2010 BRAKES

Antilock Brake System - Camaro

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	Specification	
	Metric	English
Brake Pipe Fitting	16 N.m	12 lb ft
Brake Pipe Fitting - Master Cylinder	23 N.m	17 lb ft
Brake Pressure Modulator Valve (BPMV) Nut	8 N.m	71 lb in
Electronic Brake Control Module (EBCM) Bolt	3 N.m	27 lb in
Wheel Speed Sensor Bolt	9 N.m	80 lb in
Yaw Sensor Nut	9 N.m	80 lb in

SCHEMATIC AND ROUTING DIAGRAMS

ANTILOCK BRAKE SYSTEM SCHEMATICS

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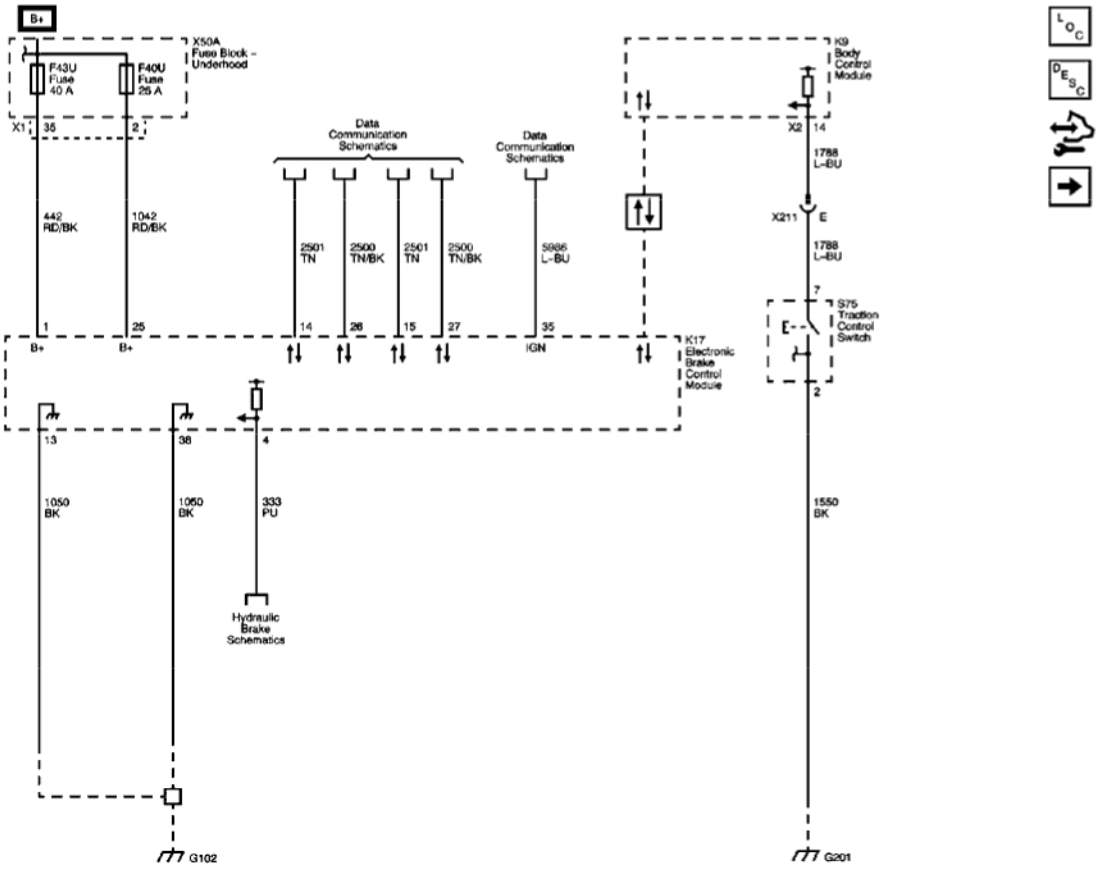


Fig. 1: Power and Ground
Courtesy of GENERAL MOTORS CORP.

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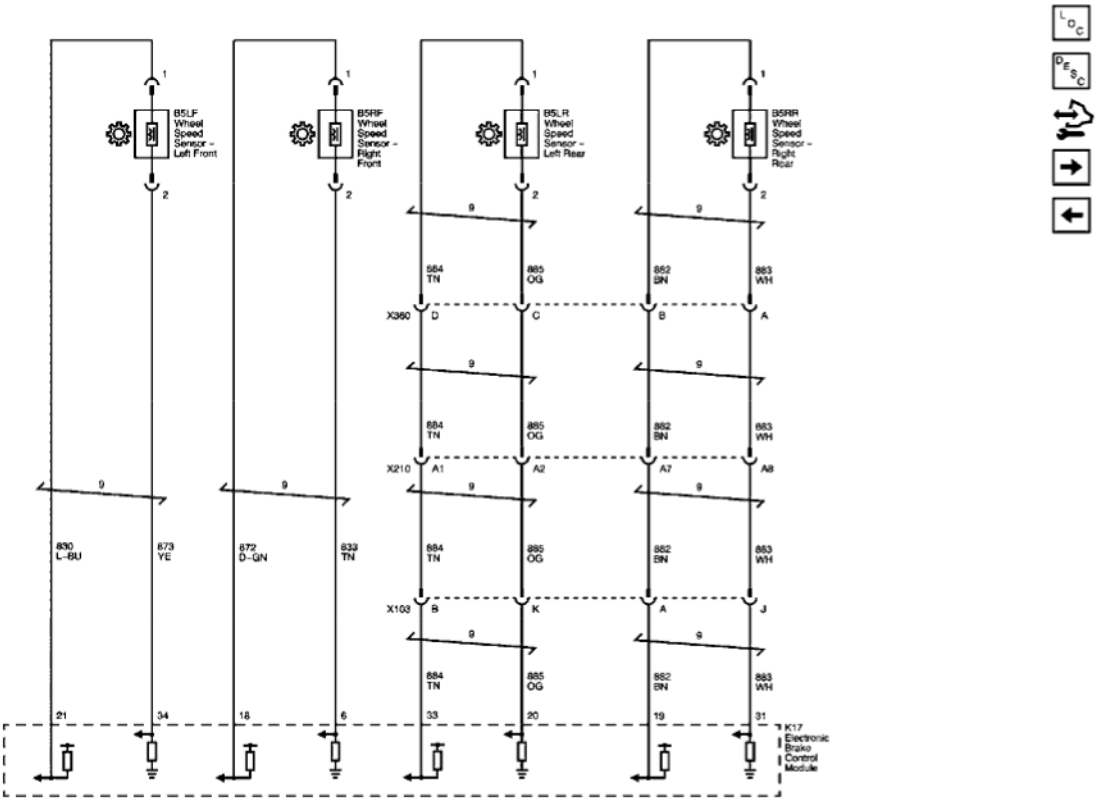


Fig. 2: Sensors
Courtesy of GENERAL MOTORS CORP.

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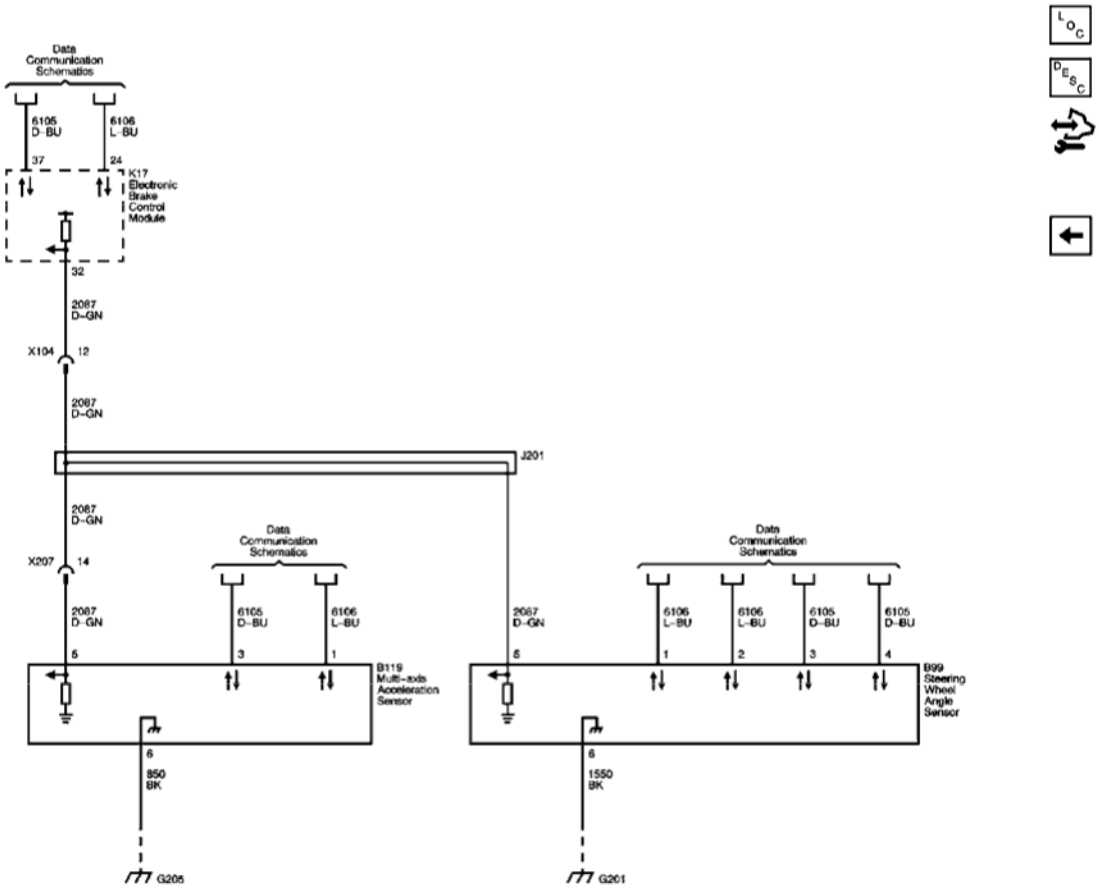


Fig. 3: Yaw and Lateral Accelerometer Sensor and Steering Angle Sensor
Courtesy of GENERAL MOTORS CORP.

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC B2745	B2745 02: Traction Control Switch Circuit Short to Ground
DTC C0035-C0050	C0035 00: Left Front Wheel Speed Sensor Circuit Malfunction C0035 5A: Left Front Wheel Speed Sensor Circuit Not Plausible C0040 00: Right Front Wheel Speed Sensor Circuit Malfunction C0040 5A: Right Front Wheel Speed Sensor Circuit Not Plausible C0045 00: Left Rear Wheel Speed Sensor Circuit Malfunction C0045 5A: Left Rear Wheel Speed Sensor Circuit Not Plausible C0050 00: Right Rear Wheel Speed Sensor Circuit Malfunction C0050 5A: Right Rear Wheel Speed Sensor Circuit Not Plausible
DTC C0060-C0095, C0121, C0141, C0146, C0151, or	C0060 00: Left Front Dump Solenoid Valve Circuit Malfunction C0065 00: Left Front Isolation Solenoid Valve Circuit Malfunction

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C0156	C0070 00: Right Front Dump Solenoid Valve Circuit Malfunction C0075 00: Right Front Isolation Solenoid Valve Circuit Malfunction C0080 00: Left Rear Dump Solenoid Valve Circuit Malfunction C0085 00: Left Rear Isolation Solenoid Valve Circuit Malfunction C0090 00: Right Rear Dump Solenoid Valve Circuit Malfunction C0095 00: Right Rear Isolation Solenoid Valve Circuit Malfunction C0121 00: Valve Relay Circuit Malfunction C0141 00: Front Prime Solenoid Valve Circuit Malfunction C0146 00: Front Isolation Solenoid Valve Circuit Malfunction C0151 00: Rear Prime Solenoid Valve Circuit Malfunction C0156 00: Rear Isolation Solenoid Valve Circuit Malfunction
DTC C0110	C0110 00: Pump Motor Circuit Malfunction
DTC C0131	C0131 00: Antilock Braking System Pressure Circuit Malfunction
DTC C0161	C0161 00: Antilock Braking System Brake Sensor Circuit Malfunction C0161 5A: Antilock Braking System Brake Sensor Circuit Not Plausible
DTC C0186, C0196, or C019B	C0186 00: Lateral Acceleration Sensor Circuit Malfunction C0186 5A: Lateral Acceleration Sensor Circuit Not Plausible C0186 71: Lateral Acceleration Sensor Circuit Invalid Data C0196 00: Yaw Rate Signal Malfunction C0196 5A: Yaw Rate Signal Not Plausible C0196 71: Yaw Rate Signal Invalid Data C019B 5A: Yaw Rate Signal Not Plausible
DTC C0242 or P0856	C0242 00: Engine Control Module Indicated Traction Control Malfunction P0856 00: Traction Control Torque Request Circuit Malfunction
DTC C0245	C0245 00: Wheel Speed Sensor Frequency Malfunction
DTC C0280	C0280 00: Stability System Active Too Long
DTC C0710	C0710 00: Steering Position Signal Malfunction C0710 42: Steering Position Signal Calibration Not Programmed C0710 5A: Steering Position Signal Not Plausible C0710 71: Steering Position Signal Invalid Data

DTC B2745

Diagnostic Instructions

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

DTC Descriptor

DTC B2745 02

Traction Control Switch Circuit Short to Ground

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Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Traction Control Switch Signal	B2745 02	1	1	-
Traction Control Switch Ground	-	1	-	-
1. Traction Control Switch Inoperative				

Circuit/System Description

The body control module (BCM) monitors the traction control switch. When the traction control switch is pressed once, the BCM will request the electronic brake control module (EBCM) via serial data to disable the traction control. When the traction control switch is pressed for 5 s, the BCM will request the EBCM to disable the stability control. The EBCM will request the instrument cluster via serial data to turn the traction control off and stability control off indicator ON to notify the driver of the deactivation.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The BCM detects a short to ground on the signal circuit.

Action Taken When the DTC Sets

The BCM ignores the traction control switch signal input.

Conditions for Clearing the DTC

A current DTC clears when the diagnostic runs and passes.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS Description and Operation

Electrical Information Reference

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- **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

Observe the scan tool BCM Traction Control Switch parameter while pressing and releasing the traction control switch. The reading should change between Active and Inactive.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the S75 Traction Control Switch.
2. Test for less than 5 ohms between the ground circuit terminal 2 and ground.
    - If greater than the specified value, test the ground circuit for an open/high resistance.
3. Ignition ON, verify the scan tool BCM Traction Control Switch parameter is Inactive.
    - If not the specified value, test the signal circuit for a short to ground. If the circuit tests normal, replace the K9 Body Control Module.
4. Install a 3 A fused jumper wire between the signal circuit terminal 7 and ground.
5. Verify the scan tool BCM Traction Control Switch parameter is Active.
    - If not the specified value, test the signal circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the K9 Body Control Module.
6. If all circuits test normal, test or replace the S75 Traction Control Switch.

Component Testing

Static Test

1. Ignition OFF, disconnect the harness connector at the S75 Traction Control Switch.
2. Test for infinite resistance between the signal circuit terminal 7 and the ground circuit terminal 2 with the switch in the released position.
    - If less than the specified value, replace the S75 Traction Control Switch.
3. Test for less than 5 ohms between the signal circuit terminal 7 and the ground circuit terminal 2 with the switch in the pressed position.
    - If greater than the specified value, replace the S75 Traction Control Switch.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

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- **Electronic Traction Control Switch Replacement**
- **Control Module References** for BCM replacement, setup and programming

DTC C0035-C0050

Diagnostic Instructions

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

DTC Descriptor

DTC C0035 00

Left Front Wheel Speed Sensor Circuit Malfunction

DTC C0035 5A

Left Front Wheel Speed Sensor Circuit Not Plausible

DTC C0040 00

Right Front Wheel Speed Sensor Circuit Malfunction

DTC C0040 5A

Right Front Wheel Speed Sensor Circuit Not Plausible

DTC C0045 00

Left Rear Wheel Speed Sensor Circuit Malfunction

DTC C0045 5A

Left Rear Wheel Speed Sensor Circuit Not Plausible

DTC C0050 00

Right Rear Wheel Speed Sensor Circuit Malfunction

DTC C0050 5A

Right Rear Wheel Speed Sensor Circuit Not Plausible

Diagnostic Fault Information

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Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Front Wheel Speed Sensor 12V Reference	C0035 00	C0035 00	C0035 00	C0035 00, C0035 5A
Left Front Wheel Speed Sensor Low Reference	C0035 00	C0035 00	C0035 00	C0035 00, C0035 5A
Right Front Wheel Speed Sensor 12V Reference	C0040 00	C0040 00	C0040 00	C0040 00, C0040 5A
Right Front Wheel Speed Sensor Low Reference	C0040 00	C0040 00	C0040 00	C0040 00, C0040 5A
Left Rear Wheel Speed Sensor 12V Reference	C0045 00	C0045 00	C0045 00	C0045 00, C0045 5A
Left Rear Wheel Speed Sensor Low Reference	C0045 00	C0045 00	C0045 00	C0045 00, C0045 5A
Right Rear Wheel Speed Sensor 12V Reference	C0050 00	C0050 00	C0050 00	C0050 00, C0050 5A
Right Rear Wheel Speed Sensor Low Reference	C0050 00	C0050 00	C0050 00	C0050 00, C0050 5A

Component	Condition	DTCs
Left Front Wheel Speed Sensor	• Physical damage • Debris on the wheel speed sensor or the encoder ring • Loose or improperly mounted sensor • Air gap between the wheel speed sensor and the encoder ring too large • Water intrusion in the wiring harness	C0035 00, C0035 5A
Right Front Wheel Speed Sensor	• Physical damage • Debris on the wheel speed sensor or the encoder ring • Loose or improperly mounted sensor • Air gap between the wheel speed sensor and the encoder ring too large • Water intrusion in the wiring harness	C0040 00, C0040 5A
Left Rear Wheel Speed Sensor	• Physical damage • Debris on the wheel speed sensor or the encoder ring • Loose or improperly mounted sensor • Air gap between the wheel speed sensor and the encoder ring too large • Water intrusion in the wiring harness	C0045 00, C0045 5A

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Right Rear Wheel Speed Sensor	• Physical damage • Debris on the wheel speed sensor or the encoder ring • Loose or improperly mounted sensor • Air gap between the wheel speed sensor and the encoder ring too large • Water intrusion in the wiring harness	C0050 00, C0050 5A

Circuit/System Description

The wheel speeds are detected by active wheel speed sensors and encoder rings. The encoder ring consists of permanent magnets. Each wheel speed sensor receives 12 V reference voltage from the electronic brake control module (EBCM) and provides an alternating current square wave signal to the EBCM. As the wheel spins, the EBCM uses the frequency of the square wave signal to calculate the wheel speed.

Conditions for Running the DTC

C0035 00 - C0050 00

Ignition ON

C0035 5A - C0050 5A

- Ignition ON
- Vehicle speed is greater than 10 km/h (7 MPH)

Conditions for Setting the DTC

C0035 00 - C0050 00

- A short to voltage, short to ground, or open/high resistance on the wheel speed sensor 12 V reference circuit is detected for 0.2 s.
- A short to voltage, short to ground, or open/high resistance on the wheel speed sensor low reference circuit is detected for 0.2 s.
- A short circuit on the wheel speed sensor 12 V reference and low reference circuit is detected.

C0035 5A - C0050 5A

- Difference between fastest and slowest wheel speed is greater than 5% for 20 s.
- No wheel speed signal for 1 s.
- An invalid wheel speed sensor signal is detected for 10 s.

Action Taken When the DTC Sets

- The EBCM disables the ABS, traction control, and stability control for the duration of the ignition cycle.

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- The ABS indicator turns ON.
- The traction control/stability control-active indicator turns ON.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The EBCM will turn OFF the indicators and enable the system functions in the next ignition cycle after driving at a speed of greater than 15 km/h (9 MPH).

Diagnostic Aids

- Do not use a magnet to clean the encoder ring.
- If 2 or more wheel speed sensors are inoperative, diagnose each wheel speed sensor individually.
- If the customer comments that the ABS indicator is ON only during moist environmental conditions (rain, snow, vehicle wash, etc.), inspect the wheel speed sensor wiring for signs of water intrusion. If the DTC is not current, clear all DTCs and simulate the effects of water intrusion by using the following procedure:

1. Spray the suspected area with a 5% saltwater solution.
2. Test drive the vehicle over various road surfaces (bumps, turns, etc.), above 40 km/h (25 MPH) for at least 30 s.
3. Rinse the area thoroughly when completed.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS Description and Operation

Electrical Information Reference

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

Scan Tool Reference

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Control Module References for scan tool information

Circuit/System Verification

Ignition ON, observe the scan tool Wheel Speed Sensor parameters. The reading should be the same speed on all sensors when driving in a straight line at a speed greater than 20 km/h (13 MPH).

Circuit/System Testing

1. Inspect the appropriate wheel speed sensor for contamination, physical damage and correct installation.
    - If contamination, physical damage or incorrect installation is diagnosed, repair or replace the wheel speed sensor.
2. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module (EBCM) and at the appropriate wheel speed sensor.
3. Ignition ON, test for less than 0.3 V between the low reference circuit terminal listed below and ground:
    - Left front wheel speed sensor circuit terminal 34 at the K17 Electronic Brake Control Module (EBCM) harness connector
    - Right front wheel speed sensor circuit terminal 6 at the K17 Electronic Brake Control Module (EBCM) harness connector
    - Left rear wheel speed sensor circuit terminal 20 at the K17 Electronic Brake Control Module (EBCM) harness connector
    - Right rear wheel speed sensor circuit terminal 31 at the K17 Electronic Brake Control Module (EBCM) harness connector
    - If greater than the specified value, test the low reference circuit for a short to voltage.
4. Test for less than 0.3 V between the 12 V reference circuit terminal listed below and ground:
    - Left front wheel speed sensor circuit terminal 21 at the K17 Electronic Brake Control Module (EBCM) harness connector
    - Right front wheel speed sensor circuit terminal 18 at the K17 Electronic Brake Control Module (EBCM) harness connector
    - Left rear wheel speed sensor circuit terminal 33 at the K17 Electronic Brake Control Module (EBCM) harness connector
    - Right rear wheel speed sensor circuit terminal 19 at the K17 Electronic Brake Control Module (EBCM) harness connector
    - If greater than the specified value, test the 12 V reference circuit for a short to voltage.
5. Ignition OFF, test for infinite resistance between the low reference circuit terminal listed below and ground:
    - Left front wheel speed sensor circuit terminal 34 at the K17 Electronic Brake Control Module (EBCM) harness connector
    - Right front wheel speed sensor circuit terminal 6 at the K17 Electronic Brake Control Module (EBCM) harness connector
    - Left rear wheel speed sensor circuit terminal 20 at the K17 Electronic Brake Control Module (EBCM) harness connector
    - Right rear wheel speed sensor circuit terminal 31 at the K17 Electronic Brake Control Module

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(EBCM) harness connector
- If less than the specified value, test the low reference circuit for a short to ground.

6. Test for infinite resistance between the 12 V reference circuit terminal listed below and ground:
   - Left front wheel speed sensor circuit terminal 21 at the K17 Electronic Brake Control Module (EBCM) harness connector
   - Right front wheel speed sensor circuit terminal 18 at the K17 Electronic Brake Control Module (EBCM) harness connector
   - Left rear wheel speed sensor circuit terminal 33 at the K17 Electronic Brake Control Module (EBCM) harness connector
   - Right rear wheel speed sensor circuit terminal 19 at the K17 Electronic Brake Control Module (EBCM) harness connector
   - If less than the specified value, test the 12 V reference circuit for a short to ground.
7. Test for infinite resistance between the circuit terminals listed below:
   - Left front wheel speed sensor 12 V reference circuit terminal 21 and low reference circuit terminal 34 at the K17 Electronic Brake Control Module (EBCM) harness connector
   - Right front wheel speed sensor 12 V reference circuit terminal 18 and low reference circuit terminal 6 at the K17 Electronic Brake Control Module (EBCM) harness connector
   - Left rear wheel speed sensor 12 V reference circuit terminal 33 and low reference circuit terminal 20 at the K17 Electronic Brake Control Module (EBCM) harness connector
   - Right rear wheel speed sensor 12 V reference circuit terminal 19 and low reference circuit terminal 31 at the K17 Electronic Brake Control Module (EBCM) harness connector
   - If less than the specified value, test the 12 V reference circuit and the low reference circuit for a short circuit.
8. Connect a fused jumper wire between the 12 V reference circuit terminal 1 and the low reference circuit terminal 2 at the wheel speed sensor harness connector.
9. Test for less than 5 ohms between the circuit terminals listed below:
   - Left front wheel speed sensor 12 V reference circuit terminal 21 and low reference circuit terminal 34 at the K17 Electronic Brake Control Module (EBCM) harness connector
   - Right front wheel speed sensor 12 V reference circuit terminal 18 and low reference circuit terminal 6 at the K17 Electronic Brake Control Module (EBCM) harness connector
   - Left rear wheel speed sensor 12 V reference circuit terminal 33 and low reference circuit terminal 20 at the K17 Electronic Brake Control Module (EBCM) harness connector
   - Right rear wheel speed sensor 12 V reference circuit terminal 19 and low reference circuit terminal 31 at the K17 Electronic Brake Control Module (EBCM) harness connector
   - If greater than the specified value, test the 12 V reference and low reference circuit for an open/high resistance.
10. If all circuits test normal, test the wheel speed sensor.

Component Testing

NOTE: Circuit/System Testing must be performed before Component Testing.

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Dynamic Test

1. Ignition OFF, connect the harness connector at the wheel speed sensor.
2. Connect a fused jumper wire between B+ and the 12 V reference circuit terminal listed below:
   - Left front wheel speed sensor circuit terminal 21 at the K17 Electronic Brake Control Module (EBCM) harness connector
   - Right front wheel speed sensor circuit terminal 18 at the K17 Electronic Brake Control Module (EBCM) harness connector
   - Left rear wheel speed sensor circuit terminal 33 at the K17 Electronic Brake Control Module (EBCM) harness connector
   - Right rear wheel speed sensor circuit terminal 19 at the K17 Electronic Brake Control Module (EBCM) harness connector
3. Spin the wheel very slowly, test for alternating current between ca. 7 mA and ca. 14 mA between the low reference circuit terminal listed below and ground:
   - Left front wheel speed sensor circuit terminal 34 at the K17 Electronic Brake Control Module (EBCM) harness connector
   - Right front wheel speed sensor circuit terminal 6 at the K17 Electronic Brake Control Module (EBCM) harness connector
   - Left rear wheel speed sensor circuit terminal 20 at the K17 Electronic Brake Control Module (EBCM) harness connector
   - Right rear wheel speed sensor circuit terminal 31 at the K17 Electronic Brake Control Module (EBCM) harness connector

   - If not within the specified range, replace the wheel speed sensor.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Front Wheel Speed Sensor Replacement**
- **Rear Wheel Speed Sensor Replacement**
- **Control Module References** for EBCM replacement, setup and programming

DTC C0060-C0095, C0121, C0141, C0146, C0151, OR C0156

Diagnostic Instructions

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

DTC Descriptors

DTC C0060 00

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Left Front Dump Solenoid Valve Circuit Malfunction

DTC C0065 00

Left Front Isolation Solenoid Valve Circuit Malfunction

DTC C0070 00

Right Front Dump Solenoid Valve Circuit Malfunction

DTC C0075 00

Right Front Isolation Solenoid Valve Circuit Malfunction

DTC C0080 00

Left Rear Dump Solenoid Valve Circuit Malfunction

DTC C0085 00

Left Rear Isolation Solenoid Valve Circuit Malfunction

DTC C0090 00

Right Rear Dump Solenoid Valve Circuit Malfunction

DTC C0095 00

Right Rear Isolation Solenoid Valve Circuit Malfunction

DTC C0121 00

Valve Relay Circuit Malfunction

DTC C0141 00

Front Prime Solenoid Valve Circuit Malfunction

DTC C0146 00

Front Isolation Solenoid Valve Circuit Malfunction

DTC C0151 00

Rear Prime Solenoid Valve Circuit Malfunction

DTC C0156 00

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Rear Isolation Solenoid Valve Circuit Malfunction

Circuit/System Description

The solenoid valves are integral parts of the brake pressure modulator valve assembly. The brake pressure modulator valve assembly contains an isolation solenoid valve and a dump solenoid valve for each wheel and a traction control/stability control prime solenoid valve and isolation solenoid valve for each brake circuit. The solenoid valves are not engaged during normal system operation. When the ABS, traction control or stability control operation is required the electronic brake control module (EBCM) turns the required solenoid valves ON.

Conditions for Running the DTC

Ignition ON

Conditions for Setting the DTC

C0060 00-C0095 00, C0141 00, C0146 00, C0151 00, or C0156 00

- A short to ground, short to voltage or open/high resistance on the solenoid valve circuit is detected for 0.03 s.
- A short circuit between the solenoid valve circuits is detected for 0.03 s.
- An invalid solenoid valve feedback signal is detected.

C0121 00

- A short to ground or open/high resistance is detected on the valve relay B+ circuit for 0.5 s.
- A malfunctioning valve relay is detected.
- A short to voltage, short to ground or open/high resistance on the valve relay output circuit is detected.

Action Taken When the DTC Sets

- The EBCM disables the ABS, traction control and stability control for the duration of the ignition cycle.
- The ABS indicator turns ON.
- The traction control/stability control-active indicator turns ON.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The EBCM will turn OFF the indicators and enable the system functions in the next ignition cycle after driving at a speed of greater than 15 km/h (9 MPH).

Reference Information

Schematic Reference

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Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS 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

Ignition ON, command the ABS and Traction Control Solenoid Valves ON and OFF with the scan tool. The solenoid valves should turn ON and OFF.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module (EBCM).
2. Verify that a test lamp illuminates between the ground circuit terminal 38 and B+.
    - If the test lamp does not illuminate, test the ground circuit for an open/high resistance.
3. Verify that a test lamp illuminates between the B+ circuit terminal 25 and ground.
    - If the test lamp does not illuminate, test the B+ circuit for a short to ground or an open/high resistance.
4. If all circuits test normal, replace the K17 Electronic Brake Control Module (EBCM) and verify the DTC does not reset.
    - If the DTC resets, replace the brake pressure modulator valve assembly.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Brake Pressure Modulator Valve Replacement**
- **Control Module References** for EBCM replacement, programming and setup

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DTC C0110

Diagnostic Instructions

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

DTC Descriptor

DTC C0110 00

Pump Motor Circuit Malfunction

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	C0110 00	C0110 00	-	-
Ground	-	C0110 00	-	-

Component	Condition	DTCs
Pump motor	• Wear • Damage • Lock	C0110 00

Circuit/System Description

The pump motor is an integral part of the brake pressure modulator valve assembly, while the pump motor relay is integral to the electronic brake control module (EBCM). The pump motor relay is not engaged during normal system operation. When the ABS, traction control or stability control operation is required, the EBCM activates the pump motor relay and turns the pump motor ON.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

- A short to ground or an open/high resistance on the pump motor B+ circuit is detected for 0.1 s.
- An open/high resistance on the pump motor ground circuit is detected for 0.1 s.
- A faulty pump motor or pump motor relay is detected.

Action Taken When the DTC Sets

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- The EBCM disables the ABS, traction control and stability control for the duration of the ignition cycle.
- The ABS indicator turns ON.
- The traction control/stability control-active indicator turns ON.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The EBCM will turn OFF the indicators and enable the system functions in the next ignition cycle after driving at a speed of greater than 15 km/h (9 MPH).

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module (EBCM).
2. Test for less than 1 ohms between the ground circuit terminal 13 and ground.
    - If greater than the specified value, test the ground circuit for an open/high resistance.
3. Verify that a test lamp illuminates between the B+ circuit terminal 1 and ground.
    - If the test lamp does not illuminate, test the B+ circuit for a short to ground or an open/high resistance.
4. If all circuits test normal, replace the brake pressure modulator valve assembly and verify the DTC does

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not reset.

- If the DTC resets, replace the K17 Electronic Brake Control Module (EBCM).

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Brake Pressure Modulator Valve Replacement**
- **Control Module References** for EBCM replacement, setup and programming

DTC C0131

Diagnostic Instructions

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

DTC Descriptor

DTC C0131 00

Antilock Braking System Pressure Circuit Malfunction

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5V Reference	C0131 00	C0131 00	C0131 00	-
Signal	C0131 00	C0131 00	C0131 00	C0131 00

Circuit/System Description

The brake pressure sensor is integral to the brake pressure modulator valve assembly. The electronic brake control module (EBCM) monitors the brake pressure sensor supply voltage and the signal voltage. The body control module (BCM) sends a serial data message when the brake pedal is applied.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

- The brake pressure sensor supply voltage is less than 4.4 V or greater than 5.4 V.
- The brake pressure sensor signal offset is out of the specified range.
- The brake pressure sensor signal is out of the specified range.

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Action Taken When the DTC Sets

- The EBCM disables the ABS, traction control and stability control for the duration of the ignition cycle.
- The ABS indicator turns ON.
- The traction control/stability control-active indicator turns ON.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The EBCM will turn OFF the indicators and enable the system functions in the next ignition cycle.

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Ignition ON, observe the scan tool Brake Pressure Sensor parameter. The reading should be 0 V, when the brake pedal is released and greater than 1 V, when the brake pedal is applied.

Circuit/System Testing

1. Observe the stop lamps while applying and releasing the brake pedal. Verify the stop lamps operate properly.
    - If the stop lamps do not operate properly, refer to **Symptoms - Lighting**

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2. Replace the brake pressure modulator valve assembly and verify the DTC does not reset.
    - If the DTC resets replace the K17 Electronic Brake Control Module (EBCM).

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Brake Pressure Modulator Valve Replacement**
- **Control Module References** for EBCM replacement, setup and programming

DTC C0161

Diagnostic Instructions

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

DTC Descriptors

DTC C0161 00

Antilock Braking System Brake Sensor Circuit Malfunction

DTC C0161 5A

Antilock Braking System Brake Sensor Circuit Not Plausible

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5V Reference	C0277 06	C0277 06	-	-
Signal	C0277 06	C0277 06	C0277 07	C0277 09
Low Reference	-	C0277 06	-	-

Circuit/System Description

The body control module (BCM) monitors the brake pedal position sensor and sends a serial data message when the brake pedal is applied. When the vehicle is stopping, the electronic brake control module (EBCM) monitors for the brake pedal applied serial data message from the BCM, with the brake pressure increasing and the vehicle slowing down, or when the vehicle is accelerating, the brake pedal is not applied and brake pressure is not increasing.

Conditions for Running the DTC

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- Ignition ON
- DTC C0131 is not present.

Conditions for Setting the DTC

- The EBCM detects that the brake pedal is permanently applied.
- The brake pedal position sensor signal is not plausible with the brake pressure sensor signal.

Action Taken When the DTC Sets

- The EBCM disables the traction control and stability control for the duration of the ignition cycle.
- The traction control/stability control-active indicator turns ON.

Conditions for Clearing the DTC

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

Diagnostic Aids

DTC C0161 can be set if the brake pedal is applied while accelerating or the brake pedal position sensor is out of adjustment.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS Description and Operation

Electrical Information Reference

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

Scan Tool Reference

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Control Module References

Circuit/System Verification

1. Ignition ON, verify that DTC C0277 is not present in the BCM.
   - If DTC C0277 is present, refer to **DTC C0277 or C0890** .
2. Ignition ON, observe the stop lamps while applying and releasing the brake pedal. Verify the stop lamps operate properly.
   - If the stop lamps do not operate properly, refer to **Stop Lamps Malfunction** .

Circuit/System Testing

Replace the K17 Electronic Brake Control Module and verify the DTC does not reset.

- If the DTC resets replace the K9 Body Control Module.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

Control Module References for control module replacement, setup and programming

DTC C0186, C0196, OR C019B

Diagnostic Instructions

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

DTC Descriptors

DTC C0186 00

Lateral Acceleration Sensor Circuit Malfunction

DTC C0186 5A

Lateral Acceleration Sensor Circuit Not Plausible

DTC C0186 71

Lateral Acceleration Sensor Circuit Invalid Data

DTC C0196 00

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Yaw Rate Signal Malfunction

DTC C0196 5A

Yaw Rate Signal Not Plausible

DTC C0196 71

Yaw Rate Signal Invalid Data

DTC C019B 5A

Yaw Rate Signal Not Plausible

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
12 V Reference	U0125, U0126	U0125, U0126	-	-
CAN Bus High Serial Data	U0073, U0100, U0101, U0125, U0126, U0140	U0073, U0100, U0101, U0125, U0126, U0140	U0073, U0100, U0101, U0125, U0126, U0140	C0186 00, C0186 5A, C0186 71, C0196 00, C0196 5A, C0196 71,
CAN Bus Low Serial Data	U0073, U0100, U0101, U0125, U0126, U0140	U0073, U0100, U0101, U0125, U0126, U0140	U0073, U0100, U0101, U0125, U0126, U0140	C0186 00, C0186 5A, C0186 71, C0196 00, C0196 5A, C0196 71,
Ground	-	U0125	-	-

Circuit/System Description

The yaw rate and lateral acceleration sensors are combined into one multi-axis acceleration sensor module, external to the electronic brake control module (EBCM). The EBCM supplies a 12 V reference voltage to the multi-axis acceleration sensor module. The multi-axis acceleration sensor module communicates with the EBCM via the high speed controller area network (CAN) serial data circuit. The EBCM activates the stability control function depending on multi-axis acceleration sensor module input.

Conditions for Running the DTC

C0186 00

- Ignition ON
- Vehicle travelling

Conditions for Setting the DTC

C0186 00

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- The lateral acceleration sensor signal is out of specified range for 1.6 s.
- The lateral acceleration sensor signal offset is out of specified range for 0.4 s.

C0186 5A

The lateral acceleration sensor signal is not plausible with the yaw rate sensor signal, steering angle sensor signal and vehicle speed for 1.6 s.

C0186 71

The EBCM has received invalid serial data from the multi-axis acceleration sensor module.

C0196 00

- The yaw rate sensor signal is out of specified range for 10 s.
- The yaw rate sensor signal offset is out of specified range for 1.6 s.

C0196 5A

- The yaw rate sensor signal is not plausible with the lateral acceleration sensor signal, steering angle sensor signal and vehicle speed for 1.6 s
- The yaw rate sensor signal is out of specified range for 0.5-5 s.

C0196 71

The EBCM has received invalid serial data from the multi-axis acceleration sensor module.

C019B 5A

The yaw rate sensor signal is out of specified range.

Action Taken When the DTC Sets

- The EBCM disables the traction control and stability control for the duration of the ignition cycle.
- The traction control/stability control-active indicator turns ON.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The EBCM will turn OFF the indicators and enable the system functions in the next ignition cycle.

Reference Information

Schematic Reference

Antilock Brake System Schematics

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Connector End View Reference

Component Connector End Views

Description and Operation

ABS 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 ON, verify that DTC C0186, C0196, or C019B is not present.
   - If any listed DTC is present, perform the **Vehicle Yaw Sensor Learn** prior to this diagnostic.
2. Inspect the B119 Multi-axis Acceleration Sensor for correct installation.
   - If loose or incorrect installation is diagnosed, correct the installation of the component.
3. Ignition OFF, disconnect the harness connector at the B119 Multi-axis Acceleration Sensor.
4. Test for less than 5 ohms between the ground circuit terminal 6 and ground.
   - If greater than the specified value, test the ground circuit for an open/high resistance.
5. Ignition ON, test for greater than 11 V between the 12 V reference circuit terminal 5 and ground.
   - If less than the specified value, test the 12 V reference circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the K17 Electronic Brake Control Module (EBCM).
6. If all circuits test normal, replace the B119 Multi-axis Acceleration Sensor and verify the DTC does not reset.
   - If the DTC resets, replace the K17 Electronic Brake Control Module (EBCM).

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Vehicle Yaw Sensor Replacement**
- **Control Module References** for EBCM replacement, setup and programming

DTC C0242 OR P0856

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Diagnostic Instructions

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

DTC Descriptor

DTC C0242 00

Engine Control Module Indicated Traction Control Malfunction

DTC P0856 00

Traction Control Torque Request Circuit Malfunction

Circuit/System Description

When traction control is active, the electronic brake control module (EBCM) sends a serial data message to the engine control module (ECM) requesting torque reduction. When certain ECM DTCs are set, the ECM will not be able to perform the torque reduction for traction control. A serial data message is sent to the EBCM indicating that traction control is not allowed.

Conditions for Running the DTC

Engine running

Conditions for Setting the DTC

The ECM detects a fault that prevents it from performing a traction control function and sends a serial data message to the EBCM indicating that torque reduction is not allowed.

Action Taken When the DTC Sets

- The EBCM disables the traction control and stability control for the duration of the ignition cycle.
- The traction control/stability control-active indicator turns ON.

Conditions for Clearing the DTC

A current DTC clears when the diagnostic runs and passes.

Reference Information

Schematic Reference

Antilock Brake System Schematics

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Connector End View Reference

Component Connector End Views

Description and Operation

ABS 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. Verify that no DTCs except P0856 are present in the ECM.
   - If any DTC is present, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** to diagnose that DTC prior to this diagnostic.
2. Replace the K20 Engine Control Module and verify the DTC does not reset.
   - If the DTC resets replace the K17 Electronic Brake Control Module (EBCM).

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

Control Module References for control module replacement, setup and programming

DTC C0245

Diagnostic Instructions

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

DTC Descriptor

DTC C0245 00

Wheel Speed Sensor Frequency Malfunction

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Circuit/System Description

The wheel speeds are detected by active wheel speed sensors. Each wheel speed sensor receives 12 V reference voltage from the electronic brake control module (EBCM) and provides an alternating current square wave signal to the EBCM. As the wheel spins, the EBCM uses the frequency of the square wave signal to calculate the wheel speed.

Conditions for Running the DTC

- DTC C0035, C0040, C0045, or C0050 is not present.
- Vehicle speed is greater than 20 km/h (13 MPH).

Conditions for Setting the DTC

- Difference between the fastest and slowest wheel speed is greater than 6 km/h (4 MPH)
- The EBCM can not determine a specific wheel speed sensor fault.

Action Taken When the DTC Sets

- The EBCM disables the ABS, traction control and stability control for the duration of the ignition cycle.
- The ABS indicator turns ON.
- The traction control/stability control-active indicator turns ON.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The EBCM will turn OFF the indicators and enable the system functions in the next ignition cycle.

Diagnostic Aids

- Do not use a magnet to clean the encoder ring.
- If 2 or more wheel speed sensors are inoperative, diagnose each wheel speed sensor individually.
- If the customer comments that the ABS indicator is ON only during moist environmental conditions (rain, snow, vehicle wash, etc.), inspect the wheel speed sensor wiring for signs of water intrusion. If the DTC is not current, clear all DTCs and simulate the effects of water intrusion by using the following procedure:

1. Spray the suspected area with a 5% saltwater solution.
2. Test drive the vehicle over various road surfaces (bumps, turns, etc.), above 40 km/h (25 MPH) for at least 30 s.
3. Rinse the area thoroughly when completed.

Reference Information

Schematic Reference

Antilock Brake System Schematics

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Connector End View Reference

Component Connector End Views

Description and Operation

ABS 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

Ignition ON, observe the scan tool Wheel Speed Sensor parameters while spinning the wheels. The readings should be analog to the wheel speeds.

Circuit/System Testing

1. Inspect for one tire that has improper air pressure or improper size.
    - If not all the same pressure, adjust all tire pressures to specification. If not all the same size, replace the incorrect tire.
2. Inspect the wheel speed sensors for contamination, physical damage and correct installation.
    - If contamination, physical damage or incorrect installation is diagnosed, repair or replace the wheel speed sensor and verify the DTC does not reset.
3. If the DTC resets, replace the K17 Electronic Brake Control Module (EBCM).

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Front Wheel Speed Sensor Replacement**
- **Rear Wheel Speed Sensor Replacement**
- **Control Module References** for EBCM replacement, setup and programming

DTC C0280

Diagnostic Instructions

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

DTC Descriptor

DTC C0280 00

Stability System Active Too Long

Circuit/System Description

The brake pressure modulator valve assembly contains an isolation solenoid valve and a dump solenoid valve for each wheel and a traction control/stability control prime solenoid valve and isolation solenoid valve for each brake circuit. The solenoid valves are not engaged during normal system operation. When the ABS, traction control or stability control operation is required the electronic brake control module (EBCM) turns the required solenoid valves ON.

Conditions for Running the DTC

- Ignition ON
- Vehicle speed is greater than 21.6 km/h (14 MPH)

Conditions for Setting the DTC

Stability control is active for more than 10 s.

Action Taken When the DTC Sets

- The EBCM disables the ABS, traction control and stability control for the duration of the ignition cycle.
- The ABS indicator turns ON.
- The traction control/stability control-active indicator turns ON.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The EBCM will turn OFF the indicators and enable the system functions in the next ignition cycle.

Diagnostic Aids

DTC can set because of extended operation of ABS, traction control or stability control.

Reference Information

Schematic Reference

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Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS 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 ON, verify that DTC C0186, C0196, C019B, or C0710 is not set as a present DTC.
   - If any listed DTC is present, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** to diagnose that DTC prior to this diagnostic.
2. Inspect the B99 Steering Wheel Angle Sensor and B119 Multi-axis Acceleration Sensor for correct installation.
   - If loose or incorrect installation is diagnosed, correct the installation of the component.
3. Verify that DTC C0280 00 is not set as a present DTC.
   - If DTC C0280 00 is present, replace the K17 Electronic Brake Control Module (EBCM) and verify DTC does not reset. If the DTC resets replace the brake pressure modulator valve assembly.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Brake Pressure Modulator Valve Replacement**
- **Control Module References** for EBCM replacement, setup and programming

DTC C0710

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

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- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C0710 00

Steering Position Signal Malfunction

DTC C0710 42

Steering Position Signal Calibration Not Programmed

DTC C0710 5A

Steering Position Signal Not Plausible

DTC C0710 71

Steering Position Signal Invalid Data

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
12 V Reference	U0125, U0126	U0125, U0126	-	-
CAN Bus High Serial Data	U0073, U0100, U0101, U0125, U0126, U0140	U0073, U0100, U0101, U0125, U0126, U0140	U0073, U0100, U0101, U0125, U0126, U0140	C0710 00, C0710 5A, C0710 71
CAN Bus Low Serial Data	U0073, U0100, U0101, U0125, U0126, U0140	U0073, U0100, U0101, U0125, U0126, U0140	U0073, U0100, U0101, U0125, U0126, U0140	C0710 00, C0710 5A, C0710 71
Ground	-	U0126	-	-

Circuit/System Description

The steering angle sensor receives a 12 V reference voltage from the electronic brake control module (EBCM). The EBCM receives high speed controller area network (CAN) message inputs from the steering angle sensor identifying the position and direction of the steering wheel rotation. The EBCM utilizes this signal to calculate the driver intended driving direction.

Conditions for Running the DTC

C0710 00

Ignition ON.

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C0710 42

Vehicle speed is greater than 20 km/h (14 MPH).

C0710 5A

Vehicle speed is greater than 5 km/h (3 MPH).

C0710 71

Vehicle is cornering.

Conditions for Setting the DTC

C0710 00

The steering angle sensor signal is out of specified range for 0.6 s.

C0710 42

The steering angle sensor is not calibrated.

C0710 5A

- The steering angle sensor signal is not plausible for 10 s.
- The steering angle sensor offset is out of specified range.
- The steering angle sensor signal is not plausible with the yaw rate sensor signal for 0.4-4.8 s.

C0710 71

The steering angle sensor signal is not plausible with the wheel speed sensor signals.

Action Taken When the DTC Sets

- The EBCM disables the traction control and stability control for the duration of the ignition cycle.
- The traction control/stability control-active indicator turns ON.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The EBCM will turn OFF the indicators and enable the system functions in the next ignition cycle.

Diagnostic Aids

The car should not pull in either direction causing the steering wheel to be OFF center while driving in a straight line on a level surface.

Reference Information

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Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS 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

Ignition ON, observe the scan tool Steering Column Position parameter. As the steering wheel is turned, the reading should travel between -550 and 550°.

Circuit/System Testing

1. Ignition ON, verify that DTC C0710 is not present.
    - If DTC C0710 is present, perform the **Steering Angle Sensor Centering**.
2. Inspect the B99 Steering Wheel Angle Sensor for correct installation.
    - If loose or incorrect installation is diagnosed, correct the installation of the component.
3. Ignition OFF, disconnect the harness connector at the B99 Steering Wheel Angle Sensor.
4. Test for less than 5 ohms between the ground circuit terminal 6 and ground.
    - If greater than the specified value, test the ground circuit for an open/high resistance.
5. Ignition ON, test for greater than 11 V between the 12 V reference circuit terminal 5 and ground.
    - If less than the specified range, test the 12 V reference circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the K17 Electronic Brake Control Module (EBCM).
6. If all circuits test normal, replace the B99 Steering Wheel Angle Sensor and verify the DTC does not reset.
    - If the DTC resets, replace the K17 Electronic Brake Control Module (EBCM).

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Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Steering Angle Sensor Replacement**
- **Control Module References** for EBCM replacement, setup and programming

SYMPTOMS - ANTILOCK BRAKE SYSTEM

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

1. Perform the **Diagnostic System Check - Vehicle** before using the symptom tables in order to verify that all of the following are true:
   - There are no DTCs set.
   - The control modules can communicate via the serial data link.
2. Review the system description and operation in order to familiarize yourself with the system functions. Refer to **ABS Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the ABS. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components, for obvious damage or conditions, which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

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

- **ABS Indicator Malfunction**
- **StabiliTrak Indicator Malfunction**

ABS INDICATOR MALFUNCTION

Diagnostic Instructions

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

Circuit/System Description

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The instrument cluster turns ON the ABS indicator for 5 s after ignition ON or when the electronic brake control module (EBCM) detects a fault and sends a serial data message to the instrument cluster commanding the indicator ON.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS 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

Ignition ON, the ABS indicator should turn ON. After 5 s the ABS indicator should turn OFF.

Circuit/System Testing

1. Ignition ON, with a scan tool command the instrument cluster All Indicators test ON and OFF. Verify the ABS indicator turns ON and OFF.
   - If the ABS indicator does not turn ON and OFF, replace the P16 Instrument Cluster.
2. Verify the ABS indicator turns OFF 5 s after ignition ON.
   - If the ABS indicator does not turn OFF, replace the K17 Electronic Brake Control Module (EBCM).

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

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Control Module References for control module replacement, setup and programming

STABILITRAK INDICATOR MALFUNCTION

Diagnostic Instructions

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

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Stability Control Switch Signal	B2745 02	1	1	-
Stability Control Switch Ground	-	1	-	-
1. Traction Control Switch Inoperative				

Circuit/System Description

The instrument cluster illuminates the traction control/stability control-active indicator for 5 s after ignition ON. The electronic brake control module (EBCM) will request the instrument cluster via serial data to turn the traction control/stability control-active indicator ON (flashing) when the system is in traction control or stability control mode. When the EBCM detects a fault it sends a serial data message to the instrument cluster commanding the traction control/stability control-active indicator ON.

The body control module (BCM) monitors the stability control switch. When the traction control switch is pressed once, the BCM will request the EBCM via serial data to disable the traction control. When the traction control switch is pressed for 5 s, the BCM will request the EBCM to disable the stability control. The EBCM will request the instrument cluster via serial data to turn the traction control off indicator and stability control off indicator ON to notify the driver of the deactivation.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS Description and Operation

Electrical Information Reference

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- **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, with a scan tool command the Instrument Cluster All Indicators test ON and OFF. Verify the traction control/stability control-active indicator, traction control off indicator and stability control off indicator turn ON and OFF.
    - If either indicator does not turn ON and OFF, replace the P16 Instrument Cluster.
2. Observe the scan tool BCM Traction Control Switch parameter while pressing and releasing the traction control switch. Verify the reading changes between Active and Inactive.
    - If the parameter does not change between the specified values, refer to Circuit/System Testing.
3. Observe the scan tool EBCM Traction Control System parameter while pressing and releasing the traction control switch. Verify the reading changes between On and Off.
    - If the parameter does not change between the specified values, replace the K9 Body Control Module.
4. Observe the scan tool EBCM Vehicle Stability System parameter while pressing the traction control switch for 5 s and releasing. Verify the reading changes between On and Off.
    - If the parameter does not change between the specified values, replace the K9 Body Control Module.
5. Observe the traction control off indicator while pressing and releasing the traction control switch. Verify the traction control off indicator turns ON and OFF.
    - If the traction control off indicator does not turn ON and OFF, replace the K17 Electronic Brake Control Module (EBCM).
6. Observe the stability control off indicator while pressing the traction control switch for 5 s and releasing. Verify the stability control off indicator turns ON and OFF.
    - If the stability control off indicator does not turn ON and OFF, replace the K17 Electronic Brake Control Module (EBCM).

Circuit/System Testing

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

1. Ignition OFF, disconnect the harness connector at the S75 Traction Control Switch.
2. Test for less than 5 ohms between the ground circuit terminal 2 and ground.
    - If greater than the specified value, test the ground circuit for an open/high resistance.
3. Ignition ON, verify the scan tool BCM Traction Control Switch parameter is Inactive.

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- If not the specified value, test the signal circuit for a short to ground. If the circuit tests normal, replace the K9 Body Control Module.

4. Install a 3 A fused jumper wire between the signal circuit terminal 7 and ground.
5. Verify the scan tool BCM Traction Control Switch parameter is Active.
   - If not the specified value, test the signal circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the K9 Body Control Module.
6. If all circuits test normal, test or replace the S75 Traction Control Switch.

Component Testing

Static Test

1. Ignition OFF, disconnect the harness connector at the S75 Traction Control Switch.
2. Test for infinite resistance between the signal circuit terminal 7 and the ground circuit terminal 2 with the switch in the released position.
   - If less than the specified value, replace the S75 Traction Control Switch.
3. Test for less than 5 ohms between the signal circuit terminal 7 and the ground circuit terminal 2 with the switch in the pressed position.
   - If greater than the specified value, replace the S75 Traction Control Switch.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Electronic Traction Control Switch Replacement**
- **Control Module References** for module replacement, setup and programming

REPAIR INSTRUCTIONS

ANTILOCK BRAKE SYSTEM AUTOMATED BLEED

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

NOTE: Before performing the ABS Automated Bleed Procedure, first perform a pressure bleed of the base brake system. Refer to Hydraulic Brake System Bleeding (Manual) or Hydraulic Brake System Bleeding (Pressure) . The automated bleed procedure is recommended when one of the following conditions exist:

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- **Base brake system bleeding does not achieve the desired pedal height or feel**
- **Extreme loss of brake fluid has occurred**
- **Air ingestion is suspected in the secondary circuits of the brake modulator assembly**

The ABS Automated Bleed Procedure uses a scan tool to cycle the system solenoid valves and run the pump in order to purge any air from the secondary circuits. These circuits are normally closed off, and are only opened during system initialization at vehicle start up and during ABS operation. The automated bleed procedure opens these secondary circuits and allows any air trapped in these circuits to flow out toward the brake corners.

Performing the Automated Bleed Procedure

CAUTION: The Auto Bleed Procedure may be terminated at any time during the process by pressing the EXIT button. No further Scan Tool prompts pertaining to the Auto Bleed procedure will be given. After exiting the bleed procedure, relieve bleed pressure and disconnect bleed equipment per manufacturers instructions. Failure to properly relieve pressure may result in spilled brake fluid causing damage to components and painted surfaces.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove all four tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** .
3. Inspect the brake system for leaks and visual damage. Refer to **Symptoms - Hydraulic Brakes** . Repair or replace components as needed.
4. Lower the vehicle.
5. Inspect the battery state of charge. Refer to **Battery Inspection/Test** .
6. Install a scan tool.
7. Turn the ignition ON, with the engine OFF.
8. With the scan tool, establish communications with the ABS system. Select Special Functions. Select Automated Bleed from the Special Functions menu.
9. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
10. Following the directions given on the scan tool, pressure bleed the base brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)** .
11. Follow the scan tool directions until the desired brake pedal height is achieved.
12. If the bleed procedure is aborted, a malfunction exists. Perform the following steps before resuming the bleed procedure:
    - If a DTC is detected, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** , and diagnose the appropriate DTC.
    - If the brake pedal feels spongy, perform the conventional brake bleed procedure again. Refer to **Hydraulic Brake System Bleeding (Manual)** **Hydraulic Brake System Bleeding (Pressure)** .
13. When the desired pedal height is achieved, press the brake pedal to inspect for firmness.

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14. Lower the vehicle.
15. Remove the scan tool.
16. Install the tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** .
17. Inspect the brake fluid level. Refer to **Master Cylinder Reservoir Filling** .
18. Road test the vehicle while inspecting that the pedal remains high and firm.

STEERING ANGLE SENSOR CENTERING

The steering angle sensor does not require a centering often. Centering of the steering angle sensor might be required after certain service procedures are performed. Some of these procedures are as follows:

- Electronic brake control module (EBCM) replacement
- Steering angle sensor replacement
- Steering gear replacement
- Steering column replacement
- Collision or other physical damage

The steering angle sensor centering procedure can be completed with a scan tool using the following steps:

1. Using the steering wheel, align the front wheels forward.
2. Apply the parking brake, or set the transmission in the P position.
3. Install the scan tool to the data link connector.
4. Ignition ON, engine OFF
5. Select Steering Wheel Angle Sensor Reset in the Steering Wheel Angle Sensor Module Configuration/Reset Functions list.
6. Follow the scan tool directions to complete the learn procedure.
7. Select Steering Wheel Angle Sensor Learn in the Steering Wheel Angle Sensor Module Configuration/Reset Functions list.
8. Follow the scan tool directions to complete the learn procedure.
9. Select Steering Wheel Angle Sensor Learn in the EBCM Configuration/Reset Functions list.
10. Follow the scan tool directions to complete the learn procedure.
11. Clear any DTCs that may be set.

ELECTRONIC BRAKE CONTROL MODULE REPLACEMENT

Removal Procedure

CAUTION: To prevent equipment damage, never connect or disconnect the wiring harness connection from the EBCM with the ignition switch in the ON position.

1. Place the ignition switch in the OFF position.

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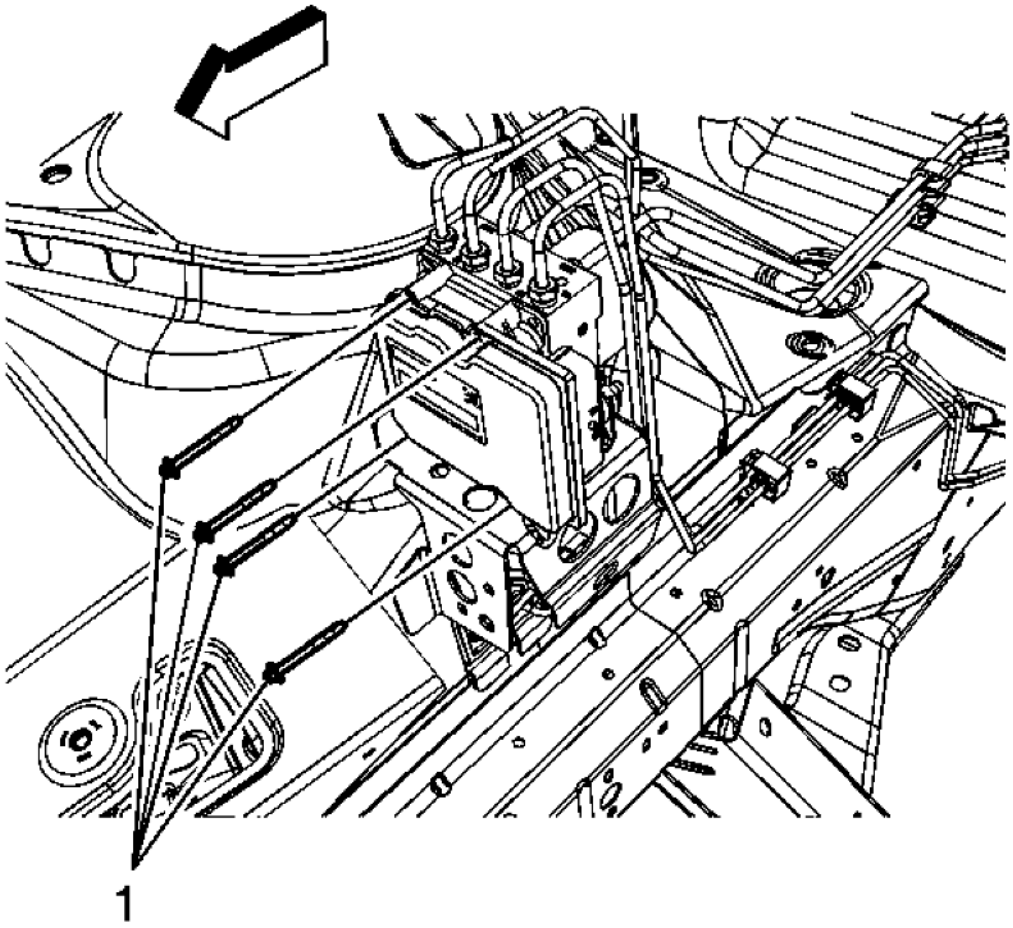


Fig. 4: Electronic Brake Control Module
Courtesy of GENERAL MOTORS CORP.

2. Thoroughly clean the area around the electronic brake control module (EBCM) of all dirt and debris.
3. Disconnect the EBCM electrical connector.
4. Remove the EBCM bolts (1).

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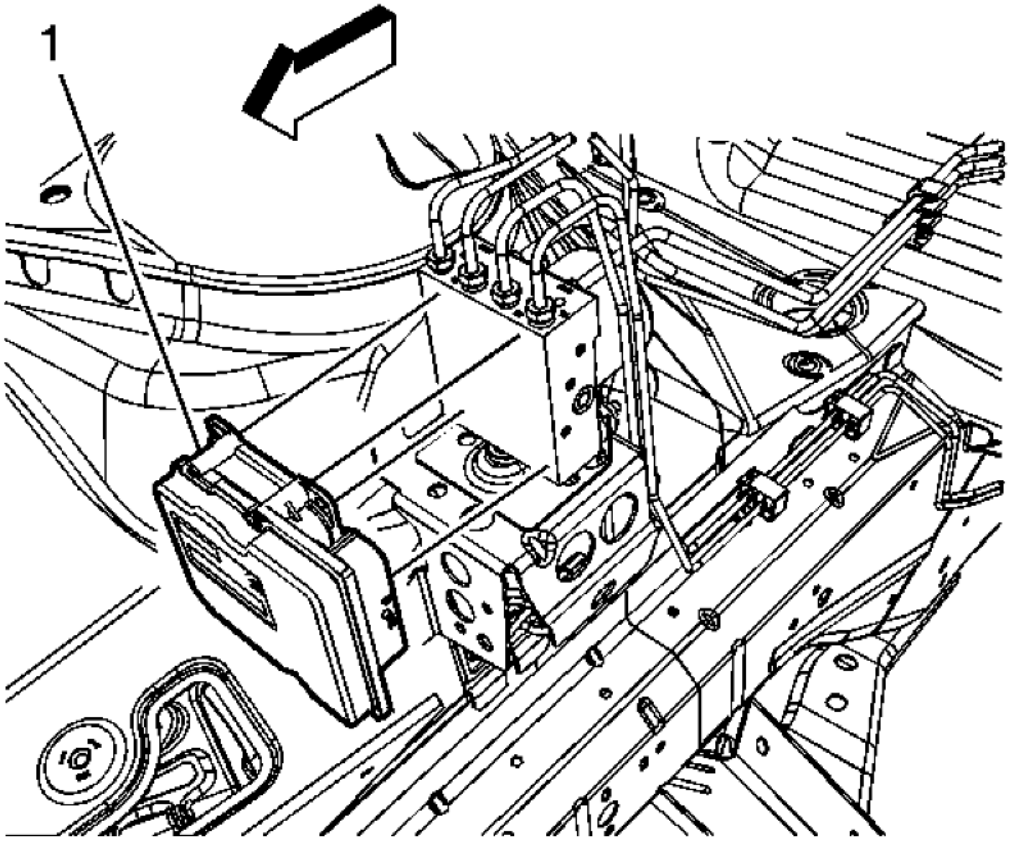


Fig. 5: EBCM & Brake Pressure Modulator Valve
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not attempt to pry or lever against the EBCM.

5. Carefully separate the EBCM from the brake pressure modulator valve (BPMV) by pulling straight away from the BPMV.

   Do not force the components apart.

Installation Procedure

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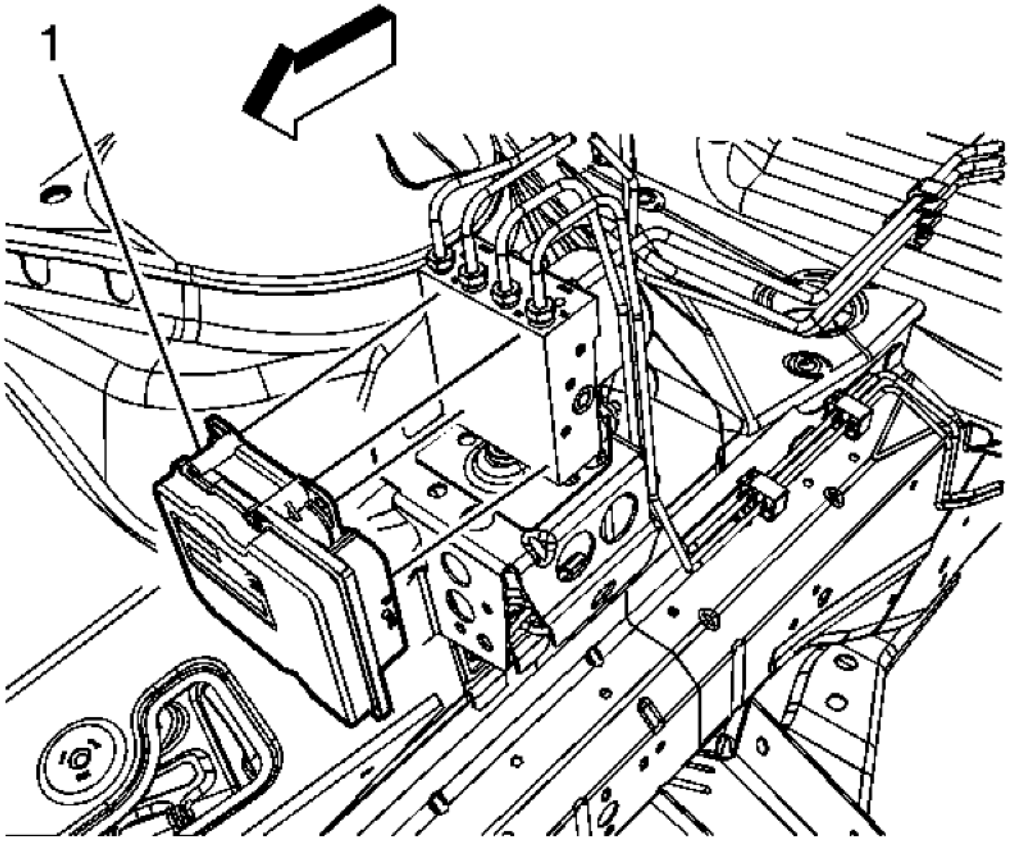


Fig. 6: EBCM & Brake Pressure Modulator Valve
Courtesy of GENERAL MOTORS CORP.

1. Clean the sealing surfaces of the EBCM and the BPMV with denatured alcohol and allow to dry.
2. Install the EBCM (1) to the BPMV.

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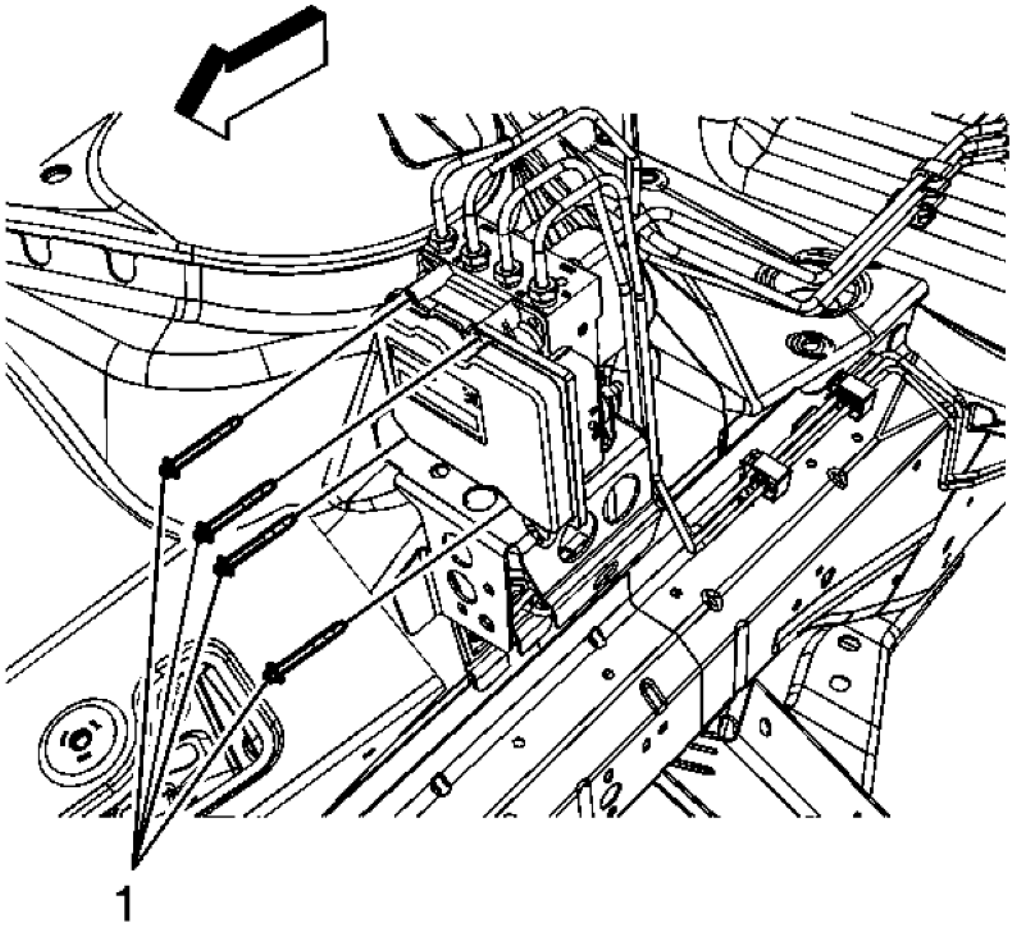


Fig. 7: Electronic Brake Control Module
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

3. Install the EBCM bolts (1) and tighten in a cross pattern to 3 N.m (27 lb in).
4. Connect the EBCM electrical connector.
5. Program the EBCM. Refer to **Control Module References** .
6. Perform the **Diagnostic System Check - Vehicle** .

BRAKE PRESSURE MODULATOR VALVE REPLACEMENT

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Removal Procedure

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

CAUTION: To prevent equipment damage, never connect or disconnect the wiring harness connection from the EBCM with the ignition switch in the ON position.

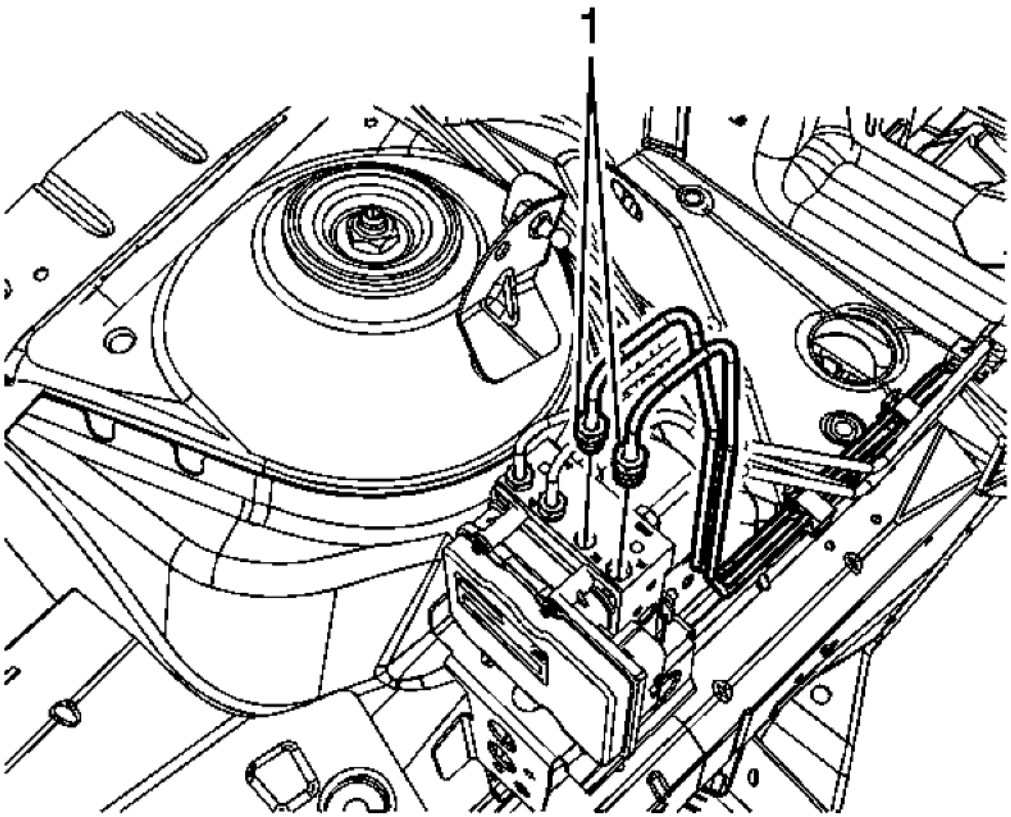


Fig. 8: Rear Brake Pipe Fittings At Brake Pressure Modulator Valve
Courtesy of GENERAL MOTORS CORP.

1. Place the ignition switch in the OFF position.

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2. Thoroughly clean the area around the electronic brake control module (EBCM) of all dirt and debris.
3. Disconnect the EBCM electrical connector.

NOTE: Note the brake pipe locations for proper installation.

4. Disconnect the rear brake pipe fittings (1) from the brake pressure modulator valve (BPMV).
5. Cap the brake pipe fittings and plug the BPMV outlet ports to prevent brake fluid loss and contamination.

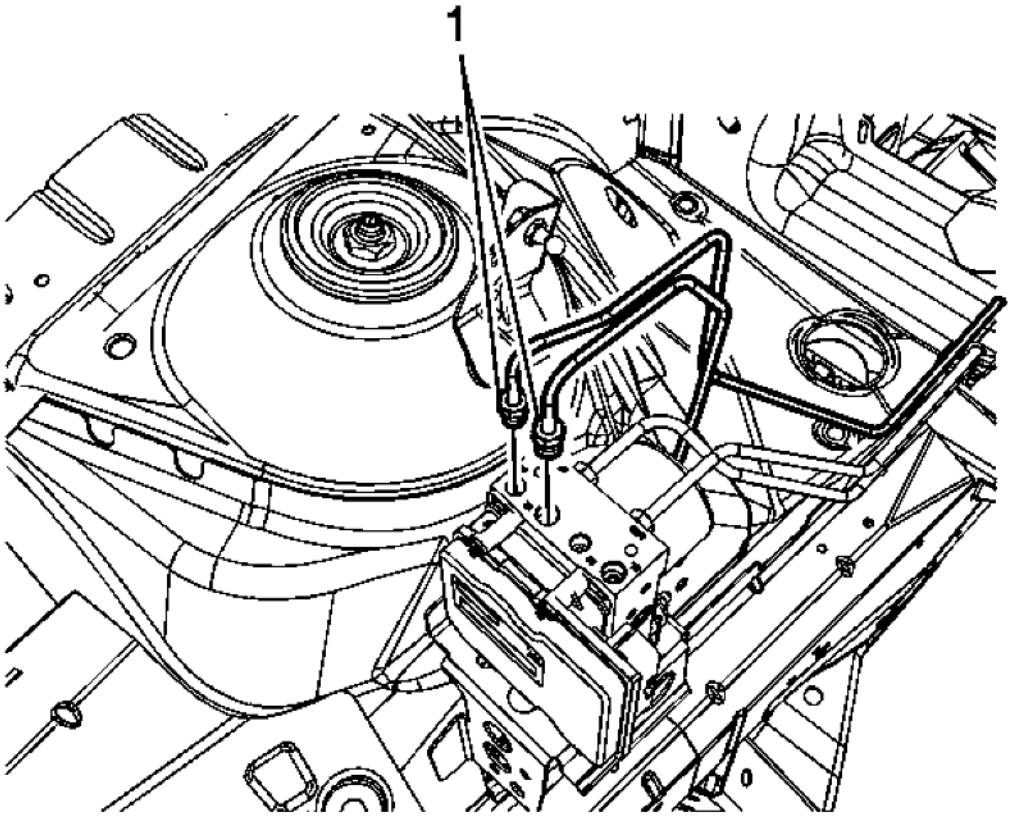


Fig. 9: Front Brake Pipe Fittings At BPMV
Courtesy of GENERAL MOTORS CORP.

NOTE: Note the brake pipe locations for proper installation.

6. Disconnect the front brake pipe fittings (1) from the BPMV.
7. Cap the brake pipe fittings and plug the BPMV outlet ports to prevent brake fluid loss and contamination.

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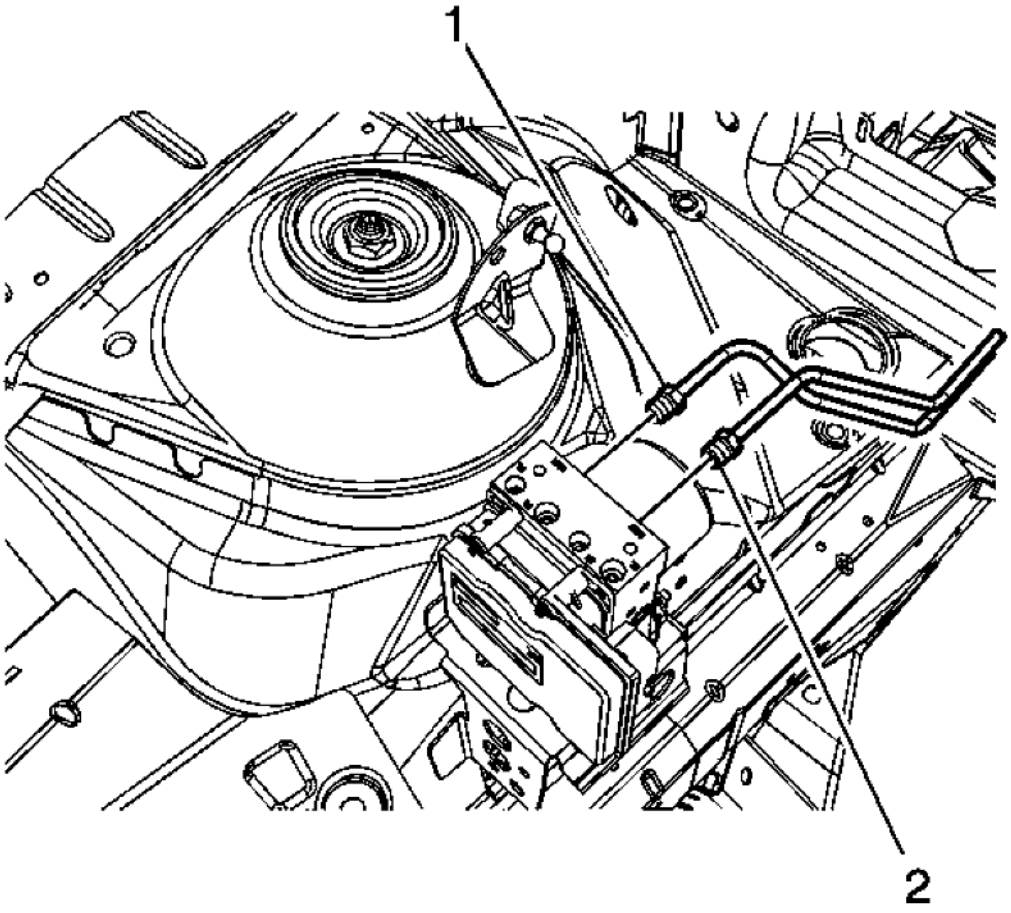


Fig. 10: Master Cylinder Brake Pipe Fittings At BPMV
Courtesy of GENERAL MOTORS CORP.

NOTE: Note the brake pipe locations for proper installation.

8. Disconnect the master cylinder brake pipe fittings (1) from the BPMV.
9. Cap the brake pipe fittings and plug the BPMV inlet ports to prevent brake fluid loss and contamination.

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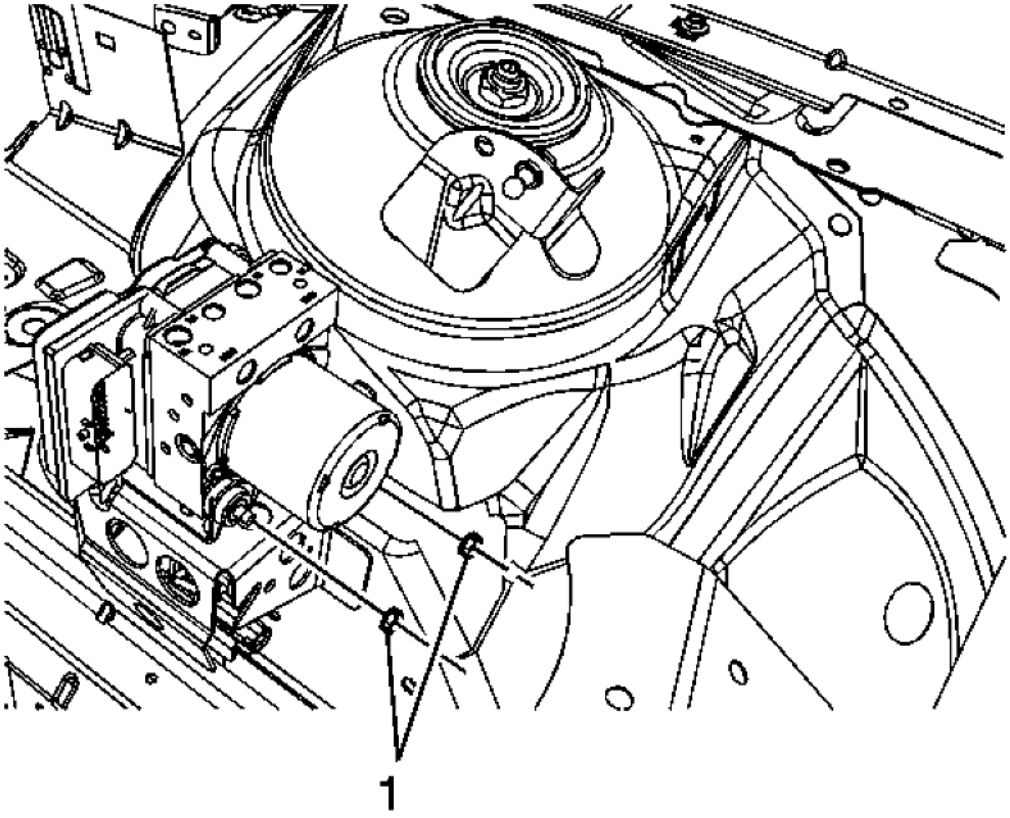


Fig. 11: BPMV Nuts
Courtesy of GENERAL MOTORS CORP.

10. Remove the BPMV nuts (1).

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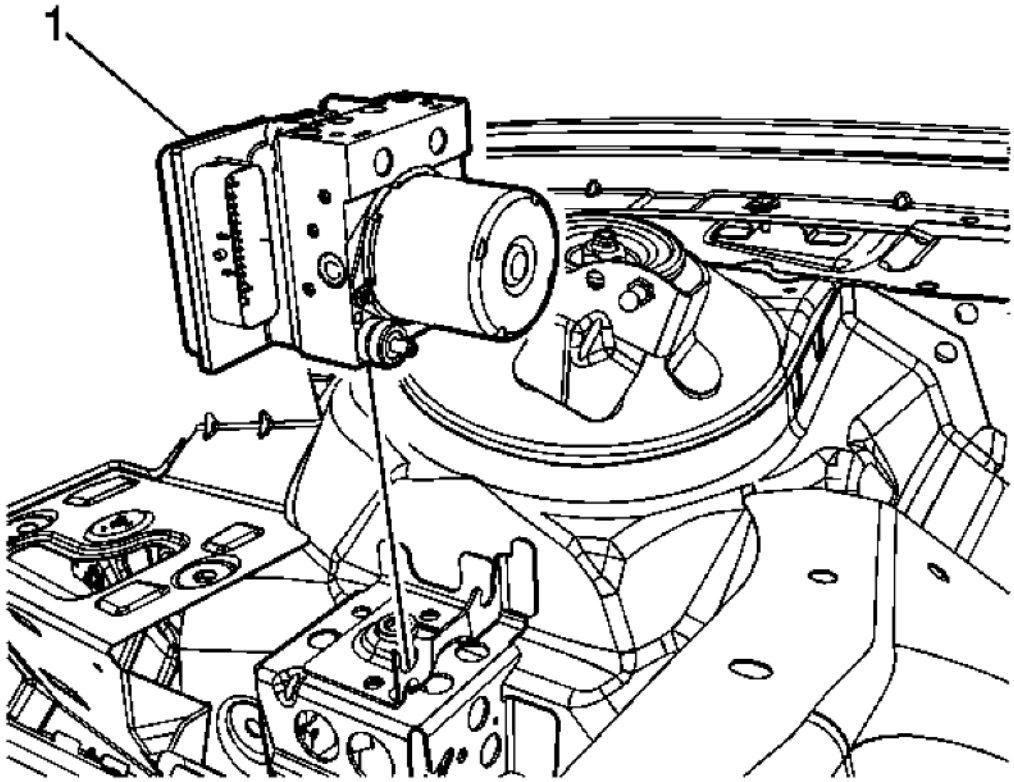


Fig. 12: Removing/Installing BPMV
Courtesy of GENERAL MOTORS CORP.

11. Remove the BPMV (1).

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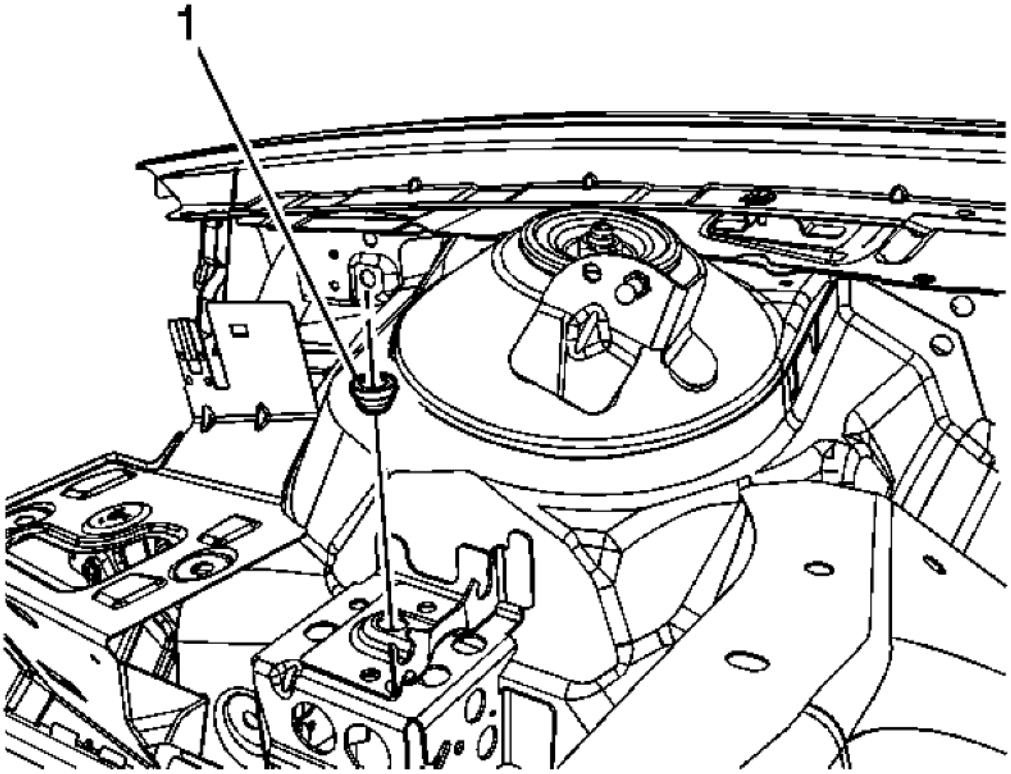


Fig. 13: BPMV Lower Insulator
Courtesy of GENERAL MOTORS CORP.

12. Remove the BPMV lower insulator (1).

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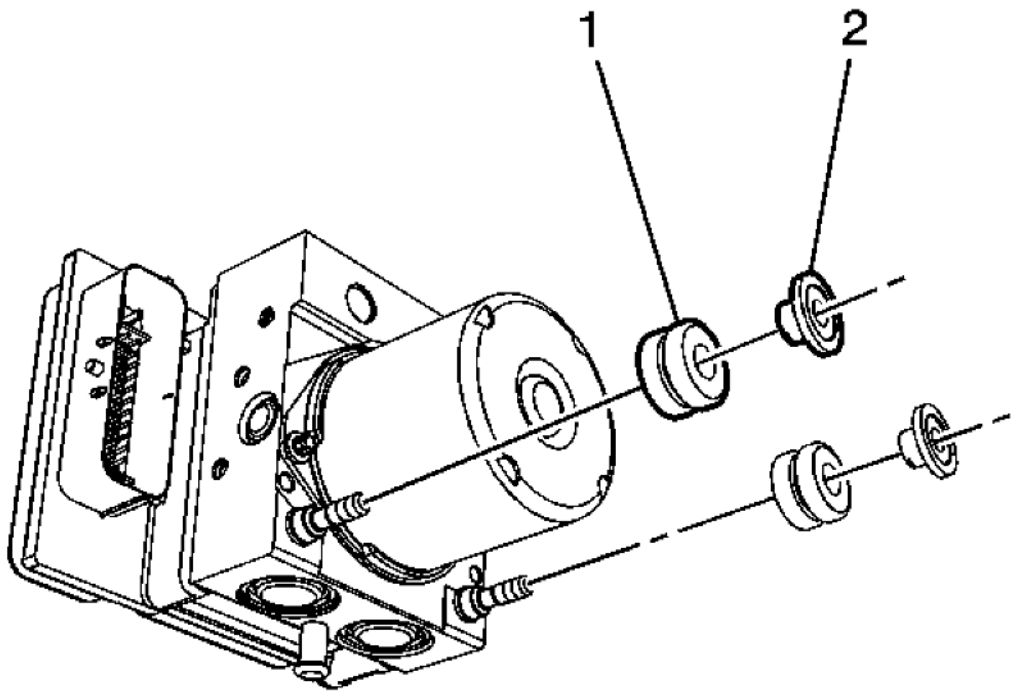


Fig. 14: BPMV Insulators & Bushings
Courtesy of GENERAL MOTORS CORP.

13. Remove the BPMV insulators (1) and bushings (2).
14. Remove the EBCM. Refer to **Electronic Brake Control Module Replacement**.

Installation Procedure

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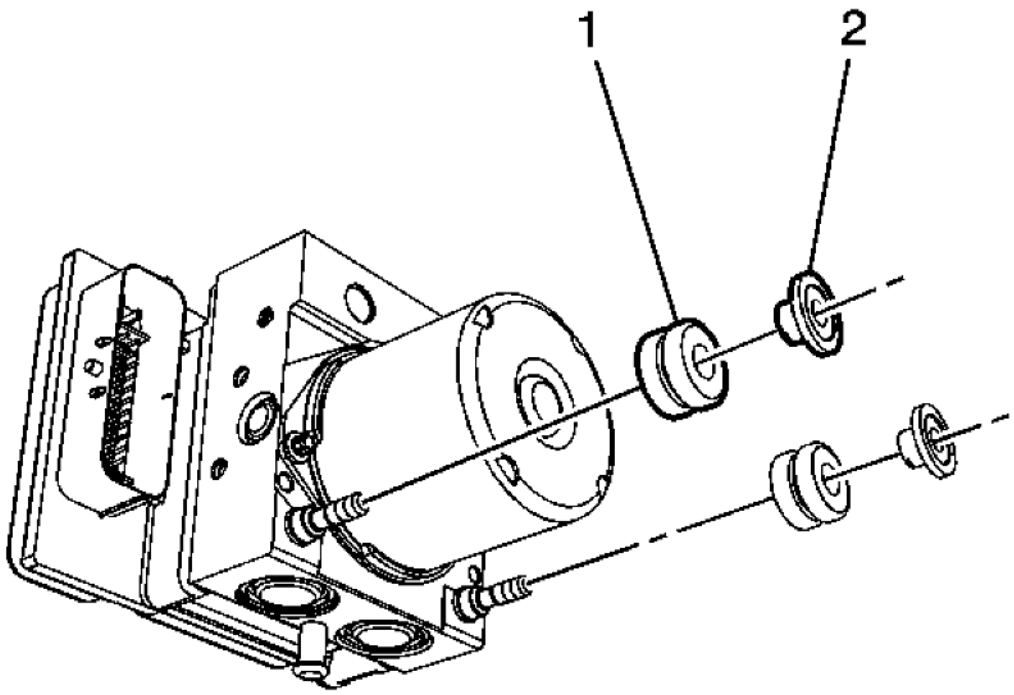


Fig. 15: BPMV Insulators & Bushings
Courtesy of GENERAL MOTORS CORP.

1. Install the EBCM. Refer to **Electronic Brake Control Module Replacement**.
2. Install the BPMV insulators (1) and bushings (2).

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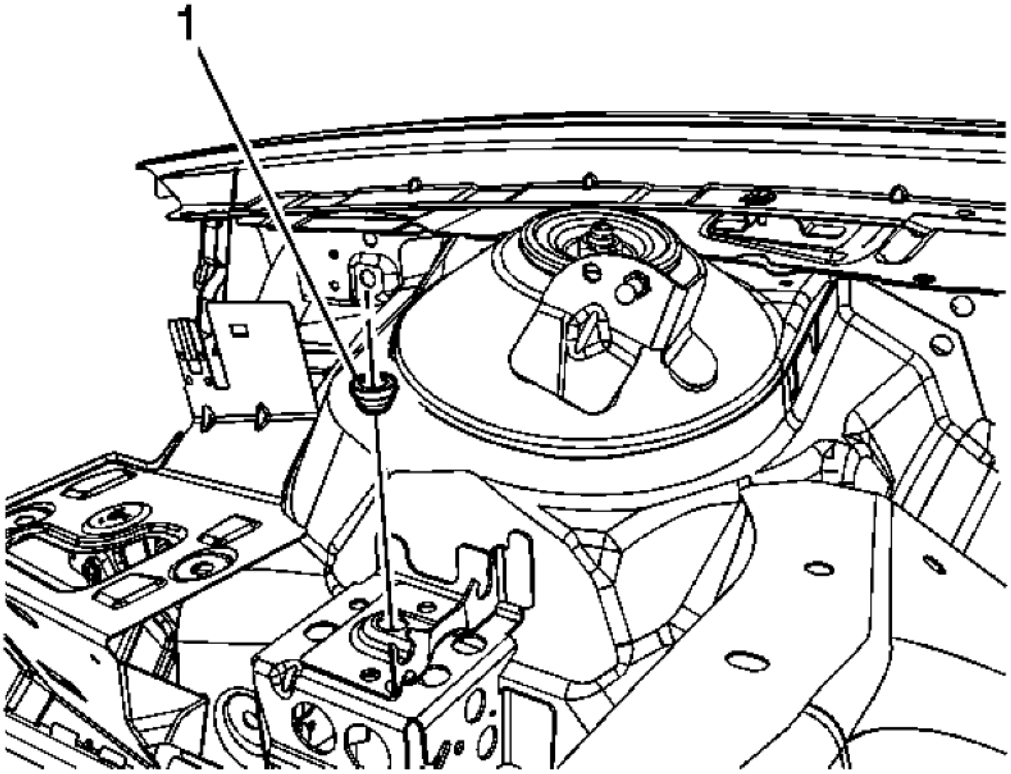


Fig. 16: BPMV Lower Insulator
Courtesy of GENERAL MOTORS CORP.

3. Install the BPMV lower insulator (1).

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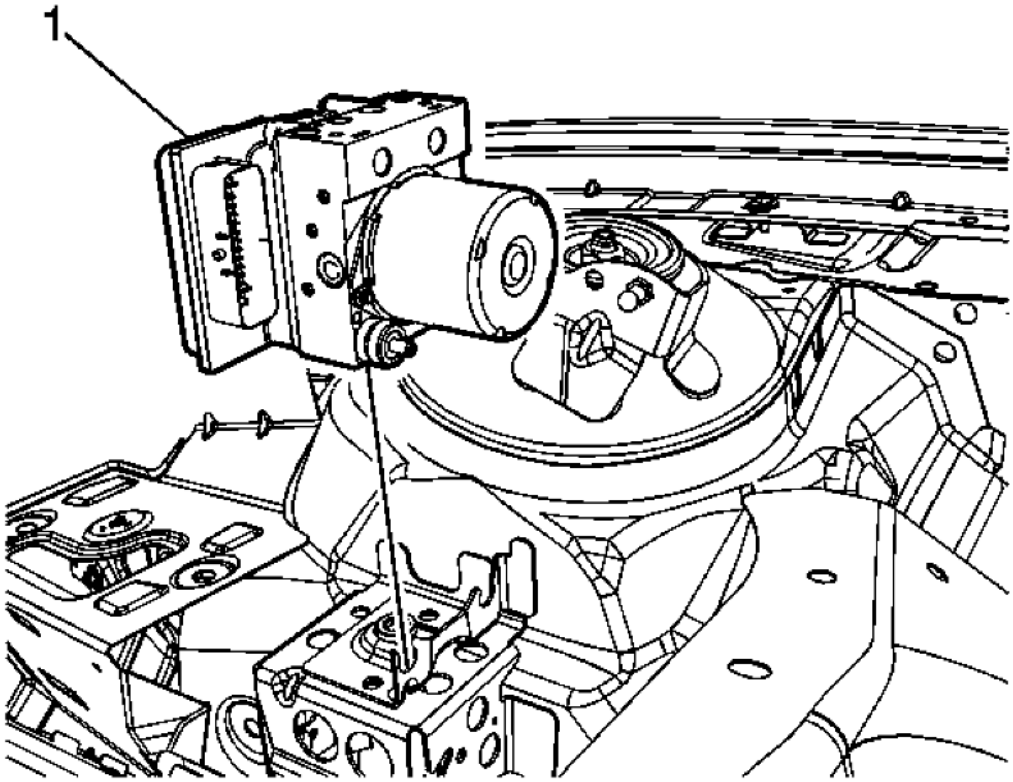


Fig. 17: Removing/Installing BPMV
Courtesy of GENERAL MOTORS CORP.

NOTE: Ensure the BPMV is fully seated in the lower insulator.

4. Install the BPMV (1).

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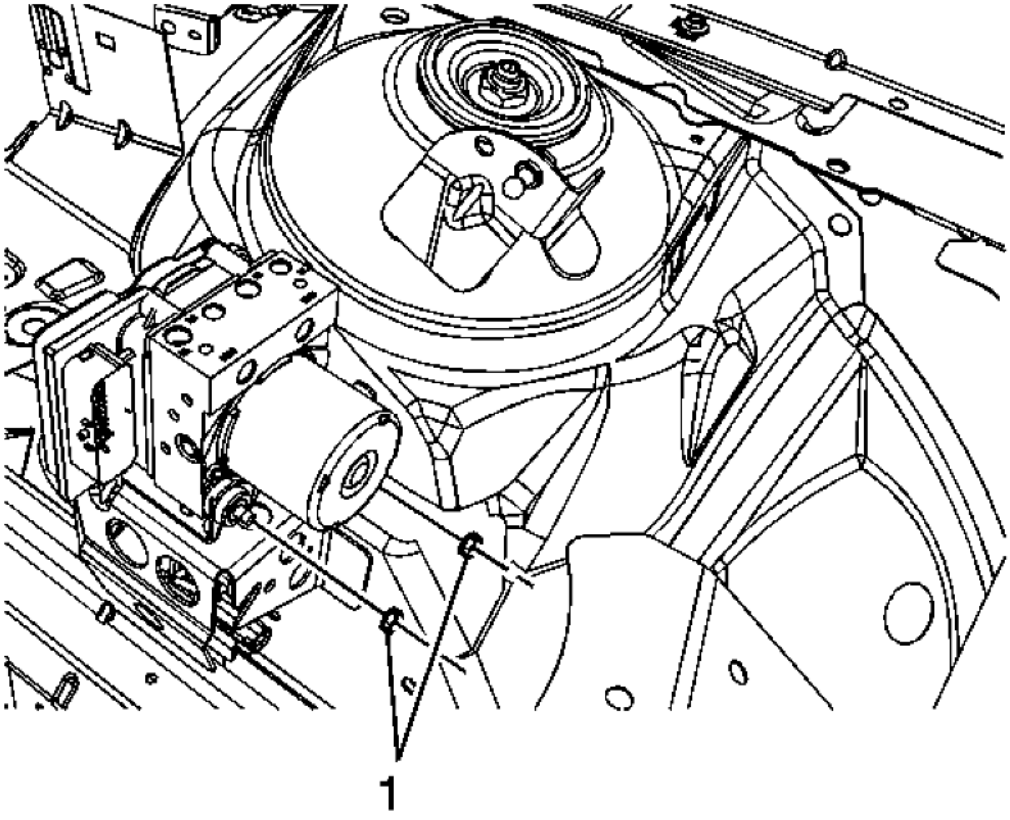


Fig. 18: BPMV Nuts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

5. Install the BPMV nuts (1) and tighten to 8 N.m (71 lb in).

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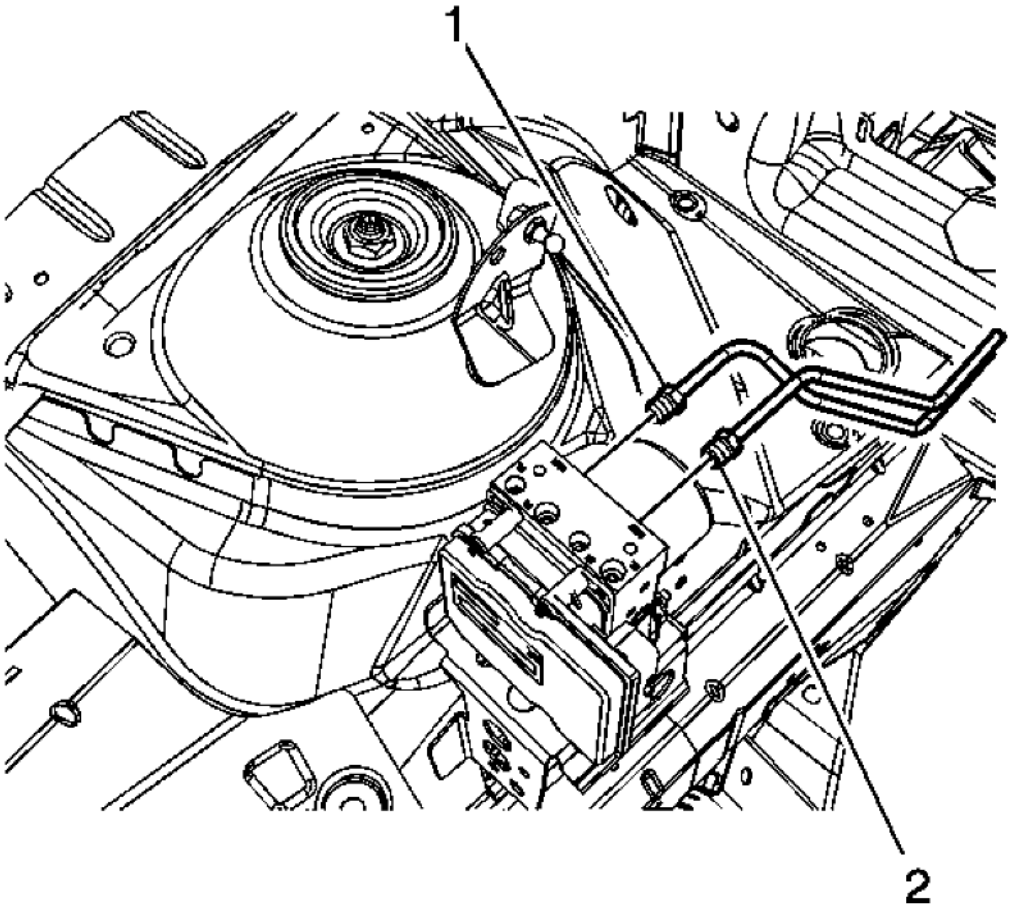


Fig. 19: Master Cylinder Brake Pipe Fittings At BPMV
Courtesy of GENERAL MOTORS CORP.

NOTE: Note the brake pipe locations for proper installation.

6. Connect the master cylinder brake pipe fittings (1) to the BPMV and tighten to 23 N.m (17 lb ft).

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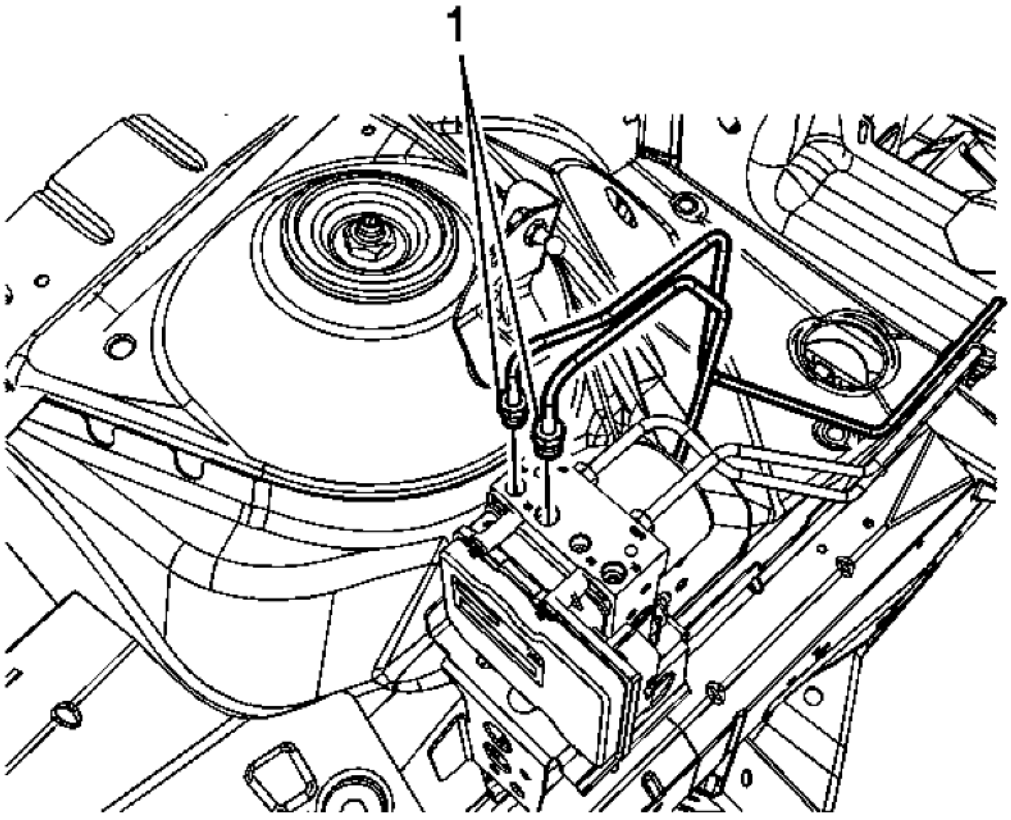


Fig. 20: Front Brake Pipe Fittings At BPMV
Courtesy of GENERAL MOTORS CORP.

NOTE: Note the brake pipe locations for proper installation.

7. Connect the front brake pipe fittings (1) to the BPMV and tighten to 16 N.m (12 lb ft).

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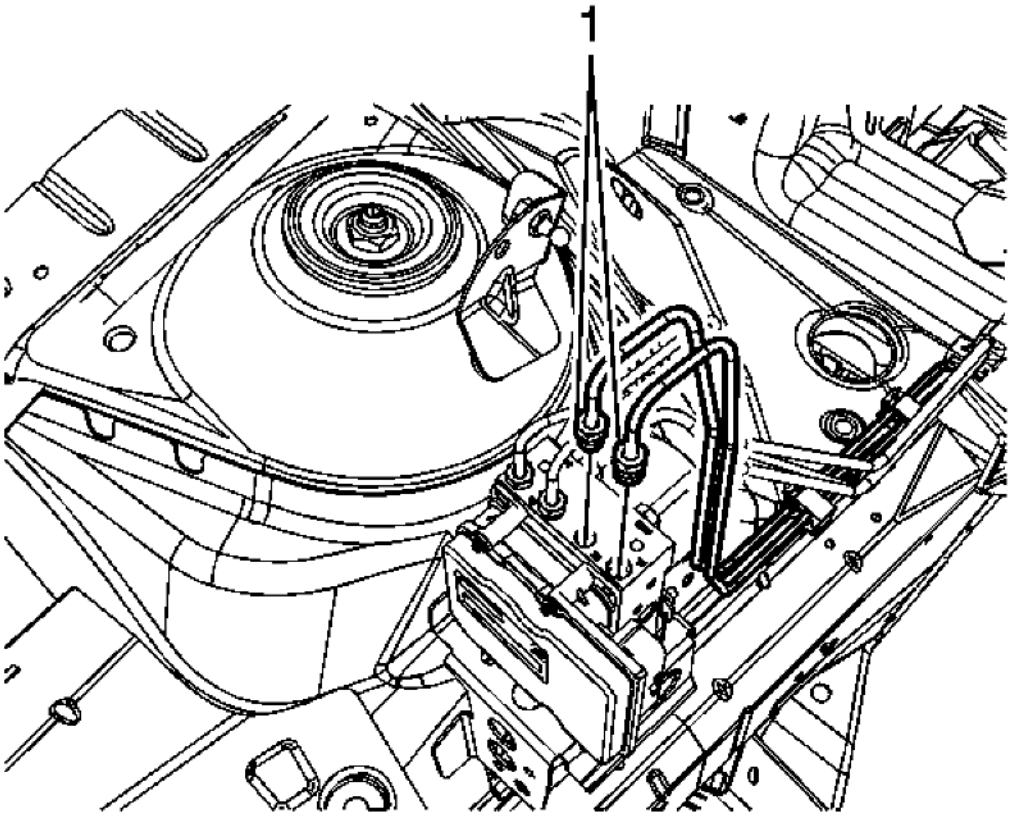


Fig. 21: Rear Brake Pipe Fittings At Brake Pressure Modulator Valve
Courtesy of GENERAL MOTORS CORP.

NOTE: Note the brake pipe locations for proper installation.

8. Connect the rear brake pipe fittings (1) to the BPMV and tighten to 16 N.m (12 lb ft).
9. Connect the EBCM electrical connector.
10. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)** .
11. Perform the **Diagnostic System Check - Vehicle** .
12. Observe the brake pedal feel after performing the diagnostic system check. If the pedal now feels spongy, air may have been in the secondary hydraulic circuit of the brake modulator which may have been introduced into the primary circuit. If the pedal feels spongy, perform the **Antilock Brake System Automated Bleed**.

FRONT WHEEL SPEED SENSOR REPLACEMENT

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Removal Procedure

WARNING: **Refer to Brake Dust Warning .**

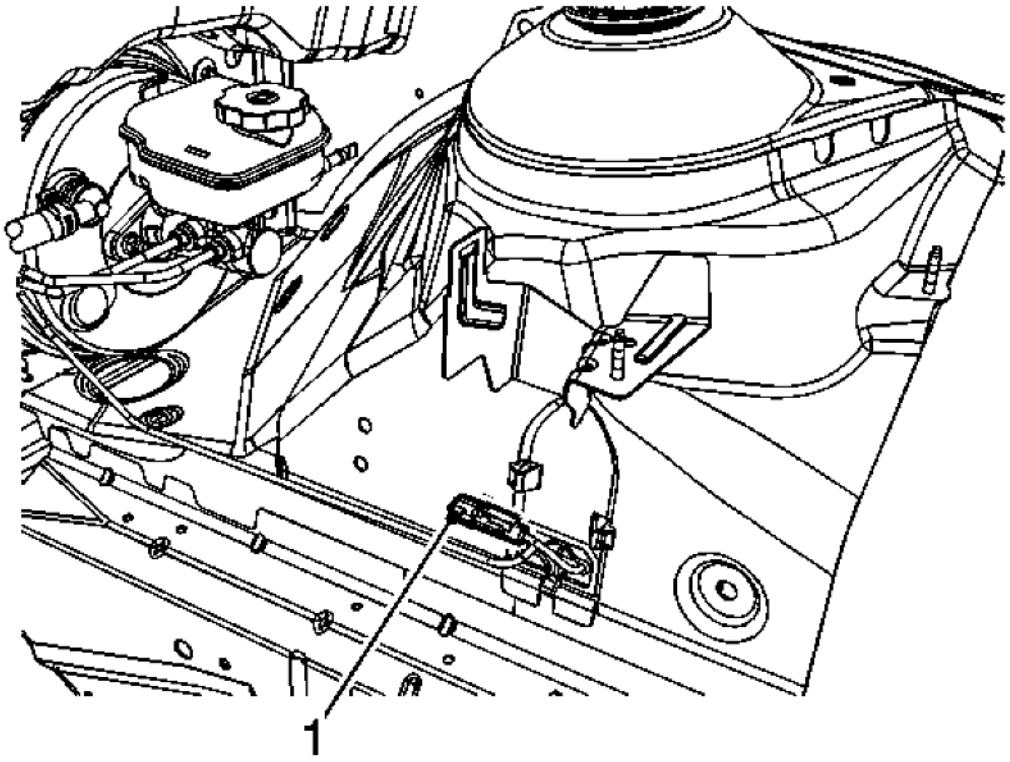


Fig. 22: Front Wheel Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. From inside the engine compartment, disconnect the front wheel sensor electrical connector (1).
2. Release the wheel speed sensor electrical connector retainer from the inner wheel house panel.
3. Feed the wheel speed sensor electrical connector and harness through the wheel house panel closeout.
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
5. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .

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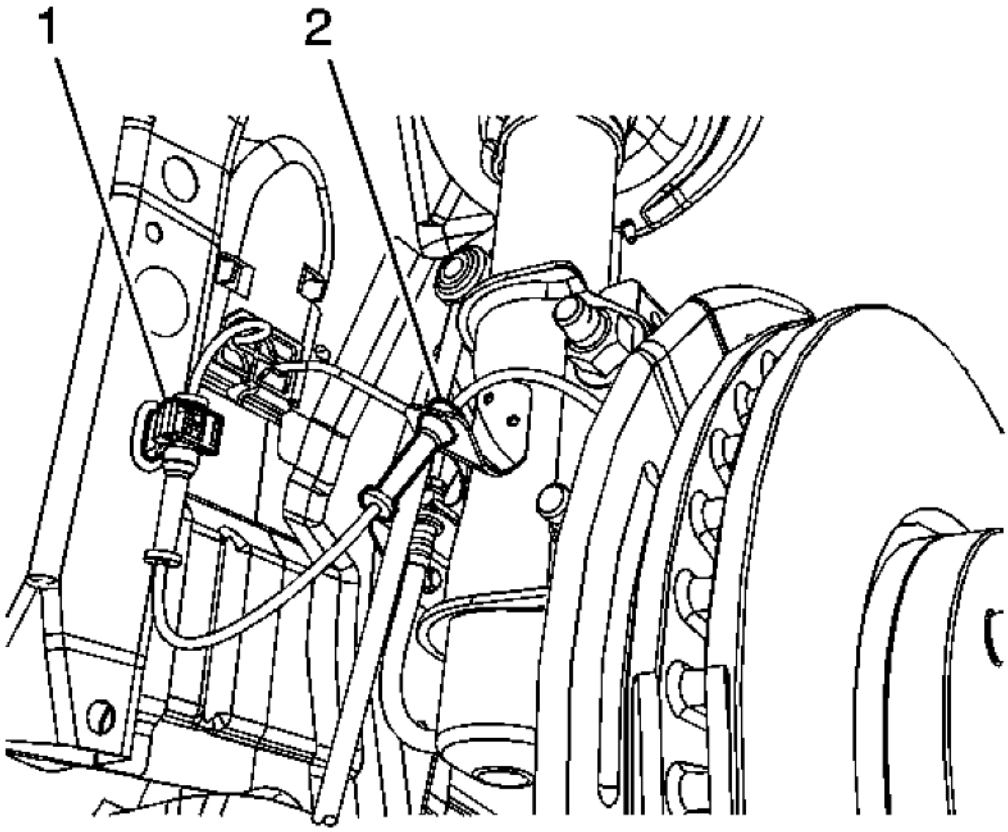


Fig. 23: Wheel Speed Sensor Wire Harness
Courtesy of GENERAL MOTORS CORP.

6. Release the wheel speed sensor wire harness retainer (1) from the outer wheel house panel.
7. Release the wheel speed sensor wire harness from the front suspension strut (2).

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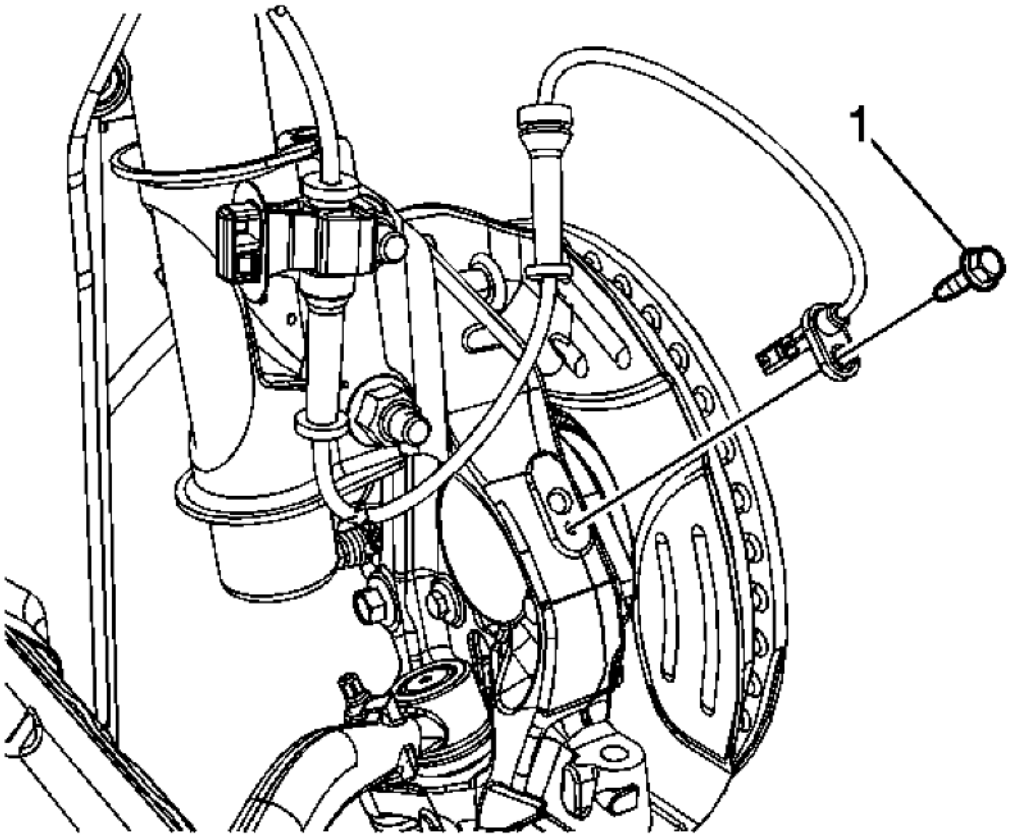


Fig. 24: Wheel Speed Sensor & Bolt
Courtesy of GENERAL MOTORS CORP.

8. Clean the wheel speed sensor area on the steering knuckle of any accumulated dirt and debris.
9. Remove the wheel speed sensor bolt (1).
10. Remove the wheel speed sensor assembly from the steering knuckle by pulling straight out.

Installation Procedure

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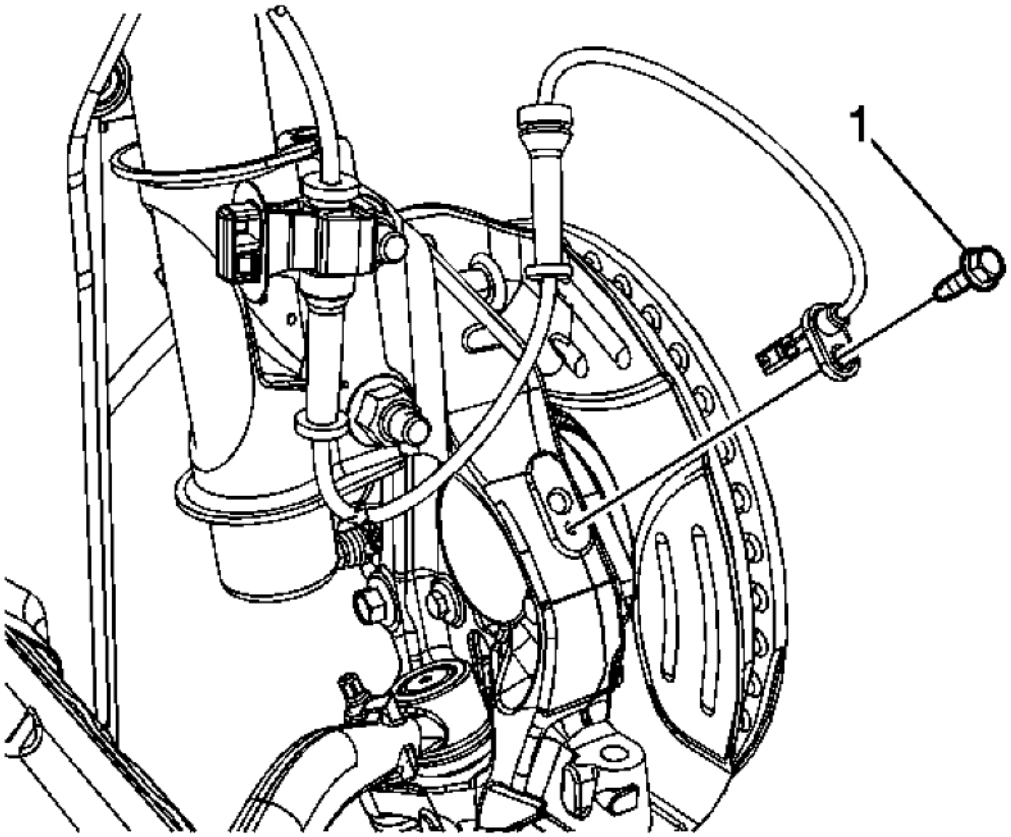


Fig. 25: Wheel Speed Sensor & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Install the wheel speed sensor assembly to the steering knuckle.

CAUTION: Refer to Fastener Caution .

2. Install the wheel speed sensor bolt (1) and tighten to 9 N.m (80 lb in).

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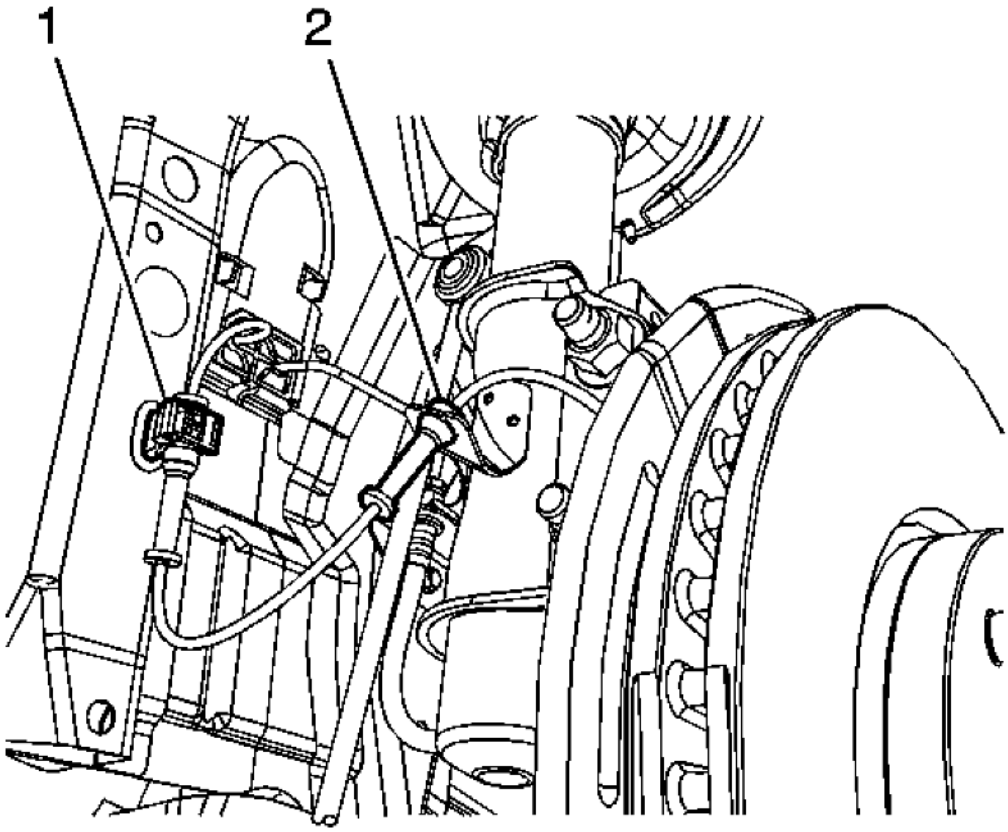


Fig. 26: Wheel Speed Sensor Wire Harness
Courtesy of GENERAL MOTORS CORP.

3. Secure the wheel speed sensor wire harness retainer (1) to the outer wheel house panel.
4. Secure the wheel speed sensor wire harness to the front suspension strut (2).
5. Feed the wheel speed sensor electrical connector and harness through the wheel house panel closeout.
6. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
7. Lower the vehicle.

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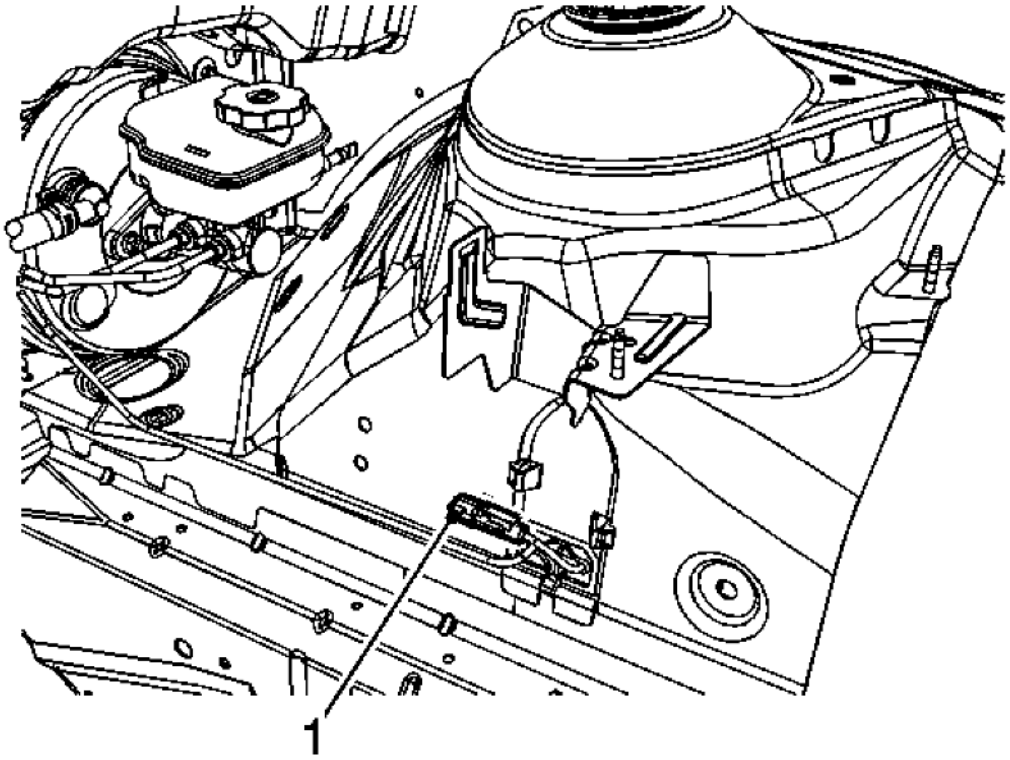


Fig. 27: Front Wheel Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

8. From inside the engine compartment, connect the front wheel sensor electrical connector (1).
9. Secure the wheel speed sensor electrical connector retainer to the inner wheel house panel.

REAR WHEEL SPEED SENSOR REPLACEMENT

Removal Procedure

WARNING: Refer to Brake Dust Warning .

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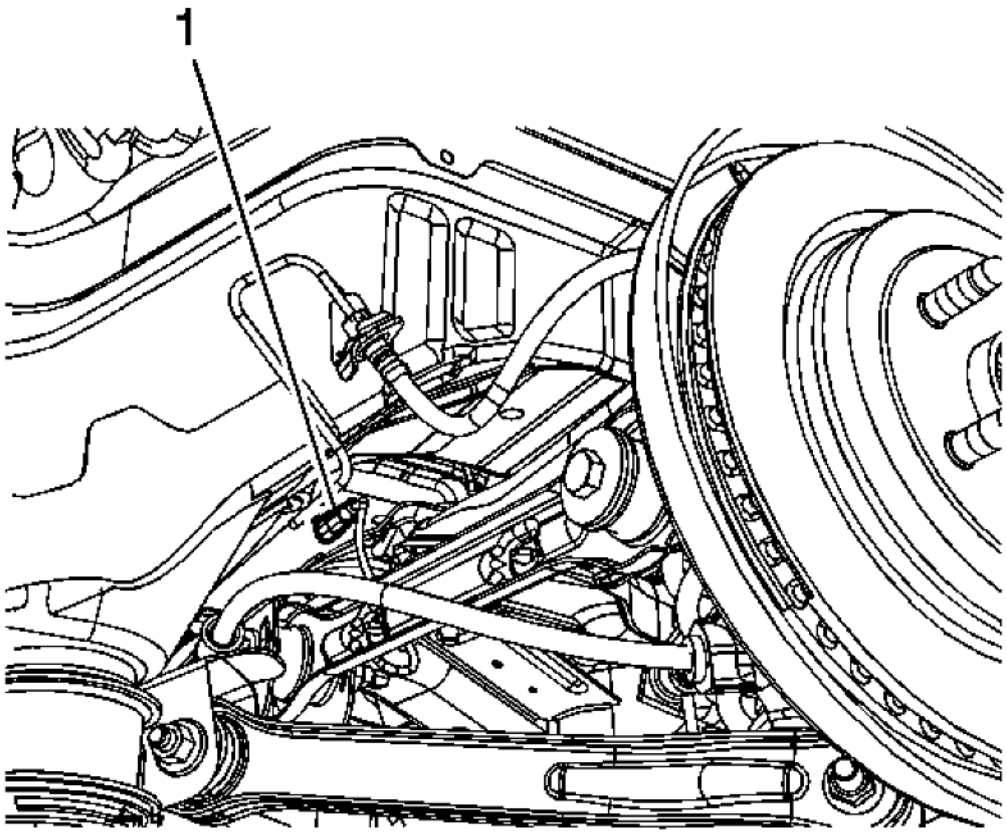


Fig. 28: Rear Wheel Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
3. Disconnect the rear wheel sensor electrical connector (1).

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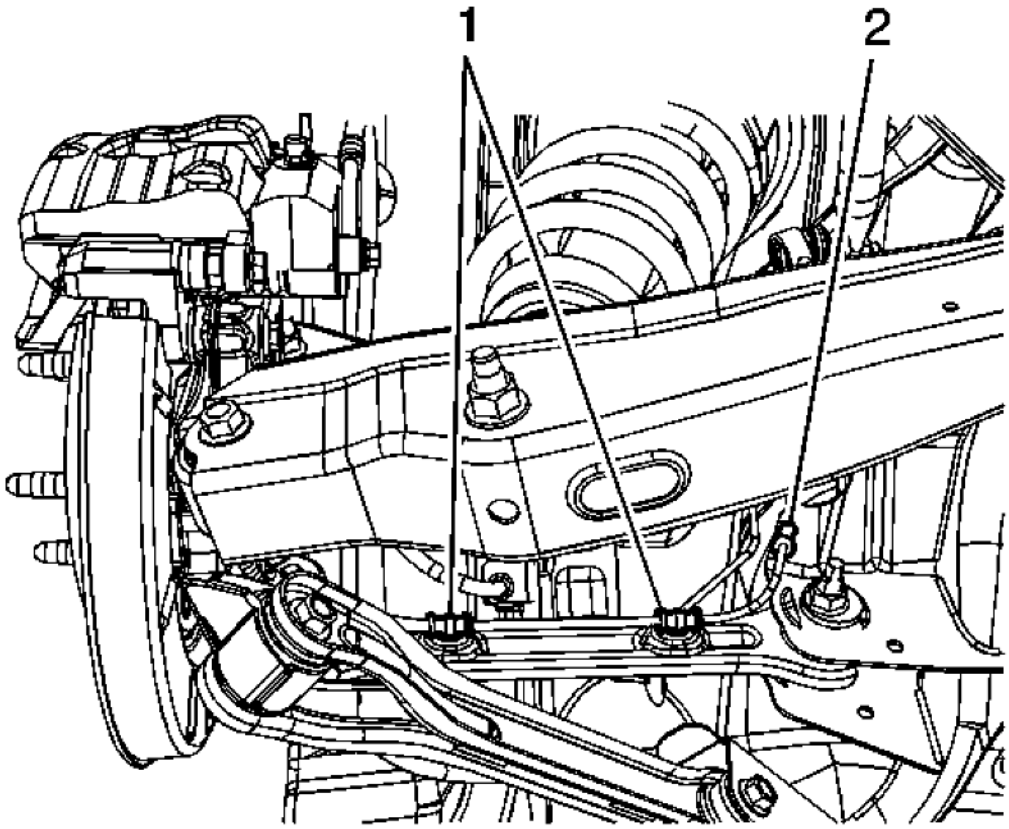


Fig. 29: Wheel Speed Sensor Wire Harness
Courtesy of GENERAL MOTORS CORP.

4. Release the wheel speed sensor wire harness retainers (1) from the rear suspension tie bar.
5. Release the wheel speed sensor wire harness from the vehicle underbody (2).

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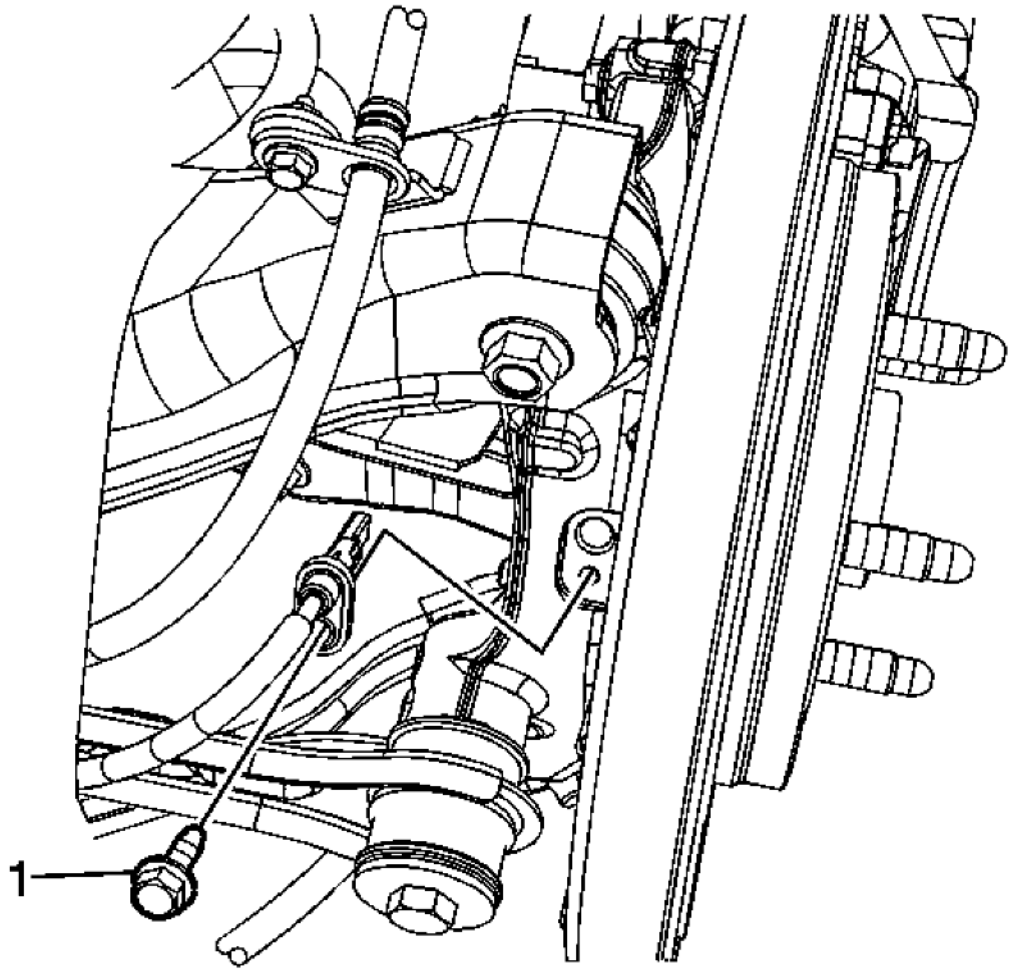


Fig. 30: Wheel Speed Sensor & Bolt
Courtesy of GENERAL MOTORS CORP.

6. Clean the wheel speed sensor area on the suspension knuckle of any accumulated dirt and debris.
7. Remove the wheel speed sensor bolt (1).
8. Remove the wheel speed sensor assembly from the suspension knuckle by pulling straight out.

Installation Procedure

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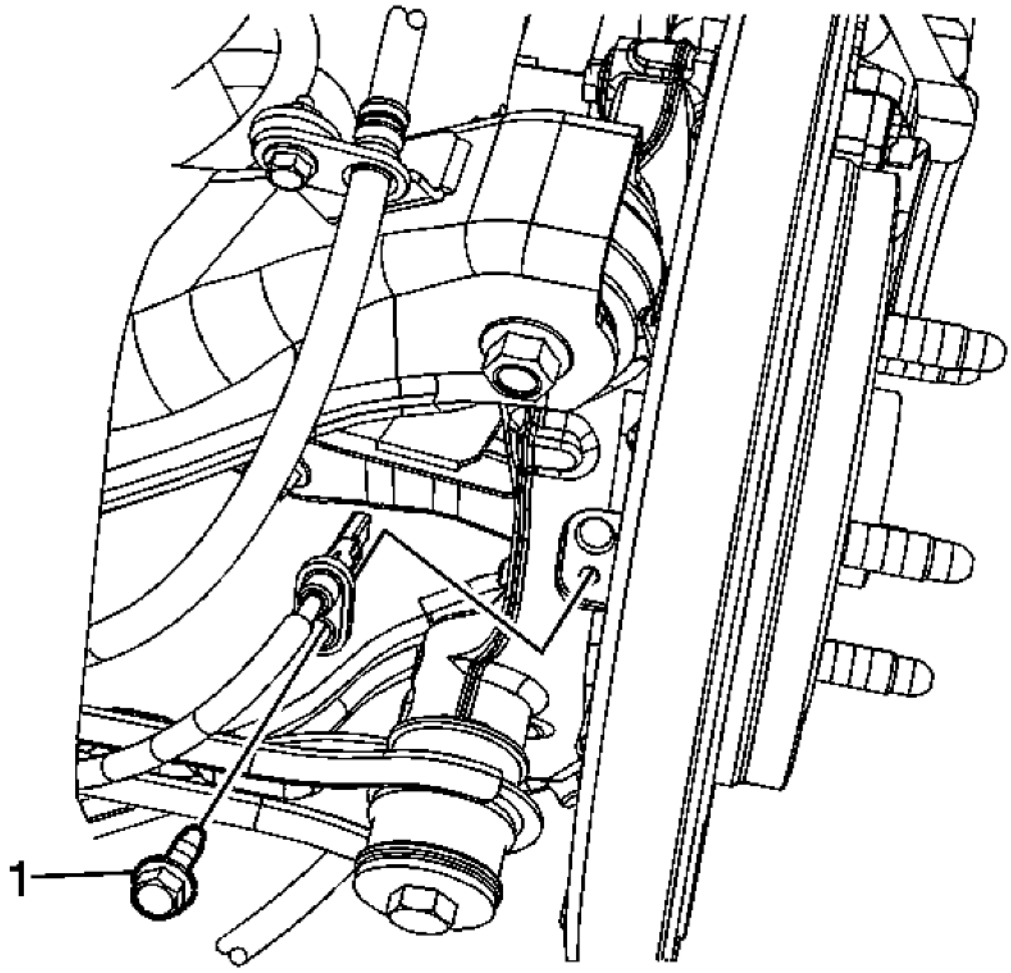


Fig. 31: Wheel Speed Sensor & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Install the wheel speed sensor assembly to the suspension knuckle.

CAUTION: Refer to Fastener Caution .

2. Install the wheel speed sensor bolt (1) and tighten to 9 N.m (80 lb in).

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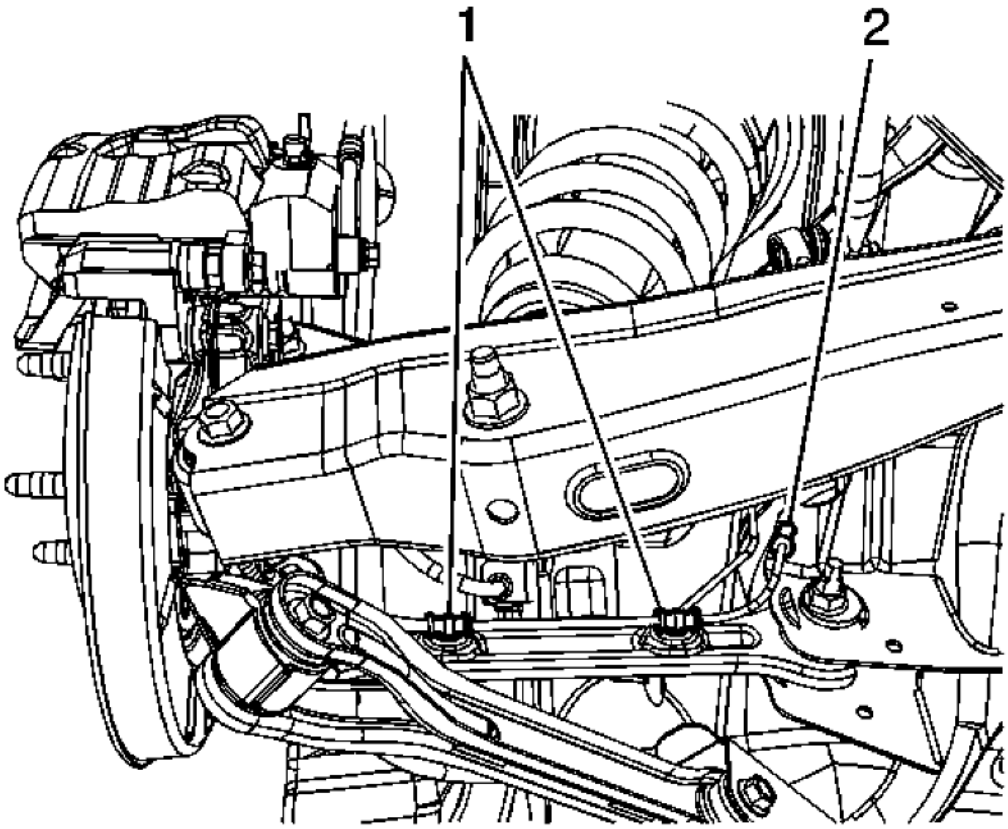


Fig. 32: Wheel Speed Sensor Wire Harness
Courtesy of GENERAL MOTORS CORP.

3. Release the wheel speed sensor wire harness retainers (1) from the rear suspension tie bar.
4. Release the wheel speed sensor wire harness from the vehicle underbody (2).

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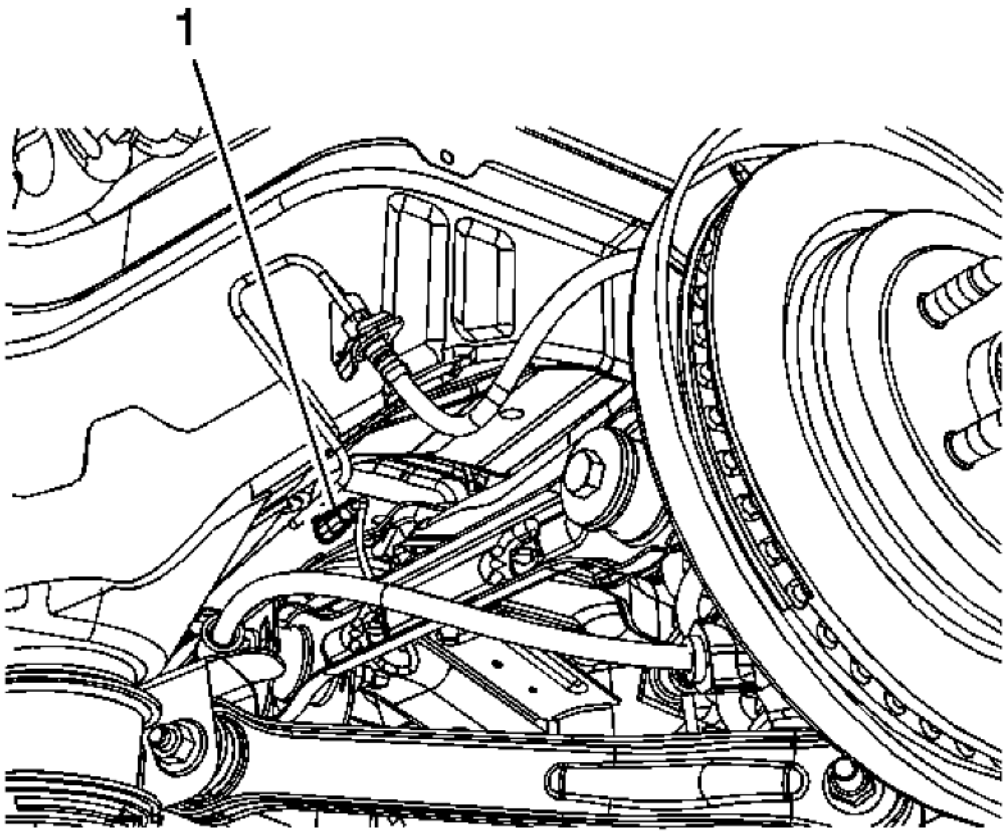


Fig. 33: Rear Wheel Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

5. Connect the rear wheel speed sensor electrical connector (1).
6. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .

