2008 BRAKES

Hydraulic Brakes - Cab & Chassis Sierra, Cab & Chassis Silverado, Sierra & Silverado

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	Specification	
	Metric	English
Brake Booster Nuts (Hydraulic)	33 N.m	24 lb ft
Brake Booster Nuts (Vacuum)	33 N.m	24 lb ft
Brake Booster Pushrod Retainer Bolt	10 N.m	89 lb in
Brake Hose Fitting Bolt - Front	40 N.m	30 lb ft
Brake Master Cylinder Pressure Sensor	26 N.m	19 lb ft
Brake Hose Fitting Bolt - Rear	40 N.m	30 lb ft
Brake Pedal Bracket to Dash Panel Bolt	36 N.m	27 lb ft
Brake Pedal Pivot Nut	35 N.m	26 lb ft
Brake Pipe Fittings	25 N.m	18 lb ft
Hose Bracket to Control Arm Bolt	9 N.m	80 lb in
Hose Bracket to Frame Bolt - Front	9 N.m	80 lb in
Hose Bracket to Frame Bolt - Rear	25 N.m	18 lb ft
Hose Bracket to Frame Nut - Rear (JH6, JH7)	25 N.m	18 lb ft
Hose Bracket to Rear Axle Bolt	9 N.m	80 lb in
Hose Bracket to Steering Knuckle Bolt	9 N.m	80 lb in
Hose to Rear Axle Bolt	25 N.m	18 lb ft
Master Cylinder Mounting Nuts	33 N.m	24 lb ft
Power Brake Booster Hose Fitting - Inlet	33 N.m	24 lb ft
Power Brake Booster Hose Fitting - Outlet	33 N.m	24 lb ft

BRAKE COMPONENT SPECIFICATIONS

Application	Specification	
	Metric	English
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

Application	Specification	
	Metric	English
Brake Pedal Maximum Travel*		
• Vacuum Power Assist	60 mm	2.36 in
• Hydraulic Power Assist	90 mm	3.54 in
* Specification with 445 N (100 lbs) of force applied to the brake pedal, the ignition OFF, and the brake booster power reserve depleted.		

SCHEMATIC AND ROUTING DIAGRAMS

HYDRAULIC BRAKE SCHEMATICS

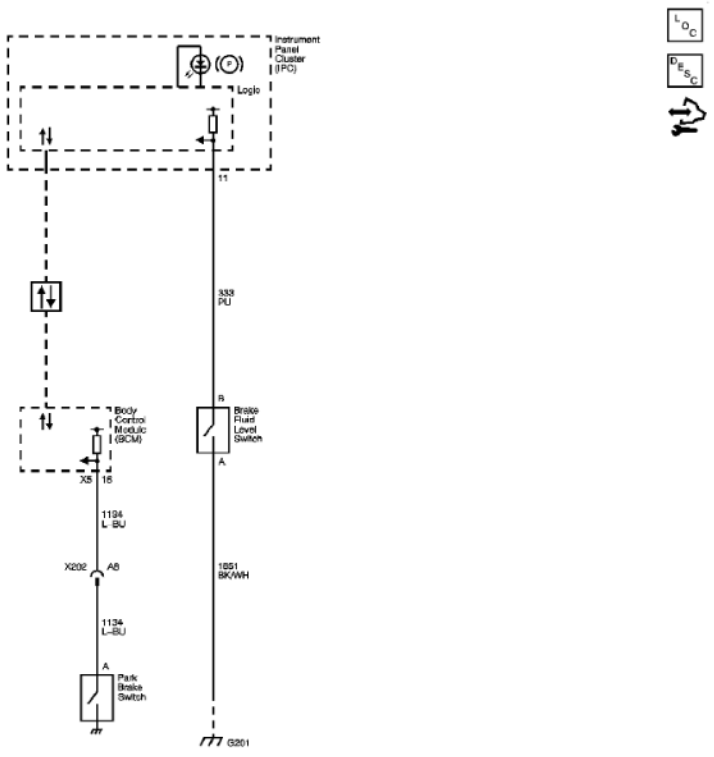


Fig. 1: Hydraulic Brake Schematic
Courtesy of GENERAL MOTORS CORP.

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC C0267	C0267 00: Low Brake Fluid Indicated

DIAGNOSTIC STARTING POINT - HYDRAULIC BRAKES

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

DTC C0267

Diagnostic Instructions

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

DTC Descriptor

DTC C0267 00

Low Brake Fluid Indicated

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Brake Fluid Level Signal	C0267 00	1	1	-
Park Brake Signal	1	1	1	-
Ground	-	1	-	-
1. Brake Warning Indicator Malfunction				

Circuit/System Description

The brake fluid level switch monitors the level of brake fluid in the master cylinder. When the

instrument panel cluster (IPC) sees the brake fluid level switch input closed, it turns ON the Red Brake Warning indicator and sends a serial data message to the electronic brake control module (EBCM) that the brake fluid level is low.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

- Low brake fluid is detected.
- A short to ground exists on the signal circuit.

Action Taken When the DTC Sets

- The EBCM disables the antilock brake system (ABS)/traction control system (TCS) dynamic rear proportion (DRP) and vehicle stability enhancement system (VSES).
- The ABS indicator illuminates.
- The StabiliTrak indicator illuminates.
- The Red Brake Warning indicator illuminates.

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

Brake Warning System Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Inspect for proper brake fluid level, the fluid level should be at or above the proper level.
    - If low, refer to **Brake Fluid Loss**.
2. Ignition ON, observe the scan tool IPC Brake Fluid parameter. The reading should be OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the brake fluid level switch.
2. Test for less than 1 ohm between the ground circuit terminal A and ground.
    - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Ignition ON, verify the scan tool IPC Brake Fluid parameter is Ok.
    - If not the specified value, test the signal circuit for a short to ground. If the circuit tests normal, replace the IPC.
4. Install a 3A fused jumper wire between the signal circuit terminal B and ground. Verify the scan tool IPC Brake Fluid parameter is Low.
    - If not the specified value, test the signal circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the IPC.
5. If all circuits test normal, test or replace the brake fluid level switch.

Component Testing

1. Ignition OFF, disconnect the harness connector at the brake fluid level switch.
2. Test for infinite resistance between the ground terminal A and the signal terminal B.
    - If less than the specified value, replace the brake fluid level switch.

Repair Procedures

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

- **Brake Fluid Level Indicator Switch Replacement (JD9, JF3, JF7)**
- **Control Module References** for IPC replacement, setup, and programming

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 procedures:
   - **Brake Warning System Description and Operation**
   - **Hydraulic Brake System Description and Operation**
   - **Brake Assist System Description and Operation (Hydraulic Assist)Brake Assist System Description and Operation (Vacuum Assist)**
   - **Disc Brake System Description and Operation**

Visual/Physical Inspection

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

Intermittent

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

Symptom List

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

- **Brake Warning Indicator Malfunction**
- **Brake Pulsation**
- **Brake System Noise**
- **Braking Action Uneven - Pulls to One Side**

- **Braking Action Uneven - Front to Rear**
- **Brake Pedal Excessive Travel**
- **Brake Pedal Excessive Effort**
- **Brakes Drag**
- **Brake System Slow Release**
- **Brake Fluid Loss**

BRAKE WARNING INDICATOR MALFUNCTION

Diagnostic Instructions

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

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Brake Fluid Level Signal	1	1	1	-
Park Brake Signal	1	1	1	-
Ground	-	1	-	-
1. Brake Warning Indicator Malfunction				

Circuit/System Description

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

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

Brake Warning System Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the park brake is released and the brake fluid is at or above the proper level.
   - If low, refer to **Brake Fluid Loss**.
2. Command the IPC display test with a scan tool, the warning indicator should turn ON.
   - If the red brake warning indicator does not illuminate, replace the IPC.
3. Ignition ON, observe the scan tool BCM Park Brake Switch parameter while applying and releasing the park brake. The parameter should cycle between Applied and Release.
   - If the parameter does not cycle between the specified values, refer to Park Brake Switch Malfunction below.
4. Observe the scan tool IPC Brake Fluid parameter. The reading should be OK.
   - If not the specified value, refer to Brake Fluid Level Switch Malfunction below.

Circuit/System Testing

Park Brake Switch Malfunction

1. Ignition OFF, disconnect the harness connector at the park brake switch.
2. Ignition ON, verify the scan tool BCM Park Brake Switch parameter is Released.
   - If not the specified value, test the signal circuit terminal A for a short to ground. If the circuit tests normal, replace the BCM.

3. Install a 3A fused jumper wire between the signal circuit terminal A and ground. Verify the scan tool BCM Park Brake Switch parameter is Applied.
    - If not the specified value, test the signal circuit for a short to voltage or an open/high resistance.
4. If all circuits test normal, test or replace the park brake switch.

Brake Fluid Level Switch Malfunction

1. Ignition OFF, disconnect the harness connector at the brake fluid level switch.
2. Test for less than 1 ohm between the ground circuit terminal A and ground.
    - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Ignition ON, verify the scan tool IPC Brake Fluid parameter is Ok.
    - If not the specified value, test the signal circuit for a short to ground. If the circuit tests normal, replace the IPC.
4. Install a 3A fused jumper wire between the signal circuit terminal B and ground. Verify the scan tool IPC Brake Fluid parameter is Low.
    - If not the specified value, test the signal circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the IPC.
5. If all circuits test normal, test or replace the brake fluid level switch.

Component Testing

Park Brake Switch Malfunction

1. Ignition OFF, disconnect the harness connector at the park brake switch.
2. Test for infinite resistance between the signal terminal A and ground with the park brake released.
    - If less than the specified value, replace the park brake switch.
3. Test for less than 1 ohm between the signal terminal A and ground with the park brake applied.
    - If greater than the specified range, replace the park brake switch.

Brake Fluid Level Switch Malfunction

1. Ignition OFF, disconnect the harness connector at the brake fluid level switch.
2. Test for infinite resistance between the ground terminal A and the signal terminal B.
    - If less than the specified value, replace the brake fluid level switch.

Repair Procedures

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

- **Brake Fluid Level Indicator Switch Replacement (JD9, JF3, JF7)**
- **Parking Brake Indicator Switch Replacement**
- **Control Module References** for BCM and IPC replacement, setup, and programming

BRAKE PULSATION

Step	Action	Yes	No
DEFINITION: Fluctuation or pulsation is felt through the brake pedal, steering wheel, seat, floor, and/or in the vehicle ONLY when braking.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
2	1. Inspect the disc brake system for the following conditions. • Excessive thickness variation of rotor friction surfaces • Excessive assembled lateral runout (LRO) of rotor friction surfaces • Hard spots, heat checks, bluing discoloration of rotor friction surfaces; possibly due to brake drag • Excessive corrosion of rotor friction surfaces; including red, gray or black oxidation • Loose, damaged or missing caliper or lining hardware • Bent or damaged caliper or mounting component • Excessive LRO of wheel hub/axle flange; due to damage and/or loose or excessively worn bearings 2. Adjust, repair or replace components as		

	necessary. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 3**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
3	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test**. Is the condition still present?	Go to **Step 2**	System OK

BRAKE SYSTEM NOISE

Step	Action	Yes	No
DEFINITION: Vehicle exhibits abnormal noise when braking; vehicle may exhibit abnormal noise during motion just after brake pedal release.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
	1. Inspect the disc brake system for the following conditions. • Lining wear indicator contact with rotor • Debris trapped between rotor and splash shield or backing plate; and/or debris trapped between rotor and linings • Contaminated linings • Aftermarket linings • Glazed linings • Distorted, cracked or damaged linings • Excessively worn linings • Damaged or excessively worn caliper hardware and/or lining hardware		

2	• Incorrectly installed, loose or missing caliper hardware and/or lining hardware • Lack of lubrication or excessive corrosion on metal to metal contact surfaces • Bent or damaged splash shield or backing plate • Hard spots, heat checks, blueing discoloration of rotor friction surfaces • Glazed rotor friction surfaces • Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 9**	Go to **Step 3**
3	1. Inspect the brake assist system for the following conditions. • Lack of lubrication or excessively worn pushrod or pedal pivots or pivot bushings • Bent or damaged pedal pushrod, pedal, or pedal bracket • Damaged or improperly operating vacuum booster and/or check valve, if equipped • Low power steering fluid level, if equipped with hydraulic boost • Improperly tensioned, excessively worn or damaged power steering belt, if equipped with hydraulic boost • Restricted return hose from hydraulic booster, if equipped		

	• Improperly operating hydraulic booster, if equipped • Improperly functioning power steering system, if equipped with a hydraulic booster assembly • Contaminated power steering fluid, if equipped with hydraulic boost 2. Adjust, repair or replace components as necessary. Refer to **Brake Assist System Diagnosis (Hydraulic Assist)**. Did you find and correct a condition?	Go to **Step 9**	Go to **Step 4**
4	1. Inspect the hydraulic brake system for the following conditions. • Improper operation of caliper pistons • Contaminated brake fluid 2. Adjust, repair or replace components as necessary. Refer to **Hydraulic Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 9**	Go to **Step 5**
5	Is the vehicle equipped with a drum-in-rotor type of park brake system?	Go to **Step 6**	Go to **Step 9**
6	Ensure the park brake shoes are not adjusted too tightly, possibly causing a noise under certain conditions. Are the park brake shoes adjusted too tightly?	Go to **Step 7**	Go to **Step 9**
7	1. Clean and inspect the park brake shoes for excessive wear and/or damage. 2. Inspect the drum portion of the rotors for excessive wear, blueing discoloration, heat spots, and excessive radial runout. 3. If any of these conditions are present, replace the affected components. 4. Adjust the park brake system. Did you find and correct a condition?	Go to **Step 9**	Go to **Step 8**

8	Inspect the park brake system for proper operation. Refer to **Park Brake System Diagnosis** . Did you find and correct a condition?	Go to **Step 9**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
9	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test**. Is the condition still present?	Go to **Step 2**	System OK

BRAKING ACTION UNEVEN - PULLS TO ONE SIDE

Test Description

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

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

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

Step	Action	Yes	No
DEFINITION: Vehicle pulls to one side only when braking.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
2	1. Inspect the hydraulic brake system for the following conditions. • Kinked, pinched or damaged brake pipe or flexible brake hose • Sticking or improperly operating caliper piston • Brake fluid leak 2. Adjust, repair or replace components as necessary. Refer to **Hydraulic Brake**		

	System Diagnosis. Did you find and correct a condition?	Go to **Step 6**	Go to **Step 3**
3	1. Inspect the disc brake system for the following conditions. • Contaminated linings • Glazed linings • Distorted, cracked or damaged linings on one side • Loose, damaged or missing caliper hardware and/or lining hardware • Incorrect linings on one side • Hard spots, heat checks, blueing discoloration of rotor friction surfaces; possibly due to brake drag • Glazed rotor friction surfaces • Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 6**	Go to **Step 4**
4	1. Inspect the suspension system for the following conditions. • Incorrect tire pressures • Loose suspension component connections • Excessively worn or damaged suspension components 2. Adjust, repair or replace components as necessary. Refer to **Diagnostic Starting Point - Suspension General Diagnosis** . Did you find and correct a condition?	Go to **Step 6**	Go to **Step 5**
	1. Inspect the steering system for the		

5	following conditions. • Loose steering component connections • Excessively worn or damaged steering components 2. Adjust, repair or replace components as necessary. Refer to **Diagnostic Starting Point - Power Steering System (w/o Electro-Hydraulic Steering)** . Did you find and correct a condition?	Go to **Step 6**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
6	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test**. Is the condition still present?	Go to **Step 2**	System OK

BRAKING ACTION UNEVEN - FRONT TO REAR

Test Descriptions

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

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

Step	Action	Yes	No
DEFINITION: Braking action or stopping force sensitive or grabbing and/or more pronounced at the front or at the rear axle. Sensitive or grabbing brakes: Excessive brake jump-in force relative to brake pedal input.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
	1. Inspect the hydraulic brake system for the following conditions:		

2	• Improper operation of caliper pistons • Kinked, pinched or damaged brake pipe or flexible brake hose • Brake fluid leak • Improperly functioning proportion valve, if equipped • Improper operation of dynamic rear proportion (DRP) system, if equipped 2. Adjust, repair or replace components as necessary. Refer to **Hydraulic Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 6**	Go to **Step 3**
3	1. Inspect the disc brake system for the following conditions: • Contaminated linings • Glazed linings • Distorted, cracked or damaged linings • Excessively worn linings • Aftermarket linings • Damaged or excessively worn caliper hardware and/or lining hardware • Hard spots, heat checks, blueing discoloration of rotor friction surfaces • Glazed rotor friction surfaces 2. Adjust, repair or replace components as necessary. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 6**	Go to **Step 4**
	1. Inspect the suspension system for the following conditions: • Loose suspension component		

4	connections • Excessively worn or damaged suspension components 2. Adjust, repair or replace components as necessary. Refer to **Diagnostic Starting Point - Suspension General Diagnosis** . Did you find and correct a condition?	Go to **Step 6**	Go to **Step 5**
5	1. Inspect the brake assist system for the following conditions: • Binding, bent or damaged pedal pushrod, pedal, or pedal bracket • Damaged or improperly operating vacuum booster, if equipped • Damaged or improperly operating hydraulic booster, if equipped 2. Adjust, repair or replace components as necessary. Refer to **Brake Assist System Diagnosis (Hydraulic Assist)**. Did you find and correct a condition?	Go to **Step 6**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
6	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test**. Is the condition still present?	Go to **Step 2**	System OK

BRAKE PEDAL EXCESSIVE TRAVEL

Step	Action	Yes	No
DEFINITION: Brake pedal travels further than expected to obtain firm pedal and/or firm pedal cannot be obtained, pedal fades away, or pedal is spongy.			
1	Were you sent here from the Hydraulic Brake Symptom table?		Go to **Diagnostic Starting Point - Hydraulic**

		Go to **Step 2**	**Brakes**
2	Inspect the travel and feel of brake pedal applies. Perform the following: 1. Apply the brake pedal several times to fully deplete the power reserve. 2. With power reserve depleted, apply the brake pedal with light, steady pressure and hold for 15 seconds. Observe pedal travel and feel. 3. Apply the brake pedal with light, steady pressure, then without pumping the pedal, reduce pressure and reapply pressure several times. Observe pedal travel and feel for each apply. 4. Apply the brake pedal slowly, then release and apply the pedal quickly. Observe pedal travel and feel for each apply. Did you complete the brake pedal travel and feel inspections?	Go to **Step 3**	-
	1. Inspect the hydraulic brake system for the conditions listed, based on the following symptoms observed during the pedal travel and feel inspections: • Pedal feel was spongy ▪ Air in hydraulic system ▪ External brake fluid leaks ▪ Soft, weak or damaged hydraulic hoses; expanding under pressure • Pedal fell away and/or traveled to or almost to floor ▪ External brake fluid leaks ▪ Poor brake fluid quality; low boiling point		

3	▪ Internal brake fluid leaks; improperly functioning master cylinder • Pedal was somewhat firm then dropped slightly, or pedal rose with successive applies, or pedal travel was different between slow and quick applies ▪ Internal brake fluid leaks; improperly functioning master cylinder ▪ Poor brake fluid quality; low boiling point • Pedal returned to rest slowly after any of the applies ▪ Internally damaged flexible brake hoses; hindering fluid return ▪ Binding caliper pistons ▪ Internal brake fluid leaks; improperly functioning master cylinder 2. Repair or replace components as necessary. Refer to **Hydraulic Brake System Diagnosis**. 3. Re-inspect brake pedal apply travel and feel. Did you find and correct a condition?	Go to **Step 8**	Go to **Step 4**
	1. Inspect the disc brake system for the following conditions: • Cracked, excessively worn or damaged linings • Cracked, excessively worn or damaged rotors • Improperly operating, binding or		

4	damaged caliper hardware and/or lining hardware • Loose or missing caliper hardware and/or lining hardware • Excessive assembled lateral runout (LRO) of rotor friction surfaces • Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. Refer to **Disc Brake System Diagnosis**. 3. Re-inspect brake pedal apply travel and feel. Did you find and correct a condition?	Go to **Step 8**	Go to **Step 5**
5	Inspect for proper brake pedal travel. Refer to **Brake Pedal Travel Measurement and Inspection**. Is the brake pedal travel distance within the acceptable limits?	Go to **Step 7**	Go to **Step 6**
6	1. Inspect for worn, missing, misaligned, bent or damaged brake pedal system components. • For the brake pedal pushrod component inspection, refer to **Brake Pedal Pushrod Inspection** . • Inspect the brake pedal bushings for binding, excessive wear and/or damage and inspect the brake pedal for a misaligned, bent, and/or damaged condition. 2. Replace the brake pedal system components that are worn, missing, misaligned, bent or damaged. Did you find and replace any worn, missing, misaligned, bent or damaged brake pedal system		

	components?	Go to **Step 8**	Go to **Step 7**
7	1. Inspect the brake assist system for the following conditions: • Vacuum leaks and/or improperly operating check valve, if equipped with vacuum assist • Damaged or improperly operating brake booster assembly 2. Adjust, repair or replace components as necessary. Refer to **Brake Assist System Diagnosis (Hydraulic Assist)**. Did you find and correct a condition?	Go to **Step 8**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
8	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test**. Is the condition still present?	Go to **Step 2**	System OK

BRAKE PEDAL EXCESSIVE EFFORT

Step	Action	Yes	No
DEFINITION: Brake pedal requires an increased amount of input from the driver to obtain good braking action and/or stopping distance is increased.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
	1. Inspect the brake assist system for the following conditions: • Vacuum leaks, if equipped with vacuum power assist • Lack of lubrication, binding or excessively worn pushrod or pedal pivots or pivot bushings		

2	• Bent or damaged pedal pushrod, pedal, or pedal bracket • Damaged or improperly operating brake booster assembly 2. Adjust, repair or replace components as necessary. Refer to **Brake Assist System Diagnosis (Hydraulic Assist)**. Did you find and correct a condition?	Go to **Step 5**	Go to **Step 3**
3	1. Inspect the hydraulic brake system for the following conditions: • Binding caliper pistons • Internally damaged flexible brake hoses; hindering fluid flow • External brake fluid leaks • Kinked or damaged flexible brake hoses and/or pipes • Internal brake fluid leaks; improperly operating master cylinder • Poor brake fluid quality; low boiling point 2. Adjust, repair or replace components as necessary. Refer to **Hydraulic Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 5**	Go to **Step 4**
	1. Inspect the disc brake system for the following conditions: • Excessively worn linings • Glazed linings • Cracked, distorted or damaged linings • Contaminated linings • Binding, damaged or excessively worn caliper hardware and/or lining hardware		

4	• Lack of lubrication or excessive corrosion on metal to metal contact surfaces • Excessively worn or corroded rotor friction surfaces • Glazed rotor friction surfaces • Hard spots, heat checks, blueing discoloration of rotor friction surfaces 2. Adjust, repair or replace components as necessary. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 5**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
5	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test**. Is the condition still present?	Go to **Step 2**	System OK

BRAKES DRAG

Step	Action	Yes	No
DEFINITION: Brake system does not fully release or has delayed release; vehicle motion may be hindered by brake system without applying brakes.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
2	Is the vehicle equipped with an adjustable stop lamp switch and/or an adjustable cruise control release switch?	Go to **Step 3**	Go to **Step 4**
	1. Inspect the stop lamp switch for proper adjustment to ensure that the brake pedal is fully releasing.		

3	2. Inspect the cruise control release switch, if equipped, for proper adjustment to ensure that the brake pedal is fully releasing. Did you find and correct a condition?	Go to **Step 14**	Go to **Step 4**
4	Is the vehicle equipped with a drum-in-rotor type of park brake system?	Go to **Step 5**	Go to **Step 7**
5	Ensure the park brake shoes are not adjusted too tightly, possibly causing drag under certain conditions. Are the park brake shoes adjusted too tightly?	Go to **Step 6**	Go to **Step 7**
6	1. Clean and inspect the park brake shoes for excessive wear and/or damage. 2. Inspect the drum portion of the rotors for excessive wear, blueing discoloration and heat spots. 3. If any of these conditions are present, replace the affected components. 4. Adjust the park brake system. Did you find and correct a condition?	Go to **Step 14**	Go to **Step 7**
7	Inspect the park brake system for proper operation. Refer to **Park Brake System Diagnosis** . Did you find and correct a condition?	Go to **Step 14**	Go to **Step 8**
8	1. Inspect the disc brake system for the following conditions: • Binding, incorrectly installed or missing caliper hardware and/or lining hardware-Ensure free movement of linings and of caliper, if equipped with sliding type caliper • Lack of lubrication or excessive corrosion on metal to metal contact surfaces • Distorted or damaged linings • Damaged or excessively worn caliper		

	hardware and/or lining hardware • Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 14**	Go to **Step 9**
9	1. Separate the brake booster pushrod from the brake pedal. 2. Inspect the brake corners to determine if the brake drag condition is still present. Do the brake corners still exhibit the brake drag condition?	Go to **Step 11**	Go to **Step 10**
10	1. Inspect the pushrod for improper positioning and/or damage. Correctly position or replace the pushrod if necessary. 2. Inspect the brake pedal assembly for damage and replace if necessary. Did you complete the repair or replacement?	Go to **Step 14**	-
11	1. For vacuum boost systems, disconnect the vacuum check valve from the booster to relieve vacuum reserve. 2. Separate the master cylinder from the brake booster. Do not disconnect any brake pipes. 3. Inspect the brake corners to determine if the brake drag condition is still present. Do the brake corners still exhibit the brake drag condition?	Go to **Step 13**	Go to **Step 12**
12	Replace the brake booster assembly. Did you complete the replacement?	Go to **Step 14**	-
	1. Inspect the hydraulic brake system for the		

13	following conditions. • Improper operation of caliper pistons • Contaminated brake fluid • Internally damaged flexible brake hoses; hindering brake release • Damaged or improperly operating master cylinder 2. Adjust, repair or replace components as necessary. Refer to **Hydraulic Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 14**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
14	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test**. Is the condition still present?	Go to **Step 2**	System OK

BRAKE SYSTEM SLOW RELEASE

Step	Action	Yes	No
DEFINITION: Brake system releases and returns to rest slowly; vehicle motion is hindered by brake system briefly after release of brake pedal.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
2	1. Inspect the hydraulic brake system for the following conditions: • Improper operation of caliper pistons • Internally damaged flexible brake hoses; hindering brake release • Contaminated brake fluid • Damaged or improperly operating		

	master cylinder 2. Adjust, repair or replace components as necessary. Refer to **Hydraulic Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 5**	Go to **Step 3**
3	1. Inspect the brake assist system for the following conditions: • Binding, bent or damaged pedal pushrod, pedal, or pedal bracket • Damaged or improperly operating vacuum booster, if equipped • Restricted return hose from hydraulic booster, if equipped • Damaged or improperly operating hydraulic booster, if equipped 2. Adjust, repair or replace components as necessary. Refer to **Brake Assist System Diagnosis (Hydraulic Assist)**. Did you find and correct a condition?	Go to **Step 5**	Go to **Step 4**
4	1. Inspect the disc brake system for the following conditions: • Damaged or excessively worn caliper hardware and/or lining hardware • Distorted or damaged linings • Lack of lubrication or excessive corrosion on metal to metal contact surfaces • Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. Refer to **Disc Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 5**	Go to **Diagnostic Starting Point - Hydraulic Brakes**

5	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test**. Is the condition still present?	Go to **Step 2**	System OK

BRAKE FLUID LOSS

Step	Action	Yes	No
DEFINITION: Brake fluid level is low not related to lining wear.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
2	1. Inspect the following hydraulic brake system components for brake fluid leaks: • Flexible brake hose connections; threaded and bolted • Flexible brake hose crimp joints • Brake pipe fittings • Caliper piston seals • Wheel cylinder piston seals, if equipped • Master cylinder reservoir • Master cylinder reservoir low pressure hose, if equipped • Brake pressure modulator valve (BPMV) assembly, if equipped 2. Repair or replace components as necessary. Refer to **Hydraulic Brake System Diagnosis**. Did you find and correct a condition?	Go to **Step 8**	Go to **Step 3**
3	Is the vehicle equipped with a vacuum brake		

	booster?	Go to **Step 4**	Go to **Step 6**
4	1. Disconnect the vacuum check valve from the booster to relieve vacuum reserve. 2. Separate the master cylinder from the vacuum brake booster. Do not disconnect any brake pipes. 3. Inspect the rear of the master cylinder for a brake fluid leak. 4. Inspect for brake fluid in the vacuum brake booster. Did you find a brake fluid leak?	Go to **Step 5**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
5	Replace the brake master cylinder and the vacuum brake booster. Did you complete the replacement?	Go to **Step 8**	-
6	1. Wipe clean the external surface of the master cylinder to hydraulic brake booster area, if equipped. 2. Separate the master cylinder from the hydraulic brake booster, if equipped. Do not disconnect any brake pipes. 3. Inspect the rear of the master cylinder for a brake fluid leak. Did you find a brake fluid leak?	Go to **Step 7**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
7	Replace the brake master cylinder. Did you complete the replacement?	Go to **Step 8**	-
8	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle to confirm proper operation. Refer to **Brake System Vehicle Road Test**. Is the condition still present?	Go to **Step 2**	System OK

BRAKES SELF APPLY WHEN TURNING STEERING WHEEL

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

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

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

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the DISC brake system in order to determine if the DISC brake system is operating properly. You will be directed by the appropriate Symptom table to go to other brake system diagnostic tables as appropriate.			
1	Were you sent here from a Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
2	Visually inspect the disc brake pads for the following conditions: Refer to **Brake Pad Inspection** . • Lining thickness below specifications • Uneven and/or abnormal wear - edge-to-edge and/or side-to-side • Looseness or damage - including pad hardware • Evidence of contamination from an external substance Did you find any conditions to indicate a concern with any of the front and/or rear disc brake pads?	Go to **Step 3**	Go to **Step 12**
3	Are any of the front and/or rear disc brake pads contaminated?	Go to **Step 8**	Go to **Step 4**
4	Are any of the front and/or rear disc brake pads worn unevenly?	Go to **Step 7**	Go to **Step 5**
5	Are any of the front and/or rear disc brake pads and/or pad hardware loose or damaged?	Go to **Step 7**	Go to **Step 6**
6	1. Remove and inspect the worn disc brake pads for glazing, looseness, heat spots or damage. 2. Replace the worn disc brake pads as a complete axle set. Refer to **Front Disc Brake Pads Replacement (JH6, JH7)** or **Front Disc Brake Pads Replacement**	-	

