

Hydraulic Brakes

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Brake Caliper Bleed Screw	12 N·m	106 lb in
Brake Pedal Bracket Bolt	25 N·m	18 lb ft
Brake Pedal Nuts	20 N·m	15 lb ft
Brake Pedal Pivot Nut	54 N·m	40 lb ft
Brake Pipe Tube Nut	16 N·m	12 lb ft
Clutch Master Cylinder Nut	27 N·m	20 lb ft
Combination Valve Pipe Fitting	32 N·m	24 lb ft
Front Brake Hose Clip Bolt	13 N·m	115 lb in
Front Brake Hose Fitting	40 N·m	30 lb ft
Brake Master Cylinder Nut	29 N·m	21 lb ft
Master Cylinder Tube Nut	32 N·m	24 lb ft
Negative Battery Cable	15 N·m	11 lb ft
Rear Brake (Center) Hose Fitting Bolt	21 N·m	15 lb ft
Rear Brake Front Pipe to Rear Brake (Center) Hose	15 N·m	11 lb ft
Rear Brake Hose Fitting	45 N·m	33 lb ft
Rear Brake Pipe to Rear Brake (Center) Hose	24 N·m	18 lb ft
Rear Brake Pipe to Rear Brake Hose	15 N·m	11 lb ft

Brake System Specifications

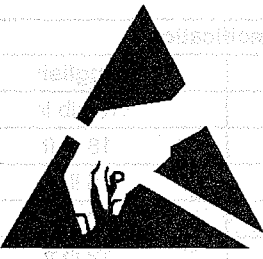
Application	Specification	
	Metric	English
Brake Pedal Travel (see note)	51–89 mm	2.0–3.5 in
Brake Pipe Clearance (Minimum)		
Moving Components	19 mm	0.75 in
Vibrating Components	13 mm	0.50 in
Hydraulic Brake (Glycol) Fluid	GM P/N 1052535 or equivalent DOT-3 fluid	
Important: Brake pedal travel maximum with 445 N (100 lb) of force applied to the pedal with the engine running at idle.		

GM SPO Group Numbers

Application	GM SPO Group Number
Brake Hose	4.000
Brake Pedal	4.000
Brake Pedal Bracket	4.000
Brake Pipe	4.000
Master Cylinder	4.000
Master Cylinder Fluid Level Sensor	4.000
Master Cylinder Reservoir	4.000
Stoplamp Switch	4.000
Vacuum Brake Booster	4.000
Vacuum Brake Booster Check Valve	4.000
Vacuum Brake Booster Hose	4.000