ELECTRONIC TRACTION CONTROL SWITCH REPLACEMENT

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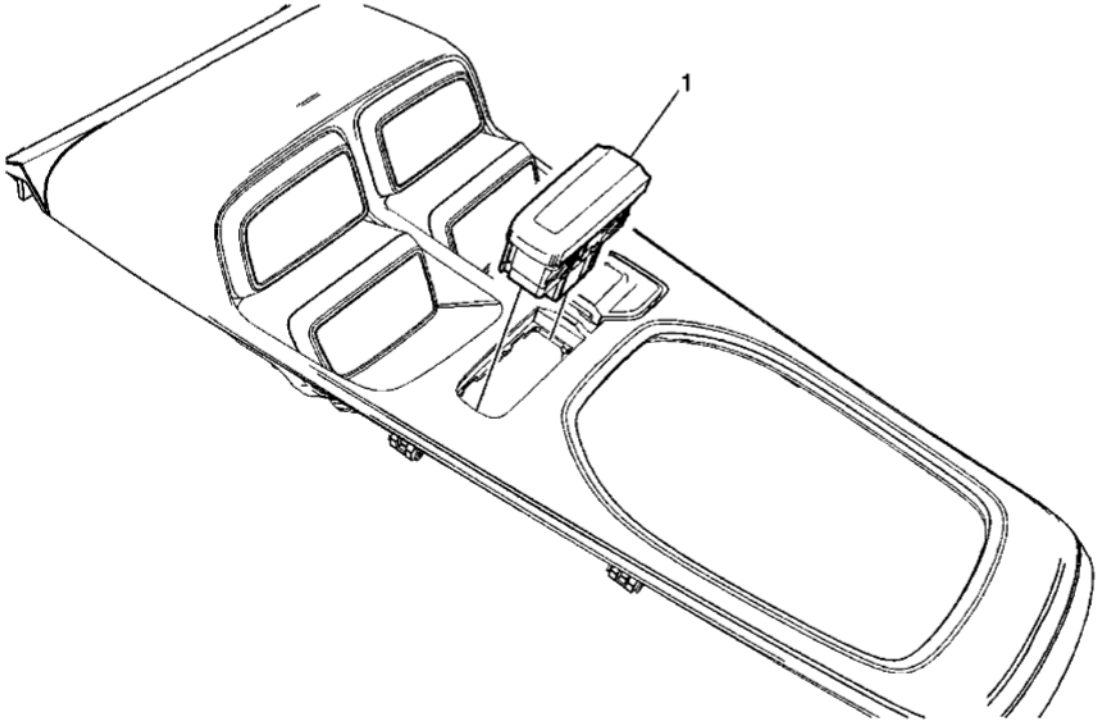


Fig. 34: Electronic Traction Control Switch
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Remove the front floor console front cover. Refer to **Front Floor Console Front Cover Replacement (Without UMQ)** or **Front Floor Console Front Cover Replacement (With UMQ)** .	
1	Traction Control Switch Assembly **Procedure** 1. Squeeze the tabs in order to release the switch from the trim plate. 2. Disconnect electrical connector.

VEHICLE YAW SENSOR LEARN

The yaw sensor does not require calibration often. Calibration of the yaw rate sensor might be required after certain service procedures are performed. Some of these procedures are as follows:

- Electronic brake control module (EBCM) replacement
- Yaw rate sensor replacement

The Yaw Rate Sensor Learn procedure can be completed with a scan tool using the following steps:

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1. Place vehicle on a level surface
2. Apply the parking brake, or set the transmission in the P position.
3. Install the scan tool to the data link connector.
4. Ignition ON, engine OFF
5. Select Yaw Rate Sensor Reset in the Multi-axis Acceleration Sensor Module Configuration/Reset Functions list.
6. Follow the scan tool directions to complete the calibration procedure.
7. Select Yaw Rate Sensor Learn in the Multi-axis Acceleration Sensor Module Configuration/Reset Functions list.
8. Follow the scan tool directions to complete the calibration procedure.
9. Clear any DTCs that may be set.

VEHICLE YAW SENSOR REPLACEMENT

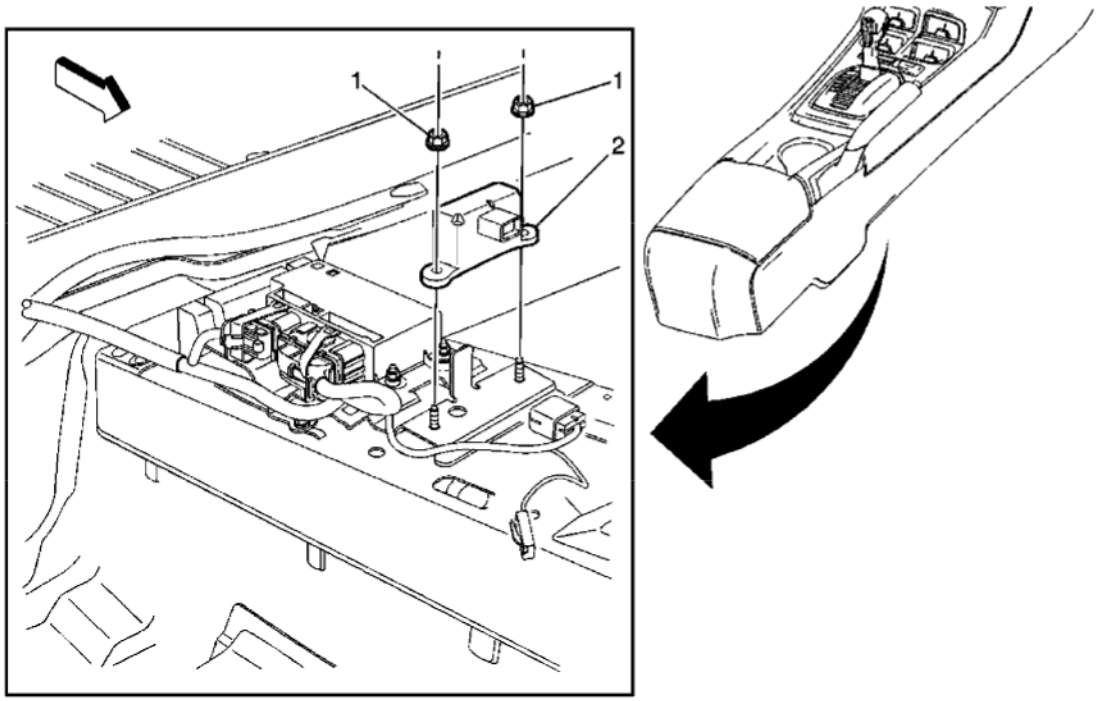


Fig. 35: Vehicle Yaw Sensor
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Remove the front floor console. Refer to **Front Floor Console Replacement** .	
	Yaw Sensor Nuts (Qty: 2) **CAUTION:**

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1	**Refer to Fastener Caution .** **Tighten:** 9 N.m (80 lb in)
2	Vehicle Yaw Sensor **Procedure** 1. Disconnect the electrical connector. 2. After the installation is complete, reset the yaw rate sensor using the following procedure: • Install a scan tool. • Using the special functions menu on the scan tool, reset the yaw rate sensor.

DESCRIPTION AND OPERATION

ABS DESCRIPTION AND OPERATION

This vehicle is equipped with a Bosch ABS 8 brake system. The electronic brake control module (EBCM) and the brake pressure modulator valve assembly are serviced separately. The brake pressure modulator valve assembly uses a 4 circuit configuration to control hydraulic pressure to each wheel independently.

The following vehicle performance enhancement systems are provided.

- Antilock brake system (ABS)
- Traction control
- Stability control
- Dynamic rear proportioning
- Hydraulic brake assist

The following components are involved in the operation of the above systems:

- EBCM - The EBCM controls the system functions and detects failures. It supplies voltage to the solenoid valves and pump motor.
- Brake pressure modulator valve assembly - The brake pressure modulator valve assembly contains the following components:

  - Hydraulic pump with pump motor
  - Four isolation solenoid vales
  - Four dump solenoid valves
  - Two traction control/stability control prime solenoid valves
  - Two traction control/stability control isolation solenoid valves
  - Pressure sensor
  - High pressure attenuator

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- Low pressure accumulator

- Multi-axis acceleration sensor - The yaw rate and lateral acceleration sensors are combined into one multi-axis acceleration sensor module, external to the EBCM. The EBCM receives serial data message inputs from the yaw rate and lateral acceleration sensor and activates stability control depending on multi-axis acceleration sensor module input.
- Steering angle sensor - The EBCM receives serial data message inputs from the steering angle sensor module. The steering angle sensor signal is used to calculate the desired yaw rate.
- Traction control switch - Traction control and stability control are manually disabled or enabled by pressing the traction control switch.
- Wheel speed sensors - The EBCM sends a 12 V reference voltage to each wheel speed sensor. As the wheel spins, the wheel speed sensor produces an alternating current square wave signal. The EBCM uses the frequency of the square wave signal to calculate the wheel speed.

ABS

When wheel slip is detected during a brake application, an ABS event occurs. During ABS braking, hydraulic pressure in the individual wheel circuits is controlled to prevent any wheel from slipping. A separate hydraulic line and specific solenoid valves are provided for each wheel. The ABS can decrease, hold, or increase hydraulic pressure to each wheel. The ABS does not, however, increase hydraulic pressure above the amount which is transmitted by the master cylinder during braking.

During ABS braking, a series of rapid pulsations is felt in the brake pedal. These pulsations are caused by the rapid changes in position of the individual solenoid valves as the EBCM responds to wheel speed sensor inputs and attempts to prevent wheel slip. These pedal pulsations are present only during ABS braking and stop when normal braking is resumed or when the vehicle comes to a stop. A ticking or popping noise may also be heard as the solenoid valves cycle rapidly. During ABS braking on dry pavement, intermittent chirping noises may be heard as the tires approach slipping. These noises and pedal pulsations are considered normal during ABS operation.

Vehicles equipped with ABS may be stopped by applying normal force to the brake pedal. Brake pedal operation during normal braking is no different than that of previous non ABS systems. Maintaining a constant force on the brake pedal provides the shortest stopping distance while maintaining vehicle stability. The typical ABS activation sequence is as follows.

Pressure Hold

The EBCM closes the isolation valve and keeps the dump valve closed in order to isolate the slipping wheel when wheel slip occurs. This holds the pressure steady on the brake so that the hydraulic pressure does not increase or decrease.

Pressure Decrease

If a pressure hold does not correct the wheel slip condition, a pressure decrease occurs. The EBCM decreases the pressure to individual wheels during deceleration when wheel slip occurs. The isolation valve is closed and the dump valve is opened. The excess fluid is stored in the accumulator until the pump can return the fluid to the master cylinder or fluid reservoir.

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Pressure Increase

After the wheel slip is corrected, a pressure increase occurs. The EBCM increases the pressure to individual wheels during deceleration in order to reduce the speed of the wheel. The isolation valve is opened and the dump valve is closed. The increased pressure is delivered from the master cylinder.

Traction Control

When drive wheel slip is noted, the EBCM will enter traction control mode.

First, the EBCM requests the engine control module (ECM) to reduce the amount of torque to the drive wheels via a serial data message. The ECM reduces torque to the drive wheels and reports the amount of delivered torque.

If the engine torque reduction does not reduce drive wheel slip, the EBCM will actively apply the brakes on the slipping drive wheel. During traction control braking, hydraulic pressure in each drive wheel circuit is controlled to prevent the drive wheels from slipping. The EBCM commands the pump motor and appropriate solenoid valves ON and OFF to apply brake pressure to the slipping wheel.

Traction control can be manually disabled by pressing the traction control switch.

Stability Control

Stability control provides added stability during aggressive maneuvers. Yaw rate is the rate of rotation about the vehicle's vertical axis. The stability control is activated when the EBCM determines that the desired yaw rate does not match the actual yaw rate as measured by the yaw rate sensor.

The desired yaw rate is calculated by the EBCM using the following inputs:

- Steering wheel position
- Vehicle speed
- Lateral acceleration

The difference between the desired yaw rate and the actual yaw rate is the yaw rate error, which is a measurement of oversteer or understeer. When a yaw rate error is detected, the EBCM attempts to correct the vehicle's yaw motion by applying brake pressure to one or more of the wheels. The amount of brake pressure which is applied varies, depending on the correction required. The engine torque may be reduced also, if it is necessary to slow the vehicle while maintaining stability.

Stability control activations generally occur in turns during aggressive driving. When braking during stability control activation, the brake pedal may pulsate.

Stability control can be manually disabled by pressing the traction control switch for 5 s.

Dynamic Rear Proportioning

The dynamic rear proportioning is a control system that replaces the mechanical proportioning valve. Under

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certain driving conditions the EBCM will reduce the rear wheel brake pressure by commanding the appropriate solenoid valves ON and OFF.

Hydraulic Brake Assist

The hydraulic brake assist function is designed to support the driver in emergency braking situations.

The EBCM receives inputs from the brake pressure sensor. When the EBCM senses an emergency braking situation, the EBCM will actively increase the brake pressure to a specific maximum.

Driver Information Indicators

Brake Warning Indicator

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

- The instrument cluster performs the bulb check.
- The EBCM detects a fault and sends a serial data message to the instrument cluster requesting illumination.
- The body control module (BCM) detects that the park brake is engaged. The instrument cluster receives a serial data message from the BCM requesting illumination.

ABS Indicator

The instrument cluster turns the ABS indicator ON when the following occurs:

- The instrument cluster performs the bulb check.
- The EBCM detects a malfunction which disables the ABS and sends a serial data message to the instrument cluster requesting illumination.

Traction Control/Stability Control Active Indicator

The instrument cluster turns the traction control/stability control-active indicator ON when the following occurs:

- The instrument cluster performs the bulb check.
- The ABS system is in traction control or stability control mode.
- The EBCM detects a malfunction which disables the traction control or stability control and sends a serial data message to the instrument cluster requesting illumination.

Traction Control Off Indicator

The instrument cluster turns the traction control off indicator ON when the following occurs:

- The instrument cluster performs the bulb check.
- The driver manually disables the traction control by pressing the traction control switch. The EBCM

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sends a serial data message to the instrument cluster requesting illumination.

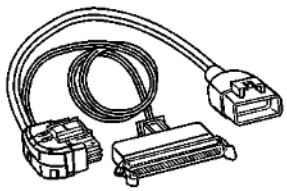
Stability Control Off Indicator

The instrument cluster turns the stability control off indicator ON when the following occurs:

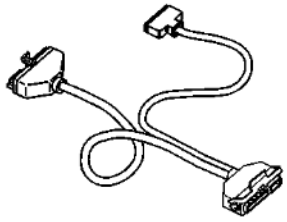
- The instrument cluster performs the bulb check.
- The driver manually disables the stability control by pressing the traction control switch. The EBCM sends a serial data message to the instrument cluster requesting illumination.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description
	J 35616 GM-Approved Terminal Test Kit
	J 39700 100-Pin Breakout Box
	J 39700-300 ABS Breakout Box Adapter

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	J 39700-530 Breakout Box Adapter

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2010 BRAKES

Disc Brakes - Camaro

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	Specification	
	Metric	English
Brake Caliper Bleeder Valve	10 N.m	89 lb in
Brake Caliper Bolt - Front (L99, LS3)	60 N.m + 90 degrees	44 lb ft + 90 degrees
Brake Caliper Bolt - Rear (L99, LS3)	40 N.m + 90 degrees	30 lb ft + 90 degrees
Brake Caliper Bracket Bolt - Front (LLT)	40 N.m + 90 degrees	30 lb ft + 90 degrees
Brake Caliper Bracket Bolt - Rear (LLT)	40 N.m + 90 degrees	30 lb ft + 90 degrees
Brake Caliper Guide Pin Bolt - Front (LLT)	27 N.m	20 lb ft
Brake Caliper Guide Pin Bolt - Rear (LLT)	27 N.m	20 lb ft
Brake Hose Fitting Bolt	40 N.m	30 lb ft
Brake Rotor Bolt	10 N.m	89 lb in
Brake Shield Bolt	9 N.m	80 lb in

DISC BRAKE COMPONENT SPECIFICATIONS

Application	Specification	
	Metric	English
Brake Pads		
• Taper	0.15 mm	0.006 in
Front Brake Rotor LLT		
• Rotor Diameter	321.0 mm	12.64 in
• Rotor Discard Thickness*	27.0 mm	1.063 in
• Rotor Maximum Allowable Assembled Lateral Runout	0.06 mm	0.002 in
• Rotor Maximum Allowable Scoring	1.50 mm	0.059 in
• Rotor Maximum Allowable Thickness Variation	0.025 mm	0.001 in
• Rotor Thickness (New)	30.0 mm	1.181 in
Front Brake Rotor L99, LS3		
• Rotor Diameter	355.0 mm	13.976 in
• Rotor Discard Thickness*	30.0 mm	1.181 in
• Rotor Maximum Allowable Assembled Lateral Runout	0.06 mm	0.002 in

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• Rotor Maximum Allowable Scoring	1.50 mm	0.059 in
• Rotor Maximum Allowable Thickness Variation	0.025 mm	0.001 in
• Rotor Thickness New	32.0 mm	1.259 in
Rear Brake Rotor LLT		
• Rotor Diameter	315.0 mm	12.40 in
• Rotor Discard Thickness*	21.5 mm	0.846 in
• Rotor Maximum Allowable Assembled Lateral Runout	0.06 mm	0.002 in
• Rotor Maximum Allowable Scoring	1.50 mm	0.059 in
• Rotor Maximum Allowable Thickness Variation	0.025 mm	0.001 in
• Rotor Thickness New	23.0 mm	0.906 in
Rear Brake Rotor L99, LS3		
• Rotor Diameter	365.0 mm	14.37 in
• Rotor Discard Thickness*	26.0 mm	1.023 in
• Rotor Maximum Allowable Assembled Lateral Runout	0.06 mm	0.002 in
• Rotor Maximum Allowable Scoring	1.50 mm	0.059 in
• Rotor Maximum Allowable Thickness Variation	0.025 mm	0.001 in
• Rotor Thickness New	28.0 mm	1.102 in
* All disc brake rotors have a minimum thickness dimension cast into them. Replace any rotor that does not meet the minimum thickness dimension.		

DIAGNOSTIC INFORMATION AND PROCEDURES

BRAKE ROTOR THICKNESS MEASUREMENT

WARNING: Refer to Brake Dust Warning .

1. If the inboard friction surface of the brake rotor is not accessible, reposition and support the caliper with the brake pads. Refer to **Front Disc Brake Pads Replacement (LLT)** or **Front Disc Brake Pads Replacement (L99, LS3)** and/or **Rear Disc Brake Pads Replacement (LLT)** or **Rear Disc Brake Pads Replacement (L99, LS3)**.
2. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.

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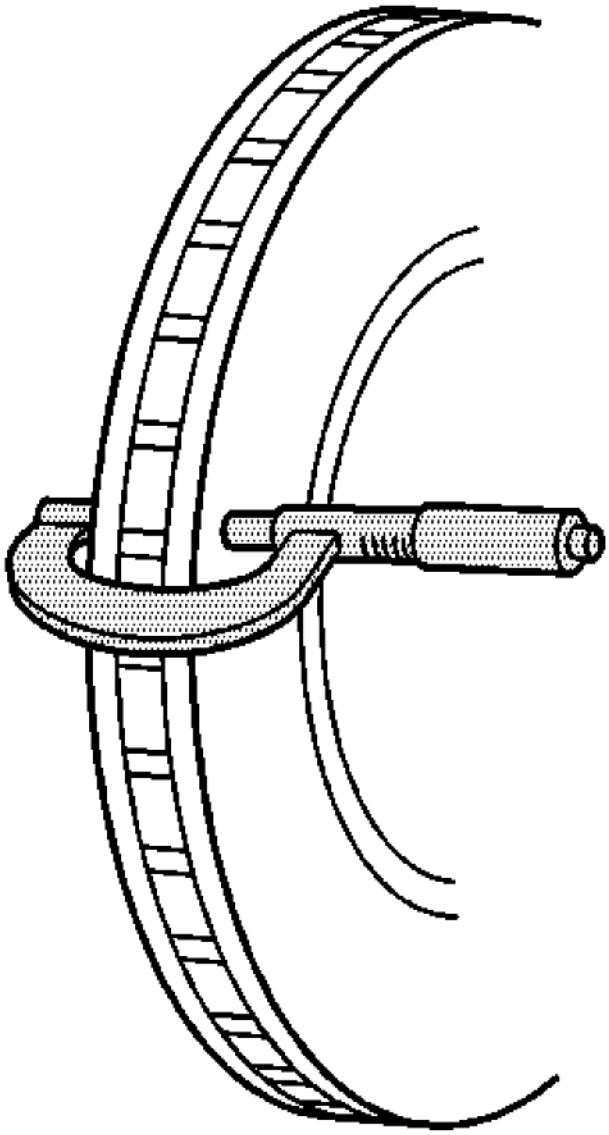


Fig. 1: Measuring Brake Rotor Thickness
Courtesy of GENERAL MOTORS CORP.

3. Using a micrometer calibrated in thousanths-of-a-millimeter, or ten-thousanths-of-an-inch, measure and record the thickness of the brake rotor at four or more points, evenly spaced around the rotor.

   Ensure that the measurements are only taken within the friction surfaces and that the micrometer is positioned the same distance from the outer edge of the rotor, about 13 mm (1/2 in), for each

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measurement.

4. Compare the lowest thickness measurement recorded specifications. Refer to **Disc Brake Component Specifications**.
5. If the lowest thickness measurement of the brake rotor is above the minimum allowable thickness after refinishing specification, the rotor may be able to be refinished, depending upon surface and wear conditions which may be present.
6. If the lowest thickness measurement of the brake rotor is at or below the minimum allowable thickness after refinishing specification, the rotor may not be refinished.
7. If the lowest thickness measurement of the brake rotor is at or below the discard thickness specification, the rotor requires replacement.

BRAKE ROTOR THICKNESS VARIATION MEASUREMENT

WARNING: Refer to Brake Dust Warning .

NOTE: Any disc brake rotor that exhibits thickness variation exceeding the maximum acceptable level must be refinished or replaced. Thickness variation exceeding the maximum acceptable level can cause brake pulsation.

1. If the inboard friction surface of the brake rotor is not accessible, reposition and support the caliper with the brake pads. Refer to **Front Disc Brake Pads Replacement (LLT)** or **Front Disc Brake Pads Replacement (L99, LS3)** and/or **Rear Disc Brake Pads Replacement (LLT)** or **Rear Disc Brake Pads Replacement (L99, LS3)**.
2. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.

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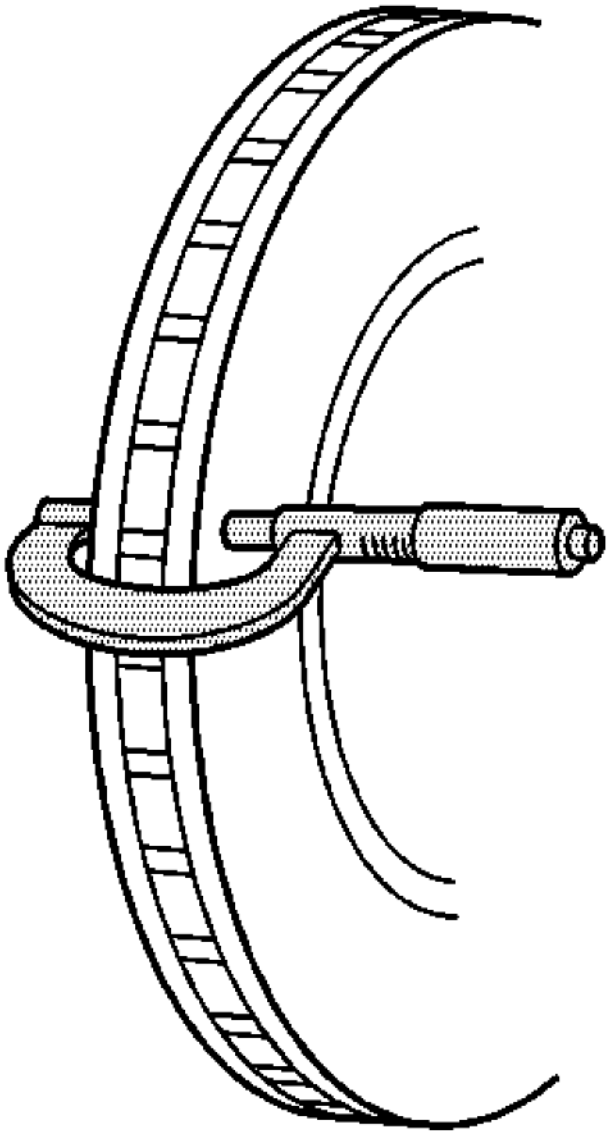


Fig. 2: Measuring Brake Rotor Thickness
Courtesy of GENERAL MOTORS CORP.

3. Using a micrometer calibrated in thousandths-of-a-millimeter, or ten-thousandths-of-an-inch, measure and record the thickness of the brake rotor at 4 or more points, evenly spaced around the rotor.

   Ensure that the measurements are only taken within the friction surfaces and that the micrometer is positioned the same distance from the outer edge of the rotor, about 13 mm (1/2 in), for each

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measurement.

4. Calculate the difference between the highest and lowest thickness measurements recorded to obtain the amount of thickness variation.
5. Compare the thickness variation measurement to the following specification:

   Specification: Brake rotor maximum allowable thickness variation: 0.025 mm (0.001 in)

   NOTE: Whenever a brake rotor is refinished or replaced, the assembled lateral runout (LRO) of the rotor must be measured to ensure optimum performance of the disc brakes.

6. If the brake rotor thickness variation measurement exceeds the specification, the rotor requires refinishing or replacement.

BRAKE ROTOR SURFACE AND WEAR INSPECTION

WARNING: Refer to Brake Dust Warning .

1. If the inboard friction surface of the brake rotor is not accessible, reposition and support the caliper with the brake pads. Refer to **Front Disc Brake Pads Replacement (LLT)** or **Front Disc Brake Pads Replacement (L99, LS3)** and/or **Rear Disc Brake Pads Replacement (LLT)** or **Rear Disc Brake Pads Replacement (L99, LS3)**.
2. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.
3. Inspect the friction surfaces of the brake rotor for the following Braking Surface Conditions:
   - Heavy rust and/or pitting

     Light surface rust can be removed with an abrasive disc. Heavy surface rust and/or pitting must be removed by refinishing the rotor.

   - Cracks and/or heat spots
   - Excessive blueing discoloration
4. If the friction surfaces of the brake rotor exhibit one or more of the Braking Surface Conditions, the rotor requires refinishing or replacement.

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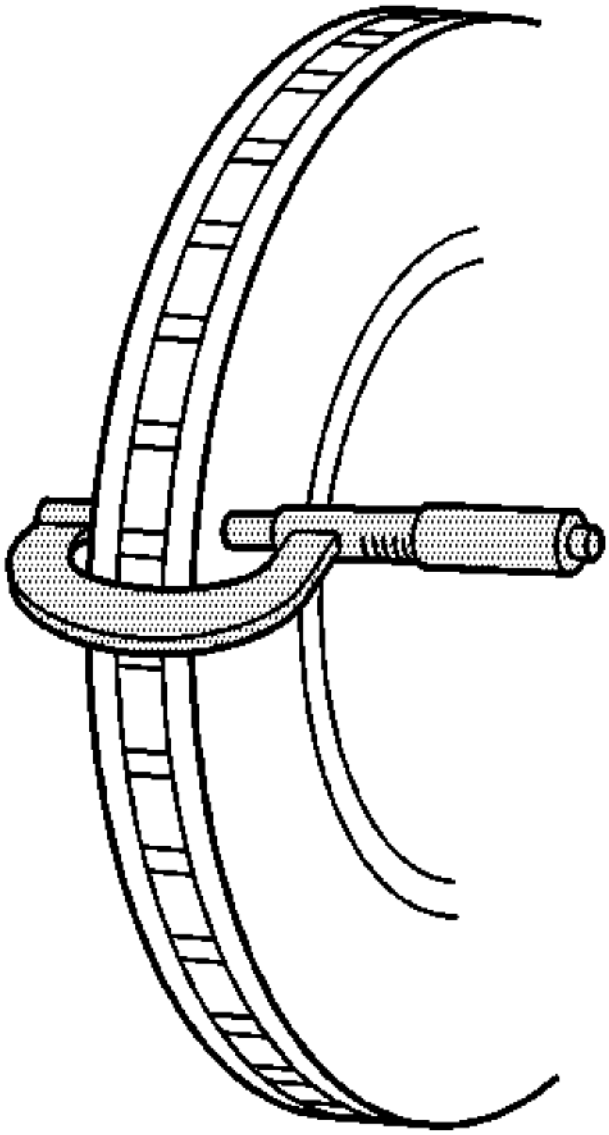


Fig. 3: Measuring Brake Rotor Thickness
Courtesy of GENERAL MOTORS CORP.

5. Using a micrometer calibrated in thousandths-of-a-millimeter, or ten-thousandths-of-an-inch, measure and record the scoring depth of any grooves present on the rotor friction surfaces.
6. Compare the groove scoring depth recorded to the following specification:

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Specification: Brake rotor maximum allowable scoring: 1.50 mm (0.059 in)

7. If the brake rotor scoring depth exceeds the specification, or if an excessive amount of scoring is present, the rotor requires refinishing or replacement.

BRAKE ROTOR ASSEMBLED LATERAL RUNOUT MEASUREMENT

Special Tools

- **CH-39544-KIT:** Complete Toorque Socket Set - 10 PCS, or equivalent
- **CH-41013:** Rotor Resurfacing Kit
- **CH-42450-A:** Wheel Hub Resurfacing Kit
- **CH-45101:** Hub and Wheel Runout Gauge
- **CH-45101-100:** Conical Brake Rotor Washers

WARNING: Refer to Brake Dust Warning .

NOTE:

- **Brake rotor assembled lateral runout (LRO) exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4,800-11,300 km (3,000-7,000 mi).**
- **Brake rotor thickness variation MUST be checked BEFORE checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to Brake Rotor Thickness Variation Measurement.**

1. Matchmark the position of the brake rotor to the wheel studs if this has not been done already.

NOTE: Whenever the brake rotor has been separated from the hub/axle flange, any rust or contaminants should be cleaned from the hub/axle flange and the brake rotor mating surfaces. Failure to do this may result in excessive assembled lateral runout (LRO) of the brake rotor, which could lead to brake pulsation.

2. Inspect the mating surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles, corrosion, rust, or debris remaining. If the wheel hub/axle flange and/or if the brake rotor mating surfaces exhibit these conditions, perform the following steps:
    1. Remove the brake rotor from the vehicle. Refer to **Front Brake Rotor Replacement (LLT)Front Brake Rotor Replacement (L99, LS3)** and/or **Rear Brake Rotor Replacement (LLT)Rear Brake Rotor Replacement (L99, LS3)** .
    2. Using the **CH-42450-A:** Wheel Hub Resurfacing Kit , thoroughly clean any rust or corrosion from the mating surface of the hub/axle flange.
    3. Using the **CH-41013:** Rotor Resurfacing Kit , thoroughly clean any rust or corrosion from the mating surface of the brake rotor.

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4. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.

3. Install the rotor to the hub/axle flange using the matchmark made prior to removal.

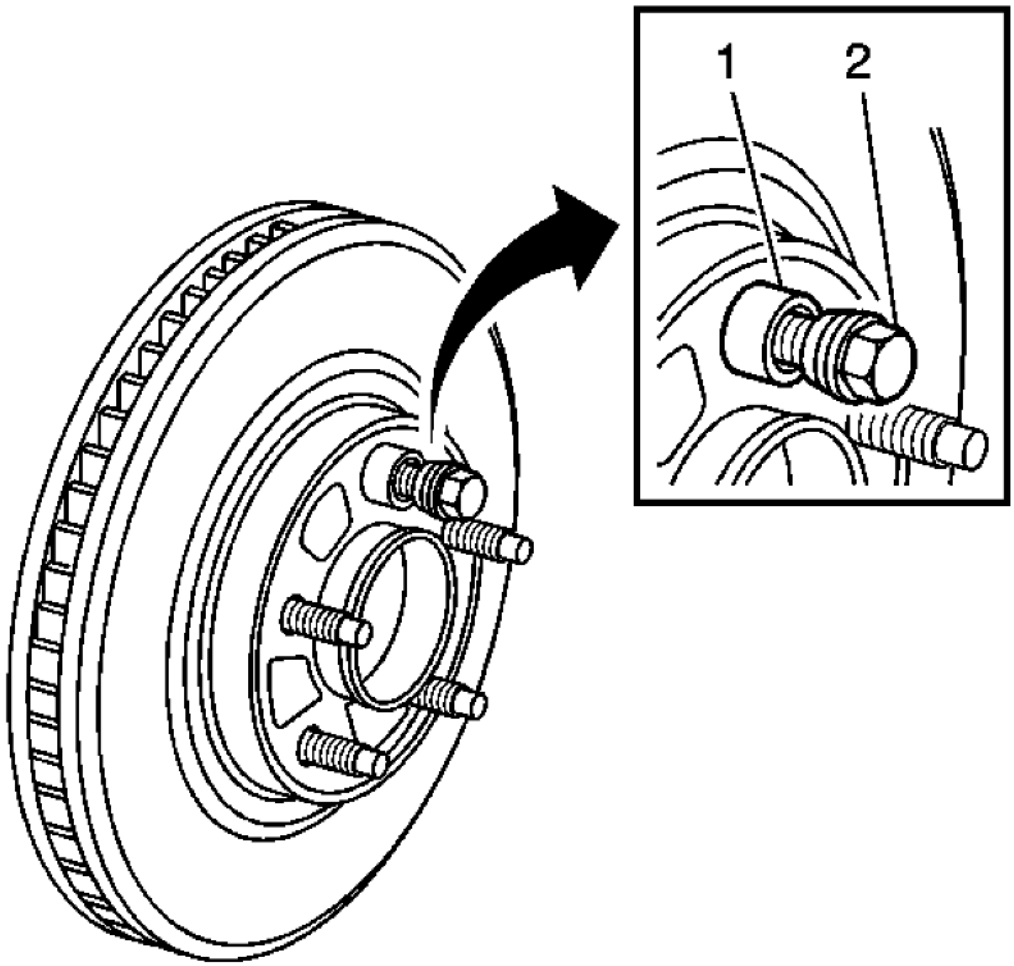


Fig. 4: Identifying Conical Brake Rotor Washer & Lug Nut
Courtesy of GENERAL MOTORS CORP.

4. Hold the rotor firmly in place against the hub/axle flange and install one of the **CH-45101-100:** Conical Brake Rotor Washers (1), and one lug nut (2) onto the upper-most wheel stud.
5. Continue to hold the rotor secure and tighten the lug nut firmly by hand.

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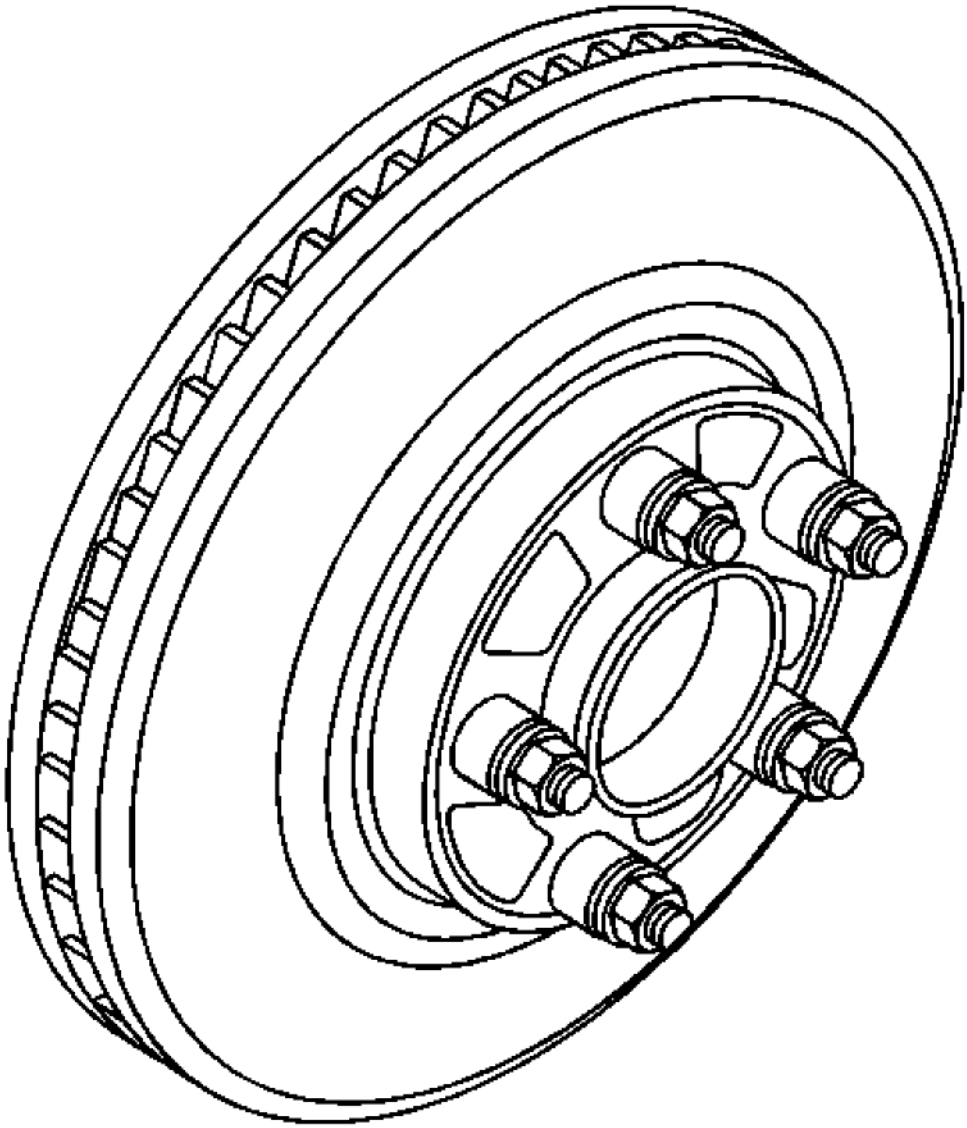


Fig. 5: View Of Conical Brake Rotor Washers & Lug Nuts
Courtesy of GENERAL MOTORS CORP.

6. Install the remaining **CH-45101-100:** Conical Brake Rotor Washers and lug nuts onto the wheel studs and tighten the nuts firmly by hand in a star-pattern.
7. Using the **CH-39544-KIT:** Complete Toorque Socket Set - 10 PCS, or equivalent, tighten the lug nuts in a star-pattern to specification, in order to properly secure the rotor. Refer to **Tire and Wheel Removal and Installation** .

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8. If the brake rotor has been REFINISHED or REPLACED with a new rotor, proceed to step 14.
9. If the brake rotor meets the following criteria, proceed to step 10.
    - The rotor is within specifications and is being REUSED.
    - The rotor has NOT been refinished.
    - The rotor does NOT exhibit thickness variation exceeding the maximum allowable level.

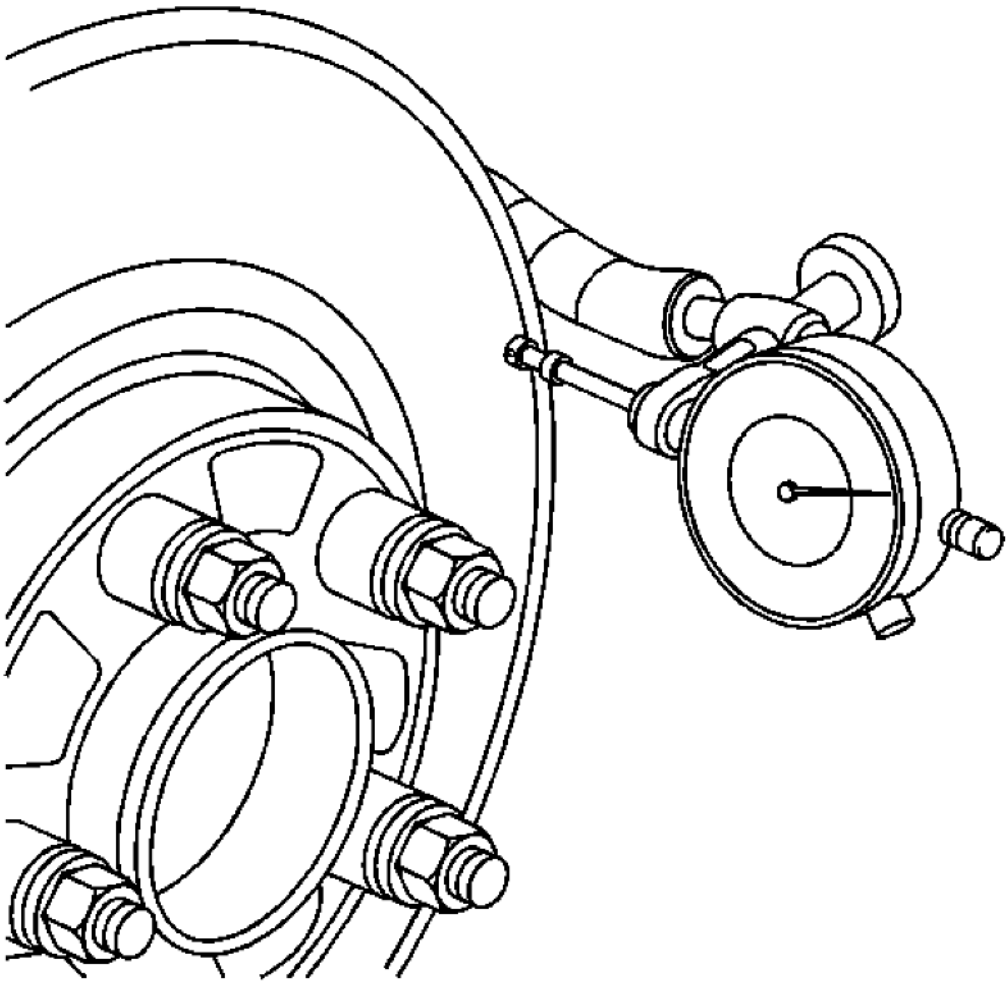


Fig. 6: Measuring Lateral Runout
Courtesy of GENERAL MOTORS CORP.

10. Mount a dial indicator, **CH-45101:** Hub and Wheel Runout Gauge, or equivalent, to the steering knuckle and position the indicator button so it contacts the brake rotor friction surface at a 90 degree angle, approximately 13 mm (0.5 in) from the outer edge of the rotor.

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11. Measure and record the assembled LRO of the brake rotor.
    1. Rotate the rotor until the lowest reading is displayed on the indicator dial, then set the dial to zero.
    2. Rotate the rotor until the highest reading is displayed on the dial.
    3. Mark the location of the high spot relative to the nearest wheel stud, or studs.
    4. Measure and record the amount of LRO.
12. Compare the brake rotor assembled LRO to the following specification:

    Specification:
    - Front brake rotor maximum allowable assembled lateral runout: 0.05 mm (0.002 in)
    - Rear brake rotor maximum allowable assembled lateral runout: 0.05 mm (0.002 in)

13. If the brake rotor assembled LRO is within specifications, proceed to step 18.

    If the brake rotor assembled LRO exceeds the specification, refinish the rotor to ensure true parallelism. Refer to **Brake Rotor Refinishing**. After refinishing the rotor, proceed to step 14.

14. Mount a dial indicator, **CH-45101:** Hub and Wheel Runout Gauge, or equivalent, to the steering knuckle and position the indicator button so it contacts the brake rotor friction surface at a 90 degree angle, approximately 13 mm (0.5 in) from the outer edge of the rotor.
15. Measure and record the assembled LRO of the brake rotor.
    1. Rotate the rotor until the lowest reading is displayed on the indicator dial, then set the dial to zero.
    2. Rotate the rotor until the highest reading is displayed on the dial.
    3. Mark the location of the high spot relative to the nearest wheel stud, or studs.
    4. Measure and record the amount of LRO.
16. Compare the brake rotor assembled LRO to the following specification:

    Specification:
    - Front brake rotor maximum allowable assembled lateral runout: 0.05 mm (0.002 in)
    - Rear brake rotor maximum allowable assembled lateral runout: 0.05 mm (0.002 in)

17. If the brake rotor assembled LRO measurement exceeds the specification, bring the LRO to within specifications. Refer to **Brake Rotor Assembled Lateral Runout Correction**.
18. If the brake rotor assembled LRO measurement is within specification, install the brake caliper and depress the brake pedal several times to secure the rotor in place before removing the **CH-45101-100:** Conical Brake Rotor Washers and the lug nuts.

BRAKE PAD INSPECTION

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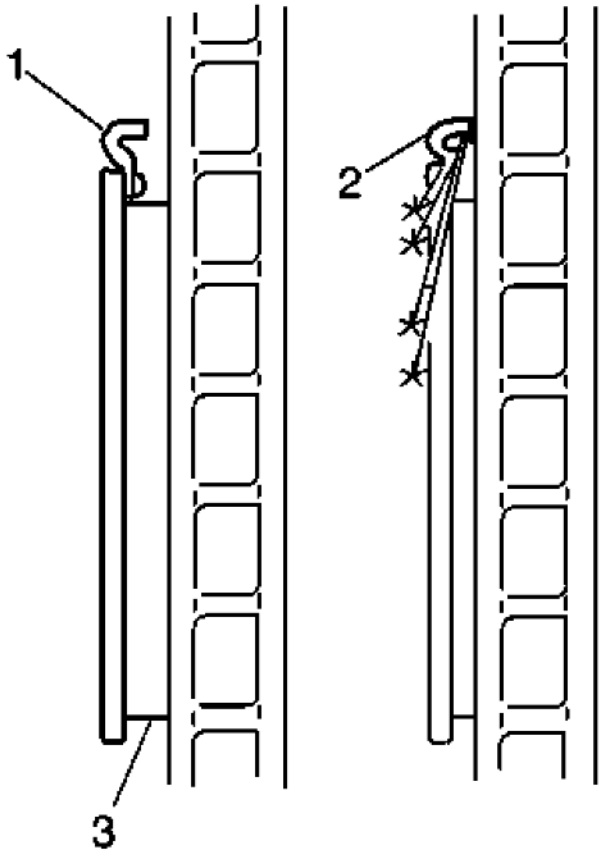


Fig. 7: View Of Brake Pads & Audible Wear Sensors
Courtesy of GENERAL MOTORS CORP.

WARNING: Refer to Brake Dust Warning .

1. Inspect the disc brake pads at regular intervals, or whenever the tire and wheel assemblies are removed from the vehicle.
2. If replacement is necessary, always replace disc brake pads in axle sets.
3. Inspect both edges of the disc brake pad friction surfaces (3). The highest rate of wear normally occurs at the trailing edge of the disc brake pads.
4. Inspect the thickness of the disc brake pads (3) in order to ensure that they have not worn prematurely. The disc brake pad wear should be approximately even per axle set.
5. Both front and rear disc brake pads have integral, audible wear sensors (1). When the disc brake pad wear

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reaches the minimum allowable thickness, the wear sensor contacts the disc brake rotor (2). The wear indicator will then produce an audible, high-pitched warning noise during wheel rotation.

6. Replace the disc brake pads when the friction surface (3) is worn to within 0.76 mm (0.030 in) of the mounting plates.
7. Remove the brake calipers and inspect the friction surfaces of the inner and outer disc brake pads to ensure that they are level. Place the disc brake pad friction surfaces together and measure the gap between the surfaces. If more than 0.13 mm (0.005 in) gap exists midway between the length of the disc brake pads, replace the disc brake pads.
8. Verify that any disc brake pad shims that may be required are in place and not damaged or excessively corroded. Replace any missing or damaged shims in order to preserve proper disc brake performance.
9. Replace the disc brake pads if any have separated from the mounting plates.
10. Inspect the disc brake pads friction surfaces for cracks, fractures, or damage which may cause noise or otherwise impair disc brake performance.

BRAKE CALIPER INSPECTION

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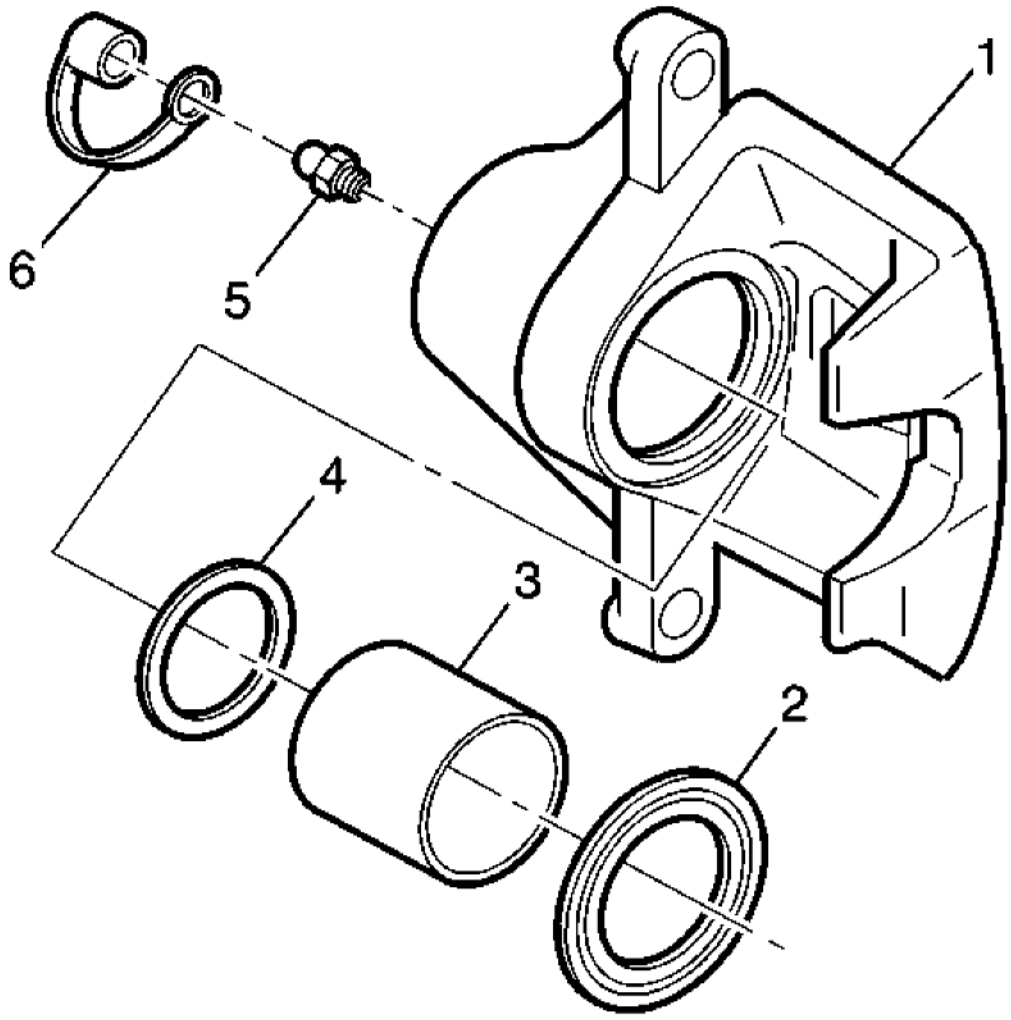


Fig. 8: Identifying Brake Caliper Components
Courtesy of GENERAL MOTORS CORP.

WARNING: Refer to Brake Dust Warning .

1. Inspect the brake caliper housing (1) for cracks, excess wear, and/or damage. If any of these conditions are present, the brake caliper requires replacement.
2. Inspect the caliper piston dust boot seal (2) for cracks, tears, cuts, deterioration and/or improper seating in the caliper body. If any of these conditions are present, the brake caliper requires overhaul or replacement.

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3. Inspect for brake fluid leakage around the caliper piston dust boot seal (2) and on the disc brake pads. If there is any evidence of brake fluid leakage, the brake caliper requires overhaul or replacement.

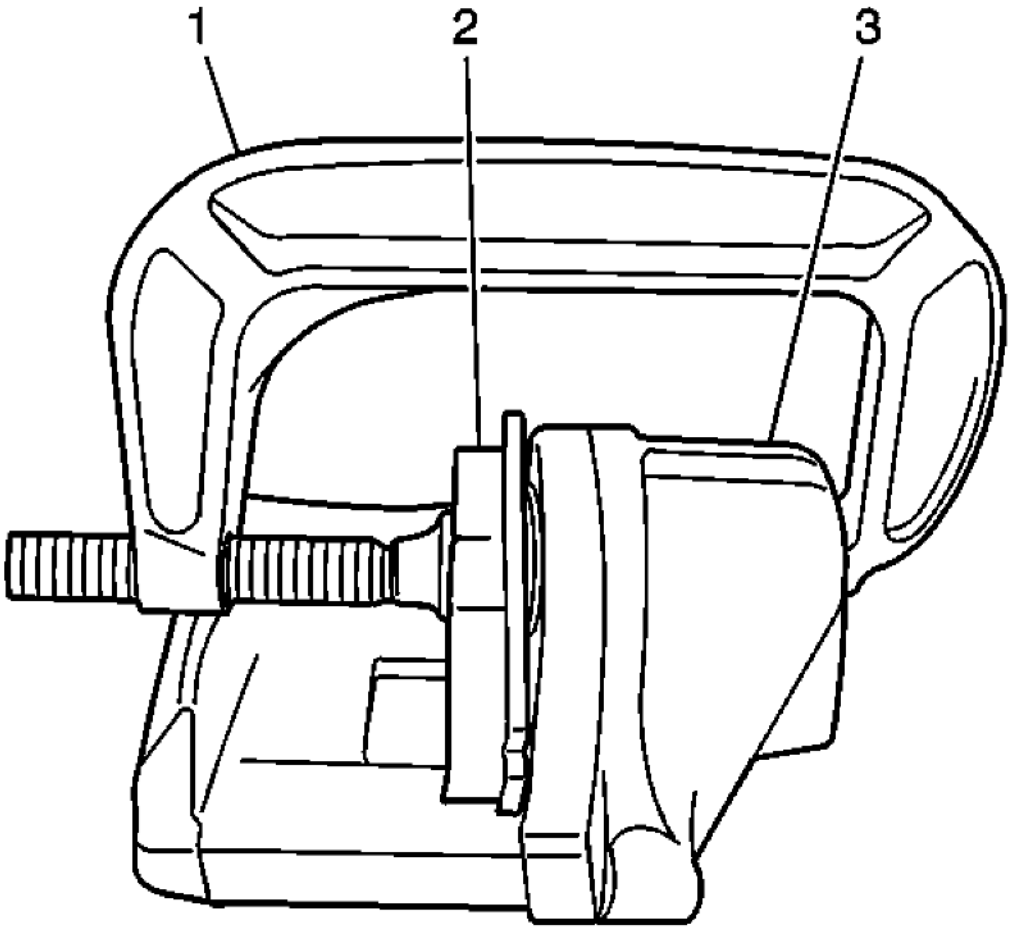


Fig. 9: Compressing Caliper Piston
Courtesy of GENERAL MOTORS CORP.

4. Inspect for smooth and complete travel of the caliper pistons into the caliper bores:

   The movement of the caliper pistons into the caliper bores should be smooth and even. If the caliper piston is frozen or difficult to bottom, the caliper requires overhaul or replacement.

   - For single piston caliper applications, insert a discarded inner brake pad (2) or block of wood in front of the piston. Using a large C-clamp (1) installed over the body of the caliper (3) and against the brake pad or block of wood, slowly bottom the piston in the bore.

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- For dual piston caliper applications, insert a discarded inner brake pad (2) or block of wood in front of the pistons. Using 2 large C-clamps (1) installed over the body of the caliper (3) and against the brake pad or block of wood, slowly bottom the pistons evenly into the bores.

FRONT DISC BRAKE MOUNTING AND HARDWARE INSPECTION

WARNING: Refer to Brake Dust Warning .

1. Inspect the fluid level in the brake master cylinder reservoir.
2. If the brake fluid level is midway between the maximum-full point and the minimum allowable level then no brake fluid needs to be removed from the reservoir before proceeding.
3. If the brake fluid level is higher than midway between the maximum-full point and the minimum allowable level then remove brake fluid to the midway point before proceeding.
4. Raise and support the vehicle. Refer **Lifting and Jacking the Vehicle** .
5. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .

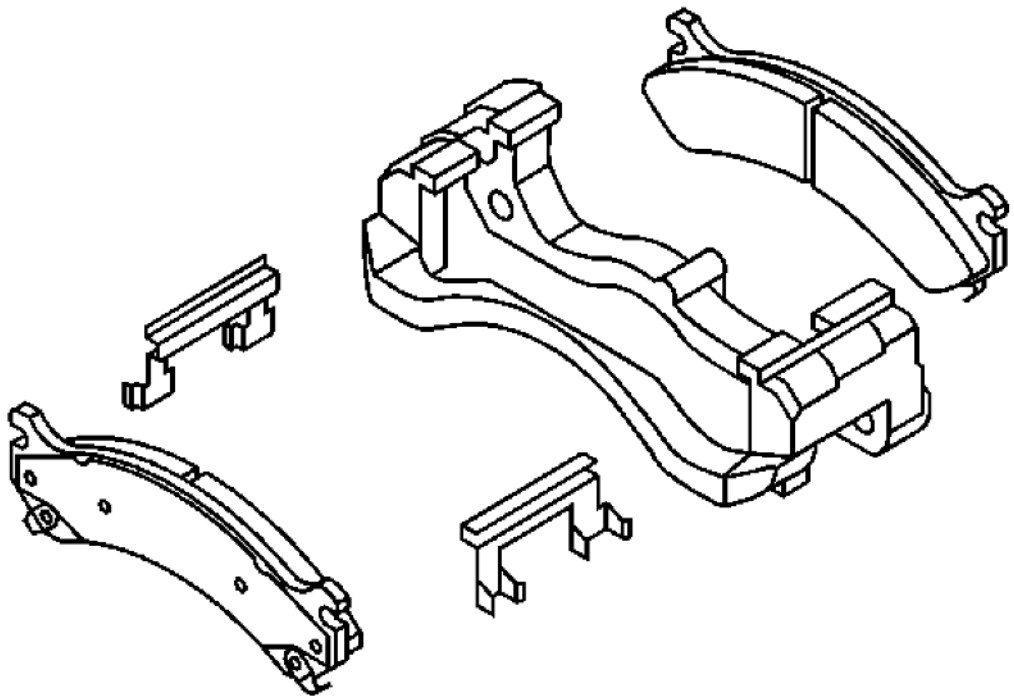


Fig. 10: View Of Disc Brake Pads & Brake Caliper Mounting Bracket
Courtesy of GENERAL MOTORS CORP.

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6. Grasp the brake caliper housing and try to move the brake caliper housing up/down and forward/reverse in relation to the brake caliper mounting bracket. If excessive looseness is observed the brake caliper bracket bushings and/or the brake caliper mounting bolts may need to be replaced.
7. Compress the front caliper pistons.
    - Install a large C-clamp over the top of the caliper housing and against the back of the outboard pad.
    - Slowly tighten the C-clamp until the pistons are pushed completely into the caliper bores.
    - Remove the C-clamp from the caliper.
8. With the pistons compressed into the caliper bores, grasp the brake caliper housing and slide it back and forth on the brake caliper mounting bolts. Check for smooth operation. If the brake caliper housing slide force is high or the brake caliper housing does not slide smoothly, inspect the brake caliper mounting bolts and/or the brake caliper mounting bracket bushings for wear or damage. If wear or damage conditions are found, replacement of the brake caliper mounting bolts and/or the brake caliper mounting bracket bushings is necessary.
9. Remove the brake caliper mounting bolts from the brake caliper mounting bracket and support the brake caliper using heavy mechanics wire. Do Not remove the hydraulic brake hose from the caliper. Refer to **Front Brake Caliper Replacement (LLT)** or **Front Brake Caliper Replacement (L99, LS3)**.
10. Remove the disc brake pads from the brake caliper mounting bracket.
11. Inspect the disc brake pad mounting hardware for the following:
    - Missing mounting hardware
    - Excessive corrosion
    - Bent mounting tabs
    - Looseness at the brake caliper mounting bracket
    - Looseness at the disc brake pads
    - Excessive contaminants in the brake caliper mounting bracket surface and threads.
12. If any of the conditions listed are found, the disc brake pad mounting hardware requires replacement.
13. Ensure the disc brake pads are held firmly in place on the brake caliper mounting bracket, yet slide easily on the mounting hardware without binding.

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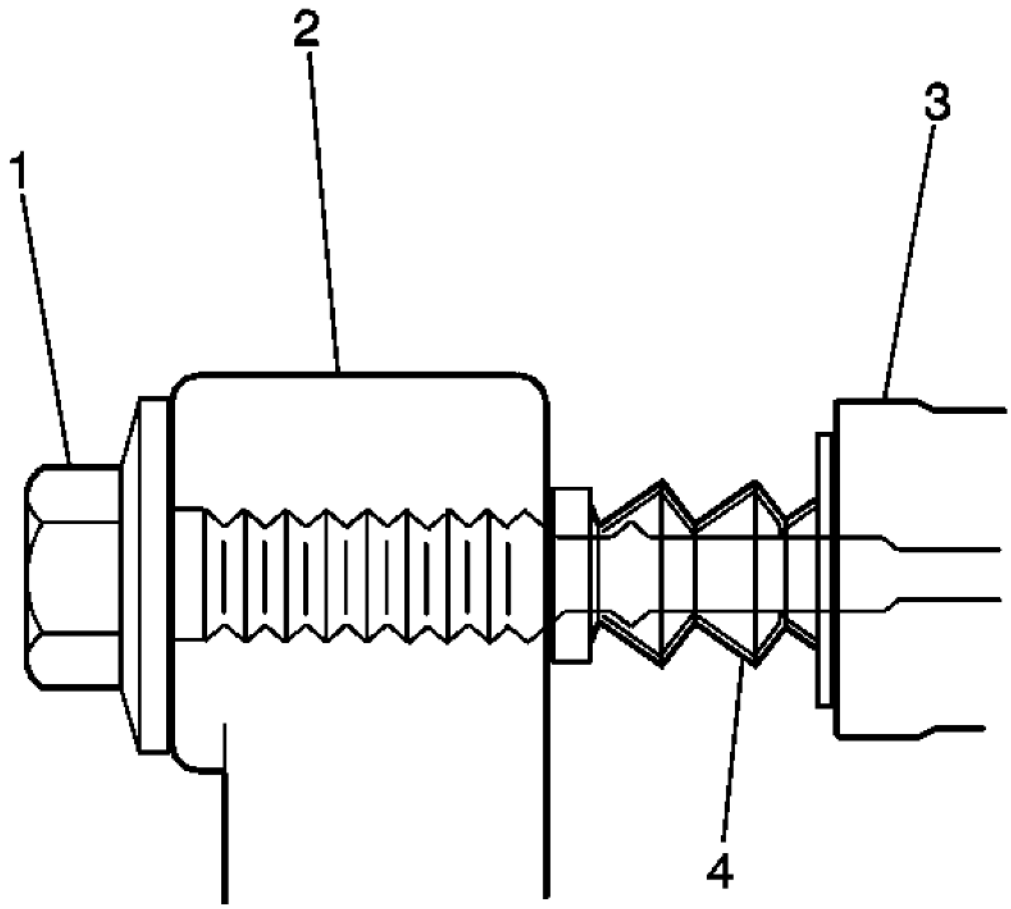


Fig. 11: View Of Caliper, Pin, Boots & Caliper Mounting Bracket
Courtesy of GENERAL MOTORS CORP.

14. Inspect the caliper bolts (1) for the following:
    - Binding
    - Seizing
    - Looseness in the brake caliper mounting bracket (3)
    - Bent or damaged brake caliper mounting bolts
    - Cracked or torn boots (4)
    - Missing boots
    - Bent or damaged brake caliper mounting bracket (3)
15. If any of the conditions listed are found then the brake caliper mounting hardware requires replacement.
16. Install the disc brake pads to the brake caliper mounting bracket.

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17. Install the disc brake caliper to the brake caliper mounting bracket. Refer to **Front Brake Caliper Replacement (LLT)** or **Front Brake Caliper Replacement (L99, LS3)**.

REAR DISC BRAKE MOUNTING AND HARDWARE INSPECTION

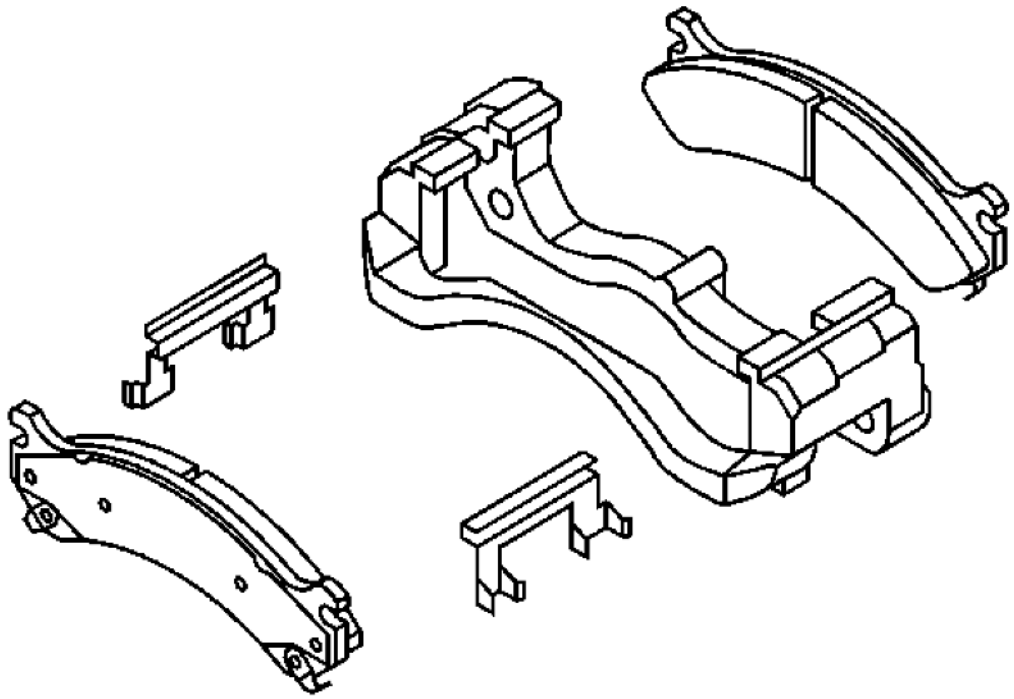


Fig. 12: View Of Disc Brake Pads & Brake Caliper Mounting Bracket
Courtesy of GENERAL MOTORS CORP.

WARNING: Refer to Brake Dust Warning .

1. Remove the disc brake caliper from the caliper mounting bracket.
2. Remove the disc brake pads from the caliper mounting bracket.
3. Inspect the disc brake pad mounting hardware for the following:
   - Missing mounting hardware
   - Excessive corrosion
   - Bent mounting tabs
   - Looseness at the caliper mounting bracket

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- Looseness at the disc brake pads

4. If any of the conditions listed are found, the disc brake pad mounting hardware requires replacement.
5. Ensure the disc brake pads are held firmly in place on the caliper mounting bracket, yet slide easily on the mounting hardware without binding.
6. Install the disc brake pads to the caliper mounting bracket.
7. Install the disc brake caliper to the mounting bracket.

REPAIR INSTRUCTIONS

FRONT DISC BRAKE PADS REPLACEMENT (LLT)

Removal Procedure

WARNING: Refer to Brake Dust Warning .

1. Inspect the fluid level in the brake master cylinder reservoir.
2. If the brake fluid level is midway between the maximum full point and the minimum allowable level, no brake fluid needs to be removed from the reservoir before proceeding.
3. If the brake fluid level is higher than midway between the maximum full point and the minimum allowable level, remove brake fluid to the midway point before proceeding.
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
5. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
6. Install a C-clamp against the outer brake pad and the rear of the brake caliper body.
7. Slowly tighten the C-clamp until the brake caliper pistons are compressed into the brake caliper bores.

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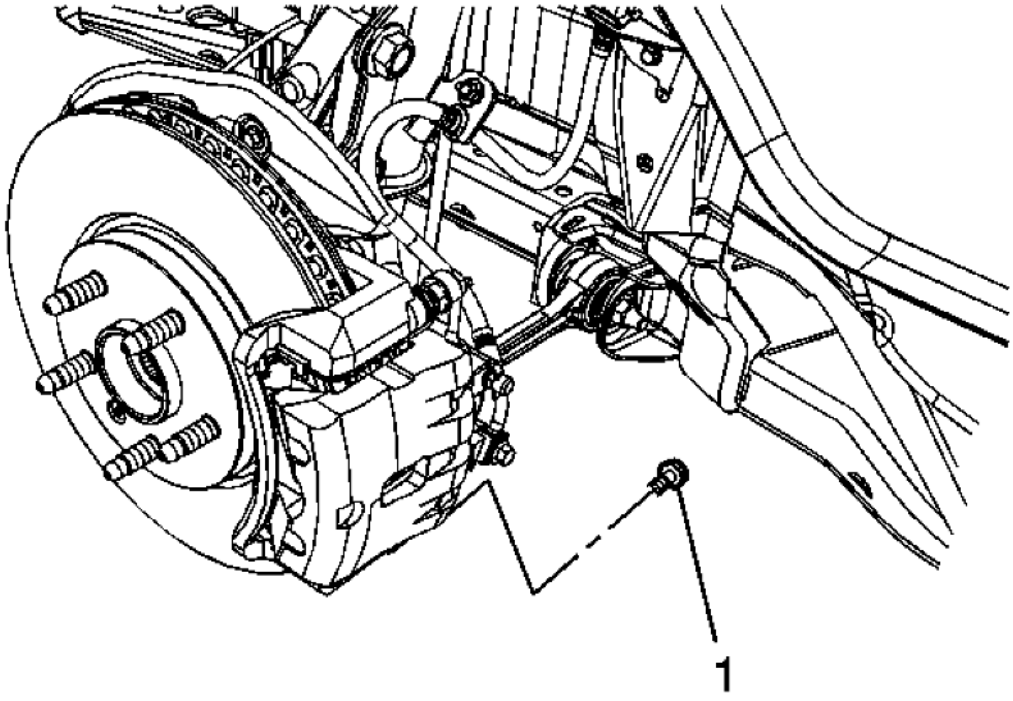


Fig. 13: Lower Brake Caliper Guide Pin Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: The brake caliper guide pin bolt is a one time use bolt. Do not reuse the brake caliper guide pin bolt.

8. Using a backup wrench on the brake caliper guide pin, remove the lower brake caliper guide pin bolt (1).
9. Discard the brake caliper guide pin bolt.

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.

10. Rotate the brake caliper upward and support with heavy mechanics wire or equivalent.

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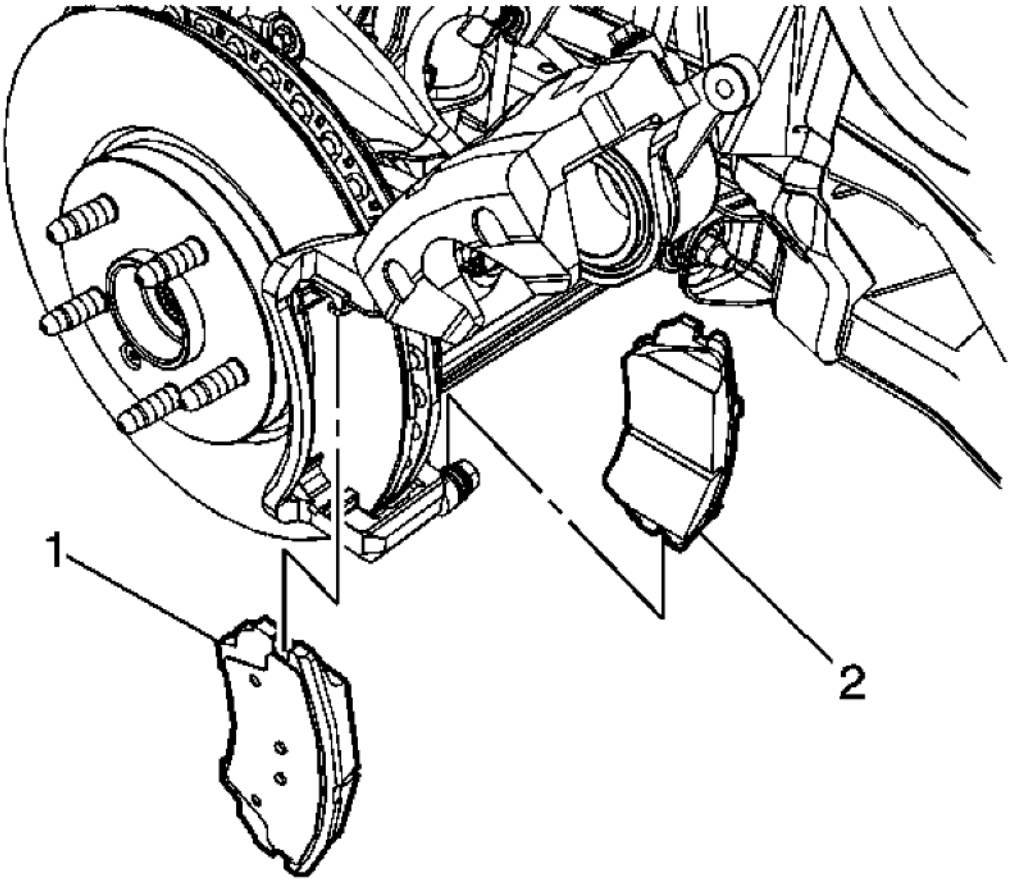


Fig. 14: Brake Pads
Courtesy of GENERAL MOTORS CORP.

11. Remove the outer brake pad (1).
12. Remove the inner brake pad (2).

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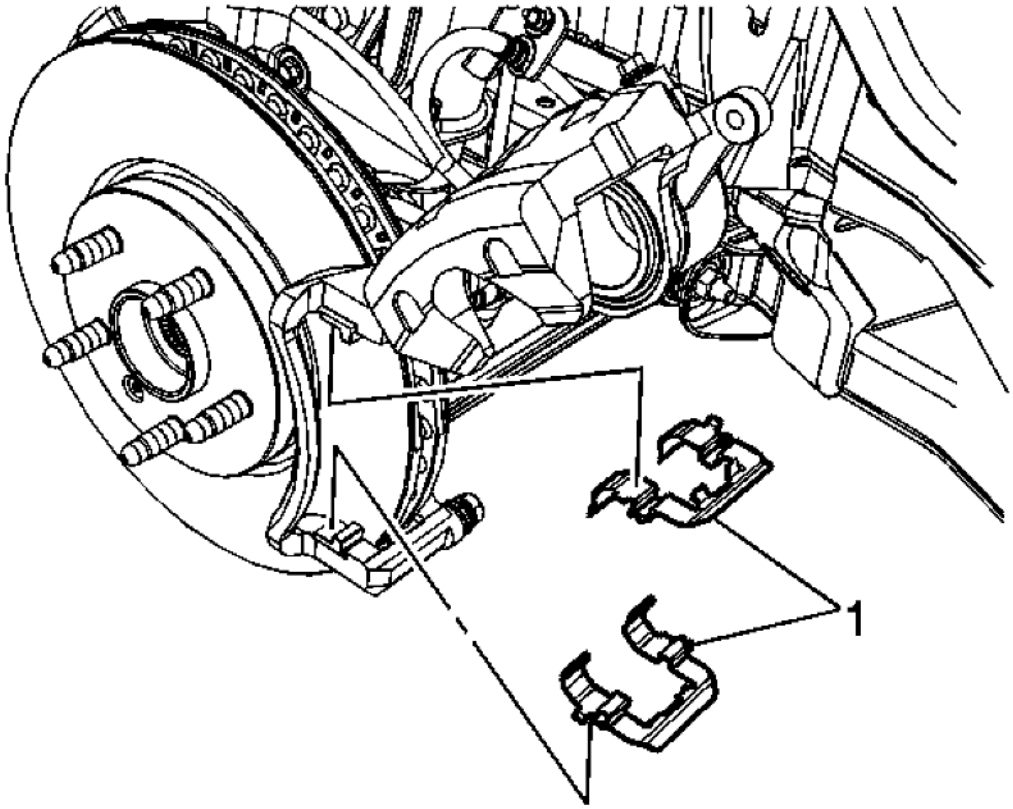


Fig. 15: Brake Pad Springs
Courtesy of GENERAL MOTORS CORP.

13. Remove the brake pad springs (1).

Installation Procedure

1. Inspect the brake caliper guide pins, seals and brake pad springs for damage and/or corrosion. Refer to **Front Disc Brake Mounting and Hardware Inspection**.
2. Clean the brake pad spring contact points on the brake caliper bracket of any corrosion or debris.

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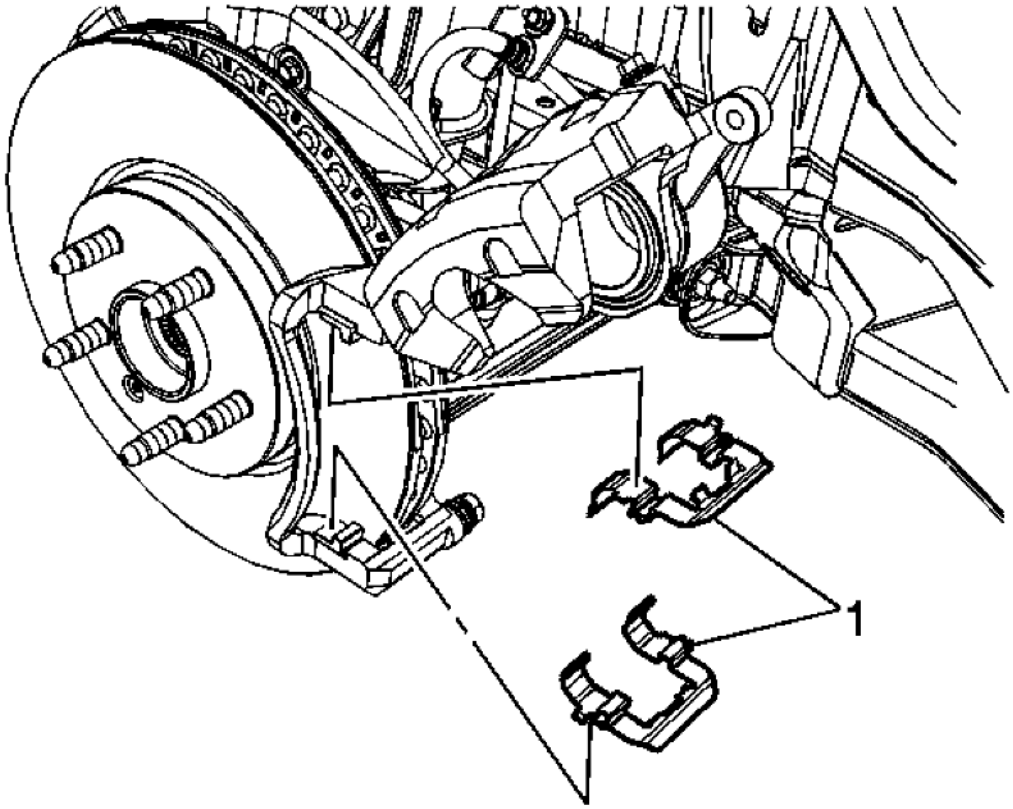


Fig. 16: Brake Pad Springs
Courtesy of GENERAL MOTORS CORP.

3. Install the brake pad springs (1).

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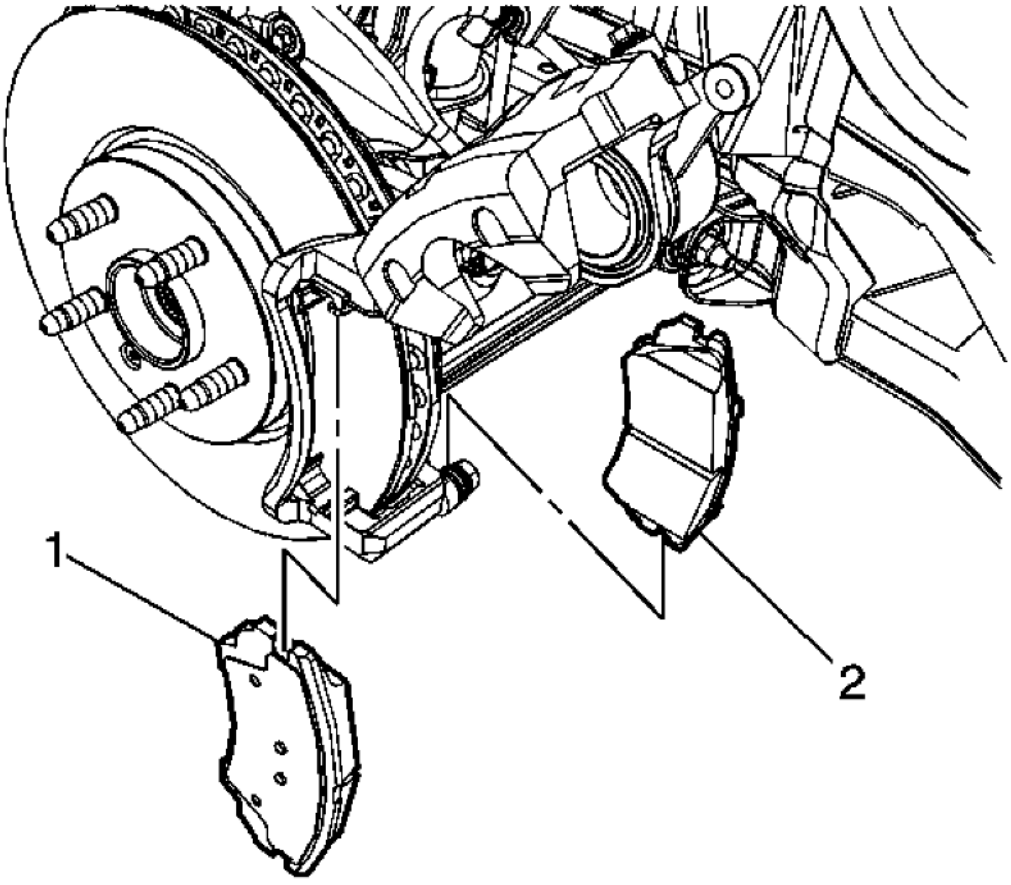


Fig. 17: Brake Pads
Courtesy of GENERAL MOTORS CORP.

4. Install the outer brake pad (1).
5. Install the inner brake pad (2).
6. Rotate the brake caliper to the installed position.

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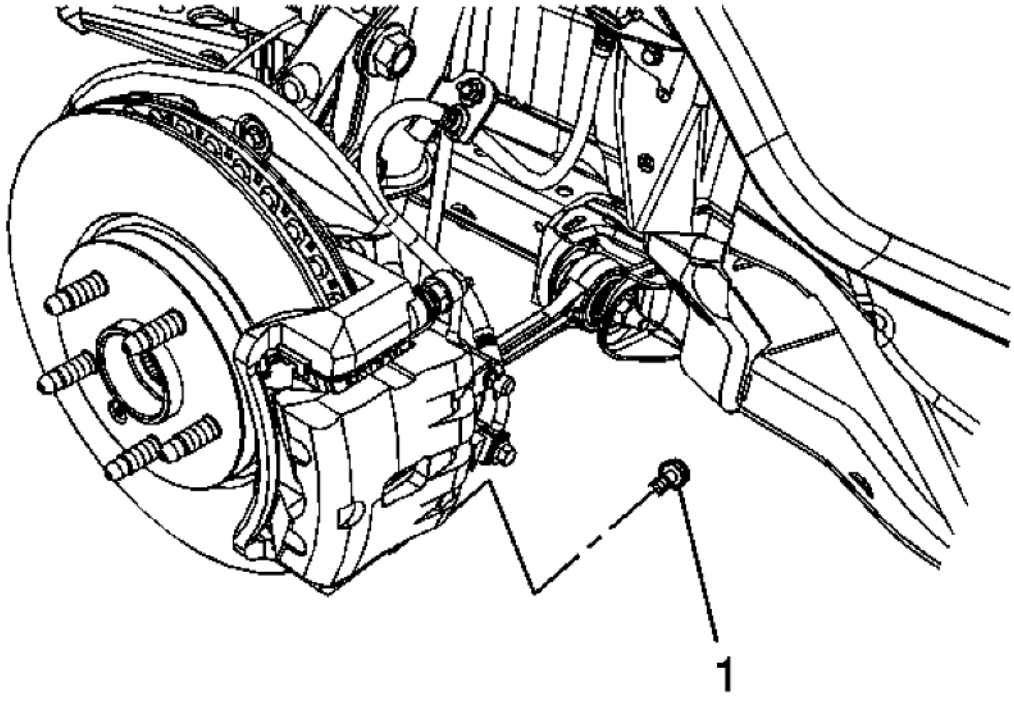


Fig. 18: Lower Brake Caliper Guide Pin Bolt
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

NOTE: Install a new brake caliper guide pin bolt.

7. Using a backup wrench on the brake caliper guide pin, install a new brake caliper guide pin bolt (1) and tighten to 27 N.m (20 lb ft).
8. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
9. With the engine OFF, gradually apply the brake pedal to approximately 2/3 of its travel distance.
10. Slowly release the brake pedal.
11. Wait 15 seconds, then repeat steps 9 and 10 until a firm brake pedal apply is obtained. This will properly seat the brake caliper pistons and brake pads.
12. Fill the brake master cylinder reservoir to the proper level. Refer to **Master Cylinder Reservoir Filling** .
13. Burnish the brake pads and rotors. Refer to **Brake Pad and Rotor Burnishing**.

FRONT DISC BRAKE PADS REPLACEMENT (L99, LS3)

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WARNING: **Refer to Brake Dust Warning .**

Removal Procedure

1. Inspect the fluid level in the brake master cylinder reservoir.
2. If the brake fluid level is midway between the maximum-full point and the minimum allowable level, no brake fluid needs to be removed from the reservoir before proceeding.
3. If the brake fluid level is higher than midway between the maximum-full point and the minimum allowable level, remove brake fluid to the midway point before proceeding.
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
5. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .

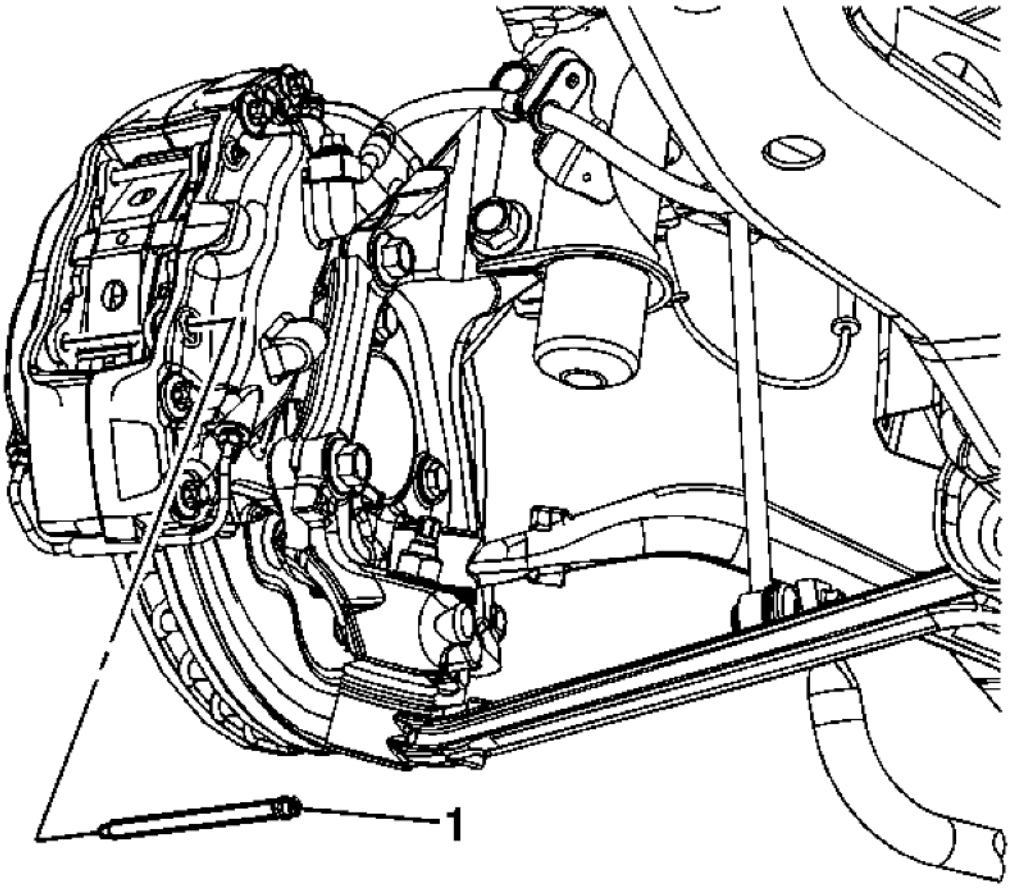


Fig. 19: Lower Brake Caliper Pin

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Courtesy of GENERAL MOTORS CORP.

6. Hold the end of the brake pad spring down and carefully drive out the lower brake caliper pin (1) from the brake caliper.

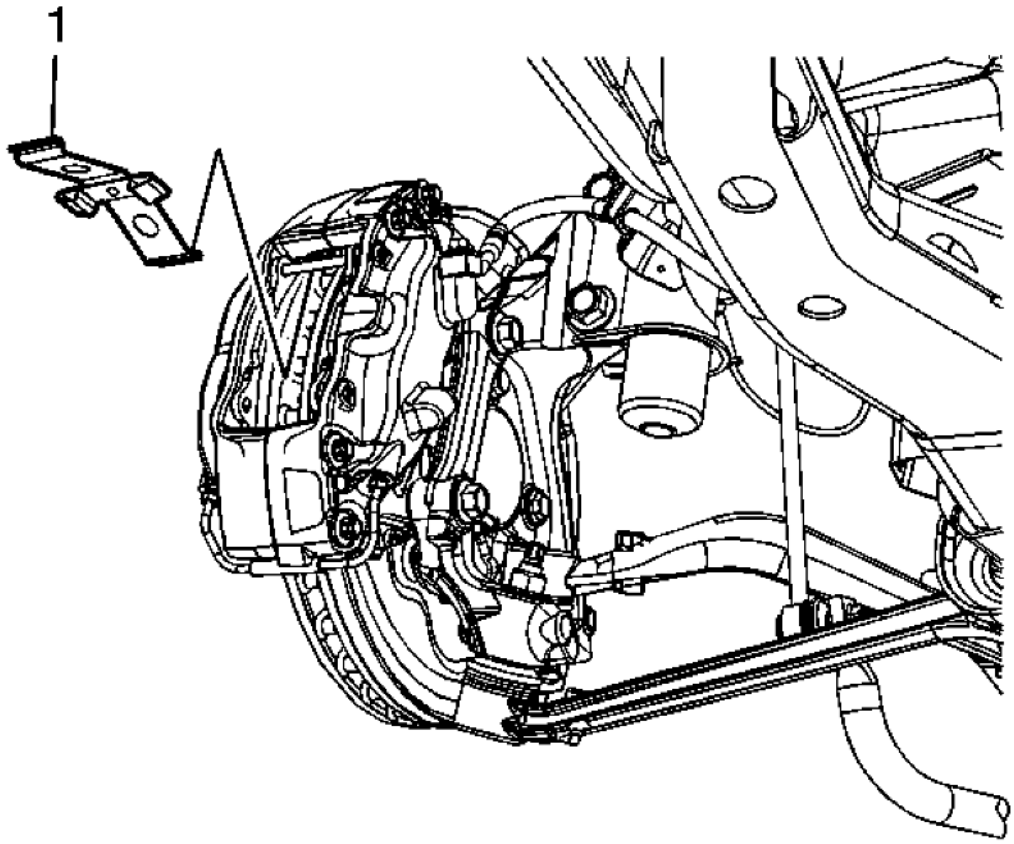


Fig. 20: Brake Pad Spring
Courtesy of GENERAL MOTORS CORP.

7. Remove the brake pad spring (1).

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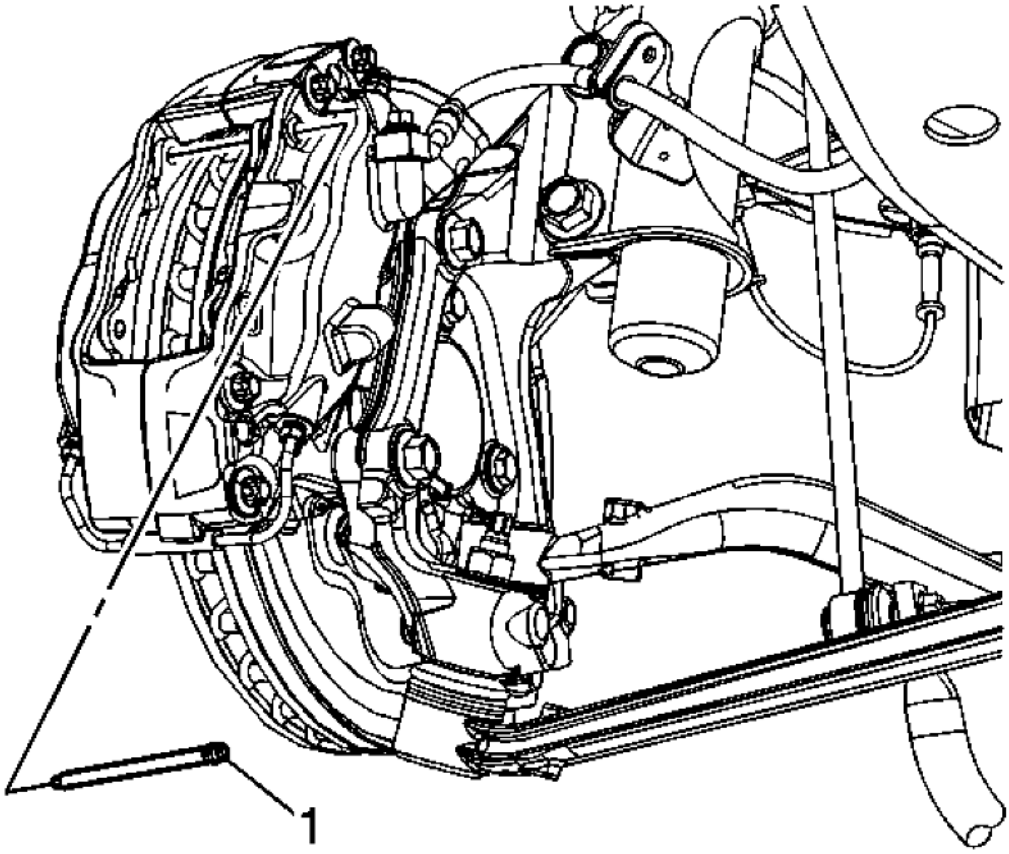


Fig. 21: Upper Brake Pad Pin
Courtesy of GENERAL MOTORS CORP.

8. Carefully drive out the upper brake pad pin (1) from the brake caliper.
9. Using a spreader tool, carefully push the brake caliper pistons into the caliper bores until fully seated.

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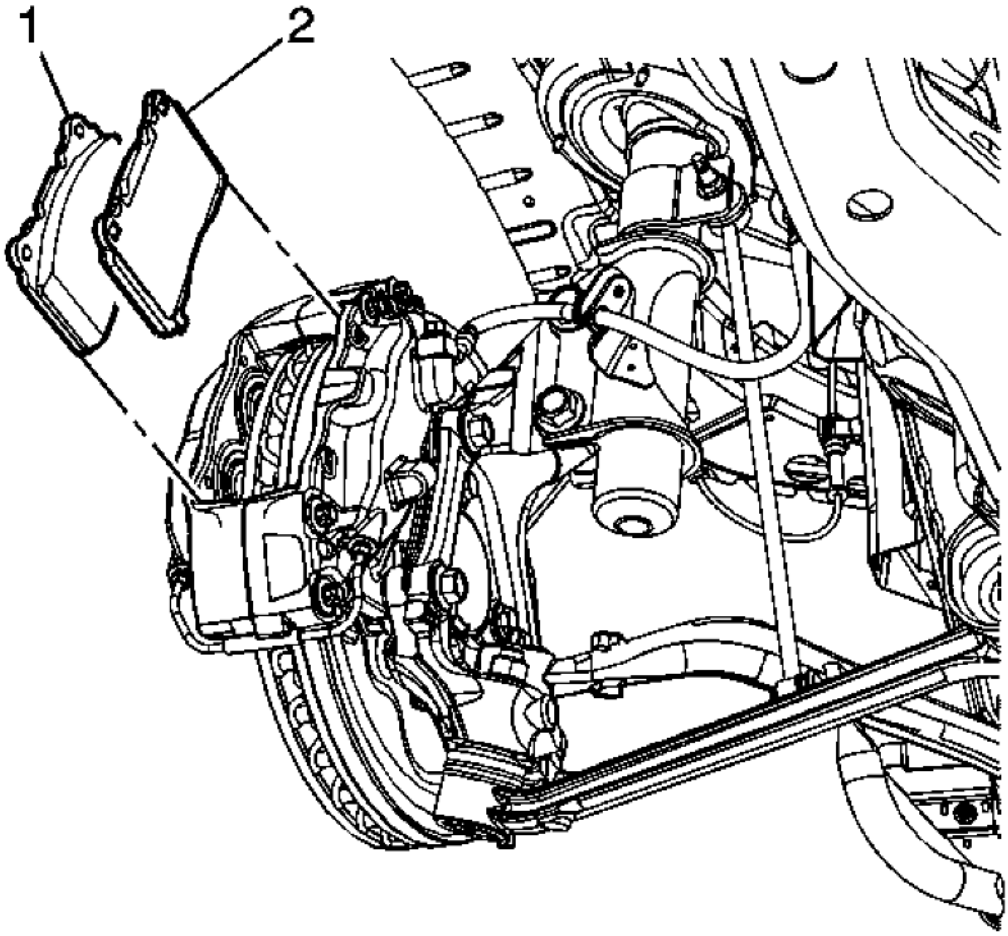


Fig. 22: Brake Pads
Courtesy of GENERAL MOTORS CORP.

10. Remove the outer brake pad (1).
11. Remove the inner brake pad (2), noting the location of the brake pad wear sensor.

Installation Procedure

1. Inspect the brake caliper pins and brake pad springs for damage or excessive corrosion and replace, if necessary.

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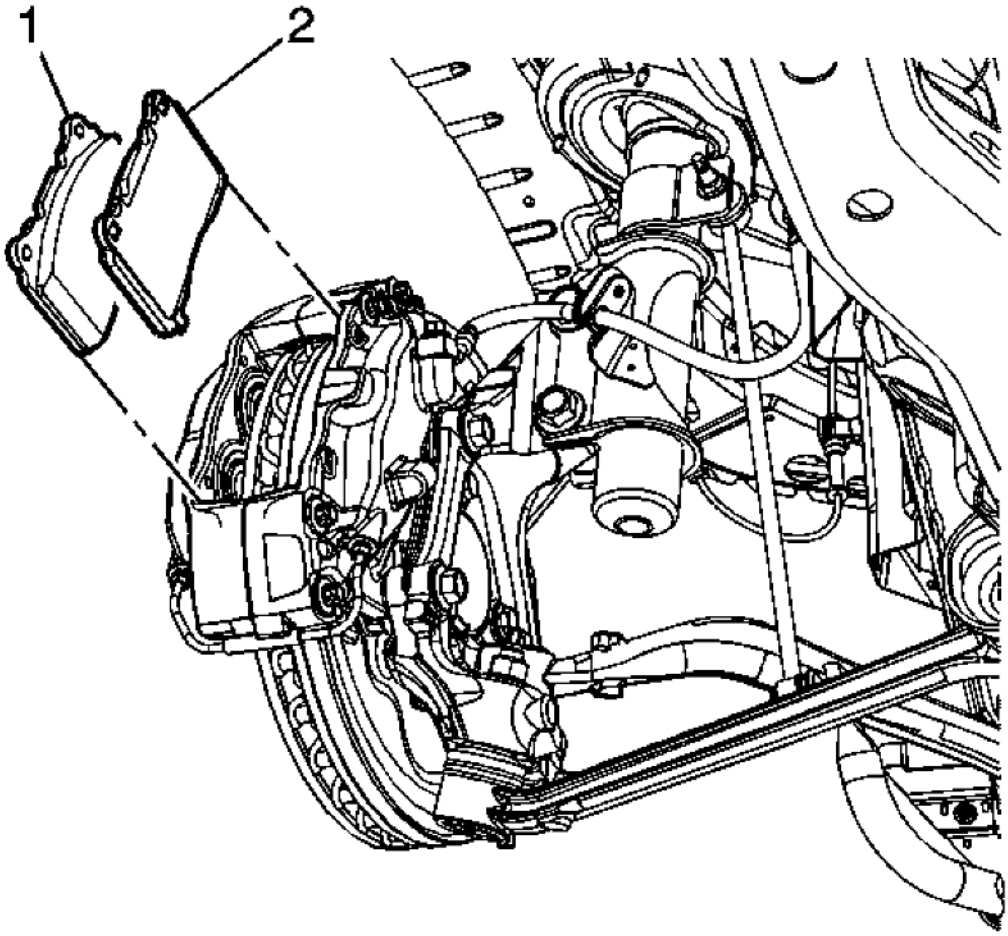


Fig. 23: Brake Pads
Courtesy of GENERAL MOTORS CORP.

2. Install the outer brake pad (1).
3. Install the inner brake pad (2), noting the location of the brake pad wear sensor.

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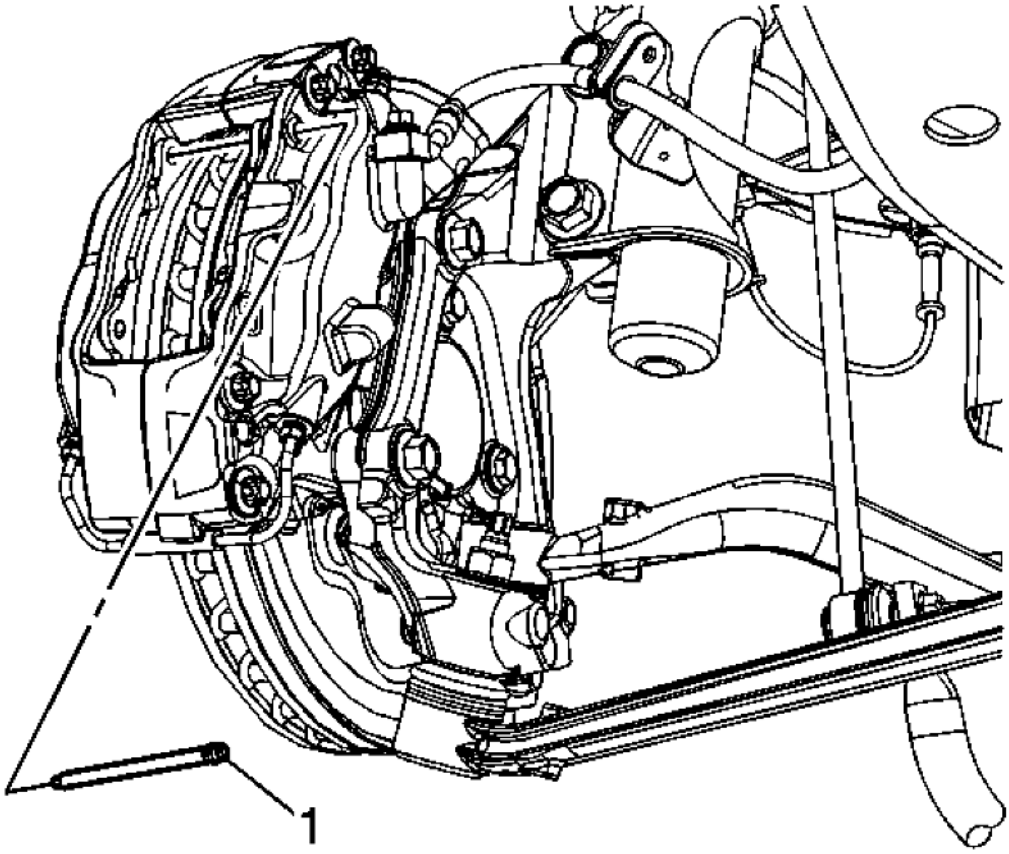


Fig. 24: Upper Brake Pad Pin
Courtesy of GENERAL MOTORS CORP.

4. Carefully drive the upper brake caliper pin (1) into the brake caliper.
5. Ensure the brake caliper pin is fully seated in the brake caliper.

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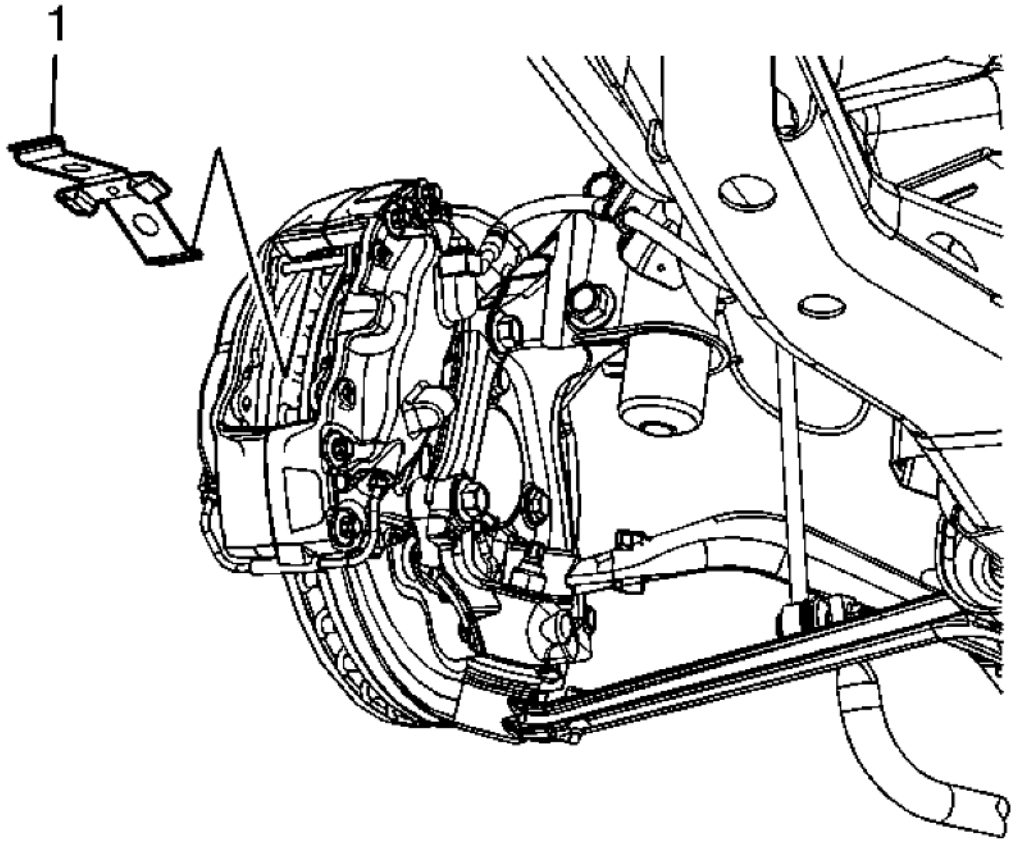


Fig. 25: Brake Pad Spring
Courtesy of GENERAL MOTORS CORP.

6. Install the brake pad spring (1).

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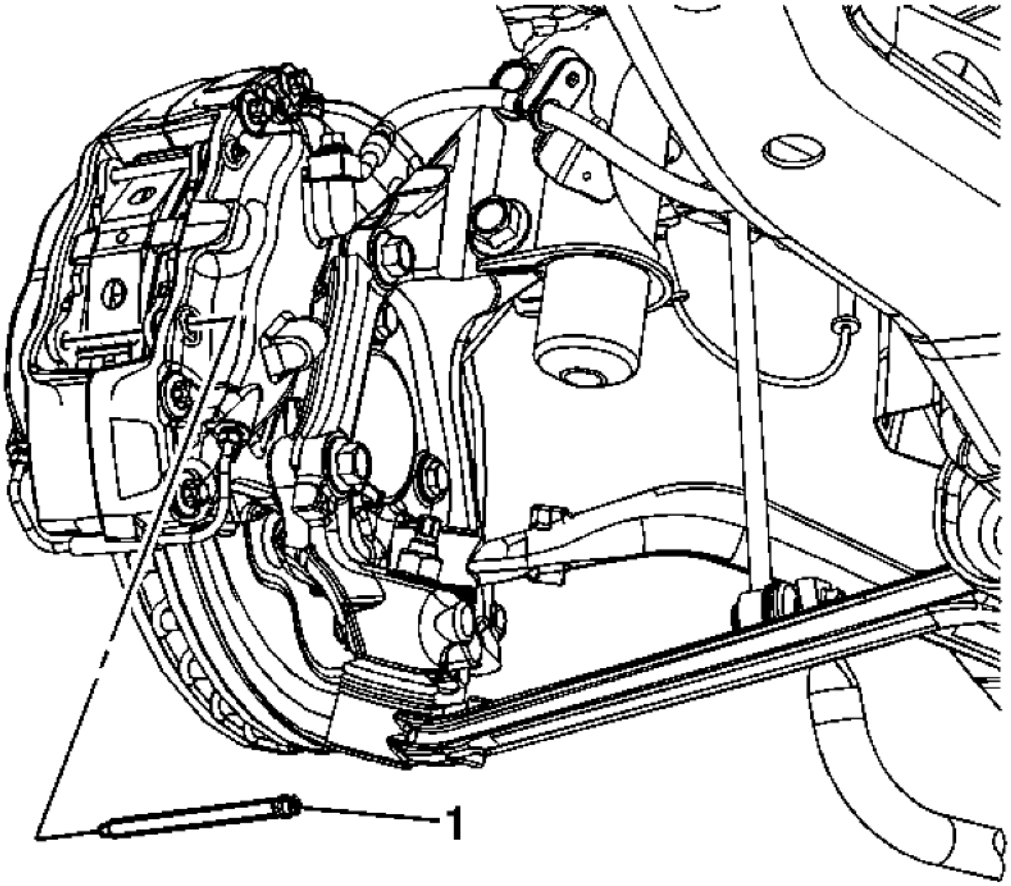


Fig. 26: Lower Brake Caliper Pin
Courtesy of GENERAL MOTORS CORP.

7. Hold the end of the brake pad spring down and carefully drive the lower brake caliper pin (1) into the brake caliper.
8. Ensure the brake caliper pin is fully seated in the brake caliper.
9. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
10. With the engine OFF, gradually apply the brake pedal to approximately 2/3 of its travel distance.
11. Slowly release the brake pedal.
12. Wait 15 seconds, then repeat steps 10 and 11 until a firm brake pedal apply is obtained. This will properly seat the brake caliper pistons and brake pads.
13. Fill the brake master cylinder reservoir to the proper level. Refer to **Master Cylinder Reservoir Filling** .
14. Burnish the brake pads and rotors. Refer to **Brake Pad and Rotor Burnishing**.

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REAR DISC BRAKE PADS REPLACEMENT (LLT)

Removal Procedure

WARNING: Refer to Brake Dust Warning .

1. Inspect the fluid level in the brake master cylinder reservoir.
2. If the brake fluid level is midway between the maximum full point and the minimum allowable level, no brake fluid needs to be removed from the reservoir before proceeding.
3. If the brake fluid level is higher than midway between the maximum full point and the minimum allowable level, remove brake fluid to the midway point before proceeding.
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
5. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
6. Install a C-clamp against the outer brake pad and the rear of the brake caliper body.
7. Slowly tighten the C-clamp until the brake caliper pistons are compressed into the brake caliper bores.

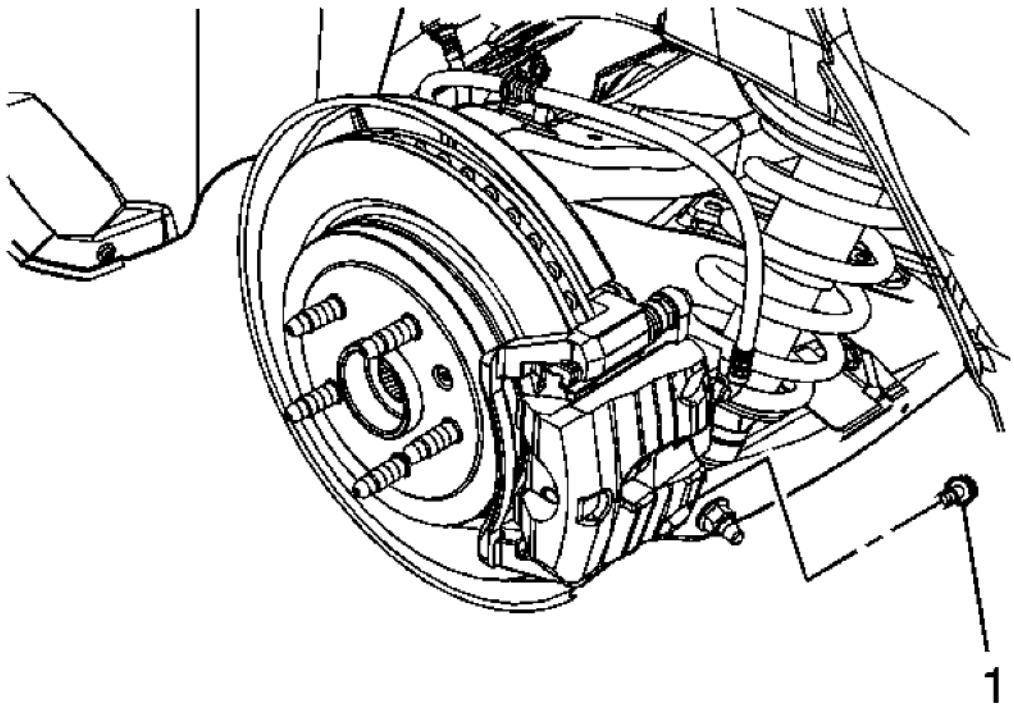


Fig. 27: Lower Brake Caliper Guide Pin Bolt
Courtesy of GENERAL MOTORS CORP.

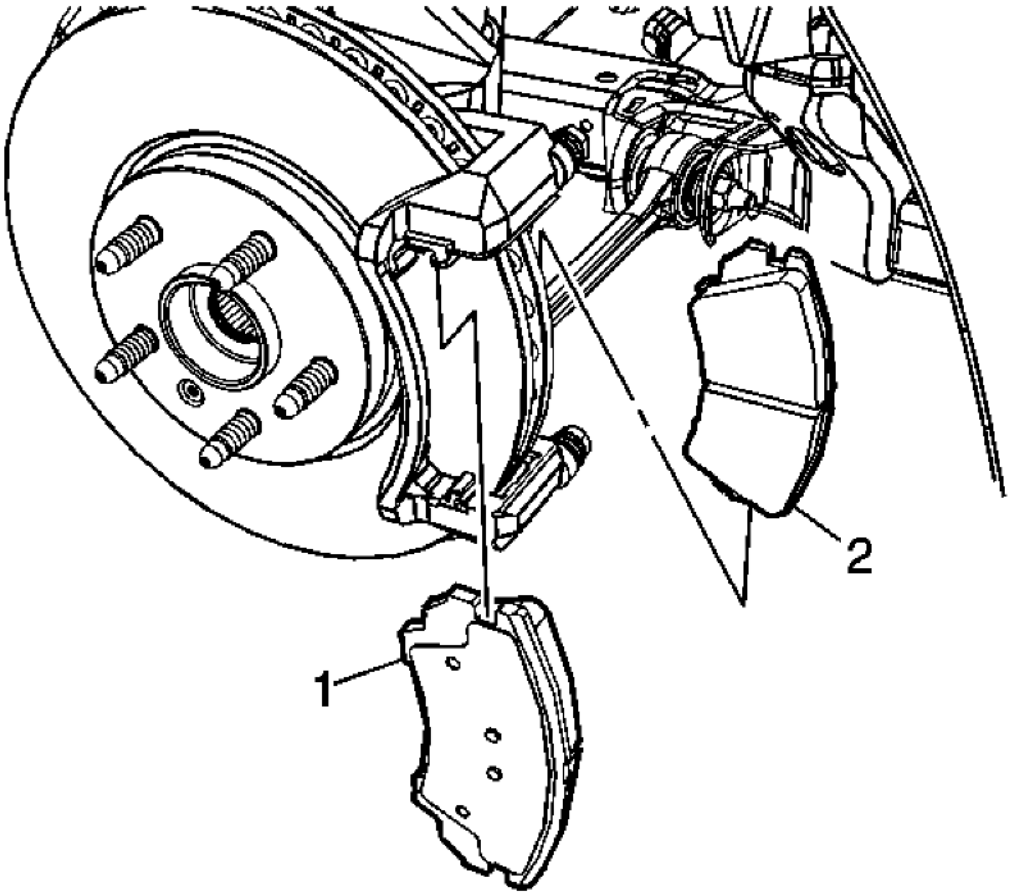
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NOTE: **The brake caliper guide pin bolt is a one time use bolt. Do not reuse the brake caliper guide pin bolt.**

8. Using a backup wrench on the brake caliper guide pin, remove the lower brake caliper guide pin bolt (1).
9. Discard the brake caliper guide pin bolt.

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.**

10. Rotate the brake caliper upward and support with heavy mechanics wire or equivalent.



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Fig. 28: Brake Pads
Courtesy of GENERAL MOTORS CORP.

11. Remove the inner brake pad (1).
12. Remove the outer brake pad (2).

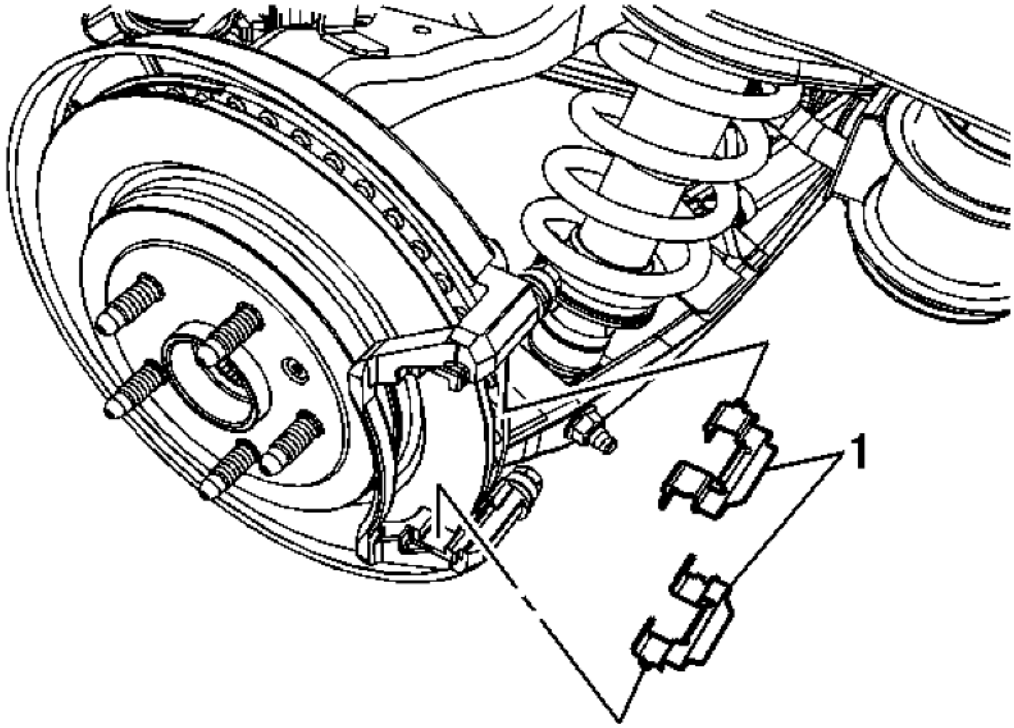


Fig. 29: Brake Pad Springs
Courtesy of GENERAL MOTORS CORP.

13. Remove the brake pad springs (1).

Installation Procedure

1. Inspect the brake caliper guide pins, seals and brake pad springs for damage and/or corrosion. Refer to **Front Disc Brake Mounting and Hardware Inspection**.
2. Clean the brake pad spring contact points on the brake caliper bracket of any corrosion or debris.

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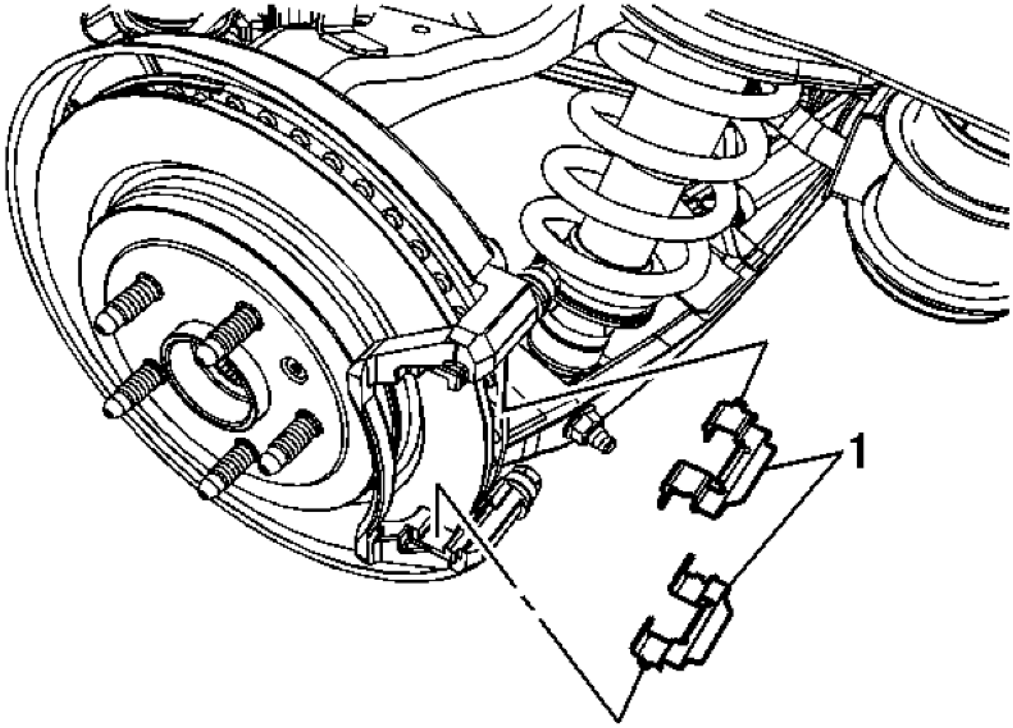


Fig. 30: Brake Pad Springs
Courtesy of GENERAL MOTORS CORP.

3. Install the brake pad springs (1).

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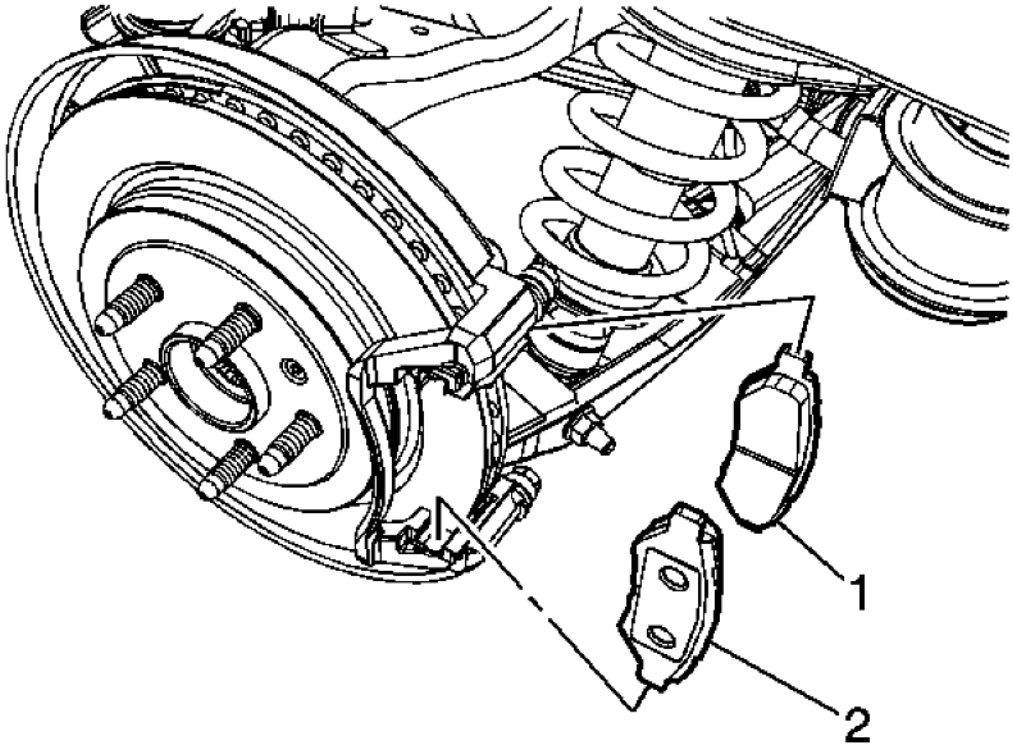


Fig. 31: Brake Pads
Courtesy of GENERAL MOTORS CORP.

4. Install the inner brake pad (1).
5. Install the outer brake pad (2).
6. Rotate the brake caliper to the installed position.

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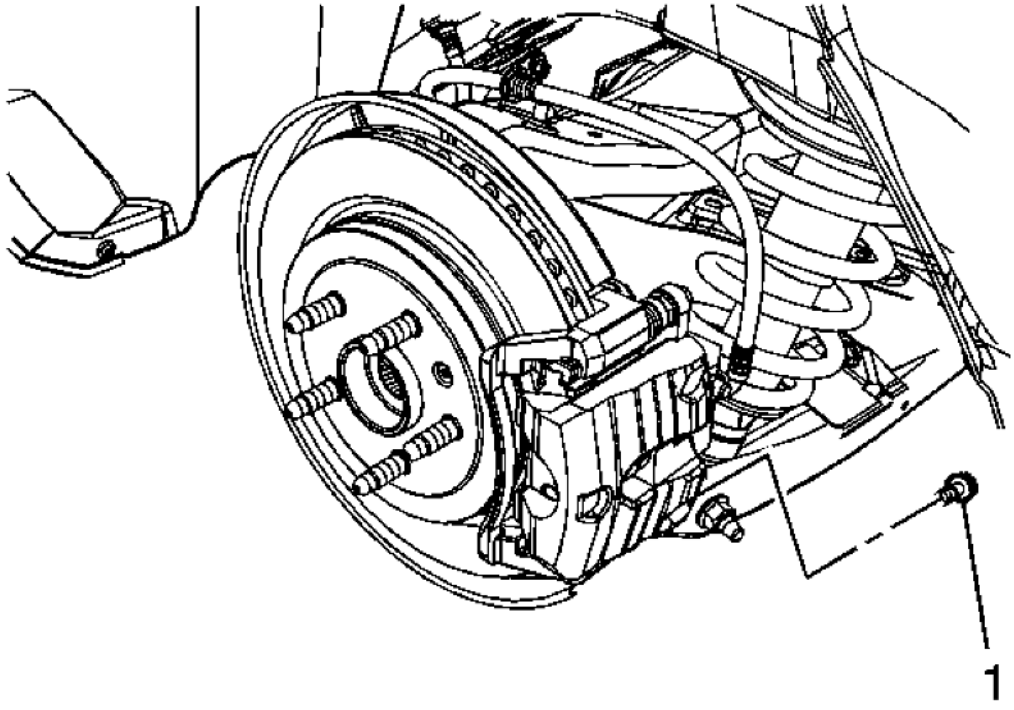


Fig. 32: Lower Brake Caliper Guide Pin Bolt
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

7. Using a backup wrench on the brake caliper guide pin, install a new brake caliper guide pin bolt (1) and tighten to 27 N.m (20 lb ft).
8. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
9. With the engine OFF, gradually apply the brake pedal to approximately 2/3 of its travel distance.
10. Slowly release the brake pedal.
11. Wait 15 seconds, then repeat steps 9 and 10 until a firm brake pedal apply is obtained. This will properly seat the brake caliper pistons and brake pads.
12. Fill the brake master cylinder reservoir to the proper level. Refer to **Master Cylinder Reservoir Filling** .
13. Burnish the pads and rotors. Refer to **Brake Pad and Rotor Burnishing**.

REAR DISC BRAKE PADS REPLACEMENT (L99, LS3)

Removal Procedure

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WARNING: **Refer to Brake Dust Warning .**

1. Inspect the fluid level in the brake master cylinder reservoir.
2. If the brake fluid level is midway between the maximum full point and the minimum allowable level, no brake fluid needs to be removed from the reservoir before proceeding.
3. If the brake fluid level is higher than midway between the maximum full point and the minimum allowable level, remove brake fluid to the midway point before proceeding.
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
5. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .

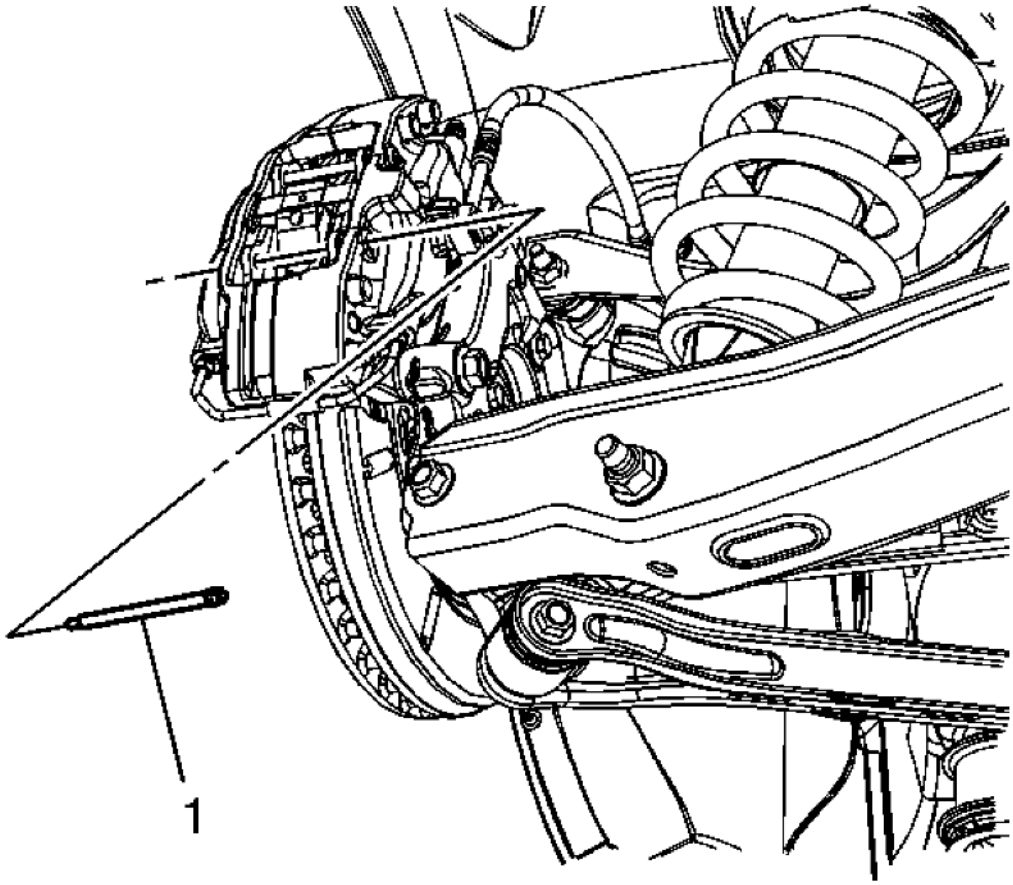


Fig. 33: Lower Brake Caliper Pin
Courtesy of GENERAL MOTORS CORP.

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6. Hold the end of the brake pad spring down and carefully drive out the lower brake caliper pin (1) from the brake caliper.

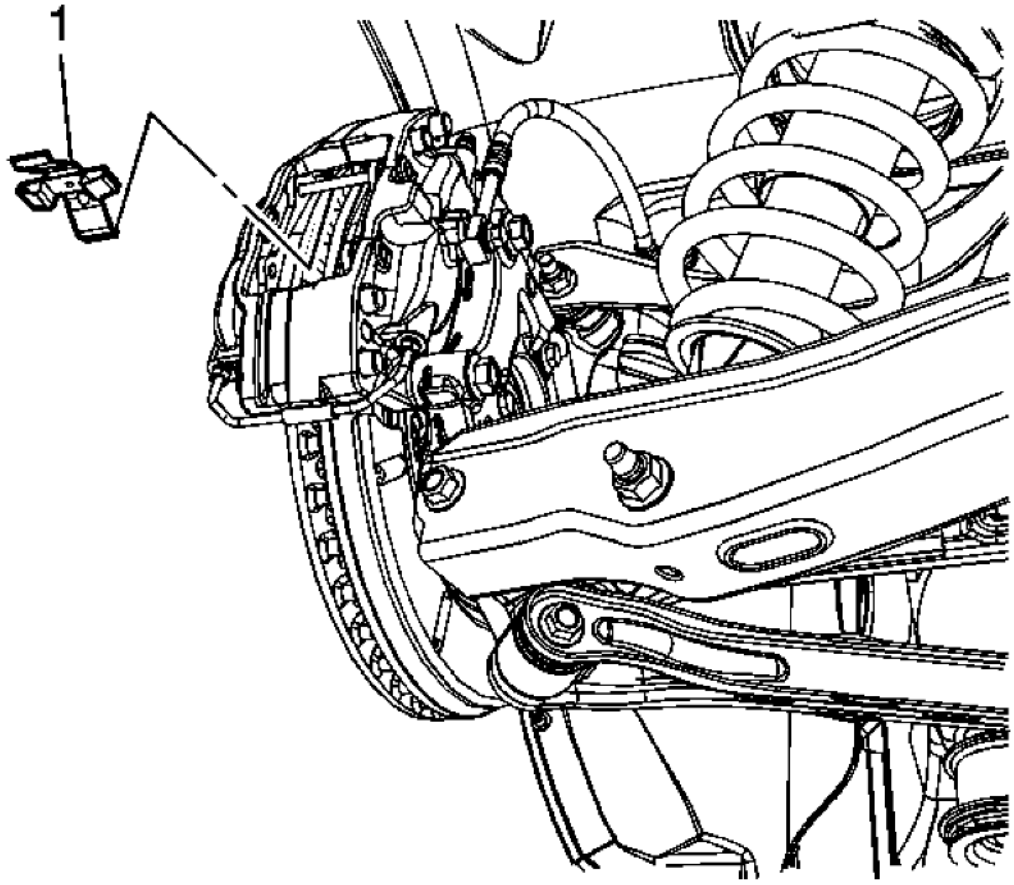


Fig. 34: Brake Pad Spring
Courtesy of GENERAL MOTORS CORP.

7. Remove the brake pad spring (1).

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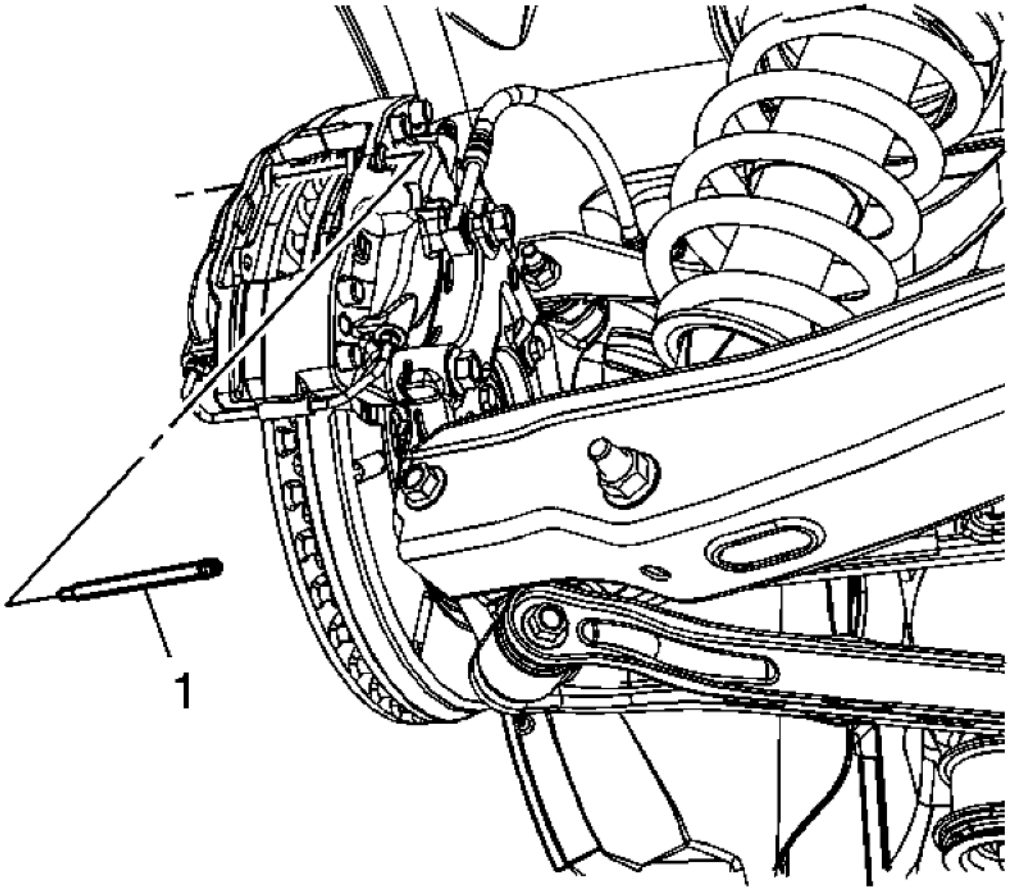


Fig. 35: Upper Brake Caliper Pin
Courtesy of GENERAL MOTORS CORP.

8. Carefully drive out the upper brake caliper pin (1) from the brake caliper.

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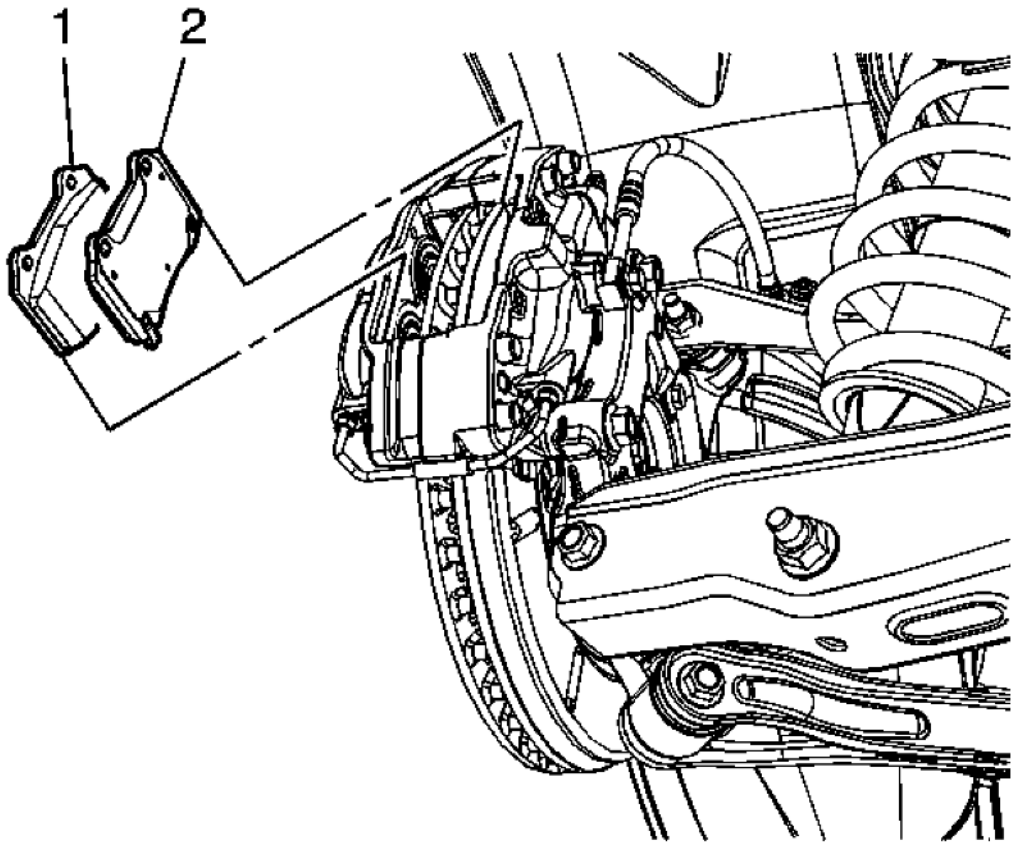


Fig. 36: Brake Pads
Courtesy of GENERAL MOTORS CORP.

9. Remove the outer brake pad (1).
10. Remove the inner brake pad (2), noting the location of the brake pad wear sensor.
11. Using a spreader tool, carefully push the brake caliper pistons into the caliper bores until fully seated.

Installation Procedure

1. Inspect the brake caliper pins and brake pad springs for damage or excessive corrosion and replace, if necessary.

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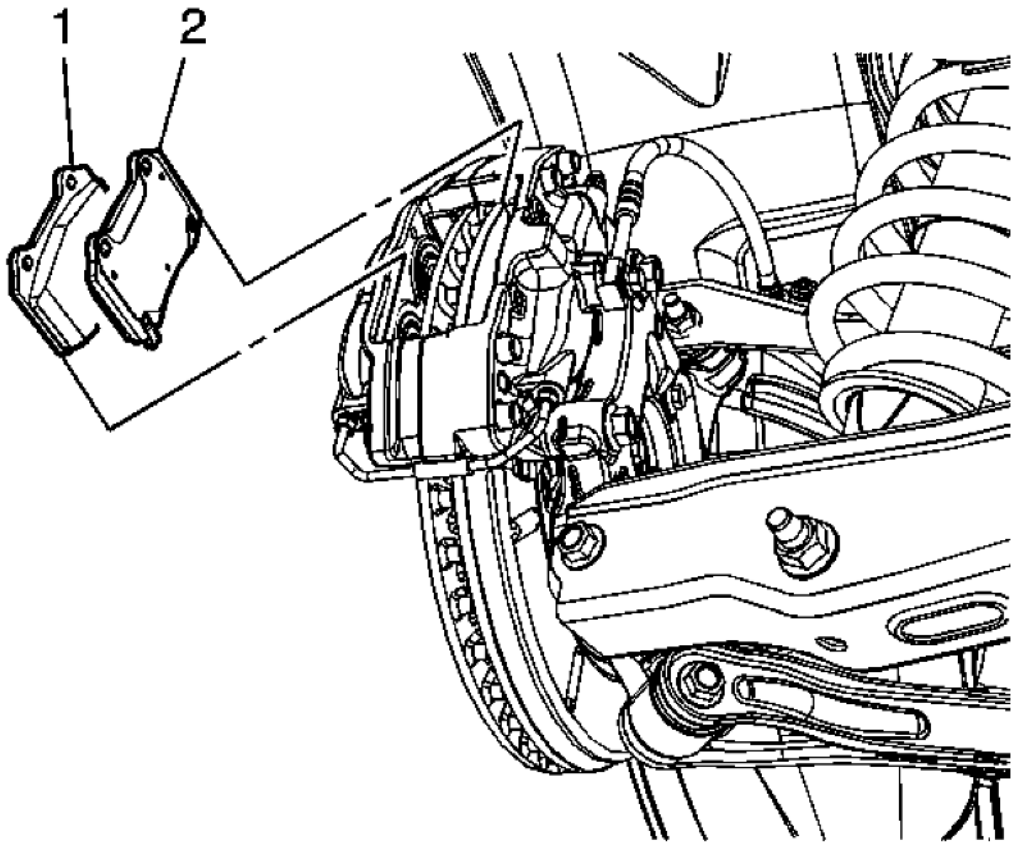


Fig. 37: Brake Pads
Courtesy of GENERAL MOTORS CORP.

2. Install the outer brake pad (1).
3. Install the inner brake pad (2), noting the location of the brake pad wear sensor.

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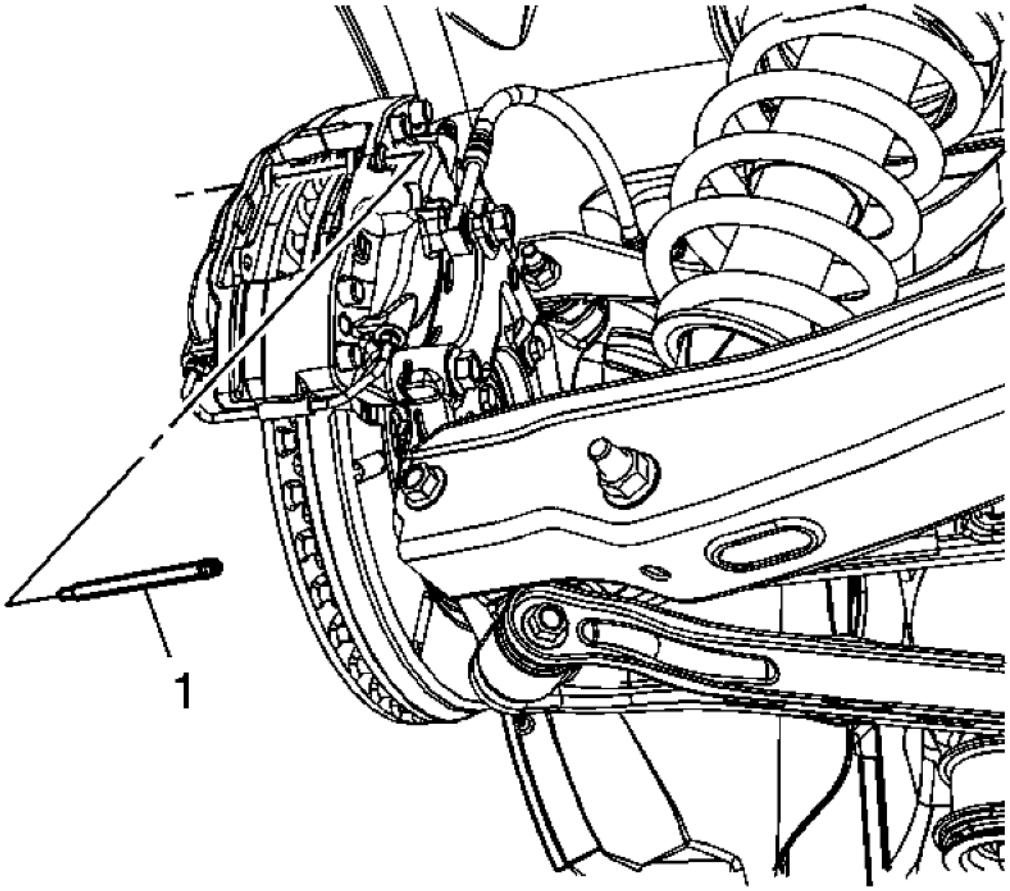


Fig. 38: Upper Brake Caliper Pin
Courtesy of GENERAL MOTORS CORP.

4. Carefully drive the upper brake caliper pin (1) into the brake caliper.
5. Ensure the brake caliper pin is fully seated in the brake caliper.

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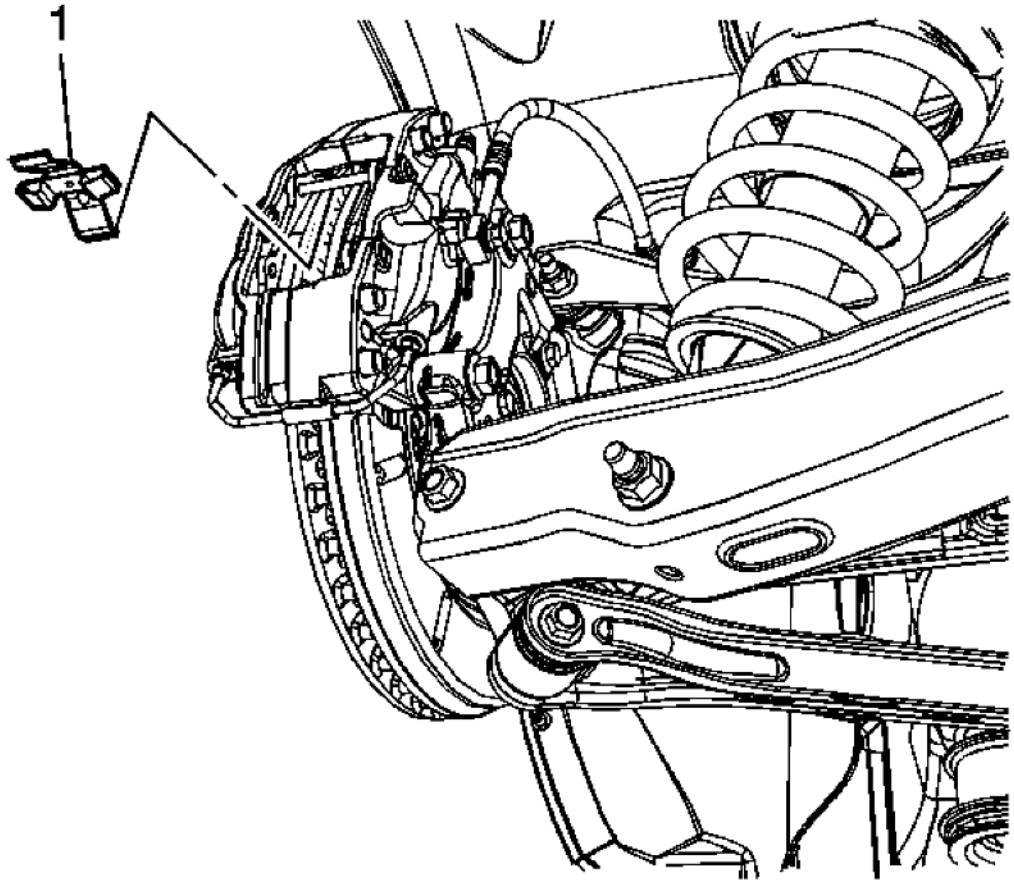


Fig. 39: Brake Pad Spring
Courtesy of GENERAL MOTORS CORP.

