2007 BRAKES

Hydraulic Brakes - Avalanche, Escalade, Suburban, Tahoe & Yukon

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Brake Booster Nuts (Hydraulic Brake Booster)	33 N.m	24 lb ft
Brake Booster Nuts (Vacuum Brake Booster)	33 N.m	24 lb ft
Brake Hose Bracket to Axle Housing Bolt (1500 Series)	25 N.m	18 lb ft
Brake Hose Bracket to Axle Housing Bolt (2500 Series)	12 N.m	106 lb in
Brake Hose Bracket to Control Arm Bolt	9 N.m	80 lb in
Brake Hose Bracket to Frame Bolt (Front)	9 N.m	80 lb in
Brake Hose Bracket to Frame Bolt (Rear)	25 N.m	18 lb ft
Brake Hose Bracket to Rear Axle Bolt (1500 Series)	9 N.m	80 lb in
Brake Hose Bracket to Steering Knuckle Bolt	9 N.m	80 lb in
Brake Hose to Caliper Bolt (Front and Rear)	40 N.m	30 lb ft
Brake Pipe Fittings	25 N.m	18 lb ft
Master Cylinder Nuts	33 N.m	24 lb ft

BRAKE COMPONENT SPECIFICATIONS

Brake Component Specifications

Application	Specification	
	Metric	English
Brake Pressure Modulator Bleeder Valves	9 N.m	80 lb in
Brake Caliper Bleeder Valve (Front)	13 N.m	115 lb in
Brake Caliper Bleeder Valve (Rear)	11 N.m	97 lb in

BRAKE SYSTEM SPECIFICATIONS

Brake System Specifications

Application	Specification	
	Metric	English
Brake Pedal Maximum Travel*		
• Hydraulic Power Assist	90 mm	3.54 in
*Specification with 445 N (100 lb) of force applied to the brake pedal, the ignition OFF, and the brake booster power reserve depleted.		

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SCHEMATIC AND ROUTING DIAGRAMS

HYDRAULIC BRAKE SCHEMATICS

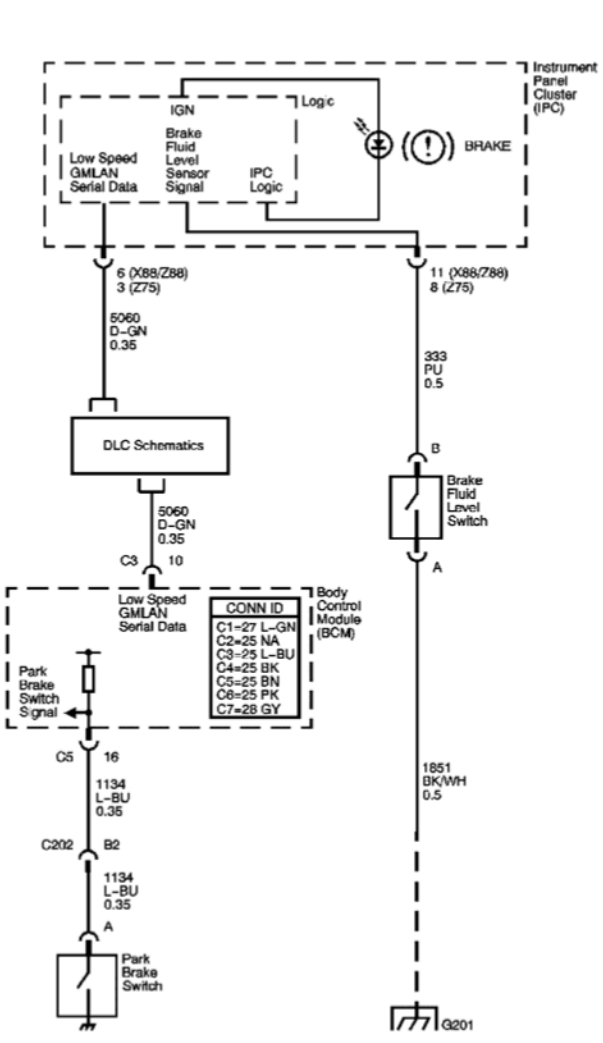


Fig. 1: Hydraulic Brake Schematic
Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

HYDRAULIC BRAKE COMPONENT VIEWS

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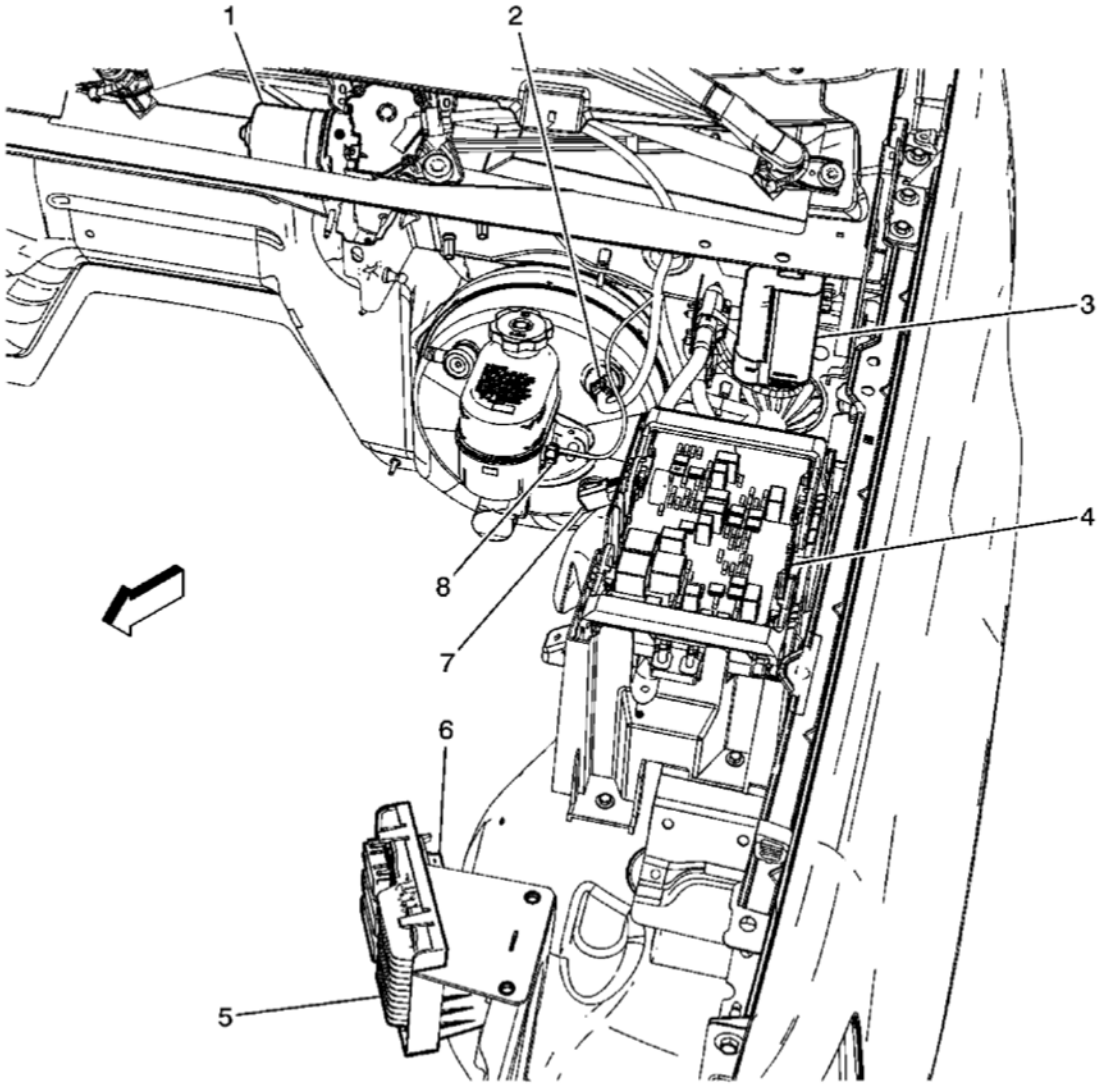


Fig. 2: Left Side of the Engine Compartment
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 2

Callout	Component Name
1	Windshield Wiper Motor
2	Power Brake Booster
3	Windshield Washer Solvent Heater
4	Fuse Block - Underhood
5	Engine Control Module (ECM)
6	Transmission Control Module (TCM)
7	Brake Booster Vacuum Sensor
8	Brake Fluid Level Switch

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HYDRAULIC BRAKE CONNECTOR END VIEWS

Park Brake Switch

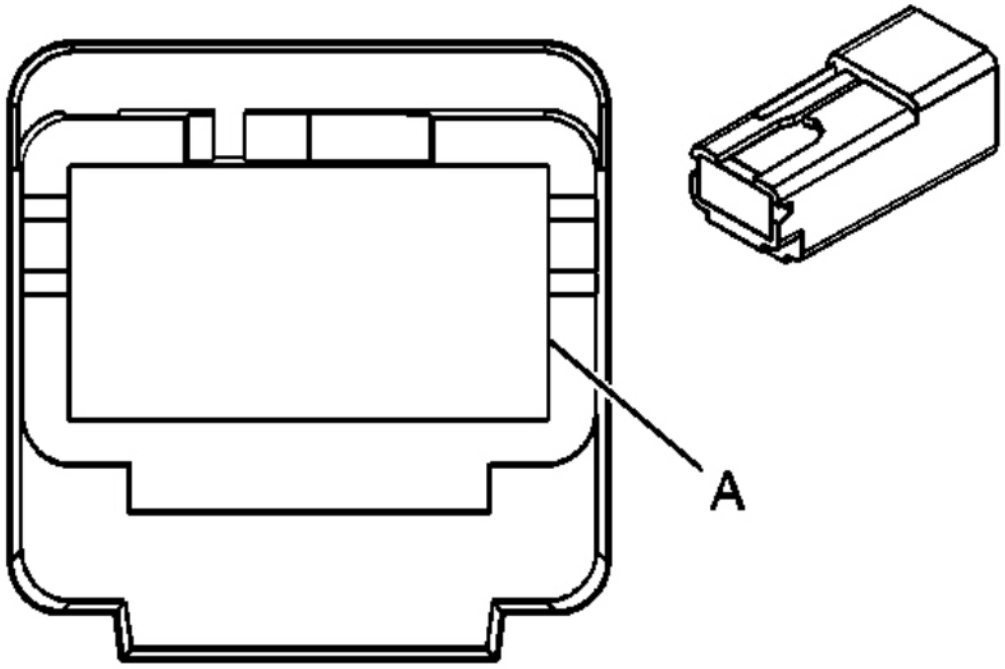


Fig. 3: Park Brake Switch Connector End View
Courtesy of GENERAL MOTORS CORP.

Park Brake Switch Connector Parts Information

Connector Part Information

- OEM: 12092133
- Service: 12167133
- Description: 1-Way F Metri-Pack 630 Series Self Lock (BK)

Terminal Part Information

- Terminal/Tray: 12103325/3
- Core/Insulation Crimp: A/B
- Release Tool/Test Probe: 12094430/J-35616-42 (RD)

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Park Brake Switch Connector Terminal Identification

Pin	Wire Color	Circuit No.	Function
A	L-BU	1134	Park Brake Switch Signal

Brake Fluid Level Switch

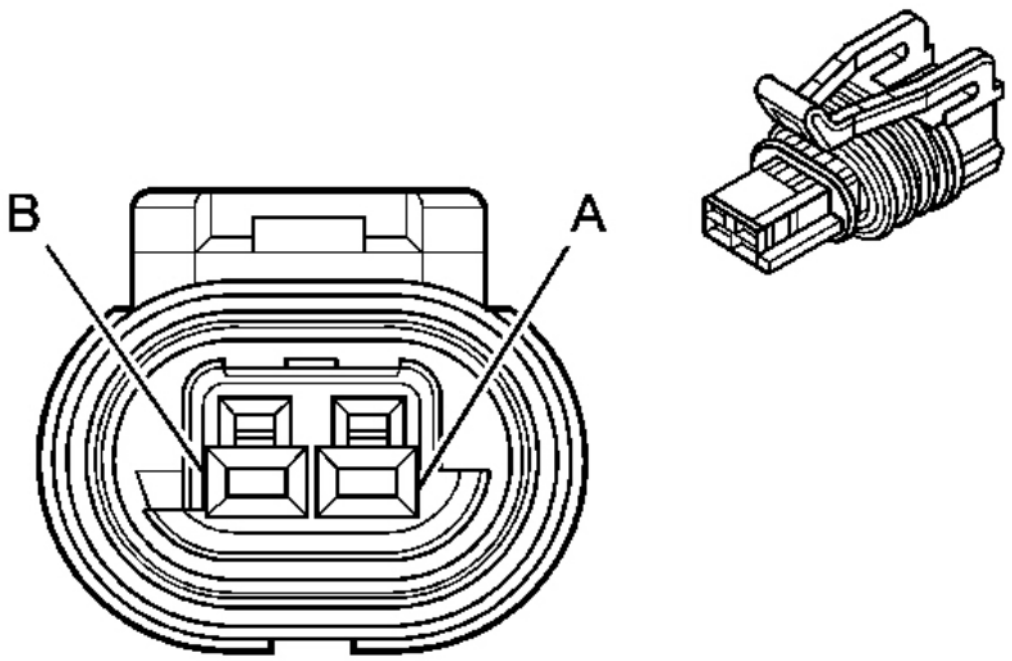


Fig. 4: Brake Fluid Level Switch Connector End View
Courtesy of GENERAL MOTORS CORP.

Brake Fluid Level Switch Connector Parts Information

Connector Part Information

- OEM: 15449028
- Service: 88987993
- Description: 2-Way F GT 150 Series, Sealed (BK)

Terminal Part Information

- Terminal/Tray: 15326267/19
- Core/Insulation Crimp: E/4

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- Release Tool/Test Probe: 15315247/J-35616-2A (GY)

Brake Fluid Level Switch Connector Terminal Identification

Pin	Wire Color	Circuit No.	Function
A	BK/WH	1851	Ground
B	PU	333	Brake Fluid Level Sensor Signal

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - HYDRAULIC BRAKES

Begin the system diagnosis by reviewing the system Description and Operation. Reviewing the Description and Operation information will help you determine the correct symptom diagnostic procedure when a malfunction exists. Reviewing the Description and Operation information will also help you determine if the condition described by the customer is normal operation. Refer to **Symptoms - Hydraulic Brakes** in order to identify the correct procedure for diagnosing the system and where the procedure is located.

DTC C0267

DTC Descriptor

DTC C0267

Low Brake Fluid Indicated

Diagnostic Fault Information

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

DTC C0267

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

Circuit/System Description

The brake fluid level switch monitors the level of brake fluid in the master cylinder. When the instrument panel cluster (IPC) sees the brake fluid level switch input grounded, it turns ON the Red Brake Warning indicator and sends a serial data message to the electronic brake control module (EBCM) that tells the EBCM that the brake fluid level is low.

Conditions for Running the DTC

The ignition is ON.

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Conditions for Setting the DTC

Low brake fluid is detected.

Action Taken When the DTC Sets

- The EBCM disables the Antilock Brake System (ABS)/Traction Control System (TCS) dynamic rear proportion (DRP) and (VSES) Vehicle Stability Enhancement System.
- The ABS indicator turns ON.
- The Traction Control indicator turns ON.
- The Red Brake Warning indicator turns ON.

Conditions for Clearing the DTC

- The condition for the DTC is no longer present.
- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

Antilock Brake System Connector End Views

Electrical Information Reference

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

Scan Tool Reference

Scan Tool Data List for EBCM

Circuit/System Verification

Inspect the master cylinder reservoir for the proper brake fluid level.

If brake fluid level is low, refer to **Brake Fluid Loss** Diagnostic Information and Procedures.

Circuit/System Testing

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Note: This test should only be performed if brake fluid is not low.

1. With the ignition OFF, disconnect the brake fluid level switch connector.
2. With the ignition ON, use a scan tool to observe the Brake Fluid Switch parameter in Instrument Panel Cluster.
   - If the Brake Fluid Switch parameter is OK, replace the brake fluid level switch.
   - If the Brake Fluid Switch parameter is Low, repair short to ground in signal circuit.
3. If all circuits test normal replace the IPC.

Repair Procedures

- **Master Cylinder Fluid Level Sensor Replacement**
- **Control Module References** for EBCM

Repair Verification

Diagnostic Repair Verification

SYMPTOMS - HYDRAULIC BRAKES

IMPORTANT: 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 Assist System Description and Operation (Hydraulic Assist)**
   - **Hydraulic Brake Component Operation Visual Inspection**

Visual/Physical Inspection

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

Intermittent

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

Symptom List

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

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

BRAKE WARNING INDICATOR ALWAYS ON

Diagnostic Fault Information

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

Circuit/System Description

The body control module (BCM) sees the park brake switch signal grounded, it sends a serial data message to the instrument panel cluster (IPC) requesting illumination of the Red Brake Warning indicator.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

Hydraulic Brake Connector End Views

Electrical Information Reference

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

Scan Tool Reference

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Scan Tool Data List

Circuit/System Testing

1. With the scan tool, select instrument panel special functions Lamp Test. Command the instrument panel lamps OFF. Verify the Red Brake Warning indicator turns OFF.
    - If the Red Brake Warning indicator does not turn OFF, replace the IPC.
2. Disconnect the park brake switch. With a scan tool, observe the Park Brake Switch parameter. Verify parameter is reading ON.
    - If the parameter is OFF, replace the park brake switch.
3. Test the park brake switch signal circuit for a short to ground. Verify no short is found.
    - If short is found, repair the circuit.
4. Replace the BCM.

Repair Procedures

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

- **Park Brake Warning Lamp Switch Replacement**
- **Control Module References** for IPC replacement, setup, and programming

BRAKE WARNING INDICATOR INOPERATIVE

Diagnostic Fault Information

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

Circuit/System Description

The instrument panel cluster (IPC) sees the brake fluid level switch input grounded and illuminates the Red Brake Warning indicator. The body control module (BCM) sees the park brake switch input grounded, it sends a serial data message to the IPC requesting illumination of the Red Brake Warning indicator.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

Hydraulic Brake Connector End Views

Electrical Information Reference

- **Circuit Testing**

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

Scan Tool Reference

Scan Tool Data List

Circuit/System Testing

1. With the scan tool, select instrument panel special functions Lamp Test. Command the instrument panel lamps ON. Verify brake lamp turns ON.
    - If the brake lamp does not turn ON, replace the IPC.
2. Release the park brake. Disconnect the brake fluid level switch. Connect a 3-amp jumper wire between the signal circuit of the brake fluid level switch and the ground circuit of the brake fluid level switch. Ignition ON, verify the brake lamp is ON.
    - If the brake lamp does not turn ON, test the signal circuit and ground circuit for a high resistance/open or replace the brake fluid level switch.
3. Disconnect the park brake switch. Connect a 3-amp jumper wire between signal circuit of the park brake switch and ground. Ignition ON, verify the Red Brake Warning indicator is ON.
    - If the Red Brake Warning indicator dose not turn ON, test the signal circuit high resistance/open or replace the BCM.
4. Replace the park brake switch.

Repair Procedures

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

- **Master Cylinder Fluid Level Sensor Replacement**
- **Park Brake Warning Lamp Switch Replacement**
- **Control Module References** for BCM and IPC replacement, setup, and programming

BRAKE PULSATION

Test Description

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

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

3: Antilock brake system operation could produce feedback through the brake pedal during application of the brake system.

Brake Pulsation

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Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
2	Inspect the suspension system for proper operation. Refer to **Diagnostic Starting Point - Suspension General Diagnosis** . Did you find and correct a condition?	Go to **Step 6**	Go to **Step 3**
3	Inspect the antilock brake system for proper operation. Refer to **Diagnostic Starting Point - Antilock Brake System** . Did you find and correct a condition?	Go to **Step 6**	Go to **Step 4**
4	Inspect the disc brake system for proper operation. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 6**	Go to **Step 5**
5	Inspect the hydraulic brake system for proper operation. Refer to **Hydraulic Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 6**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
6	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

Brake System Noise

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
2	Inspect the disc brake system for proper operation. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 9**	Go to **Step 3**
3	Inspect the brake assist system for proper operation. Refer to **Brake Assist System Diagnosis**. Did you find and correct a condition?	Go to **Step 9**	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 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 8**
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 8**

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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 - Hydraulic Brakes**
9	Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test**. Is the condition still present?	Go to **Step 2**	System OK

BRAKING ACTION UNEVEN - PULLS TO ONE SIDE

Test Description

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

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

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

Braking Action Uneven - Pulls to One Side

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
2	Inspect the suspension system for proper operation. Refer to **Diagnostic Starting Point - Suspension General Diagnosis** . Did you find and correct a condition?	Go to **Step 6**	Go to **Step 3**
3	Inspect the steering system for proper operation. Refer to **Diagnostic Starting Point - Power Steering System (w/o Electro-Hydraulic Steering)** . Did you find and correct a condition?	Go to **Step 6**	Go to **Step 4**
4	Inspect the hydraulic brake system for proper operation. Refer to **Hydraulic Brake System Diagnosis**.		

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	Did you find and correct a condition?	Go to **Step 6**	Go to **Step 5**
5	Inspect the disc brake system for proper operation. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 6**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
6	Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test**. Is the condition still present?	Go to **Step 2**	System OK

BRAKING ACTION UNEVEN - FRONT TO REAR

Test Description

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

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

Braking Action Uneven - Front to Rear

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
2	Inspect the suspension system for proper operation. Refer to **Diagnostic Starting Point - Suspension General Diagnosis** . Did you find and correct a condition?	Go to **Step 6**	Go to **Step 3**
3	Inspect the hydraulic brake system for proper operation. Refer to **Hydraulic Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 6**	Go to **Step 4**
4	Inspect the disc brake system for proper operation. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 6**	Go to **Step 5**
5	Inspect the brake assist system for proper operation. Refer to **Brake Assist System Diagnosis**. Did you find and correct a condition?	Go to **Step 6**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
6	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

Brake Pedal Excessive Travel

Step	Action	Yes	No
	Were you sent here from the		Go to **Diagnostic Starting Point -

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1	Hydraulic Brake Symptom Table?	Go to **Step 2**	**Hydraulic Brakes**
2	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 3**
3	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 bent and/or damaged condition. 2. Replace the brake pedal system components that are worn, missing, misaligned, bent or damaged, refer to the following procedure(s) as necessary. • **Brake Pedal Assembly Replacement** • **Power Brake Booster Replacement** , for pedal pushrod replacement. Did you find and replace any worn, missing, misaligned, bent or damaged brake pedal system components?	Go to **Step 4**	Go to **Step 5**
4	Reinspect for proper brake pedal travel. Refer to **Brake Pedal Travel Measurement and Inspection**. Is the brake pedal travel distance within the acceptable limits?	Go to **Step 8**	Go to **Step 5**
5	Inspect the hydraulic brake system for proper operation. Refer to **Hydraulic Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 8**	Go to **Step 6**
	Inspect the disc brake system for		

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6	proper operation. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 8**	Go to **Step 7**
7	Inspect the brake assist system for proper operation. Refer to **Brake Assist System Diagnosis**. Did you find and correct a condition?	Go to **Step 8**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
8	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

BRAKE PEDAL EXCESSIVE EFFORT

Brake Pedal Excessive Effort

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
2	Inspect the brake assist system for proper operation. Refer to **Brake Assist System Diagnosis**. Did you find and correct a condition?	Go to **Step 5**	Go to **Step 3**
3	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 **Step 4**
4	Inspect the disc brake system for proper operation. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 5**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
5	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

BRAKES DRAG

Brakes Drag

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
2	Is the vehicle equipped with a drum-in-rotor type of park brake system?	Go to **Step 3**	Go to **Step 5**
3	Ensure the park brake shoes are not adjusted too tightly, possibly causing drag under certain conditions. Are the park brake shoes adjusted too		

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	tightly?	Go to **Step 4**	Go to **Step 5**
4	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 12**	Go to **Step 5**
5	Inspect the park brake system for proper operation. Refer to **Park Brake System Diagnosis** in Park Brake. Did you find and correct a condition?	Go to **Step 12**	Go to **Step 6**
6	Inspect the disc brake system for proper operation. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 12**	Go to **Step 7**
7	1. Separate the brake booster pushrod from the brake pedal. Refer to **Brake Pedal Assembly Replacement**. 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 9**	Go to **Step 8**
8	Replace the brake pedal assembly. Refer to **Brake Pedal Assembly Replacement**. Did you complete the replacement?	Go to **Step 12**	-
9	1. Separate the master cylinder from the brake booster. Do not disconnect any brake pipes. Refer to **Master Cylinder Replacement (JD9)** or **Master Cylinder Replacement (JH6)**. 2. 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 11**	Go to **Step 10**
10	Replace the brake booster assembly. Refer to **Power Brake Booster Replacement**. Did you complete the replacement?	Go to **Step 12**	-
11	Inspect the hydraulic brake system for proper operation. Refer to **Hydraulic Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 12**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
12	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

BRAKE SYSTEM SLOW RELEASE

Brake System Slow Release

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
2	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 **Step 3**
3	Inspect the brake assist system for proper operation. Refer to **Brake Assist System Diagnosis**. Did you find and correct a condition?	Go to **Step 5**	Go to **Step 4**
4	Inspect the disc brake system for proper operation. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 5**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
5	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

BRAKE FLUID LOSS

Brake Fluid Loss

Step	Action	Yes	No

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1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
2	Inspect the hydraulic brake system for proper operation. Refer to **Hydraulic Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 4**	Go to **Step 3**
3	Inspect the disc brake system for proper operation. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 4**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
4	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

BRAKES SELF APPLY WHEN TURNING STEERING WHEEL

Brakes Self Apply When Turning Steering Wheel

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
2	Inspect the brake assist system for proper operation. Refer to **Brake Assist System Diagnosis**. Did you find and correct a condition?	Go to **Step 4**	Go to **Step 3**
3	Inspect the steering system for proper operation. Refer to **Diagnostic Starting Point - Power Steering System (w/o Electro-Hydraulic Steering)** in Power Steering System. Did you find and correct a condition?	Go to **Step 4**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
4	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

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.

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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.

Disc Brake System Diagnosis

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 - Hydraulic Brakes**
2	Visually inspect the disc brake pads for the following conditions: Refer to **Brake Pad Inspection** in Disc Brakes. • 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 (1500 Series)** or **Front Disc Brake Pads Replacement (2500 Series)** and/or **Rear Disc Brake Pads Replacement (1500 Series)** or **Rear Disc Brake Pads Replacement (2500 Series)** in Disc Brakes.	-	-

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	Did you complete the inspection and replacement?	Go to **Step 12**	
7	**NOTE:** **Support the brake caliper with heavy mechanic's 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.** **IMPORTANT:** **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 and support the calipers. Refer to **Front Brake Caliper Replacement (1500 Series)** or **Front Brake Caliper Replacement (2500 Series)** and/or **Rear Brake Caliper Replacement (1500 Series)** or **Rear Brake Caliper Replacement (2500 Series)** in Disc Brakes. 2. Inspect the disc brake caliper mounting bracket and the mounting/sliding hardware for the following conditions: Refer to **Disc Brake Mounting and Hardware Inspection - Front** and/or **Disc Brake Mounting and Hardware Inspection - Rear** in Disc Brakes. • Binding or seized hardware • Worn, damaged or missing hardware components • Loose, bent, cracked, or damaged caliper mounting bracket 3. Replace components as required. Refer to the following procedures in Disc Brakes, as required: • **Brake Caliper Bracket Replacement - Front (1500 Series)** **Brake Caliper Bracket Replacement - Front (2500 Series)** • **Rear Brake Caliper Bracket**		-

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	Replacement (1500 Series) **Rear Brake Caliper Bracket Replacement (2500 Series)** • **Disc Brake Hardware Replacement - Front (1500 Series)** **Disc Brake Hardware Replacement - Front (2500 Series)** • **Disc Brake Hardware Replacement - Rear (1500 Series)** **Disc Brake Hardware Replacement - Rear (2500 Series)** 4. Replace the unevenly-worn, loose or damaged disc brake pads as a complete axle set. Refer to **Front Disc Brake Pads Replacement (1500 Series)** or **Front Disc Brake Pads Replacement (2500 Series)** and/or **Rear Disc Brake Pads Replacement (1500 Series)** or **Rear Disc Brake Pads Replacement (2500 Series)** in Disc Brakes. Did you complete the inspection and replacement?	Go to **Step 12**	
8	1. Inspect the disc brake calipers, brake hoses and brake pipes for evidence of an external brake fluid leak. 2. Replace any components found to be leaking brake fluid. Refer to the following procedures as required: • **Front Brake Caliper Overhaul (2500 Series)** or **Front Brake Caliper Replacement (1500 Series)** **Front Brake Caliper Replacement (2500 Series)** in Disc Brakes • **Rear Brake Caliper Overhaul (2500 Series)** or **Rear Brake Caliper Replacement (1500 Series)** **Rear Brake Caliper Replacement (2500 Series)** in Disc Brakes • **Front Brake Hose Replacement (1500 Series)Front Brake Hose Replacement (2500 Series)** • **Rear Brake Hose Replacement (1500 Series)Rear Brake Hose Replacement (2500 Series)Rear Brake Hose Replacement (Frame to Rear Axle 1500 Series)Rear Brake Hose Replacement (Frame to Rear Axle 2500 Series)**		

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	• **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, if equipped, 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 and Seal Replacement** , if equipped, in Wheel Drive Shafts. 3. Inspect the rear axle seals for damage and evidence of a lubricant leak. 4. Replace any rear axle seal that is found to be leaking lubricant which may be the source of the contamination to the pads. Refer to **Rear Axle Shaft Seal and/or Bearing Replacement (8.6, 9.5 LD Axles)** or **Rear Axle Shaft Seal and/or Bearing Replacement (9.5 HD Axle)** or **Wheel Hub, Bearing, and Seal Replacement (1500 Series)** or **Wheel Hub, Bearing, and Seal Replacement (2500 Series)** in Rear Drive Axle. Did you find and correct the source of the leak causing contamination of the pads?	Go to **Step 11**	Go to **Step 10**
10	1. Inspect the automatic transmission cooling system lines, if equipped, for damage and evidence of an external fluid leak which may be the source of the contamination to the pads. 2. Inspect the power steering system hoses for damage and evidence of an external fluid leak which may be the source of the contamination to the pads. 3. Replace any components found to be leaking fluid which may be the source of the contamination to the pads. Did you find and correct the source of the leak causing contamination of the pads?	Go to **Step 11**	-
	1. Clean the remaining disc brake system components to remove any traces of the contaminant.		