Schematic and Routing Diagrams

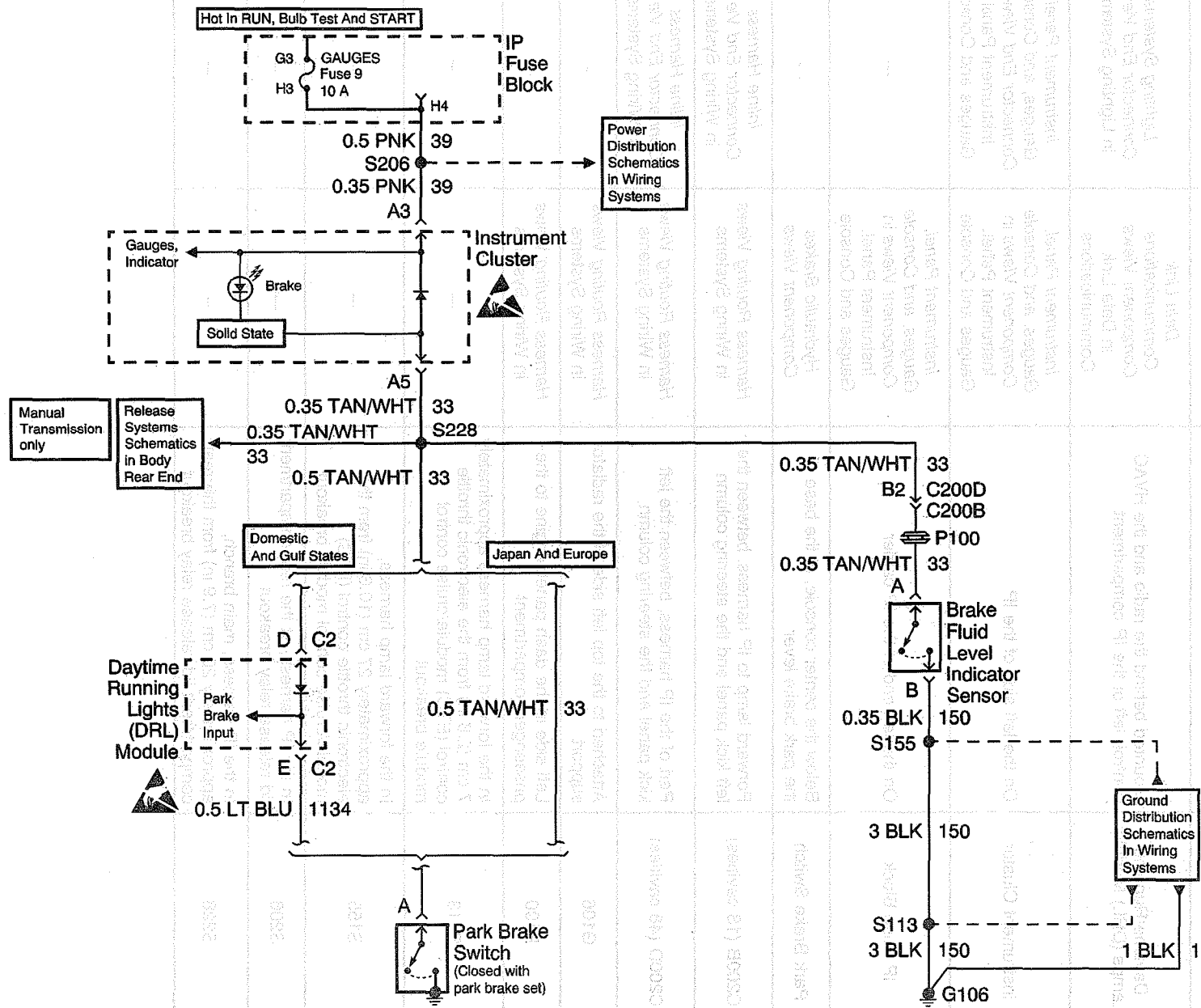
Hydraulic Brakes Schematic Icons

Icon	Icon Definition
	Refer to <i>ESD Notice</i> in Caution and Notices.
19384	
11 lb ft	Rear Brake Pipe to Rear Brake Hose
18 lb ft	Rear Brake Pipe to Rear Brake (Center) Hose
22 lb ft	Rear Brake Hose Fitting
28 lb ft	Rear Brake Front Pipe to Rear Brake (Center) Hose
31 lb ft	Rear Brake (Center) Hose Filling Bolt
32 lb ft	Negative Battery Cable
34 lb ft	Master Cylinder Tube Nut
36 lb ft	Brake Master Cylinder Nut
40 lb ft	Front Brake Hose Fitting
42 lb ft	Front Brake Hose Clip Bolt
48 lb ft	Communication Valve Pipe Fitting
50 lb ft	Brake Pedal Nut
52 lb ft	Brake Pedal Bracket Bolt
58 lb ft	Brake Caliper Bleed Screw

Application	Specification
Brake Pedal Travel (see note)	0.3-0.5 in
Brake Pipe Clearance (Minimum)	0.75 in
Moving Components	0.001 in
Hydraulic Brake (Glycol) Fluid	GM Part 155555 or equivalent DOT-3 fluid
Important: Brake pedal travel maximum with 445 N (100 lb) of force applied to the pedal with a spring return is 10 in.	

Application	GM 390 Group Number
Brake Hose	4.000
Brake Pedal	4.000
Brake Pedal Bracket	4.000
Brake Pipe	4.000
Master Cylinder	4.000
Master Cylinder Bleed Screw	4.000
Master Cylinder Nut	4.000
Stopper Switch	4.000
Valve Brake Booster	4.000
Vacuum Brake Booster Check Valve	4.000
Vacuum Brake Booster Hose	4.000

Brake Warning System Schematics (Brake Fluid Level Sensor, Instrument Cluster and Park Brake Switch)



