2004 BRAKES

Hydraulic Brakes - C/K SUV

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Brake Hose to Caliper Bolt - Front	40 N.m	30 lb ft
Brake Hose to Caliper Bolt - Rear	40 N.m	30 lb ft
Brake Pedal Bolt	47 N.m	35 lb ft
Brake Pipe Fittings	25 N.m	18 lb ft
Hose Bracket to Anchor Plate Bolt	25 N.m	18 lb ft
Hose Bracket to Frame Bolt	12 N.m	106 lb in
Hose Bracket to Knuckle Bolt	12 N.m	106 lb in
Hose Bracket to Rear Axle Bolt	12 N.m	106 lb in
Hose Bracket to Upper Control Arm Bolt	9 N.m	80 lb in
Master Cylinder Mounting Nuts	33 N.m	24 lb ft
Negative Battery Cable Bolt	17 N.m	13 lb ft
Power Brake Booster Nuts - Hydraulic	36 N.m	27 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

BRAKE WARNING SYSTEM SCHEMATICS

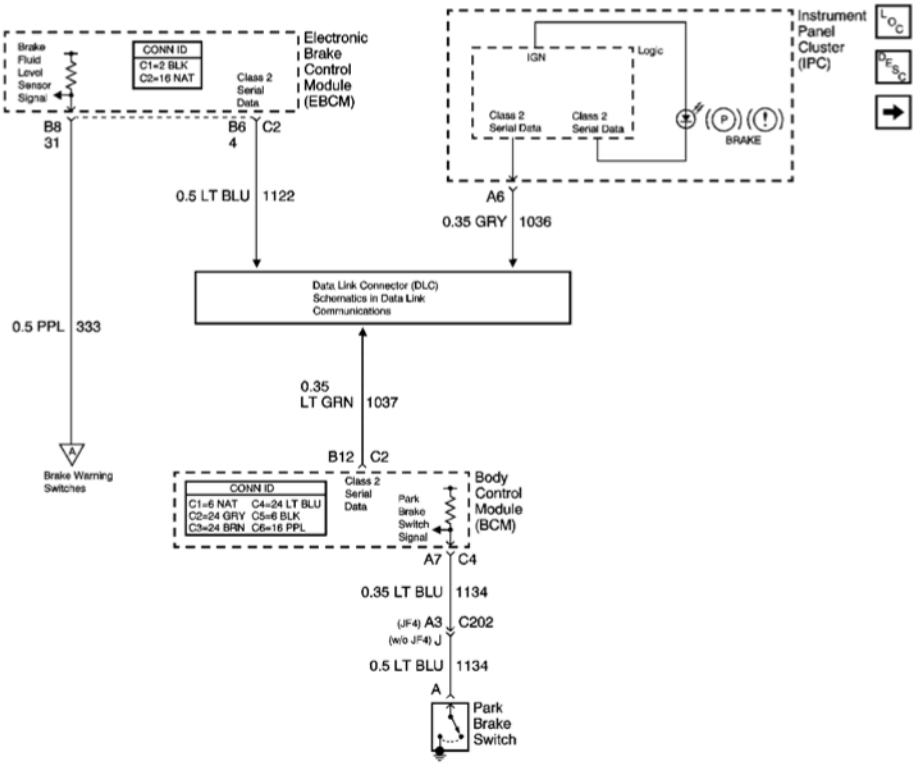


Fig. 1: Serial Data & Park Brake Signal Schematic
Courtesy of GENERAL MOTORS CORP.

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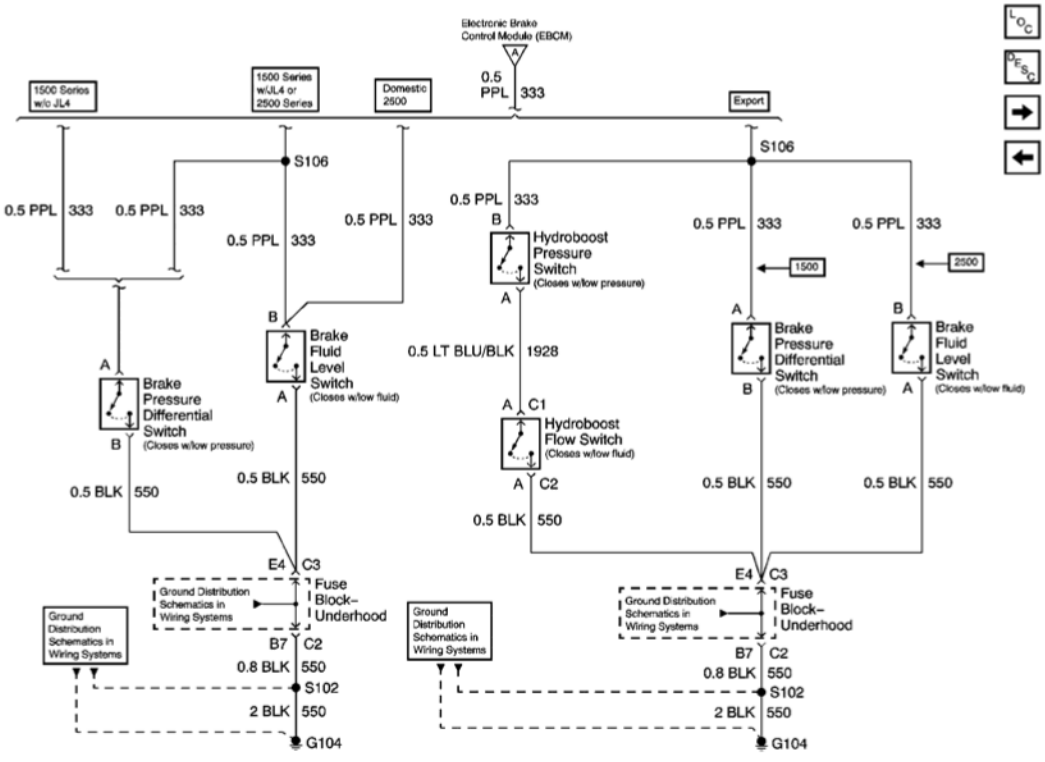


Fig. 2: Fluid Switches Schematic
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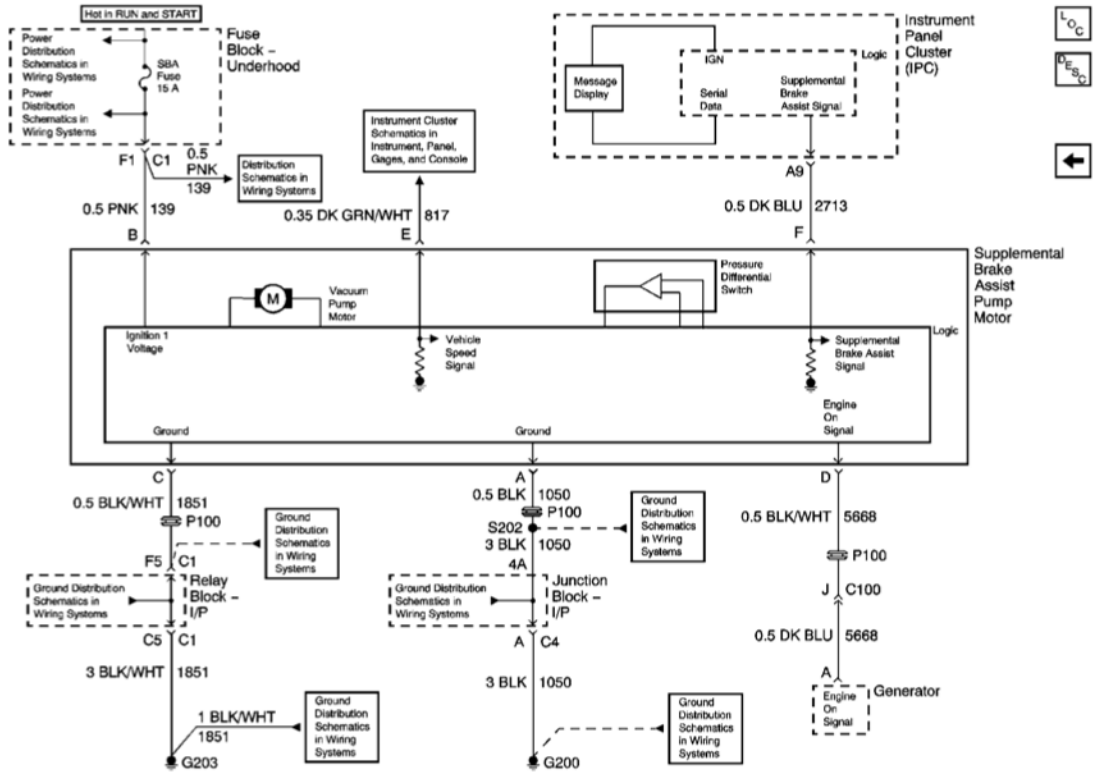


Fig. 3: Supplemental Brake Assist Schematic
Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

HYDRAULIC BRAKES COMPONENT VIEWS

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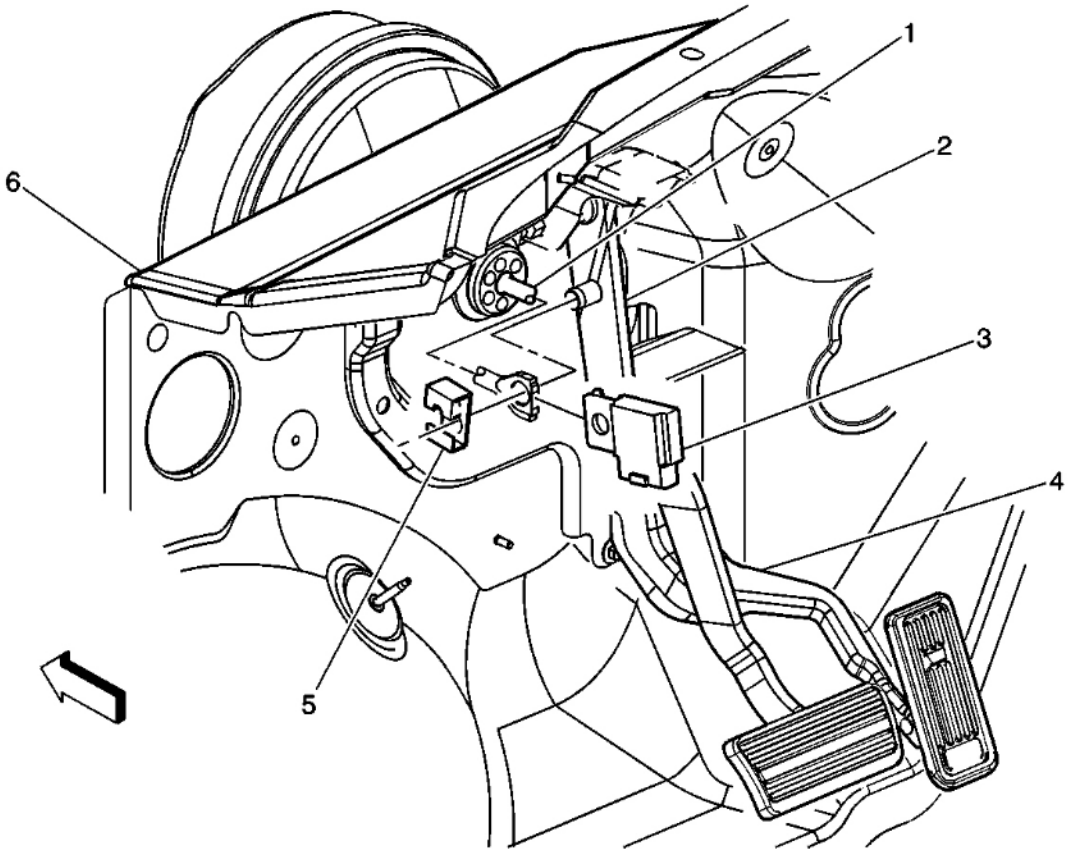


Fig. 4: Brake Pedal Components View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 4

Callout	Component Name
1	Vacuum Booster
2	Brake Pedal
3	Stoplamp Switch
4	Accelerator Pedal
5	Stoplamp Switch Retainer
6	Dash Panel

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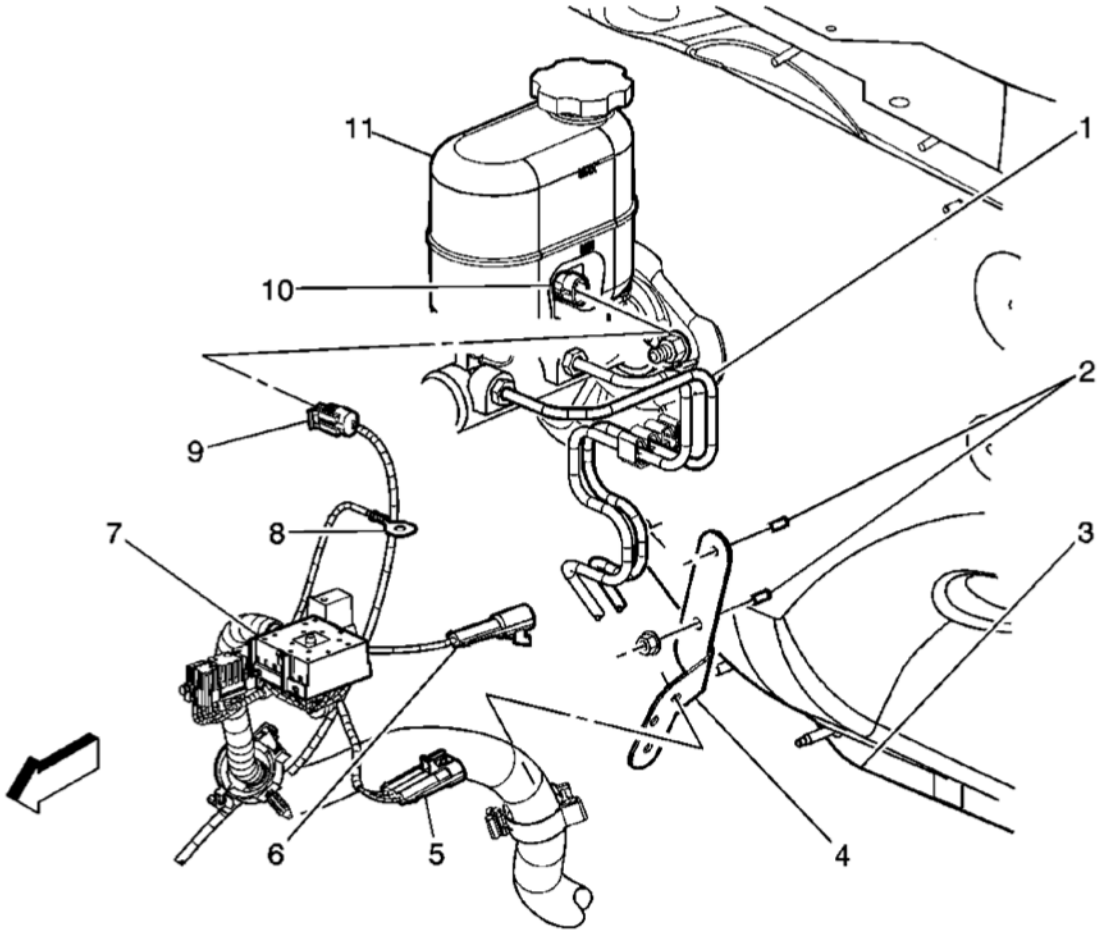


Fig. 5: LR Of Engine Compartment - Brake Components View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 5

Callout	Component Name
1	Hydraulic Brake Line
2	Bracket for Chassis Harness Studs
3	LH Front Lower Dash Panel
4	Bracket for Chassis Harness
5	Inline Connector
6	Inline Connector
7	Junction Block Underhood Connector
8	Junction Block Underhood Eyelet Connector
9	Brake Fluid Level Switch Connector
10	Brake Fluid Level Switch
11	Brake Fluid Reservoir

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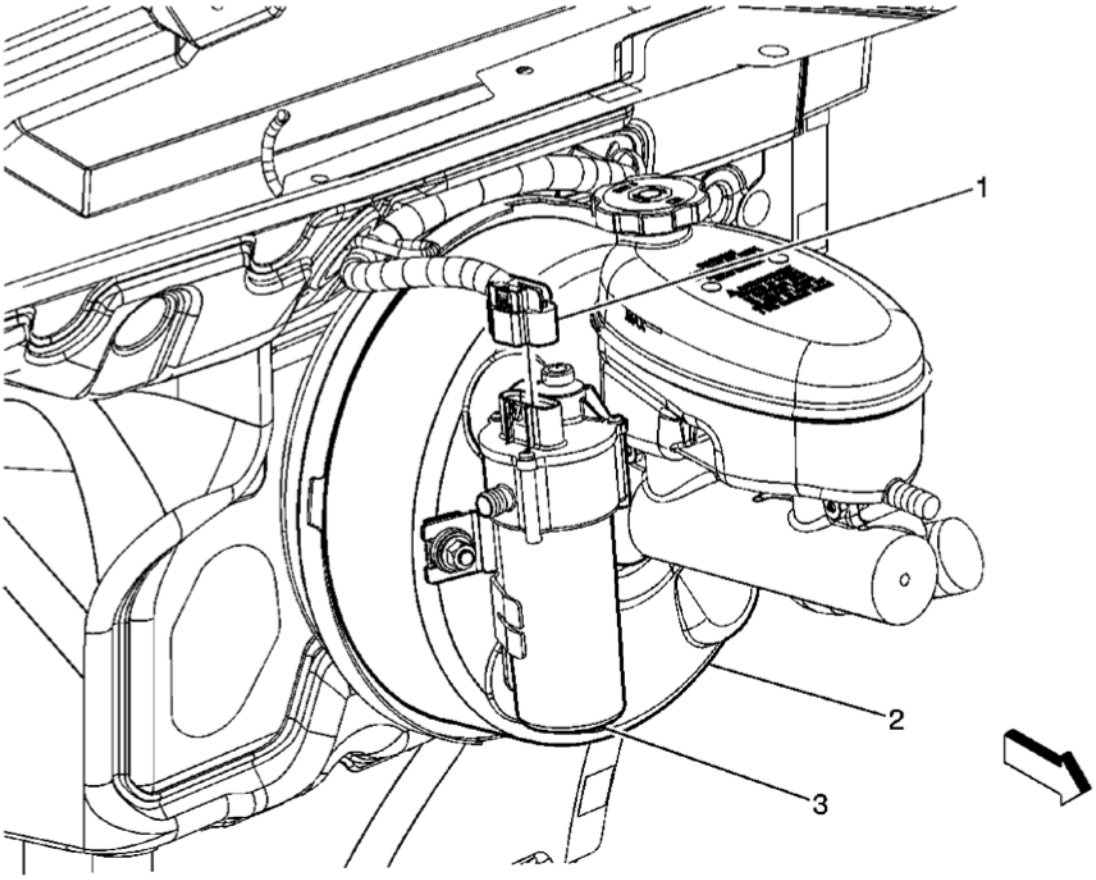


Fig. 6: Supplemental Brake Assist Pump Motor Component View
Courtesy of GENERAL MOTORS CORP.

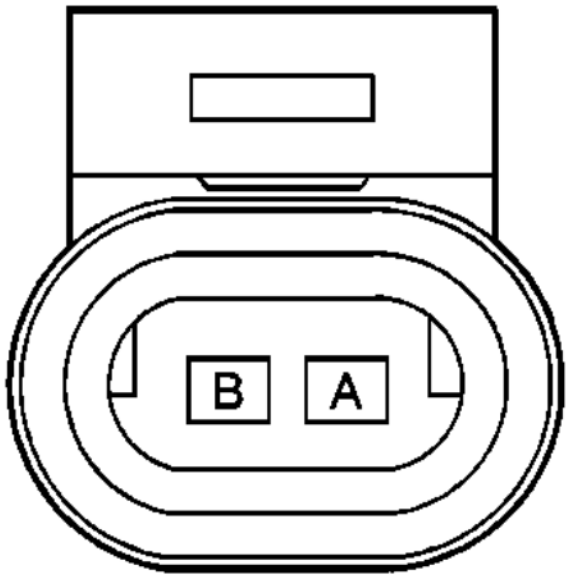
Callouts For Fig. 6

Callout	Component Name
1	Supplemental Brake Assist Pump Motor Connector
2	Brake Booster Assembly
3	Supplemental Brake Assist Pump Motor

HYDRAULIC BRAKES CONNECTOR END VIEWS

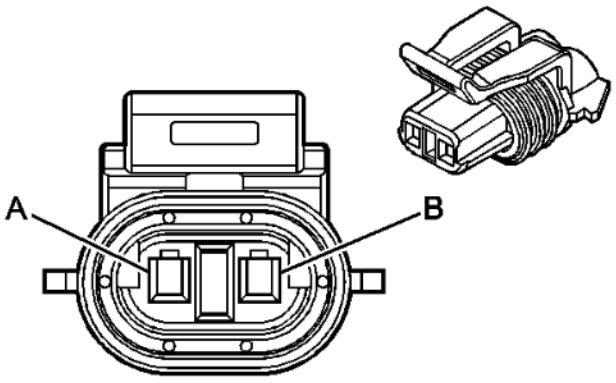
Brake Fluid Level Switch Connector End View

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Connector Part Information		• 12162194 • 2-Way F Metri-Pack 150.2 Series (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK	550	Ground
B	PPL	333	Brake Fluid Level Sensor Signal

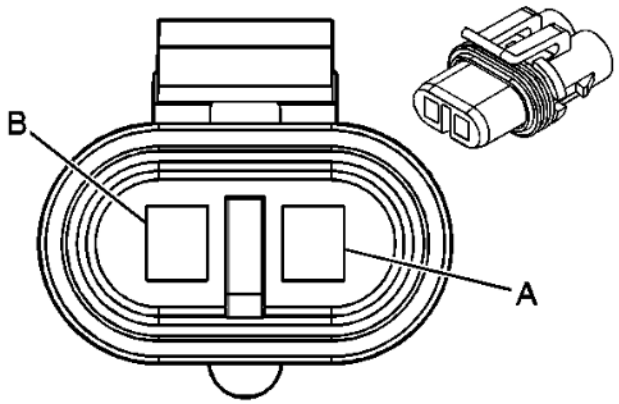
Brake Pressure Differential Switch Connector End View



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Connector Part Information		• 12052646 • 2-Way F M/P 150 SLD (WHT)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PPL	333	Brake Fluid Level Sensor Signal
B	BLK	550	Ground

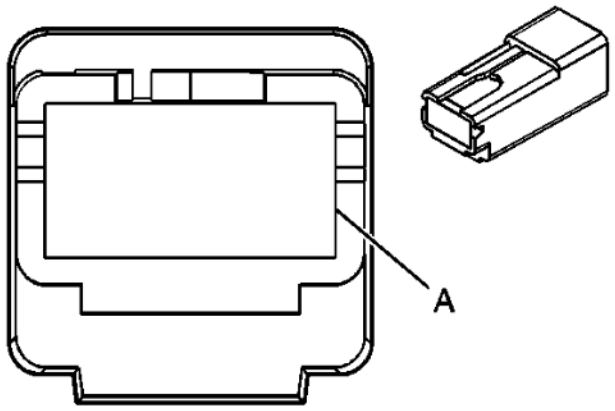
Hydroboost Pressure Switch Connector End View



Connector Part Information		• 12020599 • 2-Way F Metri-Pack 280 Series (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT BLU/ BLK	1928	Brake Booster Fluid Flow Switch Signal
B	PPL	333	Brake Fluid Level Sensor Signal

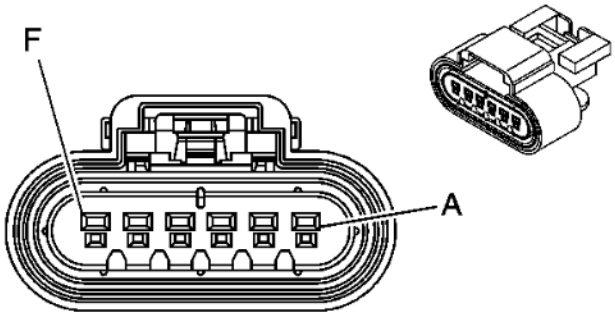
Park Brake Switch Connector End View

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Connector Part Information		• 12092133 • 1-Way F Metri-Pack 630 Self LK Series (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT BLU	1134	Park Brake Switch Signal

Supplemental Brake Assist Pump Motor Connector End View



Connector Part Information		• 15326830 • 6-Way F GT 150 (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK	150	Ground
B	PNK	139	Ignition 1 Voltage
C	BLK/WHT	1851	Ground
D	BLK/WHT	5668	Engine ON Signal
E	DK GRN/ WHT	817	Vehicle Speed Signal

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F	DK BLU	2713	Supplemental Brake Assist 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.

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** in Wiring Systems.
- 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** in Wiring Systems.

