

2017 BRAKES

Hydraulic Brakes - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Non-Threaded Fasteners/Components

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

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: <i>All fasteners listed in this table can be reused after removal.</i>	
Brake Master Cylinder Bolt	22 N.m (16 lb ft)
Brake Master Cylinder Reservoir Pin	7 N.m (62 lb in)
Brake Pedal Nut	22 N.m (16 lb ft)
Brake Pressure Modulator Valve Front Pipe Fitting	25 N.m (18 lb ft)
Brake Pressure Modulator Valve Rear Pipe Fitting	25 N.m (18 lb ft)
Front Brake Hose Fitting Bolt	40 N.m (30 lb ft)
Front Brake Pipe Fitting	18 N.m (13 lb ft)
Rear Brake Hose Fitting Bolt	40 N.m (30 lb ft)
Rear Brake Pipe Fitting	18 N.m (13 lb ft)

APPROXIMATE FLUID CAPACITIES

Application	Specification	
	Metric	US English
Hydraulic Brake System	0.6 L	1.27 pt

BRAKE COMPONENT SPECIFICATIONS

Application	Specification	
	Metric	English
Front Brake Bleeder Valve	10 N.m	89 lb in
Rear Brake Bleeder Valve	13 N.m	115 lb in

BRAKE SYSTEM SPECIFICATIONS

Application	Specification	
	Metric	English
Maximum Brake Master Cylinder (BMC) Primary Piston Travel*	N.A.	N.A.

DTC C0075

Brake Pedal Position Sensor Performance

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

Circuit/System Description

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

Conditions for Running the DTC

Ignition - On/Vehicle - In Service Mode

Conditions for Setting the DTC

Brake Pedal Position Sensor = Out Of Range

Actions Taken When the DTC Sets

Boost/Blending = Not Available

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Schematic Reference

[Hydraulic Brake Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Electrical Information Reference

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

Scan Tool Reference

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

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC C0075 is not set.
 - **If the DTC is set**

Replace the component: K177 Brake Booster Control Module
 - **If the DTC is not set**
3. All OK.

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC C0075 is not set.
 - **If the DTC is set**

1. Perform all necessary programming and setup procedures for the control module: K177 Brake Booster Control Module
 2. Verify the DTC does not set.
 - If the DTC sets - Replace the component: K177 Brake Booster Control Module
 - If the DTC is not set
 3. All OK.
 - **If the DTC is not set**
3. All OK.

Repair Instructions

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

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

DTC C0126: BRAKE FLUID LEVEL SENSOR CIRCUIT

Diagnostic Instructions

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

DTC Descriptor

DTC C0126

Brake Fluid Level Sensor Circuit

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

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	C0267 00	C0126 05	C0126 05	-
Ground	-	C0126 05	-	-

Circuit/System Description

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

Conditions for Running the DTC

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

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hydraulic Brake System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

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

- **If low**

Refer to **Brake Fluid Loss**.

- **If above minimum level**

2. Refer to Circuit/System Testing.

Circuit/System Testing

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

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

- **If 10 Ω or greater**

1. Ignition OFF/Vehicle OFF.

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

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

- **If less than 10 Ω**

3. Ignition ON/Vehicle in Service Mode.

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

- **If the parameter is not OK**

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

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

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K17 Electronic Brake Control Module.

- **If the parameter is OK**

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

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

- **If the parameter is not Low**

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

- **If the parameter is Low**

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

Repair Instructions

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

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

DTC C0267: LOW BRAKE FLUID INDICATED

Diagnostic Instructions

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

DTC Descriptor

DTC C0267

Low Brake Fluid Indicated

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

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	C0267 00	C0126 05	C0126 05	-
Ground	-	C0126 05	-	-

Circuit/System Description

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

Conditions for Running the DTC

Ignition ON/Vehicle in Service Mode.

Conditions for Setting the DTC

Low brake fluid level is detected for 8 s.

Action Taken When the DTC Sets

- The electronic brake control module disables the traction control and stability control for the duration of the ignition cycle.

- The traction control/stability control-active indicator turns ON.
- The brake warning indicator turns ON.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Brake Warning System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that the brake is above minimum level.
 - **If low**
Refer to Brake Fluid Loss.
 - **If above minimum level**
Refer to Circuit/System Testing.

Circuit/System Testing

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

- If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K17 Electronic Brake Control Module.
 - **If the parameter is OK**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and ground.
 6. Verify the scan tool Brake Fluid Level Sensor parameter is Low.
 - **If the parameter is not Low**
 1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V.
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K17 Electronic Brake Control Module.
 - **If the parameter is Low**
 7. Test or replace the B20 Brake Fluid Level Switch.

Repair Instructions

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

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

DTC C029F: BRAKE BOOSTER SYSTEM PERFORMANCE

Diagnostic Instructions

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

DTC Descriptor

DTC C029F

Brake Booster System Performance

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

Circuit/System Description

The brake booster system consists of a motor, electronic control unit (ECU), pedal travel sensor, and a master cylinder. If the electronic brake control module (EBCM) detects a brake booster system condition a DTC will be set.

Conditions for Running the DTC

Vehicle ON.

Conditions for Setting the DTC

The device has detected an internal malfunction

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hydraulic Brake System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode
2. Verify no other DTCs are set.
 - **If a DTC is set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no DTCs are set**
3. Replace K177 Brake Booster Control Module.

Repair Instructions

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

- Refer to **Control Module References** for control module replacement, programming and setup

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

Diagnostic Instructions

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

DTC Descriptor

DTC C0579

Brake Booster Control Module Temperature Sensor 2 Circuit Low Voltage

DTC C057A

DTC C057E

Brake Booster Control Module Temperature Sensor 1-2 Correlation

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

Circuit/System Description

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

Conditions for Running the DTC

Ignition - On/Vehicle - In Service Mode

Conditions for Setting the DTC

Brake Booster Temperature = Out Of Range

Actions Taken When the DTC Sets

Boost = Full

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Schematic Reference

[Hydraulic Brake Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Electrical Information Reference

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

Scan Tool Reference

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

Circuit/System Verification

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

3. All OK.

Repair Instructions

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

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

DTC C057F, C0582, C058A, C0590, C0591, C0595, C0596, OR C1275-C1277: BRAKE BOOSTER MOTOR/BRAKE BOOSTER CONTROL MODULE/BRAKE BOOSTER ROTOR POSITION SENSOR

Diagnostic Instructions

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

DTC Descriptor

DTC C057F

Brake Booster Motor 1 Phase U-V-W Circuit

DTC C0582

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

DTC C058A

Brake Booster Motor 1 Position Sensor Circuit Performance

DTC C0590

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

DTC C0591

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

DTC C0595

Brake Booster Control Module Internal Driver Performance

DTC C0596

Brake Booster Motor 1 Current Sensor Circuit Performance

DTC C1275

Brake Booster Rotor Position Sensor Unexpected Reset

DTC C1276

Brake Booster Rotor Position Sensor Message Counter Incorrect

DTC C1277

Brake Booster Rotor Position Sensor Configuration Error

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

Circuit/System Description

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

Conditions for Running the DTC

C057F, C0582, C0590, or C0591

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

C058A, C0595, C0596, C1275, C1276, or C1277

- Ignition ON/Vehicle in Service Mode.

Conditions for Setting the DTC

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

- The device has detected an internal malfunction

Action Taken When the DTC Sets

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

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

Conditions for Clearing the DTC

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

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

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hydraulic Brake System Description and Operation

Electrical Information Reference

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

Scan Tool Reference

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

Circuit/System Verification

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

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

- If DTCs U3001, U3007, U3018, U3019, U3501-U3509, or U350A is not set

3. Replace K177 Brake Booster Control Module.

Repair Instructions

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

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

DTC C0580 OR C0594: BRAKE BOOSTER MOTOR 1

Diagnostic Instructions

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

DTC Descriptor

DTC C0580

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

DTC C0594

Brake Booster Motor 1 Performance

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

Circuit/System Description

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

Conditions for Running the DTC

Ignition ON/Vehicle in Service Mode.

Conditions for Setting the DTC

The device has detected an internal malfunction

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

[Hydraulic Brake Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

Hydraulic Brake System Description and Operation

Electrical Information Reference

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

Scan Tool Reference

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

Circuit/System Verification

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

Repair Instructions

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

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

DTC C1278 OR C1279: BRAKE SYSTEM DATA 1/2 MESSAGE COUNTER INCORRECT

Diagnostic Instructions

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

DTC Descriptor

DTC C1278

Brake System Data 1 Message Counter Incorrect

DTC C1279

Brake System Data 2 Message Counter Incorrect

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

Circuit/System Description

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

Conditions for Running the DTC

Ignition - On/Vehicle - In Service Mode

Conditions for Setting the DTC

K177 Brake Booster Control Module = Internal Malfunction

Actions Taken When the DTC Sets

Boost = Full

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

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

Repair Instructions

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

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

DTC C1449: SYSTEM CONFIGURATION ERROR

Diagnostic Instructions

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

DTC Descriptor

DTC C1449

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

Circuit/System Description

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

Conditions for Running the DTC

Ignition - On/Vehicle - In Service Mode

Conditions for Setting the DTC

K177 Brake Booster Control Module = Internal Malfunction

Actions Taken When the DTC Sets

Boost/Blending = Not Available

Brake System Warning Indicator = ON

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Schematic Reference

[Hydraulic Brake Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Electrical Information Reference

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

Scan Tool Reference

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

Circuit/System Verification

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

Repair Instructions

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

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

DTC P057B-P057E, P05DC-P05DE, OR P05E0: BRAKE PEDAL POSITION SENSOR

Diagnostic Instructions

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

DTC Descriptor

DTC P057B

Brake Pedal Position Sensor 1 Performance

DTC P057C

Brake Pedal Position Sensor Circuit Low Voltage

DTC P057D

Brake Pedal Position Sensor 1 Circuit High Voltage

DTC P057E

Brake Pedal Position Sensor Circuit Erratic

DTC P05DC

Brake Pedal Position Sensor "B" Circuit Range/Performance

DTC P05DD

Brake Pedal Position Sensor 2 Circuit Low Voltage

DTC P05DE

Brake Pedal Position Sensor 2 Circuit High Voltage

DTC P05DF

Brake Pedal Position Sensor 2 Circuit Erratic

DTC P05E0

Brake Pedal Position Sensors 1-2 Not Plausible

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

Diagnostic Fault Information

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

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Low Reference	-	P057C, P05DE	-	-

Circuit/System Description

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

Conditions for Running the DTC

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

- Ignition ON/Vehicle in Service Mode.

Conditions for Setting the DTC

P057B

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

P057E

Brake pedal position sensor 1 erratic signal

P057C

Brake pedal position sensor 1 signal shorted to ground

P057D

Brake pedal position sensor 1 signal shorted to voltage

P05DC

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

P05DD

Brake pedal position sensor 2 signal shorted to ground

P05DE

Brake pedal position sensor 2 signal shorted to voltage

P05DF

Brake pedal position sensor 2 erratic signal

P05E0

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

Action Taken When the DTC Sets

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

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

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Diagnostic Aids

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

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hydraulic Brake System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B201 Brake Control Brake Pedal Position Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 3 and ground.
 - **If 10 Ω or greater**
 1. Disconnect the harness connector at the K177 Brake Booster Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K177 Brake Booster Control Module.
 - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 1 and ground.
 - **If less than 4.8 V**
 1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster Control Module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K177 Brake Booster Control Module.
 - **If greater than 5.2 V**

1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster Control Module, Ignition ON/Vehicle in Service Mode.
2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K177 Brake Booster Control Module.
- **If between 4.8 - 5.2 V**
5. Test for less than 1 V between the B201 Brake Control Brake Pedal Position Sensor signal circuit terminal 2 and ground.
 - **If greater than 1 V**
 1. Ignition OFF/Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K177 Brake Booster Control Module.
 - **If less than 1 V**
6. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster Control Module.
7. Test for infinite resistance between the B201 Brake Control Brake Pedal Position Sensor signal circuit terminal 2 and ground.
 - **If less than infinite resistance**

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

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

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

Repair the open/high resistance in the circuit.

- If less than 2 Ω

13. Replace the K177 Brake Booster Control Module.

Repair Instructions

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

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

DTC P0601, P0603, P0604, P0606, P060B, OR P062F: CONTROL MODULE

Diagnostic Instructions

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

DTC Descriptor

DTC P0601

Control Module Read Only Memory Performance

DTC P0603

Control Module Long Term Memory Reset

DTC P0604

Control Module Random Access Memory Performance

DTC P0606

Control Module Processor Performance

DTC P060B

Control Module Analog to Digital Converter Performance

DTC P062F

Control Module Long Term Memory Performance

Circuit/System Description

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

Conditions for Running the DTC

Ignition - On/Vehicle - In Service Mode

Conditions for Setting the DTC

K177 Brake Booster Control Module = Internal Malfunction

Actions Taken When the DTC Sets

Brake System Warning Indicator = ON

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

A history DTC will clear after 40 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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

Scan Tool Reference

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

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC P0601, P0603, P0604, P0606, P060B, P062F is not set.
 - **If the DTC is set**
 1. Perform all necessary programming and setup procedures for the control module: K177 Brake Booster Control Module
 2. Verify the DTC does not set.
 - If the DTC sets - Replace the component: K177 Brake Booster Control Module
 - If the DTC is not set
 3. All OK.
 - **If the DTC is not set**
3. All OK.

Repair Instructions

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

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

DTC P0642, P06A6, OR P06A7: SENSOR REFERENCE VOLTAGE

Diagnostic Instructions

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

DTC Descriptor

DTC P0642

Sensor Reference Voltage 1 Low Voltage

DTC P06A6

Sensor Reference Voltage 1 Performance

DTC P06A7

Sensor Reference Voltage 2 Performance

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

Diagnostic Fault Information

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

Circuit/System Description

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

Conditions for Running the DTC

Ignition ON/Vehicle in Service Mode.

Conditions for Setting the DTC

Pedal travel sensor voltage supply failure

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hydraulic Brake System Description and Operation

Electrical Information Reference

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

Scan Tool Reference

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

Circuit/System Testing

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

Repair Instructions

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

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

DTC P25C6 OR P25C7: BRAKE BOOSTER TEMPERATURE SENSOR CIRCUIT

Diagnostic Instructions

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

DTC Descriptor

DTC P25C6

Brake Booster Temperature Sensor Circuit Low Voltage

DTC P25C7

Brake Booster Temperature Sensor 1 Circuit High Voltage

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

Circuit/System Description

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

Conditions for Running the DTC

Ignition - On/Vehicle - In Service Mode

Conditions for Setting the DTC

Brake Booster Control Module Temperature = Out Of Range

Actions Taken When the DTC Sets

Boost = Full

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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

Scan Tool Reference

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

Circuit/System Verification

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

Repair Instructions

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

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

SYMPTOMS - HYDRAULIC BRAKES

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.
 - **Power Brake Booster Description and Operation**
 - **Brake Warning System Description and Operation**
 - **Hydraulic Brake 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

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

- **Brake Warning Indicator Malfunction**
- **Brake Pulsation**
- **Brake System Noise**
- **Braking Action Uneven - Pulls to One Side**
- **Braking Action Uneven - Front to Rear**
- **Brake Pedal Excessive Travel**
- **Brake Pedal Excessive Effort**
- **Brakes Drag**
- **Brake System Slow Release**
- **Brake Fluid Loss**

BRAKE WARNING INDICATOR MALFUNCTION

Diagnostic Instructions

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

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	C0267 00	C0267 05	C0267 05	-
Ground	-	C0267 05	-	-

Circuit/System Description

The electronic brake control module monitors the brake fluid level in the brake fluid reservoir. When the fluid within the brake fluid reservoir is below the MIN level, contacts within the brake fluid level switch closes causing the voltage within the signal circuit to drop. The electronic brake control module will

detect the voltage drop and will send a serial data message to the instrument cluster commanding the brake warning indicator to illuminate.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Brake Warning System Description and Operation

Electrical Information Reference

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

Scan Tool Reference

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

Circuit/System Verification

1. Verify that the brake fluid level is above the minimum level.
 - **If low**
Refer to [Brake Fluid Loss](#).
 - **If above minimum level**
2. Ignition ON.
3. Verify the scan tool Brake Fluid Level Sensor parameter is OK.
 - **If the parameter is Low**
Refer to Circuit/System Testing
 - **If the parameter is Ok**
4. Verify the brake warning indicator turns ON and OFF when commanding the Instrument Cluster All Indicators On and Off with a scan tool.
 - **If the brake warning indicator does not turn ON and OFF**
Replace the P16 Instrument Cluster.
 - **If the brake warning indicator turns ON and OFF**
5. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B20 Brake Fluid Level Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 2 (or B) and ground.
 - **If 10 Ω or greater**
 1. Ignition OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Ignition ON.
 4. Verify the scan tool Brake Fluid Level Sensor parameter is 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 1 (or A) and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K17 Electronic Brake Control Module.
 - **If the parameter is OK**
 5. Install a 3 A fused jumper wire between the signal circuit terminal 1 (or A) and ground.
 6. Verify the scan tool Brake Fluid Level Sensor parameter is Low.
 - **If the parameter is OK**
 1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V.
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K17 Electronic Brake Control Module.
 - **If the parameter is Low**
 7. Test or replace the B20 Brake Fluid Level Switch.

Repair Instructions

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

- Refer to [Brake Fluid Level Indicator Switch Replacement](#)
- Refer to [Control Module References](#) for electronic brake control module 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 Step 2	Go to Symptoms - Hydraulic Brakes

Step	Action	Yes	No
2	- Inspect the disc brake system for the following conditions. - Excessive thickness variation of rotor friction surfaces - Excessive assembled lateral runout (LRO) of rotor friction surfaces - Hard spots, heat checks, bluing discoloration of rotor friction surfaces; possibly due to brake drag - Excessive corrosion of rotor friction surfaces; including red, gray or black oxidation - Loose, damaged or missing caliper or lining hardware - Bent or damaged caliper or mounting component - Excessive LRO of wheel hub/axle flange; due to damage and/or loose or excessively worn bearings - Perform the disc brake system diagnostic procedure. Refer to Disc Brake System Diagnosis - Adjust, repair or replace components as necessary. Did you find and correct a condition?	Go to Step 3	Go to Symptoms - Hydraulic Brakes
3	- Install or connect components that were removed or disconnected during diagnosis. - Road test the vehicle in order to confirm proper operation. Refer to Brake System Vehicle Road Test Is the condition still present?	Go to Step 2	System OK

BRAKE SYSTEM 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 Diagnostic Starting Point - Vehicle

Step	Action	Yes	No
2	1. Inspect the disc brake system for the following conditions. • Lining wear indicator contact with rotor • Debris trapped between rotor and splash shield or backing plate; and/or debris trapped between rotor and linings • Contaminated linings • Aftermarket linings • Glazed linings • Distorted, cracked or damaged linings • Excessively worn linings • Damaged or excessively worn caliper hardware and/or lining hardware • Incorrectly installed, loose or missing caliper hardware and/or lining hardware • Lack of lubrication or excessive corrosion on metal to metal contact surfaces • Bent or damaged splash shield or backing plate • Hard spots, heat checks, blueing discoloration of rotor friction surfaces • Glazed rotor friction surfaces • Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. Refer to Disc Brake System Diagnosis Did you find and correct a condition?	Go to Step 6	Go to Step 3
3	1. Inspect the brake apply system for the following conditions. • Lack of lubrication or excessively worn pushrod or pedal pivots or pivot bushings • Bent or damaged pedal pushrod, pedal, or pedal bracket 2. Adjust, repair or replace components as necessary. Refer to Hydraulic Brake System Diagnosis Did you find and correct a condition?	Go to Step 6	Go to Step 4

Step	Action	Yes	No
4	1. Inspect the hydraulic brake system for the following conditions. • Improper operation of caliper pistons • Contaminated brake fluid 2. Adjust, repair or replace components as necessary. Refer to Hydraulic Brake System Diagnosis Did you find and correct a condition?	Go to Step 6	Go to Step 5
5	Inspect the park brake system for proper operation. Refer to Park Brake System Diagnosis Did you find and correct a condition?	Go to Step 6	Go to Diagnostic Starting Point - Vehicle
6	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to Brake System Vehicle Road Test Is the condition still present?	Go to Step 2	System OK

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 Diagnostic Starting Point - Vehicle
2	1. Inspect the hydraulic brake system for the following conditions. • Kinked, pinched or damaged brake pipe or flexible brake hose • Sticking or improperly operating caliper piston • Brake fluid leak 2. Adjust, repair or replace components as necessary. Refer to Hydraulic Brake System Diagnosis Did you find and correct a condition?	Go to Step 6	Go to Step 3

Step	Action	Yes	No
3	- Inspect the disc brake system for the following conditions. - Contaminated linings - Glazed linings - Distorted, cracked or damaged linings on one side - Loose, damaged or missing caliper hardware and/or lining hardware - Incorrect linings on one side - Hard spots, heat checks, blueing discoloration of rotor friction surfaces; possibly due to brake drag - Glazed rotor friction surfaces - Bent or damaged caliper or mounting component - Adjust, repair or replace components as necessary. Refer to Disc Brake System Diagnosis Did you find and correct a condition?	Go to Step 6	Go to Step 4
4	- Inspect the suspension system for the following conditions. - Incorrect tire pressures - Loose suspension component connections - Excessively worn or damaged suspension components - Adjust, repair or replace components as necessary. Refer to Diagnostic Starting Point - Vehicle Did you find and correct a condition?	Go to Step 6	Go to Step 5
5	- Inspect the steering system for the following conditions. - Loose steering component connections - Excessively worn or damaged steering components - Adjust, repair or replace components as necessary. Refer to Diagnostic Starting Point - Vehicle Did you find and correct a condition?	Go to Step 6	Go to Diagnostic Starting Point - Vehicle
6	- Install or connect components that were removed or disconnected during diagnosis. - Road test the vehicle in order to confirm proper operation. Refer to Brake System Vehicle Road Test Is the condition still present?	Go to Step 2	System OK

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

Step	Action	Yes	No
DEFINITION: Braking action or stopping force sensitive or grabbing and/or more pronounced at the front or at the rear axle. Sensitive or grabbing brakes: Excessive brake jump-in force relative to brake pedal input.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to Diagnostic Starting Point - Vehicle
2	- Inspect the hydraulic brake system for the following conditions: - Improper operation of caliper pistons - Kinked, pinched or damaged brake pipe or flexible brake hose - Brake fluid leak - Improper operation of dynamic rear proportion (DRP) system - Adjust, repair or replace components as necessary. Refer to Hydraulic Brake System Diagnosis		
	Did you find and correct a condition?	Go to Step 6	Go to Step 3
3	- Inspect the disc brake system for the following conditions: - Contaminated linings - Glazed linings - Distorted, cracked or damaged linings - Excessively worn linings - Aftermarket linings - Damaged or excessively worn caliper hardware and/or lining hardware - Hard spots, heat checks, blueing discoloration of rotor friction surfaces - Glazed rotor friction surfaces - Adjust, repair or replace components as necessary. Refer to Disc Brake System Diagnosis		
	Did you find and correct a condition?	Go to Step 6	Go to Step 4

Step	Action	Yes	No
4	- Inspect the suspension system for the following conditions: - Loose suspension component connections - Excessively worn or damaged suspension components - Adjust, repair or replace components as necessary. Refer to Diagnostic Starting Point - Vehicle Did you find and correct a condition?	Go to Step 6	Go to Step 5
5	- Inspect the brake apply system for the following conditions: - Binding, bent or damaged pedal pushrod, pedal, or pedal bracket - Binding, bent or damaged brake pedal - Binding, bent or damaged brake pedal bracket - Adjust, repair or replace components as necessary. Refer to Hydraulic Brake System Diagnosis Did you find and correct a condition?	Go to Step 6	Go to Diagnostic Starting Point - Vehicle
6	- Install or connect components that were removed or disconnected during diagnosis. - Road test the vehicle in order to confirm proper operation. Refer to Brake System Vehicle Road Test Is the condition still present?	Go to Step 2	System OK

BRAKE PEDAL EXCESSIVE TRAVEL

Step	Action	Yes	No
DEFINITION: Brake pedal travels further than expected to obtain firm pedal and/or firm pedal cannot be obtained, pedal fades away, or pedal is spongy.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to Symptoms - Hydraulic Brakes
2	Inspect the travel and feel of brake pedal applies. Perform the following: - Place the Power button in the Service Only mode. - Remove one of the Electric Brake Boost fuses from the Engine Compartment Fuse Block. - Apply the brake pedal with light, steady pressure and hold for 15 seconds. Observe pedal travel and feel. Did you complete the brake pedal travel and feel inspections?	Go to Step 3	-

Step	Action	Yes	No
3	1. Inspect the hydraulic brake system for the conditions listed, based on the following symptoms observed during the pedal travel and feel inspections: • Pedal feel was spongy • Air in hydraulic system • External brake fluid leaks • Soft, weak or damaged hydraulic hoses; expanding under pressure • Pedal fell away and/or traveled to or almost to floor • External brake fluid leaks • Poor brake fluid quality; low boiling point • Internal brake fluid leaks; improperly functioning master cylinder • Pedal was somewhat firm then dropped slightly, or pedal rose with successive applies, or pedal travel was different between slow and quick applies • Internal brake fluid leaks; improperly functioning master cylinder • Poor brake fluid quality; low boiling point • Pedal returned to rest slowly after any of the applies • Internally damaged flexible brake hoses; hindering fluid return • Binding caliper pistons • Internal brake fluid leaks; improperly functioning master cylinder 2. Repair or replace components as necessary. Refer to Hydraulic Brake System Diagnosis 3. Re-inspect brake pedal apply travel and feel. Did you find and correct a condition?	Go to Step 9	Go to Step 4

Step	Action	Yes	No
4	- Inspect the disc brake system for the following conditions: - Cracked, excessively worn or damaged linings - Cracked, excessively worn or damaged rotors - Improperly operating, binding or damaged caliper hardware and/or lining hardware - Loose or missing caliper hardware and/or lining hardware - Excessive assembled lateral runout (LRO) of rotor friction surfaces - Bent or damaged caliper or mounting component - Adjust, repair or replace components as necessary. Refer to Disc Brake System Diagnosis - Re-inspect brake pedal apply travel and feel. Did you find and correct a condition?	Go to Step 9	Go to Step 5
5	Inspect for proper brake pedal travel. Refer to Brake Pedal Travel Measurement and Inspection Is the brake pedal travel distance within the acceptable limits?	Go to Step 8	Go to Step 6
6	- Inspect for worn, missing, misaligned, bent or damaged brake pedal system components. - Perform the brake pedal pushrod component inspection. Refer to Brake Pedal Pushrod Inspection. - Inspect the brake pedal bushings for binding, excessive wear and/or damage and inspect the brake pedal for a misaligned, bent, and/or damaged condition. - Replace the brake pedal system components that are worn, missing, misaligned, bent or damaged. Did you find and replace any worn, missing, misaligned, bent or damaged brake pedal system components?	Go to Step 9	Go to Step 7
7	- Replace the brake master cylinder assembly. - Inspect the brake pedal travel. Refer to Brake Pedal Travel Measurement and Inspection Did you find and correct a condition?	Go to Step 9	Go to Step 8

Step	Action	Yes	No
8	1. Inspect the brake assist system for the following conditions: • Internal fluid leaks and/or restrictions within the brake modulator assembly • Damaged or improperly operating brake modulator assembly 2. Adjust, repair or replace components as necessary. Refer to Hydraulic Brake System Diagnosis		Go to Symptoms - Hydraulic Brakes
	Did you find and correct a condition?	Go to Step 9	
9	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to Brake System Vehicle Road Test		
	Is the condition still present?	Go to Step 2	System OK

BRAKE PEDAL EXCESSIVE EFFORT

Step	Action	Yes	No
DEFINITION: Brake pedal requires an increased amount of input from the driver to obtain good braking action and/or stopping distance is increased.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to Diagnostic Starting Point - Vehicle
2	1. Inspect the brake assist system for the following conditions: • Lack of lubrication, binding or excessively worn pushrod or pedal pivots or pivot bushings • Bent or damaged pedal pushrod, pedal, or pedal bracket 2. Adjust, repair or replace components as necessary. Refer to Hydraulic Brake System Diagnosis		
	Did you find and correct a condition?	Go to Step 5	Go to Step 3

Step	Action	Yes	No
3	- Inspect the hydraulic brake system for the following conditions: - Binding caliper pistons - Internally damaged flexible brake hoses; hindering fluid flow - External brake fluid leaks - Kinked or damaged flexible brake hoses and/or pipes - Internal brake fluid leaks; improperly operating master cylinder - Poor brake fluid quality; low boiling point - Adjust, repair or replace components as necessary. Refer to Hydraulic Brake System Diagnosis Did you find and correct a condition?	Go to Step 5	Go to Step 4
4	- Inspect the disc brake system for the following conditions: - Excessively worn linings - Glazed linings - Cracked, distorted or damaged linings - Contaminated linings - Binding, damaged or excessively worn caliper hardware and/or lining hardware - Lack of lubrication or excessive corrosion on metal to metal contact surfaces - Excessively worn or corroded rotor friction surfaces - Glazed rotor friction surfaces - Hard spots, heat checks, blueing discoloration of rotor friction surfaces - Adjust, repair or replace components as necessary. Refer to Disc Brake System Diagnosis Did you find and correct a condition?	Go to Step 5	Go to Diagnostic Starting Point - Vehicle
5	- Install or connect components that were removed or disconnected during diagnosis. - Road test the vehicle in order to confirm proper operation. Refer to Brake System Vehicle Road Test Is the condition still present?	Go to Step 2	System OK

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.			

