

## 2021 BRAKES

### Hydraulic Brakes - Canyon, Colorado

## SPECIFICATIONS

### FASTENER SPECIFICATIONS

#### Single Use Non-Threaded Fasteners/Components

| <b>NOTE:</b><br><i>All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.</i> |  |
|-----------------------------------------------------------------------------------------------------------------------------|--|
| Application                                                                                                                 |  |
| Front Brake Hose Washer                                                                                                     |  |
| Rear Brake Hose Fitting Gasket                                                                                              |  |

#### Single Use Threaded Fastener/Component Tightening Specifications

| <b>NOTE:</b><br><i>All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.</i> |                   |
|-----------------------------------------------------------------------------------------------------------------------------|-------------------|
| Application                                                                                                                 | Specification     |
|                                                                                                                             | Metric (English)  |
| Master Cylinder Nut                                                                                                         | 25 N.m (18 lb ft) |

#### Reusable Threaded Fastener Tightening Specifications

| <b>NOTE:</b><br><i>All fasteners listed in this table can be reused after removal.</i> |                   |
|----------------------------------------------------------------------------------------|-------------------|
| Application                                                                            | Specification     |
|                                                                                        | Metric (English)  |
| Brake Hose Bracket Bolt                                                                | 16 N.m (12 lb ft) |
| Brake Master Cylinder Reservoir Bolt                                                   | 8 N.m (71 lb in)  |
| Brake Pedal Assembly Upper Nut                                                         | 23 N.m (17 lb ft) |
| Brake Pedal Pushrod Bolt                                                               | 10 N.m (89 lb in) |
| Brake Pipe Fitting - At Rear Brake Hose Assembly                                       | 18 N.m (13 lb ft) |
| Front Brake Hose Fitting Bolt                                                          | 44 N.m (32 lb ft) |
| Front Brake Pipe Nut                                                                   | 17 N.m (13 lb ft) |
| Master Cylinder Primary Brake Pipe Fitting                                             | 45 N.m (33 lb ft) |
| Master Cylinder Secondary Brake Pipe Fitting                                           | 45 N.m (33 lb ft) |
| Power Brake Booster Nut                                                                | 23 N.m (17 lb ft) |
| Power Brake Booster Pump Bracket Nut                                                   | 22 N.m (16 lb ft) |

**NOTE:**

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

| Application                           | Specification     |
|---------------------------------------|-------------------|
|                                       | Metric (English)  |
| Power Brake Booster Pump M8 Bolt      | 22 N.m (16 lb ft) |
| Power Brake Booster Pump M12 Bolt     | 70 N.m (52 lb ft) |
| Rear Brake Hose Assembly Bracket Bolt | 16 N.m (12 lb ft) |
| Rear Brake Hose Fitting Bolt          | 34 N.m (25 lb ft) |

**APPROXIMATE FLUID CAPACITIES**

| Application            | Specification |            |
|------------------------|---------------|------------|
|                        | Metric        | US English |
| Hydraulic Brake System | 1.0 L         | 2.1 pt     |

**BRAKE COMPONENT SPECIFICATIONS**

| Application                 | Specification |          |
|-----------------------------|---------------|----------|
|                             | Metric        | English  |
| Brake Caliper Bleeder Valve | 17 N.m        | 13 lb ft |

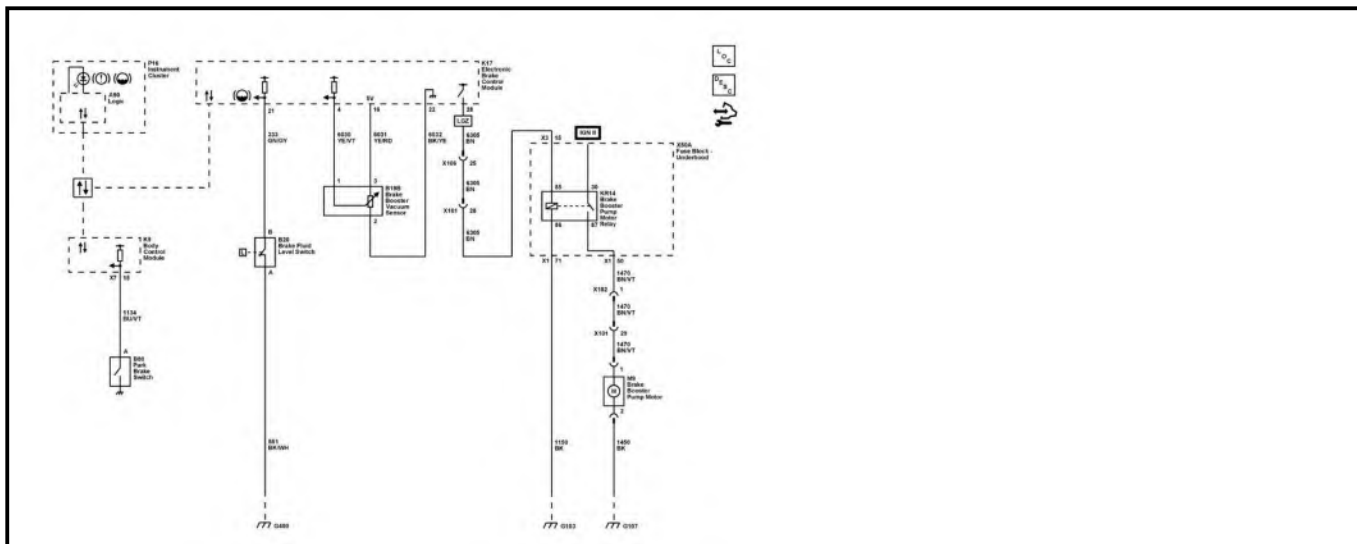
**BRAKE SYSTEM SPECIFICATIONS**

| Application                                                                                                                               | Specification |         |
|-------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------|
|                                                                                                                                           | Metric        | English |
| Brake Pedal Maximum Travel*                                                                                                               |               |         |
| • Vacuum Power Assist                                                                                                                     | 49 mm         | 1.9 in  |
| * Specification with 445 N (100 lbs) of force applied to the brake pedal, the ignition OFF, and the brake booster power reserve depleted. |               |         |

**ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS**

| Application               | Type of Material                | GM Part Number |          |
|---------------------------|---------------------------------|----------------|----------|
|                           |                                 | United States  | Canada   |
| Brake Pedal Push Rod Bolt | Threadlocker                    | 19369733       | 10953488 |
| Hydraulic Brake System    | DOT 3 Motor Vehicle Brake Fluid | 19299818       | 19299819 |

**SCHEMATIC WIRING DIAGRAMS****HYDRAULIC BRAKE WIRING SCHEMATICS****Hydraulic Brakes**



## DIAGNOSTIC INFORMATION AND PROCEDURES

### DTC C025E

#### 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 Booster Vacuum 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 | C025E 02        | C025E 00             | C025E 01         | -                  |
| Signal        | C025E 00        | C025E 00             | C025E 00         | C025E 09, C025E 5A |
| Low Reference | -               | C025E 00             | -                | -                  |

#### Circuit/System Description

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

#### Conditions for Running the DTC

Ignition ON.

#### Conditions for Setting the DTC

### C025E 00

- A short to ground, short to voltage or open/high resistance is detected on the signal circuit.
- An open/high resistance is detected on the 5 V reference circuit.
- An open/high resistance is detected on the low reference circuit.

- The electronic brake control module detects an erratic vacuum sensor signal.

#### **C025E 01**

A short to voltage is detected on the vacuum sensor 5 V reference circuit.

#### **C025E 02**

A short to ground is detected on the vacuum sensor 5 V reference circuit.

#### **C025E 09**

The vacuum sensor signal too fast transitions.

#### **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 Wiring Schematics**

Connector End View Reference

**Master Electrical Component List** , or **Inline Harness Connector End Views - Index** or **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 Testing**

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B19B Brake Booster Vacuum Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10  $\Omega$  between the low reference circuit terminal 2 and ground.
  - **If 10  $\Omega$  or greater**
    1. Disconnect the harness connector at the K17 Electronic Brake Control Module.
    2. Test for less than 2  $\Omega$  in the low reference circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , replace the K17 Electronic Brake Control Module.

- **Go to next step: If less than 10  $\Omega$**

3. Ignition ON.

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

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

- If less than infinite resistance, repair the short to ground on the circuit.
- Go to next step: If infinite resistance

3. Test for less than 2  $\Omega$  in the 5 V reference circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , replace the K17 Electronic Brake Control Module.

- **If greater than 5.2 V**

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

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

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K17 Electronic Brake Control Module.

- **Go to next step: If between 4.8 - 5.2 V**

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

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

- **If greater than 1 V**

Repair the short to voltage on the circuit.

- **Go to next step: If less than 1 V**

7. Ignition OFF.

8. 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.

- **Go to next step: If infinite resistance**

9. Test for less than 2  $\Omega$  between the B19B Brake Booster Vacuum Sensor signal circuit terminal 1 and the K17 Electronic Brake Control Module signal circuit terminal 4.

- **If 2  $\Omega$  or greater**

Repair the open/high resistance in the circuit.

- **Go to next step: If less than 2  $\Omega$**

10. Replace the B19B Brake Booster Vacuum Sensor.

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

- **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

- **Go to next step: If the DTC does not set**

12. All OK.

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

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

## DTC C0267

### 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        | C0273 00             | C0273 00         | -                  |
| Ground  | -               | C0273 00             | -                | -                  |

### 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 is low the electronic brake control module will set the DTC.

### Conditions for Running the DTC

Ignition ON.

### Conditions for Setting the DTC

Low brake fluid level is detected for 8 s.

### Action Taken When the DTC Sets

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

### Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

### Reference Information

Schematic Reference

### [Hydraulic Brake Wiring Schematics](#)

Connector End View Reference

[Master Electrical Component List](#) , or [Inline Harness Connector End Views - Index](#) or [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 is above minimum level.

- **If low**

Refer to [Brake Fluid Loss](#).

- **Go to next step: If above minimum level**

Go to next step: Refer to Circuit/System Testing.

#### Circuit/System Testing

1. Ignition 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  $\Omega$  between the ground circuit terminal A and ground.

- **If 10  $\Omega$  or greater**

1. Ignition OFF.

2. Test for less than 2  $\Omega$  in the ground circuit end to end.

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

- **If less than 10  $\Omega$**

3. Ignition ON.

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

- **If the parameter is not OK**

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

2. Test for infinite resistance between the signal circuit terminal B 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.

- **Go to next step: If the parameter is OK**

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

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

- **If the parameter is not Low**

1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, 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.
- Go to next step: If less than 1 V.

3. Test for less than 2  $\Omega$  in the signal circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , replace the K17 Electronic Brake Control Module.
- **Go to next step: 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 Master Cylinder Replacement](#)
- [Control Module References](#) for electronic brake control module replacement, programming and setup.

## DTC C0273

### 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 C0273

Brake Fluid Level Switch 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        | C0273 00             | C0273 00         | -                  |
| Ground  | -               | C0273 00             | -                | -                  |

### 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 is low the electronic brake control module will set the DTC.

### Conditions for Running the DTC

Ignition ON.

### Conditions for Setting the DTC

A open or short to battery is detected on the signal circuit.

### Action Taken When the DTC Sets

- The brake warning indicator turns ON.
- ABS indicator turns ON.
- Traction control indicator turns ON.

### Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

### Reference Information

Schematic Reference

## Hydraulic Brake Wiring Schematics

Connector End View Reference

Master Electrical Component List , or Inline Harness Connector End Views - Index or 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, 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  $\Omega$  between the ground circuit terminal A and ground.
  - **If 10  $\Omega$  or greater**
    1. Ignition OFF.
    2. Test for less than 2  $\Omega$  in the ground circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , repair the open/high resistance in the ground connection.
  - **Go to next step: If less than 10  $\Omega$**
3. Ignition ON.
4. Verify the scan tool Brake Fluid Level Sensor parameter is OK.
  - **If the parameter is not OK**
    1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.
    2. Test for infinite resistance between the signal circuit terminal B 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.
  - **Go to next step: If the parameter is OK**
5. Install a 3 A fused jumper wire between the signal circuit terminal B and ground.
6. Verify the scan tool Brake Fluid Level Sensor parameter is Low.
  - **If the parameter is not Low**
    1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, 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.
      - Go to next step: If less than 1 V.
    3. Test for less than 2  $\Omega$  in the signal circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K17 Electronic Brake Control Module.
  - **Go to next step: 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 Master Cylinder Replacement](#)
- [Control Module References](#) for electronic brake control module replacement, programming and setup.

### DTC C027B

#### 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 C027B 00

Brake Booster Electric Vacuum Pump

#### Diagnostic Fault Information

| Circuit                               | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|---------------------------------------|-----------------|----------------------|------------------|--------------------|
| Vacuum Pump Relay B+                  | -               | -                    | -                | -                  |
| Vacuum Pump Relay Control             | C027B 00        | C027B 00             | 1                | -                  |
| Vacuum Pump Relay Ground              | -               | -                    | -                | -                  |
| Brake Booster Pump Motor Control      | -               | -                    | 1                | -                  |
| Brake Booster Pump Motor Ground       | -               | -                    | -                | -                  |
| 1. Brake Booster Pump Motor Always ON |                 |                      |                  |                    |

#### Circuit/System Description

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

#### Conditions for Running the DTC

Ignition ON.

#### Conditions for Setting the DTC

An open or short to voltage is detected on the relay control circuit.

#### Action Taken When the DTC Sets

The DTC is stored in memory.

#### Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

#### Reference Information

Schematic Reference

### [Hydraulic Brake Wiring Schematics](#)

Connector End View Reference

[Master Electrical Component List](#) , or [Inline Harness Connector End Views - Index](#) or [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. 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](#)

- **Go to next step: If no damage, leakage or incorrect installation is found**

2. Ignition ON.

3. Verify the brake booster pump motor turns ON and OFF when commanding the Brake Booster Electric Vacuum Pump On and Off with a scan tool.

- **If the brake booster pump motor does not turn ON and OFF**

Refer to Circuit/System Testing.

- **Go to next step: If the brake booster pump motor turns ON and OFF**

4. Verify the brake booster pump parameter is more than 40 kPa (12 in Hg) when commanding the brake booster electric vacuum pump ON.

- **If the brake booster pump parameter is less than 40 kPa (12 in Hg)**

Replace the M9 Brake Booster Pump Motor.

- **Go to next step: If the brake booster pump parameter is more than 40kPa (12 in Hg)**

5. All OK.

### [Circuit/System Testing](#)

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

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

2. Test for less than 10  $\Omega$  between the ground circuit terminal 86 and ground.

- **If 10  $\Omega$  or greater**

1. Test for less than 2  $\Omega$  in the ground circuit end to end.

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

- **Go to next step: If less than 10  $\Omega$**

3. Ignition ON.

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

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

1. Ignition OFF.

2. Test for less than 2  $\Omega$  in the B+ circuit end to end.

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

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

1. Ignition OFF.

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

- If less than infinite resistance, repair the short to ground on the circuit.
- Go to next step: If infinite resistance

3. Ignition OFF, disconnect the harness connector at the M9 Brake Booster Pump Motor.

4. Test for infinite resistance between the brake booster pump motor control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the M9 Brake Booster Pump Motor.

- **Go to next step: If the test lamp illuminates**

5. Connect a test lamp between the control circuit terminal 85 and ground.

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

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

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

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

- If less than infinite resistance, repair the short to ground on the circuit.
- Go to next step: If infinite resistance

3. Test for less than 2  $\Omega$  in the control circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , replace the K17 Electronic Brake Control Module.

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

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

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

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K17 Electronic Brake Control Module.

- **Go to next step: If the test lamp turns ON and OFF**

7. Replace the KR14 Brake Booster Pump Motor Relay.

## Repair Instructions

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

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

## 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 C0299

Brake Booster Large Vacuum Leak Detected

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 electronic brake control module (EBCM) supplies a 5 V reference and a low reference circuit to the brake booster vacuum sensor. The vacuum sensor supplies a voltage signal in relation to the pressure in the brake booster to the electronic brake control module.

## Conditions for Running the DTC

- Engine running for a minimum of three minutes.
- Brake switch is off.

## Conditions for Setting the DTC

The EBCM detected a too low vacuum in the brake booster assembly.

## 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 brake control module will turn OFF the indicator in the next ignition cycle.

## Reference Information

Schematic Reference

## Hydraulic Brake Wiring Schematics

Connector End View Reference

[Master Electrical Component List](#) , or [Inline Harness Connector End Views - Index](#) or [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

### Circuit/System Testing

1. Ignition ON.
2. Verify that DTC C025E is not set.
  - **If the DTC is set**  
  
Refer to **DTC C025E**.
  - **Go to next step: 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**.
  - **Go to next step: 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.
  - **Go to next step: 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 (LCV)**, or **Power Brake Booster Vacuum Hose Replacement (LWN)**, or **Power Brake Booster Vacuum Hose Replacement (LGZ)** for brake booster vacuum sensor replacement
- **Control Module References** for electronic brake control module replacement, programming and setup

## **SYMPTOMS - HYDRAULIC BRAKES**

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

1. Perform **Diagnostic System Check - Vehicle** before using the brake indicator symptom tables in order to verify that all of the following are true:
  - There are no DTCs set.
  - The control module(s) can communicate via the serial data link.
2. Perform the **Brake System Vehicle Road Test** before using the hydraulic brake symptom tables in order to duplicate the customer's concern.
3. Review the system operation in order to familiarize yourself with the system functions. Refer to the following:
  - **Brake Warning System Description and Operation**
  - **Hydraulic Brake System Description and Operation**
  - **Brake Assist System Description and Operation**
  - **Disc Brake System Description and Operation**

### Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the brake warning 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 BOOSTER PUMP MOTOR MALFUNCTION

### Diagnostic Instructions

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

### Diagnostic Fault Information

| Circuit                                                                         | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|---------------------------------------------------------------------------------|-----------------|----------------------|------------------|--------------------|
| Brake Booster Pump Motor Relay B+                                               | 1               | 1                    | -                | -                  |
| Brake Booster Pump Motor Control                                                | 1               | 1                    | 2                | -                  |
| Brake Booster Pump Motor Relay Control                                          | 1               | 1                    | 2                | -                  |
| Brake Booster Pump Motor Relay Ground                                           | -               | 1                    | -                | -                  |
| Brake Booster Pump Motor Ground                                                 | -               | 1                    | 1                | -                  |
| 1. Brake Booster Pump Motor Always Off<br>2. Brake Booster Pump Motor Always ON |                 |                      |                  |                    |

### Circuit/System Description

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

### Reference Information

Schematic Reference

## Hydraulic Brake Wiring Schematics

Connector End View Reference

Master Electrical Component List , or Inline Harness Connector End Views - Index or 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

Scan Tool Reference

## Control Module References

### Circuit/System Verification

1. 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
  - **Go to next step: If no damage, leakage or incorrect installation is found**
2. Ignition ON.
3. Verify the M9 Brake Booster Pump Motor turns ON and OFF when commanding the Brake Booster Electric Vacuum Pump On and Off with a scan tool.
  - **If the M9 Brake Booster Pump Motor does not turn ON and OFF**  
Refer to Circuit/System Testing.
  - **Go to next step: If the M9 Brake Booster Pump Motor turns ON and OFF**
4. Verify the brake booster electric vacuum pump parameter is more than 40 kPa (12 in Hg) when commanding the brake booster electric vacuum pump ON.
  - **If the brake booster electric vacuum pump parameter is less than 40 kPa (12 in Hg)**  
Replace the M9 Brake Booster Pump Motor.
  - **Go to next step: If the brake booster electric vacuum pump parameter is more than 40kPa (12 in Hg)**
5. All OK.

### Circuit/System Testing

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

1. Ignition OFF and all vehicle systems OFF, disconnect the KR14 Brake Booster Pump Motor Relay. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10  $\Omega$  between the ground circuit terminal 86 and ground.
  - **If 10  $\Omega$  or greater**
    1. Ignition OFF.
    2. Test for less than 2  $\Omega$  in the ground circuit end to end.

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

- **Go to next step: If less than 10  $\Omega$**

3. Ignition ON.

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

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

1. Ignition OFF.

2. Test for less than 2  $\Omega$  in the B+ circuit end to end.

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

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

1. Ignition OFF.

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

- If less than infinite resistance, repair the short to ground on the circuit.
- Go to next step: If infinite resistance

3. Ignition OFF, disconnect the harness connector at the M9 Brake Booster Pump Motor.

4. Test for infinite resistance between the brake booster pump motor control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the M9 Brake Booster Pump Motor.

- **Go to next step: If the test lamp illuminates**

5. Connect a test lamp between the control circuit terminal 85 and ground.

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

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

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

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

- If less than infinite resistance, repair the short to ground on the circuit.
- Go to next step: If infinite resistance

3. Test for less than 2  $\Omega$  in the control circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , replace the K17 Electronic Brake Control Module.

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

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

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

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K17 Electronic Brake Control Module.

- **Go to next step: If the test lamp turns ON and OFF**

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

- **If the test lamp illuminates**

Repair the short to voltage on the control circuit

- **Go to next step: If the test lamp does not illuminate**

8. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the M9 Brake Booster Pump Motor. It may take up to 2 min for all vehicle systems to power down.

9. Test for less than 10  $\Omega$  between the M9 Brake Booster Pump Motor ground circuit terminal 2 and ground.

- **If 10  $\Omega$  or greater**

1. Ignition OFF.

2. Test for less than 2  $\Omega$  in the ground circuit end to end.

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

- **Go to next step: If less than 10  $\Omega$**

10. Connect the harness connector at the M9 Brake Booster Pump Motor.

11. Ignition ON, connect a 30 A fused jumper wire between the B+ circuit terminal 30 and the control circuit terminal 87.

12. Verify the M9 Brake Booster Pump Motor is activated.

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

1. Ignition OFF, disconnect the harness connector at the M9 Brake Booster Pump Motor.

2. Test for less than 2  $\Omega$  in the control circuit end to end.

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

- **Go to next step: If the M9 Brake Booster Pump Motor activates**

13. Test or replace the KR14 Brake Booster Pump Motor Relay.

### Repair Instructions

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

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

## 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.

### Diagnostic Fault Information

| Circuit                                | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|----------------------------------------|-----------------|----------------------|------------------|--------------------|
| Signal                                 | C0267 00        | C0273 05             | C0273 05         | -                  |
| Park Brake Signal                      | 1               | 1                    | 1                | -                  |
| Ground                                 | -               | C0273 05             | -                | -                  |
| 1. Brake Warning Indicator Malfunction | Â               | Â                    | Â                | Â                  |

### Circuit/System Description

The instrument cluster turns ON the brake warning indicator for 5 s after ignition ON. The body control module monitors the parking brake switch and will request the instrument cluster via serial data to turn the brake warning indicator ON when the parking brake is applied. The electronic brake control module monitors the brake fluid level switch and will request the instrument cluster via serial data to turn the brake warning indicator ON when low brake fluid is detected.

### Reference Information

Schematic Reference

### [Hydraulic Brake Wiring Schematics](#)

[Master Electrical Component List](#) , or [Inline Harness Connector End Views - Index](#) or [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 fluid has the proper level. The fluid level should be above minimum level.

- **If low**

Refer to [Brake Fluid Loss](#).

- **Go to next step: If above minimum level**

2. Ignition ON.

3. Verify the scan tool Brake Fluid Level Sensor parameter. The reading should be Ok.

- **If the parameter is Low**

Refer to Circuit/System Testing

- **Go to next step: If the parameter is Ok**

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

- **If the parameter does not change**

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

- **Go to next step: If the parameter changes**

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

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

Replace the P16 Instrument Cluster.

- **Go to next step: If the brake warning indicator turns ON and OFF**

6. All OK.

[Circuit/System Testing](#)

**Brake Fluid Level Switch Malfunction**

1. Ignition 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  $\Omega$  between the ground circuit terminal A and ground.

- **If 10  $\Omega$  or greater**

1. Ignition OFF.
2. Test for less than 2  $\Omega$  in the ground circuit end to end.
  - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - If less than 2  $\Omega$ , repair the open/high resistance in the ground connection.
- **Go to next step: If less than 10  $\Omega$**
3. Ignition ON.
4. Verify the scan tool Brake Fluid Level Sensor parameter is OK.
  - **If the parameter is not OK**
    1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.
    2. Test for infinite resistance between the signal circuit terminal B 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.
  - **Go to next step: If the parameter is OK**
5. Install a 3 A fused jumper wire between the signal circuit terminal B and ground.
6. Verify the scan tool Brake Fluid Level Sensor parameter is Low.
  - **If the parameter is not Low**
    1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, 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.
      - Go to next step: If less than 1 V.
    3. Test for less than 2  $\Omega$  in the signal circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K17 Electronic Brake Control Module.
  - **Go to next step: If the parameter is Low**
7. Test or replace the B20 Brake Fluid Level Switch.

### Park Brake Switch Malfunction

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

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

- If 1 V or greater, repair the short to voltage on the circuit.
  - Go to next step: If less than 1 V.
3. Test for less than 2  $\Omega$  in the signal circuit end to end.
- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - If less than 2  $\Omega$ , replace the K9 Body Control Module.
- **Go to next step: If the parameter is Applied**
7. Test or replace the B80 Park Brake Switch.

### Repair Instructions

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

- [Control Module References](#) for electronic brake control module and instrument cluster 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 <b>Step 2</b> | Go to <a href="#">Symptoms - Hydraulic Brakes</a> |
| 2                                                                                                                                           | <p>1. Inspect the disc brake system for the following conditions.</p> <ul style="list-style-type: none"> <li>• Excessive thickness variation of rotor friction surfaces</li> <li>• Excessive assembled lateral runout (LRO) of rotor friction surfaces</li> <li>• Hard spots, heat checks, bluing discoloration of rotor friction surfaces; possibly due to brake drag</li> <li>• Excessive corrosion of rotor friction surfaces; including red, gray or black oxidation</li> <li>• Loose, damaged or missing caliper or lining hardware</li> <li>• Bent or damaged caliper or mounting component</li> <li>• Excessive LRO of wheel hub/axle flange; due to damage and/or loose or excessively worn bearings</li> </ul> <p>2. Perform the disc brake system diagnostic procedure. <a href="#">Disc Brake System Diagnosis</a></p> <p>3. Adjust, repair or replace components as necessary.</p> <p>Did you find and correct a condition?</p> | Go to <b>Step 3</b> | Go to <a href="#">Symptoms - Hydraulic Brakes</a> |
| 3                                                                                                                                           | <p>1. Install or connect components that were removed or disconnected during diagnosis.</p> <p>2. Road test the vehicle in order to confirm proper operation. <a href="#">Brake System Vehicle Road Test</a></p> <p>Is the condition still present?</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Go to <b>Step 2</b> | 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 <a href="#">Diagnostic Starting Point - Vehicle</a> |
| 2                                                                                                                                          | <p>1. Inspect the disc brake system for the following conditions.</p> <ul style="list-style-type: none"> <li>• Lining wear indicator contact with rotor</li> <li>• Debris trapped between rotor and splash shield or backing plate; and/or debris trapped between rotor and linings</li> <li>• Contaminated linings</li> <li>• Aftermarket linings</li> <li>• Glazed linings</li> <li>• Distorted, cracked or damaged linings</li> <li>• Excessively worn linings</li> <li>• Damaged or excessively worn caliper hardware and/or lining hardware</li> <li>• Incorrectly installed, loose or missing caliper hardware and/or lining hardware</li> <li>• Lack of lubrication or excessive corrosion on metal to metal contact surfaces</li> <li>• Bent or damaged splash shield or backing plate</li> <li>• Hard spots, heat checks, blueing discoloration of rotor friction surfaces</li> <li>• Glazed rotor friction surfaces</li> <li>• Bent or damaged caliper or mounting component</li> </ul> <p>2. Adjust, repair or replace components as necessary.<br/>Refer to <a href="#">Disc Brake System Diagnosis</a>.</p> <p>Did you find and correct a condition?</p> | Go to Step 9 | Go to Step 3                                              |
| 3                                                                                                                                          | <p>1. Inspect the brake assist system for the following conditions.</p> <ul style="list-style-type: none"> <li>• Lack of lubrication or excessively worn pushrod or pedal pivots or pivot bushings</li> <li>• Bent or damaged pedal pushrod, pedal, or pedal bracket</li> <li>• Damaged or improperly operating vacuum booster and/or check valve, if equipped</li> <li>• Low power steering fluid level, if equipped with hydraulic boost</li> <li>• Improperly tensioned, excessively worn or damaged power steering belt, if equipped with hydraulic boost</li> <li>• Restricted return hose from hydraulic booster, if equipped</li> <li>• Improperly operating hydraulic booster, if equipped</li> <li>• Improperly functioning power steering system, if equipped with a hydraulic booster</li> </ul>                                                                                                                                                                                                                                                                                                                                                           | Go to Step 9 | Go to Step 4                                              |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                   | Yes                 | No                                                        |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-----------------------------------------------------------|
|      | assembly <ul style="list-style-type: none"> <li>Contaminated power steering fluid, if equipped with hydraulic boost</li> </ul> 2. Adjust, repair or replace components as necessary.<br>Refer to <a href="#">Brake Assist System Diagnosis</a> .<br>Did you find and correct a condition?                                                                                |                     |                                                           |
| 4    | 1. Inspect the hydraulic brake system for the following conditions. <ul style="list-style-type: none"> <li>Improper operation of caliper pistons</li> <li>Contaminated brake fluid</li> </ul> 2. Adjust, repair or replace components as necessary.<br>Refer to <a href="#">Hydraulic Brake System Diagnosis</a> .<br>Did you find and correct a condition?              | Go to <b>Step 9</b> | Go to <b>Step 5</b>                                       |
| 5    | Is the vehicle equipped with a drum-in-rotor type of park brake system?                                                                                                                                                                                                                                                                                                  | Go to <b>Step 6</b> | Go to <b>Step 9</b>                                       |
| 6    | Ensure the park brake shoes are not adjusted too tightly, possibly causing a noise under certain conditions.<br>Are the park brake shoes adjusted too tightly?                                                                                                                                                                                                           | Go to <b>Step 7</b> | Go to <b>Step 9</b>                                       |
| 7    | 1. Clean and inspect the park brake shoes for excessive wear and/or damage.<br>2. Inspect the drum portion of the rotors for excessive wear, blueing discoloration, heat spots, and excessive radial runout.<br>3. If any of these conditions are present, replace the affected components.<br>4. Adjust the park brake system.<br>Did you find and correct a condition? | Go to <b>Step 9</b> | Go to <b>Step 8</b>                                       |
| 8    | Inspect the park brake system for proper operation. Refer to <a href="#">Park Brake System Diagnosis</a> .<br>Did you find and correct a condition?                                                                                                                                                                                                                      | Go to <b>Step 9</b> | Go to <a href="#">Diagnostic Starting Point - Vehicle</a> |
| 9    | 1. Install or connect components that were removed or disconnected during diagnosis.<br>2. Road test the vehicle in order to confirm proper operation. Refer to <a href="#">Brake System Vehicle Road Test</a> .<br>Is the condition still present?                                                                                                                      | Go to <b>Step 2</b> | 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 <a href="#">Symptoms - Hydraulic Brakes</a> |
| 2                                                        | <ol style="list-style-type: none"> <li>1. Inspect the hydraulic brake system for the following conditions. <ul style="list-style-type: none"> <li>• Kinked, pinched or damaged brake pipe or flexible brake hose</li> <li>• Sticking or improperly operating caliper piston</li> <li>• Brake fluid leak</li> </ul> </li> <li>2. Perform the hydraulic brake system diagnostic procedure. Refer to <a href="#">Hydraulic Brake System Diagnosis</a>.</li> <li>3. Adjust, repair or replace components as necessary.</li> </ol> <p>Did you find and correct a condition?</p>                                                                                                                                                                                                                                                                                    | Go to Step 6 | Go to Step 3                                      |
| 3                                                        | <ol style="list-style-type: none"> <li>1. Inspect the disc brake system for the following conditions. <ul style="list-style-type: none"> <li>• Contaminated linings</li> <li>• Glazed linings</li> <li>• Distorted, cracked or damaged linings on one side</li> <li>• Loose, damaged or missing caliper hardware and/or lining hardware</li> <li>• Incorrect linings on one side</li> <li>• Hard spots, heat checks, blueing discoloration of rotor friction surfaces; possibly due to brake drag</li> <li>• Glazed rotor friction surfaces</li> <li>• Bent or damaged caliper or mounting component</li> </ul> </li> <li>2. Perform the disc brake system diagnostic procedure. Refer to <a href="#">Disc Brake System Diagnosis</a>.</li> <li>3. Adjust, repair or replace components as necessary.</li> </ol> <p>Did you find and correct a condition?</p> | Go to Step 6 | Go to Step 4                                      |
| 4                                                        | <ol style="list-style-type: none"> <li>1. Inspect the suspension system for the following conditions. <ul style="list-style-type: none"> <li>• Incorrect tire pressures</li> <li>• Loose suspension component connections</li> <li>• Excessively worn or damaged suspension components</li> </ul> </li> <li>2. Adjust, repair or replace components as necessary. Refer to <a href="#">Symptoms - Suspension General Diagnosis</a>.</li> </ol> <p>Did you find and correct a condition?</p>                                                                                                                                                                                                                                                                                                                                                                   | Go to Step 6 | Go to Step 5                                      |
| 5                                                        | <ol style="list-style-type: none"> <li>1. Inspect the steering system for the following conditions. <ul style="list-style-type: none"> <li>• Loose steering component connections</li> </ul> </li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Go to Step 6 | Go to <a href="#">Symptoms - Hydraulic Brakes</a> |

| Step | Action                                                                                                                                                                                                                                                          | Yes                 | No        |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-----------|
|      | <ul style="list-style-type: none"> <li>Excessively worn or damaged steering components</li> </ul> 2. Adjust, repair or replace components as necessary.<br>Refer to <a href="#">Symptoms - Power Steering System</a> .<br>Did you find and correct a condition? |                     |           |
| 6    | 1. Install or connect components that were removed or disconnected during diagnosis.<br>2. Road test the vehicle in order to confirm proper operation. Refer to <a href="#">Brake System Vehicle Road Test</a> .<br>Is the condition still present?             | Go to <b>Step 2</b> | 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 <b>Step 2</b> | Go to <a href="#">Diagnostic Starting Point - Vehicle</a> |
| 2                                                                                                                                                                                                                      | 1. Inspect the hydraulic brake system for the following conditions: <ul style="list-style-type: none"> <li>Improper operation of caliper pistons</li> <li>Kinked, pinched or damaged brake pipe or flexible brake hose</li> <li>Brake fluid leak</li> <li>Improperly functioning proportion valve, if equipped</li> <li>Improper operation of dynamic rear proportion (DRP) system, if equipped</li> </ul> 2. Adjust, repair or replace components as necessary.<br>Refer to <a href="#">Hydraulic Brake System Diagnosis</a> .<br>Did you find and correct a condition? | Go to <b>Step 6</b> | Go to <b>Step 3</b>                                       |
| 3                                                                                                                                                                                                                      | 1. Inspect the disc brake system for the following conditions: <ul style="list-style-type: none"> <li>Contaminated linings</li> <li>Glazed linings</li> <li>Distorted, cracked or damaged linings</li> <li>Excessively worn linings</li> <li>Aftermarket linings</li> <li>Damaged or excessively worn caliper hardware and/or lining hardware</li> </ul>                                                                                                                                                                                                                 | Go to <b>Step 6</b> | Go to <b>Step 4</b>                                       |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Yes                 | No                                                        |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-----------------------------------------------------------|
|      | <ul style="list-style-type: none"> <li>• Hard spots, heat checks, blueing discoloration of rotor friction surfaces</li> <li>• Glazed rotor friction surfaces</li> </ul> <p>2. Adjust, repair or replace components as necessary. Refer to <a href="#">Disc Brake System Diagnosis</a>.</p> <p>Did you find and correct a condition?</p>                                                                                                                                                                        |                     |                                                           |
| 4    | <p>1. Inspect the suspension system for the following conditions:</p> <ul style="list-style-type: none"> <li>• Loose suspension component connections</li> <li>• Excessively worn or damaged suspension components</li> </ul> <p>2. Adjust, repair or replace components as necessary. Refer to <a href="#">Diagnostic Starting Point - Vehicle</a>.</p> <p>Did you find and correct a condition?</p>                                                                                                          | Go to <b>Step 6</b> | Go to <b>Step 5</b>                                       |
| 5    | <p>1. Inspect the brake assist system for the following conditions:</p> <ul style="list-style-type: none"> <li>• Binding, bent or damaged pedal pushrod, pedal, or pedal bracket</li> <li>• Damaged or improperly operating vacuum booster, if equipped</li> <li>• Damaged or improperly operating hydraulic booster, if equipped</li> </ul> <p>2. Adjust, repair or replace components as necessary. Refer to <a href="#">Brake Assist System Diagnosis</a>.</p> <p>Did you find and correct a condition?</p> | Go to <b>Step 6</b> | Go to <a href="#">Diagnostic Starting Point - Vehicle</a> |
| 6    | <p>1. Install or connect components that were removed or disconnected during diagnosis.</p> <p>2. Road test the vehicle in order to confirm proper operation. Refer to <a href="#">Brake System Vehicle Road Test</a>.</p> <p>Is the condition still present?</p>                                                                                                                                                                                                                                              | Go to <b>Step 2</b> | 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 <b>Step 2</b> | Go to <a href="#">Symptoms - Hydraulic Brakes</a> |
| 2                                                                                                                                                      | <p>Inspect the travel and feel of brake pedal applies. Perform the following:</p> <ol style="list-style-type: none"> <li>1. Apply the brake pedal several times to fully deplete the power reserve.</li> <li>2. With power reserve depleted, apply the brake pedal with light, steady pressure and hold for 15 seconds. Observe pedal travel and feel.</li> <li>3. Apply the brake pedal with light, steady pressure, then without pumping the pedal, reduce pressure and</li> </ol> | Go to <b>Step 3</b> | -                                                 |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Yes                 | No                  |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------|
|      | <p>reapply pressure several times. Observe pedal travel and feel for each apply.</p> <p>4. Apply the brake pedal slowly, then release and apply the pedal quickly. Observe pedal travel and feel for each apply.</p> <p>Did you complete the brake pedal travel and feel inspections?</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |                     |
| 3    | <p>1. Inspect the hydraulic brake system for the conditions listed, based on the following symptoms observed during the pedal travel and feel inspections:</p> <ul style="list-style-type: none"> <li>Pedal feel was spongy <ul style="list-style-type: none"> <li>Air in hydraulic system</li> <li>External brake fluid leaks</li> <li>Soft, weak or damaged hydraulic hoses; expanding under pressure</li> </ul> </li> <li>Pedal fell away and/or traveled to or almost to floor <ul style="list-style-type: none"> <li>External brake fluid leaks</li> <li>Poor brake fluid quality; low boiling point</li> <li>Internal brake fluid leaks; improperly functioning master cylinder</li> </ul> </li> <li>Pedal was somewhat firm then dropped slightly, or pedal rose with successive applies, or pedal travel was different between slow and quick applies <ul style="list-style-type: none"> <li>Internal brake fluid leaks; improperly functioning master cylinder</li> <li>Poor brake fluid quality; low boiling point</li> </ul> </li> <li>Pedal returned to rest slowly after any of the applies <ul style="list-style-type: none"> <li>Internally damaged flexible brake hoses; hindering fluid return</li> <li>Binding caliper pistons</li> <li>Internal brake fluid leaks; improperly functioning master cylinder</li> </ul> </li> </ul> <p>2. Repair or replace components as necessary. Refer to <a href="#">Hydraulic Brake System Diagnosis</a>.</p> <p>3. Re-inspect brake pedal apply travel and feel.</p> <p>Did you find and correct a condition?</p> | Go to <b>Step 8</b> | Go to <b>Step 4</b> |
| 4    | <p>1. Inspect the disc brake system for the following conditions:</p> <ul style="list-style-type: none"> <li>Cracked, excessively worn or damaged linings</li> <li>Cracked, excessively worn or damaged rotors</li> <li>Improperly operating, binding or damaged caliper hardware and/or lining hardware</li> <li>Loose or missing caliper hardware and/or lining hardware</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Go to <b>Step 8</b> | Go to <b>Step 5</b> |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Yes                 | No                                                |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------------------------------------|
|      | <ul style="list-style-type: none"> <li>Excessive assembled lateral runout (LRO) of rotor friction surfaces</li> <li>Bent or damaged caliper or mounting component</li> </ul> <p>2. Adjust, repair or replace components as necessary. Refer to <a href="#">Disc Brake System Diagnosis</a>.</p> <p>3. Re-inspect brake pedal apply travel and feel.</p> <p>Did you find and correct a condition?</p>                                                                                                                                                                                                                                                  |                     |                                                   |
| 5    | <p>Inspect for proper brake pedal travel. Refer to <a href="#">Brake Pedal Travel Measurement and Inspection</a>.</p> <p>Is the brake pedal travel distance within the acceptable limits?</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Go to <b>Step 7</b> | Go to <b>Step 6</b>                               |
| 6    | <p>1. Inspect for worn, missing, misaligned, bent or damaged brake pedal system components.</p> <ul style="list-style-type: none"> <li>For the brake pedal pushrod component inspection, refer to <a href="#">Brake Pedal Pushrod Inspection</a>.</li> <li>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.</li> </ul> <p>2. Replace the brake pedal system components that are worn, missing, misaligned, bent or damaged.</p> <p>Did you find and replace any worn, missing, misaligned, bent or damaged brake pedal system components?</p> | Go to <b>Step 8</b> | Go to <b>Step 7</b>                               |
| 7    | <p>1. Inspect the brake assist system for the following conditions:</p> <ul style="list-style-type: none"> <li>Vacuum leaks and/or improperly operating check valve, if equipped with vacuum assist</li> <li>Power steering fluid leaks, if equipped with hydraulic power assist</li> <li>Damaged or improperly operating brake booster assembly</li> </ul> <p>2. Adjust, repair or replace components as necessary. Refer to <a href="#">Brake Assist System Diagnosis</a>.</p> <p>Did you find and correct a condition?</p>                                                                                                                         | Go to <b>Step 8</b> | Go to <a href="#">Symptoms - Hydraulic Brakes</a> |
| 8    | <p>1. Install or connect components that were removed or disconnected during diagnosis.</p> <p>2. Road test the vehicle in order to confirm proper operation. Refer to <a href="#">Brake System Vehicle Road Test</a>.</p> <p>Is the condition still present?</p>                                                                                                                                                                                                                                                                                                                                                                                     | Go to <b>Step 2</b> | 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 <b>Step 2</b> | Go to <a href="#">Diagnostic Starting Point -</a> |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Yes                 | No                                                        |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-----------------------------------------------------------|
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     | <a href="#">Vehicle</a>                                   |
| 2    | <p>1. Inspect the brake assist system for the following conditions:</p> <ul style="list-style-type: none"> <li>• Vacuum leaks, if equipped with vacuum power assist</li> <li>• Power steering fluid leaks, if equipped with hydraulic power assist</li> <li>• Lack of lubrication, binding or excessively worn pushrod or pedal pivots or pivot bushings</li> <li>• Bent or damaged pedal pushrod, pedal, or pedal bracket</li> <li>• Damaged or improperly operating brake booster assembly</li> </ul> <p>2. Adjust, repair or replace components as necessary. Refer to <a href="#">Brake Assist System Diagnosis</a>.</p> <p>Did you find and correct a condition?</p>                                                                                                                                     | Go to <b>Step 5</b> | Go to <b>Step 3</b>                                       |
| 3    | <p>1. Inspect the hydraulic brake system for the following conditions:</p> <ul style="list-style-type: none"> <li>• Binding caliper pistons</li> <li>• Internally damaged flexible brake hoses; hindering fluid flow</li> <li>• External brake fluid leaks</li> <li>• Kinked or damaged flexible brake hoses and/or pipes</li> <li>• Internal brake fluid leaks; improperly operating master cylinder</li> <li>• Poor brake fluid quality; low boiling point</li> </ul> <p>2. Adjust, repair or replace components as necessary. Refer to <a href="#">Hydraulic Brake System Diagnosis</a>.</p> <p>Did you find and correct a condition?</p>                                                                                                                                                                  | Go to <b>Step 5</b> | Go to <b>Step 4</b>                                       |
| 4    | <p>1. Inspect the disc brake system for the following conditions:</p> <ul style="list-style-type: none"> <li>• Excessively worn linings</li> <li>• Glazed linings</li> <li>• Cracked, distorted or damaged linings</li> <li>• Contaminated linings</li> <li>• Binding, damaged or excessively worn caliper hardware and/or lining hardware</li> <li>• Lack of lubrication or excessive corrosion on metal to metal contact surfaces</li> <li>• Excessively worn or corroded rotor friction surfaces</li> <li>• Glazed rotor friction surfaces</li> <li>• Hard spots, heat checks, blueing discoloration of rotor friction surfaces</li> </ul> <p>2. Adjust, repair or replace components as necessary. Refer to <a href="#">Disc Brake System Diagnosis</a>.</p> <p>Did you find and correct a condition?</p> | Go to <b>Step 5</b> | Go to <a href="#">Diagnostic Starting Point - Vehicle</a> |

| Step | Action                                                                                                                                                                                                                                                  | Yes          | No        |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------|
| 5    | 1. Install or connect components that were removed or disconnected during diagnosis.<br>2. Road test the vehicle in order to confirm proper operation. Refer to <a href="#">Brake System Vehicle Road Test</a> .<br><br>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 <a href="#">Diagnostic Starting Point - Vehicle</a> |
| 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.<br>2. Inspect the cruise control release switch, if equipped, for proper adjustment to ensure that the brake pedal is fully releasing.<br><br>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.<br>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.<br>2. Inspect the drum portion of the rotors for excessive wear, blueing discoloration and heat spots.<br>3. If any of these conditions are present, replace the affected components.<br>4. Adjust the park brake system.<br><br>Did you find and correct a condition?                                                                                                                                                           | Go to Step 14 | Go to Step 7                                              |
| 7                                                                                                                                               | Inspect the park brake system for proper operation. <a href="#">Park Brake System Diagnosis</a><br>Did you find and correct a condition?                                                                                                                                                                                                                                                                                                                                                                     | Go to Step 14 | Go to Step 8                                              |
| 8                                                                                                                                               | 1. Inspect the disc brake system for the following conditions: <ul style="list-style-type: none"> <li>• 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</li> <li>• Lack of lubrication or excessive corrosion on metal to metal contact surfaces</li> <li>• Distorted or damaged linings</li> <li>• Damaged or excessively worn caliper hardware and/or lining hardware</li> </ul> | Go to Step 14 | Go to Step 9                                              |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Yes                  | No                                                      |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|---------------------------------------------------------|
|      | <ul style="list-style-type: none"> <li>Bent or damaged caliper or mounting component</li> </ul> 2. Adjust, repair or replace components as necessary.<br><u><b>Disc Brake System Diagnosis</b></u><br>Did you find and correct a condition?                                                                                                                                                                                                                                       |                      |                                                         |
| 9    | 1. Separate the brake booster pushrod from the brake pedal.<br>2. Inspect the brake corners to determine if the brake drag condition is still present.<br>Do the brake corners still exhibit the brake drag condition?                                                                                                                                                                                                                                                            | Go to <b>Step 11</b> | Go to <b>Step 10</b>                                    |
| 10   | 1. Inspect the pushrod for improper positioning and/or damage. Correctly position or replace the pushrod if necessary.<br>2. Inspect the brake pedal assembly for damage and replace if necessary.<br>Did you complete the repair or replacement?                                                                                                                                                                                                                                 | Go to <b>Step 14</b> | -                                                       |
| 11   | 1. For vacuum boost systems, disconnect the vacuum check valve from the booster to relieve vacuum reserve.<br>2. Separate the master cylinder from the brake booster. Do not disconnect any brake pipes.<br>3. Inspect the brake corners to determine if the brake drag condition is still present.<br>Do the brake corners still exhibit the brake drag condition?                                                                                                               | Go to <b>Step 13</b> | Go to <b>Step 12</b>                                    |
| 12   | Replace the brake booster assembly.<br>Did you complete the replacement?                                                                                                                                                                                                                                                                                                                                                                                                          | Go to <b>Step 14</b> | -                                                       |
| 13   | 1. Inspect the hydraulic brake system for the following conditions. <ul style="list-style-type: none"> <li>Improper operation of caliper pistons</li> <li>Contaminated brake fluid</li> <li>Internally damaged flexible brake hoses; hindering brake release</li> <li>Damaged or improperly operating master cylinder</li> </ul> 2. Adjust, repair or replace components as necessary.<br><u><b>Hydraulic Brake System Diagnosis</b></u><br>Did you find and correct a condition? | Go to <b>Step 14</b> | Go to <u><b>Diagnostic Starting Point - Vehicle</b></u> |
| 14   | 1. Install or connect components that were removed or disconnected during diagnosis.<br>2. Road test the vehicle in order to confirm proper operation. <u><b>Brake System Vehicle Road Test</b></u><br>Is the condition still present?                                                                                                                                                                                                                                            | Go to <b>Step 2</b>  | 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. |        |     |    |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Yes          | No                                                        |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------------------------------------------------------|
| 1    | Were you sent here from the Hydraulic Brake Symptom table?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Go to Step 2 | Go to <a href="#">Diagnostic Starting Point - Vehicle</a> |
| 2    | <p>1. Inspect the hydraulic brake system for the following conditions:</p> <ul style="list-style-type: none"> <li>• Improper operation of caliper pistons</li> <li>• Internally damaged flexible brake hoses; hindering brake release</li> <li>• Contaminated brake fluid</li> <li>• Damaged or improperly operating master cylinder</li> </ul> <p>2. Adjust, repair or replace components as necessary. Refer to <a href="#">Hydraulic Brake System Diagnosis</a>.</p> <p>Did you find and correct a condition?</p>                                                                 | Go to Step 5 | Go to Step 3                                              |
| 3    | <p>1. Inspect the brake assist system for the following conditions:</p> <ul style="list-style-type: none"> <li>• Binding, bent or damaged pedal pushrod, pedal, or pedal bracket</li> <li>• Damaged or improperly operating vacuum booster, if equipped</li> <li>• Restricted return hose from hydraulic booster, if equipped</li> <li>• Damaged or improperly operating hydraulic booster, if equipped</li> </ul> <p>2. Adjust, repair or replace components as necessary. Refer to <a href="#">Brake Assist System Diagnosis</a>.</p> <p>Did you find and correct a condition?</p> | Go to Step 5 | Go to Step 4                                              |
| 4    | <p>1. Inspect the disc brake system for the following conditions:</p> <ul style="list-style-type: none"> <li>• Damaged or excessively worn caliper hardware and/or lining hardware</li> <li>• Distorted or damaged linings</li> <li>• Lack of lubrication or excessive corrosion on metal to metal contact surfaces</li> <li>• Bent or damaged caliper or mounting component</li> </ul> <p>2. Adjust, repair or replace components as necessary. Refer to <a href="#">Disc Brake System Diagnosis</a>.</p> <p>Did you find and correct a condition?</p>                              | Go to Step 5 | Go to <a href="#">Diagnostic Starting Point - Vehicle</a> |
| 5    | <p>1. Install or connect components that were removed or disconnected during diagnosis.</p> <p>2. Road test the vehicle in order to confirm proper operation. Refer to <a href="#">Brake System Vehicle Road Test</a>.</p> <p>Is the condition still present?</p>                                                                                                                                                                                                                                                                                                                    | 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 <b>Step 2</b> | Go to <b>Diagnostic Starting Point - Vehicle</b> |
| 2                                                                | <ol style="list-style-type: none"> <li>Inspect the following hydraulic brake system components for brake fluid leaks: <ul style="list-style-type: none"> <li>Flexible brake hose connections; threaded and bolted</li> <li>Flexible brake hose crimp joints</li> <li>Brake pipe fittings</li> <li>Caliper piston seals</li> <li>Wheel cylinder piston seals, if equipped</li> <li>Master cylinder reservoir</li> <li>Master cylinder reservoir low pressure hose, if equipped</li> <li>Brake pressure modulator valve (BPMV) assembly, if equipped</li> </ul> </li> <li>Repair or replace components as necessary.<br/><b>Hydraulic Brake System Diagnosis</b></li> </ol> <p>Did you find and correct a condition?</p> | Go to <b>Step 8</b> | Go to <b>Step 3</b>                              |
| 3                                                                | Is the vehicle equipped with a vacuum brake booster?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Go to <b>Step 4</b> | Go to <b>Step 6</b>                              |
| 4                                                                | <ol style="list-style-type: none"> <li>Disconnect the vacuum check valve from the booster to relieve vacuum reserve.</li> <li>Separate the master cylinder from the vacuum brake booster. Do not disconnect any brake pipes.</li> <li>Inspect the rear of the master cylinder for a brake fluid leak.</li> <li>Inspect for brake fluid in the vacuum brake booster.</li> </ol> <p>Did you find a brake fluid leak?</p>                                                                                                                                                                                                                                                                                                 | Go to <b>Step 5</b> | Go to <b>Diagnostic Starting Point - Vehicle</b> |
| 5                                                                | <p>Replace the brake master cylinder and the vacuum brake booster.</p> <p>Did you complete the replacement?</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Go to <b>Step 8</b> | -                                                |
| 6                                                                | <ol style="list-style-type: none"> <li>Wipe clean the external surface of the master cylinder to hydraulic brake booster area, if equipped.</li> <li>Separate the master cylinder from the hydraulic brake booster, if equipped. Do not disconnect any brake pipes.</li> <li>Inspect the rear of the master cylinder for a brake fluid leak.</li> </ol> <p>Did you find a brake fluid leak?</p>                                                                                                                                                                                                                                                                                                                        | Go to <b>Step 7</b> | Go to <b>Diagnostic Starting Point - Vehicle</b> |
| 7                                                                | <p>Replace the brake master cylinder.</p> <p>Did you complete the replacement?</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Go to <b>Step 8</b> | -                                                |
| 8                                                                | <ol style="list-style-type: none"> <li>Install or connect components that were removed or disconnected during diagnosis.</li> <li>Road test the vehicle to confirm proper operation.<br/><b>Brake System Vehicle Road Test</b></li> </ol> <p>Is the condition still present?</p>                                                                                                                                                                                                                                                                                                                                                                                                                                       | Go to <b>Step 2</b> | System OK                                        |