	(JD9, JF3, JF7) and/or **Rear Disc Brake Pads Replacement (JH6, JH7)** or **Rear Disc Brake Pads Replacement (JD9)** . Did you complete the inspection and replacement?	Go to **Step 12**	
	NOTE: **Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.** **IMPORTANT:** **Do NOT disconnect the hydraulic brake flex hoses from the calipers.** 1. Remove the front and/or rear disc brake calipers, as appropriate, from the mounting brackets and support the calipers. Refer to **Front Brake Caliper Replacement (JH6, JH7)** or **Front Brake Caliper Replacement (JD9, JF3, JF7)** and/or **Rear Brake Caliper Replacement (JH6, JH7)** or **Rear Brake Caliper Replacement (JD9)** . 2. Inspect the disc brake caliper mounting bracket and the mounting/sliding hardware for the following conditions: Refer to **Front Disc Brake Mounting and Hardware Inspection** and/or **Rear Disc Brake Mounting and Hardware Inspection** . • Binding or seized hardware • Worn, damaged or missing hardware		

7	components • Loose, bent, cracked, or damaged caliper mounting bracket 3. Replace components as required. Refer to the following procedures in Disc Brakes, as required: • **Front Brake Caliper Bracket Replacement (JH6, JH7)** **Front Brake Caliper Bracket Replacement (JD9, JF3, JF7)** • **Rear Brake Caliper Bracket Replacement (JH6, JH7)** **Rear Brake Caliper Bracket Replacement (JD9)** • **Front Disc Brake Hardware Replacement (JH6, JH7)** **Front Disc Brake Hardware Replacement (JD9, JF3, JF7)** • **Rear Disc Brake Hardware Replacement (JH6, JH7)** **Rear Disc Brake Hardware Replacement (JD9)** 4. Replace the unevenly-worn, loose or damaged disc brake pads as a complete axle set. Refer to **Front Disc Brake Pads Replacement (JH6, JH7)** or **Front Disc Brake Pads Replacement (JD9, JF3, JF7)** and/or **Rear Disc Brake Pads Replacement (JH6, JH7)** or **Rear Disc Brake Pads Replacement (JD9)** . Did you complete the inspection and replacement?	Go to **Step 12**	-
	1. Inspect the disc brake calipers, brake hoses and brake pipes for evidence of an external brake fluid leak. 2. Replace any components found to be		

8	leaking brake fluid. Refer to the following procedures as required: • **Front Brake Caliper Overhaul (JH6, JH7)** or **Front Brake Caliper Replacement (JH6, JH7) Front Brake Caliper Replacement (JD9, JF3, JF7)** • **Rear Brake Caliper Overhaul (JH6, JH7)** or **Rear Brake Caliper Replacement (JH6, JH7) Rear Brake Caliper Replacement (JD9)** • **Front Brake Hose Replacement (JD9, JF3, JF7)Front Brake Hose Replacement (JH6, JH7)** • **Rear Brake Hose Replacement (Frame to Axle - JH6, JH7)Rear Brake Hose Replacement (Frame to Axle - JD9, JF3 w/JL4)Rear Brake Hose Replacement (Caliper - JH6, JH7)Rear Brake Hose Replacement (Caliper - JD9)Rear Brake Hose Replacement (Frame to Axle - JF3 w/o JL4, JF7)** • **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**
	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 Boot Replacement** , if equipped. 3. Inspect the rear axle seals for damage and		

9	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 (w/o VSES)** or **Rear Axle Shaft Seal and/or Bearing Replacement (w VSES)** or **Front Wheel Hub, Bearing, and Seal Replacement (2500)** or **Front Wheel Hub, Bearing, and Seal Replacement (1500)** . 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 wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure**		

	to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak. **IMPORTANT:** **Do NOT disconnect the hydraulic brake flex hoses from the calipers.** 2. Remove the front and/or rear disc brake calipers, as appropriate, from the mounting brackets and support the calipers. Refer to **Front Brake Caliper Replacement (JH6, JH7)** or **Front Brake Caliper Replacement (JD9, JF3, JF7)** and/or **Rear Brake Caliper Replacement (JH6, JH7)** or **Rear Brake Caliper Replacement (JD9)** . 3. Inspect the disc brake caliper mounting/sliding hardware for the following conditions: Refer to **Front Disc Brake Mounting and Hardware Inspection** and/or **Rear Disc Brake Mounting and Hardware Inspection** . • Binding or seized hardware • Distorted, worn, damaged or missing hardware components 4. Replace the caliper mounting/sliding hardware components as required. Refer to **Front Disc Brake Hardware Replacement (JH6, JH7)** or **Front Disc Brake Hardware Replacement (JD9, JF3, JF7)** and/or **Rear Disc Brake Hardware Replacement (JH6, JH7)** or **Rear Disc Brake Hardware Replacement (JD9)** .		
11			-

	5. Replace the contaminated disc brake pads as a complete axle set. Refer to **Front Disc Brake Pads Replacement (JH6, JH7)** or **Front Disc Brake Pads Replacement (JD9, JF3, JF7)** and/or **Rear Disc Brake Pads Replacement (JH6, JH7)** or **Rear Disc Brake Pads Replacement (JD9)** . 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 **Front Brake Shield Replacement (JD9, JF3, JF7)** or **Front Brake Shield Replacement (JH6, JH7)** and/or **Rear Disc Brake Backing Plate Replacement (JD9)** or **Rear Disc Brake Backing Plate Replacement (JH6, JH7)** . Did you complete the repair or replacement?	Go to **Step 14**	-
14	1. Check the thickness of each of the disc brake rotors. **IMPORTANT:** **Make the following determination AND ANSWER the question INDIVIDUALLY for EACH rotor.** 2. Make a determination for each brake rotor if the rotor can be REFINISHED and REMAIN ABOVE the minimum requirements. Refer to **Brake Rotor Thickness**		

	Measurement .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** .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** . • 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**		

17	**Rotor Refinishing** . 2. Inspect the brake rotor thickness. Refer to **Brake Rotor Thickness Measurement** . Were you able to REFINISH the brake rotor within the minimum requirements?	Go to **Step 22**	Go to **Step 21**
18	Is the brake rotor at or below the DISCARD requirements?	Go to **Step 21**	Go to **Step 19**
19	**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** .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** . • Heavy rust and/or pitting • Cracks and/or heat spots • Excessive blueing discoloration • Deep or excessive scoring beyond maximum acceptable level **IMPORTANT:** **Make the following determination AND ANSWER the question INDIVIDUALLY for EACH rotor.** 2. Make a determination for each brake rotor if the rotor requires replacement based upon the results of the inspection.		

	If the brake rotor exhibits any of the conditions listed previously, it requires replacement. Does the brake rotor require REPLACEMENT?	Go to **Step 21**	Go to **Step 22**
21	**IMPORTANT:** **Whenever a brake rotor is replaced, the assembled lateral runout (LRO) of the rotor must be measured to ensure optimum performance of the disc brakes.** Replace the brake rotor. Refer to **Front Brake Rotor Replacement (JH6, JH7)** or **Front Brake Rotor Replacement (JD9, JF3, JF7)** or **Rear Brake Rotor Replacement (JD9)** or **Rear Brake Rotor Replacement (JH6)** or **Rear Brake Rotor Replacement (JH7)** .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 LRO that exceeds the maximum acceptable level. Refer to **Brake Rotor Assembled Lateral Runout Measurement** .Does the brake rotor exhibit assembled LRO that exceeds the maximum acceptable level?	Go to **Step 23**	Go to **Step 24**
23	Correct the LRO for each brake rotor that was determined to have LRO exceeding the maximum acceptable level. Refer to **Brake Rotor Assembled Lateral Runout Correction** . Did you complete the operation?	Go to **Step 24**	-
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	-

DRUM BRAKE SYSTEM DIAGNOSIS

Test Description

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

18: Drum brake backing plates that come in contact with brake drums may cause brake system noise.

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the DRUM brake system in order to determine if the DRUM 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
2	1. Remove the brake drums. Refer to **Brake Drum Replacement** . 2. Inspect the drum brake shoes for the following conditions: • Lining thickness below specifications • Uneven and/or abnormal wear - edge-to-edge and/or side-to-side • Contamination from an external substance • Looseness, damage, glazing, or incorrect lining material Did you find any conditions to indicate a concern with any of the drum brake shoes?	Go to **Step 3**	Go to **Step 7**
3	Are any of the brake shoes contaminated?	Go to **Step 4**	Go to **Step 5**
4	1. Inspect the wheel cylinders for evidence of an external brake fluid leak. 2. Replace any wheel cylinder that is found to be leaking brake fluid. Refer to **Wheel Cylinder Replacement** . Did you complete the inspection and		-

	replacement?	Go to **Step 6**	
5	1. Inspect the drum brake hardware for any components which are worn, damaged, discolored due to stress, broken or missing. Refer to **Drum Brake Adjusting Hardware Inspection** . 2. Replace components as required. Refer to **Brake Shoe Replacement** . 3. Replace the drum brake shoes. Refer to **Brake Shoe Replacement** . Did you complete the inspection and replacement?	Go to **Step 8**	-
6	1. Clean the remaining drum brake system components to remove any traces of the contaminant. 2. Inspect the drum brake hardware for any components which are worn, damaged, discolored due to stress, broken or missing. Refer to **Drum Brake Adjusting Hardware Inspection** . 3. Replace the drum brake hardware components as required. Refer to **Brake Shoe Replacement** . 4. Replace the contaminated brake shoes. Refer to **Brake Shoe Replacement** . Did you complete the cleaning, inspection and replacement?	Go to **Step 8**	-
7	1. Inspect the drum brake hardware for any components which are worn, damaged, discolored due to stress, broken or missing. Refer to **Drum Brake Adjusting Hardware Inspection** . 2. Replace components as required. Refer to **Brake Shoe Replacement** .		-

	Did you complete the inspection and, if necessary, the replacement?	Go to **Step 8**	
8	1. Check the diameter of each of the brake drums. **IMPORTANT:** **Make the following determination AND ANSWER the question INDIVIDUALLY for EACH drum.** 2. Make a determination for each brake drum if the drum can be REFINISHED and REMAIN ABOVE the minimum requirements. Refer to **Brake Drum Diameter Measurement** .Does the brake drum meet the minimum requirements for REFINISHING?	Go to **Step 9**	Go to **Step 11**
9	1. Inspect each of the brake drums for the following surface and wear conditions: Refer to **Brake Drum Surface and Wear Inspection** . • Braking Surface Conditions ▪ Heavy rust and/or pitting ▪ Cracks and/or heat spots ▪ Excessive blueing discoloration ▪ Missing balance weights • Braking Surface Wear Conditions ▪ Deep or excessive scoring beyond maximum acceptable level ▪ Radial runout beyond maximum acceptable level **IMPORTANT:** **Make the following determination AND**		

	ANSWER the question INDIVIDUALLY for EACH drum. 2. Make a determination for each brake drum if the drum requires refinishing based upon the results of the inspection. If the brake drum exhibits any of the following conditions, it requires refinishing. • Drum exhibits one or more of the Braking Surface Conditions listed previously • Drum is beyond the acceptable level in one or more of the Braking Surface Wear Conditions listed previously Does the brake drum require REFINISHING?	Go to **Step 10**	Go to **Step 14**
10	1. Refinish the brake drum. Refer to **Brake Drum Refinishing** . 2. Inspect the brake drum diameter. Refer to **Brake Drum Diameter Measurement** . Were you able to REFINISH the brake drum within the minimum requirements?	Go to **Step 14**	Go to **Step 13**
11	Is the brake drum at or below the DISCARD requirements?	Go to **Step 13**	Go to **Step 12**
	1. Inspect each of the brake drums for the following surface and wear conditions: Refer to **Brake Drum Surface and Wear Inspection** . • Braking Surface Conditions ▪ Heavy rust and/or pitting ▪ Cracks and/or heat spots ▪ Excessive blueing discoloration		

12	▪ Missing balance weights • Braking Surface Wear Conditions ▪ Deep or excessive scoring beyond maximum acceptable level ▪ Radial runout beyond maximum acceptable level **IMPORTANT:** **Make the following determination AND ANSWER the question INDIVIDUALLY for EACH drum.** 2. Make a determination for each brake drum if the drum requires replacement based upon the results of the inspection. If a brake drum exhibits any of the following conditions, it requires replacement. • Drum exhibits one or more of the Braking Surface Conditions listed previously • Drum is beyond the acceptable level in one or more of the Braking Surface Wear Conditions listed previously Does the brake drum require REPLACEMENT?	Go to **Step 13**	Go to **Step 14**
13	Replace the brake drum. Refer to **Brake Drum Replacement** . Did you complete the replacement?	Go to **Step 14**	-
14	Inspect the brake shoes for proper adjustment. Refer to **Drum Brake Adjustment** . Are the brake shoes adjusted properly?	Go to **Step 18**	Go to **Step 15**
15	Inspect the components of the brake drum adjustment hardware system for free movement and correct operation. Refer to **Drum Brake Adjusting Hardware Inspection** .		

	Do the drum brake adjusting hardware components operate freely and correctly?	Go to **Step 17**	Go to **Step 16**
16	Replace the drum brake adjusting hardware components as necessary. Refer to **Drum Brake Adjusting Hardware Replacement** . Is the replacement complete?	Go to **Step 17**	-
17	Adjust the drum brake shoes. Refer to **Drum Brake Adjustment** . Were you able to complete the adjustment?	Go to **Step 20**	Return to Symptom Table
18	Inspect the drum brake backing plate for the following: • Excessive wear or rust • Damage and/or evidence of contact with the brake drum Does the drum brake backing plate exhibit any of these conditions?	Go to **Step 19**	Go to **Step 20**
19	Repair or replace the drum brake backing plate as necessary. Refer to **Rear Brake Backing Plate Replacement** . Did you complete the repair or replacement?	Go to **Step 20**	-
20	Install or connect components that were removed or disconnected during diagnosis. Did you complete the operation?	Drum Brake System OK Return to Symptom Table	-

HYDRAULIC BRAKE SYSTEM DIAGNOSIS

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the HYDRAULIC brake system in order to determine if the HYDRAULIC brake system is operating properly. You will be directed by the appropriate Symptom table to go to other brake system diagnostic tables as appropriate.			
1	Were you sent here from a Brake Symptom table?		Go to **Diagnostic Starting Point - Hydraulic**

		Go to **Step 2**	**Brakes**
2	Inspect and adjust the brake fluid level in the brake master cylinder. Refer to **Master Cylinder Reservoir Filling**. Was the brake fluid level low?	Go to **Step 3**	Go to **Step 4**
3	1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination: • Fluid separation, indicating two types of fluid are present ▪ Swirled appearance - oil-based substance ▪ Layered appearance - silicone-based substance • Fluid discoloration ▪ Cloudy appearance - moisture ▪ Dark appearance/suspended particles in fluid - dirt, rust, corrosion, brake dust 2. Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating fluid contamination. Do any of the above conditions exist?	Go to **Step 5**	Go to **Step 6**
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 following steps. Refer to the procedures indicated. 1. Remove ALL of the following components listed. Each component contains internal rubber seals/linings which have been contaminated. 2. Clean out the hydraulic brake pipes using denatured alcohol, or equivalent. 3. Dry the brake pipes using non-lubricated, filtered air. 4. Repair or replace ALL of the following components listed. Each component contains internal rubber seals/linings which have been contaminated. • **Master Cylinder Replacement (JD9, JF3, JF7)Master Cylinder Replacement (JH6, JH7)** • Brake master cylinder reservoir:		

5	Clean the brake master cylinder reservoir using denatured alcohol, or equivalent, then dry the reservoir using non-lubricated, filtered air, or if necessary, replace the brake master cylinder reservoir. • Replace the brake master cylinder reservoir cap diaphragm. • **Front Brake Hose Replacement (JD9, JF3, JF7) Front Brake Hose Replacement (JH6, JH7)** • **Rear Brake Hose Replacement (Frame to Axle - JH6, JH7) Rear Brake Hose Replacement (Frame to Axle - JD9, JF3 w/JL4)Rear Brake Hose Replacement (Caliper - JH6, JH7)Rear Brake Hose Replacement (Caliper - JD9) Rear Brake Hose Replacement (Frame to Axle - JF3 w/o JL4, JF7)** • **Front Brake Caliper Overhaul (JH6, JH7)** or **Front Brake Caliper Replacement (JH6, JH7) Front Brake Caliper Replacement (JD9, JF3, JF7)** • **Rear Brake Caliper Overhaul (JH6, JH7)** or **Rear Brake Caliper Replacement (JH6, JH7) Rear Brake Caliper Replacement (JD9)** • **Brake Pressure Modulator Valve Replacement (JD9, JF3, JF7) Brake Pressure**		-

	Modulator Valve Replacement (JH6, JH7) 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 (Pressure)** or **Hydraulic Brake System Bleeding (Manual)**. Did you complete the operation and any required repairs and/or replacements?	Go to **Step 9**	
	1. Inspect the following hydraulic brake system components for external fluid leaks Repair or replace any of the components found to be leaking brake fluid. Refer to the appropriate procedures: • **Master Cylinder Replacement (JD9, JF3, JF7)Master Cylinder Replacement (JH6, JH7)** Brake master cylinder reservoir cap diaphragm • **Front Brake Hose Replacement (JD9, JF3, JF7)Front Brake Hose Replacement (JH6, JH7)** • **Rear Brake Hose Replacement (Frame to Axle - JH6, JH7)Rear Brake Hose Replacement (Frame to Axle - JD9, JF3 w/JL4)Rear Brake Hose Replacement (Caliper - JH6, JH7)Rear Brake Hose Replacement (Caliper - JD9)Rear**		

6	**Brake Hose Replacement (Frame to Axle - JF3 w/o JL4, JF7)** • **Brake Pipe Replacement** • **Front Brake Caliper Overhaul (JH6, JH7)** or **Front Brake Caliper Replacement (JH6, JH7)** **Front Brake Caliper Replacement (JD9, JF3, JF7)** • **Rear Brake Caliper Overhaul (JH6, JH7)** or **Rear Brake Caliper Replacement (JH6, JH7)** **Rear Brake Caliper Replacement (JD9)** • **Brake Pressure Modulator Valve Replacement (JD9, JF3, JF7)** **Brake Pressure Modulator Valve Replacement (JH6, JH7)** 2. If you repaired or replaced any of the brake system components listed, bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Pressure)** or **Hydraulic Brake System Bleeding (Manual)**. 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** . 2. Remove the tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** . 3. Open the suspected caliper bleeder valve. 4. Using a large C-clamp, compress the caliper piston and observe for an unrestricted flow of brake fluid and for free movement of the caliper piston. 5. Close the caliper bleeder valve. Was the flow of brake fluid unrestricted and did the caliper piston move freely?	Go to **Step 17**	Go to **Step 14**

14	Repair or replace any brake caliper that was not operating properly. Refer to the appropriate procedure: • **Front Brake Caliper Overhaul (JH6, JH7)** or **Front Brake Caliper Replacement (JH6, JH7)** or **Front Brake Caliper Replacement (JD9, JF3, JF7)** • **Rear Brake Caliper Overhaul (JH6, JH7)** or **Rear Brake Caliper Replacement (JH6, JH7)** or **Rear Brake Caliper Replacement (JD9)** 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 (Pressure)** or **Hydraulic Brake System Bleeding (Manual)**. Was there air in the system?	Go to **Step 19**	Go to **Step 16**
16	Was the flow of brake fluid unrestricted and even per axle during the bleeding procedure?	Go to **Step 21**	Go to **Step 17**
	1. Inspect the hydraulic brake pipes and flexible brake hoses for signs of a fluid restriction; such as being bent, kinked, pinched or damaged. Refer to **Brake Pipe and Hose Inspection**. 2. Replace any of the hydraulic brake pipes and/or flexible brake hoses found to be bent, kinked, pinched, or damaged. Refer to the following procedures as necessary: • **Front Brake Hose Replacement (JD9, JF3, JF7)Front Brake Hose Replacement (JH6, JH7)** • **Rear Brake Hose Replacement**		

17	**(Frame to Axle - JH6, JH7)Rear Brake Hose Replacement (Frame to Axle - JD9, JF3 w/JL4)Rear Brake Hose Replacement (Caliper - JH6, JH7)Rear Brake Hose Replacement (Caliper - JD9)Rear Brake Hose Replacement (Frame to Axle - JF3 w/o JL4, JF7)** • **Brake Pipe Replacement** 3. If none of the hydraulic brake pipes or flexible brake hoses were visibly bent, kinked, pinched, or damaged, replace the hydraulic brake flex hose at the restricted location. Did you find and correct a condition?	Go to **Step 21**	Go to **Step 18**
18	Replace the brake pressure modulator valve (BPMV), in order to correct the hydraulic brake dynamic rear proportioning mechanical operation. Refer to **Brake Pressure Modulator Valve Replacement (JD9, JF3, JF7)** or **Brake Pressure Modulator Valve Replacement (JH6, JH7)** . 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**
	1. Inspect the brake master cylinder for		

20	internal fluid leaks. Refer to **Brake System Internal Leak Test**. 2. Repair or replace the brake master cylinder if it is found to be leaking brake fluid internally. Refer to **Master Cylinder Replacement (JD9, JF3, JF7)** or **Master Cylinder Replacement (JH6, JH7)**. 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 (HYDRAULIC ASSIST)

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the brake ASSIST system in order to determine if the brake ASSIST system is operating properly. You will be directed by the appropriate Symptom table to go to other brake system diagnostic tables as appropriate.			
1	Were you sent here from a Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Hydraulic Brakes**
2	Is the symptom related to brake system noise?	Go to **Step 4**	Go to **Step 3**
3	Is the symptom related to the brake system self-applying when the steering wheel is being turned?	Go to **Step 11**	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 system operate normally from a noise standpoint?	Go to **Step 20**	Go to **Step 5**
	1. Check the power steering system fluid level and adjust the level if necessary. Refer to **Checking and Adding Power**		

5	**Steering Fluid (With Hydroboost)** or **Checking and Adding Power Steering Fluid (Without Hydroboost)** . 2. Inspect the power steering pump drive belt for proper tension and excessive wear. 3. Inspect the power steering pressure and return hoses for proper routing, possible ground-outs, possible restrictions, and/or damage. 4. Inspect the hydraulic brake booster for leaks. Refer to **Power Brake Booster Leak Inspection**. Did you find and correct a condition?	Go to **Step 20**	Go to **Step 6**
6	1. Position the vehicle on the ground with wheels straight ahead. 2. Start the engine and allow it to idle. 3. Apply the brake pedal with moderate force 130-200 N (30-45 lb). Observe for noises. 4. Release the brakes and turn the steering wheel slightly from side to side. Observe for noises. 5. Compare the noise levels between brake apply and steering input. Was the abnormal noise heard ONLY during brake apply?	Go to **Step 12**	Go to **Step 7**
7	Perform the Power Steering System Test procedure to determine if there are any restrictions in the system. Refer to **Power Steering System Test** . Did you find and correct a condition?	Go to **Step 20**	Go to **Step 8**
8	During the noise inspection, did the hydraulic brake booster produce abnormal noises?	Go to **Step 12**	Go to **Step 20**
	Inspect for proper brake pedal travel. Refer to		

9	**Brake Pedal Travel Measurement and Inspection**. Is the brake pedal travel distance within the acceptable limits?	Go to **Step 11**	Go to **Step 10**
10	1. Inspect for worn, missing, misaligned, bent or damaged brake pedal system components. • For the brake pedal pushrod component inspection, refer to **Brake Pedal Pushrod Inspection** . • Inspect the brake pedal bushings for excessive wear and/or damage and inspect the brake pedal for a misaligned, bent and/or damaged condition. 2. Replace the brake pedal system components that are worn, missing, misaligned, bent or damaged. Did you find and replace any worn, missing, misaligned, bent or damaged brake pedal system components?	Go to **Step 12**	Inspect for internal and external fluid leaks and air in the hydraulic brake system Go to **Hydraulic Brake System Diagnosis**
11	1. Check the power steering system fluid level and adjust the level if necessary. Refer to **Checking and Adding Power Steering Fluid (With Hydroboost)** or **Checking and Adding Power Steering Fluid (Without Hydroboost)** . 2. Inspect the power steering pump drive belt for proper tension and excessive wear. 3. Inspect the power steering pressure and return hoses for proper routing, possible ground-outs, possible restrictions, and/or damage. 4. Inspect the hydraulic brake booster for leaks. Refer to **Power Brake Booster**		-

	Leak Inspection. Did you complete the inspections and any necessary adjustments or replacements?	Go to **Step 12**	
12	Perform the hydraulic booster functional test: 1. With the ignition OFF, depress the brake pedal several times to deplete the power reserve. 2. Depress and maintain 178 N (40 lb) of force on the brake pedal. 3. Start the engine and observe pedal operation. **IMPORTANT:** **The brake pedal should fall slightly, then hold.** Did the brake pedal fall slightly after the engine was started, then hold?	Go to **Step 16**	Go to **Step 13**
13	Perform the Power Steering System Test procedure to determine if there are any restrictions in the system. Refer to **Power Steering System Test** . Did you find and correct a condition?	Go to **Step 14**	Go to **Step 19**
14	Perform the hydraulic booster functional test: 1. With the ignition OFF, depress the brake pedal several times to deplete the power reserve. 2. Depress and maintain 178 N (40 lb) of force on the brake pedal. 3. Start the engine and observe pedal operation. **IMPORTANT:** **The brake pedal should fall slightly, then hold.**		

	Did the brake pedal fall slightly after the engine was started, then hold?	Go to **Step 16**	Go to **Step 19**
15	Perform the Power Steering System Test procedure to determine if there are any restrictions in the system. Refer to **Power Steering System Test** . Did you find and correct a condition?	Go to **Step 14**	Go to **Step 19**
16	Perform the short-term or accumulator reserve leak-down test: 1. Start the engine and allow it to idle. 2. Charge the accumulator: Turn the steering wheel to full-lock position for 2 seconds ONLY and return to rest. 3. Turn the ignition OFF. 4. Wait 90 seconds. **IMPORTANT:** • **Both pedal applies should be assisted** • **The amount of assist could diminish slightly with the second apply** • **If 2 power assisted pedal applications could not be performed, the accumulator is losing its gas charge** 5. Depress the brake pedal 2 times to check power reserve. Observe pedal effort. Were both pedal applies power assisted?	Go to **Step 17**	Go to **Step 18**
	Perform the long-term reserve leak-down test: 1. Start the engine and allow it to idle. 2. Charge the accumulator: Turn the steering wheel to full-lock position for 2 seconds ONLY and return		

17	to rest. 3. Turn the ignition OFF. 4. Wait 1 hour. **IMPORTANT:** • **Both pedal applies should be assisted** • **The amount of assist could diminish slightly with the second apply** • **If 2 power assisted pedal applications could not be performed, the hydraulic booster assembly is not retaining power reserve** 5. Depress the brake pedal 2 times to check power reserve. Observe pedal effort. Were both pedal applies power assisted?	Go to **Step 20**	Go to **Step 19**
18	Replace the hydraulic brake booster accumulator assembly, if applicable. Did you complete the replacement?	Go to **Step 20**	-
19	Replace the hydraulic brake booster assembly. Refer to **Power Brake Booster Replacement (Adjustable Pedals)** or **Power Brake Booster Replacement (Non-Adjustable Pedals)**. Did you complete the replacement?	Go to **Step 20**	-
20	Install or connect any components that were removed or disconnected during diagnosis. Did you complete the operation?	Brake Assist System OK Return to Symptom Table	-

BRAKE SYSTEM VEHICLE ROAD TEST

Preliminary Inspections

1. Visually inspect easily accessible brake system components for obvious damage and/or leaks which may indicate that the vehicle should not be driven until further inspections have been completed.

2. Inspect the brake master cylinder reservoir fluid level and adjust only if necessary for brake system road testing. Refer to **Master Cylinder Reservoir Filling**.
3. Inspect the tire inflation pressures and adjust as necessary.
4. Inspect the tire tread patterns to ensure that they are the same or very similar, especially per axle.
5. Ensure that the vehicle is not loaded unevenly prior to brake system road testing.

Road Testing Procedure

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

1. Start the engine and allow it to idle.
2. Check to see if the brake system warning lamp remains illuminated.
3. If the brake system warning lamp remains illuminated, DO NOT proceed to test drive the vehicle until it is diagnosed and repaired. Refer to **Symptoms - Hydraulic Brakes**.
4. Select a smooth, dry, clean and level road or large lot that is as free of traffic and obstacles as possible for brake system low speed road testing.
5. With the transmission in PARK, lightly apply the brake pedal. Observe both the pedal feel and the pedal travel.
6. If the brake pedal apply felt spongy, or the pedal travel was excessive, DO NOT drive the vehicle until it is repaired.
7. If the brake pedal apply did not feel spongy and the pedal travel was not excessive, proceed to step 8.
8. Release and apply the brakes.
9. While continuing to apply the brakes, shift the transmission into DRIVE, release the brakes and allow the engine to idle the vehicle away from the stopped position. Observe for a slow release of the brake system.
10. With the aid of an assistant to observe the vehicle's performance from outside of the vehicle, drive the vehicle at a low speed and lightly apply the brakes while driving past the assistant. Have the assistant observe for brake system noise from the side of the vehicle closest to them, while you observe both the pedal effort and the pedal travel.
11. If the brake pedal apply effort was excessive, or the pedal travel was excessive, DO NOT continue to test drive the vehicle until it is repaired.

