leak coming from the brake pedal area?	Go to Step 21	Go to Step 19
19	Did the brake pedal fall slightly after the engine was started, then hold?	Go to Step 20	Go to Step 21
20	Perform the power brake booster leak-down test: 1. Release the brake pedal. 2. Accelerate the engine to approximately 3000 RPM, then release the throttle. Wait 2-3 seconds and repeat once. 3. Turn the ignition OFF. 4. Wait 60 seconds. 5. Apply the brake pedal 2 times to check for power brake booster available vacuum reserve. Observe pedal effort. • Both pedal applies should be assisted • The amount of assist could diminish slightly with the second apply Were both pedal applies power assisted?	Go to Step 22	Go to Step 21
21	Replace the power brake booster. Refer to Power Vacuum Brake Booster Replacement. Did you complete the replacement?	Go to Step 22	-
22	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

WARNING: 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. Visually inspect if the brake warning indicator 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 or Neutral, lightly apply the brake pedal. Observe both the pedal feel and the pedal travel.
 - If the brake pedal apply felt spongy, or the pedal travel was excessive, DO NOT drive the vehicle until it is repaired.
 - If the brake pedal apply did not feel spongy and the pedal travel was excessive, proceed to step 6.
6. Release and apply the brakes.
7. While continuing to apply the brakes, shift the transmission into DRIVE or 1st, 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.
8. 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.
 - 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.
 - If the brake pedal apply effort was not excessive and the pedal travel was not excessive, proceed to step 9.
9. 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 the assistant.
10. 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.
11. Select a smooth, dry, clean and level road that is as free of heavy traffic as possible for brake system moderate speed road testing.
12. Drive the vehicle at a moderate speed. Observe for a pull and/or incorrect tracking of the vehicle without the brakes applied.
13. 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.
 - 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.
 - If the brake pedal apply effort was not excessive and the pedal travel was not excessive, proceed to step 14.
14. 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.

15. 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

Special Tools

For equivalent regional tools, refer to [Special Tools](#).

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.

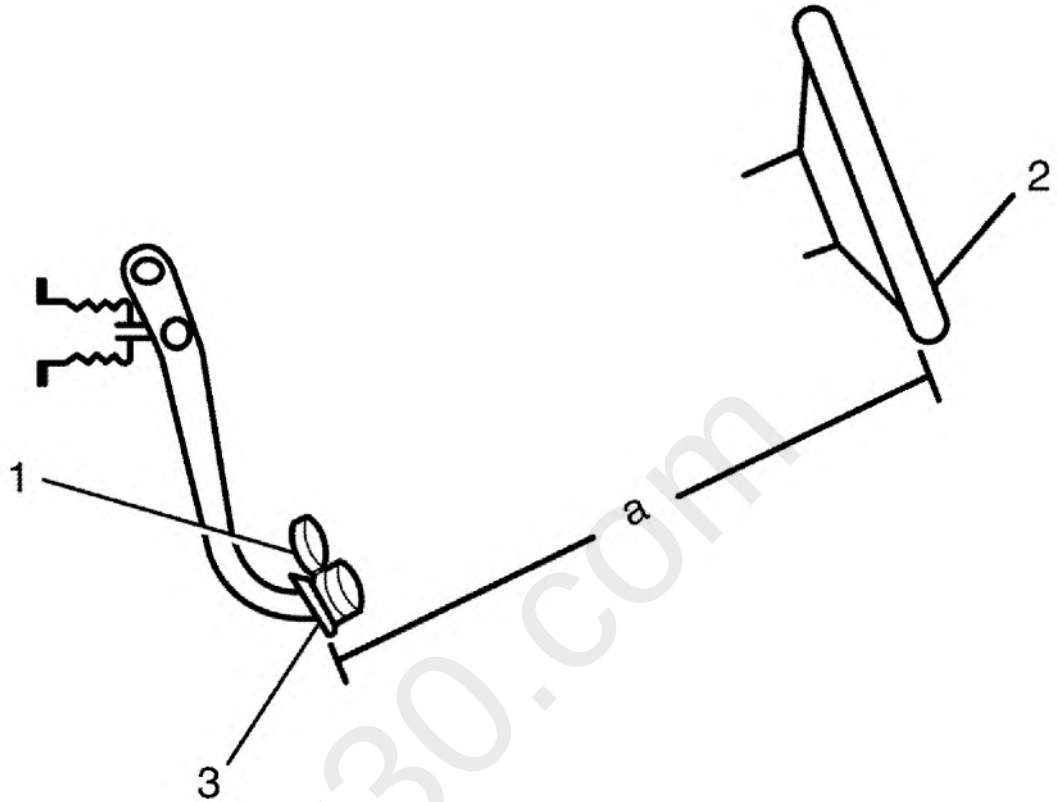


Fig. 4: Steering Wheel, Brake Pedal And Gauge
Courtesy of GENERAL MOTORS COMPANY

2. Install the **CH-28662** gauge (1), or equivalent, to the brake pedal (3).
3. Measure and record the distance (a) from the brake pedal (3) to the rim of the steering wheel (2). Note the points of measurement.

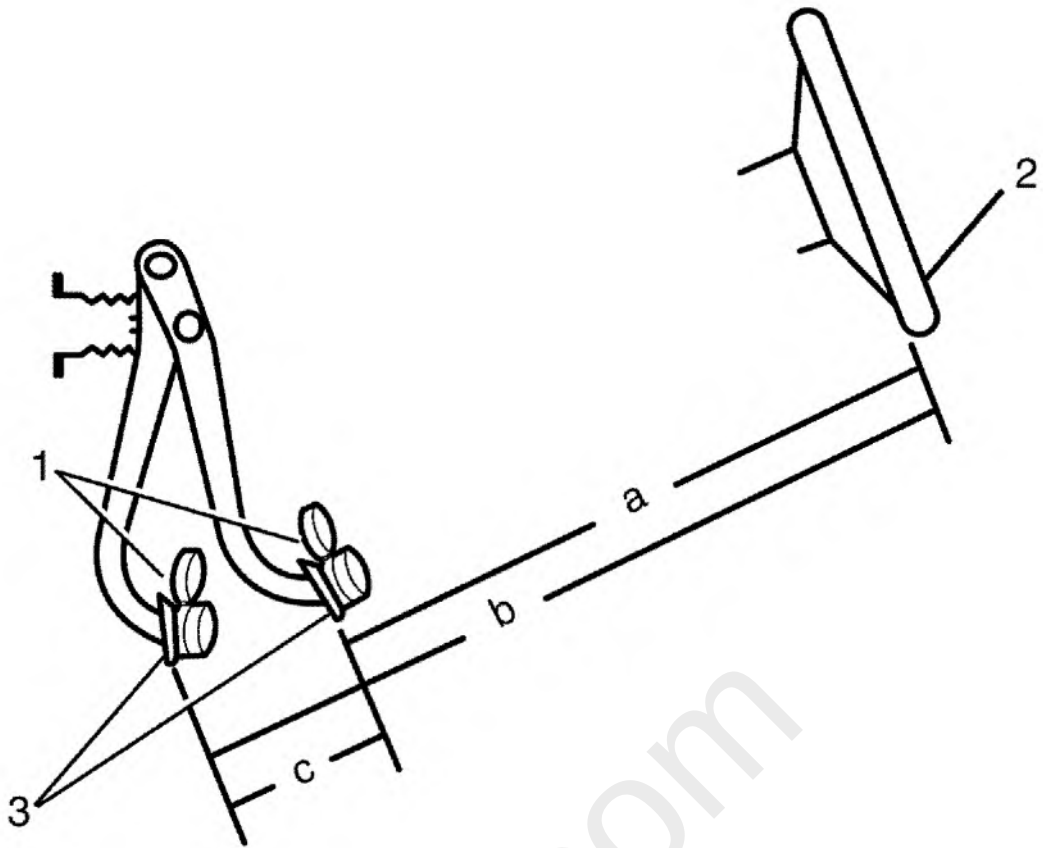


Fig. 5: Brake Pedal Components And Travel Measurement
 Courtesy of GENERAL MOTORS COMPANY

4. Apply and maintain a force of 445 N (100 lb) to the brake pedal, as indicated on the **CH-28662** gauge (1), or equivalent.
5. While maintaining 445 N (100 lb) of force to the brake pedal (3), measure and record the distance (b) from the same point on the brake pedal (3) to the same point on the rim of the steering wheel (2).
6. Release the brake pedal (3) 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 for the 2 applies of the brakes.
8. Subtract the initial unapplied distance (a), from the average applied distance (b) to obtain the brake pedal travel measurement (c).

Specification

Maximum brake pedal travel - measured with the ignition OFF, brake booster power assist depleted, and the brakes cool.

BRAKE SYSTEM VACUUM SOURCE TEST

NOTE:

- Engine temperature, accessory load, and elevation level will affect engine vacuum.
- Vacuum readings will decrease by approximately 2.7 kPa (0.8 in Hg) for every 305 m (1000 ft) of elevation above sea level.

1. Disconnect the engine vacuum hose from the vacuum brake booster check valve.
2. Install a vacuum gauge to the engine vacuum hose.

3. Install a scan tool to the vehicle.

4. Start the engine and allow the engine to idle until normal operating temperatures are reached.

NOTE: To obtain the gauge pressure from the manifold absolute pressure (MAP) sensor, subtract the absolute pressure of the MAP sensor from atmospheric pressure.

5. With the vehicle in PARK or NEUTRAL with the park brake on, the engine idling, and the air conditioning (A/C) system OFF, check to see if the engine vacuum reading is the gauge pressure calculated from the pressure of the MAP sensor indicated on the scan tool.

6. Turn the ignition OFF.

7. If the engine vacuum reading is within the specified normal range, proceed to step 11.

8. If the engine vacuum reading is NOT within the specified normal range, inspect the engine vacuum hose for the following conditions.

- Loose connection to the engine
- Collapse, deformation or contamination
- Cracks, cuts, or brittleness

9. If any of these conditions were found with the engine vacuum hose, replace the hose, then repeat steps 2-5.

10. 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.

11. Remove the vacuum brake booster check valve from the booster.

12. Install the check valve to the engine vacuum hose.

13. Install the vacuum gauge to the check valve.

14. Start the engine and allow the engine to idle in park or neutral with the park brake on and with the A/C system OFF, until normal operating temperatures are reached.

15. Turn the ignition OFF.

NOTE: To obtain the gauge pressure from the manifold absolute pressure (MAP) sensor, subtract the absolute pressure of the MAP sensor from atmospheric pressure.

16. Visually inspect the engine vacuum reading is maintained at the same gauge pressure as the pressure obtained from the MAP sensor as indicated on the scan tool.

17. If the engine vacuum reading is maintained within the specified normal range, proceed to step 19.

18. If the engine vacuum reading is NOT maintained within the specified normal range, replace the vacuum brake booster check valve, then repeat steps 12-16.

19. Inspect the vacuum brake booster check valve grommet for the following conditions:

- Loose connection to the vacuum brake booster
- Deformation or contamination
- Cracks, cuts or brittleness

20. If any of these conditions were found with the check valve grommet, replace the grommet.

BRAKE SYSTEM EXTERNAL LEAK INSPECTION

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

1. In order to inspect for external brake fluid leaks, first inspect 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 the ignition OFF.
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
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

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

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 the ignition OFF.
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 \(Manual\)](#)[Hydraulic Brake System Bleeding \(Pressure\)](#).

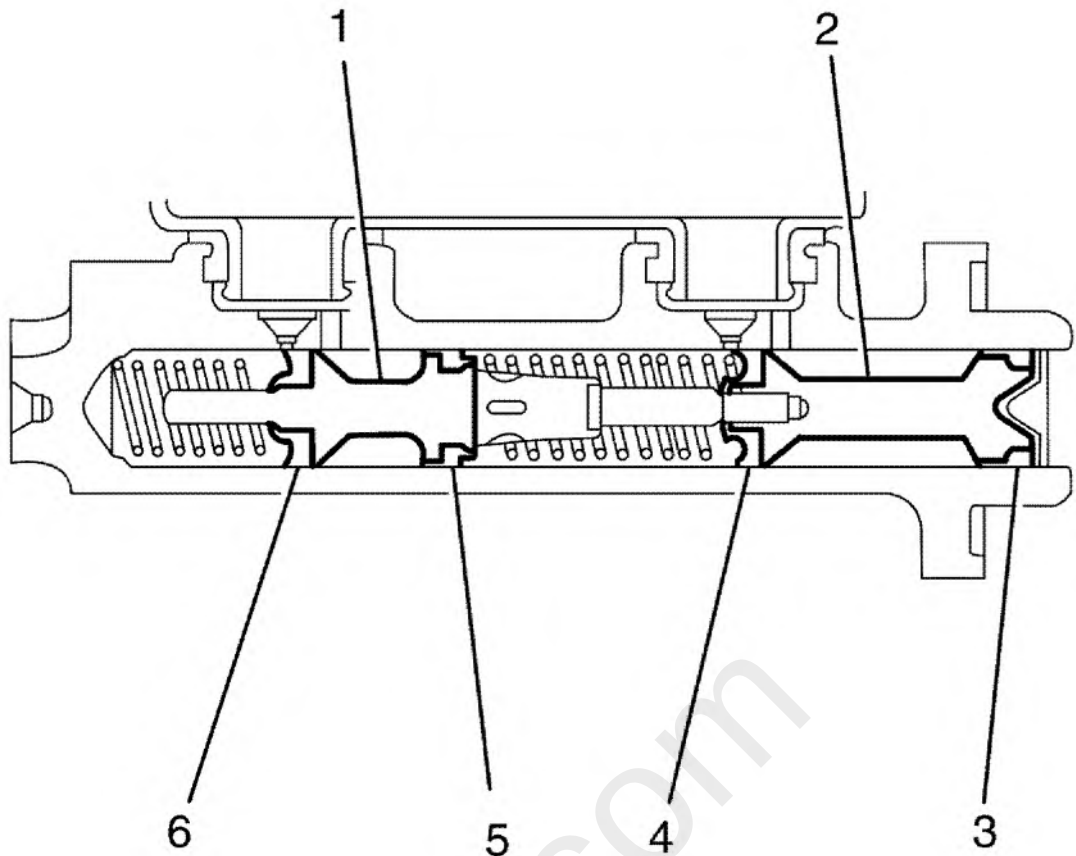


Fig. 6: Master Cylinder Component Inspection Points
Courtesy of GENERAL MOTORS COMPANY

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-vacuum brake booster retaining nuts.
 2. Carefully pull the master cylinder away from the vacuum brake 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)****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

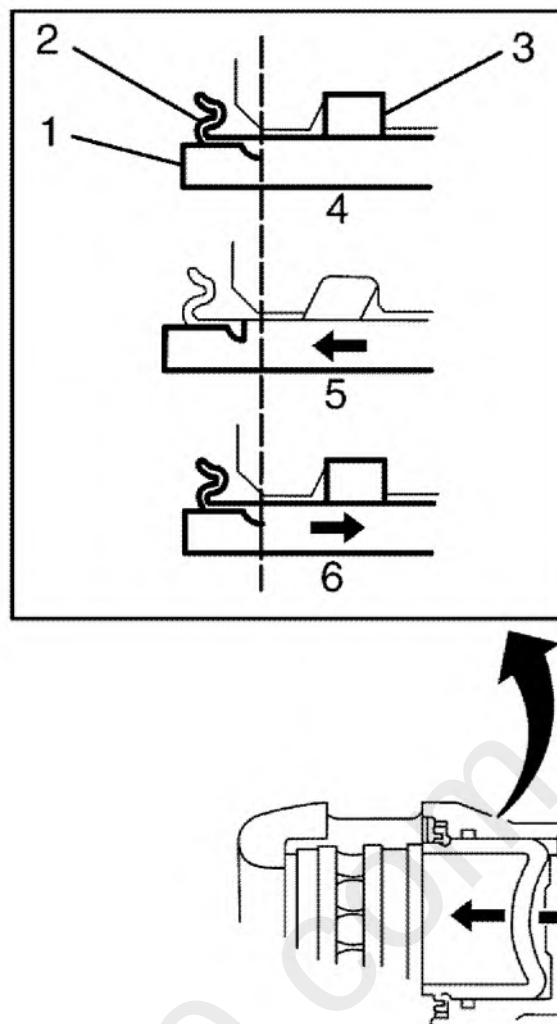


Fig. 7: Hydraulic Brake Component Operation
Courtesy of GENERAL MOTORS COMPANY

1. With the tire and wheel assemblies removed and the brake rotors retained by wheel lug nuts, visually inspect the brake 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 brake caliper piston (1) in relation to the brake 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 brake caliper piston (1) for unrestricted and even movement during each apply of the brake system (5).
 2. Observe the brake caliper piston (1) for an unrestricted and even return motion during each release of the brake system (6).
5. If the brake 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 brake caliper may require overhaul or replacement.

Drum Brakes

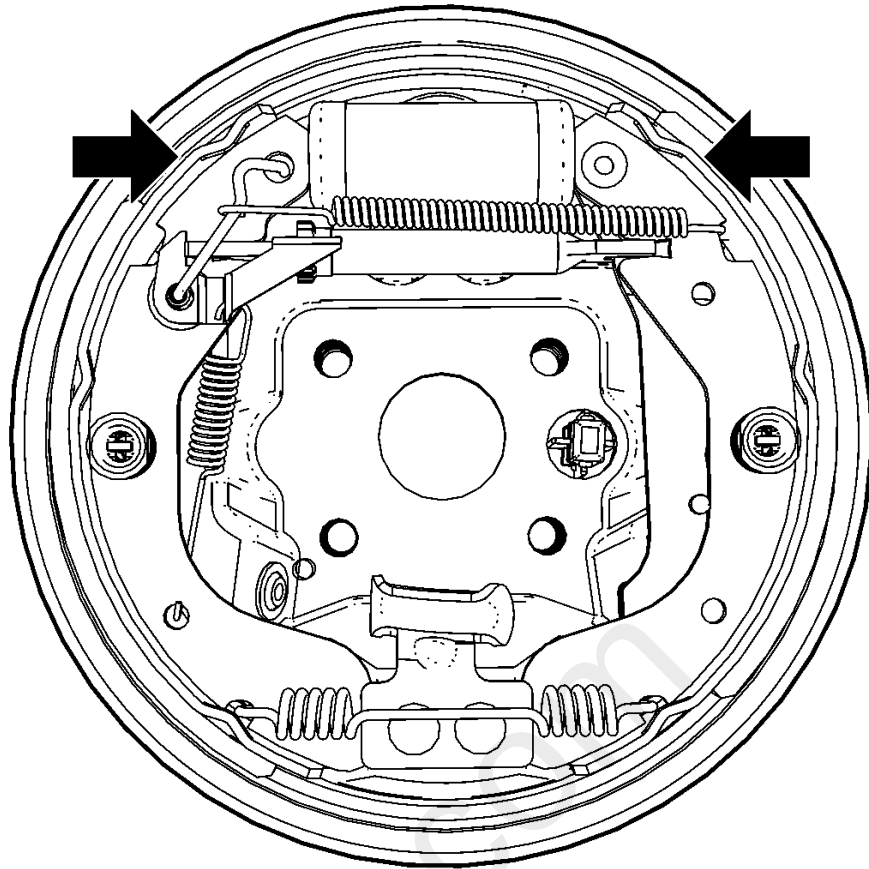


Fig. 8: Wheel Cylinder Piston Boot Sealing Areas
Courtesy of GENERAL MOTORS COMPANY

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

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

1. Visually inspect all of the brake pipes for the following conditions:
 - Kinks, incorrect 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 correctly supported at ride height in order to maintain the proper relationship of the flexible brake hoses to the chassis.

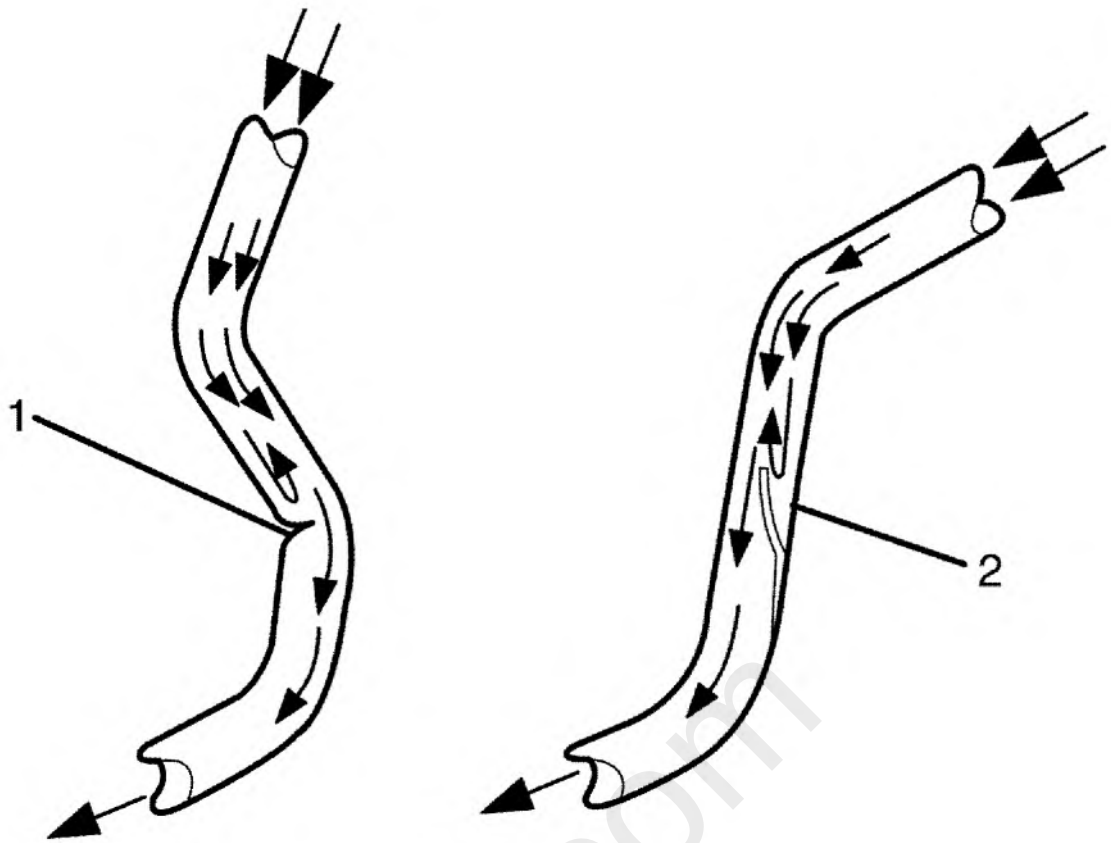


Fig. 9: Flexible Brake Hose Inspection Points
Courtesy of GENERAL MOTORS COMPANY

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, perished, cracked, blistered, brittle or bulging hoses
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 inspect for soft spots (2), indicating an internal restriction. Inspect 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

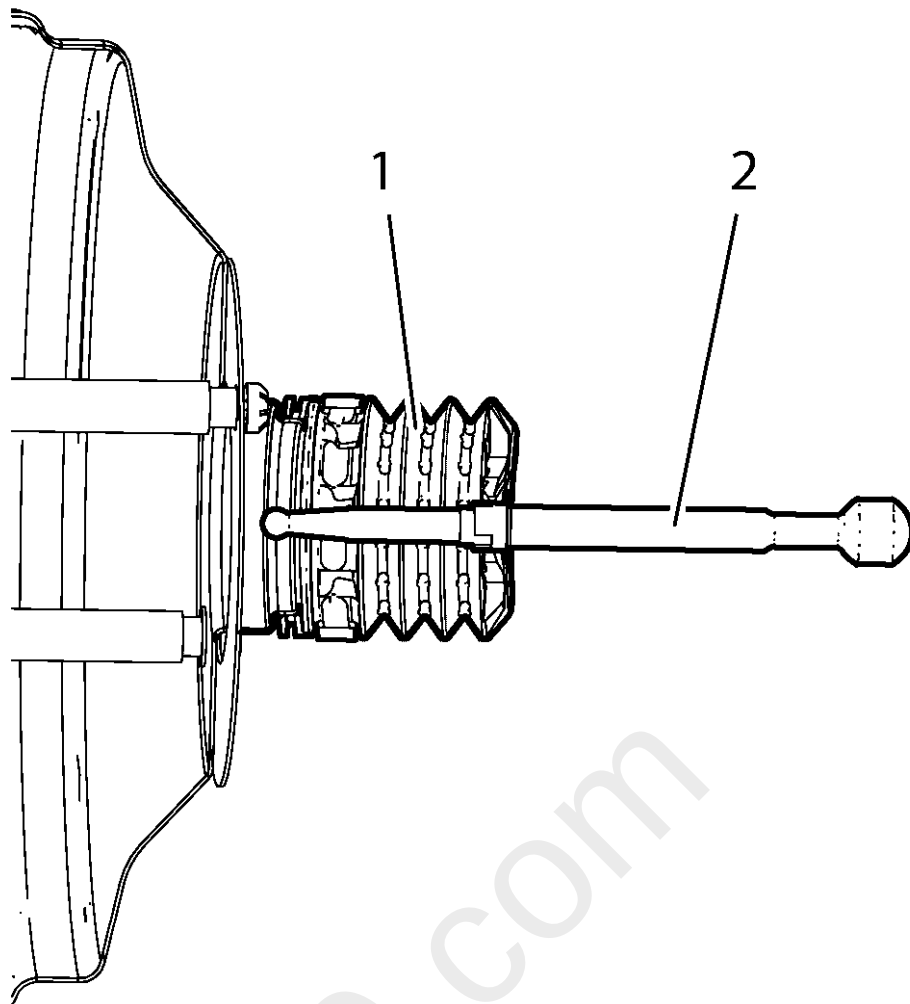


Fig. 10: Brake Pedal Pushrod & Boot

Courtesy of GENERAL MOTORS COMPANY

1. Disconnect the brake pedal pushrod (2) from the brake pedal.
2. Reposition the pedal pushrod boot (1) toward the front of the vehicle to expose as much of the pedal pushrod (2) as possible.
3. Inspect the brake pedal pushrod (2) for straightness.
4. If the brake pedal pushrod (2) is not straight, then the pushrod requires replacement.
5. Return the pedal pushrod boot (1) to its original position on the pedal pushrod (2).
6. Connect the brake pedal pushrod (2) to the brake pedal.

REPAIR INSTRUCTIONS

HYDRAULIC BRAKE FLUID REPLACEMENT

WARNING: Refer to [Brake Fluid Irritant Warning](#)

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#)

CAUTION: Only use products that comply with GM specifications and check manufacturer information respectively. We recommend the use of GM genuine products. Instructions must be followed at all times. 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.

1. With the engine OFF, apply and release the brake pedal several times until the pedal effort becomes firm to deplete the brake booster power reserve.

2. Clean the outer surface of the master cylinder brake fluid reservoir, on and around the reservoir cap, prior to removing the cap and diaphragm. Refer to [Master Cylinder Reservoir Filling](#)
3. Fill the master cylinder brake fluid reservoir to the maximum-fill level with GM approved brake fluid from a clean, sealed brake fluid container. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#)
4. Maintain the brake fluid level in the master cylinder brake fluid reservoir to between the minimum and maximum-fill level during the brake fluid replacement procedure.
5. Following the hydraulic brake system bleeding procedure, bleed each of the hydraulic brake wheel circuits until clean, clear brake fluid is observed coming from each bleeder valve. Refer to [Hydraulic Brake System Bleeding \(Manual\)](#)[Hydraulic Brake System Bleeding \(Pressure\)](#).
6. Fill the master cylinder brake fluid reservoir to the maximum-fill level with GM approved brake fluid from a clean, sealed brake fluid container. Refer to [Master Cylinder Reservoir Filling](#)
7. Securely install the master cylinder brake fluid reservoir diaphragm and cap.
8. Slowly apply and release the brake pedal, observing the brake pedal feel.
9. If the brake pedal feels spongy, perform the following:
 1. Visually inspect the hydraulic brake system for external leaks. Refer to [Brake System External Leak Inspection](#)
 2. Using a scan tool, perform the antilock brake system automated bleed procedure to remove any air that may have become trapped in the brake pressure modulator valve (BPMV). Refer to [Antilock Brake System Automated Bleed](#)

MASTER CYLINDER RESERVOIR FILLING

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

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

Removal Procedure

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

1. Remove and properly dispose of the brake fluid from the master cylinder reservoir.
2. Remove the brake master cylinder. Refer to [Master Cylinder Replacement](#).

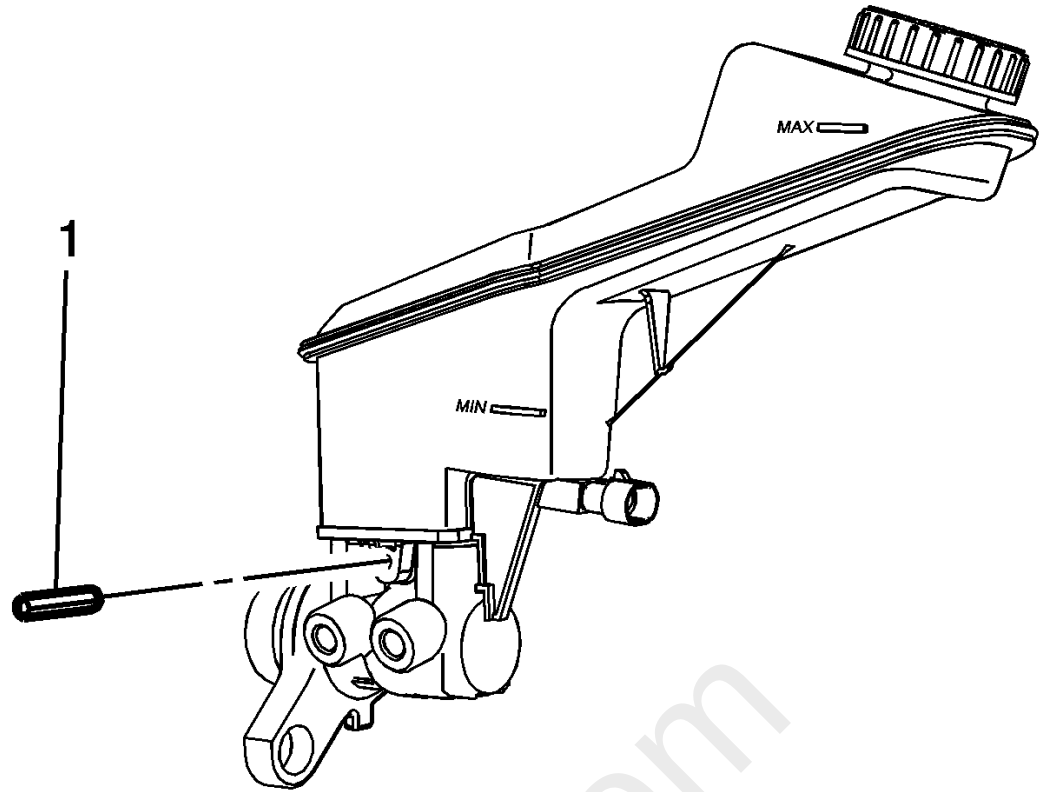


Fig. 11: Brake Master Cylinder Reservoir Roll Pin
Courtesy of GENERAL MOTORS COMPANY

3. Remove and discard the brake master cylinder reservoir roll pin (1).

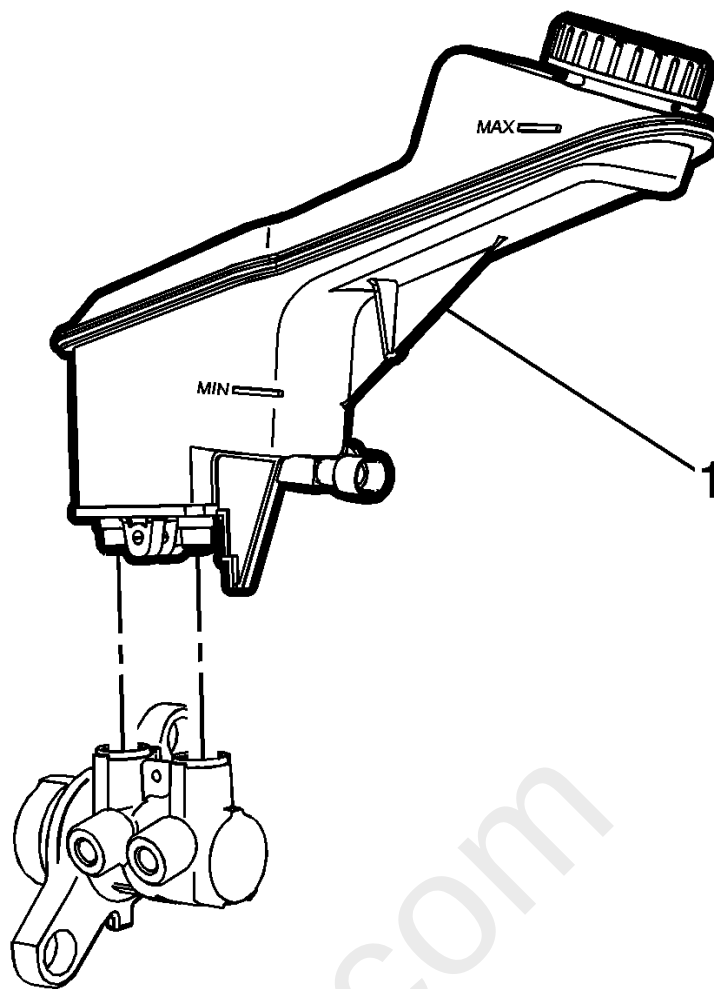


Fig. 12: Master Cylinder Reservoir

Courtesy of GENERAL MOTORS COMPANY

4. Remove the master cylinder reservoir (1) by carefully pulling straight upward.
5. Remove the brake fluid level indicator switch, if necessary. Refer to [**Brake Fluid Level Indicator Switch Replacement**](#).

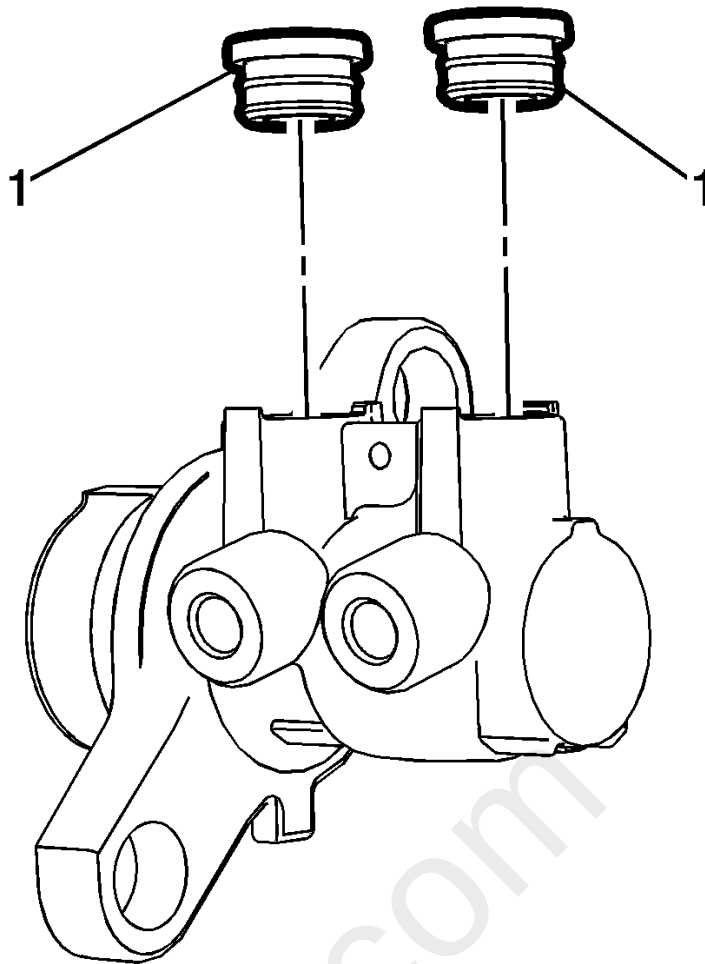


Fig. 13: Master Cylinder Reservoir Seals
Courtesy of GENERAL MOTORS COMPANY

6. Remove the brake master cylinder reservoir seals (1).
7. If replacing the master cylinder reservoir, discard the reservoir seals.

Installation Procedure

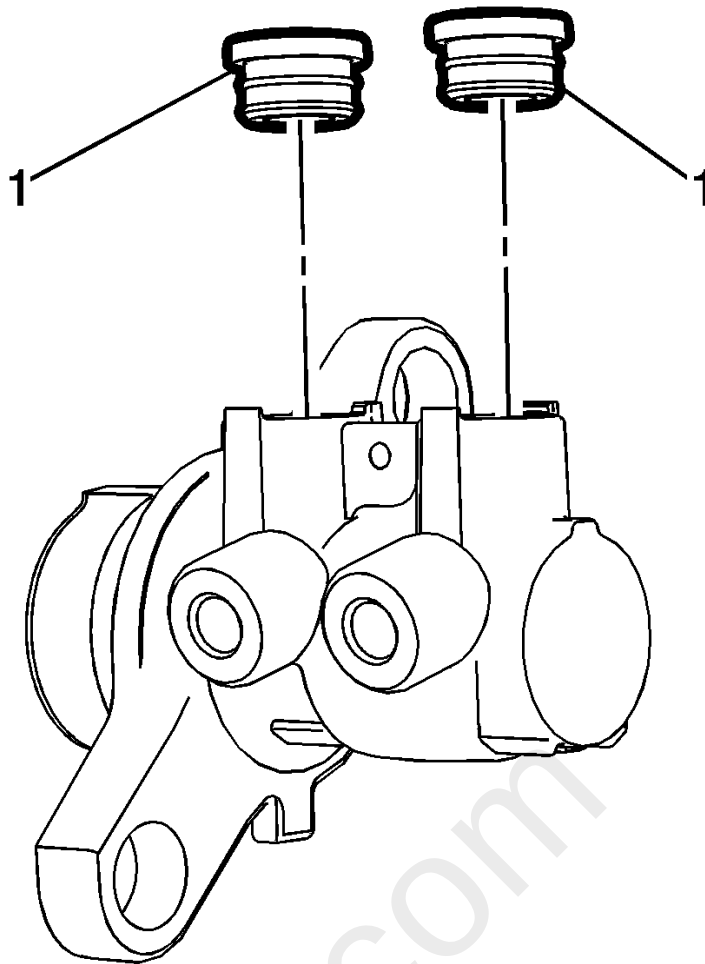


Fig. 14: Master Cylinder Reservoir Seals

Courtesy of GENERAL MOTORS COMPANY

1. Lightly lubricate the brake master cylinder reservoir seals (1) with GM approved brake fluid from a clean, sealed, brake fluid container.
2. Install the lubricated brake master cylinder reservoir seals to the brake master cylinder.

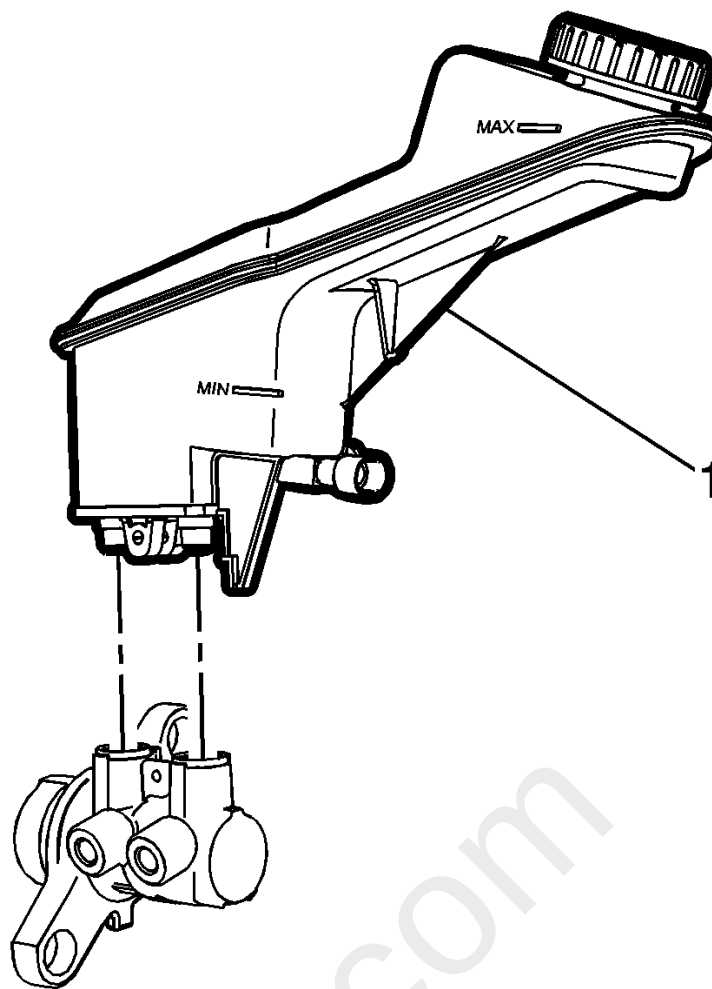


Fig. 15: Master Cylinder Reservoir

Courtesy of GENERAL MOTORS COMPANY

3. Install the master cylinder reservoir (1) by firmly pressing straight downward.
4. Install the brake fluid level indicator switch, if removed. Refer to [**Brake Fluid Level Indicator Switch Replacement**](#).

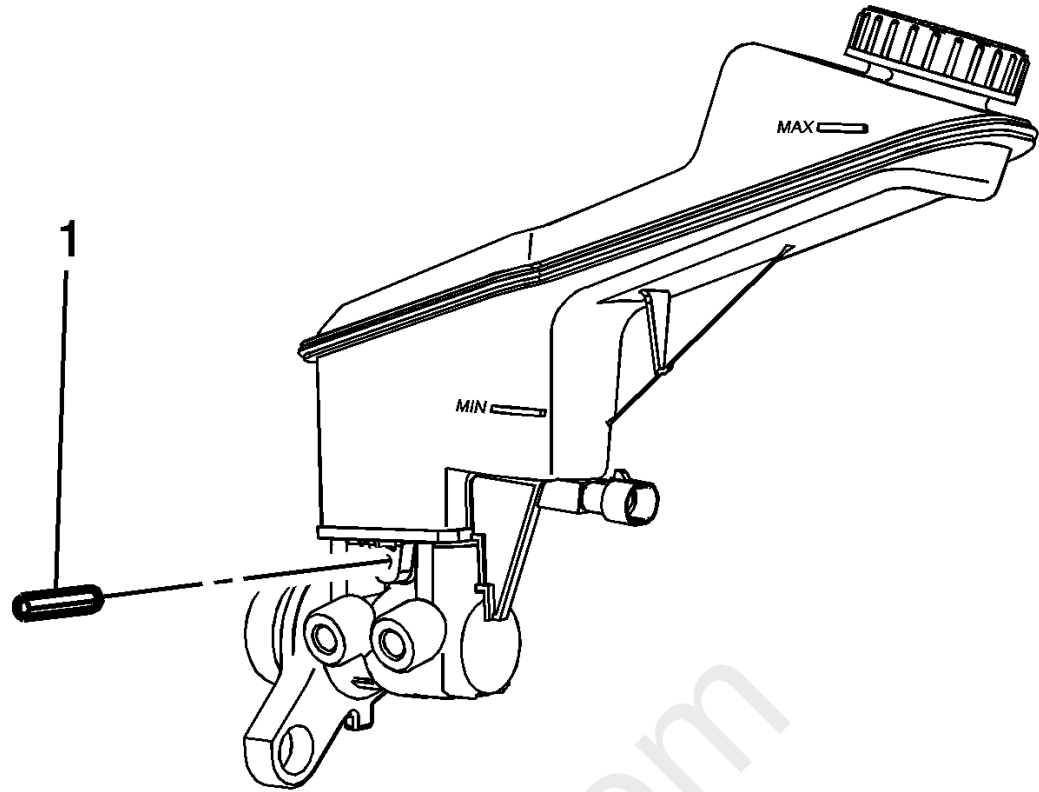


Fig. 16: Brake Master Cylinder Reservoir Roll Pin
Courtesy of GENERAL MOTORS COMPANY

5. Install a new brake master cylinder reservoir roll pin (1).
6. Install the brake master cylinder. Refer to [Master Cylinder Replacement](#).

MASTER CYLINDER REPLACEMENT

Removal Procedure

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

1. Place the ignition switch in the OFF position.
2. Remove the battery. Refer to [Battery Replacement](#) .
3. Disconnect the brake fluid level indicator switch electrical connector.
4. Using a suitable suction device, remove and properly discard the brake fluid from the brake master cylinder reservoir.

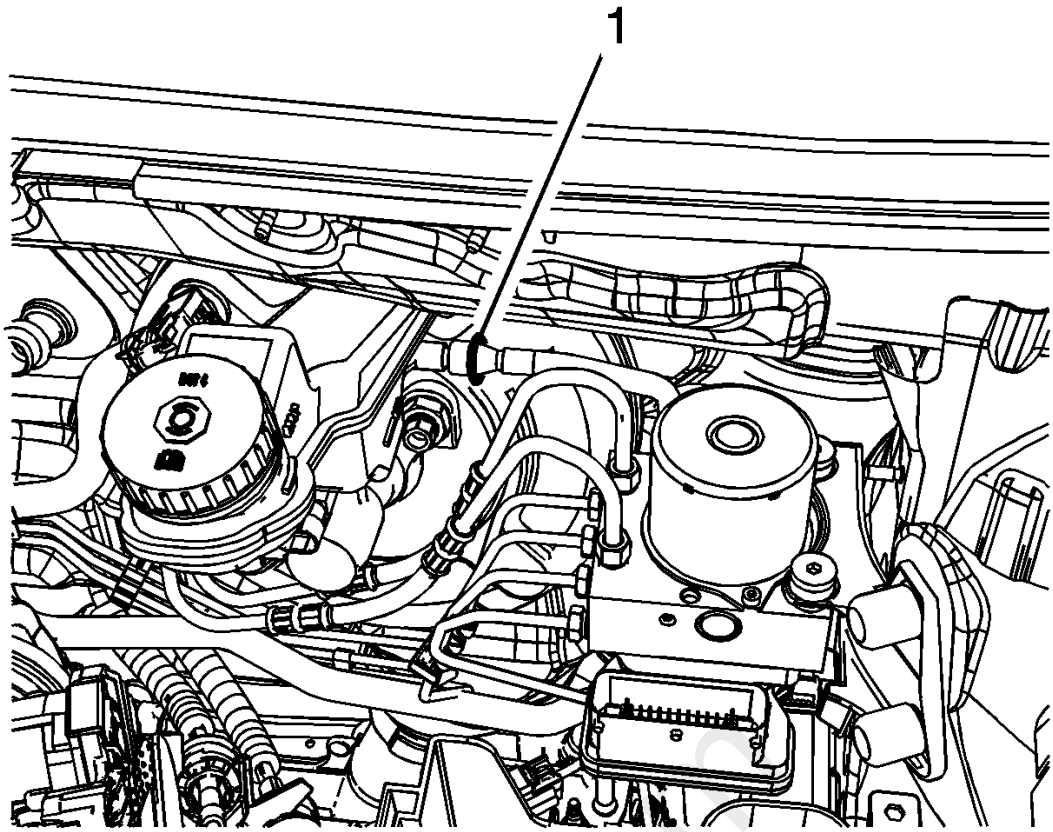


Fig. 17: Clutch Master Cylinder Reservoir Hose
Courtesy of GENERAL MOTORS COMPANY

5. On manual transmission equipped vehicles, disconnect the clutch master cylinder reservoir hose (1).

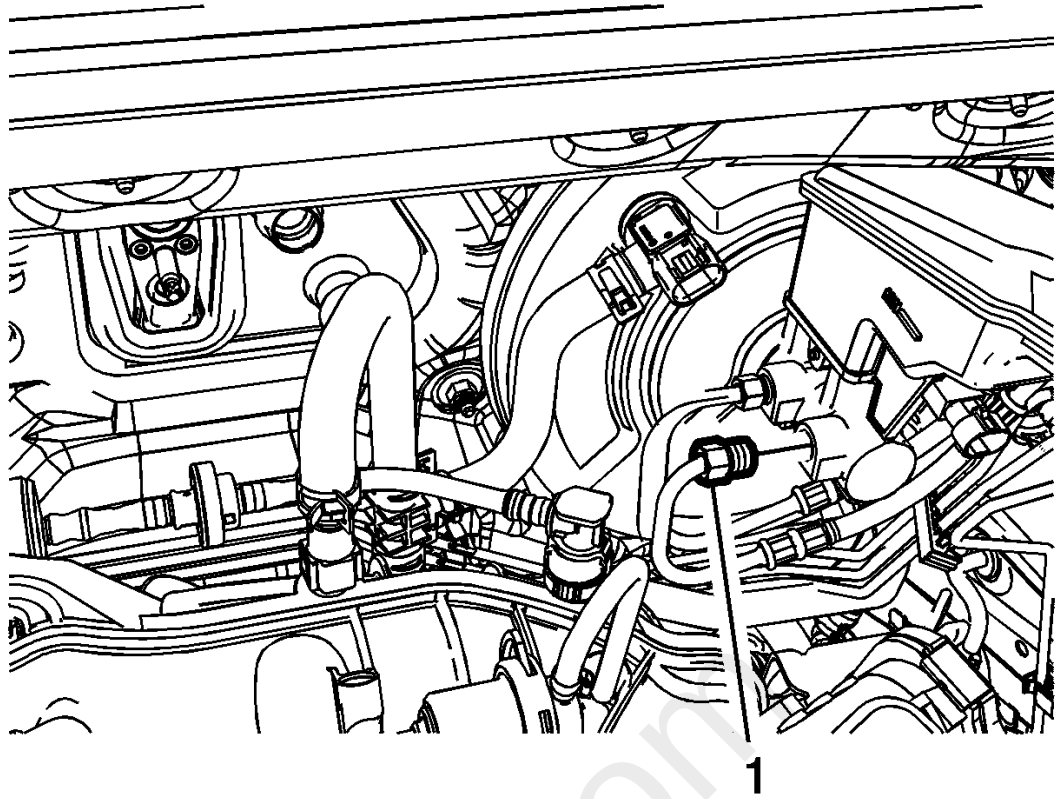


Fig. 18: Master Cylinder Secondary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

6. Disconnect the master cylinder secondary brake pipe fitting (1).
7. Cap the brake pipe fitting and plug the master cylinder outlet port to prevent brake fluid loss and contamination.

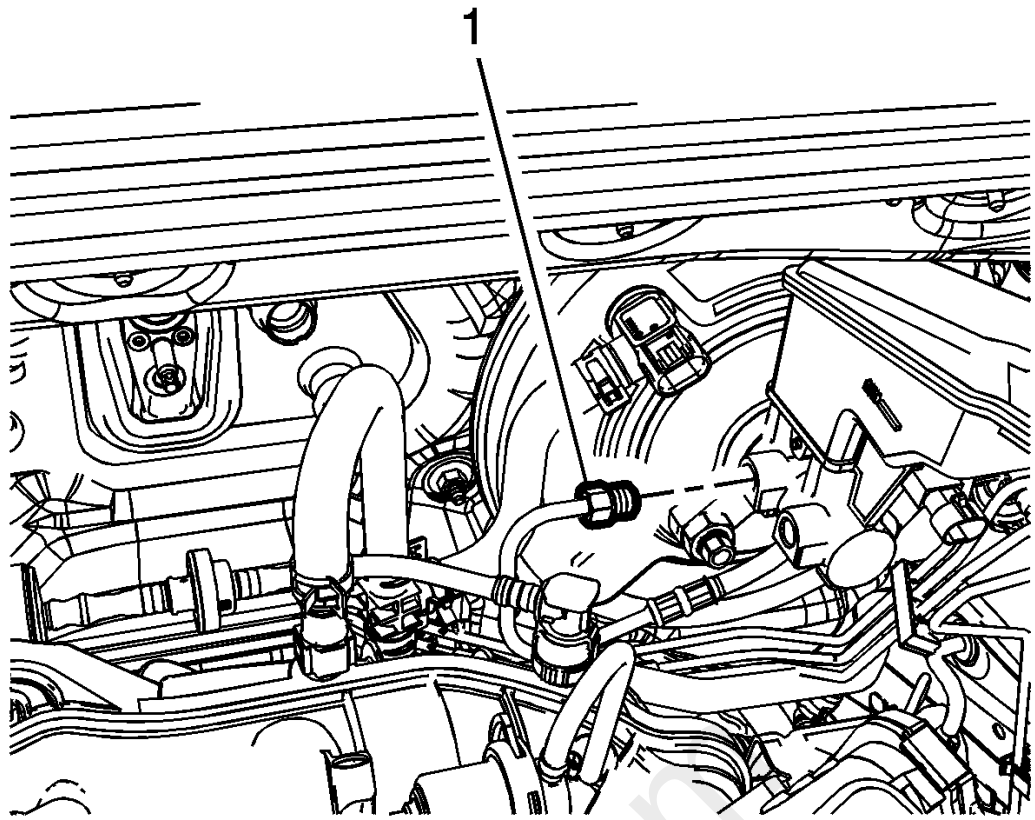


Fig. 19: Master Cylinder Primary Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

8. Disconnect the master cylinder primary brake pipe fitting (1).
9. Cap the brake pipe fitting and plug the master cylinder outlet port to prevent brake fluid loss and contamination.

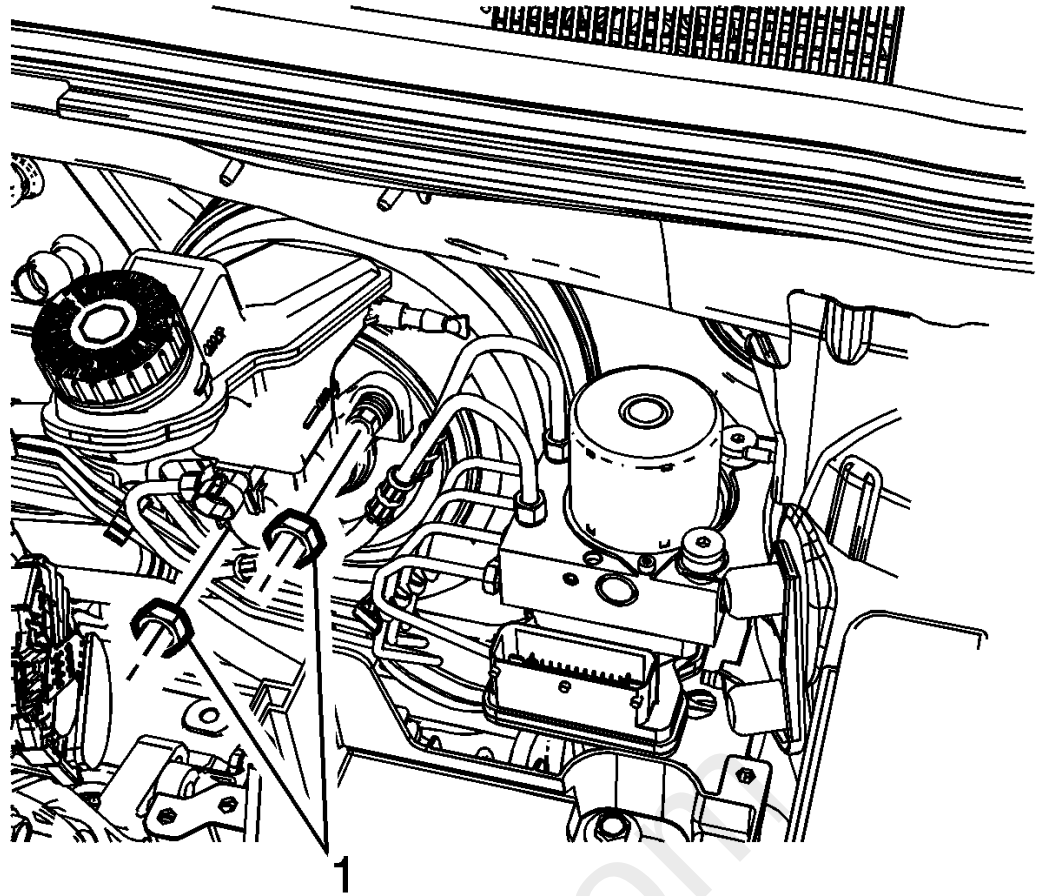


Fig. 20: Brake Master Cylinder And Nuts
Courtesy of GENERAL MOTORS COMPANY

10. Remove the master cylinder nuts (1).
11. Remove the brake master cylinder.

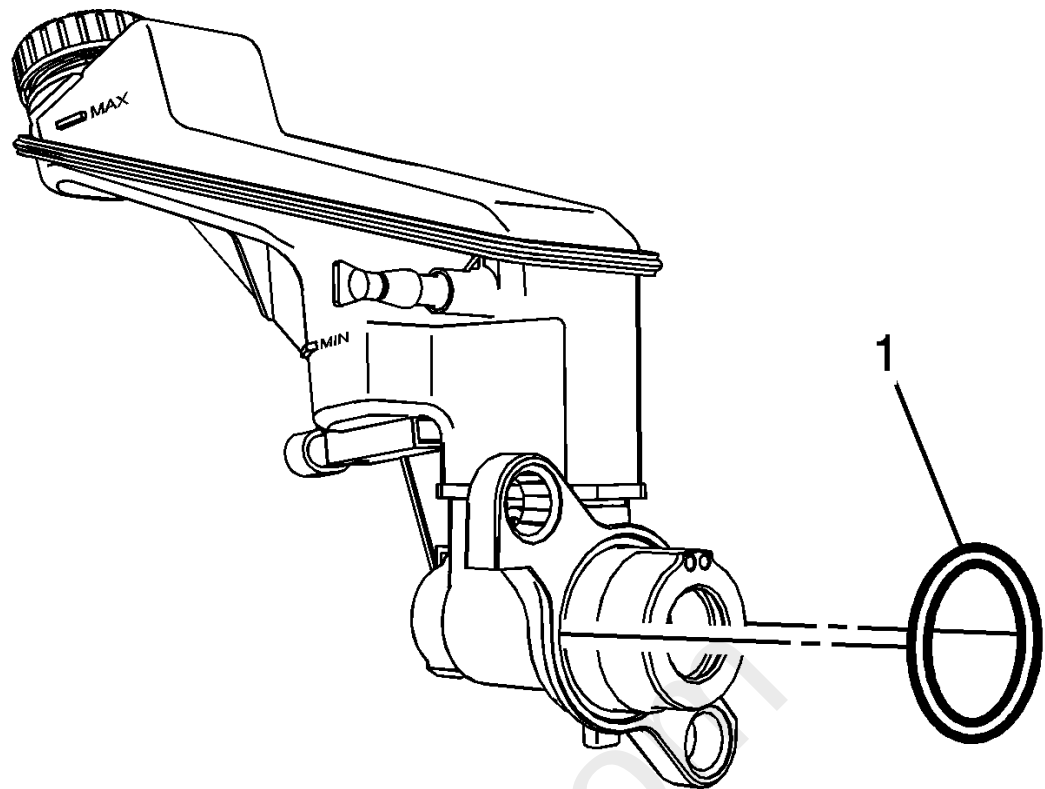


Fig. 21: Master Cylinder Seal

Courtesy of GENERAL MOTORS COMPANY

12. Remove the master cylinder seal (1).
13. Inspect the master cylinder seal for damage or deterioration and replace, if necessary.
14. Remove the brake fluid level indicator switch, if necessary. Refer to [Brake Fluid Level Indicator Switch Replacement](#).
15. Remove the master cylinder reservoir, if necessary. Refer to [Master Cylinder Reservoir Replacement](#).

Installation Procedure

1. Install the master cylinder reservoir, if removed. Refer to [Master Cylinder Reservoir Replacement](#).
2. Bench bleed the master cylinder. Refer to [Master Cylinder Bench Bleeding](#).
3. Install the brake fluid level indicator switch, if removed. Refer to [Brake Fluid Level Indicator Switch Replacement](#).

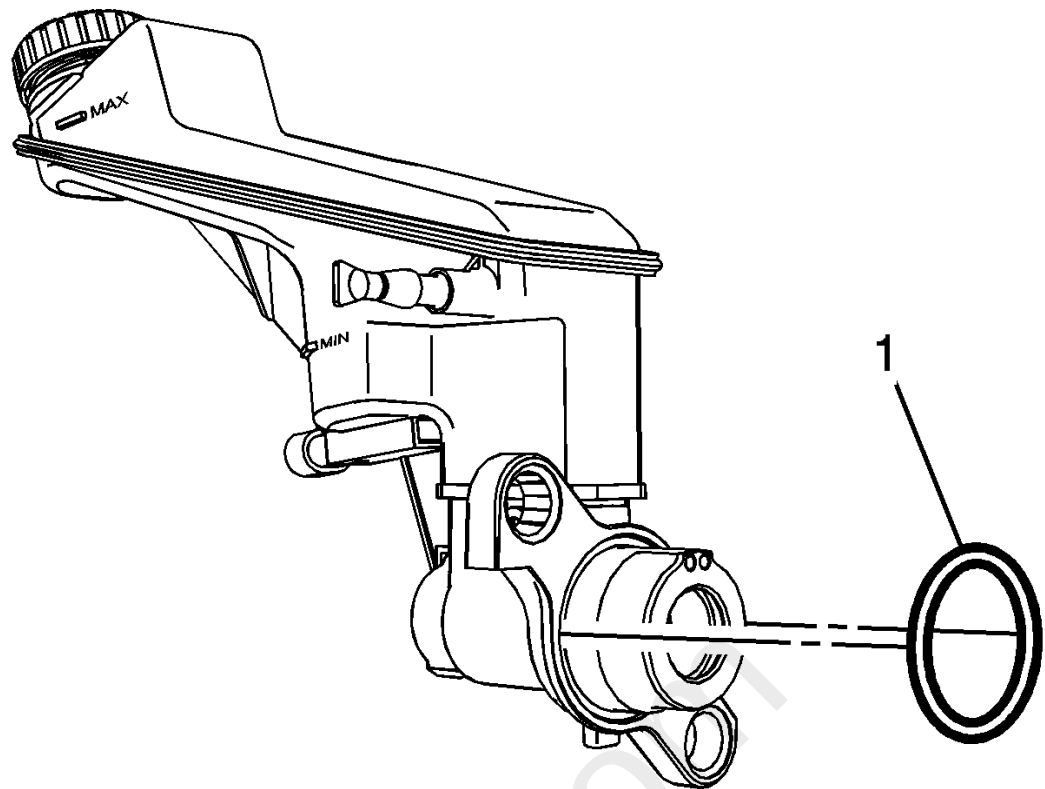


Fig. 22: Master Cylinder Seal

Courtesy of GENERAL MOTORS COMPANY

4. Install the master cylinder seal (1).
5. Install the master cylinder to the power vacuum brake booster.

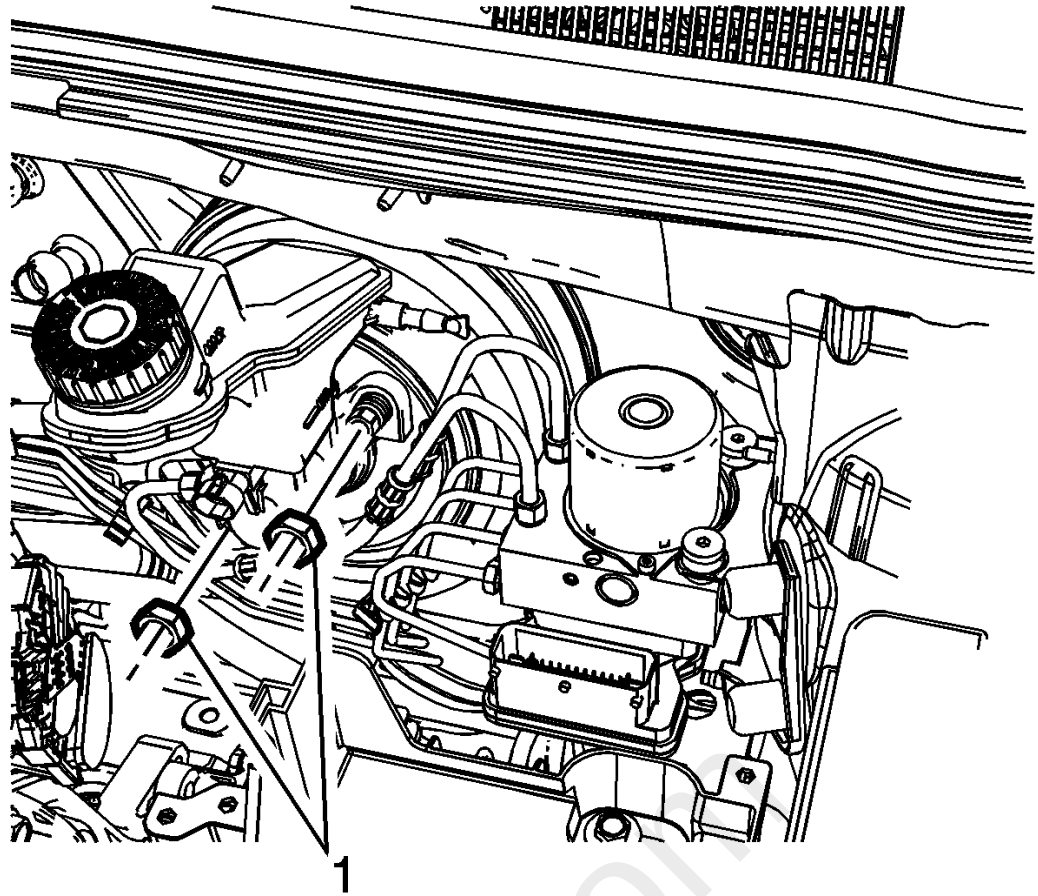


Fig. 23: Brake Master Cylinder And Nuts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

6. Install the master cylinder nuts (1) and tighten to 19 N.m (14 lb ft).

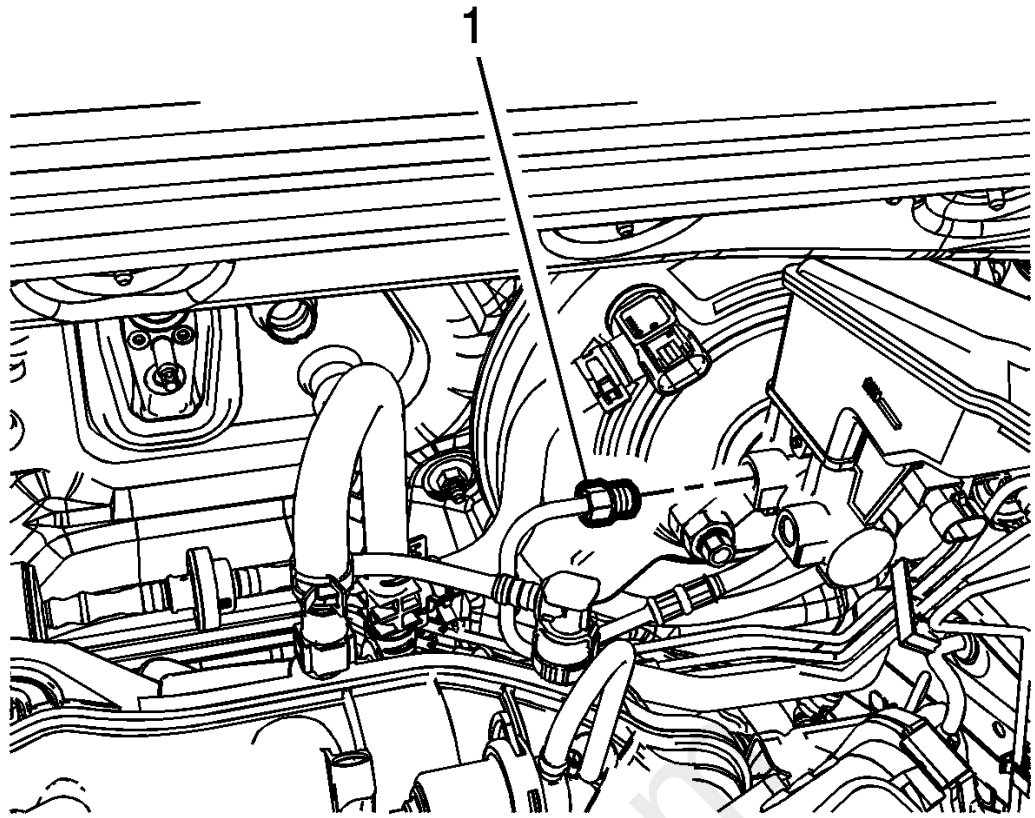


Fig. 24: Master Cylinder Primary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

7. Connect the master cylinder primary brake pipe fitting (1) and tighten to 18 N.m (13 lb ft).

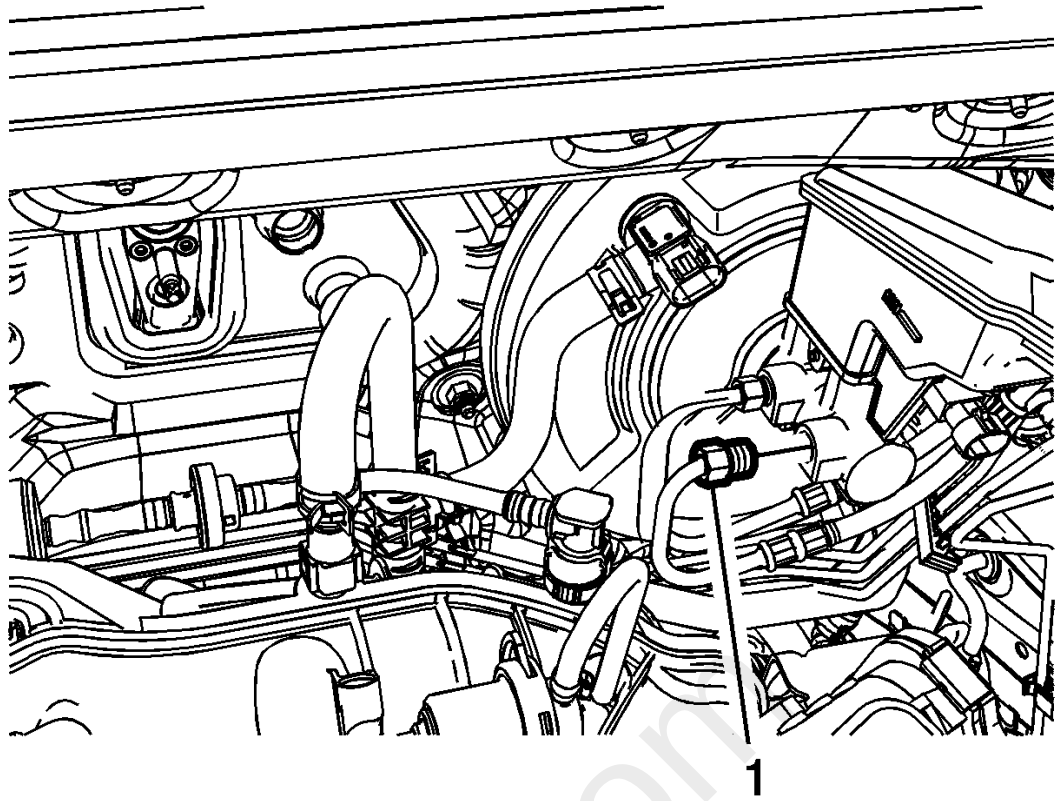


Fig. 25: Master Cylinder Secondary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

8. Connect the master cylinder secondary brake pipe fitting (1) and tighten to 18 N.m (13 lb ft).

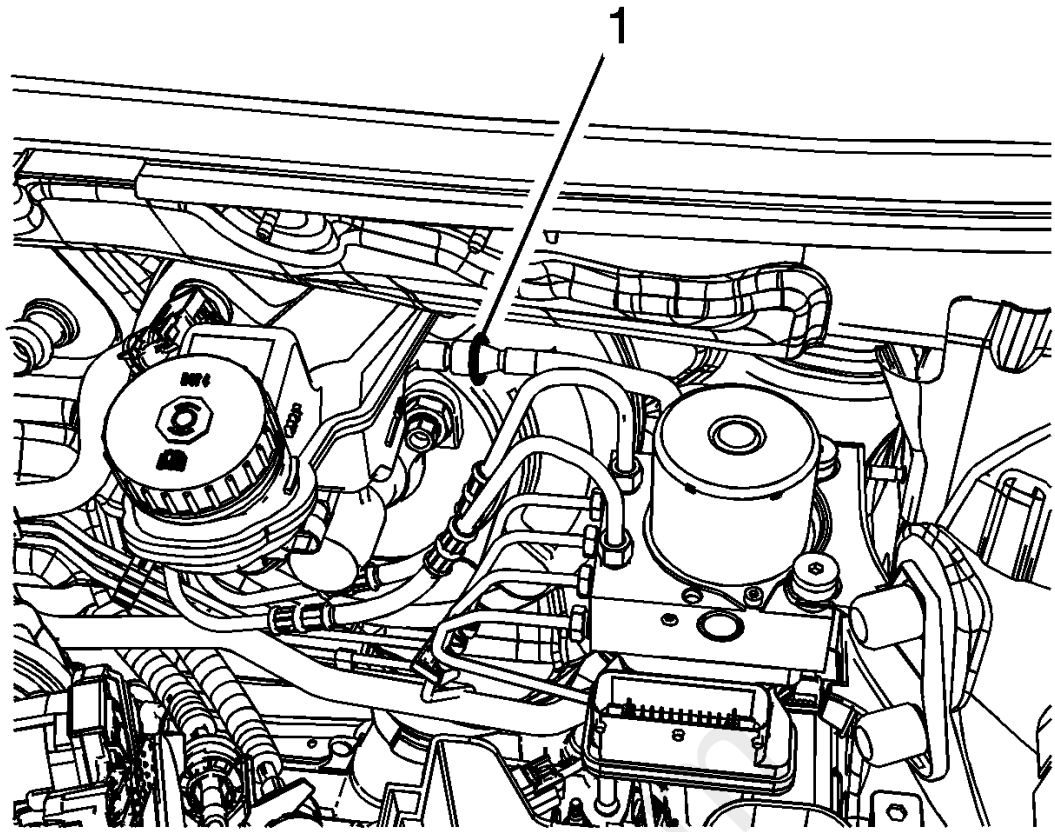


Fig. 26: Clutch Master Cylinder Reservoir Hose
Courtesy of GENERAL MOTORS COMPANY

9. On manual transmission equipped vehicles, connect the clutch master cylinder reservoir hose (1).
10. Connect the brake fluid level indicator switch electrical connector.
11. Install the battery. Refer to [**Battery Replacement**](#) .
12. Bleed the hydraulic brake system. Refer to [**Hydraulic Brake System Bleeding \(Manual\)**](#)[**Hydraulic Brake System Bleeding \(Pressure\)**](#).

MASTER CYLINDER BENCH BLEEDING

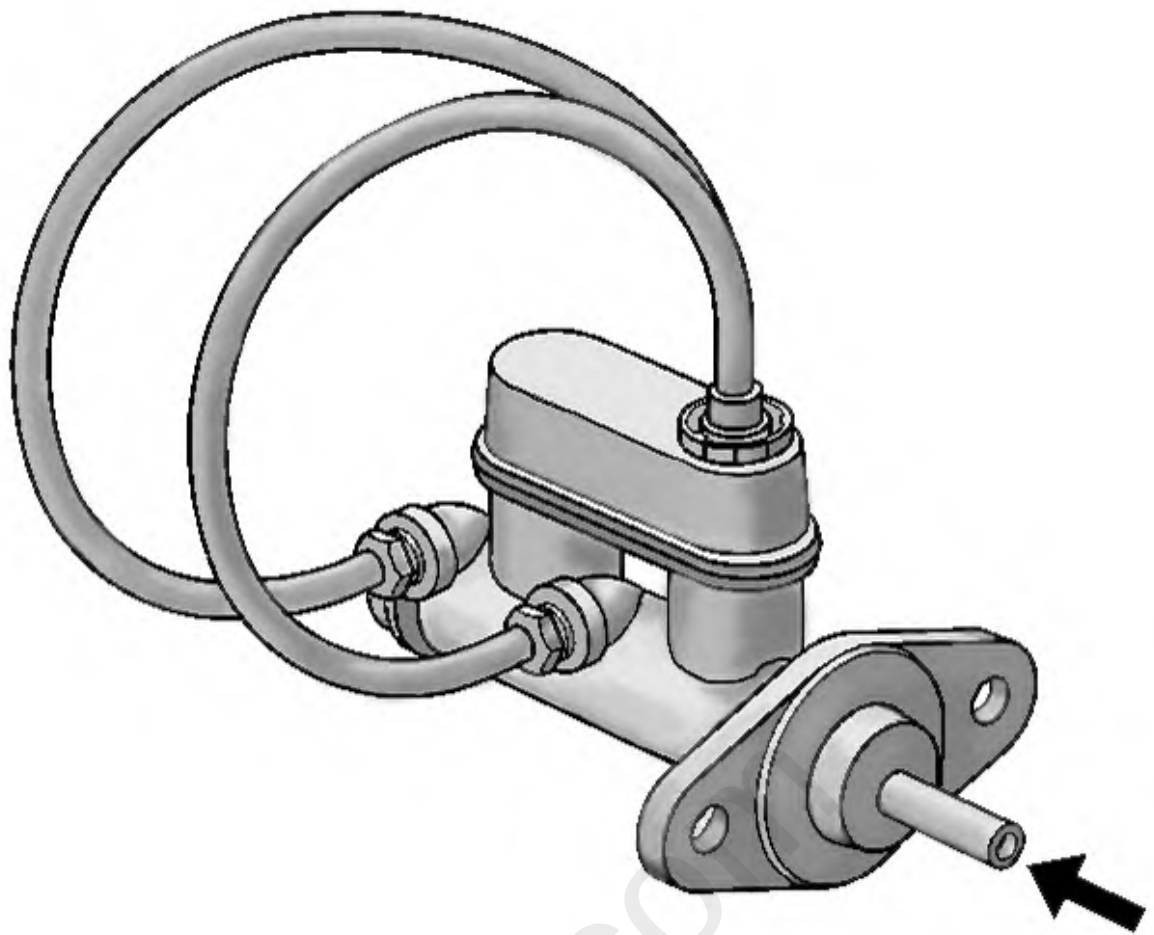


Fig. 27: Bleeding Master Cylinder

Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

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 [Adhesives, Fluids, Lubricants, and Sealers](#)
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

Removal Procedure

1. Disconnect the brake fluid level indicator switch electrical connector.

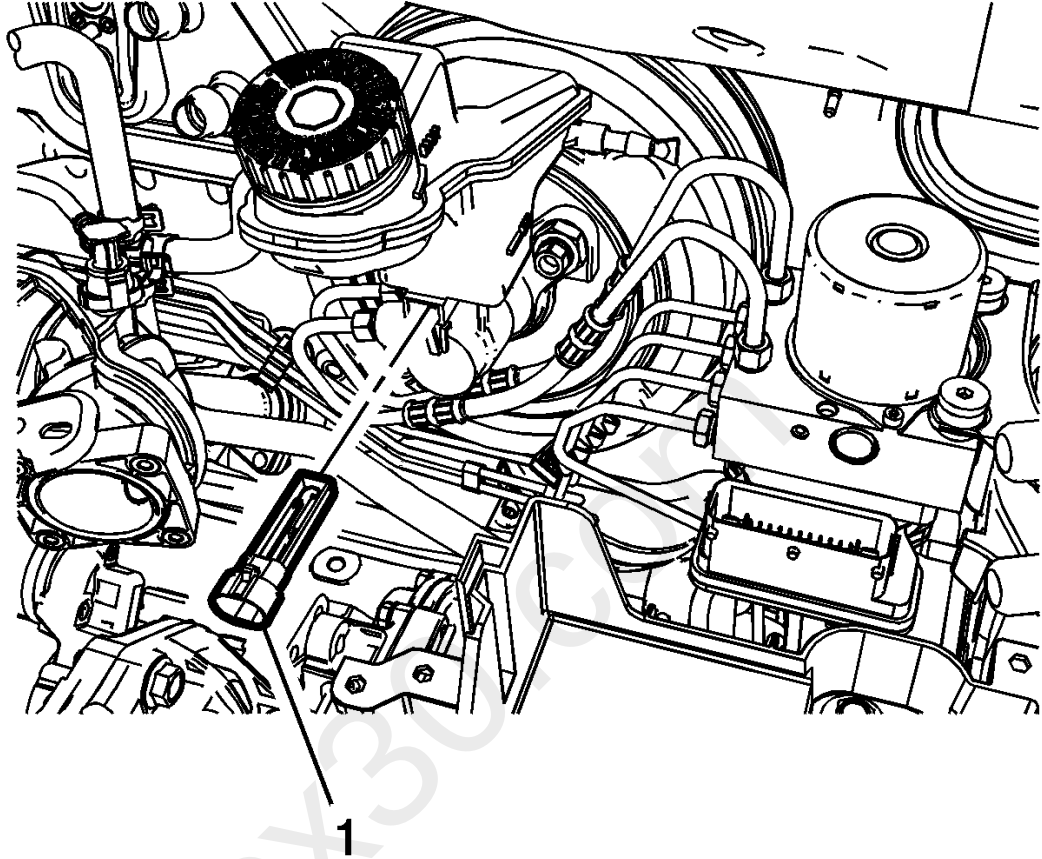


Fig. 28: Brake Fluid Level Indicator Switch
Courtesy of GENERAL MOTORS COMPANY

2. Using a small, flat-bladed tool, lift the locking tab on the underside of the brake fluid level indicator switch (1) and remove the switch.
3. Inspect the master cylinder reservoir for damage and replace, if necessary. Refer to [Master Cylinder Reservoir Replacement](#).