Symptom List

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**

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- **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

Brake Warning Indicator Always On

Step	Action	Yes	No
Schematic Reference: Brake Warning System Schematics **Connector End View Reference: Hydraulic Brakes Connector End Views ABS Connector End Views** in Antilock Brake System and **Body Control System Connector End Views** in Body Control System			
1	Did you review the Brake Warning System Description and Operation and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Hydraulic Brakes**
2	1. Turn OFF the ignition for 5 seconds. 2. Ensure the park brake is released. 3. Turn ON the ignition while observing the brake warning indicator. Does the brake warning indicator illuminate for 3 seconds and then turn OFF?	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems	Go to **Step 3**
3	1. Install a scan tool. 2. Select the Instrument Panel Cluster Special Functions menu on the scan tool. 3. Command the Brake Lamp OFF. Does the brake warning indicator turn OFF?	Go to **Step 4**	Go to **Step 11**
4	1. Select Input 1 from the Body Control Module Data Display menu on the scan tool. 2. Ensure the park brake is released. 3. Observe the Park Brake status on the scan tool. Does the scan tool display Released?	Go to **Step 5**	Go to **Step 6**
5	Disconnect the brake fluid level switch or brake pressure differential switch (if equipped), harness connector. Does the brake warning indicator turn OFF?	Go to **Step 12**	Go to **Step 8**

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6	Disconnect the park brake switch harness connector. Does the brake warning indicator turn OFF?	Go to **Step 9**	Go to **Step 7**
7	1. Disconnect from the BCM, the harness connector containing the park brake switch output circuit. 2. Test the park brake switch output circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 10**
8	1. Disconnect from the EBCM, the harness connector containing the brake fluid level sensor or brake pressure differential switch (if equipped), signal circuit. 2. Test the brake fluid level sensor or brake pressure differential switch (if equipped), signal circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 13**
9	Replace the park brake switch. Refer to **Park Brake Warning Lamp Switch Replacement** in Park Brake. Did you complete the replacement?	Go to **Step 14**	-
10	**IMPORTANT:** **Perform the setup procedure for the BCM.** Replace the BCM. Refer to **Body Control Module Replacement** in Body Control System.Did you complete the replacement?	Go to **Step 14**	-
11	Replace the instrument panel cluster. Refer to **Instrument Panel Cluster (IPC) Replacement** in Instrument Panel, Gages, and Console. Did you complete the replacement?	Go to **Step 14**	-
12	Replace the brake fluid level switch or brake pressure differential switch (if equipped). Refer to **Master Cylinder Reservoir Replacement** or **Combination Valve Replacement**. Did you complete the replacement?	Go to **Step 14**	-
13	**IMPORTANT:** **Following EBCM replacement, use the scan tool to perform the Tire Size Calibration procedure.** Replace the EBCM. Refer to **Electronic Brake Control Module Replacement (w/ JL4)** or **Electronic Brake Control Module Replacement (w/o JL4)** in Antilock		-

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	Brake System.Did you complete the replacement?	Go to **Step 14**	
14	1. Turn OFF the ignition for 5 seconds. 2. Ensure the park brake is released. 3. Turn ON the ignition while observing the brake warning indicator. Does the brake warning indicator illuminate for 3 seconds and then turn OFF?	System OK	Go to **Step 2**

BRAKE WARNING INDICATOR INOPERATIVE

Brake Warning Indicator Inoperative

Step	Action	Yes	No
Schematic Reference: Brake Warning System Schematics **Connector End View Reference: Hydraulic Brakes Connector End Views**			
1	Did you review the Brake Warning System Description and Operation and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Hydraulic Brakes**
2	Verify a fault is present. Does the system operate normally?	Go to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems	Go to **Step 3**
3	1. Install a scan tool. 2. Select the Instrument Panel Cluster Special Functions menu on the scan tool. 3. Command the Brake Lamp On. Does the brake warning indicator illuminate?	Go to **Step 4**	Go to **Step 15**
4	1. Select Input 1 from the Body Control Module Data Display menu on the scan tool. 2. Set the park brake while observing the Park Brake status on the scan tool. Does the Park Brake status change from Released to Set?	Go to **Step 5**	Go to **Step 6**
5	1. Disconnect the brake fluid level switch harness connector. 2. Connect a fused jumper wire between the brake fluid level switch output circuit and the ground circuit of the brake fluid level switch. Does the brake warning indicator illuminate?	Go to **Step 12**	Go to **Step 7**
	1. Disconnect the park brake switch harness		

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6	connector. 2. Connect a fused jumper wire between the park brake switch output circuit and a good ground. Does the brake warning indicator illuminate?	Go to **Step 11**	Go to **Step 8**
7	Connect a fused jumper wire between the brake fluid level switch output circuit and a good ground. Does the brake warning indicator illuminate?	Go to **Step 9**	Go to **Step 10**
8	Test park brake switch output circuit for an open between the park brake switch and the BCM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 16**	Go to **Step 13**
9	Repair the open in the ground circuit of the brake fluid level switch. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 16**	-
10	Test the brake fluid level switch input circuit for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 16**	Go to **Step 14**
11	Replace the park brake switch. Refer to **Park Brake Warning Lamp Switch Replacement** in Park Brake. Did you complete the replacement?	Go to **Step 16**	-
12	Replace the brake fluid level switch. Refer to **Master Cylinder Reservoir Replacement**. Did you complete the replacement?	Go to **Step 16**	-
13	**IMPORTANT:** **Perform the set up procedure for the BCM.** Replace the BCM. Refer to **Body Control Module Replacement** in Body Control System.Did you complete the replacement?	Go to **Step 16**	-
14	**IMPORTANT:** **Following EBCM replacement, use the scan tool to perform the Tire Size Calibration procedure.** Replace the EBCM. Refer to **Electronic Brake Control Module Replacement (w/ JL4)** or **Electronic Brake Control Module Replacement (w/o JL4)** in Antilock Brake System.Did you complete the replacement?	Go to **Step 16**	-
15	Replace the instrument panel cluster. Refer to **Instrument Panel Cluster (IPC) Replacement** in Instrument Panel, Gages, and Console. Did you complete the replacement?	Go to **Step 16**	-
	Verify the system is repaired.		

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16	Does the system operate normally?	System OK	Go to **Step 3**

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

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** in 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** in 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**
	Inspect the disc brake system for proper operation.		

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2	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**
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** in Park Brake. 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

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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 suspension system for proper operation. Refer to **Diagnostic Starting Point - Suspension General Diagnosis** in 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)** in Power Steering System. 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**. 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** in 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**

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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
1	Were you sent here from the Hydraulic Brake Symptom Table?	Go to **Step 2**	Go to **Diagnostic Starting Point - 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** • **Hydraulic Brake Booster Replacement**, for pedal pushrod replacement.		

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	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**
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 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

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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 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**. 2. Inspect the brake corners to determine if the		

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	brake drag condition is still present. Do the brake corners still exhibit the brake drag condition?	Go to **Step 11**	Go to **Step 10**
10	Replace the brake booster assembly. Refer to **Hydraulic 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
1	Were you sent here from the Hydraulic Brake Symptom table?		Go to **Diagnostic Starting Point -

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		Go to **Step 2**	**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 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 **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 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.

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

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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 **Brake Pads Replacement - Front** and/or **Brake Pads Replacement - Rear** in Disc Brakes. Did you complete the inspection and replacement?	Go to **Step 12**	-
	NOTE: **Support the brake caliper with heavy mechanic's wire, or equivalent, whenever it is**		

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	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 **Brake Caliper Replacement - Front** and/or **Brake Caliper Replacement - Rear (1500 Series)** or **Brake Caliper Replacement - Rear (2500 Series)** in Disc Brakes. 2. Inspect the disc brake caliper mounting bracket and the mounting/sliding hardware for the following conditions:		
7	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** • **Brake Caliper Bracket Replacement - Rear (W/O NYS)** or **Brake Caliper Bracket Replacement - Rear (W/NYS)** • **Disc Brake Hardware Replacement - Front** • **Disc Brake Hardware Replacement - Rear** 4. Replace the unevenly-worn, loose or damaged	-	

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	disc brake pads as a complete axle set. Refer to **Brake Pads Replacement - Front** and/or **Brake Pads Replacement - Rear** 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: • **Brake Caliper Overhaul - Front** or **Brake Caliper Replacement - Front** in Disc Brakes • **Brake Caliper Overhaul - Rear (15 Series)** or **Brake Caliper Overhaul - Rear (25 Series)** or **Brake Caliper Replacement - Rear (1500 Series)** or **Brake Caliper Replacement - Rear (2500 Series)** in Disc Brakes • **Brake Hose Replacement - Front** • **Brake Hose Replacement - Rear (Caliper)** or **Brake Hose Replacement - Rear (Jounce (W/O JL4))** or **Brake Hose Replacement - Rear (Jounce (W/JL4))** • **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**		

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	Inch Axle W/O JL4, 9.5 Inch Axle) or **Rear Axle Shaft Seal and/or Bearing Replacement (8.6 Inch Axle W/JL4)** or **Wheel Hub, Bearing, and Seal Replacement (RWD)** or **Wheel Hub, Bearing, and Seal Replacement (4WD)** 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. **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 **Brake Caliper Replacement - Front** and/or **Brake Caliper**		

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11	**Replacement - Rear (1500 Series)** or **Brake Caliper Replacement - Rear (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** and/or **Disc Brake Hardware Replacement - Rear** in Disc Brakes. 5. Replace the contaminated disc brake pads as a complete axle set. Refer to **Brake Pads Replacement - Front** and/or **Brake Pads Replacement - Rear** 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** and/or **Disc Brake Backing Plate Replacement - Rear (W/O NYS)** or **Disc Brake Backing Plate Replacement - Rear (15 Series W/NYS)** in Disc Brakes. Did you complete the repair or replacement?	Go to **Step 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.**		

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14	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**
16	1. Inspect each of the disc brake rotors for the following surface and wear conditions: 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**
	1. Refinish the brake rotor. Refer to **Brake Rotor Refinishing** in Disc Brakes.		

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17	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**
20	1. Inspect each of the disc brake rotors for the following surface and wear conditions: 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**
	IMPORTANT: **Whenever a brake rotor is replaced, the assembled**		

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21	**lateral runout (LRO) of the rotor must be measured to ensure optimum performance of the disc brakes.** Replace the brake rotor. Refer to **Brake Rotor Replacement - Front** or **Brake Rotor Replacement - Rear (W/NYS)** or **Brake Rotor Replacement - Rear (W/O NYS)** 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 (LRO) 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**
23	Correct the LRO for each brake rotor that was determined to have LRO exceeding the maximum acceptable level. Refer to **Brake Rotor Assembled Lateral Runout (LRO) 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**
	1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination: • Fluid separation, indicating two types of		

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3	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**
4	1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination: • Fluid separation, indicating two types of fluid are present ▪ Swirled appearance - oil-based substance ▪ Layered appearance - silicone-based substance • Fluid discoloration ▪ Cloudy appearance - moisture ▪ Dark appearance/suspended particles in fluid - dirt, rust, corrosion, brake dust 2. Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating fluid contamination. Do any of the above conditions exist?	Go to **Step 5**	Go to **Step 12**
	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		

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5	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 Overhaul** or **Master Cylinder Replacement** • Brake master cylinder reservoir: Clean the brake master cylinder reservoir using denatured alcohol, or equivalent, then dry the reservoir using non-lubricated, filtered air, or if necessary, replace the brake master cylinder reservoir. • Replace the brake master cylinder reservoir cap diaphragm. • **Brake Hose Replacement - Front** • **Brake Hose Replacement - Rear (Caliper)** or **Brake Hose Replacement - Rear (Jounce (W/O JL4))** or **Brake Hose Replacement - Rear (Jounce (W/JL4))** • **Brake Caliper Overhaul - Front** or **Brake Caliper Replacement - Front** in Disc Brakes • **Brake Caliper Overhaul - Rear (15 Series)** or **Brake Caliper Overhaul - Rear (25 Series)** or **Brake Caliper Replacement - Rear (1500 Series)** or **Brake Caliper Replacement - Rear (2500 Series)** in Disc Brakes • **Brake Pressure Modulator Valve (BPMV) Replacement (w/ JL4)** or **Brake Pressure Modulator Valve (BPMV) Replacement (w/o JL4)** in Antilock Brake System	-	

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	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**	
6	1. Inspect the following hydraulic brake system components for external fluid leaks Repair or replace any of the components found to be leaking brake fluid. Refer to the appropriate procedures: • **Master Cylinder Overhaul** or **Master Cylinder Replacement** Brake master cylinder reservoir cap diaphragm • **Brake Hose Replacement - Front** • **Brake Hose Replacement - Rear (Caliper)** or **Brake Hose Replacement - Rear (Jounce (W/O JL4))** or **Brake Hose Replacement - Rear (Jounce (W/JL4))** • **Brake Pipe Replacement** • **Brake Caliper Overhaul - Front** or **Brake Caliper Replacement - Front** in Disc Brakes • **Brake Caliper Overhaul - Rear (15 Series)** or **Brake Caliper Overhaul - Rear (25 Series)** or **Brake Caliper Replacement - Rear (1500 Series)** or **Brake Caliper Replacement - Rear (2500 Series)** in Disc Brakes • **Brake Pressure Modulator Valve (BPMV) Replacement (w/ JL4)** or **Brake Pressure Modulator Valve (BPMV) Replacement (w/o JL4)** in Antilock Brake System 2. If you repaired or replaced any of the brake		

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	system components listed, bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**. While bleeding the hydraulic brake system, observe for the following conditions: • The presence of air in the system at a bleeder valve location other than at the repair location, except if the brake master cylinder was replaced • An unrestricted and even flow of brake fluid per axle during the bleeding procedure Did you find and correct a condition?	Go to **Step 7**	Go to **Step 12**
7	Was there air in the system at a bleeder valve location other than at the repair location, except if the brake master cylinder was replaced?	Go to **Step 19**	Go to **Step 8**
8	Was the flow of brake fluid unrestricted and even per axle during the bleeding procedure?	Go to **Step 9**	Go to **Step 10**
9	Inspect the hydraulic function of the brake calipers for proper operation. Refer to **Hydraulic Brake Component Operation Visual Inspection**. Was the hydraulic function of the brake calipers operating properly?	Go to **Step 21**	Go to **Step 14**
10	Was the flow of brake fluid restricted or uneven through front axle hydraulic components during the bleeding procedure?	Go to **Step 13**	Go to **Step 11**
11	Was the flow of brake fluid restricted or uneven through rear axle hydraulic components during the bleeding procedure?	Go to **Step 17**	-
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** in General Information. 2. Remove the tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels. 3. Open the suspected caliper bleeder valve. 4. Using a large C-clamp, compress the caliper		

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	piston and observe for an unrestricted flow of brake fluid and for free movement of the caliper piston. 5. Close the caliper bleeder valve. Was the flow of brake fluid unrestricted and did the caliper piston move freely?	Go to **Step 17**	Go to **Step 14**
14	Repair or replace any brake caliper that was not operating properly. Refer to the appropriate procedure. • **Brake Caliper Overhaul - Front** or **Brake Caliper Replacement - Front** in Disc Brakes • **Brake Caliper Overhaul - Rear (15 Series)** or **Brake Caliper Overhaul - Rear (25 Series)** or **Brake Caliper Replacement - Rear (1500 Series)** or **Brake Caliper Replacement - Rear (2500 Series)** in Disc Brakes 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: • **Brake Hose Replacement - Front** • **Brake Hose Replacement - Rear (Caliper)** or **Brake Hose Replacement - Rear (Jounce (W/O JL4))** or **Brake Hose Replacement - Rear (Jounce (W/JL4))** • **Brake Pipe Replacement**		

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	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 (BPMV) Replacement (w/ JL4)** or **Brake Pressure Modulator Valve (BPMV) Replacement (w/o JL4)** in Antilock Brake System. 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 Overhaul** or **Master Cylinder Replacement**. Did you find and correct a condition?	Go to **Step 21**	Return to Symptom Table
21	Install or connect components that were removed or disconnected during diagnosis. Did you complete the operation?	Hydraulic Brake System OK Return to Symptom Table	-

BRAKE 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			

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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 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** in Engine Mechanical - 4.8L, 5.3L, 6.0L • **Drive Belt Replacement - Accessory** in Engine Mechanical - 8.1L 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** in Power Steering System. 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**
	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.		

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10	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** • **Hydraulic 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**
12	1. Inspect the power steering drive belt for conditions which could cause slipping. 2. Replace the power steering drive belt if necessary. Refer to the appropriate procedure: • **Drive Belt Replacement - Accessory** in Engine Mechanical - 4.8L, 5.3L, 6.0L • **Drive Belt Replacement - Accessory** in Engine Mechanical - 8.1L 3. Check the power steering system fluid level and adjust the level if necessary. Refer to **Checking and Adding Power Steering Fluid (Without Hydroboost)** or **Checking and Adding Power Steering Fluid (With Hydroboost)** in Power Steering System. 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**
	1. Inspect the power steering system pressure supplying the hydro-boost unit. Refer to **Power Steering System Test Procedure** in Power		

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14	Steering System. 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. 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 **Hydraulic 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.	Brake Assist System OK	-

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	Did you complete the operation?	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.
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

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13.

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

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

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

BRAKE PEDAL TRAVEL MEASUREMENT AND INSPECTION

Tools Required

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

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 and Equipment**.
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 and Equipment**.
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.

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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)

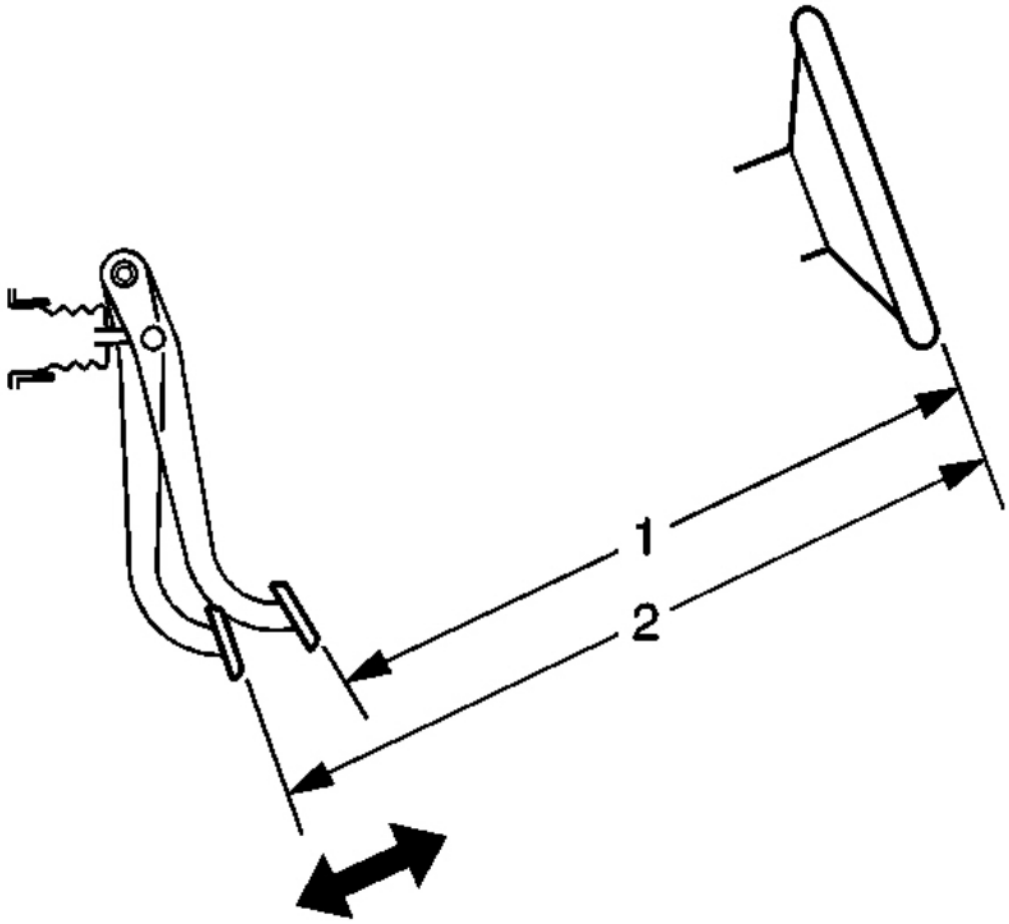


Fig. 7: Measuring Brake Pedal Travel
Courtesy of GENERAL MOTORS CORP.

HYDRAULIC BRAKE ASSIST SYSTEM NOISE INSPECTION

Tools Required

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

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1. Install the **J 28662** to the brake pedal. See **Special Tools and Equipment**.
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** . Observe for noises. See **Special Tools and Equipment**.
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 drive belt is probably slipping and would require replacement.
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 and it would require replacement.

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. Observe for noises. See **Special Tools and Equipment**.
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.
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 in Cautions and Notices.

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

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.

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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 in Cautions and Notices.

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

1. Start the engine and allow it to idle.
2. Apply light, steady pressure to the brake pedal. Observe both the brake pedal feel and travel.
3. Release the brakes and turn OFF the ignition.
4. If the brake pedal apply felt spongy, but the brake pedal travel was not excessive, perform the following steps:
   1. Inspect the brake system for external leaks. Refer to **Brake System External Leak Inspection**.
   2. Pressure bleed the brake system in order to purge any air that may be trapped in the system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.
5. If the brake pedal apply did not feel spongy, but the brake pedal travel was excessive, perform the following steps:
   1. Loosen the master cylinder-to-brake power booster mounting nuts.
   2. Carefully pull the master cylinder away from the brake power booster just enough to inspect the mounting surface of the master cylinder.
   3. Inspect the master cylinder mounting surface at the primary piston (2) for brake fluid leaks.
6. If the master cylinder exhibits any leakage around the primary piston (2), then the primary piston primary seal (4) and/or secondary seal (3) is leaking and the master cylinder requires overhaul or replacement.
7. If the master cylinder primary piston (2) does not exhibit any leakage, pressure bleed the brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding**

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(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.

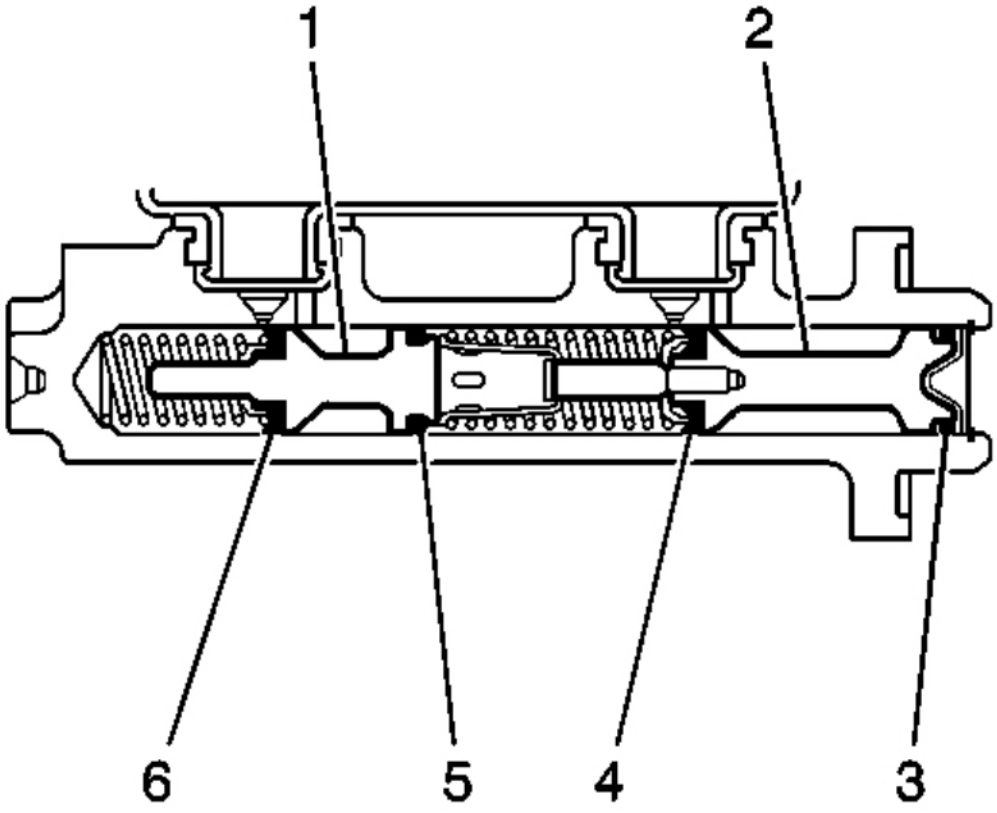


Fig. 8: Cross Sectional View Of Brake Master Cylinder
Courtesy of GENERAL MOTORS CORP.

HYDRAULIC BRAKE COMPONENT OPERATION VISUAL INSPECTION

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

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

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.

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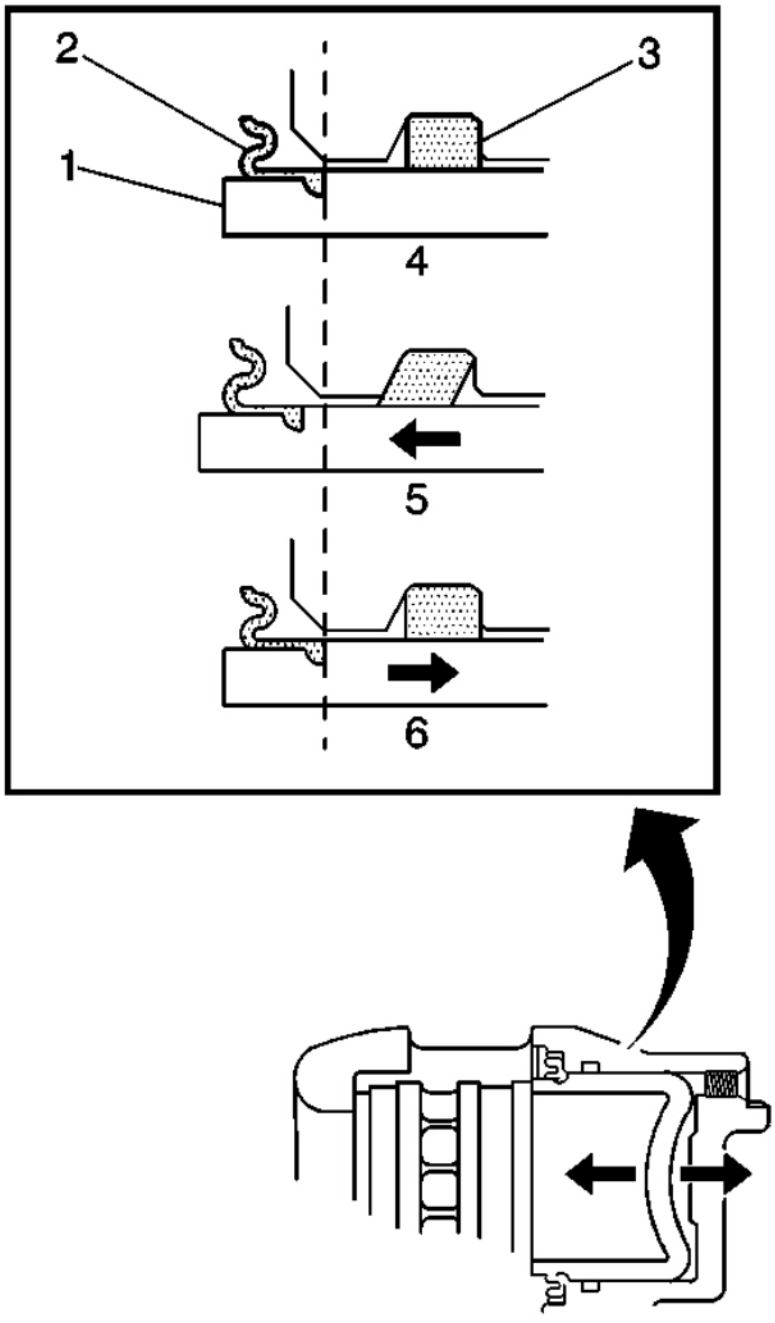


Fig. 9: Identifying Brake Caliper/Pad Inspection Areas
Courtesy of GENERAL MOTORS CORP.

BRAKE PIPE AND HOSE INSPECTION

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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.

1. Visually inspect all of the brake pipes for the following conditions:
   - Kinks, improper routing, missing or damaged retainers
   - Leaking fittings, excessive corrosion
2. If any of the brake pipes exhibited any of the conditions listed, then the identified pipe, or pipes, require replacement.
3. Ensure that the vehicle axles are properly supported at ride height in order to maintain the proper relationship of the flexible brake hoses to the chassis.
4. Visually inspect all of the flexible brake hoses for the following conditions:
   - Kinks (1), improper routing, twists, chafing, missing or damaged retainers
   - Leaking connections, cracking, dry-rot, blisters, bulges
5. If any of the flexible brake hoses exhibited any of the conditions listed, then the identified flexible brake hose, or hoses require replacement.
6. Squeeze the flexible brake hoses with firm finger pressure to check for soft spots (2), indicating an internal restriction. Check the entire length of each flexible brake hose.
7. If any of the flexible brake hoses were found to have soft spots (2), then the identified flexible brake hose, or hoses require replacement.

