

2017 BRAKES

Hydraulic Brakes - CT6

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Non-Threaded Fasteners/Components

NOTE: <i>All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.</i>
Application
Brake Hose Fitting Gasket
Brake Pedal Retainer

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 Master Cylinder Bolt	22 N.m (16 lb ft)
Brake Master Cylinder Nut	22 N.m (16 lb ft)
Brake Master Cylinder Reservoir Bolt	8 N.m (71 lb in)
Brake Pedal Bolt	10 N.m (89 lb in)
Brake Pipe Fitting	19 N.m (14 lb ft)
Brake Pressure Modulator Valve Low Pressure Brake Pipe Fitting	32 N.m (24 lb ft)
Brake Pressure Modulator Valve Primary Brake Pipe Fitting	32 N.m (24 lb ft)
Brake Pressure Modulator Valve Secondary Brake Pipe Fitting	32 N.m (24 lb ft)
Electronic Brake Booster Control Module Bolt	22 N.m (16 lb ft)
Power Vacuum Brake Booster Bolt	22 N.m (16 lb ft)

APPROXIMATE FLUID CAPACITIES

Application	Specification	
	Metric	US English
Hydraulic Brake System	0.43 L	0.909 pt

BRAKE COMPONENT SPECIFICATIONS

Application	Specification	
	Metric	English
Brake Caliper Bleeder Valve - Front	17-20 N.m	13-15 lb ft
Brake Caliper Bleeder Valve - Rear	11 N.m	97 lb in

BRAKE SYSTEM SPECIFICATIONS

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Application	Specification	
	Metric	English
Brake Pedal Travel Maximum specification with 445 N (100 lbs) of force applied to the pedal with the ignition OFF and the booster power reserve depleted.	69.85 mm	2.75 in

ADHESIVES, FLUIDS, LUBRICANTS AND SEALERS

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

SCHEMATIC WIRING DIAGRAMS

HYDRAULIC BRAKE WIRING SCHEMATICS

Hydraulic Brake (KL9)

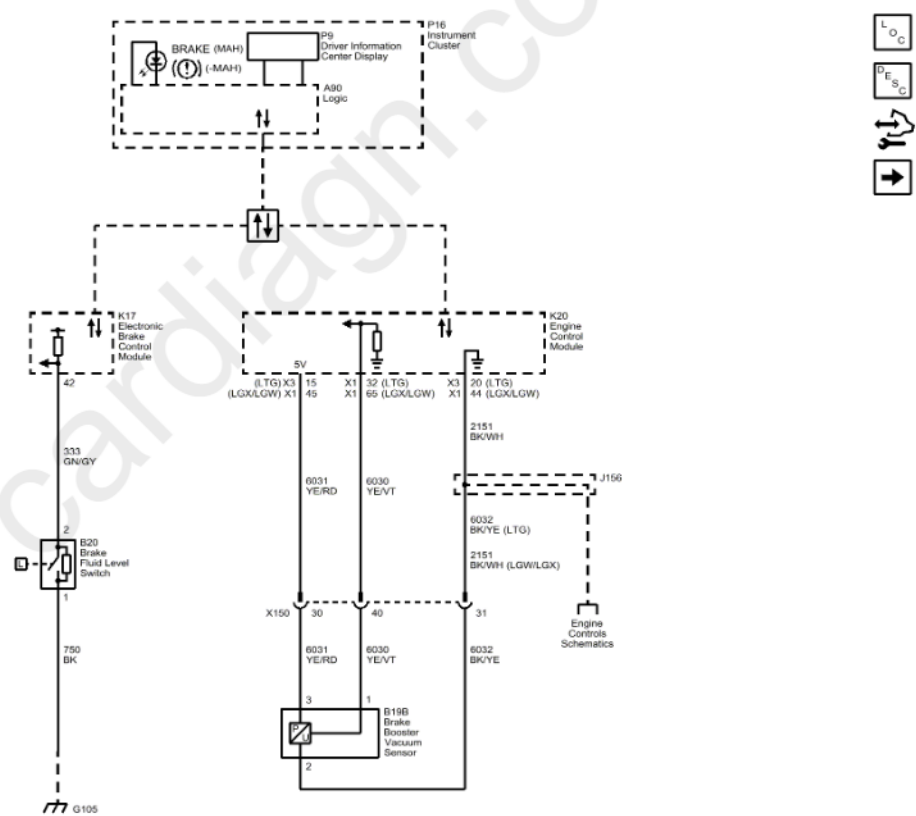


Fig. 1: Hydraulic Brake (KL9)
Courtesy of GENERAL MOTORS COMPANY

Hydraulic Brake (HP9)

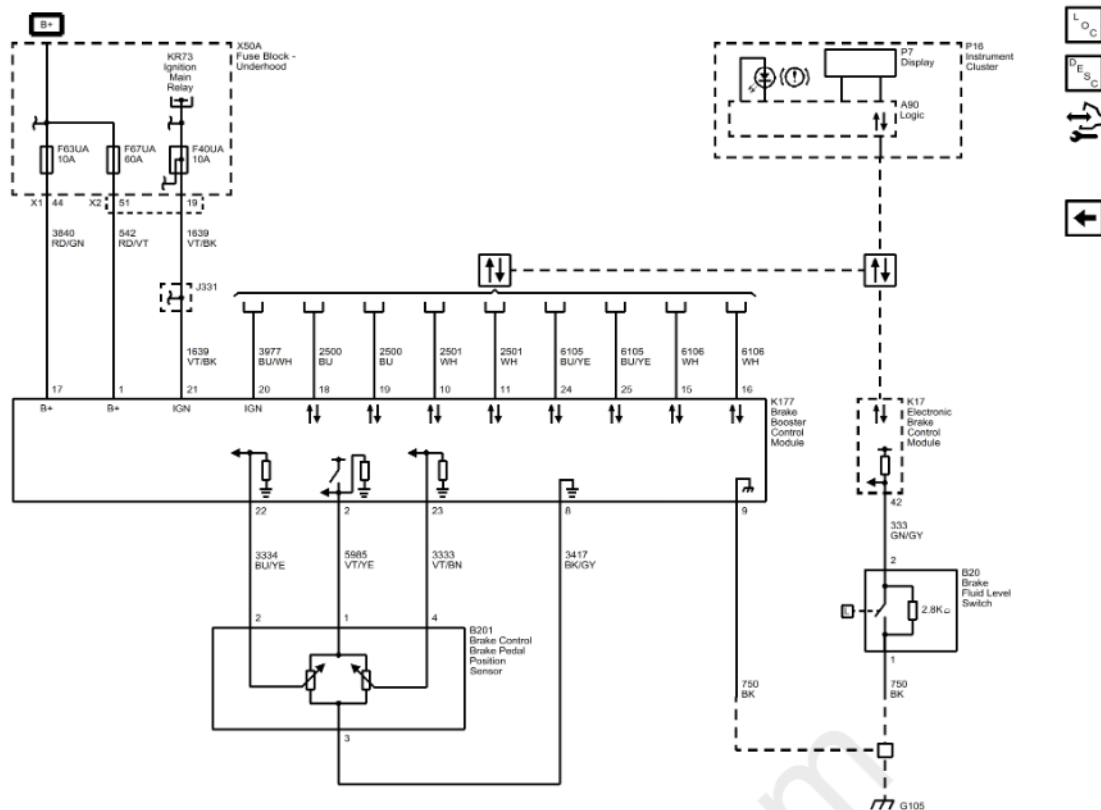


Fig. 2: Hydraulic Brake (HP9)

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC C0075: BRAKE PEDAL POSITION SENSOR PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC C0075:

Brake Pedal Position Sensor Performance

Symptom Byte Information: [Symptom Byte List](#)

Circuit/System Description

For an overview of the component/system, refer to [Hydraulic Brake System Description and Operation](#)

Conditions for Running the DTC

Ignition⌘ On / Vehicle⌘ In Service Mode

Conditions for Setting the DTC

Brake Pedal Position Sensor = Out Of Range

Actions Taken When the DTC Sets

Boost/Blending = Not Available

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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. Ignition $\hat{\mathbf{A}}$ » On / Vehicle $\hat{\mathbf{A}}$ » In Service Mode
2. Verify DTC C0075 is not set.

- **If the DTC is set**

Replace the component: K177 Brake Booster Control Module

- **If the DTC is not set**

3. All OK.

Circuit/System Verification

1. Ignition $\hat{\mathbf{A}}$ » On / Vehicle $\hat{\mathbf{A}}$ » In Service Mode
2. Verify DTC C0075 is not set.

- **If the DTC is set**

1. Perform all necessary programming and setup procedures for the control module: K177 Brake Booster Control Module

2. Verify the DTC does not set.

- If the DTC sets $\hat{\mathbf{A}}$ » Replace the component: K177 Brake Booster Control Module
- If the DTC is not set

3. All OK.

- **If the DTC is not set**

3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

For control module replacement, programming and setup, refer to **Control Module References**

DTC C0126: BRAKE FLUID LEVEL SENSOR CIRCUIT

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.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC C0126

Brake Fluid Level Sensor Circuit

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	C0126 05	C0126 05	-
Ground	-	C0126 05	-	-

Circuit/System Description

The brake fluid level switch monitors the level of the brake fluid in the brake fluid reservoir. When the brake fluid level switch input closed, the electronic brake control module will set the DTC.

Conditions for Running the DTC

Ignition ON/Vehicle in Service Mode/Vehicle in Service Mode.

Conditions for Setting the DTC

- Low brake fluid level is detected for 5 s.
- An open is detected on the ground circuit.
- An open or short to voltage is detected on the signal circuit.

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

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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 level is above the minimum level.

- **If low**

Refer to [Brake Fluid Loss](#).

- **If above minimum level**

2. Refer to Circuit/System Testing.

Circuit/System Testing

1. Ignition OFF/Vehicle 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/Vehicle 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/Vehicle in Service Mode.

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

- **If the parameter is not OK**

1. Ignition OFF/Vehicle OFF/Vehicle 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 OK**

5. Ignition OFF/Vehicle OFF.

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

7. Ignition ON/Vehicle in Service Mode.

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

- **If the parameter is not Low**

1. Ignition OFF/Vehicle 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 Low**

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

Repair Instructions

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

[Control Module References](#) for electronic brake control module replacement, programming and setup.

DTC C025E: BRAKE PRESSURE VACUUM SENSOR CIRCUIT

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.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C025E

Brake Pressure Vacuum Sensor Circuit

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

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0557	P0557	-	-
Signal	P0557	P0557	P0558	C025E, P0557
Low Reference	-	P0557	-	-

Circuit/System Description

The brake booster vacuum sensor monitors the pressure in the brake booster. The engine control module (ECM) 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 ECM.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

C025E 5A

The vacuum sensor signal is not plausible.

Action Taken When the DTC Sets

The brake warning indicator turns ON.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The electronic control module will turn OFF the indicator in the next ignition cycle.

Reference Information

Schematic Reference

[Hydraulic Brake Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Brake Assist System Description and Operation](#)

- [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

1. Ignition ON.
2. Verify that DTCs P0556, P0557 or P0558 are not set.
 - **If any of the DTCs are set**

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

- **If none of the DTCs are set**
3. Replace the K17 Electronic Brake Control Module.

Repair Instructions

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

- [Control Module References](#) for electronic brake 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.
- [Diagnostic Procedure Instructions](#) provides 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	C0126 05	C0126 05	-
Ground	-	C0126 05	-	-

Circuit/System Description

The brake fluid level switch monitors the level of the brake fluid in the brake fluid reservoir. When the brake fluid level switch input closed, the electronic brake control module will set the DTC.

Conditions for Running the DTC

Ignition ON/Vehicle in Service Mode.

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

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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**

Refer to Circuit/System Testing.

Circuit/System Testing

1. Ignition OFF/Vehicle 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/Vehicle 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/Vehicle in Service Mode.

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

- **If the parameter is not OK**

1. Ignition OFF/Vehicle OFF/Vehicle 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 OK**

5. Ignition OFF/Vehicle OFF.

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

7. Ignition ON/Vehicle in Service Mode.

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

- **If the parameter is not Low**

1. Ignition OFF/Vehicle 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 Low**

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

Repair Instructions

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

[Control Module References](#) for electronic brake control module replacement, programming and setup.

DTC C0299: 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.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C0299

Brake Booster Pressure Sensor

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

Circuit/System Description

The EBCM monitors the vacuum level in the power brake booster and will set a DTC if the vacuum is too low.

Conditions for Running the DTC

Ignition ON/Vehicle in Service Mode.

Conditions for Setting the DTC

Low vacuum is detected in the power brake booster.

Action Taken when the DTC Sets

The brake warning indicator turns ON.

Conditions for Clearing the DTC

A current DTC clears when the diagnostic runs and passes.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- [Control Module References](#) for electronic brake control module replacement, programming and setup.

DTC C0579, C057A OR C057E: BRAKE BOOSTER CONTROL MODULE TEMPERATURE SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC C0579

Brake Booster Control Module Temperature Sensor 2 Circuit Low Voltage

DTC C057A

Brake Booster Control Module Temperature Sensor 2 Circuit High Voltage

DTC C057E

Brake Booster Control Module Temperature Sensor 1-2 Correlation

Symptom Byte Information: [Symptom Byte List](#)

Circuit/System Description

For an overview of the component/system, refer to [Hydraulic Brake System Description and Operation](#)

Conditions for Running the DTC

IgnitionÂ» On / VehicleÂ» In Service Mode

Conditions for Setting the DTC

Brake Booster Temperature = Out Of Range

Actions Taken When the DTC Sets

Boost = Full

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Schematic Reference

[Hydraulic Brake Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

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. IgnitionÂ» On / VehicleÂ» In Service Mode
2. Verify DTC C0579, C057A, C057E is not set.
 - **If the DTC is set**
 1. Perform all necessary programming and setup procedures for the control module: K177 Brake Booster Control Module
 2. Verify the DTC does not set.
 - If the DTC setsÂ» Replace the component: K177 Brake Booster Control Module
 - If the DTC is not set
 3. All OK.
 - **If the DTC is not set**
3. All OK.

[Repair Instructions](#)

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

For control module replacement, programming and setup, refer to [Control Module References](#)

DTC C057F, C0582, C058A, C0590, C0591, C0595, C0596 OR C1275-C1277: BRAKE BOOSTER MOTOR

[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.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

[DTC Descriptor](#)

DTC C057F

Brake Booster Motor 1 Phase U-V-W Circuit

DTC C0582

Brake Booster Motor 1 Phase U-V-W Circuit Performance

DTC C058A

Brake Booster Motor 1 Position Sensor Circuit Performance

DTC C0590

Brake Booster Motor 1 Phase U-V-W Circuit High Current

DTC C0591

Brake Booster Motor 1 Phase U-V-W Circuit Low Current

DTC C0595

Brake Booster Control Module Internal Driver Performance

DTC C0596

DTC C1275

Brake Booster Rotor Position Sensor Unexpected Reset

DTC C1276

Brake Booster Rotor Position Sensor Message Counter Incorrect

DTC C1277

Brake Booster Rotor Position Sensor Configuration Error

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

Circuit/System Description

The brake booster system consists of a motor, electronic control unit (ECU), pedal travel sensor and a master cylinder. The motor is part of the brake booster unit. If the ECU detects a high or low voltage condition or a rotor position error in the booster motor a DTC will be set.

Conditions for Running the DTC

C057F, C0582, C0590 or C0591

- Ignition ON/Vehicle in Service Mode.
- Brake pedal released and no autonomous braking for at least 5s

C058A, C0595, C0596, C1275, C1276 or C1277

- Ignition ON/Vehicle in Service Mode.

Conditions for Setting the DTC

C057F, C0582, C058A, C0590, C0591, C0595, C0596, C1275, C1276 or C1277

- The device has detected an internal malfunction

Action Taken When the DTC Sets

C057F, C0582, C058A, C0590, C0591, C0595, C0596, C1275, C1276 or C1277

- No boost or blending available
- Red brake light and MIL are illuminated

Conditions for Clearing the DTC

C057F, C0582, C058A, C0590, C0591, C0595, C0596, C1275, C1276 or C1277

- The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hydraulic Brake System Description and Operation

- [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. Ignition ON/Vehicle in Service Mode
2. Verify that DTCs U3001, U3007, U3018, U3019, U3501-U3509 or U350A are not set.
 - If DTCs U3001, U3007, U3018, U3019, U3501-U3509 or U350A is set

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

- If DTCs U3001, U3007, U3018, U3019, U3501-U3509 or U350A is not set
3. Replace K177 Brake Booster Control Module.

Repair Instructions

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

- [Control Module References](#) for control module replacement, programming and setup.

DTC C0580 OR C0594: BRAKE BOOSTER MOTOR 1

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.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC C0580

Brake Booster Motor 1 Phase U-V-W Circuit Low Voltage

DTC C0594

Brake Booster Motor 1 Performance

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

Circuit/System Description

The brake booster system consists of a motor, electronic control unit (ECU), pedal travel sensor and a master cylinder. The motor is part of the brake booster unit and if the ECU detects a low voltage condition in the booster motor a DTC will be set.

Conditions for Running the DTC

Ignition ON/Vehicle in Service Mode.

Conditions for Setting the DTC

The device has detected an internal malfunction

Action Taken When the DTC Sets

- No boost or blending available
- Red brake light and MIL are illuminated

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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. Ignition ON/Vehicle in Service Mode
2. Verify that DTCs U3001, U3007, U3018, U3019, U3501-U3509 or U350A are not set.
 - If DTCs U3001, U3007, U3018, U3019, U3501-U3509 or U350A is set
Refer to Diagnostic Trouble Code (DTC) List - Vehicle
 - If DTCs U3001, U3007, U3018, U3019, U3501-U3509 or U350A is not set
3. Replace K177 Brake Booster Control Module.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Control Module References for control module replacement, programming and setup.

DTC C1072: BRAKE FLUID SENSOR CIRCUIT

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.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC C1072 05

Brake Fluid Sensor Circuit

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	C1072 05	C1072 05	C1072 05	-
Ground	-	C1072 05	-	-

Circuit/System Description

When the electronic brake control module detects a fault, it sends a serial data message to the instrument cluster commanding the brake warning indicator ON.

Conditions for Running the DTC

Ignition ON/Ignition ON/Vehicle in Service Mode.

Conditions for Setting the DTC

- An open or short to voltage is detected on the brake fluid level signal circuit.
- An open is detected on the brake fluid level ground circuit.

Action Taken When the DTC Sets

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

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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 has the proper level. The fluid level should be above minimum level.

- **If low**

Refer to [Brake Fluid Loss](#).

- **If above minimum level**

2. Ignition ON/Ignition ON/Vehicle in Service Mode.
3. 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**

4. Refer to Circuit/System Testing.

Circuit/System Testing

1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the B20 Brake Fluid Level Switch.
2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.

- **If 10 Ω or greater**

1. Ignition OFF/Vehicle 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/Ignition ON/Vehicle in Service Mode.
4. Verify the scan tool Electronic Brake Control Module, Brake Fluid Low Sensor parameter is No.

- **If the parameter is Yes**

1. Ignition OFF/Ignition OFF/Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.
2. Test for infinite resistance between the signal circuit terminal 2 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 No**

5. Install a 3 A fused jumper wire between the signal circuit terminal 2 and ground.
6. Verify the scan tool Electronic Brake Control Module, Brake Fluid Level Sensor parameter is Yes.

- **If the parameter is No**

1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, Ignition ON/Vehicle in Service Mode.
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 Low**

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

Repair Instructions

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

- [Brake Fluid Level Indicator Switch Replacement \(Without HP9\)](#)[Brake Fluid Level Indicator Switch Replacement \(With HP9\)](#)
- [Control Module References](#) for Electronic Brake Control Module replacement, programming and setup.

DTC C111C: 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.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC C111C 00

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	C1072 05	C1072 05	C1072 05	-
Ground	-	C111C 00, C1072 05	-	-

Circuit/System Description

When the electronic brake control module detects low fluid, it sends a serial data message to the instrument cluster commanding the brake warning indicator ON.

Conditions for Running the DTC

Ignition ON/Vehicle in Service Mode.

Conditions for Setting the DTC

An open is detected on the brake fluid level ground circuit.

Action Taken When the DTC Sets

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

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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 has the proper level. The fluid level should be above minimum level.

- **If low**

Refer to [Brake Fluid Loss](#).

- **If above minimum level**

2. Ignition ON/Vehicle in Service Mode.

3. 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**

4. Refer to Circuit/System Testing.

Circuit/System Testing

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

1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the B20 Brake Fluid Level Switch.

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

- **If 10 Ω or greater**

1. Ignition OFF/Vehicle 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/Vehicle in Service Mode.

4. Verify the scan tool Electronic Brake Control Module, Brake Fluid Low Sensor parameter is No.

- **If the parameter is Yes**

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

2. Test for infinite resistance between the signal circuit terminal 2 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 No**

5. Install a 3 A fused jumper wire between the signal circuit terminal 2 and ground.

6. Verify the scan tool Electronic Brake Control Module, Brake Fluid Level Sensor parameter is Yes.

- **If the parameter is No**

1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, Ignition ON/Vehicle in Service Mode.

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 Low**

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

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Brake Fluid Level Indicator Switch Replacement (Without HP9)****Brake Fluid Level Indicator Switch Replacement (With HP9)**
- **Control Module References** for Electronic Brake Control Module replacement, programming and setup.

DTC C1278 OR C1279: BRAKE SYSTEM DATA MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC C1278

Brake System Data 1 Message Counter Incorrect

DTC C1279

Brake System Data 2 Message Counter Incorrect

Symptom Byte Information: **Symptom Byte List**

Circuit/System Description

For an overview of the component/system, refer to **Hydraulic Brake System Description and Operation**

Conditions for Running the DTC

Ignition» On / Vehicle» In Service Mode

Conditions for Setting the DTC

K177 Brake Booster Control Module = Internal Malfunction

Actions Taken When the DTC Sets

Boost = Full

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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. Ignition» On / Vehicle» In Service Mode
2. Verify DTC C1278, C1279 is not set.
 - **If the DTC is set**
 1. Perform all necessary programming and setup procedures for the control module: K177 Brake Booster Control Module
 2. Verify the DTC does not set.
 - If the DTC sets» Replace the component: K177 Brake Booster Control Module
 - If the DTC is not set
 3. All OK.
 - **If the DTC is not set**
3. All OK.

Repair Instructions

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

For control module replacement, programming and setup, refer to [Control Module References](#)

DTC C1449: SYSTEM CONFIGURATION ERROR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC C1449

System Configuration Error

Symptom Byte Information: [Symptom Byte List](#)

Circuit/System Description

For an overview of the component/system, refer to [Hydraulic Brake System Description and Operation](#)

Conditions for Running the DTC

Ignition» On / Vehicle» In Service Mode

Conditions for Setting the DTC

K177 Brake Booster Control Module = Internal Malfunction

Actions Taken When the DTC Sets

Boost/Blending = Not Available

Brake System Warning Indicator = ON

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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. IgnitionÂ» On / VehicleÂ» In Service Mode
2. Verify DTC C1449 is not set.
 - **If the DTC is set**
 1. Perform all necessary programming and setup procedures for the control module: K177 Brake Booster Control Module
 2. Verify the DTC does not set.
 - If the DTC setsÂ» Replace the component: K177 Brake Booster Control Module
 - If the DTC is not set
 3. All OK.
 - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

For control module replacement, programming and setup, refer to **Control Module References**

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.
- **Diagnostic Procedure Instructions** provides 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

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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.

- [Power Brake Booster Vacuum Hose Replacement \(LTG\)](#)[Power Brake Booster Vacuum Hose Replacement \(LGW, LGX\)](#) for B19B Brake Booster Vacuum Sensor replacement
- [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.
- [Diagnostic Procedure Instructions](#) provides 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/Ignition ON/Vehicle in Service Mode.

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

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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**

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/Ignition OFF/Vehicle 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 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/Ignition ON/Vehicle in Service Mode.
4. 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/Ignition OFF/Vehicle 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/Ignition OFF/Vehicle 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. Test for less than 1 V between the B19B Brake Booster Vacuum Sensor signal circuit terminal 1 and ground.
 - **If greater than 1 V**
 1. Ignition OFF/Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine 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, replace the K20 Engine Control Module.
 - **If less than 1 V**
6. Ignition OFF/Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
7. 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**
8. 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**

9. Replace the B19B Brake Booster Vacuum Sensor.

10. 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**

11. All OK.

Repair Instructions

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

[Control Module References](#) for Engine Control Module replacement, programming and setup.

DTC P057B-P057E, P05DC-P05DF OR P05E0: BRAKE PEDAL POSITION 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.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P057B

Brake Pedal Position Sensor 1 Performance

DTC P057C

Brake Pedal Position Sensor Circuit Low Voltage

DTC P057D

Brake Pedal Position Sensor 1 Circuit High Voltage

DTC P057E

Brake Pedal Position Sensor Circuit Erratic

DTC P05DC

Brake Pedal Position Sensor "B" Circuit Range/Performance

DTC P05DD

Brake Pedal Position Sensor 2 Circuit Low Voltage

DTC P05DE

Brake Pedal Position Sensor 2 Circuit High Voltage

DTC P05DF

Brake Pedal Position Sensor 2 Circuit Erratic

DTC P05E0

Brake Pedal Position Sensors 1-2 Not Plausible

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

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P057C, P05DD	P057C, P05DE	-	-
Brake Pedal Position Sensor Signal 1	P057C	P057C	P057D	P057B, P05E0
Brake Pedal Position Sensor Signal 2	P05DD	P05DE	P05DE	P05DC, P05E0
Low Reference	-	P057C, P05DE	-	-

Circuit/System Description

The brake booster system consists of a motor, electronic control unit (ECU), pedal travel sensor and a master cylinder. The pedal travel sensor is connected to the brake pedal and measures the amount of brake pedal input to control the amount of boost needed. The pedal travel sensor consists of two travel sensors in one assembly, consisting of a shared 5 volt reference, shared low reference and two signal circuits.

Conditions for Running the DTC

P057B, P057C, P057D, P057E, P05DC, P05DD, P05DE, P05DF or P05E0

- Ignition ON/Vehicle in Service Mode.

Conditions for Setting the DTC

P057B

The brake pedal position sensor 1 upper and lower and lower range has been exceeded

P057E

Brake pedal position sensor 1 erratic signal

P057C

Brake pedal position sensor 1 signal shorted to ground

P057D

Brake pedal position sensor 1 signal shorted to voltage

P05DC

The brake pedal position sensor 2 upper and lower and lower range has been exceeded

P05DD

Brake pedal position sensor 2 signal shorted to ground

P05DE

Brake pedal position sensor 2 signal shorted to voltage

P05DF

Brake pedal position sensor 2 erratic signal

P05E0

The deviation between Brake pedal position sensor 1 and 2 is too large

Action Taken When the DTC Sets

P057B, P057C, P057D, P057E, P05DC, P05DD, P05DE, P05DF or P05E0

- No boost or blending is available
- Red brake light and MIL are illuminated

Conditions for Clearing the DTC

P057B, P057C, P057D, P057E, P05DC, P05DD, P05DE, P05DF or P05E0

The condition for setting the DTC is no longer present.

Diagnostic Aids

DTC P050E may set if the brake pedal is applied for 60 seconds or more while also applying the accelerator pedal.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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 Testing

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B201 Brake Control Brake Pedal Position 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 3 and ground.
 - **If 10 Ω or greater**
 1. Disconnect the harness connector at the K177 Brake Booster 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 K177 Brake Booster Control Module.
 - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 1 and ground.
 - **If less than 4.8 V**
 1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster 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 K177 Brake Booster Control Module.
- **If greater than 5.2 V**
 - 1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster Control Module, Ignition ON/Vehicle in Service Mode.
 - 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 K177 Brake Booster Control Module.
- **If between 4.8-5.2 V**
- 5. Test for less than 1 V between the B201 Brake Control Brake Pedal Position Sensor signal circuit terminal 2 and ground.
 - **If greater than 1 V**
 - 1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster 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, replace the K177 Brake Booster Control Module.
 - **If less than 1 V**
- 6. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster Control Module.
- 7. Test for infinite resistance between the B201 Brake Control Brake Pedal Position Sensor signal circuit terminal 2 and ground.
 - **If less than infinite resistance**

Repair the short to ground on the circuit.
 - **If infinite resistance**
- 8. Test for less than 2 Ω in the B201 Brake Control Brake Pedal Position Sensor signal circuit end to end.
 - **If 2 Ω or greater**

Repair the open/high resistance in the circuit.
 - **If less than 2 Ω**
- 9. Test for less than 1 V between the B201 Brake Control Brake Pedal Position Sensor signal circuit terminal 4 and ground.
 - **If greater than 1 V**
 - 1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster 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, replace the K177 Brake Booster Control Module.
 - **If less than 1 V**
- 10. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster Control Module.
- 11. Test for infinite resistance between the B201 Brake Control Brake Pedal Position Sensor signal circuit terminal 4 and ground.
 - **If less than infinite resistance**

Repair the short to ground on the circuit.
 - **If infinite resistance**

12. Test for less than 2 Ω in the B201 Brake Control Brake Pedal Position Sensor signal circuit end to end.

- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

13. Replace the K177 Brake Booster Control Module.

Repair Instructions

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

- [Control Module References](#) for control module replacement, programming and setup.

DTC P0642, P06A6 OR P06A7: SENSOR REFERENCE VOLTAGE

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.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P0642

Sensor Reference Voltage 1 Low Voltage

DTC P06A6

Sensor Reference Voltage 1 Performance

DTC P06A7

Sensor Reference Voltage 2 Performance

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

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P057C, P05DD, P06A6, P06A7	P057C, P05DE, P0642	-	P06A6, P06A7

Circuit/System Description

The brake booster system consists of a motor, electronic control unit (ECU), pedal travel sensor and a master cylinder. The pedal travel sensor is attached to the brake pedal and measures the amount of brake pedal input to control the amount of boost needed. The pedal travel sensor consists of two travel sensors in one assembly, consisting of a shared 5 volt reference, shared low reference and two signal circuits.

Conditions for Running the DTC

Ignition ON/Vehicle in Service Mode.

Conditions for Setting the DTC

Pedal travel sensor voltage supply failure

Action Taken When the DTC Sets

- No boost or blending available
- Red brake light and MIL are illuminated

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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 Testing

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B201 Brake Control Brake Pedal Position Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Ignition ON/Vehicle in Service Mode.
3. Test for 4.8-5.2 V between the 5 V reference circuit terminal 1 and ground.
 - **If less than 4.8 V**
 1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster 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 K177 Brake Booster Control Module.
 - **If greater than 5.2 V**
 1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster Control Module, Ignition ON/Vehicle in Service Mode.
 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 K177 Brake Booster Control Module.
 - **If between 4.8-5.2 V**
4. Replace the K177 Brake Booster Control Module.

Repair Instructions

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

- [Control Module References](#) for control module replacement, programming and setup.

DTC P25C6 OR P25C7: BRAKE BOOSTER TEMPERATURE SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P25C6

Brake Booster Temperature Sensor Circuit Low Voltage

DTC P25C7

Brake Booster Temperature Sensor 1 Circuit High Voltage

Symptom Byte Information: [Symptom Byte List](#)

Circuit/System Description

For an overview of the component/system, refer to [Hydraulic Brake System Description and Operation](#)

Conditions for Running the DTC

IgnitionÂ» On / VehicleÂ» In Service Mode

Conditions for Setting the DTC

Brake Booster Control Module Temperature = Out Of Range

Actions Taken When the DTC Sets

Boost = Full

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Schematic Reference

[Hydraulic Brake Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Electrical Information Reference

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

Scan Tool Reference

Circuit/System Verification

1. Ignition » On / Vehicle » In Service Mode
2. Verify DTC P25C6, P25C7 is not set.
 - **If the DTC is set**
 1. Perform all necessary programming and setup procedures for the control module: K177 Brake Booster Control Module
 2. Verify the DTC does not set.
 - If the DTC sets » Replace the component: K177 Brake Booster Control Module
 - If the DTC is not set
 3. All OK.
 - **If the DTC is not set**
3. All OK.

Repair Instructions

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

For control module replacement, programming and setup, refer to [Control Module References](#)

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 Warning Indicator Malfunction](#)
- [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 WARNING INDICATOR 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.
- [Diagnostic Procedure Instructions](#) provides 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	C0126 05	C0126 05	-
Ground	-	C0126 05	-	-

Circuit/System Description

The brake fluid level switch monitors the level of the brake fluid in the brake fluid reservoir. When the brake fluid level switch input closed, the electronic brake control module will set the DTC.

Conditions for Running the DTC

Ignition ON/Vehicle in Service Mode.

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

[Hydraulic Brake Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

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**

Refer to Circuit/System Testing.

Circuit/System Testing

1. Ignition OFF/Vehicle 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 1 and ground.

- **If 10 Ω or greater**

1. Ignition OFF/Vehicle 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/Vehicle in Service Mode.

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

- **If the parameter is not OK**

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

2. Test for infinite resistance between the signal circuit terminal 2 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 OK**

5. Install a 3 A fused jumper wire between the signal circuit terminal 2 and ground.

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

- **If the parameter is not Low**

1. Ignition OFF/Vehicle 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 Low

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

Repair Instructions

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

[Control Module References](#) for electronic brake 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 Diagnostic Starting Point - Vehicle
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, bluing 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 3	Go to Diagnostic Starting Point - Vehicle
3	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 <u>Diagnostic Starting Point - Vehicle</u>
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 <u>Disc Brake System Diagnosis</u>.		
	Did you find and correct a condition?	Go to Step 9	Go to Step 3

Step	Action	Yes	No
3	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 9	Go to Step 4
4	1. Inspect the hydraulic brake system for the following conditions. • 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 9	Go to Step 5
5	Is the vehicle equipped with a drum-in-rotor type of park brake system?	Go to Step 6	Go to Step 9
6	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 7	Go to Step 9

Step	Action	Yes	No
7	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 9	Go to Step 8
8	Inspect the park brake system for proper operation. Refer to <u>Park Brake System Diagnosis</u> . Did you find and correct a condition?	Go to Step 9	Go to <u>Diagnostic Starting Point - Vehicle</u>
9	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 <u>Brake System Vehicle Road Test</u>. Is the condition still present?	Go to Step 2	System OK

BRAKING ACTION UNEVEN - PULLS TO ONE SIDE

Test Description

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

4

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

5

Steering components that are not operating properly 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 <u>Diagnostic Starting Point - Vehicle</u>

Step	Action	Yes	No
2	- 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 - Brake fluid leak - 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
3	- 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 - 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 4
4	- Inspect the suspension system for the following conditions. - Incorrect tire pressures - Loose suspension component connections - Excessively worn or damaged suspension components - Adjust, repair or replace components as necessary. Refer to Diagnostic Starting Point - Vehicle Did you find and correct a condition?	Go to Step 6	Go to Step 5

Step	Action	Yes	No
5	- Inspect the steering system for the following conditions. - Loose steering component connections - Excessively worn or damaged steering components - Adjust, repair or replace components as necessary. Refer to <u>Diagnostic Starting Point - Vehicle</u> Did you find and correct a condition?	Go to Step 6	Go to <u>Diagnostic Starting Point - Vehicle</u>
6	- Install or connect components that were removed or disconnected during diagnosis. - Road test the vehicle in order to confirm proper operation. Refer to <u>Brake System Vehicle Road Test</u> Is the condition still present?	Go to Step 2	System OK

BRAKING ACTION UNEVEN - FRONT TO REAR

Test Descriptions

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

4

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 <u>Diagnostic Starting Point - Vehicle</u>

Step	Action	Yes	No
2	- Inspect the hydraulic brake system for the following conditions: - Improper operation of caliper pistons - Kinked, pinched or damaged brake pipe or flexible brake hose - Brake fluid leak - Improperly functioning proportion valve, if equipped - Improper operation of dynamic rear proportion (DRP) system, if equipped - 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
3	- 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 - 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 4
4	- Inspect the suspension system for the following conditions: - Loose suspension component connections - Excessively worn or damaged suspension components - Adjust, repair or replace components as necessary. Refer to Diagnostic Starting Point - Vehicle.		
	Did you find and correct a condition?	Go to Step 6	Go to Step 5

Step	Action	Yes	No
5	- 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 <u>Brake Assist System Diagnosis</u>. Did you find and correct a condition?	Go to Step 6	Go to <u>Diagnostic Starting Point - Vehicle</u>
6	- Install or connect components that were removed or disconnected during diagnosis. - Road test the vehicle in order to confirm proper operation. Refer to <u>Brake System Vehicle Road Test</u>. Is the condition still present?	Go to Step 2	System OK

BRAKE 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 <u>Diagnostic Starting Point - Vehicle</u>
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 • Pedal returned to rest slowly after any of the applies • Internally damaged flexible brake hoses; hindering fluid return • Binding caliper pistons • 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 8	Go to Step 4

Step	Action	Yes	No
4	- 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 <u>Disc Brake System Diagnosis</u>. - Re-inspect brake pedal apply travel and feel. Did you find and correct a condition?	Go to Step 8	Go to Step 5
5	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 7	Go to Step 6
6	- Inspect for worn, missing, misaligned, bent or damaged brake pedal system components. - For the brake pedal pushrod component inspection, refer to <u>Brake Pedal Pushrod Inspection</u>. - 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 8	Go to Step 7

Step	Action	Yes	No
7	- 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 <u>Brake Assist System Diagnosis</u>. Did you find and correct a condition?	Go to Step 8	Go to <u>Diagnostic Starting Point - Vehicle</u>
8	- Install or connect components that were removed or disconnected during diagnosis. - Road test the vehicle in order to confirm proper operation. Refer to <u>Brake System Vehicle Road Test</u>. Is the condition still present?	Go to Step 2	System OK

BRAKE 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 <u>Diagnostic Starting Point - Vehicle</u>
2	- 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 - Adjust, repair or replace components as necessary. Refer to <u>Brake Assist System Diagnosis</u>. Did you find and correct a condition?	Go to Step 5	Go to Step 3

Step	Action	Yes	No
3	1. Inspect the hydraulic brake system for the following conditions: • Binding caliper pistons • 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 5	Go to Step 4
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 5	Go to Diagnostic Starting Point - Vehicle

Step	Action	Yes	No
5	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 <u>Brake System Vehicle Road Test</u>. 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 <u>Diagnostic Starting Point - Vehicle</u>
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 14	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 7
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 14	Go to Step 7
7	Inspect the park brake system for proper operation. Refer to <u>Park Brake System Diagnosis</u> Did you find and correct a condition?	Go to Step 14	Go to Step 8

Step	Action	Yes	No
8	- 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 14	Go to Step 9
9	- 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 11	Go to Step 10
10	- Inspect the pushrod for improper positioning 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 14	-

Step	Action	Yes	No
11	1. For vacuum boost systems, disconnect the vacuum check valve from the booster to relieve vacuum reserve. 2. Separate the master cylinder from the brake booster. Do not disconnect any brake pipes. 3. 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 13	Go to Step 12
12	Replace the brake booster assembly. Did you complete the replacement?	Go to Step 14	-
13	1. Inspect the hydraulic brake system for the following conditions. • Improper operation of caliper pistons • Contaminated brake fluid • Internally damaged flexible brake hoses; hindering brake release • Damaged or improperly operating master cylinder 2. Adjust, repair or replace components as necessary. Refer to <u>Hydraulic Brake System Diagnosis</u> Did you find and correct a condition?	Go to Step 14	Go to <u>Diagnostic Starting Point - Vehicle</u>
14	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 <u>Brake System Vehicle Road Test</u> 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 <u>Diagnostic Starting Point - Vehicle</u>

Step	Action	Yes	No
2	- Inspect the hydraulic brake system for the following conditions: - 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 5	Go to Step 3
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 5	Go to Step 4
4	- 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 5	Go to Diagnostic Starting Point - Vehicle

Step	Action	Yes	No
5	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 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 Diagnostic Starting Point - Vehicle
2	1. Inspect the following hydraulic brake system components for brake fluid leaks: • Flexible brake hose connections; threaded and bolted • Flexible brake hose crimp 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 2. Repair or replace components as necessary. Refer to Hydraulic Brake System Diagnosis Did you find and correct a condition?	Go to Step 8	Go to Step 3
3	Is the vehicle equipped with a vacuum brake booster?	Go to Step 4	Go to Step 6
4	1. Disconnect the vacuum check valve from the booster to relieve vacuum reserve. 2. Separate the master cylinder from the vacuum brake booster. Do not disconnect any brake pipes. 3. Inspect the rear of the master cylinder for a brake fluid leak. 4. Inspect for brake fluid in the vacuum brake booster. Did you find a brake fluid leak?	Go to Step 5	Go to Diagnostic Starting Point - Vehicle
5	Replace the brake master cylinder and the vacuum brake booster. Did you complete the replacement?	Go to Step 8	-

Step	Action	Yes	No
6	1. Wipe clean the external surface of the master cylinder to hydraulic brake booster area, if equipped. 2. Separate the master cylinder from the hydraulic brake booster, if equipped. Do not disconnect any brake pipes. 3. Inspect the rear of the master cylinder for a brake fluid leak. Did you find a brake fluid leak?	Go to Step 7	Go to Diagnostic Starting Point - Vehicle
7	Replace the brake master cylinder. Did you complete the replacement?	Go to Step 8	-
8	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle to confirm proper operation. 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

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the DISC brake system in order to determine if the DISC brake system is operating properly. You will be directed by the appropriate Symptom table to go to other brake system diagnostic tables as appropriate.			
1	Were you sent here from a Brake Symptom table?	Go to Step 2	Go to <u>Diagnostic Starting Point - Vehicle</u>
2	Visually inspect the disc brake pads for the following conditions: <u>Front Disc Brake Pads Replacement</u> and/or <u>Rear Disc Brake Pads Replacement</u> • Lining thickness below specifications • Uneven and/or abnormal wear- edge-to-edge and/or side-to-side • Looseness or damage-including pad hardware • Evidence of contamination from an external substance 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 and/or rear disc brake pads contaminated?	Go to Step 8	Go to Step 4
4	Are any of the front and/or rear disc brake pads worn unevenly?	Go to Step 7	Go to Step 5
5	Are any of the front and/or rear disc brake pads and/or 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 <u>Front Disc Brake Pads Replacement</u> and/or <u>Rear Disc Brake Pads Replacement</u> Did you complete the inspection and replacement?	Go to Step 12	-

Step	Action	Yes	No
7	1. Remove the front and/or rear disc brake calipers, as appropriate, from the mounting brackets or from the suspension knuckles and support the calipers. Refer to Front Brake Caliper Replacement and/or Rear Brake Caliper Replacement 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. Inspect the disc brake caliper mounting bracket or the suspension knuckles and the mounting/sliding hardware for the following conditions: Front Disc Brake Mounting and Hardware Inspection and/or Rear Disc Brake Mounting and Hardware Inspection • Binding or seized hardware • Worn, damaged or missing hardware components • Loose, bent, cracked or damaged caliper mounting bracket or suspension knuckle 3. Replace components as required. • Rear Brake Caliper Bracket Replacement • Front Brake Caliper Hardware Replacement 4. Replace the unevenly-worn, loose or damaged disc brake pads as a complete axle set. Refer to Front Disc Brake Pads Replacement and/or Rear Disc Brake Pads Replacement Did you complete the inspection and replacement?	-	
		Go to Step 12	