6. Install the brake pad spring (1).

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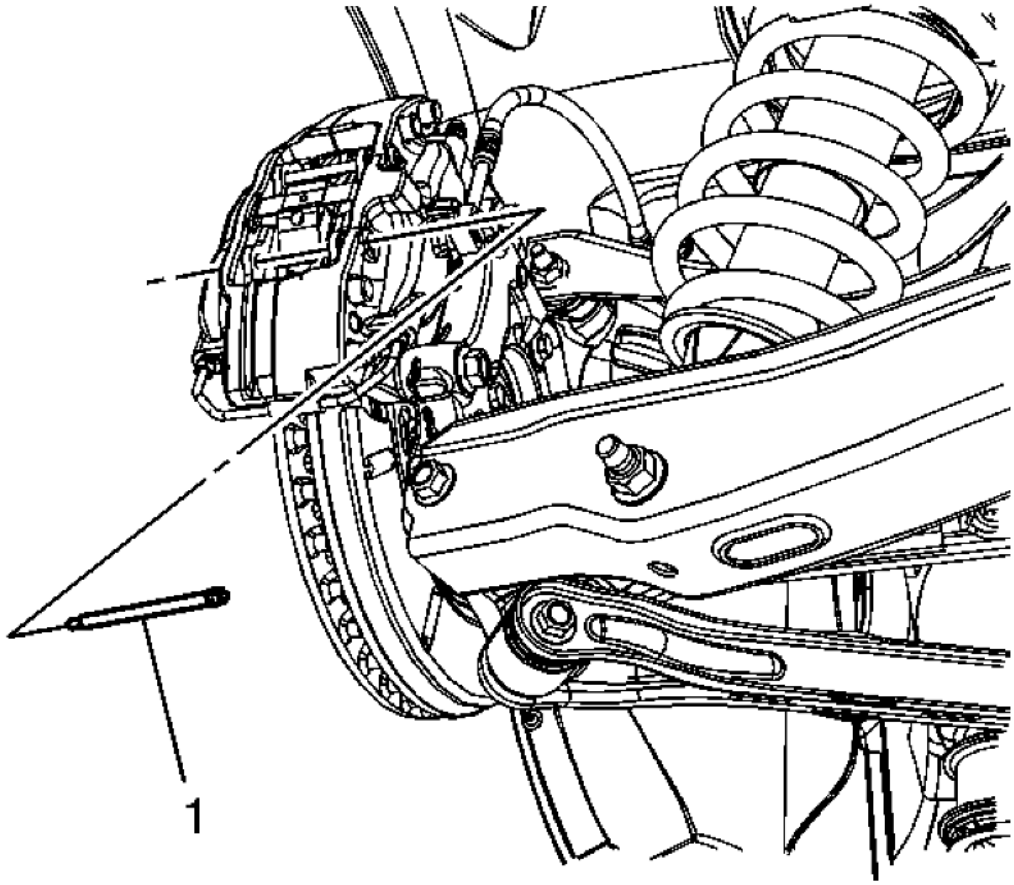


Fig. 40: Lower Brake Caliper Pin
Courtesy of GENERAL MOTORS CORP.

7. Hold the end of the brake pad spring down and carefully drive the lower brake caliper pin (1) into the brake caliper.
8. Ensure the brake caliper pin is fully seated in the brake caliper.
9. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
10. With the engine OFF, gradually apply the brake pedal to approximately 2/3 of its travel distance.
11. Slowly release the brake pedal.
12. Wait 15 seconds, then repeat steps 10 and 11 until a firm brake pedal apply is obtained. This will properly seat the brake caliper pistons and brake pads.
13. Fill the brake master cylinder reservoir to the proper level. Refer to **Master Cylinder Reservoir Filling** .
14. Burnish the brake pads and rotors. Refer to **Brake Pad and Rotor Burnishing**.

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BRAKE PAD AND ROTOR BURNISHING

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.

Burnishing the brake pads and brake rotors is necessary in order to ensure that the braking surfaces are properly prepared after service has been performed on the disc brake system.

This procedure should be performed whenever the disc brake rotors have been refinished or replaced, and/or whenever the disc brake pads have been replaced.

1. Select a smooth road with little or no traffic.
2. Accelerate the vehicle to 48 km/h (30 mph).

NOTE: Use care to avoid overheating the brakes while performing this step.

3. Using moderate to firm pressure, apply the brakes to bring the vehicle to a stop. Do not allow the brakes to lock.
4. Repeat steps 2 and 3 until approximately 20 stops have been completed. Allow sufficient cooling periods between stops in order to properly burnish the brake pads and rotors.

FRONT BRAKE CALIPER REPLACEMENT (LLT)

Removal Procedure

WARNING: Refer to Brake Dust Warning .

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

1. Inspect the fluid level in the brake master cylinder reservoir.
2. If the brake fluid level is midway between the maximum full point and the minimum allowable level, no brake fluid needs to be removed from the reservoir before proceeding.
3. If the brake fluid level is higher than midway between the maximum full point and the minimum allowable level, remove brake fluid to the midway point before proceeding.
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
5. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .

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6. Install a C-clamp against the outer brake pad and the rear of the brake caliper body.
7. Slowly tighten the C-clamp until the brake caliper piston is compressed into the brake caliper bore.

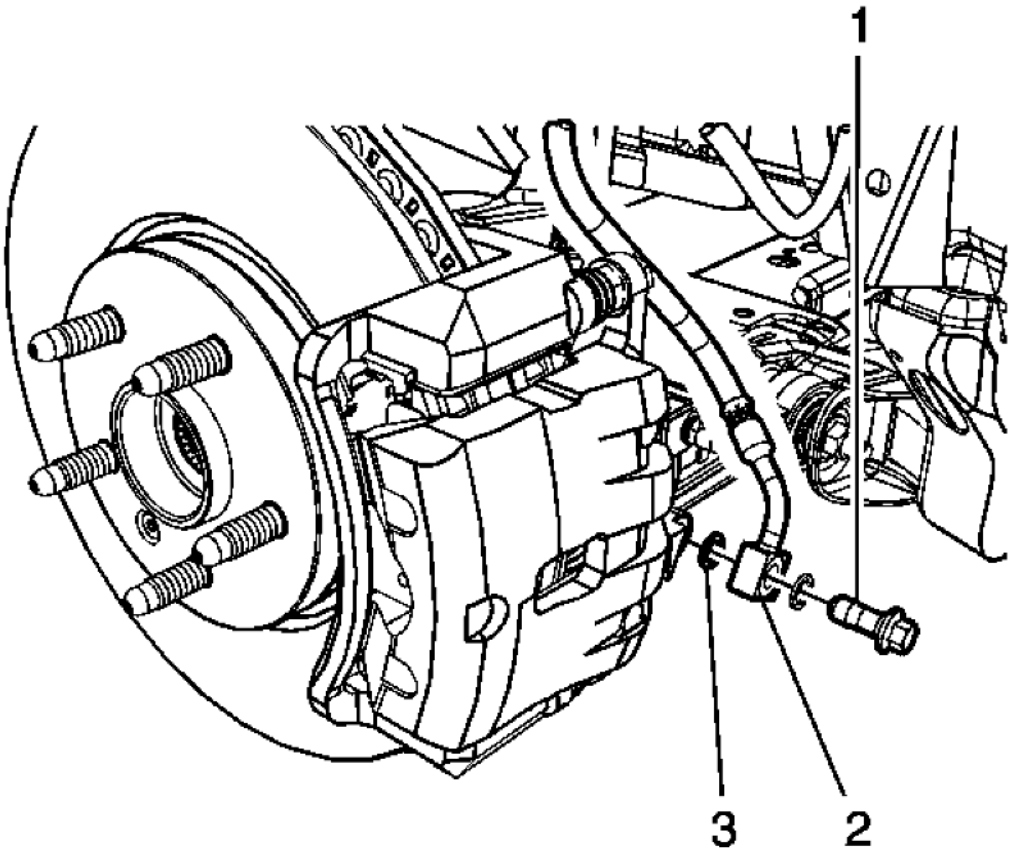


Fig. 41: Brake Hose Components
Courtesy of GENERAL MOTORS CORP.

8. Remove the brake hose fitting bolt (1).
9. Remove the brake hose fitting gaskets (2) and the brake hose (3).
10. Discard the brake hose fitting gaskets.

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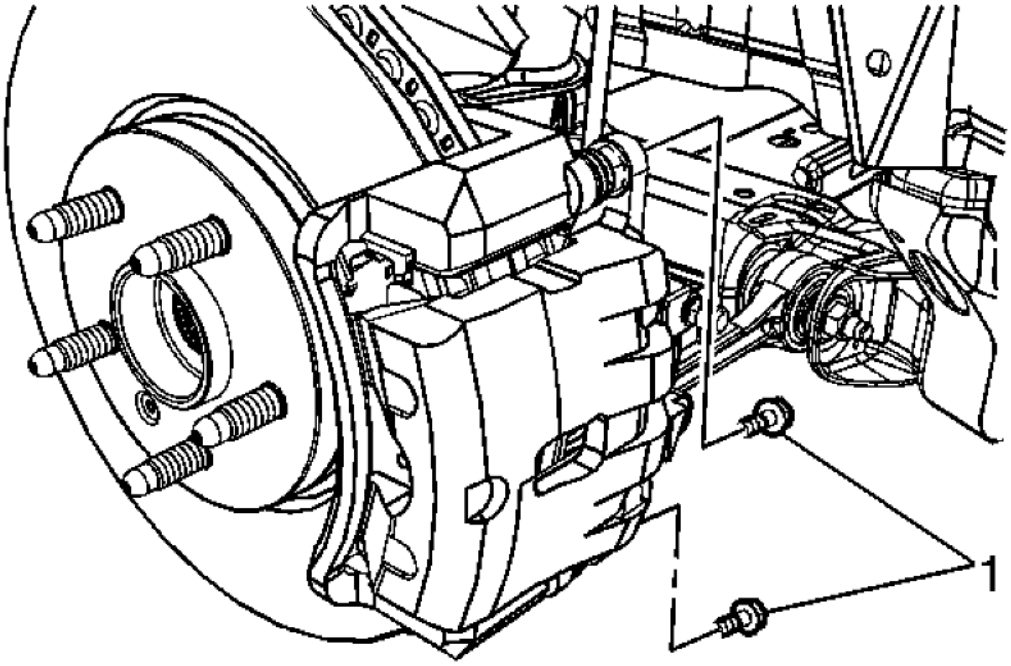


Fig. 42: Brake Caliper Guide Pin Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: The brake caliper guide pin bolts must be replaced any time they are removed. Do not reuse the brake caliper guide pin bolts.

11. Using a backup wrench on the brake caliper guide pin, remove the brake caliper guide pin bolts (1).

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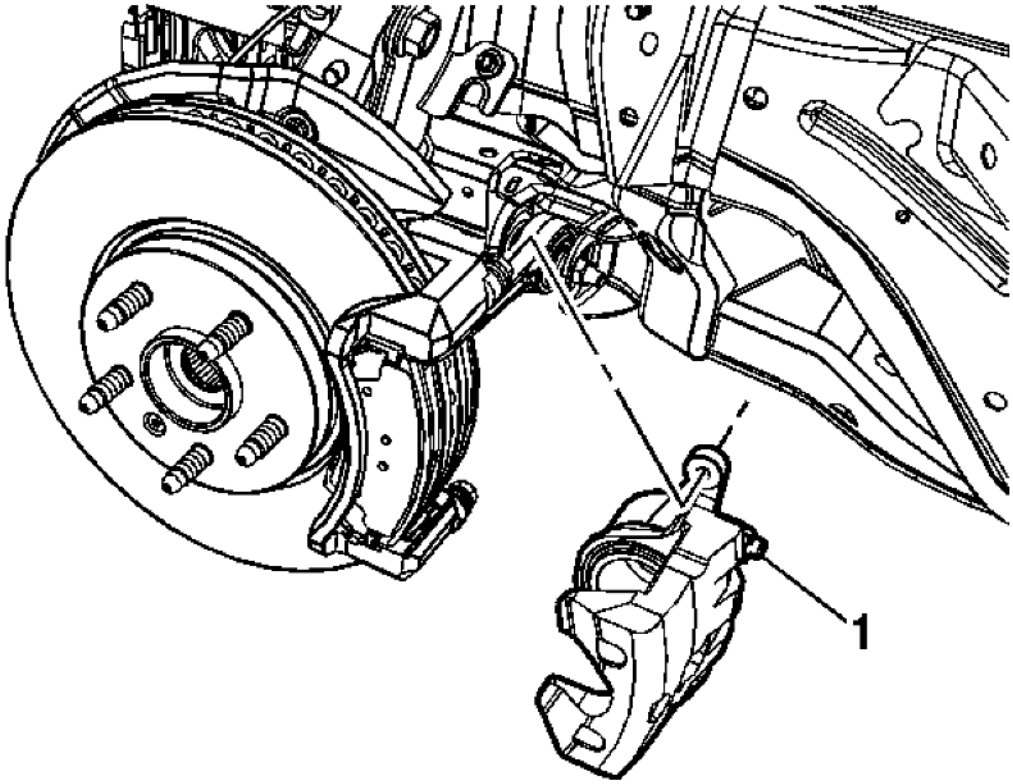


Fig. 43: Brake Caliper
Courtesy of GENERAL MOTORS CORP.

12. Remove the brake caliper (1).

Installation Procedure

1. Inspect the brake caliper guide pins, seals and brake pad springs for damage and/or corrosion. Refer to **Front Disc Brake Mounting and Hardware Inspection**.

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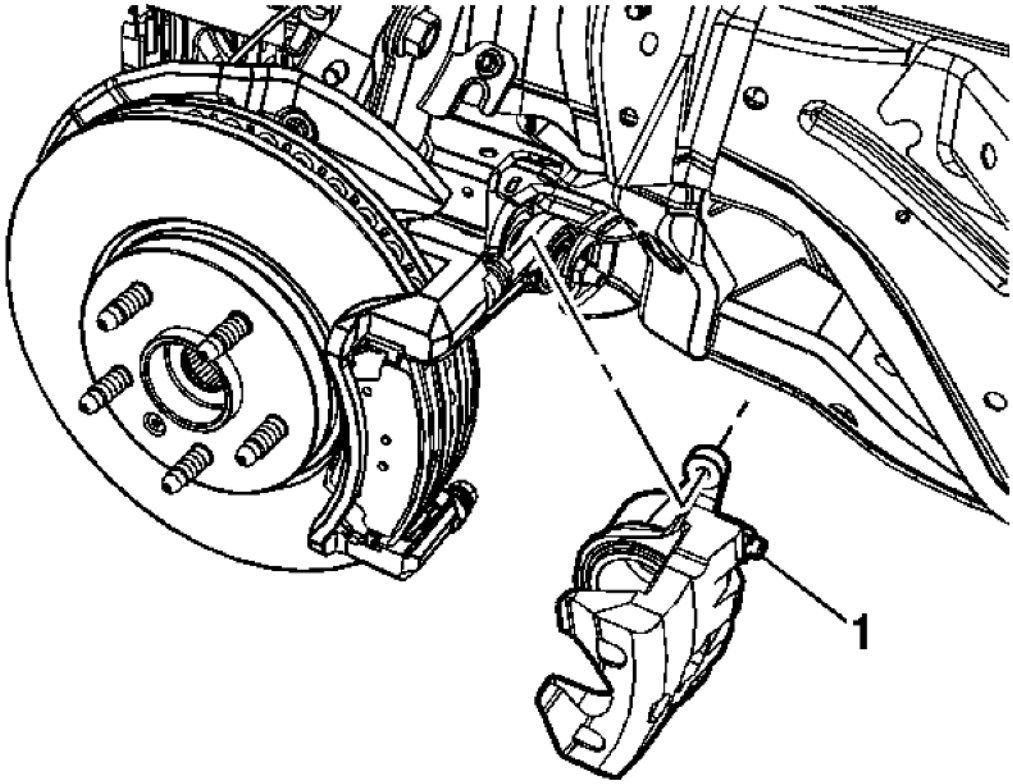


Fig. 44: Brake Caliper
Courtesy of GENERAL MOTORS CORP.

2. Install the brake caliper (1).

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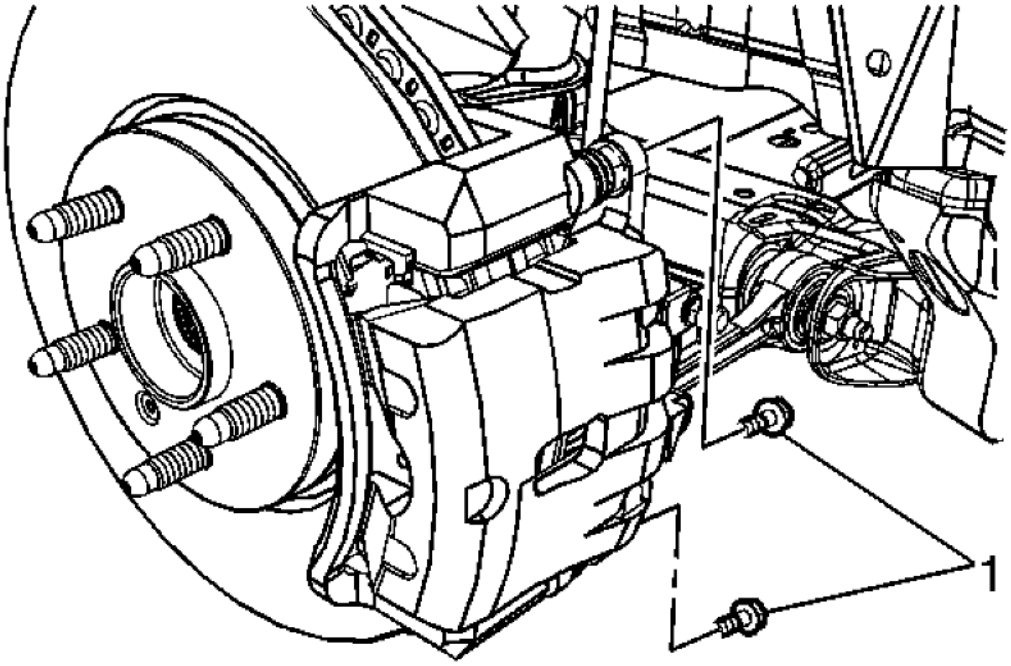


Fig. 45: Brake Caliper Guide Pin Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

NOTE: The brake caliper guide pin bolts must be replaced any time they are removed.

3. Using a backup wrench on the brake caliper guide pin, install 2 new brake caliper guide pin bolts (1) and tighten to 27 N.m (20 lb ft).

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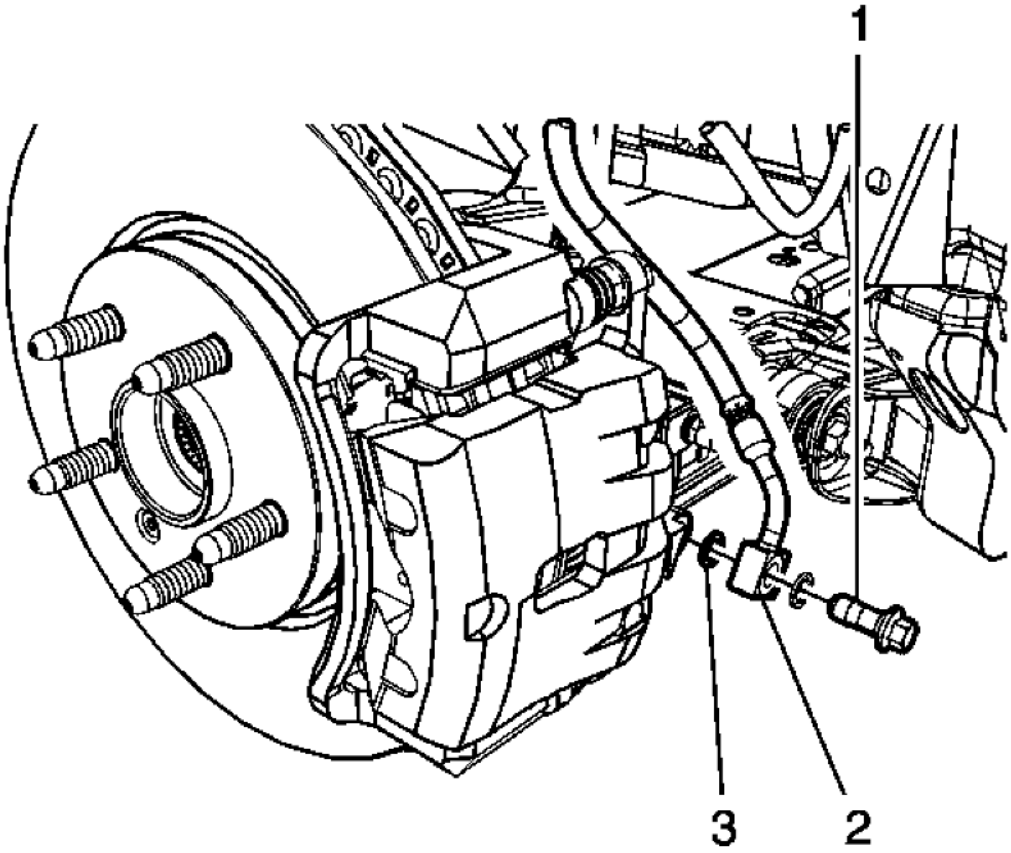


Fig. 46: Brake Hose Components
Courtesy of GENERAL MOTORS CORP.

4. Assemble the brake hose fitting bolt (1) and 2 new brake hose fitting gaskets (2) to the brake hose (3) and tighten the fitting bolt to 40 N.m (30 lb ft).
5. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)** .
6. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
7. With the engine OFF, gradually apply the brake pedal to approximately 2/3 of its travel distance.
8. Slowly release the brake pedal.
9. Wait 15 seconds, then repeat steps 7-8 until a firm brake pedal apply is obtained. This will properly seat the brake caliper pistons and brake pads.
10. Fill the brake master cylinder reservoir to the proper level. Refer to **Master Cylinder Reservoir Filling** .

FRONT BRAKE CALIPER REPLACEMENT (L99, LS3)

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Removal Procedure

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

1. Inspect the fluid level in the brake master cylinder reservoir.
2. If the brake fluid level is midway between the maximum-full point and the minimum allowable level, no brake fluid needs to be removed from the reservoir before proceeding.
3. If the brake fluid level is higher than midway between the maximum-full point and the minimum allowable level, remove brake fluid to the midway point before proceeding.
4. Remove the front disc brake pads. Refer to **Front Disc Brake Pads Replacement (LLT)** or **Front Disc Brake Pads Replacement (L99, LS3)**.

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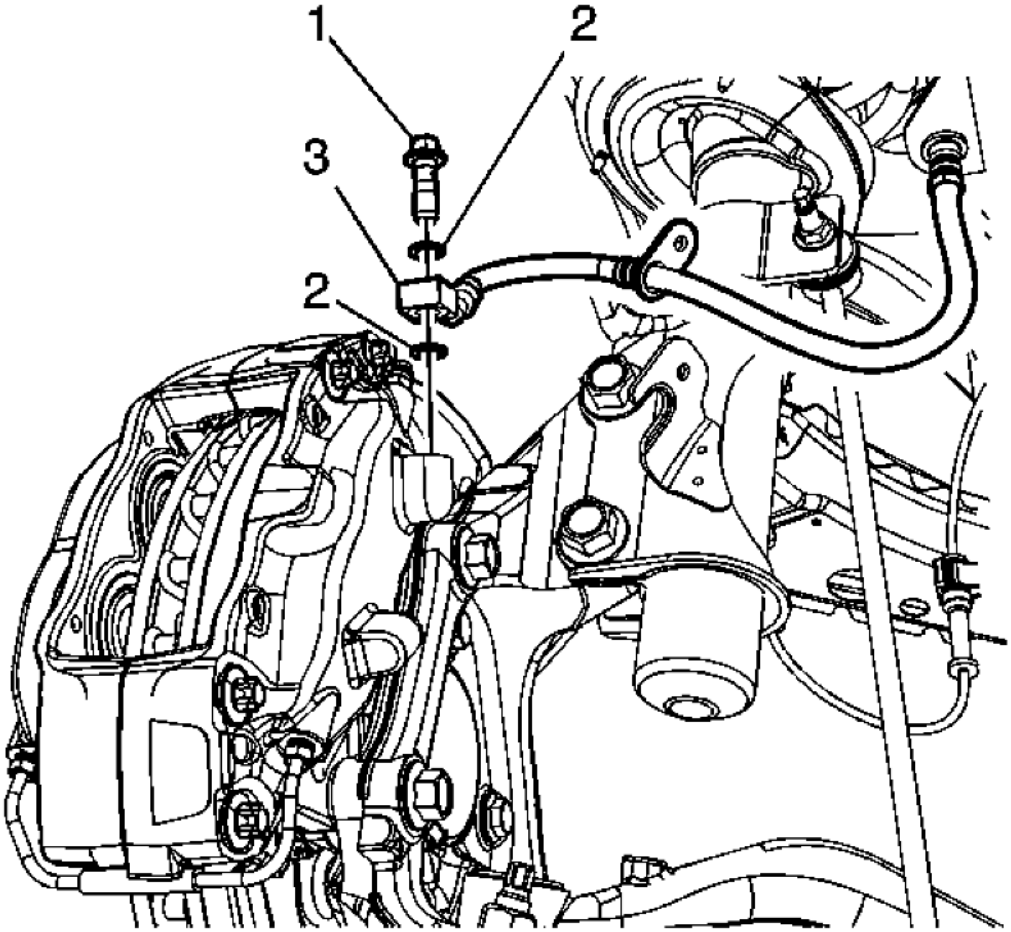


Fig. 47: Brake Hose Components
Courtesy of GENERAL MOTORS CORP.

5. Remove the brake hose fitting bolt (1).
6. Cap the brake caliper inlet port to prevent brake fluid loss and contamination.

NOTE: Do not reuse the brake hose fitting gaskets.

7. Remove and discard the brake hose fitting gaskets (2) from the brake hose (3).
8. Cap the brake hose fitting to prevent brake fluid loss and contamination.

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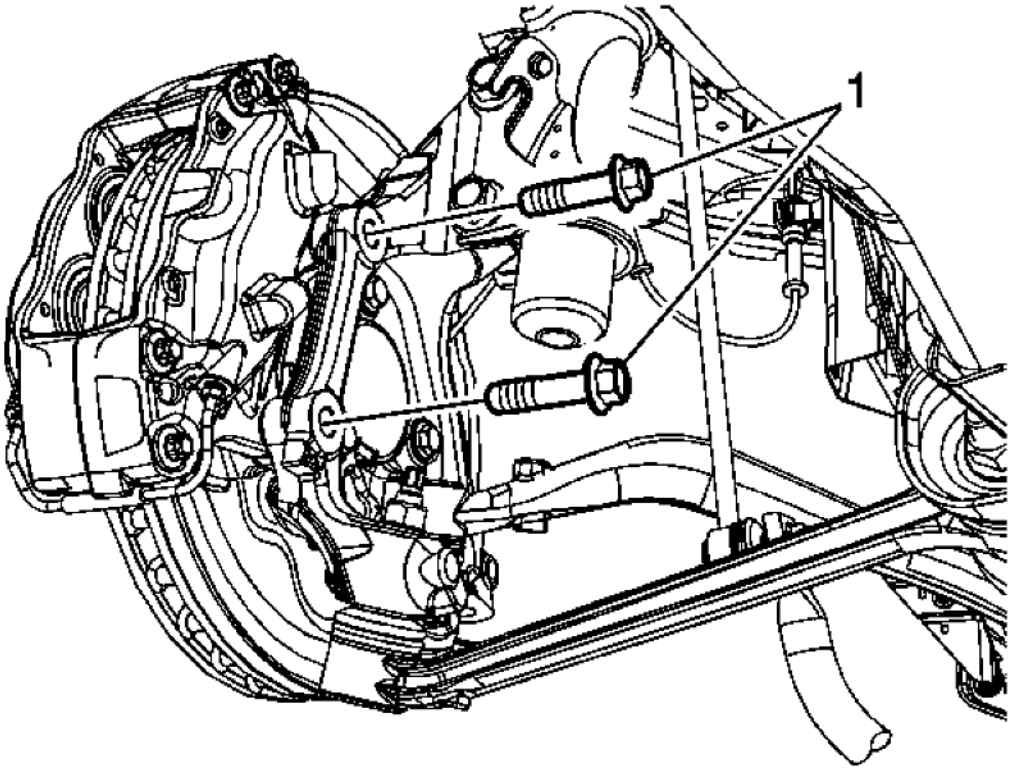


Fig. 48: Brake Caliper Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: The brake caliper bolts must be replaced any time they are removed. Do not reuse the brake caliper bolts.

9. Remove and discard the brake caliper bolts (1).
10. Remove the brake caliper.

Installation Procedure

1. Install the brake caliper to the steering knuckle.

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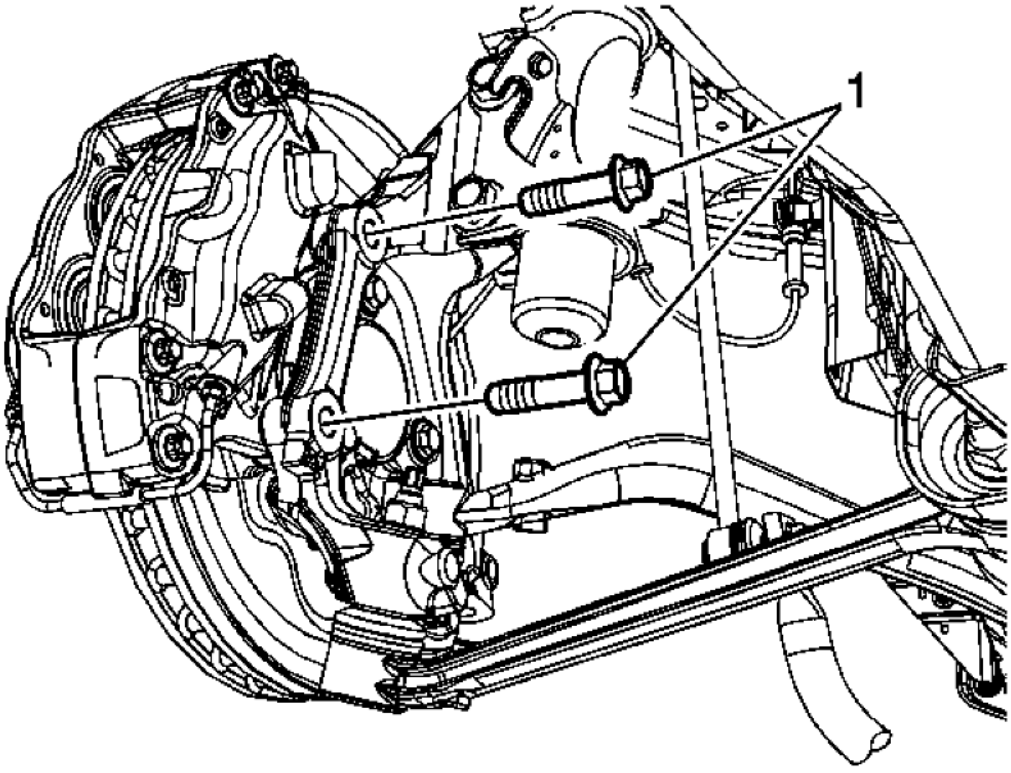


Fig. 49: Brake Caliper Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

NOTE: The brake bolts must be replaced any time they are removed.

2. Install 2 new brake caliper bolts (1) and tighten to 40 N.m (33 lb ft) +90 degrees.

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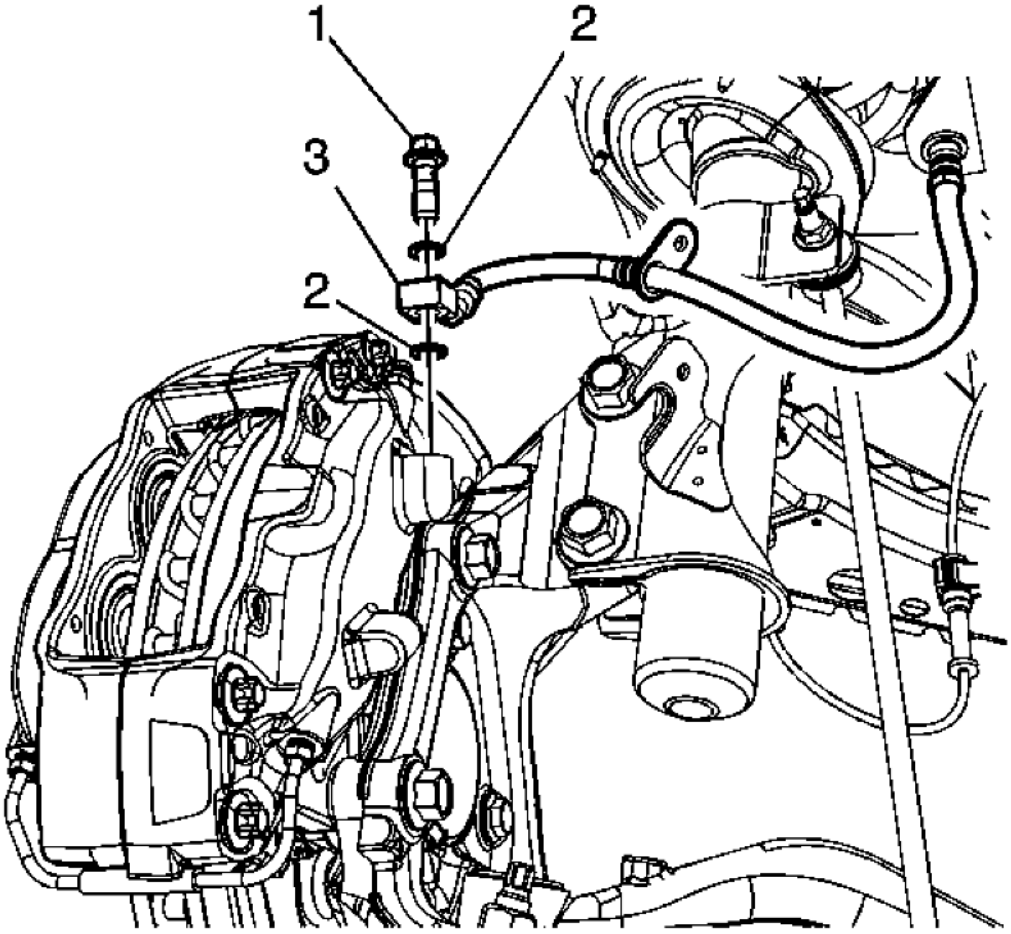


Fig. 50: Brake Hose Components
Courtesy of GENERAL MOTORS CORP.

3. Assemble the brake hose fitting bolt (1) and the 2 new brake hose fitting gaskets (2) to the brake hose (3).
4. Install the brake hose assembly to the brake caliper and tighten the brake hose fitting bolt to 40 N.m (30 lb ft).
5. Install the brake pads. Refer to **Front Disc Brake Pads Replacement (LLT)** or **Front Disc Brake Pads Replacement (L99, LS3)**.
6. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)** .

REAR BRAKE CALIPER REPLACEMENT (LLT)

Removal Procedure

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WARNING: **Refer to Brake Dust Warning .**

WARNING: **Refer to Brake Fluid Irritant Warning .**

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

1. Inspect the fluid level in the brake master cylinder reservoir.
2. If the brake fluid level is midway between the maximum full point and the minimum allowable level, no brake fluid needs to be removed from the reservoir before proceeding.
3. If the brake fluid level is higher than midway between the maximum full point and the minimum allowable level, remove brake fluid to the midway point before proceeding.
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
5. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
6. Install a C-clamp against the outer brake pad and the rear of the brake caliper body.
7. Slowly tighten the C-clamp until the brake caliper piston is compressed into the brake caliper bore.

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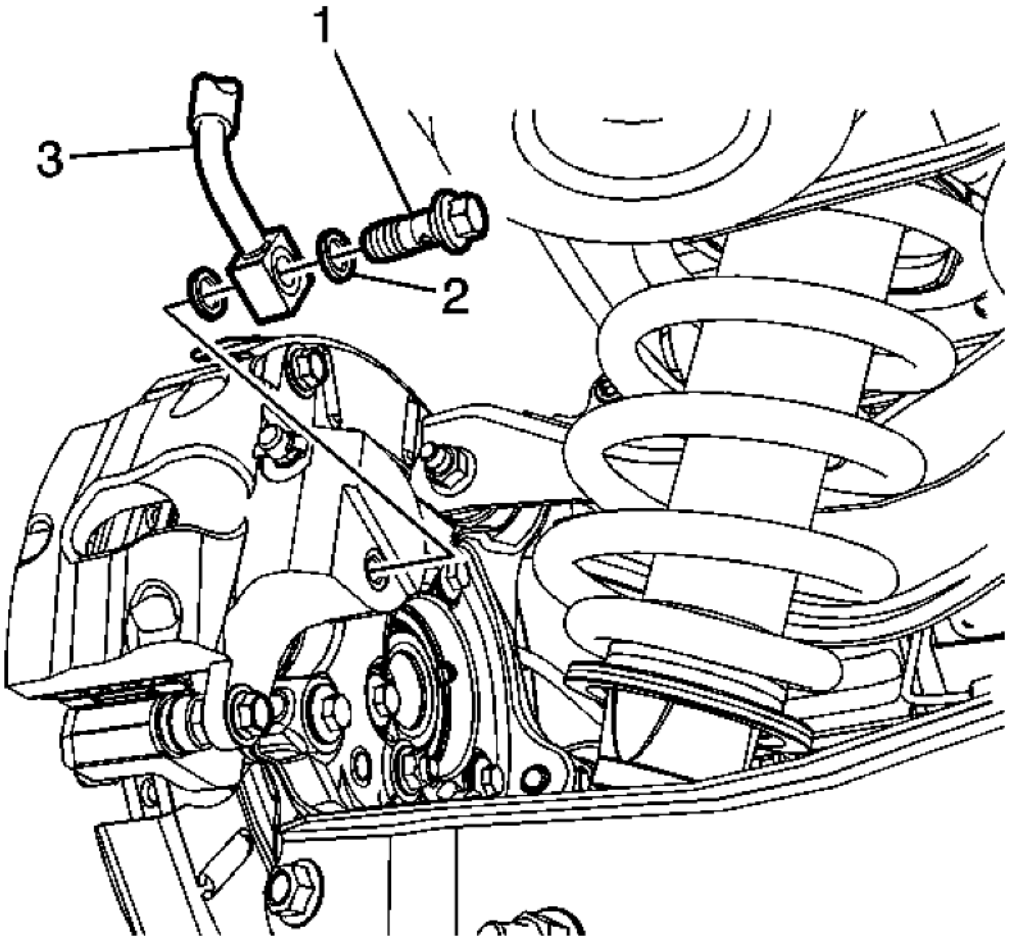


Fig. 51: Brake Hose Components
Courtesy of GENERAL MOTORS CORP.

8. Remove the brake hose fitting bolt (1).
9. Remove the brake hose fitting gaskets (2) and the brake hose (3).
10. Discard the brake hose fittng gaskets.

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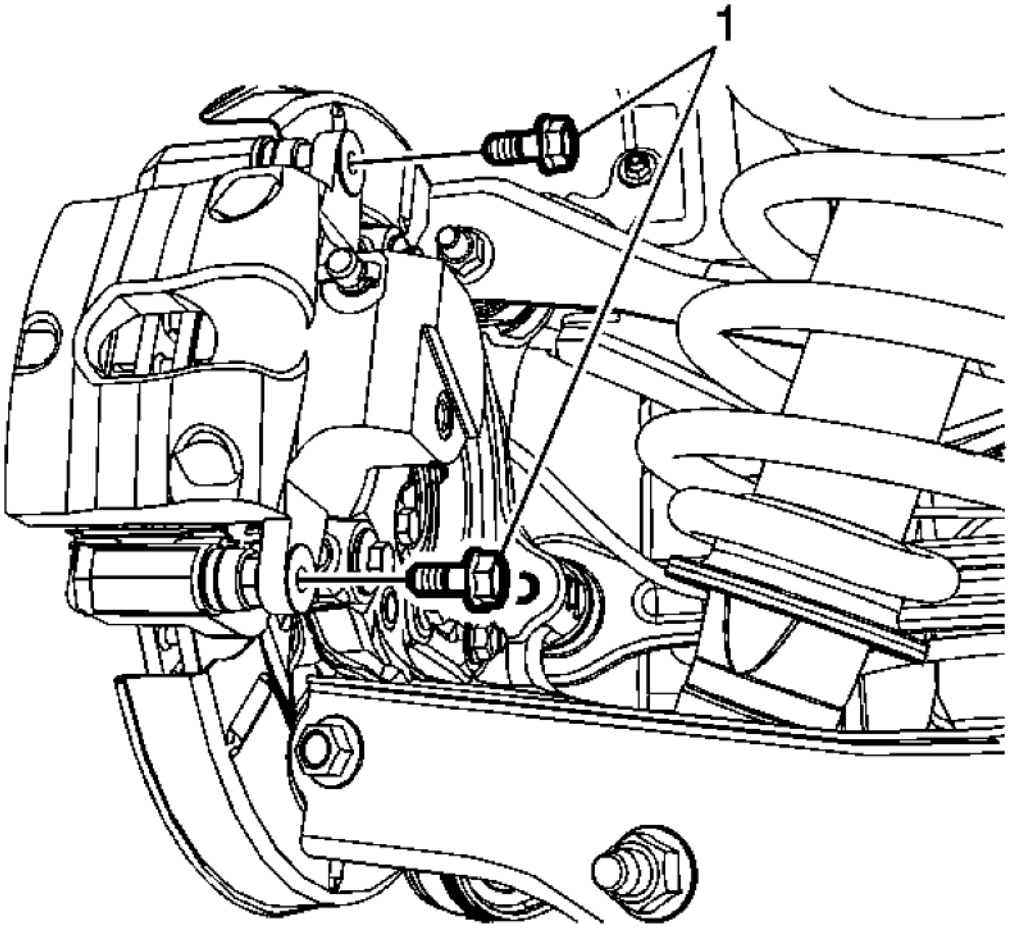


Fig. 52: Brake Caliper Guide Pin Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: The brake caliper guide pin bolts must be replaced any time they are removed. Do not reuse the brake caliper guide pin bolts.

11. Using a backup wrench on the brake caliper guide pin, remove the brake caliper guide pin bolts (1).

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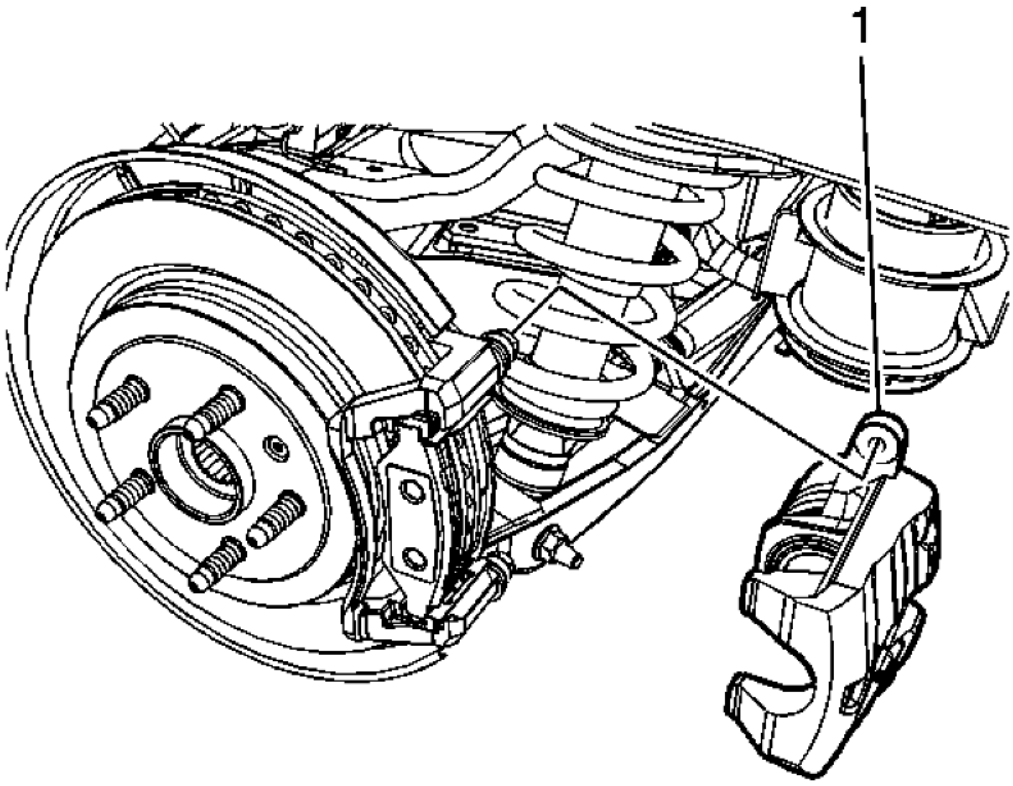


Fig. 53: Brake Caliper
Courtesy of GENERAL MOTORS CORP.

12. Remove the brake caliper (1).

Installation Procedure

1. Inspect the brake caliper guide pins, seals and brake pad springs for damage and/or corrosion. Refer to **Rear Disc Brake Mounting and Hardware Inspection**.

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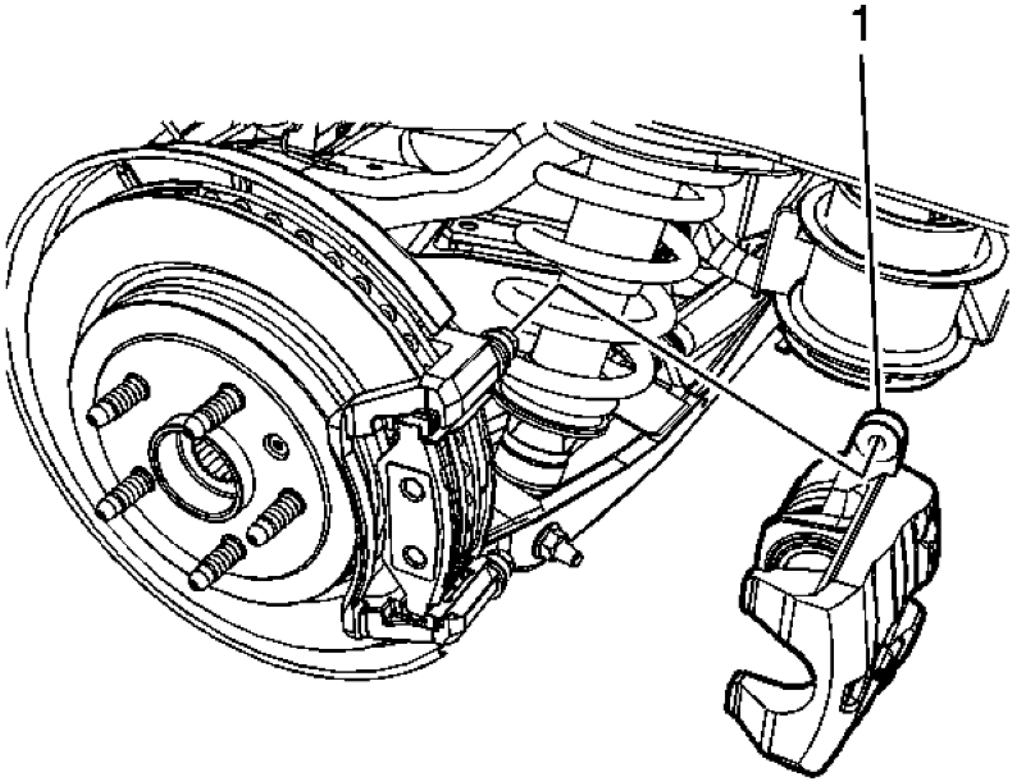


Fig. 54: Brake Caliper
Courtesy of GENERAL MOTORS CORP.

2. Install the brake caliper (1).

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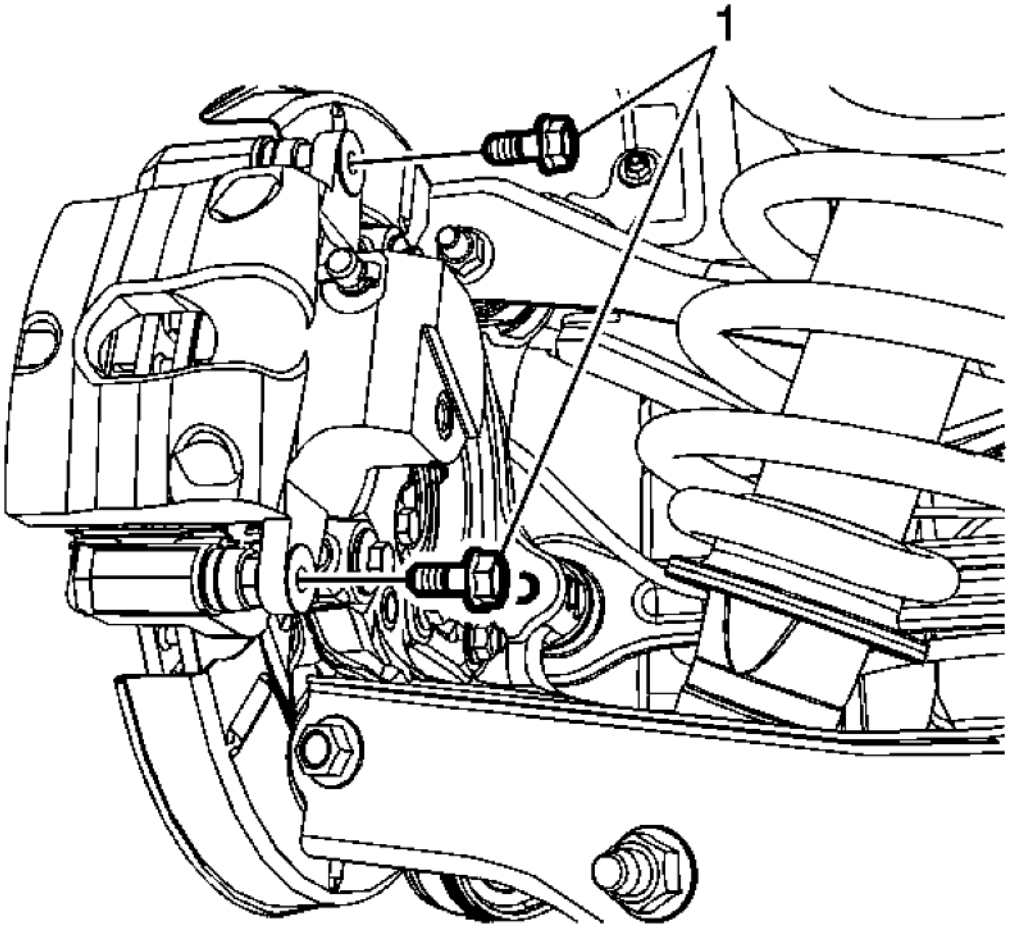


Fig. 55: Brake Caliper Guide Pin Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

NOTE: The brake caliper guide pin bolts must be replaced any time they are removed.

3. Using a backup wrench on the brake caliper guide pin, install the brake caliper guide pin bolts (1) and tighten to 27 N.m (20 lb ft).

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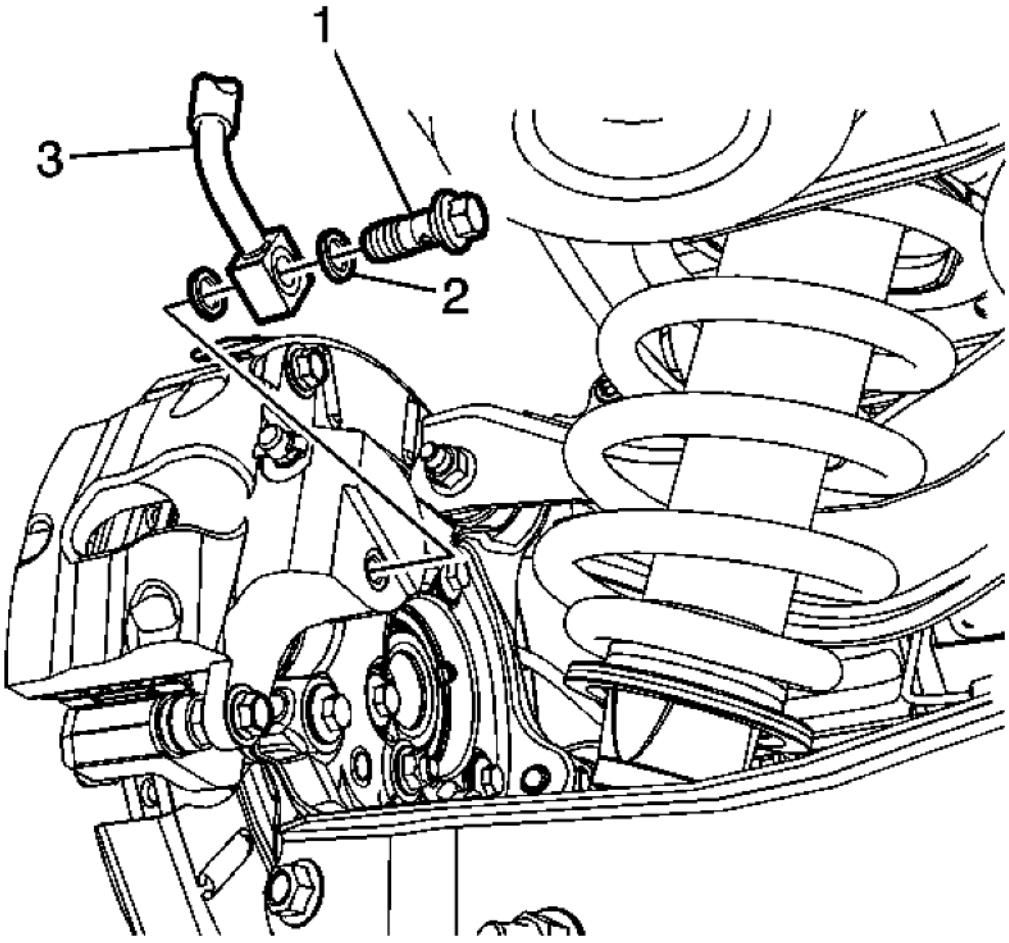


Fig. 56: Brake Hose Components
Courtesy of GENERAL MOTORS CORP.

4. Assemble the brake hose fitting bolt (1) and 2 new brake hose fitting gaskets (2) to the brake hose (3) and tighten the fitting bolt to 40 N.m (30 lb ft).
5. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)** .
6. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
7. With the engine OFF, gradually apply the brake pedal to approximately 2/3 of its travel distance.
8. Slowly release the brake pedal.
9. Wait 15 seconds, then repeat steps 7-8 until a firm brake pedal apply is obtained. This will properly seat the brake caliper pistons and brake pads.
10. Fill the brake master cylinder reservoir to the proper level. Refer to **Master Cylinder Reservoir Filling** .

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REAR BRAKE CALIPER REPLACEMENT (L99, LS3)

Removal Procedure

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

1. Inspect the fluid level in the brake master cylinder reservoir.
2. If the brake fluid level is midway between the maximum-full point and the minimum allowable level, no brake fluid needs to be removed from the reservoir before proceeding.
3. If the brake fluid level is higher than midway between the maximum-full point and the minimum allowable level, remove brake fluid to the midway point before proceeding.
4. Remove the rear disc brake pads. Refer to **Rear Disc Brake Pads Replacement (LLT)** or **Rear Disc Brake Pads Replacement (L99, LS3)**.

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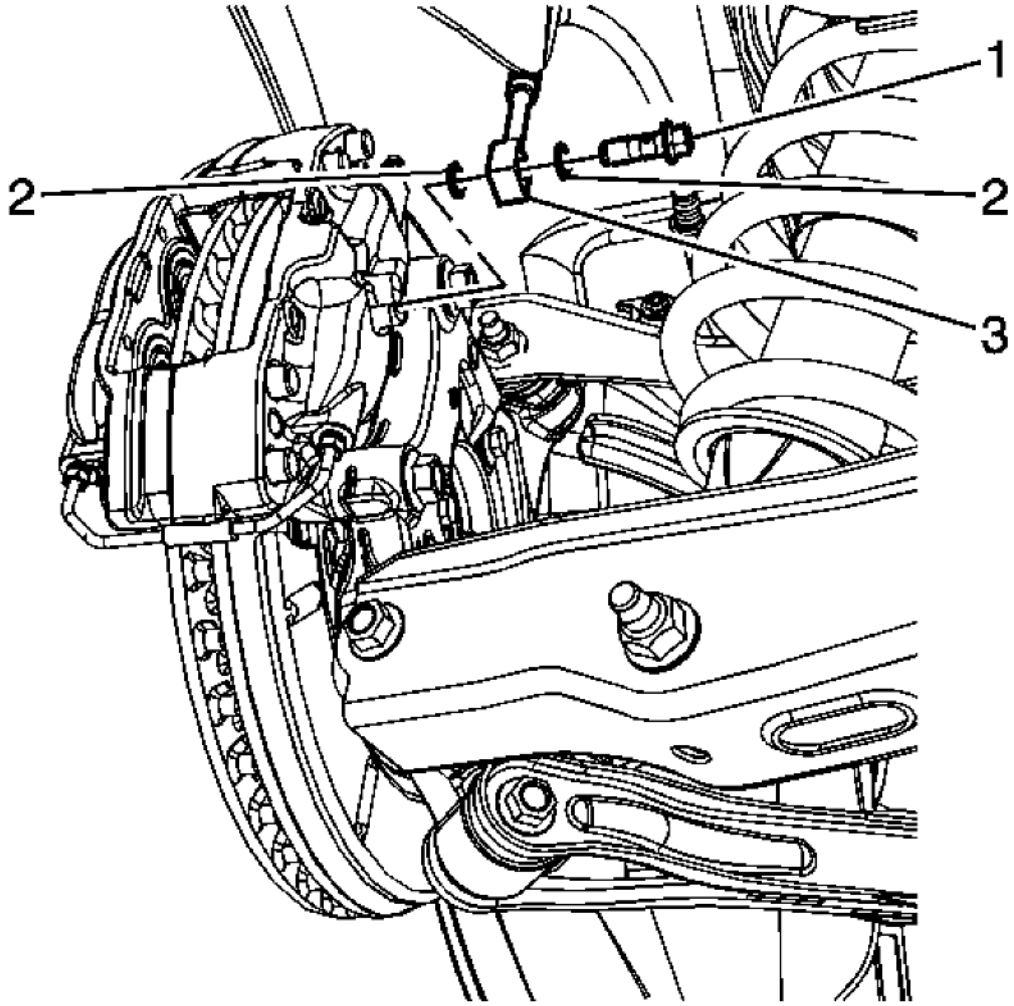


Fig. 57: Brake Hose Components
Courtesy of GENERAL MOTORS CORP.

5. Remove the brake hose fitting bolt (1).
6. Cap the brake caliper inlet port to prevent brake fluid loss and contamination.

NOTE: Do not reuse the brake hose fitting gaskets.

7. Remove and discard the brake hose fitting gaskets (2) from the brake hose (3).
8. Cap the brake hose fitting to prevent brake fluid loss and contamination.

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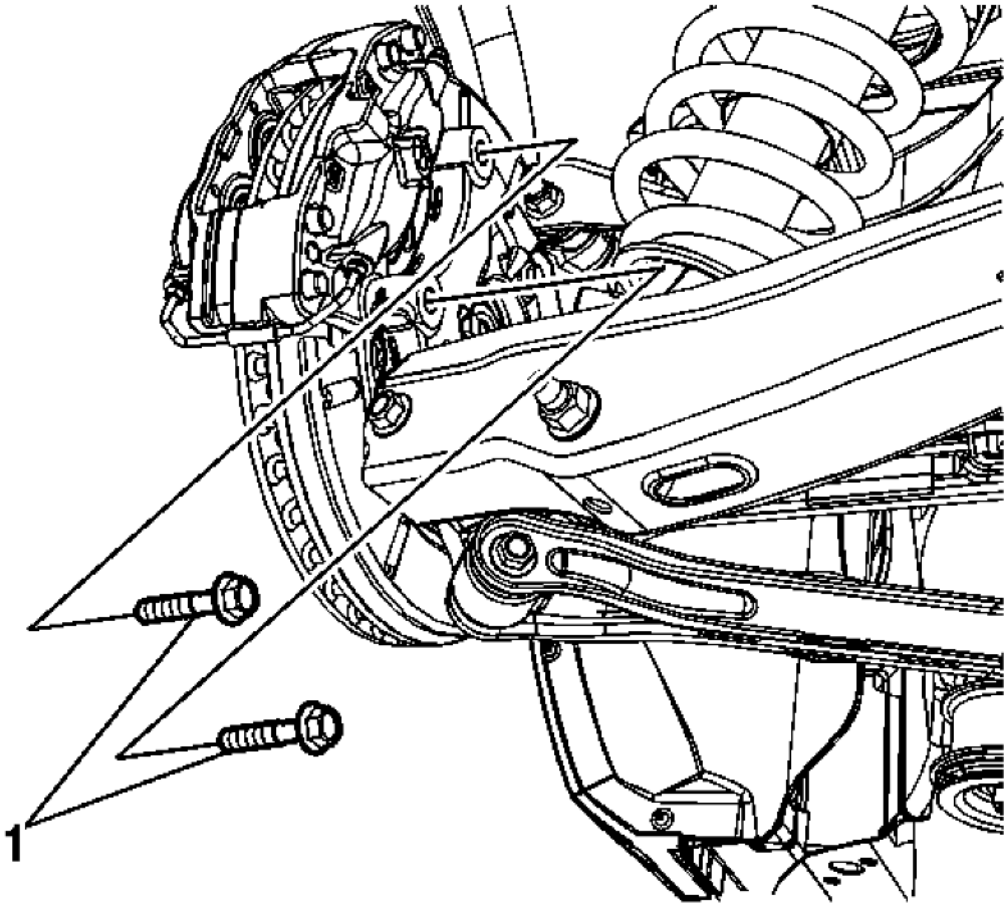


Fig. 58: Brake Caliper Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: The brake caliper bolts must be replaced any time they are removed. Do not reuse the brake caliper bolts.

9. Remove and discard the brake caliper bolts (1).

Installation Procedure

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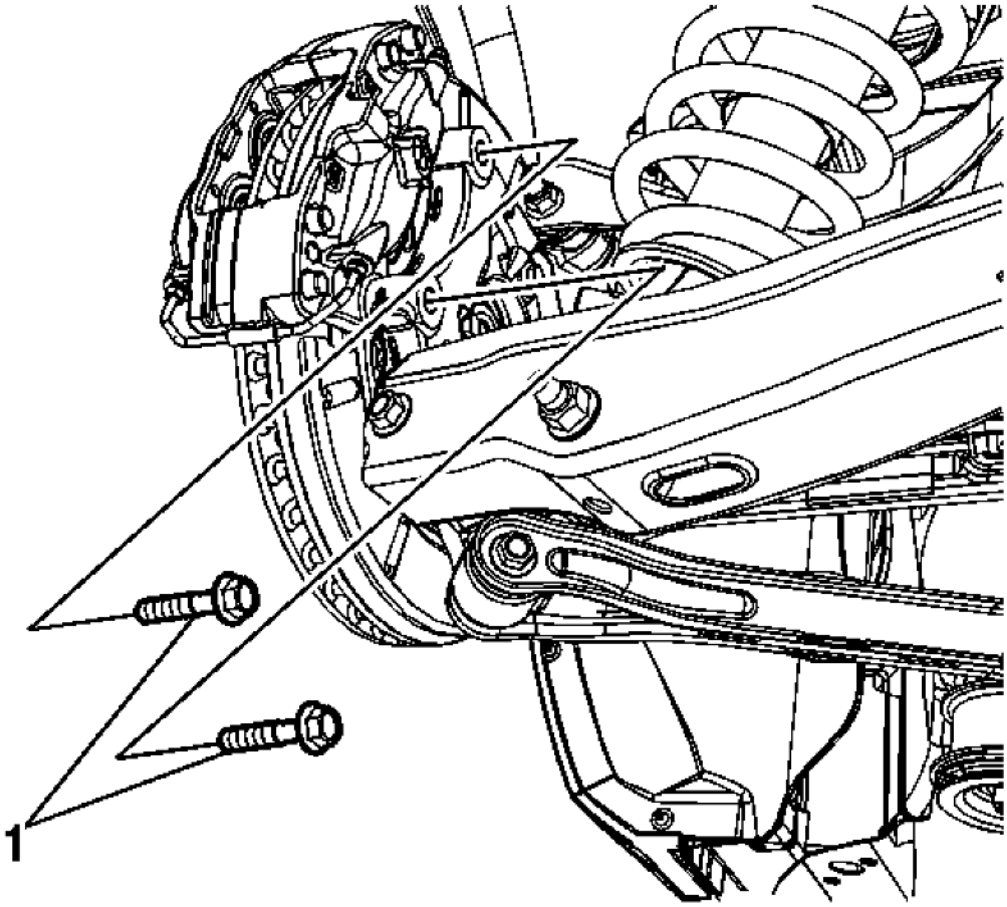


Fig. 59: Brake Caliper Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the brake caliper to the suspension knuckle.

NOTE: The brake caliper bolts must be replaced any time they are removed.

2. Hand install new brake caliper bolts (1)

CAUTION: Refer to Fastener Caution .

3. Tighten the brake caliper bolts to 40 N.m (30 lb ft) + 90 degrees.

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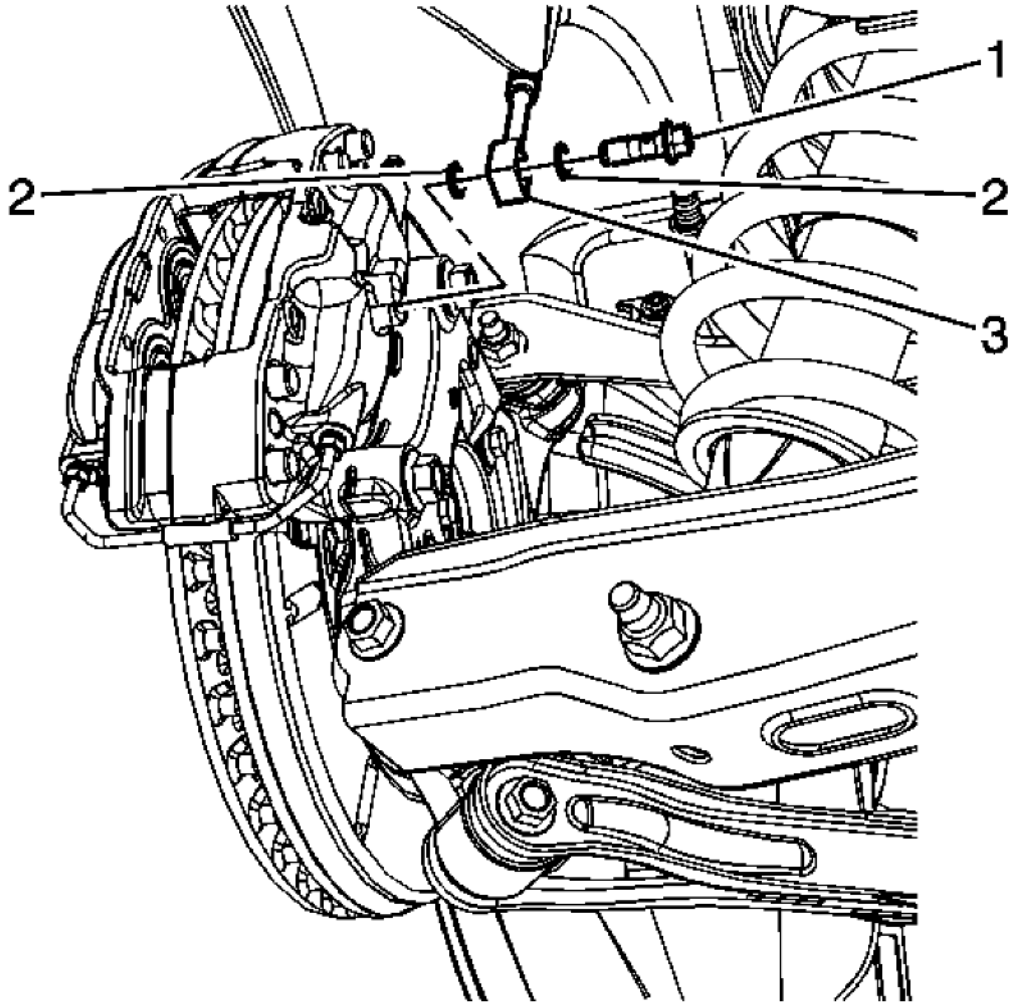


Fig. 60: Brake Hose Components
Courtesy of GENERAL MOTORS CORP.

4. Assemble the brake hose fitting bolt (1) and the 2 new brake hose fitting gaskets (2) to the brake hose (3).
5. Install the brake hose assembly to the brake caliper and tighten the brake hose fitting bolt to 40 N.m (30 lb ft).
6. Install the rear disc brake pads. Refer to **Rear Disc Brake Pads Replacement (LLT)** or **Rear Disc Brake Pads Replacement (L99, LS3)**.
7. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)** .

FRONT BRAKE CALIPER OVERHAUL (LLT)

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WARNING: **Refer to Brake Fluid Irritant Warning .**

WARNING: **Refer to Brake Dust Warning .**

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

Disassembly Procedure

WARNING: **Do not place fingers in front of the caliper piston(s) in an attempt to catch or protect it when applying compressed air. The piston(s) can fly out with force and could result in serious bodily injury.**

NOTE:

- **Replace all the components included in the repair kits used to service this brake caliper.**
- **Lubricate the rubber parts with GM approved brake fluid from a clean, sealed brake fluid container to make assembly easier.**
- **If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.**
- **The torque values specified are for dry, non-lubricated fasteners.**
- **Perform the service operations on a clean bench, free from all mineral oil materials.**

1. Remove the brake caliper from the vehicle. Refer to **Front Brake Caliper Replacement (LLT)** or **Front Brake Caliper Replacement (L99, LS3)**.
2. Drain the brake fluid from the brake caliper.

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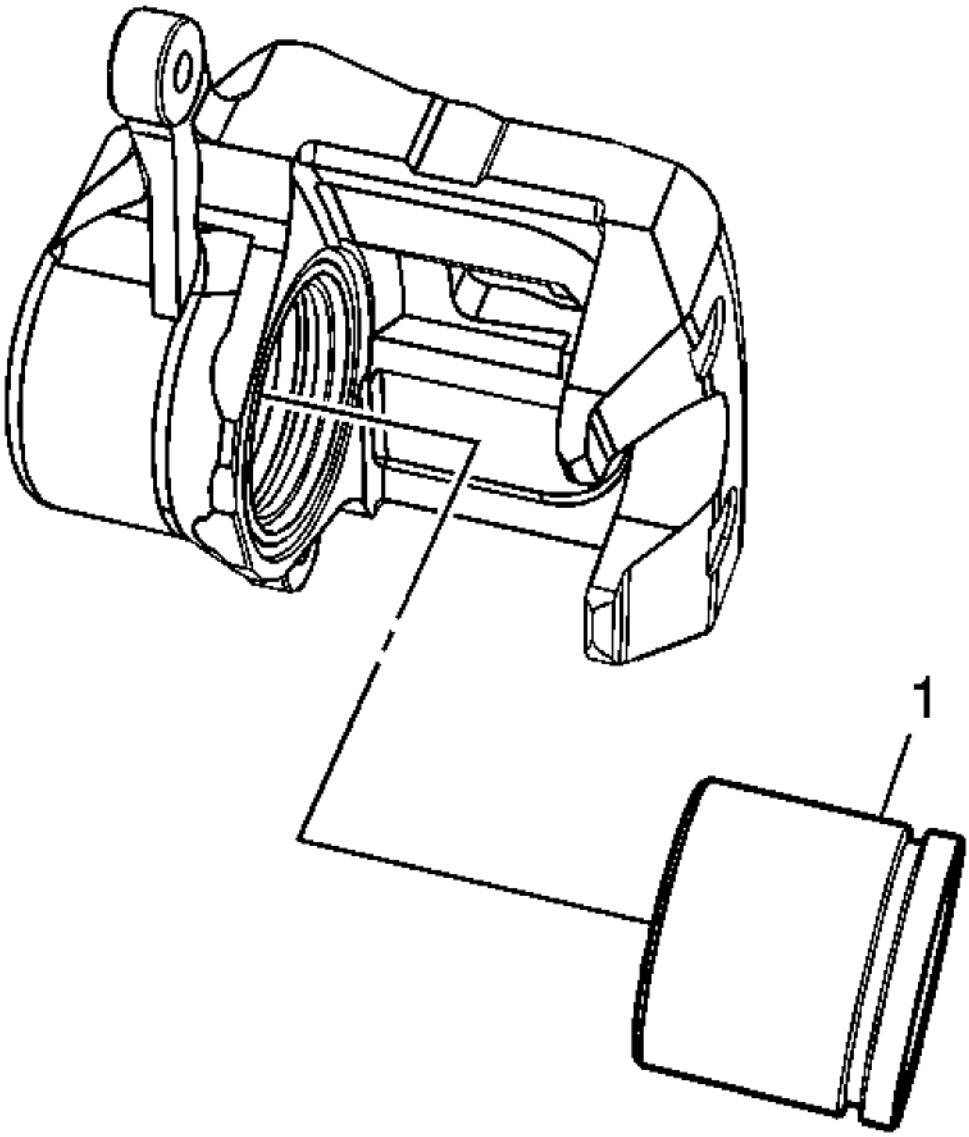


Fig. 61: Brake Caliper Piston
Courtesy of GENERAL MOTORS CORP.

CAUTION: Use clean cloths to pad interior of caliper housing during piston removal. Use just enough air to ease the pistons out of the bores. If the pistons are blown out, even with the padding provided, it may be damaged.

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3. Place a 25 mm (1 in) block of wood between the caliper housing and the piston.
4. Install a large C-clamp over the body of the brake caliper with the C-clamp ends against the rear of the caliper body and against the block of wood.
5. Carefully remove the brake caliper piston (1) by directing low pressure compressed air into the brake caliper inlet hole.
6. Remove the C-clamp from the caliper.
7. Remove the block of wood from the caliper.

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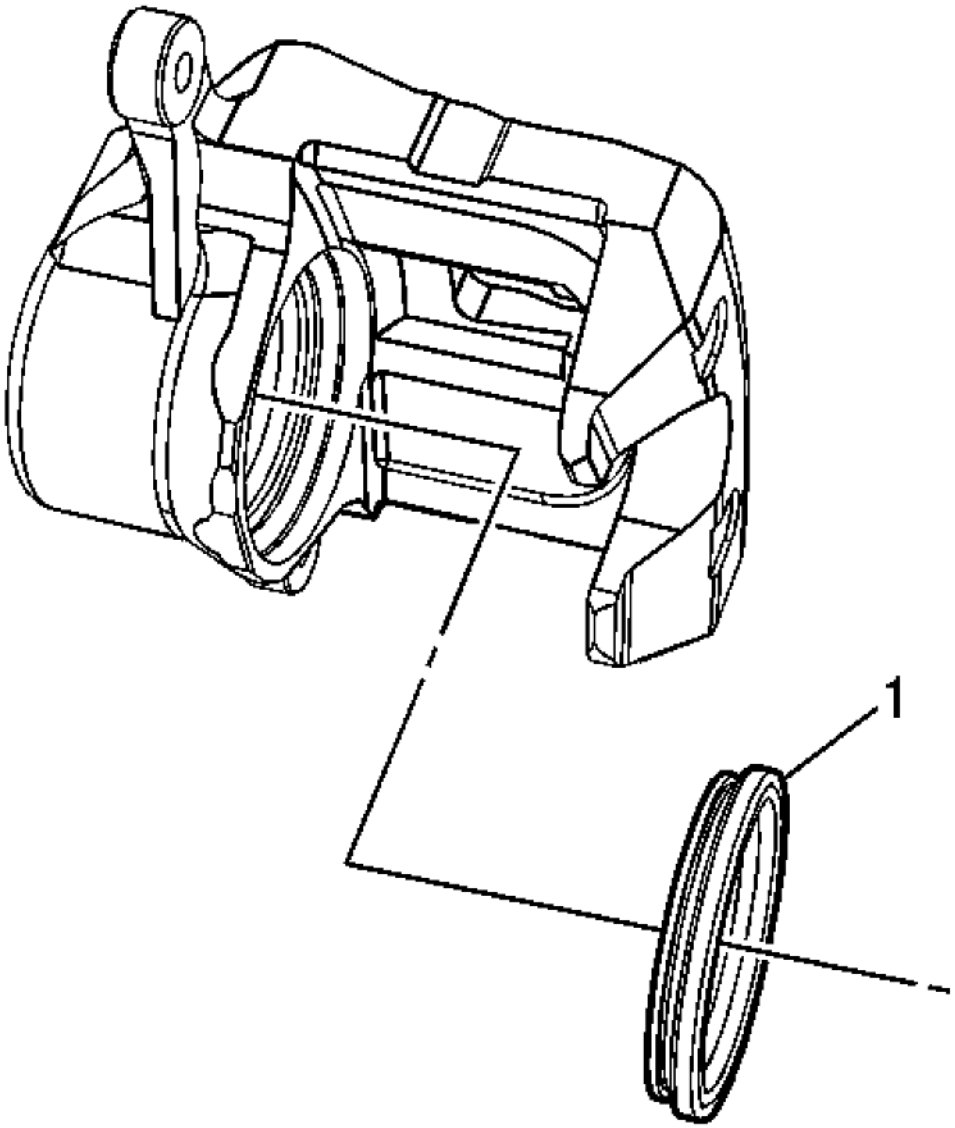


Fig. 62: Piston Dust Boot Seal
Courtesy of GENERAL MOTORS CORP.

8. Remove the piston dust boot seal (1) from the seal counterbore in the brake caliper and discard the dust boot seal.

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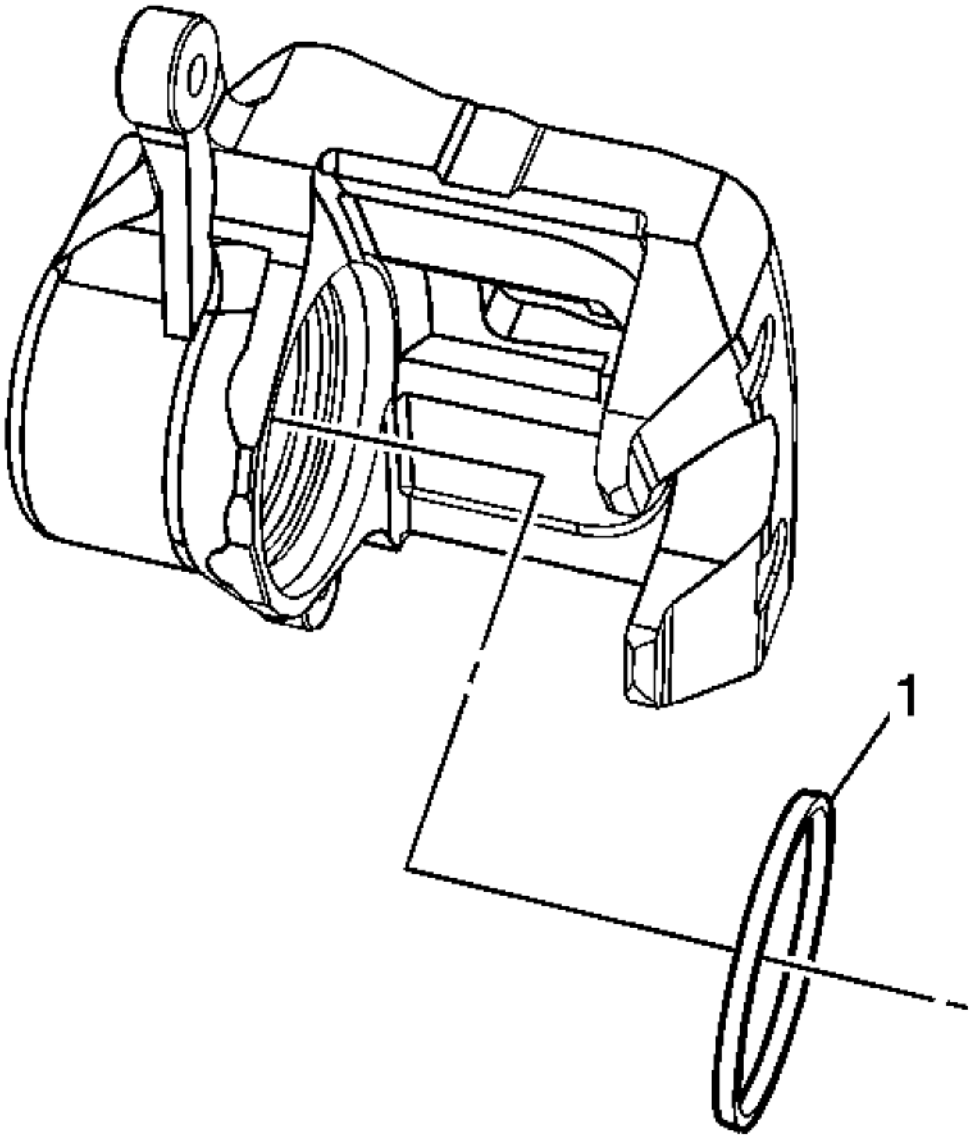


Fig. 63: Piston Seal
Courtesy of GENERAL MOTORS CORP.

9. Using a small wooden or plastic tool, remove the piston seal (1) from the brake caliper bore and discard the piston seal.

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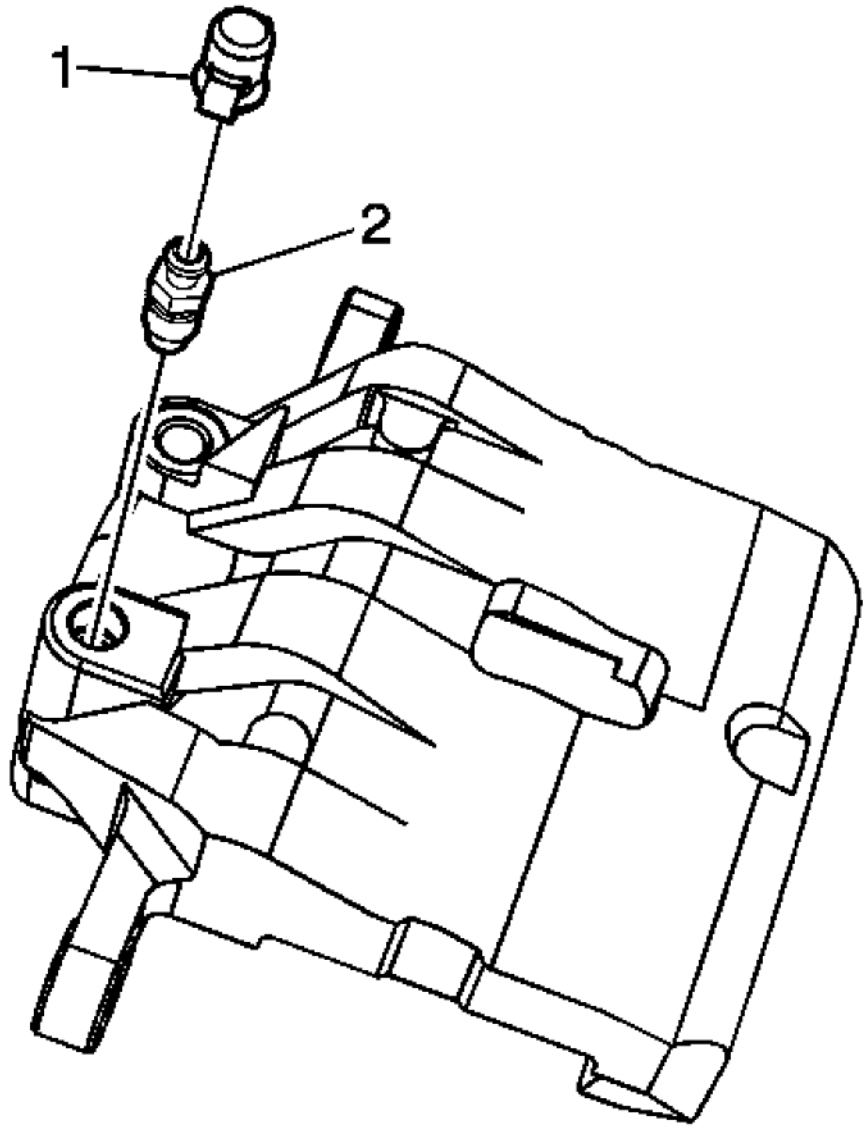


Fig. 64: Brake Caliper Bleeder Valve & Cap
Courtesy of GENERAL MOTORS CORP.

10. Remove the brake caliper bleeder valve cap (1) and bleeder valve (2).

NOTE: Do not use abrasives to clean the brake caliper pistons.

11. Inspect the brake caliper mounting bracket guide surfaces for corrosion and wear. Remove and replace

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the brake caliper mounting bracket if damaged or worn.

12. Clean the brake caliper piston bores and seal counterbore with denatured alcohol, or equivalent.
13. Clean the brake caliper piston with denatured alcohol, or equivalent.
14. Dry the caliper piston bore and counterbore with non-lubricated, filtered air.
15. Dry the brake caliper piston with non-lubricated, filtered air.
16. Inspect the caliper bore for cracks, scoring, pitting, excessive corrosion.
17. If light corrosion is present in the caliper bore, attempt to remove the imperfection with a fine emery paper. If the imperfection cannot be removed, replace the caliper assembly.
18. If cracks, scoring, pitting, and excessive corrosion are present in the caliper bore, replace the caliper assembly.
19. Inspect the caliper piston for cracks, scoring, and/or damage. Replace the caliper piston if any of these conditions exist.

Assembly Procedure

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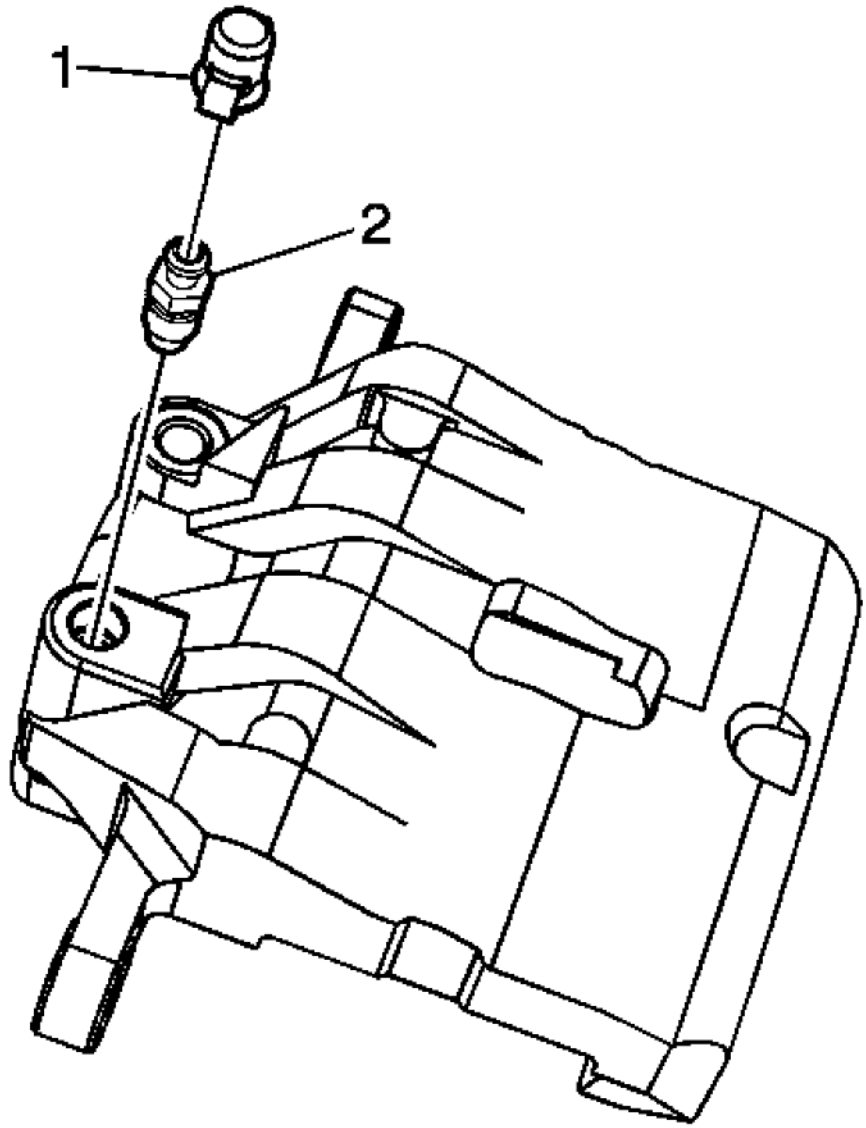


Fig. 65: Brake Caliper Bleeder Valve & Cap
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

1. Install the brake caliper bleeder valve (2) and tighten to 10 N.m (89 lb in).

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2. Install the brake caliper bleeder valve cap (1).

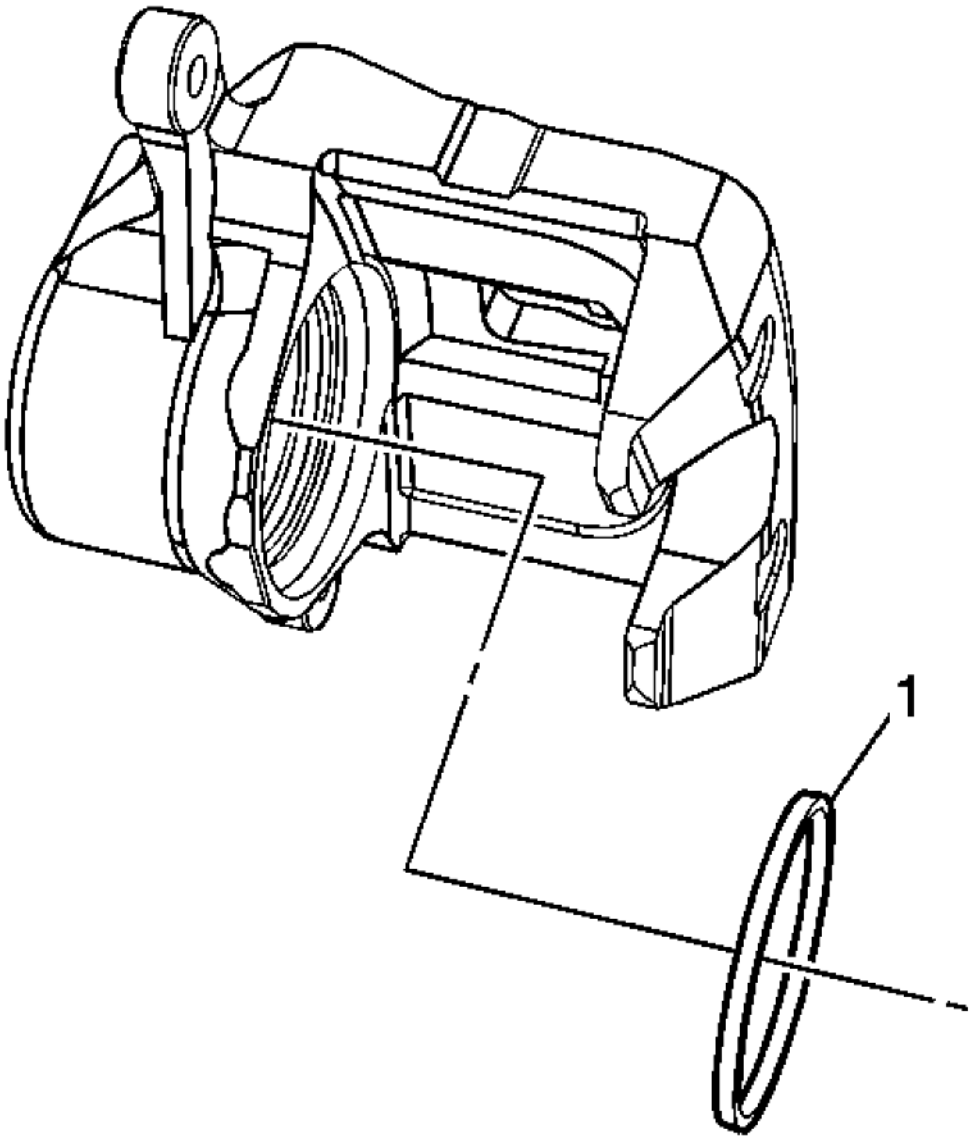


Fig. 66: Piston Seal
Courtesy of GENERAL MOTORS CORP.

3. Lubricate the new piston seal (1) with GM approved brake fluid from a clean, sealed brake fluid container.

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4. Install lubricated piston seal into the brake caliper bore seal groove.

   Ensure the seal is not twisted.

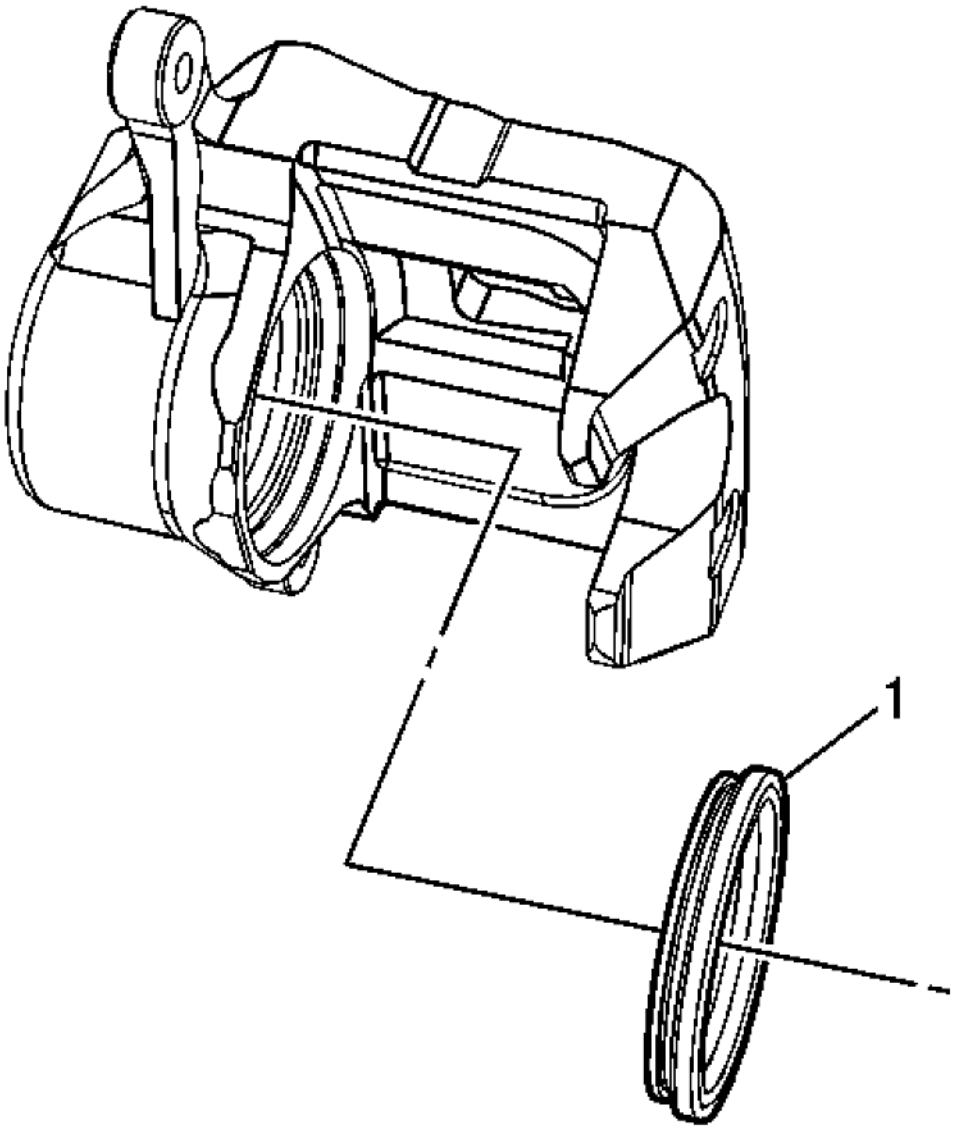


Fig. 67: Piston Dust Boot Seal
Courtesy of GENERAL MOTORS CORP.

5. Install the piston dust boot seal (1) to the caliper.

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Ensure the seal is seated evenly and completely into the groove in the caliper housing.

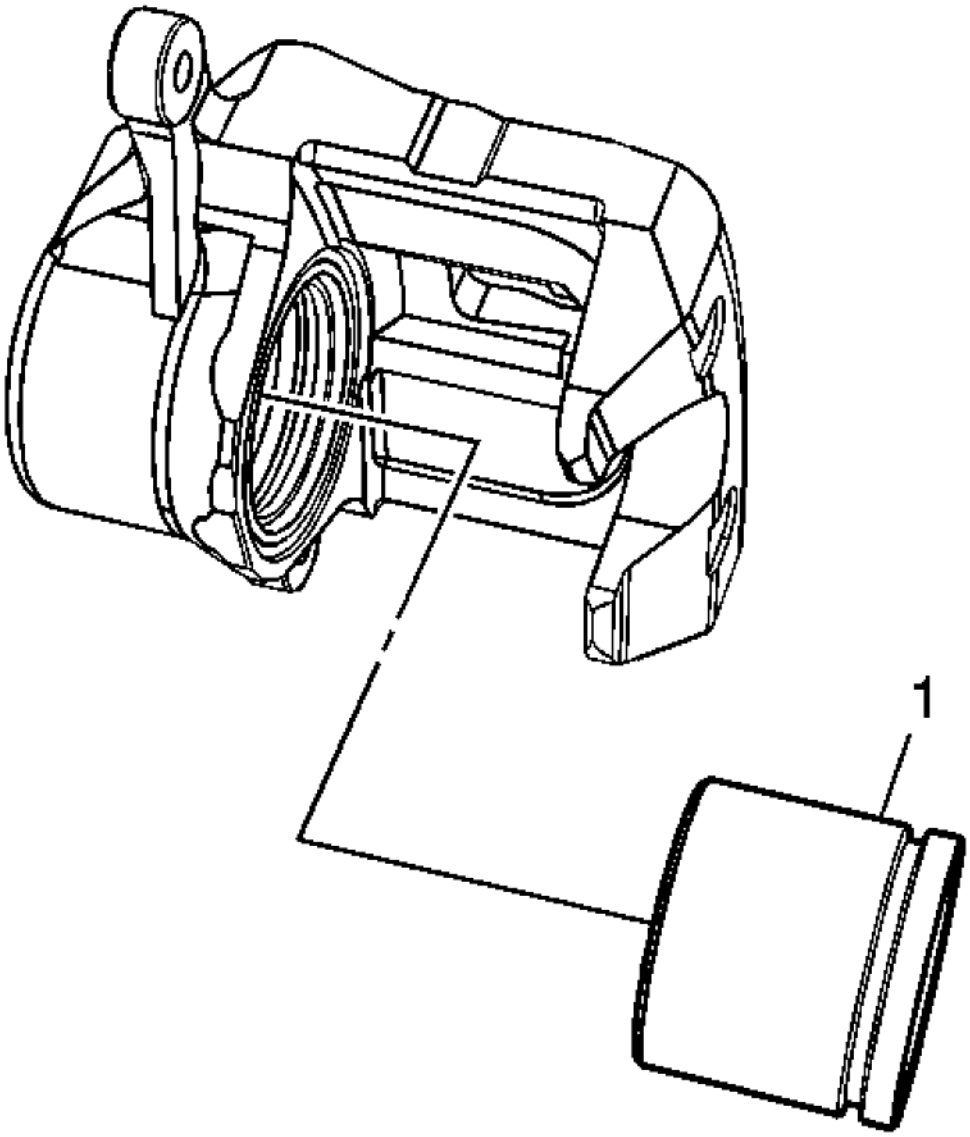


Fig. 68: Brake Caliper Piston
Courtesy of GENERAL MOTORS CORP.

6. Place the caliper piston into the caliper housing by carefully lifting the edge of the dust boot seal.
7. Carefully push the piston (1) squarely into the brake caliper bore.

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8. Ensure the caliper dust boot is properly seated into the piston groove and into the groove in the brake caliper bore.
9. Install the brake caliper to the vehicle. Refer to **Front Brake Caliper Replacement (LLT)** or **Front Brake Caliper Replacement (L99, LS3)**.

FRONT BRAKE CALIPER OVERHAUL (L99, LS3)

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

CAUTION: This brake caliper is coated with a specialized paint. Use care when handling and servicing to ensure the paint does not get chipped or scratched. Clean any brake fluid from painted surfaces with denatured alcohol, or equivalent, as soon as possible.

CAUTION: Do not remove the caliper external crossover tube or separate the 2 caliper halves. If the crossover tube and/or the caliper halves are separated, corrosion and damage to the caliper may result.

NOTE:

- **Replace all the components included in the repair kits used to service this brake caliper.**
- **Lubricate the rubber parts with GM approved brake fluid from a clean, sealed brake fluid container.**
- **If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.**
- **The torque values specified are for dry, non-lubricated fasteners.**
- **Perform the service operations on a clean bench, free from all mineral oil materials.**

Disassembly Procedure

WARNING: Do not place fingers in front of the caliper piston(s) in an attempt to catch or protect it when applying compressed air. The piston(s) can fly out with force and could result in serious bodily injury.

CAUTION: Use clean cloths to pad interior of caliper housing during piston removal. Use just enough air to ease the pistons out of the bores. If the pistons are blown out, even with the padding provided, it may be damaged.

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NOTE: **It will be necessary to fabricate one or more blocks of wood to the following dimensions to be used during this procedure:**

- **Must fabricate 1 block: 19 mm (3/4 in) X 51 mm (2 in) X 51 mm (2 in)**
- **Optional to fabricate 1 block, rather than using an old brake pad: 19 mm (3/4 in) X 51 mm (2 in) X 127 mm (5 in)**
- **Optional to fabricate 1 block to cushion piston removal: 19 mm (3/4 in) X 51 mm (2 in) X 127 mm (5 in)**

1. Remove the brake caliper from the vehicle. Refer to **Front Brake Caliper Replacement (LLT)** or **Front Brake Caliper Replacement (L99, LS3)**.
2. Drain the brake fluid from the brake caliper.
3. Place the caliper in a vise using plastic vise caps or suitable material to protect the caliper mounting bosses from the vise jaws.

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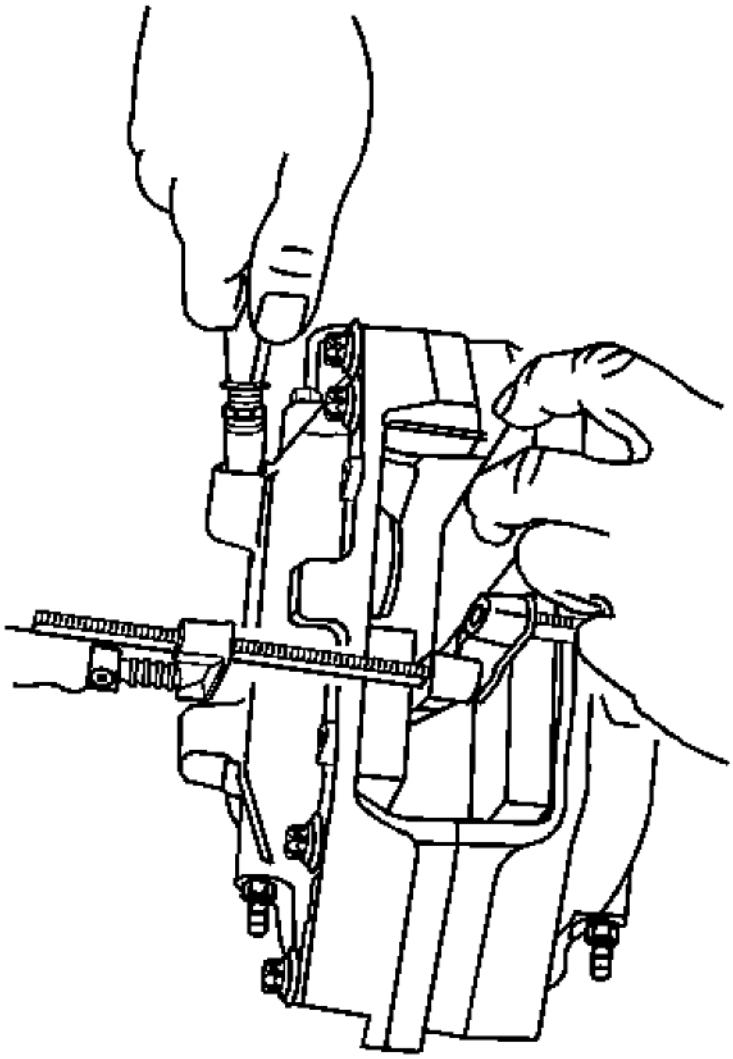


Fig. 69: Blocking Piston Bores
Courtesy of GENERAL MOTORS CORP.

4. Place an old brake pad or the fabricated 127 mm (5 in) long block of wood over 2 adjoining piston bores and secure in place with a non-marring C-clamp.
5. Place the fabricated 51 mm (2 in) long block of wood over one of the opposing piston bores and secure it in place with a non-marring C-clamp.
6. Use clean cloths or the other fabricated 127 mm (5 in) long block of wood to pad the interior of caliper housing during removal of the piston.

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7. Carefully remove the brake caliper piston by directing low pressure compressed air into the brake caliper inlet hole. If the dust boot seal slides out with the piston, remove the dust boot seal from piston and reinstall the seal into the caliper.
8. Move the fabricated 51 mm (2 in) long block of wood over the emptied piston bore and secure it in place with a non-marring C-clamp.
9. Move the clean cloths or the other fabricated 127 mm (5 in) long block of wood to pad the interior of caliper housing during the removal of the piston.
10. Carefully remove the brake caliper piston by directing low pressure compressed air into the brake caliper inlet hole. If the dust boot seal slides out with the piston, remove the dust boot seal from piston and reinstall the seal into the caliper.
11. Repeat steps 4 through 10 for the opposite side of the caliper.

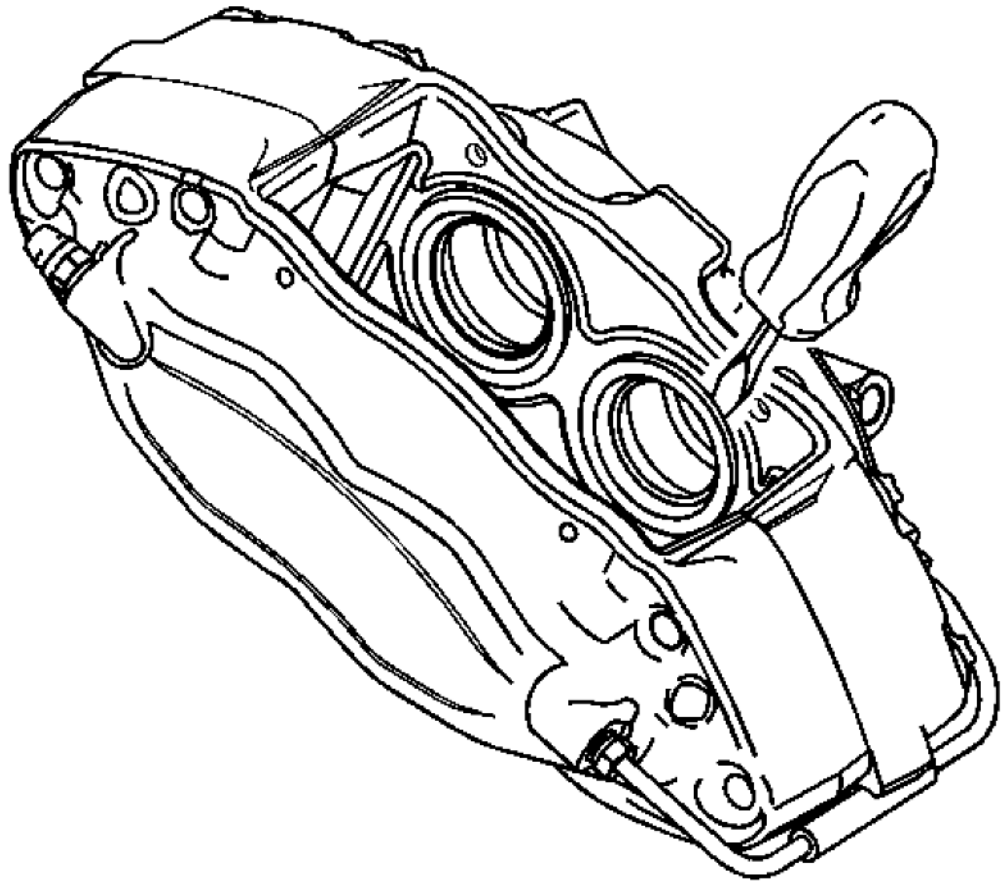


Fig. 70: Removing Dust Boot Seals
Courtesy of GENERAL MOTORS CORP.

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12. Using care to not scratch or mar the painted surfaces or piston bore, remove all the dust boot seals using a flat-bladed tool. Discard the dust boot seals.

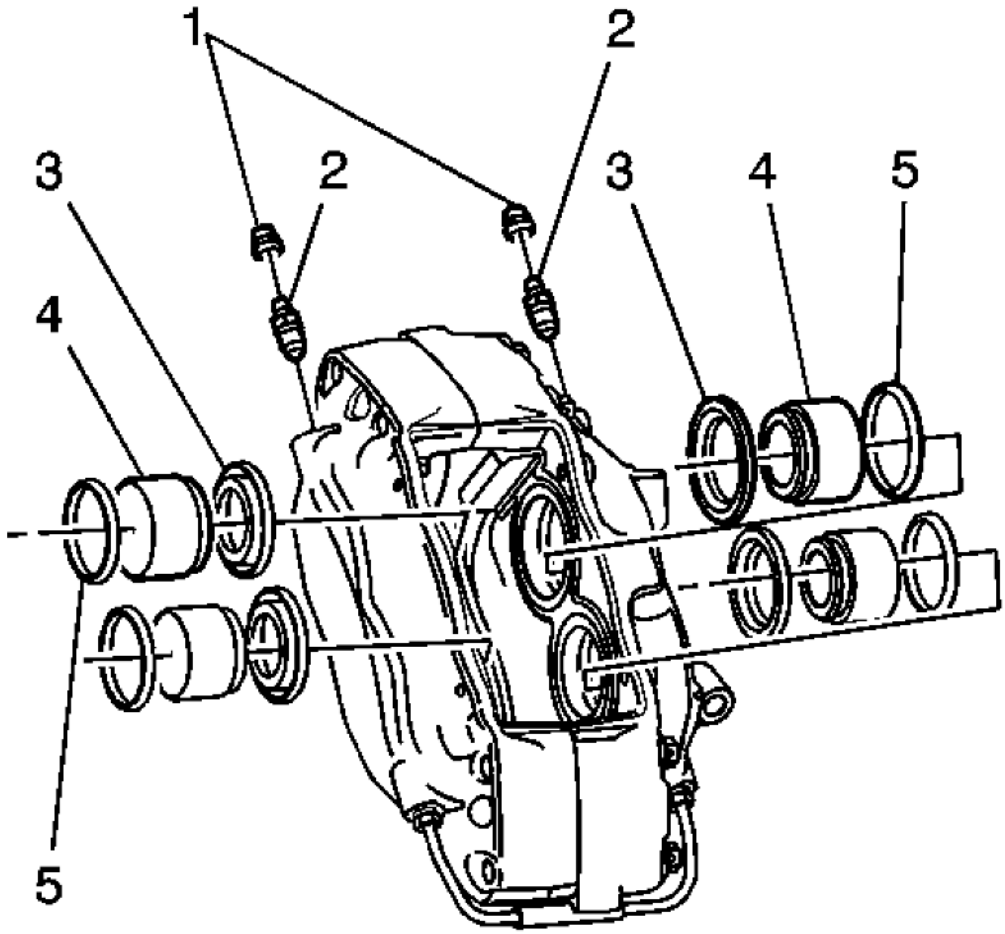


Fig. 71: Exploded View Of Caliper
Courtesy of GENERAL MOTORS CORP.

13. Using wooden or plastic tool, remove the piston seals (5) from the piston bores. Discard the piston seals.
14. Remove both brake caliper bleeder caps (1) and valves (2).
15. Remove the caliper from the vise and clean the entire caliper with denatured alcohol, or equivalent.
16. Dry the caliper piston bores with non-lubricated filtered air. Make sure the external crossover pipe and the internal fluid ports are clean and free of obstructions.
17. Inspect the caliper cylinder bores and piston seal counter-bores for scratches, cracks, pitting, and/or corrosion.

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NOTE: Do NOT clean the caliper piston bores by honing or cleaning with abrasives.

18. If the caliper piston bores are scratched, cracked, or pitted, or if corrosion cannot be cleaned with denatured alcohol, replace the caliper assembly.

Assembly Procedure

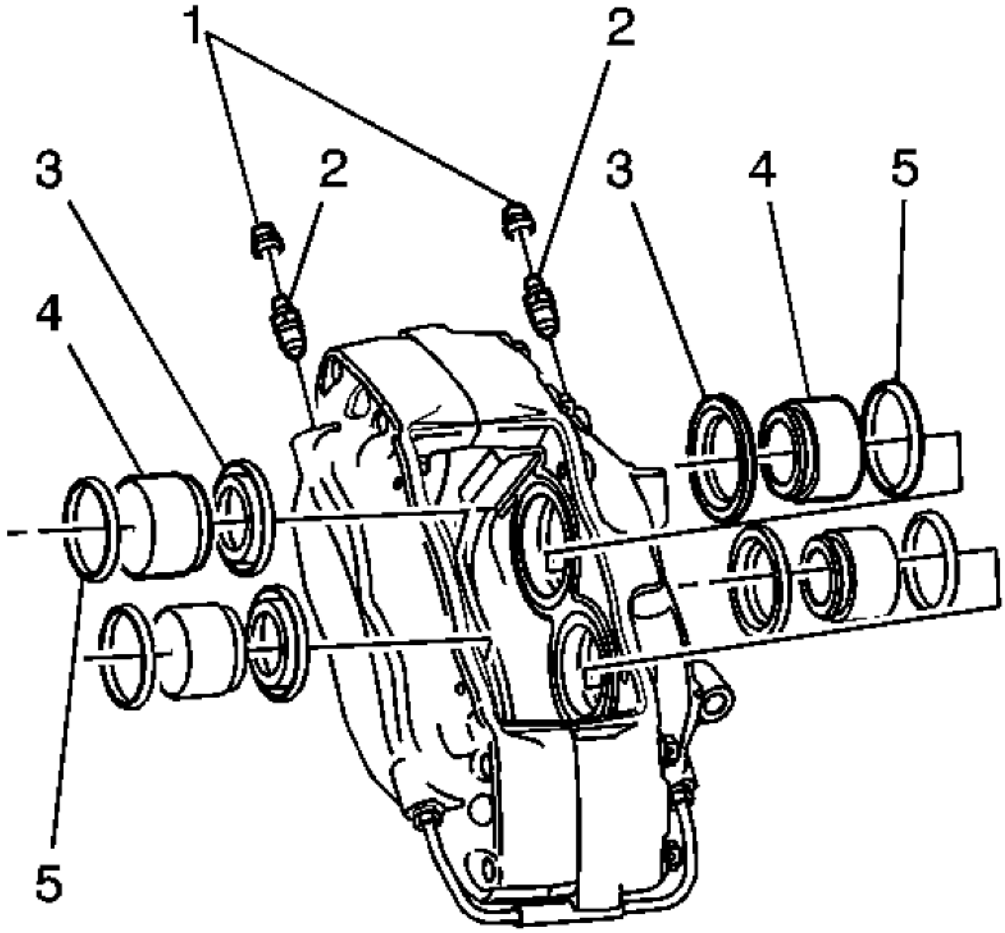


Fig. 72: Exploded View Of Caliper
Courtesy of GENERAL MOTORS CORP.

1. Install the new piston dust boot seals (3) over the pistons (4). Make sure the dust boot seal is properly seated on the piston, in the dust boot seal groove.
2. Lubricate the new piston seals (5) with GM approved or equivalent brake fluid from a clean, sealed brake

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fluid container.

3. Install the lubricated, new piston seals (5) into the brake caliper bore seal grooves. Make sure the seals are not twisted.
4. Apply a thin coat of GM approved or equivalent brake fluid from a clean, sealed brake fluid container, onto the caliper piston bores and the outer surface of the caliper pistons.
5. Install the piston and dust boot assemblies into the correct caliper bores. Press the pistons and dust boot seals all the way in by hand.
6. Place a clean old brake pad or the fabricated 127 mm (5 in) long block of wood over 2 adjoining piston bores and apply light pressure with non-marring C-clamp. This will ensure the dust boots and pistons are fully seated into the caliper.
7. Repeat step 6 for the opposite pistons.

CAUTION: Refer to Fastener Caution .

8. Install the brake caliper bleeder valves (2) and tighten to 10 N.m (89 lb in)..
9. Install the brake caliper bleeder valve caps (1).
10. Install the caliper to the vehicle. Refer to **Front Brake Caliper Replacement (LLT)** or **Front Brake Caliper Replacement (L99, LS3)**.

REAR BRAKE CALIPER OVERHAUL (LLT)

WARNING: Refer to Brake Fluid Irritant Warning .

WARNING: Refer to Brake Dust Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

Disassembly Procedure

WARNING: Do not place fingers in front of the caliper piston(s) in an attempt to catch or protect it when applying compressed air. The piston(s) can fly out with force and could result in serious bodily injury.

NOTE:

- **Replace all the components included in the repair kits used to service this brake caliper.**
- **Lubricate the rubber parts with GM approved brake fluid from a clean, sealed brake fluid container to make assembly easier.**

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- **If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.**
- **The torque values specified are for dry, non-lubricated fasteners.**
- **Perform the service operations on a clean bench, free from all mineral oil materials.**

1. Remove the brake caliper from the vehicle. Refer to **Rear Brake Caliper Replacement (LLT)** or **Rear Brake Caliper Replacement (L99, LS3)**.
2. Drain the brake fluid from the brake caliper.

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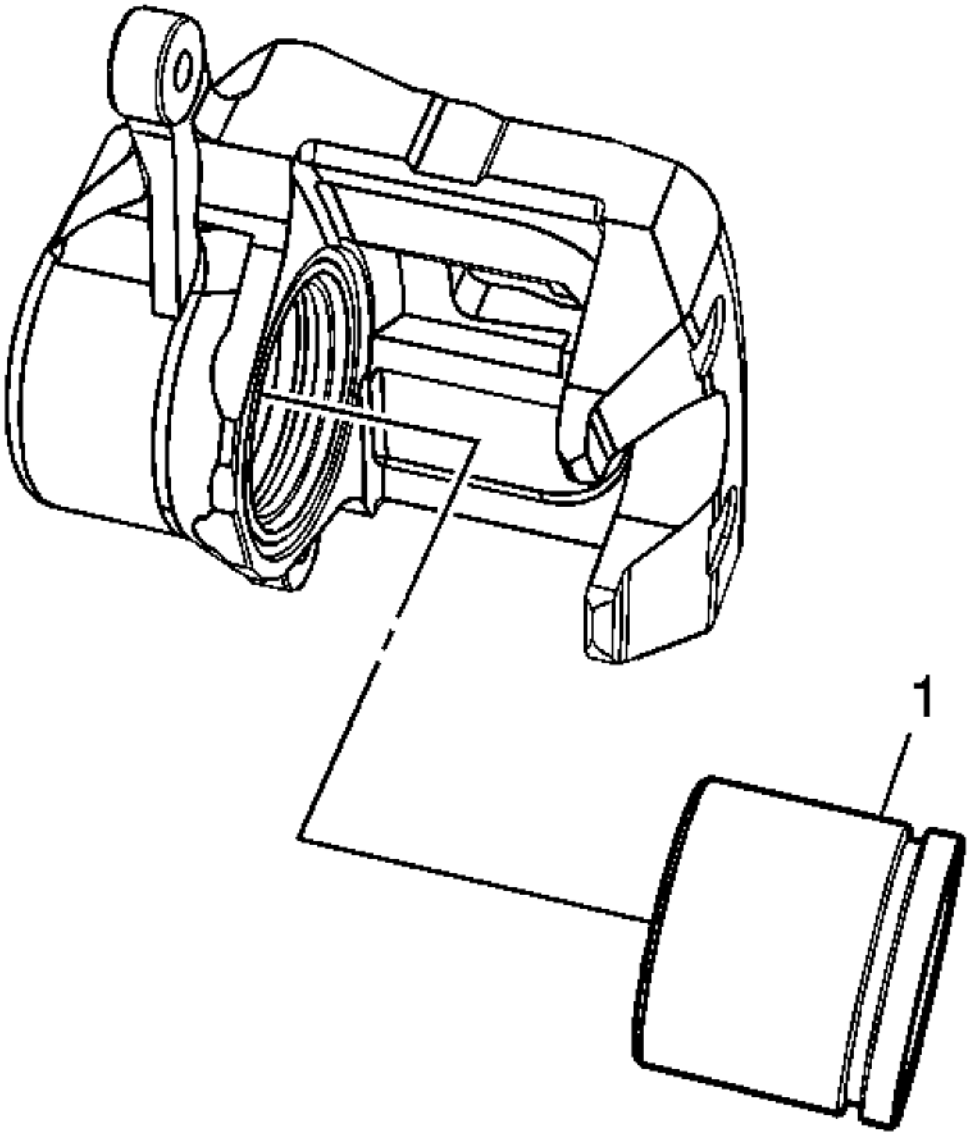


Fig. 73: Brake Caliper Piston
Courtesy of GENERAL MOTORS CORP.

CAUTION: Use clean cloths to pad interior of caliper housing during piston removal. Use just enough air to ease the pistons out of the bores. If the pistons are blown out, even with the padding provided, it may be damaged.

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3. Place a 25 mm (1 in) block of wood between the caliper housing and the piston.
4. Install a large C-clamp over the body of the brake caliper with the C-clamp ends against the rear of the caliper body and against the block of wood.
5. Carefully remove the brake caliper piston (1) by directing low pressure compressed air into the brake caliper inlet hole.
6. Remove the C-clamp from the caliper.
7. Remove the block of wood from the caliper.

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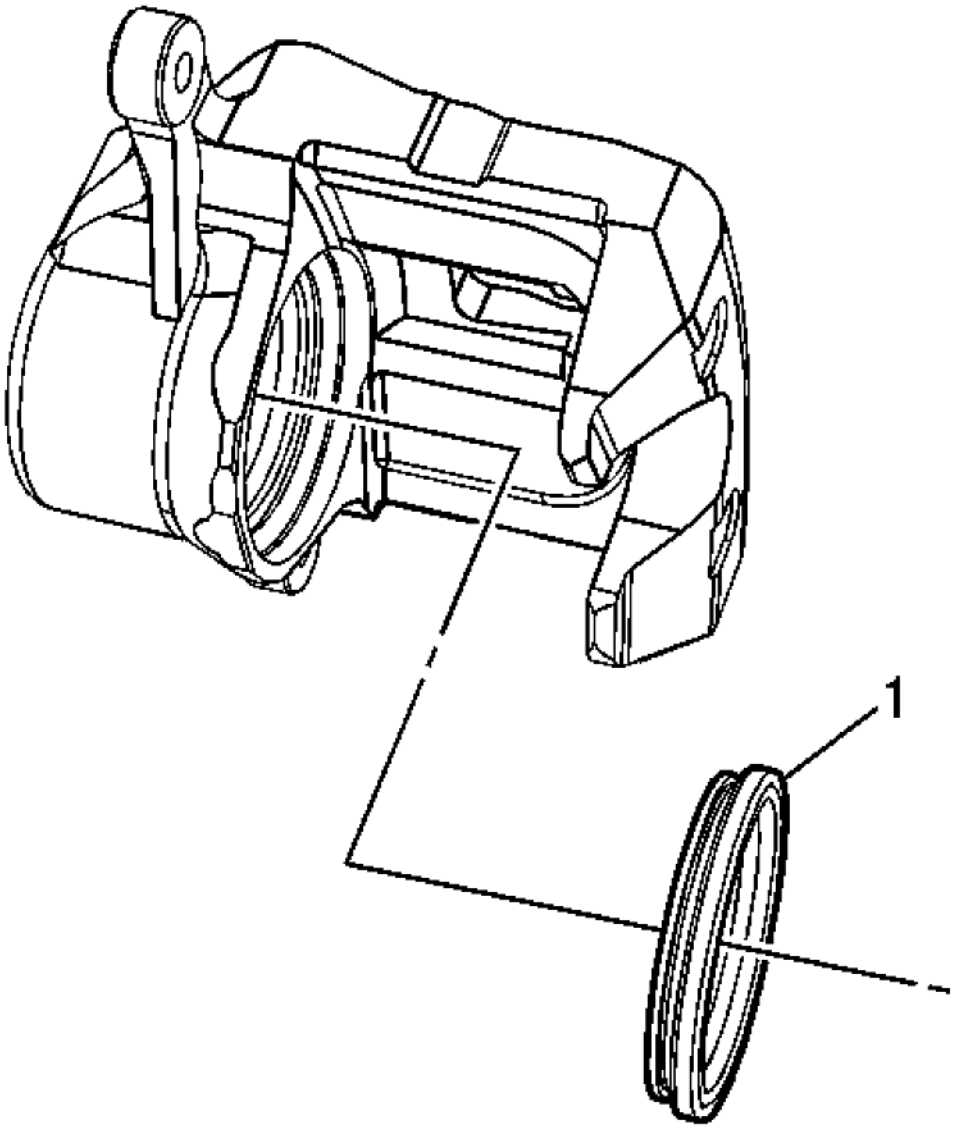


Fig. 74: Piston Dust Boot Seal
Courtesy of GENERAL MOTORS CORP.

8. Remove the piston dust boot seal (1) from the seal counterbore in the brake caliper and discard the dust boot seal.

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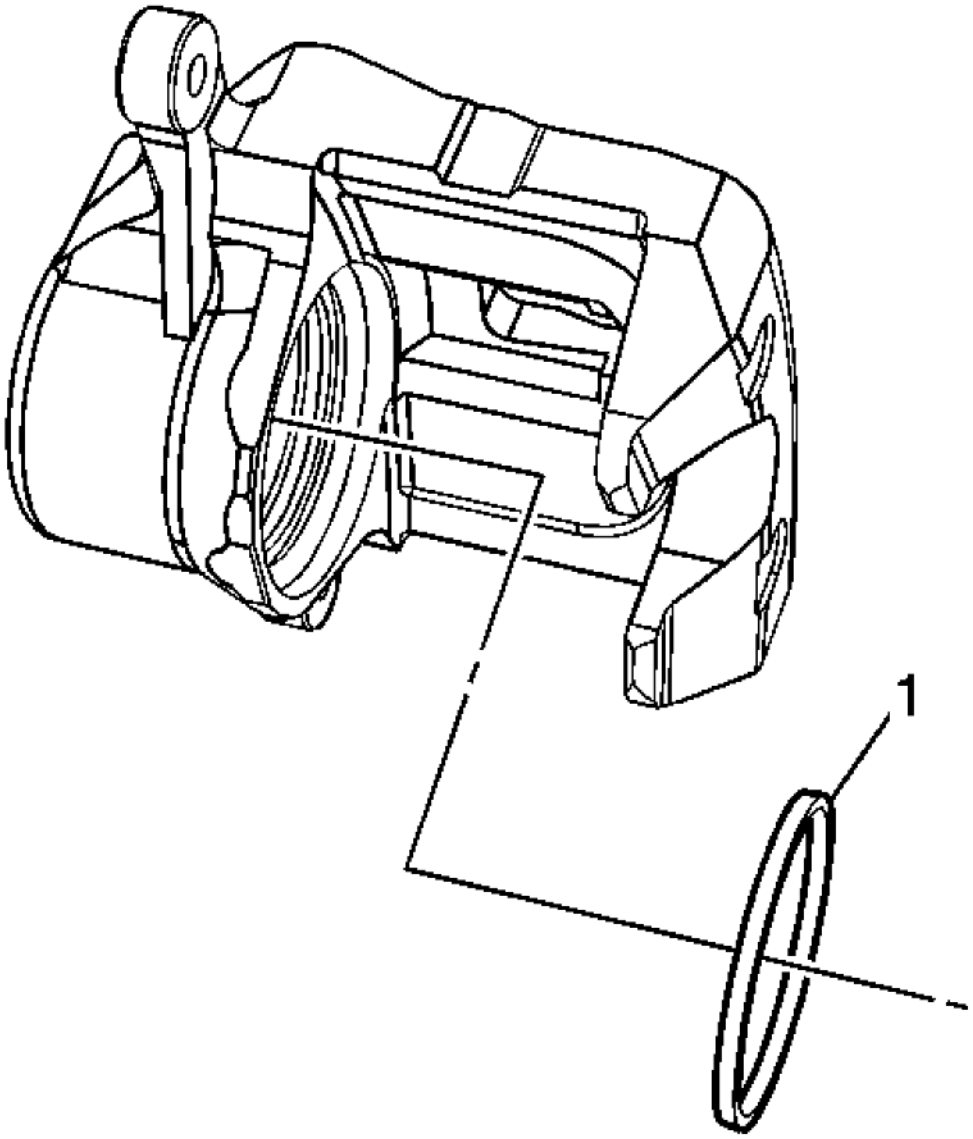


Fig. 75: Piston Seal
Courtesy of GENERAL MOTORS CORP.

9. Using a small wooden or plastic tool, remove the piston seal (1) from the brake caliper bore and discard the piston seal.

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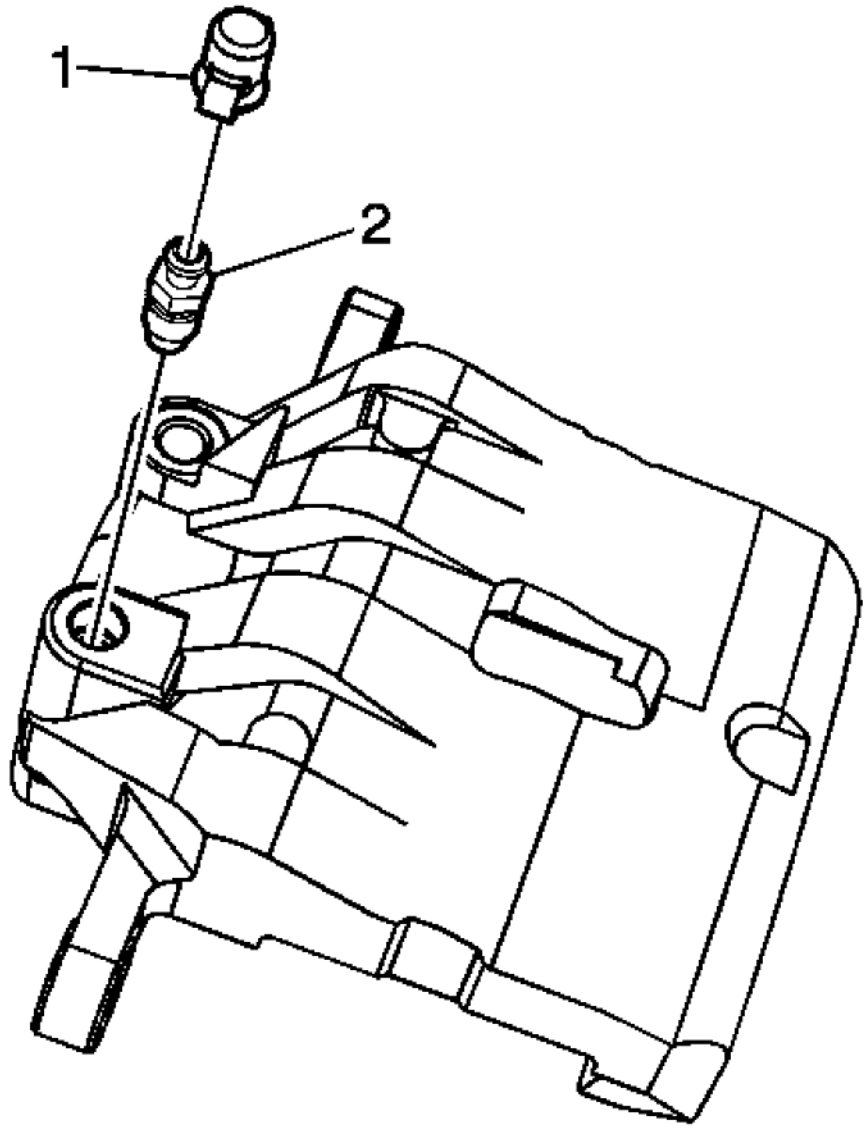


Fig. 76: Brake Caliper Bleeder Valve & Cap
Courtesy of GENERAL MOTORS CORP.

10. Remove the brake caliper bleeder valve cap (1) and bleeder valve (2).

NOTE: Do not use abrasives to clean the brake caliper pistons.

11. Inspect the brake caliper mounting bracket guide surfaces for corrosion and wear. Remove and replace

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the brake caliper mounting bracket if damaged or worn.

12. Clean the brake caliper piston bores and seal counterbore with denatured alcohol, or equivalent.
13. Clean the brake caliper piston with denatured alcohol, or equivalent.
14. Dry the caliper piston bore and counterbore with non-lubricated, filtered air.
15. Dry the brake caliper piston with non-lubricated, filtered air.
16. Inspect the caliper bore for cracks, scoring, pitting, excessive corrosion.
17. If light corrosion is present in the caliper bore, attempt to remove the imperfection with a fine emery paper. If the imperfection cannot be removed, replace the caliper assembly.
18. If cracks, scoring, pitting, and excessive corrosion are present in the caliper bore, replace the caliper assembly.
19. Inspect the caliper piston for cracks, scoring, and/or damage. Replace the caliper piston if any of these conditions exist.

Assembly Procedure

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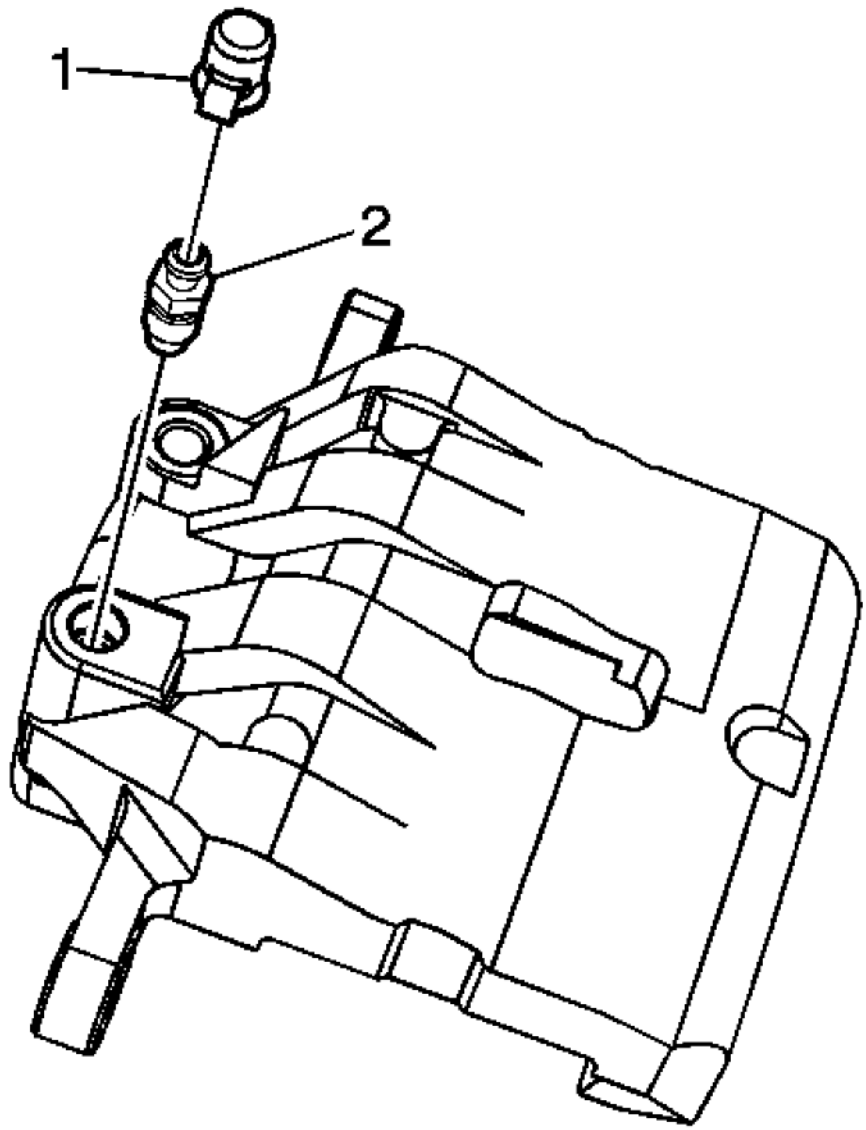


Fig. 77: Brake Caliper Bleeder Valve & Cap
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

1. Install the brake caliper bleeder valve (2) and tighten to 10 N.m (89 lb in).

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2. Install the brake caliper bleeder valve cap (1).

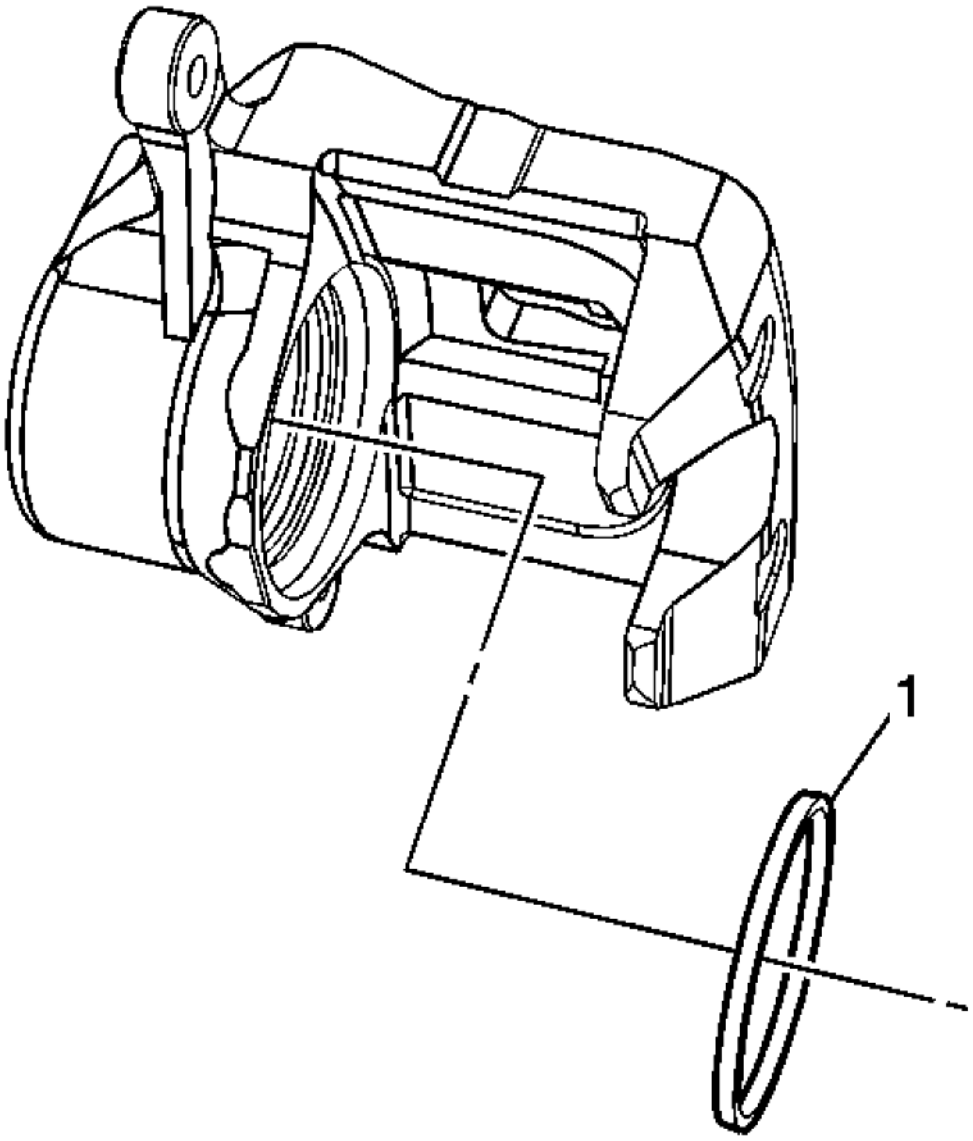


Fig. 78: Piston Seal
Courtesy of GENERAL MOTORS CORP.

3. Lubricate the new piston seal (1) with GM approved brake fluid from a clean, sealed brake fluid container.

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4. Install lubricated piston seal into the brake caliper bore seal groove.

   Ensure the seal is not twisted.

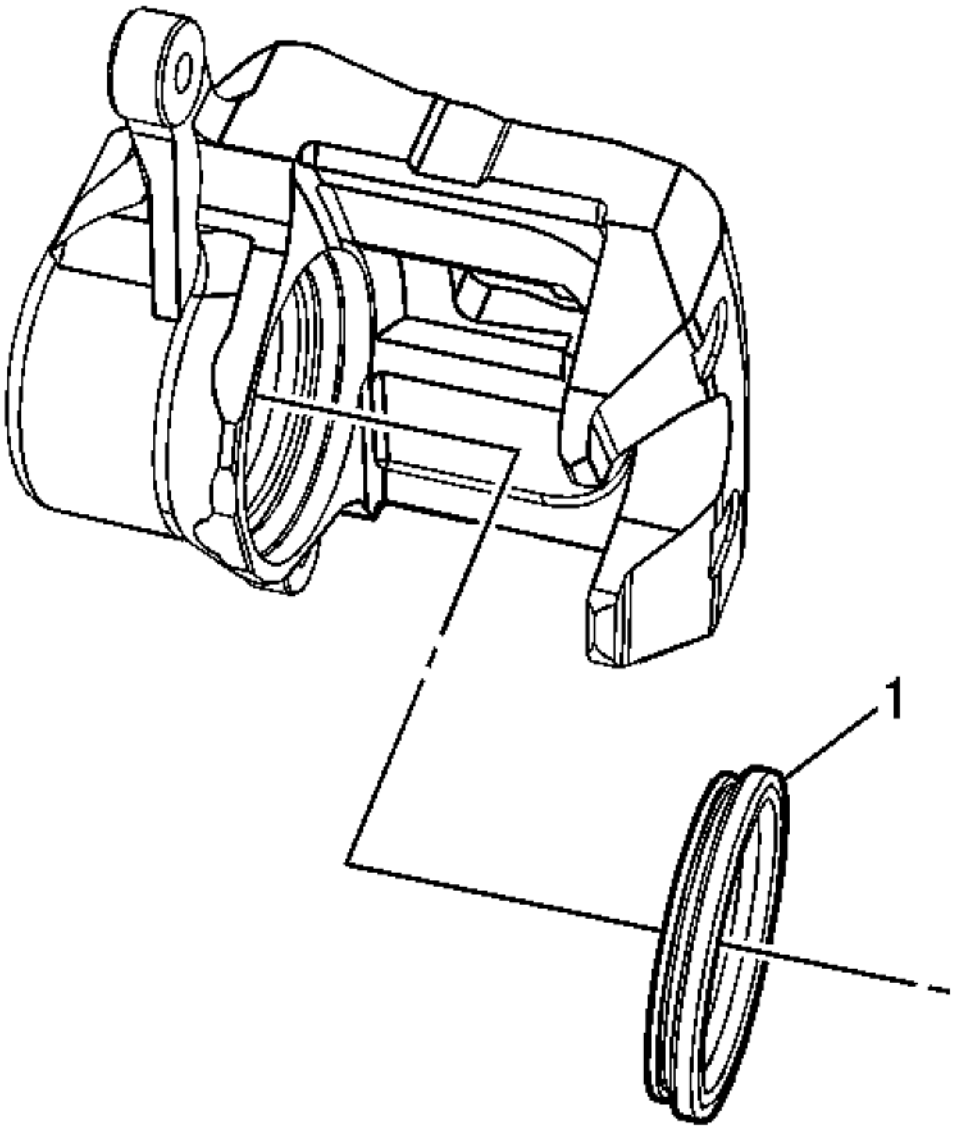


Fig. 79: Piston Dust Boot Seal
Courtesy of GENERAL MOTORS CORP.

5. Install the piston dust boot seal (1) to the caliper.

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Ensure the seal is seated evenly and completely into the groove in the caliper housing.

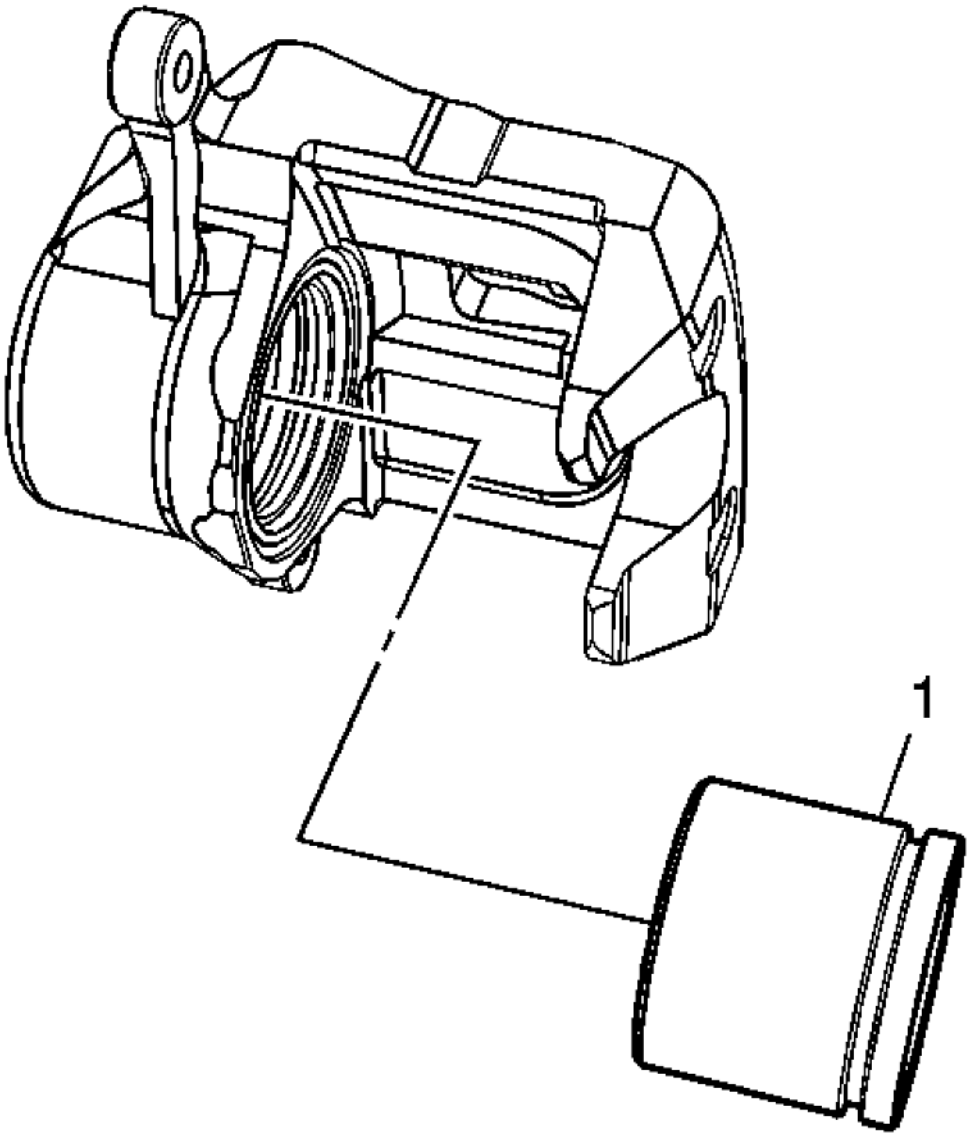


Fig. 80: Brake Caliper Piston
Courtesy of GENERAL MOTORS CORP.