LOC
DESC



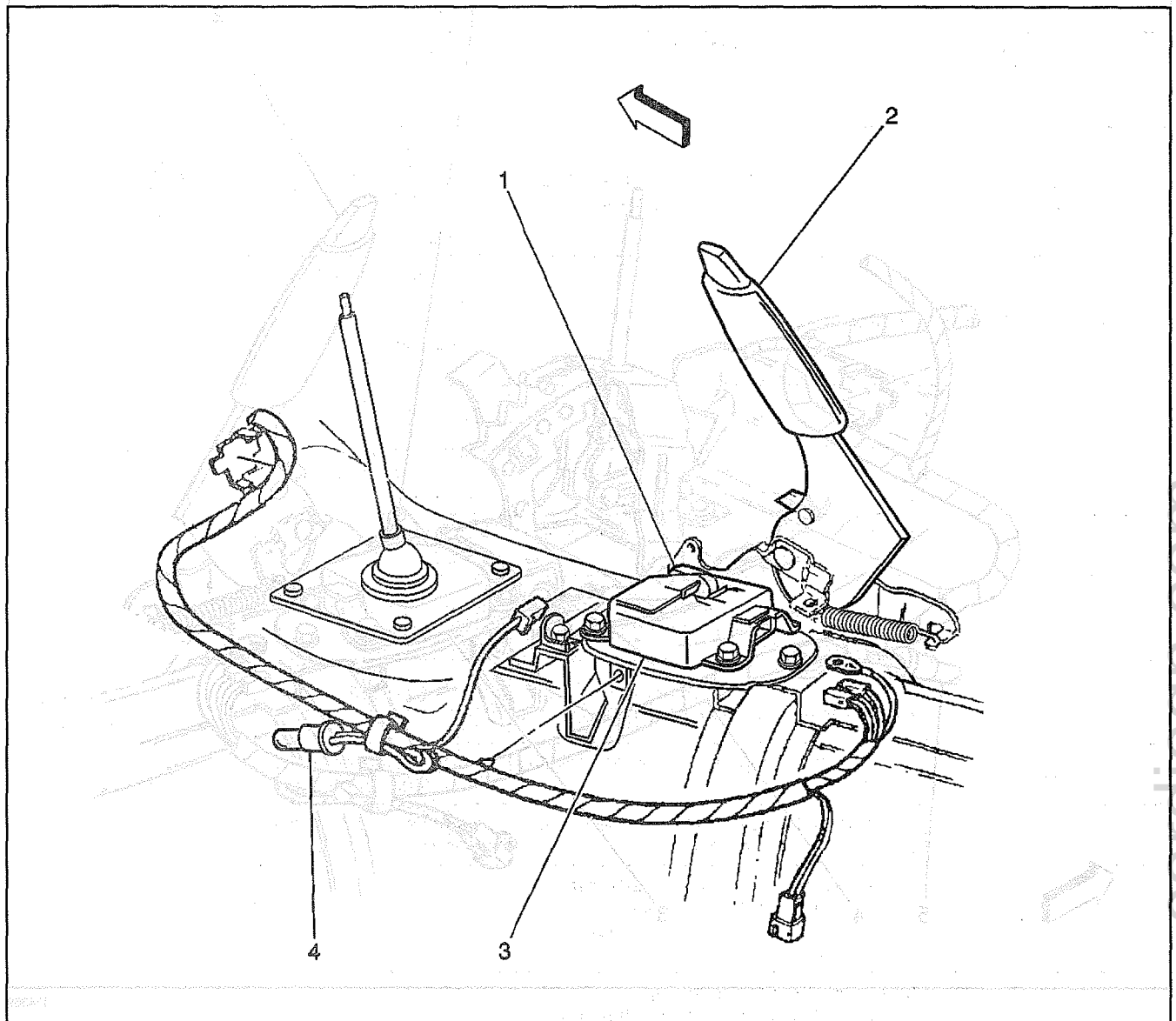
Component Locator

Hydraulic Brakes Components

Name	Location	Locator View	Connector End View
Brake Fluid Level Indicator Sensor	Part of the master cylinder	—	<i>Hydraulic Brakes Connector End Views</i>
Daytime Running Lamps (DRL) Module	Mounted behind the radio and the HVAC control, left of the IP compartment	<i>Data Link Communications Component Views in Data Link Communications</i>	<i>Lighting Systems Connector End Views in Lighting Systems</i>
Instrument Cluster	On the left side of the IP	<i>Instrument Panel, Gauges, and Console Component Views in Instrument Panel, Gauges and Console</i>	<i>Instrument Panel, Gauges, and Console Connector End Views in Instrument Panel, Gauges and Console</i>
IP Fuse Block	On the left end of the IP carrier	<i>Instrument Panel, Gauges, and Console Component Views in Instrument Panel, Gauges and Console</i>	—
Park Brake Switch	Below the center console, at the base of the park brake lever	<i>Hydraulic Brakes Component Views</i>	—
C200B (18 cavities)	Forward lamp to IP harness, between the left kick panel and the steering column	<i>Harness Routing Views in Wiring Systems</i>	<i>Inline Harness Connector End Views in Wiring Systems</i>
C200D (48 cavities)	Part of the IP harness, between the left kick panel and the steering column	<i>Harness Routing Views in Wiring Systems</i>	<i>Inline Harness Connector End Views in Wiring Systems</i>
G106	Attached to the top left side of the radiator support	<i>Harness Routing Views in Wiring Systems</i>	—
P100	Left side in the dash panel, engine to the passenger compartment	<i>Harness Routing Views in Wiring Systems</i>	—
S113	In the forward lamp harness approximately 7 cm (2.8 in) from the electronic throttle control (ETC) module/cruise control module breakout	—	—
S155	In the forward lamp harness, approximately 27 cm (10.6 in) from the electronic throttle control (ETC) module/cruise control module breakout	—	—
S206	In the IP harness, at the rear compartment lid release relay breakout	—	—
S228	In the IP harness, main branch, approximately 20 cm (7.9 in) from the rear compartment lid release relay breakout	—	—

Hydraulic Brakes Component Views

Under Center Console (Manual Transmission)