Step	Action	Yes	No
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. • Front Brake Caliper Overhaul or Front Brake Caliper Replacement • Rear Brake Caliper Replacement • Front Brake Hose Replacement • Rear Brake Hose Replacement • Brake Pipe Replacement Did you find and correct the source of the leak causing contamination of the 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 pads. Refer to Front Wheel Drive Shaft Replacement - Left Side and/or Front Wheel Drive Shaft Replacement - Right Side and/or Rear Wheel Drive Shaft Replacement - Left Side (LTG) Rear Wheel Drive Shaft Replacement - Left Side (LGX, LGW) and/or Rear Wheel Drive Shaft Replacement - Right Side Did you find and correct the source of the leak causing contamination of the pads?	Go to Step 11	Go to Step 10
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. Inspect the power steering system hoses for damage and evidence of an external fluid leak which may be the source of the contamination to the pads. 3. Replace any components found to be leaking fluid 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	-

Step	Action	Yes	No
11	1. Clean the remaining disc brake system components to remove any traces of the contaminant. 2. Remove the front and/or rear disc brake calipers, as appropriate, from the mounting brackets or the suspension knuckles and support the calipers. Refer to Front Brake Caliper Replacement and/or Rear Brake Caliper Replacement 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. 3. Inspect the disc brake caliper mounting/sliding hardware for the following conditions: Front Disc Brake Mounting and Hardware Inspection and/or Rear Disc Brake Mounting and Hardware Inspection • Binding or seized hardware • Distorted, worn, damaged or missing hardware components 4. Replace the caliper mounting/sliding hardware components as required. Refer to Front Brake Caliper Hardware Replacement and/or Rear Brake Caliper Bracket Replacement 5. Replace the contaminated disc brake pads as a complete axle set. Refer to Front Disc Brake Pads Replacement and/or Rear Disc Brake Pads Replacement Did you complete the cleaning, inspection and replacement?	Go to Step 12	-

Step	Action	Yes	No
12	Visually inspect each of the disc brake rotor shields/backing plates, if equipped, for evidence of contact with the brake rotors. Are any of the brake rotor shields/backing plates contacting the brake rotors?	Go to Step 13	Go to Step 14
13	Repair or replace the disc brake rotor shields/backing plates as required. Refer to Front Brake Shield Replacement and/or Rear Brake Shield Replacement Did you complete the repair or replacement?	Go to Step 14	-
14	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 rotor can be REFINISHED and REMAIN ABOVE the minimum requirements. Brake Rotor Thickness Measurement Does the disc brake rotor meet the minimum requirements for REFINISHING?	Go to Step 15	Go to Step 18
15	NOTE: Perform the following inspection AND ANSWER the question INDIVIDUALLY for EACH rotor. Inspect each of the disc 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 17	Go to Step 16

Step	Action	Yes	No
16	1. Inspect each of the disc brake rotors for the following surface and wear conditions: <u>Brake Rotor Surface and Wear Inspection</u> • Heavy rust and/or pitting • Cracks and/or heat spots • Excessive blueing discoloration • Deep or excessive scoring beyond maximum acceptable level 2. Make a determination for each brake rotor if the rotor requires refinishing based upon the results of the inspection. If the brake rotor exhibits any of the conditions listed previously, it requires refinishing. NOTE: Make the following determination AND ANSWER the question INDIVIDUALLY for EACH rotor. Does the brake rotor require REFINISHING?	Go to Step 17	Go to Step 22
17	1. Refinish the brake rotor. Refer to <u>Brake Rotor Refinishing</u> 2. Inspect the brake rotor thickness. Refer to <u>Brake Rotor Thickness Measurement</u> Were you able to REFINISH the brake rotor within the minimum requirements?	Go to Step 22	Go to Step 21
18	Is the brake rotor at or below the MINIMUM THICKNESS requirements?	Go to Step 21	Go to Step 19
19	NOTE: Perform the following inspection AND ANSWER the question INDIVIDUALLY for EACH rotor. Inspect each of the disc brake rotors for thickness variation that exceeds the maximum acceptable level. Refer to <u>Brake Rotor Thickness Variation Measurement</u> Does the brake rotor exhibit thickness variation that exceeds the maximum acceptable level?	Go to Step 21	Go to Step 20

Step	Action	Yes	No
20	1. Inspect each of the disc brake rotors for the following surface and wear conditions: <u>Brake Rotor Surface and Wear Inspection</u> • Heavy rust and/or pitting • Cracks and/or heat spots • Excessive blueing discoloration • Deep or excessive scoring beyond maximum acceptable level 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. NOTE: Make the following determination AND ANSWER the question INDIVIDUALLY for EACH rotor. Does the brake rotor require REPLACEMENT?	Go to Step 21	Go to Step 22
21	NOTE: Whenever a brake rotor is replaced, the assembled lateral runout (LRO) of the rotor must be measured to ensure optimum performance of the disc brakes. Replace the brake rotor. <u>Front Brake Rotor Replacement</u> and/or <u>Rear Brake Rotor Replacement</u> Did you complete the replacement?	Go to Step 24	-
22	NOTE: Perform the following inspection AND ANSWER the question INDIVIDUALLY for EACH rotor. Inspect each of the disc brake rotors for assembled lateral runout (LRO) that exceeds the maximum acceptable level. Refer to <u>Brake Rotor Assembled Lateral Runout Measurement</u> Does the brake rotor exhibit assembled LRO that exceeds the maximum acceptable level?	Go to Step 23	Go to Step 24

Step	Action	Yes	No
23	Correct the LRO for each brake rotor that was determined to have LRO exceeding the maximum acceptable level. Refer to <u>Brake Rotor Assembled Lateral Runout Correction</u> Did you complete the operation?	Go to Step 24	-
24	Install or connect components that were removed or disconnected during diagnosis. Did you complete the operation?	Disc 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 <u>Diagnostic Starting Point - Vehicle</u>
2	Inspect and adjust the brake fluid level in the brake master cylinder. Refer to <u>Master Cylinder Reservoir Filling</u> Was the brake fluid level low?	Go to Step 3	Go to Step 4
3	- 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 - 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

Step	Action	Yes	No
5	1. Flush the hydraulic brake system. <u>Hydraulic Brake System Flushing</u> 2. If the brake fluid WAS contaminated with an oil-based or a silicone-based fluid, indicated by fluid separation and/or a swollen master cylinder reservoir cap diaphragm and/or swollen reservoir-to-master cylinder grommets, perform the following steps. 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. • <u>Master Cylinder Replacement (Without HP9)</u><u>Master Cylinder Replacement (With HP9)</u> • Brake master cylinder reservoir: Clean the brake master cylinder reservoir using denatured alcohol or equivalent, then dry the reservoir using non-lubricated, filtered air or if necessary, replace the brake master cylinder reservoir. • Replace the brake master cylinder reservoir cap diaphragm. • <u>Front Brake Hose Replacement</u> • <u>Rear Brake Hose Replacement</u> • <u>Front Brake Caliper Overhaul</u> or <u>Front Brake Caliper Replacement</u> • <u>Rear Brake Caliper Replacement</u> • <u>Electronic Brake Control Module Replacement</u> 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 <u>Hydraulic Brake System Bleeding (Manual)</u> and/or <u>Hydraulic Brake System Bleeding (Pressure)</u> 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. • <u>Master Cylinder Replacement (Without HP9)</u><u>Master Cylinder Replacement (With HP9)</u> • Brake master cylinder reservoir cap diaphragm • <u>Front Brake Hose Replacement</u> • <u>Rear Brake Hose Replacement</u> • <u>Brake Pipe Replacement</u> • <u>Front Brake Caliper Overhaul</u> or <u>Front Brake Caliper Replacement</u> • <u>Rear Brake Caliper Replacement</u> • <u>Electronic Brake Control Module Replacement</u> 2. If you repaired or replaced any of the brake system components listed, bleed the hydraulic brake system. Refer to <u>Hydraulic Brake System Bleeding (Manual)</u> and/or <u>Hydraulic Brake System Bleeding (Pressure)</u> While bleeding the hydraulic brake system, observe for the following conditions: • The presence of air in the system at a bleeder valve location other than at the repair location, except if the brake master cylinder was replaced • An unrestricted and even flow of brake fluid per axle during the bleeding procedure		
	Did you find and correct a condition?	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 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 for proper operation. Was the hydraulic function of the brake calipers 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 for proper operation. Was the hydraulic function of the brake calipers 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. <u>Lifting and Jacking the Vehicle</u> 2. Remove the tire and wheel assemblies. <u>Tire and Wheel Removal and Installation</u> 3. Open the suspected caliper bleeder valve. 4. Using a large C-clamp, compress the caliper piston and observe for an unrestricted flow of brake fluid and for free movement of the caliper piston. 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 that was not operating properly. • <u>Front Brake Caliper Overhaul</u> or <u>Front Brake Caliper Replacement</u> • <u>Rear Brake Caliper Replacement</u> 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 <u>Hydraulic Brake System Bleeding (Manual)</u> and/or <u>Hydraulic Brake System Bleeding (Pressure)</u> 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 <u>Brake Pipe and Hose Inspection</u> 2. Replace any of the hydraulic brake pipes and/or flexible brake hoses found to be bent, kinked, pinched or damaged. • <u>Front Brake Hose Replacement</u> • <u>Rear Brake Hose Replacement</u> • <u>Brake Pipe Replacement</u> 3. If none of the hydraulic brake pipes or flexible brake hoses were visibly bent, kinked, pinched or damaged, replace the hydraulic brake flex hose at the restricted location. Did you find and correct a condition?	Go to Step 21	Go to Step 18
18	Replace the brake pressure modulator valve (BPMV), in order to correct the hydraulic brake dynamic rear proportioning mechanical operation. <u>Electronic Brake Control Module Replacement</u> Did you complete the replacement?	Go to Step 21	-

Step	Action	Yes	No
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. Replace the brake master cylinder if it is found to be leaking brake fluid internally. Refer to <u>Master Cylinder Replacement (Without HP9)</u> and/or <u>Master Cylinder Replacement (With HP9)</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	1. Inspect for worn, missing, misaligned, bent or damaged brake pedal system components. - For the brake pedal pushrod component inspection, refer to <u>Brake Pedal Pushrod Inspection</u>. - Inspect the brake pedal bushings for excessive wear and/or damage and inspect the brake pedal for a misaligned, bent and/or damaged condition. 2. Replace the brake pedal system components that are worn, missing, misaligned, bent or damaged. Did you find and replace any worn, missing, misaligned, bent or damaged brake pedal system components?	Go to Step 5	Go to <u>Hydraulic Brake System Diagnosis</u> 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 vacuum brake booster. Refer to <u>Brake System Vacuum Source Test</u> Is the vacuum reading within the acceptable limits?	Go to Step 6	Go to 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 vacuum booster check valve operate properly?	Go to Step 10	Go to Step 9
9	Replace the vacuum booster check valve. Refer to <u>Power Brake Booster Vacuum Hose Replacement (LTG)</u> and/or <u>Power Brake Booster Vacuum Hose Replacement (LGW, LGX)</u>. 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	-

Step	Action	Yes	No
12	1. If the vehicle is equipped with a vacuum sensor, install a scan tool. 2. 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 vacuum sensor data available through the scan tool?	Go to Step 13	Go to Step 16
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 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

Step	Action	Yes	No
14	1. Deplete the vacuum reserve by pressing the brake pedal several times or by removing the vacuum booster check valve. 2. Separate the master cylinder from the vacuum brake booster. Do not disconnect any brake pipes. Refer to Master Cylinder Replacement (Without HP9) and/or Master Cylinder Replacement (With HP9). 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 (Without HP9) and/or Master Cylinder Replacement (With HP9). Did you complete the operation?	Go to Step 15	-
15	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 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

Step	Action	Yes	No
16	1. Separate the master cylinder from the vacuum brake booster. Do not disconnect any brake pipes. Before removing the master cylinder, first deplete the vacuum by removing the check valve or applying the brake pedal several times. Refer to Master Cylinder Replacement (Without HP9) and/or Master Cylinder Replacement (With HP9) 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 (Without HP9) and/or Master Cylinder Replacement (With HP9) 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 (Without HP9) and/or Master Cylinder Replacement (With HP9). 2. If the engine was started after reinstalling the master cylinder to the booster, perform the following: With the engine OFF, depress the brake pedal several times to deplete the vacuum reserve. 3. Depress and maintain moderate foot 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 vacuum 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. Depress the brake pedal 2 times to check for vacuum 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 vacuum brake booster. Refer to Power Vacuum Brake Booster Replacement Did you complete the replacement?	Go to Step 22	-

Step	Action	Yes	No
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. Check to see if the brake system warning lamp remains illuminated.
3. If the brake system warning lamp remains illuminated, DO NOT proceed to test drive the vehicle until it is diagnosed and repaired. Refer to [Symptoms - Hydraulic Brakes](#)
4. Select a smooth, dry, clean and level road or large lot that is as free of traffic and obstacles as possible for brake system low speed road testing.
5. With the transmission in PARK, lightly apply the brake pedal. Observe both the pedal feel and the pedal travel.
6. If the brake pedal apply felt spongy or the pedal travel was excessive, DO NOT drive the vehicle until it is repaired.
7. If the brake pedal apply did not feel spongy and the pedal travel was not excessive, proceed to step 8.
8. Release and apply the brakes.
9. While continuing to apply the brakes, shift the transmission into DRIVE, release the brakes and allow the engine to idle the vehicle away from the stopped position. Observe for a slow release of the brake system.
10. With the aid of an assistant to observe the vehicle's performance from outside of the vehicle, drive the vehicle at a low speed and lightly apply the brakes while driving past the assistant. Have the assistant observe for brake system noise from the side of the vehicle closest to them, while you observe both the pedal effort and the pedal travel.
11. If the brake pedal apply effort was excessive or the pedal travel was excessive, DO NOT continue to test drive the vehicle until it is repaired.
12. If the brake pedal apply effort was not excessive and the pedal travel was not excessive, proceed to step 13.
13. Drive the vehicle in the opposite direction, at the same low speed and lightly apply the brakes while driving past the assistant. Have the assistant observe for brake system noise from the side of the vehicle closest to him.
14. Drive the vehicle at a low speed and shift the transmission into NEUTRAL without applying the brakes. Observe for a rapid deceleration in vehicle speed, indicating possible brake drag.
15. Select a smooth, dry, clean and level road that is as free of heavy traffic as possible for brake system moderate speed road testing.

16. Drive the vehicle at a moderate speed. Observe for a pull and/or incorrect tracking of the vehicle without the brakes applied.
17. While continuing to drive the vehicle at a moderate speed, perform several light applies of the brakes. Observe the pedal effort and the pedal travel, observe for brake system noise, pulsation and/or brake drag.
18. If the brake pedal apply effort was excessive or the pedal travel was excessive, DO NOT continue to test drive the vehicle until it is repaired.
19. If the brake pedal apply effort was not excessive and the pedal travel was not excessive, proceed to step 20.
20. While continuing to drive the vehicle at a moderate speed, perform several moderate applies of the brakes. Observe the pedal effort and the pedal travel, observe for brake system pulsation and/or uneven braking action - either side to side or front to rear.

A small amount of vehicle front end dip is expected during a moderate apply of the brakes.

21. If the brake pedal apply effort was excessive or the pedal travel was excessive, DO NOT continue to test drive the vehicle until it is repaired.

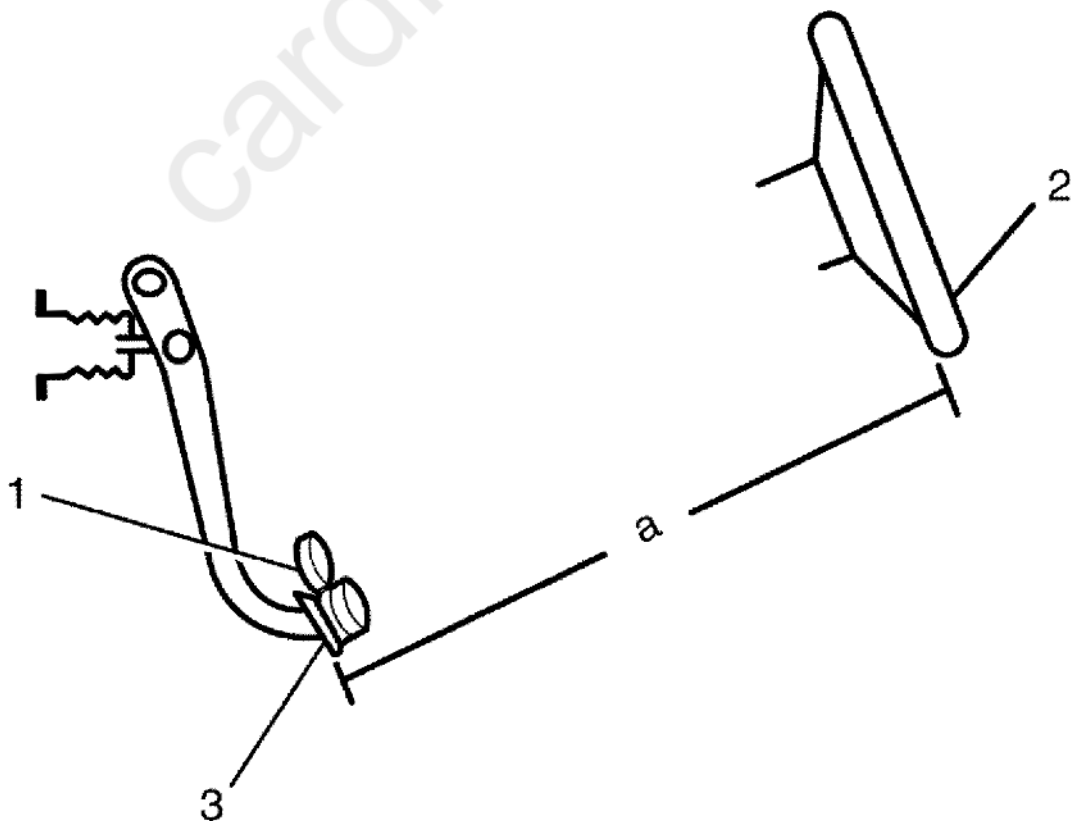
BRAKE PEDAL TRAVEL MEASUREMENT AND INSPECTION

Special Tools

CH-28662 Brake Pedal Effort Gauge

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.
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.
4. Apply and maintain a force of 445 N.m (100 lb) to the brake pedal, as indicated on the **CH-28662** gauge (1) or equivalent.

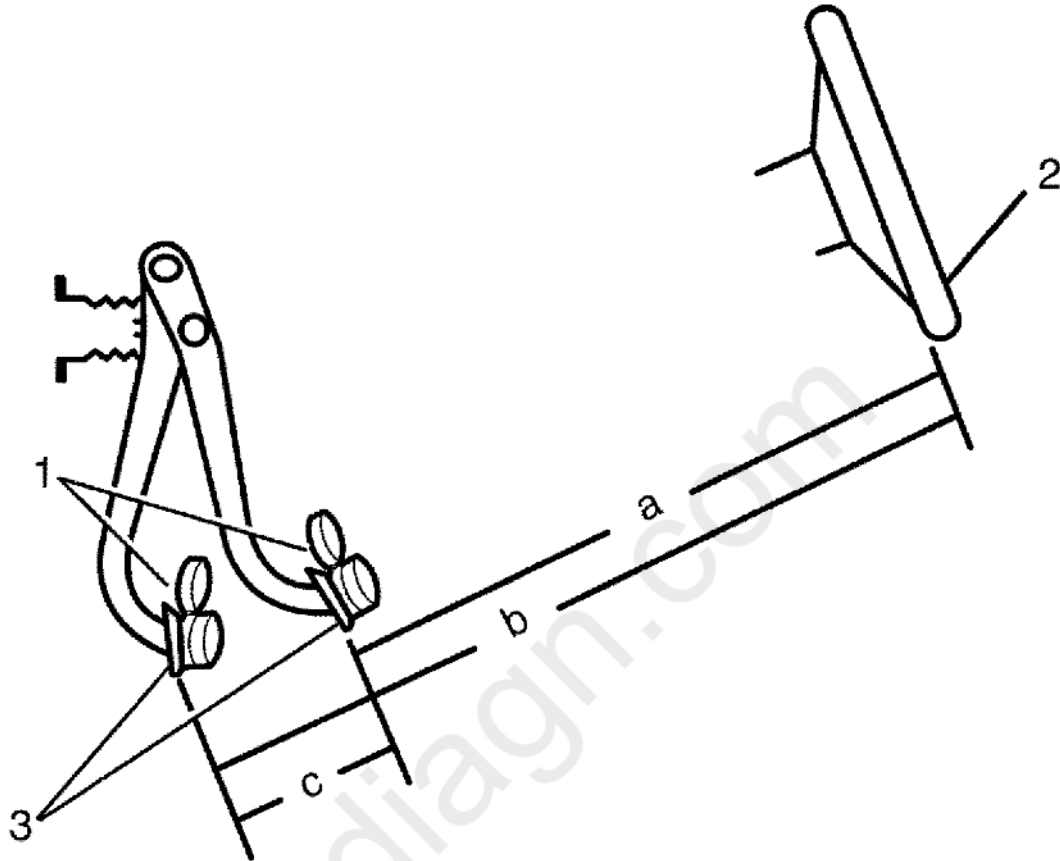


Fig. 4: Brake Pedal Components And Travel Measurement
Courtesy of GENERAL MOTORS COMPANY

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).
9. Compare the measurement obtained with the specification. Refer to **Brake System Specifications**.

BRAKE SYSTEM VACUUM SOURCE TEST

1. Disconnect the engine vacuum hose from the vacuum brake booster check valve.

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.

2. Install a vacuum gauge to the engine vacuum hose.
3. Start the engine and allow the engine to idle until normal operating temperatures are reached.
4. With the vehicle in PARK, the engine idling and the air conditioning (A/C) system OFF, check to see if the engine vacuum reading is within the specified normal engine vacuum range.

Specification

47-68 kPa (14-20 in Hg)

5. Turn the ignition OFF.
6. If the engine vacuum reading was within the specified normal range, proceed to step 10.
7. If the engine vacuum reading was 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, dry-rot
8. If any of these conditions were found with the engine vacuum hose, replace the hose, then repeat steps 2-4.
9. If none of these conditions were found with the engine vacuum hose, then there is an engine vacuum source problem, check the engine vacuum system.
10. Remove the vacuum brake booster check valve from the booster.
11. Install the check valve to the engine vacuum hose.
12. Install the vacuum gauge to the check valve.
13. Start the engine and allow the engine to idle in PARK with the A/C system OFF, until normal operating temperatures are reached.
14. Turn the ignition OFF.
15. Check to see if the engine vacuum reading is maintained within the specified normal engine vacuum range.

Specification

47-68 kPa (14-20 in Hg)

16. If the engine vacuum reading is maintained within the specified normal range, proceed to step 18.
17. If the engine vacuum reading is NOT maintained within the specified normal range, replace the brake booster check valve, then repeat steps 11-15.
18. Inspect the brake booster check valve grommet for the following conditions:
 - Loose connection to the vacuum brake booster
 - Deformation or contamination
 - Cracks, cuts, dry-rot
19. If any of these conditions were found with the check valve grommet, replace the grommet.

BRAKE SYSTEM EXTERNAL LEAK INSPECTION

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 check the fluid level in the master cylinder.

While a slight brake fluid level drop can be considered a normal condition due to brake lining wear, a very low level may indicate a brake fluid leak in the hydraulic system.

If the fluid level is abnormally low, adjust the brake fluid level. Refer to [Master Cylinder Reservoir Filling](#)

2. Start the engine and allow it to idle.
3. 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.

4. Turn OFF the ignition.
5. Visually inspect the following brake system components for brake fluid leaks, excessive corrosion and damage. Give particular attention to all brake pipe and flexible hose connections to ensure that there are not any slight brake fluid leaks - even though the brake pedal may feel firm and hold steady:
 - Master cylinder brake pipe fittings
 - All brake pipe connections
 - Brake pipes
 - Brake hoses and connections
 - Brake calipers and/or wheel cylinders, if equipped
6. 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 OFF the ignition.
4. If the brake pedal apply felt spongy, but the brake pedal travel was not excessive, perform the following steps:
 1. Inspect the brake system for external leaks. Refer to [Brake System External Leak Inspection](#).
 2. Pressure bleed the brake system in order to purge any air that may be trapped in the system. Refer to [Hydraulic Brake System Bleeding \(Manual\)](#) and/or [Hydraulic Brake System Bleeding \(Pressure\)](#).
5. If the brake pedal apply did not feel spongy, but the brake pedal travel was excessive, perform the following steps:

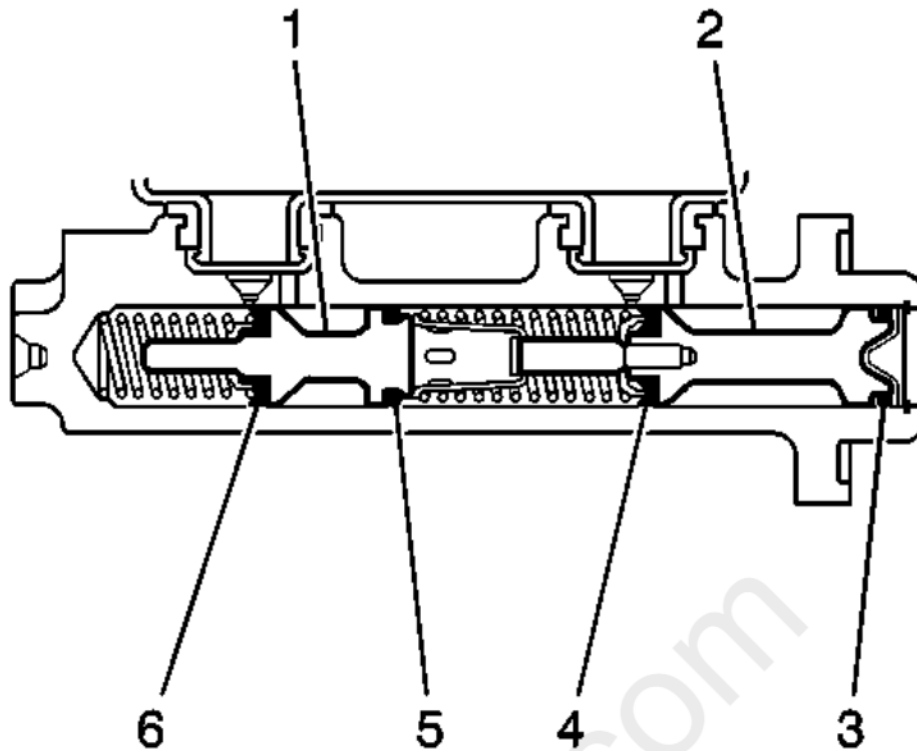


Fig. 5: Identifying Brake Master Cylinder (Cross Sectional View)

Courtesy of GENERAL MOTORS COMPANY

1. Loosen the master cylinder-to-brake power booster mounting nuts.
2. Carefully pull the master cylinder away from the brake power booster just enough to inspect the mounting surface of the master cylinder.
3. Inspect the master cylinder mounting surface at the primary piston (2) for brake fluid leaks.
6. If the master cylinder exhibits any leakage around the primary piston (2), then the primary piston primary seal (4) and/or secondary seal (3) is leaking and the master cylinder requires overhaul or replacement.
7. If the master cylinder primary piston (2) does not exhibit any leakage, pressure bleed the brake system. Refer to [Hydraulic Brake System Bleeding \(Manual\)](#) and/or [Hydraulic Brake System Bleeding \(Pressure\)](#).
8. If the brake pedal apply did not feel spongy and the brake pedal travel was initially steady and not excessive, but then gradually fell, then the master cylinder requires overhaul or replacement due to an internal leak past the secondary piston (1) from the secondary piston primary seal (6) or secondary seal (5).
9. If the brake pedal apply did not feel spongy and the brake pedal travel was initially steady and not excessive, then fell slightly, then became steady again, then the brake pressure modulator valve (BPMV) may be leaking internally and may require replacement.

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, improper routing, missing or damaged retainers

- Leaking fittings, excessive corrosion
2. If any of the brake pipes exhibited any of the conditions listed, then the identified pipe or pipes, require replacement.
 3. Ensure that the vehicle axles are properly supported at ride height in order to maintain the proper relationship of the flexible brake hoses to the chassis.
 4. Visually inspect all of the flexible brake hoses for the following conditions:

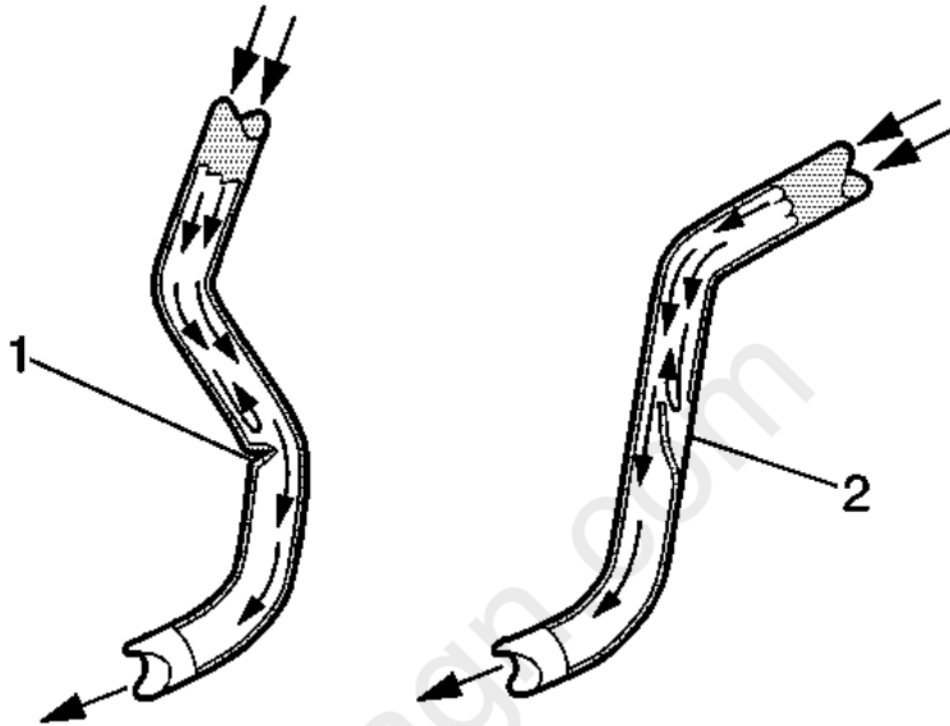


Fig. 6: Identifying Flexible Brake Hose Failure Conditions

Courtesy of GENERAL MOTORS COMPANY

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

BRAKE PEDAL PUSHROD INSPECTION

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

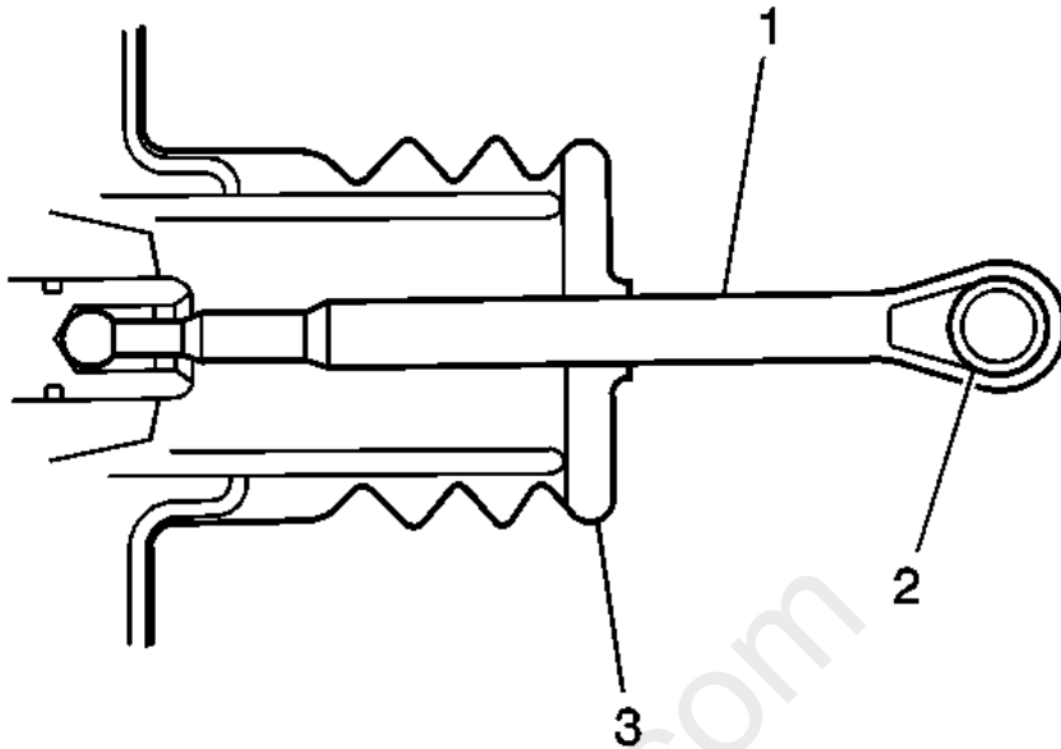


Fig. 7: View of Brake Pedal Pushrod

Courtesy of GENERAL MOTORS COMPANY

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

REPAIR INSTRUCTIONS

HYDRAULIC BRAKE FLUID REPLACEMENT

WARNING: Brake Fluid Irritant Warning

CAUTION: 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 \(Manual\)](#) and/or [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 (WITHOUT HP9)

Removal Procedure

WARNING: [Brake Fluid Irritant Warning](#)

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

1. Place the ignition switch in the OFF position.
2. Air Inlet Grille Panel» Remove - [Air Inlet Grille Panel Replacement](#)
3. Remove and properly dispose of the brake fluid in the master cylinder reservoir.
4. Brake Fluid Level Indicator Switch Electrical Connector» Disconnect

5. Power Brake Booster Vacuum Sensor Electrical ConnectorA» Disconnect
6. Brake Master Cylinder Reservoir Bolt (1)» Remove

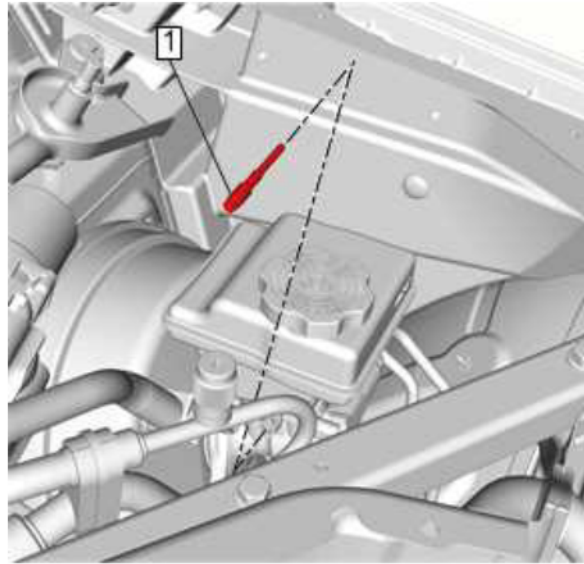


Fig. 8: Brake Master Cylinder Reservoir Bolt
Courtesy of GENERAL MOTORS COMPANY

7. Master Cylinder Reservoir (1)» Remove

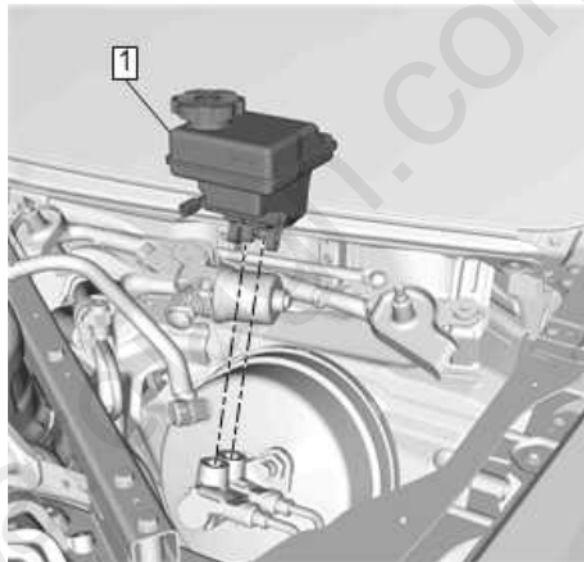
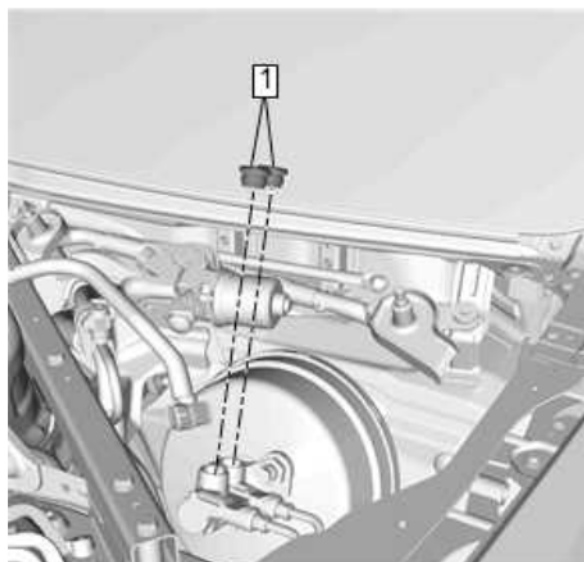


Fig. 9: Master Cylinder Reservoir
Courtesy of GENERAL MOTORS COMPANY

8. Master Cylinder Reservoir Seal (1)» Remove [2x]



Installation Procedure

1. Lightly lubricate the master cylinder reservoir seals with GM approved brake fluid from a clean, sealed brake fluid container. Refer to **Adhesives, Fluids, Lubricants and Sealers**
2. Master Cylinder Reservoir Seal (1)» Install [2x]

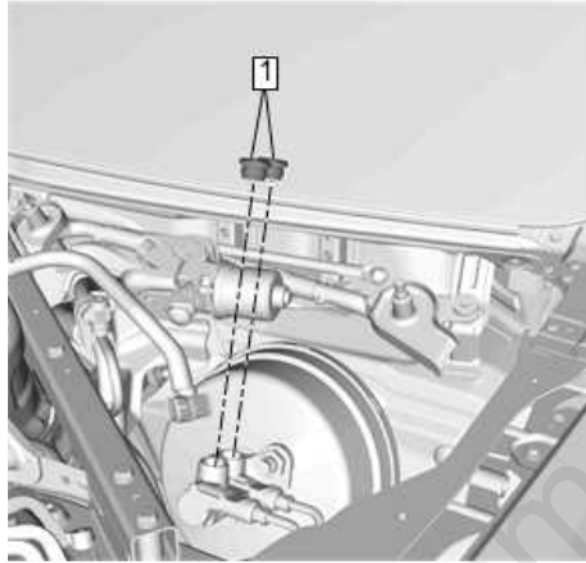


Fig. 11: Master Cylinder Reservoir Seal
Courtesy of GENERAL MOTORS COMPANY

3. Master Cylinder Reservoir (1)» Install

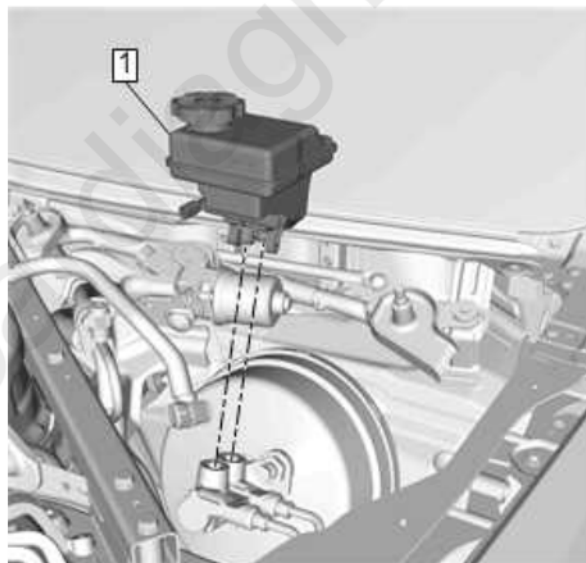


Fig. 12: Master Cylinder Reservoir
Courtesy of GENERAL MOTORS COMPANY

4. Brake Master Cylinder Reservoir Bolt (1)» Install and tighten 8 N.m (71 lb in)

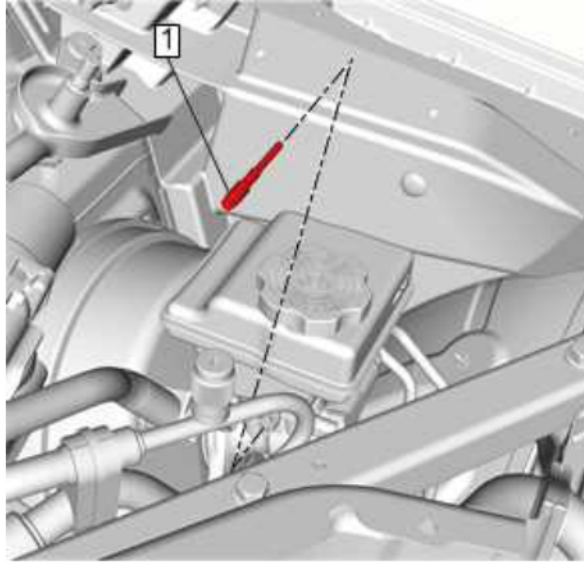


Fig. 13: Brake Master Cylinder Reservoir Bolt
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

5. Power Brake Booster Vacuum Sensor Electrical Connector» Connect
6. Brake Fluid Level Indicator Switch Electrical Connector» Connect
7. Fill the brake master cylinder reservoir. Refer to Master Cylinder Reservoir Filling
8. Air Inlet Grille Panel» Install - Air Inlet Grille Panel Replacement

MASTER CYLINDER RESERVOIR REPLACEMENT (WITH HP9)

Removal Procedure

WARNING: Brake Fluid Irritant Warning

CAUTION: Brake Fluid Effects on Paint and Electrical Components Caution

CAUTION: If there is no brake fluid in the master cylinder, remove one of the brake booster fuses before applying the brake pedal. Failure to do so may damage the electric brake booster.