6. Place the caliper piston into the caliper housing by carefully lifting the edge of the dust boot seal.
7. Carefully push the piston (1) squarely into the brake caliper bore.

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8. Ensure the caliper dust boot is properly seated into the piston groove and into the groove in the brake caliper bore.
9. Install the brake caliper to the vehicle. Refer to **Rear Brake Caliper Replacement (LLT)** or **Rear Brake Caliper Replacement (L99, LS3)**.

REAR BRAKE CALIPER OVERHAUL (L99, LS3)

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

CAUTION: Do not remove the caliper external crossover tube or separate the 2 caliper halves. If the crossover tube and/or the caliper halves are separated, corrosion and damage to the caliper may result.

CAUTION: This brake caliper is coated with a specialized paint. Use care when handling and servicing to ensure the paint does not get chipped or scratched. Clean any brake fluid from painted surfaces with denatured alcohol, or equivalent, as soon as possible.

NOTE:

- **Replace all the components included in the repair kits used to service this brake caliper.**
- **Lubricate the rubber parts with GM approved brake fluid to make assembly easier.**
- **If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.**
- **The torque values specified are for dry, non-lubricated fasteners.**
- **Perform the service operations on a clean bench, free from all mineral oil materials.**

Disassembly Procedure

WARNING: Do not place fingers in front of the caliper piston(s) in an attempt to catch or protect it when applying compressed air. The piston(s) can fly out with force and could result in serious bodily injury.

CAUTION: Use clean cloths to pad interior of caliper housing during piston removal. Use just enough air to ease the pistons out of the bores. If the pistons are blown out, even with the padding provided, it may be damaged.

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NOTE: **It will be necessary to fabricate one or more blocks of wood to the following dimensions to be used during this procedure:**

- **Must fabricate 1 block: 19 mm (3/4 in) X 51 mm (2 in) X 51 mm (2 in)**
- **Optional to fabricate 1 block, rather than using an old brake pad: 19 mm (3/4 in) X 51 mm (2 in) X 127 mm (5 in)**
- **Optional to fabricate 1 block to cushion piston removal: 19 mm (3/4 in) X 51 mm (2 in) X 127 mm (5 in)**

1. Remove the brake caliper from the vehicle. Refer to **Rear Brake Caliper Replacement (LLT)** or **Rear Brake Caliper Replacement (L99, LS3)**.
2. Drain the brake fluid from the brake caliper.
3. Place the caliper in a vise using plastic vise caps or suitable material to protect the caliper mounting bosses from the vise jaws.

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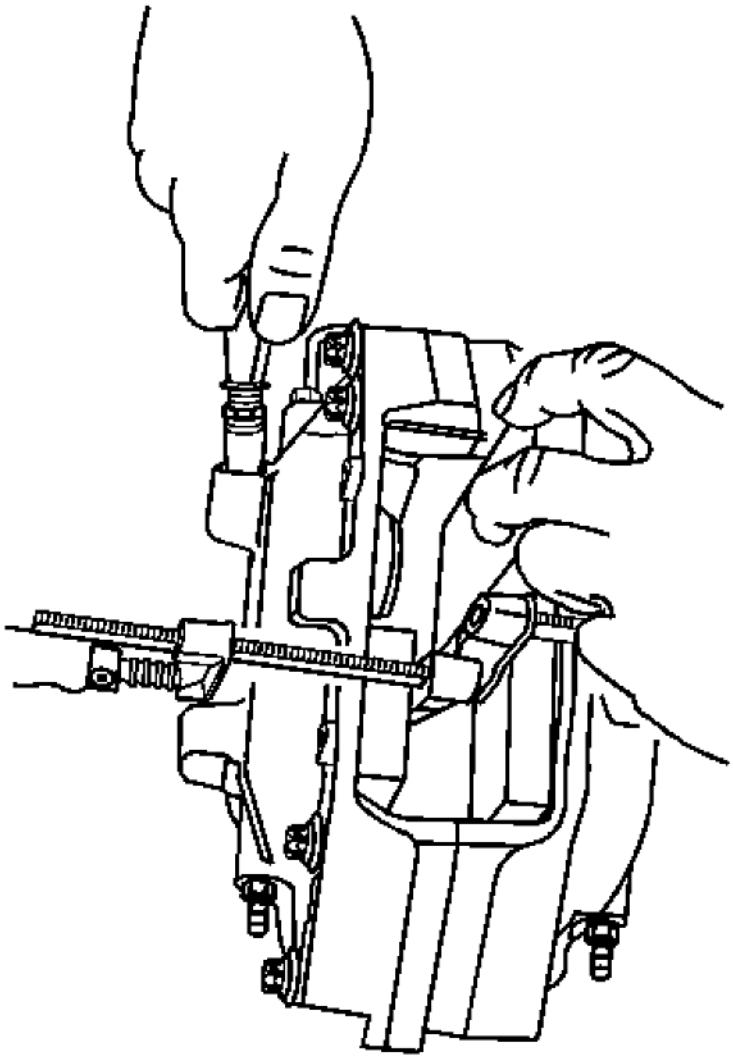


Fig. 81: Blocking Piston Bores
Courtesy of GENERAL MOTORS CORP.

4. Place an old brake pad or the fabricated 127 mm (5 in) long block of wood over 2 adjoining piston bores and secure in place with a non-marring C-clamp.
5. Place the fabricated 51 mm (2 in) long block of wood over one of the opposing piston bores and secure it in place with a non-marring C-clamp.
6. Use clean cloths or the other fabricated 127 mm (5 in) long block of wood to pad the interior of caliper housing during removal of the piston.

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7. Carefully remove the brake caliper piston by directing low pressure compressed air into the brake caliper inlet hole. If the dust boot seal slides out with the piston, remove the dust boot seal from piston and reinstall the seal into the caliper.
8. Move the fabricated 51 mm (2 in) long block of wood over the emptied piston bore and secure it in place with a non-marring C-clamp.
9. Move the clean cloths or the other fabricated 127 mm (5 in) long block of wood to pad the interior of caliper housing during the removal of the piston.
10. Carefully remove the brake caliper piston by directing low pressure compressed air into the brake caliper inlet hole. If the dust boot seal slides out with the piston, remove the dust boot seal from piston and reinstall the seal into the caliper.
11. Repeat steps 4 through 10 for the opposite side of the caliper.

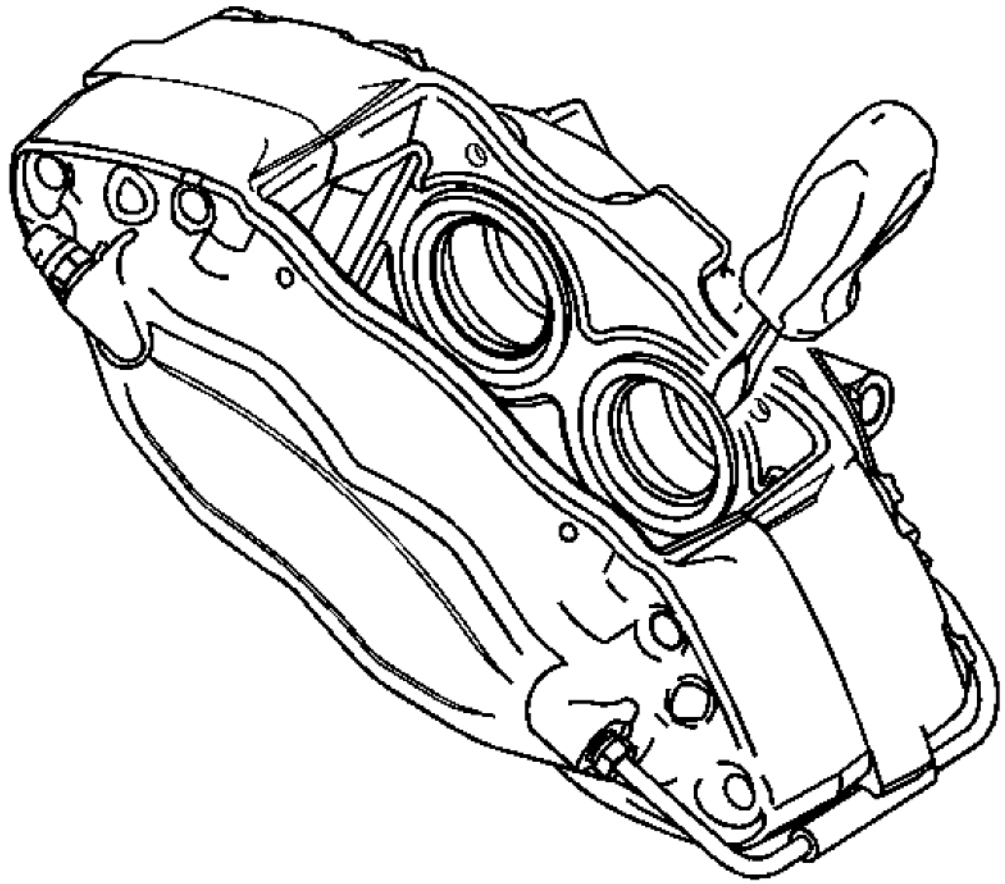


Fig. 82: Removing Dust Boot Seals
Courtesy of GENERAL MOTORS CORP.

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12. Using care to not scratch or mar the painted surfaces or piston bore, remove all the dust boot seals using a flat-bladed tool. Discard the dust boot seals.

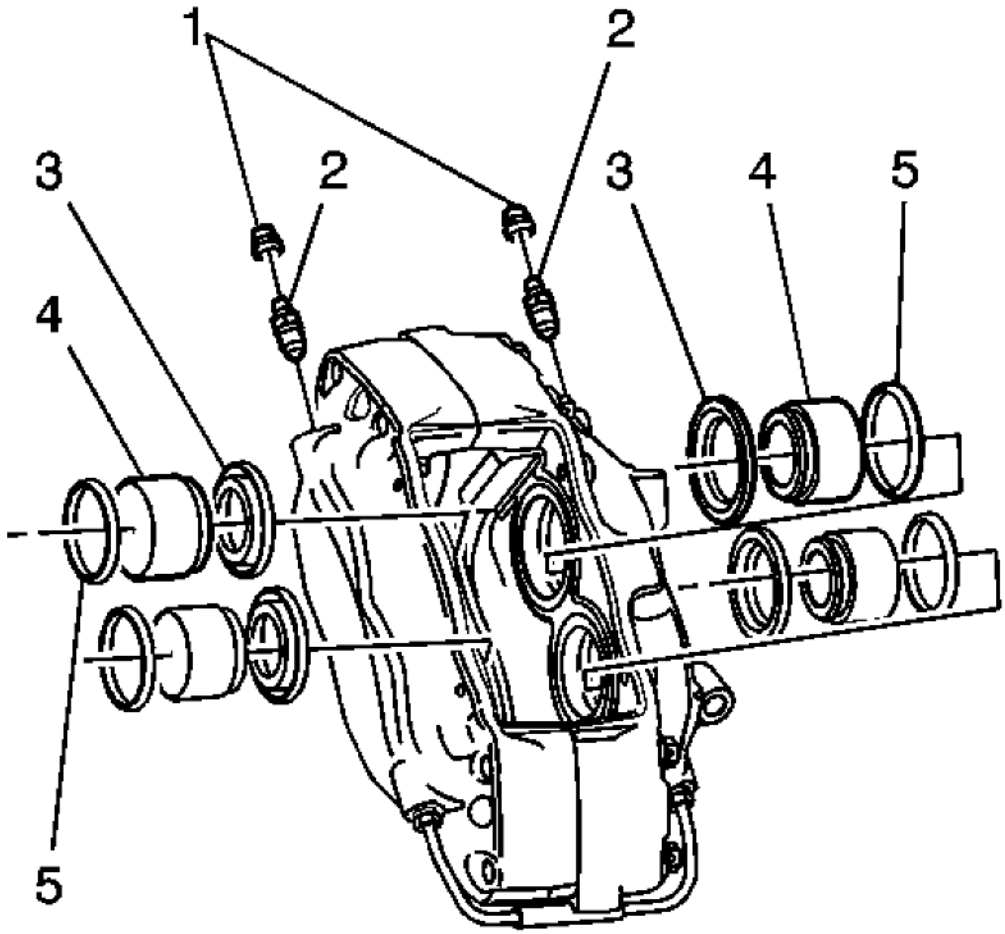


Fig. 83: Exploded View Of Caliper
Courtesy of GENERAL MOTORS CORP.

13. Using wooden or plastic tool, remove the piston seals (5) from the piston bores. Discard the piston seals.
14. Remove both brake caliper bleeder caps and valves (1, 2).
15. Remove the caliper from the vise and clean the entire caliper with denatured alcohol, or equivalent.
16. Dry the caliper piston bores with non-lubricated filtered air. Make sure the external crossover pipe and the internal fluid ports are clean and free of obstructions.
17. Inspect the caliper cylinder bores and piston seal counter-bores for scratches, cracks, pitting, and/or corrosion.

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NOTE: **Do not clean the caliper piston bores by honing or cleaning with abrasives.**

18. If the caliper piston bores are scratched, cracked, or pitted, or if corrosion cannot be cleaned with denatured alcohol, replace the caliper assembly.

Assembly Procedure

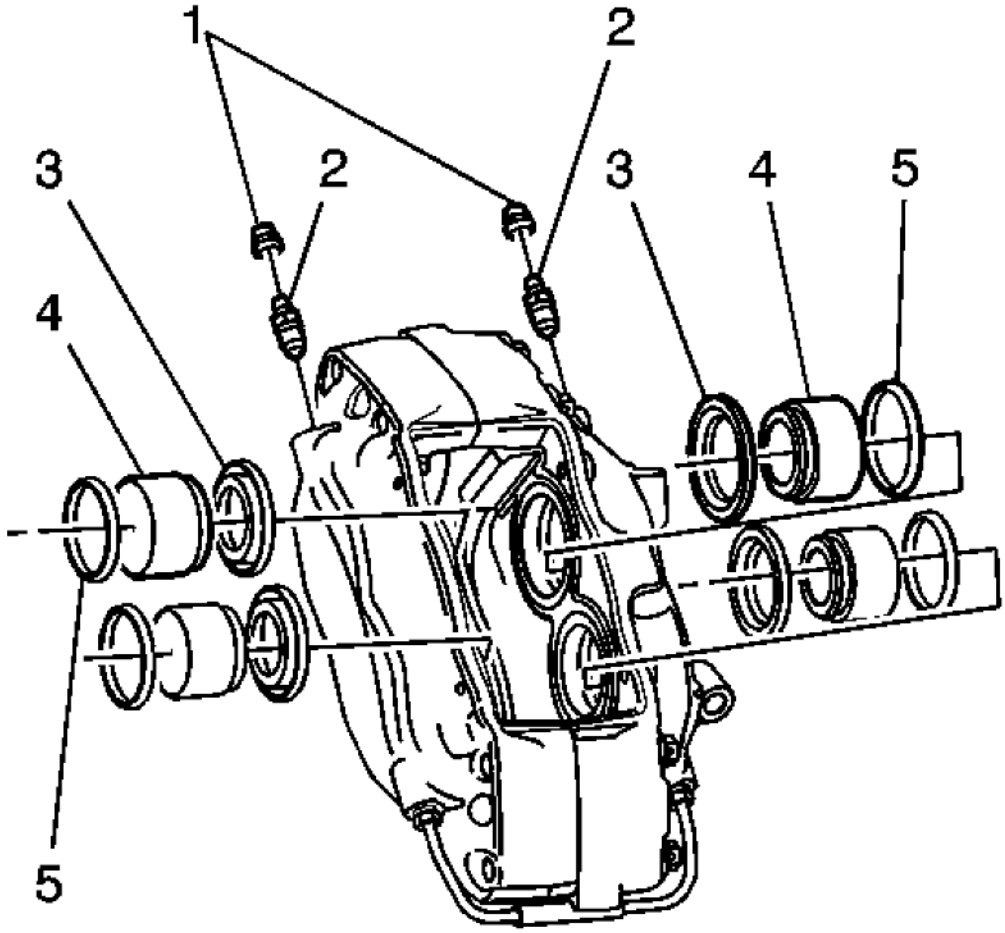


Fig. 84: Exploded View Of Caliper
Courtesy of GENERAL MOTORS CORP.

1. Install the new piston dust boot seals (3) over the pistons (4). Make sure the dust boot seal is properly seated on the piston, in the dust boot seal groove.
2. Lubricate the new piston seals (5) with GM approved brake fluid from a clean, sealed brake fluid

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container.

3. Install the lubricated, new piston seals (5) into the brake caliper bore seal grooves. Make sure the seals are not twisted.
4. Apply a thin coat of GM approved brake fluid from a clean, sealed brake fluid container, onto the caliper piston bores and the outer surface of the caliper pistons.
5. Install the piston and dust boot assemblies into the correct caliper bores. Press the pistons and dust boot seals all the way in by hand.
6. Place a clean old brake pad or the fabricated 127 mm (5 in) long block of wood over 2 adjoining piston bores and apply light pressure with non-marring C-clamp. This will ensure the dust boots and pistons are fully seated into the caliper.
7. Repeat step 6 for the opposite pistons.

CAUTION: Refer to Fastener Caution .

8. Install the brake caliper bleeder valves (2) and tighten to 10 N.m (89 lb in).
9. Install the brake caliper bleeder valve caps (1).
10. Install the caliper to the vehicle. Refer to **Rear Brake Caliper Replacement (LLT)** or **Rear Brake Caliper Replacement (L99, LS3)**.

FRONT BRAKE CALIPER HARDWARE REPLACEMENT (LLT)

Removal Procedure

WARNING: Refer to Brake Dust Warning .

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

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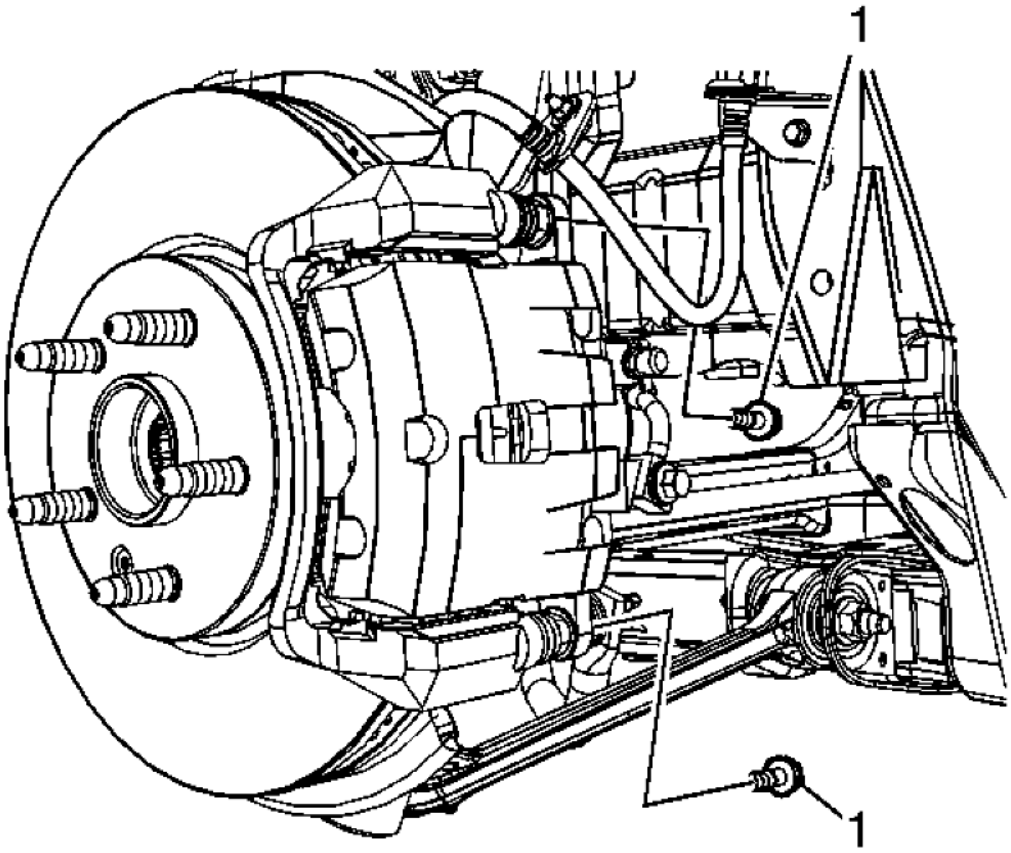


Fig. 85: Brake Caliper Guide Pin Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: The brake caliper guide pin bolts must be replaced any time they are removed. Do not reuse the brake caliper guide pin bolts.

3. Using a backup wrench on the brake caliper guide pin, remove and discard the brake caliper guide pin bolts (1).

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.

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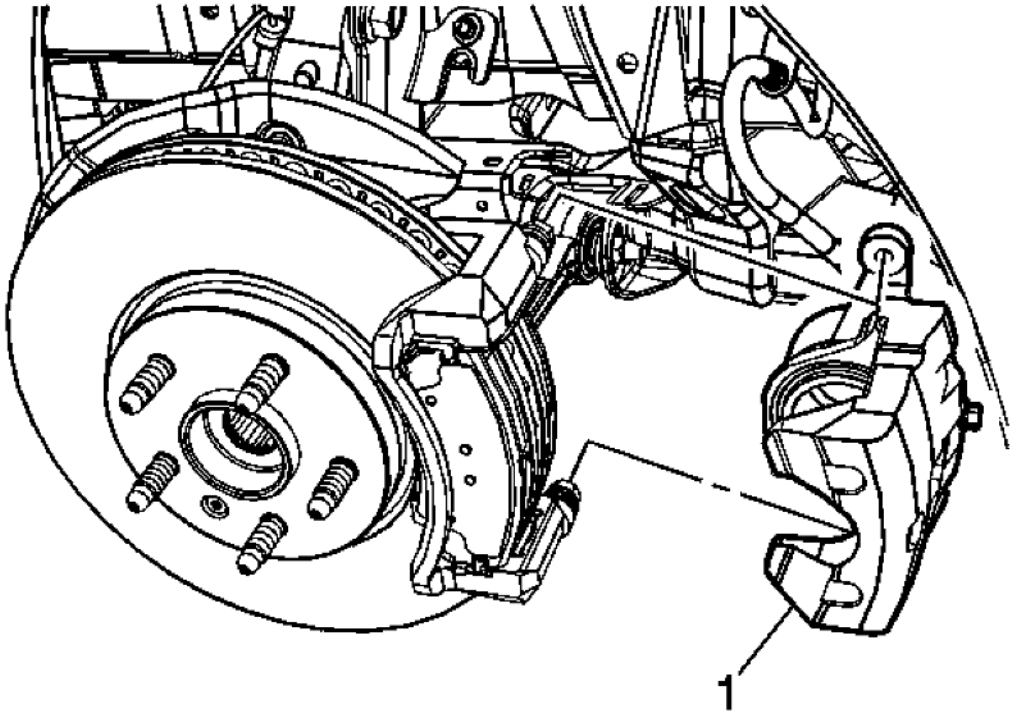


Fig. 86: Brake Caliper
Courtesy of GENERAL MOTORS CORP.

4. Remove the brake caliper (1) and support with heavy mechanics wire or equivalent.

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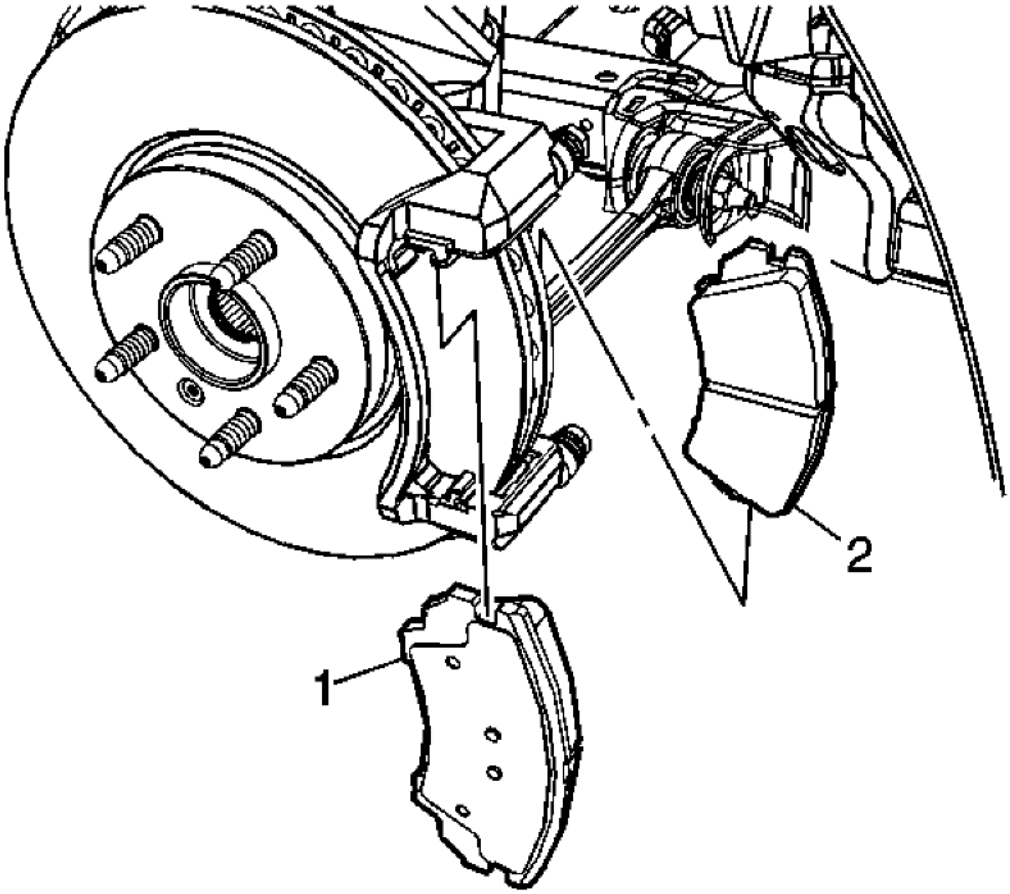


Fig. 87: Brake Pads
Courtesy of GENERAL MOTORS CORP.

5. Remove the outer brake pad (1).
6. Remove the inner brake pad (2).

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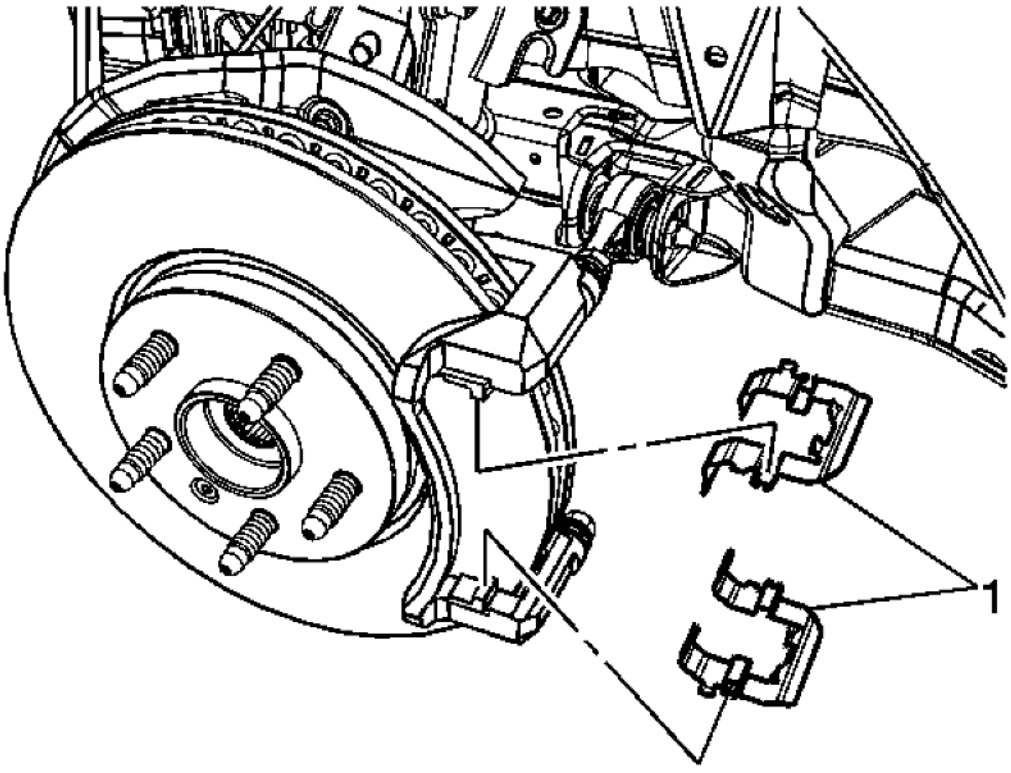


Fig. 88: Brake Pad Springs
Courtesy of GENERAL MOTORS CORP.

7. Remove the brake pad springs (1).

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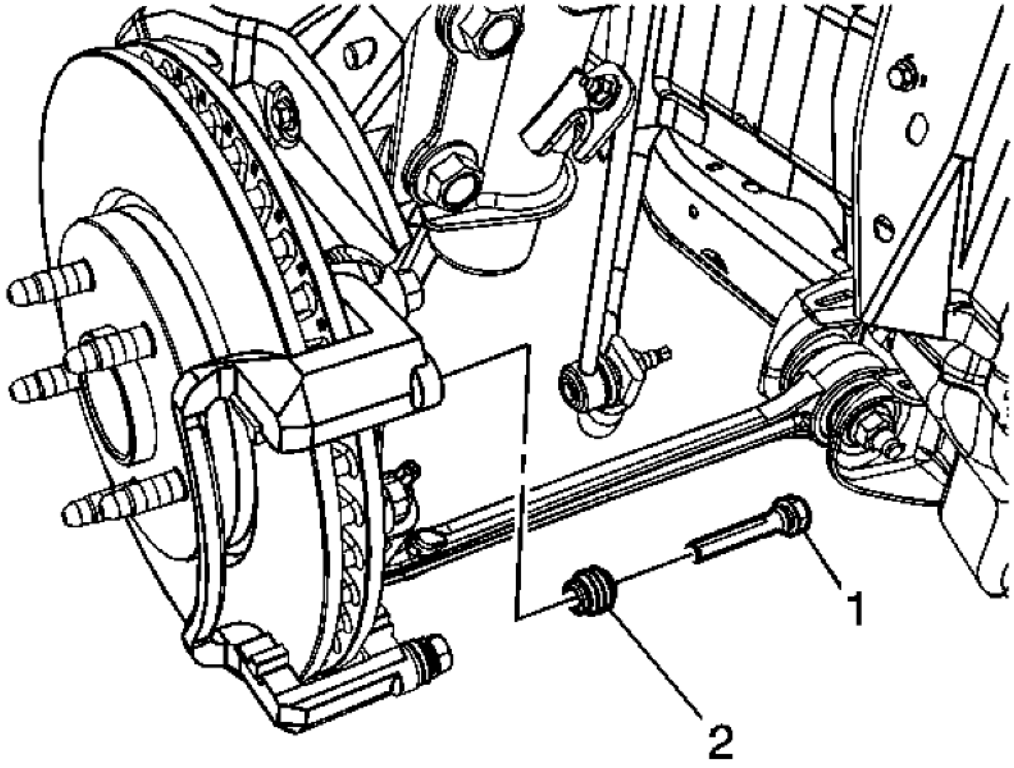


Fig. 89: Upper Brake Caliper Guide Pin & Seal
Courtesy of GENERAL MOTORS CORP.

8. Remove the upper brake caliper guide pin (1).
9. Remove the upper guide pin seal (2).

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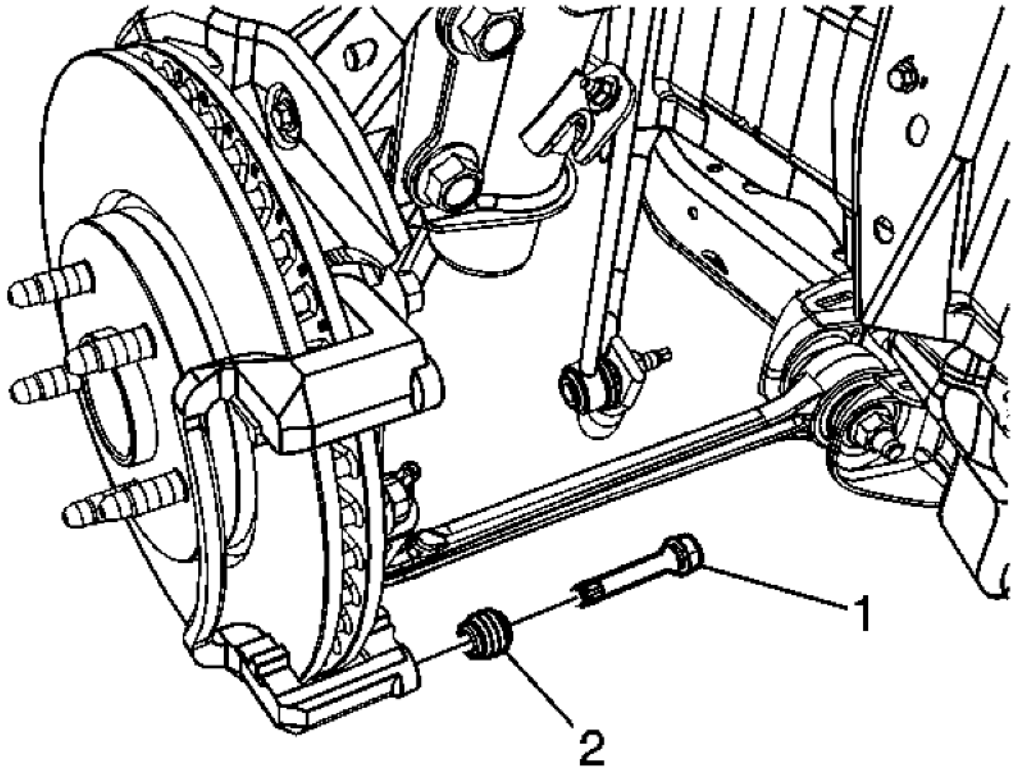


Fig. 90: Lower Brake Caliper Guide Pin & Seal
Courtesy of GENERAL MOTORS CORP.

NOTE: The lower brake caliper guide pin is equipped with a bushing.

10. Remove the lower brake caliper guide pin (1).
11. Remove the lower guide pin seal (2).

Installation Procedure

1. Inspect the brake caliper guide pins, seals and brake pad springs for damage and/or corrosion. Refer to **Front Disc Brake Mounting and Hardware Inspection**.

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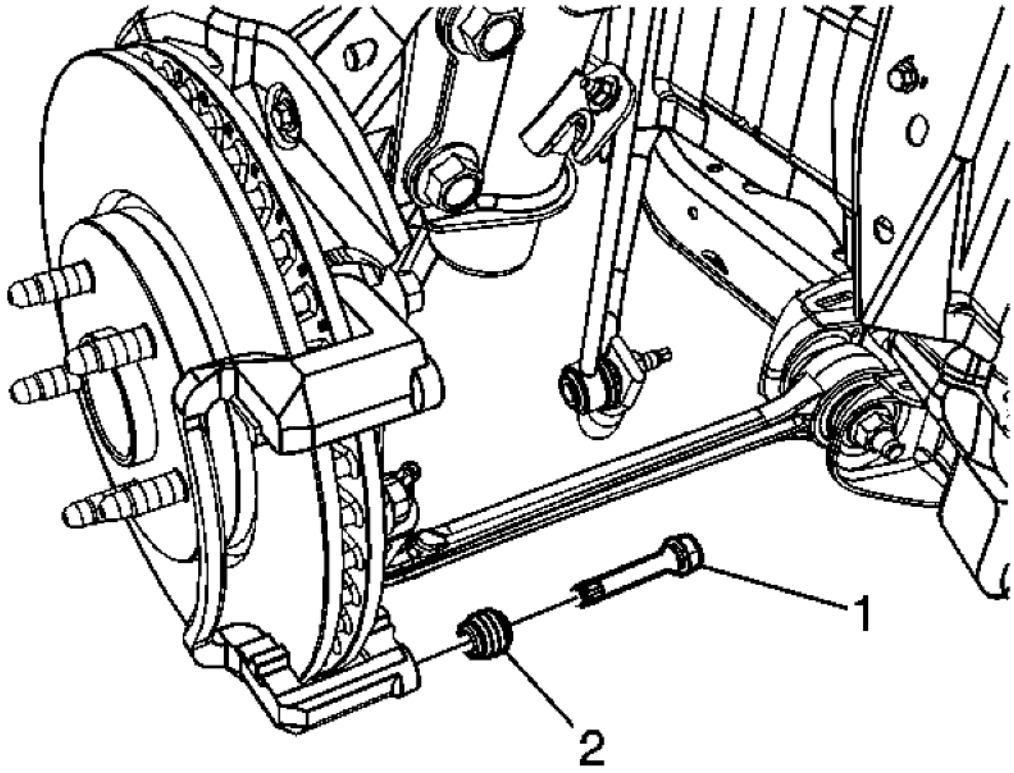


Fig. 91: Lower Brake Caliper Guide Pin & Seal
Courtesy of GENERAL MOTORS CORP.

2. Apply a thin coat of high temperature silicone brake lubricant the brake caliper guide pin.

NOTE: The lower brake caliper guide pin is equipped with a bushing.

3. Install the lower brake caliper guide pin (1) to the guide pin seal (2).
4. Ensure the guide pin seal is fully seated in the groove of the brake caliper guide pin.
5. Install the lower guide pin and seal to the brake caliper bracket.
6. Ensure the guide pin seal is fully seated in the groove of the brake caliper bracket.

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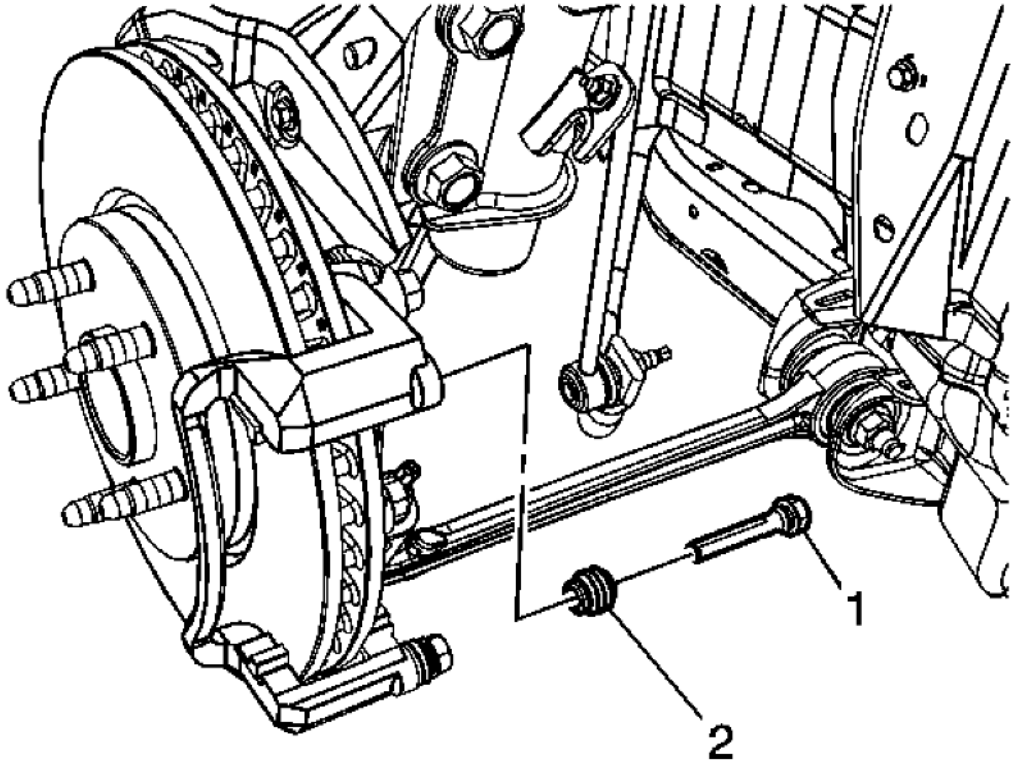


Fig. 92: Upper Brake Caliper Guide Pin & Seal
Courtesy of GENERAL MOTORS CORP.

7. Apply a thin coat of high temperature silicone brake lubricant the brake caliper guide pin.
8. Install the upper brake caliper guide pin (1) to the guide pin seal (2).
9. Ensure the guide pin seal is fully seated in the groove of the brake caliper guide pin.
10. Install the upper guide pin and seal to the brake caliper bracket.
11. Ensure the guide pin seal is fully seated in the groove of the brake caliper bracket.

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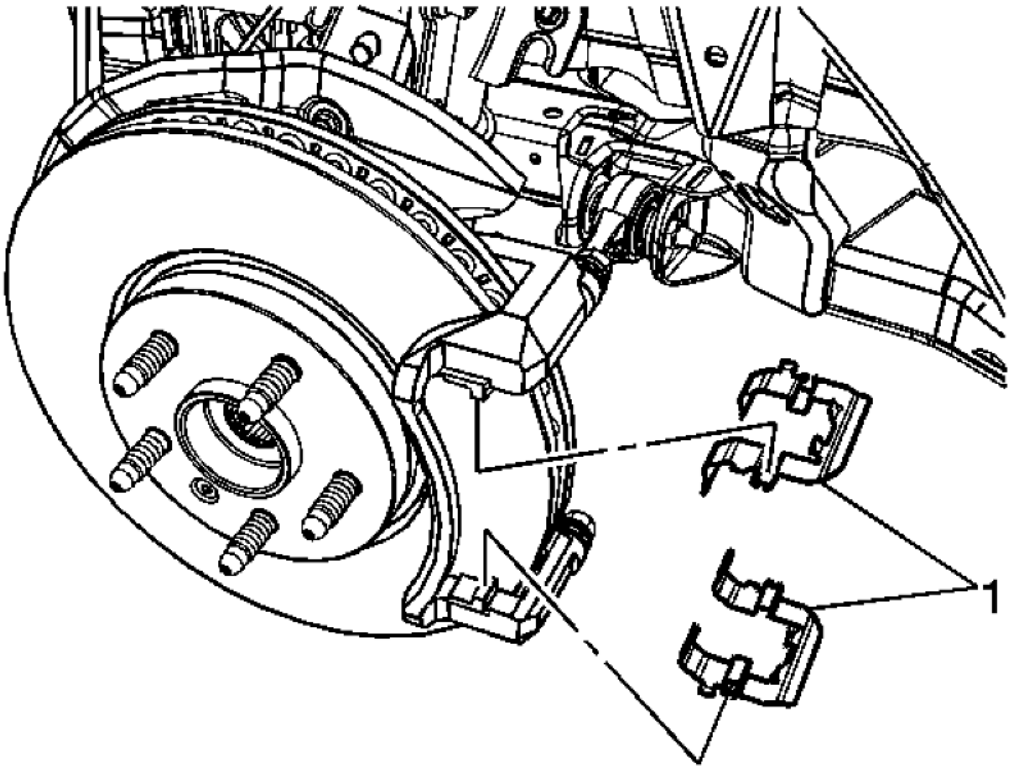


Fig. 93: Brake Pad Springs
Courtesy of GENERAL MOTORS CORP.

12. Install the brake pad springs (1).

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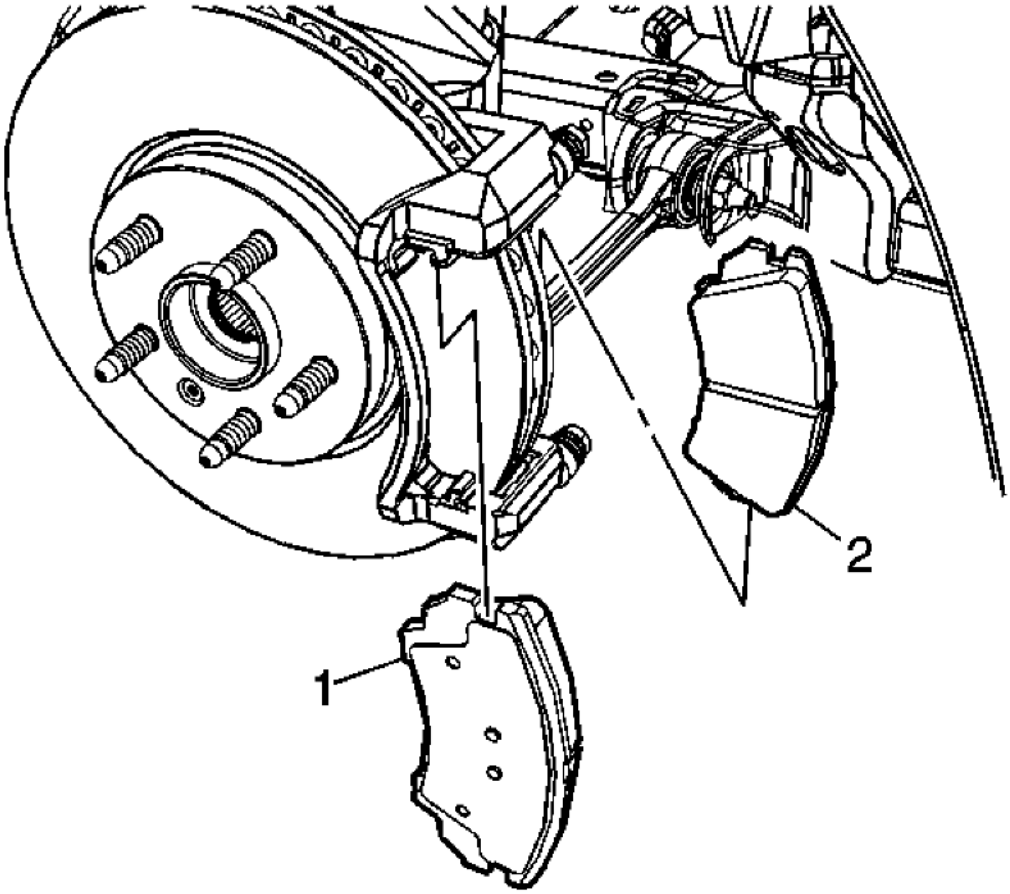


Fig. 94: Brake Pads
Courtesy of GENERAL MOTORS CORP.

13. Install the outer brake pad (1).
14. Install the inner brake pad (2).

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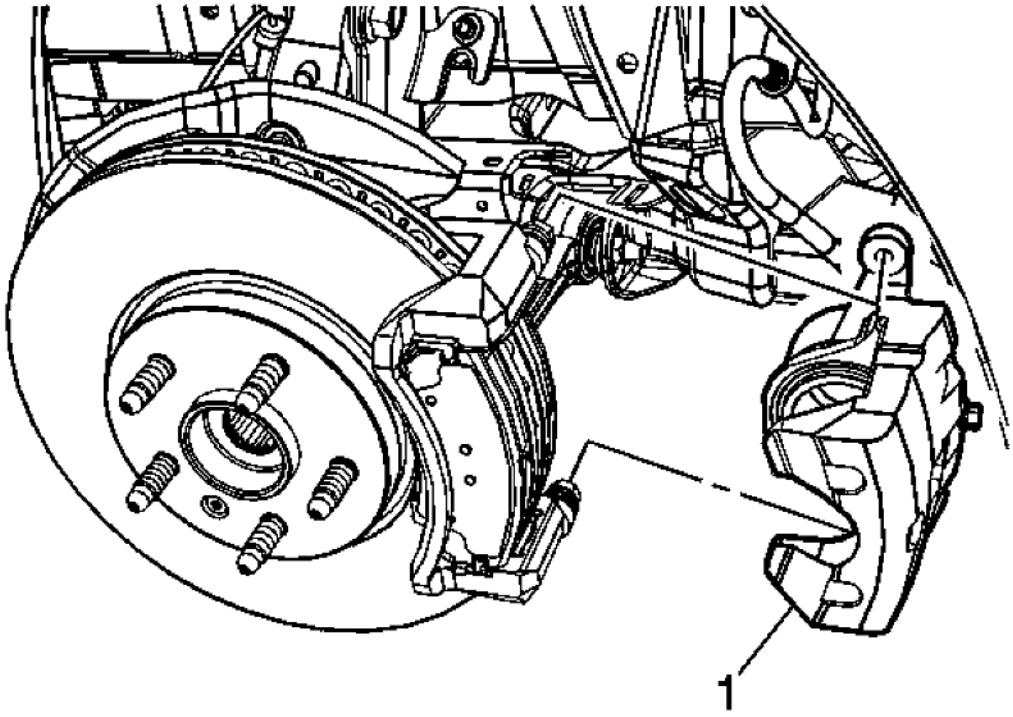


Fig. 95: Brake Caliper
Courtesy of GENERAL MOTORS CORP.

15. Install the brake caliper (1) to the caliper bracket.

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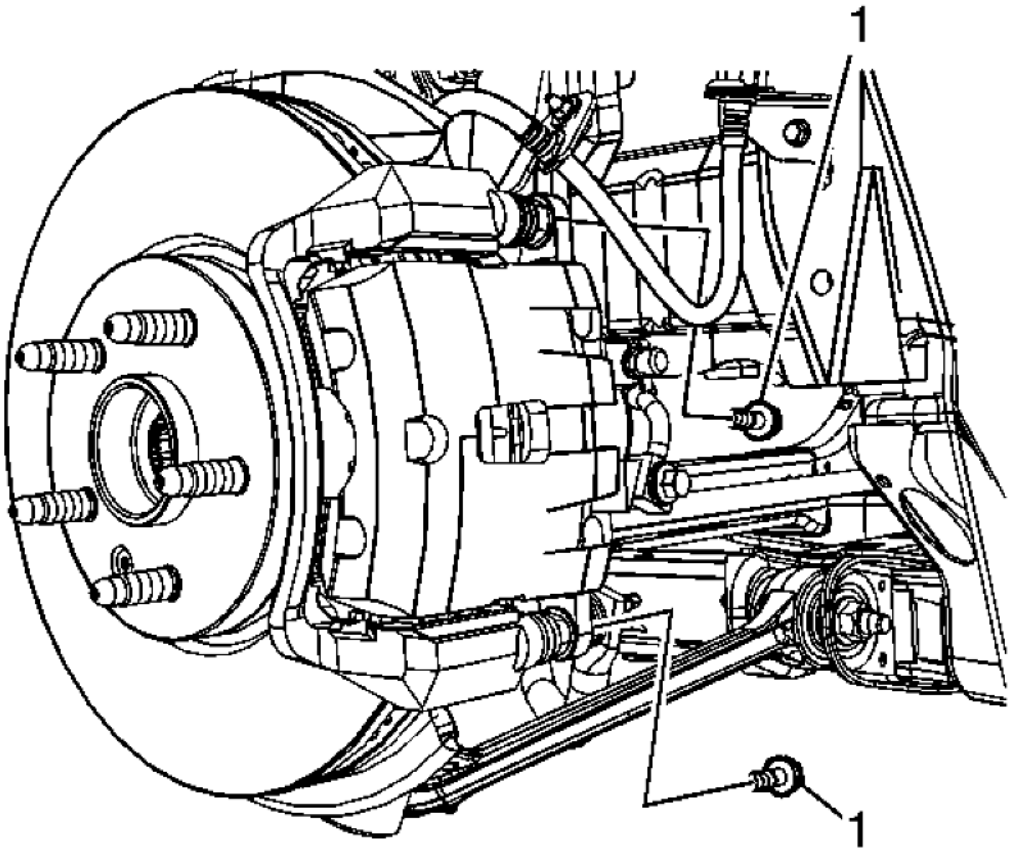


Fig. 96: Brake Caliper Guide Pin Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

NOTE: The brake caliper guide pin bolts must be replaced any time they are removed.

16. Using a backup wrench on the brake caliper guide pins, install 2 new brake caliper guide pin bolts (1) and tighten to 27 N.m (20 lb ft).
17. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .

FRONT BRAKE CALIPER HARDWARE REPLACEMENT (L99, LS3)

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WARNING: **Refer to Brake Dust Warning .**

Removal Procedure

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

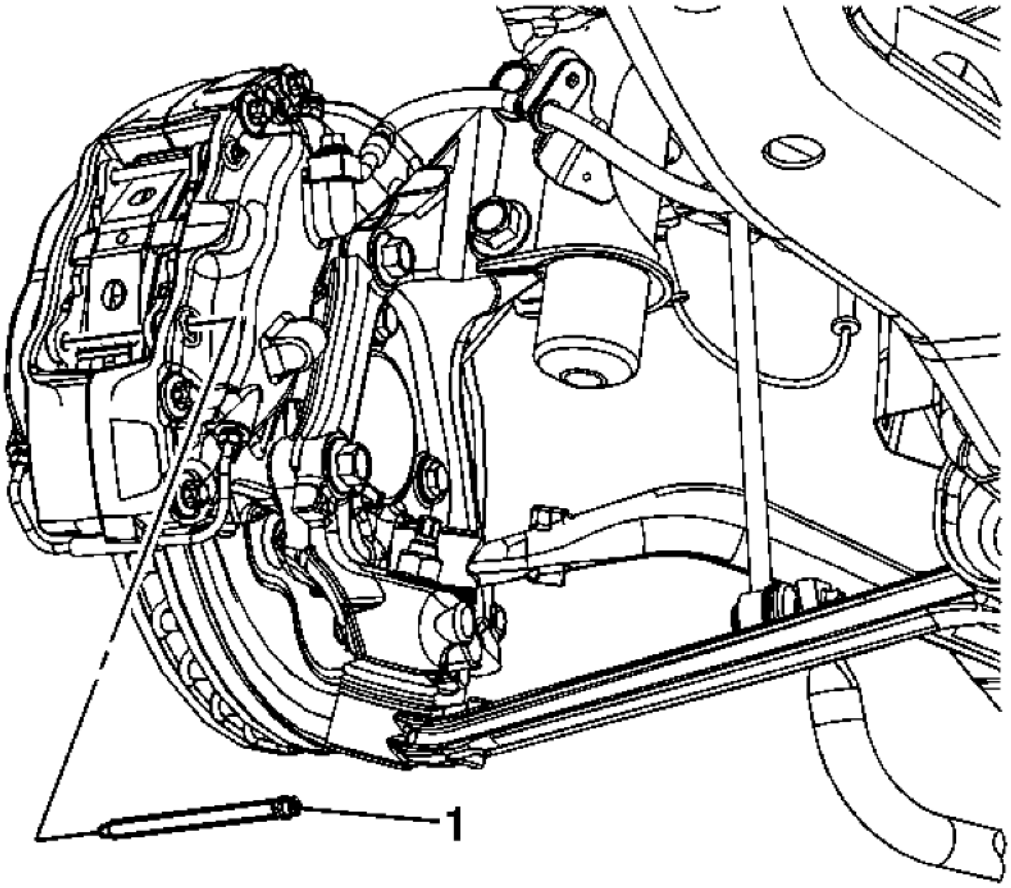


Fig. 97: Lower Brake Caliper Pin
Courtesy of GENERAL MOTORS CORP.

3. Hold the end of the brake pad spring down and carefully drive out the lower brake pad pin (1) from the brake caliper.

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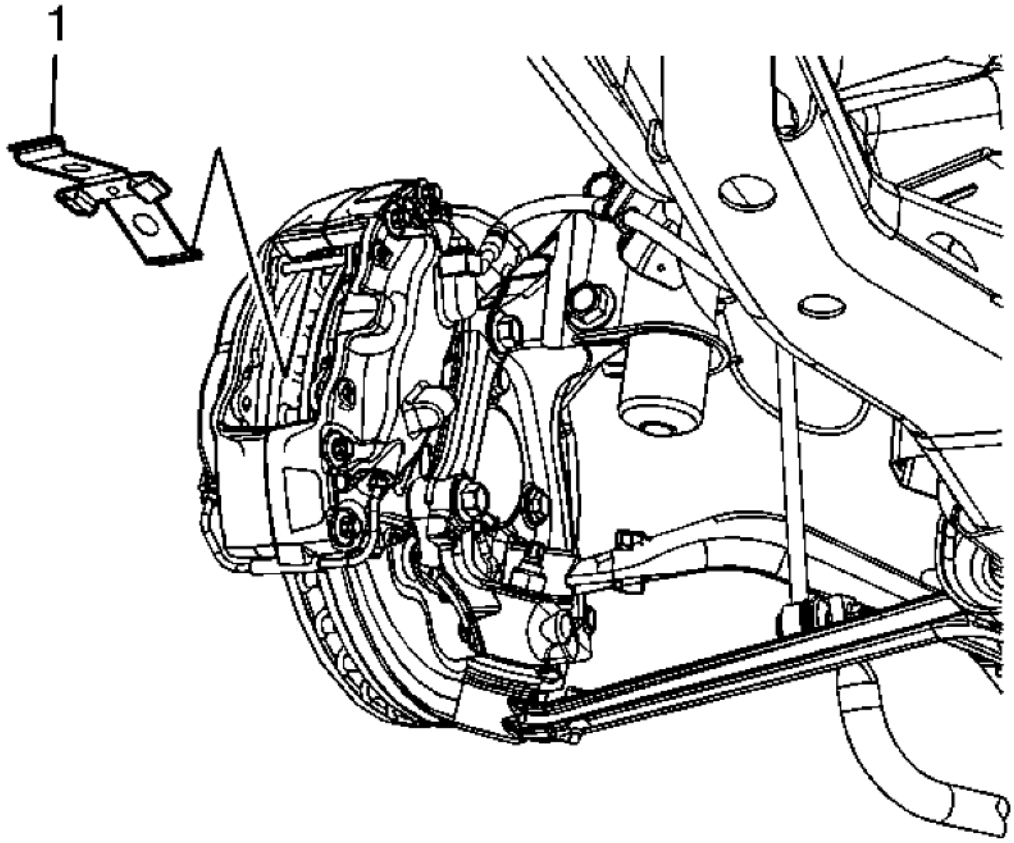


Fig. 98: Brake Pad Spring
Courtesy of GENERAL MOTORS CORP.

4. Remove the brake pad spring (1).

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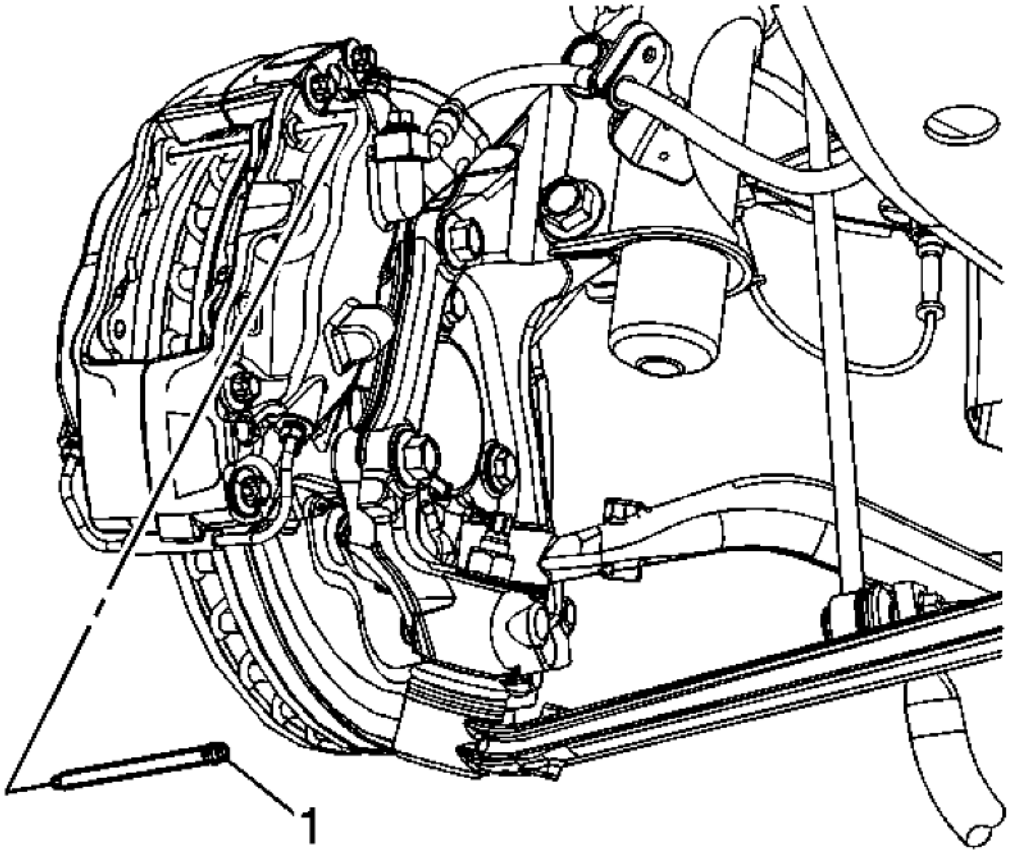


Fig. 99: Upper Brake Pad Pin
Courtesy of GENERAL MOTORS CORP.

5. Carefully drive out the upper brake pad pin (1) from the brake caliper.

Installation Procedure

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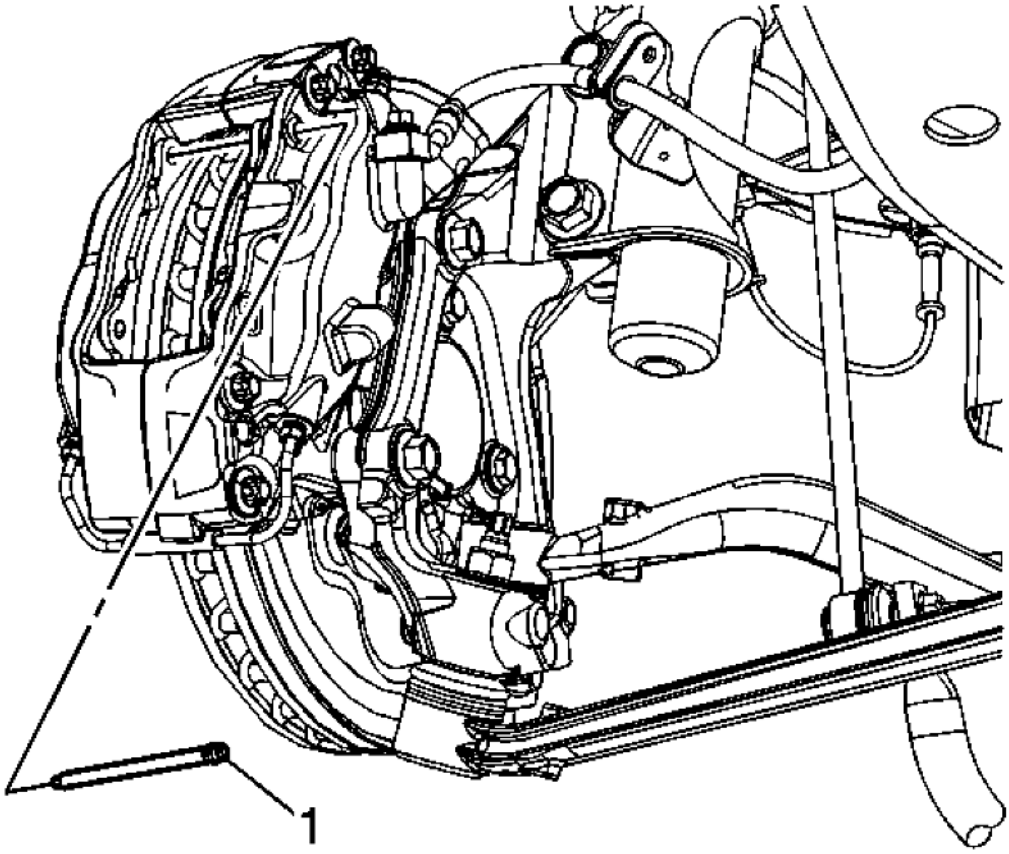


Fig. 100: Upper Brake Pad Pin
Courtesy of GENERAL MOTORS CORP.

1. Inspect the brake pad pins and brake pad spring for damage or excessive corrosion and replace, if necessary. Refer to **Front Disc Brake Mounting and Hardware Inspection**.
2. Carefully drive the upper brake pad pin (1) into the brake caliper.
3. Ensure the brake pad pin is fully seated in the brake caliper.

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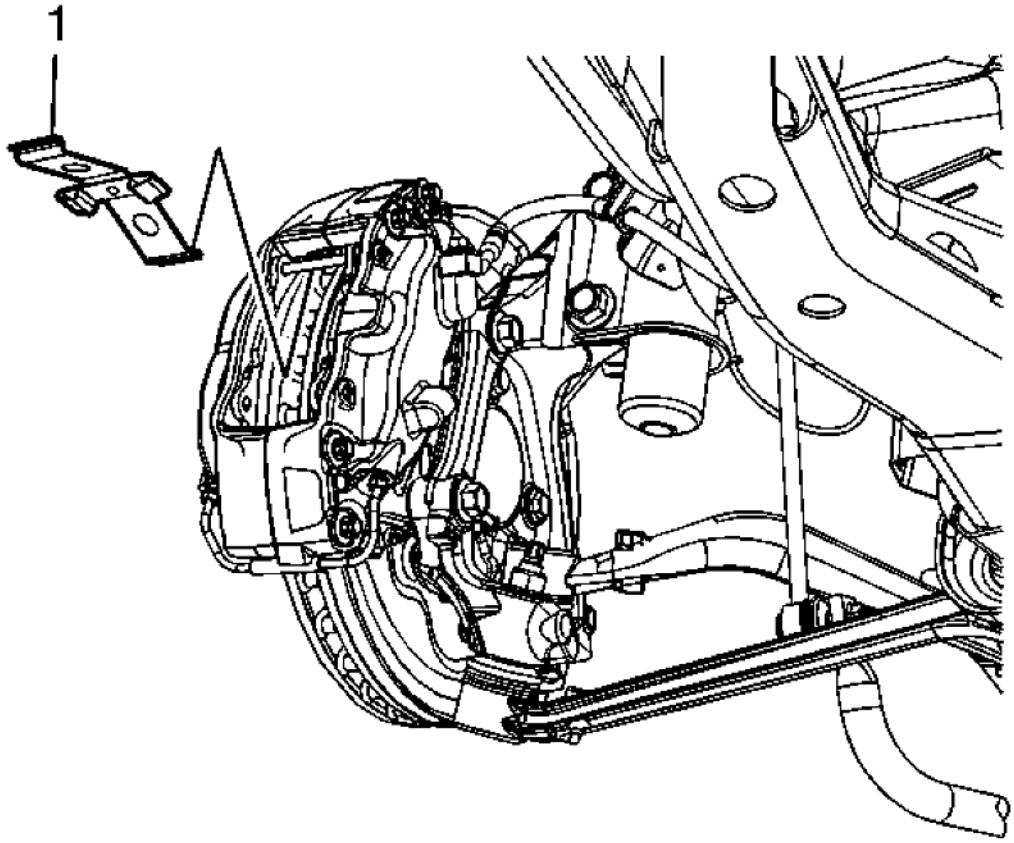


Fig. 101: Brake Pad Spring
Courtesy of GENERAL MOTORS CORP.

4. Install the brake pad spring (1).

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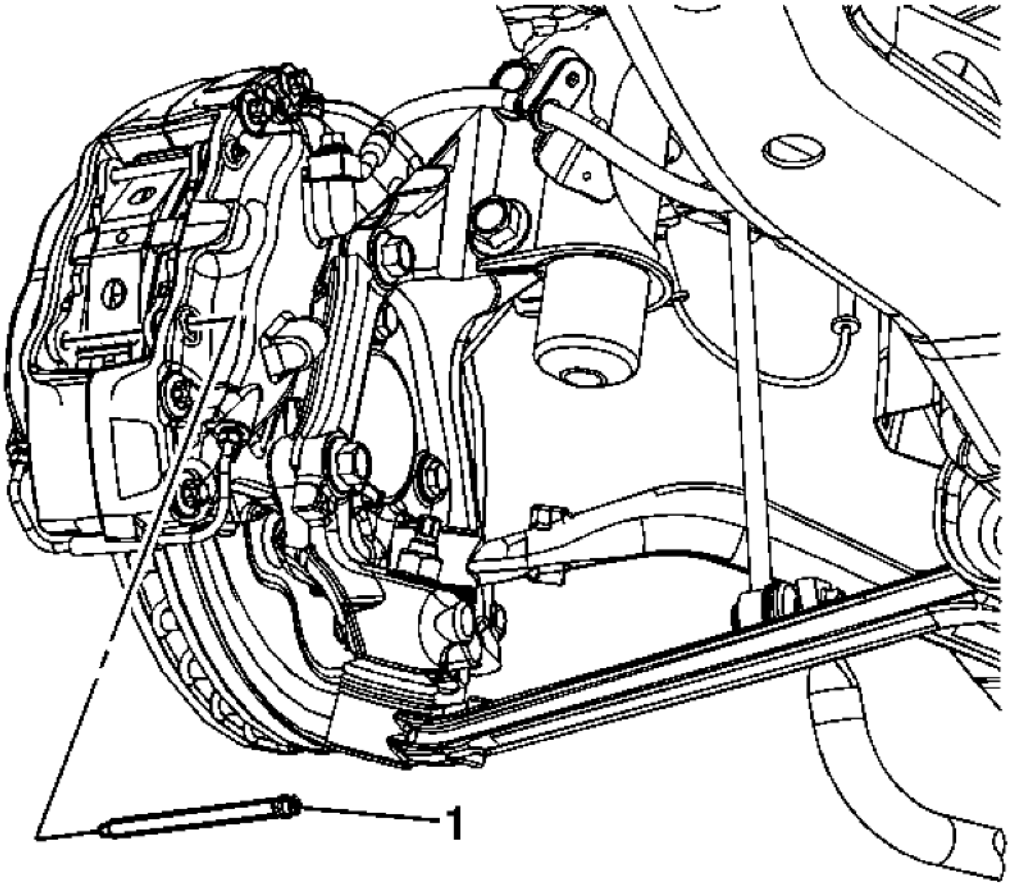


Fig. 102: Lower Brake Caliper Pin
Courtesy of GENERAL MOTORS CORP.

5. Hold the end of the brake pad spring down and carefully drive the lower brake pad pin (1) into the brake caliper.
6. Ensure the brake pad pin is fully seated in the brake caliper.
7. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .

REAR BRAKE CALIPER HARDWARE REPLACEMENT (LLT)

Removal Procedure

WARNING: Refer to Brake Dust Warning .

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

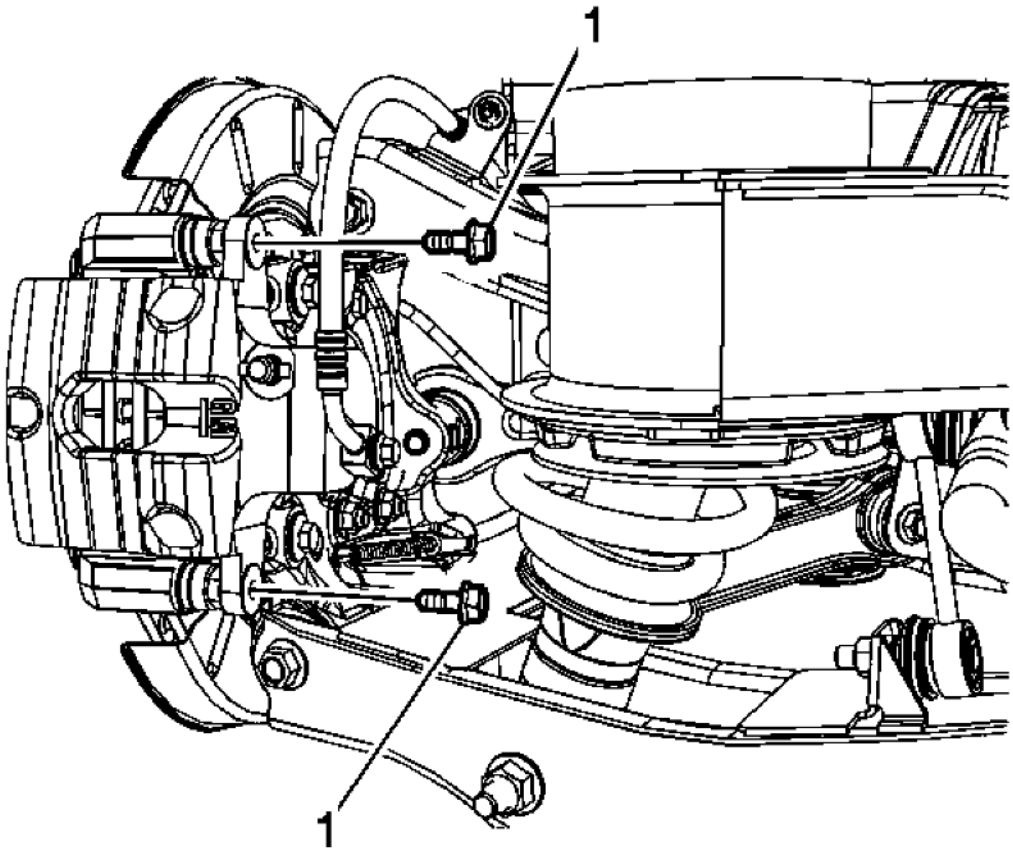


Fig. 103: Brake Caliper Guide Pin Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: The brake caliper guide pin bolts must be replaced any time they are removed. Do not reuse the brake caliper guide pin bolts.

3. Using a backup wrench on the brake caliper guide pin, remove and discard the brake caliper guide pin bolts (1).

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

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caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

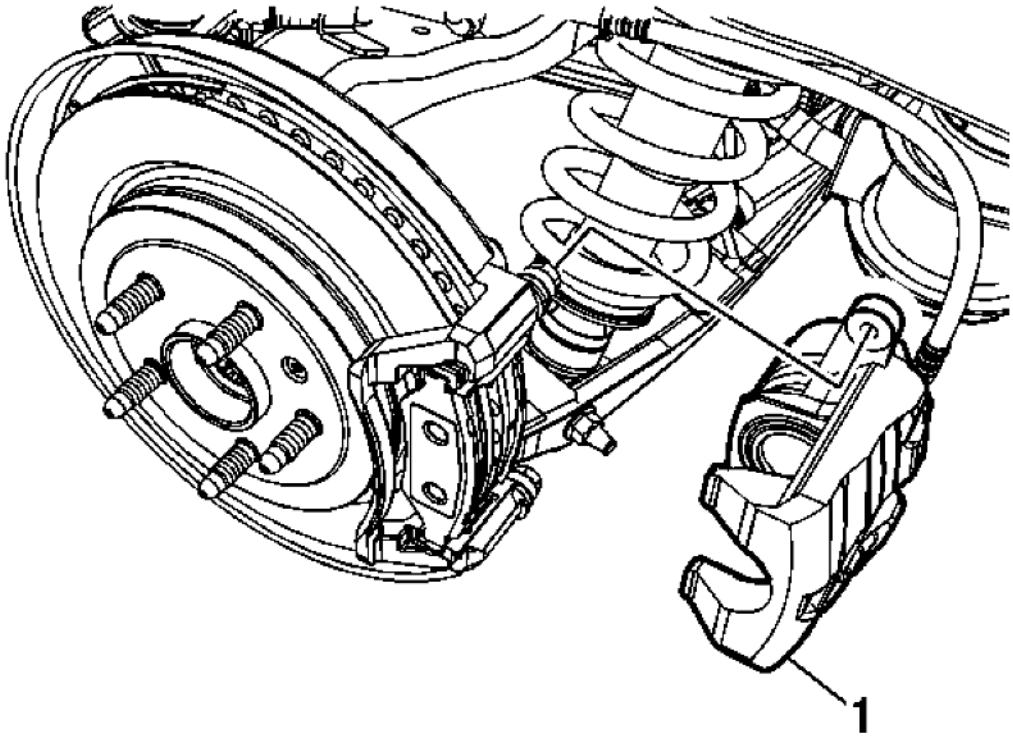


Fig. 104: Brake Caliper
Courtesy of GENERAL MOTORS CORP.

4. Remove the brake caliper (1) and support with heavy mechanics wire or equivalent.

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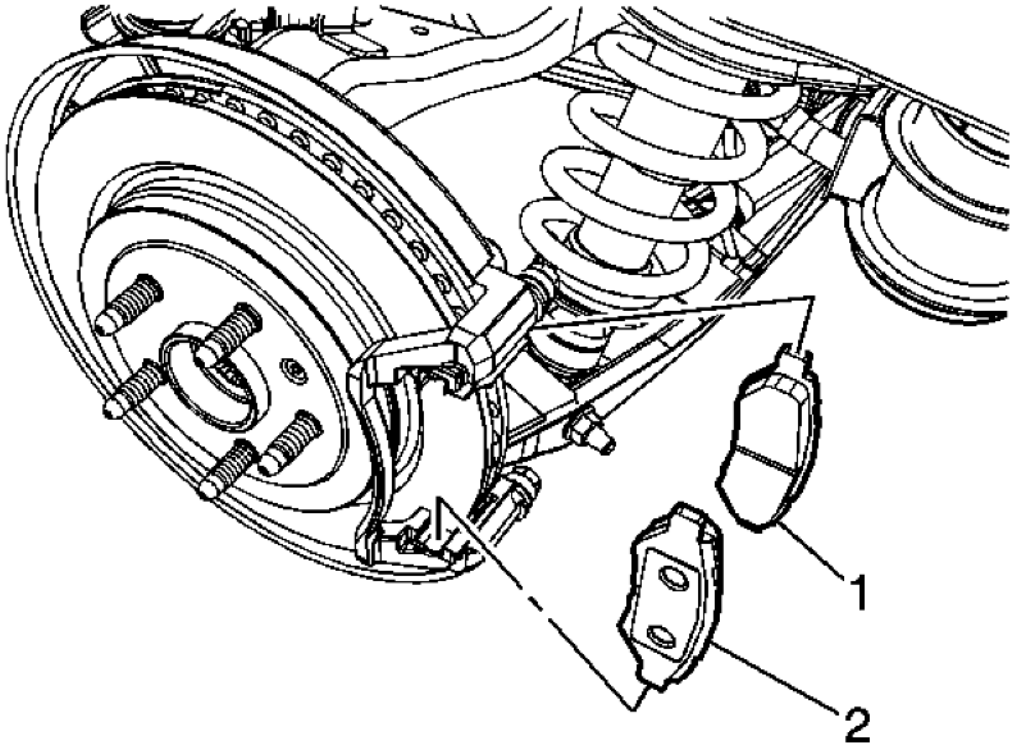


Fig. 105: Brake Pads
Courtesy of GENERAL MOTORS CORP.

5. Remove the inner brake pad (1).
6. Remove the outer brake pad (2).

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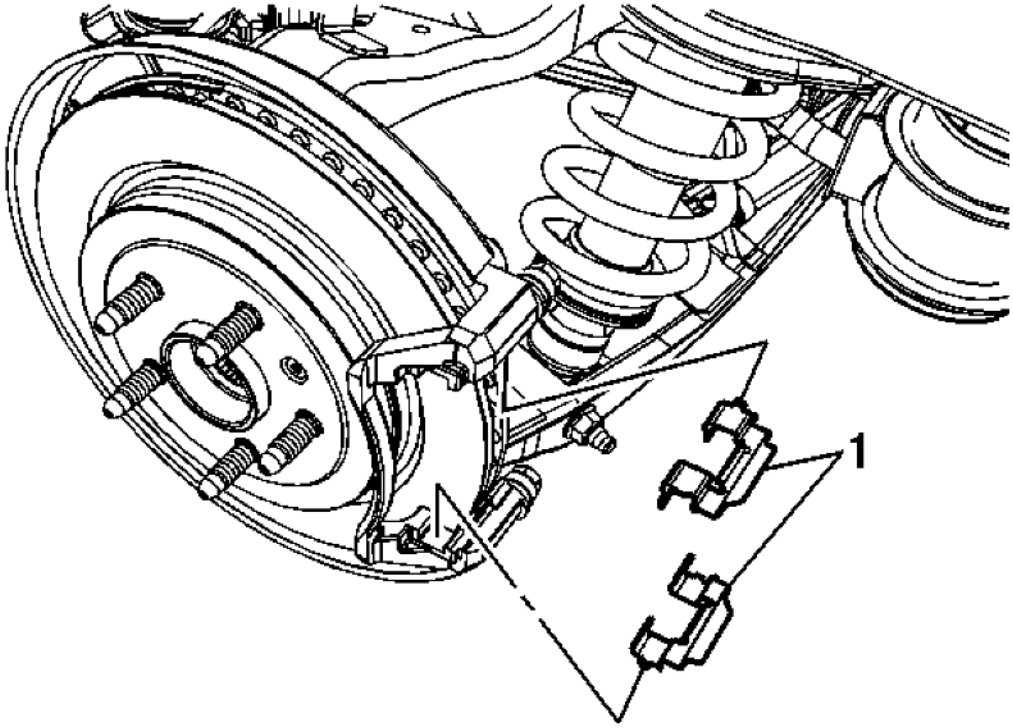


Fig. 106: Brake Pad Springs
Courtesy of GENERAL MOTORS CORP.

7. Remove the brake pad springs (1).

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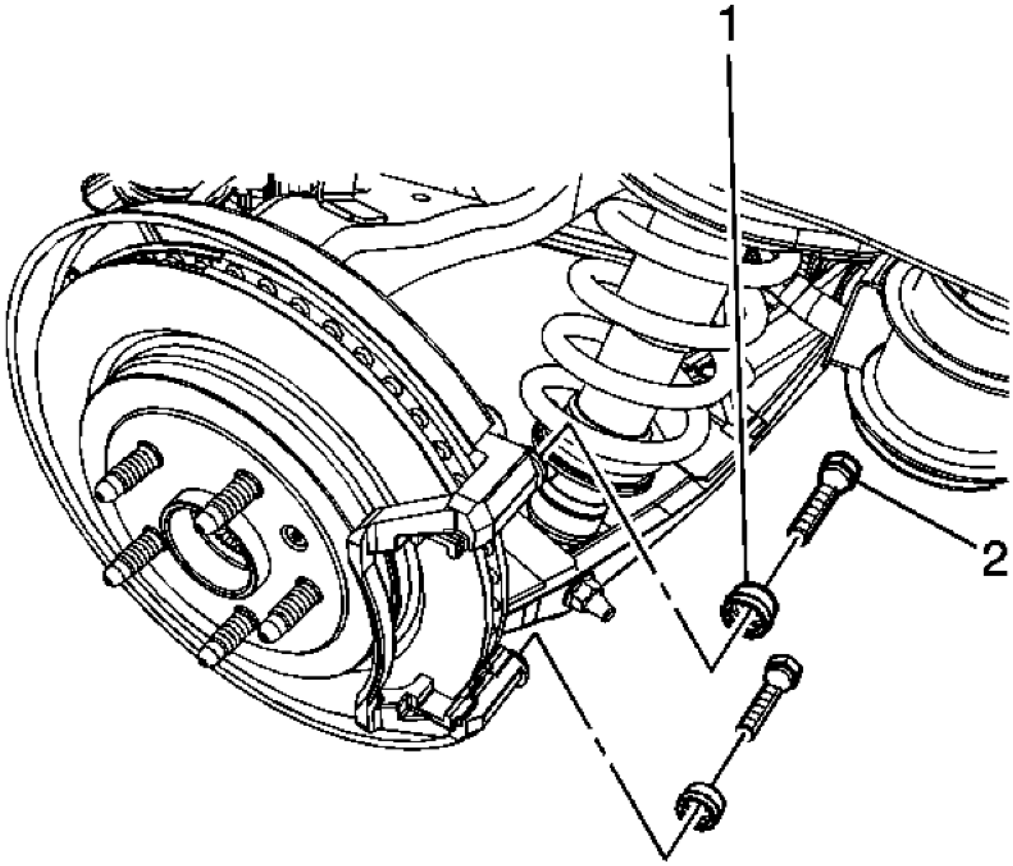


Fig. 107: Brake Caliper Guide Pins & Seals
Courtesy of GENERAL MOTORS CORP.

8. Remove the 2 brake caliper guide pin seals (1) and guide pins (2).

Installation Procedure

1. Inspect the brake caliper guide pins, seals and brake pad springs for damage and/or corrosion. Refer to **Rear Disc Brake Mounting and Hardware Inspection**.

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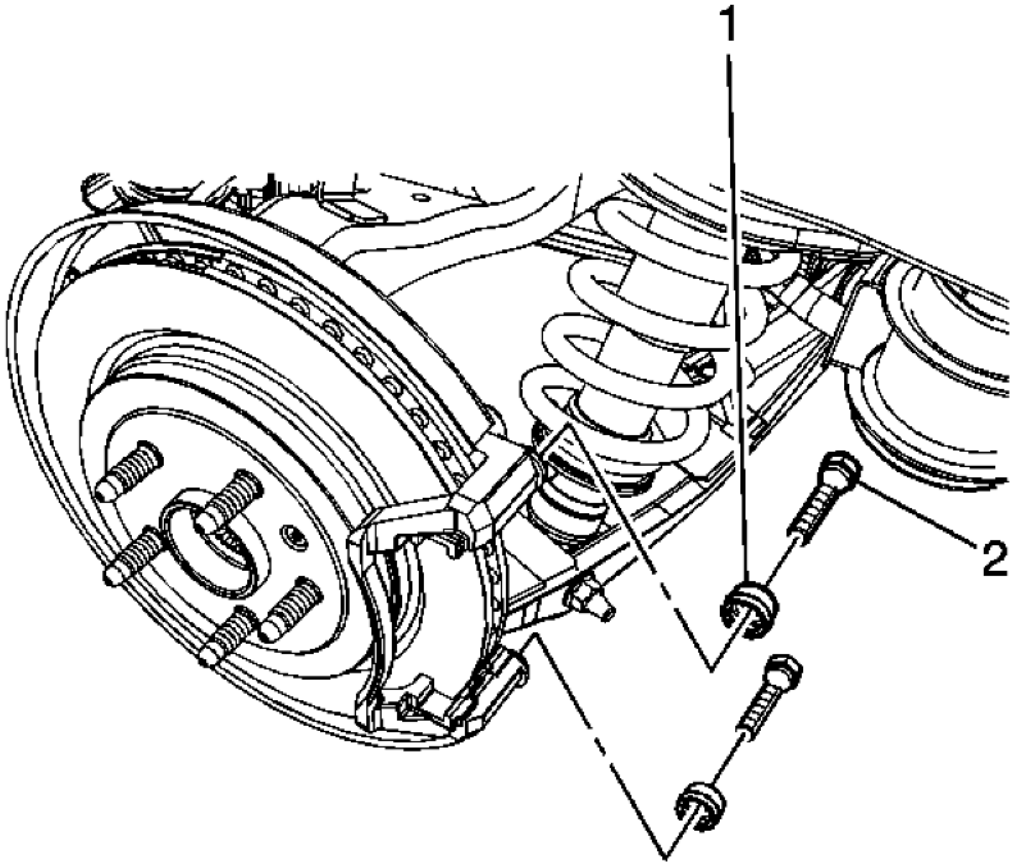


Fig. 108: Brake Caliper Guide Pins & Seals
Courtesy of GENERAL MOTORS CORP.

2. Apply a thin coat of high temperature silicone brake lubricant the brake caliper guide pins.
3. Install the 2 brake caliper guide pin seals (1) to the guide pins (2).
4. Ensure the guide pin seals are fully seated in the groove of the brake caliper guide pins.
5. Install the 2 guide pins and seals to the brake caliper bracket.
6. Ensure the guide pin seal is fully seated in the groove of the brake caliper bracket.

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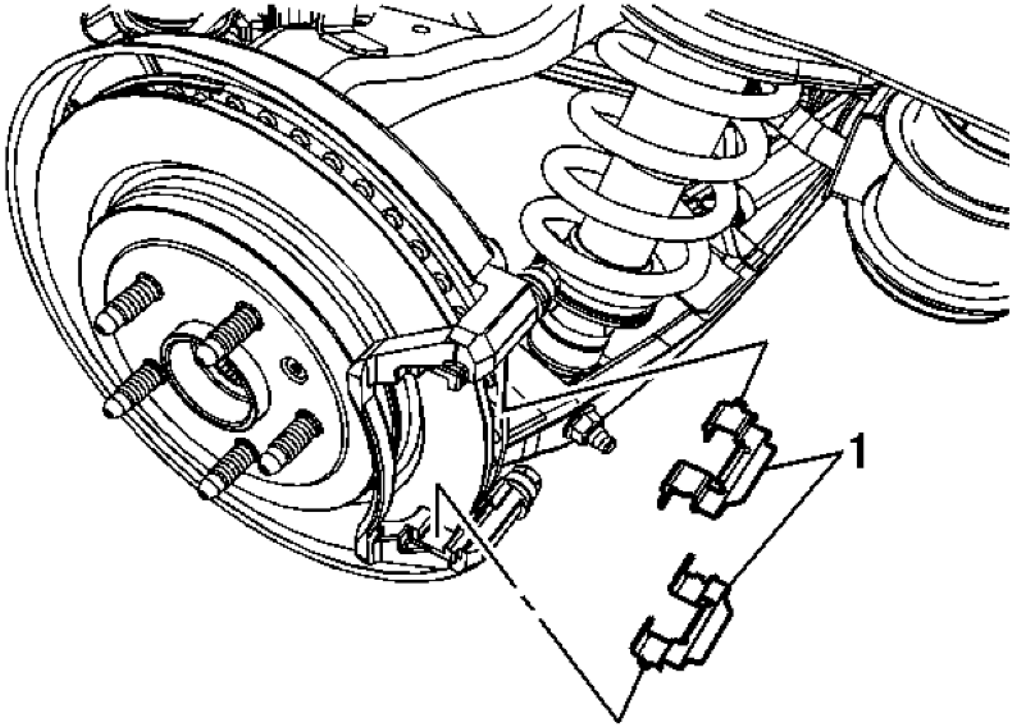


Fig. 109: Brake Pad Springs
Courtesy of GENERAL MOTORS CORP.

7. Install the brake pad springs (1).

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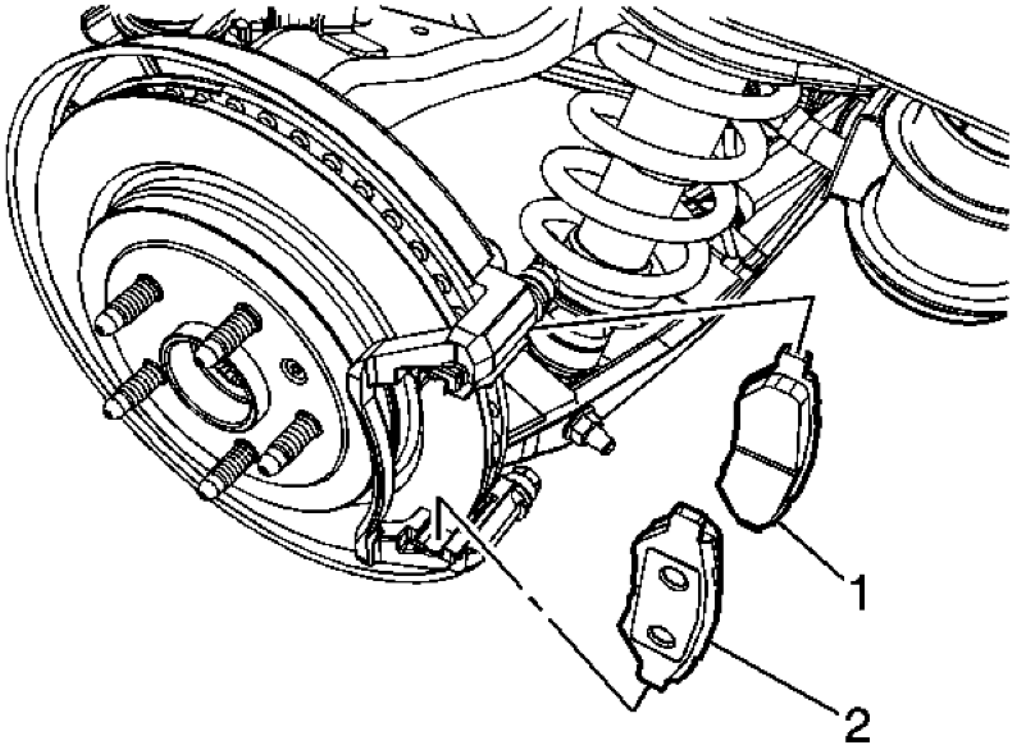


Fig. 110: Brake Pads
Courtesy of GENERAL MOTORS CORP.

8. Install the inner brake pad (1).
9. Install the outer brake pad (2).

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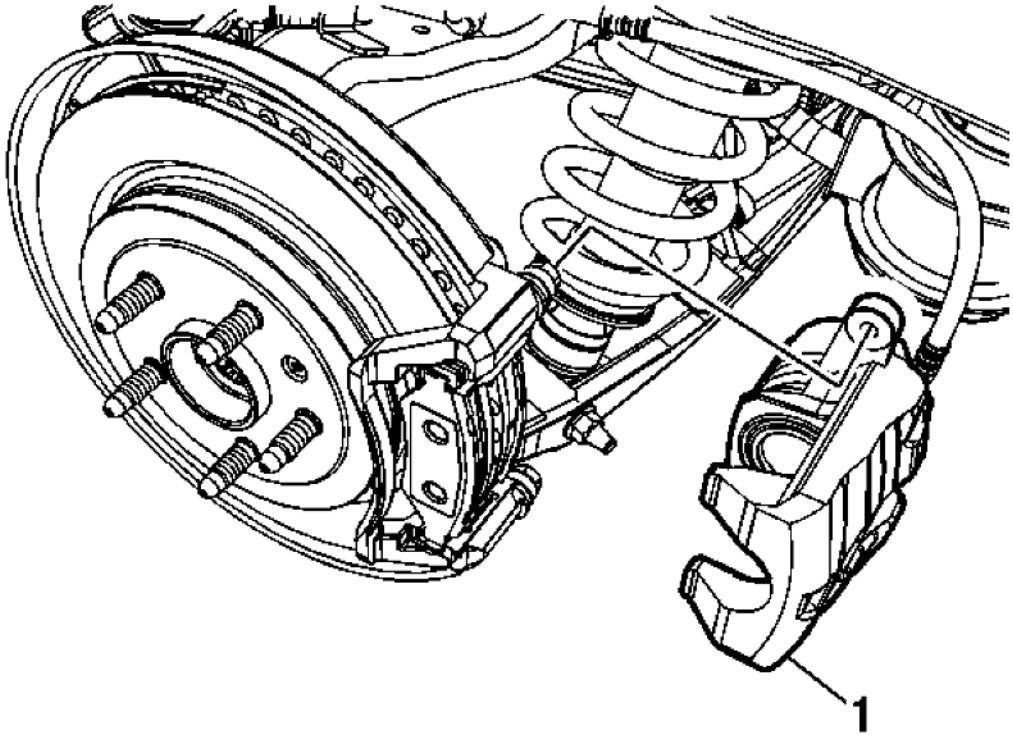


Fig. 111: Brake Caliper
Courtesy of GENERAL MOTORS CORP.

10. Install the brake caliper (1) to the brake caliper bracket.

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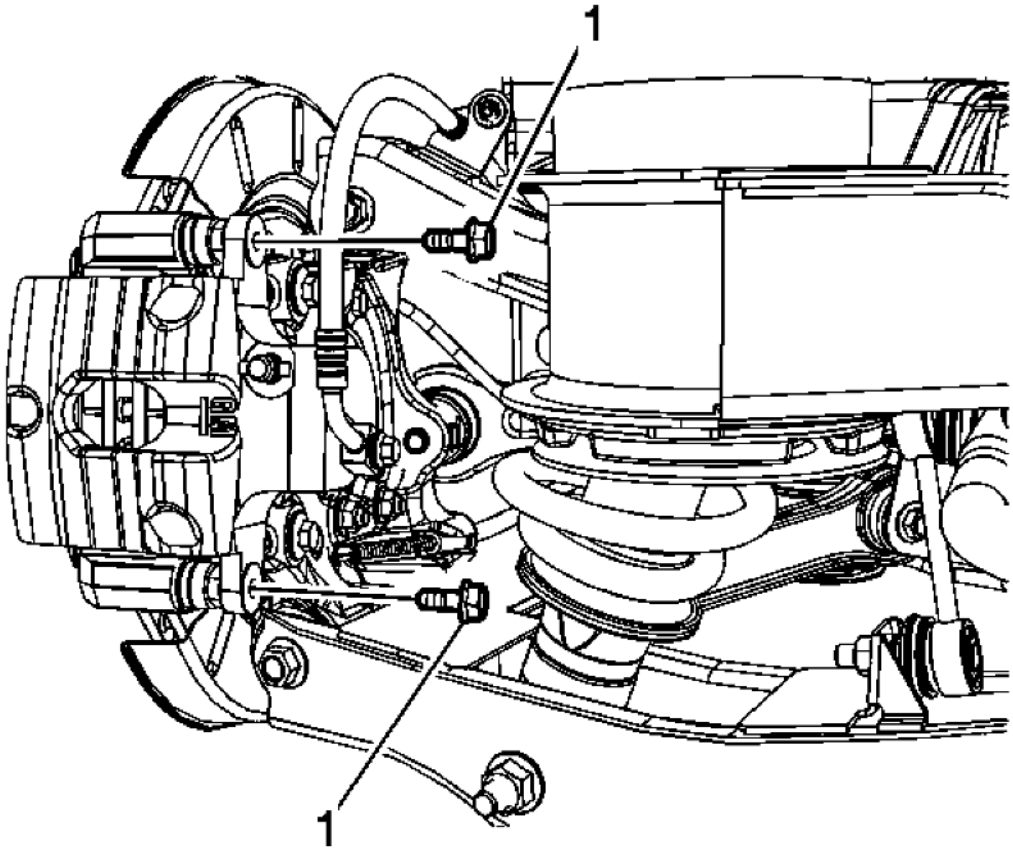


Fig. 112: Brake Caliper Guide Pin Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

NOTE: The brake caliper guide pin bolts must be replaced any time they are removed.

11. Using a backup wrench on the brake caliper guide pins, install 2 new brake caliper guide pin bolts (1) and tighten to 27 N.m (20 lb ft).
12. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .

REAR BRAKE CALIPER HARDWARE REPLACEMENT (L99, LS3)

Removal Procedure

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WARNING: **Refer to Brake Dust Warning .**

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

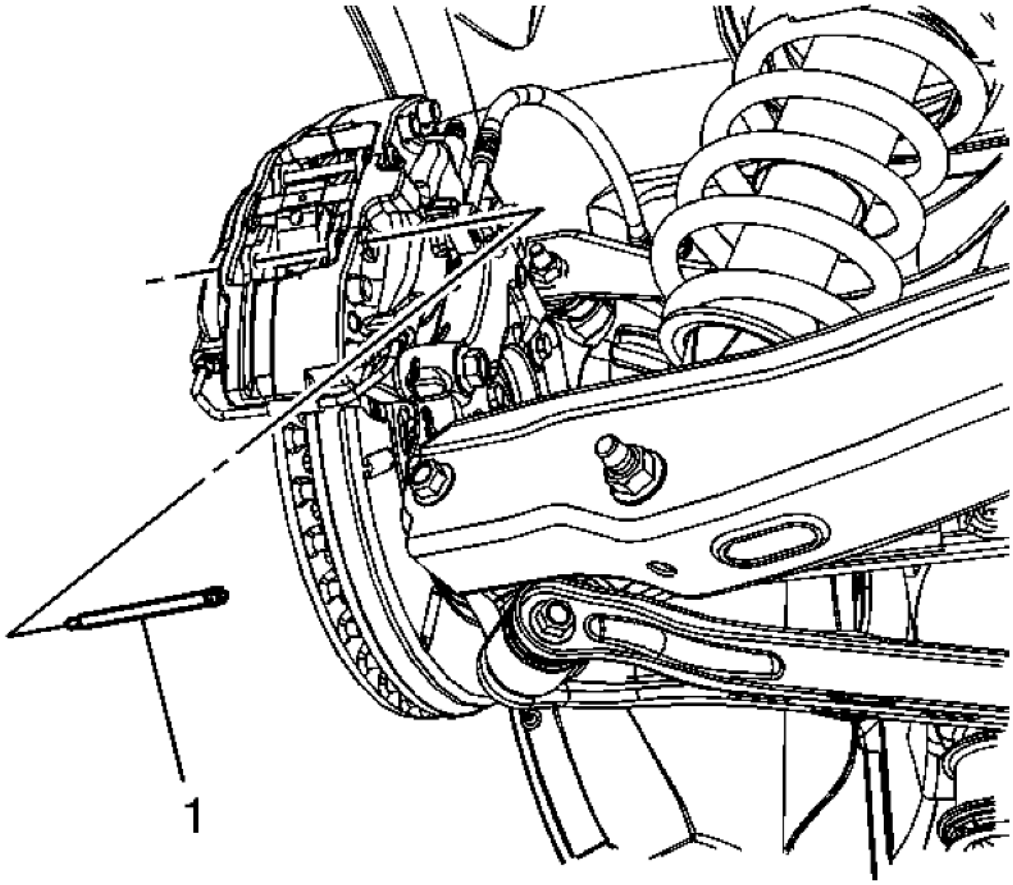


Fig. 113: Lower Brake Caliper Pin
Courtesy of GENERAL MOTORS CORP.

3. Hold the end of the brake pad spring down and carefully drive out the lower brake pad pin (1) from the brake caliper.

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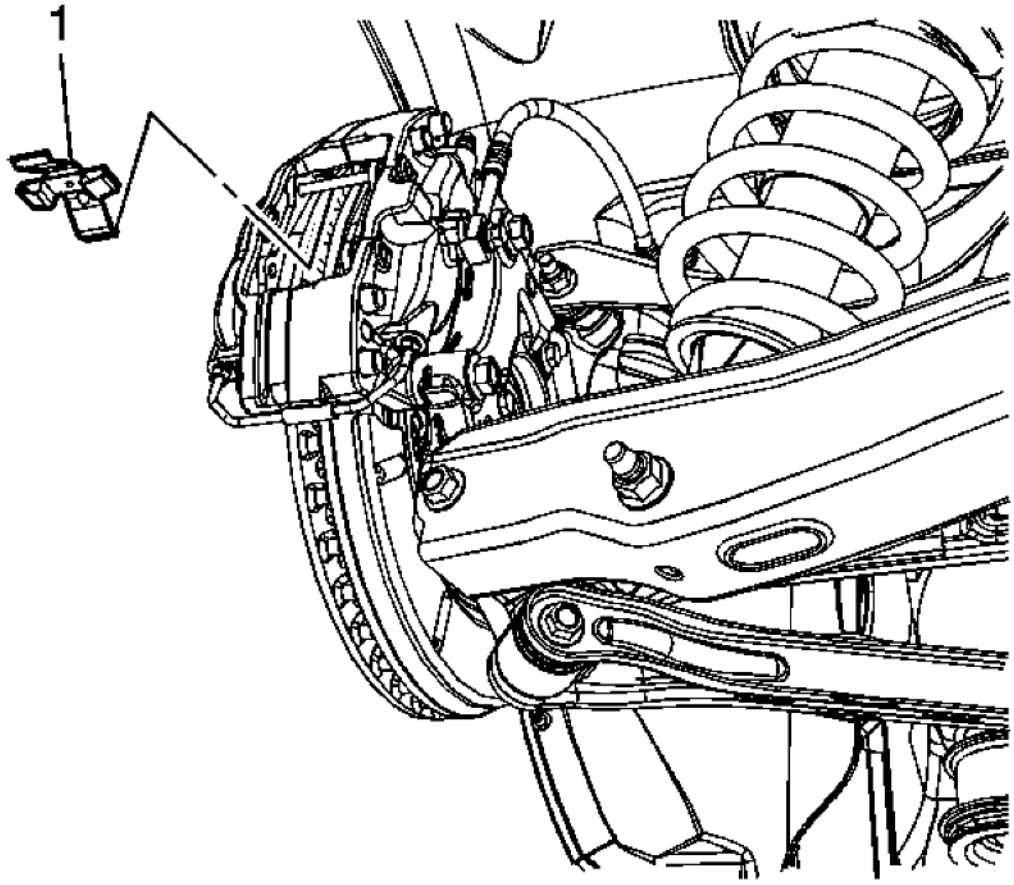


Fig. 114: Brake Pad Spring
Courtesy of GENERAL MOTORS CORP.

4. Remove the brake pad spring (1).

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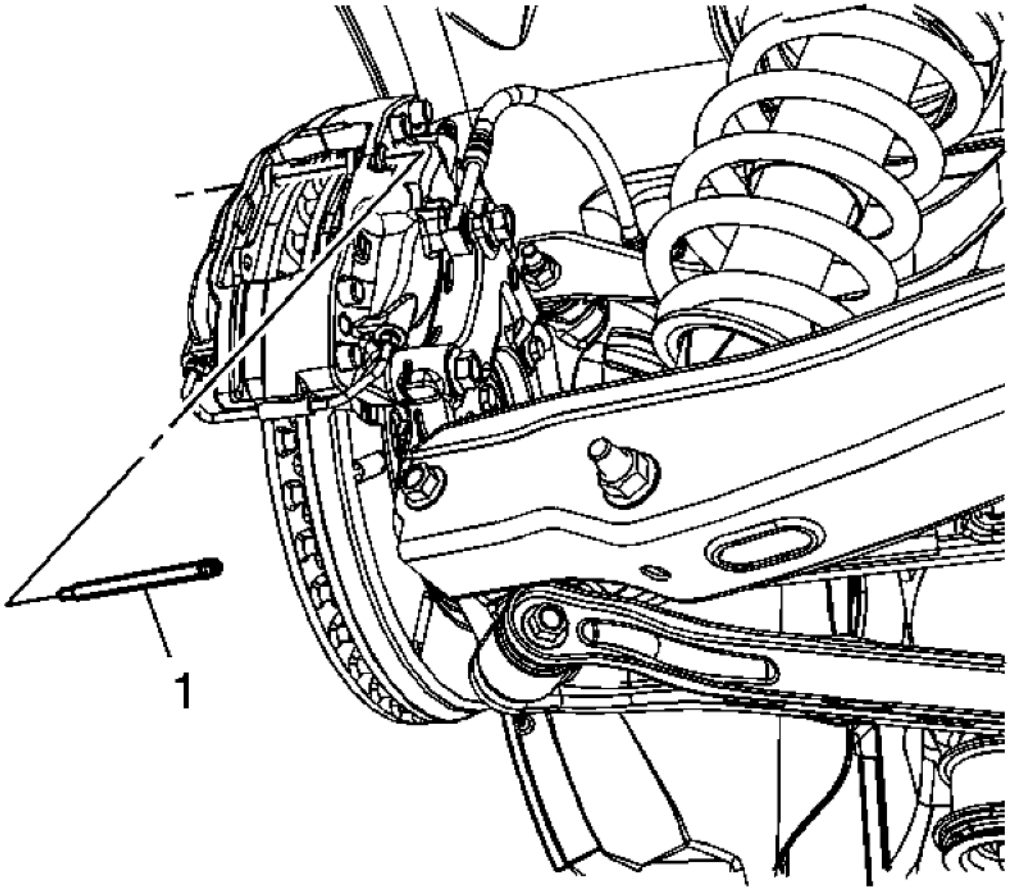


Fig. 115: Upper Brake Caliper Pin
Courtesy of GENERAL MOTORS CORP.

5. Carefully drive out the upper brake pad pin (1) from the brake caliper.

Installation Procedure

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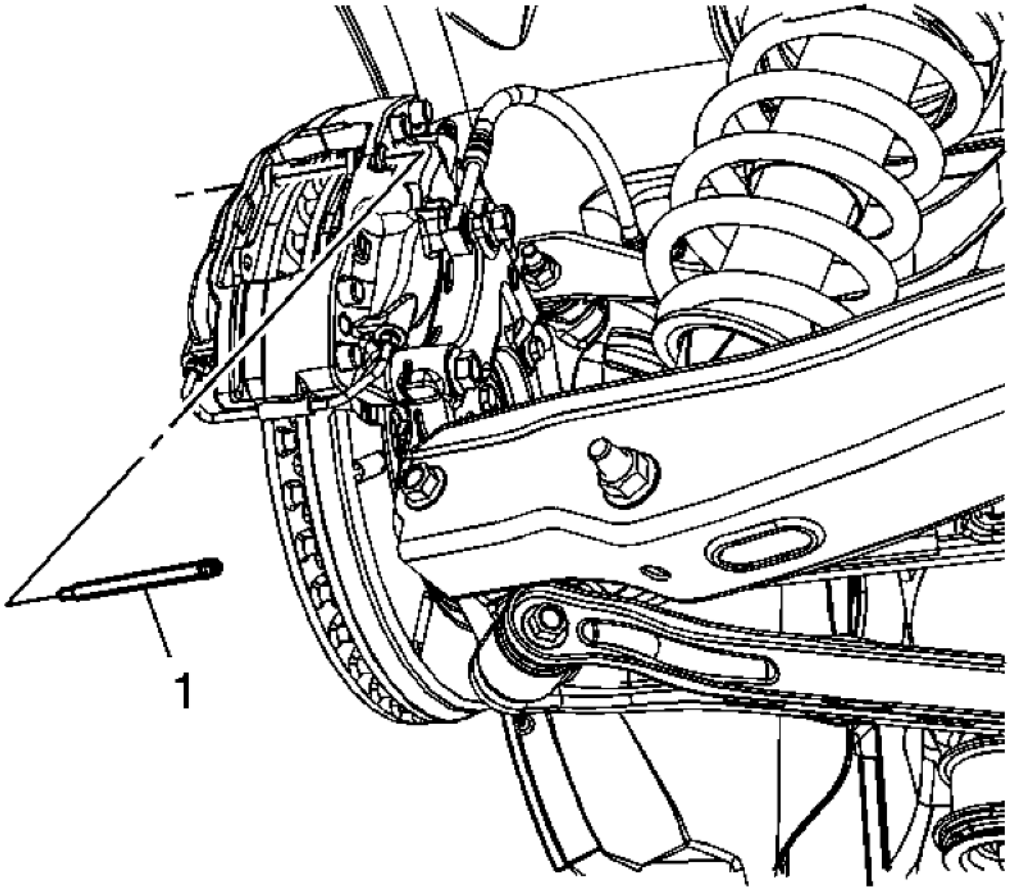


Fig. 116: Upper Brake Caliper Pin
Courtesy of GENERAL MOTORS CORP.

1. Inspect the brake pad pins and brake pad spring for damage or excessive corrosion and replace, if necessary. Refer to **Front Disc Brake Mounting and Hardware Inspection**.
2. Carefully drive the upper brake pad pin (1) into the brake caliper.
3. Ensure the brake pad pin is fully seated in the brake caliper.

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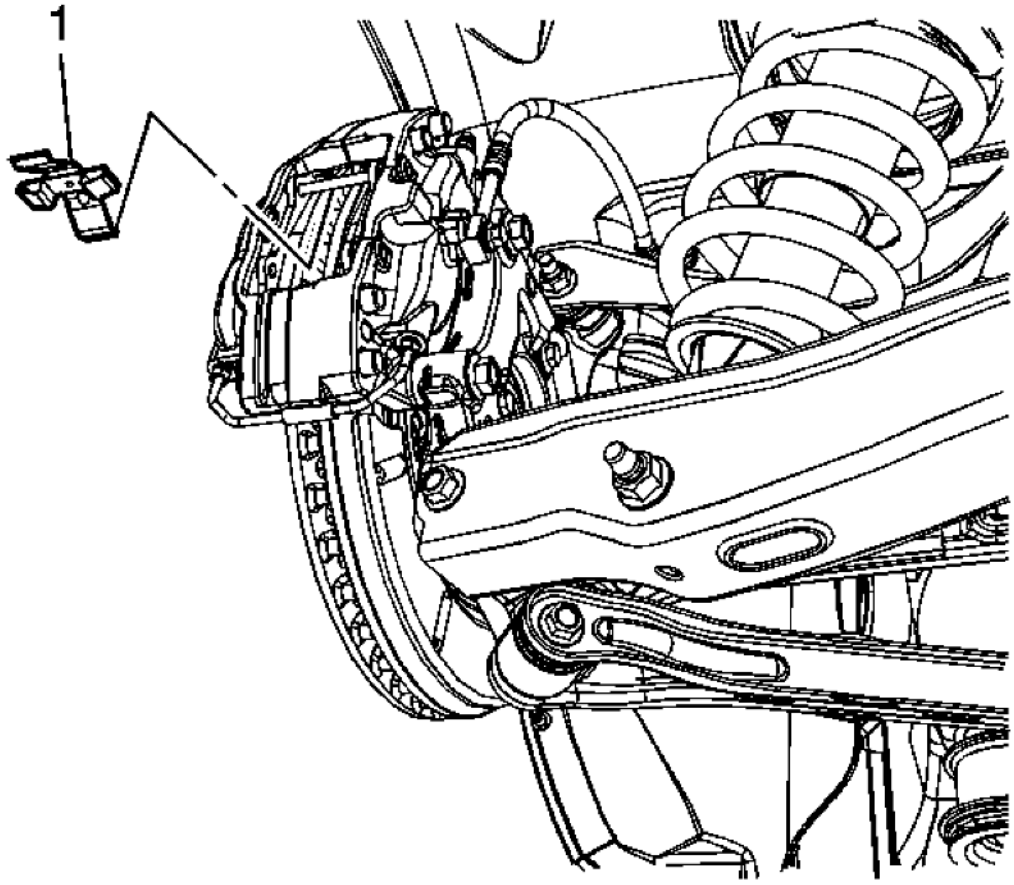


Fig. 117: Brake Pad Spring
Courtesy of GENERAL MOTORS CORP.

4. Install the brake pad spring (1).

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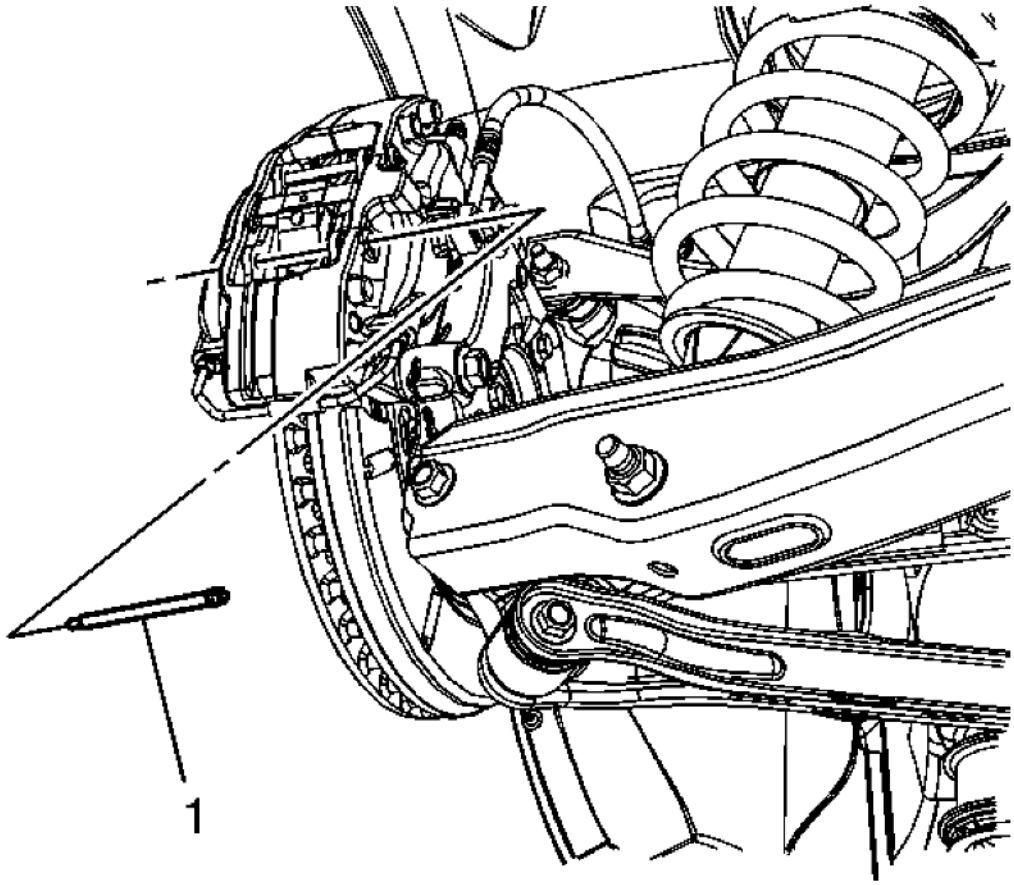


Fig. 118: Lower Brake Caliper Pin
Courtesy of GENERAL MOTORS CORP.

5. Hold the end of the brake pad spring down and carefully drive the lower brake pad pin (1) into the brake caliper.
6. Ensure the brake pad pin is fully seated in the brake caliper.
7. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .

FRONT BRAKE CALIPER BRACKET REPLACEMENT

Removal Procedure

WARNING: Refer to Brake Dust Warning .

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

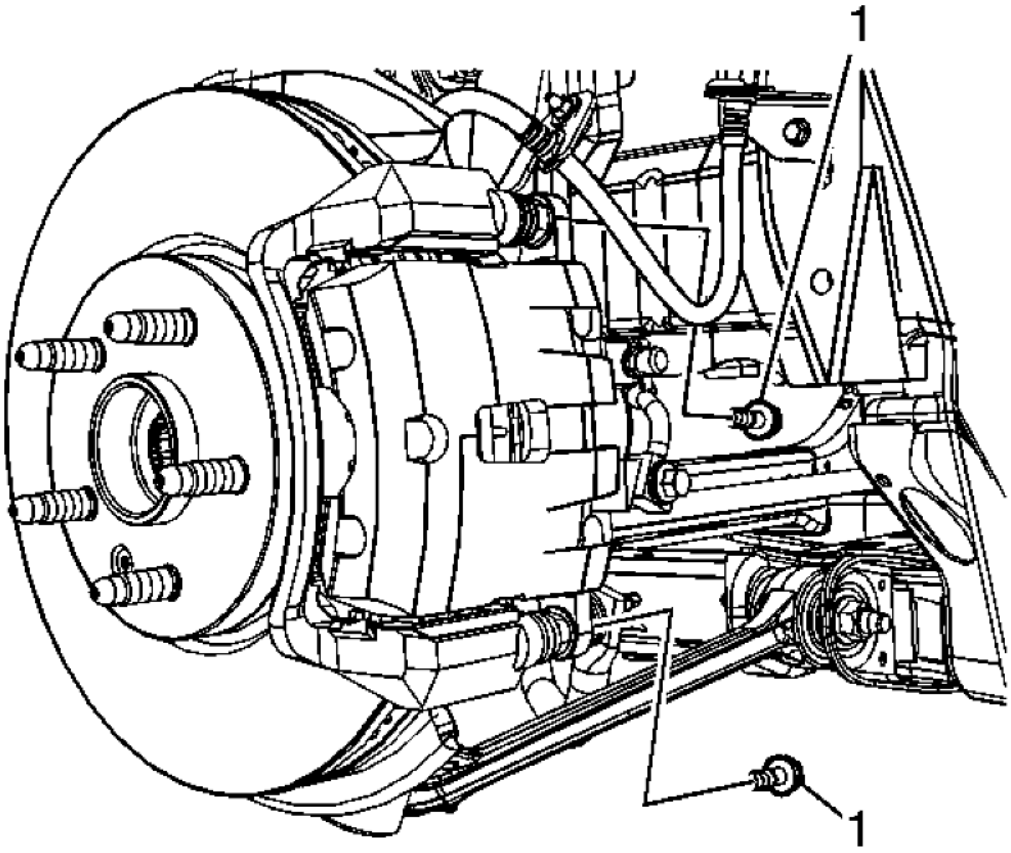


Fig. 119: Brake Caliper Guide Pin Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: **The brake caliper guide pin bolts must be replaced any time they are removed. Do not reuse the brake caliper guide pin bolts.**

3. Using a backup wrench on the brake caliper guide pins, remove and discard the brake caliper guide pin bolts (1).

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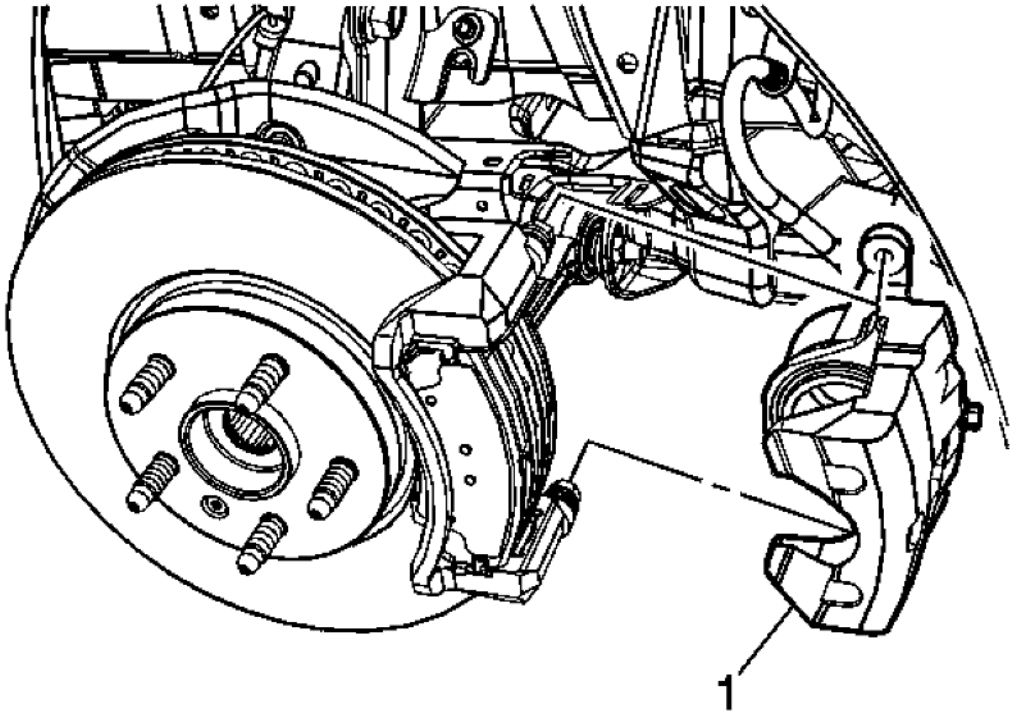


Fig. 120: Brake Caliper
Courtesy of GENERAL MOTORS CORP.

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.

4. Remove the disc brake caliper (1) and support with heavy mechanics wire or equivalent.

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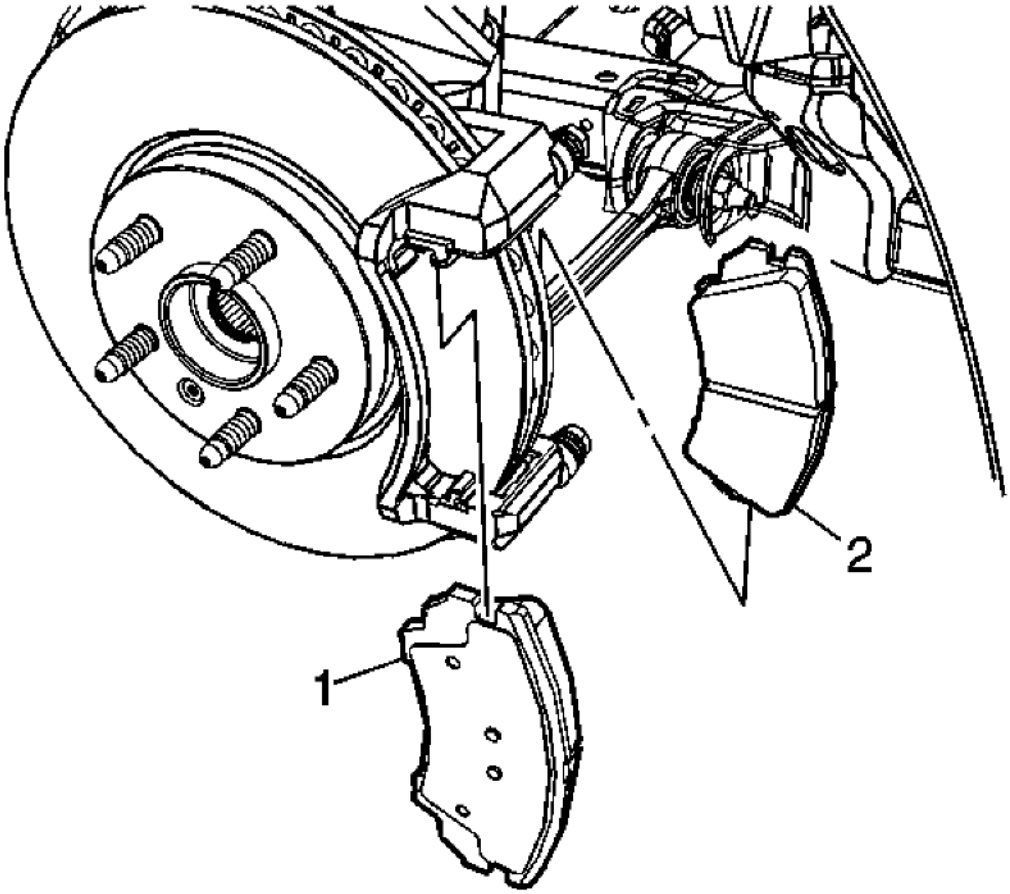


Fig. 121: Brake Pads
Courtesy of GENERAL MOTORS CORP.

5. Remove the outer disc brake pad (1).
6. Remove the inner disc brake pad (2).

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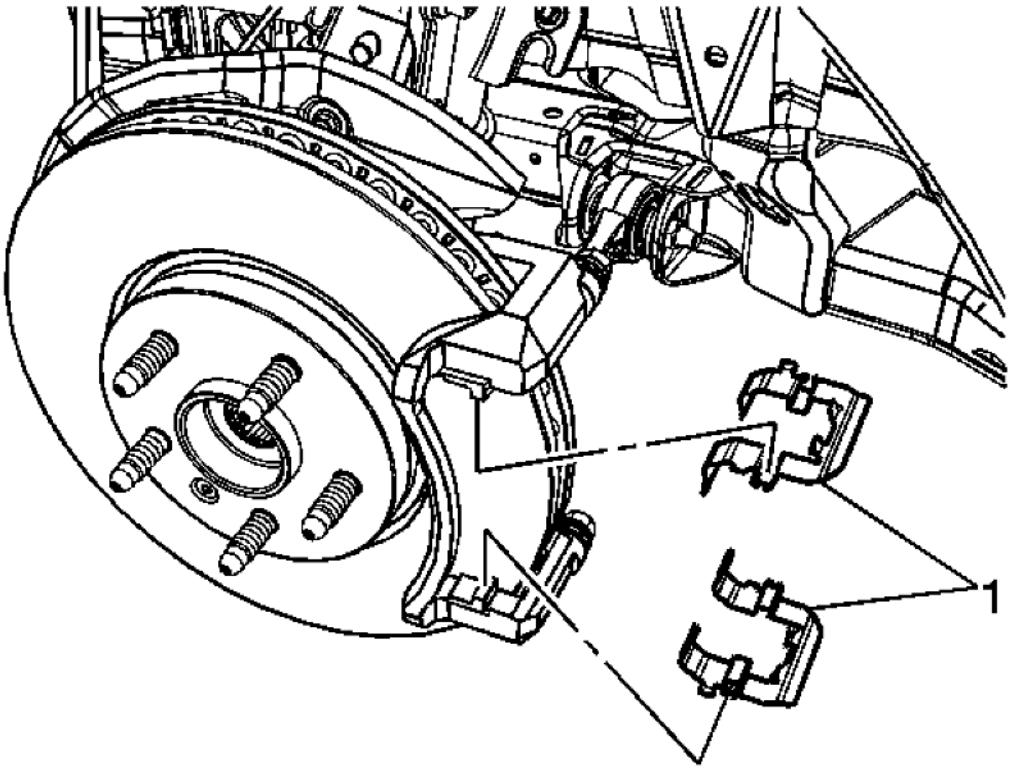


Fig. 122: Brake Pad Springs
Courtesy of GENERAL MOTORS CORP.

7. Remove the disc brake pad springs (1).

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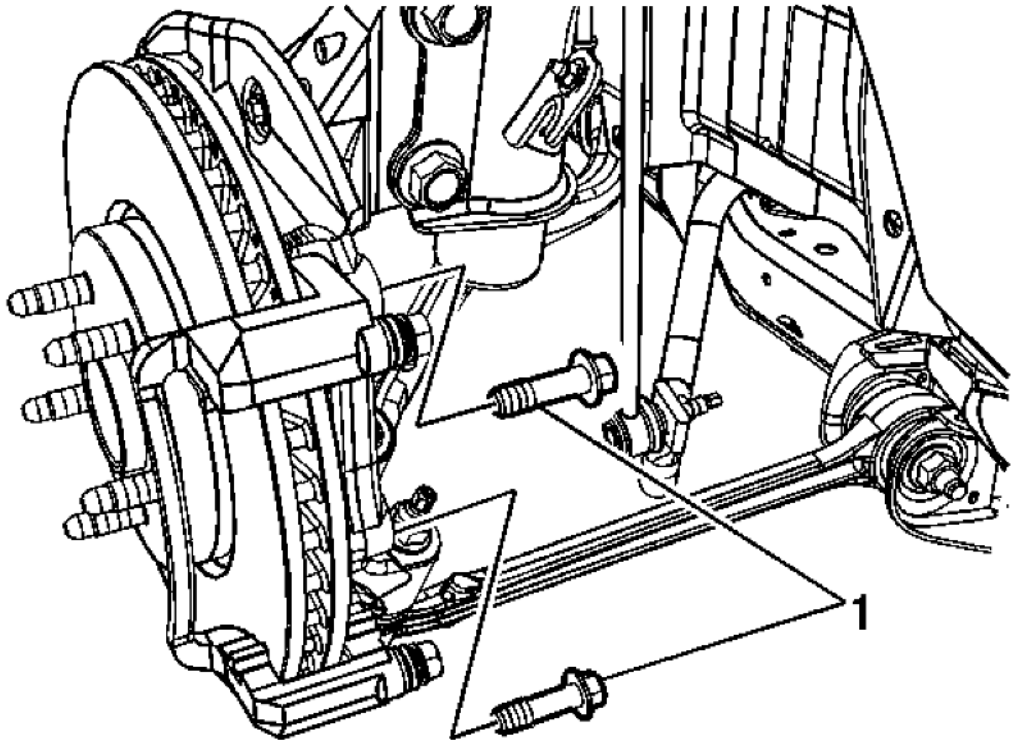


Fig. 123: Disc Brake Caliper Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: The brake caliper backet bolts must be replaced any time they are removed. Do not reuse the brake caliper bracket bolts.

8. Remove and discard the disc brake caliper bracket bolts (1).

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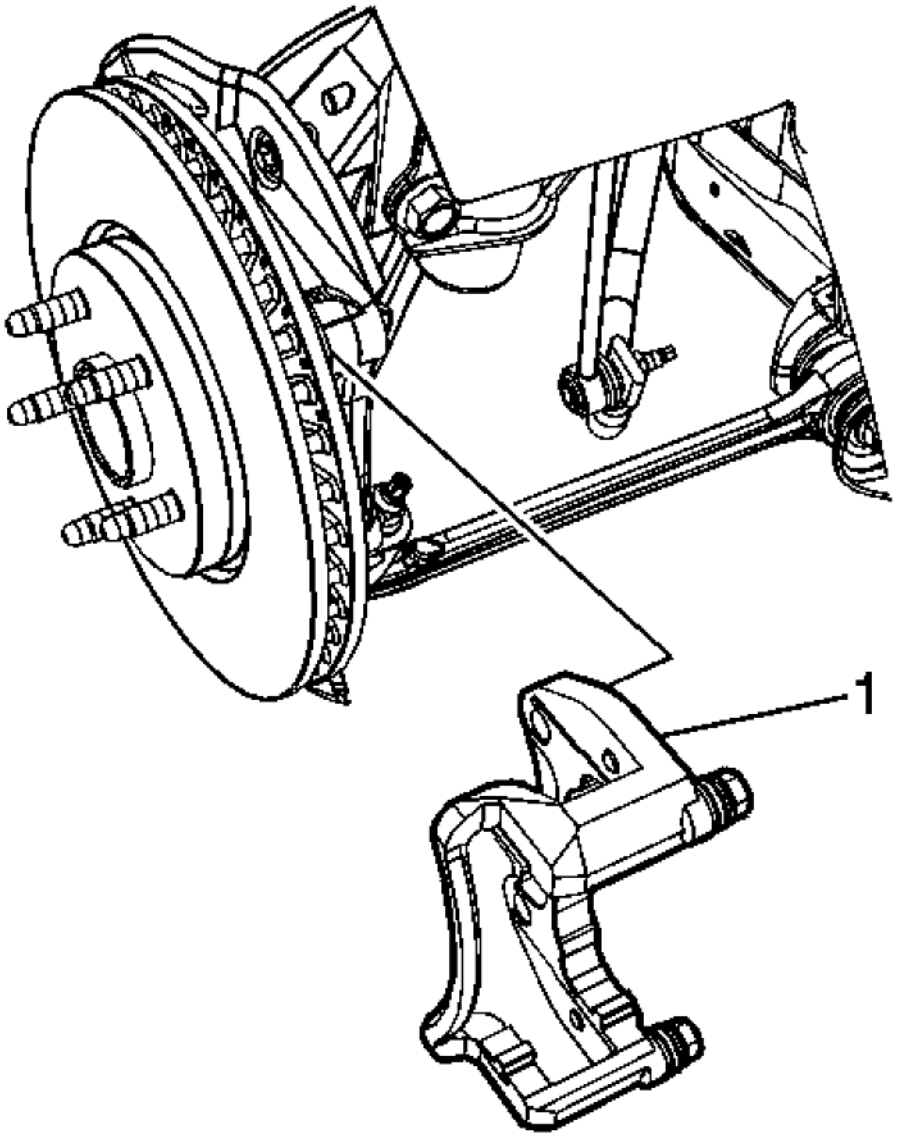


Fig. 124: Disc Brake Caliper Bracket
Courtesy of GENERAL MOTORS CORP.

9. Remove the disc brake caliper bracket (1).
10. Inspect the disc brake hardware. Refer to **Front Disc Brake Mounting and Hardware Inspection**.

Installation Procedure

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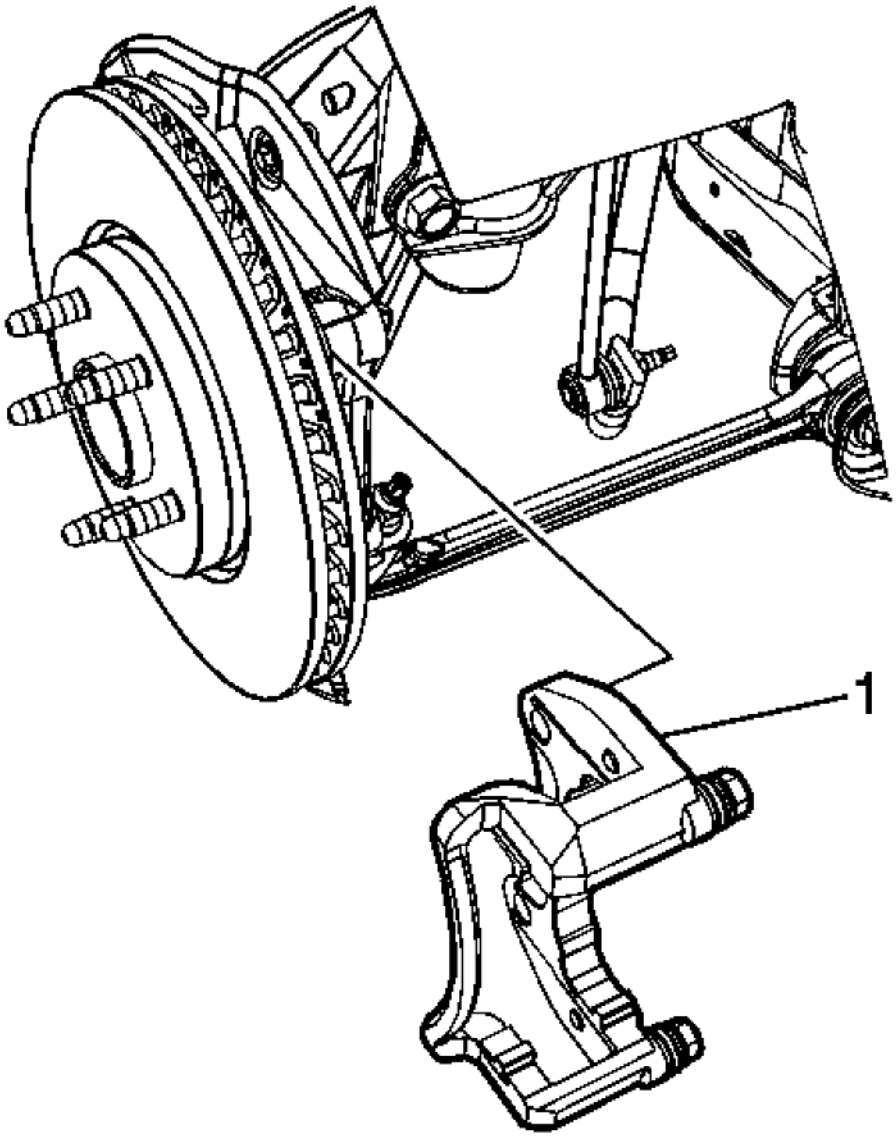


Fig. 125: Disc Brake Caliper Bracket
Courtesy of GENERAL MOTORS CORP.

1. Install the disc brake caliper bracket (1).

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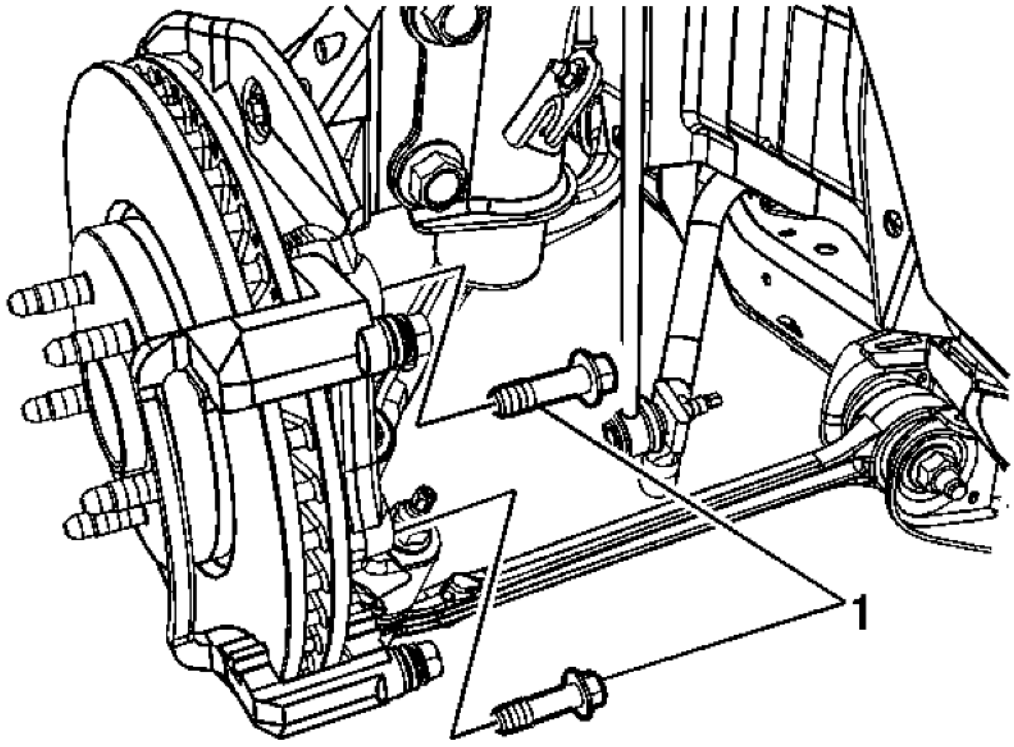


Fig. 126: Disc Brake Caliper Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

NOTE: The brake caliper bracket bolts must be replaced any time they are removed.

2. Install 2 new disc brake caliper bracket bolts (1) and tighten to 40 N.m (30 lb ft) + 90 degrees.

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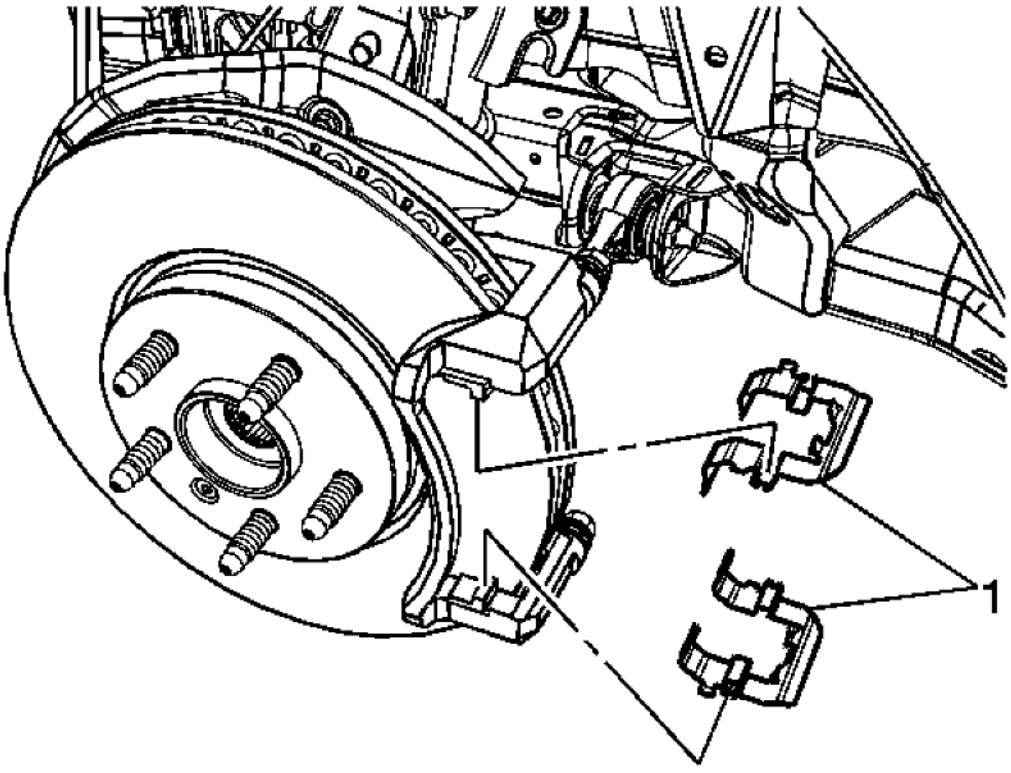


Fig. 127: Brake Pad Springs
Courtesy of GENERAL MOTORS CORP.

3. Install the disc brake pad springs (1).

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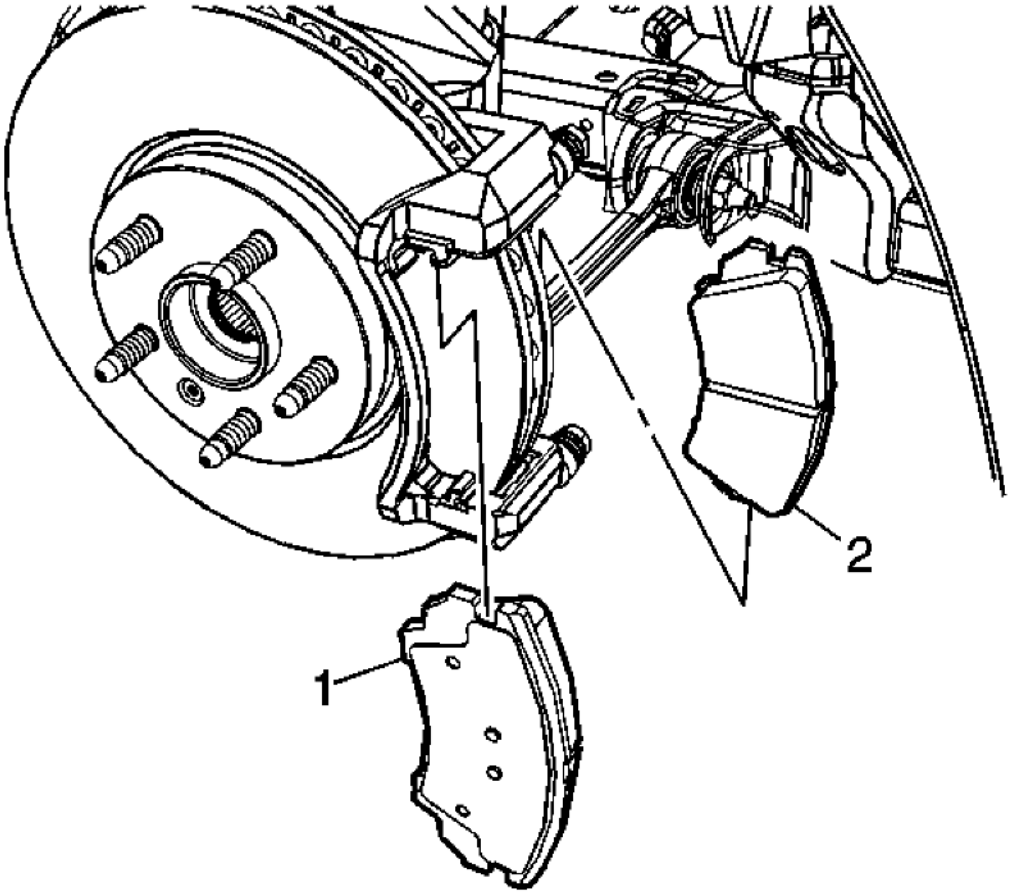


Fig. 128: Brake Pads
Courtesy of GENERAL MOTORS CORP.