Installation Procedure

1. Install the master cylinder reservoir, if removed. Refer to [Master Cylinder Reservoir Replacement](#).

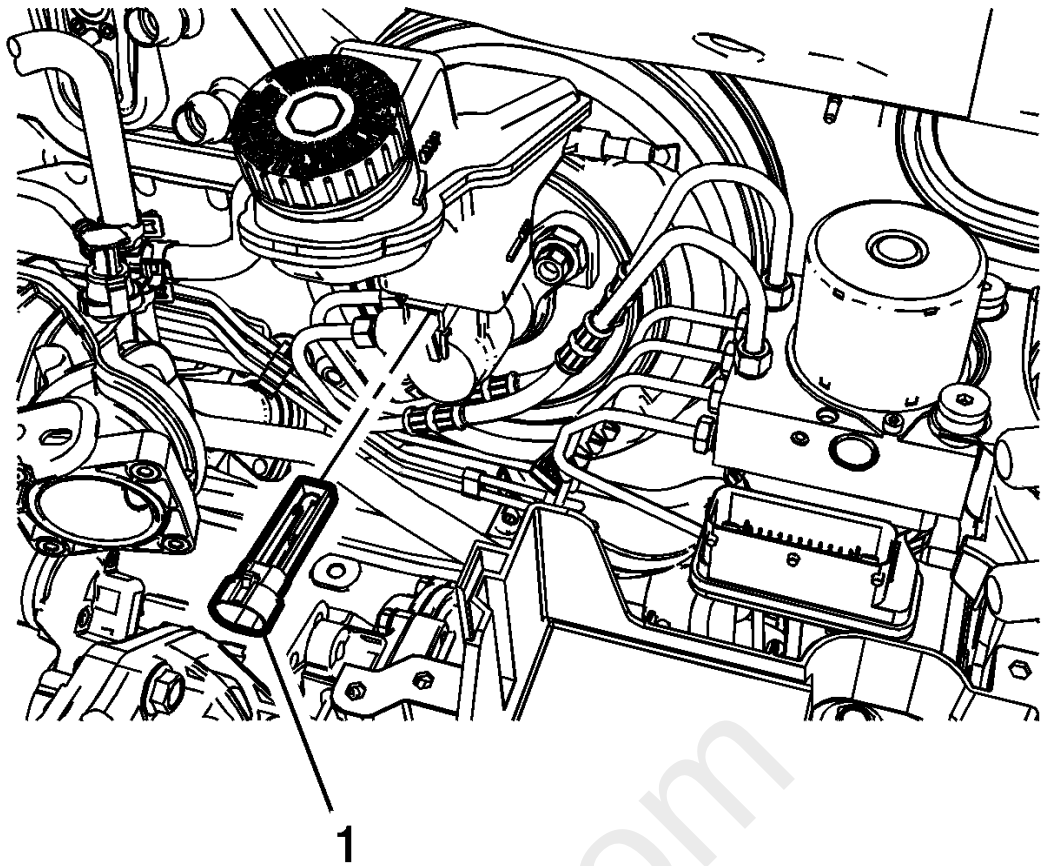


Fig. 29: Brake Fluid Level Indicator Switch
Courtesy of GENERAL MOTORS COMPANY

2. Install the brake fluid level indicator switch (1) by pressing the switch firmly into the brake master cylinder reservoir.
3. Connect the brake fluid level indicator switch electrical connector.

BRAKE, ACCELERATOR, AND CLUTCH PEDAL REPLACEMENT

Removal Procedure

1. Remove the battery tray. Refer to [Battery Tray Replacement](#) .

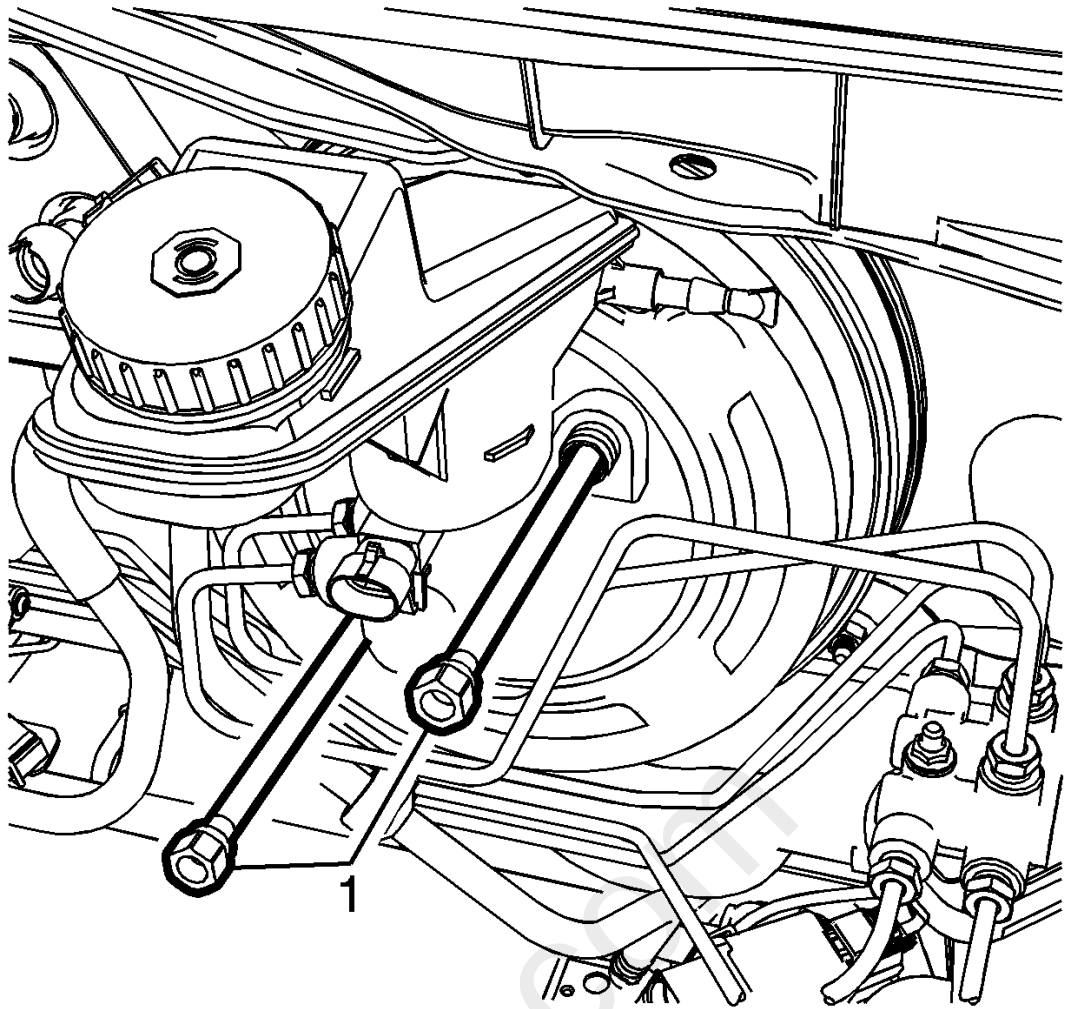


Fig. 30: Power Vacuum Brake Booster Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Remove the power vacuum brake booster bolts (1).

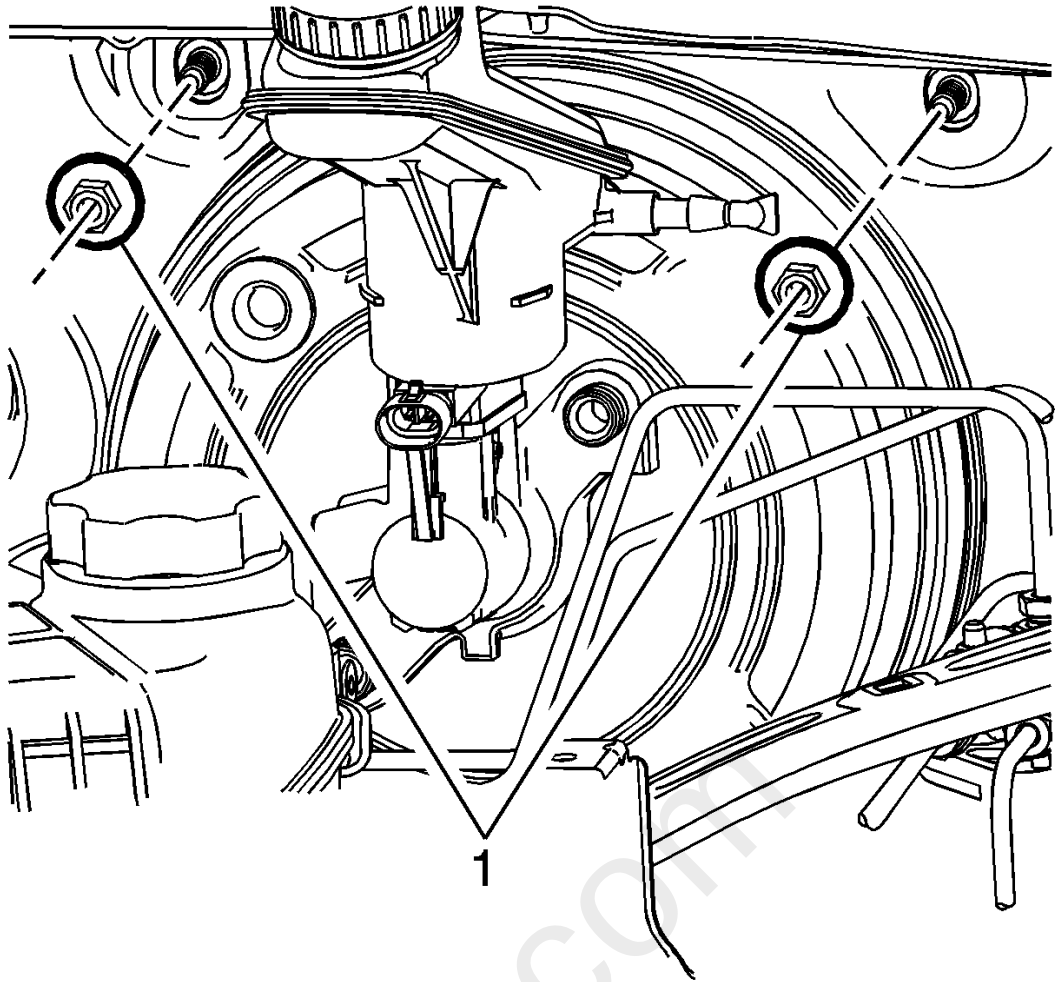


Fig. 31: Brake Pedal Assembly Upper Nuts
Courtesy of GENERAL MOTORS COMPANY

3. Remove the brake pedal assembly upper nuts (1)

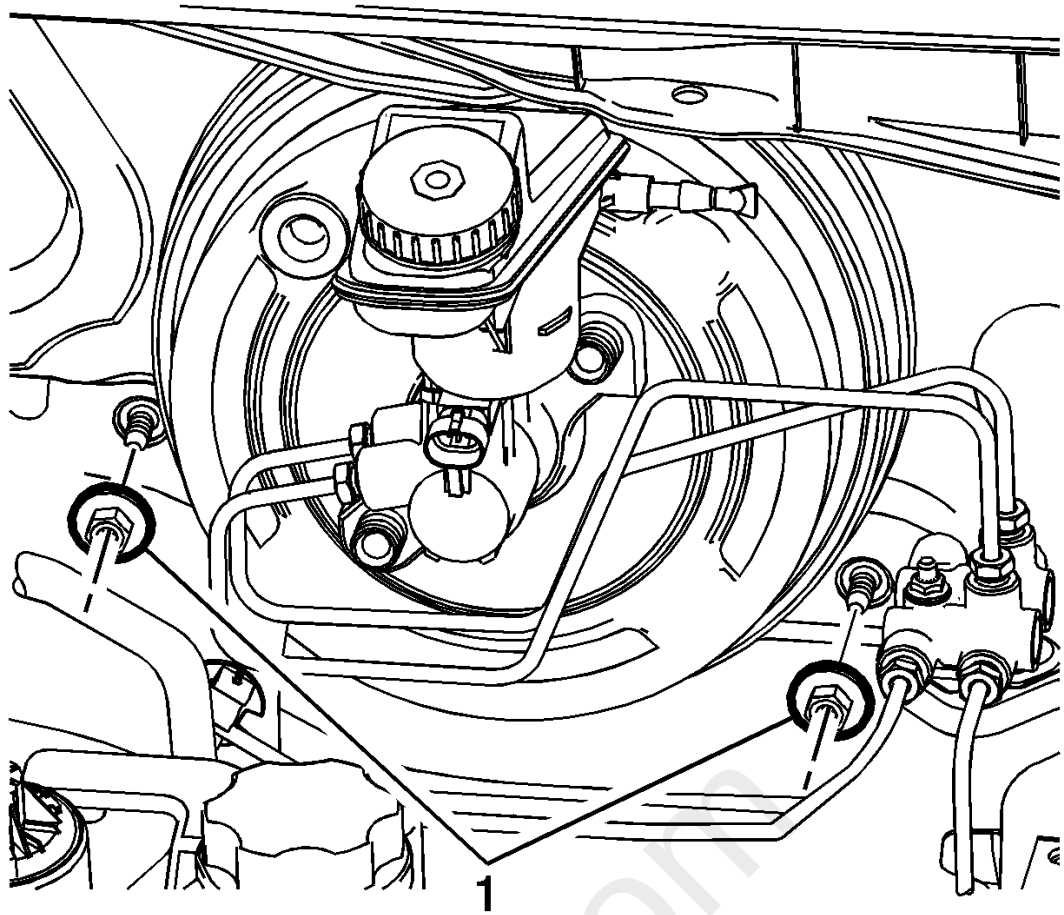


Fig. 32: Brake Pedal Assembly Lower Nuts

Courtesy of GENERAL MOTORS COMPANY

4. Remove the brake pedal assembly lower nuts (1)
5. Remove the steering column. Refer to [Steering Column Replacement \(Buick, Mexico, NJ1, With BTM, With N06\)](#) [Steering Column Replacement \(Buick, Canada/United States, NJ1, With BTM, Without N06\)](#) [Steering Column Replacement \(Chevrolet, Mexico, NJ1, With BTM, With N06\)](#) [Steering Column Replacement \(Chevrolet, Canada/United States, NJ1, With BTM, Without N06\)](#) [Steering Column Replacement \(Chevrolet, Canada/United States, NJ1, Without BTM, Without N06\)](#) [Steering Column Replacement \(Chevrolet, Mexico, NJ1, Without BTM, Without N06\)](#) [Steering Column Replacement \(Mexico, N40\)](#) .

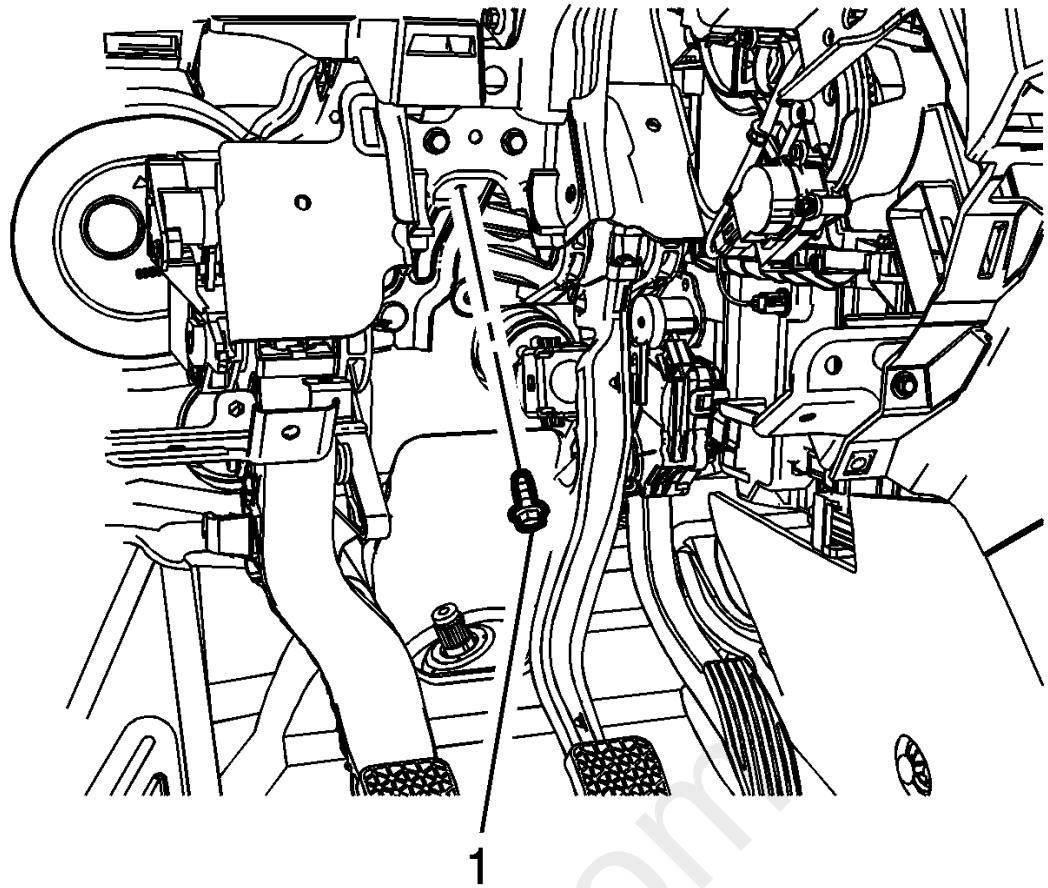


Fig. 33: Brake Pedal Release Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

6. Remove the brake pedal release bracket bolt (1).

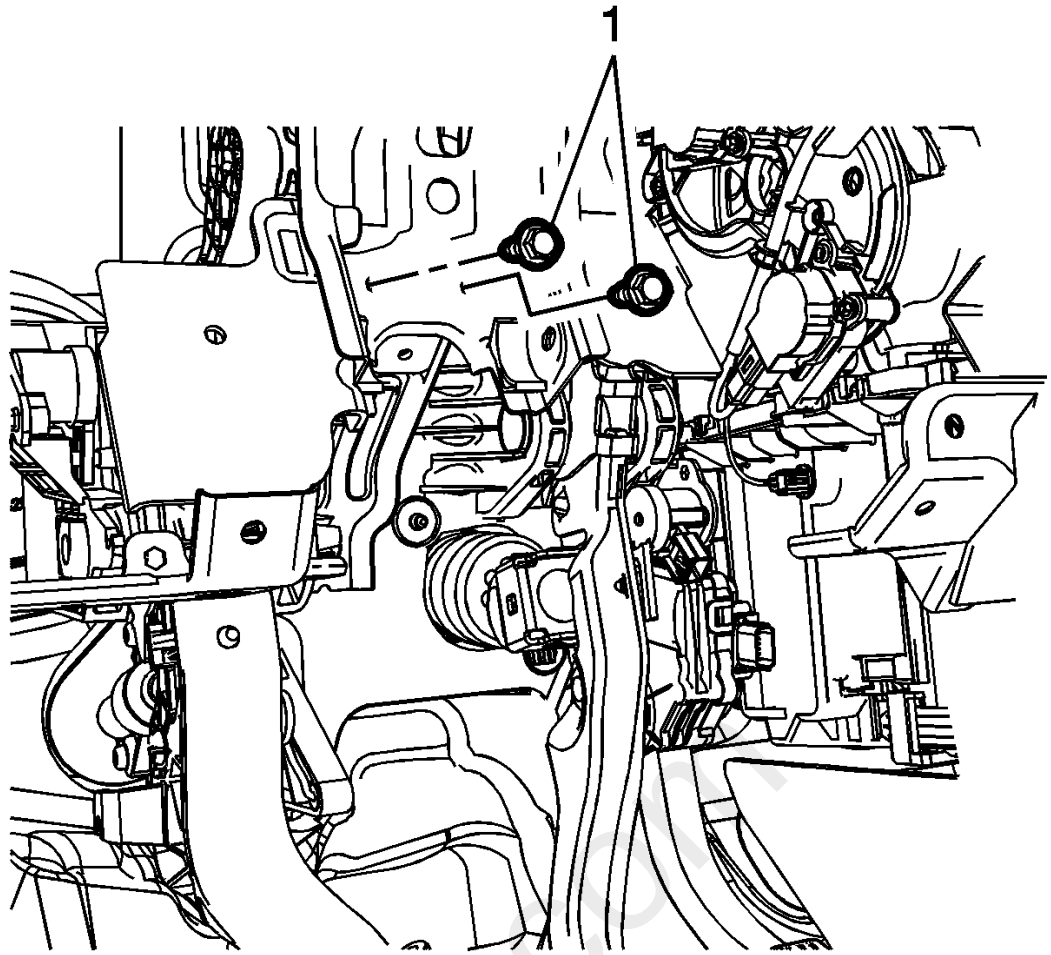


Fig. 34: Brake Pedal Release Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Remove the brake pedal release bracket bolts (1).

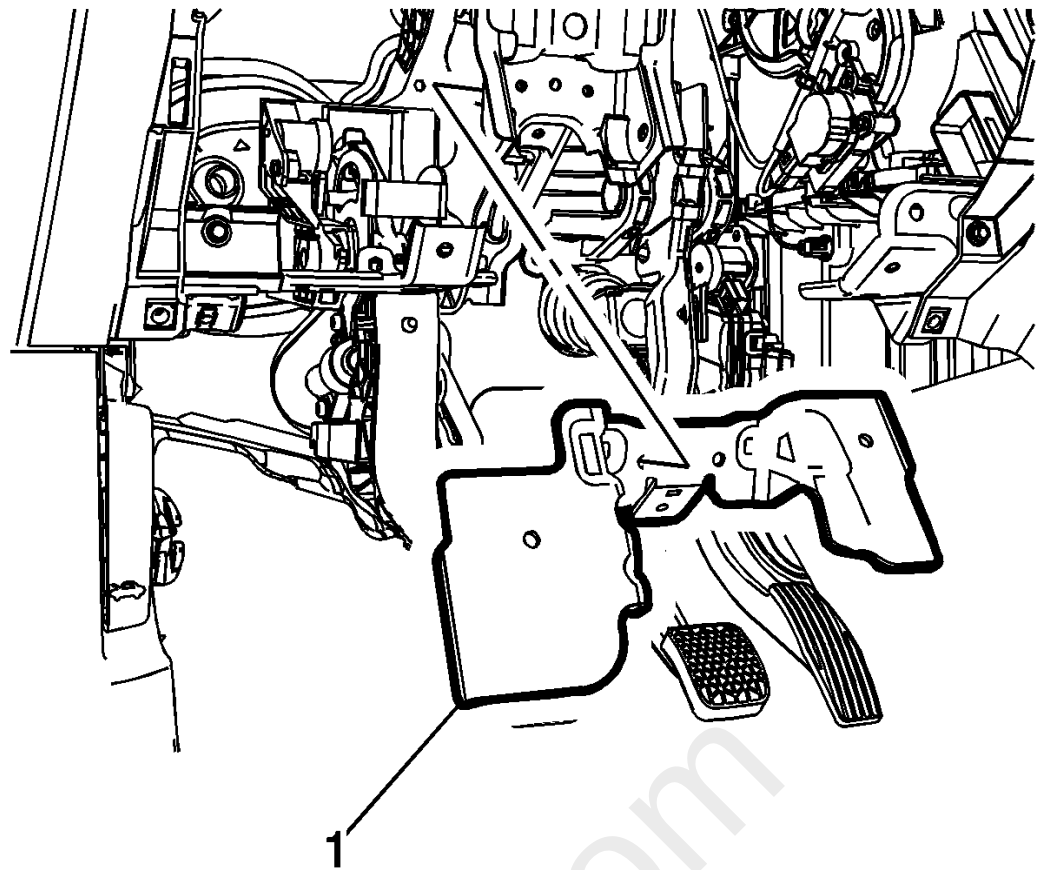


Fig. 35: Brake Pedal Release Bracket

Courtesy of GENERAL MOTORS COMPANY

8. Remove the brake pedal release bracket (1).
9. Remove the brake pedal position sensor. Refer to [Brake Pedal Position Sensor Replacement](#) .
10. On manual transmission equipped vehicles, remove the clutch pedal position sensor. Refer to [Clutch Pedal Position Sensor Replacement](#) .
11. Remove the accelerator pedal position sensor. Refer to [Accelerator Pedal Position Sensor Replacement](#) , or [Accelerator Pedal Position Sensor Replacement](#) .

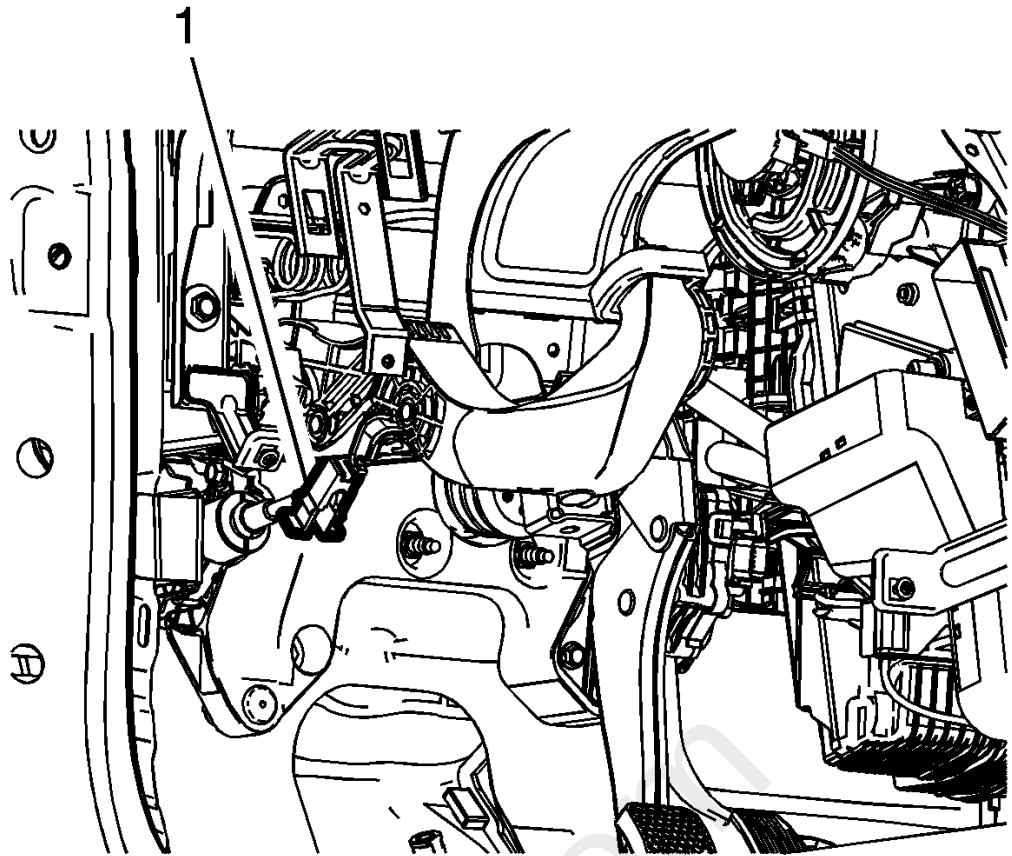


Fig. 36: Clutch Master Cylinder Pushrod Locking Tabs

Courtesy of GENERAL MOTORS COMPANY

12. On manual transmission equipped vehicles, compress the clutch master cylinder pushrod locking tabs (1) and release the clutch pedal by lifting the pedal upward.

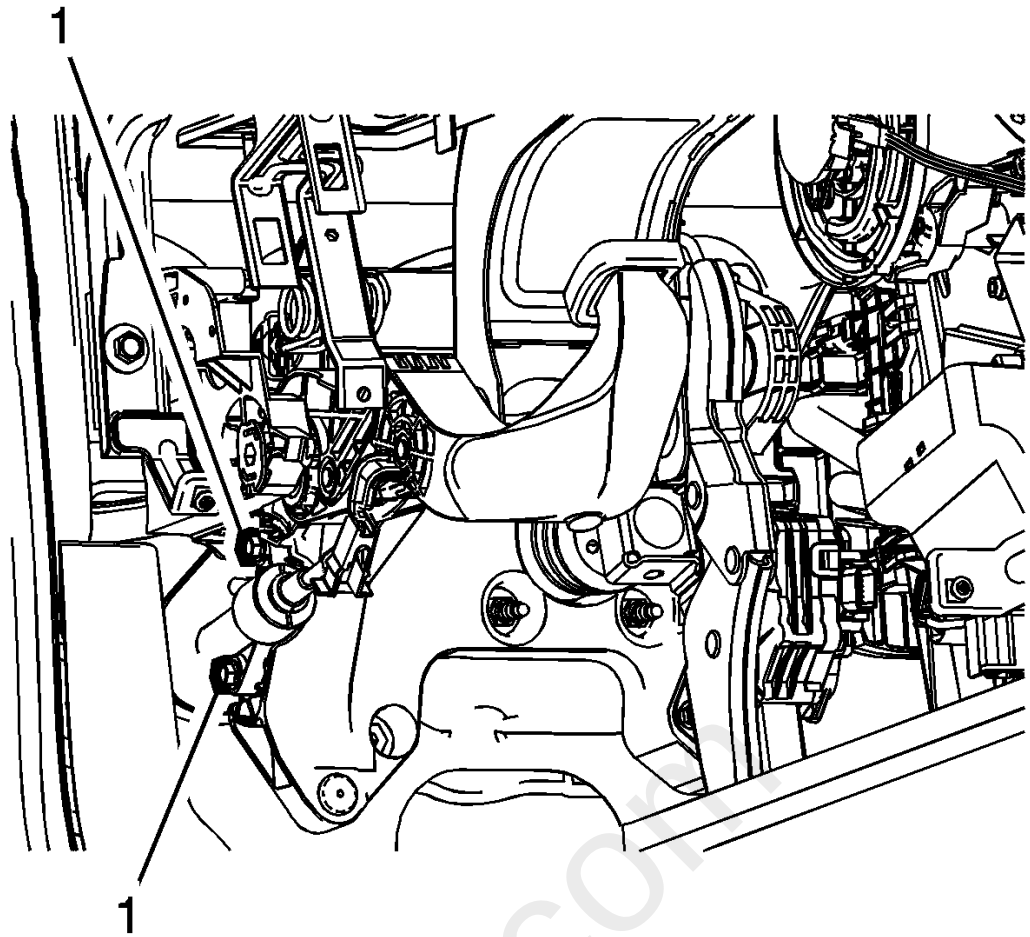


Fig. 37: Clutch Master Cylinder Bolts

Courtesy of GENERAL MOTORS COMPANY

13. On manual transmission equipped vehicles, remove the clutch master cylinder bolts (1) and position the clutch master cylinder aside. Refer to [Clutch Master Cylinder Replacement](#).
14. Position aside any wiring harnesses attached to the brake pedal assembly bracket, as necessary.

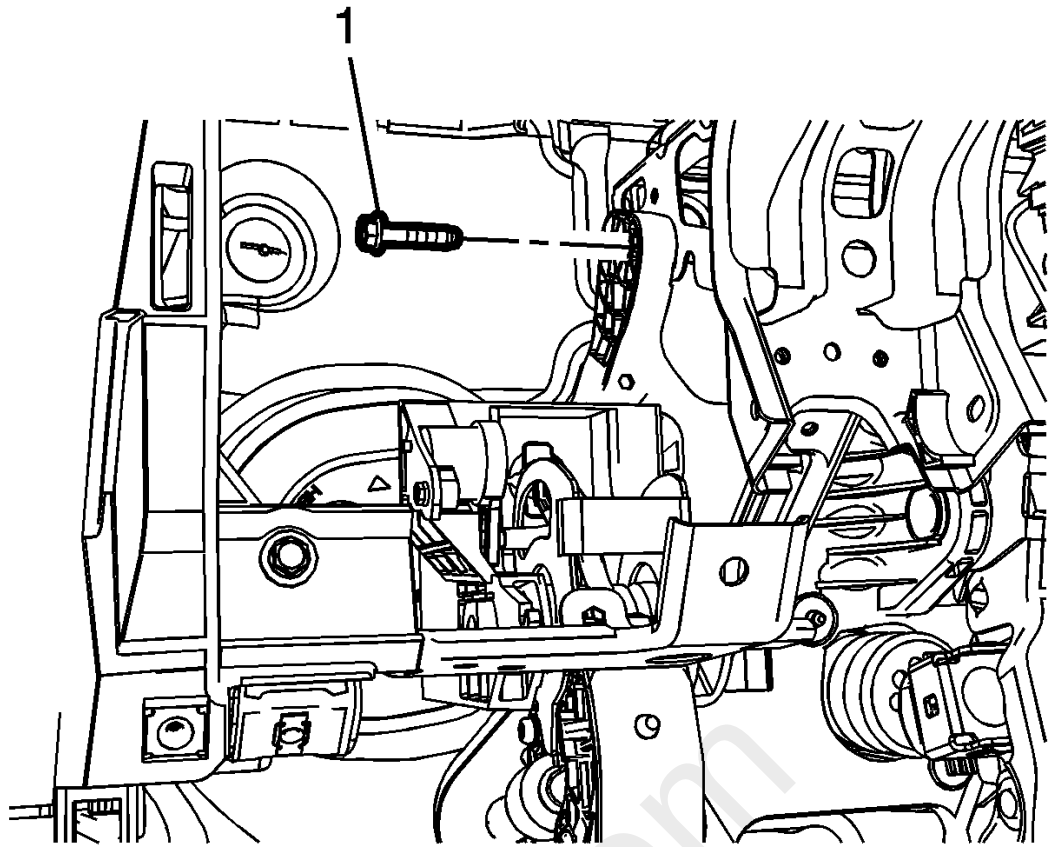


Fig. 38: Upper Brake Pedal Assembly Bolts
Courtesy of GENERAL MOTORS COMPANY

15. Remove the 2 upper brake pedal assembly bolts (1).

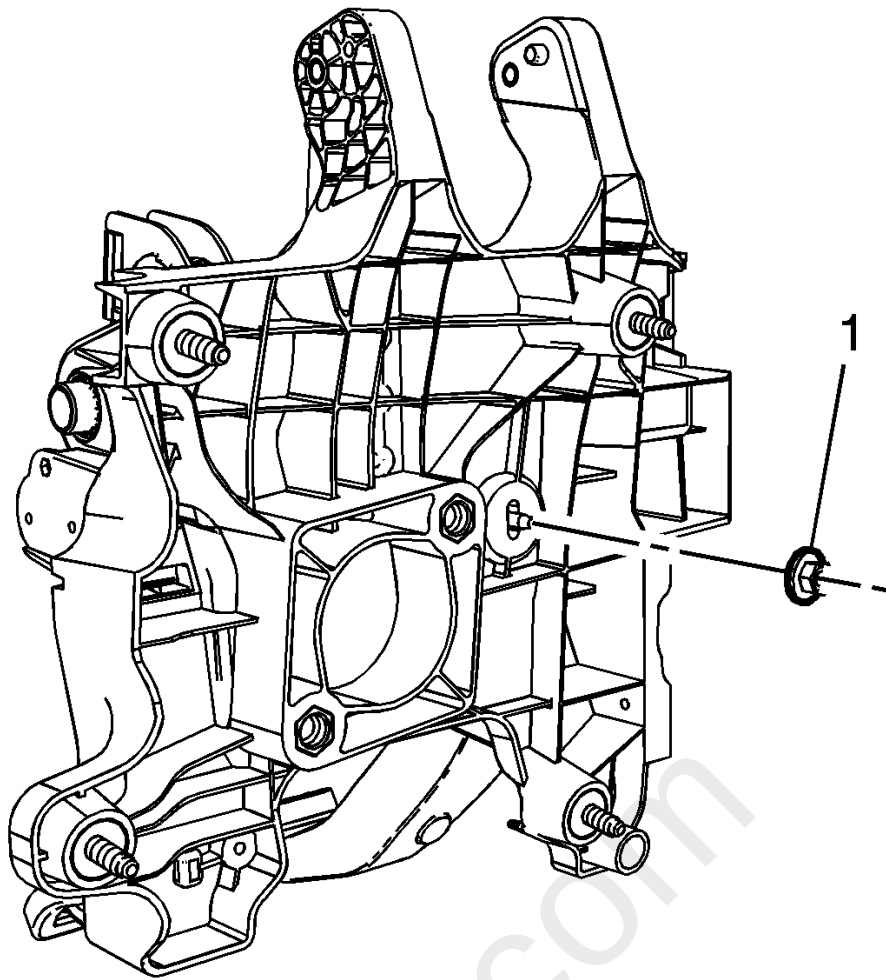


Fig. 39: Brake Pedal Assembly Bracket Nut
Courtesy of GENERAL MOTORS COMPANY

16. Pull the brake pedal assembly away from the dash panel.
17. From behind the brake pedal assembly, remove the brake pedal assembly bracket nut (1).

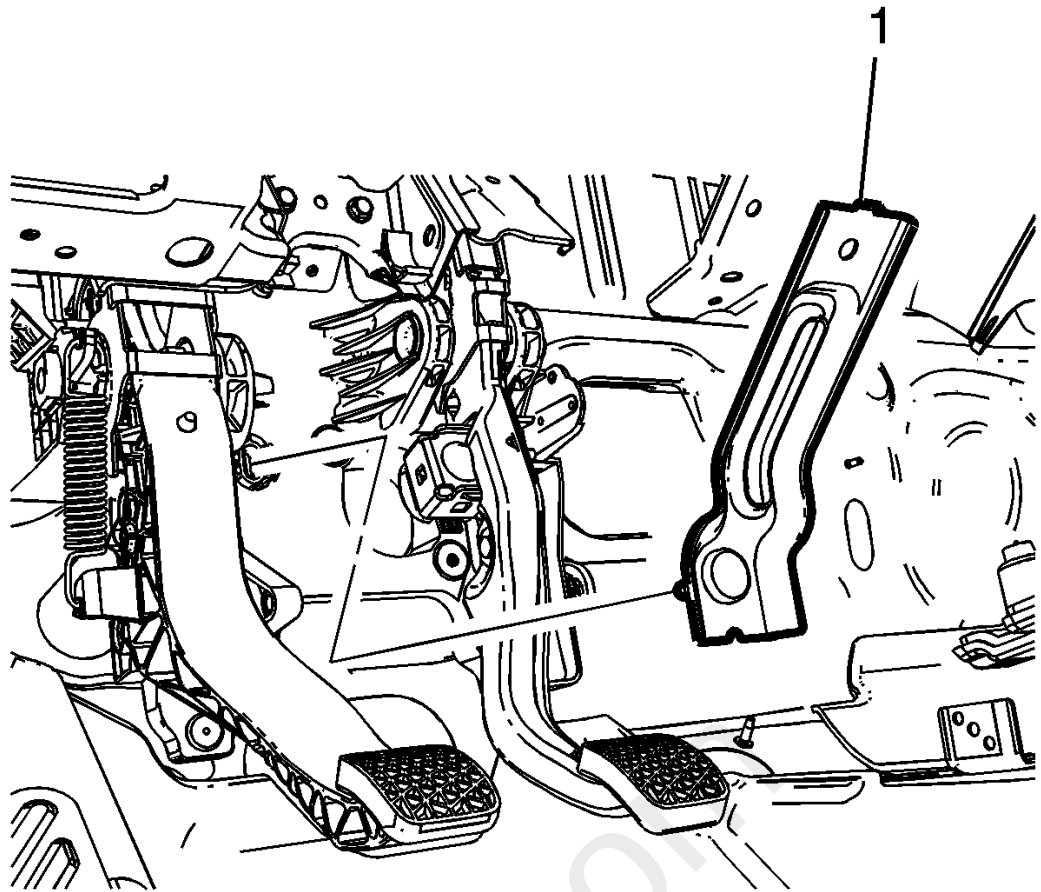


Fig. 40: Brake Pedal Assembly Bracket

Courtesy of GENERAL MOTORS COMPANY

18. Remove the brake pedal assembly bracket (1).
19. Remove the brake pedal assembly from the vehicle.
20. Remove any necessary components from the brake pedal assembly.

Installation Procedure

1. Install any removed components from the brake pedal assembly.
2. Install the brake pedal assembly to the vehicle.

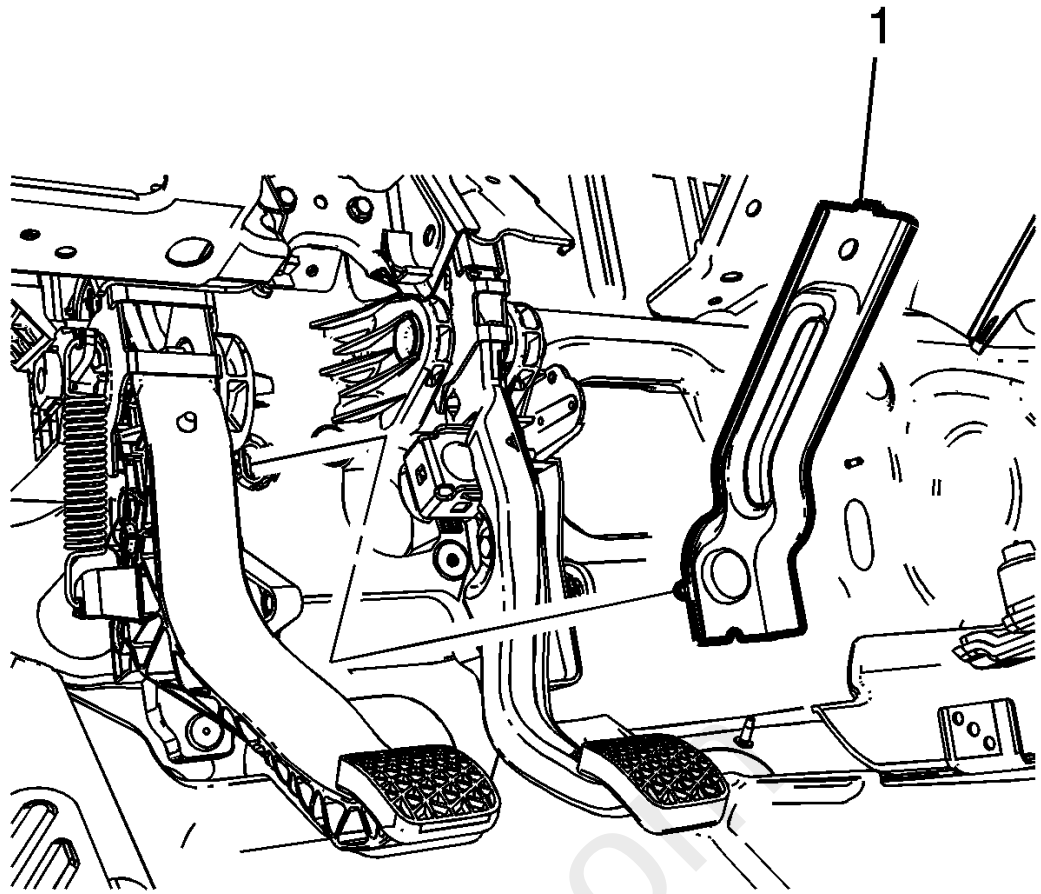


Fig. 41: Brake Pedal Assembly Bracket
Courtesy of GENERAL MOTORS COMPANY

3. Install the brake pedal assembly bracket (1).

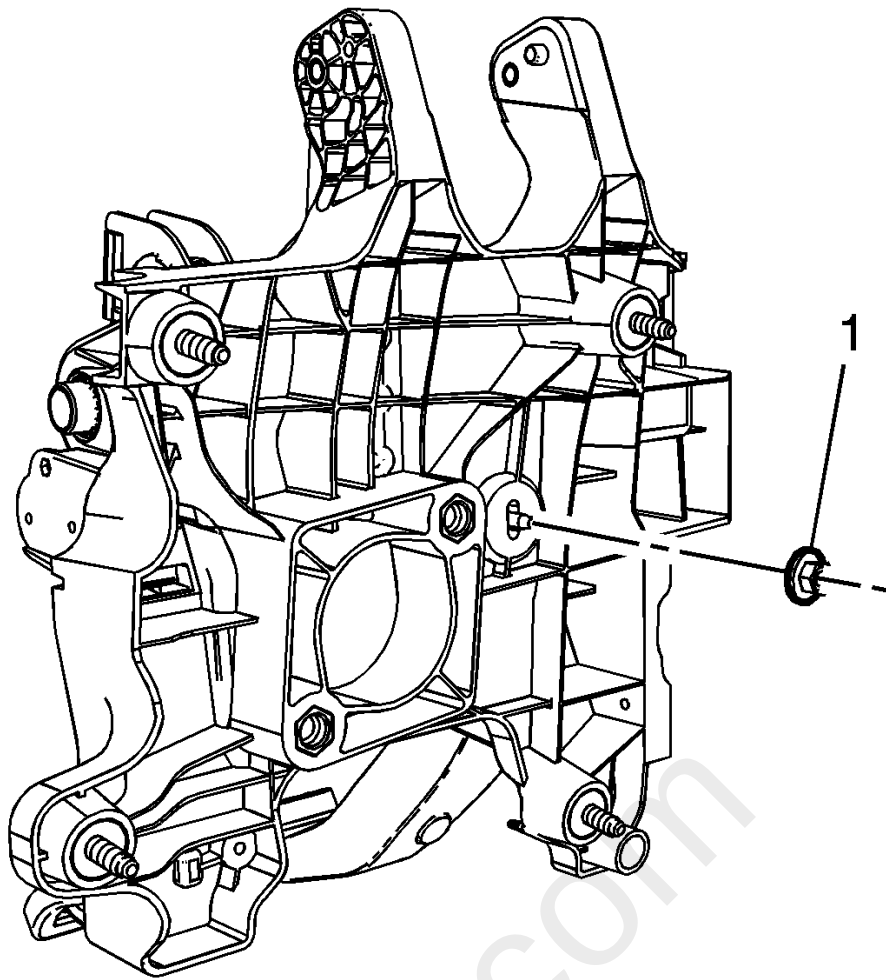


Fig. 42: Brake Pedal Assembly Bracket Nut
Courtesy of GENERAL MOTORS COMPANY

4. Pull the brake pedal assembly away from the dash panel.

CAUTION: Refer to **Fastener Caution** .

5. From behind the brake pedal assembly, install the brake pedal assembly bracket nut (1) and tighten to 9 N.m (80 lb in).

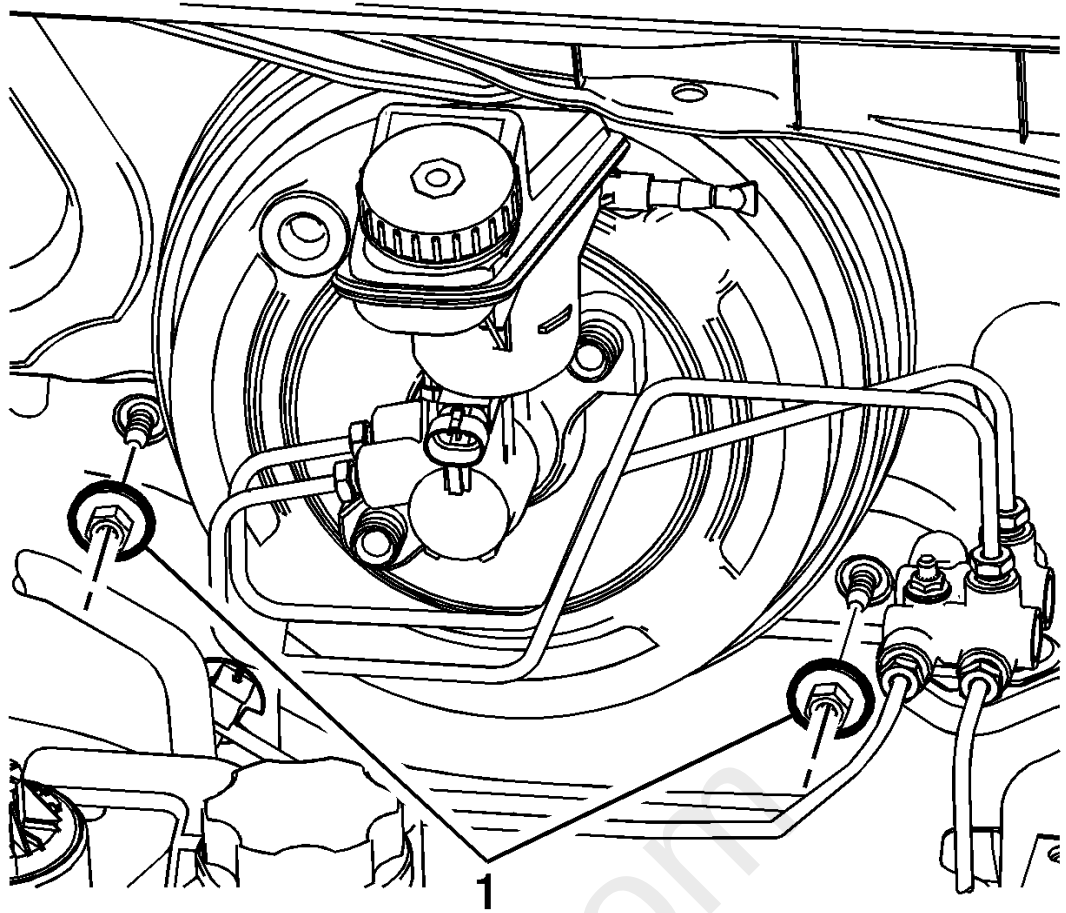


Fig. 43: Brake Pedal Assembly Lower Nuts
Courtesy of GENERAL MOTORS COMPANY

6. Install the brake pedal assembly lower nuts (1) and tighten to 19 N.m (14 lb ft).

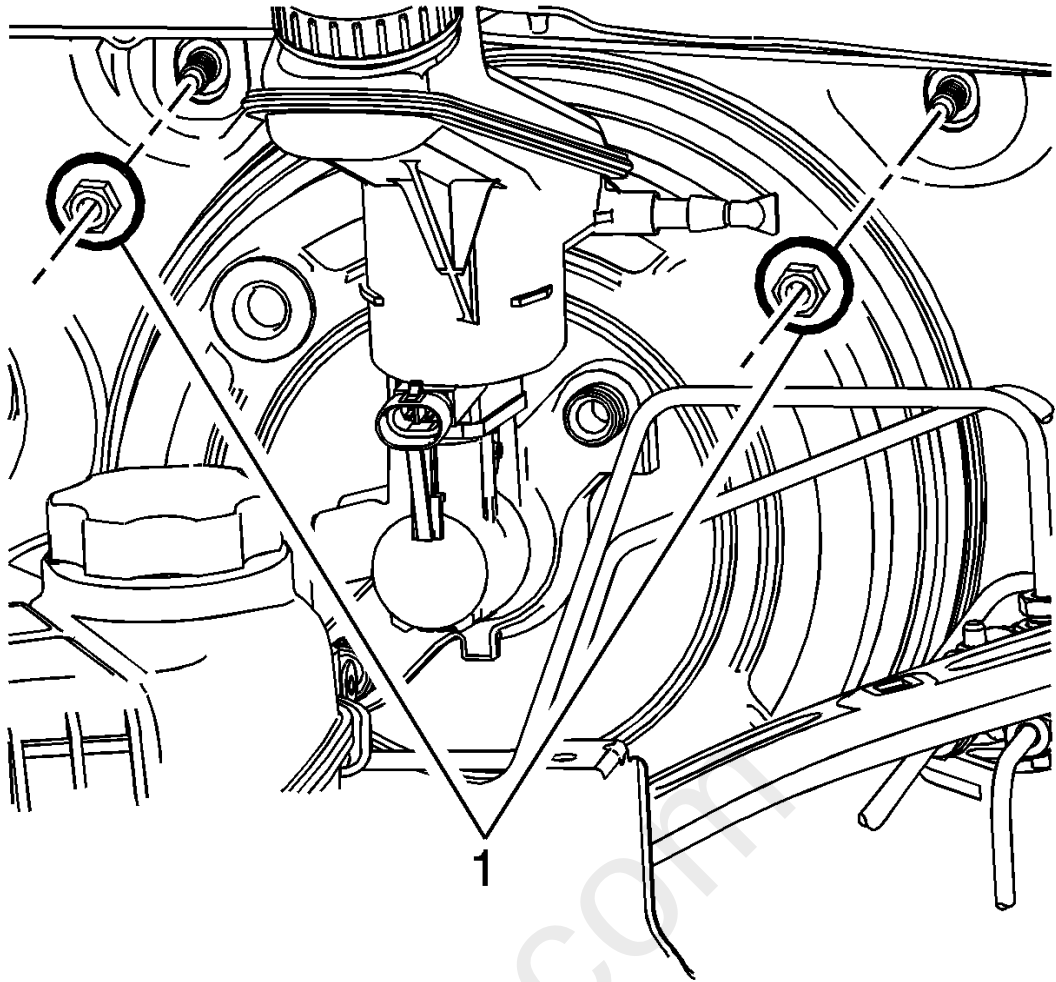


Fig. 44: Brake Pedal Assembly Upper Nuts
Courtesy of GENERAL MOTORS COMPANY

7. Install the brake pedal assembly upper nuts (1) and tighten to 19 N.m (14 lb ft).

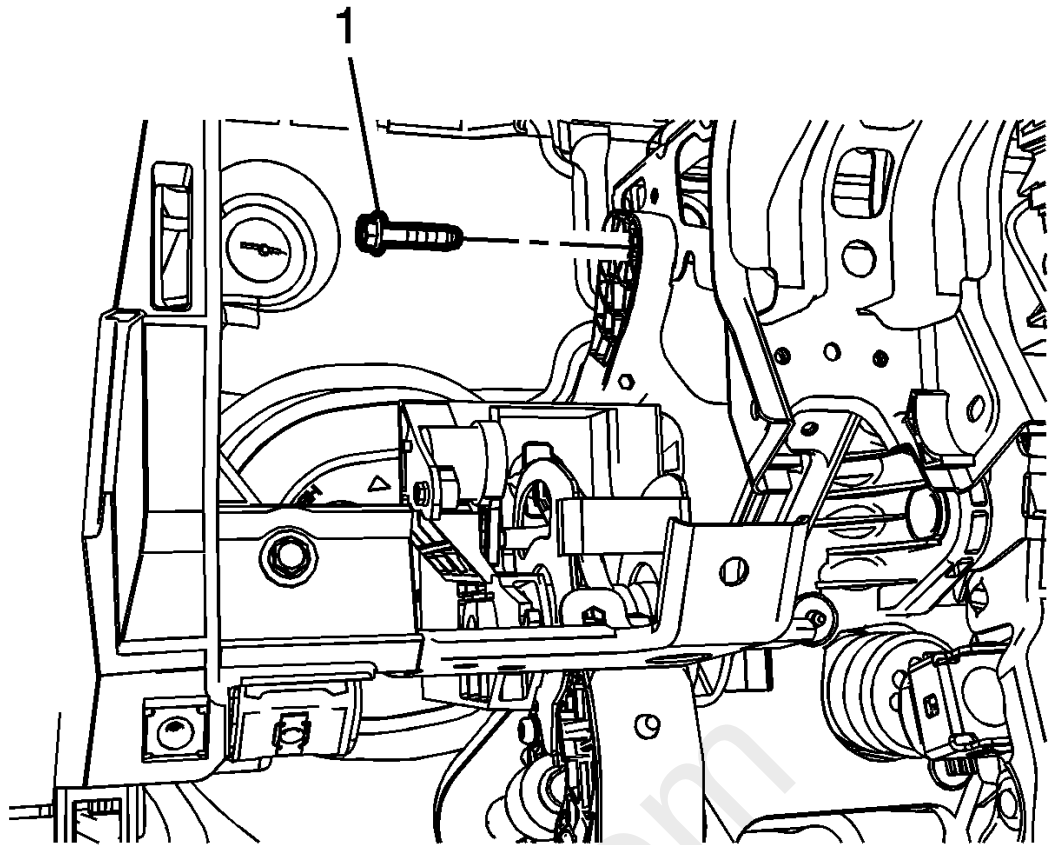


Fig. 45: Upper Brake Pedal Assembly Bolts
Courtesy of GENERAL MOTORS COMPANY

8. Install the 2 upper brake pedal assembly bolts (1) and tighten to 9 N.m (80 lb in).
9. Reposition any wiring harnesses attached to the brake pedal assembly bracket, as necessary.

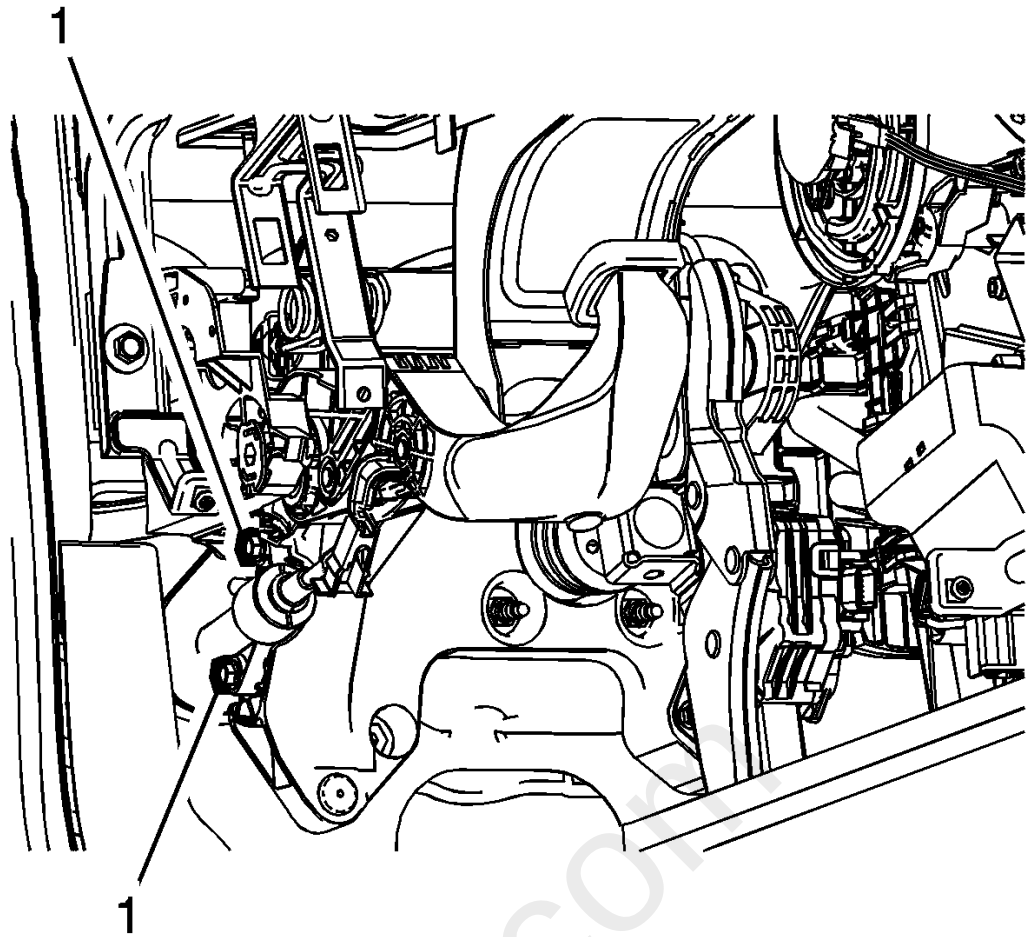


Fig. 46: Clutch Master Cylinder Bolts

Courtesy of GENERAL MOTORS COMPANY

10. On manual transmission equipped vehicles, install the clutch master cylinder and bolts (1). Refer to [Clutch Master Cylinder Replacement](#).

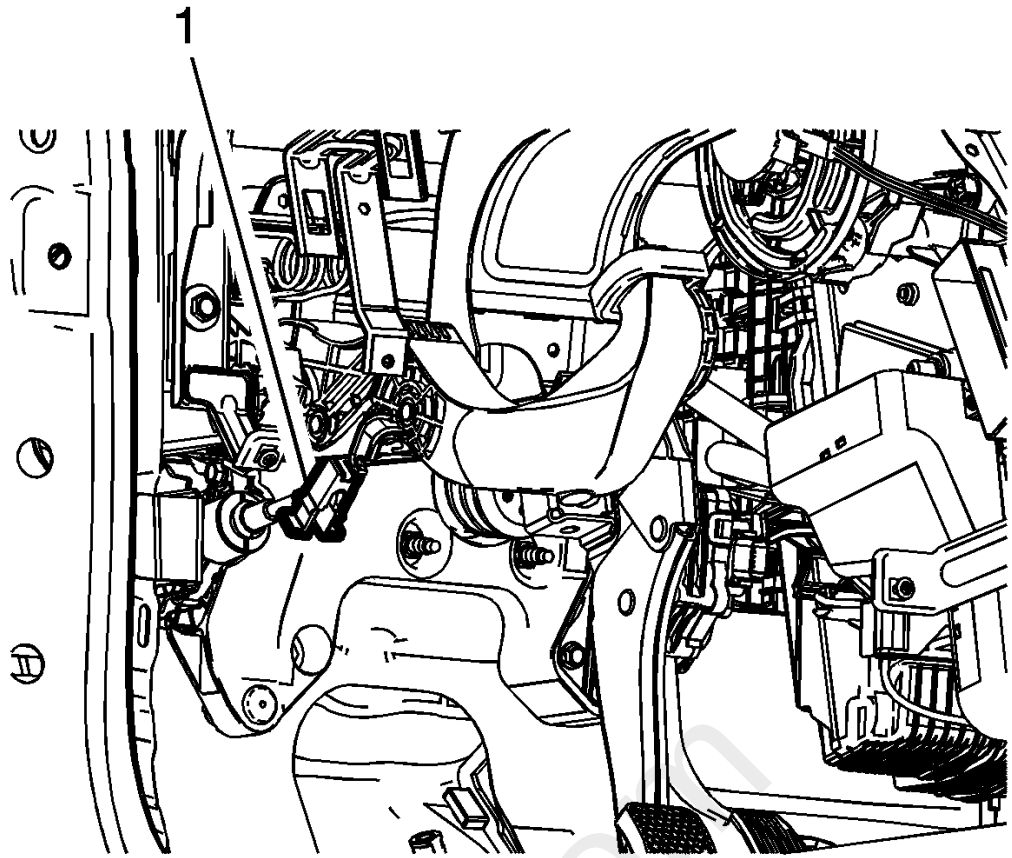


Fig. 47: Clutch Master Cylinder Pushrod Locking Tabs

Courtesy of GENERAL MOTORS COMPANY

11. On manual transmission equipped vehicles, compress the clutch master cylinder pushrod locking tabs (1) and install the clutch pedal to the clutch master cylinder pushrod.
12. Install the brake pedal position sensor. Refer to [**Brake Pedal Position Sensor Replacement**](#) .
13. On manual transmission equipped vehicles, install the clutch pedal position sensor. Refer to [**Clutch Pedal Position Sensor Replacement**](#) .
14. Install the accelerator pedal position sensor. Refer to [**Accelerator Pedal Position Sensor Replacement**](#) , or [**Accelerator Pedal Position Sensor Replacement**](#) .

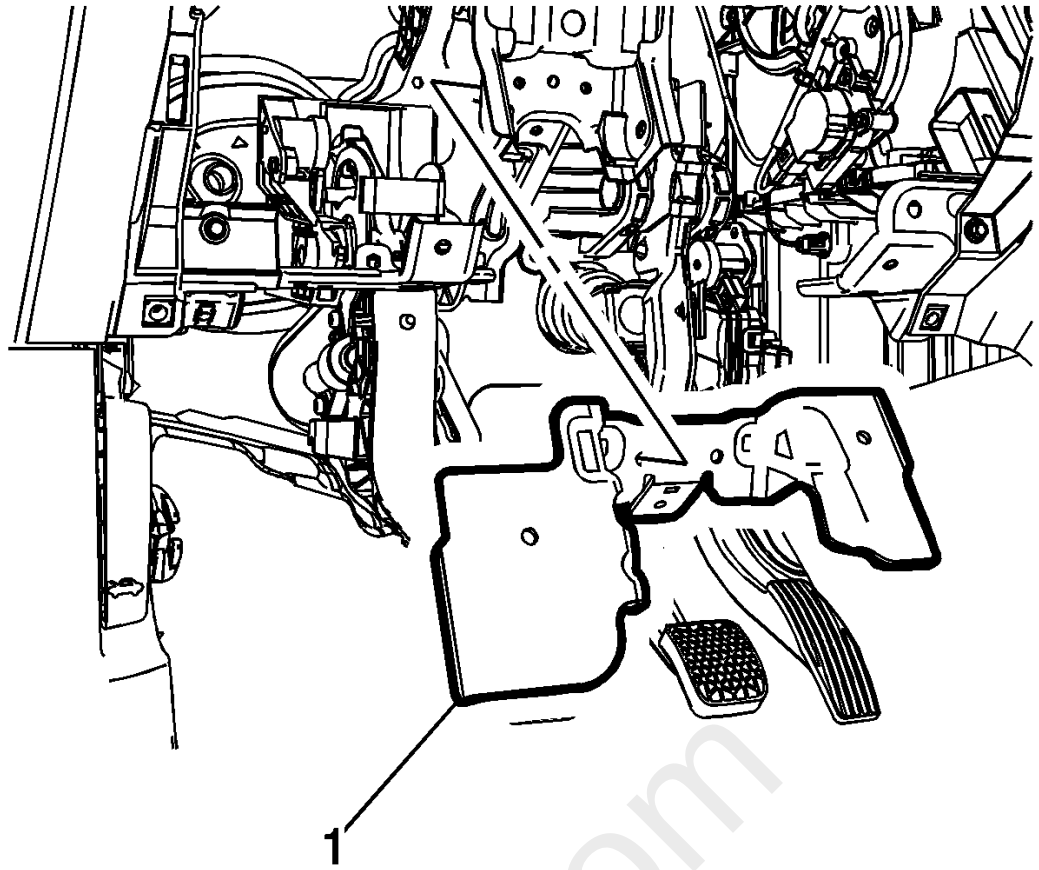


Fig. 48: Brake Pedal Release Bracket

Courtesy of GENERAL MOTORS COMPANY

15. Install the brake pedal release bracket (1).

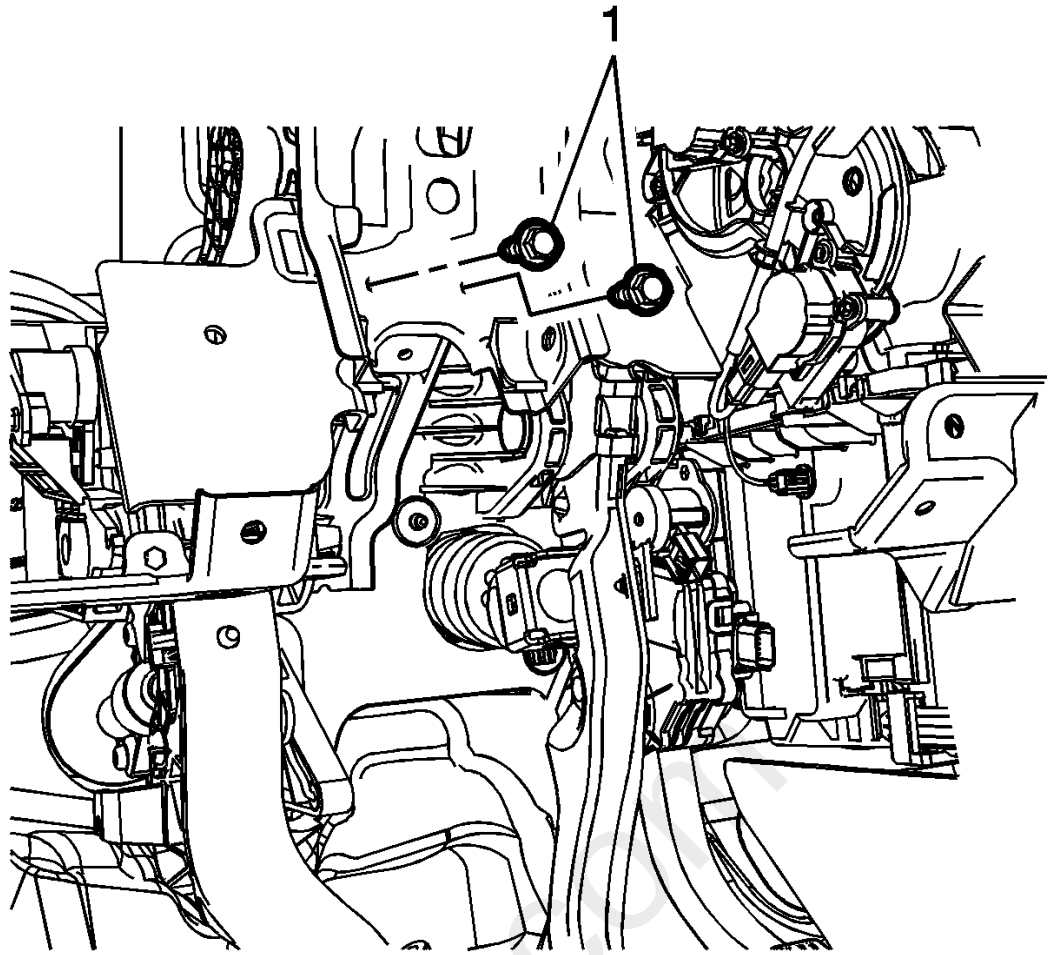


Fig. 49: Brake Pedal Release Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

16. Install the brake pedal release bracket bolts (1) and tighten to 22 N.m (16 lb ft).

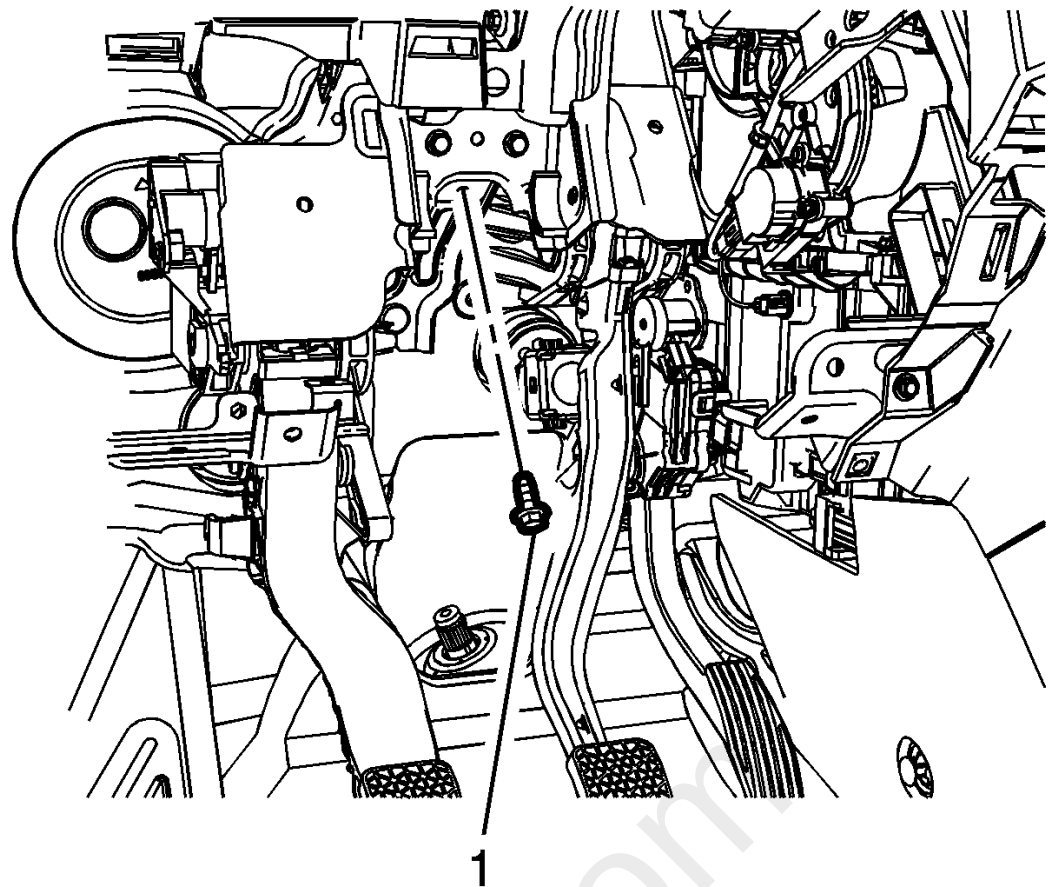


Fig. 50: Brake Pedal Release Bracket Bolt
 Courtesy of GENERAL MOTORS COMPANY

17. Install the brake pedal release bracket bolt (1) and tighten to 22 N.m (16 lb ft).
18. Connect the brake pedal position sensor electrical connector.
19. Install the steering column. Refer to [Steering Column Replacement \(Buick, Mexico, NJ1, With BTM, With N06\)](#) [Steering Column Replacement \(Buick, Canada/United States, NJ1, With BTM, Without N06\)](#) [Steering Column Replacement \(Chevrolet, Mexico, NJ1, With BTM, With N06\)](#) [Steering Column Replacement \(Chevrolet, Canada/United States, NJ1, With BTM, Without N06\)](#) [Steering Column Replacement \(Chevrolet, Canada/United States, NJ1, Without BTM, Without N06\)](#) [Steering Column Replacement \(Chevrolet, Mexico, NJ1, Without BTM, Without N06\)](#) [Steering Column Replacement \(Mexico, N40\)](#) .

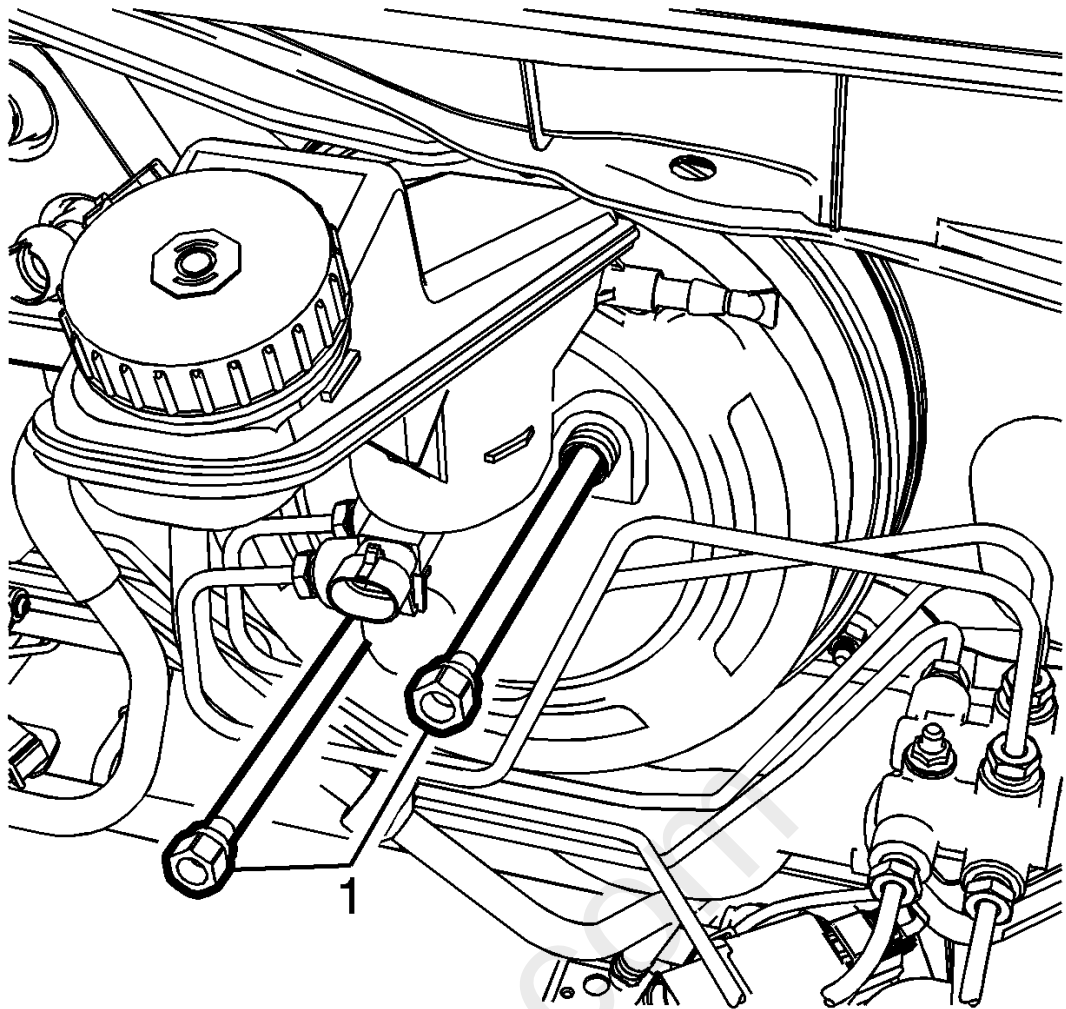


Fig. 51: Power Vacuum Brake Booster Bolts
Courtesy of GENERAL MOTORS COMPANY

20. Install the power vacuum brake booster bolts (1) and tighten to 19 N.m (14 lb ft).
21. Install the battery tray. Refer to [Battery Tray Replacement](#) .

BRAKE PROPORTION VALVE REPLACEMENT

Removal Procedure

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

1. Remove the battery. Refer to [Battery Replacement](#) .
2. Clean the area surrounding the proportion valve of any accumulated dirt and debris.

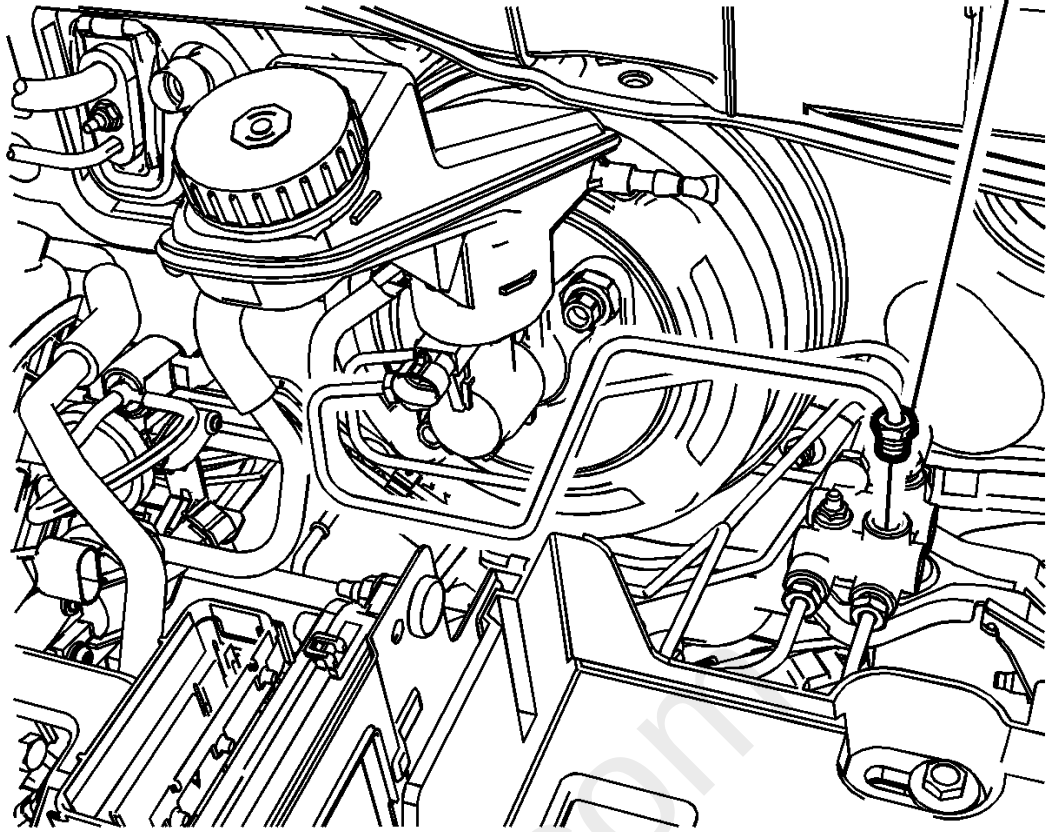


Fig. 52: Master Cylinder Secondary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the master cylinder secondary brake pipe fitting (1) from the brake proportion valve.
4. Cap the brake pipe fitting and plug the proportion valve inlet port to prevent brake fluid loss and contamination.