1. Place the ignition switch in the OFF position.
2. Air Inlet Grille Panel» Remove - Air Inlet Grille Panel Replacement
3. Remove and properly dispose of the brake fluid in the master cylinder reservoir.
4. Brake Fluid Level Indicator Switch Electrical Connector» Disconnect
5. Brake Pressure Modulator Valve Low Pressure Pipe Quick Connect (1)» Disconnect

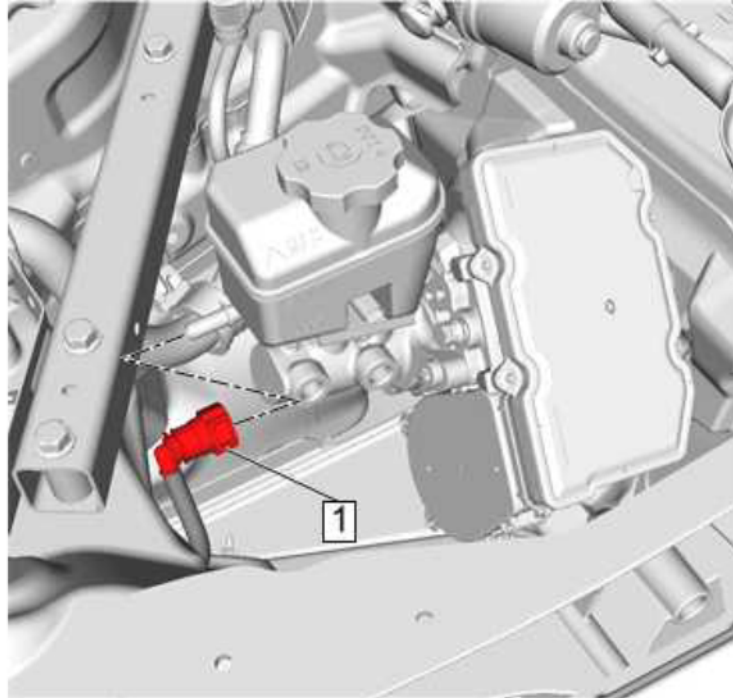


Fig. 14: Brake Pressure Modulator Valve Low Pressure Pipe Quick Connect
 Courtesy of GENERAL MOTORS COMPANY

6. Cap the brake pressure modulator valve low pressure pipe to prevent brake fluid loss and contamination.
7. Brake Master Cylinder Reservoir Bolt (1)» Remove

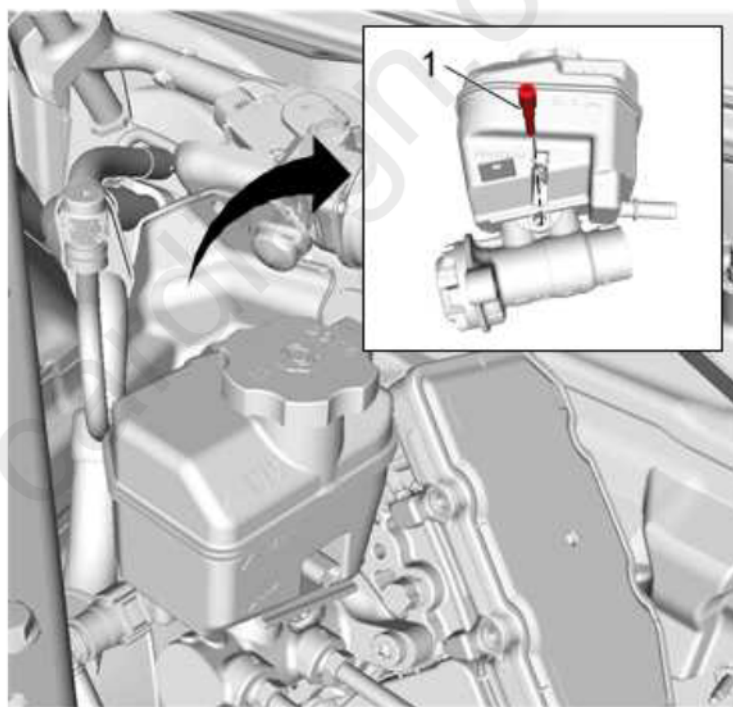


Fig. 15: Brake Master Cylinder Reservoir Bolt
 Courtesy of GENERAL MOTORS COMPANY

8. Brake Master Cylinder Reservoir (1)» Remove

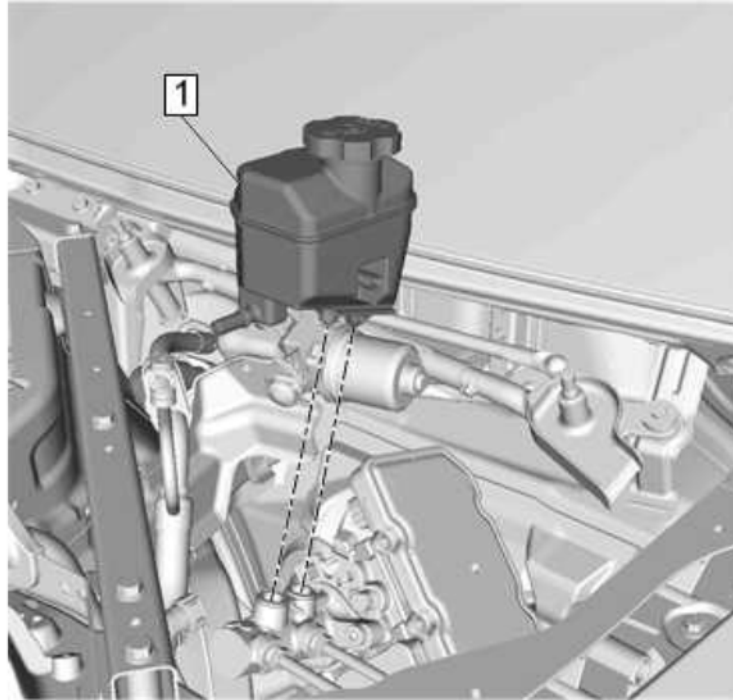


Fig. 16: Brake Master Cylinder Reservoir
Courtesy of GENERAL MOTORS COMPANY

9. Brake Master Cylinder Reservoir Seal (1)» Remove [2x]

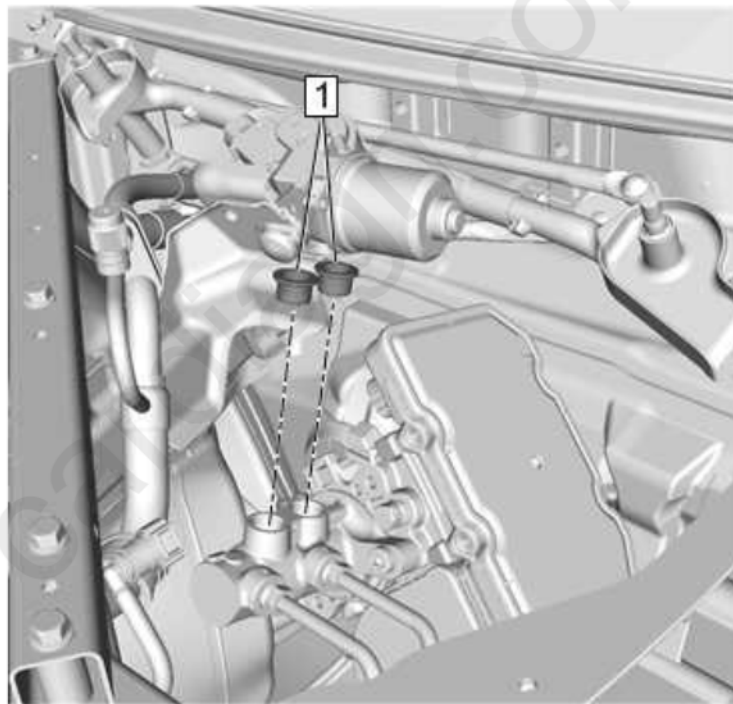


Fig. 17: Brake Master Cylinder Reservoir Seal
Courtesy of GENERAL MOTORS COMPANY

Installation Procedure

1. Lightly lubricate the master cylinder reservoir seals with GM approved brake fluid from a clean, sealed brake fluid container. Refer to **Adhesives, Fluids, Lubricants and Sealers**
2. Brake Master Cylinder Reservoir Seal (1)» Install [2x]

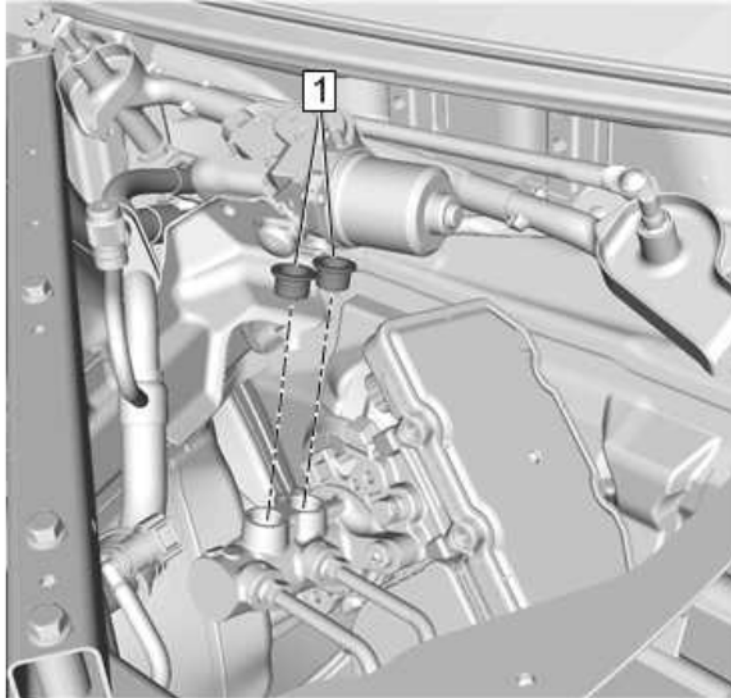


Fig. 18: Brake Master Cylinder Reservoir Seal
Courtesy of GENERAL MOTORS COMPANY

3. Brake Master Cylinder Reservoir (1)» Install

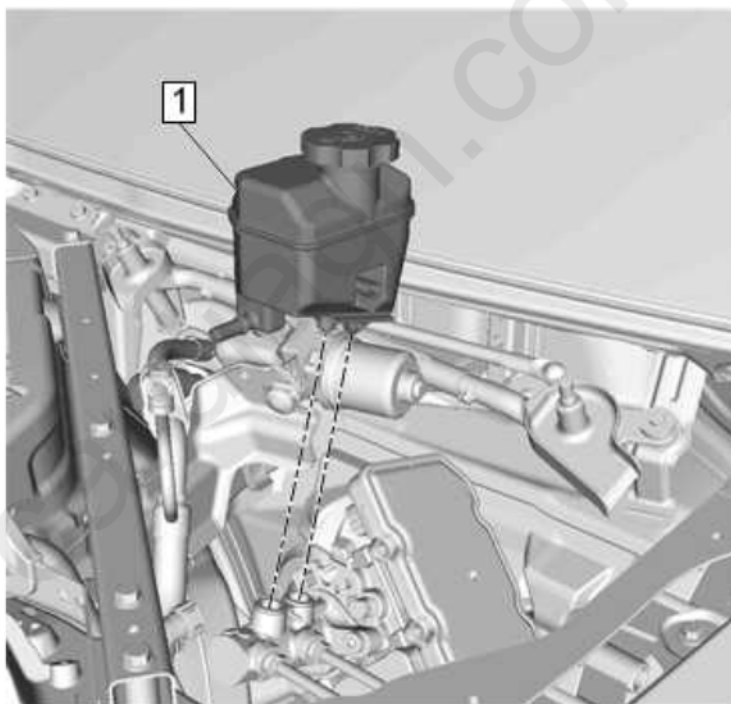


Fig. 19: Brake Master Cylinder Reservoir
Courtesy of GENERAL MOTORS COMPANY

4. Brake Master Cylinder Reservoir Bolt (1)» Install and tighten 8 N.m (71 lb in)

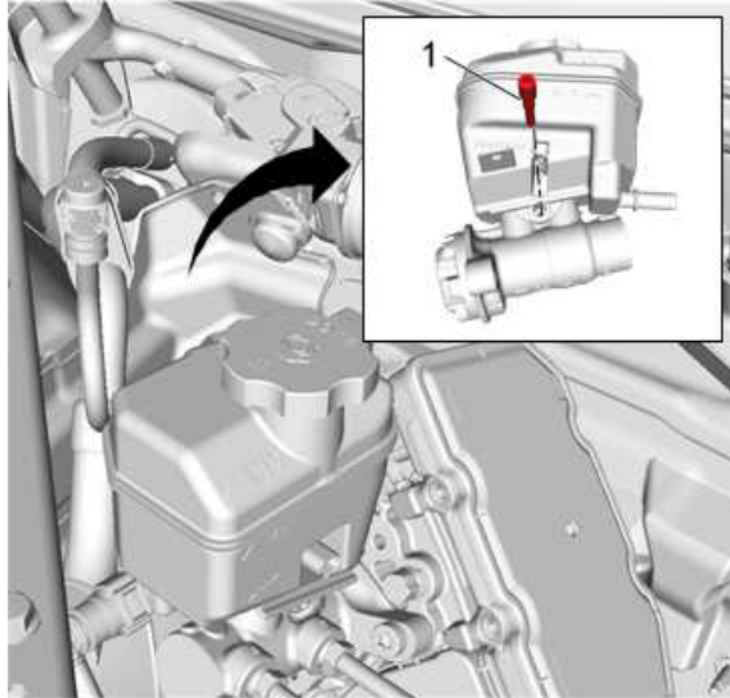


Fig. 20: Brake Master Cylinder Reservoir Bolt
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

5. Brake Pressure Modulator Valve Low Pressure Pipe Quick Connect (1)» Connect

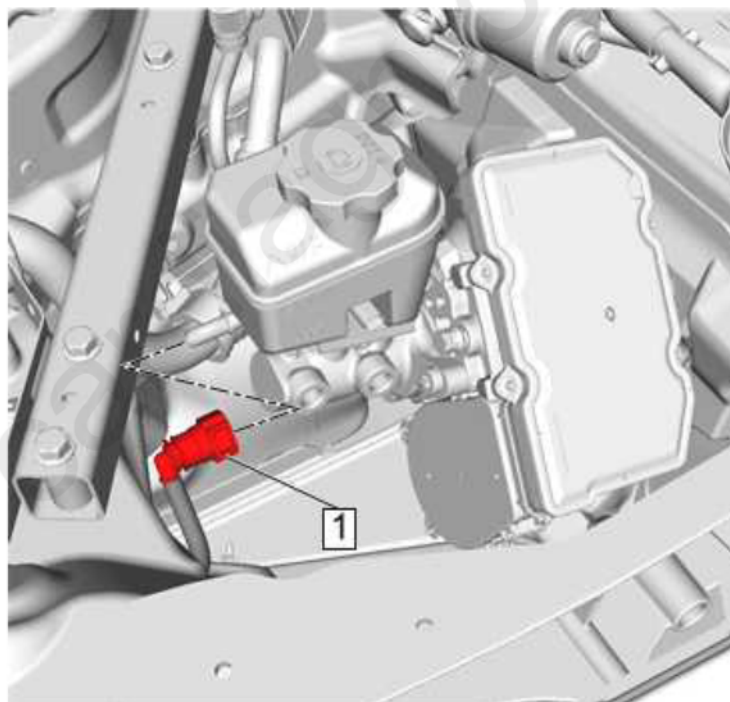


Fig. 21: Brake Pressure Modulator Valve Low Pressure Pipe Quick Connect
Courtesy of GENERAL MOTORS COMPANY

6. Brake Fluid Level Indicator Switch Electrical Connector» Connect
7. Fill the brake master cylinder reservoir. Refer to Master Cylinder Reservoir Filling
8. Air Inlet Grille Panel» Install - Air Inlet Grille Panel Replacement

MASTER CYLINDER REPLACEMENT (WITHOUT HP9)

Removal Procedure

WARNING: Brake Fluid Irritant Warning

CAUTION: Brake Fluid Effects on Paint and Electrical Components Caution

1. Place the ignition switch in the OFF position.
2. Apply and release the brake pedal several times until the brake pedal becomes firm to deplete the power brake booster vacuum reserve.
3. Air Inlet Grille Panel» Remove - [Air Inlet Grille Panel Replacement](#)
4. Remove and properly dispose of the brake fluid in the master cylinder reservoir.
5. Brake Fluid Level Indicator Switch Electrical Connector» Disconnect
6. Brake Pressure Modulator Valve Secondary Brake Pipe Fitting (1)» Disconnect

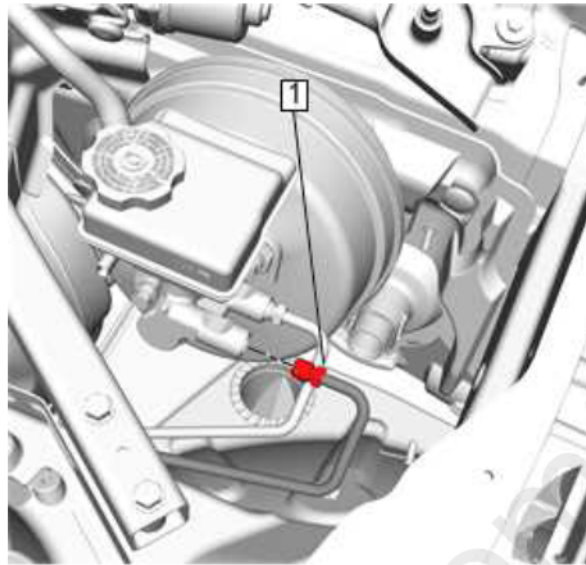


Fig. 22: Brake Pressure Modulator Valve Secondary Brake Pipe Fitting
 Courtesy of GENERAL MOTORS COMPANY

7. Cap the brake pipe fitting to prevent brake fluid loss and contamination.
8. Brake Pressure Modulator Valve Primary Brake Pipe Fitting (1)» Disconnect

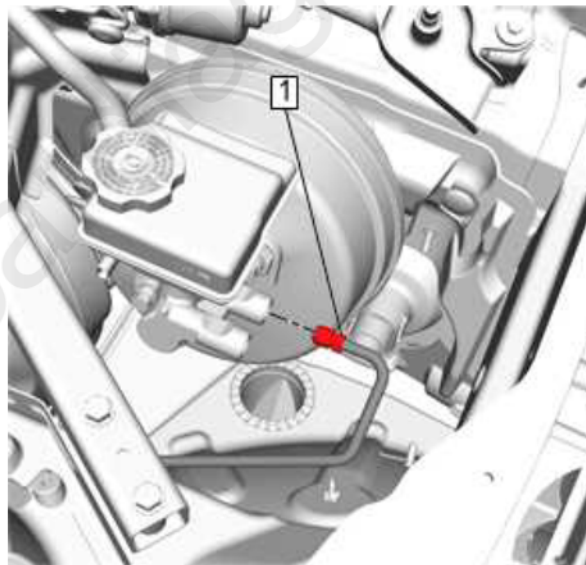


Fig. 23: Brake Pressure Modulator Valve Primary Brake Pipe Fitting
 Courtesy of GENERAL MOTORS COMPANY

9. Cap the brake pipe fitting to prevent brake fluid loss and contamination.
10. Brake Master Cylinder Nut (1)» Remove [2x]

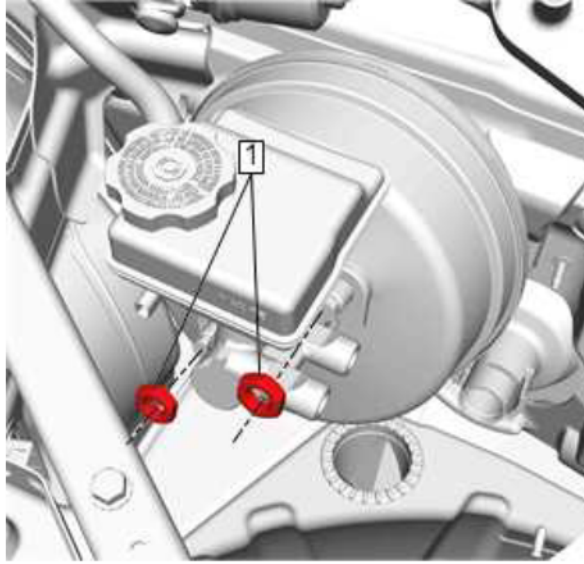


Fig. 24: Brake Master Cylinder Nut
 Courtesy of GENERAL MOTORS COMPANY

11. Brake Master Cylinder (1) » Remove

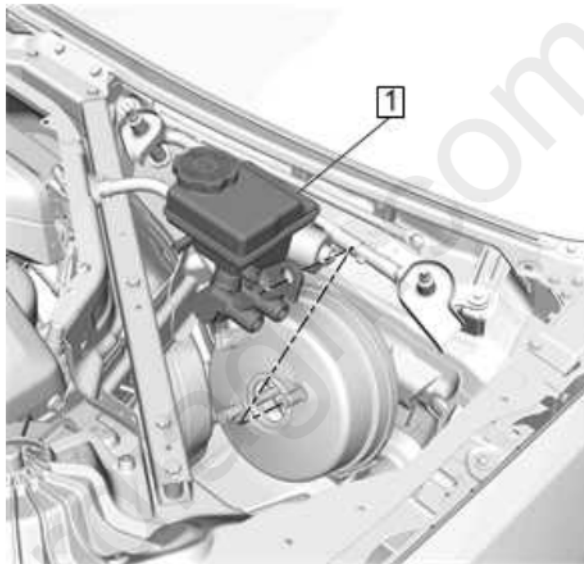


Fig. 25: Brake Master Cylinder
 Courtesy of GENERAL MOTORS COMPANY

12. Brake Master Cylinder Reservoir Bolt (1) » Remove

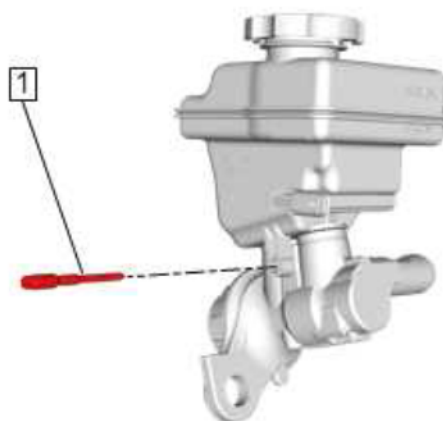


Fig. 26: Brake Master Cylinder Reservoir Bolt
 Courtesy of GENERAL MOTORS COMPANY

13. Brake Master Cylinder Reservoir (1)» Remove



Fig. 27: Brake Master Cylinder Reservoir
Courtesy of GENERAL MOTORS COMPANY

14. Brake Master Cylinder Reservoir Seal (1)» Remove [2x]



Fig. 28: Brake Master Cylinder Reservoir Seal
Courtesy of GENERAL MOTORS COMPANY

Installation Procedure

1. Lightly lubricate the master cylinder reservoir seals with GM approved brake fluid from a clean, sealed brake fluid container. Refer to **Adhesives, Fluids, Lubricants and Sealers**
2. Brake Master Cylinder Reservoir Seal (1)» Install [2x]



Fig. 29: Brake Master Cylinder Reservoir Seal
 Courtesy of GENERAL MOTORS COMPANY

3. Brake Master Cylinder Reservoir (1)» Install



Fig. 30: Brake Master Cylinder Reservoir
 Courtesy of GENERAL MOTORS COMPANY

4. Brake Master Cylinder Reservoir Bolt (1)» Install and tighten 8 N.m (71 lb in)

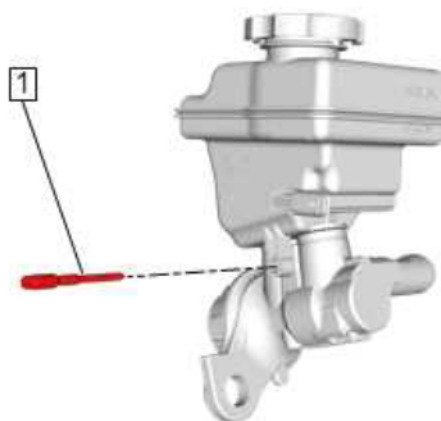


Fig. 31: Brake Master Cylinder Reservoir Bolt
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

5. Bench bleed the brake master cylinder. Refer to [Master Cylinder Bench Bleeding](#)
6. Brake Master Cylinder (1)» Install

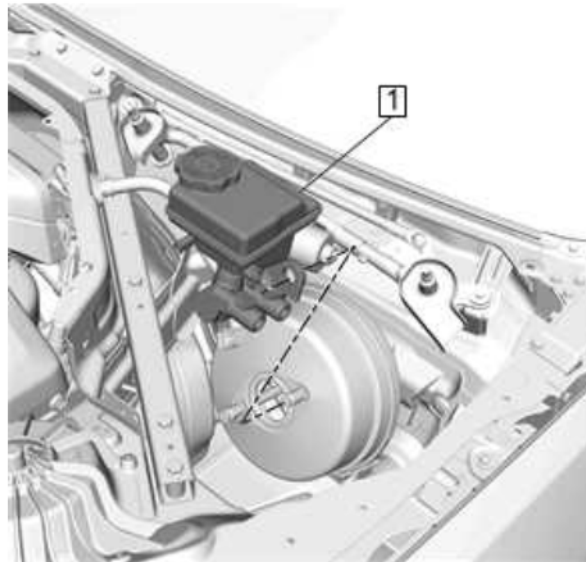


Fig. 32: Brake Master Cylinder
Courtesy of GENERAL MOTORS COMPANY

7. Brake Master Cylinder Nut (1)» Install and tighten [2x] 22 N.m (16 lb ft)

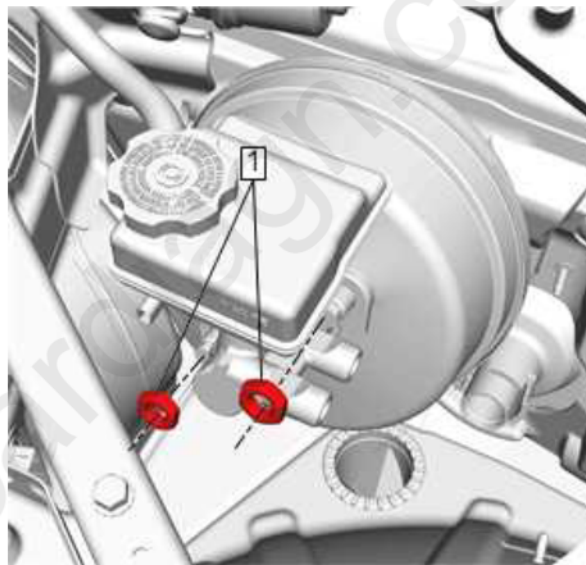


Fig. 33: Brake Master Cylinder Nut
Courtesy of GENERAL MOTORS COMPANY

8. Brake Pressure Modulator Valve Primary Brake Pipe Fitting (1)» Install and tighten 32 N.m (24 lb ft)

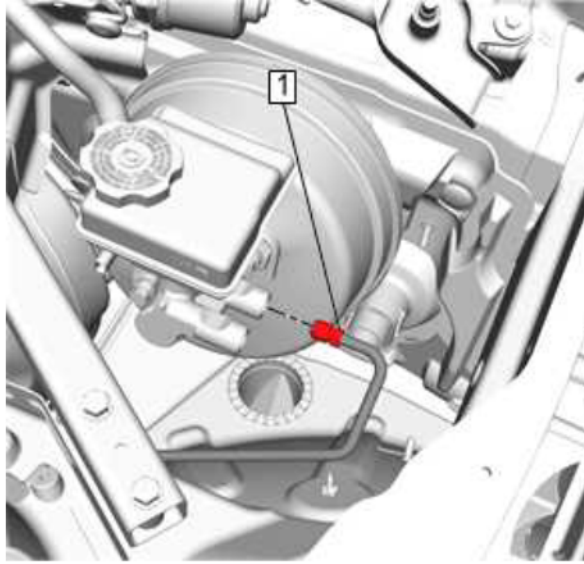


Fig. 34: Brake Pressure Modulator Valve Primary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

9. Brake Pressure Modulator Valve Secondary Brake Pipe Fitting (1)» Install and tighten 32 N.m (24 lb ft)

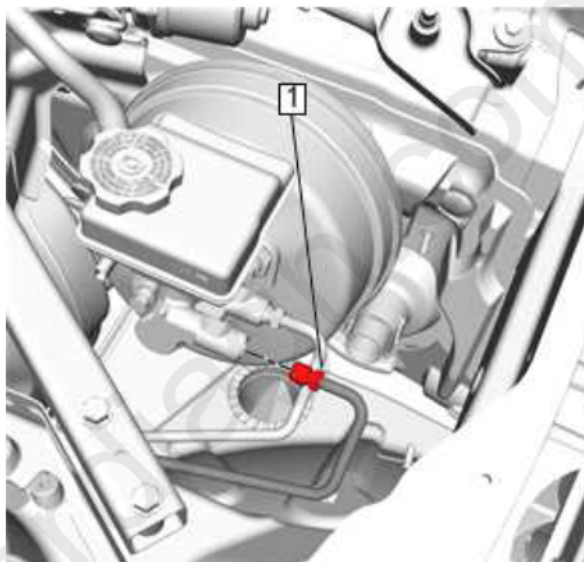


Fig. 35: Brake Pressure Modulator Valve Secondary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

10. Brake Fluid Level Indicator Switch Electrical Connector» Connect
11. Bleed the brake system. Refer to [Hydraulic Brake System Bleeding.\(Manual\)](#) and/or [Hydraulic Brake System Bleeding.\(Pressure\)](#)
12. Air Inlet Grille Panel» Install - [Air Inlet Grille Panel Replacement](#)

MASTER CYLINDER REPLACEMENT (WITH HP9)

Removal Procedure

WARNING: [Brake Fluid Irritant Warning](#)

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

CAUTION: If there is no brake fluid in the master cylinder, remove one of the brake booster fuses before applying the brake pedal. Failure to do so may damage the electric brake booster.

1. Place the ignition switch in the OFF position.

2. Remove one of the electronic brake booster control module fuses from the engine compartment fuse block.
3. Air Inlet Grille Panel» Remove - [Air Inlet Grille Panel Replacement](#)
4. Remove and properly dispose of the brake fluid in the master cylinder reservoir.
5. Brake Fluid Level Indicator Switch Electrical Connector» Disconnect
6. Brake Pressure Modulator Valve Secondary Brake Pipe Fitting (1)» Disconnect

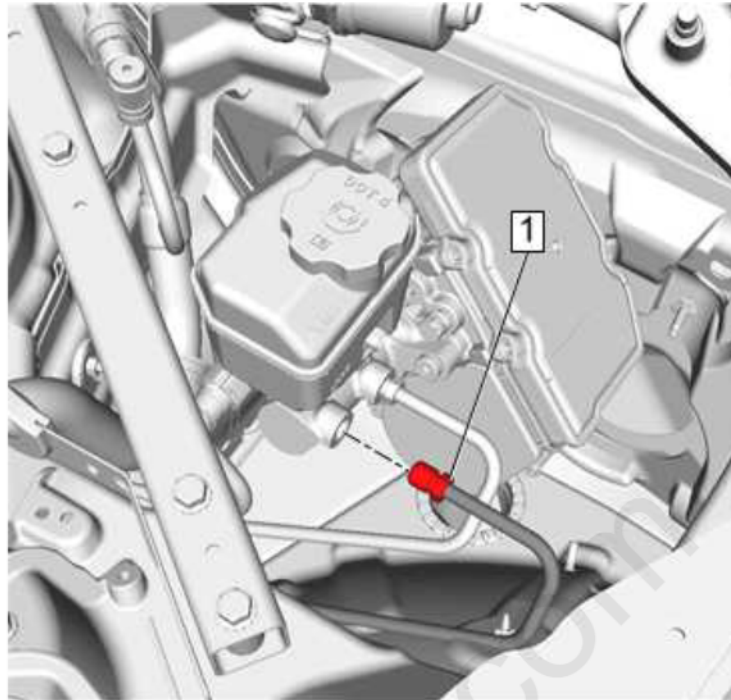


Fig. 36: Brake Pressure Modulator Valve Secondary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

7. Cap the brake pipe fitting to prevent brake fluid loss and contamination.
8. Brake Pressure Modulator Valve Primary Brake Pipe Fitting (1)» Disconnect

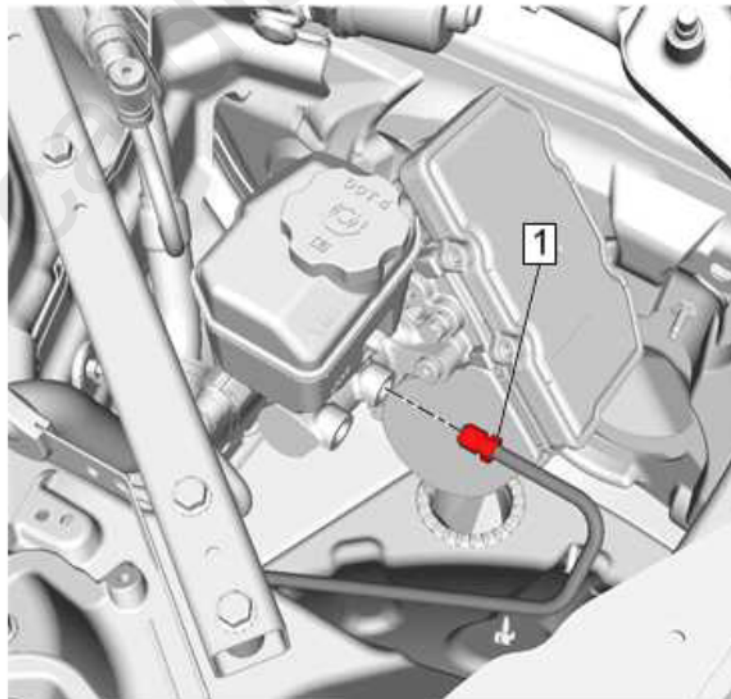


Fig. 37: Brake Pressure Modulator Valve Primary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

9. Cap the brake pipe fitting to prevent brake fluid loss and contamination.
10. Brake Pressure Modulator Valve Low Pressure Pipe Quick Connect (1)» Disconnect

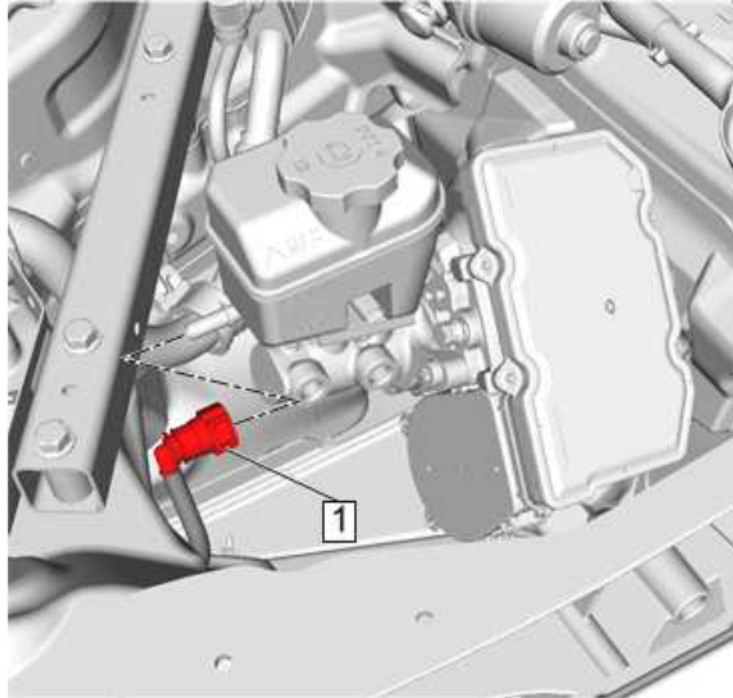


Fig. 38: Brake Pressure Modulator Valve Low Pressure Pipe Quick Connect
Courtesy of GENERAL MOTORS COMPANY

11. Cap the brake pressure modulator valve low pressure pipe to prevent brake fluid loss and contamination.
12. Brake Master Cylinder Bolt (1) » Remove [2x]

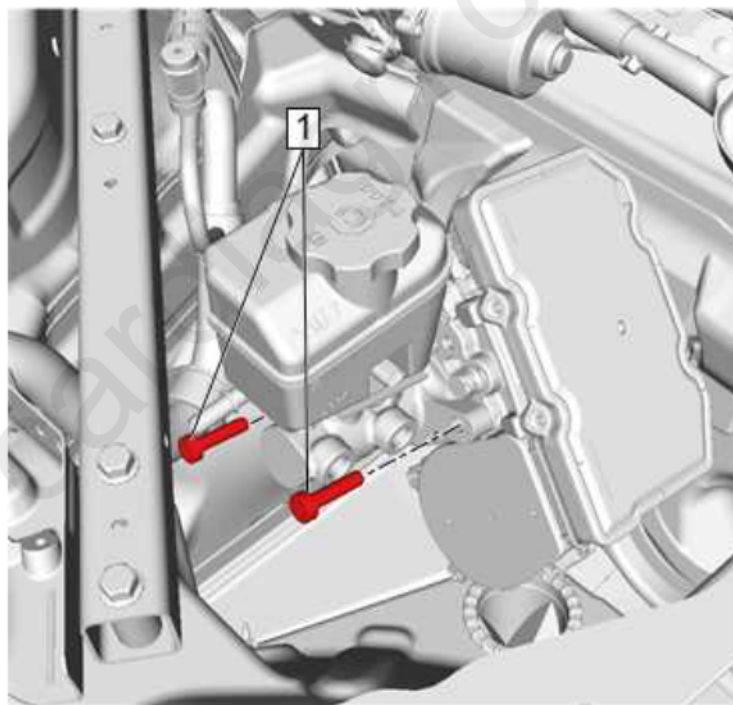


Fig. 39: Brake Master Cylinder Bolts
Courtesy of GENERAL MOTORS COMPANY

13. Brake Master Cylinder (1) » Remove

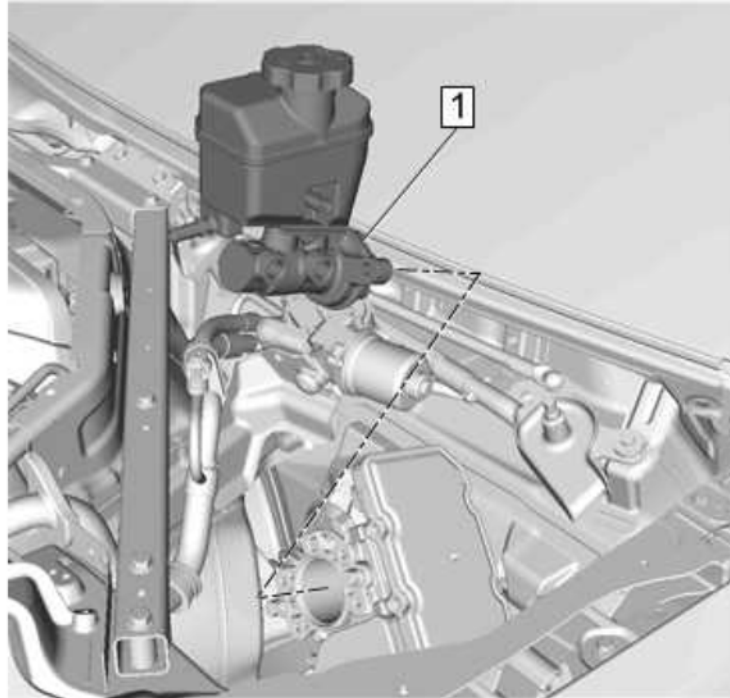


Fig. 40: Brake Master Cylinder

Courtesy of GENERAL MOTORS COMPANY

14. Brake Master Cylinder Reservoir Bolt (1)» Remove

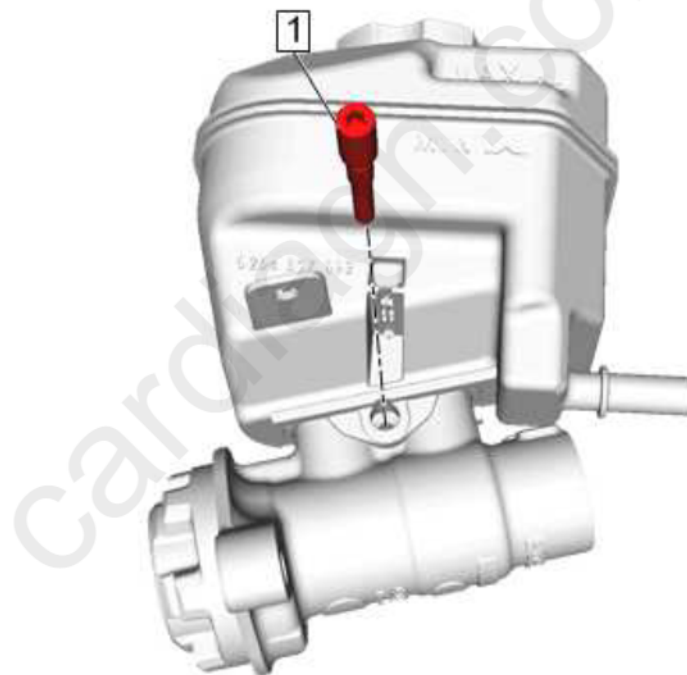


Fig. 41: Brake Master Cylinder Reservoir Bolt

Courtesy of GENERAL MOTORS COMPANY

15. Brake Master Cylinder Reservoir (1)» Remove

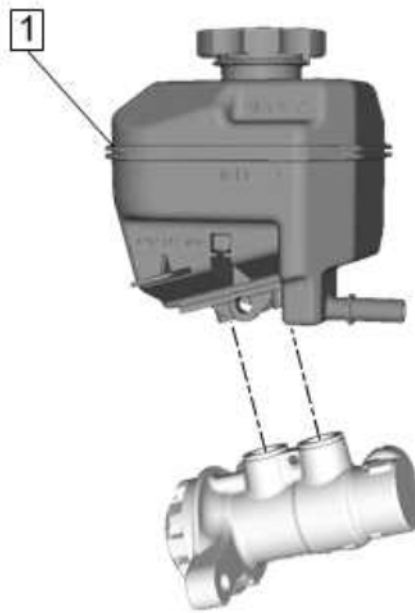


Fig. 42: Brake Master Cylinder Reservoir
Courtesy of GENERAL MOTORS COMPANY

16. Brake Master Cylinder Reservoir Seal (1) » Remove [2x]



Fig. 43: Brake Master Cylinder Reservoir Seals
Courtesy of GENERAL MOTORS COMPANY

Installation Procedure

1. Lightly lubricate the brake master cylinder reservoir seals with GM approved brake fluid from a clean, sealed brake fluid container. Refer to [Adhesives, Fluids, Lubricants and Sealers](#)
2. Brake Master Cylinder Reservoir Seal (1) » Install [2x]



Fig. 44: Brake Master Cylinder Reservoir Seals
 Courtesy of GENERAL MOTORS COMPANY