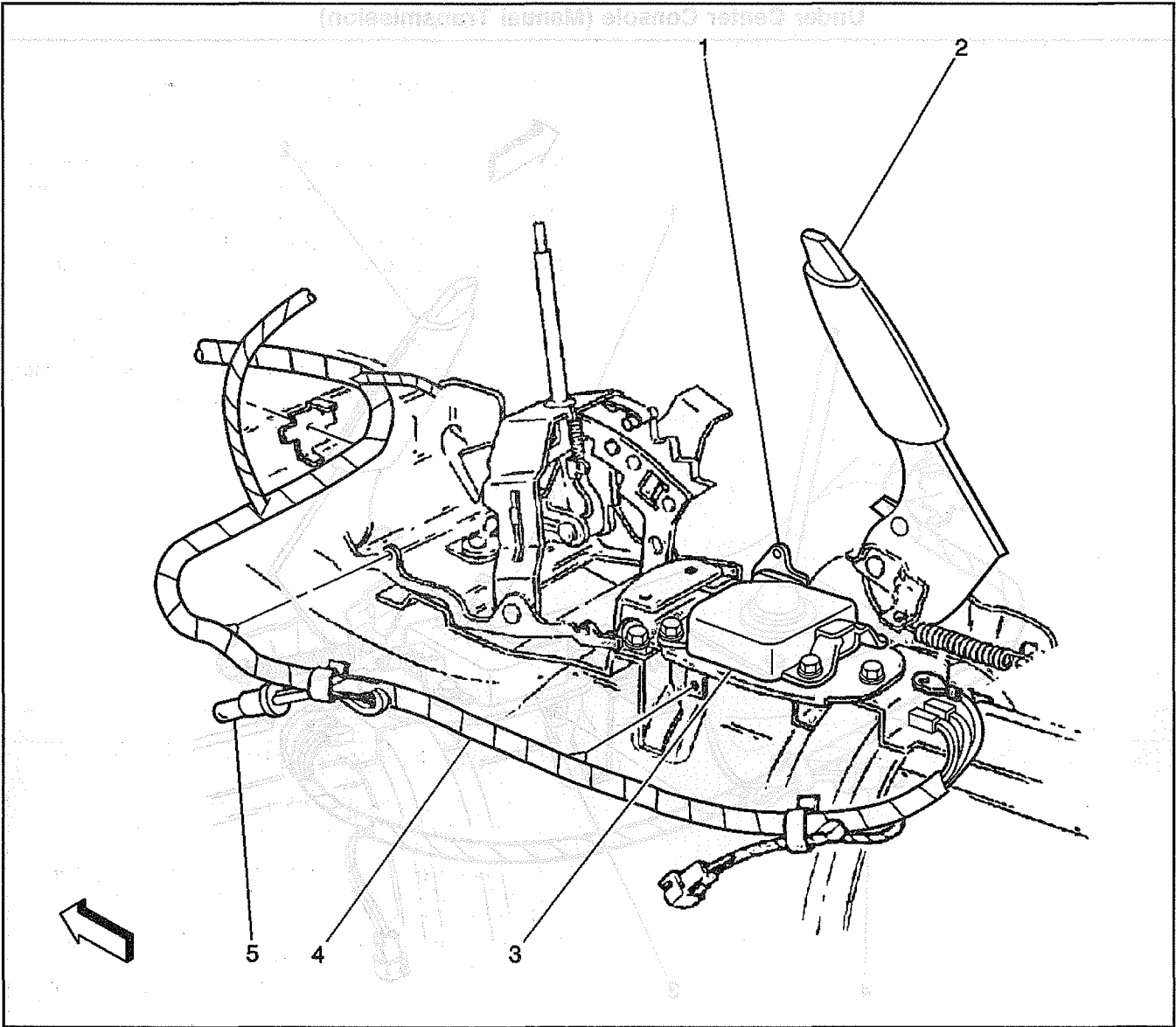
Legend

- (1) Park Brake Switch
- (2) Park Brake Lever
- (3) Inflatable Restraint Sensing and Diagnostic Module (SDM)

- (4) Ash Tray Lamp

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Under Center Console (Automatic Transmission)



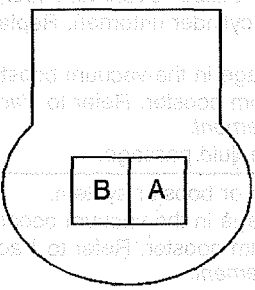
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Legend

- | | |
|--|-----------------------|
| (1) Park Brake Switch | (4) IP Wiring Harness |
| (2) Park Brake Lever | (5) PRNDL Lamp |
| (3) Inflatable Restraint Sensing and Diagnostic Module (SDM) | |

Hydraulic Brakes Connector End Views

Brake Fluid Level Indicator Sensor

			
Connector Part Information		• 1216-2195 • 2 Way F Metri-Pack 150 Series Pull to Seat (BLK)	
Pin	Wire Color	Circuit No.	Function
A	TAN/WHT	33	Brake Warning Indicator Sensor Output
B	BLK	150	Ground

Diagnostic Information and Procedures

A 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.