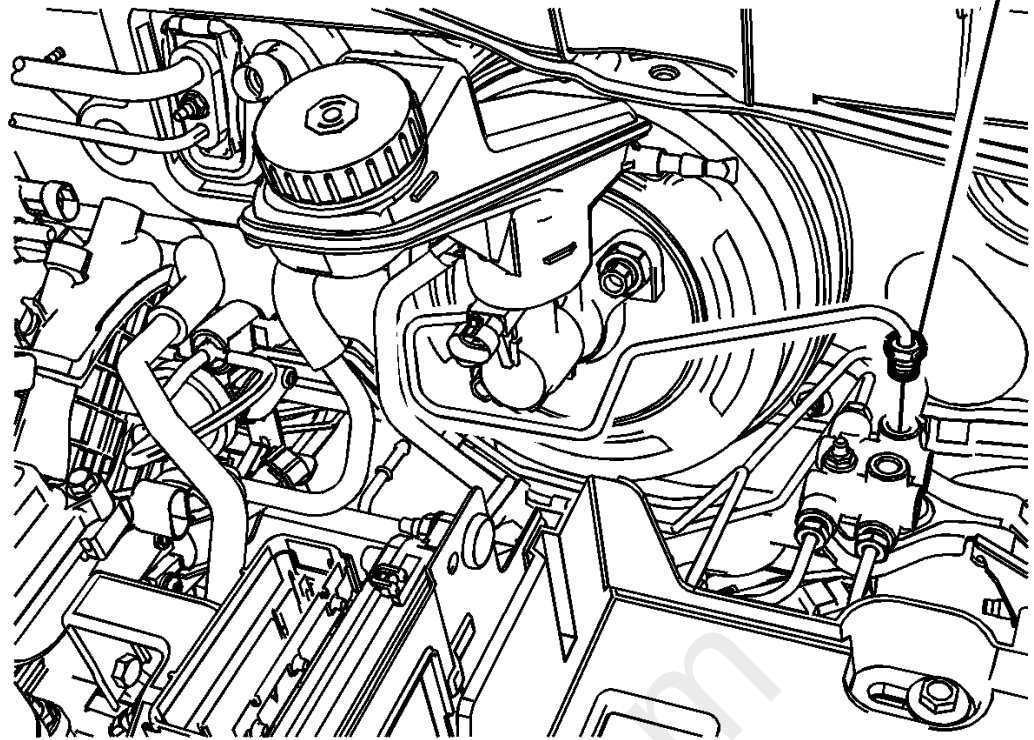


Fig. 53: Master Cylinder Primary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the master cylinder primary brake pipe fitting (1) from the brake proportion valve.
6. Cap the brake pipe fitting and plug the proportion valve inlet port to prevent brake fluid loss and contamination.

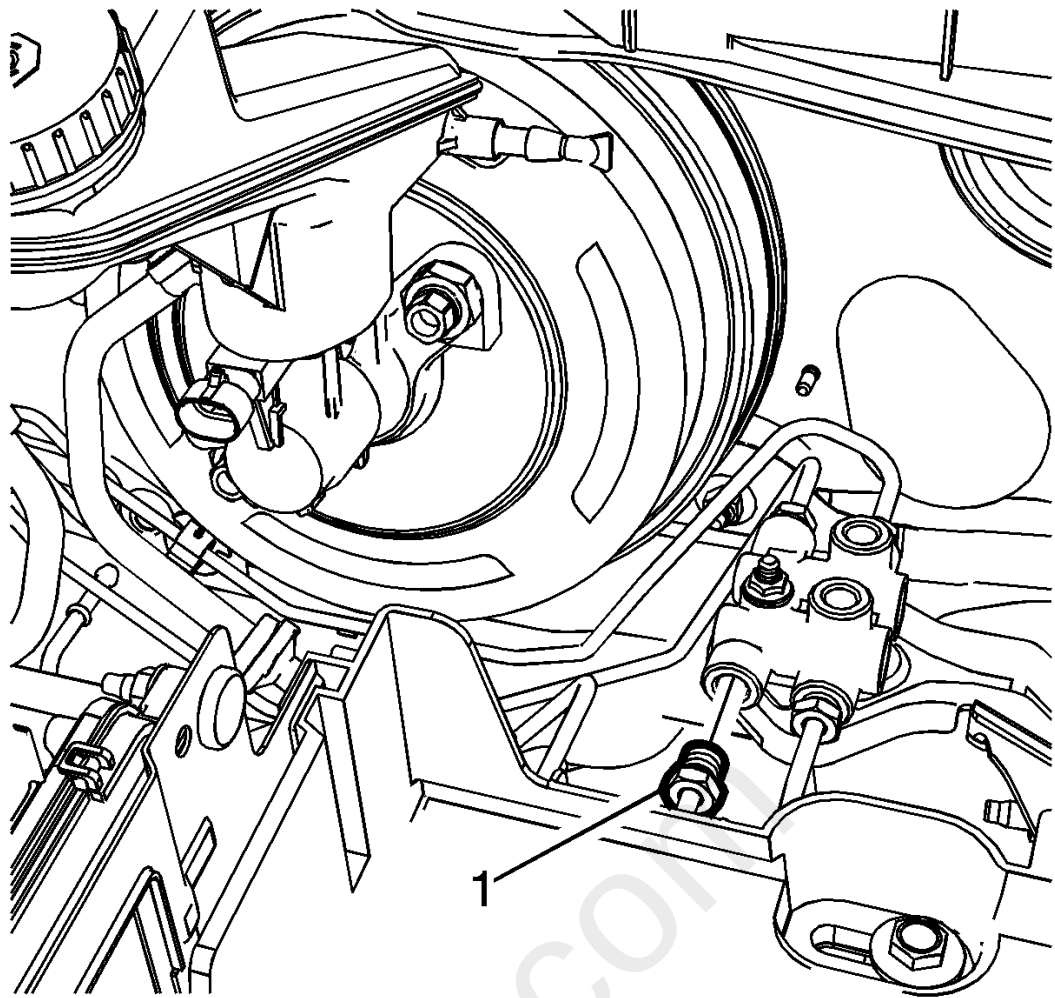


Fig. 54: Master Cylinder Right Rear Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

7. Disconnect the right rear brake pipe fitting (1).
8. Cap the brake pipe fitting and plug the proportion valve outlet port to prevent brake fluid loss and contamination.

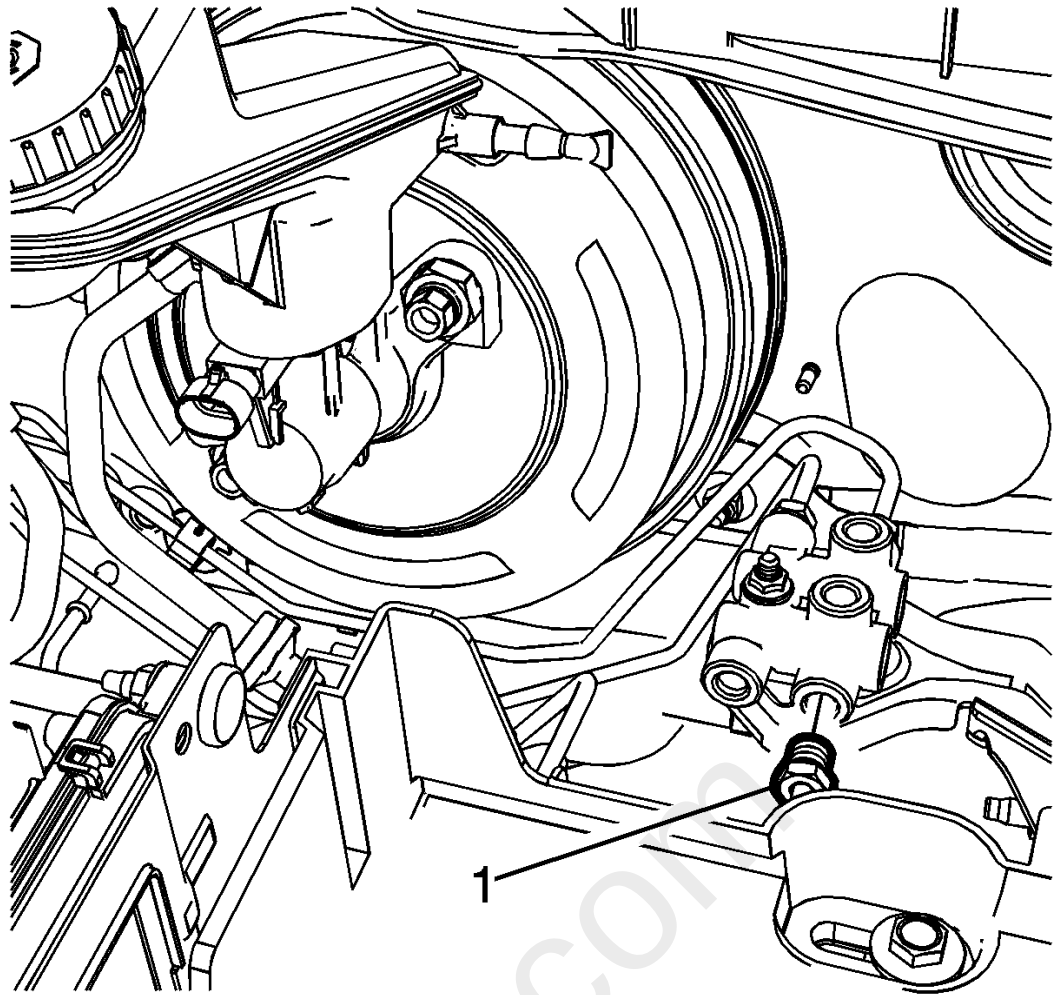


Fig. 55: Master Cylinder Left Front Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

9. Disconnect the left front brake pipe fitting (1).
10. Cap the brake pipe fitting and plug the proportion valve outlet port to prevent brake fluid loss and contamination.

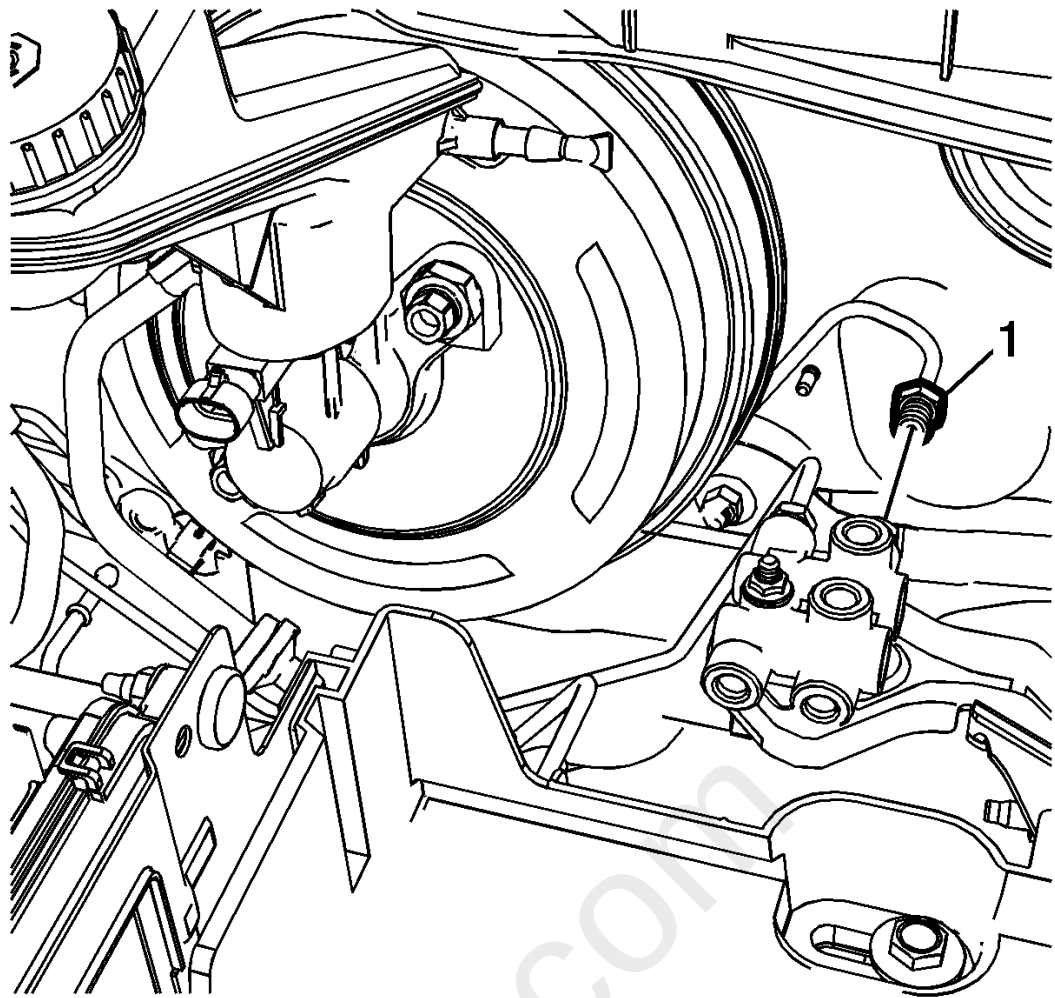


Fig. 56: Master Cylinder Right Front Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

11. Disconnect the right front brake pipe fitting (1).
12. Cap the brake pipe fitting and plug the proportion valve outlet port to prevent brake fluid loss and contamination.

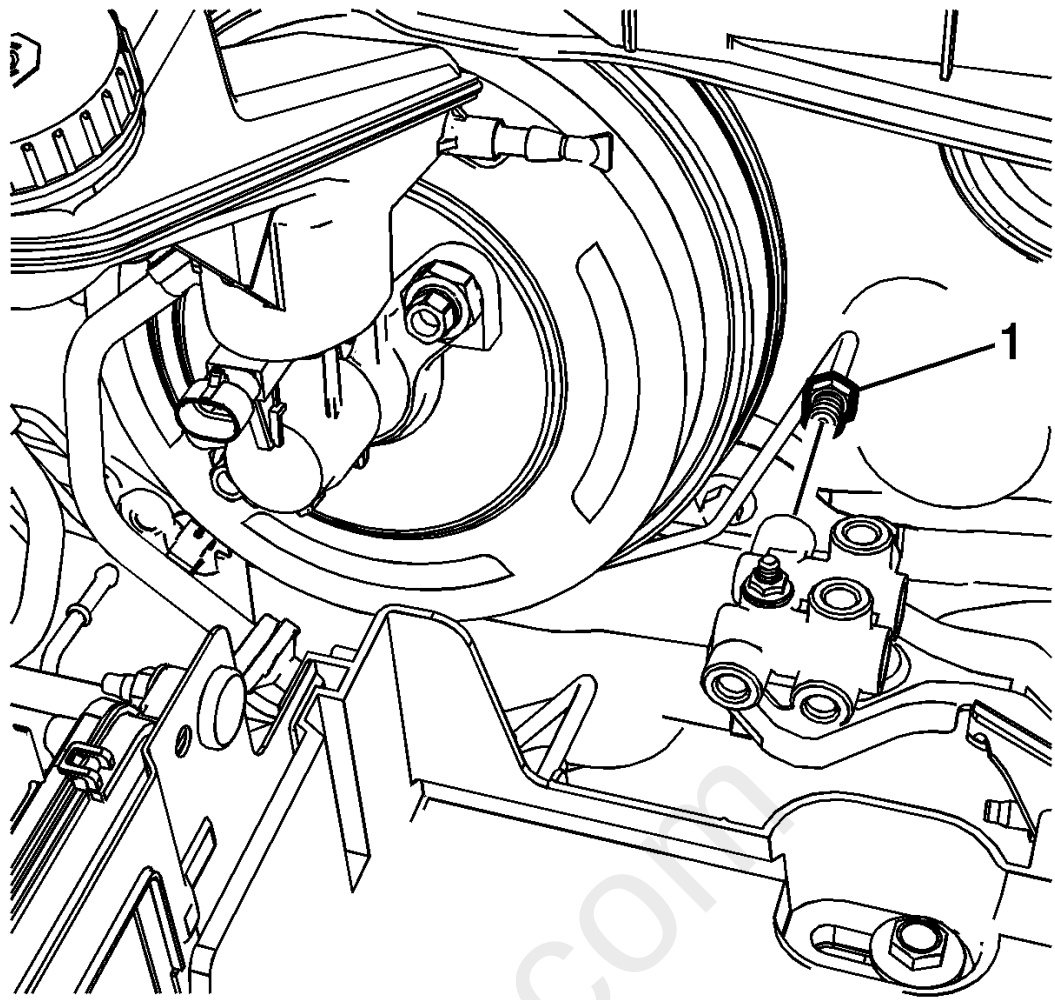


Fig. 57: Master Cylinder Left Rear Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

13. Disconnect the left rear brake pipe fitting (1).
14. Cap the brake pipe fitting and plug the proportion valve outlet port to prevent brake fluid loss and contamination.

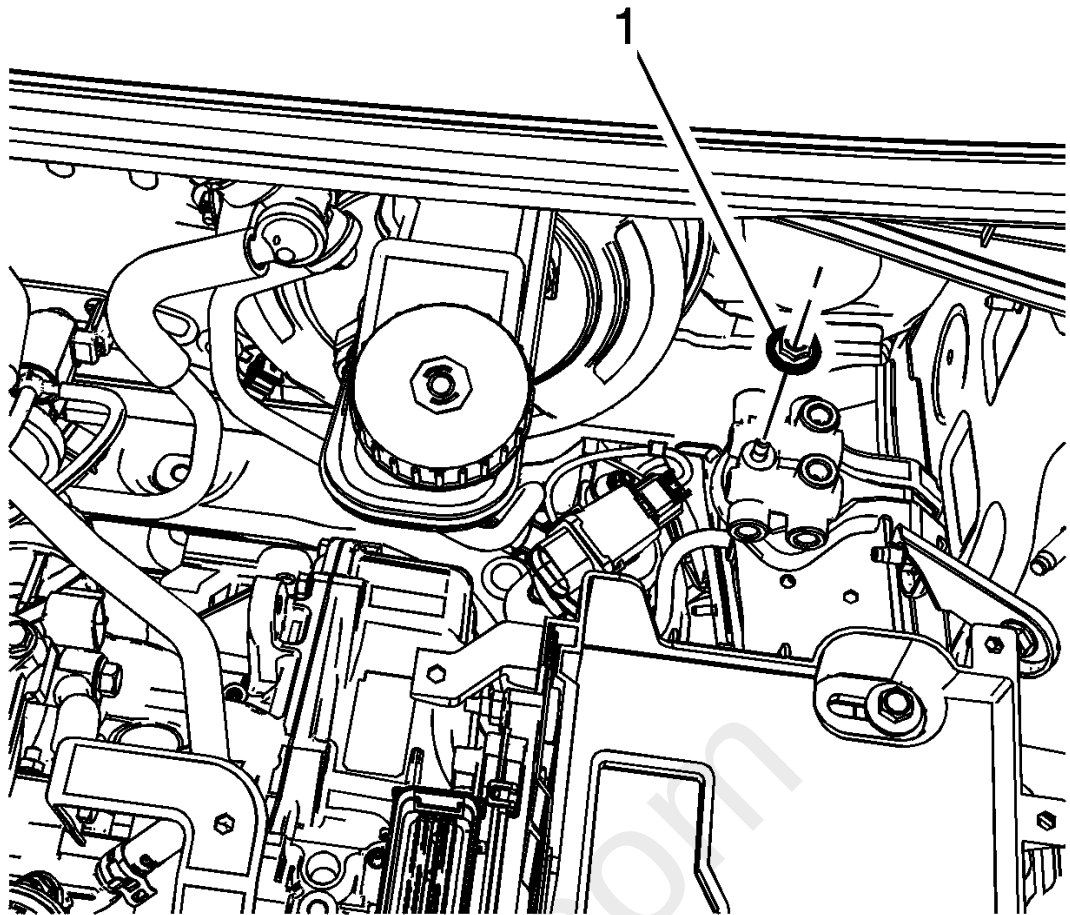


Fig. 58: Proportion Valve Nut

Courtesy of GENERAL MOTORS COMPANY

15. Remove the proportion valve nut (1).

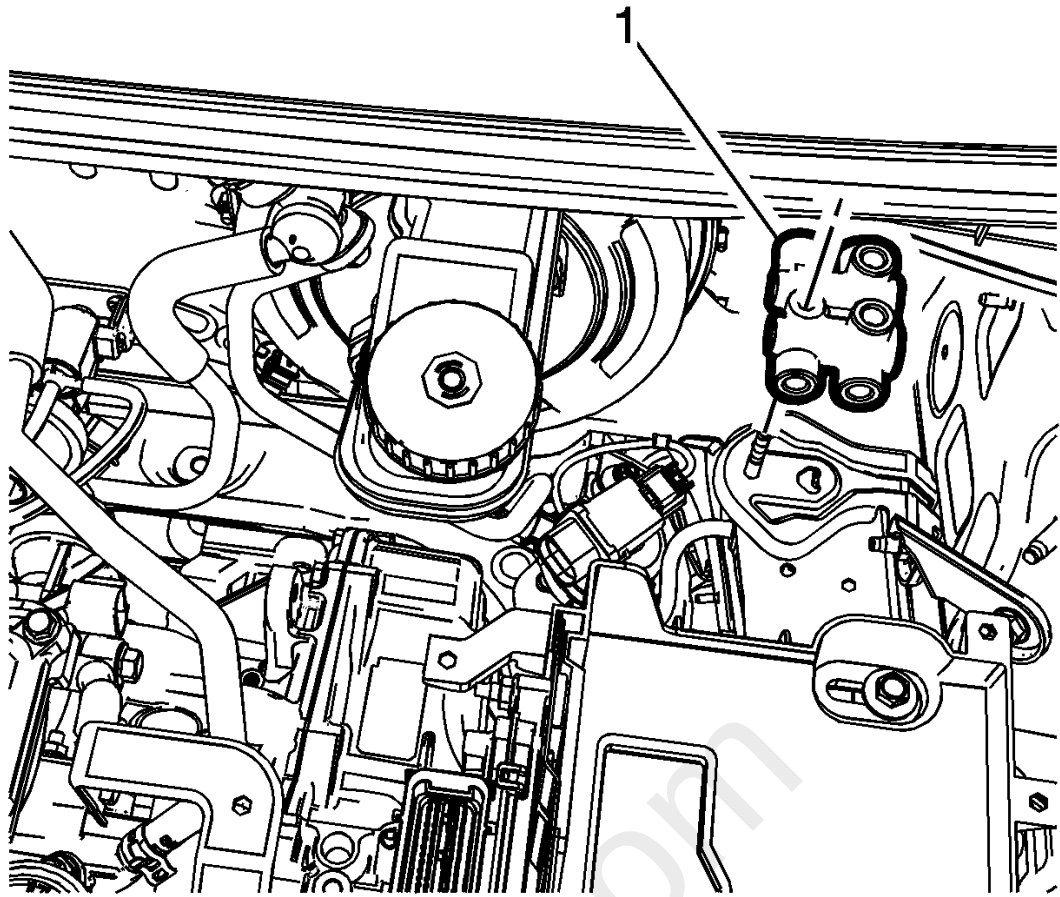


Fig. 59: Proportion Valve

Courtesy of GENERAL MOTORS COMPANY

16. Remove the proportion valve (1).

Installation Procedure

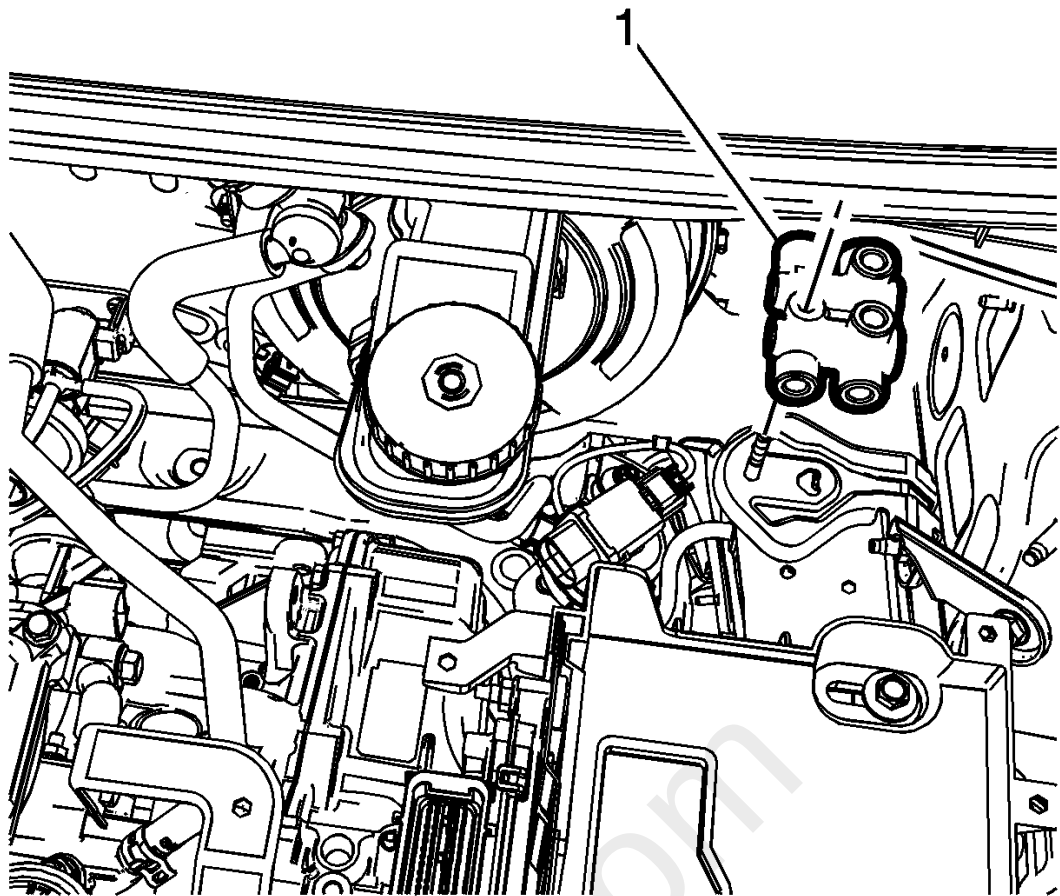


Fig. 60: Proportion Valve

Courtesy of GENERAL MOTORS COMPANY

1. Install the proportion valve (1).

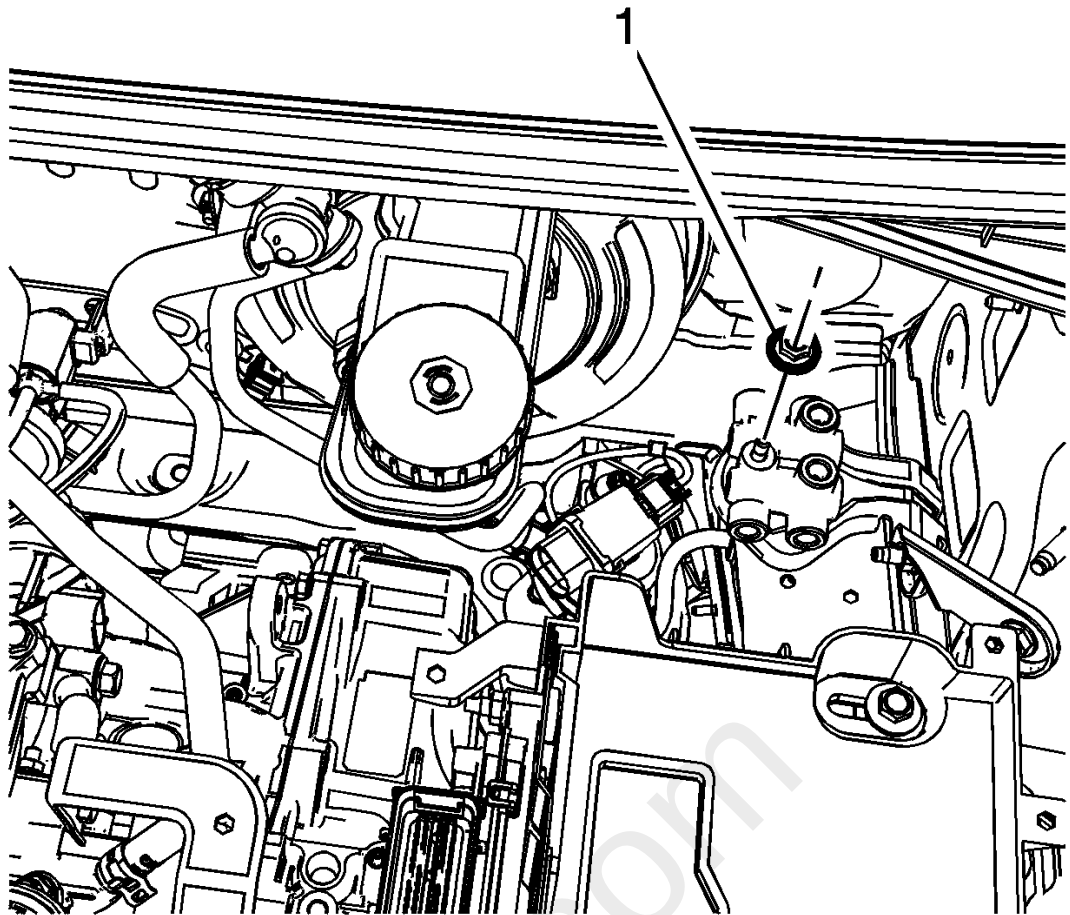


Fig. 61: Proportion Valve Nut

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

2. Install the proportion valve nut (1) and tighten to 15 N.m (11 lb ft).

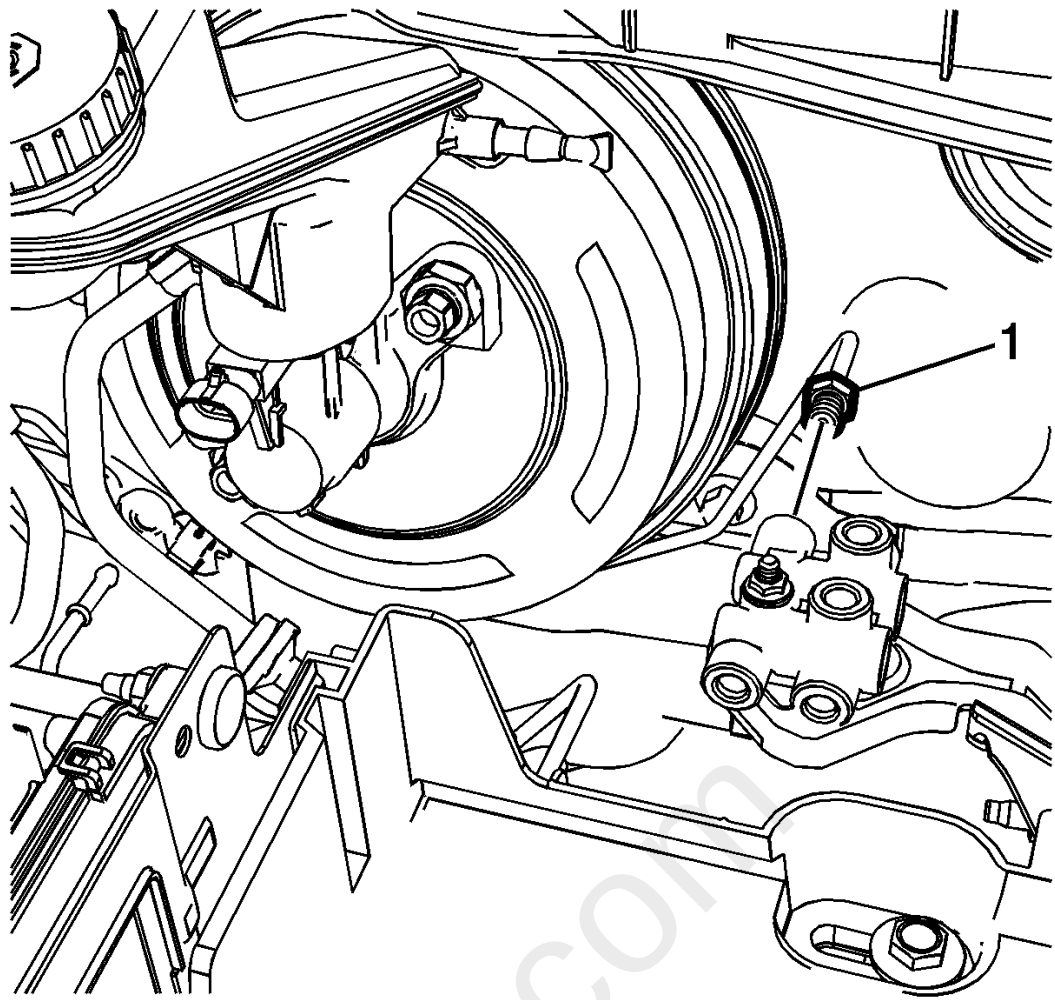


Fig. 62: Master Cylinder Left Rear Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

3. Connect the left rear brake pipe fitting (1) and tighten to 18 N.m (13 lb ft).

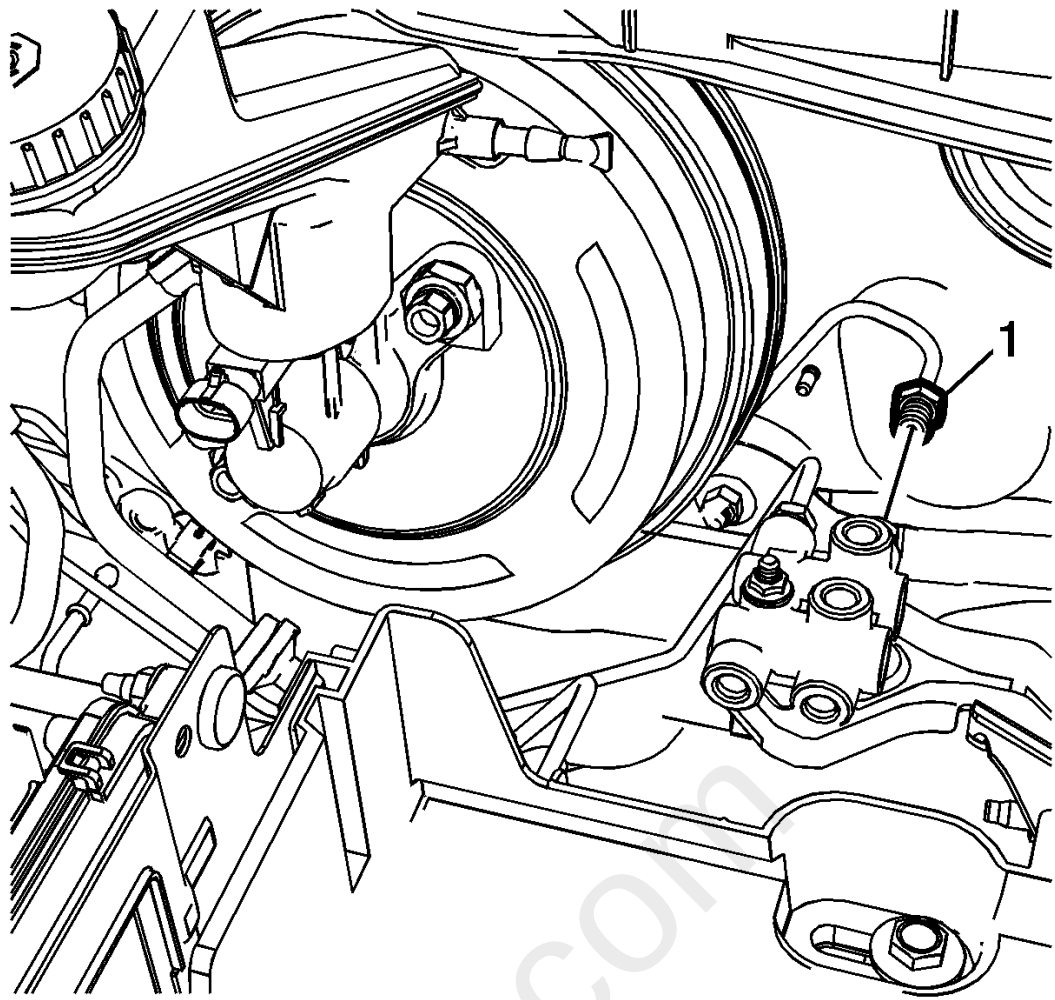


Fig. 63: Master Cylinder Right Front Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

4. Connect the right front brake pipe fitting (1) and tighten to 18 N.m (13 lb ft).

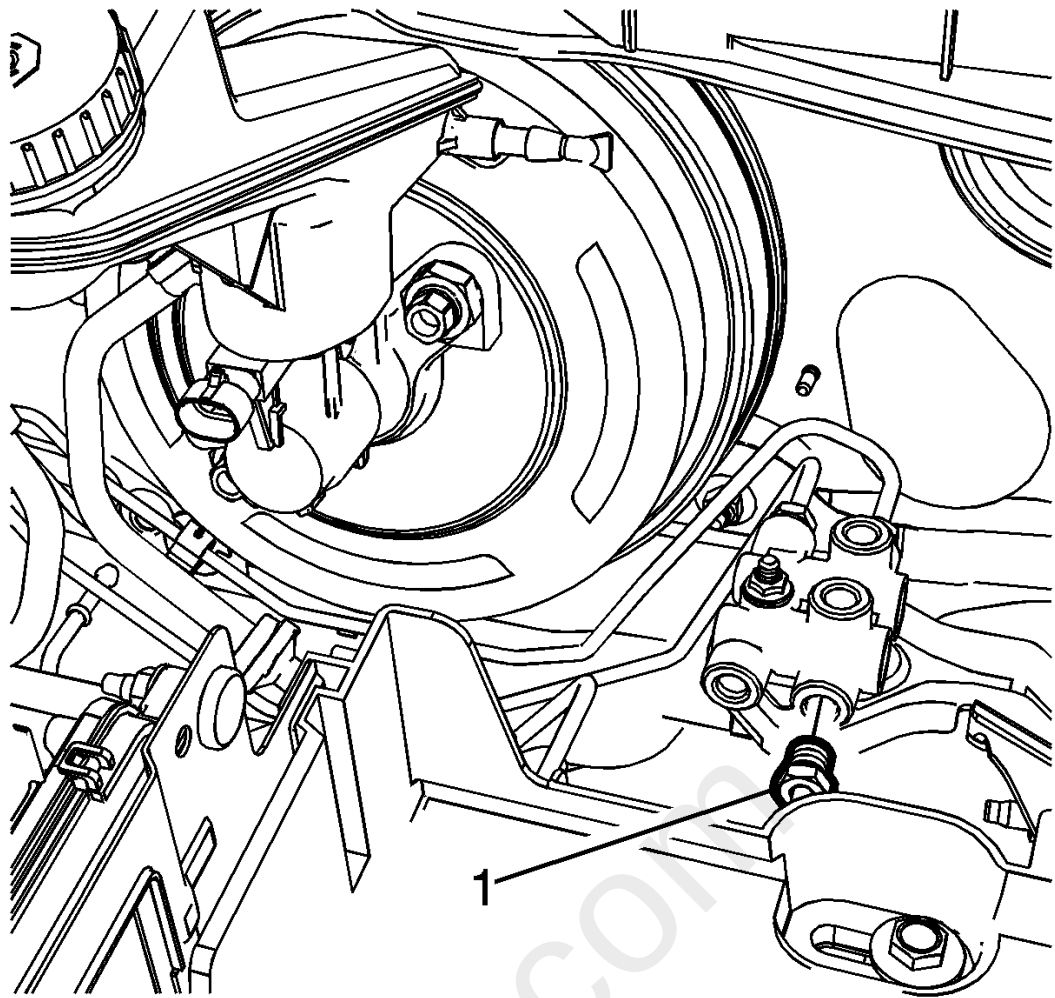


Fig. 64: Master Cylinder Left Front Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

5. Connect the left front brake pipe fitting (1) and tighten to 18 N.m (13 lb ft).

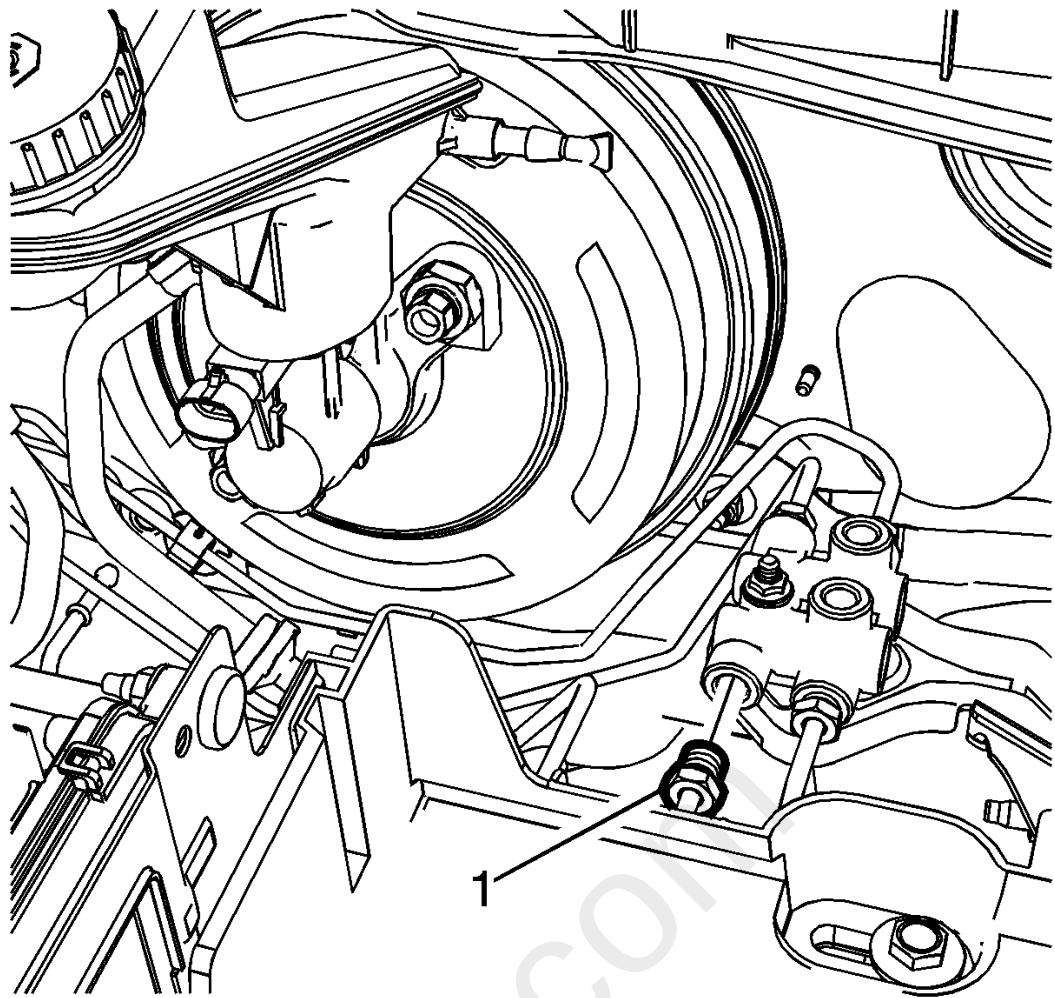


Fig. 65: Master Cylinder Right Rear Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

6. Connect the right rear brake pipe fitting (1) and tighten to 18 N.m (13 lb ft).

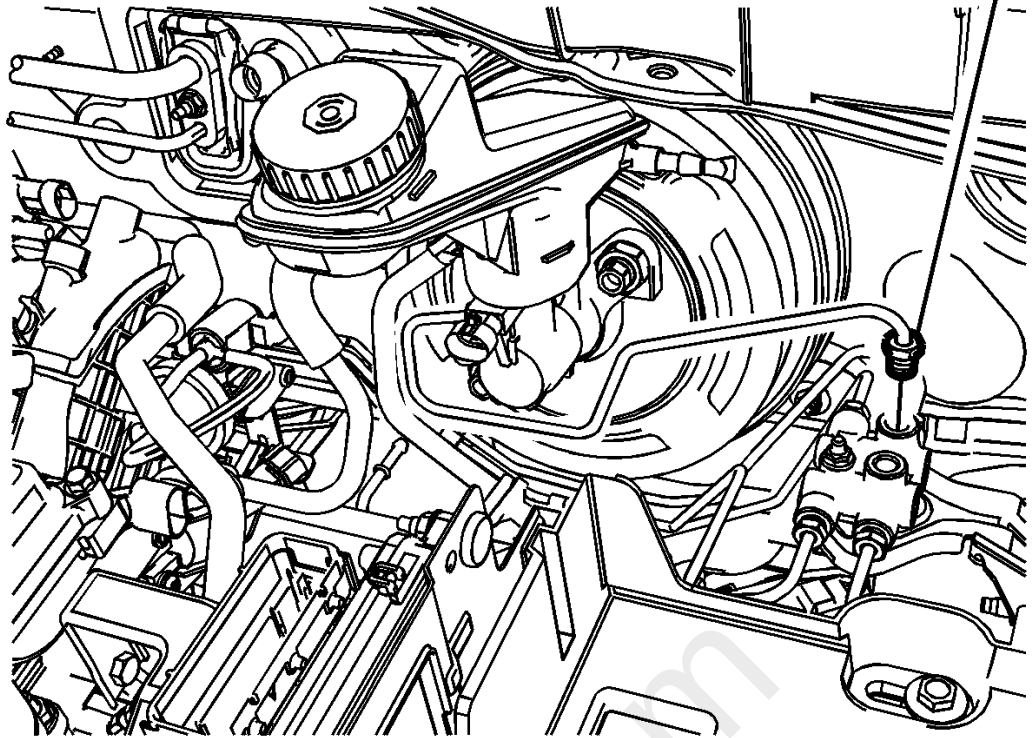


Fig. 66: Master Cylinder Primary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

7. Connect the master cylinder primary brake pipe fitting (1) to the brake proportion valve and tighten to 18 N.m (13 lb ft).

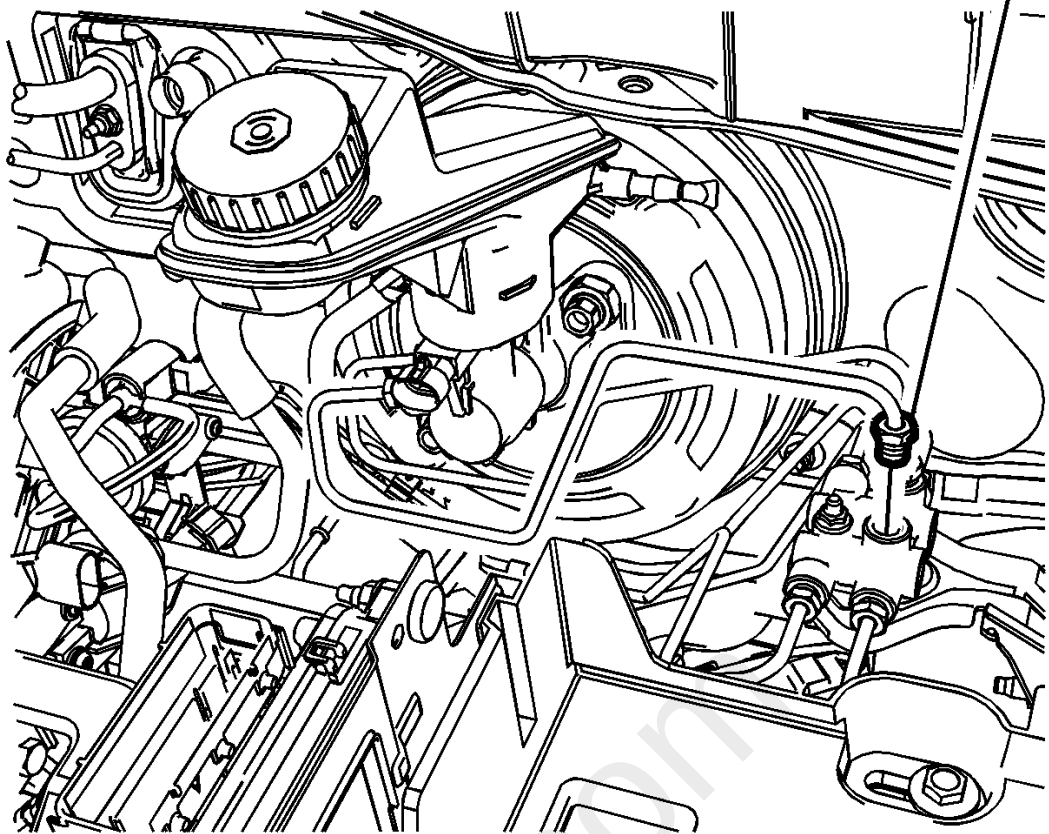


Fig. 67: Master Cylinder Secondary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

8. Connect the master cylinder secondary brake pipe fitting (1) to the brake proportion valve and tighten to 18 N.m (13 lb ft).
9. Install the battery. Refer to [Battery Replacement](#) .
10. Bleed the hydraulic brake system. Refer to [Hydraulic Brake System Bleeding \(Manual\)](#)[Hydraulic Brake System Bleeding \(Pressure\)](#).

BRAKE PRESSURE MODULATOR VALVE FRONT PIPE REPLACEMENT

Removal Procedure

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

1. Remove the battery. Refer to [Battery Replacement](#) .

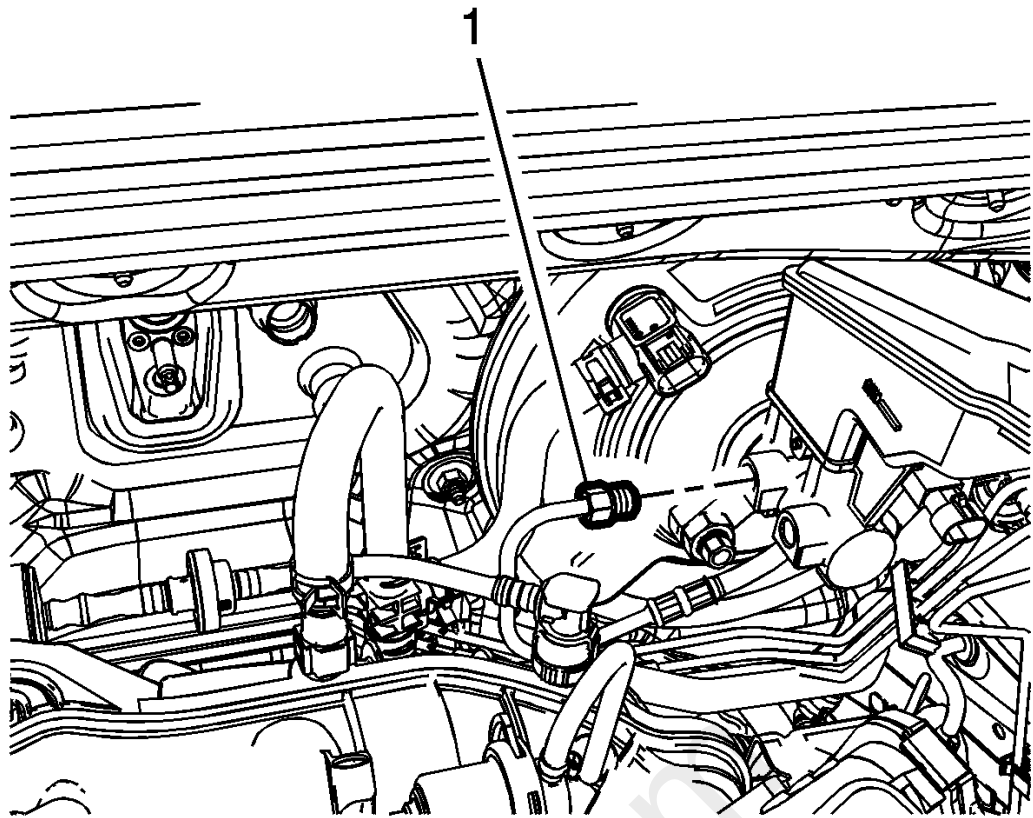


Fig. 68: Brake Pressure Modulator Valve Front Pipe Fitting At Master Cylinder
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the brake pressure modulator valve (BPMV) front pipe fitting (1) from the master cylinder.
3. Plug the master cylinder outlet port to prevent brake fluid loss and contamination.

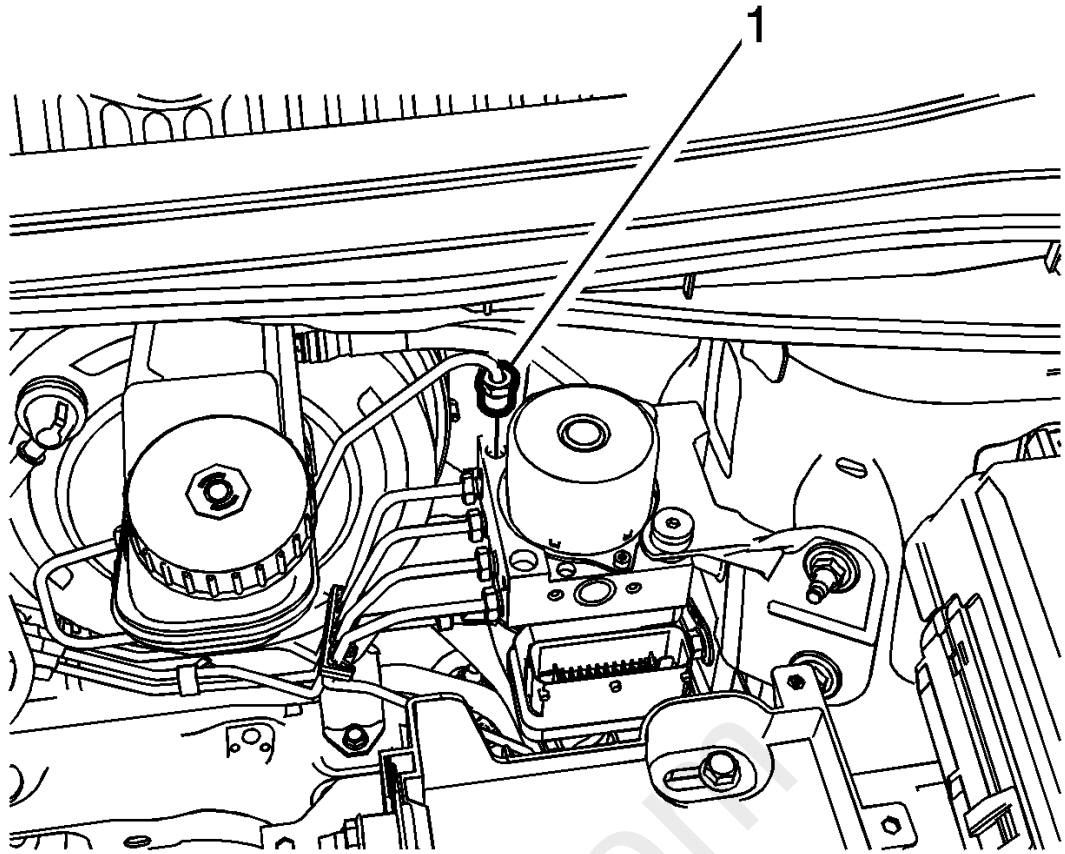


Fig. 69: Brake Pressure Modulator Valve Front Pipe Fitting At BPMV
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the BPMV front pipe fitting (1) from the BPMV.
5. Plug the BPMV inlet port to prevent brake fluid loss and contamination.
6. Remove the brake pipe from the vehicle.

Installation Procedure

1. Install the brake pipe to the vehicle.

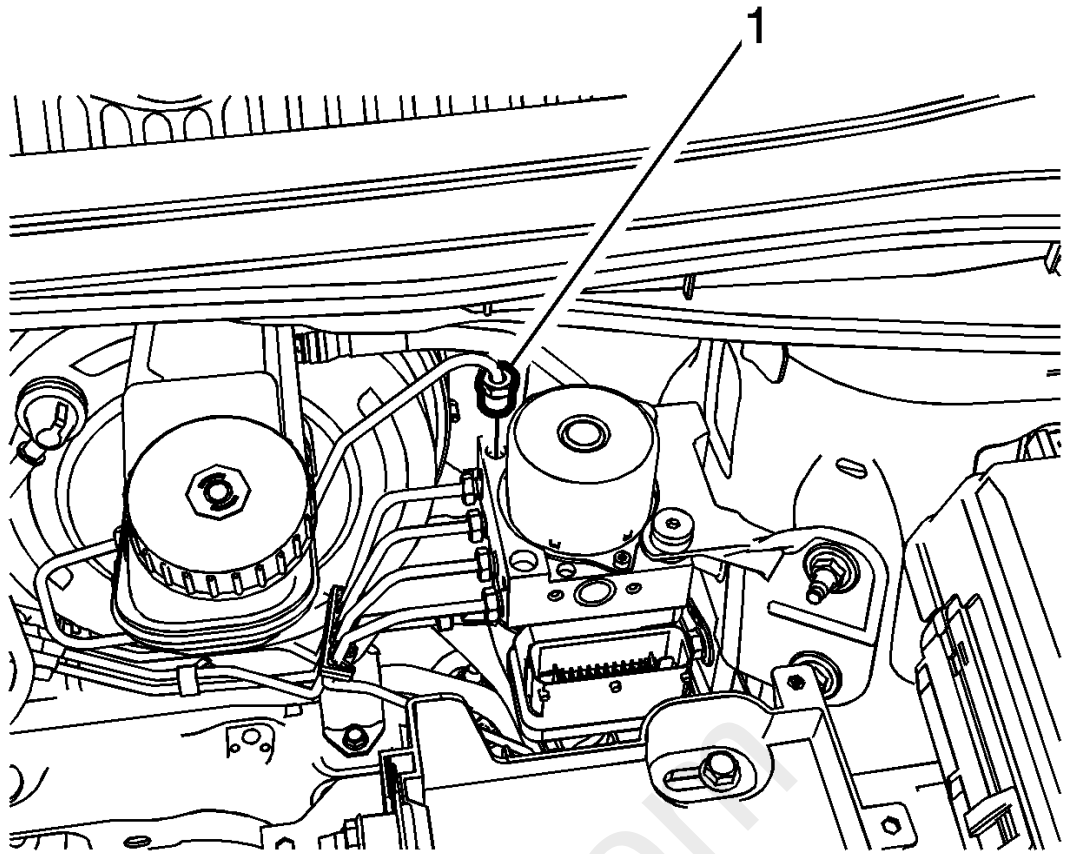


Fig. 70: Brake Pressure Modulator Valve Front Pipe Fitting At BPMV
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

2. Install the BPMV front pipe fitting (1) to the BPMV and tighten the fitting to 18 N.m (13 lb ft).

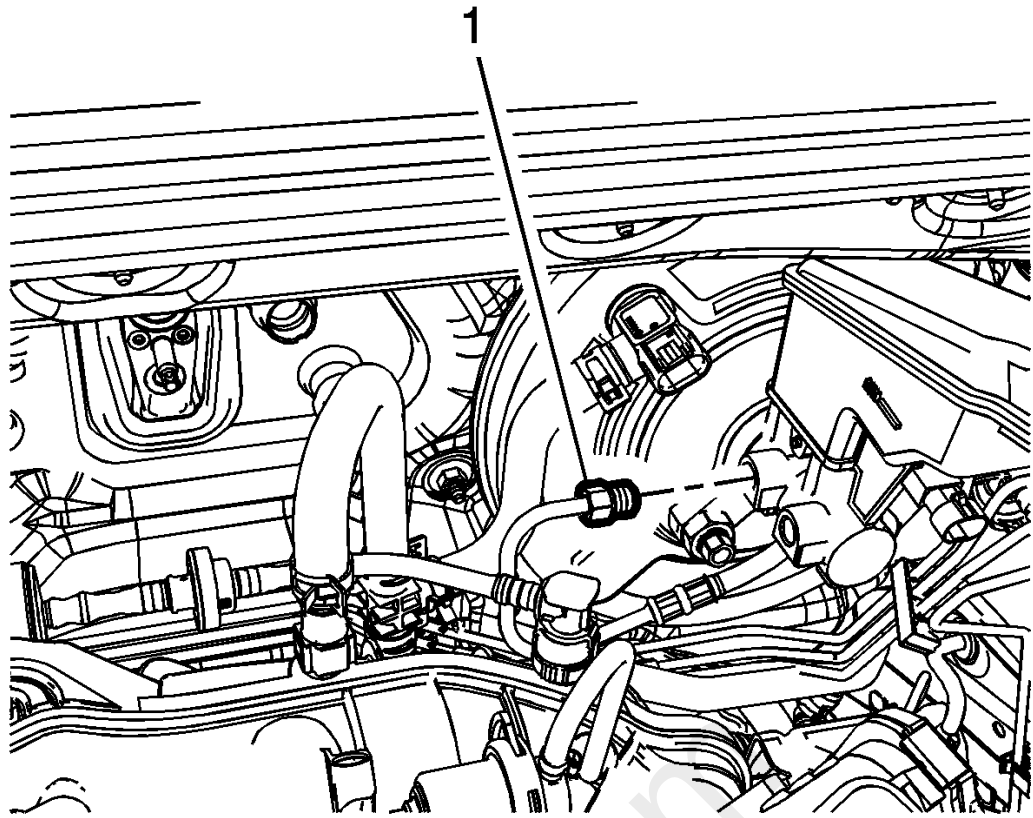


Fig. 71: Brake Pressure Modulator Valve Front Pipe Fitting At Master Cylinder
Courtesy of GENERAL MOTORS COMPANY

3. Install the BPMV front pipe fitting (1) to the master cylinder and tighten the fitting to 18 N.m (13 lb ft).
4. Install the battery. Refer to [Battery Replacement](#) .
5. Bleed the hydraulic brake system. Refer to [Hydraulic Brake System Bleeding \(Manual\)](#)[Hydraulic Brake System Bleeding \(Pressure\)](#).

BRAKE PRESSURE MODULATOR VALVE REAR PIPE REPLACEMENT

Removal Procedure

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

1. Remove the battery. Refer to [Battery Replacement](#) .

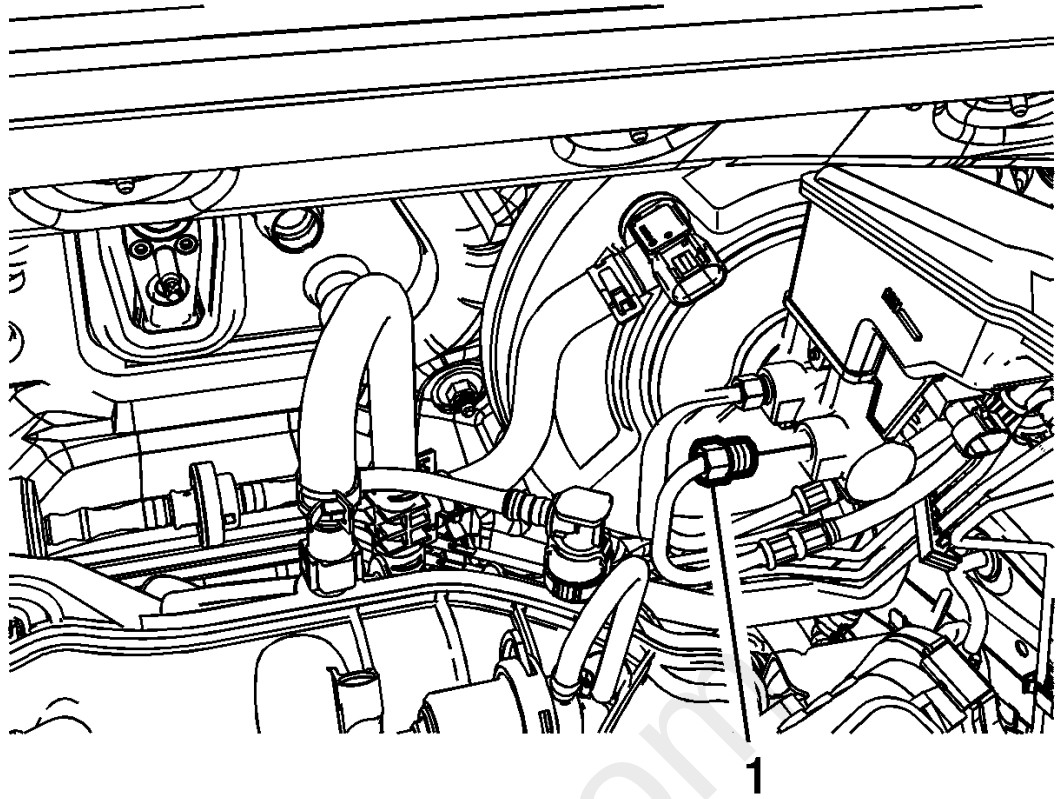


Fig. 72: Brake Pressure Modulator Valve Rear Pipe Fitting At Master Cylinder
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the brake pressure modulator valve (BPMV) rear pipe fitting (1) from the master cylinder.
3. Plug the master cylinder outlet port to prevent brake fluid loss and contamination.

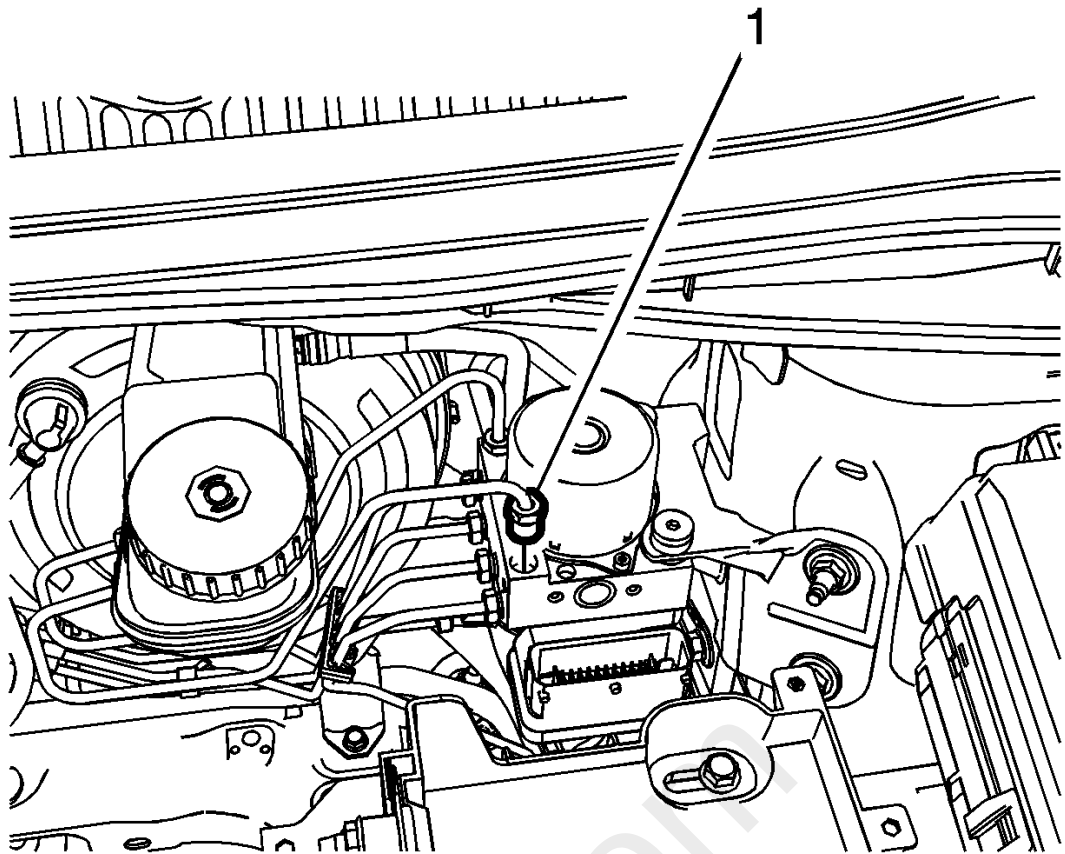


Fig. 73: Brake Pressure Modulator Valve Rear Pipe Fitting At BPMV
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the BPMV rear pipe fitting (1) from the BPMV.
5. Plug the BPMV inlet port to prevent brake fluid loss and contamination.
6. Remove the brake pipe from the vehicle.

Installation Procedure

1. Install the brake pipe to the vehicle.

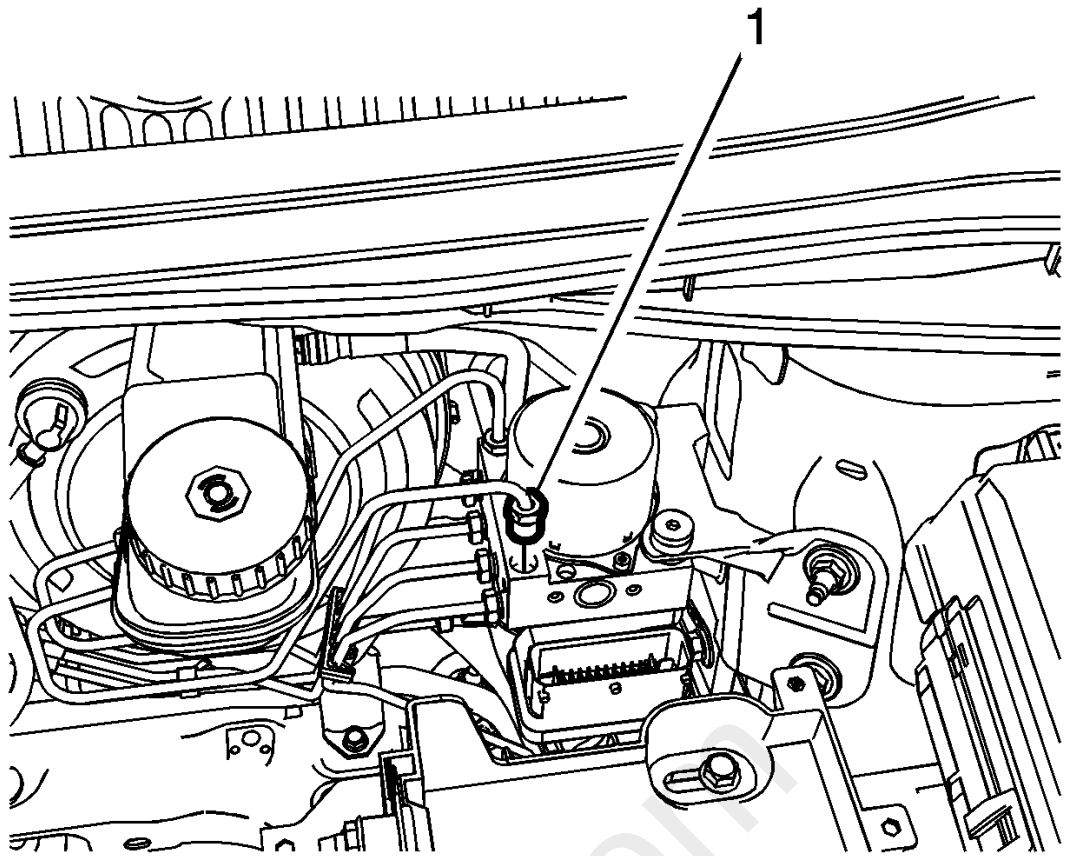


Fig. 74: Brake Pressure Modulator Valve Rear Pipe Fitting At BPMV
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

2. Install the BPMV rear pipe fitting (1) to the BPMV and tighten the fitting to 18 N.m (13 lb ft).

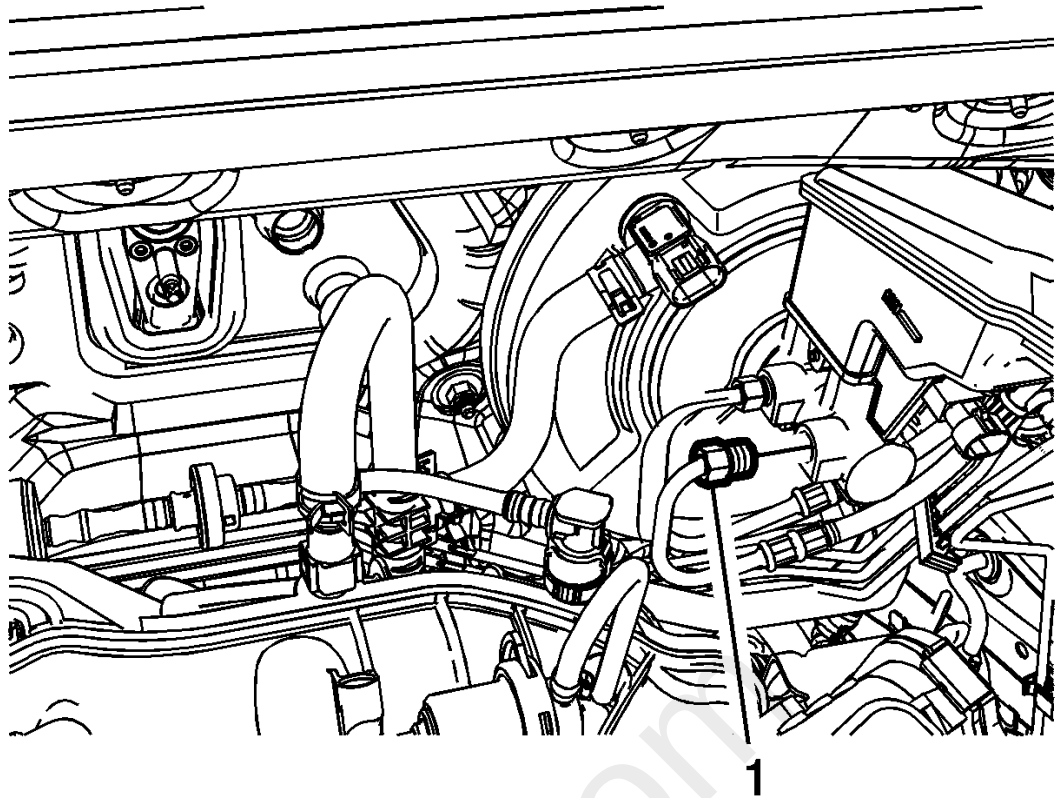


Fig. 75: Brake Pressure Modulator Valve Rear Pipe Fitting At Master Cylinder
Courtesy of GENERAL MOTORS COMPANY

3. Install the BPMV rear pipe fitting (1) to the master cylinder and tighten the fitting to 18 N.m (13 lb ft).
4. Install the battery. Refer to [Battery Replacement](#) .
5. Bleed the hydraulic brake system. Refer to [Hydraulic Brake System Bleeding \(Manual\)](#)[Hydraulic Brake System Bleeding \(Pressure\)](#).

BRAKE PRESSURE MODULATOR VALVE FRONT BRAKE PIPE REPLACEMENT (LEFT)

Removal Procedure

WARNING: Refer to [Brake Dust Warning](#) .

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

1. Remove the battery. Refer to [Battery Replacement](#) .

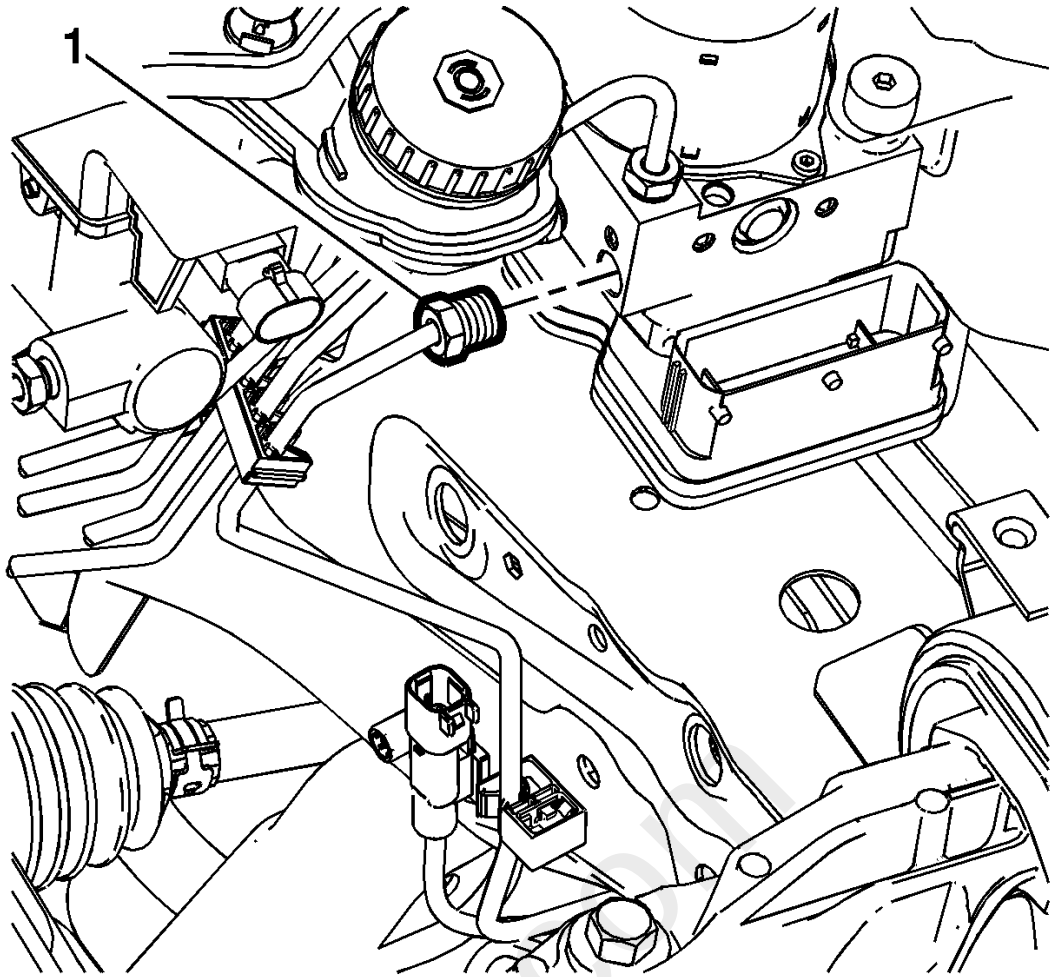


Fig. 76: Brake Pressure Modulator Valve (BPMV) Front Brake Pipe Fitting At BPMV
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the brake pressure modulator valve (BPMV) front brake pipe fitting (1) from the BPMV.
3. Plug the BPMV outlet port to prevent brake fluid loss and contamination.

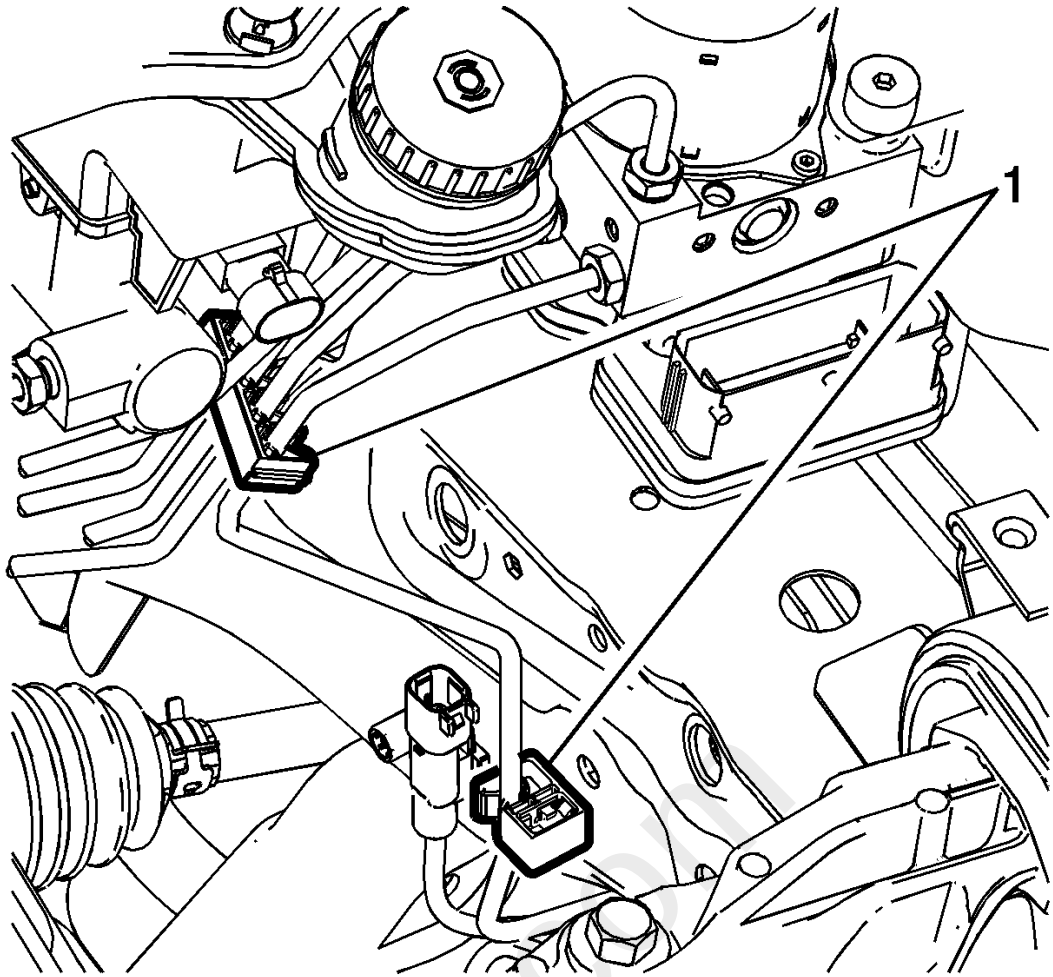


Fig. 77: BPMV Front Brake Pipe Retaining Clip
Courtesy of GENERAL MOTORS COMPANY

4. Release the BPMV front brake pipe from the retaining clip (1).
5. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .
6. Remove the left front tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#) .