3. Brake Master Cylinder Reservoir (1)» Install

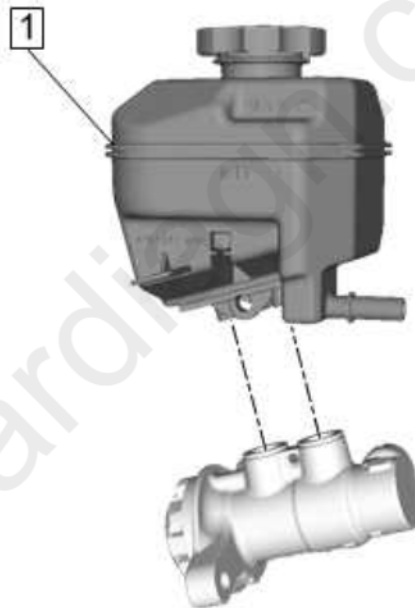


Fig. 45: Brake Master Cylinder Reservoir
 Courtesy of GENERAL MOTORS COMPANY

4. Brake Master Cylinder Reservoir Bolt (1)» Install and tighten 8 N.m (71 lb in)

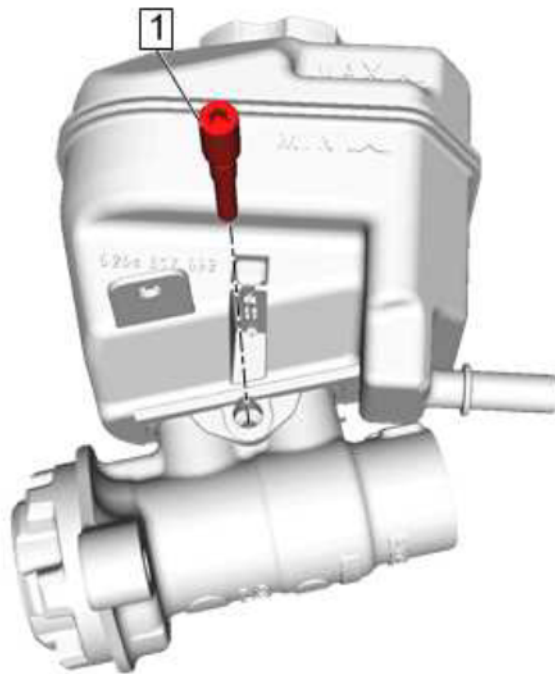


Fig. 46: Brake Master Cylinder Reservoir Bolt
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

5. Bench bleed the brake master cylinder. Refer to Master Cylinder Bench Bleeding
6. Brake Master Cylinder (1)» Install

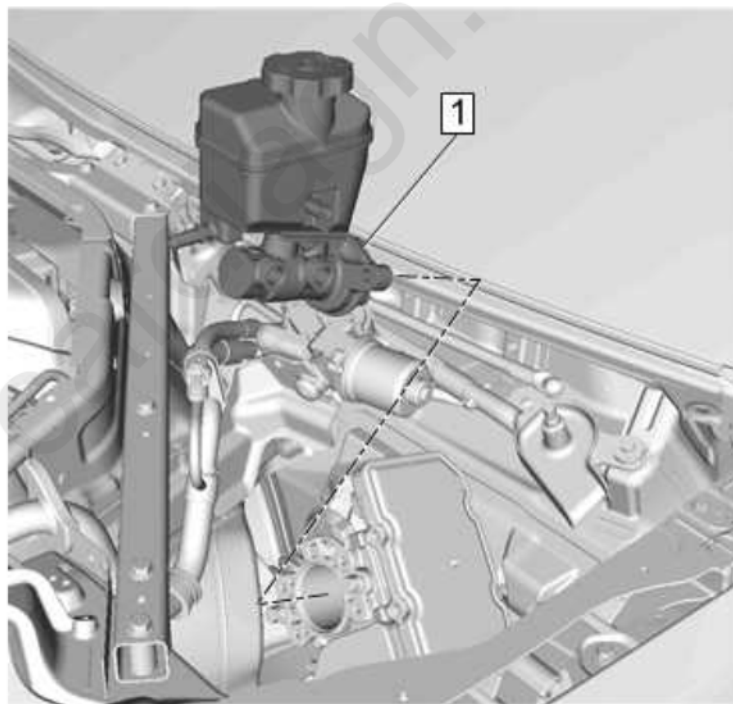


Fig. 47: Brake Master Cylinder
 Courtesy of GENERAL MOTORS COMPANY

7. Brake Master Cylinder Bolt (1)» Install and tighten [2x] 22 N.m (16 lb ft)

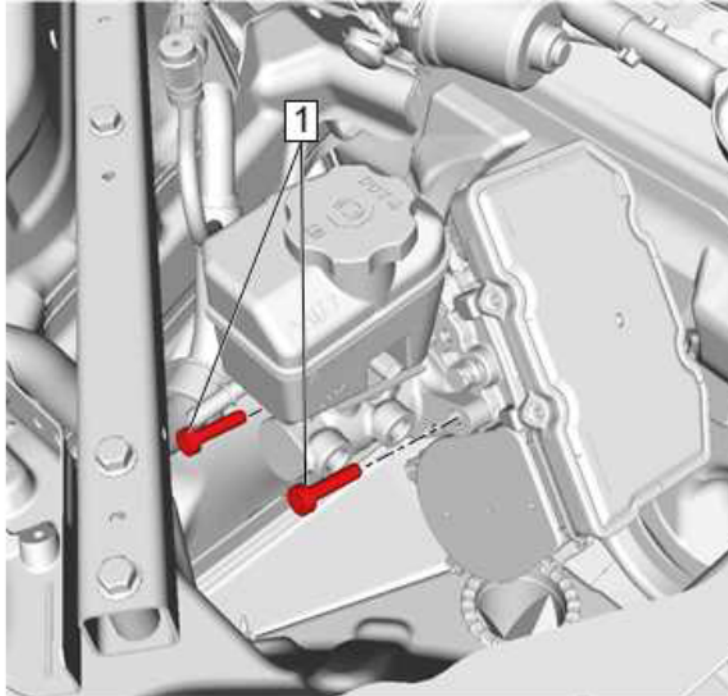


Fig. 48: Brake Master Cylinder Bolts

Courtesy of GENERAL MOTORS COMPANY

8. Brake Pressure Modulator Valve Low Pressure Pipe Quick Connect (1)» Connect

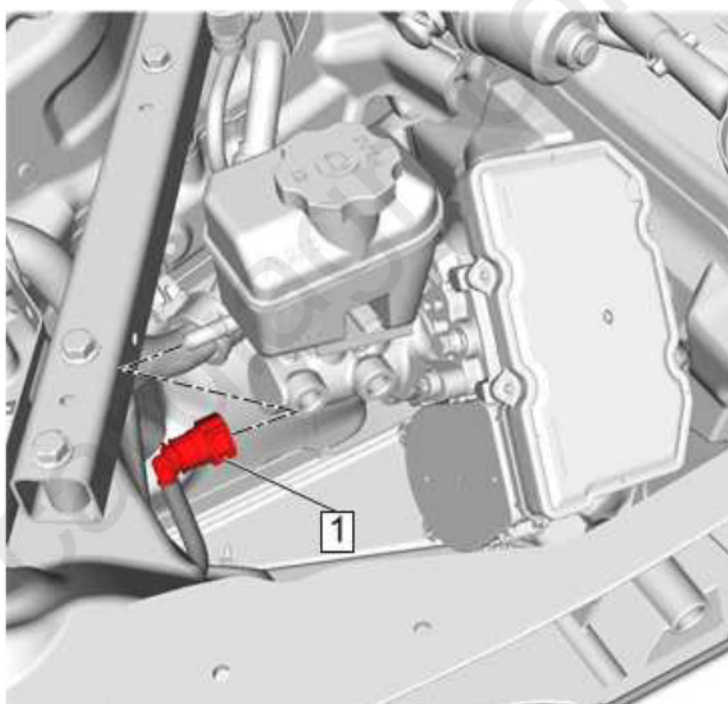


Fig. 49: Brake Pressure Modulator Valve Low Pressure Pipe Quick Connect

Courtesy of GENERAL MOTORS COMPANY

9. Brake Pressure Modulator Valve Primary Brake Pipe Fitting (1)» Install and tighten 32 N.m (24 lb ft)

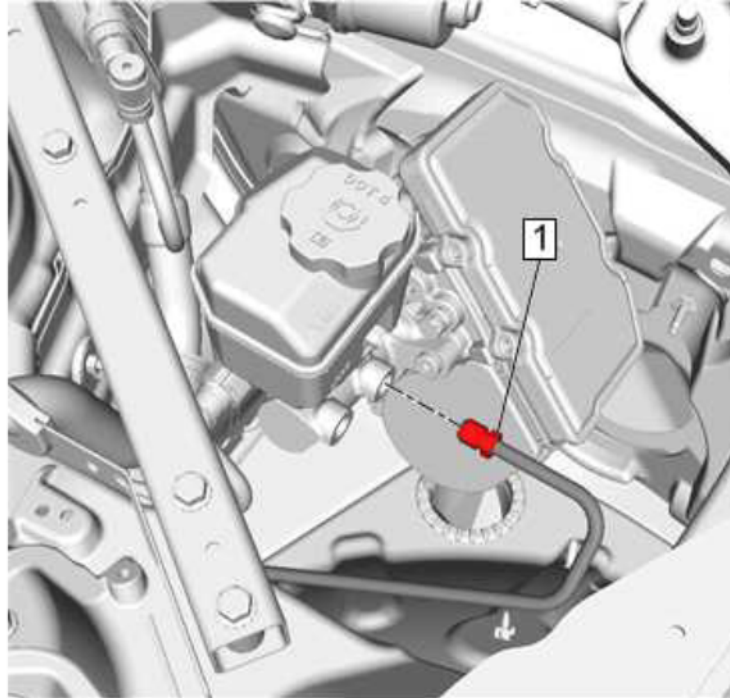


Fig. 50: Brake Pressure Modulator Valve Primary Brake Pipe Fitting
 Courtesy of GENERAL MOTORS COMPANY

10. Brake Pressure Modulator Valve Secondary Brake Pipe Fitting (1)» Install and tighten 32 N.m (24 lb ft)

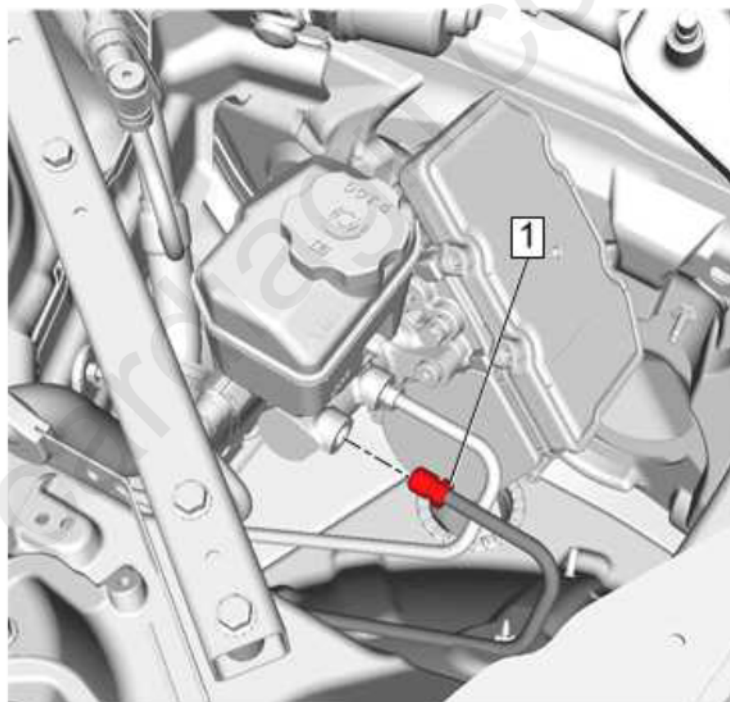


Fig. 51: Brake Pressure Modulator Valve Secondary Brake Pipe Fitting
 Courtesy of GENERAL MOTORS COMPANY

11. Brake Fluid Level Indicator Switch Electrical Connector» Connect
12. Install the electronic brake booster control module fuse to the engine compartment fuse block.
13. Bleed the brake system. Refer to [Hydraulic Brake System Bleeding \(Manual\)](#) and/or [Hydraulic Brake System Bleeding \(Pressure\)](#)
14. Air Inlet Grille Panel» Install - [Air Inlet Grille Panel Replacement](#)

MASTER CYLINDER BENCH BLEEDING

1. Secure the mounting flange of the brake master cylinder in a bench vise so that the rear of the primary piston is accessible.

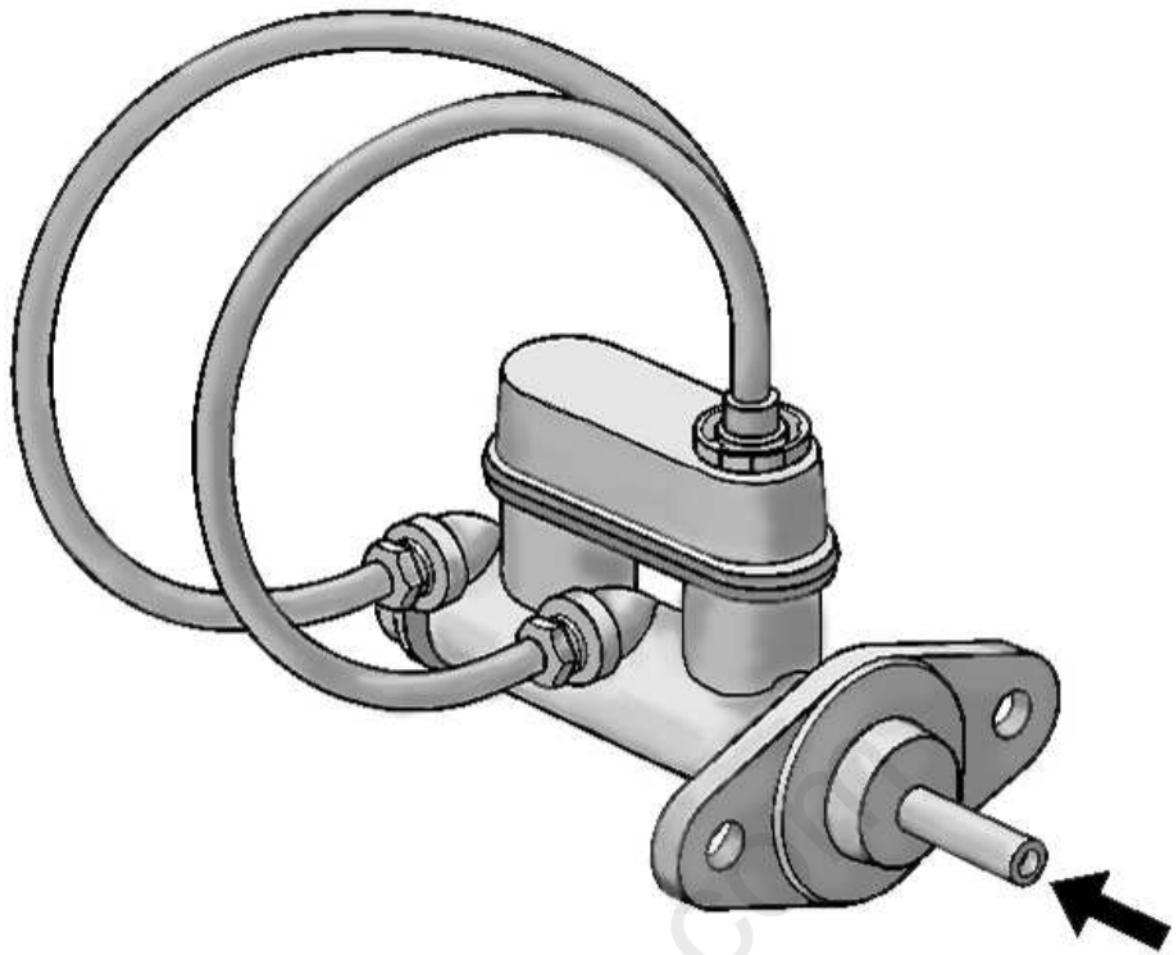


Fig. 52: Bleeding Master Cylinder
Courtesy of GENERAL MOTORS COMPANY

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

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

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 (WITHOUT HP9)

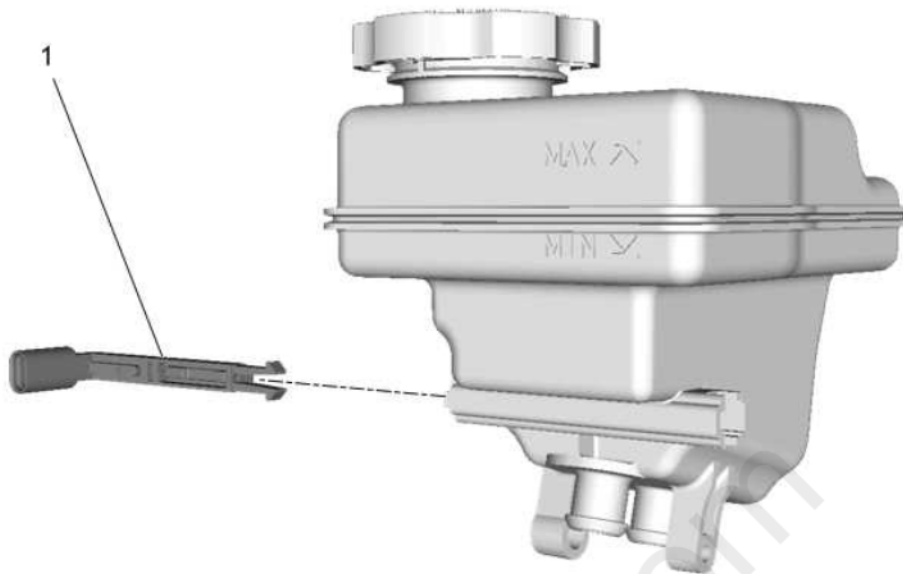


Fig. 53: Brake Fluid Level Indicator Switch

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Master Cylinder Reservoir Replacement (Without HP9)</u>	
1	Brake Fluid Level Indicator Switch Compress the locking tabs to release the switch from the master cylinder reservoir.

BRAKE FLUID LEVEL INDICATOR SWITCH REPLACEMENT (WITH HP9)

Removal Procedure

1. Place the ignition switch in the OFF position.
2. Air Inlet Grille Panel» Remove - **Air Inlet Grille Panel Replacement**
3. Brake Fluid Level Indicator Switch Electrical Connector» Disconnect
4. Brake Fluid Level Indicator Switch (1)» Remove

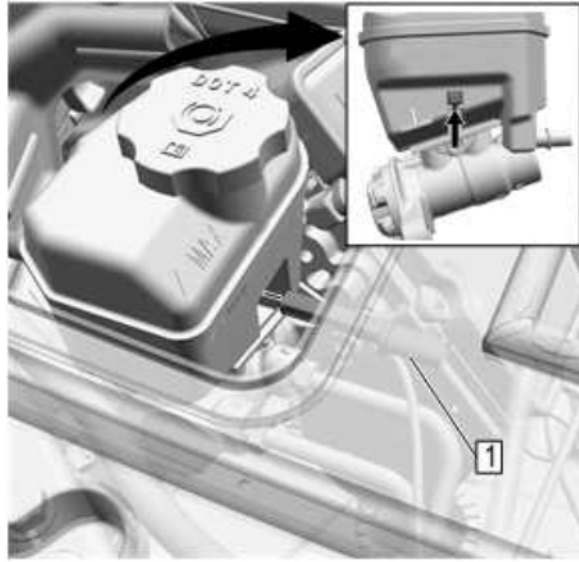


Fig. 54: Brake Fluid Level Indicator Switch

Courtesy of GENERAL MOTORS COMPANY

5. Using a small, pointed tool, press upward on the underside of the brake fluid level indicator switch opposite the electrical connection.

Installation Procedure

1. Brake Fluid Level Indicator Switch (1) » Install

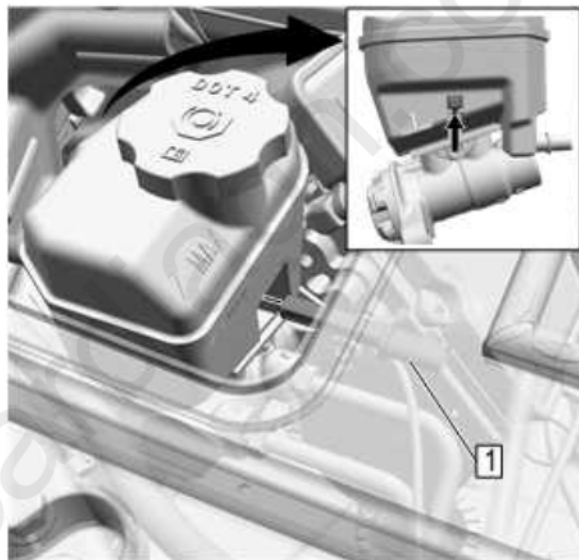


Fig. 55: Brake Fluid Level Indicator Switch

Courtesy of GENERAL MOTORS COMPANY

2. Brake Fluid Level Indicator Switch Electrical Connector » Connect
3. Air Inlet Grille Panel » Install - **Air Inlet Grille Panel Replacement**

BRAKE PEDAL ASSEMBLY REPLACEMENT (WITHOUT HP9)

Removal Procedure

1. Place the ignition switch in the OFF position.
2. **Brake Pedal Position Sensor Replacement** » Remove
3. Brake Pedal Retainer (1) @ Brake Pedal (2) » Release

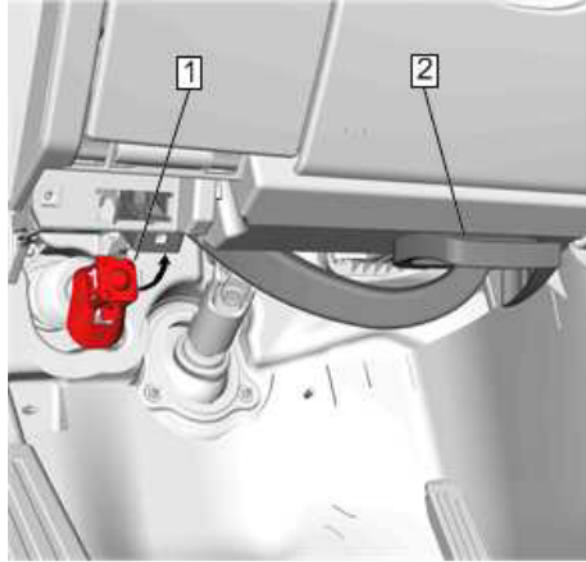


Fig. 56: Brake Pedal Retainer

Courtesy of GENERAL MOTORS COMPANY

4. Brake Pedal Retainer» Remove and DISCARD
5. Brake Pedal Bolt» Remove [2x]

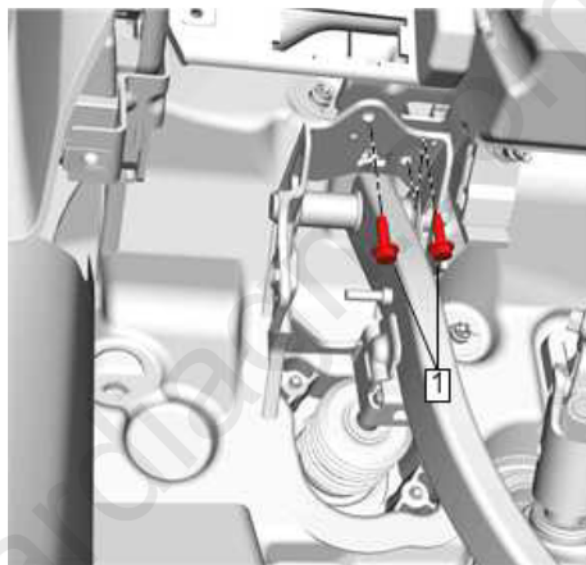
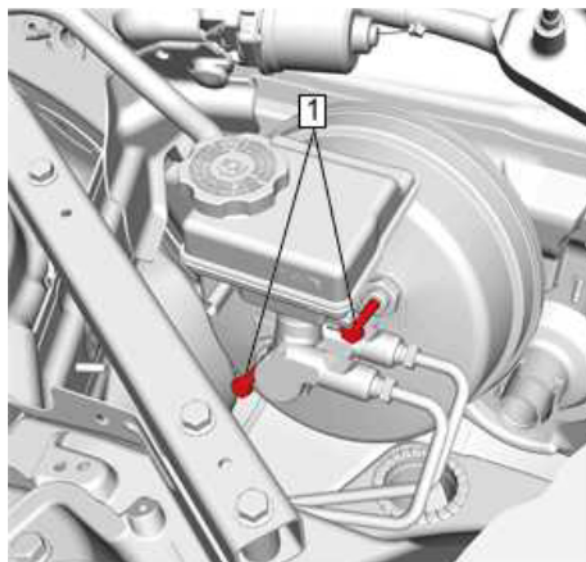


Fig. 57: Brake Pedal Bolt

Courtesy of GENERAL MOTORS COMPANY

6. **Air Inlet Grille Panel Replacement** » Remove
7. Power Vacuum Brake Booster Bolt (1)» Loosen [2x]



8. Brake Pedal Assembly (1) » Remove

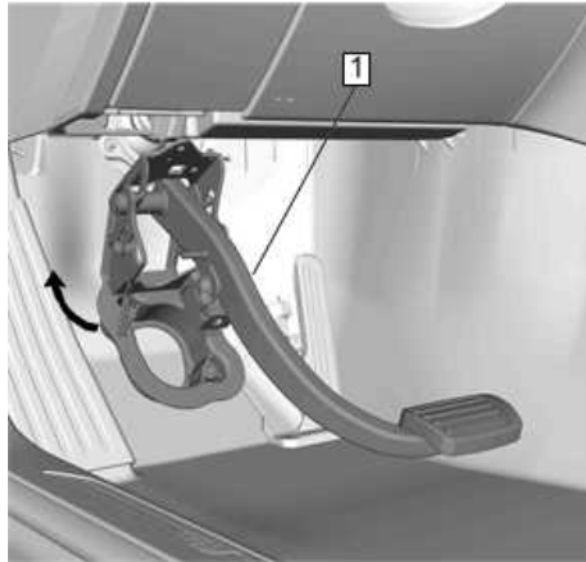


Fig. 59: Brake Pedal Assembly
Courtesy of GENERAL MOTORS COMPANY

Installation Procedure

1. Brake Pedal Assembly (1) » Install

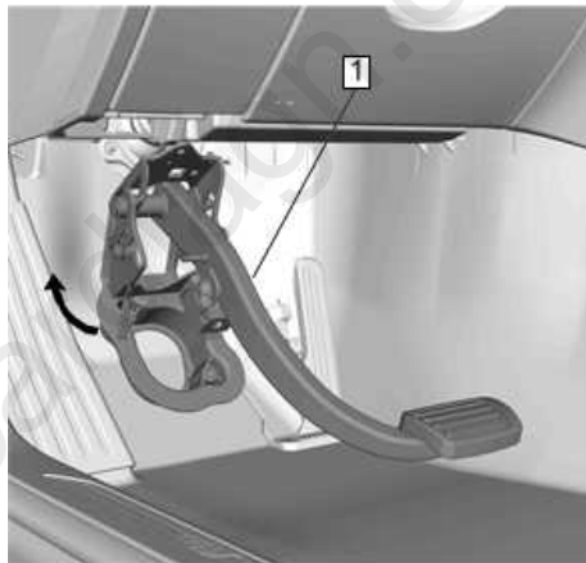


Fig. 60: Brake Pedal Assembly
Courtesy of GENERAL MOTORS COMPANY

2. Brake Pedal Bolt » Install and tighten 10 N.m (89 lb in)

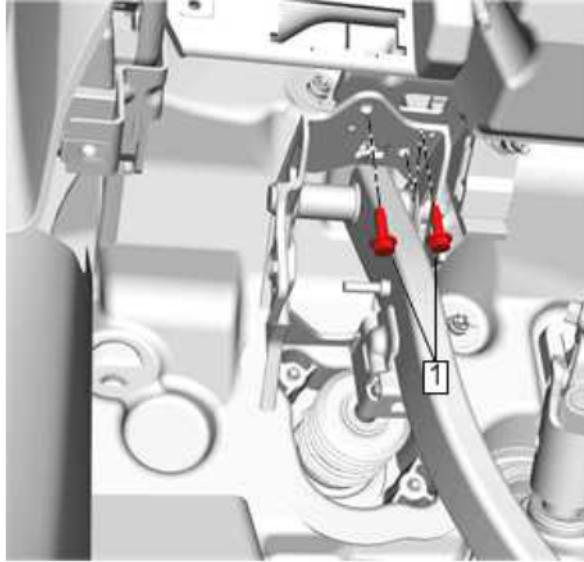


Fig. 61: Brake Pedal Bolt

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

3. Power Vacuum Brake Booster Bolt (1)» Install and tighten 22 N.m (16 lb ft) [2x]

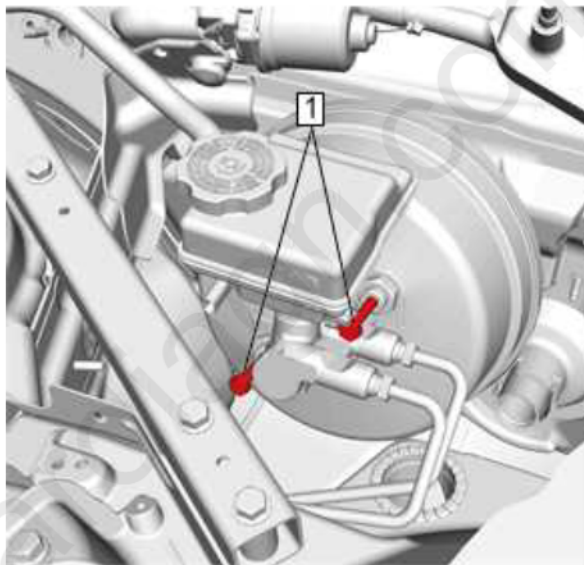


Fig. 62: Power Vacuum Brake Booster Bolt

Courtesy of GENERAL MOTORS COMPANY

4. Air Inlet Grille Panel Replacement » Install
5. Brake Pedal Retainer (1) @ Brake Pedal (2)» Secure

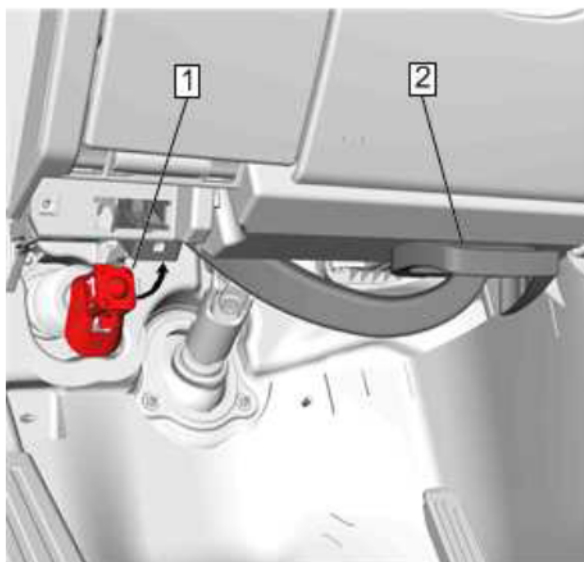


Fig. 63: Brake Pedal Retainer

Courtesy of GENERAL MOTORS COMPANY

NOTE: Install a NEW brake pedal retainer.

6. **Brake Pedal Position Sensor Replacement** » Install

BRAKE PEDAL ASSEMBLY REPLACEMENT (WITH HP9)

Removal Procedure

1. Place the ignition switch in the OFF position.
2. Brake Pedal Position Sensor » Remove - **Brake Pedal Position Sensor Replacement**
3. Brake Pedal Retainer (1) @ Brake Pedal (2) » Release

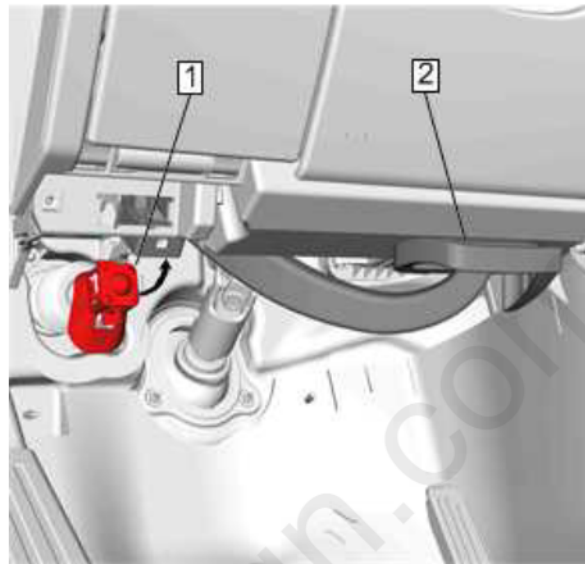


Fig. 64: Brake Pedal Retainer

Courtesy of GENERAL MOTORS COMPANY

4. Brake Pedal Retainer » Remove and DISCARD
5. Brake Pedal Bolt » Remove [2x]

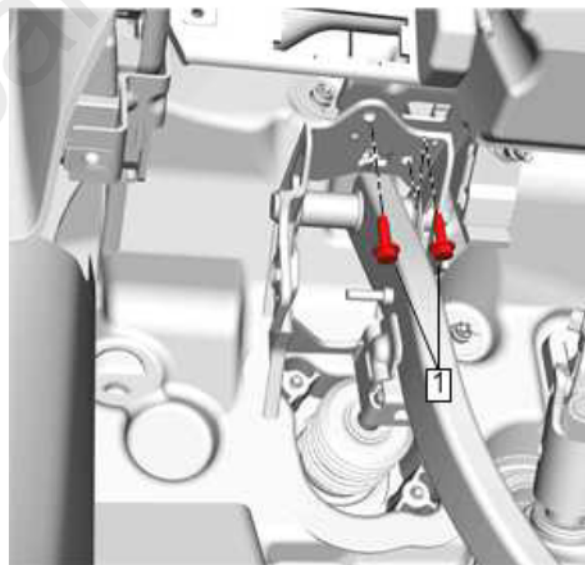


Fig. 65: Brake Pedal Bolt

Courtesy of GENERAL MOTORS COMPANY

6. Air Inlet Grille Panel » Remove - **Air Inlet Grille Panel Replacement**
7. Support the electronic brake booster control module with heavy mechanics wire.
8. Electronic Brake Booster Control Module Bolt (1) » Loosen [2x]

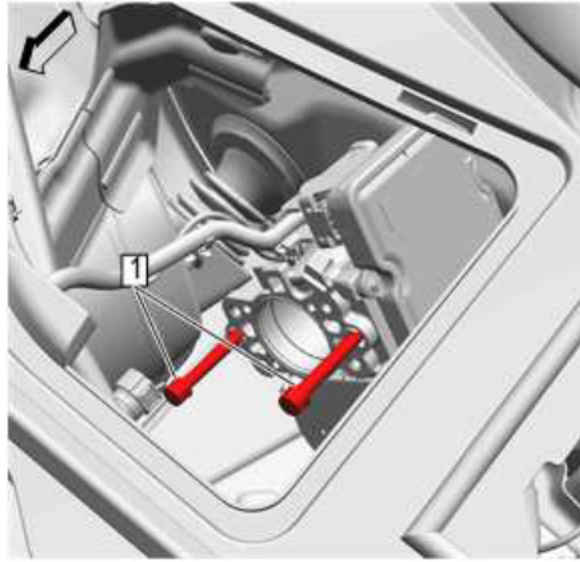


Fig. 66: Electronic Brake Booster Control Module Bolts
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Master cylinder not shown for clarity.

9. Brake Pedal Assembly (1) » Remove

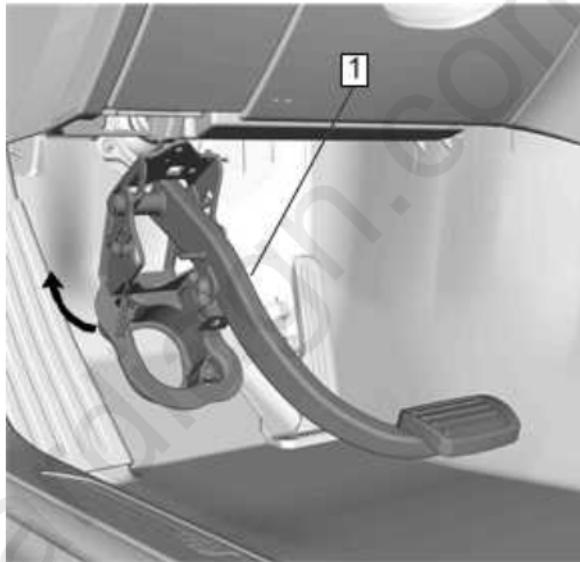


Fig. 67: Brake Pedal Assembly
 Courtesy of GENERAL MOTORS COMPANY

Installation Procedure

1. Brake Pedal Assembly (1) » Install

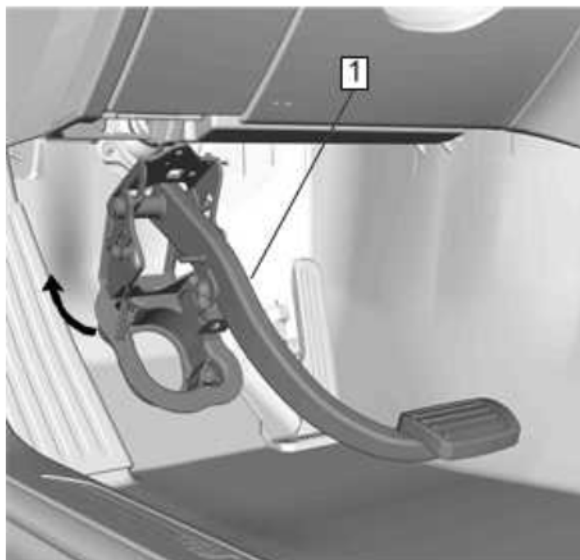


Fig. 68: Brake Pedal Assembly

Courtesy of GENERAL MOTORS COMPANY

2. Brake Pedal Bolt» Install and tighten [2x] 10 N.m (89 lb in)

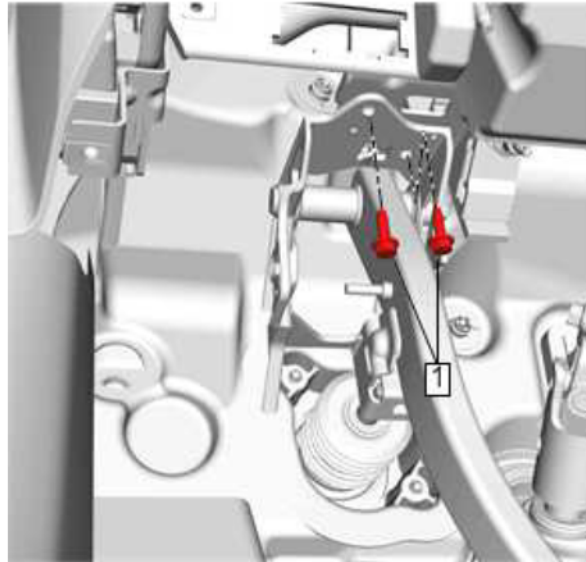


Fig. 69: Brake Pedal Bolt

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

3. Electronic Brake Booster Control Module Bolt (1)» Install and tighten [2x] 22 N.m (16 lb ft)

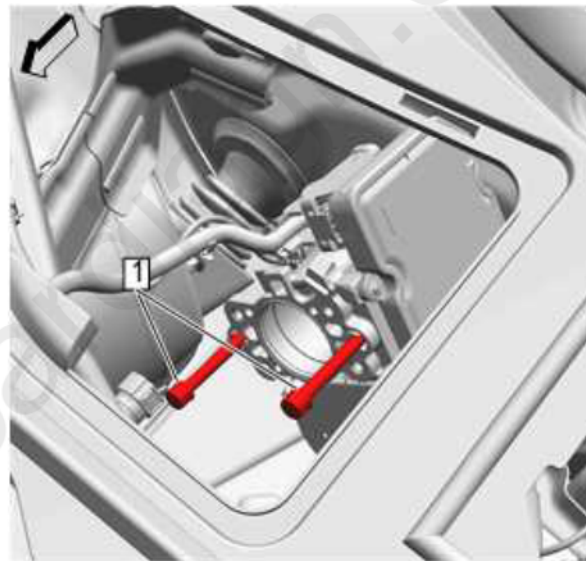


Fig. 70: Electronic Brake Booster Control Module Bolts

Courtesy of GENERAL MOTORS COMPANY

4. Remove the mechanics wire from the electronic brake booster control module.
5. Air Inlet Grille Panel» Install - [Air Inlet Grille Panel Replacement](#)
6. Brake Pedal Retainer (1)» Install NEW

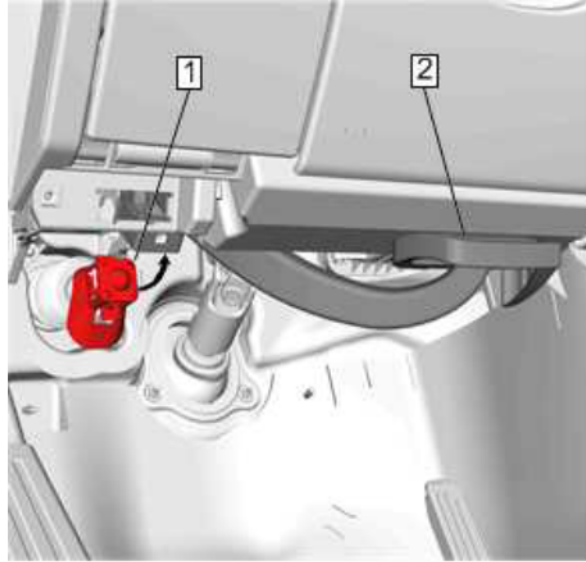


Fig. 71: Brake Pedal Retainer

Courtesy of GENERAL MOTORS COMPANY

7. Brake Pedal (2)» Secure

8. Brake Pedal Position Sensor» Install - [Brake Pedal Position Sensor Replacement](#)

BRAKE PRESSURE MODULATOR VALVE PIPE REPLACEMENT (LTG WITHOUT HP9)

Removal Procedure

WARNING: [Brake Fluid Irritant Warning](#)

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

1. Air Inlet Grille Panel» Remove - [Air Inlet Grille Panel Replacement](#)

2. Brake Pressure Modulator Valve Secondary Brake Pipe Fitting (1)» Disconnect

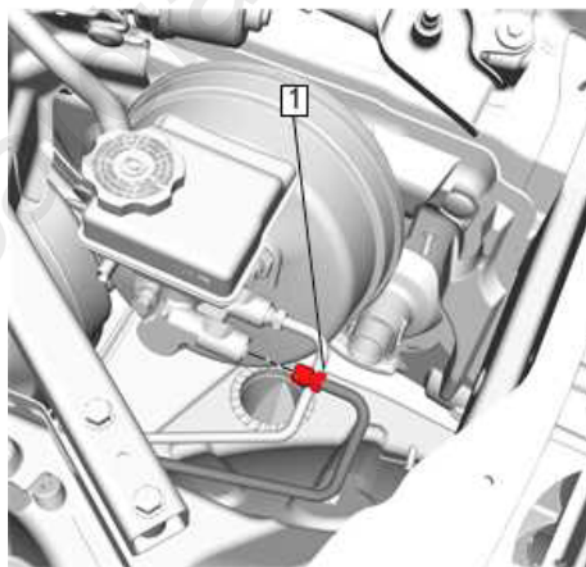


Fig. 72: Brake Pressure Modulator Valve Secondary Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