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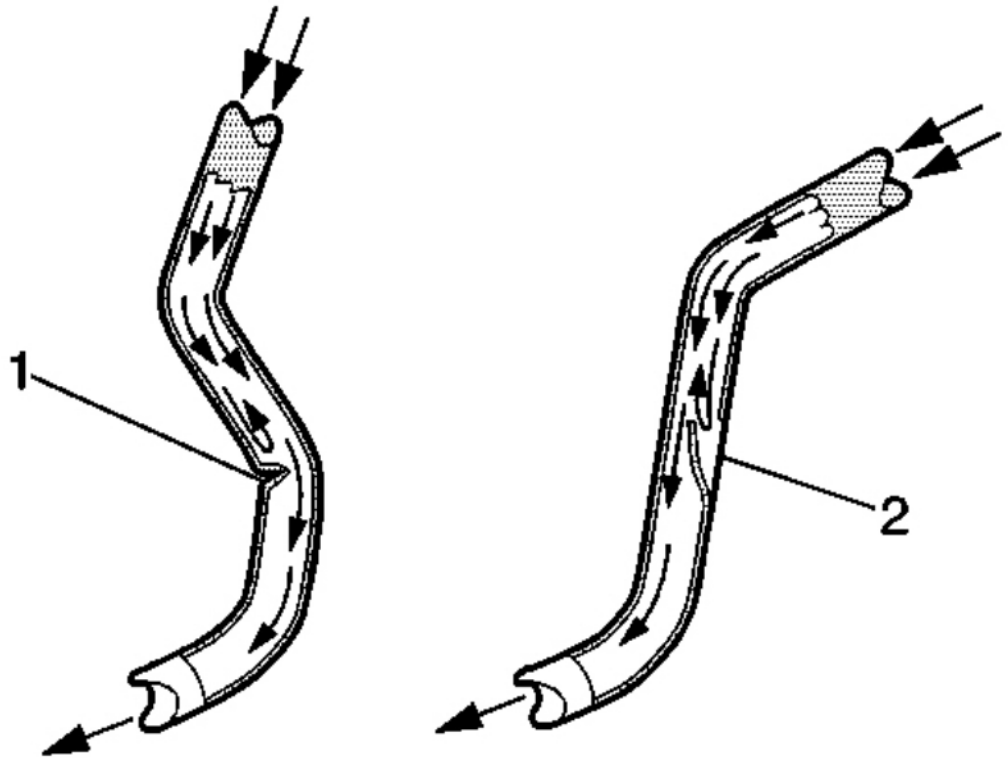


Fig. 10: Identifying Flexible Brake Hose Failure Conditions
Courtesy of GENERAL MOTORS CORP.

BRAKE PEDAL PUSHROD INSPECTION

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

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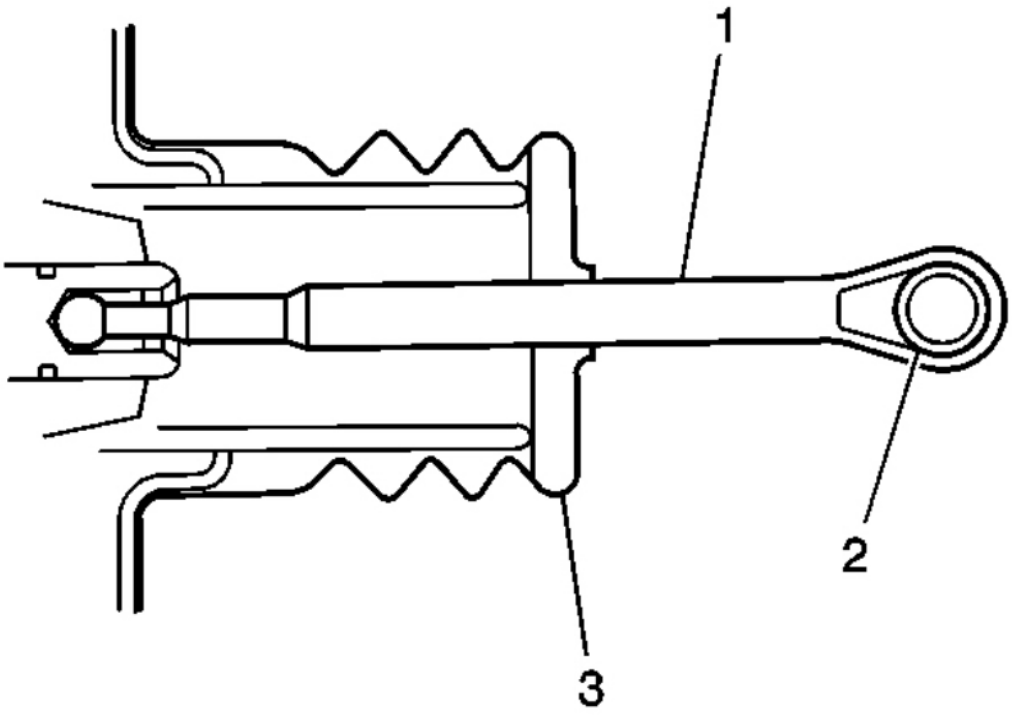


Fig. 11: View of Brake Pedal Pushrod
Courtesy of GENERAL MOTORS CORP.

REPAIR INSTRUCTIONS

MASTER CYLINDER RESERVOIR FILLING

CAUTION: Refer to Brake Fluid Irritant Caution 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.

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

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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.

1. Apply the park brake and block the wheels.
2. Remove the master cylinder. Refer to **Master Cylinder Replacement**.
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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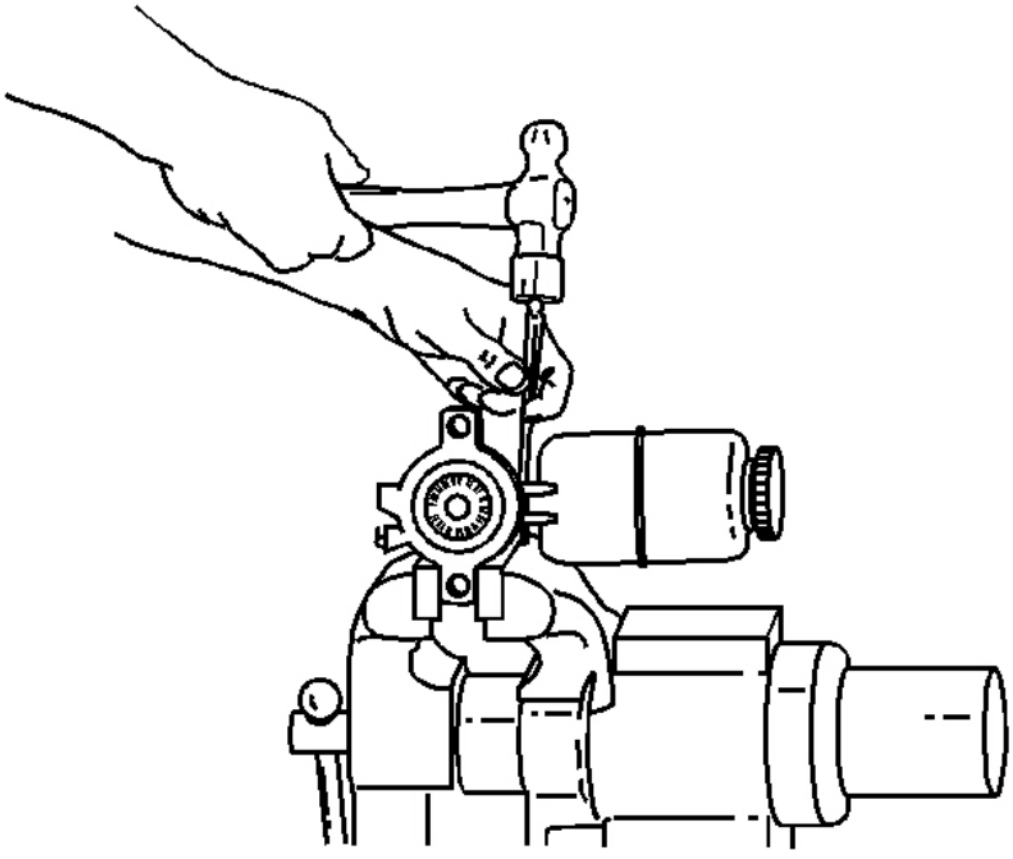


Fig. 12: Removing & Installing Master Cylinder Reservoir Retaining Pins
Courtesy of GENERAL MOTORS CORP.

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

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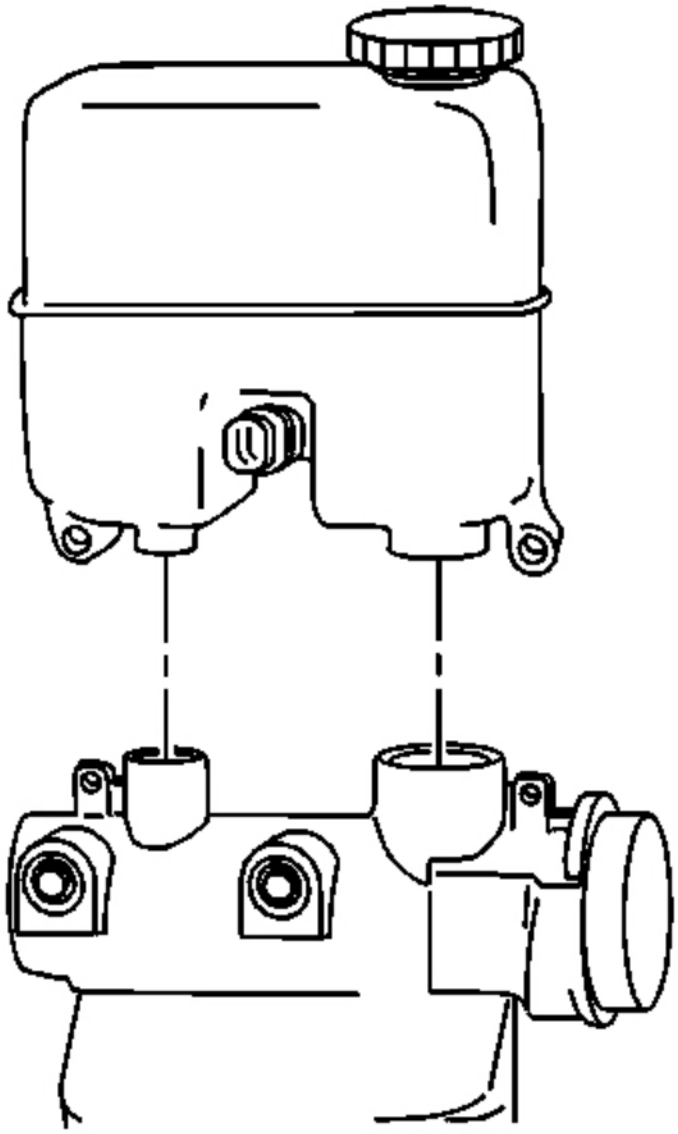


Fig. 13: View Of Master Cylinder Reservoir
Courtesy of GENERAL MOTORS CORP.

8. Remove the seals from the master cylinder.

Installation Procedure

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

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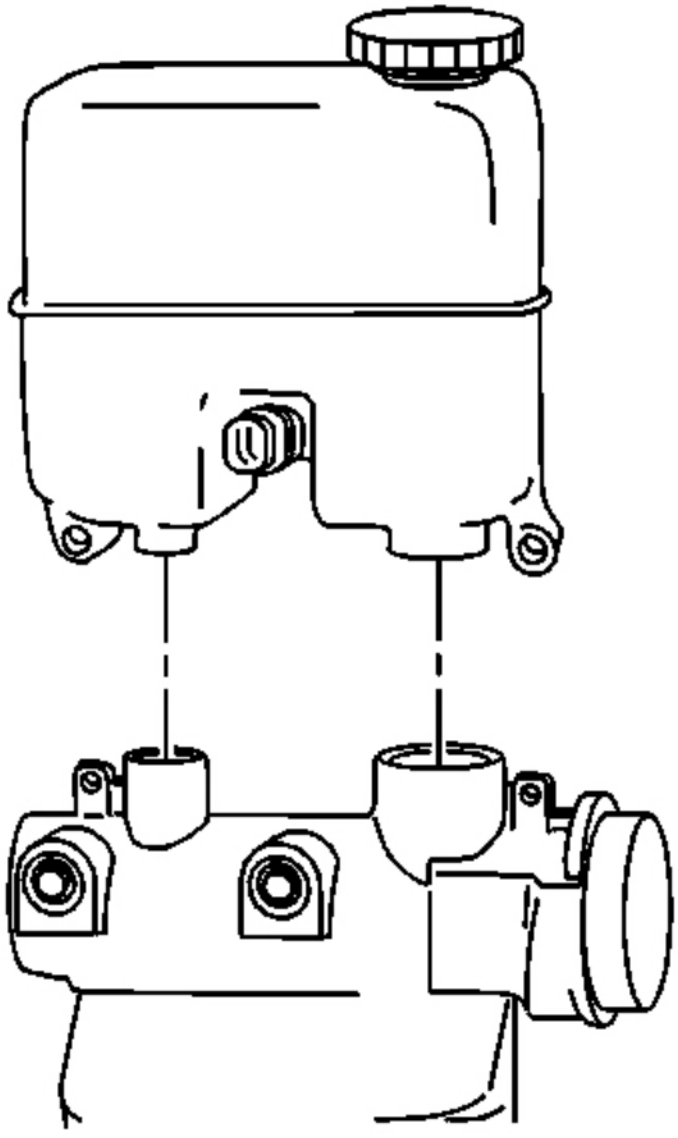


Fig. 14: View Of Master Cylinder Reservoir
Courtesy of GENERAL MOTORS CORP.

7. Carefully install the reservoir retaining pins to secure the reservoir.

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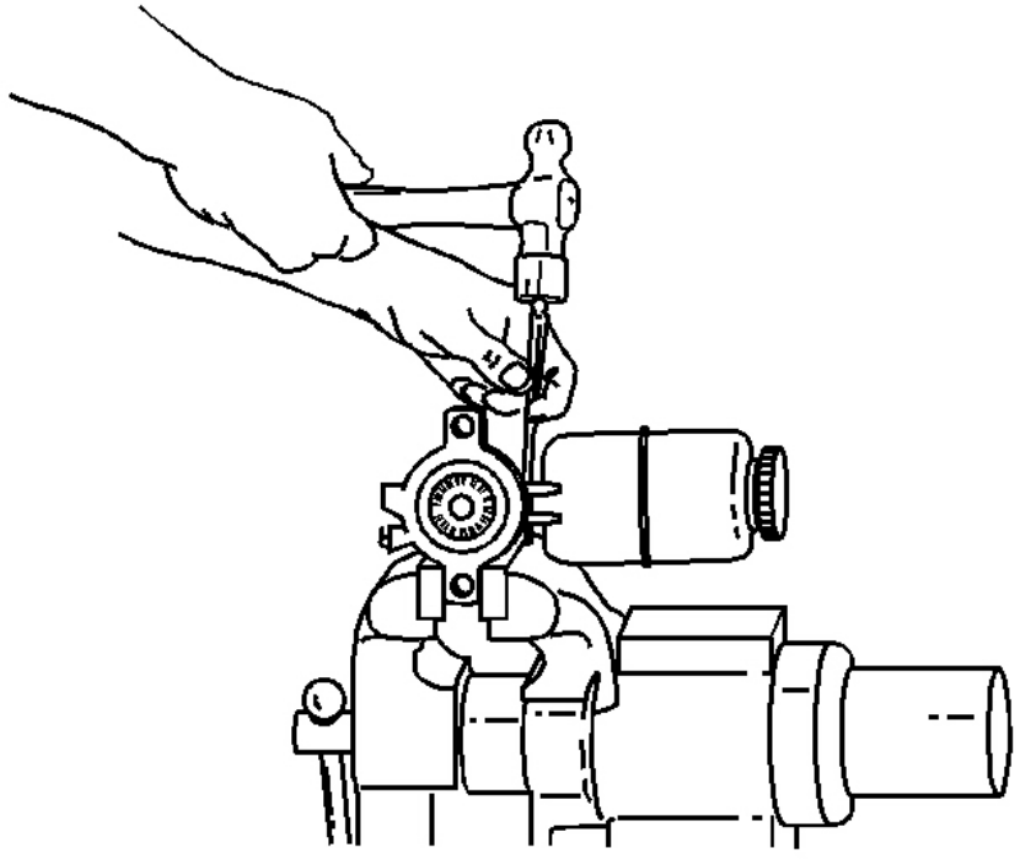


Fig. 15: Removing & Installing Master Cylinder Reservoir Retaining Pins
Courtesy of GENERAL MOTORS CORP.

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.
10. Install the master cylinder. Refer to **Master Cylinder Replacement**.
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

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

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

Removal Procedure

1. Apply the park brake and block the wheels.
2. Disconnect the electrical connector from the brake fluid level sensor.

IMPORTANT: Install a rubber cap or plug to the exposed brake pipe fitting ends in order to prevent brake fluid loss and contamination.

3. Disconnect the brake pipes from the master cylinder.
4. Plug the open brake pipe ends.

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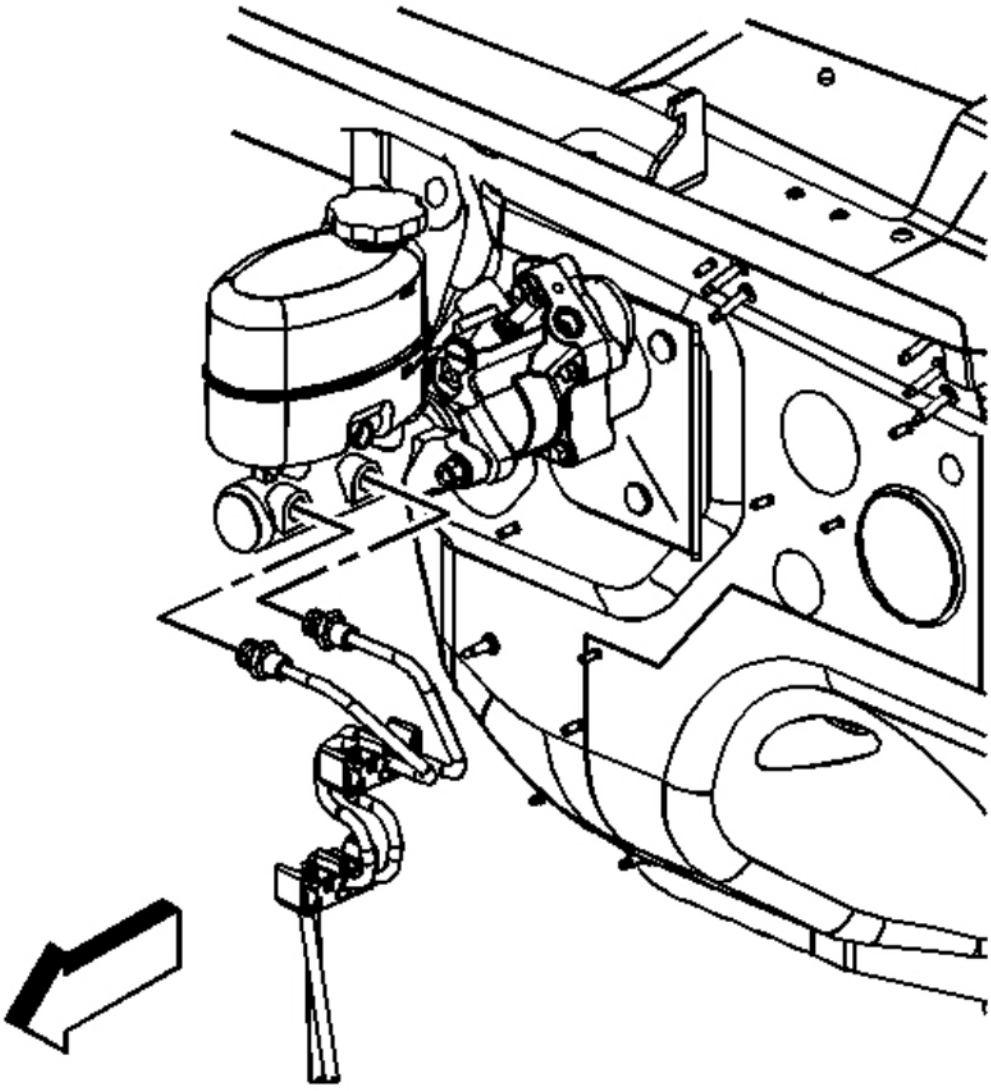


Fig. 16: View Of Brake Pipes To Master Cylinder
Courtesy of GENERAL MOTORS CORP.

5. Remove the master cylinder mounting nuts.
6. Remove the master cylinder from the vehicle.

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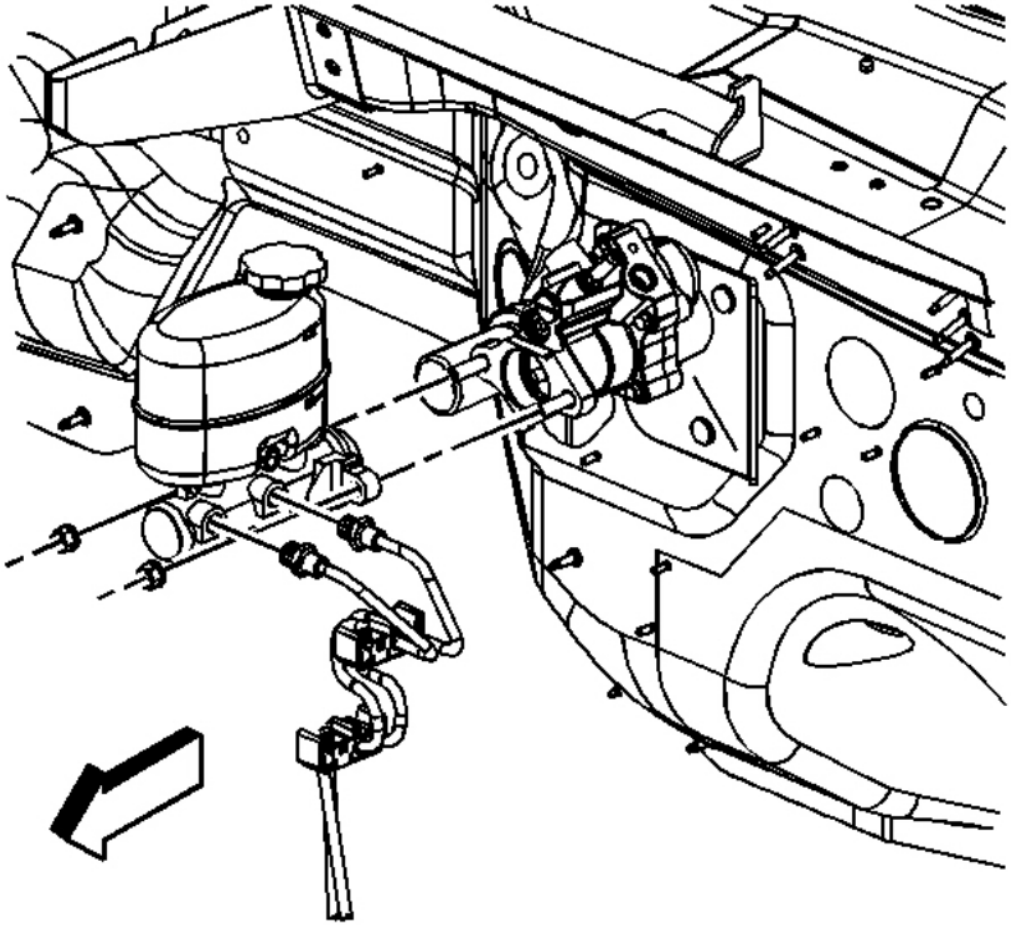


Fig. 17: View Of Master Cylinder & Mounting Nuts
Courtesy of GENERAL MOTORS CORP.

7. Remove the master cylinder reservoir. Refer to **Master Cylinder Reservoir Replacement**.

Installation Procedure

1. Install the master cylinder reservoir. Refer to **Master Cylinder Reservoir Replacement**.
2. Bench bleed the master cylinder. Refer to **Master Cylinder Bench Bleeding**.
3. Install the master cylinder to the vehicle.

NOTE: Refer to Fastener Notice in Cautions and Notices.

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4. Install the master cylinder mounting nuts.

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

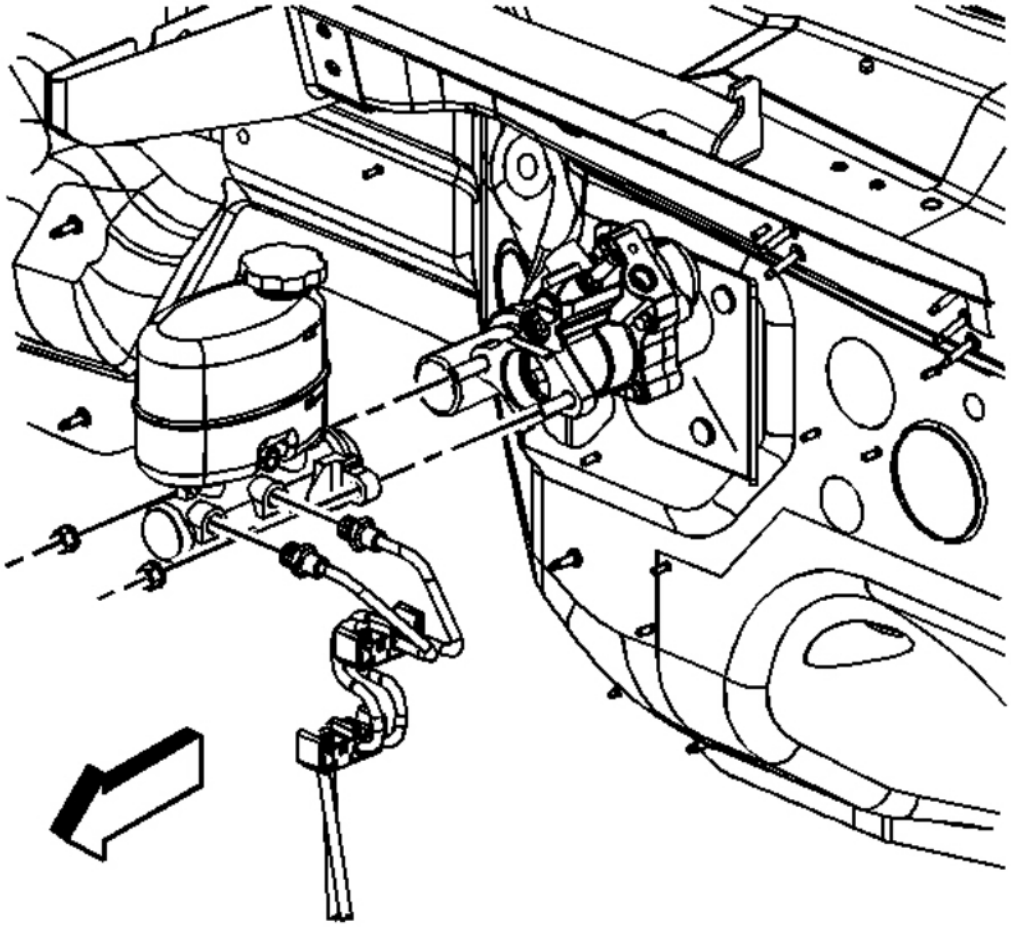


Fig. 18: View Of Master Cylinder & Mounting Nuts
Courtesy of GENERAL MOTORS CORP.