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to Diagnostic Starting Point - Vehicle
2	Is the vehicle equipped with an adjustable stop lamp switch and/or an adjustable cruise control release switch?	Go to Step 3	Go to Step 4
3	1. Inspect the stop lamp switch for proper adjustment to ensure that the brake pedal is fully releasing. 2. Inspect the cruise control release switch, if equipped, for proper adjustment to ensure that the brake pedal is fully releasing. Did you find and correct a condition?	Go to Step 14	Go to Step 4
4	Is the vehicle equipped with a drum-in-rotor type of park brake system?	Go to Step 5	Go to Step 7
5	Ensure the park brake shoes are not adjusted too tightly, possibly causing drag under certain conditions. Are the park brake shoes adjusted too tightly?	Go to Step 6	Go to Step 7
6	1. Clean and inspect the park brake shoes for excessive wear and/or damage. 2. Inspect the drum portion of the rotors for excessive wear, blueing discoloration and heat spots. 3. If any of these conditions are present, replace the affected components. 4. Adjust the park brake system. Did you find and correct a condition?	Go to Step 14	Go to Step 7
7	Inspect the park brake system for proper operation. Refer to Park Brake System Diagnosis 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: • Binding, incorrectly installed or missing caliper hardware and/or lining hardware - Ensure free movement of linings and of caliper, if equipped with sliding type caliper • Lack of lubrication or excessive corrosion on metal to metal contact surfaces • Distorted or damaged linings • Damaged or excessively worn caliper hardware and/or lining hardware • Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. Refer to Disc Brake System Diagnosis Did you find and correct a condition?	Go to Step 14	Go to Step 9

Step	Action	Yes	No
9	1. Separate the brake booster pushrod from the brake pedal. 2. Inspect the brake corners to determine if the brake drag condition is still present. Do the brake corners still exhibit the brake drag condition?	Go to Step 11	Go to Step 10
10	1. Inspect the pushrod for improper positioning and/or damage. Correctly position or replace the pushrod if necessary. 2. Inspect the brake pedal assembly for damage and replace if necessary. Did you complete the repair or replacement?	Go to Step 14	-
11	1. For vacuum boost systems, disconnect the vacuum check valve from the booster to relieve vacuum reserve. 2. Separate the master cylinder from the brake booster. Do not disconnect any brake pipes. 3. Inspect the brake corners to determine if the brake drag condition is still present. Do the brake corners still exhibit the brake drag condition?	Go to Step 13	Go to Step 12
12	Replace the brake booster assembly. Did you complete the replacement?	Go to Step 14	-
13	1. Inspect the hydraulic brake system for the following conditions. • Improper operation of caliper pistons • Contaminated brake fluid • Internally damaged flexible brake hoses; hindering brake release • Damaged or improperly operating master cylinder 2. Adjust, repair or replace components as necessary. Refer to Hydraulic Brake System Diagnosis Did you find and correct a condition?	Go to Step 14	Go to Diagnostic Starting Point - Vehicle
14	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to Brake System Vehicle Road Test Is the condition still present?	Go to Step 2	System OK

BRAKE SYSTEM SLOW RELEASE

Step	Action	Yes	No
DEFINITION: Brake system releases and returns to rest slowly; vehicle motion is hindered by brake system briefly after release of brake pedal.			

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to Symptoms - Hydraulic Brakes
2	1. Inspect the hydraulic brake and assist system for the following conditions: • Improper operation of caliper pistons • Internally damaged flexible brake hoses; hindering brake release • Contaminated brake fluid • Damaged or improperly operating master cylinder • Damaged or improperly operating hydraulic booster, if equipped • Binding, bent or damaged pedal pushrod, pedal, or pedal bracket 2. Adjust, repair or replace components as necessary. Refer to Hydraulic Brake System Diagnosis Did you find and correct a condition?	Go to Step 4	Go to Step 3
3	1. Inspect the disc brake system for the following conditions: • Damaged or excessively worn caliper hardware and/or lining hardware • Distorted or damaged linings • Lack of lubrication or excessive corrosion on metal to metal contact surfaces • Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. Refer to Disc Brake System Diagnosis Did you find and correct a condition?	Go to Step 4	Go to Symptoms - Hydraulic Brakes
4	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to Brake System Vehicle Road Test Is the condition still present?	Go to Step 2	System OK

BRAKE FLUID LOSS

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

Step	Action	Yes	No
2	- Inspect the following hydraulic brake system components for brake fluid leaks: - Flexible brake hose connections; threaded and bolted - Flexible brake hose crimp joints - Brake pipe fittings - Caliper piston seals - Wheel cylinder piston seals, if equipped - Master cylinder reservoir - Master cylinder reservoir low pressure hose, if equipped - Brake pressure modulator valve (BPMV) assembly, if equipped - Repair or replace components as necessary. Refer to Hydraulic Brake System Diagnosis Did you find and correct a condition?	Go to Step 8	Go to Step 3
3	Is the vehicle equipped with a vacuum brake booster?	Go to Step 4	Go to Step 6
4	- Disconnect the vacuum check valve from the booster to relieve vacuum reserve. - Separate the master cylinder from the vacuum brake booster. Do not disconnect any brake pipes. - Inspect the rear of the master cylinder for a brake fluid leak. - Inspect for brake fluid in the vacuum brake booster. Did you find a brake fluid leak?	Go to Step 5	Go to Diagnostic Starting Point - Vehicle
5	Replace the brake master cylinder and the vacuum brake booster. Did you complete the replacement?	Go to Step 8	-
6	- Wipe clean the external surface of the master cylinder to hydraulic brake booster area, if equipped. - Separate the master cylinder from the hydraulic brake booster, if equipped. Do not disconnect any brake pipes. - Inspect the rear of the master cylinder for a brake fluid leak. Did you find a brake fluid leak?	Go to Step 7	Go to Diagnostic Starting Point - Vehicle
7	Replace the brake master cylinder. Did you complete the replacement?	Go to Step 8	-

Step	Action	Yes	No
8	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle to confirm proper operation. Refer to Brake System Vehicle Road Test Is the condition still present?	Go to Step 2	System OK

DISC BRAKE SYSTEM DIAGNOSIS

Test Description

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

9

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

10

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

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 Step 2	Go to Diagnostic Starting Point - Vehicle

Step	Action	Yes	No
2	Visually inspect the disc brake pads for the following conditions: <u>Brake Pad Inspection</u> • Lining thickness below specifications • Uneven and/or abnormal wear - edge-to-edge and/or side-to-side • Looseness or damage - including pad hardware • Evidence of contamination from an external substance Did you find any conditions to indicate a concern with any of the front and/or rear disc brake pads?	Go to Step 3	Go to Step 12
3	Are any of the front and/or rear disc brake pads contaminated?	Go to Step 8	Go to Step 4
4	Are any of the front and/or rear disc brake pads worn unevenly?	Go to Step 7	Go to Step 5
5	Are any of the front and/or rear disc brake pads and/or pad hardware loose or damaged?	Go to Step 7	Go to Step 6
6	1. Remove and inspect the worn disc brake pads for glazing, looseness, heat spots or damage. 2. Replace the worn disc brake pads as a complete axle set. Refer to <u>Front Disc Brake Pads Replacement</u> , and/or <u>Rear Disc Brake Pads Replacement</u> Did you complete the inspection and replacement?	Go to Step 12	-

Step	Action	Yes	No
7	CAUTION: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak. NOTE: Do NOT disconnect the hydraulic brake flex hoses from the calipers. 1. Remove the front and/or rear disc brake calipers, as appropriate, from the mounting brackets or from the suspension knuckles and support the calipers. Refer to Front Brake Caliper Replacement , and/or Rear Brake Caliper Replacement 2. Inspect the disc brake caliper mounting bracket and the mounting/sliding hardware for the following conditions: Front Disc Brake Mounting and Hardware Inspection , and/or Rear Disc Brake Mounting and Hardware Inspection • Binding or seized hardware • Worn, damaged or missing hardware components • Loose, bent, cracked, or damaged caliper mounting bracket 3. Replace components as required. Refer to the following procedures, as required: • Front Brake Caliper Bracket Replacement • Rear Brake Caliper Bracket Replacement 4. Replace the unevenly-worn, loose or damaged disc brake pads as a complete axle set. Refer to Front Disc Brake Pads Replacement , and/or Rear Disc Brake Pads Replacement Did you complete the inspection and replacement?	Go to Step 12	-

Step	Action	Yes	No
8	1. Inspect the disc brake calipers, brake hoses and brake pipes for evidence of an external brake fluid leak. 2. Replace any components found to be leaking brake fluid. Refer to the following procedures as required: • Front Brake Caliper Replacement • Rear Brake Caliper Replacement • Front Brake Hose Replacement • Rear Brake Hose Replacement • Brake Pipe Replacement Did you find and correct the source of the leak causing contamination of the pads?	Go to Step 11	Go to Step 9
9	1. Inspect the wheel drive shaft outer seals for damage and evidence of a grease leak. 2. Replace any wheel drive shaft seal that is found to be leaking grease which may be the source of the contamination to the pads. Did you find and correct the source of the leak causing contamination of the pads?	Go to Step 11	Go to Step 10
10	1. Inspect the automatic transmission cooling system lines, if equipped, for damage and evidence of an external fluid leak which may be the source of the contamination to the pads. 2. Inspect the power steering system hoses for damage and evidence of an external fluid leak which may be the source of the contamination to the pads. 3. Replace any components found to be leaking fluid which may be the source of the contamination to the pads. Did you find and correct the source of the leak causing contamination of the pads?	Go to Step 11	-

Step	Action	Yes	No
11	1. Clean the remaining disc brake system components to remove any traces of the contaminant. CAUTION: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak. NOTE: Do NOT disconnect the hydraulic brake flex hoses from the calipers. 2. Remove the front and/or rear disc brake calipers, as appropriate, from the mounting brackets and support the calipers. Refer to Front Brake Caliper Replacement , and/or Rear Brake Caliper Replacement 3. Inspect the disc brake caliper mounting/sliding hardware for the following conditions: Front Disc Brake Mounting and Hardware Inspection , and/or Rear Disc Brake Mounting and Hardware Inspection • Binding or seized hardware • Distorted, worn, damaged or missing hardware components 4. Replace the caliper mounting/sliding hardware components as required. 5. Replace the contaminated disc brake pads as a complete axle set. Refer to Front Disc Brake Pads Replacement , and/or Rear Disc Brake Pads Replacement Did you complete the cleaning, inspection and replacement?	Go to Step 12	-
12	Visually inspect each of the rear disc brake rotor shields/backing plates, if equipped, for evidence of contact with the brake rotors. Are any of the brake rotor shields/backing plates contacting the brake rotors?	Go to Step 13	Go to Step 14
13	Repair or replace the disc brake rotor shields/backing plates as required. Refer to Front Brake Shield Replacement , or Rear Brake Shield Replacement Did you complete the repair or replacement?	Go to Step 14	-

Step	Action	Yes	No
14	1. Check the thickness of each of the disc brake rotors. NOTE: Make the following determination AND ANSWER the question INDIVIDUALLY for EACH rotor. 2. Make a determination for each brake rotor if the rotor can be REFINISHED and REMAIN ABOVE the minimum requirements. Refer to <u>Brake Rotor Thickness Measurement</u> Does the disc brake rotor meet the minimum requirements for REFINISHING?	Go to Step 15	Go to Step 18
15	NOTE: Perform the following inspection AND ANSWER the question INDIVIDUALLY for EACH rotor. Inspect each of the disc brake rotors for thickness variation that exceeds the maximum acceptable level. Refer to <u>Brake Rotor Thickness Variation Measurement</u> Does the brake rotor exhibit thickness variation that exceeds the maximum acceptable level?	Go to Step 17	Go to Step 16
16	1. Inspect each of the disc brake rotors for the following surface and wear conditions: <u>Brake Rotor Surface and Wear Inspection</u> • Heavy rust and/or pitting • Cracks and/or heat spots • Excessive blueing discoloration • Deep or excessive scoring beyond maximum acceptable level NOTE: Make the following determination AND ANSWER the question INDIVIDUALLY for EACH rotor. 2. Make a determination for each brake rotor if the rotor requires refinishing based upon the results of the inspection. If the brake rotor exhibits any of the conditions listed previously, it requires refinishing. Does the brake rotor require REFINISHING?	Go to Step 17	Go to Step 22

Step	Action	Yes	No
17	1. Refinish the brake rotor. Refer to Brake Rotor Refinishing 2. Inspect the brake rotor thickness. Refer to Brake Rotor Thickness Measurement Were you able to REFINISH the brake rotor within the minimum requirements?	Go to Step 22	Go to Step 21
18	Is the brake rotor at or below the DISCARD requirements?	Go to Step 21	Go to Step 19
19	NOTE: Perform the following inspection AND ANSWER the question INDIVIDUALLY for EACH rotor. Inspect each of the disc brake rotors for thickness variation that exceeds the maximum acceptable level. Refer to Brake Rotor Thickness Variation Measurement Does the brake rotor exhibit thickness variation that exceeds the maximum acceptable level?	Go to Step 21	Go to Step 20
20	1. Inspect each of the disc brake rotors for the following surface and wear conditions: Brake Rotor Surface and Wear Inspection • Heavy rust and/or pitting • Cracks and/or heat spots • Excessive blueing discoloration • Deep or excessive scoring beyond maximum acceptable level NOTE: Make the following determination AND ANSWER the question INDIVIDUALLY for EACH rotor. 2. Make a determination for each brake rotor if the rotor requires replacement based upon the results of the inspection. If the brake rotor exhibits any of the conditions listed previously, it requires replacement. Does the brake rotor require REPLACEMENT?	Go to Step 21	Go to Step 22
21	NOTE: Whenever a brake rotor is replaced, the assembled lateral runout (LRO) of the rotor must be measured to ensure optimum performance of the disc brakes. Replace the brake rotor. Refer to Front Brake Rotor Replacement , or Rear Brake Rotor Replacement Did you complete the replacement?	Go to Step 24	-

Step	Action	Yes	No
22	NOTE: Perform the following inspection AND ANSWER the question INDIVIDUALLY for EACH rotor. Inspect each of the disc brake rotors for assembled LRO that exceeds the maximum acceptable level. Refer to <u>Brake Rotor Assembled Lateral Runout Measurement</u> Does the brake rotor exhibit assembled LRO that exceeds the maximum acceptable level?	Go to Step 23	Go to Step 24
23	Correct the LRO for each brake rotor that was determined to have LRO exceeding the maximum acceptable level. Refer to <u>Brake Rotor Assembled Lateral Runout Measurement</u> Did you complete the operation?	Go to Step 24	-
24	Install or connect components that were removed or disconnected during diagnosis. Did you complete the operation?	Disc Brake System OK Return to Symptom Table	-

HYDRAULIC BRAKE SYSTEM DIAGNOSIS

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the HYDRAULIC brake system in order to determine if the HYDRAULIC brake system is operating properly. You will be directed by the appropriate Symptom table to go to other brake system diagnostic tables as appropriate.			
1	Were you sent here from a Brake Symptom table?	Go to Step 2	Go to <u>Symptoms - Hydraulic Brakes</u>
2	Inspect and adjust the brake fluid level in the brake master cylinder. Refer to <u>Master Cylinder Reservoir Filling</u> Was the brake fluid level low?	Go to Step 3	Go to Step 4
3	1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination: - Fluid separation, indicating two types of fluid are present - Swirled appearance - oil-based substance - Layered appearance - silicone-based substance - Fluid discoloration - Cloudy appearance - moisture - Dark appearance/suspended particles in fluid - dirt, rust, corrosion, brake dust 2. Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating fluid contamination. Do any of the above conditions exist?	Go to Step 5	Go to Step 6

Step	Action	Yes	No
4	1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination: • Fluid separation, indicating two types of fluid are present • Swirled appearance - oil-based substance • Layered appearance - silicone-based substance • Fluid discoloration • Cloudy appearance - moisture • Dark appearance/suspended particles in fluid - dirt, rust, corrosion, brake dust 2. Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating fluid contamination. Do any of the above conditions exist?	Go to Step 5	Go to Step 12

Step	Action	Yes	No
5	1. Flush the hydraulic brake system. Refer to <u>Hydraulic Brake System Flushing</u> 2. If the brake fluid WAS contaminated with an oil-based or a silicone-based fluid, indicated by fluid separation and/or a swollen master cylinder reservoir cap diaphragm and/or swollen reservoir-to-master cylinder grommets, perform the following steps. Refer to the procedures indicated. 1. Remove ALL of the following components listed. Each component contains internal rubber seals/linings which have been contaminated. 2. Clean out the hydraulic brake pipes using denatured alcohol, or equivalent. 3. Dry the brake pipes using non-lubricated, filtered air. 4. Repair or replace ALL of the following components listed. Each component contains internal rubber seals/linings which have been contaminated. • Replace the brake master cylinder reservoir cap diaphragm. • <u>Master Cylinder Replacement</u> • Brake master cylinder reservoir: Clean the brake master cylinder reservoir using denatured alcohol, or equivalent, then dry the reservoir using non-lubricated, filtered air, or if necessary, replace the brake master cylinder reservoir. • <u>Front Brake Hose Replacement</u> • <u>Rear Brake Hose Replacement</u> • <u>Front Brake Caliper Overhaul , Front Brake Caliper Replacement</u> • <u>Rear Brake Caliper Replacement</u> • <u>Electronic Brake Control Module with Brake Pressure Modulator Valve Replacement</u> 3. If the brake fluid was NOT contaminated with an oil-based fluid, but WAS contaminated with water or dirt, rust, corrosion, and/or brake dust, replace the brake master cylinder reservoir cap diaphragm which may have allowed moisture or dirt to enter the system. 4. Refill and bleed the hydraulic brake system. Refer to <u>Hydraulic Brake System Bleeding</u> Did you complete the operation and any required repairs and/or replacements?	-	
		Go to Step 9	

Step	Action	Yes	No
6	1. Inspect the following hydraulic brake system components for external fluid leaks. Repair or replace any of the components found to be leaking brake fluid. Refer to the appropriate procedures: • Brake master cylinder reservoir cap diaphragm • Refer to Master Cylinder Replacement • Refer to Front Brake Hose Replacement • Refer to Rear Brake Hose Replacement • Refer to Brake Pipe Replacement • Refer to Front Brake Caliper Overhaul , Front Brake Caliper Replacement • Refer to Rear Brake Caliper Replacement • Refer to Electronic Brake Control Module with Brake Pressure Modulator Valve Replacement 2. If you repaired or replaced any of the brake system components listed, bleed the hydraulic brake system. Refer to Hydraulic Brake System Bleeding While bleeding the hydraulic brake system, observe for the following conditions: • The presence of air in the system at a bleeder valve location other than at the repair location, except if the brake master cylinder, and/or the proportioning valve assembly, was replaced • An unrestricted and even flow of brake fluid per axle during the bleeding procedure Did you find and correct a condition?		
7	Was there air in the system at a bleeder valve location other than at the repair location, except if the brake master cylinder, and/or the proportioning valve assembly, was replaced?	Go to Step 7	Go to Step 12
8	Was the flow of brake fluid unrestricted and even per axle during the bleeding procedure?	Go to Step 19	Go to Step 8
9	Inspect the hydraulic function of the brake calipers and/or wheel cylinders, if equipped for proper operation. Refer to Hydraulic Brake Component Operation Visual Inspection Was the hydraulic function of the brake calipers/wheel cylinders operating properly?	Go to Step 9	Go to Step 10
10	Was the flow of brake fluid restricted or uneven through front axle hydraulic components during the bleeding procedure?	Go to Step 21	Go to Step 14
11	Was the flow of brake fluid restricted or uneven through rear axle hydraulic components during the bleeding procedure?	Go to Step 13	Go to Step 11
12	Inspect the hydraulic function of the brake calipers/wheel cylinders for proper operation. Refer to Hydraulic Brake Component Operation Visual Inspection Was the hydraulic function of the brake calipers/wheel cylinders operating properly?	Go to Step 17	-
		Go to Step 15	Go to Step 13

Step	Action	Yes	No
13	Determine if the brake caliper is restricting the flow of brake fluid and/or not operating properly: 1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle 2. Remove the tire and wheel assemblies. Refer to Tire and Wheel Removal and Installation 3. Open the suspected caliper bleeder valve. 4. Using a large C-clamp, compress the caliper piston and observe for an unrestricted flow of brake fluid and for free movement of the caliper piston. 5. Close the caliper bleeder valve. Was the flow of brake fluid unrestricted and did the caliper piston move freely?	Go to Step 17	Go to Step 14
14	Repair or replace any brake caliper/wheel cylinder that was not operating properly. • Refer to Front Brake Caliper Overhaul , Front Brake Caliper Replacement • Refer to Rear Brake Caliper Replacement Did you complete the repair and/or replacement?	Go to Step 21	-
15	Bleed the hydraulic brake system to observe for the presence of air in the system and to observe for an unrestricted and even flow of brake fluid per axle during the bleeding procedure. Refer to Hydraulic Brake System Bleeding Was there air in the system?	Go to Step 19	Go to Step 16
16	Was the flow of brake fluid unrestricted and even per axle during the bleeding procedure?	Go to Step 21	Go to Step 17
17	1. Inspect the hydraulic brake pipes and flexible brake hoses for signs of a fluid restriction; such as being bent, kinked, pinched or damaged. Refer to Brake Pipe and Hose Inspection 2. Replace any of the hydraulic brake pipes and/or flexible brake hoses found to be bent, kinked, pinched, or damaged. • Refer to Front Brake Hose Replacement • Refer to Rear Brake Hose Replacement • Refer to Brake Pipe Replacement 3. If none of the hydraulic brake pipes or flexible brake hoses were visibly bent, kinked, pinched, or damaged, replace the hydraulic brake flex hose at the restricted location. Did you find and correct a condition?	Go to Step 21	Go to Step 18
18	Replace the brake modulator assembly, in order to correct the hydraulic brake dynamic rear proportioning mechanical operation. Refer to Electronic Brake Control Module with Brake Pressure Modulator Valve Replacement Did you complete the replacement?	Go to Step 21	-

Step	Action	Yes	No
19	1. Inspect the hydraulic brake system components for brake fluid seepage at a seal and/or fitting location, which may have drawn air into the system. 2. Inspect the hydraulic brake system components for evidence of a recent repair, which may have introduced air into the system. 3. Repair or replace any of the components found to be installed incorrectly or seeping brake fluid. Did you find and correct a condition?	Go to Step 21	Go to Step 20
20	1. Inspect the brake master cylinder for internal fluid leaks. Refer to Brake System Internal Leak Test 2. Repair or replace the brake master cylinder if it is found to be leaking brake fluid internally. Refer to Master Cylinder Replacement Did you find and correct a condition?	Go to Step 21	Return to Symptom Table
21	Install or connect components that were removed or disconnected during diagnosis. Did you complete the operation?	Hydraulic Brake System OK Return to Symptom Table	-

BRAKE SYSTEM VEHICLE ROAD TEST

Preliminary Inspections

1. Visually inspect easily accessible brake system components for obvious damage and/or leaks which may indicate that the vehicle should not be driven until further inspections have been completed.
2. Inspect the brake master cylinder reservoir fluid level and adjust only if necessary for brake system road testing. Refer to [Master Cylinder Reservoir Filling](#)
3. Inspect the tire inflation pressures and adjust as necessary.
4. Inspect the tire tread patterns to ensure that they are the same or very similar, especially per axle.
5. Ensure that the vehicle is not loaded unevenly prior to brake system road testing.

Road Testing Procedure

WARNING: Road test a vehicle under safe conditions and while obeying all traffic laws. Do not attempt any maneuvers that could jeopardize vehicle control. Failure to adhere to these precautions could lead to serious personal injury and vehicle damage.

1. Start the engine and allow it to idle.
2. Check to see if the brake system warning lamp remains illuminated.
3. If the brake system warning lamp remains illuminated, DO NOT proceed to test drive the vehicle until it is diagnosed and repaired. Refer to [Symptoms - Hydraulic Brakes](#)
4. Select a smooth, dry, clean and level road or large lot that is as free of traffic and obstacles as possible for brake system low speed road testing.
5. With the transmission in PARK, lightly apply the brake pedal. Observe both the pedal feel and the pedal travel.
6. If the brake pedal apply felt spongy, or the pedal travel was excessive, DO NOT drive the vehicle until it is repaired.
7. If the brake pedal apply did not feel spongy and the pedal travel was not excessive, proceed to step 8.

8. Release and apply the brakes.
9. While continuing to apply the brakes, shift the transmission into DRIVE, release the brakes and allow the engine to idle the vehicle away from the stopped position. Observe for a slow release of the brake system.
10. With the aid of an assistant to observe the vehicle's performance from outside of the vehicle, drive the vehicle at a low speed and lightly apply the brakes while driving past the assistant. Have the assistant observe for brake system noise from the side of the vehicle closest to them, while you observe both the pedal effort and the pedal travel.
11. If the brake pedal apply effort was excessive, or the pedal travel was excessive, DO NOT continue to test drive the vehicle until it is repaired.
12. If the brake pedal apply effort was not excessive and the pedal travel was not excessive, proceed to step 13.
13. Drive the vehicle in the opposite direction, at the same low speed and lightly apply the brakes while driving past the assistant. Have the assistant observe for brake system noise from the side of the vehicle closest to him.
14. Drive the vehicle at a low speed and shift the transmission into NEUTRAL without applying the brakes. Observe for a rapid deceleration in vehicle speed, indicating possible brake drag.
15. Select a smooth, dry, clean and level road that is as free of heavy traffic as possible for brake system moderate speed road testing.
16. Drive the vehicle at a moderate speed. Observe for a pull and/or incorrect tracking of the vehicle without the brakes applied.
17. While continuing to drive the vehicle at a moderate speed, perform several light applies of the brakes. Observe the pedal effort and the pedal travel, observe for brake system noise, pulsation and/or brake drag.
18. If the brake pedal apply effort was excessive, or the pedal travel was excessive, DO NOT continue to test drive the vehicle until it is repaired.
19. If the brake pedal apply effort was not excessive and the pedal travel was not excessive, proceed to step 20.
20. While continuing to drive the vehicle at a moderate speed, perform several moderate applies of the brakes. Observe the pedal effort and the pedal travel, observe for brake system pulsation and/or uneven braking action - either side to side, or front to rear.

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

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

BRAKE PEDAL TRAVEL MEASUREMENT AND INSPECTION

NOTE: **The brake corners must be cool to obtain the most accurate measurement.**

1. Install a scan tool to the vehicle.
2. Place the power button in the Service Only Mode without applying the brake pedal.
3. Using the scan tool, perform the following steps:
 1. Select Diagnostics
 2. Enter the VIN
 3. Select Electronic Brake Control Module (EBCM)
 4. Select Data Display
 5. Scroll through the Data List, select Brake Pressure
4. While observing the master cylinder pressure on the scan tool data display, using moderate speed and moderate effort, apply the brake pedal to a force of 5000 kPa (725 psi) and maintain this pedal force.
5. Select Brake Boost Control Module.
6. Select Data Display.
7. Scroll through the Data List, select Output Rod Position.

8. Record the distance displayed on the scan tool that the brake pedal has travelled at a pedal apply force of 5000 kPa (725 psi).
9. Release the brake pedal.

Specification

Maximum brake pedal travel: 18 mm (0.71 in)

BRAKE SYSTEM EXTERNAL LEAK INSPECTION

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

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

1. In order to inspect for external brake fluid leaks, first check the fluid level in the master cylinder.

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

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

2. Start the engine and allow it to idle.
3. Apply constant, moderate foot pressure to the brake pedal.

If the brake pedal gradually falls away while under foot pressure, there may be a brake fluid leak.

4. Turn OFF the ignition.
5. Visually inspect the following brake system components for brake fluid leaks, excessive corrosion, and damage. Give particular attention to all brake pipe and flexible hose connections to ensure that there are not any slight brake fluid leaks - even though the brake pedal may feel firm and hold steady:
 - Master cylinder brake pipe fittings
 - All brake pipe connections
 - Brake pipes
 - Brake hoses and connections
 - Brake calipers and/or wheel cylinders, if equipped
6. While slight dampness around the master cylinder reservoir can be considered acceptable, brake fluid leaking from any of the brake system components requires immediate attention. If any of these components exhibit signs of brake fluid leakage, repair or replace those components. After the repair or replacement, reinspect the hydraulic brake system to assure proper function.