4. Install the outer disc brake pad (1).
5. Install the inner disc brake pad (2).

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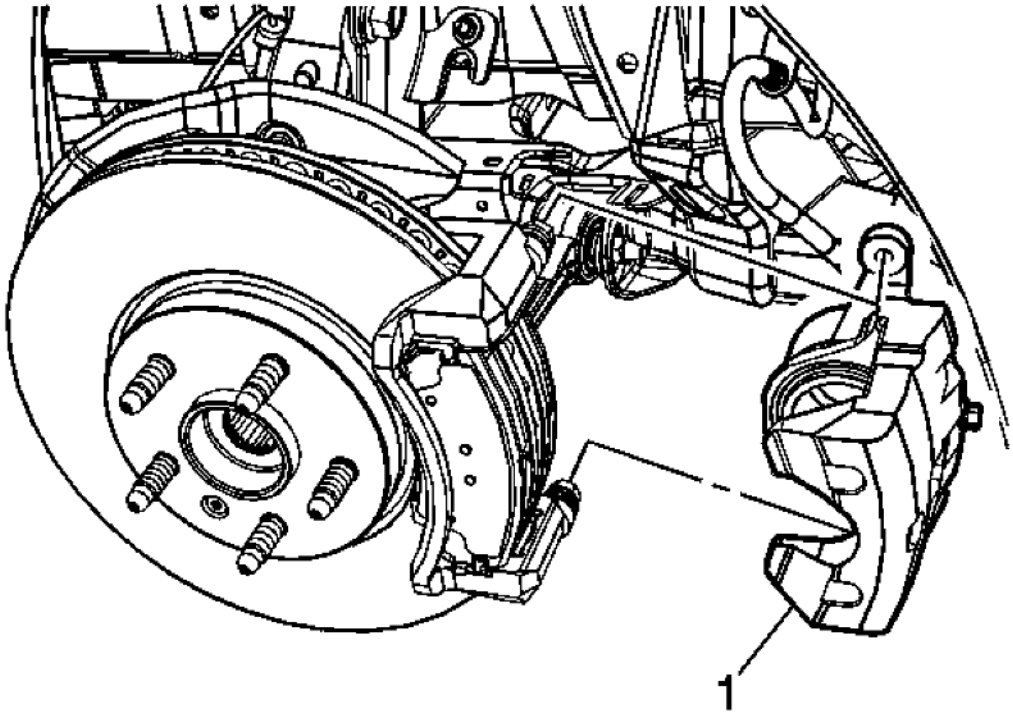


Fig. 129: Brake Caliper
Courtesy of GENERAL MOTORS CORP.

6. Install the disc brake caliper (1).

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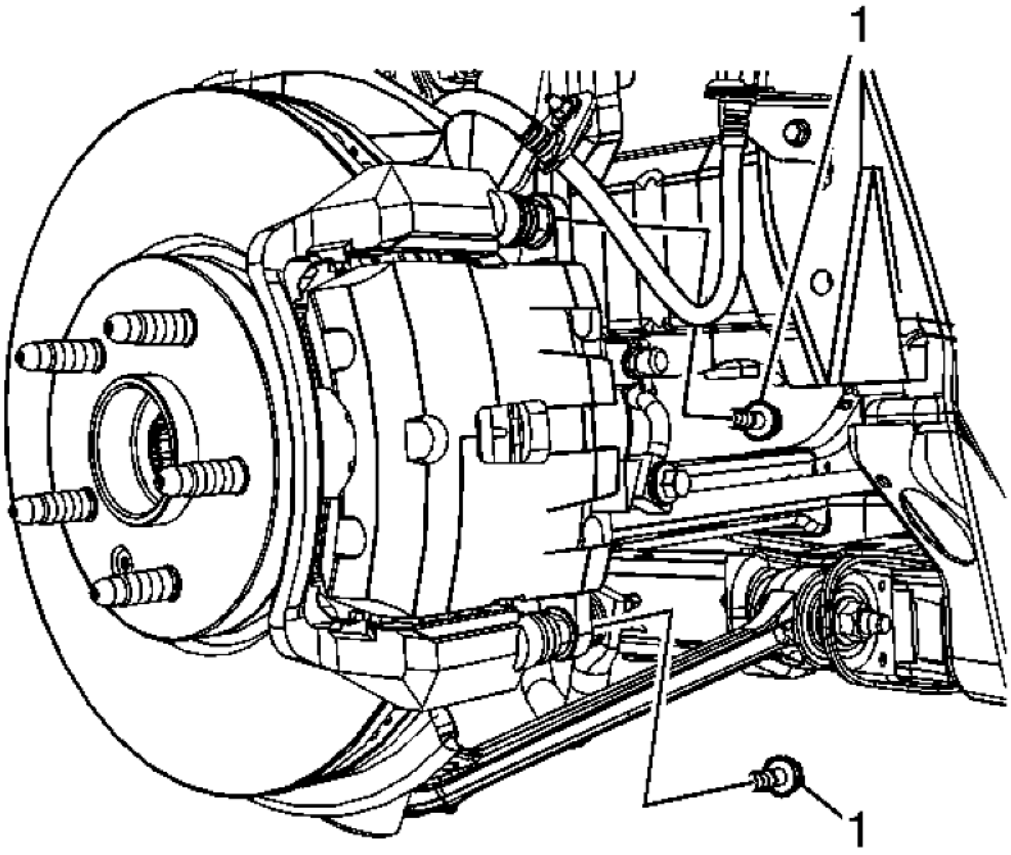


Fig. 130: Brake Caliper Guide Pin Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: The brake caliper guide pin bolts must be replaced any time they are removed.

7. Using a backup wrench on the brake caliper guide pins, install 2 new brake caliper guide pin bolts (1) and tighten to 27 N.m (20 lb ft).
8. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .

REAR BRAKE CALIPER BRACKET REPLACEMENT

Removal Procedure

WARNING: Refer to Brake Dust Warning .

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

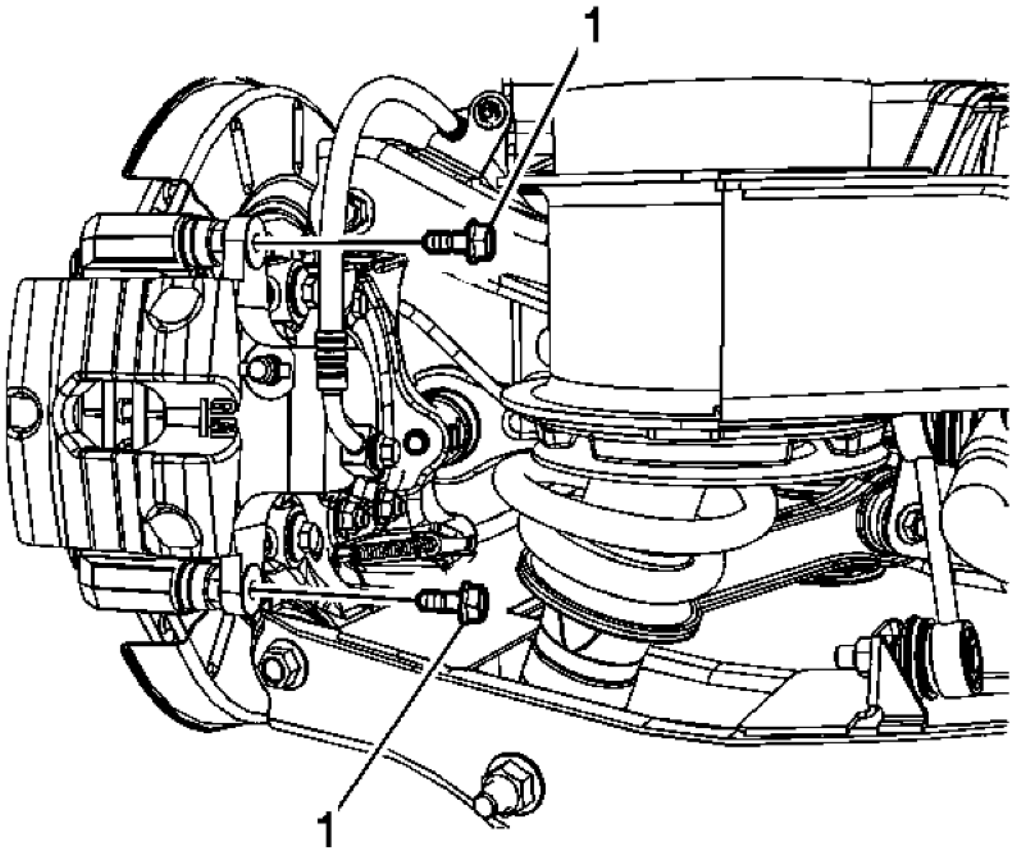


Fig. 131: Brake Caliper Guide Pin Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: **The brake caliper guide pin bolts must be replaced any time they are removed. Do not reuse the brake caliper guide pin bolts.**

3. Using a backup wrench on the brake caliper guide pins, remove and discard the brake caliper guide pin bolts (1).

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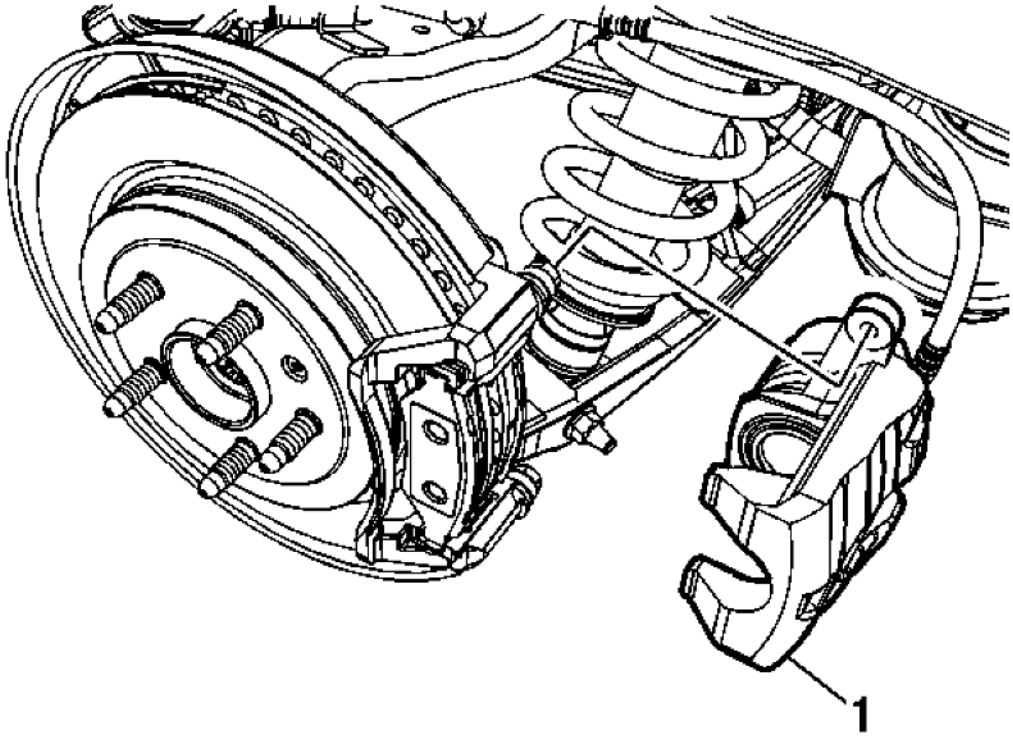


Fig. 132: Brake Caliper
Courtesy of GENERAL MOTORS CORP.

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.

4. Remove the disc brake caliper (1) and support with heavy mechanics wire or equivalent.

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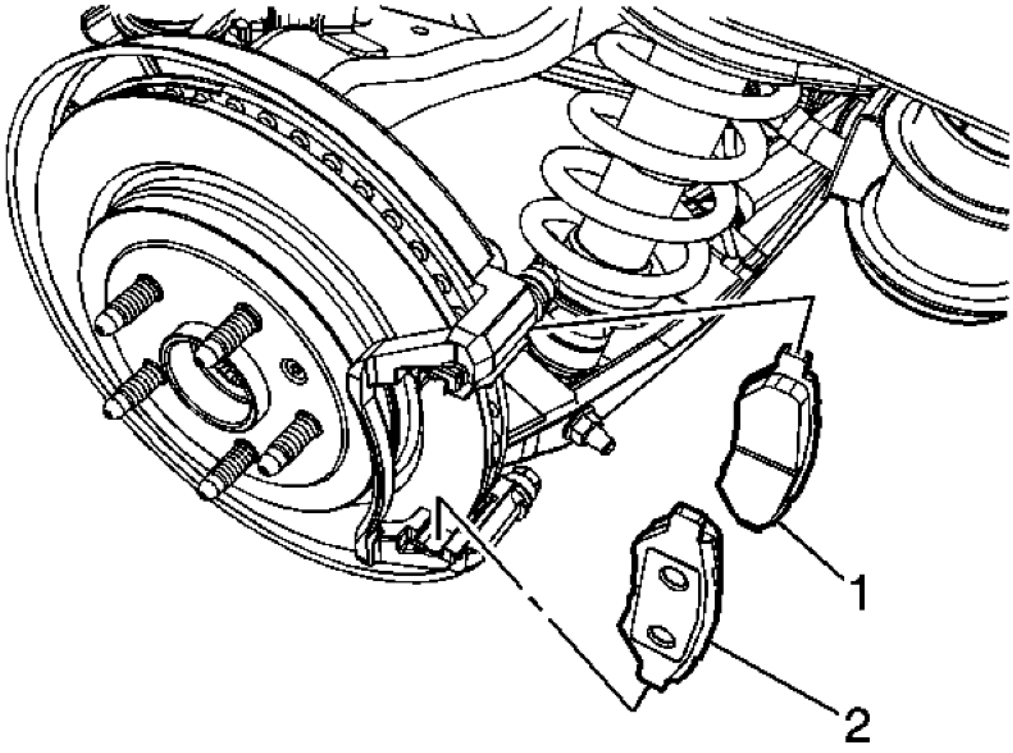


Fig. 133: Brake Pads
Courtesy of GENERAL MOTORS CORP.

5. Remove the inner disc brake pad (1).
6. Remove the outer disc brake pad (2).

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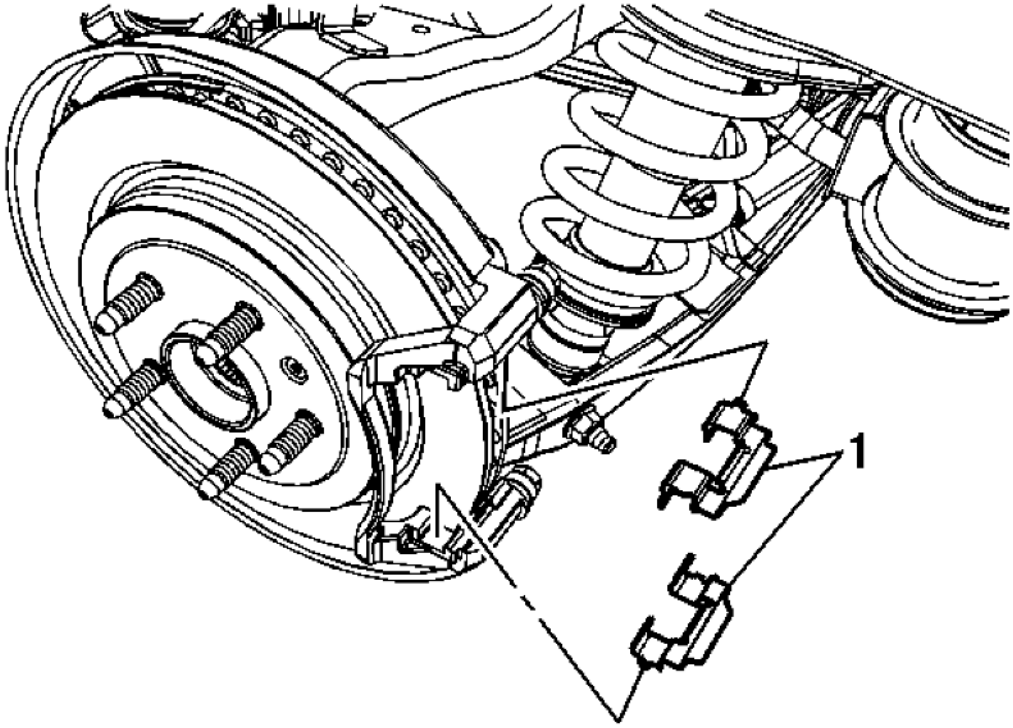


Fig. 134: Brake Pad Springs
Courtesy of GENERAL MOTORS CORP.

7. Remove the disc brake pad springs (1).

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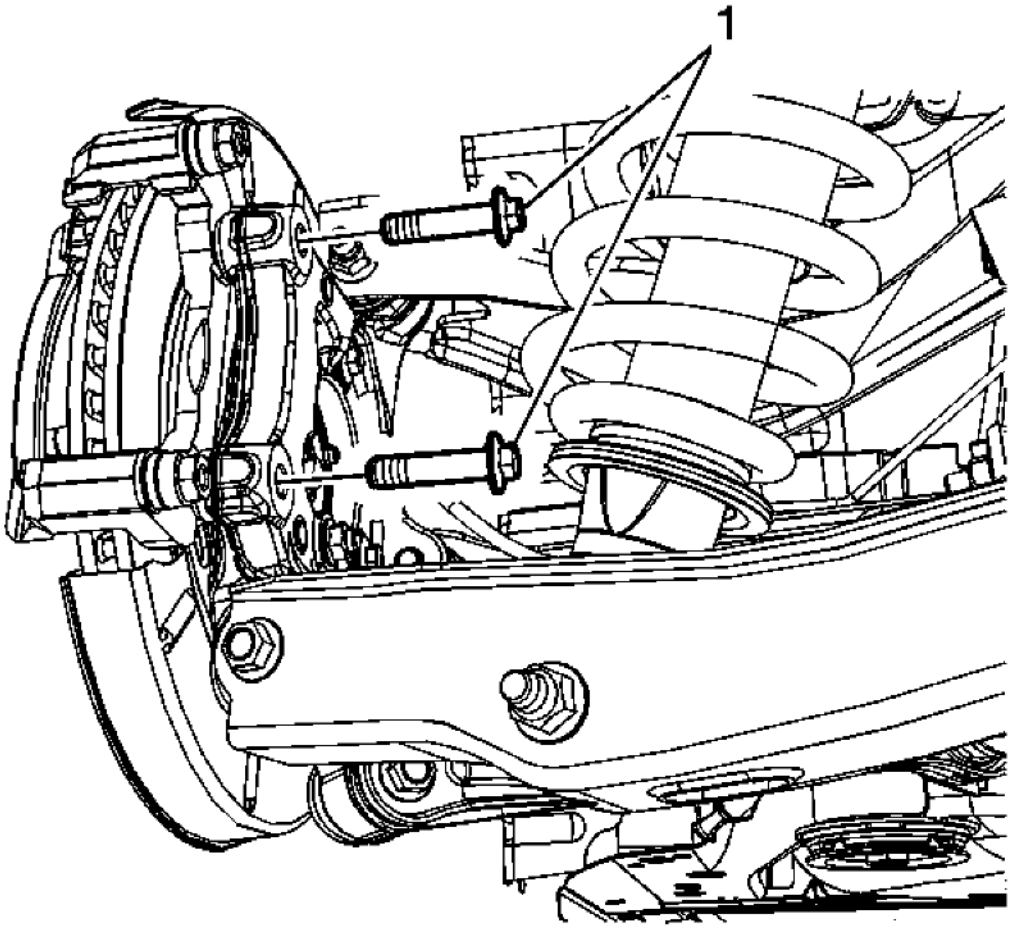


Fig. 135: Disc Brake Caliper Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: The brake caliper bracket bolts must be replaced any time they are removed. Do not reuse the brake caliper bracket bolts.

8. Remove and discard the disc brake caliper bracket bolts (1).
9. Remove the disc brake caliper bracket.
10. Inspect the disc brake hardware. Refer to **Front Disc Brake Mounting and Hardware Inspection**.

Installation Procedure

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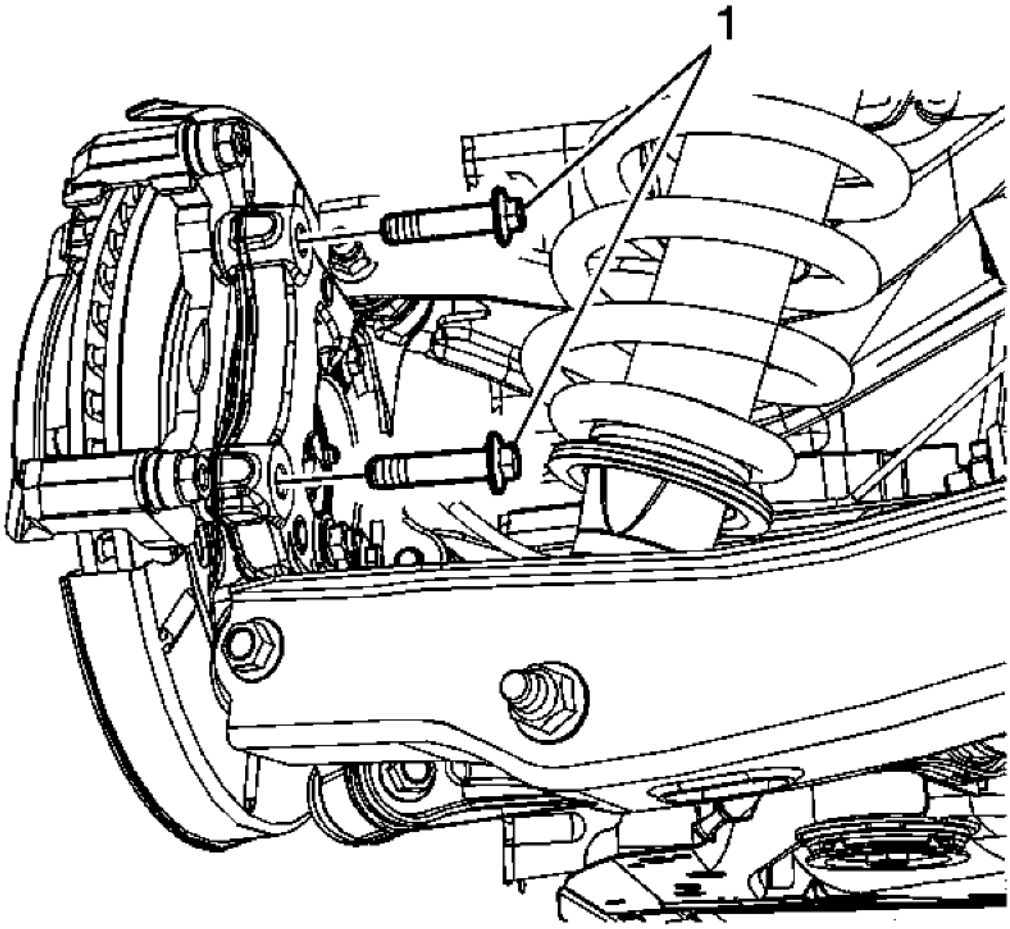


Fig. 136: Disc Brake Caliper Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

NOTE: The brake caliper bracket bolts must be replaced any time they are removed.

1. Install 2 new disc brake caliper bracket and the disc brake caliper bracket bolts (1) and tighten to 40 N.m (30 lb ft) + 90 degrees.

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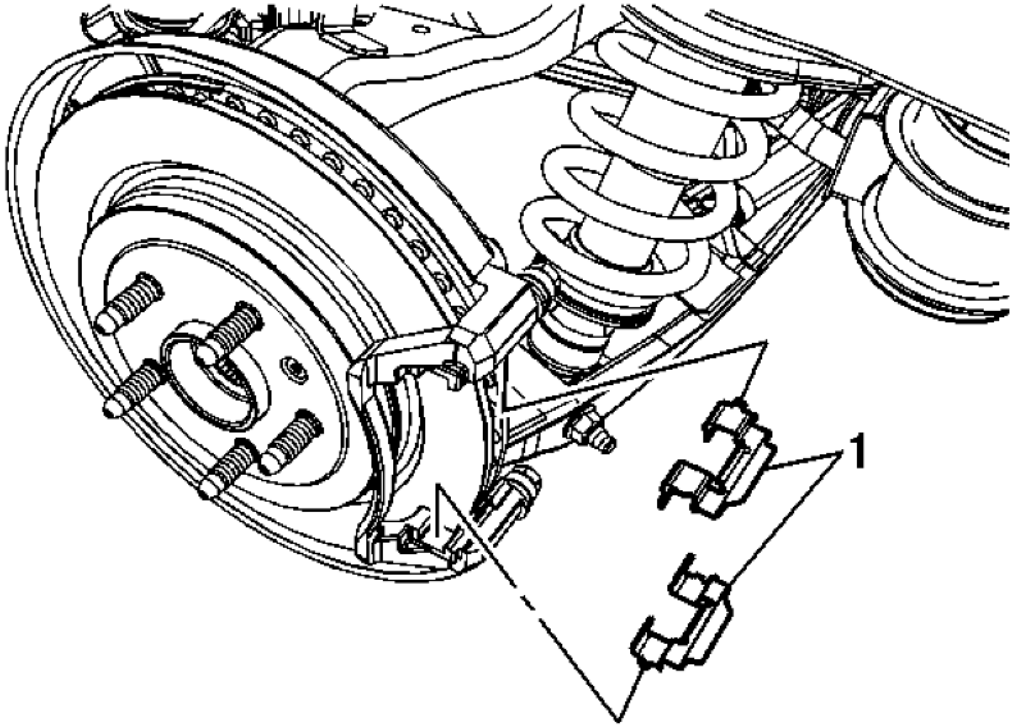


Fig. 137: Brake Pad Springs
Courtesy of GENERAL MOTORS CORP.

2. Install the disc brake pad springs (1).

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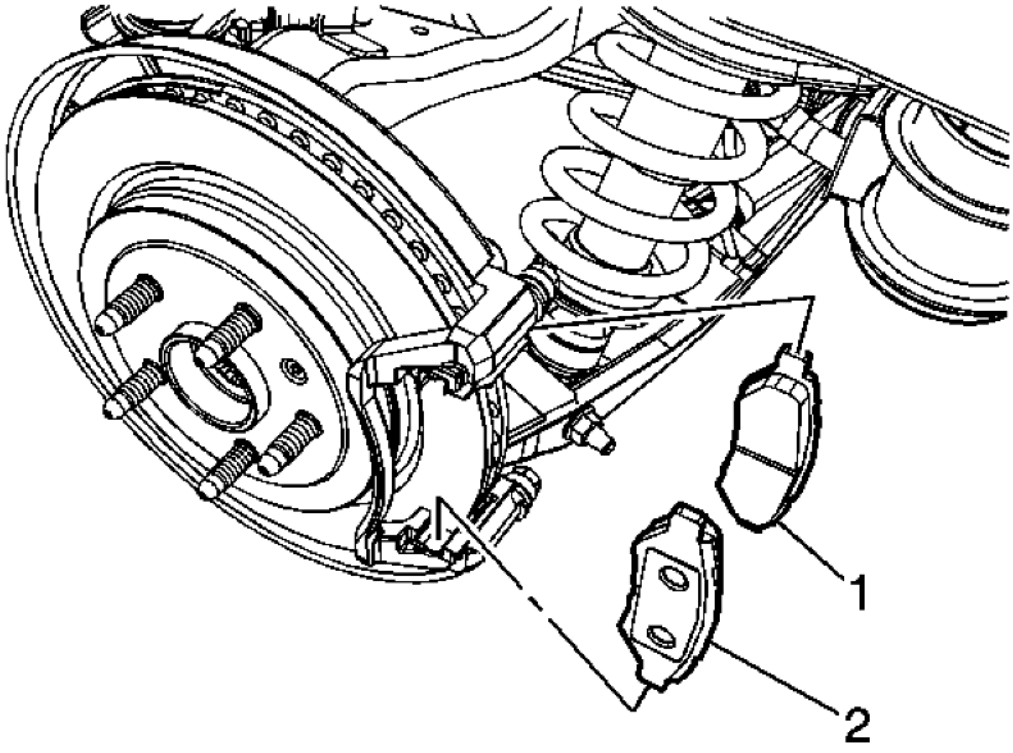


Fig. 138: Brake Pads
Courtesy of GENERAL MOTORS CORP.

3. Install the inner disc brake pad (1).
4. Install the outer disc brake pad (2).

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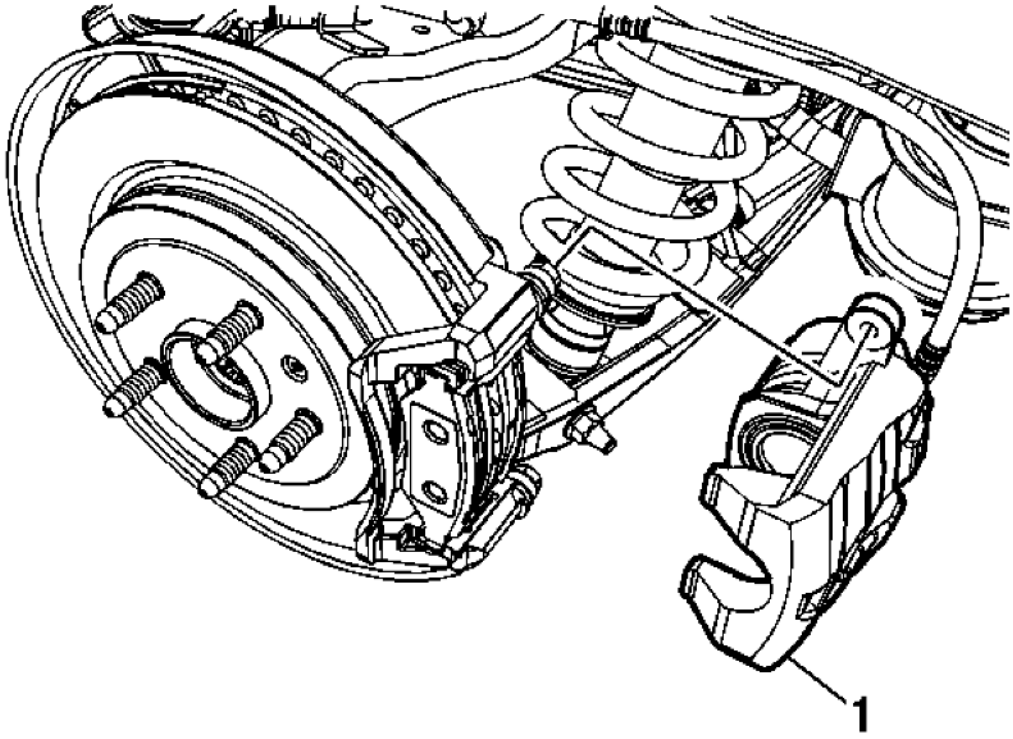


Fig. 139: Brake Caliper
Courtesy of GENERAL MOTORS CORP.

5. Install the disc brake caliper (1).

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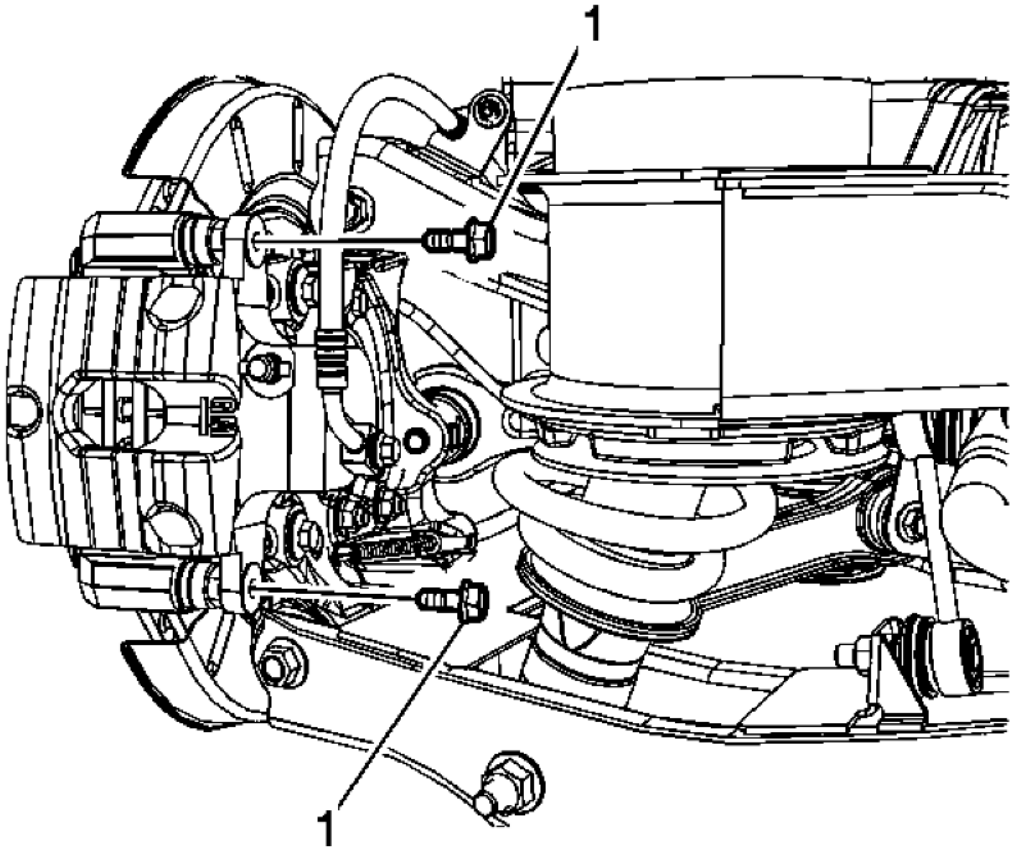


Fig. 140: Brake Caliper Guide Pin Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: **The brake caliper guide pin bolts must be replaced any time they are removed.**

6. Using a backup wrench on the brake caliper guide pins, install 2 new brake caliper guide pin bolts (1) and tighten to 27 N.m (20 lb ft).
7. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .

FRONT BRAKE ROTOR REPLACEMENT (LLT)

Special Tools

- **J-41013:** Rotor Resurfacing Kit
- **J-42450-A:** Wheel Hub Resurfacing Kit

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For equivalent regional tools, refer to **Special Tools**.

Removal Procedure

WARNING: Refer to Brake Dust Warning .

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

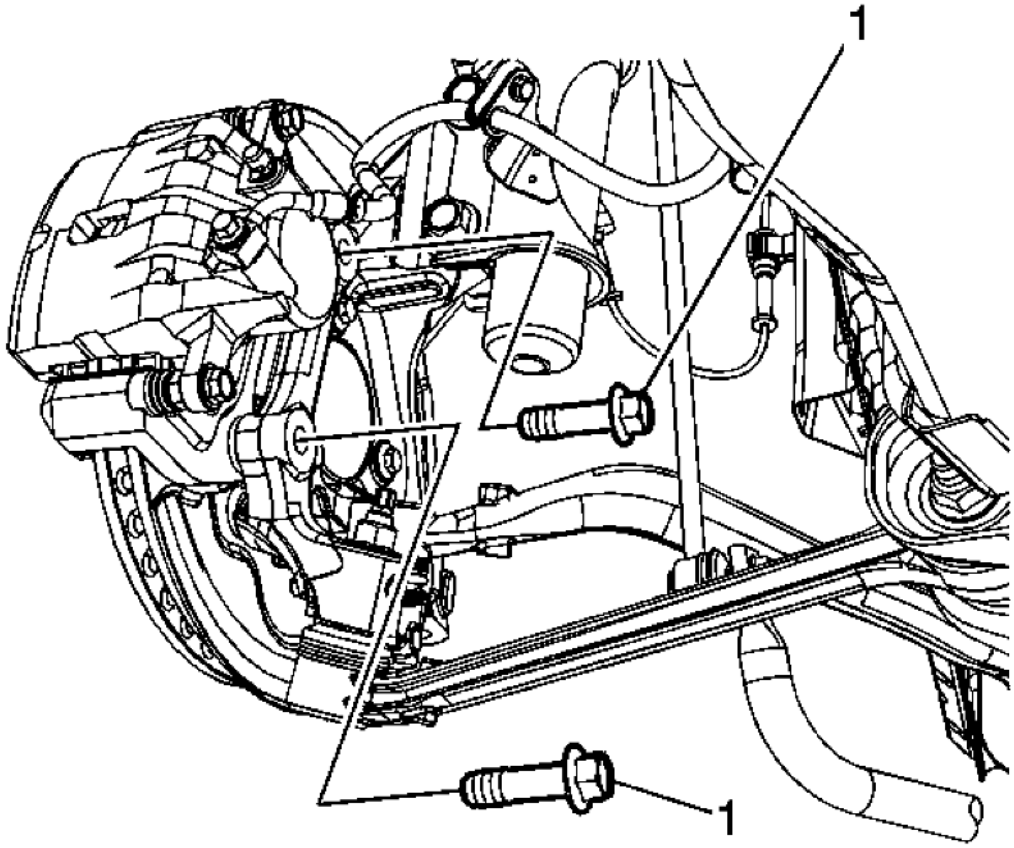


Fig. 141: Disc Brake Caliper Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: The disc brake caliper bracket bolts must be replaced any time they are removed. Do not reuse the disc brake caliper bracket bolts.

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3. Remove and discard the disc brake caliper bracket bolts (1).

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.

4. Remove the disc brake caliper and bracket assembly and support with heavy mechanics wire or equivalent.

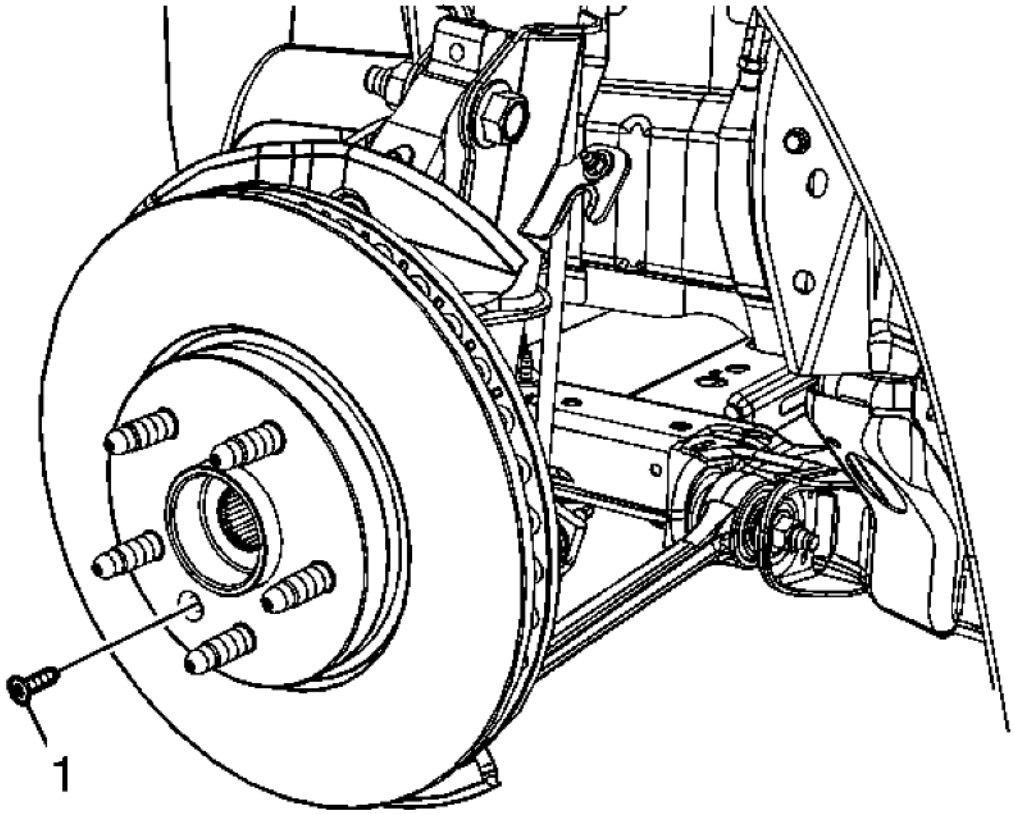


Fig. 142: Disc Brake Rotor Bolt
Courtesy of GENERAL MOTORS CORP.

5. Remove the disc brake rotor bolt (1).

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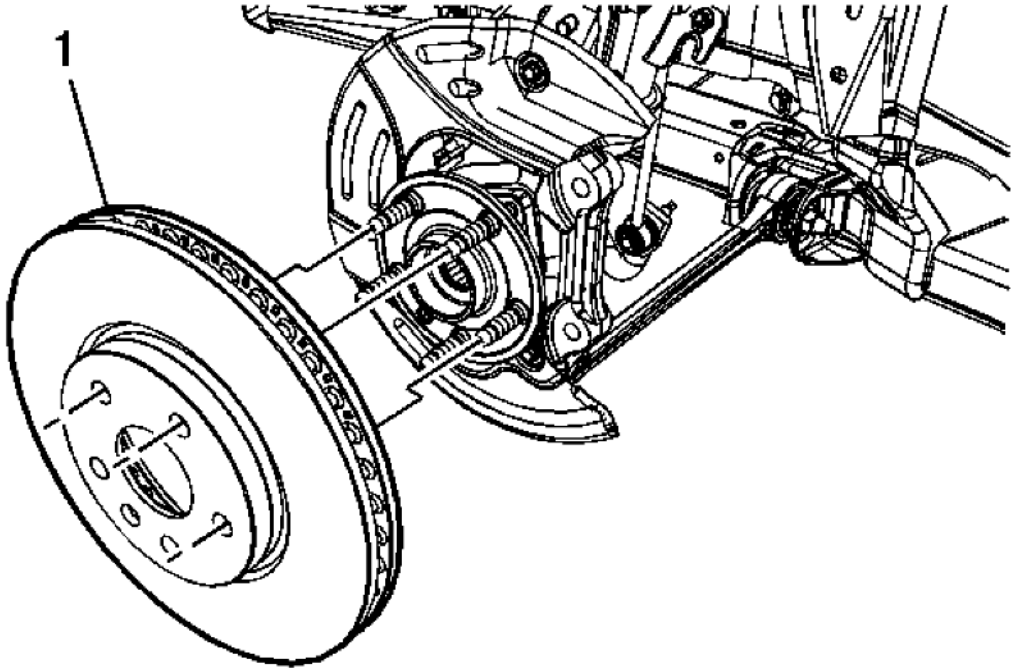


Fig. 143: Disc Brake Rotor
Courtesy of GENERAL MOTORS CORP.

6. Remove the disc brake rotor (1).

Installation Procedure

NOTE: Whenever the brake rotor has been separated from the hub/axle flange, any rust or contaminants should be cleaned from the hub/axle flange and the brake rotor mating surfaces. Failure to do this may result in excessive assembled lateral runout (LRO) of the brake rotor, which could lead to brake pulsation.

1. Using the **J-42450-A:** Wheel Hub Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface of the hub/axle flange.
2. Using the **J-41013:** Rotor Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface and mounting surface of the brake rotor.
3. Inspect the mating surfaces of the hub/axle flange and the rotor to ensure there are no foreign particles or debris remaining.

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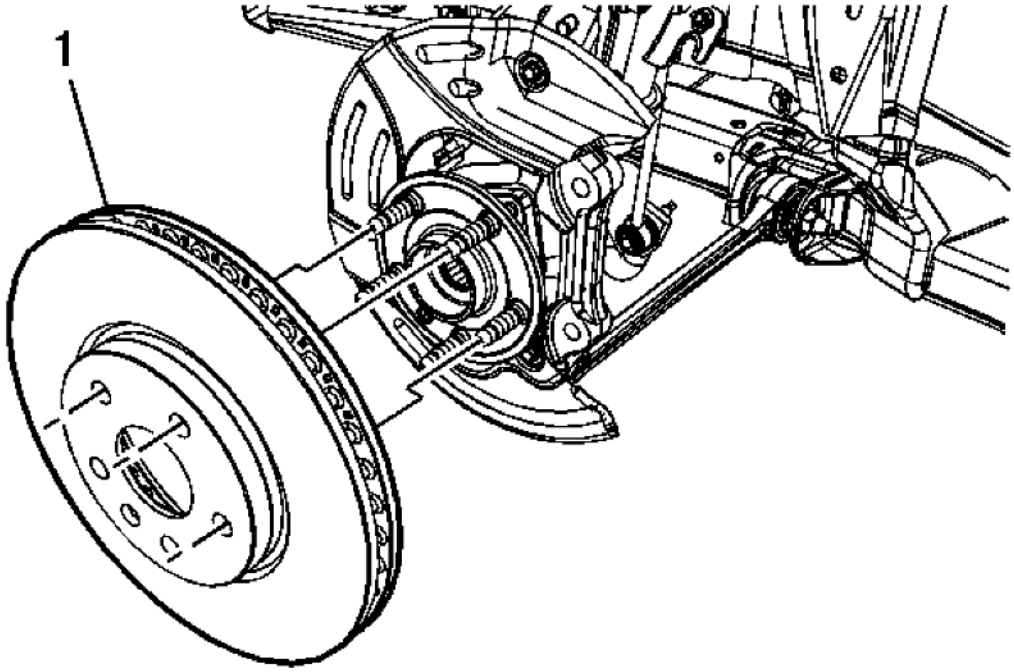


Fig. 144: Disc Brake Rotor
Courtesy of GENERAL MOTORS CORP.

4. Install the disc brake rotor (1).

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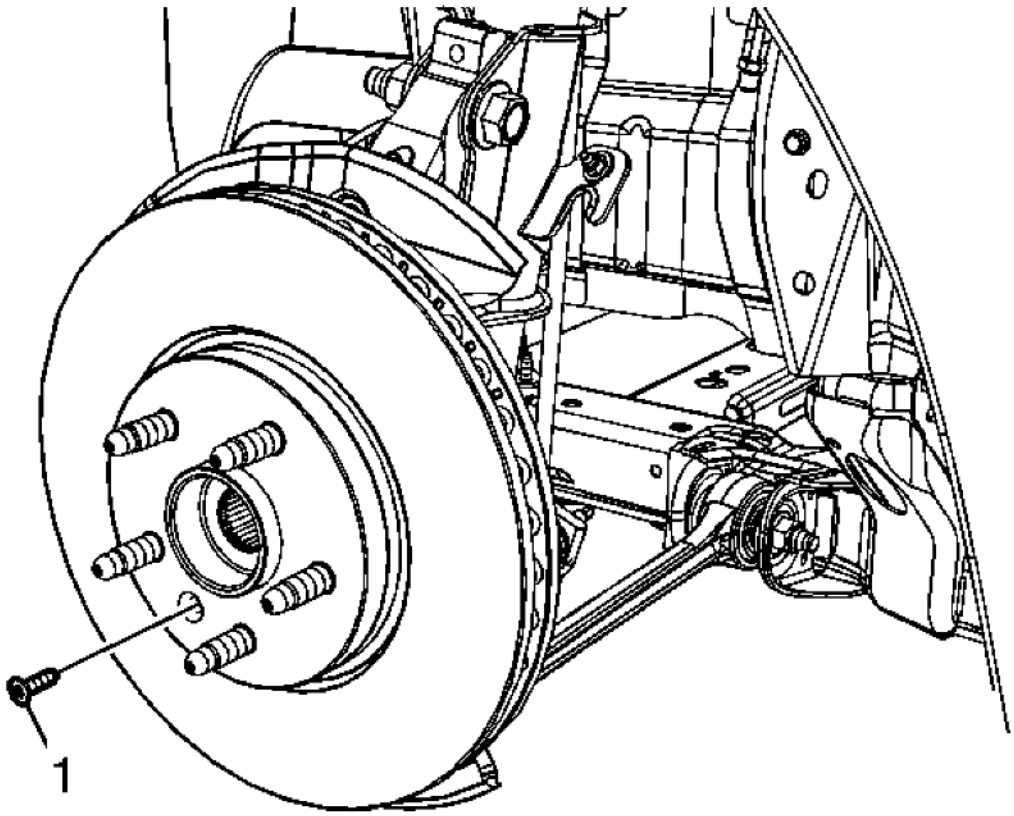


Fig. 145: Disc Brake Rotor Bolt
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

5. Install the disc brake rotor bolt (1) and tighten to 10 N.m (89 lb in).
6. Install the disc brake caliper and bracket assembly.

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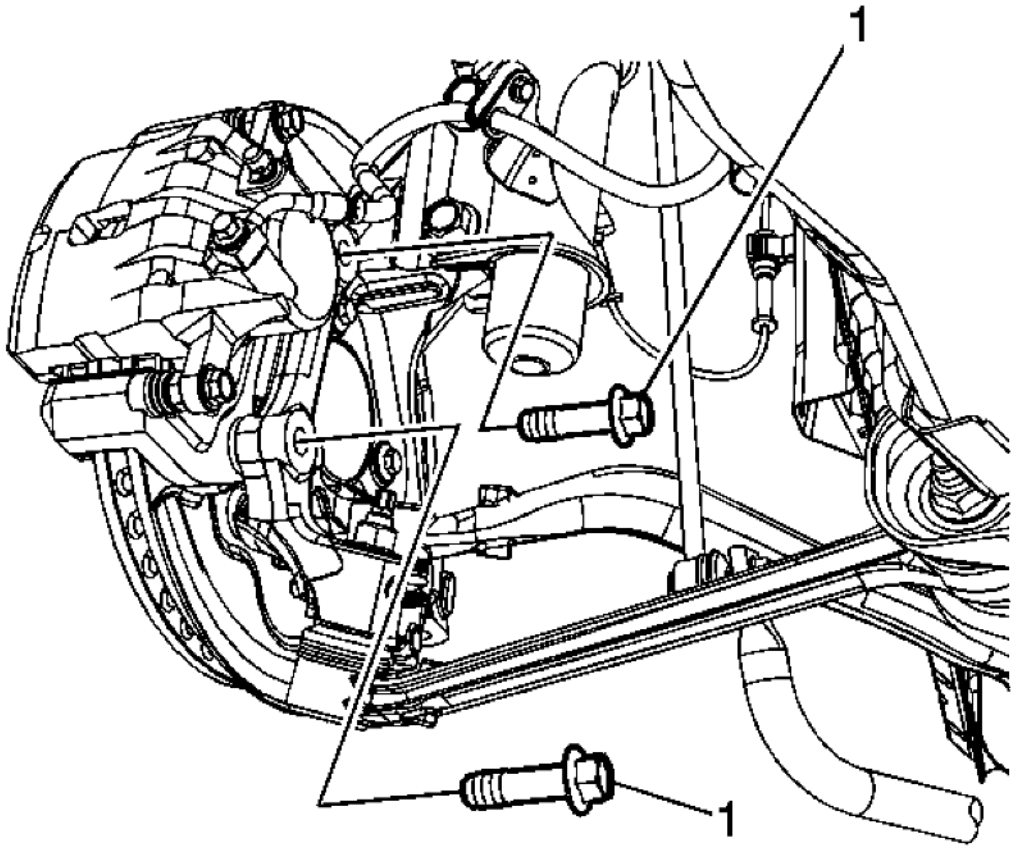


Fig. 146: Disc Brake Caliper Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Install new disc brake caliper bracket bolts any time the bolts are removed.

7. Install 2 new disc brake caliper bracket bolts (1) and tighten to 60 N.m (44 lb ft) + 90 degrees.
8. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
9. If the brake rotor was refinished or replaced, or if new brake pads were installed, burnish the pads and rotors. Refer to **Brake Pad and Rotor Burnishing**.

FRONT BRAKE ROTOR REPLACEMENT (L99, LS3)

Special Tools

- **J-41013:** Rotor Resurfacing Kit
- **J-42450-A:** Wheel Hub Resurfacing Kit

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For equivalent regional tools, refer to **Special Tools**.

Removal Procedure

WARNING: Refer to Brake Dust Warning .

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

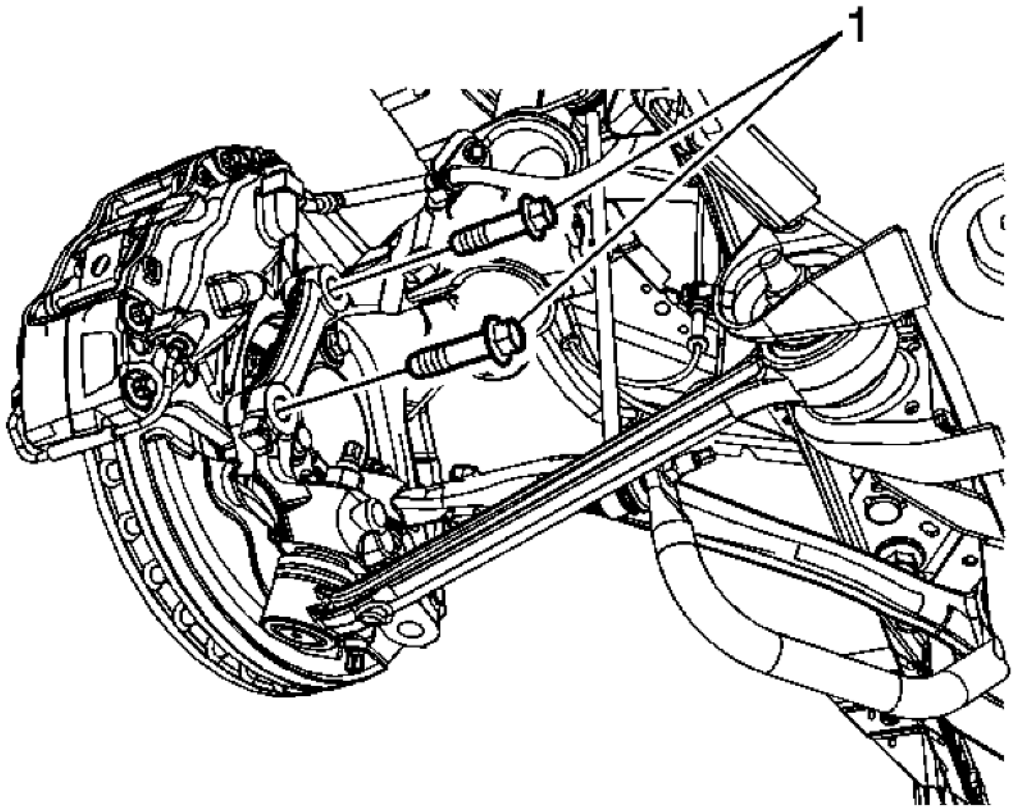


Fig. 147: Brake Caliper Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: The brake caliper bolts must be replaced any time they are removed. Do not reuse the disc brake caliper bolts.

3. Remove and discard the brake caliper bolts (1).

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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.

4. Remove the brake caliper assembly and support with heavy mechanics wire or equivalent.

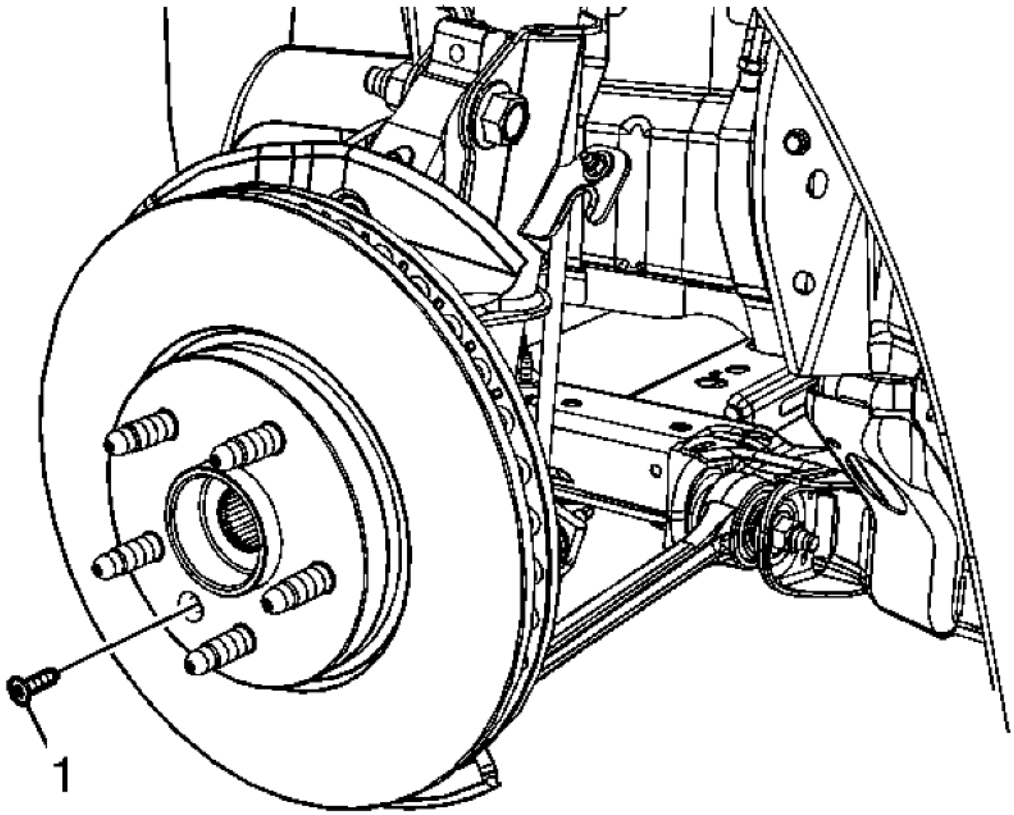


Fig. 148: Disc Brake Rotor Bolt
Courtesy of GENERAL MOTORS CORP.

5. Remove the brake rotor bolt (1).

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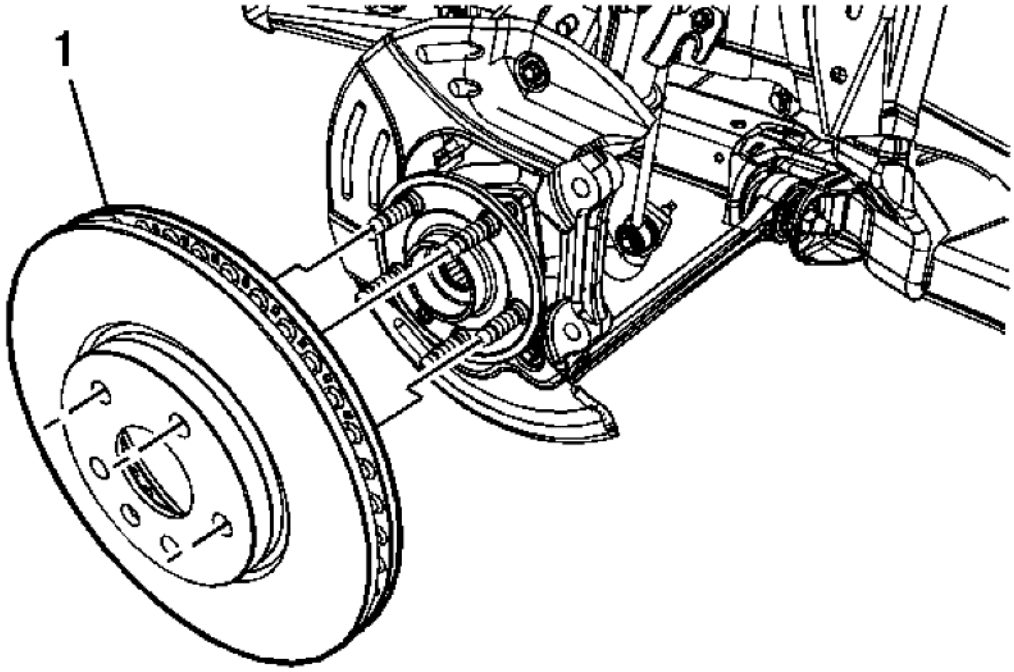


Fig. 149: Disc Brake Rotor
Courtesy of GENERAL MOTORS CORP.

6. Remove the brake rotor (1).

Installation Procedure

NOTE: Whenever the brake rotor has been separated from the hub/axle flange, any rust or contaminants should be cleaned from the hub/axle flange and the brake rotor mating surfaces. Failure to do this may result in excessive assembled lateral runout (LRO) of the brake rotor, which could lead to brake pulsation.

1. Using the **J-42450-A:** Wheel Hub Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface of the hub/axle flange.
2. Using the **J-41013:** Rotor Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface and mounting surface of the brake rotor.

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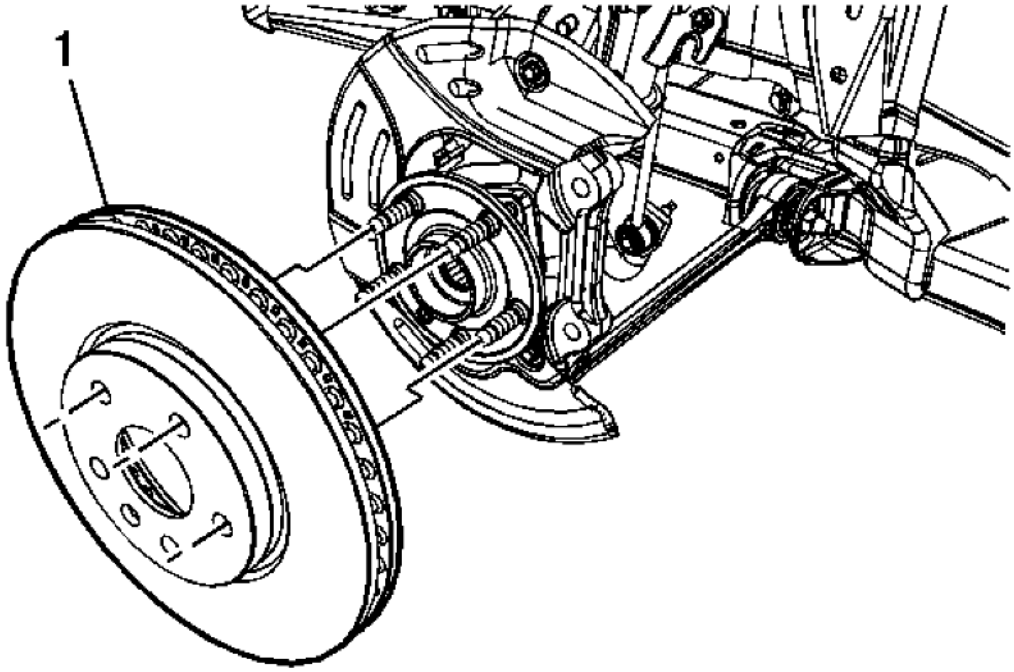


Fig. 150: Disc Brake Rotor
Courtesy of GENERAL MOTORS CORP.

3. Install the brake rotor (1).

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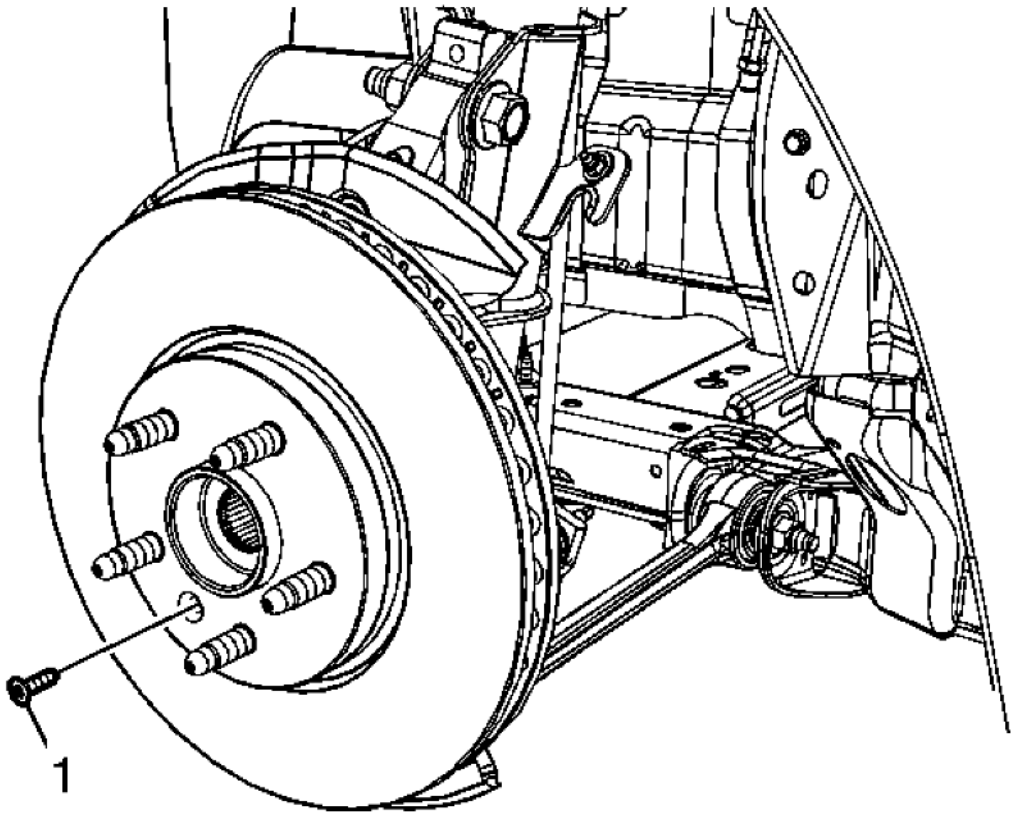


Fig. 151: Disc Brake Rotor Bolt
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

4. Install the brake rotor bolt (1) and tighten to 10 N.m (89 lb in).
5. Position the brake caliper assembly to the steering knuckle.

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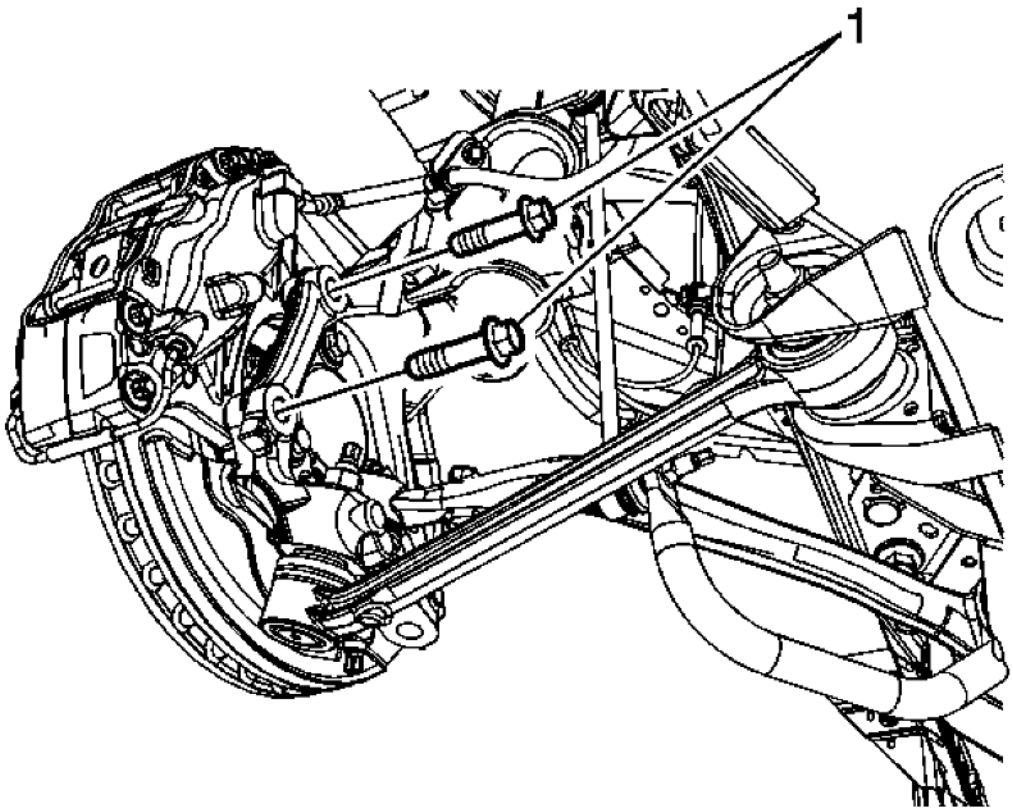


Fig. 152: Brake Caliper Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Install new brake caliper bolts any time the bolts are removed.

6. Install 2 new brake caliper bolts (1) and tighten to 60 N.m (44 lb ft) + 90 degrees.
7. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
8. If the brake rotor was refinished or replaced, or if new brake pads were installed, burnish the brake pads and rotors. Refer to **Brake Pad and Rotor Burnishing**.

REAR BRAKE ROTOR REPLACEMENT (LLT)

Special Tools

- **J-41013:** Rotor Resurfacing Kit
- **J-42450-A:** Wheel Hub Resurfacing Kit

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For equivalent regional tools, refer to **Special Tools**.

Removal Procedure

WARNING: Refer to Brake Dust Warning .

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

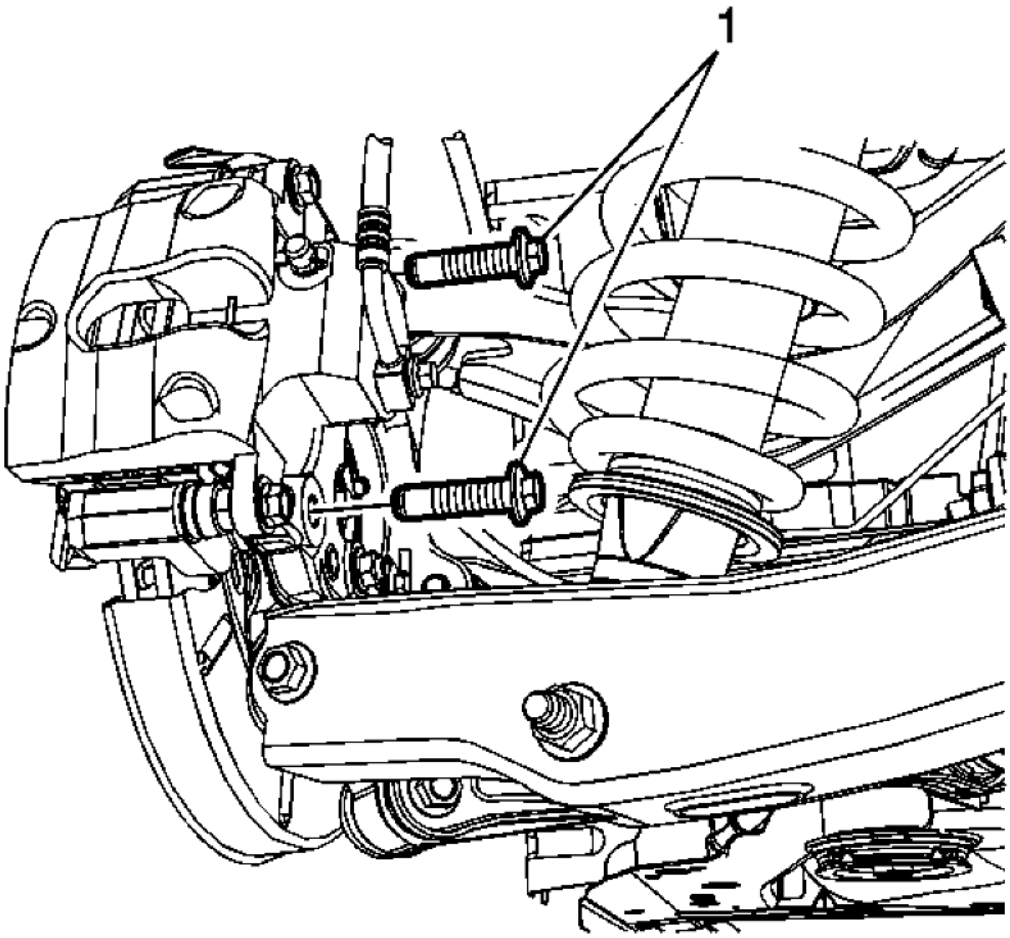


Fig. 153: Disc Brake Caliper Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

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NOTE: **The disc brake caliper bracket bolts must be replaced any time they are removed. Do not reuse the disc brake caliper bracket bolts.**

3. Remove and discard the disc brake caliper bracket bolts (1).

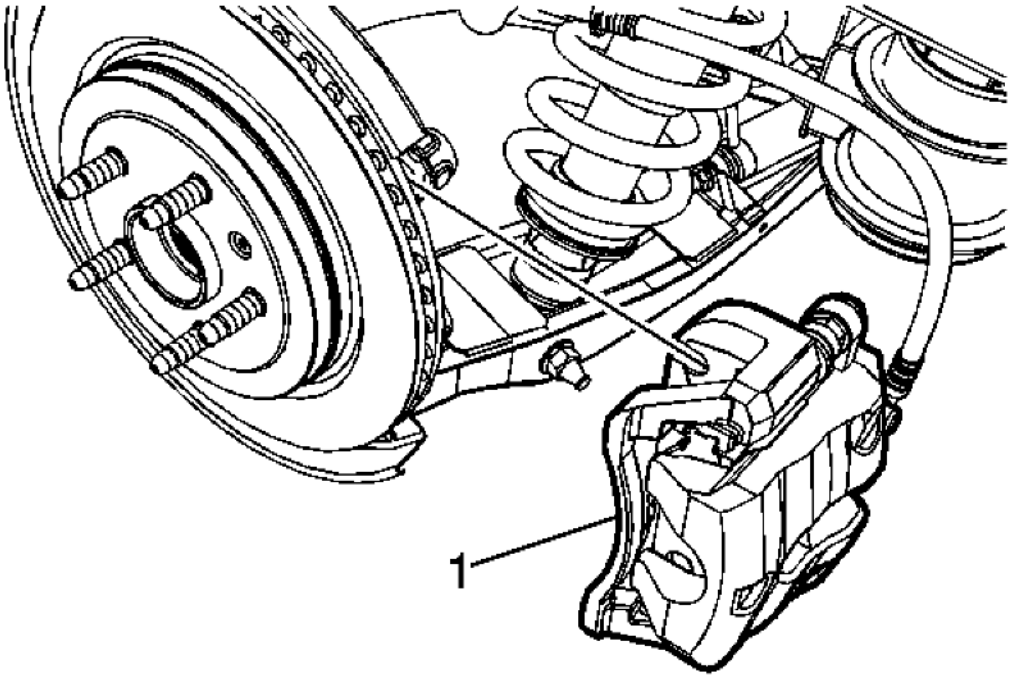


Fig. 154: Disc Brake Caliper & Bracket Assembly
Courtesy of GENERAL MOTORS CORP.

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.

4. Remove the disc brake caliper and bracket assembly (1) and support with heavy mechanics wire or equivalent.

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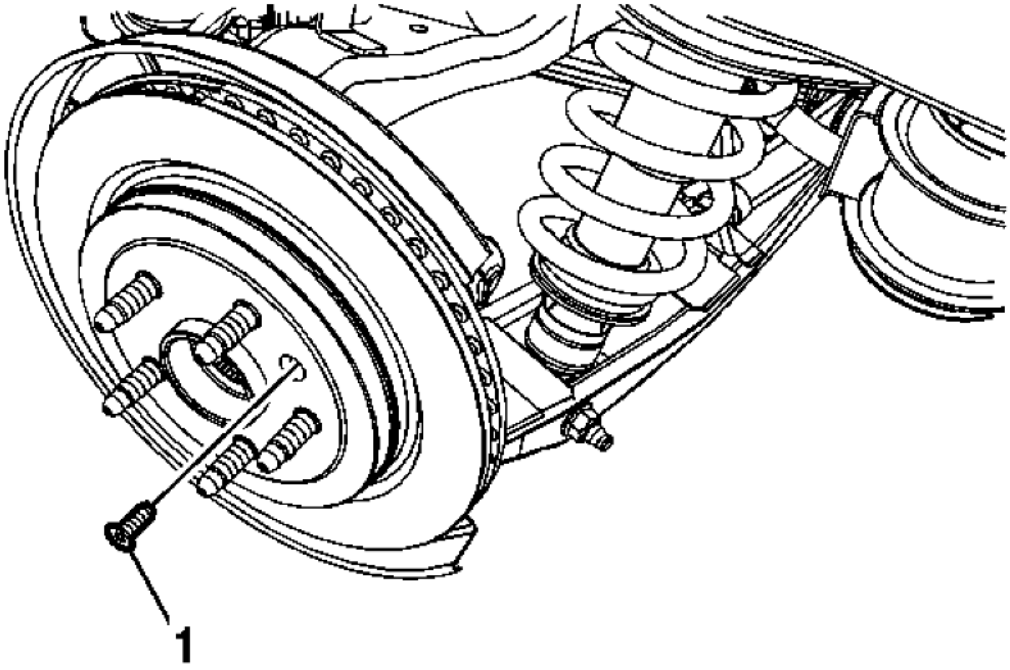


Fig. 155: Disc Brake Rotor Bolt
Courtesy of GENERAL MOTORS CORP.

5. Remove the disc brake rotor bolt (1).

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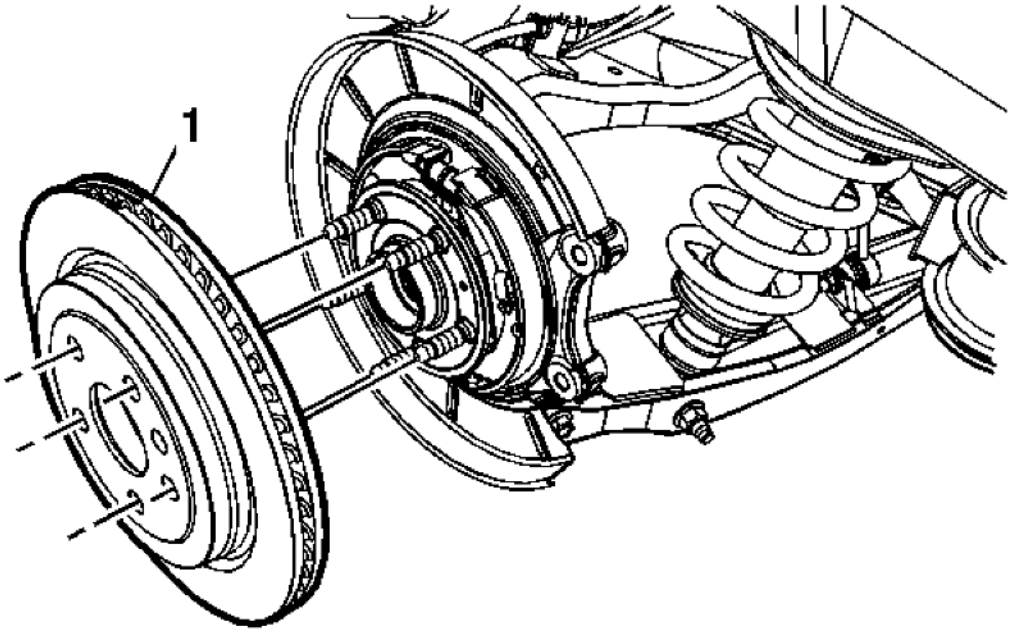


Fig. 156: Disc Brake Rotor
Courtesy of GENERAL MOTORS CORP.

6. Remove the disc brake rotor (1).

Installation Procedure

NOTE: Whenever the brake rotor has been separated from the hub/axle flange, any rust or contaminants should be cleaned from the hub/axle flange and the brake rotor mating surfaces. Failure to do this may result in excessive assembled lateral runout (LRO) of the brake rotor, which could lead to brake pulsation.

1. Using the **J-42450-A:** Wheel Hub Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface of the hub/axle flange.
2. Using the **J-41013:** Rotor Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface and mounting surface of the brake rotor.
3. Inspect the mating surfaces of the hub/axle flange and the rotor to ensure there are no foreign particles or debris remaining.

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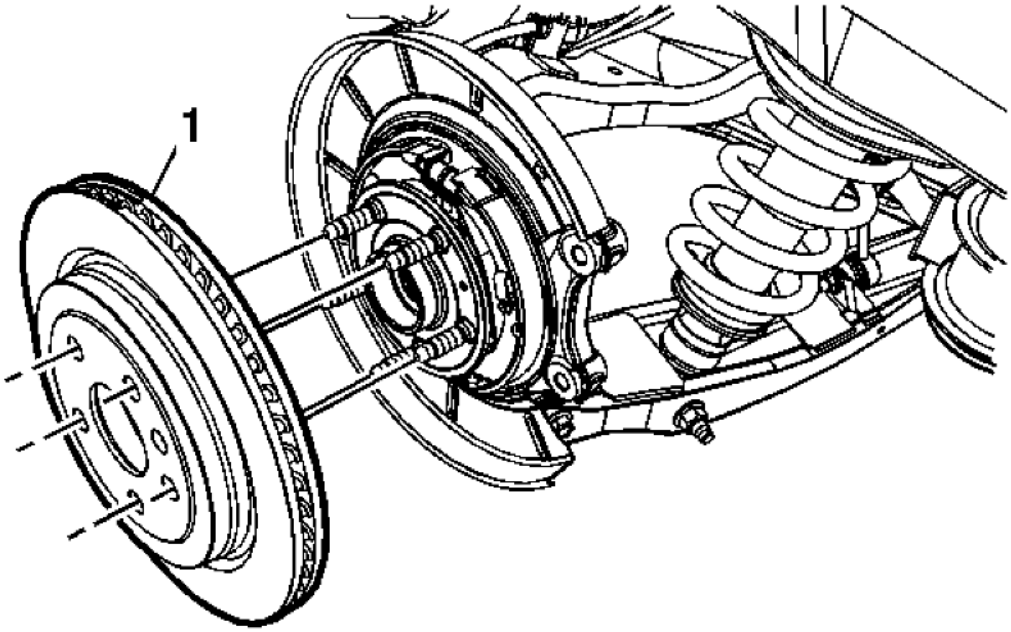


Fig. 157: Disc Brake Rotor
Courtesy of GENERAL MOTORS CORP.

4. Install the disc brake rotor (1).

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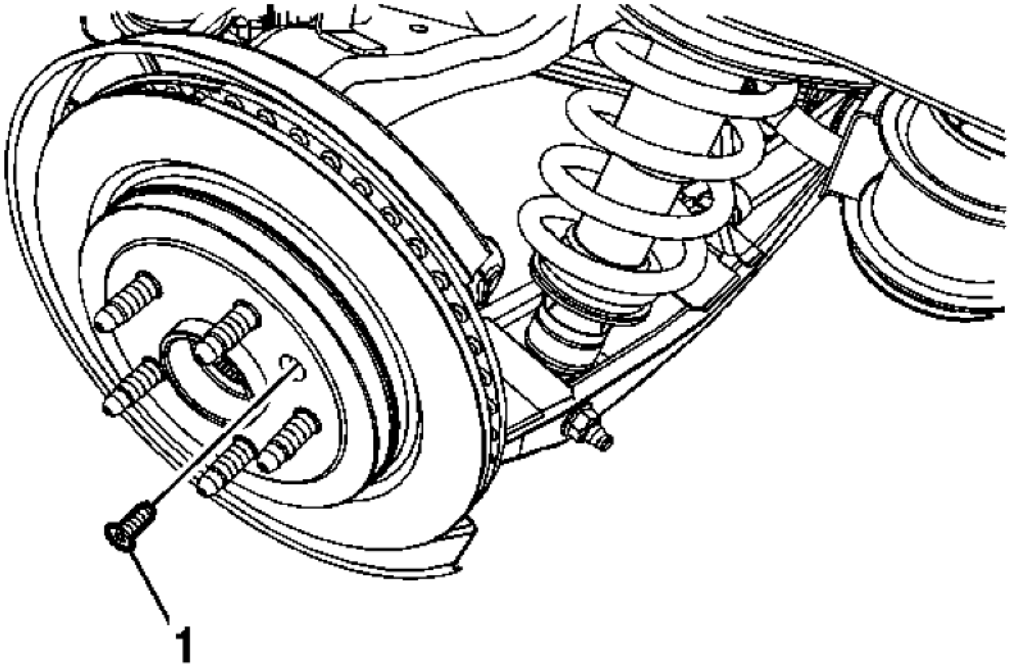


Fig. 158: Disc Brake Rotor Bolt
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

5. Install the disc brake rotor bolt (1) and tighten to 10 N.m (89 lb in).

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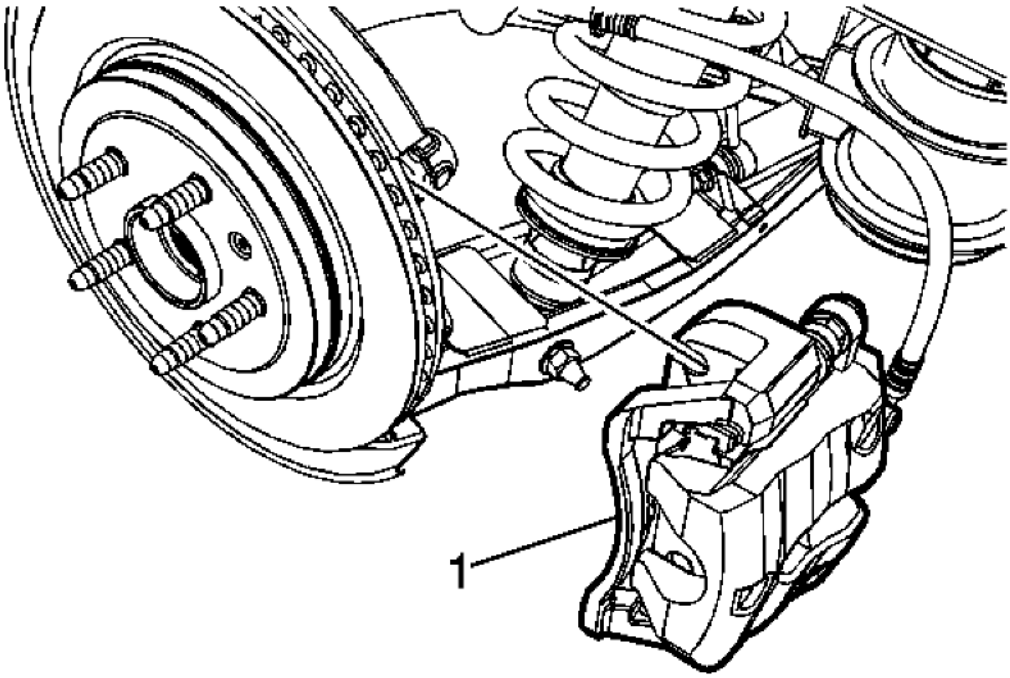


Fig. 159: Disc Brake Caliper & Bracket Assembly
Courtesy of GENERAL MOTORS CORP.

6. Install the disc brake caliper and bracket assembly (1).

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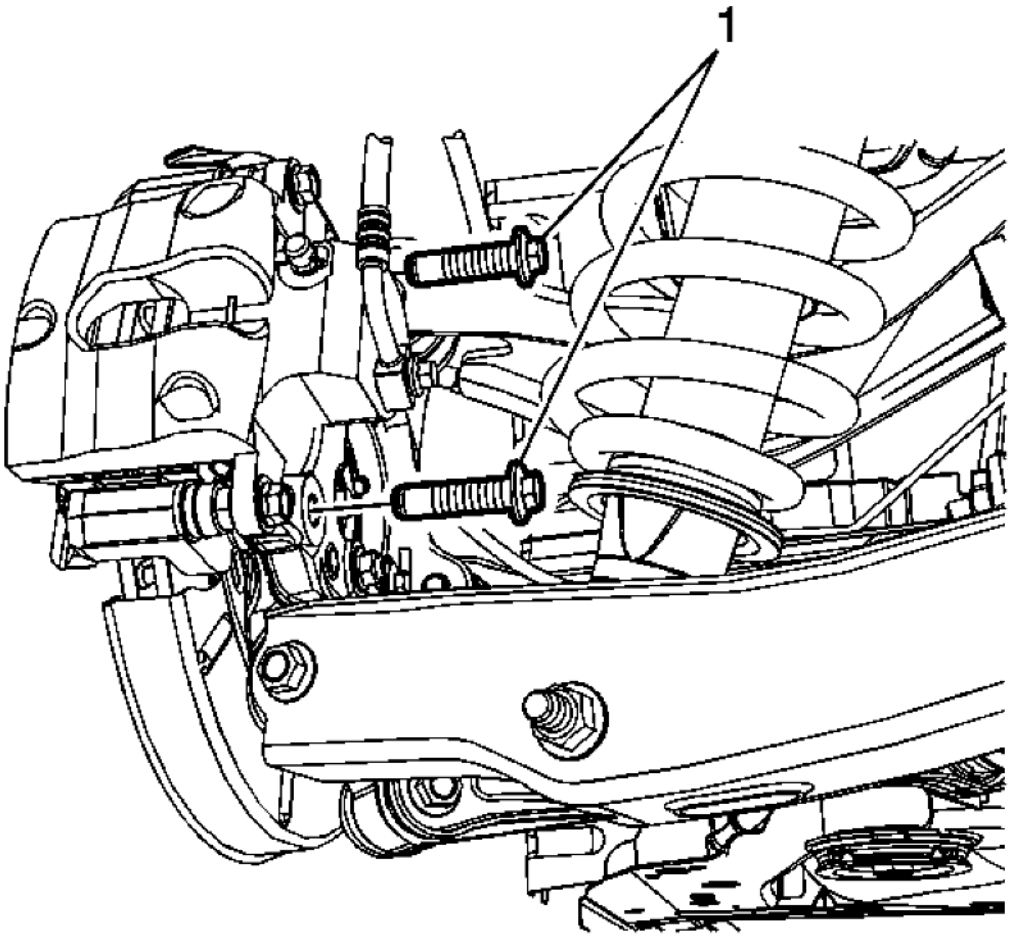


Fig. 160: Disc Brake Caliper Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: **The disc brake caliper bracket bolts must be replaced any time they are removed.**

7. Install 2 new disc brake caliper bracket bolts (1) and tighten to 40 N.m (30 lb ft) +90 degrees.
8. Inspect the parking brake adjustment. Refer to **Parking Brake Adjustment** .
9. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
10. If the brake rotor was refinished or replaced, or if new brake pads were installed, burnish the pads and rotors. Refer to **Brake Pad and Rotor Burnishing**.

REAR BRAKE ROTOR REPLACEMENT (L99, LS3)

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Special Tools

- **J-41013:** Rotor Resurfacing Kit
- **J-42450-A:** Wheel Hub Resurfacing Kit

For equivalent regional tools, refer to **Special Tools**.

Removal Procedure

WARNING: Refer to Brake Dust Warning .

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

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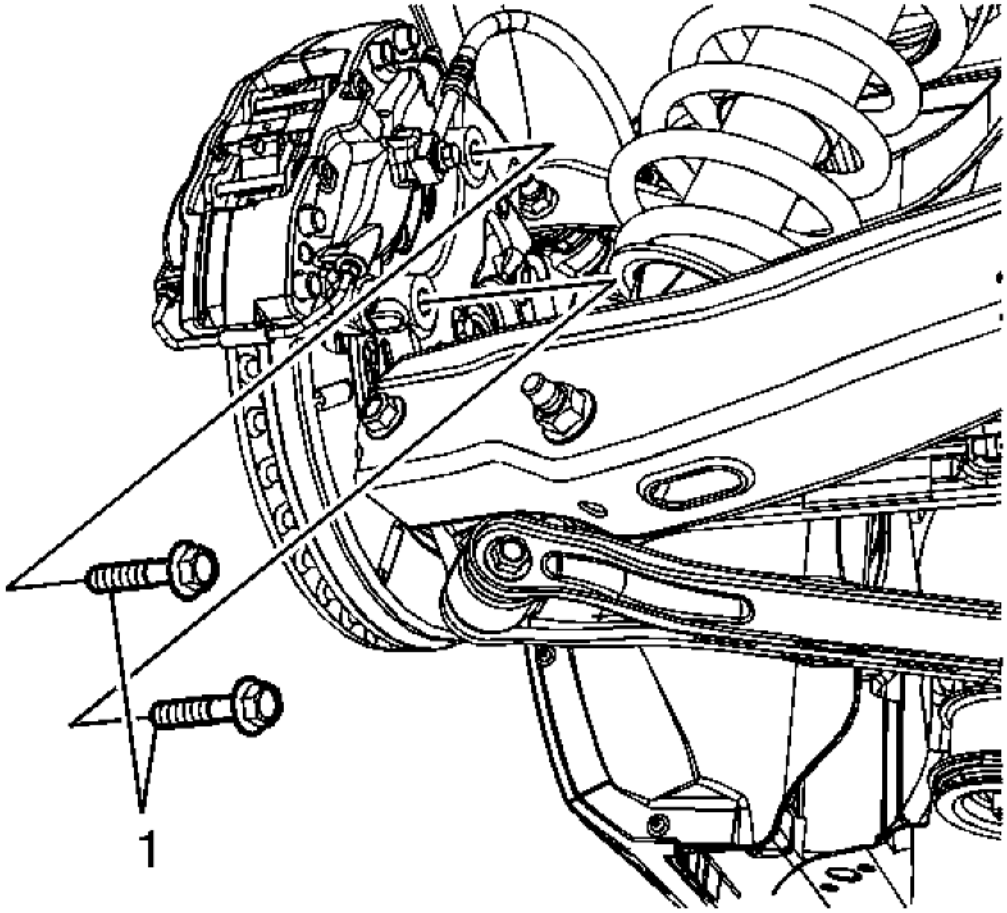


Fig. 161: Brake Caliper Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: The brake caliper bolts must be replaced any time they are removed. Do not reuse the brake caliper bolts.

3. Remove and discard the brake caliper bolts (1).

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.

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4. Remove the brake caliper assembly and support with heavy mechanics wire or equivalent.

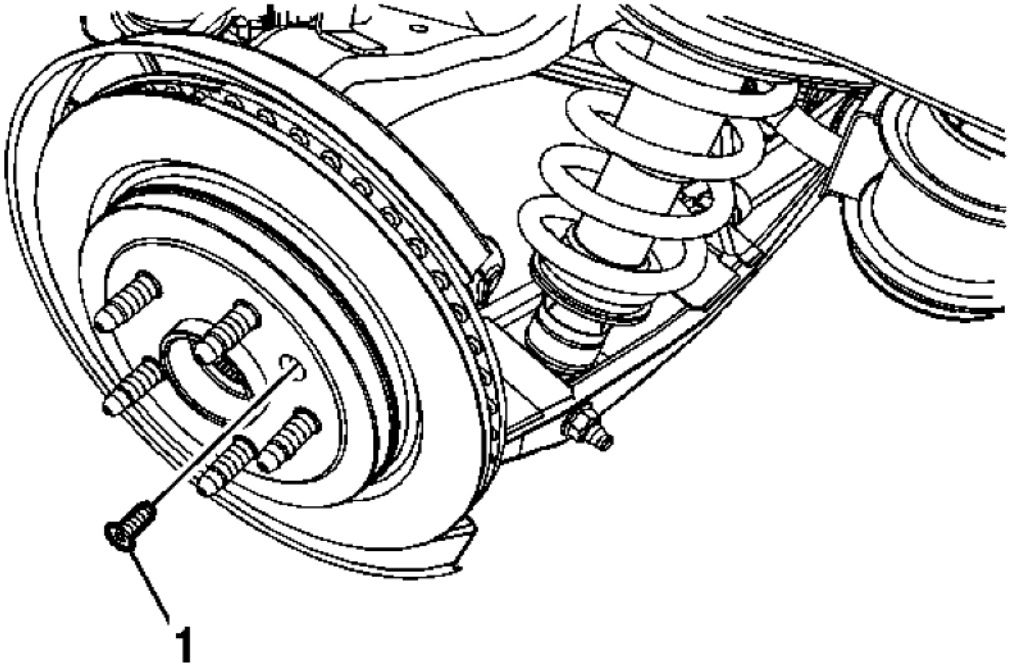


Fig. 162: Disc Brake Rotor Bolt
Courtesy of GENERAL MOTORS CORP.

5. Remove the brake rotor bolt (1).

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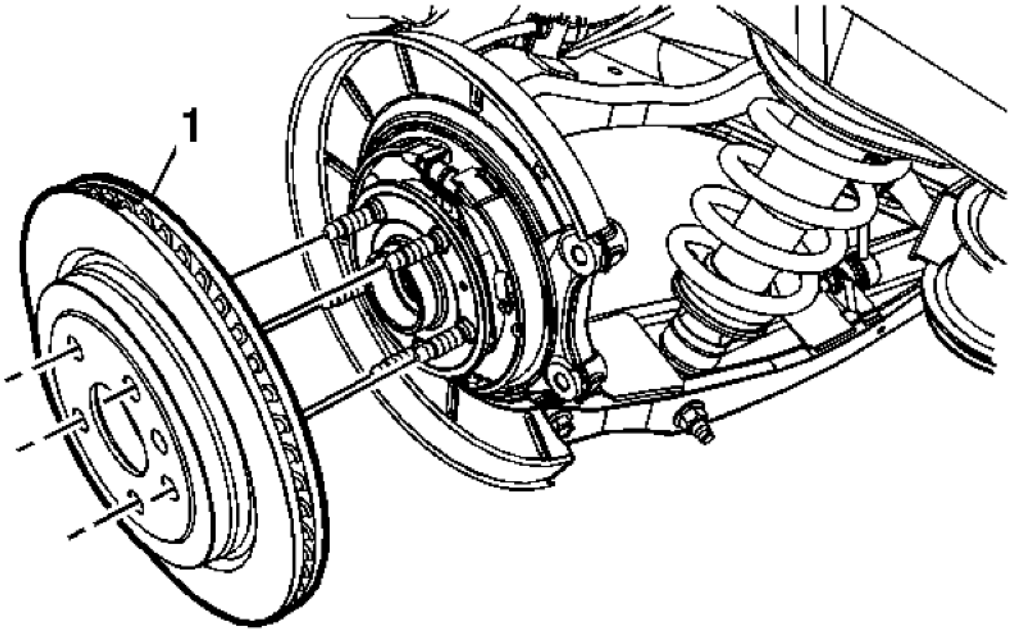


Fig. 163: Disc Brake Rotor
Courtesy of GENERAL MOTORS CORP.

6. Remove the brake rotor (1).

Installation Procedure

NOTE: Whenever the brake rotor has been separated from the hub/axle flange, any rust or contaminants should be cleaned from the hub/axle flange and the brake rotor mating surfaces. Failure to do this may result in excessive assembled lateral runout (LRO) of the brake rotor, which could lead to brake pulsation.

1. Using the **J-42450-A:** Wheel Hub Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface of the hub/axle flange.
2. Using the **J-41013:** Rotor Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface and mounting surface of the brake rotor.

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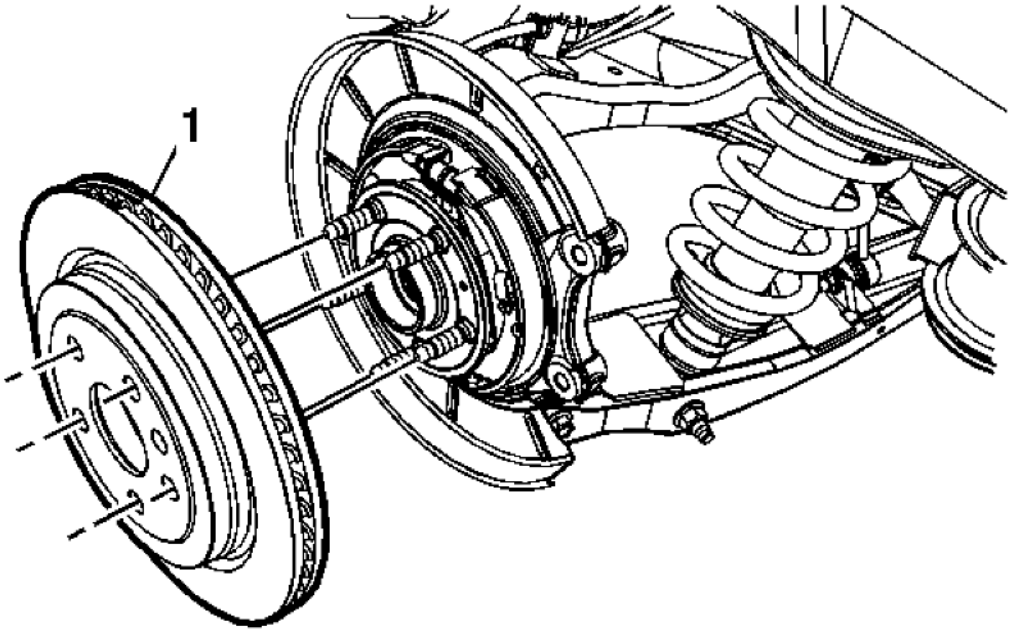


Fig. 164: Disc Brake Rotor
Courtesy of GENERAL MOTORS CORP.

3. Install the brake rotor (1).

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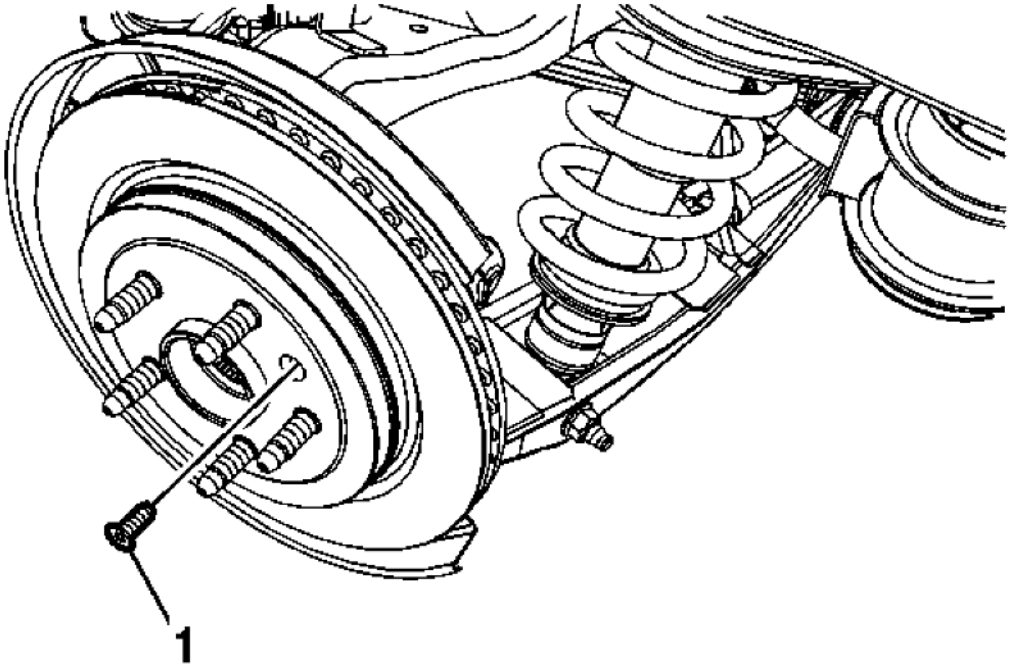


Fig. 165: Disc Brake Rotor Bolt
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

4. Install the brake rotor bolt (1) and tighten to 10 N.m (89 lb in).
5. Position the brake caliper assembly to the suspension knuckle.

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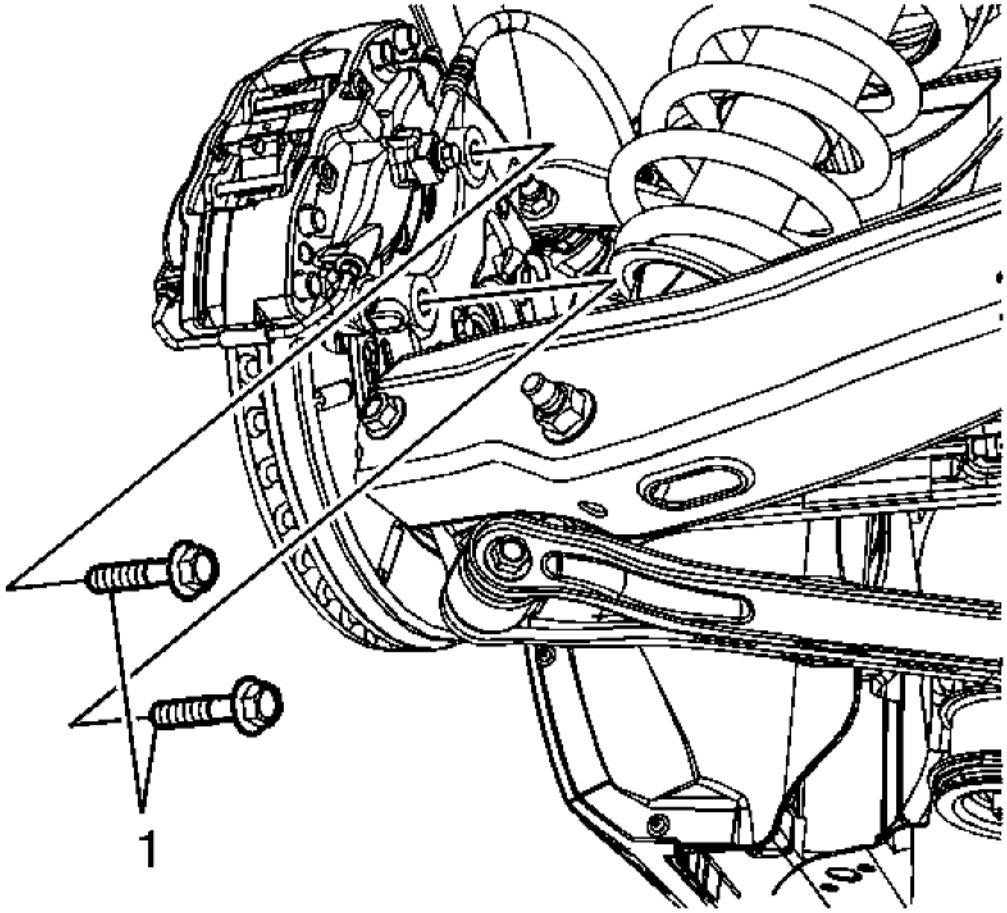


Fig. 166: Brake Caliper Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: The brake caliper bolts must be replace any time they are removed.

6. Install 2 new brake caliper bolts (1) and tighten to 40 N.m (30 lb ft) +90 degrees.
7. Inspect the parking brake adjustment. Refer to **Parking Brake Adjustment** .
8. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
9. If the brake rotor was refinished or replaced, or if new brake pads were installed, burnish the brake pads and rotors. Refer to **Brake Pad and Rotor Burnishing**.

FRONT BRAKE SHIELD REPLACEMENT

Removal Procedure

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WARNING: **Refer to Brake Dust Warning .**

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

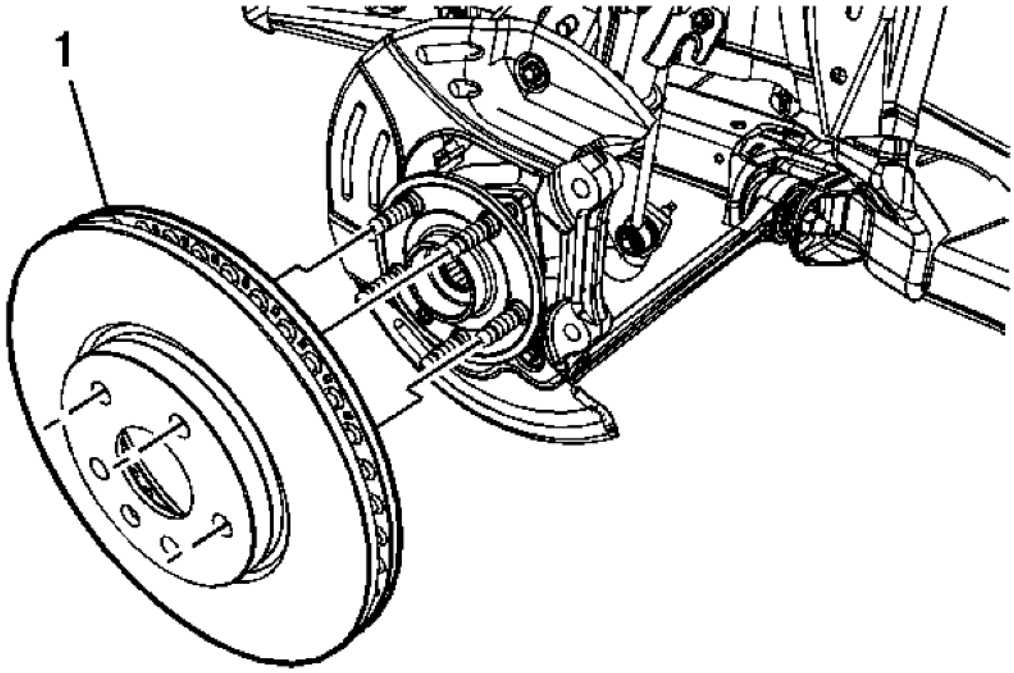


Fig. 167: Disc Brake Rotor
Courtesy of GENERAL MOTORS CORP.

3. Remove the front disc brake rotor (1). Refer to **Front Brake Rotor Replacement (LLT)** or **Front Brake Rotor Replacement (L99, LS3)**.

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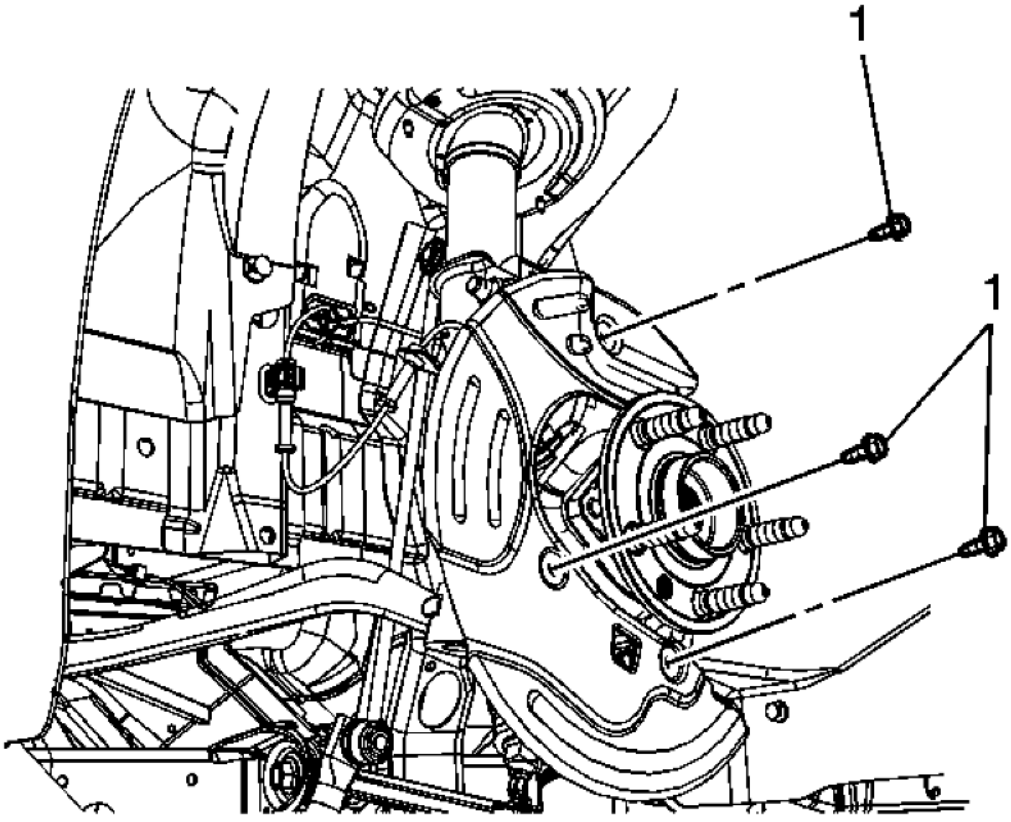


Fig. 168: Front Brake Shield Bolts
Courtesy of GENERAL MOTORS CORP.

4. Remove the front brake shield bolts (1).

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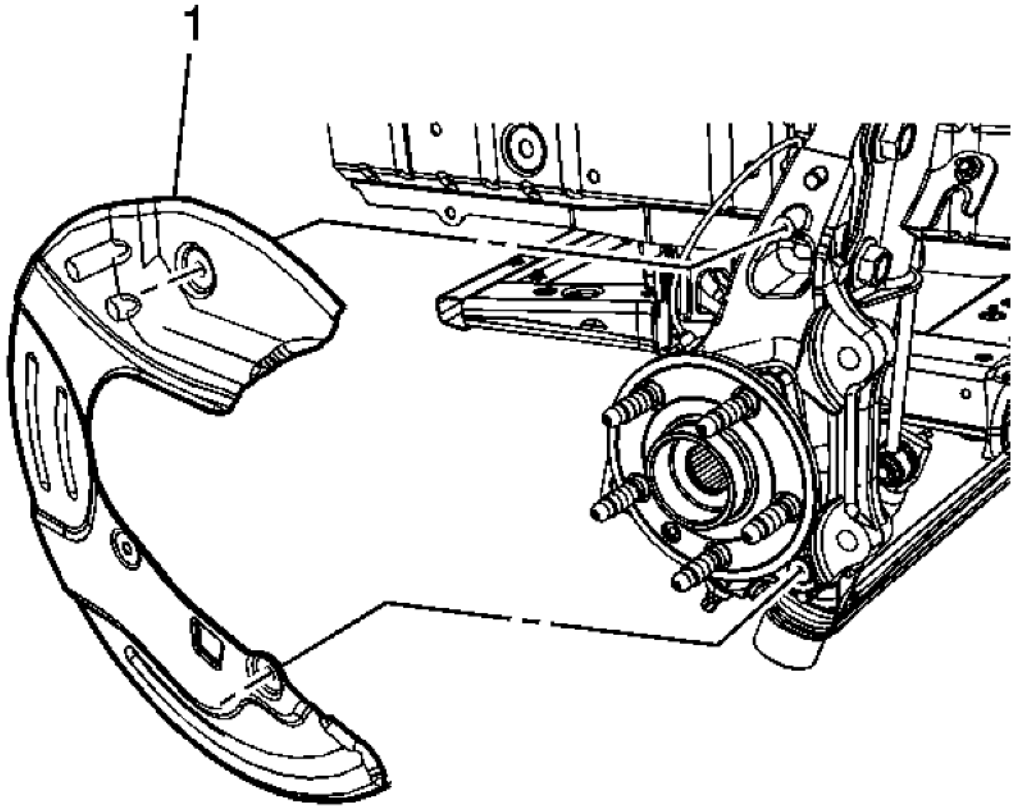


Fig. 169: Front Brake Shield
Courtesy of GENERAL MOTORS CORP.

5. Remove the front brake shield (1).

Installation Procedure

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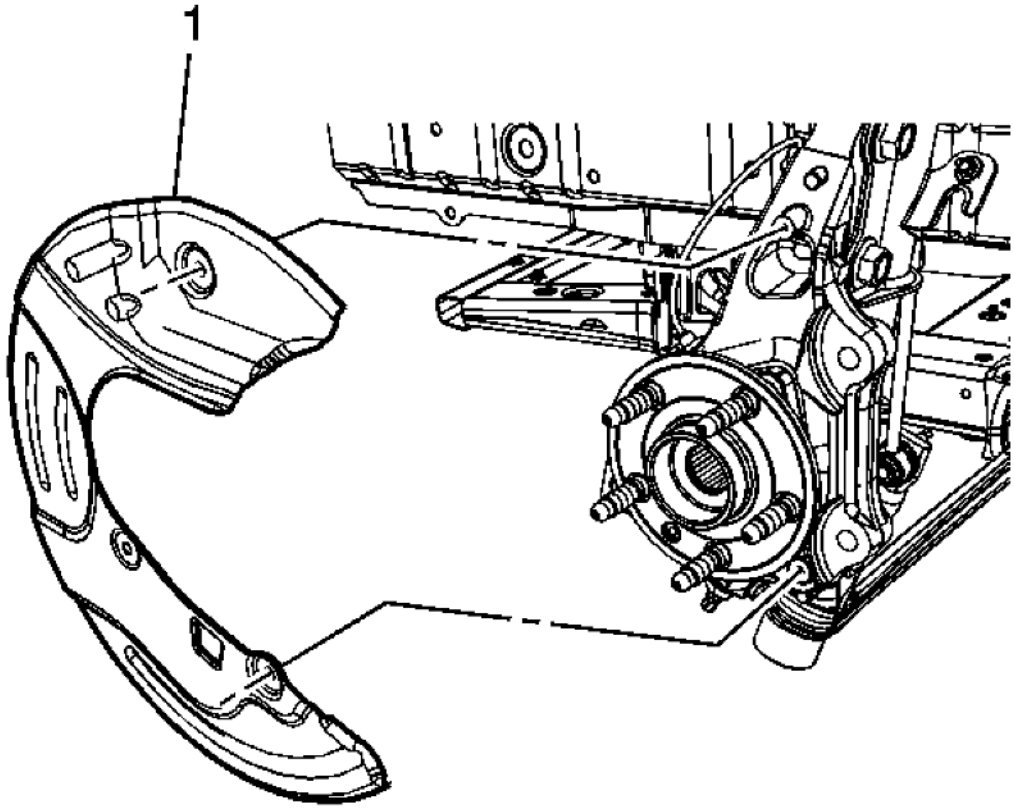


Fig. 170: Front Brake Shield
Courtesy of GENERAL MOTORS CORP.

1. Install the front brake shield (1).

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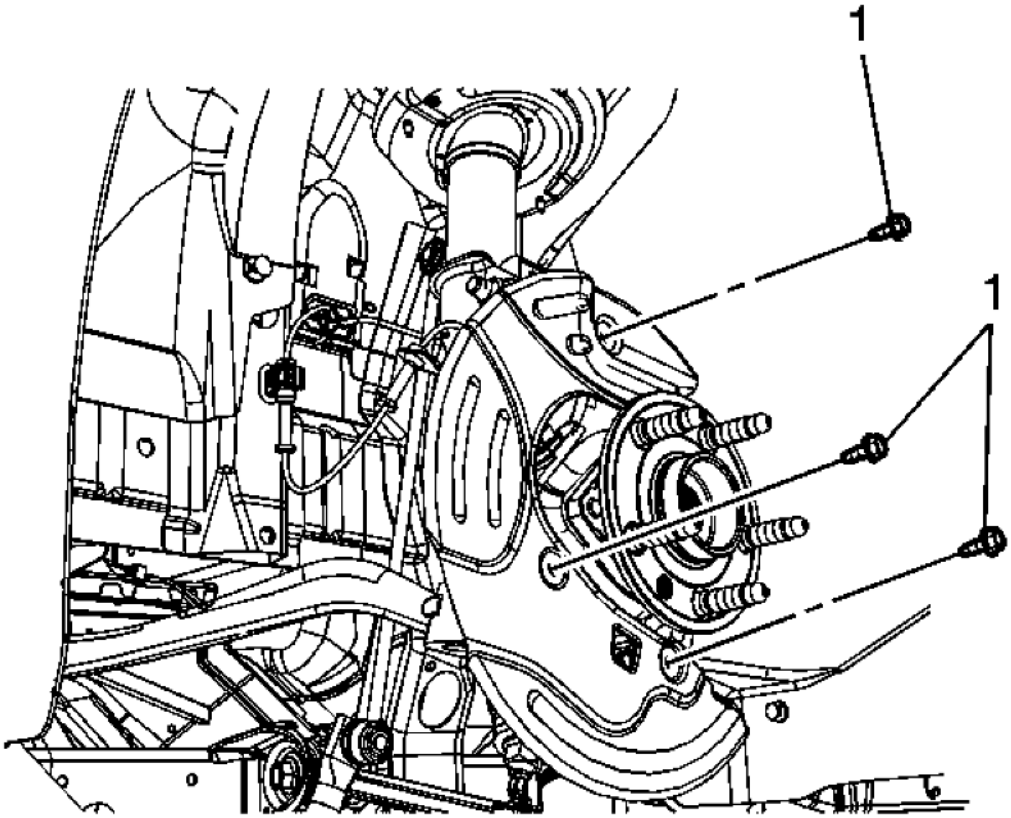


Fig. 171: Front Brake Shield Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

2. Install the front brake shield bolts (1) and tighten to 9 N.m (80 lb in).

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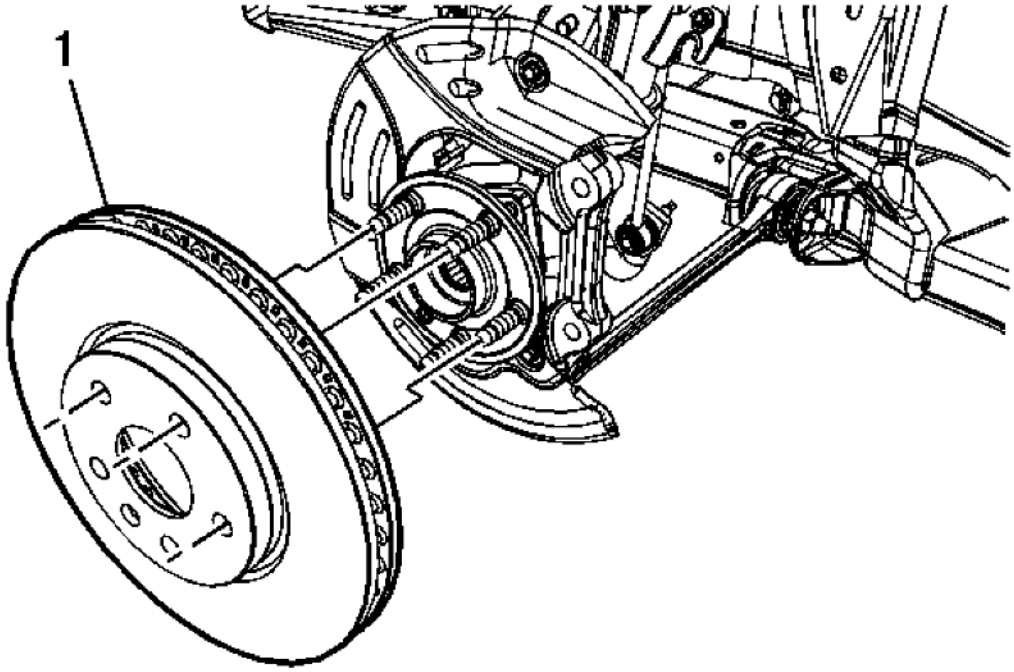


Fig. 172: Disc Brake Rotor
Courtesy of GENERAL MOTORS CORP.

3. Install the front disc brake rotor (1). Refer to **Front Brake Rotor Replacement (LLT)** or **Front Brake Rotor Replacement (L99, LS3)**.
4. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .

REAR BRAKE BACKING PLATE REPLACEMENT

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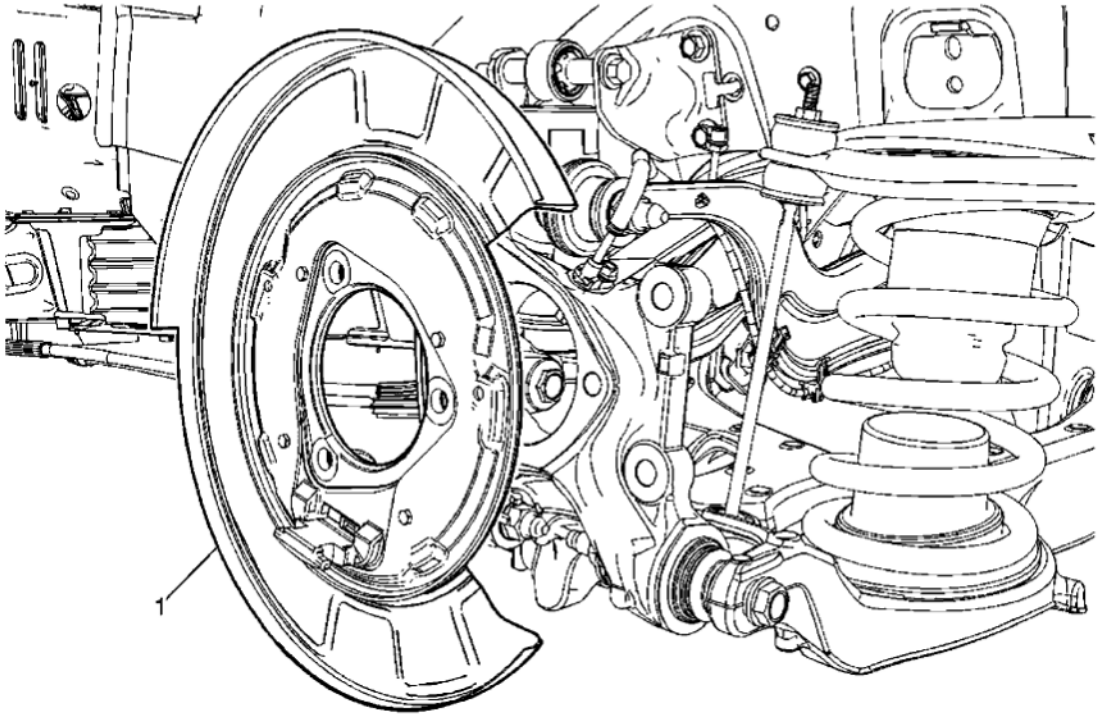


Fig. 173: Rear Brake Backing Plate
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
WARNING: Refer to **Brake Dust Warning** . **Preliminary Procedures** 1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** . 3. Remove the park brake shoes. Refer to **Parking Brake Shoe Replacement** . 4. Remove the park brake actuator. Refer to **Parking Brake Actuator Replacement** . 5. Remove the wheel hub and bearing assembly. Refer to **Rear Wheel Bearing and Hub Replacement** .	
1	Disc Brake Backing Plate

BRAKE ROTOR ASSEMBLED LATERAL RUNOUT CORRECTION

NOTE:

- **Brake rotor thickness variation MUST be checked BEFORE checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to Brake Rotor Thickness Variation Measurement.**

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- **Brake rotor assembled lateral runout (LRO) exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4 800-11 300 km (3,000-7,000 mi). Refer to Brake Rotor Assembled Lateral Runout Measurement.**

Review the following acceptable methods for bringing the brake rotor assembled LRO to within specifications. Determine which method to use for the specific vehicle being repaired.

- The correction plate method of correcting assembled LRO involves the addition of a tapered plate between the brake rotor and the hub/axle flange. The correction plate method can be used to correct LRO that exceeds the specification by up to 0.23 mm (0.009 in). Refer to **Brake Rotor Assembled Lateral Runout Correction - Correction Plates**.
- The on-vehicle brake lathe method is used to bring the LRO to within specifications through compensating for LRO while refinishing the brake rotor. Refer to **Brake Rotor Assembled Lateral Runout Correction - On Vehicle Lathe**.

If the assembled LRO cannot be corrected using these methods, then other components must be suspected as causing and/or contributing to the LRO concern.

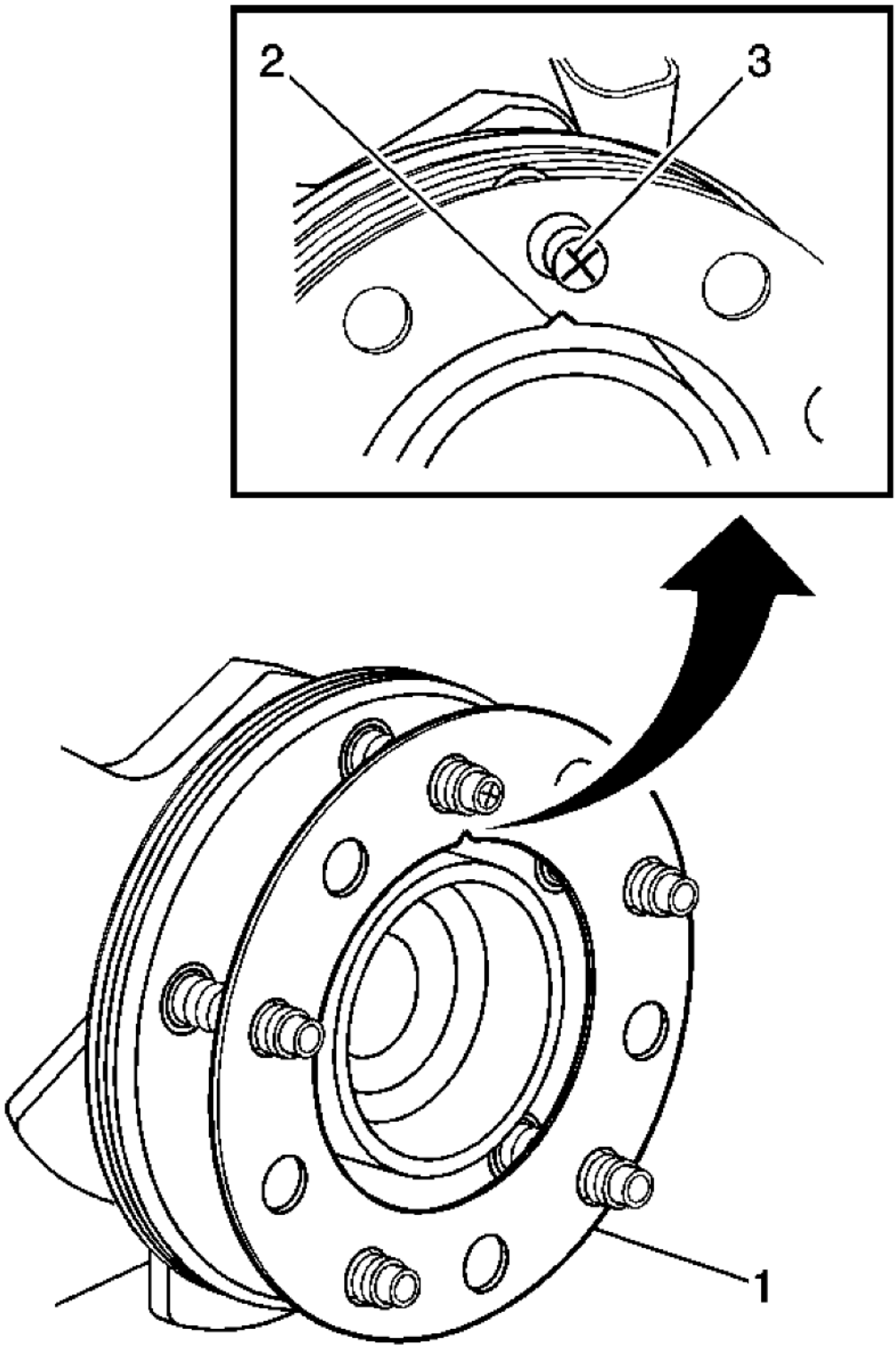
BRAKE ROTOR ASSEMBLED LATERAL RUNOUT CORRECTION - CORRECTION PLATES

Special Tools

- **CH-39544-KIT:** Complete Torque Socket Set - 10 PCS, or equivalent
- **CH-45101-100:** Conical Brake Rotor Washers

For equivalent regional tools, refer to **Special Tools**.

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Fig. 174: Identifying Correction Plate, High Spot Mark & V-Shaped Notch
Courtesy of GENERAL MOTORS CORP.

WARNING: Refer to Brake Dust Warning .

NOTE:

- **Brake rotor thickness variation MUST be checked BEFORE checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to Brake Rotor Thickness Variation Measurement.**
- **Brake rotor assembled LRO exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4,800-11,300 km (3,000-7,000 mi). Refer to Brake Rotor Assembled Lateral Runout Measurement.**

1. Rotate the brake rotor to position the high spot, identified and marked during the brake rotor assembled LRO measurement procedure, to face upward.
2. Remove the **CH-45101-100:** Conical Brake Rotor Washers and the lug nuts that were installed during the assembled LRO measurement procedure and/or the indexing correction procedure.
3. Inspect the mounting surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles or debris remaining.
4. Select the correction plate, following the manufacturer's instructions, which has a specification closest to the assembled LRO measurement.

   For example: If the assembled LRO measurement was 0.076 mm (0.003 in), the 0.076 mm (0.003 in) correction plate would be used. If the measurement was 0.127 mm (0.005 in), the 0.152 mm (0.006 in) correction plate would be used.

5. Determine the positioning for the correction plate (1) using the high spot mark (3) made during the brake rotor assembled LRO measurement procedure.

NOTE:

- **Do NOT install used correction plates in an attempt to correct brake rotor assembled LRO.**
- **Do NOT stack up, or install more than one correction plate onto one hub/axle flange location, in an attempt to correct brake rotor assembled LRO.**

6. Install the correction plate (1) onto the hub/axle flange, with the V-shaped notch (2) orientated to align with the high spot mark (3), that was positioned to face upward.

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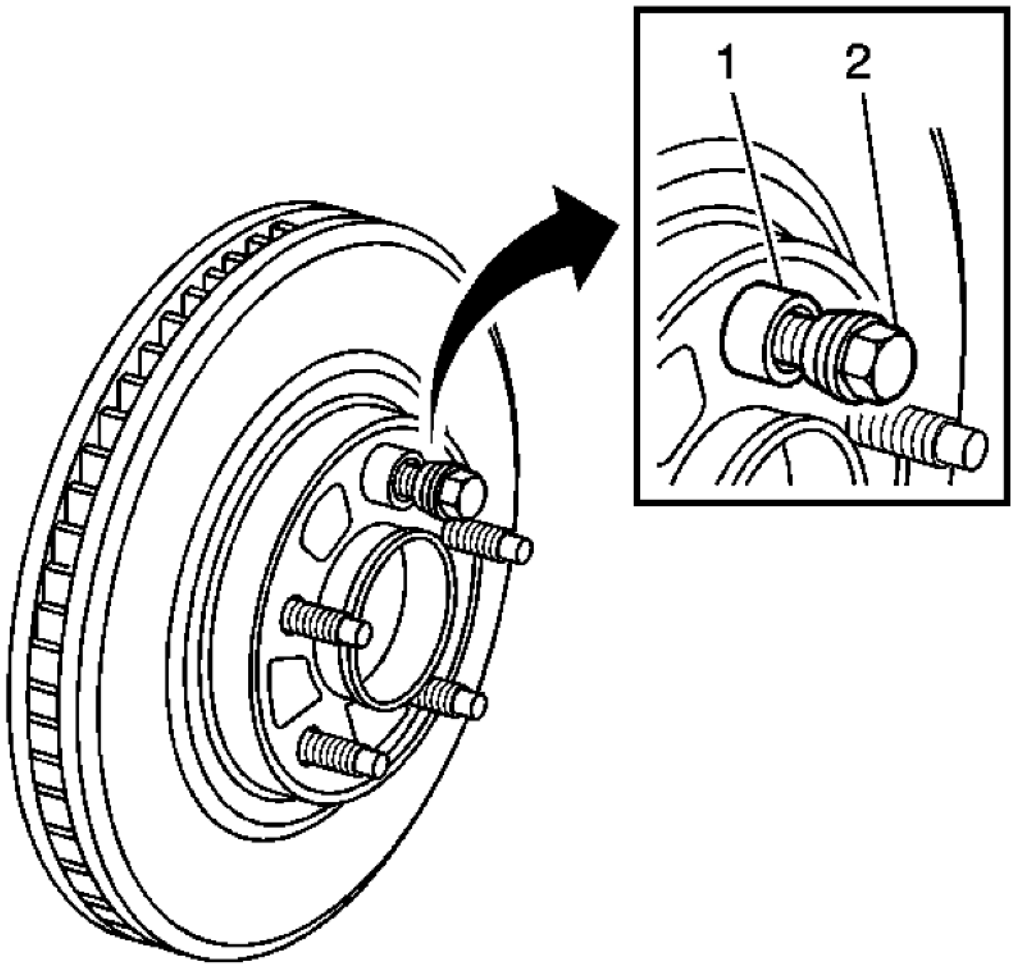


Fig. 175: Identifying Conical Brake Rotor Washer & Lug Nut
Courtesy of GENERAL MOTORS CORP.

7. Install the brake rotor to the hub/axle flange. Use the matchmark made prior to removal for proper orientation to the flange.
8. Hold the rotor firmly in place against the hub/axle flange and install one of the **CH-45101-100:** Conical Brake Rotor Washers (1) and one lug nut (2) onto the upper-most wheel stud.
9. Continue to hold the rotor secure and tighten the lug nut firmly by hand.

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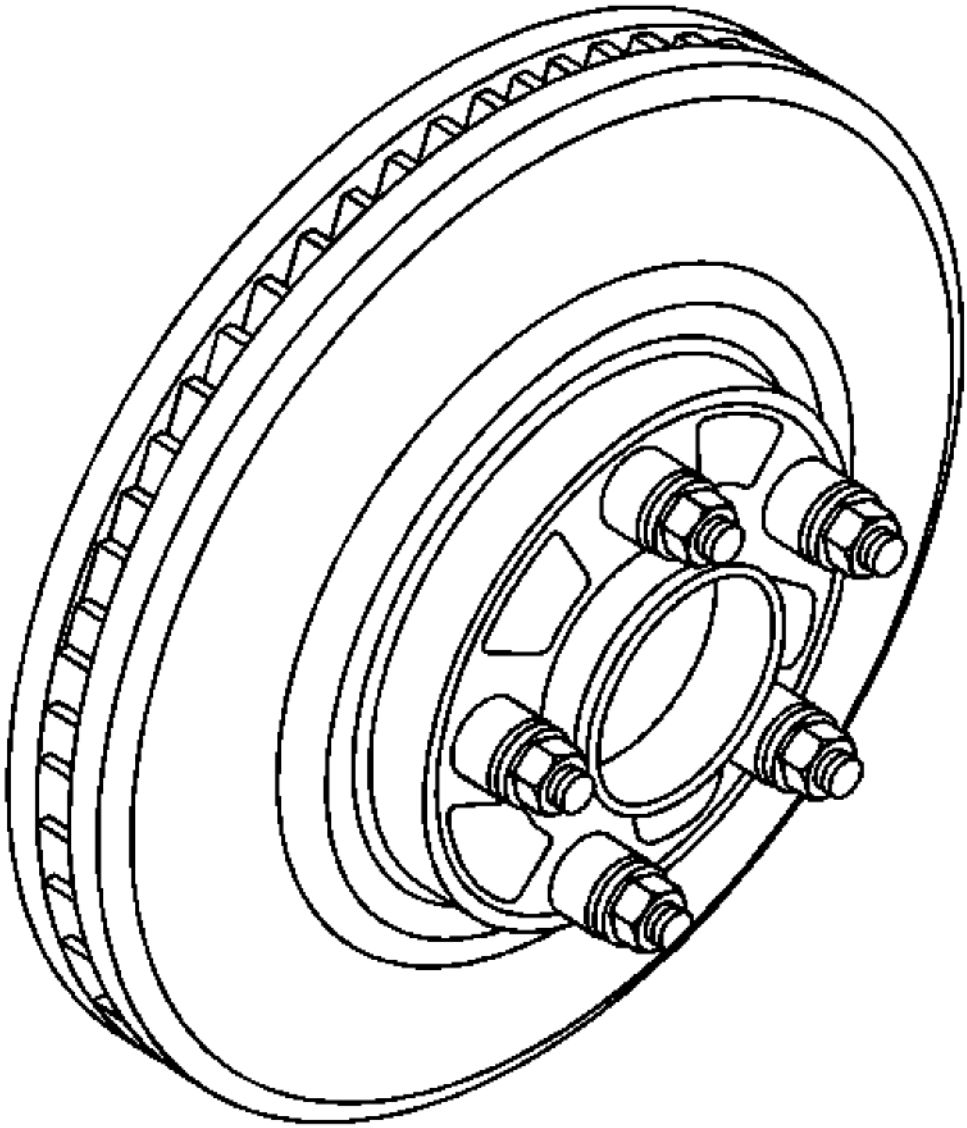


Fig. 176: View Of Conical Brake Rotor Washers & Lug Nuts
Courtesy of GENERAL MOTORS CORP.

10. Install the remaining **CH-45101-100:** Conical Brake Rotor Washers and lug nuts onto the wheel studs and tighten the nuts firmly by hand in a star-pattern.
11. Using the **CH-39544-KIT:** Complete Torque Socket Set - 10 PCS, or equivalent, tighten the lug nuts in a star-pattern to specification, in order to properly secure the rotor. Refer to **Tire and Wheel Removal and Installation** .

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12. Measure the assembled LRO of the brake rotor. Refer to **Brake Rotor Assembled Lateral Runout Measurement**.
13. If the brake rotor assembled LRO measurement still exceeds the maximum allowable specification, refer to **Brake Rotor Assembled Lateral Runout Correction**.
14. If the brake rotor assembled LRO measurement is within specification, install the brake caliper and depress the brake pedal several times to secure the rotor in place before removing the **CH-45101-100:** Conical Brake Rotor Washers and the lug nuts.

BRAKE ROTOR ASSEMBLED LATERAL RUNOUT CORRECTION - ON VEHICLE LATHE

Special Tools

CH-45101-100: Conical Brake Rotor Washers

For equivalent regional tools, refer to **Special Tools**.

WARNING: Refer to Brake Dust Warning .

NOTE:

- **Brake rotor thickness variation MUST be checked BEFORE checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to Brake Rotor Thickness Variation Measurement.**
- **Brake rotor assembled LRO exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4 800-11 300 km (3,000-7,000 mi). Refer to Brake Rotor Assembled Lateral Runout Measurement.**

1. Ensure that the caliper and caliper bracket that are already being supported, are clear from contacting any rotating components, such as the brake rotor.
2. Remove the **CH-45101-100:** Conical Brake Rotor Washers and the lug nuts that were installed during the assembled LRO measurement procedure and/or the indexing correction procedure.
3. Inspect the mounting surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles or debris remaining.
4. Set up the lathe, following the manufacturer's instructions.
5. Refinish the brake rotor, following the brake lathe manufacturer's instructions.
6. After each successive cut, inspect the brake rotor thickness. Refer to **Brake Rotor Thickness Measurement**.
7. If at any time the brake rotor exceeds the minimum allowable thickness after refinish specification, the brake rotor must be replaced. After replacing the rotor, proceed to step 10.
8. After refinishing the brake rotor, use the following procedure in order to obtain the desired non-directional finish:
    1. Follow the brake lathe manufacturer's recommended speed setting for applying a non-directional

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finish.

2. Using moderate pressure, apply the non-directional finish:
   - If the lathe is equipped with a non-directional finishing tool, apply the finish with 120-grit aluminum oxide sandpaper.
   - If the lathe is not equipped with a non-directional finishing tool, apply the finish with a sanding block and 150-grit aluminum oxide sandpaper.
3. After applying a non-directional finish, clean each friction surface of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.

9. Remove the lathe from the vehicle.
10. Measure the assembled LRO of the brake rotor. Refer to **Brake Rotor Assembled Lateral Runout Measurement**.
11. If the brake rotor assembled LRO measurement still exceeds the maximum allowable specification, refer to **Brake Rotor Assembled Lateral Runout Correction**.
12. If the brake rotor assembled LRO is within specification, install the brake caliper and depress the brake pedal several times to secure the rotor in place before removing the **CH-45101-100:** Conical Brake Rotor Washers and the lug nuts.

BRAKE ROTOR REFINISHING

Special Tools

- **CH-41013:** Rotor Resurfacing Kit
- **CH-42450-A:** Wheel Hub Resurfacing Kit

For equivalent regional tools, refer to **Special Tools**.

WARNING: Refer to Brake Dust Warning .

NOTE:

- **The disc brake rotors do not require refinishing as part of routine brake system service. New disc brake rotors do not require refinishing.**

  Do not refinish disc brake rotors in an attempt to correct the following conditions:

  - **Brake system noise - squeal, growl, groan**
  - **Uneven and/or premature disc brake pad wear**
  - **Superficial or cosmetic corrosion/rust of the disc brake rotor friction surface**
  - **Scoring of the disc brake rotor friction surface less than the maximum allowable specification**
- **Before refinishing a brake rotor, the rotor MUST first be checked for adequate thickness to allow the rotor to be refinished and remain above**

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the minimum allowable thickness after refinish specification. Refer to Brake Rotor Thickness Measurement.

Disc brake rotors should only be refinished if they have adequate thickness to be refinished and if one or more of the following conditions exist:

- **Thickness variation in excess of the maximum allowable specification**
- **Excessive corrosion/rust and/or pitting**
- **Cracks and/or heat spots**
- **Excessive blueing discoloration**
- **Scoring of the disc brake rotor surface in excess of the maximum allowable specification**

- **Disc brake rotors may need to be refinished as part of the process for correcting brake rotor assembled lateral runout (LRO) that exceeds the maximum allowable specification.**

NOTE: **If the vehicle is equipped with cross-drilled rotors, use a lathe with positive rake tooling. This setup requires less cutting pressure, which will result in less vibration, and a better surface finish. Also, use a vibration dampener when cutting. Otherwise, refinish according to the following instructions.**

NOTE: **Whenever the brake rotor has been separated from the hub/axle flange, clean any rust or contaminants from the hub/axle flange and the brake rotor mating surfaces. Failure to do this may result in increased assembled lateral runout (LRO) of the brake rotor, which could lead to brake pulsation.**

1. Using the **CH-42450-A:** Wheel Hub Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface of the hub/axle flange.
2. Using the **CH-41013:** Rotor Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface and mounting surface of the brake rotor.
3. Inspect the mating surfaces of the hub/axle flange and the rotor to ensure that there are no foreign particles or debris remaining.
4. Mount the brake rotor to the brake lathe according to the lathe manufacturer's instructions, ensuring that all mounting attachments and adapters are clean and free of debris.
5. Ensure that any vibration dampening attachments are securely in place.
6. With the brake lathe running, slowly bring in the cutting tools until they just contact the brake rotor friction surfaces.
7. Observe the witness mark on the brake rotor. If the witness mark extends approximately three-quarters or more of the way around the brake rotor friction surface on each side, the brake rotor is properly mounted to the lathe.

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8. If the witness mark does not extend three-quarters or more of the way around the brake rotor, re-mount the rotor to the lathe.
9. Following the brake lathe manufacturer's instructions, refinish the brake rotor.
10. After each successive cut, inspect the brake rotor thickness. Refer to **Brake Rotor Thickness Measurement**.
11. If at any time the brake rotor exceeds the minimum allowable thickness after refinish specification, the brake rotor must be replaced.
12. After refinishing the brake rotor, use the following procedure in order to obtain the desired non-directional finish:
    1. Follow the brake lathe manufacturer's recommended speed setting for applying a non-directional finish.
    2. Using moderate pressure, apply the non-directional finish:
        - If the lathe is equipped with a non-directional finishing tool, apply the finish with 120-grit aluminum oxide sandpaper.
        - If the lathe is not equipped with a non-directional finishing tool, apply the finish with a sanding block and 150-grit aluminum oxide sandpaper.
    3. After applying a non-directional finish, clean each friction surface of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner and wipe each friction surface using a clean shop towel to remove metal particles remaining from machining. Repeat the cleaning process if necessary to remove all metal particles.
13. Remove the brake rotor from the brake lathe.
14. Measure the assembled LRO of the brake rotor to ensure optimum performance of the disc brakes. Refer to **Brake Rotor Assembled Lateral Runout Measurement**.
15. If the brake rotor assembled LRO measurement exceeds the specification, bring the LRO to within specifications. Refer to **Brake Rotor Assembled Lateral Runout Correction**.

DESCRIPTION AND OPERATION

DISC BRAKE SYSTEM DESCRIPTION AND OPERATION

System Component Description

The disc brake system consists of the following components:

Disc Brake Pads

Applies mechanical output force from the hydraulic brake calipers to friction surfaces of brake rotors.

Disc Brake Rotors

Uses mechanical output force applied to friction surfaces from the disc brake pads to slow speed of tire and wheel assembly rotation.

Disc Brake Pad Hardware

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Secures disc brake pads firmly in proper relationship to the hydraulic brake calipers. Enables a sliding motion of brake pads when mechanical output force is applied.

Disc Brake Caliper Hardware (Floating Caliper)

Provides mounting for hydraulic brake caliper and secures the caliper firmly in proper relationship to caliper bracket. Enables a sliding motion of the brake caliper to the brake pads when mechanical output force is applied.

System Operation (Floating Caliper)

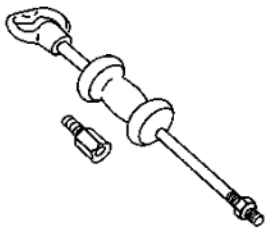
Mechanical output force is applied from the hydraulic brake caliper pistons to the inner brake pads. As the pistons press the inner brake pads outward, the caliper housings draw the outer brake pads inward. This allows the output force to be equally distributed. The brake pads apply the output force to the friction surfaces on both sides of the brake rotors, which slows the rotation of the tire and wheel assemblies. The correct function of both the brake pad and brake caliper hardware is essential for even distribution of braking force.