## DISC BRAKE SYSTEM DIAGNOSIS

### Test Description

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

**9**

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

**10**

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

**12**

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

**15**

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

**19**

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

**22**

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

| Step                                                                                                                                                                                                                                                                                             | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Yes                 | No                                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------------------------------------|
| DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the DISC brake system in order to determine if the DISC brake system is operating 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 <b>Step 2</b> | Go to <b>Symptoms - Hydraulic Brakes</b> |
| 2                                                                                                                                                                                                                                                                                                | Visually inspect the disc brake pads for the following conditions:<br>Refer to <b>Brake Pad Inspection</b> . <ul style="list-style-type: none"><li>• Lining thickness below specifications</li><li>• Uneven and/or abnormal wear - edge-to-edge and/or side-to-side</li><li>• Looseness or damage - including pad hardware</li><li>• Evidence of contamination from an external substance</li></ul> Did you find any conditions to indicate a concern with any of the front and/or rear disc brake pads? | Go to <b>Step 3</b> | Go to <b>Step 12</b>                     |
| 3                                                                                                                                                                                                                                                                                                | Are any of the front and/or rear disc brake pads contaminated?                                                                                                                                                                                                                                                                                                                                                                                                                                           | Go to <b>Step 8</b> | Go to <b>Step 4</b>                      |
| 4                                                                                                                                                                                                                                                                                                | Are any of the front and/or rear disc brake pads worn unevenly?                                                                                                                                                                                                                                                                                                                                                                                                                                          | Go to <b>Step 7</b> | Go to <b>Step 5</b>                      |
| 5                                                                                                                                                                                                                                                                                                | Are any of the front and/or rear disc brake pads and/or pad hardware loose or damaged?                                                                                                                                                                                                                                                                                                                                                                                                                   | Go to <b>Step 7</b> | Go to <b>Step 6</b>                      |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Yes                  | No |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----|
| 6    | <ol style="list-style-type: none"> <li>1. Remove and inspect the worn disc brake pads for glazing, looseness, heat spots or damage.</li> <li>2. Replace the worn disc brake pads as a complete axle set. Refer to <a href="#">Front Disc Brake Pads Replacement</a> , and/or <a href="#">Rear Disc Brake Pads Replacement</a> .</li> </ol> <p>Did you complete the inspection and replacement?</p>                                                                                                                                                                                                                                                                                                                                                                                                      | Go to <b>Step 12</b> | -  |
| 7    | <p><b>CAUTION:</b></p> <p>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.</p> <p><b>NOTE:</b></p> <p>Do NOT disconnect the hydraulic brake flex hoses from the calipers.</p> <ol style="list-style-type: none"> <li>1. Remove the front and/or rear disc brake calipers, as appropriate, from the mounting brackets and support the calipers. Refer to <a href="#">Front Brake Caliper Replacement</a> , and/or <a href="#">Rear Brake Caliper Replacement</a> .</li> </ol> | Go to <b>Step 12</b> | -  |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Yes                  | No                   |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------------------|
|      | <p>2. Inspect the disc brake caliper mounting bracket and the mounting/sliding hardware for the following conditions:</p> <p>Refer to <a href="#">Front Disc Brake Mounting and Hardware Inspection</a> , and/or <a href="#">Rear Disc Brake Mounting and Hardware Inspection</a> .</p> <ul style="list-style-type: none"> <li>• Binding or seized hardware</li> <li>• Worn, damaged or missing hardware components</li> <li>• Loose, bent, cracked, or damaged caliper mounting bracket</li> </ul> <p>3. Replace components as required. Refer to the following procedures in Disc Brakes, as required:</p> <ul style="list-style-type: none"> <li>• <a href="#">Front Brake Caliper Replacement</a></li> <li>• <a href="#">Rear Brake Caliper Bracket Replacement</a></li> </ul> <p>4. Replace the unevenly-worn, loose or damaged disc brake pads as a complete axle set. Refer to <a href="#">Front Disc Brake Pads Replacement</a> , and/or <a href="#">Rear Disc Brake Pads Replacement</a> .</p> <p>Did you complete the inspection and replacement?</p> |                      |                      |
| 8    | <p>1. Inspect the disc brake calipers, brake hoses and brake pipes for evidence of an external brake fluid leak.</p> <p>2. Replace any components found to be leaking brake fluid. Refer to the following procedures as required:</p> <ul style="list-style-type: none"> <li>• <a href="#">Front Brake Caliper Replacement</a></li> <li>• <a href="#">Rear Brake Caliper Replacement</a></li> <li>• <a href="#">Front Brake Hose Replacement</a>, or <a href="#">Front Brake Hose Replacement</a></li> <li>• <a href="#">Rear Brake Hose Replacement</a>, or <a href="#">Rear Brake Hose Replacement (Frame to Axle)</a>, or <a href="#">Rear Brake Hose Replacement (Axle to Caliper)</a></li> <li>• <a href="#">Brake Pipe Replacement</a></li> </ul> <p>Did you find and correct the source of the leak causing contamination of the pads?</p>                                                                                                                                                                                                               | Go to <b>Step 11</b> | Go to <b>Step 9</b>  |
| 9    | <p>1. Inspect the wheel drive shaft outer seals, if equipped, for damage and evidence of a grease leak.</p> <p>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 <a href="#">Front Wheel Drive Shaft Outer Joint and Boot Replacement (Without ZR2)</a> , or <a href="#">Front Wheel Drive Shaft Outer Joint and Boot Replacement (With ZR2)</a> , if equipped.</p> <p>3. Inspect the rear axle seals for damage and evidence of a lubricant leak.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Go to <b>Step 11</b> | Go to <b>Step 10</b> |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Yes                  | No |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----|
|      | <p>4. Replace any rear axle seal that is found to be leaking lubricant which may be the source of the contamination to the pads. Refer to <a href="#">Rear Axle Shaft Seal Replacement</a> .</p> <p>Did you find and correct the source of the leak causing contamination of the pads?</p>                                                                                                                                                                                                                                                                               |                      |    |
| 10   | <p>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.</p> <p>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.</p> <p>3. Replace any components found to be leaking fluid which may be the source of the contamination to the pads.</p> <p>Did you find and correct the source of the leak causing contamination of the pads?</p> | Go to <b>Step 11</b> | -  |
| 11   | <p>1. Clean the remaining disc brake system components to remove any traces of the contaminant.</p> <p><b>CAUTION:</b><br/>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</p>                                                                                 | Go to <b>Step 12</b> | -  |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Yes                  | No                   |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------------------|
|      | <p><b>brake fluid leak.</b></p> <p><b>NOTE:</b><br/>Do NOT disconnect the hydraulic brake flex hoses from the calipers.</p> <p>2. Remove the front and/or rear disc brake calipers, as appropriate, from the mounting brackets and support the calipers. Refer to <a href="#">Front Brake Caliper Replacement</a> , and/or <a href="#">Rear Brake Caliper Replacement</a> .</p> <p>3. Inspect the disc brake caliper mounting/sliding hardware for the following conditions:</p> <p>Refer to <a href="#">Front Disc Brake Mounting and Hardware Inspection</a> , and/or <a href="#">Rear Disc Brake Mounting and Hardware Inspection</a> .</p> <ul style="list-style-type: none"> <li>• Binding or seized hardware</li> <li>• Distorted, worn, damaged or missing hardware components</li> </ul> <p>4. Replace the caliper mounting/sliding hardware components as required. Refer to <a href="#">Front Brake Caliper Replacement</a> , and/or <a href="#">Rear Brake Caliper Bracket Replacement</a> .</p> <p>5. Replace the contaminated disc brake pads as a complete axle set. Refer to <a href="#">Front Disc Brake Pads Replacement</a> , and/or <a href="#">Rear Disc Brake Pads Replacement</a> .</p> <p>Did you complete the cleaning, inspection and replacement?</p> |                      |                      |
| 12   | <p>Visually inspect each of the disc brake rotor shields/backing plates for evidence of contact with the brake rotors.</p> <p>Are any of the brake rotor shields/backing plates contacting the brake rotors?</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Go to <b>Step 13</b> | Go to <b>Step 14</b> |
| 13   | <p>Repair or replace the disc brake rotor shields/backing plates as required. Refer to <a href="#">Front Brake Shield Replacement</a> .</p> <p>Did you complete the repair or replacement?</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Go to <b>Step 14</b> | -                    |
| 14   | <p>1. Check the thickness of each of the disc brake rotors.</p> <p><b>NOTE:</b><br/>Make the following determination AND ANSWER the question INDIVIDUALLY</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Go to <b>Step 15</b> | Go to <b>Step 18</b> |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Yes           | No            |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------|
|      | <p><b>for EACH rotor.</b></p> <p>2. Make a determination for each brake rotor if the rotor can be REFINISHED and REMAIN ABOVE the minimum requirements.</p> <p>Refer to <a href="#">Brake Rotor Thickness Measurement</a> .Does the disc brake rotor meet the minimum requirements for REFINISHING?</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |               |               |
| 15   | <p><b>NOTE:</b><br/>Perform the following inspection AND ANSWER the question INDIVIDUALLY for EACH rotor.</p> <p>Inspect each of the disc brake rotors for thickness variation that exceeds the maximum acceptable level. Refer to <a href="#">Brake Rotor Thickness Variation Measurement</a> .Does the brake rotor exhibit thickness variation that exceeds the maximum acceptable level?</p>                                                                                                                                                                                                                                                                                                                                                                                                                | Go to Step 17 | Go to Step 16 |
| 16   | <p>1. Inspect each of the disc brake rotors for the following surface and wear conditions:</p> <p>Refer to <a href="#">Brake Rotor Surface and Wear Inspection</a> .</p> <ul style="list-style-type: none"> <li>• Heavy rust and/or pitting</li> <li>• Cracks and/or heat spots</li> <li>• Excessive blueing discoloration</li> <li>• Deep or excessive scoring beyond maximum acceptable level</li> </ul> <p><b>NOTE:</b><br/>Make the following determination AND ANSWER the question INDIVIDUALLY for EACH rotor.</p> <p>2. Make a determination for each brake rotor if the rotor requires refinishing based upon the results of the inspection.</p> <p>If the brake rotor exhibits any of the conditions listed previously, it requires refinishing.</p> <p>Does the brake rotor require REFINISHING?</p> | Go to Step 17 | Go to Step 22 |
| 17   | <p>1. Refinish the brake rotor. Refer to <a href="#">Brake Rotor Refinishing</a> .</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Go to Step 22 | Go to Step 21 |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Yes                  | No                   |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------------------|
|      | <p>2. Inspect the brake rotor thickness. Refer to <a href="#">Brake Rotor Thickness Measurement</a> .</p> <p>Were you able to REFINISH the brake rotor within the minimum requirements?</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                      |                      |
| 18   | Is the brake rotor at or below the DISCARD requirements?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Go to <b>Step 21</b> | Go to <b>Step 19</b> |
| 19   | <p><b>NOTE:</b><br/>Perform the following inspection AND ANSWER the question INDIVIDUALLY for EACH rotor.</p> <p>Inspect each of the disc brake rotors for thickness variation that exceeds the maximum acceptable level. Refer to <a href="#">Brake Rotor Thickness Variation Measurement</a> .Does the brake rotor exhibit thickness variation that exceeds the maximum acceptable level?</p>                                                                                                                                                                                                                                                                                                                                                                                                                | Go to <b>Step 21</b> | Go to <b>Step 20</b> |
| 20   | <p>1. Inspect each of the disc brake rotors for the following surface and wear conditions:</p> <p>Refer to <a href="#">Brake Rotor Surface and Wear Inspection</a> .</p> <ul style="list-style-type: none"> <li>• Heavy rust and/or pitting</li> <li>• Cracks and/or heat spots</li> <li>• Excessive blueing discoloration</li> <li>• Deep or excessive scoring beyond maximum acceptable level</li> </ul> <p><b>NOTE:</b><br/>Make the following determination AND ANSWER the question INDIVIDUALLY for EACH rotor.</p> <p>2. Make a determination for each brake rotor if the rotor requires replacement based upon the results of the inspection.</p> <p>If the brake rotor exhibits any of the conditions listed previously, it requires replacement.</p> <p>Does the brake rotor require REPLACEMENT?</p> | Go to <b>Step 21</b> | Go to <b>Step 22</b> |
| 21   | <p><b>NOTE:</b><br/>Whenever a brake rotor is replaced, the</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Go to <b>Step 24</b> | -                    |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                          | Yes                                             | No                   |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|----------------------|
|      | <p><b>assembled lateral runout (LRO) of the rotor must be measured to ensure optimum performance of the disc brakes.</b></p> <p>Replace the brake rotor. Refer to <a href="#">Front Brake Rotor Replacement</a> , or <a href="#">Rear Brake Rotor Replacement</a> .Did you complete the replacement?</p>                                                                                        |                                                 |                      |
| 22   | <p><b>NOTE:</b><br/>Perform the following inspection <b>AND ANSWER the question INDIVIDUALLY for EACH rotor.</b></p> <p>Inspect each of the disc brake rotors for assembled LRO that exceeds the maximum acceptable level. Refer to <a href="#">Brake Rotor Assembled Lateral Runout Measurement</a> .Does the brake rotor exhibit assembled LRO that exceeds the maximum acceptable level?</p> | Go to <b>Step 23</b>                            | Go to <b>Step 24</b> |
| 23   | <p>Correct the LRO for each brake rotor that was determined to have LRO exceeding the maximum acceptable level. Refer to <a href="#">Brake Rotor Assembled Lateral Runout Correction</a> . Did you complete the operation?</p>                                                                                                                                                                  | Go to <b>Step 24</b>                            | -                    |
| 24   | <p>Install or connect components that were removed or disconnected during diagnosis. Did you complete the operation?</p>                                                                                                                                                                                                                                                                        | Disc Brake System OK<br>Return to Symptom Table | -                    |

## HYDRAULIC BRAKE SYSTEM DIAGNOSIS

| Step                                                                                                                                                                                                                                                                                                                     | Action                                                                                                                                                                                                              | Yes                 | No                                                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------------------------------------|
| <p><b>DEFINITION:</b> This diagnostic table is designed to diagnose ONLY the components of the HYDRAULIC brake system in order to determine if the HYDRAULIC brake system is operating properly. You will be directed by the appropriate Symptom table to go to other brake system diagnostic tables as appropriate.</p> |                                                                                                                                                                                                                     |                     |                                                   |
| 1                                                                                                                                                                                                                                                                                                                        | Were you sent here from a Brake Symptom table?                                                                                                                                                                      | Go to <b>Step 2</b> | Go to <a href="#">Symptoms - Hydraulic Brakes</a> |
| 2                                                                                                                                                                                                                                                                                                                        | <p>Inspect and adjust the brake fluid level in the brake master cylinder. Refer to <a href="#">Brake Master Cylinder Reservoir Filling</a> .</p> <p>Was the brake fluid level low?</p>                              | Go to <b>Step 3</b> | Go to <b>Step 4</b>                               |
| 3                                                                                                                                                                                                                                                                                                                        | <p>1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination:</p> <ul style="list-style-type: none"> <li>Fluid separation, indicating two types of fluid are present</li> </ul> | Go to <b>Step 5</b> | Go to <b>Step 6</b>                               |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Yes                 | No                   |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|
|      | <ul style="list-style-type: none"> <li>• Swirled appearance - oil-based substance</li> <li>• Layered appearance - silicone-based substance</li> <li>• Fluid discoloration</li> <li>• Cloudy appearance - moisture</li> <li>• Dark appearance/suspended particles in fluid - dirt, rust, corrosion, brake dust</li> </ul> <p>2. Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating fluid contamination.</p> <p>Do any of the above conditions exist?</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |                      |
| 4    | <p>1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination:</p> <ul style="list-style-type: none"> <li>• Fluid separation, indicating two types of fluid are present <ul style="list-style-type: none"> <li>• Swirled appearance - oil-based substance</li> <li>• Layered appearance - silicone-based substance</li> </ul> </li> <li>• Fluid discoloration <ul style="list-style-type: none"> <li>• Cloudy appearance - moisture</li> <li>• Dark appearance/suspended particles in fluid - dirt, rust, corrosion, brake dust</li> </ul> </li> </ul> <p>2. Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating fluid contamination.</p> <p>Do any of the above conditions exist?</p>                                                                                                                                                                                                                                                                                                                                                                                                     | Go to <b>Step 5</b> | Go to <b>Step 12</b> |
| 5    | <p>1. Flush the hydraulic brake system. Refer to <b>Hydraulic Brake System Flushing</b>.</p> <p>2. If the brake fluid WAS contaminated with an oil-based or a silicone-based fluid, indicated by fluid separation and/or a swollen master cylinder reservoir cap diaphragm and/or swollen reservoir-to-master cylinder grommets, perform the following steps. Refer to the procedures indicated.</p> <ol style="list-style-type: none"> <li>1. Remove ALL of the following components listed. Each component contains internal rubber seals/linings which have been contaminated.</li> <li>2. Clean out the hydraulic brake pipes using denatured alcohol, or equivalent.</li> <li>3. Dry the brake pipes using non-lubricated, filtered air.</li> <li>4. Repair or replace ALL of the following components listed. Each component contains internal rubber seals/linings which have been contaminated. <ul style="list-style-type: none"> <li>• <b>Brake Master Cylinder Replacement</b></li> <li>• Brake master cylinder reservoir: Clean the brake master cylinder reservoir using denatured alcohol, or equivalent, then dry the reservoir using non-lubricated, filtered</li> </ul> </li> </ol> | Go to <b>Step 9</b> | -                    |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Yes                 | No                   |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|
|      | <p>air, or if necessary, replace the brake master cylinder reservoir.</p> <ul style="list-style-type: none"> <li>• Replace the brake master cylinder reservoir cap diaphragm.</li> <li>• <a href="#">Front Brake Hose Replacement</a>, or <a href="#">Front Brake Hose Replacement</a></li> <li>• <a href="#">Rear Brake Hose Replacement</a>, or <a href="#">Rear Brake Hose Replacement (Frame to Axle)</a>, or <a href="#">Rear Brake Hose Replacement (Axle to Caliper)</a></li> <li>• <a href="#">Front Brake Caliper Replacement</a></li> <li>• <a href="#">Rear Brake Caliper Replacement</a></li> <li>• <a href="#">Brake Pressure Modulator Valve Replacement</a></li> </ul> <p>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.</p> <p>4. Refill and bleed the hydraulic brake system. Refer to <a href="#">Hydraulic Brake System Bleeding (Manual)</a>, or <a href="#">Hydraulic Brake System Bleeding (Pressure)</a>.</p> <p>Did you complete the operation and any required repairs and/or replacements?</p>                                                                                                                                                                                                                                                                                                                                                      |                     |                      |
| 6    | <p>1. Inspect the following hydraulic brake system components for external fluid leaks Repair or replace any of the components found to be leaking brake fluid. Refer to the appropriate procedures:</p> <ul style="list-style-type: none"> <li>• <a href="#">Brake Master Cylinder Replacement</a></li> </ul> <p>Brake master cylinder reservoir cap diaphragm</p> <ul style="list-style-type: none"> <li>• <a href="#">Front Brake Hose Replacement</a>, or <a href="#">Front Brake Hose Replacement</a></li> <li>• <a href="#">Rear Brake Hose Replacement</a>, or <a href="#">Rear Brake Hose Replacement (Frame to Axle)</a>, or <a href="#">Rear Brake Hose Replacement (Axle to Caliper)</a></li> <li>• <a href="#">Brake Pipe Replacement</a></li> <li>• <a href="#">Front Brake Caliper Replacement</a></li> <li>• <a href="#">Rear Brake Caliper Replacement</a></li> <li>• <a href="#">Brake Pressure Modulator Valve Replacement</a></li> </ul> <p>2. If you repaired or replaced any of the brake system components listed, bleed the hydraulic brake system. Refer to <a href="#">Hydraulic Brake System Bleeding (Manual)</a>, or <a href="#">Hydraulic Brake System Bleeding (Pressure)</a>. While bleeding the hydraulic brake system, observe for the following conditions:</p> <ul style="list-style-type: none"> <li>• 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</li> <li>• An unrestricted and even flow of brake fluid per axle during the bleeding procedure</li> </ul> | Go to <b>Step 7</b> | Go to <b>Step 12</b> |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Yes                  | No                   |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------------------|
|      | Did you find and correct a condition?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                      |                      |
| 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 <b>Step 19</b> | Go to <b>Step 8</b>  |
| 8    | Was the flow of brake fluid unrestricted and even per axle during the bleeding procedure?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Go to <b>Step 9</b>  | Go to <b>Step 10</b> |
| 9    | Inspect the hydraulic function of the brake calipers for proper operation. Refer to <a href="#">Hydraulic Brake Component Operation Visual Inspection</a> .<br>Was the hydraulic function of the brake calipers operating properly?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Go to <b>Step 21</b> | Go to <b>Step 14</b> |
| 10   | Was the flow of brake fluid restricted or uneven through front axle hydraulic components during the bleeding procedure?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Go to <b>Step 13</b> | Go to <b>Step 11</b> |
| 11   | Was the flow of brake fluid restricted or uneven through rear axle hydraulic components during the bleeding procedure?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Go to <b>Step 17</b> | -                    |
| 12   | Inspect the hydraulic function of the brake calipers for proper operation. Refer to <a href="#">Hydraulic Brake Component Operation Visual Inspection</a> .<br>Was the hydraulic function of the brake calipers operating properly?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Go to <b>Step 15</b> | Go to <b>Step 13</b> |
| 13   | Determine if the brake caliper is restricting the flow of brake fluid and/or not operating properly:<br><br><ol style="list-style-type: none"> <li>1. Raise and support the vehicle. Refer to <a href="#">Lifting and Jacking the Vehicle</a>.</li> <li>2. Remove the tire and wheel assemblies. Refer to <a href="#">Tire and Wheel Removal and Installation</a>.</li> <li>3. Open the suspected caliper bleeder valve.</li> <li>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.</li> <li>5. Close the caliper bleeder valve.</li> </ol><br>Was the flow of brake fluid unrestricted and did the caliper piston move freely? | Go to <b>Step 17</b> | Go to <b>Step 14</b> |
| 14   | Repair or replace any brake caliper that was not operating properly. Refer to the appropriate procedure:<br><br><ul style="list-style-type: none"> <li>• <a href="#">Front Brake Caliper Replacement</a></li> <li>• <a href="#">Rear Brake Caliper Replacement</a></li> </ul><br>Did you complete the repair and/or replacement?                                                                                                                                                                                                                                                                                                                                                                                                     | Go to <b>Step 21</b> | -                    |
| 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 <a href="#">Hydraulic Brake System Bleeding (Manual)</a> , or <a href="#">Hydraulic Brake System Bleeding (Pressure)</a> .<br>Was there air in the system?                                                                                                                                                                                                                                                                                                                                                                        | Go to <b>Step 19</b> | Go to <b>Step 16</b> |
| 16   | Was the flow of brake fluid unrestricted and even per axle during the bleeding procedure?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Go to <b>Step 21</b> | Go to <b>Step 17</b> |
| 17   | <ol style="list-style-type: none"> <li>1. Inspect the hydraulic brake pipes and flexible brake hoses for signs of a fluid restriction; such as being</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Go to <b>Step 21</b> | Go to <b>Step 18</b> |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Yes                                                  | No                      |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|-------------------------|
|      | <p>bent, kinked, pinched or damaged. Refer to <a href="#">Brake Pipe and Hose Inspection</a>.</p> <p>2. Replace any of the hydraulic brake pipes and/or flexible brake hoses found to be bent, kinked, pinched, or damaged. Refer to the following procedures as necessary:</p> <ul style="list-style-type: none"> <li>• <a href="#">Front Brake Hose Replacement</a>, or <a href="#">Front Brake Hose Replacement</a></li> <li>• <a href="#">Rear Brake Hose Replacement</a>, or <a href="#">Rear Brake Hose Replacement (Frame to Axle)</a>, or <a href="#">Rear Brake Hose Replacement (Axle to Caliper)</a></li> <li>• <a href="#">Brake Pipe Replacement</a></li> </ul> <p>3. If none of the hydraulic brake pipes or flexible brake hoses were visibly bent, kinked, pinched, or damaged, replace the hydraulic brake flex hose at the restricted location.</p> <p>Did you find and correct a condition?</p> |                                                      |                         |
| 18   | <p>Replace the brake pressure modulator valve (BPMV), in order to correct the hydraulic brake dynamic rear proportioning mechanical operation. Refer to <a href="#">Brake Pressure Modulator Valve Replacement</a>.</p> <p>Did you complete the replacement?</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Go to <b>Step 21</b>                                 | -                       |
| 19   | <p>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.</p> <p>2. Inspect the hydraulic brake system components for evidence of a recent repair, which may have introduced air into the system.</p> <p>3. Repair or replace any of the components found to be installed incorrectly or seeping brake fluid.</p> <p>Did you find and correct a condition?</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Go to <b>Step 21</b>                                 | Go to <b>Step 20</b>    |
| 20   | <p>1. Inspect the brake master cylinder for internal fluid leaks. Refer to <a href="#">Brake System Internal Leak Test</a>.</p> <p>2. Repair or replace the brake master cylinder if it is found to be leaking brake fluid internally. Refer to <a href="#">Brake Master Cylinder Replacement</a>.</p> <p>Did you find and correct a condition?</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Go to <b>Step 21</b>                                 | Return to Symptom Table |
| 21   | <p>Install or connect components that were removed or disconnected during diagnosis.</p> <p>Did you complete the operation?</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Hydraulic Brake System OK<br>Return to Symptom Table | -                       |

## BRAKE ASSIST SYSTEM DIAGNOSIS

| Step                                                                                                                                                                                                                                                                                                        | Action                                                                                                 | Yes                 | No                                                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|---------------------|-----------------------------------------------------------|
| <p>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.</p> |                                                                                                        |                     |                                                           |
| 1                                                                                                                                                                                                                                                                                                           | Were you sent here from a Brake Symptom table?                                                         | Go to <b>Step 3</b> | Go to <b>Step 2</b>                                       |
| 2                                                                                                                                                                                                                                                                                                           | Were you sent here directly from an electrical diagnostic to investigate vacuum as a possible concern? | Go to <b>Step 5</b> | Go to <a href="#">Diagnostic Starting Point - Vehicle</a> |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Yes                  | No                                                                                                                                          |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | Inspect for proper brake pedal travel. Refer to <a href="#">Brake Pedal Travel Measurement and Inspection</a> .<br>Is the brake pedal travel distance within the acceptable limits?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Go to <b>Step 5</b>  | Go to <b>Step 4</b>                                                                                                                         |
| 4    | <ol style="list-style-type: none"> <li>Inspect for worn, missing, misaligned, bent or damaged brake pedal system components. <ul style="list-style-type: none"> <li>For the brake pedal pushrod component inspection, refer to <a href="#">Brake Pedal Pushrod Inspection</a>.</li> <li>Inspect the brake pedal bushings for excessive wear and/or damage and inspect the brake pedal for a misaligned, bent and/or damaged condition.</li> </ul> </li> <li>Replace the brake pedal system components that are worn, missing, misaligned, bent or damaged.</li> </ol> Did you find and replace any worn, missing, misaligned, bent or damaged brake pedal system components? | Go to <b>Step 5</b>  | Go to <a href="#">Hydraulic Brake System Diagnosis</a> 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 <a href="#">Brake System Vacuum Source Test</a> .<br>Is the vacuum reading within the acceptable limits?                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Go to <b>Step 6</b>  | 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 <b>Step 7</b>  | Go to <b>Step 8</b>                                                                                                                         |
| 7    | Check engine vacuum, and vacuum pump operation, if equipped, under the same cold start-up conditions. Refer to Engine Controls Diagnostics.<br>Did you find and correct a condition?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Go to <b>Step 22</b> | Go to <b>Step 9</b>                                                                                                                         |
| 8    | During the vacuum source test, did the vacuum booster check valve operate properly?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Go to <b>Step 10</b> | Go to <b>Step 9</b>                                                                                                                         |
| 9    | Replace the vacuum booster check valve. Refer to <a href="#">Power Brake Booster Vacuum Hose Replacement (LCV)</a> , or <a href="#">Power Brake Booster Vacuum Hose Replacement (LWN)</a> , or <a href="#">Power Brake Booster Vacuum Hose Replacement (LGZ)</a> .<br>Did you complete the replacement?                                                                                                                                                                                                                                                                                                                                                                      | Go to <b>Step 10</b> | -                                                                                                                                           |
| 10   | If equipped with a booster mounted separate vacuum sensor, inspect the vacuum sensor grommet for cracks, cuts, dry-rot, or damage.<br>Does the vacuum sensor grommet exhibit any of the conditions listed?                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Go to <b>Step 11</b> | Go to <b>Step 12</b>                                                                                                                        |
| 11   | Replace the vacuum sensor grommet.<br>Did you complete the replacement?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Go to <b>Step 12</b> | -                                                                                                                                           |
| 12   | <ol style="list-style-type: none"> <li>If the vehicle is equipped with a vacuum sensor, install a scan tool.</li> <li>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.</li> </ol> Is vacuum sensor data available through the scan tool?                                                                                                                                                                                                                                                                                                    | Go to <b>Step 13</b> | Go to <b>Step 16</b>                                                                                                                        |
| 13   | Perform the vacuum booster leak-down test using a scan tool:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Go to <b>Step 18</b> | Go to <b>Step 14</b>                                                                                                                        |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Yes                  | No                   |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------------------|
|      | <ol style="list-style-type: none"> <li>1. Release the brake pedal.</li> <li>2. Accelerate the engine to approximately 3000 RPM, then release the throttle. Wait 2 - 3 seconds and repeat once.</li> <li>3. Turn the ignition OFF.</li> <li>4. Turn the ignition ON. Do not start the engine.</li> <li>5. Observe and record the vacuum sensor reading on the scan tool over a period of 60 seconds.</li> </ol> <p><b>NOTE:</b><br/> <b>Vacuum readings will decrease by approximately 2.7 kPa (0.8 Hg) for every 305 m (1000 ft) of elevation above sea level.</b></p> <ol style="list-style-type: none"> <li>6. Determine the rate of vacuum leak.</li> </ol> <p>Was the rate of vacuum leak below the specified allowable range of 10 kPa (3 in Hg) in 60 seconds?</p> |                      |                      |
| 14   | <ol style="list-style-type: none"> <li>1. Deplete the vacuum reserve by pressing the brake pedal several times, or by removing the vacuum booster check valve.</li> <li>2. Separate the master cylinder from the vacuum brake booster. Do not disconnect any brake pipes. Refer to <b><u>Brake Master Cylinder Replacement</u></b>.</li> <li>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.</li> <li>4. Carefully reinstall the master cylinder to the brake booster. Refer to <b><u>Brake Master Cylinder Replacement</u></b>.</li> </ol> <p>Did you complete the operation?</p>                                               | Go to <b>Step 15</b> | -                    |
| 15   | <p>Perform the vacuum booster leak-down test using a scan tool:</p> <ol style="list-style-type: none"> <li>1. Release the brake pedal.</li> <li>2. Accelerate the engine to approximately 3000 RPM, then release the throttle. Wait 2 - 3 seconds and repeat once.</li> <li>3. Turn the ignition OFF.</li> <li>4. Turn the ignition ON. Do not start the engine.</li> <li>5. Observe and record the vacuum sensor reading on the scan tool over a period of 60 seconds.</li> </ol> <p><b>NOTE:</b></p>                                                                                                                                                                                                                                                                   | Go to <b>Step 22</b> | Go to <b>Step 21</b> |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Yes                  | No                   |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------------------|
|      | <p><b>Vacuum readings will decrease by approximately 2.7 kPa (0.8 Hg) for every 305 m (1000 ft) of elevation above sea level.</b></p> <p>6. Determine the rate of vacuum leak.</p> <p>Was the rate of vacuum leak below the specified allowable range of 10 kPa (3 in Hg) in 60 seconds?</p>                                                                                                                                                                                                                                                                                                                                                                                           |                      |                      |
| 16   | <ol style="list-style-type: none"> <li>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 <a href="#">Brake Master Cylinder Replacement</a>.</li> <li>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.</li> <li>3. If equipped with a vacuum seal that is part of the booster, inspect the seal for damage.</li> </ol> <p>Does the vacuum seal exhibit any of the conditions listed?</p> | Go to <b>Step 17</b> | Go to <b>Step 18</b> |
| 17   | <ol style="list-style-type: none"> <li>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.</li> <li>2. If equipped with a vacuum seal that requires replacement and which is part of the booster, the booster assembly must be replaced.</li> <li>3. Carefully reinstall the master cylinder to the brake booster. Refer to <a href="#">Brake Master Cylinder Replacement</a>.</li> </ol> <p>Did you complete the replacement?</p>                                                                                                                                | Go to <b>Step 18</b> | -                    |
| 18   | <p>Perform the vacuum boost functional test:</p> <ol style="list-style-type: none"> <li>1. If still separated, reinstall the master cylinder to the booster. Refer to <a href="#">Brake Master Cylinder Replacement</a>.</li> <li>2. If the engine was started after reinstalling the master cylinder to the booster, perform the following:<br/><br/>With the engine OFF, depress the brake pedal several times to deplete the vacuum reserve.</li> <li>3. Depress and maintain moderate foot pressure on the brake pedal.</li> </ol>                                                                                                                                                 | Go to <b>Step 21</b> | Go to <b>Step 19</b> |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Yes                                               | No                   |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|----------------------|
|      | 4. Start the engine and observe pedal operation.<br>5. Observe for audible vacuum leaks.<br><br>The brake pedal should fall slightly, then hold.<br><br>Is there an audible vacuum leak coming from the brake pedal area?                                                                                                                                                                                                                                                                                                                                                                 |                                                   |                      |
| 19   | Did the brake pedal fall slightly after the engine was started, then hold?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Go to <b>Step 20</b>                              | Go to <b>Step 21</b> |
| 20   | Perform the vacuum booster leak-down test:<br><br>1. Release the brake pedal.<br>2. Accelerate the engine to approximately 3000 RPM, then release the throttle. Wait 2 - 3 seconds and repeat once.<br>3. Turn the ignition OFF.<br>4. Wait 60 seconds.<br>5. Depress the brake pedal 2 times to check for vacuum booster available vacuum reserve. Observe pedal effort. <ul style="list-style-type: none"> <li>• Both pedal applies should be assisted</li> <li>• The amount of assist could diminish slightly with the second apply</li> </ul> Were both pedal applies power assisted? | Go to <b>Step 22</b>                              | Go to <b>Step 21</b> |
| 21   | Replace the vacuum brake booster. Refer to <b>Power Brake Booster Replacement</b> .<br>Did you complete the replacement?                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Go to <b>Step 22</b>                              | -                    |
| 22   | Install or connect any components that were removed or disconnected during diagnosis.<br>Did you complete the operation?                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Brake Assist System OK<br>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. **Brake 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. **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.

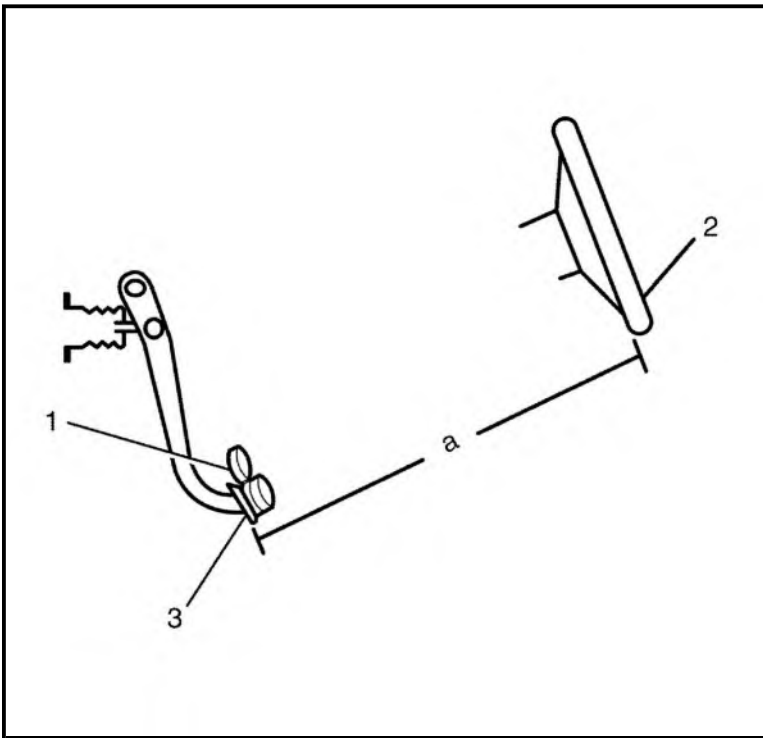
## **BRAKE PEDAL TRAVEL MEASUREMENT AND INSPECTION**

### **Special Tools**

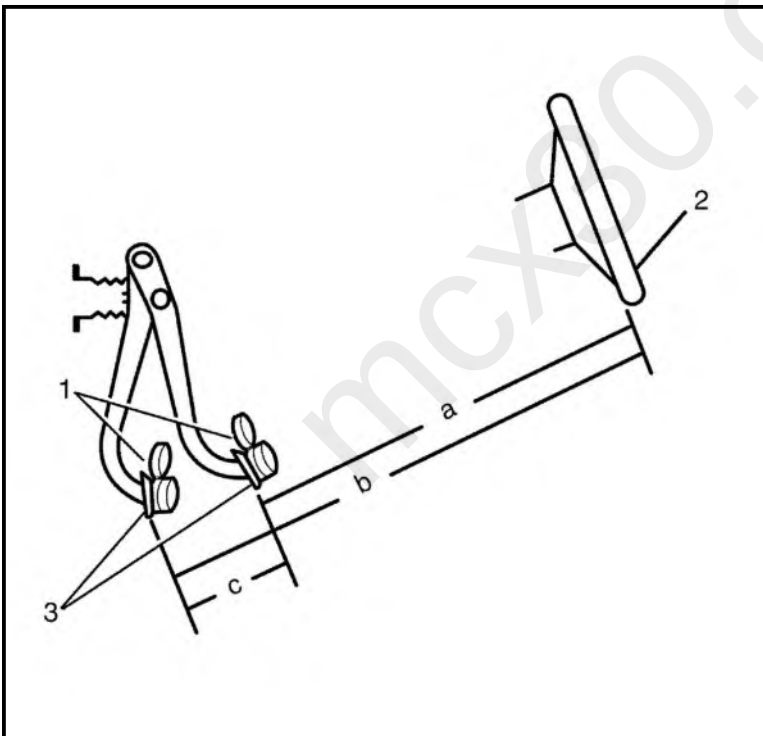
#### **CH-28662 Brake Pedal Effort Gauge**

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** Brake Pedal Effort 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 (100 lb) to the brake pedal, as indicated on the **CH-28662** Brake Pedal Effort Gauge (1), or equivalent.



5. While maintaining 445 N (100 lb) of force to the brake pedal (3), measure and record the distance (b) from the same point on the brake pedal (3) to the same point on the rim of the steering wheel (2).
6. Release the brake pedal (3) and repeat steps 4 and 5 to obtain a second measurement. After obtaining a second measurement, proceed to step 7.
7. Average the first and second measurements recorded for the 2 applies of the brakes.
8. Subtract the initial unapplied distance (a), from the average applied distance (b) to obtain the brake pedal travel measurement (c).

## Specification

Maximum brake pedal travel - measured with the ignition OFF, brake booster power assist depleted, and the brakes cool 49 mm (2 in)

## **BRAKE SYSTEM VACUUM SOURCE TEST**

### **NOTE:**

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

1. Disconnect the vacuum hose from the vacuum brake booster check valve.
2. Install a vacuum gauge to the 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 vacuum reading is within the specified normal vacuum range.

### **Specification**

47 - 68 kPa (14 - 20 in Hg)

5. Turn the ignition OFF.
6. If the vacuum reading was within the specified normal range, proceed to step 10.
7. If the vacuum reading was NOT within the specified normal range, inspect the vacuum hoses for the following conditions:
  - Loose connection to the vacuum source.
  - Collapse, deformation or contamination
  - Cracks, cuts, or dry-rot
8. If any of these conditions were found with the vacuum hoses, replace the hose, then repeat steps 2 - 4.
9. If none of these conditions were found with the vacuum hoses, then there is an vacuum source problem, check the vacuum system.
10. Remove the vacuum brake booster check valve from the booster.
11. Install the check valve to the 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 vacuum reading is maintained within the specified normal vacuum range.

### **Specification**

47 - 68 kPa (14 - 20 in Hg)

16. If the vacuum reading is maintained within the specified normal range, proceed to step 18.
17. If the 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. [Brake 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.

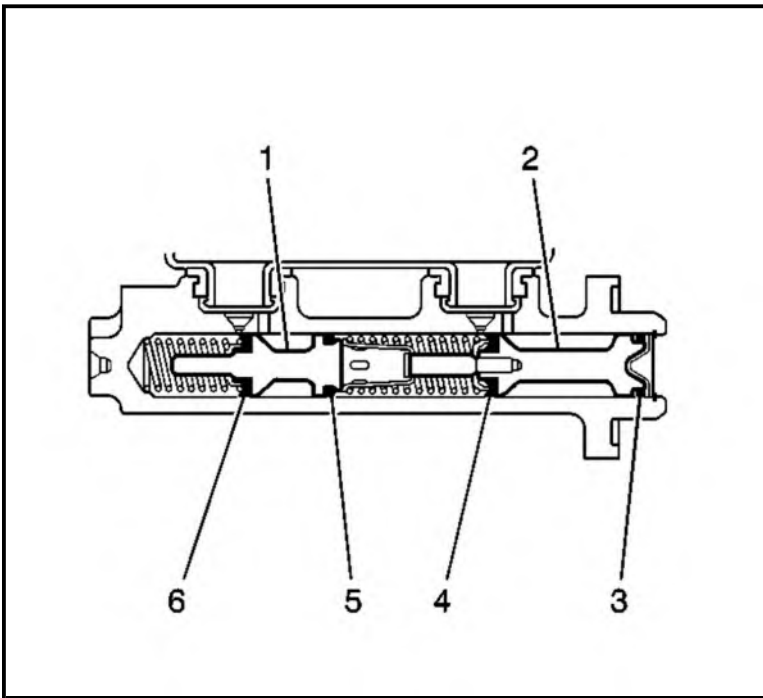
4. Turn OFF the ignition.
5. Visually inspect the following brake system components for brake fluid leaks, excessive corrosion, and damage. Give particular attention to all brake pipe and flexible hose connections to ensure that there are not any slight brake fluid leaks - even though the brake pedal 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](#) .

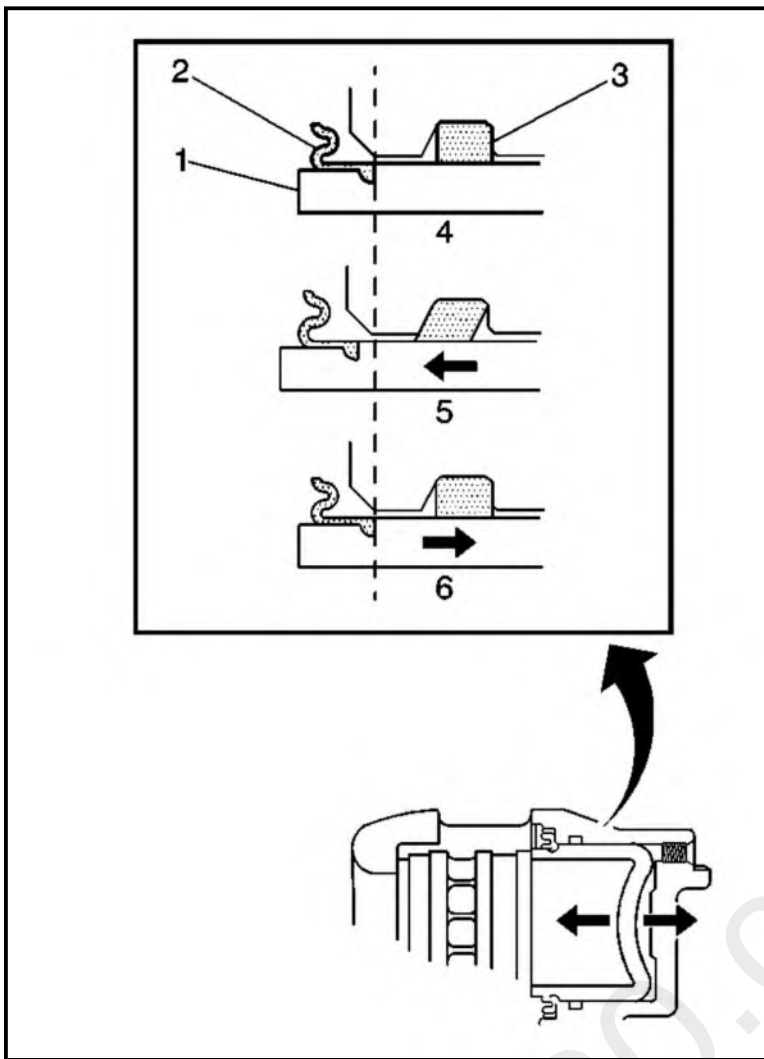
1. Start the engine and allow it to idle.
2. Apply light, steady pressure to the brake pedal. Observe both the brake pedal feel and travel.
3. Release the brakes and turn OFF the ignition.
4. If the brake pedal apply felt spongy, but the brake pedal travel was not excessive, perform the following steps:
  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 \(Manual\)](#), 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:



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

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

1. With the tire and wheel assemblies removed and the brake rotors retained by wheel lug nuts, visually inspect the caliper piston dust boot (2) sealing area to ensure that there are no brake fluid leaks.



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

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

2. If any evidence of a brake fluid leak is present, the brake caliper requires overhaul or replacement.
3. While the brake system is at rest (4), observe the position of the caliper piston (1) in relation to the caliper housing.
4. Have an assistant apply and release the brake pedal several times while you observe the operation of the hydraulic brake caliper.
  1. Observe the caliper piston (1) for unrestricted and even movement during each apply of the brake system (5).
  2. Observe the caliper piston (1) for an unrestricted and even return motion during each release of the brake system (6).
5. If the caliper piston (1) did not exhibit unrestricted and even movement during brake system apply and/or release, the piston square seal (3) may be worn or damaged and the caliper may require overhaul or replacement.

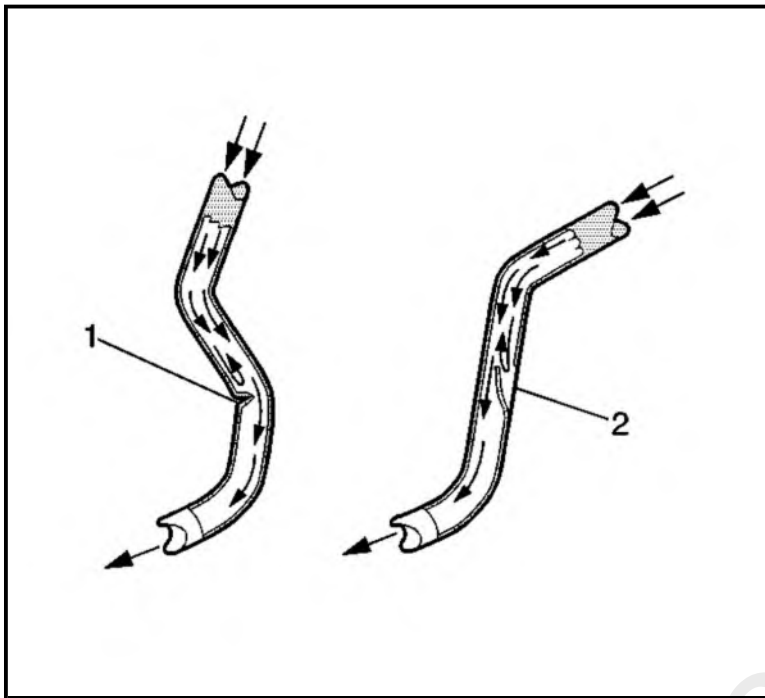
## BRAKE PIPE AND HOSE INSPECTION

**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

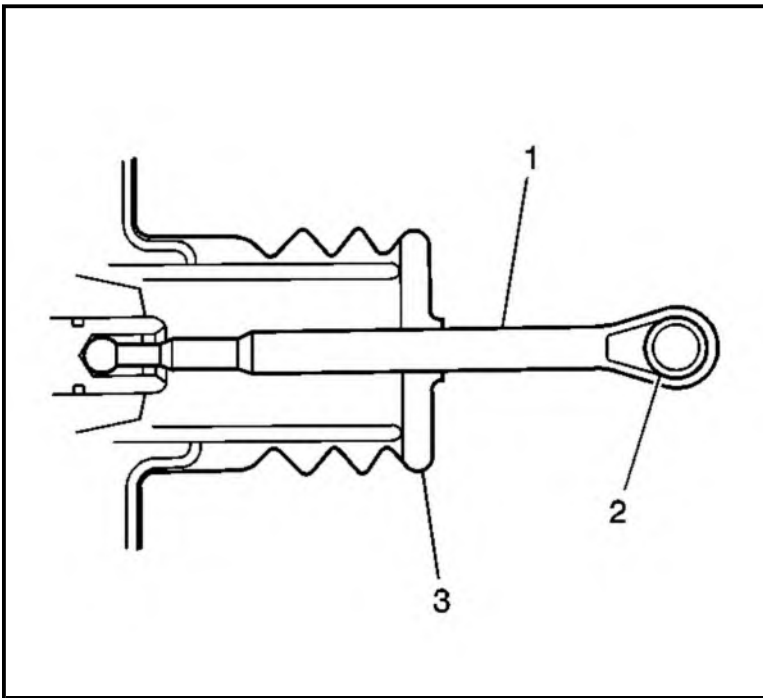
2. If any of the brake pipes exhibited any of the conditions listed, then the identified pipe, or pipes, require replacement.
3. Ensure that the vehicle axles are properly supported at ride height in order to maintain the proper relationship of the flexible brake hoses to the chassis.
4. Visually inspect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



- 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.