BRAKE SYSTEM INTERNAL LEAK TEST

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

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

1. Ensure is ignition is OFF for at least 60 seconds to allow the system to depressurize and deplete the power reserve.
2. Apply the brake pedal several times to verify the power reserve is fully depleted.
3. Apply light, steady pressure to the brake pedal. Observe both the brake pedal feel and travel.
4. Release the brake pedal.
5. 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](#)

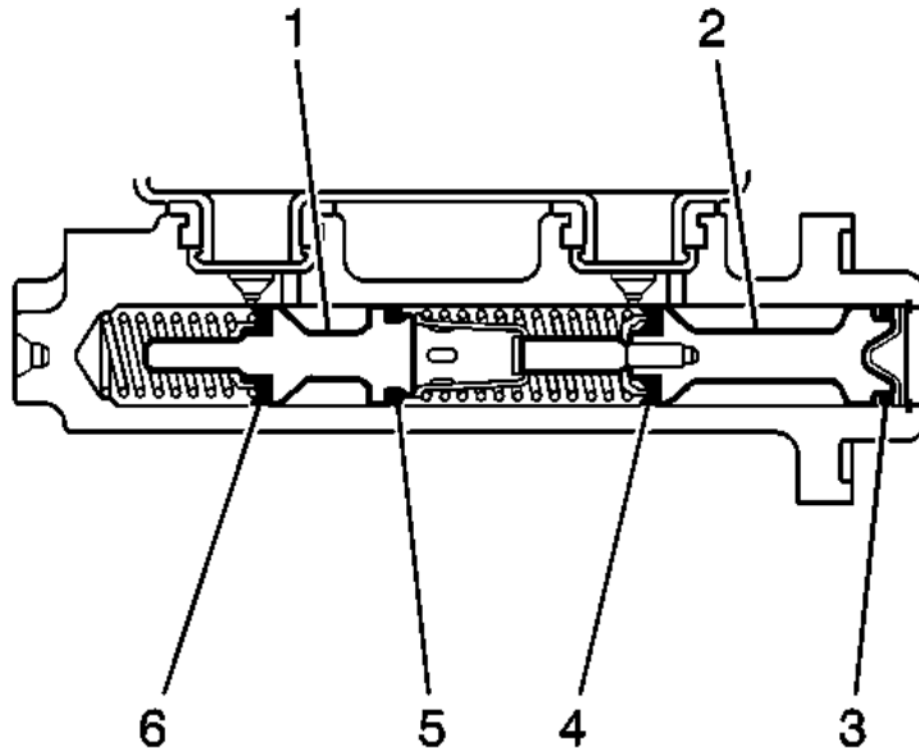


Fig. 2: Cross Sectional View Of Brake Master Cylinder And Components
Courtesy of GENERAL MOTORS COMPANY

6. 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-adapter mounting nuts.
 2. Carefully pull the master cylinder away from the adapter 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.
7. 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 replacement.
8. If the master cylinder primary piston (2) does not exhibit any leakage, install the master cylinder to the adapter and pressure bleed the brake system. Refer to [Hydraulic Brake System Bleeding](#)
9. 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 replacement due to an internal leak past a piston seal.
10. 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

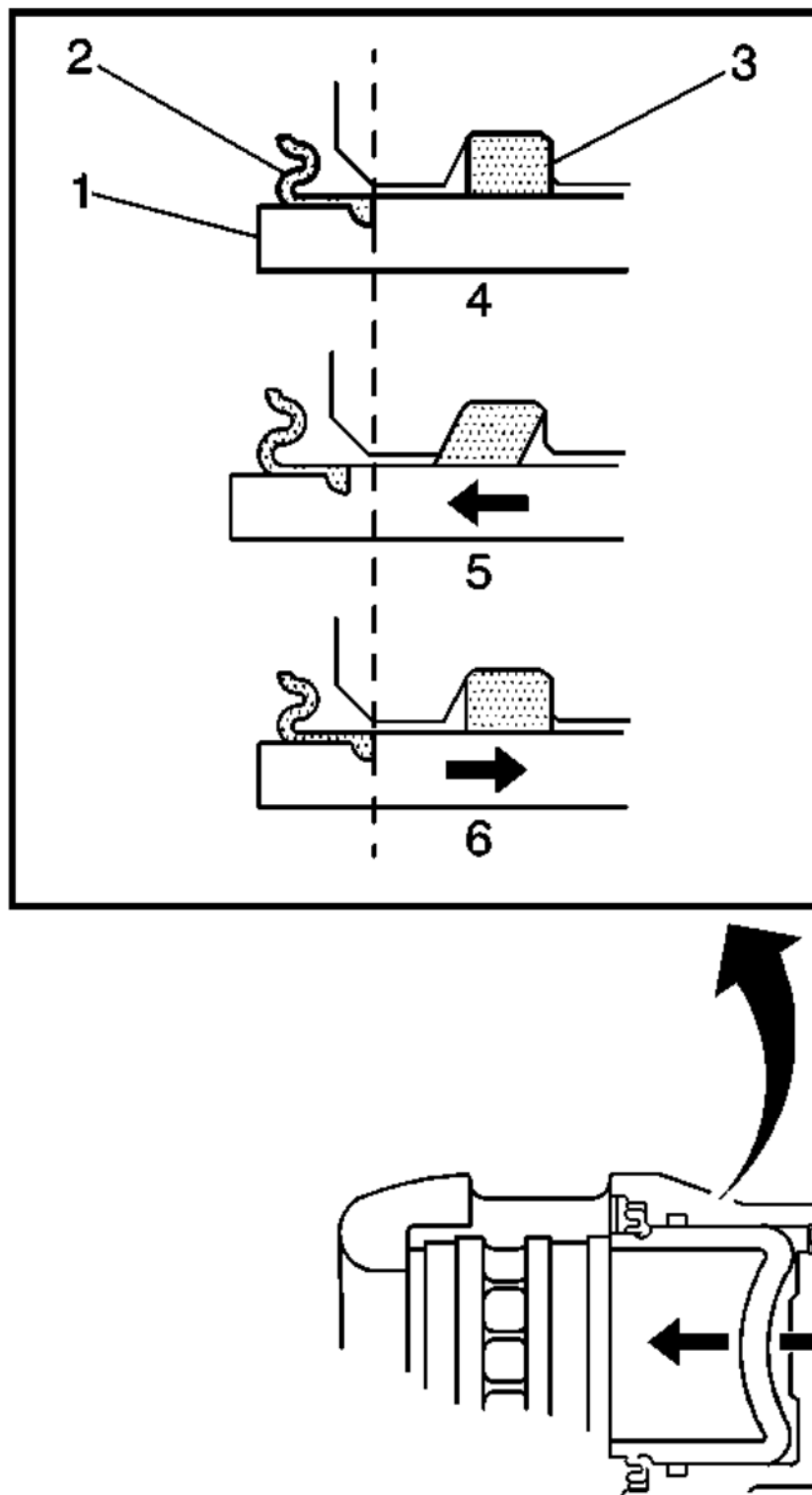


Fig. 3: Brake Caliper/Pad Inspection Areas

Courtesy of GENERAL MOTORS COMPANY

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

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

1. With the tire and wheel assemblies removed and the brake rotors retained by wheel lug nuts, visually inspect the caliper piston dust boot (2) sealing area to ensure that there are no brake fluid leaks.
2. If any evidence of a brake fluid leak is present, the brake caliper requires overhaul or replacement.
3. While the brake system is at rest (4), observe the position of the caliper piston (1) in relation to the caliper housing.

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

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.

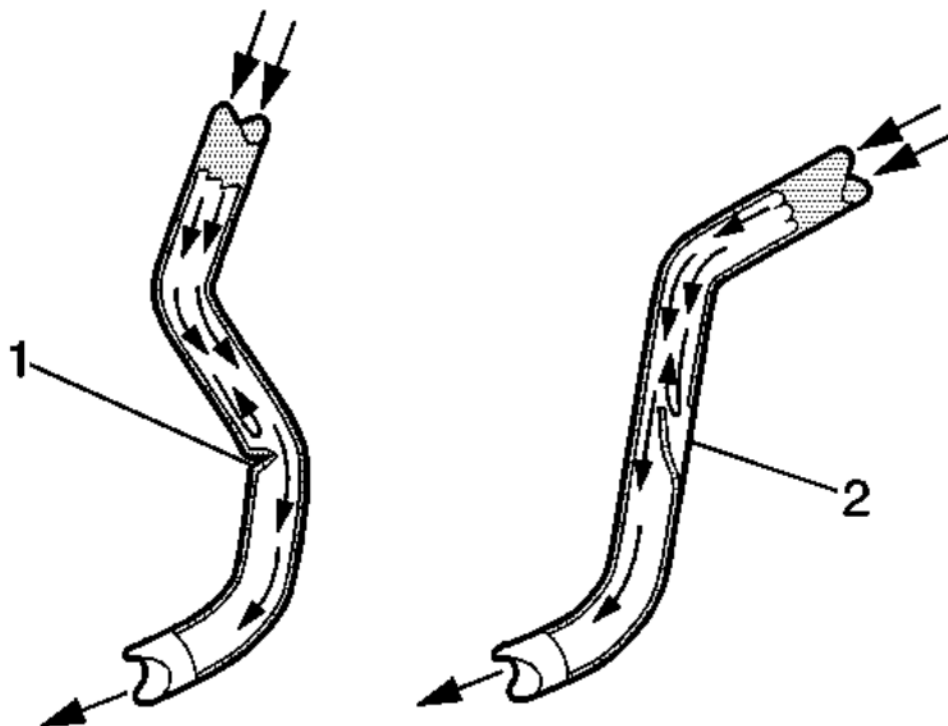


Fig. 4: Flexible Brake Hose Failure Conditions
Courtesy of GENERAL MOTORS COMPANY

4. Visually inspect all of the flexible brake hoses for the following conditions:
 - Kinks (1), improper routing, twists, chafing, missing or damaged retainers

- Leaking connections, 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. Tightly press the flexible brake hose with fingers to check whether there are any spongy spots (2) (which indicates the existence of interior blocking). Inspect the entire length of each hose.
 7. If any of the flexible brake hoses were found to have soft spots (2), then the identified flexible brake hose, or hoses require replacement.

BRAKE PEDAL PUSHROD INSPECTION

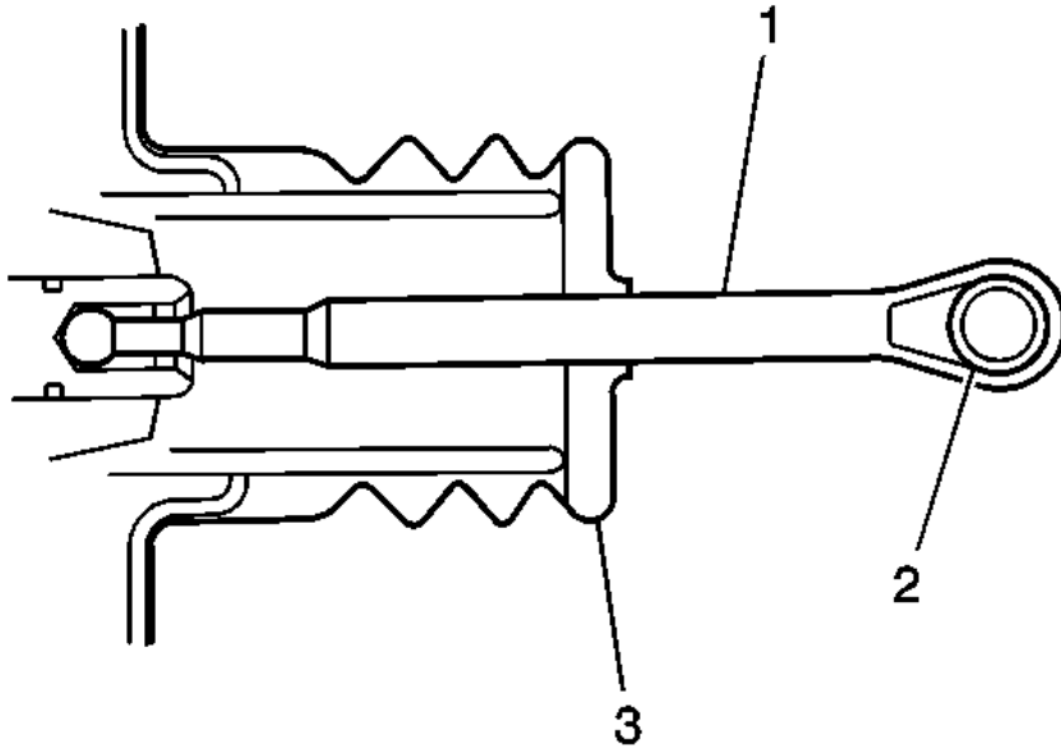


Fig. 5: Brake Pedal Pushrod, Eyelet Bushing And Boot
 Courtesy of GENERAL MOTORS COMPANY

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

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

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

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

MASTER CYLINDER RESERVOIR FILLING

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

CAUTION: 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.

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. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).

MASTER CYLINDER RESERVOIR REPLACEMENT

Removal Procedure

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

WARNING: Use of eye goggles is necessary to prevent personal injury.

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

1. Using an appropriate siphon device, remove as much brake fluid from the reservoir as possible.
2. Place absorbent towels beneath the reservoir to catch any residual fluid.
3. Remove Engine Control Module @ Vehicle. Refer to [Engine Control Module Replacement](#)

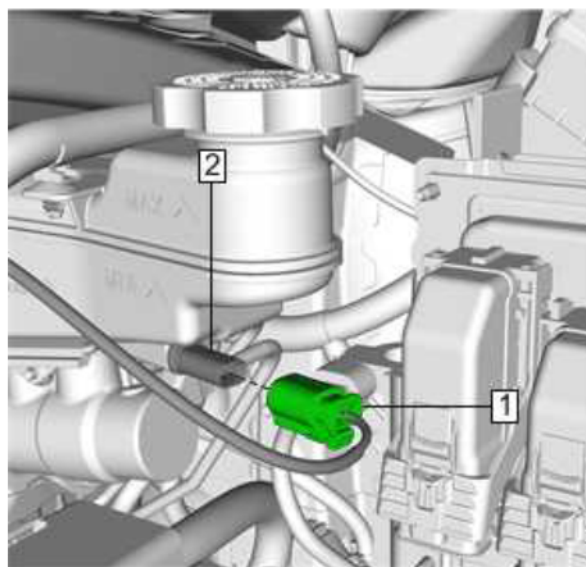


Fig. 6: Brake Fluid Level Indicator Switch And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect Electrical Connector (1) @ Brake Fluid Level Indicator Switch (2)

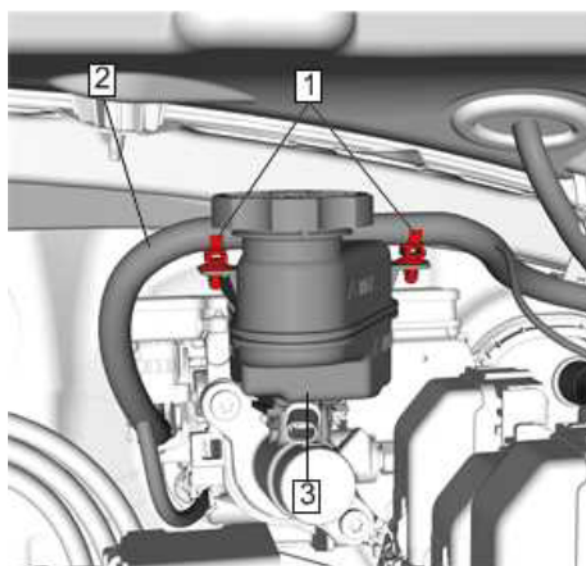


Fig. 7: Brake Master Cylinder Reservoir, Wiring Harness And Clips
Courtesy of GENERAL MOTORS COMPANY

5. Unclip Clips (1) (Qty: 2) @ Brake Master Cylinder Reservoir (3)

6. Reposition Body Wiring Harness (2) @ Brake Master Cylinder Reservoir (3)

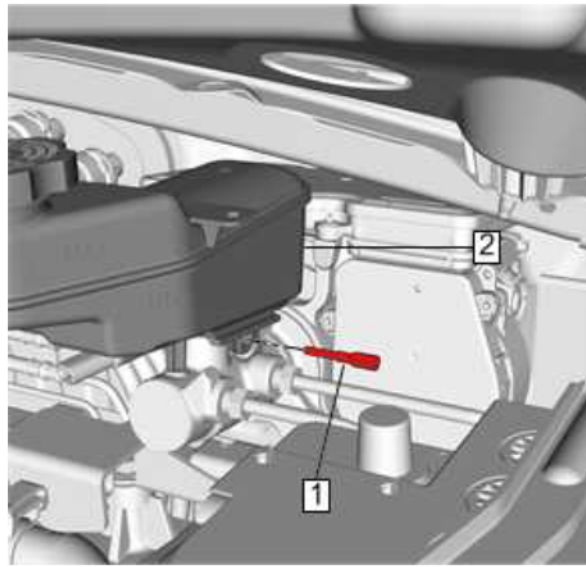


Fig. 8: Brake Master Cylinder Reservoir And Pin
Courtesy of GENERAL MOTORS COMPANY

7. Remove Brake Master Cylinder Reservoir Pin (1) @ Brake Master Cylinder Reservoir (3)

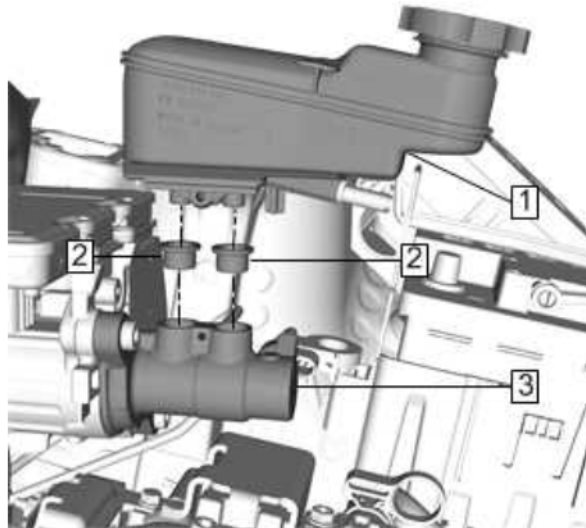


Fig. 9: Brake Master Cylinder, Reservoir And Seals
Courtesy of GENERAL MOTORS COMPANY

8. Remove Brake Master Cylinder Reservoir (1)@ Brake Master Cylinder (3)

9. Remove and DISCARD Brake Master Cylinder Reservoir Seals (2) (Qty: 2) @ Brake Master Cylinder (3)

10. Remove Brake Fluid Level Indicator Switch @ Brake Master Cylinder Reservoir. Refer to **Brake Fluid Level Indicator Switch Replacement**

Installation Procedure

1. Install Brake Fluid Level Indicator Switch @ Brake Master Cylinder Reservoir. Refer to **Brake Fluid Level Indicator Switch Replacement**

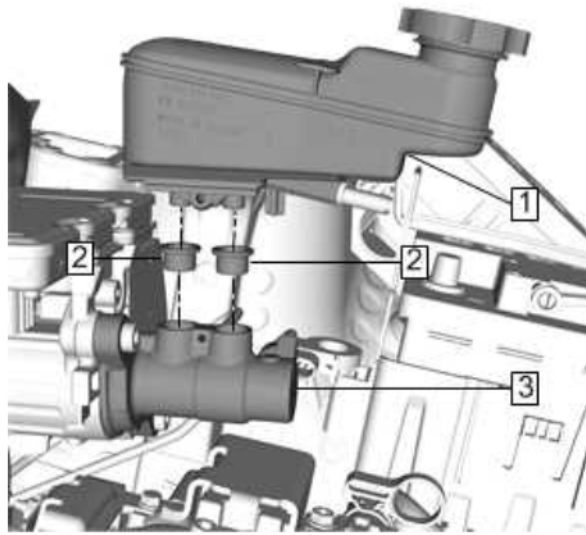


Fig. 10: Brake Master Cylinder, Reservoir And Seals
 Courtesy of GENERAL MOTORS COMPANY

2. Lubricate the brake master cylinder reservoir seals with GM approved brake fluid from a clean, sealed, brake fluid container.
3. Install NEW Brake Master Cylinder Reservoir Seals (2) (Qty: 2) @ Brake Master Cylinder (3)
4. Install Brake Master Cylinder Reservoir (1) @ Brake Master Cylinder (3)

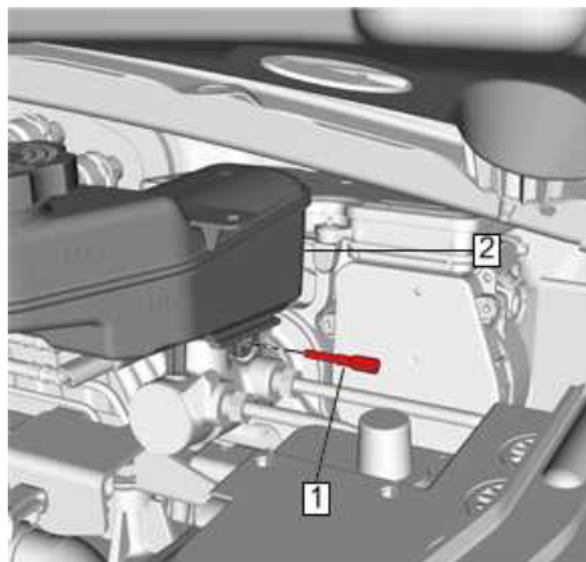


Fig. 11: Brake Master Cylinder Reservoir And Pin
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

5. Install and tighten Brake Master Cylinder Reservoir Pin (1) @ Brake Master Cylinder Reservoir (3) to 7 N.m (62 lb in)

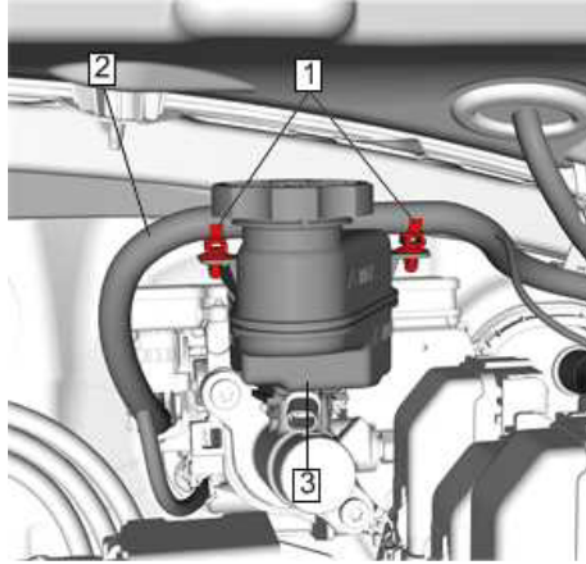


Fig. 12: Brake Master Cylinder Reservoir, Wiring Harness And Clips
 Courtesy of GENERAL MOTORS COMPANY

6. Install Body Wiring Harness (2) @ Brake Master Cylinder Reservoir (3)
7. Install Clips (1) (Qty: 2) @ Brake Master Cylinder Reservoir (3)

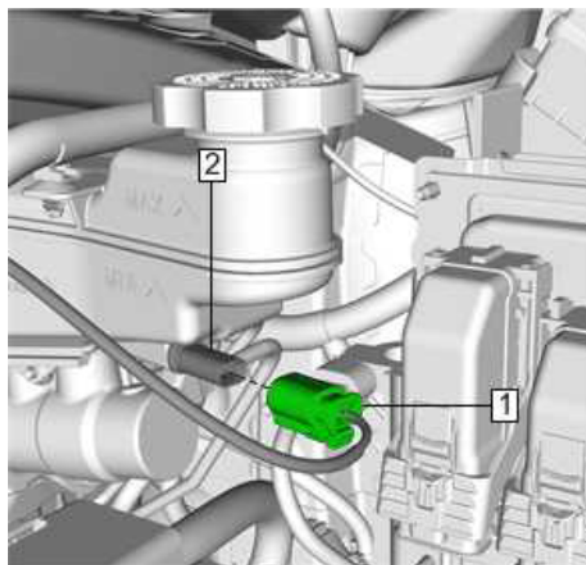


Fig. 13: Brake Fluid Level Indicator Switch And Electrical Connector
 Courtesy of GENERAL MOTORS COMPANY

8. Connect Electrical Connector (1) @ Brake Fluid Level Indicator Switch (2)
9. Install Engine Control Module @ Vehicle. Refer to [Engine Control Module Replacement](#)
10. Bleed the brake system. Refer to [Hydraulic Brake System Bleeding](#)

MASTER CYLINDER REPLACEMENT

Removal Procedure

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

WARNING: Use of eye goggles is necessary to prevent personal injury.

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

1. Remove Engine Control Module @ Vehicle. Refer to [Engine Control Module Replacement](#)

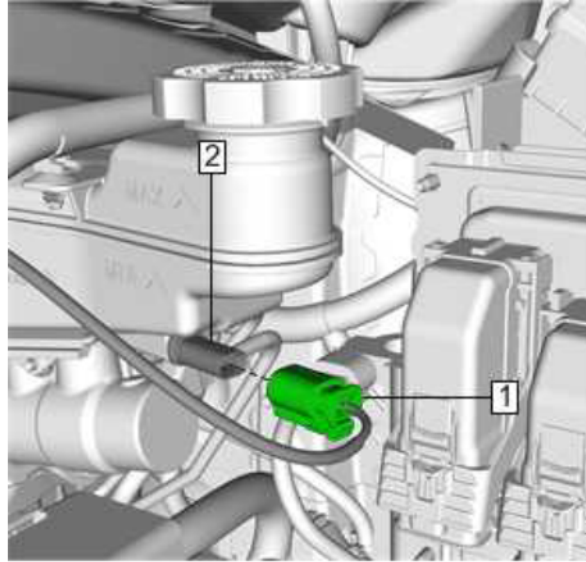


Fig. 14: Brake Fluid Level Indicator Switch And Electrical Connector
 Courtesy of GENERAL MOTORS COMPANY

2. Disconnect Electrical Connector (1) @ Brake Fluid Level Indicator Switch (2)

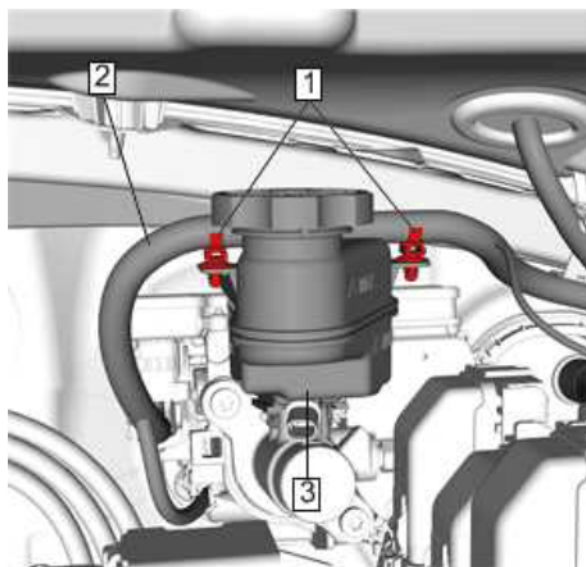


Fig. 15: Brake Master Cylinder Reservoir, Wiring Harness And Clips
 Courtesy of GENERAL MOTORS COMPANY

3. Unclip Clips (1) (Qty: 2) @ Brake Master Cylinder Reservoir (3)
4. Reposition Body Wiring Harness (2) @ Brake Master Cylinder Reservoir (3)

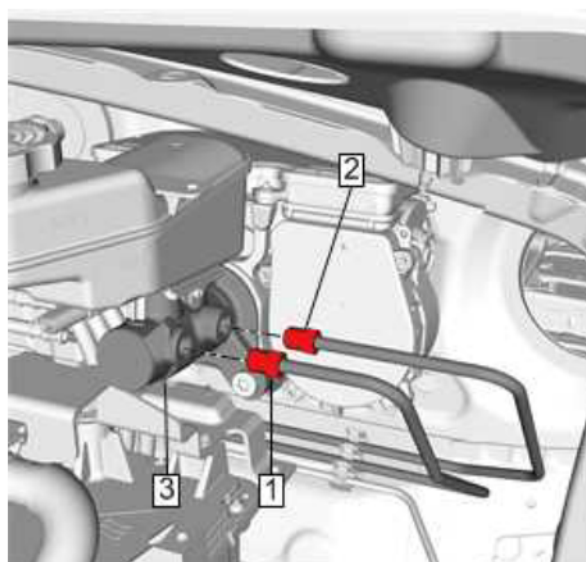


Fig. 16: BPMV Front And Rear Pipe Fittings At Brake Master Cylinder
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Cap the brake pipe fittings to prevent brake fluid loss and contamination.