5. Remove the rubber cap or plug from the exposed brake pipe fitting ends.
6. Connect the brake pipes.

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

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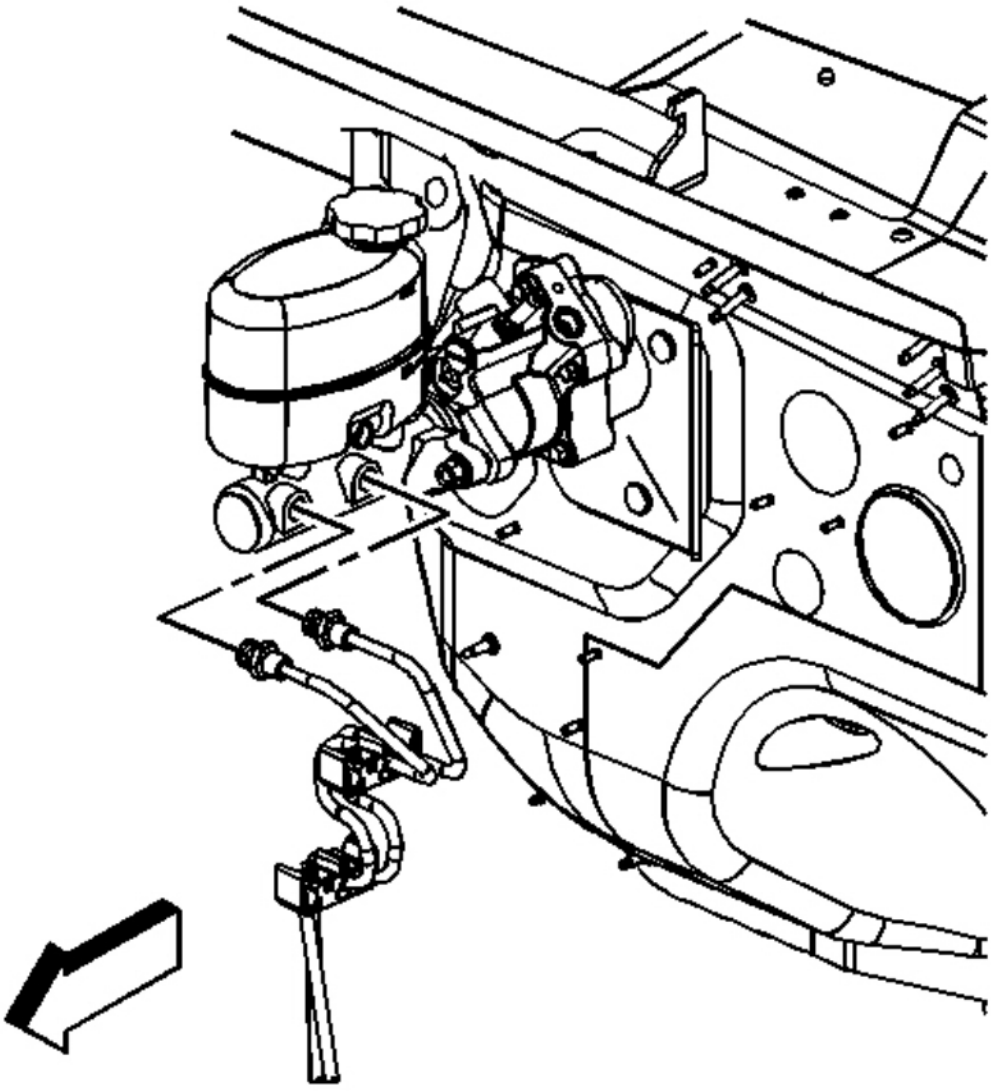


Fig. 19: View Of Brake Pipes To Master Cylinder
Courtesy of GENERAL MOTORS CORP.

7. Connect the electrical connector to the brake fluid level sensor.
8. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.
9. Release the park brake and unblock the wheels.

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MASTER CYLINDER OVERHAUL

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.

Disassembly Procedure

1. Remove the brake master cylinder from the vehicle. Refer to **Master Cylinder Replacement**.
2. Secure the mounting flange of the brake master cylinder in a bench vise so that the rear of the primary piston is accessible.
3. Clean the outside of the master cylinder reservoir on and around the reservoir cap prior to removing the cap and diaphragm.
4. Remove the reservoir cap and diaphragm from the reservoir.
5. Inspect the reservoir cap and diaphragm for the following conditions. If any of these conditions are present, replace the affected components.
   - Cuts or cracks
   - Nicks or deformation
6. Remove the master cylinder reservoir from the master cylinder. Refer to **Master Cylinder Reservoir Replacement**.
7. Using a smooth, round-ended tool, depress the primary piston (2) and remove the piston retainer.
8. Remove the primary piston assembly from the cylinder bore.
9. Plug the cylinder inlet ports and the rear outlet port. Apply low pressure, non-lubricated, filtered air into the front outlet port, in order the remove the secondary piston (1) with the primary (6) and secondary (5) seals, and the return spring.
10. Discard the primary piston assembly, the piston retainer, and the seals and seal retainer from the secondary piston.

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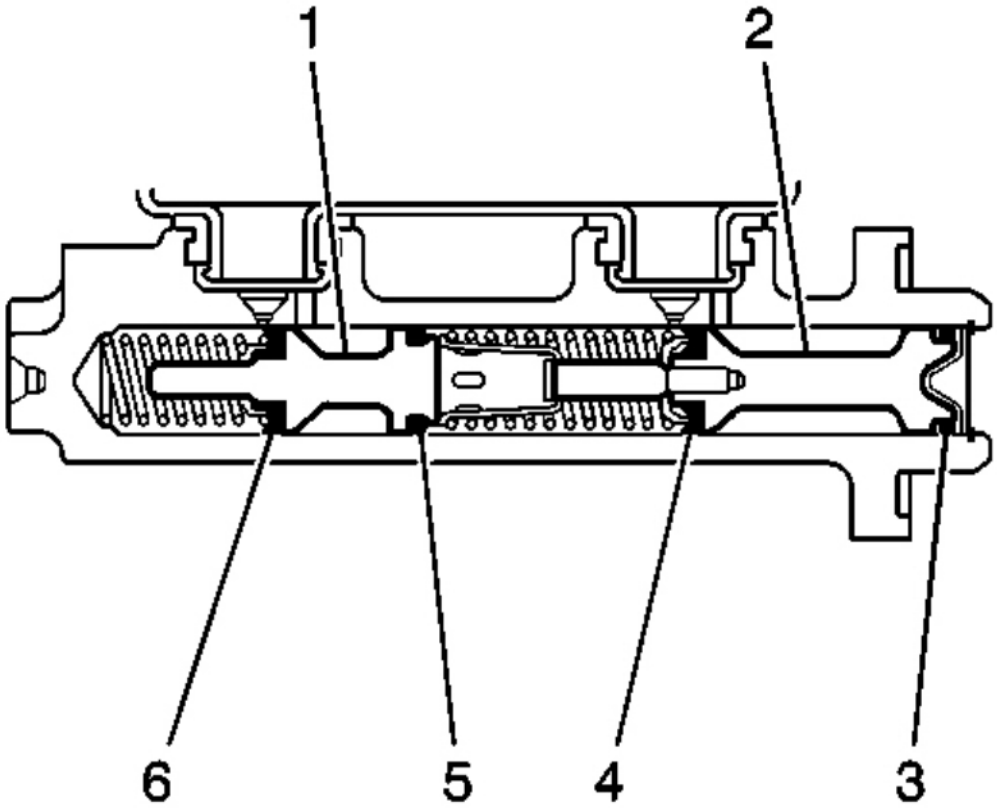


Fig. 20: Cross Sectional View Of Brake Master Cylinder
Courtesy of GENERAL MOTORS CORP.

Assembly Procedure

IMPORTANT: Do not use abrasives to clean the brake master cylinder bore.

1. Clean the interior and exterior of the master cylinder, the secondary piston (1), and the return spring in denatured alcohol, or equivalent.
2. Inspect the master cylinder bore, inlet and outlet ports, the secondary piston (1), and the return spring for cracks, scoring, pitting, and/or corrosion. Replace the master cylinder if any of these conditions exist.
3. Dry the master cylinder and the individual components with non-lubricated, filtered air.
4. Lubricate the master cylinder bore, the secondary piston (1), the return spring, and all of the individual overhaul components 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.

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5. Assemble the lubricated, new primary seal (6) and retainer, and new secondary seal (5) onto the secondary piston.
6. Install the lubricated return spring and secondary piston assembly (1) into the cylinder bore.
7. Install the lubricated, new primary piston assembly (2) into the cylinder bore.
8. Using a smooth, round-ended tool, depress the primary piston (2) and install the new piston retainer.

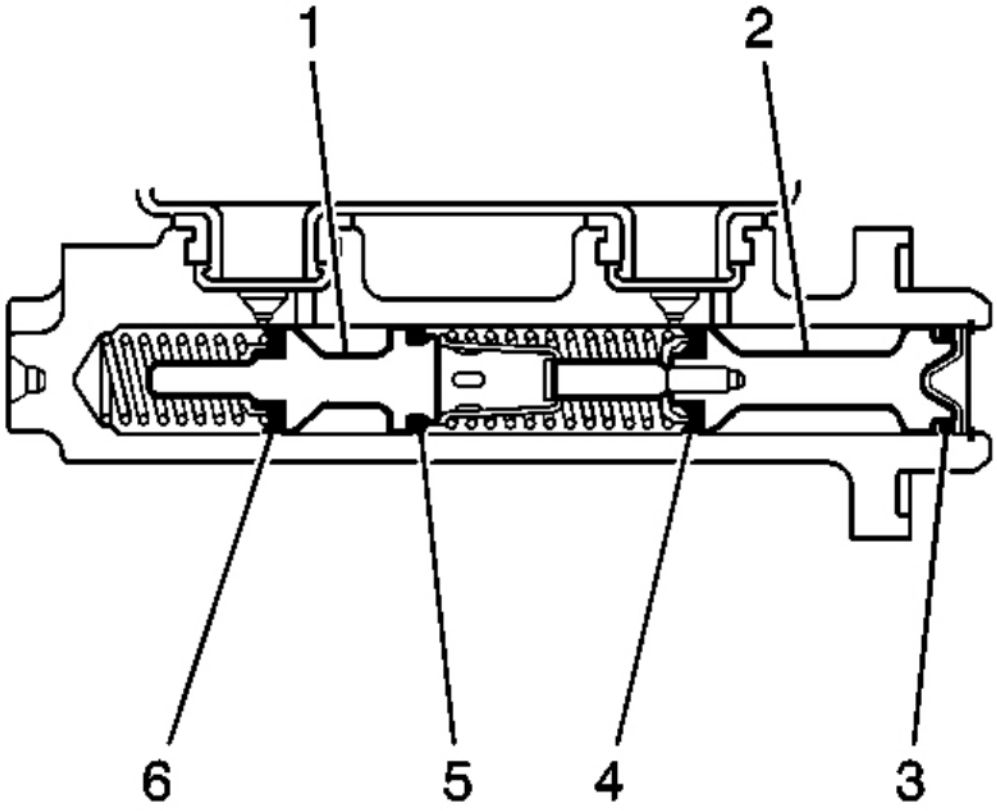


Fig. 21: Cross Sectional View Of Brake Master Cylinder
Courtesy of GENERAL MOTORS CORP.

9. Install the master cylinder reservoir to the master cylinder. Refer to **Master Cylinder Reservoir Replacement**.
10. Install the reservoir cap and diaphragm to the reservoir.
11. Install the master cylinder to the vehicle. Refer to **Master Cylinder Replacement**.

MASTER CYLINDER BENCH BLEEDING

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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. 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 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.

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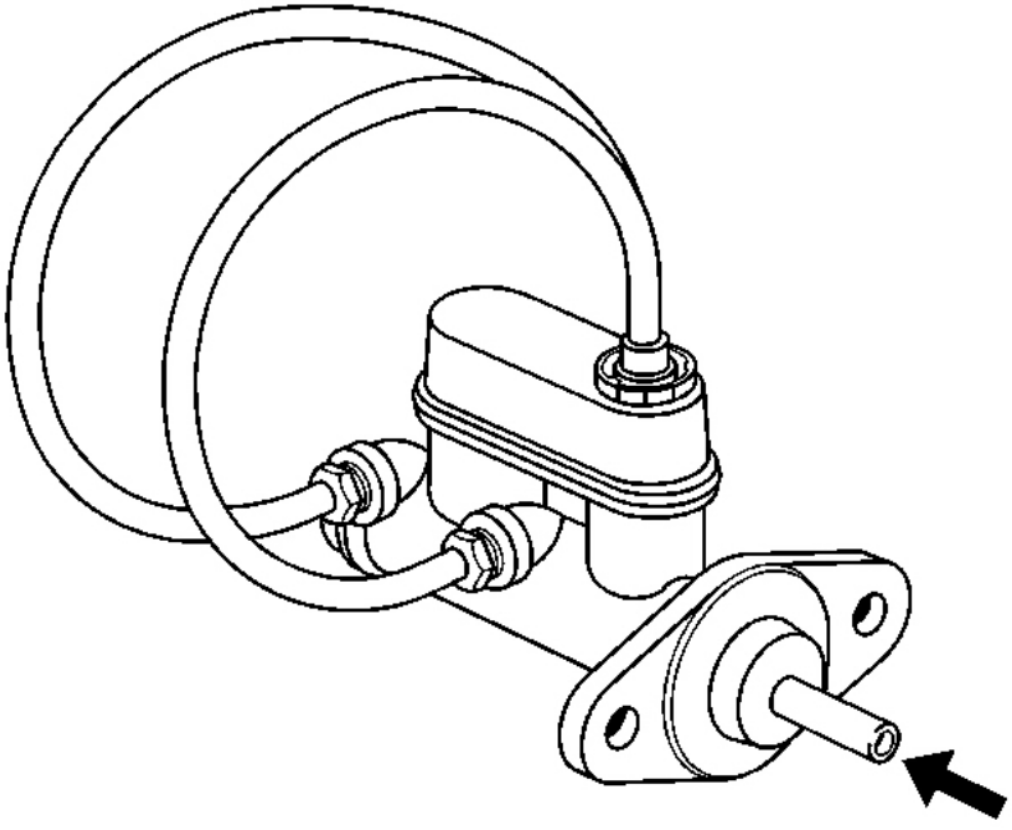


Fig. 22: Bleeding Master Cylinder
Courtesy of GENERAL MOTORS CORP.

MASTER CYLINDER FLUID LEVEL SENSOR REPLACEMENT

Removal Procedure

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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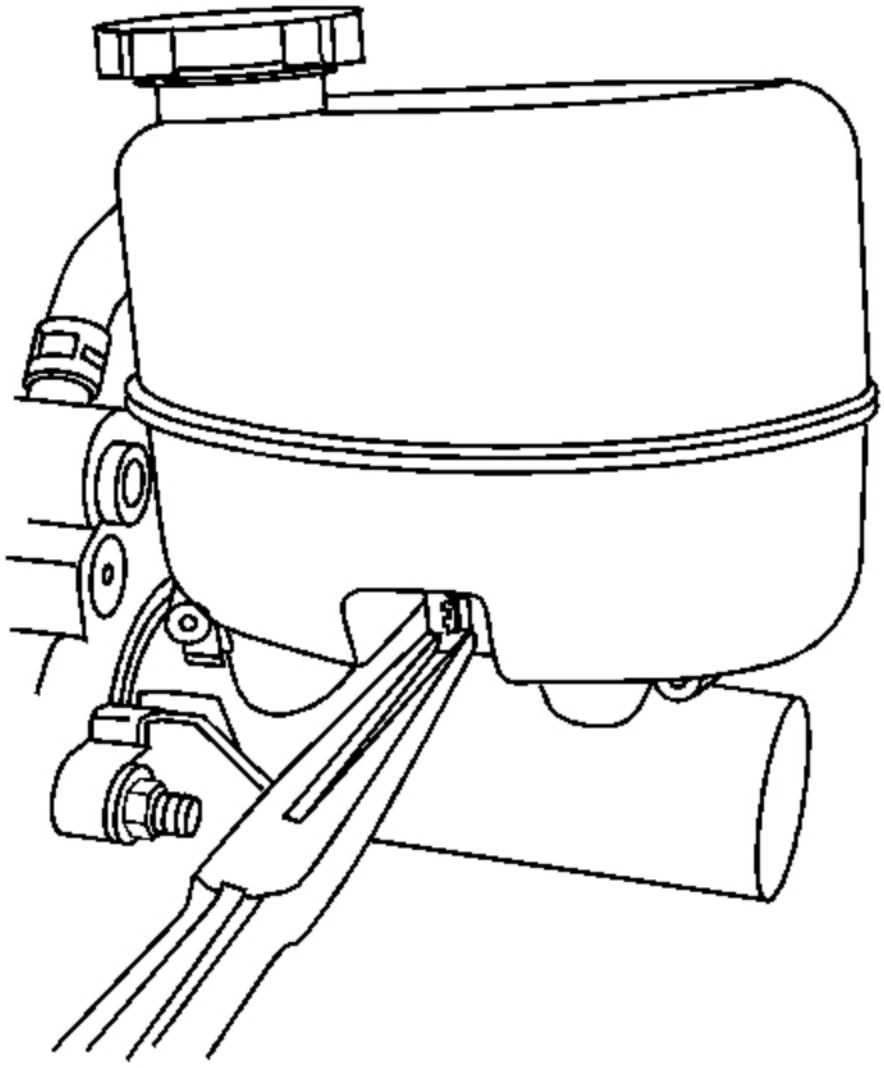


Fig. 23: Compressing Locking Tabs On Master Cylinder
Courtesy of GENERAL MOTORS CORP.

3. Remove the fluid level sensor.

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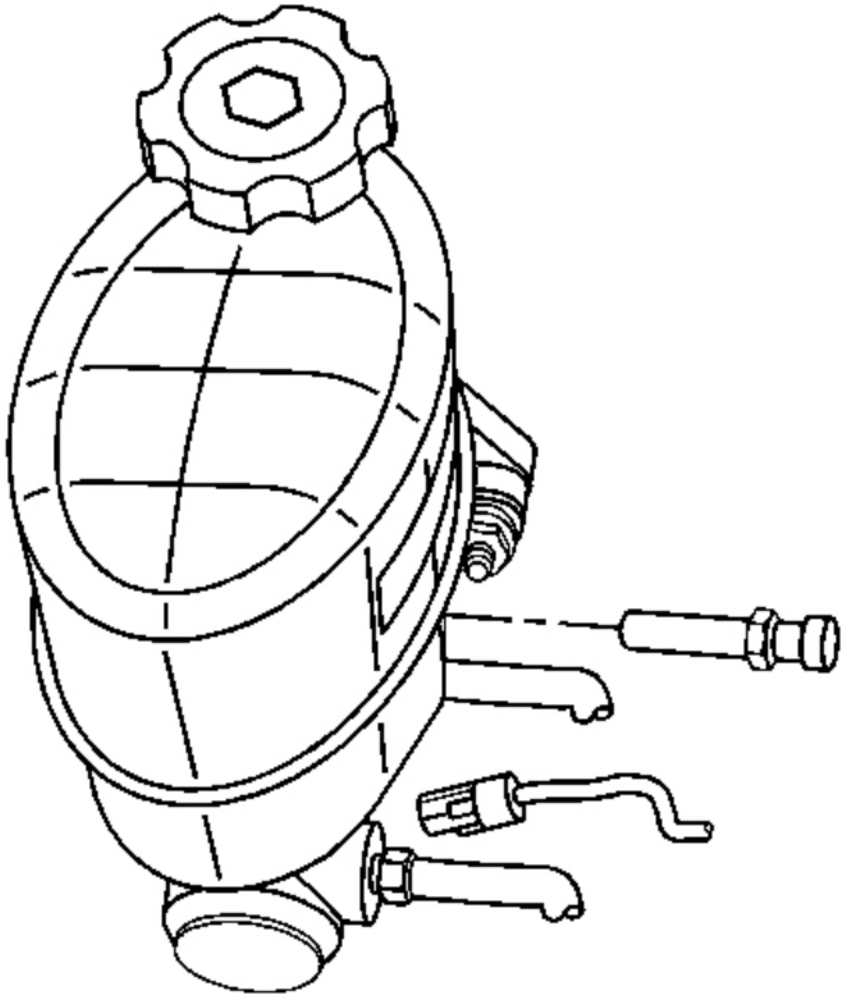


Fig. 24: View Of Master Cylinder Fluid Level Sensor
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

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

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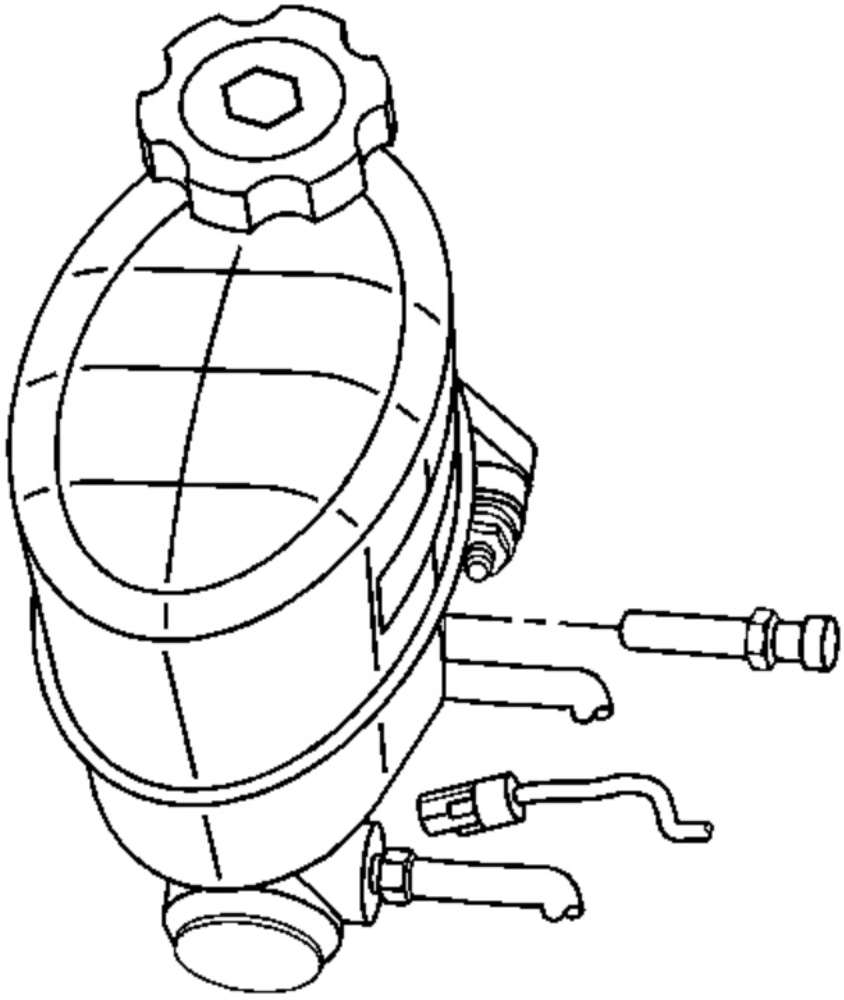


Fig. 25: View Of Master Cylinder Fluid Level Sensor
Courtesy of GENERAL MOTORS CORP.

BRAKE PEDAL ASSEMBLY REPLACEMENT

Removal Procedure

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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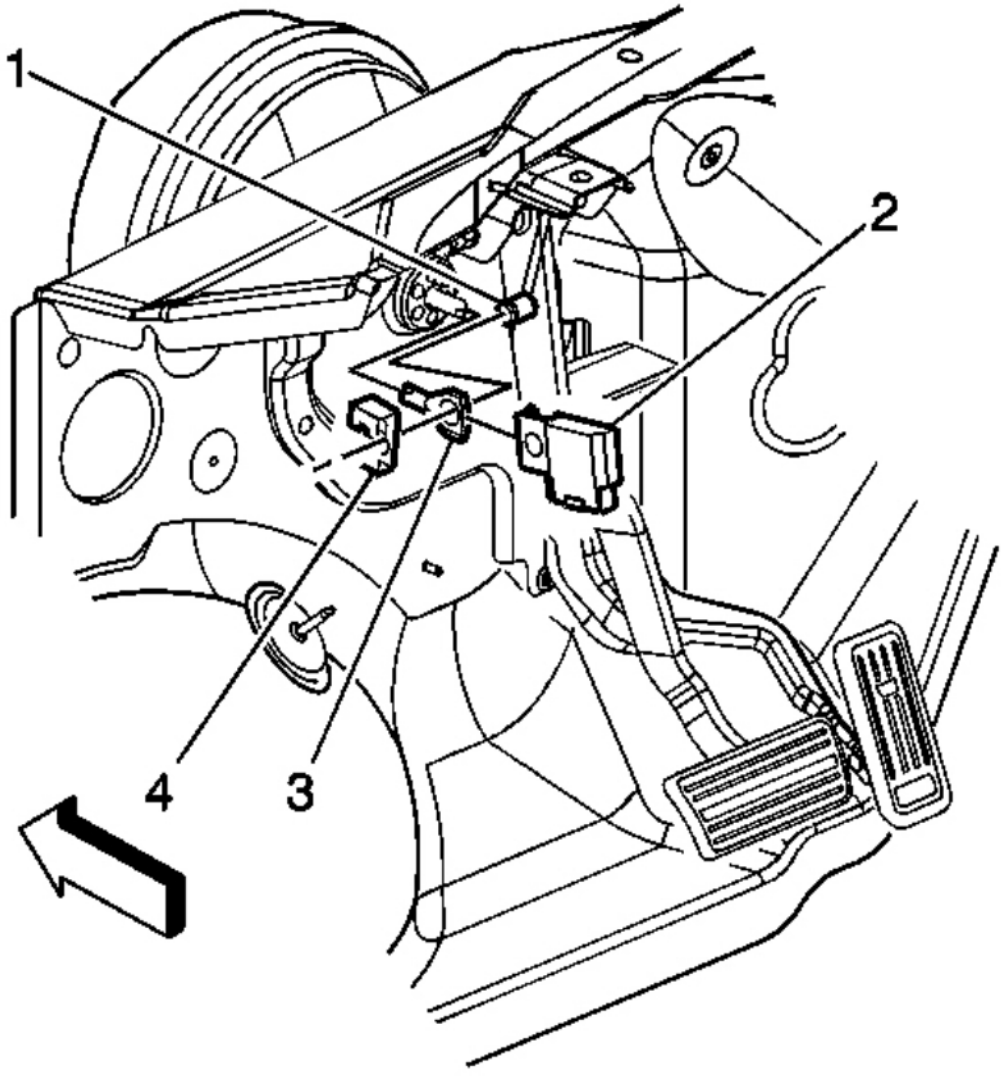


Fig. 26: View Of Pedal Stud, Stop Lamp Switch, Pushrod & Retaining Clip
Courtesy of GENERAL MOTORS CORP.