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. Brake 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. 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. Hydraulic Brake System Bleeding (Manual), 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. [Brake 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. [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). [Antilock Brake System Automated Bleed](#)

## **BRAKE 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.
7. Use only GM approved brake fluid from a clean, sealed brake fluid container to SLOWLY fill the brake master cylinder reservoir to avoid spillage due to overfilling. [Adhesives, Fluids, Lubricants, and Sealers](#)

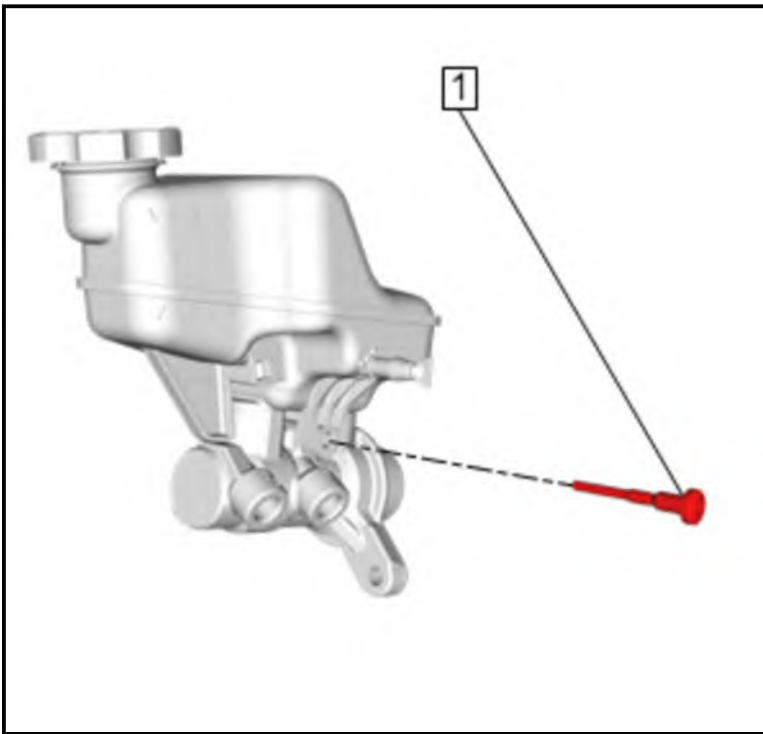
## **BRAKE MASTER CYLINDER RESERVOIR REPLACEMENT**

### **Removal Procedure**

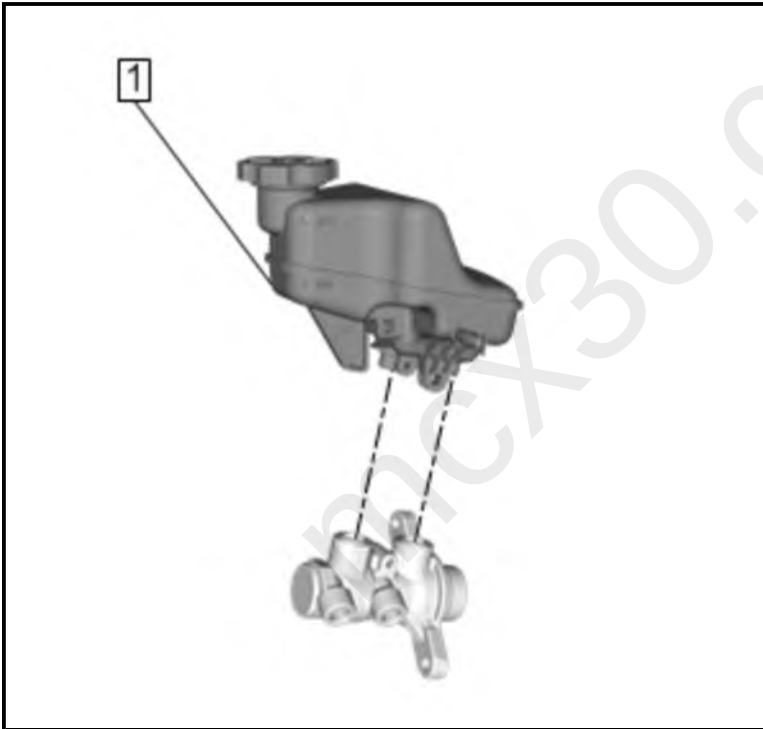
**WARNING:** Refer to [Brake Fluid Irritant Warning](#) .

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

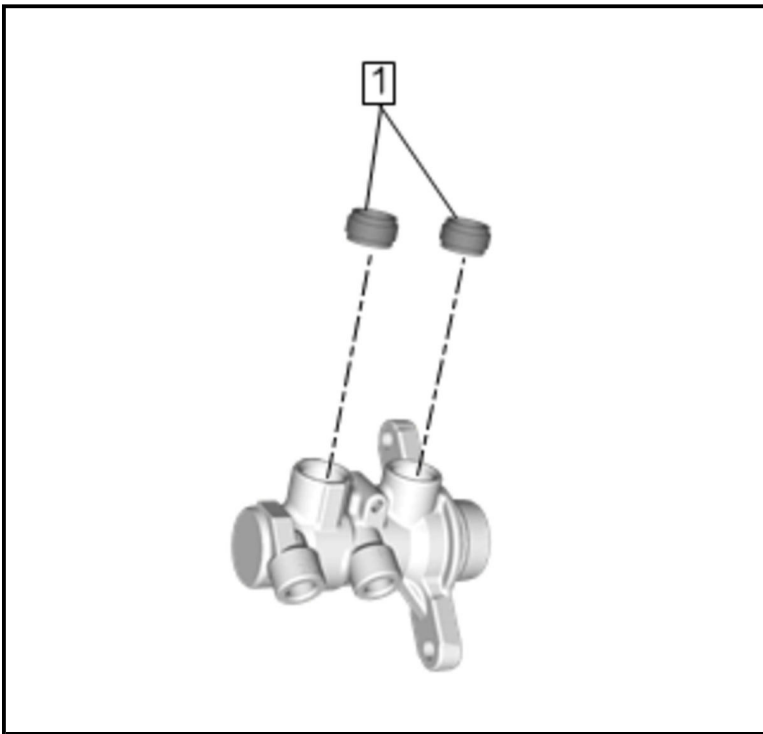
1. [Brake Master Cylinder Replacement](#) - Remove
2. Brake Master Cylinder Reservoir Bolt (1) - Remove



3. Brake Master Cylinder Reservoir (1) - Remove

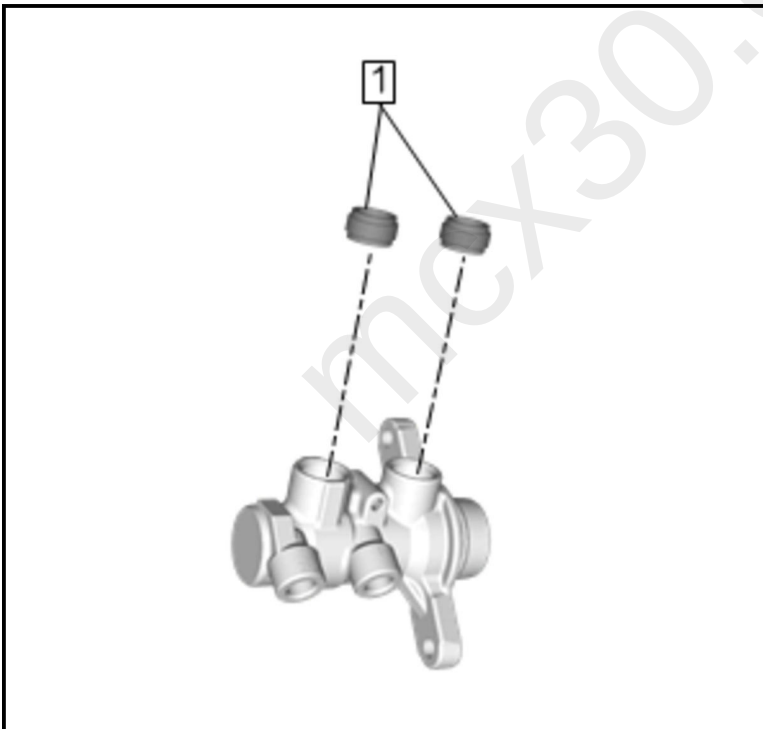


4. Master Cylinder Reservoir Seal (1) - Remove [2x]

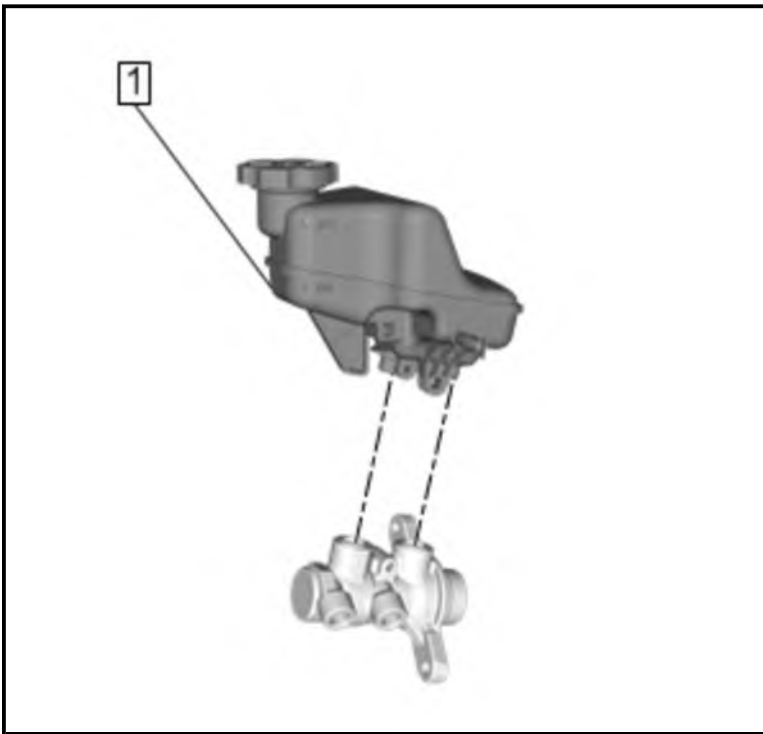


#### Installation Procedure

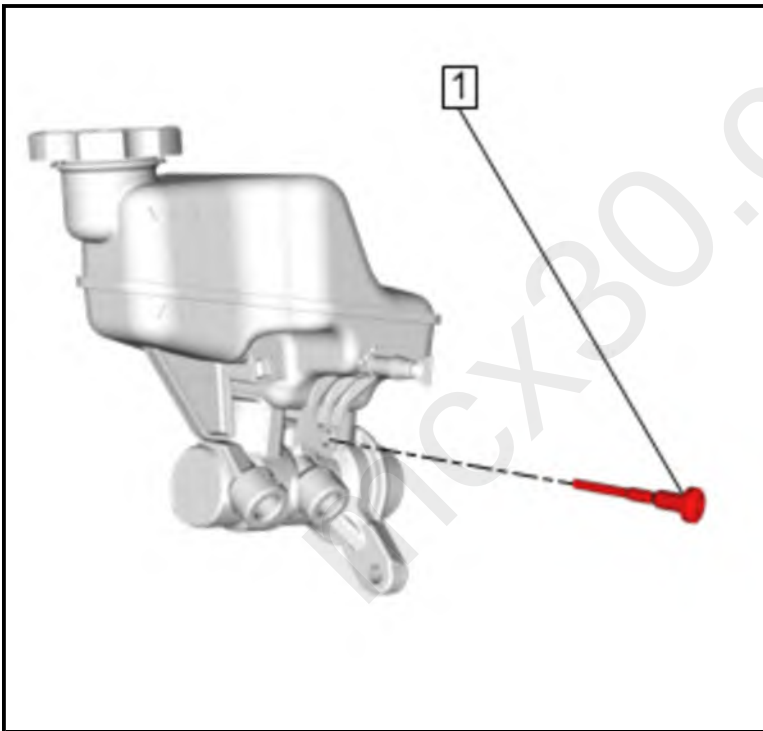
1. Lightly lubricate the master cylinder reservoir seals with GM approved brake fluid from a clean, sealed brake fluid container. [Adhesives, Fluids, Lubricants, and Sealers](#)
2. Master Cylinder Reservoir Seal (1) - Install [2x]



3. Brake Master Cylinder Reservoir (1) - Install



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



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

5. [Brake Master Cylinder Replacement](#) - Install

## **BRAKE MASTER CYLINDER REPLACEMENT**

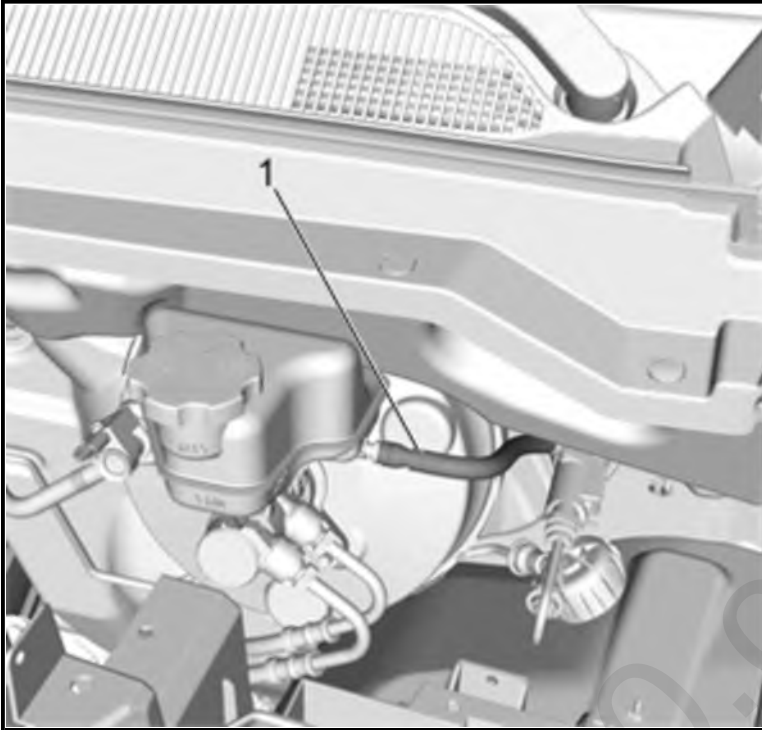
### **Removal Procedure**

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

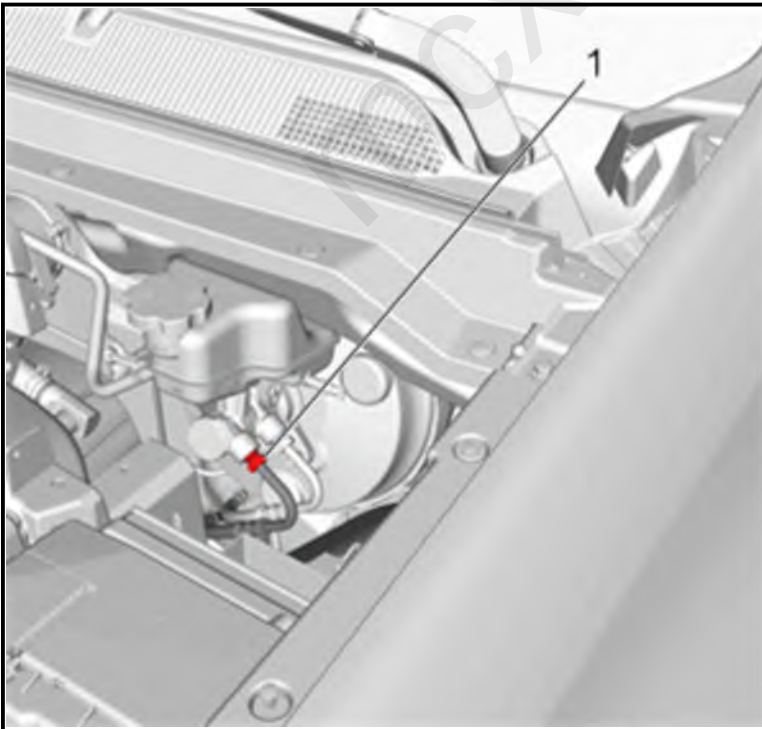
**CAUTION:** Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

1. Place the ignition switch in the OFF position.

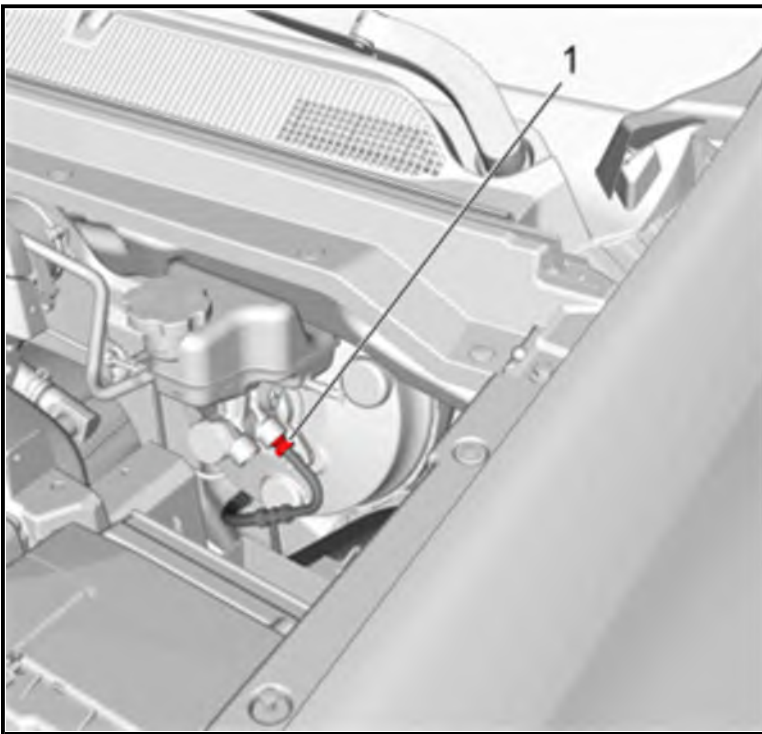
2. Apply and release the brake pedal several times until the pedal becomes firm to deplete the power vacuum brake booster vacuum reserve.
3. Thoroughly clean the master cylinder reservoir and the master cylinder body to remove any dirt and debris.
4. Disconnect the brake fluid level indicator switch electrical connector.
5. Remove and properly dispose of the brake fluid in the master cylinder reservoir.
6. If equipped with a manual transmission, disconnect the hydraulic clutch feed hose (1) from the master cylinder reservoir.



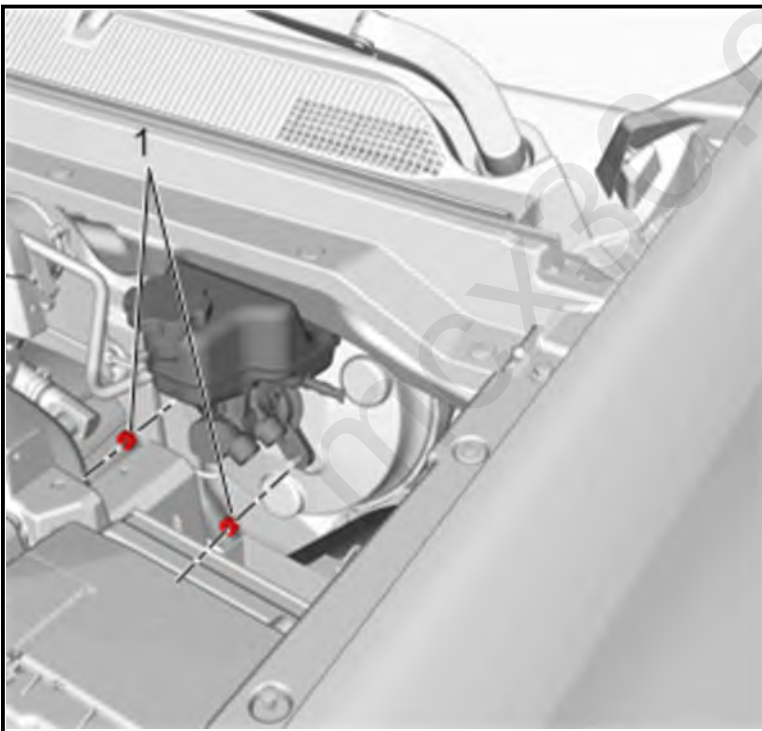
7. Cap the clutch feed hose to prevent brake fluid loss and contamination.
8. Disconnect the master cylinder secondary brake pipe fitting (1).



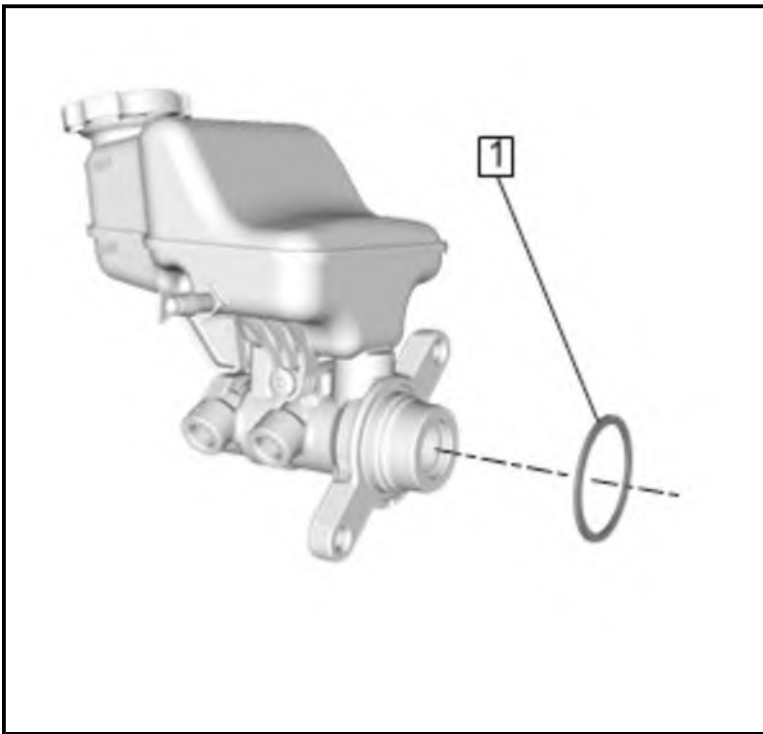
9. Cap the brake pipe fitting and plug the master cylinder outlet port to prevent brake fluid loss and contamination.
10. Disconnect the master cylinder primary brake pipe fitting (1).



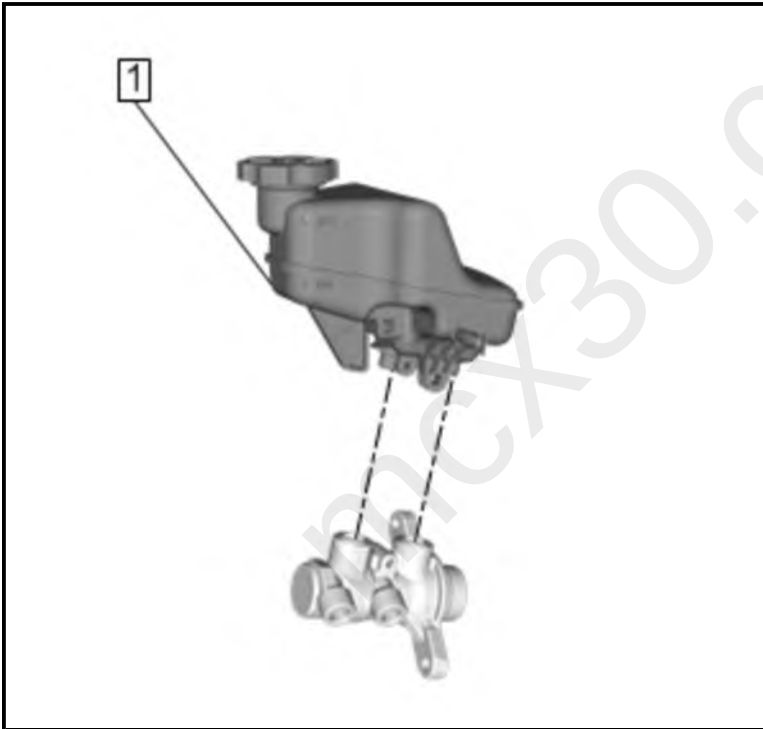
11. Cap the brake pipe fitting and plug the master cylinder outlet port to prevent brake fluid loss and contamination.
12. Remove and DISCARD the 2 master cylinder nuts (1).



13. Remove the master cylinder from the power brake booster.
14. Inspect the master cylinder O-ring seal (1) for damage and replace, if necessary.

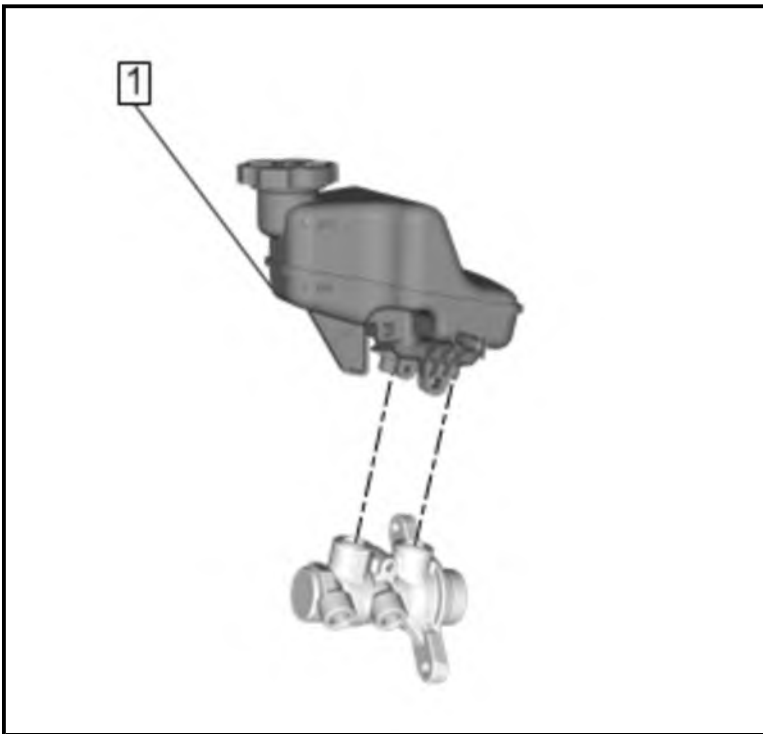


15. If necessary, remove the master cylinder reservoir (1). [Brake Master Cylinder Reservoir Replacement](#)

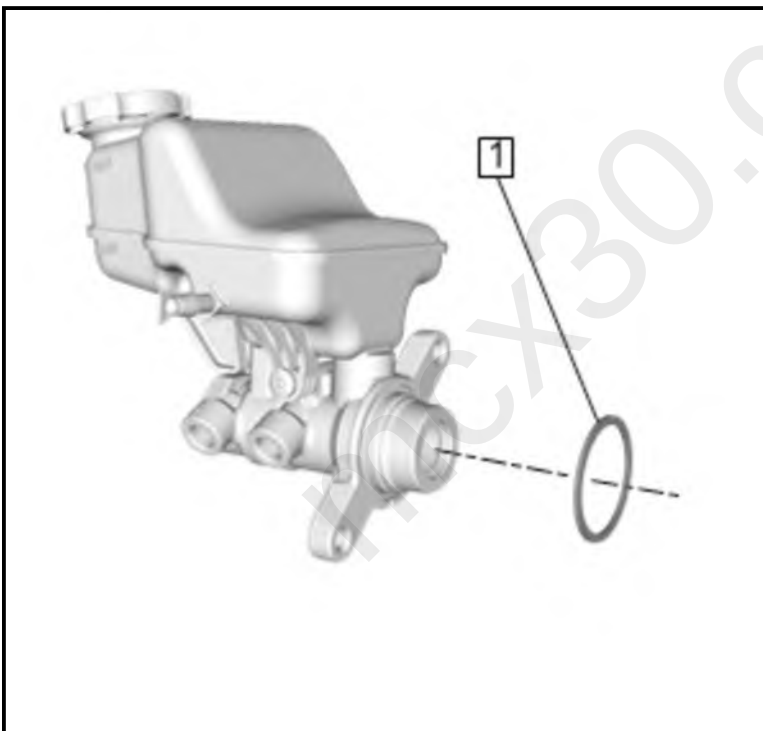


#### Installation Procedure

1. If removed, install the master cylinder reservoir (1). [Brake Master Cylinder Reservoir Replacement](#)



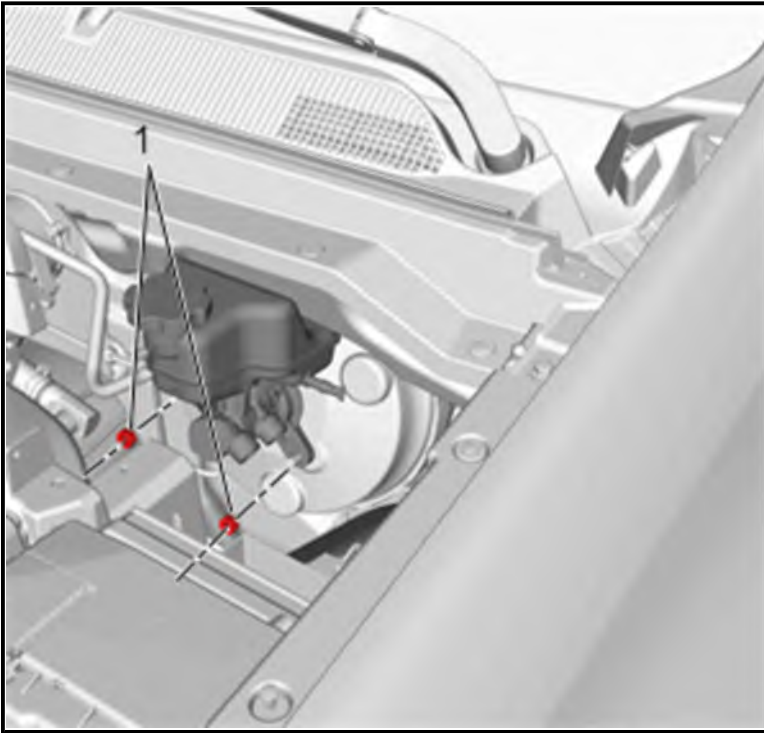
2. Bench bleed the master cylinder. [Brake Master Cylinder Bench Bleeding](#)
3. Install the master cylinder O-ring seal (1).



**NOTE:** Ensure the master cylinder O-ring seal is properly seated in the master cylinder body to prevent vacuum leaks.

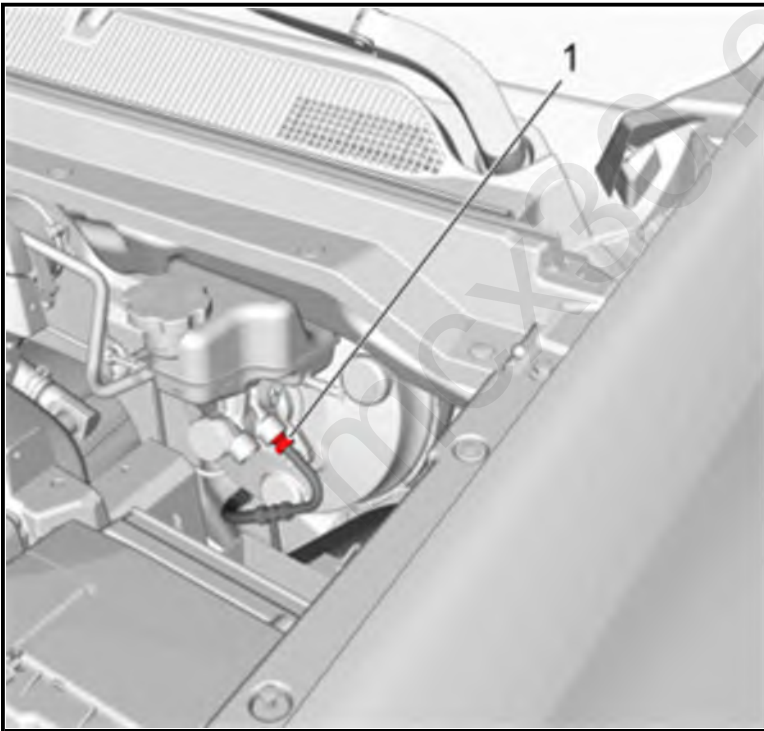
**NOTE:** Center the power brake booster pushrod in the master cylinder piston.

4. Install the master cylinder assembly to the power brake booster.
5. Install 2 NEW master cylinder nuts (1) and tighten to 25 N.m (18 lb ft).

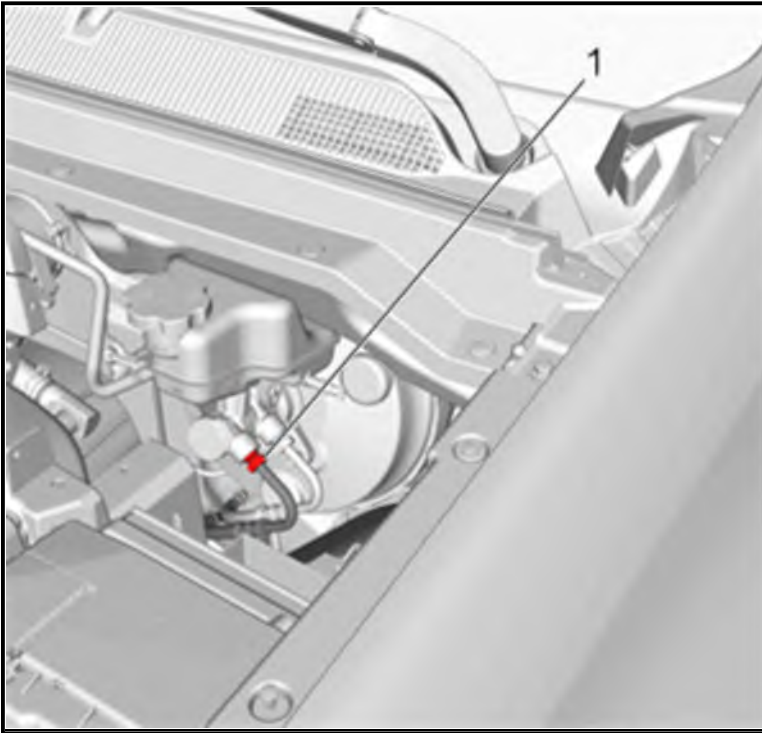


**CAUTION:** Refer to [Fastener Caution](#) .

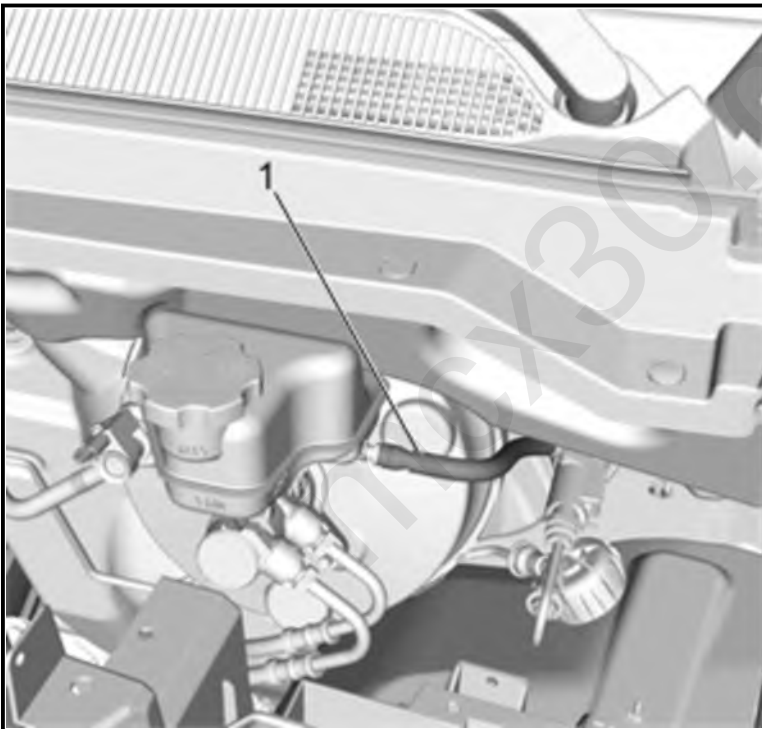
6. Connect the master cylinder primary brake pipe fitting (1) and tighten to 45 N.m (33 lb ft).



7. Connect the master cylinder secondary brake pipe fitting (1) and tighten to 45 N.m (33 lb ft).



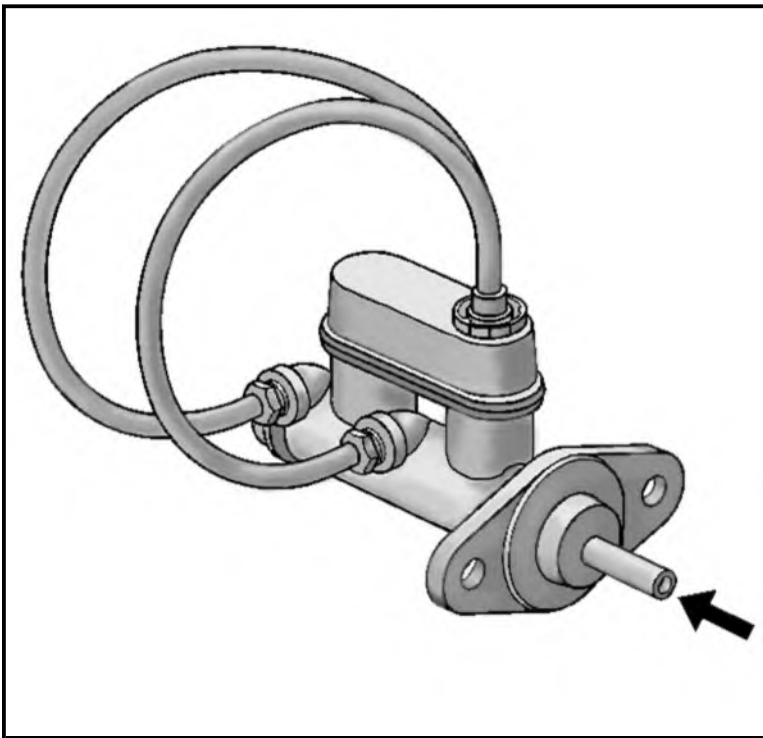
8. If equipped with a manual transmission, connect the hydraulic clutch feed hose (1) to the master cylinder reservoir.



9. Connect the brake fluid level indicator switch electrical connector.
10. Bleed the hydraulic brake system. [Hydraulic Brake System Bleeding \(Manual\)](#), or [Hydraulic Brake System Bleeding \(Pressure\)](#).
11. Check for brake system leaks.

### **BRAKE 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.



**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. [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.

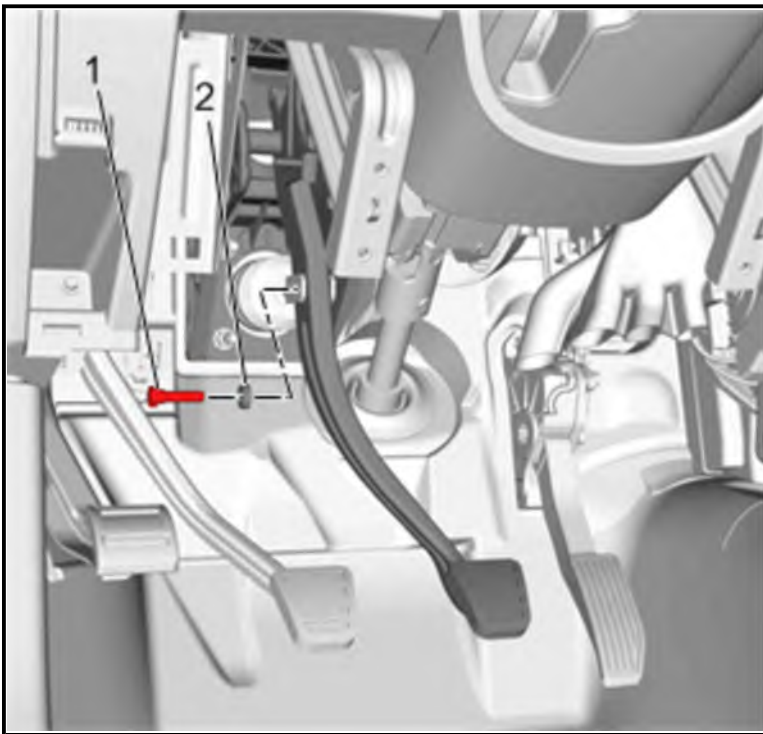
As air is bled from the primary and secondary pistons, the effort required to depress the primary piston will increase and the amount of travel will decrease.

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.

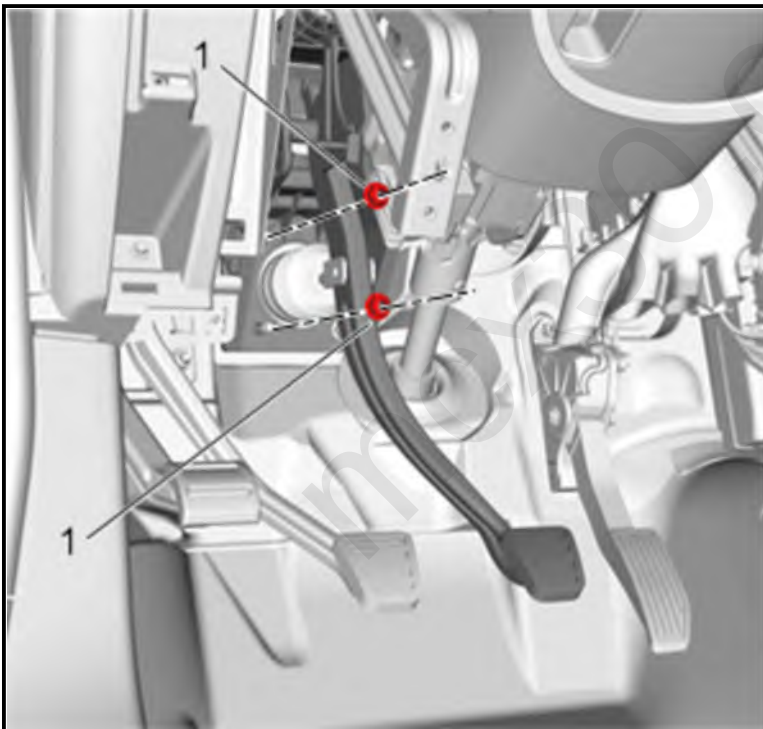
## **BRAKE PEDAL ASSEMBLY REPLACEMENT**

### **Removal Procedure**

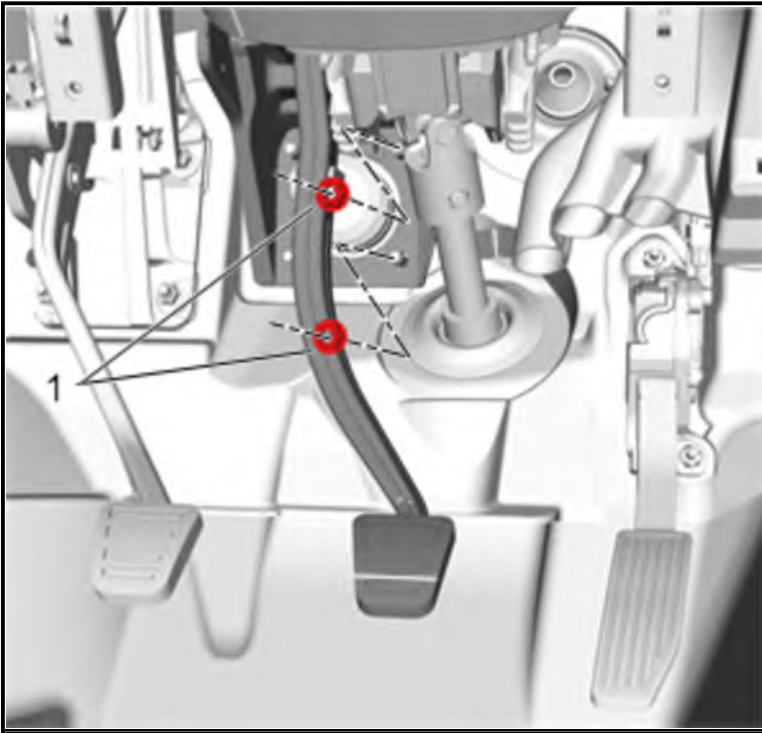
1. Remove the instrument panel tie bar. [Instrument Panel Tie Bar Replacement](#)
2. Remove the brake pedal position sensor. [Brake Pedal Position Sensor Replacement](#)
3. Remove the brake pedal pushrod bolt (1) and bushing (2).



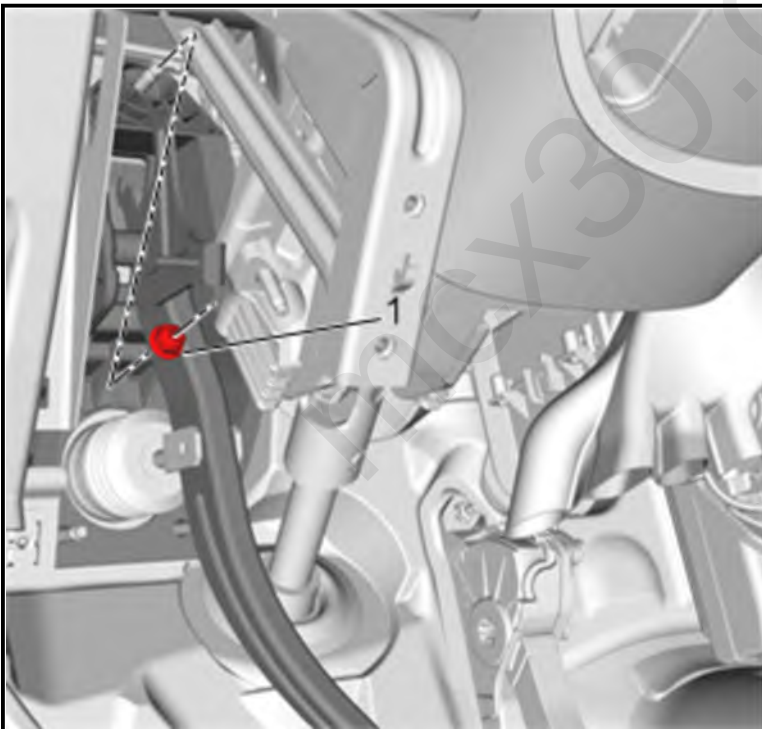
4. Disconnect the brake pedal pushrod from the brake pedal.
5. Remove the left side power brake booster nuts (1).



6. Remove the right side power brake booster nuts (1).



7. From inside the engine compartment, carefully pull the power brake booster and master cylinder assembly away from the dash panel.
8. Secure the power brake booster and master cylinder assembly with heavy mechanics wire.
9. Remove the brake pedal assembly upper nut (1).



10. Maneuver the brake pedal assembly from under the instrument panel and remove the pedal assembly from the vehicle.

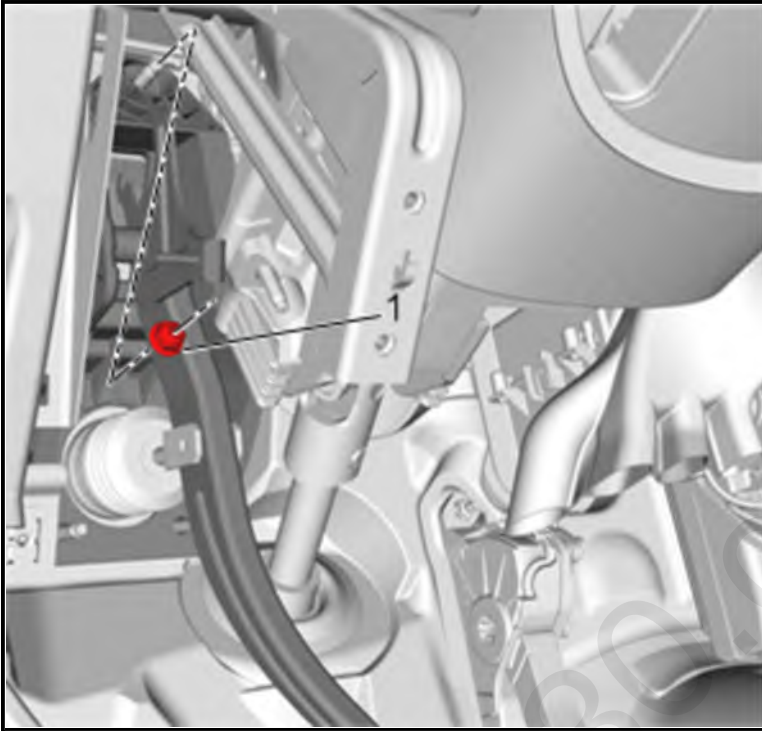
#### Installation Procedure

1. Prepare the brake pedal push rod bolt for installation as follows:
  1. Remove any loose cured adhesive from the external threads of the component using a lint free cloth.
  2. Thread the cleaned component into the internal mating threads and remove to loosen trapped cured adhesive.
  3. Apply thread locking adhesive to the external threads of the component. Adhesives, Fluids, Lubricants, and Sealers

4. Ensure there are no gaps in the thread locking adhesive once applied to the component.
2. Position the brake pedal assembly to the upper dash panel stud.

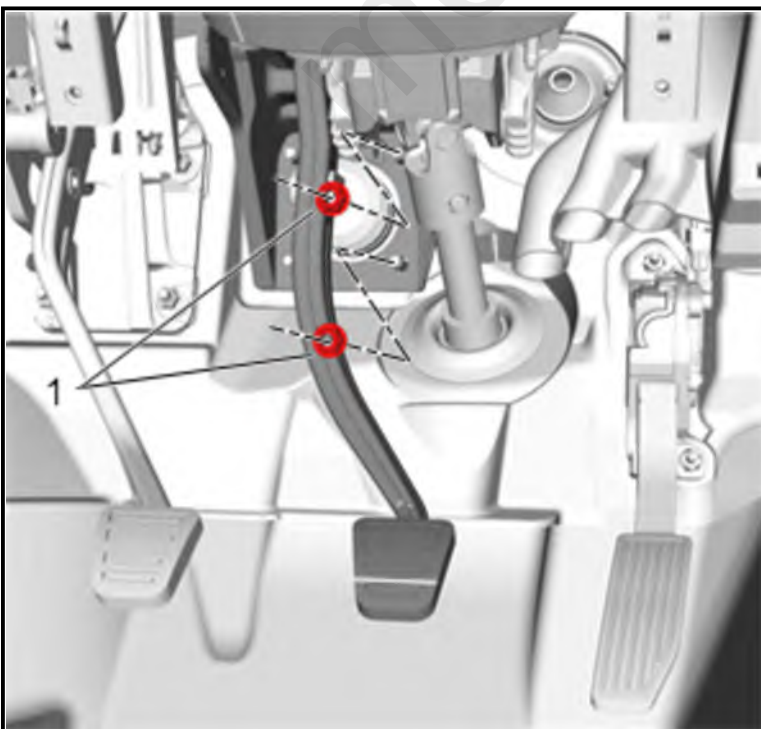
**NOTE:** Do not tighten the brake pedal assembly upper nut at this step.

3. Loosely install the brake pedal assembly upper nut.
4. From inside the engine compartment, remove the mechanics wire and position the power brake booster and master cylinder assembly to the dash panel.
5. Install the brake pedal assembly upper nut (1) and tighten to 23 N.m (17 lb ft).