3. Plug the master cylinder outlet port to prevent brake fluid loss and contamination.

4. Brake Pressure Modulator Valve Primary Brake Pipe Fitting (1)» Disconnect

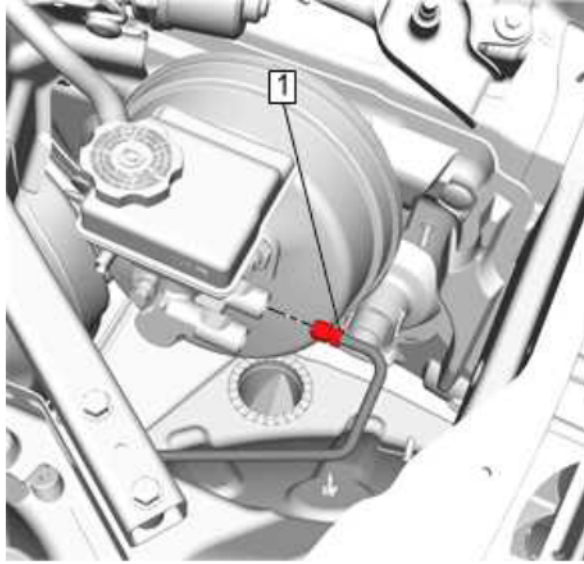


Fig. 73: Brake Pressure Modulator Valve Primary Brake Pipe Fitting
 Courtesy of GENERAL MOTORS COMPANY

5. Plug the master cylinder outlet port to prevent brake fluid loss and contamination.
6. Engine Wiring Harness Fuse Block Bracket» Remove - **Engine Wiring Harness Fuse Block Bracket Replacement**
7. Without separating the engine from the transmission, remove the powertrain. - **Engine Replacement (Except Hybrid) Engine Replacement (Hybrid)**
8. Brake Pressure Modulator Valve Pipe Pass Through Grommet (1)» Release

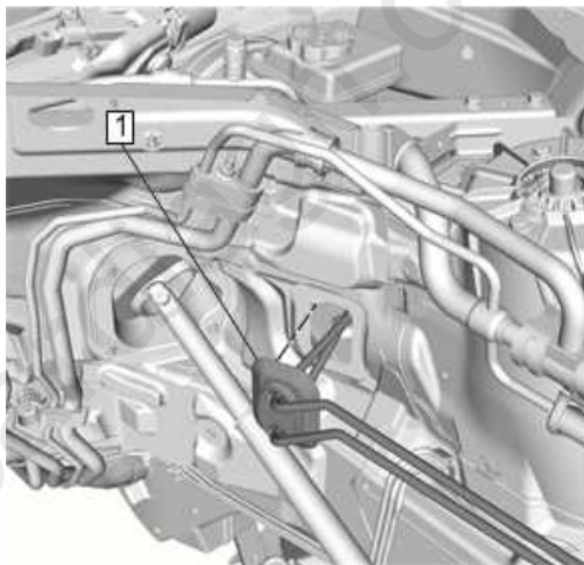


Fig. 74: Brake Pressure Modulator Valve Pipe
 Courtesy of GENERAL MOTORS COMPANY

9. Retainer (1)» Release

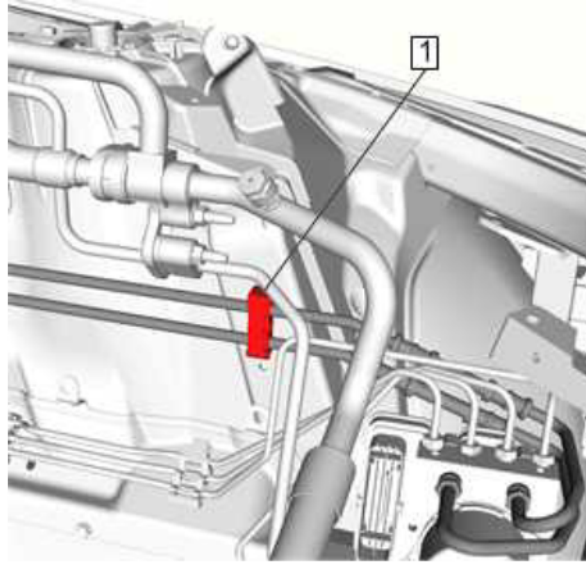


Fig. 75: Retainer

Courtesy of GENERAL MOTORS COMPANY

10. Brake Pressure Modulator Valve Primary Brake Pipe Fitting (1) @ Brake Pressure Modulator Valve» Disconnect

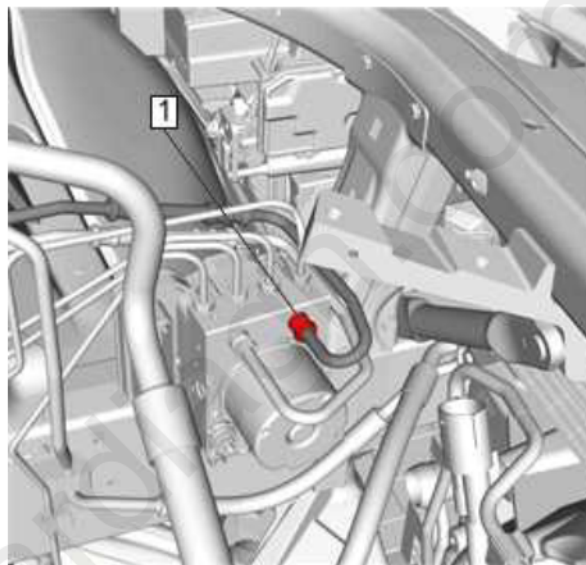


Fig. 76: Brake Pressure Modulator Valve Primary Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

11. Plug the brake pressure modulator valve inlet port to prevent brake fluid loss and contamination.
12. Brake Pressure Modulator Valve Secondary Brake Pipe Fitting (1) @ Brake Pressure Modulator Valve» Disconnect

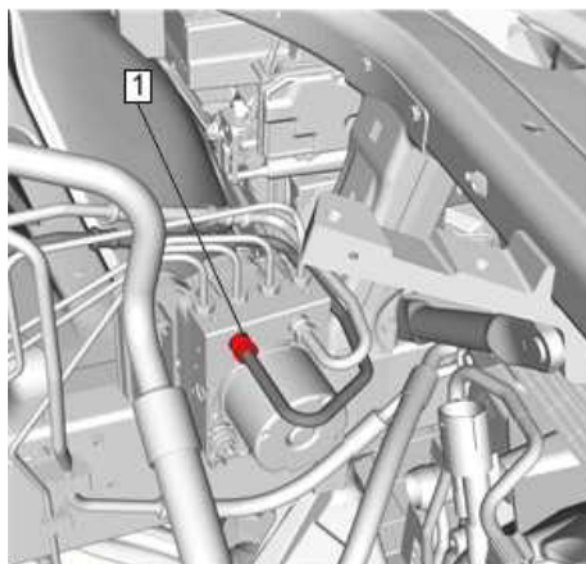


Fig. 77: Brake Pressure Modulator Valve Secondary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

13. Plug the brake pressure modulator valve inlet port to prevent brake fluid loss and contamination.
14. Brake Pressure Modulator Valve Pipe» Remove

Installation Procedure

1. Brake Pressure Modulator Valve Pipe» Install
2. Brake Pressure Modulator Valve Secondary Brake Pipe Fitting (1)» Install, but do NOT tighten

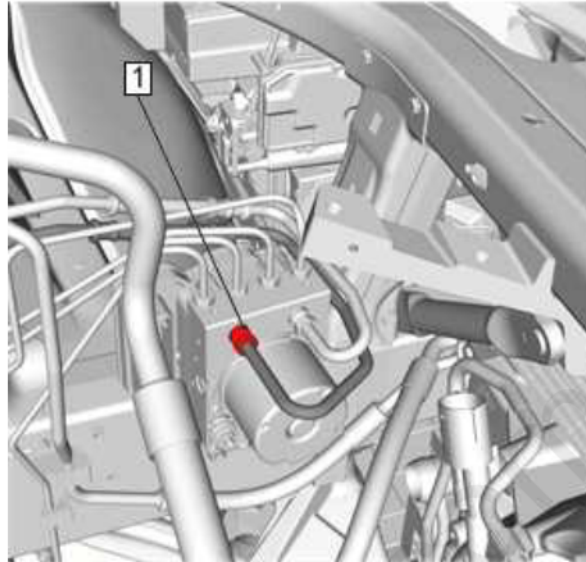


Fig. 78: Brake Pressure Modulator Valve Secondary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT tighten the brake pipe fitting until instructed.

3. Brake Pressure Modulator Valve Primary Brake Pipe Fitting (1)» Install, but do NOT tighten

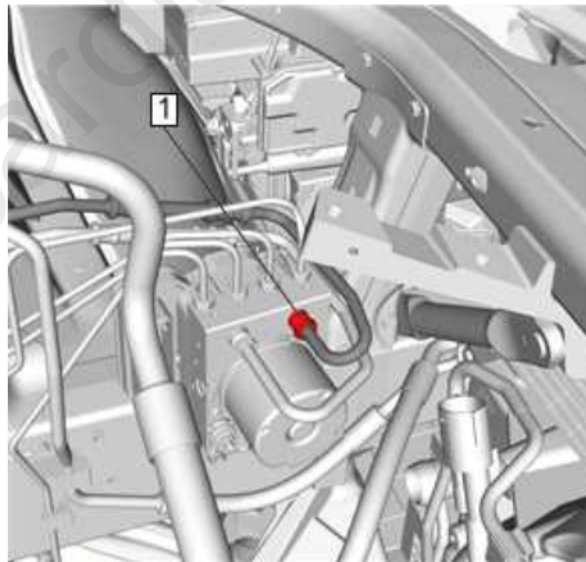


Fig. 79: Brake Pressure Modulator Valve Primary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT tighten the brake pipe fitting until instructed.

4. Retainer (1)» Secure

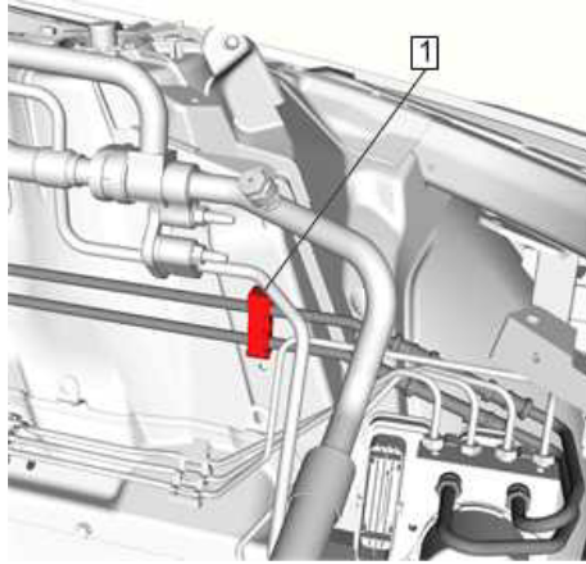


Fig. 80: Retainer

Courtesy of GENERAL MOTORS COMPANY

5. Brake Pressure Modulator Valve Pipe Pass Through Grommet (1)» Secure

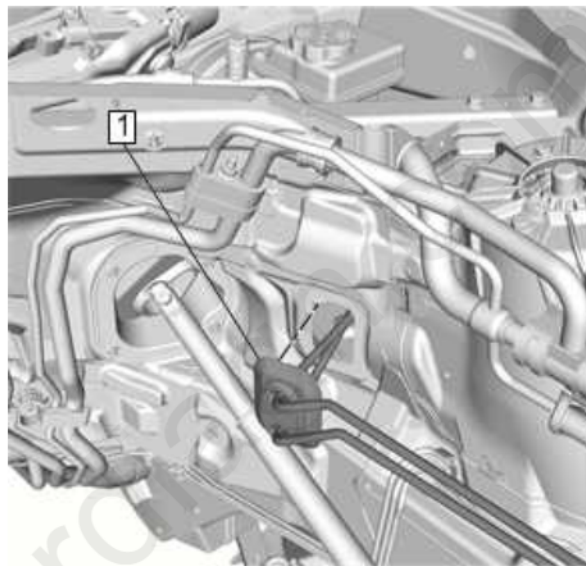
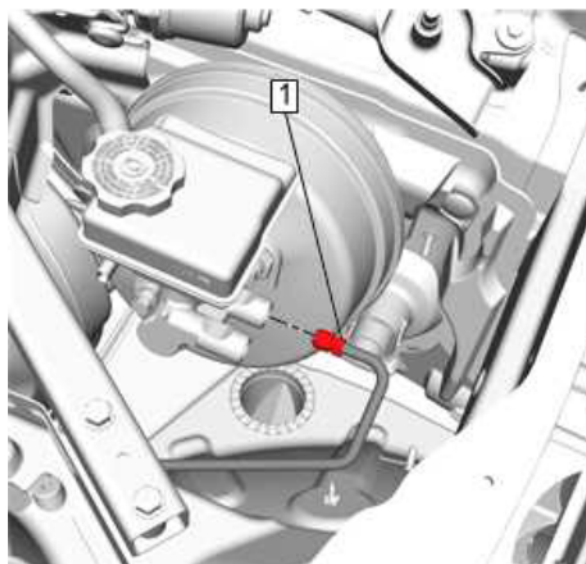


Fig. 81: Brake Pressure Modulator Valve Pipe

Courtesy of GENERAL MOTORS COMPANY

6. Install the powertrain. Refer to [Engine Replacement \(Except Hybrid\)](#) and/or [Engine Replacement \(Hybrid\)](#)
7. Brake Pressure Modulator Valve Primary Brake Pipe Fitting (1)» Install and tighten 32 N.m (24 lb ft)



CAUTION: **Fastener Caution**

8. Brake Pressure Modulator Valve Secondary Brake Pipe Fitting (1) » Install and tighten 32 N.m (24 lb ft)

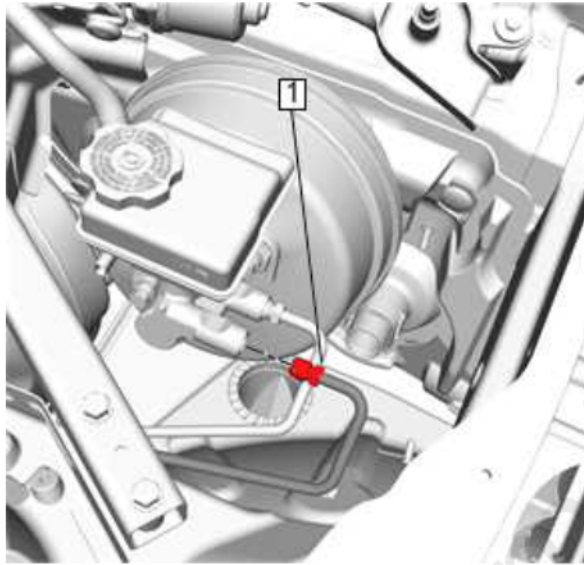


Fig. 83: Brake Pressure Modulator Valve Secondary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

9. Brake Pressure Modulator Valve Secondary Brake Pipe Fitting (1) @ Brake Pressure Modulator Valve » Install and tighten 32 N.m (24 lb ft)

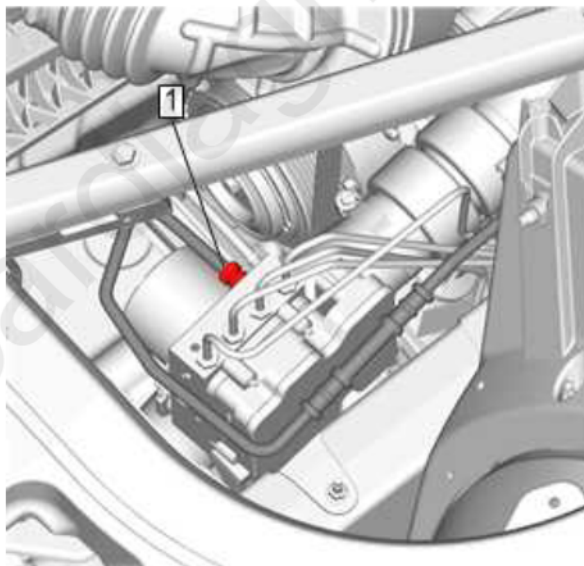


Fig. 84: Brake Pressure Modulator Valve Secondary Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

10. Brake Pressure Modulator Valve Primary Brake Pipe Fitting (1) @ Brake Pressure Modulator Valve » Install and tighten 32 N.m (24 lb ft)

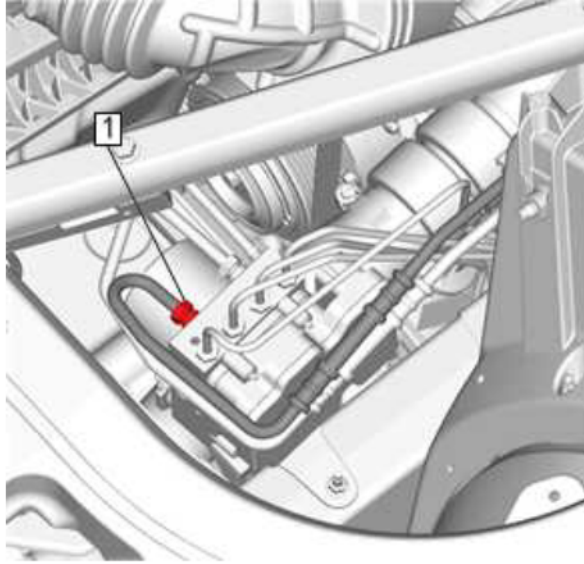


Fig. 85: Brake Pressure Modulator Valve Primary Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

11. Engine Wiring Harness Fuse Block Bracket» Install - [Engine Wiring Harness Fuse Block Bracket Replacement](#)
12. Bleed the brake system. Refer to [Hydraulic Brake System Bleeding \(Manual\)](#) and/or [Hydraulic Brake System Bleeding \(Pressure\)](#)
13. Air Inlet Grille Panel» Install - [Air Inlet Grille Panel Replacement](#)

BRAKE PRESSURE MODULATOR VALVE PIPE REPLACEMENT (LGW, LGX)

Removal Procedure

WARNING: [Brake Fluid Irritant Warning](#)

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

1. Air Inlet Grille Panel» Remove - [Air Inlet Grille Panel Replacement](#)
2. Brake Pressure Modulator Valve Secondary Brake Pipe Fitting (1)» Disconnect

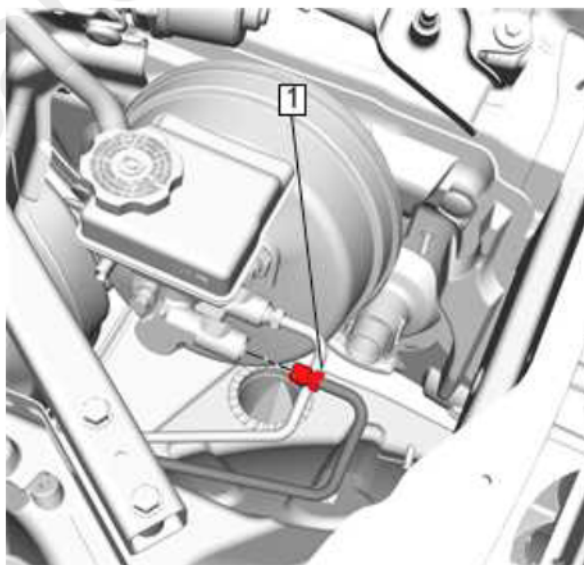


Fig. 86: Brake Pressure Modulator Valve Secondary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

3. Plug the master cylinder outlet port to prevent brake fluid loss and contamination.
4. Brake Pressure Modulator Valve Primary Brake Pipe Fitting (1)» Disconnect

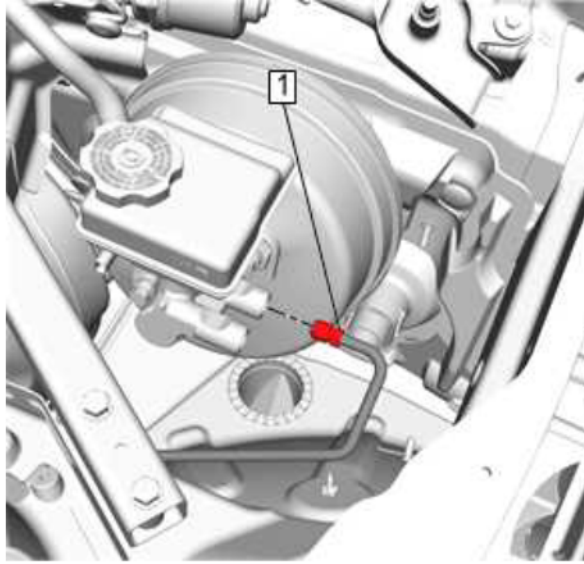


Fig. 87: Brake Pressure Modulator Valve Primary Brake Pipe Fitting
 Courtesy of GENERAL MOTORS COMPANY

5. Plug the master cylinder outlet port to prevent brake fluid loss and contamination.
6. Engine Wiring Harness Fuse Block Bracket» Remove - **Engine Wiring Harness Fuse Block Bracket Replacement**
7. Without separating the engine from the transmission, lower the powertrain. - **Engine Replacement (LGW) Engine Replacement (LGX)**
8. Brake Pressure Modulator Valve Pipe Pass Through Grommet (1)» Release

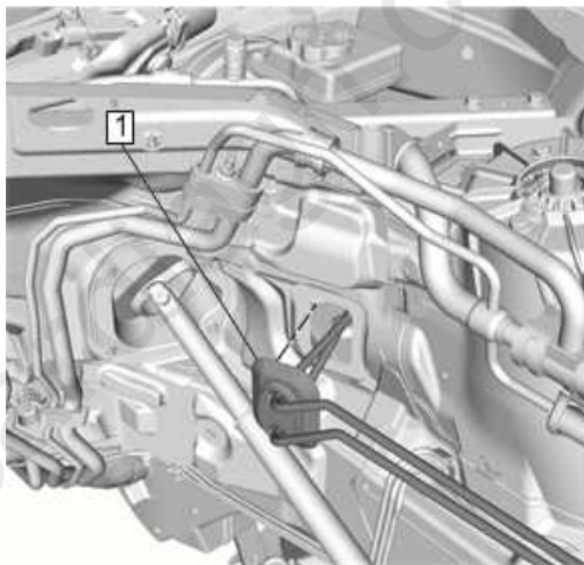


Fig. 88: Brake Pressure Modulator Valve Pipe
 Courtesy of GENERAL MOTORS COMPANY

9. Retainer (1)» Release

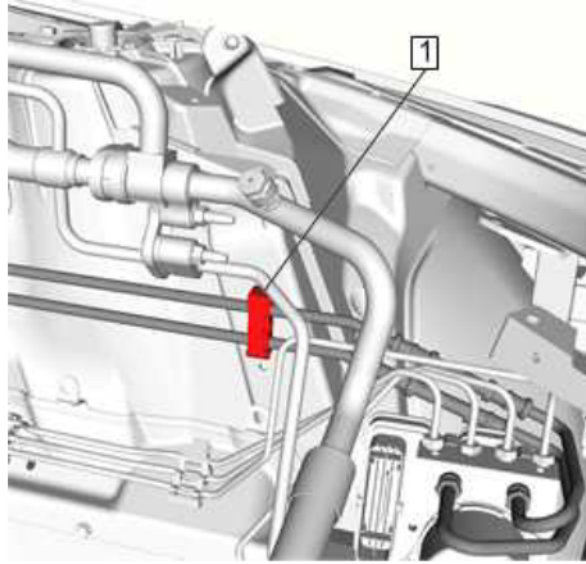


Fig. 89: Retainer

Courtesy of GENERAL MOTORS COMPANY

10. Brake Pressure Modulator Valve Primary Brake Pipe Fitting (1) @ Brake Pressure Modulator Valve» Disconnect

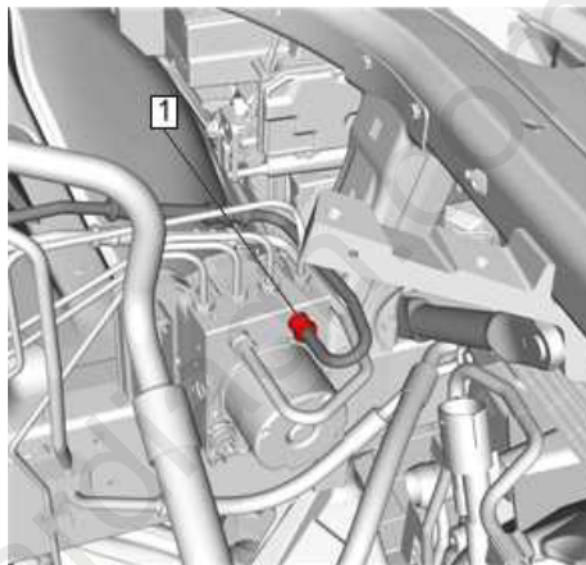


Fig. 90: Brake Pressure Modulator Valve Primary Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

11. Plug the brake pressure modulator valve inlet port to prevent brake fluid loss and contamination.
12. Brake Pressure Modulator Valve Secondary Brake Pipe Fitting (1) @ Brake Pressure Modulator Valve» Disconnect

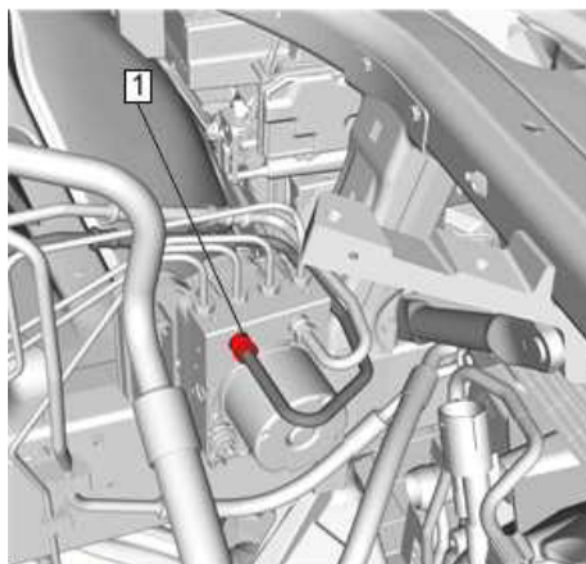


Fig. 91: Brake Pressure Modulator Valve Secondary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

13. Plug the brake pressure modulator valve inlet port to prevent brake fluid loss and contamination.
14. Brake Pressure Modulator Valve Pipe» Remove

Installation Procedure

1. Brake Pressure Modulator Valve Pipe» Install
2. Brake Pressure Modulator Valve Secondary Brake Pipe Fitting (1)» Install, but do NOT tighten

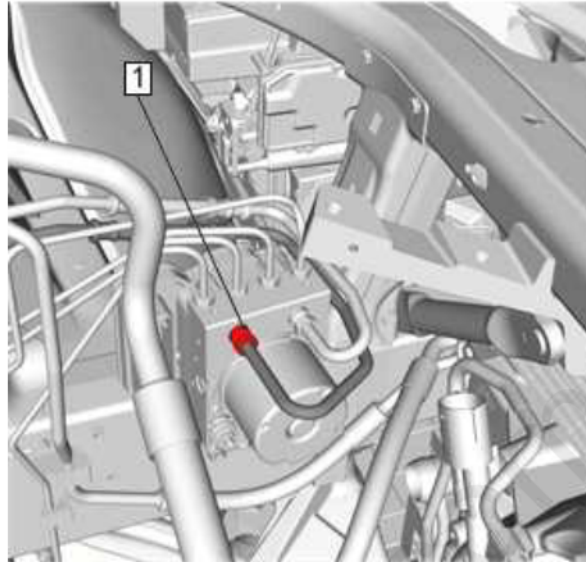


Fig. 92: Brake Pressure Modulator Valve Secondary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT tighten the brake pipe fitting until instructed.

3. Brake Pressure Modulator Valve Primary Brake Pipe Fitting (1)» Install, but do NOT tighten

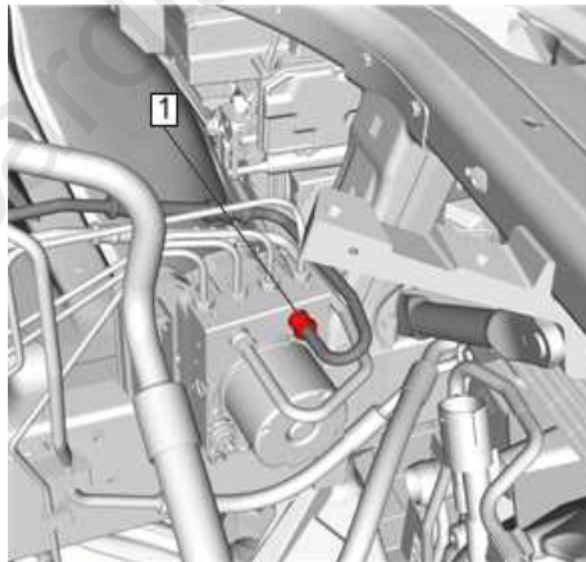


Fig. 93: Brake Pressure Modulator Valve Primary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT tighten the brake pipe fitting until instructed.

4. Retainer (1)» Secure

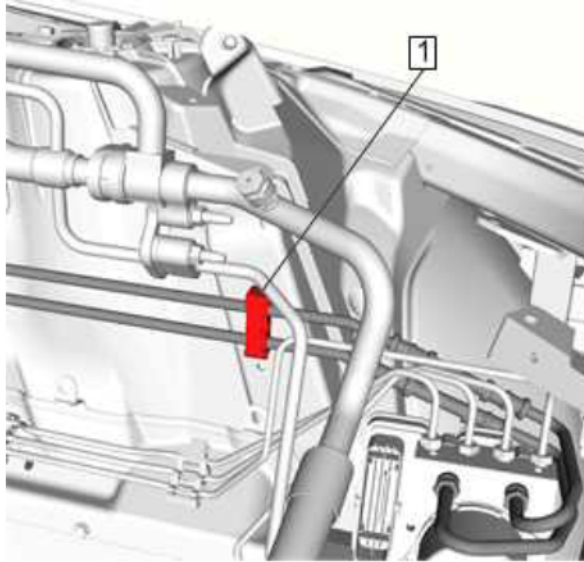


Fig. 94: Retainer

Courtesy of GENERAL MOTORS COMPANY

5. Brake Pressure Modulator Valve Pipe Pass Through Grommet (1)» Secure

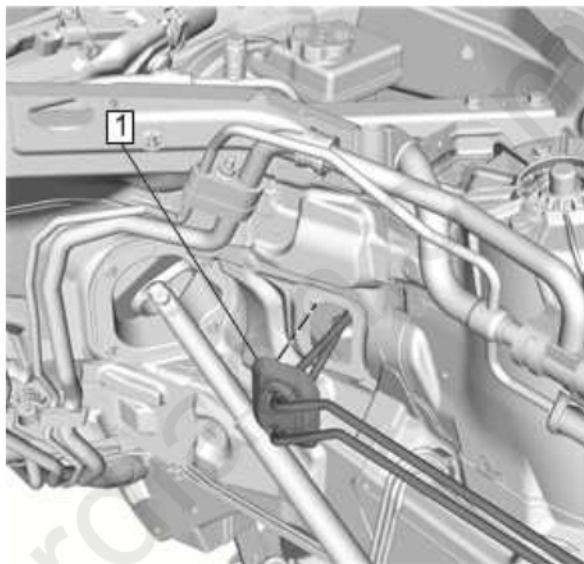
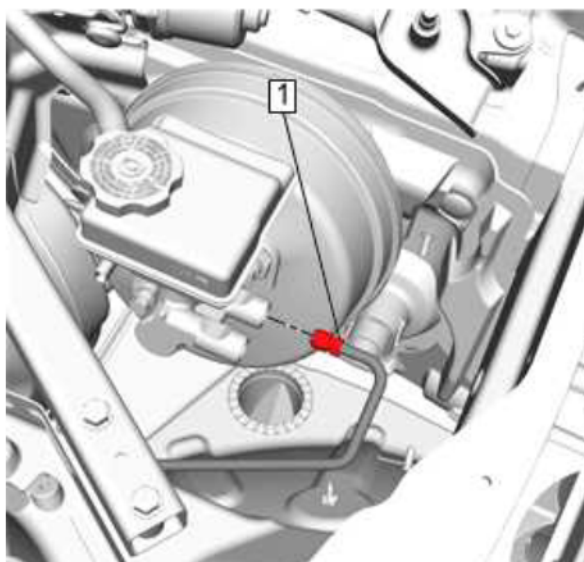


Fig. 95: Brake Pressure Modulator Valve Pipe

Courtesy of GENERAL MOTORS COMPANY

6. Install the powertrain. Refer to [Engine Replacement \(LGW\)](#) and/or [Engine Replacement \(LGX\)](#)
7. Brake Pressure Modulator Valve Primary Brake Pipe Fitting (1)» Install and tighten 32 N.m (24 lb ft)



CAUTION: **Fastener Caution**

8. Brake Pressure Modulator Valve Secondary Brake Pipe Fitting (1) » Install and tighten 32 N.m (24 lb ft)

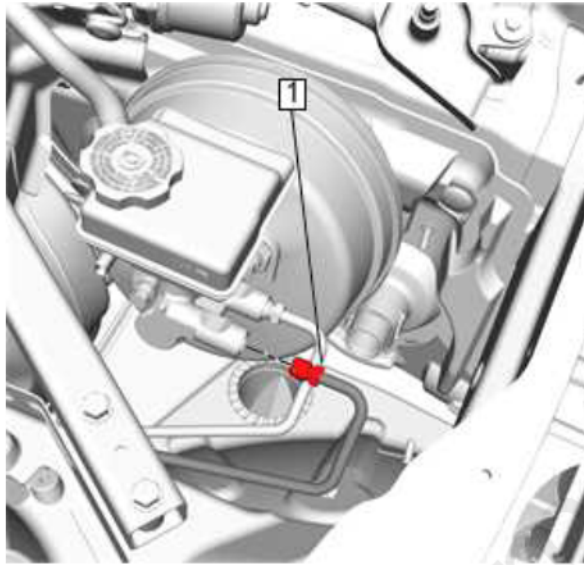


Fig. 97: Brake Pressure Modulator Valve Secondary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

9. Brake Pressure Modulator Valve Secondary Brake Pipe Fitting (1) @ Brake Pressure Modulator Valve » Install and tighten 32 N.m (24 lb ft)

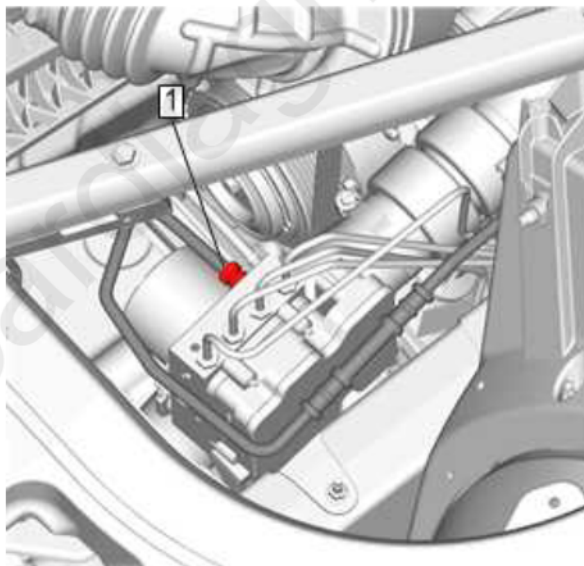


Fig. 98: Brake Pressure Modulator Valve Secondary Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

10. Brake Pressure Modulator Valve Primary Brake Pipe Fitting (1) @ Brake Pressure Modulator Valve » Install and tighten 32 N.m (24 lb ft)

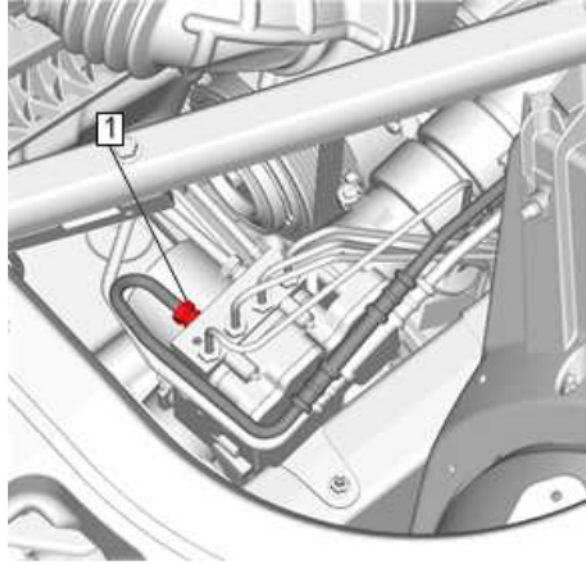


Fig. 99: Brake Pressure Modulator Valve Primary Pipe Fitting
 Courtesy of GENERAL MOTORS COMPANY

11. Engine Wiring Harness Fuse Block Bracket» Install - [Engine Wiring Harness Fuse Block Bracket Replacement](#)
12. Bleed the brake system. Refer to [Hydraulic Brake System Bleeding \(Manual\)](#) and/or [Hydraulic Brake System Bleeding \(Pressure\)](#)
13. Air Inlet Grille Panel» Install - [Air Inlet Grille Panel Replacement](#)

BRAKE PRESSURE MODULATOR VALVE PIPE REPLACEMENT (LTG WITH HP9)

Removal Procedure

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

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

1. Air Inlet Grille Panel» Remove - [Air Inlet Grille Panel Replacement](#)
2. Engine Wiring Harness Fuse Block Bracket» Remove - [Engine Wiring Harness Fuse Block Bracket Replacement](#)
3. Remove and properly dispose of the brake fluid in the master cylinder reservoir.
4. Brake Pressure Modulator Valve Secondary Brake Pipe Fitting (1)» Disconnect

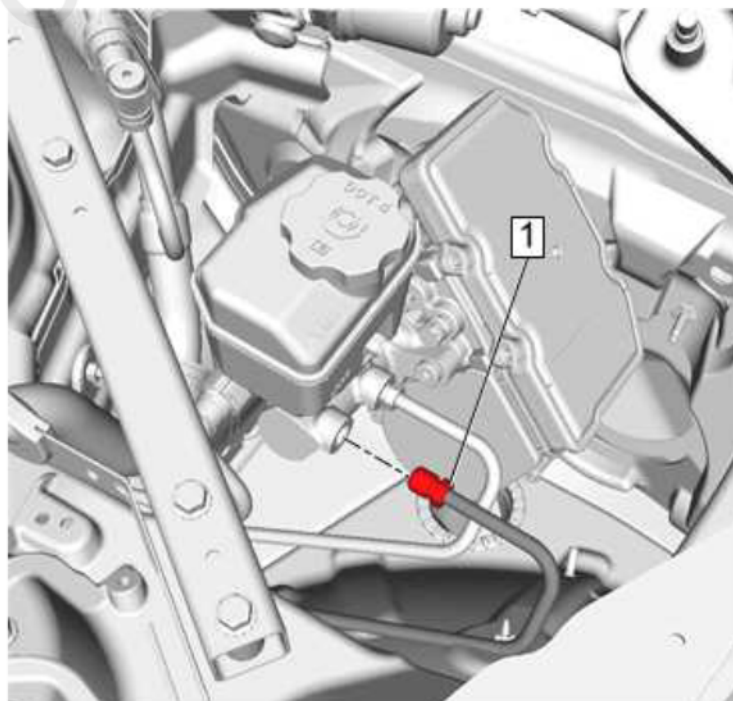


Fig. 100: Brake Pressure Modulator Valve Secondary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

5. Plug the brake master cylinder outlet port to prevent brake fluid loss and contamination.
6. Brake Pressure Modulator Valve Primary Brake Pipe Fitting (1) » Disconnect

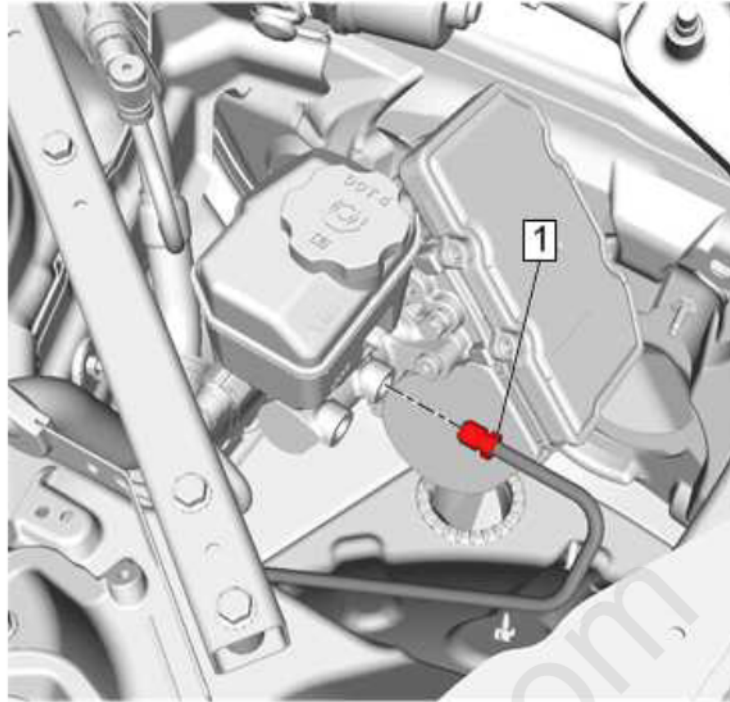


Fig. 101: Brake Pressure Modulator Valve Primary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

7. Plug the brake master cylinder outlet port to prevent brake fluid loss and contamination.
8. Brake Pressure Modulator Valve Low Pressure Pipe Quick Connect (1) » Disconnect

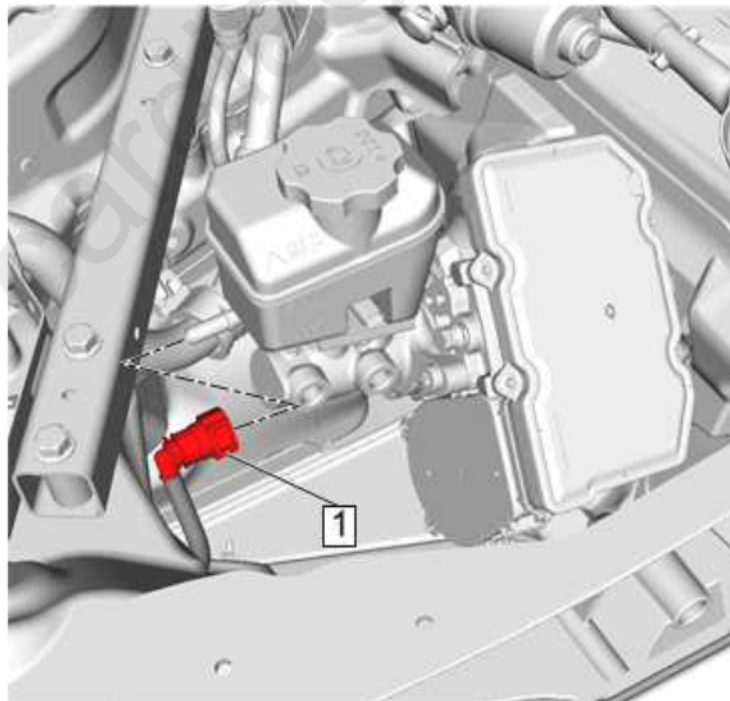


Fig. 102: Brake Pressure Modulator Valve Low Pressure Pipe Quick Connect
Courtesy of GENERAL MOTORS COMPANY