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11	**NOTE:** **Support the brake caliper with heavy mechanic's 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.** **IMPORTANT:** **Do NOT disconnect the hydraulic brake flex hoses from the calipers.** 2. Remove the front and/or rear disc brake calipers, as appropriate, from the mounting brackets and support the calipers. Refer to **Front Brake Caliper Replacement (1500 Series)** or **Front Brake Caliper Replacement (2500 Series)** and/or **Rear Brake Caliper Replacement (1500 Series)** or **Rear Brake Caliper Replacement (2500 Series)** in Disc Brakes. 3. Inspect the disc brake caliper mounting/sliding hardware for the following conditions: Refer to **Disc Brake Mounting and Hardware Inspection - Front** and/or **Disc Brake Mounting and Hardware Inspection - Rear** in Disc Brakes. • Binding or seized hardware • Distorted, worn, damaged or missing hardware components 4. Replace the caliper mounting/sliding hardware components as required. Refer to **Disc Brake Hardware Replacement - Front (1500 Series)** or **Disc Brake Hardware Replacement - Front (2500 Series)** and/or **Disc Brake Hardware Replacement - Rear (1500 Series)** or **Disc Brake Hardware Replacement - Rear (2500 Series)** in Disc Brakes. 5. Replace the contaminated disc brake pads as a complete axle set. Refer to **Front Disc Brake Pads Replacement (1500 Series)** or **Front Disc Brake Pads Replacement (2500 Series)** and/or	-	

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	Rear Disc Brake Pads Replacement (1500 Series) or **Rear Disc Brake Pads Replacement (2500 Series)** in Disc Brakes. Did you complete the cleaning, inspection and replacement?	Go to **Step 12**	
12	Visually inspect each of the disc brake rotor shields/backing plates 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 **Disc Brake Splash Shield Replacement - Front (1500 Series)** or **Disc Brake Splash Shield Replacement - Front (2500 Series)** and/or **Disc Brake Backing Plate Replacement - Rear** in Disc Brakes. Did you complete the repair or replacement?	Go to **Step 14**	-
14	1. Check the thickness of each of the disc brake rotors. **IMPORTANT:** **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** in Disc Brakes.Does the disc brake rotor meet the minimum requirements for REFINISHING?	Go to **Step 15**	Go to **Step 18**
15	**IMPORTANT:** **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** in Disc Brakes.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:		

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16	Refer to **Brake Rotor Surface and Wear Inspection** in Disc Brakes. • Heavy rust and/or pitting • Cracks and/or heat spots • Excessive blueing discoloration • Deep or excessive scoring beyond maximum acceptable level **IMPORTANT:** **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** in Disc Brakes. 2. Inspect the brake rotor thickness. Refer to **Brake Rotor Thickness Measurement** in Disc Brakes. Were you able to REFINISH the brake rotor within the minimum requirements?	Go to **Step 22**	Go to **Step 21**
18	Is the brake rotor at or below the DISCARD requirements?	Go to **Step 21**	Go to **Step 19**
19	**IMPORTANT:** **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** in Disc Brakes.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:		

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20	Refer to **Brake Rotor Surface and Wear Inspection** in Disc Brakes. • Heavy rust and/or pitting • Cracks and/or heat spots • Excessive blueing discoloration • Deep or excessive scoring beyond maximum acceptable level **IMPORTANT:** **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	**IMPORTANT:** **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 (1500 Series)** or **Front Brake Rotor Replacement (2500 Series)** or **Rear Brake Rotor Replacement (1500 Series)** or **Rear Brake Rotor Replacement (2500 Series)** in Disc Brakes.Did you complete the replacement?	Go to **Step 24**	-
22	**IMPORTANT:** **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** in Disc Brakes.Does the brake rotor exhibit assembled LRO that exceeds the maximum acceptable level?	Go to **Step 23**	Go to **Step 24**
	Correct the LRO for each brake rotor that was determined to have LRO exceeding the maximum		

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23	acceptable level. Refer to **Brake Rotor Assembled Lateral Runout Correction** in Disc Brakes. Did you complete the operation?	Go to **Step 24**	-
24	Install or connect components that were removed or disconnected during diagnosis. Did you complete the operation?	Disc Brake System OK Return to Symptom Table	-

HYDRAULIC BRAKE SYSTEM DIAGNOSIS

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 - Hydraulic Brakes**
2	Inspect and adjust the brake fluid level in the brake master cylinder. Refer to **Master Cylinder Reservoir Filling**. Was the brake fluid level low?	Go to **Step 3**	Go to **Step 4**
3	1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination: • Fluid separation, indicating two types of fluid are present ○ Swirled appearance - oil-based substance ○ Layered appearance - silicone-based substance • Fluid discoloration ○ Cloudy appearance - moisture ○ Dark appearance/suspended particles in fluid - dirt, rust, corrosion, brake dust 2. Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating fluid contamination. Do any of the above conditions exist?	Go to **Step 5**	Go to **Step 6**
	1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination:		

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4	• Fluid separation, indicating two types of fluid are present ○ Swirled appearance - oil-based substance ○ Layered appearance - silicone-based substance • Fluid discoloration ○ Cloudy appearance - moisture ○ Dark appearance/suspended particles in fluid - dirt, rust, corrosion, brake dust 2. Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating fluid contamination. Do any of the above conditions exist?	Go to **Step 5**	Go to **Step 12**
	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 (JD9)Master Cylinder Replacement (JH6)** • Brake master cylinder reservoir: Clean the brake master cylinder reservoir using denatured alcohol, or		

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5	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 (1500 Series)Front Brake Hose Replacement (2500 Series)** • **Rear Brake Hose Replacement (1500 Series)Rear Brake Hose Replacement (2500 Series)Rear Brake Hose Replacement (Frame to Rear Axle 1500 Series)Rear Brake Hose Replacement (Frame to Rear Axle 2500 Series)** • **Front Brake Caliper Overhaul (2500 Series)** or **Front Brake Caliper Replacement (1500 Series) Front Brake Caliper Replacement (2500 Series)** • **Rear Brake Caliper Overhaul (2500 Series)** or **Rear Brake Caliper Replacement (1500 Series) Rear Brake Caliper Replacement (2500 Series)** • **Brake Pressure Modulator Valve Replacement (W/JL4) Brake Pressure Modulator Valve Replacement (W/O JL4)** 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		

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6	replace any of the components found to be leaking brake fluid. Refer to the appropriate procedures: • **Master Cylinder Replacement (JD9) Master Cylinder Replacement (JH6)** Brake master cylinder reservoir cap diaphragm • **Front Brake Hose Replacement (1500 Series)Front Brake Hose Replacement (2500 Series)** • **Rear Brake Hose Replacement (1500 Series)Rear Brake Hose Replacement (2500 Series)Rear Brake Hose Replacement (Frame to Rear Axle 1500 Series)Rear Brake Hose Replacement (Frame to Rear Axle 2500 Series)** • **Brake Pipe Replacement** • **Front Brake Caliper Overhaul (2500 Series)** or **Front Brake Caliper Replacement (1500 Series) Front Brake Caliper Replacement (2500 Series)** • **Rear Brake Caliper Overhaul (2500 Series)** or **Rear Brake Caliper Replacement (1500 Series) Rear Brake Caliper Replacement (2500 Series)** • **Brake Pressure Modulator Valve Replacement (W/JL4) Brake Pressure Modulator Valve Replacement (W/O JL4)** 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**

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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**	-
12	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 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**
	Repair or replace any brake caliper that was not operating properly. Refer to the appropriate procedure: • **Front Brake Caliper Overhaul (2500 Series)** or **Front Brake Caliper Replacement (1500 Series)** or **Front Brake Caliper Replacement (2500 Series)**		

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14	• **Rear Brake Caliper Overhaul (2500 Series)** or **Rear Brake Caliper Replacement (1500 Series)** or **Rear Brake Caliper Replacement (2500 Series)** 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**
17	1. Inspect the hydraulic brake pipes and flexible brake hoses for signs of a fluid restriction; such as being bent, kinked, pinched or damaged. Refer to **Brake Pipe and Hose Inspection**. 2. Replace any of the hydraulic brake pipes and/or flexible brake hoses found to be bent, kinked, pinched, or damaged. Refer to the following procedures as necessary: • **Front Brake Hose Replacement (1500 Series)Front Brake Hose Replacement (2500 Series)** • **Rear Brake Hose Replacement (1500 Series)Rear Brake Hose Replacement (2500 Series)Rear Brake Hose Replacement (Frame to Rear Axle 1500 Series)Rear Brake Hose Replacement (Frame to Rear Axle 2500 Series)** • **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 (W/JL4)** or **Brake Pressure Modulator Valve Replacement (W/O**		-

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	JL4) . 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. Repair or replace the brake master cylinder if it is found to be leaking brake fluid internally. Refer to **Master Cylinder Replacement (JD9)** or **Master Cylinder Replacement (JH6)**. Did you find and correct a condition?	Go to **Step 21**	Return to Symptom Table
21	Install or connect components that were removed or disconnected during diagnosis. Did you complete the operation?	Hydraulic Brake System OK Return to Symptom Table	-

BRAKE ASSIST SYSTEM DIAGNOSIS

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 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
2	Is the symptom related to brake system noise?	Go to **Step 4**	Go to **Step 3**
3	Is the symptom related to the brake system self-applying when the steering wheel is being turned?	Go to **Step 14**	Go to **Step 9**
4	Check the hydraulic assist system operation for the presence of abnormal noise. Refer to **Hydraulic Brake Assist System Noise Inspection**. Did the noise inspection indicate a concern with the		

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	power steering system drive belt?	Go to **Step 5**	Go to **Step 6**
5	Replace the power steering system drive belt. Refer to the appropriate procedure: **Drive Belt Replacement - Accessory** . Did you complete the replacement?	Go to **Step 6**	-
6	Did the noise inspection indicate a possible restriction in the hydraulic brake booster power steering system return hose?	Go to **Step 7**	Go to **Step 8**
7	Replace the restricted hydraulic brake booster power steering return hose. Refer to **Power Brake Booster Outlet Hose Replacement** . Did you complete the replacement?	Go to **Step 8**	-
8	During the noise inspection, did the hydraulic brake booster produce abnormal noises?	Go to **Step 14**	Go to **Step 9**
9	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 12**	Go to **Step 10**
10	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, refer to the following procedures as necessary. • **Brake Pedal Assembly Replacement** • **Power Brake Booster Replacement** for a bent or damaged pedal pushrod replacement Did you find and replace any worn, missing, misaligned, bent or damaged brake pedal system components?	Go to **Step 11**	Go to **Step 12**
11	Reinspect 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 14**	Go to **Step 12**
	1. Inspect the power steering drive belt for conditions which could cause slipping.		

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12	2. Replace the power steering drive belt if necessary. Refer to the appropriate procedure: 3. **Drive Belt Replacement - Accessory** . 4. Check the power steering system fluid level and adjust the level if necessary. Refer to **Checking and Adding Power Steering Fluid (With Hydroboost)** or **Checking and Adding Power Steering Fluid (Without Hydroboost)** . Did you complete the operations?	Go to **Step 13**	-
13	1. With the ignition OFF, depress the brake pedal four times or until the effort required to apply the pedal increases significantly. 2. Maintain moderate foot pressure on the brake pedal and start the engine. Observe pedal operation. Did the brake pedal fall slightly, then hold after the engine was started?	Go to **Step 16**	Go to **Step 14**
14	1. Inspect the power steering system pressure supplying the hydro-boost unit. Refer to **Power Steering System Test** . 2. Replace power steering components as indicated by the results of the pressure analysis. Did you find and correct a condition?	Go to **Step 15**	Go to **Step 19**
15	1. With the ignition OFF, depress the brake pedal four times or until the effort required to apply the pedal increases significantly. 2. Maintain moderate foot pressure on the brake pedal and start the engine. Observe pedal operation. Did the brake pedal fall slightly, then hold after the engine was started?	Go to **Step 16**	Go to **Step 19**
16	1. Release the brake pedal. 2. Allow the engine to continue to idle in order to pressurize the system. 3. Turn the ignition OFF. 4. Wait 90 seconds, then depress the brake pedal two times to check for hydraulic brake booster immediate reserve. Observe pedal effort.		

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	Did the brake pedal apply effort significantly increase when the brake pedal was applied the second time?	Go to **Step 19**	Go to **Step 17**
17	1. Release the brake pedal. 2. Start the engine to pressurize the system. 3. Turn the ignition OFF. 4. Wait 1 hour, then depress the brake pedal four times to check for hydraulic brake booster accumulator reserve leak-down. Observe pedal effort. Did the brake pedal apply effort significantly increase when the brake pedal was applied the fourth time?	Go to **Step 18**	Go to **Step 20**
18	Replace the hydraulic brake booster accumulator assembly. Refer to **Hydraulic Brake Booster Accumulator Replacement**. Did you complete the replacement?	Go to **Step 20**	-
19	Replace the hydraulic brake booster assembly. Refer to **Power Brake Booster Replacement**. Did you complete the replacement?	Go to **Step 20**	-
20	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

CAUTION: 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.

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

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

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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 Gage. 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**.

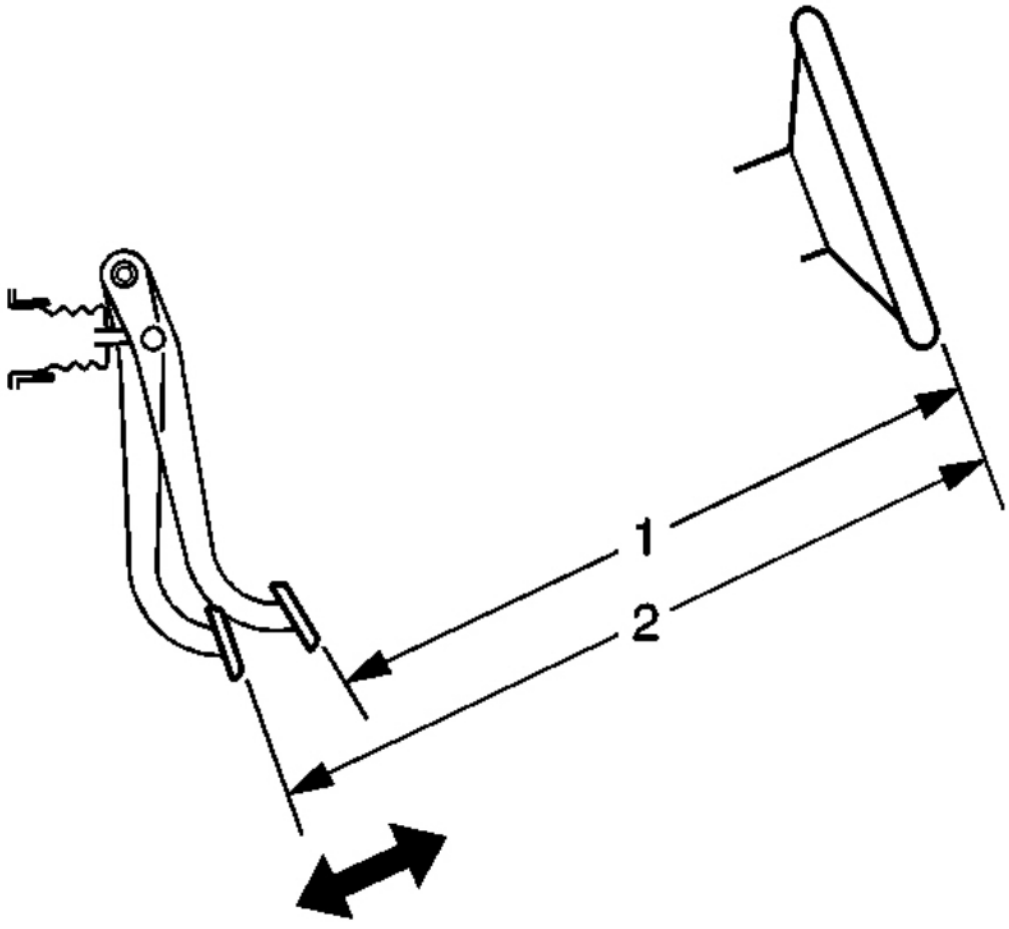


Fig. 5: Measuring Brake Pedal Travel

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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 brake pedal travel distance.

Specification: Hydraulic assist equipped, maximum brake pedal travel (measured with the ignition OFF, brake booster power assist depleted, and the brakes cool): 90 mm (3.54 in)

HYDRAULIC BRAKE ASSIST SYSTEM NOISE INSPECTION

Tools Required

J 28662 Brake Pedal Effort Gage. See **Special Tools**.

1. Install the **J 28662** to the brake pedal. See **Special Tools**.
2. Start the engine and allow it to idle. Ensure that the wheels are directed straight ahead.
3. Apply and maintain the brakes with 111 N (25 lb) of force to the brake pedal, as indicated on the **J 28662** . See **Special Tools**. Observe for noises.
4. Quickly release the brakes. Observe for noises.
5. If chatter and/or a vibration of the brake pedal was apparent during the brake system apply of 111 N (25 lb) of force, the power steering pump drive belt not may have proper tension or may be excessively worn.
6. If any significant noise was apparent during the quick release of the brakes following the brake system apply of 111 N (25 lb) of force, there is likely a restriction in the hydraulic brake booster power steering return hose.

IMPORTANT: Do NOT apply 445 N (100 lb) of force or more to the brake system pedal for more than 5 seconds at a time.

7. Apply the brakes with 178 N (40 lb) of force to the brake pedal, as indicated on the **J 28662** , then gradually increase pedal effort up to 445 N (100 lb) of force for not more than 5 seconds at a time. See **Special Tools**. Observe for noises.
8. Quickly release the brakes. Observe for noises.
9. If a hiss noise was apparent and increased during the brake system increasing apply of 178-445 N (40-100 lb) of force, the hydraulic brake booster assist system is operating normally from an audible standpoint.

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10. If a clunk, chatter, and/or clicking noise was apparent during the quick release of the brakes following the brake system increasing apply of 178-445 N (40-100 lb) of force, the hydraulic brake booster assist system is operating normally from an audible standpoint.

BRAKE SYSTEM EXTERNAL LEAK INSPECTION

CAUTION: Refer to Brake Fluid Irritant Caution .

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice .

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.

BRAKE SYSTEM INTERNAL LEAK TEST

CAUTION: Refer to Brake Fluid Irritant Caution .

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NOTE: **Refer to Brake Fluid Effects on Paint and Electrical Components Notice .**

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)** .

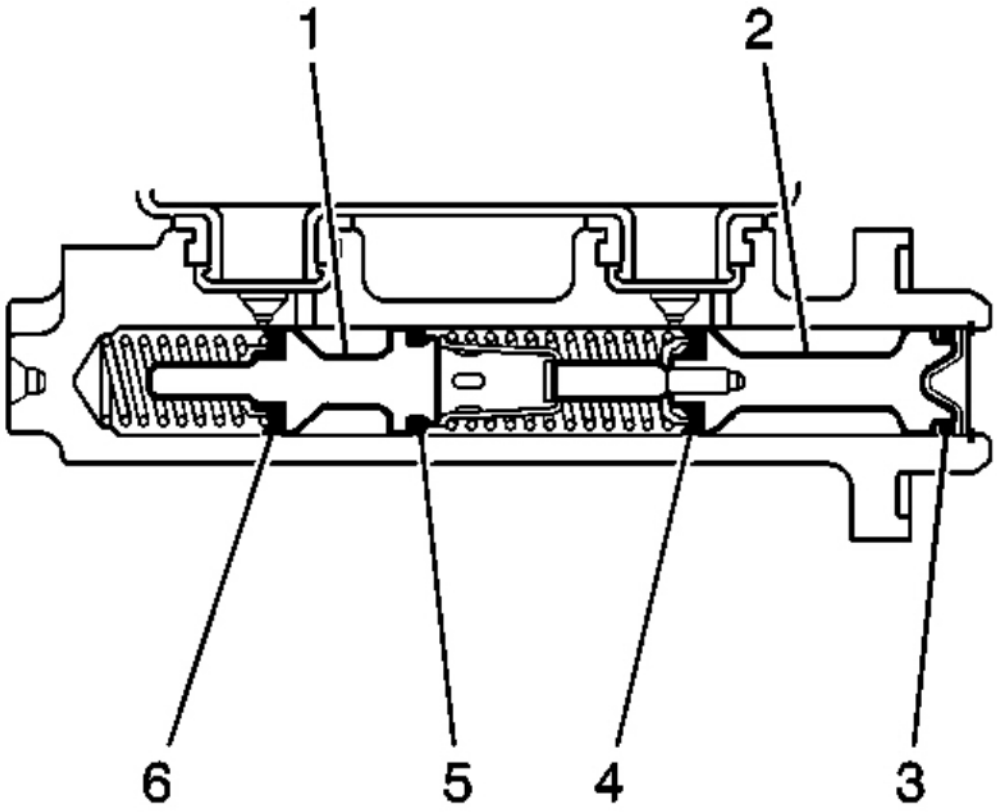


Fig. 6: Cross Sectional View Of Brake Master Cylinder
Courtesy of GENERAL MOTORS CORP.

5. If the brake pedal apply did not feel spongy, but the brake pedal travel was excessive, perform the

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following steps:

1. Loosen the master cylinder-to-brake power booster mounting nuts.
2. Carefully pull the master cylinder away from the brake power booster just enough to inspect the mounting surface of the master cylinder.
3. Inspect the master cylinder mounting surface at the primary piston (2) for brake fluid leaks.

6. If the master cylinder exhibits any leakage around the primary piston (2), then the primary piston primary seal (4) and/or secondary seal (3) is leaking and the master cylinder requires overhaul or replacement.
7. If the master cylinder primary piston (2) does not exhibit any leakage, pressure bleed the brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.
8. If the brake pedal apply did not feel spongy, and the brake pedal travel was initially steady and not excessive, but then gradually fell, then the master cylinder requires overhaul or replacement due to an internal leak past the secondary piston (1) from the secondary piston primary seal (6) or secondary seal (5).
9. If the brake pedal apply did not feel spongy, and the brake pedal travel was initially steady and not excessive, then fell slightly, then became steady again, then the brake pressure modulator valve (BPMV) may be leaking internally, and may require replacement.

HYDRAULIC BRAKE COMPONENT OPERATION VISUAL INSPECTION

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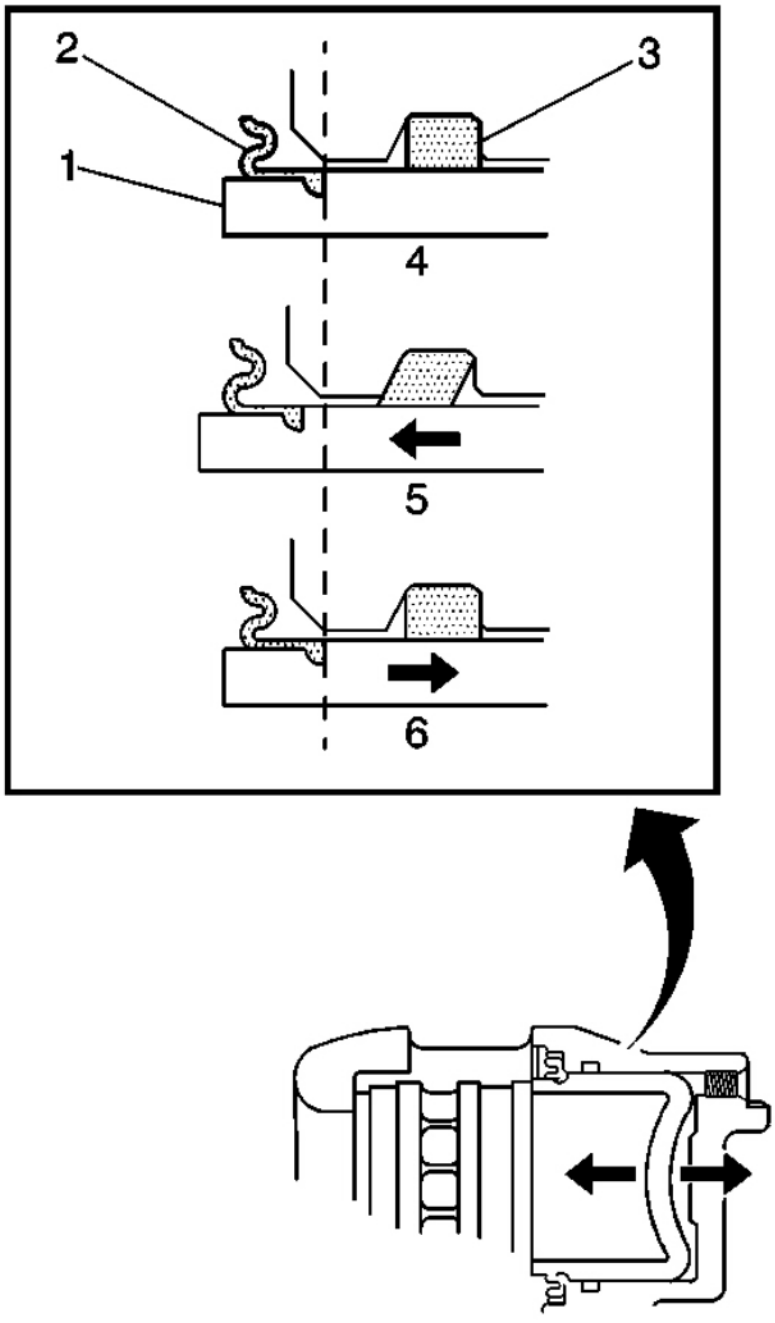


Fig. 7: Identifying Brake Caliper/Pad Inspection Areas
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Brake Fluid Irritant Caution .

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NOTE: **Refer to Brake Fluid Effects on Paint and Electrical Components Notice .**

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

CAUTION: Refer to Brake Fluid Irritant Caution .