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

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

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

BRAKE PEDAL TRAVEL MEASUREMENT AND INSPECTION

Tools Required

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

Measurement and Inspection

1. With the ignition OFF and the brakes cool, apply the brakes 3-5 times, or until the brake pedal becomes firm, in order to deplete the brake booster power reserve.
2. Install the **J 28662** to the brake pedal. See **Special Tools**.

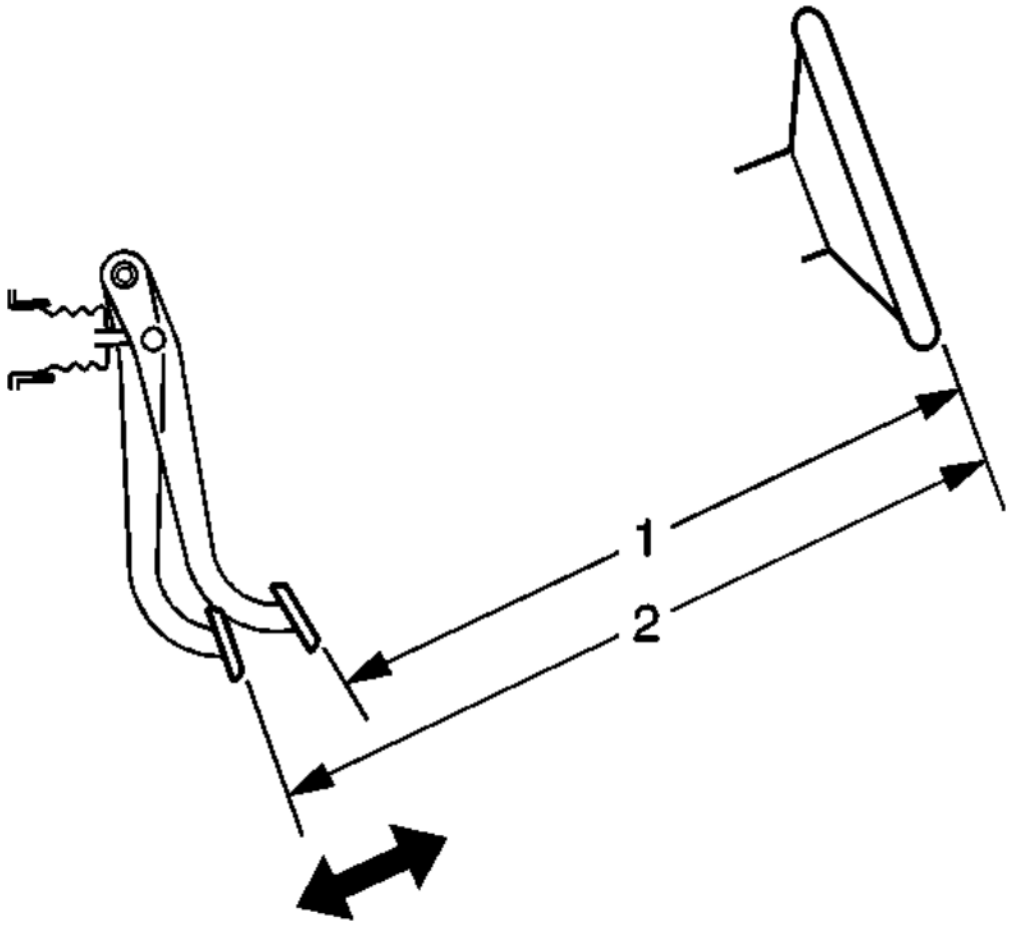


Fig. 2: Measuring Brake Pedal Travel
Courtesy of GENERAL MOTORS CORP.

3. Measure and record the distance (1) from the brake pedal to the rim of the steering wheel; note the points of measurement.
4. Apply and maintain the brakes with 445 N (100 lb) of force to the brake pedal, as indicated on the **J 28662** . See **Special Tools**.
5. While maintaining 445 N (100 lb) of force to the brake pedal, measure and record the distance (2) from the same point on the brake pedal to the same point on the rim of the steering wheel.
6. Release the brakes and repeat steps 4 and 5 to obtain a second measurement. After obtaining

a second measurement, proceed to step 7.

7. Average the first and second measurements recorded during the two applies of the brakes.
8. Subtract the initial measurement, unapplied (1), from the averaged, applied measurement (2) to obtain the brake pedal travel distance.

Specification:

- Vacuum assist equipped, maximum brake pedal travel (measured with the ignition OFF, brake booster power assist depleted, and the brakes cool): 60 mm (2.36 in)
- 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)

BRAKE SYSTEM VACUUM SOURCE TEST

IMPORTANT:

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

1. Disconnect the engine vacuum hose from the vacuum brake booster check valve.
2. Install a vacuum gage to the engine vacuum hose.
3. Start the engine and allow the engine to idle until normal operating temperatures are reached.
4. With the vehicle in PARK, the engine idling, and the air conditioning (A/C) system OFF, check to see if the engine vacuum reading is within the specified normal engine vacuum range.

Specification: 47-68 kPa (14-20 in Hg)

5. Turn the ignition OFF.
6. If the engine vacuum reading is within the specified normal range, proceed to step 10.
7. If the engine vacuum reading is NOT within the specified normal range, inspect the engine vacuum hose for the following conditions:
   - Loose connection to the engine
   - Collapse, deformation or contamination
   - Cracks, cuts, dry-rot
8. If any of these conditions were found with the engine vacuum hose, replace the hose, then

repeat steps 2-4.

9. If none of these conditions were found with the engine vacuum hose, then there is an engine vacuum source problem, check the engine vacuum system.
10. Remove the vacuum brake booster check valve from the booster.
11. Install the check valve to the engine vacuum hose.
12. Install the vacuum gage to the check valve.
13. Start the engine and allow the engine to idle in PARK with the A/C system OFF, until normal operating temperatures are reached.
14. Turn the ignition OFF.
15. Check to see if the engine vacuum reading is maintained within the specified normal engine vacuum range.

    Specification: 47-68 kPa (14-20 in Hg)

16. If the engine vacuum reading is maintained within the specified normal range, proceed to step 18.
17. If the engine vacuum reading is NOT maintained within the specified normal range, replace the brake booster check valve, then repeat steps 11-15.
18. Inspect the brake booster check valve grommet for the following conditions:
    - Loose connection to the vacuum brake booster
    - Deformation or contamination
    - Cracks, cuts, dry-rot
19. If any of these conditions were found with the check valve grommet, replace the grommet.

HYDRAULIC BRAKE ASSIST SYSTEM NOISE INSPECTION

Tools Required

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

Inspection

1. Install the **J 28662** to the brake pedal. See **Special Tools**.
2. Start the engine and allow it to idle. Ensure that the wheels are directed straight ahead.
3. Apply and maintain the brakes with 111 N (25 lb) of force to the brake pedal, as indicated on the **J 28662** . See **Special Tools**. Observe for noises.
4. Quickly release the brakes. Observe for noises.

5. If chatter and/or a vibration of the brake pedal was apparent during the brake system apply of 111 N (25 lb) of force, the power steering pump drive belt not may have proper tension or may be excessively worn.
6. If any significant noise was apparent during the quick release of the brakes following the brake system apply of 111 N (25 lb) of force, there is likely a restriction in the hydraulic brake booster power steering return hose.

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

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

BRAKE SYSTEM EXTERNAL LEAK INSPECTION

CAUTION: Refer to Brake Fluid Irritant Caution .

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

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

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

2. If the fluid level is abnormally low, adjust the brake fluid level. Refer to **Master Cylinder Reservoir Filling**.
3. Start the engine and allow it to idle.

4. Apply constant, moderate foot pressure to the brake pedal.

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

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

BRAKE SYSTEM INTERNAL LEAK TEST

CAUTION: Refer to Brake Fluid Irritant Caution .

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

1. Start the engine and allow it to idle.
2. Apply light, steady pressure to the brake pedal. Observe both the brake pedal feel and travel.
3. Release the brakes and turn OFF the ignition.
4. If the brake pedal apply felt spongy, but the brake pedal travel was not excessive, perform the following steps:
   1. Inspect the brake system for external leaks. Refer to **Brake System External Leak Inspection** .

2. Pressure bleed the brake system in order to purge any air that may be trapped in the system. Refer to **Hydraulic Brake System Bleeding (Pressure)Hydraulic Brake System Bleeding (Manual)** .

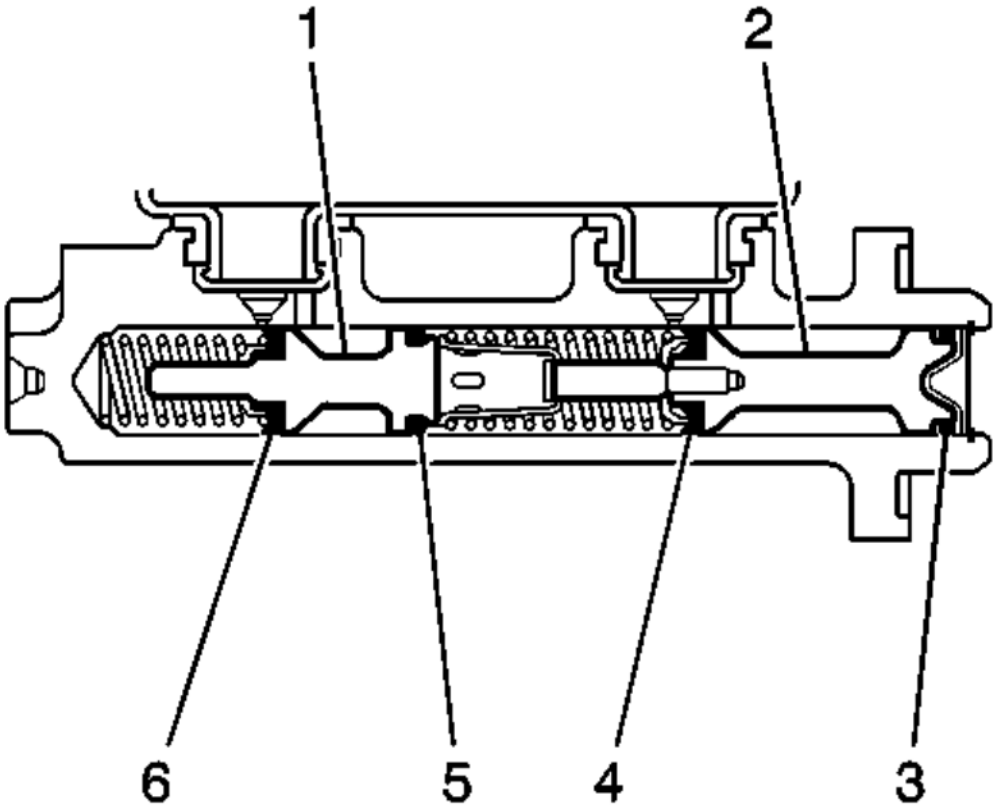


Fig. 3: Cross Sectional View Of Brake Master Cylinder
Courtesy of GENERAL MOTORS CORP.

5. If the brake pedal apply did not feel spongy, but the brake pedal travel was excessive, perform the following steps:
    1. Loosen the master cylinder-to-brake power booster mounting nuts.
    2. Carefully pull the master cylinder away from the brake power booster just enough to inspect the mounting surface of the master cylinder.
    3. Inspect the master cylinder mounting surface at the primary piston (2) for brake fluid

leaks.

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

HYDRAULIC BRAKE COMPONENT OPERATION VISUAL INSPECTION

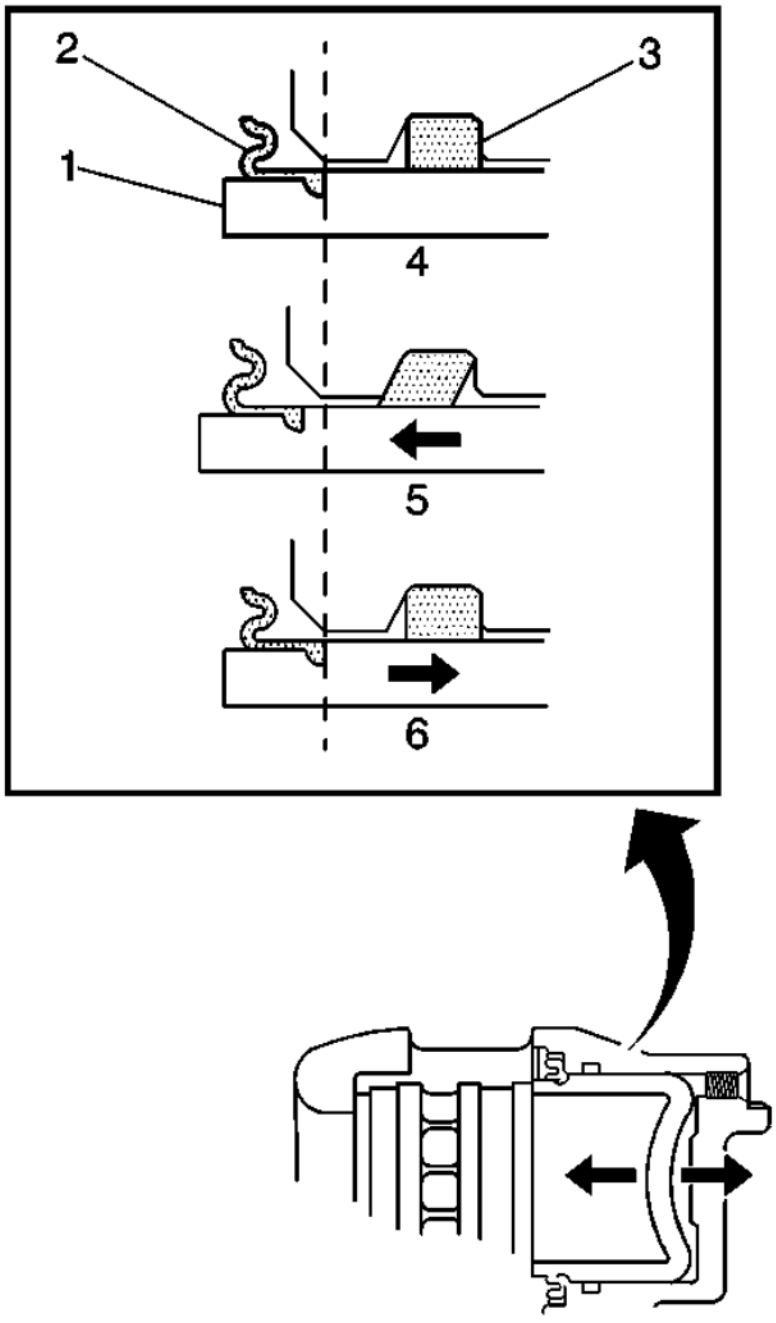


Fig. 4: Identifying Brake Caliper/Pad Inspection Areas
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Brake Fluid Irritant Caution .

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

1. With the tire and wheel assemblies removed and the brake rotors retained by wheel lug nuts, visually inspect the caliper piston dust boot (2) sealing area to ensure that there are no brake fluid leaks.
2. If any evidence of a brake fluid leak is present, the brake caliper requires overhaul or replacement.
3. While the brake system is at rest (4), observe the position of the caliper piston (1) in relation to the caliper housing.
4. Have an assistant apply and release the brake pedal several times while you observe the operation of the hydraulic brake caliper.
    1. Observe the caliper piston (1) for unrestricted and even movement during each apply of the brake system (5).
    2. Observe the caliper piston (1) for an unrestricted and even return motion during each release of the brake system (6).
5. If the caliper piston (1) did not exhibit unrestricted and even movement during brake system apply and/or release, the piston square seal (3) may be worn or damaged and the caliper may require overhaul or replacement.

BRAKE PIPE AND HOSE INSPECTION

CAUTION: Refer to Brake Fluid Irritant Caution .

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

1. Visually inspect all of the brake pipes for the following conditions:
    - Kinks, improper routing, missing or damaged retainers
    - Leaking fittings, excessive corrosion
2. If any of the brake pipes exhibited any of the conditions listed, then the identified pipe, or pipes, require replacement.
3. Ensure that the vehicle axles are properly supported at ride height in order to maintain the proper relationship of the flexible brake hoses to the chassis.

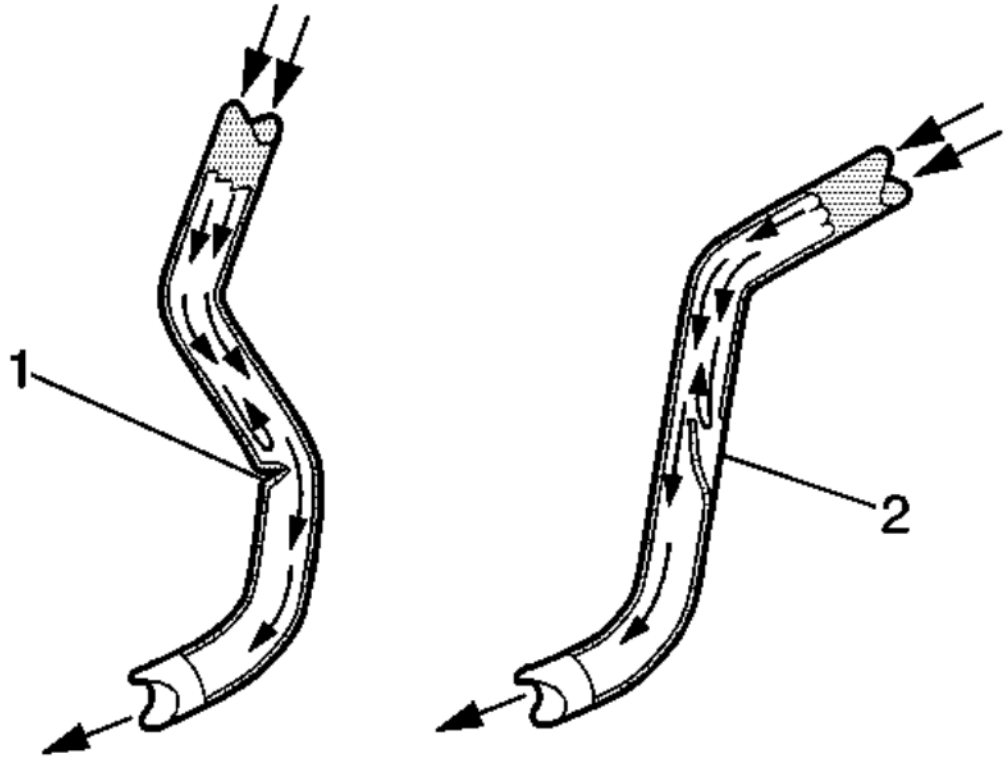


Fig. 5: Identifying Flexible Brake Hose Failure Conditions
Courtesy of GENERAL MOTORS CORP.

4. Visually inspect all of the flexible brake hoses for the following conditions:
   - Kinks (1), improper routing, twists, chafing, missing or damaged retainers
   - Leaking connections, cracking, dry-rot, blisters, bulges
5. If any of the flexible brake hoses exhibited any of the conditions listed, then the identified flexible brake hose, or hoses require replacement.
6. Squeeze the flexible brake hoses with firm finger pressure to check for soft spots (2), indicating an internal restriction. Check the entire length of each flexible brake hose.
7. If any of the flexible brake hoses were found to have soft spots (2), then the identified flexible brake hose, or hoses require replacement.

BRAKE PEDAL PUSHROD INSPECTION

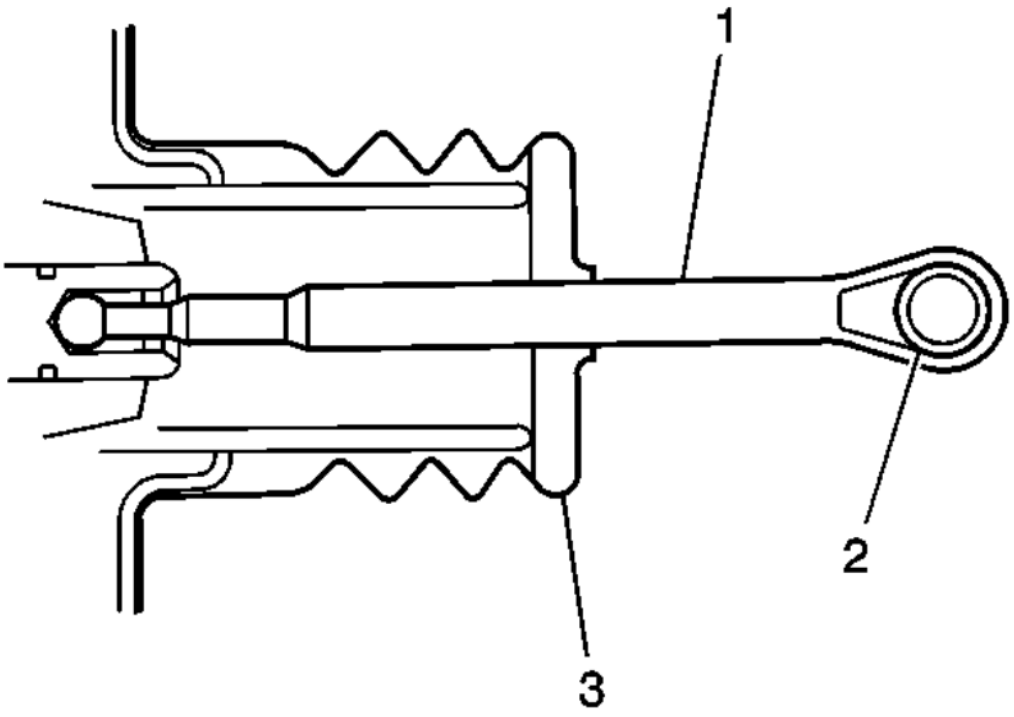


Fig. 6: View of Brake Pedal Pushrod
Courtesy of GENERAL MOTORS CORP.

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

REPAIR INSTRUCTIONS

MASTER CYLINDER RESERVOIR FILLING

CAUTION: Refer to Brake Fluid Irritant Caution .

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

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

1. Visually inspect the brake fluid level through the brake master cylinder reservoir.
2. If the brake fluid level is at or below the half-full point during routine fluid checks, the brake system should be inspected for wear and possible brake fluid leaks.
3. If the brake fluid level is at or below the half-full point during routine fluid checks, and an inspection of the brake system did not reveal wear or brake fluid leaks, the brake fluid may be topped-off up to the maximum-fill level.
4. If brake system service was just completed, the brake fluid may be topped-off up to the maximum-fill level.
5. If the brake fluid level is above the half-full point, adding brake fluid is not recommended under normal conditions.
6. If brake fluid is to be added to the master cylinder reservoir, clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm. Use only Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container.

MASTER CYLINDER RESERVOIR REPLACEMENT (JD9, JF3, JF7)

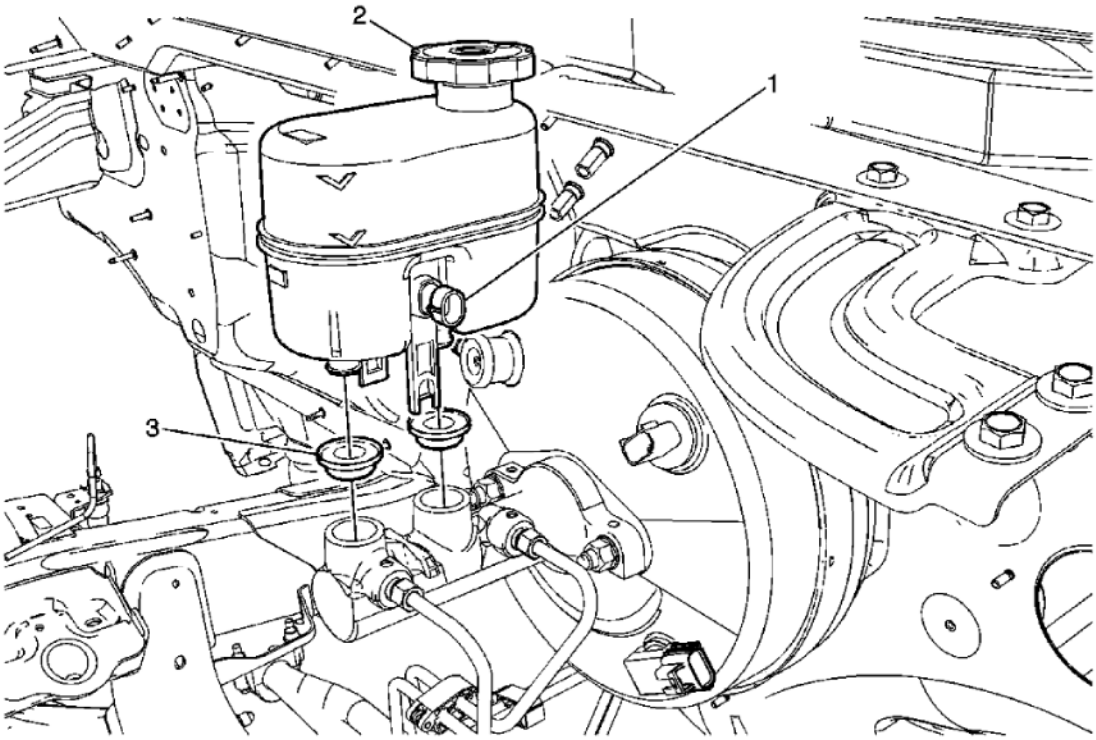


Fig. 7: Master Cylinder Reservoir Replacement (JD9, JF3, JF7)
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
CAUTION: **Refer to Brake Fluid Irritant Caution .** **NOTE:** **Refer to Brake Fluid Effects on Paint and Electrical Components Notice .** **Preliminary Procedures** 1. Using a suitable tool, remove the brake fluid from the brake master cylinder reservoir. 2. Discard the brake fluid into an approved container.	
1	Master Cylinder Fluid Level Sensor Electrical Connector
2	Master Cylinder Reservoir **Procedure:** Carefully spread the 2 locking tabs and lift the master cylinder reservoir upward.
	Master Cylinder Reservoir Seals (Qty: 2)

3	**Tip:** Lubricate the 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.

MASTER CYLINDER RESERVOIR REPLACEMENT (JH6, JH7)

Removal Procedure

CAUTION: Refer to Brake Fluid Irritant Caution .

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

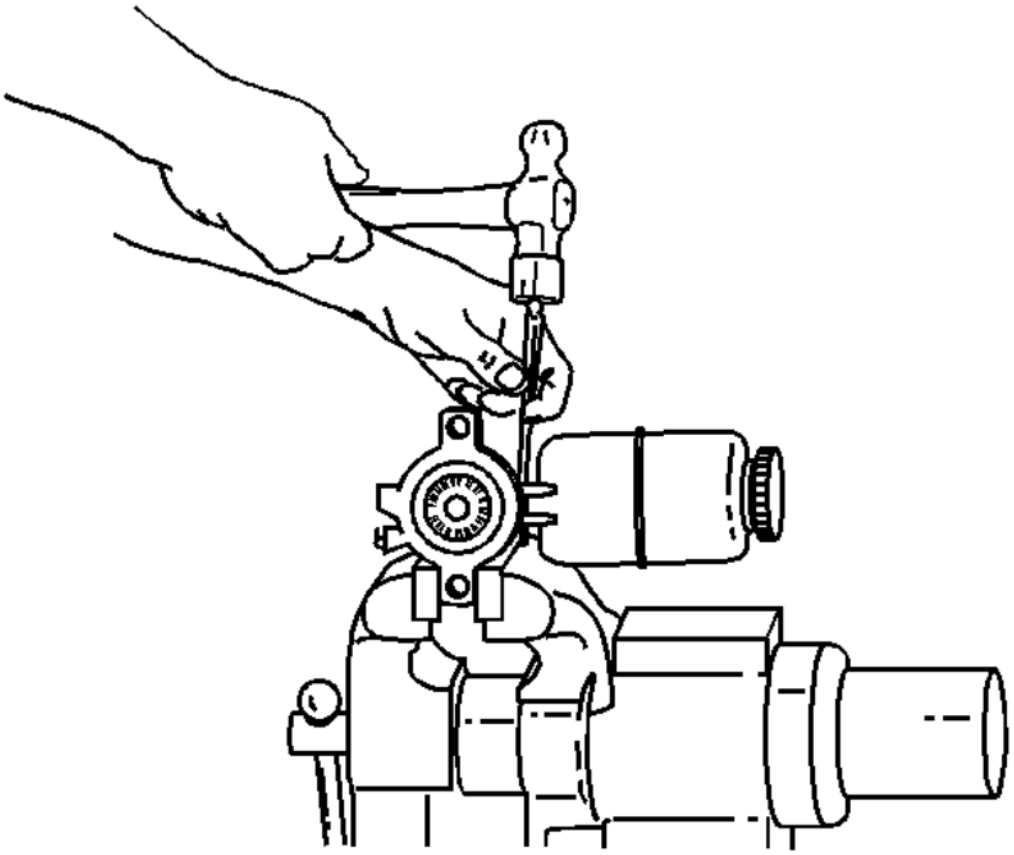


Fig. 8: Master Cylinder Reservoir Retaining Pins
Courtesy of GENERAL MOTORS CORP.

1. Apply the park brake and block the wheels.
2. Remove the master cylinder. Refer to **Master Cylinder Replacement (JD9, JF3, JF7)** or **Master Cylinder Replacement (JH6, JH7)**.
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.