5. Remove Brake Pressure Modulator Valve Front Pipe Fitting (1) @ Brake Master Cylinder (3)
6. Remove Brake Pressure Modulator Valve Rear Pipe Fitting (2) @ Brake Master Cylinder (3)

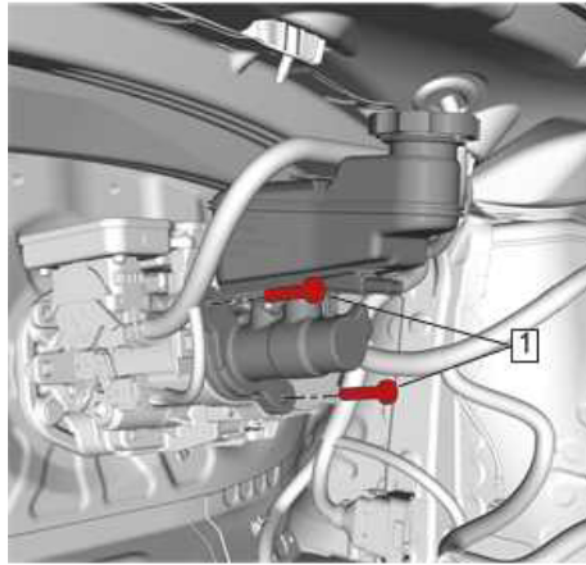


Fig. 17: Brake Master Cylinder Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Remove Brake Master Cylinder Bolts (1) (Qty: 2)

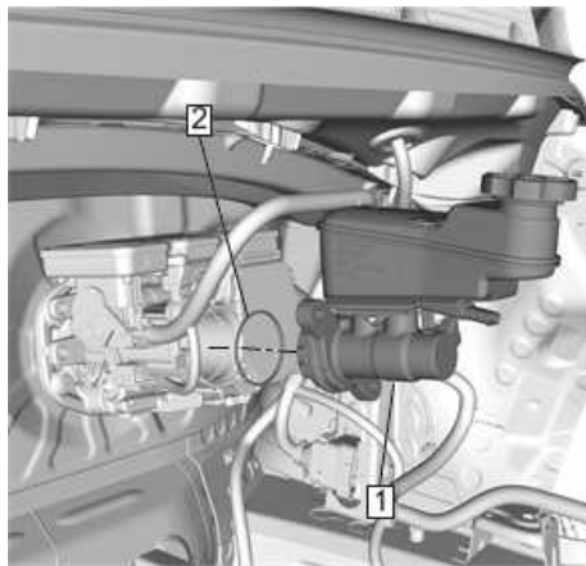


Fig. 18: Brake Master Cylinder And Seal
Courtesy of GENERAL MOTORS COMPANY

8. Remove Brake Master Cylinder (1)
9. Remove Brake Master Cylinder Seal (2)
10. Remove Brake Master Cylinder Reservoir @ Brake Master Cylinder. Refer to [Master Cylinder Reservoir Replacement](#)

Installation Procedure

1. Install Brake Master Cylinder Reservoir @ Brake Master Cylinder. Refer to [Master Cylinder Reservoir Replacement](#)

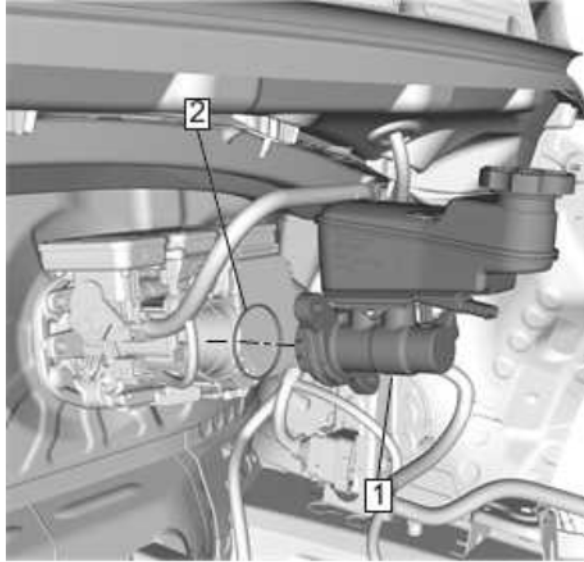


Fig. 19: Brake Master Cylinder And Seal
 Courtesy of GENERAL MOTORS COMPANY

2. Install Brake Master Cylinder Seal (2)
3. Install Brake Master Cylinder (1)

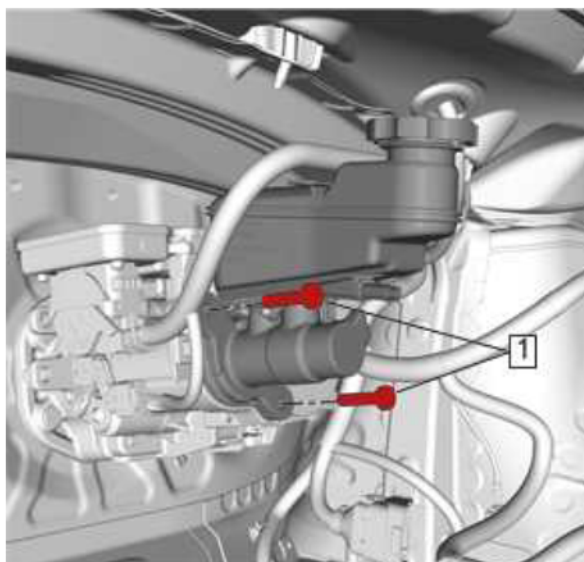


Fig. 20: Brake Master Cylinder Bolts
 Courtesy of GENERAL MOTORS COMPANY

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

4. Install and tighten Brake Master Cylinder Bolts (1) (Qty: 2) to 22 N.m (16 lb ft)

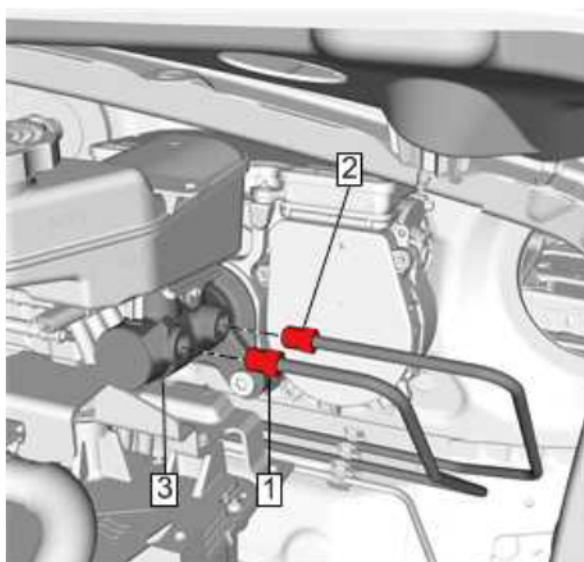


Fig. 21: BPMV Front And Rear Pipe Fittings At Brake Master Cylinder
Courtesy of GENERAL MOTORS COMPANY

5. Install and tighten Brake Pressure Modulator Valve Rear Pipe Fitting (2) @ Brake Master Cylinder (3) to 25 N.m (18 lb ft)
6. Install and tighten Brake Pressure Modulator Valve Front Pipe Fitting (1) @ Brake Master Cylinder (3) to 25 N.m (18 lb ft)

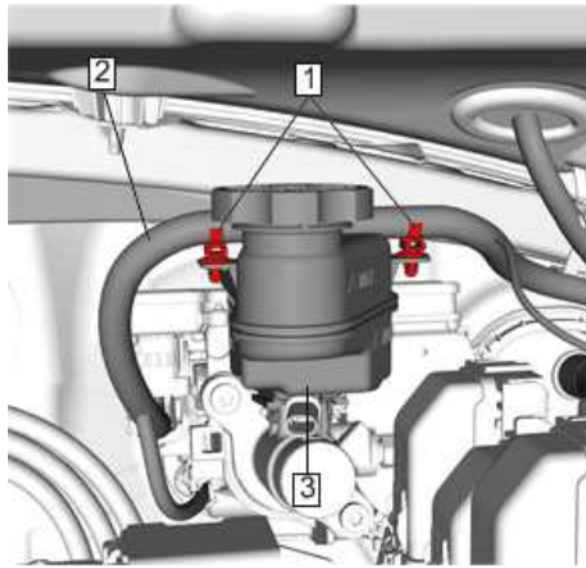


Fig. 22: Brake Master Cylinder Reservoir, Wiring Harness And Clips
Courtesy of GENERAL MOTORS COMPANY

7. Install Body Wiring Harness (2) @ Brake Master Cylinder Reservoir (3)
8. Install Clips (1) (Qty: 2) @ Brake Master Cylinder Reservoir (3)

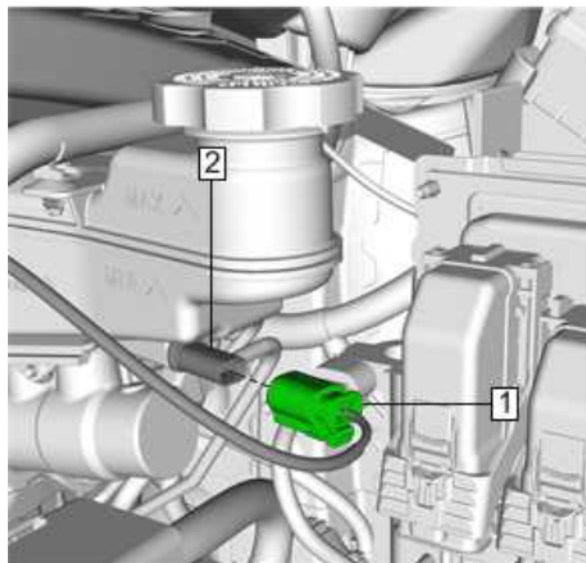


Fig. 23: Brake Fluid Level Indicator Switch And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

9. Connect Electrical Connector (1) @ Brake Fluid Level Indicator Switch (2)
10. Install Engine Control Module @ Vehicle. Refer to [**Engine Control Module Replacement**](#)
11. Bleed the brake system. Refer to [**Hydraulic Brake System Bleeding**](#)

BRAKE FLUID LEVEL INDICATOR SWITCH REPLACEMENT

Removal Procedure

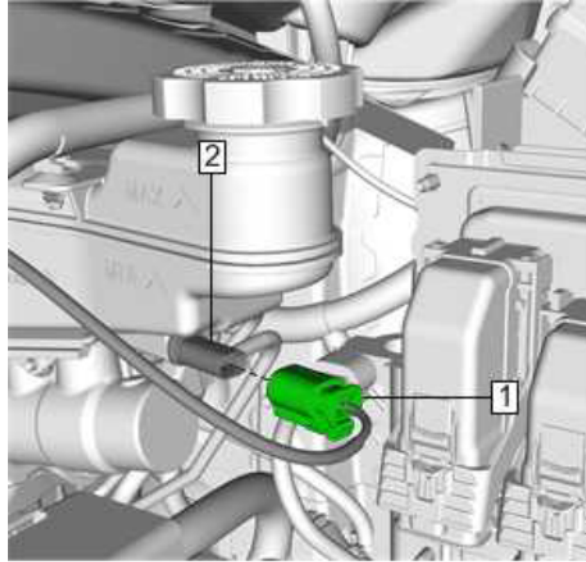


Fig. 24: Brake Fluid Level Indicator Switch And Electrical Connector
 Courtesy of GENERAL MOTORS COMPANY

1. Disconnect Electrical Connector (1) @ Brake Fluid Level Indicator Switch (2)

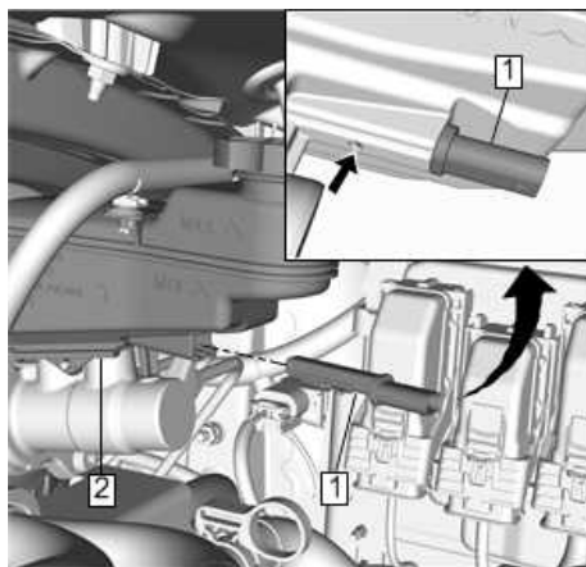


Fig. 25: Brake Fluid Level Indicator Switch And Brake Master Cylinder Reservoir
 Courtesy of GENERAL MOTORS COMPANY

2. Using an appropriate tool, lift upward to release the brake fluid level indicator switch locking tab.
3. Remove Brake Fluid Level Indicator Switch (1) @ Brake Master Cylinder Reservoir (2)

Installation Procedure

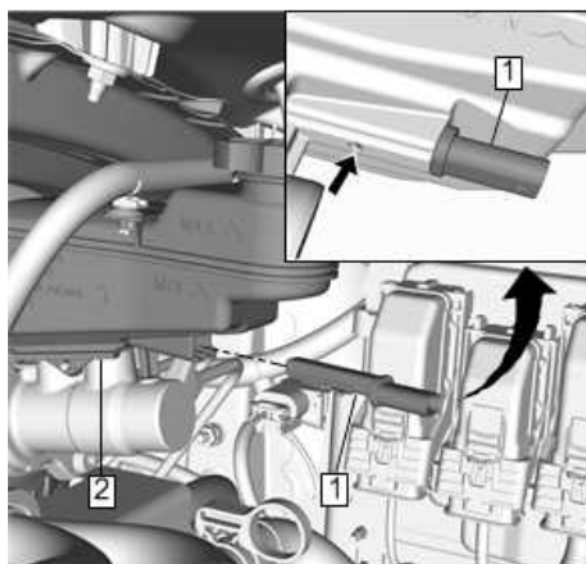


Fig. 26: Brake Fluid Level Indicator Switch And Brake Master Cylinder Reservoir
Courtesy of GENERAL MOTORS COMPANY

1. Install Brake Fluid Level Indicator Switch (1) @ Brake Master Cylinder Reservoir (2)
2. Ensure the brake fluid level indicator switch locking tab is fully engaged.

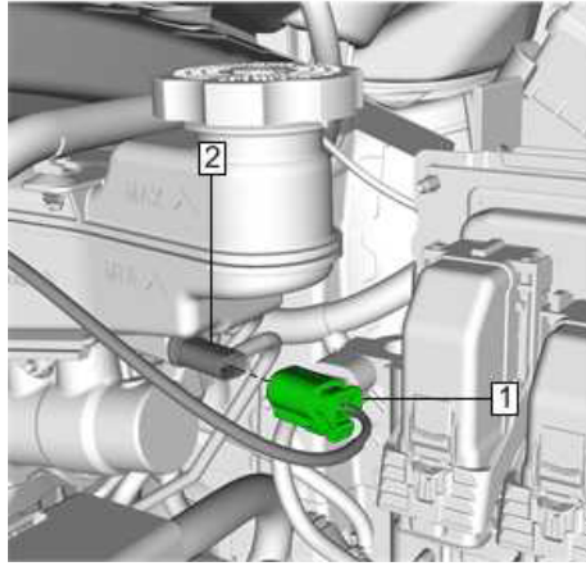


Fig. 27: Brake Fluid Level Indicator Switch And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

3. Connect Electrical Connector (1) @ Brake Fluid Level Indicator Switch (2)

BRAKE AND ACCELERATOR PEDAL ASSEMBLY REPLACEMENT

Removal Procedure

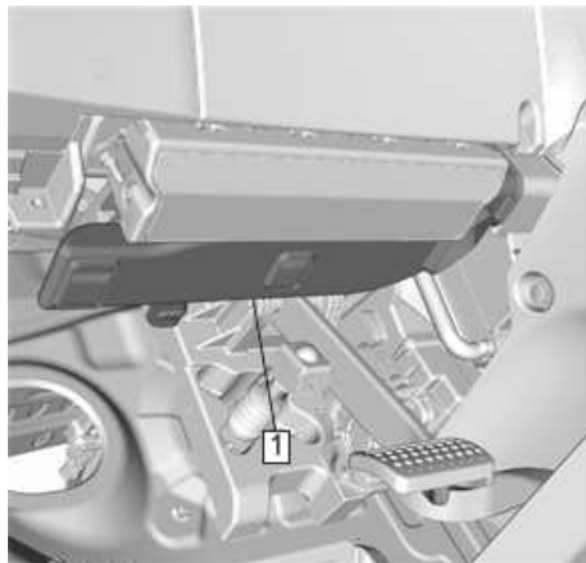


Fig. 28: Floor Front Air Outlet Duct - Left Side
Courtesy of GENERAL MOTORS COMPANY

1. Remove Floor Front Air Outlet Duct - Left Side (1). Refer to **Floor Front Air Outlet Duct Replacement - Left Side**

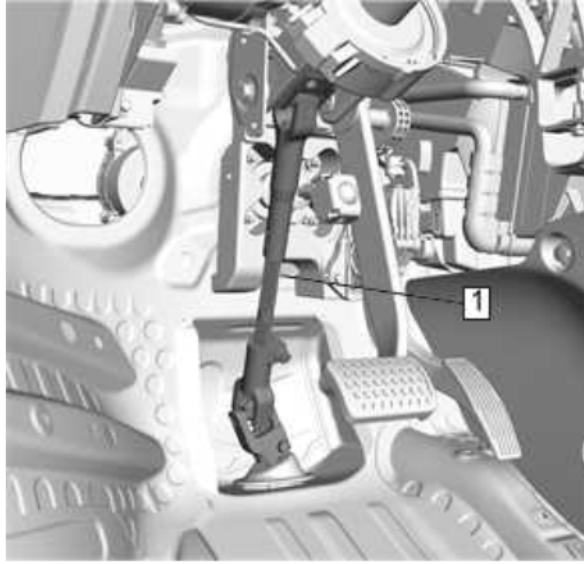


Fig. 29: Intermediate Steering Shaft

Courtesy of GENERAL MOTORS COMPANY

2. Remove Intermediate Steering Shaft (1). Refer to [Intermediate Steering Shaft Replacement](#)

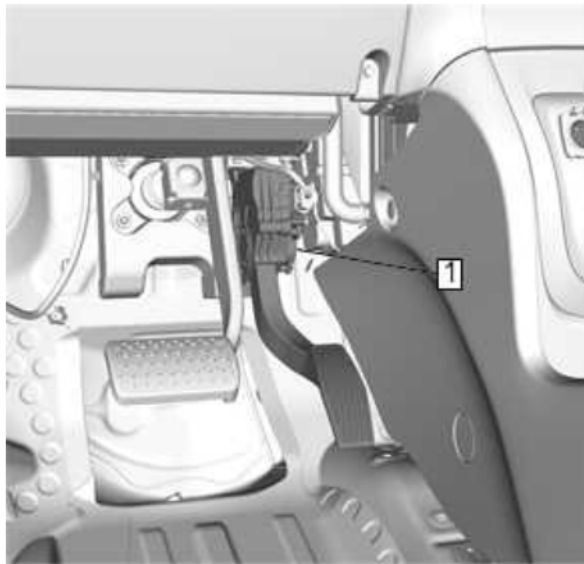


Fig. 30: Accelerator Pedal Assembly

Courtesy of GENERAL MOTORS COMPANY

3. Remove Accelerator Pedal Assembly (1) @ Vehicle. Refer to [Accelerator Pedal Assembly Replacement](#)

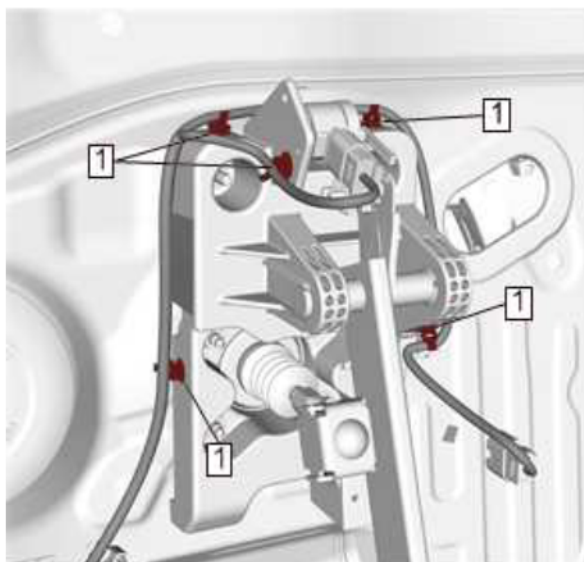


Fig. 31: Body Wiring Harness Retainers

Courtesy of GENERAL MOTORS COMPANY

4. Unclip Body Wiring Harness Retainers (1) (Qty: 5) @ Vehicle

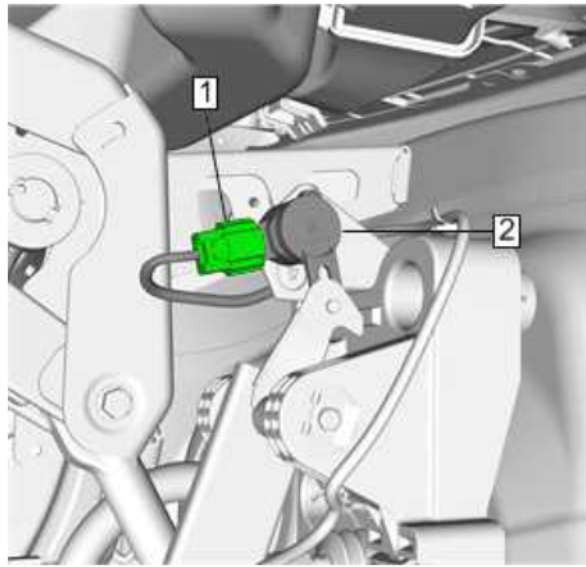


Fig. 32: Brake Pedal Position Sensor And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Electrical Connector (1) @ Brake Pedal Position Sensor (2)

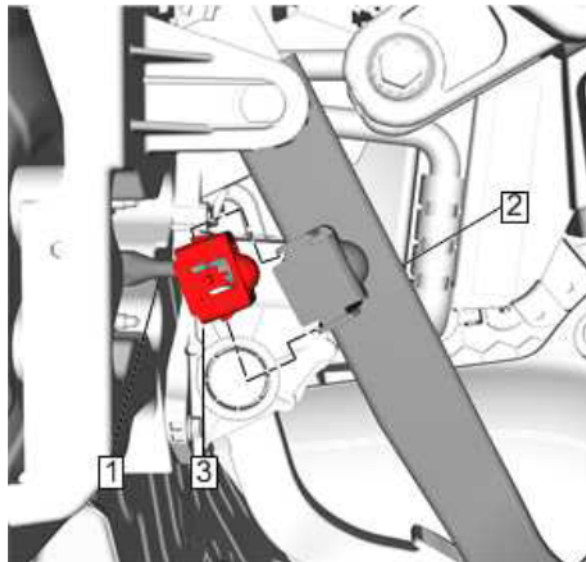


Fig. 33: Brake Pedal, Pushrod And Click Fit Connector
Courtesy of GENERAL MOTORS COMPANY

6. Disconnect Brake Pedal Pushrod (1) @ Brake Pedal (2)

Press the 2 tabs of the click fit connector (3) together and pull the brake pedal a bit to facilitate the removal.

7. Remove and DISCARD Click Fit Connector (3) @ Brake Pedal Pushrod (1)

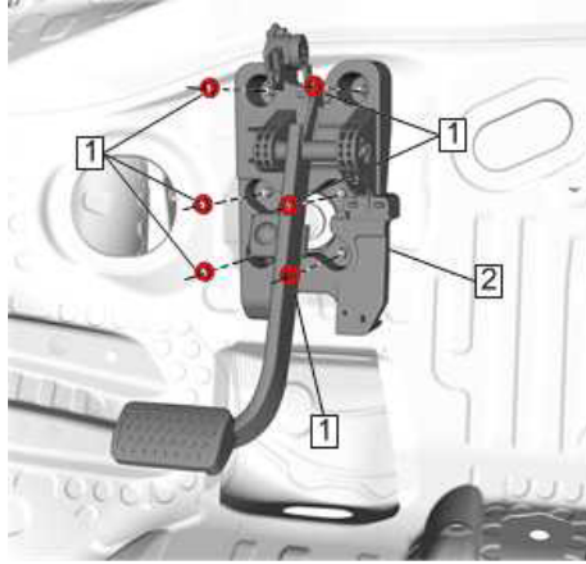


Fig. 34: Brake/Accelerator Pedal Assembly And Nuts
 Courtesy of GENERAL MOTORS COMPANY

8. Remove Brake Pedal Nuts (1) (Qty: 6)
9. Remove Brake and Accelerator Pedal Assembly (2) @ Vehicle
10. Remove Brake Pedal Position Sensor. Refer to [Brake Pedal Position Sensor Replacement](#)

Installation Procedure

1. Install Brake Pedal Position Sensor. Refer to [Brake Pedal Position Sensor Replacement](#)

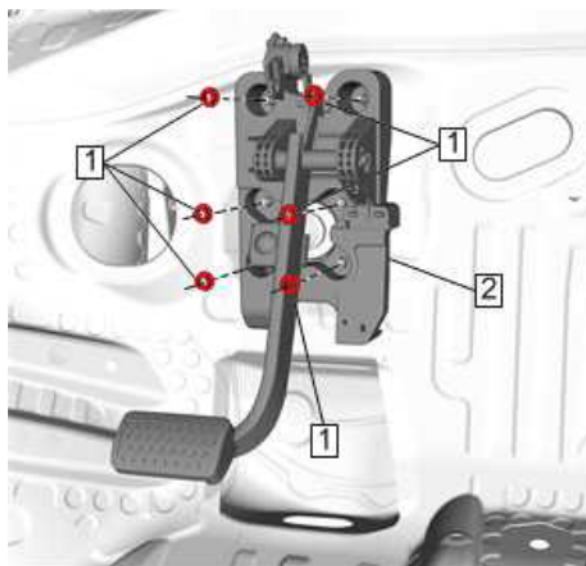


Fig. 35: Brake/Accelerator Pedal Assembly And Nuts
 Courtesy of GENERAL MOTORS COMPANY

2. Install Brake and Accelerator Pedal Assembly (2) @ Vehicle

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

3. Install and tighten Brake Pedal Nuts (1) (Qty: 6) to 22 N.m (16 lb ft)

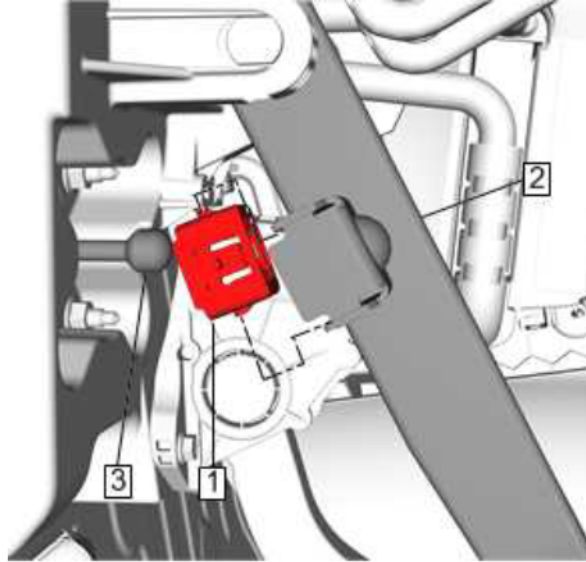


Fig. 36: Brake Pedal, Pushrod And Click Fit Connector
 Courtesy of GENERAL MOTORS COMPANY

4. Install NEW Click Fit Connector (1) @ Brake Pedal (2)
5. Connect Brake Pedal Pushrod (3) @ Brake Pedal (2)

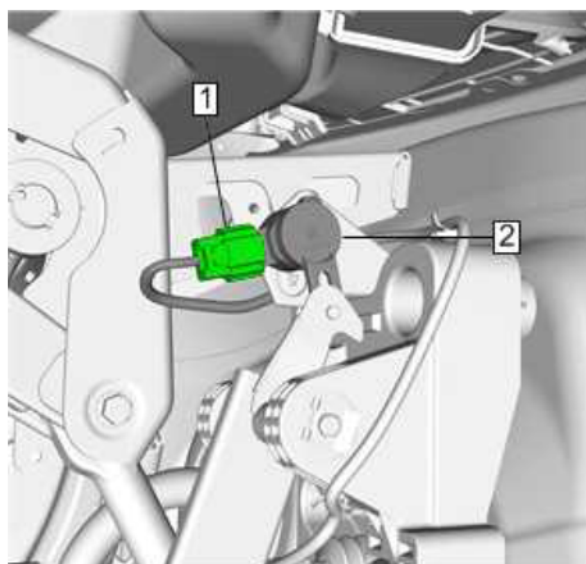


Fig. 37: Brake Pedal Position Sensor And Electrical Connector
 Courtesy of GENERAL MOTORS COMPANY

6. Connect Electrical Connector (1) @ Brake Pedal Position Sensor (2)

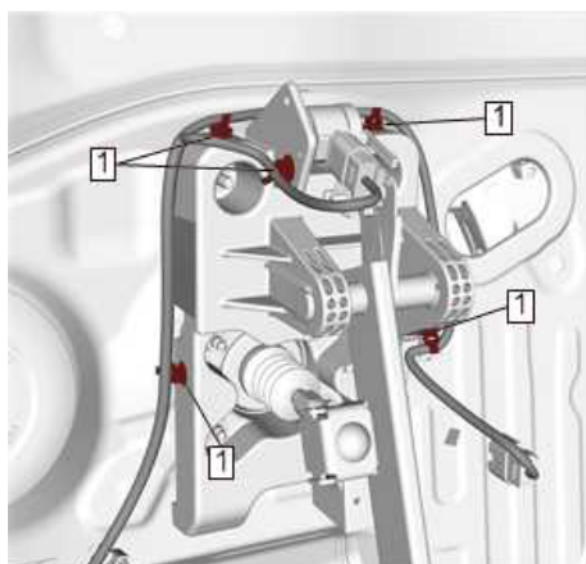


Fig. 38: Body Wiring Harness Retainers
 Courtesy of GENERAL MOTORS COMPANY

7. Install Body Wiring Harness Retainers (1) (Qty: 5) @ Vehicle

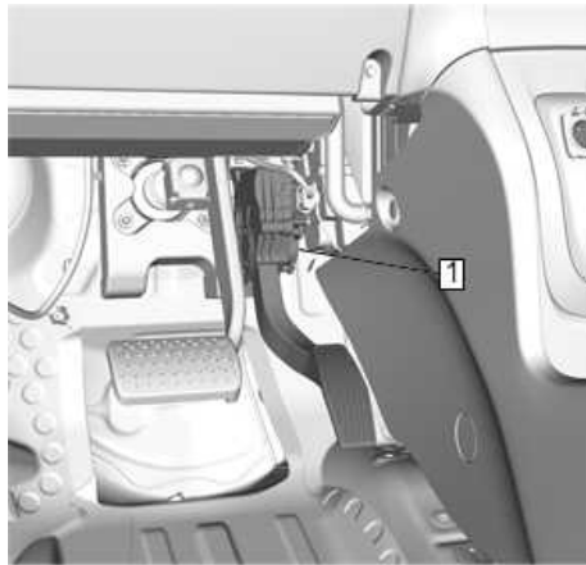


Fig. 39: Accelerator Pedal Assembly

Courtesy of GENERAL MOTORS COMPANY

8. Install Accelerator Pedal Assembly (1) @ Vehicle. Refer to [Accelerator Pedal Assembly Replacement](#)

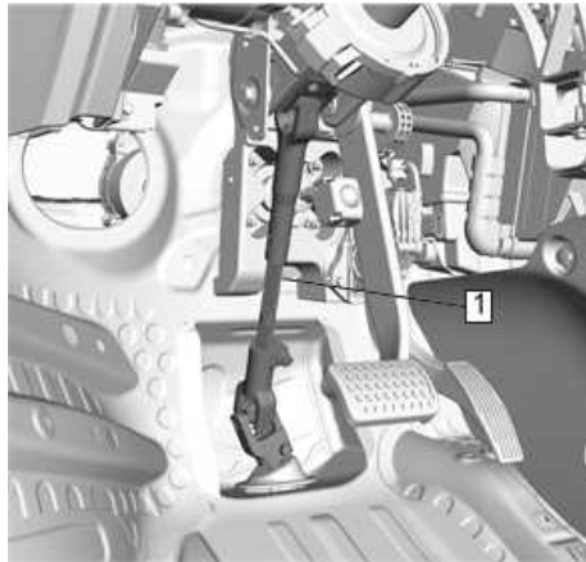
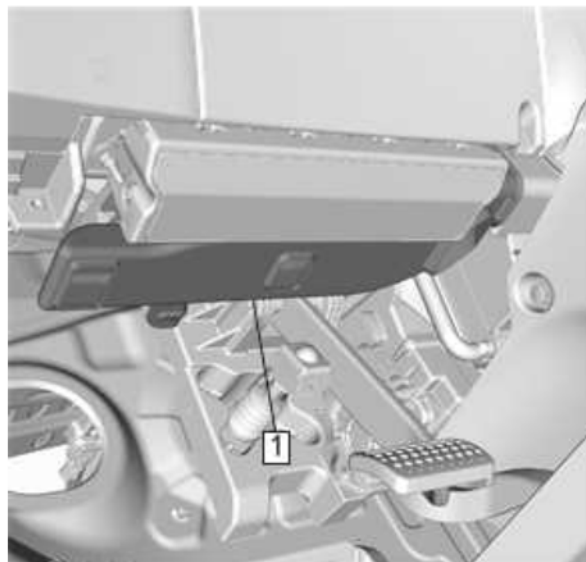


Fig. 40: Intermediate Steering Shaft

Courtesy of GENERAL MOTORS COMPANY

9. Install Intermediate Steering Shaft (1). Refer to [Intermediate Steering Shaft Replacement](#)



10. Install Floor Front Air Outlet Duct - Left Side (1). Refer to [Floor Front Air Outlet Duct Replacement - Left Side](#)

BRAKE PRESSURE MODULATOR VALVE FRONT PIPE REPLACEMENT

Removal Procedure

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

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

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Remove Engine Control Module @ Vehicle. Refer to [Engine Control Module Replacement](#)
3. Clean all dirt and foreign material from the brake pipe fitting.