NOTE: **Refer to Brake Fluid Effects on Paint and Electrical Components Notice .**

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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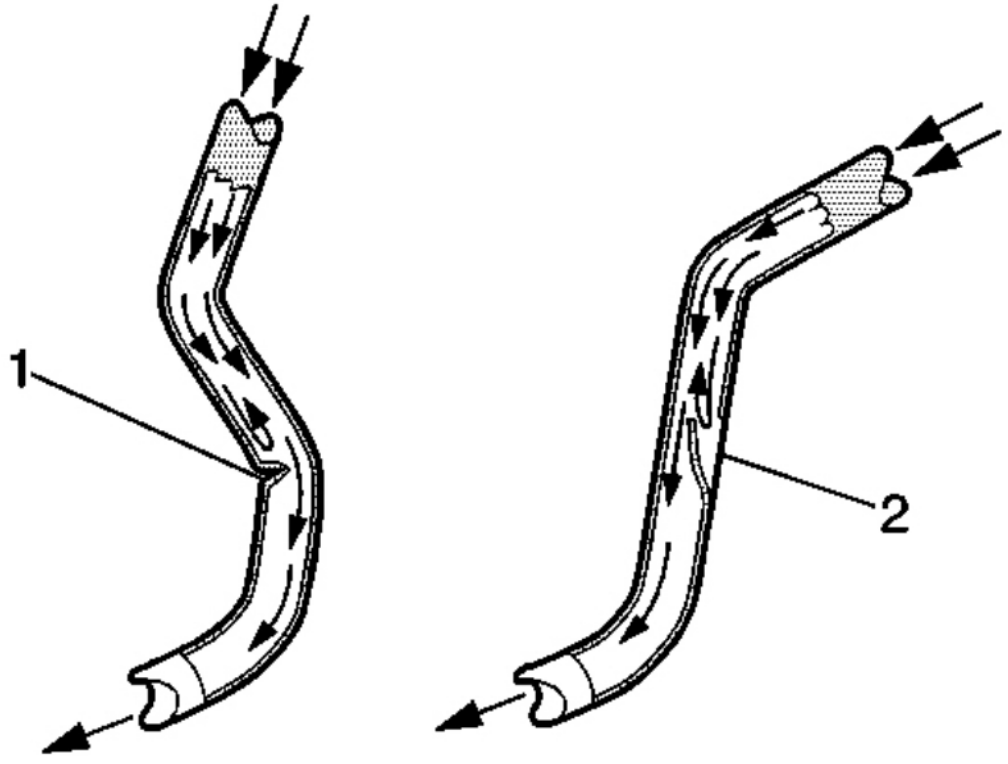


Fig. 8: Identifying Flexible Brake Hose Failure Conditions
Courtesy of GENERAL MOTORS CORP.

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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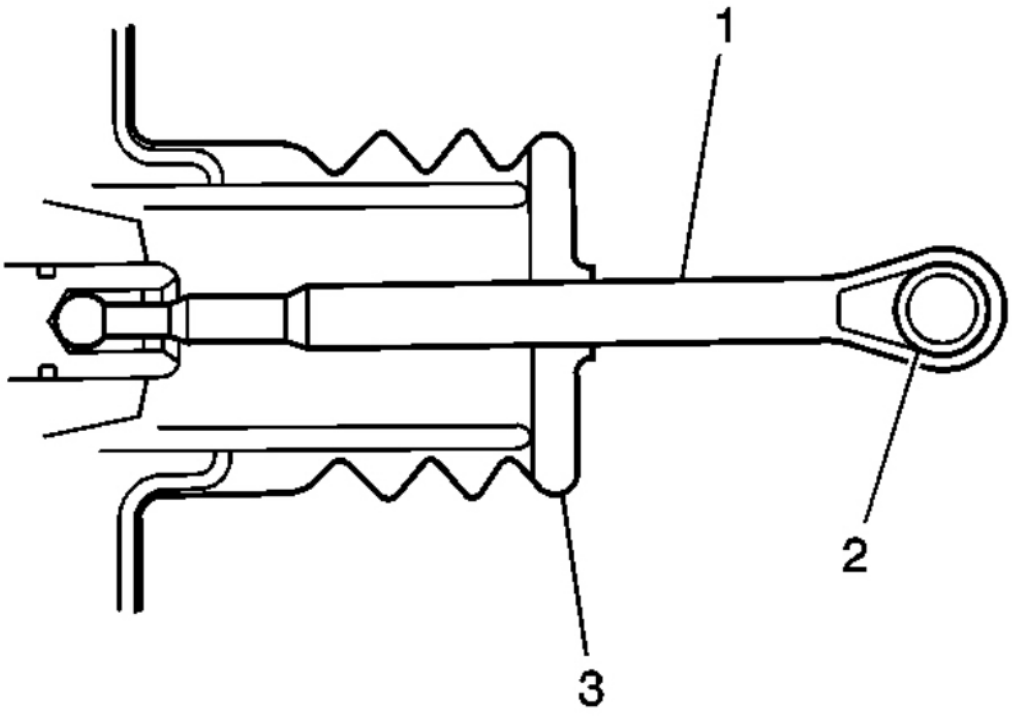


Fig. 9: View of Brake Pedal Pushrod
Courtesy of GENERAL MOTORS CORP.

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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CAUTION: Refer to Brake Fluid Irritant Caution .

NOTE: When adding fluid to the brake master cylinder reservoir, use only Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container. The use of any type of fluid other than the recommended type of brake fluid, may cause contamination which could result in damage to the internal rubber seals and/or rubber linings of hydraulic brake system components.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice .

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 Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container.

MASTER CYLINDER RESERVOIR REPLACEMENT

Removal Procedure

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

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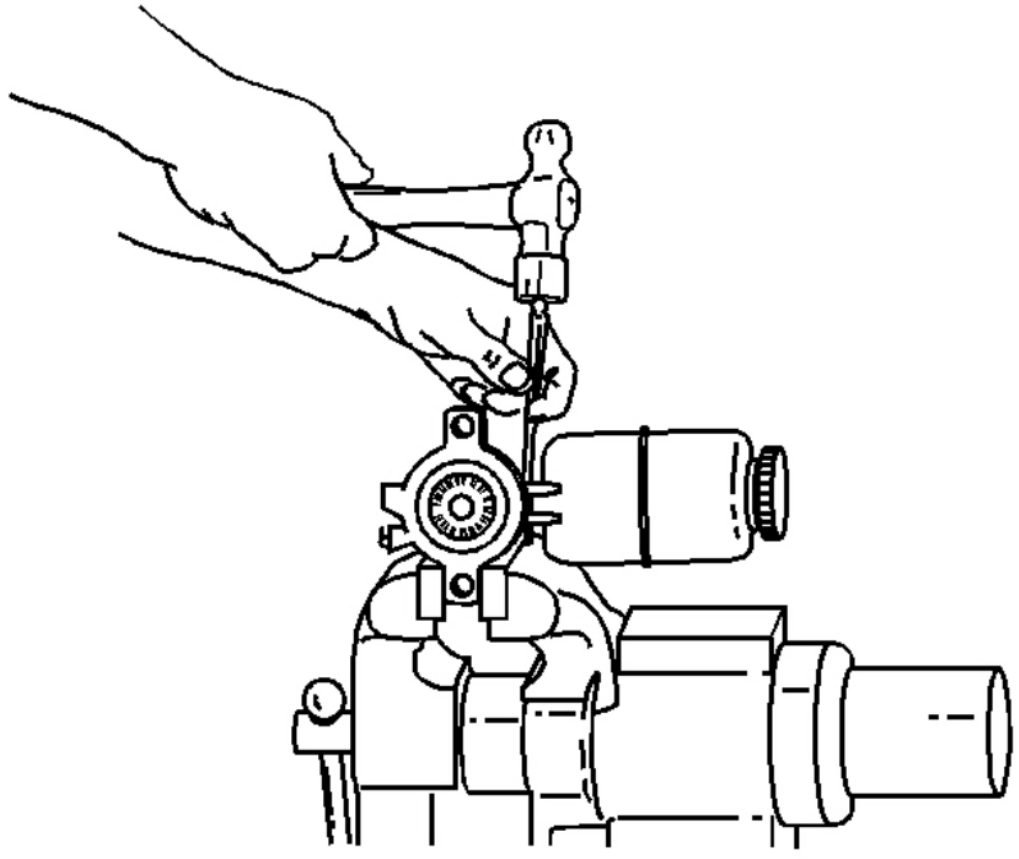


Fig. 10: Removing Reservoir Retaining Pins
Courtesy of GENERAL MOTORS CORP.

1. Apply the park brake and block the wheels.
2. Remove the master cylinder. Refer to **Master Cylinder Replacement (JD9)** or **Master Cylinder Replacement (JH6)**.
3. Drain the master cylinder reservoir.
4. Secure the master cylinder in a vise. Do not clamp the master cylinder body, secure only at the flange.
5. Remove the brake fluid level sensor by carefully depressing the retaining tabs and pushing the sensor through the reservoir.
6. Carefully remove the reservoir retaining pins.

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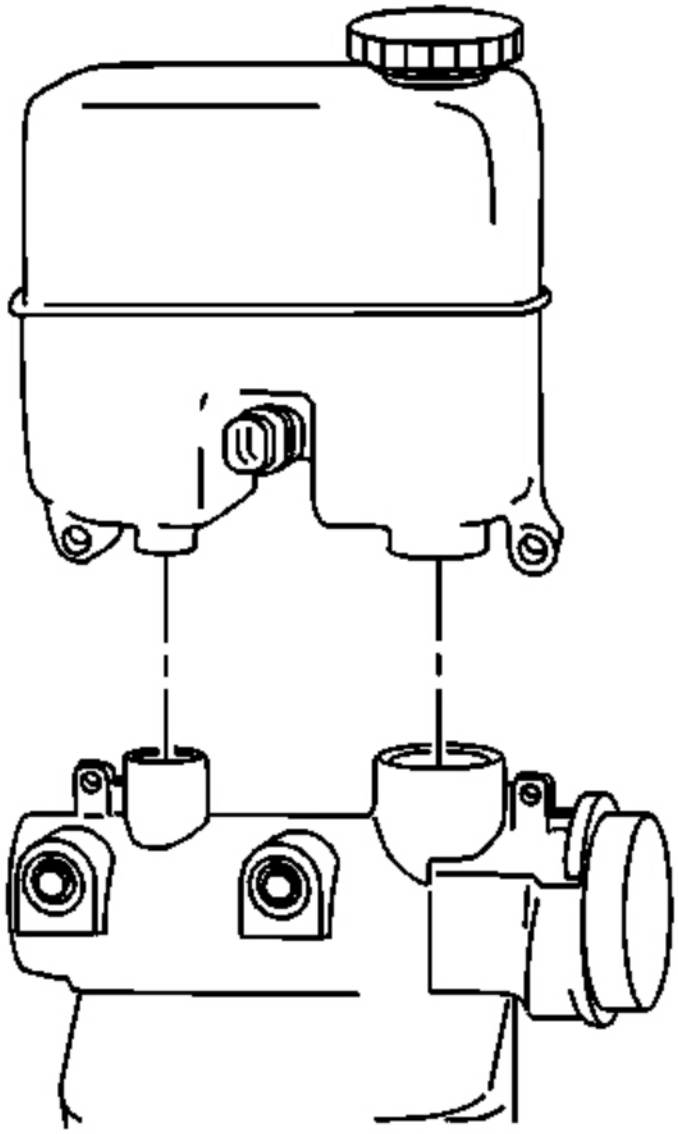


Fig. 11: View Of Master Cylinder Reservoir
Courtesy of GENERAL MOTORS CORP.

7. Remove the reservoir from the master cylinder by pulling the reservoir straight up and away from the cylinder.
8. Remove the seals from the master cylinder.

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Installation Procedure

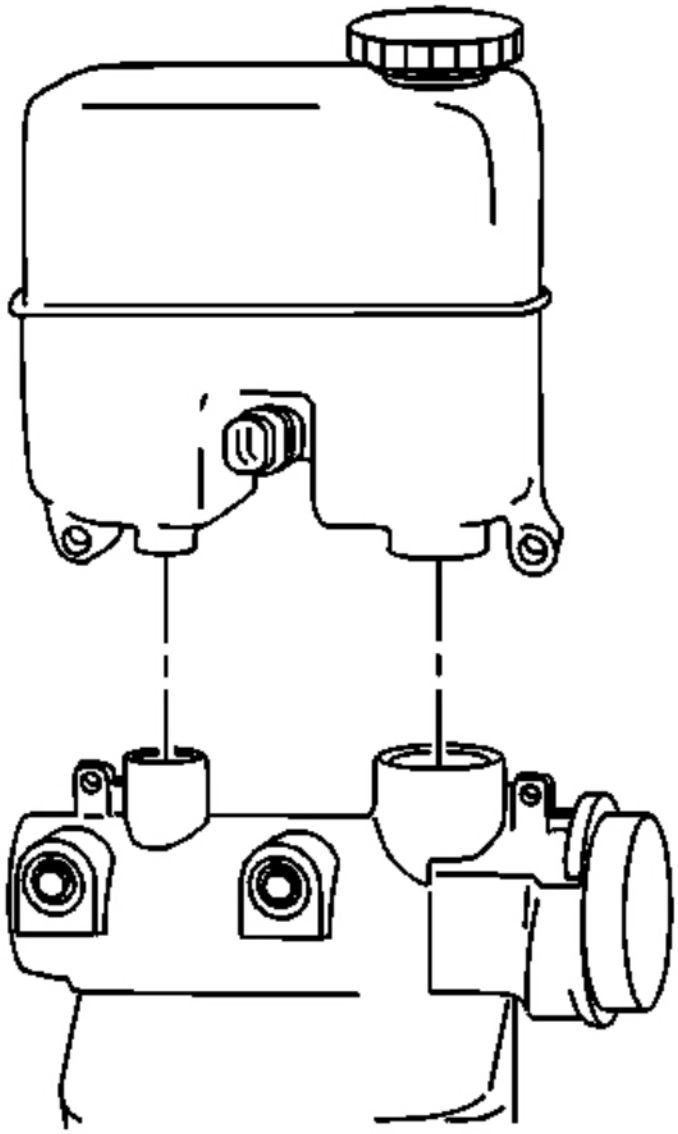


Fig. 12: View Of Master Cylinder Reservoir
Courtesy of GENERAL MOTORS CORP.

1. Inspect the reservoir for cracks or deformation. If found, replace the reservoir.
2. Clean the reservoir with denatured alcohol, or equivalent.

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3. Dry the reservoir with non-lubricated, filtered air.
4. Lubricate the new seals and the outer surface area of the reservoir-to-housing barrels with Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667) or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container.
5. Install the lubricated seals. Ensure that they are fully seated.
6. Install the reservoir to the master cylinder by pressing the reservoir straight down on the master cylinder until the pin holes are aligned.

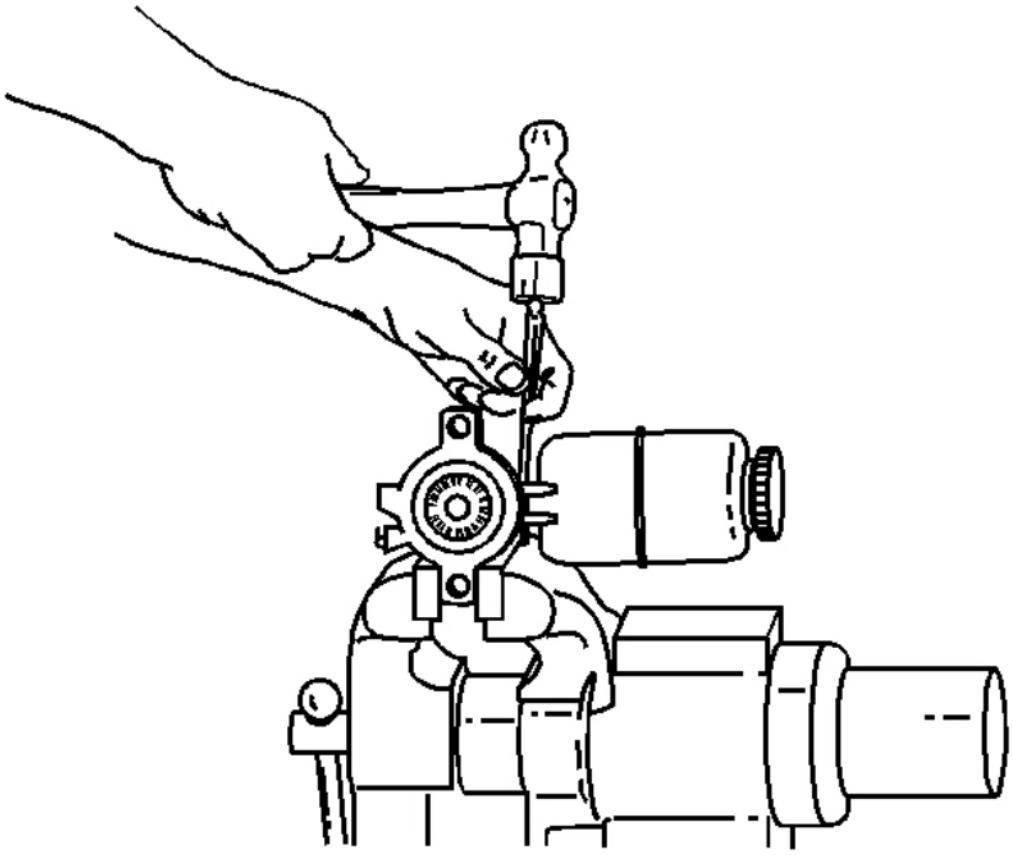


Fig. 13: Removing Reservoir Retaining Pins
Courtesy of GENERAL MOTORS CORP.

7. Carefully install the reservoir retaining pins to secure the reservoir.
8. Place the brake fluid level sensor into the reservoir, press into place to secure the sensor retaining tabs.
9. Remove the master cylinder from the vice.

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10. Install the master cylinder. Refer to **Master Cylinder Replacement (JD9)** or **Master Cylinder Replacement (JH6)**.
11. Release the park brake.
12. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.

MASTER CYLINDER REPLACEMENT (JD9)

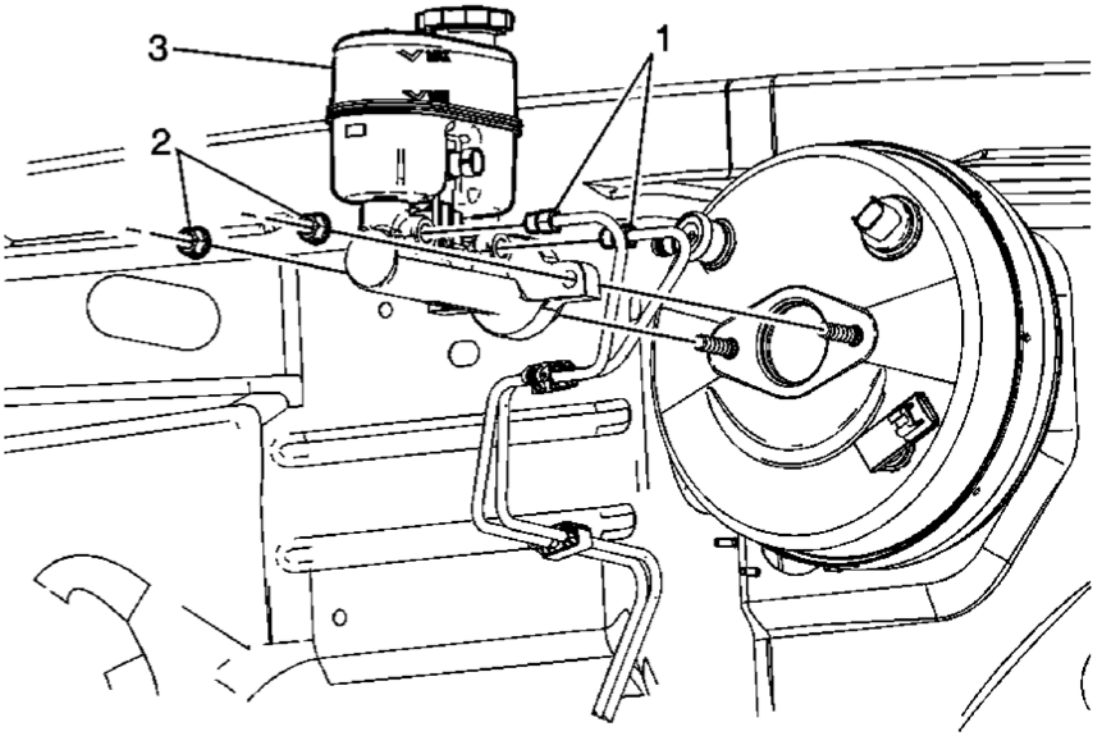


Fig. 14: View Of Master Cylinder & Components
Courtesy of GENERAL MOTORS CORP.

Master Cylinder Replacement (JD9)

Callout	Component Name
CAUTION: Refer to Brake Fluid Irritant Caution . **CAUTION:** Refer to Brake Fluid Effects on Paint and Electrical Components Notice .	
	Brake Pipe Fitting (Qty: 2) **NOTE:** Refer to Fastener Notice .

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1	**Tighten:** 25 N.m (18 lb ft) **Tip:** • Using a suitable tool, remove the brake fluid from the master cylinder reservoir. • Cap or plug the brake pipes to prevent brake fluid loss and the contamination of the brake system.
2	Master Cylinder Nuts (Qty: 2) **Tighten:** 33 N.m (24 lb ft)
3	Brake Master Cylinder **Tip:** • Disconnect/connect the brake fluid level sensor electrical connector. • Bleed the brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.

MASTER CYLINDER REPLACEMENT (JH6)

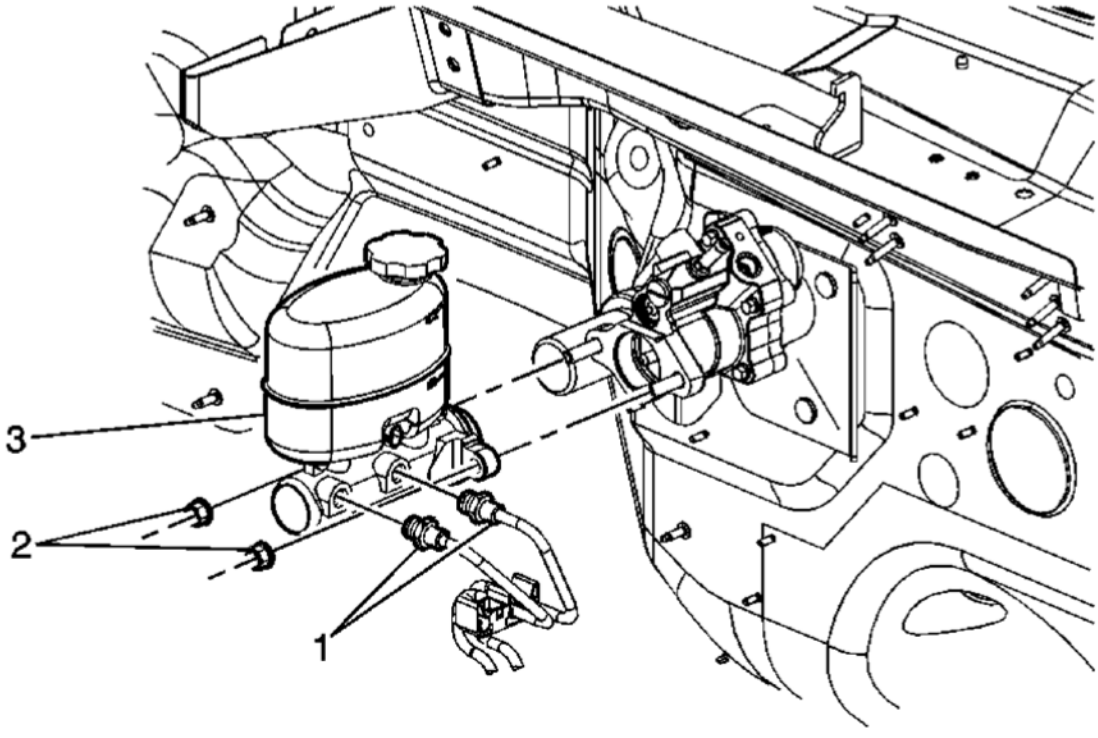


Fig. 15: View Of Master Cylinder & Components
Courtesy of GENERAL MOTORS CORP.

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Master Cylinder Replacement (JH6)

Callout	Component Name
CAUTION: Refer to Brake Fluid Irritant Caution . **CAUTION:** Refer to Brake Fluid Effects on Paint and Electrical Components Notice .	
1	Brake Pipe Fitting (Qty: 2) **NOTE:** Refer to Fastener Notice . **Tighten:** 25 N.m (18 lb ft) **Tip:** • Using a suitable tool, remove the brake fluid from the master cylinder reservoir. • Cap or plug the brake pipes to prevent brake fluid loss and contamination of the brake system.
2	Brake Master Cylinder Nuts (Qty: 2) **Tighten:** 33 N.m (24 lb ft)
3	Brake Master Cylinder **Tip:** • Disconnect/connect the brake fluid level sensor electrical connector. • Bleed the brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.

MASTER CYLINDER BENCH BLEEDING

CAUTION: Refer to Brake Fluid Irritant Caution .

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice .

NOTE: When adding fluid to the brake master cylinder reservoir, use only Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container. The use of any type of fluid other than the recommended type of brake fluid, may cause contamination which could result in damage to the internal rubber seals and/or rubber linings of hydraulic brake system components.

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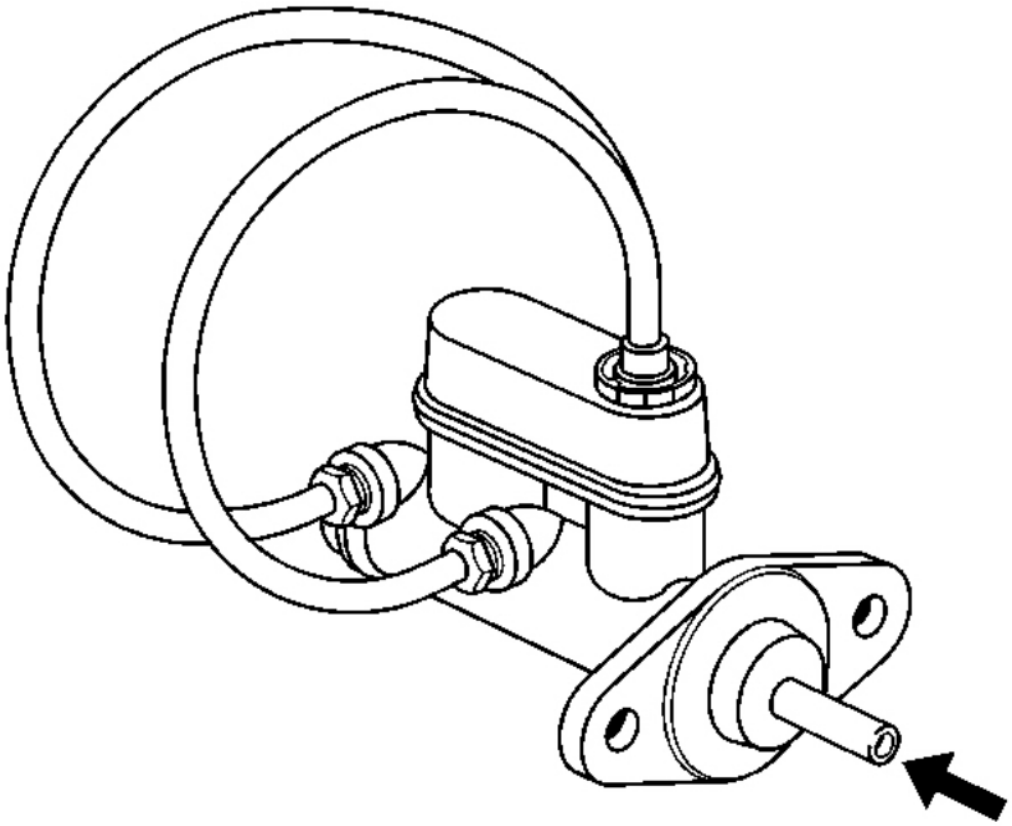


Fig. 16: Identifying Master Cylinder
Courtesy of GENERAL MOTORS CORP.

1. Secure the mounting flange of the brake master cylinder in a bench vise so that the rear of the primary piston is accessible.
2. Remove the master cylinder reservoir cap and diaphragm.
3. Install suitable fittings to the master cylinder ports that match the type of flare seat required and also provide for hose attachment.
4. Install transparent hoses to the fittings installed to the master cylinder ports, then route the hoses into the master cylinder reservoir.
5. Fill the master cylinder reservoir to at least the half-way point with Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container.
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

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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.