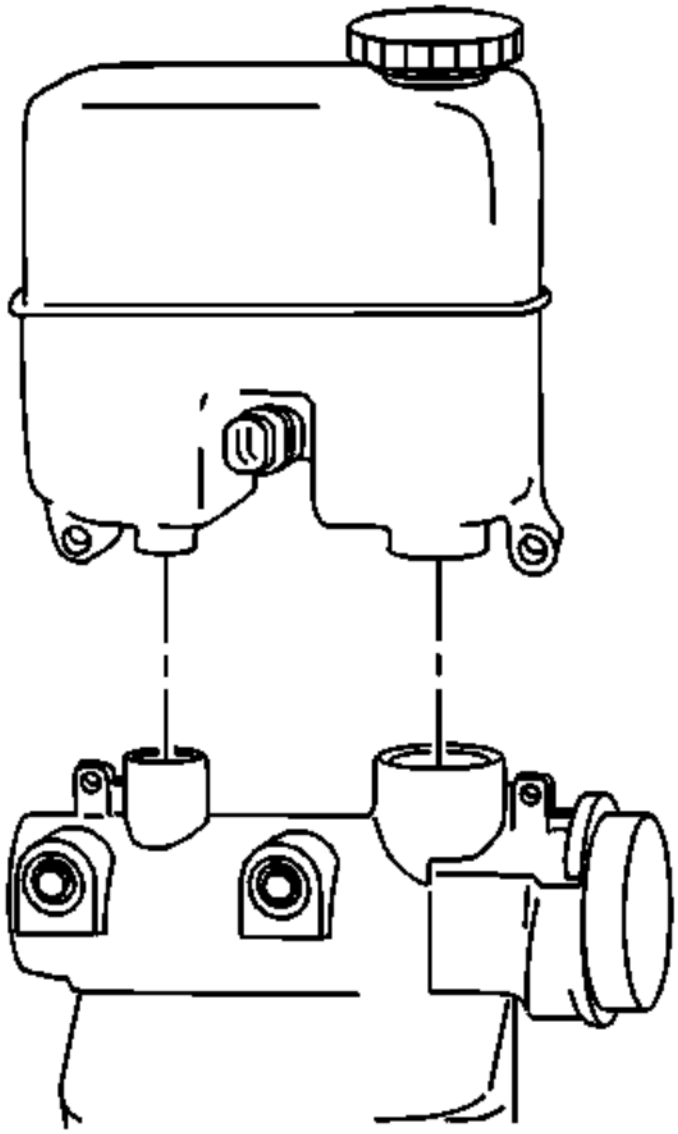


Fig. 9: Reservoir & Master Cylinder
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

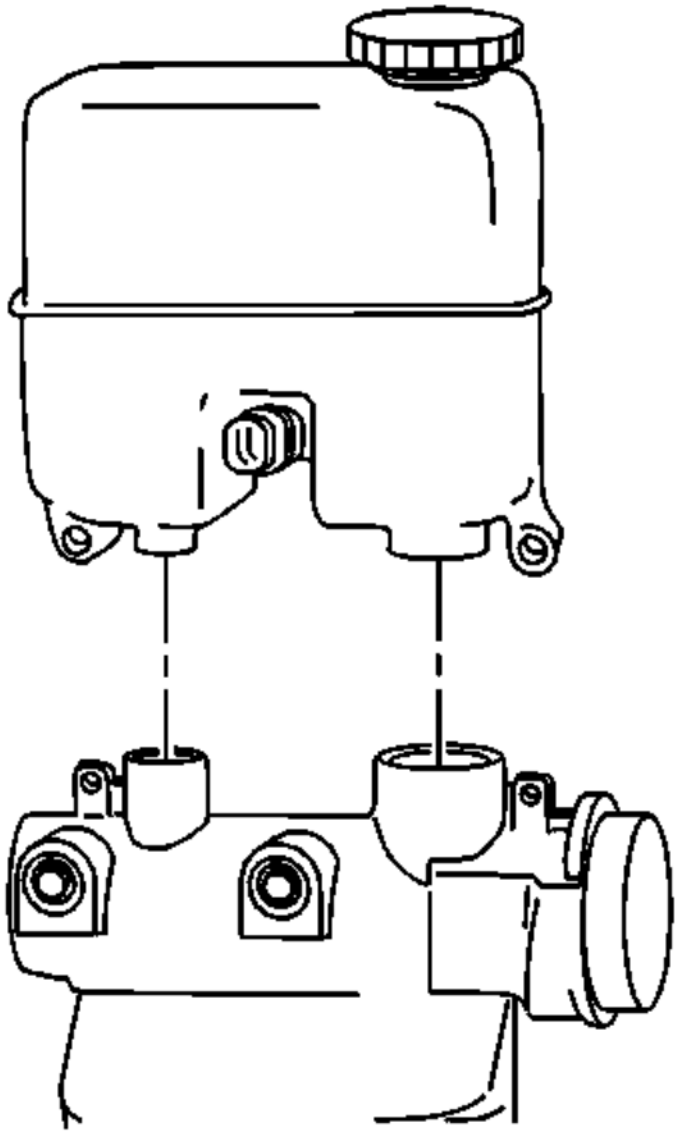


Fig. 10: Reservoir & Master Cylinder
Courtesy of GENERAL MOTORS CORP.

1. Inspect the reservoir for cracks or deformation. If found, replace the reservoir.

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

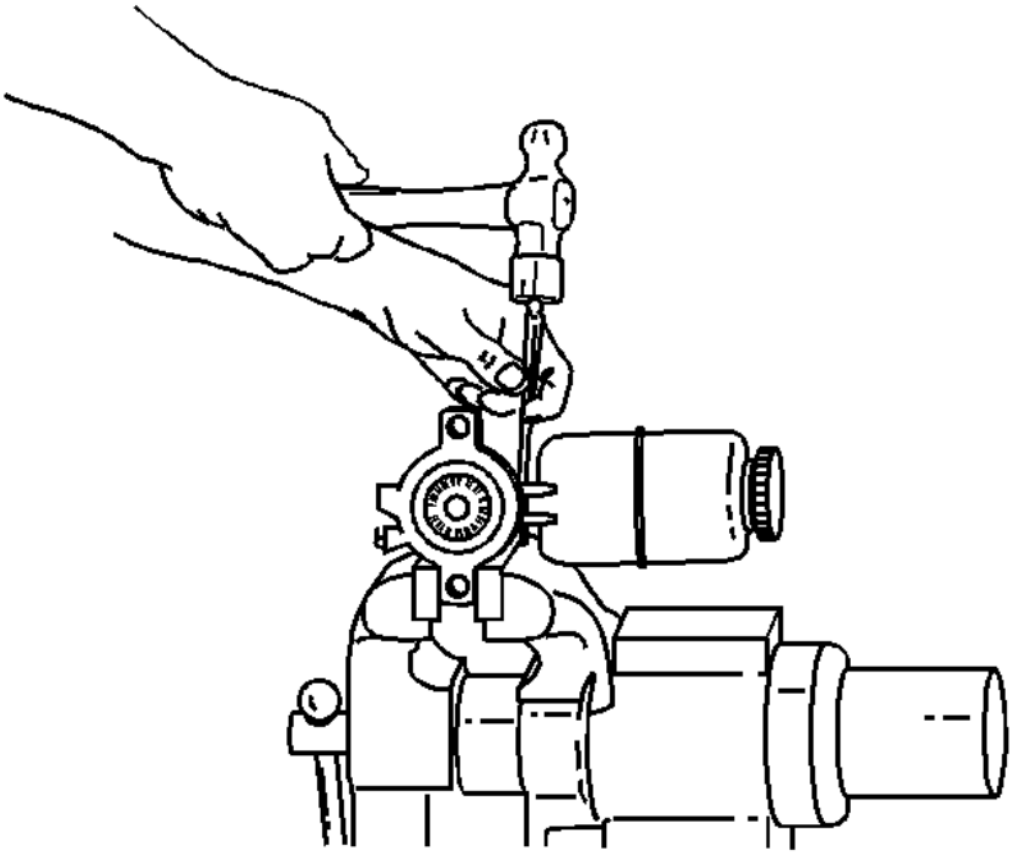


Fig. 11: Master Cylinder Reservoir Retaining Pins
Courtesy of GENERAL MOTORS CORP.

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

8. Place the brake fluid level sensor into the reservoir, press into place to secure the sensor retaining tabs.
9. Remove the master cylinder from the vice.
10. Install the master cylinder. Refer to **Master Cylinder Replacement (JD9, JF3, JF7)** or **Master Cylinder Replacement (JH6, JH7)**.
11. Release the park brake.
12. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Pressure)** or **Hydraulic Brake System Bleeding (Manual)**.

MASTER CYLINDER REPLACEMENT (JD9, JF3, JF7)

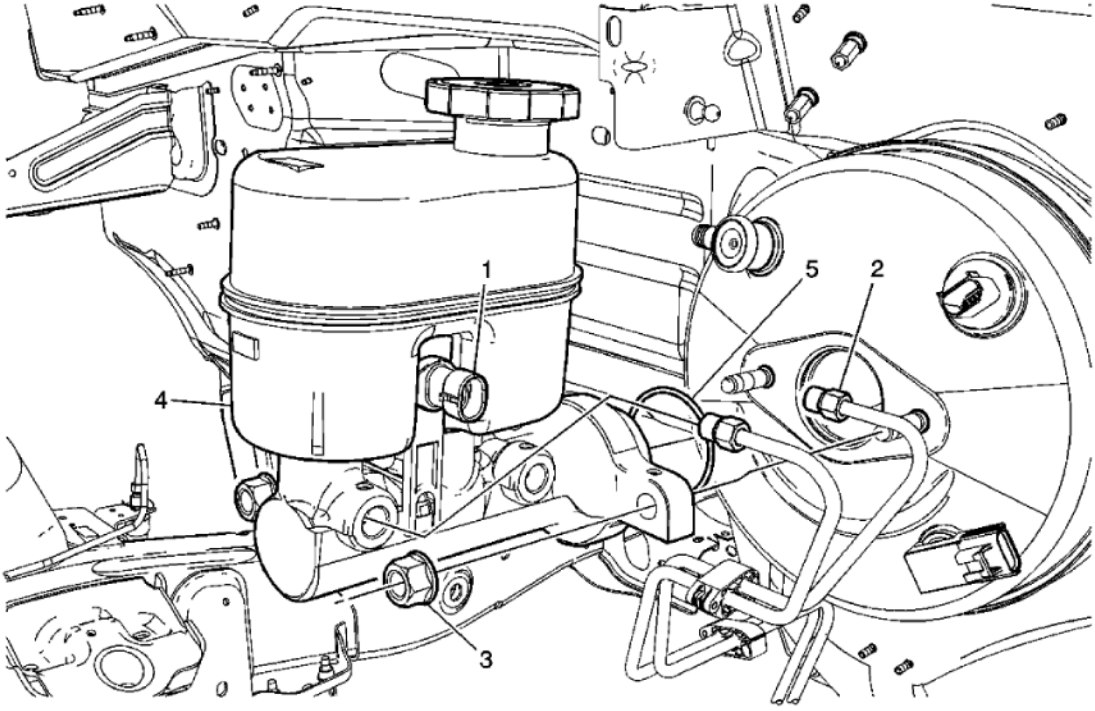


Fig. 12: Master Cylinder Replacement (JD9, JF3, JF7)
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
CAUTION: Refer to Brake Fluid Irritant Caution . **NOTE:** Refer to Brake Fluid Effects on Paint and Electrical Components Notice .	

Preliminary Procedures

1. With the engine OFF, apply the brake pedal several times until the brake pedal becomes firm to deplete the vacuum brake booster vacuum reserve.
2. Using a suitable tool, remove the brake fluid from the brake master cylinder reservoir.
3. Discard the brake fluid into an approved container.

1	Master Cylinder Fluid Level Sensor Electrical Connector
2	Brake Pipe Fitting (Qty: 2) **NOTE:** **Refer to Fastener Notice .** **Procedure** 1. Remove any dirt or debris from the brake pipe fitting. 2. Cap the brake pipe fittings to prevent brake fluid loss and contamination. **Tighten:** 25 N.m (18 lb ft)
3	Brake Master Cylinder Nut (Qty: 2) **Tighten:** 33 N.m (24 lb ft)
4	Brake Master Cylinder Assembly
5	Brake Master Cylinder to Vacuum Booster Seal **Procedure** 1. Inspect the brake master cylinder to vacuum booster seal for damage and replace if necessary. 2. Ensure the brake master cylinder to vacuum booster seal is properly seated against the base of the brake master cylinder. Do not place the brake master cylinder to vacuum booster seal in the groove of the master cylinder body. 3. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Pressure)** or **Hydraulic Brake System Bleeding (Manual)**.

MASTER CYLINDER REPLACEMENT (JH6, JH7)

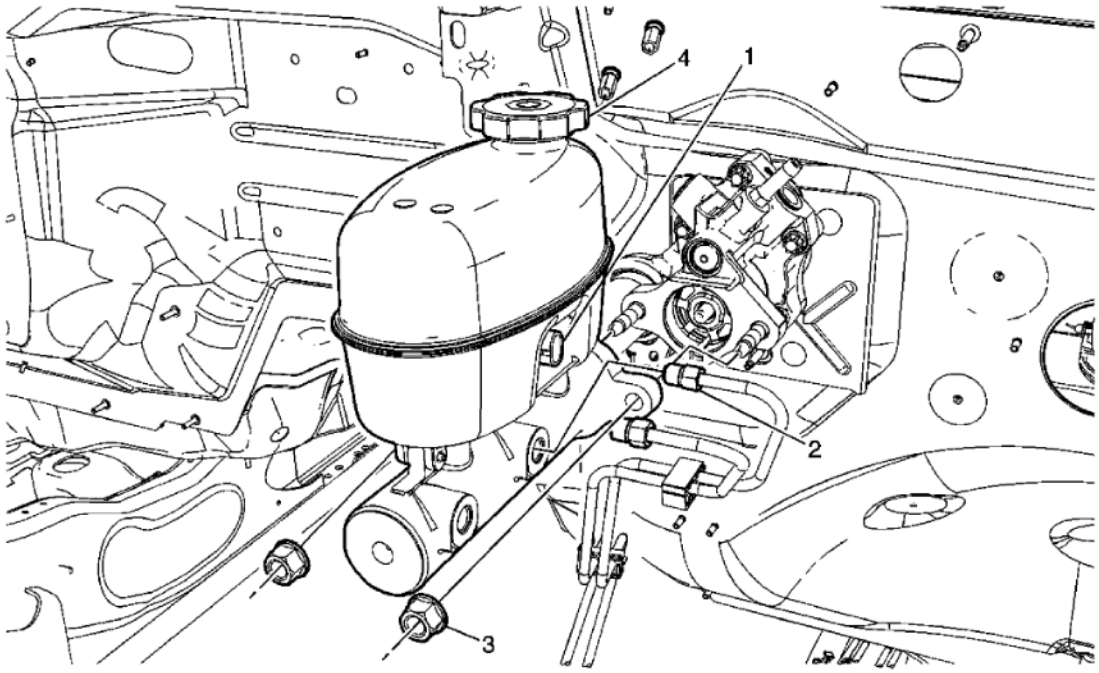


Fig. 13: Master Cylinder Replacement (JH6, JH7)
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
CAUTION: **Refer to Brake Fluid Irritant Caution .** **NOTE:** **Refer to Brake Fluid Effects on Paint and Electrical Components Notice .** **Preliminary Procedures** 1. Using a suitable tool, remove the brake fluid from the brake master cylinder reservoir. 2. Discard the brake fluid into an approved container.	
1	Master Cylinder Fluid Level Sensor Electrical Connector
2	Brake Pipe Fitting (Qty: 2) **NOTE:** **Refer to Fastener Notice .** **Procedure**

	1. Remove any dirt or debris from the brake pipe fitting. 2. Cap the brake pipe fittings to prevent brake fluid loss and contamination. **Tighten:** 25 N.m (18 lb ft)
3	Brake Master Cylinder Nut (Qty: 2) **Tighten:** 33 N.m (24 lb ft)
4	Brake Master Cylinder Assembly **Procedure** 1. Remove and discard the push-on nuts on the master cylinder mounting studs, if equipped. 2. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Pressure)** or **Hydraulic Brake System Bleeding (Manual)**.

MASTER CYLINDER BENCH BLEEDING

CAUTION: Refer to Brake Fluid Irritant Caution .

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

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

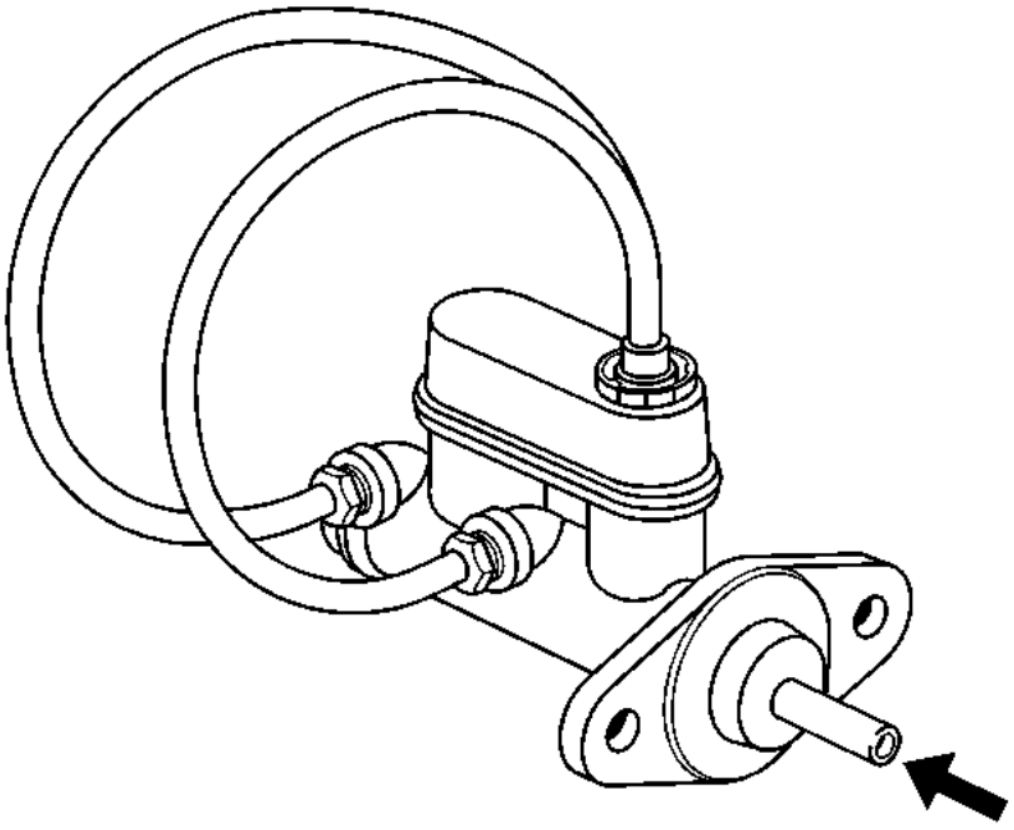


Fig. 14: Bleeding Master Cylinder
Courtesy of GENERAL MOTORS CORP.

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

6. Ensure that the ends of the transparent hoses running into the master cylinder reservoir are fully submerged in the brake fluid.
7. Using a smooth, round-ended tool, depress and release the primary piston as far as it will travel, a depth of about 25 mm (1 in), several times. Observe the flow of fluid coming from the ports.

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

8. Continue to depress and release the primary piston until fluid flows freely from the ports with no evidence of air bubbles.
9. Remove the transparent hoses from the master cylinder reservoir.
10. Install the master cylinder reservoir cap and diaphragm.
11. Remove the fittings with the transparent hoses from the master cylinder ports. Wrap the master cylinder with a clean shop cloth to prevent brake fluid spills.
12. Remove the master cylinder from the vise.

BRAKE FLUID LEVEL INDICATOR SWITCH REPLACEMENT (JD9, JF3, JF7)

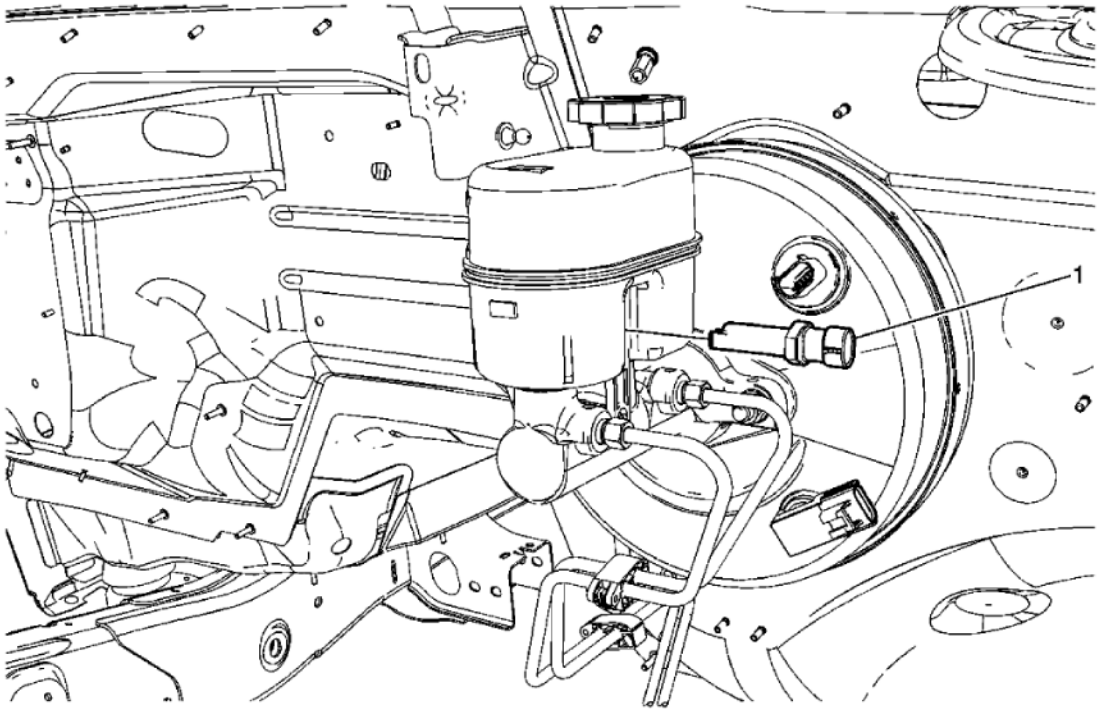


Fig. 15: Brake Fluid Level Indicator Switch Replacement (JD9, JF3, JF7)

Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Disconnect the master cylinder fluid level sensor electrical connector.	
1	Master Cylinder Fluid Level Sensor **Tip:** Compress the locking tabs on the sensor to release the sensor from the brake master cylinder reservoir.

BRAKE PEDAL ASSEMBLY REPLACEMENT

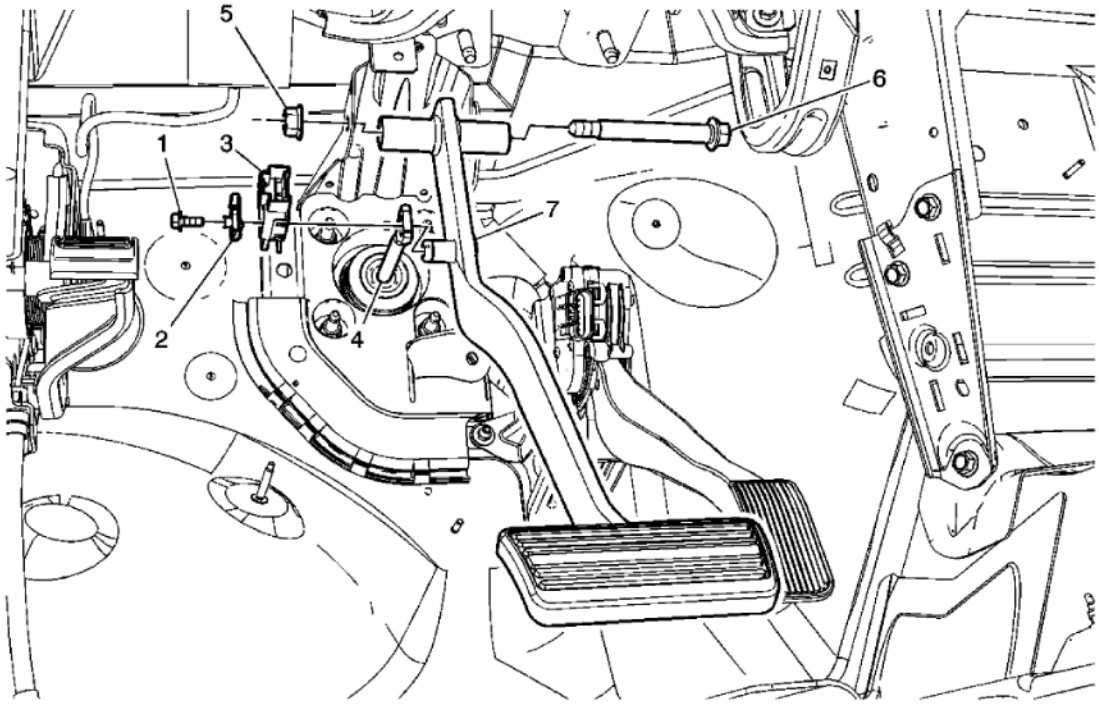


Fig. 16: Brake Pedal Assembly Replacement
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Apply the park brake.	
1	Brake Booster Pushrod Retainer Bolt **NOTE:** **Refer to Fastener Notice .**

	Tighten: 10 N.m (89 lb in)
2	Brake Booster Pushrod Retainer **Procedure:** After installing the retainer to the pushrod pin on the brake pedal, rotate the retainer 360 degrees to ensure it is seated properly before tightening the retainer bolt.
3	Stoplamp Switch
4	Brake Booster Pushrod **Procedure:** For reassembly, apply a thin coat of high temperature grease GM P/N 12345994 (Canadian P/N 10953501) to the pushrod pin on the brake pedal.
5	Brake Pedal Pivot Nut **Procedure:** Hold the brake pedal pivot bolt stationary and tighten the brake pedal pivot nut. **Tighten:** 35 N.m (26 lb ft)
6	Brake Pedal Pivot Bolt
7	Brake Pedal **Procedure** 1. If installing a new brake pedal pivot bushing, ensure the conical flange end of the bushing is on the inboard side of the pedal. 2. For reassembly, apply high temperature grease GM P/N 12345994 (Canadian P/N 10953501) to the ID of the brake pedal pivot bushing.

BRAKE PIPE REPLACEMENT

Tools Required

J 45405 Pipe Flaring Tool Kit. See **Special Tools**.

Replacement

CAUTION: Refer to Brake Fluid Irritant Caution .

CAUTION: Always use double walled steel brake pipe when replacing brake pipes. The use of any other pipe is not recommended

and may cause brake system failure. Carefully route and retain replacement brake pipes. Always use the correct fasteners and the original location for replacement brake pipes. Failure to properly route and retain brake pipes may cause damage to the brake pipes and cause brake system failure.

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

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

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

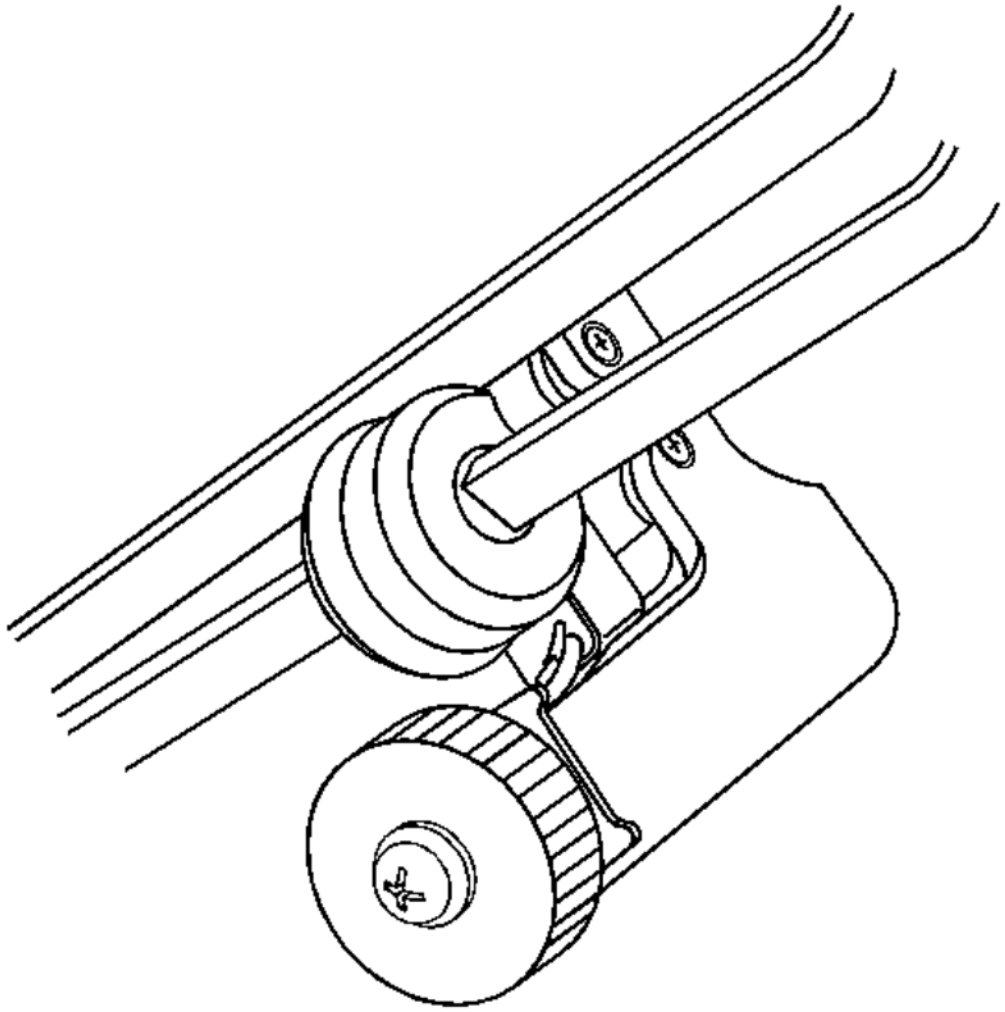


Fig. 17: Sectioning Brake Pipe Using Pipe Cutter
Courtesy of GENERAL MOTORS CORP.