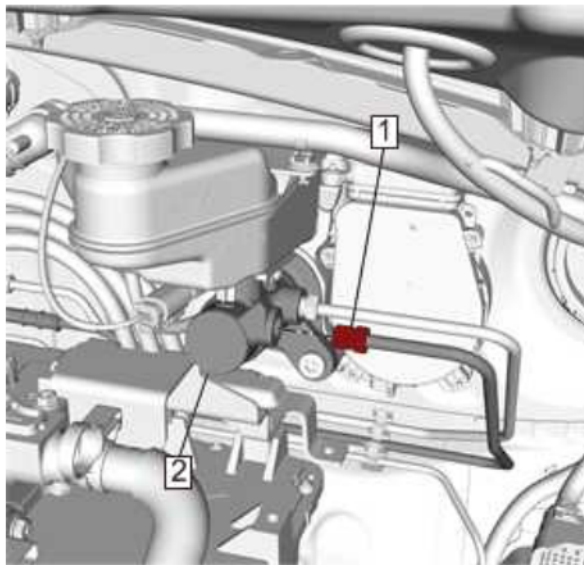


Fig. 42: Brake Pressure Modulator Valve Front Pipe Fitting And Brake Master Cylinder
Courtesy of GENERAL MOTORS COMPANY

NOTE: Cap the brake pipe fitting and plug the brake master cylinder outlet port to prevent brake fluid loss and contamination.

4. Remove Brake Pressure Modulator Valve Front Pipe Fitting (1) @ Brake Master Cylinder (2)

Drain the brake fluid out of the master cylinder.

5. Remove the radiator surge tank bolts and reposition the heater surge tank from the heater surge tank bracket with the hoses connected. Refer to [Heater Coolant Surge Tank Replacement](#)

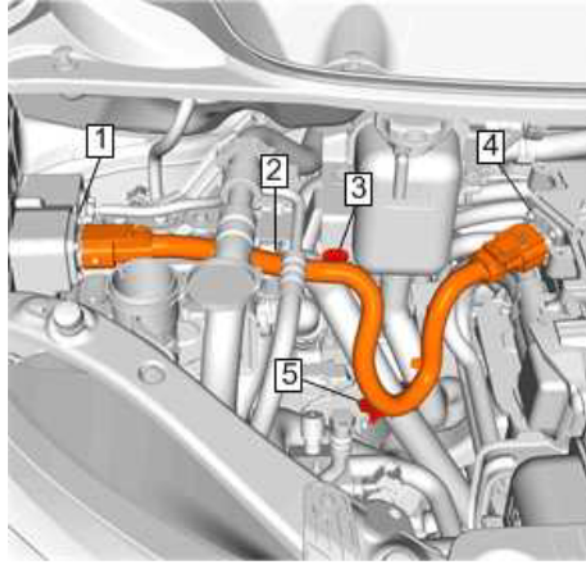


Fig. 43: Drive Motor Battery Positive and Negative Cable
 Courtesy of GENERAL MOTORS COMPANY

6. Remove Drive Motor Battery Positive and Negative Cable (1). Refer to **Drive Motor Battery Positive and Negative Cable Replacement**

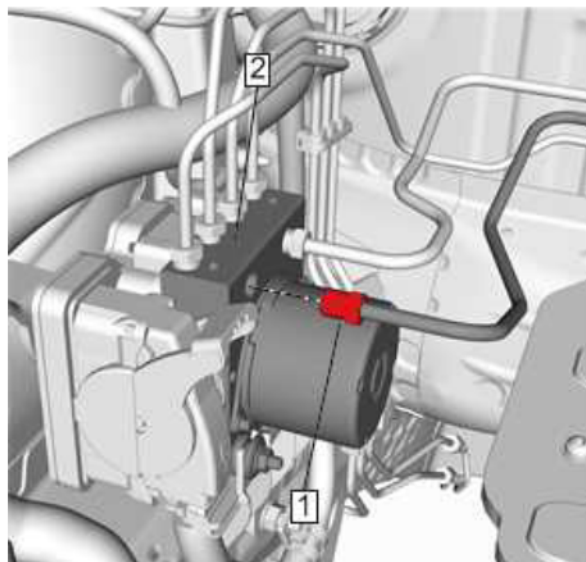


Fig. 44: Brake Pressure Modulator Valve Front Pipe Fitting And Brake Pressure Modulator Valve
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Cap the brake pipe fitting and plug the brake pressure modulator valve inlet port to prevent brake fluid loss and contamination.

- 7.
8. Remove Brake Pressure Modulator Valve Front Pipe Fitting (1) @ Brake Pressure Modulator Valve (2)

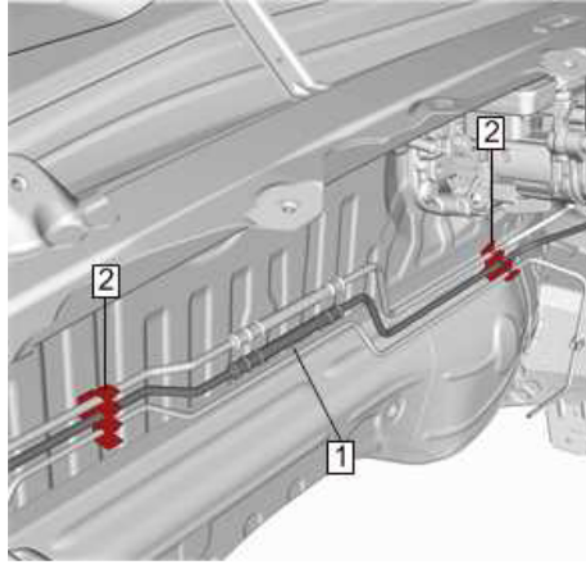


Fig. 45: Brake Pressure Modulator Valve Front Pipe And Brake Pipe Clips
 Courtesy of GENERAL MOTORS COMPANY

9. Unclip Brake Pressure Modulator Valve Front Pipe (1) @ Brake Pipe Clips (2) (Qty: 2)
10. Remove Brake Pressure Modulator Valve Front Pipe (1) @ Vehicle

Installation Procedure

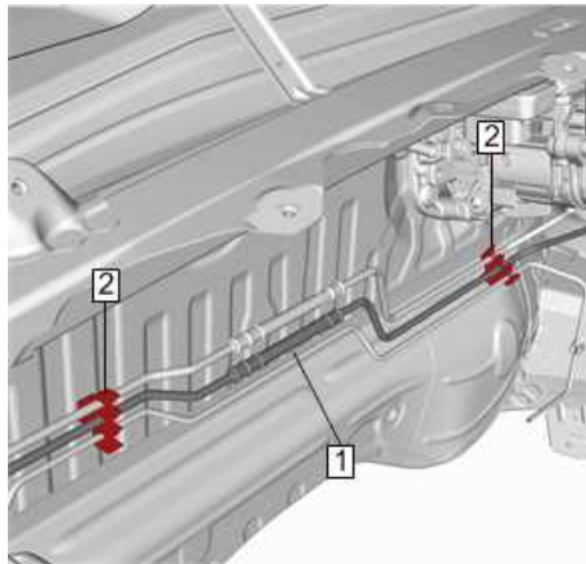
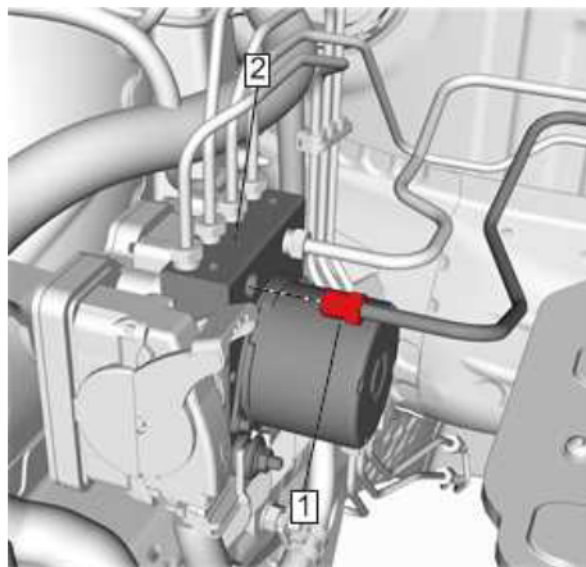


Fig. 46: Brake Pressure Modulator Valve Front Pipe And Brake Pipe Clips
 Courtesy of GENERAL MOTORS COMPANY

1. Install Brake Pressure Modulator Valve Front Pipe (1) @ Vehicle
2. Install Brake Pressure Modulator Valve Front Pipe (1) @ Brake Pipe Clips (2) (Qty: 2)



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

3. Install and tighten Brake Pressure Modulator Valve Front Pipe Fitting (1) @ Brake Pressure Modulator Valve (2) to 25 N.m (18 lb ft)

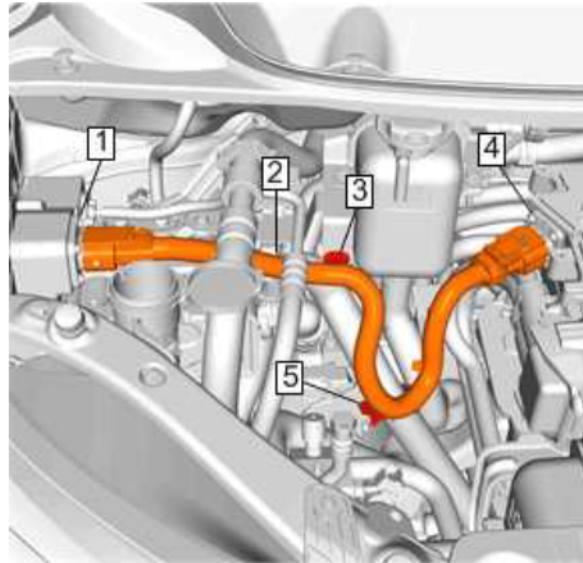


Fig. 48: Drive Motor Battery Positive and Negative Cable

4. Install Drive Motor Battery Positive and Negative Cable (1). Refer to [Drive Motor Battery Positive and Negative Cable Replacement](#)
5. Install the heater surge tank to the heater surge tank bracket. Refer to [Heater Coolant Surge Tank Replacement](#)

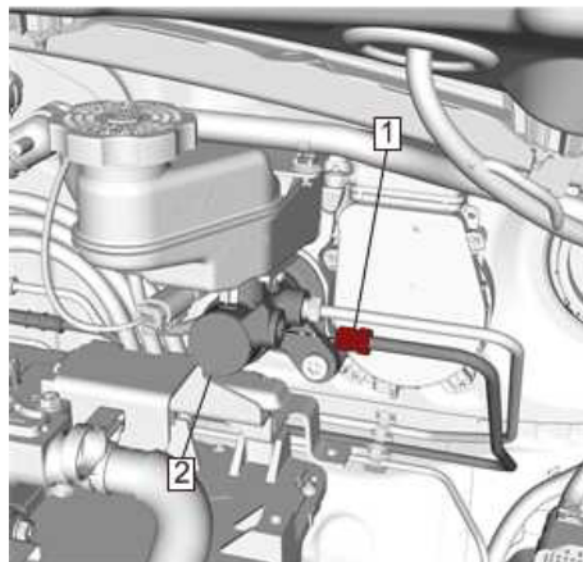


Fig. 49: Brake Pressure Modulator Valve Front Pipe Fitting And Brake Master Cylinder

6. Install and tighten Brake Pressure Modulator Valve Front Pipe Fitting (1) @ Brake Master Cylinder (2) to 25 N.m (18 lb ft)
7. Install Engine Control Module @ Vehicle. Refer to [Engine Control Module Replacement](#)
8. Enable the high voltage system. Refer to [High Voltage Enabling](#)
9. Bleed the brake system. Refer to [Hydraulic Brake System Bleeding](#)

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

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

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Remove Engine Control Module @ Vehicle. Refer to [Engine Control Module Replacement](#)
3. Clean all dirt and foreign material from the brake pipe fitting.

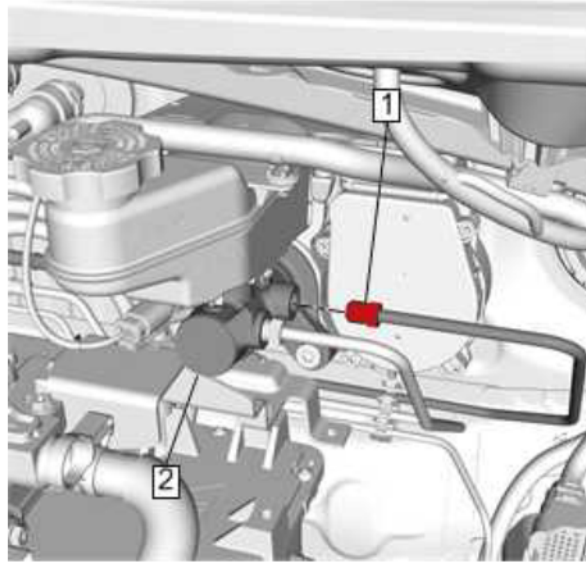


Fig. 50: Brake Pressure Modulator Valve Rear Pipe Fitting And Brake Master Cylinder
Courtesy of GENERAL MOTORS COMPANY

NOTE: Cap the brake pipe fitting and plug the brake master cylinder outlet port to prevent brake fluid loss and contamination.

4. Remove Brake Pressure Modulator Valve Rear Pipe Fitting (1) @ Brake Master Cylinder (2)

Drain the brake fluid out of the master cylinder.

5. Remove the radiator surge tank bolts and reposition the heater surge tank from the heater surge tank bracket with the hoses connected. Refer to [Heater Coolant Surge Tank Replacement](#)

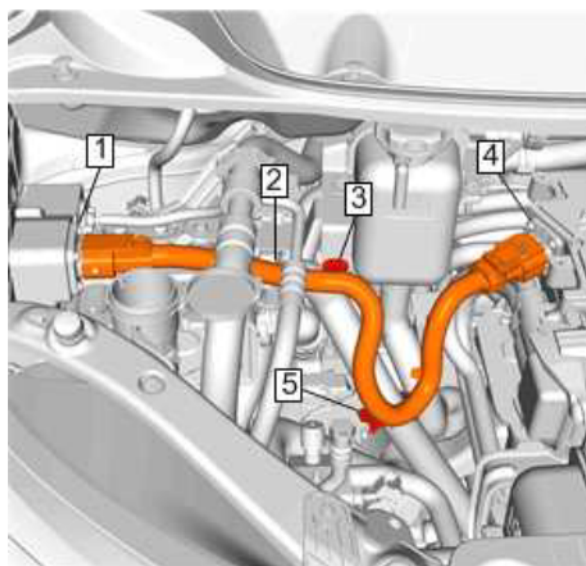


Fig. 51: Drive Motor Battery Positive and Negative Cable
Courtesy of GENERAL MOTORS COMPANY

6. Remove Drive Motor Battery Positive and Negative Cable (1). Refer to [Drive Motor Battery Positive and Negative Cable Replacement](#)

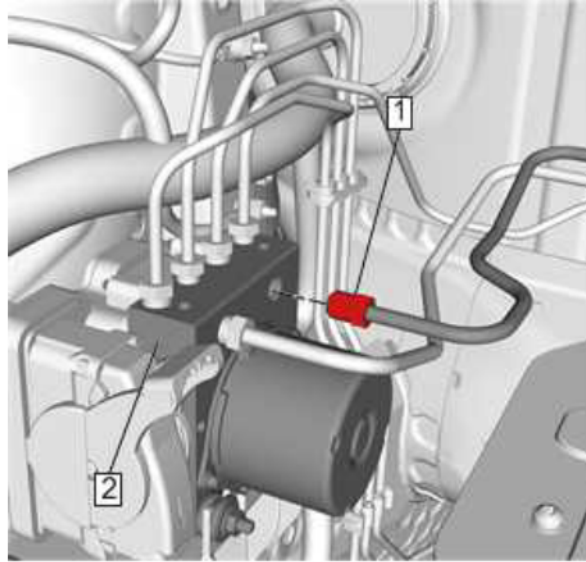


Fig. 52: Brake Pressure Modulator Valve Rear Pipe Fitting And Brake Pressure Modulator Valve

Courtesy of GENERAL MOTORS COMPANY

NOTE: Cap the brake pipe fitting and plug the brake pressure modulator valve inlet port to prevent brake fluid loss and contamination.

- 7.
8. Remove Brake Pressure Modulator Valve Rear Pipe Fitting (1) @ Brake Pressure Modulator Valve (2)

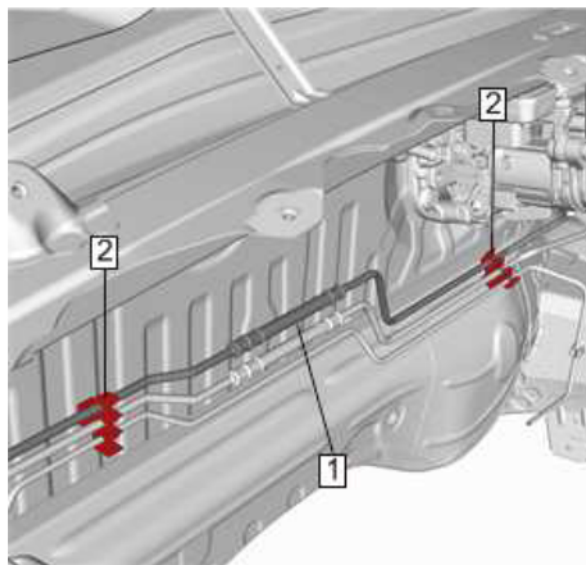


Fig. 53: Brake Pressure Modulator Valve Rear Pipe And Brake Pipe Clips

Courtesy of GENERAL MOTORS COMPANY

9. Unclip Brake Pressure Modulator Valve Rear Pipe (1) @ Brake Pipe Clips (2) (Qty: 2)
10. Remove Brake Pressure Modulator Valve Rear Pipe (1) @ Vehicle

Installation Procedure

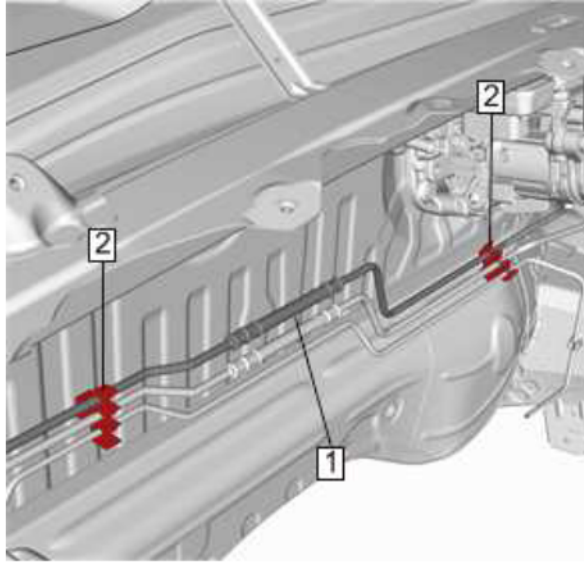


Fig. 54: Brake Pressure Modulator Valve Rear Pipe And Brake Pipe Clips
 Courtesy of GENERAL MOTORS COMPANY

1. Install Brake Pressure Modulator Valve Rear Pipe (1) @ Vehicle
2. Install Brake Pressure Modulator Valve Rear Pipe (1) @ Brake Pipe Clips (2) (Qty: 2)

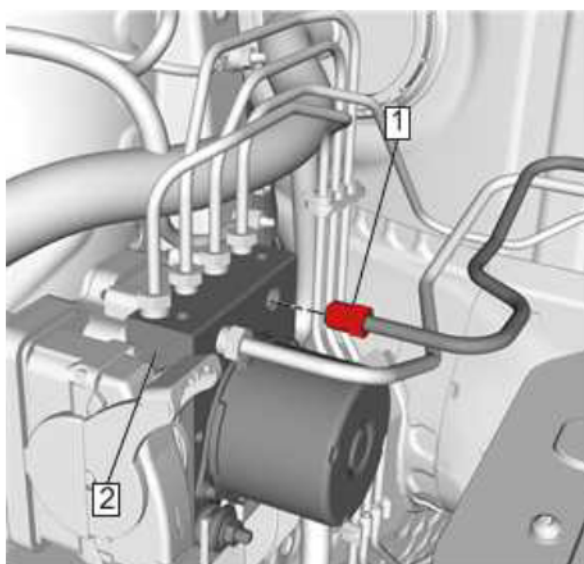


Fig. 55: Brake Pressure Modulator Valve Rear Pipe Fitting And Brake Pressure Modulator Valve
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

3. Install and tighten Brake Pressure Modulator Valve Rear Pipe Fitting (1) @ Brake Pressure Modulator Valve (2) to 25 N.m (18 lb ft)

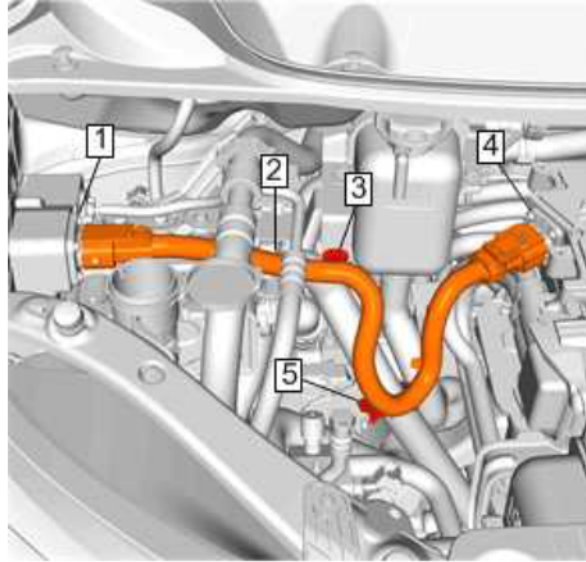


Fig. 56: Drive Motor Battery Positive and Negative Cable
 Courtesy of GENERAL MOTORS COMPANY

4. Install Drive Motor Battery Positive and Negative Cable (1). Refer to [Drive Motor Battery Positive and Negative Cable Replacement](#)
5. Install the heater surge tank to the heater surge tank bracket. Refer to [Heater Coolant Surge Tank Replacement](#)

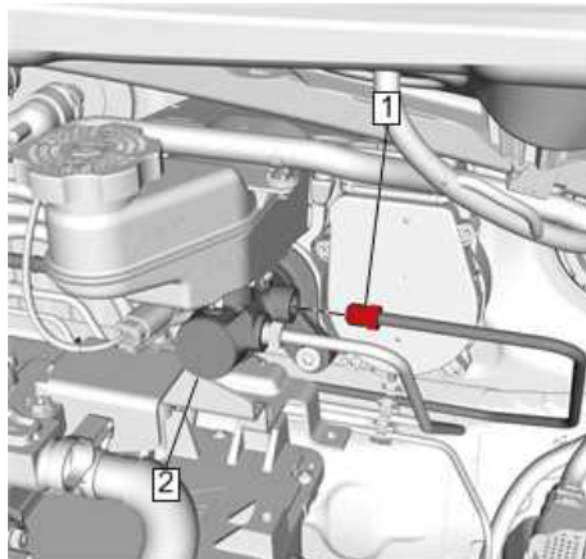


Fig. 57: Brake Pressure Modulator Valve Rear Pipe Fitting And Brake Master Cylinder
 Courtesy of GENERAL MOTORS COMPANY

6. Install and tighten Brake Pressure Modulator Valve Rear Pipe Fitting (1) @ Brake Master Cylinder (2) to 25 N.m (18 lb ft)
7. Install Engine Control Module @ Vehicle. Refer to [Engine Control Module Replacement](#)
8. Enable the high voltage system. Refer to [High Voltage Enabling](#)
9. Bleed the brake system. Refer to [Hydraulic Brake System Bleeding](#)

BRAKE PIPE REPLACEMENT

Special Tools

CH-45405 Brake Pipe Flaring Kit

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

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

WARNING: Always use double walled steel brake pipe when replacing brake pipes.

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

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

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

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

1. Inspect the area of brake pipe to be repaired or replaced.
2. Remove components as necessary to gain access to the brake pipe to be repaired or replaced.
3. Release the brake pipe to be replaced from the retainers, as required.
4. 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.
5. Using a string or wire, measure the length of the pipe to be replaced including all pipe bends.
6. 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

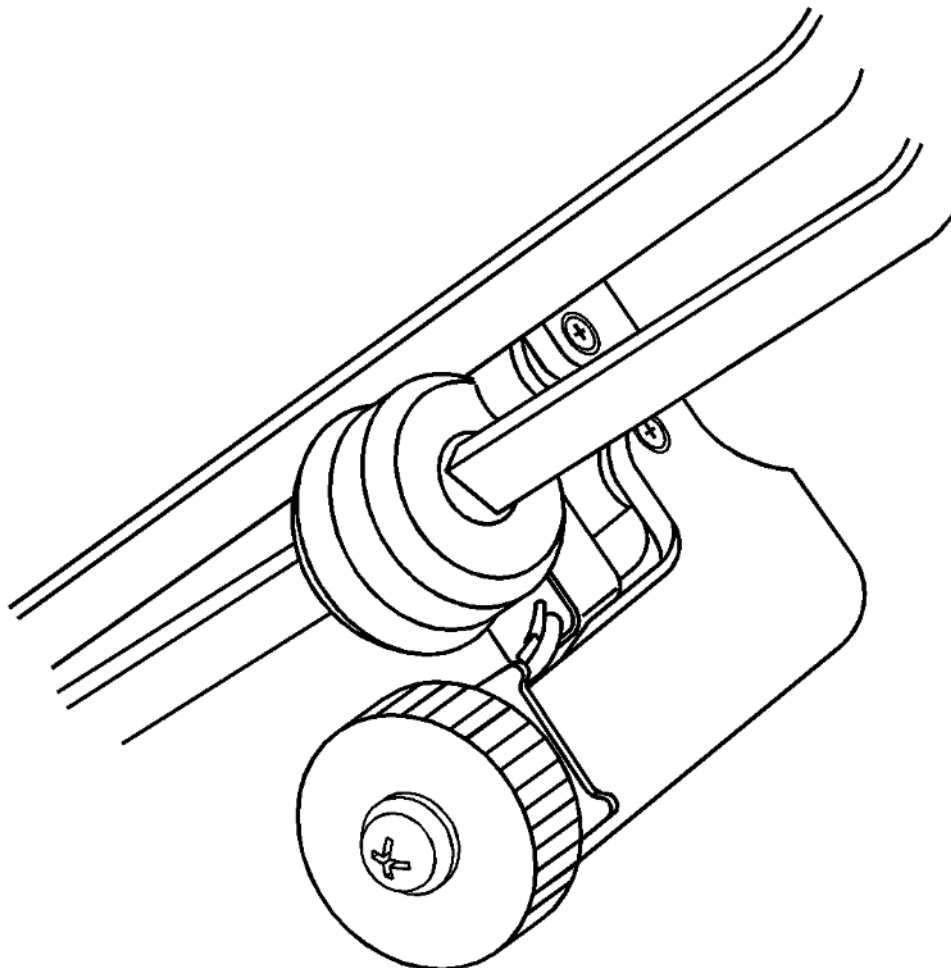


Fig. 58: Brake Pipe And Pipe Cutter

Courtesy of GENERAL MOTORS COMPANY

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

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

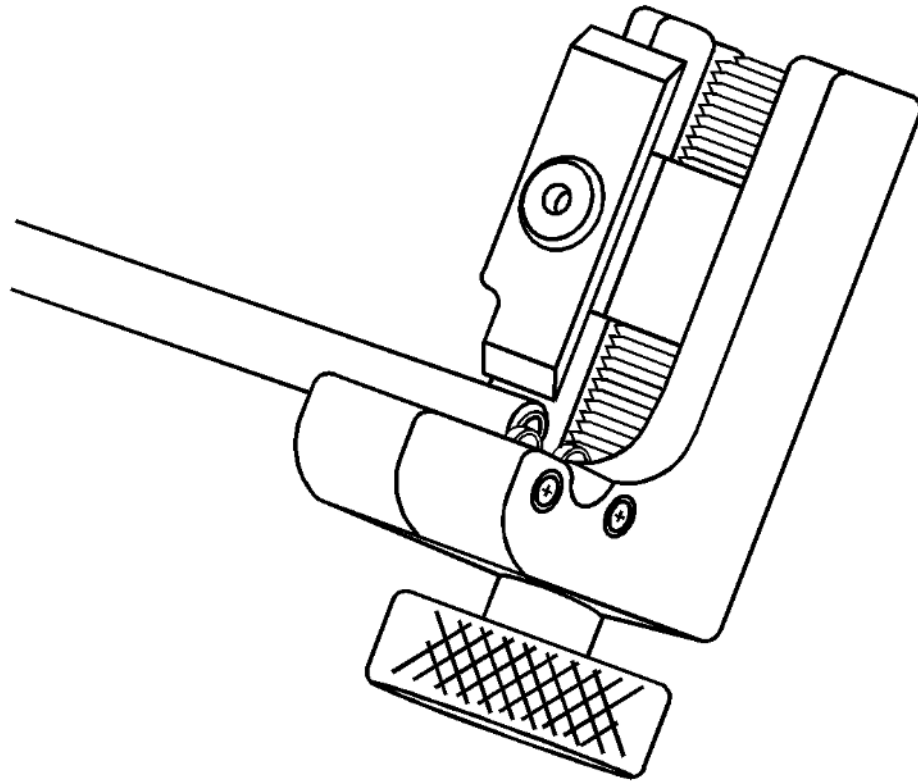


Fig. 59: Stripping Nylon Coating From Brake Pipe Ends
Courtesy of GENERAL MOTORS COMPANY

10. Strip the nylon coating from the brake pipe end to be flared, if necessary.
- Select the appropriate blade on the coating stripping tool included in the **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
- Insert the brake pipe end to be flared into the stripping tool to the depth of the ledge on the tool rollers.
- While holding the brake pipe firmly against the stripping tool roller ledges, rotate the thumbwheel of the tool until the blade contacts the brake pipe coated surface.