System Operation (Fixed Caliper)

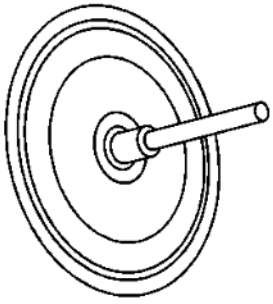
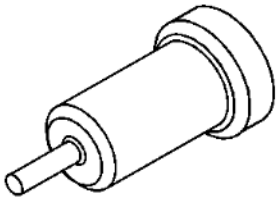
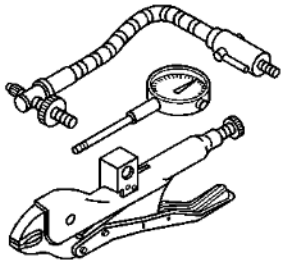
Mechanical output force is applied from the hydraulic brake caliper inboard and outboard pistons to the inner and outer brake pads. The brake calipers are a fixed, opposed-piston design, allowing the output force to be equally distributed through the distribution of the pressurized brake fluid within the caliper. The brake pads apply the output force to the friction surfaces on both sides of the brake rotors, which slows the rotation of the tire and wheel assemblies. The correct function of the brake pad hardware and of the brake caliper inboard and outboard pistons is essential for even distribution of braking force.

SPECIAL TOOLS AND EQUIPMENT

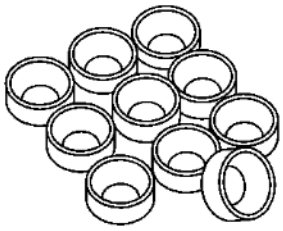
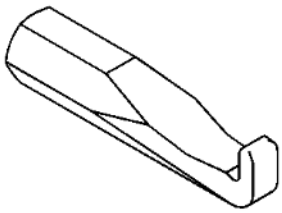
SPECIAL TOOLS

Illustration	Tool Number/ Description
	J 2619-A Slide Hammer w/Adapter

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	J 39544-KIT Complete Torque Socket Set - 10 PCS
	J 41013 Rotor Resurfacing Kit
	J 42450-A Wheel Hub Resurfacing Kit
	J 45101 Hub and Wheel Runout Gauge

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	J 45101-100 Conical Brake Rotor Washers
	J 46277 Rotor Removal Tool

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2010 BRAKES

Hydraulic Brakes - Camaro

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	Specification	
	Metric	English
Brake Booster Pushrod Retainer Bolt	9 N.m	80 lb in
Brake Hose Bracket Bolt	9 N.m	80 lb in
Brake Hose Fitting Bolt	40 N.m	30 lb in
Brake Pedal Assembly Bolt	22 N.m	16 lb ft
Brake Pedal Assembly Nut	17 N.m	13 lb ft
Brake Pipe Fitting	16 N.m	12 lb ft
Master Cylinder Nut	25 N.m	18 lb ft
Master Cylinder Reservoir Bolt	8 N.m	71 lb in
Power Brake Booster Auxiliary Pump Bolt and Nut	22 N.m	16 lb ft
Power Brake Booster Auxiliary Pump M6 Bolt	10 N.m	89 lb in
Power Brake Booster Auxiliary Pump M12 Bolt	70 N.m	52 lb ft

BRAKE COMPONENT SPECIFICATIONS

Application	Specification	
	Metric	English
Brake Caliper Bleeder Valve - Front (All)	10 N.m	89 lb in
Brake Caliper Bleeder Valve - Rear (All)	10 N.m	89 lb in

BRAKE SYSTEM SPECIFICATIONS

Application	Specification	
	Metric	English
Brake Pedal Travel • Maximum Specification with 445 N (100 lbs) of force applied to the pedal with the ignition OFF and the booster power reserve depleted.	63.5 mm	2.5 in

SCHEMATIC AND ROUTING DIAGRAMS

HYDRAULIC BRAKE SCHEMATICS

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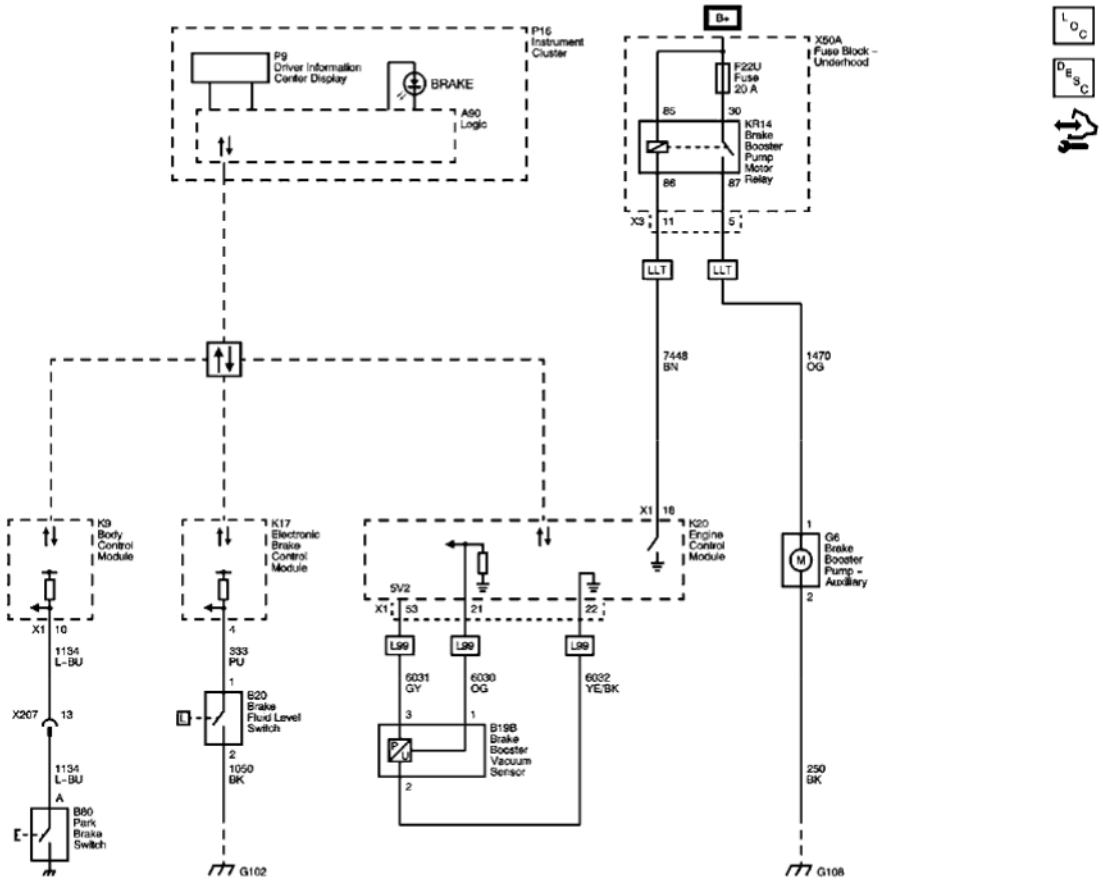


Fig. 1: Hydraulic Brake
Courtesy of GENERAL MOTORS CORP.

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC C0267	C0267 00: Low Brake Fluid Indicated
DTC P0556, P0557, or P0558	P0556: Brake Booster Pressure Sensor Performance P0557: Brake Booster Pressure Sensor Circuit Low Voltage P0558: Brake Booster Pressure Sensor Circuit High Voltage
DTC P258A-P258D	P258A: Vacuum Pump Relay Control Circuit P258B: Vacuum Pump Performance P258C: Vacuum Pump Relay Control Circuit Low Voltage P258D: Vacuum Pump Relay Control Circuit High Voltage

DTC C0267

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Diagnostic Instructions

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

DTC Descriptor

DTC C0267 00

Low Brake Fluid Indicated

Diagnostic Fault Information

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

Circuit/System Description

The brake fluid level switch monitors the level of brake fluid in the brake fluid reservoir.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

- A short to ground detected on the brake fluid level signal circuit for 5 seconds.
- Low brake fluid level is detected for 5 seconds.

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

Description and Operation

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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. Inspect for proper brake fluid level. The fluid level should be above minimum level.
    - If low, refer to **Brake Fluid Loss**.
2. Ignition ON, observe the scan tool Brake Fluid Level Sensor parameter. The reading should be OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the B20 Brake Fluid Level Switch.
2. Test for less than 5 ohms between the ground circuit terminal 2 and ground.
    - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Ignition ON, verify the scan tool Brake Fluid Level Sensor parameter is OK.
    - If not the specified value, test the signal circuit for a short to ground. If the circuit tests normal, replace the K17 Electronic Brake Control Module (EBCM).
4. Install a 3A fused jumper wire between the signal circuit terminal 1 and ground.
5. Verify the scan tool Brake Fluid Level Sensor parameter is Low.
    - If not the specified value, test the signal circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the K17 electronic brake control module (EBCM).
6. If all circuits test normal, test or replace the B20 Brake Fluid Level Switch.

Component Testing

1. Ignition OFF, disconnect the harness connector at the B20 Brake Fluid Level Switch.
2. Test for greater than 5 ohms between the ground circuit terminal 2 and the signal circuit terminal 1.
    - If less than the specified value, replace the B20 Brake Fluid Level Switch. Infinite resistance between signal terminal 1 and ground.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

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- **Master Cylinder Reservoir Replacement**
- **Control Module References** for EBCM replacement, setup and programming

DTC P0556, P0557, OR P0558

Diagnostic Instructions

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

DTC Descriptors

DTC P0556

Brake Booster Pressure Sensor Performance

DTC P0557

Brake Booster Pressure Sensor Circuit Low Voltage

DTC P0558

Brake Booster Pressure Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0557	P0557	P0651	P0556
Sensor Signal	P0557	P0557	P0558	P0556
Low Reference	-	P0557	-	P0556

Circuit/System Description

The brake booster pressure sensor measures the negative air pressure or vacuum reserve in the brake booster assembly. During engine running conditions, the brake booster pressure sensor signal circuit voltage varies, depending on the vacuum reserve internal to the brake booster.

Conditions for Running the DTC

P0556

Engine running at idle.

P0557 or P0558

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Ignition ON.

Conditions for Setting the DTC

P0556

The ECM detects brake booster vacuum as being less than the intake manifold vacuum for more than 100 milliseconds.

P0557

The ECM detects less than 0.04 V on the brake booster sensor signal circuit for more than 12.5 milliseconds.

P0558

The ECM detects greater than 4.89 V on the brake booster sensor signal circuit for more than 12.5 milliseconds.

Action Taken When the DTC Sets

DTCs P0556, P0557 or P0558 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0556, P0557 or P0558 are Type B DTCs.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

Brake Assist System Description and Operation

Electrical Information Reference

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

DTC Type Reference

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Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the brake booster vacuum sensor.
2. Ignition OFF, test for less than 10 ohms between the low reference circuit terminal 2 and ground.
    - If greater than the specified range, test the low reference circuit for an open/high resistance. If the circuit tests normal, replace the ECM.
3. Ignition ON, test for 4.8-5.2 V between the 5 V reference circuit terminal 3 and ground.
    - If less than the specified range, test the 5 V reference circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the ECM.
    - If greater than the specified range, test the 5 V reference circuit for a short to voltage. If the circuit tests normal, replace the ECM.
4. Ignition ON, test for 4.5-5.2 V between the 5 V reference circuit terminal 3 and the signal circuit terminal 1.
    - If less than the specified range, test the signal circuit for an open/high resistance. If the circuit tests normal, replace the ECM.
    - If greater than the specified range, test the signal circuit for a short to voltage. If the circuit tests normal, replace the ECM.
5. Ignition OFF, disconnect the X1 harness connector at the ECM.
6. Ignition OFF, test for infinite resistance between the signal circuit terminal 21 and ground.
    - If not the specified value, test the signal circuit for a short to ground.
7. If all circuits test normal, test or replace the power brake booster vacuum sensor.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Power Brake Booster Vacuum Sensor Replacement**
- **Control Module References** for ECM replacement, setup, and programming

DTC P258A-P258D

Diagnostic Instructions

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

DTC Descriptors

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DTC P258A

Vacuum Pump Relay Control Circuit

DTC P258B

Vacuum Pump Performance

DTC P258C

Vacuum Pump Relay Control Circuit Low Voltage

DTC P258D

Vacuum Pump Relay Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ Terminal 85	P258A	P258A, P258C	-	P258B
B+ Terminal 30	1	1	-	-
Control Terminal 86	P258C	P258A, P258C	P258D	P258B
Control Terminal 87	1	1	-	-
Brake Booster Pump Ground	-	1	-	-
1. Brake Booster Pump Malfunction				

Circuit/System Description

The engine control module (ECM) monitors the control circuit of the brake booster pump relay. The ECM supplies ground through the pump relay control circuit which then supplies B+ voltage to actuate the brake booster pump. B+ voltage is supplied at all times to the coil side of the pump relay.

Conditions for Running the DTC

P258A, P258C, P258D

Ignition ON.

P258B

- Engine Running
- Vacuum pump is activated for greater than 1.6 seconds.

Conditions for Setting the DTC

P258A, P258C

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The ECM detects an open/high resistance on the relay coil control circuit.

P258B

The ECM detects an excessive difference in vacuum levels between the power brake booster and the manifold absolute pressure (MAP).

P258D

The ECM detects a short to voltage on the relay control circuit.

Action Taken When the DTC Sets

DTC P258A, P258B, P258C, P258D are Type B DTCs.

Conditions for Clearing the DTC

DTC P258A, P258B, P258C, P258D are Type B DTCs.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

Brake Booster Vacuum Assist Description and Operation

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

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Circuit/System Verification

1. Verify that a vacuum leak is not present, refer to **Brake System Vacuum Source Test**.
2. Ignition ON, command the relay ON and OFF with a scan tool. Observe to verify that the vacuum relay and motor turns ON and OFF with each command.

Circuit/System Testing

1. Ignition OFF, disconnect the vacuum pump relay.
2. Ignition ON, verify that a test lamp does not illuminate between the control circuit terminal 86 and ground.
    - If the test lamp illuminates, test the control circuit for a short to voltage.
3. Verify that a test lamp illuminates between the B+ circuit terminals listed below and ground.
    - Terminal 30
    - Terminal 85
    - If the test lamp does not illuminate, test the B+ circuit for a short to ground or an open/high resistance. If the circuit tests normal and the B+ circuit fuse is open, test or replace the relay.
4. Verify that a test lamp does not illuminate between the control circuit terminal 87 and ground.
    - If the test lamp illuminates, test the control circuit for a short to voltage.
5. Disconnect the harness connector at the vacuum pump.
6. Test for less than 2 ohms between the vacuum pump ground circuit terminal 2 and ground.
    - If greater than the specified range, test the ground circuit for an open/high resistance.
7. Connect the harness connector at the vacuum pump.
8. Connect a 20A fused jumper wire between the B+ circuit terminal 30 and the control circuit terminal 87. Verify the vacuum pump is activated.
    - If the vacuum pump does not activate, test the control circuit for a short ground or an open/high resistance. If the circuit tests normal, test or replace the vacuum pump.
9. Ignition OFF, test for infinite resistance between the control circuit terminal 86 and ground.
    - If less than the specified value, test the control circuit for a short to ground. If the circuit tests normal, replace the ECM.
10. Disconnect the X1 harness connector at the ECM.
11. Test for less than 2 ohms between the control circuit terminal 86 at the relay cavity and terminal 18 at the ECM harness connector.
    - If greater than the specified range, test the control circuit for an open/high resistance.
12. If all circuits test normal, replace the brake booster pump relay.

Component Testing

1. Ignition OFF, disconnect the vacuum pump relay.
2. Test for 60-180 ohms between terminals 85 and 86.
    - If the resistance is not within the specified range, replace the relay.
3. Test for infinite resistance between the following terminals:

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- 30 and 85
- 30 and 87
- 30 and 86
- 86 and 87
  - If not the specified value, replace the relay.

4. Install a 30A fused jumper wire between relay terminal 86 and B+. Install a jumper wire between relay terminal 85 and ground.
5. Test for less than 2 ohms between terminals 30 and 87.
   - If greater than the specified range, replace the relay.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Relay Replacement (Attached to Wire Harness)** or **Relay Replacement (Within an Electrical Center)**
- **Power Brake Booster Auxiliary Pump Replacement**
- **Control Module References** for ECM replacement, setup, and programming

SYMPTOMS - HYDRAULIC BRAKES

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

1. Perform the **Brake System Vehicle Road Test** before using the hydraulic brake symptom tables in order to duplicate the customer's concern.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to the following:
   - **Brake Warning System Description and Operation**
   - **Hydraulic Brake System Description and Operation**
   - **Brake Booster Vacuum Assist Description and Operation**
   - **Brake Assist System Description and Operation**
   - **ABS Description and Operation**
   - **Park Brake System Description and Operation**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the hydraulic brake system. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components, for obvious damage or conditions, which could cause the symptom.

Intermittent

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Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

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

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

BRAKE BOOSTER PUMP MOTOR MALFUNCTION

Diagnostic Instructions

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

DTC Descriptors

DTC P258A

Vacuum Pump Relay Control Circuit

DTC P258B

Vacuum Pump Performance

DTC P258C

Vacuum Pump Relay Control Circuit Low Voltage

DTC P258D

Vacuum Pump Relay Control Circuit High Voltage

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Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ Term 85	P258A	P258A, P258C	-	P258B
B+ Term 30	P258C	P258A	P258D	P258B
Brake Booster Pump Control	1	1	1	-
Brake Booster Pump Ground	1	1	-	-
1. Brake Booster Pump Malfunction				

Circuit/System Description

The engine control module (ECM) monitors the control circuit of the brake booster pump relay. The ECM supplies ground through the pump relay control circuit which then supplies B+ voltage to actuate the brake booster pump. B+ voltage is supplied at all times to the coil side of the pump relay.

Conditions for Running the DTC

P258A, P258C, P258D

Ignition ON.

P258B

- Engine Running
- Vacuum pump is activated for greater than 1.6 seconds.

Conditions for Setting the DTC

P258A, P258C

The ECM detects an open/high resistance on the relay coil control circuit.

P258B

The ECM detects an excessive difference in vacuum levels between the power brake booster and the manifold absolute pressure (MAP).

P258D

The ECM detects a short to voltage on the relay control circuit.

Action Taken When the DTC Sets

DTC P258A, P258B, P258C, P258D are Type B DTCs.

Conditions for Clearing the DTC

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DTC P258A, P258B, P258C, P258D are Type B DTCs.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

Brake Booster Vacuum Assist Description and Operation

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that a vacuum leak is not present, refer to **Brake System Vacuum Source Test**.
2. Ignition ON, command the relay ON and OFF with a scan tool. Observe to verify that the vacuum relay and motor turns ON and OFF with each command.

Circuit/System Testing

1. Ignition OFF, disconnect the vacuum pump relay.
2. Ignition ON, verify that a test lamp does not illuminate between the control circuit terminal 86 and ground.
    - If the test lamp illuminates, test the control circuit for a short to voltage.
3. Verify that a test lamp illuminates between the B+ circuit terminals listed below and ground.
    - Terminal 30

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- Terminal 85
  - If the test lamp does not illuminate, test the B+ circuit for a short to ground or an open/high resistance. If the circuit tests normal and the B+ circuit fuse is open, test or replace the relay.

4. Verify that a test lamp does not illuminate between the control circuit terminal 86 and ground.
   - If the test lamp illuminates, test the control circuit for a short to voltage.
5. Disconnect the harness connector at the vacuum pump.
6. Test for less than 2 ohms between the vacuum pump ground circuit terminal 2 and ground.
   - If greater than the specified range, test the ground circuit for an open/high resistance.
7. Connect the harness connector at the vacuum pump.
8. Connect a 20A fused jumper wire between the B+ circuit terminal 30 and the control circuit terminal 87. Verify the vacuum pump is activated.
   - If the vacuum pump does not activate, test the control circuit for a short ground or an open/high resistance. If the circuit tests normal, test or replace the vacuum pump.
9. Ignition OFF, test for infinite resistance between the control circuit terminal 86 and ground.
   - If less than the specified value, test the control circuit for a short to ground. If the circuit tests normal, replace the ECM.
10. Disconnect the X1 harness connector at the ECM.
11. Test for less than 2 ohms between the control circuit terminal 86 at the relay cavity and terminal 18 at the ECM harness connector.
    - If greater than the specified range, test the control circuit for an open/high resistance.
12. If all circuits test normal, replace the brake booster pump relay.

Component Testing

1. Ignition OFF, disconnect the vacuum pump relay.
2. Test for 60-180 ohms between terminals 85 and 86.
   - If the resistance is not within the specified range, replace the relay.
3. Test for infinite resistance between the following terminals:
   - 30 and 85
   - 30 and 87
   - 30 and 86
   - 86 and 87
   - If not the specified value, replace the relay.
4. Install a 30A fused jumper wire between relay terminal 86 and B+. Install a jumper wire between relay terminal 85 and ground.
5. Test for less than 2 ohms between terminals 30 and 87.
   - If greater than the specified range, replace the relay.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

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- **Relay Replacement (Attached to Wire Harness)** or **Relay Replacement (Within an Electrical Center)**
- **Power Brake Booster Auxiliary Pump Replacement**
- **Control Module References** for ECM replacement, setup, and programming

BRAKE WARNING INDICATOR MALFUNCTION

Diagnostic Instructions

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

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Brake Fluid Level Signal	C0267 00	1	1	-
Park Brake Signal	1	1	1	-
Ground	-	1	-	-
1. Brake Warning Indicator Malfunction				

Circuit/System Description

The brake fluid level switch monitors the level of brake fluid in the master cylinder. When the electronic brake control module (EBCM) sees the brake fluid level switch input grounded, it sends a serial data message to the instrument panel cluster to turn ON the Red Brake Warning indicator.

The BCM sees the park brake switch input grounded and sends a serial data message to the instrument panel cluster requesting illumination of the Red Brake Warning indicator.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

Brake Warning System Description and Operation

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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 the park brake is released and the brake fluid is at or above the proper level.
   - If low, refer to **Brake Fluid Loss**.
2. Command the instrument panel cluster lamp test with a scan tool, the warning indicator should turn ON.
   - If the red brake warning indicator does not illuminate, replace the instrument panel cluster.
3. Ignition ON, observe the scan tool BCM Park Brake Switch parameter while applying and releasing the park brake. The parameter should cycle between Applied and Released.
   - If the parameter does not cycle between the specified values, refer to Park Brake Switch Malfunction.
4. Observe the scan tool EBCM Brake Fluid Level parameter. The reading should be OK.
   - If not the specified value, refer to Brake Fluid Level Switch Malfunction.

Circuit/System Testing

Park Brake Switch Malfunction

1. Ignition OFF, disconnect the harness connector at the park brake switch.
2. Ignition ON, verify the scan tool BCM Park Brake Switch parameter is Released.
   - If not the specified value, test the signal circuit terminal A for a short to ground. If the circuit tests normal, replace the BCM.
3. Install a 3 A fused jumper wire between the signal circuit terminal A and ground. Verify the scan tool BCM Park Brake Switch parameter is Applied.
   - If not the specified value, test the signal circuit for a short to voltage or an open/high resistance.
4. If all circuits test normal, test or replace the park brake switch.

Brake Fluid Level Switch Malfunction

1. Ignition OFF, disconnect the harness connector at the brake fluid level switch.
2. Test for less than 1 ohms between the ground circuit terminal 1 and ground.
   - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Ignition ON, verify the scan tool EBCM Brake Fluid Level parameter is OK.

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- If not the specified value, test the signal circuit for a short to ground. If the circuit tests normal, replace the EBCM.

4. Install a 3 A fused jumper wire between the signal circuit terminal 2 and ground. Verify the scan tool EBCM Brake Fluid Level parameter is Low.
   - If not the specified value, test the signal circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the EBCM.
5. If all circuits test normal, test or replace the brake fluid level switch.

Component Testing

Park Brake Switch Malfunction

1. Ignition OFF, disconnect the harness connector at the park brake switch.
2. Test for infinite resistance between the signal terminal A and ground with the park brake released.
   - If less than the specified value, replace the park brake switch.
3. Test for less than 1 ohms between the signal terminal A and ground with the park brake applied.
   - If greater than the specified range, replace the park brake switch.

Brake Fluid Level Switch Malfunction

1. Ignition OFF, disconnect the harness connector at the brake fluid level switch.
2. Test for infinite resistance between the ground terminal 2 and the signal terminal 1.
   - If less than the specified value, replace the brake fluid level switch.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Master Cylinder Reservoir Replacement**
- **Parking Brake Indicator Switch Replacement**
- **Control Module References** for BCM, instrument panel cluster, and EBCM replacement, setup, and programming

BRAKE PULSATION

Step	Action	Yes	No
DEFINITION: Fluctuation or pulsation is felt through the brake pedal, steering wheel, seat, floor, and/or in the vehicle ONLY when braking.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Vehicle**
	1. Inspect the disc brake system for the following conditions.		

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2	• Excessive thickness variation of rotor friction surfaces • Excessive assembled lateral runout (LRO) of rotor friction surfaces • Hard spots, heat checks, bluing discoloration of rotor friction surfaces; possibly due to brake drag • Excessive corrosion of rotor friction surfaces; including red, gray or black oxidation • Loose, damaged or missing caliper or lining hardware • Bent or damaged caliper or mounting component • Excessive LRO of wheel hub/axle flange; due to damage and/or loose or excessively worn bearings 2. Adjust, repair or replace components as necessary. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 3**	Go to **Diagnostic Starting Point - Vehicle**
3	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test**. Is the condition still present?	Go to **Step 2**	System OK

BRAKE SYSTEM NOISE

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

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2	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 9**	Go to **Step 3**
3	1. Inspect the brake assist system for the following conditions. • Lack of lubrication or excessively worn pushrod or pedal pivots or pivot bushings • Bent or damaged pedal pushrod, pedal, or pedal bracket • Damaged or improperly operating vacuum booster and/or check valve, if equipped • Low power steering fluid level, if equipped with hydraulic boost • Improperly tensioned, excessively worn or damaged power steering belt, if equipped with hydraulic boost • Restricted return hose from hydraulic booster, if equipped • Improperly operating hydraulic booster, if equipped		

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	• Improperly functioning power steering system, if equipped with a hydraulic booster assembly • Contaminated power steering fluid, if equipped with hydraulic boost 2. Adjust, repair or replace components as necessary. Refer to **Brake Assist System Diagnosis**. Did you find and correct a condition?	Go to **Step 9**	Go to **Step 4**
4	1. Inspect the hydraulic brake system for the following conditions. • Improper operation of caliper pistons • Contaminated brake fluid 2. Adjust, repair or replace components as necessary. Refer to **Hydraulic Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 9**	Go to **Step 5**
5	Is the vehicle equipped with a drum-in-rotor type of park brake system?	Go to **Step 6**	Go to **Step 9**
6	Ensure the park brake shoes are not adjusted too tightly, possibly causing a noise under certain conditions. Are the park brake shoes adjusted too tightly?	Go to **Step 7**	Go to **Step 9**
7	1. Clean and inspect the park brake shoes for excessive wear and/or damage. 2. Inspect the drum portion of the rotors for excessive wear, blueing discoloration, heat spots, and excessive radial runout. 3. If any of these conditions are present, replace the affected components. 4. Adjust the park brake system. Did you find and correct a condition?	Go to **Step 9**	Go to **Step 8**
8	Inspect the park brake system for proper operation. Refer to **Park Brake System Diagnosis** . Did you find and correct a condition?	Go to **Step 9**	Go to **Diagnostic Starting Point - Vehicle**
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**.		

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	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**
3	1. Inspect the disc brake system for the following conditions. • Contaminated linings • Glazed linings • Distorted, cracked or damaged linings on one side • Loose, damaged or missing caliper hardware and/or lining hardware • Incorrect linings on one side • Hard spots, heat checks, blueing discoloration of rotor friction surfaces; possibly due to brake drag • Glazed rotor friction surfaces		

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	• 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 4**
4	1. Inspect the suspension system for the following conditions. • Incorrect tire pressures • Loose suspension component connections • Excessively worn or damaged suspension components 2. 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	1. Inspect the steering system for the following conditions. • Loose steering component connections • Excessively worn or damaged steering components 2. Adjust, repair or replace components as necessary. Refer to **Diagnostic Starting Point - Vehicle** . 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 - FRONT TO REAR

Test Descriptions

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

4: Suspension components that are not operating properly may cause a disturbance to the vehicle during

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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	1. Inspect the hydraulic brake system for the following conditions: • Improper operation of caliper pistons • Kinked, pinched or damaged brake pipe or flexible brake hose • Brake fluid leak • Improperly functioning proportion valve, if equipped • Improper operation of dynamic rear proportion (DRP) system, if equipped 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**
3	1. Inspect the disc brake system for the following conditions: • Contaminated linings • Glazed linings • Distorted, cracked or damaged linings • Excessively worn linings • Aftermarket linings • Damaged or excessively worn caliper hardware and/or lining hardware • Hard spots, heat checks, blueing discoloration of rotor friction surfaces • Glazed rotor friction surfaces 2. Adjust, repair or replace components as necessary. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 6**	Go to **Step 4**
	1. Inspect the suspension system for the following		

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4	conditions: • Loose suspension component connections • Excessively worn or damaged suspension components 2. 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	1. Inspect the brake assist system for the following conditions: • Binding, bent or damaged pedal pushrod, pedal, or pedal bracket • Damaged or improperly operating vacuum booster, if equipped • Damaged or improperly operating hydraulic booster, if equipped 2. Adjust, repair or replace components as necessary. Refer to **Brake Assist System Diagnosis**. Did you find and correct a condition?	Go to **Step 6**	Go to **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

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 **Diagnostic Starting Point - Vehicle**
	Inspect the travel and feel of brake pedal applies. Perform the following: 1. Apply the brake pedal several times to fully deplete the power reserve.		

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2	2. With power reserve depleted, apply the brake pedal with light, steady pressure and hold for 15 seconds. Observe pedal travel and feel. 3. Apply the brake pedal with light, steady pressure, then without pumping the pedal, reduce pressure and reapply pressure several times. Observe pedal travel and feel for each apply. 4. Apply the brake pedal slowly, then release and apply the pedal quickly. Observe pedal travel and feel for each apply. Did you complete the brake pedal travel and feel inspections?	Go to **Step 3**	-
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		

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	○ Internal brake fluid leaks; improperly functioning master cylinder 2. Repair or replace components as necessary. Refer to **Hydraulic Brake System Diagnosis**. 3. Re-inspect brake pedal apply travel and feel. Did you find and correct a condition?	Go to **Step 8**	Go to **Step 4**
4	1. 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 2. Adjust, repair or replace components as necessary. Refer to **Disc Brake System Diagnosis**. 3. Re-inspect brake pedal apply travel and feel. Did you find and correct a condition?	Go to **Step 8**	Go to **Step 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 7**	Go to **Step 6**
6	1. Inspect for worn, missing, misaligned, bent or damaged brake pedal system components. • For the brake pedal pushrod component inspection, refer to **Brake Pedal Pushrod Inspection** . • Inspect the brake pedal bushings for binding, excessive wear and/or damage and inspect the brake pedal for a misaligned, bent, and/or damaged condition. 2. Replace the brake pedal system components that are worn, missing, misaligned, bent or damaged.		

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	Did you find and replace any worn, missing, misaligned, bent or damaged brake pedal system components?	Go to **Step 8**	Go to **Step 7**
7	1. Inspect the brake assist system for the following conditions: • Vacuum leaks and/or improperly operating check valve, if equipped with vacuum assist • Power steering fluid leaks, if equipped with hydraulic power assist • Damaged or improperly operating brake booster assembly 2. Adjust, repair or replace components as necessary. Refer to **Brake Assist System Diagnosis**. Did you find and correct a condition?	Go to **Step 8**	Go to **Diagnostic Starting Point - Vehicle**
8	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: • Vacuum leaks, if equipped with vacuum power assist • Power steering fluid leaks, if equipped with hydraulic power assist • Lack of lubrication, binding or excessively worn pushrod or pedal pivots or pivot bushings • Bent or damaged pedal pushrod, pedal, or pedal bracket		

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	• Damaged or improperly operating brake booster assembly 2. Adjust, repair or replace components as necessary. Refer to **Brake Assist System Diagnosis**. Did you find and correct a condition?	Go to **Step 5**	Go to **Step 3**
3	1. Inspect the hydraulic brake system for the following conditions: • Binding caliper pistons • Internally damaged flexible brake hoses; hindering fluid flow • External brake fluid leaks • Kinked or damaged flexible brake hoses and/or pipes • Internal brake fluid leaks; improperly operating master cylinder • Poor brake fluid quality; low boiling point 2. Adjust, repair or replace components as necessary. Refer to **Hydraulic Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 5**	Go to **Step 4**
4	1. Inspect the disc brake system for the following conditions: • Excessively worn linings • Glazed linings • Cracked, distorted or damaged linings • Contaminated linings • Binding, damaged or excessively worn caliper hardware and/or lining hardware • Lack of lubrication or excessive corrosion on metal to metal contact surfaces • Excessively worn or corroded rotor friction surfaces • Glazed rotor friction surfaces • Hard spots, heat checks, blueing discoloration of rotor friction surfaces 2. Adjust, repair or replace components as necessary. Refer to **Disc Brake System Diagnosis**.		Go to **Diagnostic Starting Point -**

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	Did you find and correct a condition?	Go to **Step 5**	**Vehicle**
5	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test**. Is the condition still present?	Go to **Step 2**	System OK

BRAKES DRAG

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

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7	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**
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.		

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	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.			
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: • Improper operation of caliper pistons • Internally damaged flexible brake hoses; hindering brake release • Contaminated brake fluid • Damaged or improperly operating master cylinder 2. Adjust, repair or replace components as		

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	necessary. Refer to **Hydraulic Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 5**	Go to **Step 3**
3	1. Inspect the brake assist system for the following conditions: • Binding, bent or damaged pedal pushrod, pedal, or pedal bracket • Damaged or improperly operating vacuum booster, if equipped • Restricted return hose from hydraulic booster, if equipped • Damaged or improperly operating hydraulic booster, if equipped 2. Adjust, repair or replace components as necessary. Refer to **Brake Assist System Diagnosis**. Did you find and correct a condition?	Go to **Step 5**	Go to **Step 4**
4	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 5**	Go to **Diagnostic Starting Point - Vehicle**
5	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test**. Is the condition still present?	Go to **Step 2**	System OK

BRAKE FLUID LOSS

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

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	3. Inspect the rear of the master cylinder for a brake fluid leak. Did you find a brake fluid leak?	Go to **Step 7**	Go to **Diagnostic Starting Point - Vehicle**
7	Replace the brake master cylinder. Did you complete the replacement?	Go to **Step 8**	-
8	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle to confirm proper operation. 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**
	Visually inspect the disc brake pads for the following conditions: Refer to **Front Disc Brake Pads Replacement (LLT)**		

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2	or **Front Disc Brake Pads Replacement (L99, LS3)** . • 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 **Front Disc Brake Pads Replacement (LLT)** or **Front Disc Brake Pads Replacement (L99, LS3)** and/or **Rear Disc Brake Pads Replacement (LLT)** or **Rear Disc Brake Pads Replacement (L99, LS3)** . Did you complete the inspection and replacement?	Go to **Step 12**	-
	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**		

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7	**Replacement (LLT)** or **Front Brake Caliper Replacement (L99, LS3)** and/or **Rear Brake Caliper Replacement (LLT)** or **Rear Brake Caliper Replacement (L99, LS3)** . 2. Inspect the disc brake caliper mounting bracket or the suspension knuckles and the mounting/sliding hardware for the following conditions: Refer to **Front Disc Brake Mounting and Hardware Inspection** and/or **Rear Disc Brake Mounting and Hardware Inspection** . • Binding or seized hardware • Worn, damaged or missing hardware components • Loose, bent, cracked, or damaged caliper mounting bracket or suspension knuckle 3. Replace components as required. Refer to the following procedures, as required: • **Front Brake Caliper Bracket Replacement** • **Rear Brake Caliper Bracket Replacement** • **Front Brake Caliper Hardware Replacement (LLT) Front Brake Caliper Hardware Replacement (L99, LS3)** • **Rear Brake Caliper Hardware Replacement (LLT) Rear Brake Caliper Hardware Replacement (L99, LS3)** 4. Replace the unevenly-worn, loose or damaged disc brake pads as a complete axle set. Refer to **Front Disc Brake Pads Replacement (LLT)** or **Front Disc Brake Pads Replacement (L99, LS3)** and/or **Rear Disc Brake Pads Replacement (LLT)** or **Rear Disc Brake Pads Replacement (L99, LS3)** . Did you complete the inspection and replacement?	Go to **Step 12**	-
	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		

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8	brake fluid. Refer to the following procedures as required: • **Front Brake Caliper Overhaul (LLT) Front Brake Caliper Overhaul (L99, LS3)** or **Front Brake Caliper Replacement (LLT) Front Brake Caliper Replacement (L99, LS3)** • **Rear Brake Caliper Overhaul (LLT) Rear Brake Caliper Overhaul (L99, LS3)** or **Rear Brake Caliper Replacement (LLT) Rear Brake Caliper Replacement (L99, LS3)** • **Front Brake Hose Replacement (LLT) Front Brake Hose Replacement (LS3, L99)** • **Rear Brake Hose Replacement (LLT) Rear Brake Hose Replacement (LS3, L99)** • **Brake Pipe Replacement** Did you find and correct the source of the leak causing contamination of the pads?	Go to **Step 11**	Go to **Step 9**
9	1. Inspect the wheel drive shaft outer seals for damage and evidence of a grease leak. 2. Replace any wheel drive shaft seal that is found to be leaking grease which may be the source of the contamination to the pads. Refer to **Wheel Drive Shaft Outer Joint Inspection** and/or **Wheel Drive Shaft Inner Joint Inspection** . 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		-

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	contamination of the pads?	Go to **Step 11**	
11	1. Clean the remaining disc brake system components to remove any traces of the contaminant. **CAUTION:** **Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.** **NOTE:** **Do NOT disconnect the hydraulic brake flex hoses from the calipers.** 2. Remove the front and/or rear disc brake calipers, as appropriate, from the mounting brackets or the suspension knuckles and support the calipers. Refer to **Front Brake Caliper Replacement (LLT)** or **Front Brake Caliper Replacement (L99, LS3)** and/or **Rear Brake Caliper Replacement (LLT)** or **Rear Brake Caliper Replacement (L99, LS3)** . 3. Inspect the disc brake caliper mounting/sliding hardware for the following conditions: Refer to **Front Disc Brake Mounting and Hardware Inspection** and/or **Rear Disc Brake Mounting and Hardware Inspection** . • Binding or seized hardware • Distorted, worn, damaged or missing hardware components 4. Replace the caliper mounting/sliding hardware components as required. Refer to **Front Brake Caliper Hardware Replacement (LLT)** or **Front Brake Caliper Hardware Replacement (L99, LS3)** and/or **Rear Brake Caliper Hardware Replacement (LLT)** or **Rear Brake Caliper Hardware Replacement (L99, LS3)** . 5. Replace the contaminated disc brake pads as a complete axle set. Refer to **Front Disc Brake**		-

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	Pads Replacement (LLT) or **Front Disc Brake Pads Replacement (L99, LS3)** and/or **Rear Disc Brake Pads Replacement (LLT)** or **Rear Disc Brake Pads Replacement (L99, LS3)** . Did you complete the cleaning, inspection and replacement?	Go to **Step 12**	
12	Visually inspect each of the disc brake rotor shields/backing plates, if equipped, for evidence of contact with the brake rotors. Are any of the brake rotor shields/backing plates contacting the brake rotors?	Go to **Step 13**	Go to **Step 14**
13	Repair or replace the disc brake rotor shields/backing plates as required. Refer to **Front Brake Shield Replacement** . Did you complete the repair or replacement?	Go to **Step 14**	-
14	1. Check the thickness of each of the disc brake rotors. **NOTE:** **Make the following determination AND ANSWER the question INDIVIDUALLY for EACH rotor.** 2. Make a determination for each brake rotor if the rotor can be REFINISHED and REMAIN ABOVE the minimum requirements. Refer to **Brake Rotor Thickness Measurement** .Does the disc brake rotor meet the minimum requirements for REFINISHING?	Go to **Step 15**	Go to **Step 18**
15	**NOTE:** **Perform the following inspection AND ANSWER the question INDIVIDUALLY for EACH rotor.** Inspect each of the disc brake rotors for thickness variation that exceeds the maximum acceptable level. Refer to **Brake Rotor Thickness Variation Measurement** .Does the brake rotor exhibit thickness variation that exceeds the maximum acceptable level?	Go to **Step 17**	Go to **Step 16**
	1. Inspect each of the disc brake rotors for the following surface and wear conditions: Refer to **Brake Rotor Surface and Wear Inspection** .		

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	• Heavy rust and/or pitting • Cracks and/or heat spots • Excessive blueing discoloration • Deep or excessive scoring beyond maximum acceptable level		
16	**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**
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 MINIMUM THICKNESS requirements?	Go to **Step 21**	Go to **Step 19**
19	**NOTE:** **Perform the following inspection AND ANSWER the question INDIVIDUALLY for EACH rotor.** Inspect each of the disc brake rotors for thickness variation that exceeds the maximum acceptable level. Refer to **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**
	1. Inspect each of the disc brake rotors for the following surface and wear conditions: Refer to **Brake Rotor Surface and Wear Inspection** . • Heavy rust and/or pitting		

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20	• 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 (LLT)** or **Front Brake Rotor Replacement (L99, LS3)** or **Rear Brake Rotor Replacement (LLT)** or **Rear Brake Rotor Replacement (L99, LS3)** .Did you complete the replacement?	Go to **Step 24**	-
22	**NOTE:** **Perform the following inspection AND ANSWER the question INDIVIDUALLY for EACH rotor.** Inspect each of the disc brake rotors for assembled lateral runout (LRO) that exceeds the maximum acceptable level. Refer to **Brake Rotor Assembled Lateral Runout Measurement** .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 **Brake Rotor Assembled Lateral Runout Correction** . Did you complete the operation?	Go to **Step 24**	-
	Install or connect components that were removed or disconnected during diagnosis.	Disc Brake System OK	

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24	Did you complete the operation?	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 **Diagnostic Starting Point - Vehicle**
2	Inspect and adjust the brake fluid level in the brake master cylinder. Refer to **Master Cylinder Reservoir Filling**. Was the brake fluid level low?	Go to **Step 3**	Go to **Step 4**
3	1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination: • Fluid separation, indicating two types of fluid are present o Swirled appearance-oil-based substance o Layered appearance-silicone-based substance • Fluid discoloration o Cloudy appearance-moisture o 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**
	1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination: • Fluid separation, indicating two types of fluid are present o Swirled appearance-oil-based substance o Layered appearance-silicone-based substance		

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4	• 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**
5	1. Flush the hydraulic brake system. Refer to **Hydraulic Brake System Flushing**. 2. If the brake fluid WAS contaminated with an oil-based or a silicone-based fluid, indicated by fluid separation and/or a swollen master cylinder reservoir cap diaphragm and/or swollen reservoir-to-master cylinder grommets, perform the following steps. Refer to the procedures indicated. 1. Remove ALL of the following components listed. Each component contains internal rubber seals/linings which have been contaminated. 2. Clean out the hydraulic brake pipes using denatured alcohol, or equivalent. 3. Dry the brake pipes using non-lubricated, filtered air. 4. Repair or replace ALL of the following components listed. Each component contains internal rubber seals/linings which have been contaminated. • **Master Cylinder Replacement** • Brake master cylinder reservoir: Clean the brake master cylinder reservoir using denatured alcohol, or equivalent, then dry the reservoir using non-lubricated, filtered air, or if necessary, replace the brake master cylinder reservoir. • Replace the brake master cylinder reservoir cap diaphragm. • **Front Brake Hose Replacement (LLT)Front Brake Hose Replacement (LS3, L99)**		-

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	• **Rear Brake Hose Replacement (LLT)Rear Brake Hose Replacement (LS3, L99)** • **Front Brake Caliper Overhaul (LLT) Front Brake Caliper Overhaul (L99, LS3)** or **Front Brake Caliper Replacement (LLT) Front Brake Caliper Replacement (L99, LS3)** • **Rear Brake Caliper Overhaul (LLT) Rear Brake Caliper Overhaul (L99, LS3)** or **Rear Brake Caliper Replacement (LLT) Rear Brake Caliper Replacement (L99, LS3)** • **Brake Pressure Modulator Valve Replacement** 3. If the brake fluid was NOT contaminated with an oil-based fluid, but WAS contaminated with water or dirt, rust, corrosion, and/or brake dust, replace the brake master cylinder reservoir cap diaphragm which may have allowed moisture or dirt to enter the system. 4. Refill and bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**. Did you complete the operation and any required repairs and/or replacements?	Go to **Step 9**	
	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: • **Master Cylinder Replacement** • Brake master cylinder reservoir cap diaphragm • **Front Brake Hose Replacement (LLT) Front Brake Hose Replacement (LS3, L99)** • **Rear Brake Hose Replacement (LLT) Rear Brake Hose Replacement (LS3, L99)** • **Brake Pipe Replacement**		

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6	• **Front Brake Caliper Overhaul (LLT) Front Brake Caliper Overhaul (L99, LS3)** or **Front Brake Caliper Replacement (LLT) Front Brake Caliper Replacement (L99, LS3)** • **Rear Brake Caliper Overhaul (LLT) Rear Brake Caliper Overhaul (L99, LS3)** or **Rear Brake Caliper Replacement (LLT) Rear Brake Caliper Replacement (L99, LS3)** • **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 (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**. While bleeding the hydraulic brake system, observe for the following conditions: • The presence of air in the system at a bleeder valve location other than at the repair location, except if the brake master cylinder was replaced • An unrestricted and even flow of brake fluid per axle during the bleeding procedure Did you find and correct a condition?	Go to **Step 7**	Go to **Step 12**
7	Was there air in the system at a bleeder valve location other than at the repair location, except if the brake master cylinder was replaced?	Go to **Step 19**	Go to **Step 8**
8	Was the flow of brake fluid unrestricted and even per axle during the bleeding procedure?	Go to **Step 9**	Go to **Step 10**
9	Inspect the hydraulic function of the brake calipers for proper operation. Refer to **Hydraulic Brake Component Operation Visual Inspection**. Was the hydraulic function of the brake calipers operating properly?	Go to **Step 21**	Go to **Step 14**
10	Was the flow of brake fluid restricted or uneven through front axle hydraulic components during the bleeding procedure?	Go to **Step 13**	Go to **Step 11**
11	Was the flow of brake fluid restricted or uneven through rear axle hydraulic components during the bleeding procedure?	Go to **Step 17**	-
	Inspect the hydraulic function of the brake calipers for proper operation. Refer to **Hydraulic Brake**		

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12	**Component Operation Visual Inspection**. Was the hydraulic function of the brake calipers operating properly?	Go to **Step 15**	Go to **Step 13**
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 that was not operating properly. Refer to the appropriate procedure: • **Front Brake Caliper Overhaul (LLT)** or **Front Brake Caliper Overhaul (L99, LS3)** or **Front Brake Caliper Replacement (LLT)** or **Front Brake Caliper Replacement (L99, LS3)** • **Rear Brake Caliper Overhaul (LLT)** or **Rear Brake Caliper Overhaul (L99, LS3)** or **Rear Brake Caliper Replacement (LLT)** or **Rear Brake Caliper Replacement (L99, LS3)** Did you complete the repair and/or replacement?	Go to **Step 21**	-
15	Bleed the hydraulic brake system to observe for the presence of air in the system and to observe for an unrestricted and even flow of brake fluid per axle during the bleeding procedure. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**. Was there air in the system?	Go to **Step 19**	Go to **Step 16**
16	Was the flow of brake fluid unrestricted and even per axle during the bleeding procedure?	Go to **Step 21**	Go to **Step 17**
	1. Inspect the hydraulic brake pipes and flexible brake hoses for signs of a fluid restriction; such as		

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17	being bent, kinked, pinched or damaged. Refer to **Brake Pipe and Hose Inspection**. 2. Replace any of the hydraulic brake pipes and/or flexible brake hoses found to be bent, kinked, pinched or damaged. Refer to the following procedures as necessary: • **Front Brake Hose Replacement (LLT) Front Brake Hose Replacement (LS3, L99)** • **Rear Brake Hose Replacement (LLT) Rear Brake Hose Replacement (LS3, L99)** • **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 pressure modulator valve (BPMV), in order to correct the hydraulic brake dynamic rear proportioning mechanical operation. Refer to **Brake Pressure Modulator Valve Replacement** . Did you complete the replacement?	Go to **Step 21**	-
19	1. Inspect the hydraulic brake system components for brake fluid seepage at a seal and/or fitting location, which may have drawn air into the system. 2. Inspect the hydraulic brake system components for evidence of a recent repair, which may have introduced air into the system. 3. Repair or replace any of the components found to be installed incorrectly or seeping brake fluid. Did you find and correct a condition?	Go to **Step 21**	Go to **Step 20**
20	1. Inspect the brake master cylinder for internal fluid leaks. Refer to **Brake System Internal Leak Test**. 2. 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
	Install or connect components that were removed or	Hydraulic Brake	

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21	disconnected during diagnosis. Did you complete the operation?	System OK Return to Symptom Table	-

BRAKE ASSIST SYSTEM DIAGNOSIS

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the brake ASSIST system in order to determine if the brake ASSIST system is operating properly. You will be directed by the appropriate Symptom table to go to other brake system diagnostic tables as appropriate.			
1	Were you sent here from a Brake Symptom table?	Go to **Step 3**	Go to **Step 2**
2	Were you sent here directly from an electrical diagnostic to investigate vacuum as a possible concern?	Go to **Step 5**	Go to **Diagnostic Starting Point - Vehicle**
3	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 5**	Go to **Step 4**
4	1. Inspect for worn, missing, misaligned, bent or damaged brake pedal system components. • For the brake pedal pushrod component inspection, refer to **Brake Pedal Pushrod Inspection** . • Inspect the brake pedal bushings for excessive wear and/or damage and inspect the brake pedal for a misaligned, bent and/or damaged condition. 2. Replace the brake pedal system components that are worn, missing, misaligned, bent or damaged. Did you find and replace any worn, missing, misaligned, bent or damaged brake pedal system components?	Go to **Step 5**	Go to **Hydraulic Brake System Diagnosis** to check for internal and external fluid leaks and air in the hydraulic brake system
5	Check the engine vacuum source that supplies vacuum to the vacuum brake booster. Refer to **Brake System Vacuum Source Test**. Is the vacuum reading within the acceptable limits?	Go to **Step 6**	Go to Engine Controls Diagnostics Information to check for vacuum issues, including vacuum pump operation, if equipped
6	Does the condition occur during cold start-up conditions?	Go to **Step 7**	Go to **Step 8**
	Check engine vacuum, and vacuum pump operation, if		

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7	equipped, under the same cold start-up conditions. Refer to Engine Controls Diagnostics. Did you find and correct a condition?	Go to **Step 22**	Go to **Step 9**
8	During the vacuum source test, did the vacuum booster check valve operate properly?	Go to **Step 10**	Go to **Step 9**
9	Replace the vacuum booster check valve. Refer to **Power Brake Booster Vacuum Check Valve and Hose Replacement (LLT)** or **Power Brake Booster Vacuum Check Valve and Hose Replacement (L99, LS3)**. Did you complete the replacement?	Go to **Step 10**	-
10	If equipped with a booster mounted separate vacuum sensor, inspect the vacuum sensor grommet for cracks, cuts, dry-rot, or damage. Does the vacuum sensor grommet exhibit any of the conditions listed?	Go to **Step 11**	Go to **Step 12**
11	Replace the vacuum sensor grommet. Did you complete the replacement?	Go to **Step 12**	-
12	1. If the vehicle is equipped with a vacuum sensor, install a scan tool. 2. Using the Data Display function, determine if brake booster vacuum sensor data is available within either the chassis brake controls area or the powertrain engine controls area. Is vacuum sensor data available through the scan tool?	Go to **Step 13**	Go to **Step 16**
13	Perform the vacuum booster leak-down test using a scan tool: 1. Release the brake pedal. 2. Accelerate the engine to approximately 3000 RPM, then release the throttle. Wait 2-3 seconds and repeat once. 3. Turn the ignition OFF. 4. Turn the ignition ON. Do not start the engine. 5. Observe and record the vacuum sensor reading on the scan tool over a period of 60 seconds. **NOTE:** **Vacuum readings will decrease by approximately 2.7 kPa (0.8 Hg) for every 305 m (1000 ft) of elevation above sea level.** 6. Determine the rate of vacuum leak.		

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	Specification: Maximum allowable vacuum leak rate: 10 kPa (3 in Hg) in 60 seconds Was the rate of vacuum leak within the specified allowable range?	Go to **Step 18**	Go to **Step 14**
14	1. Deplete the vacuum reserve by pressing the brake pedal several times, or by removing the vacuum booster check valve. 2. Separate the master cylinder from the vacuum brake booster. Do not disconnect any brake pipes. Refer to **Master Cylinder Replacement**. 3. If equipped with a vacuum seal on the rear of the master cylinder, inspect the seal for damage and correct positioning on the master cylinder. Replace the vacuum seal as necessary. 4. Carefully reinstall the master cylinder to the brake booster. Refer to **Master Cylinder Replacement**. Did you complete the operation?	Go to **Step 15**	-
15	Perform the vacuum booster leak-down test using a scan tool: 1. Release the brake pedal. 2. Accelerate the engine to approximately 3000 RPM, then release the throttle. Wait 2-3 seconds and repeat once. 3. Turn the ignition OFF. 4. Turn the ignition ON. Do not start the engine. 5. Observe and record the vacuum sensor reading on the scan tool over a period of 60 seconds. **NOTE:** **Vacuum readings will decrease by approximately 2.7 kPa (0.8 Hg) for every 305 m (1000 ft) of elevation above sea level.** 6. Determine the rate of vacuum leak. **Specification:** Maximum allowable vacuum leak rate: 10 kPa (3 in Hg) in 60 seconds Was the rate of vacuum leak within the specified		

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	allowable range?	Go to **Step 22**	Go to **Step 21**
16	1. Separate the master cylinder from the vacuum brake booster. Do not disconnect any brake pipes. Before removing the master cylinder, first deplete the vacuum by removing the check valve or applying the brake pedal several times. Refer to **Master Cylinder Replacement**. 2. If equipped with a vacuum seal on the rear of the master cylinder, inspect the seal for damage and correct positioning on the master cylinder. 3. If equipped with a vacuum seal that is part of the booster, inspect the seal for damage. Does the vacuum seal exhibit any of the conditions listed?	Go to **Step 17**	Go to **Step 18**
17	1. If equipped with a vacuum seal on the rear of the master cylinder, replace the vacuum seal as necessary. Ensure the seal is positioned correctly during installation. 2. If equipped with a vacuum seal that requires replacement and which is part of the booster, the booster assembly must be replaced. 3. Carefully reinstall the master cylinder to the brake booster. Refer to **Master Cylinder Replacement**. Did you complete the replacement?	Go to **Step 18**	-
18	Perform the vacuum boost functional test: 1. If still separated, reinstall the master cylinder to the booster. Refer to **Master Cylinder Replacement**. 2. If the engine was started after reinstalling the master cylinder to the booster, perform the following: With the engine OFF, depress the brake pedal several times to deplete the vacuum reserve. 3. Depress and maintain moderate foot pressure on the brake pedal. 4. Start the engine and observe pedal operation. 5. Observe for audible vacuum leaks. The brake pedal should fall slightly, then hold.		

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	Is there an audible vacuum leak coming from the brake pedal area?	Go to **Step 21**	Go to **Step 19**
19	Did the brake pedal fall slightly after the engine was started, then hold?	Go to **Step 20**	Go to **Step 21**
20	Perform the vacuum booster leak-down test: 1. Release the brake pedal. 2. Accelerate the engine to approximately 3000 RPM, then release the throttle. Wait 2-3 seconds and repeat once. 3. Turn the ignition OFF. 4. Wait 60 seconds. 5. Depress the brake pedal 2 times to check for vacuum booster available vacuum reserve. Observe pedal effort. • Both pedal applies should be assisted • The amount of assist could diminish slightly with the second apply Were both pedal applies power assisted?	Go to **Step 22**	Go to **Step 21**
21	Replace the vacuum brake booster. Refer to **Power Vacuum Brake Booster Replacement**. Did you complete the replacement?	Go to **Step 22**	-
22	Install or connect any components that were removed or disconnected during diagnosis. Did you complete the operation?	Brake Assist System OK Return to Symptom Table	-

BRAKE SYSTEM VEHICLE ROAD TEST

Preliminary Inspections

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

Road Testing Procedure

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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.

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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

Tools Required

J 28662 Brake Pedal Effort Gauge. See **Special Tools**.

1. With the ignition OFF and the brakes cool, apply the brakes 3-5 times, or until the brake pedal becomes firm, in order to deplete the brake booster power reserve.
2. Install the **J 28662** to the brake pedal. See **Special Tools**.

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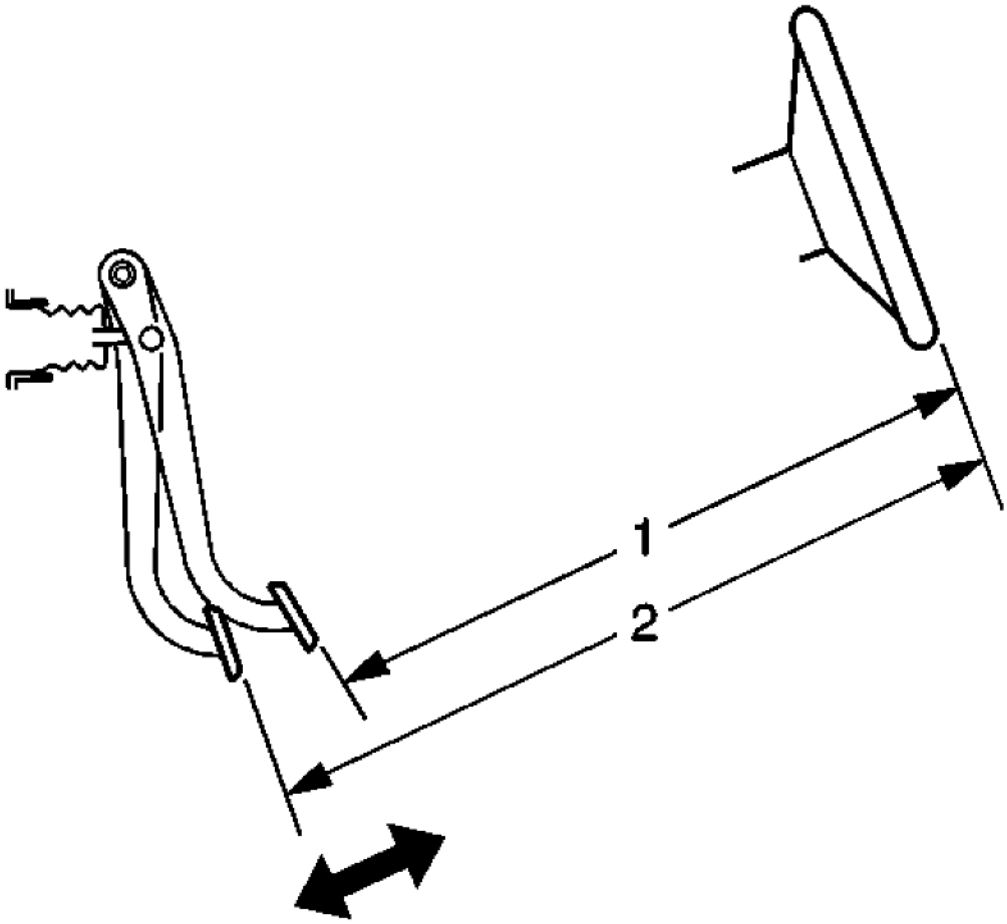


Fig. 2: Measuring Brake Pedal Travel
Courtesy of GENERAL MOTORS CORP.

3. Measure and record the distance (1) from the brake pedal to the rim of the steering wheel; note the points of measurement.
4. Apply and maintain the brakes with 445 N (100 lb) of force to the brake pedal, as indicated on the **J 28662** . See **Special Tools**.
5. While maintaining 445 N (100 lb) of force to the brake pedal, measure and record the distance (2) from the same point on the brake pedal to the same point on the rim of the steering wheel.
6. Release the brakes and repeat steps 4 and 5 to obtain a second measurement. After obtaining a second measurement, proceed to step 7.
7. Average the first and second measurements recorded during the two applies of the brakes.
8. Subtract the initial measurement, unapplied (1), from the averaged, applied measurement (2) to obtain the

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brake pedal travel distance.

Specification: Maximum brake pedal travel (measured with the ignition OFF, brake booster power assist depleted, and the brakes cool): 63.5 mm (2.5 in).

BRAKE SYSTEM VACUUM SOURCE TEST

NOTE:

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

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

   Specification: 47-68 kPa (14-20 in Hg)

5. Turn the ignition OFF.
6. If the engine vacuum reading was within the specified normal range, proceed to step 10.
7. If the engine vacuum reading was NOT within the specified normal range, inspect the engine vacuum hose for the following conditions:
   - Loose connection to the engine
   - Collapse, deformation or contamination
   - Cracks, cuts, dry-rot
8. If any of these conditions were found with the engine vacuum hose, replace the hose, then repeat steps 2-4.
9. If none of these conditions were found with the engine vacuum hose, then there is an engine vacuum source problem, check the engine vacuum system.
10. Remove the vacuum brake booster check valve from the booster.
11. Install the check valve to the engine vacuum hose.
12. Install the vacuum gauge to the check valve.
13. Start the engine and allow the engine to idle in PARK with the A/C system OFF, until normal operating temperatures are reached.
14. Turn the ignition OFF.
15. Check to see if the engine vacuum reading is maintained within the specified normal engine vacuum range.

    Specification: 47-68 kPa (14-20 in Hg)

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

BRAKE SYSTEM EXTERNAL LEAK INSPECTION

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

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

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

2. If the fluid level is abnormally low, adjust the brake fluid level. Refer to **Master Cylinder Reservoir Filling**.
3. Start the engine and allow it to idle.
4. Apply constant, moderate foot pressure to the brake pedal.

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

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

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BRAKE SYSTEM INTERNAL LEAK TEST

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

1. Start the engine and allow it to idle.
2. Apply light, steady pressure to the brake pedal. Observe both the brake pedal feel and travel.
3. Release the brakes and turn OFF the ignition.
4. If the brake pedal apply felt spongy, but the brake pedal travel was not excessive, perform the following steps:
    1. Inspect the brake system for external leaks. Refer to **Brake System External Leak Inspection** .
    2. Pressure bleed the brake system in order to purge any air that may be trapped in the system. Refer to **Hydraulic Brake System Bleeding (Manual)Hydraulic Brake System Bleeding (Pressure)** .

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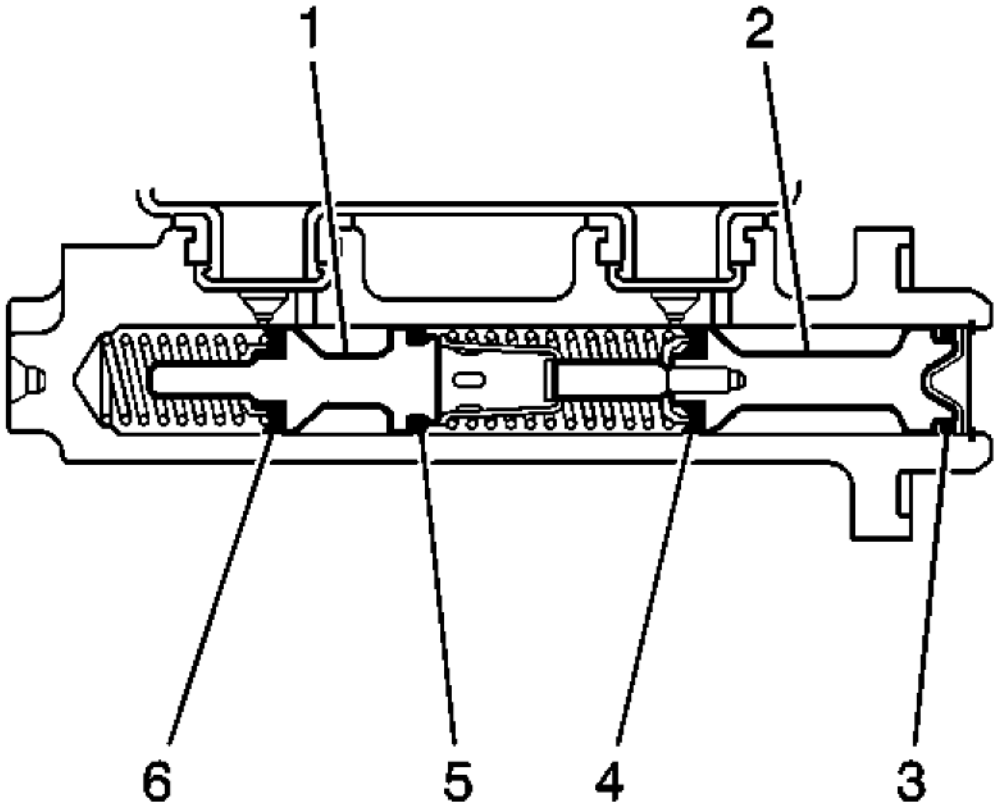


Fig. 3: Cross Sectional View Of Brake Master Cylinder
Courtesy of GENERAL MOTORS CORP.

5. If the brake pedal apply did not feel spongy, but the brake pedal travel was excessive, perform the following steps:
    1. Loosen the master cylinder-to-brake power booster mounting nuts.
    2. Carefully pull the master cylinder away from the brake power booster just enough to inspect the mounting surface of the master cylinder.
    3. Inspect the master cylinder mounting surface at the primary piston (2) for brake fluid leaks.
6. If the master cylinder exhibits any leakage around the primary piston (2), then the primary piston primary seal (4) and/or secondary seal (3) is leaking and the master cylinder requires overhaul or replacement.
7. If the master cylinder primary piston (2) does not exhibit any leakage, pressure bleed the brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.
8. If the brake pedal apply did not feel spongy, and the brake pedal travel was initially steady and not excessive, but then gradually fell, then the master cylinder requires overhaul or replacement due to an

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internal leak past the secondary piston (1) from the secondary piston primary seal (6) or secondary seal (5).

9. If the brake pedal apply did not feel spongy, and the brake pedal travel was initially steady and not excessive, then fell slightly, then became steady again, then the brake pressure modulator valve (BPMV) may be leaking internally, and may require replacement.

HYDRAULIC BRAKE COMPONENT OPERATION VISUAL INSPECTION

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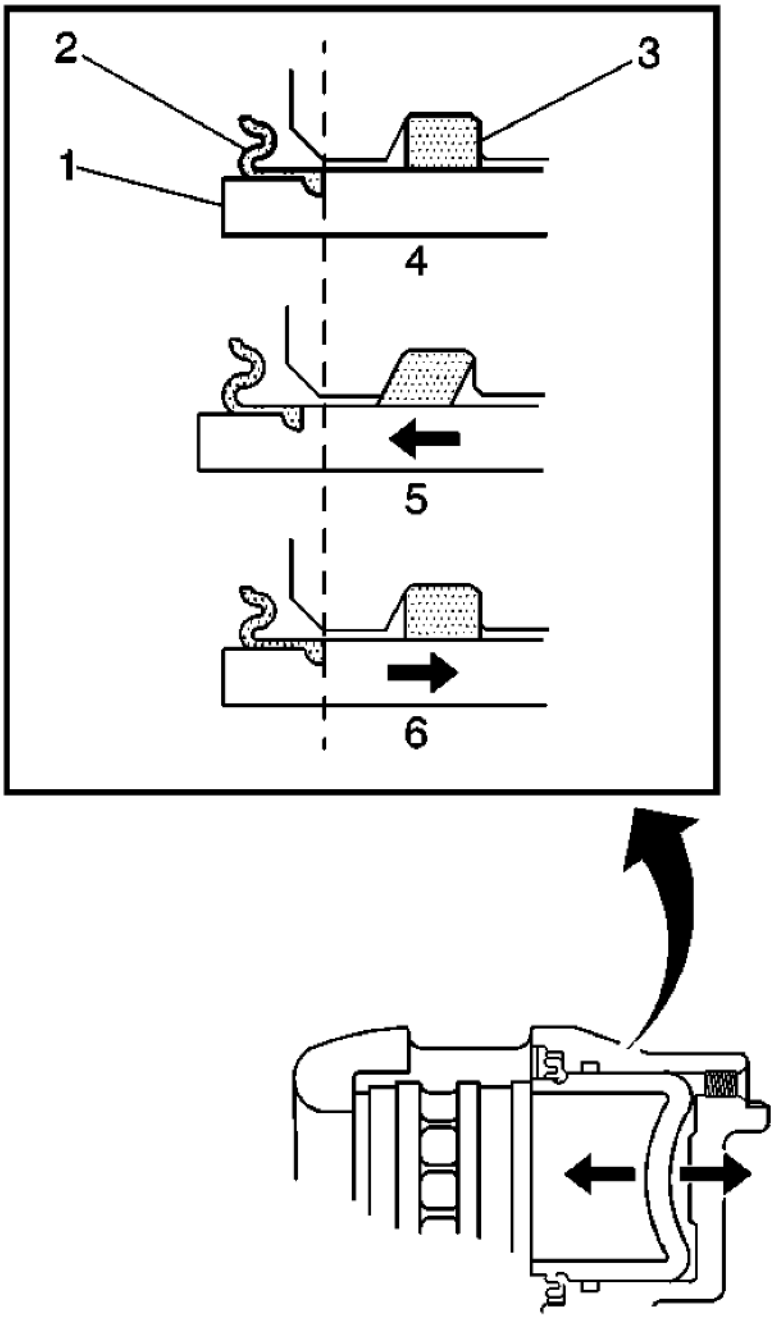


Fig. 4: Identifying Brake Caliper/Pad Inspection Areas
Courtesy of GENERAL MOTORS CORP.

WARNING: **Refer to Brake Fluid Irritant Warning .**

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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.

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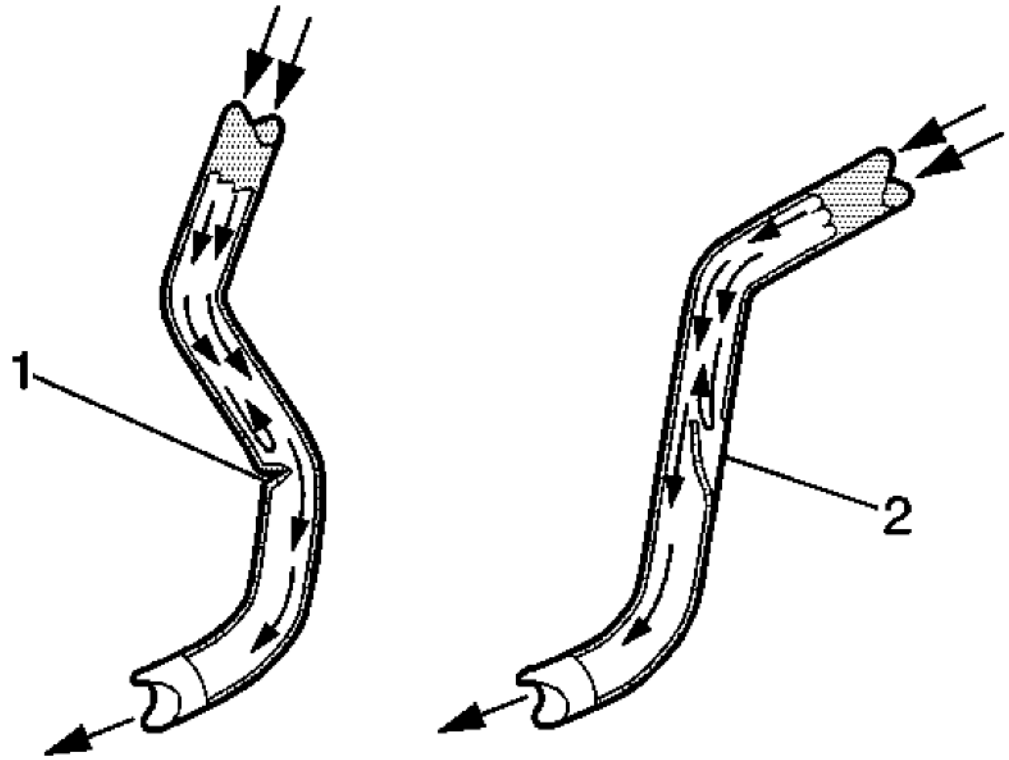


Fig. 5: Identifying Flexible Brake Hose Failure Conditions
Courtesy of GENERAL MOTORS CORP.

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

BRAKE PEDAL PUSHROD INSPECTION

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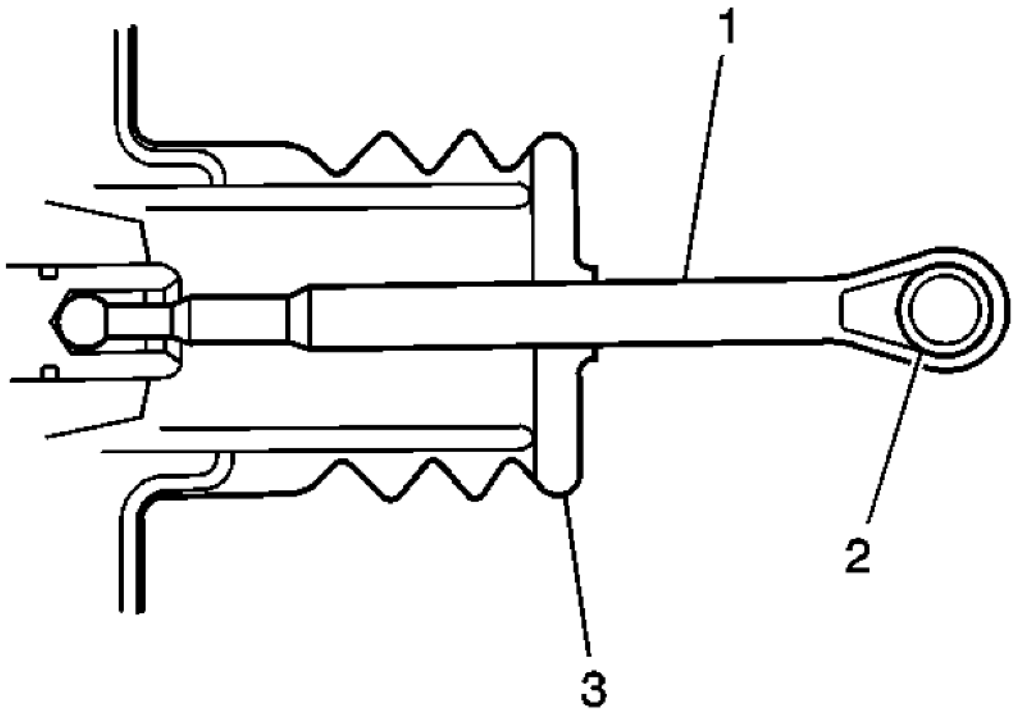


Fig. 6: View of Brake Pedal Pushrod
Courtesy of GENERAL MOTORS CORP.

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

MASTER CYLINDER RESERVOIR FILLING

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WARNING: **Refer to Brake Fluid Irritant Warning .**

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

1. Visually inspect the brake fluid level through the brake master cylinder reservoir.
2. If the brake fluid level is at or below the half-full point during routine fluid checks, the brake system should be inspected for wear and possible brake fluid leaks.
3. If the brake fluid level is at or below the half-full point during routine fluid checks, and an inspection of the brake system did not reveal wear or brake fluid leaks, the brake fluid may be topped-off up to the maximum-fill level.
4. If brake system service was just completed, the brake fluid may be topped-off up to the maximum-fill level.
5. If the brake fluid level is above the half-full point, adding brake fluid is not recommended under normal conditions.
6. If brake fluid is to be added to the master cylinder reservoir, clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm. Use only GM approved brake fluid from a clean, sealed brake fluid container.

MASTER CYLINDER RESERVOIR REPLACEMENT

Removal Procedure

WARNING: **Refer to Brake Fluid Irritant Warning .**

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

1. Remove the brake fluid from the master cylinder reservoir.
2. Disconnect the clutch master cylinder supply hose, if equipped.

   Cap the hose to prevent brake fluid loss and contamination.

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

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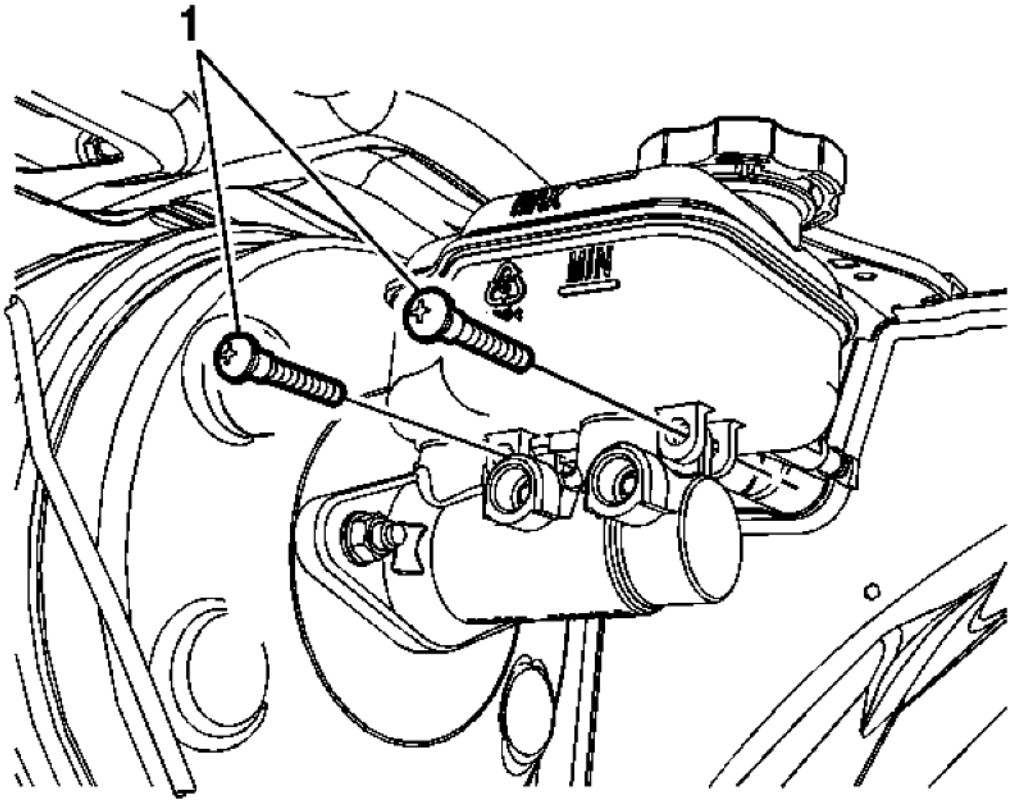


Fig. 7: Master Cylinder Reservoir Bolts
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4. Remove the master cylinder reservoir bolts (1).

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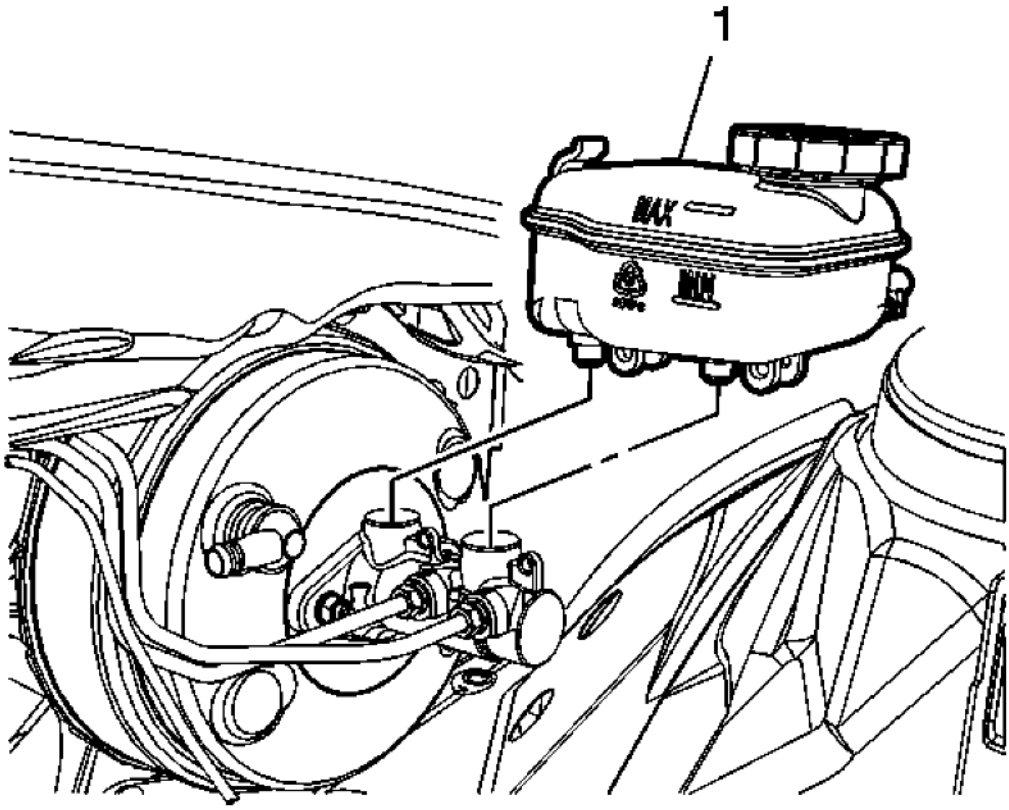


Fig. 8: Master Cylinder Reservoir
Courtesy of GENERAL MOTORS CORP.

5. Remove the master cylinder reservoir (1).

   Carefully pull the reservoir straight upward.

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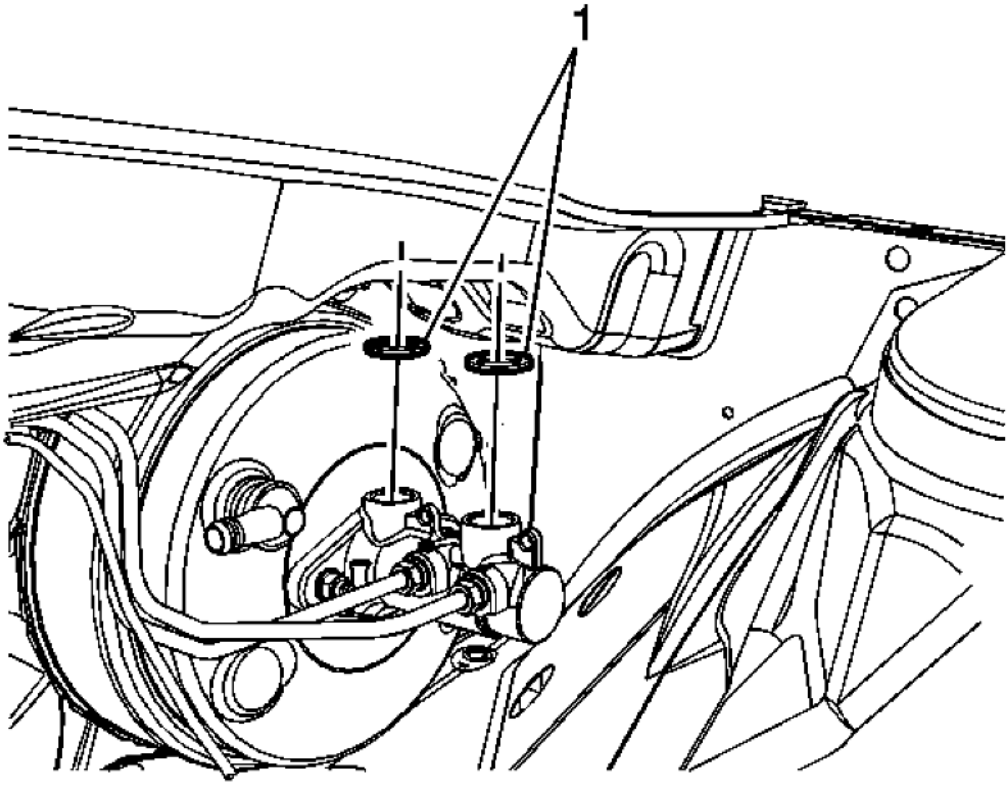


Fig. 9: Master Cylinder Reservoir Seals
Courtesy of GENERAL MOTORS CORP.

6. Remove the master cylinder reservoir seals (1).

Installation Procedure

1. If installing the original master cylinder reservoir, clean the master cylinder reservoir with denatured alcohol and dry with filtered, non-lubricated compressed air.

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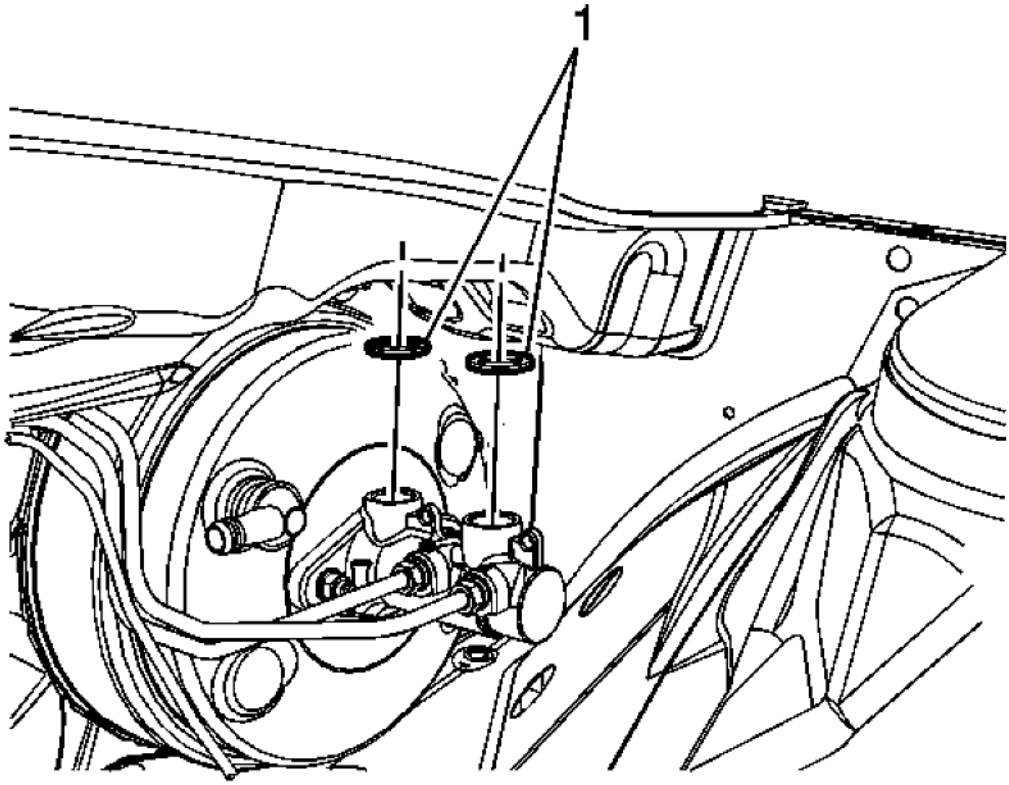


Fig. 10: Master Cylinder Reservoir Seals
Courtesy of GENERAL MOTORS CORP.

2. Install the master cylinder reservoir seals (1).

   Lubricate the seals with GM approved or equivalent brake fluid from a clean, sealed brake fluid container.

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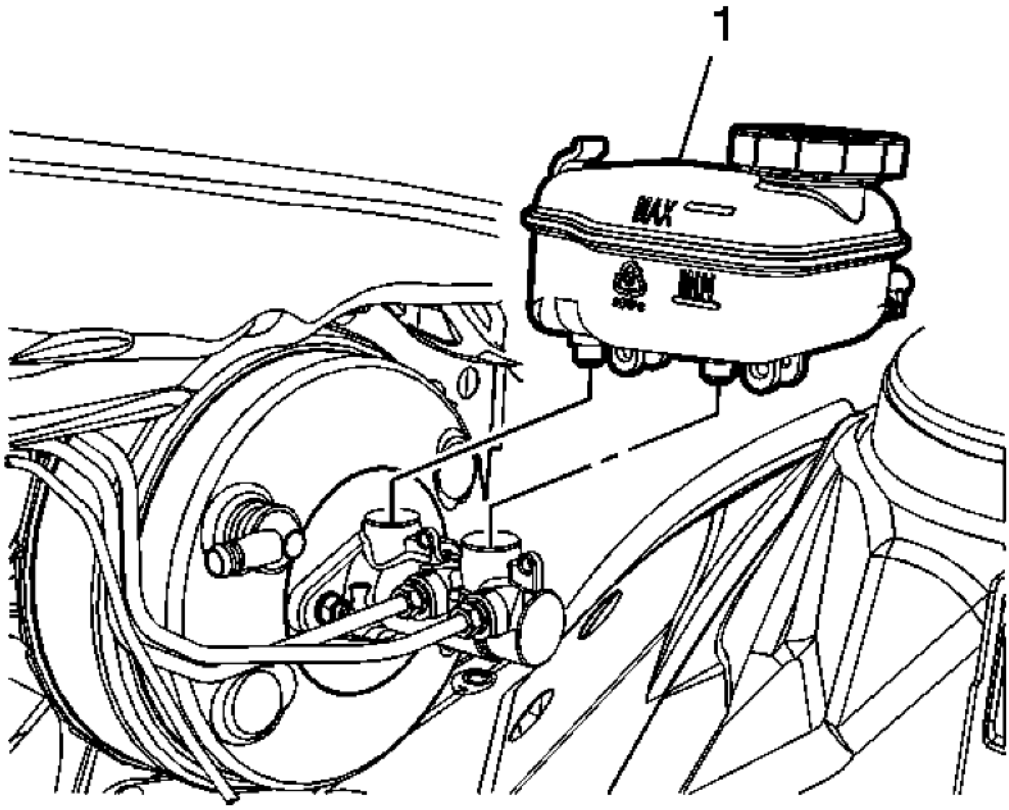


Fig. 11: Master Cylinder Reservoir
Courtesy of GENERAL MOTORS CORP.

3. Install the master cylinder reservoir (1).

   Carefully press the reservoir straight downward.

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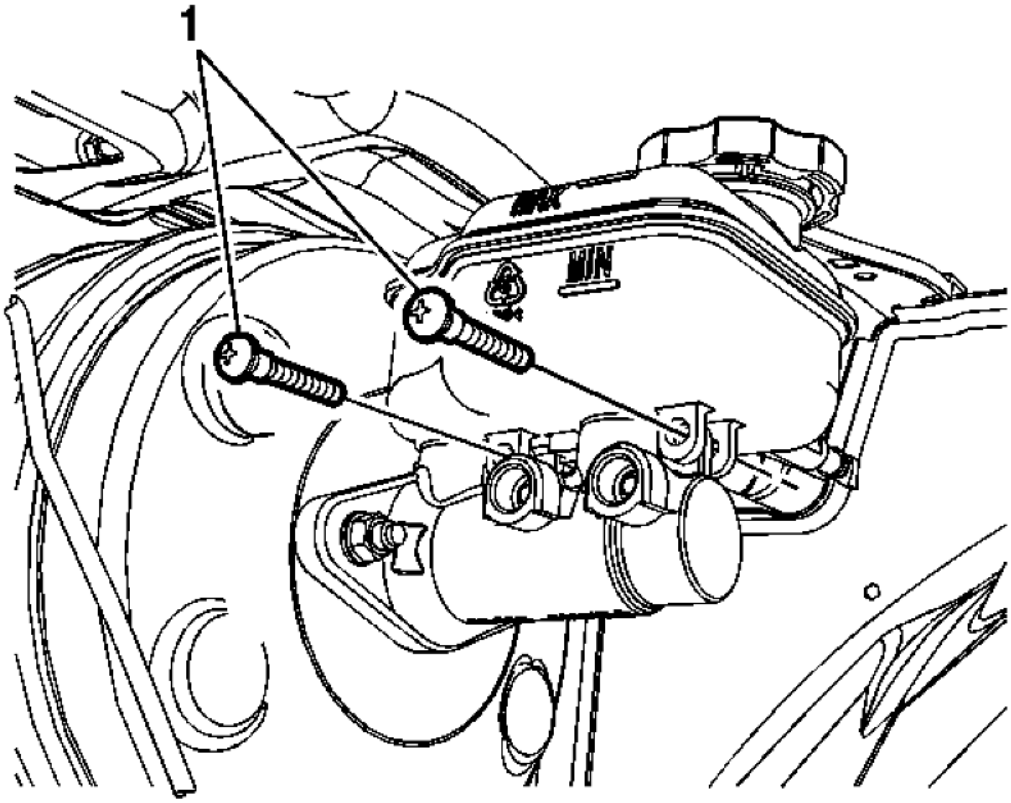


Fig. 12: Master Cylinder Reservoir Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

4. Install the master cylinder reservoir bolts (1) and tighten to 8 N.m (71 lb in).
5. Connect the clutch master cylinder supply hose, if equipped.
6. Connect the brake fluid level indicator switch electrical connector.
7. Fill the master cylinder reservoir. Refer to **Master Cylinder Reservoir Filling**.

MASTER CYLINDER REPLACEMENT

Removal Procedure

WARNING: Refer to Brake Fluid Irritant Warning .

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CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

1. With the engine OFF, apply and release the brake pedal several times until the pedal becomes firm to deplete the power vacuum brake booster vacuum reserve.
2. Disconnect the clutch master cylinder supply hose, if equipped.
3. Disconnect the brake fluid level indicator switch electrical connector.

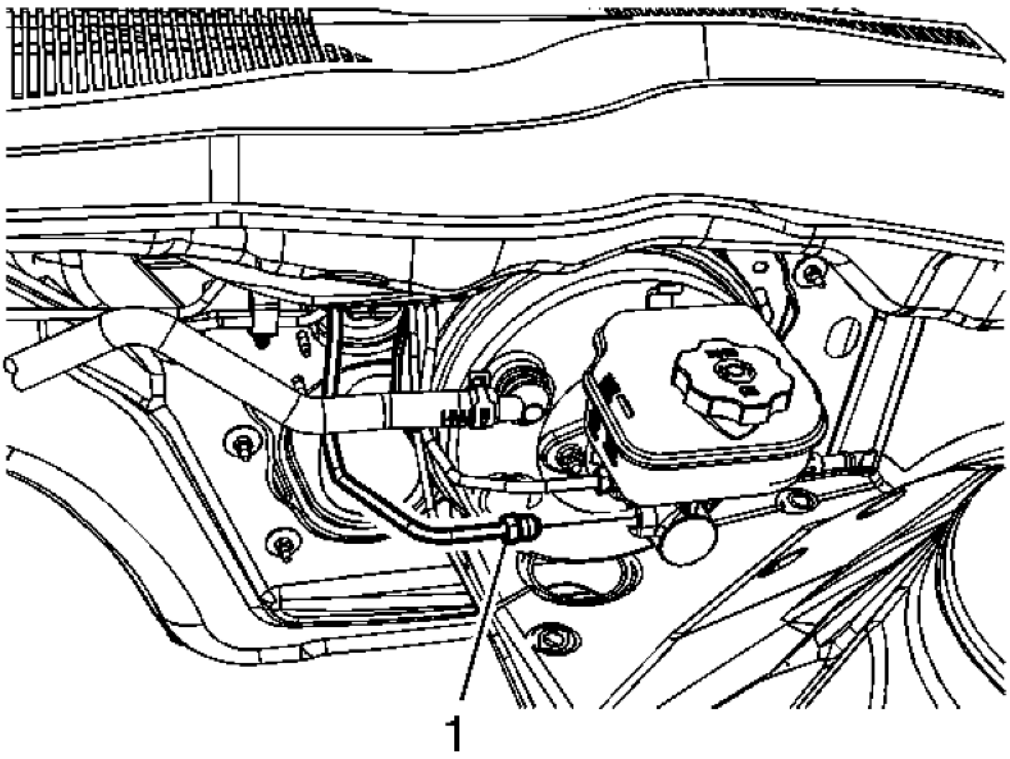


Fig. 13: Master Cylinder Secondary Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

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

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

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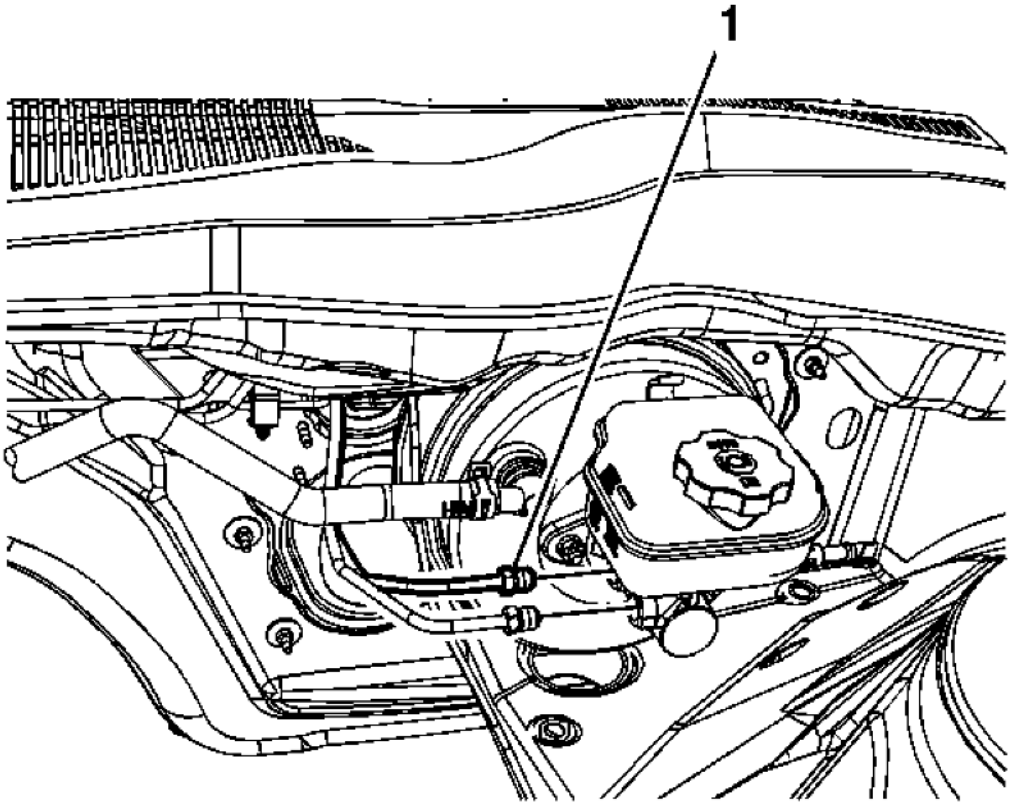


Fig. 14: Master Cylinder Primary Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

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

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

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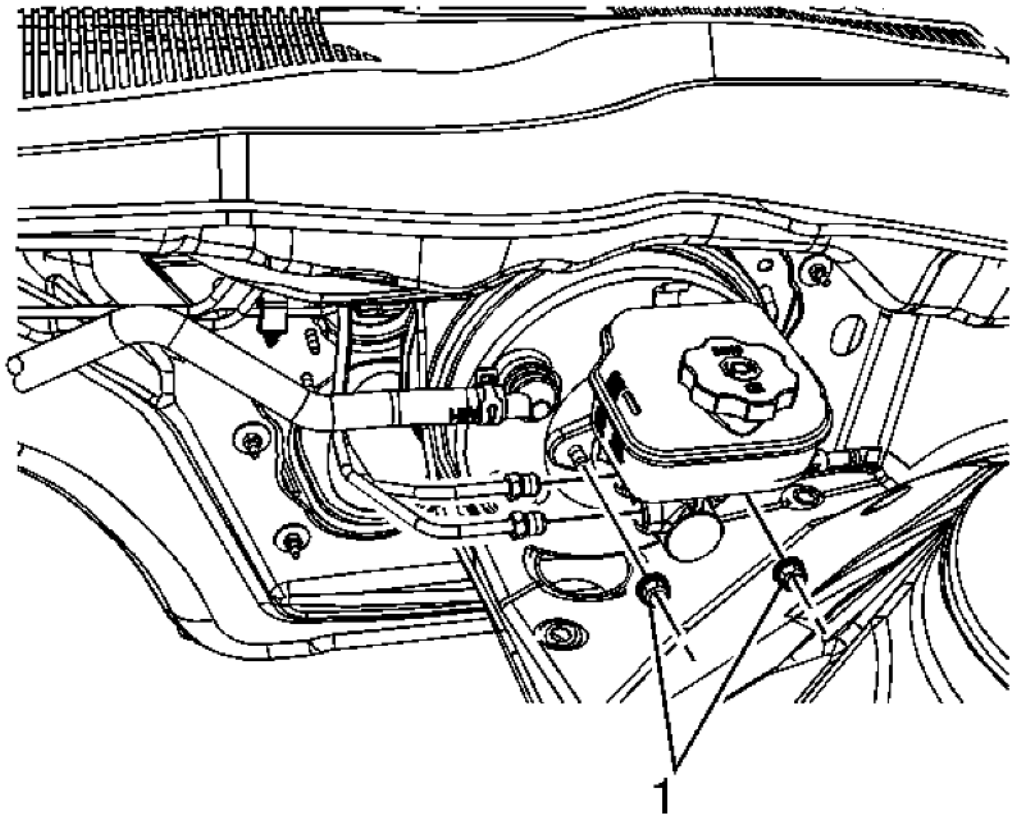


Fig. 15: Master Cylinder Nuts
Courtesy of GENERAL MOTORS CORP.

6. Remove the master cylinder nuts (1).

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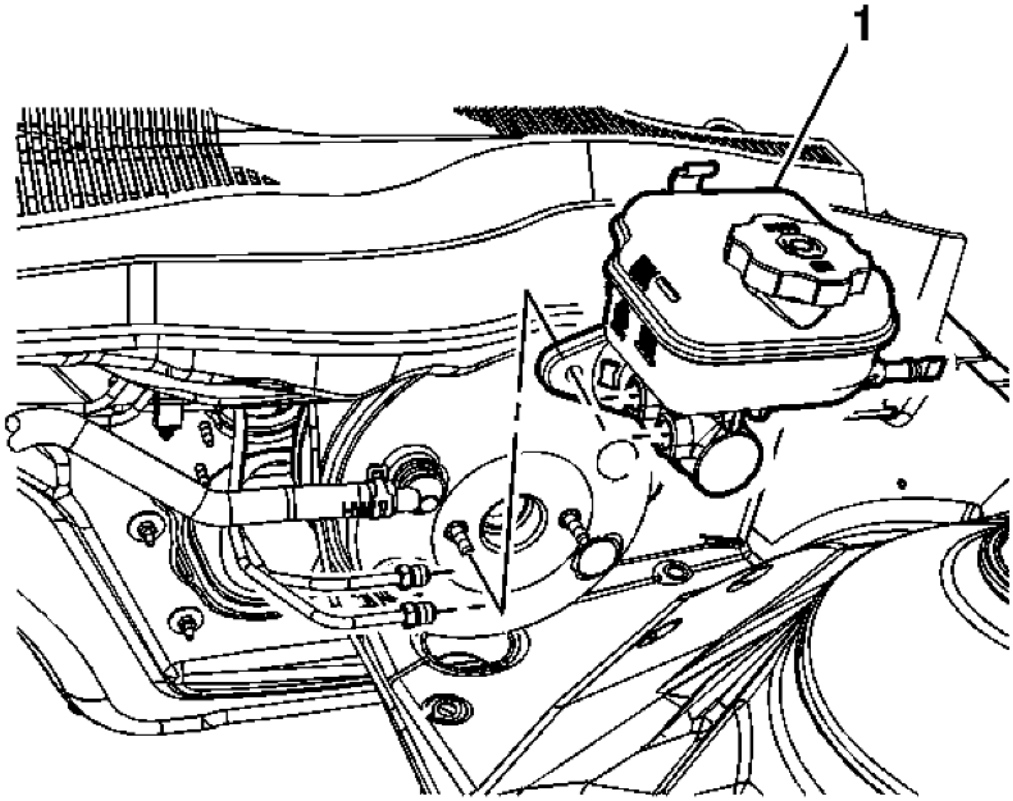


Fig. 16: Master Cylinder
Courtesy of GENERAL MOTORS CORP.

7. Remove the master cylinder (1) from the power vacuum brake booster.

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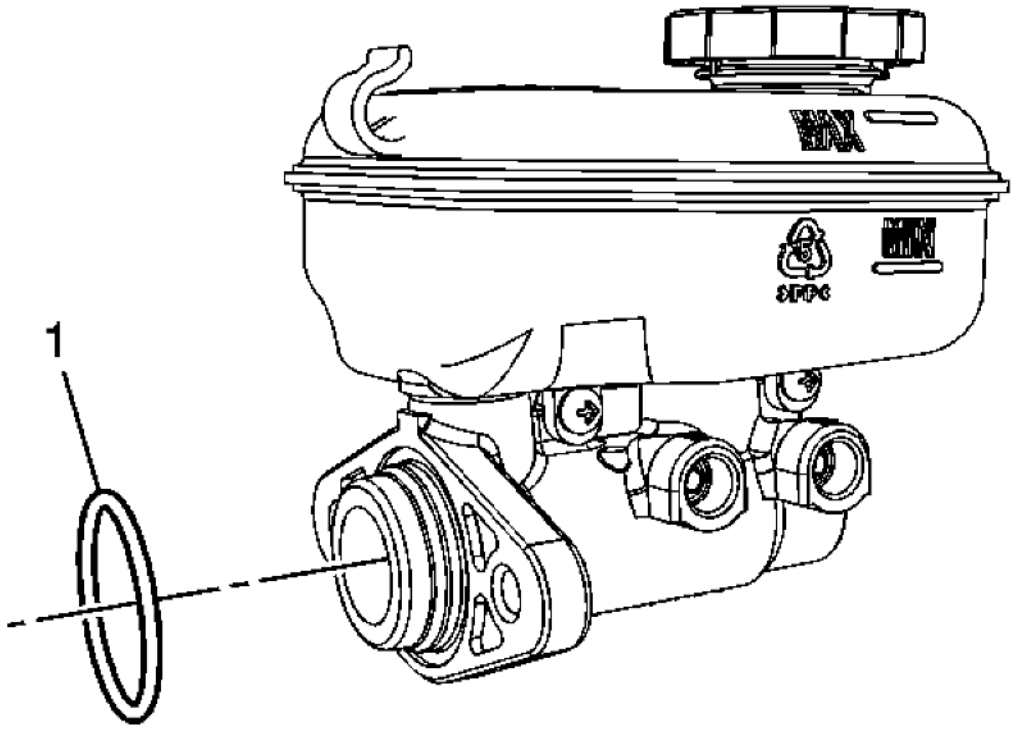


Fig. 17: Master Cylinder O-Ring Seal
Courtesy of GENERAL MOTORS CORP.

8. Remove the master cylinder O-ring seal (1).

   Inspect the O-ring seal for damage and replace, if necessary.

Installation Procedure

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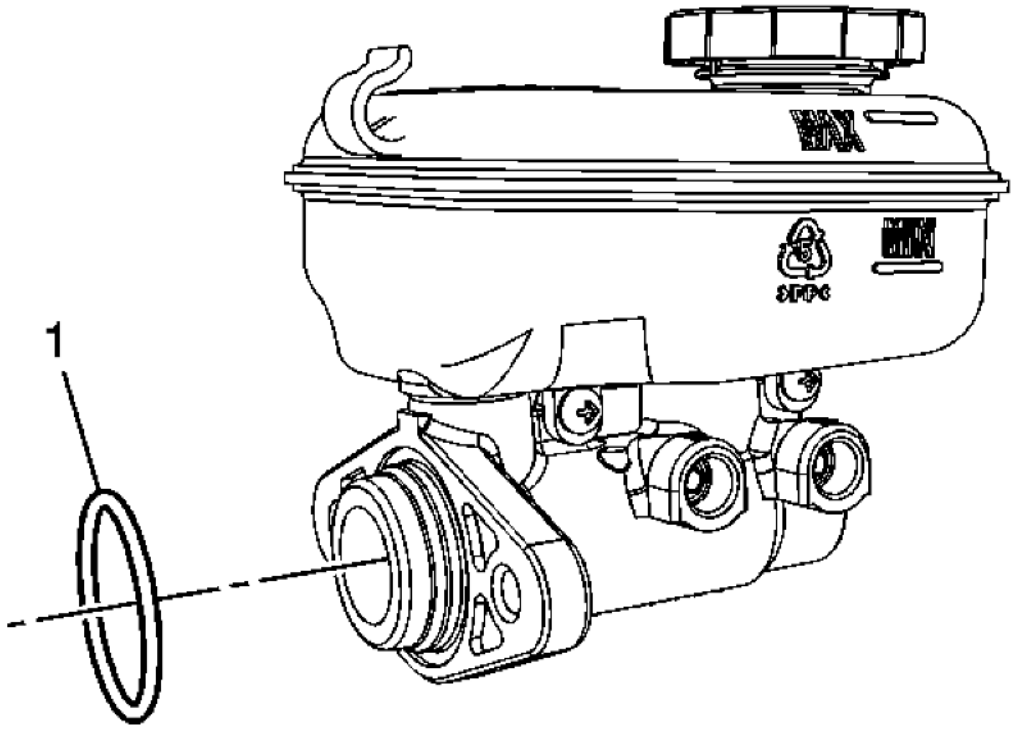


Fig. 18: Master Cylinder O-Ring Seal
Courtesy of GENERAL MOTORS CORP.

1. Install the master cylinder O-ring seal (1).

   Position the O-ring seal in the groove in the master cylinder body.

2. If installing a new master cylinder, bench bleed the master cylinder. Refer to **Master Cylinder Bench Bleeding**.

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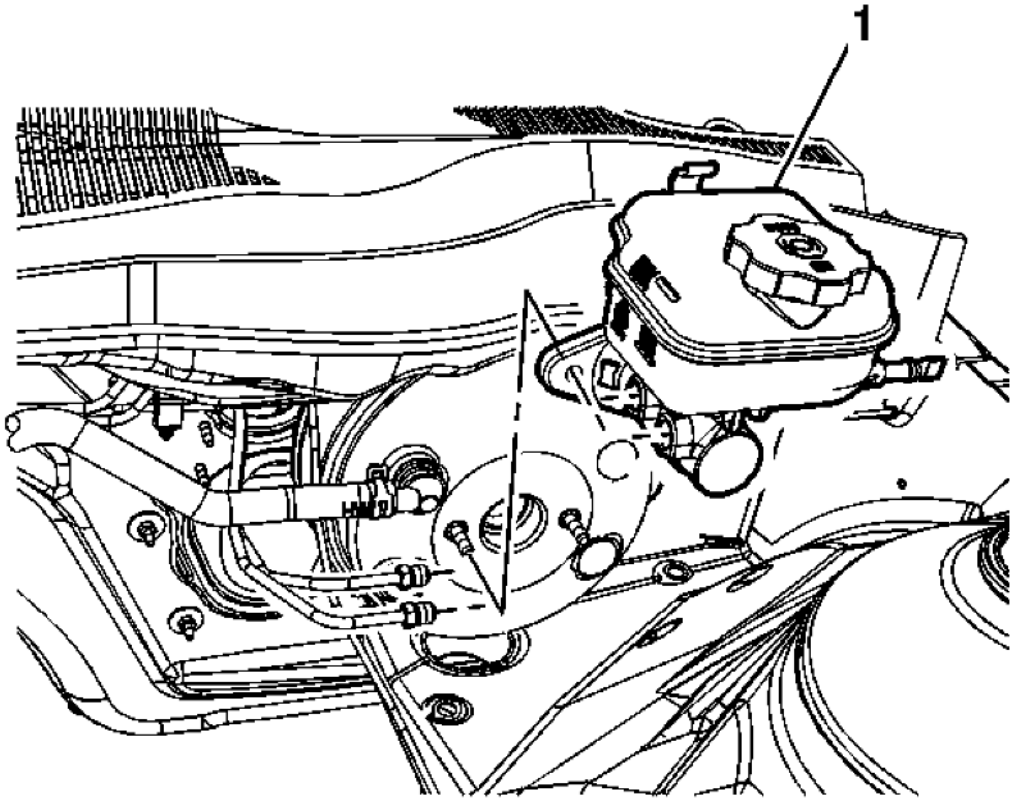


Fig. 19: Master Cylinder
Courtesy of GENERAL MOTORS CORP.

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

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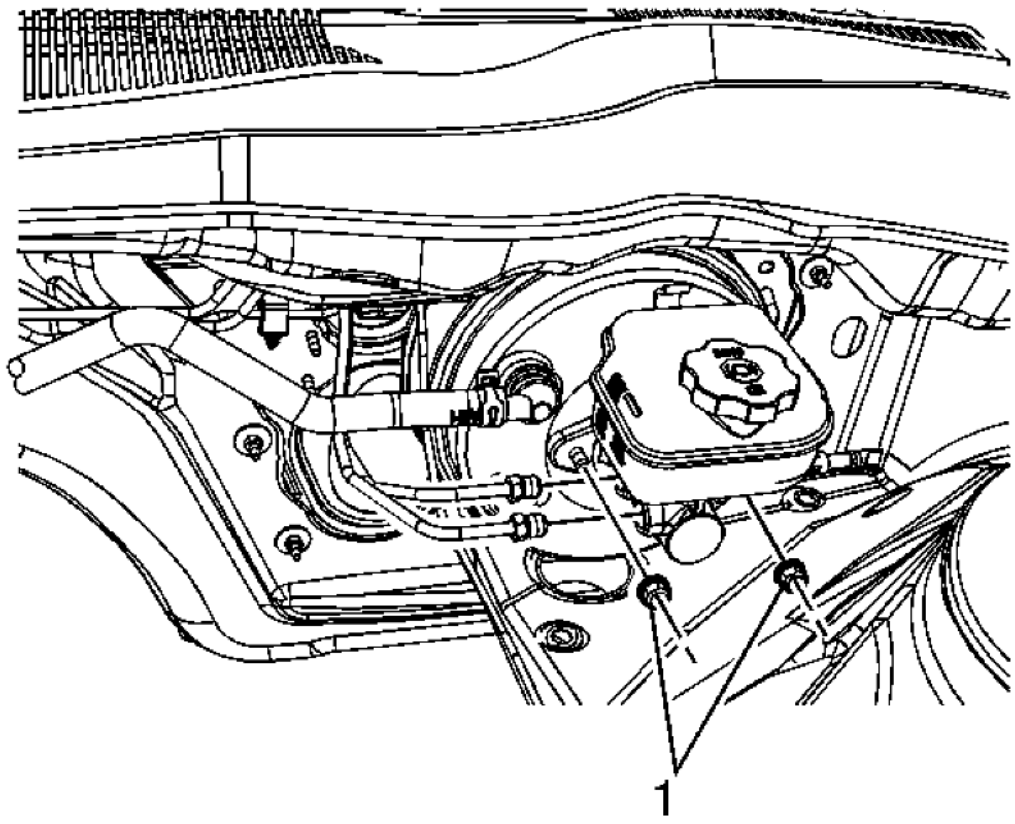


Fig. 20: Master Cylinder Nuts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

4. Install the master cylinder nuts (1) and tighten to 25 N.m (18 lb ft).

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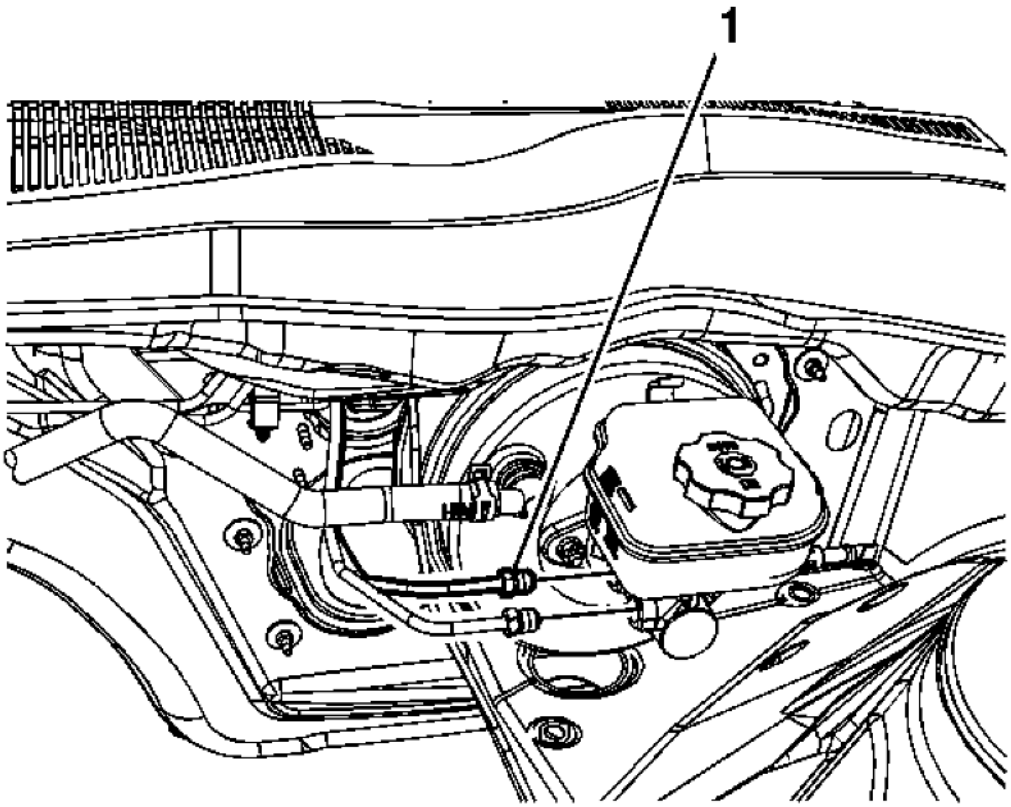


Fig. 21: Master Cylinder Primary Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

5. Connect the master cylinder primary brake pipe fitting (1) and tighten the fitting to 16 N.m (12 lb ft).

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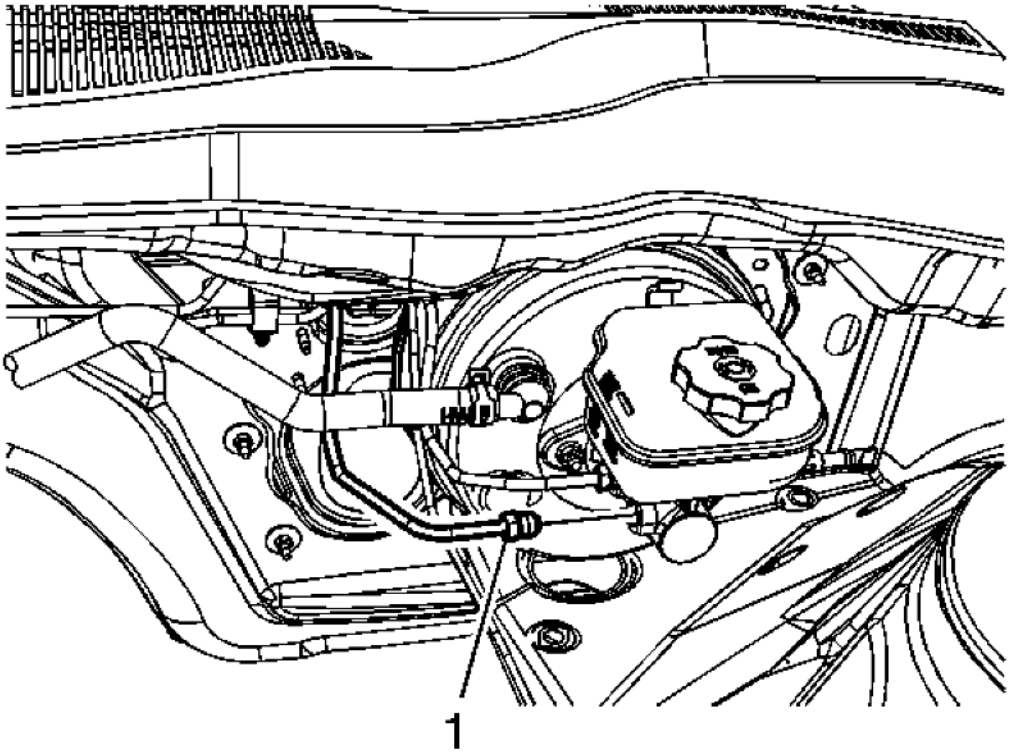


Fig. 22: Master Cylinder Secondary Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

6. Connect the master cylinder secondary brake pipe fitting (1) and tighten the fitting to 16 N.m (12 lb ft).
7. Connect the clutch master cylinder supply hose, if equipped.
8. Connect the brake fluid level indicator switch electrical connector.
9. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.

MASTER CYLINDER BENCH BLEEDING

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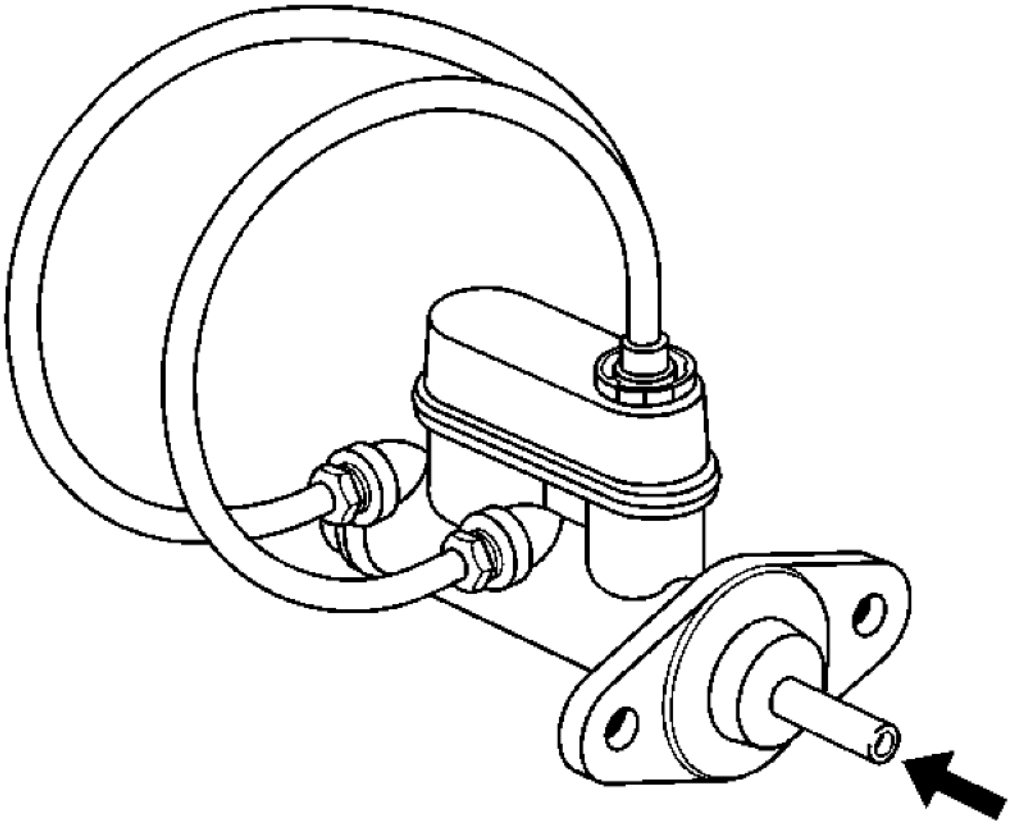


Fig. 23: Bleeding Master Cylinder
Courtesy of GENERAL MOTORS CORP.

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

1. Secure the mounting flange of the brake master cylinder in a bench vise so that the rear of the primary piston is accessible.
2. Remove the master cylinder reservoir cap and diaphragm.
3. Install suitable fittings to the master cylinder ports that match the type of flare seat required and also provide for hose attachment.
4. Install transparent hoses to the fittings installed to the master cylinder ports, then route the hoses into the

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master cylinder reservoir.

5. Fill the master cylinder reservoir to at least the half-way point with GM approved brake fluid from a clean, sealed brake fluid container. Refer to **Master Cylinder Reservoir Filling**.
6. Ensure that the ends of the transparent hoses running into the master cylinder reservoir are fully submerged in the brake fluid.
7. Using a smooth, round-ended tool, depress and release the primary piston as far as it will travel, a depth of about 25 mm (1 in), several times. Observe the flow of fluid coming from the ports.

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

8. Continue to depress and release the primary piston until fluid flows freely from the ports with no evidence of air bubbles.
9. Remove the transparent hoses from the master cylinder reservoir.
10. Install the master cylinder reservoir cap and diaphragm.
11. Remove the fittings with the transparent hoses from the master cylinder ports. Wrap the master cylinder with a clean shop cloth to prevent brake fluid spills.
12. Remove the master cylinder from the vise.

BRAKE PEDAL ASSEMBLY REPLACEMENT

Removal Procedure

1. Disconnect the brake pedal position sensor electrical connector.

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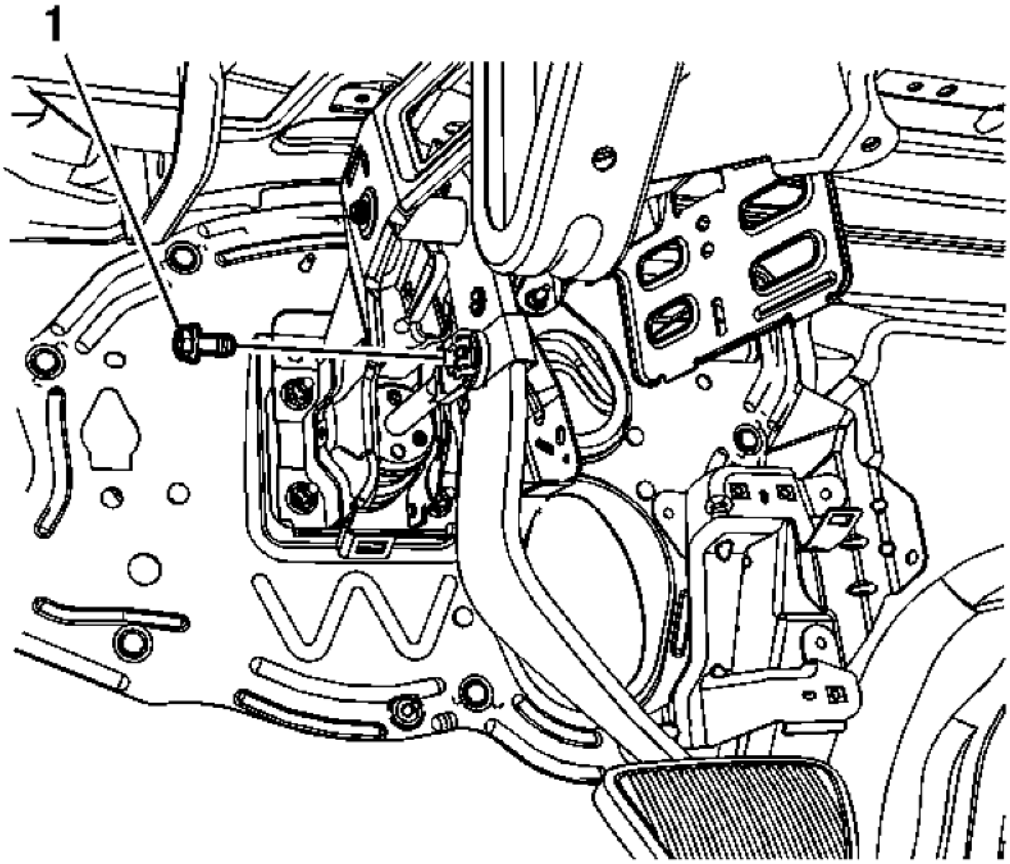


Fig. 24: Power Brake Booster Pushrod Retainer Bolt
Courtesy of GENERAL MOTORS CORP.

2. Remove the power brake booster pushrod retainer bolt (1).

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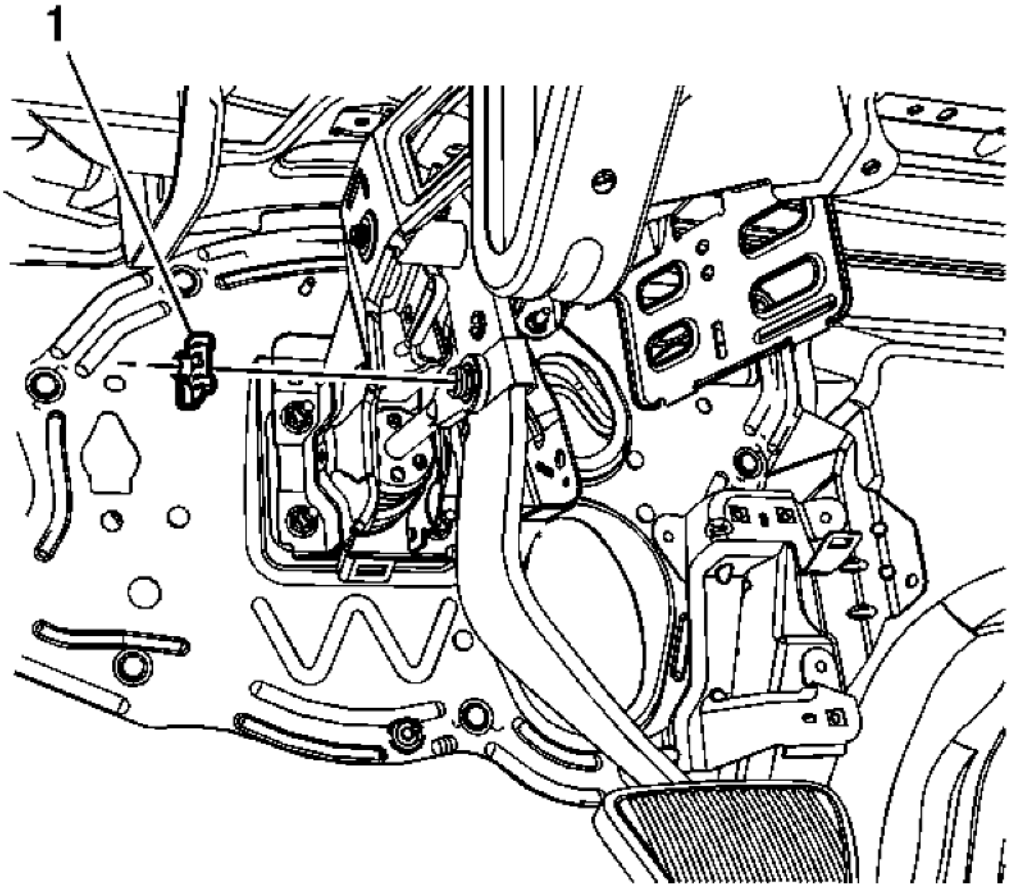


Fig. 25: Power Brake Booster Pushrod Retainer
Courtesy of GENERAL MOTORS CORP.

3. Remove the power brake booster pushrod retainer (1).

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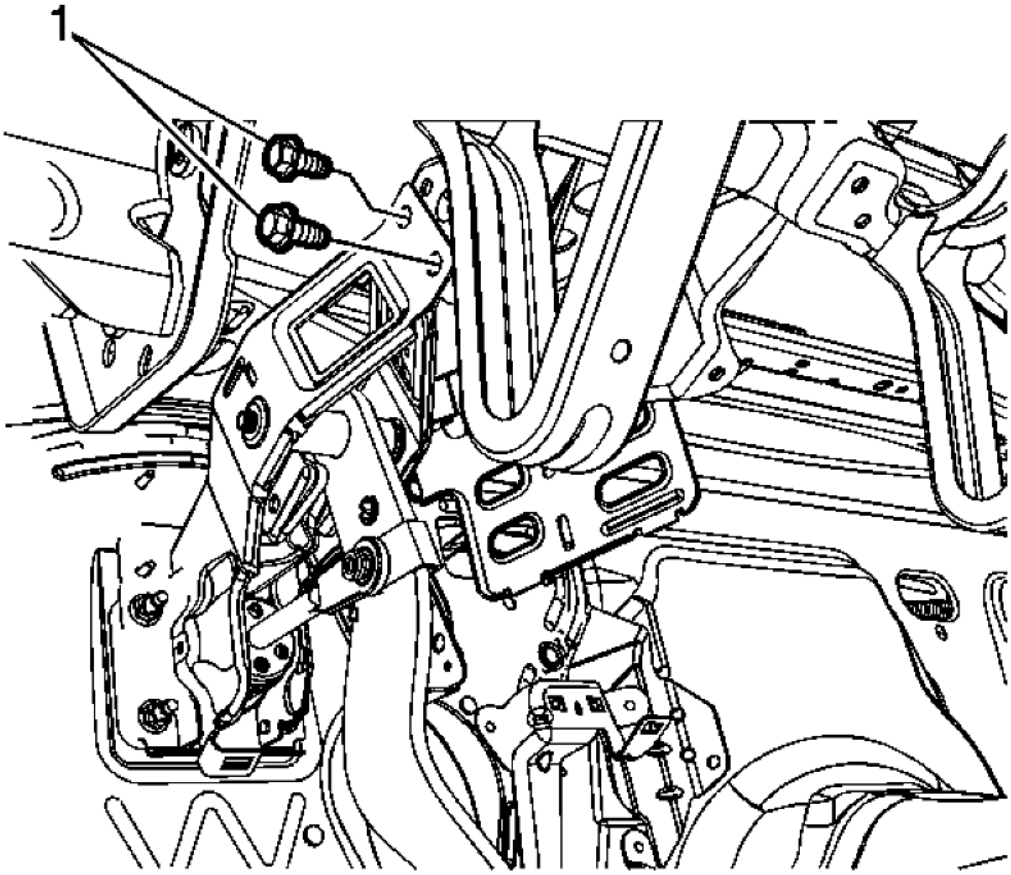


Fig. 26: Brake Pedal Assembly Bolts
Courtesy of GENERAL MOTORS CORP.

4. Remove the brake pedal assembly bolts (1).

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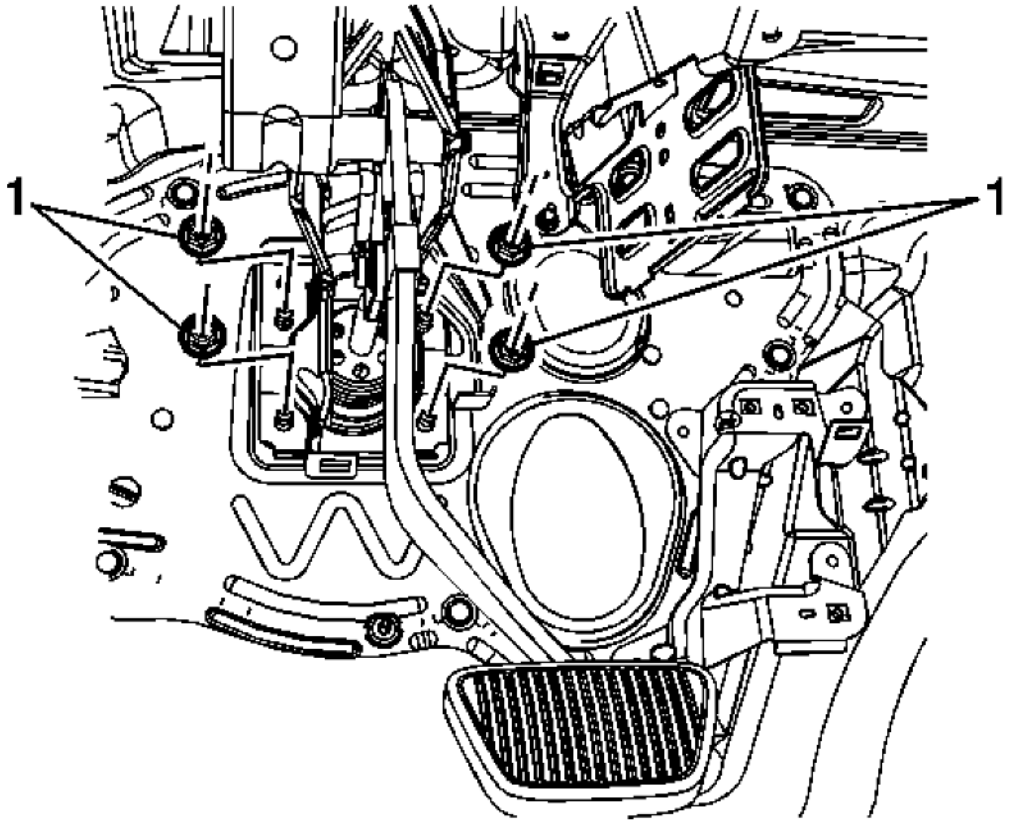


Fig. 27: Brake Pedal Assembly Nuts
Courtesy of GENERAL MOTORS CORP.

5. Remove the brake pedal assembly nuts (1).
6. Disconnect the power brake booster pushrod from the brake pedal.
7. Release the electrical harness from the retaining clips on the brake pedal bracket assembly.
8. Carefully push against the power brake booster studs to position the power vacuum brake booster forward slightly.
9. Maneuver the brake pedal assembly from under the instrument panel and remove the brake pedal assembly from the vehicle.

Installation Procedure

1. Maneuver the brake pedal assembly into the installed position from under the instrument panel.
2. Position the power vacuum brake booster rearward.
3. Ensure the power vacuum brake booster studs engage the brake pedal assembly.

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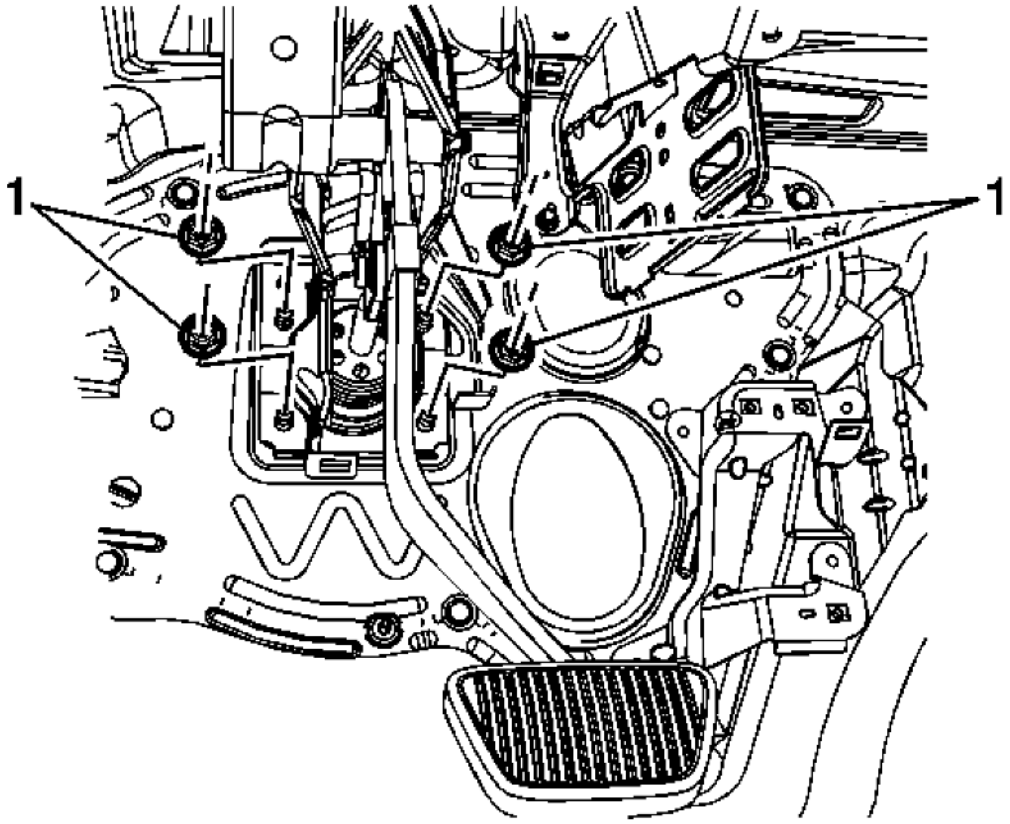


Fig. 28: Brake Pedal Assembly Nuts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

4. Install the brake pedal assembly nuts (1) and tighten to 17 N.m (13 lb ft).

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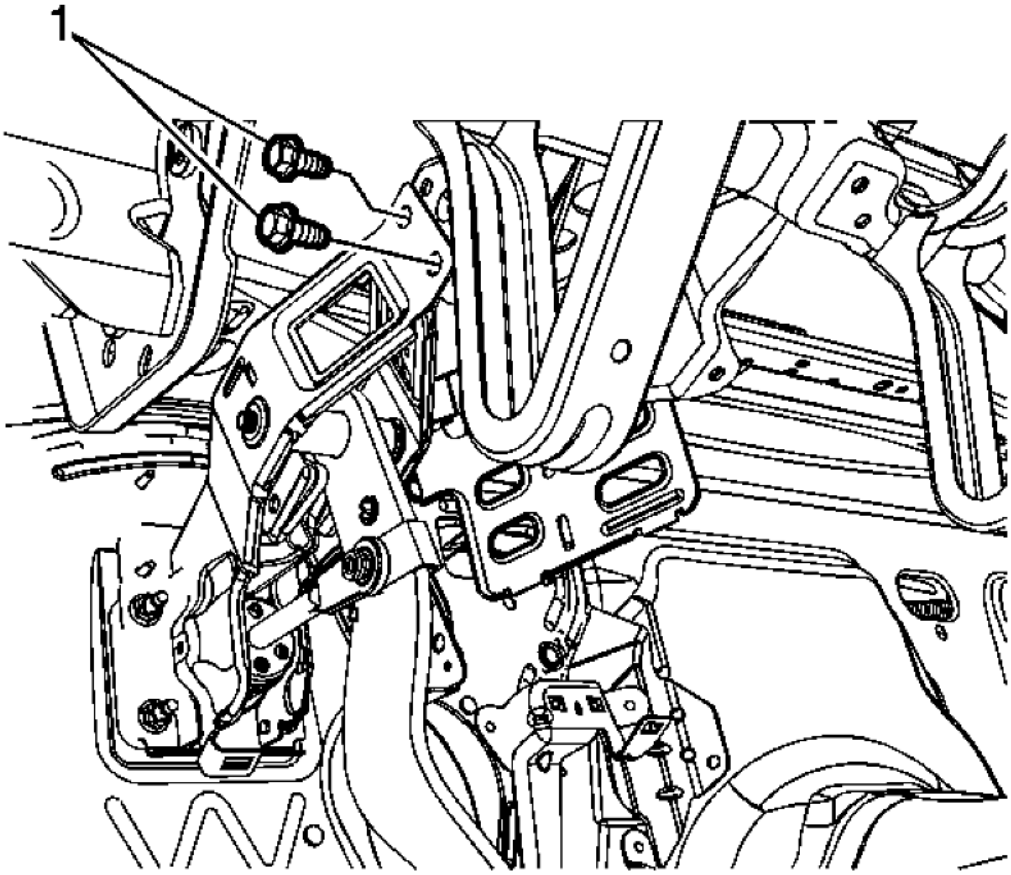


Fig. 29: Brake Pedal Assembly Bolts
Courtesy of GENERAL MOTORS CORP.

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

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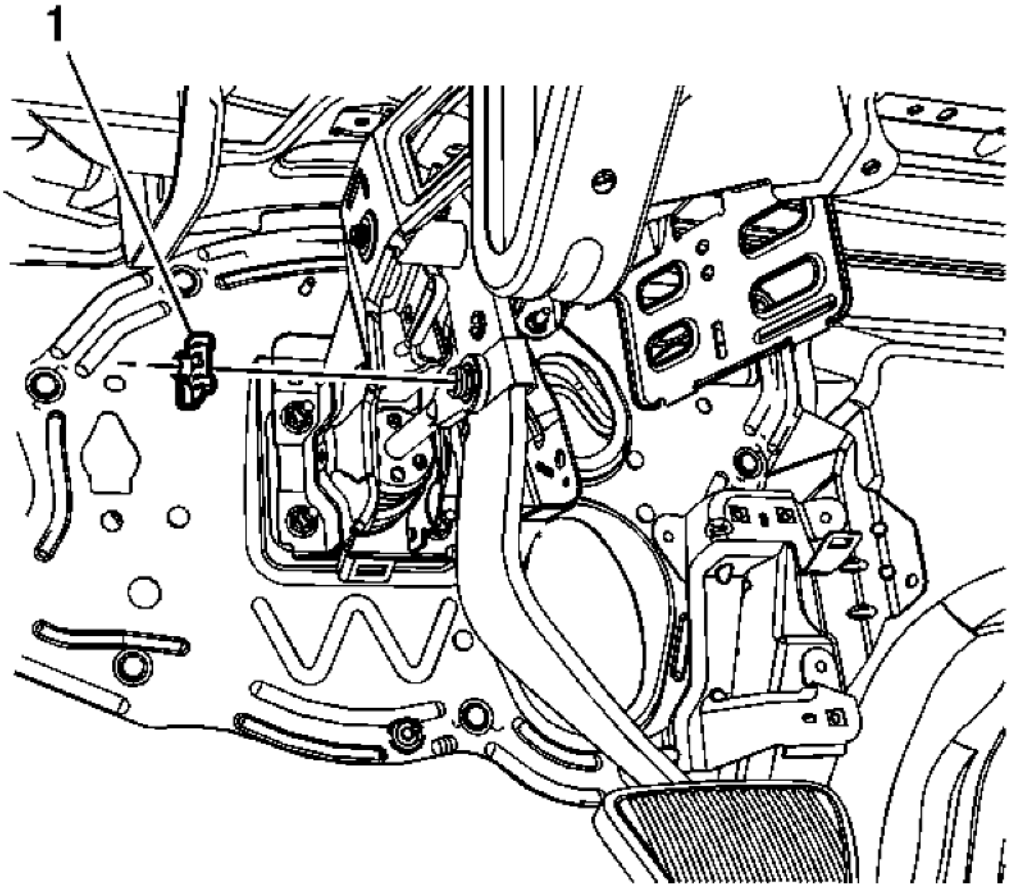


Fig. 30: Power Brake Booster Pushrod Retainer
Courtesy of GENERAL MOTORS CORP.

6. Connect the power brake booster pushrod to the brake pedal pivot pin.
7. Install the power brake booster pushrod retainer (1).

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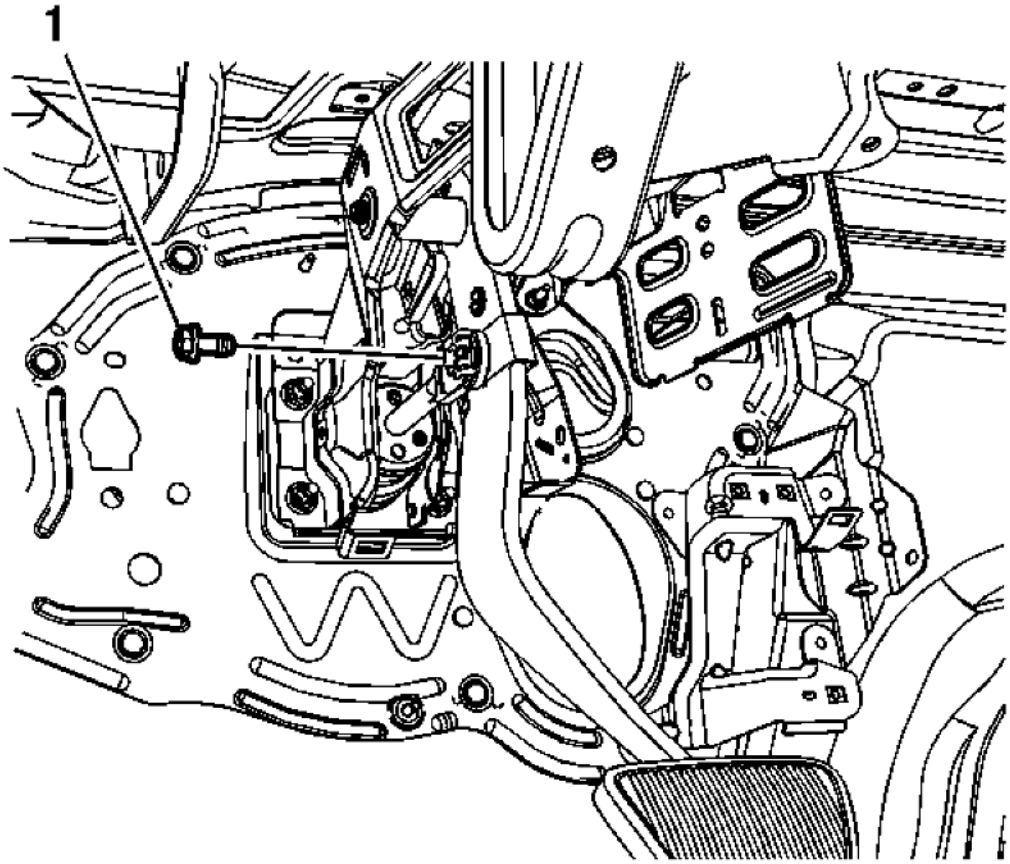


Fig. 31: Power Brake Booster Pushrod Retainer Bolt
Courtesy of GENERAL MOTORS CORP.