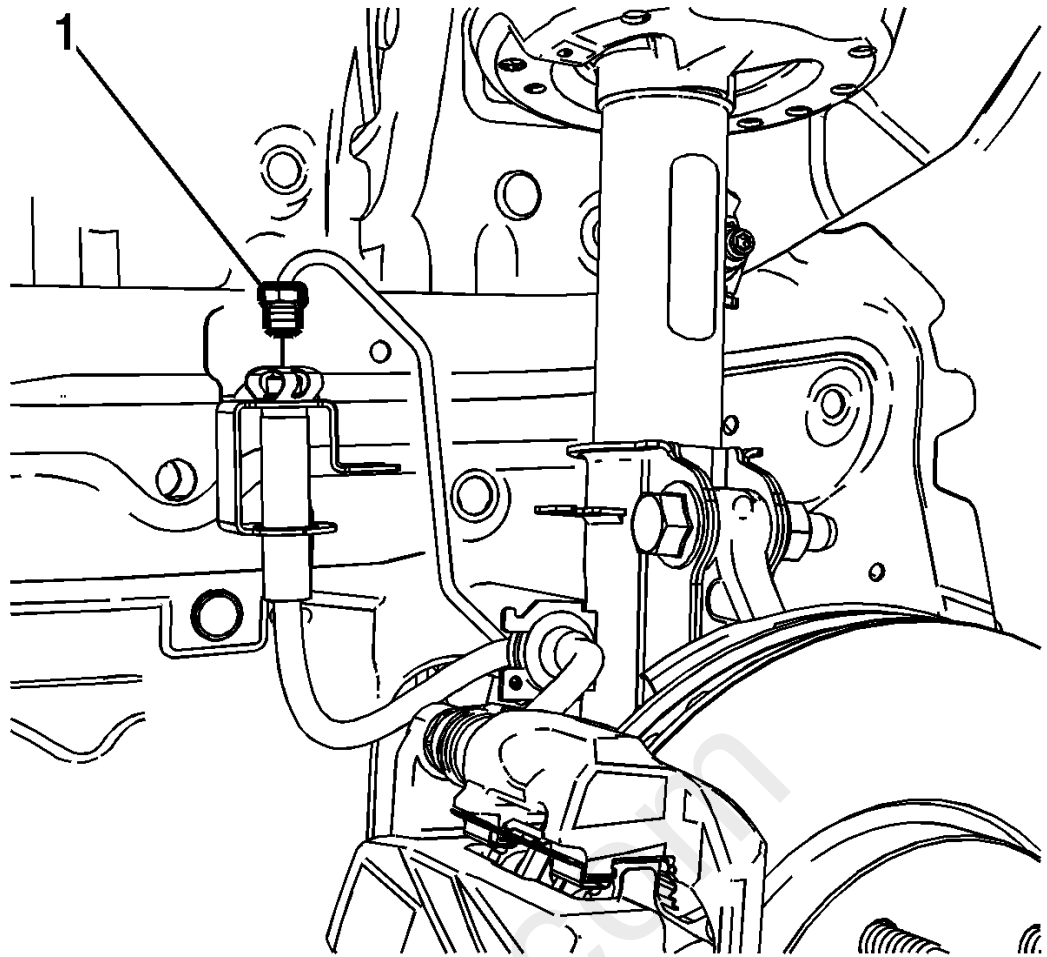


Fig. 78: Brake Pressure Modulator Valve (BPMV) Front Brake Pipe Fitting At Left Front Brake Hose
Courtesy of GENERAL MOTORS COMPANY

7. Disconnect the BPMV front brake pipe fitting (1) from the left front brake hose.
8. Remove the BPMV front brake pipe from the vehicle.

Installation Procedure

1. Install the BPMV front brake pipe to the vehicle.
2. Position, but do not secure, the BPMV front brake pipe to the retaining clip.

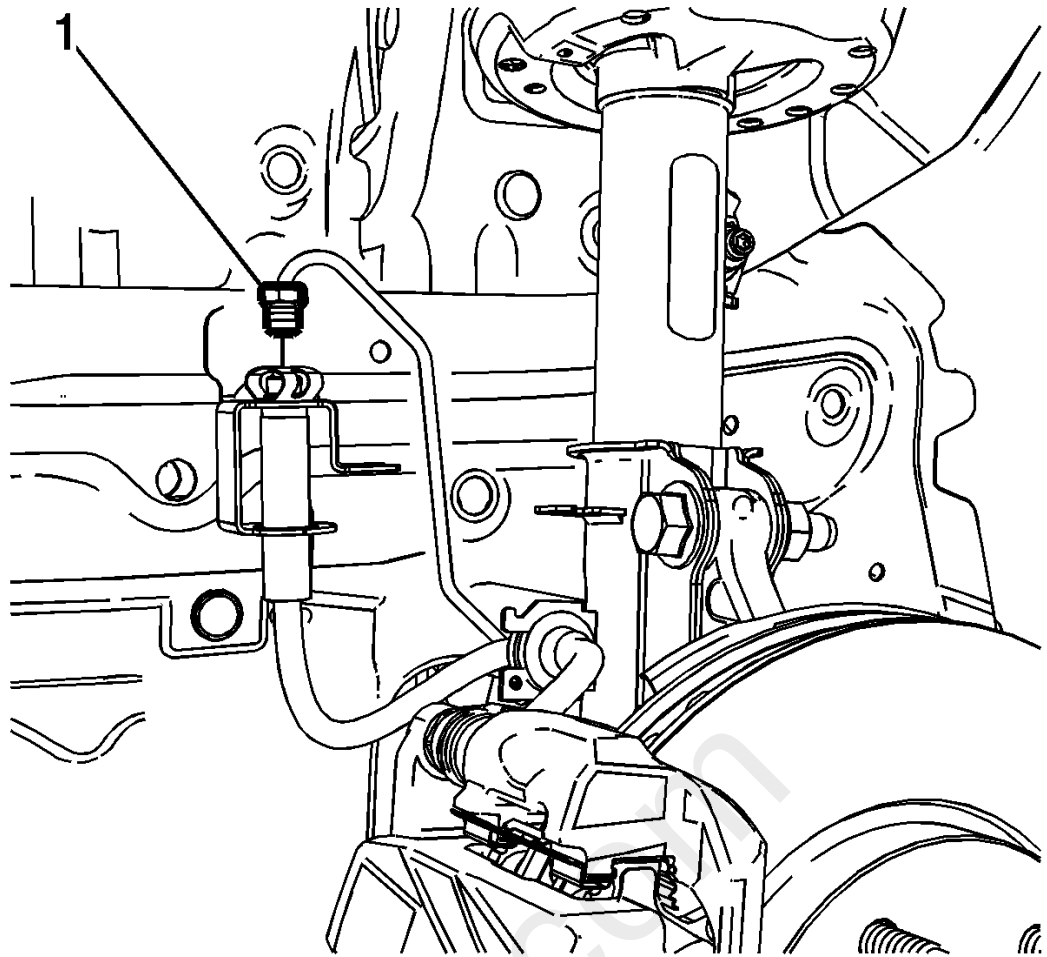


Fig. 79: Brake Pressure Modulator Valve (BPMV) Front Brake Pipe Fitting At Left Front Brake Hose
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

3. Install the BPMV front brake pipe fitting (1) to the left front brake hose and tighten the fitting to 18 N.m (13 lb ft).
4. Lower the vehicle to access the brake pipe retaining clip.

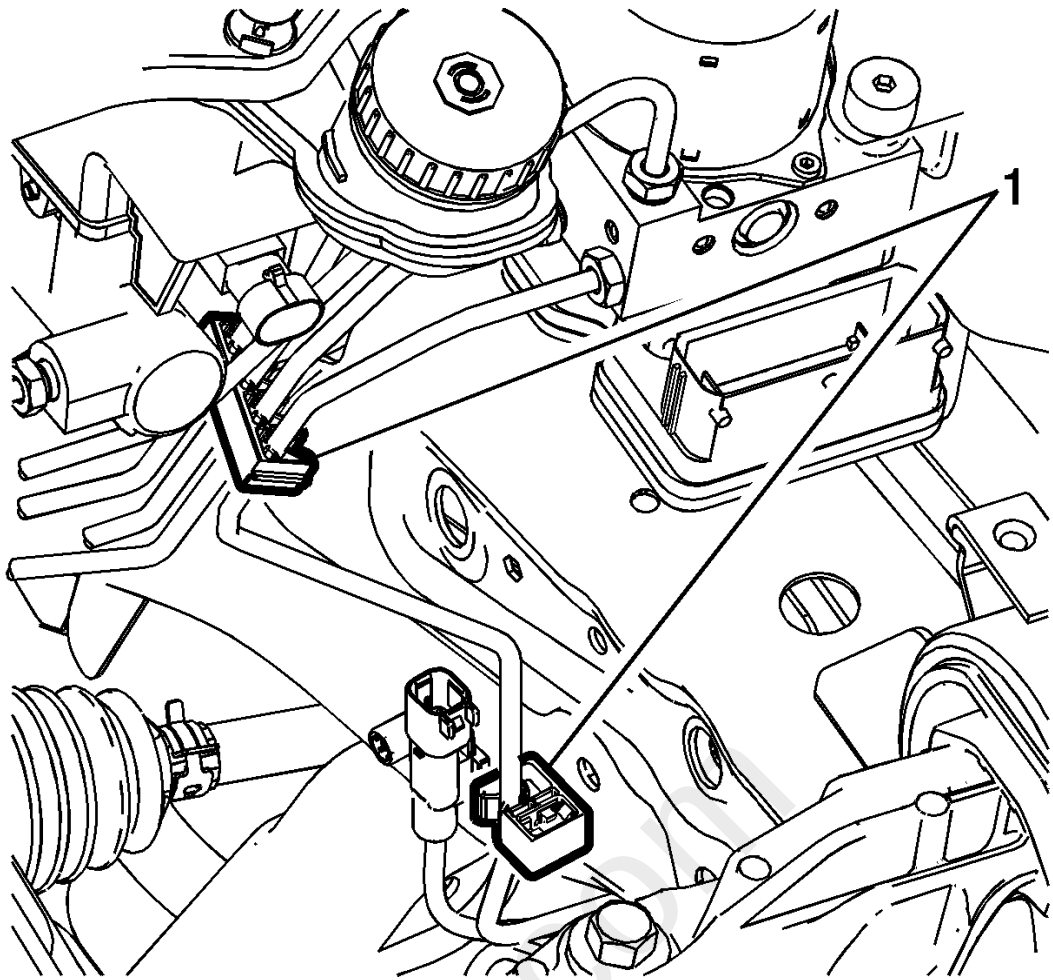


Fig. 80: BPMV Front Brake Pipe Retaining Clip
Courtesy of GENERAL MOTORS COMPANY

5. Secure the BPMV front brake pipe to the retaining clip (1).

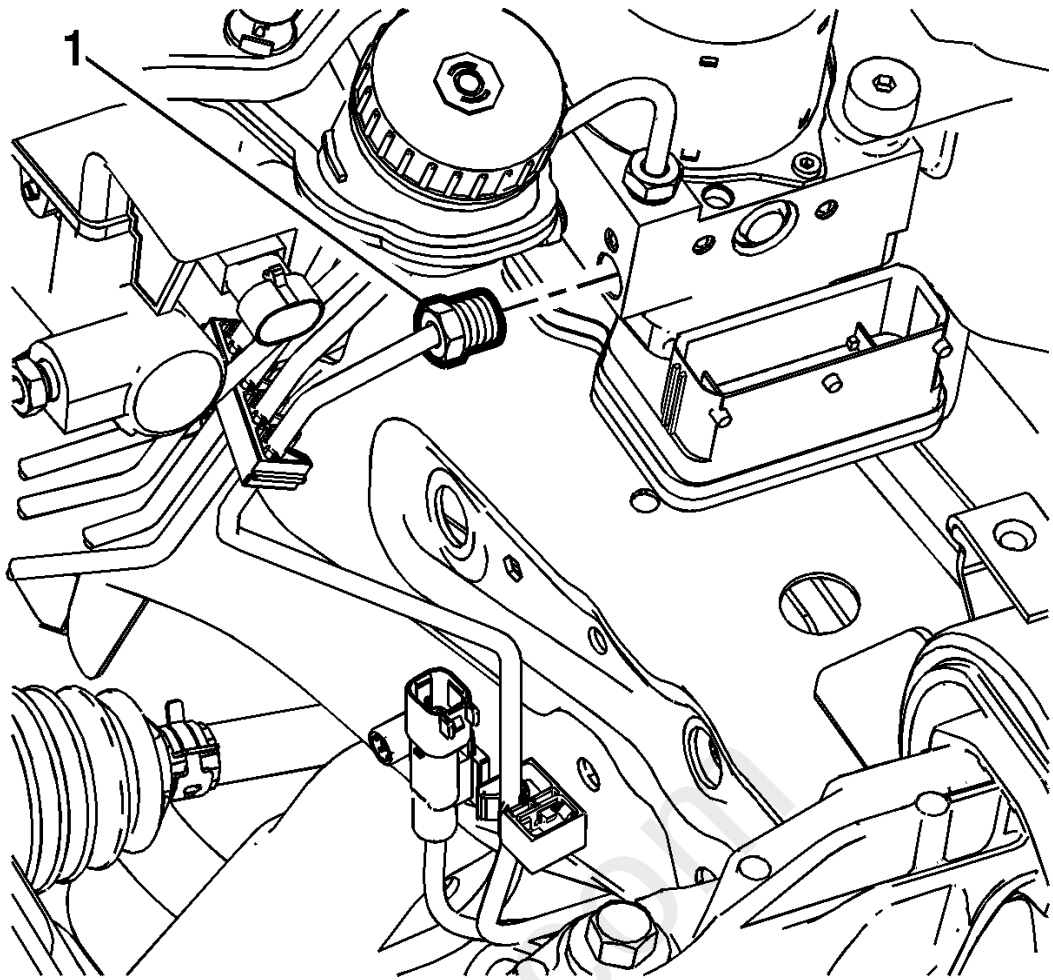


Fig. 81: Brake Pressure Modulator Valve (BPMV) Front Brake Pipe Fitting At BPMV
Courtesy of GENERAL MOTORS COMPANY

6. Install the BPMV front brake pipe fitting (1) to the BPMV and tighten the fitting to 18 N.m (13 lb ft).
7. Install the battery. Refer to [Battery Replacement](#) .
8. Bleed the hydraulic brake system. Refer to [Hydraulic Brake System Bleeding \(Manual\)Hydraulic Brake System Bleeding \(Pressure\)](#).
9. Install the left front tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#) .

BRAKE PRESSURE MODULATOR VALVE FRONT BRAKE PIPE REPLACEMENT (RIGHT)

Removal Procedure

WARNING: Refer to [Brake Dust Warning](#) .

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

1. Remove the battery. Refer to [Battery Replacement](#) .

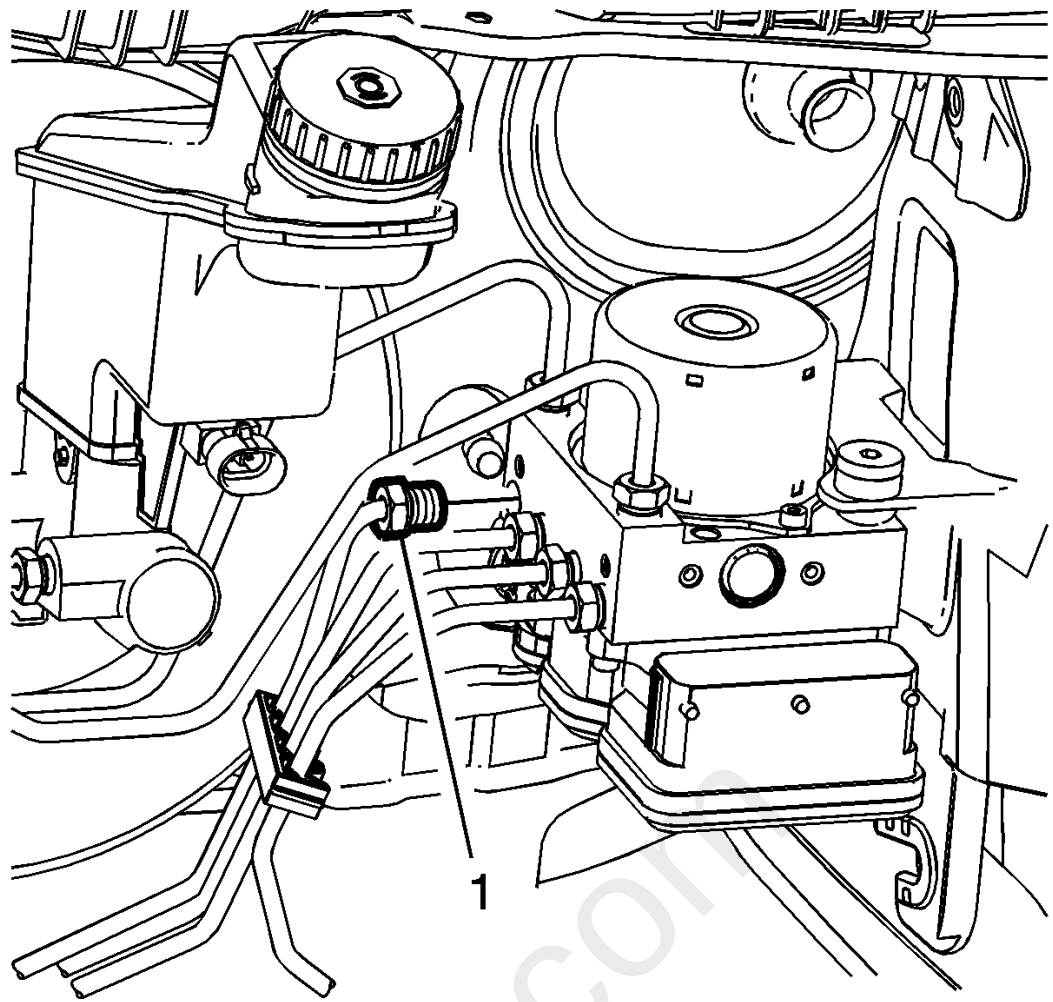


Fig. 82: Brake Pressure Modulator Valve (BPMV) Front Brake Pipe Fitting At BPMV
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the brake pressure modulator valve (BPMV) front brake pipe fitting (1) from the BPMV.
3. Plug the BPMV outlet port to prevent brake fluid loss and contamination.

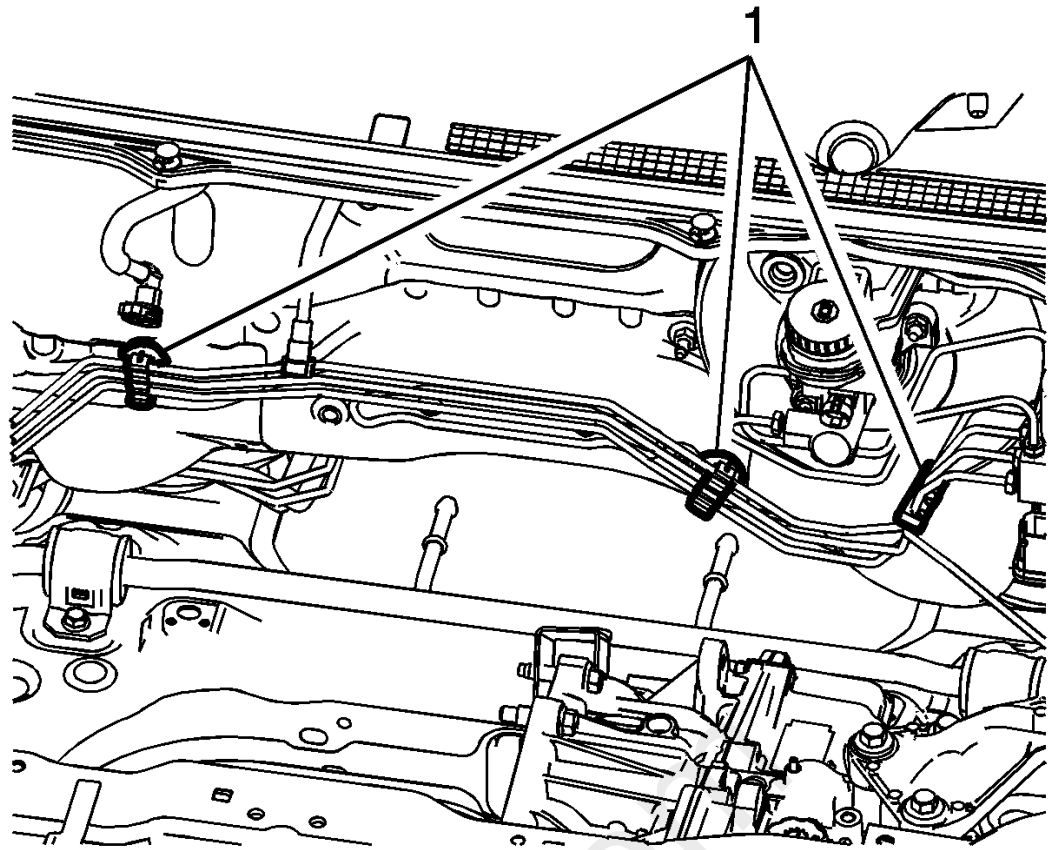


Fig. 83: BPMV Front Brake Pipe Retaining Clips

Courtesy of GENERAL MOTORS COMPANY

4. Release the BPMV front brake pipe from the retaining clips (1).
5. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .

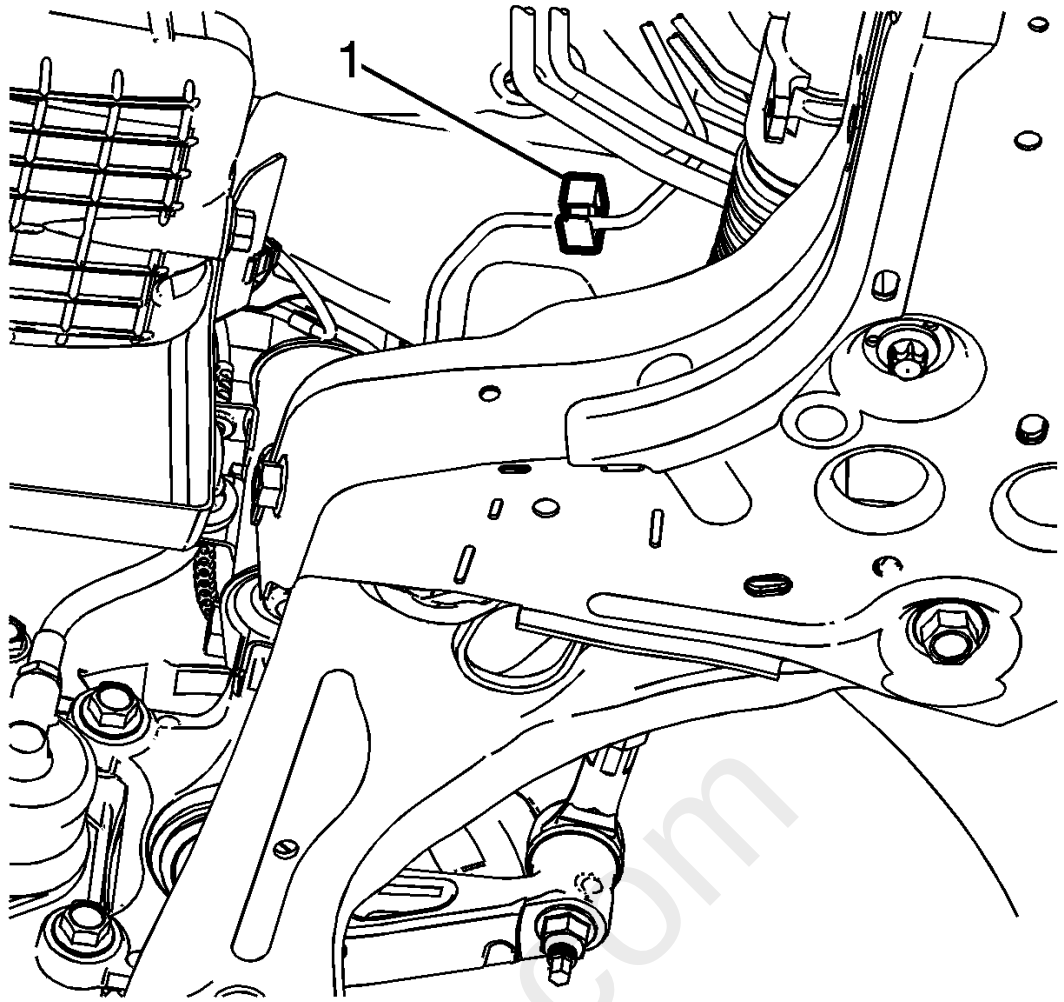


Fig. 84: BPMV Front Brake Pipe Retaining Clip
Courtesy of GENERAL MOTORS COMPANY

6. Release the BPMV front brake pipe from the retaining clip (1).
7. Remove the right front tire and wheel assembly. Refer to [**Tire and Wheel Removal and Installation**](#) .

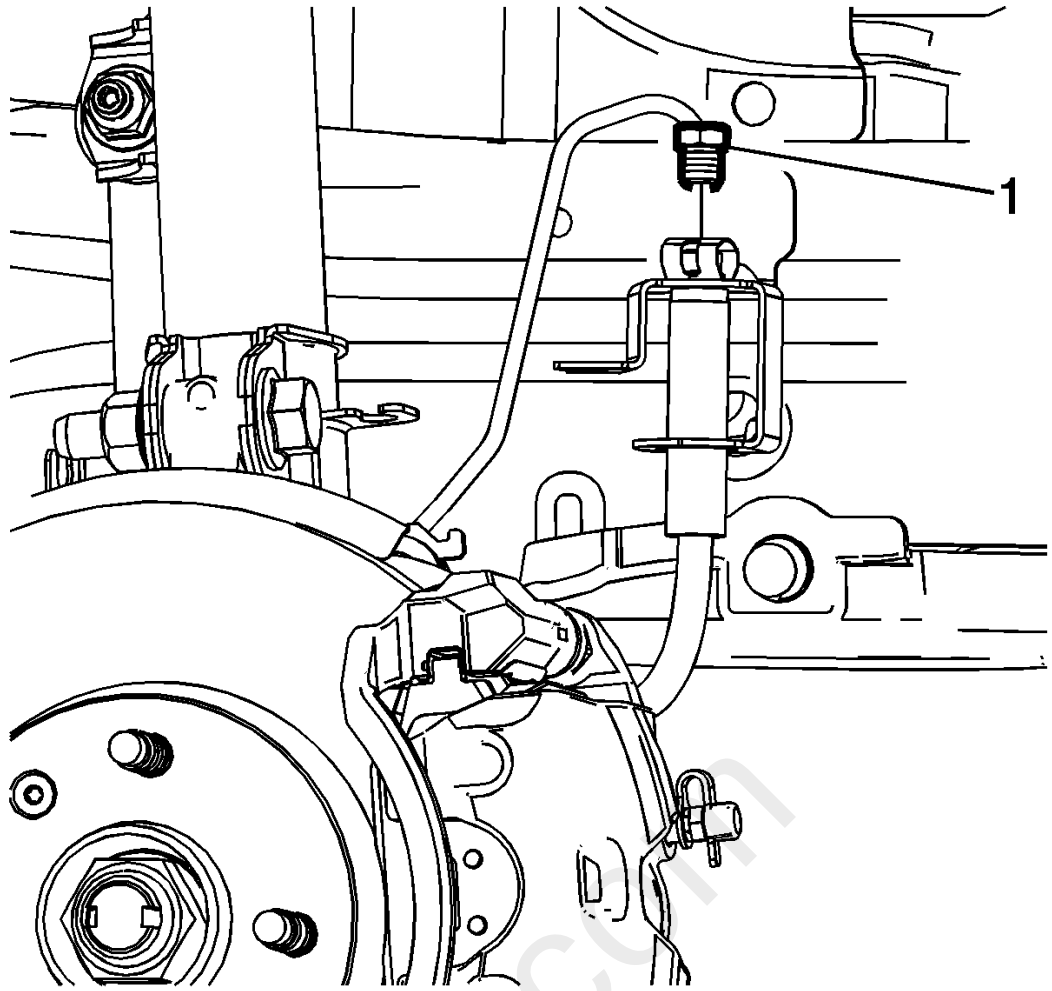


Fig. 85: Brake Pressure Modulator Valve (BPMV) Front Brake Pipe Fitting At Right Front Brake Hose
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect the BPMV front brake pipe fitting (1) from the right front brake hose.
9. Remove the BPMV front brake pipe from the vehicle.

Installation Procedure

1. Install the BPMV front brake pipe to the vehicle.
2. Position, but do not secure, the BPMV front brake pipe to the retaining clips.

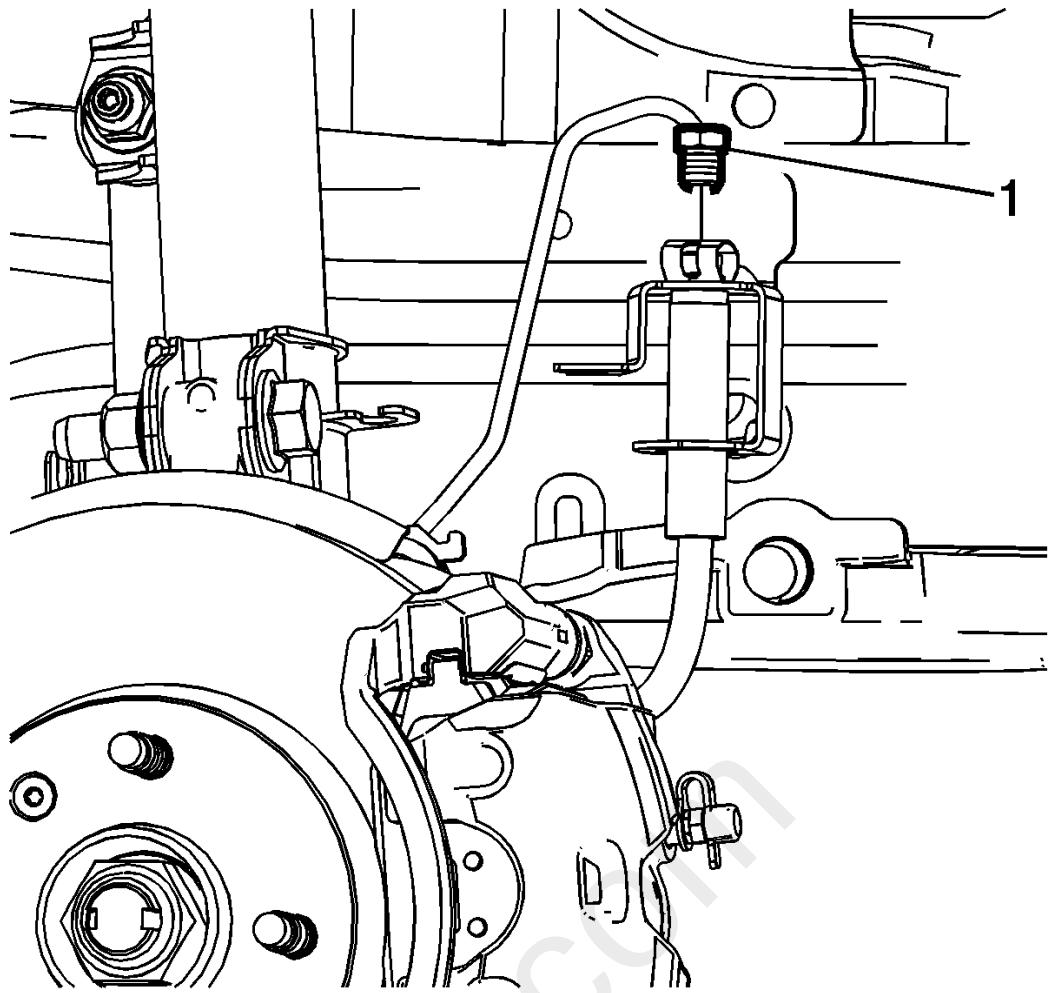


Fig. 86: Brake Pressure Modulator Valve (BPMV) Front Brake Pipe Fitting At Right Front Brake Hose
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

3. Install the BPMV front brake pipe fitting (1) to the right front brake hose and tighten the fitting to 18 N.m (13 lb ft).

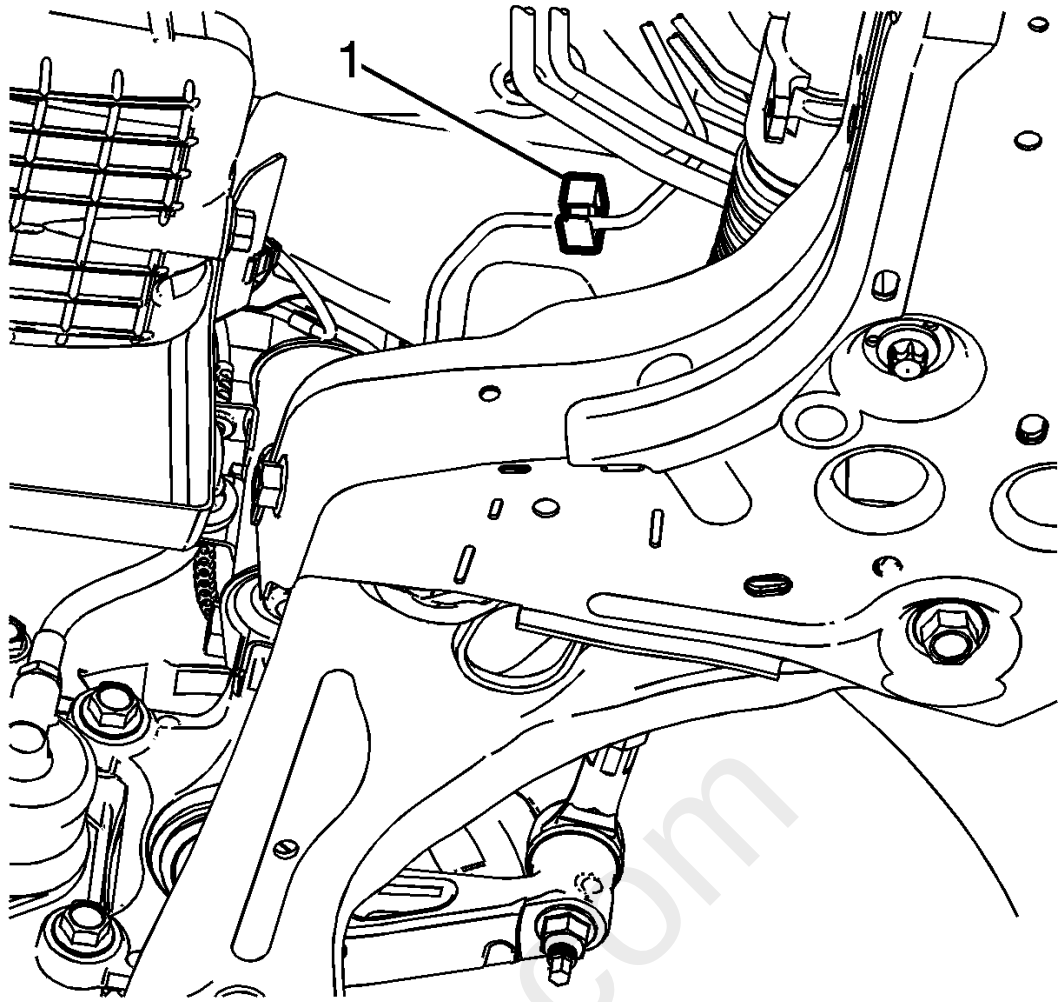


Fig. 87: BPMV Front Brake Pipe Retaining Clip
Courtesy of GENERAL MOTORS COMPANY

4. Secure the BPMV front brake pipe to the retaining clip (1).
5. Lower the vehicle to access the upper brake pipe retaining clips.

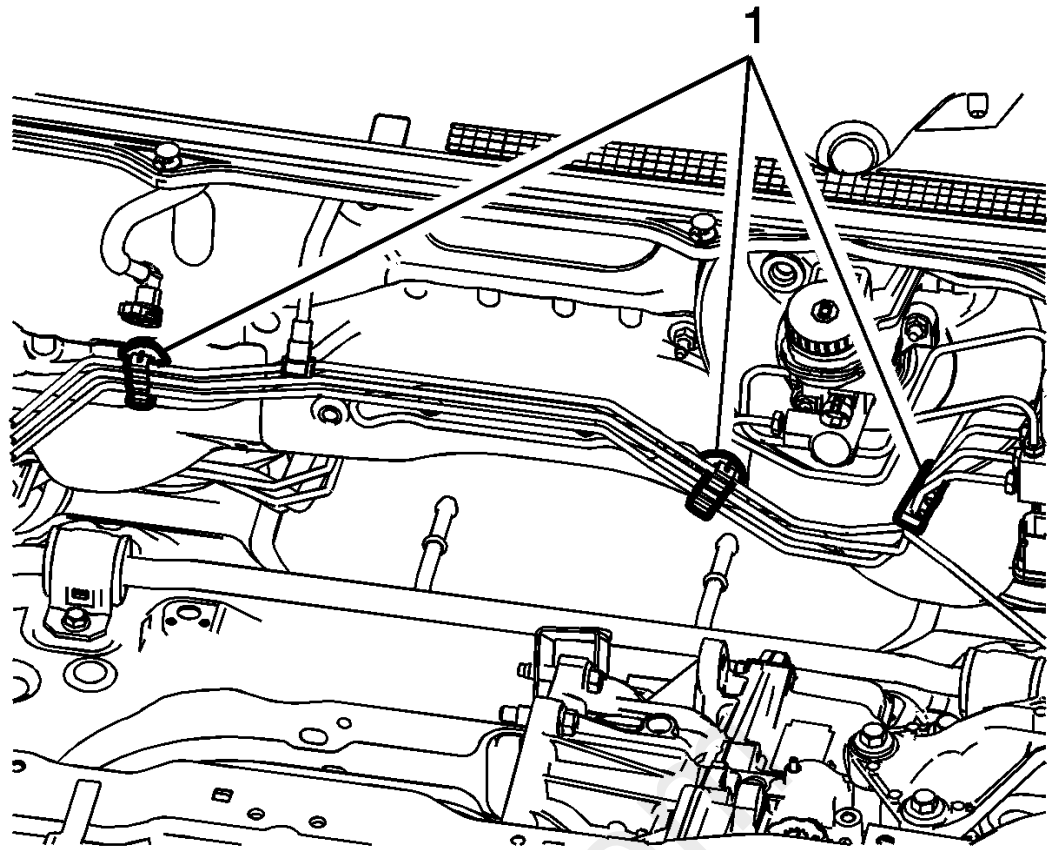


Fig. 88: BPMV Front Brake Pipe Retaining Clips
Courtesy of GENERAL MOTORS COMPANY

6. Secure the BPMV front brake pipe to the retaining clips (1).

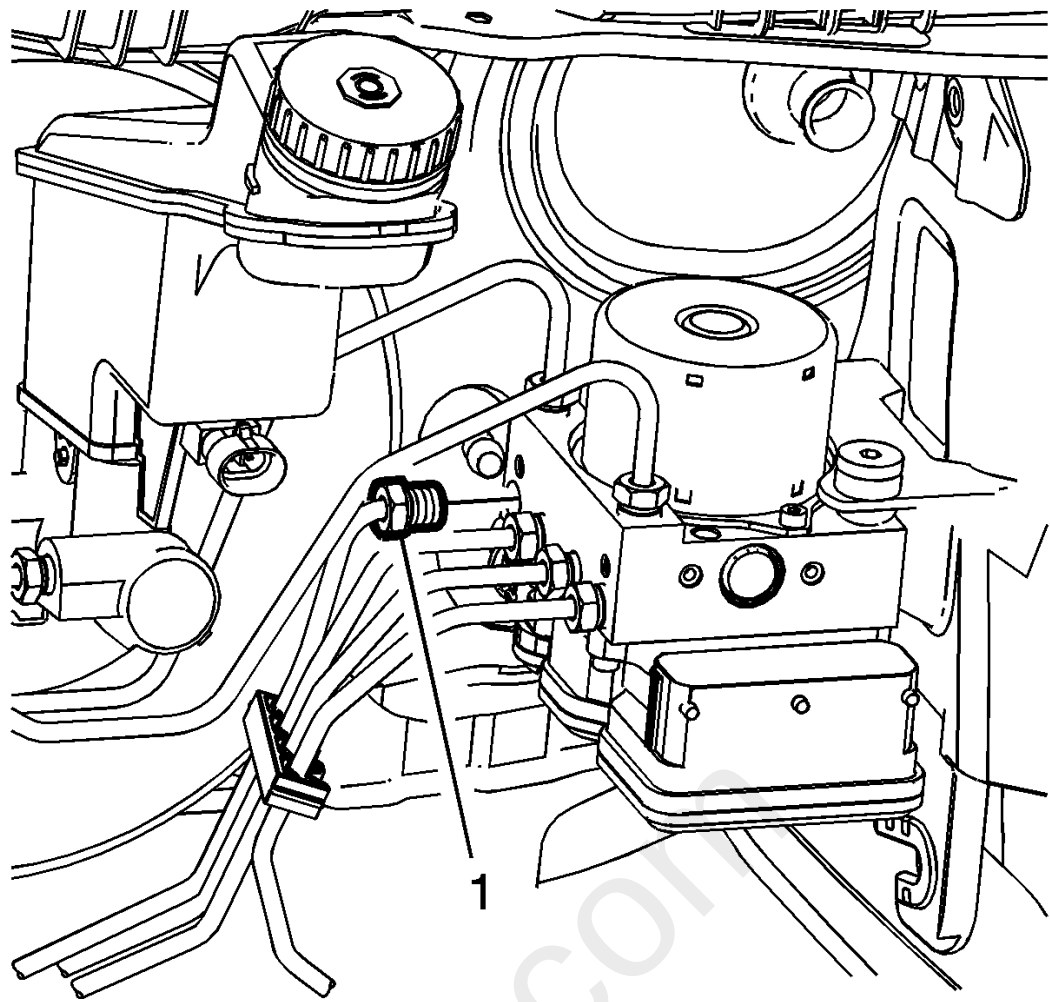


Fig. 89: Brake Pressure Modulator Valve (BPMV) Front Brake Pipe Fitting At BPMV
Courtesy of GENERAL MOTORS COMPANY

7. Install the BPMV front brake pipe fitting (1) to the BPMV and tighten the fitting to 18 N.m (13 lb ft).
8. Install the battery. Refer to [Battery Replacement](#) .
9. Bleed the hydraulic brake system. Refer to [Hydraulic Brake System Bleeding \(Manual\)Hydraulic Brake System Bleeding \(Pressure\)](#).
10. Install the right front tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#) .

BRAKE PIPE REPLACEMENT

Special Tools

CH-45405 Brake Pipe Flaring Tool Kit

For equivalent regional tools, refer to [Special Tools](#).

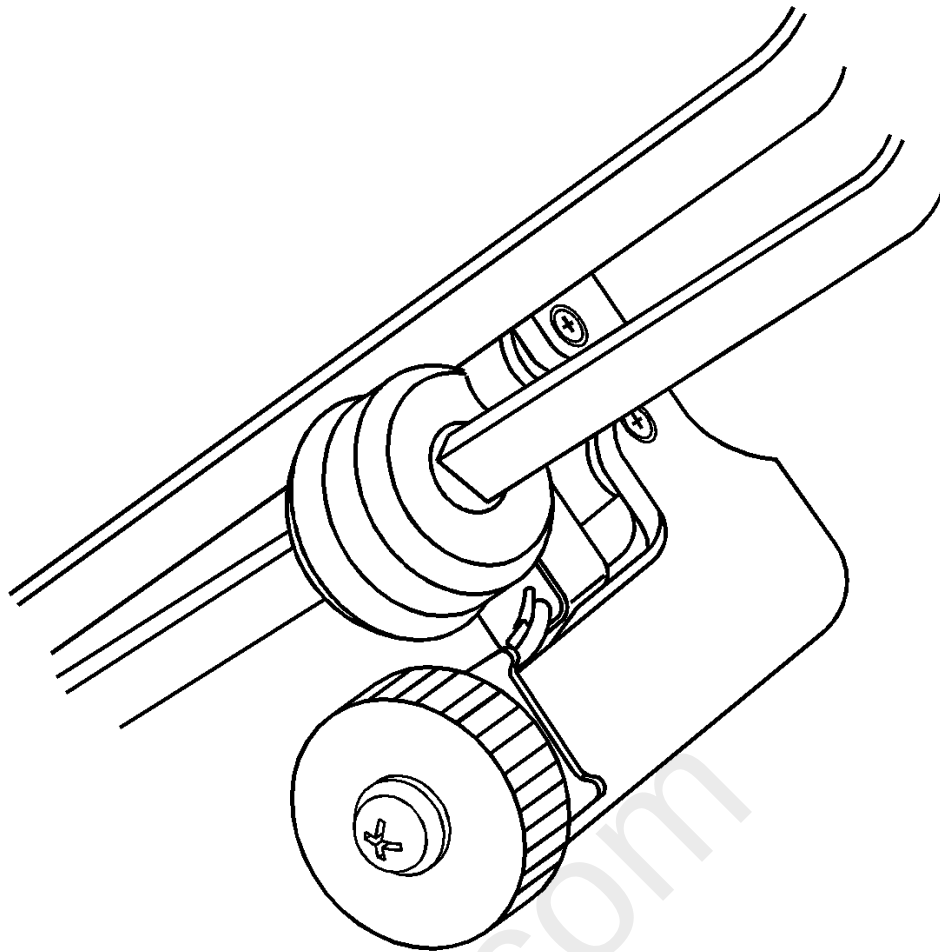


Fig. 90: Brake Pipe And Pipe Cutter
Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

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](#) .

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 **CH-45405** Brake Pipe Flaring Tool Kit.
 - 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 **CH-45405** Brake Pipe Flaring Tool Kit, 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.

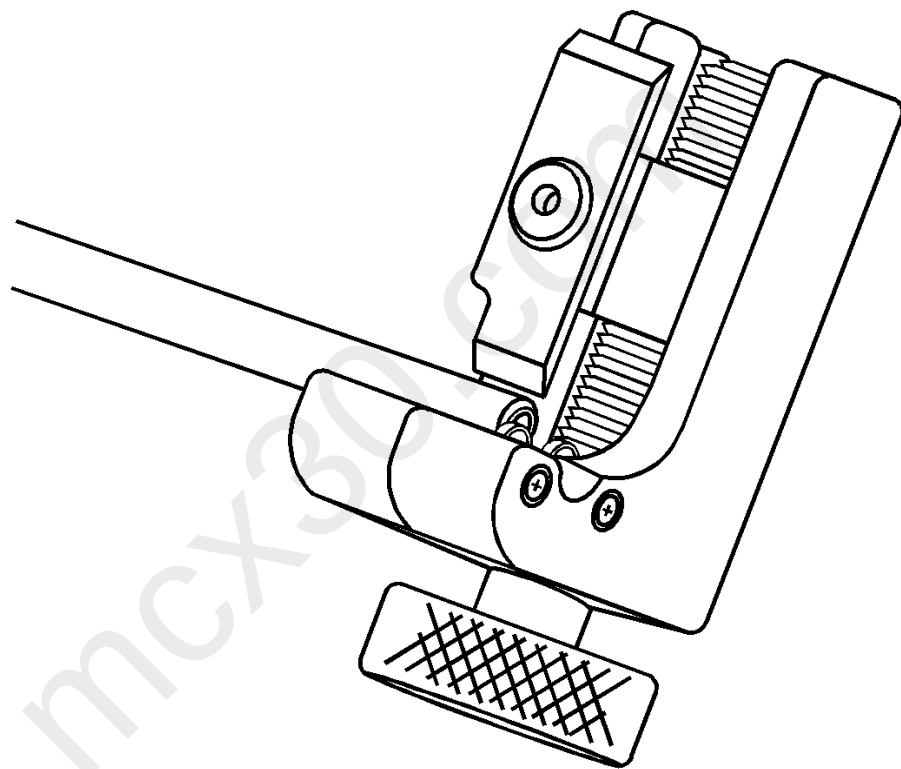


Fig. 91: Stripping Nylon Coating From Brake Pipe Ends

Courtesy of GENERAL MOTORS COMPANY

9. Strip the nylon coating from the brake pipe end to be flared, if necessary.
 1. Select the appropriate blade on the coating stripping tool included in the **CH-45405** Brake Pipe Flaring Tool Kit, 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
2. Insert the brake pipe end to be flared into the stripping tool to the depth of the ledge on the tool rollers.
 3. 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.

4. Rotate the stripping tool in a clockwise direction, ensuring that the brake pipe end remains against the tool roller ledges.
5. 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.
6. 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.

7. 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

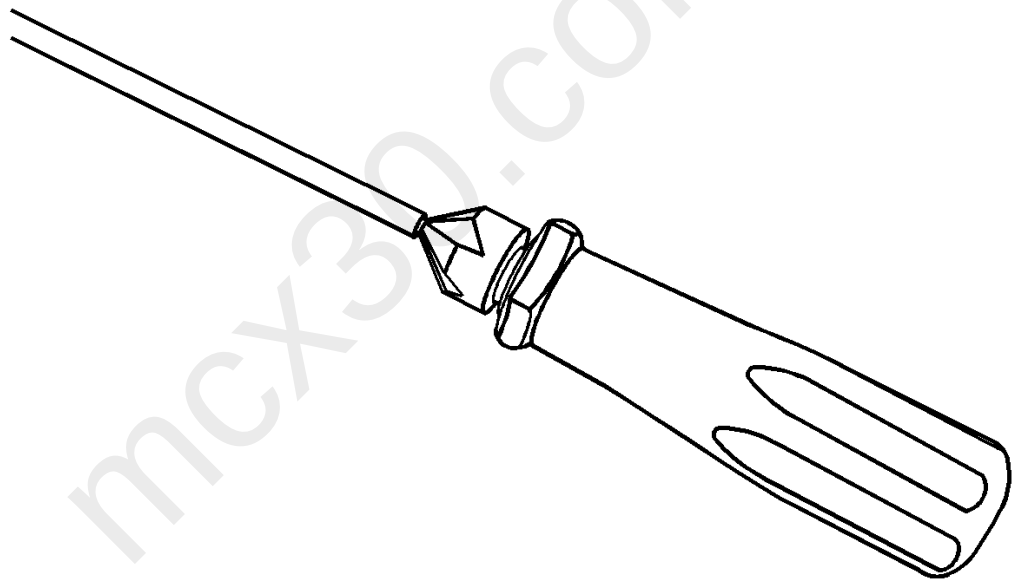


Fig. 92: Chamfering Pipe Using De-Burring Tool
Courtesy of GENERAL MOTORS COMPANY

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

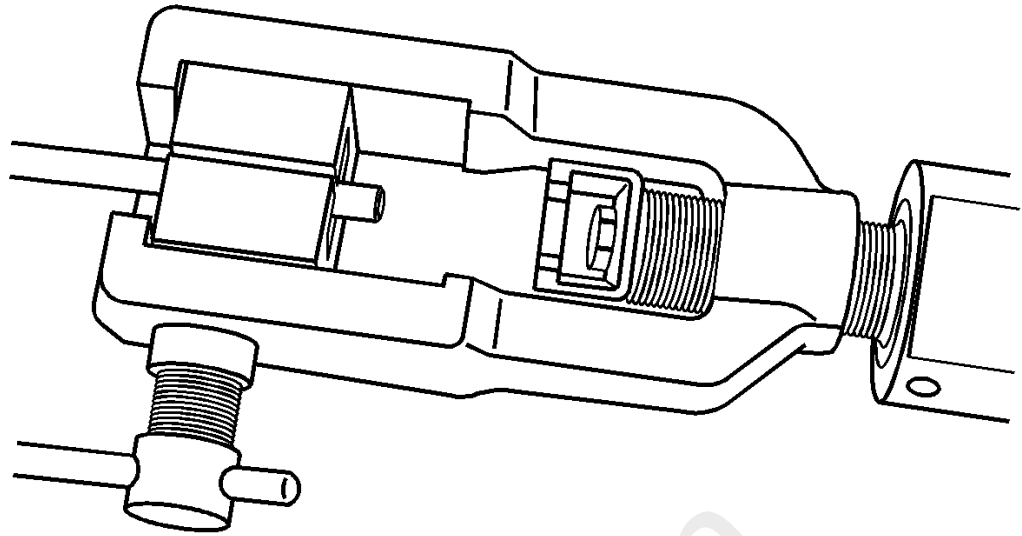


Fig. 93: Installing Die Halves Into Die Cage
 Courtesy of GENERAL MOTORS COMPANY

13. Loosen the die clamping screw of the **CH-45405** Brake Pipe Flaring Tool Kit.
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.

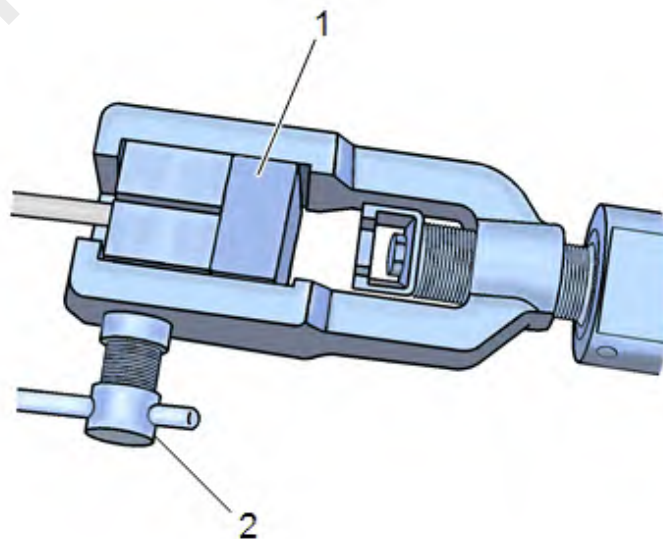


Fig. 94: Clamping Screw And Unused Die
 Courtesy of GENERAL MOTORS COMPANY

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.

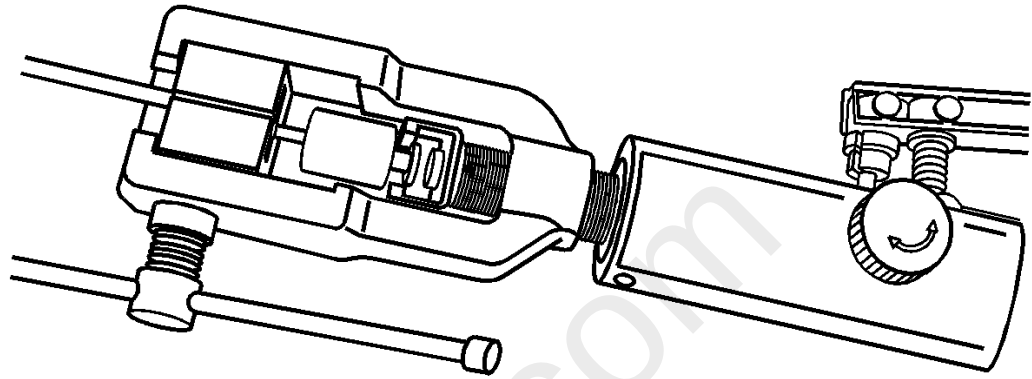


Fig. 95: Rotating Body Of Special Tool To Bottom Against Die Cage
Courtesy of GENERAL MOTORS COMPANY

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 **CH-45405** Brake Pipe Flaring Tool Kit until it bottoms against the die cage.

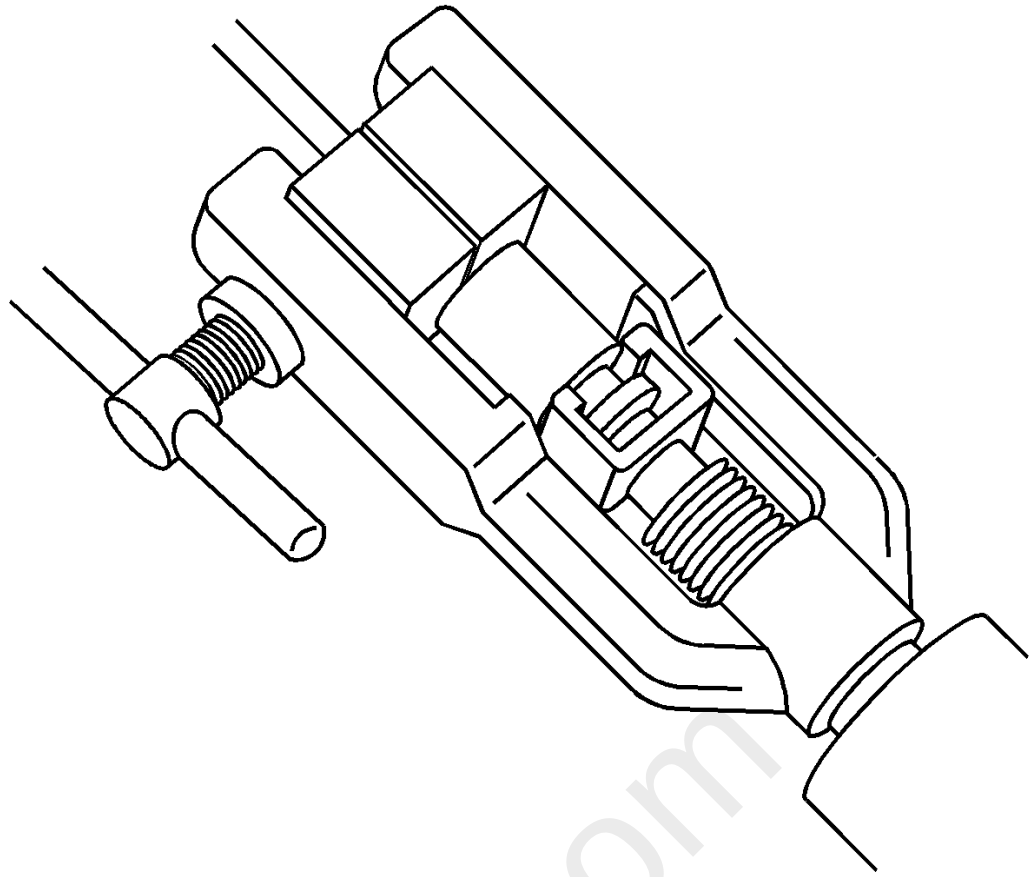


Fig. 96: Bottoming Forming Mandrel Against Clamping Dies Using Pipe Flaring Tool
Courtesy of GENERAL MOTORS COMPANY

23. While guiding the forming mandrel into the exposed end of pipe to be flared, operate the lever of the **CH-45405** Pipe Flaring Tool Kit 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.

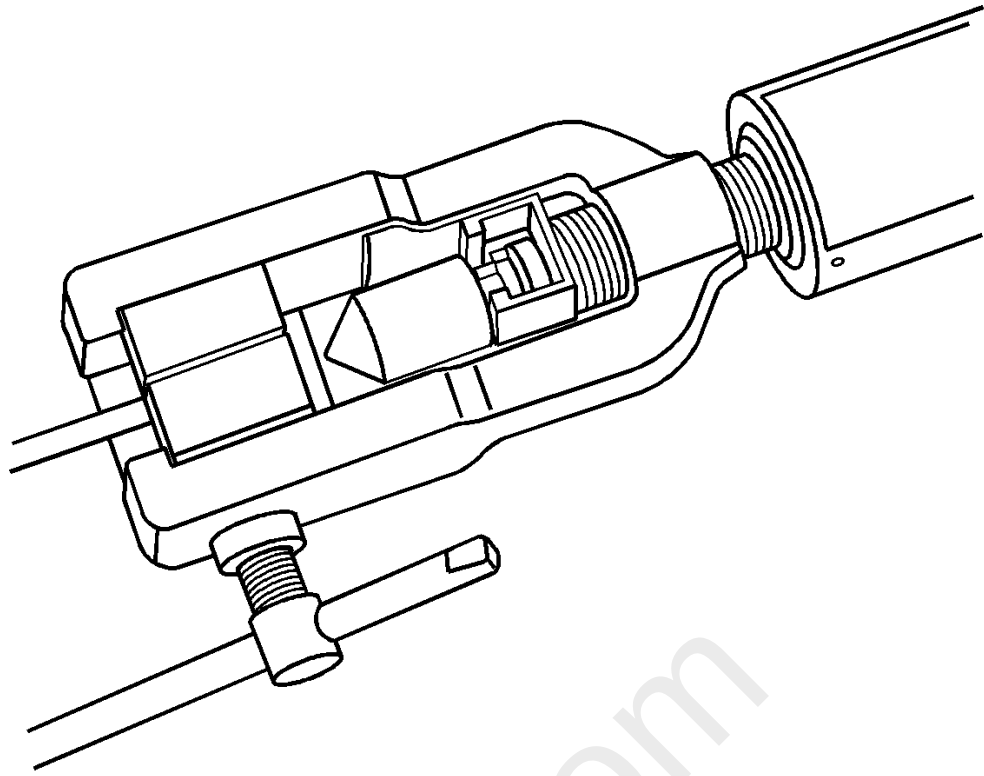


Fig. 97: Using Pipe Flaring Tool

Courtesy of GENERAL MOTORS COMPANY

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 **CH-45405** Brake Pipe Flaring Tool Kit 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 **CH-45405** Brake Pipe Flaring Tool Kit 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.

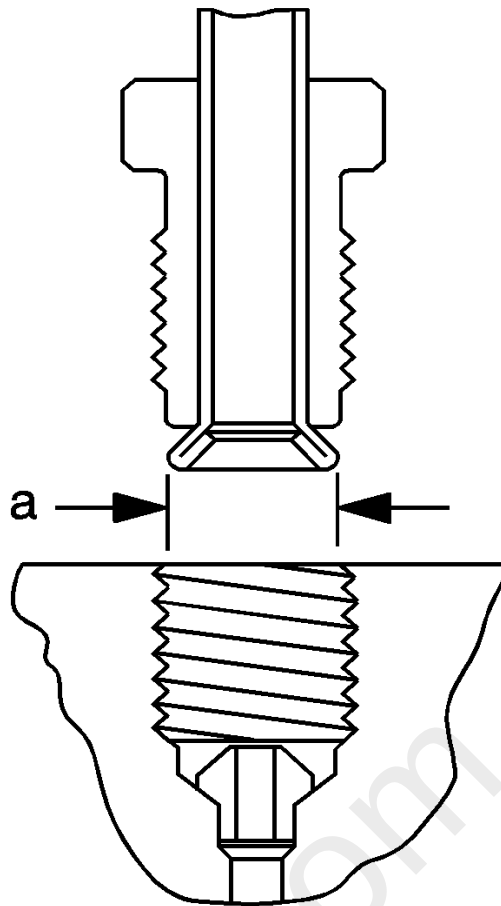


Fig. 98: Correct Brake Pipe Flare Shape And Diameter
Courtesy of GENERAL MOTORS COMPANY

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 \(Manual\)](#)[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.

FRONT BRAKE HOSE REPLACEMENT

Removal Procedure

WARNING: Refer to [Brake Dust Warning](#) .

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

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](#) .

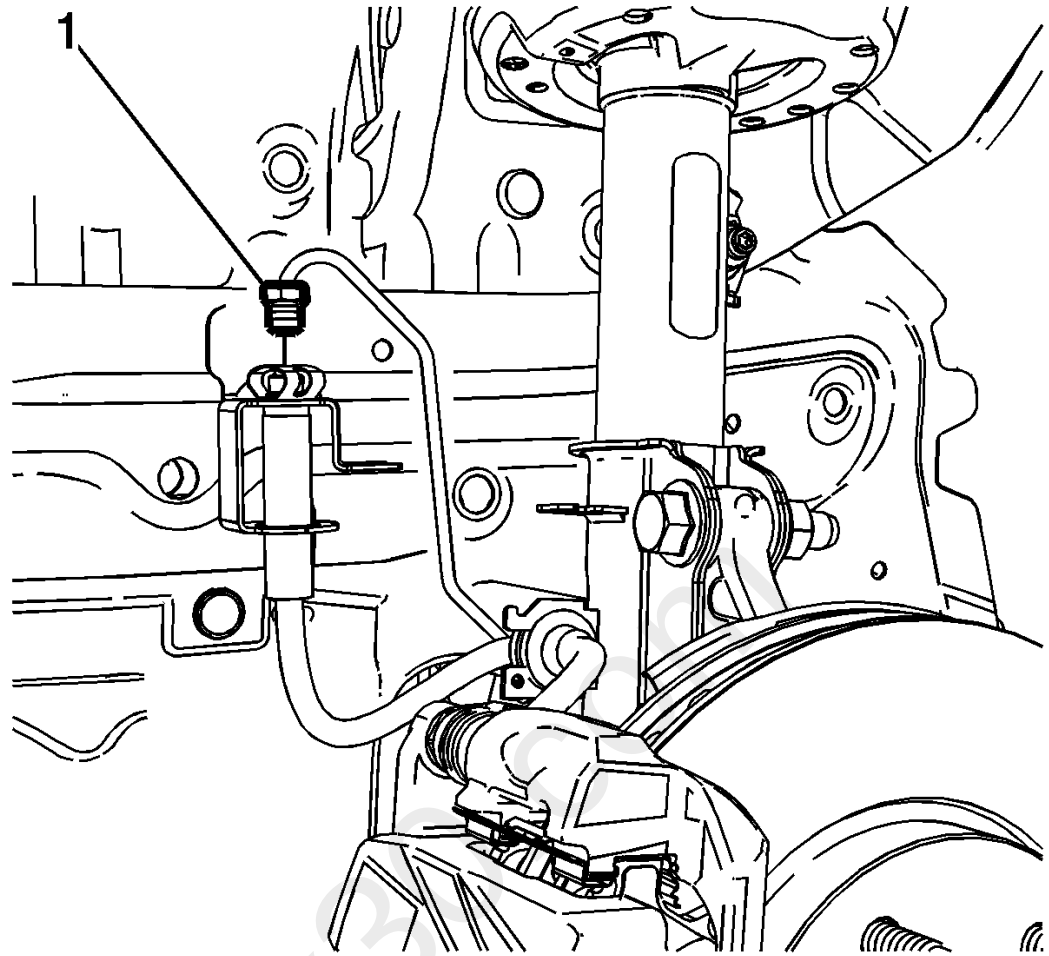


Fig. 99: Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

3. Remove the brake pipe fitting (1) from the front brake hose.
4. Cap the brake pipe fitting to prevent brake fluid loss and contamination.

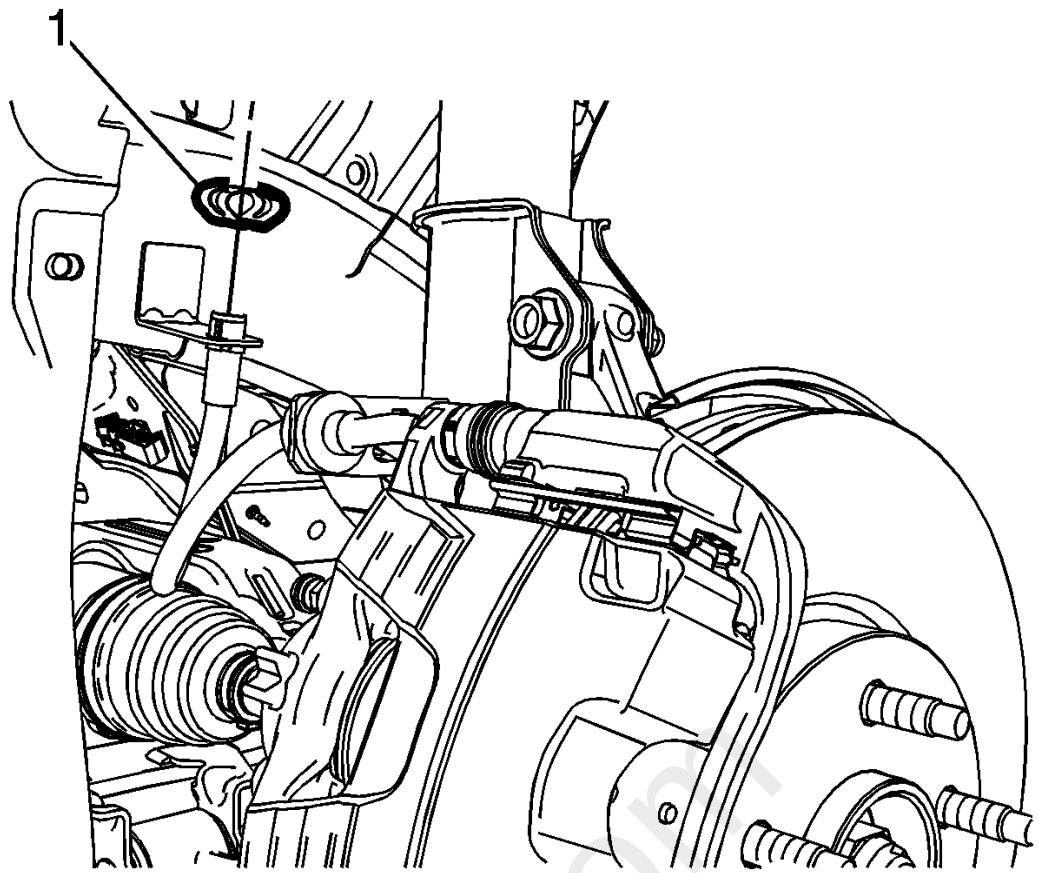


Fig. 100: Brake Hose Retainer

Courtesy of GENERAL MOTORS COMPANY

5. Remove the brake hose retainer (1).

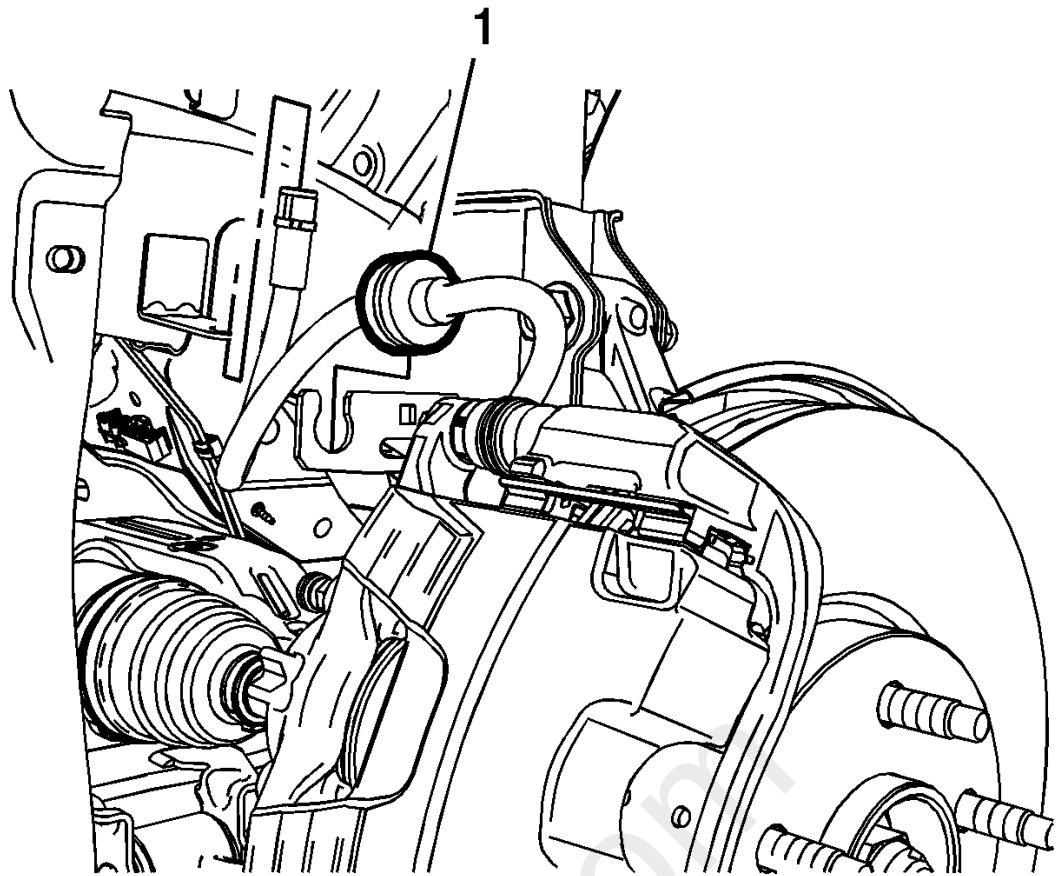


Fig. 101: Brake Hose Grommet

Courtesy of GENERAL MOTORS COMPANY

6. Release the brake hose grommet (1) from the strut bracket.

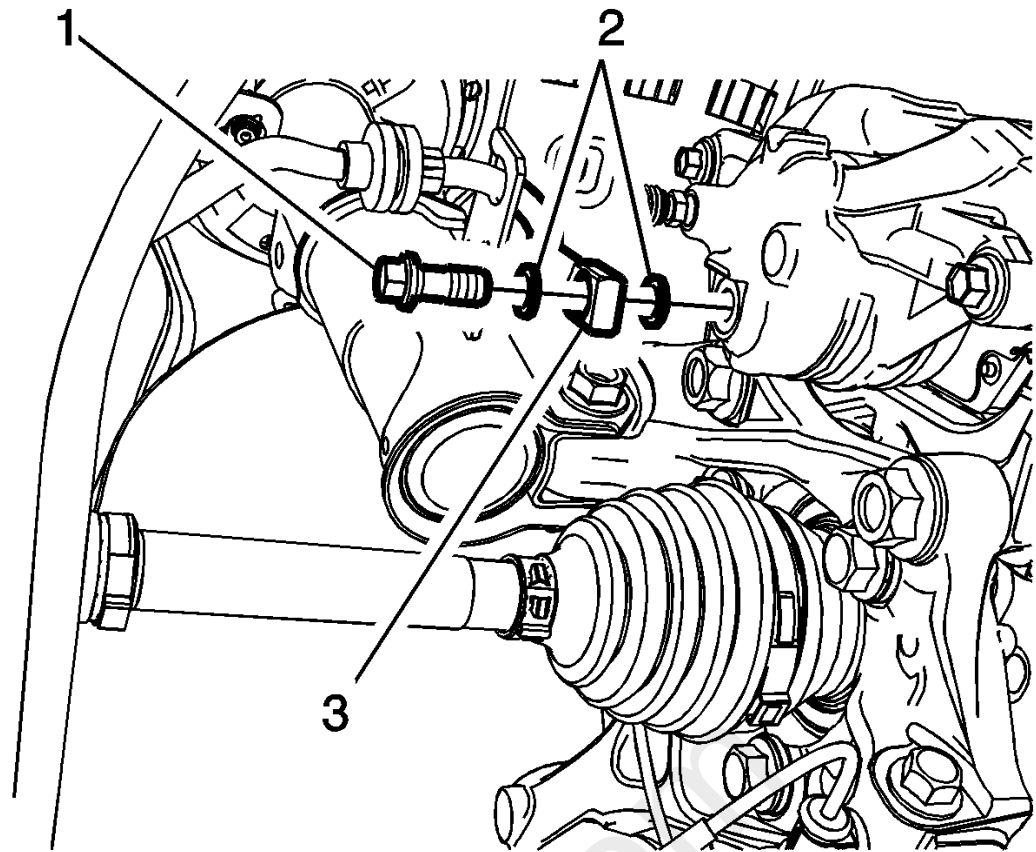


Fig. 102: Brake Hose Fitting, Bolt And Gaskets
Courtesy of GENERAL MOTORS COMPANY

7. Remove the brake hose fitting bolt (1).

NOTE: Do not reuse the brake hose fitting gaskets.

8. Remove and discard the brake hose fitting gaskets (2) from the brake hose fitting (3).

9. Remove the brake hose.

Installation Procedure

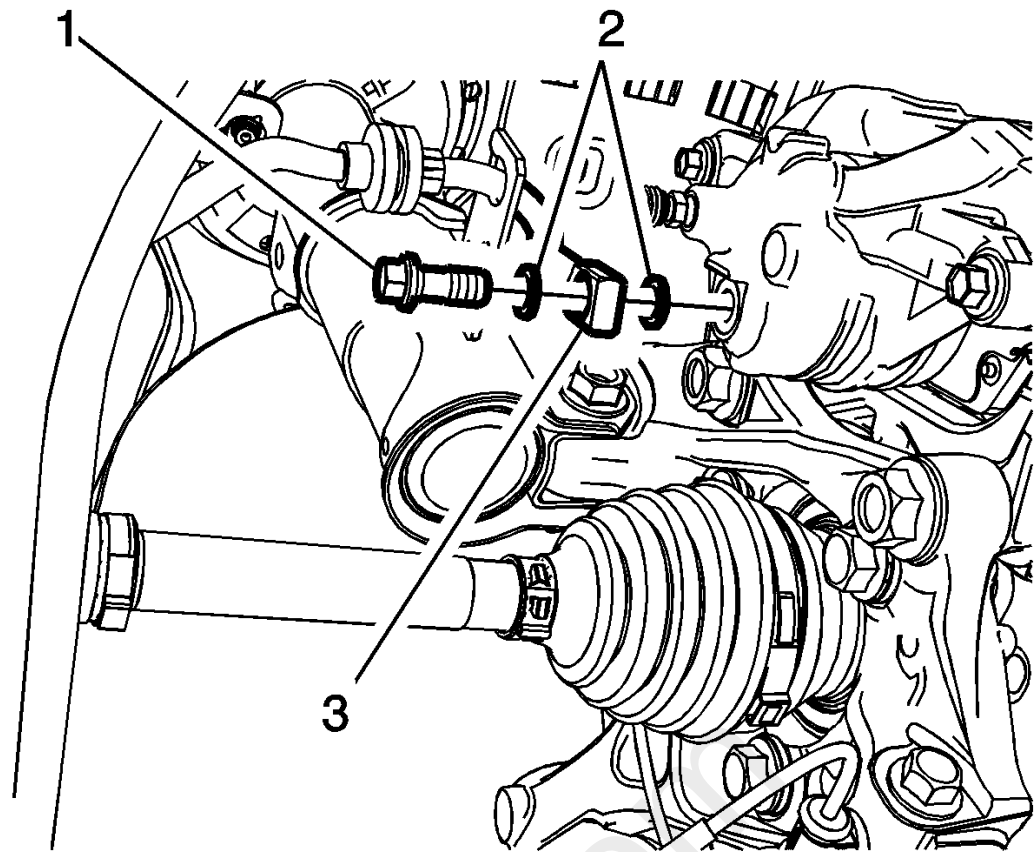


Fig. 103: Brake Hose Fitting, Bolt And Gaskets
Courtesy of GENERAL MOTORS COMPANY

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

CAUTION: Refer to **Fastener Caution** .