MASTER CYLINDER FLUID LEVEL SENSOR REPLACEMENT

Removal Procedure

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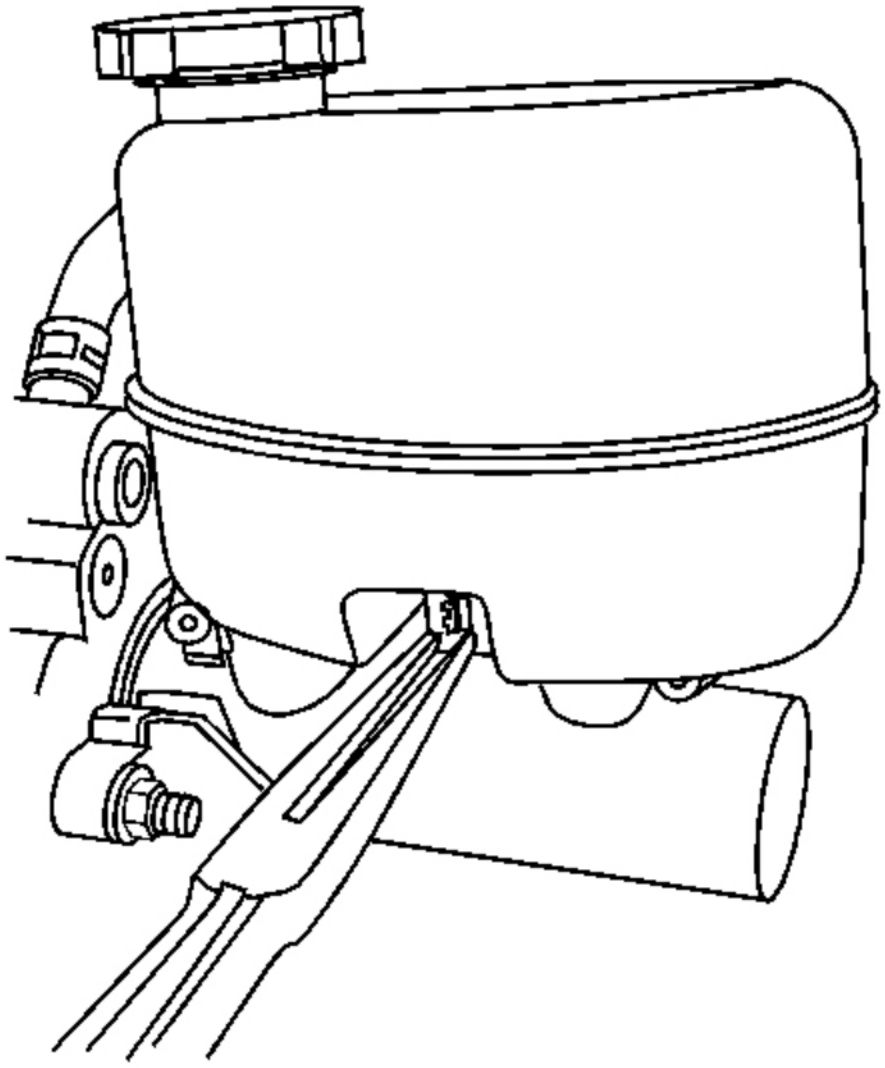


Fig. 17: Compressing Master Cylinder Locking Tabs
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the electrical connector from the fluid level sensor.
2. Using needle nose pliers, compress the locking tabs at the opposite side of the master cylinder.

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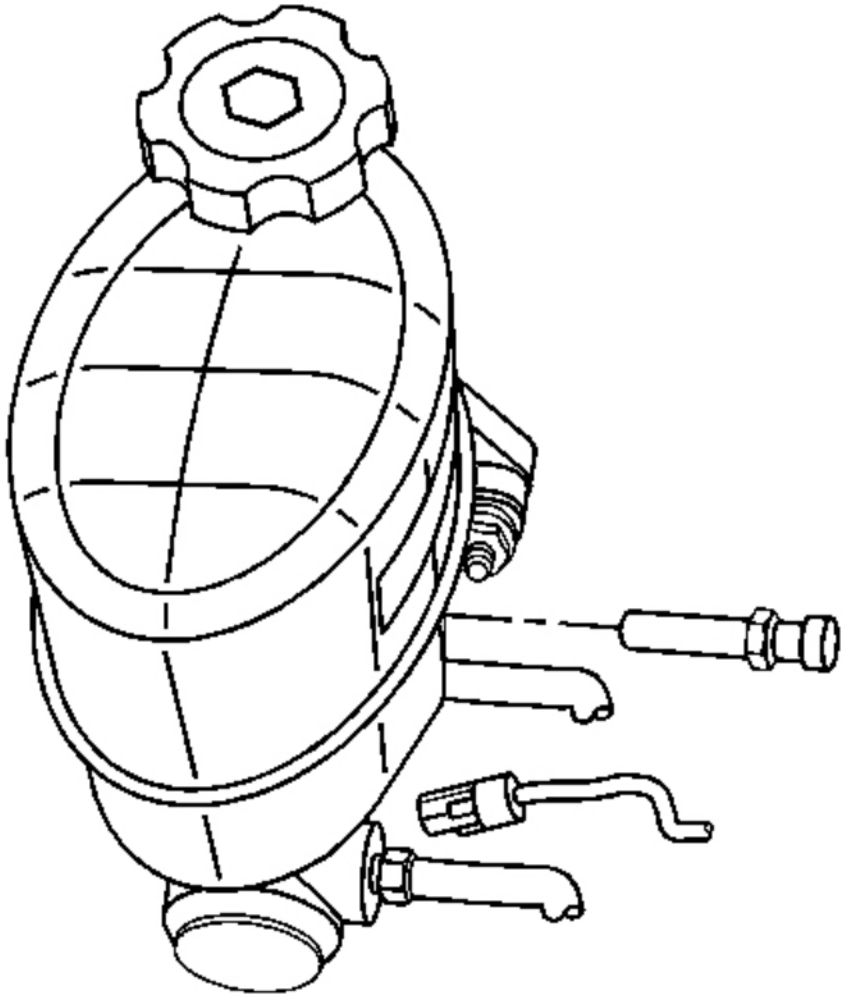


Fig. 18: View Of Master Cylinder Fluid Level Sensor
Courtesy of GENERAL MOTORS CORP.

3. Remove the fluid level sensor.

Installation Procedure

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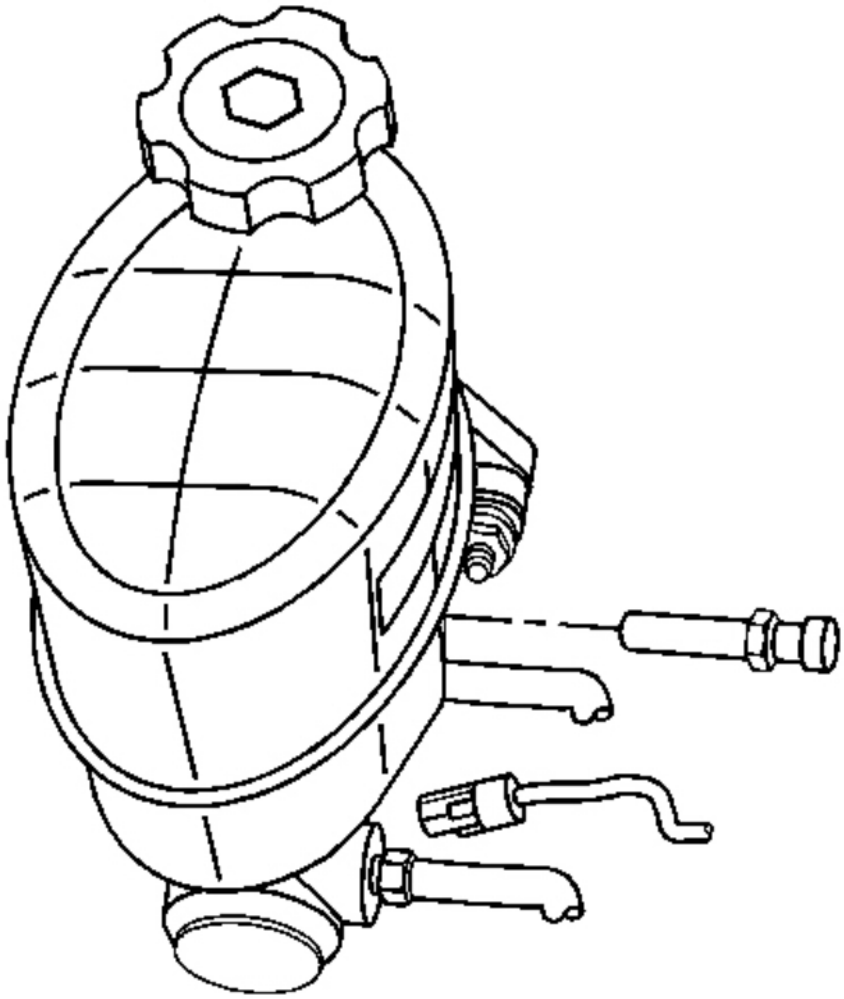


Fig. 19: View Of Master Cylinder Fluid Level Sensor
Courtesy of GENERAL MOTORS CORP.

1. Install the fluid level sensor until the locking tabs snap into place.
2. Connect the electrical connector to the fluid level sensor.

BRAKE PEDAL ASSEMBLY REPLACEMENT

Removal Procedure

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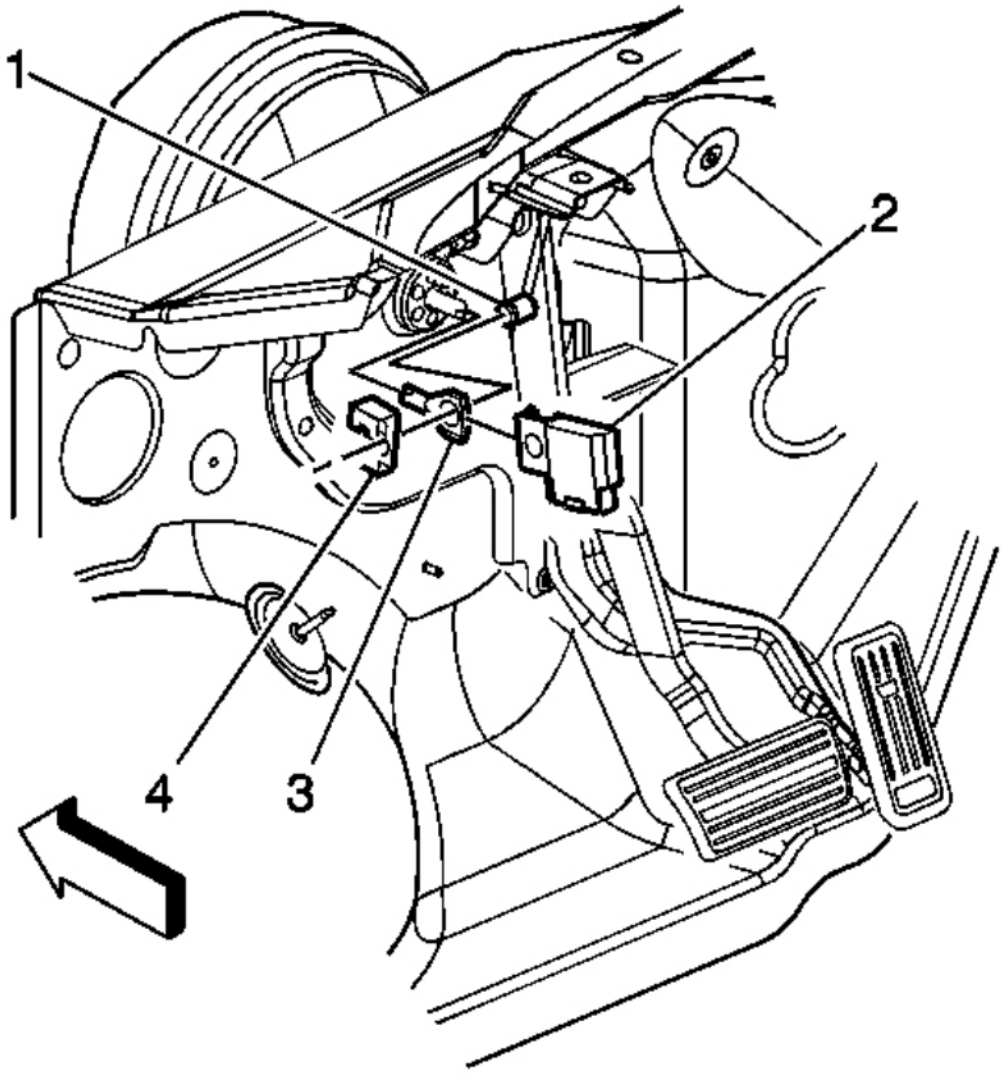


Fig. 20: View Of Pedal Stud, Stop Lamp Switch, Pushrod & Retaining Clip
Courtesy of GENERAL MOTORS CORP.

1. Remove the pushrod retaining clip (4).
2. Remove the stop lamp switch (2) and the pushrod (3) from the brake pedal stud (1).

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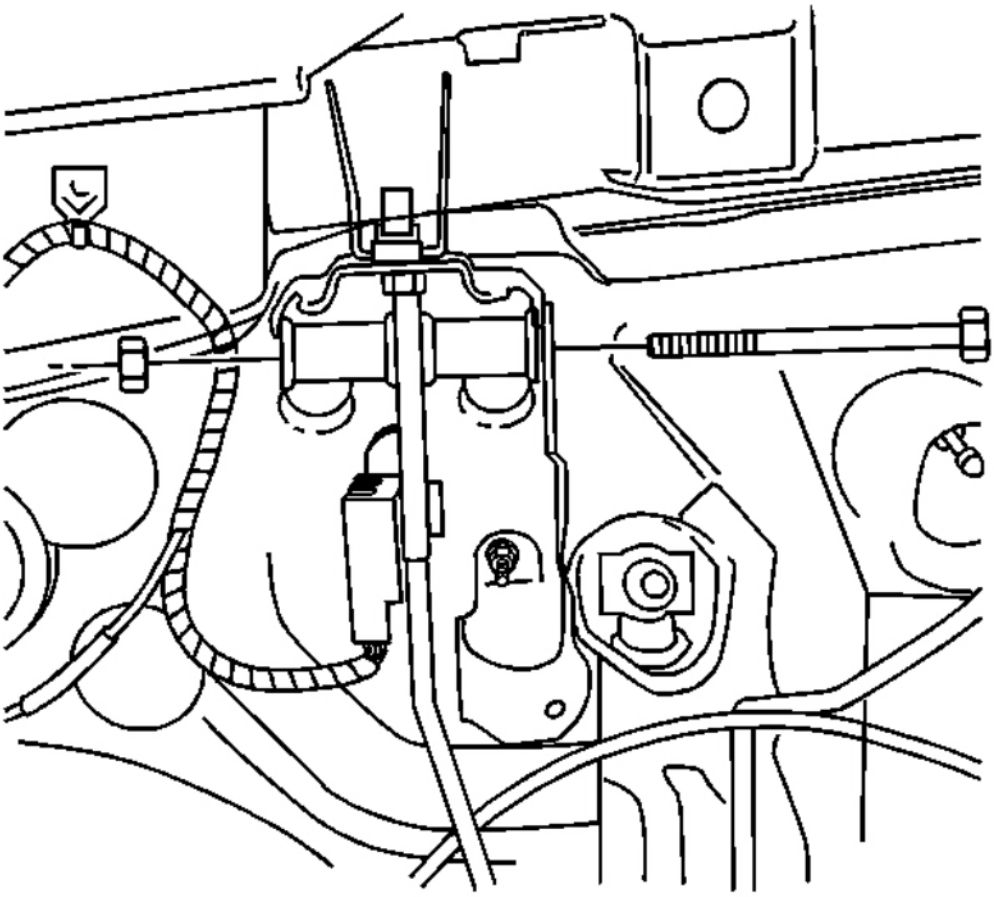


Fig. 21: View Of Brake Pedal Bolt & Nut
Courtesy of GENERAL MOTORS CORP.

3. Remove the nut from the brake pedal bolt.
4. Remove the brake pedal bolt.
5. Remove the brake pedal.

Installation Procedure

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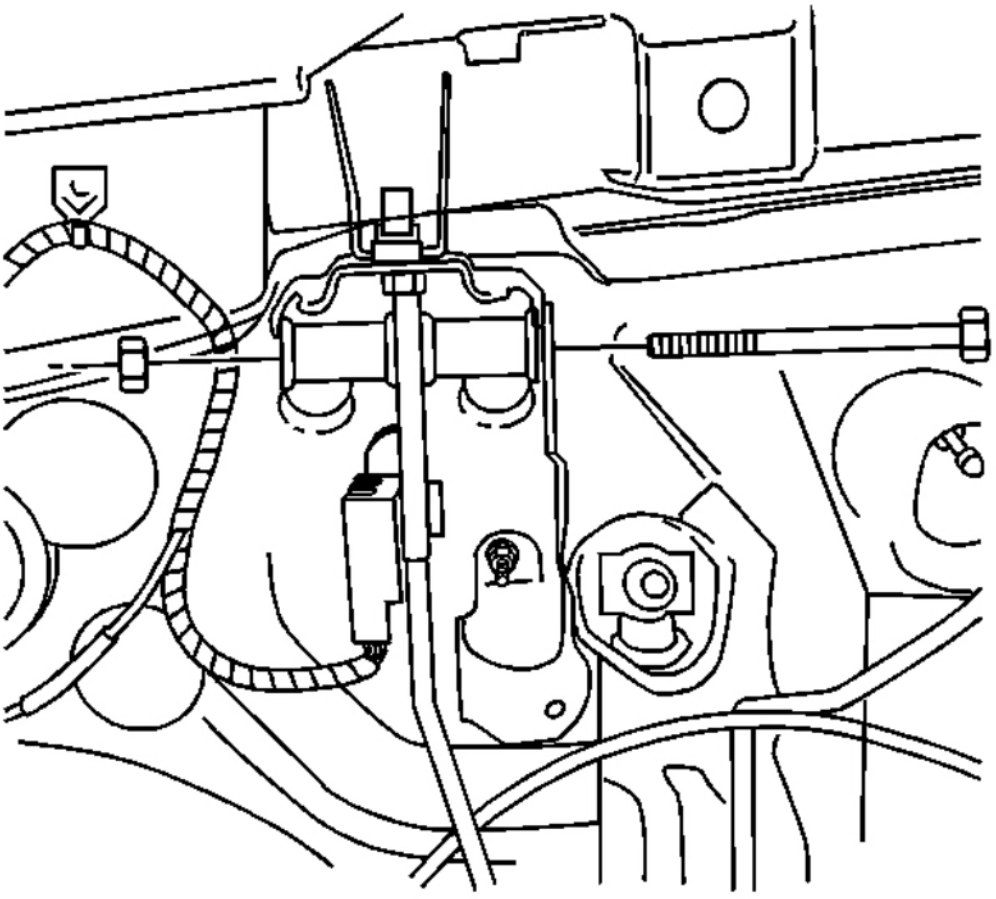


Fig. 22: View Of Brake Pedal Bolt & Nut
Courtesy of GENERAL MOTORS CORP.

1. Install the brake pedal.
2. Install the brake pedal bolt.

NOTE: **Refer to Fastener Notice .**

3. Install the nut to the brake pedal bolt.

Tighten: Hold the nut with a wrench and tighten the brake pedal bolt to 47 N.m (35 lb ft).

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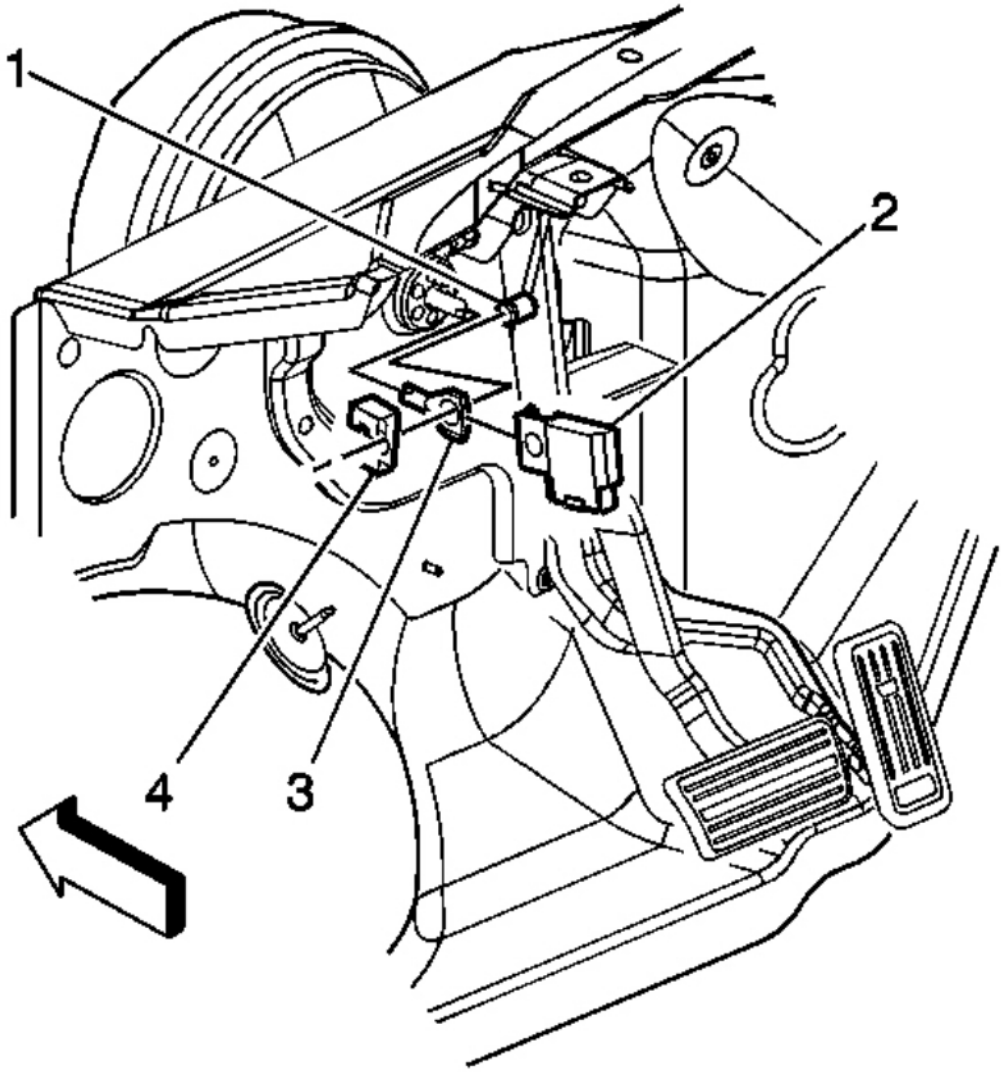


Fig. 23: View Of Pedal Stud, Stop Lamp Switch, Pushrod & Retaining Clip
Courtesy of GENERAL MOTORS CORP.

4. Install the pushrod (3) and the stop lamp switch (2) to the brake pedal pin (1).
5. Install the pushrod retaining clip (4).

BRAKE PIPE REPLACEMENT

Removal Procedure

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CAUTION: Refer to Brake Fluid Irritant Caution .

CAUTION: 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 in the original location for replacement brake pipes. Failure to properly route and retain brake pipes may cause damage to the brake pipes and brake system resulting in personal injury.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice .

IMPORTANT: Brake pipes that run parallel to each other must maintain a 6 mm (1/4 in) clearance.

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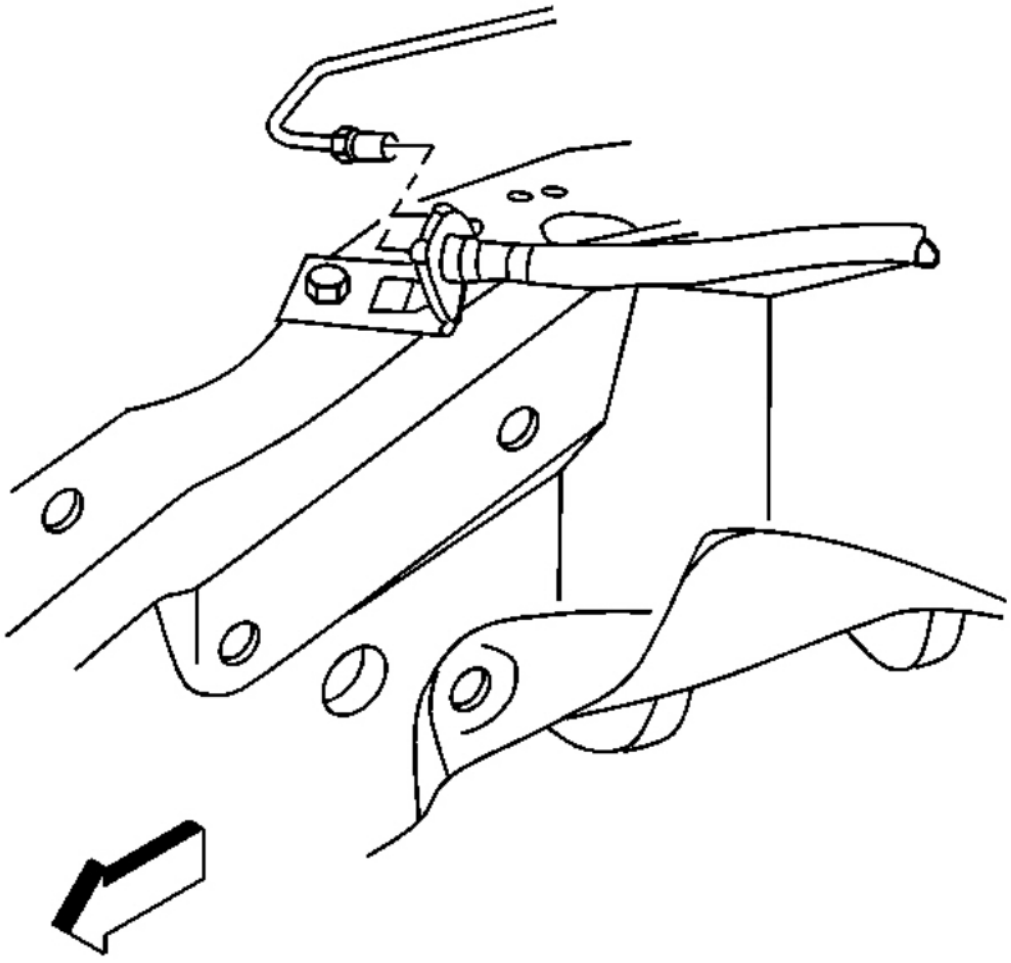


Fig. 24: View Of Brake Pipe
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the brake pipe fittings.
2. Remove the brake pipe fasteners from the vehicle.
3. Remove the brake pipe from the vehicle.

Installation Procedure

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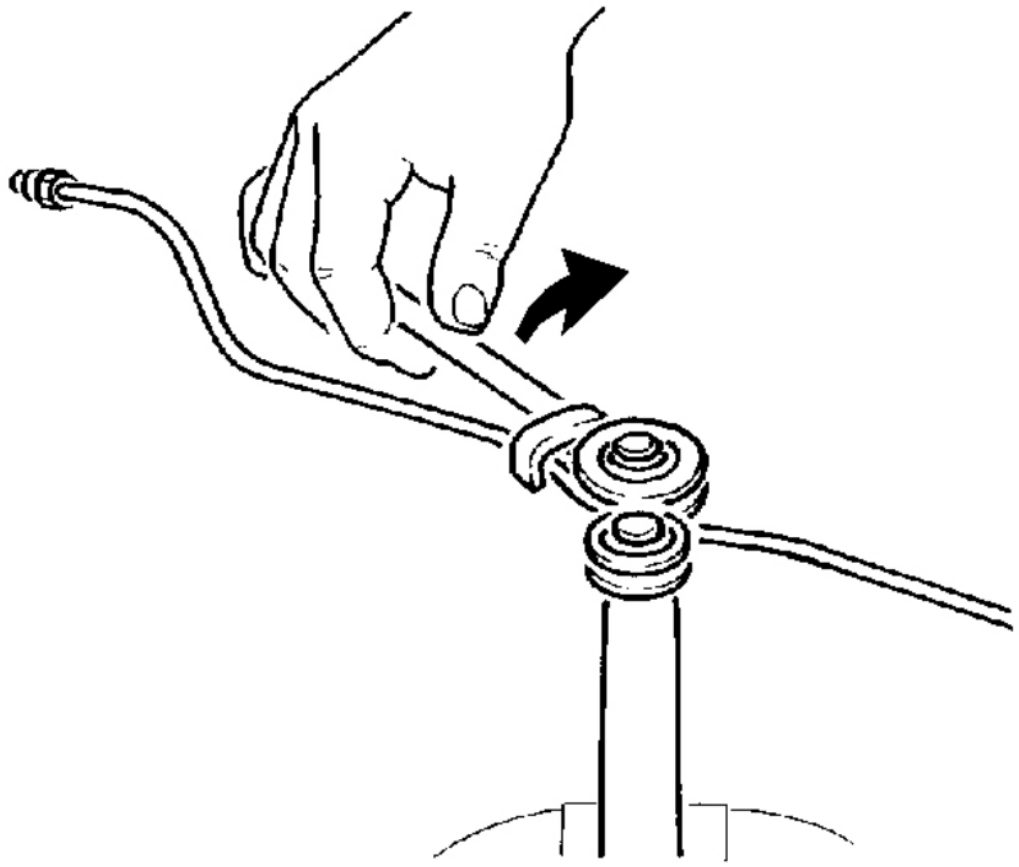


Fig. 25: Bending Brake Pipe
Courtesy of GENERAL MOTORS CORP.