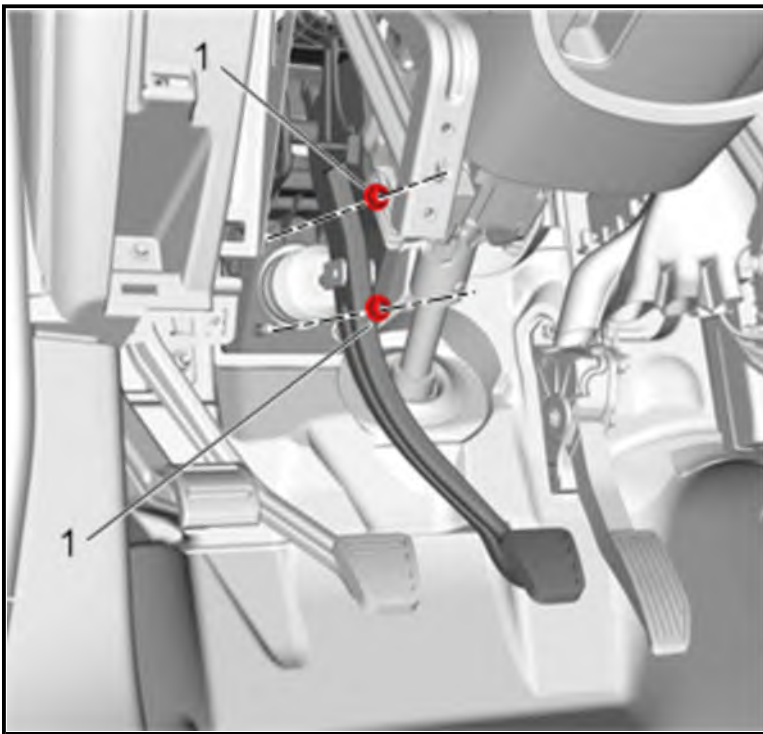


**CAUTION:** Refer to [Fastener Caution](#) .

6. Install the right side power brake booster nuts (1) and tighten to 23 N.m (17 lb ft).

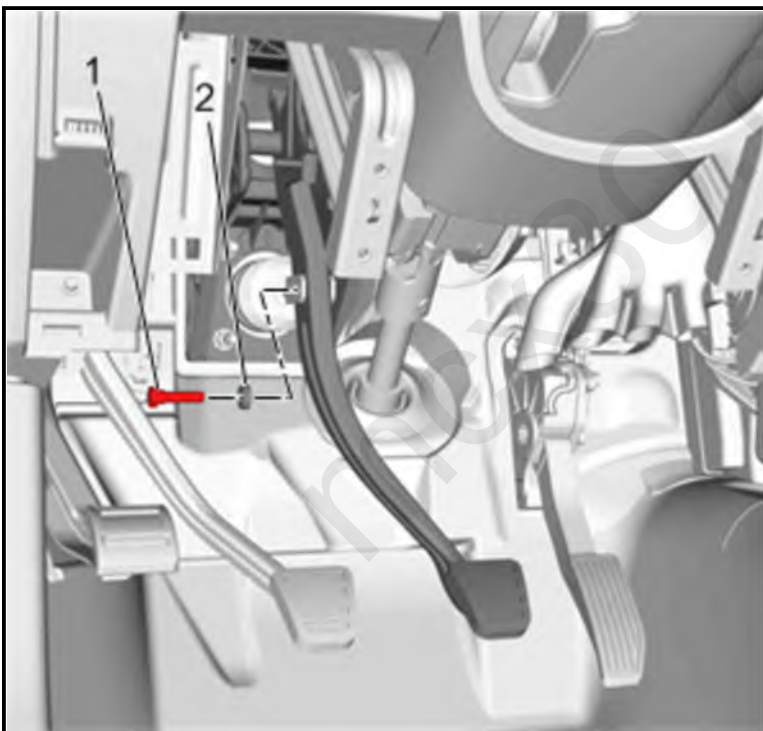


7. Install the left side power brake booster nuts (1) and tighten to 23 N.m (17 lb ft).



8. Connect the brake pedal pushrod to the brake pedal.

9. Install the brake pedal pushrod bolt (1) and bushing (2) and tighten the bolt to 10 N.m (89 lb in).



10. Install the brake pedal position sensor. [Brake Pedal Position Sensor Replacement](#)

11. Install the instrument panel tie bar. [Instrument Panel Tie Bar Replacement](#)

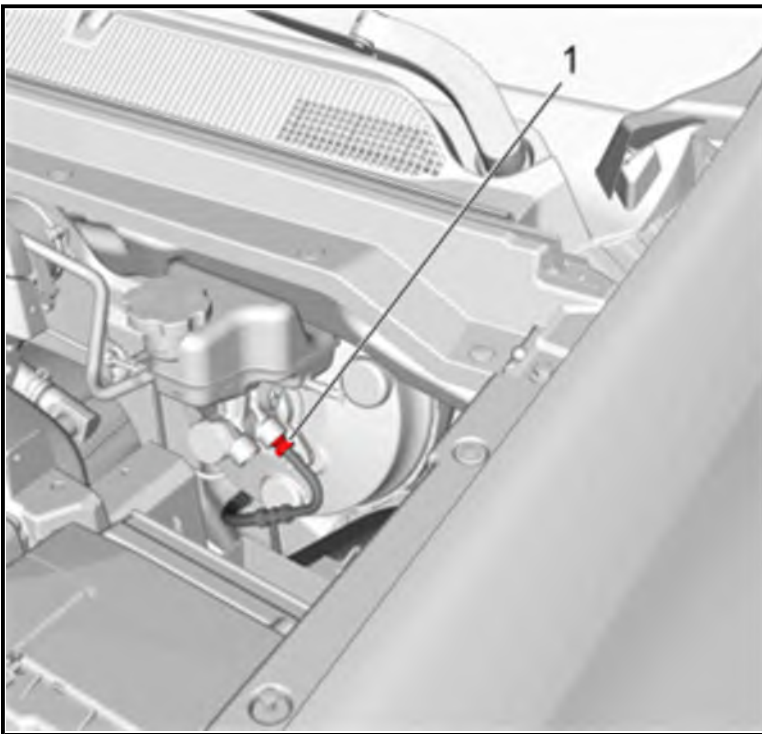
## **BRAKE PRESSURE MODULATOR VALVE PRIMARY PIPE REPLACEMENT**

### **Removal Procedure**

**WARNING:** [Brake Fluid Irritant Warning](#)

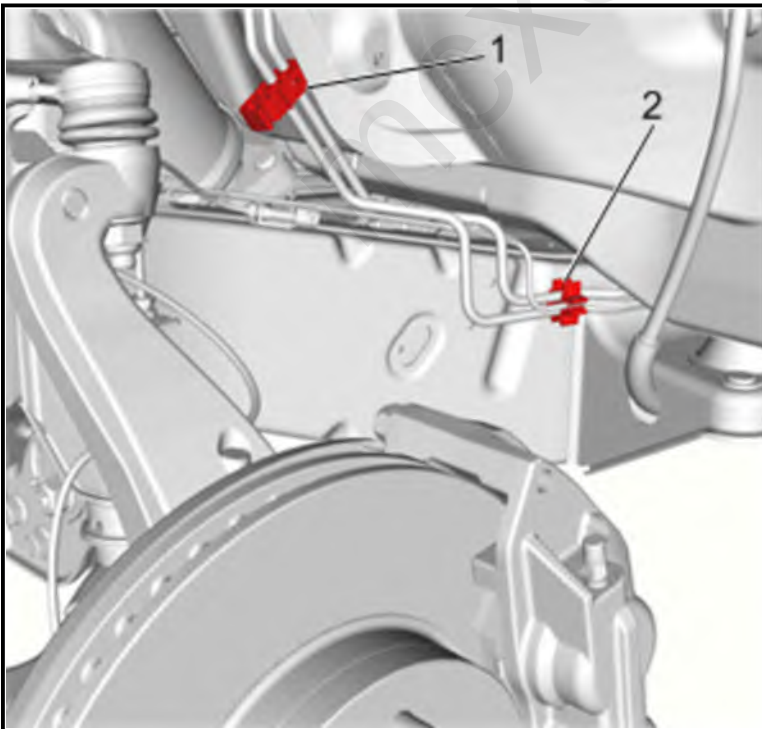
**CAUTION:** [Brake Fluid Effects on Paint and Electrical Components Caution](#)

1. Disconnect the master cylinder primary brake pipe fitting (1).

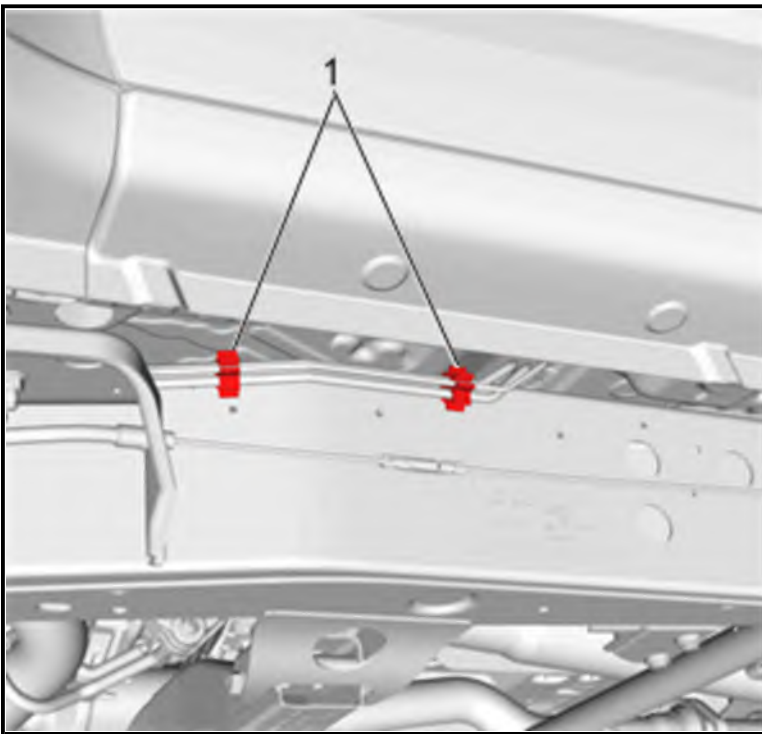


**NOTE:** Some components not shown for graphic clarity.

2. Plug the master cylinder outlet port to prevent brake fluid loss and contamination.
3. Separate intermediate steering shaft at lower steering shaft. [Intermediate Steering Shaft Replacement](#)
4. Remove the left front wheelhouse liner. [Front Wheelhouse Liner Replacement \(Without ZR2\)](#), or [Front Wheelhouse Liner Replacement \(With ZR2\)](#), or [Front Wheelhouse Liner Replacement \(Bison\)](#).
5. Disconnect left front wheel speed sensor harness connector. [Front Wheel Speed Sensor Replacement \(Without ZR2\)](#), or [Front Wheel Speed Sensor Replacement \(With ZR2\)](#).
6. Disconnect the master cylinder secondary brake pipe, master cylinder primary brake pipe, and left front brake pipe from the retaining clips (1, 2).



7. Disconnect the master cylinder secondary brake pipe, master cylinder primary brake pipe, and left front brake pipe from the left frame rail retaining clips (1).



8. Remove fuel feed rear pipe.

- For LCV engines, refer to [Fuel Feed Rear Pipe Replacement](#) .
- For LWN engines, refer to [Fuel Feed Front Pipe Replacement](#) .
- For LGZ engines, refer to [Fuel Feed Rear Pipe Replacement](#) .

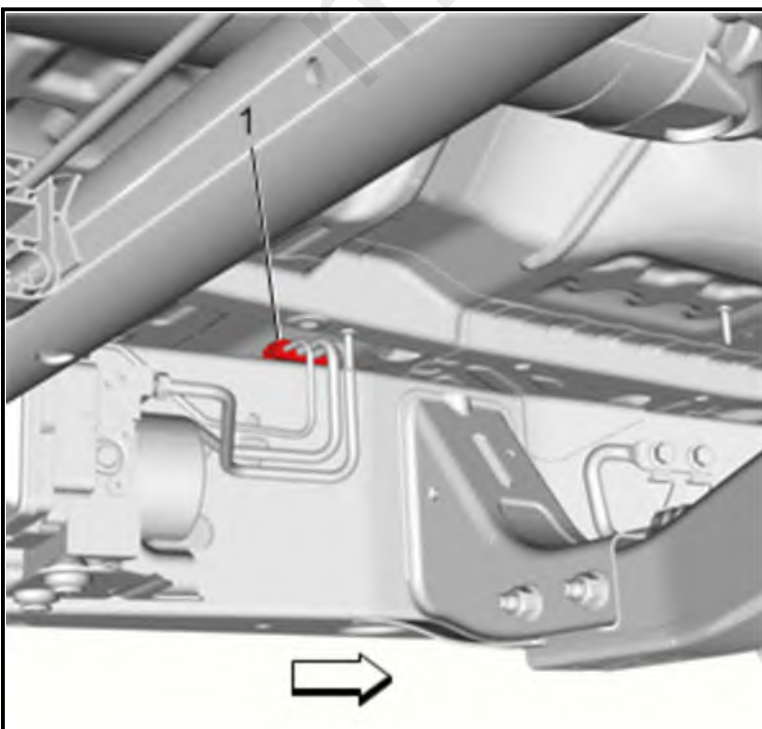
9. {If equipped} Remove evaporative emission rear pipe.

- For LCV engines, refer to [Evaporative Emission Rear Pipe Replacement](#) .
- For LGZ engines, refer to [Evaporative Emission Rear Pipe Replacement](#) .

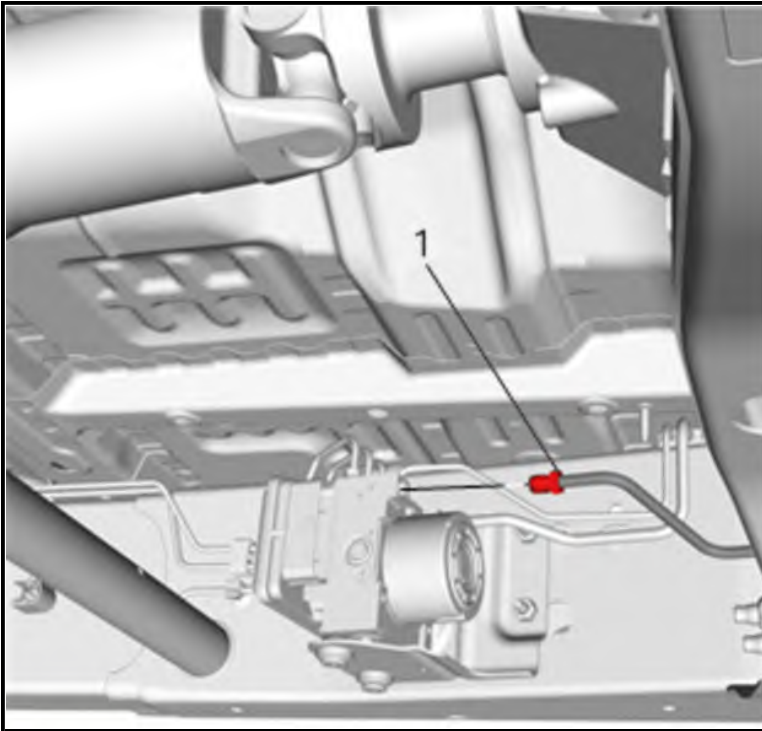
**NOTE:** Only lift the body enough to allow removal of the brake pipe assembly.

10. Separate and support the vehicle body from the frame. [Body Mount Upper and Lower Cushion Replacement \(Long Wheel Base\)](#) , or [Body Mount Upper and Lower Cushion Replacement \(Short Wheel Base\)](#)

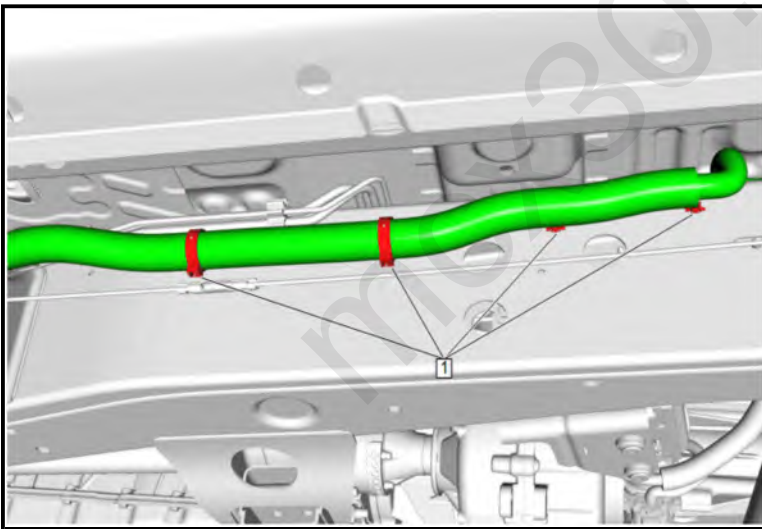
11. Disconnect the master cylinder primary brake pipe from the top frame rail retaining clip (1).



12. Disconnect the master cylinder primary brake pipe fitting (1) from the brake pressure modulator valve (BPMV).



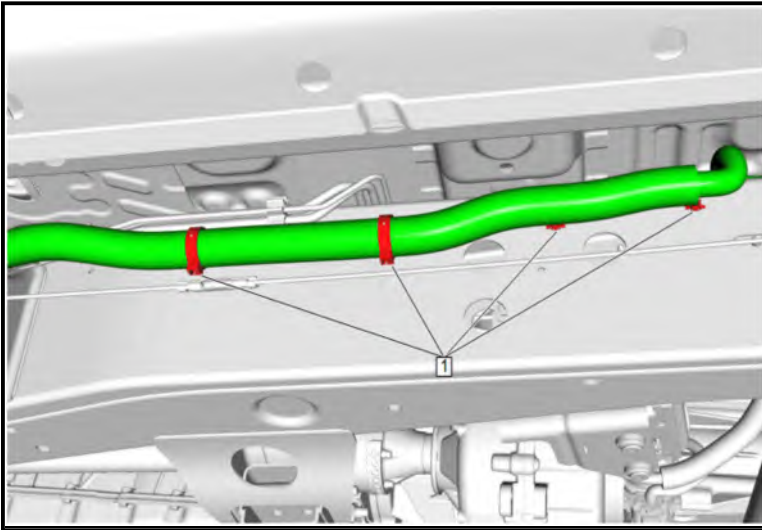
13. Plug the BPMV inlet port to prevent brake fluid loss and contamination.
14. Release retainers (1) to relocate the body harness to allow for access to the master cylinder primary brake pipe to be removed.



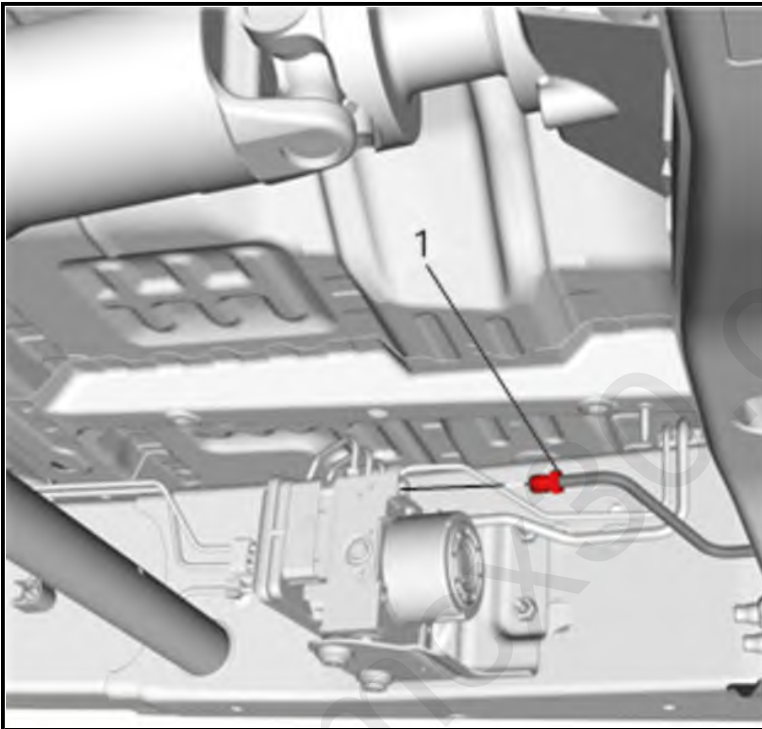
15. Remove the master cylinder primary brake pipe from the vehicle.

#### Installation Procedure

1. Install the master cylinder primary brake pipe to the vehicle.
2. Install the retainers (1) for the body harness.

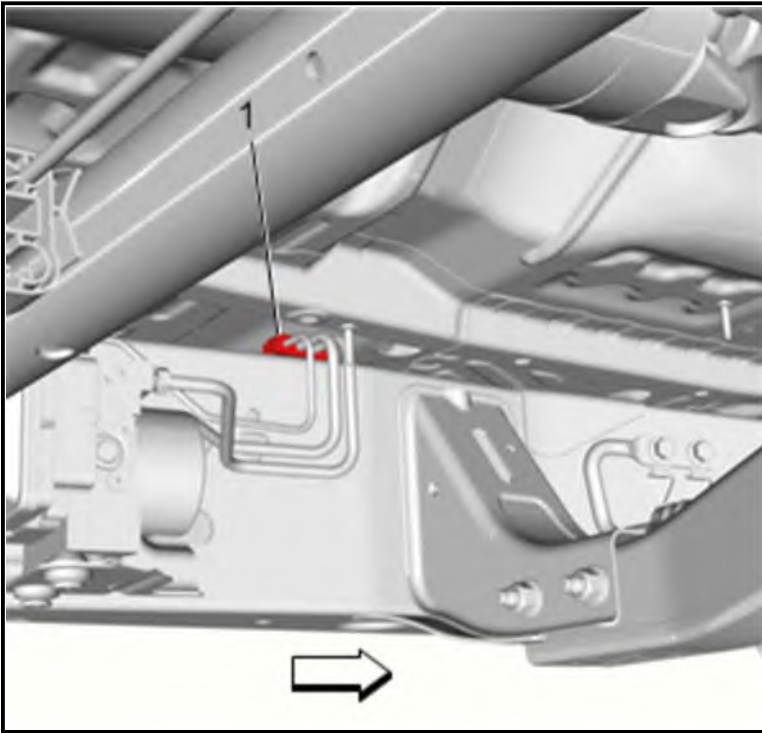


3. Remove plug from the BPMV inlet port.

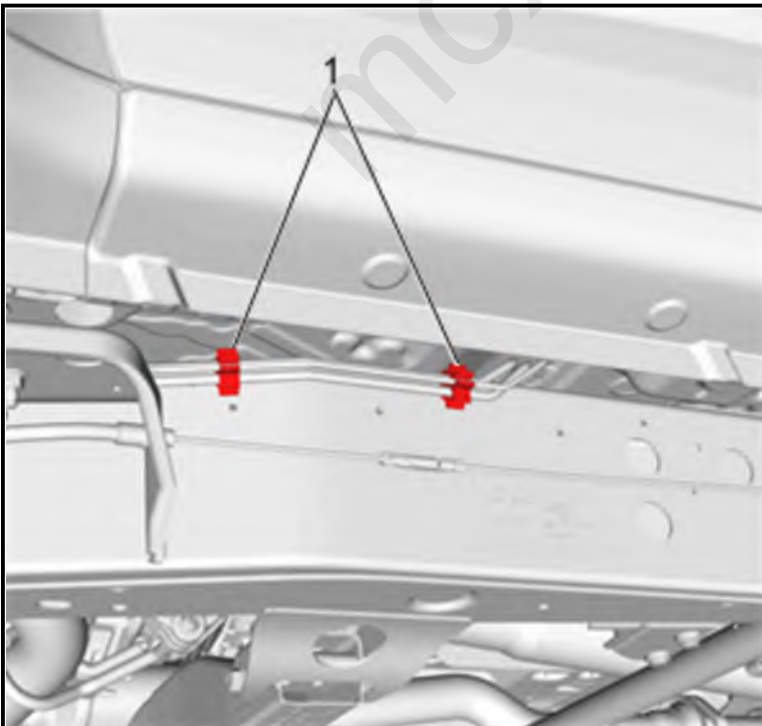


4. Install the master cylinder primary brake pipe fitting (1) to the BPMV. [Brake Pressure Modulator Valve Replacement](#)

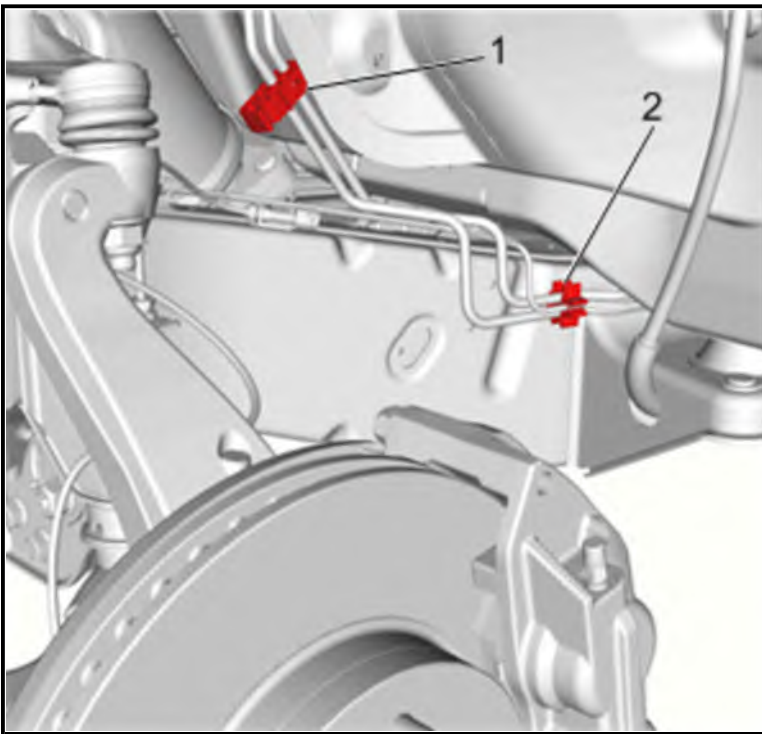
5. Install the master cylinder primary brake pipe to the top frame rail retaining clip (1).



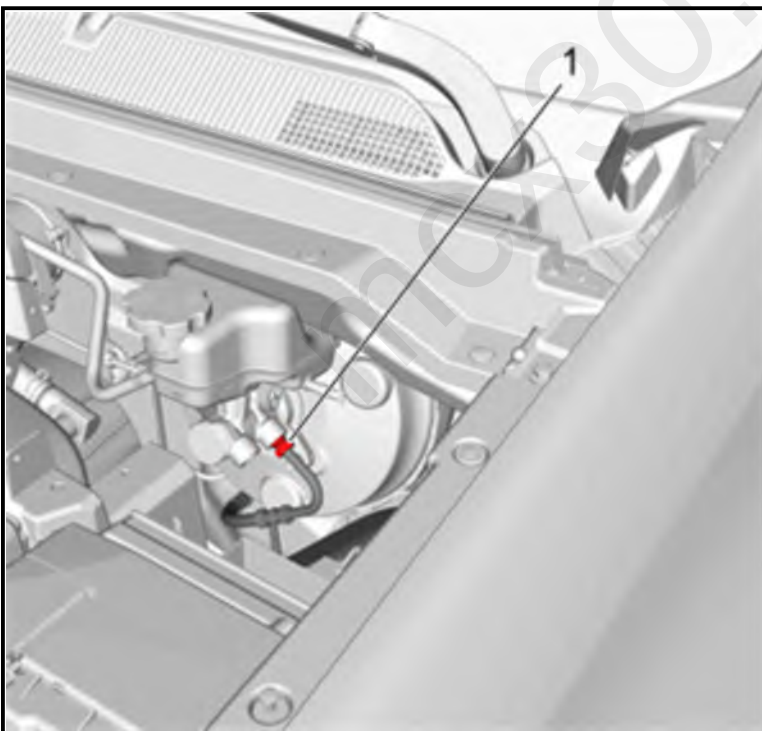
6. Reposition the vehicle body to the frame and install the cushions. [Body Mount Upper and Lower Cushion Replacement \(Long Wheel Base\)](#) , or [Body Mount Upper and Lower Cushion Replacement \(Short Wheel Base\)](#)
7. {If equipped} Install evaporative emission rear pipe.
  - For LCV engines, refer to [Evaporative Emission Rear Pipe Replacement](#) .
  - For LGZ engines, refer to [Evaporative Emission Rear Pipe Replacement](#) .
8. Install fuel feed rear pipe.
  - For LCV engines, refer to [Fuel Feed Rear Pipe Replacement](#) .
  - For LWN engines, refer to [Fuel Feed Front Pipe Replacement](#) .
  - For LGZ engines, refer to [Fuel Feed Rear Pipe Replacement](#) .
9. Install the master cylinder primary brake pipe to the left frame rail retaining clips (1).



10. Install the master cylinder primary brake pipe to the retaining clips (1).



11. Connect left front wheel speed sensor harness connector. [Front Wheel Speed Sensor Replacement \(Without ZR2\)](#) , or [Front Wheel Speed Sensor Replacement \(With ZR2\)](#).
12. Install the left front wheelhouse liner. Refer to [Front Wheelhouse Liner Replacement \(Without ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(With ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(Bison\)](#) .
13. Install the intermediate steering shaft. Refer to [Intermediate Steering Shaft Replacement](#) .
14. Remove the plugs from the master cylinder outlet port.



**NOTE:** Some components not shown for graphic clarity.

15. Install the master cylinder primary brake pipe fitting (1). [Brake Master Cylinder Replacement](#)
16. Bleed the hydraulic brake system. [Hydraulic Brake System Bleeding \(Manual\)](#), or [Hydraulic Brake System Bleeding \(Pressure\)](#).

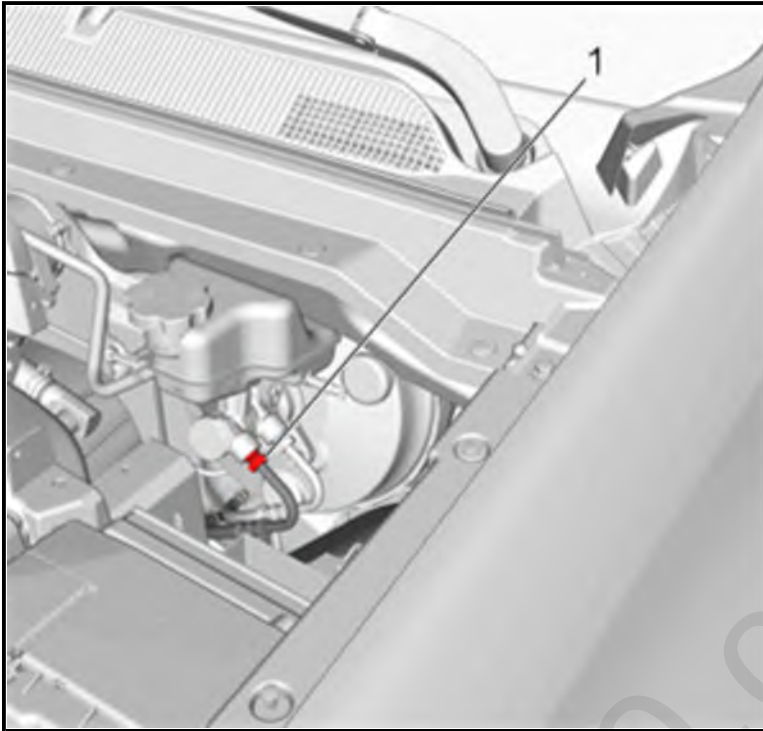
## **BRAKE PRESSURE MODULATOR VALVE SECONDARY PIPE REPLACEMENT**

## Removal Procedure

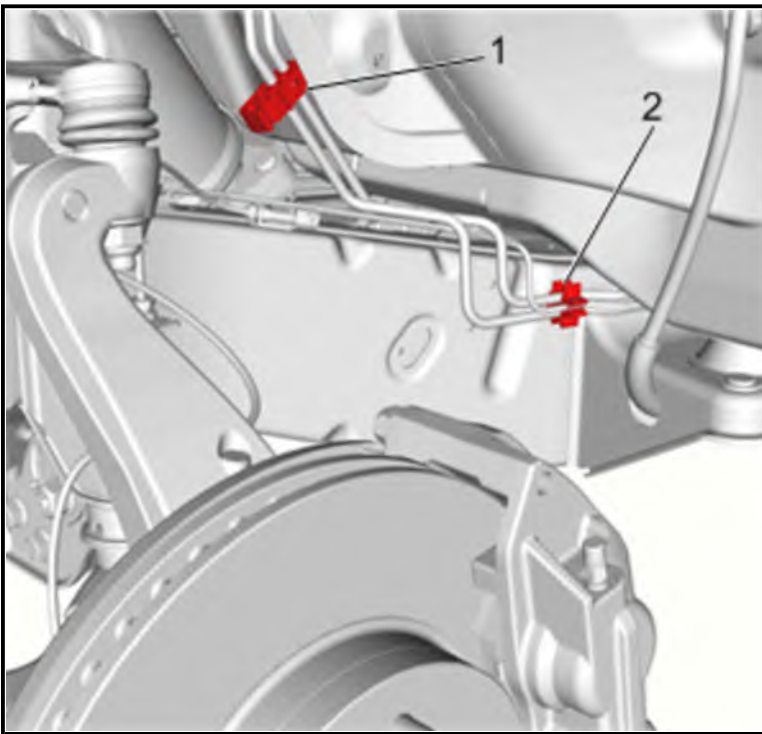
**WARNING:** Brake Fluid Irritant Warning

**CAUTION:** Brake Fluid Effects on Paint and Electrical Components Caution

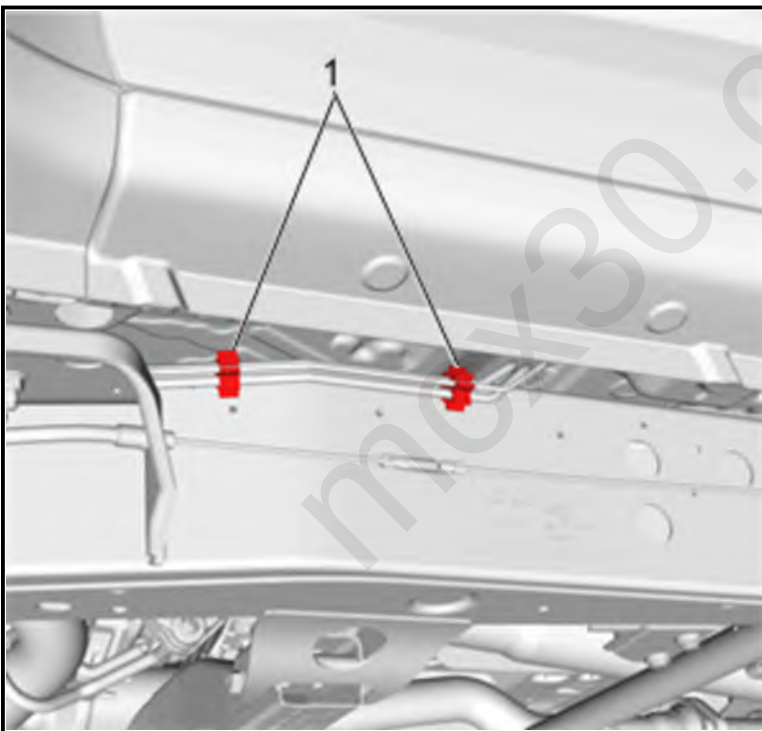
1. Disconnect the master cylinder secondary brake pipe fitting (1).



2. Plug the master cylinder outlet port to prevent brake fluid loss and contamination.
3. Separate intermediate steering shaft at lower steering shaft. Intermediate Steering Shaft Replacement
4. Remove the left front wheelhouse liner. Front Wheelhouse Liner Replacement (Without ZR2), or Front Wheelhouse Liner Replacement (With ZR2), or Front Wheelhouse Liner Replacement (Bison).
5. Disconnect left front wheel speed sensor harness connector. Front Wheel Speed Sensor Replacement (Without ZR2), or Front Wheel Speed Sensor Replacement (With ZR2).
6. Disconnect the master cylinder secondary brake pipe, master cylinder primary brake pipe, and left front brake pipe from the retaining clips (1, 2).



7. Disconnect the master cylinder secondary brake pipe, master cylinder primary brake pipe, and left front brake pipe from the left frame rail retaining clips (1).



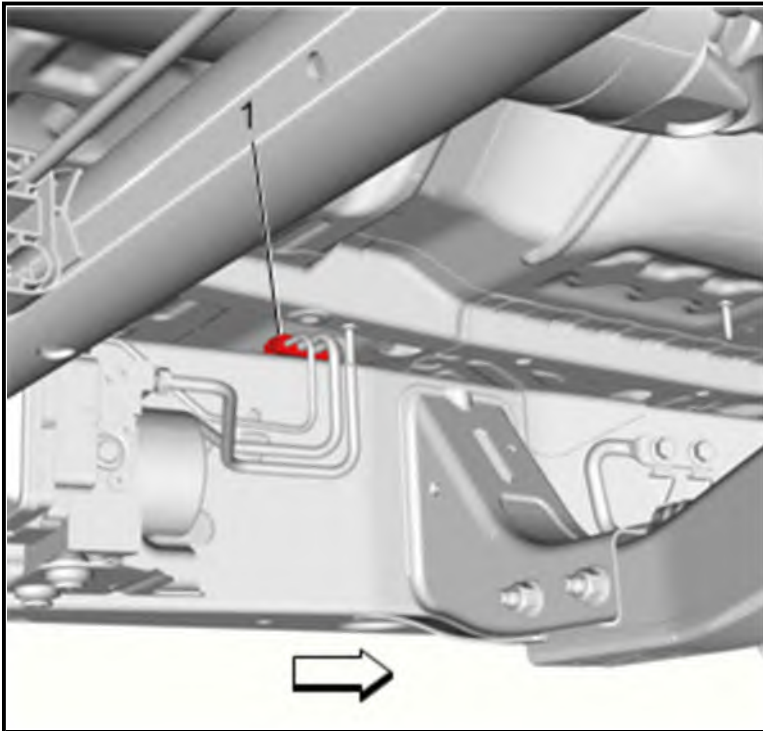
8. Remove fuel feed rear pipe.
- For LCV engines, refer to [Fuel Feed Rear Pipe Replacement](#) .
  - For LWN engines, refer to [Fuel Feed Front Pipe Replacement](#) .
  - For LGZ engines, refer to [Fuel Feed Rear Pipe Replacement](#) .
9. {If equipped} Remove evaporative emission rear pipe.
- For LCV engines, refer to [Evaporative Emission Rear Pipe Replacement](#) .
  - For LGZ engines, refer to [Evaporative Emission Rear Pipe Replacement](#) .

**NOTE:** Only lift the body enough to allow removal of the brake pipe assembly.

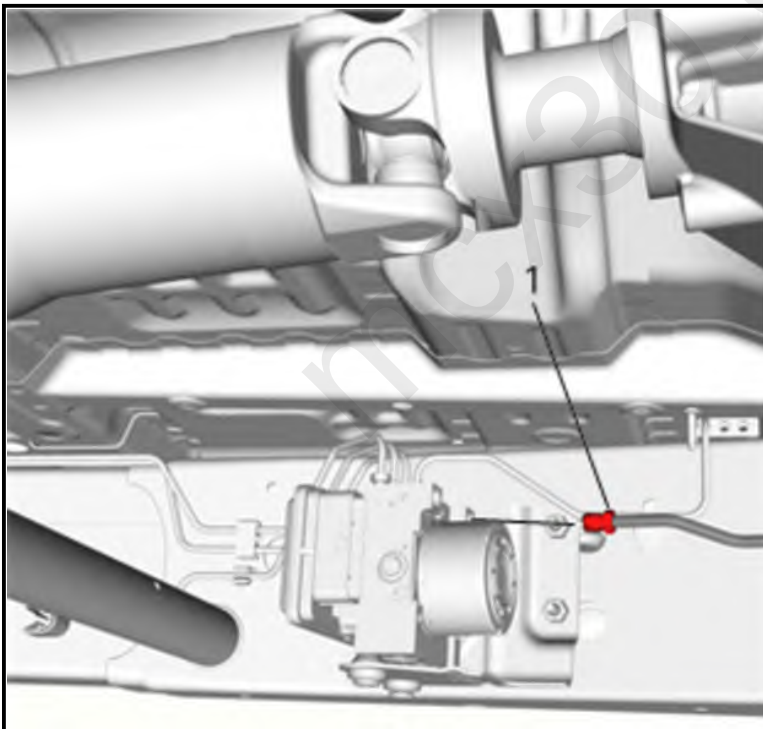
10. Separate and support the vehicle body from the frame. [Body Mount Upper and Lower Cushion Replacement \(Long Wheel Base\)](#) , or [Body Mount Upper and Lower Cushion Replacement \(Short](#)

### Wheel Base)

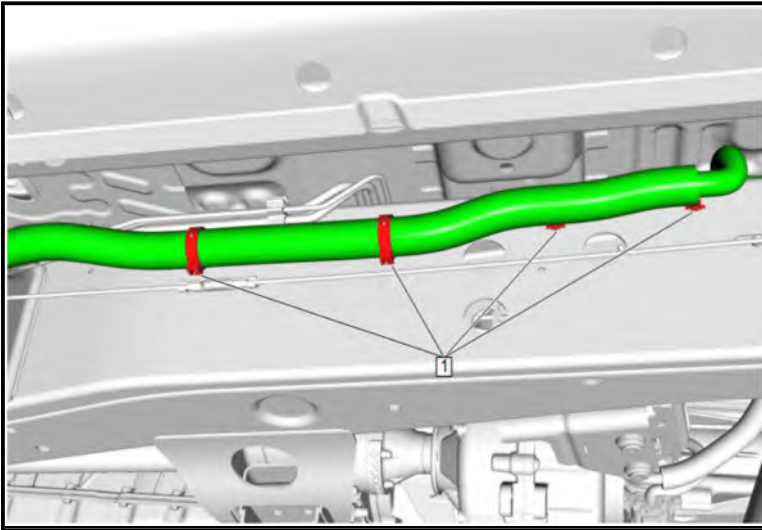
11. Disconnect the master cylinder secondary brake pipe from the top frame rail retaining clip (1).



12. Disconnect the master cylinder secondary brake pipe fitting (1) from the brake pressure modulator valve (BPMV).



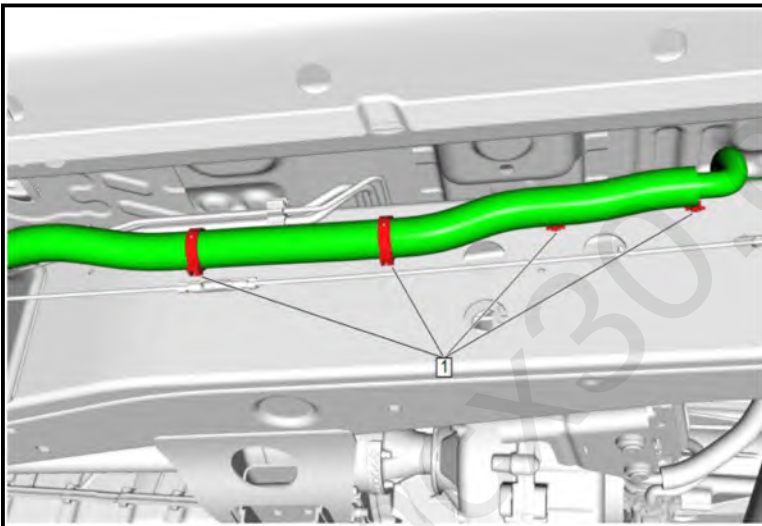
13. Plug the BPMV inlet port to prevent brake fluid loss and contamination.
14. Release retainers (1) to relocate the body harness to allow for access to the master cylinder secondary brake pipe to be removed.



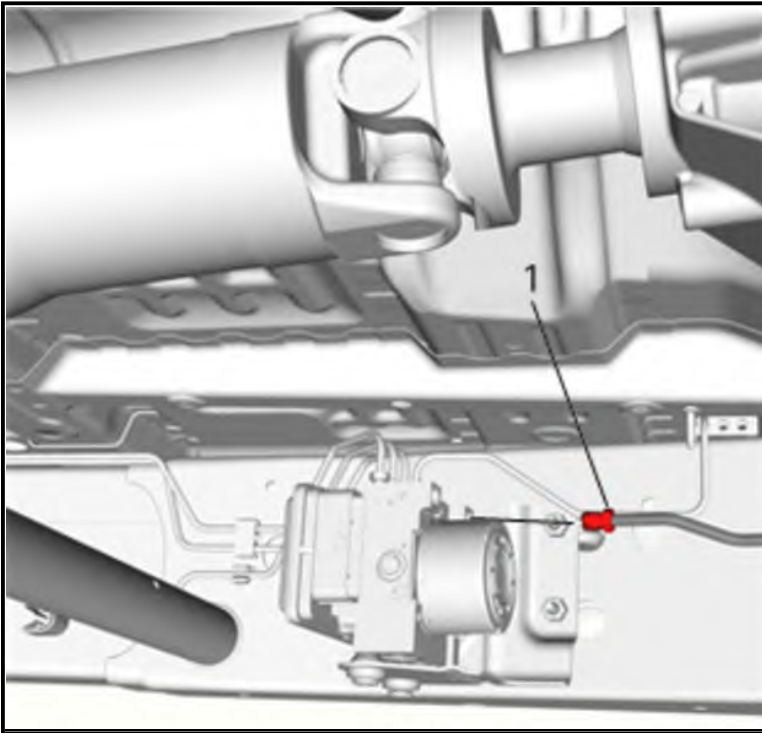
15. Remove the master cylinder secondary brake pipe from the vehicle.

#### Installation Procedure

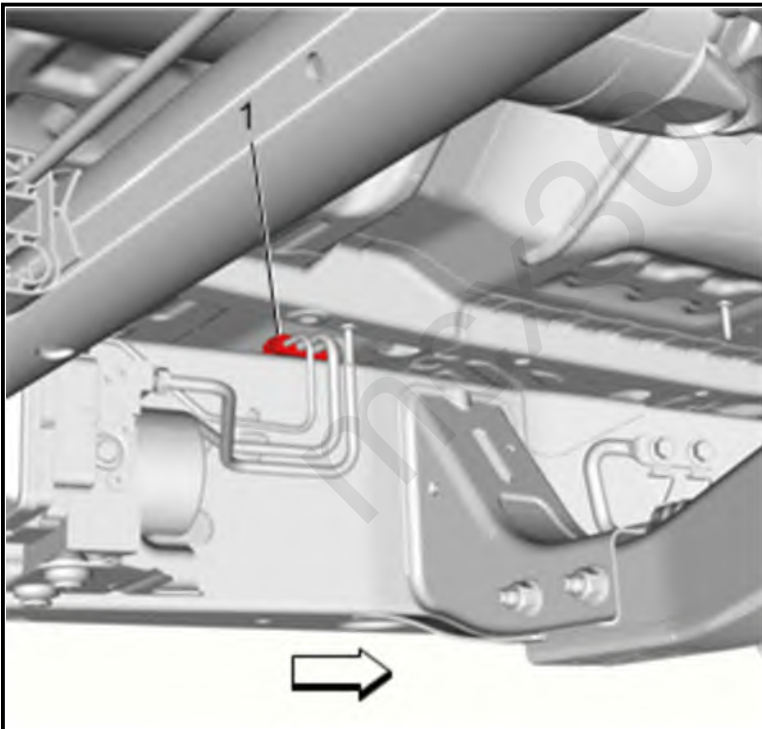
1. Install the master cylinder secondary brake pipe to the vehicle.
2. Install the retainers (1) for the body harness.



3. Remove plug from the BPMV inlet port.

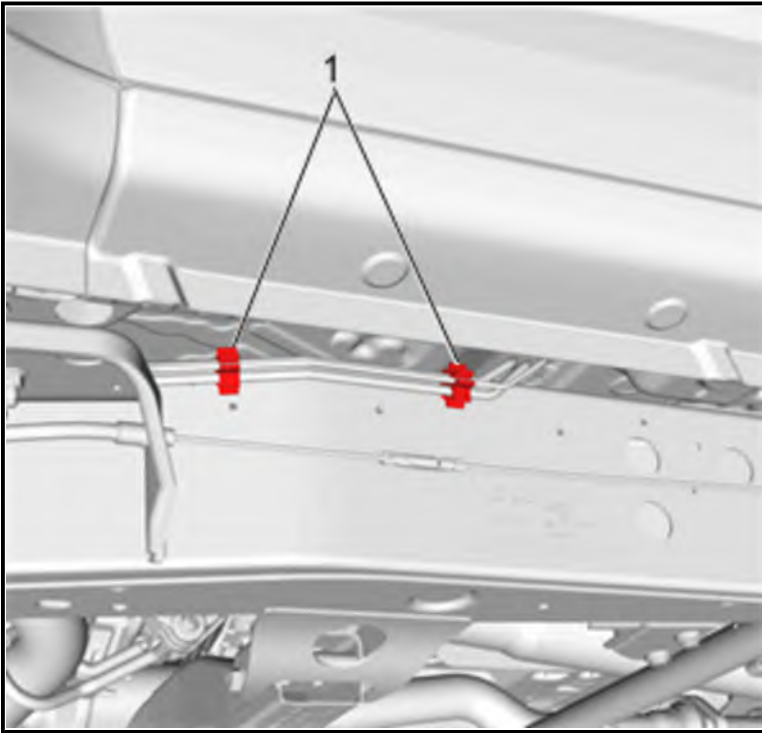


4. Install the master cylinder secondary brake pipe fitting (1) to the BPMV. [Brake Pressure Modulator Valve Replacement](#)
5. Install the master cylinder secondary brake pipe to the top frame rail retaining clip (1).

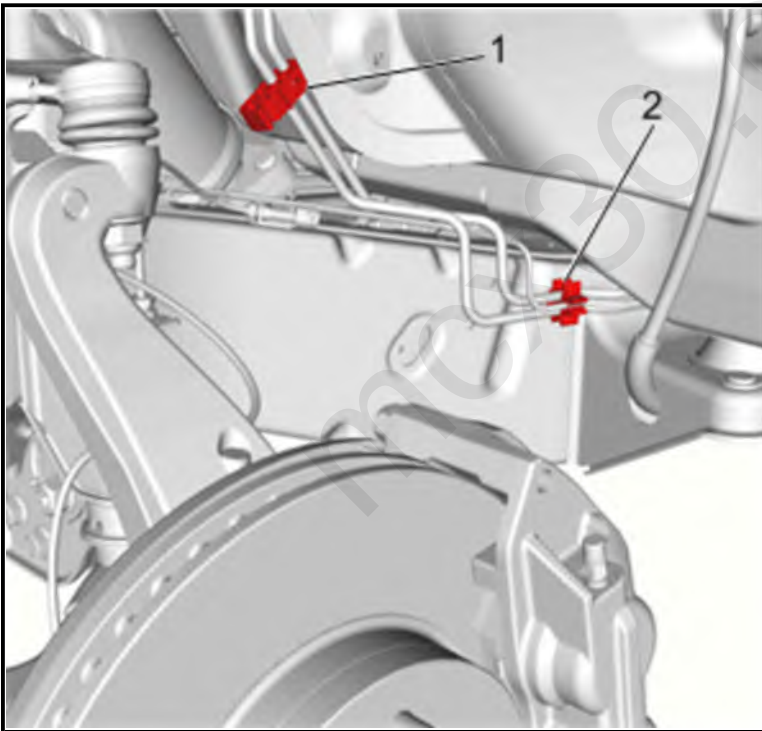


6. Reposition the vehicle body to the frame and install the cushions. [Body Mount Upper and Lower Cushion Replacement \(Long Wheel Base\)](#) , or [Body Mount Upper and Lower Cushion Replacement \(Short Wheel Base\)](#)
7. {If equipped} Install evaporative emission rear pipe.
  - For LCV engines, refer to [Evaporative Emission Rear Pipe Replacement](#) .
  - For LGZ engines, refer to [Evaporative Emission Rear Pipe Replacement](#) .
8. Install fuel feed rear pipe.
  - For LCV engines, refer to [Fuel Feed Rear Pipe Replacement](#) .
  - For LWN engines, refer to [Fuel Feed Front Pipe Replacement](#) .
  - For LGZ engines, refer to [Fuel Feed Rear Pipe Replacement](#) .

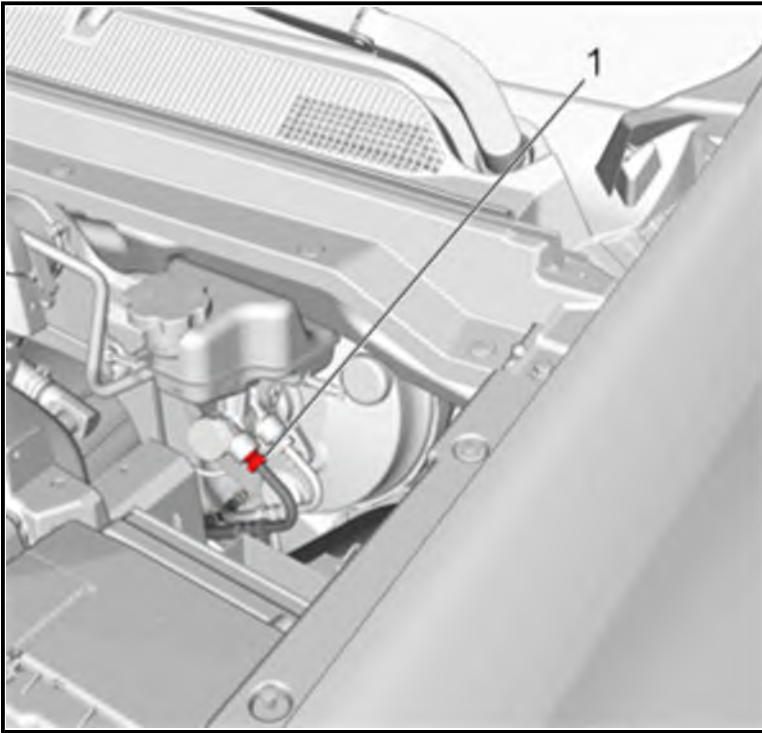
9. Install the master cylinder secondary brake pipe to the left frame rail retaining clips (1).



10. Install the master cylinder secondary brake pipe to the retaining clips (1, 2).



11. Connect left front wheel speed sensor harness connector. [Front Wheel Speed Sensor Replacement \(Without ZR2\)](#) , or [Front Wheel Speed Sensor Replacement \(With ZR2\)](#)
12. Install the left front wheelhouse liner. [Front Wheelhouse Liner Replacement \(Without ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(Bison\)](#)
13. Install the intermediate steering shaft at lower steering shaft. [Intermediate Steering Shaft Replacement](#)
14. Remove the plugs from the master cylinder outlet port.



15. Install the master cylinder secondary brake pipe fitting (1). [Brake Master Cylinder Replacement](#)

16. Bleed the hydraulic brake system. [Hydraulic Brake System Bleeding \(Manual\)](#), or [Hydraulic Brake System Bleeding \(Pressure\)](#).