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

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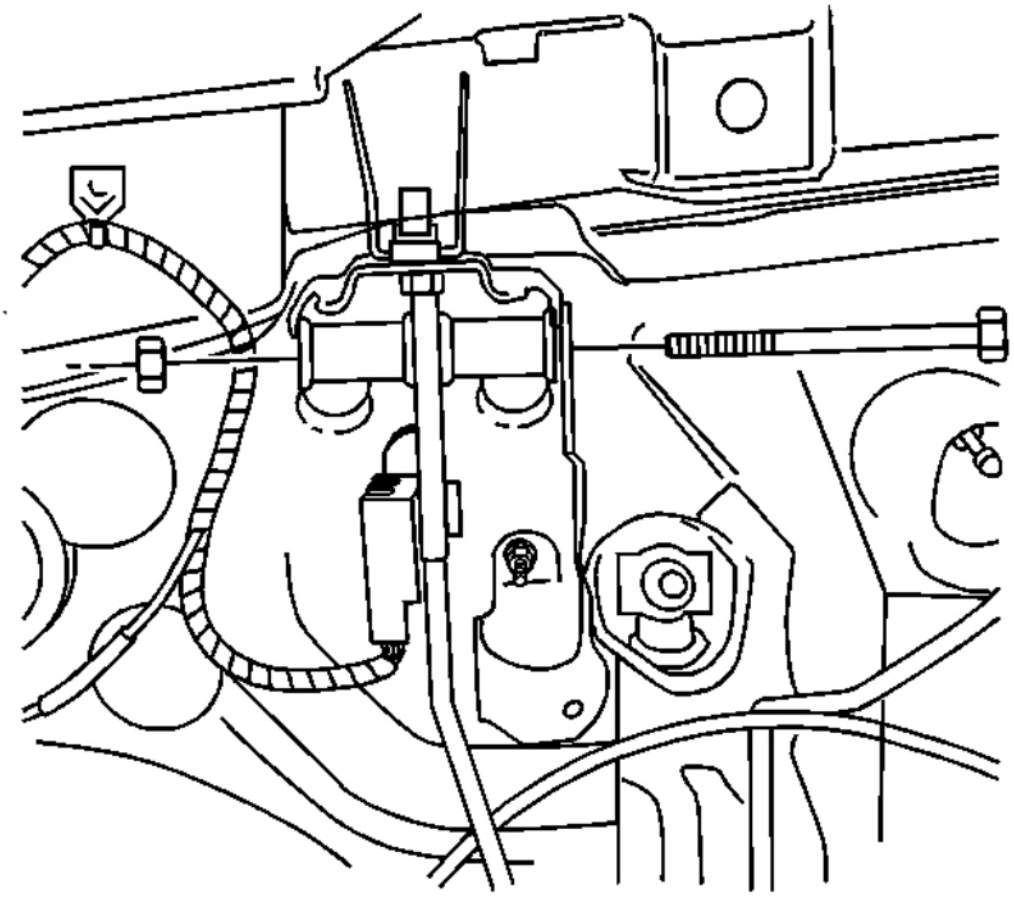


Fig. 27: View Of Brake Pedal Bolt & Nut
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

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

NOTE: Refer to Fastener Notice in Cautions and Notices.

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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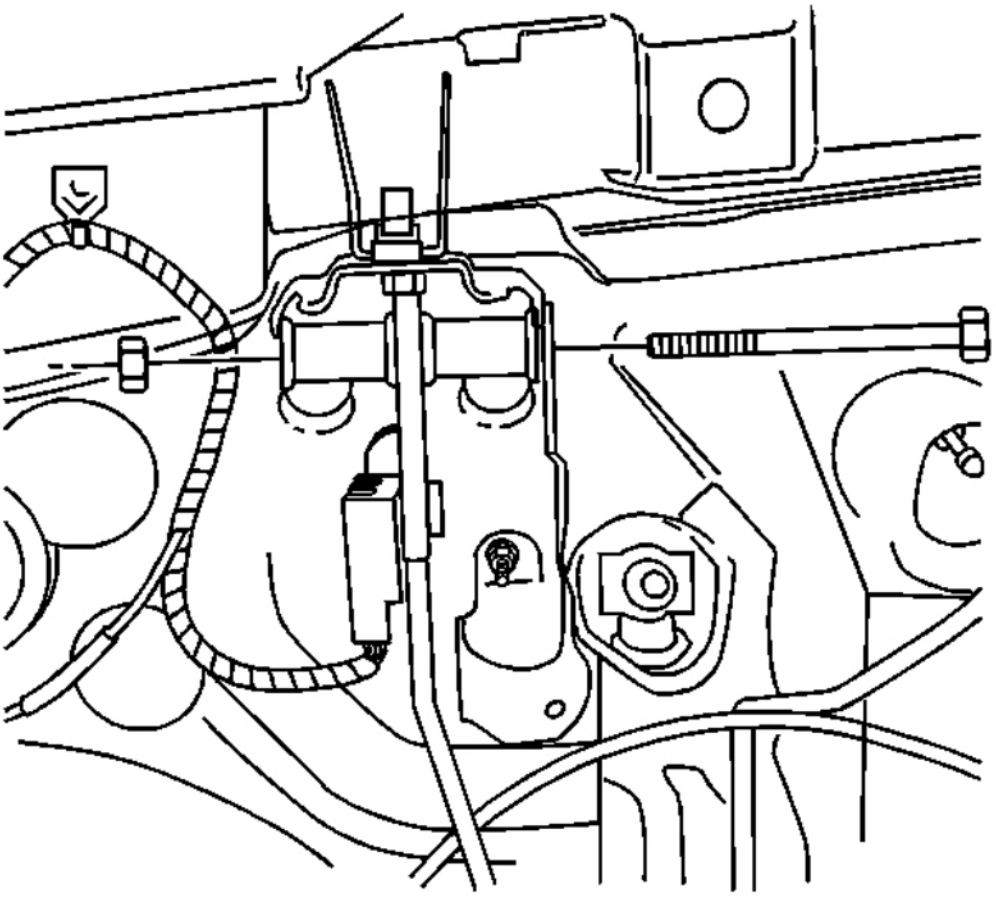


Fig. 28: View Of Brake Pedal Bolt & Nut
Courtesy of GENERAL MOTORS CORP.

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

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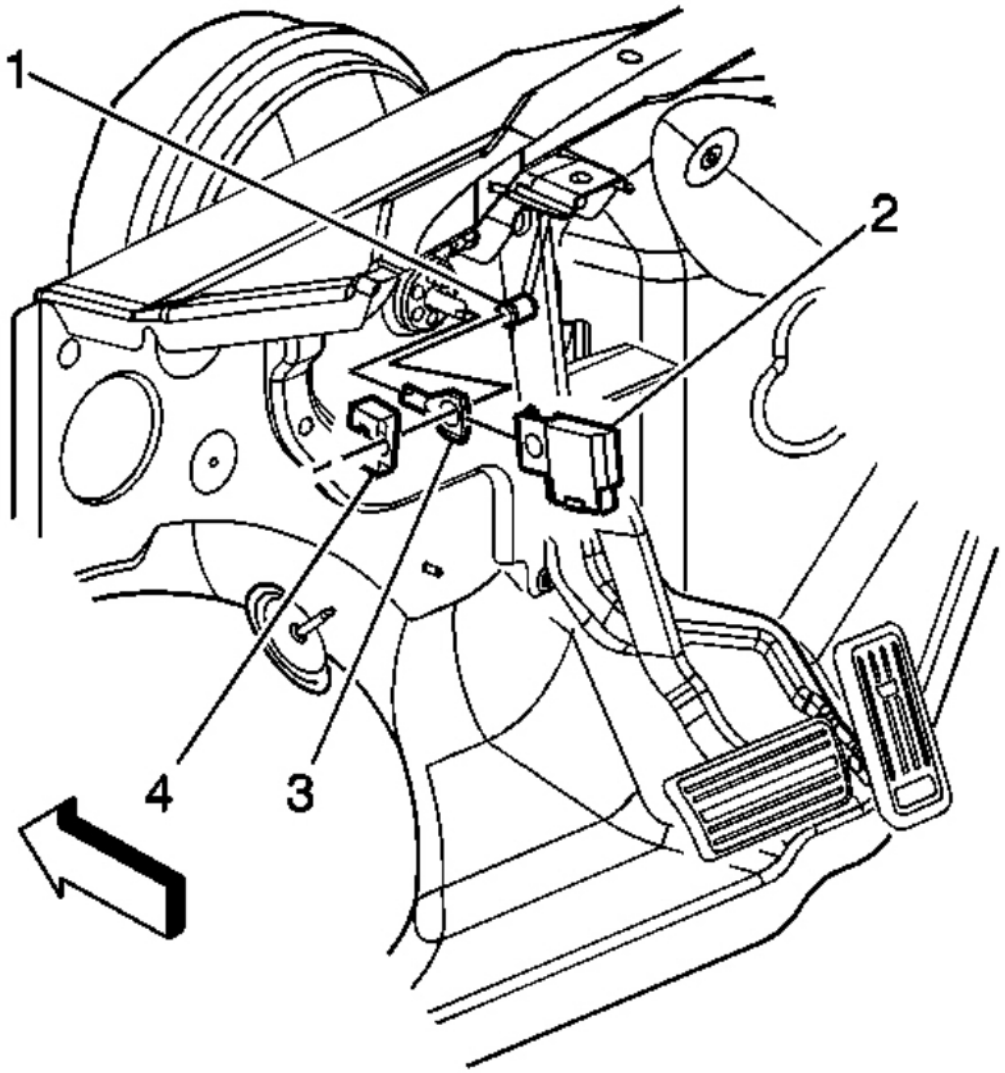


Fig. 29: View Of Pedal Stud, Stop Lamp Switch, Pushrod & Retaining Clip
Courtesy of GENERAL MOTORS CORP.

COMBINATION VALVE REPLACEMENT

Removal Procedure

IMPORTANT: Note the identification code on the combination valve. The new valve must have the same identification number as the old valve.

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1. Remove the combination valve electrical connector.
2. Remove the front and the rear brake pipes.
3. Remove the combination valve from the vehicle.

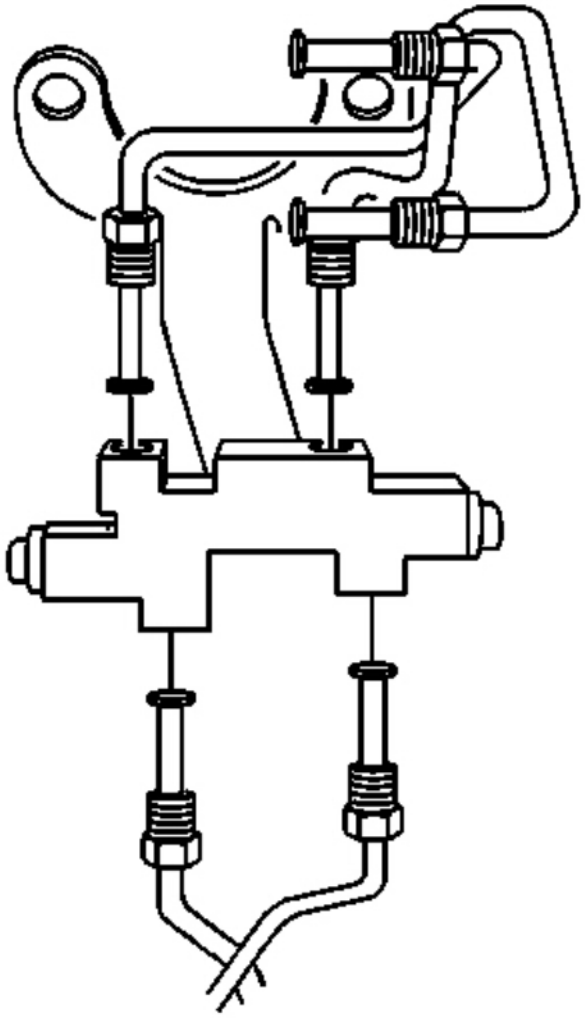


Fig. 30: Identifying Combination Valve
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

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IMPORTANT: Verify that the replacement combination valve has the same pin punched identification code as the code on the old combination valve.

1. Install the combination valve to the vehicle.

   NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the front and the rear brake pipes to the combination valve.

   Tighten: Tighten the brake pipe nuts to 25 N.m (18 lb ft).

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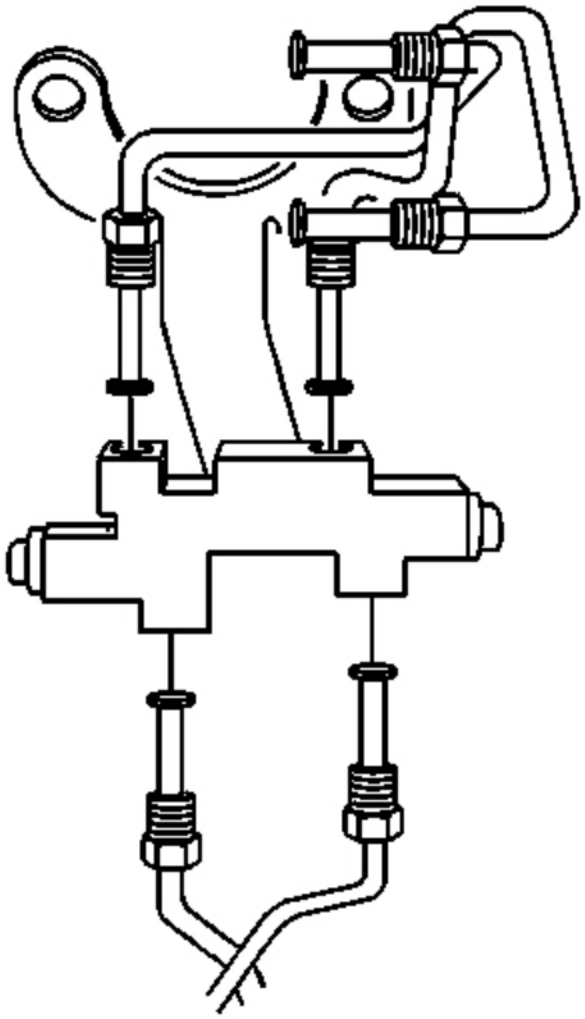


Fig. 31: Identifying Combination Valve
Courtesy of GENERAL MOTORS CORP.

3. Connect the combination valve electrical connector.

IMPORTANT: Verify that the combination valve metering rod is depressed during bleeding.

4. Bleed the brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.

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BRAKE PIPE REPLACEMENT

Removal Procedure

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

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 in Cautions and Notices.

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

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

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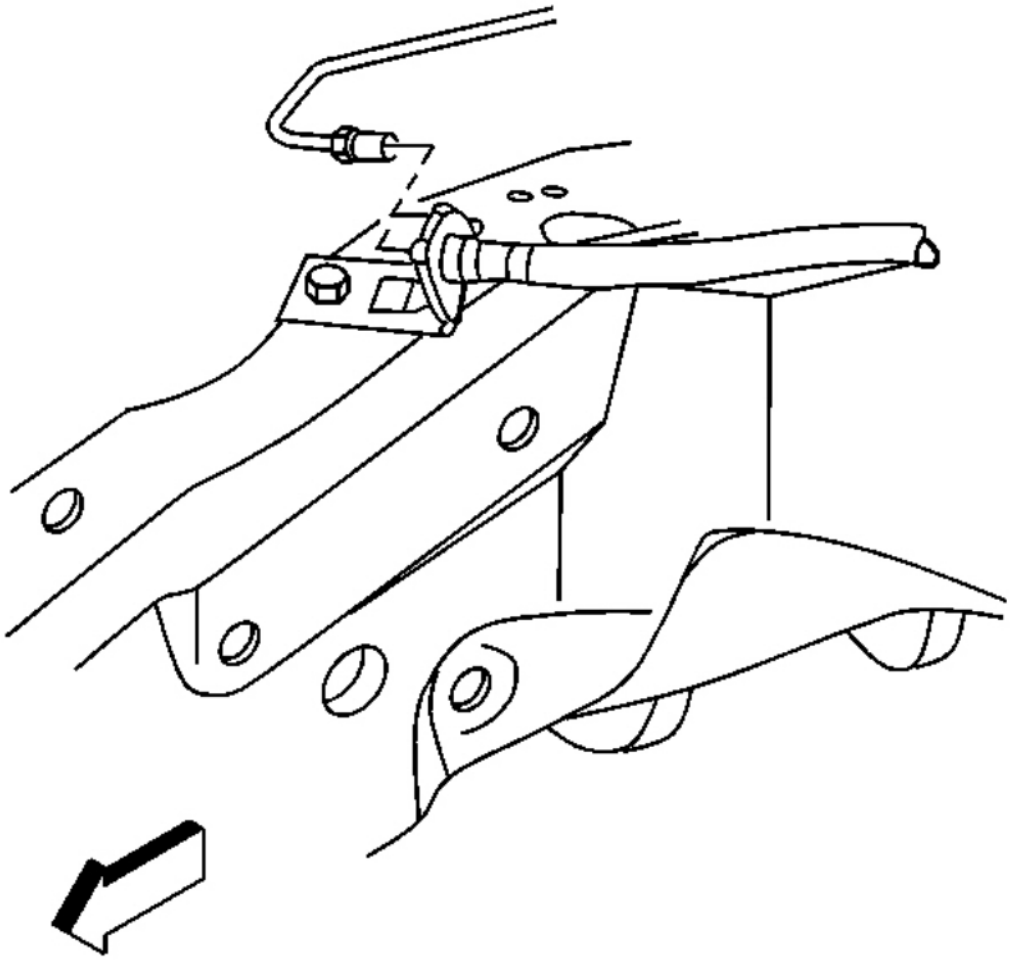


Fig. 32: View Of Brake Pipe
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Bend the brake pipe to achieve proper fit.
2. Install the brake pipe to the vehicle. Maintain a clearance of 19 mm (3/4 in) for all moving or vibrating components.
3. Install the brake pipe fasteners to the vehicle.

NOTE: Refer to Fastener Notice in Cautions and Notices.

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

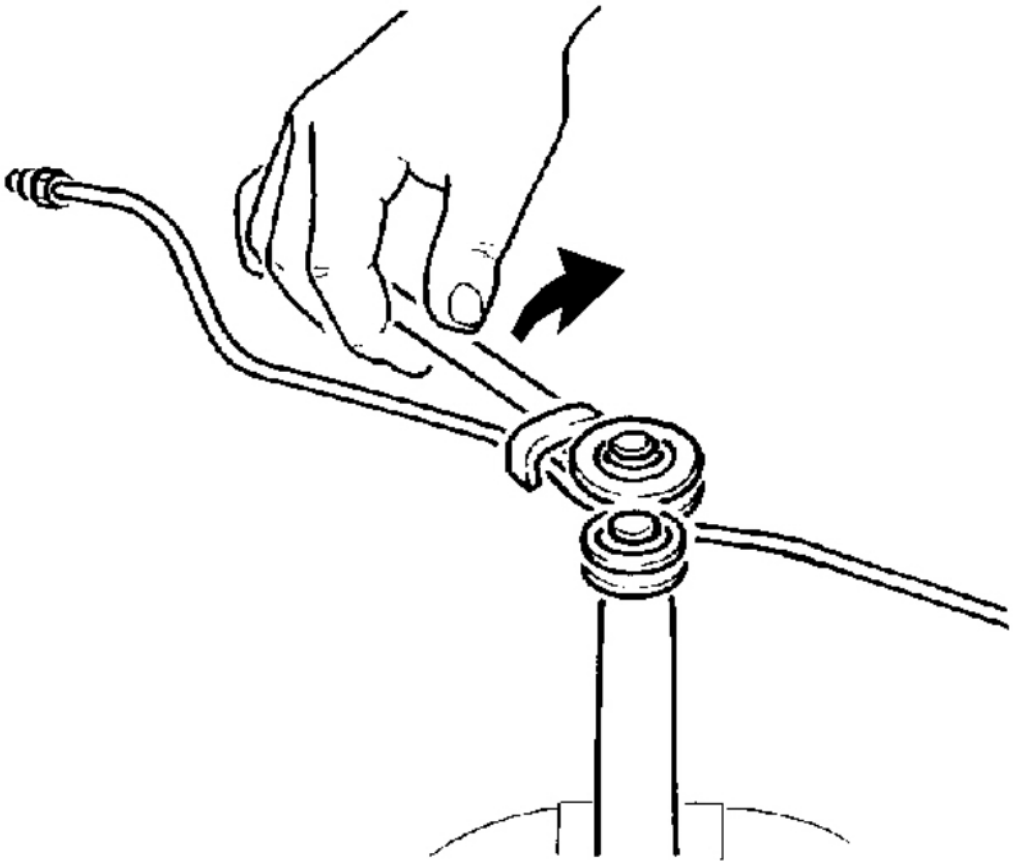


Fig. 33: Tightening Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

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

BRAKE HOSE REPLACEMENT - FRONT

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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.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
3. Clean all dirt and foreign material from the brake hose end and brake pipe fitting.

IMPORTANT: Install a rubber cap or plug to the exposed brake pipe fitting end in order to prevent brake fluid loss and contamination.

4. Use a backup wrench on the brake hose fitting end (2), disconnect the brake pipe fitting end (1) from the brake hose (2), then cap or plug the brake pipe fitting end.
5. Remove the brake hose retaining clip (3) from the brake hose mounting bracket.

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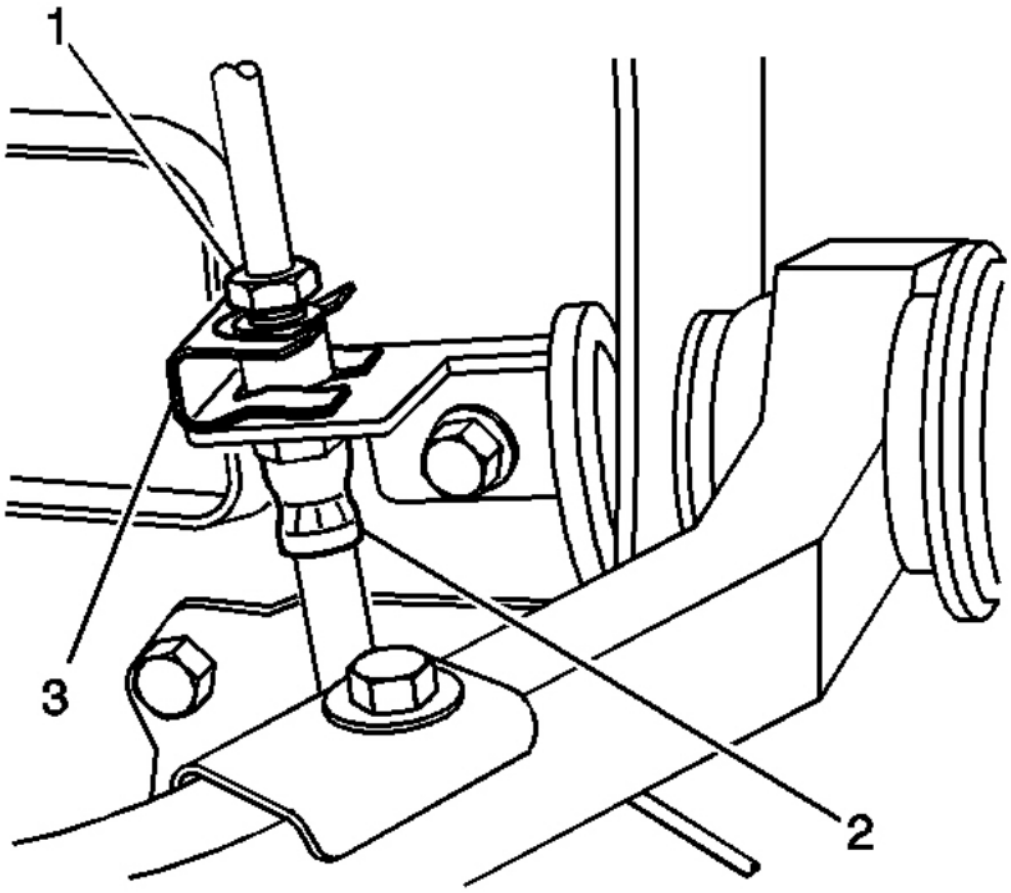


Fig. 34: Identifying Brake Pipe, Brake Hose & Retaining Clip - Front
Courtesy of GENERAL MOTORS CORP.

6. Remove the brake hose bracket bolt from the upper control arm.
7. Remove the brake hose bracket bolt from the steering knuckle.

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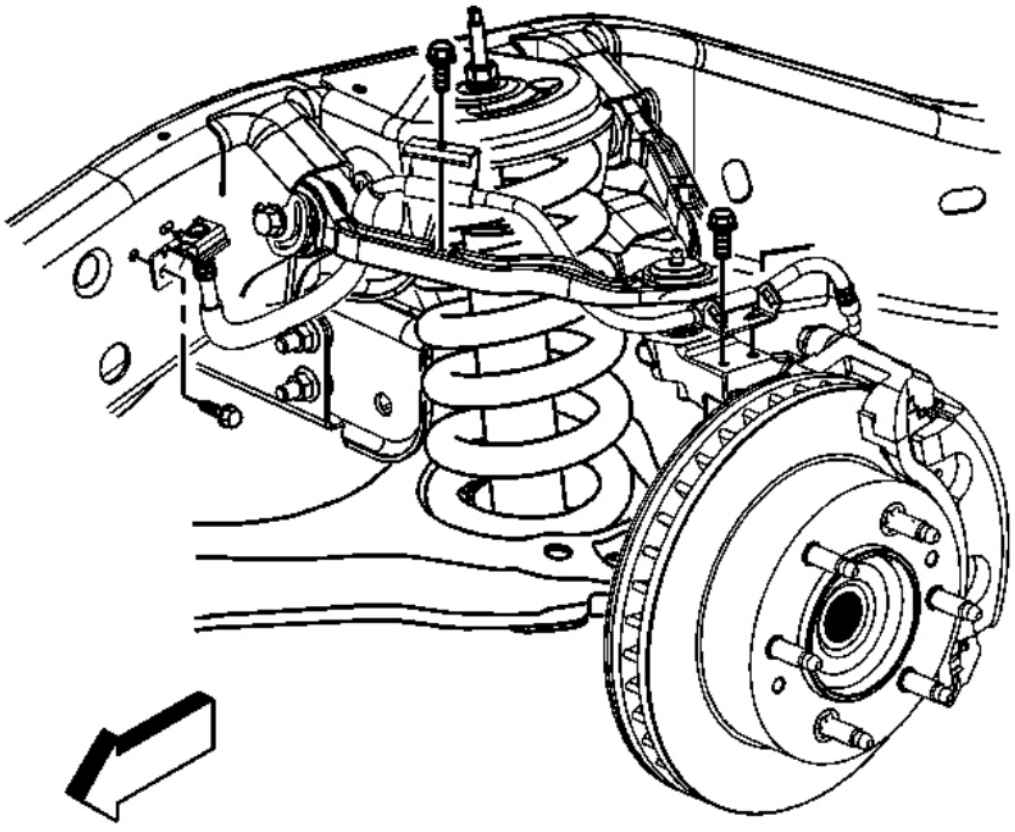


Fig. 35: View Of Retaining Bolts For Brake Hose And Wheel Speed Sensor Brackets
Courtesy of GENERAL MOTORS CORP.

8. Remove the brake hose to caliper bolt from the brake caliper.
9. Remove and discard the 2 copper brake hose gaskets. These gaskets may be stuck to the brake caliper housing or the brake hose end.