2. Install the brake hose assembly to the brake caliper and tighten the fitting bolt to 40 N.m (30 lb ft).

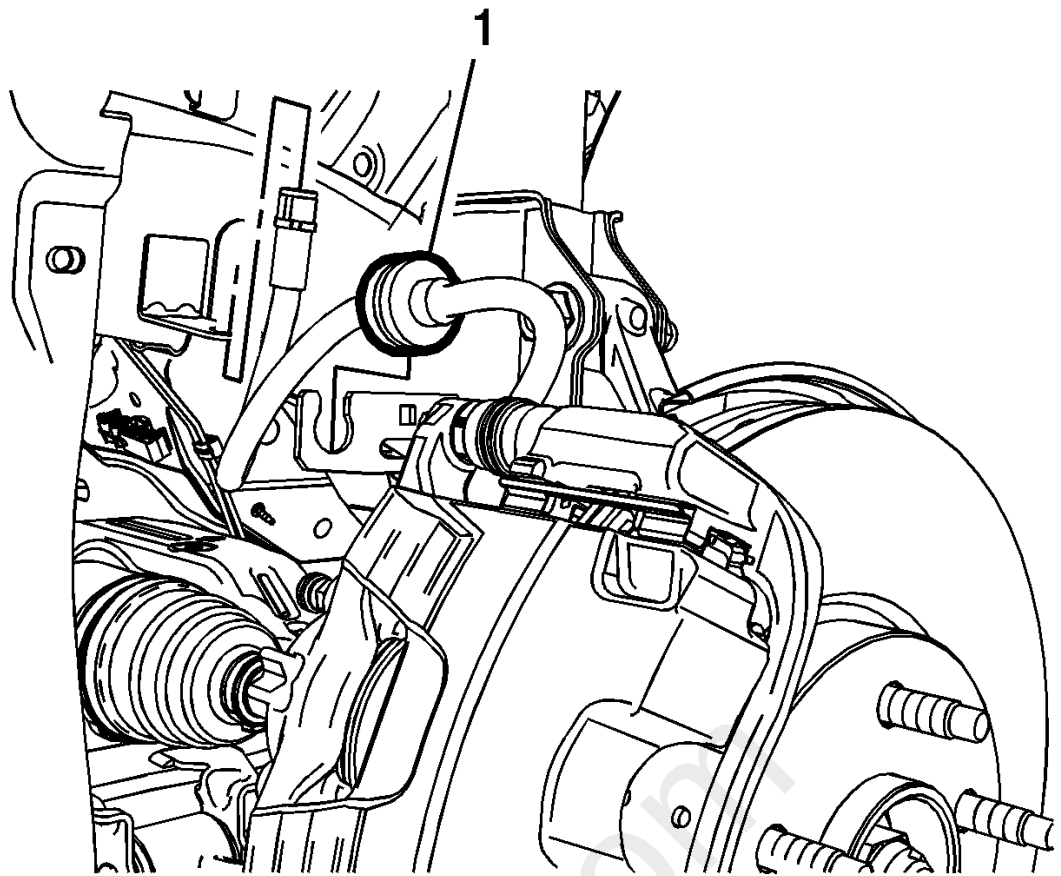


Fig. 104: Brake Hose Grommet

Courtesy of GENERAL MOTORS COMPANY

3. Install the brake hose grommet (1) to the strut bracket.

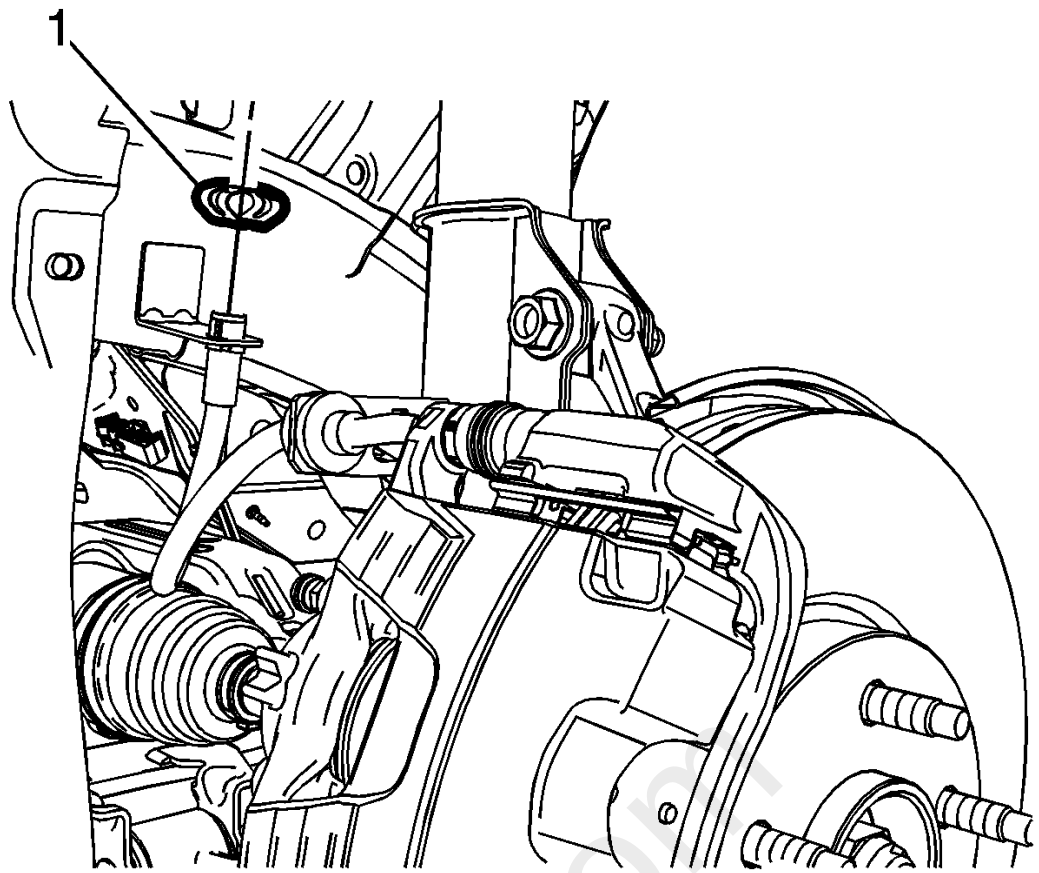


Fig. 105: Brake Hose Retainer

Courtesy of GENERAL MOTORS COMPANY

4. Install the brake hose to the wheelhouse bracket and install the retainer (1).

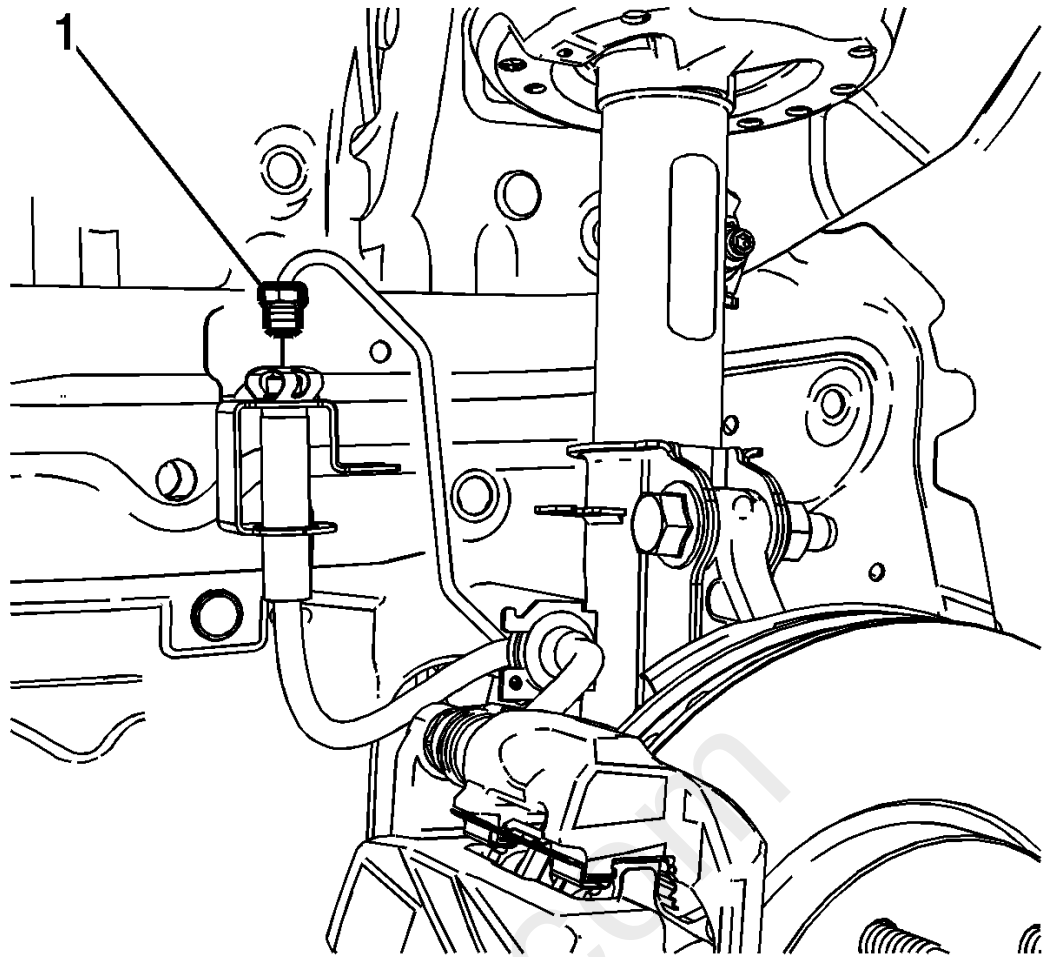


Fig. 106: Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

5. Install the brake pipe fitting (1) to the front brake hose and tighten the fitting to 18 N.m (13 lb ft).
6. Bleed the hydraulic brake system. Refer to [Hydraulic Brake System Bleeding \(Manual\)](#)[Hydraulic Brake System Bleeding \(Pressure\)](#).
7. Install the tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#) .

REAR BRAKE INTERMEDIATE PIPE REPLACEMENT (LEFT)

Removal Procedure

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

1. Remove the battery. Refer to [Battery Replacement](#) .

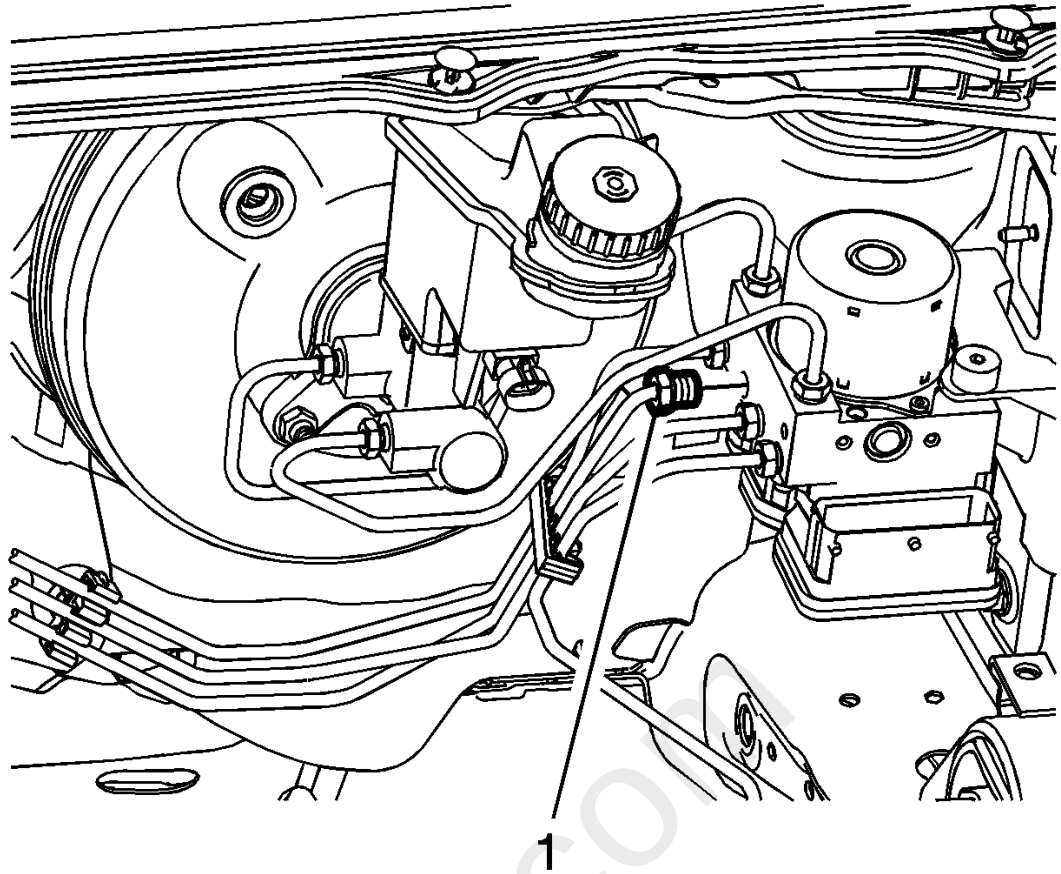


Fig. 107: Left Rear Intermediate Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the left rear intermediate pipe fitting (1) from the brake pressure modulator valve (BPMV).
3. Plug the BPMV outlet port to prevent brake fluid loss and contamination.

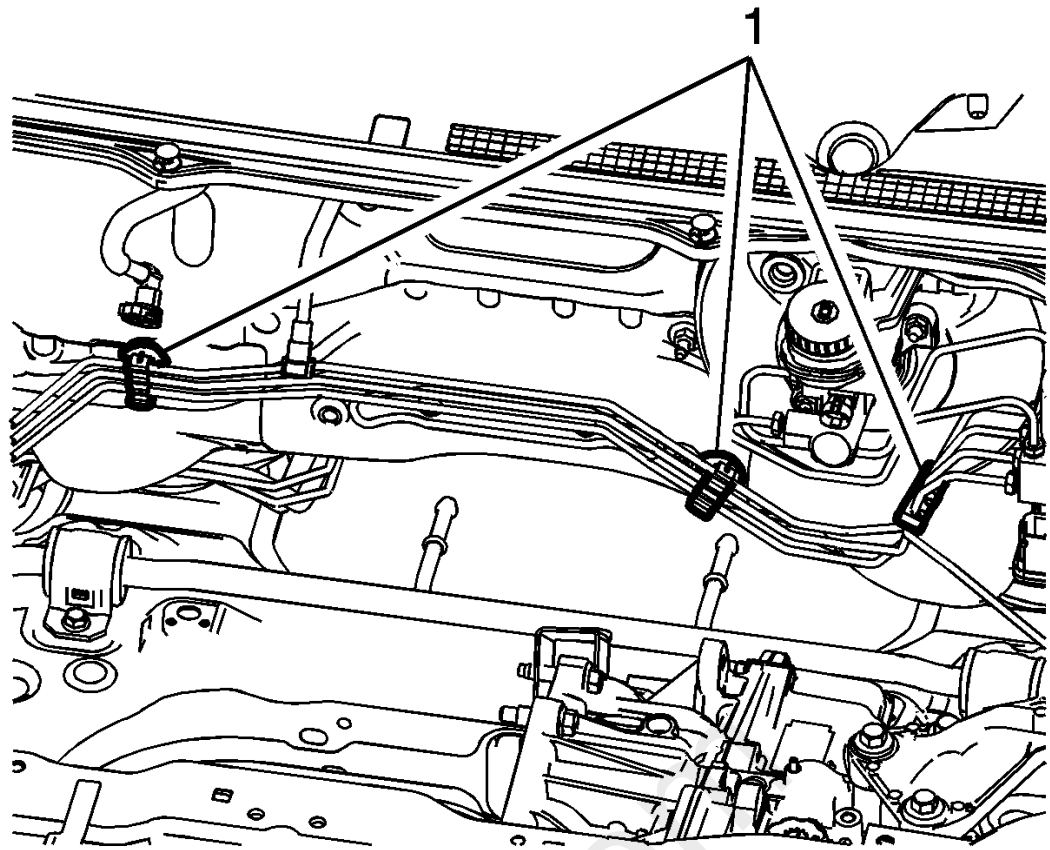


Fig. 108: BPMV Left Rear Intermediate Pipe Retaining Clips

Courtesy of GENERAL MOTORS COMPANY

4. Release the left rear intermediate pipe from the retaining clips (1).
5. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .

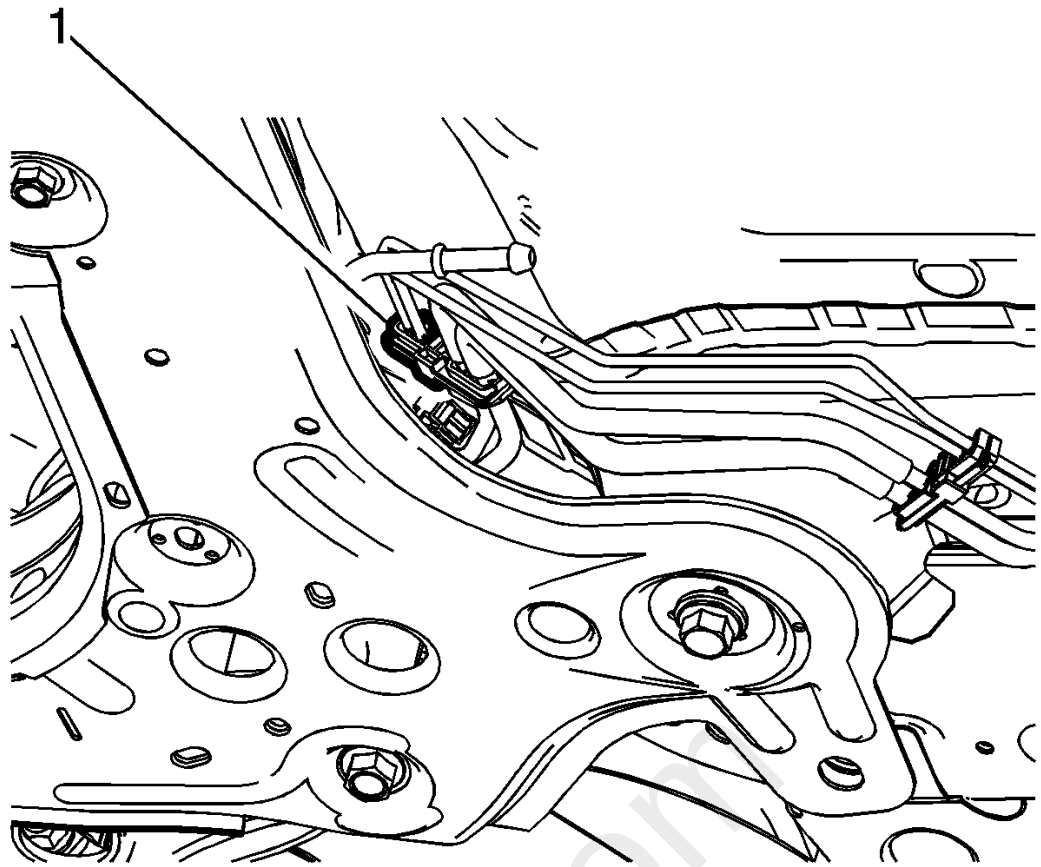


Fig. 109: Left Rear Intermediate Pipe And Retaining Clip
Courtesy of GENERAL MOTORS COMPANY

6. Release the left rear intermediate pipe from the retaining clip (1).

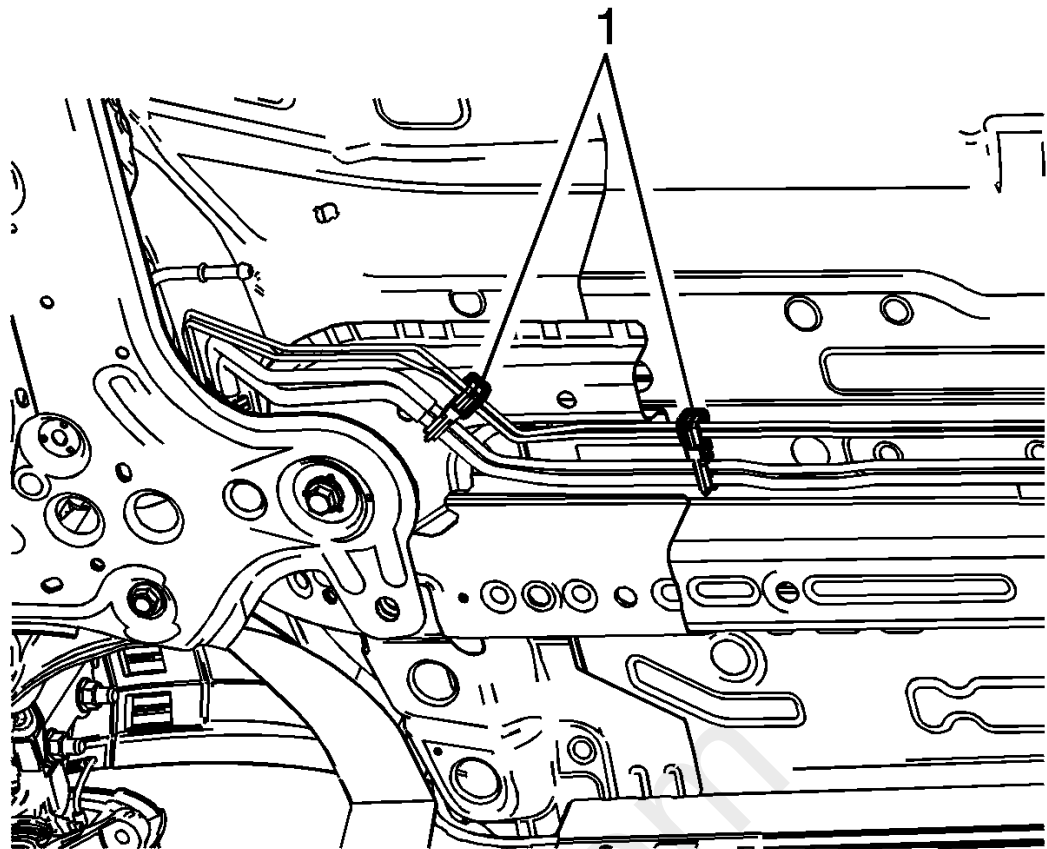


Fig. 110: Front Floor Retaining Clips

Courtesy of GENERAL MOTORS COMPANY

7. Release the left rear intermediate pipe from the front floor retaining clips (1).

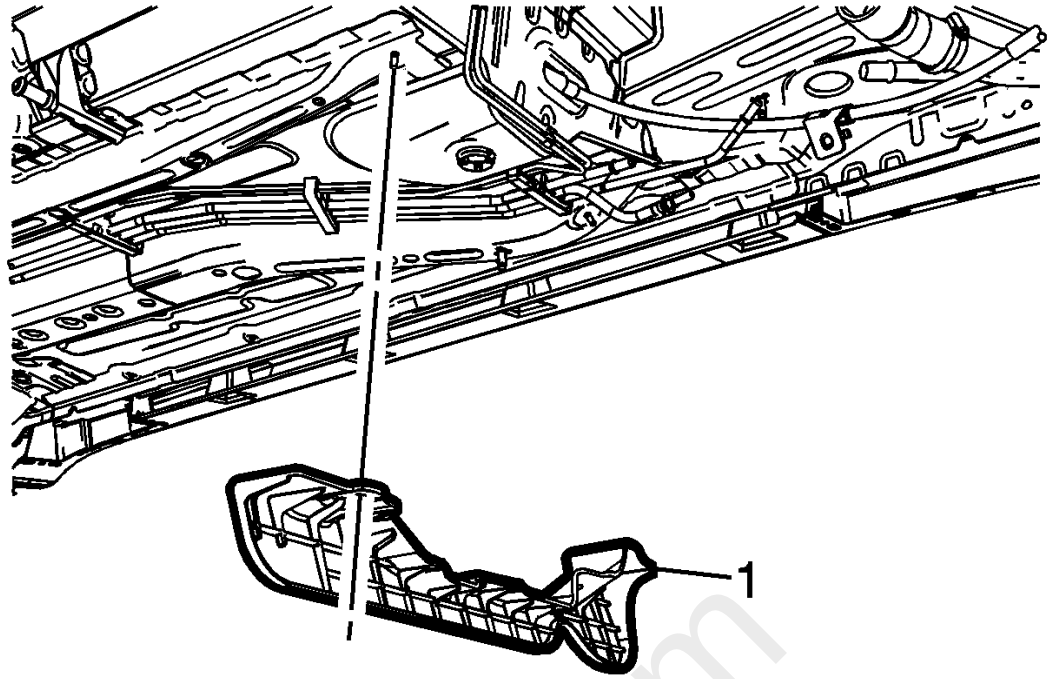


Fig. 111: Underbody Cross Sill Shield

Courtesy of GENERAL MOTORS COMPANY

8. Remove the 2 nuts and the underbody cross sill shield (1).
9. Remove the fuel tank. Refer to [Fuel Tank Replacement \(AWD\)](#) , or [Fuel Tank Replacement](#) .

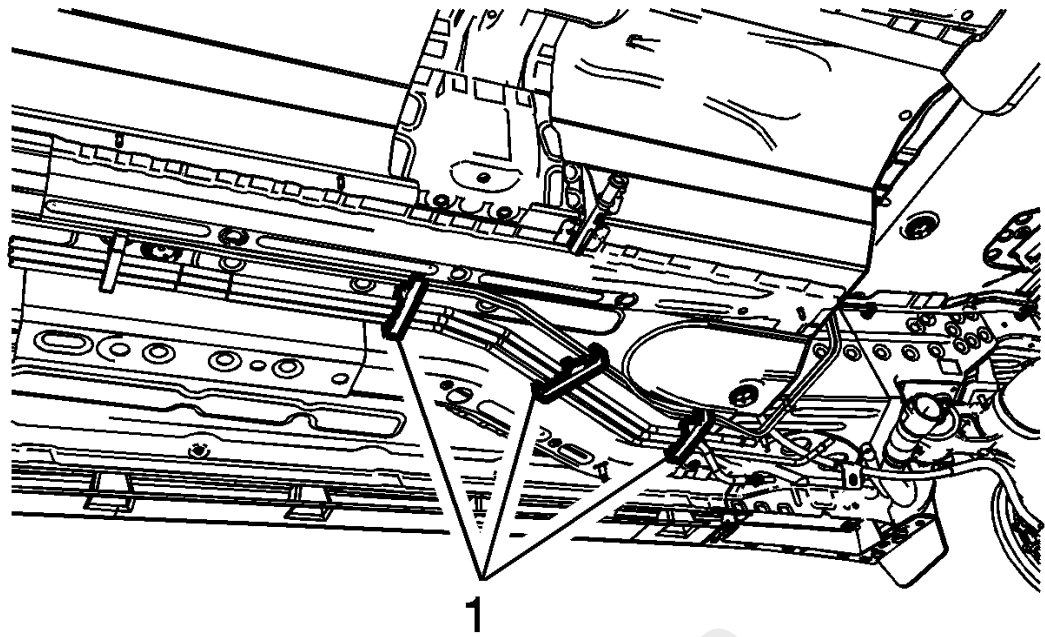


Fig. 112: Rear Floor Retaining Clips

Courtesy of GENERAL MOTORS COMPANY

10. Release the left rear intermediate pipe from the rear floor retaining clips (1).

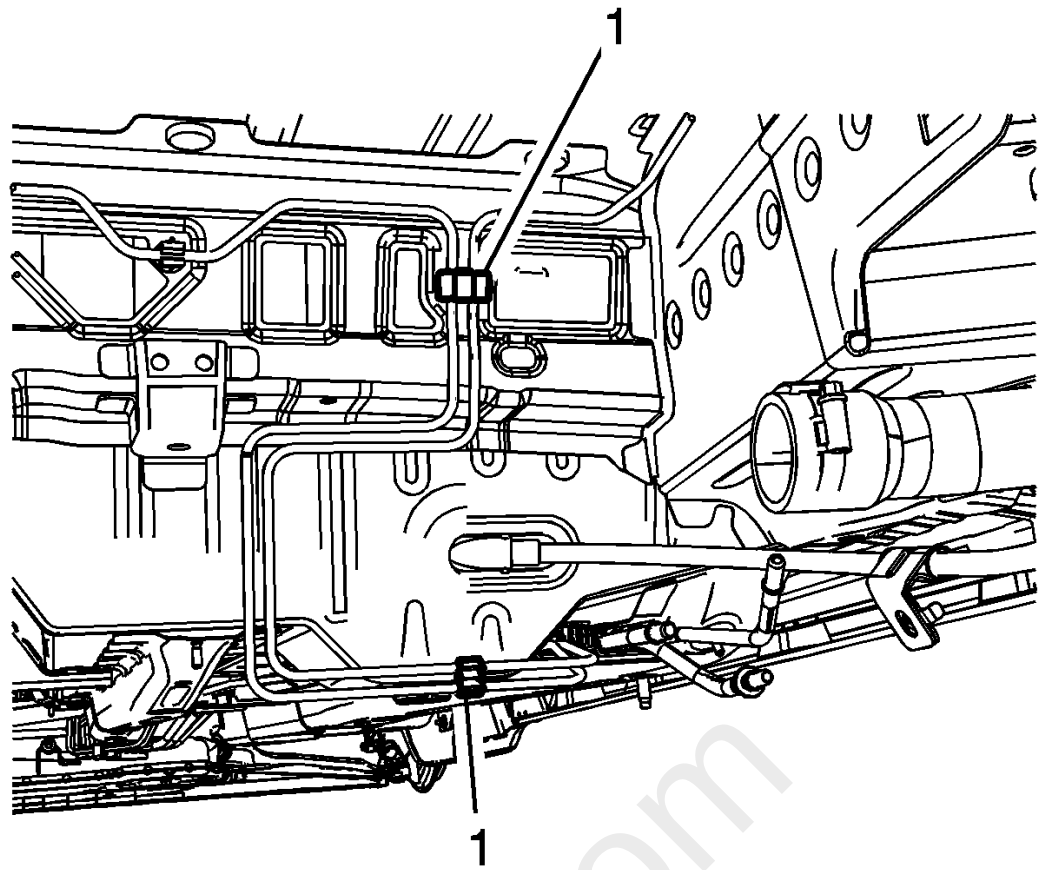


Fig. 113: Left Rear Intermediate Pipe Retaining Clips
Courtesy of GENERAL MOTORS COMPANY

11. Release the left rear intermediate pipe from the retaining clips (1).

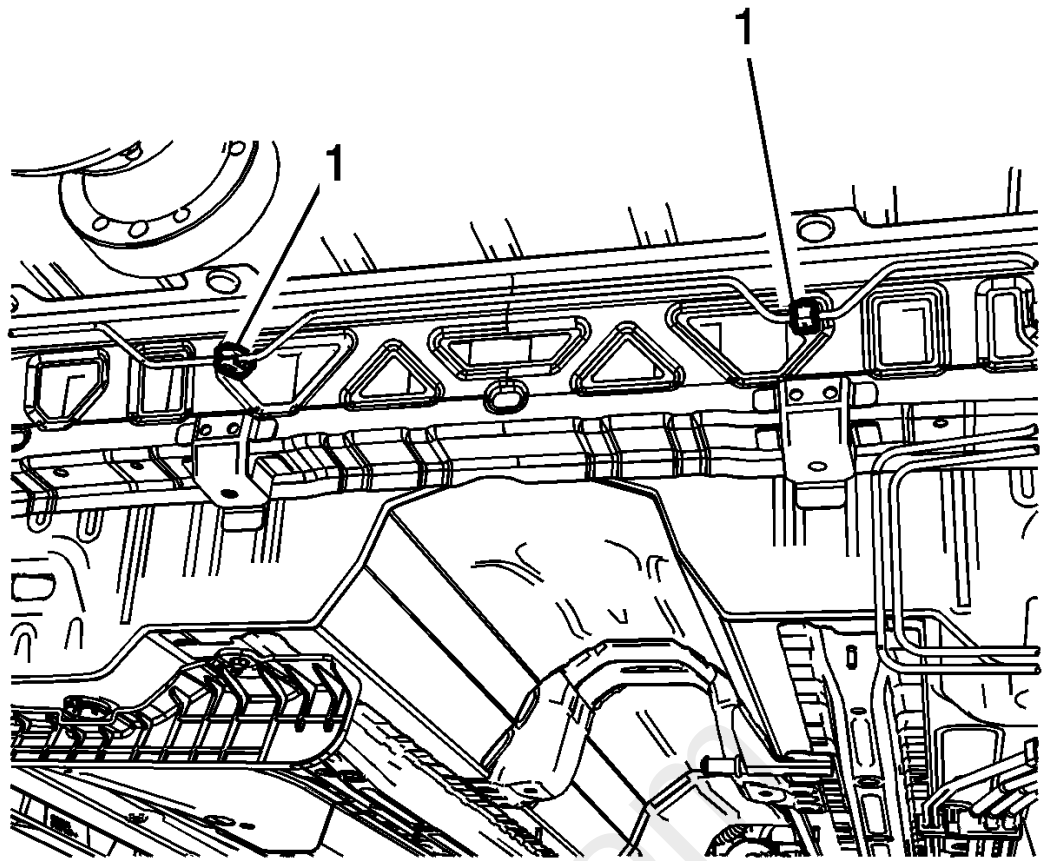


Fig. 114: Left Rear Intermediate Pipe Cross Vehicle Retaining Clips
Courtesy of GENERAL MOTORS COMPANY

12. Release the left rear intermediate pipe from the cross vehicle retaining clips (1).

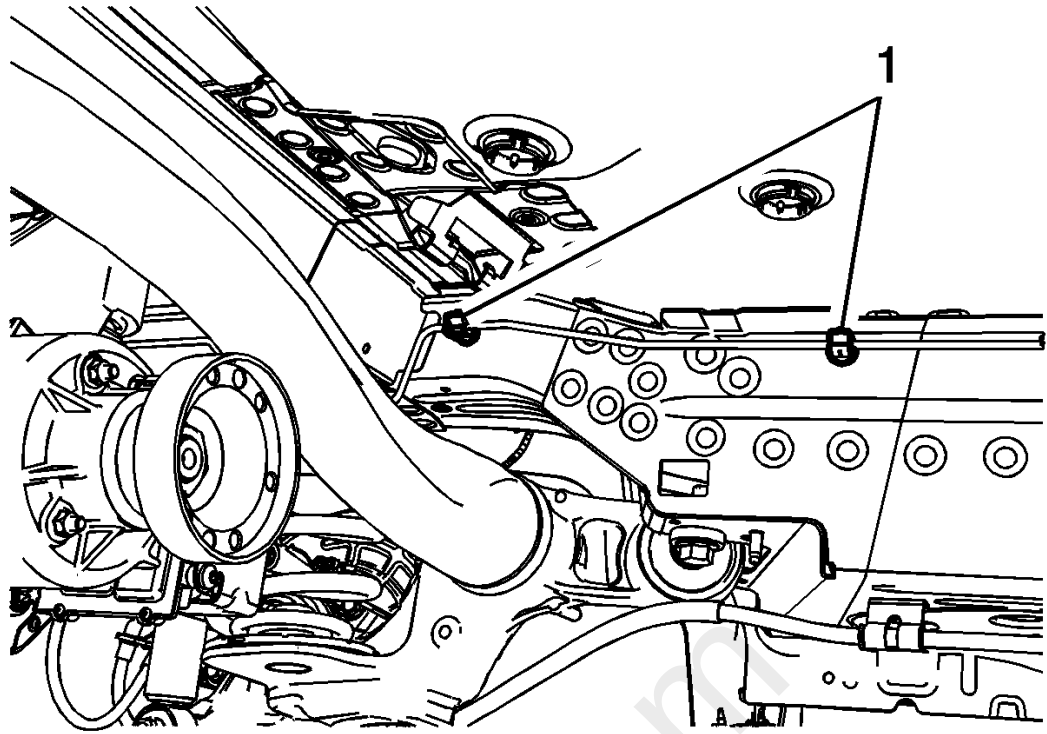


Fig. 115: Left Rear Intermediate Pipe Left Rail Retaining Clips
Courtesy of GENERAL MOTORS COMPANY

13. Release the left rear intermediate pipe from the left rail retaining clips (1).

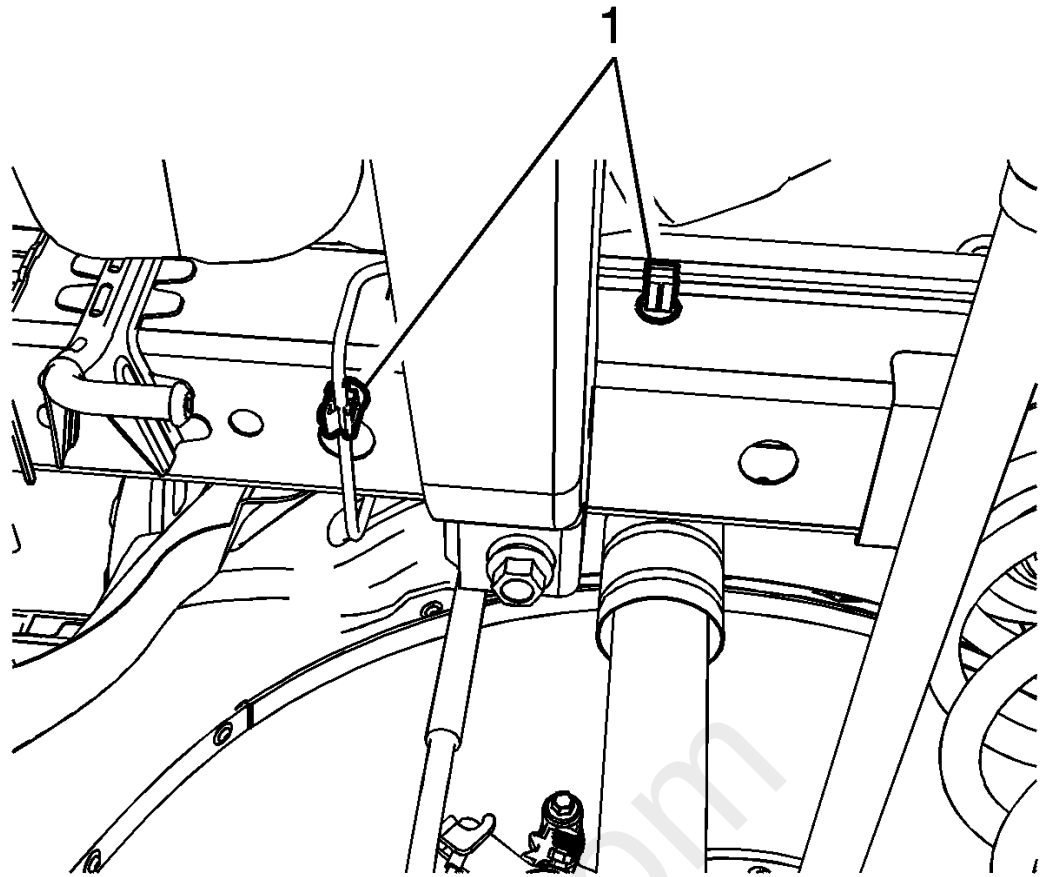


Fig. 116: Left Rear Intermediate Pipe Left Rail Retaining Clips
Courtesy of GENERAL MOTORS COMPANY

14. Release the left rear intermediate pipe from the left rear rail retaining clips (1).

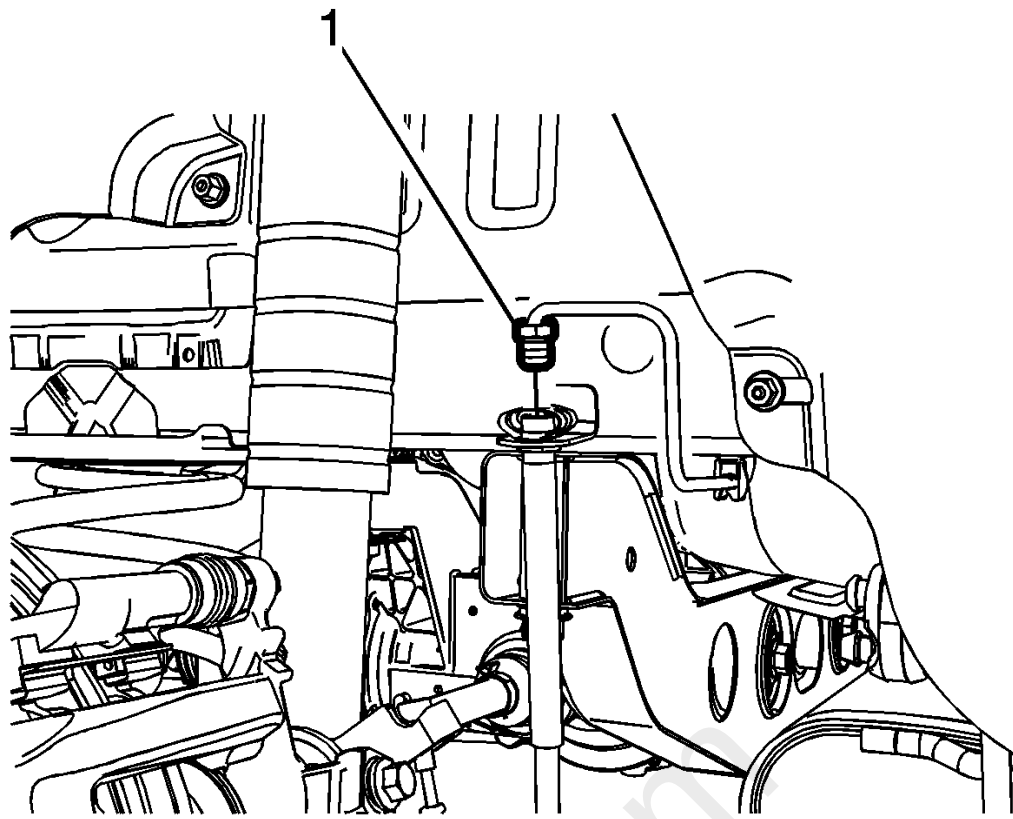


Fig. 117: Left Rear Intermediate Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

15. Disconnect the left rear intermediate pipe fitting (1) from the rear brake hose fitting.
16. Cap the brake hose fitting to prevent brake fluid loss and contamination.
17. Remove the left rear intermediate pipe from the vehicle.

Installation Procedure

1. Install the left rear intermediate pipe from the vehicle.
2. Position, but do not secure, the left rear intermediate pipe to the retaining clips.

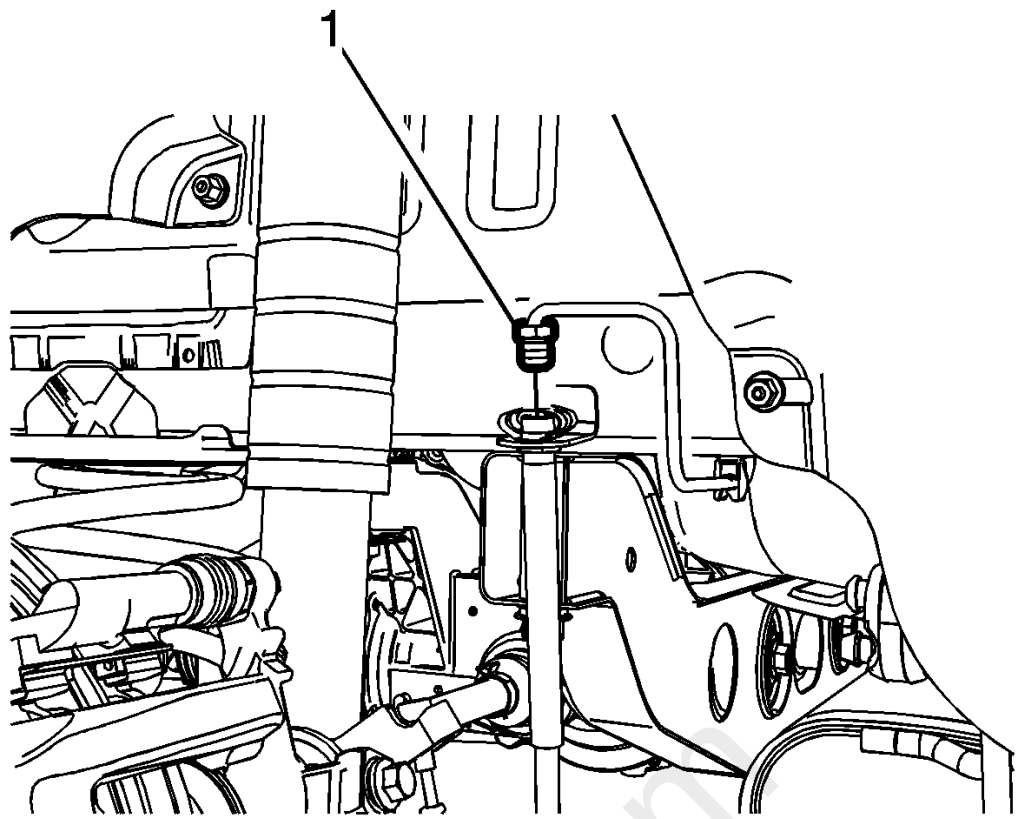


Fig. 118: Left Rear Intermediate Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

3. Install the left rear intermediate pipe fitting (1) to the rear brake hose fitting and tighten the fitting to 18 N.m (13 lb ft).

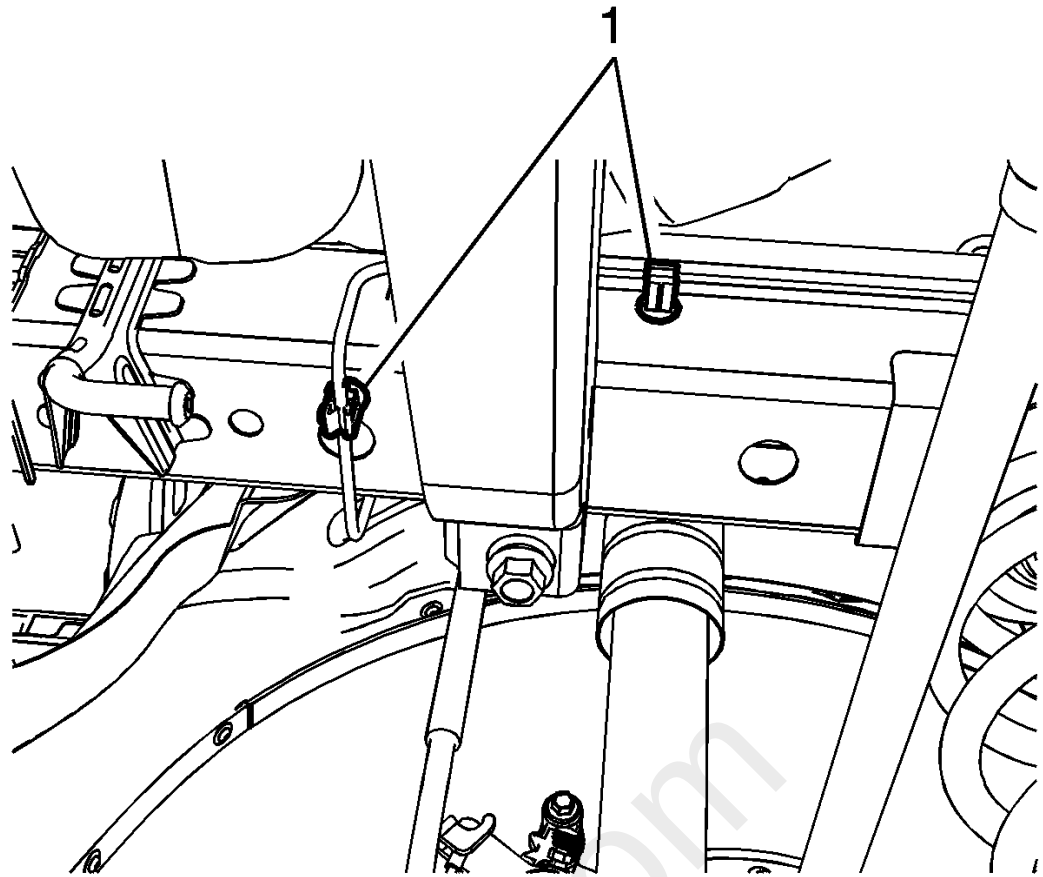


Fig. 119: Left Rear Intermediate Pipe Left Rear Rail Retaining Clips
Courtesy of GENERAL MOTORS COMPANY

4. Secure the left rear intermediate pipe to the left rear rail retaining clips (1).

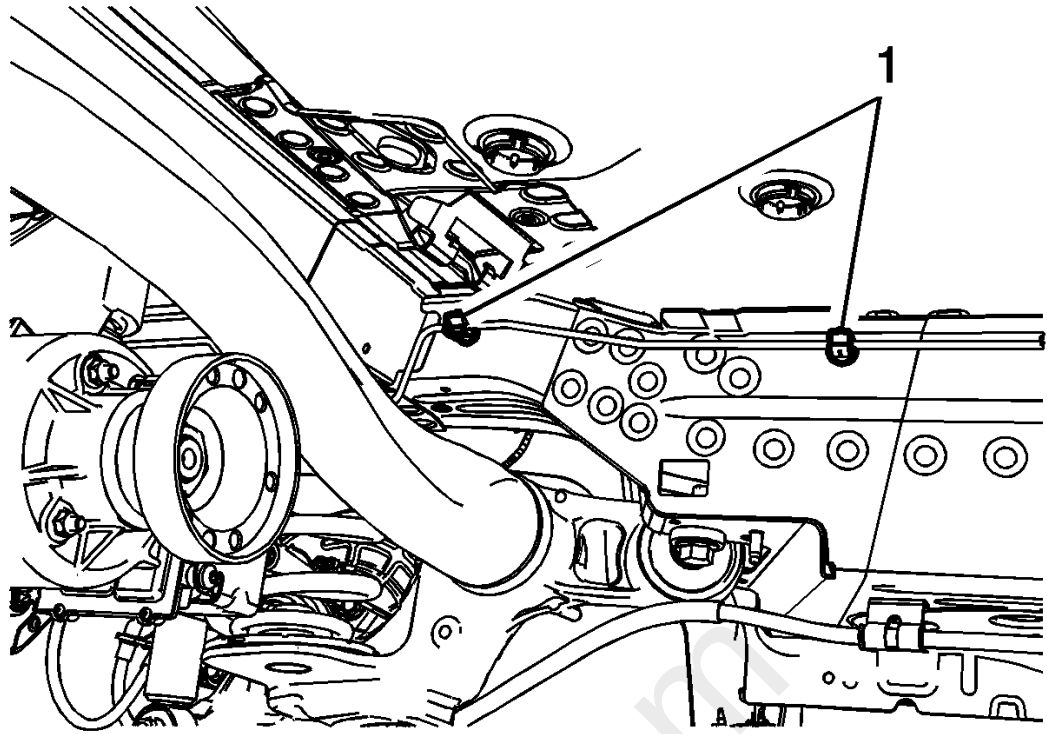


Fig. 120: Left Rear Intermediate Pipe Left Rail Retaining Clips
Courtesy of GENERAL MOTORS COMPANY

5. Secure the left rear intermediate pipe to the left rail retaining clips (1).

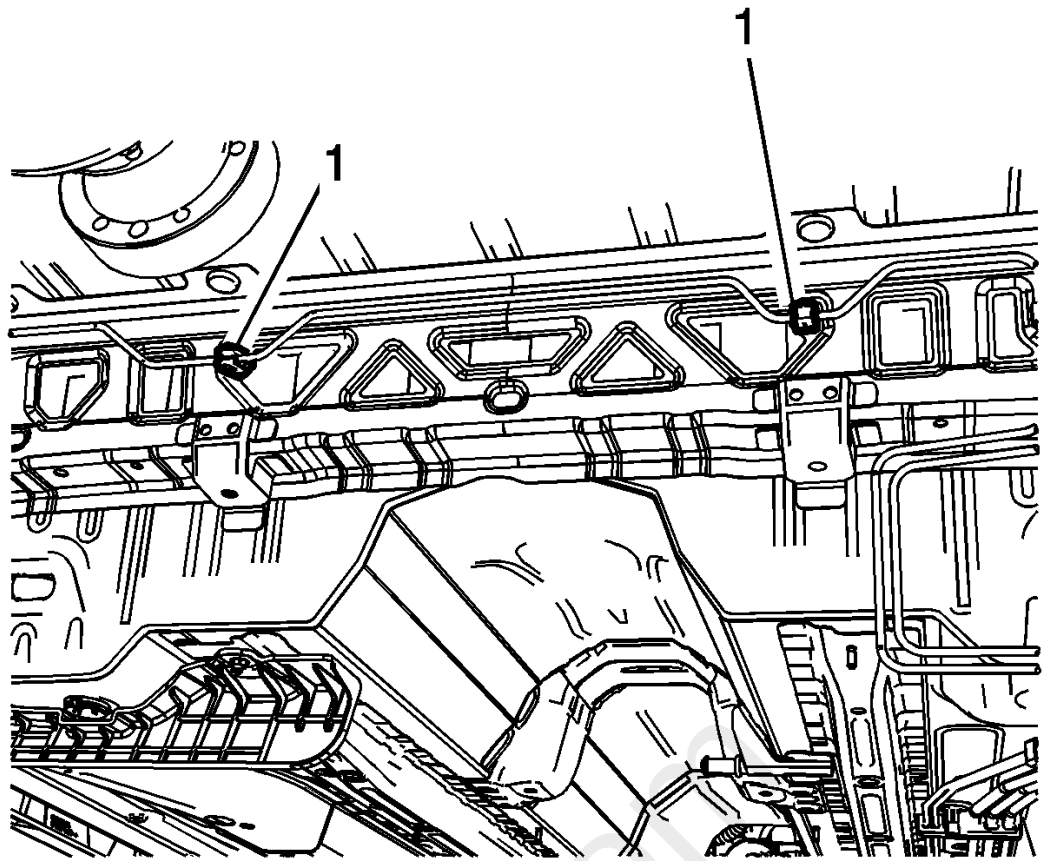


Fig. 121: Left Rear Intermediate Pipe Cross Vehicle Retaining Clips
Courtesy of GENERAL MOTORS COMPANY

6. Secure the left rear intermediate pipe to the cross vehicle retaining clips (1).

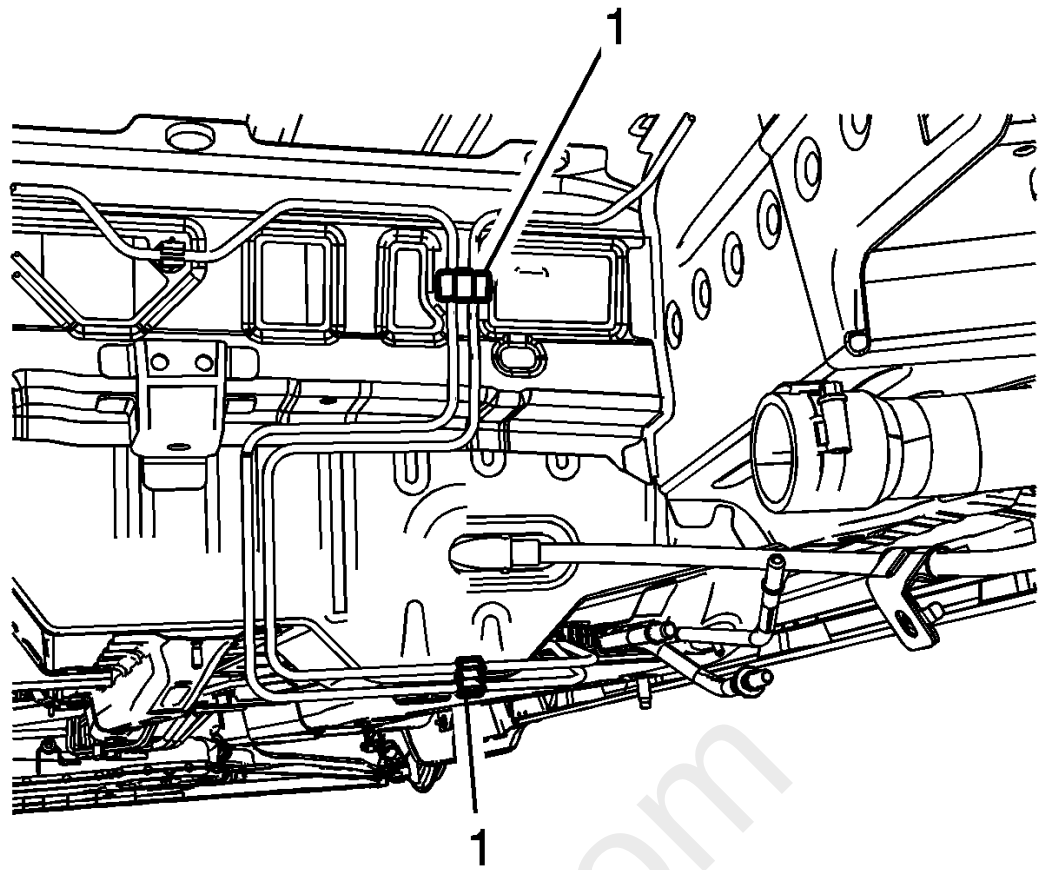


Fig. 122: Left Rear Intermediate Pipe Retaining Clips
Courtesy of GENERAL MOTORS COMPANY

7. Secure the left rear intermediate pipe to the retaining clips (1).

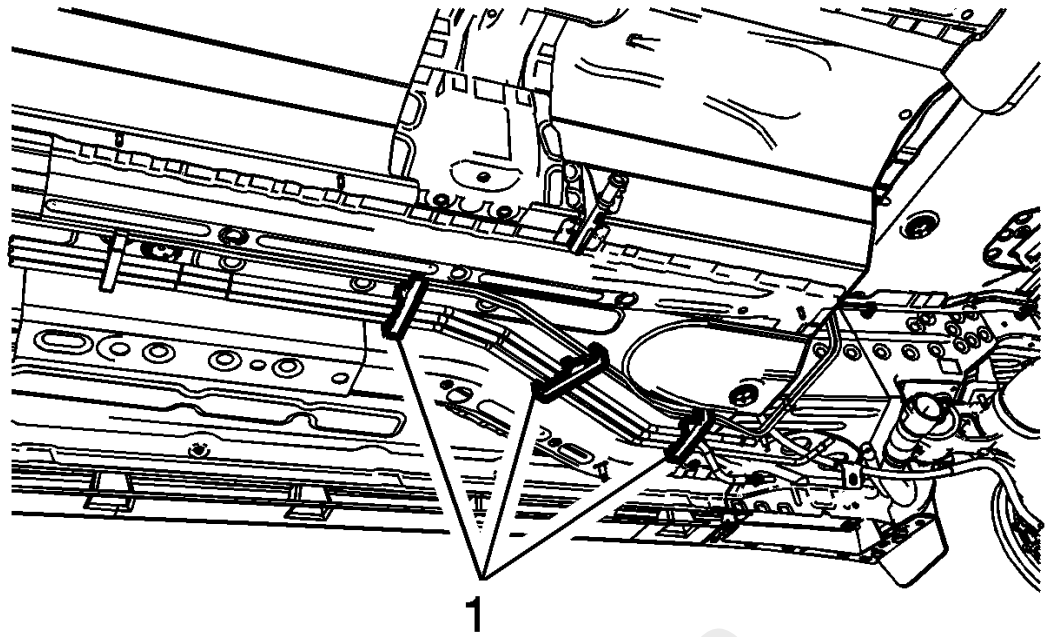


Fig. 123: Rear Floor Retaining Clips

Courtesy of GENERAL MOTORS COMPANY

8. Secure the left rear intermediate pipe to the rear floor retaining clips (1).
9. Install the fuel tank. Refer to [Fuel Tank Replacement \(AWD\)](#) , or [Fuel Tank Replacement](#) .

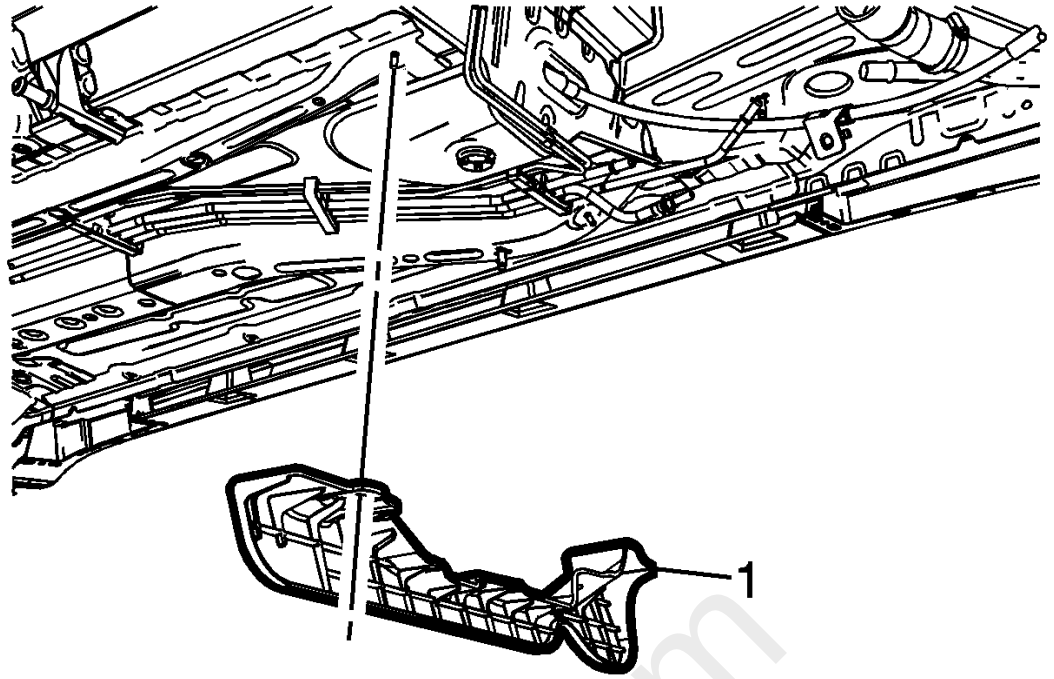


Fig. 124: Underbody Cross Sill Shield

Courtesy of GENERAL MOTORS COMPANY

10. Install the underbody cross sill shield (1) and the 2 nuts.

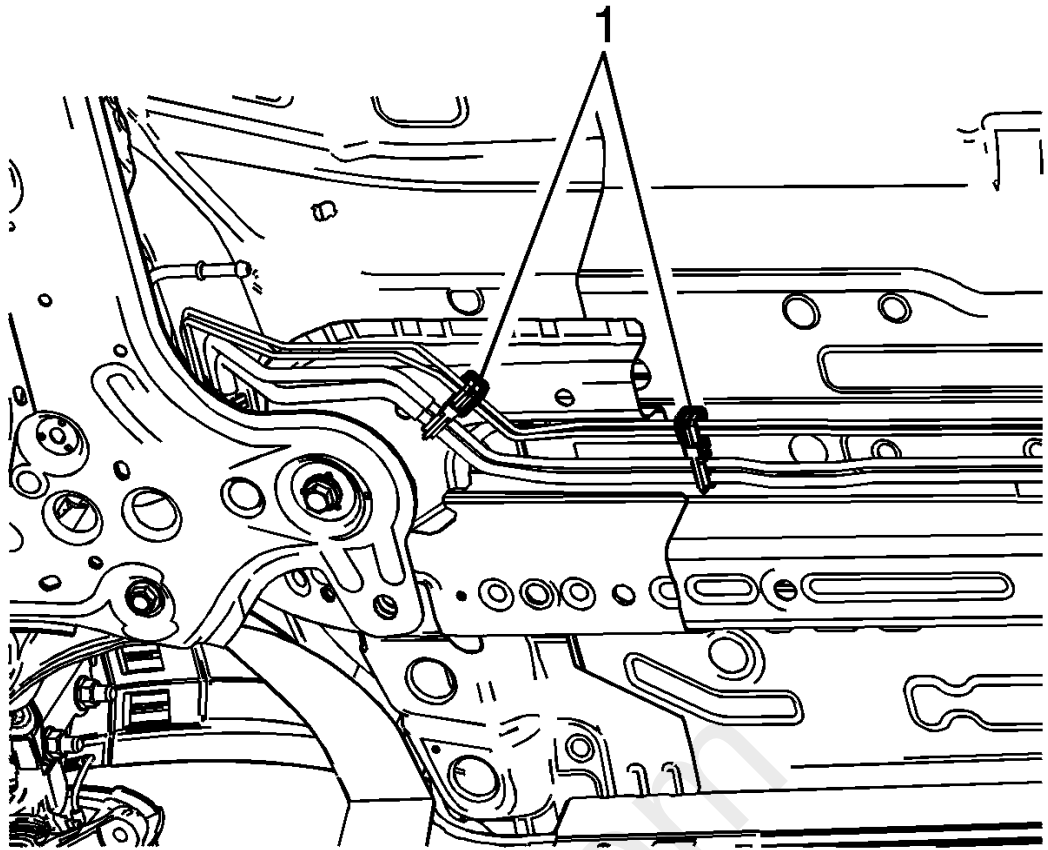


Fig. 125: Front Floor Retaining Clips

Courtesy of GENERAL MOTORS COMPANY

11. Secure the left rear intermediate pipe to the front floor retaining clips (1).

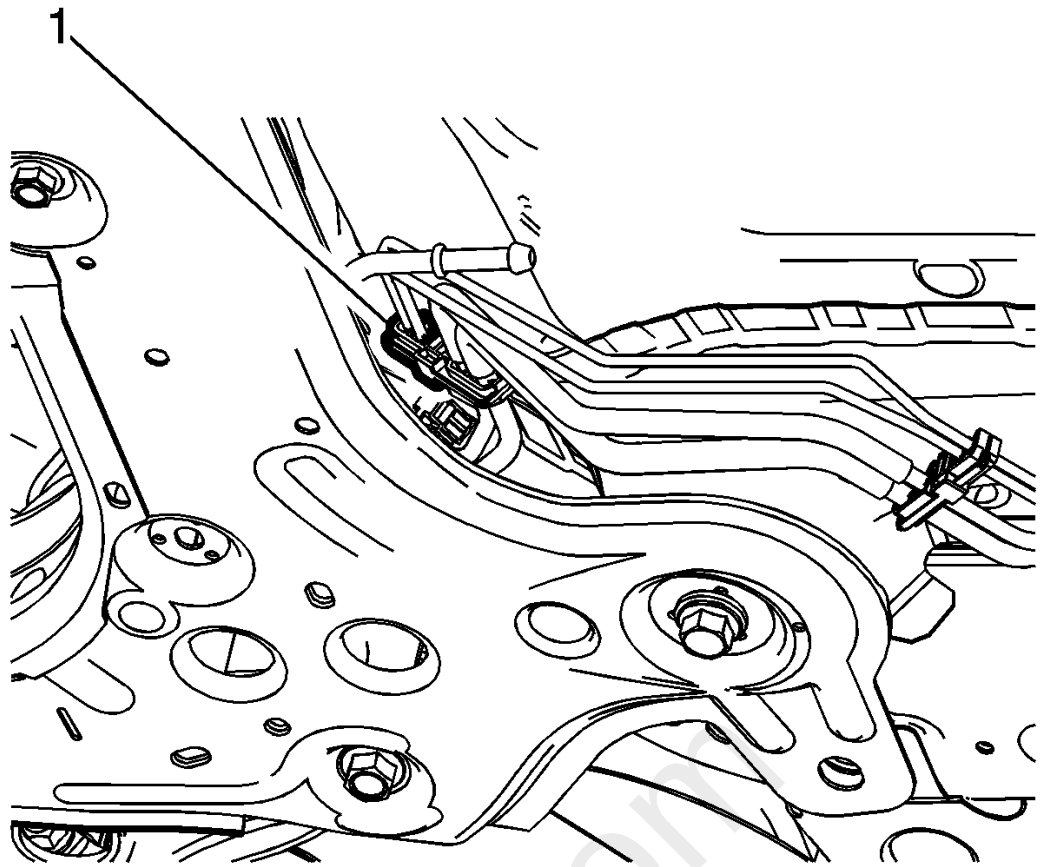


Fig. 126: Left Rear Intermediate Pipe Retaining Clip

Courtesy of GENERAL MOTORS COMPANY

12. Secure the left rear intermediate pipe to the retaining clip (1).

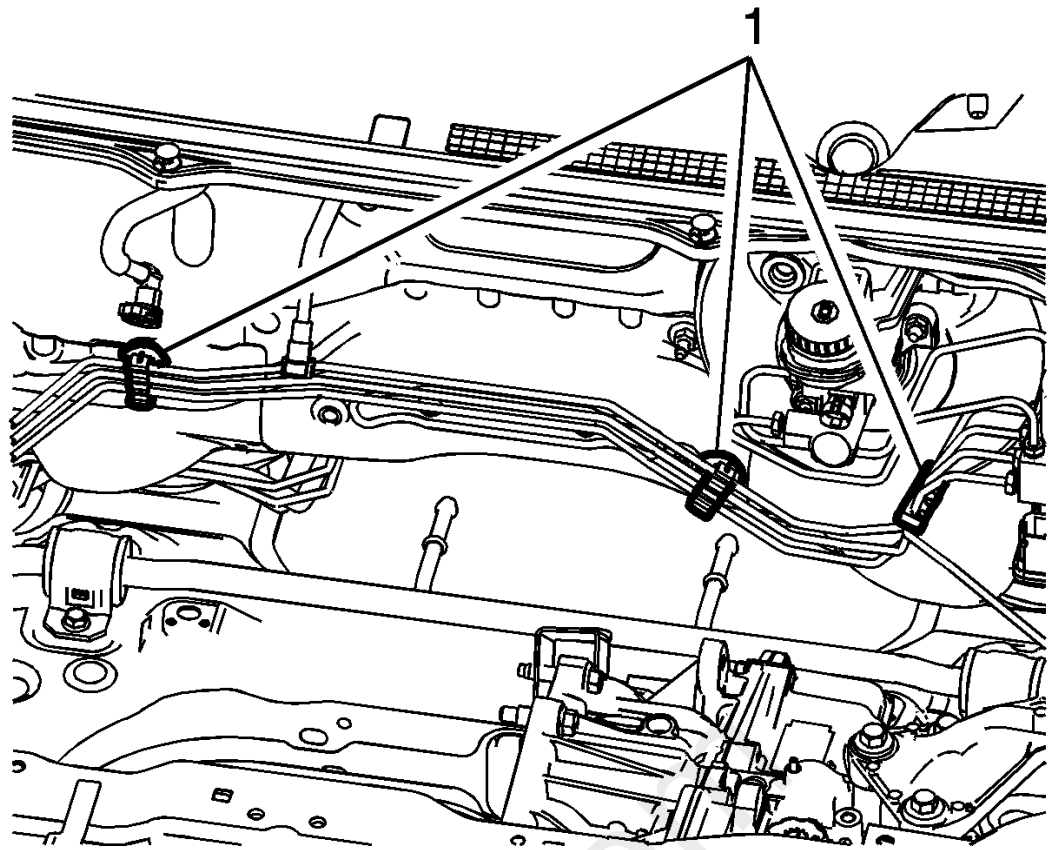


Fig. 127: Left Rear Intermediate Pipe Retaining Clips
Courtesy of GENERAL MOTORS COMPANY

13. Secure the left rear intermediate pipe to the retaining clips (1).

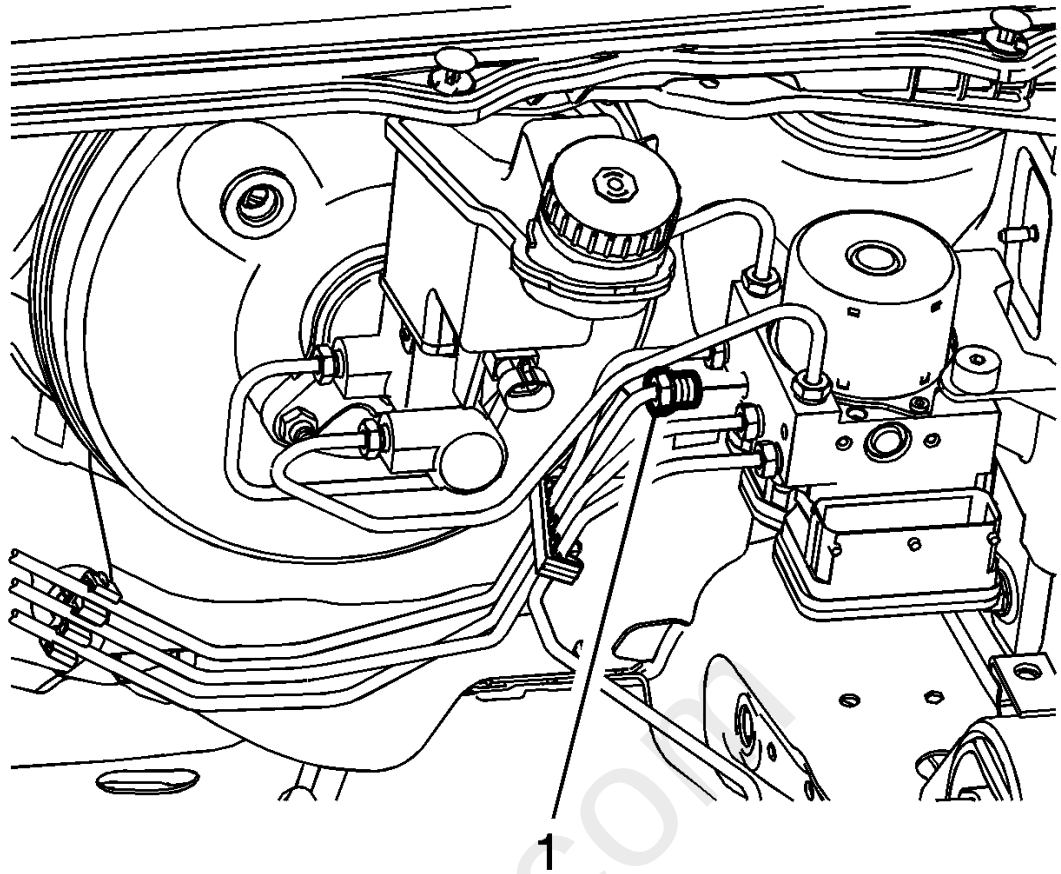


Fig. 128: Left Rear Intermediate Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

14. Connect the left rear intermediate pipe fitting (1) to the BPMV and tighten the fitting to 18 N.m (13 lb ft).
15. Install the battery. Refer to [Battery Replacement](#) .
16. Bleed the hydraulic brake system. Refer to [Hydraulic Brake System Bleeding \(Manual\)](#)[Hydraulic Brake System Bleeding \(Pressure\)](#).

REAR BRAKE INTERMEDIATE PIPE REPLACEMENT (RIGHT)

Removal Procedure

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

1. Remove the battery. Refer to [Battery Replacement](#) .

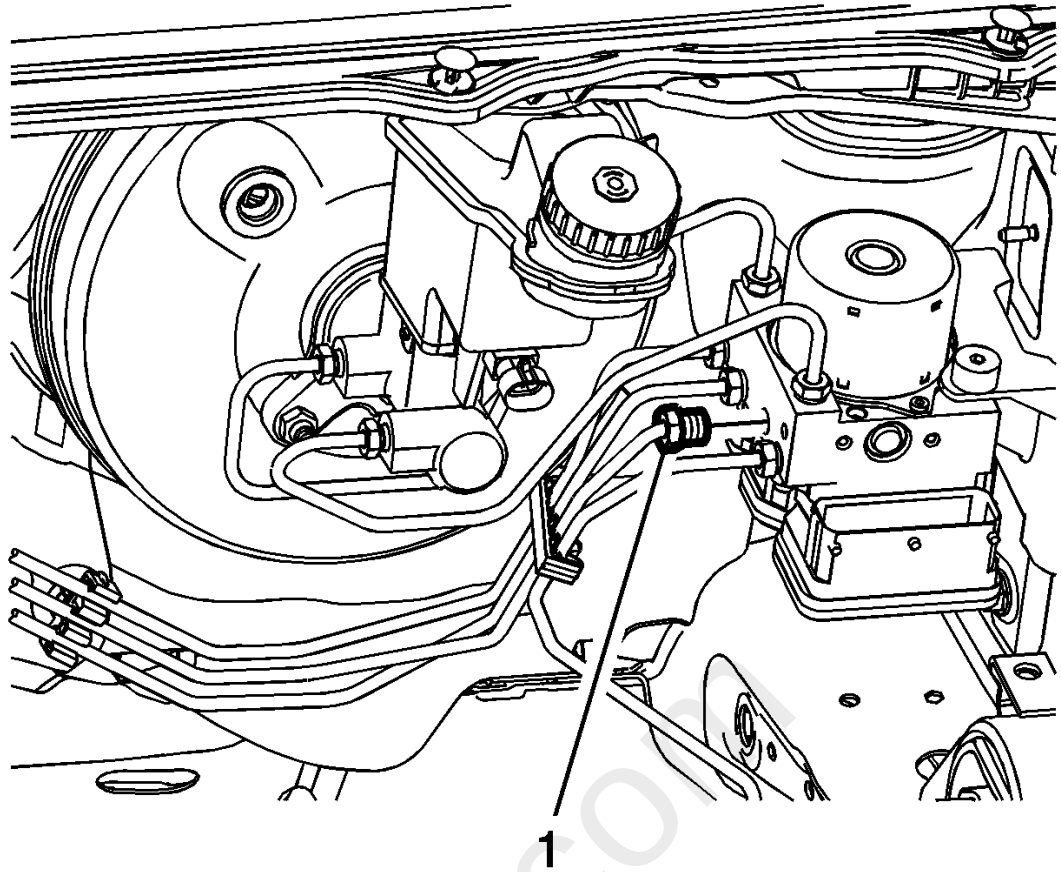


Fig. 129: Right Rear Intermediate Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the right rear intermediate pipe fitting (1) from the brake pressure modulator valve (BPMV).
3. Plug the BPMV outlet port to prevent brake fluid loss and contamination.

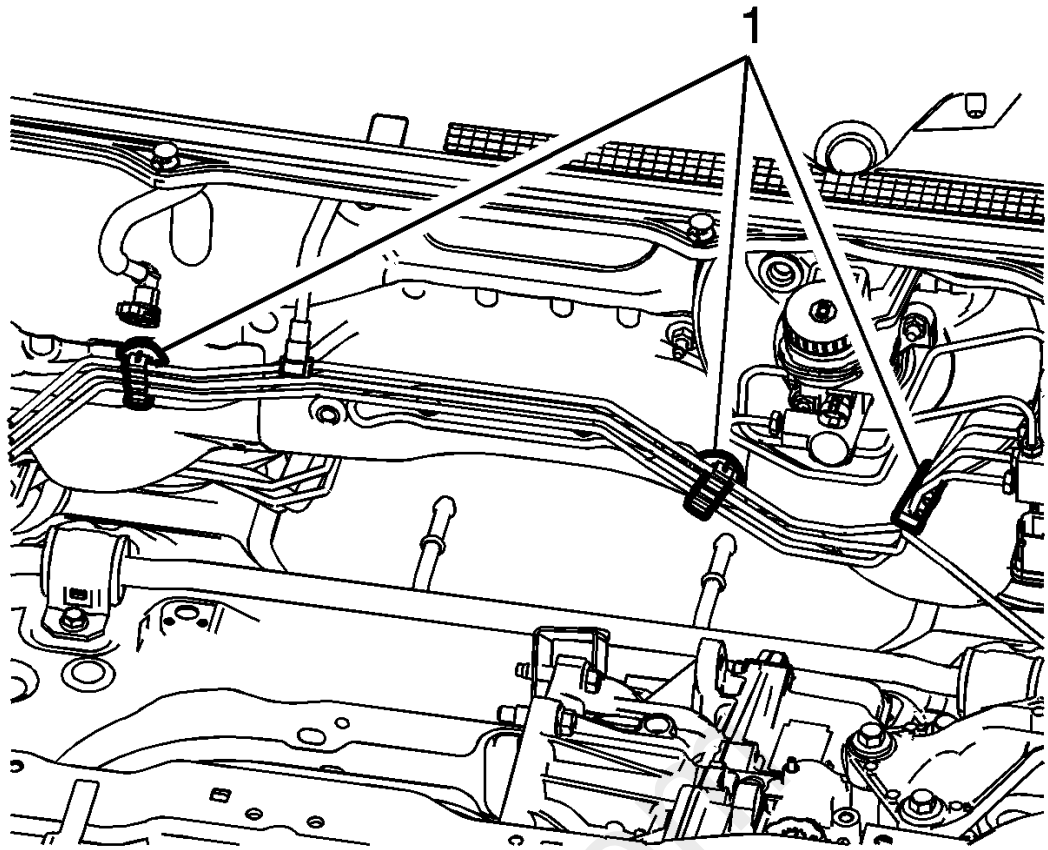


Fig. 130: Right Rear Intermediate Pipe Retaining Clips

Courtesy of GENERAL MOTORS COMPANY

4. Release the right rear intermediate pipe from the retaining clips (1).
5. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .

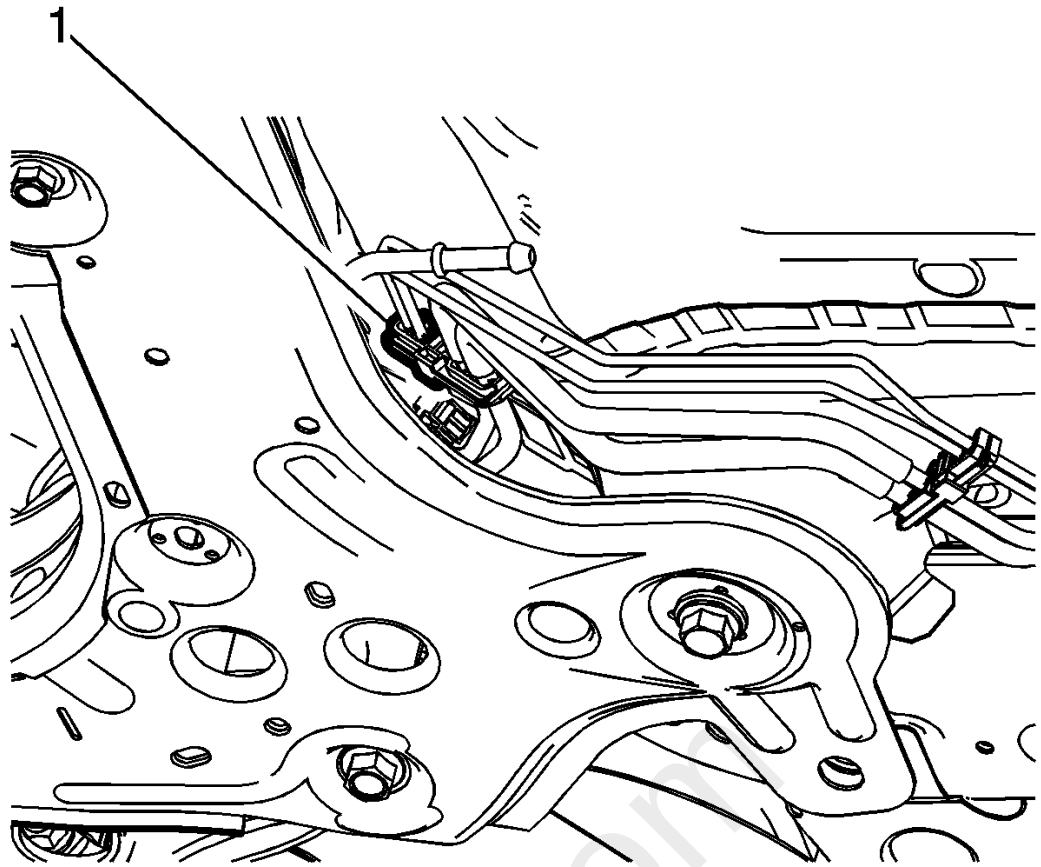


Fig. 131: Right Rear Intermediate Pipe And Retaining Clip
Courtesy of GENERAL MOTORS COMPANY

6. Release the right rear intermediate pipe from the retaining clip (1).

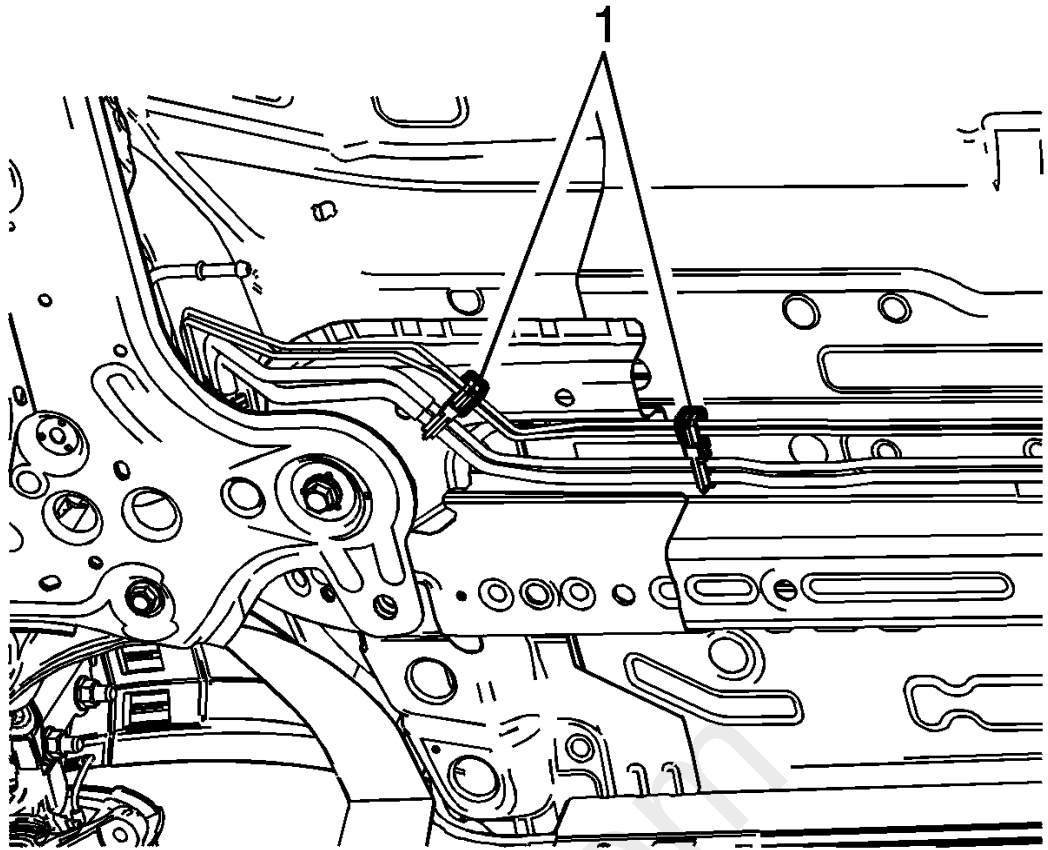


Fig. 132: Front Floor Retaining Clips

Courtesy of GENERAL MOTORS COMPANY

7. Release the right rear intermediate pipe from the front floor retaining clips (1).

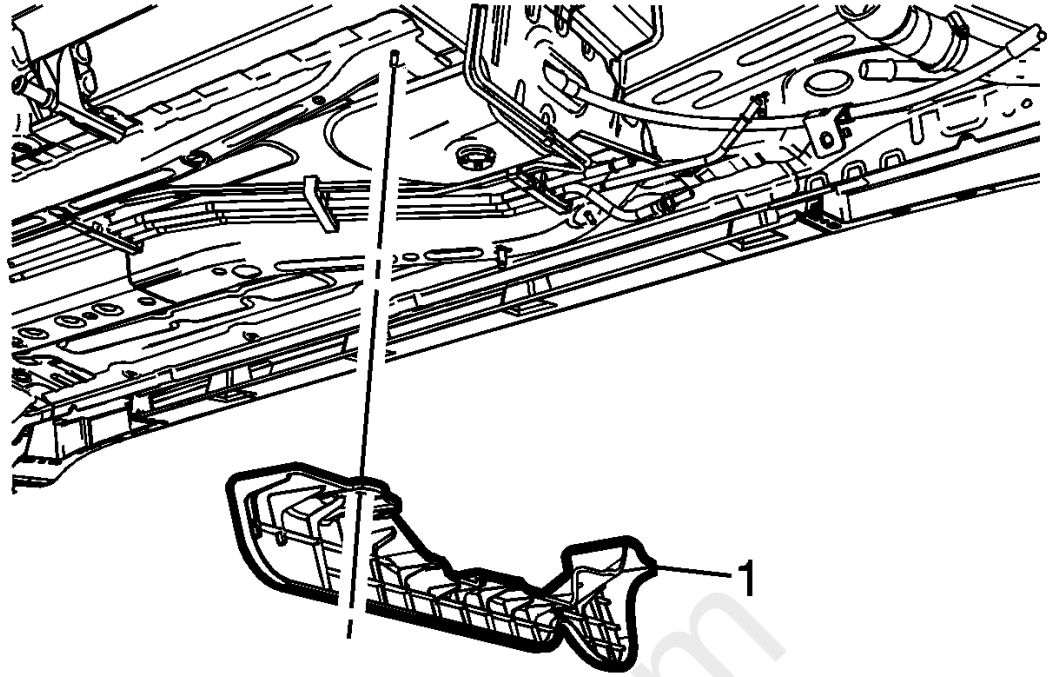


Fig. 133: Underbody Cross Sill Shield

Courtesy of GENERAL MOTORS COMPANY

8. Remove the 2 nuts and the underbody cross sill shield (1).
9. Remove the fuel tank. Refer to [Fuel Tank Replacement \(AWD\)](#) , or [Fuel Tank Replacement](#) .