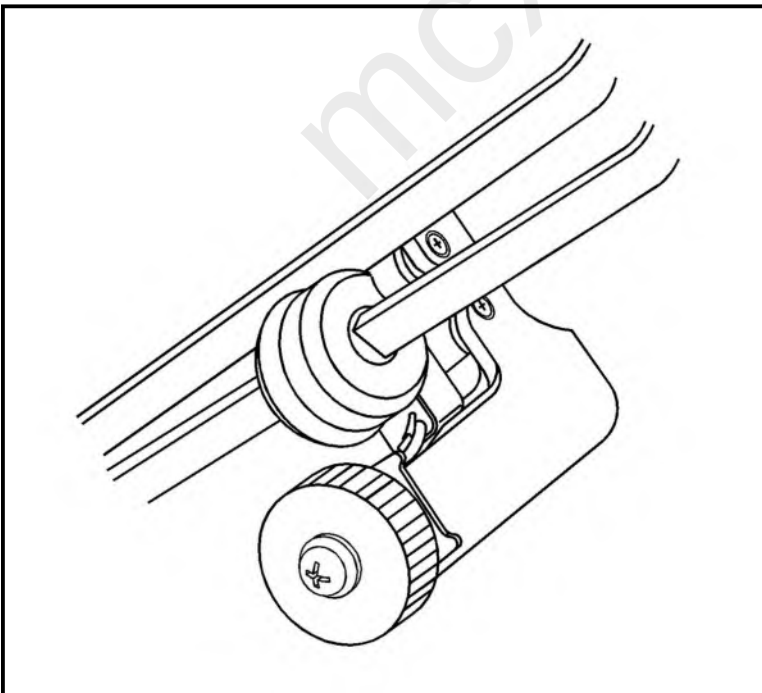
## **BRAKE PIPE REPLACEMENT**

### **Special Tools**

**CH-45405** Brake Pipe Flaring Kit

For equivalent regional tools: [Special Tools](#)

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



**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.

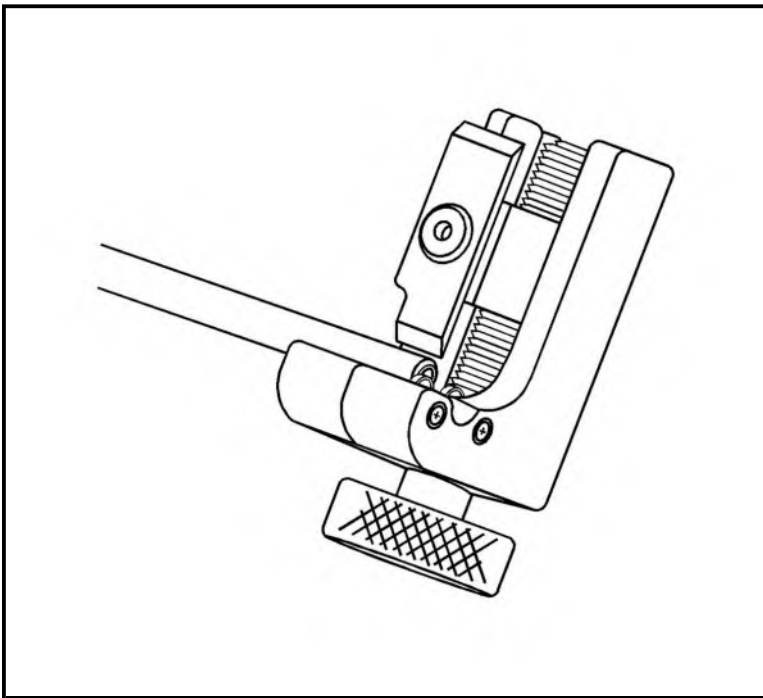
2. Release the brake pipe to be replaced from the retainers, as required.
3. Select an appropriate location to section the brake pipe, if necessary.
  - Allow adequate clearance in order to maneuver the **CH-45405** Brake Pipe Flaring Kit.
  - Avoid sectioning the brake pipe at bends or mounting points.
4. Using a string or wire, measure the length of the pipe to be replaced including all pipe bends.
5. Add to the measurement taken the appropriate additional length required for each flare to be created.

#### Specification

- 6.35 mm (0.250 in) for 4.76 mm (3/16 in) diameter pipe
- 9.50 mm (0.374 in) for 6.35 mm (1/4 in) diameter pipe
- 12.67 mm (0.499 in) for 7.94 mm (5/16 in) diameter pipe

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

6. Using the pipe cutter included in the **CH-45405** Brake Pipe Flaring Kit, carefully cut the brake pipe squarely to the measured length.
7. Remove the sectioned brake pipe from the vehicle.
8. Select the appropriate size of brake pipe and tube nuts, as necessary. The brake pipe outside diameter determines brake pipe size.
9. Strip the nylon coating from the brake pipe end to be flared, if necessary.



1. Select the appropriate blade on the coating stripping tool included in the **CH-45405** Brake Pipe Flaring Kit, by unthreading the blade block from the stripping tool and installing the block with the desired blade facing the tool rollers.

#### **Specification**

- 6.35 mm (0.250 in) blade for 4.76 mm (3/16 in) diameter pipe
  - 9.50 mm (0.374 in) blade for 6.35 mm (1/4 in) and 7.94 mm (5/16 in) diameter pipe
2. Insert the brake pipe end to be flared into the stripping tool to the depth of the ledge on the tool rollers.
  3. While holding the brake pipe firmly against the stripping tool roller ledges, rotate the thumbwheel of the tool until the blade contacts the brake pipe coated surface.

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

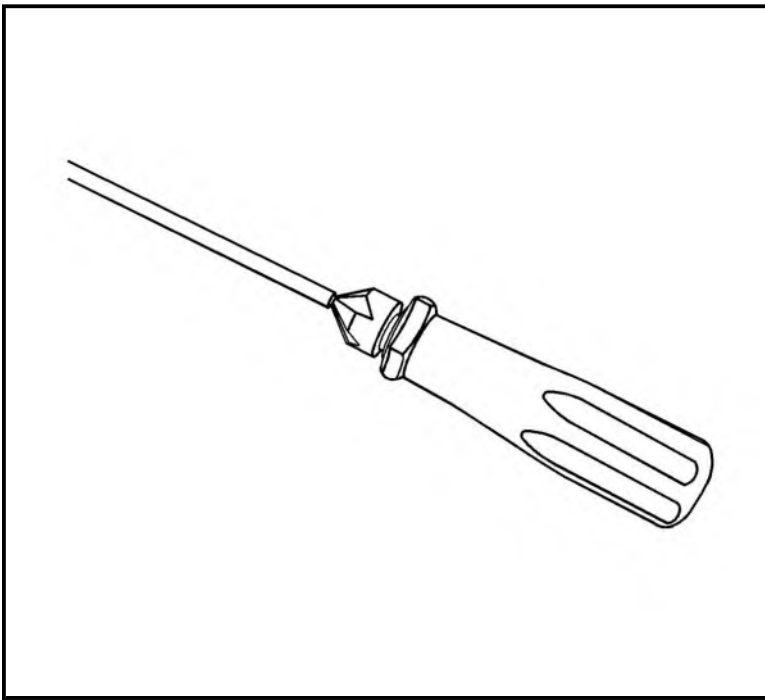
4. Rotate the stripping tool in a clockwise direction, ensuring that the brake pipe end remains against the tool roller ledges.
5. After each successive revolution of the stripping tool, carefully rotate the thumbwheel of the tool clockwise, in order to continue stripping the coating from the brake pipe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

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

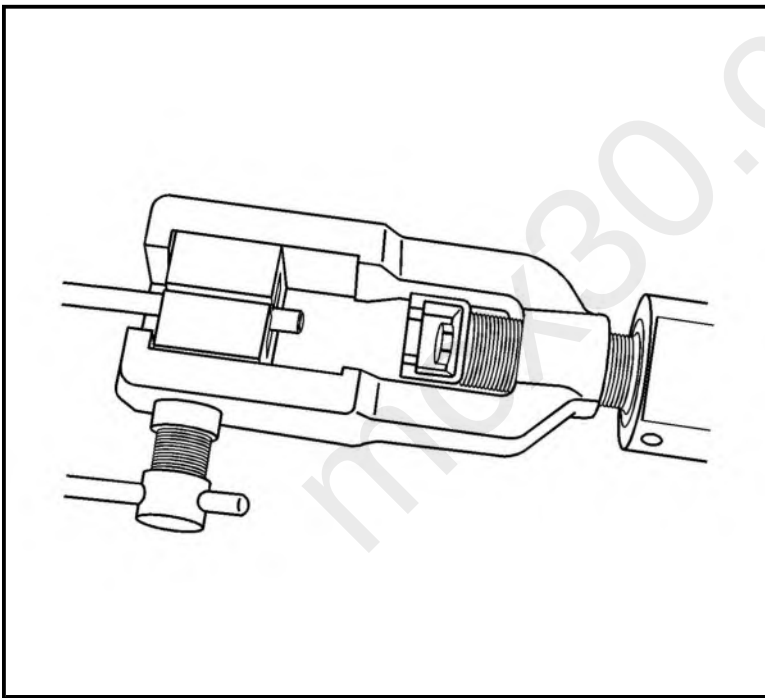
7. Inspect the stripped end of the brake pipe to ensure that the proper amount of coating has been removed.

#### **Specification**

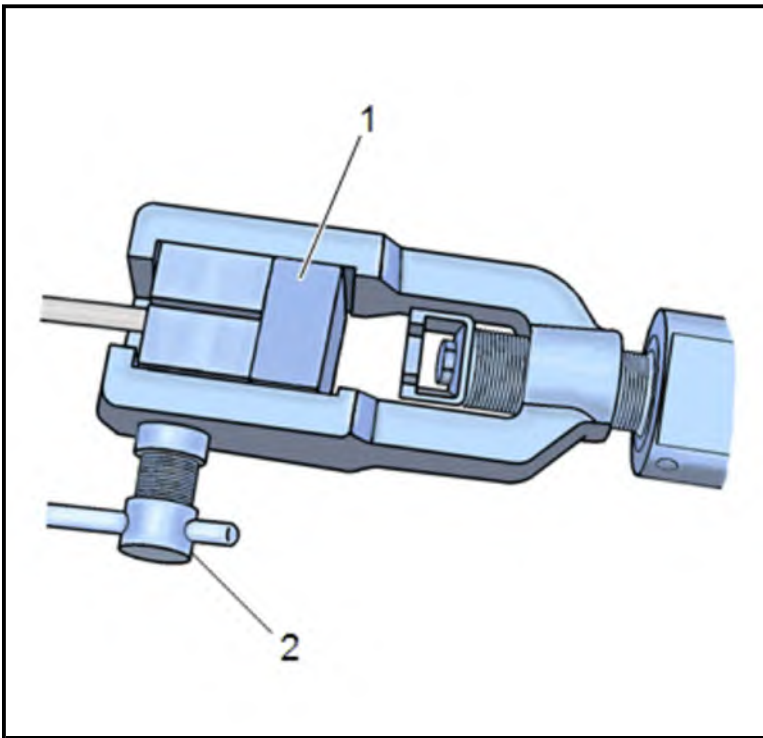
- 6.35 mm (0.250 in) for 4.76 mm (3/16 in) diameter pipe
  - 9.50 mm (0.374 in) for 6.35 mm (1/4 in) and 7.94 mm (5/16 in) diameter pipe
10. Chamfer the inside and outside diameter of the pipe with the de-burring tool included in the **CH-45405** Brake Pipe Flaring Kit.



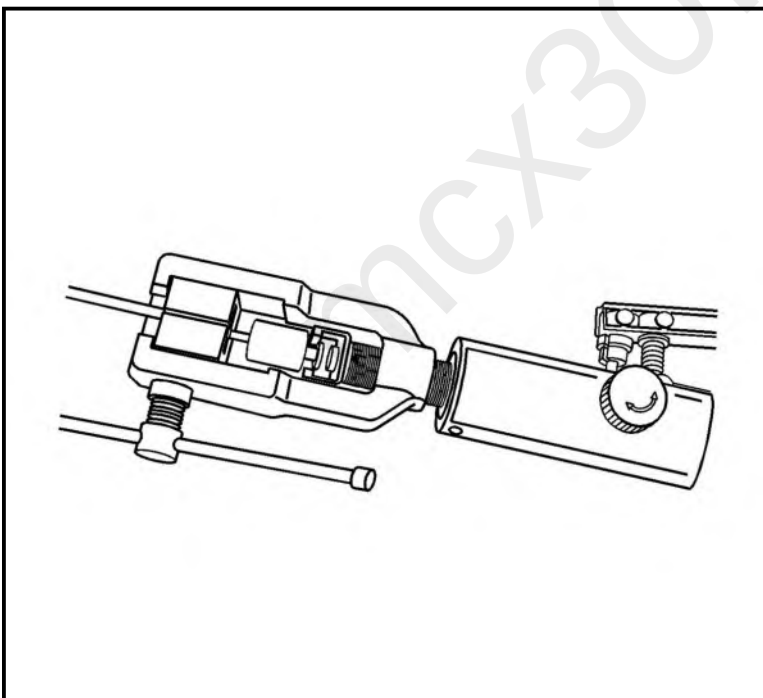
11. Install the tube nuts on the brake pipe, noting their orientation.
12. Clean the brake pipe and the **CH-45405** Brake Pipe Flaring Kit of lubricant, contaminants, and debris.
13. Loosen the die clamping screw of the **CH-45405** Brake Pipe Flaring Kit.



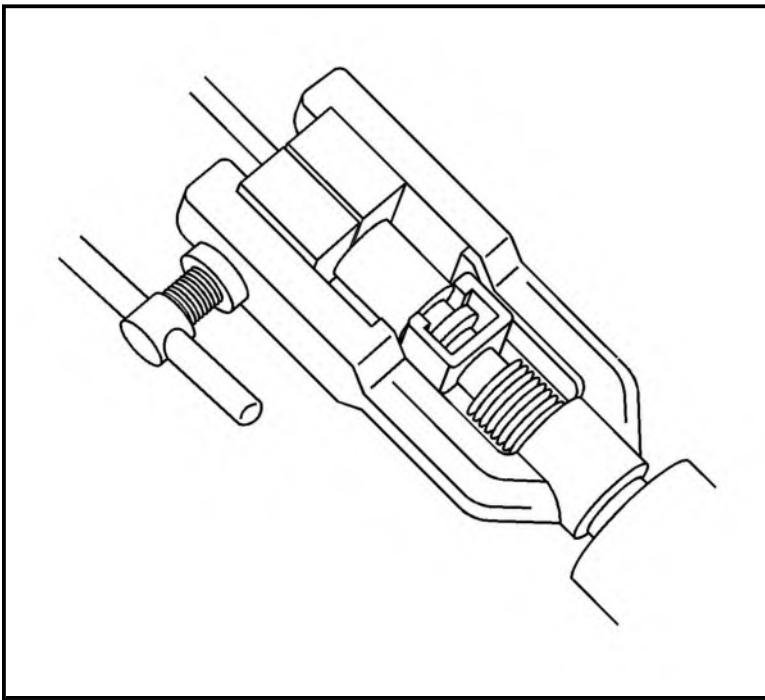
14. Select the corresponding die set and install the die halves into the die cage with the full, flat face of one die facing the clamping screw, and the counterbores of both dies facing the forming ram.
15. Place the flat face of an unused die (1) against the die halves in the clamping cage and hold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



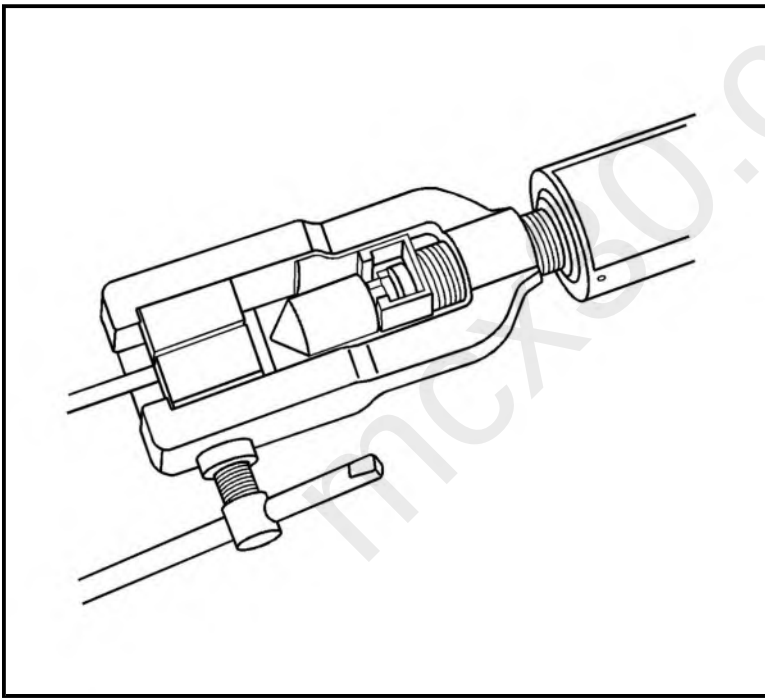
16. Insert the prepared end of the pipe to be flared through the back of the dies until the pipe is seated against the flat surface of the unused die (1).
17. Remove the unused die (1).
18. Ensure that the rear of both dies are seated firmly against the enclosed end of the die cage.
19. Firmly hand tighten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



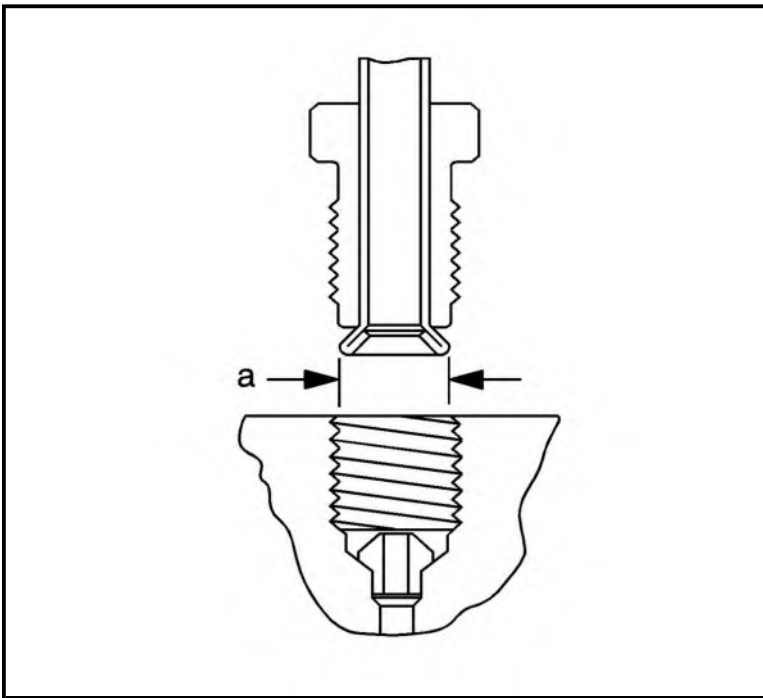
21. Rotate the hydraulic fluid control valve clockwise to the closed position.
22. Rotate the body of the **CH-45405** Brake Pipe Flaring Kit until it bottoms against the die cage.
23. While guiding the forming mandrel into the exposed end of pipe to be flared, operate the lever of the **CH-45405** Brake Pipe Flaring Kit until the forming mandrel bottoms against the clamping dies.



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



26. Rotate the hydraulic fluid control valve clockwise to the closed position.
27. Rotate the body of the **CH-45405** Brake Pipe Flaring 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 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).



### 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. [Hydraulic Brake System Bleeding \(Manual\)](#), 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.

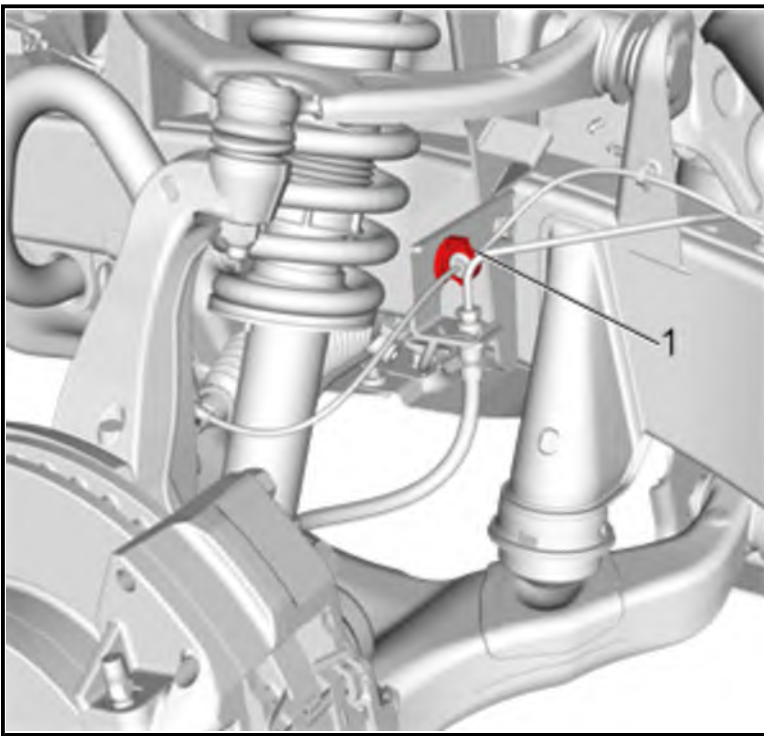
## FRONT BRAKE HOSE REPLACEMENT

### Removal Procedure

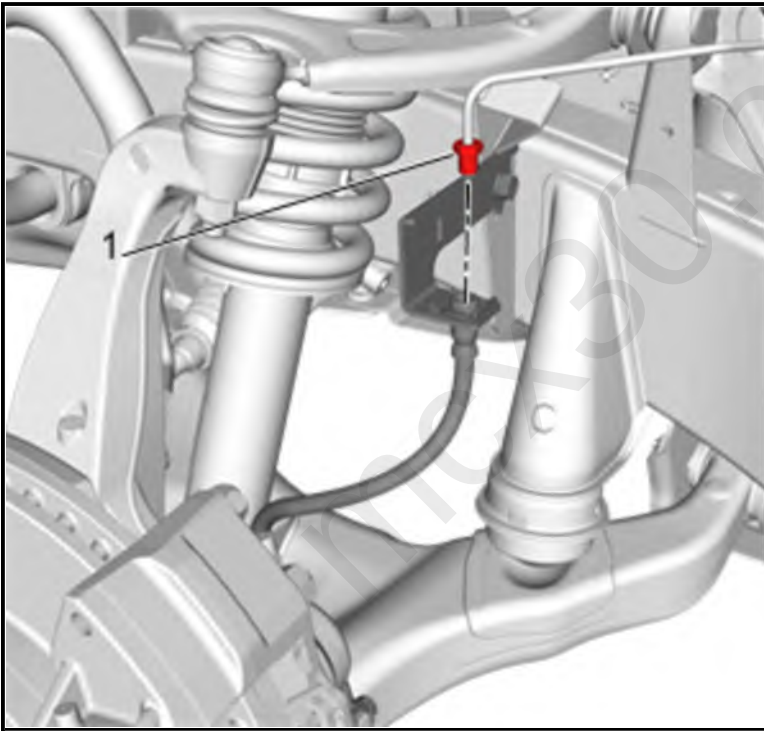
**WARNING:** Refer to [Brake Fluid Irritant Warning](#) .

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

1. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
2. Remove the tire and wheel assembly. [Tire and Wheel Removal and Installation](#)
3. Release the front wheel speed sensor harness from the clip (1) on the brake hose bracket and position the harness aside.

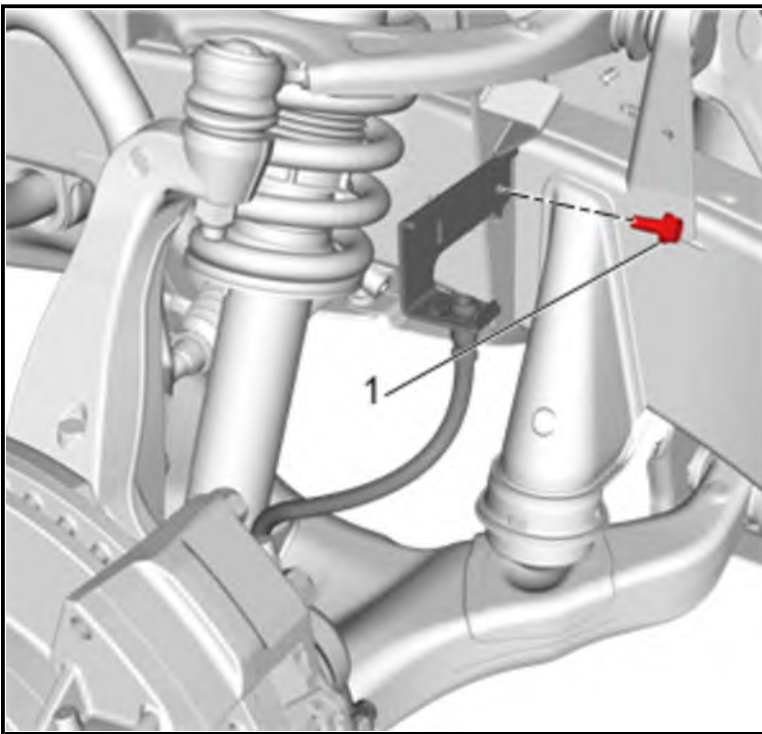


4. Remove the brake pipe fitting (1) from the front brake hose.

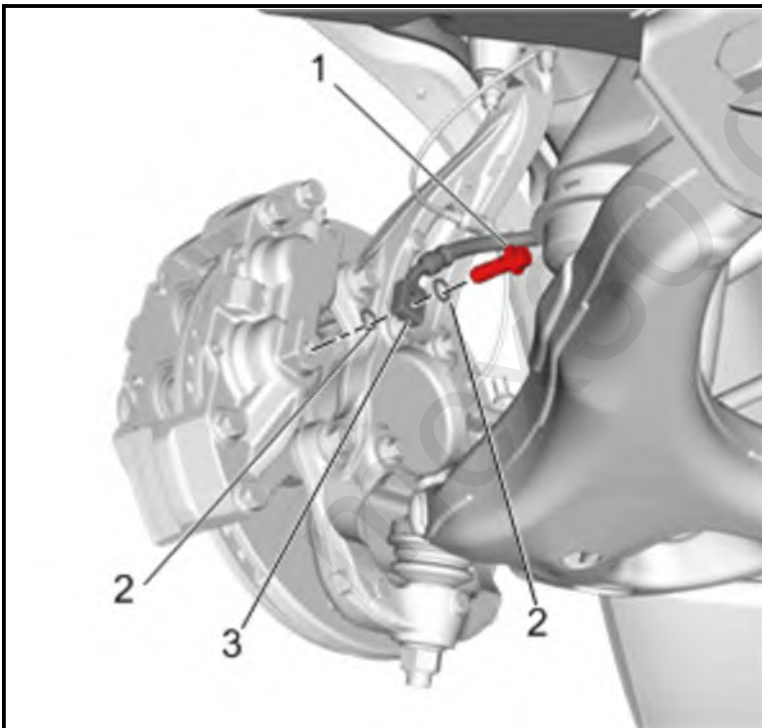


5. Cap the brake pipe fitting to prevent brake fluid loss and contamination.

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



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



**NOTE:** Do not reuse the brake hose fitting gaskets.

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

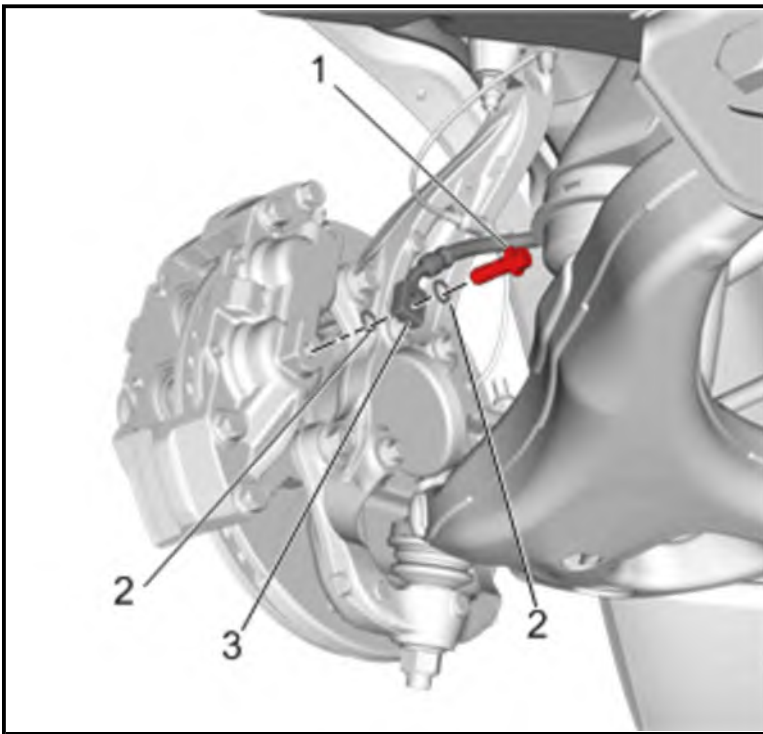
9. Remove the front brake hose assembly.

10. Plug the brake caliper inlet to prevent brake fluid loss and contamination.

#### Installation Procedure

1. Install the front brake hose assembly.

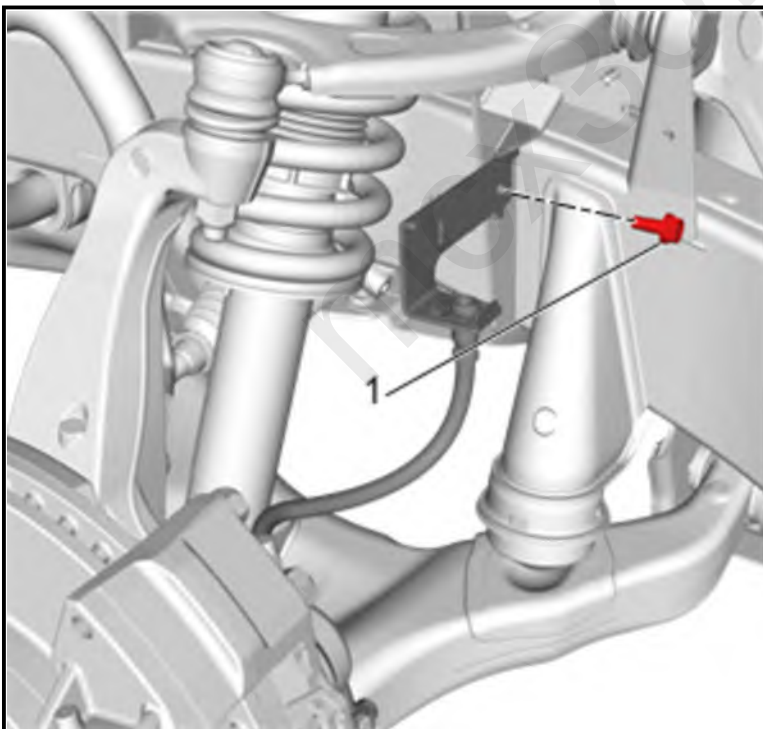
2. Assemble the brake hose fitting bolt (1) and 2 NEW brake hose fitting gaskets (2) to the brake hose fitting (3).



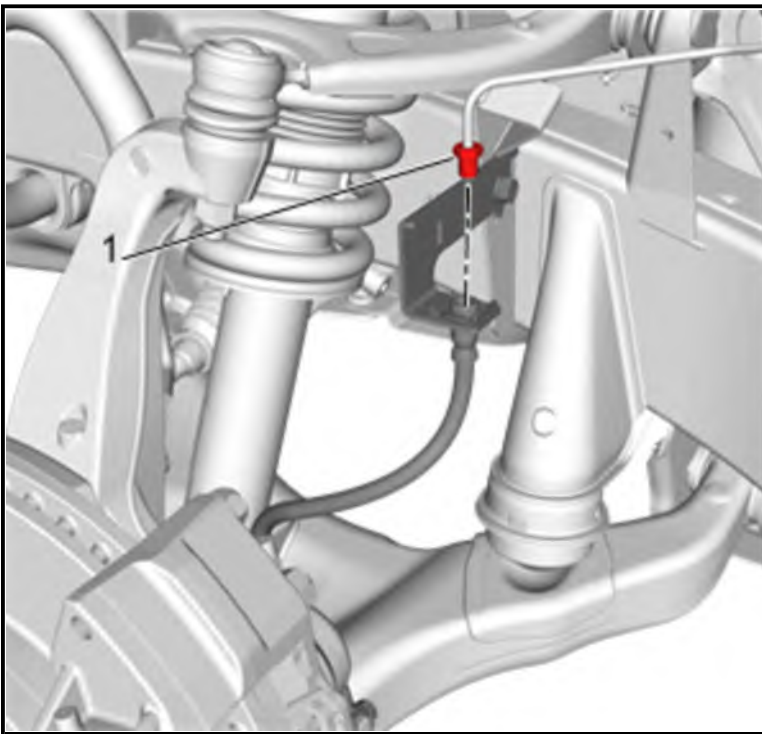
**NOTE:** Install NEW brake hose fitting gaskets.

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

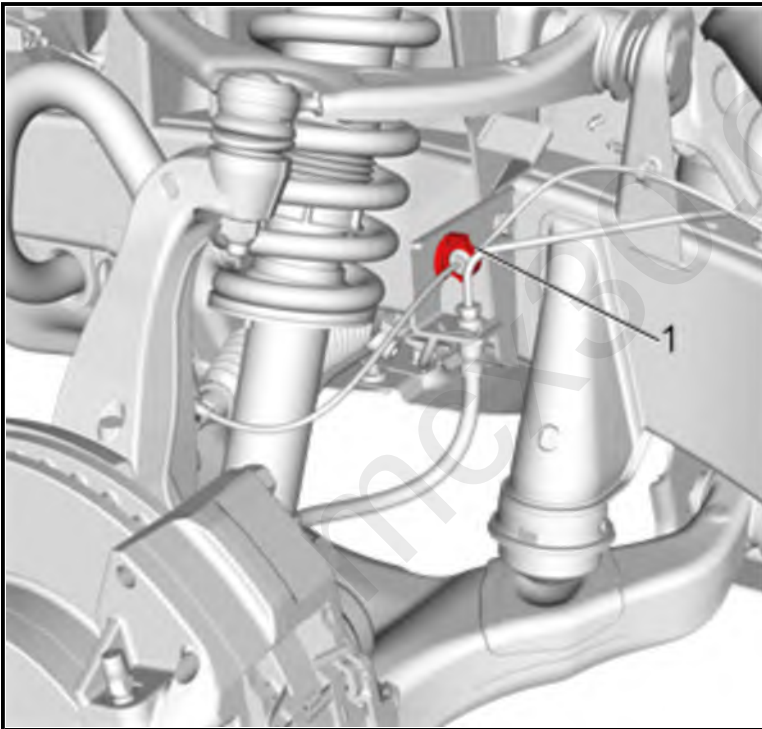
3. Install the brake hose assembly to the brake caliper and tighten the fitting bolt to 44 N.m (32 lb ft).
4. Install the brake hose bracket bolt (1) and tighten to 16 N.m (12 lb ft).



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



6. Secure the front wheel speed sensor harness to the clip (1) on the brake hose bracket.



7. Bleed the hydraulic brake system. [Hydraulic Brake System Bleeding \(Manual\)](#), or [Hydraulic Brake System Bleeding \(Pressure\)](#).

8. Check for brake system leaks.

## FRONT BRAKE HOSE REPLACEMENT

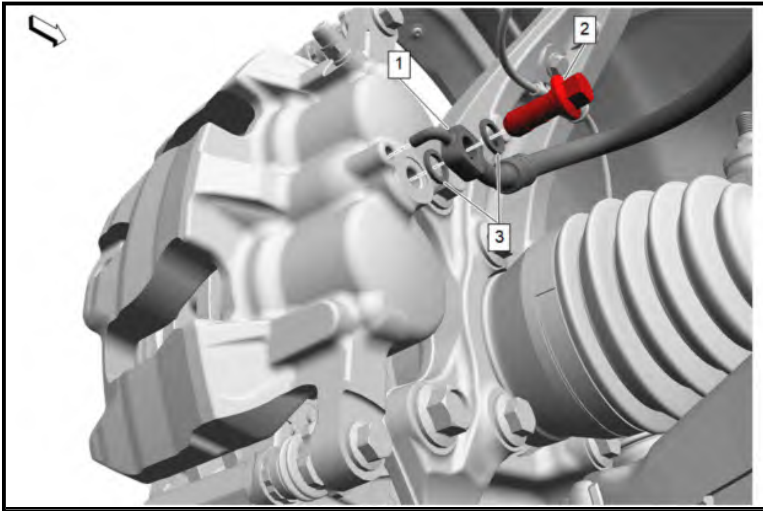
**WARNING:** [Brake Dust Warning](#)

**WARNING:** [Brake Fluid Irritant Warning](#)

### Removal Procedure

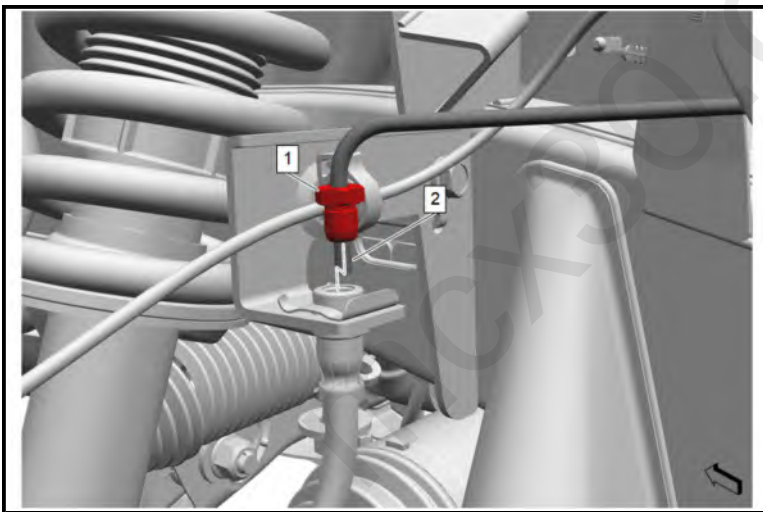
1. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
2. Remove the front tire and wheel assembly. [Tire and Wheel Removal and Installation](#)

3. Clean all dirt and foreign material from the brake hose ends and the brake pipe fitting.
4. Front Brake Hose Fitting (2) - Remove

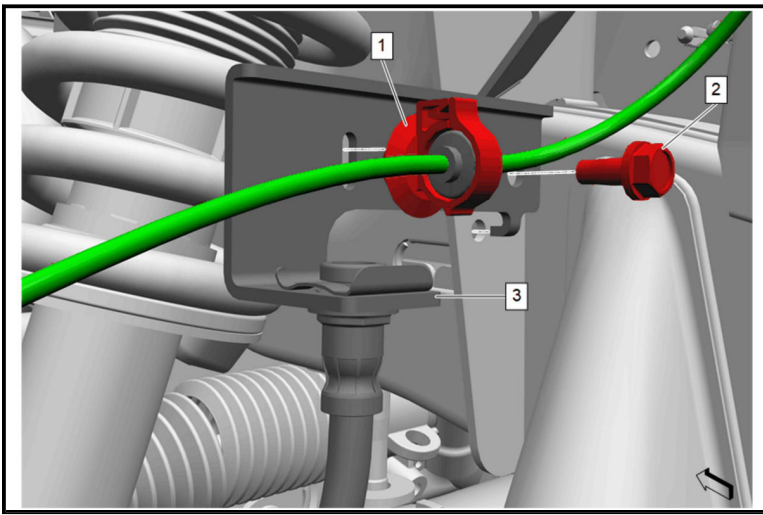


**NOTE:** Do NOT reuse the brake hose washers.

5. Front Brake Hose Washer (3) - Remove and DISCARD [2x]
6. Front Brake Hose (1) @ Front Brake Caliper - Remove
7. Cap the brake caliper inlet to prevent brake fluid loss and contamination.
8. Front Brake Pipe Nut (1) - Remove



9. Front Brake Pipe @ Front Brake Hose (2) - Remove
10. Cap the brake pipe fitting to prevent brake fluid loss and contamination.
11. Front Wheel Speed Sensor (1) @ Front Brake Hose (3) - Unclip

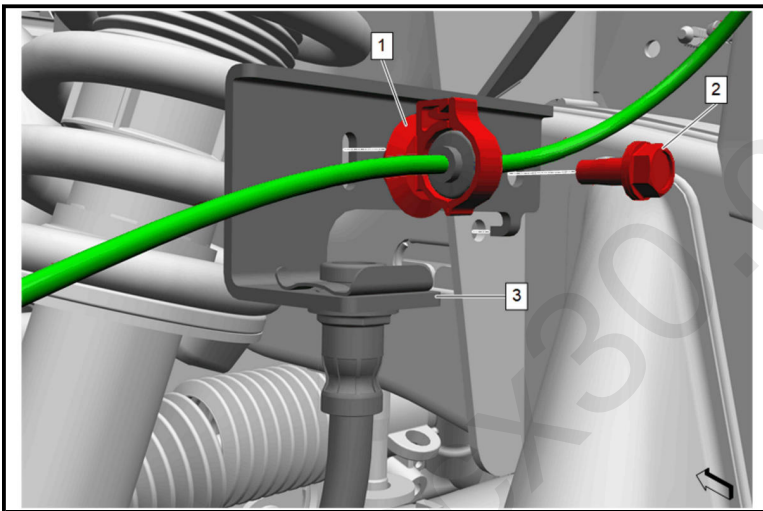


12. Front Brake Hose Bracket Bolt (2) - Remove

13. Front Brake Hose (3) - Remove

### Installation Procedure

1. Front Brake Hose (3) - Install

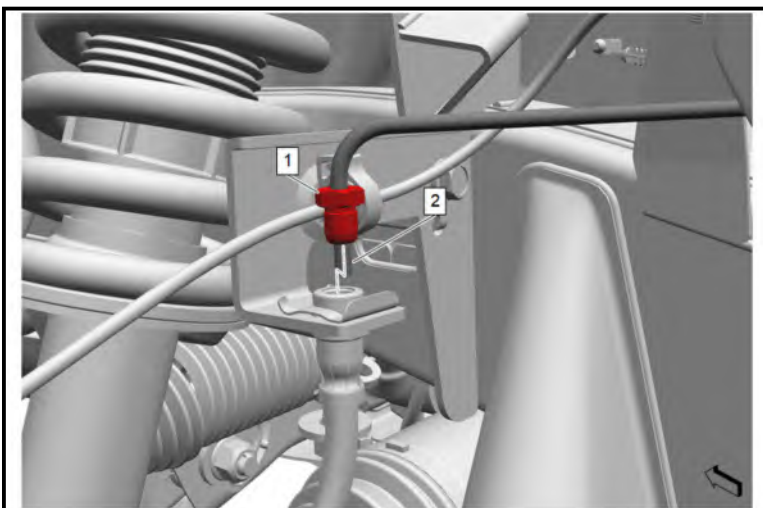


**CAUTION:** Refer to [Fastener Caution](#) .

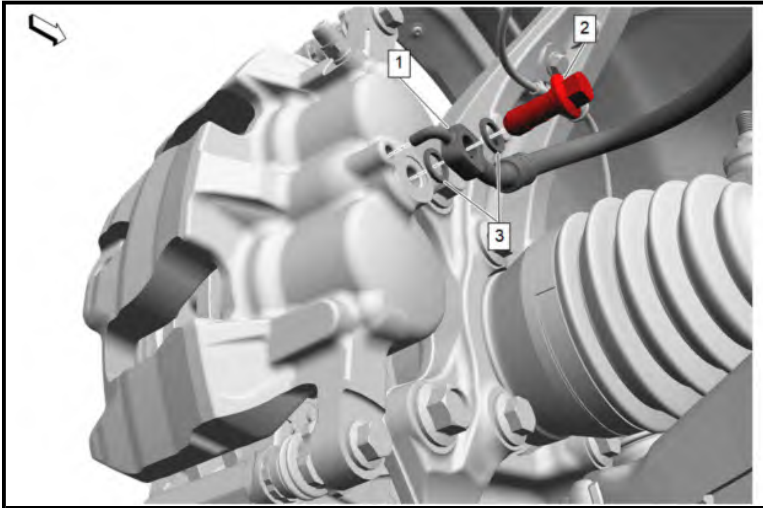
2. Front Brake Hose Bracket Bolt (2) - Install and tighten 16 N.m (12 lb ft)

3. Front Wheel Speed Sensor (1) @ Front Brake Hose (3) - Install

4. Remove the cap from the brake pipe fitting.



5. Front Brake Pipe @ Front Brake Hose (2) - Install
6. Front Brake Pipe Nut (1) - Install and tighten 17 N.m (13 lb ft)
7. Remove the cap from the brake caliper inlet.



8. Front Brake Hose Washer (3) - Install NEW [2x]
9. Front Brake Hose (1) @ Front Brake Caliper - Install
10. Front Brake Hose Fitting (2) - Install and tighten 44 N.m (32 lb ft)
11. Bleed the brake system. [Hydraulic Brake System Bleeding \(Manual\)](#), or [Hydraulic Brake System Bleeding \(Pressure\)](#).
12. Install the front tire and wheel assembly. [Tire and Wheel Removal and Installation](#)
13. Remove the support and lower the vehicle.

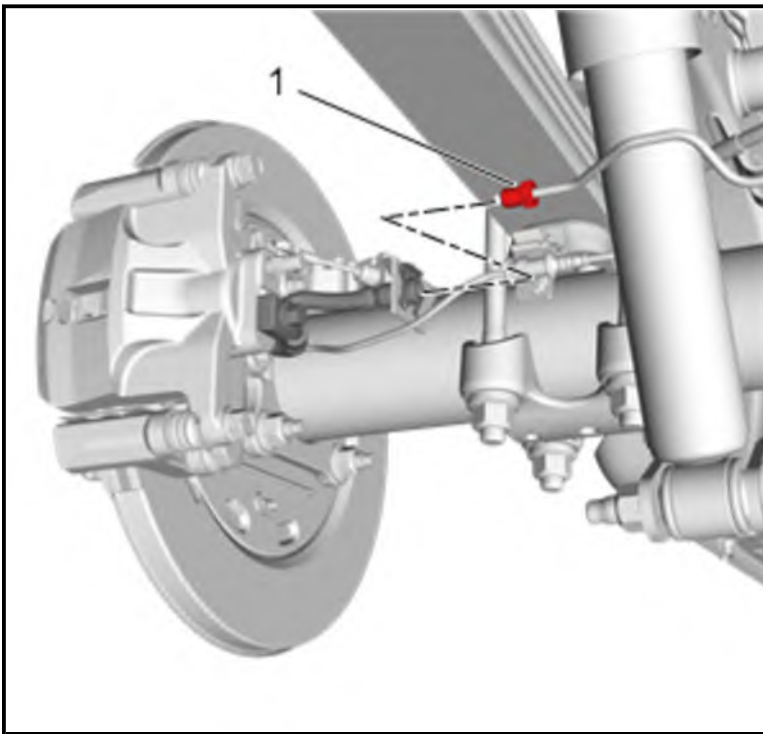
## REAR BRAKE HOSE REPLACEMENT

### Removal Procedure

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

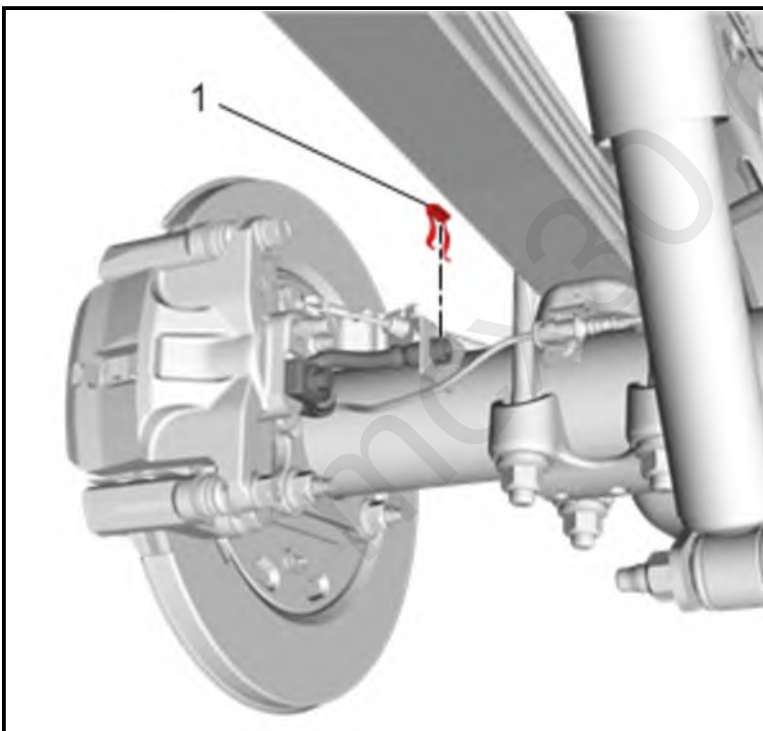
**CAUTION:** Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .
2. Remove the tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#) .
3. Remove the brake pipe fitting (1) from the brake hose.

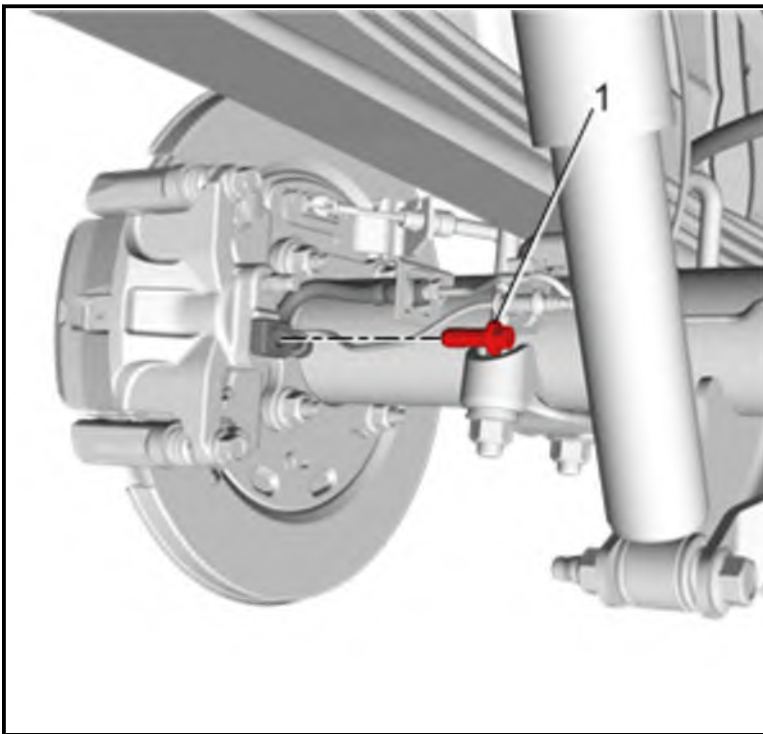


4. Cap the brake pipe fitting to prevent brake fluid loss and contamination.

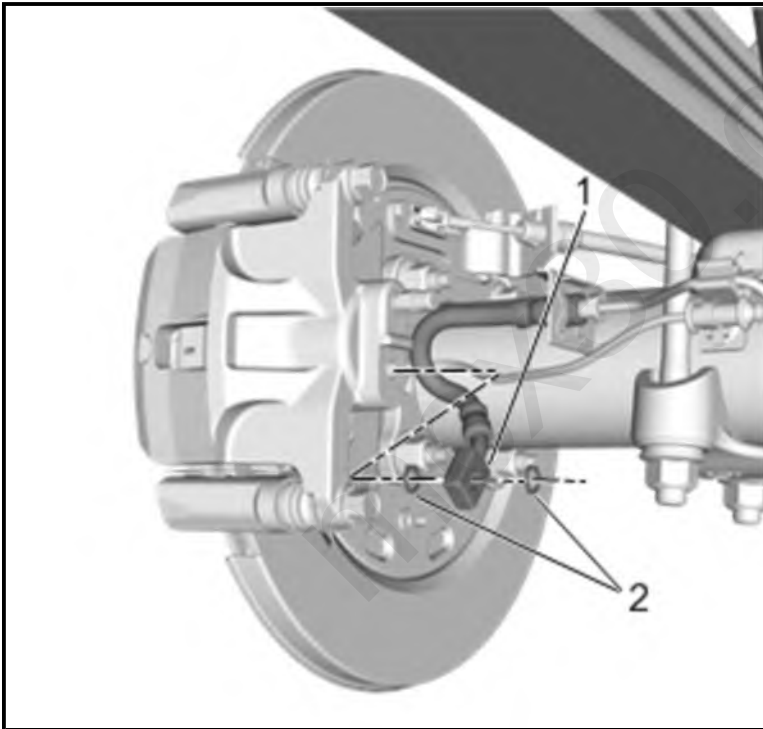
5. Remove the brake hose retaining clip (1).