9. Without separating the engine from the transmission, remove the powertrain. Refer to [Engine Replacement \(Except Hybrid\)](#) and/or [Engine Replacement \(Hybrid\)](#)
10. Brake Pressure Modulator Valve Brake Pipe Pass Through Grommet (1) » Release

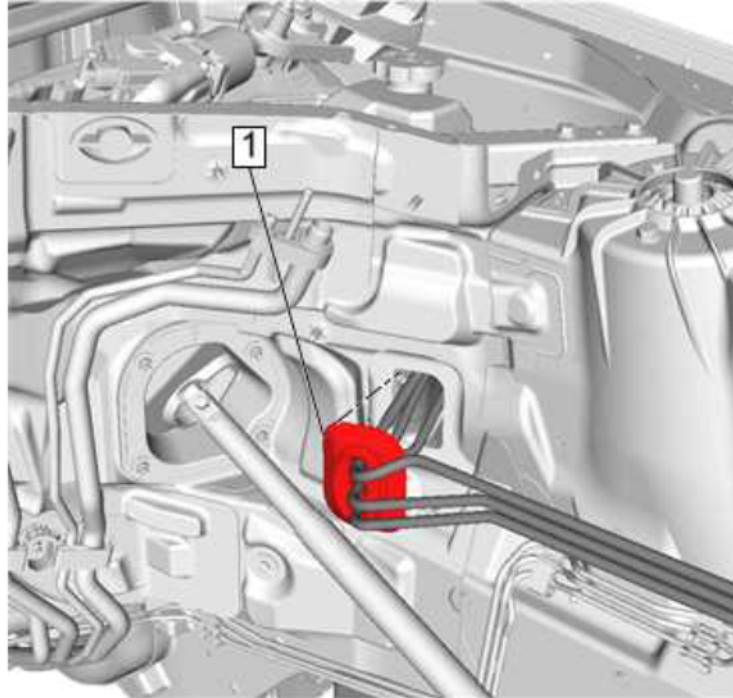


Fig. 103: Brake Pressure Modulator Valve Brake Pipe Pass Through Grommet
Courtesy of GENERAL MOTORS COMPANY

11. Brake Pipe Retainer (1) » Release

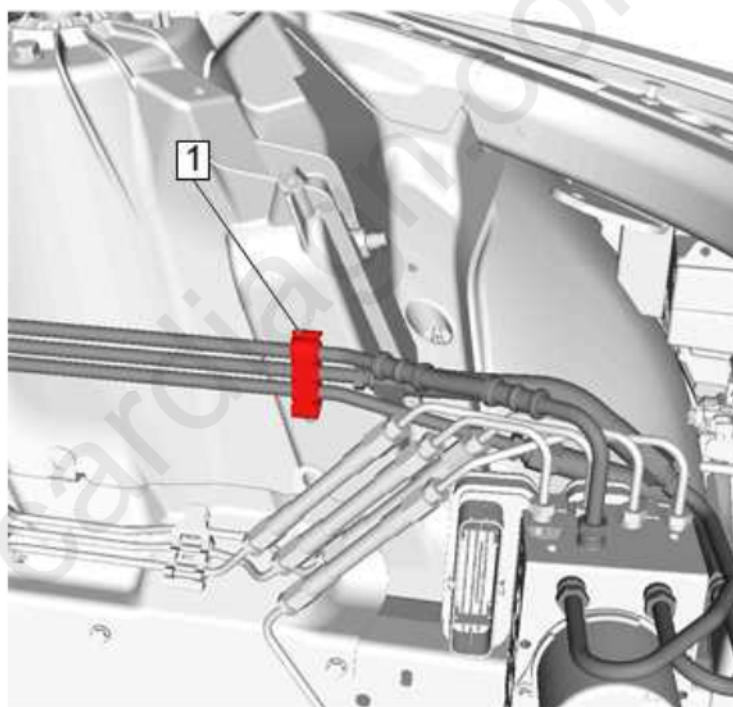


Fig. 104: Brake Pipe Retainer
Courtesy of GENERAL MOTORS COMPANY

12. Brake Pressure Modulator Valve Low Pressure Pipe Fitting (1) » Disconnect

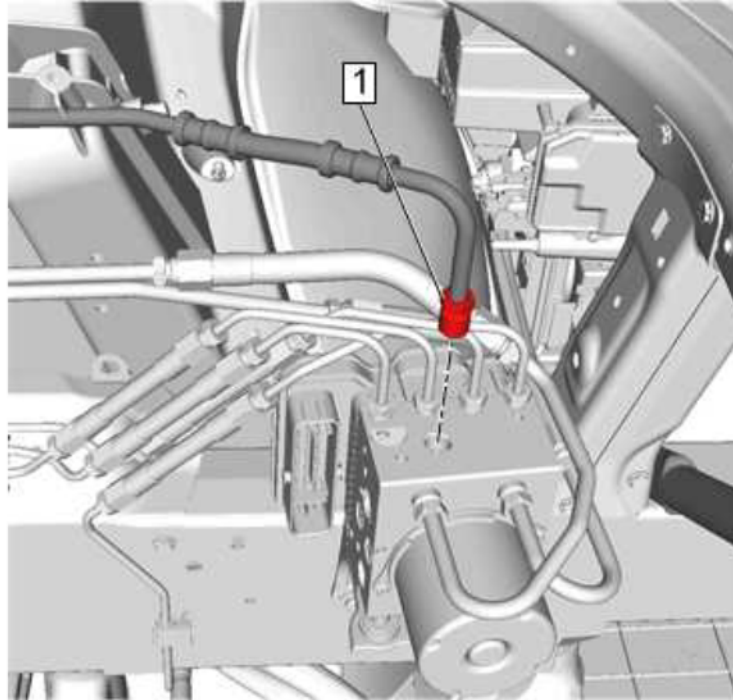


Fig. 105: Brake Pressure Modulator Valve Low Pressure Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

13. Plug the brake pressure modulator valve inlet port to prevent brake fluid loss and contamination.
14. Brake Pressure Modulator Valve Secondary Brake Pipe Fitting (1)» Disconnect

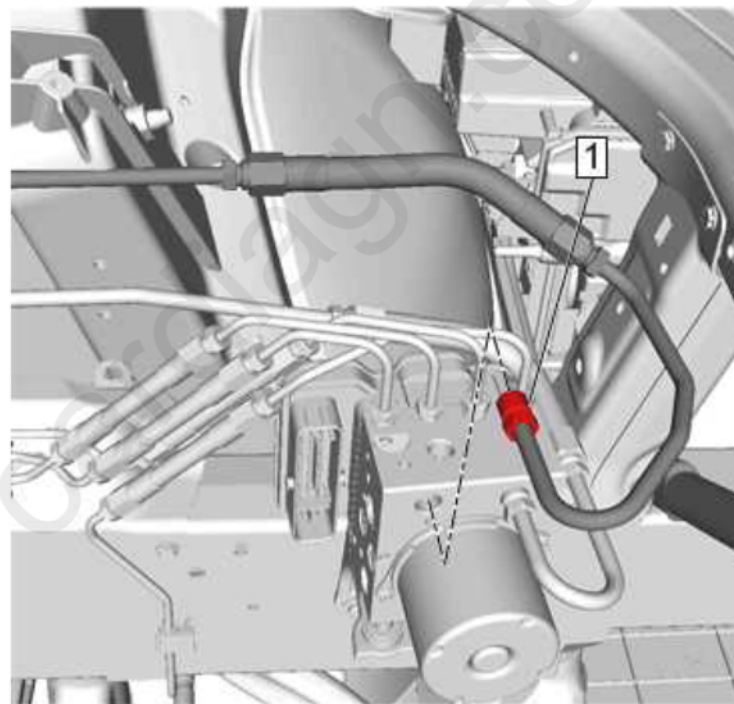


Fig. 106: Brake Pressure Modulator Valve Secondary Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

15. Plug the brake pressure modulator valve inlet port to prevent brake fluid loss and contamination.
16. Brake Pressure Modulator Valve Primary Brake Pipe Fitting (1)» Disconnect

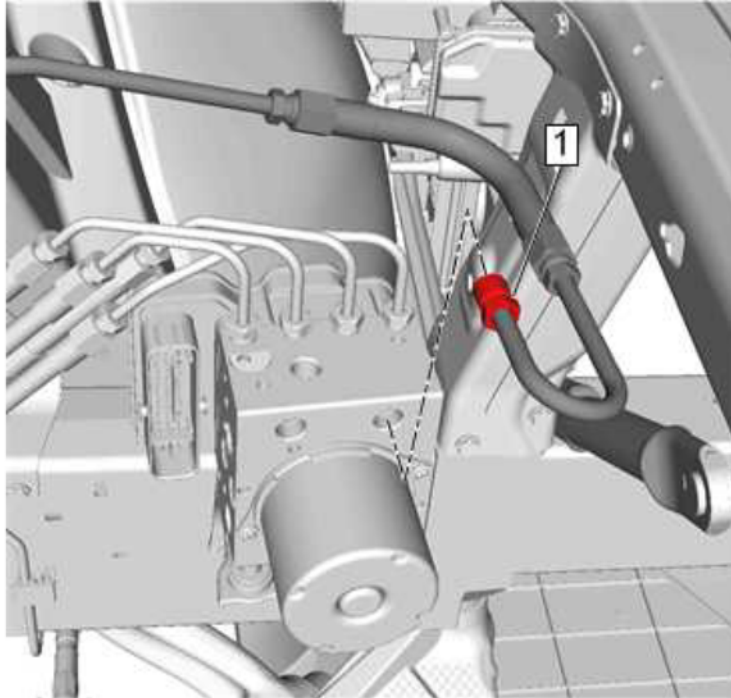


Fig. 107: Brake Pressure Modulator Valve Primary Brake Pipe Fitting
 Courtesy of GENERAL MOTORS COMPANY

17. Plug the brake pressure modulator valve inlet port to prevent brake fluid loss and contamination.
18. Brake Pressure Modulator Valve Brake Pipe Assembly (1)» Remove

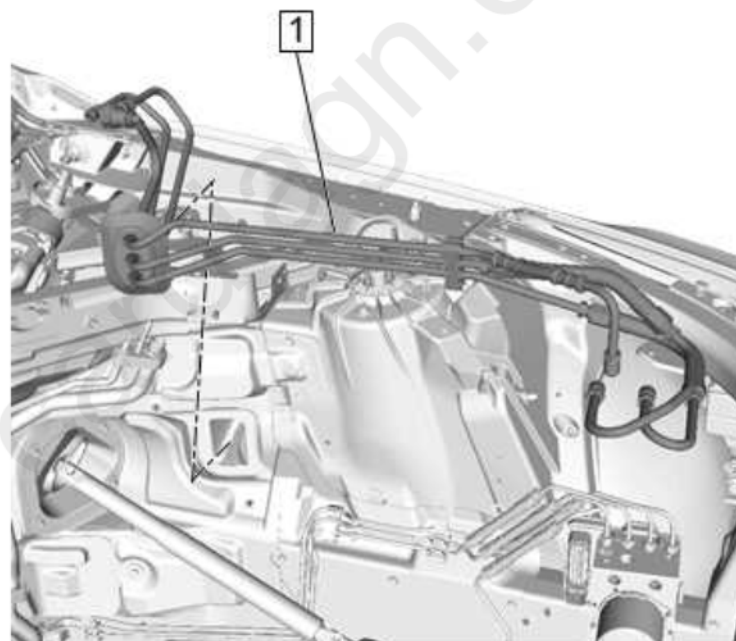


Fig. 108: Brake Pressure Modulator Valve Brake Pipe Assembly
 Courtesy of GENERAL MOTORS COMPANY

Installation Procedure

1. Brake Pressure Modulator Valve Pipe Assembly» Install

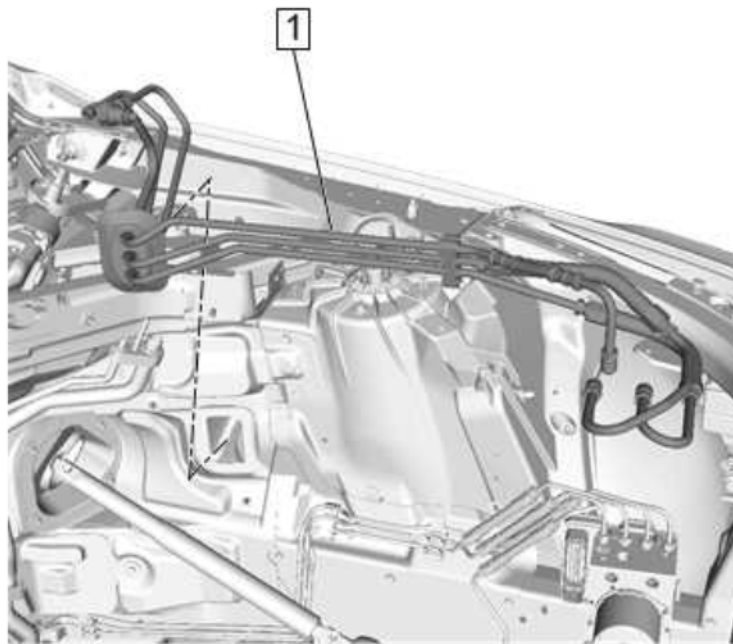


Fig. 109: Brake Pressure Modulator Valve Brake Pipe Assembly
 Courtesy of GENERAL MOTORS COMPANY

2. Brake Pressure Modulator Valve Primary Brake Pipe Fitting (1)» Install, but do NOT tighten

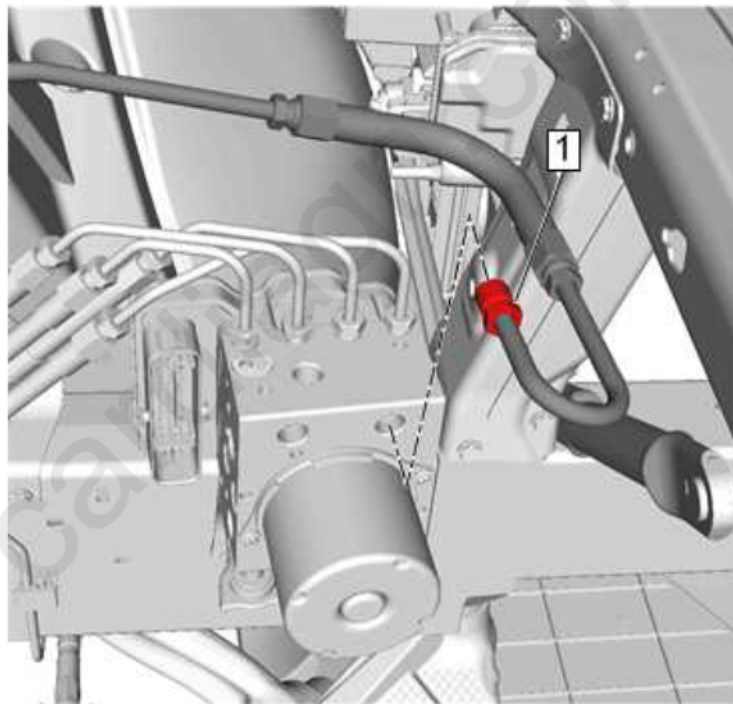


Fig. 110: Brake Pressure Modulator Valve Primary Brake Pipe Fitting
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT tighten the brake pipe fitting until instructed.

3. Brake Pressure Modulator Valve Secondary Brake Pipe Fitting (1)» Install, but do NOT tighten

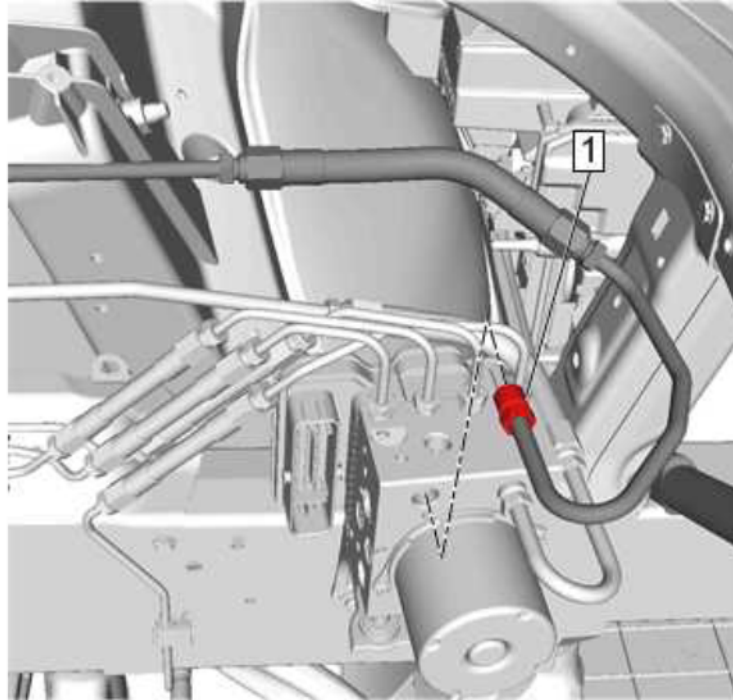


Fig. 111: Brake Pressure Modulator Valve Secondary Brake Pipe Fitting
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT tighten the brake pipe fitting until instructed.

4. Brake Pressure Modulator Valve Low Pressure Pipe Fitting (1)» Install, but do NOT tighten

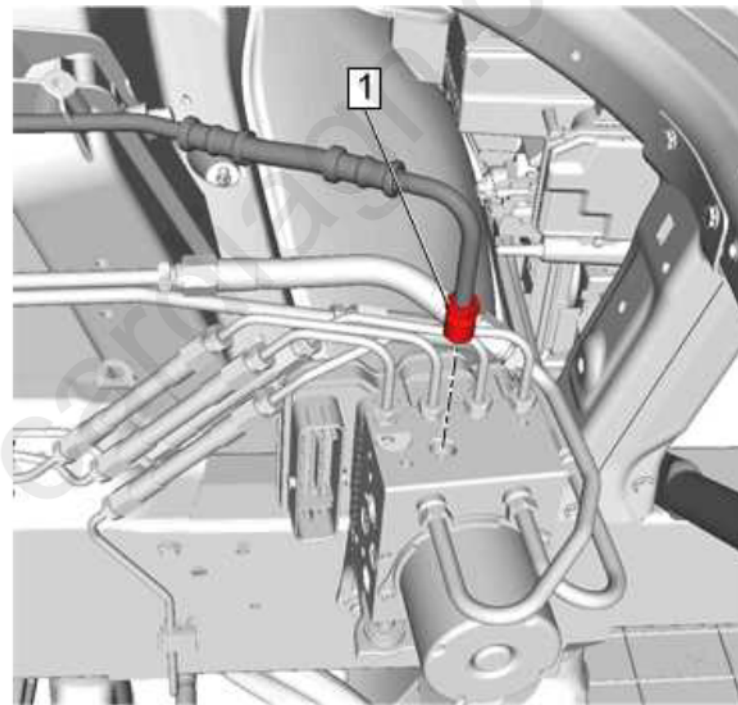


Fig. 112: Brake Pressure Modulator Valve Low Pressure Pipe Fitting
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT tighten the brake pipe fitting until instructed.

5. Brake Pipe Retainer (1)» Secure

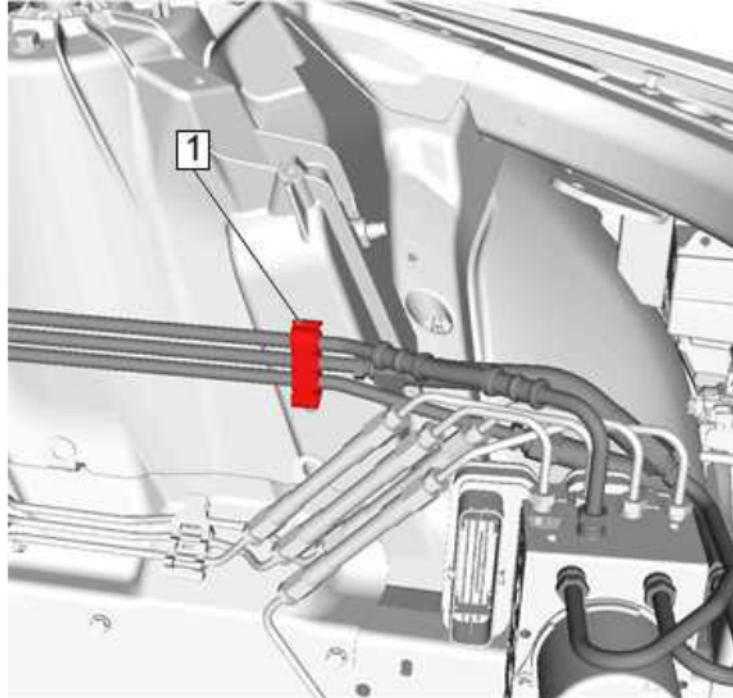


Fig. 113: Brake Pipe Retainer

Courtesy of GENERAL MOTORS COMPANY

6. Brake Pressure Modulator Valve Pipe Pass Through Grommet (1)» Secure

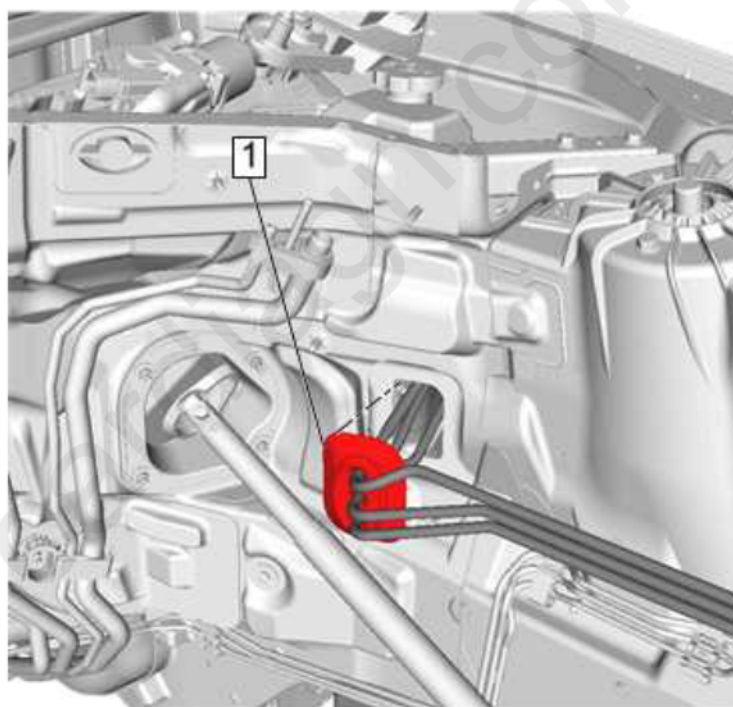


Fig. 114: Brake Pressure Modulator Valve Brake Pipe Pass Through Grommet

Courtesy of GENERAL MOTORS COMPANY

7. Install the powertrain. Refer to **Engine Replacement (Except Hybrid)** and/or **Engine Replacement (Hybrid)**
8. Brake Pressure Modulator Valve Primary Brake Pipe Fitting (1)» Install and tighten 32 N.m (24 lb ft)

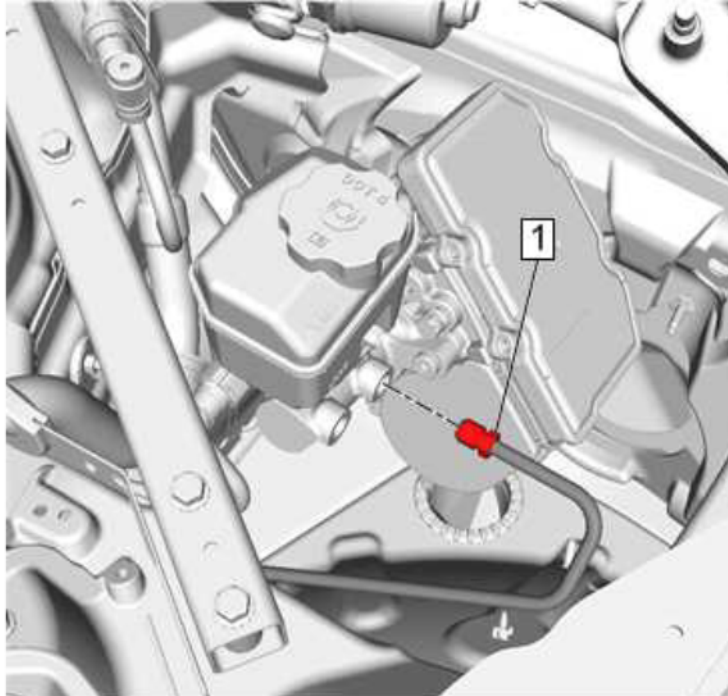


Fig. 115: Brake Pressure Modulator Valve Primary Brake Pipe Fitting
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

9. Brake Pressure Modulator Valve Secondary Brake Pipe Fitting (1) » Install and tighten 32 N.m (24 lb ft)

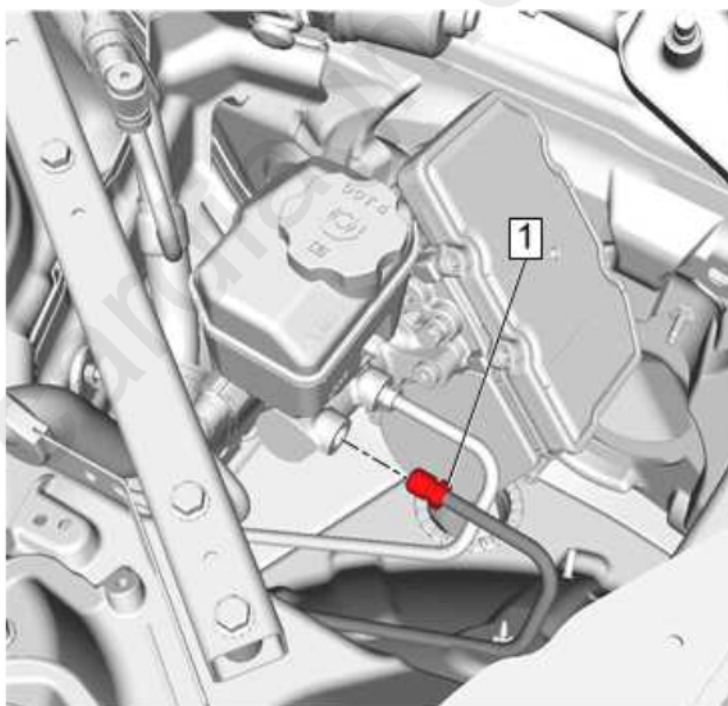


Fig. 116: Brake Pressure Modulator Valve Secondary Brake Pipe Fitting
 Courtesy of GENERAL MOTORS COMPANY

10. Brake Pressure Modulator Valve Low Pressure Pipe Quick Connect (1) » Connect

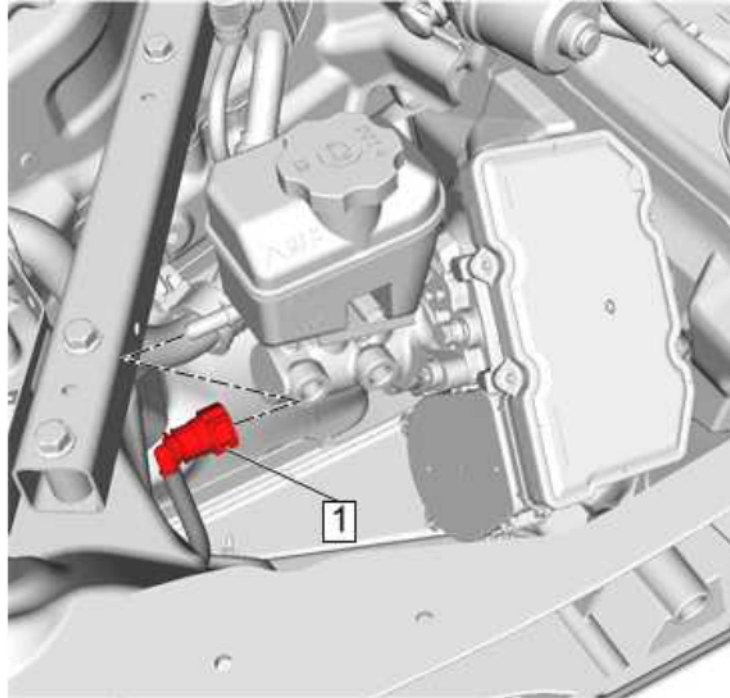


Fig. 117: Brake Pressure Modulator Valve Low Pressure Pipe Quick Connect
 Courtesy of GENERAL MOTORS COMPANY

11. Brake Pressure Modulator Valve Low Pressure Pipe Fitting (1)» Install and tighten 32 N.m (24 lb ft)

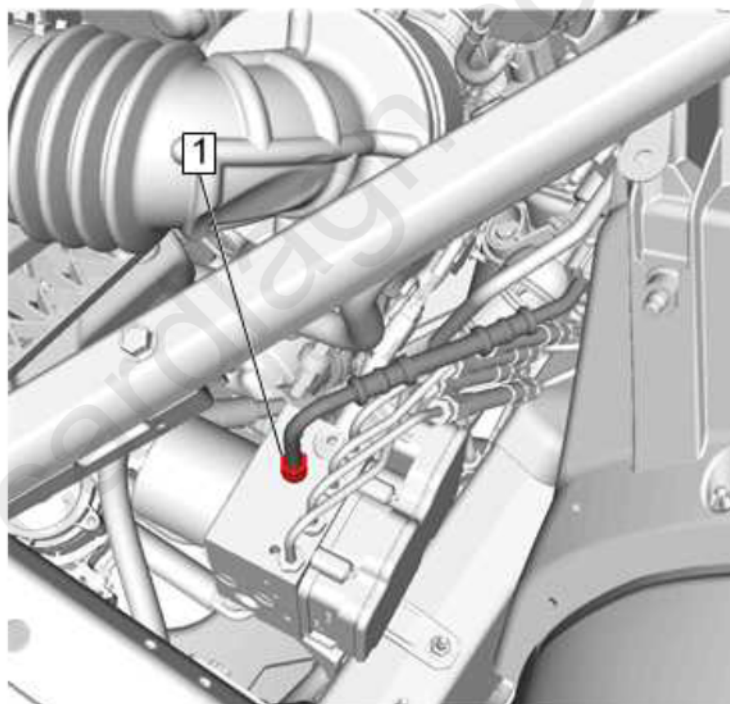


Fig. 118: Brake Pressure Modulator Valve Low Pressure Pipe Fitting
 Courtesy of GENERAL MOTORS COMPANY

12. Brake Pressure Modulator Valve Secondary Brake Pipe Fitting (1)» Install and tighten 32 N.m (24 lb ft)

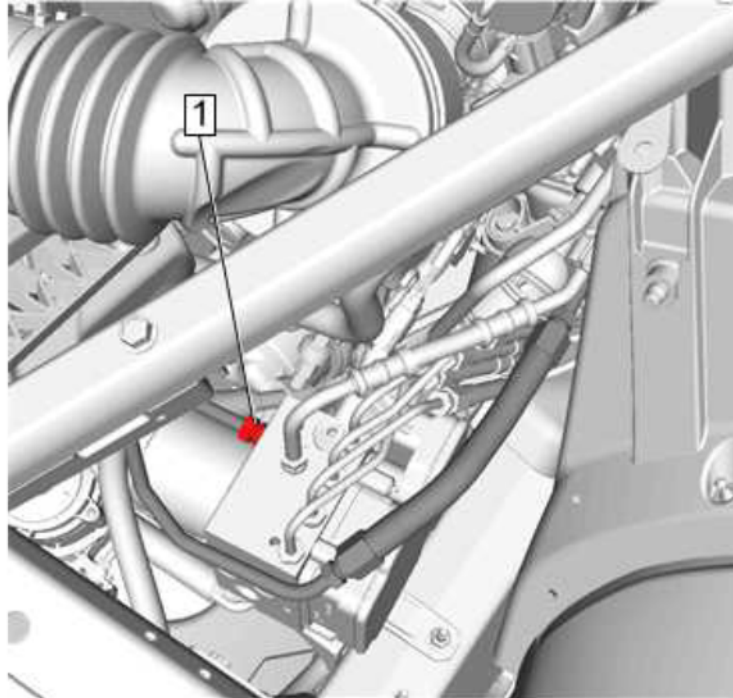


Fig. 119: Brake Pressure Modulator Valve Secondary Brake Pipe Fitting
 Courtesy of GENERAL MOTORS COMPANY

13. Brake Pressure Modulator Valve Primary Brake Pipe Fitting (1)» Install and tighten 32 N.m (24 lb ft)

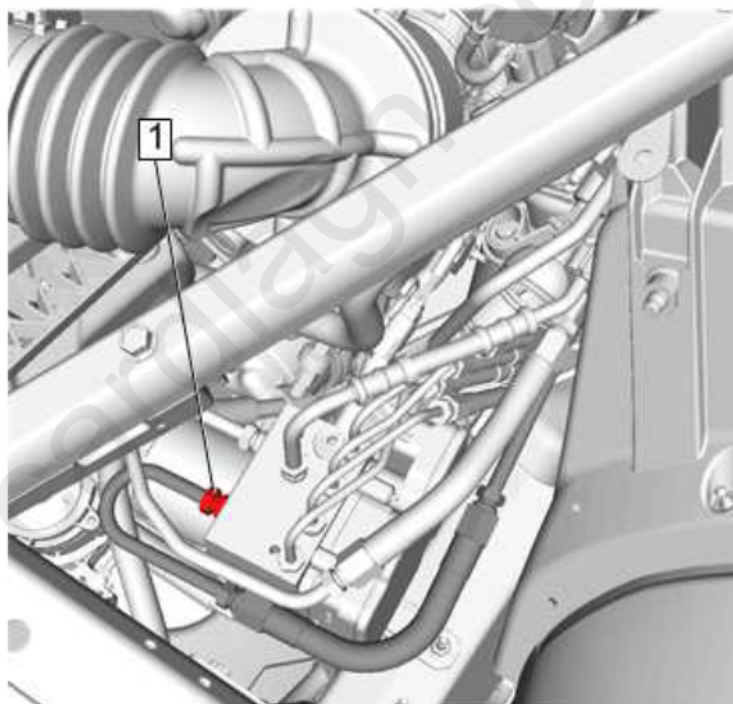


Fig. 120: Brake Pressure Modulator Valve Primary Brake Pipe Fitting
 Courtesy of GENERAL MOTORS COMPANY

14. Engine Wiring Harness Fuse Block Bracket» Install - [Engine Wiring Harness Fuse Block Bracket Replacement](#)
15. Bleed the brake system. Refer to [Hydraulic Brake System Bleeding \(Manual\)](#) and/or [Hydraulic Brake System Bleeding \(Pressure\)](#)
16. Air Inlet Grille Panel» Install - [Air Inlet Grille Panel Replacement](#)

BRAKE PIPE REPLACEMENT

Special Tools

CH-45405 Brake Pipe Flaring Tool Kit

1. Inspect the area of brake pipe to be repaired or replaced.

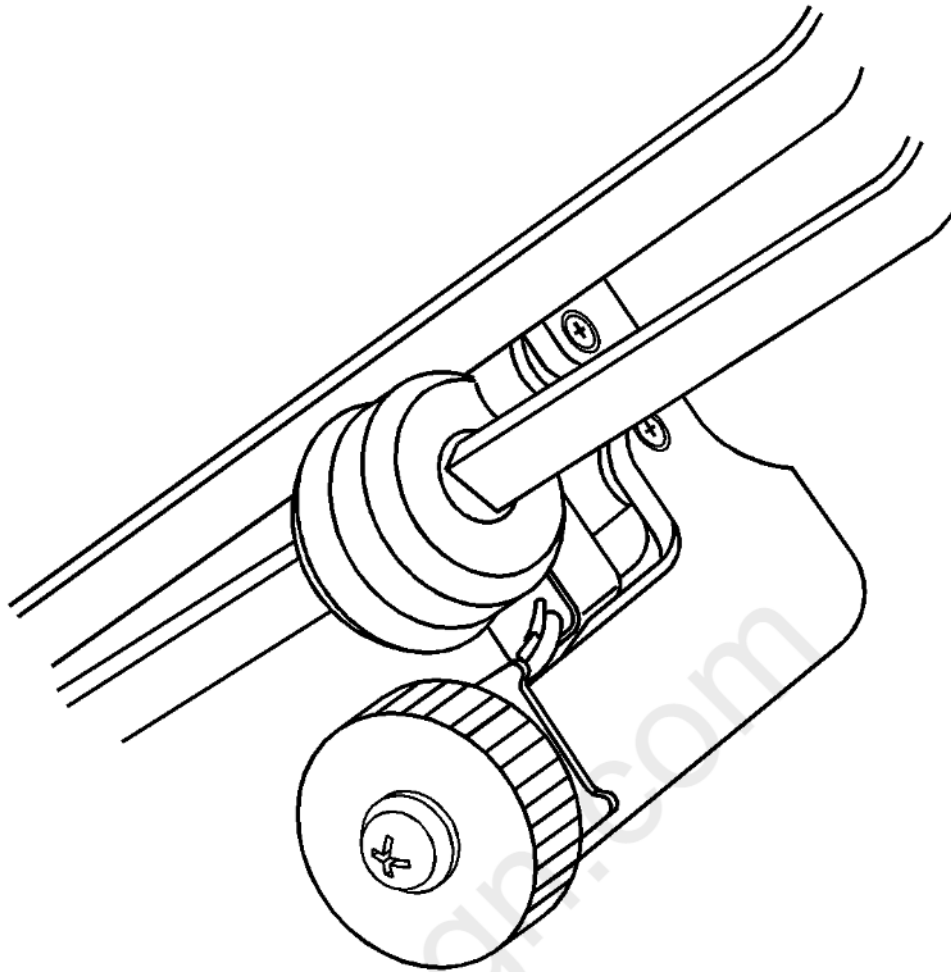


Fig. 121: Sectioning Brake Pipe Using Pipe Cutter

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.

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
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.

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

7. Remove the sectioned brake pipe from the vehicle.
8. Select the appropriate size of brake pipe and tube nuts, as necessary. The brake pipe outside diameter determines brake pipe size.
9. Strip the nylon coating from the brake pipe end to be flared, if necessary.

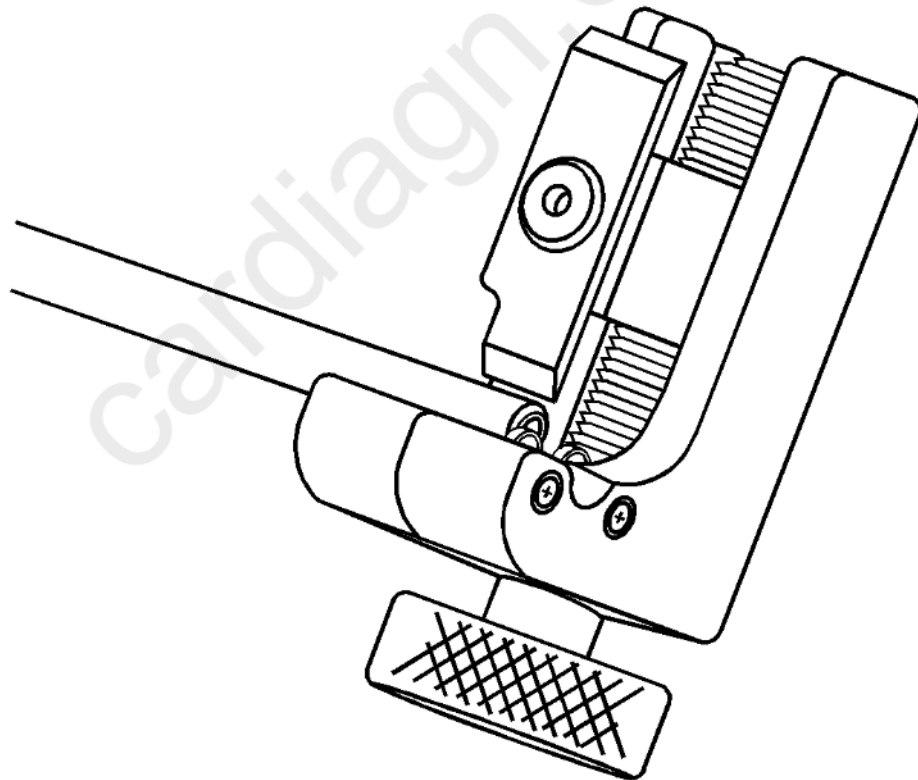


Fig. 122: Stripping Nylon Coating From Brake Pipe Ends
Courtesy of GENERAL MOTORS COMPANY

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

NOTE: **Do not gouge the metal surface of the brake pipe.**

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
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.