Hydraulic Brake Diagnostic System Check

Symptom	Causes
Improper Brake Pedal Travel	• Leaking brake line or connection. Refer to Hydraulic Brakes. • Leaking piston seal. Refer to Disc Brakes. • Leaking master cylinder (internal). Replace master cylinder. • Air in brake system. Refer to <i>Hydraulic Brake System Bleeding (Manual Bleeding)</i> or <i>Hydraulic Brake System Bleeding (Pressure Bleeding)</i>. • Contaminated or improper brake fluid. Refer to <i>Brake Fluid and Brake Fluid Handling</i>. • Leaking vacuum or booster system. Refer to Hydraulic Brakes. • Damaged vacuum booster. Refer to <i>Vacuum Brake Booster Replacement</i>. • Uneven brake lining wear. Refer to Disc Brakes. • Brake lining damage by abuse. Refer to Disc Brakes. • Improper thickness variation in rotor. Refer to <i>Brake Rotor Thickness Variation Check</i>. • Excessive lateral runout in rotor. Refer to <i>Brake Rotor Lateral Runout Check</i>. • Brake assembly attachments loose (including splash shield).
	• Improperly adjusted stoplamp switch or cruise control vacuum dump. Refer to <i>Stoolamp Switch Adjustment</i>. • Incorrect vacuum booster pushrod length. • Low brake fluid. Refer to <i>Master Cylinder Reservoir Filling</i>. • Improper rear brake adjustment. • Low engine vacuum.

Hydraulic Brake Diagnostic System Check (cont'd)

Symptom	Causes
Brake Pedal Travel Gradually Increases	- Leaking brake line or connection. Refer to <i>Brake Fluid Leak</i>. - Leaking piston seal. Refer to <i>Brake Caliper Overhaul (Front)</i> or <i>Brake Caliper Overhaul (Rear)</i>. - Leaking master cylinder (internal). Replace master cylinder. - Restricted passage in the vacuum booster. - Damaged vacuum booster. Refer to <i>Vacuum Brake Booster Replacement</i>. - Restricted brake fluid passage.
Excessive Brake Pedal Effort	- Leaking vacuum or booster system. - Restricted passage in the vacuum booster. - Damaged vacuum booster. Refer to <i>Vacuum Brake Booster Replacement</i>. - Worn out brake lining. - Glazed brake lining. - Incorrect brake lining material. - Contaminated brake lining. - Brake lining damage by abuse. - Improper rotor surface finish. - Restricted brake fluid passage. - Brake pedal linkage interference or binding. - Operator riding the brake pedal. - Low engine vacuum. - Excessive vehicle loading. - Rotor corroded.
Excessive Braking Action	- Damaged vacuum booster. Refer to <i>Vacuum Brake Booster Replacement</i>. - Worn out brake lining. - Uneven brake lining wear. - Incorrect brake lining material. - Brake lining damage by abuse. - Improper rotor surface finish. - Scored rotor. Refer to <i>Refinishing Brake Rotors (Front)</i>. - Brake assembly attachments loose (including splash shield).
Brakes Slow To Respond	- Air in the brake system. Refer to <i>Hydraulic Brake System Bleeding (Manual Bleeding)</i> or <i>Hydraulic Brake System Bleeding (Pressure Bleeding)</i>. - Contaminated or improper brake fluid. Refer to <i>Brake Fluid and Brake Fluid Handling</i>. - Leaking vacuum or booster system. Refer to <i>Hydraulic Brakes</i>. - Damaged vacuum booster. Refer to <i>Vacuum Brake Booster Replacement</i>. - Uneven brake lining wear. Refer to <i>Disc Brakes</i>. - Brake lining damage by abuse. Refer to <i>Disc Brakes</i>. - Improper thickness variation in rotor. Refer to <i>Brake Rotor Thickness Variation Check</i>. - Excessive lateral runout in rotor. Refer to <i>Brake Rotor Lateral Runout Check</i>. - Brake assembly attachments loose (including splash shield).
Brakes Slow To Release	- Contaminated or improper brake fluid. Refer to <i>Brake Fluid and Brake Fluid Handling</i>. - Restricted passage in the vacuum booster. - Damaged vacuum booster. Refer to <i>Vacuum Brake Booster Replacement</i>. - Restricted brake fluid passage. - Brake pedal linkage interference or binding. - Sticking caliper or caliper pistons. Refer to <i>Brake Caliper Overhaul (Front)</i> or <i>Brake Caliper Overhaul (Rear)</i>. - Low engine vacuum. - Parking brake not releasing. - Caliper to knuckle clearance.