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



7. Remove the rear brake hose fitting (1) from the rear brake caliper.



8. Plug the rear brake caliper inlet to prevent brake fluid loss and contamination.

**NOTE:** Do not reuse the brake hose fitting gaskets.

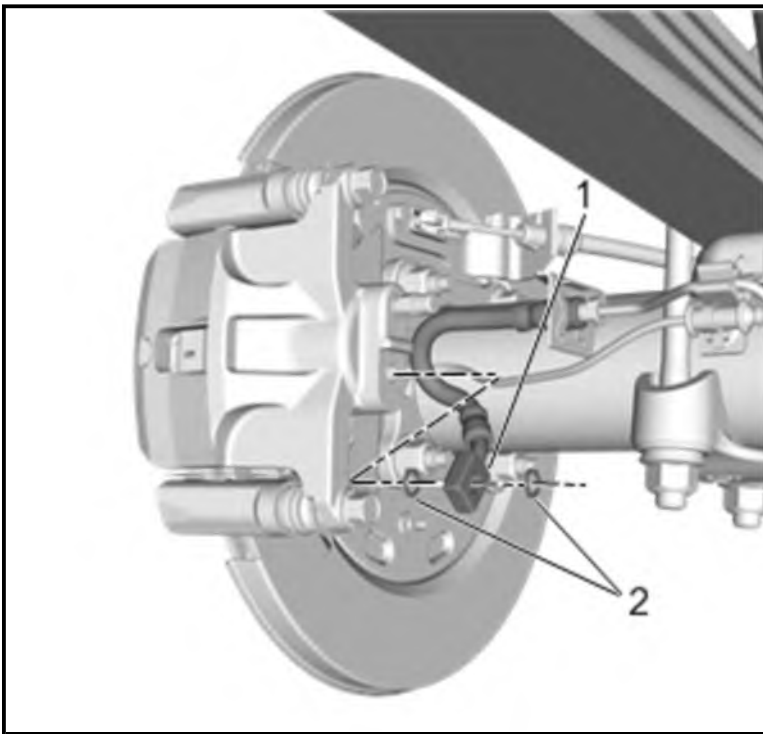
9. Remove and discard the brake hose fitting gaskets (2).

10. Remove the rear brake hose.

#### Installation Procedure

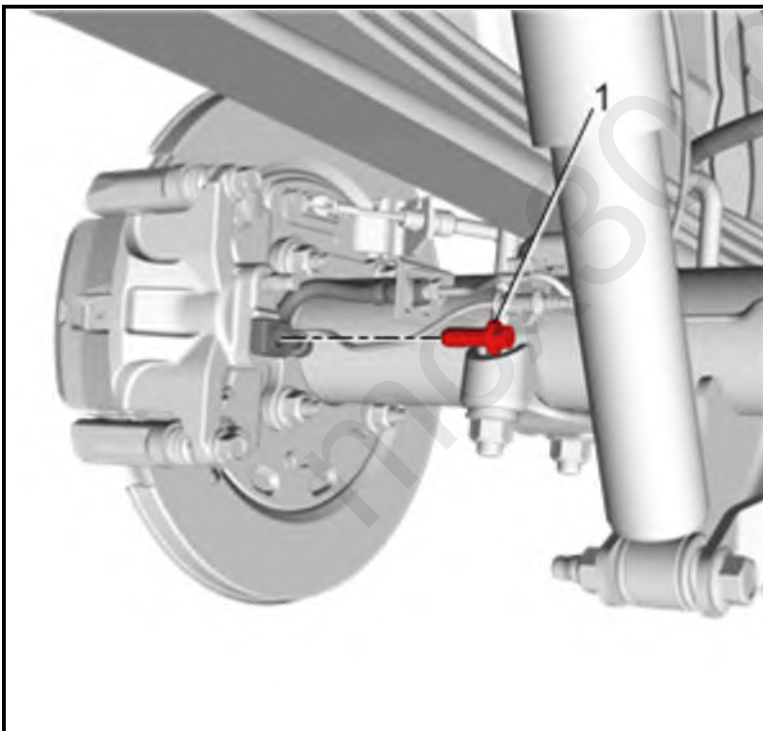
1. Install the rear brake hose.

2. Position the brake hose fitting (1) with 2 new brake hose fitting gaskets (2) to the rear brake caliper.



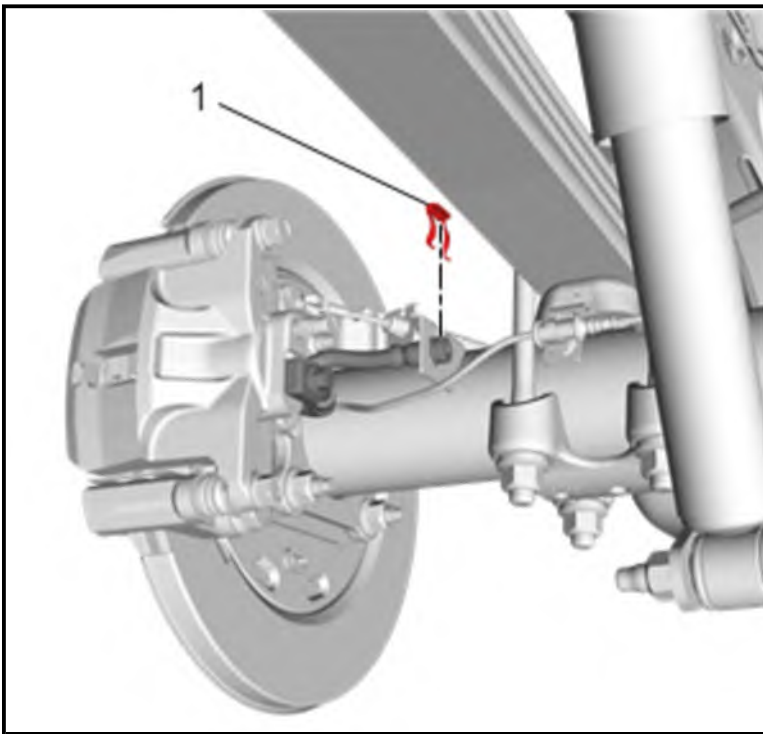
**NOTE:** Install new brake hose fitting gaskets.

3. Install the brake hose fitting bolt (1) and tighten to 34 N.m (25 lb ft).

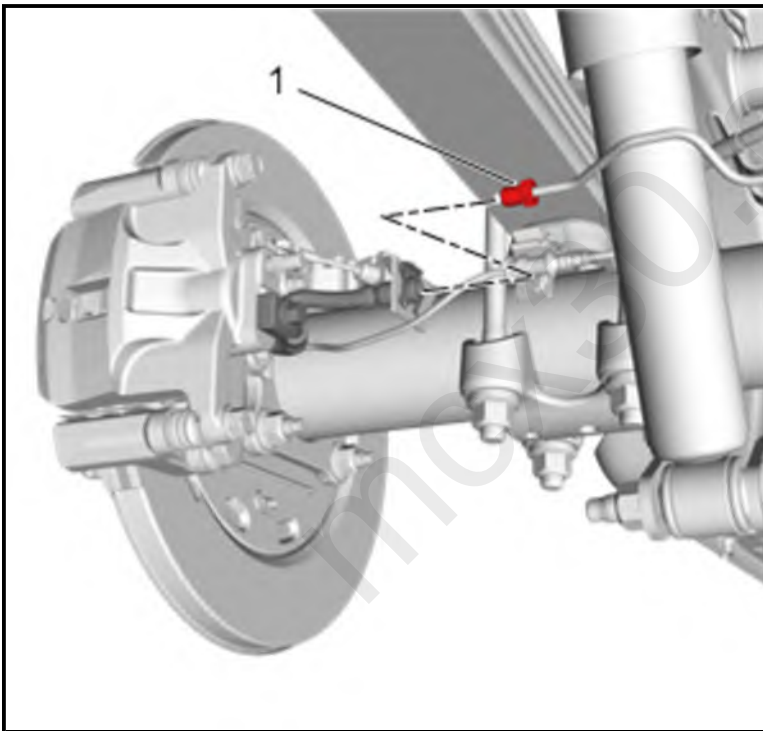


**CAUTION:** Refer to [Fastener Caution](#) .

4. Position the rear brake hose to the rear axle bracket and install the brake hose retaining clip (1).



5. Install the brake pipe fitting (1) to the rear brake hose and tighten the fitting to 16 N.m (12 lb ft).



6. Bleed the hydraulic brake system. Refer to [Hydraulic Brake System Bleeding \(Manual\)](#), or [Hydraulic Brake System Bleeding \(Pressure\)](#).

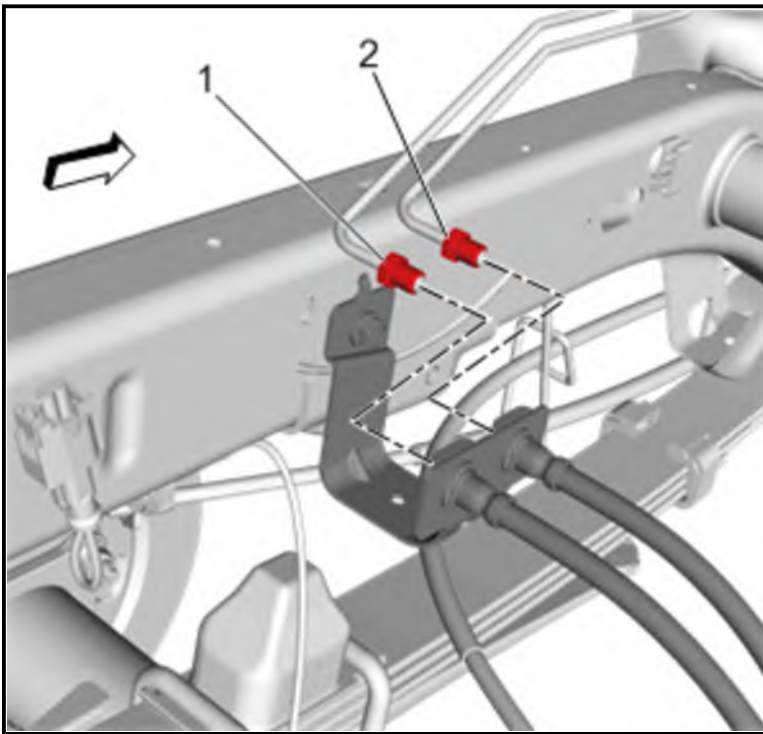
## REAR BRAKE HOSE REPLACEMENT (FRAME TO AXLE)

### Removal Procedure

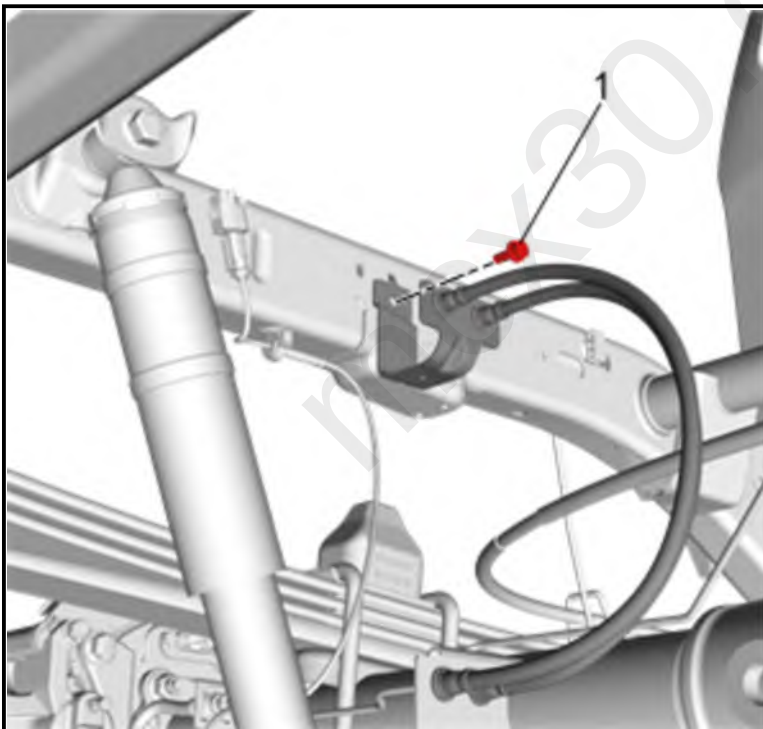
**WARNING:** Refer to [Brake Fluid Irritant Warning](#) .

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

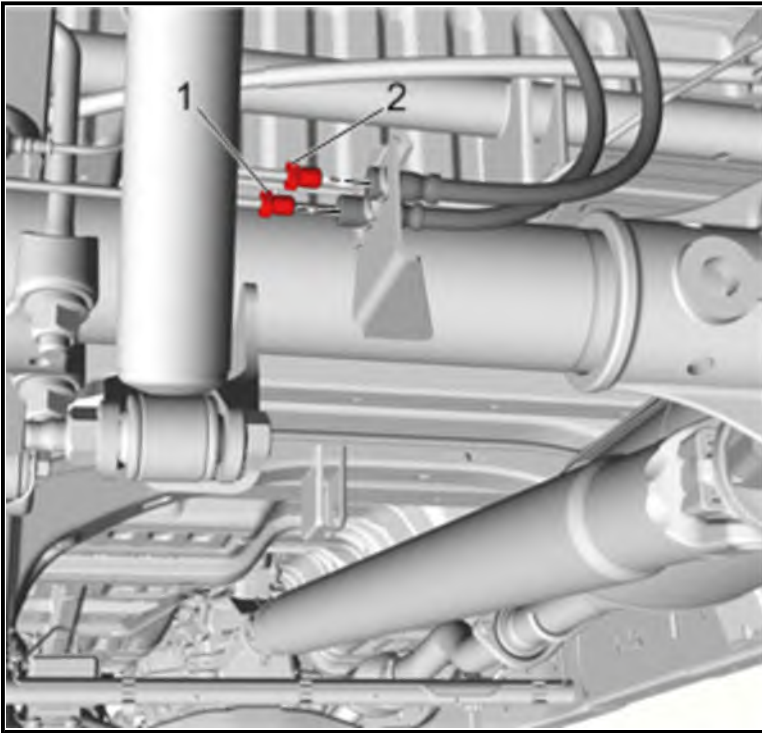
1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .
2. Remove the tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#) .
3. Remove the left rear brake pipe fitting (1) from the rear brake hose assembly.



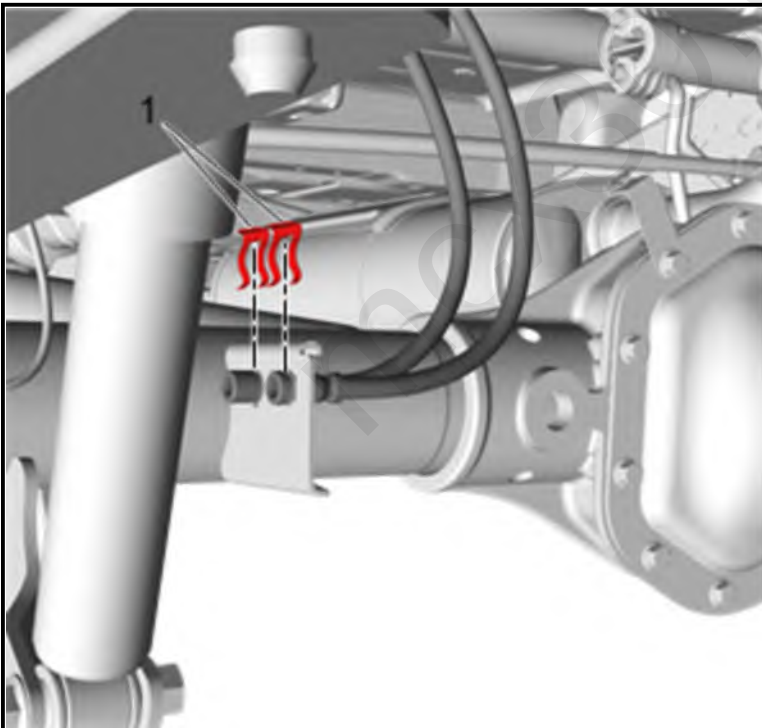
4. Cap the brake pipe fitting to prevent brake fluid loss and contamination.
5. Remove the right rear brake pipe fitting (2) from the rear brake hose assembly.
6. Cap the brake pipe fitting to prevent brake fluid loss and contamination.
7. Remove the rear brake hose assembly bracket bolt (1).



8. Remove the right rear brake pipe fitting (1) from the rear brake hose assembly.



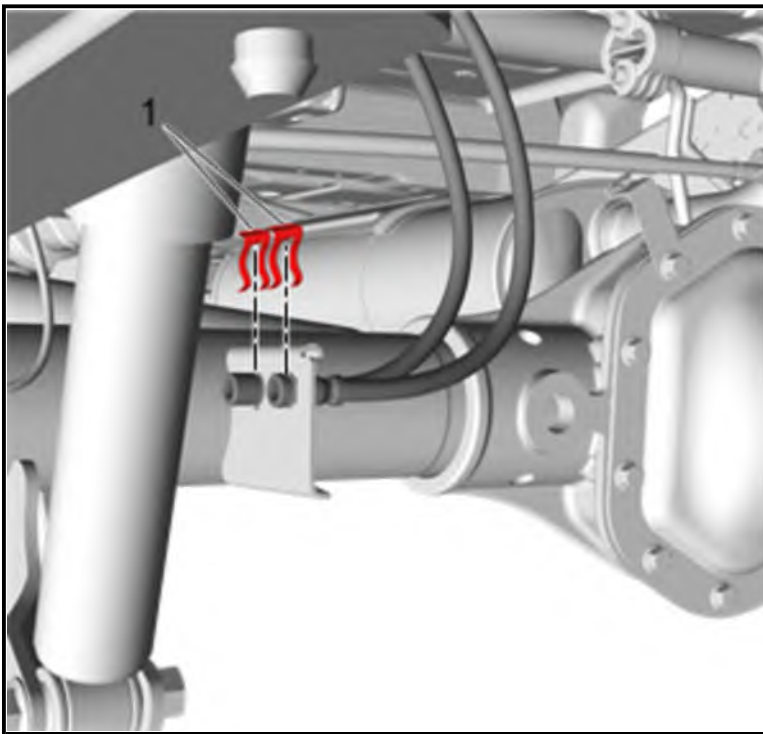
9. Cap the brake pipe fitting to prevent brake fluid loss and contamination.
10. Remove the left rear brake pipe fitting (2) from the rear brake hose assembly.
11. Cap the brake pipe fitting to prevent brake fluid loss and contamination.
12. Remove the rear brake hose assembly clips (1) and remove the rear brake hose assembly from the rear axle bracket.



**NOTE:** The brake hose assembly fittings are indexed for proper assembly.

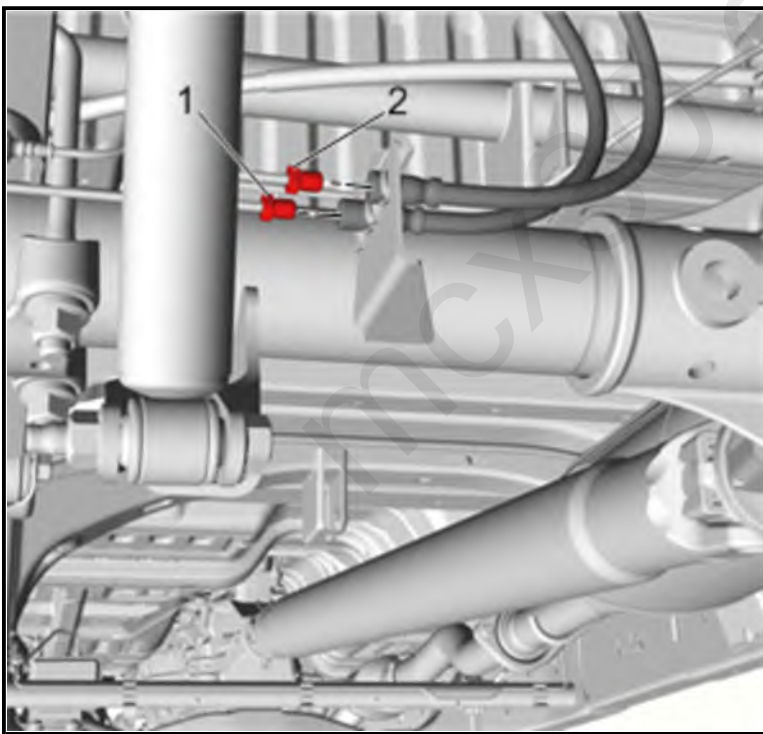
#### Installation Procedure

1. Position the rear brake hose assembly to the rear axle bracket and install the brake hose assembly clips (1).



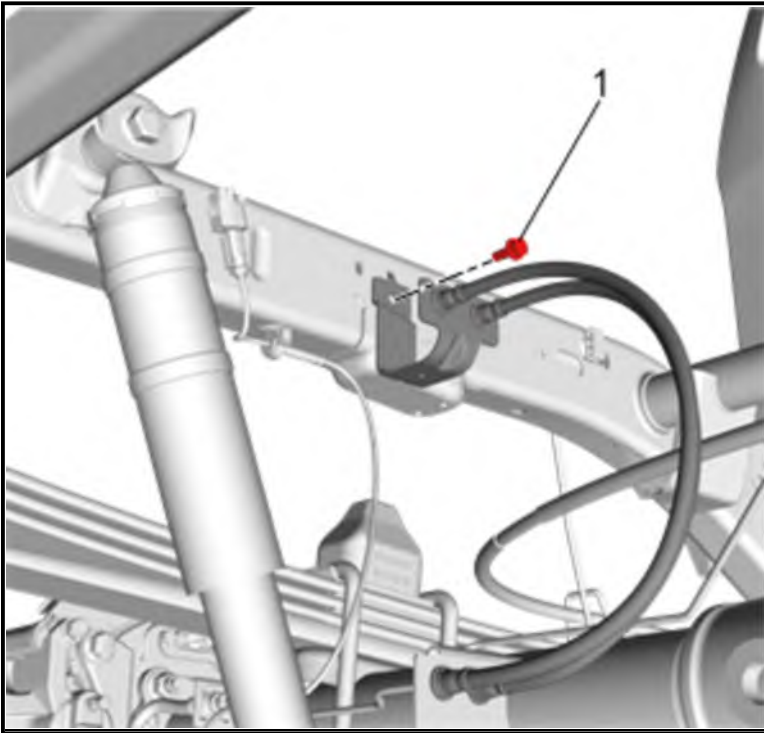
**NOTE:** The brake hose assembly fittings are indexed for proper assembly.

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

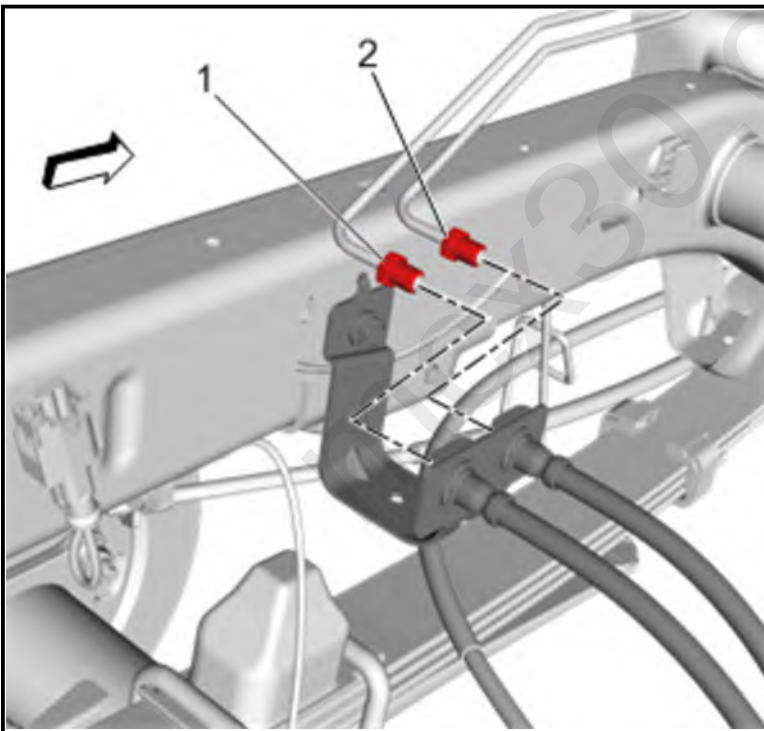


**CAUTION:** Refer to [Fastener Caution](#) .

3. Install the left rear brake pipe fitting (2) to the rear brake hose assembly and tighten the fitting to 18 N.m (13 lb ft).
4. Position the rear brake hose assembly bracket to the frame rail.



5. Install the rear brake hose assembly bracket bolt and tighten to 16 N.m (12 lb ft).
6. Install the left rear brake pipe fitting (1) to the rear brake hose assembly and tighten the fitting to 18 N.m (13 lb ft).



7. Install the right rear brake pipe fitting (2) to the rear brake hose assembly and tighten the fitting to 18 N.m (13 lb ft).
8. Bleed the hydraulic brake system. Refer to [Hydraulic Brake System Bleeding \(Manual\)](#), or [Hydraulic Brake System Bleeding \(Pressure\)](#).

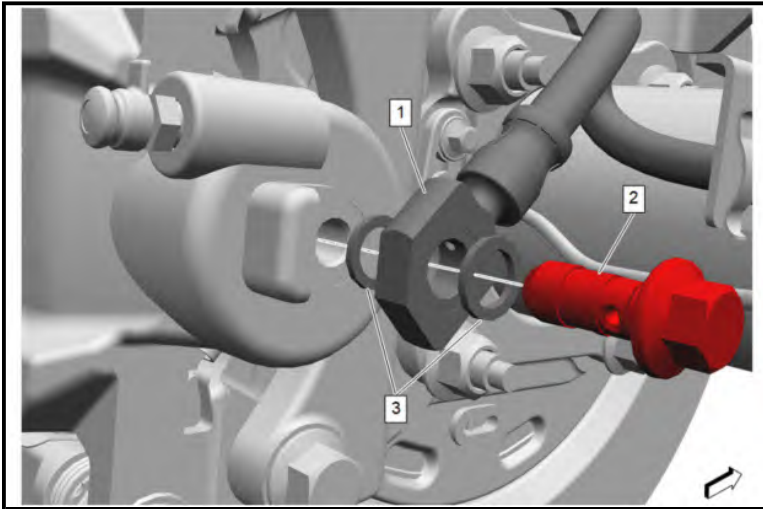
## REAR BRAKE HOSE REPLACEMENT (AXLE TO CALIPER)

**WARNING:** [Brake Dust Warning](#)

**WARNING:** [Brake Fluid Irritant Warning](#)

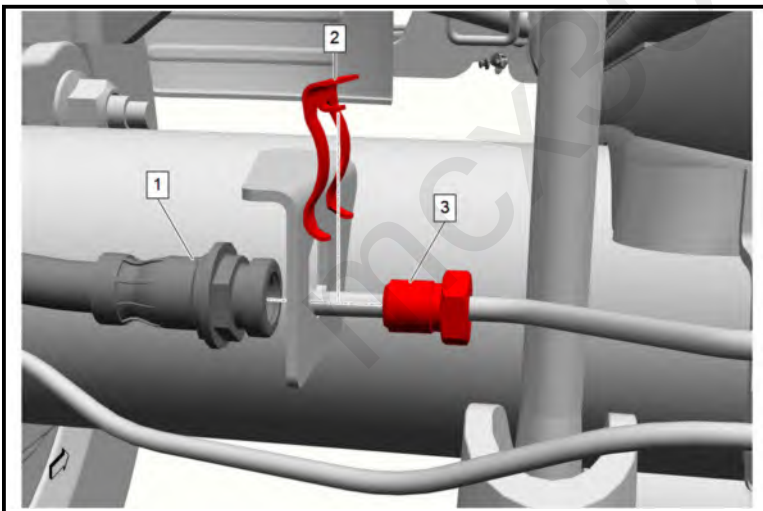
### Removal Procedure

1. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
2. Remove the rear tire and wheel assembly. [Tire and Wheel Removal and Installation](#)
3. Clean all dirt and foreign material from the brake hose ends and the brake pipe fitting.
4. Rear Brake Hose Fitting Bolt (2) - Remove



**NOTE:** Do NOT reuse the rear brake hose fitting gaskets.

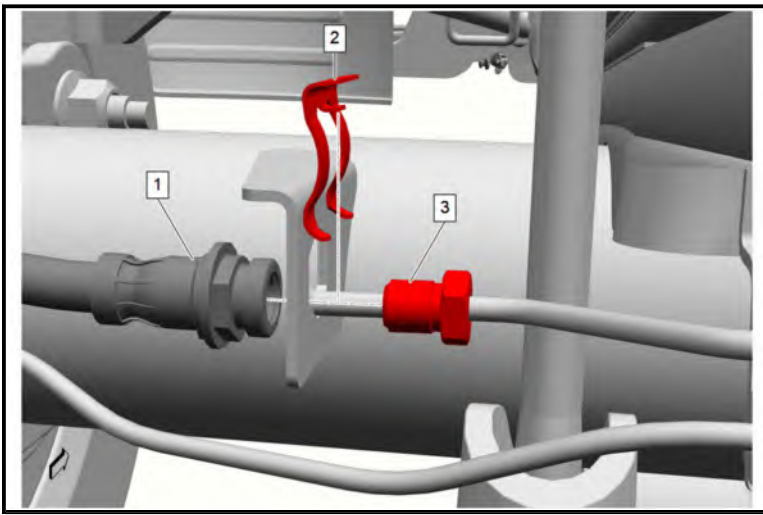
5. Rear Brake Hose Fitting Gasket (3) - Remove and DISCARD [2x]
6. Rear Brake Hose (1) @ Rear Brake Caliper - Remove
7. Plug the rear brake caliper inlet to prevent brake fluid loss and contamination.
8. Brake Pipe Fitting (3) @ Rear Brake Hose - Remove



9. Rear Brake Hose Clip (2) - Remove
10. Rear Brake Hose (1) - Remove
11. Cap the brake pipe fittings to prevent brake fluid loss and contamination.

#### Installation Procedure

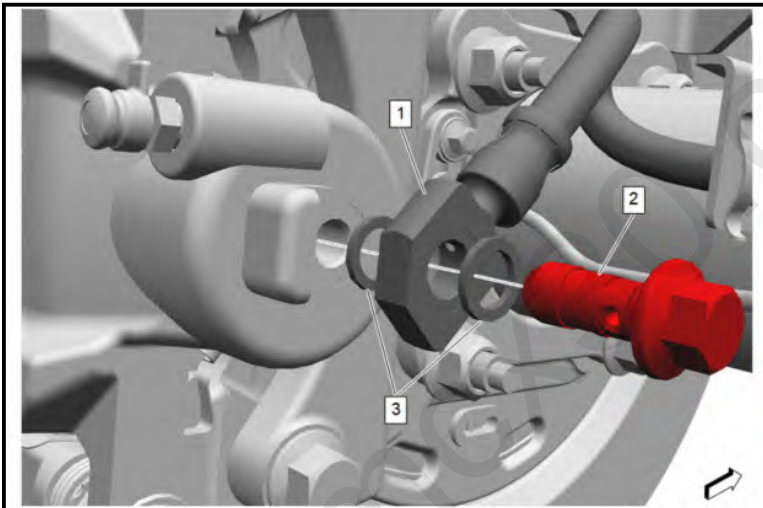
1. Remove the cap from the brake pipe fittings.



2. Rear Brake Hose (1) - Install
3. Rear Brake Hose Clip (2) - Install

**CAUTION:** Fastener Caution

4. Brake Pipe Fitting (3) @ Rear Brake Hose - Install and tighten 18 N.m (13 lb ft)
5. Remove the cap from the rear brake hose outlet.



6. Rear Brake Hose Fitting Gasket (3) - Install NEW [2x]
7. Rear Brake Hose (1) @ Rear Brake Caliper - Install
8. Rear Brake Hose Fitting Bolt (2) - Install and tighten 34 N.m (25 lb ft)
9. Bleed the brake system. Hydraulic Brake System Bleeding (Manual), or Hydraulic Brake System Bleeding (Pressure).
10. Install the rear tire and wheel assembly. Tire and Wheel Removal and Installation
11. Remove the support and lower the vehicle.

**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.

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

27. If the brake system warning lamp remains illuminated. Refer to [Symptoms - Hydraulic Brakes](#).

## **HYDRAULIC BRAKE SYSTEM BLEEDING (PRESSURE)**

### **Special Tools**

- J-29532 Diaphragm Type Brake Pressure Bleeder, or equivalent
- J-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.

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

32. If the brake system warning lamp remains illuminated. Refer to [Symptoms - Hydraulic Brakes](#).

## HYDRAULIC BRAKE SYSTEM FLUSHING

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

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

**CAUTION:** Only use products that comply with GM specifications and check manufacturer information respectively. We recommend the use of GM genuine products. Instructions must be followed at all times. The use of any type of fluid other than the recommended type of brake fluid, may cause contamination which could result in damage to the internal rubber seals and/or rubber linings of hydraulic brake system components.

1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination:
  - Fluid separation, indicating two types of fluid are present; a substance other than the recommended brake fluid has been introduced into the brake hydraulic system
    - Swirled appearance - oil-based substance
    - Layered appearance - silicone-based substance
  - Fluid discoloration, indicating the presence of moisture or particles that have been introduced into the brake hydraulic system
    - Cloudy appearance - moisture
    - Dark appearance/suspended particles in fluid - dirt, rust, corrosion, brake dust
2. Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating brake fluid contamination.
3. If the brake fluid WAS contaminated with an oil-based or a silicone-based substance, indicated by fluid separation and/or a swollen master cylinder reservoir cap diaphragm and/or swollen reservoir-to-master cylinder grommets, perform the following:
  1. Remove ALL of the following components listed from the vehicle. Each component contains internal rubber seals/linings which have been contaminated by the contaminated brake fluid in the brake hydraulic system.

Refer to the procedures indicated:

- [Brake Master Cylinder Replacement](#)
  - [Front Brake Hose Replacement](#), or [Front Brake Hose Replacement](#)
  - [Rear Brake Hose Replacement](#), or [Rear Brake Hose Replacement \(Frame to Axle\)](#), or [Rear Brake Hose Replacement \(Axle to Caliper\)](#)
  - [Front Brake Caliper Replacement](#)
  - [Rear Brake Caliper Replacement](#)
  - [Brake Pressure Modulator Valve 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.

Refer to the procedures indicated:

- [Brake Master Cylinder Replacement](#); also perform the following:

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

Replace the brake master cylinder reservoir cap and diaphragm.

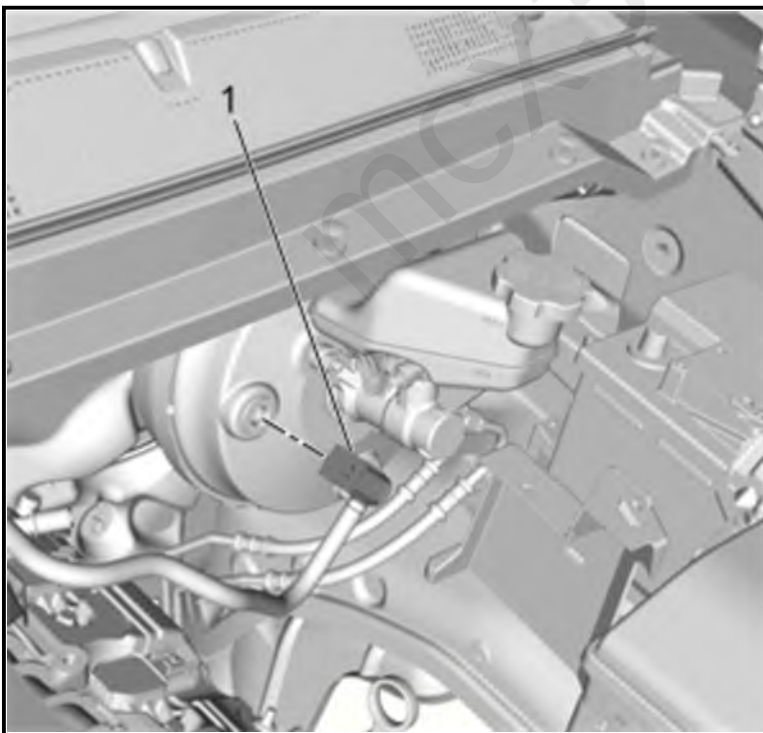
- [Front Brake Hose Replacement](#), or [Front Brake Hose Replacement](#)
- [Rear Brake Hose Replacement](#), or [Rear Brake Hose Replacement \(Frame to Axle\)](#), or [Rear Brake Hose Replacement \(Axle to Caliper\)](#)
- [Front Brake Caliper Replacement](#)
- [Rear Brake Caliper Replacement](#)
- [Brake Pressure Modulator Valve Replacement](#)

4. If the brake fluid was NOT contaminated with an oil-based or a silicone-based substance, but WAS contaminated with water or dirt, rust, corrosion, and/or brake dust, replace the brake master cylinder reservoir cap diaphragm. The diaphragm may have allowed the moisture or particles to enter the hydraulic system.
5. Fill the brake master cylinder reservoir to the maximum-fill level with GM approved brake fluid from a clean, sealed brake fluid container. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).
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 \(Manual\)](#), or [Hydraulic Brake System Bleeding \(Pressure\)](#).

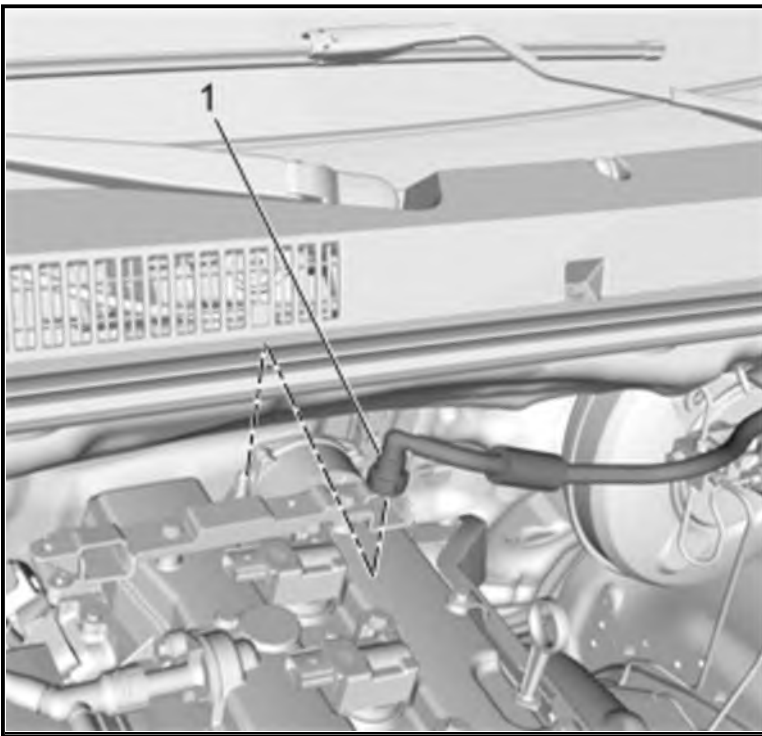
## **POWER BRAKE BOOSTER VACUUM HOSE REPLACEMENT (LCV)**

### **Removal Procedure**

1. Apply the brake pedal several times until the pedal becomes firm to deplete the vacuum reserve in the brake booster.
2. Remove the intake manifold cover. [Intake Manifold Cover Replacement](#)
3. Disconnect the power brake booster vacuum sensor electrical connector.
4. Remove the power brake booster vacuum sensor (1) from the power brake booster.



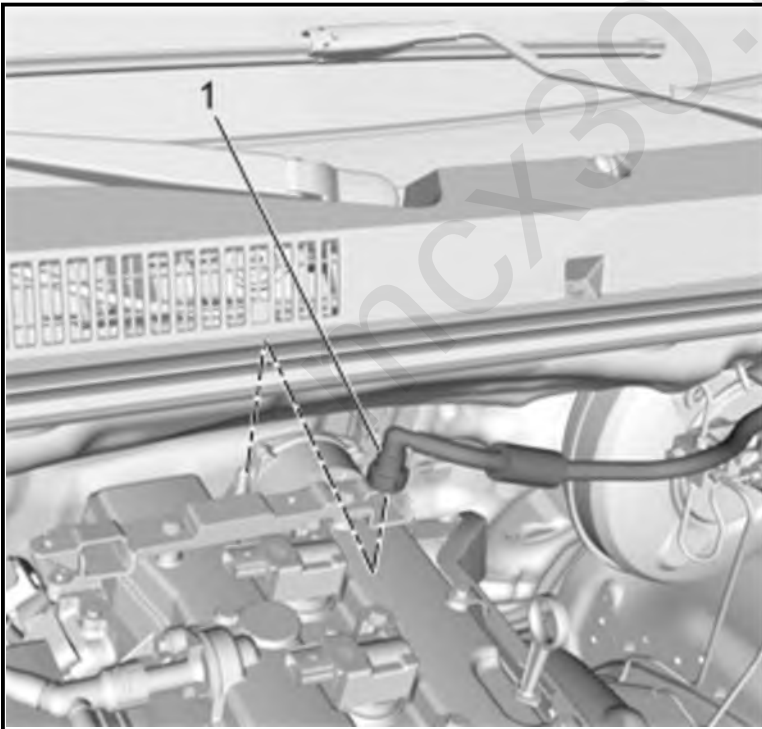
5. Release the power brake booster vacuum hose quick connect (1) from the vacuum pump.



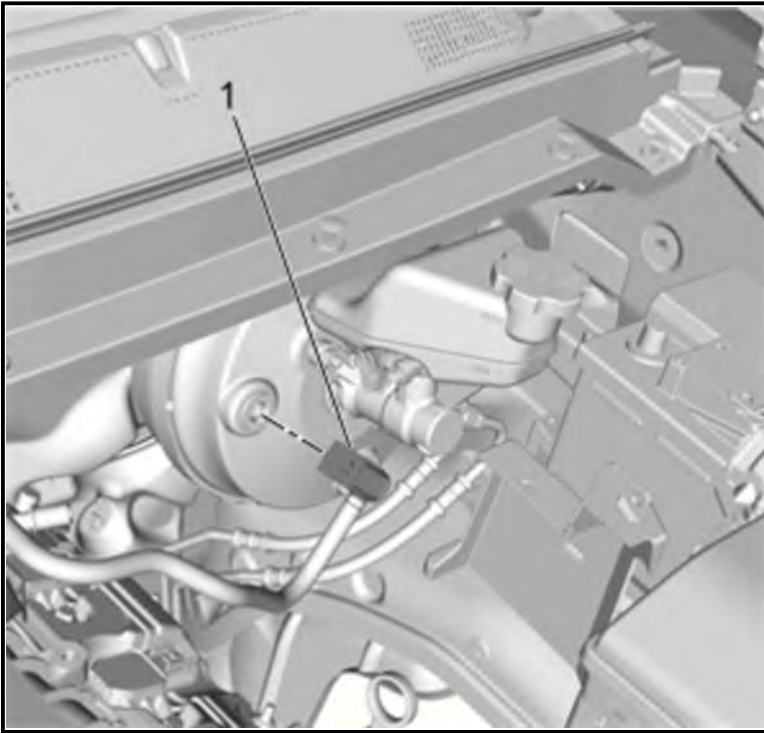
6. Remove the power brake booster vacuum hose assembly from the vehicle.

#### Installation Procedure

1. Install the power brake booster vacuum hose assembly to the vehicle.
2. Install the power brake booster vacuum hose quick connect (1) to the vacuum pump.



3. Install the power brake booster vacuum sensor (1) to the power brake booster.



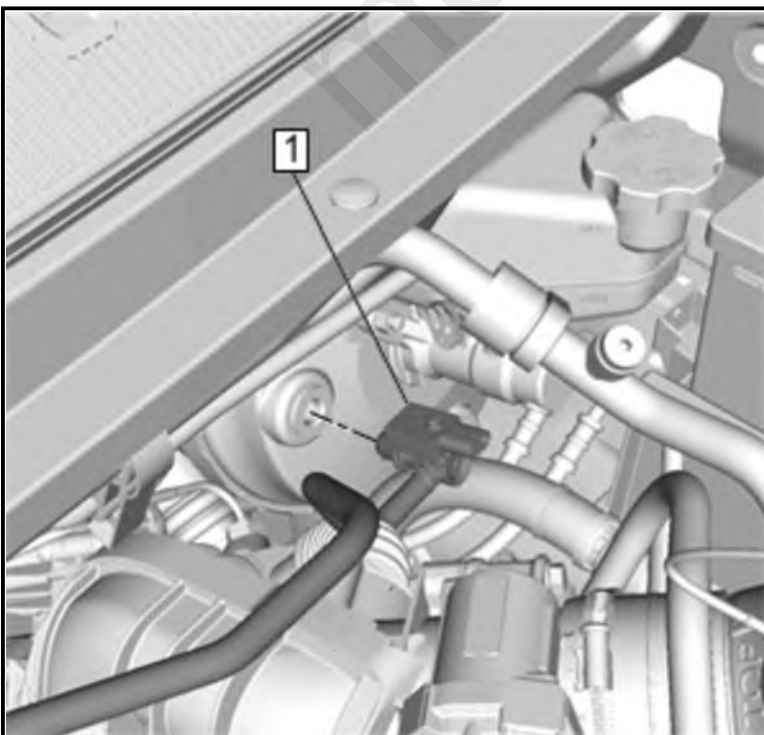
**NOTE:** A small amount of denatured alcohol may be used as a lubricant for assembly.

4. Connect the power brake booster vacuum sensor electrical connector.
5. Install the intake manifold cover. [Intake Manifold Cover Replacement](#)

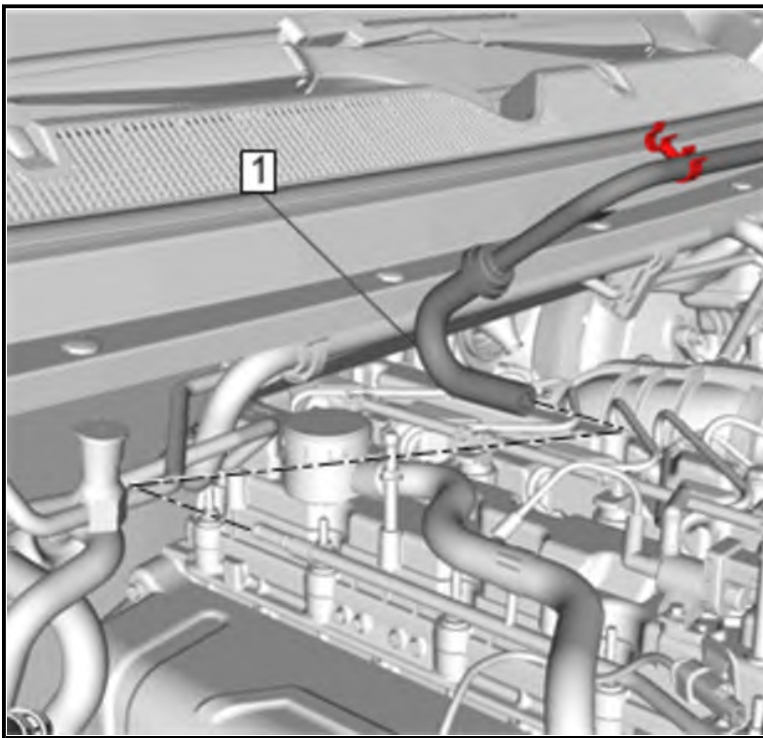
### **POWER BRAKE BOOSTER VACUUM HOSE REPLACEMENT (LWN)**

#### **Removal Procedure**

1. Apply and release the brake pedal several times until the pedal becomes firm to deplete the power brake booster vacuum reserve.
2. [Intake Manifold Cover Replacement](#) - Remove
3. Disconnect the power brake booster vacuum sensor electrical connector.
4. Power Brake Booster Vacuum Sensor (1) - Remove



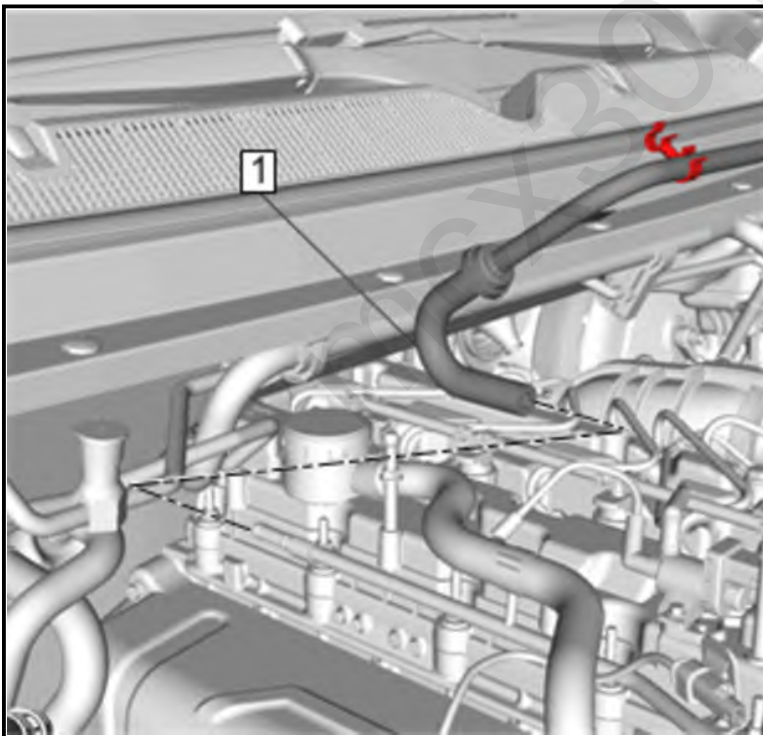
5. Power Brake Booster Vacuum Hose (1) @ Vacuum Pump Pipe - Remove



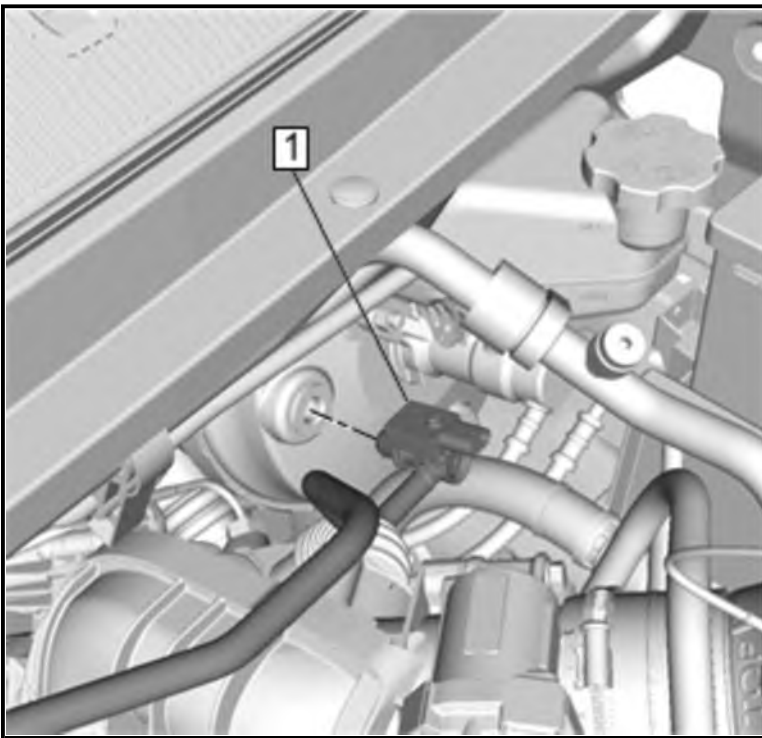
6. Power Brake Booster Vacuum Hose - Remove

#### Installation Procedure

1. Power Brake Booster Vacuum Hose - Install
2. Power Brake Booster Vacuum Hose (1) @ Vacuum Pump Pipe - Install



3. Power Brake Booster Vacuum Sensor (1) - Install



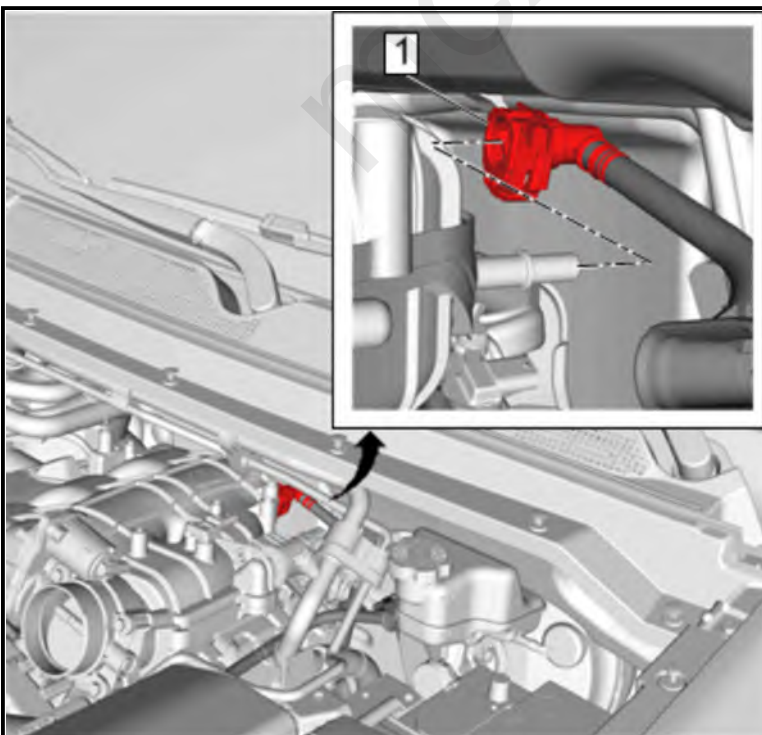
**NOTE:** A small amount of denatured alcohol may be used to ease assembly.