1. Inspect the area of brake pipe to be repaired or replaced.
2. Release the brake pipe to be replaced from the retainers, as required.
3. Select an appropriate location to section the brake pipe, if necessary.
   - Allow adequate clearance in order to maneuver the **J 45405** . See **Special Tools**.
   - Avoid sectioning the brake pipe at bends or mounting points.

4. Using a string or wire, measure the length of the pipe to be replaced including all pipe bends.
5. Add to the measurement taken the appropriate additional length required for each flare to be created.

   Specification:

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

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

6. Using the pipe cutter included in the **J 45405** , carefully cut the brake pipe squarely to the measured length. See **Special Tools**.
7. Remove the sectioned brake pipe from the vehicle.
8. Select the appropriate size of brake pipe and tube nuts, as necessary. The brake pipe outside diameter determines brake pipe size.

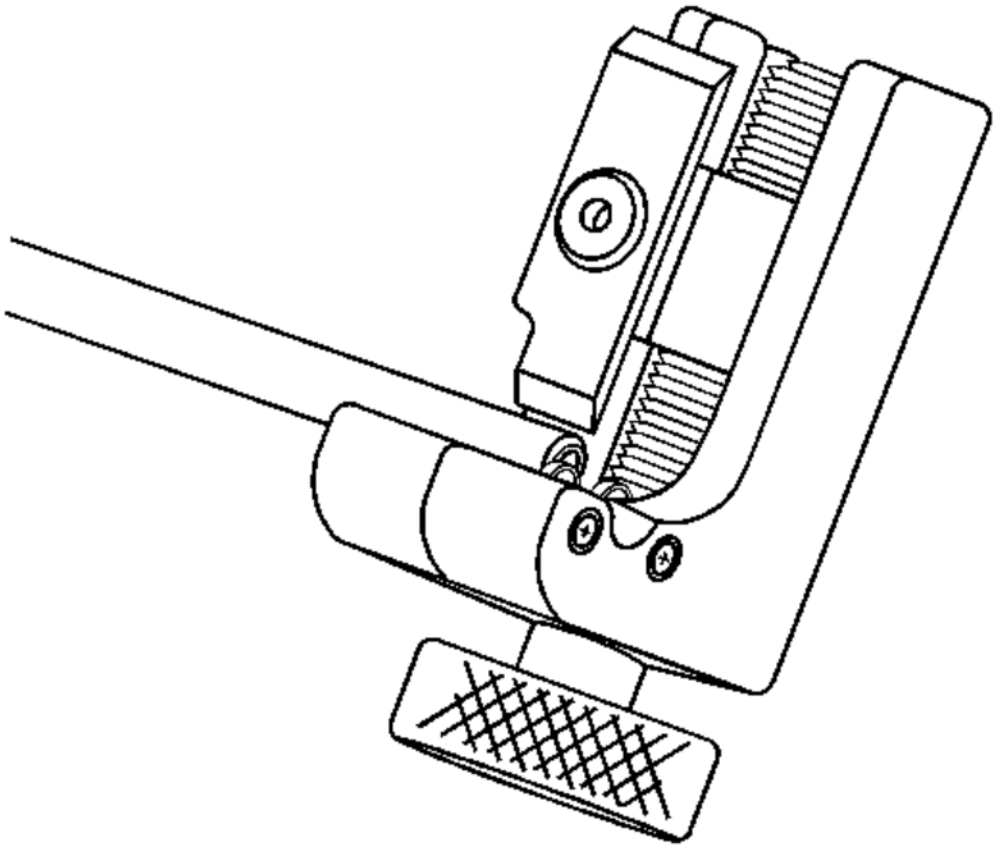


Fig. 18: Stripping Nylon Coating From Brake Pipe Ends
Courtesy of GENERAL MOTORS CORP.

9. Strip the nylon coating from the brake pipe end to be flared, if necessary.
   - Select the appropriate blade on the coating stripping tool included in the **J 45405** , by unthreading the blade block from the stripping tool and installing the block with the desired blade facing the tool rollers. See **Special Tools**.

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

- Insert the brake pipe end to be flared into the stripping tool to the depth of the ledge on the tool rollers.
- While holding the brake pipe firmly against the stripping tool roller ledges, rotate the thumbwheel of the tool until the blade contacts the brake pipe coated surface.

IMPORTANT: Do not gouge the metal surface of the brake pipe.

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

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

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

Specification:

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

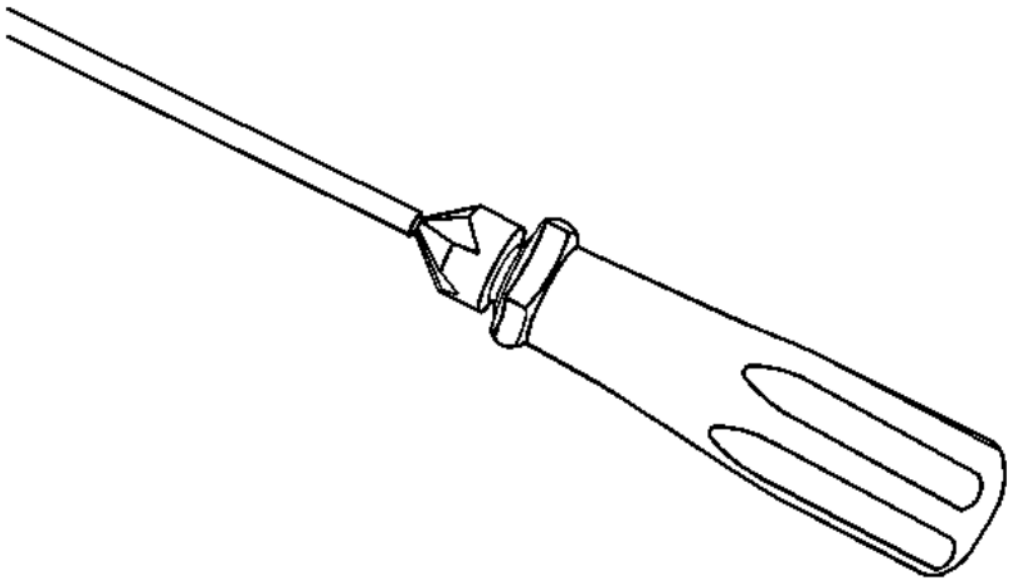


Fig. 19: Chamfering Pipe Using De-Burring Tool
Courtesy of GENERAL MOTORS CORP.

10. Chamfer the inside and outside diameter of the pipe with the de-burring tool included in the **J 45405** . See **Special Tools**.
11. Install the tube nuts on the brake pipe, noting their orientation.
12. Clean the brake pipe and the **J 45405** of lubricant, contaminants, and debris. See **Special Tools**.

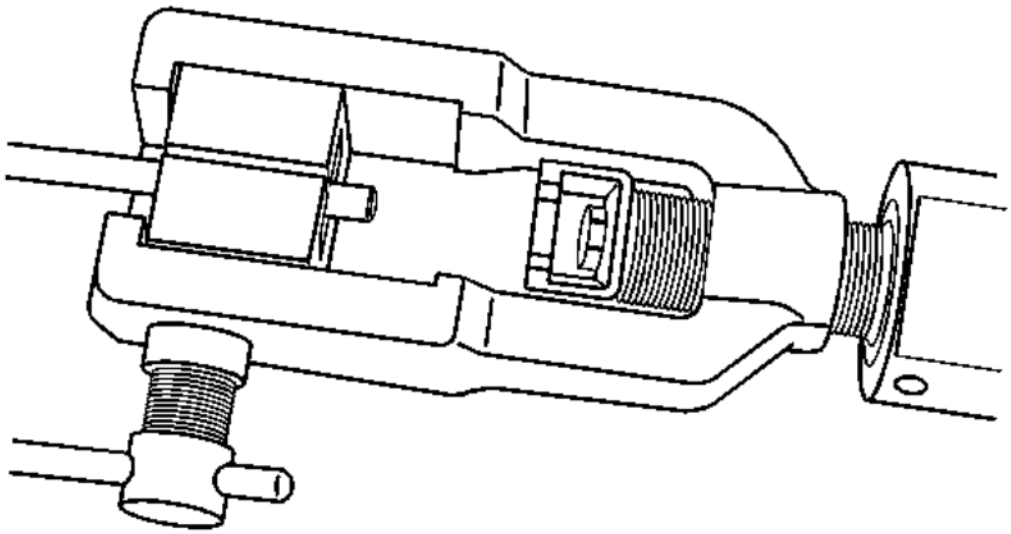


Fig. 20: Installing Die Halves Into Die Cage
Courtesy of GENERAL MOTORS CORP.

13. Loosen the die clamping screw of the **J 45405** . See **Special Tools**.
14. Select the corresponding die set and install the die halves into the die cage with the full, flat face of one die facing the clamping screw, and the counterbores of both dies facing the forming ram.

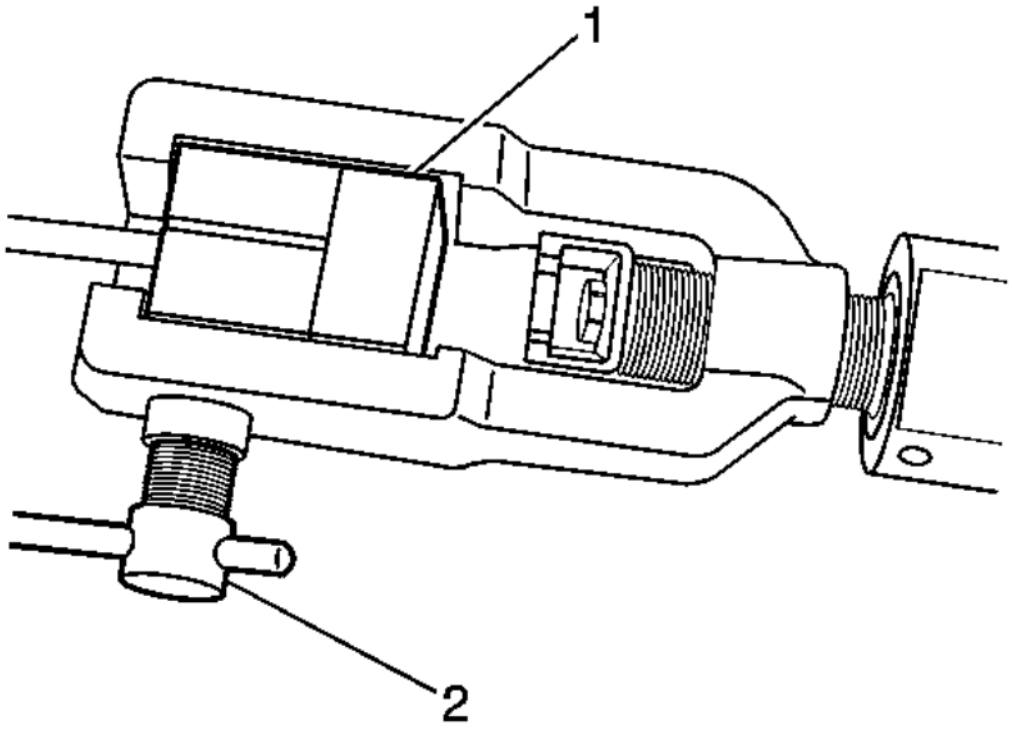


Fig. 21: View Of Clamping Screw & Unused Die
Courtesy of GENERAL MOTORS CORP.

15. Place the flat face of an unused die (1) against the die halves in the clamping cage and hold firmly against the counterbored face of the dies.
16. Insert the prepared end of the pipe to be flared through the back of the dies until the pipe is seated against the flat surface of the unused die (1).
17. Remove the unused die (1).
18. Ensure that the rear of both dies are seated firmly against the enclosed end of the die cage.
19. Firmly hand tighten the clamping screw (2) against the dies.

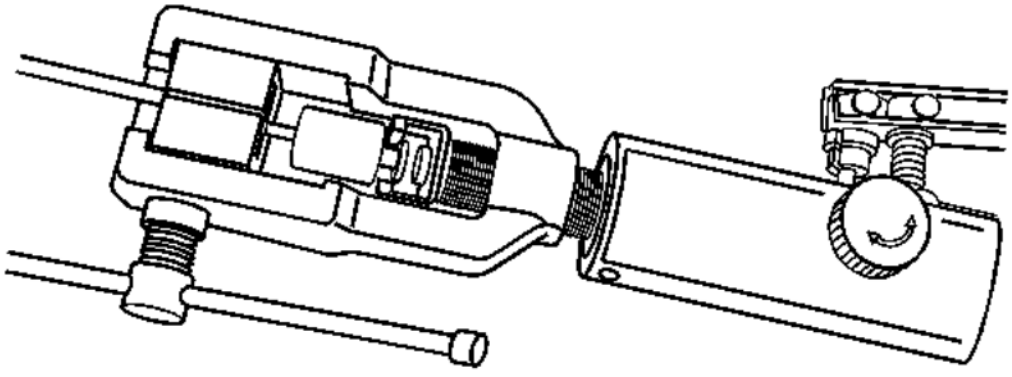


Fig. 22: Rotating J 45405 To Bottom Against Die Cage
Courtesy of GENERAL MOTORS CORP.

20. Select the appropriate forming mandrel and place into the forming ram.
21. Rotate the hydraulic fluid control valve clockwise to the closed position.
22. Rotate the body of the **J 45405** until it bottoms against the die cage. See **Special Tools**.

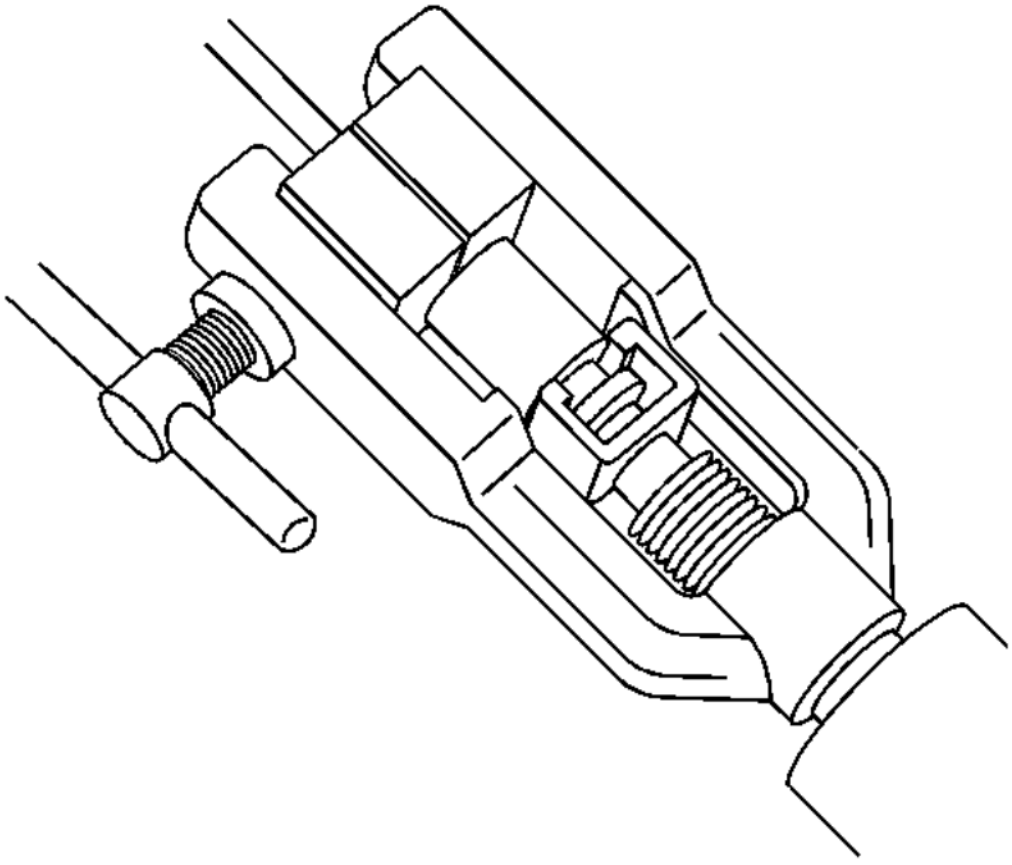


Fig. 23: Bottoming Forming Mandrel Against Clamping Dies Using Pipe Flaring Tool
Courtesy of GENERAL MOTORS CORP.

23. While guiding the forming mandrel into the exposed end of pipe to be flared, operate the lever of the **J 45405** until the forming mandrel bottoms against the clamping dies. See **Special Tools**.
24. Rotate the hydraulic fluid control valve counterclockwise to the open position to allow the hydraulic forming ram to retract.

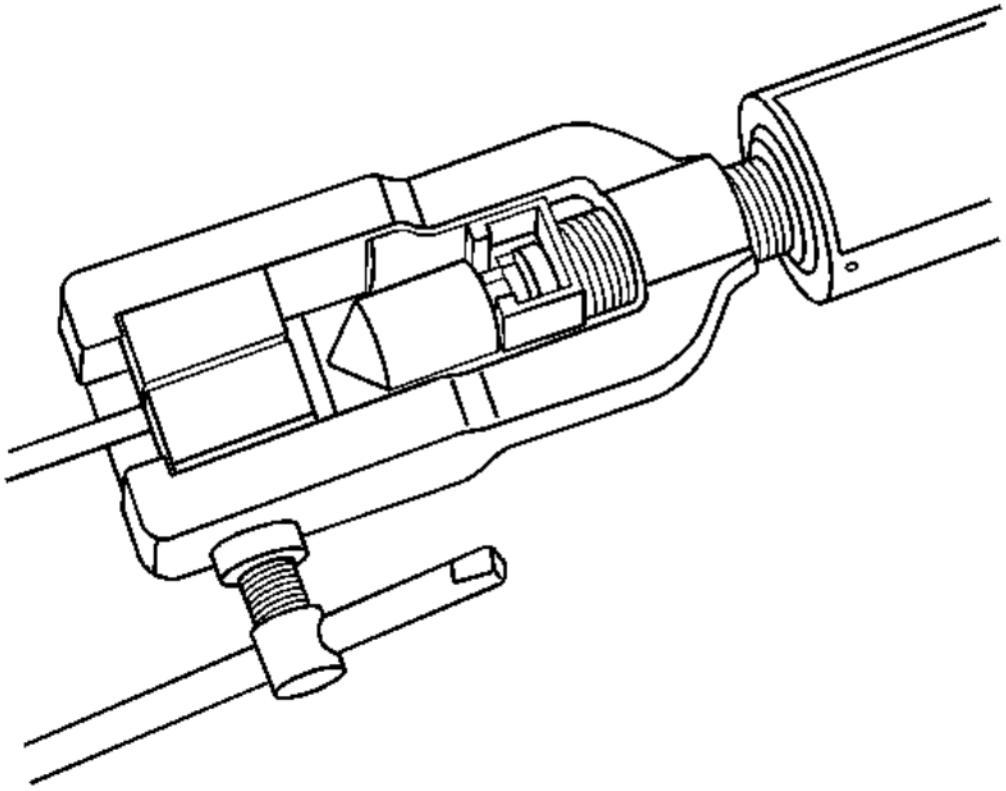


Fig. 24: Using Pipe Flaring Tool
Courtesy of GENERAL MOTORS CORP.

25. Insert the finishing cone into the forming ram.
26. Rotate the hydraulic fluid control valve clockwise to the closed position.
27. Rotate the body of the **J 45405** until it bottoms against the die cage. See **Special Tools**.
28. While guiding the finishing cone into the exposed end of pipe to be flared, operate the lever of the **J 45405** until the finishing cone bottoms against the dies. See **Special Tools**.
29. Rotate the hydraulic fluid control valve counterclockwise to the open position to allow the hydraulic forming ram to retract.
30. Loosen the die clamping screw and remove the dies and pipe.
31. If necessary, lightly tap the dies until the die halves separate.

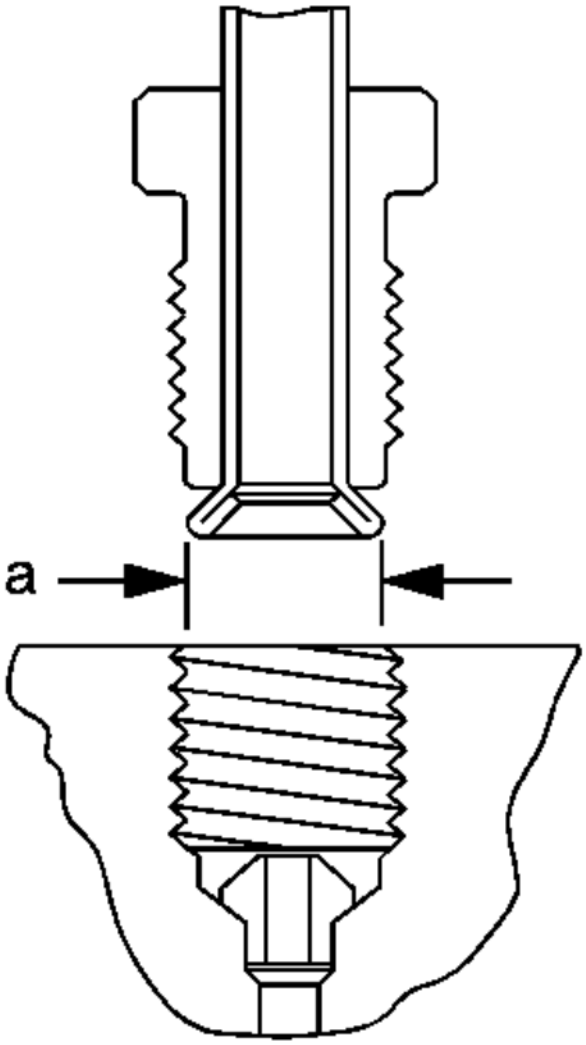


Fig. 25: Identifying Correct Brake Pipe Flare Shape & Diameter
Courtesy of GENERAL MOTORS CORP.

32. Inspect the brake pipe flare for correct shape and diameter (a).

Specification:

- 6.74-7.10 mm (0.265-0.279 in) flare diameter for 4.76 mm (3/16 in) diameter pipe
- 8.57-9.27 mm (0.344-0.358 in) flare diameter for 6.35 mm (1/4 in) diameter pipe

- 10.42-10.79 mm (0.410-0.425 in) flare diameter for 7.94 mm (5/16 in) diameter pipe

33. If necessary, using the removed section of brake pipe as a template, shape the new pipe with a suitable brake pipe bending tool.

IMPORTANT: When installing the pipe, maintain a clearance of 19 mm (3/4 in) from all moving or vibrating components.

34. Install the pipe to the vehicle with the appropriate brake pipe unions, as required.
35. If previously released, secure the brake pipe to the retainers.
36. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Pressure)** or **Hydraulic Brake System Bleeding (Manual)**.
37. With the aid of an assistant, inspect the brake pipe flares for leaks by starting the engine and applying the brakes.

FRONT BRAKE HOSE REPLACEMENT (JD9, JF3, JF7)

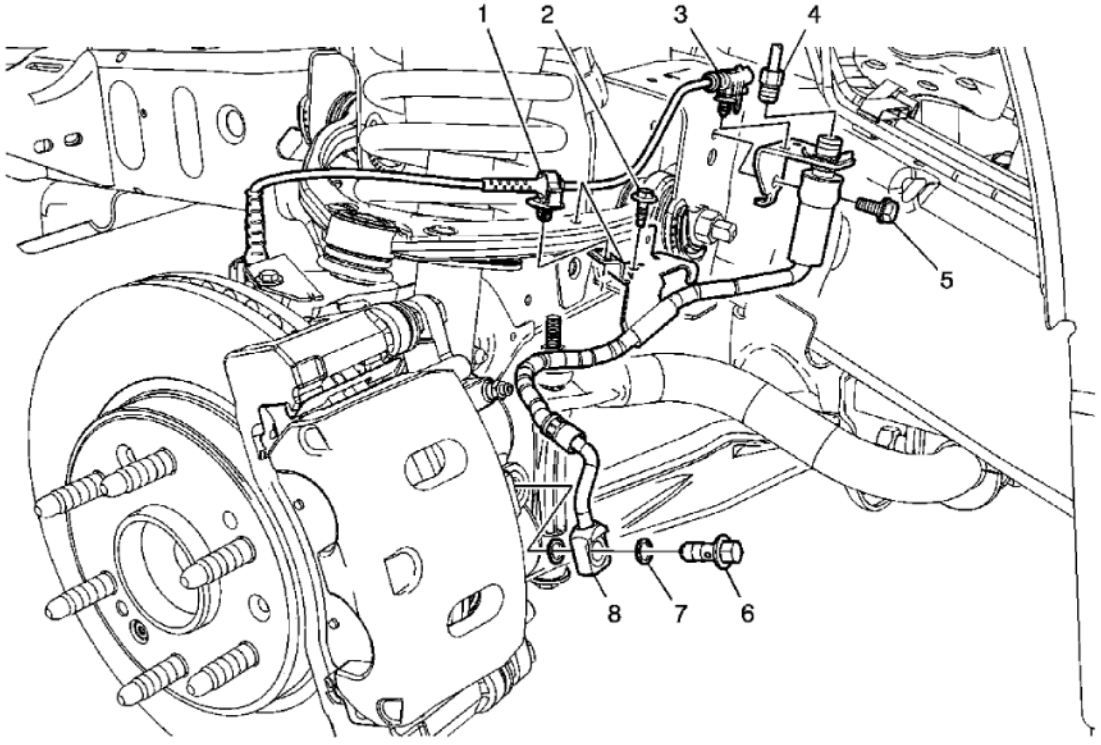


Fig. 26: Front Brake Hose Replacement (JD9, JF3, JF7)
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
CAUTION: Refer to **Brake Dust Caution** . **CAUTION:** Refer to **Brake Fluid Irritant Caution** . **Preliminary Procedures** 1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .	
1	Wheel Speed Sensor Wire Clip
2	Hose Bracket to Control Arm Bolt **NOTE:** Refer to **Fastener Notice** . **Tighten:** 9 N.m (80 lb in)
3	Wheel Speed Sensor Wire Clip
4	Brake Pipe Fitting **Procedure** 1. Remove any dirt or debris from the brake pipe fitting. 2. Cap the brake pipe fitting to prevent brake fluid loss and contamination. **Tighten:** 25 N.m (18 lb ft)
5	Hose Bracket to Frame Bolt **Tighten:** 9 N.m (80 lb in)
6	Brake Hose Fitting Bolt **Tighten:** 40 N.m (30 lb ft)
7	Brake Hose Fitting Gasket (Qty: 2) **Procedure** 1. Discard the brake hose fitting gaskets.

	2. Install 2 new brake hose fitting gaskets.
8	Brake Hose **Procedure:** Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Pressure)** or **Hydraulic Brake System Bleeding (Manual)**.

FRONT BRAKE HOSE REPLACEMENT (JH6, JH7)

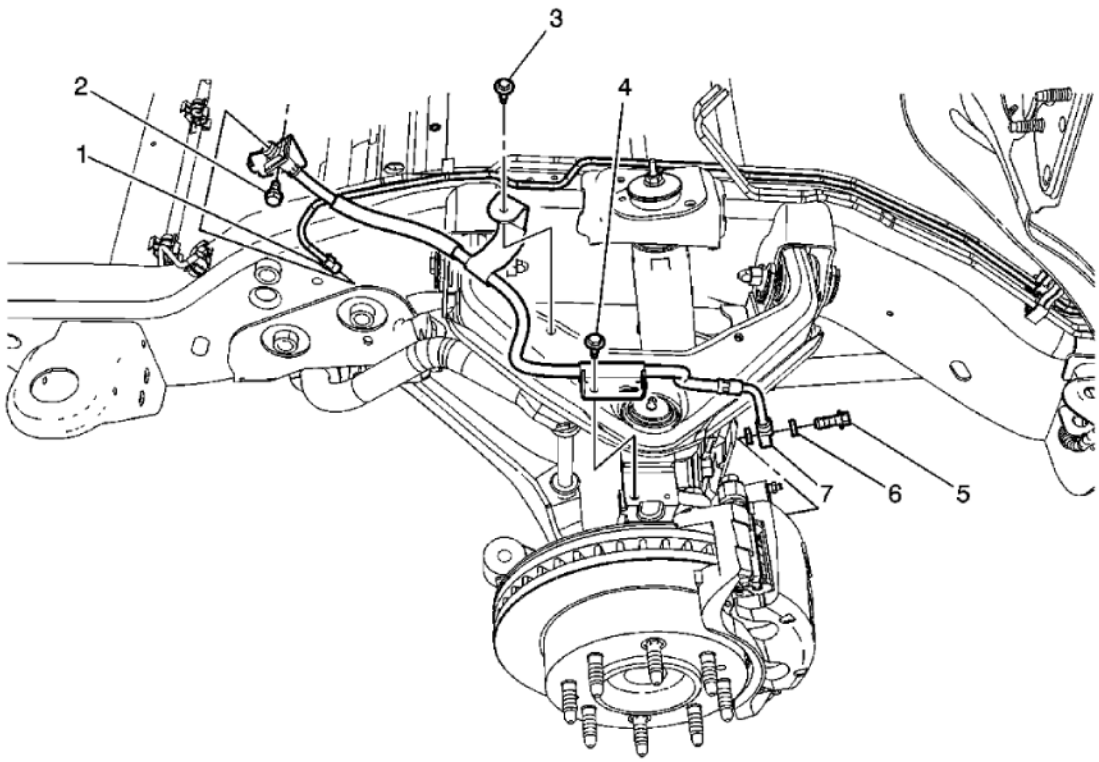


Fig. 27: Front Brake Hose Replacement (JH6, JH7)
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
CAUTION: Refer to Brake Dust Caution . **CAUTION:** Refer to Brake Fluid Irritant Caution . **Preliminary Procedures**	

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

1	Brake Pipe Fitting **NOTE:** **Refer to Fastener Notice .** **Procedure** 1. Remove any dirt or debris from the brake pipe fitting. 2. Cap the brake pipe fitting to prevent brake fluid loss and contamination. **Tighten:** 25 N.m (18 lb ft)
2	Hose Bracket to Frame Bolt **Tighten:** 9 N.m (80 lb in)
3	Hose Bracket to Control Arm Bolt **Tighten:** 9 N.m (80 lb in)
4	Hose Bracket to Steering Knuckle Bolt **Tighten:** 9 N.m (80 lb in)
5	Brake Hose Fitting Bolt **Tighten:** 40 N.m (30 lb ft)
6	Brake Hose Fitting Gasket (Qty: 2) **Procedure** 1. Discard the brake hose fitting gaskets. 2. Install 2 new brake hose fitting gaskets.
7	Brake Hose **Procedure:** Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Pressure)** or **Hydraulic Brake System Bleeding (Manual)**.