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

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

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

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

Specification

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

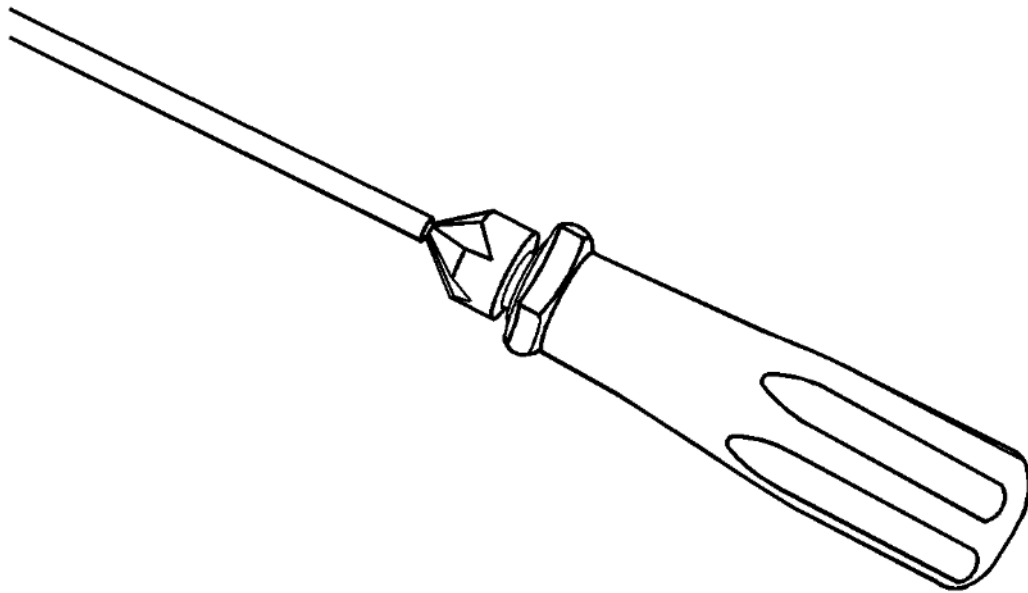


Fig. 60: Chamfering Pipe Using De-Burring Tool
Courtesy of GENERAL MOTORS COMPANY

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

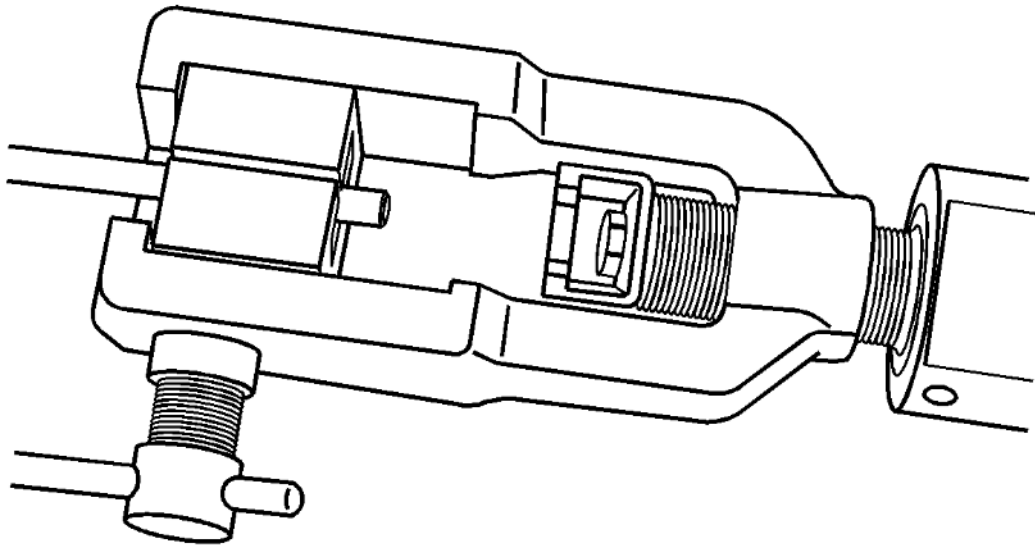


Fig. 61: Installing Die Halves Into Die Cage

Courtesy of GENERAL MOTORS COMPANY

14. Loosen the die clamping screw of the **CH-45405** Brake Pipe Flaring Kit.
15. Select the corresponding die set and install the die halves into the die cage with the full, flat face of one die facing the clamping screw, and the counterbores of both dies facing the forming ram.

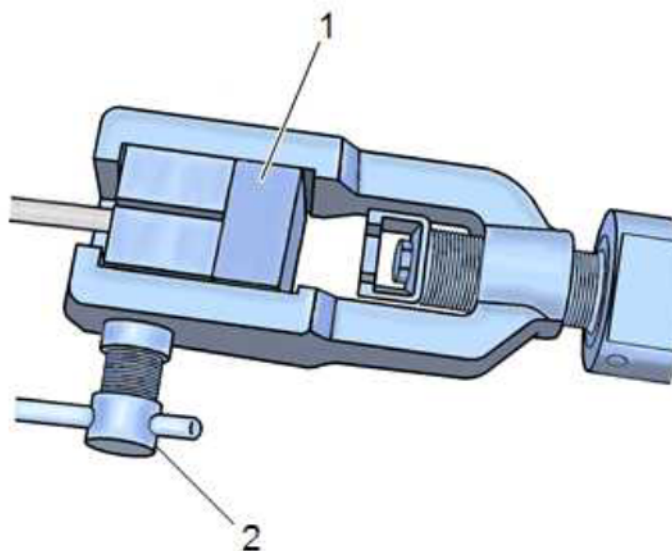


Fig. 62: Clamping Screw And Unused Die

Courtesy of GENERAL MOTORS COMPANY

16. 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.
17. 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).
18. Remove the unused die (1).
19. Ensure that the rear of both dies are seated firmly against the enclosed end of the die cage.
20. Firmly hand tighten the clamping screw (2) against the dies.

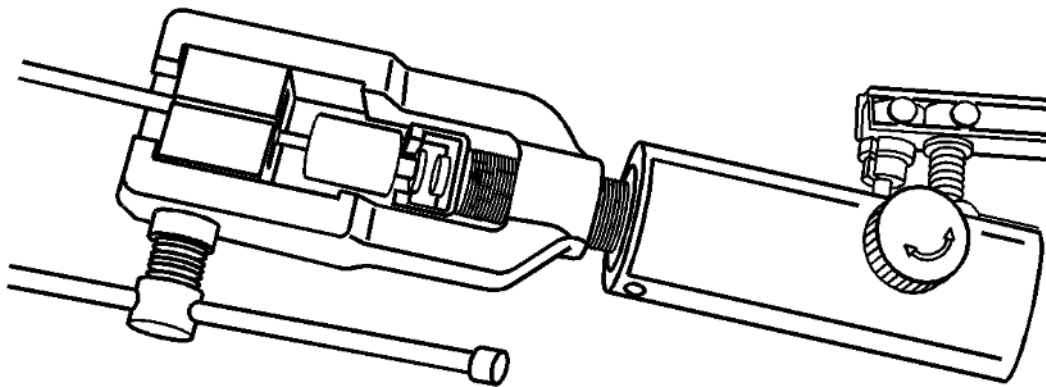


Fig. 63: Rotating Body Of Special Tool To Bottom Against Die Cage
Courtesy of GENERAL MOTORS COMPANY

21. Select the appropriate forming mandrel and place into the forming ram.
22. Rotate the hydraulic fluid control valve clockwise to the closed position.
23. Rotate the body of the **CH-45405** Brake Pipe Flaring Kit until it bottoms against the die cage.

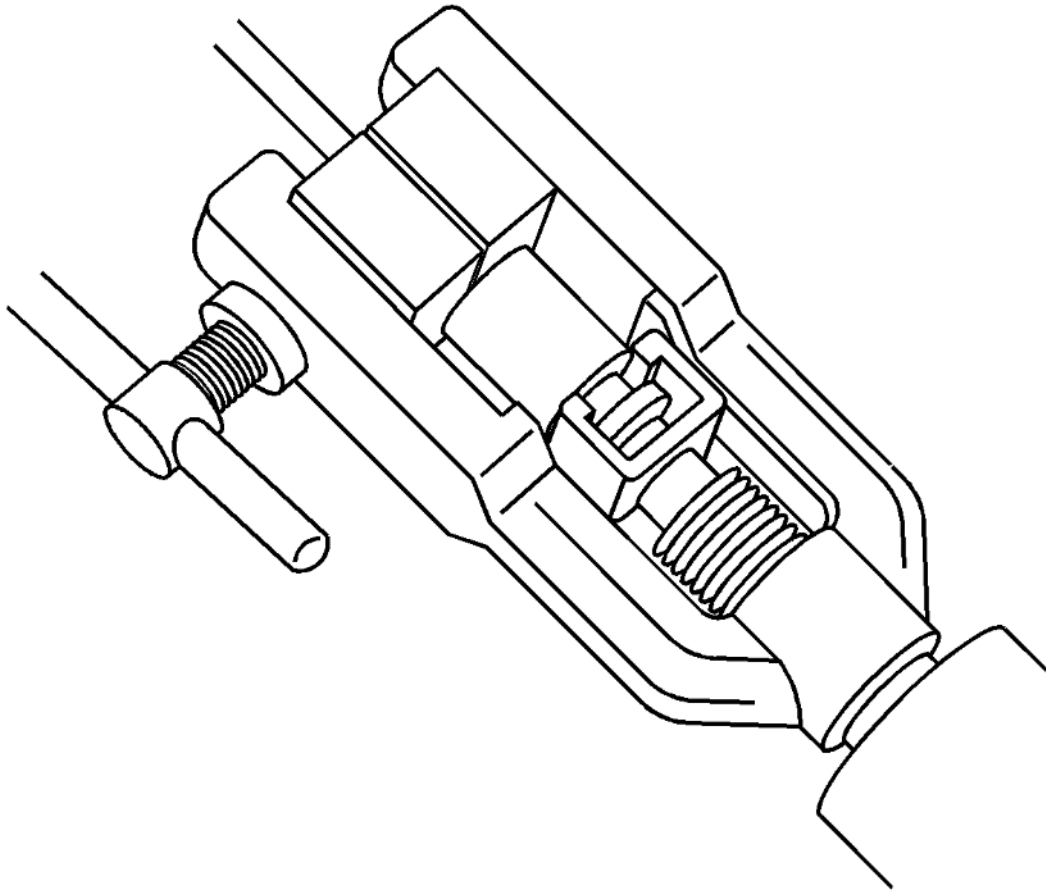


Fig. 64: Bottoming Forming Mandrel Against Clamping Dies Using Pipe Flaring Tool
Courtesy of GENERAL MOTORS COMPANY

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

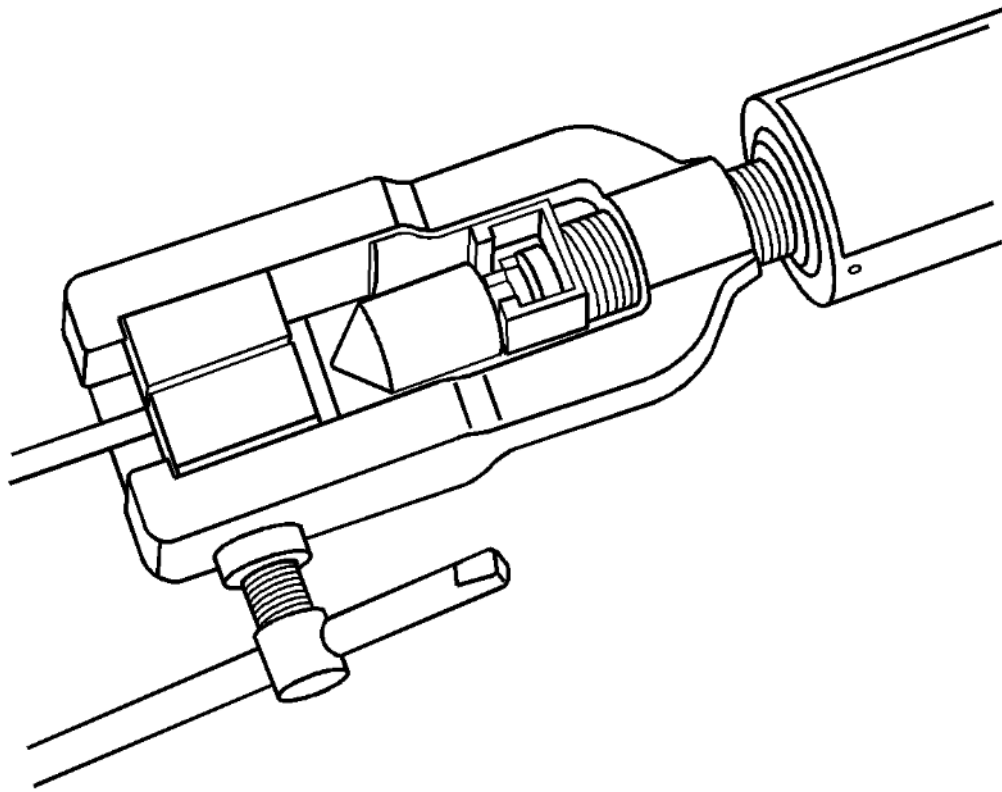


Fig. 65: Finishing Cone In Forming Ram
Courtesy of GENERAL MOTORS COMPANY

26. Insert the finishing cone into the forming ram.
27. Rotate the hydraulic fluid control valve clockwise to the closed position.
28. Rotate the body of the **CH-45405** Brake Pipe Flaring Kit until it bottoms against the die cage.
29. 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.
30. Rotate the hydraulic fluid control valve counterclockwise to the open position to allow the hydraulic forming ram to retract.
31. Loosen the die clamping screw and remove the dies and pipe.
32. If necessary, lightly tap the dies until the die halves separate.

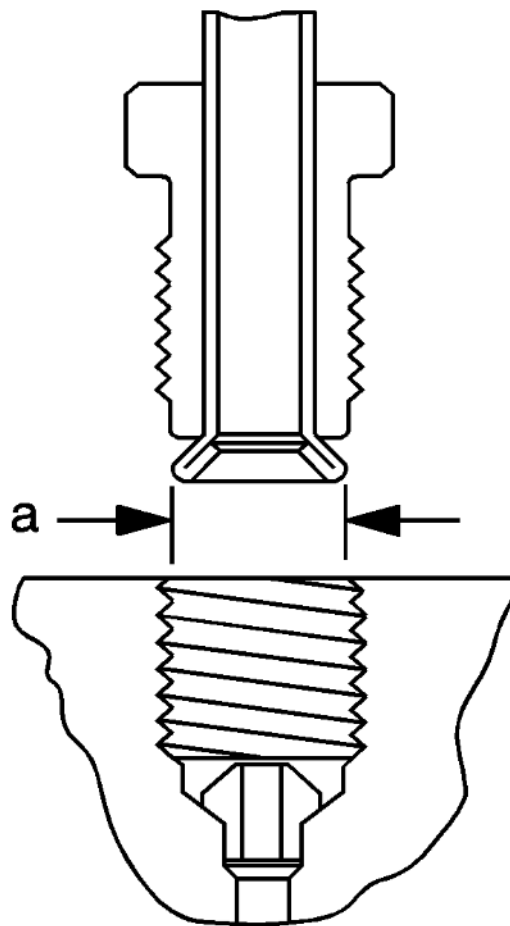


Fig. 66: Identifying Correct Brake Pipe Flare Shape & Diameter
 Courtesy of GENERAL MOTORS COMPANY

33. 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

34. 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.

35. Install the pipe to the vehicle with the appropriate brake pipe unions, as required.

36. If previously released, secure the brake pipe to the retainers.

37. Install any components that may have been removed to gain access to the brake pipe.

38. Bleed the hydraulic brake system. Refer to [Hydraulic Brake System Bleeding](#)

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

FRONT BRAKE PIPE REPLACEMENT - RIGHT SIDE

Removal Procedure

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

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Remove Front Wheelhouse Liner-Right Side @ Vehicle. Refer to [Front Wheelhouse Liner Replacement](#)
3. Remove the radiator surge tank bolts and reposition the heater surge tank from the heater surge tank bracket with the hoses connected. Refer to [Heater Coolant Surge Tank Replacement](#)

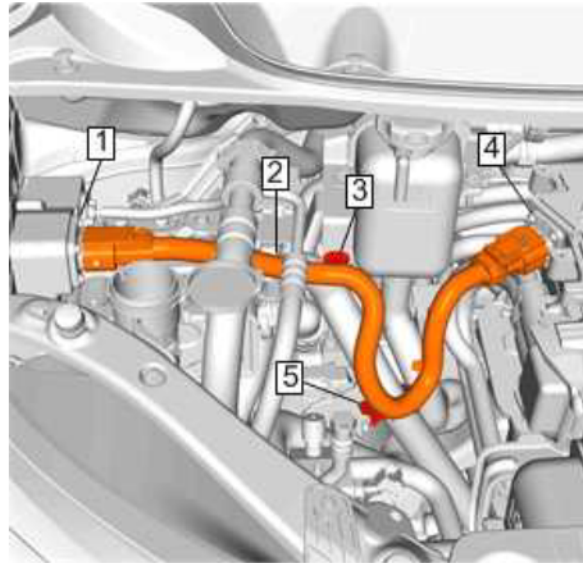


Fig. 67: Drive Motor Battery Positive and Negative Cable
Courtesy of GENERAL MOTORS COMPANY

4. Remove Drive Motor Battery Positive and Negative Cable (1). Refer to [Drive Motor Battery Positive and Negative Cable Replacement](#)

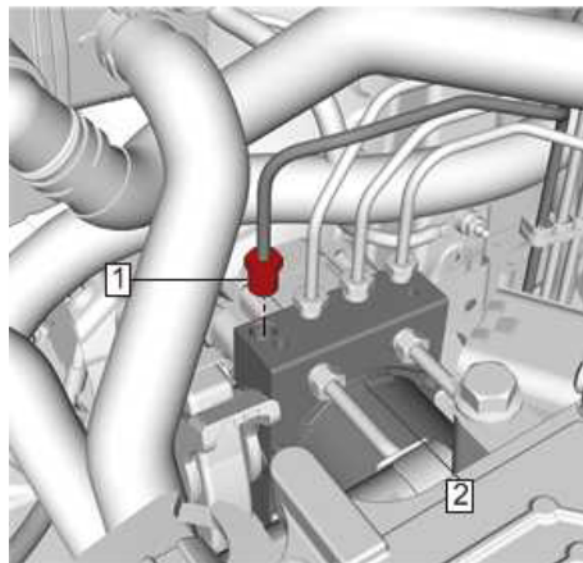


Fig. 68: Front Brake Pipe Fitting And Brake Pressure Modulator Valve
Courtesy of GENERAL MOTORS COMPANY

NOTE: Cap the brake pressure modulator valve port to prevent brake fluid loss and contamination.

5. Remove Front Brake Pipe Fitting (1) @ Brake Pressure Modulator Valve (2)

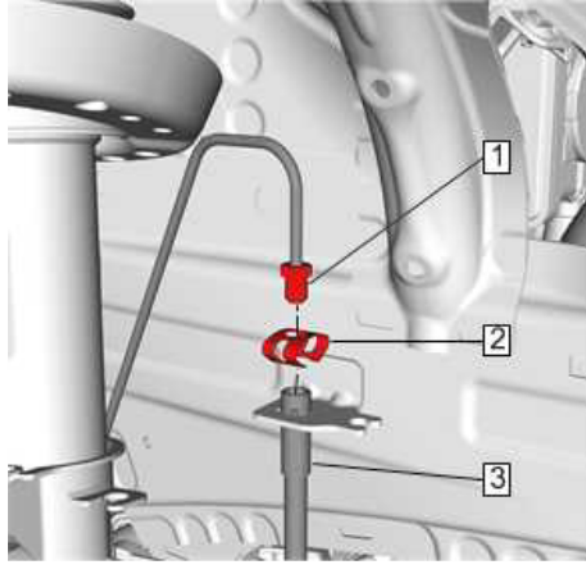


Fig. 69: Front Brake Pipe Fitting, Hose And Retainer
 Courtesy of GENERAL MOTORS COMPANY

6. Remove Front Brake Pipe Fitting (1) @ Front Brake Hose (3)
7. Remove Front Brake Hose Retainer (2)

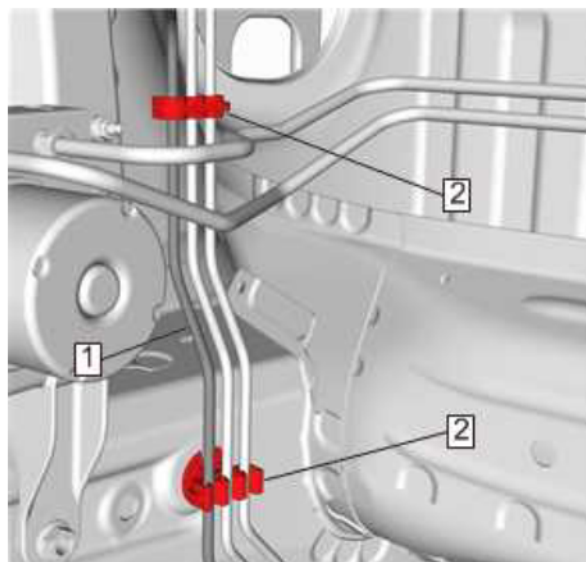


Fig. 70: Front Brake Pipe And Brake Pipe Clips
 Courtesy of GENERAL MOTORS COMPANY

8. Unclip Front Brake Pipe (1) @ Brake Pipe Clips (2) (Qty: 2)

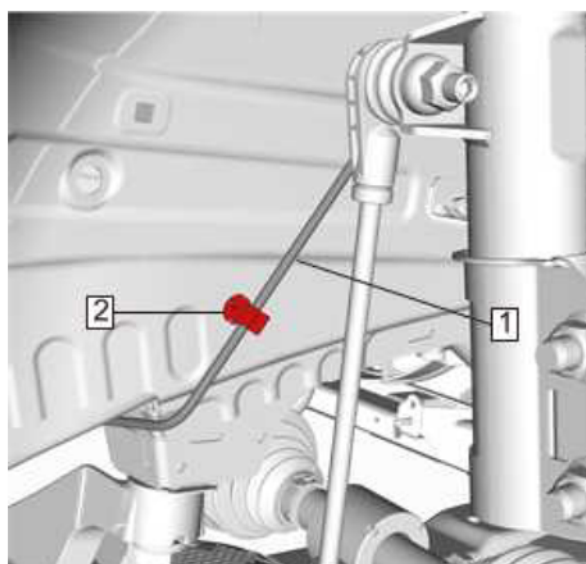


Fig. 71: Front Brake Pipe And Brake Pipe Clip
 Courtesy of GENERAL MOTORS COMPANY

9. Unclip Front Brake Pipe (1) @ Brake Pipe Clip (2)
10. Remove Front Brake Pipe (1) @ Vehicle

Installation Procedure

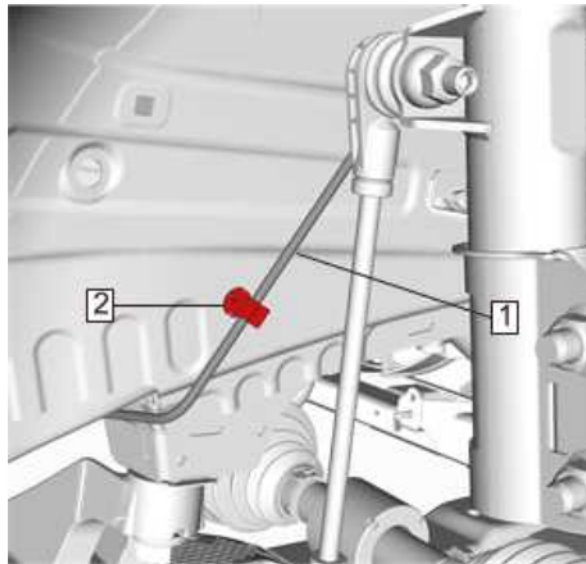


Fig. 72: Front Brake Pipe And Brake Pipe Clip
Courtesy of GENERAL MOTORS COMPANY

1. Install Front Brake Pipe (1) @ Vehicle
2. Install Front Brake Pipe (1) @ Brake Pipe Clip (2)

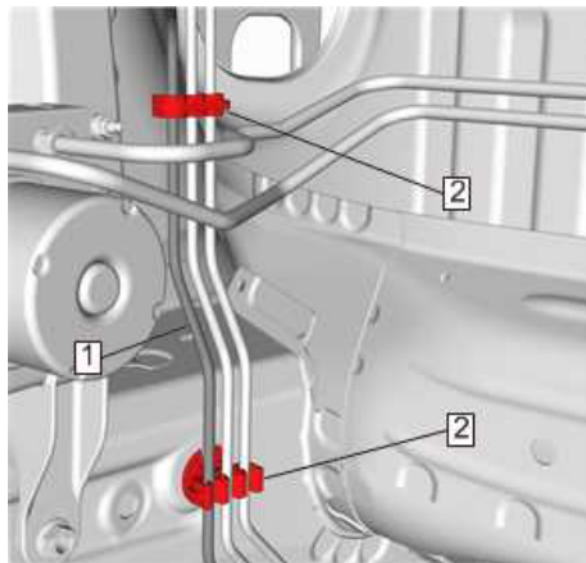


Fig. 73: Front Brake Pipe And Brake Pipe Clips
Courtesy of GENERAL MOTORS COMPANY

3. Install Front Brake Pipe (1) @ Brake Pipe Clips (2) (Qty: 2)

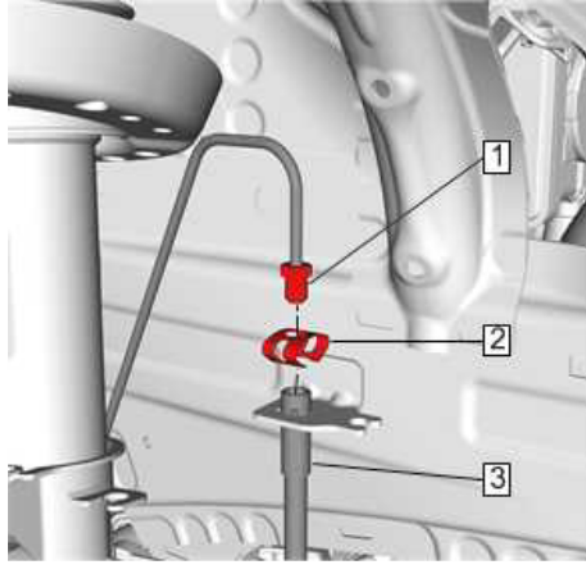


Fig. 74: Front Brake Pipe Fitting, Hose And Retainer
 Courtesy of GENERAL MOTORS COMPANY

4. Install Front Brake Hose Retainer (2)

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

5. Install and tighten Front Brake Pipe Fitting (1) @ Front Brake Hose (3) to 18 N.m (13 lb ft)

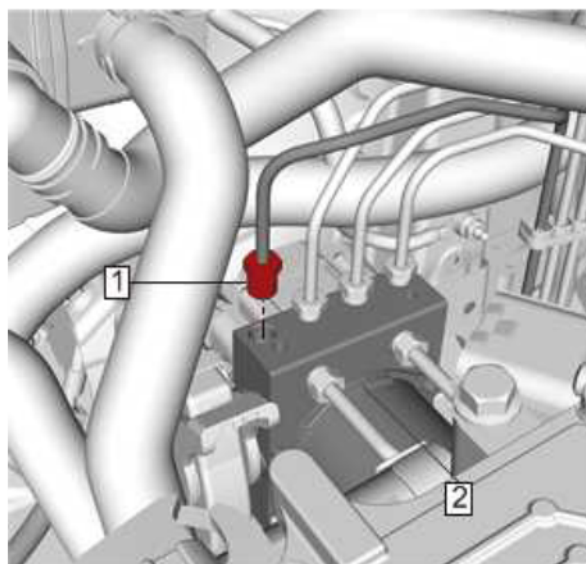


Fig. 75: Front Brake Pipe Fitting And Brake Pressure Modulator Valve
 Courtesy of GENERAL MOTORS COMPANY

6. Install and tighten Front Brake Pipe Fitting (1) @ Brake Pressure Modulator Valve (2) to 18 N.m (13 lb ft)

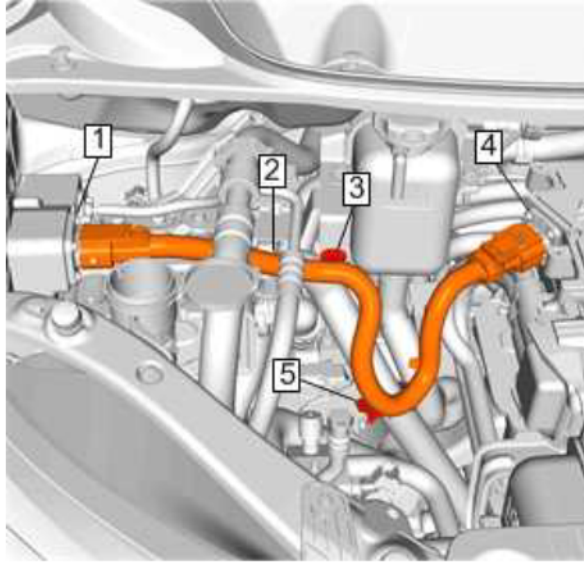


Fig. 76: Drive Motor Battery Positive and Negative Cable
 Courtesy of GENERAL MOTORS COMPANY

7. Install Drive Motor Battery Positive and Negative Cable (1). Refer to [Drive Motor Battery Positive and Negative Cable Replacement](#)
8. Install the heater surge tank to the heater surge tank bracket. Refer to [Heater Coolant Surge Tank Replacement](#)
9. Install Front Wheelhouse Liner-Right Side @ Vehicle. Refer to [Front Wheelhouse Liner Replacement](#)
10. Enable the high voltage system. Refer to [High Voltage Enabling](#)
11. Bleed the brake system. Refer to [Hydraulic Brake System Bleeding](#)

FRONT BRAKE PIPE REPLACEMENT - LEFT SIDE

Removal Procedure

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

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

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Remove the radiator surge tank bolts and reposition the heater surge tank from the heater surge tank bracket with the hoses connected. Refer to [Heater Coolant Surge Tank Replacement](#)

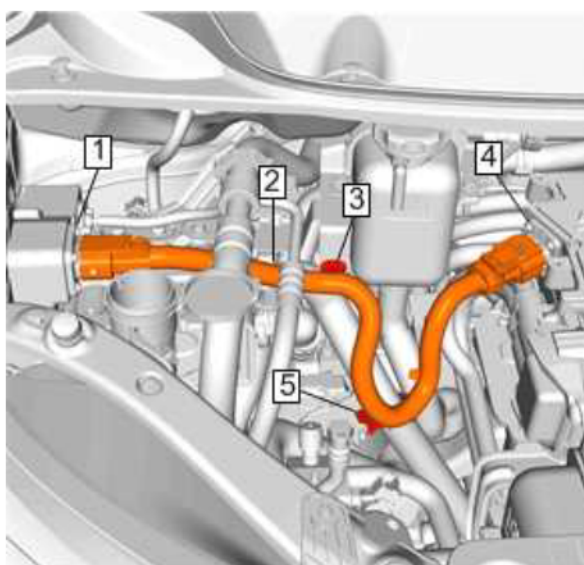


Fig. 77: Drive Motor Battery Positive and Negative Cable
 Courtesy of GENERAL MOTORS COMPANY

3. Remove Drive Motor Battery Positive and Negative Cable (1). Refer to [Drive Motor Battery Positive and Negative Cable Replacement](#)

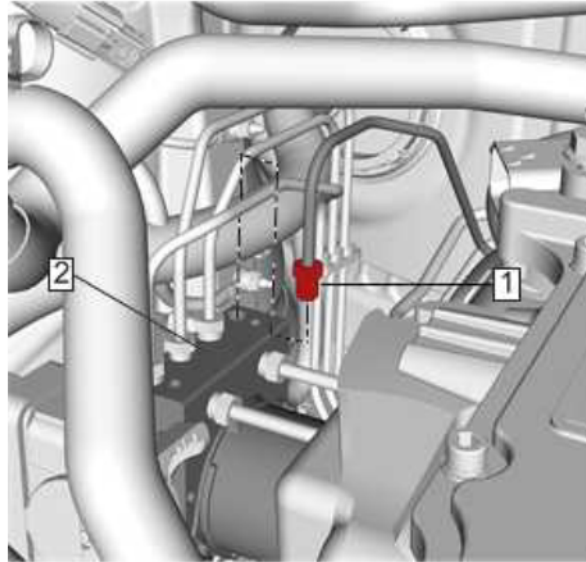


Fig. 78: Front Brake Pipe Fitting And Brake Pressure Modulator Valve
Courtesy of GENERAL MOTORS COMPANY

NOTE: Cap the brake pressure modulator valve port to prevent brake fluid loss and contamination.