Hydraulic Brake Diagnostic System Check (cont'd)

Symptom	Causes
Brakes Drag - Leaking brake line or connection. Refer to <i>Brake Fluid Leak</i>. - Leaking piston seal. Refer to <i>Brake Caliper Overhaul (Front)</i> or <i>Brake Caliper Overhaul (Rear)</i>. - Leaking master cylinder (internal). Replace master cylinder. - Air in brake system. Refer to <i>Hydraulic Brake System Bleeding (Manual Bleeding)</i> or <i>Hydraulic Brake System Bleeding (Pressure Bleeding)</i>. - Contaminated or improper brake fluid. Refer to <i>Brake Fluid and Brake Fluid Handling</i>. - Worn out brake lining. - Uneven brake lining wear. - Glazed brake lining. - Incorrect brake lining material. - Contaminated brake lining. - Brake lining damage by abuse. - Improper rotor surface finish. - Scored rotor. Refer to <i>Refinishing Brake Rotors (Front)</i> or <i>Refinishing Brake Rotors (Rear)</i>.	- Contaminated or improper brake fluid. Refer to <i>Brake Fluid and Brake Fluid Handling</i>. - Brake lining damage by abuse. - Excessive lateral runout in rotor. Refer to <i>Brake Rotor Lateral Runout Check</i>. - Brake assembly attachments loose (including splash shield). - Restricted brake fluid passage. - Improperly adjusted stoplamp switch or cruise control vacuum dump. Refer to <i>Stoplamp Switch Adjustment</i>. - Brake pedal linkage interference or binding. - Incorrect vacuum booster pushrod length. - Loose front suspension parts. - Operator riding the brake pedal. - Sticking caliper or caliper pistons. Refer to <i>Brake Caliper Overhaul (Front)</i> or <i>Brake Caliper Overhaul (Rear)</i>. - Parking brake not releasing. - Caliper to knuckle clearance. - Improper rear brake adjustment. - Parking brake cables seized.
Uneven Braking Action (Side to Side) - Restricted brake fluid passage. - Sticking caliper or caliper pistons. Refer to <i>Brake Caliper Overhaul (Front)</i> or <i>Brake Caliper Overhaul (Rear)</i>. - Low brake fluid. Refer to <i>Master Cylinder Reservoir Filling</i>. - Improper rear brake adjustment. - Excessive vehicle loading. - Worn out brake lining. - Uneven brake lining wear. - Glazed brake lining. - Incorrect brake lining material. - Brake lining damage by abuse. - Brake assembly attachments loose (including splash shield). - Loose front suspension parts. - Rotor corroded. - Worn out brake lining. - Uneven brake lining wear. - Glazed brake lining. - Incorrect brake lining material. - Contaminated brake lining.	- Contaminated or improper brake fluid. Refer to <i>Brake Fluid and Brake Fluid Handling</i>. - Worn out brake lining. - Uneven brake lining wear. - Glazed brake lining. - Incorrect brake lining material. - Contaminated brake lining. - Brake lining damage by abuse. - Improper rotor surface finish. - Scored rotor. Refer to <i>Refinishing Brake Rotors (Front)</i> or <i>Refinishing Brake Rotors (Rear)</i>. - Brake assembly attachments loose (including splash shield). - Restricted brake fluid passage. - Incorrect front wheel alignment. - Incorrect tire pressure. - Loose front suspension parts. - Sticking caliper or caliper pistons. Refer to <i>Brake Caliper Overhaul (Front)</i> or <i>Brake Caliper Overhaul (Rear)</i>. - Parking brake not releasing. - Caliper to knuckle clearance. - Rotor corroded.
- Brake lining damage by abuse. - Scored rotor. Refer to <i>Refinishing Brake Rotors (Front)</i> or <i>Refinishing Brake Rotors (Rear)</i>. - Improperly adjusted stoplamp switch or cruise control vacuum dump. Refer to <i>Stoplamp Switch Adjustment</i>. - Incorrect vacuum booster pushrod length. - Sticking caliper or caliper pistons. Refer to <i>Brake Caliper Overhaul (Front)</i> or <i>Brake Caliper Overhaul (Rear)</i>. - Caliper to knuckle clearance. - Worn out brake lining. - Uneven brake lining wear. - Glazed brake lining. - Incorrect brake lining material. - Contaminated brake lining. - Brake lining damage by abuse. - Scored rotor. Refer to <i>Refinishing Brake Rotors (Front)</i> or <i>Refinishing Brake Rotors (Rear)</i>. - Brake assembly attachments loose (including splash shield). - Excessive vehicle loading.	