REAR BRAKE HOSE REPLACEMENT (FRAME TO AXLE - JH6, JH7)

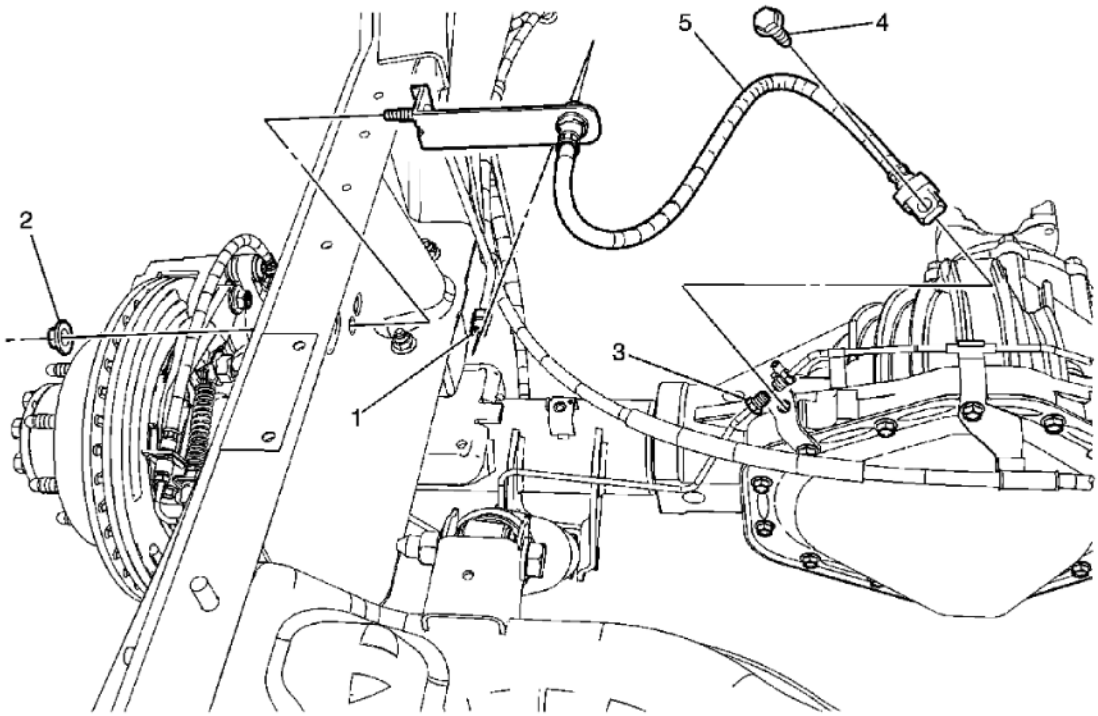


Fig. 28: Rear Brake Hose Replacement (Frame to Axle - JH6, JH7)
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
CAUTION: Refer to Brake Dust Caution . **CAUTION:** Refer to Brake Fluid Irritant Caution . **Preliminary Procedure:** Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .	
1	Brake Pipe Fitting **NOTE:** Refer to Fastener Notice . **Procedure** 1. Remove any dirt or debris from the brake pipe fitting. 2. Cap the brake pipe fitting to prevent brake fluid loss and contamination.

	Tighten: 25 N.m (18 lb ft)
2	Hose Bracket to Frame Nut **Tighten:** 25 N.m (18 lb ft)
3	Brake Pipe Fitting (Qty: 2) **Procedure** 1. Remove any dirt or debris from the brake pipe fittings. 2. Cap the brake pipe fittings to prevent brake fluid loss and contamination. **Tighten:** 25 N.m (18 lb ft)
4	Hose to Rear Axle Bolt **Tighten:** 25 N.m (18 lb ft)
5	Rear Brake Hose Assembly **Procedure:** Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Pressure)** or **Hydraulic Brake System Bleeding (Manual)**.

REAR BRAKE HOSE REPLACEMENT (FRAME TO AXLE - JD9, JF3 W/JL4)

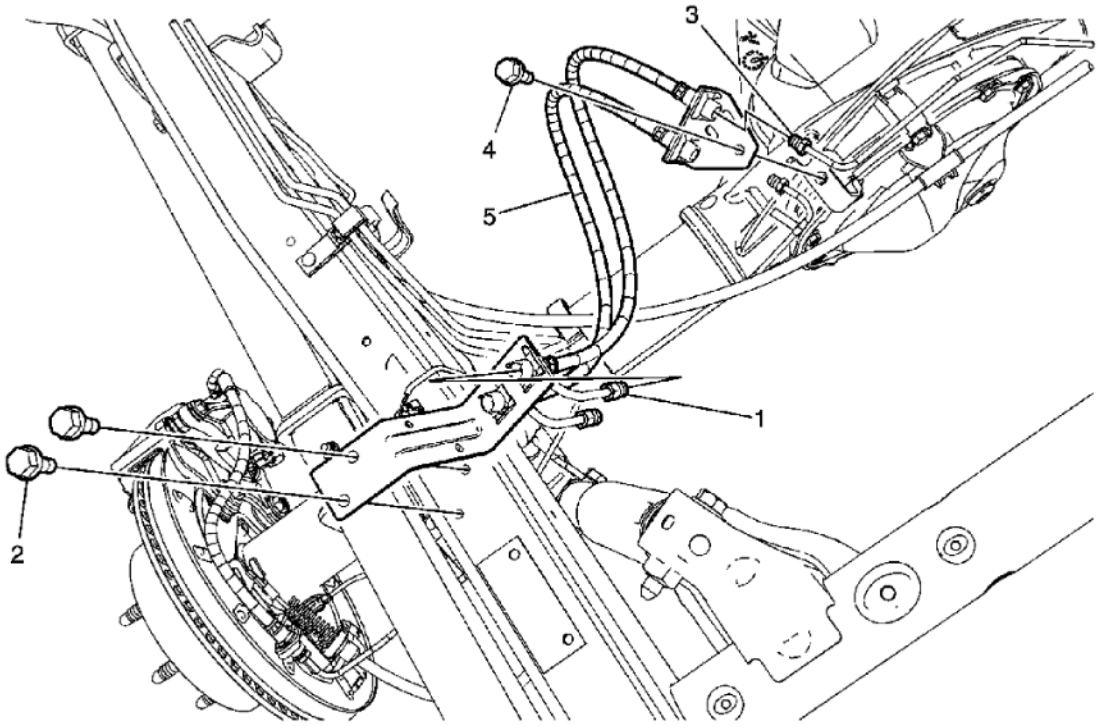


Fig. 29: Rear Brake Hose Replacement (Frame to Axle - JD9, JF3 w/JL4)
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
CAUTION: **Refer to Brake Dust Caution .** **CAUTION:** **Refer to Brake Fluid Irritant Caution .** **Preliminary Procedure:** Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .	
1	Brake Pipe Fitting (Qty: 2) **NOTE:** **Refer to Fastener Notice .** **Procedure** 1. Remove any dirt or debris from the brake pipe fitting. 2. Cap the brake pipe fitting to prevent brake fluid loss and contamination.

	Tighten: 25 N.m (18 lb ft)
2	Hose Bracket to Frame Bolt (Qty: 2) **Tighten:** 25 N.m (18 lb ft)
3	Brake Pipe Fitting (Qty: 2) **Procedure** 1. Remove any dirt or debris from the brake pipe fittings. 2. Cap the brake pipe fittings to prevent brake fluid loss and contamination. **Tighten:** 25 N.m (18 lb ft)
4	Hose to Rear Axle Bolt **Tighten:** 25 N.m (18 lb ft)
5	Rear Brake Hose Assembly **Procedure:** Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Pressure)** or **Hydraulic Brake System Bleeding (Manual)**.

REAR BRAKE HOSE REPLACEMENT (CALIPER - JH6, JH7)

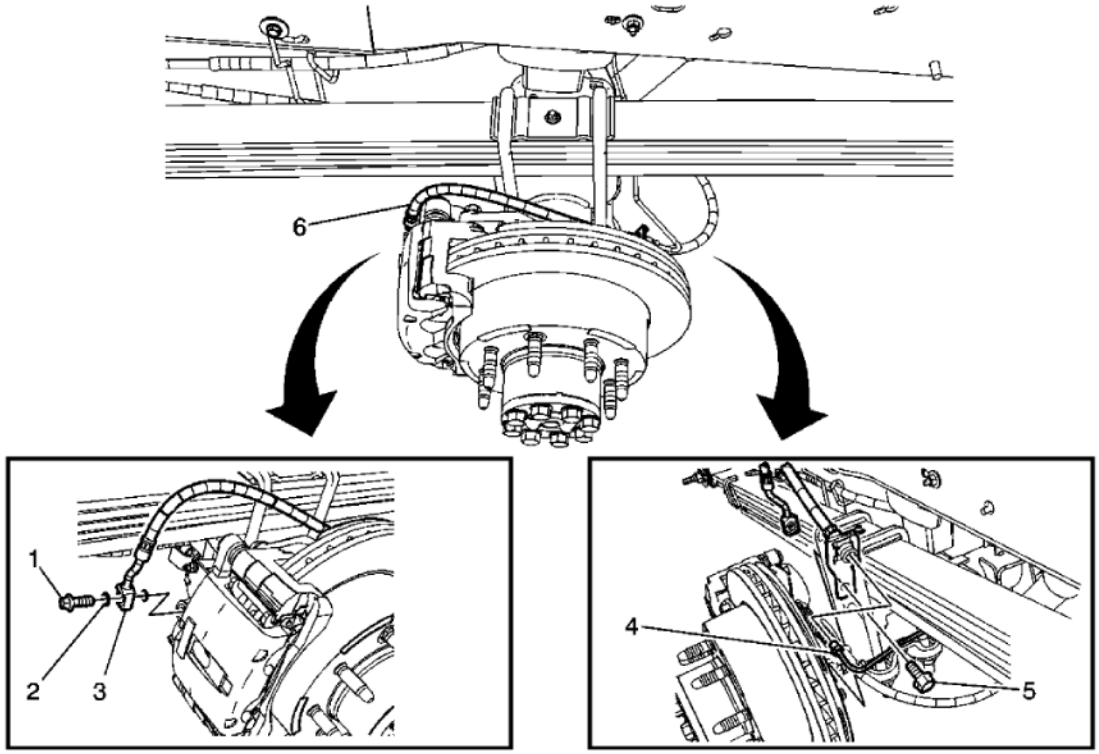


Fig. 30: Rear Brake Hose Replacement (Caliper - JH6, JH7)
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
CAUTION: **Refer to Brake Dust Caution .** **CAUTION:** **Refer to Brake Fluid Irritant Caution .** **Preliminary Procedures** 1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .	
1	Brake Hose Fitting Bolt **NOTE:** **Refer to Fastener Notice .**

	Tighten: 40 N.m (30 lb ft)
2	Brake Hose Fitting Gasket (Qty: 2) **Procedure** 1. Discard the brake hose fitting gaskets. 2. Install 2 new brake hose fitting gaskets.
3	Brake Hose Fitting
4	Brake Pipe Fitting **Procedure** 1. Remove any dirt or debris from the brake pipe fitting. 2. Cap the brake pipe fittings to prevent brake fluid loss and contamination. **Tighten:** 25 N.m (18 lb ft)
5	Hose Bracket to Rear Axle Bolt **Tighten:** 9 N.m (80 lb in)
6	Brake Hose **Procedure:** Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Pressure)** or **Hydraulic Brake System Bleeding (Manual)**.

REAR BRAKE HOSE REPLACEMENT (CALIPER - JD9)

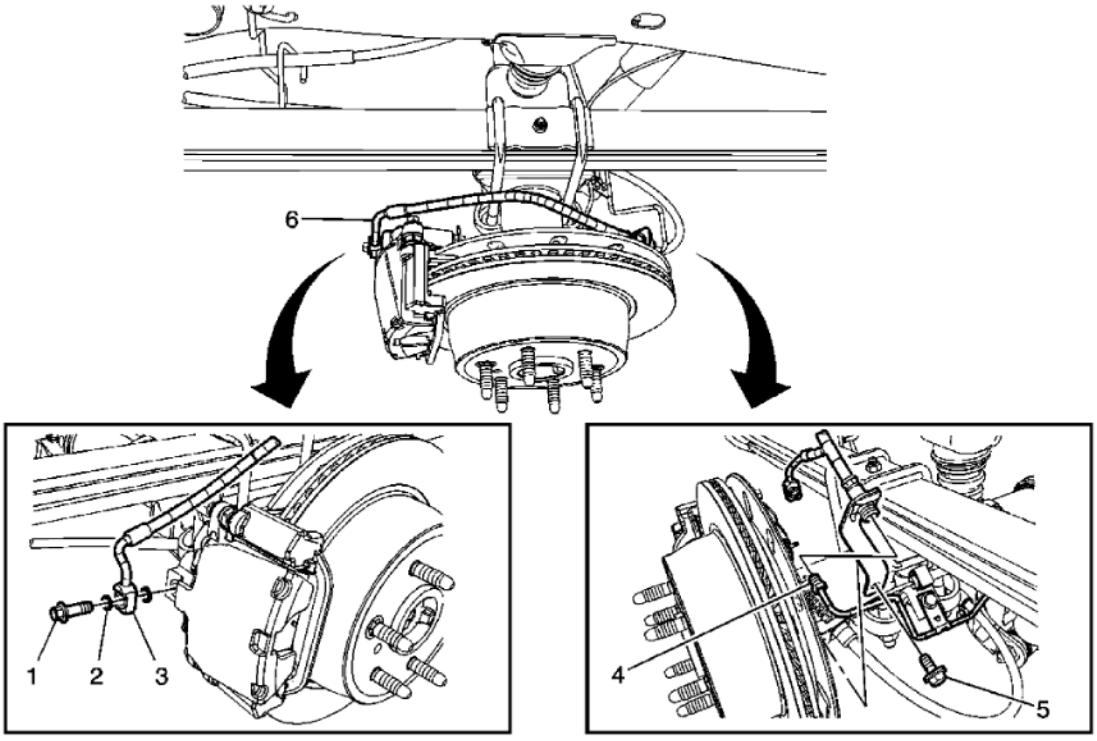


Fig. 31: Rear Brake Hose Replacement (Caliper - JD9)
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
CAUTION: **Refer to Brake Dust Caution .** **CAUTION:** **Refer to Brake Fluid Irritant Caution .** **Preliminary Procedures** 1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .	
1	Brake Hose Fitting Bolt **NOTE:** **Refer to Fastener Notice .**

	Tighten: 40 N.m (30 lb ft)
2	Brake Hose Fitting Gasket (Qty: 2) **Procedure** 1. Discard the brake hose fitting gaskets. 2. Install 2 new brake hose fitting gaskets.
3	Brake Hose Fitting
4	Brake Pipe Fitting **Procedure** 1. Remove any dirt or debris from the brake pipe fitting. 2. Cap the brake pipe fitting to prevent brake fluid loss and contamination. **Tighten:** 25 N.m (18 lb ft)
5	Hose Bracket to Rear Axle Bolt **Tighten:** 9 N.m (80 lb in)
6	Brake Hose **Procedure:** Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Pressure)** or **Hydraulic Brake System Bleeding (Manual)**.

REAR BRAKE HOSE REPLACEMENT (FRAME TO AXLE - JF3 W/O JL4, JF7)

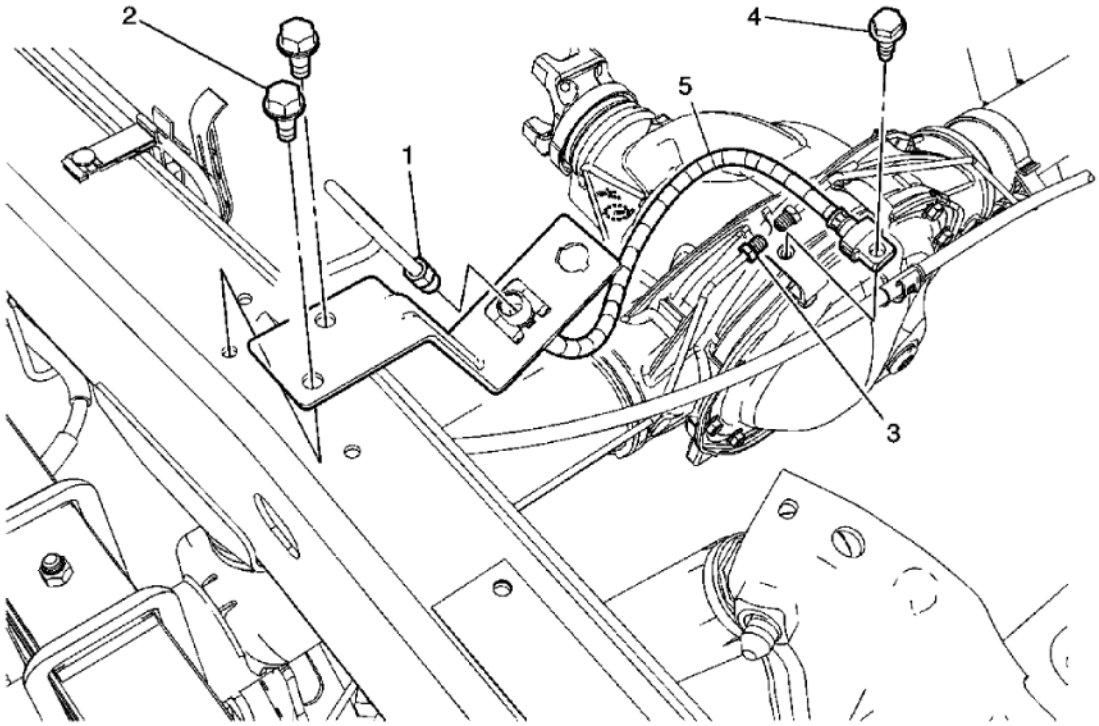


Fig. 32: Rear Brake Hose Replacement (Frame to Axle - JF3 w/o JL4, JF7)
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
CAUTION: **Refer to Brake Dust Caution .** **CAUTION:** **Refer to Brake Fluid Irritant Caution .** **Preliminary Procedure:** Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .	
1	Brake Pipe Fitting **NOTE:** **Refer to Fastener Notice .** **Procedure** 1. Remove any dirt or debris from the brake pipe fitting. 2. Cap the brake pipe fitting to prevent brake fluid loss and contamination.

	Tighten: 25 N.m (18 lb ft)
2	Hose Bracket to Frame Bolt (Qty: 2) **Tighten:** 25 N.m (18 lb ft)
3	Brake Pipe Fitting (Qty: 2) **Procedure** 1. Remove any dirt or debris from the brake pipe fittings. 2. Cap the brake pipe fittings to prevent brake fluid loss and contamination. **Tighten:** 25 N.m (18 lb ft)
4	Hose to Rear Axle Bolt **Tighten:** 9 N.m (80 lb in)
5	Rear Brake Hose **Procedure:** Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Pressure)** or **Hydraulic Brake System Bleeding (Manual)**.

HYDRAULIC BRAKE SYSTEM BLEEDING (PRESSURE)

Tools Required

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

Bleeding

CAUTION: Refer to Brake Fluid Irritant Caution .

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

NOTE: When adding fluid to the brake master cylinder reservoir, use only Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid

container. The use of any type of fluid other than the recommended type of brake fluid, may cause contamination which could result in damage to the internal rubber seals and/or rubber linings of hydraulic brake system components.

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

Clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm.

5. Install the **J 35589-A** to the brake master cylinder reservoir. See **Special Tools**.
6. Check the brake fluid level in the **J 29532** , or equivalent. See **Special Tools**. Add Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container as necessary to bring the level to approximately the half-full point.
7. Connect the **J 29532** , or equivalent, to the **J 35589-A** . See **Special Tools**.
8. Charge the **J 29532** , or equivalent, air tank to 175-205 kPa (25-30 psi). See **Special Tools**.
9. Open the **J 29532** , or equivalent, fluid tank valve to allow pressurized brake fluid to enter the brake system. See **Special Tools**.
10. Wait approximately 30 seconds, then inspect the entire hydraulic brake system in order to ensure that there are no existing external brake fluid leaks.

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

11. Install a proper box-end wrench onto the RIGHT REAR wheel hydraulic circuit bleeder valve.
12. Install a transparent hose over the end of the bleeder valve.
13. Submerge the open end of the transparent hose into a transparent container partially filled with Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container.
14. Loosen the bleeder valve to purge air from the wheel hydraulic circuit. Allow fluid to flow until air bubbles stop flowing from the bleeder, then tighten the bleeder valve.
15. With the right rear wheel hydraulic circuit bleeder valve tightened securely, after all air has been purged from the right rear hydraulic circuit, install a proper box-end wrench onto the LEFT REAR wheel hydraulic circuit bleeder valve.
16. Install a transparent hose over the end of the bleeder valve, then repeat steps 13-14.
17. With the left rear wheel hydraulic circuit bleeder valve tightened securely, after all air has been purged from the left rear hydraulic circuit, install a proper box-end wrench onto the RIGHT FRONT wheel hydraulic circuit bleeder valve.
18. Install a transparent hose over the end of the bleeder valve, then repeat steps 13-14.
19. With the right front wheel hydraulic circuit bleeder valve tightened securely, after all air has been purged from the right front hydraulic circuit, install a proper box-end wrench onto the LEFT FRONT wheel hydraulic circuit bleeder valve.
20. Install a transparent hose over the end of the bleeder valve, then repeat steps 13-14.

21. After completing the final wheel hydraulic circuit bleeding procedure, ensure that each of the 4 wheel hydraulic circuit bleeder valves are properly tightened.
22. Close the **J 29532** , or equivalent, fluid tank valve, then disconnect the **J 29532** , or equivalent, from the **J 35589-A** . See **Special Tools**.
23. Remove the **J 35589-A** from the brake master cylinder reservoir. See **Special Tools**.
24. Fill the brake master cylinder reservoir to the maximum-fill level with Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid container.
25. Slowly depress and release the brake pedal. Observe the feel of the brake pedal.
26. If the brake pedal feels spongy perform the following steps:
    1. Inspect the brake system for external leaks. Refer to **Brake System External Leak Inspection** .
    2. Using a scan tool, perform the antilock brake system automated bleeding procedure to remove any air that may have been trapped in the brake pressure modulator valve (BPMV). Refer to **Antilock Brake System Automated Bleed Procedure (With JL4)** **Antilock Brake System Automated Bleed Procedure (Without JL4)** .
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 BLEEDING (MANUAL)

CAUTION: Refer to Brake Fluid Irritant Caution .

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

NOTE: When adding fluid to the brake master cylinder reservoir, use only Delco Supreme 11®, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT-3 brake fluid from a clean, sealed brake fluid

container. The use of any type of fluid other than the recommended type of brake fluid, may cause contamination which could result in damage to the internal rubber seals and/or rubber linings of hydraulic brake system components.

1. 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.
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 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 FLUSHING

CAUTION: Refer to Brake Fluid Irritant Caution .

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

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

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

- Cloudy appearance - moisture
- Dark appearance/suspended particles in fluid - dirt, rust, corrosion, brake dust

2. Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating brake fluid contamination.
3. If the brake fluid WAS contaminated with an oil-based or a silicone-based substance, indicated by fluid separation and/or a swollen master cylinder reservoir cap diaphragm and/or swollen reservoir-to-master cylinder grommets, perform the following:
    1. Remove ALL of the following components listed from the vehicle. Each component contains internal rubber seals/linings which have been contaminated by the contaminated brake fluid in the brake hydraulic system.

       Refer to the procedures indicated:

       - **Master Cylinder Replacement (JD9, JF3, JF7)Master Cylinder Replacement (JH6, JH7)**
       - **Front Brake Hose Replacement (JD9, JF3, JF7)Front Brake Hose Replacement (JH6, JH7)**
       - **Rear Brake Hose Replacement (Frame to Axle - JH6, JH7)Rear Brake Hose Replacement (Frame to Axle - JD9, JF3 w/JL4)Rear Brake Hose Replacement (Caliper - JH6, JH7)Rear Brake Hose Replacement (Caliper - JD9)Rear Brake Hose Replacement (Frame to Axle - JF3 w/o JL4, JF7)**
       - **Front Brake Caliper Replacement (JH6, JH7) Front Brake Caliper Replacement (JD9, JF3, JF7)**
       - **Rear Brake Caliper Replacement (JH6, JH7) Rear Brake Caliper Replacement (JD9)**
       - **Brake Pressure Modulator Valve Replacement (JD9, JF3, JF7) Brake Pressure Modulator Valve Replacement (JH6, JH7)**
    2. Clean out all the hydraulic brake pipes using denatured alcohol, or equivalent.
    3. Dry the brake pipes using non-lubricated, filtered air.
    4. Repair or replace ALL of the following components listed and install them to the vehicle. Each component contains internal rubber seals/linings which have been contaminated by the contaminated brake fluid in the brake hydraulic system.

       Refer to the procedures indicated:

       - **Master Cylinder Replacement (JD9, JF3, JF7)Master Cylinder Replacement (JH6, JH7)** ; 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 (JD9, JF3, JF7)Master Cylinder Reservoir Replacement (JH6, JH7)** .

Replace the brake master cylinder reservoir cap diaphragm.

- **Front Brake Hose Replacement (JD9, JF3, JF7)Front Brake Hose Replacement (JH6, JH7)**
- **Rear Brake Hose Replacement (Frame to Axle - JH6, JH7)Rear Brake Hose Replacement (Frame to Axle - JD9, JF3 w/JL4)Rear Brake Hose Replacement (Caliper - JH6, JH7)Rear Brake Hose Replacement (Caliper - JD9)Rear Brake Hose Replacement (Frame to Axle - JF3 w/o JL4, JF7)**
- **Front Brake Caliper Overhaul (JH6, JH7)** or **Front Brake Caliper Replacement (JH6, JH7) Front Brake Caliper Replacement (JD9, JF3, JF7)**
- **Rear Brake Caliper Overhaul (JH6, JH7)** or **Rear Brake Caliper Replacement (JH6, JH7) Rear Brake Caliper Replacement (JD9)**
- **Brake Pressure Modulator Valve Replacement (JD9, JF3, JF7) Brake Pressure Modulator Valve Replacement (JH6, JH7)**

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 (Pressure)** or **Hydraulic Brake System Bleeding (Manual)**.

POWER VACUUM BRAKE BOOSTER REPLACEMENT (NON-ADJUSTABLE PEDALS)

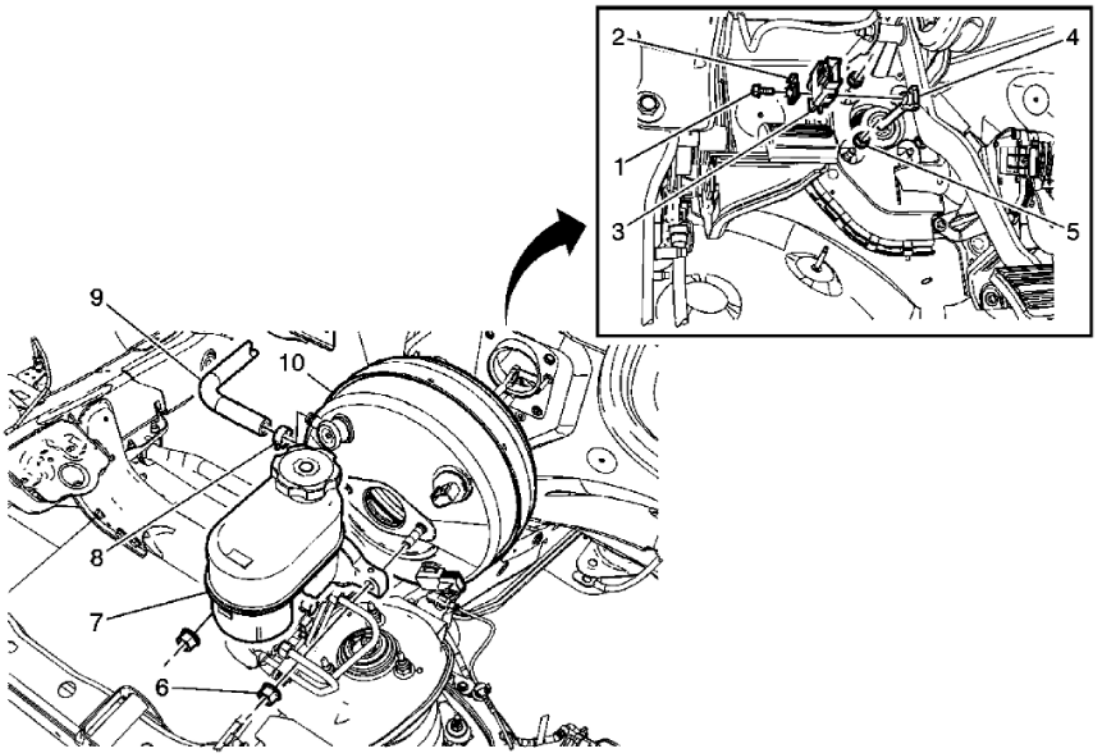


Fig. 33: Power Vacuum Brake Booster Replacement (Non-Adjustable Pedals)
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedures 1. Apply the park brake. 2. Deplete the vacuum reserve in the vacuum booster by applying the brake pedal 3 times or until the pedal becomes firm.	
1	Brake Booster Pushrod Retainer Bolt **NOTE:** **Refer to Fastener Notice .** **Tighten:** 10 N.m (89 lb in)
2	Brake Booster Pushrod Retainer
3	Stop Lamp Switch
4	Brake Booster Pushrod
	Brake Booster Nut (Qty: 4)

5	**Tip:** Tighten the upper right vacuum brake booster nut first. **Tighten:** 33 N.m (24 lb ft)
6	Master Cylinder Nut (Qty: 2) **Tighten:** 33 N.m (24 lb ft)
7	Master Cylinder Assembly **Procedure** 1. Without disconnecting the brake pipe fittings, carefully position the master cylinder assembly aside and support with heavy mechanics wire or equivalent. 2. Inspect the brake master cylinder to vacuum brake booster seal for damage and replace if necessary. 3. Ensure the brake master cylinder to vacuum brake booster seal is properly seated in the groove of the master cylinder.
8	Vacuum Brake Booster Hose Clamp
9	Vacuum Brake Booster Hose
10	Vacuum Brake Booster **Procedure** 1. Disconnect the vacuum brake booster electrical connectors, if equipped. 2. Discard the vacuum brake booster gasket. 3. Install a new vacuum brake booster gasket.