8. Install the power brake booster pushrod retainer bolt (1) and tighten to 9 N.m (80 lb in).
9. Position the electrical harness to the brake pedal bracket assembly and secure to the routing clips.
10. Connect the brake pedal position sensor electrical connector.
11. Calibrate the brake pedal position sensor. Refer to **Brake Pedal Position Sensor Calibration** .

BRAKE PIPE REPLACEMENT

Special Tools

J-45405: Pipe Flaring Tool Kit

For equivalent regional tools, refer to **Special Tools**.

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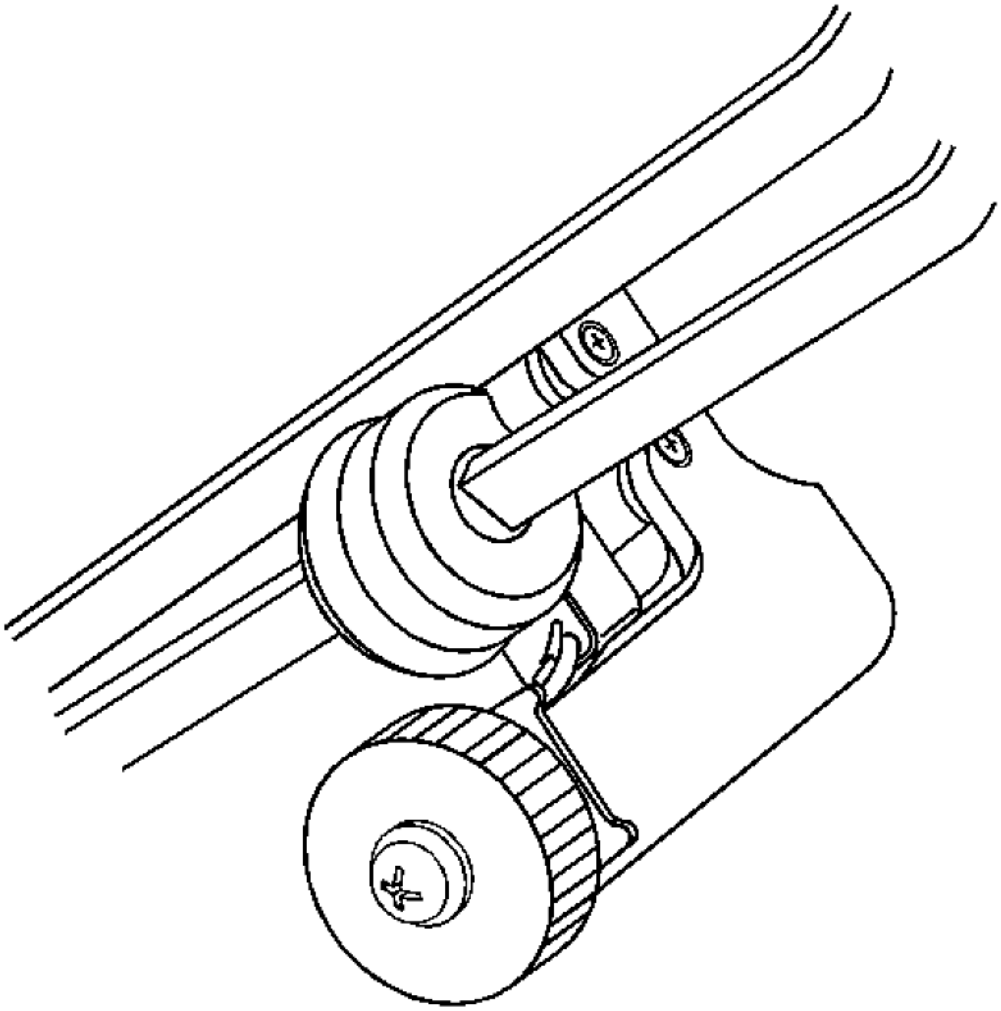


Fig. 32: Sectioning Brake Pipe Using Pipe Cutter
Courtesy of GENERAL MOTORS CORP.

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**

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pipes may cause damage to the brake pipes and cause brake system failure.

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

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

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

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

Specification:

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

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

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

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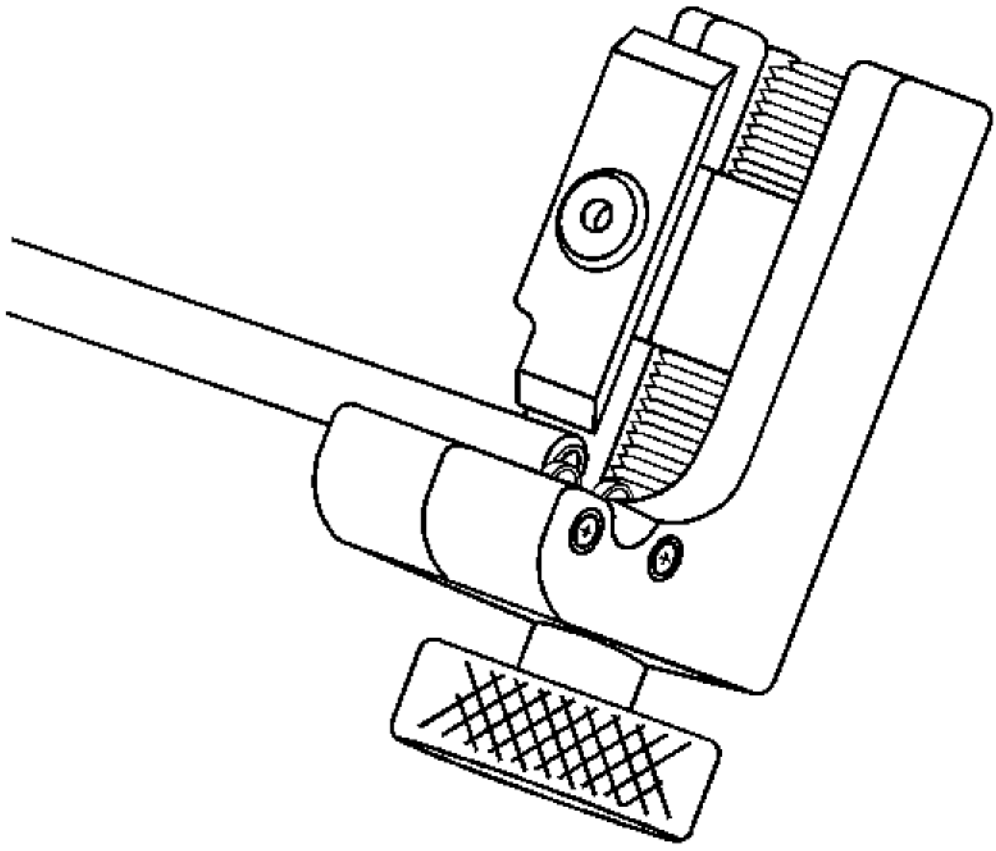


Fig. 33: Stripping Nylon Coating From Brake Pipe Ends
Courtesy of GENERAL MOTORS CORP.

9. Strip the nylon coating from the brake pipe end to be flared, if necessary.
    1. Select the appropriate blade on the coating stripping tool included in the **J-45405:** Pipe Flaring Tool Kit , by unthreading the blade block from the stripping tool and installing the block with the desired blade facing the tool rollers.

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

    2. Insert the brake pipe end to be flared into the stripping tool to the depth of the ledge on the tool rollers.
    3. While holding the brake pipe firmly against the stripping tool roller ledges, rotate the thumbwheel

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of the tool until the blade contacts the brake pipe coated surface.

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

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

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

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

Specification:

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

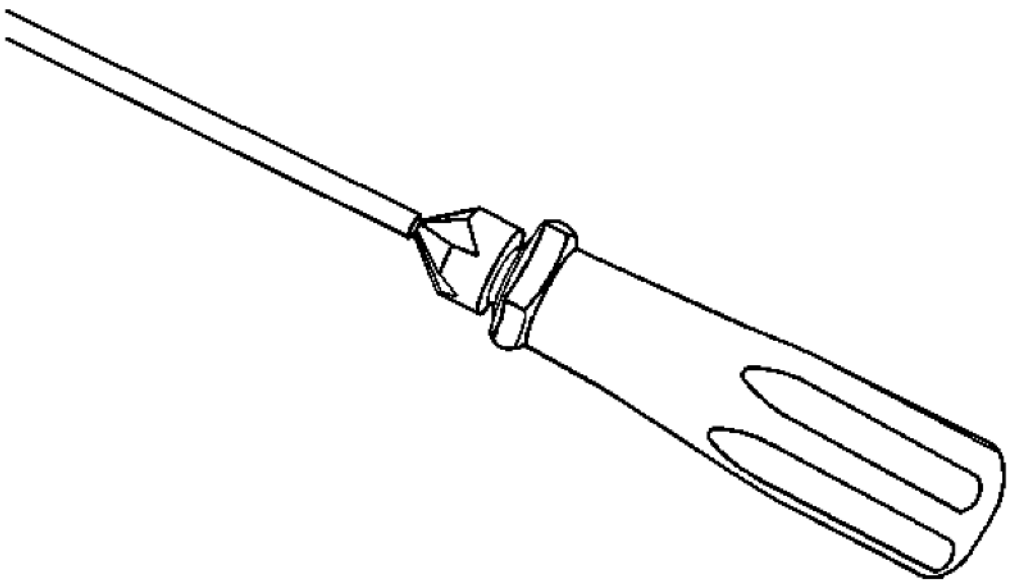


Fig. 34: Chamfering Pipe Using De-Burring Tool

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Courtesy of GENERAL MOTORS CORP.

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

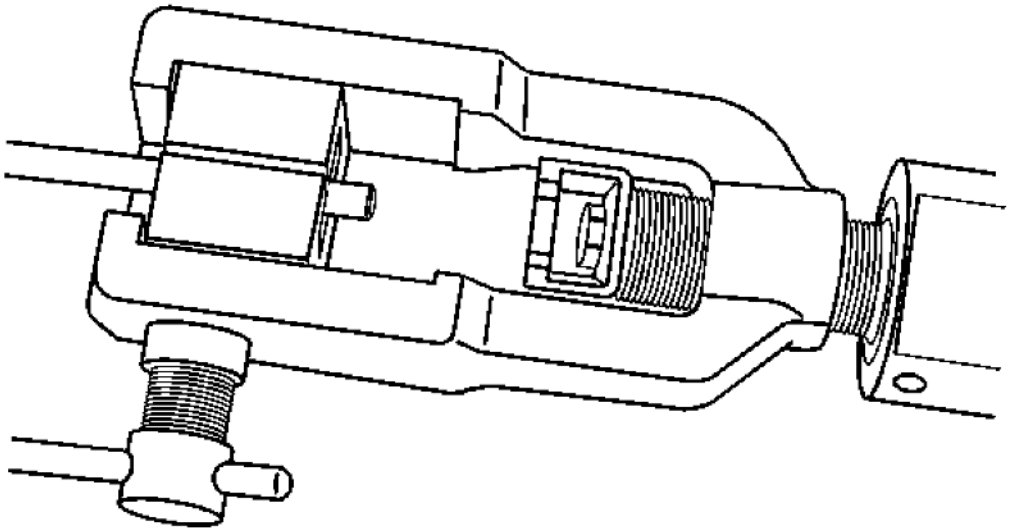


Fig. 35: Installing Die Halves Into Die Cage
Courtesy of GENERAL MOTORS CORP.

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

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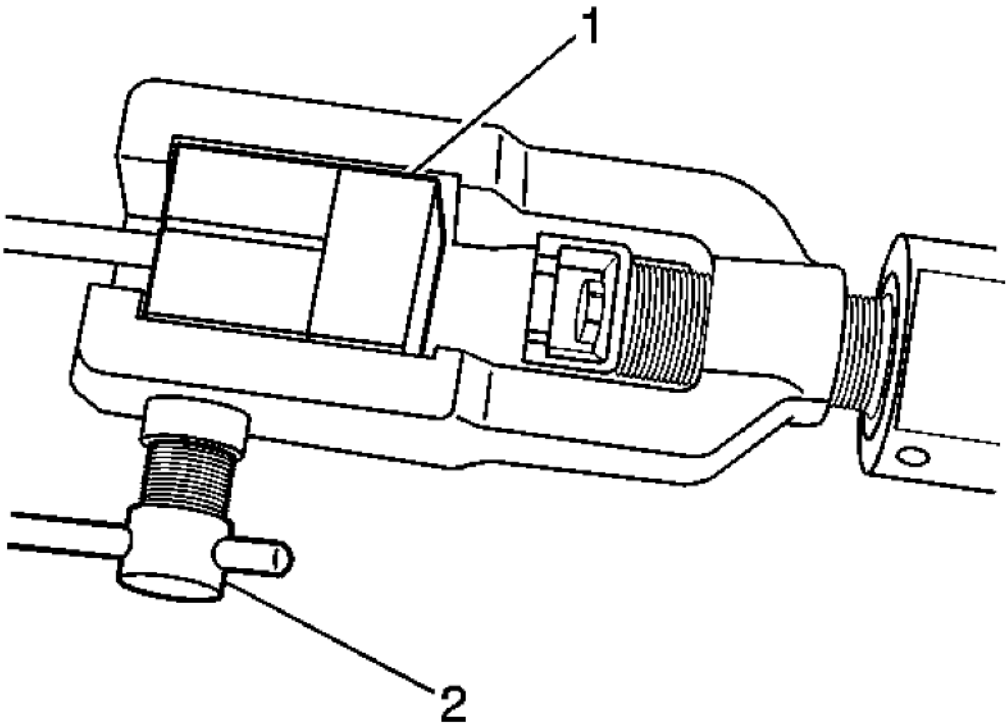


Fig. 36: View Of Clamping Screw & Unused Die
Courtesy of GENERAL MOTORS CORP.

15. Place the flat face of an unused die (1) against the die halves in the clamping cage and hold firmly against the counterbored face of the dies.
16. Insert the prepared end of the pipe to be flared through the back of the dies until the pipe is seated against the flat surface of the unused die (1).
17. Remove the unused die (1).
18. Ensure that the rear of both dies are seated firmly against the enclosed end of the die cage.
19. Firmly hand tighten the clamping screw (2) against the dies.

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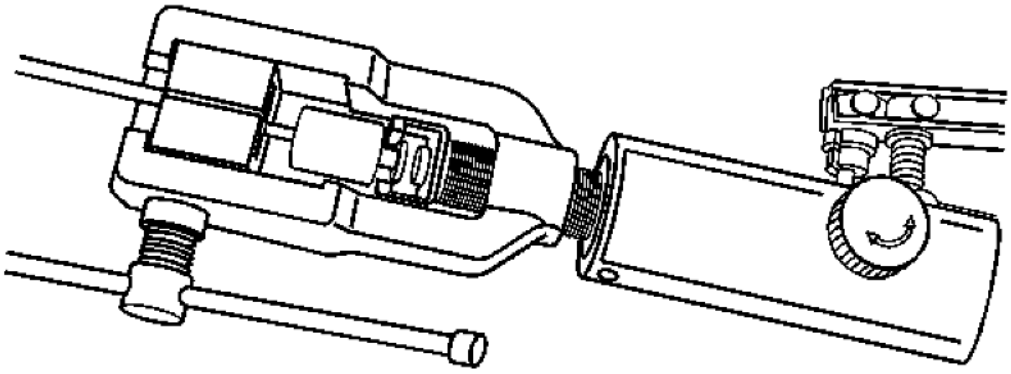


Fig. 37: Rotating J 45405 To Bottom Against Die Cage
Courtesy of GENERAL MOTORS CORP.

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

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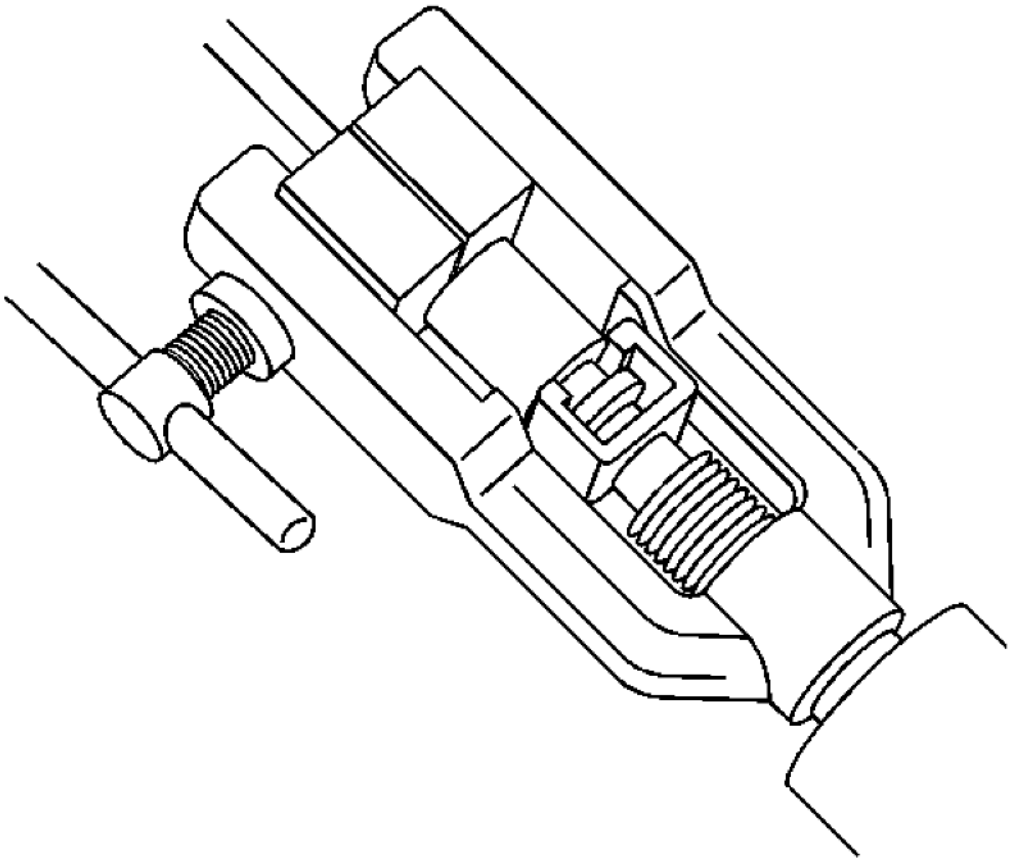


Fig. 38: Bottoming Forming Mandrel Against Clamping Dies Using Pipe Flaring Tool
Courtesy of GENERAL MOTORS CORP.

23. While guiding the forming mandrel into the exposed end of pipe to be flared, operate the lever of the **J-45405:** Pipe Flaring Tool Kit until the forming mandrel bottoms against the clamping dies.
24. Rotate the hydraulic fluid control valve counterclockwise to the open position to allow the hydraulic forming ram to retract.

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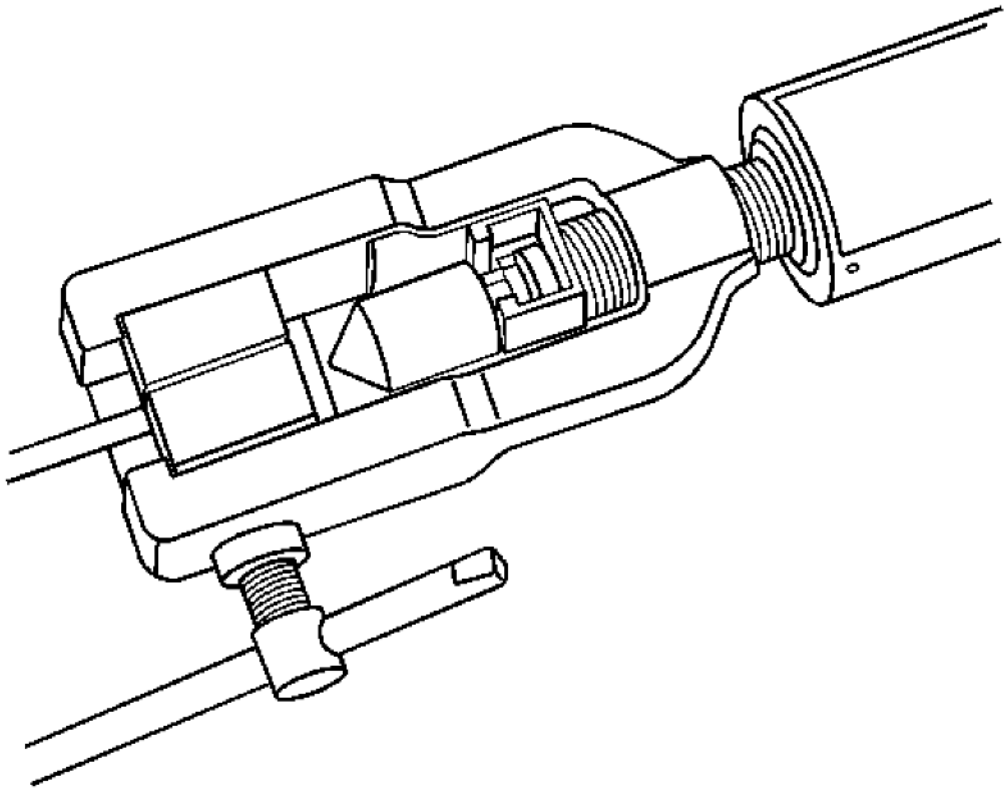


Fig. 39: Using Pipe Flaring Tool
Courtesy of GENERAL MOTORS CORP.

25. Insert the finishing cone into the forming ram.
26. Rotate the hydraulic fluid control valve clockwise to the closed position.
27. Rotate the body of the **J-45405:** Pipe Flaring Tool Kit until it bottoms against the die cage.
28. While guiding the finishing cone into the exposed end of pipe to be flared, operate the lever of the **J-45405:** Pipe Flaring Tool Kit until the finishing cone bottoms against the dies.
29. Rotate the hydraulic fluid control valve counterclockwise to the open position to allow the hydraulic forming ram to retract.
30. Loosen the die clamping screw and remove the dies and pipe.
31. If necessary, lightly tap the dies until the die halves separate.

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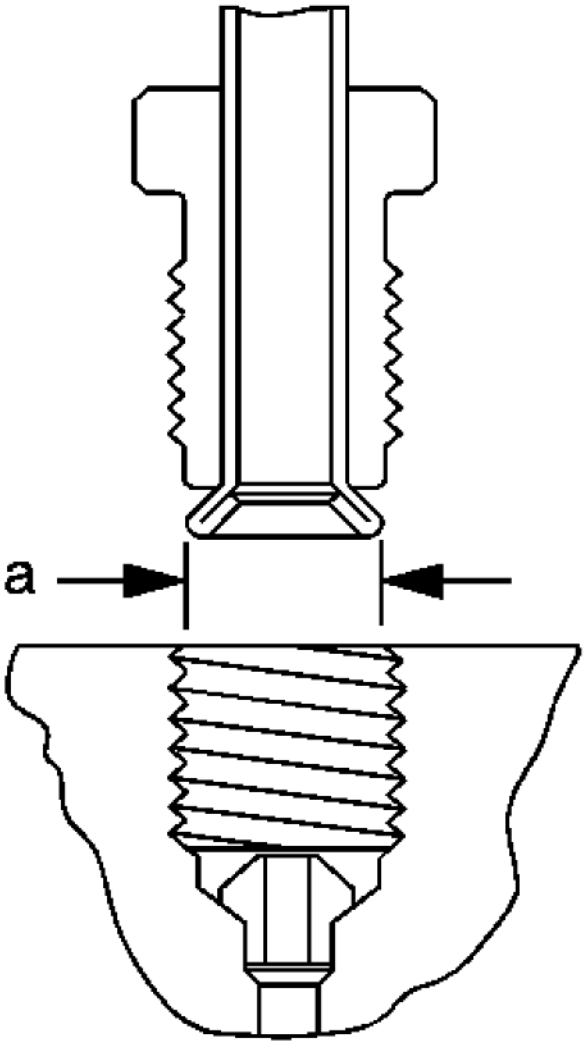


Fig. 40: Identifying Correct Brake Pipe Flare Shape & Diameter
Courtesy of GENERAL MOTORS CORP.

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

Specification:

- 6.74-7.10 mm (0.265-0.279 in) flare diameter for 4.76 mm (3/16 in) diameter pipe
- 8.57-9.27 mm (0.344-0.358 in) flare diameter for 6.35 mm (1/4 in) diameter pipe
- 10.42-10.79 mm (0.410-0.425 in) flare diameter for 7.94 mm (5/16 in) diameter pipe

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

NOTE: When installing the pipe, maintain a clearance of 19 mm (3/4 in) from all moving or vibrating components.

34. Install the pipe to the vehicle with the appropriate brake pipe unions, as required.
35. If previously released, secure the brake pipe to the retainers.
36. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.
37. With the aid of an assistant, inspect the brake pipe flares for leaks by starting the engine and applying the brakes.

FRONT BRAKE HOSE REPLACEMENT (LLT)

Removal Procedure

WARNING: Refer to Brake Dust Warning .

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

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

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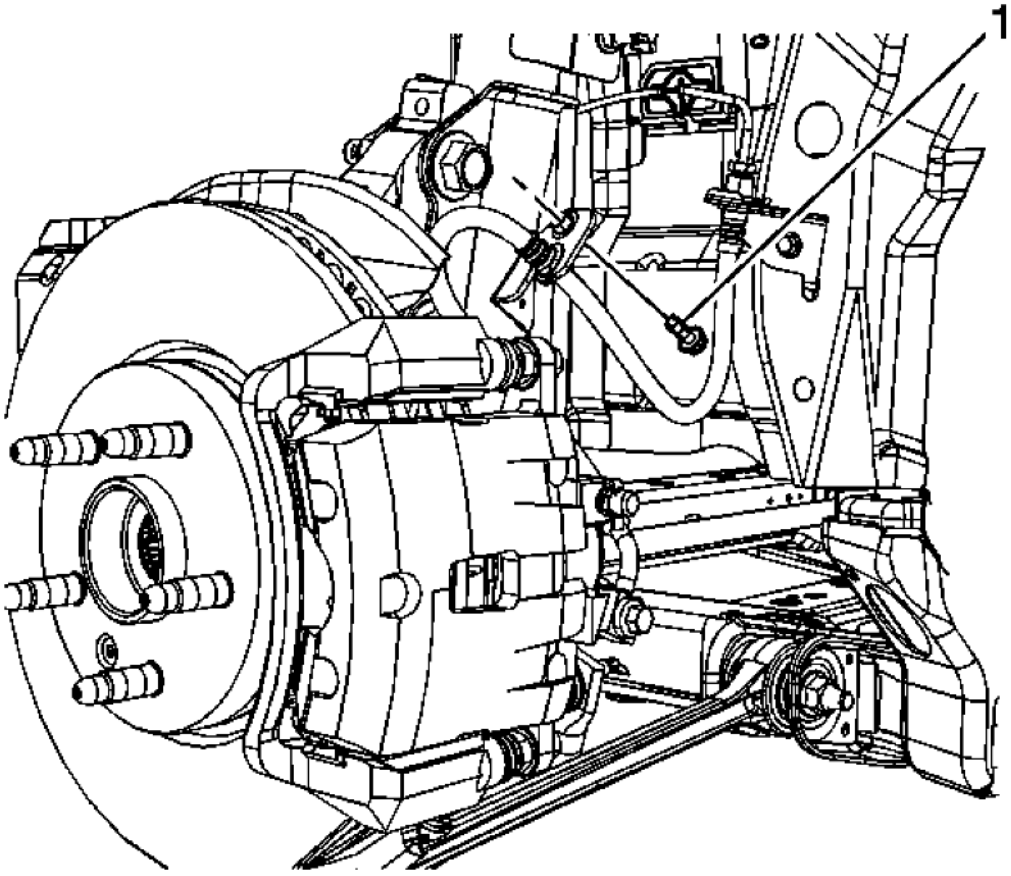


Fig. 41: Brake Hose Bracket Bolt At Strut Assembly
Courtesy of GENERAL MOTORS CORP.

3. Remove the brake hose bracket bolt (1) from the strut assembly.

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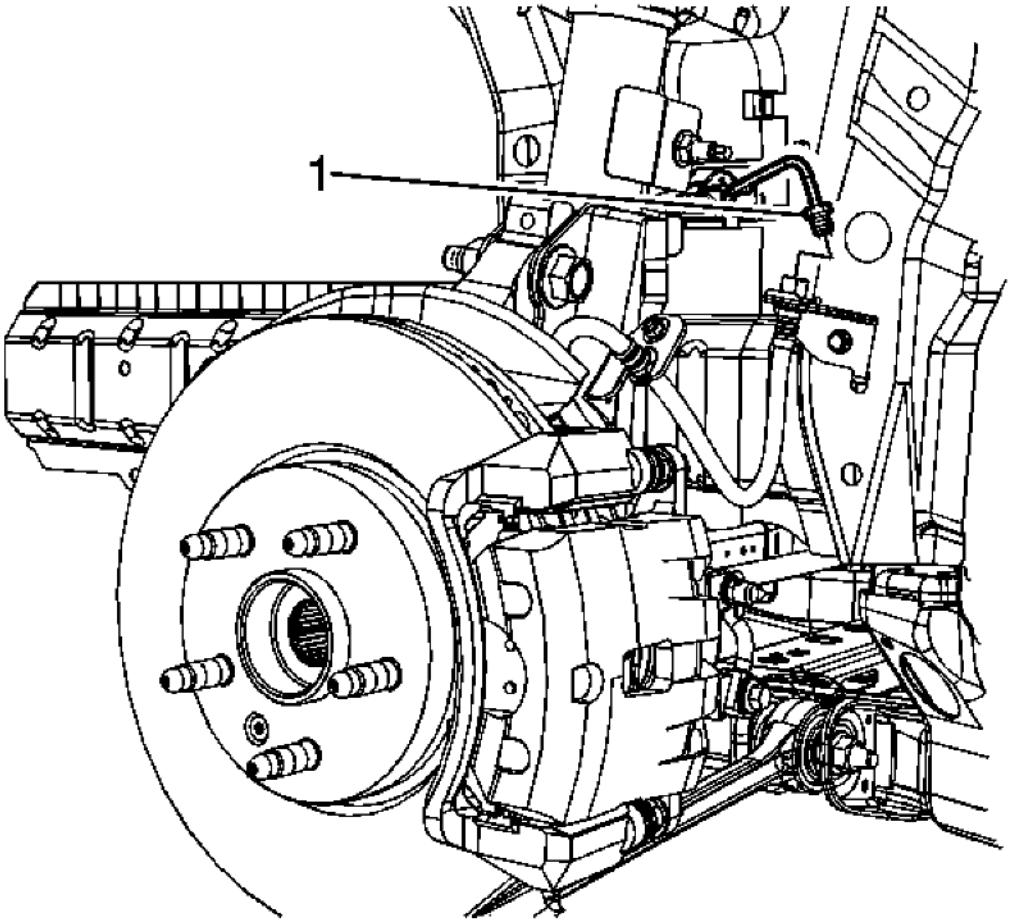


Fig. 42: Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the brake pipe fitting (1).
5. Cap the brake pipe fitting to prevent brake fluid loss and contamination.

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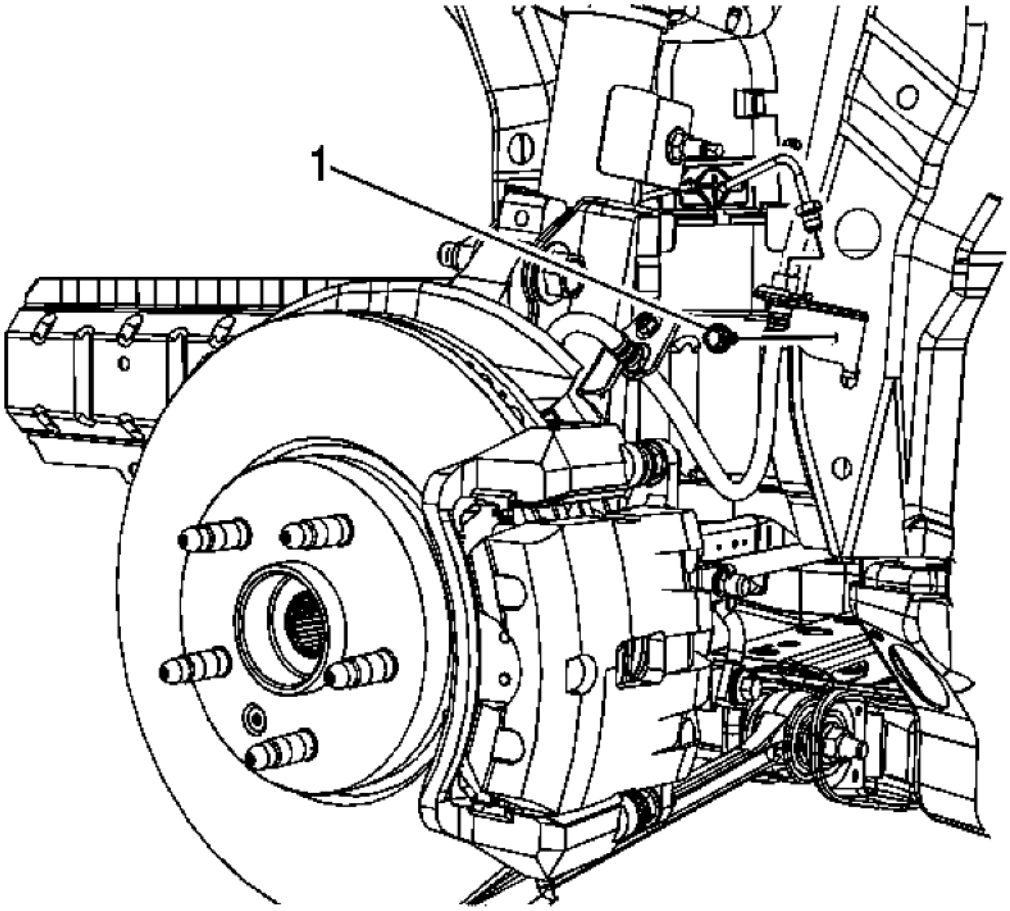


Fig. 43: Brake Hose Bracket Bolt At Wheelhouse Panel
Courtesy of GENERAL MOTORS CORP.

6. Remove the brake hose bracket bolt (1) from the wheelhouse panel.

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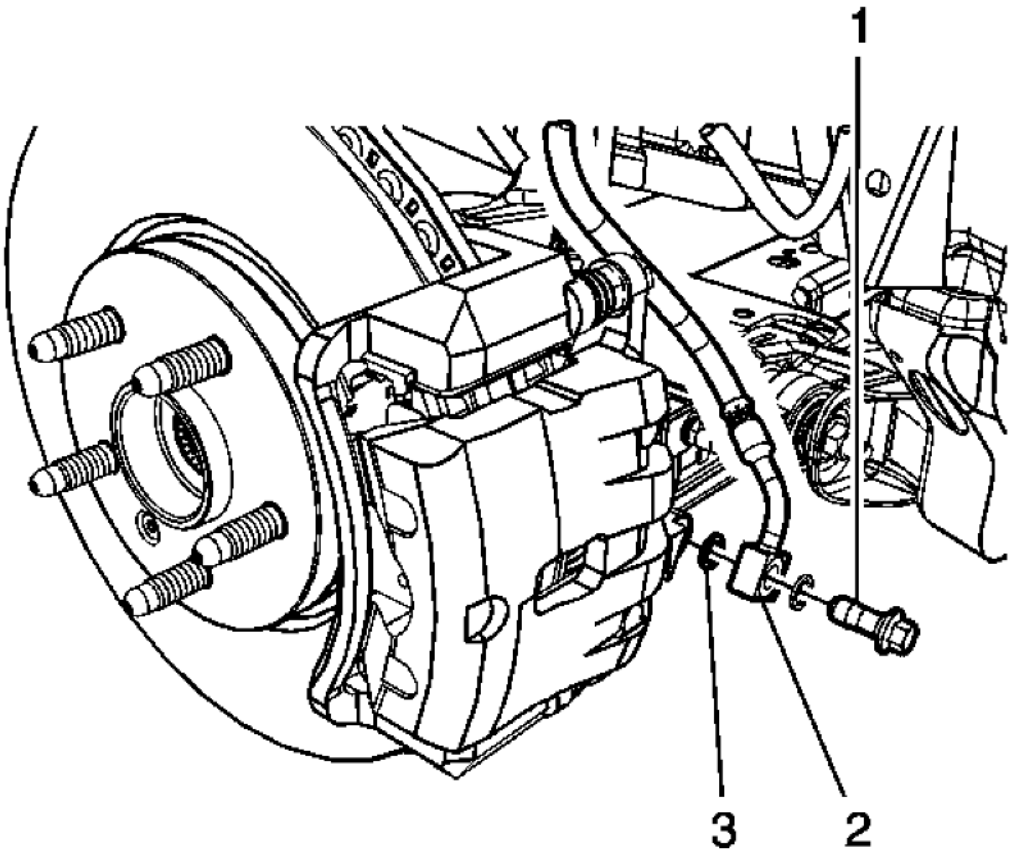


Fig. 44: Brake Hose Fitting Bolt
Courtesy of GENERAL MOTORS CORP.

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

NOTE: Do not reuse the brake hose fitting gaskets.

8. Remove the brake hose fitting gaskets (2) from the brake hose (3)..
9. Discard the brake hose fitting gaskets.
10. Remove the brake hose.

Installation Procedure

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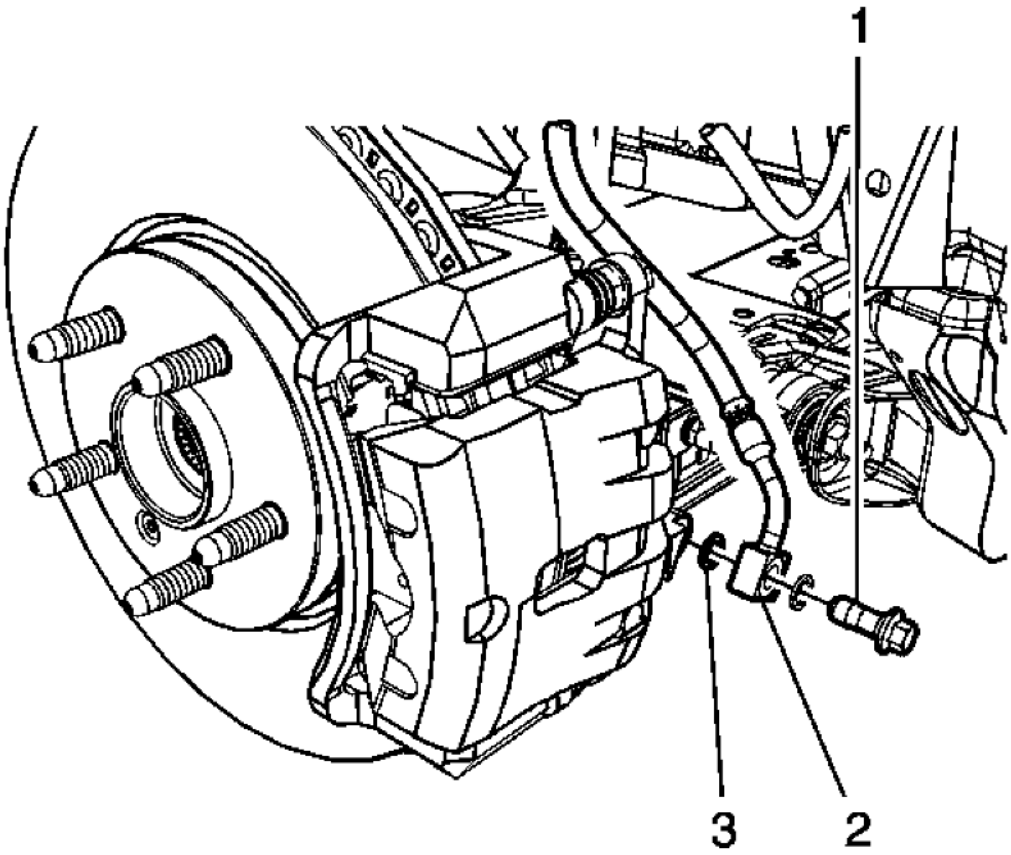


Fig. 45: Brake Hose Fitting Bolt
Courtesy of GENERAL MOTORS CORP.

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

   CAUTION: Refer to Fastener Caution .

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

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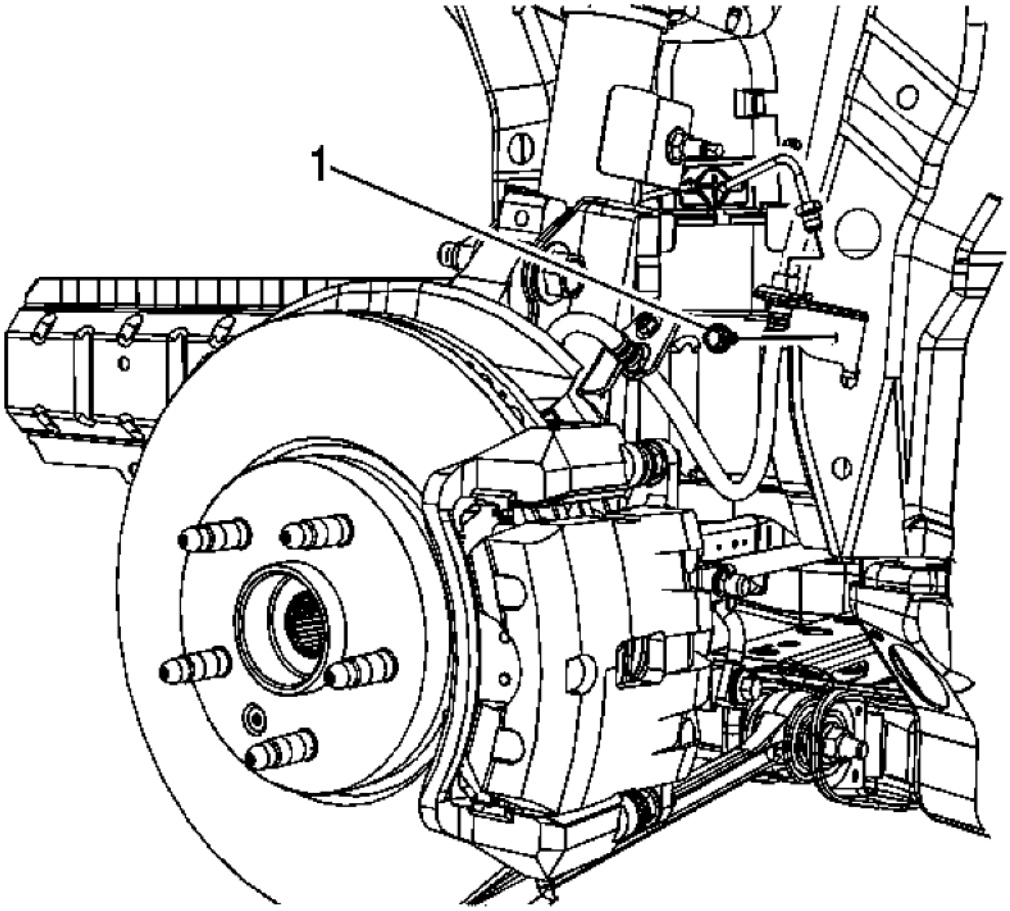


Fig. 46: Brake Hose Bracket Bolt At Wheelhouse Panel
Courtesy of GENERAL MOTORS CORP.

3. Install the brake hose bracket bolt (1) on the wheelhouse panel and tighten to 9 N.m (80 lb in).

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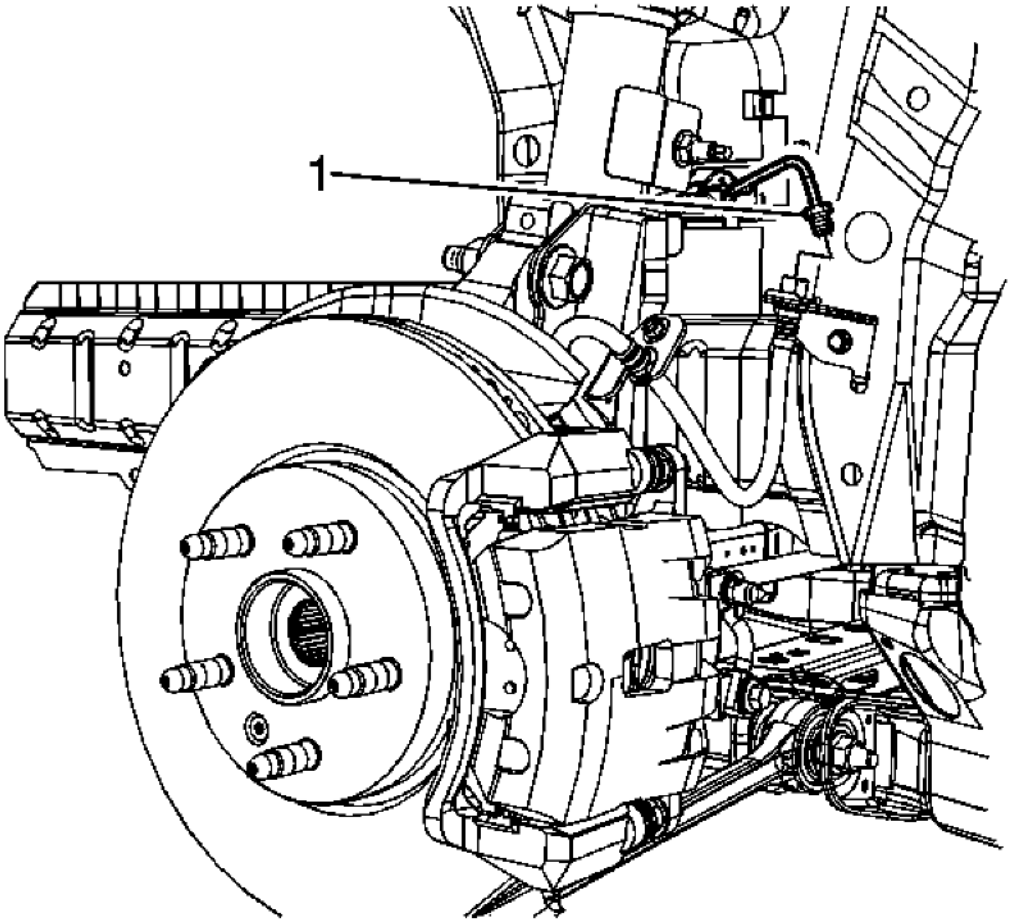


Fig. 47: Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

4. Connect the brake pipe fitting (1) and tighten to 16 N.m (12 lb ft).

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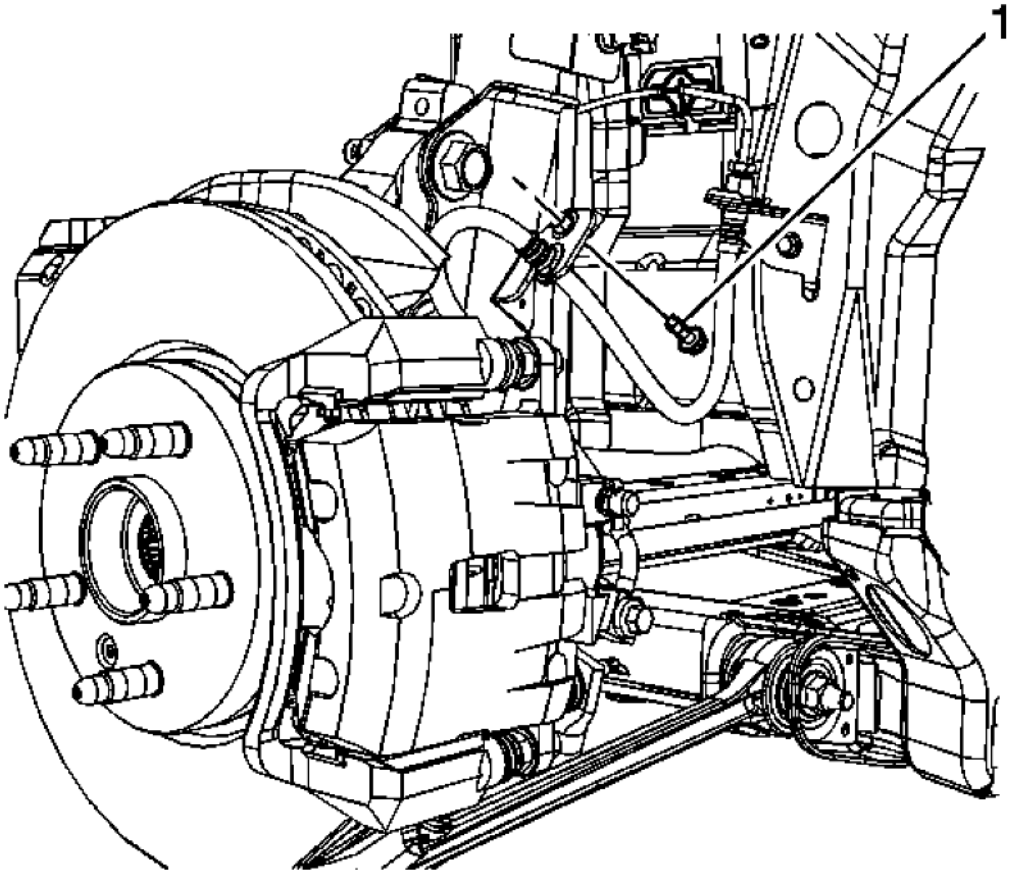


Fig. 48: Brake Hose Bracket Bolt At Strut Assembly
Courtesy of GENERAL MOTORS CORP.

5. Install the brake hose bracket bolt (1) on the strut assembly and tighten to 9 N.m (80 lb in).
6. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.
7. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .

FRONT BRAKE HOSE REPLACEMENT (LS3, L99)

Removal Procedure

WARNING: Refer to Brake Dust Warning .

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WARNING: **Refer to Brake Fluid Irritant Warning .**

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

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

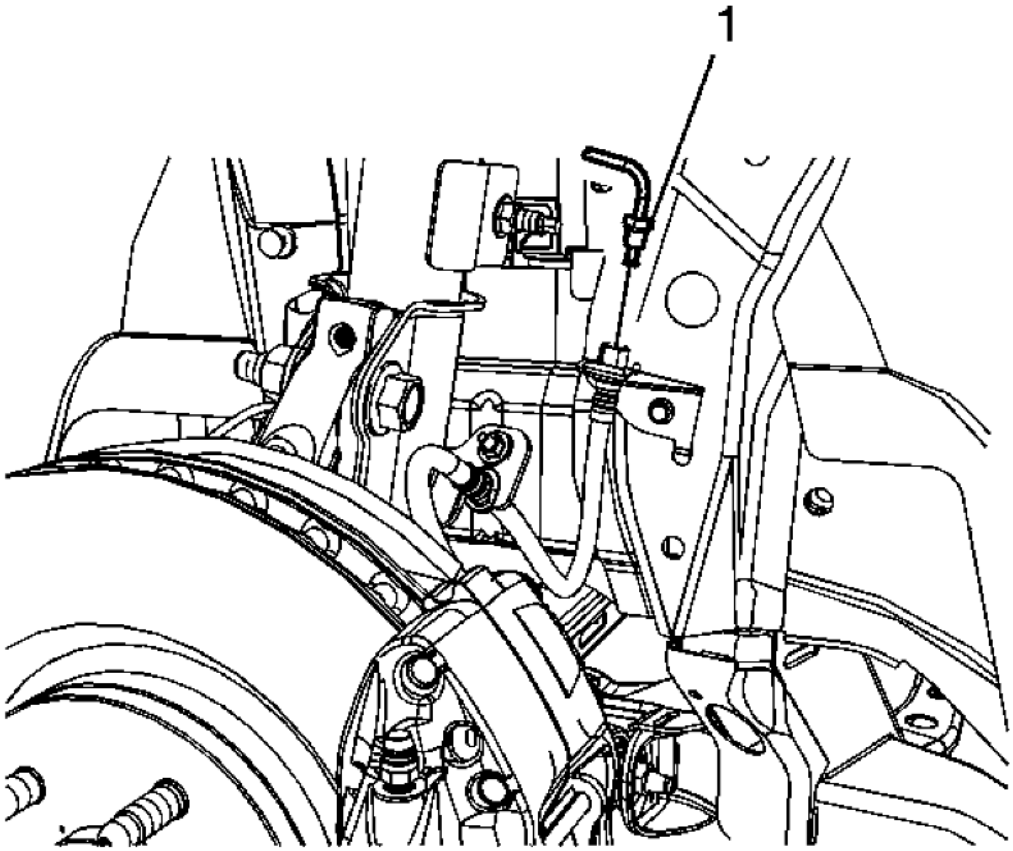


Fig. 49: Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

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

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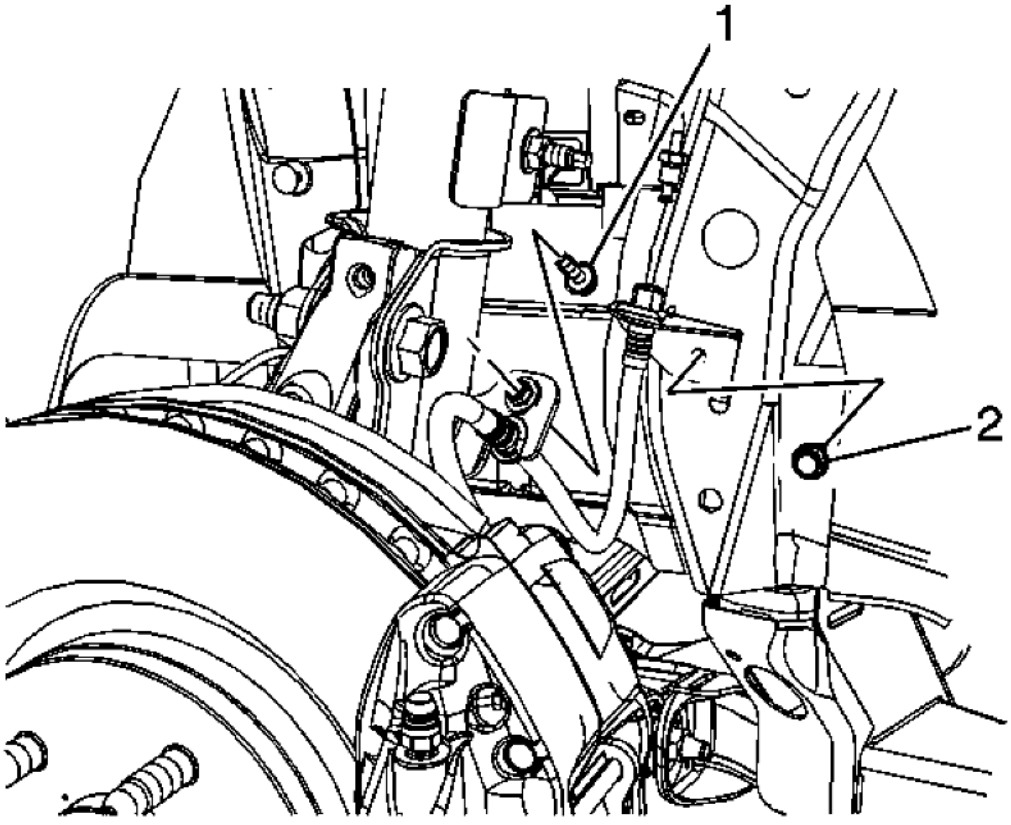


Fig. 50: Brake Hose Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the brake hose bracket bolt (1) from the front suspension strut.
6. Remove the brake hose bracket bolt (2) from the wheelhouse panel.

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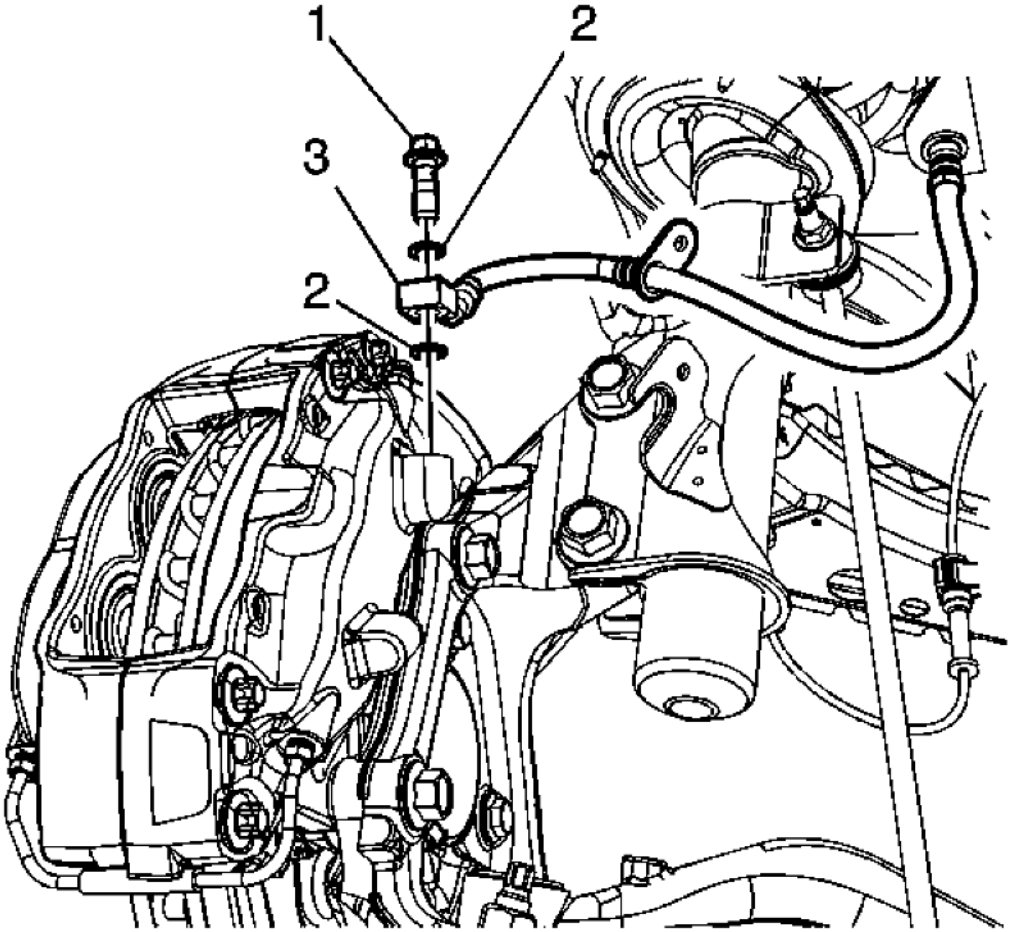


Fig. 51: Brake Hose, Fitting Bolt & Gaskets
Courtesy of GENERAL MOTORS CORP.

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

NOTE: Do not reuse the brake hose fitting gaskets.

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

Installation Procedure

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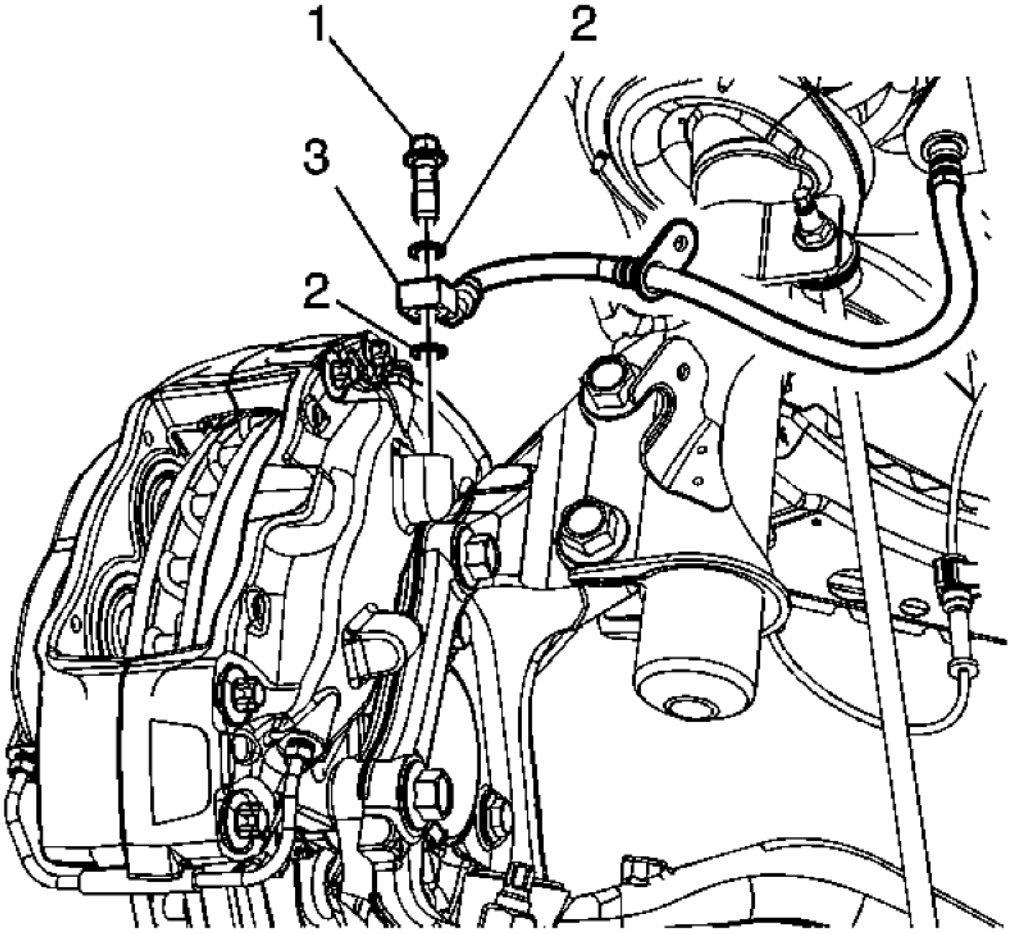


Fig. 52: Brake Hose, Fitting Bolt & Gaskets
Courtesy of GENERAL MOTORS CORP.

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

   CAUTION: Refer to Fastener Caution .

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

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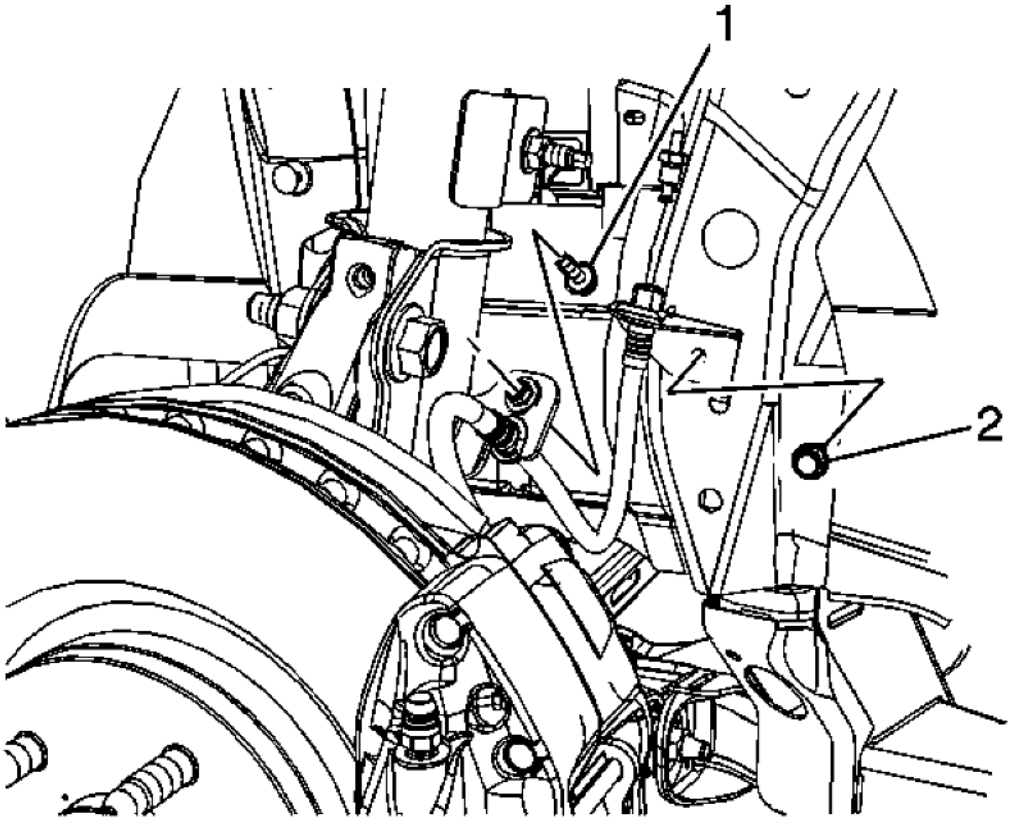


Fig. 53: Brake Hose Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

3. Install the brake hose bracket bolt (1) to the front suspension strut and tighten to 9 N.m (80 lb in).
4. Install the brake hose bracket bolt (2) to the wheelhouse panel and tighten to 9 N.m (80 lb in).

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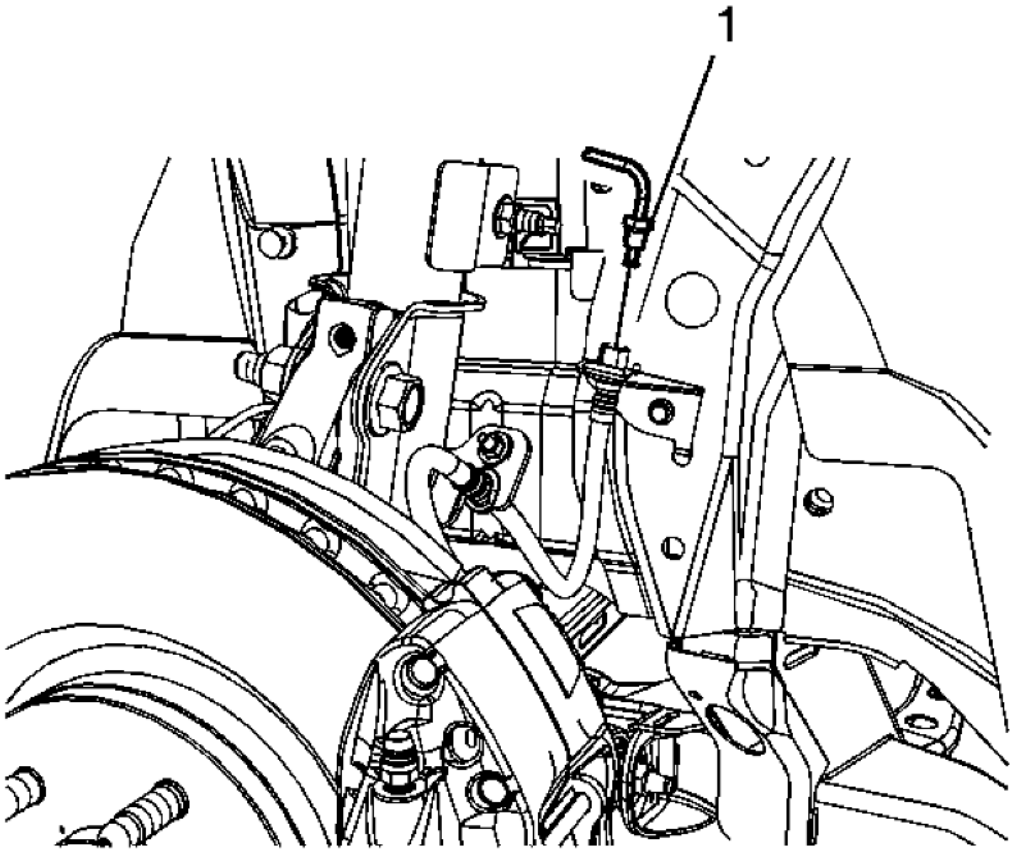


Fig. 54: Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

5. Connect the brake pipe fitting (1) and tighten to 16 N.m (12 lb ft).
6. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.
7. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .

REAR BRAKE HOSE REPLACEMENT (LLT)

Removal Procedure

WARNING: Refer to Brake Dust Warning .

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WARNING: **Refer to Brake Fluid Irritant Warning .**

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

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

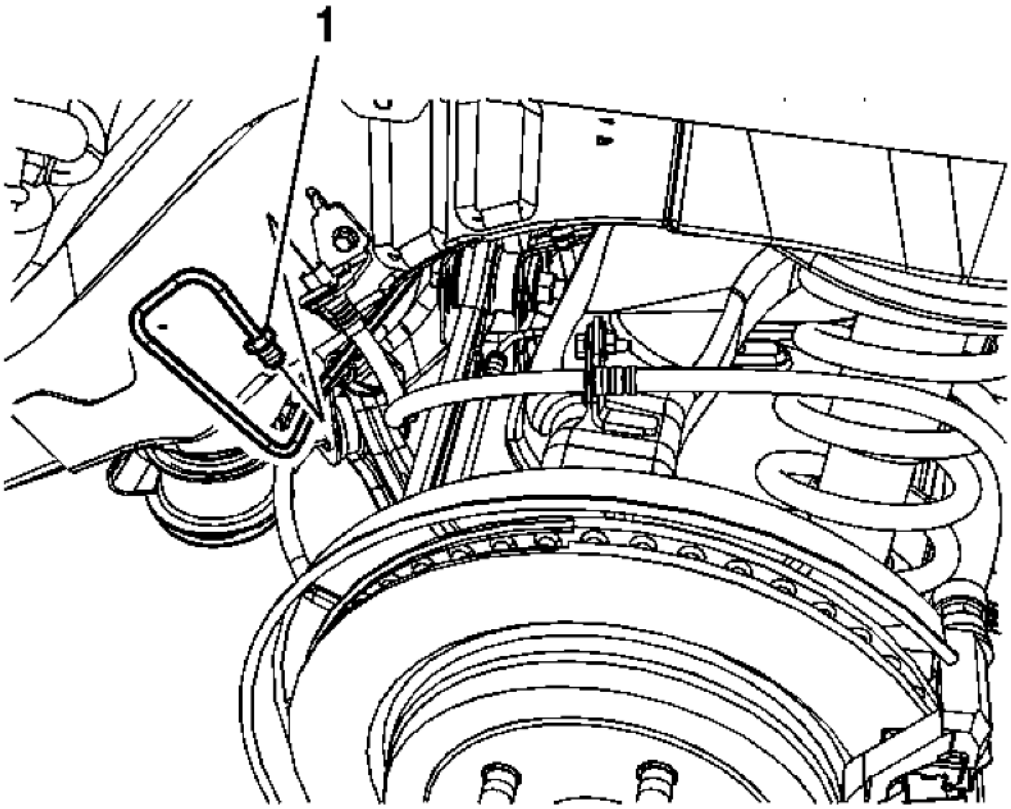


Fig. 55: Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

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

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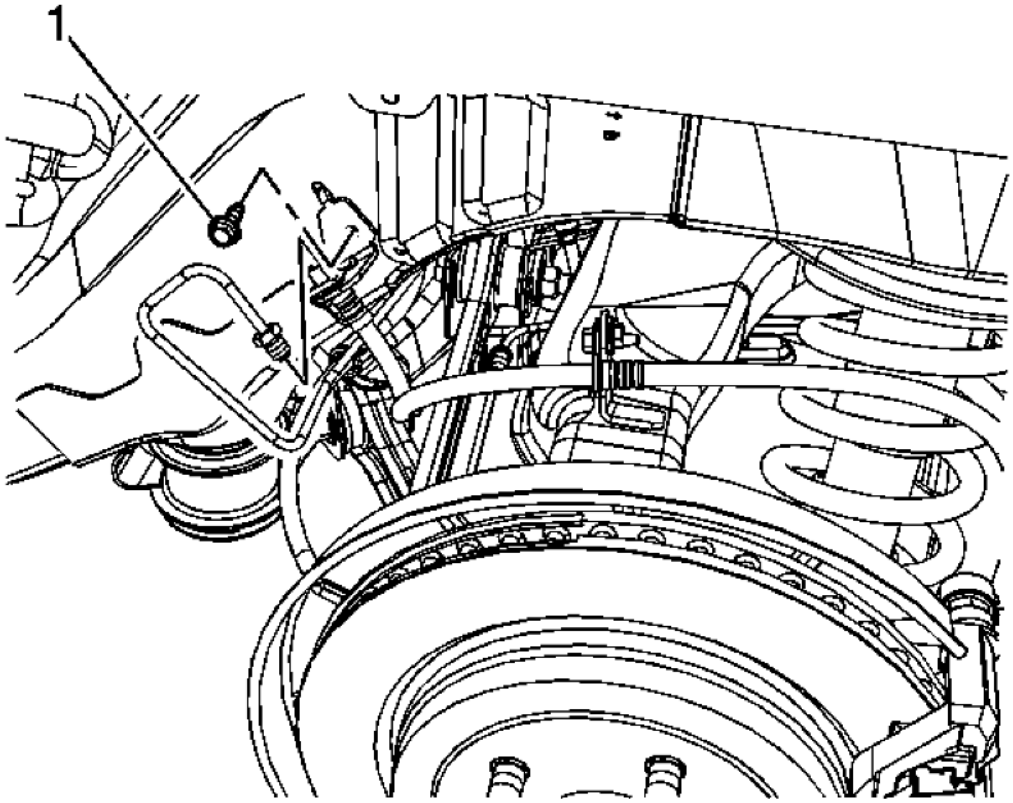


Fig. 56: Brake Hose Bracket Bolt At Wheelhouse Panel
Courtesy of GENERAL MOTORS CORP.

5. Remove the brake hose bracket bolt (1) from the wheelhouse panel.

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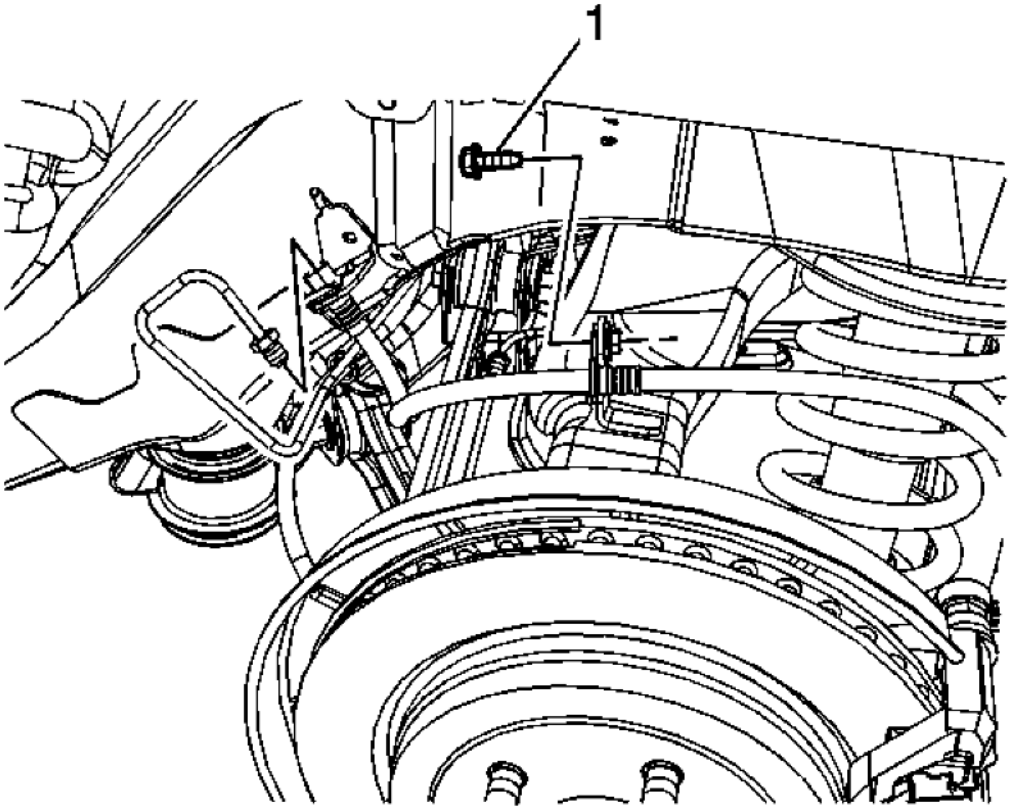


Fig. 57: Brake Hose Bracket Bolt At Upper Suspension Arm
Courtesy of GENERAL MOTORS CORP.

6. Remove the brake hose bracket bolt (1) from the upper suspension arm.

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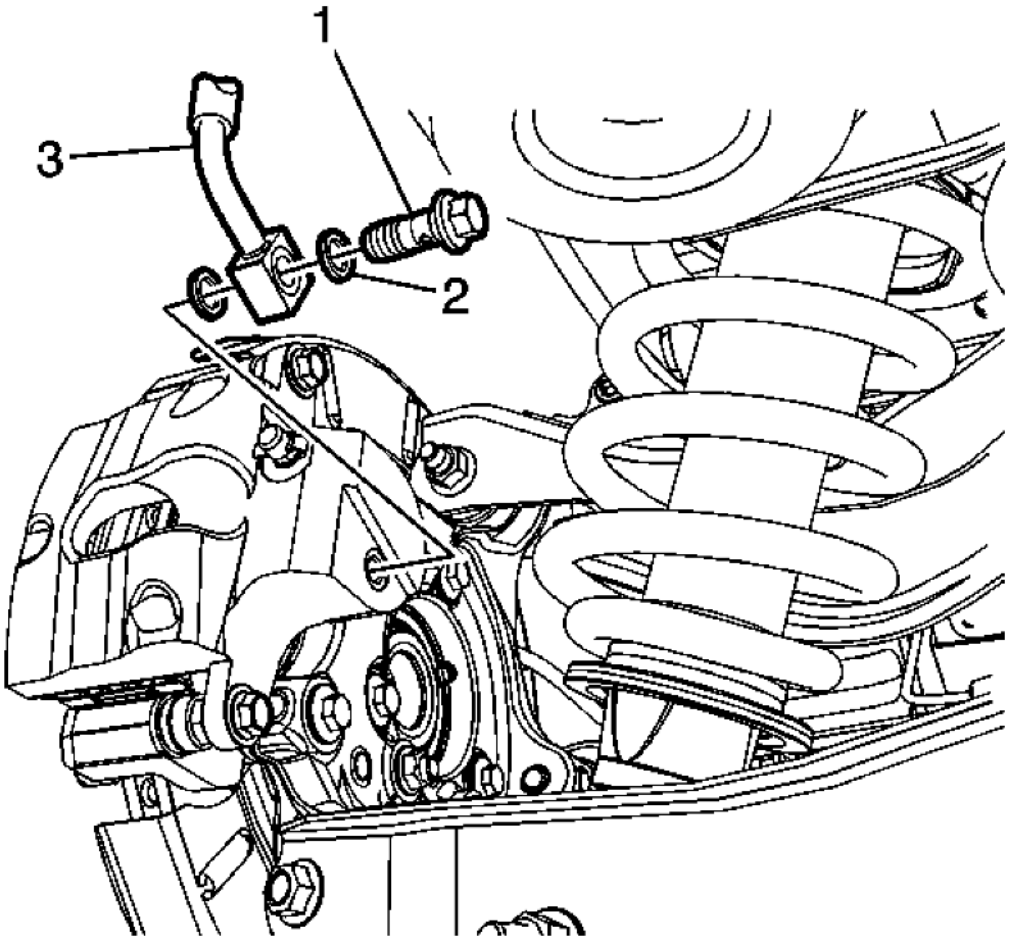


Fig. 58: Brake Hose, Fitting Bolt & Gaskets
Courtesy of GENERAL MOTORS CORP.

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

NOTE: Do not reuse the brake hose fitting gaskets.

8. Remove the brake hose fitting gaskets (2) from the brake hose (3).
9. Discard the brake hose fitting gaskets.
10. Remove the brake hose.

Installation Procedure

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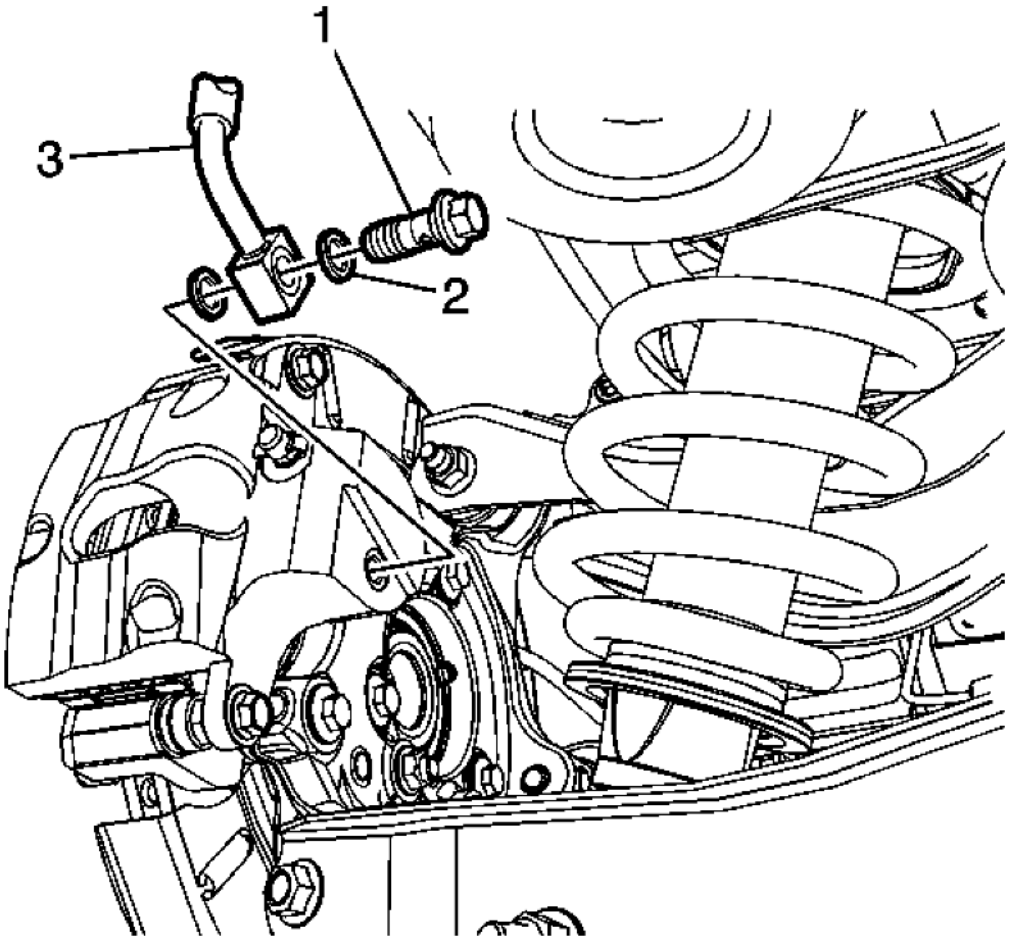


Fig. 59: Brake Hose, Fitting Bolt & Gaskets
Courtesy of GENERAL MOTORS CORP.

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

   CAUTION: Refer to Fastener Caution .

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

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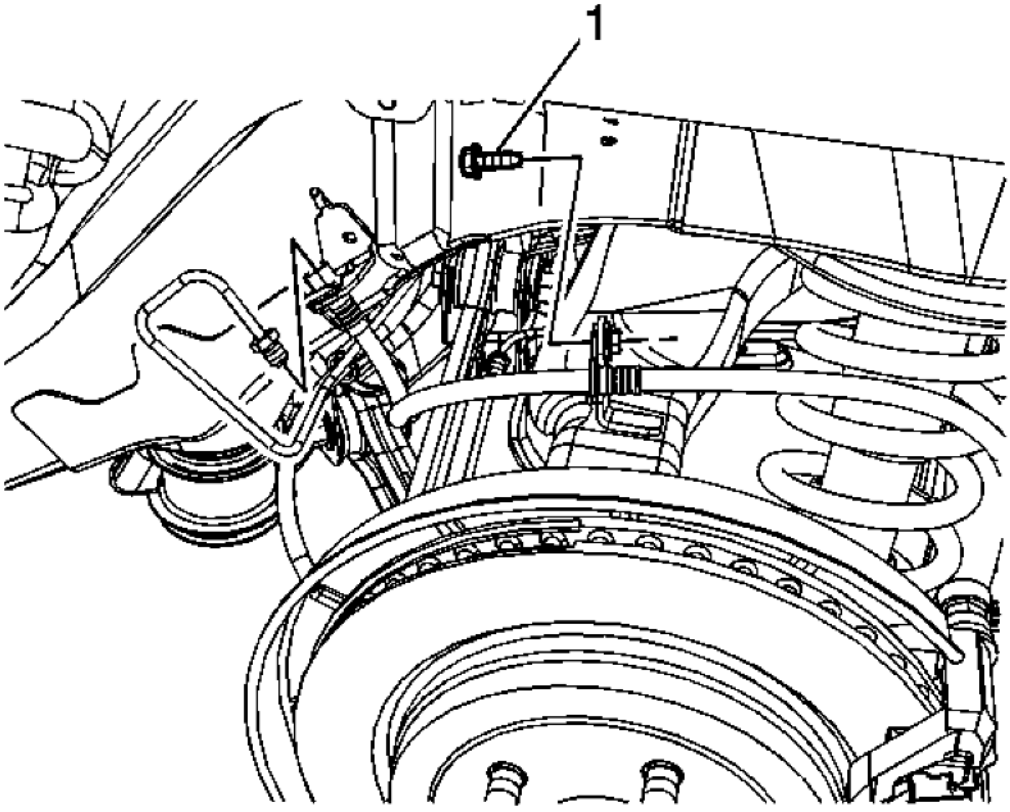


Fig. 60: Brake Hose Bracket Bolt At Upper Suspension Arm
Courtesy of GENERAL MOTORS CORP.

3. Install the brake hose bracket bolt (1) to the upper suspension arm and tighten to 9 N.m (80 lb in).

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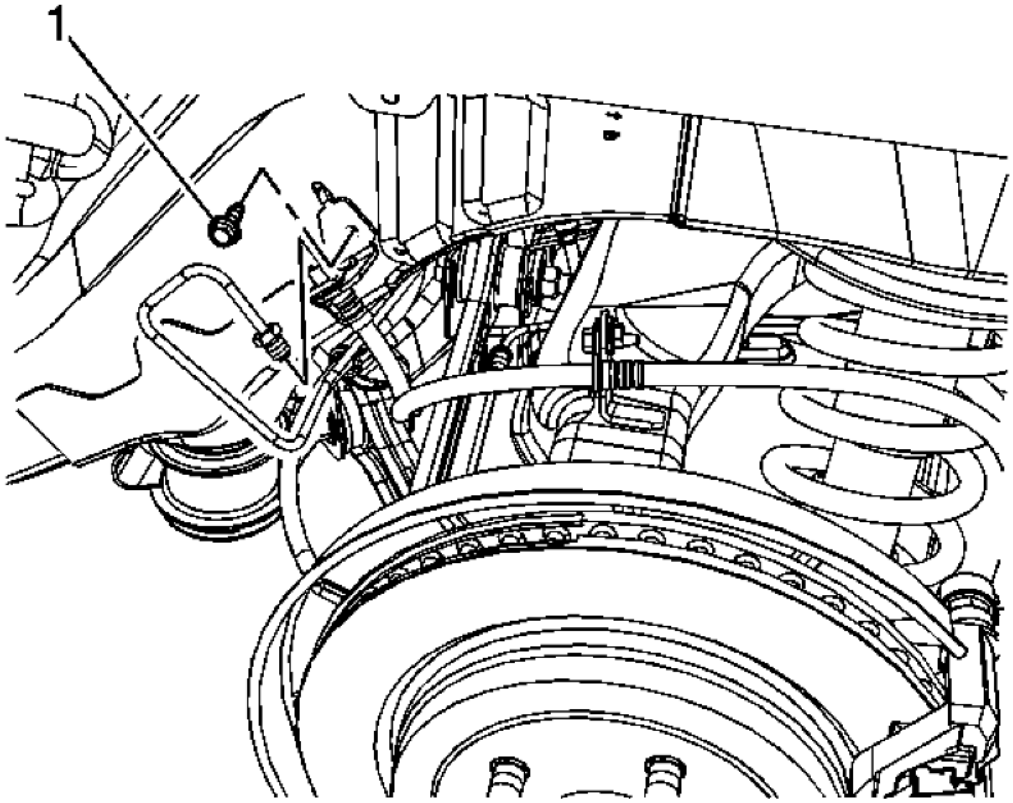


Fig. 61: Brake Hose Bracket Bolt At Wheelhouse Panel
Courtesy of GENERAL MOTORS CORP.

4. Install the brake hose bracket bolt (1) to the wheelhouse panel and tighten to 9 N.m (80 lb in).

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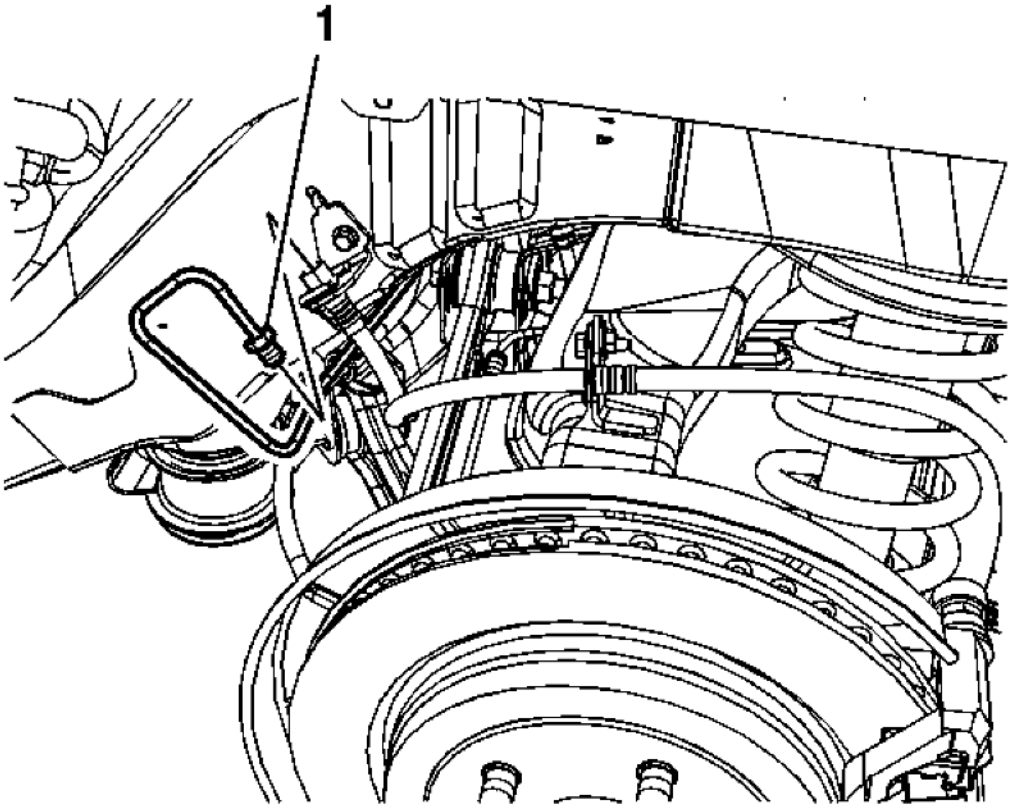


Fig. 62: Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

5. Connect the brake pipe fitting (1) and tighten to 16 N.m (12 lb ft).
6. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.
7. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .

REAR BRAKE HOSE REPLACEMENT (LS3, L99)

Removal Procedure

WARNING: Refer to Brake Dust Warning .

WARNING: Refer to Brake Fluid Irritant Warning .

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CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

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

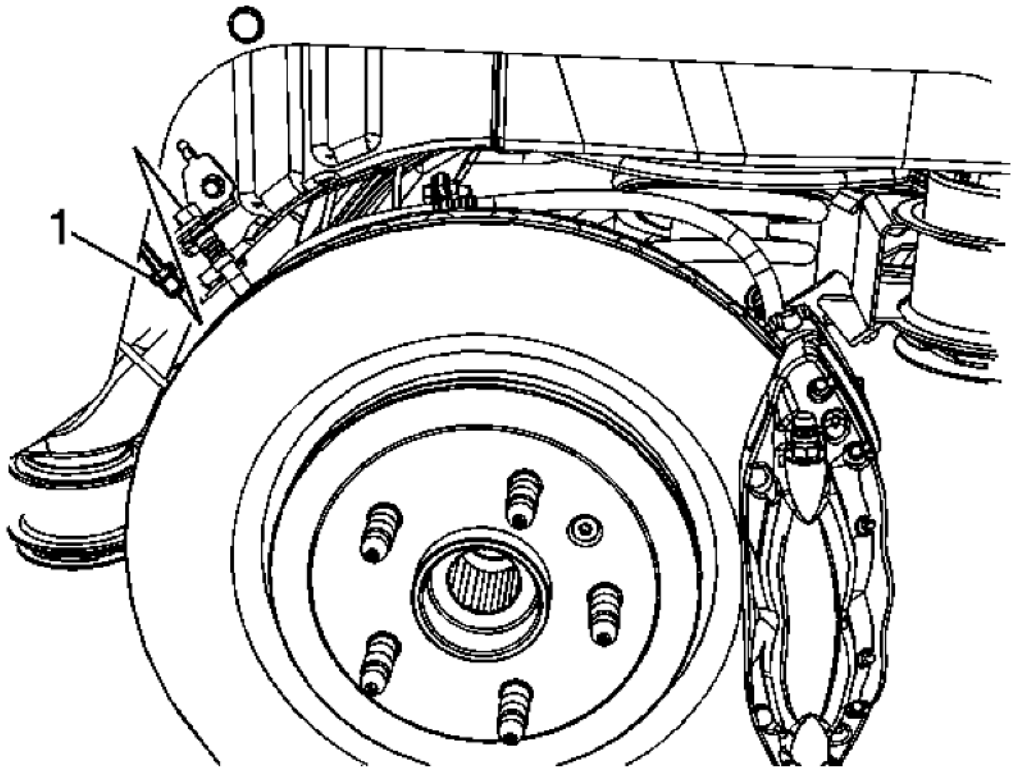


Fig. 63: Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

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

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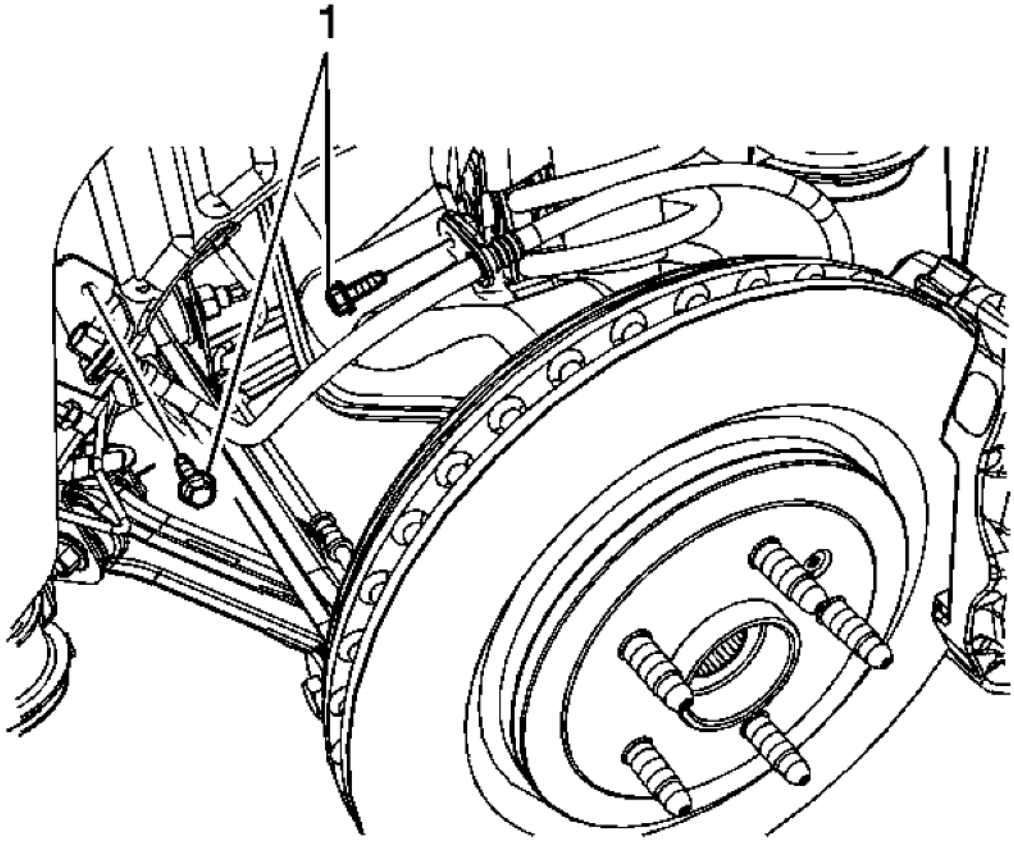


Fig. 64: Brake Hose Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the brake hose bracket bolts (1).

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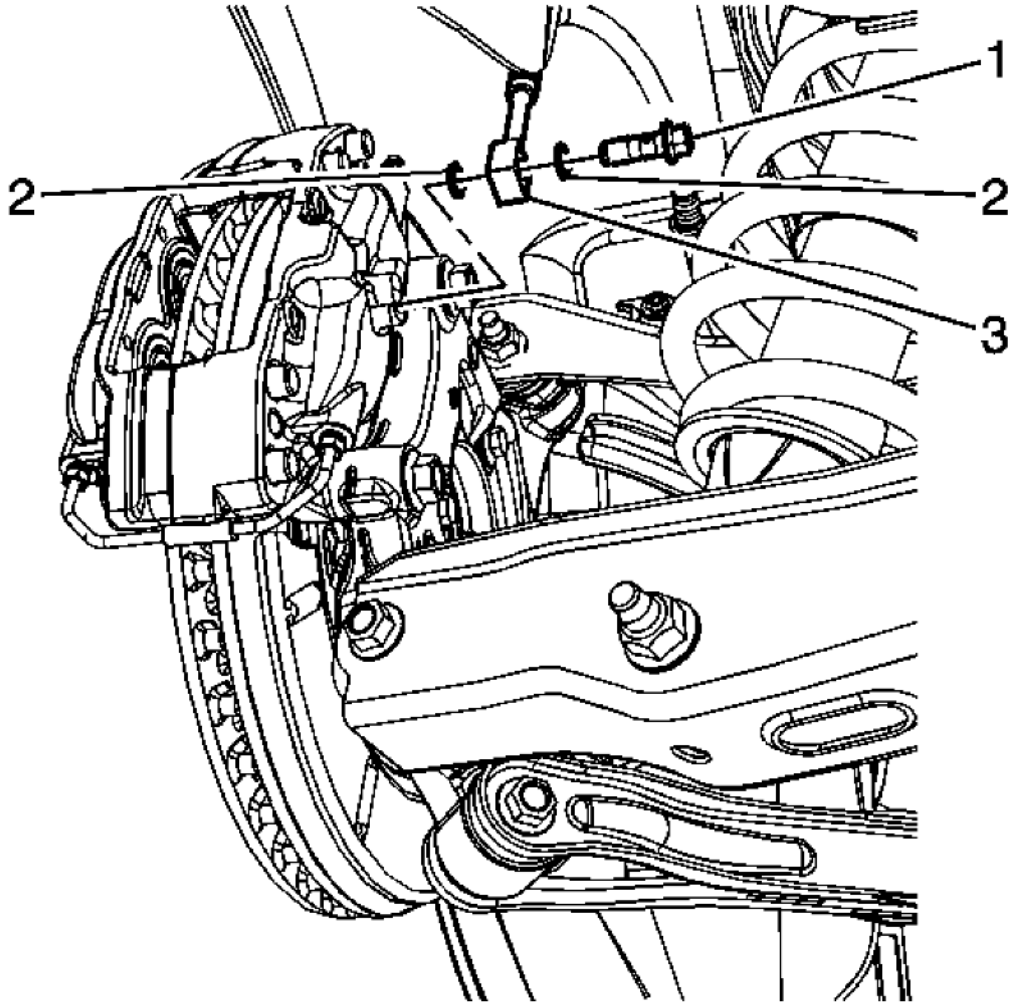


Fig. 65: Brake Hose, Fitting Bolt & Gaskets
Courtesy of GENERAL MOTORS CORP.

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

NOTE: Do not reuse the brake hose fitting gaskets.

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

Installation Procedure

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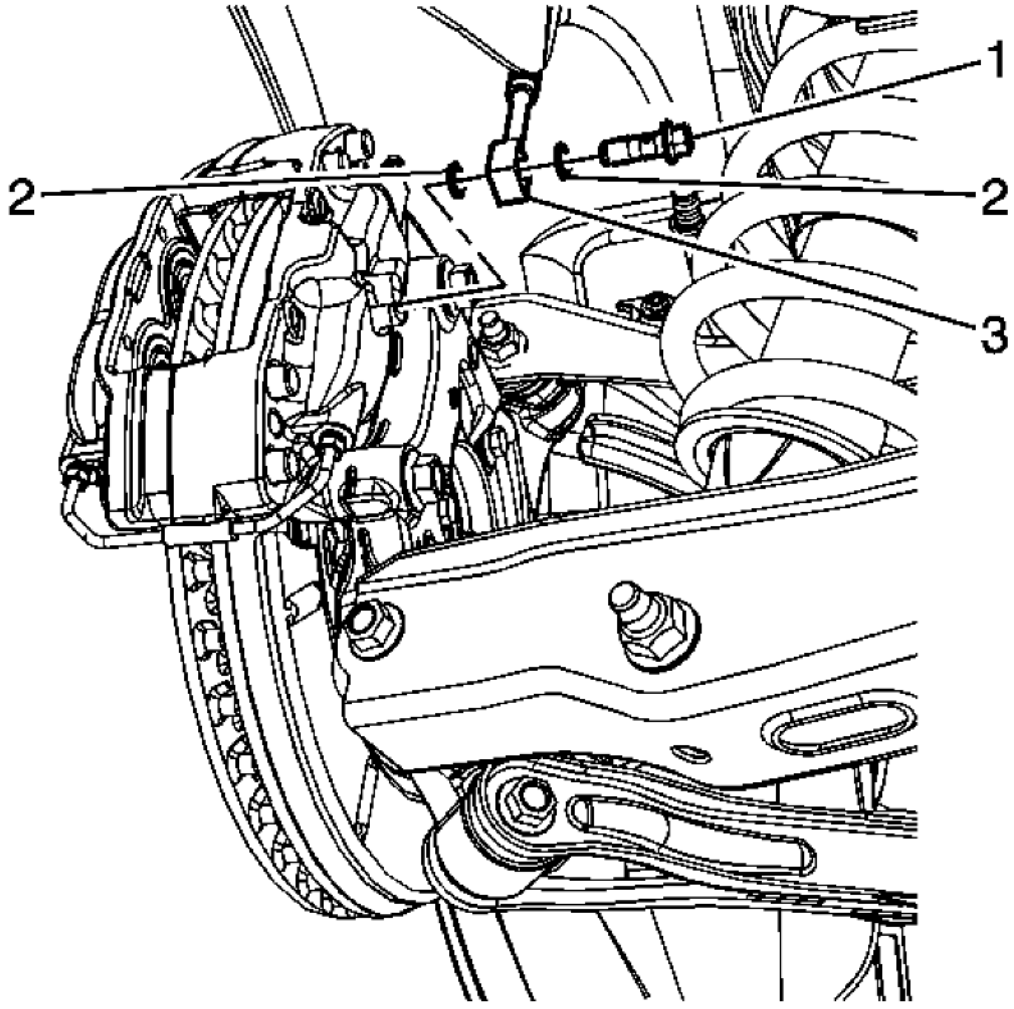


Fig. 66: Brake Hose, Fitting Bolt & Gaskets
Courtesy of GENERAL MOTORS CORP.

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

   CAUTION: Refer to Fastener Caution .

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

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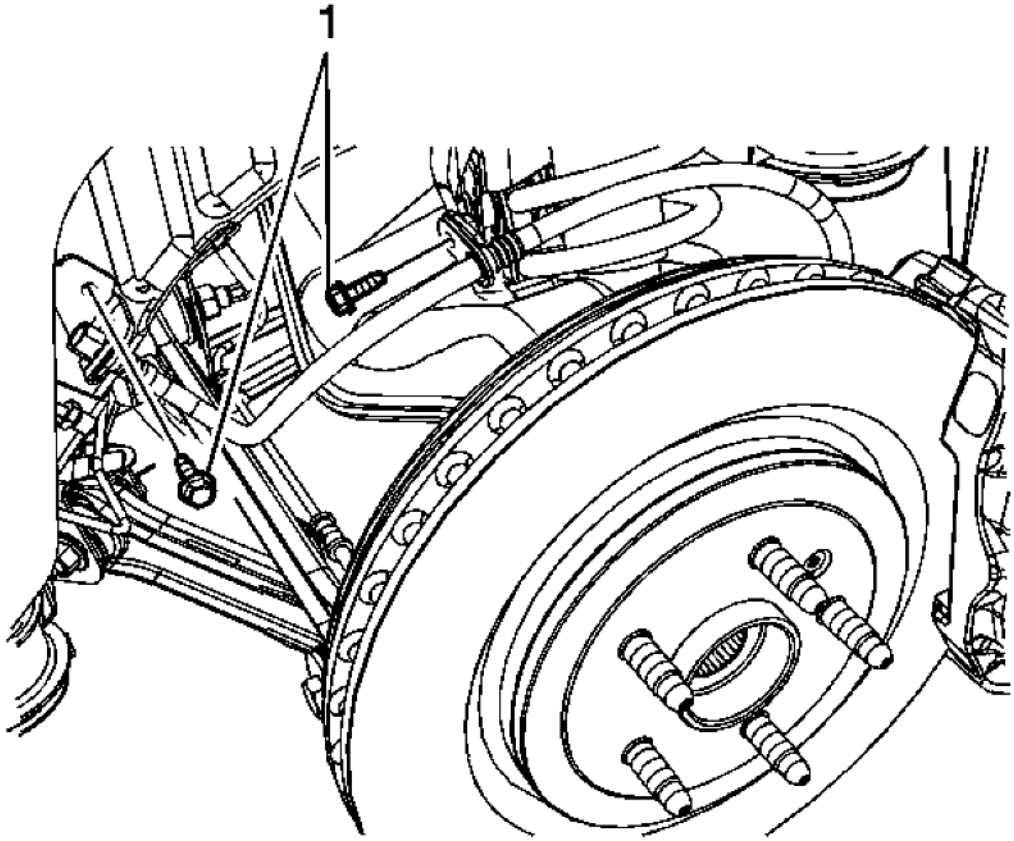


Fig. 67: Brake Hose Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

3. Install the brake hose bracket bolts (1) and tighten to 9 N.m (80 lb in).

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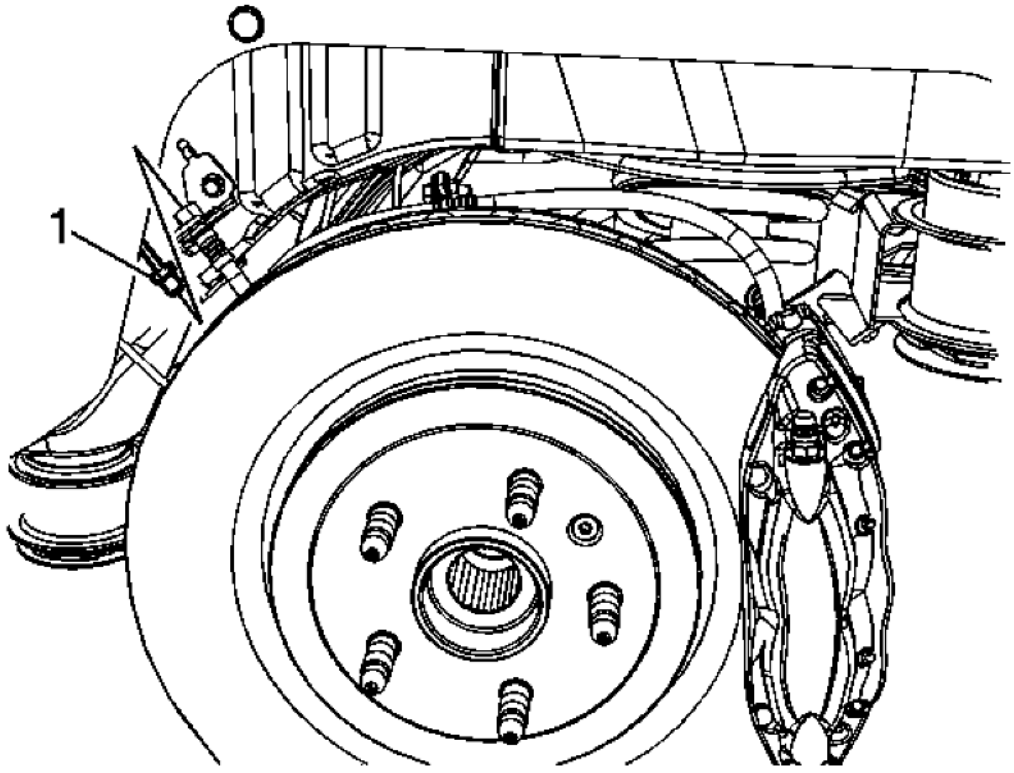


Fig. 68: Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

4. Connect the brake pipe fitting (1) and tighten to 16 N.m (12 lb ft).
5. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.
6. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .

HYDRAULIC BRAKE SYSTEM BLEEDING (MANUAL)

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

1. Place a clean shop cloth beneath the brake master cylinder to prevent brake fluid spills.

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

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

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

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

5. Install a proper box-end wrench onto the RIGHT REAR wheel hydraulic circuit, inboard (fixed caliper), bleeder valve.
6. Install a transparent hose over the end of the bleeder valve.
7. Submerge the open end of the transparent hose into a transparent container partially filled with GM approved brake fluid from a clean, sealed brake fluid container.
8. Have an assistant slowly depress the brake pedal fully and maintain steady pressure on the pedal.
9. Loosen the bleeder valve to purge air from the wheel hydraulic circuit.
10. Tighten the bleeder valve, then have the assistant slowly release the brake pedal.
11. Wait 15 seconds, then repeat steps 8-10 until all air is purged from the same wheel hydraulic circuit.
12. For fixed caliper models, repeat steps 5-11 for the outboard bleeder valve.
13. With the right rear wheel hydraulic circuit bleeder valve, or valves (fixed caliper), tightened securely -

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after all air has been purged from the right rear hydraulic circuit - install a proper box-end wrench onto the LEFT FRONT wheel hydraulic circuit, inner (fixed caliper), bleeder valve.

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

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

27. If the brake system warning lamp remains illuminated. Refer to **Symptoms - Hydraulic Brakes**.

HYDRAULIC BRAKE SYSTEM BLEEDING (PRESSURE)

Special Tools

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

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

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

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

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

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

5. Install the **J-35589-A:** Master Cylinder Bleeder Adapter to the brake master cylinder reservoir.
6. Check the brake fluid level in the **J-29532:** Diaphragm Type Brake Pressure Bleeder, or equivalent. Add GM approved brake fluid from a clean, sealed brake fluid container as necessary to bring the level to approximately the half-full point.
7. Connect the **J-29532:** Diaphragm Type Brake Pressure Bleeder, or equivalent, to the **J-35589-A:** Master Cylinder Bleeder Adapter.
8. Charge the **J-29532:** Diaphragm Type Brake Pressure Bleeder, or equivalent, air tank to 175-205 kPa (25-30 psi).
9. Open the **J-29532:** Diaphragm Type Brake Pressure Bleeder, or equivalent, fluid tank valve to allow pressurized brake fluid to enter the brake system.

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10. Wait approximately 30 seconds, then inspect the entire hydraulic brake system in order to ensure that there are no existing external brake fluid leaks.

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

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

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illuminated.

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

32. If the brake system warning lamp remains illuminated. Refer to **Symptoms - Hydraulic Brakes**.

HYDRAULIC BRAKE SYSTEM FLUSHING

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

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

      Refer to the procedures indicated:

      - **Master Cylinder Replacement**
      - **Front Brake Hose Replacement (LLT)Front Brake Hose Replacement (LS3, L99)**
      - **Rear Brake Hose Replacement (LLT)Rear Brake Hose Replacement (LS3, L99)**
      - **Front Brake Caliper Replacement (LLT) Front Brake Caliper Replacement (L99, LS3)**
      - **Rear Brake Caliper Replacement (LLT) Rear Brake Caliper Replacement (L99, LS3)**
      - **Brake Pressure Modulator Valve Replacement**
   2. Clean out all the hydraulic brake pipes using denatured alcohol, or equivalent.

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3. Dry the brake pipes using non-lubricated, filtered air.
4. Repair or replace ALL of the following components listed and install them to the vehicle. Each component contains internal rubber seals/linings which have been contaminated by the contaminated brake fluid in the brake hydraulic system.

   Refer to the procedures indicated:

   - **Master Cylinder Replacement** -Also perform the following:

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

     Replace the brake master cylinder reservoir cap diaphragm.

   - **Front Brake Hose Replacement (LLT)Front Brake Hose Replacement (LS3, L99)**
   - **Rear Brake Hose Replacement (LLT)Rear Brake Hose Replacement (LS3, L99)**
   - **Front Brake Caliper Overhaul (LLT)** **Front Brake Caliper Overhaul (L99, LS3)** or **Front Brake Caliper Replacement (LLT)** **Front Brake Caliper Replacement (L99, LS3)**
   - **Rear Brake Caliper Overhaul (LLT)** **Rear Brake Caliper Overhaul (L99, LS3)** or **Rear Brake Caliper Replacement (LLT)** **Rear Brake Caliper Replacement (L99, LS3)**
   - **Brake Pressure Modulator Valve Replacement**

4. If the brake fluid was NOT contaminated with an oil-based or a silicone-based substance, but WAS contaminated with water or dirt, rust, corrosion, and/or brake dust, replace the brake master cylinder reservoir cap diaphragm which may have allowed the moisture or particles to enter the hydraulic system.
5. Fill the brake master cylinder reservoir to the maximum-fill level with GM approved brake fluid from a clean, sealed brake fluid container.
6. Pressure bleed the hydraulic brake system; begin the procedure with the pressure bleeder reservoir filled to the maximum-fill level with the correct brake fluid as indicated. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.

POWER VACUUM BRAKE BOOSTER REPLACEMENT

Removal Procedure

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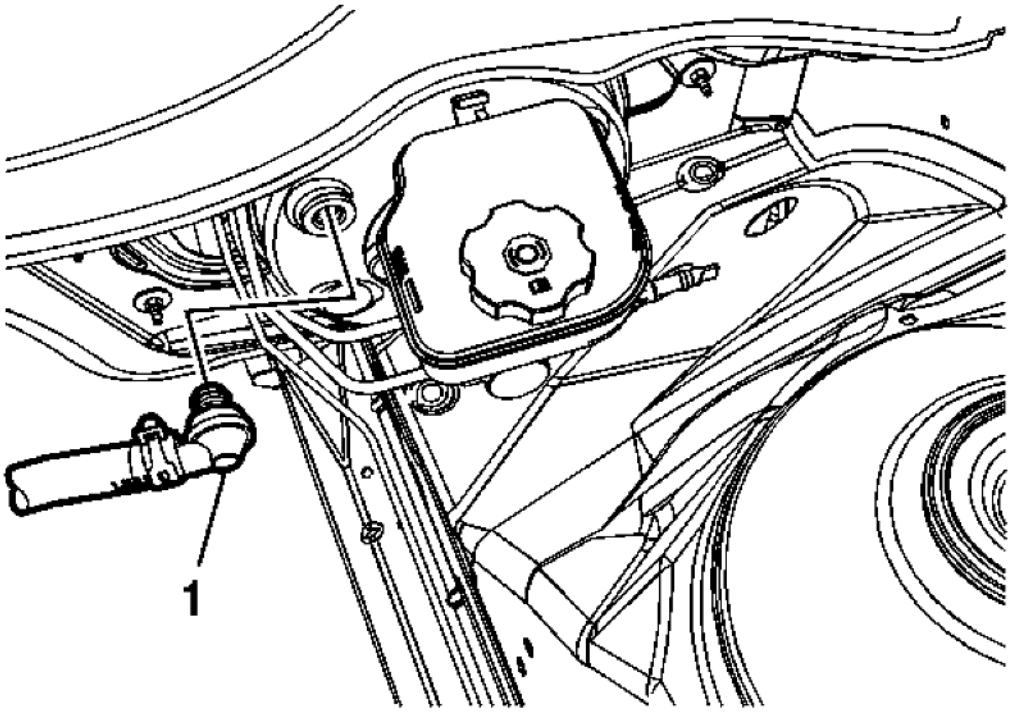


Fig. 69: Power Vacuum Brake Booster Check Valve & Hose Assembly
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the power brake booster vacuum sensor electrical connector, if equipped.
2. Disconnect the power vacuum brake booster check valve (1) and hose assembly.
3. Position the check valve and hose aside.
4. Remove the master cylinder. Refer to **Master Cylinder Replacement**.

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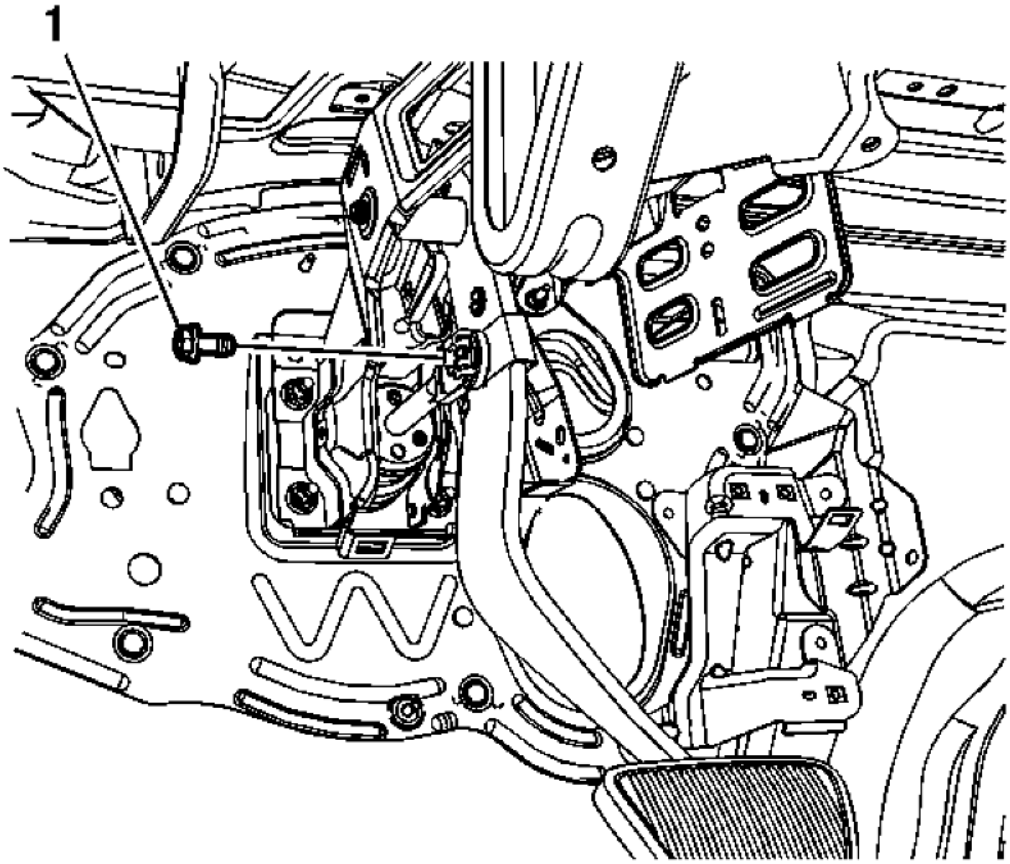


Fig. 70: Power Brake Booster Pushrod Retainer Bolt
Courtesy of GENERAL MOTORS CORP.

5. Remove the brake booster pushrod retainer bolt (1).

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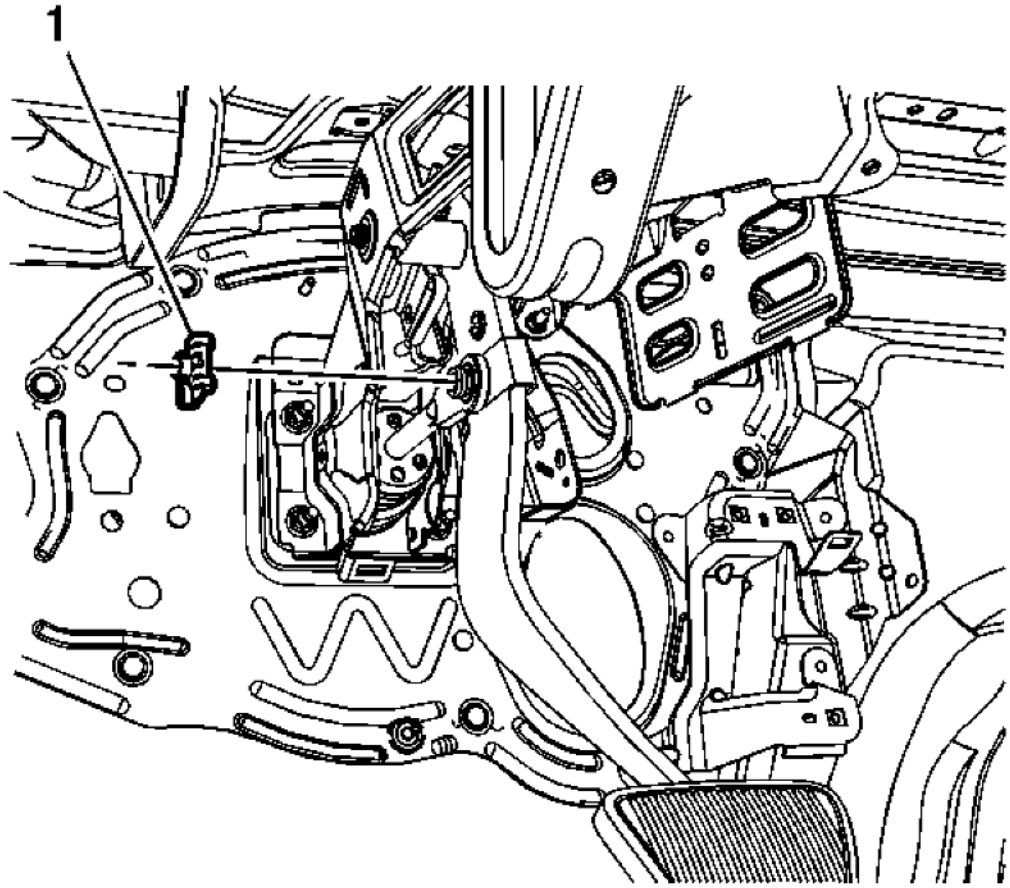


Fig. 71: Power Brake Booster Pushrod Retainer
Courtesy of GENERAL MOTORS CORP.

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

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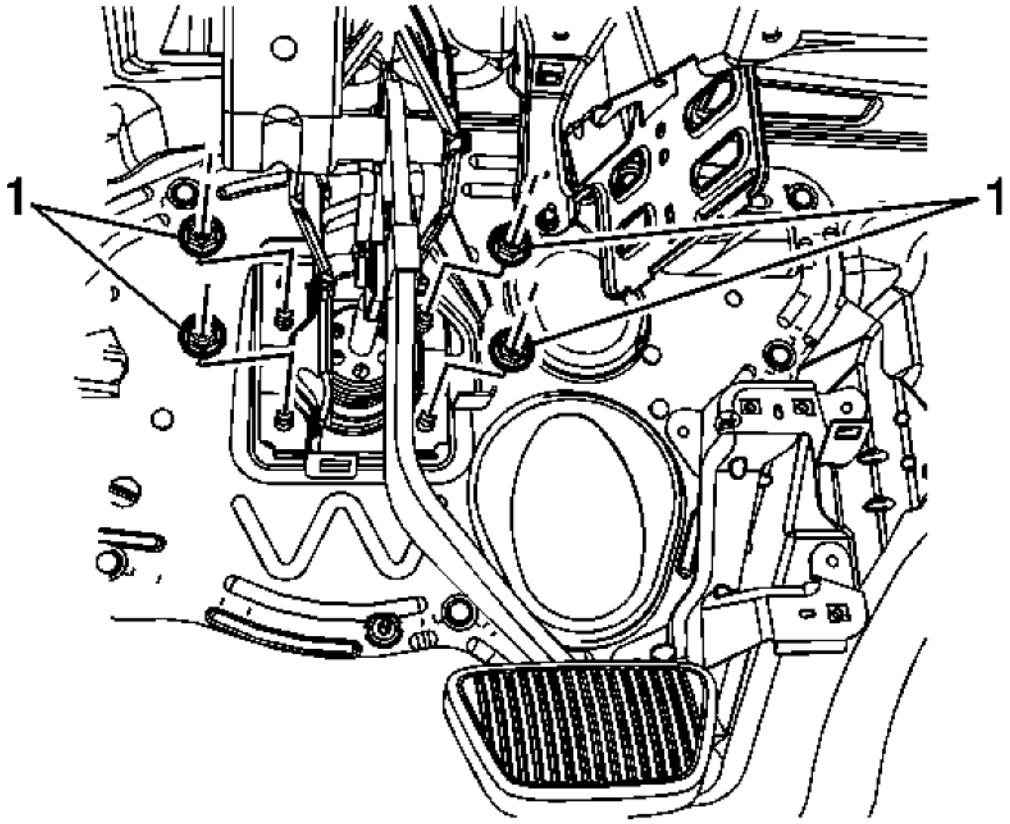


Fig. 72: Brake Pedal Assembly Nuts
Courtesy of GENERAL MOTORS CORP.

7. Remove the brake pedal assembly nuts (1).
8. Disconnect the brake booster pushrod from the brake pedal pivot pin.
9. Remove the power vacuum brake booster from the vehicle.

Installation Procedure

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

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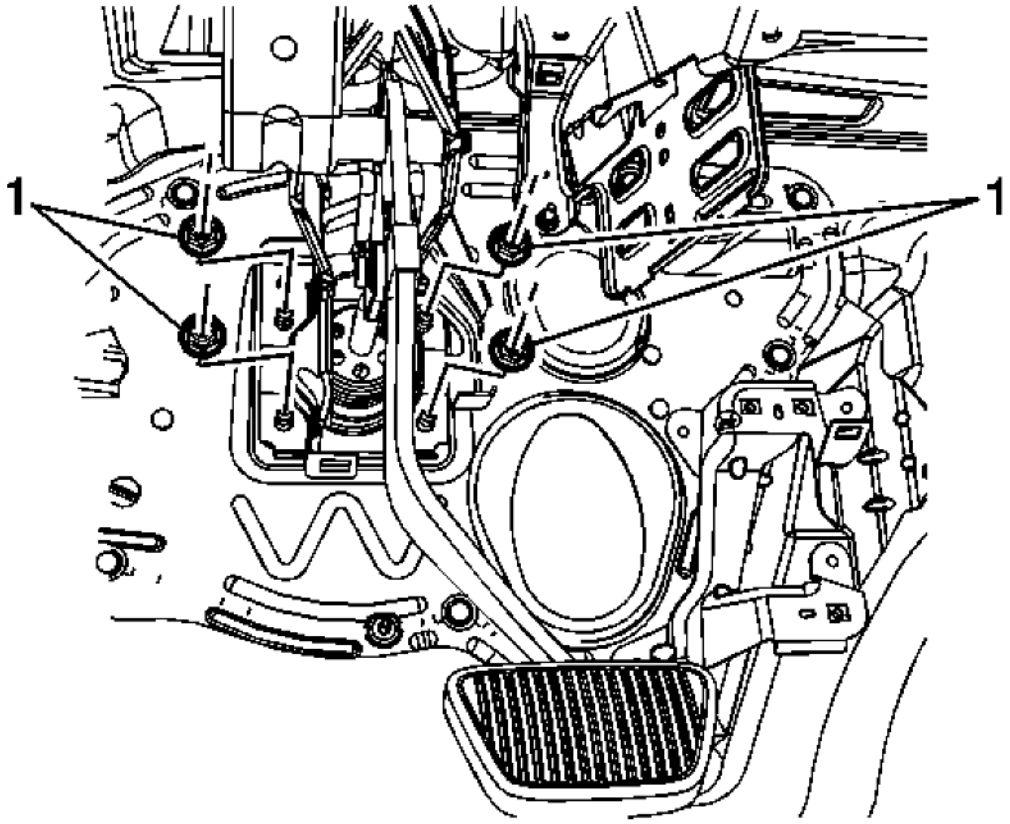


Fig. 73: Brake Pedal Assembly Nuts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

2. Install the brake pedal assembly nuts (1) and tighten to 17 N.m (13 lb ft).
3. Connect the brake booster pushrod to the brake pedal pivot pin.

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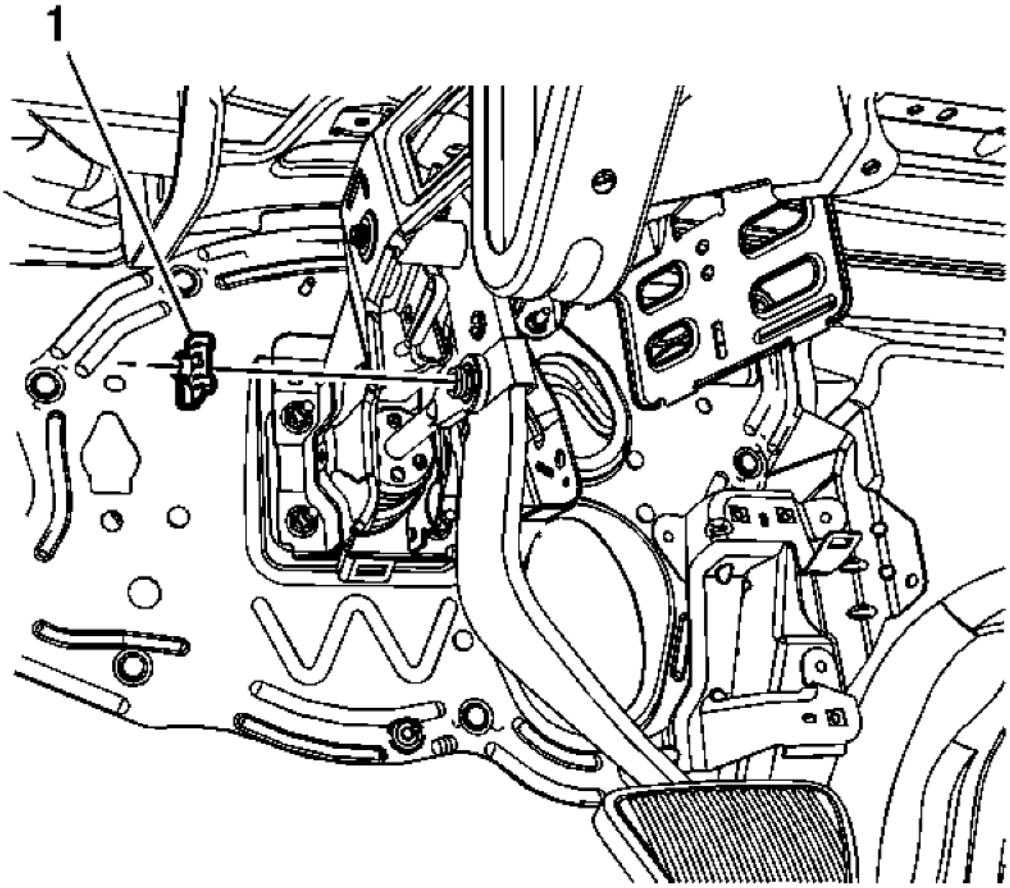


Fig. 74: Power Brake Booster Pushrod Retainer
Courtesy of GENERAL MOTORS CORP.

4. Install the brake booster pushrod retainer (1).

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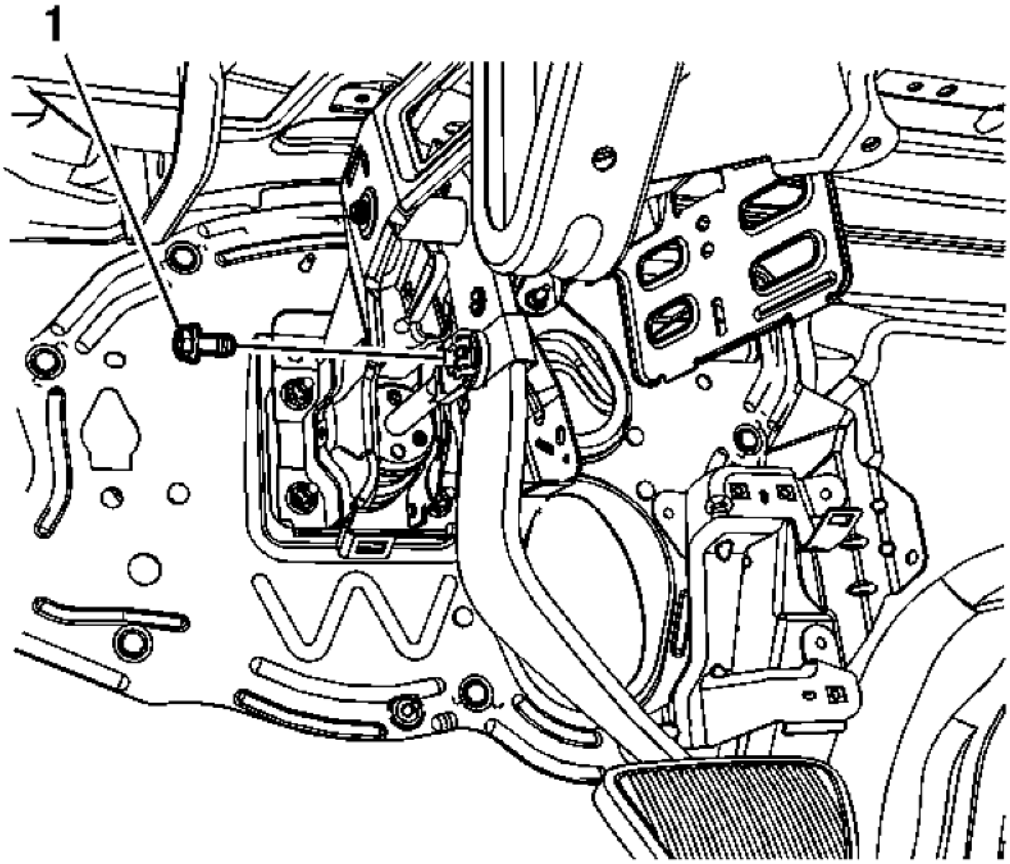


Fig. 75: Power Brake Booster Pushrod Retainer Bolt
Courtesy of GENERAL MOTORS CORP.

5. Install the brake booster pushrod retainer bolt (1) and tighten to 9 N.m (80 lb in).

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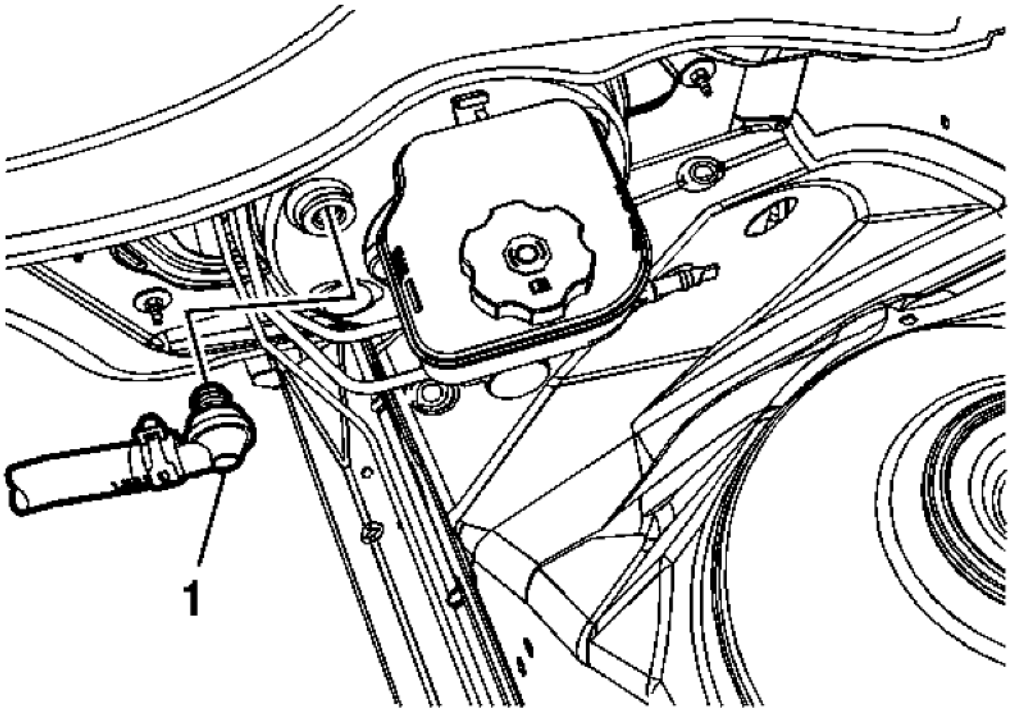


Fig. 76: Power Vacuum Brake Booster Check Valve & Hose Assembly
Courtesy of GENERAL MOTORS CORP.

6. Connect the power vacuum brake booster check valve (1) and hose assembly.
7. Connect the power brake booster vacuum sensor electrical connector, if equipped.
8. Install the master cylinder. Refer to **Master Cylinder Replacement**.

POWER BRAKE BOOSTER VACUUM CHECK VALVE AND HOSE REPLACEMENT (LLT)

Removal Procedure

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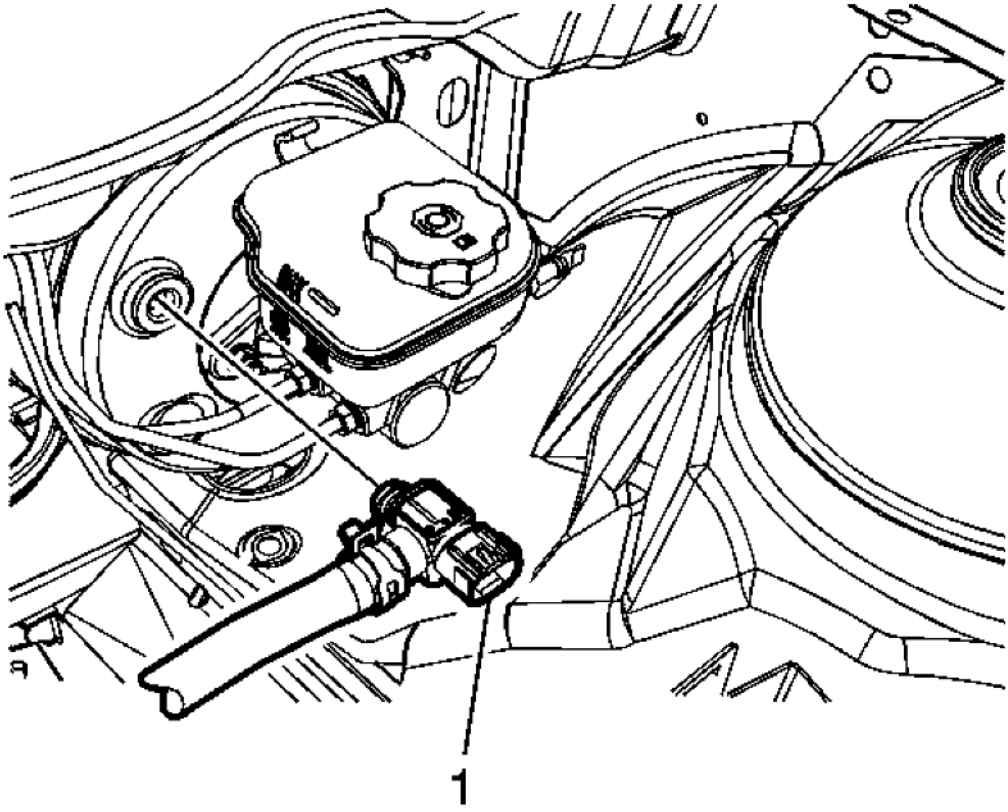


Fig. 77: Check Valve
Courtesy of GENERAL MOTORS CORP.

1. Apply the brake pedal several times until the pedal becomes firm to deplete the vacuum reserve in the brake booster.
2. Remove the rear intake manifold cover. Refer to **Intake Manifold Cover Replacement - Rear** .
3. Disconnect the power brake booster vacuum sensor electrical connector.
4. Remove the check valve (1) from the vacuum brake booster.

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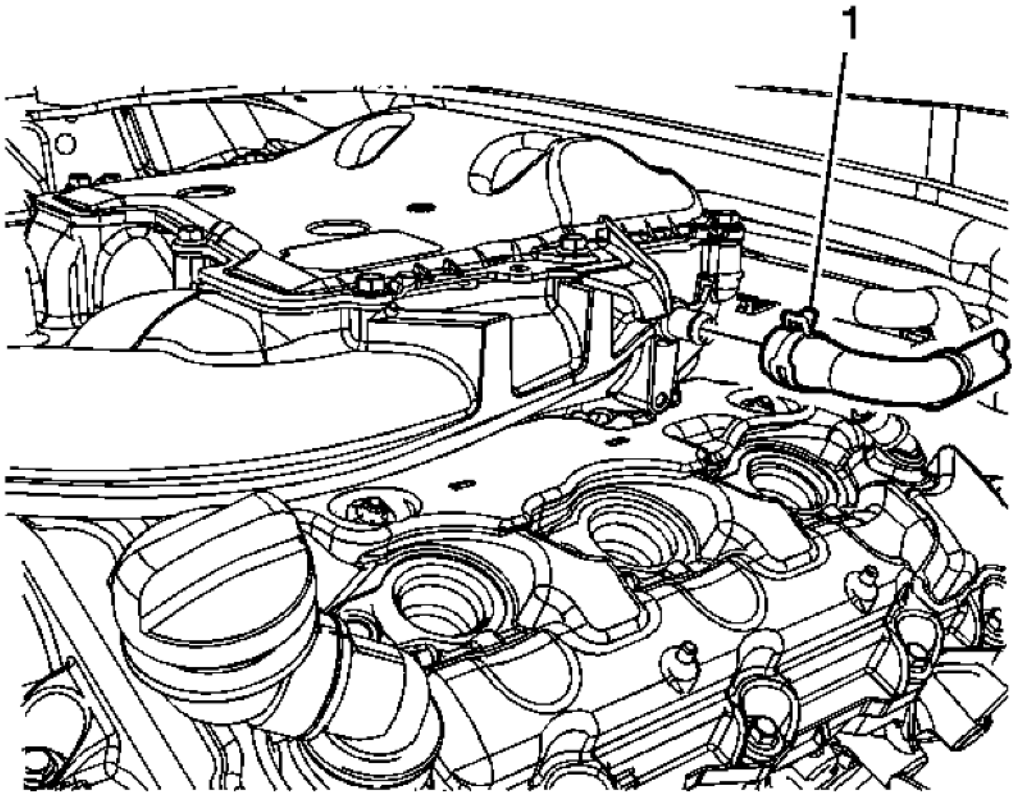


Fig. 78: Power Brake Booster Vacuum Hose At Vacuum Port On LH Side Of Intake Manifold
Courtesy of GENERAL MOTORS CORP.

5. Release the clamp and remove the power brake booster vacuum hose (1) from the vacuum port on the LH side of the intake manifold.

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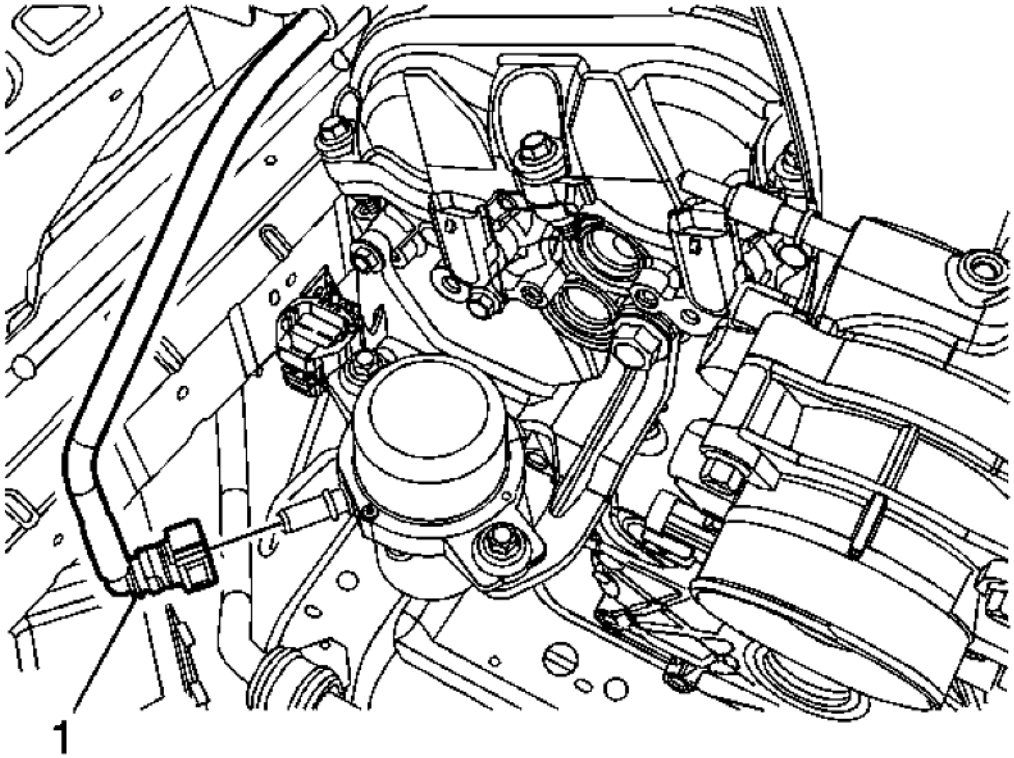


Fig. 79: Power Brake Booster Vacuum Hose Quick Connect At Power Brake Booster Vacuum Pump
Courtesy of GENERAL MOTORS CORP.

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

   Remove the power brake booster vacuum hose and check valve assembly from the vehicle.