Hydraulic Brake Diagnostic System Check (cont'd)

Symptom	Causes
Uneven Braking Action (Front to Rear) - Contaminated or improper brake fluid. Refer to <i>Brake Fluid and Brake Fluid Handling</i>. - Brake lining damage by abuse. - Excessive rotor runout. Refer to <i>Brake Rotor</i>. - Brake assembly attachments loose (including splash shield). - Restricted brake fluid passage. - Improperly adjusted stoplamp switch or cruise control vacuum dump. Refer to <i>Stoplamp Switch Adjustment</i>. - Brake pedal linkage interference or binding. - Incorrect vacuum booster pushrod length. - Loose front suspension parts. - Operator riding the brake pedal. - Sticking caliper or caliper pistons. Refer to <i>Brake Caliper Overhaul (Front)</i> or <i>Brake Caliper Overhaul (Rear)</i>. - Parking brake not released. - Caliper to knuckle clearance. - Improper rear brake adjustment. - Parking brake cables seized.	- Leaking brake line or connection. Refer to <i>Brake Fluid Leak</i>. - Leaking piston seal. Refer to <i>Brake Caliper Overhaul (Front)</i> or <i>Brake Caliper Overhaul (Rear)</i>. - Leaking master cylinder (internal). Replace master cylinder. - Air in brake system. Refer to <i>Hydraulic Brake System Bleeding (Manual Bleeding)</i> or <i>Hydraulic Brake System Bleeding (Pressure Bleeding)</i>. - Contaminated or improper brake fluid. Refer to <i>Brake Fluid and Brake Fluid Handling</i>. - Worn out brake lining. - Uneven brake lining wear. - Glazed brake lining. - Incorrect brake lining material. - Contaminated brake lining. - Brake lining damage by abuse. - Improper rotor surface finish. - Scored rotor. Refer to <i>Refinishing Brake Rotors (Front)</i> or <i>Refinishing Brake Rotors (Rear)</i>. - Brake assembly attachments loose (including splash shield). - Restricted brake fluid passage. - Sticking caliper or caliper pistons. Refer to <i>Brake Caliper Overhaul (Front)</i> or <i>Brake Caliper Overhaul (Rear)</i>. - Low brake fluid. Refer to <i>Master Cylinder Reservoir Filling</i>. - Improper rear brake adjustment. - Excessive Vehicle Loading.
Scraping Noise from Brakes - Improper rear brake adjustment. - Scored rotor. Refer to <i>Refinishing Brake Rotors (Front)</i> or <i>Refinishing Brake Rotors (Rear)</i>. - Brake assembly attachments loose (including splash shield). - Restricted brake fluid passage. - Incorrect front wheel alignment. - Incorrect tire pressure. - Loose front suspension parts.	- Worn out brake lining. - Uneven brake lining wear. - Contaminated brake lining. - Brake lining damage by abuse. - Brake assembly attachments loose (including splash shield). - Loose front suspension parts. - Rotor corroded.
Brakes Squeak without Application - Sticking caliper or caliper pistons. Refer to <i>Brake Caliper Overhaul (Front)</i> or <i>Brake Caliper Overhaul (Rear)</i>. - Parking brake not released. - Caliper to knuckle clearance. - Rotor corroded.	- Worn out brake lining. - Uneven brake lining wear. - Glazed brake lining. - Incorrect brake lining material. - Contaminated brake lining. - Brake lining damage by abuse. - Scored Rotor. Refer to <i>Refinishing Brake Rotors (Front)</i> or <i>Refinishing Brake Rotors (Rear)</i>. - Improperly adjusted stoplamp switch or cruise control vacuum dump. Refer to <i>Stoplamp Switch Adjustment</i>. - Incorrect vacuum booster pushrod length. - Sticking caliper or caliper pistons. Refer to <i>Brake Caliper Overhaul (Front)</i> or <i>Brake Caliper Overhaul (Rear)</i>. - Caliper to knuckle clearance.
Brakes Squeak During Application	- Worn out brake lining. - Uneven brake lining wear. - Glazed brake lining. - Incorrect brake lining material. - Contaminated brake lining. - Brake lining damage by abuse. - Scored rotor. Refer to <i>Refinishing Brake Rotors (Front)</i> or <i>Refinishing Brake Rotors (Rear)</i>. - Brake assembly attachments loose (including splash shield). - Excessive vehicle loading.

Hydraulic Brake Diagnostic System Check (cont'd)