4. Remove Front Brake Pipe Fitting (1) @ Brake Pressure Modulator Valve (2)

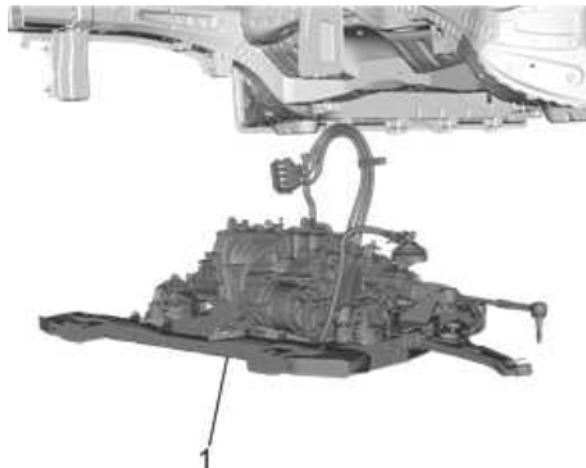


Fig. 79: Automatic Transmission and Drivetrain and Front Suspension Frame Assembly
Courtesy of GENERAL MOTORS COMPANY

5. Remove Automatic Transmission and Drivetrain and Front Suspension Frame Assembly (1).
Refer to [Drivetrain and Front Suspension Frame Removal and Installation](#)

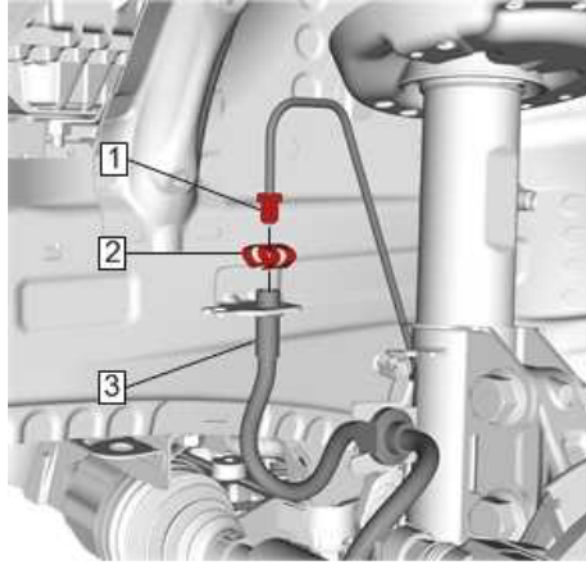


Fig. 80: Front Brake Pipe Fitting, Hose And Retainer
 Courtesy of GENERAL MOTORS COMPANY

6. Remove Front Brake Pipe Fitting (1) @ Front Brake Hose (3)
7. Remove Front Brake Hose Retainer (2)

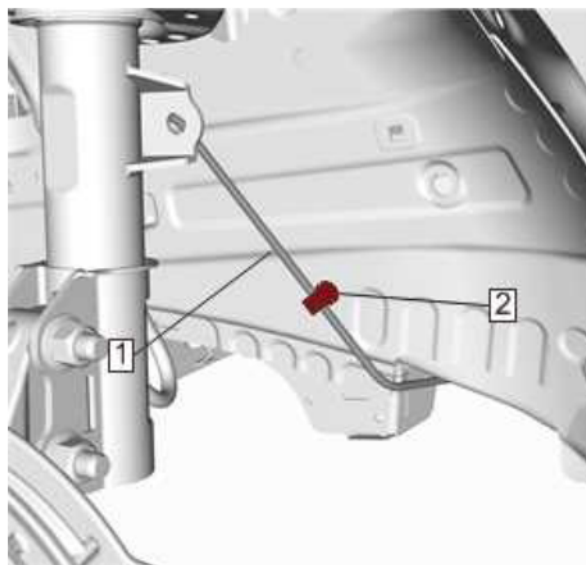


Fig. 81: Front Brake Pipe And Brake Pipe Clip
 Courtesy of GENERAL MOTORS COMPANY

8. Unclip Front Brake Pipe (1) @ Brake Pipe Clip (2)

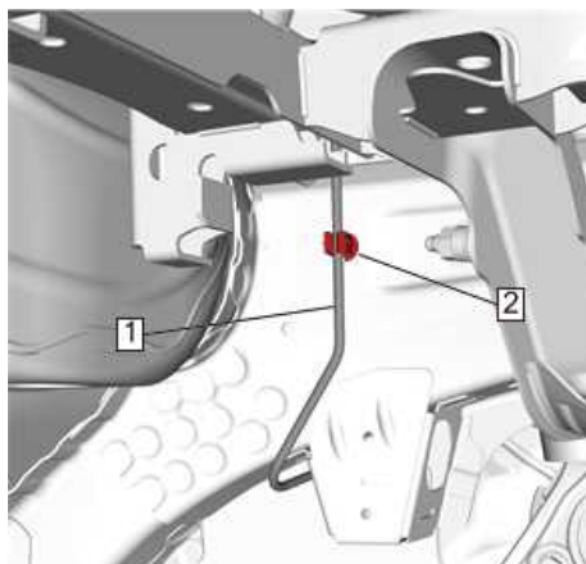


Fig. 82: Front Brake Pipe And Brake Pipe Clip
 Courtesy of GENERAL MOTORS COMPANY

9. Unclip Front Brake Pipe (1) @ Brake Pipe Clip (2)

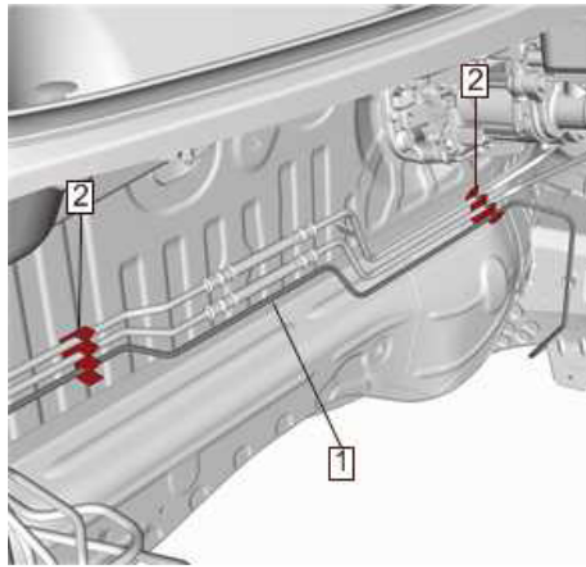


Fig. 83: Front Brake Pipe And Brake Pipe Clips
Courtesy of GENERAL MOTORS COMPANY

10. Unclip Front Brake Pipe (1) @ Brake Pipe Clips (2) (Qty: 2)
11. Remove Front Brake Pipe (1) @ Vehicle

Installation Procedure

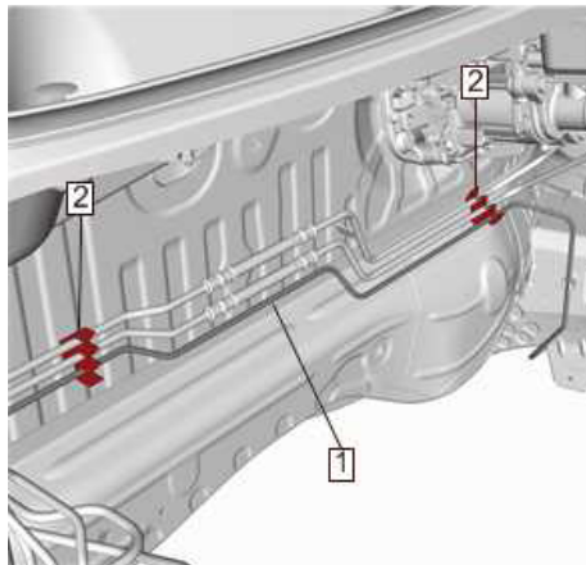


Fig. 84: Front Brake Pipe And Brake Pipe Clips
Courtesy of GENERAL MOTORS COMPANY

1. Install Front Brake Pipe (1) @ Vehicle
2. Install Front Brake Pipe (1) @ Brake Pipe Clips (2) (Qty: 2)

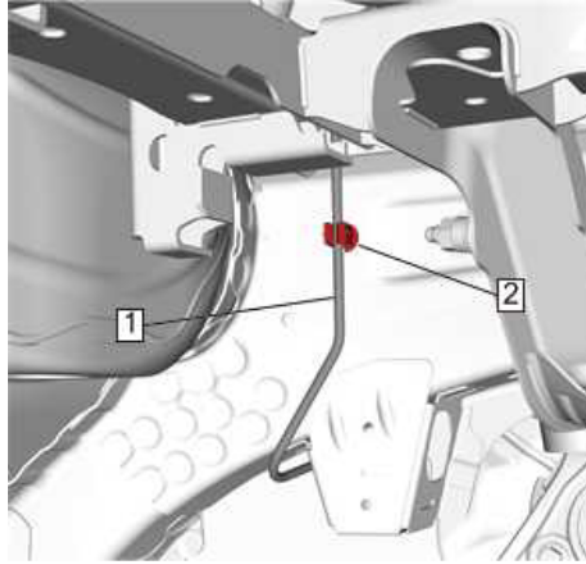


Fig. 85: Front Brake Pipe And Brake Pipe Clip
Courtesy of GENERAL MOTORS COMPANY

3. Install Front Brake Pipe (1) @ Brake Pipe Clip (2)

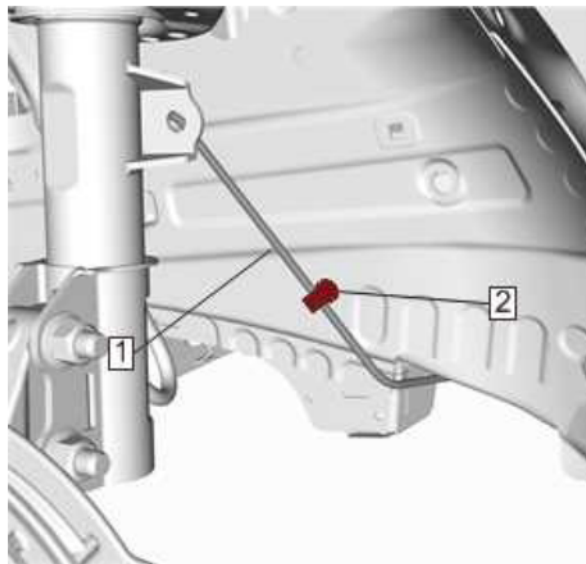


Fig. 86: Front Brake Pipe And Brake Pipe Clip
Courtesy of GENERAL MOTORS COMPANY

4. Install Front Brake Pipe (1) @ Brake Pipe Clip (2)

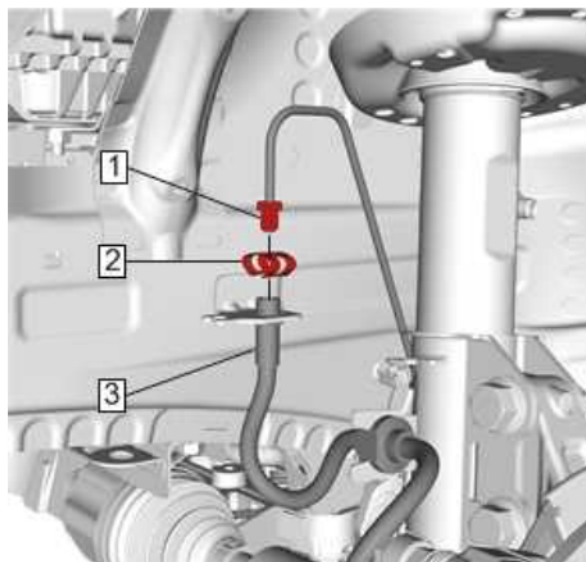


Fig. 87: Front Brake Pipe Fitting, Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

5. Install Front Brake Hose Retainer (2)

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

6. Install and tighten Front Brake Pipe Fitting (1) @ Front Brake Hose (3) to 18 N.m (13 lb ft)

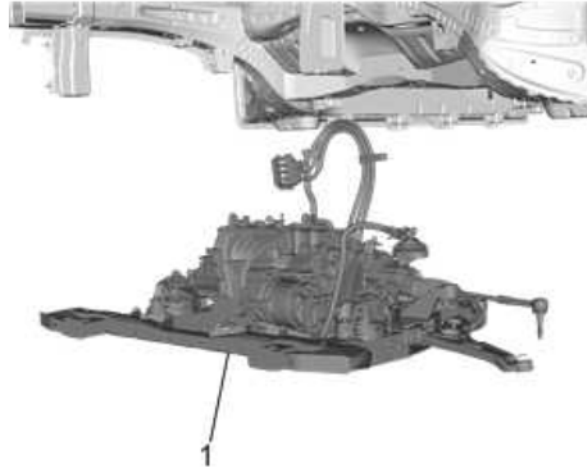


Fig. 88: Automatic Transmission and Drivetrain and Front Suspension Frame Assembly
Courtesy of GENERAL MOTORS COMPANY

7. Install Automatic Transmission and Drivetrain and Front Suspension Frame Assembly (1). Refer to [Drivetrain and Front Suspension Frame Removal and Installation](#)

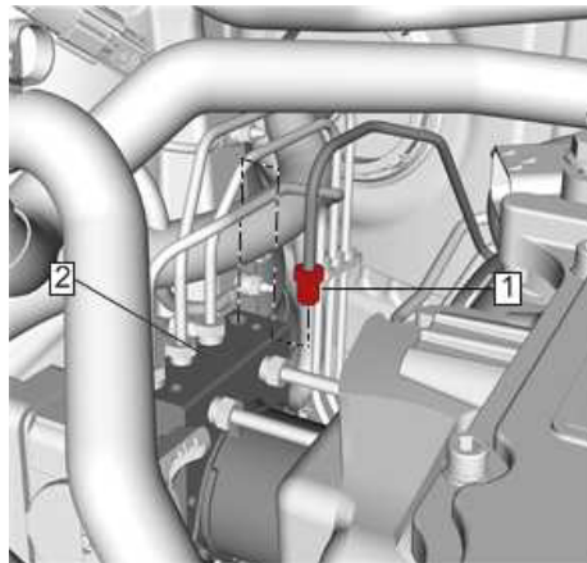


Fig. 89: Front Brake Pipe Fitting And Brake Pressure Modulator Valve
Courtesy of GENERAL MOTORS COMPANY

8. Install and tighten Front Brake Pipe Fitting (1) @ Brake Pressure Modulator Valve (2) to 18 N.m (13 lb ft)

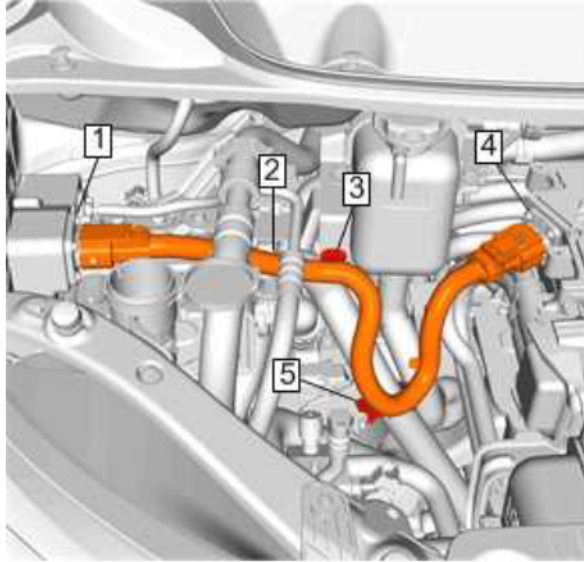


Fig. 90: Drive Motor Battery Positive and Negative Cable
 Courtesy of GENERAL MOTORS COMPANY

9. Install Drive Motor Battery Positive and Negative Cable (1). Refer to [Drive Motor Battery Positive and Negative Cable Replacement](#)
10. Install the heater surge tank to the heater surge tank bracket. Refer to [Heater Coolant Surge Tank Replacement](#)
11. Enable the high voltage system. Refer to [High Voltage Enabling](#)
12. Bleed the brake system. Refer to [Hydraulic Brake System Bleeding](#)

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. Refer to [Lifting and Jacking the Vehicle](#)
2. Remove the front tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#)
3. Clean all dirt and foreign material from the brake hose ends and the brake pipe fitting.

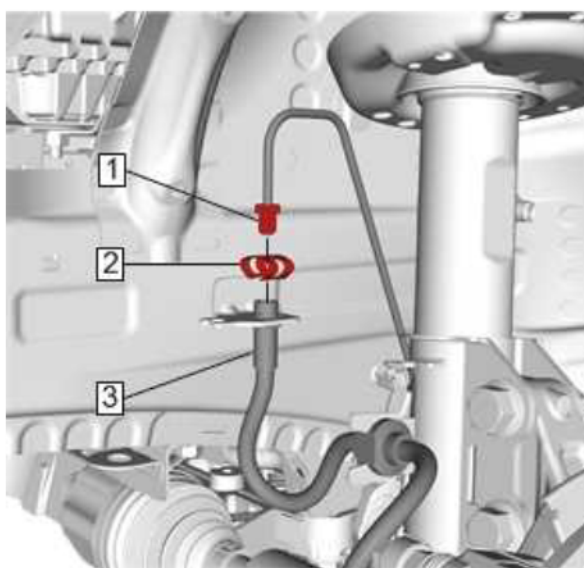


Fig. 91: Front Brake Pipe Fitting, Hose And Retainer
 Courtesy of GENERAL MOTORS COMPANY

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

4. Remove Front Brake Pipe Fitting (1) @ Front Brake Hose (3)
5. Remove Front Brake Hose Retainer (2)

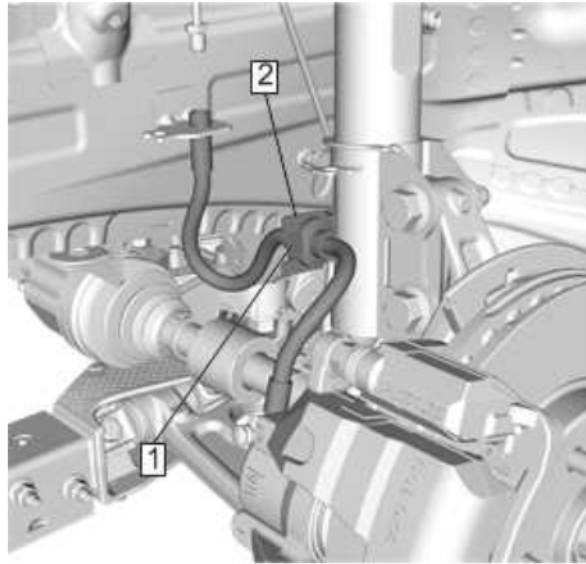


Fig. 92: Front Brake Hose And Front Suspension Strut Mounted Bracket
Courtesy of GENERAL MOTORS COMPANY

6. Unclip Front Brake Hose (1) @ Front Suspension Strut Mounted Bracket (2)

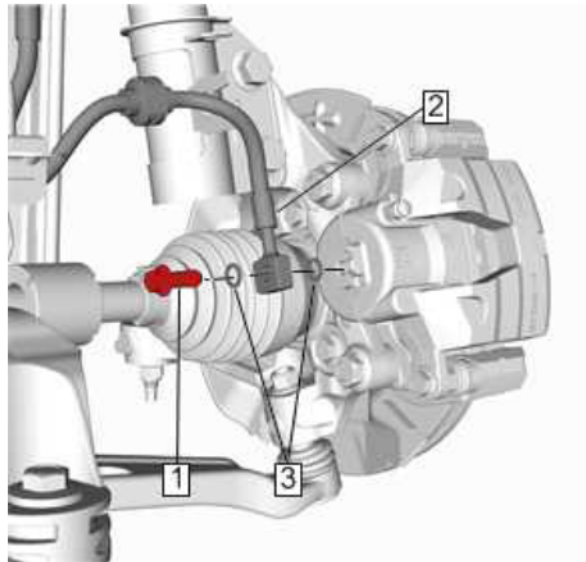


Fig. 93: Front Brake Hose, Fitting Bolt And Washers
Courtesy of GENERAL MOTORS COMPANY

7. Remove Front Brake Hose Fitting Bolt (1) @ Front Brake Caliper
8. Remove Front Brake Hose (2) @ Front Brake Caliper
9. Remove and DISCARD Front Brake Hose Washers (3) (Qty: 2)

NOTE: These washers may be stuck to the brake caliper and/or the brake hose end.

Installation Procedure

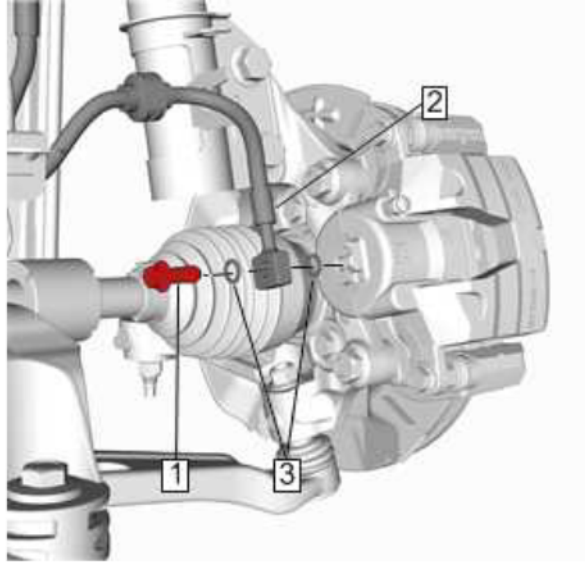


Fig. 94: Front Brake Hose, Fitting Bolt And Washers
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT reuse the brake hose washers.

1. Install NEW Front Brake Hose Washers (3) (Qty: 2). Install NEW.
2. Install Front Brake Hose (2) @ Front Brake Caliper

CAUTION: Refer to **Fastener Caution** .

3. Install and tighten Front Brake Hose Fitting Bolt (1) @ Front Brake Caliper to 40 N.m (30 lb ft)

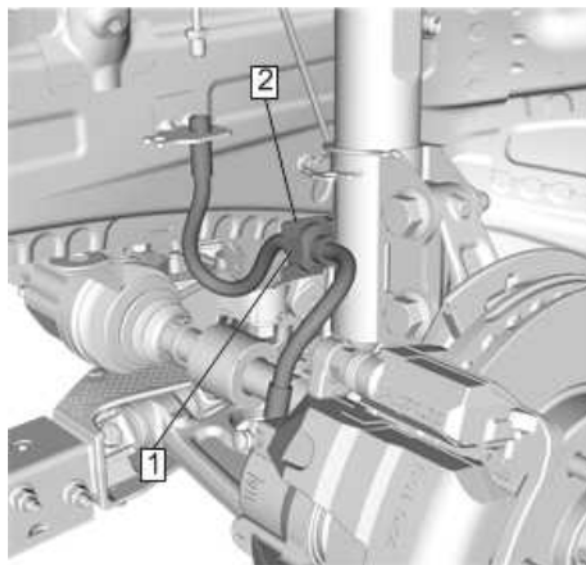


Fig. 95: Front Brake Hose And Front Suspension Strut Mounted Bracket
 Courtesy of GENERAL MOTORS COMPANY

4. Install Front Brake Hose (1) @ Front Suspension Strut Mounted Bracket (2)

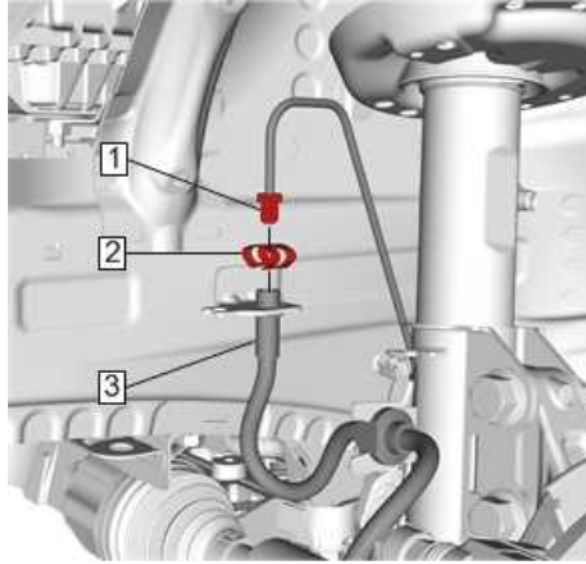


Fig. 96: Front Brake Pipe Fitting, Hose And Retainer
 Courtesy of GENERAL MOTORS COMPANY

5. Install Front Brake Hose Retainer (2)
6. Install and tighten Front Brake Pipe Fitting (1) @ Front Brake Hose (3) to 18 N.m (13 lb ft)
7. Bleed the brake system. Refer to [Hydraulic Brake System Bleeding](#)
8. Install the front tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#)
9. Lower the vehicle.

REAR BRAKE PIPE 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 rear tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#)
3. Clean all dirt and foreign material from the brake hose ends and the brake pipe fitting.

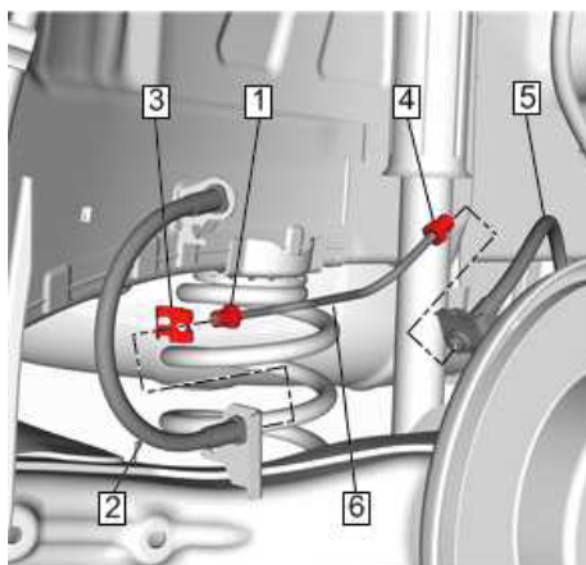


Fig. 97: Rear Brake Pipe, Fittings, Hoses And Retainer
 Courtesy of GENERAL MOTORS COMPANY

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

4. Remove Rear Brake Pipe Fitting (1) @ Rear Brake Hose (2)

5. Remove Rear Brake Pipe Fitting (4) @ Rear Brake Front Hose (5)
6. Remove Rear Brake Pipe (6) @ Vehicle
7. Remove Rear Brake Hose Retainer (3)

Installation Procedure

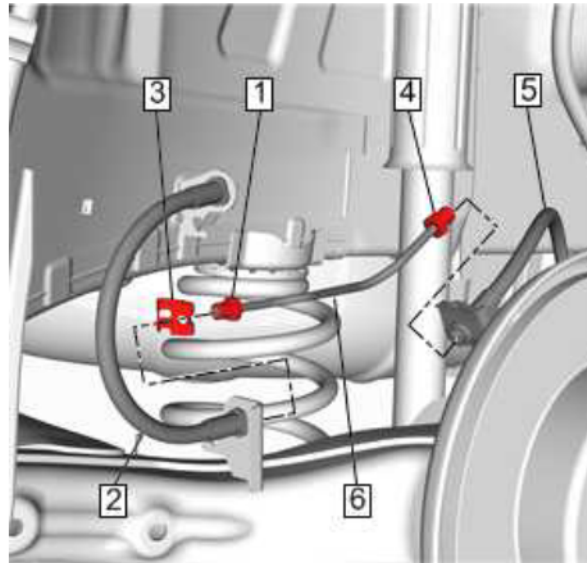


Fig. 98: Rear Brake Pipe, Fittings, Hoses And Retainer
Courtesy of GENERAL MOTORS COMPANY

1. Install Rear Brake Hose Retainer (3)
2. Install Rear Brake Pipe (6) @ Vehicle

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

3. Install and tighten Rear Brake Pipe Fitting (4) @ Rear Brake Front Hose (5) to 18 N.m (13 lb ft)
4. Install and tighten Rear Brake Pipe Fitting (1) @ Rear Brake Hose (2) to 18 N.m (13 lb ft)
5. Bleed the brake system. Refer to [Hydraulic Brake System Bleeding](#)
6. Install the rear tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#)
7. Lower the vehicle.

REAR BRAKE FRONT 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 rear tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#)
3. Clean all dirt and foreign material from the brake hose ends and the brake pipe fitting.