POWER VACUUM BRAKE BOOSTER REPLACEMENT (ADJUSTABLE PEDALS)

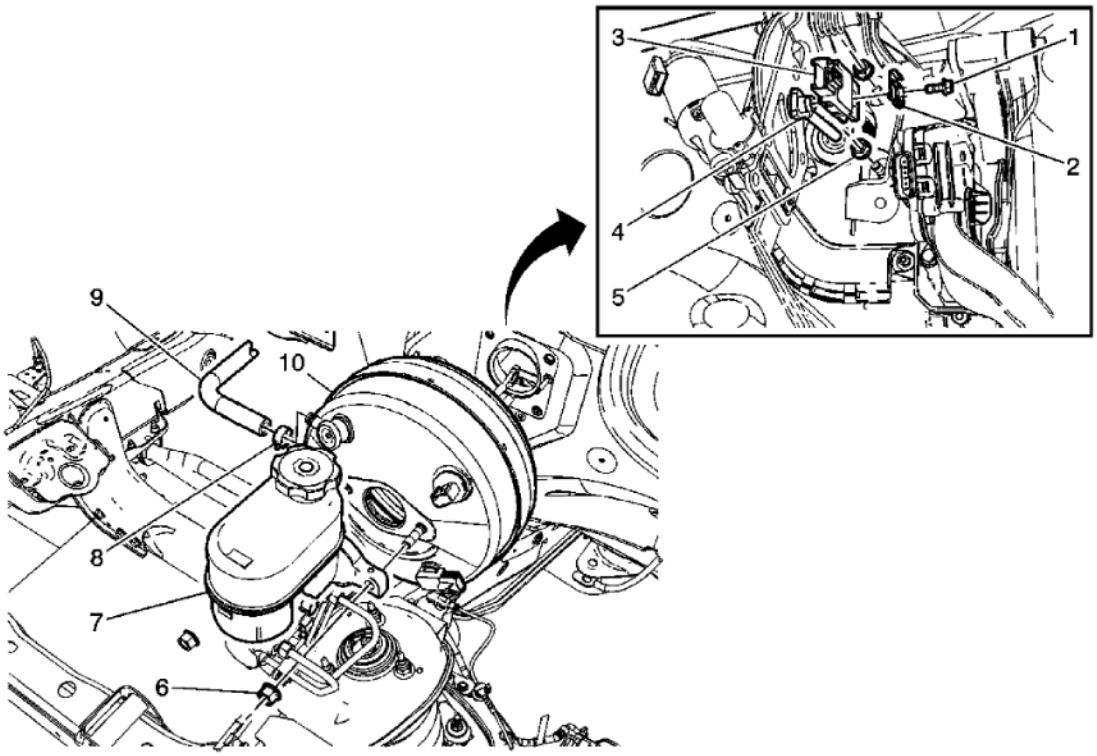


Fig. 34: Power Vacuum Brake Booster Replacement (Adjustable Pedals)
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedures 1. Apply the park brake. 2. Deplete the vacuum reserve in the vacuum booster by applying the brake pedal 3 times or until the pedal becomes firm.	
1	Brake Booster Pushrod Retainer Bolt **NOTE:** **Refer to Fastener Notice .** **Tighten:** 10 N.m (89 lb in)
2	Brake Booster Pushrod Retainer
3	Stop Lamp Switch
4	Brake Booster Pushrod
	Brake Booster Nut (Qty: 4)

5	**Tip:** Tighten the upper right vacuum brake booster nut first. **Tighten:** 33 N.m (24 lb ft)
6	Master Cylinder Nut (Qty: 2) **Tighten:** 33 N.m (24 lb ft)
7	Master Cylinder Assembly **Procedure** 1. Without disconnecting the brake pipe fittings, carefully position the master cylinder assembly aside and support with heavy mechanics wire or equivalent. 2. Inspect the brake master cylinder to vacuum brake booster seal for damage and replace if necessary. 3. Ensure the brake master cylinder to vacuum brake booster seal is properly seated in the groove of the master cylinder.
8	Vacuum Brake Booster Hose Clamp
9	Vacuum Brake Booster Hose
10	Vacuum Brake Booster **Procedure** 1. Disconnect the vacuum brake booster electrical connectors, if equipped. 2. Discard the vacuum brake booster gasket. 3. Install a new vacuum brake booster gasket.

VACUUM BRAKE BOOSTER CHECK VALVE AND/OR HOSE REPLACEMENT

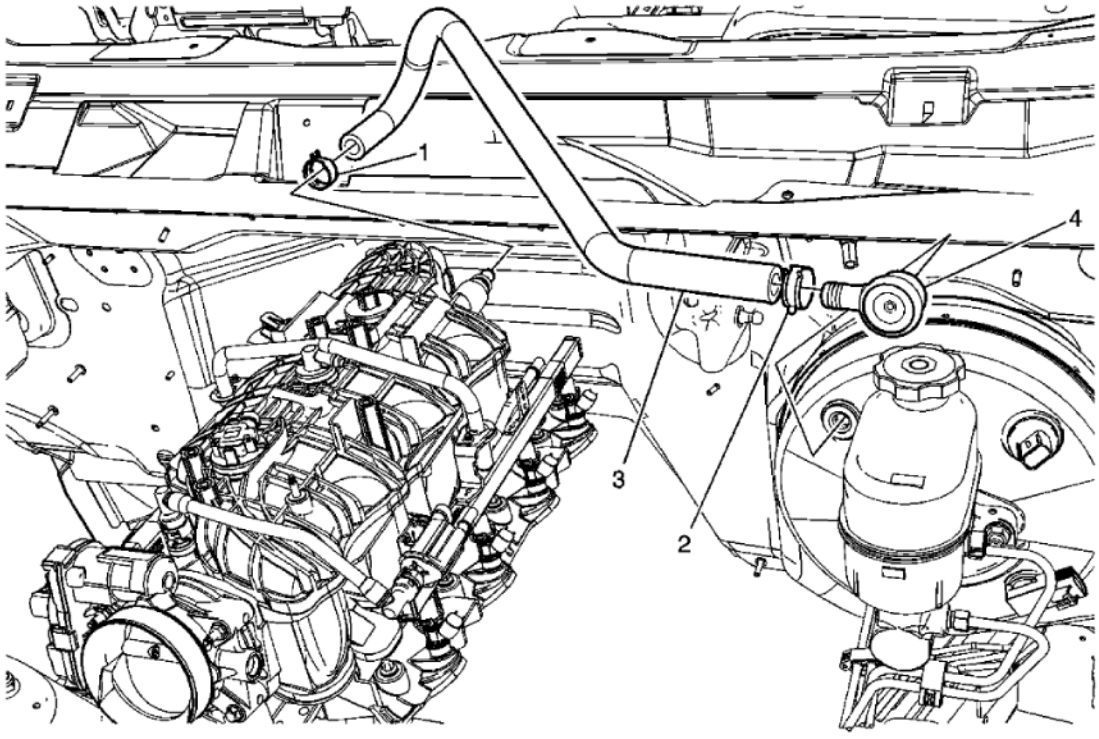


Fig. 35: Vacuum Brake Booster Check Valve and/or Hose Replacement
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedures 1. Deplete the vacuum reserve in the vacuum booster by applying the brake pedal 3 times or until the pedal becomes firm. 2. If equipped with the 4.8L, 5.3L, 6.0L, or 6.2L engine, remove the upper intake manifold sight shield. Refer to **Upper Intake Manifold Sight Shield Replacement** .	
1	Vacuum Brake Booster Hose Clamp
2	Vacuum Brake Booster Hose Clamp
3	Vacuum Brake Booster Hose
4	Vacuum Brake Booster Check Valve

BRAKE MASTER CYLINDER PRESSURE SENSOR REPLACEMENT (WITH RPO JL1 AND WITHOUT JL4)

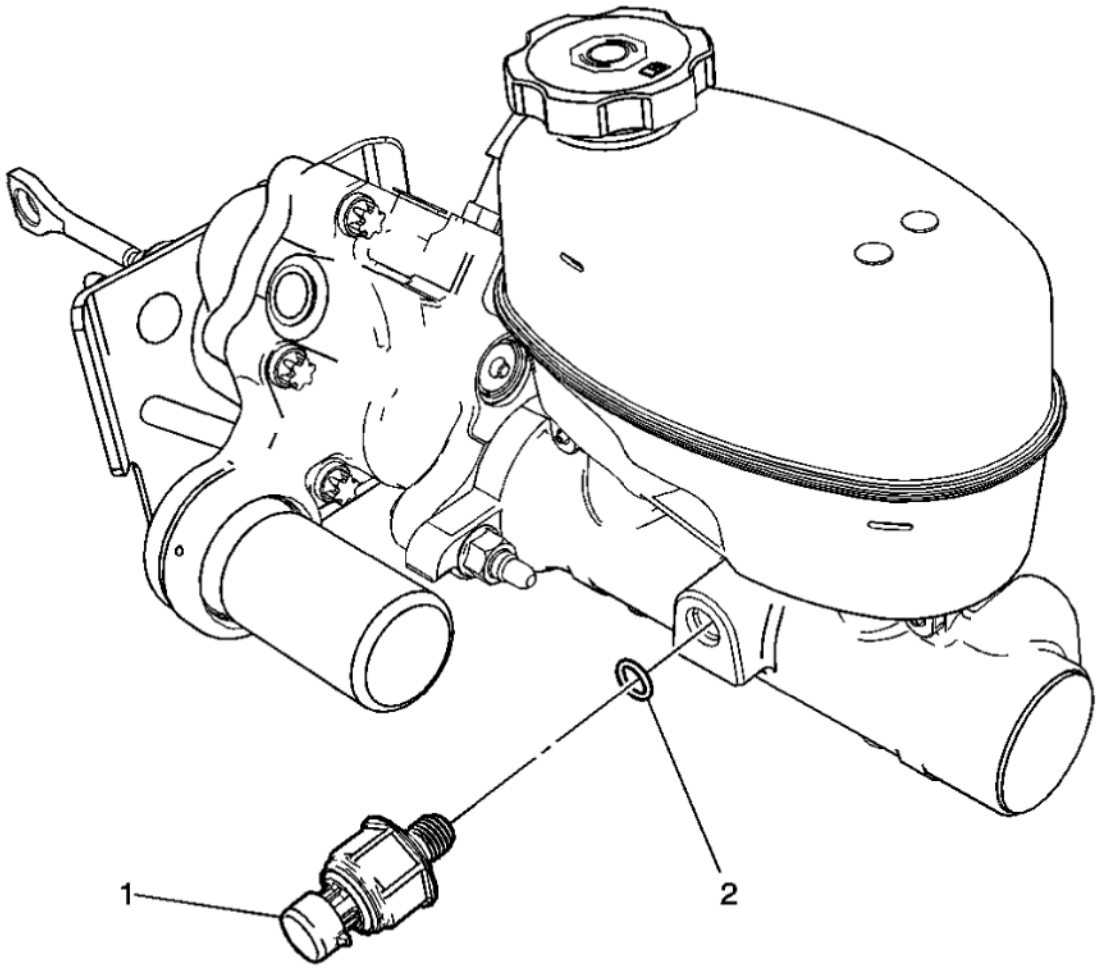


Fig. 36: Brake Master Cylinder Pressure Sensor Replacement (With RPO JL1 and Without JL4)
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name

CAUTION:
Refer to Brake Fluid Irritant Caution .

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

Preliminary Procedures

1. Turn the ignition switch to the OFF position.
2. Apply the park brake.

3. Disconnect the brake master cylinder pressure sensor electrical connector.	
1	**NOTE:** **Refer to Fastener Notice .** Brake Master Cylinder Pressure Sensor **Procedure** 1. After the installation is complete, bleed the hydraulic brake system at the front wheels only. It is not necessary the bleed the rear hydraulic circuit. Refer to **Hydraulic Brake System Bleeding (Pressure)** or **Hydraulic Brake System Bleeding (Manual)**. 2. Do not lubricate the sensor threads prior to installation. **Tighten:** 26 N.m (19 lb ft)
2	Brake Master Cylinder Pressure Sensor O-ring Seal **Procedure** 1. Discard the O-ring seal. 2. Do not lubricate the O-ring seal prior to installation.

POWER BRAKE BOOSTER LEAK INSPECTION

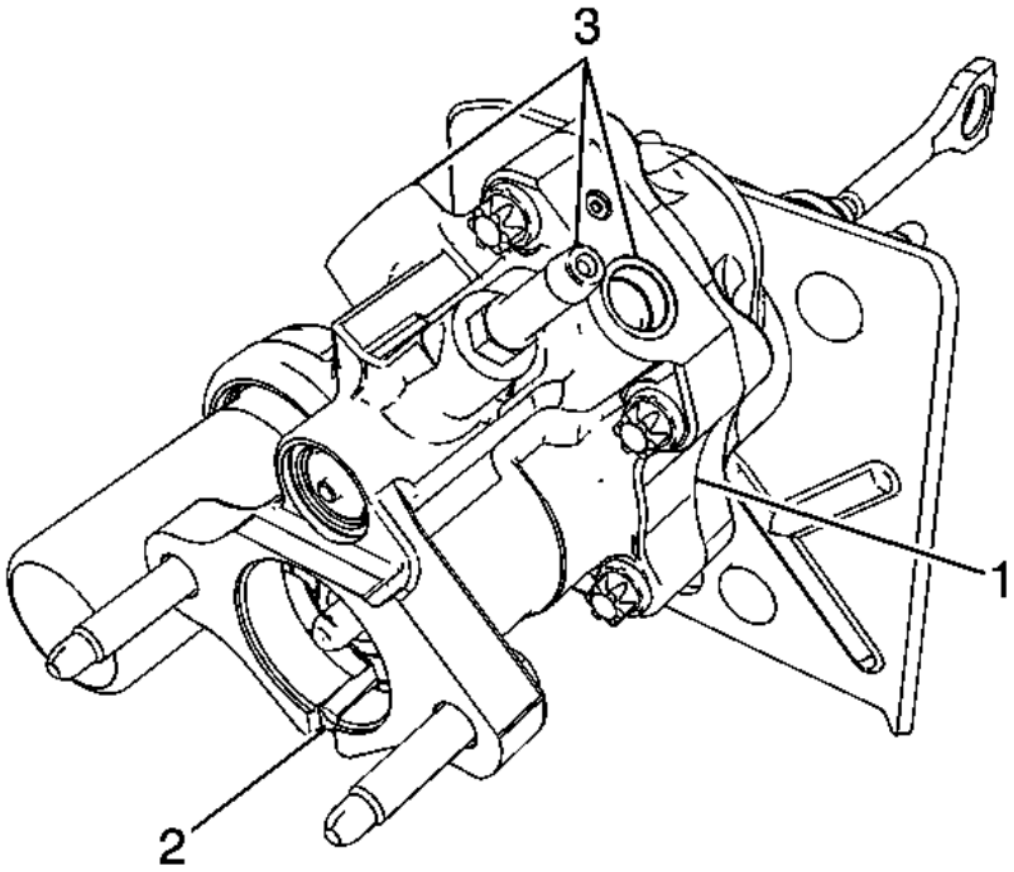


Fig. 37: View Of Power Brake Booster
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The power brake booster may appear wet due to excessive assembly fluid during manufacturing or brake fluid that could have been spilled during system fill. In an effort to prevent unnecessary replacement of the power steering boosters, perform the following power brake booster leak inspection before replacing the power brake booster.

1. Check the power steering system fluid and adjust the level if necessary. Refer to **Checking and Adding Power Steering Fluid (With Hydroboost)** or **Checking and Adding Power Steering Fluid (Without Hydroboost)** .

2. Clean any fluid off all of the following areas:
   - The power brake booster housing and fittings 3
   - The joint between the power brake booster housing and master cylinder 2
   - The end cap
   - The joint between the power brake booster housing and end cap 1

IMPORTANT: To properly diagnose a leak condition, aid from an assistant may be required. The power brake booster system must be observed while completing this inspection.

3. Start the engine and allow the power steering fluid to reach operating temperature.
4. Allow the engine to idle and slowly apply the brake pedal to run-out, holding until the power steering pump reaches the pressure relief valve setting and hisses. Then maintain this brake pedal force for approximately two seconds longer, then release the brake pedal.
5. Allow the engine to idle with your foot off the brake for fifteen seconds.
6. Repeat steps 4 and 5 four more times.

IMPORTANT: Do not hold the wheel for more than three seconds at full stop, as this will increase the fluid temperature in the pump above operating temperature.

7. With the engine idling, turn the steering wheel from stop to stop four times and hold the wheel at each stop for two seconds.
8. Increase the engine idle speed to approximately 1000 RPM and turn the steering wheel from stop to stop six times at a rate of one turn of the steering wheel approximately every second. Do not hold the wheel at full stop.
9. Allow the engine to idle with your foot off the brake for thirty seconds.
10. With the engine idling, apply the brake pedal to run-out and hold the pedal force at run-out for approximately one second and the release the brake pedal.
11. Repeat steps 7 through 10 four times.
12. Allow the engine to idle for thirty seconds and then turn the engine off.

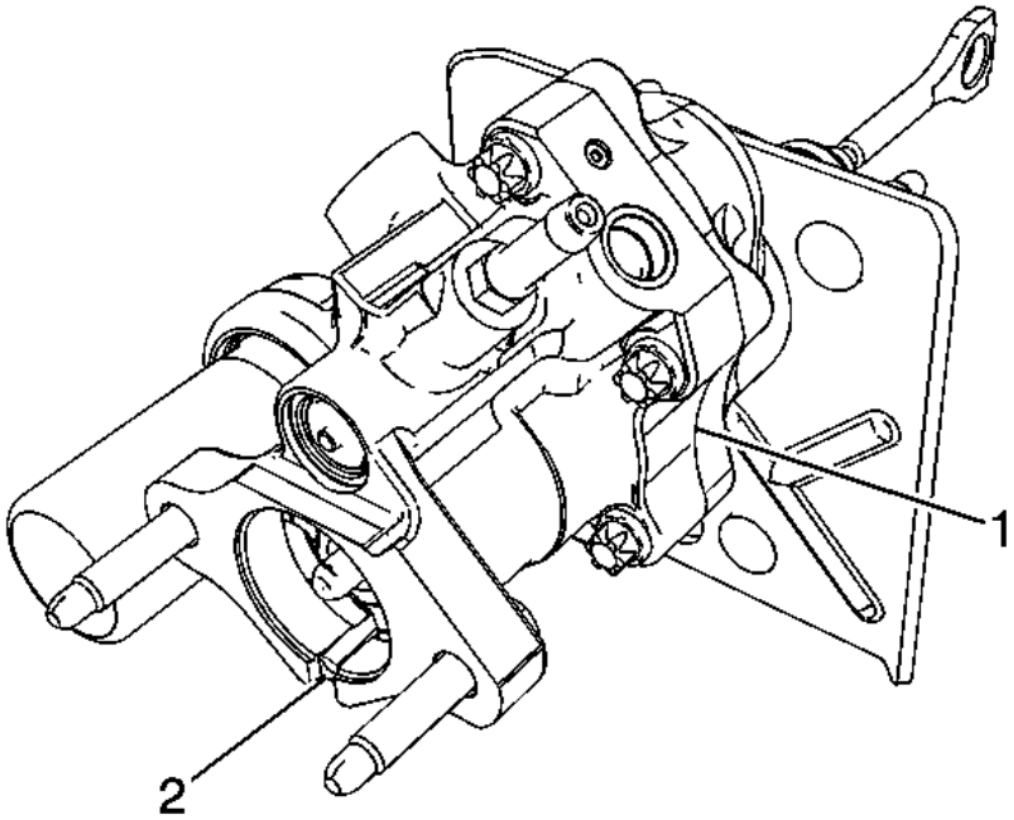


Fig. 38: View Of Power Brake Booster
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: On low mileage vehicles, at joint between the power brake booster housing and end cap 1, light moisture is acceptable. If fluid droplets develop, the power brake booster must be replaced.

13. Inspect the power brake booster for any leaks

IMPORTANT: A leak between the power steering brake booster 2 and the master cylinder is not acceptable. If a leak is present, the type of fluid must be determined. Power steering fluid indicates that the power brake booster needs to be replaced.

Brake fluid indicates an issue with the brake master cylinder.

14. If the power brake booster is leaking, replace the power brake booster. Refer to **Power Brake Booster Replacement (Adjustable Pedals)** or **Power Brake Booster Replacement (Non-Adjustable Pedals)**.
15. If brake fluid is leaking, refer to **Brake Fluid Loss** for additional diagnostics.

POWER BRAKE BOOSTER REPLACEMENT (ADJUSTABLE PEDALS)

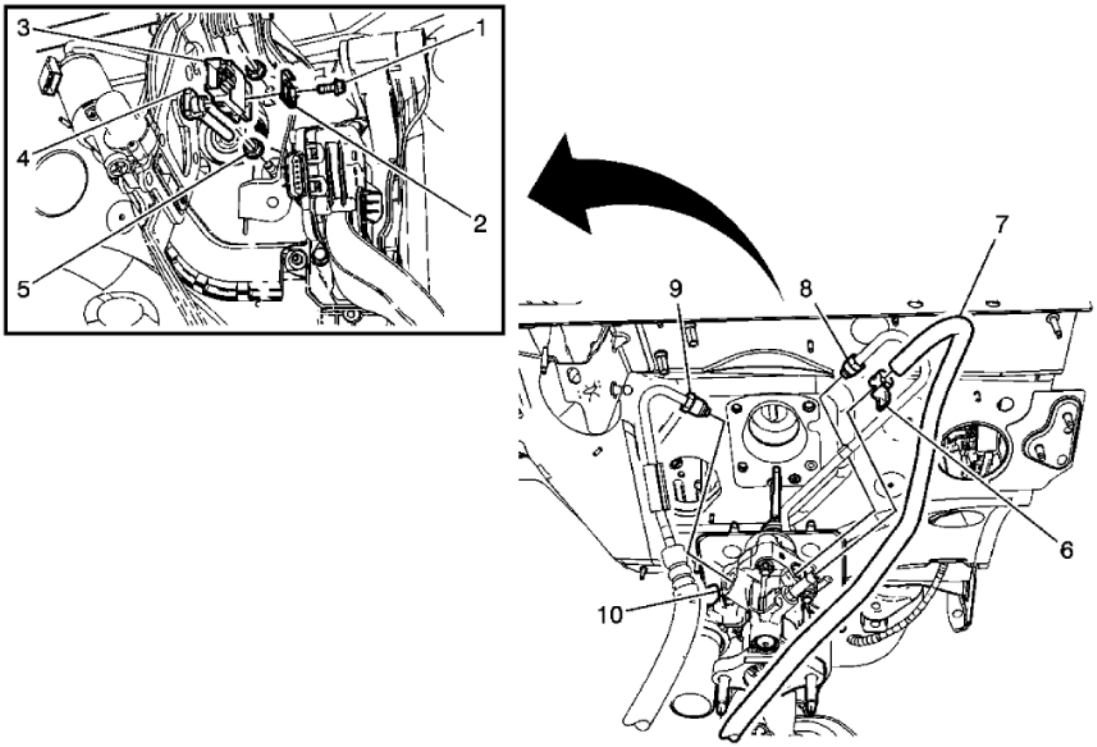


Fig. 39: Power Brake Booster Replacement (Adjustable Pedals)
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name

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.

Preliminary Procedures

1. Apply the park brake.
2. Deplete the power reserve in the brake booster by applying the brake pedal several times until the pedal becomes firm.
3. Without disconnecting the brake pipes, remove and position the brake master cylinder aside and support with heavy mechanics wire or equivalent. Refer to **Master Cylinder Replacement (JD9, JF3, JF7)** or **Master Cylinder Replacement (JH6, JH7)**.

1	Brake Booster Pushrod Retainer Bolt **NOTE:** **Refer to Fastener Notice .** **Tighten:** 10 N.m (89 lb in)
2	Brake Booster Pushrod Retainer
3	Stop Lamp Switch
4	Power Brake Booster Pushrod
5	Brake Booster Nut (Qty: 4) **Tip:** Tighten the upper right power brake booster nut first. **Tighten:** 33 N.m (24 lb ft)
6	Power Brake Booster Return Hose Clamp
7	Power Brake Booster Return Hose
8	Power Brake Booster Outlet Hose Fitting **Tighten:** 33 N.m (24 lb ft)
9	Power Brake Booster Inlet Hose Fitting **Tighten:** 33 N.m (24 lb ft)
10	Power Brake Booster **Procedure** 1. Inspect the power brake booster to cowl gasket for damage. Replace if necessary. 2. Bleed the power steering system. Refer to **Power Steering System Bleeding** .

POWER BRAKE BOOSTER REPLACEMENT (NON-ADJUSTABLE PEDALS)

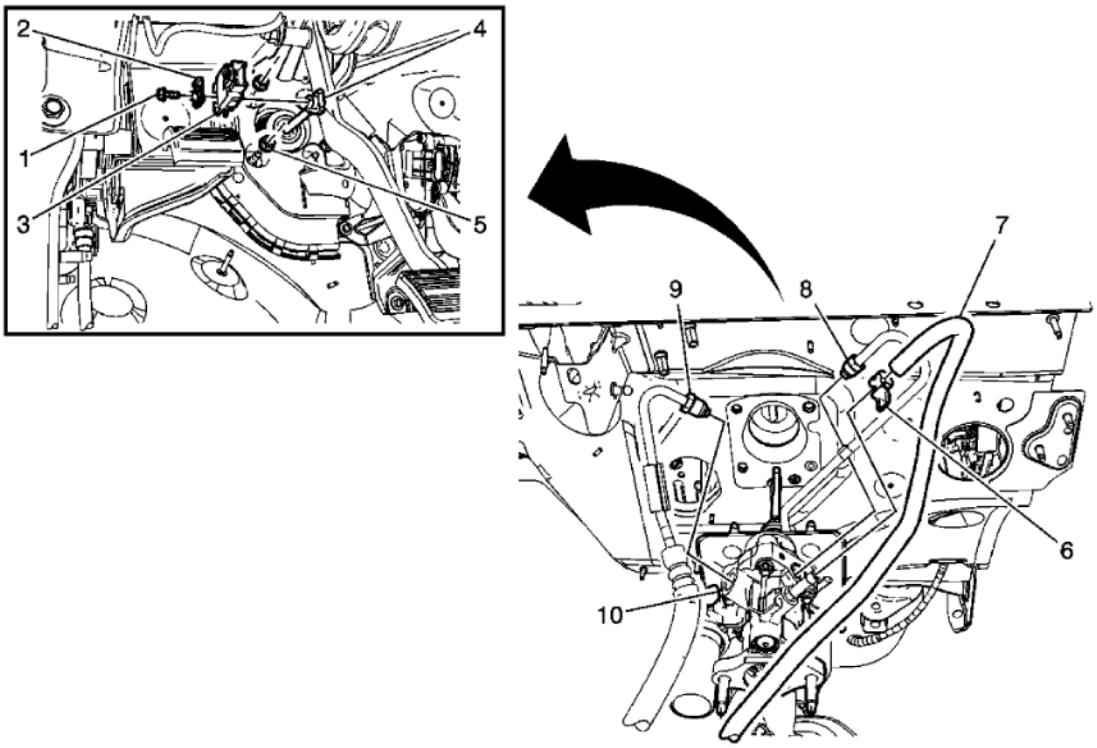


Fig. 40: Power Brake Booster Replacement (Non-Adjustable Pedals)
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
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.** **Preliminary Procedures** 1. Apply the park brake. 2. Deplete the power reserve in the brake booster by applying the brake pedal several times until the pedal becomes firm. 3. Without disconnecting the brake pipes, remove and position the brake master cylinder aside and support with heavy mechanics wire or equivalent. Refer to **Master Cylinder Replacement (JD9, JF3, JF7)** or **Master Cylinder Replacement (JH6, JH7)**.	
	Brake Booster Pushrod Retainer Bolt

1	**NOTE:** Refer to **Fastener Notice** . **Tighten:** 10 N.m (89 lb in)
2	Brake Booster Pushrod Retainer
3	Stop Lamp Switch
4	Brake Booster Pushrod
5	Brake Booster Nut (Qty: 4) **Tip:** Tighten the upper right power brake booster nut first. **Tighten:** 33 N.m (24 lb ft)
6	Power Brake Booster Return Hose Clamp
7	Power Brake Booster Return Hose
8	Power Brake Booster Outlet Hose Fitting **Tighten:** 33 N.m (24 lb ft)
9	Power Brake Booster Inlet Hose Fitting **Tighten:** 33 N.m (24 lb ft)
10	Power Brake Booster **Procedure** 1. Inspect the power brake booster gasket for damage. Replace if necessary. 2. Bleed the power steering system. Refer to **Power Steering System Bleeding** .