1. Bend the brake pipe to achieve proper fit.
2. Install the brake pipe to the vehicle. Maintain a clearance of 25 mm (1 in) for all moving or vibrating components.
3. Install the brake pipe fasteners to the vehicle.

NOTE: **Refer to Fastener Notice .**

4. Connect the brake pipe fittings.

Tighten:

- Tighten the brake pipe fittings to the brake pressure modulator valve (BPMV) or the wheel jounce hoses to 25 N.m (18 lb ft).

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- Tighten the brake pipe fittings to the master cylinder to 25 N.m (18 lb ft).

5. Bleed the hydraulic brake system. Refer to **Antilock Brake System Automated Bleed Procedure (W/JL4)** or **Antilock Brake System Automated Bleed Procedure (W/O JL4)** .

FRONT BRAKE HOSE REPLACEMENT (1500 SERIES)

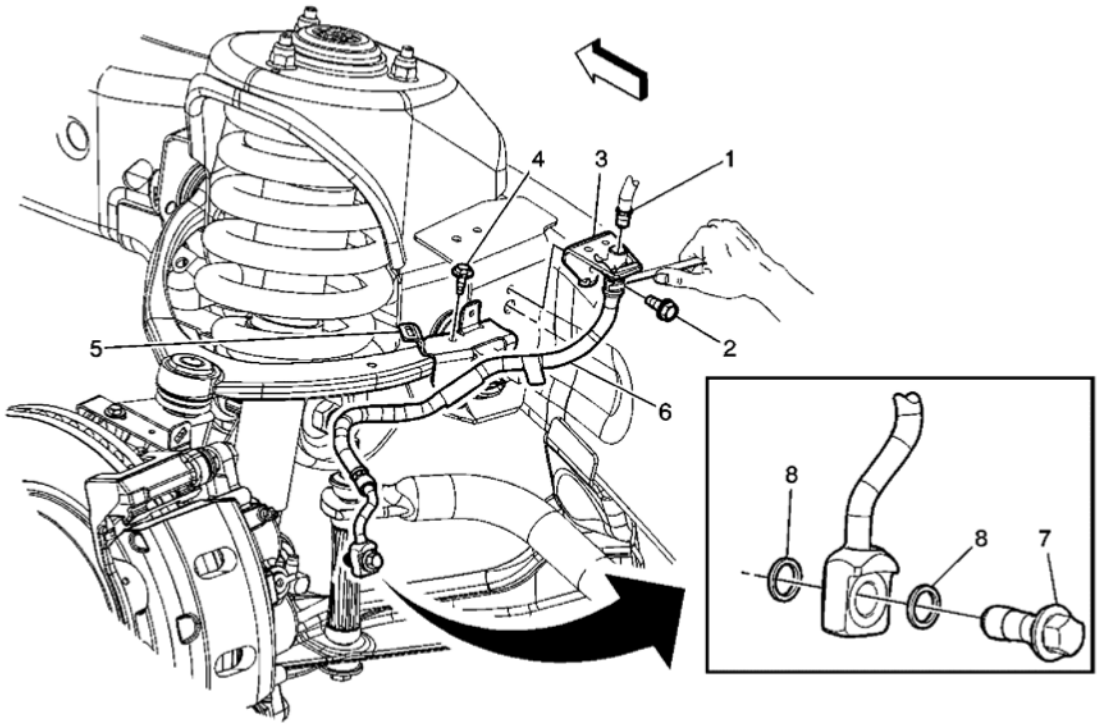


Fig. 26: View Of Brake Hose & Components
Courtesy of GENERAL MOTORS CORP.

Front Brake Hose Replacement (1500 Series)

Callout	Component Name
CAUTION: Refer to Brake Dust Caution . **CAUTION:** Refer to Brake Fluid Irritant Caution . **Preliminary Procedures** 1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Remove the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .	
	Fitting, Brake Pipe Front

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1	**NOTE:** **Refer to Fastener Notice .** **Tighten:** 25 N.m (18 lb ft) **Tip:** • Remove any dirt or debris from the brake pipe fitting. • Cap the brake pipe fitting to prevent brake fluid loss and contamination. • Use a backup wrench on the brake hose fitting when removing or installing the brake hose.
2	Bolt, Brake Hose Bracket to Frame Front **Tighten:** 9 N.m (80 lb in)
3	Bracket, Brake Hose to Frame Front
4	Bolt, Brake Hose Bracket to Control Arm Front **Tighten:** 9 N.m (80 lb in)
5	Bracket, Brake Hose to Control Arm Front
6	Hose, Brake
7	Bolt, Brake Hose to Caliper Front **Tighten:** 40 N.m (30 lb ft)
8	Gaskets, Brake Hose to Caliper (Qty: 2) **Tip:** 1. Ensure the gaskets are not still attached to the brake caliper or hose. 2. DO NOT reuse the copper gaskets. Install NEW gaskets. 3. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.

FRONT BRAKE HOSE REPLACEMENT (2500 SERIES)

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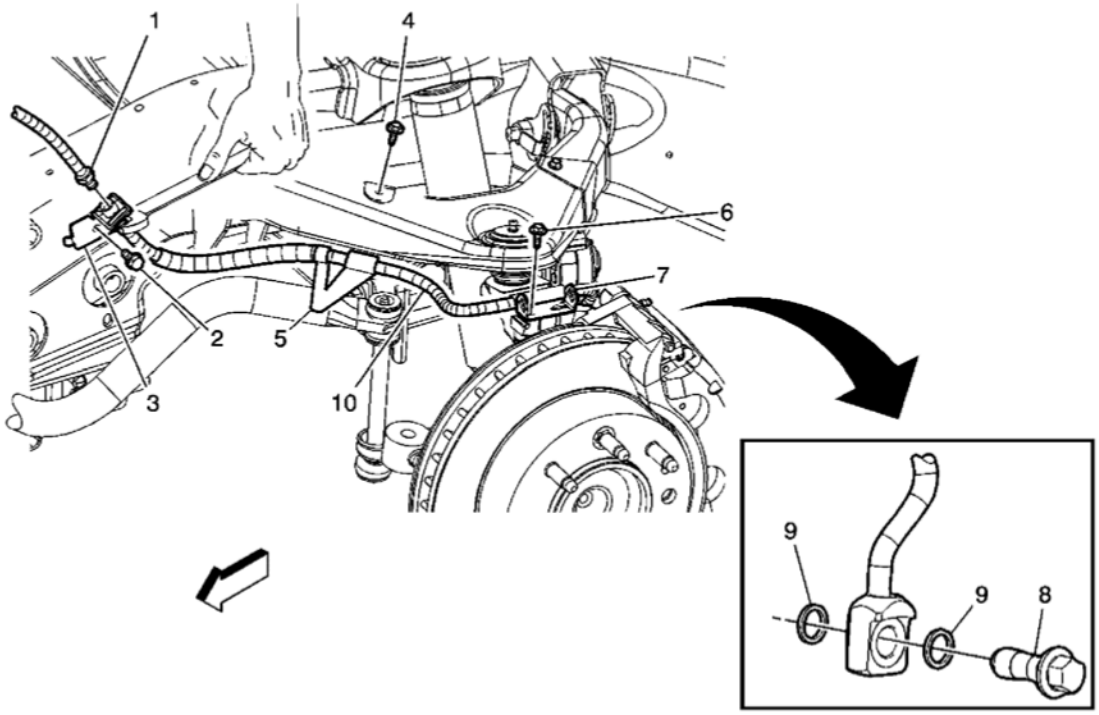


Fig. 27: View Of Brake Hose & Components
Courtesy of GENERAL MOTORS CORP.

Front Brake Hose Replacement (2500 Series)

Callout	Component Name
	CAUTION: Refer to **Brake Dust Caution** . **CAUTION:** Refer to **Brake Fluid Irritant Caution** . **Preliminary Procedures** 1. Raise and support the vehicle. **Lifting and Jacking the Vehicle** 2. Remove the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .
1	Fitting, Brake Pipe Front **NOTE:** Refer to **Fastener Notice** . **Tighten:** 25 N.m (18 lb ft)

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	Tip: • Remove any dirt or debris from the brake pipe fitting. • Use a backup wrench to hold the brake hose fitting when removing or installing the brake hose or pipe. • Cap the brake pipe fitting to prevent brake fluid loss or contamination.
2	Bolt, Brake Hose Bracket to Frame Front **Tighten:** 9 N.m (80 lb in)
3	Bracket, Brake Hose to Frame Front
4	Bolt, Brake Hose Bracket to Control Arm Front **Tighten:** 9 N.m (80 lb in)
5	Bracket, Brake Hose to Control Arm Front
6	Bolt, Brake Hose Bracket to Steering Knuckle Front **Tighten:** 9 N.m (80 lb in)
7	Bracket, Brake Hose to Steering Knuckle Front
8	Bolt, Brake Hose to Caliper Front **Tighten:** 40 N.m (30 lb ft)
9	Gasket, Brake Hose to Caliper (Qty: 2) **Tip:** 1. Ensure the copper gaskets are not still attached to the brake caliper or hose. 2. DO NOT re-use the copper gaskets. Install NEW gaskets.
10	Hose, Brake **Tip:** • During the removal and installation of the brake hose, DO NOT twist the brake hose. • Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.

REAR BRAKE HOSE REPLACEMENT (1500 SERIES)

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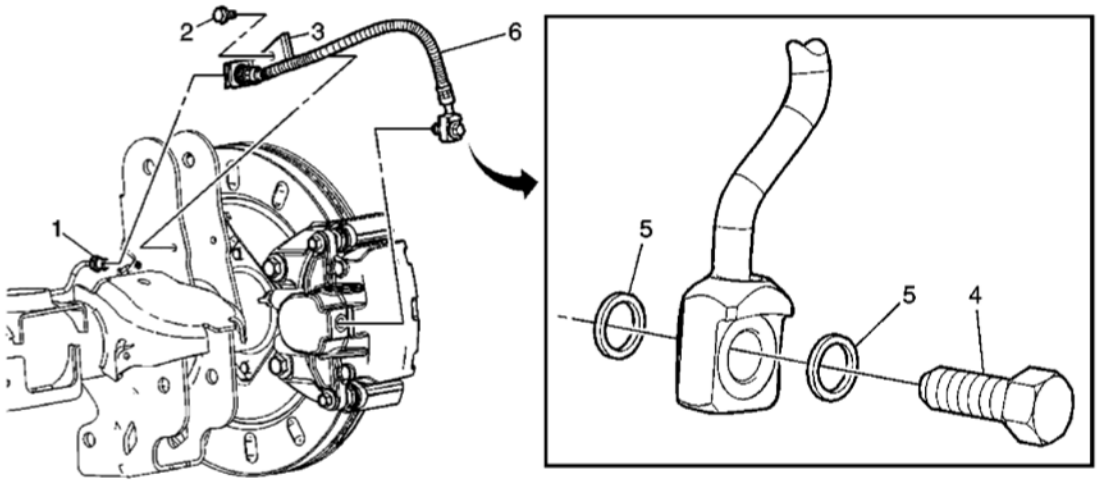


Fig. 28: View Of Brake Hose & Components
Courtesy of GENERAL MOTORS CORP.

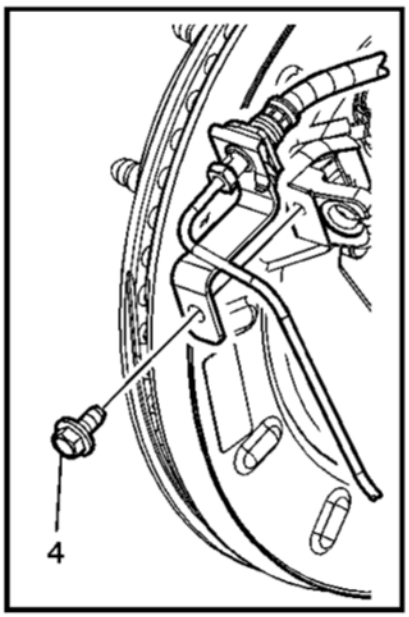
Rear Brake Hose Replacement (1500 Series)

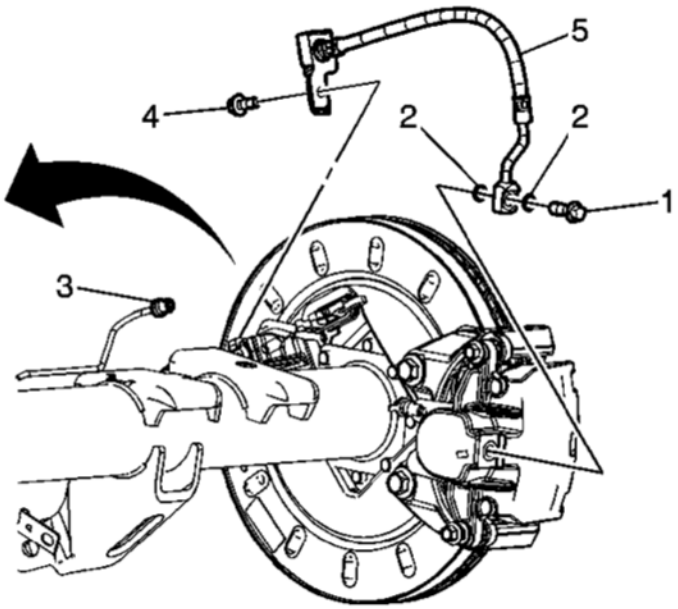
Callout	Component Name
	CAUTION: Refer to Brake Fluid Caution . **CAUTION:** Refer to Brake Fluid Irritant Caution . **Preliminary Procedures** 1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Remove the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .
1	Fitting, Brake Pipe Rear **NOTE:** Refer to Fastener Notice . **Tighten:** 25 N.m (18 lb ft) **Tip:** • Remove any dirt or debris from the brake pipe fitting. • The mounting bracket for the brake hose is serviced as part of the brake hose assembly and is not serviced separately. • Use a backup wrench when removing or installing the brake pipe fitting.

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	• Cap the brake pipe fitting to prevent brake fluid loss or contamination.
2	Bolt, Brake Hose to Axle Rear **Tighten:** 9 N.m (80 lb in) **Tip:** Finger tighten mounting bolt before torquing to the specified value.
3	Bracket, Brake Hose to Axle Rear
4	Bolt, Brake Hose to Caliper Rear **Tighten:** 40 N.m (30 lb ft)
5	Gaskets, Brake Hose to Caliper (Qty: 2) **Tip:** • Make sure the gaskets are not still attached to the brake hose or bolt, if not remove them. • DO NOT re-use the gaskets. Install NEW gaskets.
6	Hose, Brake Rear **Tip:** • When installing the brake hose, DO NOT twist or pinch the brake hose. • Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.

REAR BRAKE HOSE REPLACEMENT (2500 SERIES)





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Fig. 29: View Of Brake Hose & Components
Courtesy of GENERAL MOTORS CORP.

Rear Brake Hose Replacement (2500 Series)

Callout	Component Name
CAUTION: Refer to **Brake Fluid Caution** . **CAUTION:** Refer to **Brake Fluid Irritant Caution** . **Preliminary Procedures** 1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Remove the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .	
1	Bolt, Brake Hose to Caliper Rear **NOTE:** Refer to **Fastener Notice** . **Tighten:** 40 N.m (30 lb ft)
2	Gasket, Brake Hose to Caliper (Qty: 2) **Tip:** DO NOT re-use the copper gaskets. Install NEW gaskets.
3	Fitting, Brake Pipe Rear **Tighten:** 25 N.m (18 lb ft) **Tip:** • Remove any dirt or debris fron the brake pipe fitting. • Use a backup wrench when removing or installing the brake pipe fitting. • Cap the brake pipe fitting to prevent brake fluid loss and contamination.
4	Bolt, Brake Hose Bracket to Rear Axle **Tighten:** 12 N.m (106 lb in)
5	Hose, Brake Rear **Tip:** • When installing or removing the brake hose, DO NOT bend or twist the brake hose. • Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.

REAR BRAKE HOSE REPLACEMENT (FRAME TO REAR AXLE 1500 SERIES)

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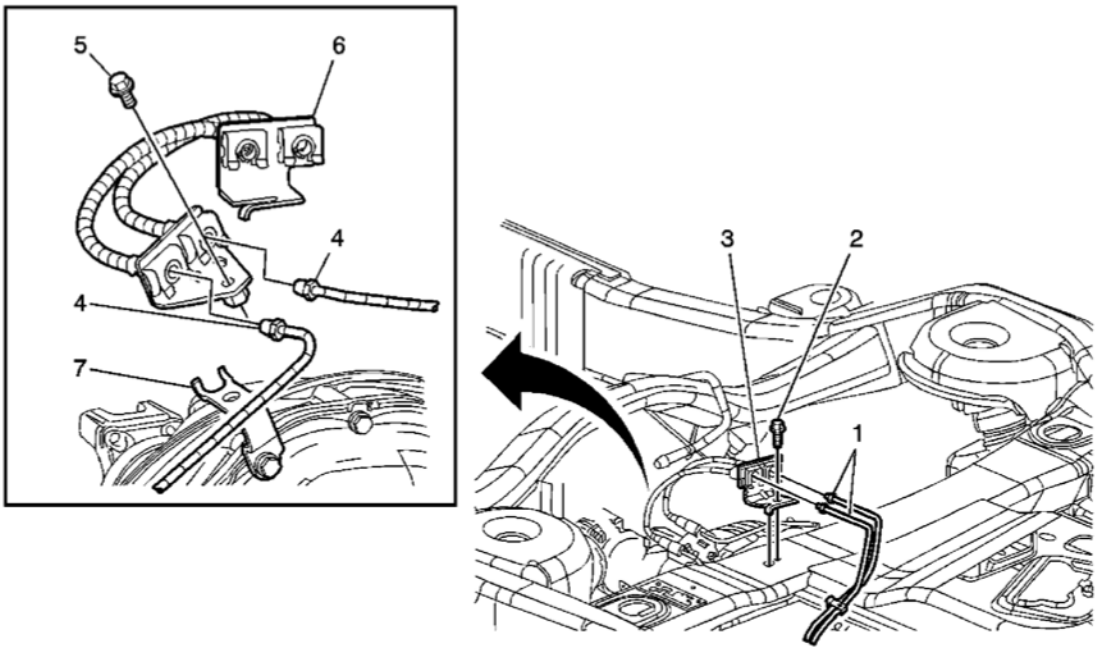


Fig. 30: View Of Frame To Rear Axle Brake Hose & Components
Courtesy of GENERAL MOTORS CORP.

Rear Brake Hose Replacement (Frame to Rear Axle 1500 Series)

Callout	Component Name
CAUTION: Refer to **Brake Fluid Caution** . **CAUTION:** Refer to **Brake Fluid Irritant Caution** . **Preliminary Procedure:** Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .	
1	Fitting, Brake Pipe Rear (Qty: 2) **NOTE:** Refer to **Fastener Notice** . **Tighten:** 25 N.m (18 lb ft) **Tip:** • Remove any dirt or debris from the brake pipe fitting. • Use a backup wrench to hold the brake hose while removing or installing either the brake hose or brake pipe.

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	• Cap the brake pipe fitting to prevent brake fluid loss and contamination.
2	Bolt, Brake Hose Bracket to Frame Rear **Tighten:** 25 N.m (18 lb ft).
3	Bracket, Brake Hose to Frame Rear
4	Fitting, Brake Pipe Rear (Qty: 2) **Tip:** • Remove any dirt or debris from the brake pipe fitting. • Use a backup wrench to hold the brake hose while removing or installing either the brake hose or brake pipe. • Cap the brake pipe fitting to prevent brake fluid loss and contamination. **Tighten:** 25 N.m (18 lb ft)
5	Bolt, Brake Hose Bracket to Axle Housing Rear **Tighten:** 25 N.m (18 lb ft)
6	Hose, Frame to Axle Rear Brake **Tip:** • When installing the brake hose bracket to the axle housing, ensure the brake hose bracket is properly located and properly seated on the rear axle housing mounting bracket. • Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.
7	Bracket, Brake Hose to Rear Axle Housing

REAR BRAKE HOSE REPLACEMENT (FRAME TO REAR AXLE 2500 SERIES)

Removal Procedure

IMPORTANT: The mounting bracket and brake hose are serviced as an assembly.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Clean the dirt and debris from the brake hose and brake pipe fitting.

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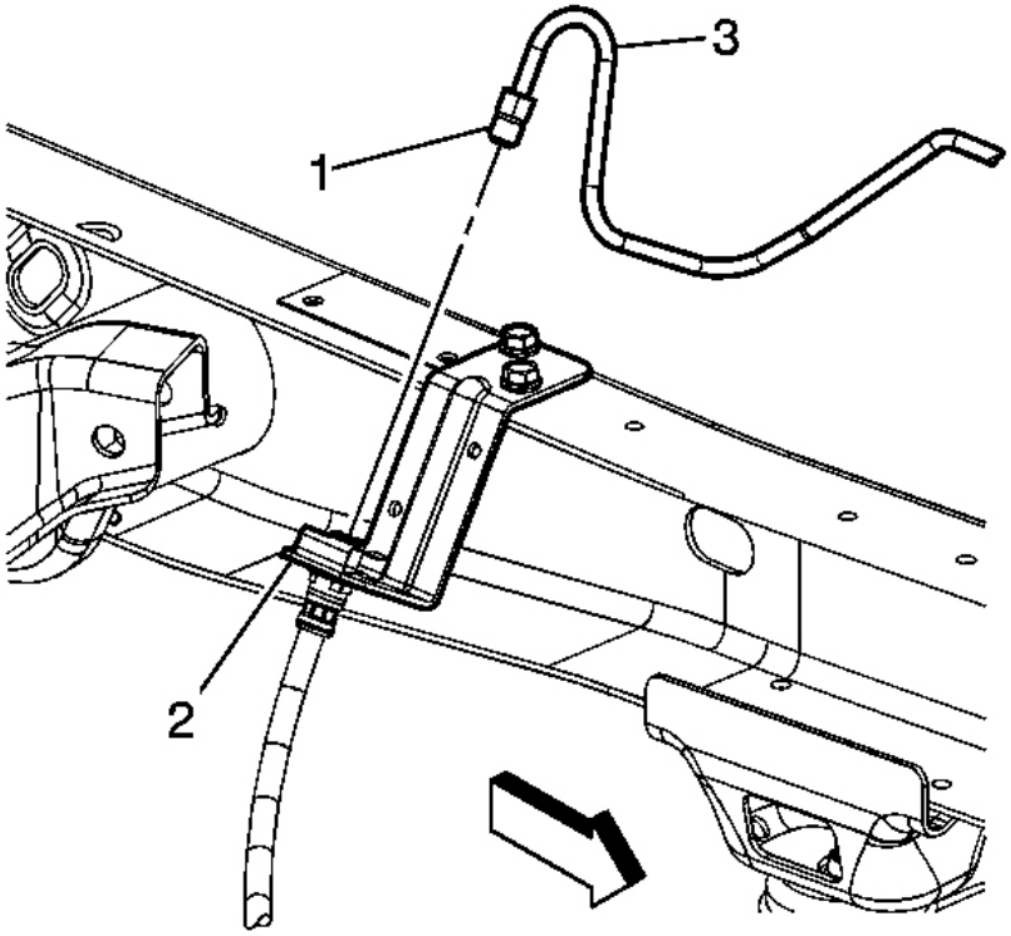


Fig. 31: View Of Brake Pipe, Brake Hose & Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Use a backup wrench when removing or installing brake hose or brake pipe fittings.

3. Using a backup wrench, remove the brake pipe fitting (1) from the brake hose (2).

IMPORTANT: Install a rubber plug or cap to prevent brake fluid leakage and contamination of the brake system.

4. Remove the brake pipe (3) from the brake hose (2).

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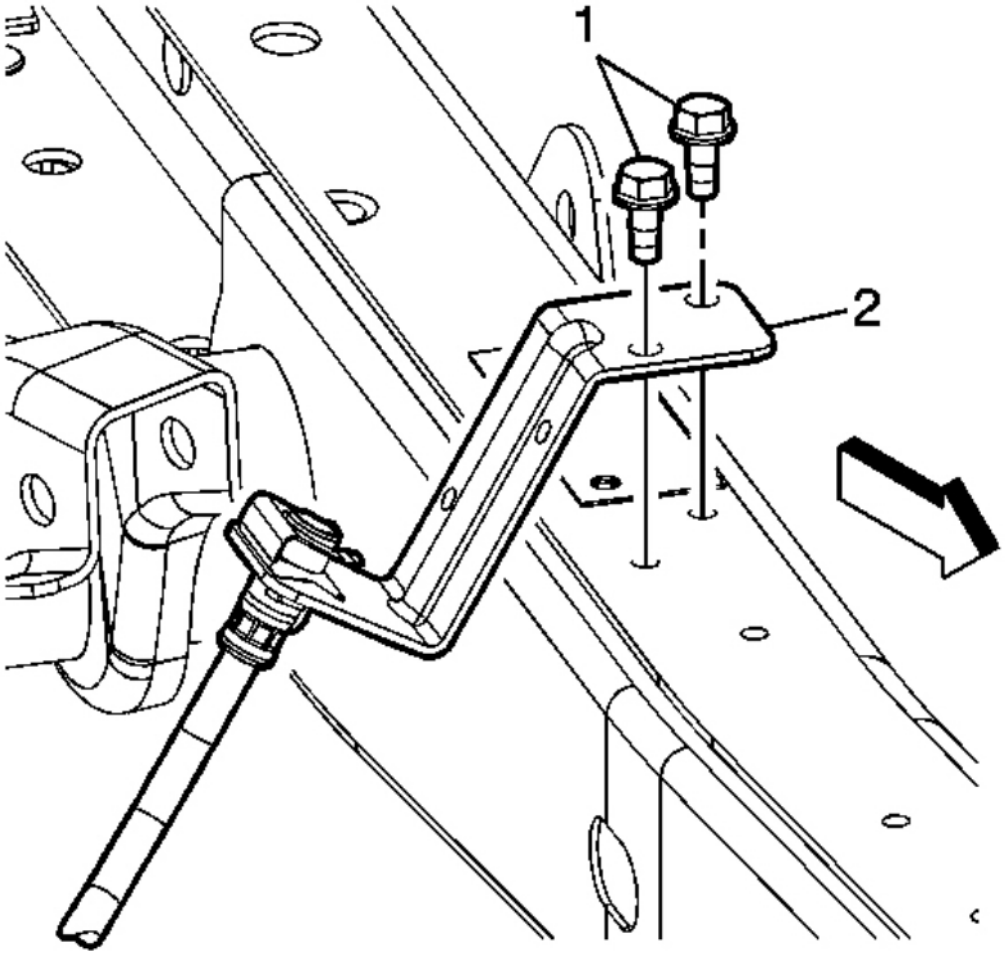


Fig. 32: View Of Mounting Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the mounting bracket bolts (1) from the mounting bracket (2).