4. Connect the power brake booster vacuum sensor electrical connector.
5. Intake Manifold Cover Replacement - Install

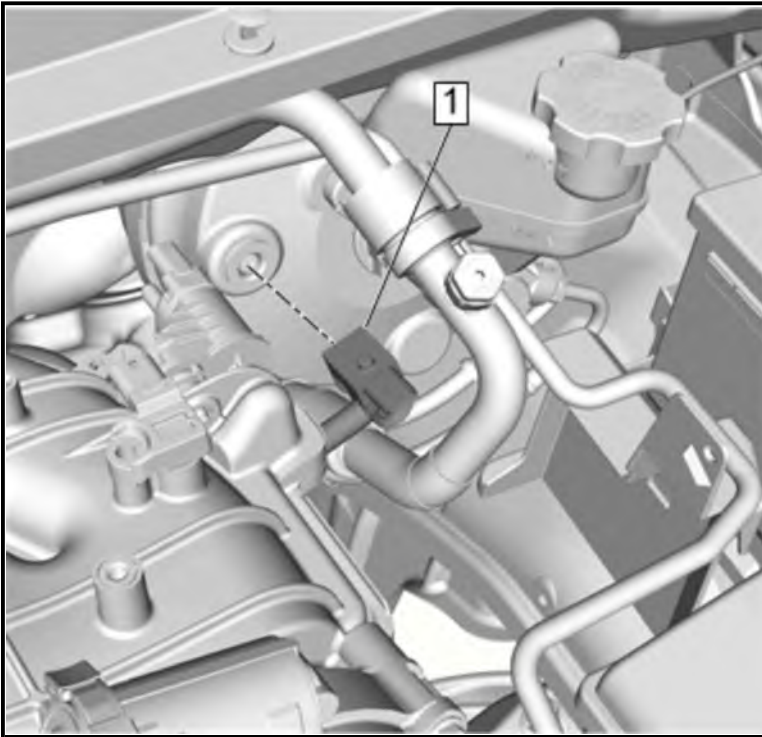
## **POWER BRAKE BOOSTER VACUUM HOSE REPLACEMENT (LGZ)**

### **Removal Procedure**

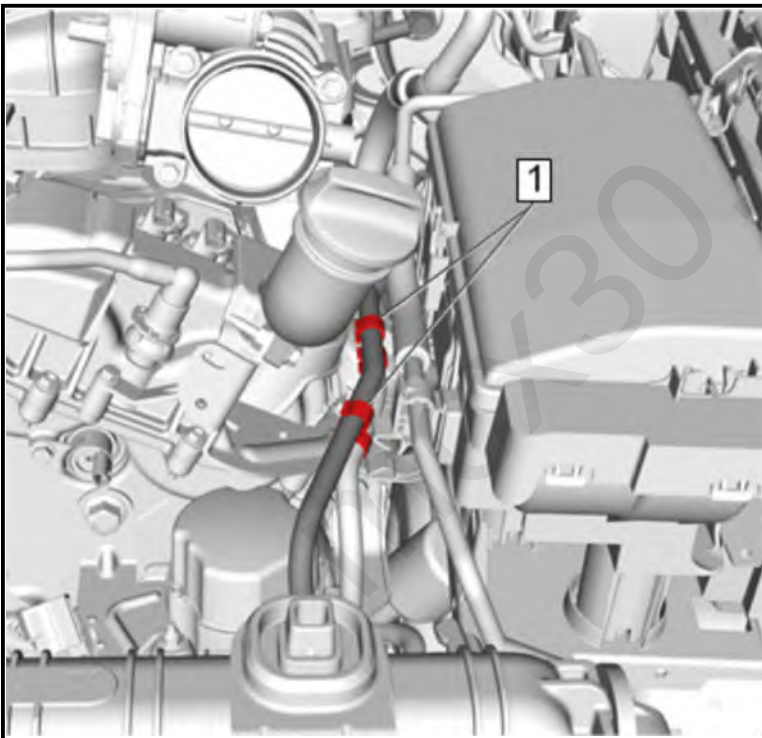
1. Apply and release the brake pedal several times until the pedal becomes firm to deplete the power brake booster vacuum reserve.
2. Disconnect the power brake booster vacuum sensor electrical connector.
3. Quick Connect Fitting (1) @ Intake Manifold - Disconnect



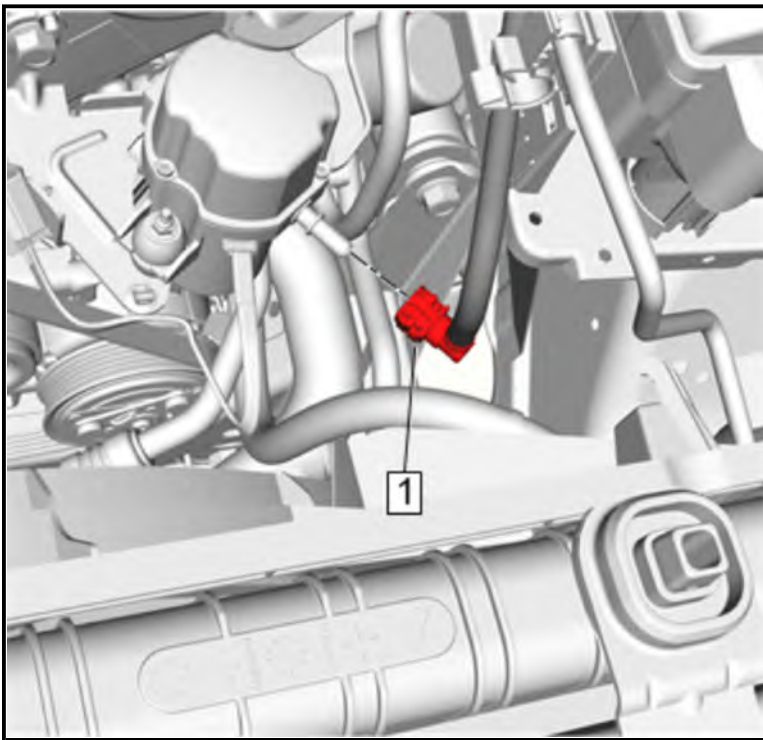
4. Power Brake Booster Vacuum Sensor (1) - Remove



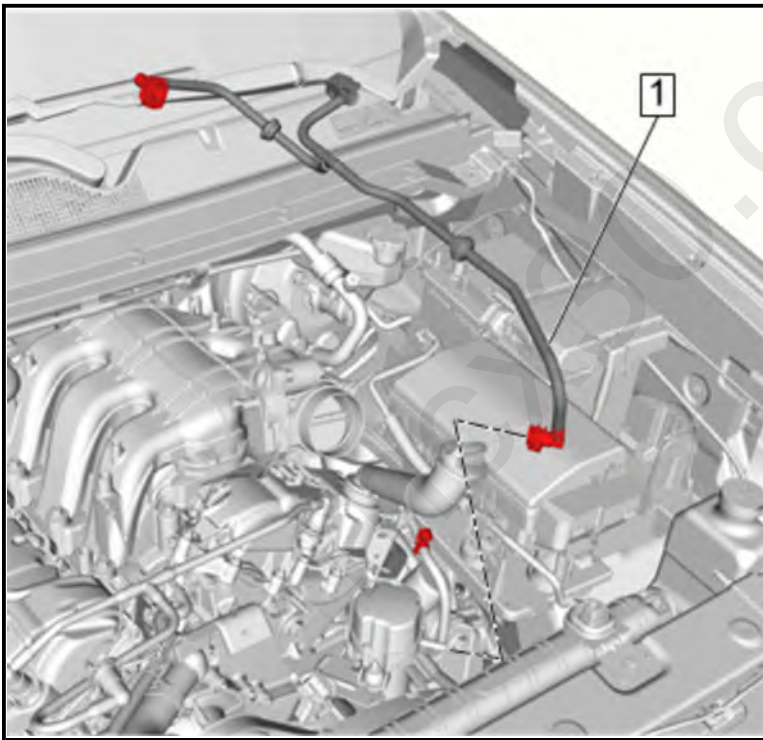
5. Clip (1) @ Power Brake Booster Vacuum Hose - Release [2x]



6. Quick Connect Fitting (1) @ Power Brake Booster Pump - Disconnect

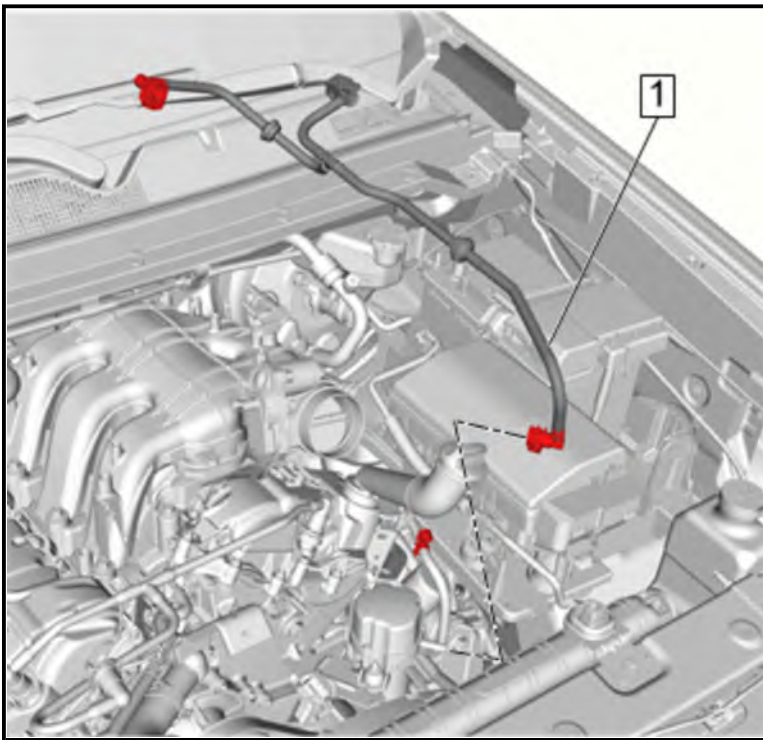


7. Power Brake Booster Vacuum Hose (1) - Remove

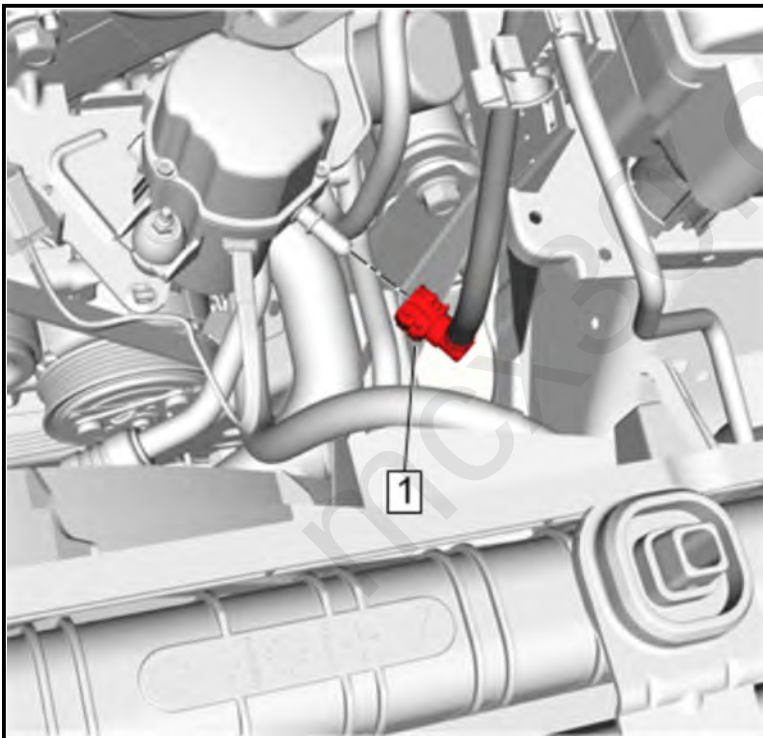


#### Installation Procedure

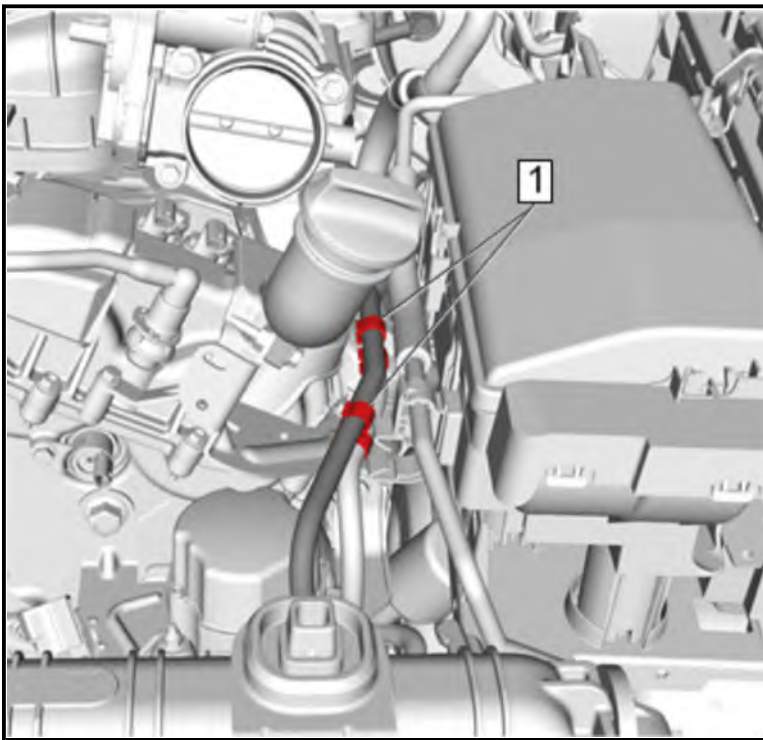
1. Power Brake Booster Vacuum Hose (1) - Install



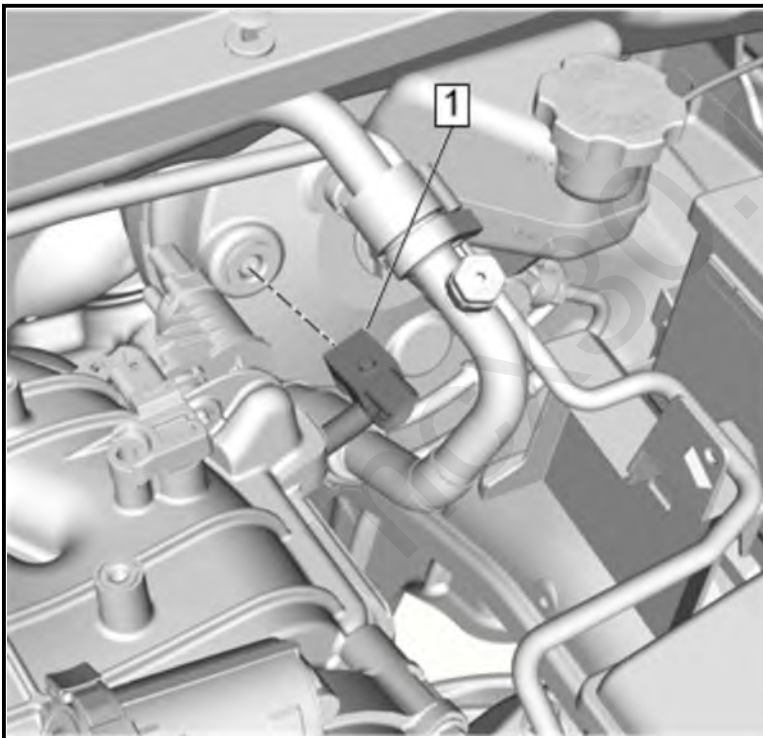
2. Quick Connect Fitting (1) @ Power Brake Booster Pump - Connect



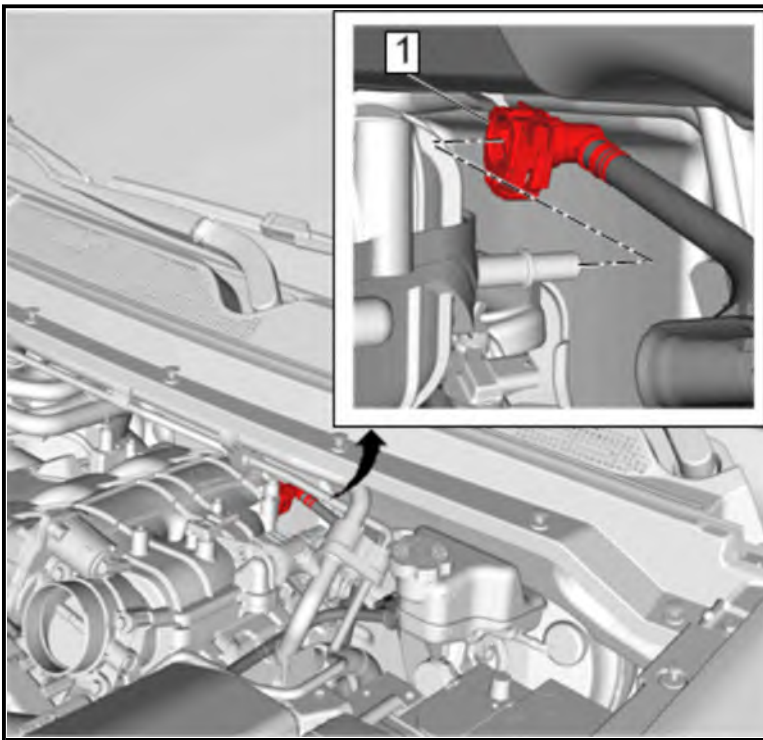
3. Clip (1) @ Power Brake Booster Vacuum Hose - Secure [2x]



4. Power Brake Booster Vacuum Sensor (1) - Install



5. Quick Connect Fitting (1) @ Intake Manifold - Connect

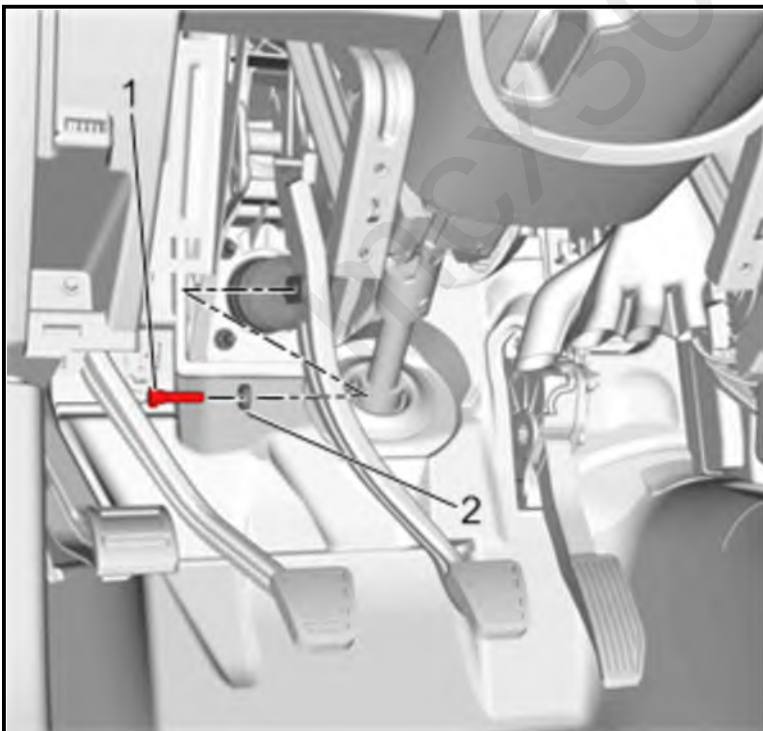


6. Connect the power brake booster vacuum sensor electrical connector.

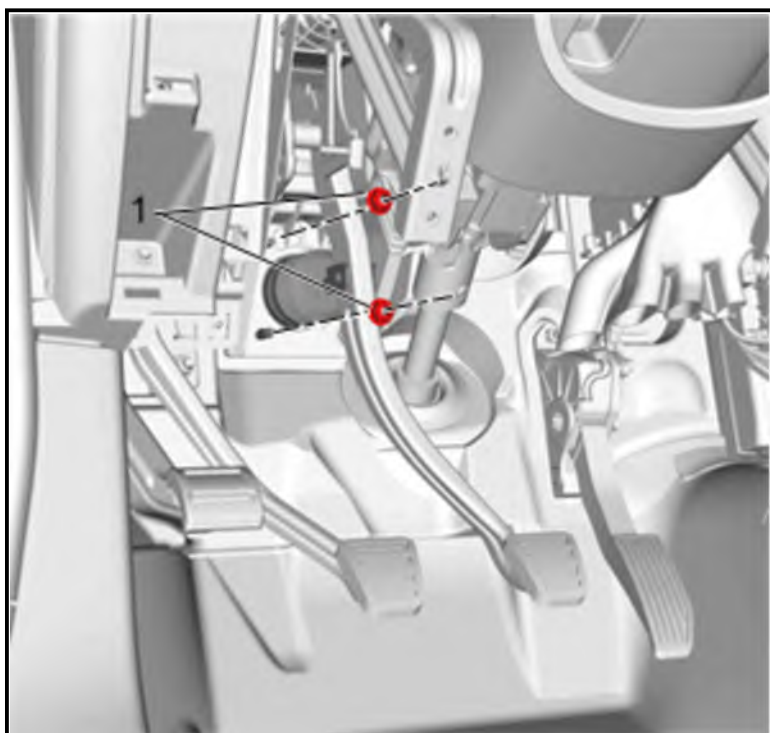
## **POWER BRAKE BOOSTER REPLACEMENT**

### **Removal Procedure**

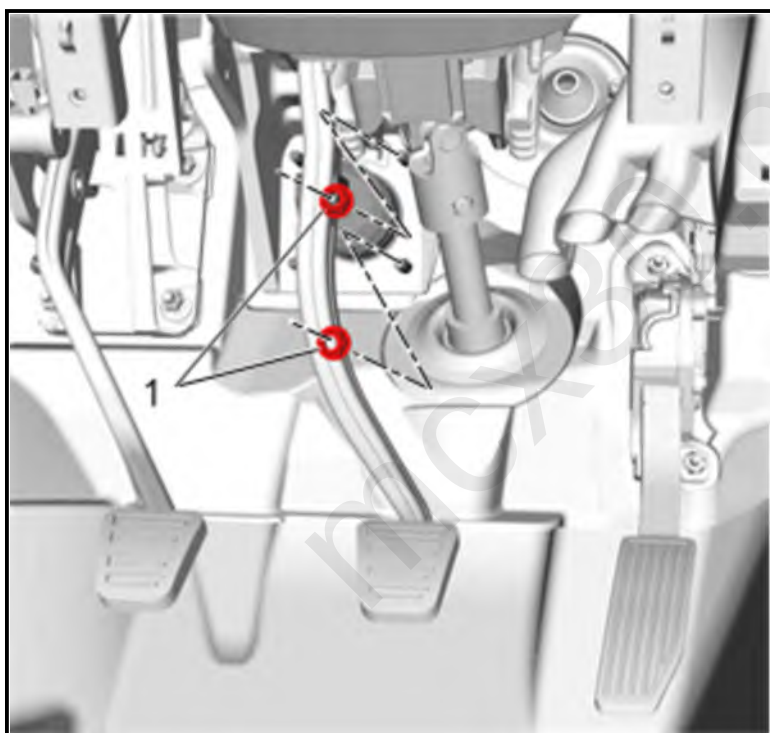
1. Remove the brake pedal position sensor. [Brake Pedal Position Sensor Replacement](#)
2. Remove the brake pedal pushrod bolt (1) and bushing (2).



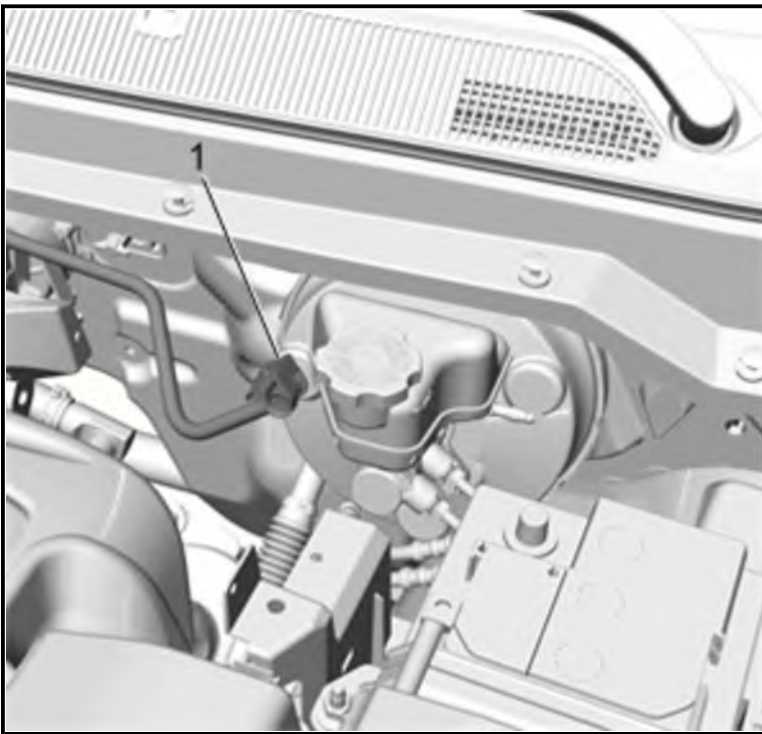
3. Disconnect the brake pedal pushrod from the brake pedal.
4. Remove the left side power brake booster nuts (1).



5. Remove the right side power brake booster nuts (1).



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



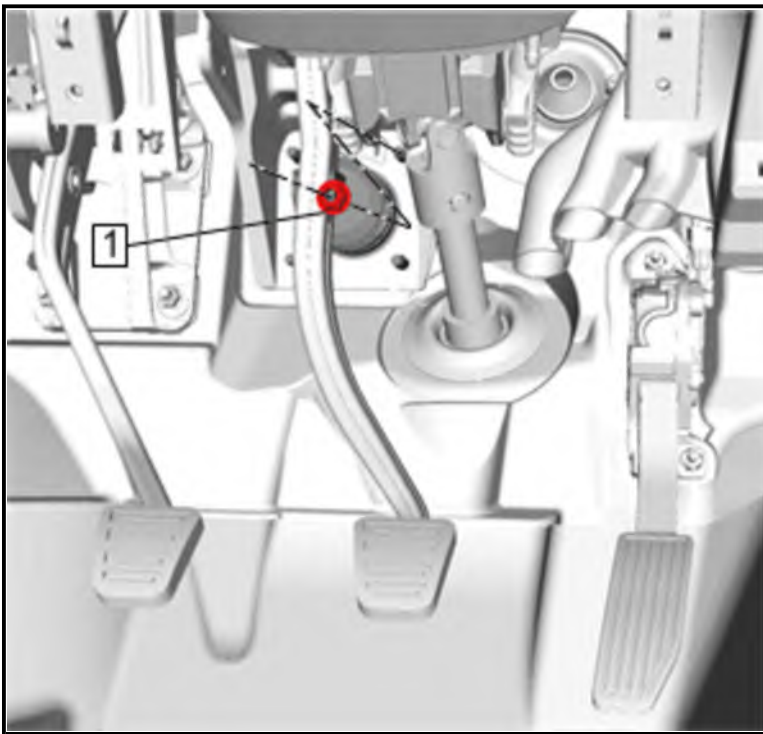
7. Remove the power brake booster vacuum sensor (1) from the power brake booster and position aside.
8. Remove the battery tray. [Battery Tray Replacement](#)

**NOTE:** Do not allow the master cylinder flexible brake pipes bend beyond a 76 mm (3 in) radius to prevent internal failure of the flexible brake pipes.

9. Remove the brake master cylinder. [Brake Master Cylinder Replacement](#)
10. Carefully pull the power brake booster away from the dash panel and remove the power brake booster.

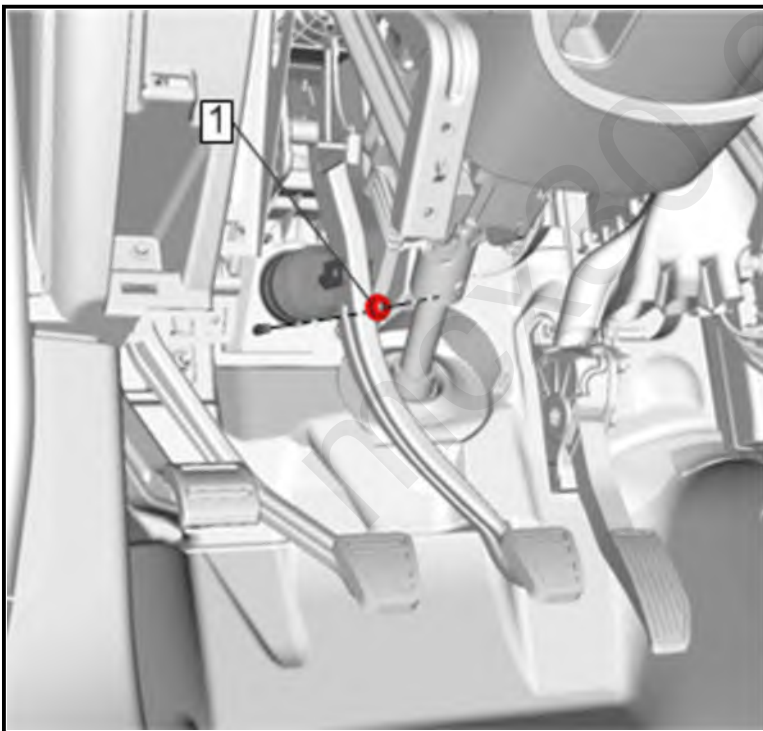
#### **Installation Procedure**

1. Prepare the brake pedal pushrod bolt for installation as follows:
  1. Remove any loose cured adhesive from the external threads of the component using a lint free cloth.
  2. Thread the cleaned component into the internal mating threads and remove to loosen trapped cured adhesive.
  3. Apply thread locking adhesive to the external threads of the component. [Adhesives, Fluids, Lubricants, and Sealers](#)
  4. Ensure there are no gaps in the thread locking adhesive once applied to the component.
2. Have an assistant position and hold the power brake booster to the dash panel.
3. Install the right side upper power brake booster nut (1) and tighten to 23 N.m (17 lb ft).

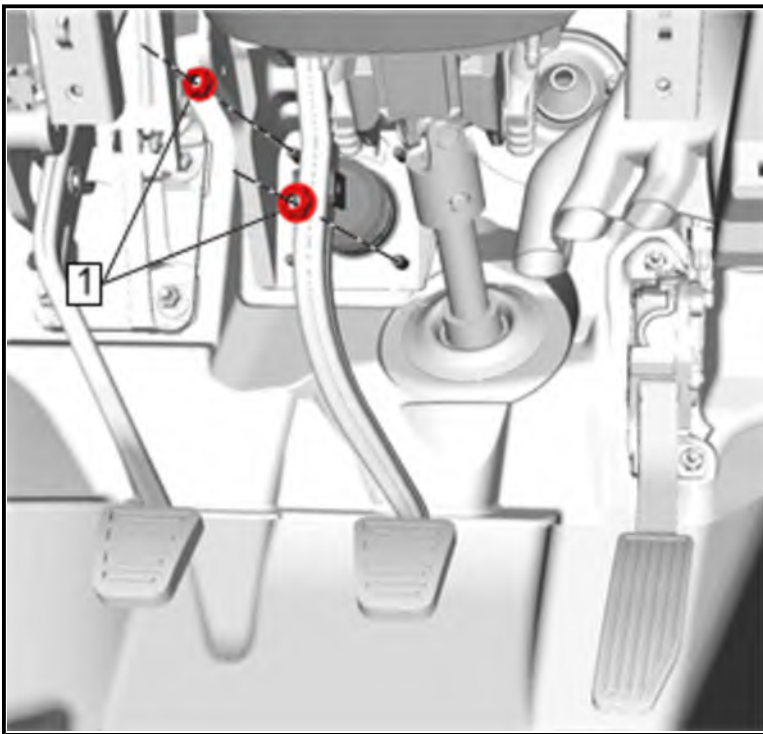


**CAUTION:** Refer to [Fastener Caution](#) .

4. Install the left side lower power brake booster nut (1) and tighten to 23 N.m (17 lb ft).

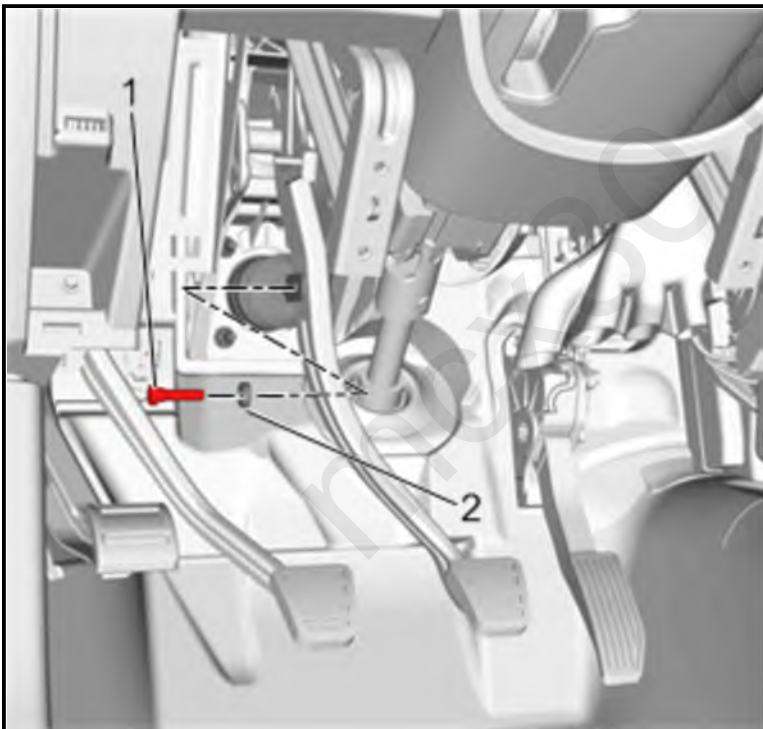


5. Install the left side upper and right side lower power brake booster nuts (1) and tighten to 23 N.m (17 lb ft).



6. Install the brake pedal pushrod to the brake pedal.

7. Install the brake pedal pushrod bolt (1) and bushing (2) and tighten the pushrod bolt to 10 N.m (89 lb in).

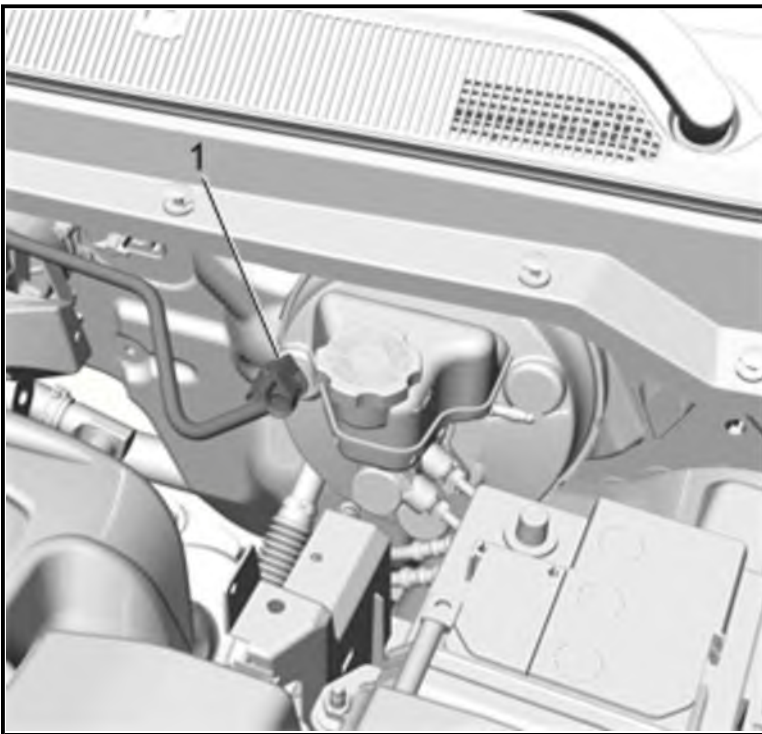


8. Install the brake pedal position sensor. [Brake Pedal Position Sensor Replacement](#)

9. Install the brake master cylinder. [Brake Master Cylinder Replacement](#)

10. Install the battery tray. [Battery Tray Replacement](#)

11. Install the power brake booster vacuum sensor (1) to the power brake booster.



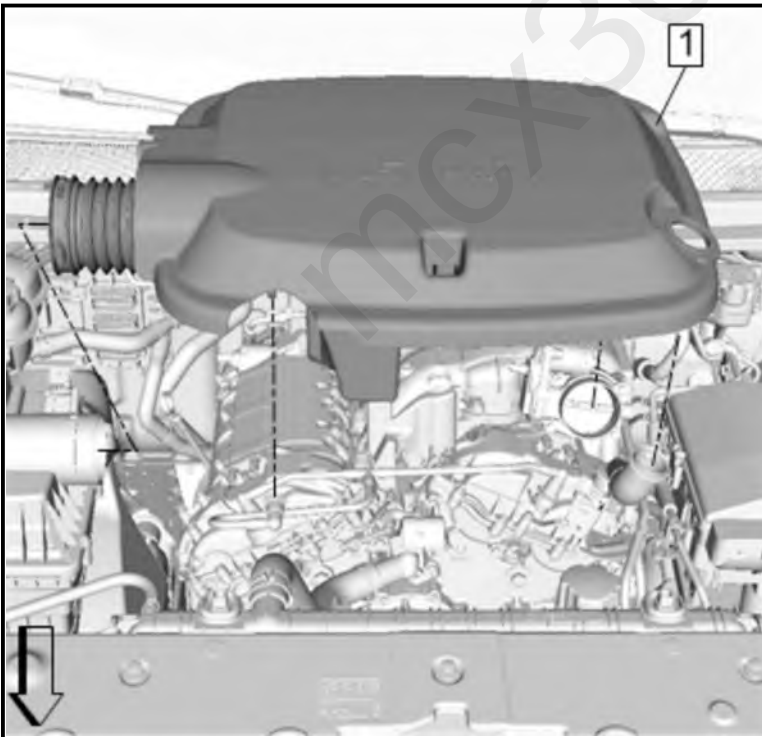
**NOTE:** A small amount of denatured alcohol may be used as a lubricant for assembly.

12. Connect the power brake booster vacuum sensor electrical connector.

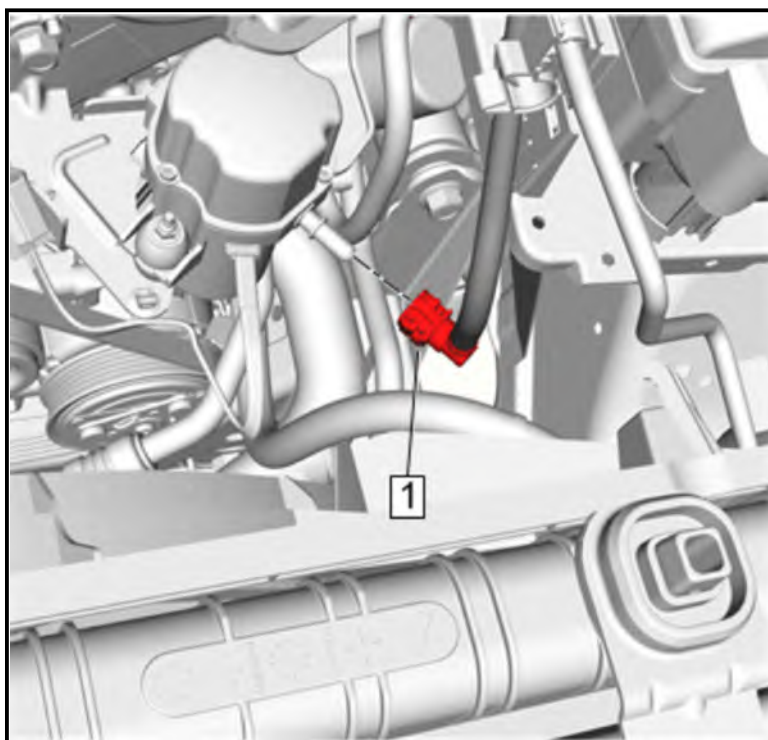
## **POWER BRAKE BOOSTER PUMP REPLACEMENT**

### **Removal Procedure**

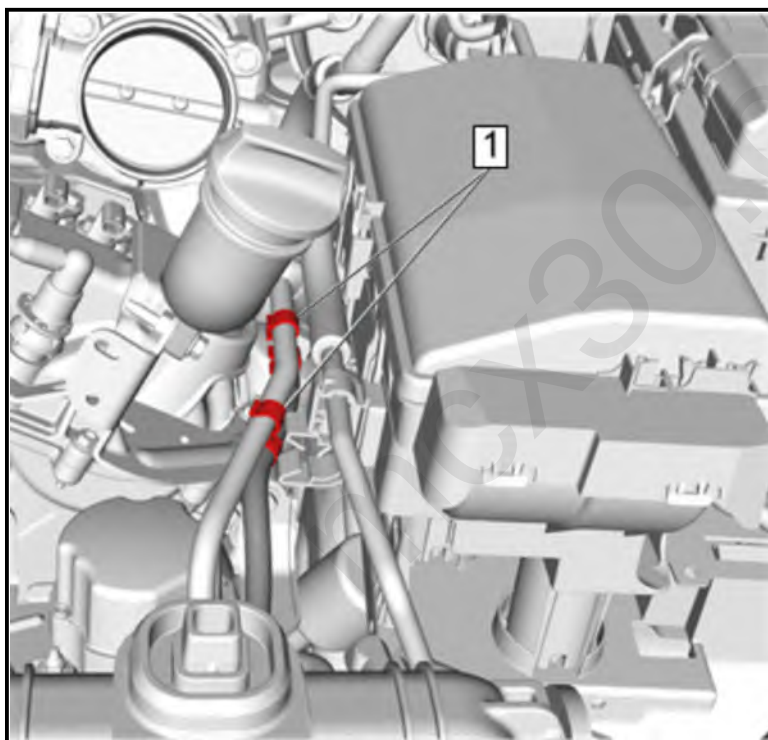
1. Air Cleaner Outlet Duct (1) - Remove - [Air Cleaner Outlet Duct Replacement](#)



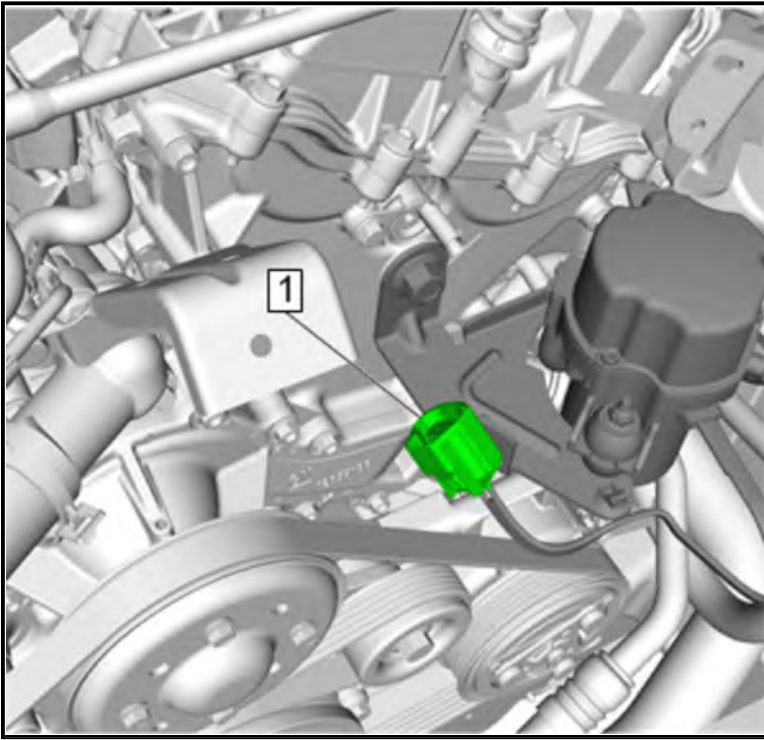
2. Power Brake Booster Vacuum Hose Quick Connect Fitting (1) - Disconnect



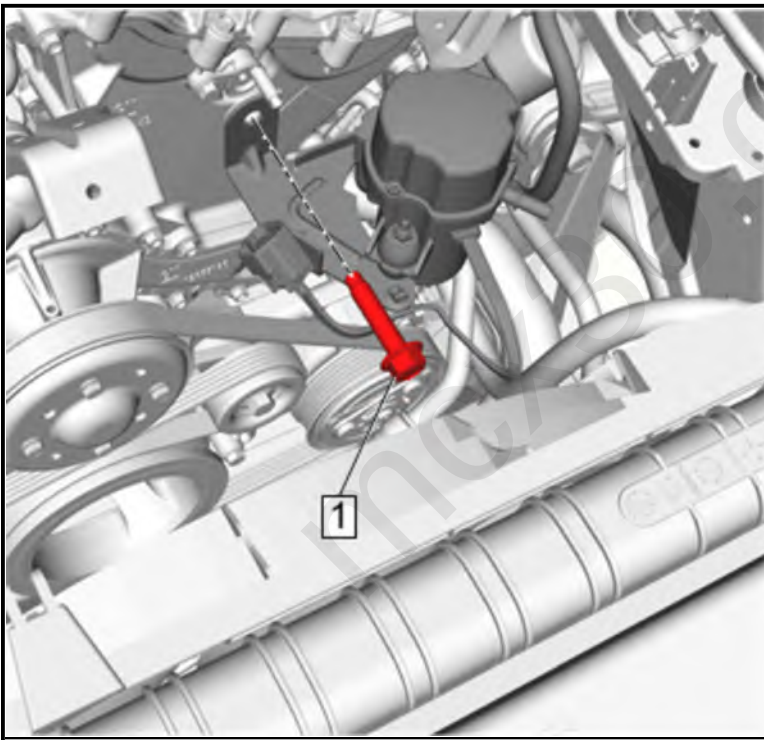
3. Clip (1) @ Power Brake Booster Vacuum Hose - Release [2x]



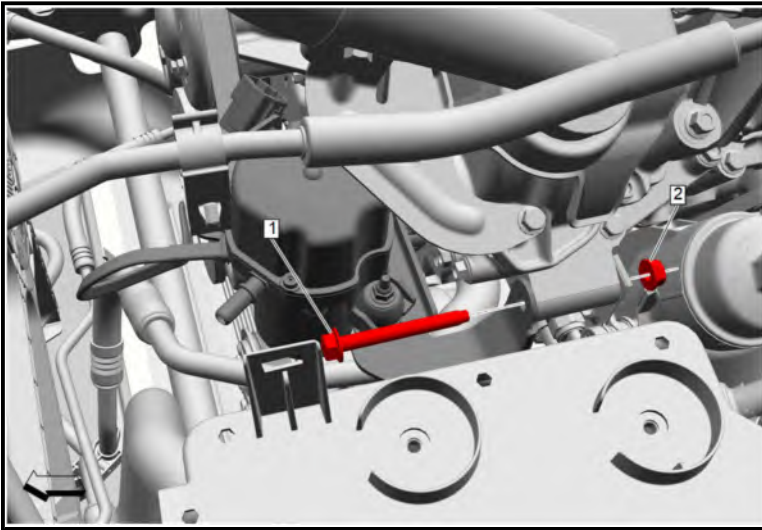
4. Electrical Connector (1) - Disconnect



5. Power Brake Booster Pump M12 Bolt (1) - Remove

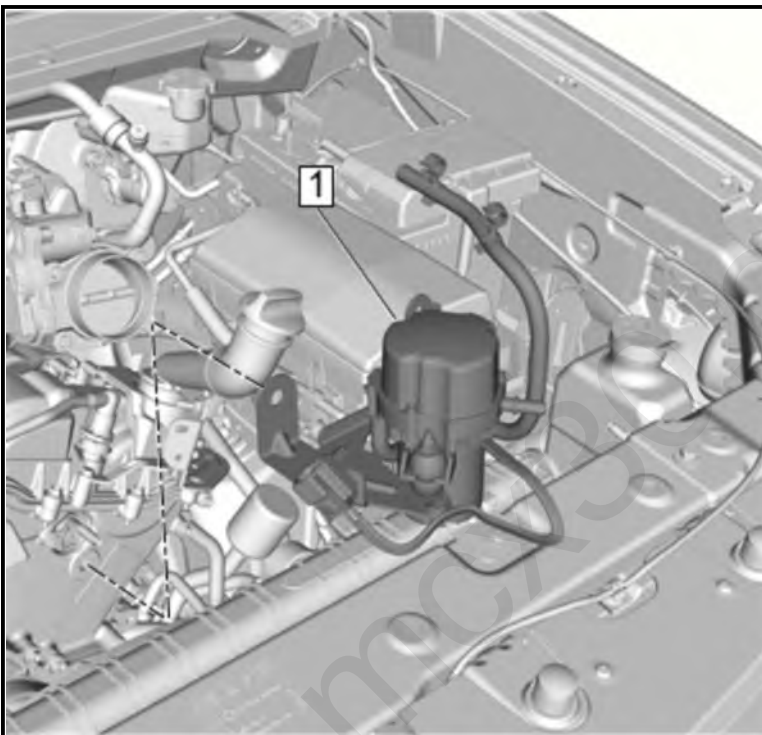


6. Power Brake Booster Pump M8 Bolt (1) - Remove

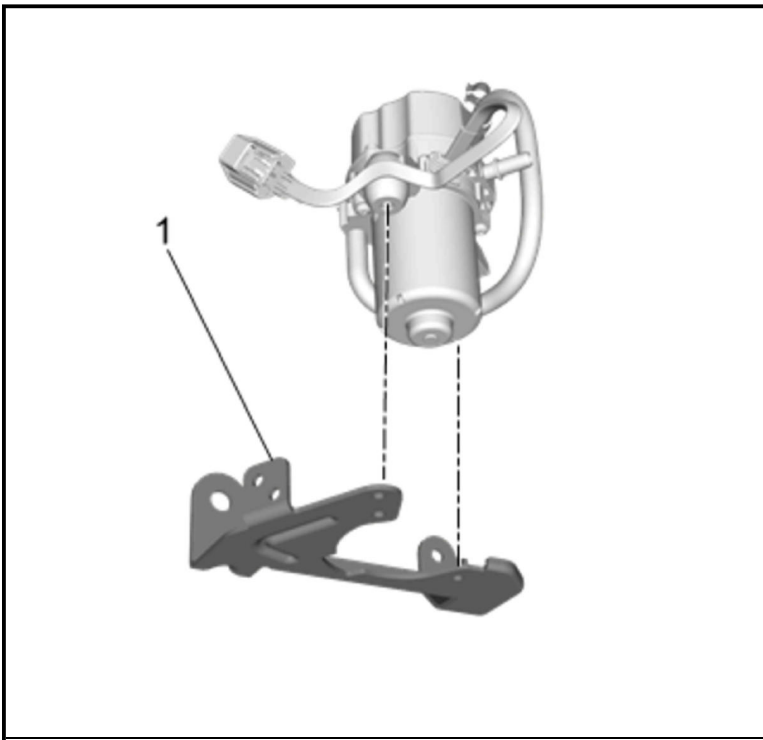


7. Power Brake Booster Pump Bracket Nut (2) - Remove

8. Power Brake Booster Pump (1) - Remove

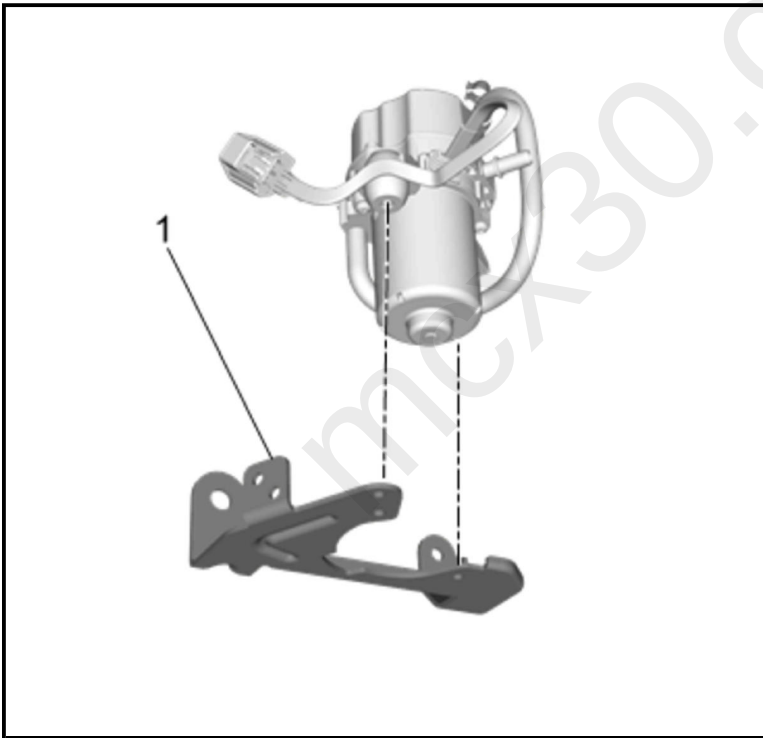


9. Power Brake Booster Pump Bracket (1) - Remove - [Power Brake Booster Pump Bracket Replacement](#)

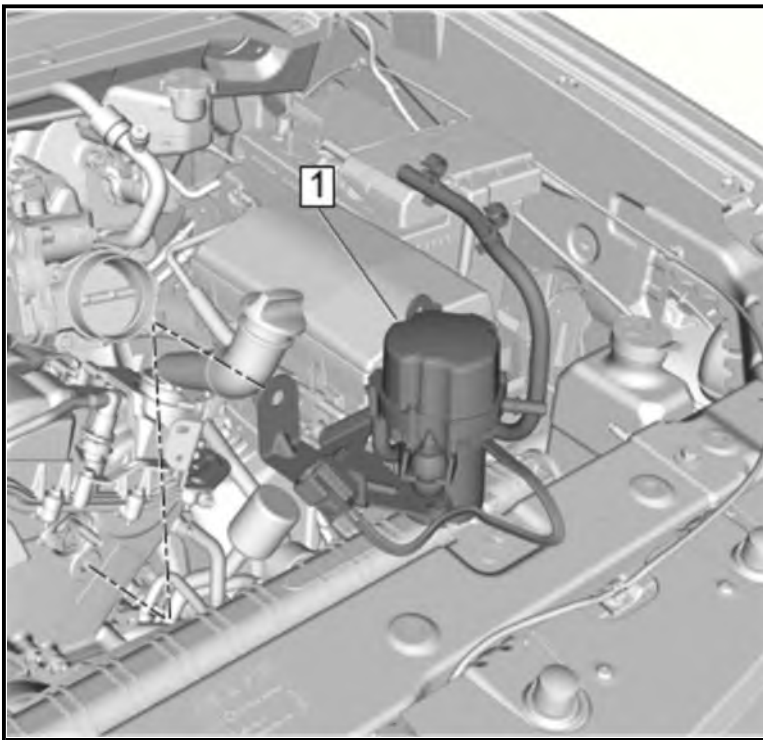


### Installation Procedure

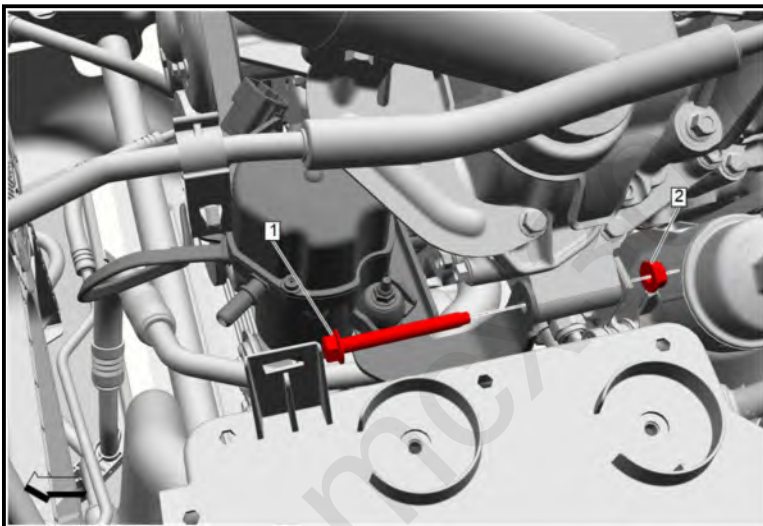
1. Power Brake Booster Pump Bracket (1) - Install - [Power Brake Booster Pump Bracket Replacement](#)