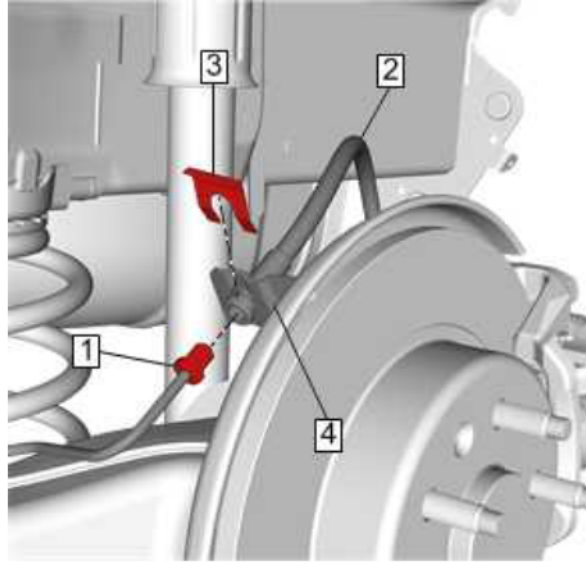


Fig. 99: Rear Brake Pipe Fitting, Rear Brake Front Hose, Clip And Bracket
 Courtesy of GENERAL MOTORS COMPANY

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

4. Remove Rear Brake Pipe Fitting (1) @ Rear Brake Front Hose (2)
5. Remove Rear Brake Hose Clip (3) @ Rear Brake Hose Bracket (4)

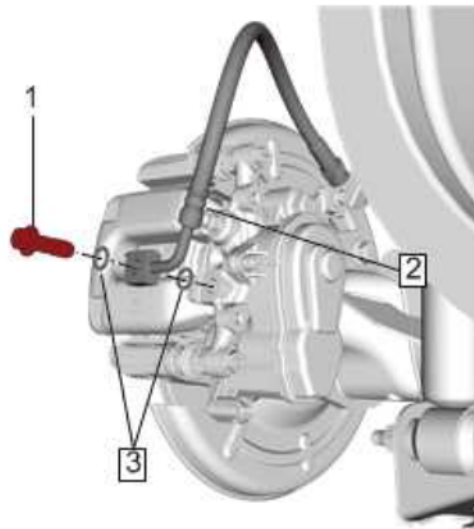


Fig. 100: Rear Brake Front Hose, Fitting Bolt And Sealing Washers
 Courtesy of GENERAL MOTORS COMPANY

6. Remove Rear Brake Hose Fitting Bolt (1) @ Rear Brake Caliper
7. Remove Rear Brake Front Hose (2) @ Rear Brake Caliper
8. Remove and DISCARD Rear Brake Hose Washers (3) (Qty: 2)

NOTE: These washers may be stuck to the brake caliper and/or the brake hose end.

Installation Procedure

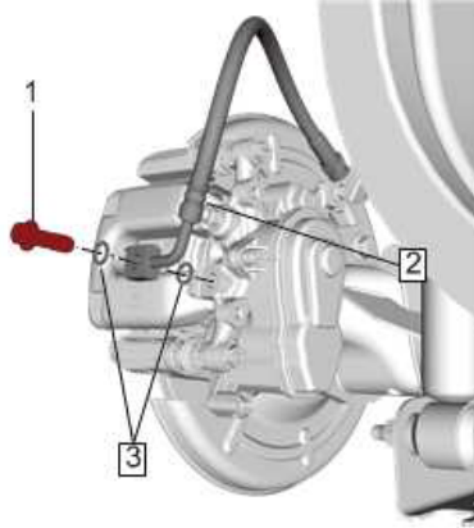


Fig. 101: Rear Brake Front Hose, Fitting Bolt And Sealing Washers
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT reuse the brake hose washers.

1. Install NEW Rear Brake Hose Washers (3) (Qty: 2). Install NEW.
2. Install Rear Brake Front Hose (2) @ Rear Brake Caliper

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

3. Install and tighten Rear Brake Hose Fitting Bolt (1) @ Rear Brake Caliper to 40 N.m (30 lb ft)

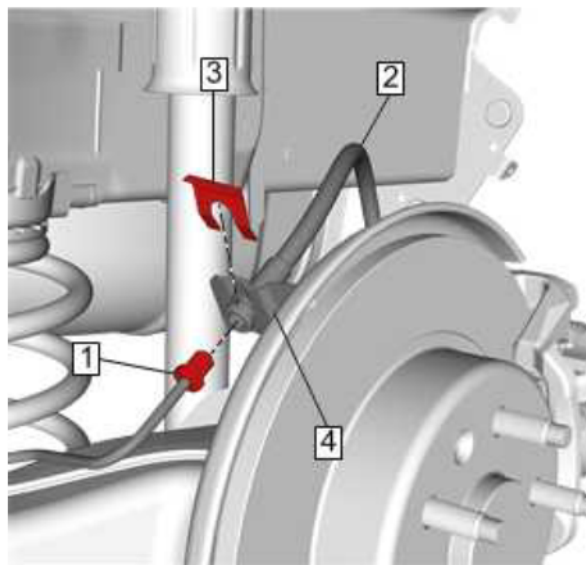


Fig. 102: Rear Brake Pipe Fitting, Rear Brake Front Hose, Clip And Bracket
 Courtesy of GENERAL MOTORS COMPANY

4. Install Rear Brake Hose Clip (3) @ Rear Brake Hose Bracket (4)
5. Install and tighten Rear Brake Pipe Fitting (1) @ Rear Brake Front Hose (2) to 18 N.m (13 lb ft)
6. Bleed the brake system. Refer to [Hydraulic Brake System Bleeding](#)
7. Install the rear tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#)
8. 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 rear tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#)
3. Clean all dirt and foreign material from the brake hose ends and the brake pipe fitting.
4. Unclip Rear Wheel Speed Sensor Harness @ Rear Brake Hose

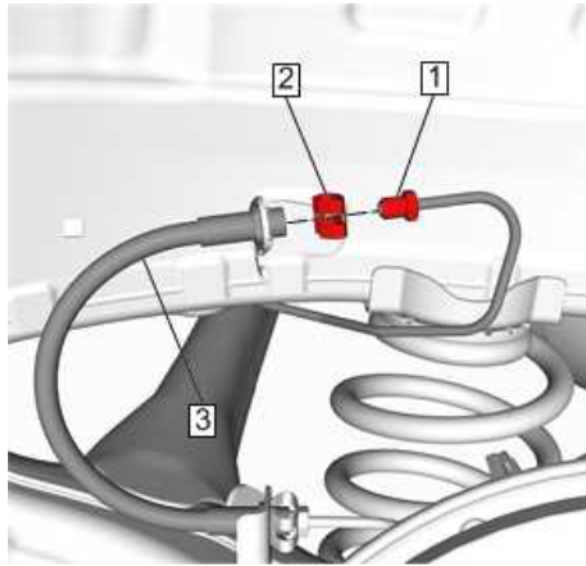


Fig. 103: Rear Brake Pipe Fitting, Rear Brake Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

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

5. Remove Rear Brake Pipe Fitting (1) @ Rear Brake Hose (3)
6. Remove Rear Brake Hose Retainer (2)

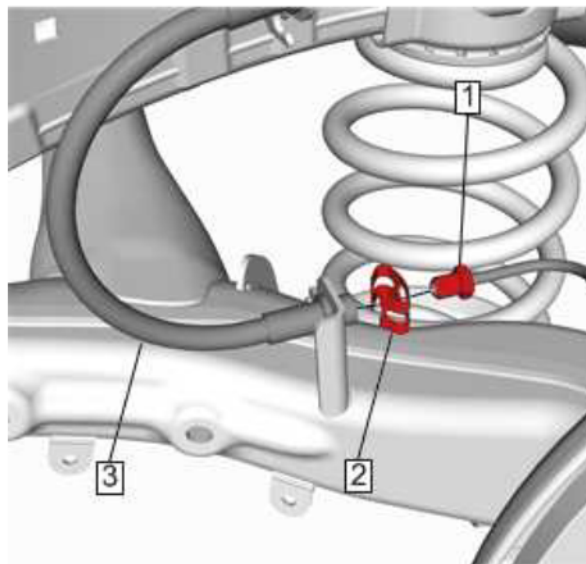


Fig. 104: Rear Brake Pipe Fitting, Rear Brake Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

7. Remove Rear Brake Pipe Fitting (1) @ Rear Brake Hose (3)
8. Remove Rear Brake Hose Retainer (2)
9. Remove Rear Brake Hose (3) @ Vehicle

Installation Procedure

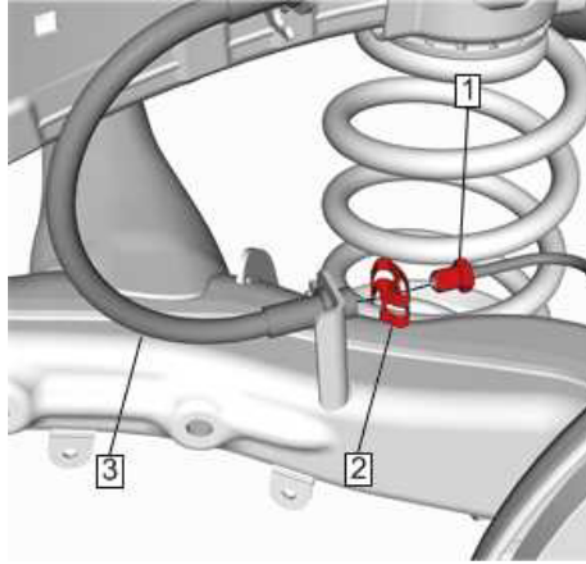


Fig. 105: Rear Brake Pipe Fitting, Rear Brake Hose And Retainer
 Courtesy of GENERAL MOTORS COMPANY

1. Install Rear Brake Hose (3) @ Vehicle
2. Install Rear Brake Hose Retainer (2)

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

3. Install and tighten Rear Brake Pipe Fitting (1) @ Rear Brake Hose (3) to 18 N.m (13 lb ft)

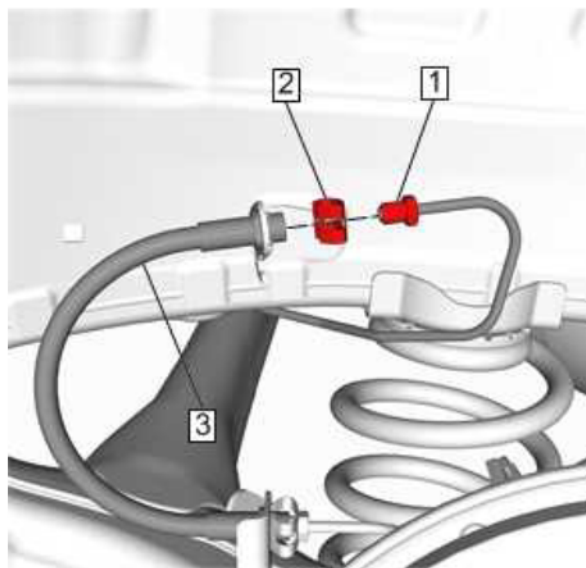


Fig. 106: Rear Brake Pipe Fitting, Rear Brake Hose And Retainer
 Courtesy of GENERAL MOTORS COMPANY

4. Install Rear Brake Hose Retainer (2)
5. Install and tighten Rear Brake Pipe Fitting (1) @ Rear Brake Hose (3) to 18 N.m (13 lb ft)
6. Clip Rear Wheel Speed Sensor Harness @ Rear Brake Hose
7. Bleed the brake system. Refer to [Hydraulic Brake System Bleeding](#)
8. Install the rear tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#)
9. Lower the vehicle.

HYDRAULIC BRAKE SYSTEM BLEEDING

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

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .
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CAUTION: Only use products that comply with GM specifications and check

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

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

Bleeding a Single Hydraulic Brake Circuit

1. Place the Power button in the Service Only Mode.
2. Place a clean shop cloth beneath the brake master cylinder to catch brake fluid spills.
3. Clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm.
4. Fill the brake master cylinder reservoir to the maximum-full level with GM approved brake fluid from a clean, sealed brake fluid container. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#)

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

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

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

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

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

16. Close the brake pressure bleeder fluid tank valve then disconnect the brake pressure bleeder from the master cylinder reservoir bleeder adapter.
17. Remove the master cylinder reservoir bleeder adapter from the master cylinder reservoir.
18. Fill the brake master cylinder reservoir to the maximum-fill level with GM approved brake fluid from a clean, sealed brake fluid container.
19. Slowly press and release the brake pedal. Observe the brake pedal feel.

20. If the brake pedal feels spongy, perform the Bleeding the Complete Brake Hydraulic System procedure:
21. Turn the ignition key ON, with the engine OFF. Check to see if the brake system warning lamp remains illuminated.

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

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

Bleeding the Complete Brake Hydraulic System

1. Place the Power button in the Service Only Mode.
2. Place a clean shop cloth beneath the brake master cylinder to catch brake fluid spills.
3. Clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm.
4. Fill the brake master cylinder reservoir to the maximum-full level with GM approved brake fluid from a clean, sealed brake fluid container. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#)

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

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

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

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

NOTE: **The brake reservoir may have residual pressure after the bleeding operation is complete. Wrap a clean shop towel around the bleeder adapter and all hose connections before disconnecting the pressure**

bleeding equipment to prevent brake fluid from contacting and damaging vehicle components and painted surfaces.

20. Remove the brake pressure bleeding equipment from the vehicle.
21. Fill the brake master cylinder reservoir to the maximum-full level with GM approved brake fluid from a clean, sealed brake fluid container. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#)
22. Slowly press and release the brake pedal. Observe the brake pedal feel.
23. If the brake pedal feels spongy, perform the following procedure.
 1. If equipped with antilock brakes, install a scan tool and perform the [Antilock Brake System Automated Bleed](#) to remove air which may be trapped in the BPMV.
 2. Inspect the hydraulic brake system for external leaks. Refer to [Brake System External Leak Inspection](#)
 3. Repeat the Bleeding the Complete Brake Hydraulic System procedure.
24. If the brake pedal still feels spongy, pressure bleed the hydraulic brake system. Refer to [Hydraulic Brake System Bleeding](#)
25. Turn the ignition switch ON with the engine OFF. Check to see if the brake system warning lamp remains illuminated.

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

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

HYDRAULIC BRAKE SYSTEM FLUSHING

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

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

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 as applicable:

- [Master Cylinder Replacement](#)
 - [Front Brake Hose Replacement](#)
 - [Rear Brake Hose Replacement](#)
 - [Front Brake Caliper Replacement](#)
 - [Rear Brake Caliper Replacement](#)
 - [Electronic Brake Control Module with 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 as applicable:

- [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. [Master Cylinder Reservoir Replacement](#)

Replace the brake master cylinder reservoir cap.

- [Front Brake Hose Replacement](#)
 - [Rear Brake Hose Replacement](#)
 - [Front Brake Caliper Replacement](#)
 - [Rear Brake Caliper Replacement](#)
 - [Electronic Brake Control Module with 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. 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 recommended brake fluid. 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](#)

POWER BRAKE MASTER CYLINDER BOOSTER ASSEMBLY REPLACEMENT

Removal Procedure

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

WARNING: Use of eye goggles is necessary to prevent personal injury.

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

1. Remove Brake Master Cylinder. Refer to [Master Cylinder Replacement](#)

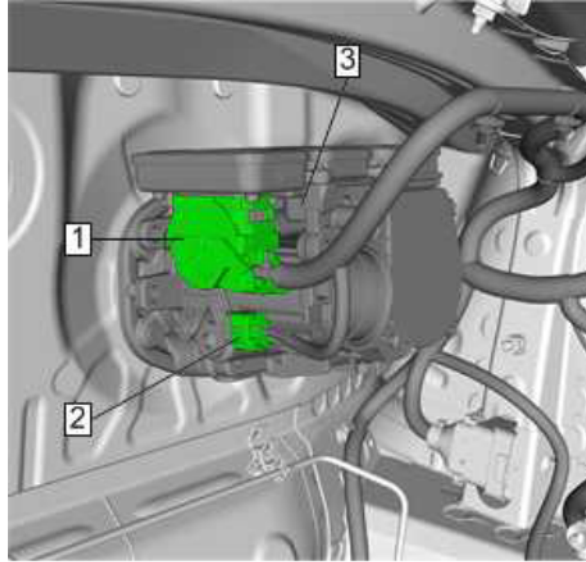


Fig. 107: Power Brake Booster And Electrical Connectors

Courtesy of GENERAL MOTORS COMPANY

2. Disconnect Brake Booster Control Module Electrical Connector (1) @ Power Brake Booster (3)
3. Disconnect Brake Control Brake Pedal Position Sensor Electrical Connector (2) @ Power Brake Booster (3)

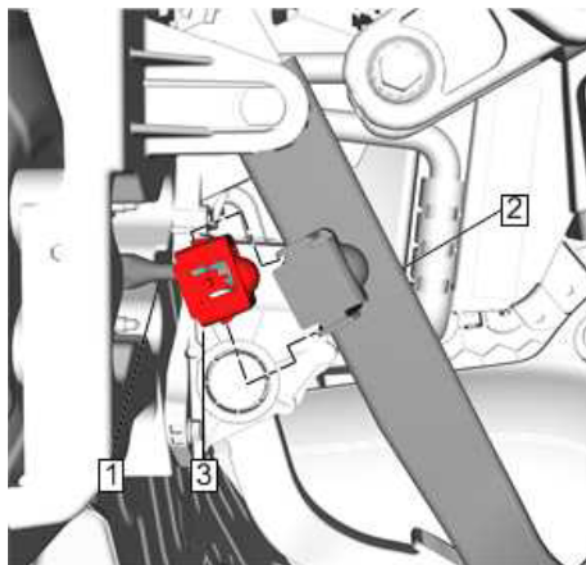


Fig. 108: Brake Pedal, Pushrod And Click Fit Connector

Courtesy of GENERAL MOTORS COMPANY

4. Disconnect Brake Pedal Pushrod (1) @ Brake Pedal (2)

Press the 2 tabs of the click fit connector (3) together and pull the brake pedal a bit to facilitate the removal.

5. Remove and DISCARD Click Fit Connector (3) @ Brake Pedal Pushrod (1)

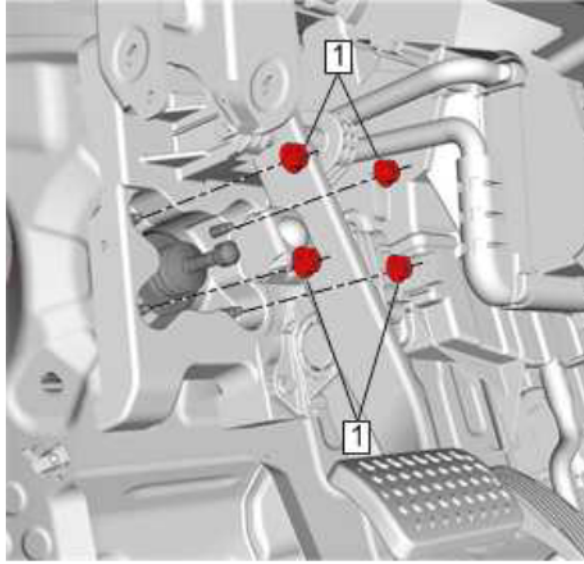


Fig. 109: Brake Pedal Nuts

Courtesy of GENERAL MOTORS COMPANY

6. Remove Brake Pedal Nuts (1) (Qty: 4)

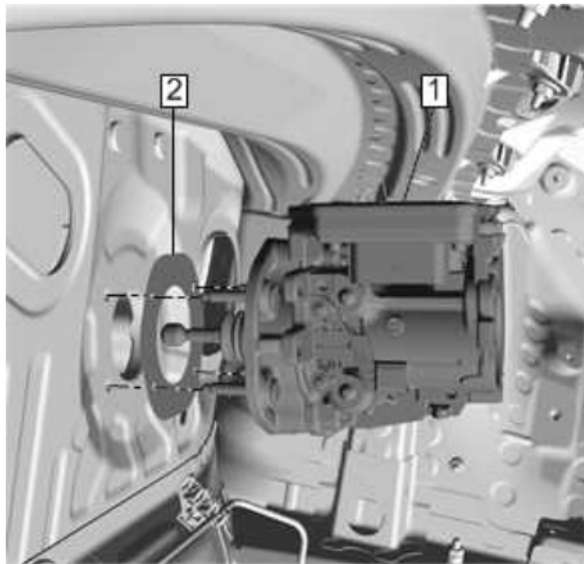


Fig. 110: Power Brake Booster And Brake Master Cylinder Spacer Gasket

Courtesy of GENERAL MOTORS COMPANY

7. Remove Power Brake Booster (1) @ Vehicle
8. Remove and DISCARD Brake Master Cylinder Spacer Gasket (2) @ Power Brake Booster (1)

Installation Procedure

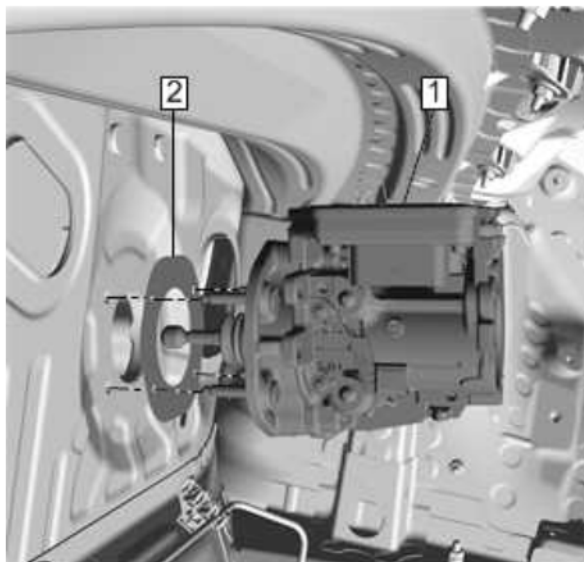


Fig. 111: Power Brake Booster And Brake Master Cylinder Spacer Gasket
Courtesy of GENERAL MOTORS COMPANY

1. Install NEW Brake Master Cylinder Spacer Gasket (2) @ Power Brake Booster (1).
2. Install Power Brake Booster (1) @ Vehicle

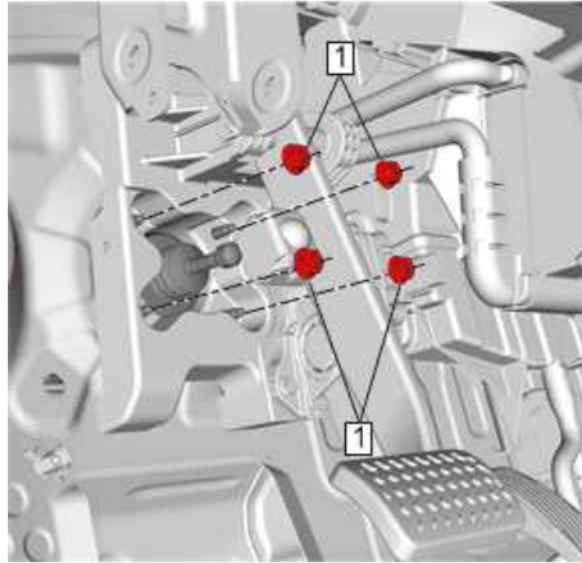


Fig. 112: Brake Pedal Nuts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

3. Install and tighten Brake Pedal Nuts (1) (Qty: 4) to 22 N.m (16 lb ft)

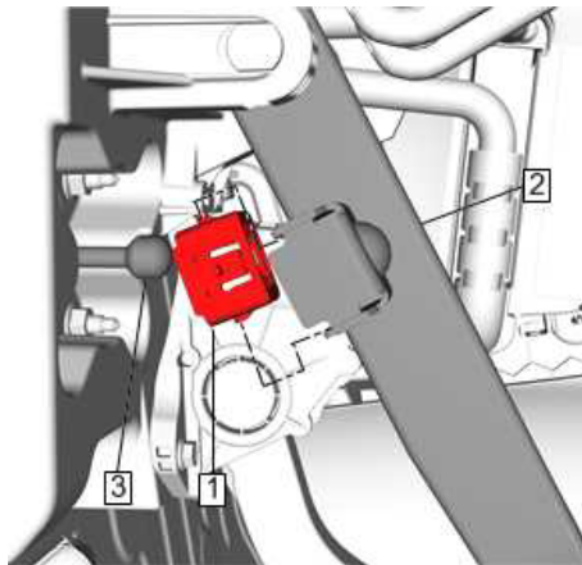


Fig. 113: Brake Pedal, Pushrod And Click Fit Connector
Courtesy of GENERAL MOTORS COMPANY

4. Install NEW Click Fit Connector (1) @ Brake Pedal (2)
5. Connect Brake Pedal Pushrod (3) @ Brake Pedal (2)

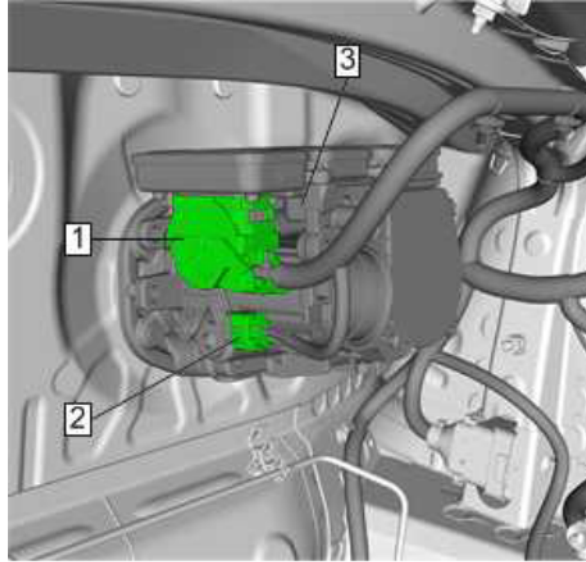


Fig. 114: Power Brake Booster And Electrical Connectors
Courtesy of GENERAL MOTORS COMPANY

6. Connect Brake Control Brake Pedal Position Sensor Electrical Connector (2) @ Power Brake Booster (3)
7. Connect Brake Booster Control Module Electrical Connector (1) @ Power Brake Booster (3)
8. Install Brake Master Cylinder. Refer to [Master Cylinder Replacement](#)
9. Bleed the brake system. Refer to [Hydraulic Brake System Bleeding](#)
10. Program and calibrate the power brake booster control module. Refer to [Control Module References](#)

DESCRIPTION AND OPERATION

POWER BRAKE BOOSTER DESCRIPTION AND OPERATION

Power Brake Booster Description and Operation

The brake booster is an electromechanical brake booster that replaces a vacuum booster including its vacuum supply. It is designed to make hybrid and electric vehicles more efficient by providing situation-dependent support when a driver initiates braking.

The brake booster unit takes the driver applied brake demand and transforms this into an amplified brake pressure and does not rely on vacuum to function. The brake booster unit is designed to operate together with an electronic stability control module which is normally responsible for ABS, traction control and stability control.

Since the brake booster unit operates electromechanically, it does not require vacuum from the engine and recovers almost all the energy lost in typical braking. It uses electrical current only during braking.

The brake booster unit consists of a PSM motor for force build up, and ECU for the control of the brake booster, a stage gear control to transmit the motor torque to the output pressure in the master cylinder, a vehicle interface to connect the brake booster and the vehicle, a pedal coupling unit to couple the brake booster with the vehicle pedal unit, a pedal travel sensor to detect the driver brake request, TMC to connect the brake booster with the braking system and a reservoir to support the braking system with brake fluid.

For maximum efficiency, a hybrid or EV must recover as much energy as possible when braking. Ideally, a vehicle would be slowed down purely by the electric motor, avoiding the loss of valuable energy through braking. The system recovers almost all the energy lost in typical braking operations by ensuring deceleration rates of up to 0.3 g are achieved using the electric motor alone. If the brakes are applied harder, the brake booster system generates the additional braking pressure needed in the traditional way, using the brake master cylinder.

The brake booster unit is purely electromechanical, without brake fluid, which means it can be rotated flexibly about the longitudinal axis.

BRAKE WARNING SYSTEM DESCRIPTION AND OPERATION

Brake Warning Indicator

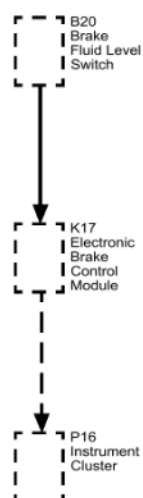


Fig. 115: Brake Warning System Block Diagram

Courtesy of GENERAL MOTORS COMPANY

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

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

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

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

HYDRAULIC BRAKE SYSTEM DESCRIPTION AND OPERATION

System Component Description

The hydraulic brake system consists of the following:

Hydraulic Brake Master Cylinder Fluid Reservoir

Contains supply of brake fluid for the hydraulic brake system.

Hydraulic Brake Master Cylinder

Converts mechanical input force into hydraulic output pressure.

Hydraulic output pressure is distributed from the master cylinder through 2 hydraulic circuits,

supplying diagonally-opposed wheel apply circuits.

Hydraulic Brake Pressure Balance Control System

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

Pressure balance control is achieved through dynamic rear proportioning (DRP), which is a function of the ABS modulator.

Hydraulic Brake Pipes and Flexible Brake Hoses

Carries brake fluid to and from hydraulic brake system components.

Hydraulic Brake Wheel Apply Components

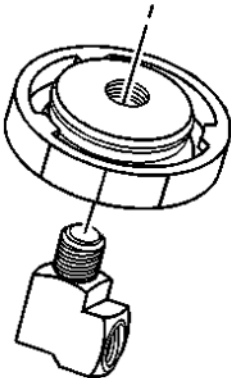
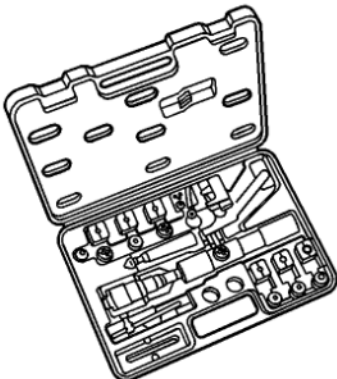
Converts hydraulic input pressure into mechanical output force.

System Operation

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

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description
	CH 29532-A J 29532-A Pressure Brake Bleeder
	CH 35589-A J 35589-A Brake Pressure Bleeder Adapter
	CH 45405 J 45405 Brake Pipe Flaring Kit