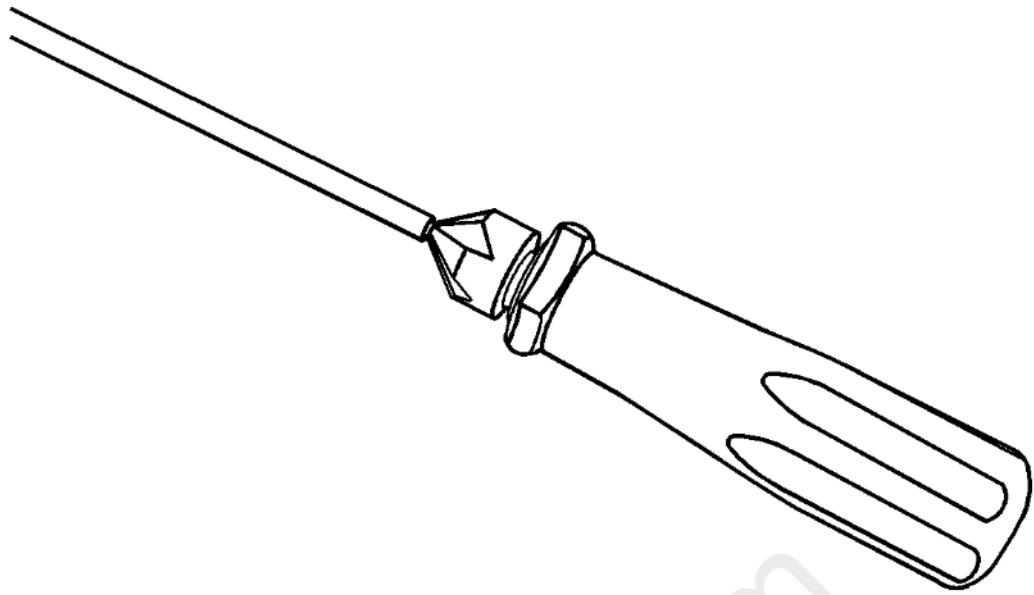


Fig. 123: Chamfering Pipe Using De-Burring Tool
Courtesy of GENERAL MOTORS COMPANY

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

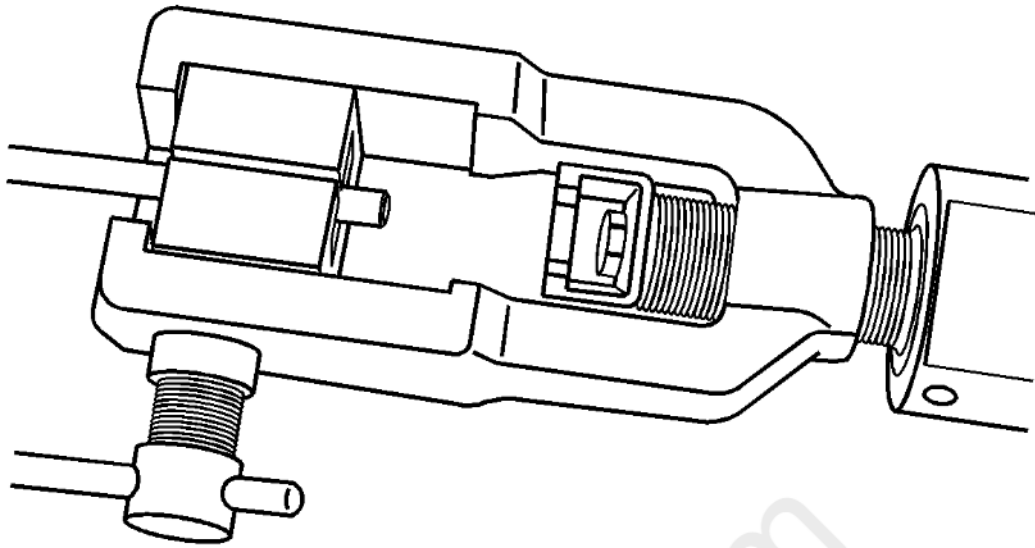


Fig. 124: Installing Die Halves Into Die Cage
 Courtesy of GENERAL MOTORS COMPANY

14. Select the corresponding die set and install the die halves into the die cage with the full, flat face of one die facing the clamping screw and the counterbores of both dies facing the forming ram.
15. Place the flat face of an unused die (1) against the die halves in the clamping cage and hold firmly against the counterbored face of the dies.

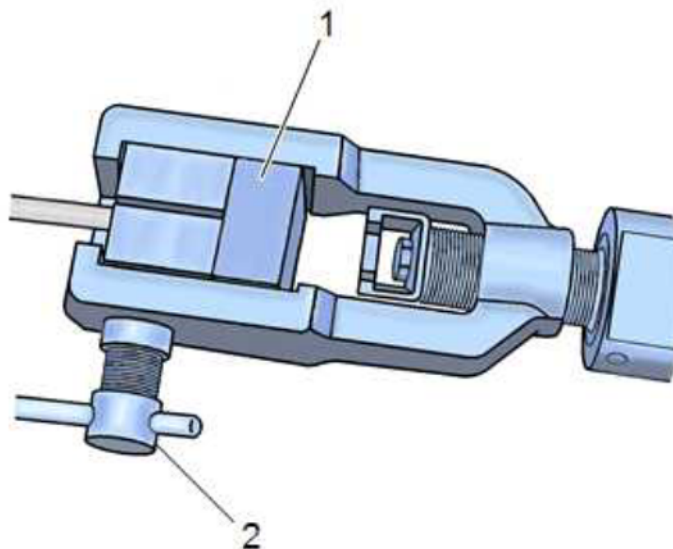


Fig. 125: View Of Clamping Screw & Unused Die
 Courtesy of GENERAL MOTORS COMPANY

16. Insert the prepared end of the pipe to be flared through the back of the dies until the pipe is seated against the flat surface of the unused die (1).
17. Remove the unused die (1).
18. Ensure that the rear of both dies are seated firmly against the enclosed end of the die cage.
19. Firmly hand tighten the clamping screw (2) against the dies.
20. Select the appropriate forming mandrel and place into the forming ram.

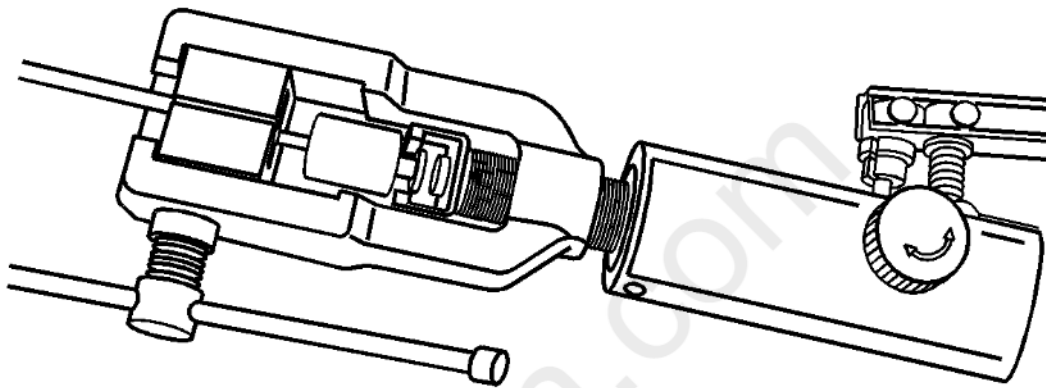


Fig. 126: Rotating J 45405 To Bottom Against Die Cage
Courtesy of GENERAL MOTORS COMPANY

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.
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.

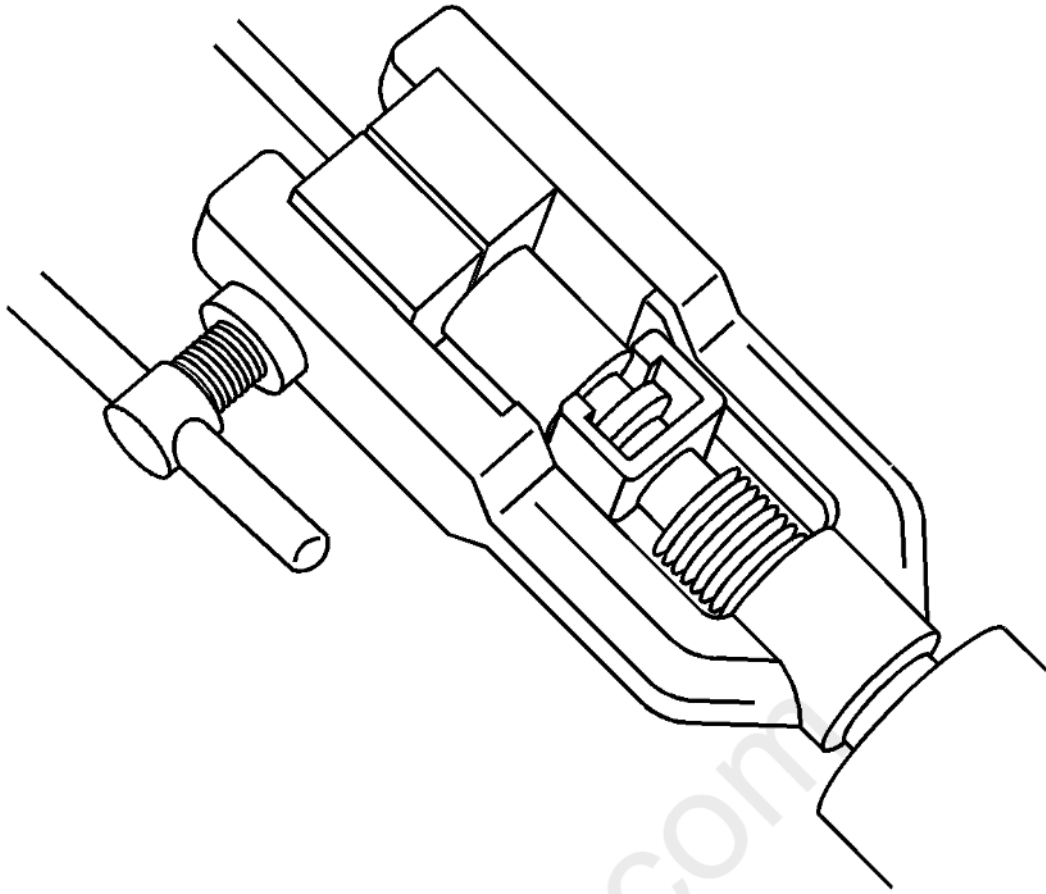


Fig. 127: Bottoming Forming Mandrel Against Clamping Dies Using Pipe Flaring Tool
Courtesy of GENERAL MOTORS COMPANY

24. Rotate the hydraulic fluid control valve counterclockwise to the open position to allow the hydraulic forming ram to retract.
25. Insert the finishing cone into the forming ram.

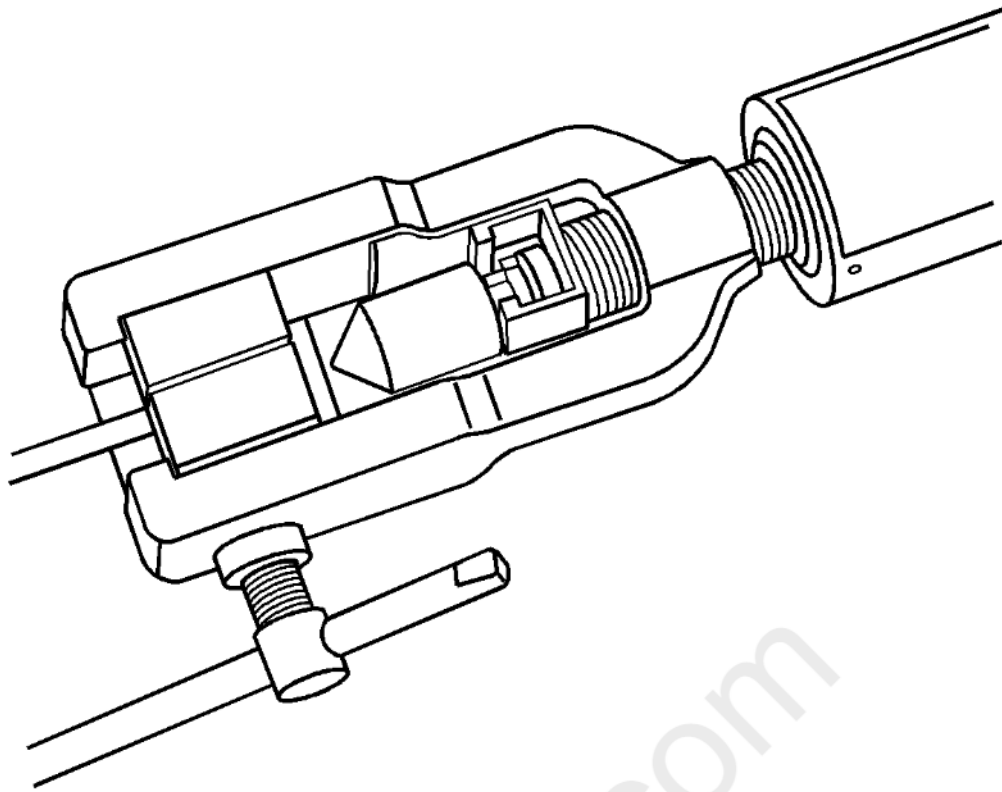


Fig. 128: Using Pipe Flaring Tool

Courtesy of GENERAL MOTORS COMPANY

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

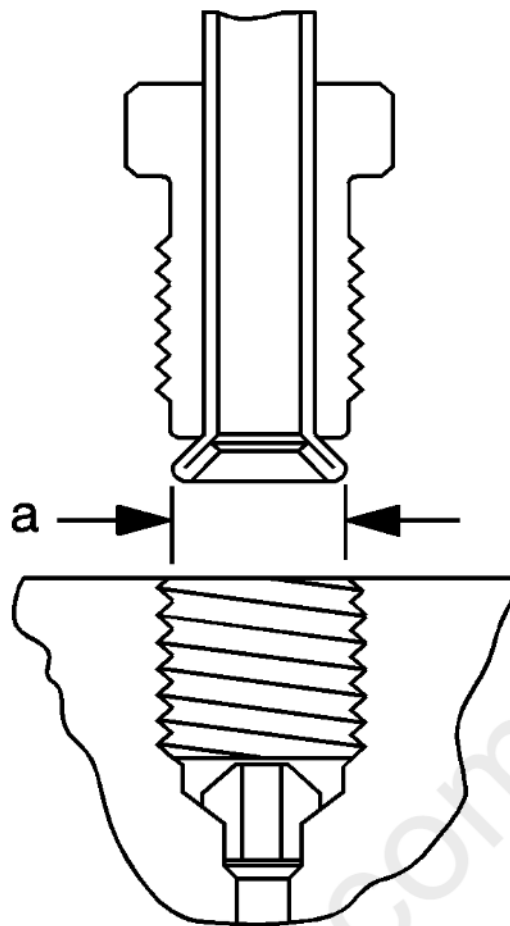


Fig. 129: Identifying Correct Brake Pipe Flare Shape & Diameter
 Courtesy of GENERAL MOTORS COMPANY

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 \(Manual\)](#) and/or [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: [Brake Dust Warning](#)

WARNING: [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](#)
3. Brake Pipe Fitting (1) » Disconnect

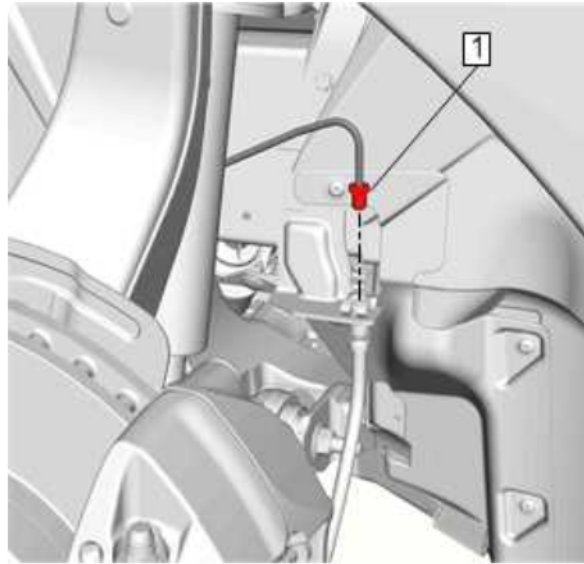


Fig. 130: Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

4. Cap the brake pipe fitting to prevent brake fluid loss and contamination.
5. Brake Hose Retainer (1) » Remove

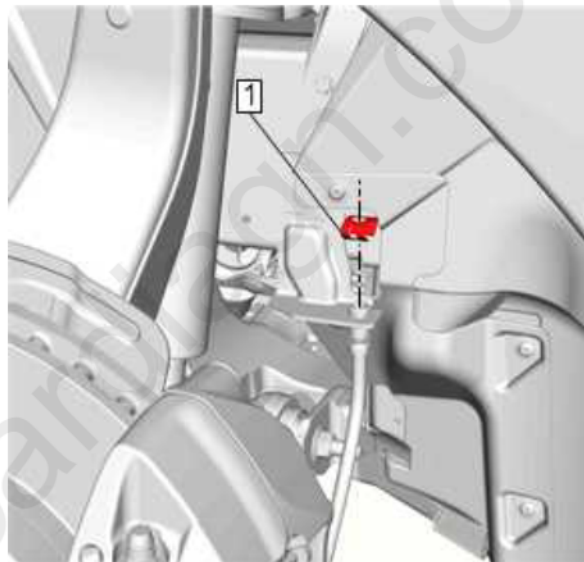


Fig. 131: Brake Hose Retainer

Courtesy of GENERAL MOTORS COMPANY

6. Brake Hose Fitting Bolt (1) » Remove

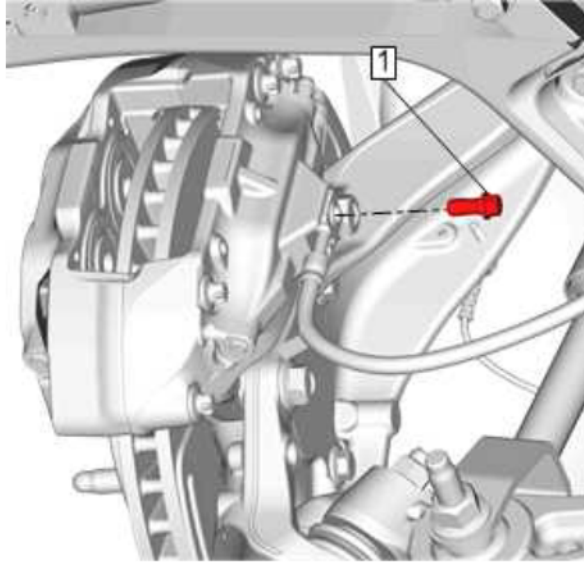


Fig. 132: Brake Hose Fitting Bolt

Courtesy of GENERAL MOTORS COMPANY

7. Brake Hose Fitting Gasket (1) @ Brake Hose Fitting (2) » Remove and DISCARD [2x]

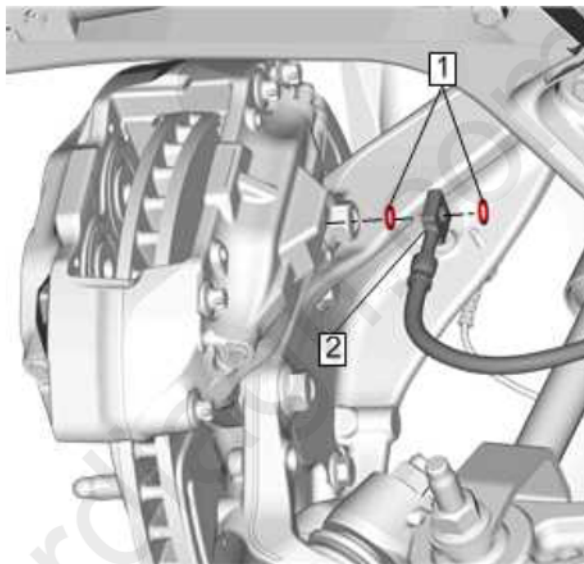
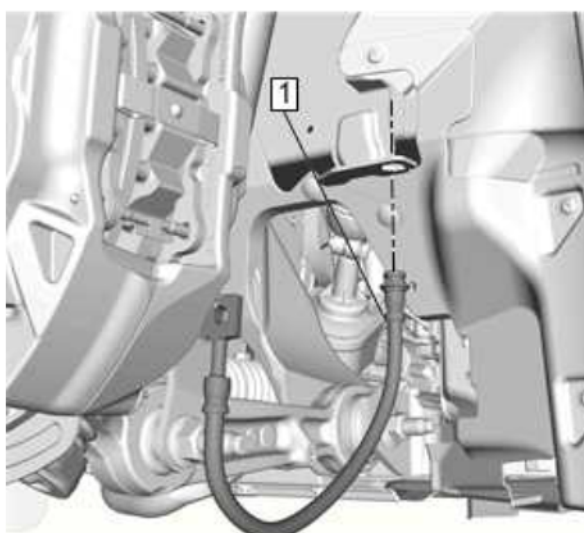


Fig. 133: Brake Hose Fitting Gasket

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT reuse the brake hose fitting gaskets.

8. Plug the caliper inlet to prevent brake fluid loss and contamination.
9. Front Brake Hose (1) » Remove



Installation Procedure

1. Front Brake Hose (1)» Install

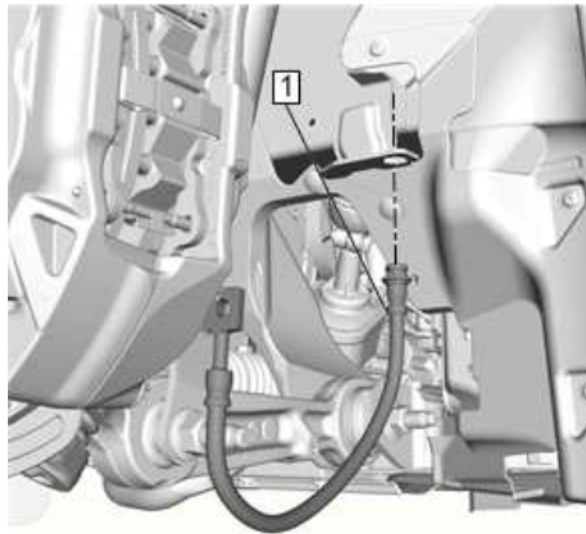


Fig. 135: Front Brake Hose
Courtesy of GENERAL MOTORS COMPANY

2. Brake Hose Fitting Gasket (1) @ Brake Hose Fitting (2)» Install [2x]

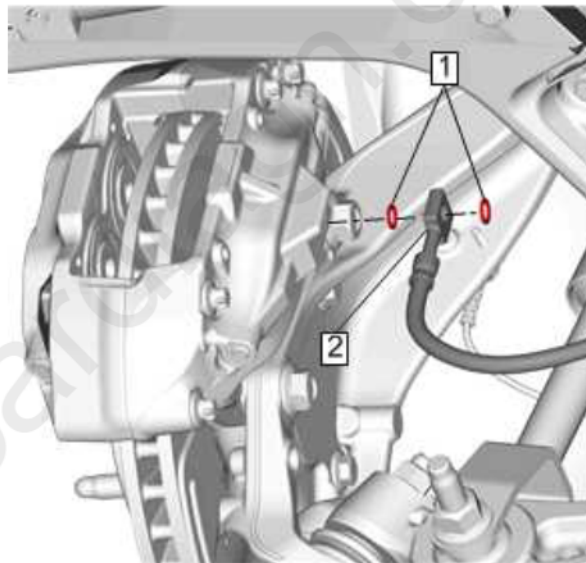


Fig. 136: Brake Hose Fitting Gasket
Courtesy of GENERAL MOTORS COMPANY

NOTE: Install NEW brake hose fitting gaskets.

3. Brake Hose Fitting Bolt (1)» Install and tighten 40 N.m (30 lb ft)

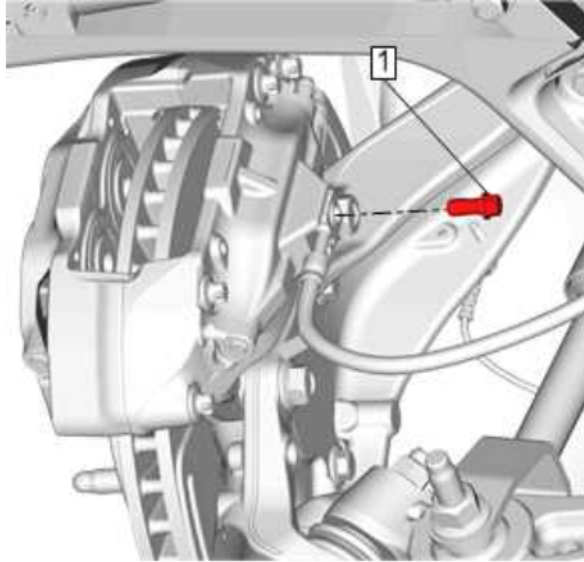


Fig. 137: Brake Hose Fitting Bolt
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

4. Brake Hose Retainer (1) » Install

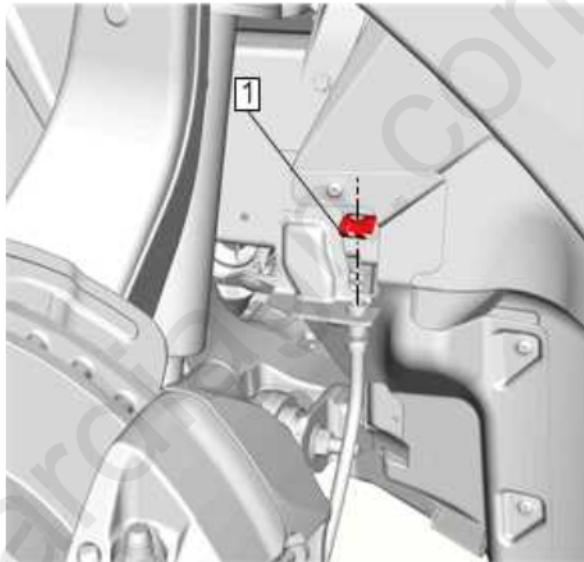


Fig. 138: Brake Hose Retainer
 Courtesy of GENERAL MOTORS COMPANY

5. Brake Pipe Fitting (1) » Install and tighten 19 N.m (14 lb ft)

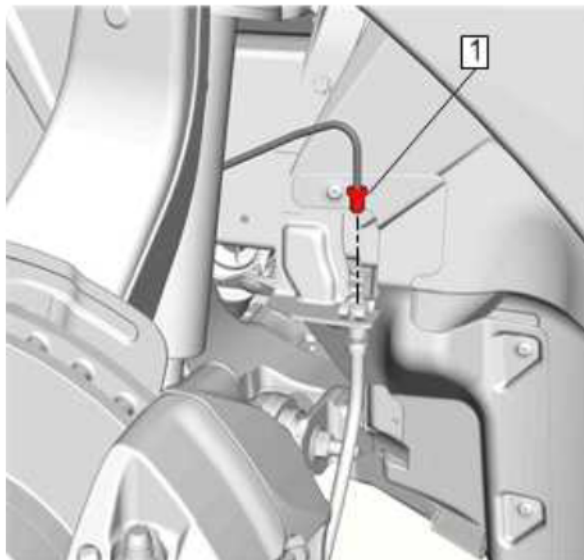


Fig. 139: Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

6. Bleed the brake system. Refer to [Hydraulic Brake System Bleeding \(Manual\)](#) and/or [Hydraulic Brake System Bleeding \(Pressure\)](#)
7. Install the tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#)

REAR BRAKE HOSE REPLACEMENT

Removal Procedure

WARNING: [Brake Dust Warning](#)

WARNING: [Brake Fluid Irritant Warning](#)

1. [Rear Wheelhouse Liner Replacement \(LTG\)](#) [Rear Wheelhouse Liner Replacement \(LGX, LGW\)](#) » Remove
2. Brake Pipe Fitting (1) » Disconnect



Fig. 140: Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

3. Cap the brake pipe fitting to prevent brake fluid loss and contamination.
4. Brake Hose Retainer (1) » Remove

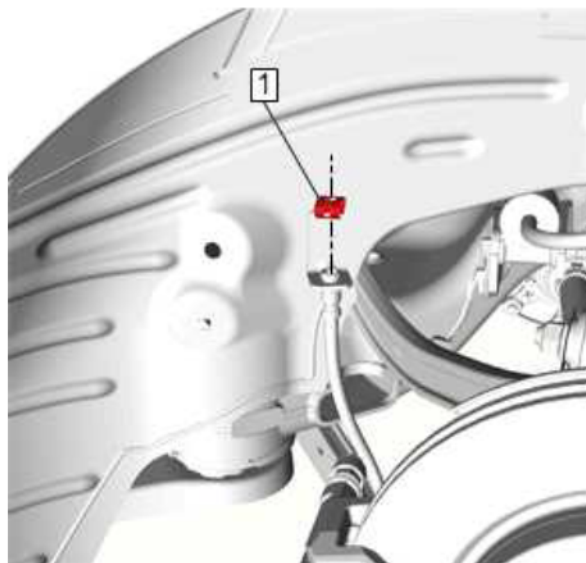


Fig. 141: Brake Hose Retainer

Courtesy of GENERAL MOTORS COMPANY

5. Brake Hose Fitting Bolt (1) » Remove

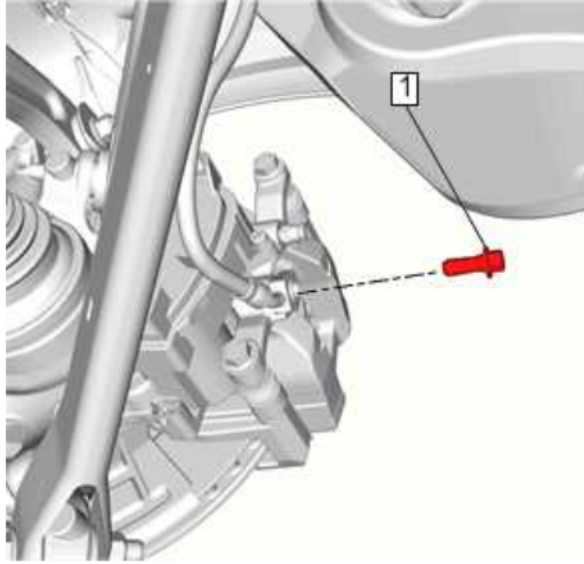


Fig. 142: Brake Hose Fitting Bolt

Courtesy of GENERAL MOTORS COMPANY

6. Brake Hose Fitting Gasket (1) [2x] @ Brake Hose Fitting (2) » Remove and DISCARD

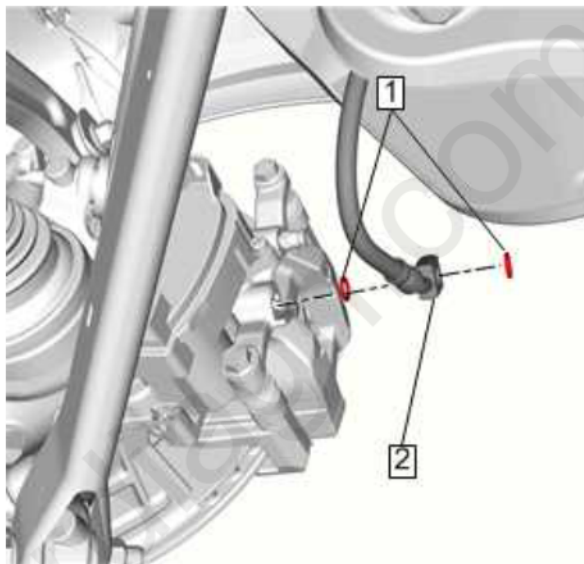
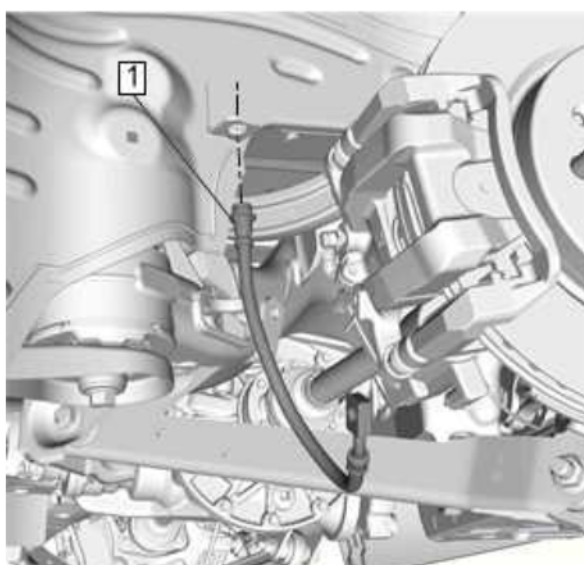


Fig. 143: Brake Hose Fitting Gasket

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT reuse the brake hose fitting gaskets.

7. Plug the caliper inlet to prevent brake fluid loss and contamination.
8. Rear Brake Hose (1) » Remove



Installation Procedure

1. Rear Brake Hose (1) » Install

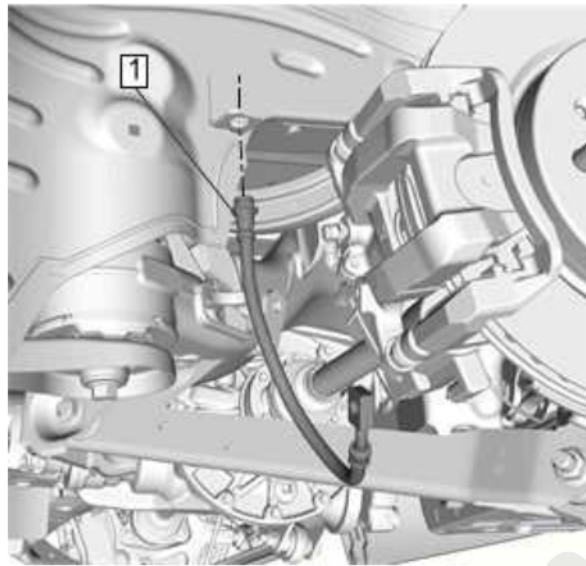


Fig. 145: Rear Brake Hose
Courtesy of GENERAL MOTORS COMPANY

2. Brake Hose Fitting Gasket (1) [2x] @ Brake Hose Fitting (2) » Install

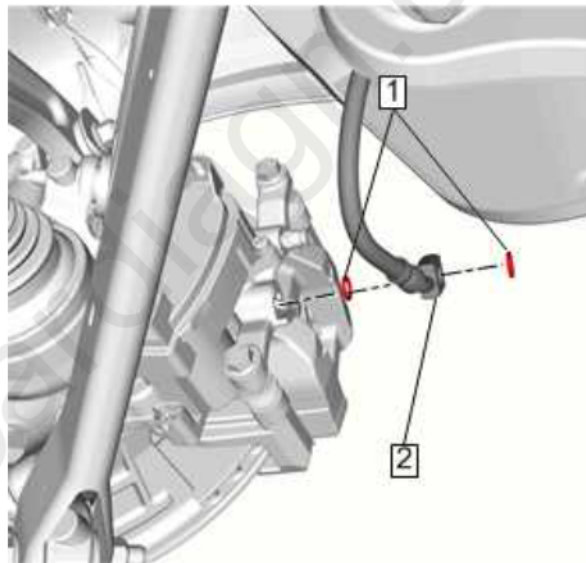


Fig. 146: Brake Hose Fitting Gasket
Courtesy of GENERAL MOTORS COMPANY

NOTE: Install NEW brake hose fitting gaskets.

3. Brake Hose Fitting Bolt (1) » Install and tighten 40 N.m (30 lb ft)

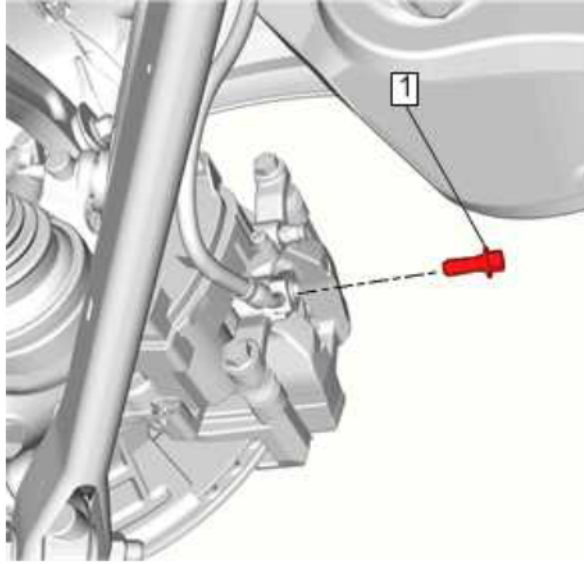


Fig. 147: Brake Hose Fitting Bolt
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

4. Brake Hose Retainer (1) » Install

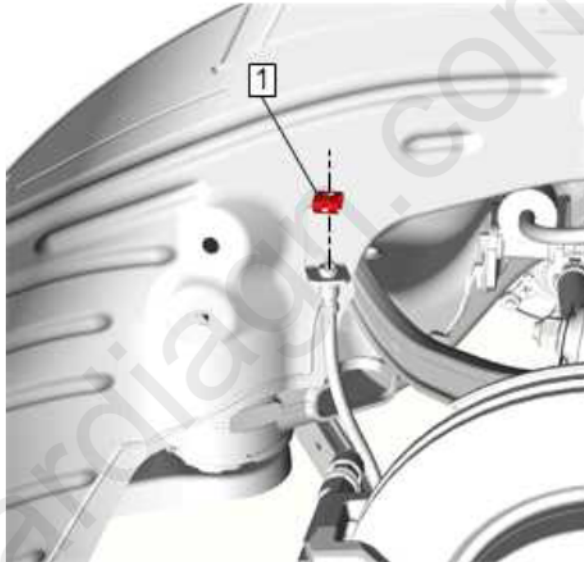
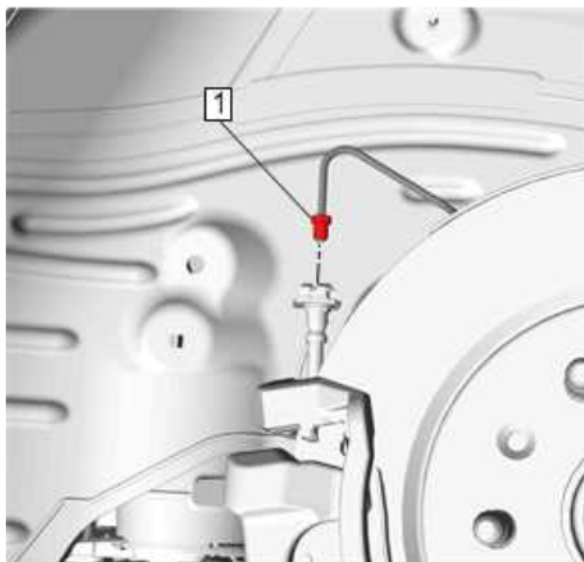


Fig. 148: Brake Hose Retainer
Courtesy of GENERAL MOTORS COMPANY

5. Brake Pipe Fitting (1) » Install and tighten 19 N.m (14 lb ft)



6. Bleed the brake system. Refer to [Hydraulic Brake System Bleeding \(Manual\)](#) and/or [Hydraulic Brake System Bleeding \(Pressure\)](#).
7. [Rear Wheelhouse Liner Replacement \(LTG\)](#), [Rear Wheelhouse Liner Replacement \(LGX, LGW\)](#). A» Install

HYDRAULIC BRAKE SYSTEM BLEEDING (MANUAL)

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

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

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

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

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

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

5. Install a proper box-end wrench onto the RIGHT REAR wheel hydraulic circuit, inboard (fixed caliper), bleeder valve.
6. Install a transparent hose over the end of the bleeder valve.
7. Submerge the open end of the transparent hose into a transparent container partially filled with GM approved brake fluid from a clean, sealed brake fluid container.
8. Have an assistant slowly depress the brake pedal fully and maintain steady pressure on the pedal.
9. Loosen the bleeder valve to purge air from the wheel hydraulic circuit.
10. Tighten the bleeder valve, then have the assistant slowly release the brake pedal.

11. Wait 15 seconds, then repeat steps 8-10 until all air is purged from the same wheel hydraulic circuit.
12. For fixed caliper models, repeat steps 5-11 for the outboard bleeder valve.
13. With the right rear wheel hydraulic circuit bleeder valve or valves (fixed caliper), tightened securely - after all air has been purged from the right rear hydraulic circuit - install a proper box-end wrench onto the LEFT FRONT wheel hydraulic circuit, inner (fixed caliper), bleeder valve.
14. Install a transparent hose over the end of the bleeder valve, then repeat steps 7-11.
15. For fixed caliper models, repeat steps 5-11 for the outboard bleeder valve.
16. With the left front wheel hydraulic circuit bleeder valve or valves (fixed caliper), tightened securely, after all air has been purged from the left front hydraulic circuit, install a proper box-end wrench onto the LEFT REAR wheel hydraulic circuit, inner (fixed caliper), bleeder valve.
17. Install a transparent hose over the end of the bleeder valve, then repeat steps 7-11.
18. For fixed caliper models, repeat steps 5-11 for the outboard bleeder valve.
19. With the left rear wheel hydraulic circuit bleeder valve or valves (fixed caliper), tightened securely, after all air has been purged from the left rear hydraulic circuit, install a proper box-end wrench onto the RIGHT FRONT wheel hydraulic circuit, inner (fixed caliper), bleeder valve.
20. Install a transparent hose over the end of the bleeder valve, then repeat steps 7-11.
21. For fixed caliper models, repeat steps 5-11 for the outboard bleeder valve.
22. After completing the final wheel hydraulic circuit bleeding procedure, ensure that each of the 4 wheel hydraulic circuit bleeder valves or 8 bleeder valves (fixed caliper), are properly tightened.
23. Fill the brake master cylinder reservoir to the maximum-fill level with GM approved brake fluid from a clean, sealed brake fluid container.
24. Slowly depress and release the brake pedal. Observe the feel of the brake pedal.
25. If the brake pedal feels spongy, repeat the bleeding procedure again. If the brake pedal still feels spongy after repeating the bleeding procedure, perform the following steps:
 1. Inspect the brake system for external leaks. Refer to [Brake System External Leak Inspection](#).
 2. Pressure bleed the hydraulic brake system in order to purge any air that may still be trapped in the system.
26. Turn the ignition key ON, with the engine OFF. Check to see if the brake system warning lamp remains illuminated.
27. If the brake system warning lamp remains illuminated. Refer to [Symptoms - Hydraulic Brakes](#).

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

HYDRAULIC BRAKE SYSTEM BLEEDING (PRESSURE)

Special Tools

- J-29532 Diaphragm Type Brake Pressure Bleeder or equivalent
- J-35589 A Master Cylinder Bleeder Adapter

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

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

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

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

2. With the rear brake pipe installed securely to the master cylinder, loosen and separate the front brake pipe from the front port of the brake master cylinder.
 3. Allow a small amount of brake fluid to gravity bleed from the open port of the master cylinder.
 4. Reconnect the brake pipe to the master cylinder port and tighten securely.
 5. Have an assistant slowly depress the brake pedal fully and maintain steady pressure on the pedal.
 6. Loosen the same brake pipe to purge air from the open port of the master cylinder.
 7. Tighten the brake pipe, then have the assistant slowly release the brake pedal.
 8. Wait 15 seconds, then repeat steps 3.3-3.7 until all air is purged from the same port of the master cylinder.
 9. With the front brake pipe installed securely to the master cylinder, after all air has been purged from the front port of the master cylinder, loosen and separate the rear brake pipe from the master cylinder, then repeat steps 3.3-3.8.
 10. After completing the final master cylinder port bleeding procedure, ensure that both of the brake pipe-to-master cylinder fittings are properly tightened.
4. Fill the brake master cylinder reservoir to the maximum-fill level with GM approved brake fluid from a clean, sealed brake fluid container.

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

5. Install the **J-35589-A** Master Cylinder Bleeder Adapter to the brake master cylinder reservoir.
6. Check the brake fluid level in the **J-29532** Diaphragm Type Brake Pressure Bleeder or equivalent. Add GM approved brake fluid from a clean, sealed brake fluid container as necessary to bring the level to approximately the half-full point.
7. Connect the **J-29532** Diaphragm Type Brake Pressure Bleeder or equivalent, to the **J-35589-A** Master Cylinder Bleeder Adapter.
8. Charge the **J-29532** Diaphragm Type Brake Pressure Bleeder or equivalent, air tank to 175-205 kPa (25-30 psi).
9. Open the **J-29532** Diaphragm Type Brake Pressure Bleeder or equivalent, fluid tank valve to allow pressurized brake fluid to enter the brake system.
10. Wait approximately 30 seconds, then inspect the entire hydraulic brake system in order to ensure that there are no existing external brake fluid leaks.