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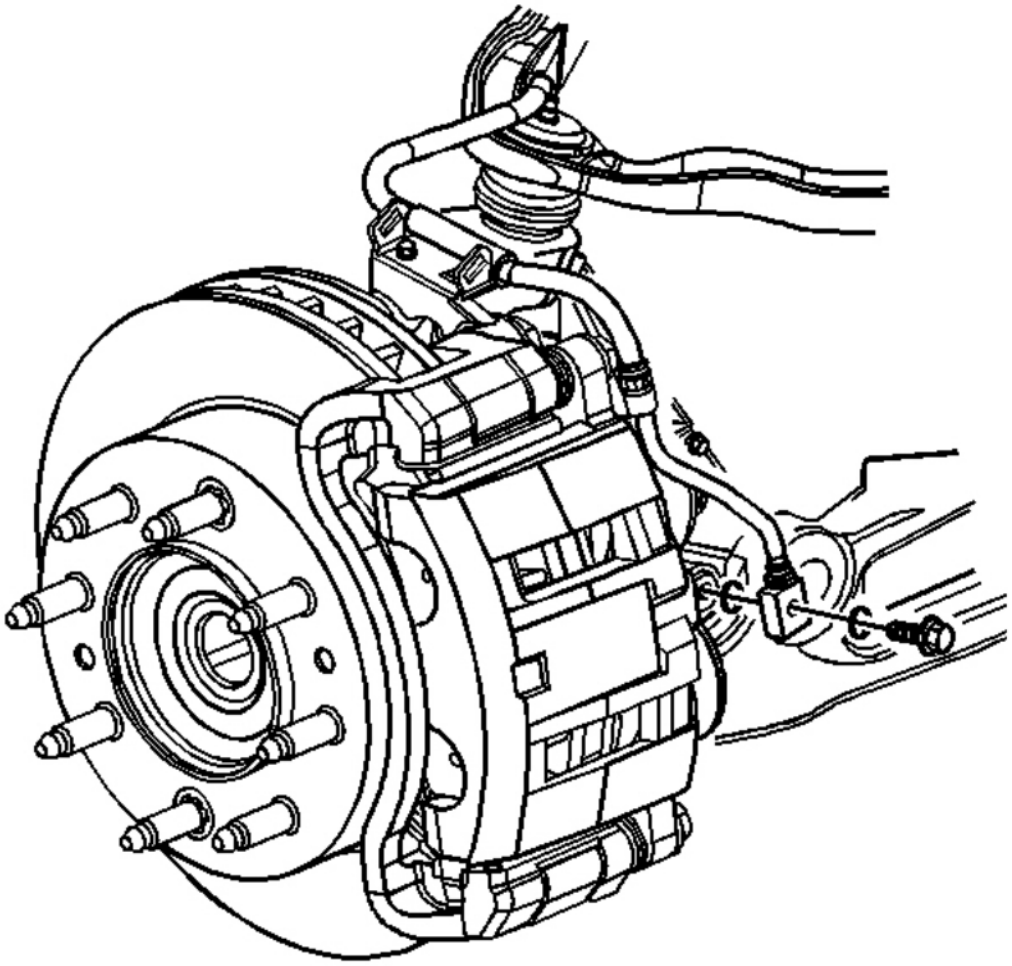


Fig. 36: View Of Brake Hose To Caliper Bolt
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

IMPORTANT: Install 2 new copper brake hose gaskets.

1. Assemble the 2 new copper brake hose gaskets and the brake hose bolt to the brake hose.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the brake hose to caliper bolt and 2 new washers to the brake caliper.

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Tighten: Tighten the bolt to 40 N.m (30 lb ft).

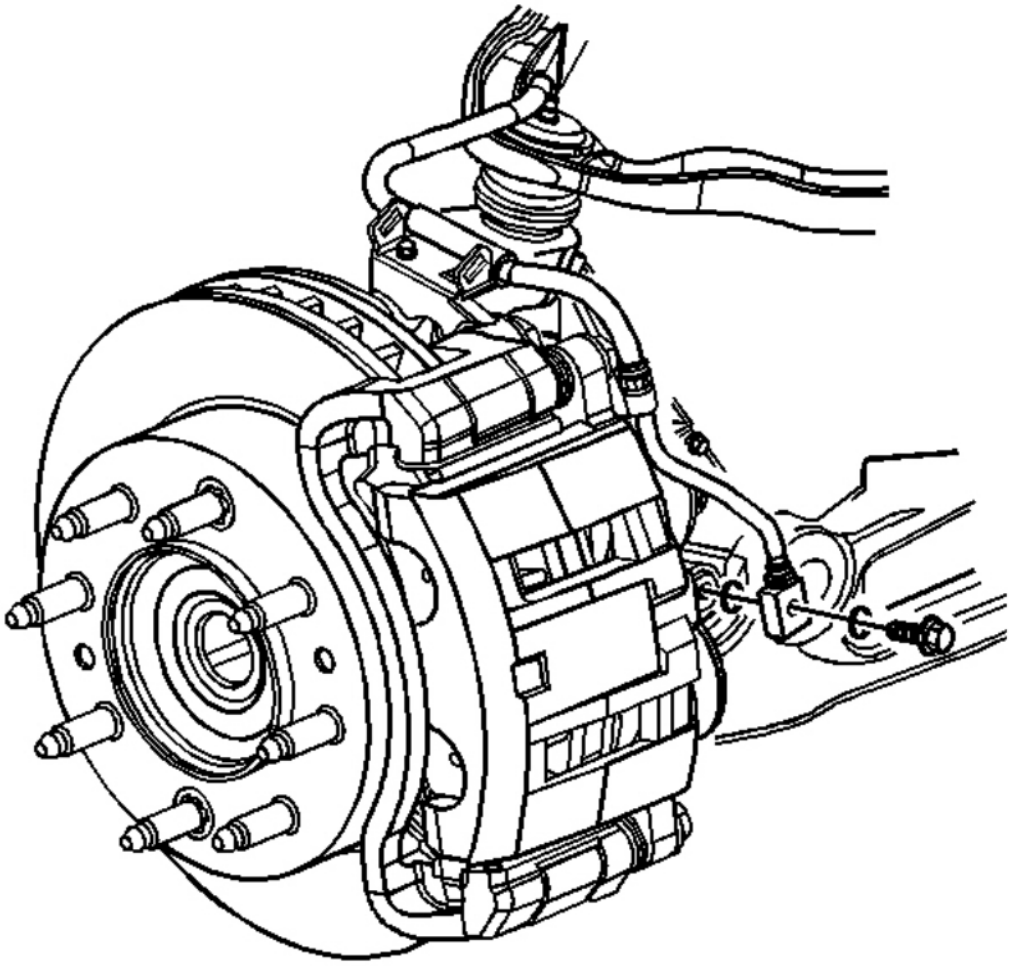


Fig. 37: View Of Brake Hose To Caliper Bolt
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The brake hose must not be twisted. Make sure the brake hose is not in contact with any suspension component.

3. Install the brake hose bracket bolt and the bracket to the steering knuckle.

   Tighten: Tighten the bolt to 9 N.m (80 lb in).

4. Install the brake hose bracket bolt and the bracket to the upper control arm.

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Tighten: Tighten the bolt to 9 N.m (80 lb in).

5. Install the brake hose into the brake hose bracket.

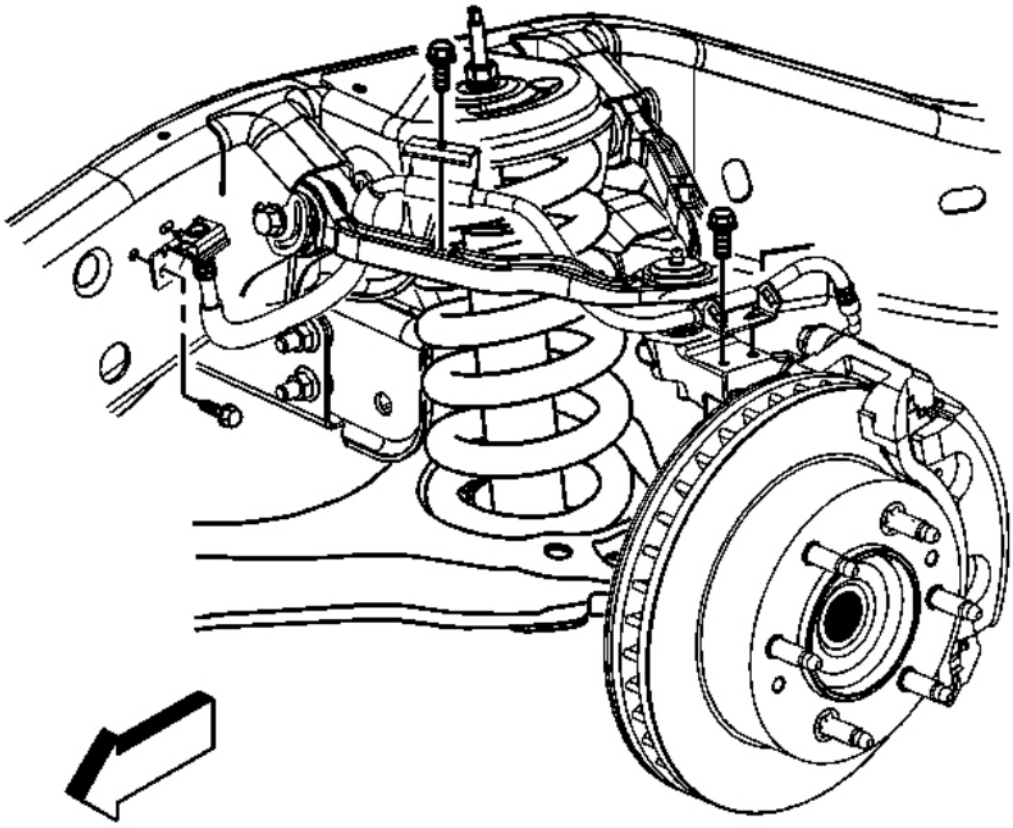


Fig. 38: View Of Retaining Bolts For Brake Hose And Wheel Speed Sensor Brackets
Courtesy of GENERAL MOTORS CORP.

6. Install the brake hose retaining clip (3).
7. Remove the rubber cap or plug from the brake pipe fitting end.
8. Connect the brake pipe fitting end (1) to the brake hose (2):
   - Use a backup wrench on the brake hose fitting end (2).
   - Do not bend the mounting bracket or the brake pipe.

   Tighten: Tighten the brake pipe fitting end (1) to 25 N.m (18 lb ft).

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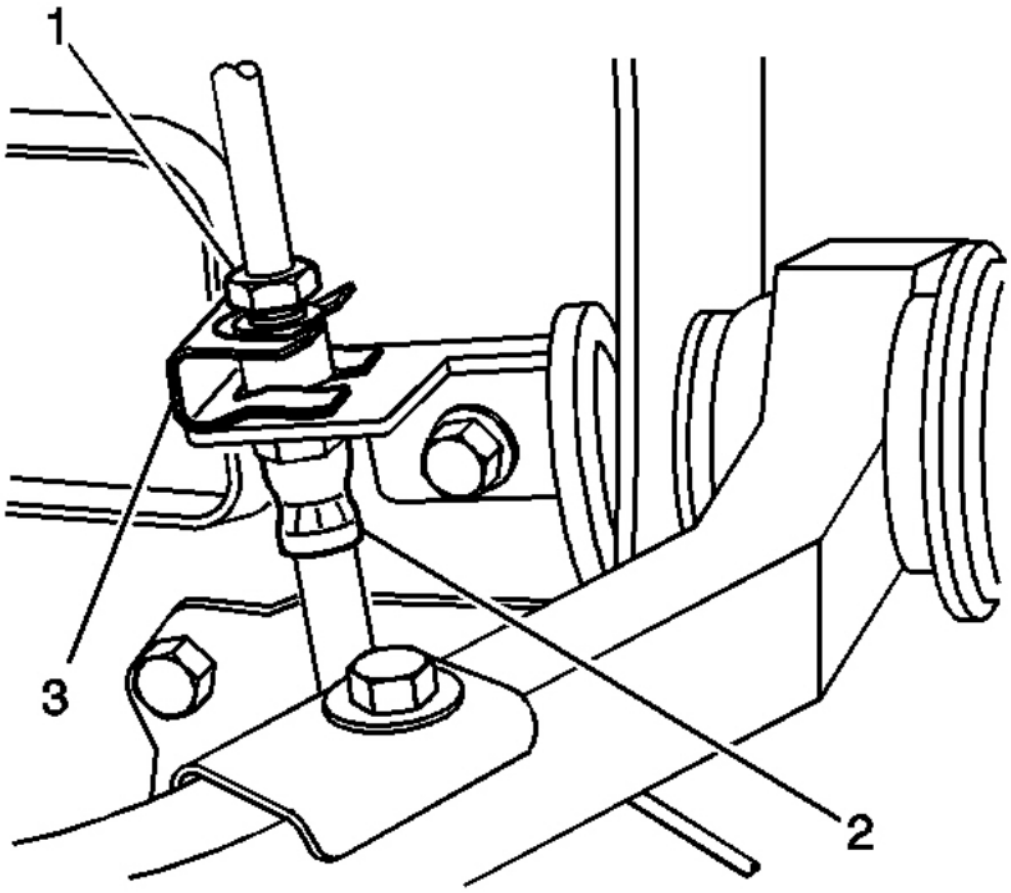


Fig. 39: Identifying Brake Pipe, Brake Hose & Retaining Clip - Front
Courtesy of GENERAL MOTORS CORP.

9. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.
10. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.

IMPORTANT: Ensure that the brake hose does not make contact with any part of the suspension or the tire/wheel assembly. Inspect the brake hose in extreme right and left turn conditions. If the brake hose makes contact remove the brake hose and correct the condition.

11. Lower the vehicle.

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BRAKE HOSE REPLACEMENT - REAR (CALIPER)

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.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
3. Clean all dirt and foreign material from the brake hose end and brake pipe fitting.

IMPORTANT: Install a rubber cap or plug to the exposed brake pipe fitting end in order to prevent brake fluid loss and contamination.

4. Use a backup wrench on the brake hose fitting end (1), disconnect the brake pipe fitting end (2) from the brake hose (1) then cap or plug the brake pipe fitting end.
5. Remove the brake hose retaining clip (3) from the brake hose mounting bracket.
6. Remove the brake hose (1) from the mounting bracket.

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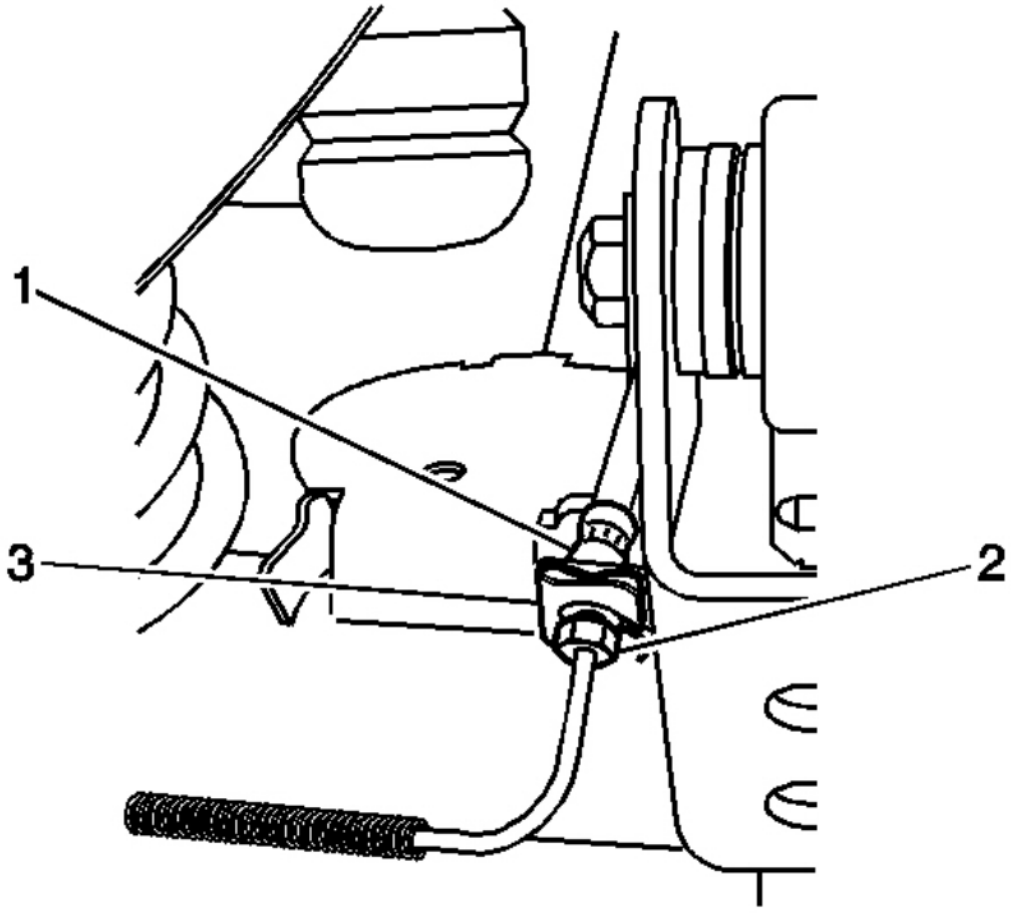


Fig. 40: Identifying Brake Pipe, Brake Hose & Retaining Clip - Rear Caliper
Courtesy of GENERAL MOTORS CORP.

7. Remove the brake hose to caliper bolt from the brake caliper.
8. Remove and discard the 2 copper brake hose gaskets. These gaskets may be stuck to the brake caliper housing or the brake hose end.

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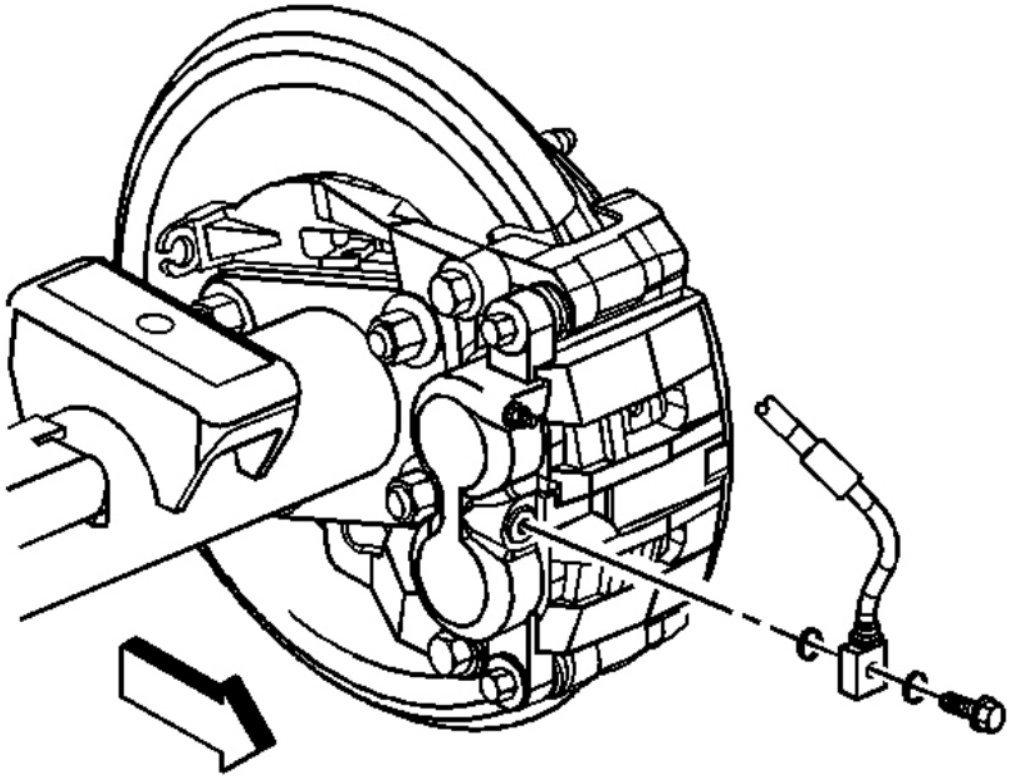


Fig. 41: View Of Brake Hose To Caliper - Rear
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

IMPORTANT: Install 2 new copper brake hose gaskets.

1. Assemble the 2 new copper brake hose gaskets and the brake hose bolt to the brake hose.

   NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the brake hose to caliper bolt and 2 new washers to the brake caliper.

   Tighten: Tighten the bolt to 40 N.m (30 lb ft).

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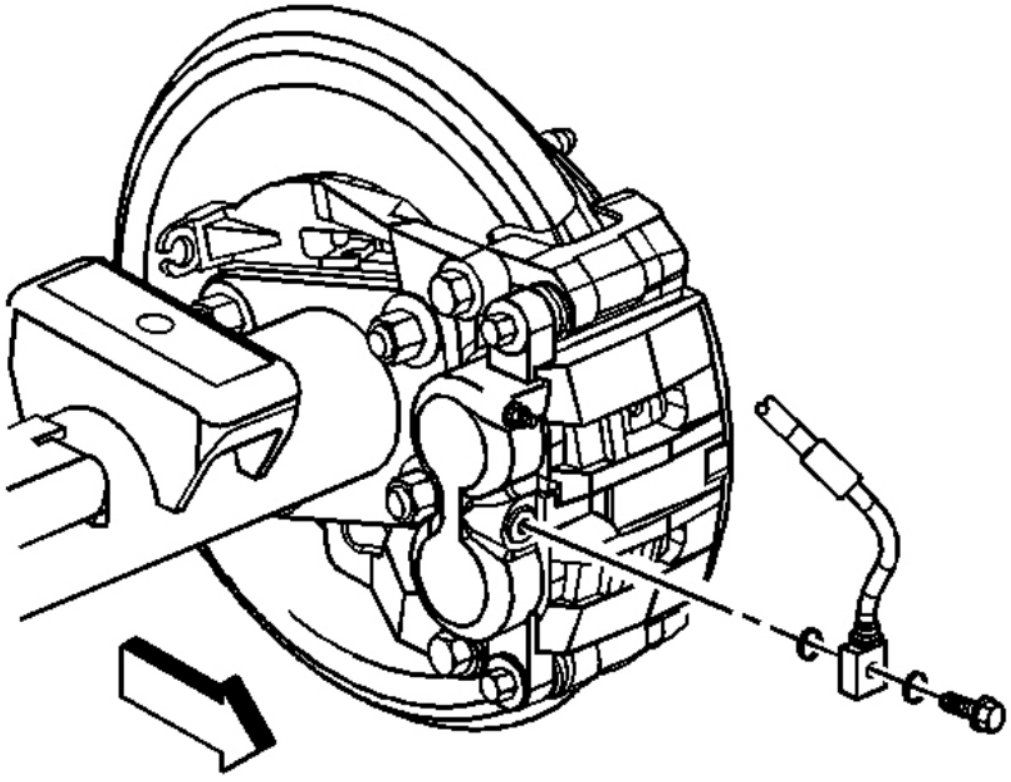


Fig. 42: View Of Brake Hose To Caliper - Rear
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The brake hose must not be twisted. Make sure the brake hose is not in contact with any suspension component.

3. Install the brake hose (1) into the mounting bracket.
4. Install the brake hose retaining clip (3).
5. Remove the rubber cap or plug from the exposed brake pipe fitting end.
6. Connect the brake pipe fitting end (2) to the brake hose (1):
   - Use a backup wrench on the brake hose fitting end (1).
   - Do not bend the mounting bracket or the brake pipe.

   Tighten: Tighten the brake pipe fitting end (2) to 25 N.m (18 lb ft).

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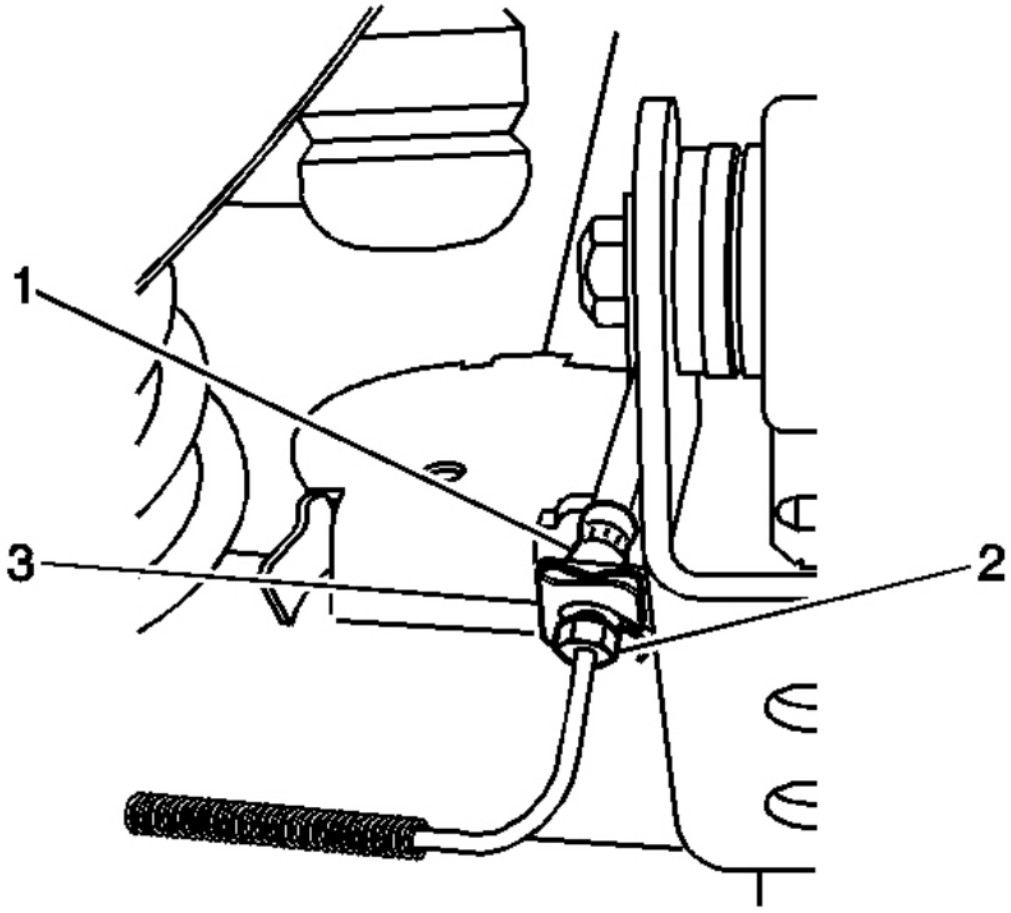


Fig. 43: Identifying Brake Pipe, Brake Hose & Retaining Clip - Rear Caliper
Courtesy of GENERAL MOTORS CORP.

7. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.
8. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.

IMPORTANT: Ensure that the brake hose does not make contact with any part of the suspension or the tire/wheel assembly. If the brake hose makes contact remove the brake hose and correct the condition.

9. Lower the vehicle.

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BRAKE HOSE REPLACEMENT - REAR (JOUNCE (W/O JL4))

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.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Clean all dirt and foreign material from the brake hose and brake pipe fittings.

IMPORTANT: Install a rubber cap or plug to the exposed brake pipe fitting ends in order to prevent brake fluid loss and contamination.

3. Use a backup wrench on the hose fitting, disconnect the brake pipe fitting from the brake hose, then cap or plug the brake pipe fitting end.
4. Remove the brake hose retaining clip from the hose mounting bracket.
5. Remove the jounce hose from the bracket.

IMPORTANT: Install a rubber cap or plug to the exposed brake pipe fitting ends in order to prevent brake fluid loss and contamination.

6. Disconnect the 2 rear brake pipes from the junction block on the rear axle and cap or plug the brake pipe fitting ends.
7. Remove the junction block retaining bolt from the axle.
8. Remove the brake hose from the vehicle.