7. Remove the check valve from the vacuum brake booster hose, if necessary.

Installation Procedure

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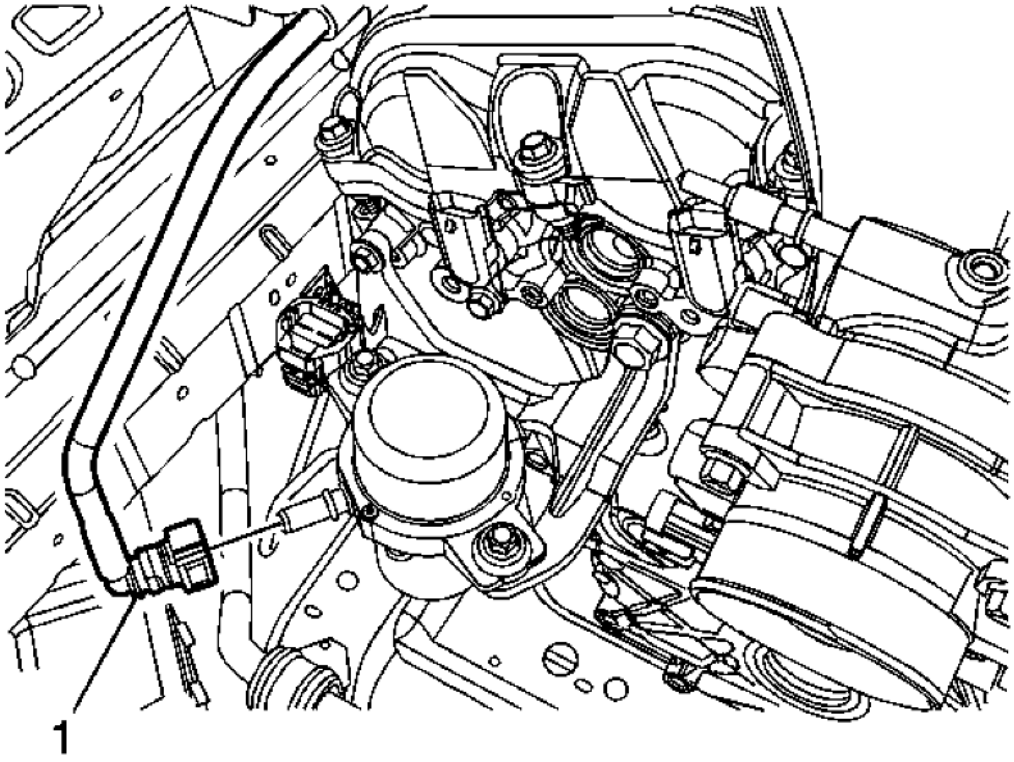


Fig. 80: Power Brake Booster Vacuum Hose Quick Connect At Power Brake Booster Vacuum Pump
Courtesy of GENERAL MOTORS CORP.

1. Install the check valve to the vacuum brake booster hose, if removed.
2. Install the power brake booster vacuum hose and check valve assembly to the vehicle.
3. Connect the power brake booster vacuum hose quick connect (1) to the power brake booster vacuum pump.

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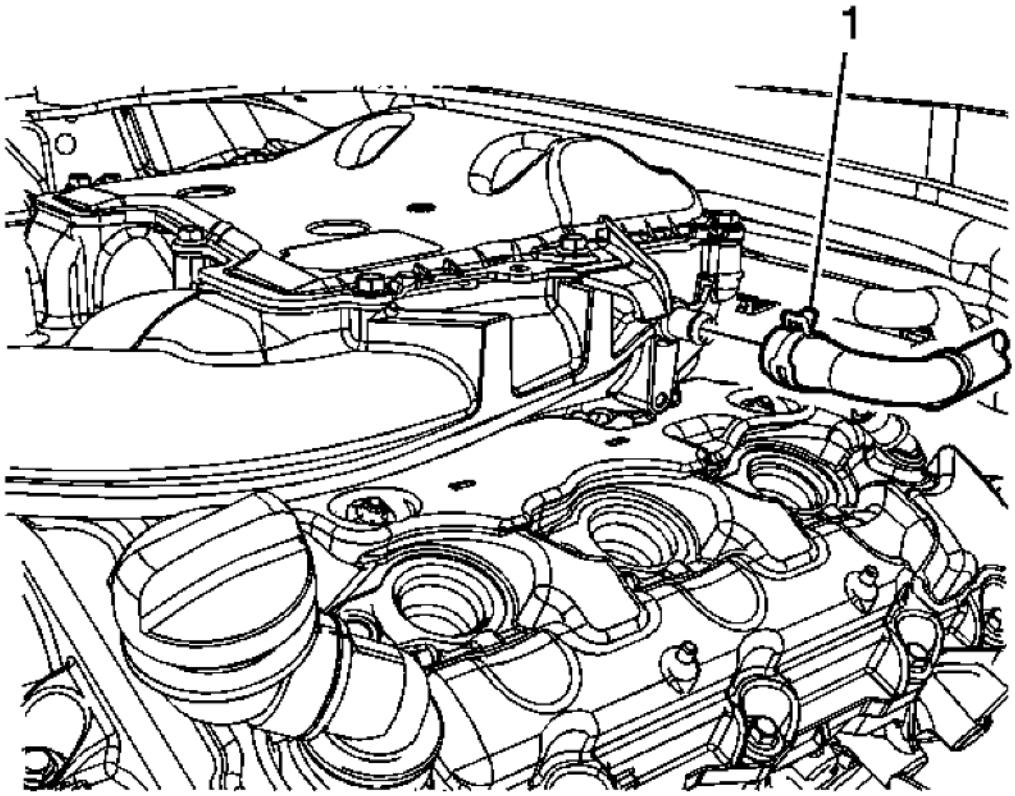


Fig. 81: Power Brake Booster Vacuum Hose At Vacuum Port On LH Side Of Intake Manifold
Courtesy of GENERAL MOTORS CORP.

4. Install the power brake booster vacuum hose (1) to the vacuum port on the LH side of the intake manifold.

   Position the clamp and secure the hose to the vacuum port.

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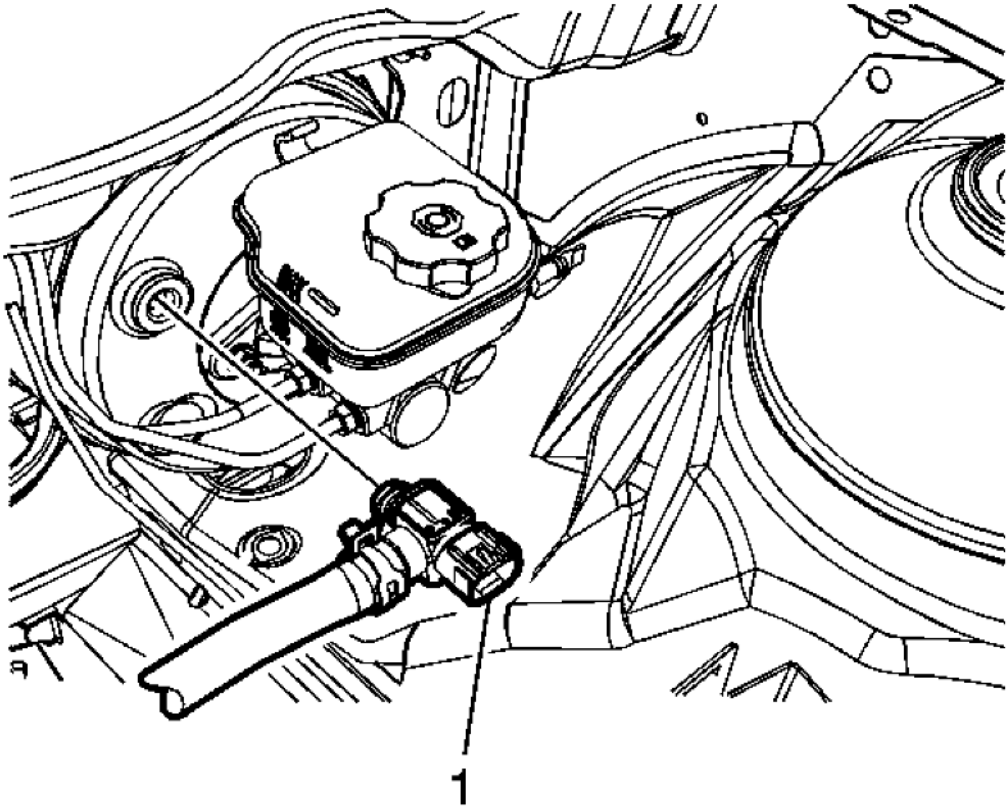


Fig. 82: Check Valve
Courtesy of GENERAL MOTORS CORP.

5. Install the check valve (1) and hose assembly to the vacuum brake booster.

   If necessary, a small amount of denatured alcohol may be used as a lubricant for assembly. Do not use soap.

6. Connect the power brake booster vacuum sensor electrical connector.
7. Install the rear intake manifold cover. Refer to **Intake Manifold Cover Replacement - Rear** .

POWER BRAKE BOOSTER VACUUM CHECK VALVE AND HOSE REPLACEMENT (L99, LS3)

Removal Procedure

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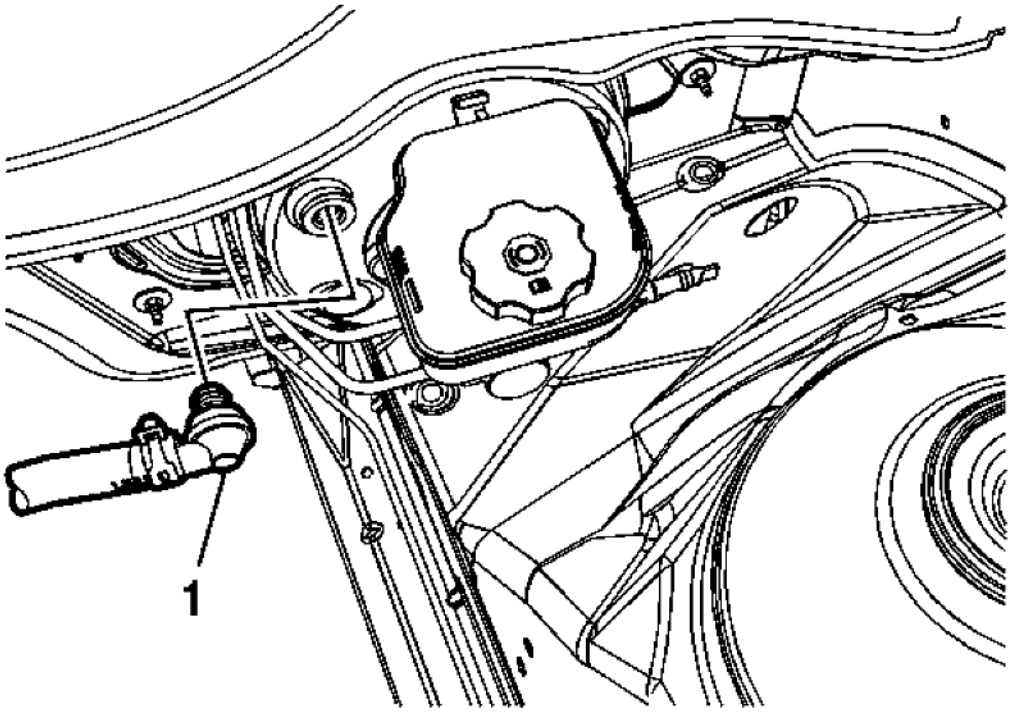


Fig. 83: Power Vacuum Brake Booster Check Valve & Hose Assembly
Courtesy of GENERAL MOTORS CORP.

1. Apply the brake pedal several times until the pedal becomes firm to deplete the vacuum reserve in the brake booster.
2. Remove the engine cover. Refer to **Engine Cover Replacement** .
3. Remove the check valve (1) from the vacuum brake booster.

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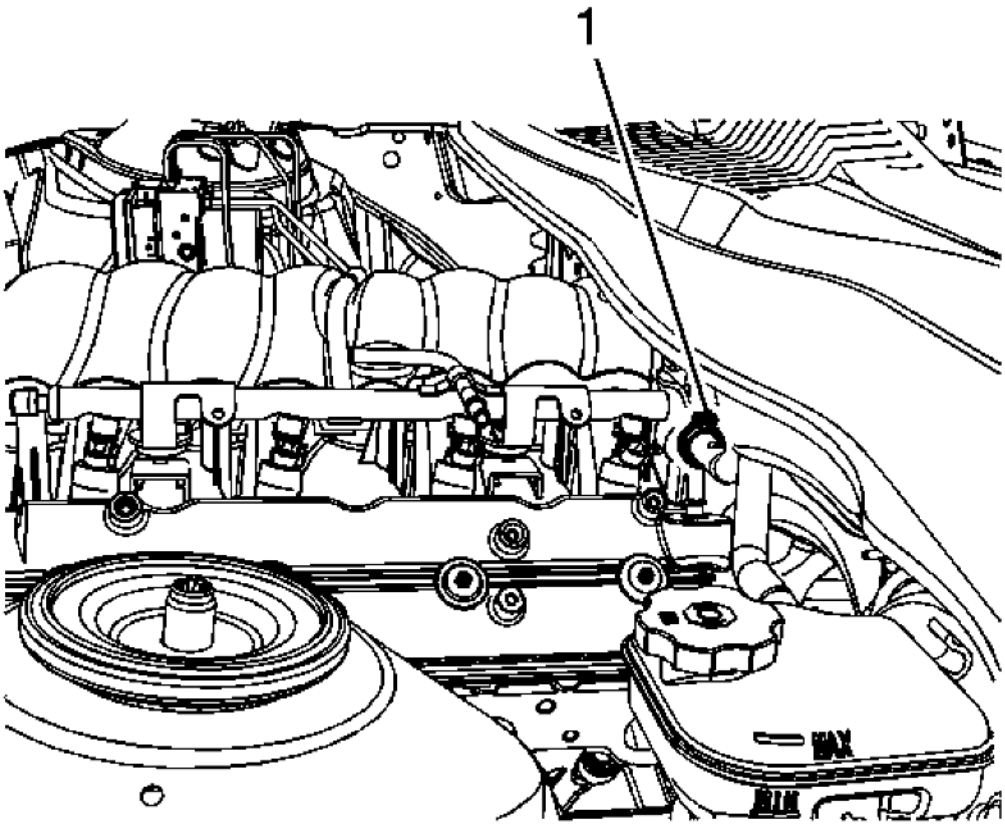


Fig. 84: Power Brake Booster Vacuum Hose
Courtesy of GENERAL MOTORS CORP.

4. Release the clamp and remove the power brake booster vacuum hose (1) from the vacuum port on the LH side of the intake manifold.

   Remove the power brake booster vacuum check valve and hose assembly from the vehicle.

5. Release the clamp and remove the check valve, if necessary.

Installation Procedure

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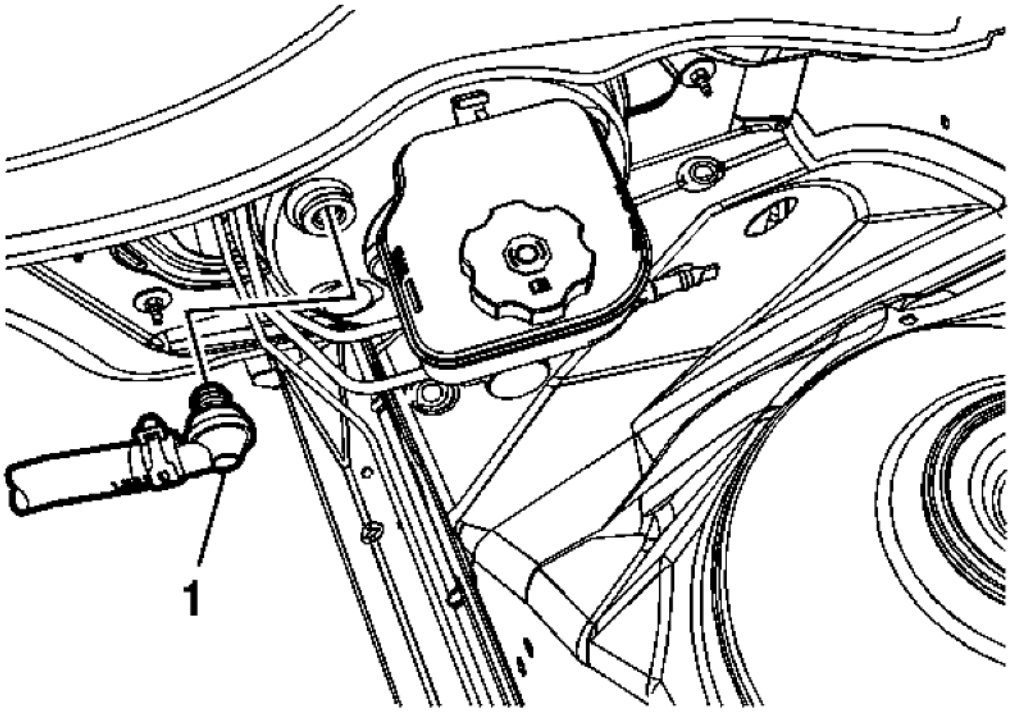


Fig. 85: Power Vacuum Brake Booster Check Valve & Hose Assembly
Courtesy of GENERAL MOTORS CORP.

1. Install the check valve to the vacuum brake booster hose, if removed.

   If necessary, a small amount of denatured alcohol may be used as a lubricant for assembly. Do not use soap.

2. Position the clamp and secure the vacuum hose to the check valve.

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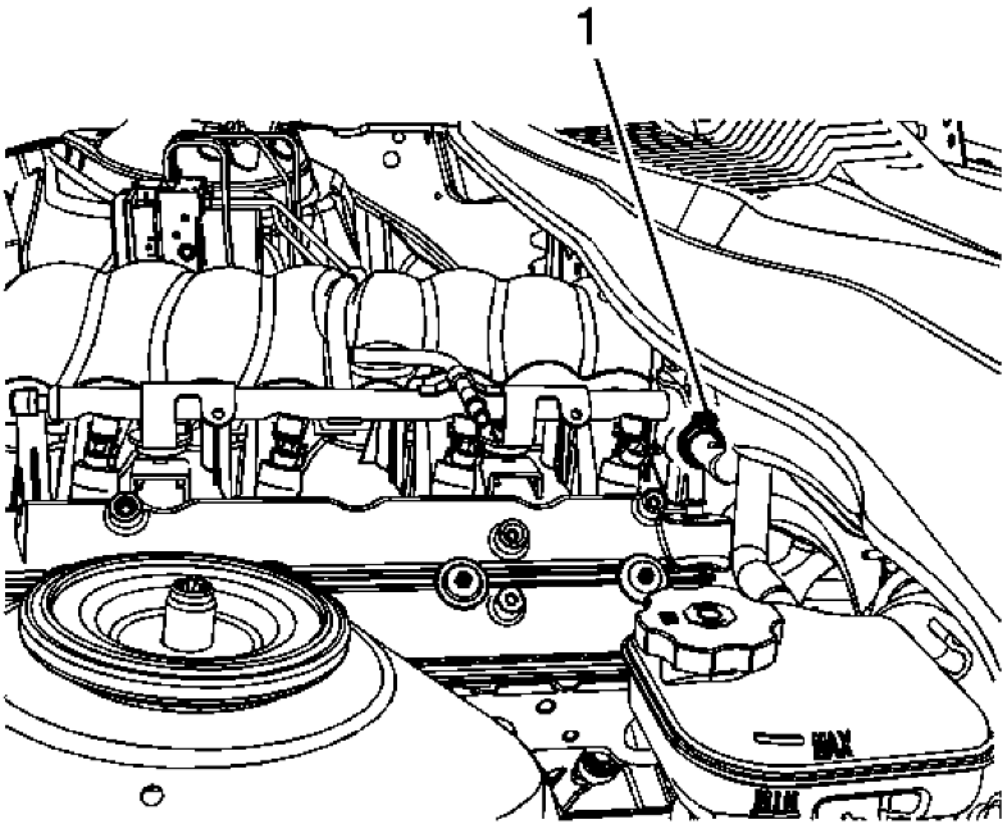


Fig. 86: Power Brake Booster Vacuum Hose
Courtesy of GENERAL MOTORS CORP.

3. Install the power brake booster vacuum hose (1) to the vacuum port on the LH side of the intake manifold.

   Position the clamp and secure the vacuum hose to the vacuum port.

4. Install the engine cover. Refer to **Engine Cover Replacement** .

POWER BRAKE BOOSTER VACUUM SENSOR REPLACEMENT

Removal Procedure

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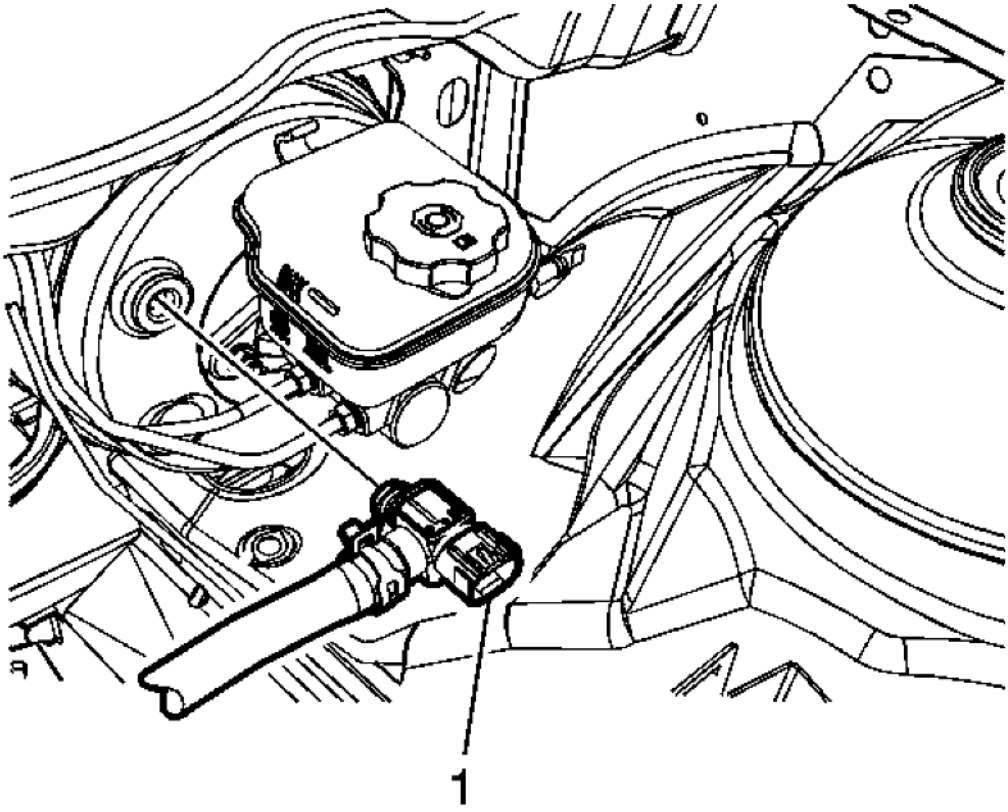


Fig. 87: Check Valve
Courtesy of GENERAL MOTORS CORP.

1. Apply the brake pedal several times until the pedal becomes firm to deplete the vacuum reserve in the brake booster.
2. Disconnect the power brake booster vacuum sensor electrical connector.
3. Remove the power brake booster vacuum sensor and check valve assembly (1) from the vacuum brake booster.
4. Release the clamp and remove the power brake booster vacuum sensor and check valve assembly from the vacuum hose.

Installation Procedure

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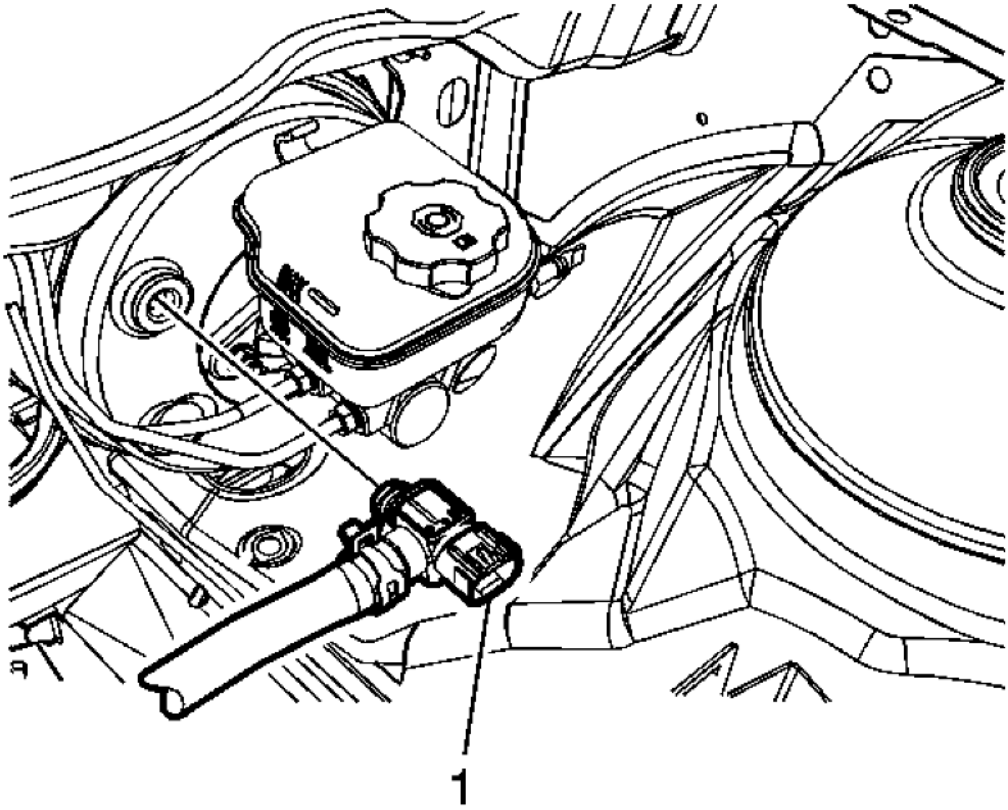


Fig. 88: Check Valve
Courtesy of GENERAL MOTORS CORP.

1. Install the power brake booster vacuum sensor and check valve assembly to the vacuum hose.

   If necessary, a small amount of denatured alcohol may be used as a lubricant for assembly. Do not use soap.

2. Position the clamp to the vacuum hose.
3. Install the vacuum sensor and check valve assembly (1) to the vacuum brake booster.
4. Connect the power brake booster vacuum sensor electrical connector.

POWER BRAKE BOOSTER AUXILIARY PUMP REPLACEMENT

Removal Procedure

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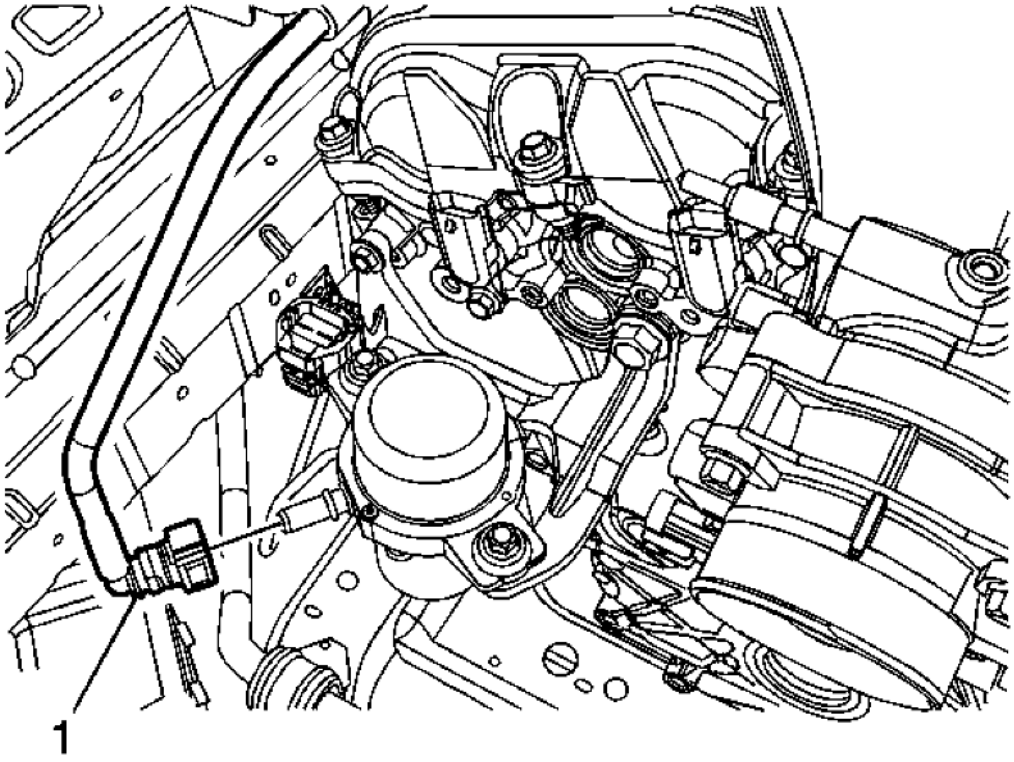


Fig. 89: Power Brake Booster Vacuum Hose Quick Connect At Power Brake Booster Vacuum Pump
Courtesy of GENERAL MOTORS CORP.

1. Remove the air cleaner resonator and outlet duct. Refer to **Air Cleaner Resonator and Outlet Duct Replacement** .
2. Release the power brake booster vacuum pump hose quick connect (1).
3. Disconnect the power brake booster vacuum pump hose from the auxiliary pump.
4. Disconnect the power brake booster vacuum pump electrical connector.

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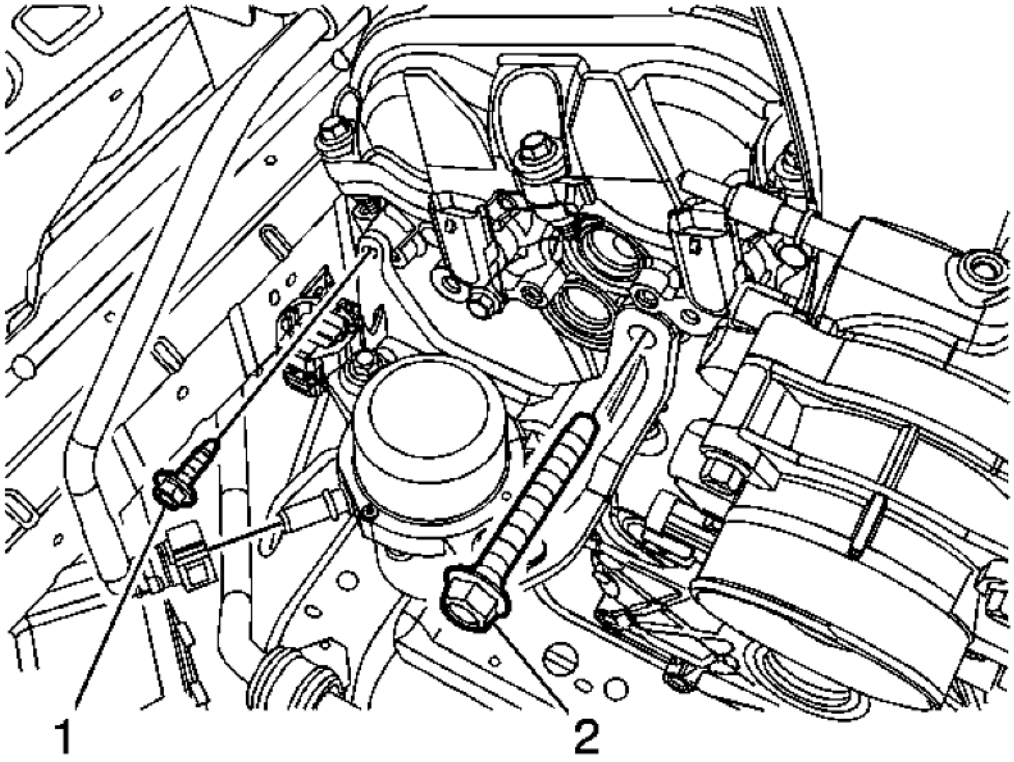


Fig. 90: Power Brake Booster Vacuum Pump Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the power brake booster vacuum pump bracket M6 bolt (1).
6. Remove the power brake booster vacuum pump bracket M12 bolt (2).
7. Remove the power brake booster vacuum pump from the engine.

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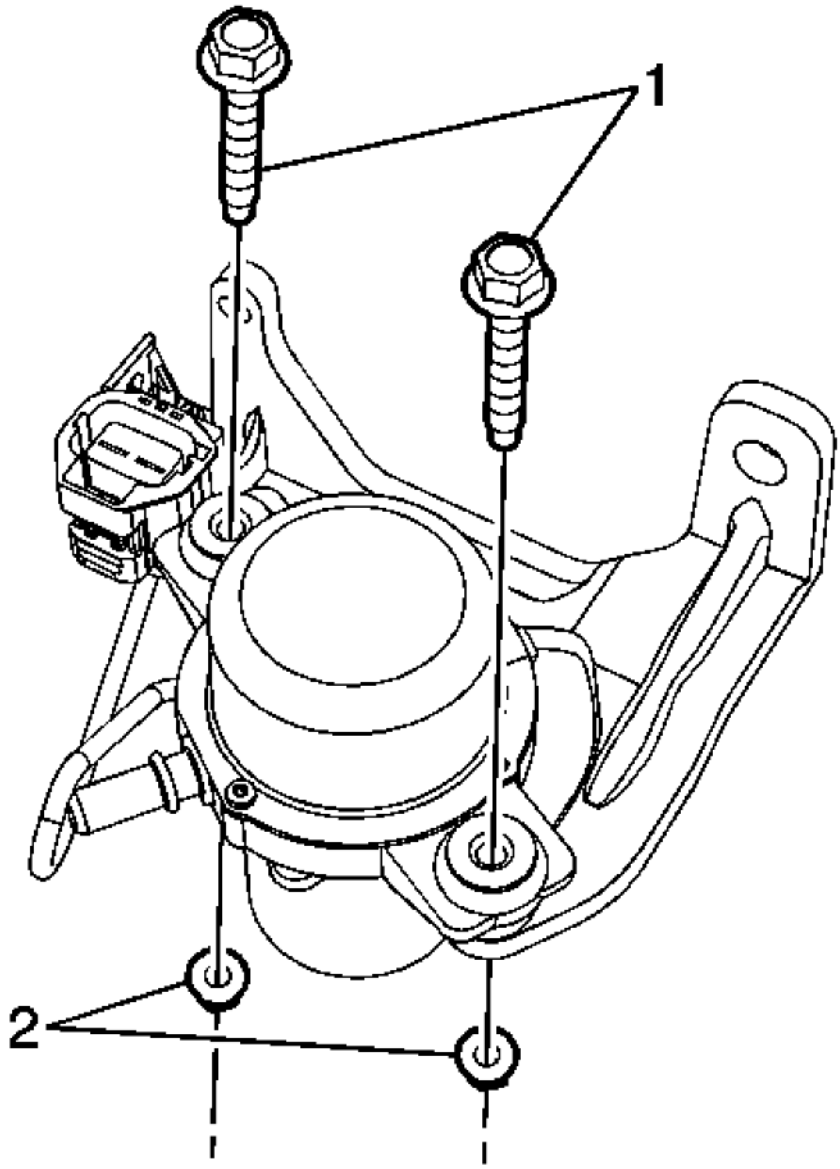


Fig. 91: Power Brake Booster Vacuum Pump Bolts & Nuts
Courtesy of GENERAL MOTORS CORP.

8. Remove the power brake booster vacuum pump bolts (1) and nuts (2).
9. Release the power brake booster vacuum pump electrical harness connector retainer from the bracket.

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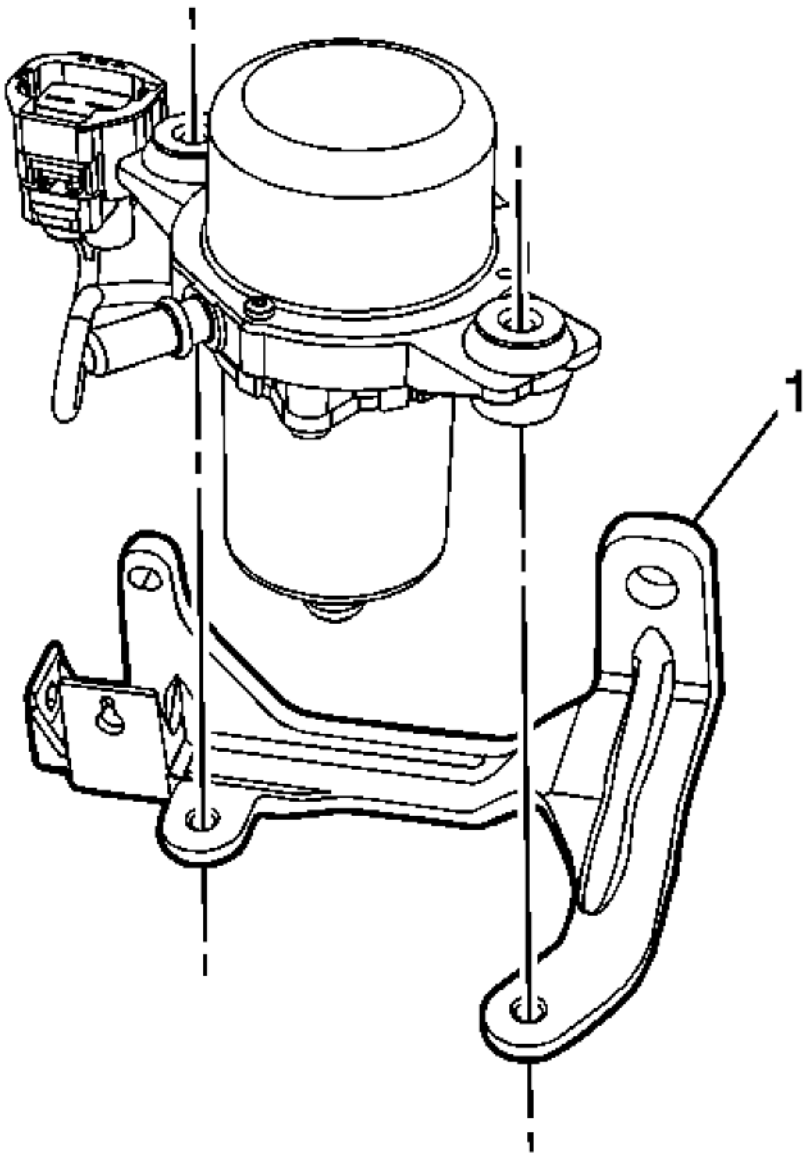


Fig. 92: Power Brake Booster Vacuum Pump Bracket
Courtesy of GENERAL MOTORS CORP.

10. Remove the power brake booster vacuum pump bracket (1).

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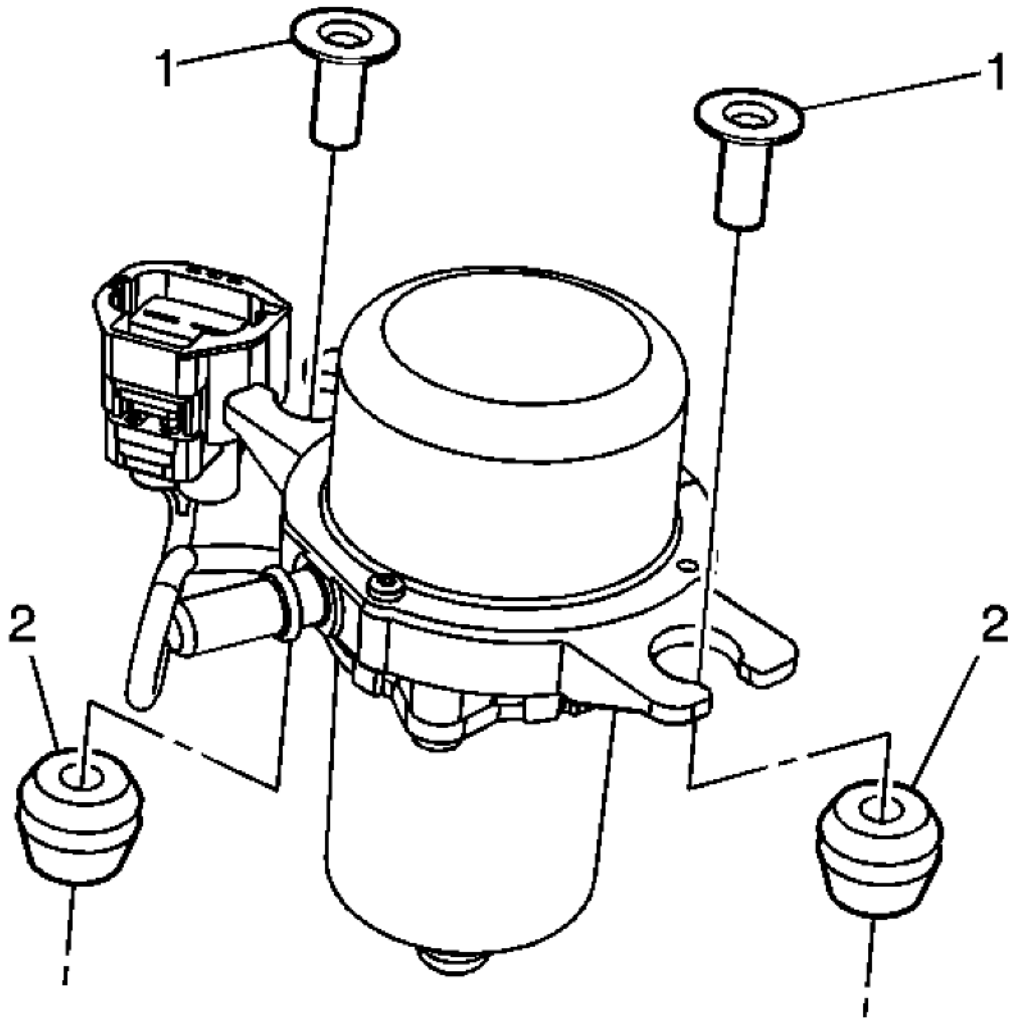


Fig. 93: Power Brake Booster Vacuum Pump Insulators & Sleeves
Courtesy of GENERAL MOTORS CORP.

11. Remove the power brake booster vacuum pump insulator sleeves (1).
12. Remove the power brake booster vacuum pump insulators (2).

Installation Procedure

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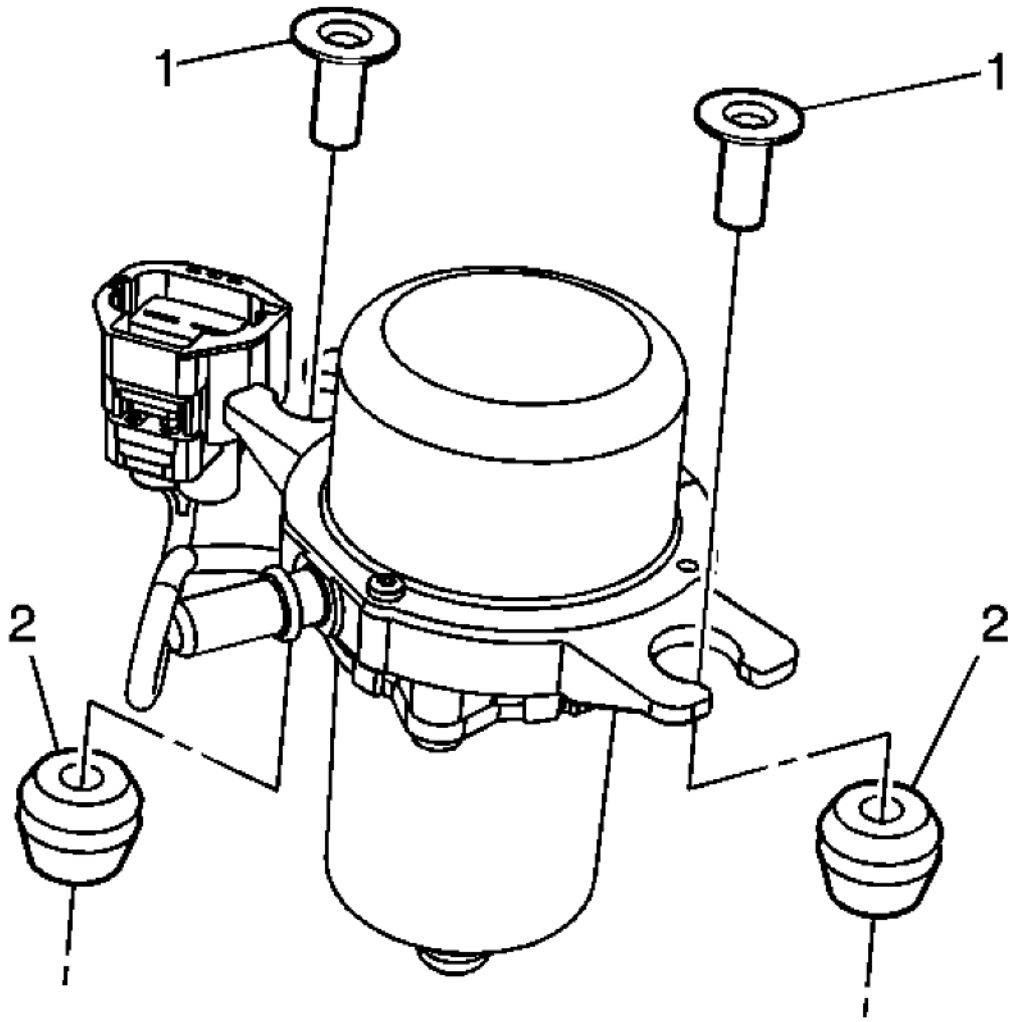


Fig. 94: Power Brake Booster Vacuum Pump Insulators & Sleeves
Courtesy of GENERAL MOTORS CORP.

1. Assemble the power brake booster pump sleeves (1) to the insulators (2).
2. Install the power brake booster pump insulators.

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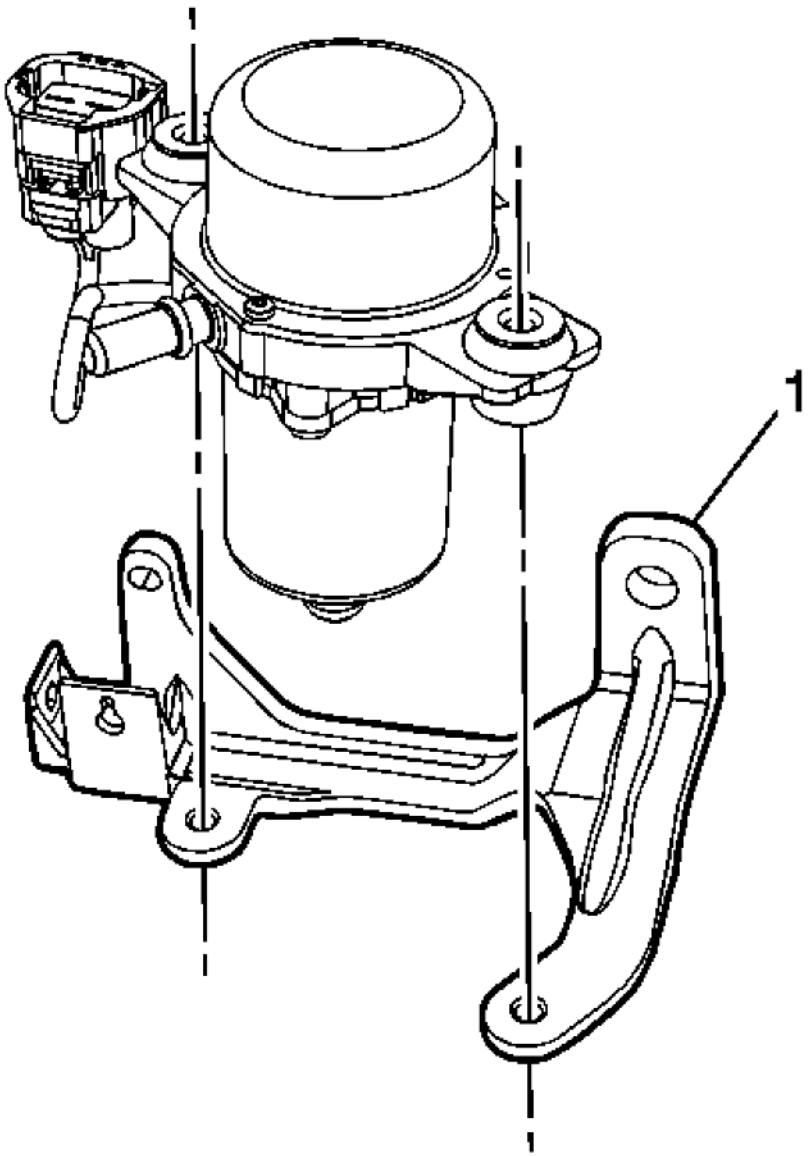


Fig. 95: Power Brake Booster Vacuum Pump Bracket
Courtesy of GENERAL MOTORS CORP.

3. Install the power brake booster vacuum pump bracket (1).

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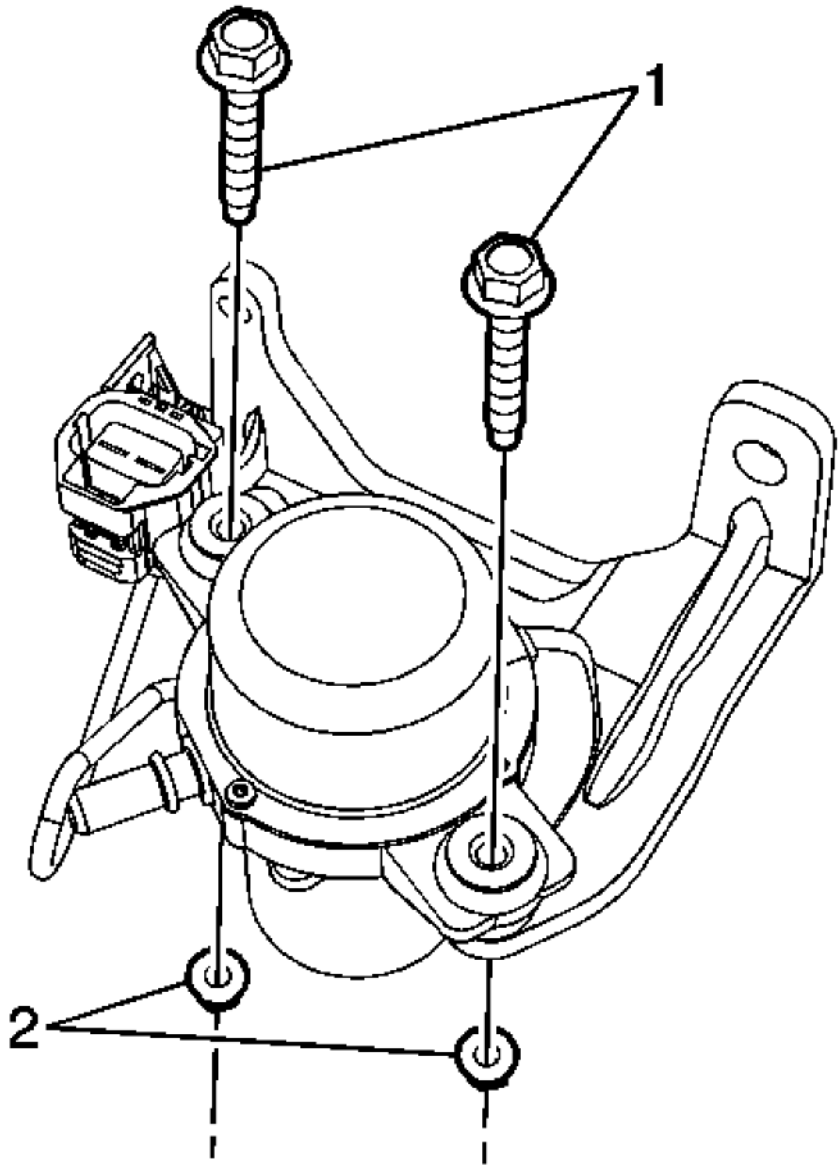


Fig. 96: Power Brake Booster Vacuum Pump Bolts & Nuts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

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4. Install the power brake booster pump bolts (1) and nuts (2) and tighten to 22 N.m (16 lb ft).
5. Install the power brake booster vacuum pump electrical harness connector retainer to the bracket.

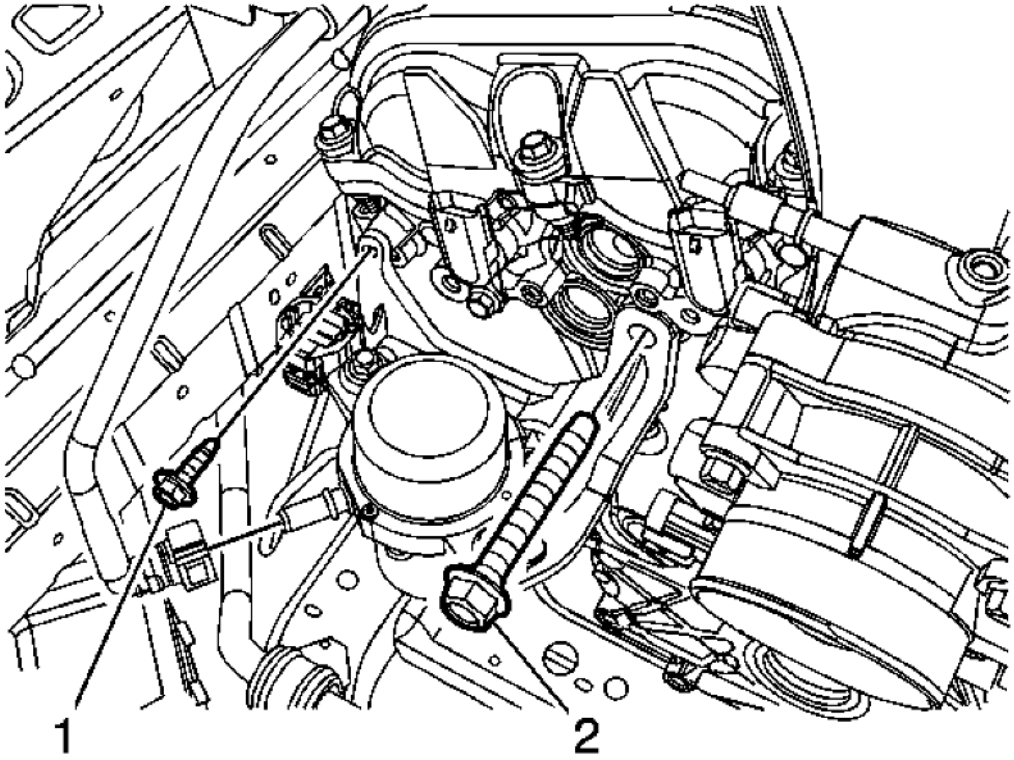


Fig. 97: Power Brake Booster Vacuum Pump Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

6. Position the power brake booster vacuum pump to the engine.
7. Loosely install the power brake booster vacuum pump bracket M6 bolt (1).
8. Loosely install the power brake booster vacuum pump bracket M12 bolt (2).
9. Tighten the power brake booster vacuum pump bracket M6 bolt to 10 N.m (89 lb in).
10. Tighten the power brake booster vacuum pump bracket M12 bolt to 70 N.m (52 lb ft).

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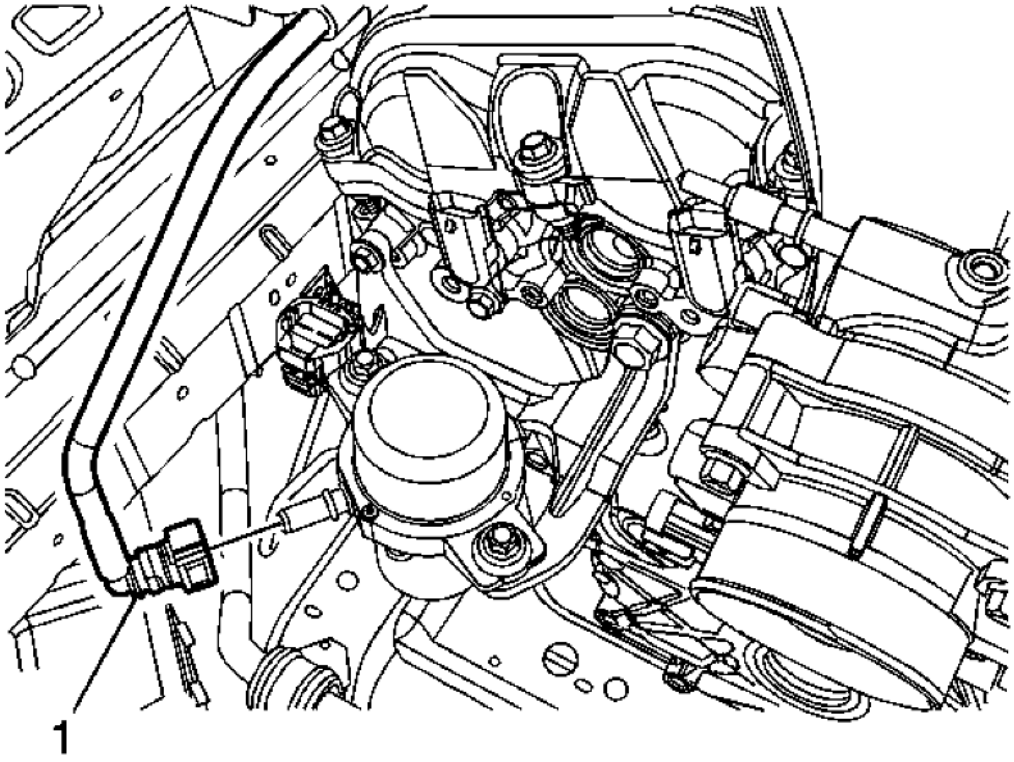


Fig. 98: Power Brake Booster Vacuum Hose Quick Connect At Power Brake Booster Vacuum Pump
Courtesy of GENERAL MOTORS CORP.

11. Install the power brake booster vacuum pump hose.
12. Connect the power brake booster vacuum pump hose quick connect (1).
13. Connect the power brake booster vacuum pump electrical connector.
14. Install the air cleaner resonator and outlet duct. Refer to **Air Cleaner Resonator and Outlet Duct Replacement** .

DESCRIPTION AND OPERATION

BRAKE ASSIST SYSTEM DESCRIPTION AND OPERATION

System Component Description

The brake assist system consists of the following:

Brake Pedal

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

Brake Pedal Pushrod

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

Vacuum Brake Booster

Uses source vacuum to decrease effort required by driver when applying brake system input force.
At rest, source vacuum is applied to both sides of the vacuum diaphragm for single boosters, or to both sides of each of the diaphragms for tandem boosters. Return springs maintain the booster in a rest position.
When brake system input force is applied, vacuum to the rear of the diaphragm(s) is cut off, and air at atmospheric pressure is admitted in its place. This provides a decrease in brake pedal effort required.
When input force is removed, vacuum again replaces atmospheric pressure within the booster.

Vacuum Source

Supplies force used by vacuum brake booster to decrease brake pedal effort.
The primary source for vacuum is typically the vehicle's internal combustion engine. Some vehicles may use a vacuum pump to ensure and adequate supply of vacuum under various operating conditions, such as during cold start-up, heavy throttle, and high altitude.

Vacuum Pump Relay

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

Vacuum Monitoring System

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

Vacuum Source Control

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

Vacuum Source Delivery System

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Enables delivery and retention of source vacuum for vacuum brake booster.
This typically consists of a vacuum check valve and a vacuum hose or pipe. If a vacuum pump is used, additional check valves may be used.

System Operation

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

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

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

BRAKE BOOSTER VACUUM ASSIST DESCRIPTION AND OPERATION

System Component Description

The brake booster vacuum assist system consists of the following:

Brake Vacuum Sensor:

The brake vacuum sensor is mounted to the vacuum brake booster. The sensor monitors the amount of vacuum in the brake booster. The sensor is an input to the electronic brake control module.

Brake Booster Auxiliary Vacuum Pump

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

Vacuum Brake Booster

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

Vacuum Source

Vacuum is supplied by engine vacuum or by the brake booster vacuum pump.

System Operation

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

BRAKE WARNING SYSTEM DESCRIPTION AND OPERATION

Brake System Indicators and Driver Information Center Messages

Brake Warning Indicator

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

- The instrument cluster performs the bulb check. The brake warning indicator illuminates for 5 s.
- The electronic brake control module (EBCM) detects a faulty pump motor, solenoid valves, an internal hardware failure or a too high or too low battery voltage and sends a serial data message to the instrument cluster requesting illumination.
- The body control module (BCM) detects that the parking brake is engaged. The instrument cluster receives a serial data message from the BCM requesting illumination.

BRAKE FLUID LOW Message

When the EBCM detects a too low brake fluid level it sets DTC C0267 and sends a serial data message to the instrument cluster, which will display the following message:

BRAKE FLUID LOW

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 front-rear opposed wheel apply circuits.

Hydraulic Brake Pressure Balance Control System

Regulates brake fluid pressure delivered to hydraulic brake wheel circuits, in order to control the distribution of braking force.
Pressure balance control is achieved through dynamic rear proportioning (DRP), which is a function of the ABS modulator. Refer to **ABS Description and Operation** for specific information on the operation

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of DRP.

Hydraulic Brake Pipes and Flexible Brake Hoses

Carries brake fluid to and from hydraulic brake system components.

Hydraulic Brake Wheel Apply Components

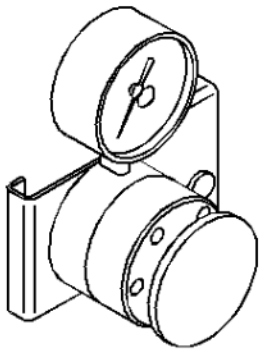
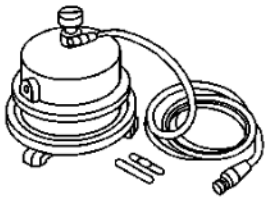
Converts hydraulic input pressure into mechanical output force.

System Operation

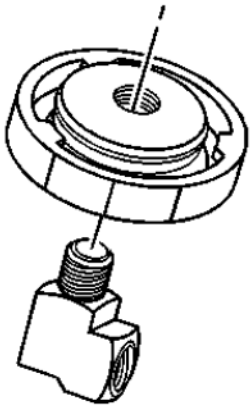
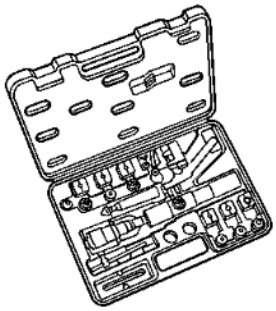
Mechanical force is converted into hydraulic pressure by the master cylinder, regulated to meet braking system demands by the pressure balance control system, and delivered to the hydraulic brake wheel circuits by the pipes and flexible hoses. The wheel apply components then convert the hydraulic pressure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

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description
	J 28662 Brake Pedal Effort Gauge
	J 29532 Diaphragm Pressure Bleeder

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	J 35589-A Master Cylinder Bleeder Adapter
	J 45405 Pipe Flaring Tool Kit

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2010 BRAKES

Park Brake - Camaro

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	Specification	
	Metric	English
Parking Brake Cable Retainer Nut	7 N.m	61 lb in
Parking Brake Indicator Switch Bolt	3 N.m	27 lb in
Parking Brake Lever Nut	22 N.m	16 lb ft

DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - PARK BRAKE

IMPORTANT: Review the system operation in order to familiarize yourself with the system functions.

Refer to **Park Brake System Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the park brake system.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Symptom List

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

Park Brake Will Not Hold or Release

PARK BRAKE WILL NOT HOLD OR RELEASE

Step	Action	Yes	No
1	Were you sent here from the Park Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Vehicle**
2	Inspect the park brake system for proper operation. Refer to **Park Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 5**	Go to **Step 3**
	Inspect the disc brake system for proper operation.		

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3	Refer to **Disc Brake System Diagnosis** . Did you find and correct a condition?	Go to **Step 5**	Go to **Step 4**
4	Inspect the hydraulic brake system for proper operation. Refer to **Hydraulic Brake System Diagnosis** . Did you find and correct a condition?	Go to **Step 5**	Go to **Diagnostic Starting Point - Vehicle**
5	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

PARK BRAKE SYSTEM DIAGNOSIS

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the PARK brake system in order to determine if the PARK 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 Hydraulic Brake Symptom table?	Go to **Step 3**	Go to **Step 2**
2	Were you sent here from a Park Brake Symptom table?	Go to **Step 3**	Go to **Diagnostic Starting Point - Vehicle**
3	1. Raise and support the vehicle with the rear axle supported by jack stands. Refer to **Lifting and Jacking the Vehicle** . 2. Shift the transmission into NEUTRAL. 3. With the park brake RELEASED, attempt to rotate the rear wheels to check the rear brakes for a significant amount of drag. Do the rear brakes have a significant amount of drag?	Go to **Step 8**	Go to **Step 4**
4	1. Apply the park brake. 2. Attempt to rotate the rear wheels to check the rear brakes for a significant amount of drag. Do the rear brakes have a significant amount of drag?	Go to **Step 18**	Go to **Step 5**
5	Visually inspect the park brake cable connections and the cables that are accessible on the UNDERSIDE of the vehicle for disconnections and/or damage. Were any of the park brake cables disconnected and/or damaged?	Go to **Step 6**	Go to **Step 7**
	Reconnect or replace the park brake cables as necessary. Refer to the following procedures as necessary:		

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6	• **Parking Brake Lever Replacement** • **Parking Brake Rear Cable Replacement** Did you complete the repair and/or replacement?	Go to **Step 18**	-
7	Check the adjustment of the park brake. Refer to **Parking Brake Adjustment**. Did you find and correct the condition?	Go to **Step 18**	Go to **Step 8**
8	**CAUTION:** **Do not depress the brake pedal with the brake rotors and/or the brake drums removed, or with the brake calipers repositioned away from the brake rotors, or damage to the brake system may result.** 1. Remove the rear brake rotors. Refer to **Rear Brake Rotor Replacement (LLT)** or **Rear Brake Rotor Replacement (L99, LS3)** . 2. Inspect the park brake shoe hardware for looseness, damaged, broken or missing components. 3. Check the park brake actuators for a seized condition. Does the park brake hardware and/or the park brake actuators require replacement?	Go to **Step 9**	Go to **Step 10**
9	1. Replace park brake hardware components as necessary. Refer to **Parking Brake Shoe Replacement**. 2. Replace the park brake actuators as necessary. Refer to **Parking Brake Actuator Replacement**. Did you find and correct the condition?	Go to **Step 18**	Go to **Step 17**
10	Have an assistant apply and release the park brake, while you observe the park brake cables for free movement. Did the park brake cables move freely?	Go to **Step 11**	Go to **Step 13**
11	Check the adjustment of the park brake. Refer to **Parking Brake Adjustment**. Did you find and correct the condition?	Go to **Step 18**	Go to **Step 12**
	1. With the transmission still in NEUTRAL, apply the park brake. 2. Attempt to rotate the rear wheels to check the rear brakes for a significant amount of drag.		

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12	3. Release the park brake. 4. Rotate the rear wheels to check the rear brakes for a significant reduction of drag. Did the park brake apply and release properly?	Go to **Step 18**	Go to **Symptoms - Park Brake**
13	Disconnect the park brake cable connections that are accessible on the UNDERSIDE of the vehicle one at a time and check each cable for free movement. Do any of the park brake cables accessible on the underside of the vehicle require replacement?	Go to **Step 14**	Go to **Step 15**
14	Replace any of the park brake cables that do not have free movement - not releasing properly. Refer to the following procedures as necessary: • **Parking Brake Lever Replacement** • **Parking Brake Rear Cable Replacement** Did you complete the replacement?	Go to **Step 18**	-
15	Disconnect the front park brake cable connection accessible INSIDE the vehicle at the park brake lever assembly and check for free movement. Replace the front park brake cable if it does not have free movement. Refer to **Parking Brake Lever Replacement**. Did you find and correct a condition?	Go to **Step 18**	Go to **Step 16**
16	Inspect the park brake lever assembly for proper operation and replace if necessary. Refer to **Parking Brake Lever Replacement**. Did you find and correct the condition?	Go to **Step 18**	Go to **Step 17**
17	1. Replace the component that is used to adjust the park brake system. Refer to **Parking Brake Lever Replacement**. 2. Adjust the park brake. Refer to **Parking Brake Adjustment**. Did you complete the replacement and adjustment?	Go to **Step 18**	Go to **Symptoms - Park Brake**
18	1. Install or connect any components that were removed or disconnected during diagnosis. 2. Verify the operation of the park brake system. Does the park brake operate correctly?	System OK	Go to **Symptoms - Park Brake**

PARKING BRAKE SHOE INSPECTION

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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. Remove the rear brake caliper. Refer to **Rear Brake Caliper Replacement (LLT)** or **Rear Brake Caliper Replacement (L99, LS3)** .
4. Remove the rear brake caliper bracket. Refer to **Rear Brake Caliper Bracket Replacement** .
5. Remove the rear brake rotor. Refer to **Rear Brake Rotor Replacement (LLT)** or **Rear Brake Rotor Replacement (L99, LS3)** .
6. Inspect and replace the park brake shoe and lining if any of the following conditions are found:
   - Excessive wear indicated by the park brake lining being worn down to the shoe
   - Brake lining cracking
   - Oil or fluid contamination of the brake lining
7. Adjust the park brake shoe. Refer to **Parking Brake Adjustment**.
8. Install the rear brake rotor. Refer to **Rear Brake Rotor Replacement (LLT)** or **Rear Brake Rotor Replacement (L99, LS3)** .
9. Install the rear brake caliper bracket. Refer to **Rear Brake Caliper Bracket Replacement** .
10. Install the rear brake caliper. Refer to **Rear Brake Caliper Replacement (LLT)** or **Rear Brake Caliper Replacement (L99, LS3)** .
11. Install the rear tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
12. Lower the vehicle.

REPAIR INSTRUCTIONS

PARKING BRAKE SHOE REPLACEMENT

Removal Procedure

WARNING: Refer to Brake Dust Warning .

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
3. Remove the rear brake rotor. Refer to **Rear Brake Rotor Replacement (LLT)** or **Rear Brake Rotor Replacement (L99, LS3)** .
4. Retract the park brake shoe adjuster to ease removal. Refer to **Parking Brake Adjustment**.

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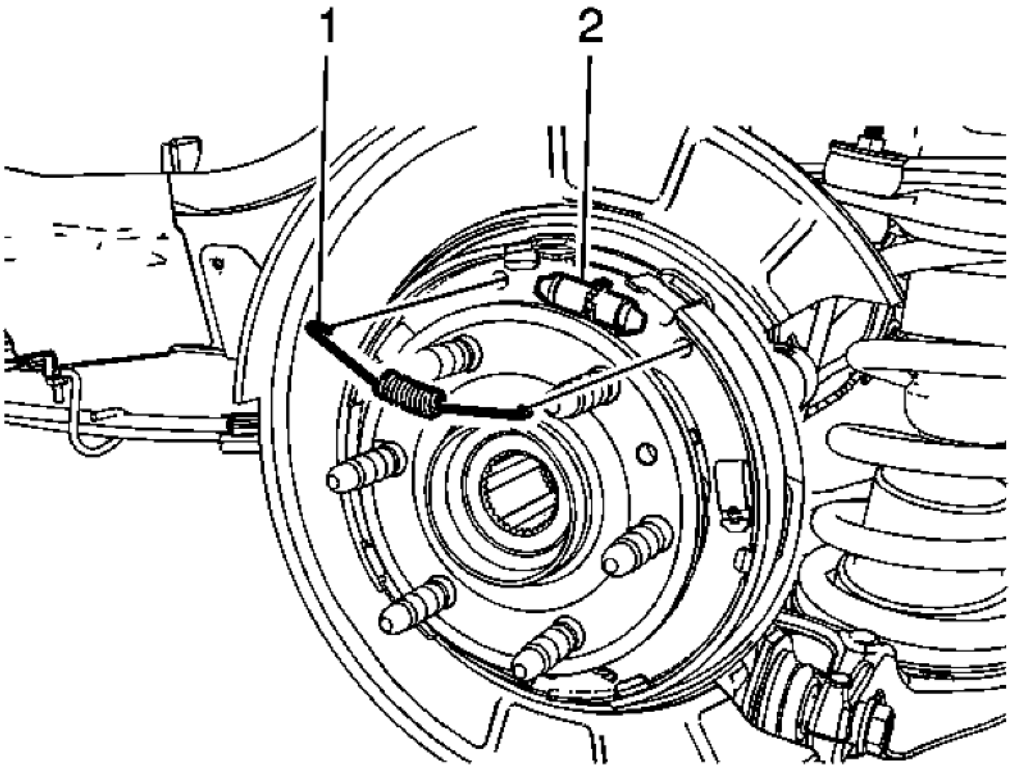


Fig. 1: Identifying Upper Park Brake Shoe Retainer Spring
Courtesy of GENERAL MOTORS CORP.

5. Remove the upper park brake shoe retainer spring (1).
6. Remove the park brake shoe adjuster (2).

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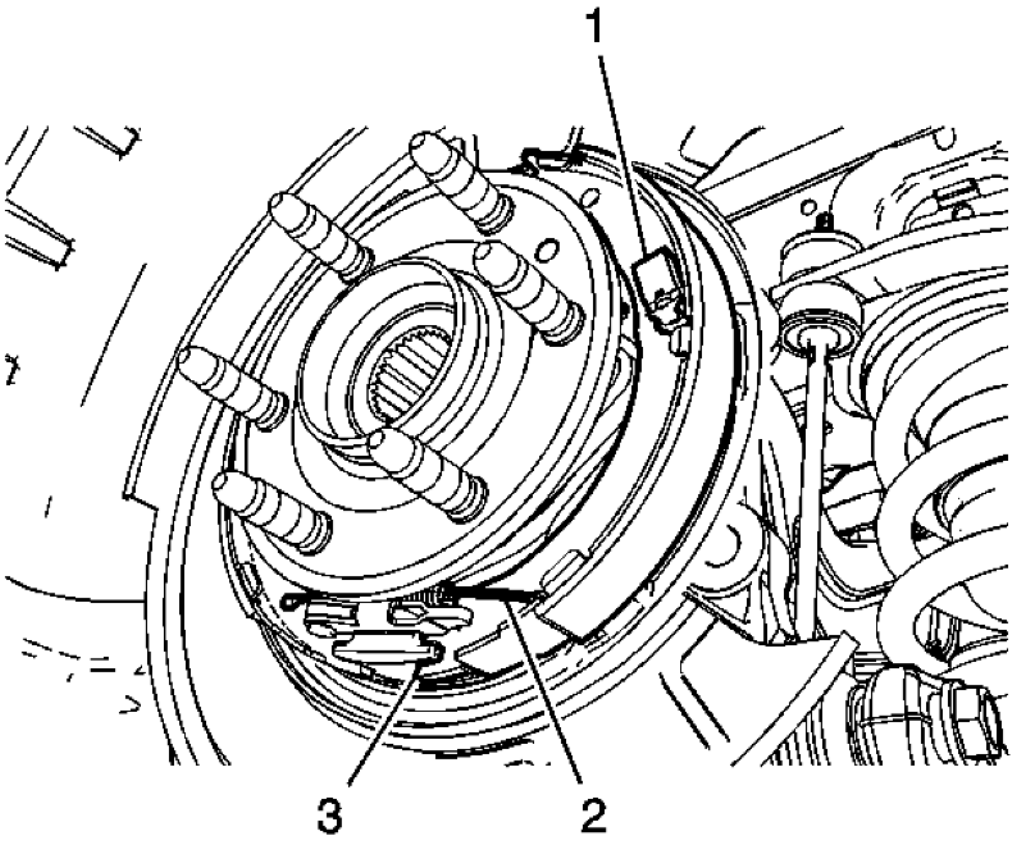


Fig. 2: View Of Lower Park Brake Shoe Retainer Spring & Rear Park Brake Shoe
Courtesy of GENERAL MOTORS CORP.

7. Remove the rear park brake shoe hold down spring (1) by compressing the spring and rotating 1/4 turn.
8. Remove the lower park brake shoe retainer spring (2) and the rear park brake shoe (3).

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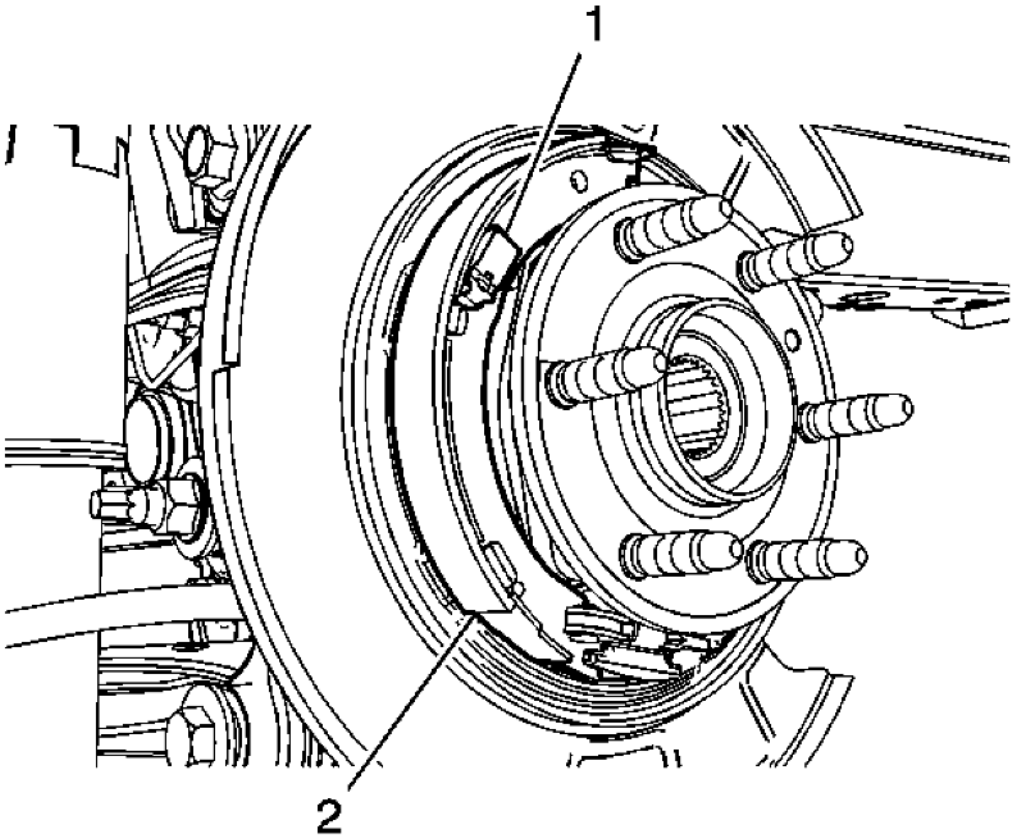


Fig. 3: Identifying Front Park Brake Shoe
Courtesy of GENERAL MOTORS CORP.

9. Remove the front park brake shoe hold down spring (1) by compressing the spring and rotating 1/4 turn.
10. Remove the front park brake shoe (2).
11. Clean the rear brake backing plate with denatured alcohol or equivalent and allow to dry.

Installation Procedure

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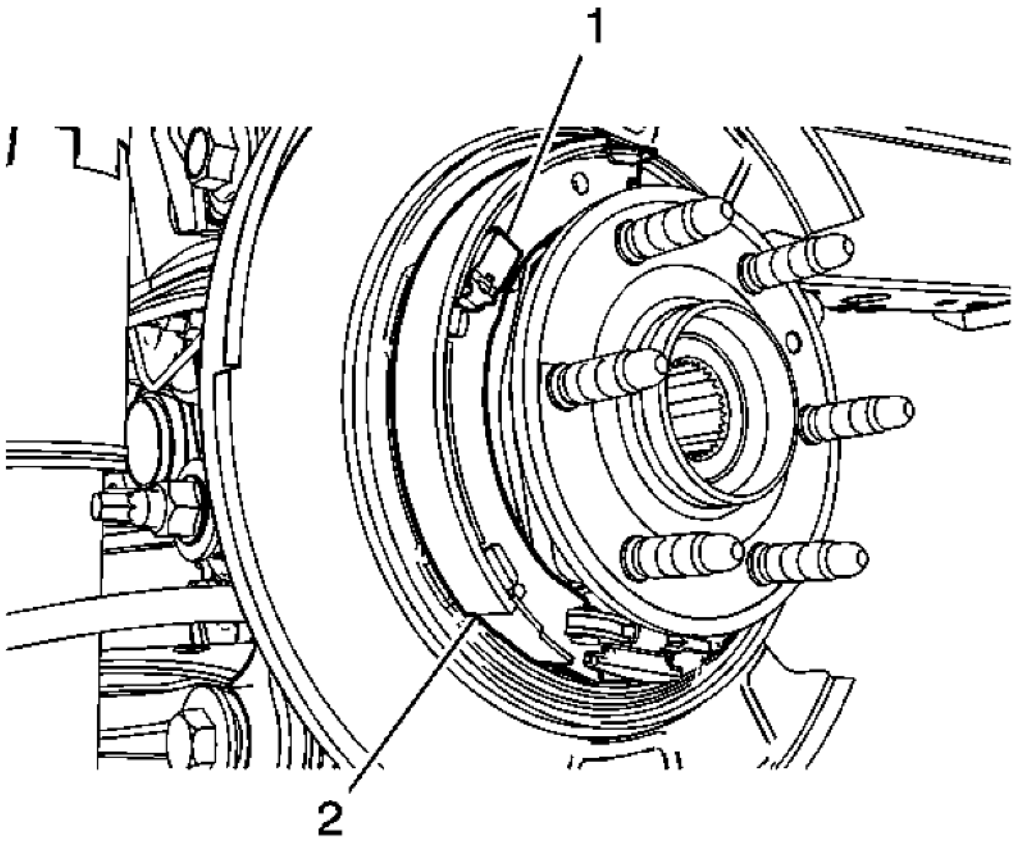


Fig. 4: Identifying Front Park Brake Shoe
Courtesy of GENERAL MOTORS CORP.

1. Apply a light coat of high temperature brake lubricant to the park brake shoe contact areas of the brake backing plate.
2. Install the front park brake shoe (2).

   Ensure the park brake shoe is properly seated in the park brake actuator.

3. Install the front park brake shoe hold down spring (1) by compressing the spring and rotating 1/4 turn.

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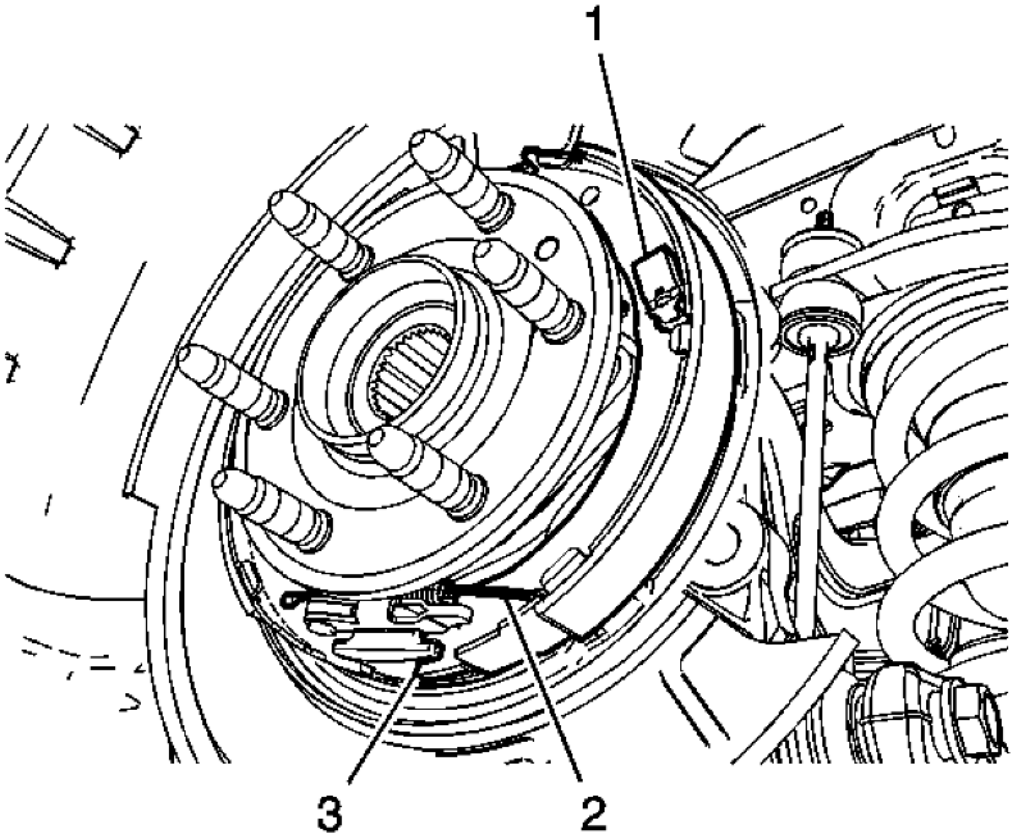


Fig. 5: View Of Lower Park Brake Shoe Retainer Spring & Rear Park Brake Shoe
Courtesy of GENERAL MOTORS CORP.

4. Install the rear park brake shoe (3) and the lower park brake shoe retainer spring (2).

   Ensure the park brake shoe is properly seated in the park brake actuator.

5. Install the rear park brake shoe hold down spring (1) by compressing the spring and rotating 1/4 turn.

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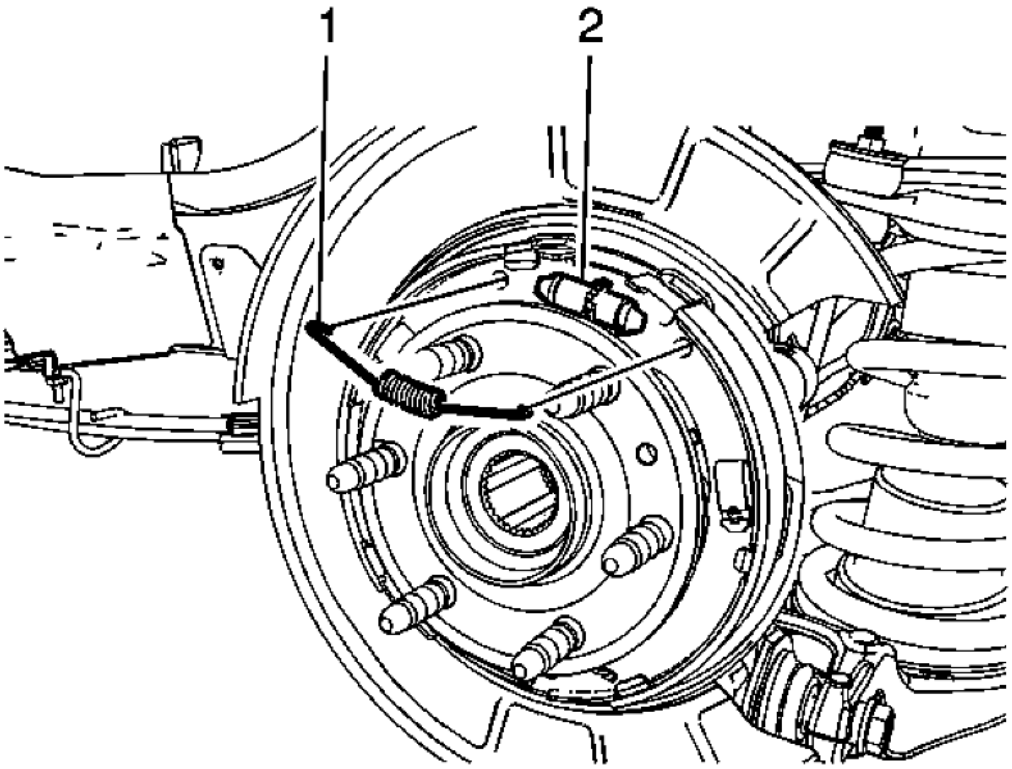


Fig. 6: Identifying Upper Park Brake Shoe Retainer Spring
Courtesy of GENERAL MOTORS CORP.

6. Install the park brake shoe adjuster (2).
7. Install the upper park brake shoe retainer spring (1).
8. Adjust the park brake. Refer to **Parking Brake Adjustment**.

PARKING BRAKE LEVER REPLACEMENT

Removal Procedure

1. Remove the exhaust muffler intermediate heat shield. Refer to **Exhaust Muffler Intermediate Heat Shield Replacement** .

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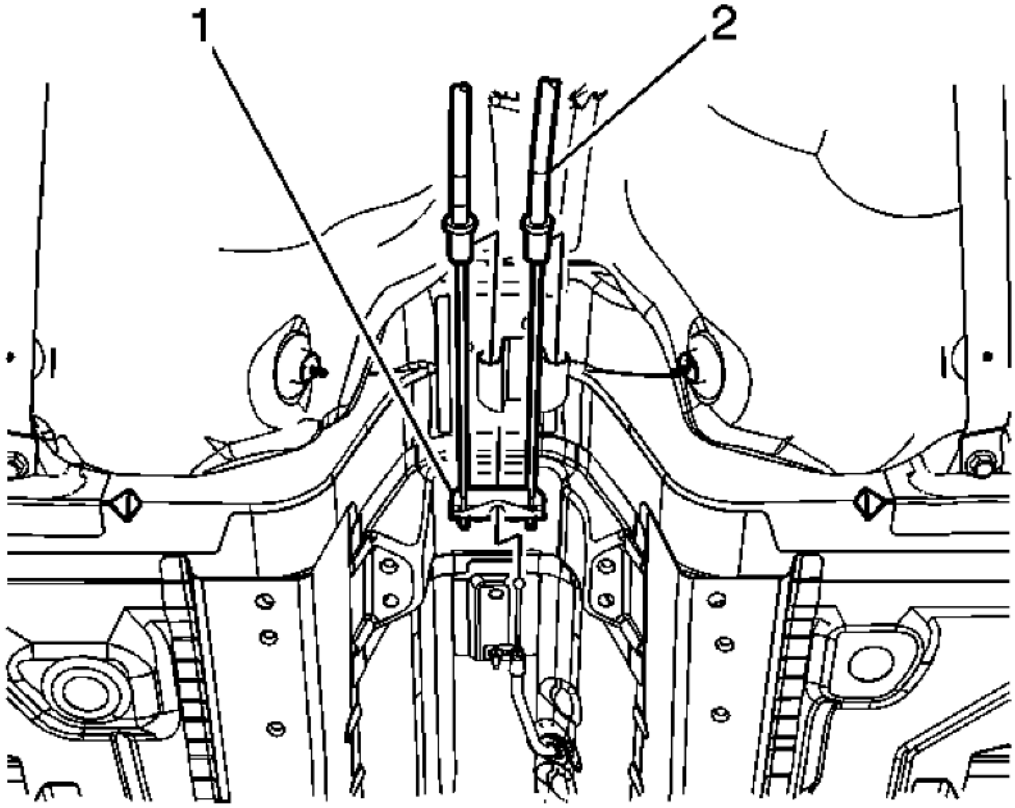


Fig. 7: Equalizer
Courtesy of GENERAL MOTORS CORP.

2. Pull the rear park brake cables forward and disengage the front park brake cable from the equalizer (1).

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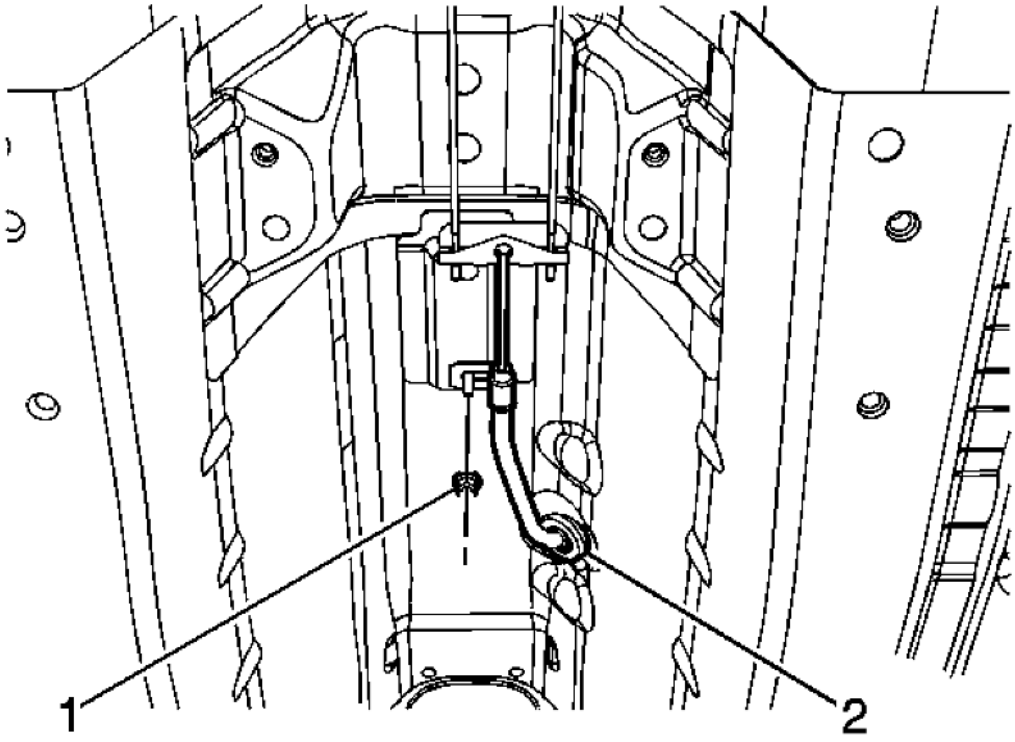


Fig. 8: Front Park Brake Cable Retainer Nut & Grommet
Courtesy of GENERAL MOTORS CORP.

3. Remove the front park brake cable retainer nut (1).
4. Release the front park brake cable pass through grommet (2) from the driveline tunnel by pressing the grommet inward.
5. Lower the vehicle.
6. Remove the front floor console. Refer to **Front Floor Console Replacement** .

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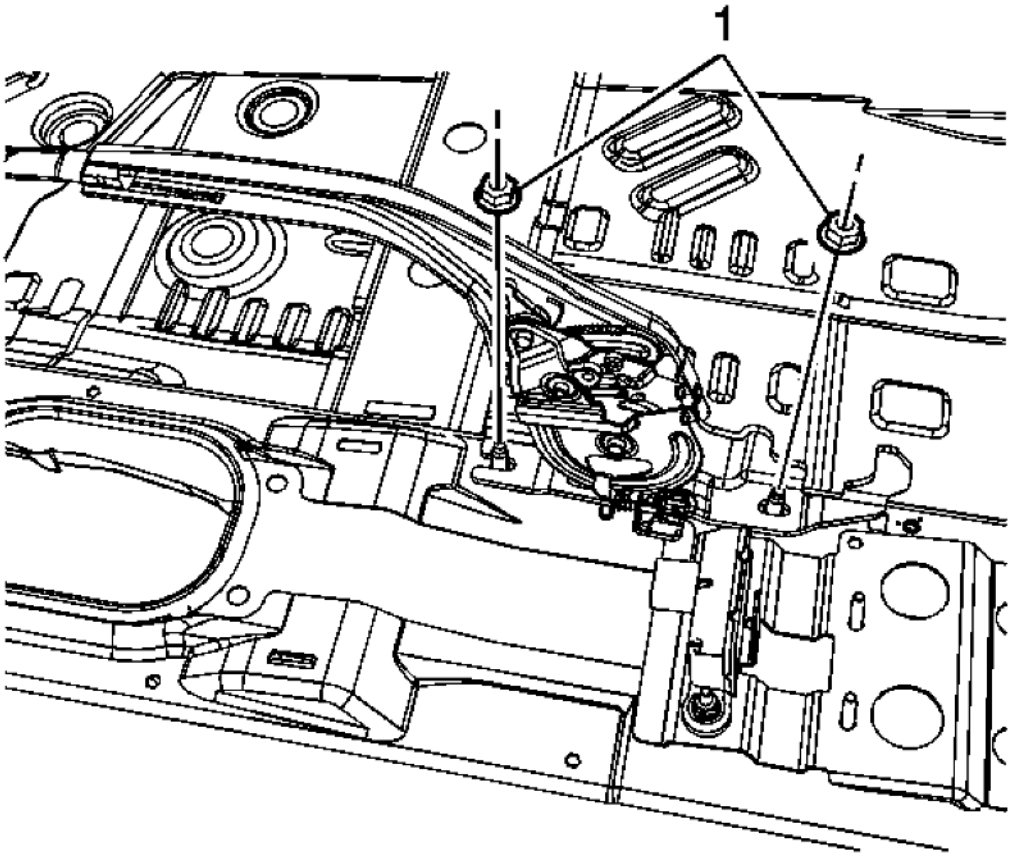


Fig. 9: Park Brake Lever Nuts
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the park brake indicator switch electrical connector.
8. Remove the park brake lever nuts (1).
9. Remove the park brake lever assembly.

Route the front park brake cable and grommet through the hole in the driveline tunnel.

Installation Procedure

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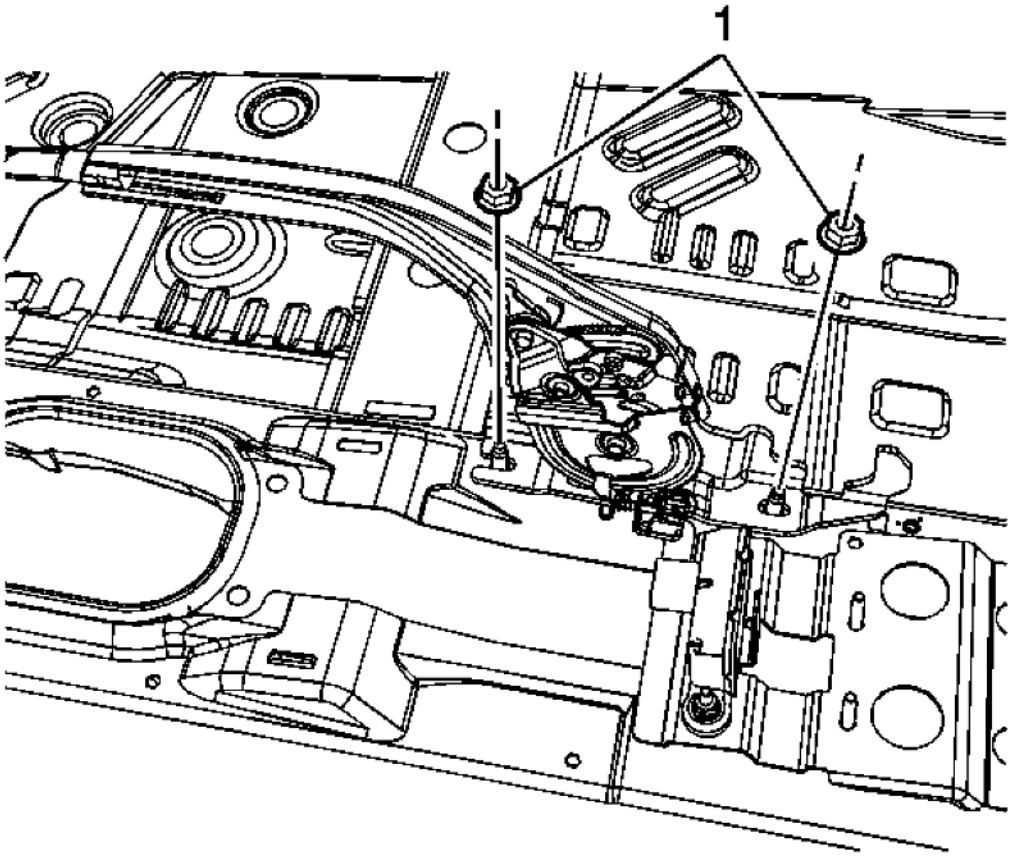


Fig. 10: Park Brake Lever Nuts
Courtesy of GENERAL MOTORS CORP.

1. Route the front park brake cable and grommet through the hole in the driveline tunnel.
2. Install the park brake lever assembly.

CAUTION: Refer to Fastener Caution .

3. Install the park brake lever nuts (1) and tighten to 22 N.m (16 lb ft).
4. Connect the park brake indicator switch electrical connector.
5. Install the front floor console. Refer to **Front Floor Console Replacement** .
6. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

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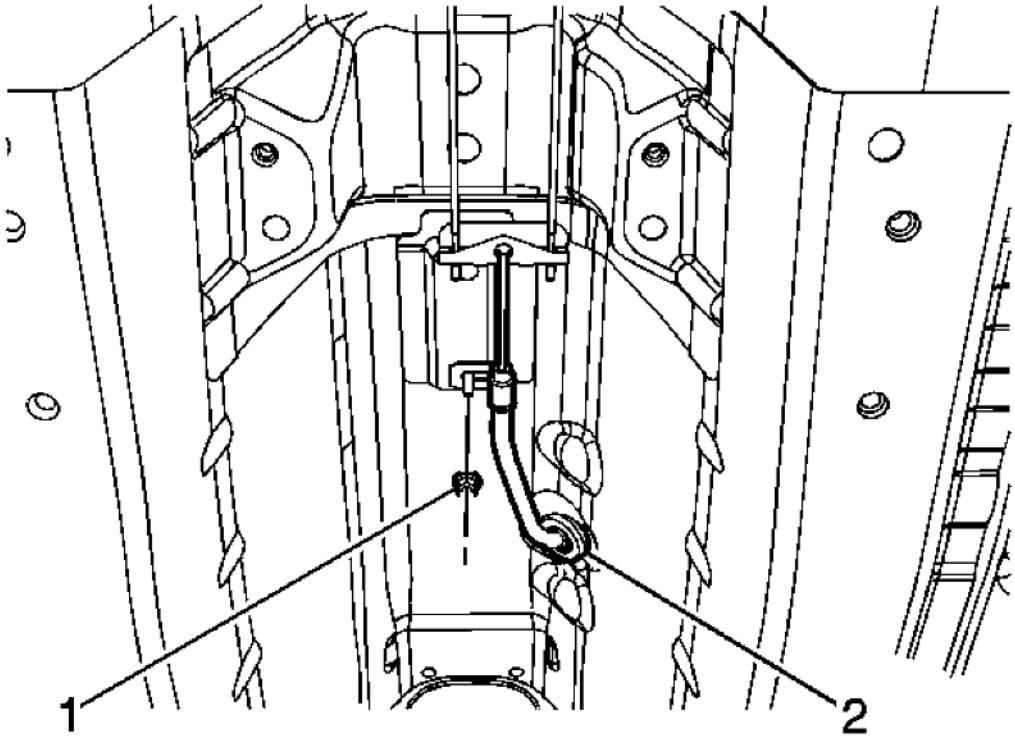


Fig. 11: Front Park Brake Cable Retainer Nut & Grommet
Courtesy of GENERAL MOTORS CORP.

7. Install the front park brake cable retainer nut (1) and tighten to 7 N.m (61 lb in).
8. Seat the front park brake cable pass through grommet (2) in the driveline tunnel.

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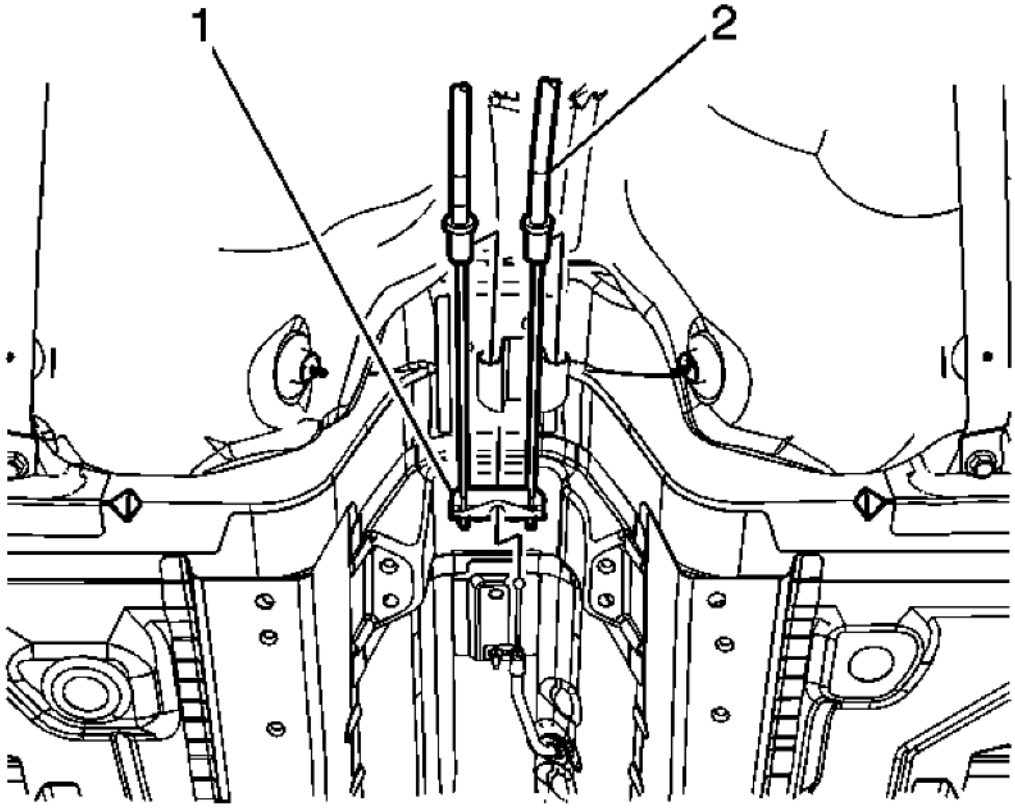


Fig. 12: Equalizer
Courtesy of GENERAL MOTORS CORP.

9. Pull the rear park brake cables forward and connect the front park brake cable to the equalizer (1).
10. Install the exhaust muffler intermediate heat shield. Refer to **Exhaust Muffler Intermediate Heat Shield Replacement** .
11. Apply and release the park brake lever 3-4 times to ensure proper operation.

PARKING BRAKE INDICATOR SWITCH REPLACEMENT

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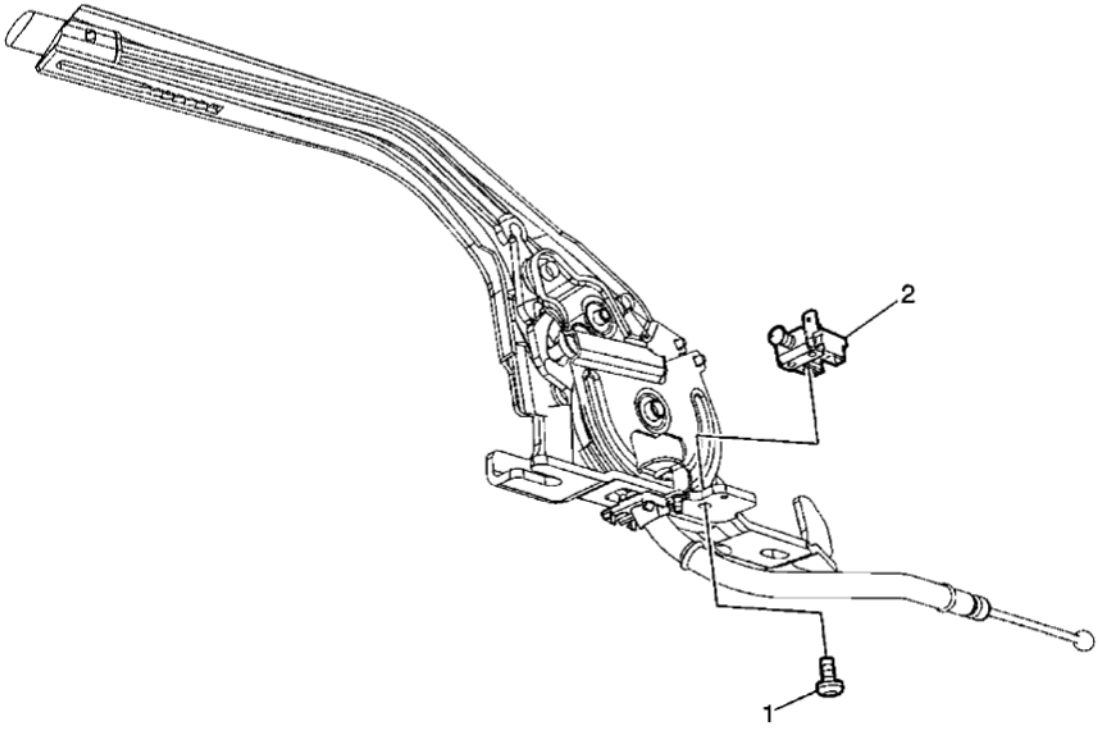


Fig. 13: Parking Brake Indicator Switch
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedures: Remove the parking brake lever assembly. Refer to **Parking Brake Lever Replacement**.	
1	Parking Brake Indicator Switch Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten:** 3 N.m (27 lb in)
2	Parking Brake Indicator Switch

PARKING BRAKE REAR CABLE REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the exhaust muffler intermediate heat shield. Refer to **Exhaust Muffler Intermediate Heat Shield Replacement** .
3. Remove the fuel tank heat shield. Refer to **Fuel Tank Replacement** .

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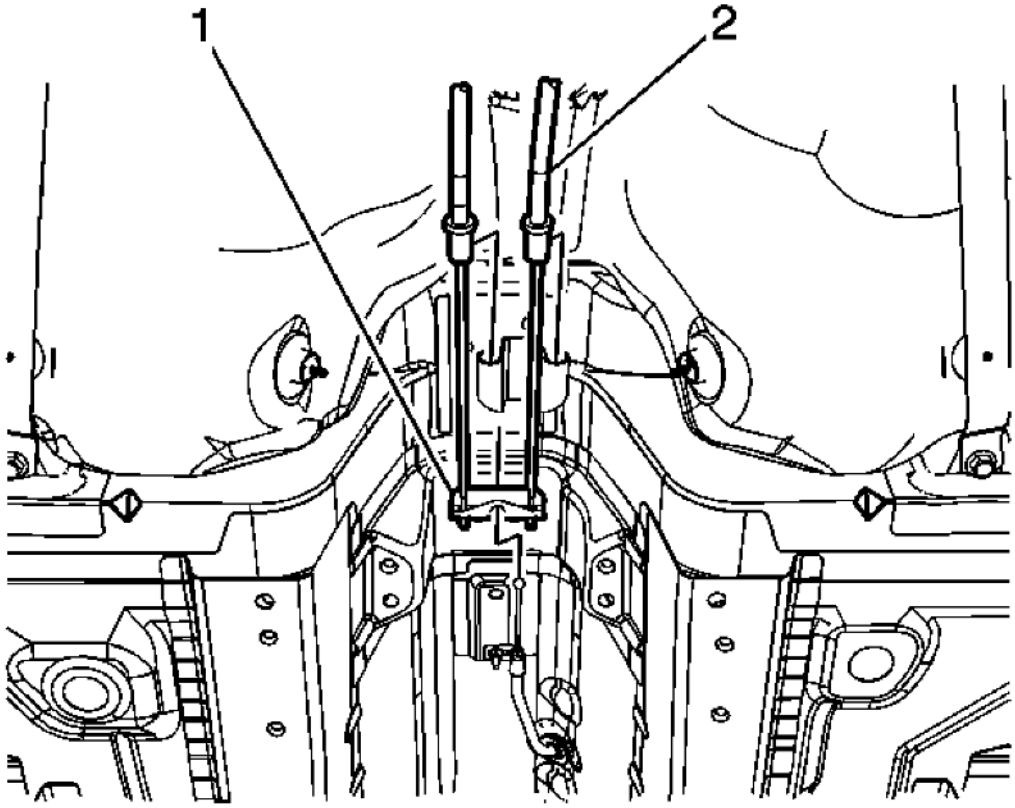


Fig. 14: Equalizer
Courtesy of GENERAL MOTORS CORP.

NOTE: The rear park brake cables are replaced as an assembly.

4. Pull the rear park brake cable equalizer (1) forward and disengage the front park brake cable from the equalizer.
5. Release the rear park brake cable ferrules (2) from the retaining bracket.

   Push the cable ferrules rearward to release.

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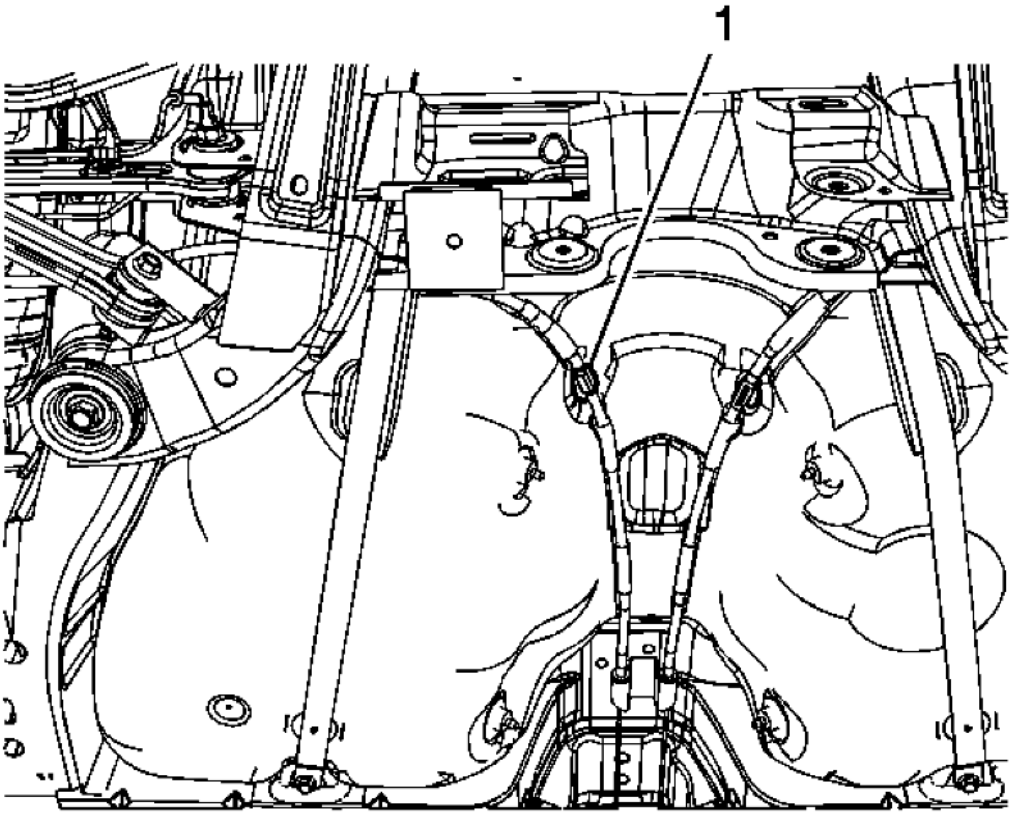


Fig. 15: Rear Park Brake Cable Retainers On Fuel Tank
Courtesy of GENERAL MOTORS CORP.

6. Release the rear park brake cables from the 2 retainers (1) on the fuel tank.

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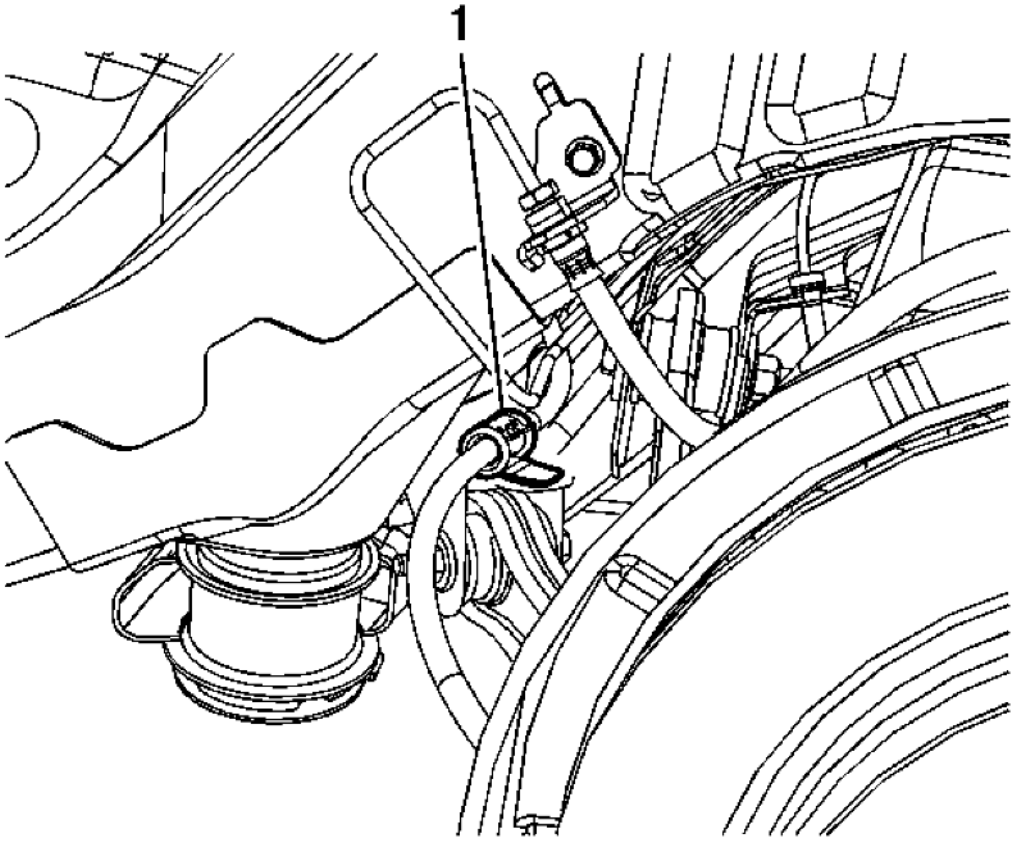


Fig. 16: Rear Park Brake Cable Retainer On Each Side Of Rear Suspension Cradle
Courtesy of GENERAL MOTORS CORP.

7. Release the rear park brake cables from the retainer (1) on each side of the rear suspension cradle.

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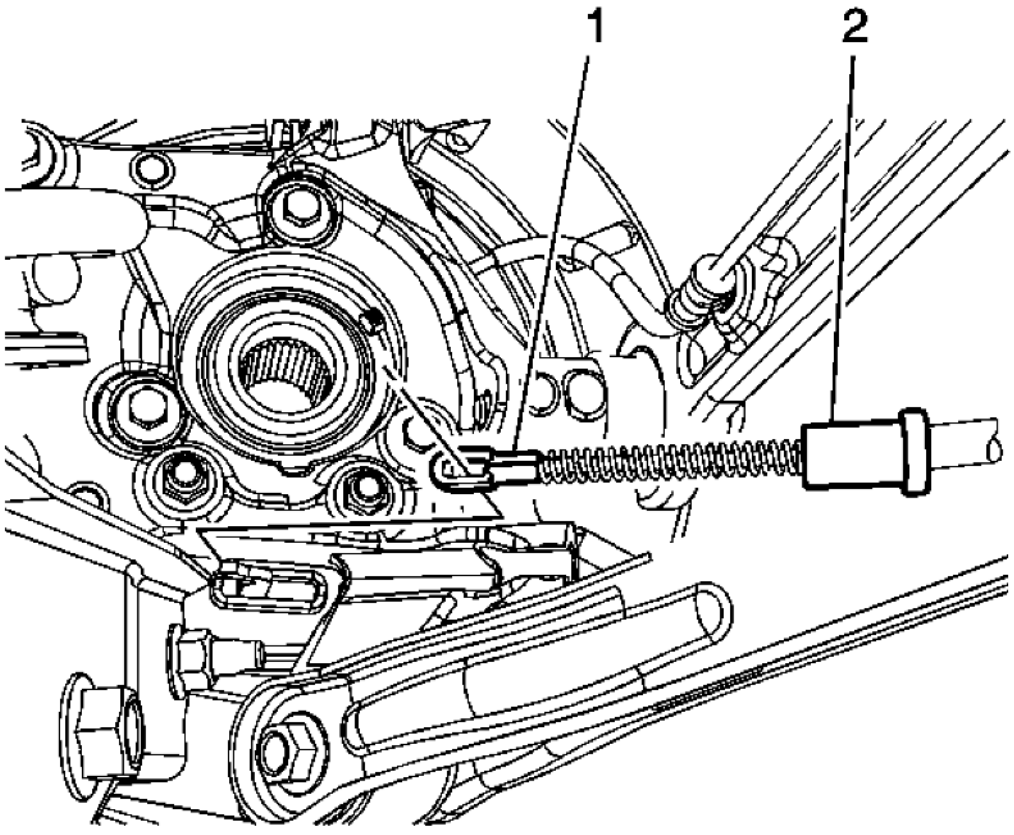


Fig. 17: Rear Park Brake Cable Eyes & Ferrules
Courtesy of GENERAL MOTORS CORP.

8. Disconnect the rear park brake cable eyes (1) from the park brake actuators.
9. Release the rear park brake cable ferrules (2) from the suspension knuckles.

   Push the cable ferrules forward to release.

10. Remove the rear park brake cable assembly.

Installation Procedure

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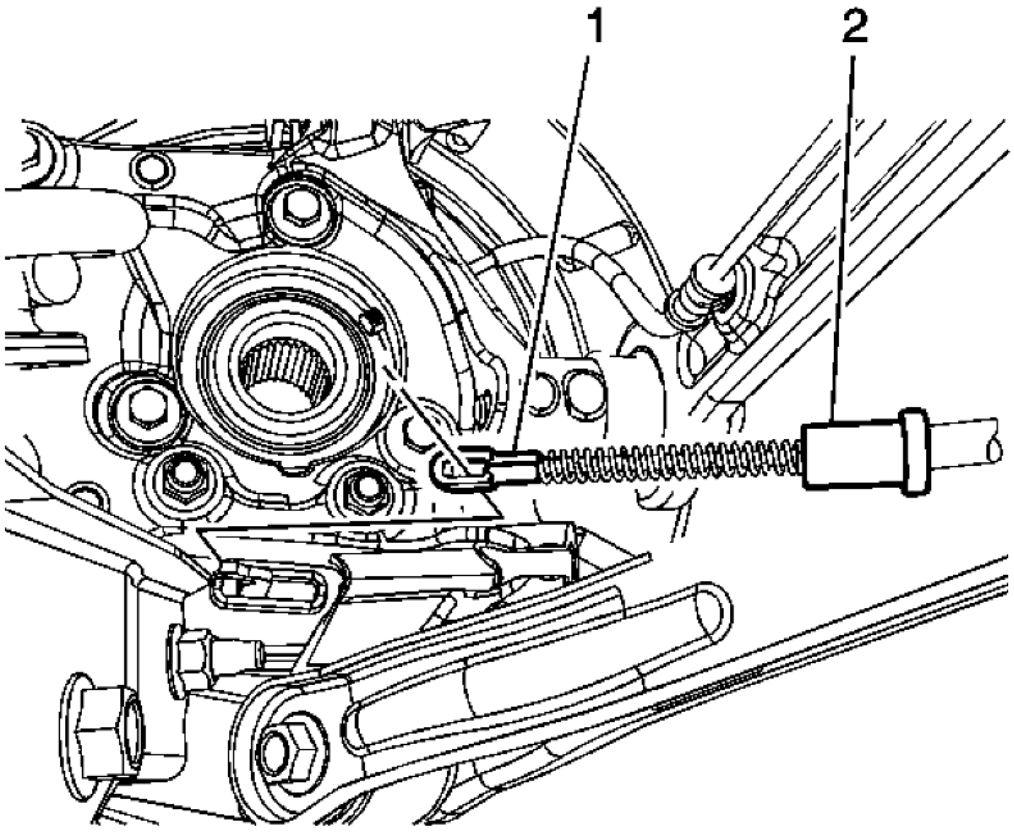


Fig. 18: Rear Park Brake Cable Eyes & Ferrules
Courtesy of GENERAL MOTORS CORP.

1. Install the rear park brake cable assembly.
2. Connect the rear park brake cable eyes (1) to the park brake actuators.
3. Install the rear park brake cable ferrules (2) to the suspension knuckles.

   Seat the cable ferrules fully in suspension knuckles.

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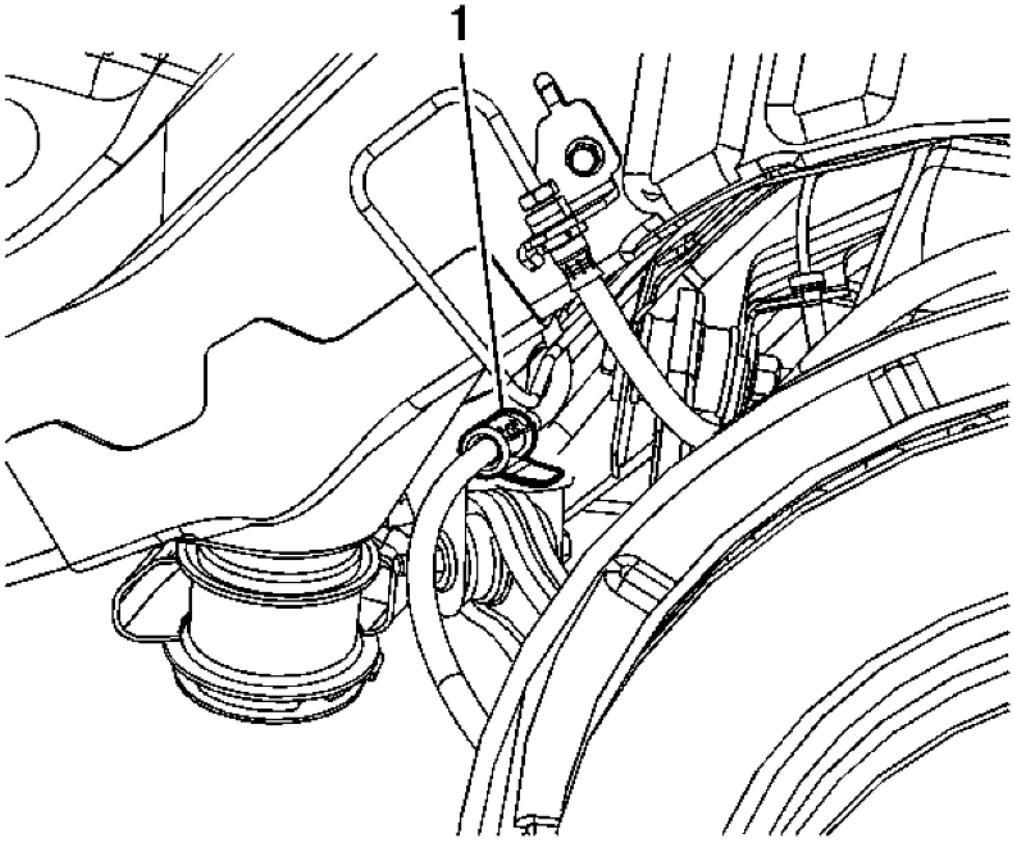


Fig. 19: Rear Park Brake Cable Retainer On Each Side Of Rear Suspension Cradle
Courtesy of GENERAL MOTORS CORP.

4. Install the rear park brake cables to the retainer (1) on each side of the rear suspension cradle.

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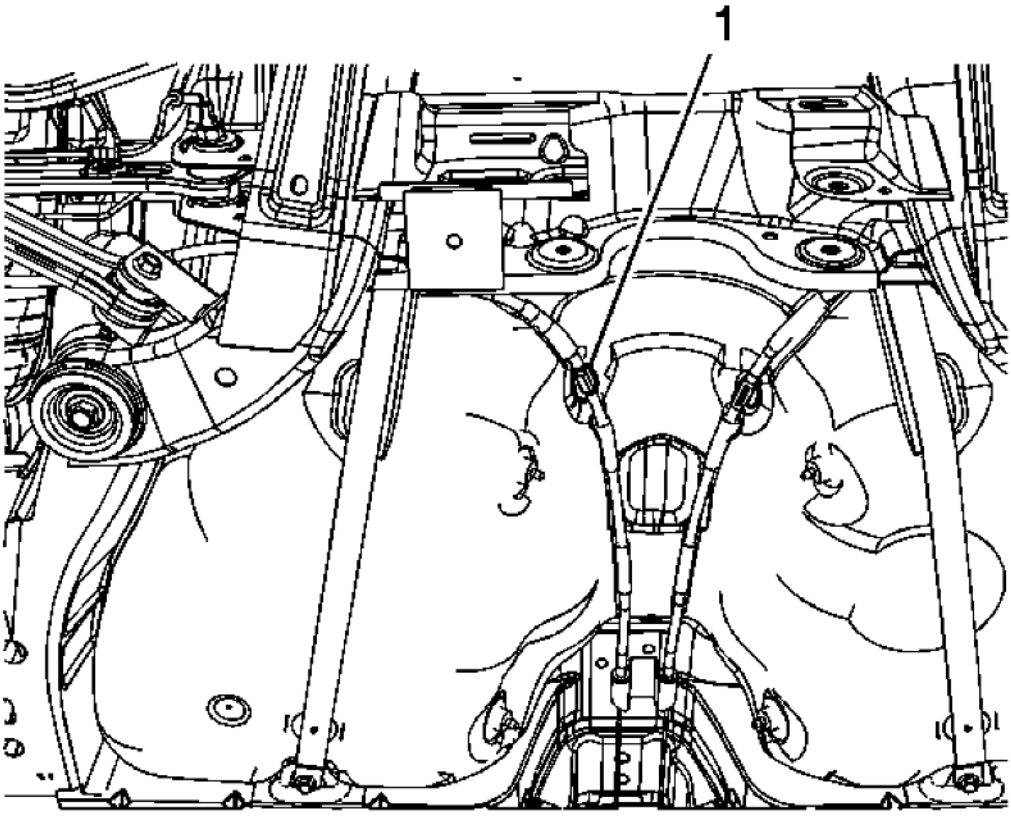


Fig. 20: Rear Park Brake Cable Retainers On Fuel Tank
Courtesy of GENERAL MOTORS CORP.

5. Install the rear park brake cables to the 2 retainers (1) on the fuel tank.

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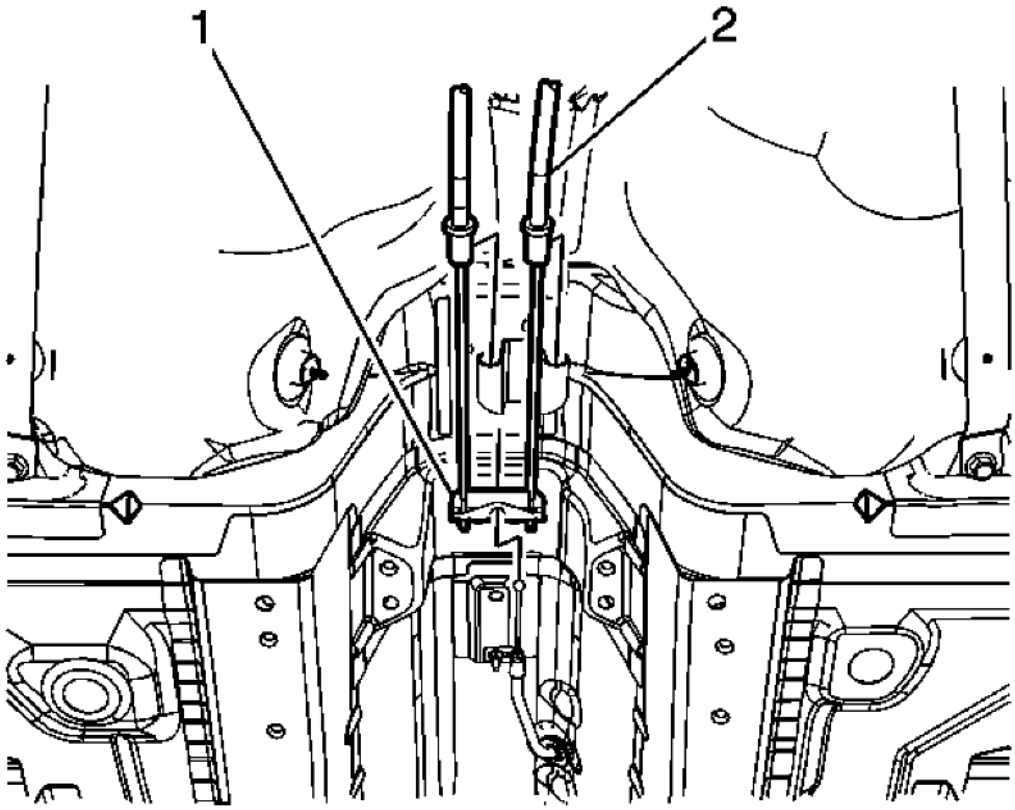


Fig. 21: Equalizer
Courtesy of GENERAL MOTORS CORP.

NOTE: The rear park brake cables are replaced as an assembly.

6. Pull the rear park brake cable equalizer (1) forward and connect the front park brake cable to the equalizer.
7. Install the rear park brake cable ferrules (2) to the retaining bracket.

   Seat the cable ferrules fully in the retaining bracket.

8. Install the fuel tank heat shield. Refer to **Fuel Tank Replacement** .
9. Install the exhaust muffler intermediate heat shield. Refer to **Exhaust Muffler Intermediate Heat Shield Replacement** .
10. Apply and release the park brake lever 2-3 times to set the park brake cable tension and inspect for proper operation.

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PARKING BRAKE ACTUATOR REPLACEMENT

Removal Procedure

WARNING: Refer to Brake Dust Warning .

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the parking brake shoes. Refer to **Parking Brake Shoe Replacement**.

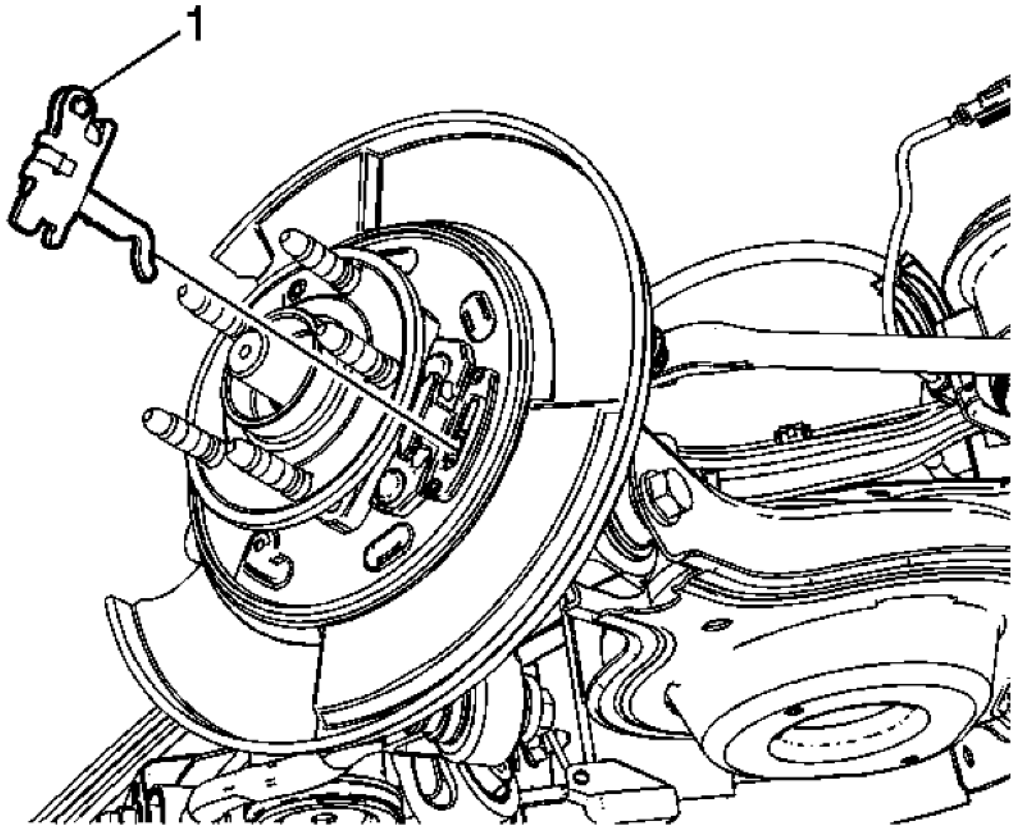


Fig. 22: Identifying Parking Brake Actuator
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the parking brake cable from the actuator.
4. Remove the parking brake actuator (1).

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Installation Procedure

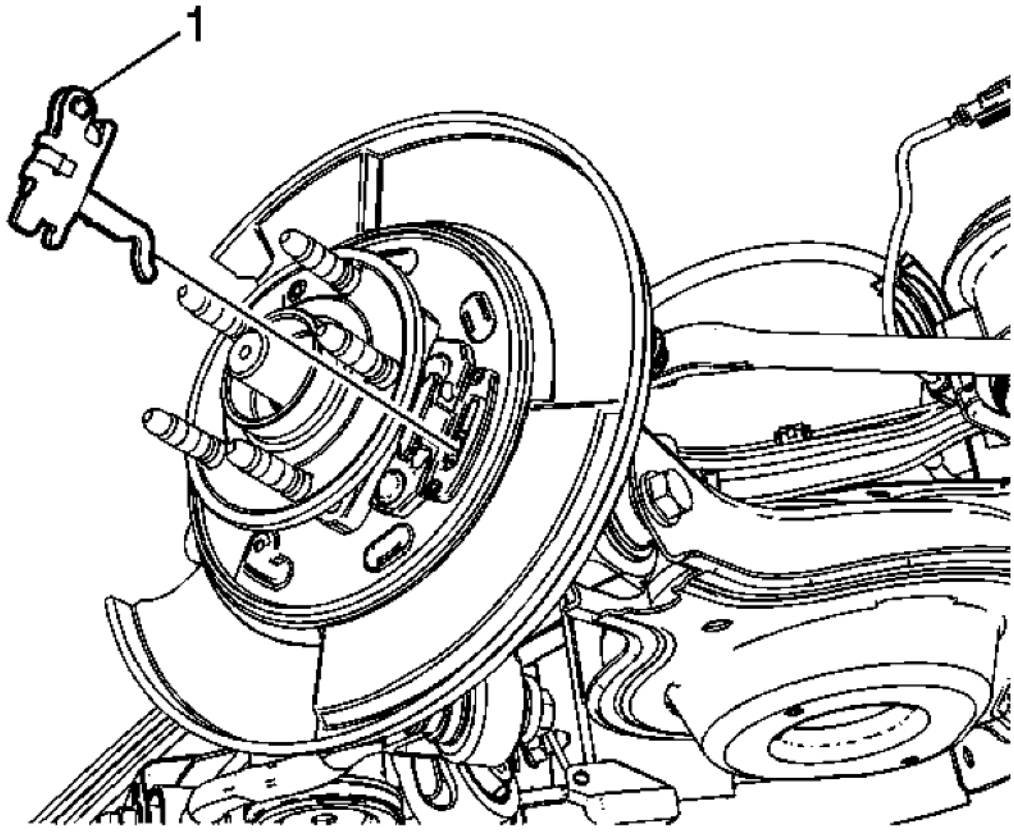


Fig. 23: Identifying Parking Brake Actuator
Courtesy of GENERAL MOTORS CORP.

1. Install the parking brake actuator (1).
2. Connect the parking brake cable from the actuator.
3. Install the parking brake shoes. Refer to **Parking Brake Shoe Replacement**.
4. Adjust the parking brake. Refer to **Parking Brake Adjustment**.

PARKING BRAKE ADJUSTMENT

Special Tools

J-21177-A: Drum To Brake Shoe Clearance Gauge

1. Adjustments to the park brake shoe are not necessary after replacing the park brake lever or park brake

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cables. The park brake is adjusted automatically by cycling the park brake lever 3 times.

2. DO not operate the park brake lever with the rear disc brake rotor(s) removed.
3. Apply and fully release the parking brake 3 times.
4. Verify that the parking brake pedal releases completely.
5. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
6. Remove the rear tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** .
7. Remove the rear brake rotors. Refer to **Rear Brake Rotor Replacement (LLT)** or **Rear Brake Rotor Replacement (L99, LS3)** .

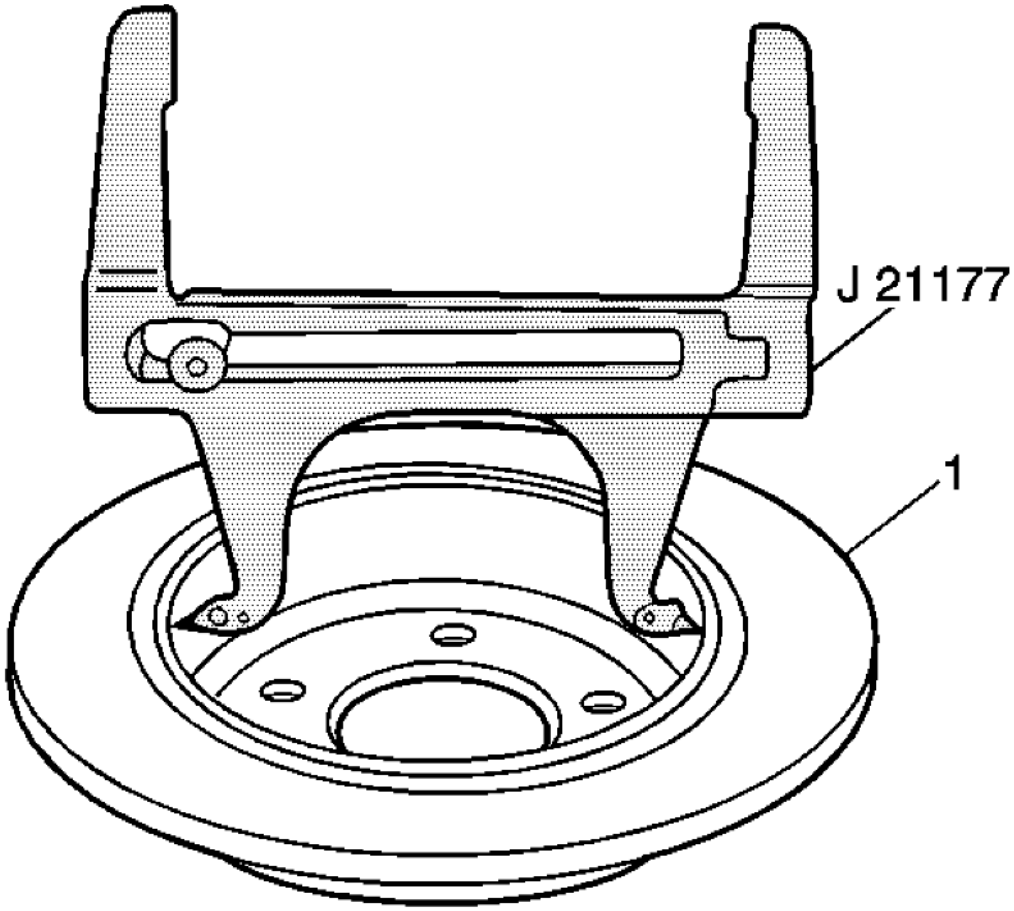


Fig. 24: Measuring Inside Of Rotor
Courtesy of GENERAL MOTORS CORP.

8. Set the **J-21177-A:** Drum To Brake Shoe Clearance Gauge inside of the park brake drum at the widest point.

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- Place the contacts of the tool at the widest point of the drum (1).
- Tighten the set screw on the tool to ensure the proper measurement when removing the tool from the drum.

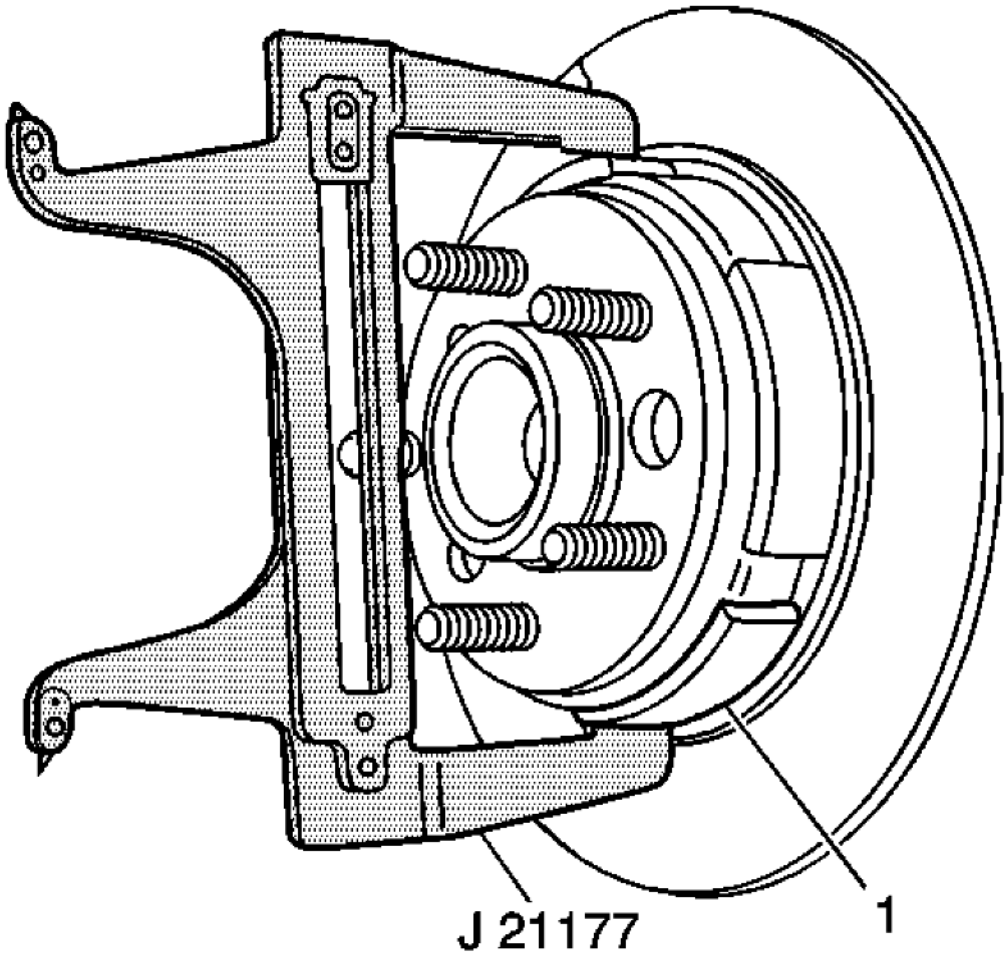


Fig. 25: Adjusting Parking Brake Shoes
Courtesy of GENERAL MOTORS CORP.

9. Position the **J-21177-A:** Drum To Brake Shoe Clearance Gauge over the park brake shoe (1) at the widest point.
10. Turn the adjuster on the actuator until the park brake shoe just contacts the **J-21177-A:** Drum To Brake Shoe Clearance Gauge.
11. Repeat steps 8 through 10 for the opposite side.

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12. Install the rear brake rotors. Refer to **Rear Brake Rotor Replacement (LLT)** or **Rear Brake Rotor Replacement (L99, LS3)** .
13. Install the rear tire and wheel. Refer to **Tire and Wheel Removal and Installation** .
14. Lower the vehicle to curb height.
15. Set and release the park brake lever 3 times.

NOTE: If the rear wheels rotate during the following test, readjust the parking brake shoes.

16. Apply the parking brake. Inspect the rotation of the rear wheels:
    - The wheels should not rotate forward.
    - The wheels should not drag or rotate backward.
17. Release the parking brake. Verify that the wheels rotate freely.
18. Lower the vehicle.

DESCRIPTION AND OPERATION

PARK BRAKE SYSTEM DESCRIPTION AND OPERATION

System Component Description

The park brake system consists of the following:

Park Brake Lever Assembly

Receives and transfers park brake system apply input force from driver to park brake cable system.
Releases applied park brake system when the lever is returned to the at-rest rest position.

Park Brake Cables

Transfers input force received from park brake lever, through park brake cable equalizer, to park brake apply lever.

Park Brake Cable Equalizer

Evenly distributes input force to both the left and right park brake units.
An auto adjust spring is used to remove the slack in the park brake cables.

Park Brake Actuator/Adjuster

Uses multiplied input force from apply lever via the cables to expand park brake shoe toward the friction surface of the drum-in-hat portion of the rear brake rotor.
Threaded park brake actuators/adjusters are also used to control clearance between the park brake shoe and the friction surface of the drum-in-hat portion of the rear brake rotor.

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Park Brake Shoe (Rear Disc, Drum-In-Hat System)

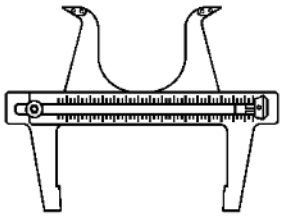
Applies mechanical output force from park brake actuator/adjuster to friction surface of the drum-in-hat portion of the rear brake rotor.

System Operation

Park brake apply input force is received by the park brake lever assembly being raised, transferred and evenly distributed, through the park brake cables and the park brake cable equalizer, to the left and right park brake apply levers. The park brake apply levers multiply and transfer the apply input force to the park brake actuators/adjusters which expand the park brake shoe toward the friction surface of the drum-in-hat portion of the rear brake rotor in order to prevent the rotation of the rear tire and wheel assemblies. The park brake lever assembly releases an applied park brake system when the lever is returned to the at-rest rest position.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description
	J 21177-A Drum to Brake Shoe Clearance Gauge

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