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

11. Install a proper box-end wrench onto the RIGHT REAR wheel hydraulic circuit, inboard (fixed caliper), 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. Allow fluid to flow until air bubbles stop flowing from the bleeder, then tighten the bleeder valve.
15. For fixed caliper models, repeat steps 11-14 for the outboard bleeder valve.
16. With the right rear wheel hydraulic circuit bleeder valve or valves (fixed caliper), tightened securely, after all air has been purged from the right rear hydraulic circuit, install a proper box-end wrench onto the LEFT FRONT wheel hydraulic circuit, inboard (fixed caliper), bleeder valve.
17. Install a transparent hose over the end of the bleeder valve, then repeat steps 13-14.
18. For fixed caliper models, repeat steps 11-14 for the outboard bleeder valve.
19. With the left front wheel hydraulic circuit bleeder valve or valves (fixed caliper), tightened securely, after all air has been purged from the left front hydraulic circuit, install a proper box-end wrench onto the LEFT REAR wheel hydraulic circuit, inner (fixed caliper), bleeder valve.

20. Install a transparent hose over the end of the bleeder valve, then repeat steps 13-14.
21. For fixed caliper models, repeat steps 11-14 for the outboard bleeder valve.
22. With the left rear wheel hydraulic circuit bleeder valve or valves (fixed caliper), tightened securely, after all air has been purged from the left rear hydraulic circuit, install a proper box-end wrench onto the RIGHT FRONT wheel hydraulic circuit, inner (fixed caliper), bleeder valve.
23. Install a transparent hose over the end of the bleeder valve, then repeat steps 13-14.
24. For fixed caliper models, repeat steps 11-14 for the outboard bleeder valve.
25. After completing the final wheel hydraulic circuit bleeding procedure, ensure that each of the 4 wheel hydraulic circuit bleeder valves or 8 bleeder valves (fixed caliper), are properly tightened.
26. Close the **J-29532** Diaphragm Type Brake Pressure Bleeder or equivalent, fluid tank valve, then disconnect the **J-29532** Diaphragm Type Brake Pressure Bleeder or equivalent, from the **J-35589-A** Master Cylinder Bleeder Adapter.
27. Remove the **J-35589-A** Master Cylinder Bleeder Adapter from the brake master cylinder reservoir.
28. Fill the brake master cylinder reservoir to the maximum-fill level with GM approved brake fluid from a clean, sealed brake fluid container.
29. Slowly depress and release the brake pedal. Observe the feel of the brake pedal.
30. If the brake pedal feels spongy perform the following steps:
 1. Inspect the brake system for external leaks. Refer to [Brake System External Leak Inspection](#).
 2. Using a scan tool, perform the antilock brake system automated bleeding procedure to remove any air that may have been trapped in the BPMV. Refer to [Antilock Brake System Automated Bleed](#).
31. Turn the ignition key ON, with the engine OFF. Check to see if the brake system warning lamp remains illuminated.
32. If the brake system warning lamp remains illuminated. Refer to [Symptoms - Hydraulic Brakes](#).

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

HYDRAULIC BRAKE SYSTEM FLUSHING

WARNING: [Brake Fluid Irritant Warning](#)

CAUTION: [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, 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.
 - [Master Cylinder Reservoir Replacement \(Without HP9\)](#)[Master Cylinder Reservoir Replacement \(With HP9\)](#)

- [Master Cylinder Replacement \(Without HP9\)](#)[Master Cylinder Replacement \(With HP9\)](#)
 - [Front Brake Hose Replacement](#)
 - [Rear Brake Hose Replacement](#)
 - [Front Brake Caliper Replacement](#)
 - [Rear Brake Caliper Replacement](#)
 - [Electronic Brake Control Module Replacement](#)
2. Clean out all the hydraulic brake pipes using denatured alcohol or equivalent.
 3. Dry the brake pipes using non-lubricated, filtered air.
 4. Repair or replace ALL of the following components listed and install them to the vehicle. Each component contains internal rubber seals/linings which have been contaminated by the contaminated brake fluid in the brake hydraulic system.

- [Master Cylinder Replacement \(Without HP9\)](#)[Master Cylinder Replacement \(With HP9\)](#); also perform the following:

Clean the brake master cylinder reservoir using denatured alcohol or equivalent, then dry the reservoir using non-lubricated, filtered air. Inspect the reservoir for cracks and/or damage and replace if necessary. Refer to [Master Cylinder Reservoir Replacement \(Without HP9\)](#) and/or [Master Cylinder Reservoir Replacement \(With HP9\)](#)

Replace the brake master cylinder reservoir cap diaphragm.

- [Front Brake Hose Replacement](#)
 - [Rear Brake Hose Replacement](#)
 - [Front Brake Caliper Replacement](#)
 - [Rear Brake Caliper Replacement](#)
 - [Electronic Brake Control Module Replacement](#)
4. If the brake fluid was NOT contaminated with an oil-based or a silicone-based substance, but WAS contaminated with water or dirt, rust, corrosion and/or brake dust, replace the brake master cylinder reservoir cap diaphragm. The diaphragm may have allowed the moisture or particles to enter the hydraulic system.
 5. Fill the brake master cylinder reservoir to the maximum-fill level with approved brake fluid from a clean, sealed brake fluid container as specified in the owners manual.
 6. Pressure bleed the hydraulic brake system. Begin the procedure with the pressure bleeder reservoir filled to the maximum-fill level with the correct brake fluid as indicated. Refer to [Hydraulic Brake System Bleeding \(Manual\)](#) and/or [Hydraulic Brake System Bleeding \(Pressure\)](#)

POWER VACUUM BRAKE BOOSTER REPLACEMENT

Removal Procedure

1. Place the ignition switch in the OFF position.
2. Apply and release the brake pedal several times until the brake pedal becomes firm to deplete the power brake booster vacuum reserve.
3. [Instrument Panel Lower Trim Panel Insulator Replacement - Left Side](#) » Remove
4. Brake Pedal Retainer (1) @ Brake Pedal (2) » Release

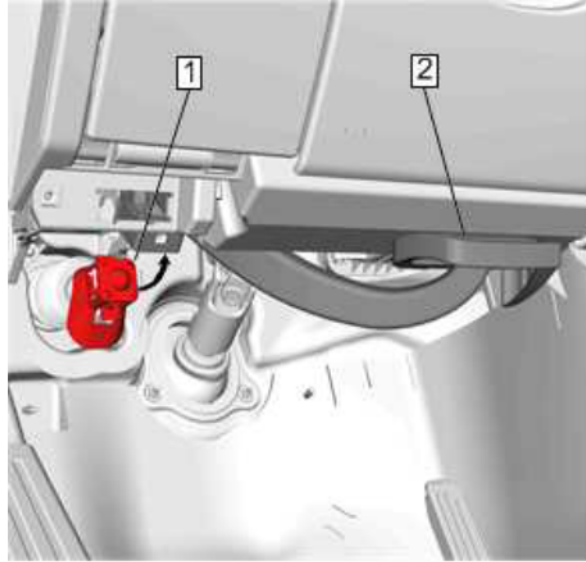


Fig. 150: Brake Pedal Retainer

Courtesy of GENERAL MOTORS COMPANY

5. Brake Pedal Retainer» Remove and DISCARD
6. **Master Cylinder Replacement (Without HP9)Master Cylinder Replacement (With HP9)**» Remove
7. Disconnect the power vacuum brake booster vacuum sensor electrical connector.

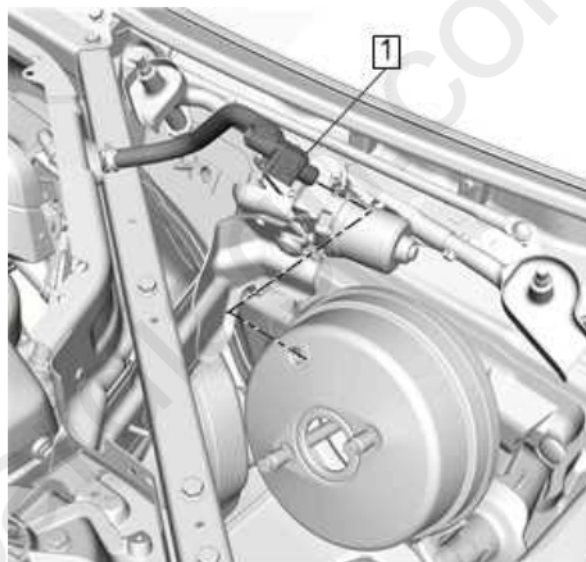


Fig. 151: Power Vacuum Brake Booster Vacuum Sensor

Courtesy of GENERAL MOTORS COMPANY

8. Remove the power vacuum brake booster vacuum sensor (1) and hose assembly and position aside.
9. Power Vacuum Brake Booster Bolt (1)» Loosen [2x]

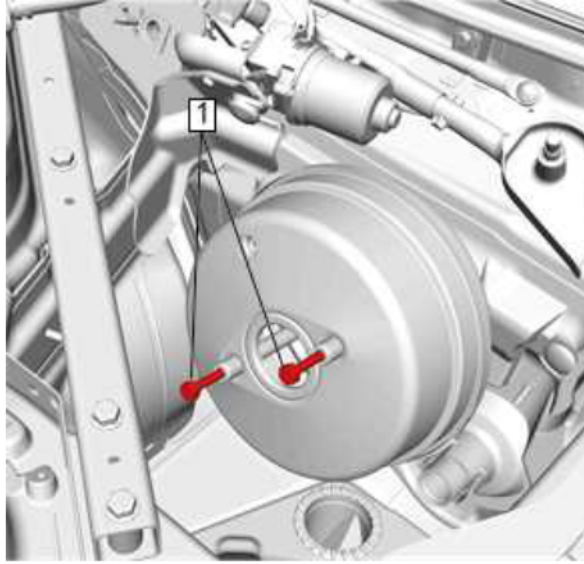


Fig. 152: Power Vacuum Brake Booster Bolt
 Courtesy of GENERAL MOTORS COMPANY

10. Power Vacuum Brake Booster (1) » Remove

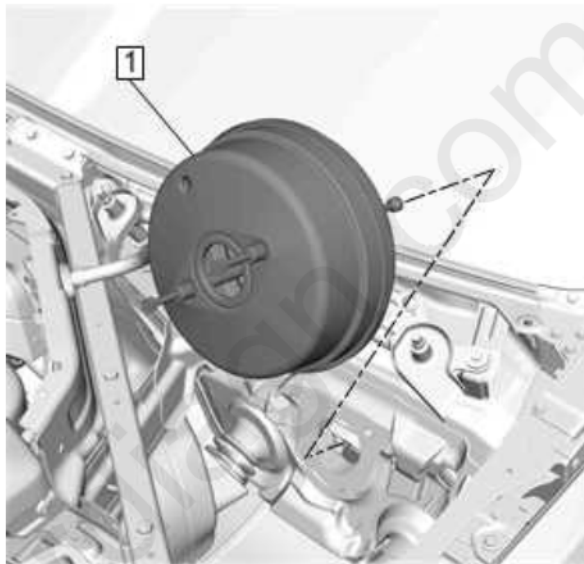


Fig. 153: Power Vacuum Brake Booster
 Courtesy of GENERAL MOTORS COMPANY

Installation Procedure

1. Power Vacuum Brake Booster (1) » Install

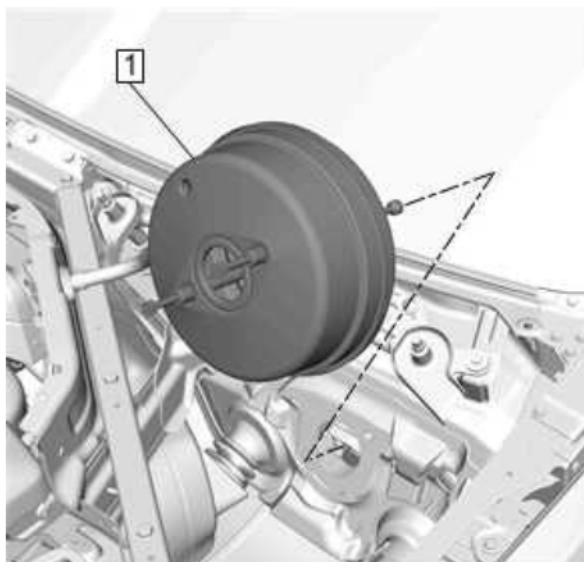


Fig. 154: Power Vacuum Brake Booster
Courtesy of GENERAL MOTORS COMPANY

2. Power Vacuum Brake Booster Bolt (1)» Install and tighten 22 N.m (16 lb ft) [2x]

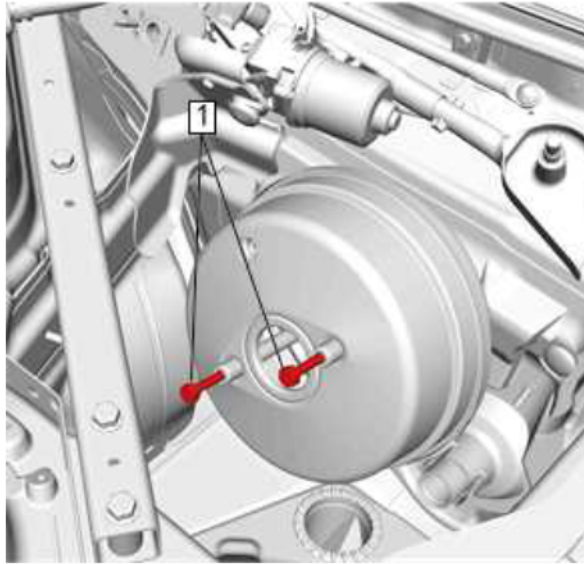


Fig. 155: Power Vacuum Brake Booster Bolt
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

3. Install the power vacuum brake booster vacuum sensor (1) and hose assembly.

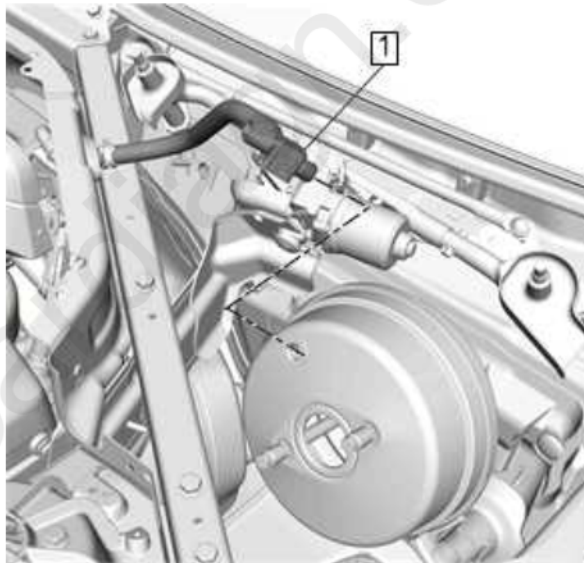


Fig. 156: Power Vacuum Brake Booster Vacuum Sensor
Courtesy of GENERAL MOTORS COMPANY

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

4. Connect the power vacuum brake booster vacuum sensor electrical connector.
5. Brake Pedal Retainer (1) @ Brake Pedal (2)» Secure

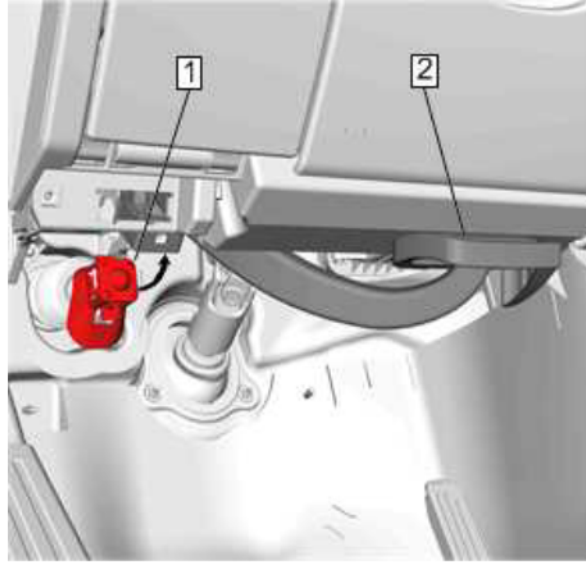


Fig. 157: Brake Pedal Retainer

Courtesy of GENERAL MOTORS COMPANY

NOTE: Install a NEW brake pedal retainer.

6. Instrument Panel Lower Trim Panel Insulator Replacement - Left Side » Install
7. Master Cylinder Replacement (Without HP9) Master Cylinder Replacement (With HP9) » Install

POWER BRAKE BOOSTER VACUUM HOSE REPLACEMENT (LTG)

Removal Procedure

1. Place the ignition switch in the OFF position.
2. Apply and release the brake pedal several times until the brake pedal becomes firm to deplete the power brake booster vacuum reserve.
3. Air Inlet Grille Panel Replacement » Remove
4. Disconnect the power vacuum brake booster vacuum sensor electrical connector.

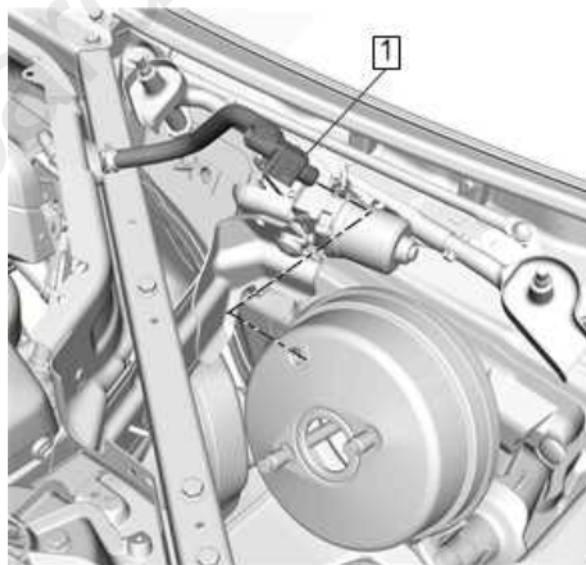


Fig. 158: Power Vacuum Brake Booster Vacuum Sensor

Courtesy of GENERAL MOTORS COMPANY

5. Remove the power vacuum brake booster vacuum sensor (1).
6. Clamp (1) @ Power Brake Booster Vacuum Hose (2) » Release

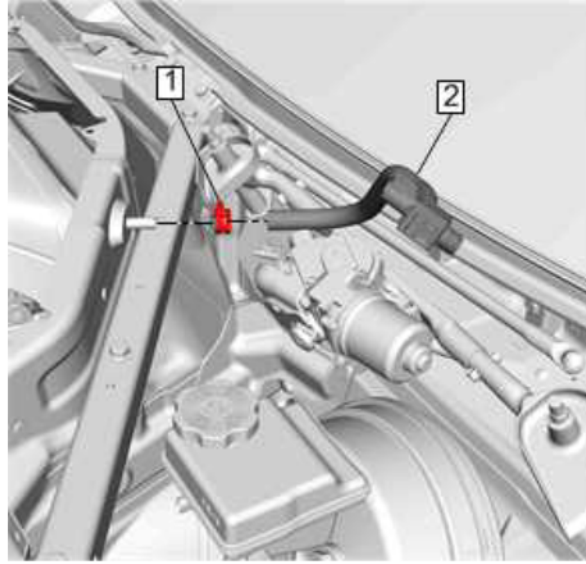


Fig. 159: Power Brake Booster Vacuum Hose
 Courtesy of GENERAL MOTORS COMPANY

7. Power Brake Booster Vacuum Hose @ Power Brake Booster» Remove
8. **Fuel Pump Insulator Replacement** » Remove
9. Power Brake Booster Vacuum Hose Quick Connect Fitting (1) @ Vacuum Pump» Release

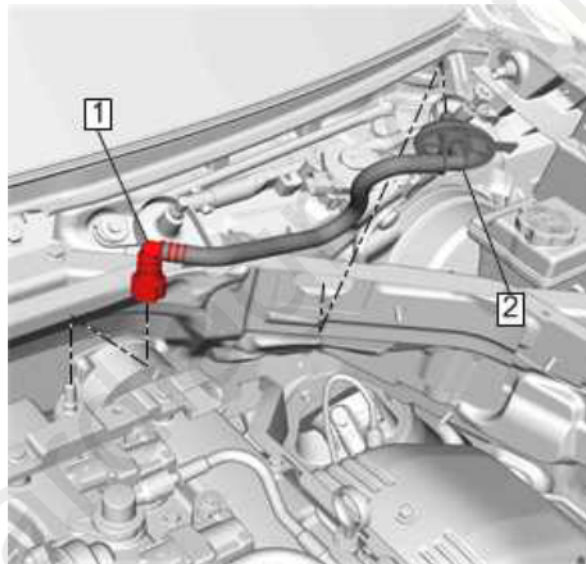


Fig. 160: Power Brake Booster Vacuum Hose Quick Connect Fitting
 Courtesy of GENERAL MOTORS COMPANY

10. Power Brake Booster Vacuum Hose Pass Through Grommet (2)» Release
11. Power Brake Booster Vacuum Hose @ Vacuum Pump» Remove

Installation Procedure

1. Power Brake Booster Vacuum Hose @ Vacuum Pump» Install
2. Power Brake Booster Vacuum Hose Quick Connect Fitting (1) @ Vacuum Pump» Connect

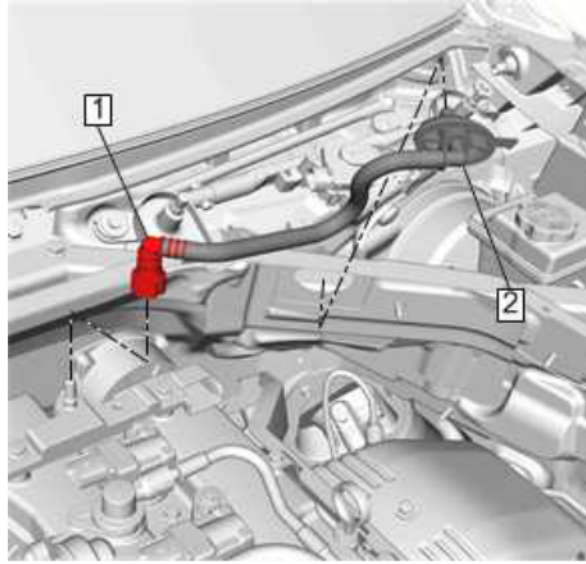


Fig. 161: Power Brake Booster Vacuum Hose Quick Connect Fitting
 Courtesy of GENERAL MOTORS COMPANY

3. Power Brake Booster Vacuum Hose Pass Through Grommet (2)» Secure
4. **Fuel Pump Insulator Replacement** » Install
5. Power Brake Booster Vacuum Hose @ Power Brake Booster» Install
6. Clamp (1) @ Power Brake Booster Vacuum Hose (2)» Secure

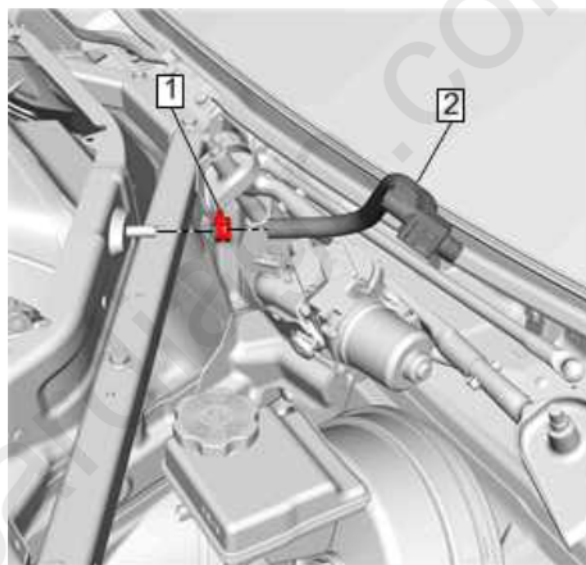
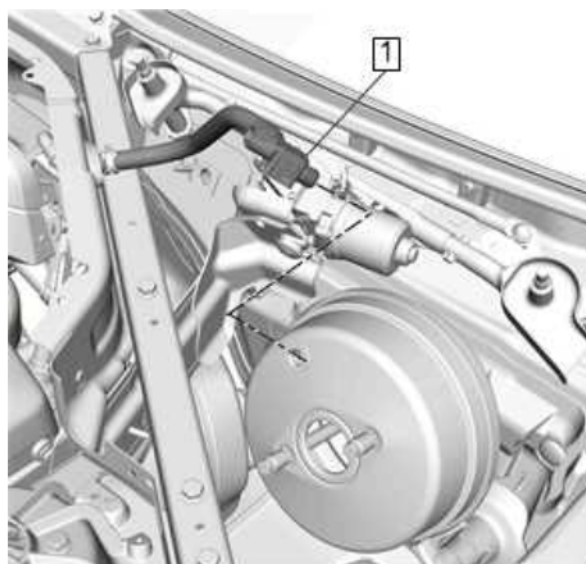


Fig. 162: Power Brake Booster Vacuum Hose
 Courtesy of GENERAL MOTORS COMPANY

7. Install the power vacuum brake booster vacuum sensor (1).



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

8. Connect the power vacuum brake booster vacuum sensor electrical connector.
9. **Air Inlet Grille Panel Replacement** » Install

POWER BRAKE BOOSTER VACUUM HOSE REPLACEMENT (LGW, LGX)

Removal Procedure

1. Place the ignition switch in the OFF position.
2. Apply and release the brake pedal several times until the brake pedal becomes firm to deplete the power brake booster vacuum reserve.
3. **Air Inlet Grille Panel Replacement** » Remove
4. Disconnect the power vacuum brake booster vacuum sensor electrical connector.

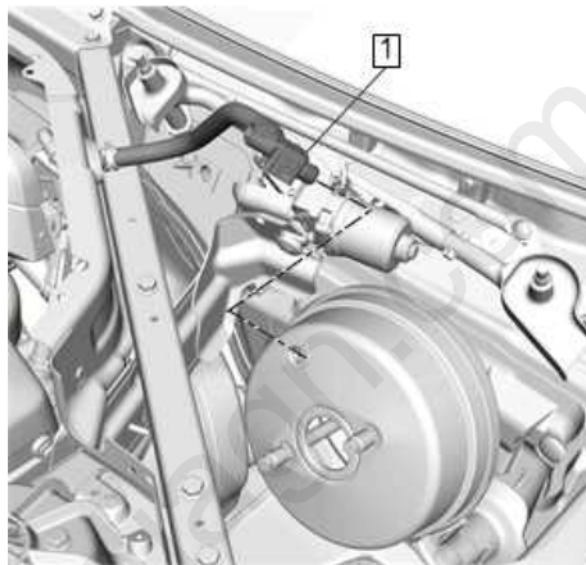


Fig. 164: Power Vacuum Brake Booster Vacuum Sensor
Courtesy of GENERAL MOTORS COMPANY

5. Remove the power vacuum brake booster vacuum sensor (1).
6. Clamp (1) @ Power Brake Booster Vacuum Hose (2) » Release

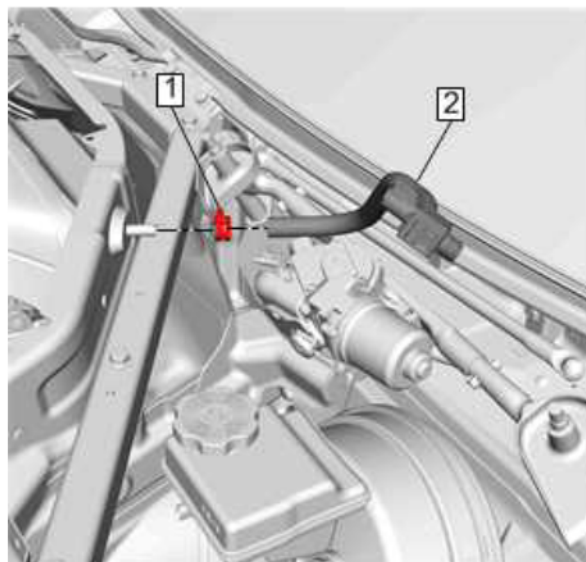


Fig. 165: Power Brake Booster Vacuum Hose
Courtesy of GENERAL MOTORS COMPANY

7. Power Brake Booster Vacuum Hose @ Power Brake Booster» Remove
8. Power Brake Booster Vacuum Hose Pass Through Grommet (1)» Release

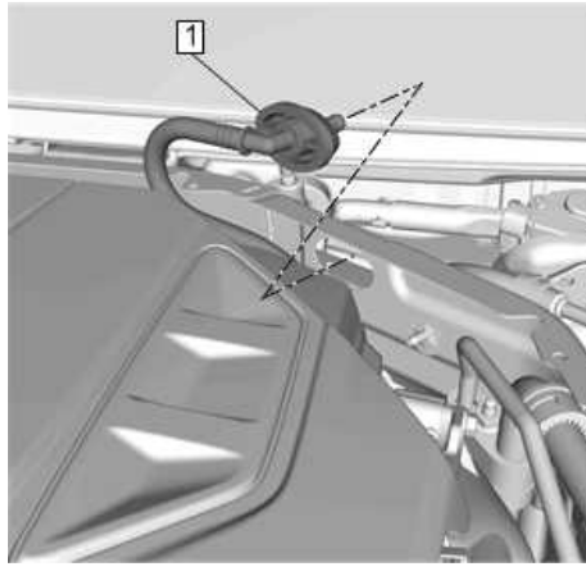


Fig. 166: Power Brake Booster Vacuum Hose Pass Through Grommet
Courtesy of GENERAL MOTORS COMPANY

9. **Warm Up Three-Way Catalytic Converter Replacement (Left, LGW) Warm Up Three-Way Catalytic Converter Replacement (Right, LGW) Warm Up Three-Way Catalytic Converter Replacement (Left, LGX) Warm Up Three-Way Catalytic Converter Replacement (Right, LGX) Left Side» Remove**
10. Power Brake Booster Vacuum Hose Quick Connect Fitting (1) @ Vacuum Pipe» Release

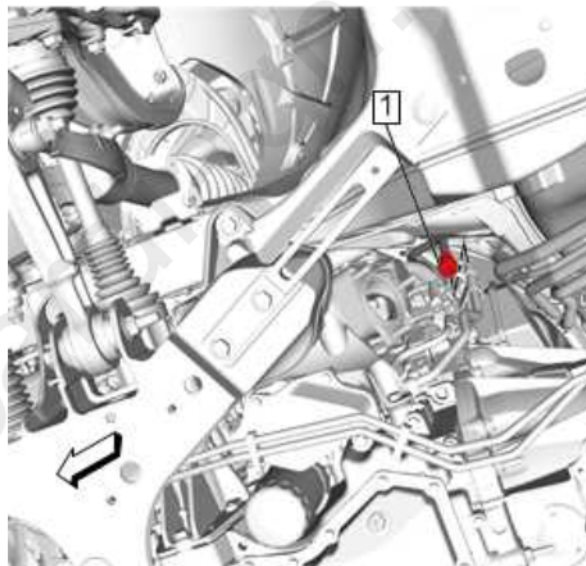


Fig. 167: Power Brake Booster Vacuum Hose Quick Connect Fitting And Vacuum Pipe
Courtesy of GENERAL MOTORS COMPANY

11. Power Brake Booster Vacuum Hose @ Vacuum Pipe» Remove

Installation Procedure

1. Power Brake Booster Vacuum Hose @ Vacuum Pipe» Install
2. Power Brake Booster Vacuum Hose Quick Connect Fitting (1) @ Vacuum Pipe» Connect

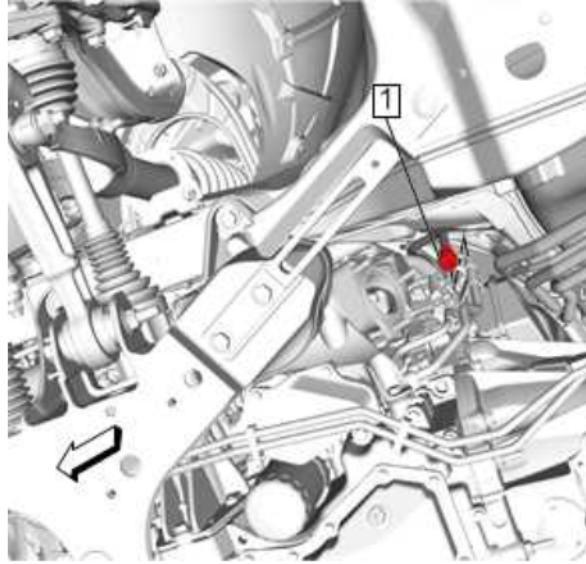


Fig. 168: Power Brake Booster Vacuum Hose Quick Connect Fitting And Vacuum Pipe
 Courtesy of GENERAL MOTORS COMPANY

3. **Warm Up Three-Way Catalytic Converter Replacement (Left, LGW) Warm Up Three-Way Catalytic Converter Replacement (Right, LGW) Warm Up Three-Way Catalytic Converter Replacement (Left, LGX) Warm Up Three-Way Catalytic Converter Replacement (Right, LGX)** Left Side» Install
4. Power Brake Booster Vacuum Hose Pass Through Grommet (1)» Secure

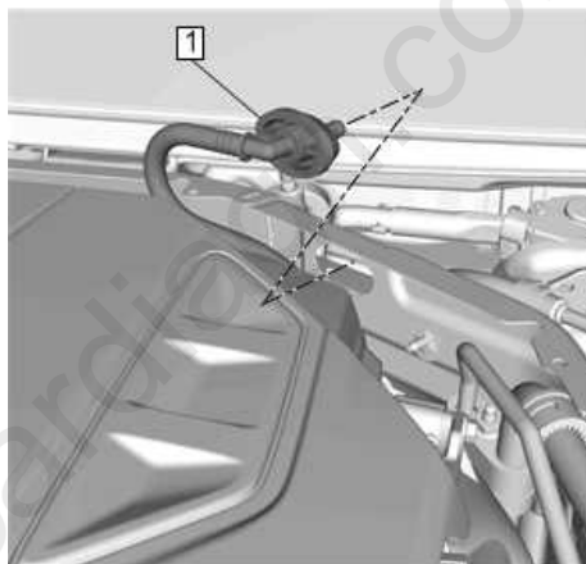


Fig. 169: Power Brake Booster Vacuum Hose Pass Through Grommet
 Courtesy of GENERAL MOTORS COMPANY

5. Power Brake Booster Vacuum Hose @ Power Brake Booster» Install
6. Clamp (1) @ Power Brake Booster Vacuum Hose (2)» Secure

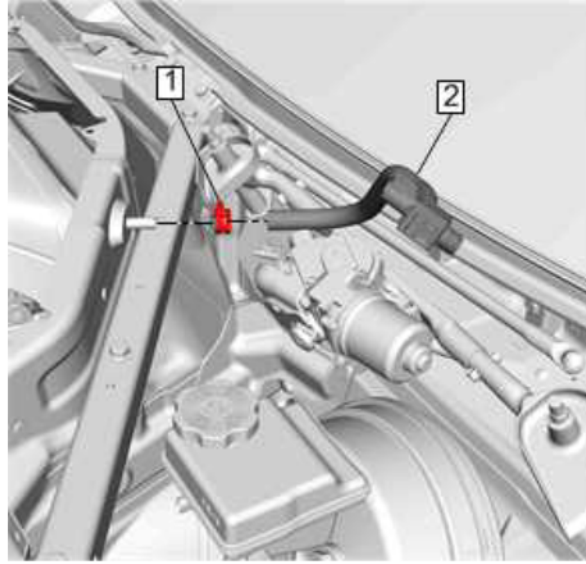


Fig. 170: Power Brake Booster Vacuum Hose
Courtesy of GENERAL MOTORS COMPANY

7. Install the power vacuum brake booster vacuum sensor (1).

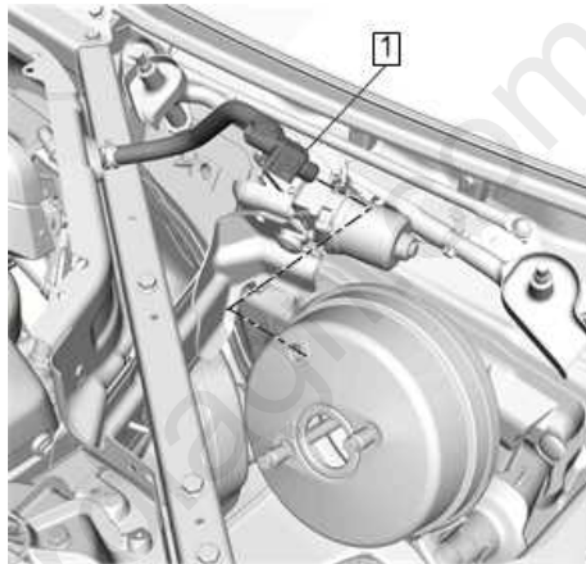


Fig. 171: Power Vacuum Brake Booster Vacuum Sensor
Courtesy of GENERAL MOTORS COMPANY

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

8. Connect the power vacuum brake booster vacuum sensor electrical connector.
9. [Air Inlet Grille Panel Replacement](#) » Install

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 brake pedal to 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 boosters or to both sides of each of the diaphragms for tandem boosters. Return springs maintain the booster in a rest position.

When brake system input force is applied, vacuum to the rear of the diaphragm(s) 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 primary source for vacuum is typically the vehicle's internal combustion engine. Some vehicles may use a vacuum pump to ensure an adequate supply of vacuum under various operating conditions, such as during cold start-up, heavy throttle and high altitude.

Vacuum Pump Relay

Vehicles equipped with a vacuum pump will typically be equipped with a relay used to provide voltage to the vacuum pump motor, when commanded by the powertrain controller.

Vacuum Monitoring System

Provides a feedback voltage signal relative to the amount of vacuum available for the vacuum power brake booster.

This typically consists of a vacuum sensor mounted either into the power vacuum brake booster, integrated with the vacuum check valve or in-line within the vacuum hose. The sensor feedback is typically monitored by the powertrain control module(s).

Vacuum Source Control

If equipped with a system to monitor available levels of vacuum for the brake assist system, the powertrain control module(s) typically perform the primary monitoring function.

The powertrain controller will typically monitor the feedback signal of a vacuum sensor, as it relates to available vacuum at the vacuum power brake booster. The powertrain controller uses the information to make sure available vacuum remains above predetermined levels. If additional vacuum is required, the powertrain controller may reactivate engine cylinders, if equipped or command a vacuum pump ON, if equipped and/or may alter the operation of various other engine controls and devices, as necessary.

Vacuum Source Delivery System

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

This typically consists of a vacuum check valve and a vacuum hose or pipe. If a vacuum pump is used, additional check valves may be used.

System Operation

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

When brake system force is applied, vacuum to the rear of the diaphragm(s) is cut off and air at atmospheric pressure is admitted in its place. The vacuum acts to pull the diaphragm(s) forward, while the atmospheric pressure acts to push from behind. As a result, the amount of effort required by the driver is reduced. When input force is removed, vacuum again replaces atmospheric pressure within the vacuum power brake booster to help return the booster to rest. Return springs maintain the system in a rest position.

If the vehicle is equipped with a vacuum monitoring system, the powertrain control module(s) typically will alter powertrain functions and/or command the vacuum pump ON, if equipped, to provide for the vacuum needs of the brake assist system, as operating conditions warrant.

BRAKE BOOSTER VACUUM ASSIST DESCRIPTION AND OPERATION

System Component Description

The brake booster vacuum assist system consists of the following:

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

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. When the vehicle is equipped with Stop/Start System the brake booster vacuum sensor provides also feedback to the engine control module.

System Operation

The electronic brake control module (EBCM) actuates the auxiliary brake booster pump to generate additional vacuum to the vacuum brake booster if low vacuum is detected by brake booster vacuum sensor.

BRAKE WARNING SYSTEM DESCRIPTION AND OPERATION

Brake Warning Indicator

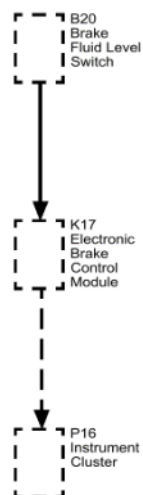


Fig. 172: Brake Warning Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
P16	P16 Instrument Cluster
B20	B20 Brake Fluid Level Switch
K17	K17 Electronic Brake Control Module

The instrument cluster turns the brake warning indicator ON when the following occurs:

- The instrument cluster performs the bulb check. The brake warning indicator illuminates for 5 seconds.
- When the EBCM detects a too low brake fluid level it sets a DTC and sends a serial data message to the instrument cluster, which will illuminate.

Electronic brake control module (EBCM) monitors the brake fluid level in the brake fluid reservoir. When the fluid within the brake fluid reservoir is below the MIN level, contacts within the brake fluid level switch closes causing the voltage within the signal circuit to drop. The electronic brake control module (EBCM) will detect the voltage drop and will send a serial data message to the instrument cluster commanding the brake warning indicator to illuminate.

HYDRAULIC BRAKE SYSTEM DESCRIPTION AND OPERATION

System Component Description

The hydraulic brake system consists of the following:

Hydraulic Brake Master Cylinder Fluid Reservoir

Contains supply of brake fluid for the hydraulic brake system.

Hydraulic Brake Master Cylinder

Converts mechanical input force into hydraulic output pressure.

Hydraulic output pressure is distributed from the master cylinder through 2 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 is achieved through dynamic rear proportioning (DRP), which is a function of the ABS modulator.

Hydraulic Brake Pipes and Flexible Brake Hoses

Carries brake fluid to and from hydraulic brake system components.

Hydraulic Brake Wheel Apply Components

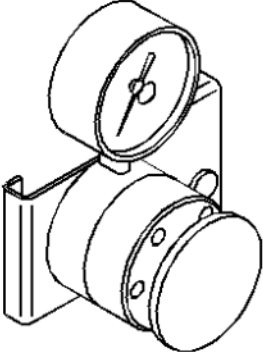
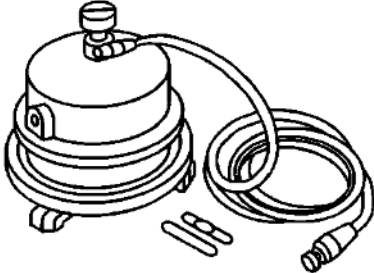
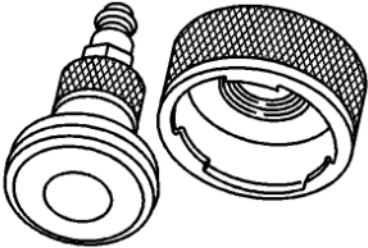
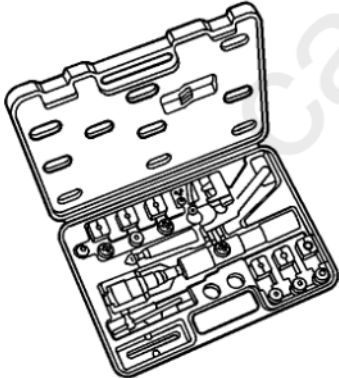
Converts hydraulic input pressure into mechanical output force.

System Operation

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

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description
	CH 28662 J 28662 Brake Pedal Effort Gauge
	CH 29532-A J 29532-B Pressure Brake Bleeder
	CH 44894-A J 44894-A Brake Bleeder Adapter
	CH 45405 J 45405 Brake Pipe Flaring Kit