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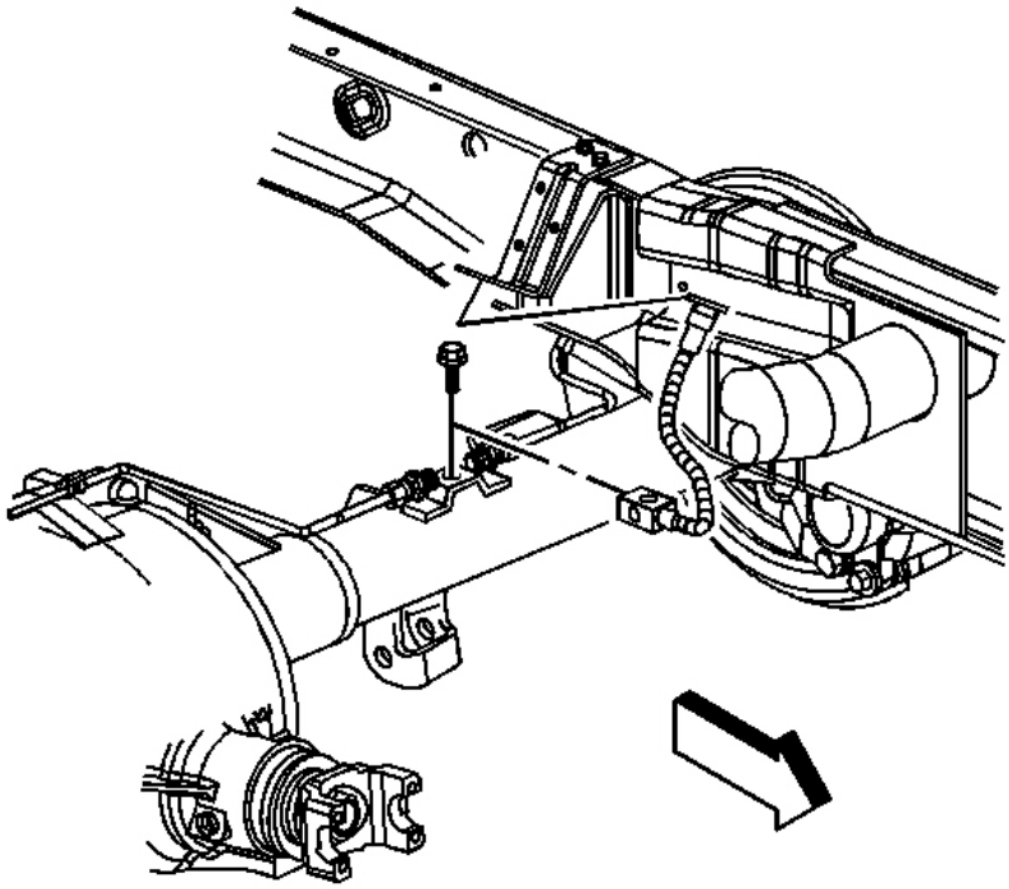


Fig. 44: View Of Brake Hose - Rear Jounce (W/O JL4)
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Install the rear brake hose

   NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the junction block retaining bolt to the axle.

   Tighten: Tighten the bolt to 12 N.m (106 lb in).

3. Remove the caps or plugs from the rear brake pipes and connect the pipes to the junction block on the axle.

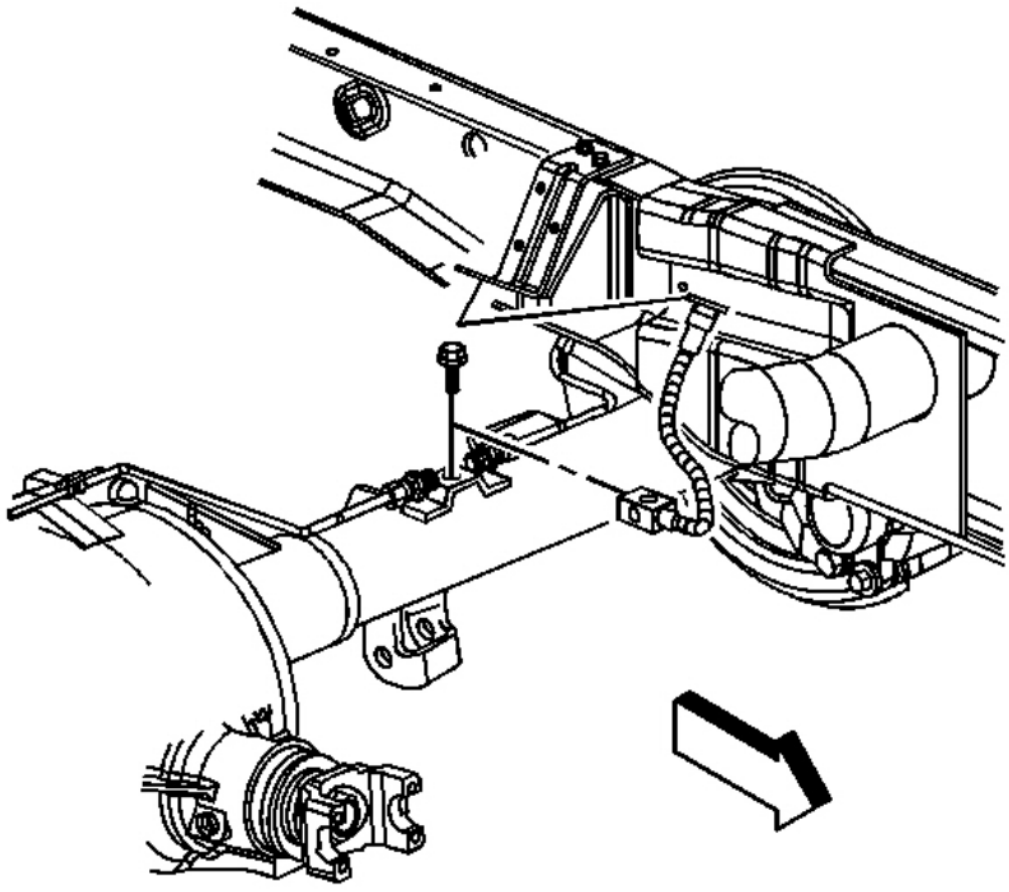
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Tighten: Tighten the fitting to 25 N.m (18 lb ft).

IMPORTANT: The hose must not be twisted. Make sure the hose is not in contact with any suspension component.

4. With the weight of the vehicle on the suspension, install the brake hose into the bracket.
5. Install the jounce hose retaining clip.
6. Remove the rubber cap or plug from the exposed brake pipe fitting end.
7. Connect the brake pipe fitting to the brake hose:
   - Use a backup wrench on the hose fitting.
   - Do not bend the bracket or the pipe.

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



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Fig. 45: View Of Brake Hose - Rear Jounce (W/O JL4)
Courtesy of GENERAL MOTORS CORP.

8. Ensure that the hose does not make contact with any part of the suspension. If the hose makes contact, remove the hose and correct the condition.
9. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.
10. Lower the vehicle.

BRAKE HOSE REPLACEMENT - REAR (JOUNCE (W/JL4))

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.

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Clean all dirt and foreign material from the brake hose and brake pipe fittings.

IMPORTANT: Install a rubber cap or plug to the exposed brake pipe fitting ends in order to prevent brake fluid loss and contamination.

3. Use a backup wrench on the hose fitting, disconnect the brake pipe fitting from the brake hose, then cap or plug the brake pipe fitting end.
4. Remove the brake hose upper bracket bolt.

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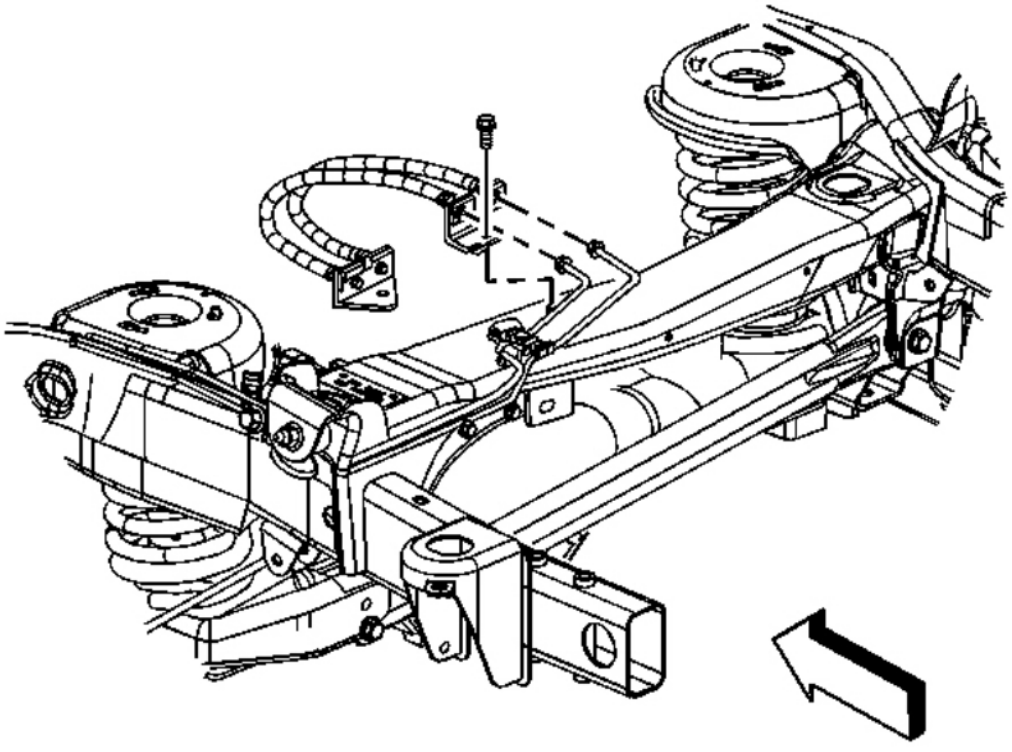


Fig. 46: View Of Brake Hoses & Upper Bracket Bolt - Rear Jounce (W/JL4)
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Install a rubber cap or plug to the exposed brake pipe fitting ends in order to prevent brake fluid loss and contamination.

5. Using a backup wrench on the hose fittings, disconnect the brake pipe fittings from the brake hoses (1), then cap or plug the brake pipe fitting ends.
6. Remove the brake hose lower bracket bolt (2).
7. Remove the jounce hoses.

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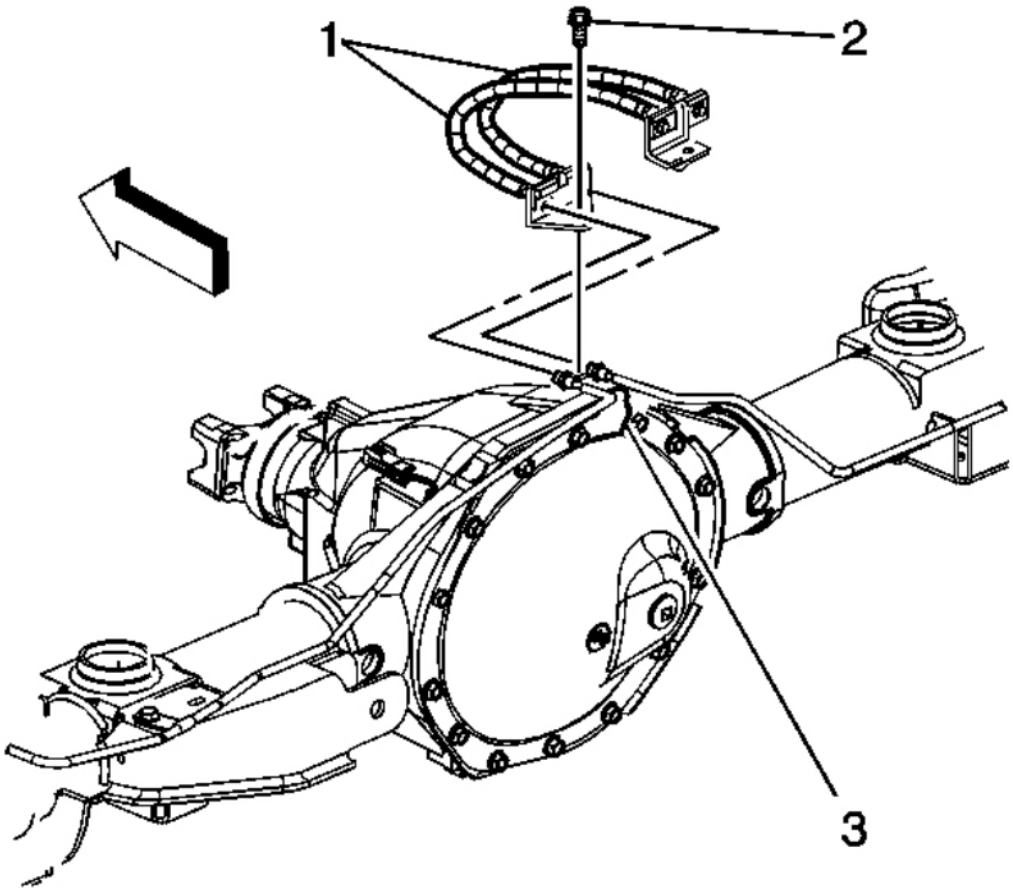


Fig. 47: View Of Brake Hoses & Lower Bracket Bolt - Rear Jounce (W/JL4)
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Install the rear jounce brake hoses (1).

   NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the brake hose lower bracket and bolt (2) to the axle.

   Tighten: Tighten the bolt to 12 N.m (106 lb in).

3. Remove the caps or plugs from the rear brake pipes and connect the pipes to the jounce hoses.

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

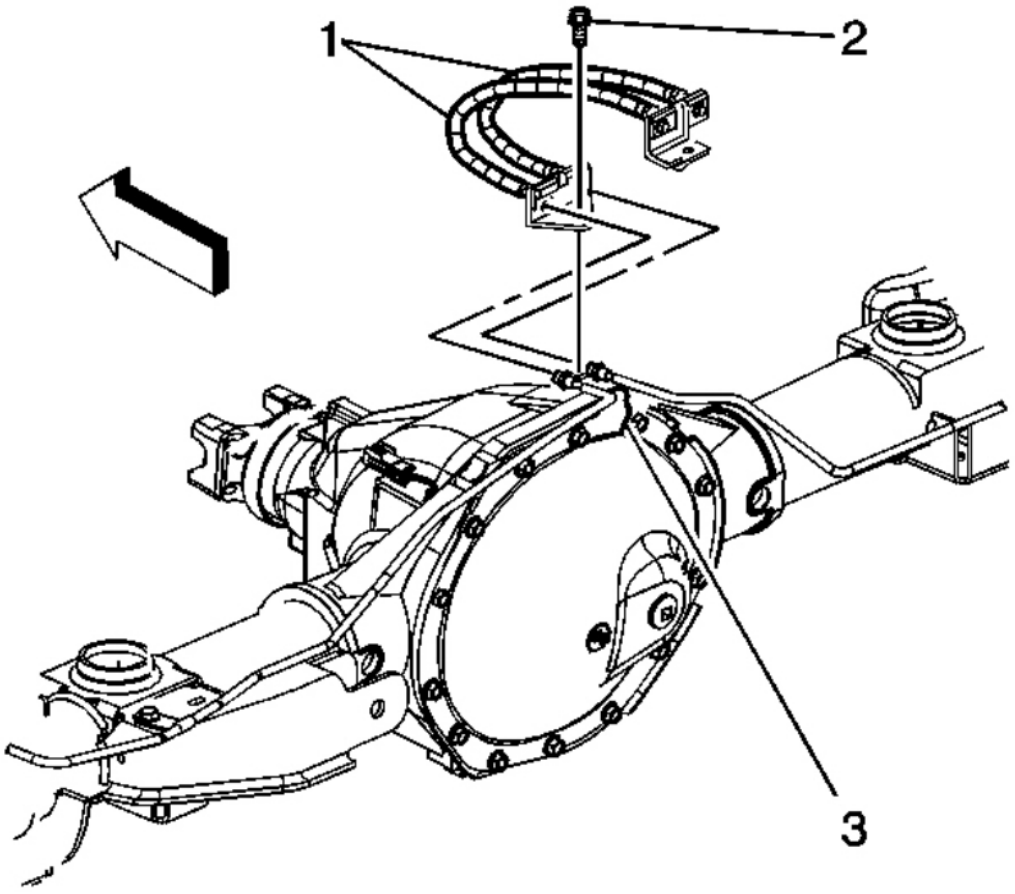


Fig. 48: View Of Brake Hoses & Lower Bracket Bolt - Rear Jounce (W/JL4)
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The hoses must not be twisted. Make sure the hoses are not in contact with any suspension component.

4. With the weight of the vehicle on the suspension, install the brake hose bracket bolt.
5. Remove the rubber cap or plug from the exposed brake pipe fitting end.
6. Connect the brake pipe fittings to the brake hoses:
   - Use a backup wrench on the hose fitting.
   - Do not bend the bracket or the pipe.

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Tighten: Tighten the brake pipe fitting to 25 N.m (18 lb ft).

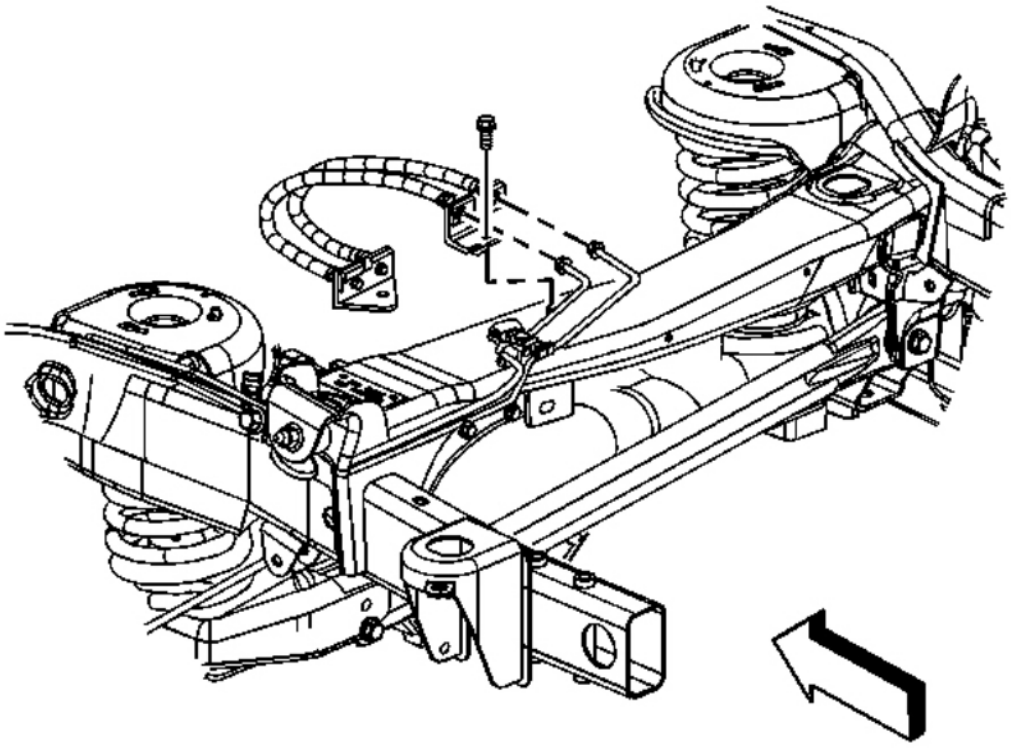


Fig. 49: View Of Brake Hoses & Upper Bracket Bolt - Rear Jounce (W/JL4)
Courtesy of GENERAL MOTORS CORP.

7. Ensure that the hose does not make contact with any part of the suspension. If the hose makes contact, remove the hose and correct the condition.
8. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)**.
9. Lower the vehicle.

HYDRAULIC BRAKE SYSTEM BLEEDING (MANUAL)

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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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.

   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.

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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**.

HYDRAULIC BRAKE SYSTEM BLEEDING (PRESSURE)

Tools Required

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

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.

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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 and Equipment**.
6. Check the brake fluid level in the **J 29532** , or equivalent. See **Special Tools and Equipment**. 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. See **Special Tools and Equipment**.**J 35589-A** . See **Special Tools and Equipment**.
8. Charge the **J 29532** , or equivalent, air tank to 175-205 kPa (25-30 psi). See **Special Tools and Equipment**.
9. Open the **J 29532** , or equivalent, fluid tank valve to allow pressurized brake fluid to enter the brake system. See **Special Tools and Equipment**.
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 hydraulic circuit bleeder valves are properly tightened.

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22. Close the **J 29532** , or equivalent, fluid tank valve, then disconnect the**J 29532** , or equivalent, from the **J 35589-A** .
23. Remove the **J 35589-A** from the brake master cylinder reservoir. See **Special Tools and Equipment**.
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 **ABS Automated Bleed Procedure (w/o JL4)** or **ABS Automated Bleed Procedure (W/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 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. Inspect the brake fluid for the following conditions, indicating brake fluid contamination:
    - Fluid separation, indicating two types of fluid are present; a substance other than the recommended brake fluid has been introduced into the brake hydraulic system
        - Swirled appearance - oil-based substance
        - Layered appearance - silicone-based substance
    - Fluid discoloration, indicating the presence of moisture or particles that have been introduced into the brake hydraulic system

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- 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**
        - **Brake Hose Replacement - Front**
        - **Brake Hose Replacement - Rear (Caliper)** or **Brake Hose Replacement - Rear (Jounce (W/O JL4))** or **Brake Hose Replacement - Rear (Jounce (W/JL4))**
        - **Brake Caliper Replacement - Front** in Disc Brakes
        - **Brake Caliper Replacement - Rear (1500 Series)** or **Brake Caliper Replacement - Rear (2500 Series)** in Disc Brakes
        - **Brake Pressure Modulator Valve (BPMV) Replacement (w/ JL4)** or **Brake Pressure Modulator Valve (BPMV) Replacement (w/o JL4)** in Antilock Brake System
    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 Overhaul** or **Master Cylinder Replacement**; also perform the following:

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

            Replace the brake master cylinder reservoir cap diaphragm.

        - **Brake Hose Replacement - Front**
        - **Brake Hose Replacement - Rear (Caliper)** or **Brake Hose Replacement - Rear (Jounce (W/O JL4))** or **Brake Hose Replacement - Rear (Jounce (W/JL4))**
        - **Brake Caliper Overhaul - Front** or **Brake Caliper Replacement - Front** in Disc Brakes
        - **Brake Caliper Overhaul - Rear (15 Series)** or **Brake Caliper Overhaul - Rear (25 Series)**

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or **Brake Caliper Replacement - Rear (1500 Series)** or **Brake Caliper Replacement - Rear (2500 Series)** in Disc Brakes

- **Brake Pressure Modulator Valve (BPMV) Replacement (w/ JL4)** or **Brake Pressure Modulator Valve (BPMV) Replacement (w/o JL4)** in Antilock Brake System

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)**.

HYDRAULIC 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 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 (Without Hydroboost)** or **Checking and Adding Power Steering Fluid (With Hydroboost)** in Power Steering System.

Bleeding the Hydraulic Booster System

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

Flushing the Hydraulic Booster System

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

Removal Procedure

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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.
3. Remove the master cylinder. Refer to **Master Cylinder Replacement**.
4. Remove the stop lamp switch. Refer to **Stop Lamp Switch Replacement** in Lighting Systems.
5. Remove the 4 booster to bulkhead nuts.
6. Remove the booster assembly.
7. Remove the gasket.

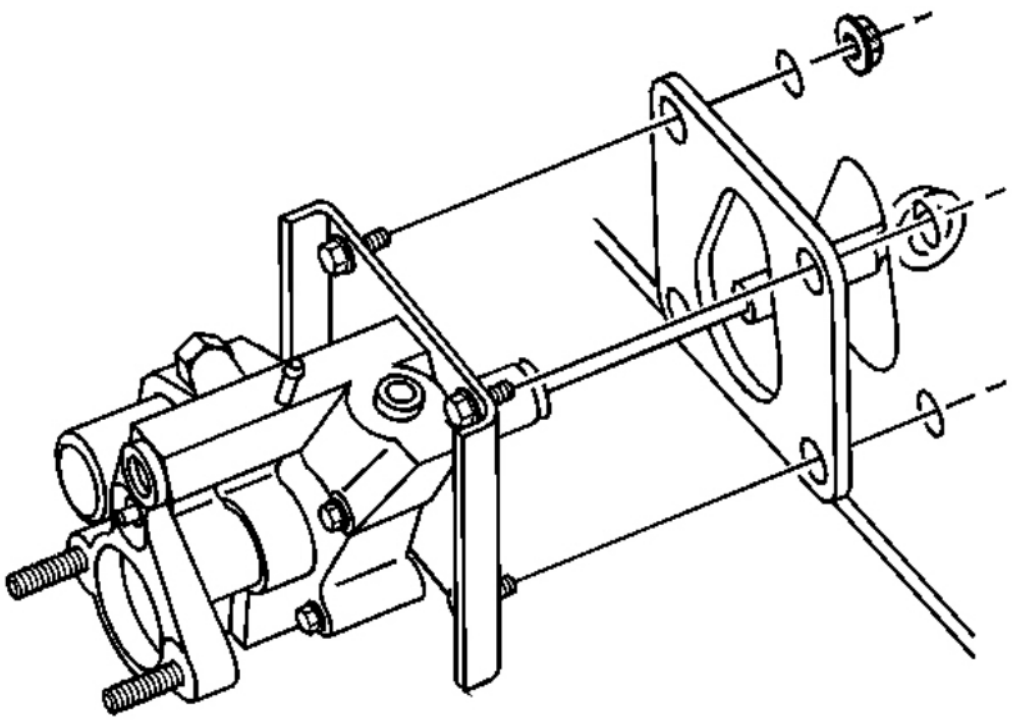


Fig. 50: View Of Hydraulic Brake Booster Assembly, Nuts & Gasket
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

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

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

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3. Install the 4 booster to bulkhead nuts.

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

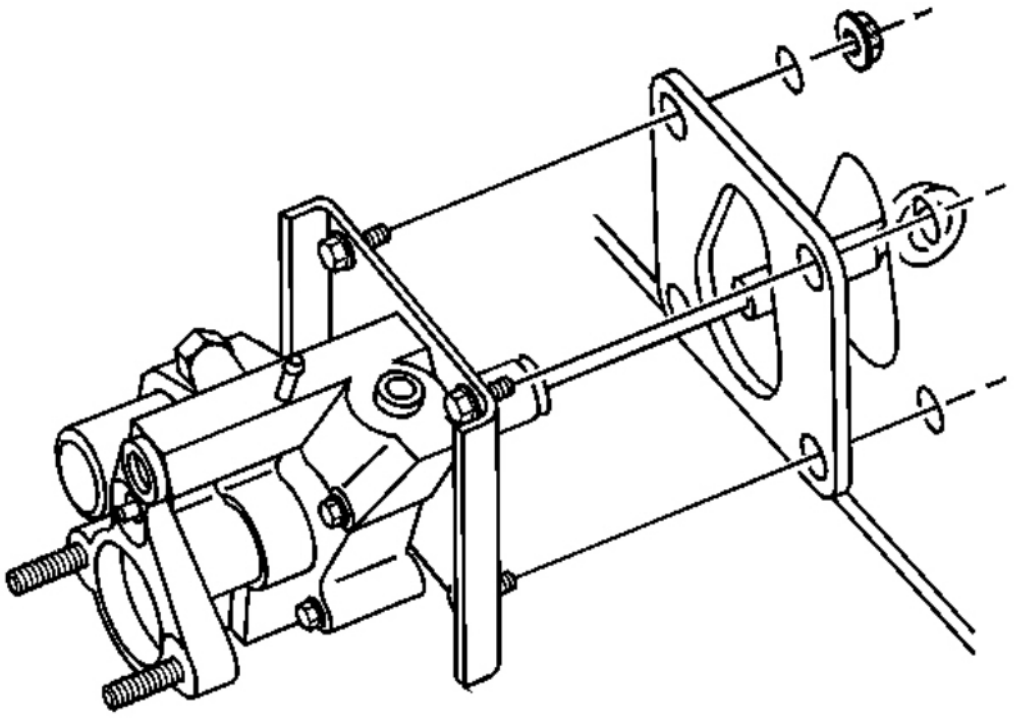


Fig. 51: View Of Hydraulic Brake Booster Assembly, Nuts & Gasket
Courtesy of GENERAL MOTORS CORP.