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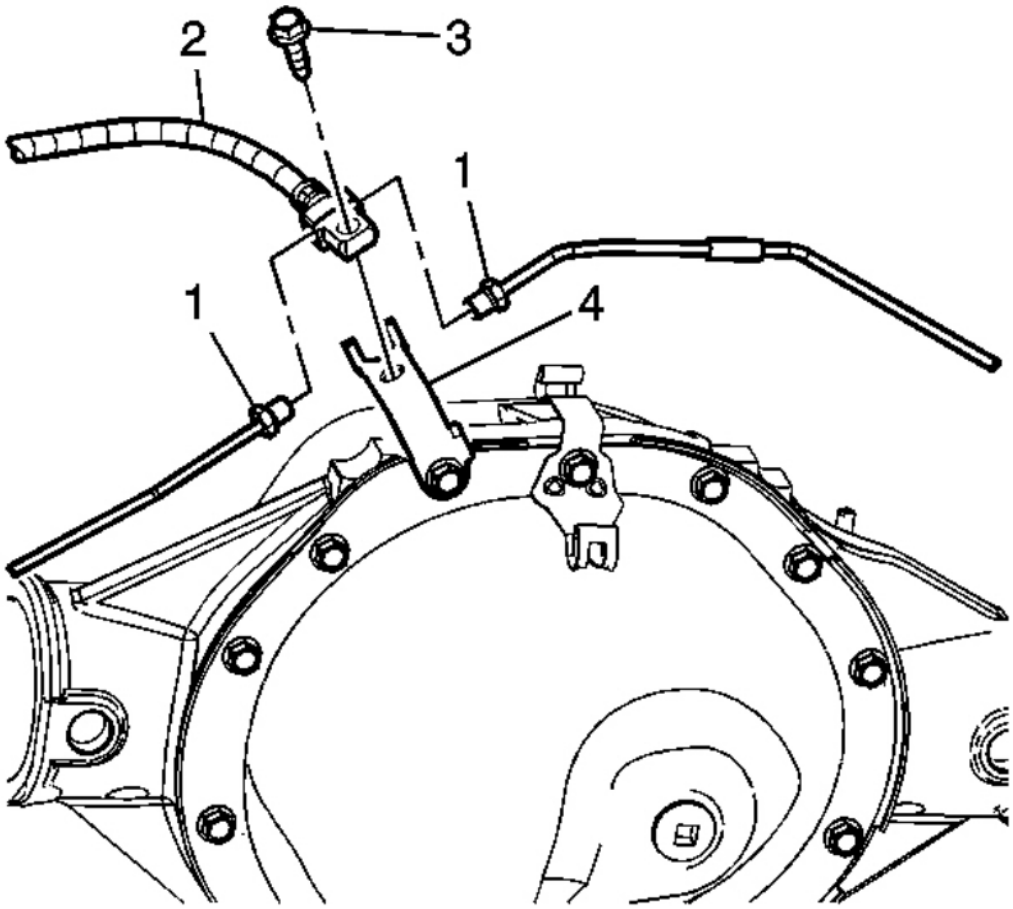


Fig. 33: View Of Brake Hose, Pipe Fittings, Mounting Bracket & Bolt
Courtesy of GENERAL MOTORS CORP.

6. Remove the brake pipe fittings (1) from the brake hose (2).
7. Remove the brake hose bracket mounting bolt (3) from the mounting bracket (4).
8. Remove the brake hose and bracket assembly.

Installation Procedure

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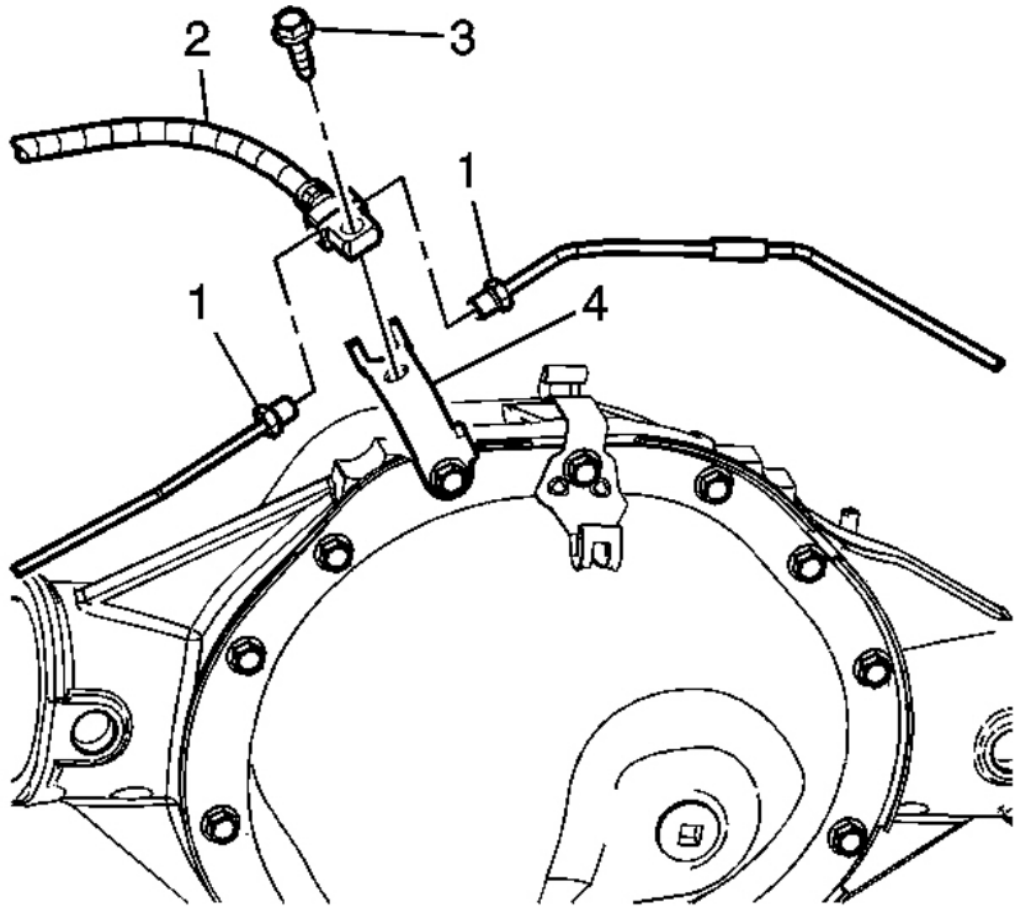


Fig. 34: View Of Brake Hose, Pipe Fittings, Mounting Bracket & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Position the brake hose (2) to the rear axle housing mounting bracket (4).

IMPORTANT:

- **The brake hose must NOT be twisted during installation.**
- **Leave the brake hose bracket loose, this will ease in installation the brake pipe fittings in the brake hose.**

2. Install the brake hose mounting bracket bolt (3).
3. Remove the plugs or caps from the brake pipes fittings that were installed during the removal process.
4. Finger tighten the brake pipe fittings (1) in the brake hose (2).

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NOTE: **Refer to Fastener Notice .**

IMPORTANT: It maybe necessary to use a open end wrench to hold the brake hose while tightening the brake hose mounting bolt.

5. Tighten the brake hose bracket bolt (3).

   Tighten: Tighten the bolt to 25 N.m (18 lb ft).

6. Tighten the brake pipe fittings (1).

   Tighten: Tighten the fittings to 25 N.m (18 lb ft).

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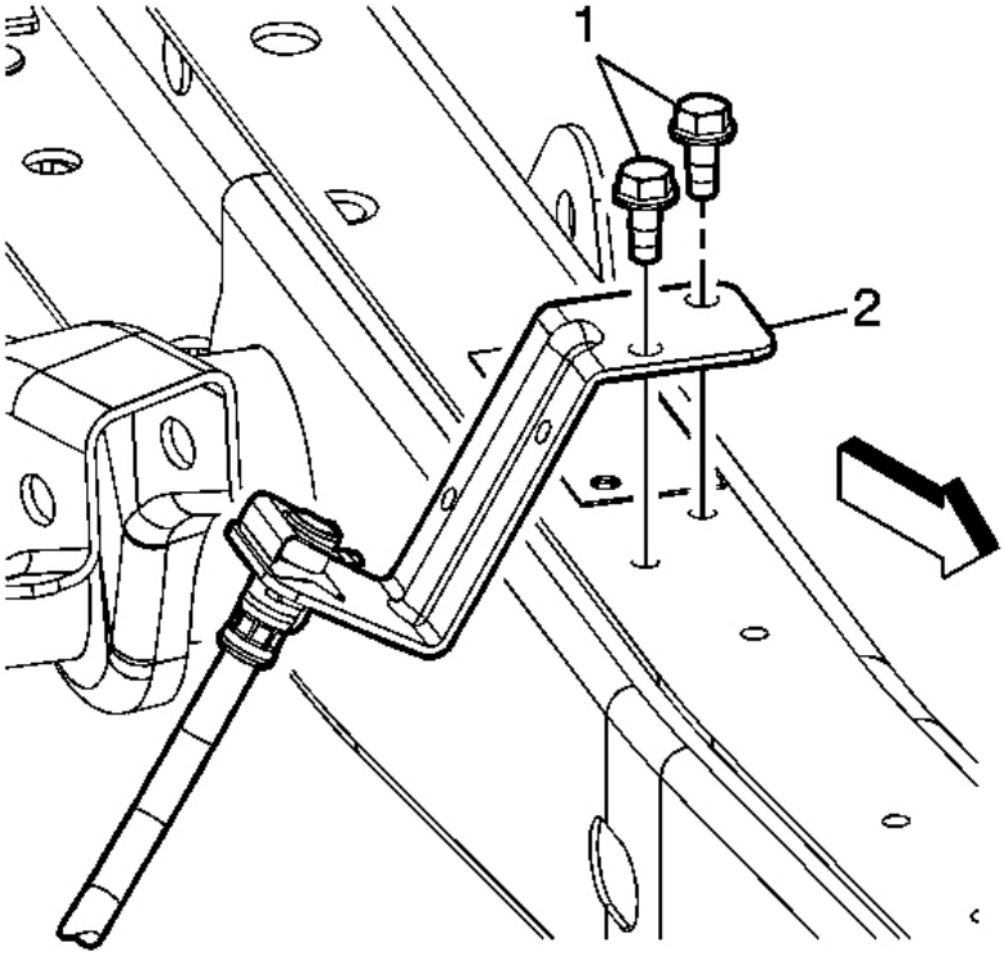


Fig. 35: View Of Mounting Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

7. Position the brake hose bracket (2) to the frame.
8. Install the bolts (1).

Tighten: Tighten the bolts to 25 N.m (18 lb ft).

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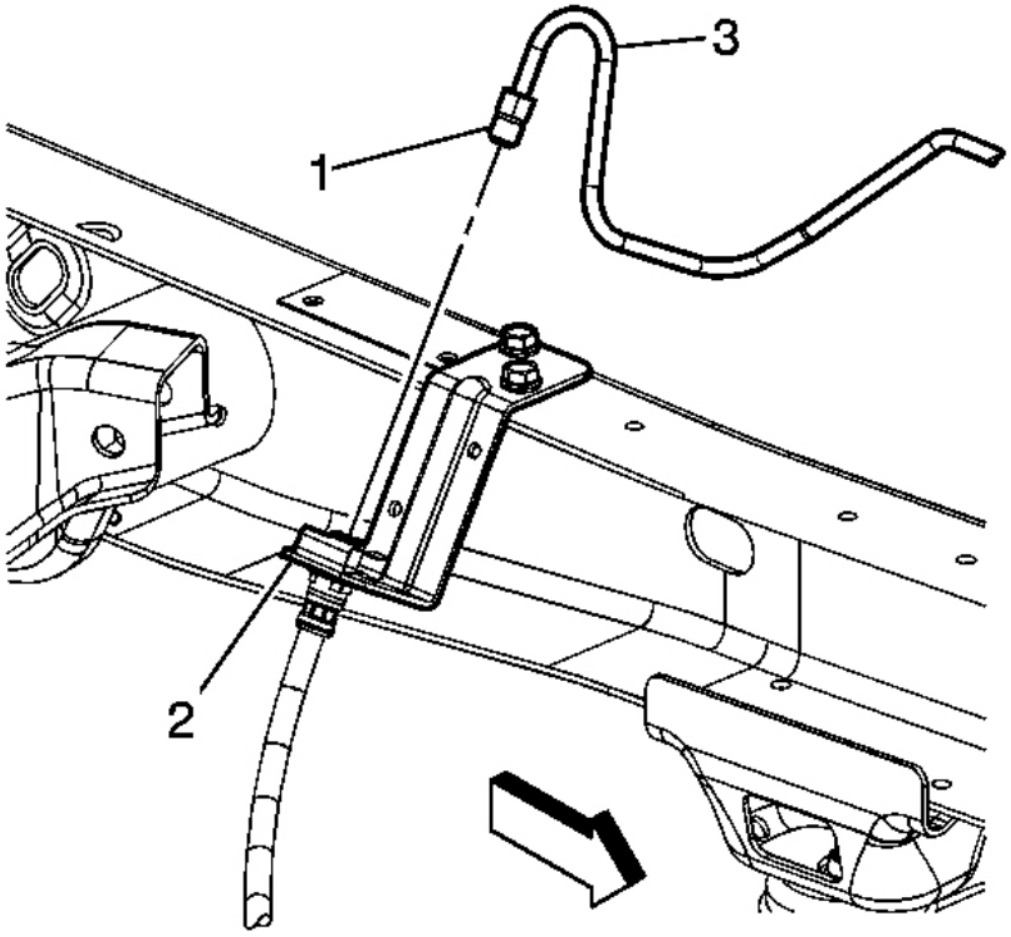


Fig. 36: View Of Brake Pipe, Brake Hose & Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

9. Position the brake pipe (3) and install the brake pipe fitting (1) in the brake hose (2).

   Tighten: Tighten the fittings to 25 N.m (18 lb ft).

10. Bleed the brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.
11. Lower the vehicle.

HYDRAULIC BRAKE SYSTEM BLEEDING (MANUAL)

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CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

NOTE: When adding fluid to the brake master cylinder reservoir, use only Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container. The use of any type of fluid other than the recommended type of brake fluid, may cause contamination which could result in damage to the internal rubber seals and/or rubber linings of hydraulic brake system components.

1. 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 Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 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 Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 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.

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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 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 Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 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. With the right rear wheel hydraulic circuit bleeder valve tightened securely - after all air has been purged from the right rear hydraulic circuit - install a proper box-end wrench onto the LEFT REAR wheel hydraulic circuit bleeder valve.
13. Install a transparent hose over the end of the bleeder valve, then repeat steps 7-11.
14. With the left rear wheel hydraulic circuit bleeder valve 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 bleeder valve.
15. Install a transparent hose over the end of the bleeder valve, then repeat steps 7-11.
16. With the right front wheel hydraulic circuit bleeder valve tightened securely - after all air has been purged from the right front hydraulic circuit - install a proper box-end wrench onto the LEFT FRONT wheel hydraulic circuit bleeder valve.
17. Install a transparent hose over the end of the bleeder valve, then repeat steps 7-11.
18. After completing the final wheel hydraulic circuit bleeding procedure, ensure that each of the 4 wheel hydraulic circuit bleeder valves are properly tightened.
19. Fill the brake master cylinder reservoir to the maximum-fill level with Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container.
20. Slowly depress and release the brake pedal. Observe the feel of the brake pedal.
21. 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.
22. Turn the ignition key ON, with the engine OFF. Check to see if the brake system warning lamp remains illuminated.

IMPORTANT: If the brake system warning lamp remains illuminated, DO NOT allow the vehicle to be driven until it is diagnosed and repaired.

23. If the brake system warning lamp remains illuminated, refer to **Symptoms - Hydraulic Brakes**.

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HYDRAULIC BRAKE SYSTEM BLEEDING (PRESSURE)

Tools Required

- **J 29532** Diaphragm Type Brake Pressure Bleeder, or equivalent. See **Special Tools**.
- **J 35589-A** Brake Pressure Bleeder Adapter. See **Special Tools**.

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

NOTE: When adding fluid to the brake master cylinder reservoir, use only Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container. The use of any type of fluid other than the recommended type of brake fluid, may cause contamination which could result in damage to the internal rubber seals and/or rubber linings of hydraulic brake system components.

1. 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 Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 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

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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 Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 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** to the brake master cylinder reservoir. See **Special Tools**.
6. Check the brake fluid level in the **J 29532** , or equivalent. See **Special Tools**. Add Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 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** , or equivalent, to the **J 35589-A** . See **Special Tools**.
8. Charge the **J 29532** , or equivalent, air tank to 175-205 kPa (25-30 psi). See **Special Tools**.
9. Open the **J 29532** , or equivalent, fluid tank valve to allow pressurized brake fluid to enter the brake system. See **Special Tools**.
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 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 Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 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. With the right rear wheel hydraulic circuit bleeder valve tightened securely - after all air has been purged from the right rear hydraulic circuit - install a proper box-end wrench onto the LEFT REAR wheel hydraulic circuit bleeder valve.
16. Install a transparent hose over the end of the bleeder valve, then repeat steps 13-14.
17. With the left rear wheel hydraulic circuit bleeder valve 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 bleeder valve.
18. Install a transparent hose over the end of the bleeder valve, then repeat steps 13-14.
19. With the right front wheel hydraulic circuit bleeder valve tightened securely - after all air has been purged from the right front hydraulic circuit - install a proper box-end wrench onto the LEFT FRONT wheel hydraulic circuit bleeder valve.
20. Install a transparent hose over the end of the bleeder valve, then repeat steps 13-14.
21. After completing the final wheel hydraulic circuit bleeding procedure, ensure that each of the 4 wheel

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hydraulic circuit bleeder valves are properly tightened.

22. Close the **J 29532** , or equivalent, fluid tank valve, then disconnect the **J 29532** , or equivalent, from the **J 35589-A** . See **Special Tools**.
23. Remove the **J 35589-A** from the brake master cylinder reservoir. See **Special Tools**.
24. Fill the brake master cylinder reservoir to the maximum-fill level with Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container.
25. Slowly depress and release the brake pedal. Observe the feel of the brake pedal.
26. 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 Procedure (W/JL4)** **Antilock Brake System Automated Bleed Procedure (W/O JL4)** in Antilock Brake System.
27. Turn the ignition key ON, with the engine OFF. Check to see if the brake system warning lamp remains illuminated.

IMPORTANT: If the brake system warning lamp remains illuminated, DO NOT allow the vehicle to be driven until it is diagnosed and repaired.

28. If the brake system warning lamp remains illuminated, refer to **Symptoms - Hydraulic Brakes**.

HYDRAULIC BRAKE SYSTEM FLUSHING

CAUTION: Refer to Brake Fluid Irritant Caution .

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice .

NOTE: When adding fluid to the brake master cylinder reservoir, use only Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container. The use of any type of fluid other than the recommended type of brake fluid, may cause contamination which could result in damage to the internal rubber seals and/or rubber linings of hydraulic brake system components.

1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination:
    - Fluid separation, indicating two types of fluid are present; a substance other than the recommended brake fluid has been introduced into the brake hydraulic system
        - Swirled appearance - oil-based substance
        - Layered appearance - silicone-based substance
    - Fluid discoloration, indicating the presence of moisture or particles that have been introduced into

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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 (JD9)Master Cylinder Replacement (JH6)**
        - **Front Brake Hose Replacement (1500 Series)Front Brake Hose Replacement (2500 Series)**
        - **Rear Brake Hose Replacement (1500 Series)Rear Brake Hose Replacement (2500 Series)Rear Brake Hose Replacement (Frame to Rear Axle 1500 Series)Rear Brake Hose Replacement (Frame to Rear Axle 2500 Series)**
        - **Front Brake Caliper Replacement (1500 Series) Front Brake Caliper Replacement (2500 Series)**
        - **Rear Brake Caliper Replacement (1500 Series) Rear Brake Caliper Replacement (2500 Series)**
        - **Brake Pressure Modulator Valve Replacement (W/JL4) Brake Pressure Modulator Valve Replacement (W/O JL4)**
    2. Clean out all the hydraulic brake pipes using denatured alcohol, or equivalent.
    3. Dry the brake pipes using non-lubricated, filtered air.
    4. Repair or replace ALL of the following components listed and install them to the vehicle. Each component contains internal rubber seals/linings which have been contaminated by the contaminated brake fluid in the brake hydraulic system.

        Refer to the procedures indicated:

        - **Master Cylinder Replacement (JD9)Master Cylinder Replacement (JH6)** ; 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 (1500 Series)Front Brake Hose Replacement (2500**

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Series)

- **Rear Brake Hose Replacement (1500 Series)Rear Brake Hose Replacement (2500 Series)Rear Brake Hose Replacement (Frame to Rear Axle 1500 Series)Rear Brake Hose Replacement (Frame to Rear Axle 2500 Series)**
- **Front Brake Caliper Overhaul (2500 Series)** or **Front Brake Caliper Replacement (1500 Series) Front Brake Caliper Replacement (2500 Series)**
- **Rear Brake Caliper Overhaul (2500 Series)** or **Rear Brake Caliper Replacement (1500 Series) Rear Brake Caliper Replacement (2500 Series)**
- **Brake Pressure Modulator Valve Replacement (W/JL4) Brake Pressure Modulator Valve Replacement (W/O JL4)**

4. If the brake fluid was NOT contaminated with an oil-based or a silicone-based substance, but WAS contaminated with water or dirt, rust, corrosion, and/or brake dust, replace the brake master cylinder reservoir cap diaphragm. The diaphragm may have allowed the moisture or particles to enter the hydraulic system.
5. Fill the brake master cylinder reservoir to the maximum-fill level with Delco Supreme 11®, GM P/N 12377967 (Canada P/N 992667) or equivalent, DOT-3 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)**.

VACUUM BRAKE BOOSTER REPLACEMENT

Removal Procedure

CAUTION: Refer to Brake Fluid Irritant Caution .

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice .

1. Apply the park brake.
2. Deplete the vacuum reserve in the vacuum booster by applying the brake pedal 3 times or until the pedal becomes firm.

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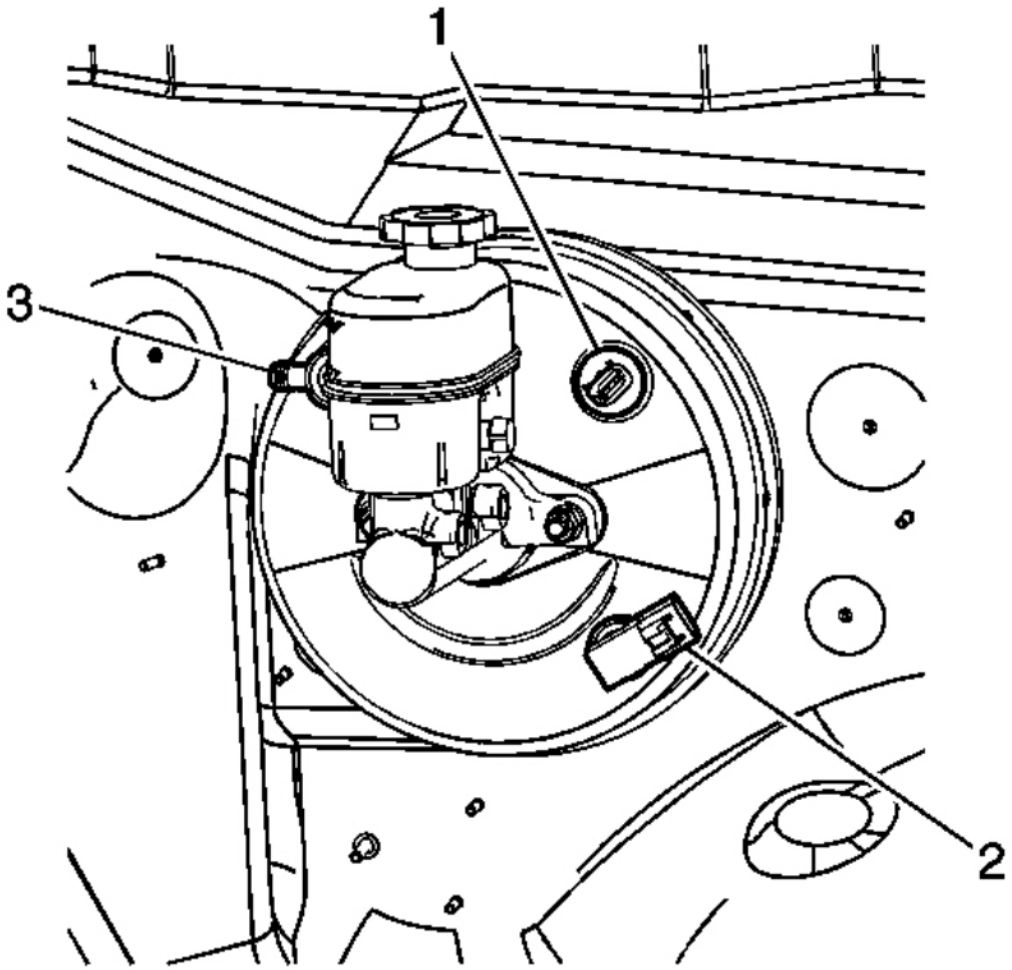


Fig. 37: View Of DOD Sensor, Booster Connector & Check Valve
Courtesy of GENERAL MOTORS CORP.

3. Remove the electrical connectors for the DOD sensor (1) and the active booster connector (2).
4. Remove the vacuum hose from the check valve (3).
5. Remove the 2 master cylinder nuts.

IMPORTANT:

- **It is not necessary to disconnect the brake pipes from the master cylinder.**
- **Ensure the O-ring vacuum seal is on the master cylinder after removal.**

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6. Position the master cylinder aside and secure with heavy mechanics wire or equivalent.

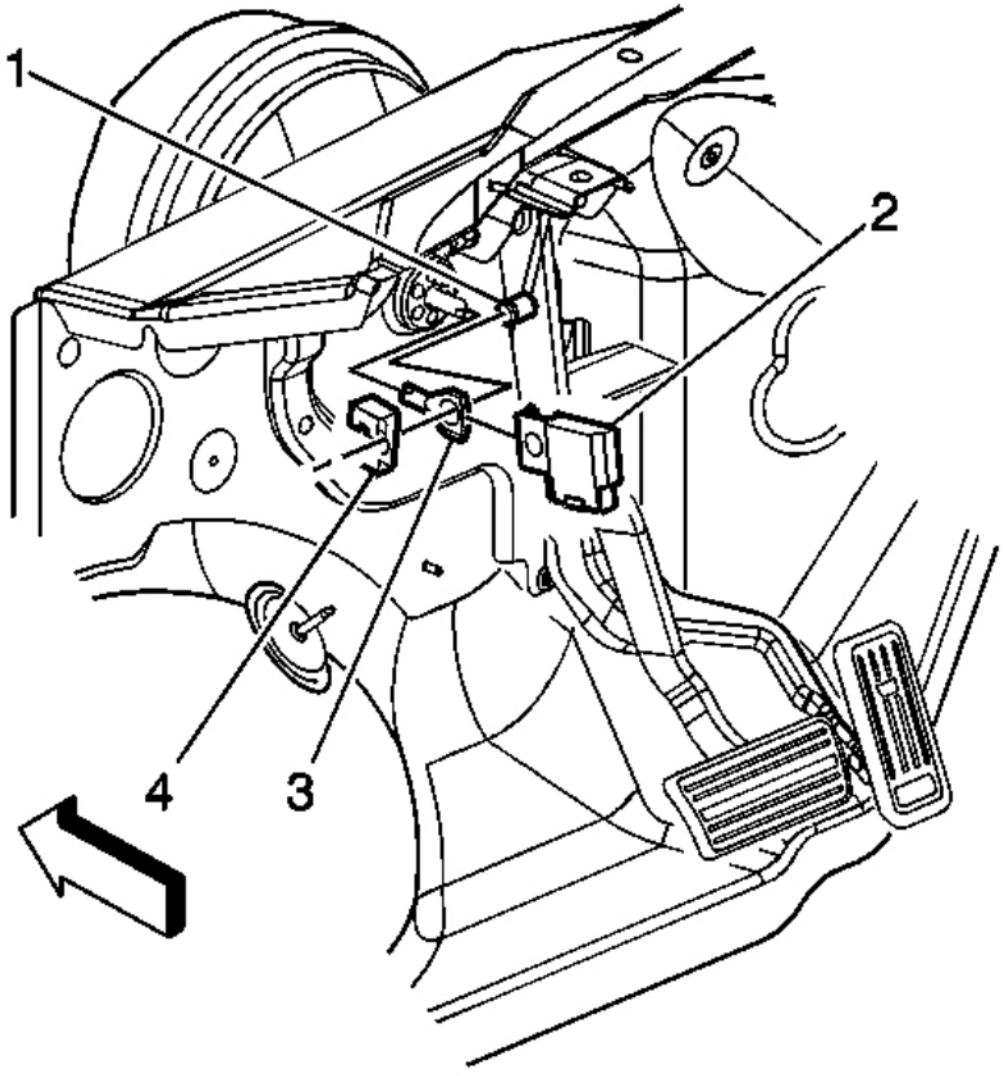


Fig. 38: View Of Pedal Stud, Stop Lamp Switch, Pushrod & Retaining Clip
Courtesy of GENERAL MOTORS CORP.