HYDRAULIC BRAKE BOOSTER ACCUMULATOR REPLACEMENT

Tools Required

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

Removal Procedure

CAUTION: The accumulator contains compressed gas. Always use the proper tools and follow the recommended procedures or personal injury may result. Do not apply heat to accumulator. Do not attempt to repair an inoperative accumulator. Always

replace an inoperative accumulator with a new one. Dispose of an inoperative accumulator by drilling a 1.5 mm (1/16 in) diameter hole through the end of the accumulator can, opposite the O-ring.

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

1. Apply the park brake and block the wheels.
2. Depress brake pedal at least 10 times in order to relieve pressure in the accumulator.
3. Remove the master cylinder from the hydraulic booster. Refer to **Master Cylinder Replacement (JD9, JF3, JF7)** or **Master Cylinder Replacement (JH6, JH7)**.

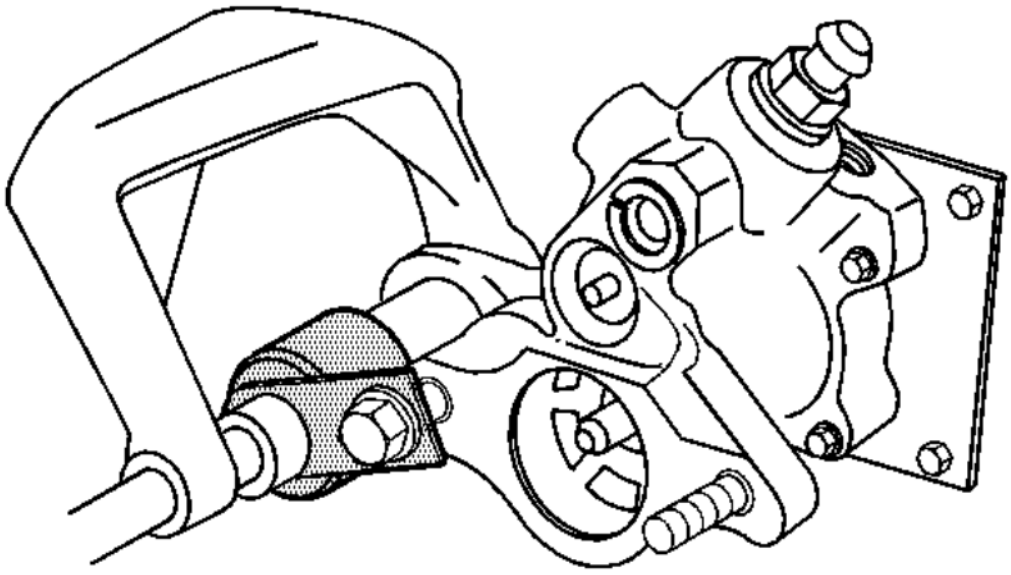


Fig. 41: View Of Accumulator With C-Clamp
Courtesy of GENERAL MOTORS CORP.

4. Place the **J 26889** over the end of the accumulator. See **Special Tools**.

5. Install the nut on the stud.
6. Depress the accumulator with a C-clamp. If the accumulator does not move with moderate pressure, remove the C-clamp and depress the brake pedal ten times in order to relieve pressure in the accumulator.

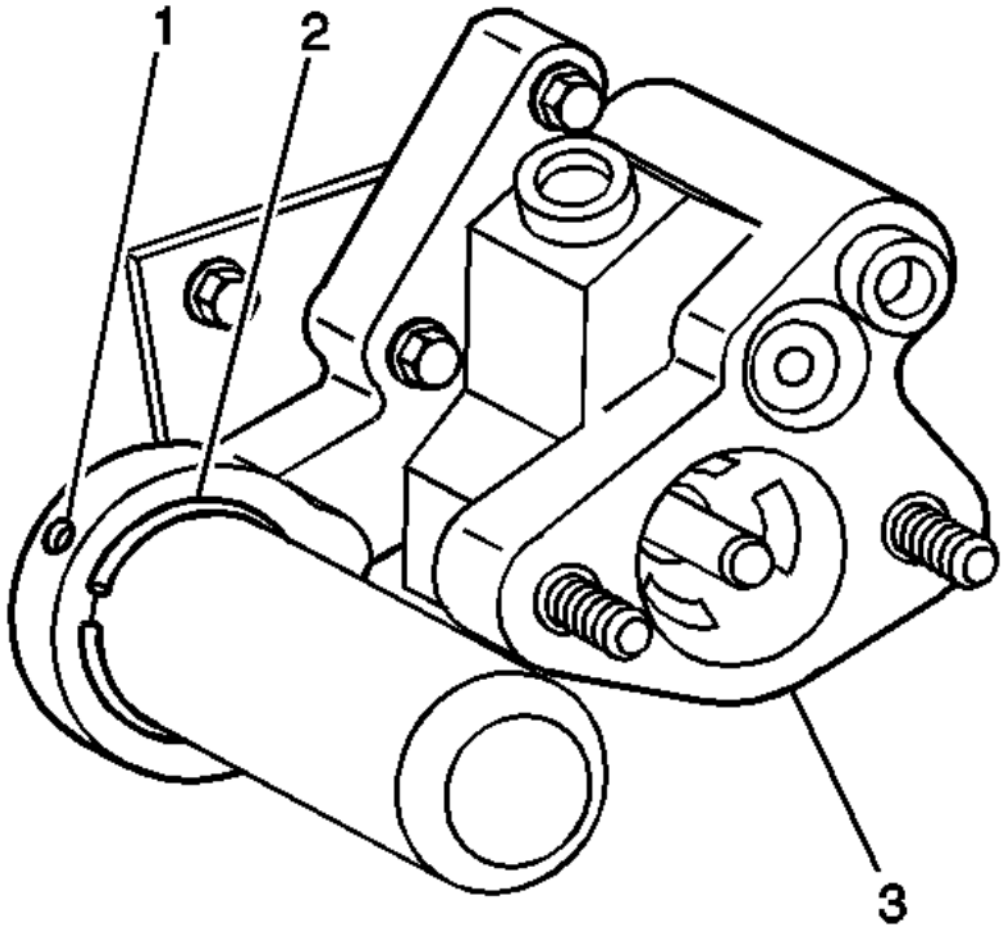


Fig. 42: Identifying Brake Booster Retaining Ring & Access Hole
Courtesy of GENERAL MOTORS CORP.

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

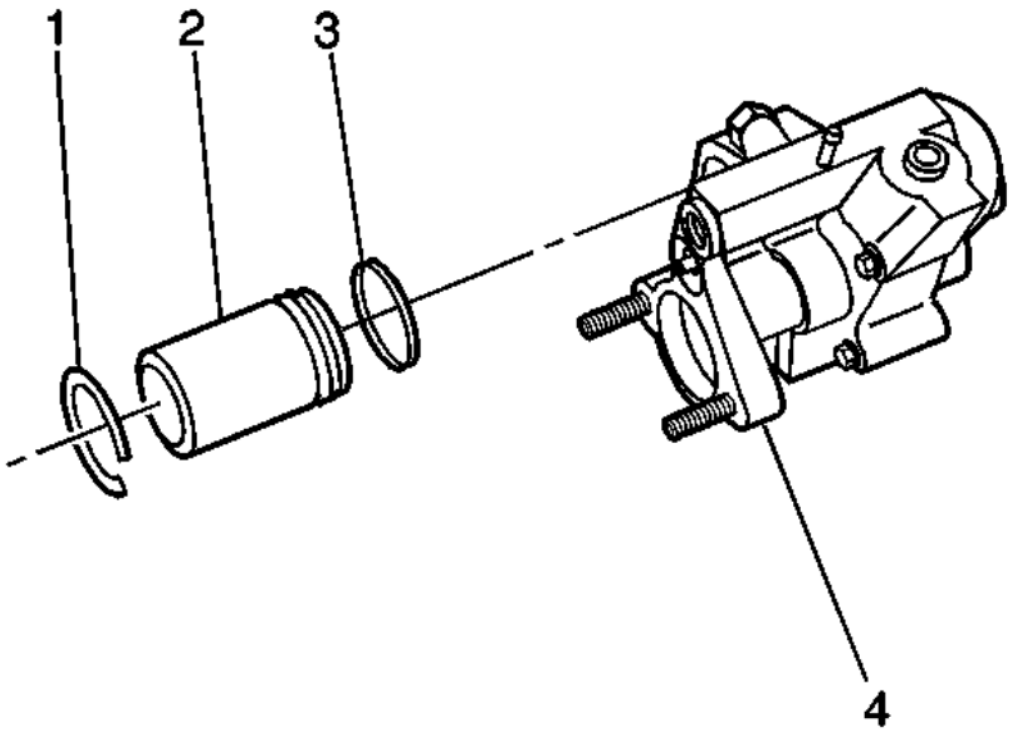


Fig. 43: Identifying Accumulator Components
Courtesy of GENERAL MOTORS CORP.

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

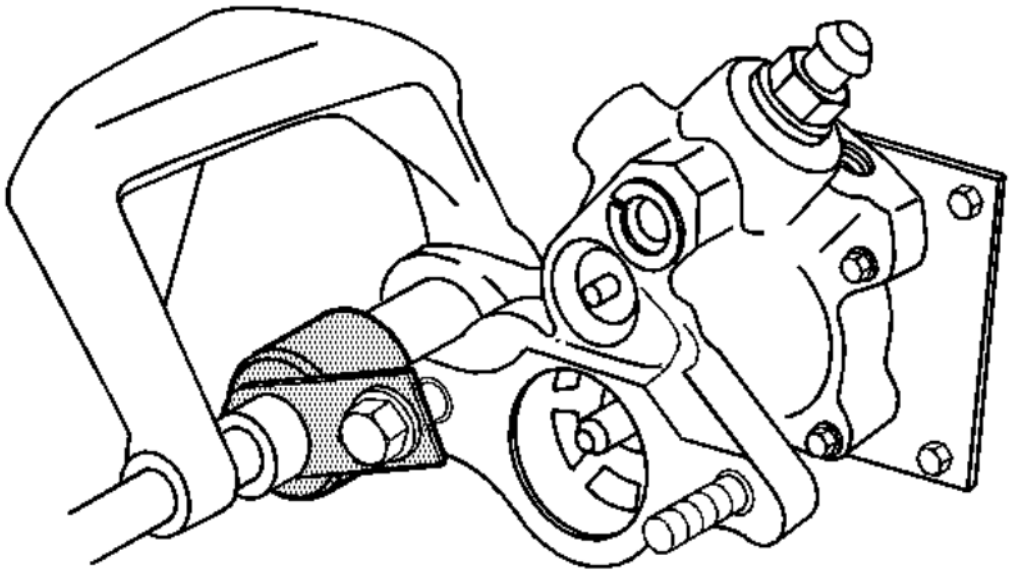


Fig. 44: View Of Accumulator With C-Clamp
Courtesy of GENERAL MOTORS CORP.

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

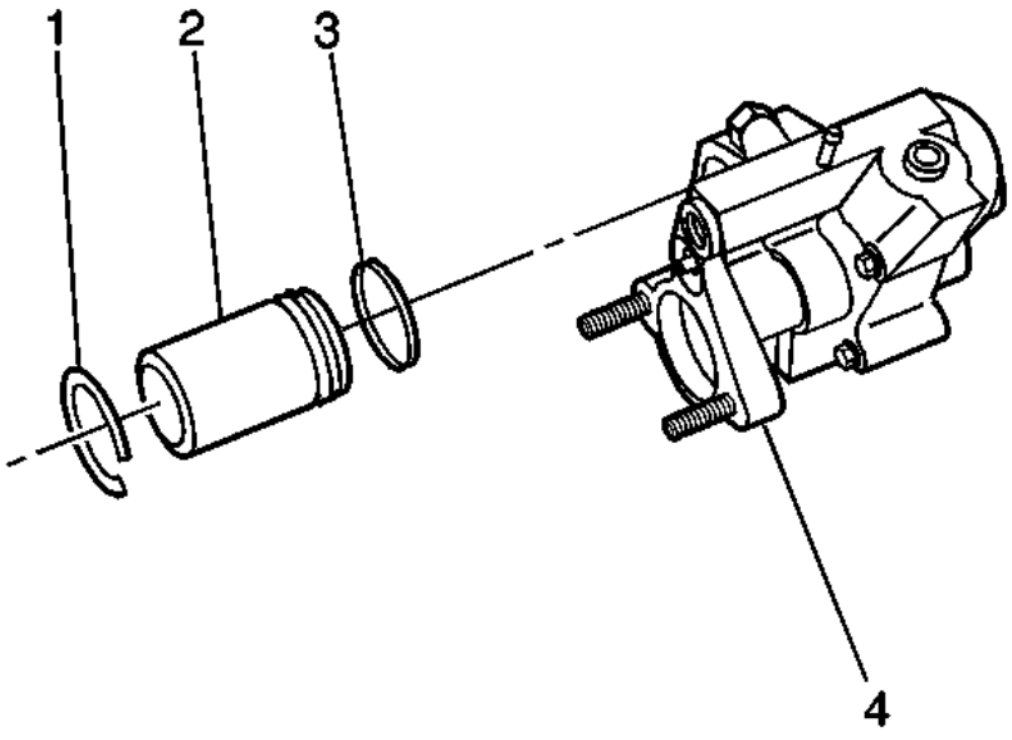


Fig. 45: Identifying Accumulator Components
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

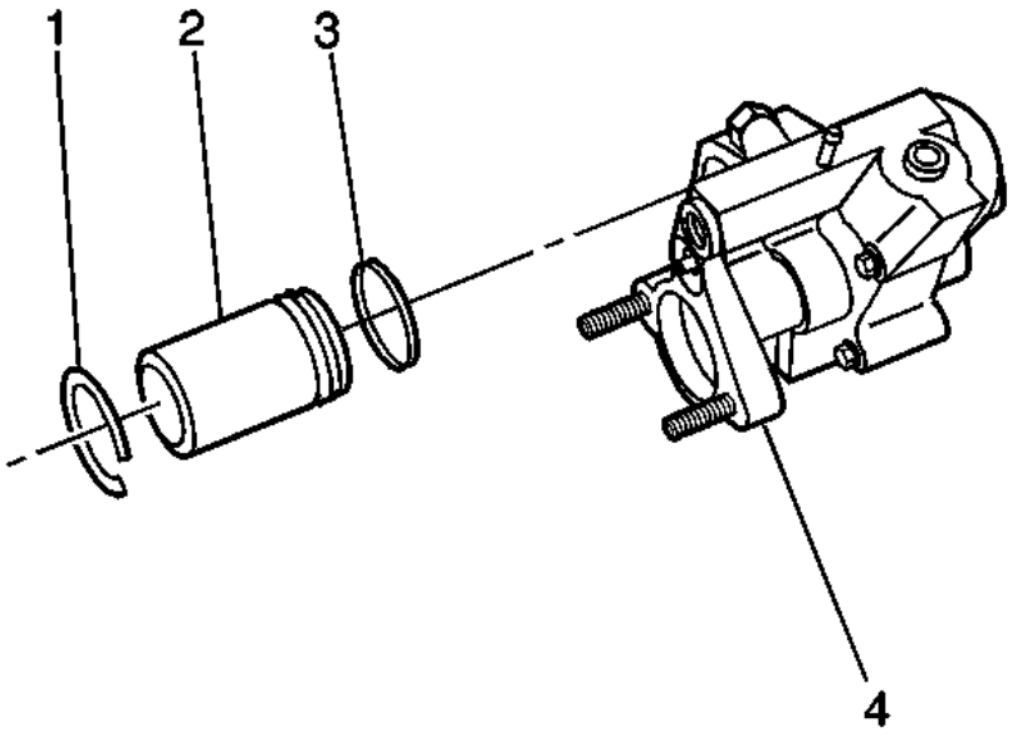


Fig. 46: Identifying Accumulator Components
Courtesy of GENERAL MOTORS CORP.

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

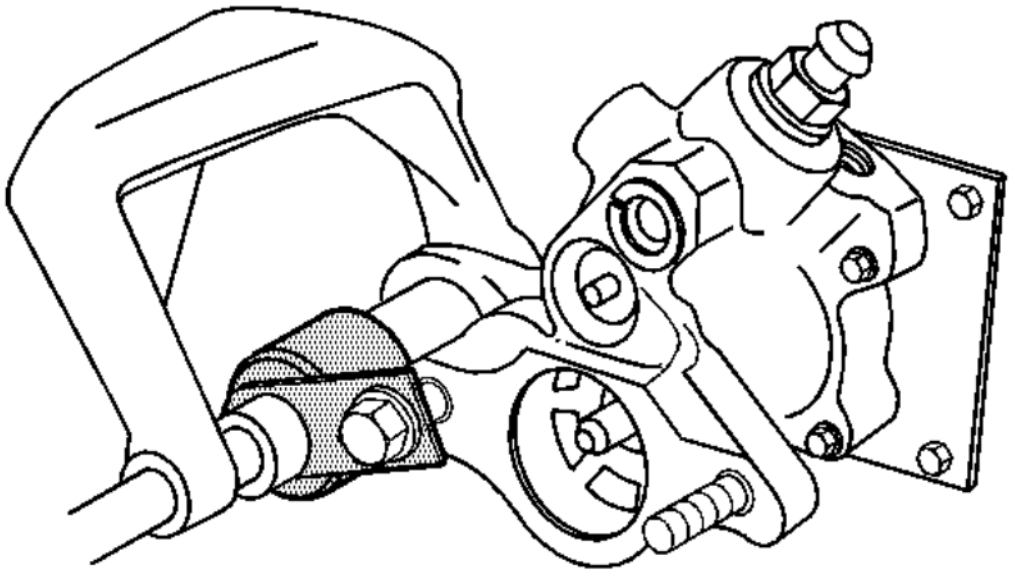


Fig. 47: View Of Accumulator With C-Clamp
Courtesy of GENERAL MOTORS CORP.

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

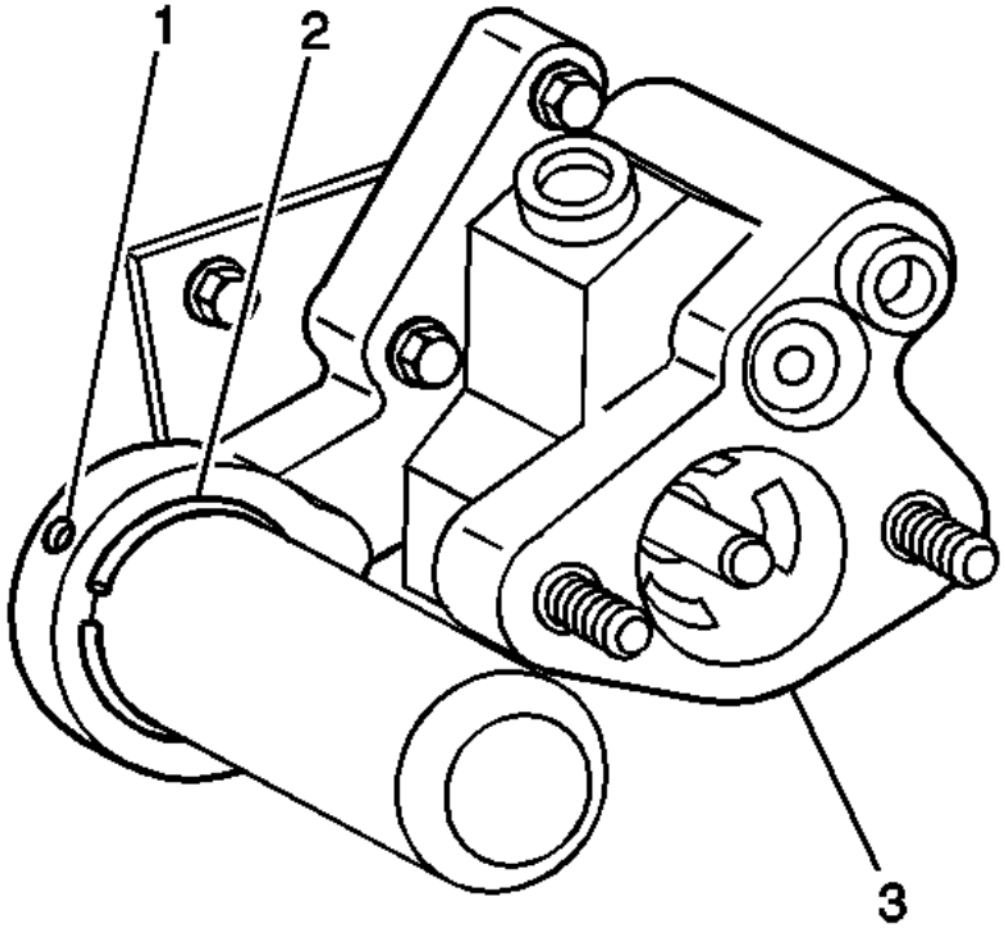


Fig. 48: Identifying Brake Booster Retaining Ring & Access Hole
Courtesy of GENERAL MOTORS CORP.

6. Install the accumulator retainer ring (1).

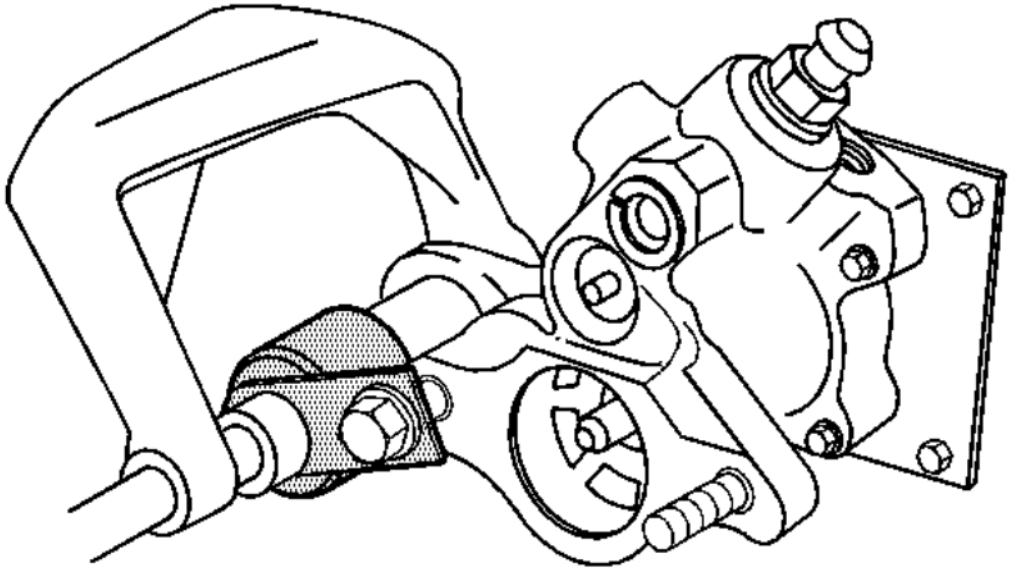


Fig. 49: View Of Accumulator With C-Clamp
Courtesy of GENERAL MOTORS CORP.

7. Release the C-clamp.
8. Remove the nut from the stud.
9. Remove the **J 26889** . See **Special Tools**.
10. Install the master cylinder to the hydraulic booster. Refer to **Master Cylinder Replacement (JD9, JF3, JF7)** or **Master Cylinder Replacement (JH6, JH7)**.
11. Release the park brake and unblock the wheels.

DESCRIPTION AND OPERATION

BRAKE WARNING SYSTEM DESCRIPTION AND OPERATION

Brake Warning Indicator

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

- The body control module (BCM) detects that the park brake is engaged.

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

HYDRAULIC BRAKE SYSTEM DESCRIPTION AND OPERATION

System Component Description

The hydraulic brake system consists of the following:

Hydraulic Brake Master Cylinder Fluid Reservoir

Contains supply of brake fluid for the hydraulic brake system.

Hydraulic Brake Master Cylinder

Converts mechanical input force into hydraulic output pressure.
Hydraulic output pressure is distributed from the master cylinder through 2 hydraulic circuits, supplying front-rear opposed wheel apply circuits.

Hydraulic Brake Pressure Balance Control System

Regulates brake fluid pressure delivered to hydraulic brake wheel circuits, in order to control the distribution of braking force.
Pressure balance control is achieved through dynamic rear proportioning (DRP), which is a function of the ABS modulator. Refer to **ABS Description and Operation (With JL4)** or **ABS Description and Operation (Without JL4)** for specific information on the operation of DRP.

Hydraulic Brake Pipes and Flexible Brake Hoses

Carries brake fluid to and from hydraulic brake system components.

Hydraulic Brake Wheel Apply Components

Converts hydraulic input pressure into mechanical output force.

System Operation

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

BRAKE ASSIST SYSTEM DESCRIPTION AND OPERATION (HYDRAULIC ASSIST)

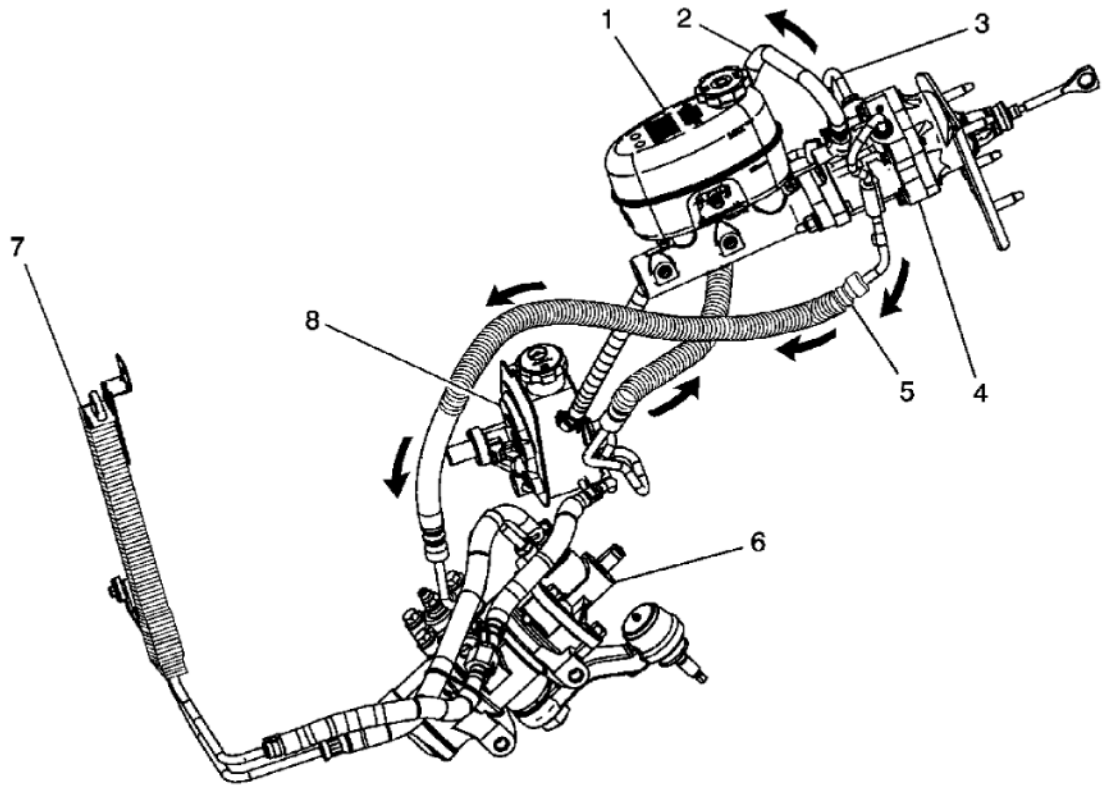


Fig. 50: View of Brake Assist System
Courtesy of GENERAL MOTORS CORP.

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

6	Steering Gear
7	Power Steering Cooler
8	Power Steering Pump

System Component Description

The brake assist system consists of the following:

Brake Pedal

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

Brake Pedal Pushrod

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

Hydraulic Brake Booster

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

Power Steering System

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

System Operation

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

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

steering pump (8).

BRAKE ASSIST SYSTEM DESCRIPTION AND OPERATION (VACUUM 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.

Vacuum Brake Booster

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

Vacuum Source

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

Vacuum Source Delivery System

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

System Operation

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

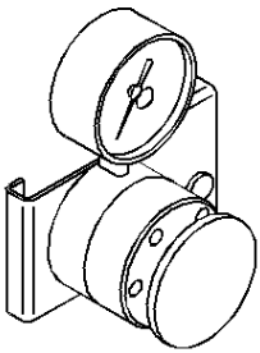
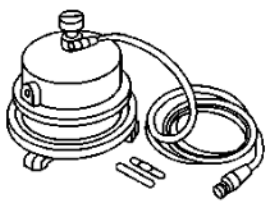
Active Brake Booster

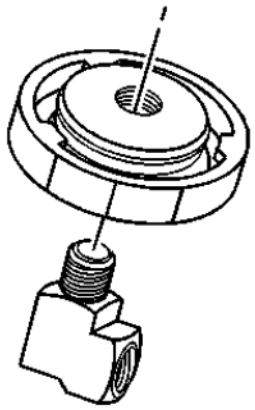
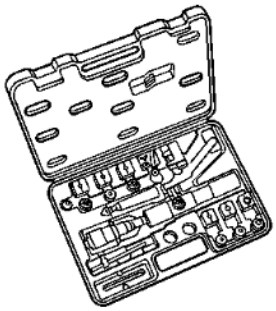
Incorporated into the vacuum brake booster, is an electric solenoid actuator. This actuator can be used to apply the brake booster and thus the master cylinder as commanded by the electronic brake control module (EBCM). During stability events, the EBCM can command the solenoid

actuator in the brake booster to apply the booster. This quickly provides a large volume of pressurized brake fluid to the brake pressure modulator valve (BPMV). The BPMV will then control the flow of fluid to the brake corners to obtain the appropriate response for the vehicle.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

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

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