4. Install the stop lamp switch. Refer to **Stop Lamp Switch Replacement** in Lighting Systems.
5. Install the master cylinder. Refer to **Master Cylinder Replacement**.
6. Connect the return hose, the steering gear, and the inlet hoses.
7. Bleed the hydraulic booster system. Refer to **Bleeding the Power Steering System** 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 and Equipment**.

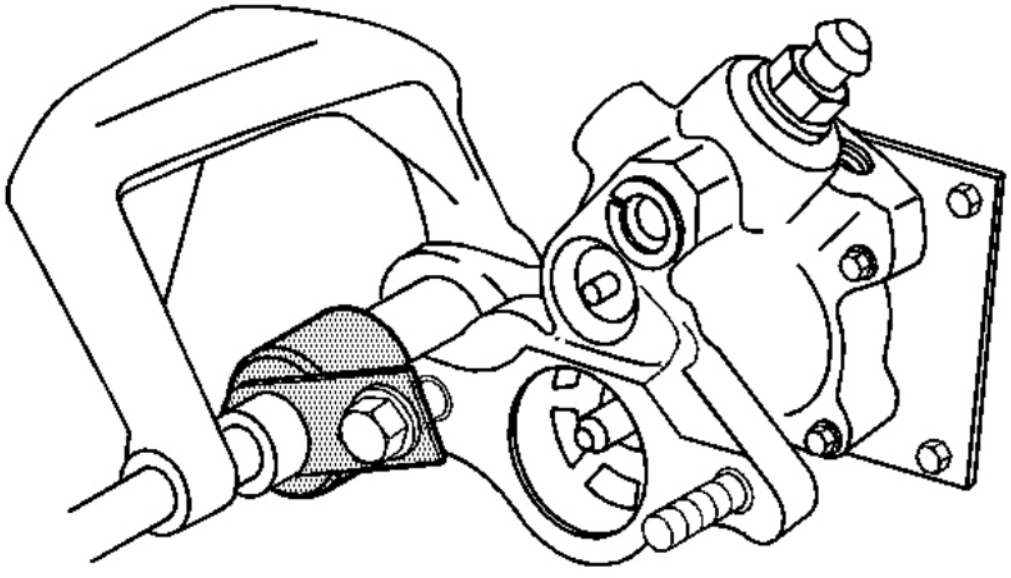
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Removal Procedure

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**.
4. Place the **J 26889** over the end of the accumulator. See **Special Tools and Equipment**.
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. 52: View Of Accumulator With C-Clamp
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).

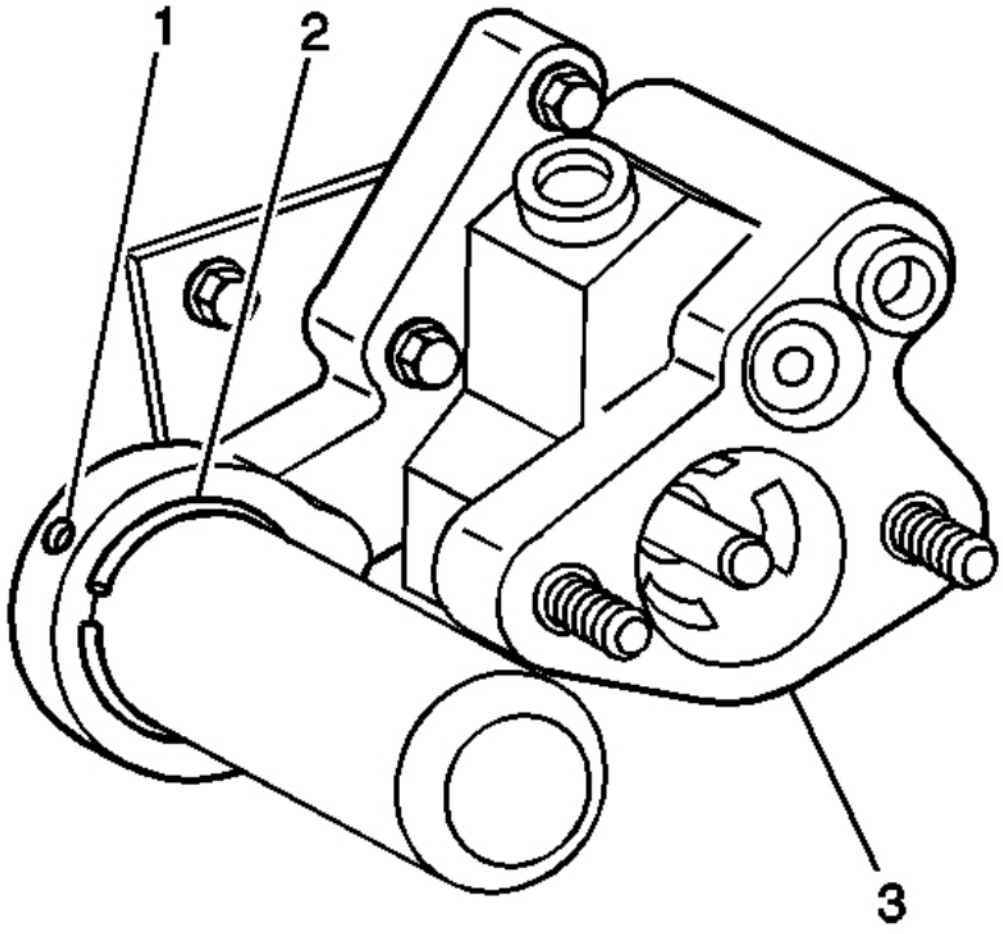


Fig. 53: Identifying Brake Booster Retaining Ring & Access Hole
Courtesy of GENERAL MOTORS CORP.

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

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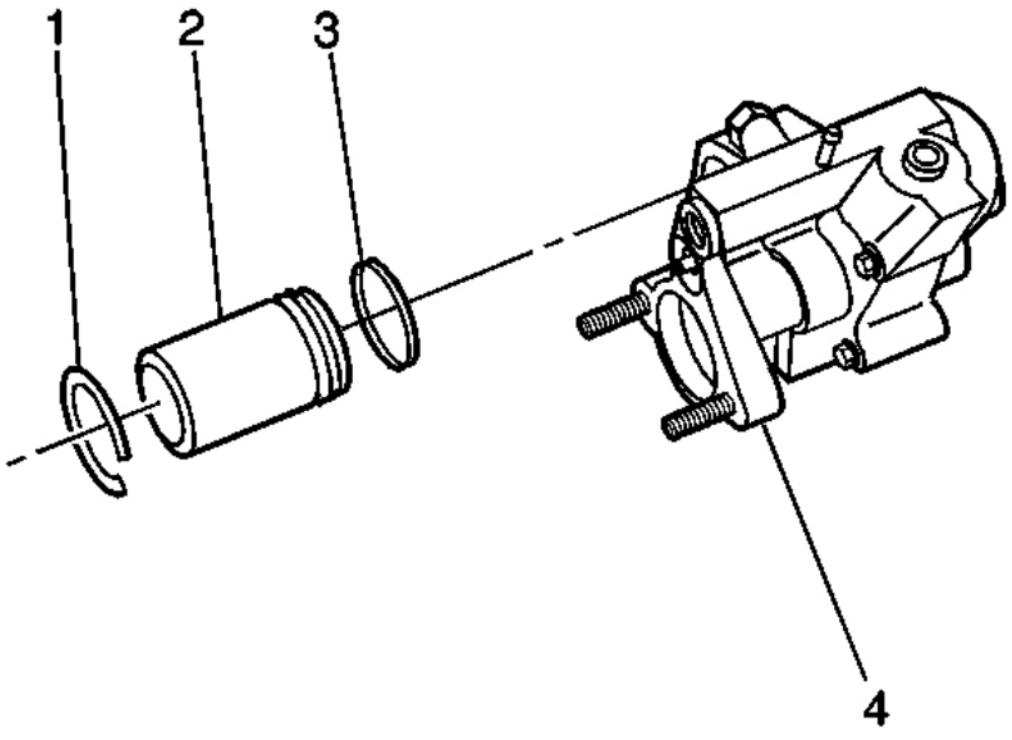


Fig. 54: Identifying Accumulator Components
Courtesy of GENERAL MOTORS CORP.

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

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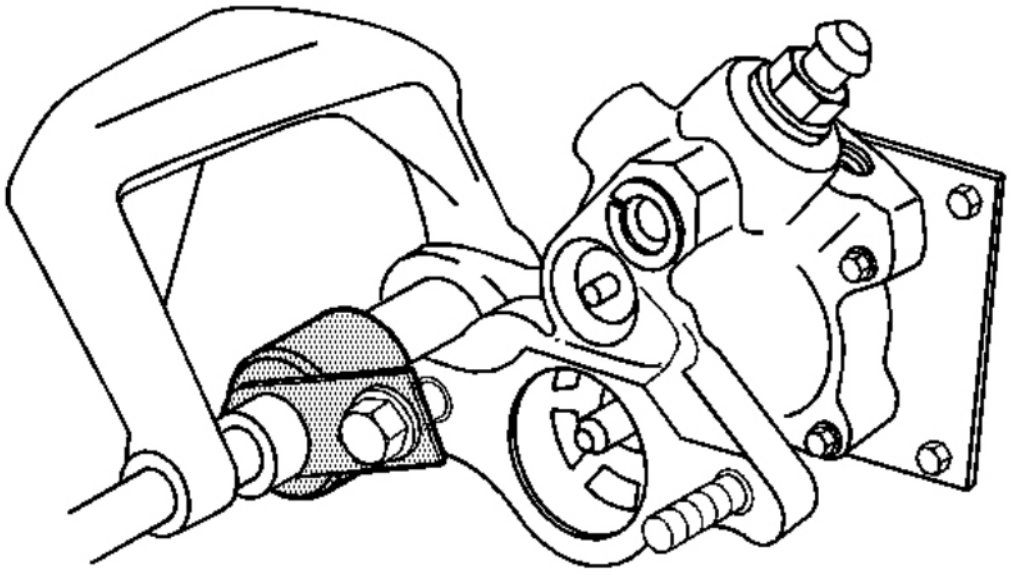


Fig. 55: View Of Accumulator With C-Clamp
Courtesy of GENERAL MOTORS CORP.

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

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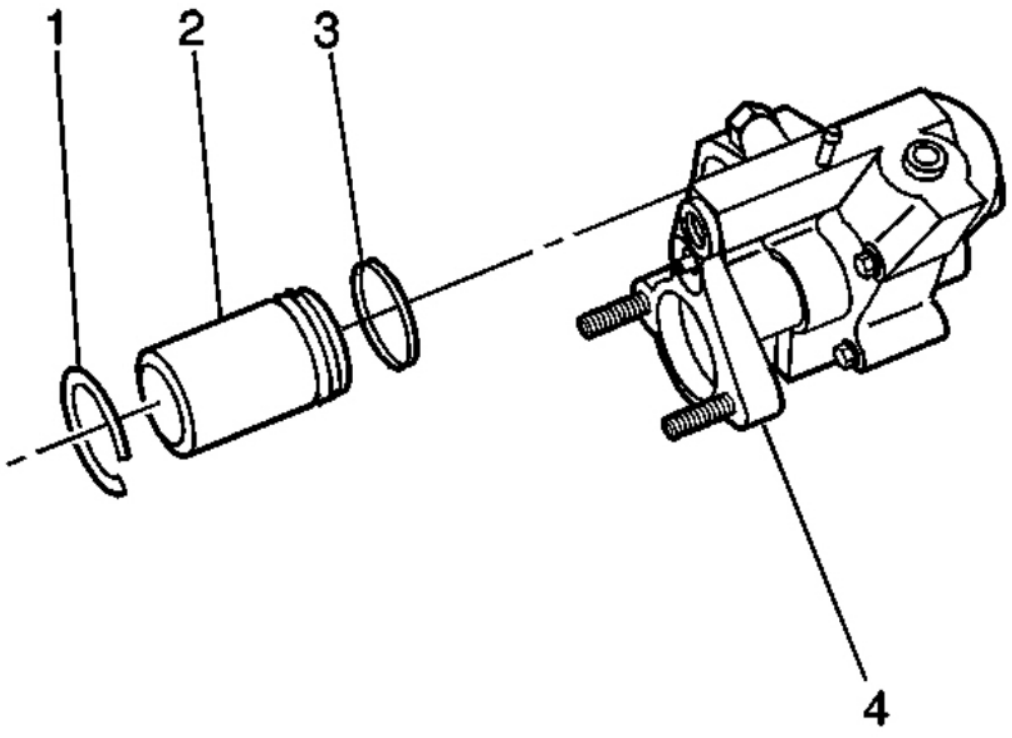


Fig. 56: Identifying Accumulator Components
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

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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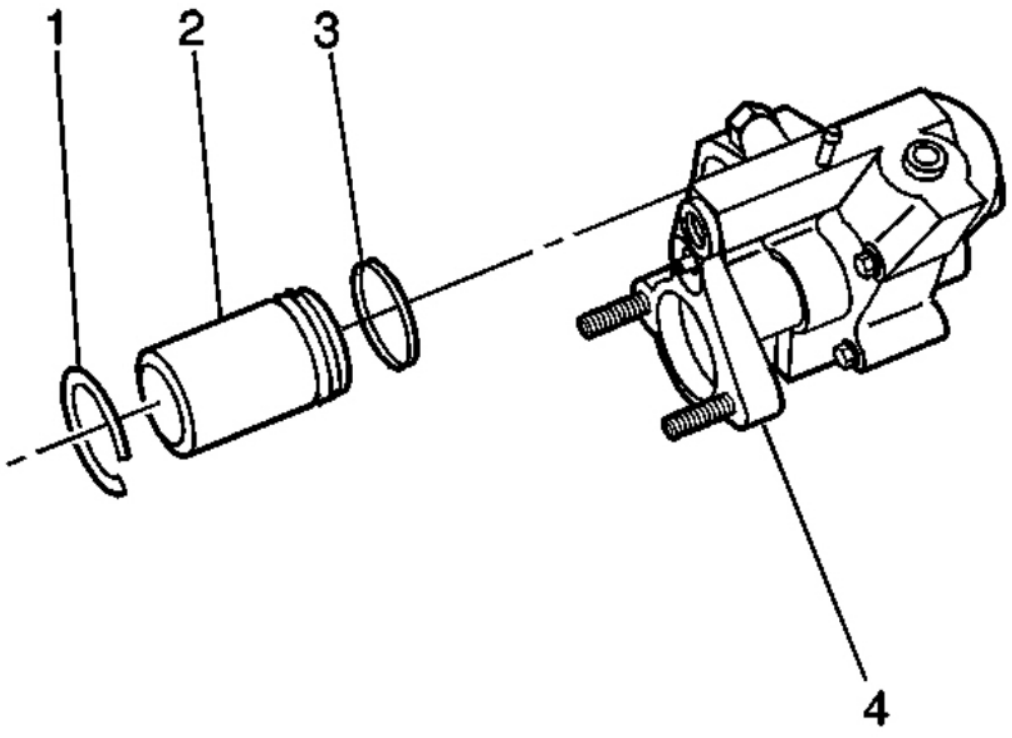


Fig. 57: Identifying Accumulator Components
Courtesy of GENERAL MOTORS CORP.

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

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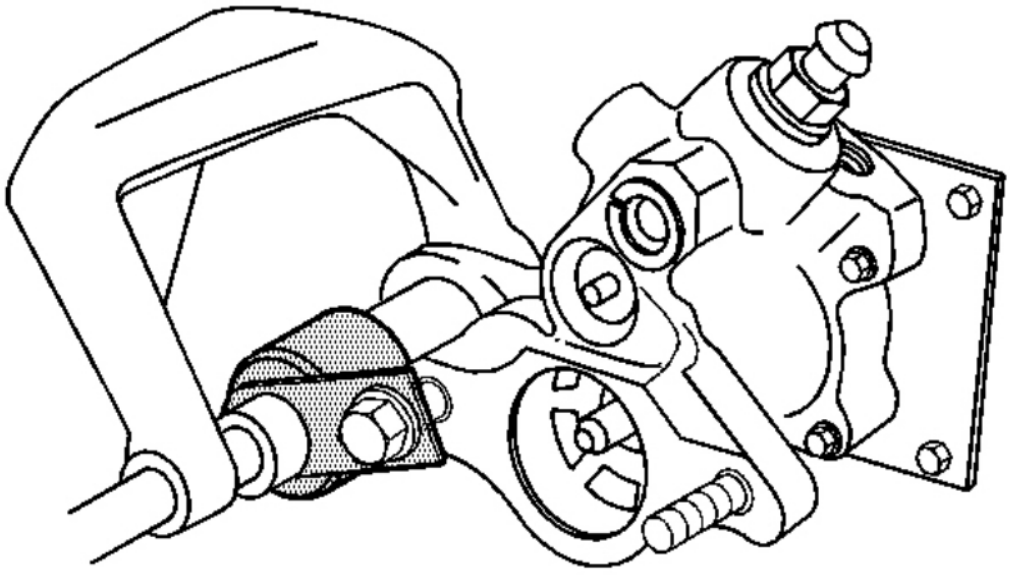


Fig. 58: View Of Accumulator With C-Clamp
Courtesy of GENERAL MOTORS CORP.

6. Install the accumulator retainer ring (1).

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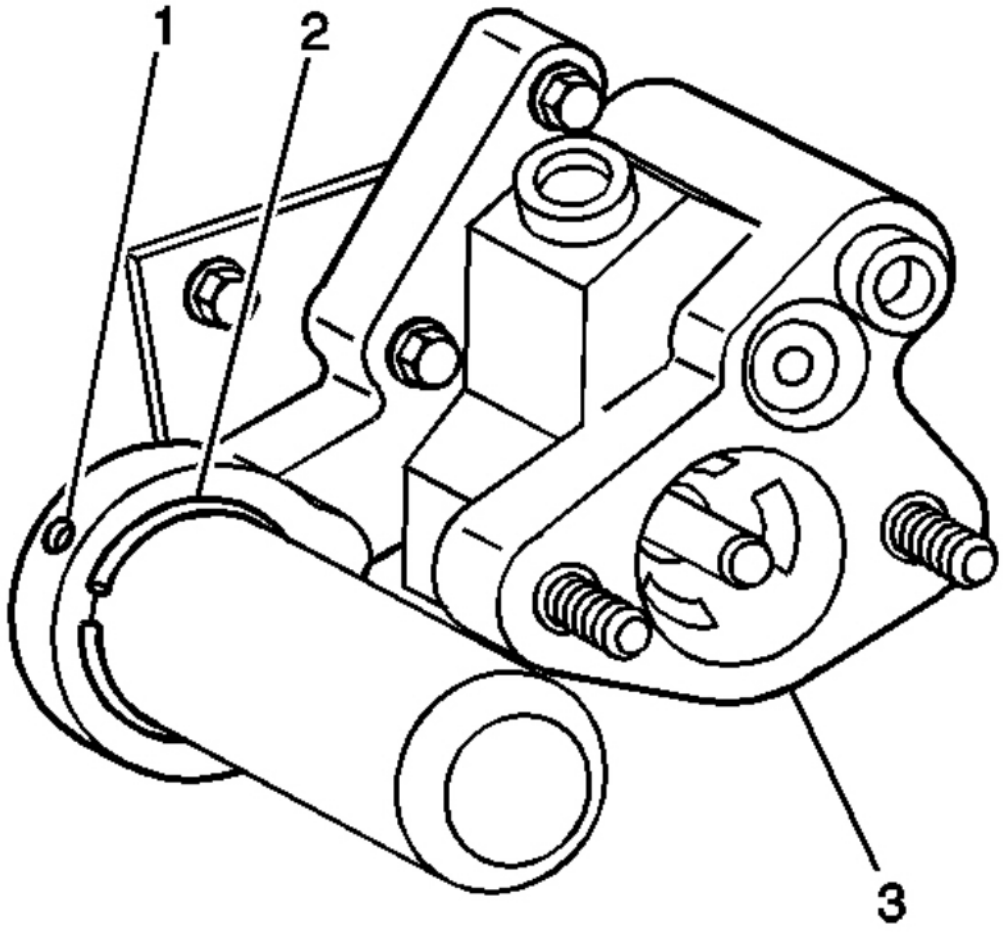


Fig. 59: Identifying Brake Booster Retaining Ring & Access Hole
Courtesy of GENERAL MOTORS CORP.

7. Release the C-clamp.
8. Remove the nut from the stud.
9. Remove the **J 26889** . See **Special Tools and Equipment**.

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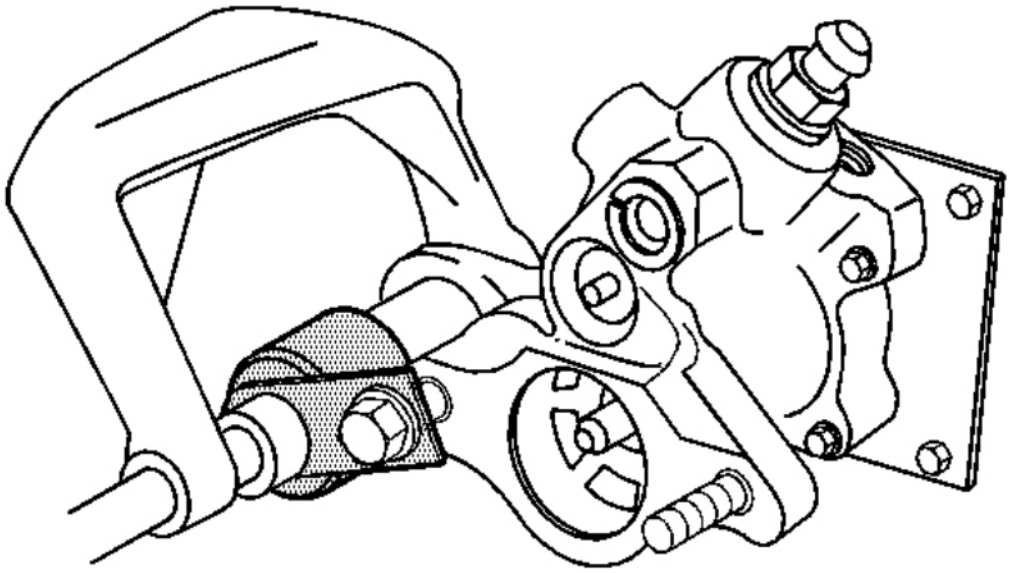


Fig. 60: View Of Accumulator With C-Clamp
Courtesy of GENERAL MOTORS CORP.

10. Install the master cylinder to the hydraulic booster. Refer to **Master Cylinder Replacement**.
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 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 receives a class 2 message from the BCM requesting illumination.
- The electronic brake control module (EBCM) detects a low brake fluid condition. The IPC receives a class 2 message from the EBCM requesting illumination.
- The EBCM detects an ABS malfunction which disables dynamic rear proportioning (DRP). The IPC receives a class 2 message from the EBCM requesting illumination.
- The IPC performs the bulb check at the start of each ignition cycle. The brake warning indicator illuminates for approximately 3 seconds before turning OFF.

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- The IPC detects a loss of class 2 communications with the BCM or with the EBCM.

Service Brake System Message

The service brake system message is displayed whenever the red brake warning indicator is illuminated.

Supplemental Brake Assist

The Supplemental Brake Assist (SBA) displays two messages through the Driver Information Center (DIC).

REDUCED BRAKE POWER

The REDUCED BRAKE POWER message is displayed when the supplemental brake assist signal circuit is held low. This happens when the SBA is active and maintaining reduced brake power levels.

SERVICE BRAKE BOOSTER

The SERVICE BRAKE BOOSTER message will be displayed when the supplemental brake assist signal circuit is toggled at 1.0 Hz with a 50 percent duty cycle. This message is also displayed if the instrument panel cluster (IPC) does not see an alive and well signal at key on. When this message is displayed it indicates a problem with the SBA and should be serviced or replaced.

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 (W/JL4)** or **ABS Description and Operation (W/O JL4)** in Antilock Brake System for specific information on the operation of DRP.

Hydraulic Brake Pipes and Flexible Brake Hoses

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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.

BRAKE ASSIST SYSTEM DESCRIPTION AND OPERATION (HYDRAULIC ASSIST)

System Component Description

The brake assist system consists of the following:

Brake Pedal

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

Brake Pedal Pushrod

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

Hydraulic Brake Booster

Uses power steering fluid pressure to decrease effort required by driver when applying brake system input force. When brake system input force is applied, pressurized power steering fluid is admitted to the rear of an apply piston, providing a decrease in brake pedal effort required. When input force is removed, pressurized power steering fluid is blocked off from the piston.

Power Steering System

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

System Operation

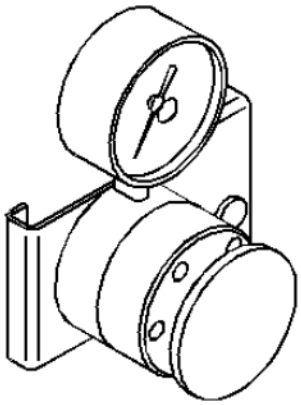
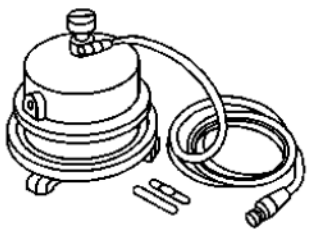
Brake system input force is multiplied by the brake pedal and transferred by the pedal pushrod to the hydraulic brake master cylinder. Effort required to apply the brake system is reduced by the hydraulic brake booster.

SPECIAL TOOLS AND EQUIPMENT

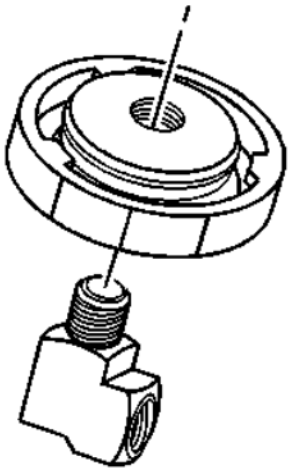
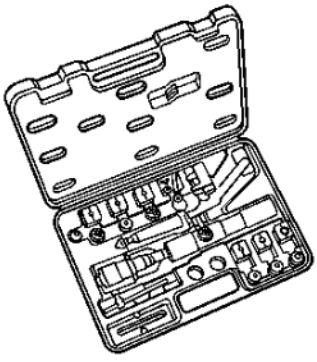
SPECIAL TOOLS

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Special Tools

Illustrations	Tool Number/Description
	J 26889 Accumulator Piston Compressor
	J 28662 Brake Pedal Effort Gauge
	J 29532 Diaphragm Type Brake Pressure Bleeder

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	J 35589-A Brake Pressure Bleeder Adapter
	J 45405 Pipe Flaring Tool Kit

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