7. Remove the retaining clip (4) for the pushrod (1).
8. Remove the stop lamp switch (2) and the pushrod (3) from the brake pedal (1).

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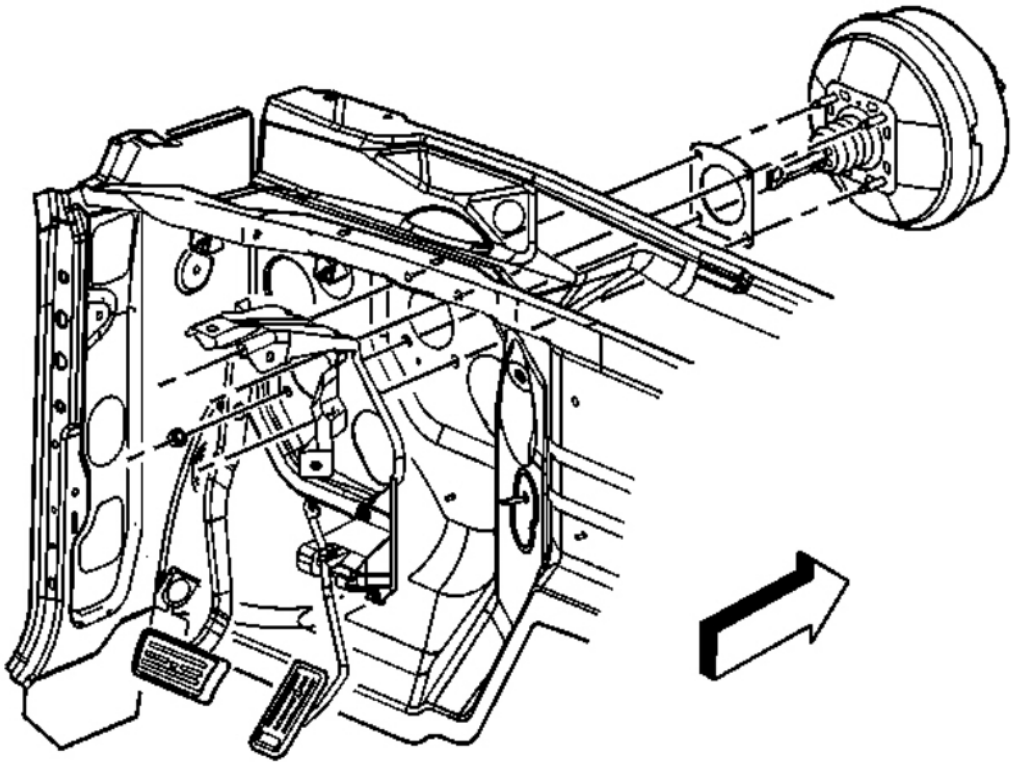


Fig. 39: Identifying Vacuum Booster & Nuts
Courtesy of GENERAL MOTORS CORP.

9. Remove the brake booster mounting nuts.
10. Remove the brake booster.
11. Remove and discard the brake booster gasket.

Installation Procedure

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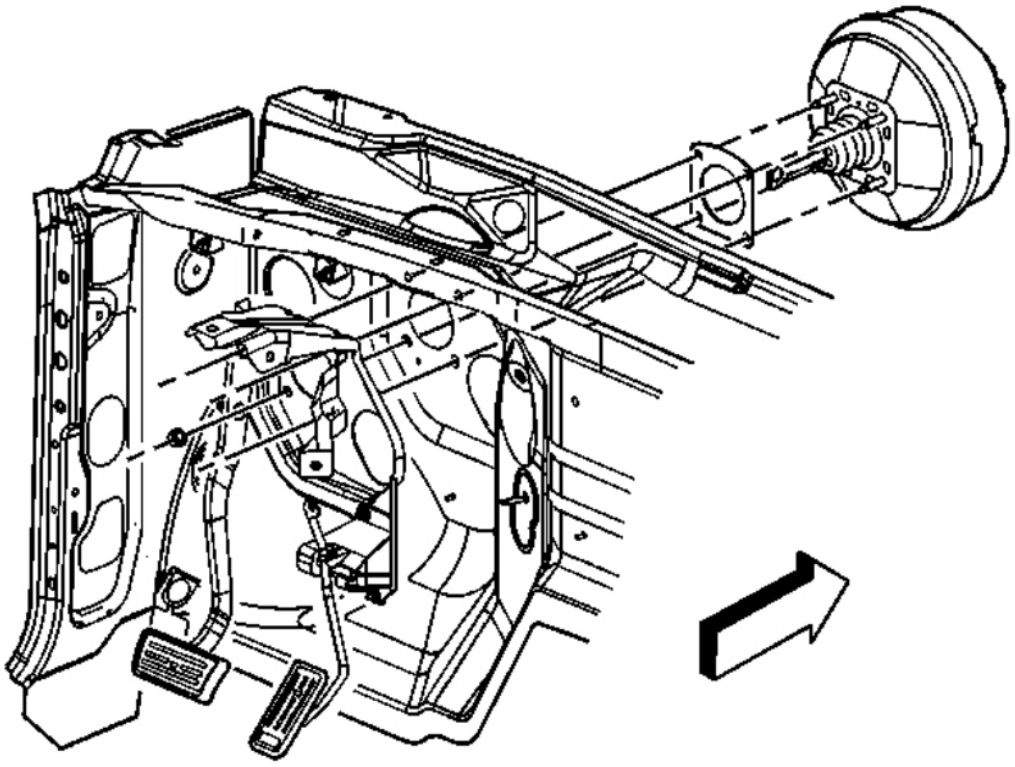


Fig. 40: Identifying Vacuum Booster & Nuts
Courtesy of GENERAL MOTORS CORP.

1. Install the NEW brake booster gasket.

IMPORTANT: An assistant may be necessary to hold the brake booster in place while installing the nuts.

2. Install the brake booster to the vehicle.

NOTE: Refer to Fastener Notice .

IMPORTANT: Tighten the upper right brake booster nut first.

3. Install the brake booster nuts.

Tighten: Tighten the nuts to 33 N.m (24 lb ft).

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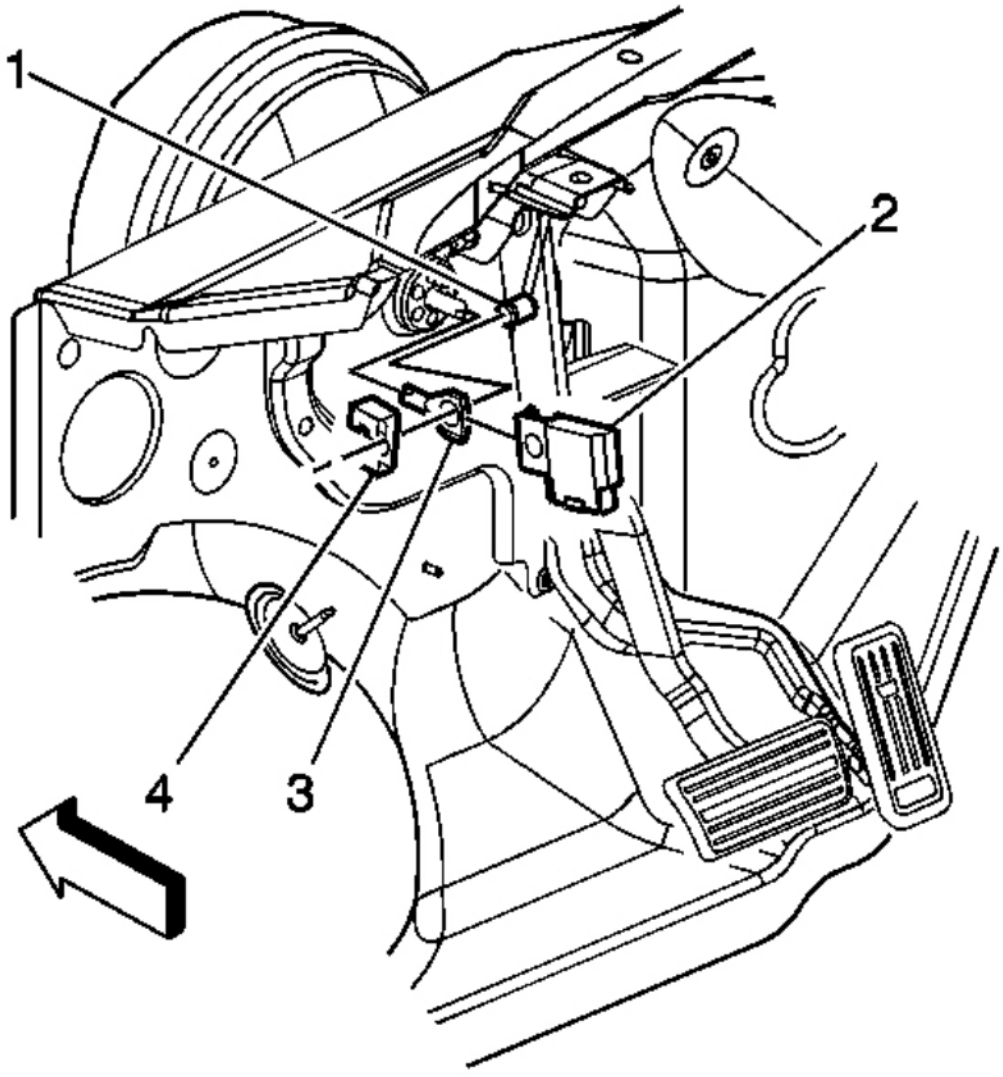


Fig. 41: View Of Pedal Stud, Stop Lamp Switch, Pushrod & Retaining Clip
Courtesy of GENERAL MOTORS CORP.

4. Install the pushrod (3) and stop lamp switch (2) to the brake pedal (1).
5. Install the pushrod retaining clip (4) to the brake pedal (1).

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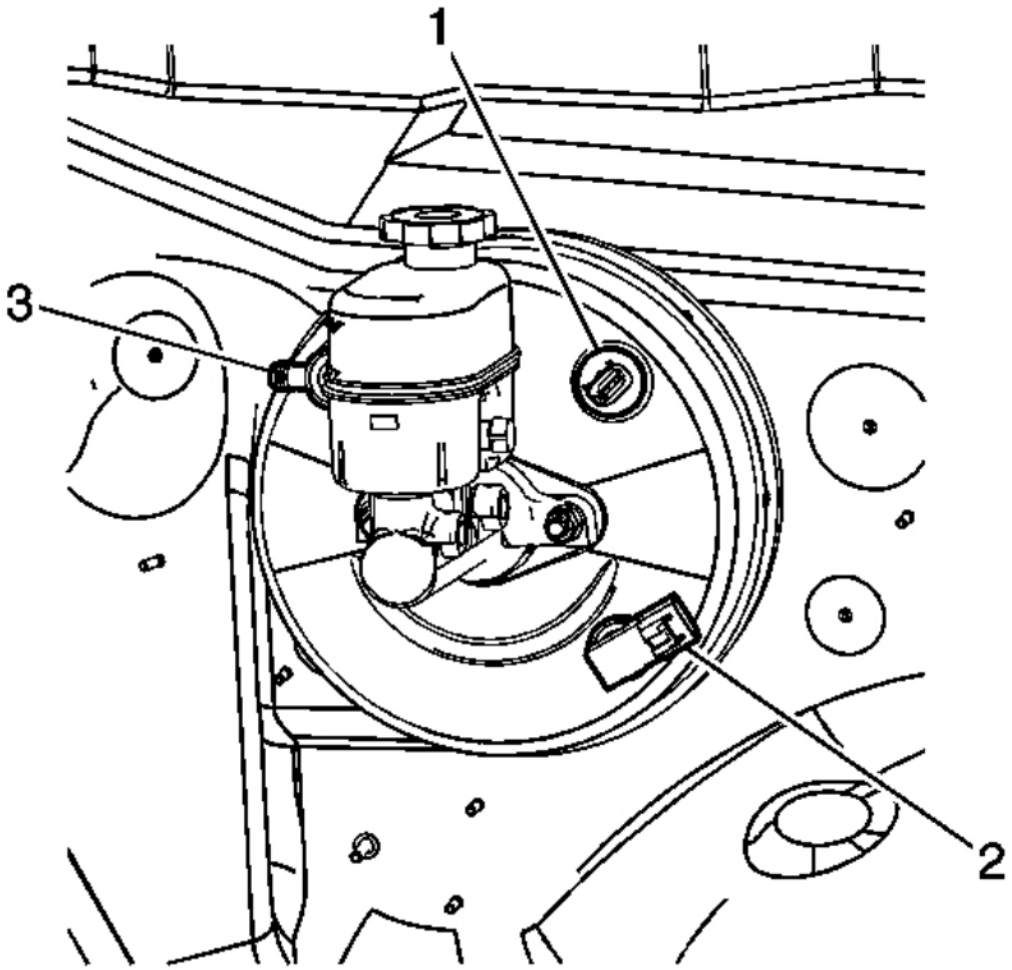


Fig. 42: View Of DOD Sensor, Booster Connector & Check Valve
Courtesy of GENERAL MOTORS CORP.

6. Install the vacuum hose to the check valve (3).
7. Install the electrical connectors to the DOD sensor (1) and the active booster connector (2).
8. Install the master cylinder.
9. Install the 2 master cylinder nuts.

Tighten: Tighten the nuts to 33 N.m (24 lb ft).

VACUUM BRAKE BOOSTER CHECK VALVE AND/OR HOSE REPLACEMENT

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Removal Procedure

1. Remove the vacuum brake booster check valve from the vacuum brake booster.
2. Remove the vacuum brake booster hose clamp at the check valve.
3. Remove the vacuum brake booster check valve from the hose.
4. Remove the intake manifold. Refer to **Intake Manifold Replacement (RPOs LC9/LMG/LY5/L76/L92)** or **Intake Manifold Replacement (RPOs LY2/LY6)** .

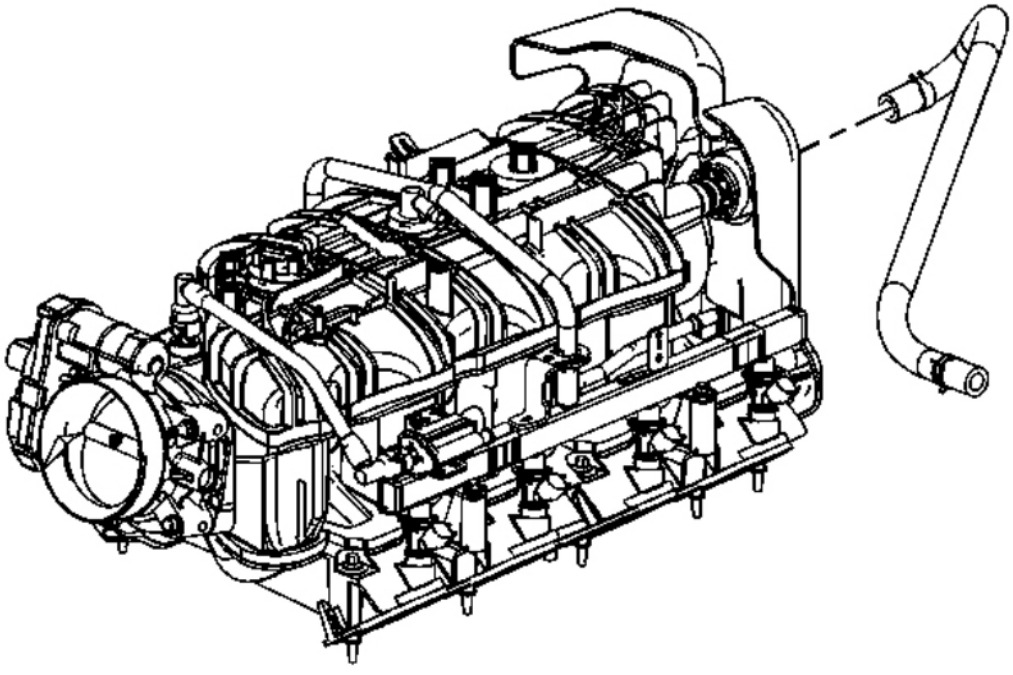


Fig. 43: View Of Vacuum Brake Booster Hose
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the vacuum brake booster hose at the engine.
6. Remove the vacuum brake booster hose from the vehicle.

Installation Procedure

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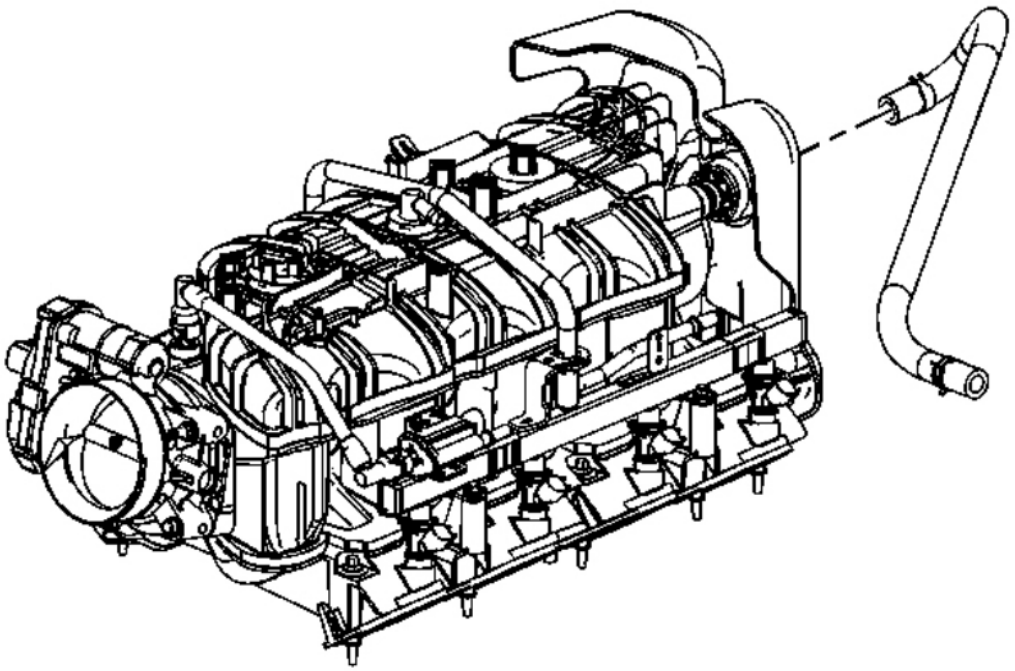


Fig. 44: View Of Vacuum Brake Booster Hose
Courtesy of GENERAL MOTORS CORP.

1. Connect the vacuum brake booster hose at the engine.
2. Install the vacuum brake booster check valve to the hose.
3. Install the vacuum brake booster hose clamp to the check valve.
4. Install the vacuum brake booster check valve to the vacuum brake booster.

POWER BRAKE BOOSTER REPLACEMENT

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

NOTE: Hydraulic brake systems use two distinct and incompatible fluids. Power steering fluid is used in the hydraulic brake booster system. Brake fluid is used in the master cylinder and brake pipes. Use extreme care when selecting brake

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system fluids, or seal damage can result. Refer to General Information to select the correct fluid.

Checking and Adding Fluid

For information on checking and adding fluid to the hydraulic booster system, refer to **Checking and Adding Power Steering Fluid (With Hydroboost)** or **Checking and Adding Power Steering Fluid (Without Hydroboost)** in Power Steering System.

Bleeding the Hydraulic Booster System

Refer to **Power Steering System Bleeding** in Power Steering System.

Flushing the Hydraulic Booster System

Refer to **Power Steering System Flushing** in Power Steering System.

Removal Procedure

1. Apply the park brake and block the wheels.
2. Disconnect the inlet hose, the steering gear, and the return hoses from the booster assembly.

IMPORTANT: DO NOT remove the pipes from the master cylinder.

3. Remove the master cylinder to hydraulic booster nuts and set the master cylinder aside in the engine compartment.
4. Remove the stop lamp switch. Refer to **Stop Lamp Switch Replacement (Adjustable Pedal)** or **Stop Lamp Switch Replacement (Non-Adjustable Pedal)** in Lighting Systems.

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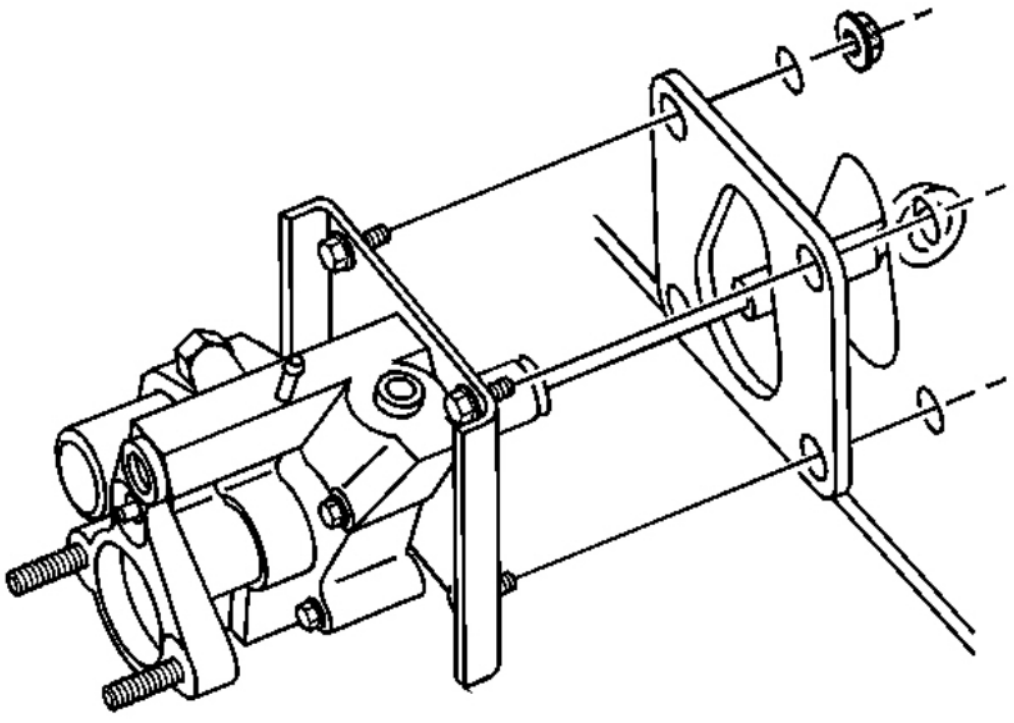


Fig. 45: Booster Assembly & Bulkhead Nuts
Courtesy of GENERAL MOTORS CORP.

5. Remove the 4 booster to bulkhead nuts.
6. Remove the booster assembly.
7. Remove the gasket.

Installation Procedure

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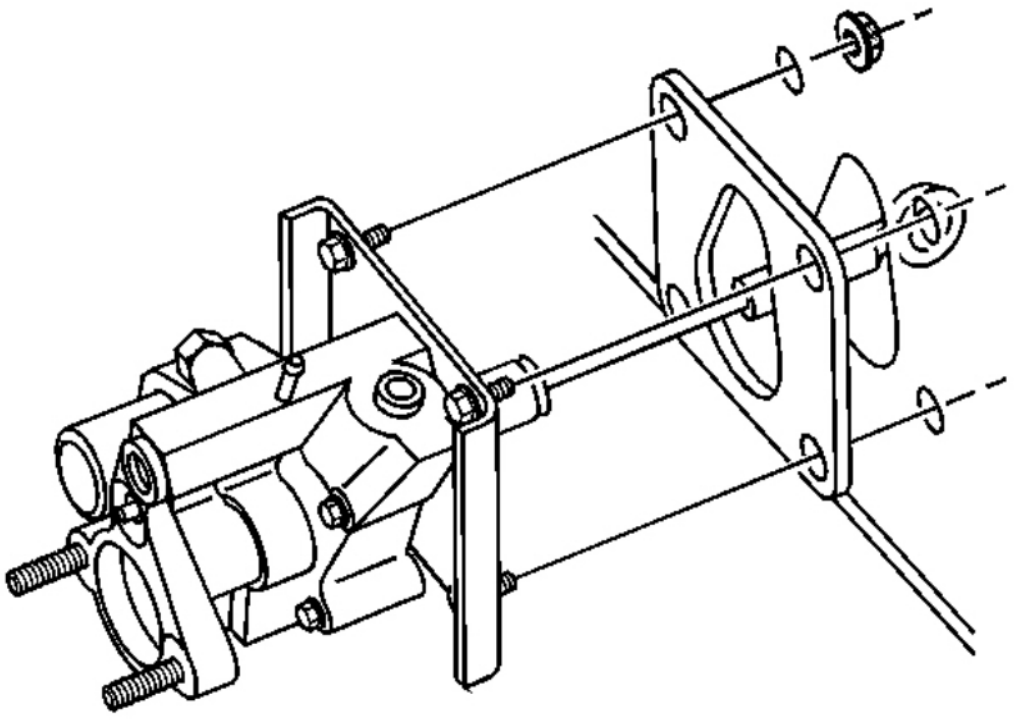


Fig. 46: Booster Assembly & Bulkhead Nuts
Courtesy of GENERAL MOTORS CORP.

1. Install the gasket.
2. Install the booster assembly.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

3. Install the 4 booster to bulkhead nuts.

   Tighten: Tighten the nuts to 33 N.m (24 lb ft).

4. Install the stop lamp switch. Refer to **Stop Lamp Switch Replacement (Adjustable Pedal)** or **Stop Lamp Switch Replacement (Non-Adjustable Pedal)** in Lighting Systems.
5. Install the master cylinder to the brake booster.

   Tighten: Tighten the nuts to 33 N.m (24 lb ft).

6. Connect the return hose, the steering gear, and the inlet hoses.

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7. Bleed the hydraulic booster system. Refer to **Power Steering System Bleeding** in Power Steering System.
8. Release the park brake and unblock the wheels.

HYDRAULIC BRAKE BOOSTER ACCUMULATOR REPLACEMENT

Tools Required

J 26889 Accumulator Piston Compressor. See **Special Tools**.

Removal Procedure

CAUTION: The accumulator contains compressed gas. Always use the proper tools and follow the recommended procedures or personal injury may result. Do not apply heat to accumulator. Do not attempt to repair an inoperative accumulator. Always replace an inoperative accumulator with a new one. Dispose of an inoperative accumulator by drilling a 1.5 mm (1/16 in) diameter hole through the end of the accumulator can, opposite the O-ring.

CAUTION: Push rod removal is not recommended. Improper staking of the push rod to the Hydroboost reaction piston can result in a loss of brakes. If the rod or seals require service, the entire unit must be replaced.

1. Apply the park brake and block the wheels.
2. Depress brake pedal at least 10 times in order to relieve pressure in the accumulator.
3. Remove the master cylinder from the hydraulic booster. Refer to **Master Cylinder Replacement (JD9)** or **Master Cylinder Replacement (JH6)**.

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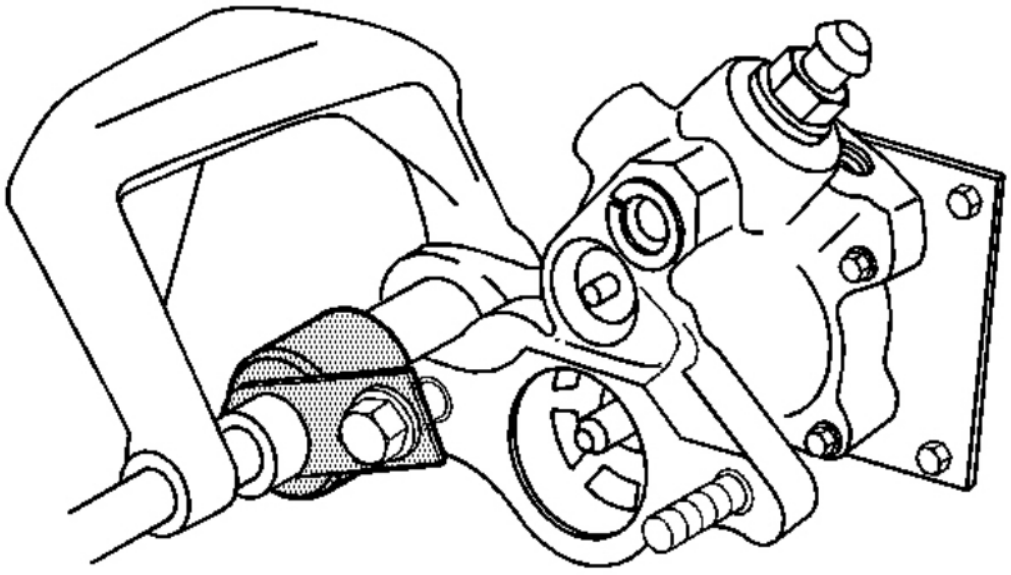


Fig. 47: View Of Accumulator With C-Clamp
Courtesy of GENERAL MOTORS CORP.