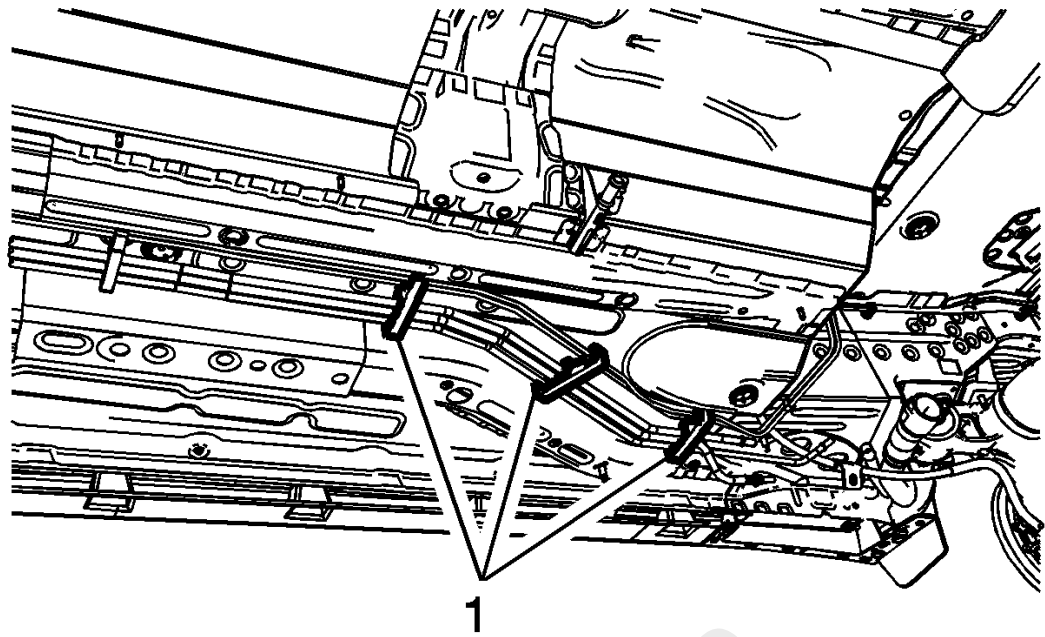


Fig. 134: Rear Floor Retaining Clips

Courtesy of GENERAL MOTORS COMPANY

10. Release the right rear intermediate pipe from the rear floor retaining clips (1).

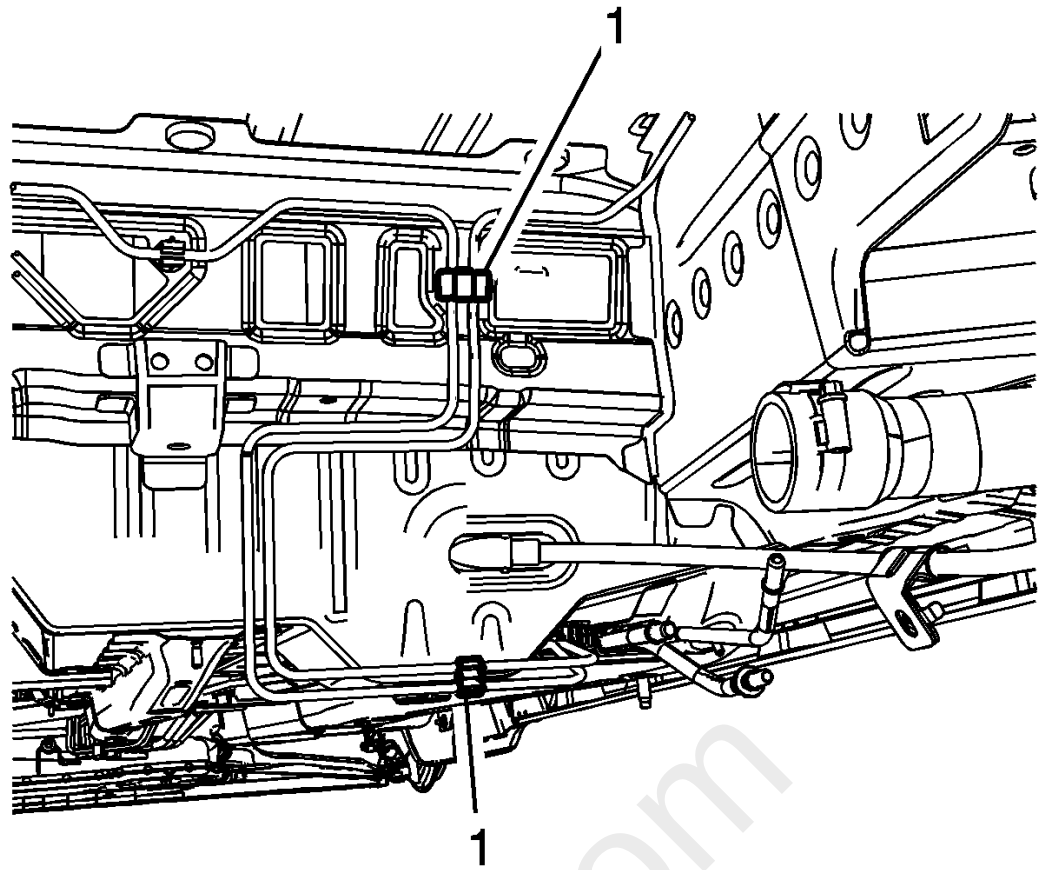


Fig. 135: Right Rear Intermediate Pipe Retaining Clips
Courtesy of GENERAL MOTORS COMPANY

11. Release the right rear intermediate pipe from the retaining clips (1).

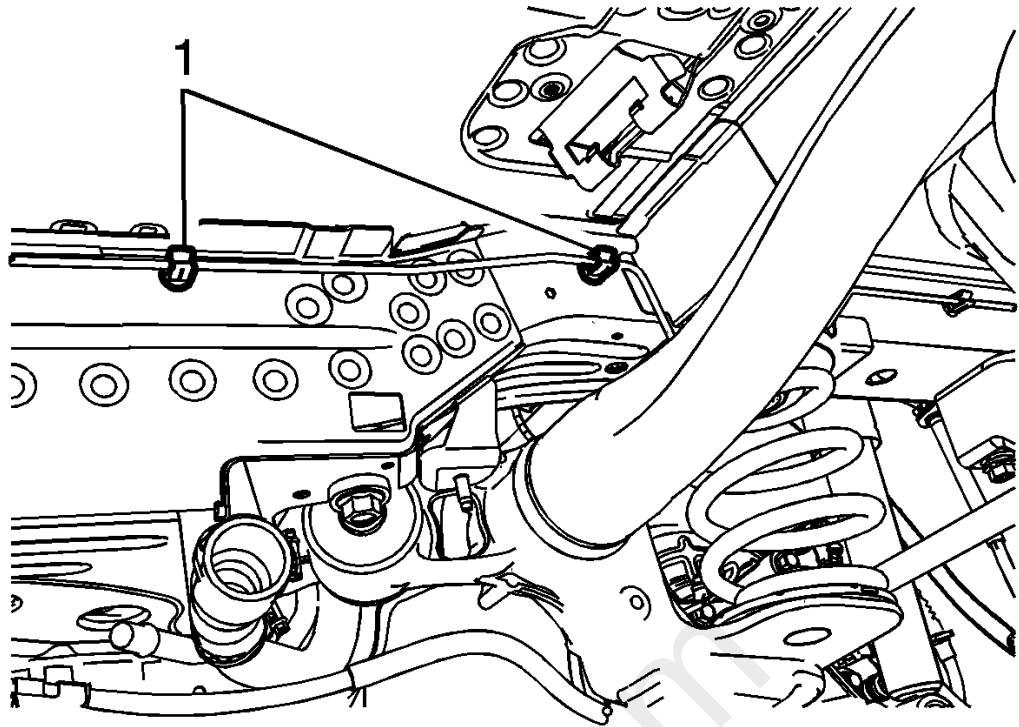


Fig. 136: Right Rear Intermediate Pipe Right Rail Retaining Clips
Courtesy of GENERAL MOTORS COMPANY

12. Release the right rear intermediate pipe from the right rail retaining clips (1).

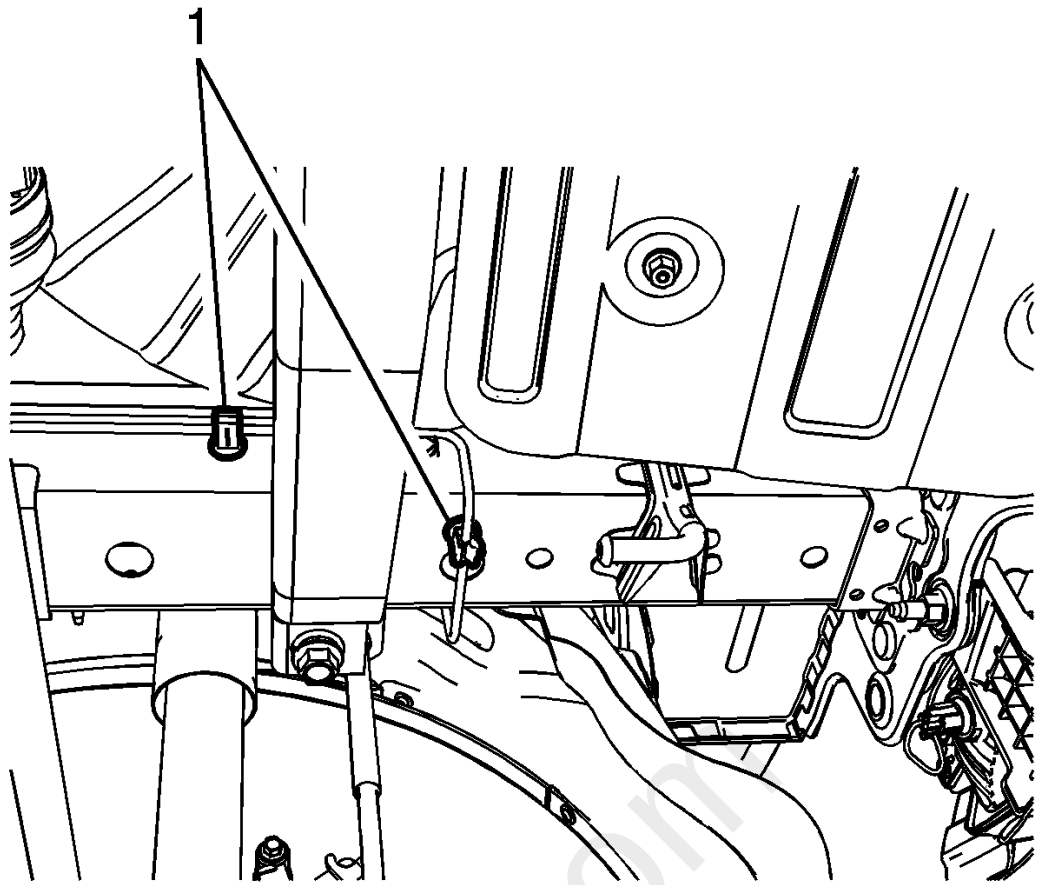


Fig. 137: Right Rear Intermediate Pipe Right Rear Rail Retaining Clips
Courtesy of GENERAL MOTORS COMPANY

13. Release the right rear intermediate pipe from the right rear rail retaining clips (1).

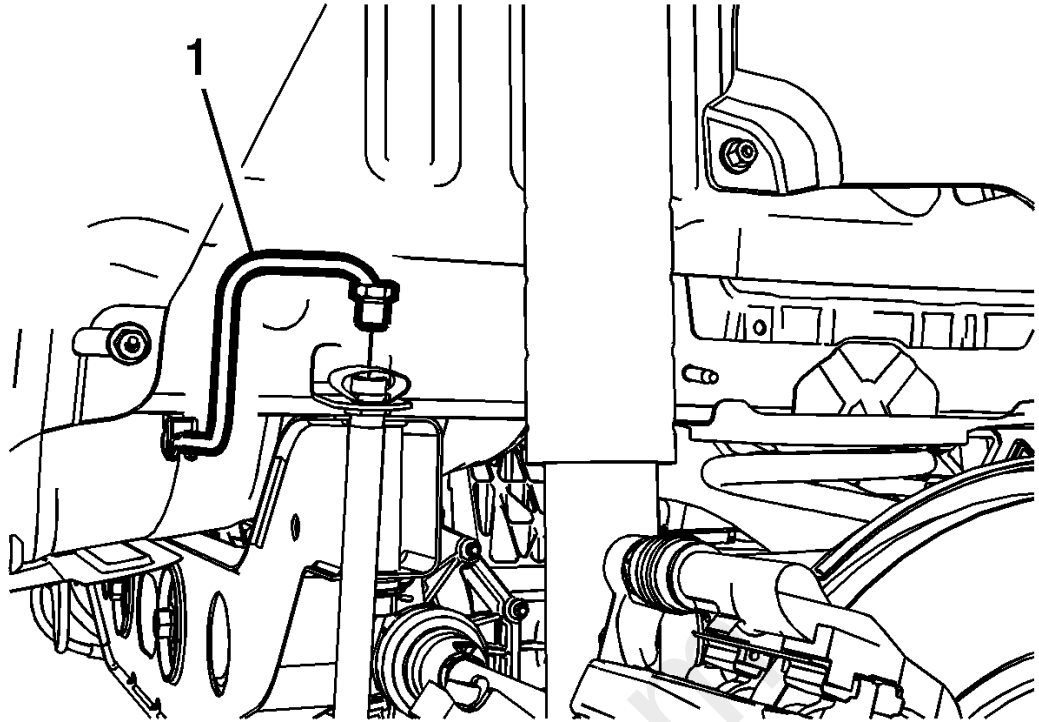


Fig. 138: Right Rear Intermediate Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

14. Disconnect the right rear intermediate pipe fitting (1) from the rear brake hose fitting.
15. Cap the brake hose fitting to prevent brake fluid loss and contamination.
16. Remove the right rear intermediate pipe from the vehicle.

Installation Procedure

1. Install the right rear intermediate pipe to the vehicle.
2. Position, but do not secure, the right rear intermediate pipe to the retaining clips.

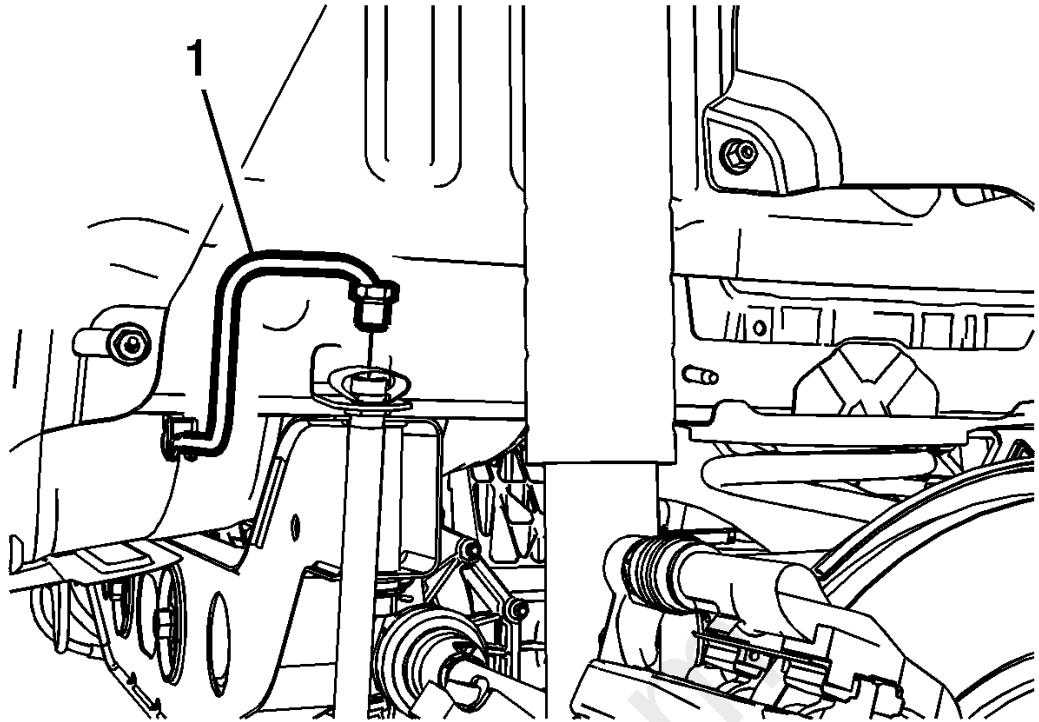


Fig. 139: Right Rear Intermediate Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

3. Install the right rear intermediate pipe fitting (1) to the rear brake hose fitting and tighten the fitting to 18 N.m (13 lb ft).

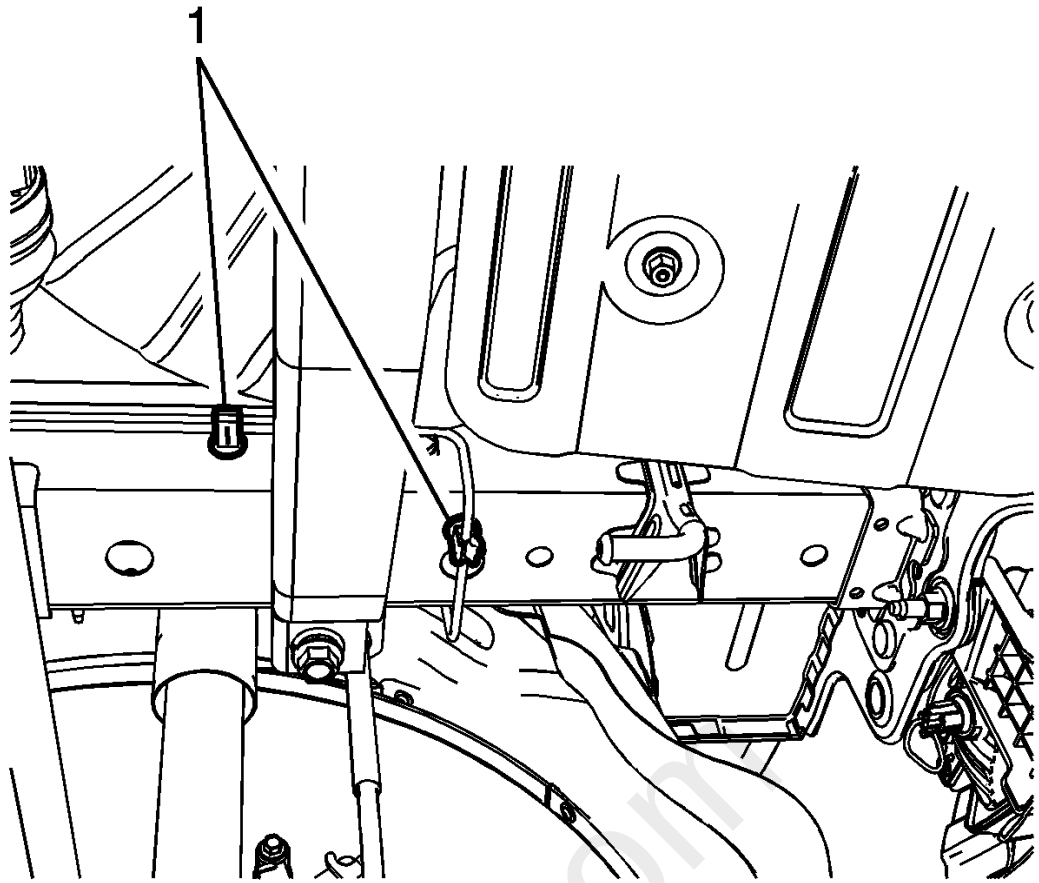


Fig. 140: Right Rear Intermediate Pipe Right Rear Rail Retaining Clips
Courtesy of GENERAL MOTORS COMPANY

4. Secure the right rear intermediate pipe to the right rear rail retaining clips (1).

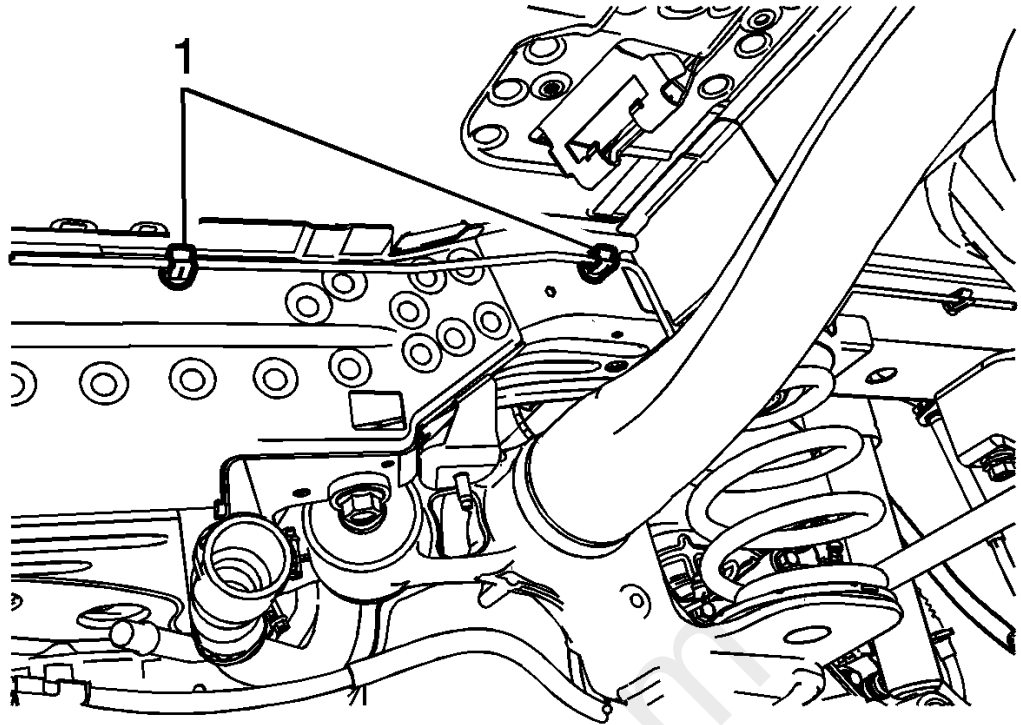


Fig. 141: Right Rear Intermediate Pipe Right Rail Retaining Clips
Courtesy of GENERAL MOTORS COMPANY

5. Secure the right rear intermediate pipe to the right rail retaining clips (1).

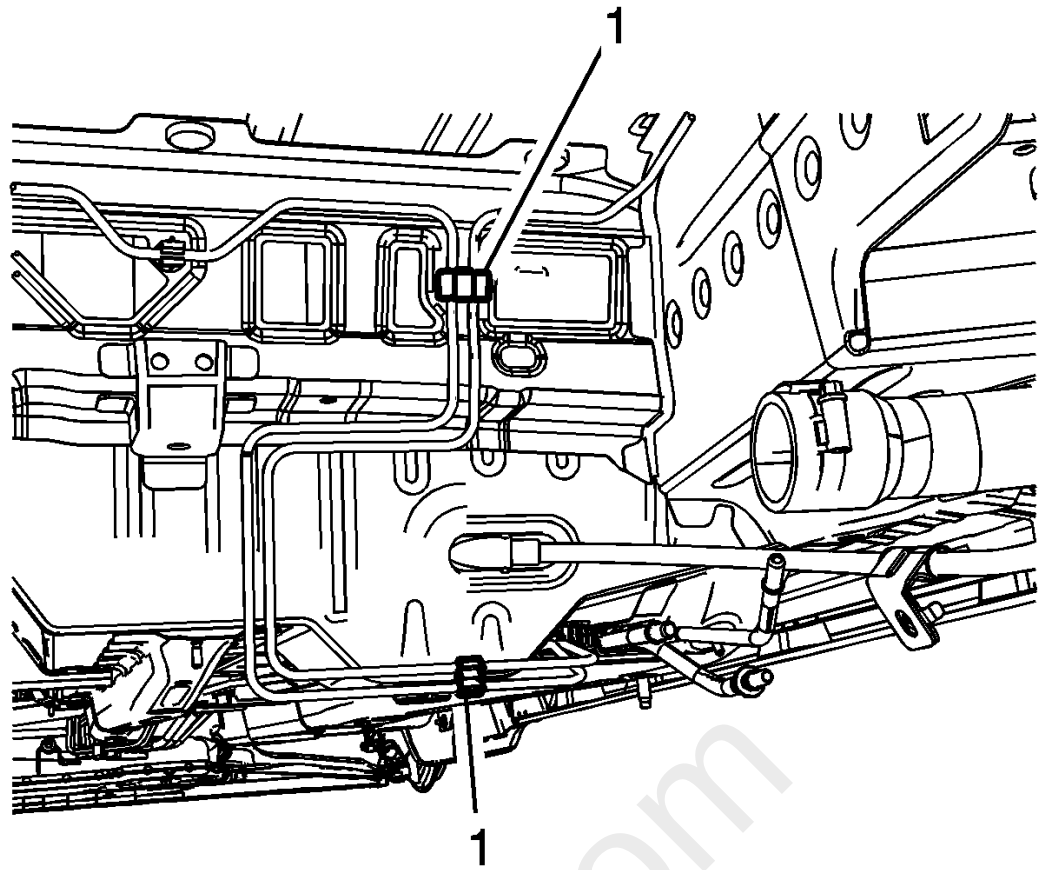


Fig. 142: Right Rear Intermediate Pipe Retaining Clips
Courtesy of GENERAL MOTORS COMPANY

6. Secure the right rear intermediate pipe to the retaining clips (1).

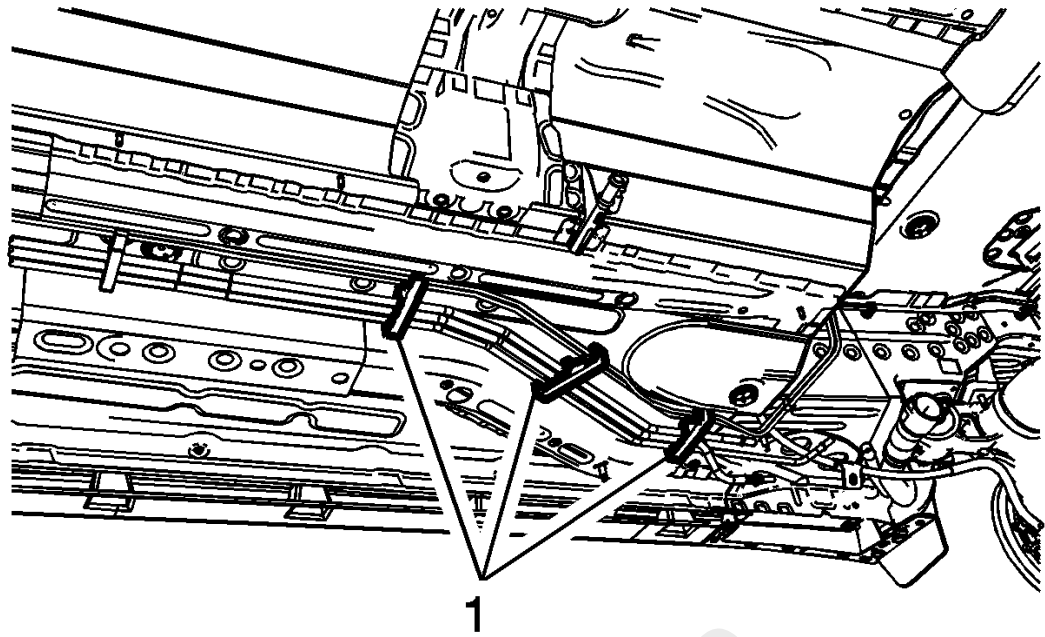


Fig. 143: Rear Floor Retaining Clips

Courtesy of GENERAL MOTORS COMPANY

7. Secure the right rear intermediate pipe to the rear floor retaining clips (1).
8. Install the fuel tank. Refer to [Fuel Tank Replacement \(AWD\)](#) , or [Fuel Tank Replacement](#) .

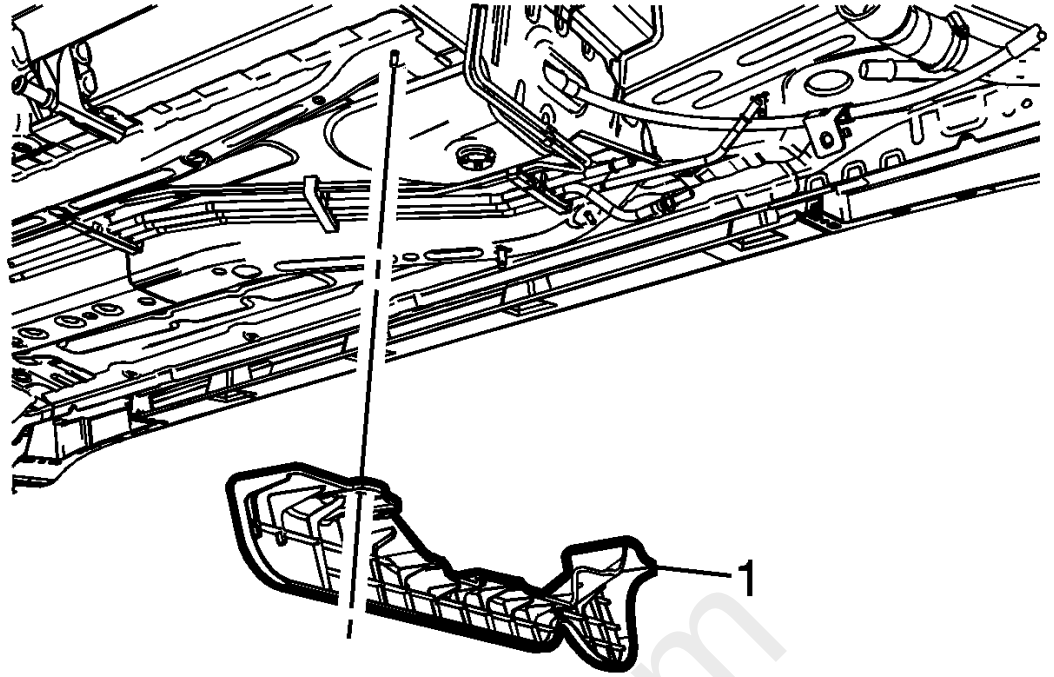


Fig. 144: Underbody Cross Sill Shield

Courtesy of GENERAL MOTORS COMPANY

9. Install the underbody cross sill shield (1) and the 2 nuts.

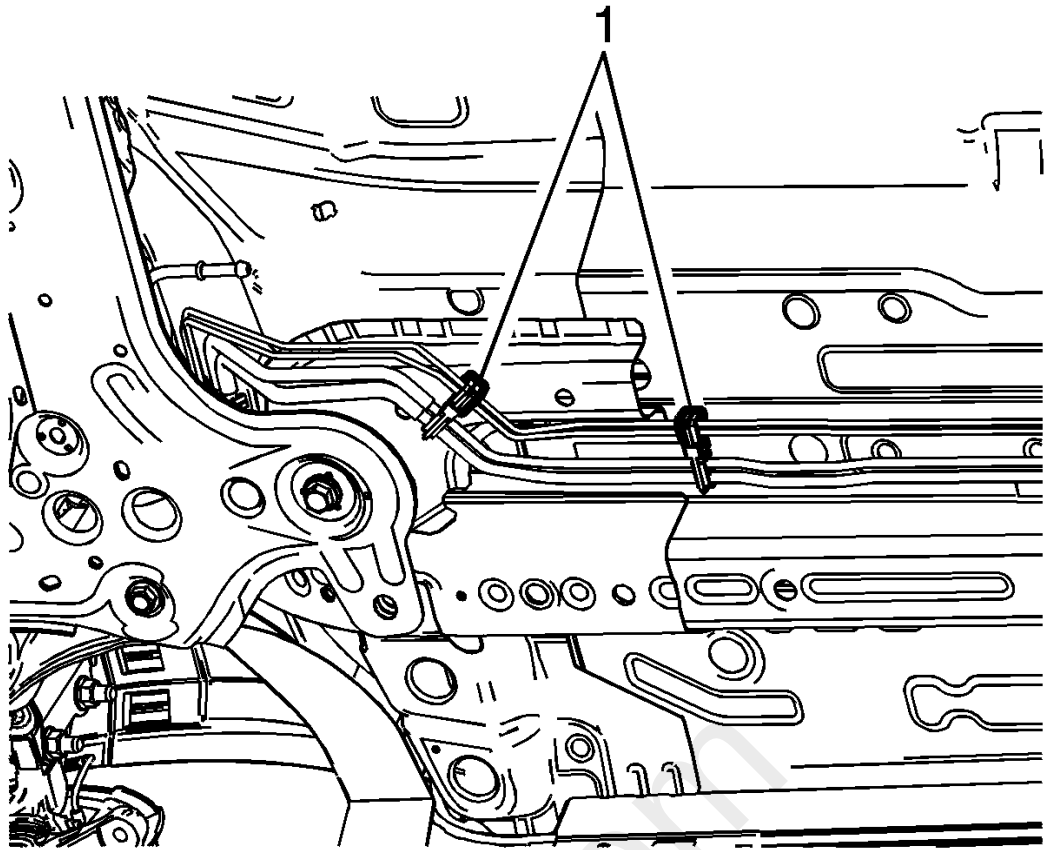


Fig. 145: Front Floor Retaining Clips

Courtesy of GENERAL MOTORS COMPANY

10. Secure the right rear intermediate pipe to the front floor retaining clips (1).

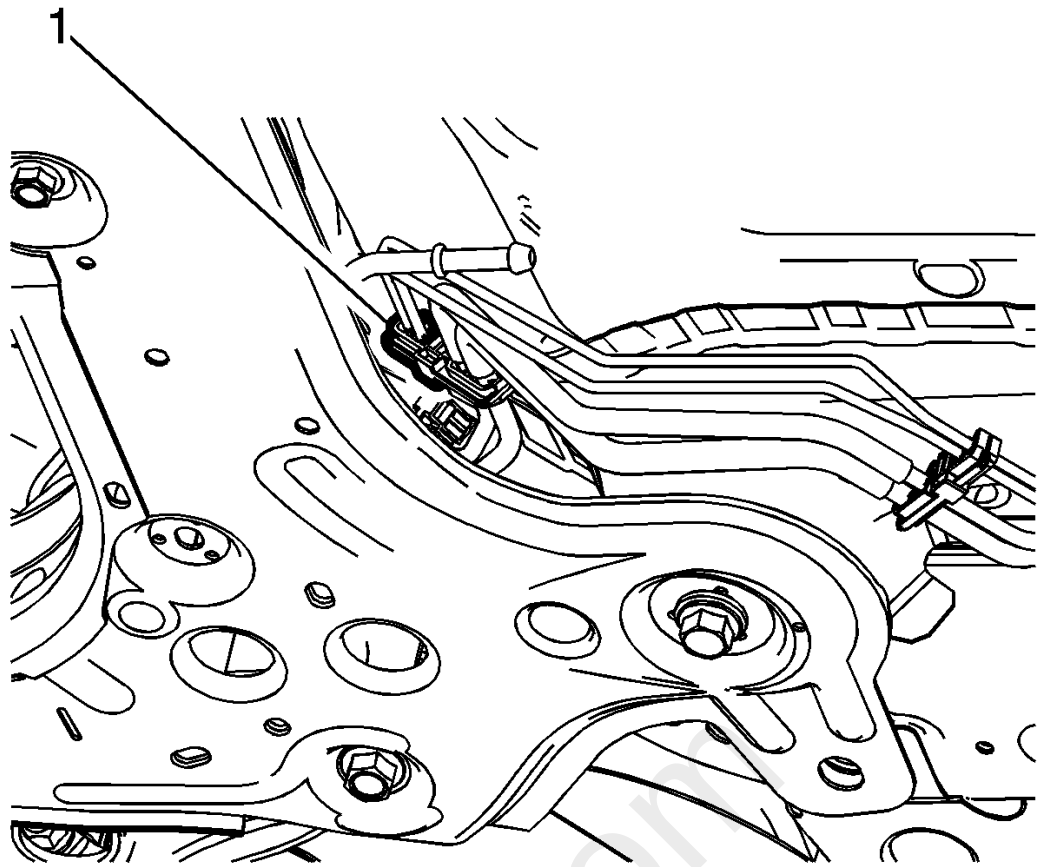


Fig. 146: Right Rear Intermediate Pipe Retaining Clip
Courtesy of GENERAL MOTORS COMPANY

11. Secure the right rear intermediate pipe to the retaining clip (1).

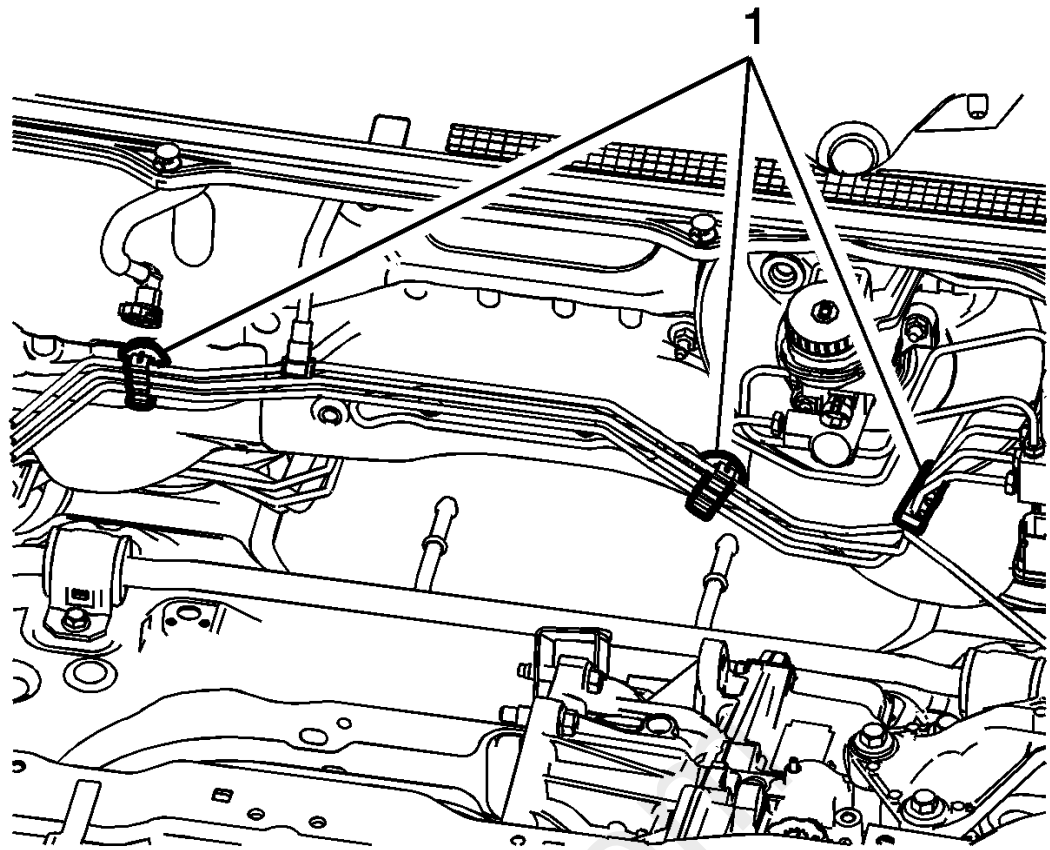


Fig. 147: Right Rear Intermediate Pipe Retaining Clips
Courtesy of GENERAL MOTORS COMPANY

12. Secure the right rear intermediate pipe to the retaining clips (1).

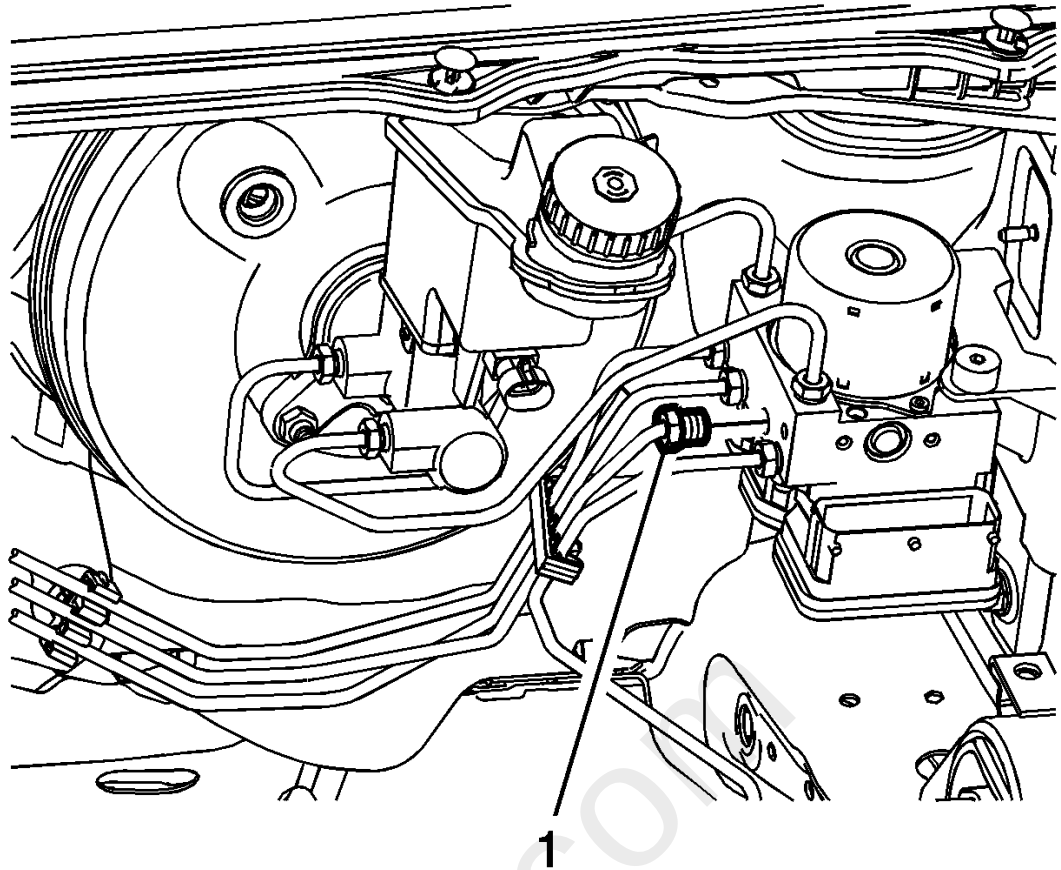


Fig. 148: Right Rear Intermediate Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

13. Connect the right rear intermediate pipe fitting (1) to the BPMV and tighten the fitting to 18 N.m (13 lb ft).
14. Install the battery. Refer to [Battery Replacement](#).
15. Bleed the hydraulic brake system. Refer to [Hydraulic Brake System Bleeding \(Manual\)](#)[Hydraulic Brake System Bleeding \(Pressure\)](#).

REAR BRAKE REAR PIPE REPLACEMENT

Removal Procedure

WARNING: Refer to [Brake Dust Warning](#).

WARNING: Refer to [Brake Fluid Irritant Warning](#).

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](#).

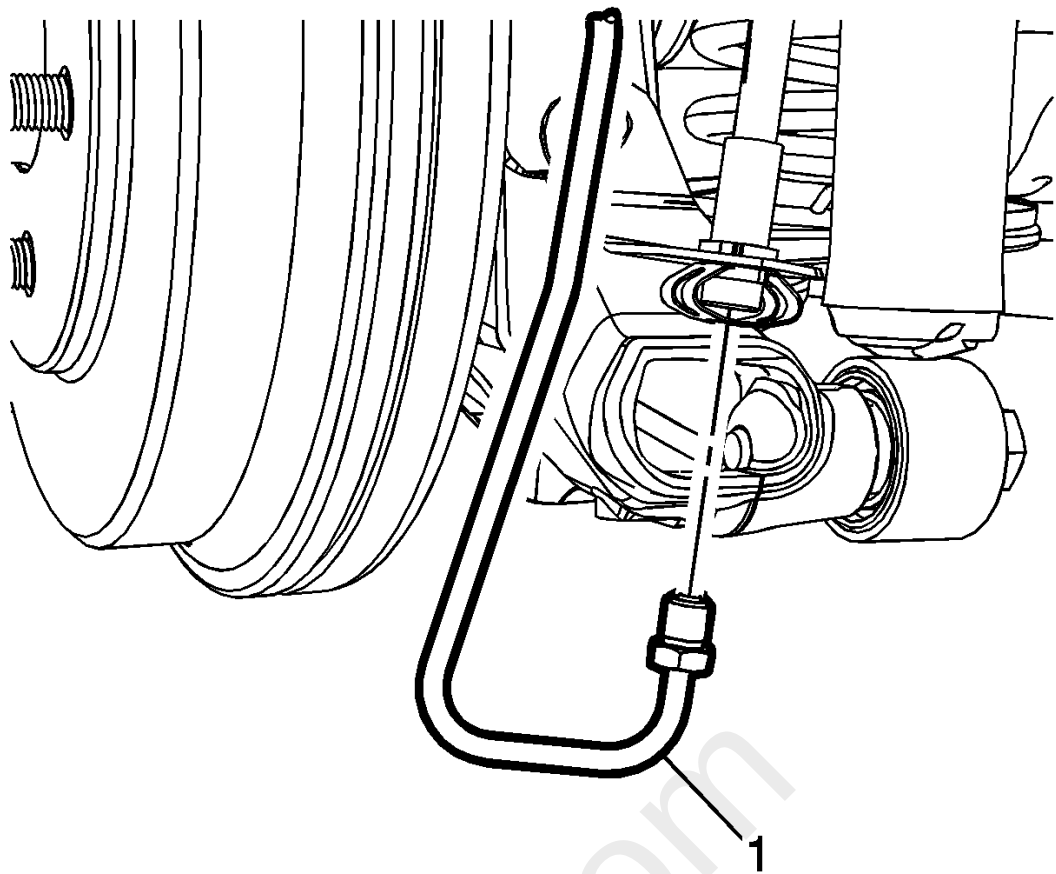


Fig. 149: Rear Brake Rear Pipe Fitting And Rear Brake Hose
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the rear brake rear pipe fitting (1) from the rear brake hose.
4. Cap the brake hose fitting to prevent brake fluid loss and contamination.

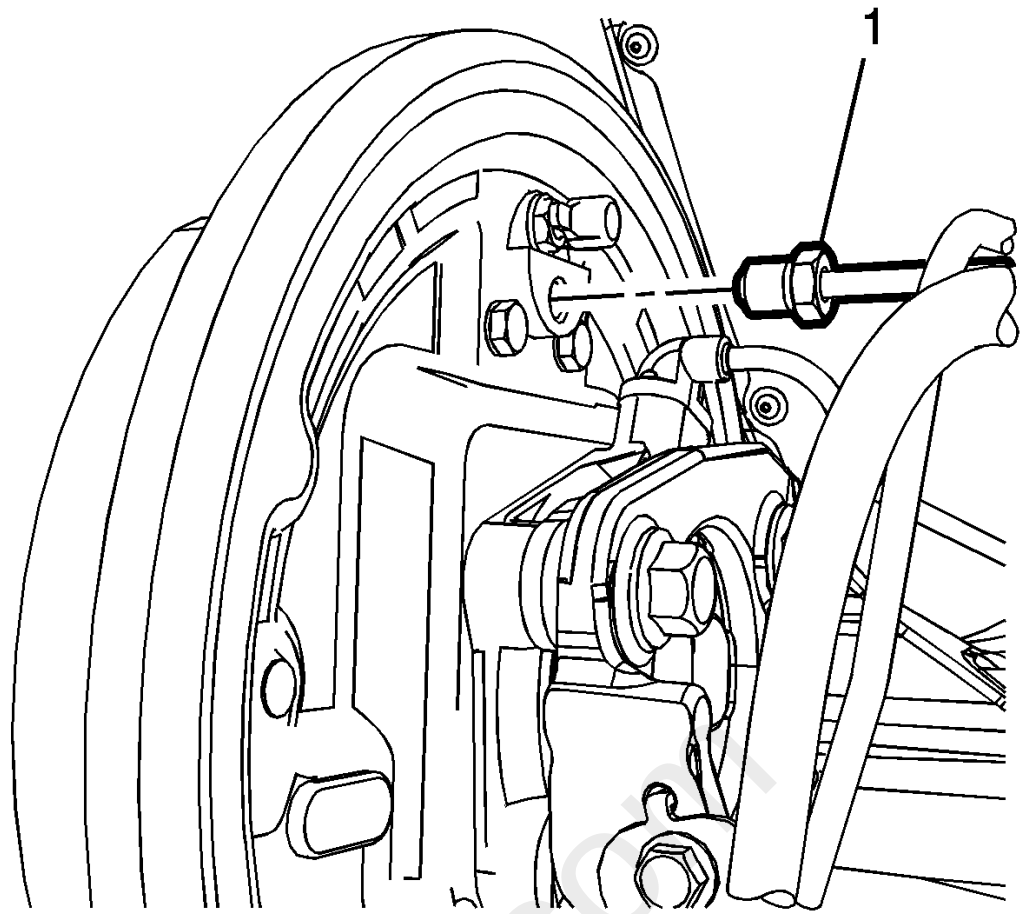


Fig. 150: Rear Brake Rear Pipe Fitting And Rear Brake Cylinder
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the rear brake rear pipe fitting (1) from the rear brake cylinder.
6. Remove the rear brake rear pipe from the vehicle.

Installation Procedure

1. Install the rear brake rear pipe to the vehicle.

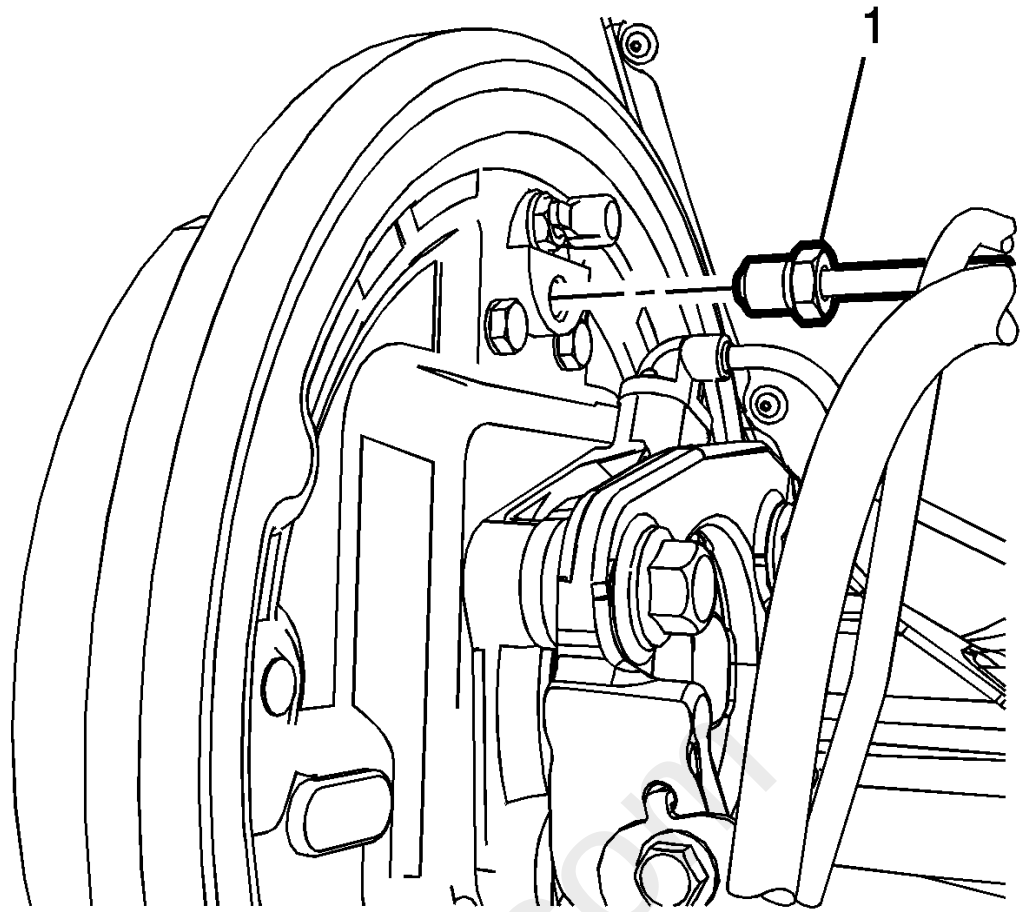


Fig. 151: Rear Brake Rear Pipe Fitting And Rear Brake Cylinder
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

2. Install the rear brake rear pipe fitting (1) to the rear brake cylinder and tighten the fitting to 18 N.m (13 lb ft).

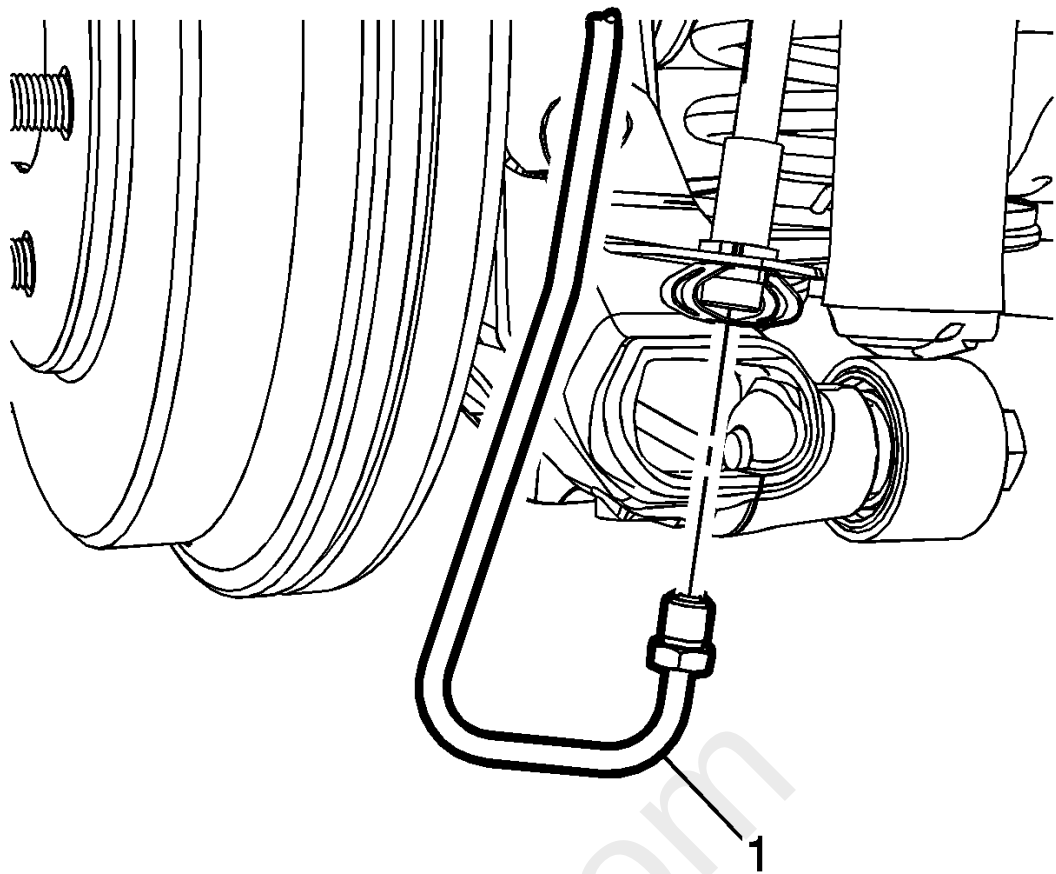


Fig. 152: Rear Brake Rear Pipe Fitting And Rear Brake Hose
Courtesy of GENERAL MOTORS COMPANY

3. Install the rear brake rear pipe fitting (1) to the rear brake hose and tighten the fitting to 18 N.m (13 lb ft).
4. Bleed the hydraulic brake system. Refer to [Hydraulic Brake System Bleeding \(Manual\)](#)[Hydraulic Brake System Bleeding \(Pressure\)](#).
5. Install the tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#) .

REAR BRAKE HOSE REPLACEMENT (DRUM BRAKE)

Removal Procedure

WARNING: Refer to [Brake Dust Warning](#) .

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

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](#) .

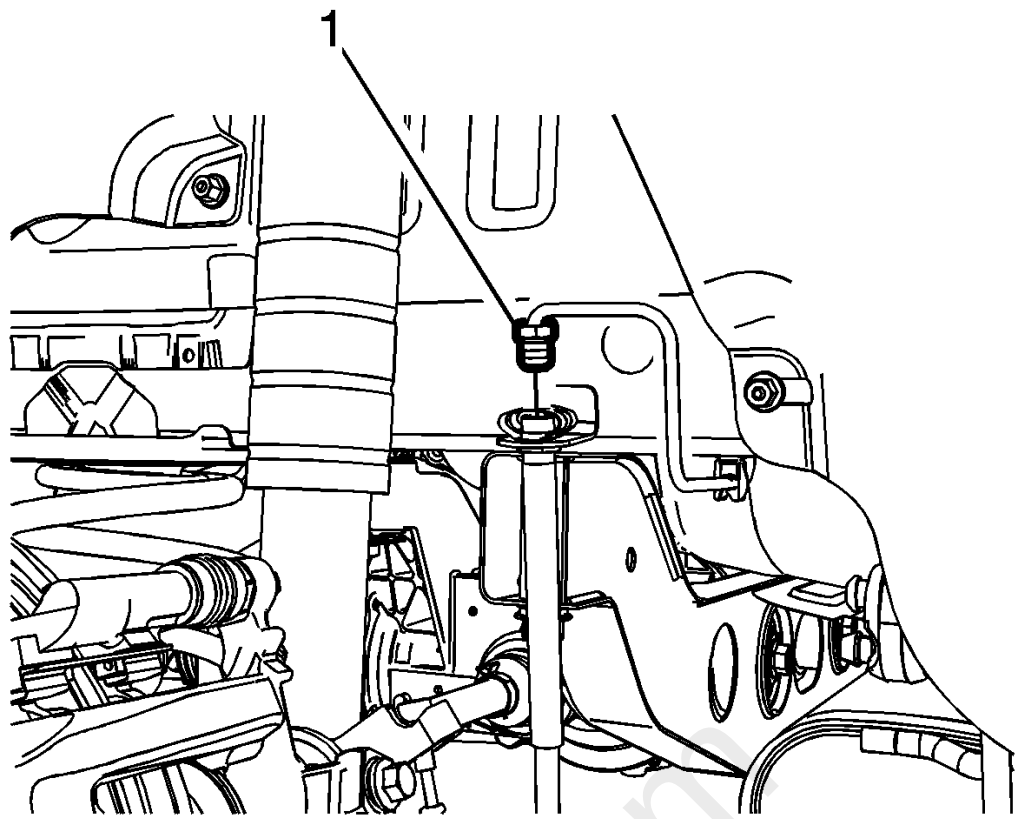


Fig. 153: Brake Rear Pipe Fitting And Rear Brake Hose
Courtesy of GENERAL MOTORS COMPANY

3. Remove the brake pipe fitting (1) from the rear brake hose.
4. Cap the brake pipe fitting to prevent brake fluid loss and contamination.

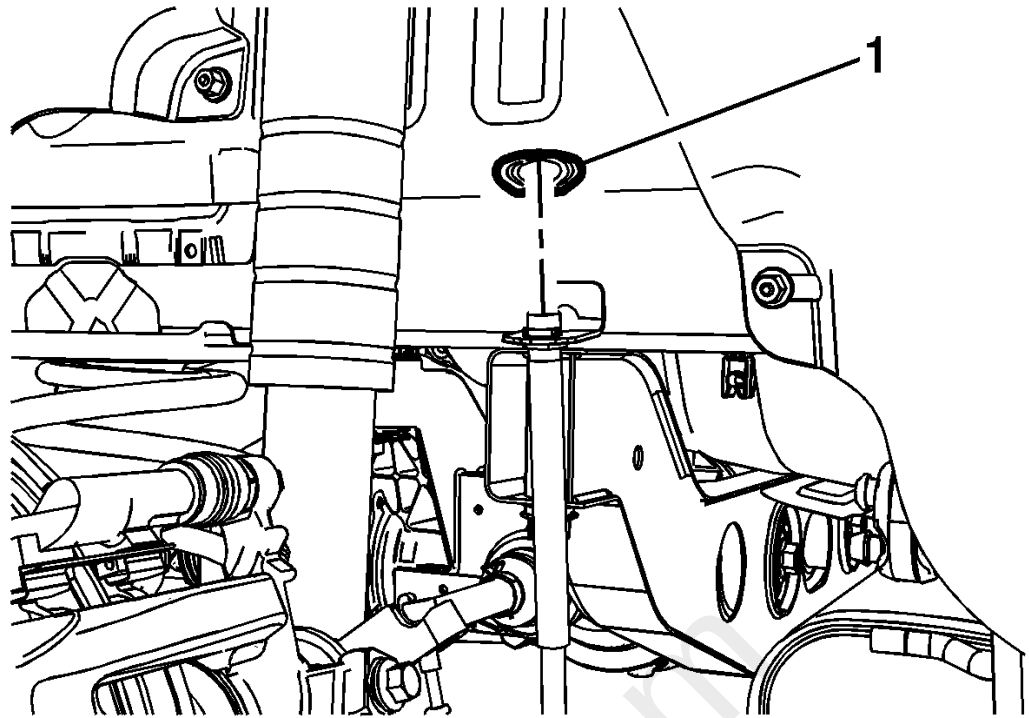


Fig. 154: Brake Hose Retainer

Courtesy of GENERAL MOTORS COMPANY

5. Remove the brake hose retainer (1).

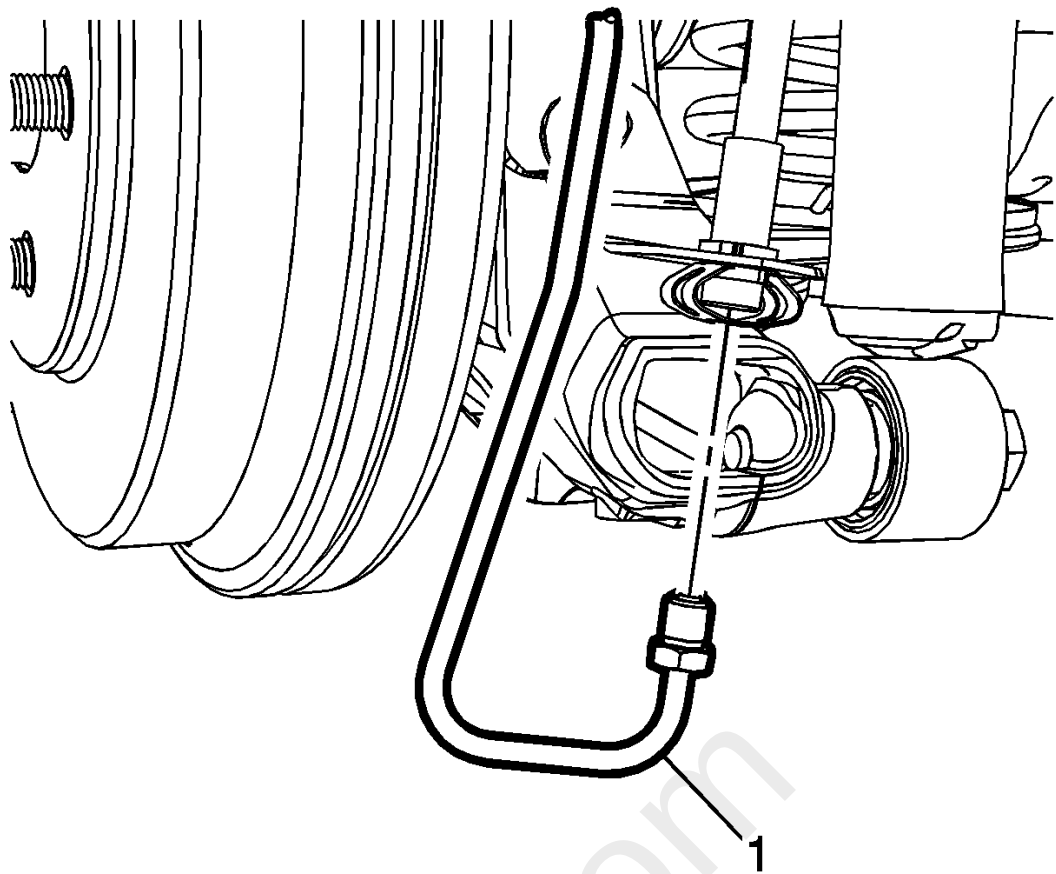


Fig. 155: Rear Brake Rear Pipe Fitting And Rear Brake Hose
Courtesy of GENERAL MOTORS COMPANY

6. Remove the brake pipe fitting (1) from the rear brake hose.
7. Cap the brake pipe fitting to prevent brake fluid loss and contamination.

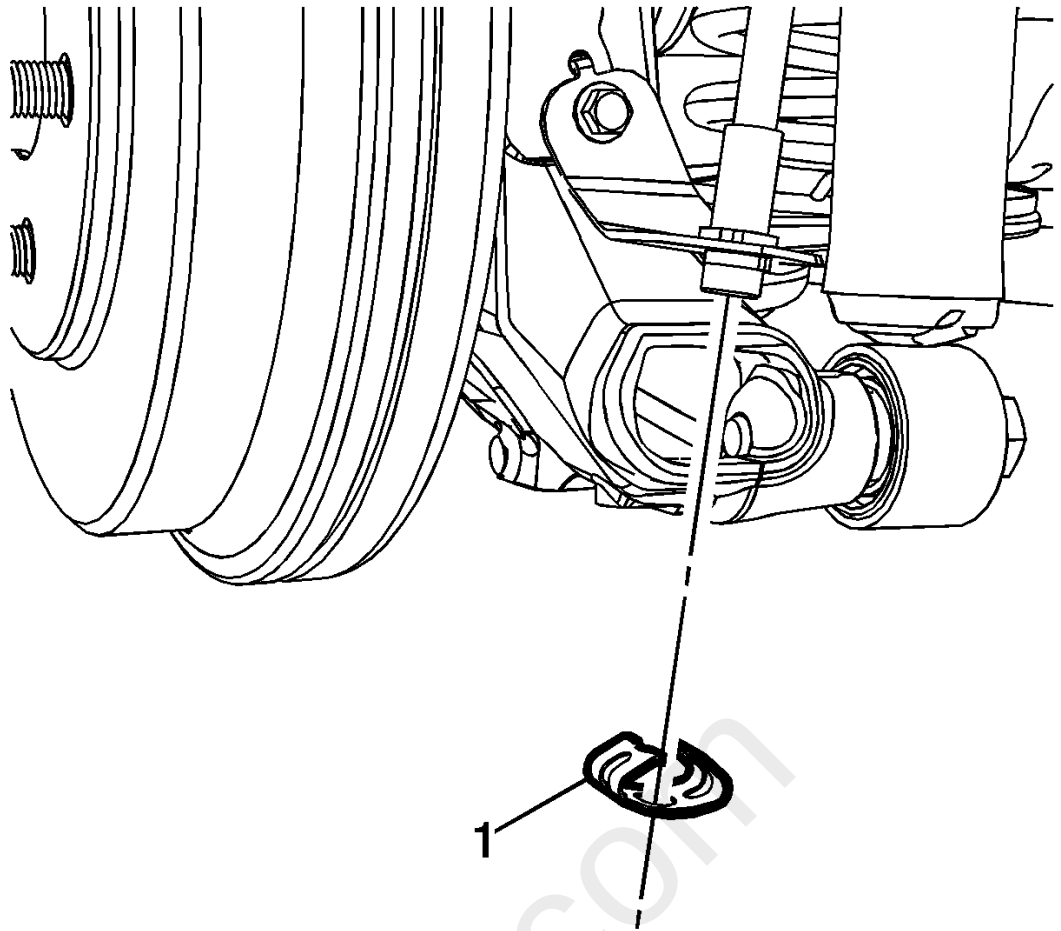


Fig. 156: Brake Hose Retainer

Courtesy of GENERAL MOTORS COMPANY

8. Remove the brake hose retainer (1).
9. Remove the brake hose.

Installation Procedure

1. Install the brake hose.

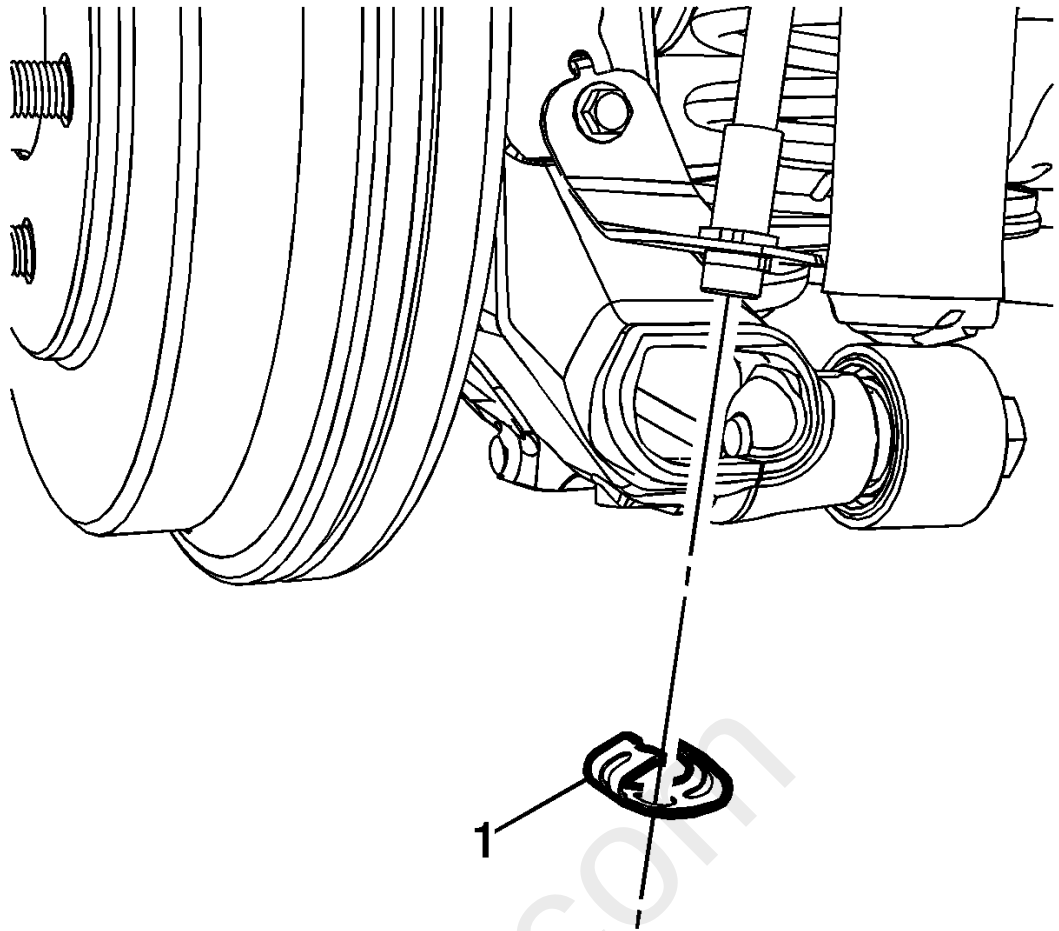


Fig. 157: Brake Hose Retainer

Courtesy of GENERAL MOTORS COMPANY

2. Install the brake hose retainer (1).

CAUTION: Refer to **Fastener Caution** .

3. Install the brake pipe fitting (1) to the rear brake hose and tighten the fitting to 18 N.m (13 lb ft).

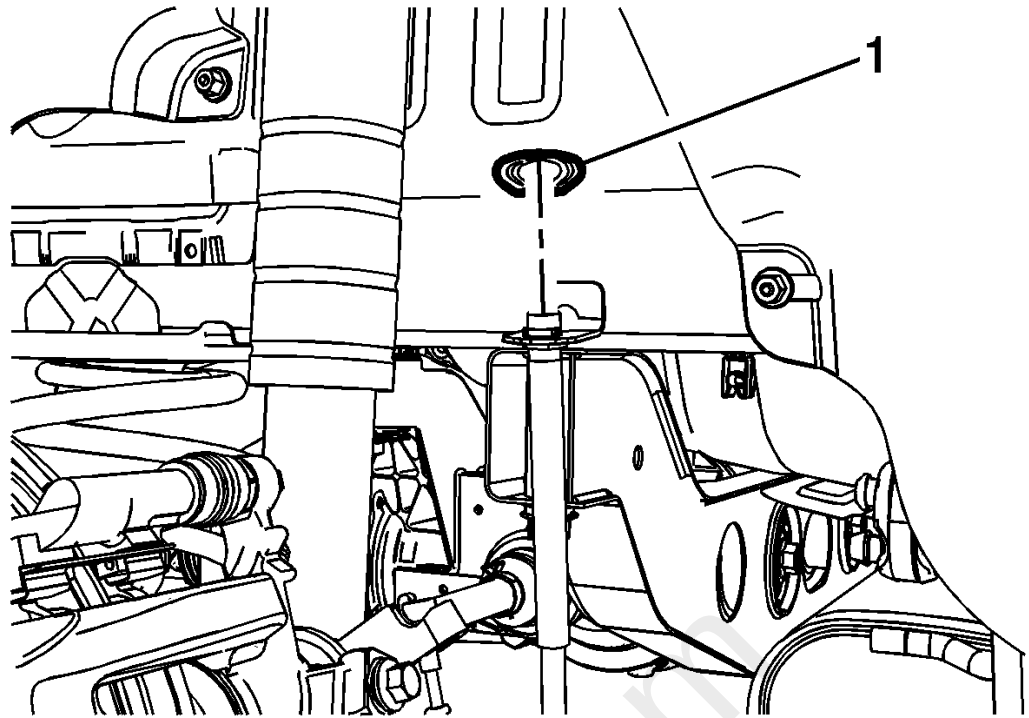


Fig. 158: Brake Hose Retainer

Courtesy of GENERAL MOTORS COMPANY

4. Install the brake hose to the wheelhouse bracket and install the retainer (1).

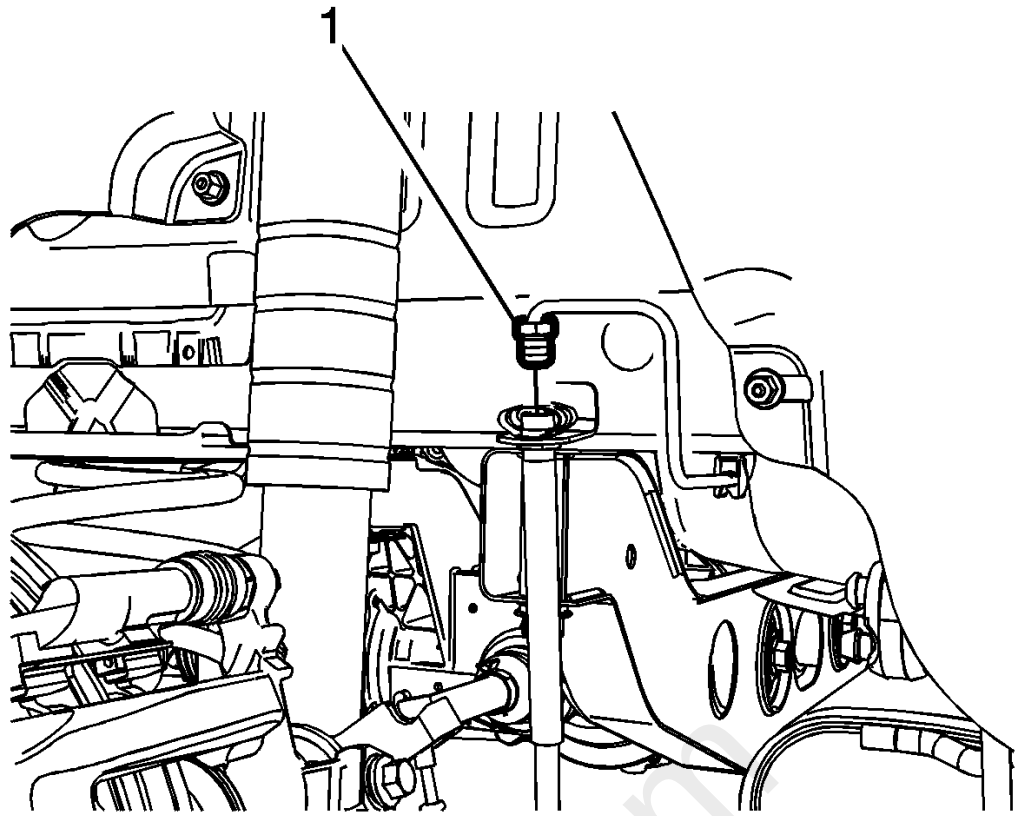


Fig. 159: Brake Rear Pipe Fitting And Rear Brake Hose
Courtesy of GENERAL MOTORS COMPANY

5. Install the brake pipe fitting (1) to the rear brake hose and tighten the fitting to 18 N.m (13 lb ft).
6. Bleed the hydraulic brake system. Refer to [Hydraulic Brake System Bleeding \(Manual\)](#)[Hydraulic Brake System Bleeding \(Pressure\)](#).
7. Install the tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#) .

REAR BRAKE HOSE REPLACEMENT (DISC BRAKE)

Removal Procedure

WARNING: Refer to [Brake Dust Warning](#) .

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

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](#) .