2. Power Brake Booster Pump (1) - Install

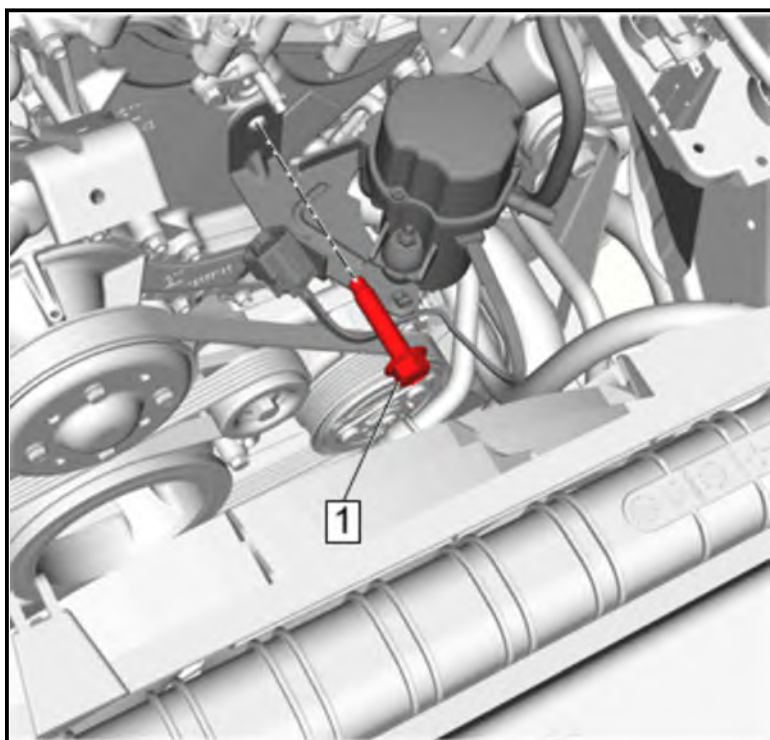


3. Install the power brake booster pump M8 bolt (1) and the power brake booster pump bracket nut (2) and tighten the power brake booster pump M8 bolt (1) to 22 N.m (16 lb ft)

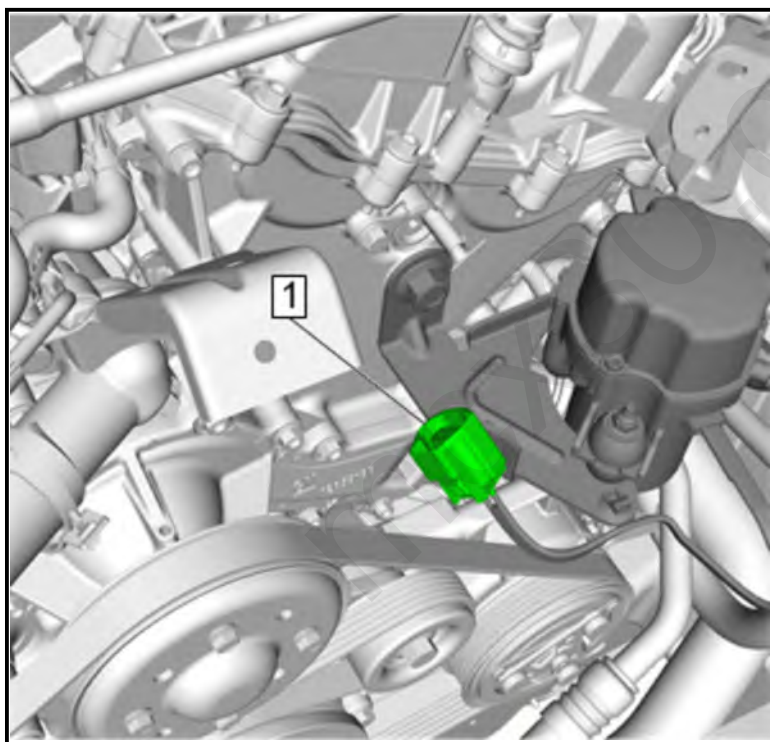


**CAUTION:** Refer to [Fastener Caution](#) .

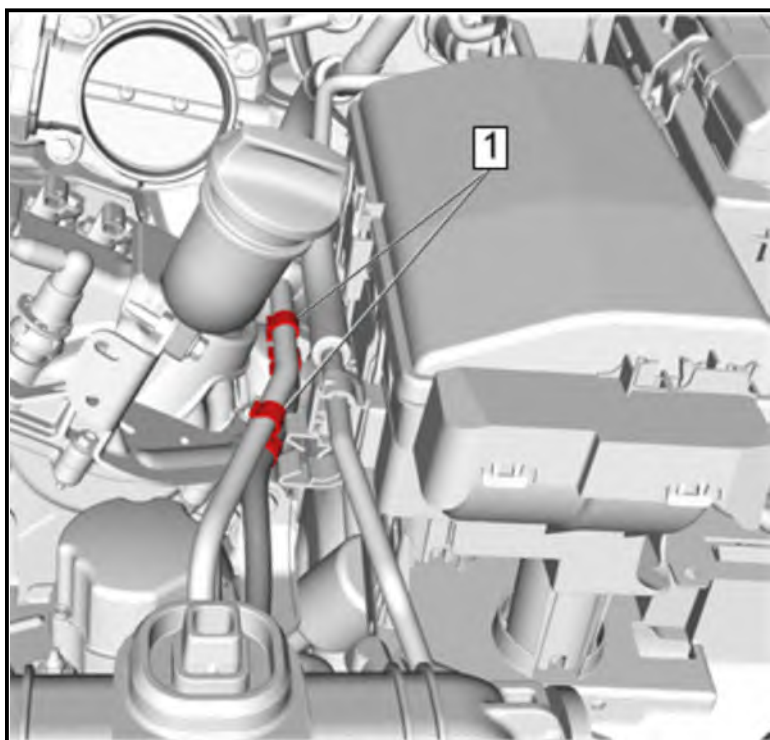
4. Power Brake Booster Pump M12 Bolt (1) - Install and tighten 70 N.m (52 lb ft)



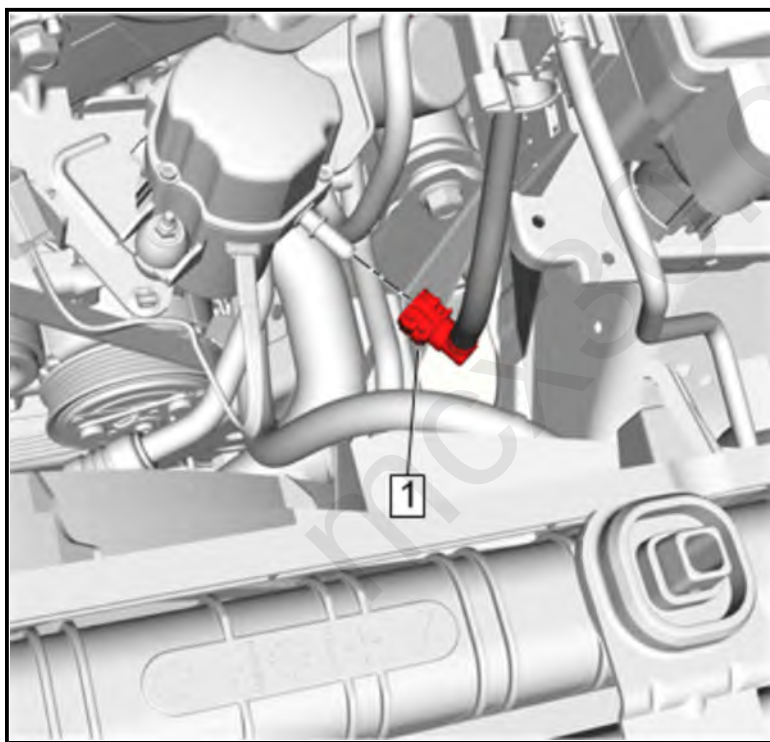
5. Electrical Connector (1) - Connect



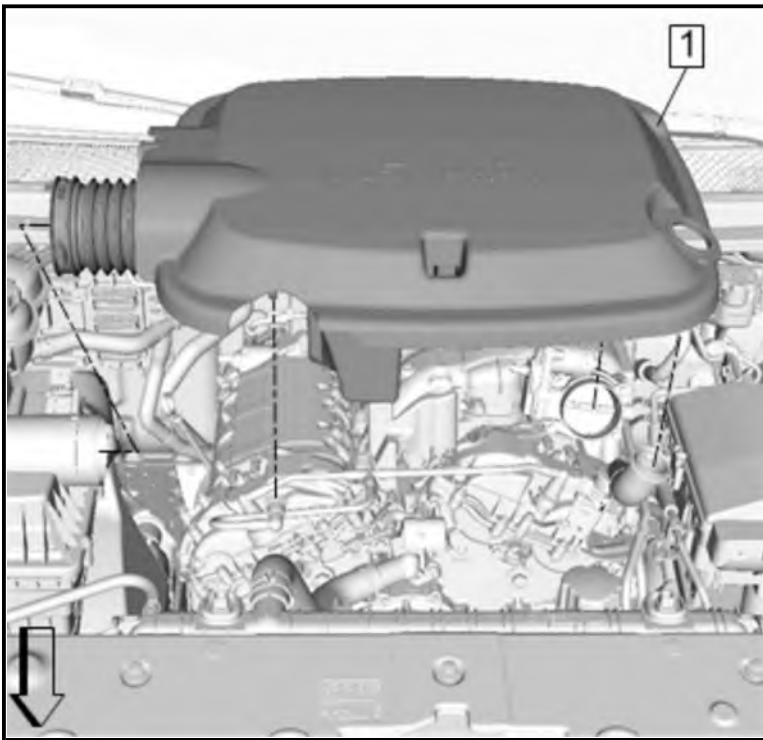
6. Clip (1) @ Power Brake Booster Vacuum Hose - Secure [2x]



7. Power Brake Booster Vacuum Hose Quick Connect Fitting (1) - Connect



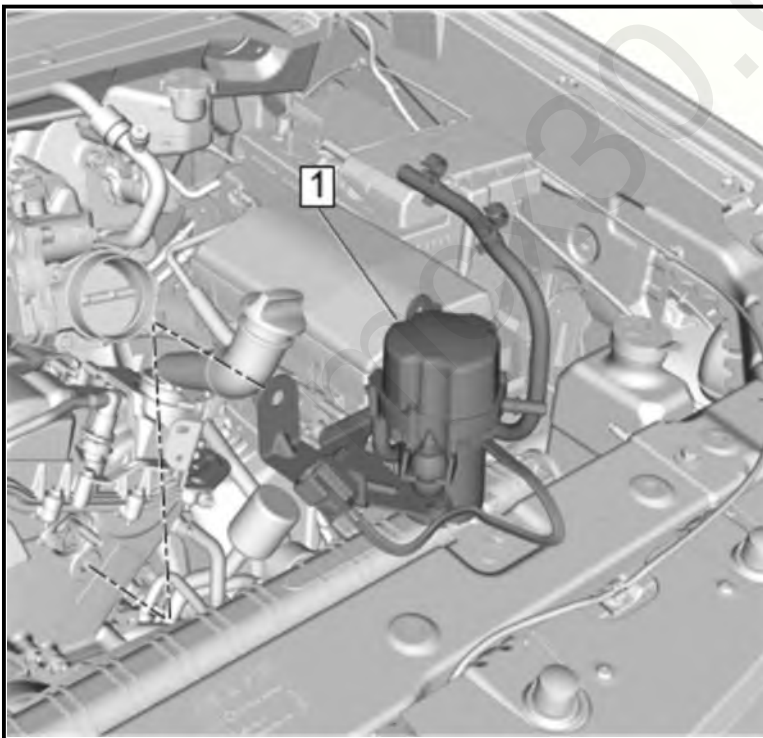
8. Air Cleaner Outlet Duct (1) - Install - [Air Cleaner Outlet Duct Replacement](#)



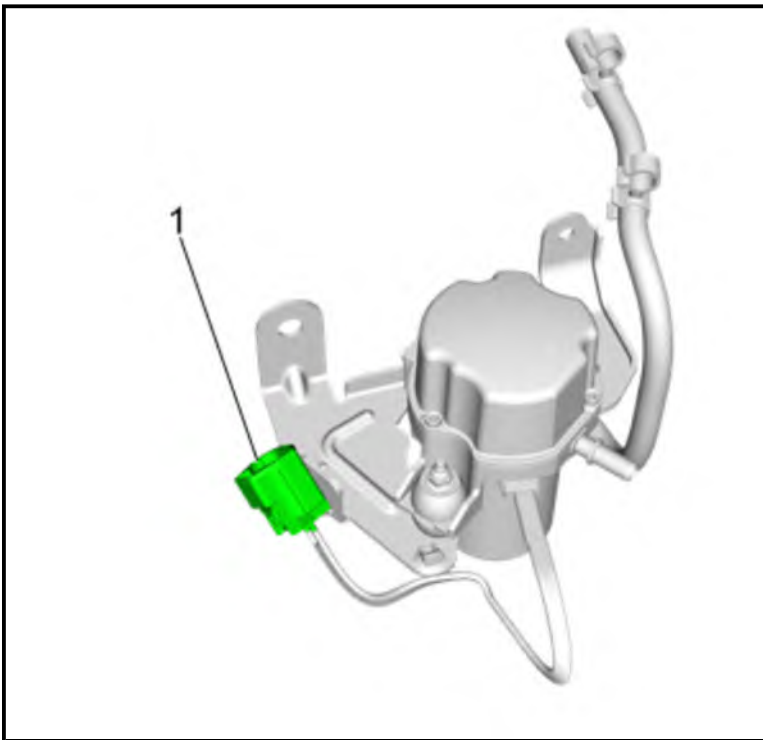
## **POWER BRAKE BOOSTER PUMP BRACKET REPLACEMENT**

### **Removal Procedure**

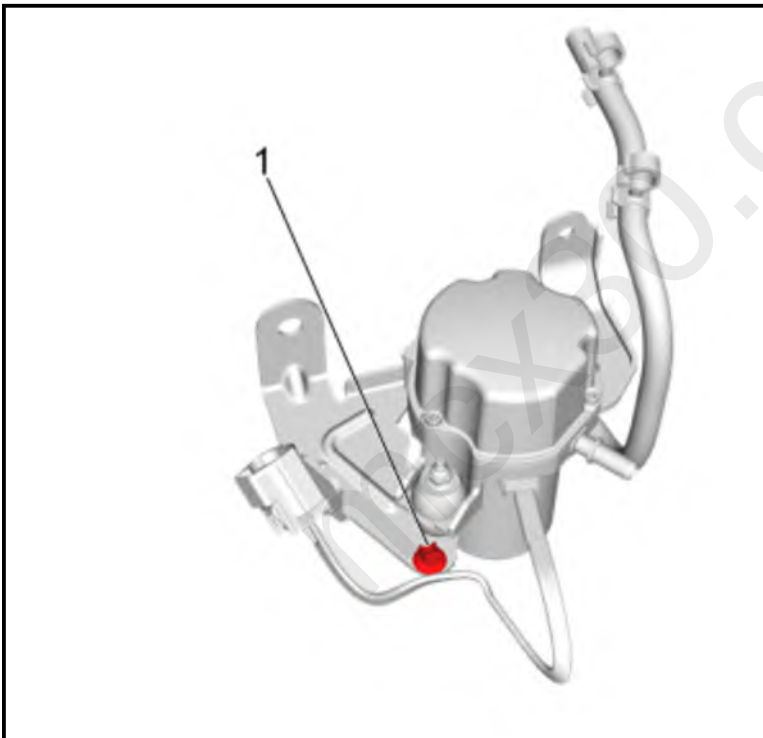
1. Power Brake Booster Pump (1) - Remove - [Power Brake Booster Pump Replacement](#)



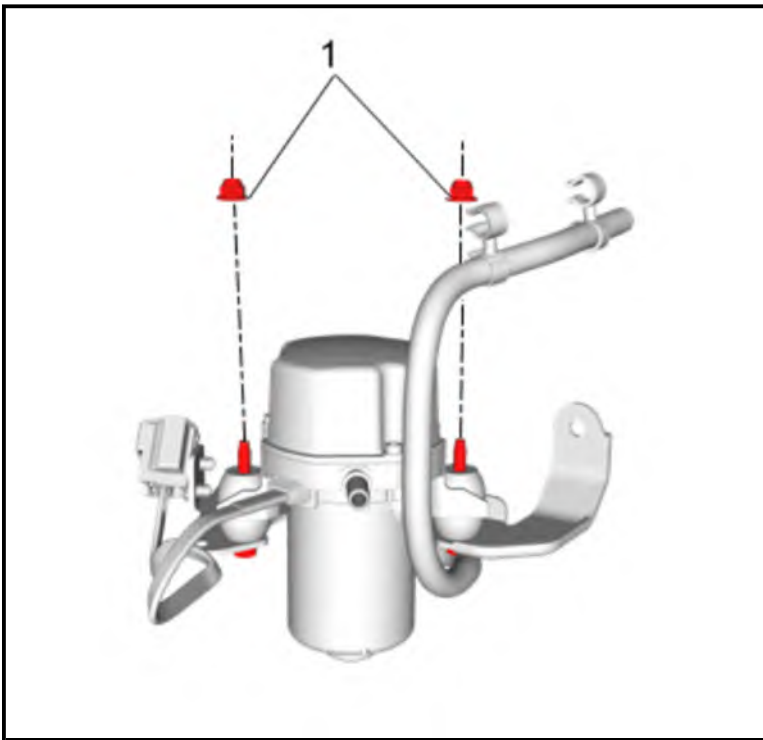
2. Electrical Connector (1) @ Power Brake Booster Pump Bracket - Release



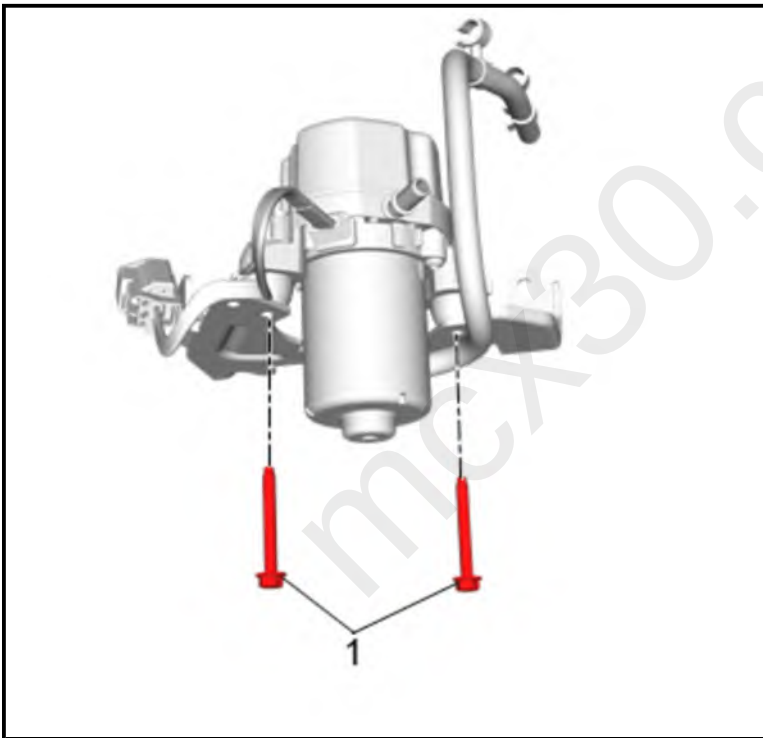
3. Retainer (1) - Release



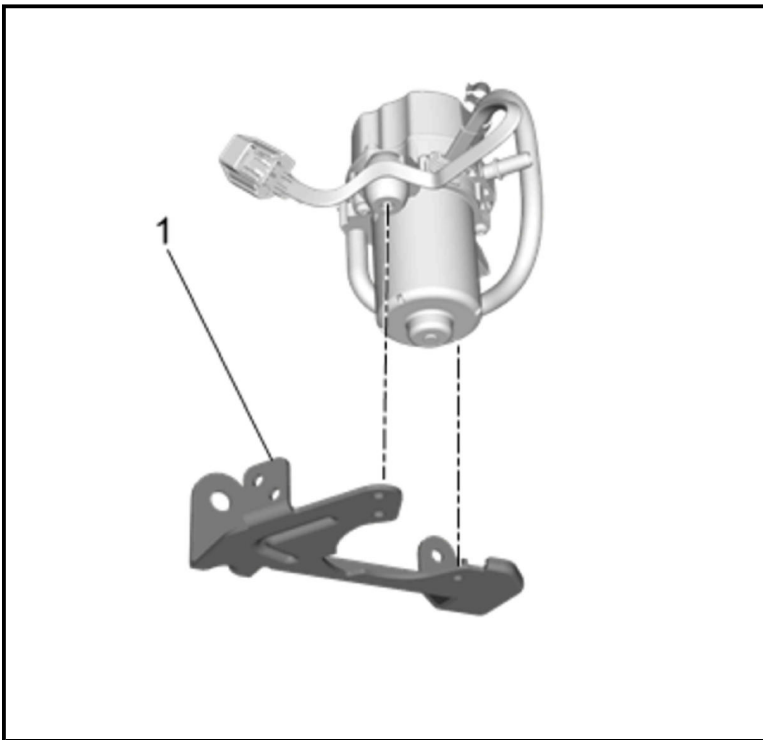
4. Power Brake Booster Pump Bracket Nut (1) - Remove [2x]



5. Power Brake Booster Pump Bracket Bolt (1) - Remove [2x]

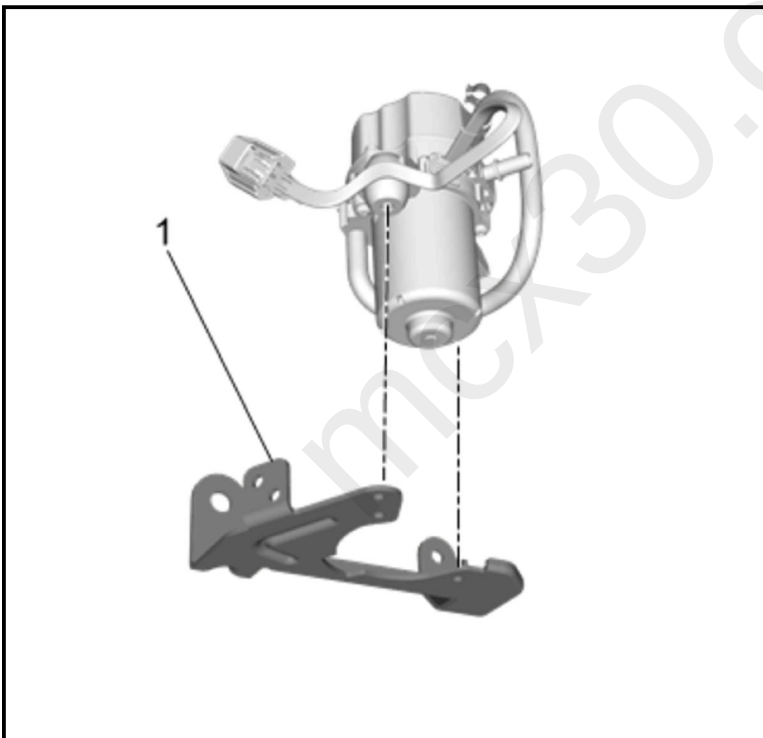


6. Power Brake Booster Pump Bracket (1) - Remove

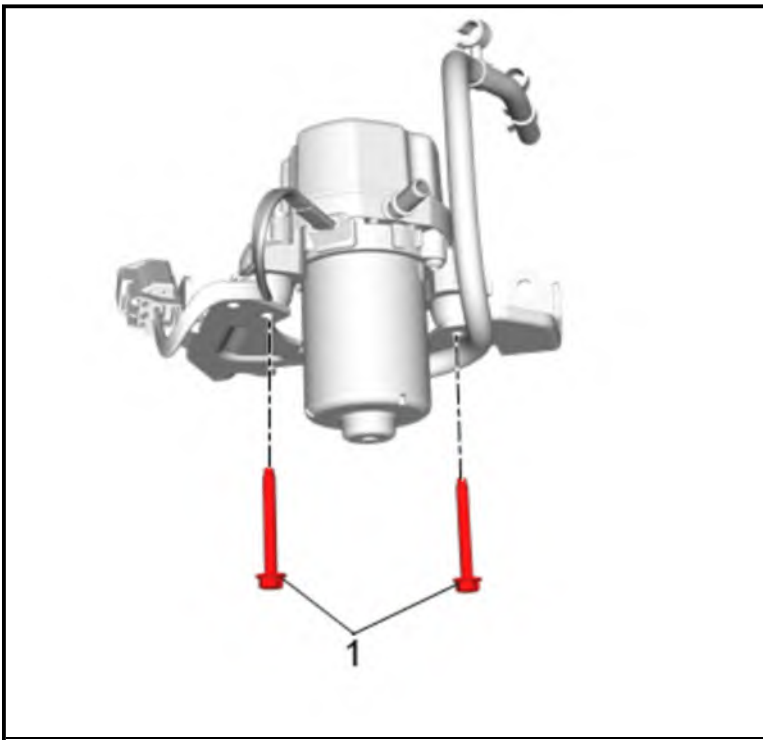


### Installation Procedure

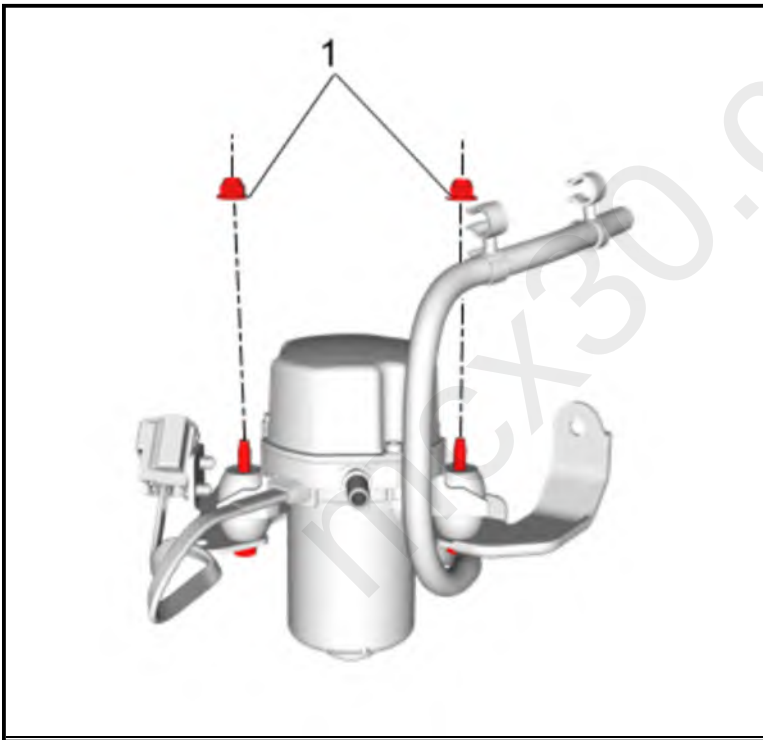
1. Power Brake Booster Pump Bracket (1) - Install



2. Power Brake Booster Pump Bracket Bolt (1) - Install [2x]

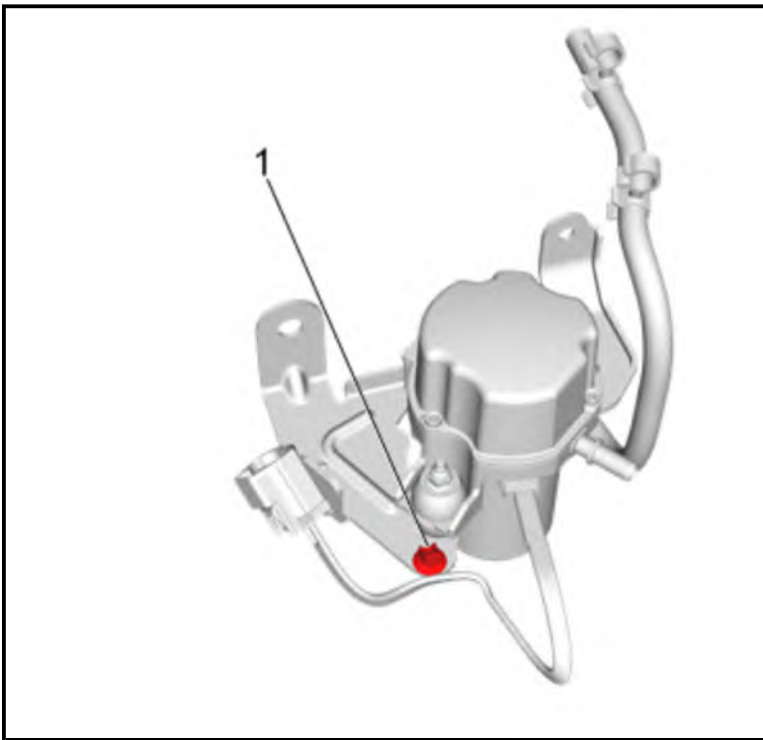


3. Power Brake Booster Pump Bracket Nut (1) - Install and tighten 22 N.m (16 lb ft) [2x]

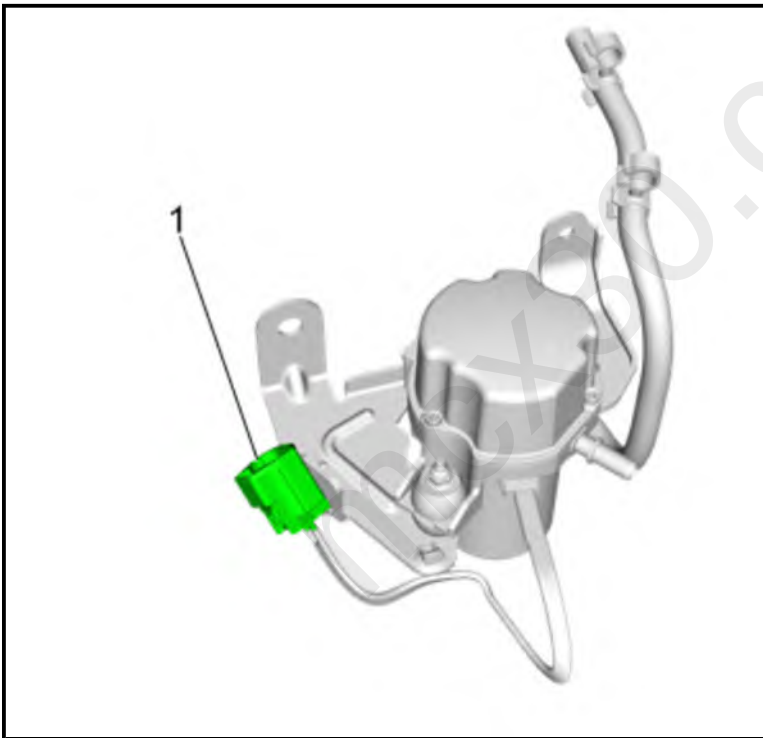


**CAUTION:** Refer to [Fastener Caution](#) .

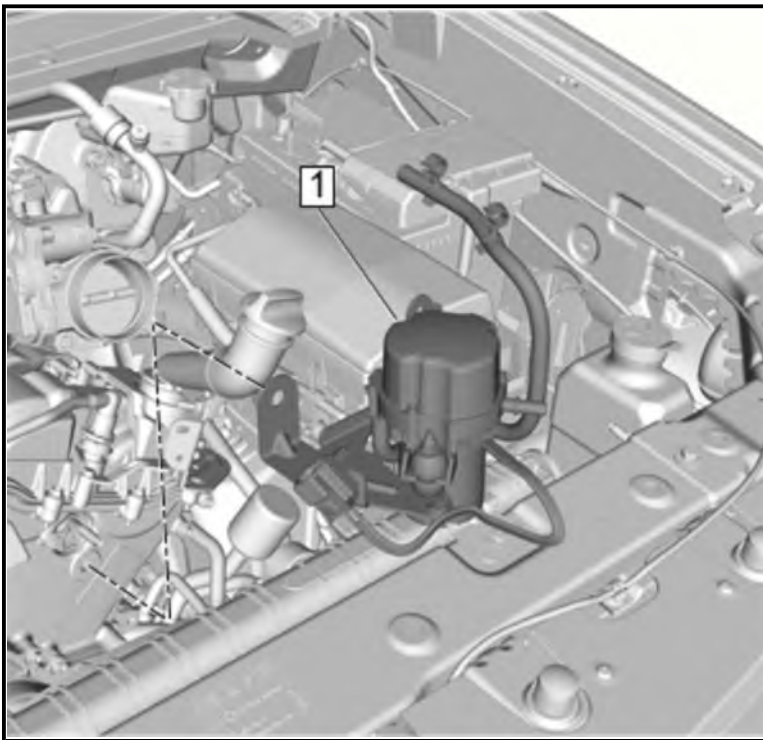
4. Retainer (1) - Install



5. Electrical Connector (1) @ Power Brake Booster Pump Bracket - Secure



6. Power Brake Booster Pump (1) - Install - [Power Brake Booster Pump Replacement](#)



## DESCRIPTION AND OPERATION

### BRAKE ASSIST SYSTEM DESCRIPTION AND OPERATION

#### System Component Description

The brake assist system consists of the following:

##### Brake Pedal

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

##### Brake Pedal Pushrod

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

##### Vacuum Brake Booster

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

##### Vacuum Source

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

##### Vacuum Source Delivery System

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

#### System Operation

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

### BRAKE BOOSTER VACUUM ASSIST DESCRIPTION AND OPERATION

#### Brake Booster Vacuum Assist Block Diagram



**NOTE:** Callouts in the following chart represent components shown in graphic above.

| Callout | Component Name                      |
|---------|-------------------------------------|
| B19B    | B19B Brake Booster Vacuum Sensor    |
| K17     | K17 Electronic Brake Control Module |
| M9      | M9 Brake Booster Pump Motor         |

The brake booster vacuum assist system consists of the following:

**Brake Booster Auxiliary Vacuum Pump (electric or mechanical)**

The brake booster vacuum pump is a secondary vacuum supply to the brake booster used to maintain sufficient vacuum for brake assist.

**Brake Booster Vacuum Sensor**

The vacuum sensor is used to measure the level of vacuum available in the brake booster. The electronic brake control module supplies a 5 V reference and a low reference circuit to the brake booster vacuum sensor. The vacuum sensor is located in the brake booster or vacuum hose. The brake booster vacuum sensor supplies a voltage signal in relation to the pressure in the brake booster to the electronic brake control module.

**Electronic Brake Control Module**

The electronic brake control module monitors the vacuum in the brake booster using the brake booster vacuum sensor. When the vacuum within the system drops the electronic brake control module turns ON the brake booster auxiliary vacuum pump.

**Vacuum Brake Booster**

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 the atmospheric pressure within the booster. The booster uses source vacuum to decrease the effort required by driver when applying the brake.

**Vacuum Source**

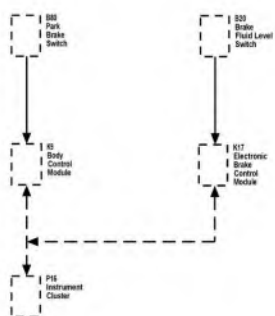
Vacuum is supplied by the engine vacuum or by the brake booster auxiliary vacuum pump (electric or mechanical).

**System Operation**

The electric pump can be switched on and off by the electronic brake control module based on the required vacuum. Pressure variations during braking can be measured, and the pump can be activated to generate additional vacuum if required to increase the braking force.

**BRAKE WARNING SYSTEM DESCRIPTION AND OPERATION**

**Brake Warning System Block Diagram**



| Callout | Component Name                      |
|---------|-------------------------------------|
| B80     | B80 Park Brake Switch               |
| B20     | B20 Brake Fluid Level Switch        |
| K9      | K9 Body Control Module              |
| K17     | K17 Electronic Brake Control Module |
| P16     | P16 Instrument Cluster              |

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 s.
- When the Electronic Brake Control Module (EBCM) detects low brake fluid level it sets DTC C0267 and sends a serial data message to the instrument cluster, which will illuminate the red brake indicator.
- The Body Control Module (BCM) detects that the parking brake is engaged. The instrument cluster receives a serial data message from the BCM requesting illumination.

#### Driver Information Center Messages

When the Electronic Brake Control Module (EBCM) detects low brake fluid level it sets DTC C0267 and sends a serial data message to the Driver Information Center, which will display Brake Fluid Low message.

## 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. Refer to [ABS Description and Operation](#) for specific information on the operation of DRP.

#### Hydraulic Brake Pipes and Flexible Brake Hoses

Carries brake fluid to and from hydraulic brake system components.

### Hydraulic Brake Wheel Apply Components

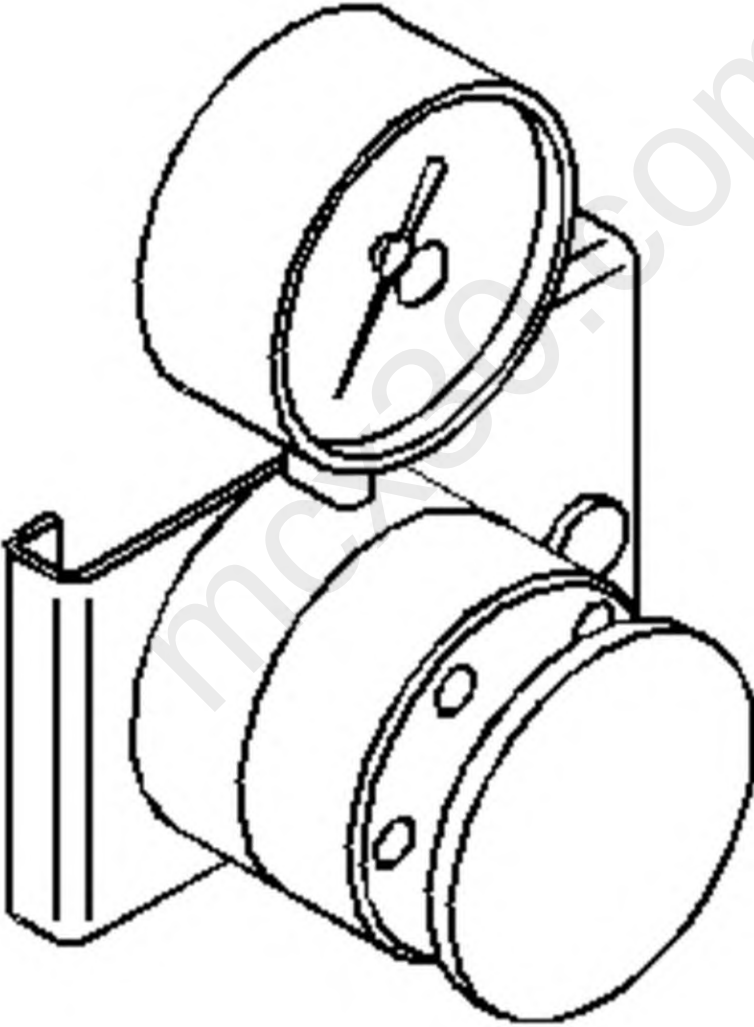
Converts hydraulic input pressure into mechanical output force.

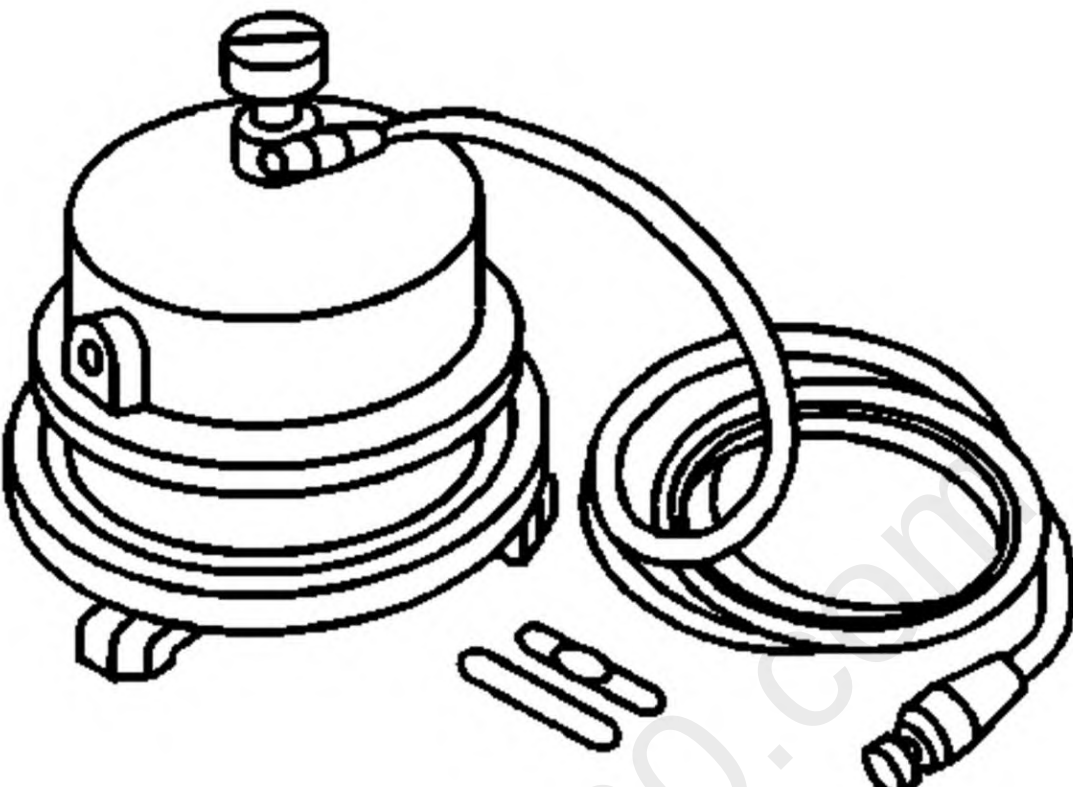
#### System Operation

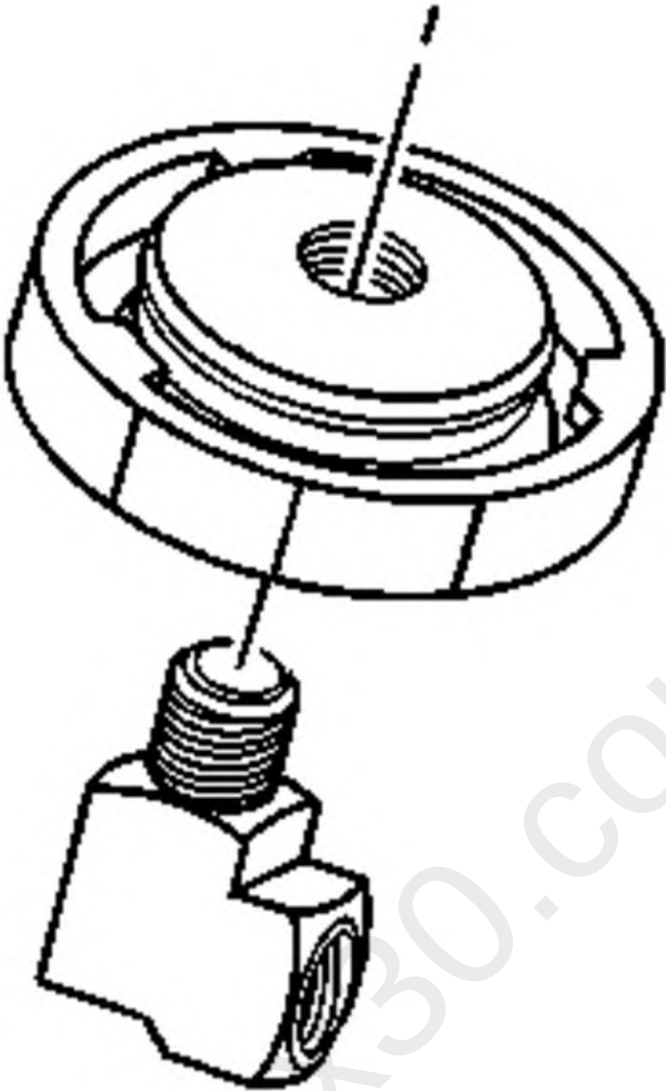
Mechanical force is converted into hydraulic pressure by the master cylinder, regulated to meet braking system demands by the pressure balance control system, and delivered to the hydraulic brake wheel circuits by the pipes and flexible hoses. The wheel apply components then convert the hydraulic pressure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

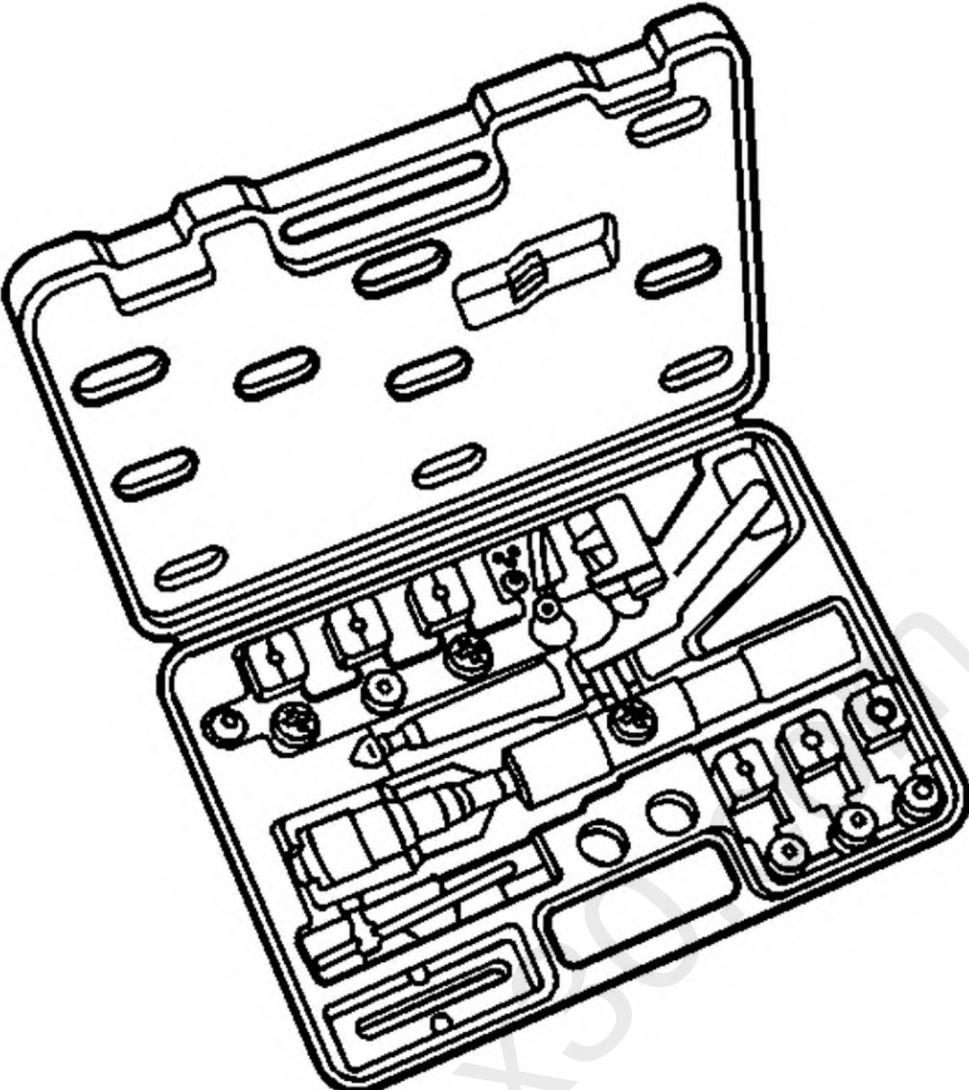
## SPECIAL TOOLS AND EQUIPMENT

### SPECIAL TOOLS

| Illustrations                                                                       | Tool Number/Description                         |
|-------------------------------------------------------------------------------------|-------------------------------------------------|
|  | CH 28662<br>J 28662<br>Brake Pedal Effort Gauge |
|                                                                                     |                                                 |

| Illustrations                                                                                                                                                                                                                                                                                                                                         | Tool<br>Number/Description                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|
|  <p>A line drawing of a pressure brake bleeder tool. The tool has a cylindrical body with a handle on top. A hose is connected to the side of the cylinder, and a coiled hose with a connector at the end is shown next to it. Two small clips are also shown.</p> | <p>CH 29532-A<br/>J 29532-A<br/>Pressure Brake<br/>Bleeder</p> |
|                                                                                                                                                                                                                                                                                                                                                       |                                                                |

| Illustrations                                                                       | Tool<br>Number/Description                                    |
|-------------------------------------------------------------------------------------|---------------------------------------------------------------|
|  | <p>CH 35589-A<br/>J 35589-A<br/>Brake Bleeder<br/>Adapter</p> |
|                                                                                     |                                                               |

| Illustrations                                                                       | Tool<br>Number/Description                                 |
|-------------------------------------------------------------------------------------|------------------------------------------------------------|
|  | <p>CH 45405<br/>J 45405<br/>Brake Pipe Flaring<br/>Kit</p> |