4. Place the **J 26889** over the end of the accumulator. See **Special Tools**.
5. Install the nut on the stud.
6. Depress the accumulator with a C-clamp. If the accumulator does not move with moderate pressure, remove the C-clamp and depress the brake pedal ten times in order to relieve pressure in the accumulator.

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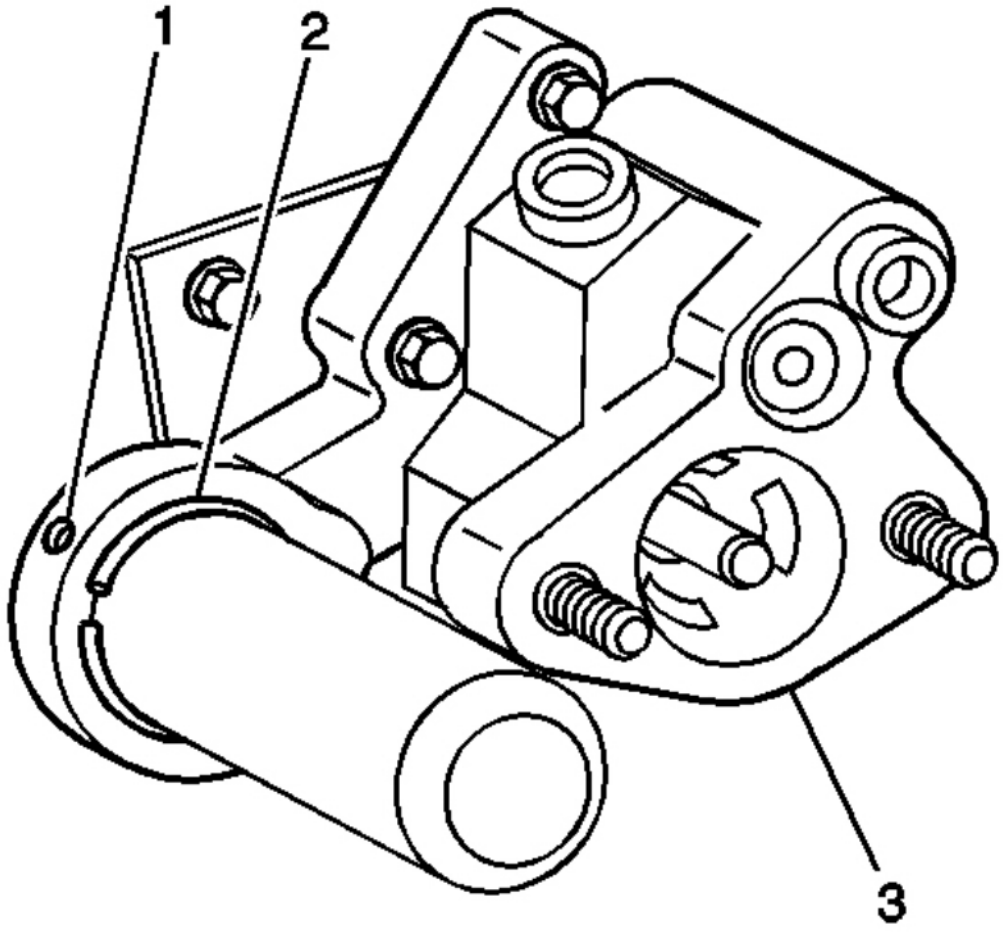


Fig. 48: Identifying Brake Booster Retaining Ring & Access Hole
Courtesy of GENERAL MOTORS CORP.

7. Rotate the retaining ring (2) until either end of the ring is under the access hole (1).
8. Depress and hold the retaining ring (2) with a small tool inserted into the access hole (1).

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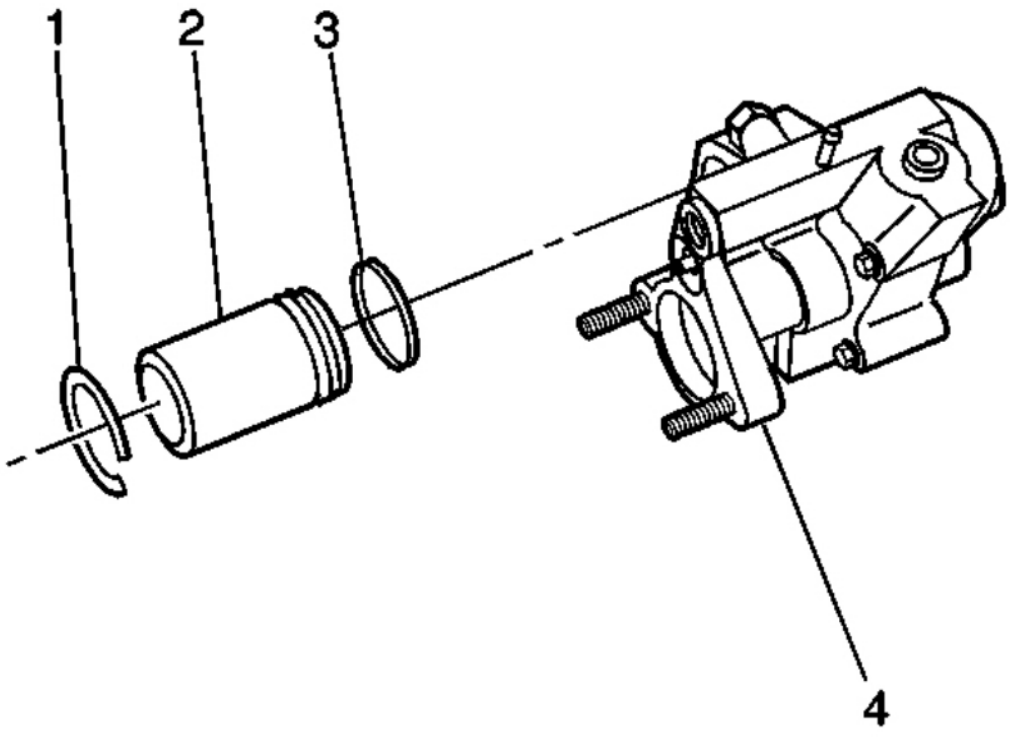


Fig. 49: Identifying Accumulator Components
Courtesy of GENERAL MOTORS CORP.

9. Remove the accumulator retainer ring (1) using a small hook shaped tool.

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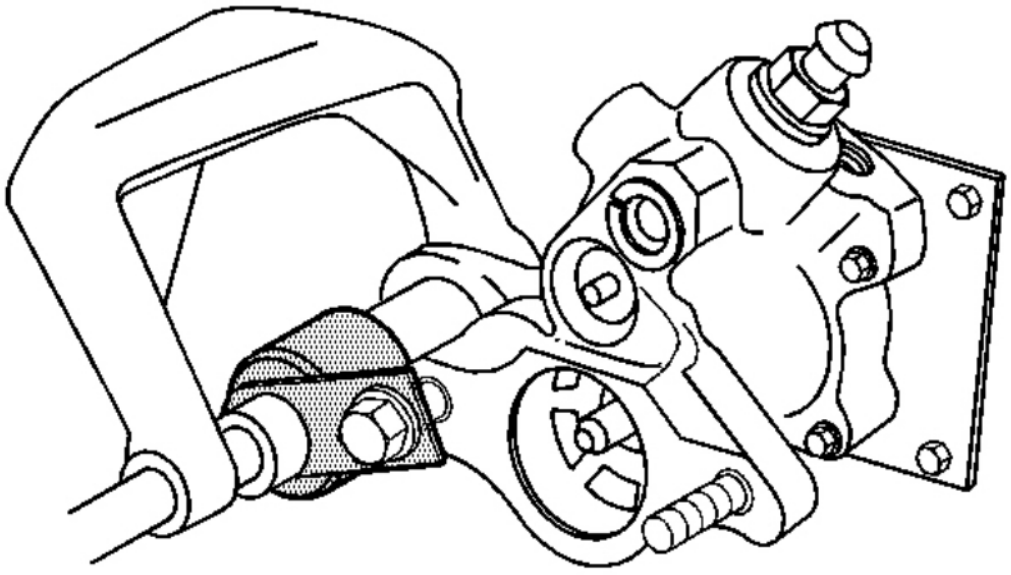


Fig. 50: View Of Accumulator With C-Clamp
Courtesy of GENERAL MOTORS CORP.

10. Release the C-clamp.
11. Remove the nut from the stud.
12. Remove the **J 26889** . See **Special Tools**.

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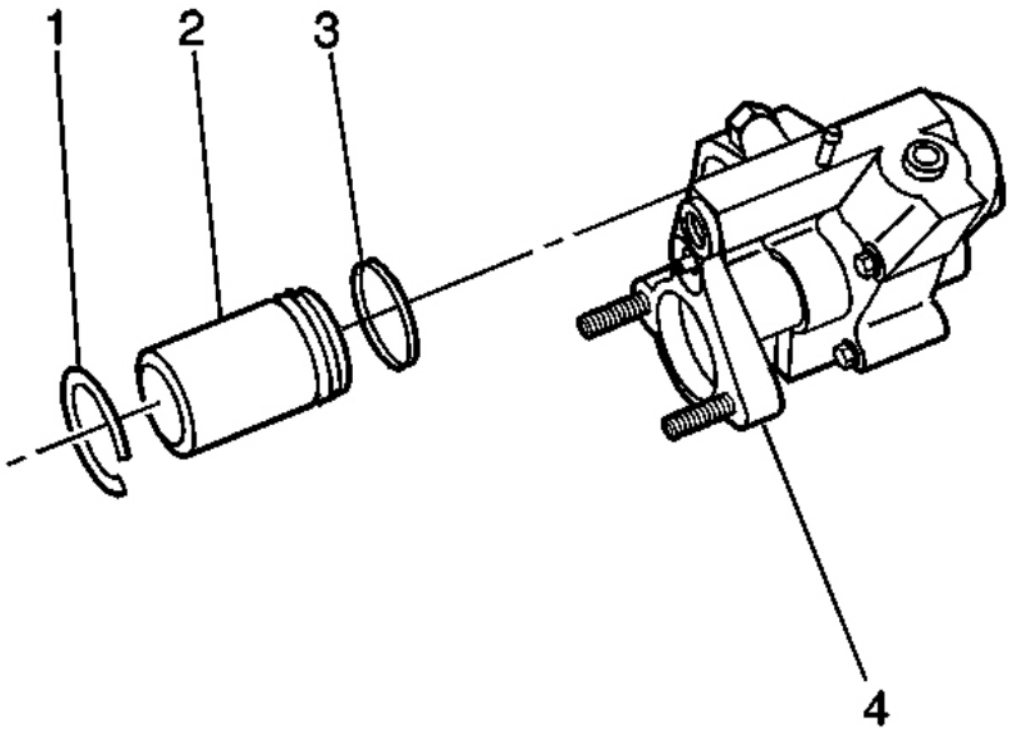


Fig. 51: Identifying Accumulator Components
Courtesy of GENERAL MOTORS CORP.

13. Remove the accumulator (2) and the O-ring seal (3).

Installation Procedure

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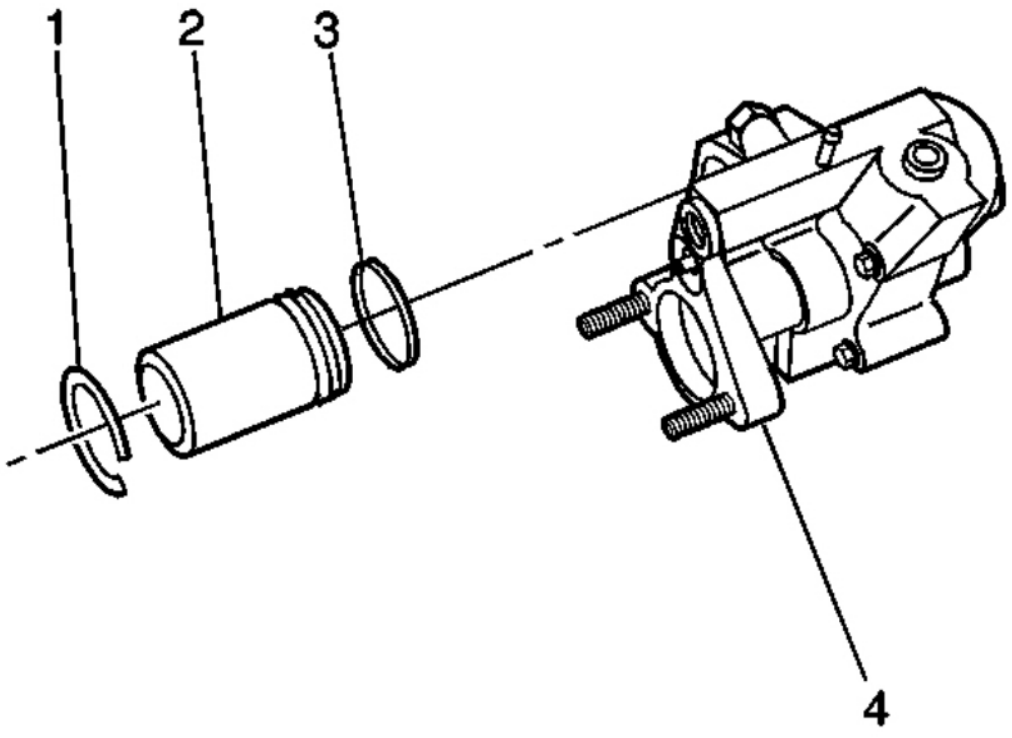


Fig. 52: Identifying Accumulator Components
Courtesy of GENERAL MOTORS CORP.

1. Lubricate all of the seals and the metal friction points with power steering fluid.
2. Install the accumulator (2) and the O-ring seal (3).

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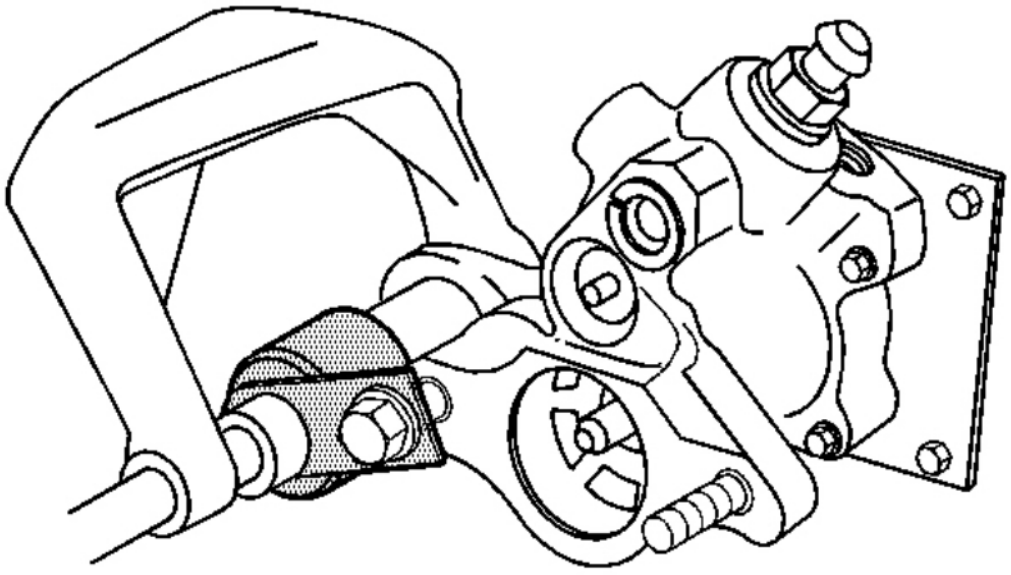


Fig. 53: View Of Accumulator With C-Clamp
Courtesy of GENERAL MOTORS CORP.

3. Place the **J 26889** over the end of the accumulator. See **Special Tools**.
4. Install the nut on the stud.
5. Depress the accumulator with a C-clamp.

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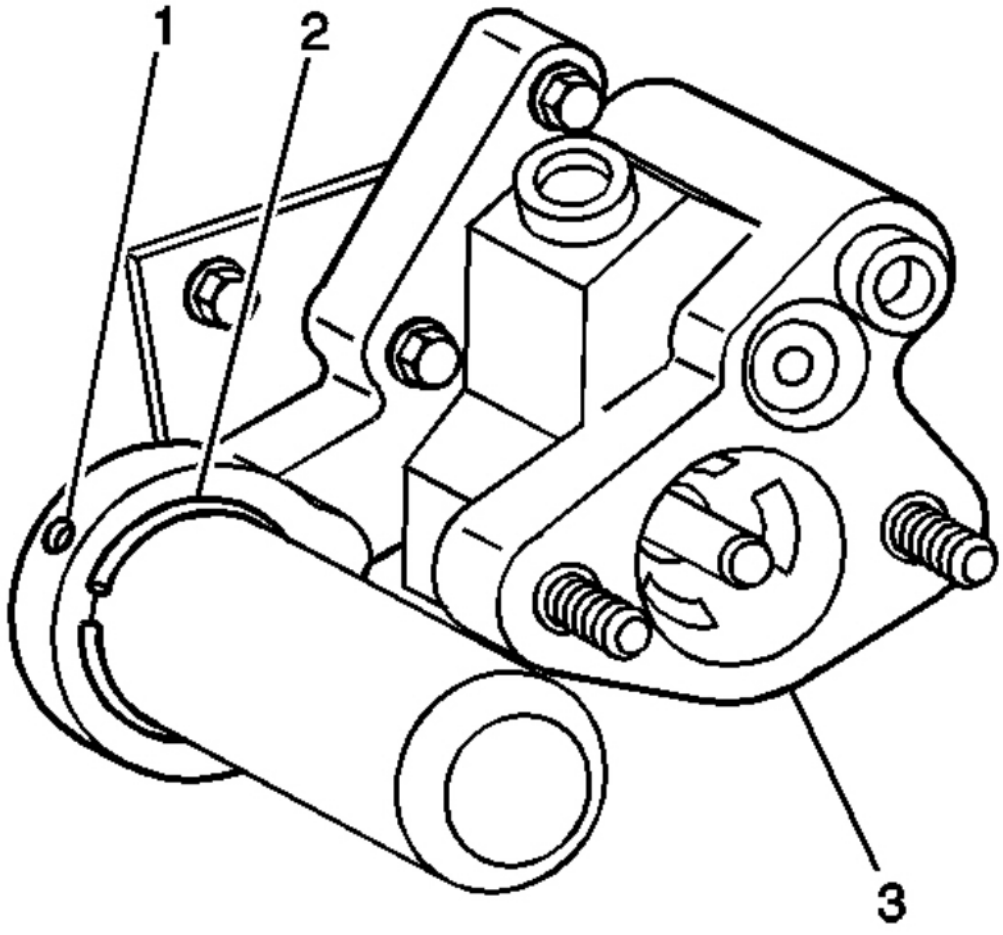


Fig. 54: Identifying Brake Booster Retaining Ring & Access Hole
Courtesy of GENERAL MOTORS CORP.

6. Install the accumulator retainer ring (1).

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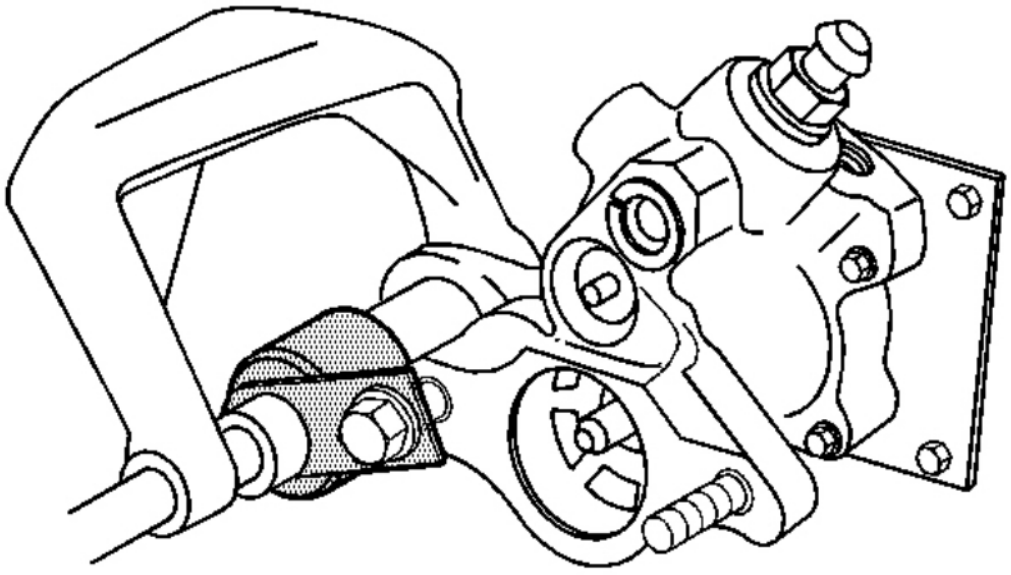


Fig. 55: View Of Accumulator With C-Clamp
Courtesy of GENERAL MOTORS CORP.

7. Release the C-clamp.
8. Remove the nut from the stud.
9. Remove the **J 26889** . See **Special Tools**.
10. Install the master cylinder to the hydraulic booster. Refer to **Master Cylinder Replacement (JD9)** or **Master Cylinder Replacement (JH6)**.
11. Release the park brake and unblock the wheels.

DESCRIPTION AND OPERATION

BRAKE WARNING SYSTEM DESCRIPTION AND OPERATION

Brake Warning Indicator

The instrument panel cluster (IPC) illuminates the Red Brake Warning indicator when one or more of the following occurs.

- The body control module (BCM) detects that the park brake is engaged.
- The IPC detects a low brake fluid condition. The IPC receives a low brake fluid signal from the low brake fluid switch in the master cylinder reservoir requesting illumination.

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- The electronic brake control module (EBCM) detects an ABS malfunction which disables dynamic rear proportioning (DRP). The IPC receives a GMLAN message from the EBCM requesting illumination.
- The IPC performs the bulb check at the start of each ignition cycle. The Red Brake Warning indicator illuminates for approximately 3 seconds before turning OFF.
- The IPC detects a loss of GMLAN communications with the EBCM.

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 two 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 (8600 GVW or Less)** or **ABS Description and Operation (Over 8600 GVW)** in Antilock Brake System for specific information on the operation of DRP.

Hydraulic Brake Pipes and Flexible Brake Hoses

Carries brake fluid to and from hydraulic brake system components.

Hydraulic Brake Wheel Apply Components

Converts hydraulic input pressure into mechanical output force.

System Operation

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

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BRAKE ASSIST SYSTEM DESCRIPTION AND OPERATION (HYDRAULIC ASSIST)

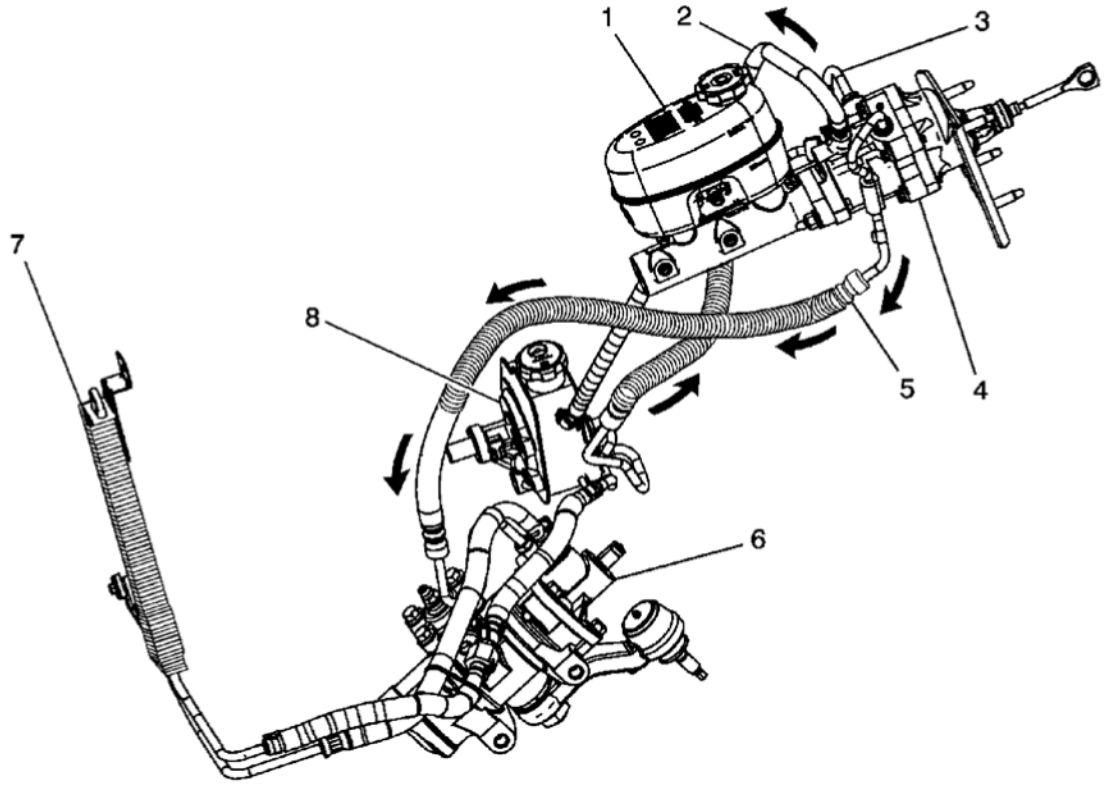


Fig. 56: View of Brake Assist System
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 56

Callout	Component Name
1	Master Cylinder
2	Power Brake Booster Outlet Hose
3	Power Brake Booster Inlet Pipe/Hose
4	Hydraulic Brake Booster
5	Power Steering Gear Inlet Pipe/Hose
6	Steering Gear
7	Power Steering Cooler
8	Power Steering Pump

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.

Hydraulic Brake Booster

Uses power steering fluid pressure to decrease effort required by driver when applying brake system input force.

Power Steering System

Supplies pressurized power steering fluid used by hydraulic brake booster to decrease brake pedal effort.

System Operation

The hydraulic brake boost system uses fluid from the power steering pump (8) through the hydraulic boost inlet hose (3) and to the brake booster assembly (4). In addition to supplying the brake system with fluid for increased apply, the power steering pump is also connected to the power steering gear (6) and cooler (7).

The steering pump (8) is a continuous flow device supplying approximately 3 GPM at 1000 RPM, at the pump shaft. The fluid flows through the booster spool valve, then the return hose (5), and then to the steering gear (6). Pressure is produced by applying the brake pedal, resulting in the spool valve being actuated, internal to the hydraulic brake booster. The spool valve produces a marginal restriction that causes pressure in the booster (4) to rise and forces the power piston and therefore the output rod forward to generate force and motion at the master cylinder (1). The brake corners are actuated by the fluid impulse generated by the master cylinder (1). Internal blow by, or pressure relief, is directed to the low pressure return hose (2) back to the power steering pump (8).

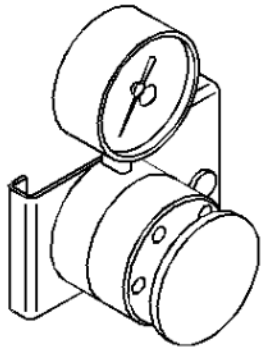
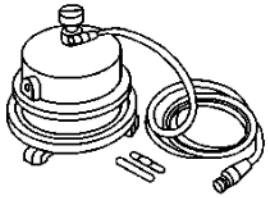
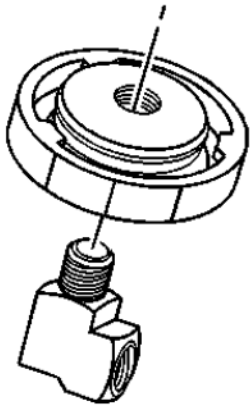
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Special Tools

Illustrations	Tool Number/Description
	J 26889 Accumulator Piston Compressor

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	J 28662 Brake Pedal Effort Gauge
	J 29532 Diaphragm Pressure Bleeder
	J 35589-A Brake Pressure Bleeder Adapter

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