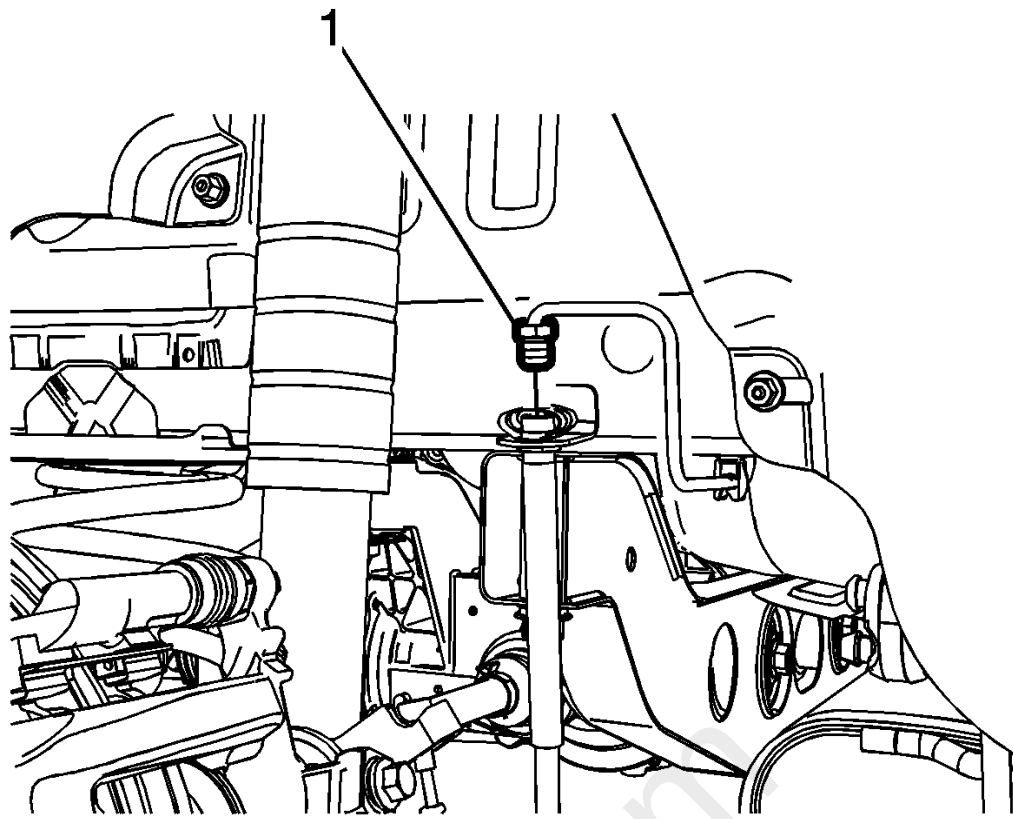


Fig. 160: Brake Rear Pipe Fitting And Rear Brake Hose
Courtesy of GENERAL MOTORS COMPANY

3. Remove the brake pipe fitting (1) from the rear brake hose.
4. Cap the brake pipe fitting to prevent brake fluid loss and contamination.

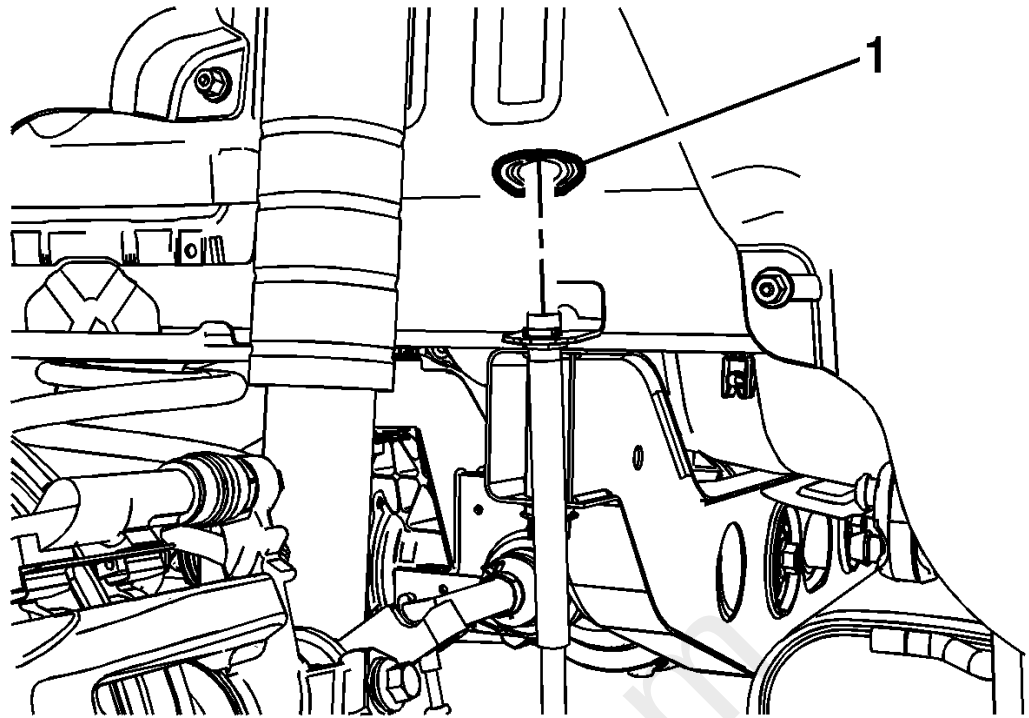


Fig. 161: Brake Hose Retainer

Courtesy of GENERAL MOTORS COMPANY

5. Remove the brake hose retainer (1).

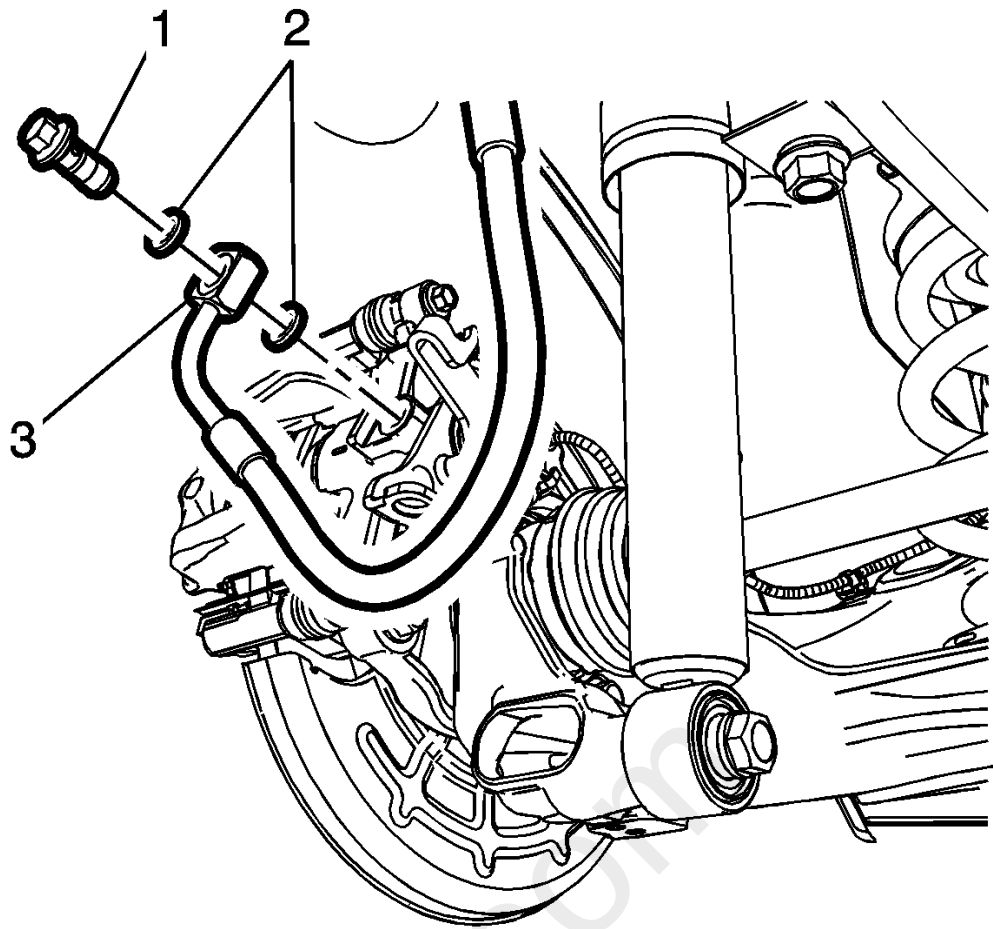


Fig. 162: Brake Hose Fitting, Bolt And Gaskets
Courtesy of GENERAL MOTORS COMPANY

6. Remove the brake hose fitting bolt (1).

NOTE: Do not reuse the brake hose fitting gaskets.

7. Remove and discard the brake hose fitting gaskets (2) from the brake hose fitting (3).

8. Remove the brake hose.

Installation Procedure

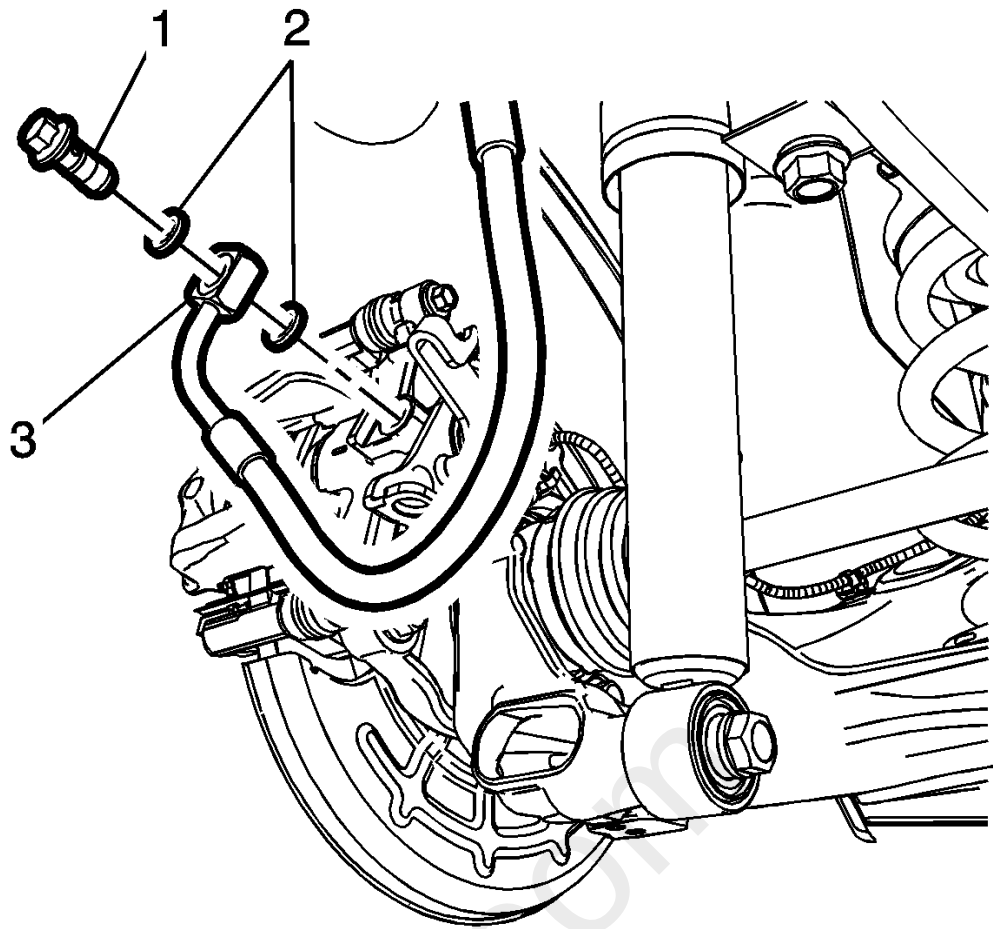


Fig. 163: Brake Hose Fitting, Bolt And Gaskets
Courtesy of GENERAL MOTORS COMPANY

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

CAUTION: Refer to **Fastener Caution** .

2. Install the brake hose assembly to the brake caliper and tighten the fitting bolt to 40 N.m (30 lb ft).

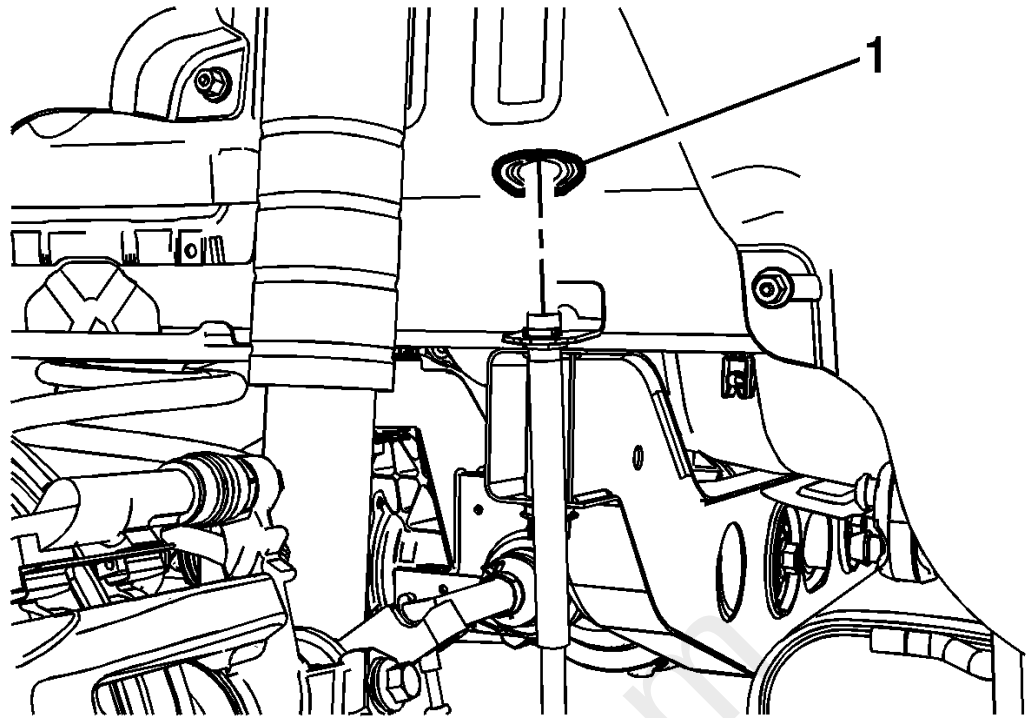


Fig. 164: Brake Hose Retainer

Courtesy of GENERAL MOTORS COMPANY

3. Install the brake hose to the wheelhouse bracket and install the retainer (1).

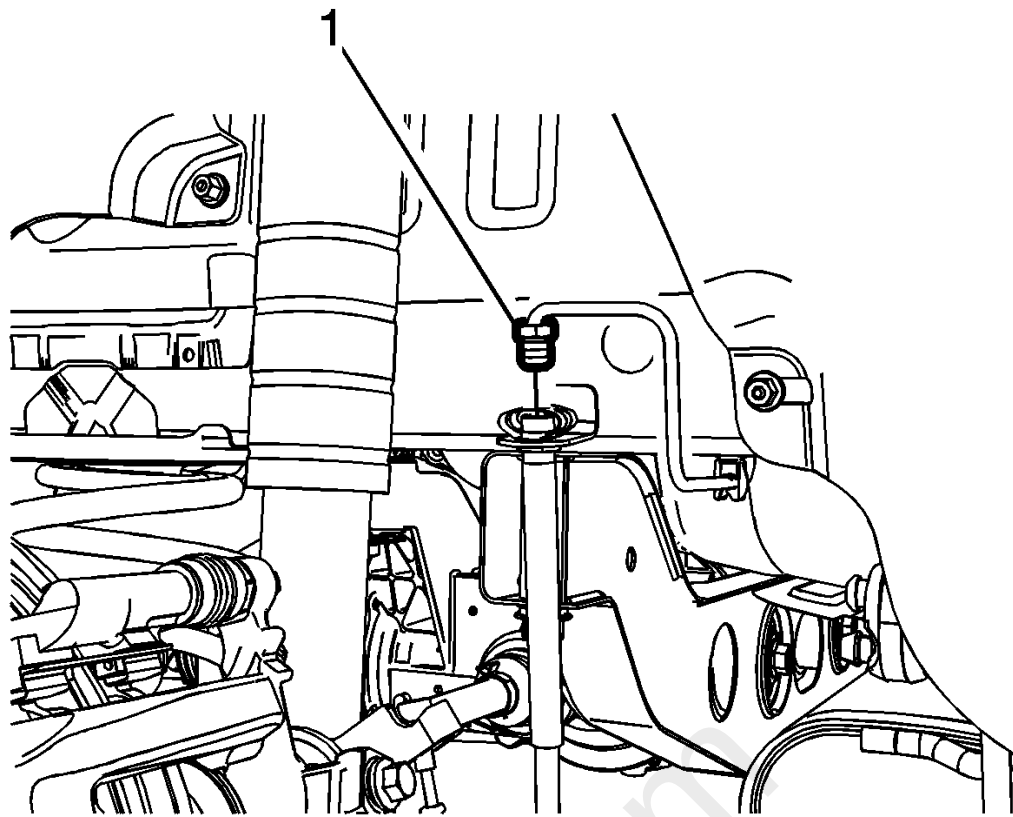


Fig. 165: Brake Rear Pipe Fitting And Rear Brake Hose
 Courtesy of GENERAL MOTORS COMPANY

4. Install the brake pipe fitting (1) to the rear brake hose and tighten the fitting to 18 N.m (13 lb ft).
5. Bleed the hydraulic brake system. Refer to [Hydraulic Brake System Bleeding \(Manual\)](#)[Hydraulic Brake System Bleeding \(Pressure\)](#).
6. Install the tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#) .

HYDRAULIC BRAKE SYSTEM BLEEDING (MANUAL)

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

CAUTION: Only use products that comply with GM specifications and check manufacturer information respectively. We recommend the use of GM genuine products. Instructions must be followed at all times. 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.

If hydraulic components were serviced on only one wheel hydraulic circuit, perform the following procedure.

Bleeding a Single Hydraulic Brake Circuit

1. With the ignition OFF and the brakes cool, apply the brakes 3-5 times, or until the brake pedal effort increases significantly, in order to deplete the brake booster power reserve.
2. Place a clean shop cloth beneath the brake master cylinder to catch brake fluid spills.
3. Clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm.
4. Fill the brake master cylinder reservoir to the maximum-full level with GM approved brake fluid from a clean, sealed brake fluid container. Add brake fluid as needed to ensure that the brake master cylinder reservoir

remains at least half-full throughout the bleed procedure. The reservoir cap must be installed at all times except when filling the reservoir. Refer to [Fluid and Lubricant Recommendations](#) .

5. Install a proper box-end wrench onto the wheel hydraulic circuit bleeder valve which has been serviced.
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 brake fluid from a clean, sealed brake fluid container.
8. Have an assistant slowly press 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 wheel hydraulic circuit.
12. After all air has been purged from the hydraulic circuit, tighten the bleeder valve and install the dust cap.
13. Fill the brake master cylinder reservoir to the maximum-fill level with GM approved brake fluid from a clean, sealed brake fluid container.
14. Slowly press and release the brake pedal. Observe the brake pedal feel.
15. If the brake pedal feels spongy, perform the Bleeding the Complete Brake Hydraulic System procedure:
16. 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.**

17. If the brake system warning lamp remains illuminated, refer to [Diagnostic Starting Point - Vehicle](#) .

Bleeding the Complete Brake Hydraulic System

1. With the ignition OFF and the brakes cool, apply the brakes 3-5 times, or until the brake pedal effort increases significantly, in order to deplete the brake booster power reserve.
2. Place a clean shop cloth beneath the brake master cylinder to catch brake fluid spills.
3. Clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm.
4. Fill the brake master cylinder reservoir to the maximum-full level with GM approved brake fluid from a clean, sealed brake fluid container. Add brake fluid as needed to ensure that the brake master cylinder reservoir remains at least half-full throughout the bleed procedure. The reservoir cap must be installed at all times except when filling the reservoir. Refer to [Fluid and Lubricant Recommendations](#) .
5. If the master cylinder was replaced, the master cylinder must be bench bled. Refer to [Master Cylinder Bench Bleeding](#).
6. If the brake pipes have been removed from the master cylinder, the following steps must be performed.
 1. With the rear brake pipe installed securely to the master cylinder, loosen and separate the front brake pipe fitting from the front port of the brake master cylinder.
 2. Allow a small amount of brake fluid to gravity bleed from the open port of the master cylinder. Capture and properly dispose of the brake fluid in an approved container.
 3. Install the front brake pipe fitting to the front port of the brake master cylinder and tighten the fitting. Refer to [Fastener Specifications](#).
 4. Have an assistant slowly press the brake pedal fully and maintain steady pressure on the pedal.
 5. Loosen the front brake pipe fitting from the front port of the brake master cylinder to purge air from the master cylinder port.
 6. Tighten the front brake pipe fitting, then have the assistant slowly release the brake pedal.
 7. Wait 15 seconds, then repeat steps 6.4-6.6 until all air is purged from the front brake pipe fitting of the front port of the master cylinder.
 8. After all air is purged from the front port of the brake master cylinder, tighten the front master cylinder brake pipe fitting. Refer to [Fastener Specifications](#).
 9. With the front brake pipe fitting installed securely to the front port of the brake master cylinder, loosen and separate the rear brake pipe fitting from the rear port of the brake master cylinder.
 10. Repeat steps 6.2-6.7 for the rear port of the brake master cylinder.
 11. After all air is purged from the rear port of the brake master cylinder, tighten the rear master cylinder brake pipe fitting. Refer to [Fastener Specifications](#).
 12. Slowly press and release the brake pedal. Observe the brake pedal feel.

13. If the brake pedal feels spongy, proceed to step 7.
14. If the brake pedal feels firm, proceed to step 24.
7. If the brake pipes have been removed from the brake pressure modulator valve (BPMV) assembly, if equipped, or the brake proportion valve assembly, if equipped, air must be purged from each port of the respective assembly beginning with the feed pipes from the master cylinder.
 1. Loosen and separate one of the master cylinder brake pipe fittings from the inlet port of the assembly to be bled.
 2. Allow a small amount of brake fluid to gravity bleed from the open port of the assembly. Capture and properly dispose of the brake fluid in an approved container.
 3. Install the brake pipe fitting and to the inlet port of the assembly and tighten securely.
 4. Have an assistant slowly press the brake pedal fully and maintain steady pressure on the pedal.
 5. Loosen the same brake pipe fitting to purge air from the open port of the assembly.
 6. Tighten the brake pipe fitting, then have the assistant slowly release the brake pedal.
 7. Wait 15 seconds, then repeat steps 7.4-7.6 until all air is purged from the brake pipe fitting of the assembly.
 8. Repeat steps 7.1-7.7 for all of the remaining ports of the assembly.
 9. After bleeding each port of the assembly, tighten all of the brake pipe fittings on the assembly. Refer to [Fastener Specifications](#).
 10. Fill the master cylinder reservoir to the maximum-full level with GM approved brake fluid from a clean, sealed brake fluid container.
 11. Slowly press and release the brake pedal. Observe the brake pedal feel.
 12. If the brake pedal feels spongy, proceed to step 8.
 13. If the brake pedal feels firm, proceed to step 24.
8. Install a proper box-end wrench onto the RIGHT REAR wheel hydraulic circuit bleeder valve.
9. Install a transparent hose over the end of the bleeder valve.
10. 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.
11. Have an assistant slowly press the brake pedal fully and maintain steady pressure on the brake pedal.
12. Loosen the bleeder valve to purge air from the wheel hydraulic circuit.
13. Tighten the bleeder valve, then have the assistant slowly release the brake pedal.
14. Wait 15 seconds, then repeat steps 11-13 until all air is purged from the wheel hydraulic circuit.
15. Tighten the RIGHT REAR hydraulic wheel circuit bleeder valve securely.
16. Install a proper box-end wrench onto the LEFT REAR wheel hydraulic circuit bleeder valve, then repeat steps 9-14.
17. Install a proper box-end wrench onto the RIGHT FRONT wheel hydraulic circuit bleeder valve, then repeat steps 9-14.
18. Install a proper box-end wrench onto the LEFT FRONT wheel hydraulic circuit bleeder valve, then repeat steps 9-14.
19. After completing the final wheel hydraulic circuit bleeding procedure, tighten all of the wheel hydraulic circuit bleeder valves and install the bleeder valve dust caps.
20. Fill the master cylinder reservoir to the maximum-full level with GM approved brake fluid from a clean, sealed brake fluid container.
21. Slowly press and release the brake pedal. Observe the brake pedal feel.
22. If the brake pedal feels spongy, perform the following procedure.
 1. If equipped with antilock brakes, install a scan tool and perform the [Antilock Brake System Automated Bleed](#) to remove air which may be trapped in the BPMV.
 2. Inspect the hydraulic brake system for external leaks. Refer to [Brake System External Leak Inspection](#).
 3. Repeat the Bleeding the Complete Brake Hydraulic System procedure.
23. If the brake pedal still feels spongy, pressure bleed the hydraulic brake system. Refer to [Hydraulic Brake System Bleeding \(Manual\)Hydraulic Brake System Bleeding \(Pressure\)](#)
24. Turn the ignition switch 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 the brake system is diagnosed and repaired.

25. If the brake system warning lamp remains illuminated, refer to [Diagnostic Starting Point - Vehicle](#) .

HYDRAULIC BRAKE SYSTEM BLEEDING (PRESSURE)

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

CAUTION: Only use products that comply with GM specifications and check manufacturer information respectively. We recommend the use of GM genuine products. Instructions must be followed at all times. 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.

If hydraulic components were serviced on only one wheel hydraulic circuit, perform the following procedure.

Bleeding a Single Hydraulic Brake Circuit

1. With the ignition OFF and the brakes cool, apply the brakes 3-5 times, or until the brake pedal effort increases significantly, in order to deplete the brake booster power reserve.
2. Place a clean shop cloth beneath the brake master cylinder to catch brake fluid spills.
3. Clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm.
4. Fill the brake master cylinder reservoir to the maximum-full level with GM approved brake fluid from a clean, sealed brake fluid container. Refer to [Fluid and Lubricant Recommendations](#) .

NOTE: The pressure bleeding equipment must be the diaphragm type. The rubber diaphragm between the air supply and the brake fluid prevents air, moisture, oil, and other contaminants from entering the hydraulic system.

5. Following the brake pressure bleeder manufacturer's instructions, fill the brake pressure bleeder with GM approved brake fluid from a clean, sealed brake fluid container.
6. Install the appropriate master cylinder reservoir adapter and connect the brake pressure bleeder.
7. Charge the brake pressure bleeder air tank to 170-200 kPa/1.7-2.0 bar (25-30 psi), or as recommended by the brake pressure bleeder manufacturer's instructions.
8. Open the brake pressure bleeder fluid tank valve to allow pressurized brake fluid to enter the brake hydraulic system.

NOTE: Any brake fluid leaks identified require repair prior to completing this procedure.

9. Wait approximately 30 seconds, then inspect the entire hydraulic brake system for external brake fluid leaks.
10. Install a proper box-end wrench onto the wheel hydraulic circuit bleeder valve which has been serviced.
11. Install a transparent hose over the end of the bleeder valve.
12. Submerge the open end of the transparent hose into a transparent container partially filled with brake fluid from a clean, sealed brake fluid container.
13. Loosen the bleeder valve to purge air from the wheel hydraulic circuit.
14. Allow fluid to flow until air bubbles stop flowing from the bleeder.
15. After all air has been purged from the hydraulic circuit, tighten the bleeder valve and install the dust cap.

NOTE: The brake reservoir may have residual pressure after the bleeding operation is complete. Wrap a clean shop towel around the bleeder adapter and all hose connections before disconnecting the pressure bleeding equipment to prevent brake fluid from contacting and damaging vehicle components and painted surfaces.

16. Close the brake pressure bleeder fluid tank valve then disconnect the brake pressure bleeder from the master cylinder reservoir bleeder adapter.
17. Remove the master cylinder reservoir bleeder adapter from the master cylinder reservoir.
18. Fill the brake master cylinder reservoir to the maximum-fill level with GM approved brake fluid from a clean, sealed brake fluid container.
19. Slowly press and release the brake pedal. Observe the brake pedal feel.
20. If the brake pedal feels spongy, perform the Bleeding the Complete Brake Hydraulic System procedure:
21. 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.**

22. If the brake system warning lamp remains illuminated, refer to [Diagnostic Starting Point - Vehicle](#) .

Bleeding the Complete Brake Hydraulic System

1. With the ignition OFF and the brakes cool, apply the brakes 3-5 times, or until the brake pedal effort increases significantly, in order to deplete the brake booster power reserve.
2. Place a clean shop cloth beneath the brake master cylinder to catch brake fluid spills.
3. Clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm.
4. Fill the brake master cylinder reservoir to the maximum-full level with GM approved brake fluid from a clean, sealed brake fluid container. Refer to [Fluid and Lubricant Recommendations](#) .
5. If the master cylinder was replaced, the master cylinder must be bench bled. Refer to [Master Cylinder Bench Bleeding](#).

NOTE: **The pressure bleeding equipment must be the diaphragm type. The rubber diaphragm between the air supply and the brake fluid prevents air, moisture, oil, and other contaminants from entering the hydraulic system.**

6. Following the brake pressure bleeder manufacturer's instructions, fill the brake pressure bleeder with GM approved brake fluid from a clean, sealed brake fluid container.
7. Install the appropriate master cylinder reservoir adapter and connect the brake pressure bleeder.
8. Charge the brake pressure bleeder air tank to 170-200 kPa/1.7-2.0 bar (25-30 psi), or as recommended by the brake pressure bleeder manufacturer's instructions.
9. Open the brake pressure bleeder fluid tank valve to allow pressurized brake fluid to enter the brake hydraulic system.

NOTE: **Any brake fluid leaks identified require repair prior to completing this procedure.**

10. Wait approximately 30 seconds, then inspect the entire hydraulic brake system for external brake fluid leaks.
11. Install a proper box-end wrench onto the RIGHT REAR wheel hydraulic circuit bleeder valve.
12. Install a transparent hose over the end of the bleeder valve.
13. 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.
14. Loosen the bleeder valve to purge air from the wheel hydraulic circuit.
15. Allow fluid to flow until air bubbles stop flowing from the bleeder.
16. After all air has been purged from the hydraulic circuit, tighten the bleeder valve and install the dust cap.
17. Install a proper box-end wrench onto the LEFT REAR wheel hydraulic circuit bleeder valve, then repeat steps 12-16.
18. Install a proper box-end wrench onto the RIGHT FRONT wheel hydraulic circuit bleeder valve, then repeat steps 12-16.
19. Install a proper box-end wrench onto the LEFT FRONT wheel hydraulic circuit bleeder valve, then repeat steps 12-16.
20. Close the brake pressure bleeder fluid tank valve.

NOTE: **The brake reservoir may have residual pressure after the bleeding operation is**

complete. Wrap a clean shop towel around the bleeder adapter and all hose connections before disconnecting the pressure bleeding equipment to prevent brake fluid from contacting and damaging vehicle components and painted surfaces.

21. Remove the brake pressure bleeding equipment from the vehicle.
22. Fill the brake master cylinder reservoir to the maximum-full level with GM approved brake fluid from a clean, sealed brake fluid container. Refer to [Fluid and Lubricant Recommendations](#) .
23. Slowly press and release the brake pedal. Observe the brake pedal feel.
24. If the brake pedal feels spongy, perform the following procedure.
 1. If equipped with antilock brakes, install a scan tool and perform the [Antilock Brake System Automated Bleed](#) to remove air which may be trapped in the BPMV.
 2. Inspect the hydraulic brake system for external leaks. Refer to [Brake System External Leak Inspection](#).
 3. Repeat the Bleeding the Complete Brake Hydraulic System procedure.
25. If the brake pedal still feels spongy, pressure bleed the hydraulic brake system. Refer to [Hydraulic Brake System Bleeding \(Manual\)](#)[Hydraulic Brake System Bleeding \(Pressure\)](#).
26. Turn the ignition switch 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 the brake system is diagnosed and repaired.**

27. If the brake system warning lamp remains illuminated, refer to [Diagnostic Starting Point - Vehicle](#) .

HYDRAULIC BRAKE SYSTEM FLUSHING

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

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 and/or 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 Replacement](#)
- [Front Brake Hose Replacement](#)
- [Rear Brake Hose Replacement \(Drum Brake\)](#)[Rear Brake Hose Replacement \(Disc Brake\)](#)
- [Front Brake Caliper Replacement](#)
- [Rear Brake Caliper Replacement](#) , if equipped
- [Rear Brake Cylinder Replacement](#) , if equipped

- **Brake Proportion Valve Replacement**, if equipped
 - **Brake Pressure Modulator Valve Replacement**, if equipped
2. Clean out all the hydraulic brake pipes using denatured alcohol.
 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 Replacement**; also perform the following:
 - Clean the brake master cylinder reservoir using denatured alcohol, 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**.
 - **Front Brake Hose Replacement**
 - **Rear Brake Hose Replacement (Drum Brake)****Rear Brake Hose Replacement (Disc Brake)**
 - **Front Brake Caliper Replacement**
 - **Rear Brake Caliper Replacement**, if equipped
 - **Rear Brake Cylinder Replacement**, if equipped
 - **Brake Proportion Valve Replacement**, if equipped
 - **Brake Pressure Modulator Valve Replacement**, if equipped
- 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. Fill the brake master cylinder reservoir to the maximum-fill level with GM approved brake fluid from a clean, sealed brake fluid container.
- 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 (Manual)****Hydraulic Brake System Bleeding (Pressure)**.

POWER VACUUM BRAKE BOOSTER REPLACEMENT

Removal Procedure

1. With the engine OFF, apply and release the brake pedal several times until the pedal becomes firm to deplete the power vacuum brake booster vacuum reserve.
2. Remove the battery tray. Refer to **Battery Tray Replacement**.
3. Disconnect the power vacuum brake booster vacuum sensor electrical connector, if equipped.

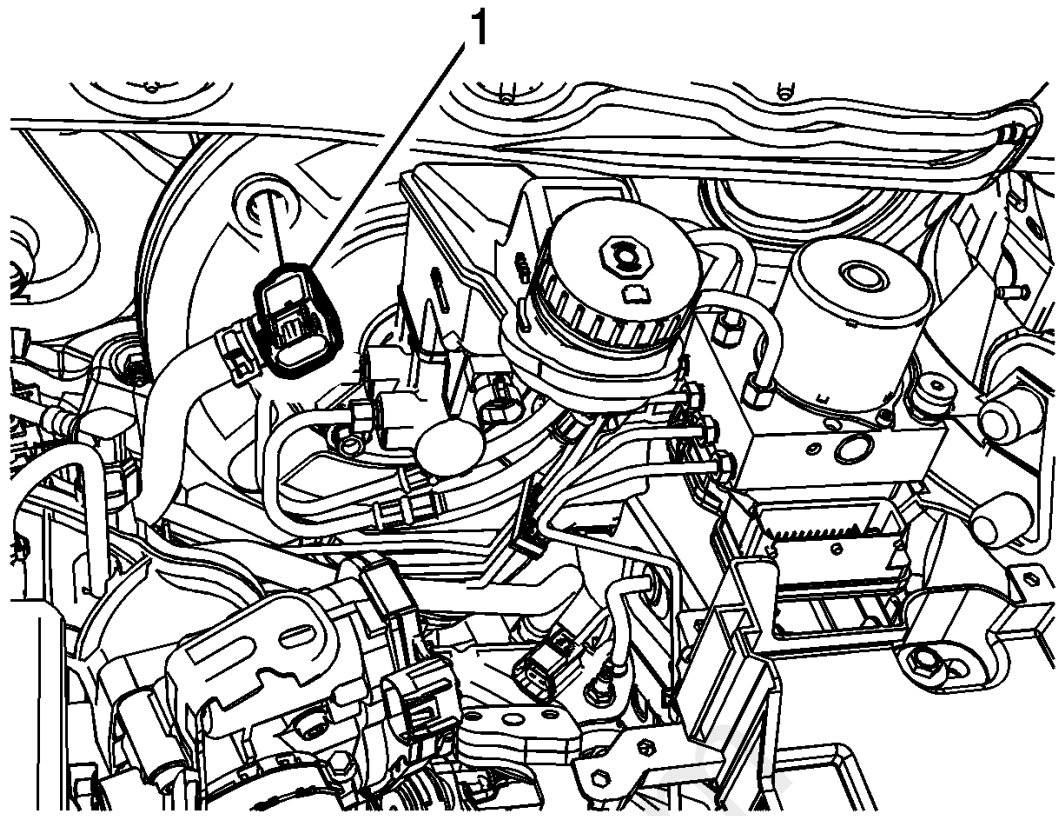


Fig. 166: Power Brake Booster Vacuum Sensor And Hose Assembly
Courtesy of GENERAL MOTORS COMPANY

4. If equipped, remove the power vacuum brake booster vacuum sensor (1) from the power vacuum brake booster.

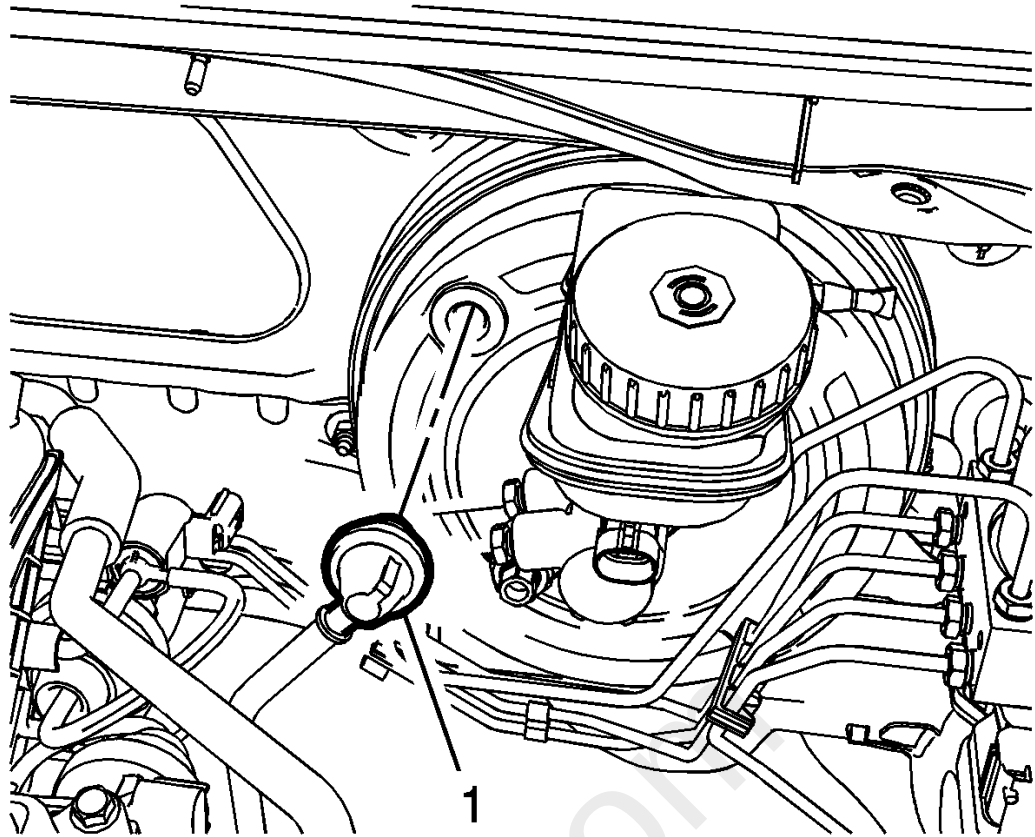


Fig. 167: Power Brake Booster Vacuum Check Valve
Courtesy of GENERAL MOTORS COMPANY

5. If equipped, remove the power brake booster vacuum check valve (1) from the power vacuum brake booster.
6. Remove the driver side instrument panel knee bolster. Refer to [**Instrument Panel Knee Bolster Replacement \(Buick\)**](#) [**Instrument Panel Knee Bolster Replacement \(Chevrolet\)**](#) .

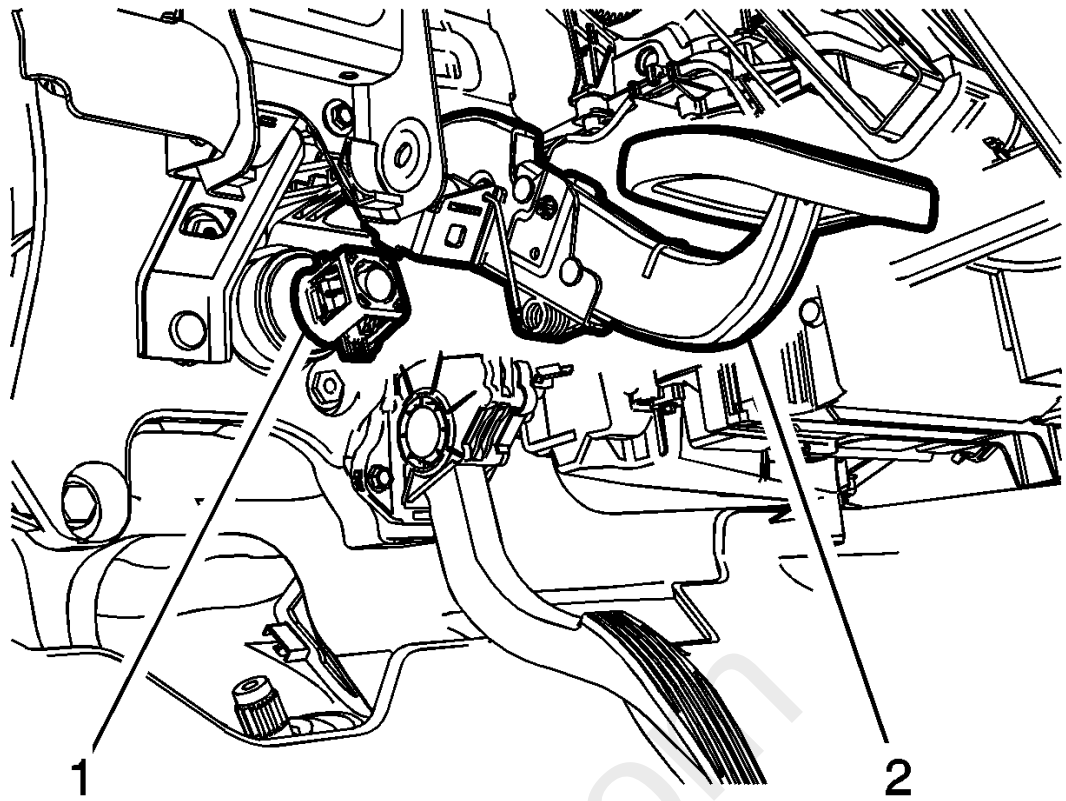


Fig. 168: Brake Booster Pushrod Retainer And Brake Pedal
Courtesy of GENERAL MOTORS COMPANY

7. Compress the tabs on the top and bottom of the brake booster pushrod retainer (1) and lift the brake pedal (2) rearward to disconnect the brake pedal from the power brake booster pushrod.
8. Inspect the brake booster pushrod retainer for damage and replace, if necessary.
9. Remove the master cylinder. Refer to [Master Cylinder Replacement](#).

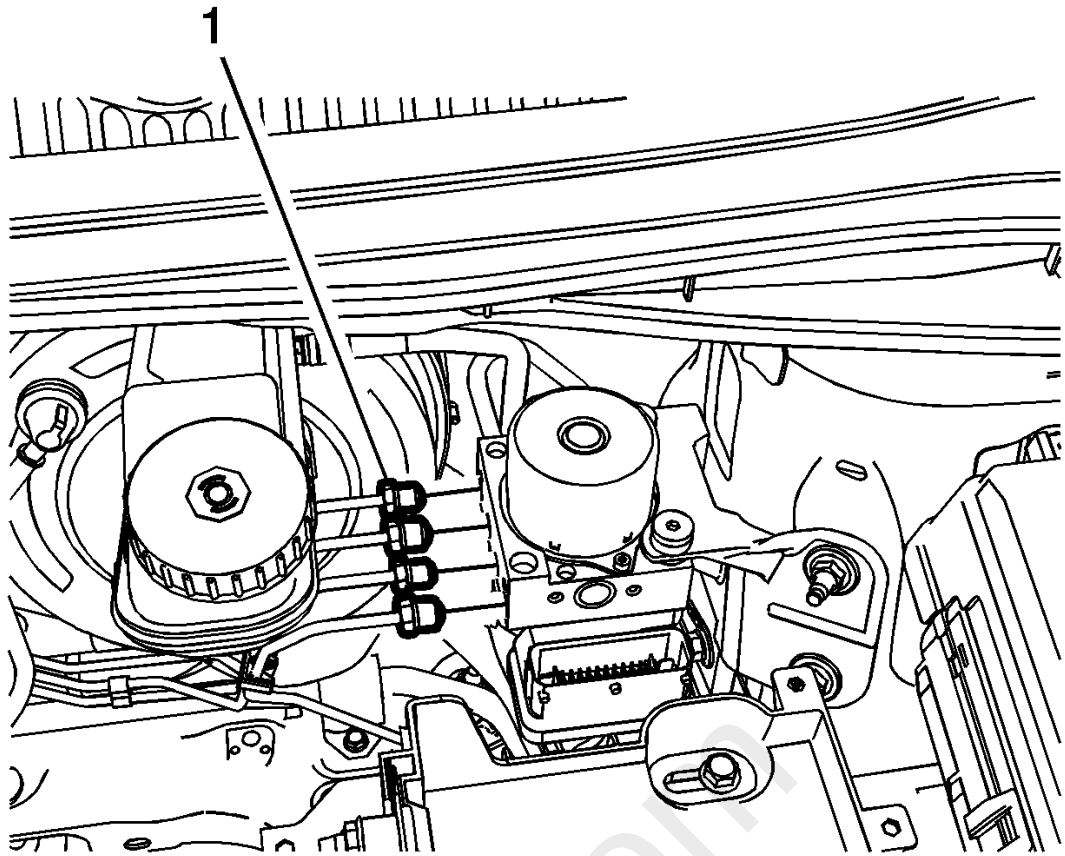


Fig. 169: Front And Rear Brake Pipe Fittings
Courtesy of GENERAL MOTORS COMPANY

10. If equipped with antilock brakes, disconnect the front and rear brake pipe fittings (1) from the brake pressure modulator valve (BPMV). Refer to **Brake Pressure Modulator Valve Replacement**.

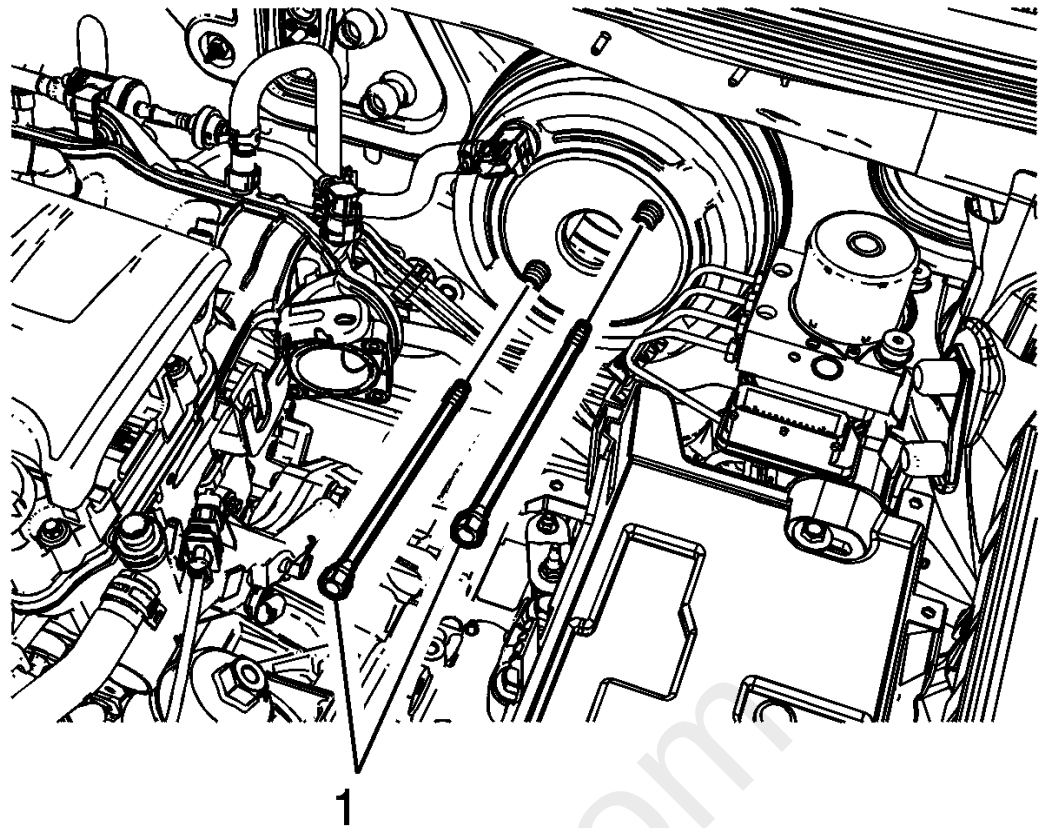


Fig. 170: Power Vacuum Brake Booster And Bolts
Courtesy of GENERAL MOTORS COMPANY

11. Completely loosen the power vacuum brake booster bolts (1).
12. Remove the power vacuum brake booster.
13. Inspect the power vacuum brake booster gasket for damage and replace, if necessary.

Installation Procedure

1. Install the power vacuum brake booster gasket, if removed.

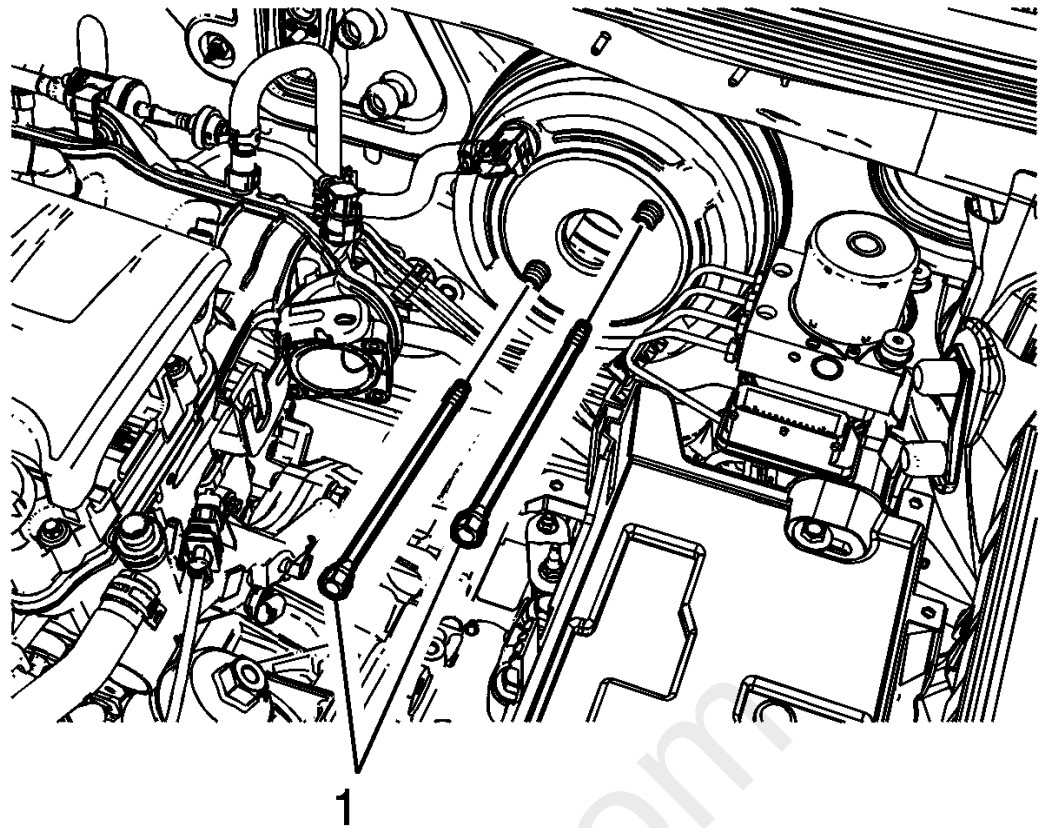


Fig. 171: Power Vacuum Brake Booster And Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Install the power vacuum brake booster and bolts.

CAUTION: Refer to [Fastener Caution](#) .

NOTE: Do not over tighten the power vacuum brake booster bolts. If the power vacuum brake booster bolts are over tightened, the brake pedal may remain applied after a high pressure brake pedal application.

3. Install the power vacuum brake booster bolts (1) and tighten to 19 N.m (14 lb ft).

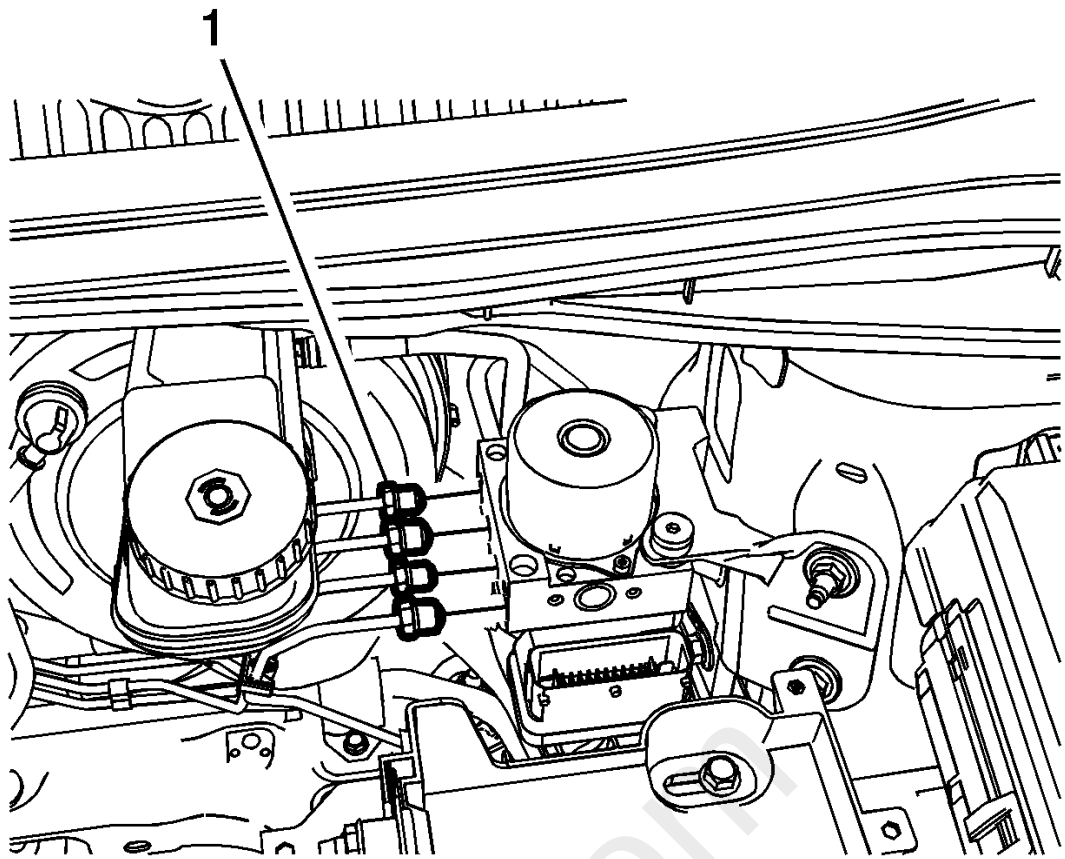


Fig. 172: Front And Rear Brake Pipe Fittings
Courtesy of GENERAL MOTORS COMPANY

4. If equipped with antilock brakes, connect the front and rear brake pipe fittings (1) to the BPMV. Refer to [Brake Pressure Modulator Valve Replacement](#) .
5. Install the master cylinder. Refer to [Master Cylinder Replacement](#).

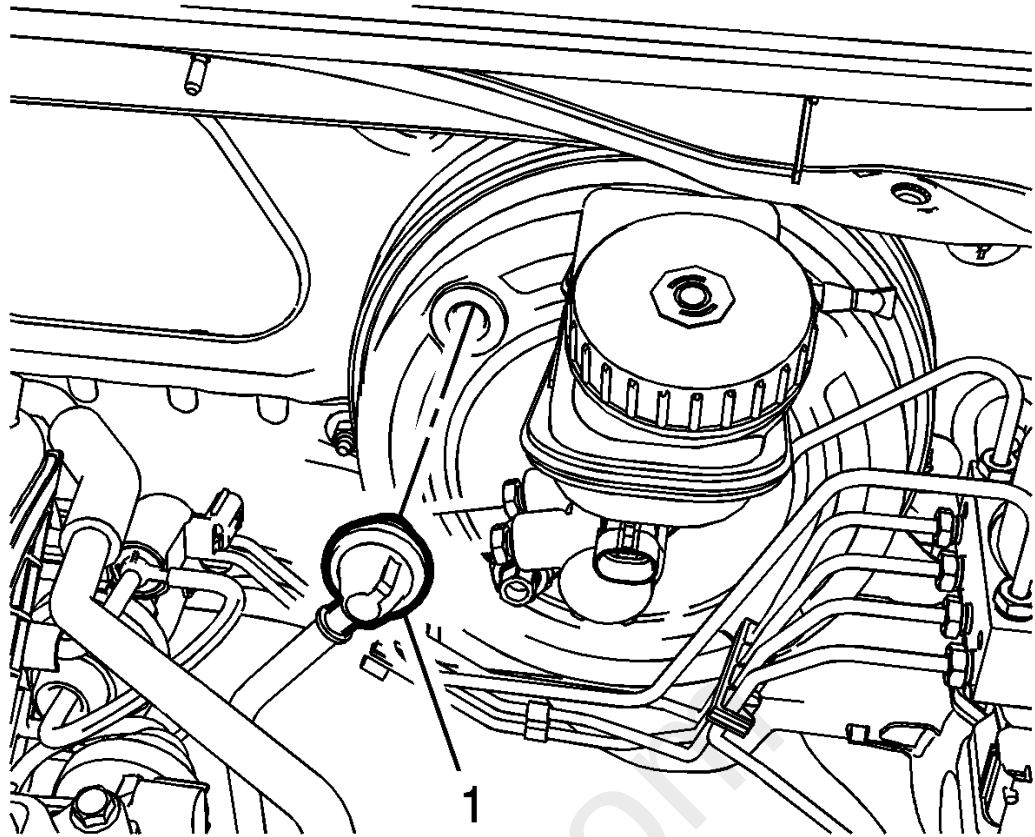


Fig. 173: Power Brake Booster Vacuum Check Valve
Courtesy of GENERAL MOTORS COMPANY

6. If equipped, install the power brake booster vacuum check valve (1) to the power vacuum brake booster.

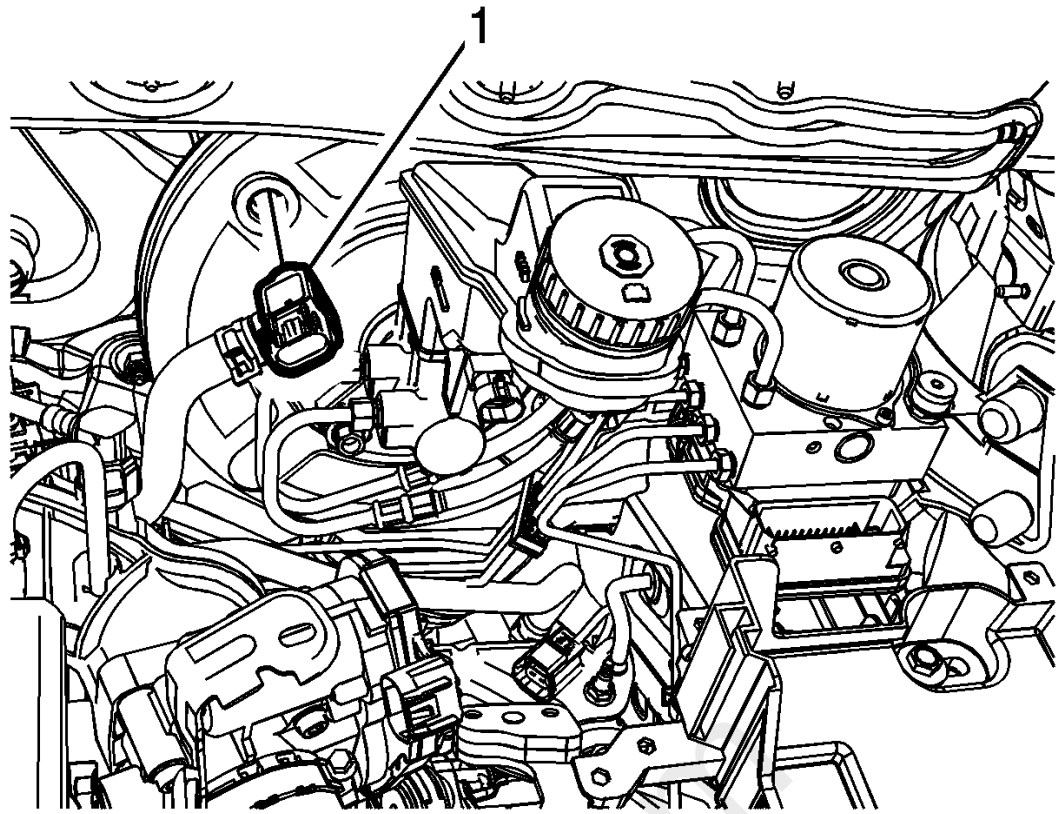


Fig. 174: Power Brake Booster Vacuum Sensor And Hose Assembly
Courtesy of GENERAL MOTORS COMPANY

7. If equipped, install the power vacuum brake booster vacuum sensor (1) to the power vacuum brake booster and connect the electrical connector.

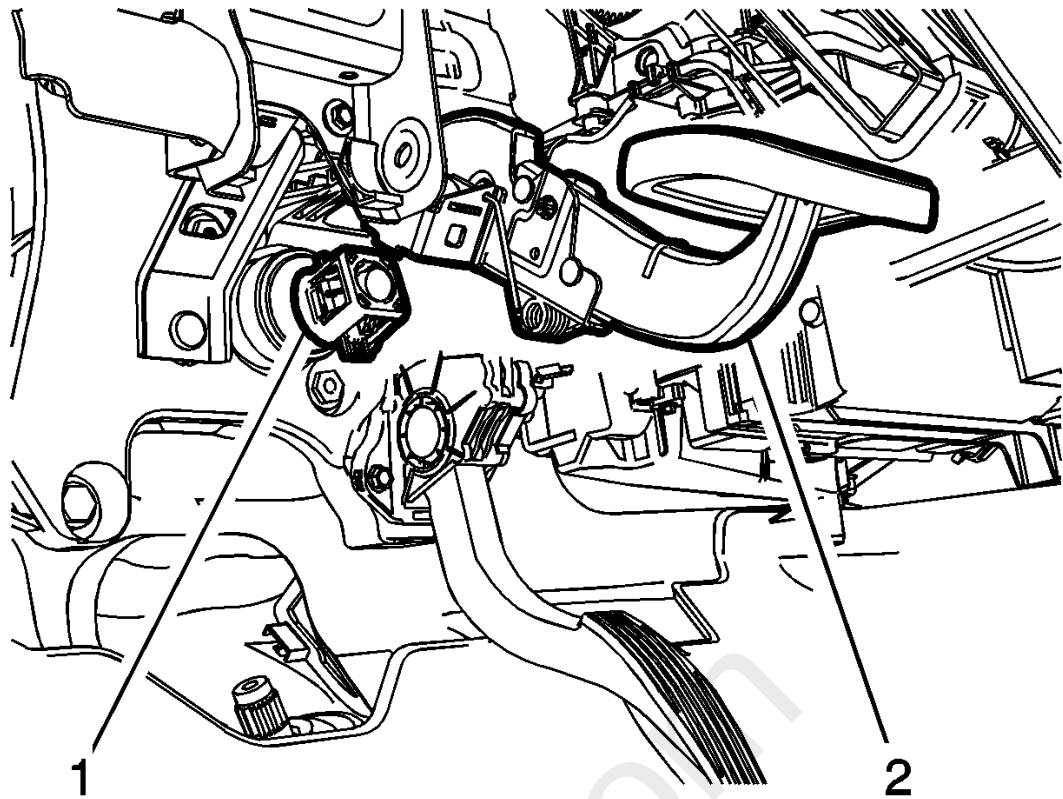


Fig. 175: Brake Booster Pushrod Retainer And Brake Pedal
Courtesy of GENERAL MOTORS COMPANY

8. Install the power brake booster pushrod retainer (1) to the power brake booster pushrod, if removed.

NOTE: Ensure the power vacuum brake booster pushrod retainer is fully seated in the brake pedal arm.

9. Position the brake pedal (2) to the power brake booster pushrod retainer and firmly seat the brake pedal to the retainer.
10. Install the driver side instrument panel knee bolster. Refer to [Instrument Panel Knee Bolster Replacement \(Buick\)](#) [Instrument Panel Knee Bolster Replacement \(Chevrolet\)](#) .
11. Install the battery tray. Refer to [Battery Tray Replacement](#) .

POWER BRAKE BOOSTER VACUUM SENSOR REPLACEMENT

Removal Procedure

1. Disconnect the power brake booster vacuum sensor electrical connector.

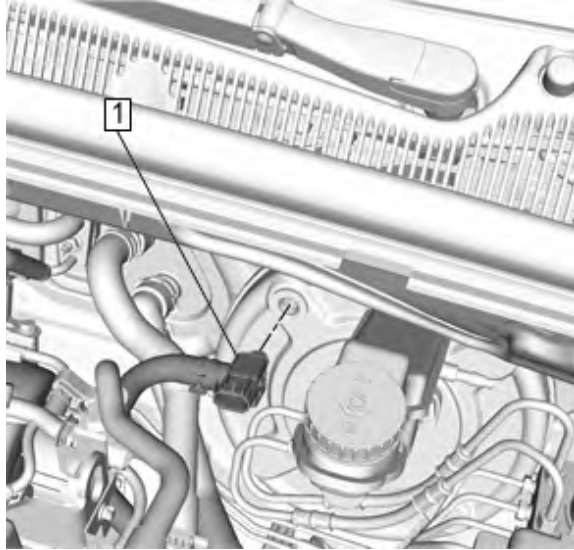


Fig. 176: Power Brake Booster Vacuum Sensor
Courtesy of GENERAL MOTORS COMPANY

2. Remove Power Brake Booster Vacuum Sensor (1)

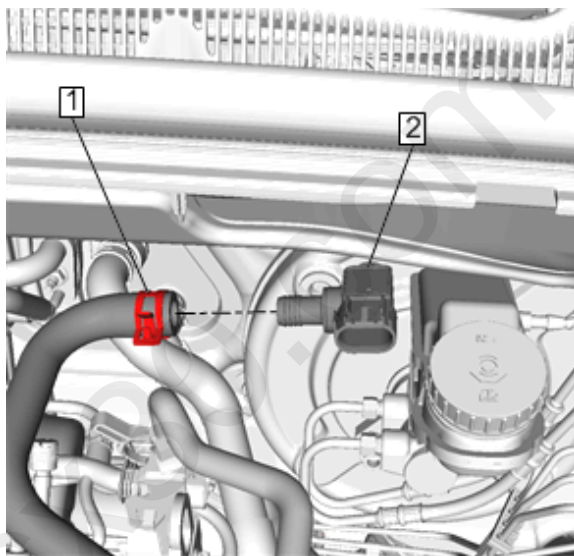
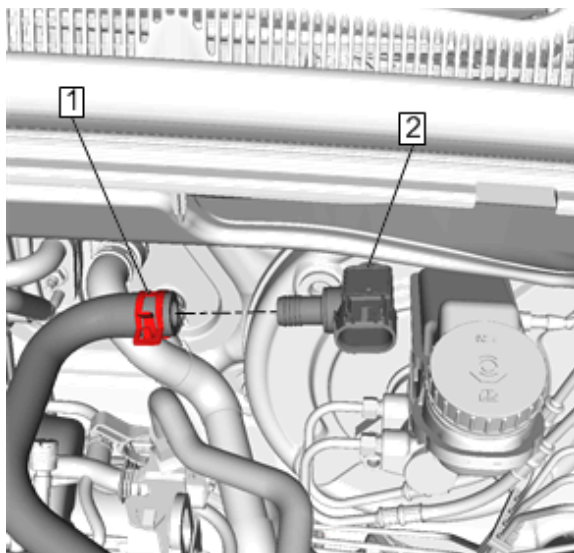


Fig. 177: Power Brake Booster Vacuum Sensor And Clamp
Courtesy of GENERAL MOTORS COMPANY

3. Release Clamp (1)
4. Remove Power Brake Booster Vacuum Sensor (2)

Installation Procedure



1. Install Clamp (1)

NOTE: A small amount of denatured alcohol may be used as a lubricant for assembly.

2. Install Power Brake Booster Vacuum Sensor (2)
3. Secure Clamp

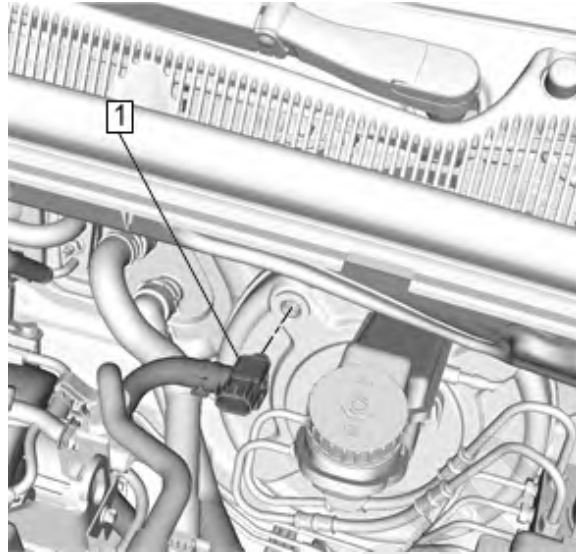


Fig. 179: Power Brake Booster Vacuum Sensor
Courtesy of GENERAL MOTORS COMPANY

NOTE: A small amount of denatured alcohol may be used as a lubricant for assembly.

4. Install Power Brake Booster Vacuum Sensor (1)
5. Connect the power brake booster vacuum sensor electrical connector.

POWER BRAKE BOOSTER VACUUM HOSE REPLACEMENT (LUV)

Removal Procedure

1. With the engine OFF, apply and release the brake pedal several times to deplete the power vacuum brake booster vacuum reserve.
2. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .

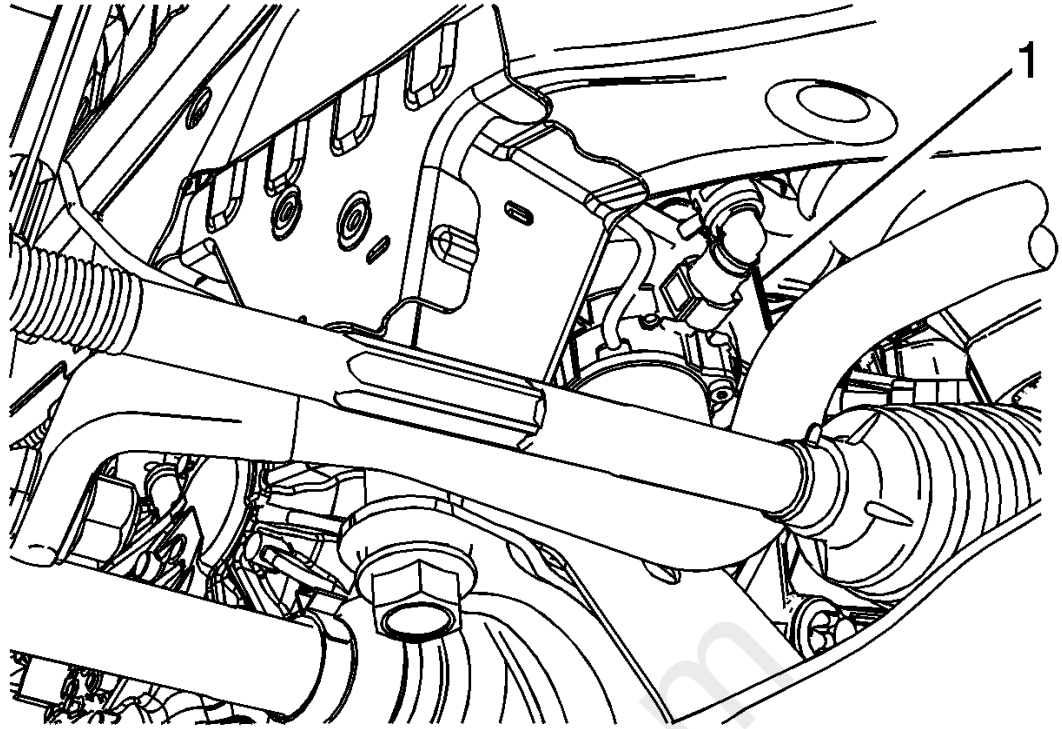


Fig. 180: Power Brake Booster Vacuum Hose Quick Connect
Courtesy of GENERAL MOTORS COMPANY

3. Through the left front wheelhouse, disconnect the power brake booster vacuum hose quick connect (1) from the power brake booster pump port.
4. Lower the vehicle.

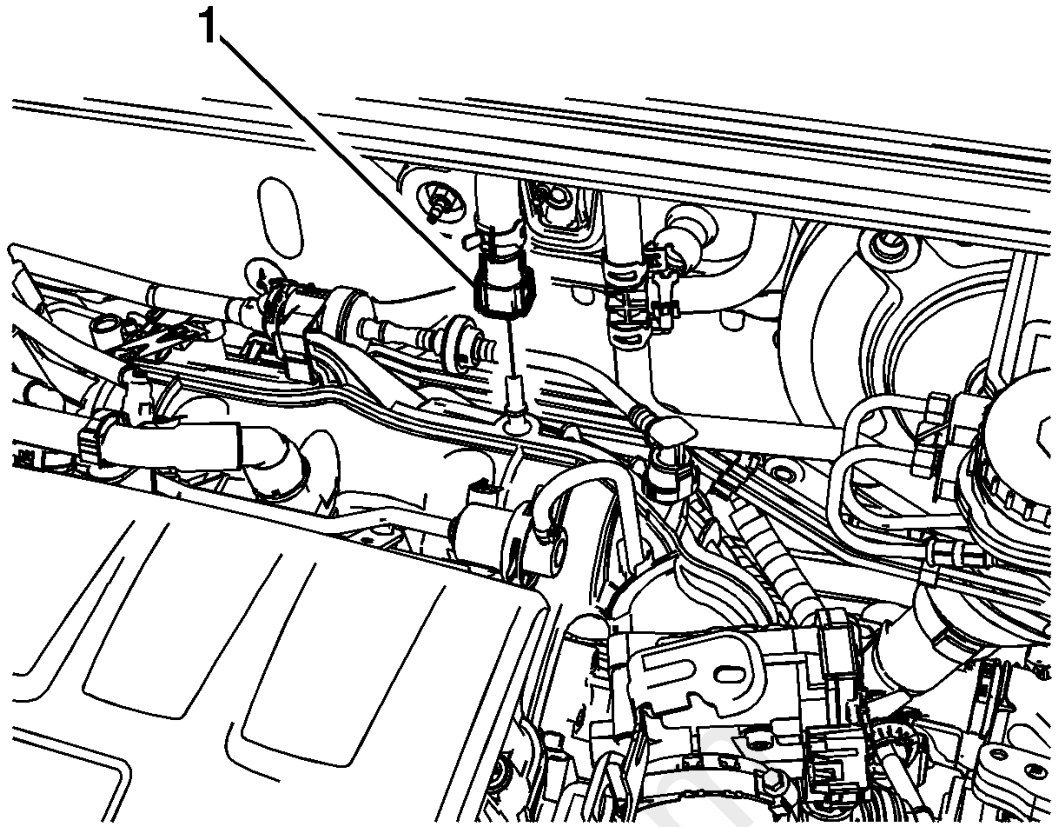


Fig. 181: Power Brake Booster Vacuum Hose Quick Connect
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the power brake booster vacuum hose quick connect (1) from the intake manifold vacuum port.
6. Disconnect the power brake booster vacuum sensor electrical connector.

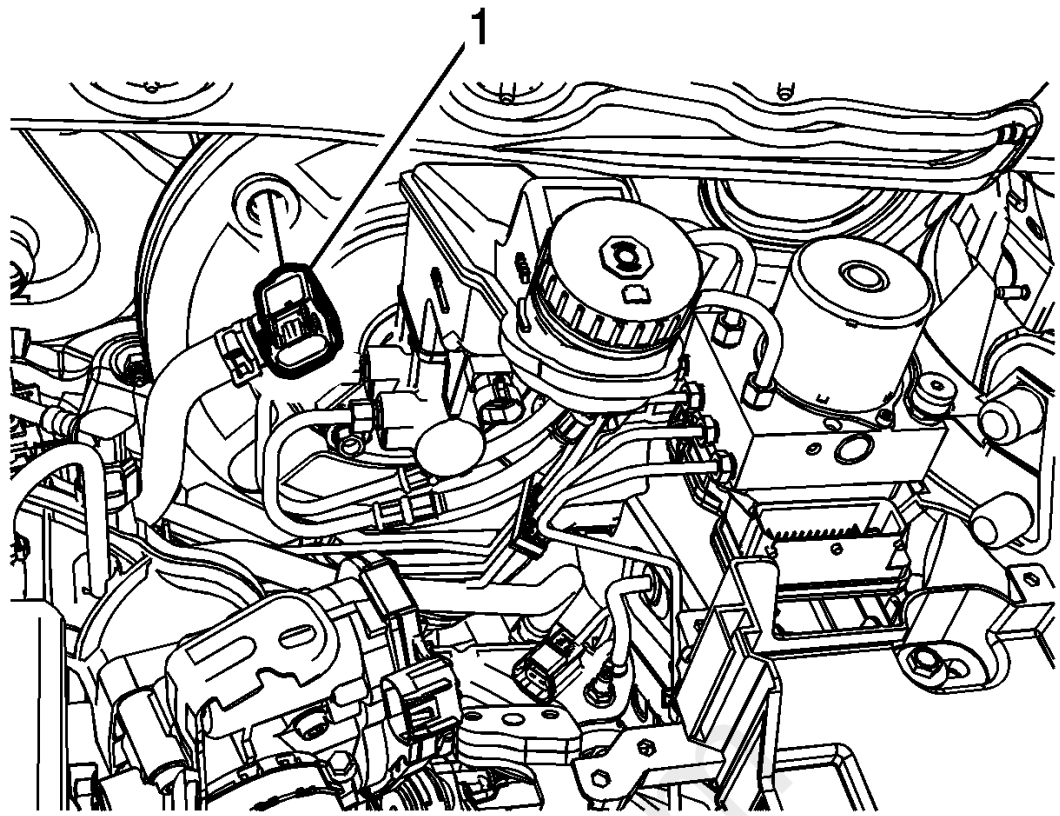


Fig. 182: Power Brake Booster Vacuum Sensor And Hose Assembly
Courtesy of GENERAL MOTORS COMPANY

7. Remove the power brake booster vacuum sensor and hose assembly (1) from the power vacuum brake booster grommet.

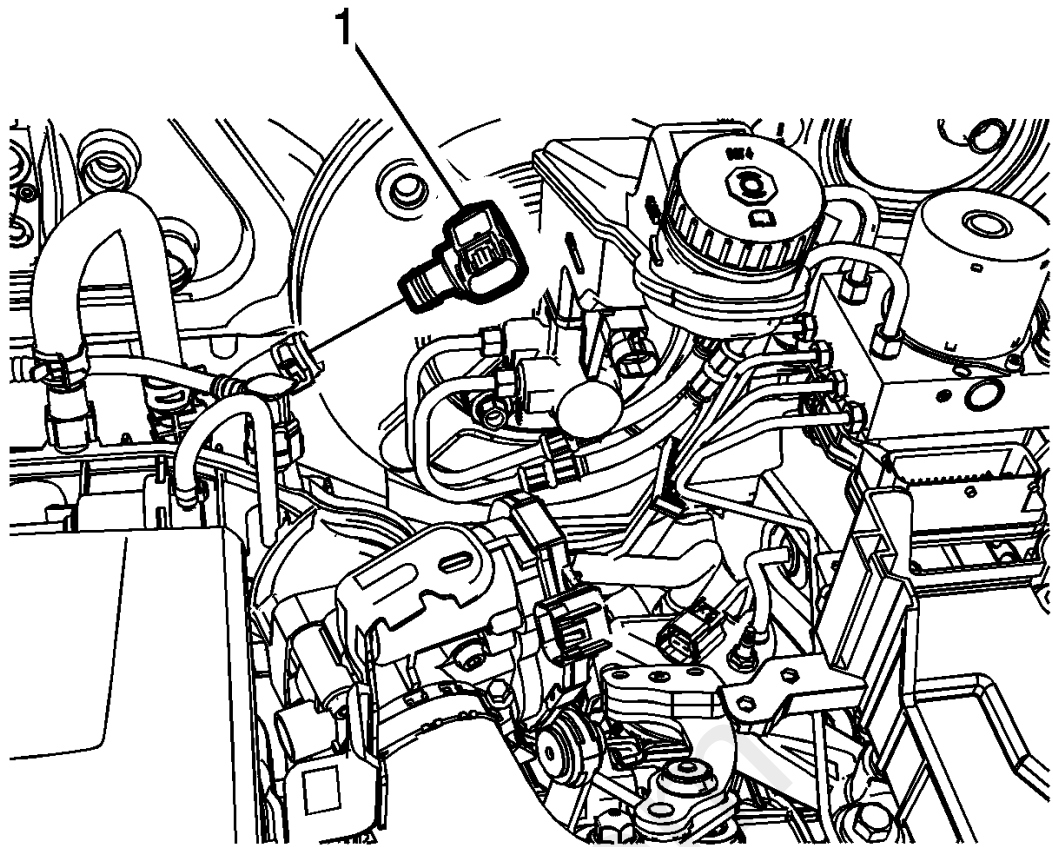


Fig. 183: Power Brake Booster Vacuum Sensor
Courtesy of GENERAL MOTORS COMPANY

8. Release the clamp and remove the power brake booster vacuum sensor (1).
9. Remove the power brake booster vacuum hose assembly.

Installation Procedure

1. Install the power brake booster vacuum hose assembly to the vehicle.

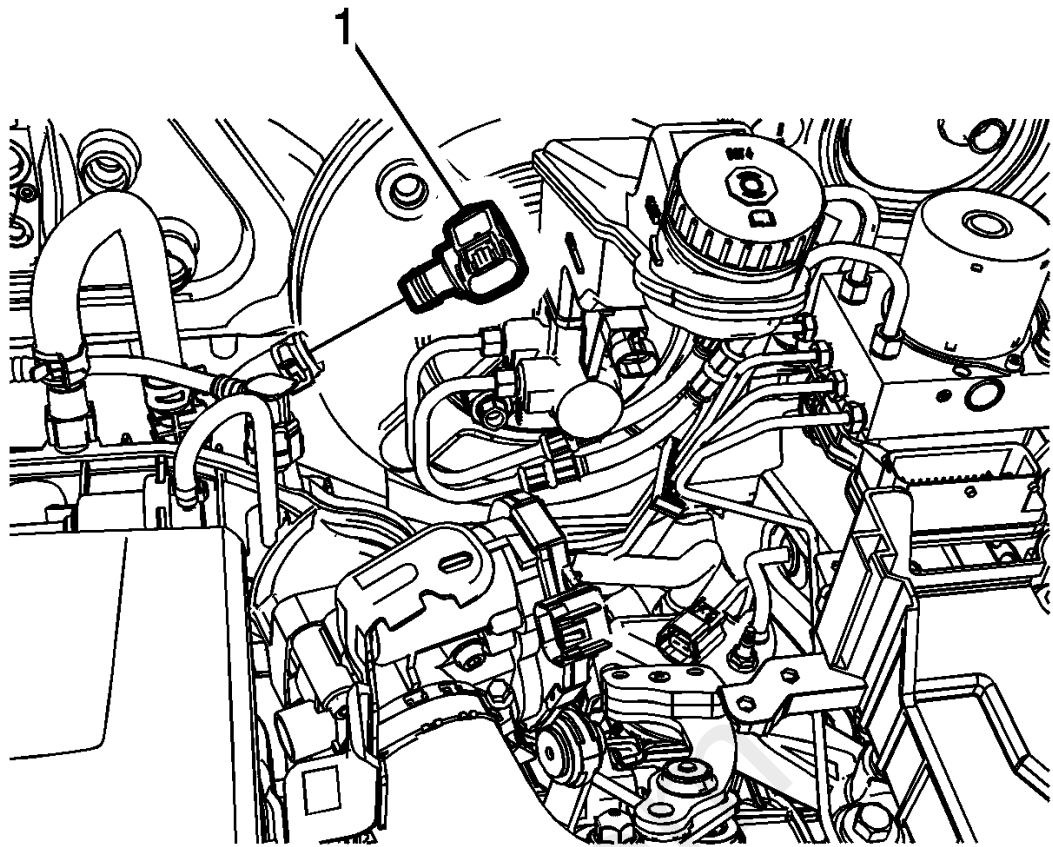


Fig. 184: Power Brake Booster Vacuum Sensor
Courtesy of GENERAL MOTORS COMPANY

NOTE: A small amount of denatured alcohol may be used as a lubricant for assembly.

2. Release the clamp and install the power brake booster vacuum sensor (1).

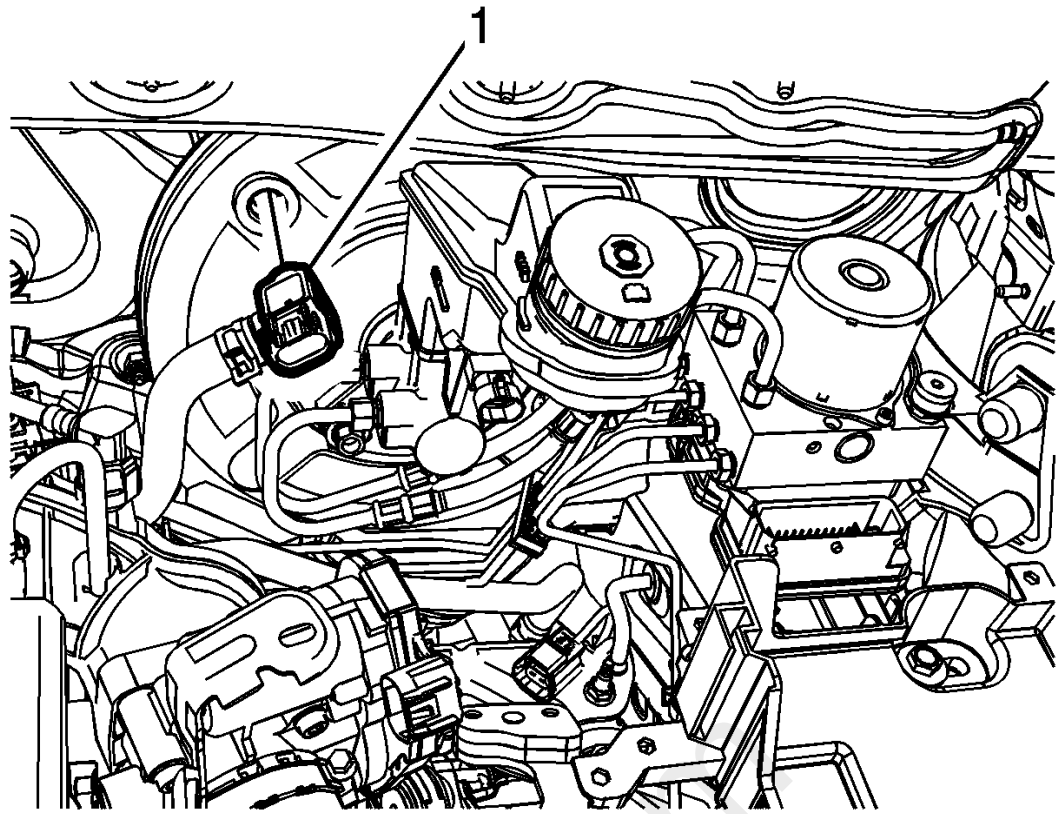


Fig. 185: Power Brake Booster Vacuum Sensor And Hose Assembly
Courtesy of GENERAL MOTORS COMPANY

NOTE: A small amount of denatured alcohol may be used as a lubricant for assembly.

3. Install the power brake booster vacuum sensor and hose assembly (1) to the power vacuum brake booster grommet.
4. Connect the power brake booster vacuum sensor electrical connector.

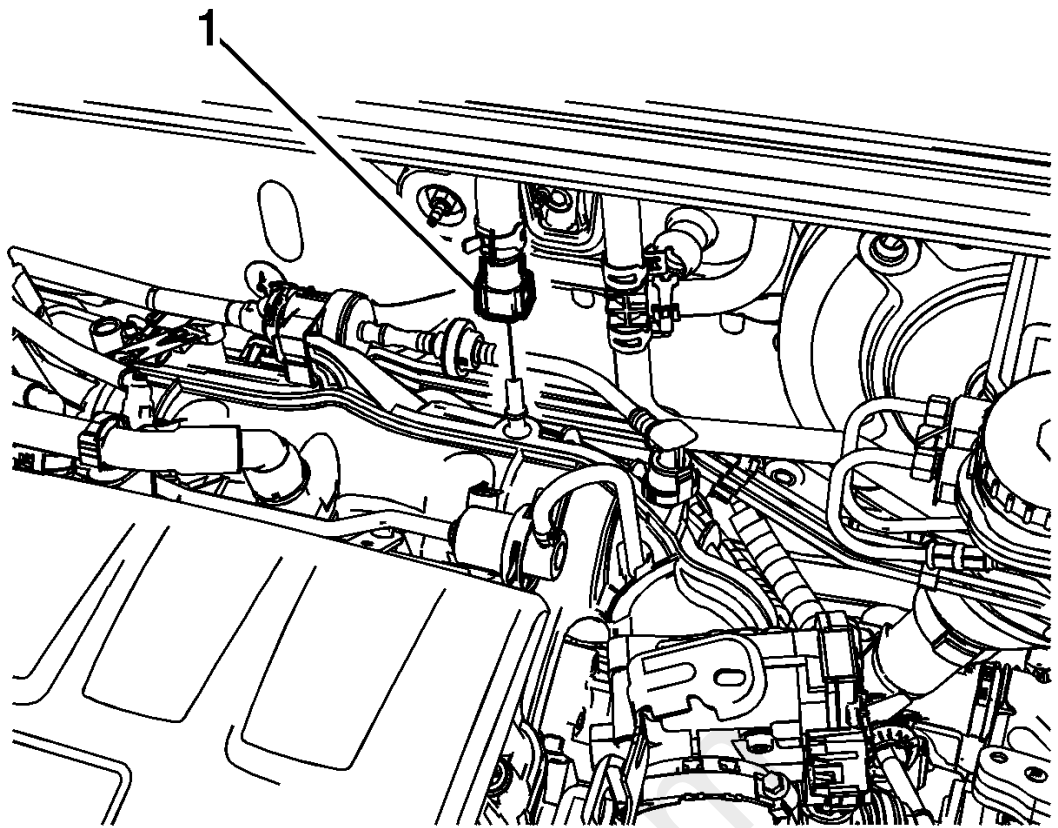


Fig. 186: Power Brake Booster Vacuum Hose Quick Connect
Courtesy of GENERAL MOTORS COMPANY

5. Connect the power brake booster vacuum hose quick connect (1) to the intake manifold vacuum port.
6. Raise and support the vehicle. Refer to [**Lifting and Jacking the Vehicle**](#) .

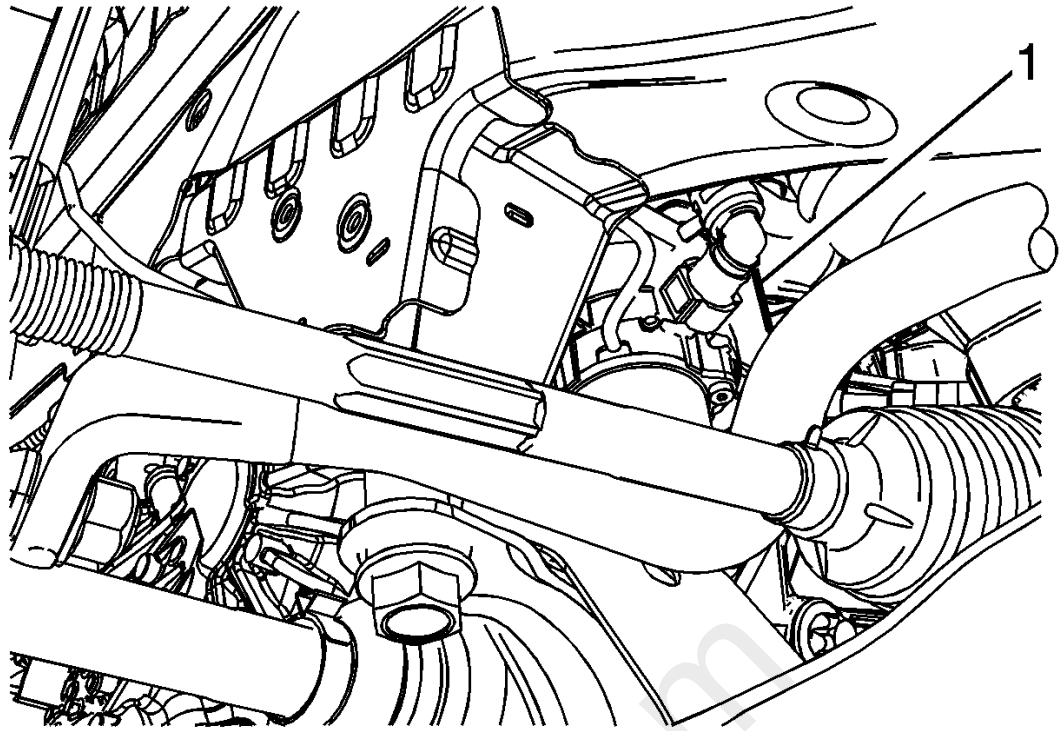


Fig. 187: Power Brake Booster Vacuum Hose Quick Connect
 Courtesy of GENERAL MOTORS COMPANY

7. Through the left front wheelhouse, connect the power brake booster vacuum hose quick connect (1) to the power brake booster pump port.

POWER BRAKE BOOSTER VACUUM HOSE REPLACEMENT (LE2)

Removal Procedure

1. With the engine OFF, apply and release the brake pedal several times until the brake pedal becomes firm to deplete the power brake booster vacuum reserve.
2. Disconnect the power brake booster vacuum sensor electrical connector.

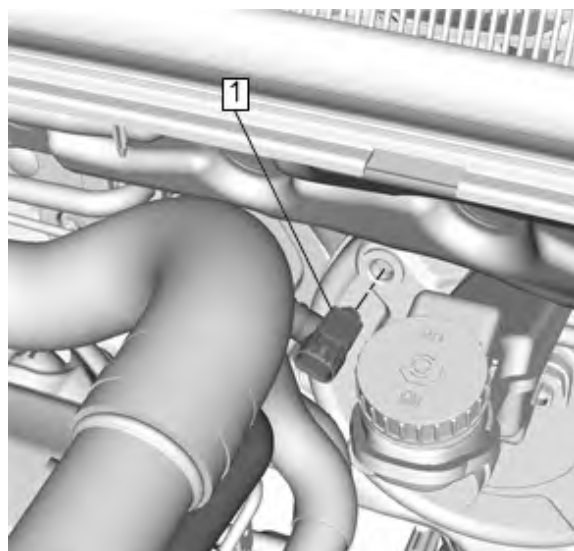


Fig. 188: Power Brake Booster Vacuum Sensor
 Courtesy of GENERAL MOTORS COMPANY

3. Remove Power Brake Booster Vacuum Sensor (1)

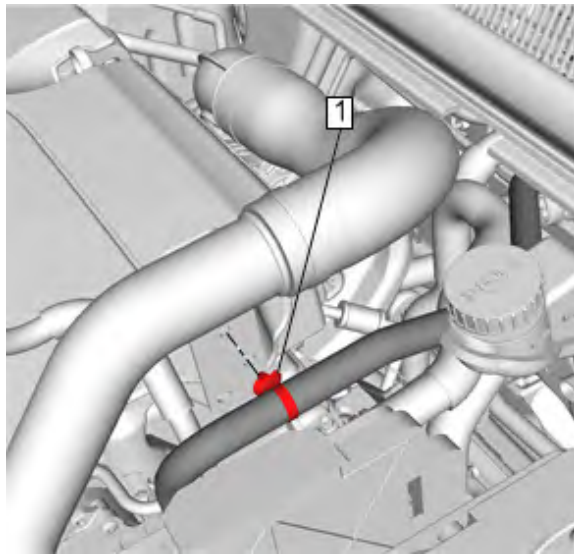


Fig. 189: Retainer

Courtesy of GENERAL MOTORS COMPANY

4. Remove Retainer (1)

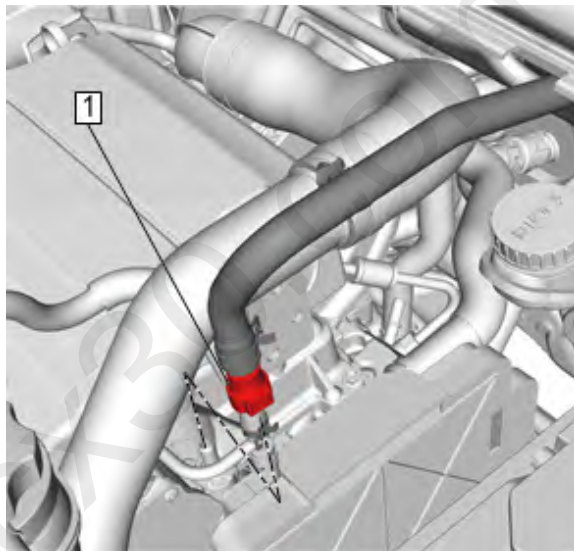


Fig. 190: Quick Connect Fitting

Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Quick Connect Fitting (1)
6. Remove Power Brake Booster Vacuum Hose Assembly

Installation Procedure

1. Install Power Brake Booster Vacuum Hose Assembly

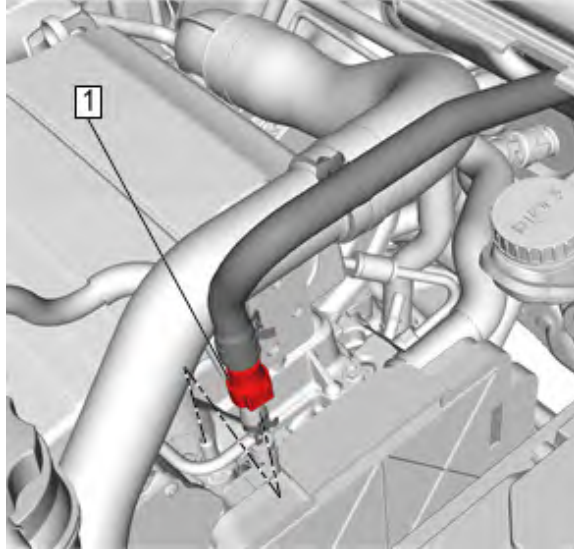


Fig. 191: Quick Connect Fitting

Courtesy of GENERAL MOTORS COMPANY

2. Connect Quick Connect Fitting (1)

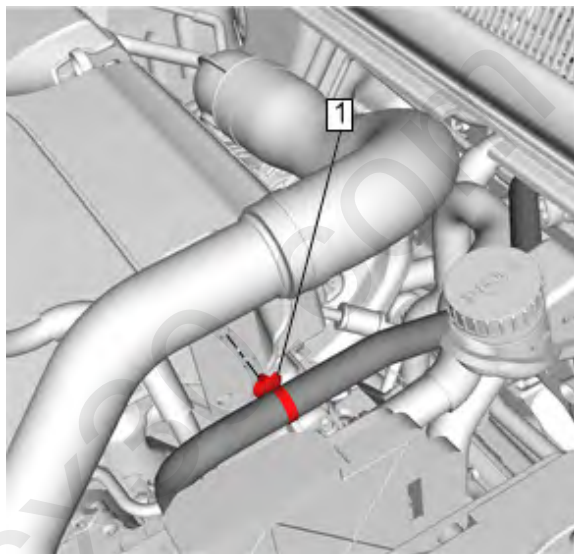


Fig. 192: Retainer

Courtesy of GENERAL MOTORS COMPANY

3. Install Retainer (1)

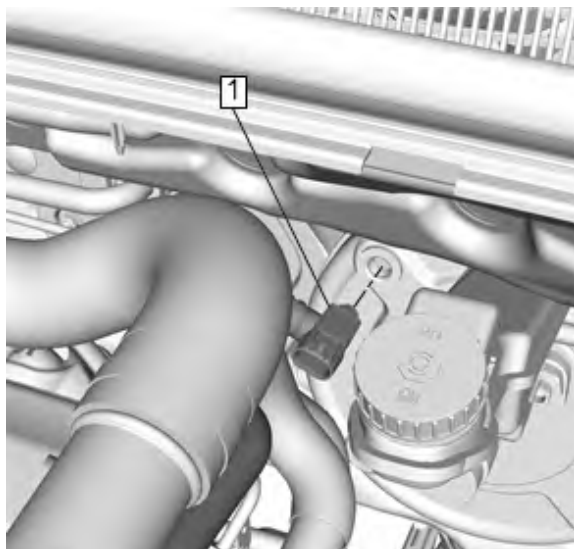


Fig. 193: Power Brake Booster Vacuum Sensor

Courtesy of GENERAL MOTORS COMPANY

NOTE: A small amount of denatured alcohol may be used as a lubricant for assembly.

4. Install Power Brake Booster Vacuum Sensor (1)
5. Connect the power brake booster vacuum sensor electrical connector.

POWER BRAKE BOOSTER VACUUM HOSE REPLACEMENT (2H0)

Removal Procedure

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)

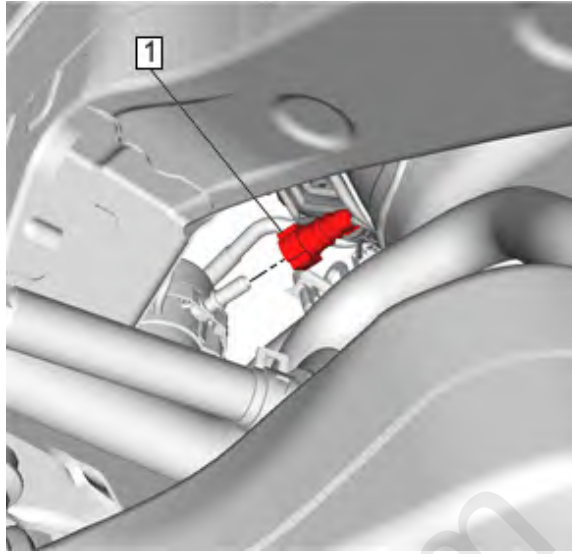


Fig. 194: Quick Connect Fitting

Courtesy of GENERAL MOTORS COMPANY

NOTE: Access the power brake booster vacuum hose quick connect fitting through the left front wheelhouse.

2. Disconnect Quick Connect Fitting (1)
3. Lower the vehicle.
4. Disconnect the power brake booster vacuum sensor electrical connector.

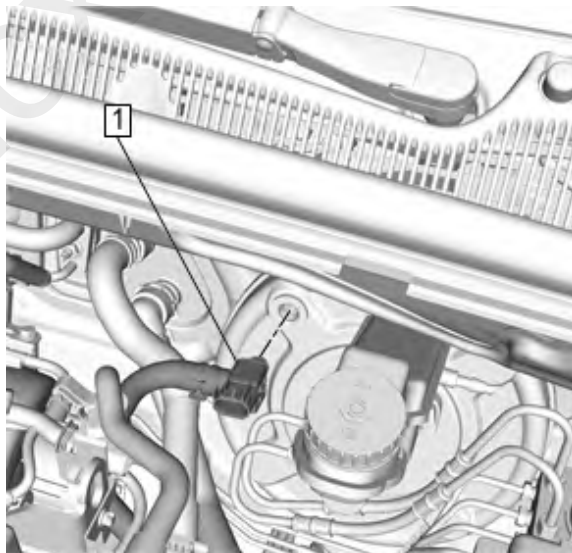


Fig. 195: Power Brake Booster Vacuum Sensor

Courtesy of GENERAL MOTORS COMPANY

5. Remove Power Brake Booster Vacuum Sensor (1)

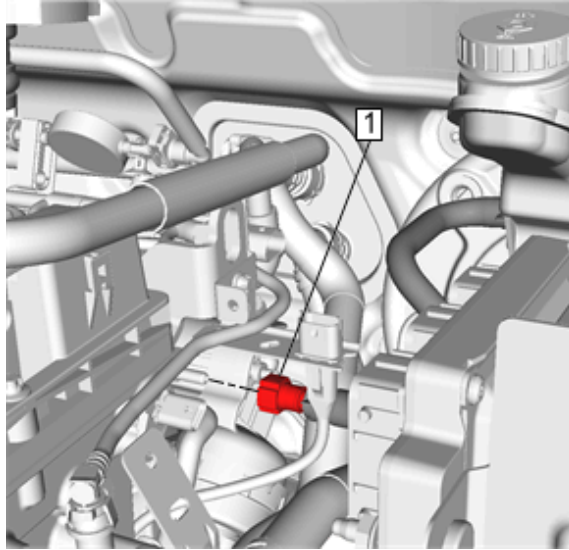


Fig. 196: Quick Connect Fitting

Courtesy of GENERAL MOTORS COMPANY

6. Disconnect Quick Connect Fitting (1)
7. Remove Power Brake Booster Vacuum Hose

Installation Procedure

1. Install Power Brake Booster Vacuum Hose

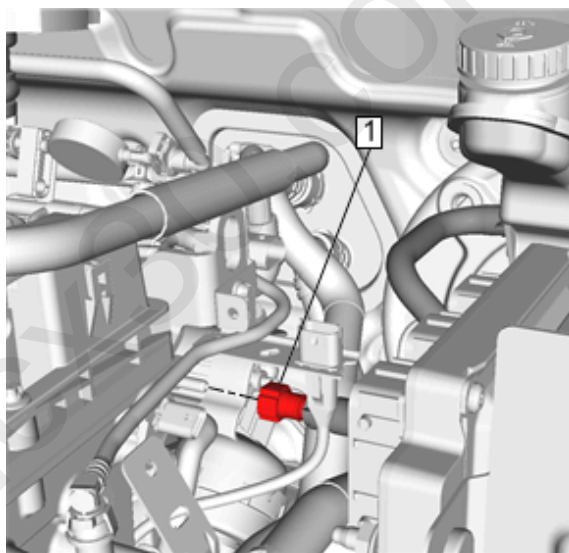
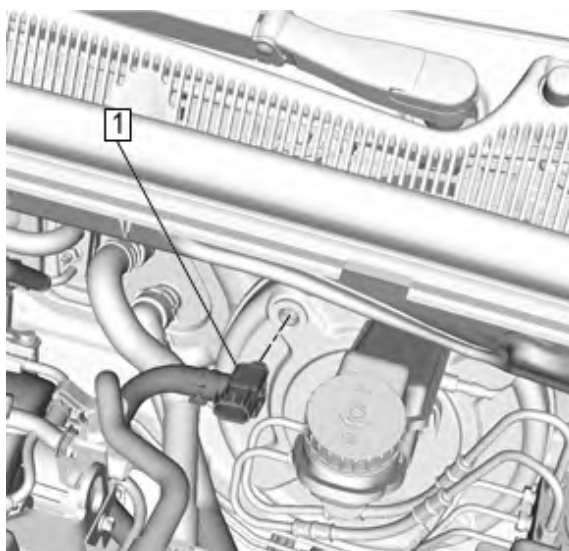


Fig. 197: Quick Connect Fitting

Courtesy of GENERAL MOTORS COMPANY

2. Connect Quick Connect Fitting (1)



NOTE: A small amount of denatured alcohol may be used as a lubricant for assembly.

3. Install Power Brake Booster Vacuum Sensor (1)
4. Connect the electrical connector.
5. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)

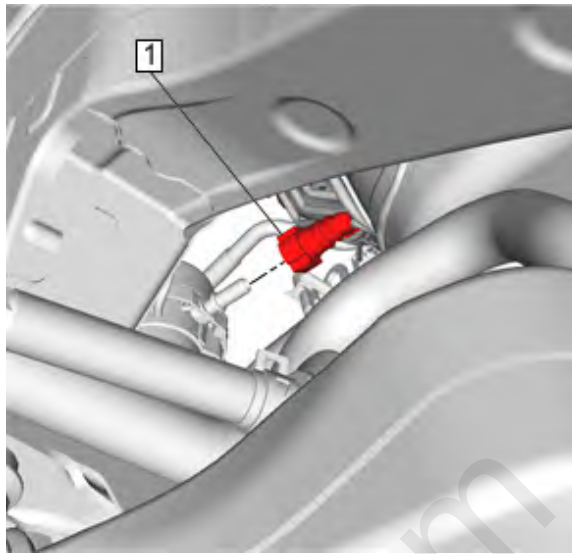


Fig. 199: Quick Connect Fitting
Courtesy of GENERAL MOTORS COMPANY

6. Connect Quick Connect Fitting (1)

POWER BRAKE BOOSTER PUMP REPLACEMENT

Removal Procedure

1. With the engine OFF, apply and release the brake pedal several times until the brake pedal becomes firm to deplete the power brake booster vacuum reserve.
2. Remove the battery tray. Refer to [Battery Tray Replacement](#) .
3. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .

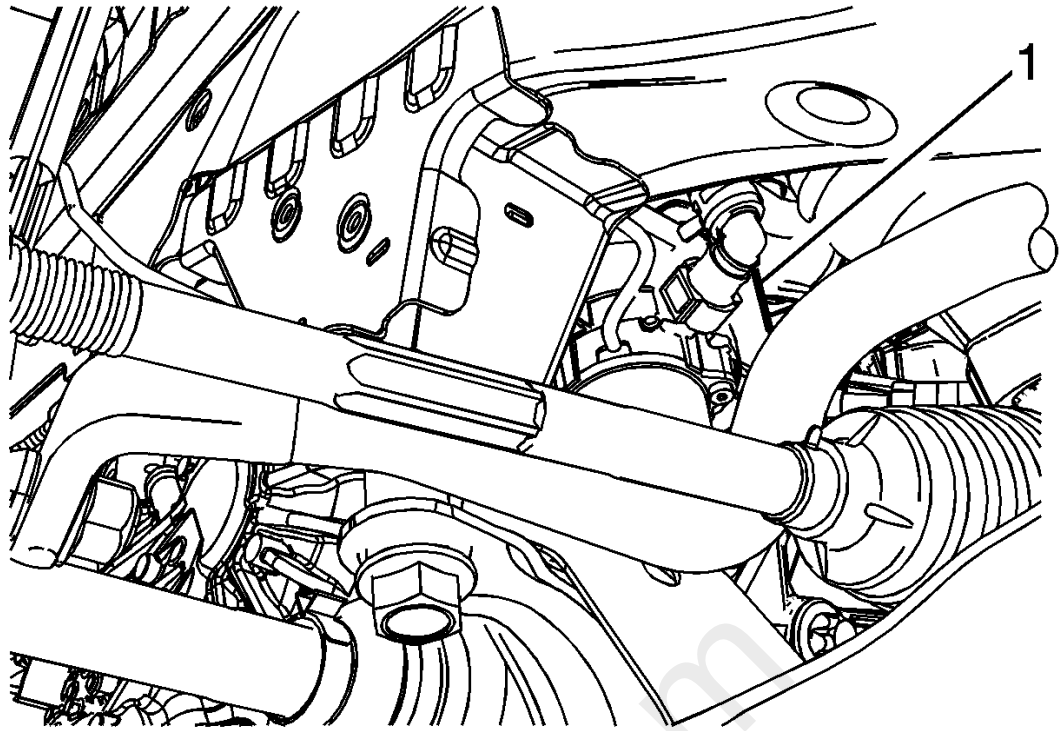


Fig. 200: Power Brake Booster Vacuum Hose Quick Connect
Courtesy of GENERAL MOTORS COMPANY

4. Through the left front wheelhouse, disconnect the power brake booster vacuum hose quick connect (1) from the power brake booster pump port.
5. Lower the vehicle.
6. Disconnect the power brake booster pump electrical connector.

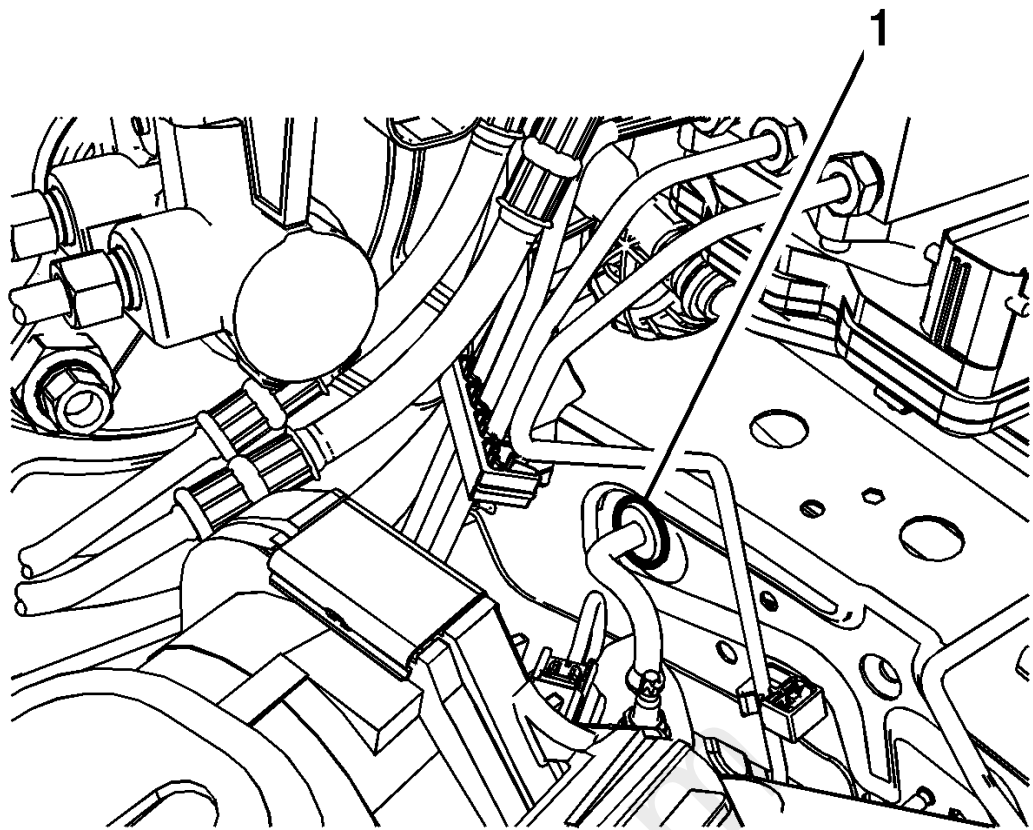


Fig. 201: Power Brake Booster Pump Vent Hose And Grommet
Courtesy of GENERAL MOTORS COMPANY

7. Release the power brake booster pump vent hose and grommet (1) from the left side rail.

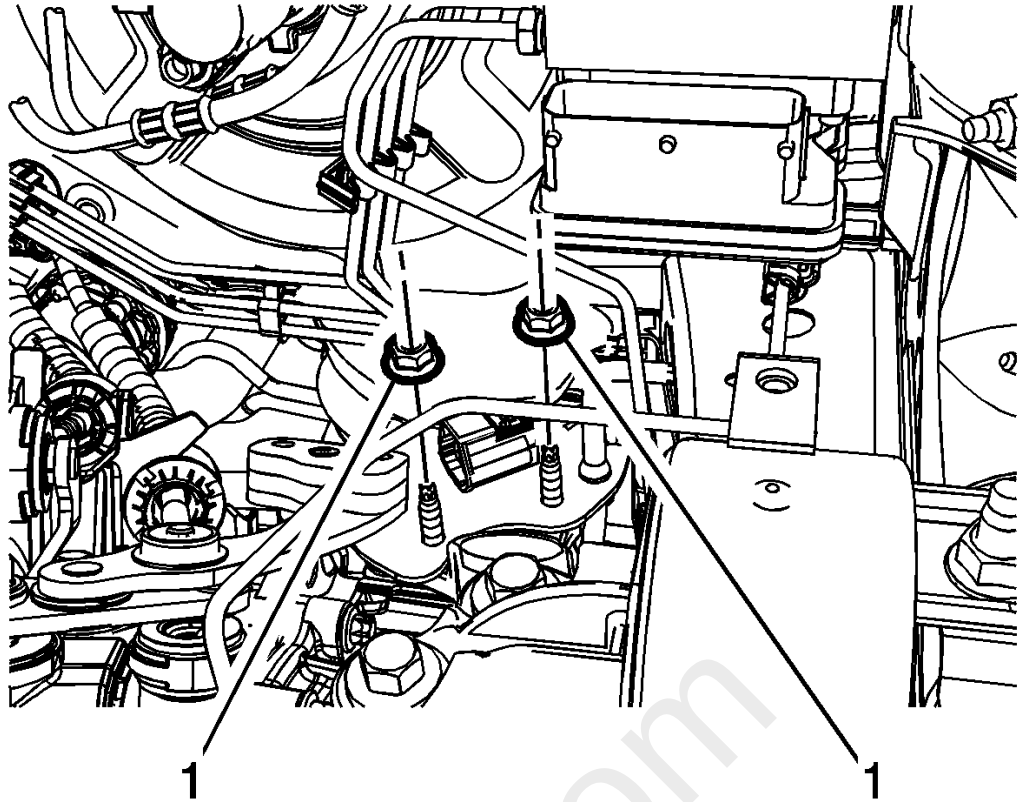


Fig. 202: Brake Booster Pump Bracket Nuts
Courtesy of GENERAL MOTORS COMPANY

8. Remove the power brake booster pump bracket nuts (1).
9. Remove the power brake booster pump assembly.
10. If replacing the power brake booster pump, remove the power brake booster pump bracket. Refer to [**Power Brake Booster Pump Bracket Replacement**](#).

Installation Procedure

1. Install the power brake booster pump bracket, if removed. Refer to [**Power Brake Booster Pump Bracket Replacement**](#).
2. Install the power brake booster pump assembly.

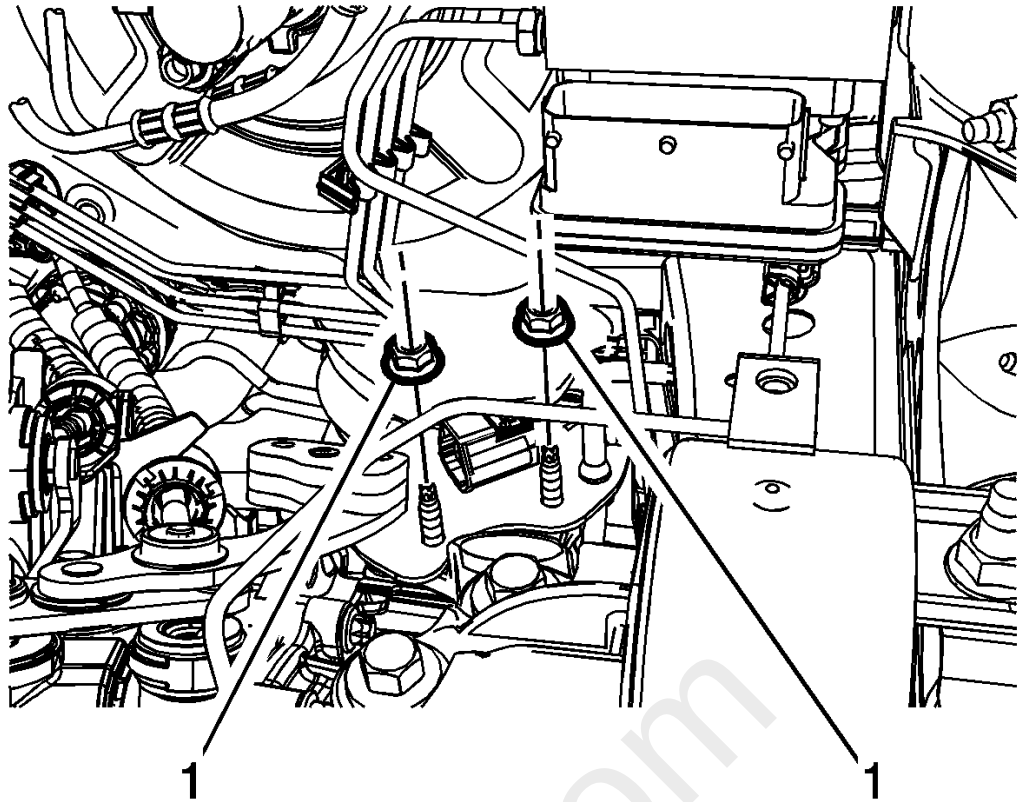


Fig. 203: Brake Booster Pump Bracket Nuts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

3. Install the power brake booster pump bracket nuts (1).
 - 5 speed manual transmission: Tighten the nuts to 58 N.m (43 lb ft)
 - 6 speed automatic transmission, 6 speed manual transmission: Tighten the nuts to 22 N.m (16 lb ft)

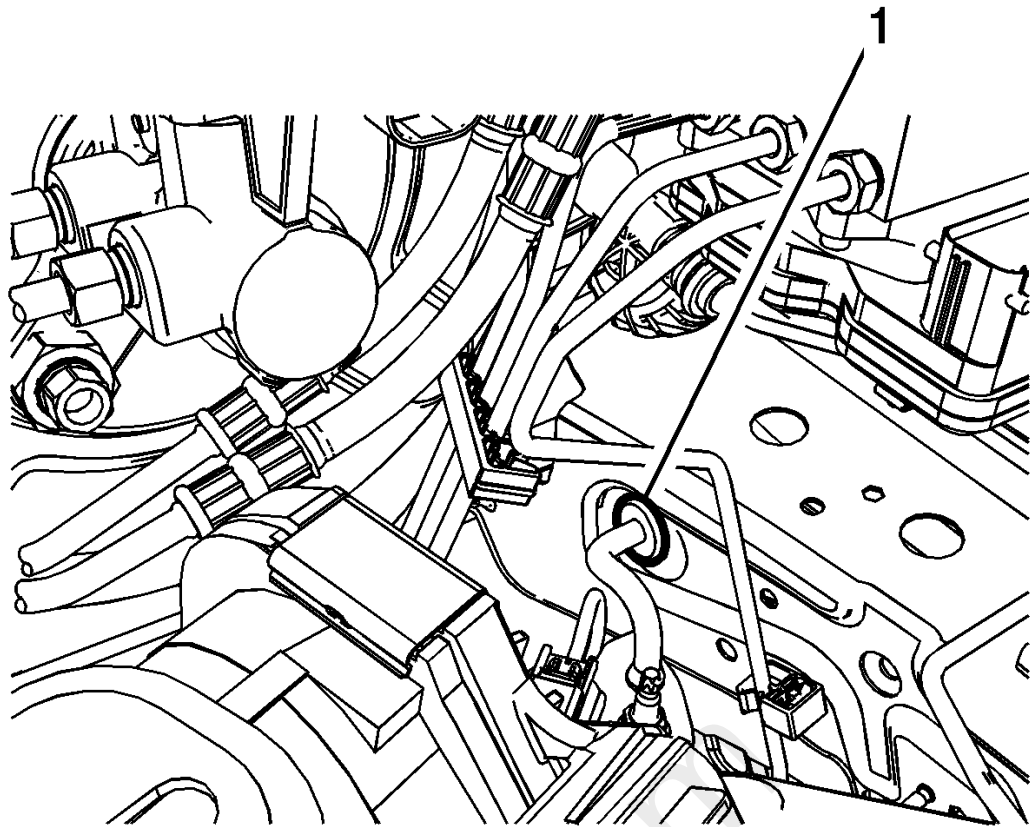


Fig. 204: Power Brake Booster Pump Vent Hose And Grommet
Courtesy of GENERAL MOTORS COMPANY

4. Install the power brake booster pump vent hose and grommet (1) to the left side rail.
5. Connect the power brake booster pump electrical connector.
6. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .

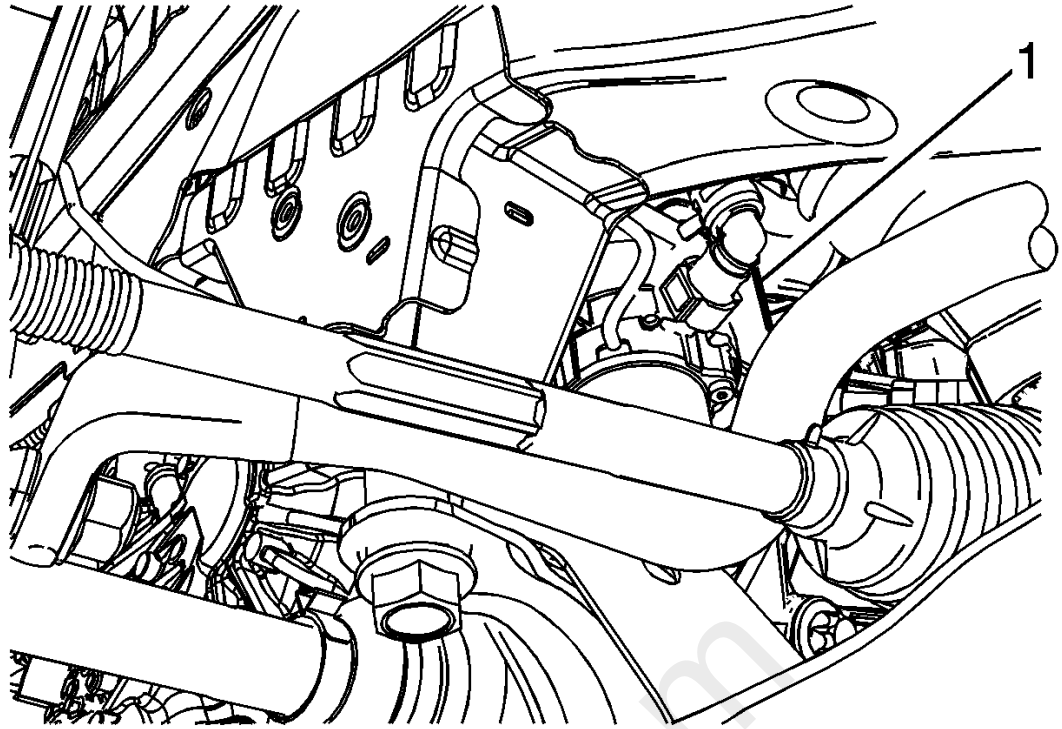


Fig. 205: Power Brake Booster Vacuum Hose Quick Connect
Courtesy of GENERAL MOTORS COMPANY

7. Through the left front wheelhouse, connect the power brake booster vacuum hose quick connect (1) to the power brake booster pump port.
8. Install the battery tray. Refer to [Battery Tray Replacement](#) .

POWER BRAKE BOOSTER PUMP BRACKET REPLACEMENT

Removal Procedure

1. Remove the power brake booster pump assembly. Refer to [Power Brake Booster Pump Replacement](#).

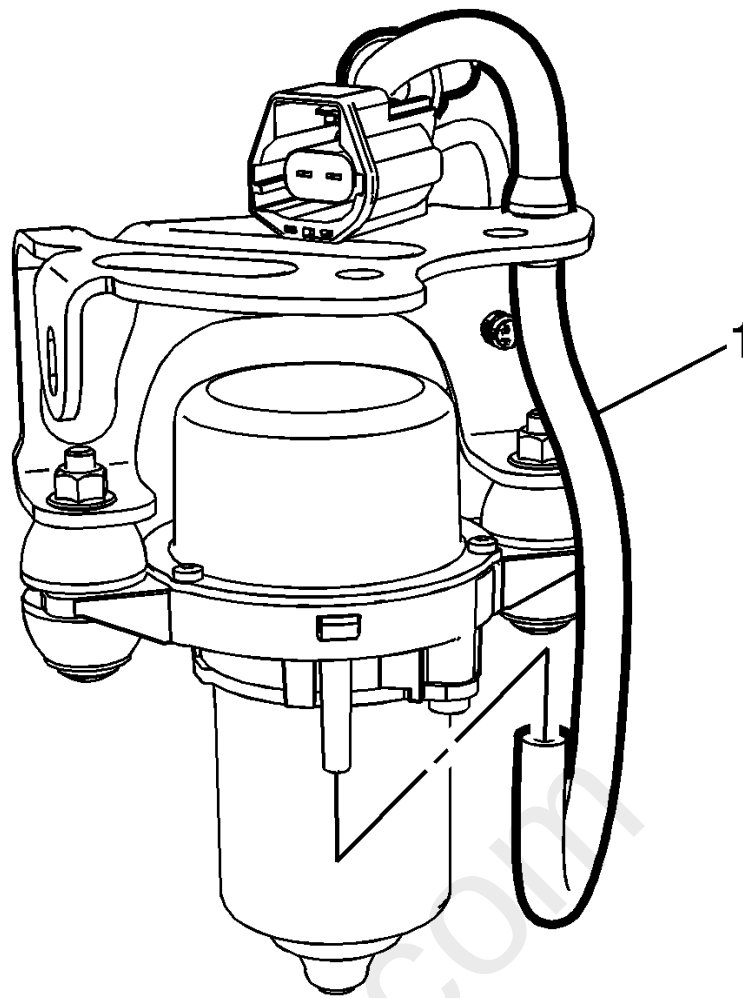


Fig. 206: Power Brake Booster Pump Vent Hose
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the power brake booster pump vent hose (1).
3. Release the power brake booster pump electrical harness and retainer from the power brake booster pump bracket.

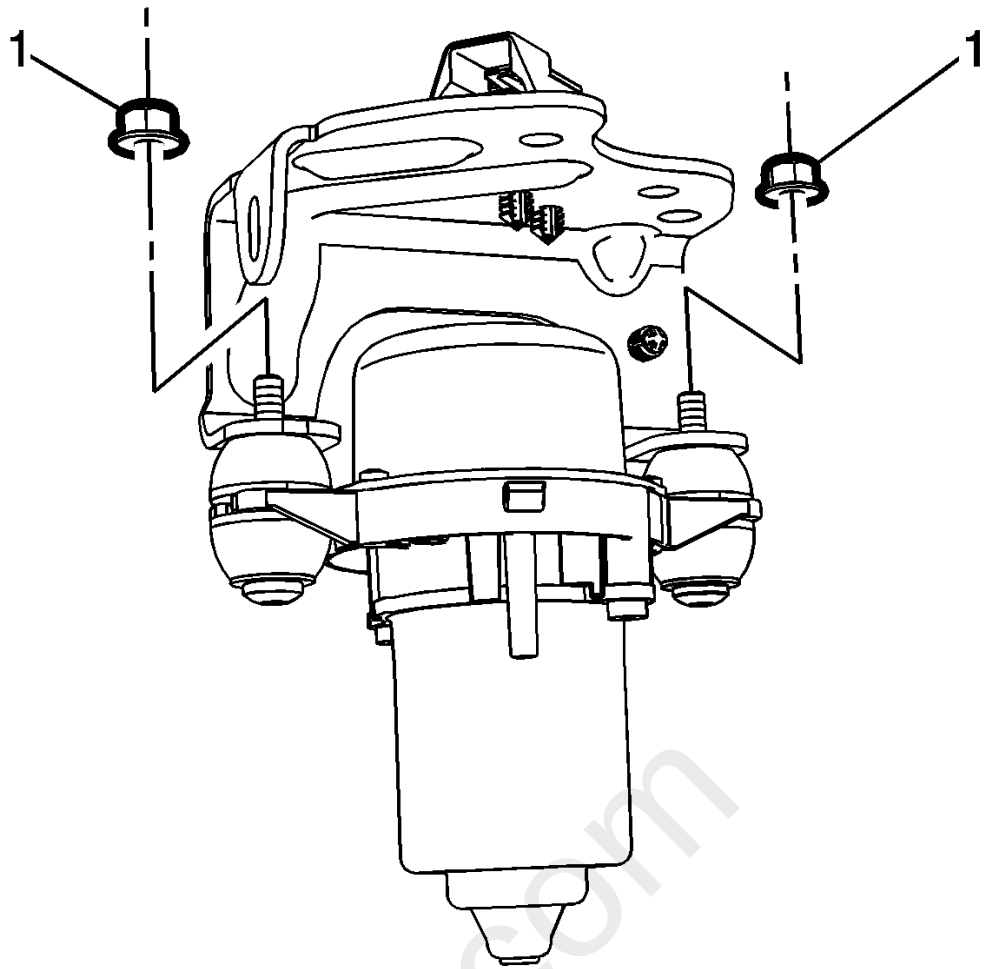


Fig. 207: Power Brake Booster Pump Nuts
Courtesy of GENERAL MOTORS COMPANY

4. Remove the power brake booster pump nuts (1).

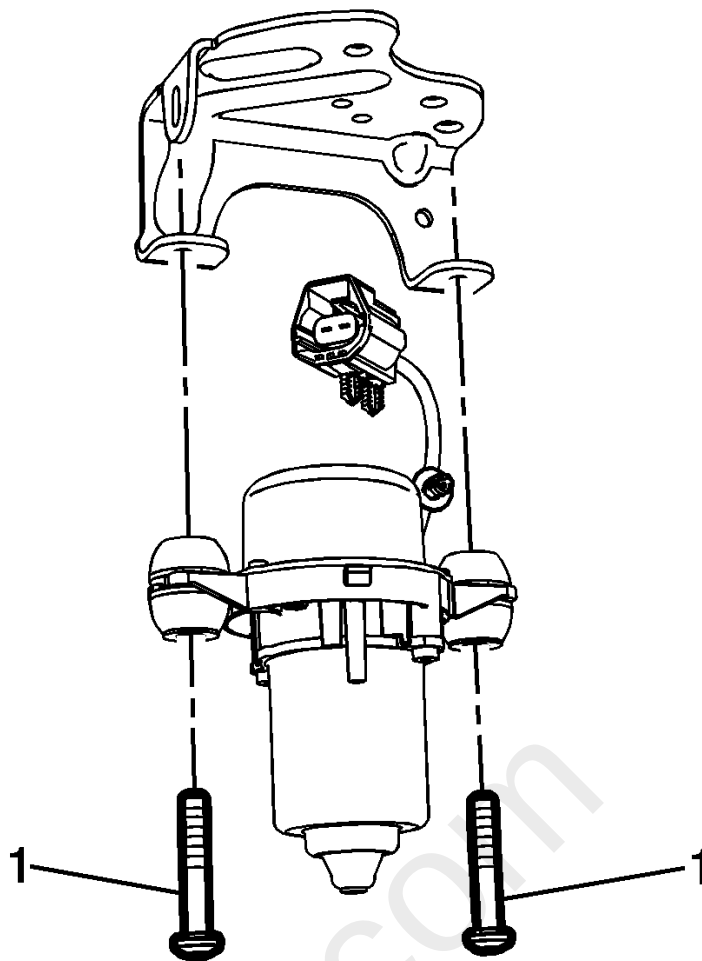


Fig. 208: Power Brake Booster Pump Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the power brake booster pump bolts (1).
6. Remove the power brake booster pump bracket.

Installation Procedure

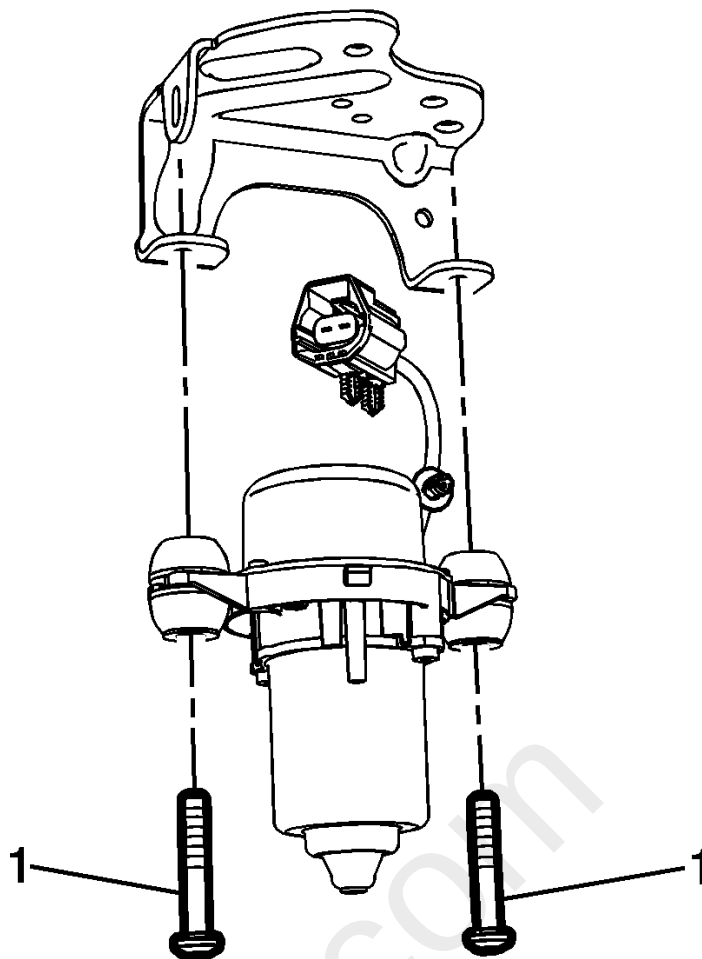


Fig. 209: Power Brake Booster Pump Bolts
Courtesy of GENERAL MOTORS COMPANY

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

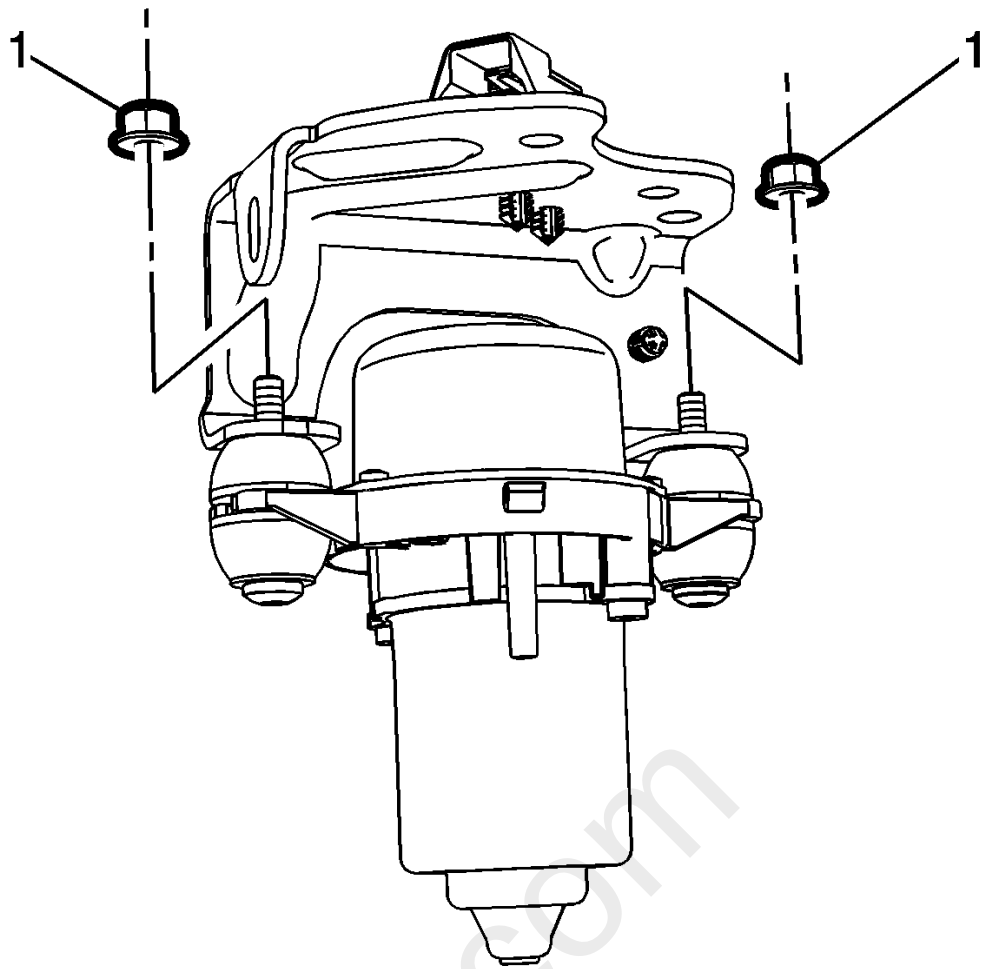


Fig. 210: Power Brake Booster Pump Nuts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

3. Install the power brake booster pump nuts (1) and tighten to 7 N.m (62 lb in).

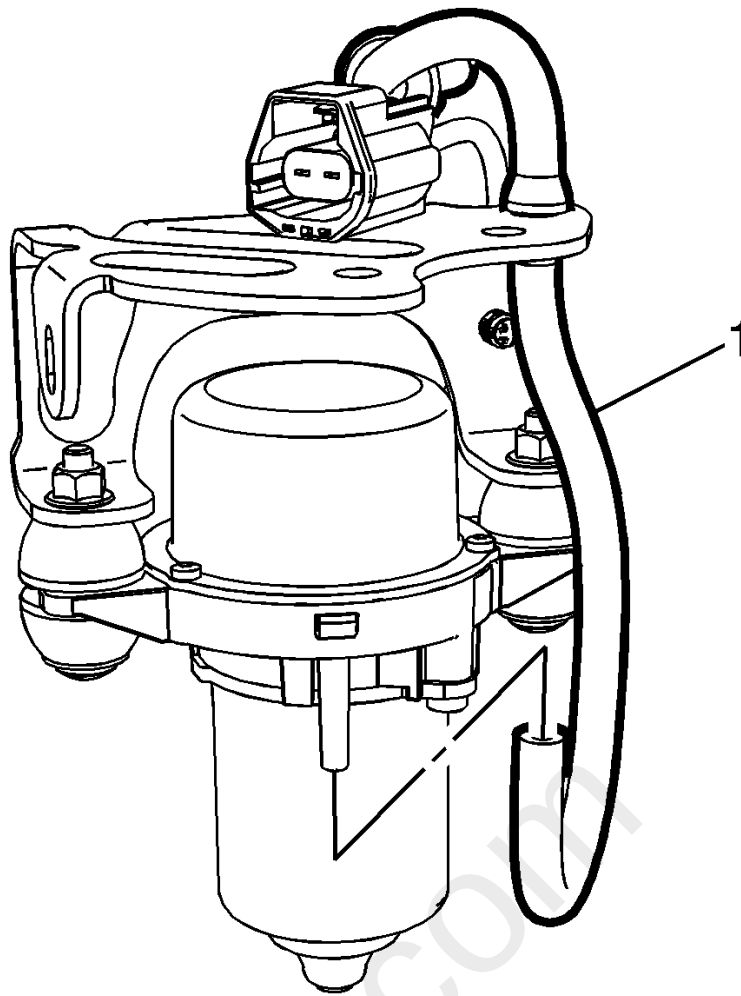


Fig. 211: Power Brake Booster Pump Vent Hose
Courtesy of GENERAL MOTORS COMPANY

4. Connect the power brake booster pump vent hose (1).
5. Install the power brake booster pump electrical harness and retainer to the power brake booster pump bracket.
6. Install the power brake booster pump. Refer to [Power Brake Booster Pump Replacement](#).

DESCRIPTION AND OPERATION

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 the brake pedal to the vacuum brake booster.

Vacuum Brake Booster

Uses source vacuum to decrease effort required by driver when applying brake system input force. At rest, source vacuum is applied to both sides of the vacuum diaphragm for single booster. Return springs maintain the booster in a rest position. When brake system input force is applied, vacuum to the rear of the diaphragm is cut off, and air at atmospheric pressure is admitted in its place. This provides a decrease in brake pedal effort required. When input force is removed, vacuum again replaces atmospheric pressure within the booster.

Vacuum Source

Supplies force used by vacuum brake booster to decrease brake pedal effort. The source vacuum for a spark ignition engine is normally derived from the intake manifold.

Vacuum Source Delivery System

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

System Operation

Under normal driving conditions, without the brakes applied, vacuum is allowed to act on both sides of the diaphragm within the vacuum brake booster. When the brake pedal is applied, the effort by the driver is multiplied due to the relative length of the brake pedal in relationship to its pivot point and the point at which the push rod to the vacuum brake booster is attached.

Movement of the push rod causes a valve within the vacuum brake booster to close between the two sides of the diaphragm, thus isolating each side. It also allows a valve to open that allows atmospheric pressure to act on the pedal side of the vacuum brake booster while maintaining vacuum on the vacuum source side of the diaphragm. The movement of the brake pedal pushrod is transferred to the hydraulic brake master cylinder via the vacuum brake booster. The pressure differential within the vacuum brake booster reduces the effort required by the driver in applying the brakes.

BRAKE BOOSTER VACUUM ASSIST DESCRIPTION AND OPERATION

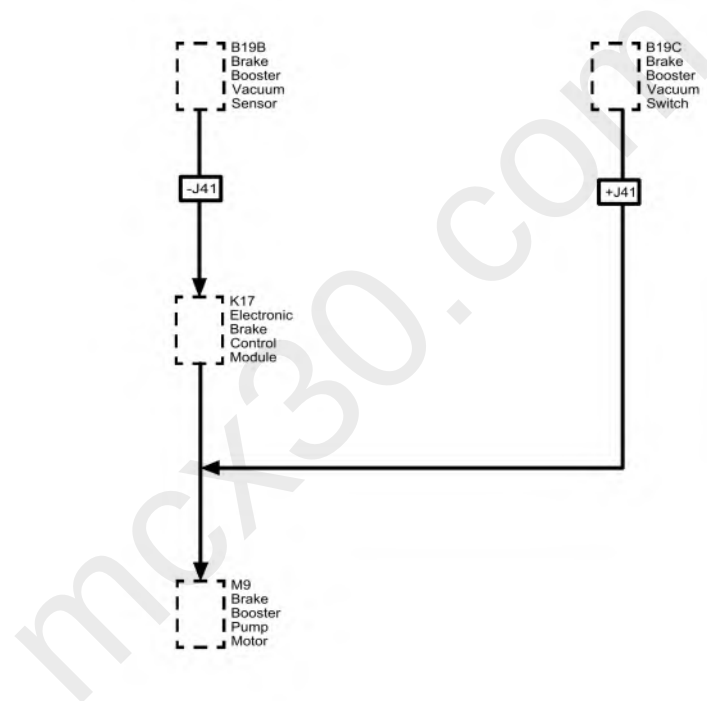


Fig. 212: Hydraulic Brake Booster Vacuum System Block Diagram

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
J41	BRAKE SYSTEM: PWR, FRT DISC, RR DRUM, CAST IRON
J41	BRAKE SYSTEM: PWR, FRT DISC, RR DRUM, CAST IRON
B19B	B19B Brake Booster Vacuum Sensor
B19C	B19C Brake Booster Vacuum Switch
K17	K17 Electronic Brake Control Module
M9	M9 Brake Booster Pump Motor

In order to assure that vacuum is available to the vacuum brake booster, the car can contain a vacuum pump either in addition to the normal intake manifold vacuum source or as stand-alone. The pump provides negative pressure when the engine cannot properly accommodate the requirement, e.g. cold start, heavy throttle, high altitude and turbo pressure.

Auxiliary Brake Booster Pump

The auxiliary brake booster pump is a secondary vacuum supply to the brake booster to maintain sufficient vacuum needed for brake assist.

Vacuum Brake Booster

Uses source vacuum to decrease effort required by driver when applying the brake. 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

Vacuum is supplied by engine vacuum or by the auxiliary brake booster pump.

Brake Booster Vacuum Sensor Without J41

The brake booster vacuum sensor is mounted on the vacuum brake booster and provides feedback to the electronic brake control module relative to the amount of vacuum available for the vacuum brake booster.

Brake Booster Vacuum Switch With J41

The low vacuum switch controls the 12 V to the relay coil in the brake vacuum assist pump. When more vacuum is needed the vacuum switch closes. The relay coil closes the relay contact and connects the electric motor to ground. The electric motor is fed with 12 V. When sufficient vacuum is reached the switch opens and the pump stops.

BRAKE WARNING SYSTEM DESCRIPTION AND OPERATION

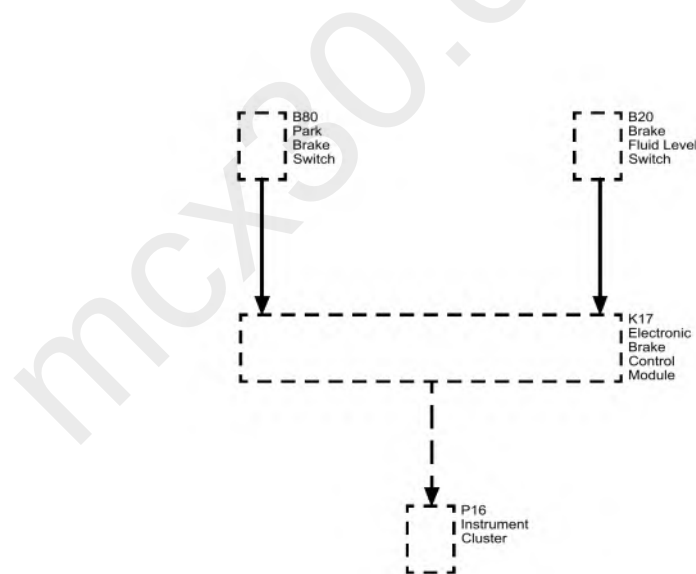


Fig. 213: Hydraulic Brake Warning System Block Diagram

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
B80	B80 Park Brake Switch
B20	B20 Brake Fluid Level Switch
K17	K17 Electronic Brake Control Module
P16	P16 Instrument Cluster

The purpose of the brake warning system is to warn the driver of the park brake being applied while the vehicle is being driven, a brake electronic brake distribution (EBD) failure and/or a low brake fluid level condition.

- When the ignition switch in the ON position and park brake is applied, the brake warning indicator lamp is illuminated. While the ignition switch is turned to the ON position, the battery voltage is provided to the brake warning indicator on the instrument panel cluster (IPC). When the park brake is applied, the park brake switch is grounded and the brake warning indicator is illuminated.
- EBCM monitors the EBD system. If EBCM detects EBD failure condition, EBCM sends a signal to IPC and IPC illuminates the brake warning indicator.
- Brake fluid level indicator switch is negative thermal coefficient (NTC) type. When the brake fluid level is too low, the brake warning indicator is illuminated by being grounded through the brake fluid level indicator switch.

HYDRAULIC BRAKE SYSTEM DESCRIPTION AND OPERATION

System Component Description

The hydraulic brake system consists of the following:

Hydraulic Brake Master Cylinder Reservoir

Contains a 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 electronic brake distribution (EBD), which is a function of the ABS modulator.

Hydraulic Brake Pipes and Flexible Brake Hoses

Carries brake fluid to and from hydraulic brake system components.

Hydraulic Brake Wheel Apply Components

Converts hydraulic input pressure into mechanical output force.

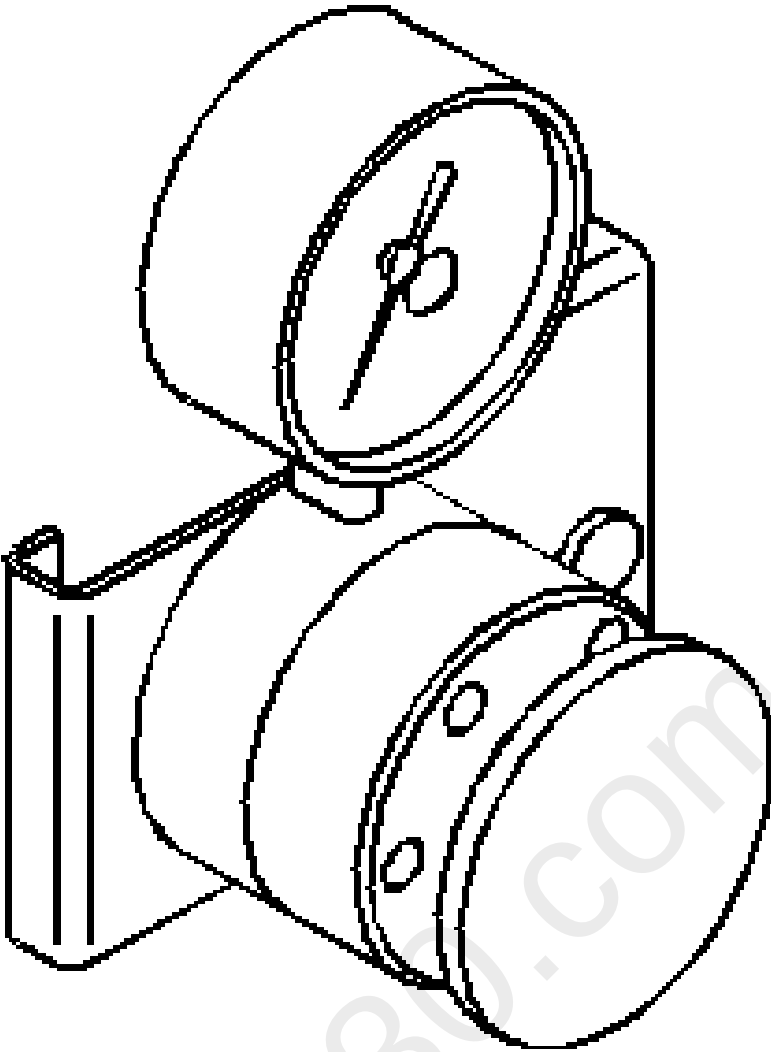
System Operation

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 brake linings against rotating brake system components.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description

Illustration	Tool Number/Description
	CH 28662 J 28662 Brake Pedal Effort Gauge
	CH 29532 J 29532 Diaphragm Pressure Bleeder

Illustration

Tool
Number/Description

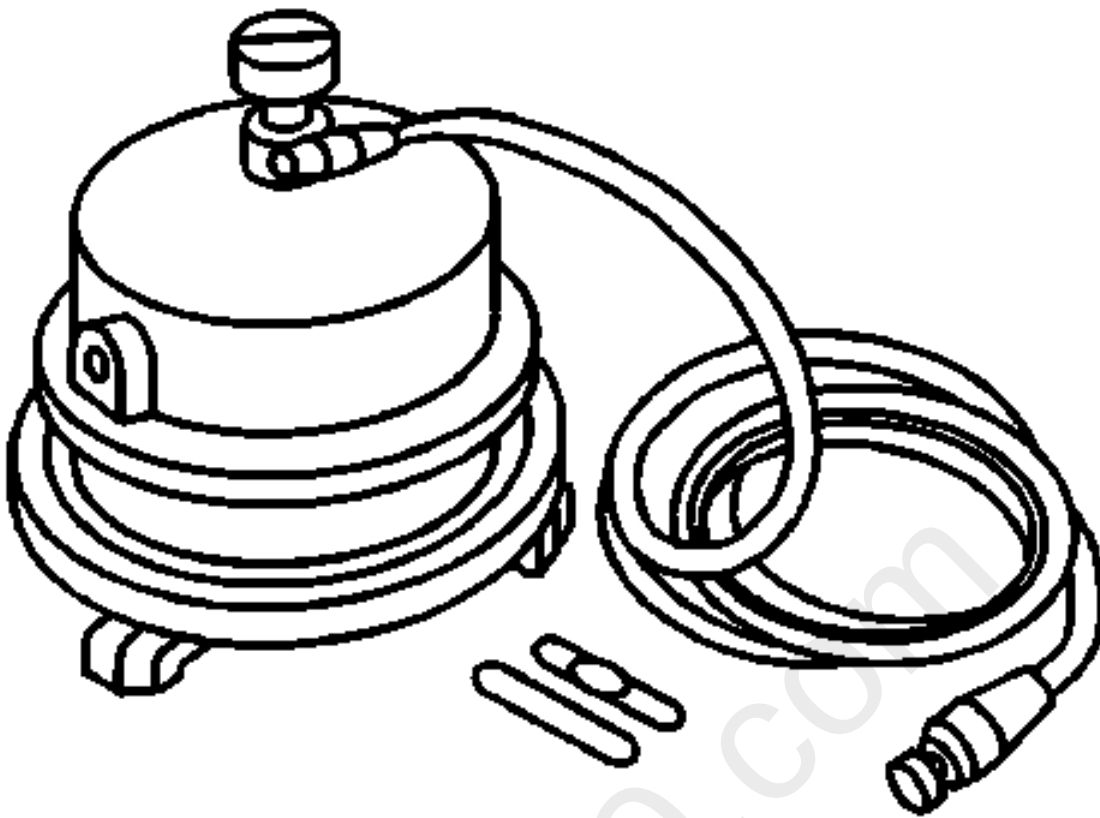
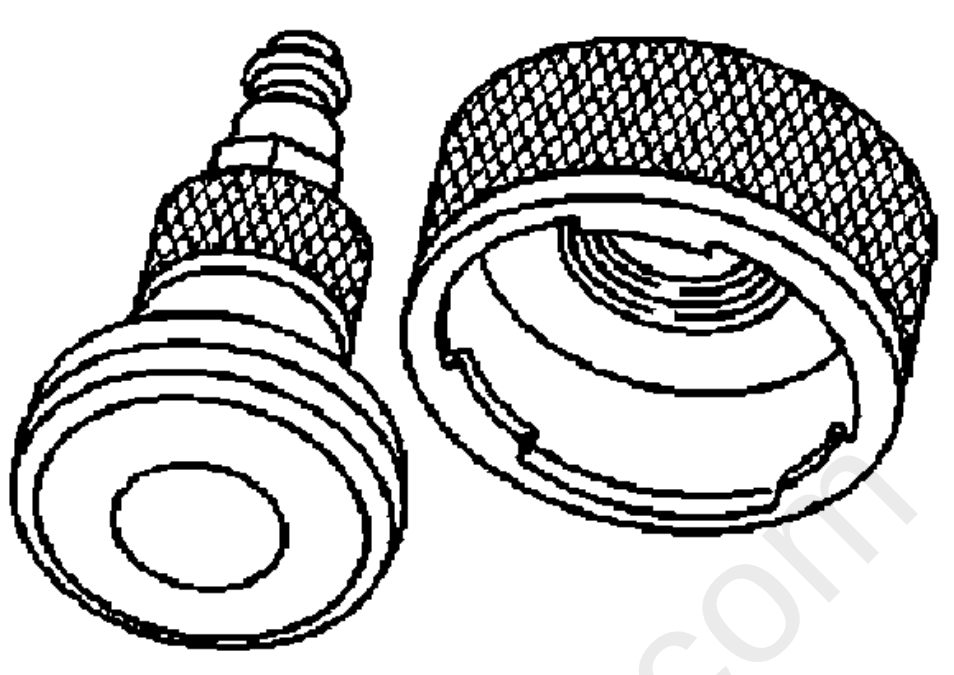
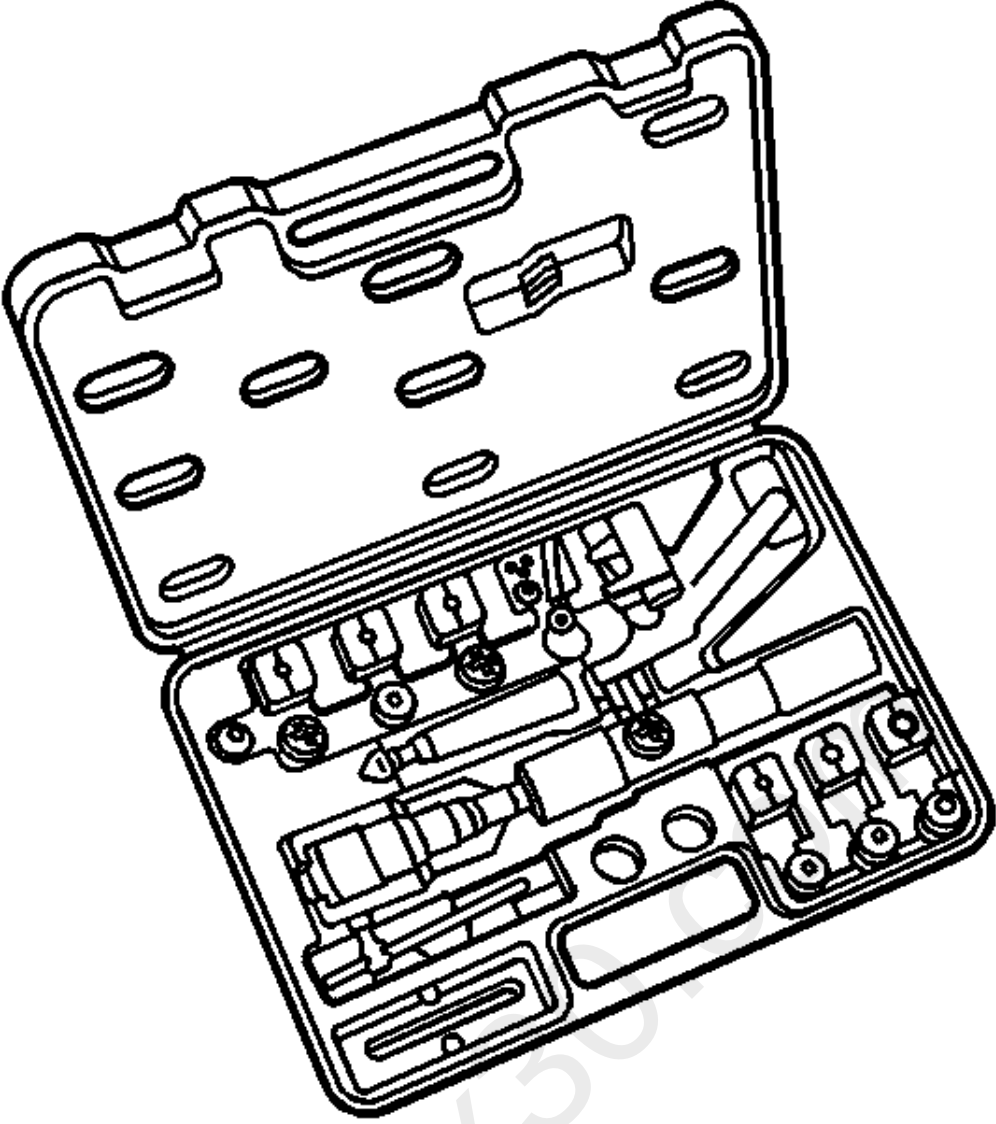


Illustration	Tool Number/Description
	CH 44894-A J 44894-A Brake Bleeder Adapter

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Illustration	Tool Number/Description
	CH 45405 J 45405 Brake Pipe Flaring Kit