Symptom	Causes
Brakes Chatter (Roughness)	• Scored rotor. Refer to <i>Refinishing Brake Rotors (Front)</i> or <i>Refinishing Brake Rotors (Rear)</i>. • Improper thickness variation in rotor. Refer to <i>Brake Rotor Thickness Variation Check</i>. • Excessive lateral runout in rotor. Refer to <i>Brake Rotor Lateral Runout Check</i>. • Brake assembly attachments loose (including splash shield). • Loose front suspension parts. • Out-of-balance wheel assembly. • Improperly torqued wheel nuts. • Rotor corroded. • Grease or dirt on the rotor.
Brakes Groan at the End of Stop	• Incorrect lining material. • Contaminated brake lining. • Brake lining damage by abuse. • Grease or dirt on the rotor.
Brake Warning Lamp ON	• Leaking brake line or connection. Refer to <i>Brake Fluid Leak</i>. • Leaking piston seal. Refer to <i>Brake Caliper Overhaul (Front)</i> or <i>Brake Caliper Overhaul (Rear)</i>. • Leaking master cylinder (internal). Replace master cylinder. Refer to <i>Master Cylinder Replacement</i>. • Air in brake system. Refer to <i>Hydraulic Brake System Bleeding (Manual Bleeding)</i> or <i>Hydraulic Brake System Bleeding (Pressure Bleeding)</i>. • Contaminated or improper brake fluid. Refer to <i>Brake Fluid and Brake Fluid Handling</i>. • Parking brake switch circuit grounded. • Parking brake not releasing. • Low brake fluid. Refer to <i>Master Cylinder Reservoir Filling</i>.
Premature Lining Wear	• Leaking brake line or connection. Refer to <i>Brake Fluid Leak</i>. • Incorrect lining material. • Brake lining damaged by abuse. • Improperly adjusted stoplamp switch or cruise control vacuum dump. Refer to <i>Stoplamp Switch Adjustment</i>. • Brake pedal linkage interference or binding. • Incorrect vacuum booster pushrod length. • Operator riding brake pedal. • Sticking caliper or caliper pistons. Refer to <i>Brake Caliper Overhaul (Front)</i> or <i>Brake Caliper Overhaul (Rear)</i>. • Parking brake not releasing. • Caliper to knuckle clearance. • Improper rear brake adjustment. • Excessive vehicle loading. • Parking brake cable seized.
Parking Brake Won't Hold	• Worn out brake lining. • Uneven brake lining wear. • Incorrect lining material. • Contaminated brake lining. • Brake lining damaged by abuse. • Improper rotor surface finish. • Sticking caliper or caliper pistons. Refer to <i>Brake Caliper Overhaul (Front)</i> or <i>Brake Caliper Overhaul (Rear)</i>. • Parking brake cables seized.
Parking Brake Won't Release	• Sticking caliper or caliper pistons. Refer to <i>Brake Caliper Overhaul (Front)</i> or <i>Brake Caliper Overhaul (Rear)</i>. • Parking brake cables seized.

Hydraulic Brake Diagnostic System Check (cont'd)

Symptom	Causes
Brake Pulsation	• Incorrect lining material. • Contaminated brake lining. • Brake linings damaged by abuse. • Scored rotor. Refer to <i>Refinishing Brake Rotors (Front)</i> or <i>Refinishing Brake Rotors (Rear)</i>. • Improper thickness variation in rotor. Refer to <i>Brake Rotor Thickness Variation Check</i>. • Excessive lateral runout in rotor. Refer to <i>Brake Rotor Lateral Runout Check</i>. • Loose front suspension parts. • Out-of-balance wheel assembly. • Improperly torqued wheel nuts. • Rotor corroded.
Brake Pulls	• Worn out brake lining. • Uneven brake lining wear. • Incorrect lining material. • Contaminated brake lining. • Brake linings damaged by abuse. • Improper rotor surface finish. • Scored rotor. Refer to <i>Refinishing Brake Rotors (Front)</i> or <i>Refinishing Brake Rotors (Rear)</i>. • Restricted brake fluid passage. • Incorrect front wheel alignment. • Incorrect tire pressure. • Loose front suspension parts. • Sticking caliper or caliper pistons. Refer to <i>Brake Caliper Overhaul (Front)</i> or <i>Brake Caliper Overhaul (Rear)</i>. • Caliper to knuckle clearance. • Rotor corroded.

Symptoms - Hydraulic Brakes

Important: Review the system description in order to familiarize yourself with the system functions. Refer to one of the following descriptions:

- *Master Cylinder Description*
- *Vacuum Brake Booster Description*
- *Brake Warning System Description*

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Brake Warning System. Refer to one of the following descriptions: *Checking Aftermarket Accessories* in Wiring Systems.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

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

Symptom List

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

- *Brake Warning Indicator Always On*
- *Brake Warning Indicator Inoperative*
- *Brake System Testing*
- *Brake Pedal Travel*
- *Brake Fluid Leak*

Brake Warning Indicator Always On

Step	Action	Value(s)	Yes	No
Important: - Check for ABS diagnostic trouble codes prior to performing this diagnosis. Refer to <i>A Diagnostic System Check - ABS</i>. - Check the brake fluid level prior to performing this diagnosis. Refer to <i>Master Cylinder Reservoir Filling</i>.				
1	Did you review the system operation and perform the necessary inspections?	—	Go to Step 2	Go to Symptoms - Hydraulic Brakes
2	Turn the ignition to the RUN position. Does the brake warning indicator illuminate during the bulb test and then turn off?	—	Go to Testing for Intermittent and Poor Connections in Wiring Systems	Go to Step 3
3	1. Disconnect the brake fluid level indicator sensor. 2. Turn the ignition switch to the RUN position. Is the brake warning indicator still on?	—	Go to Step 4	Go to Step 9
4	1. Disconnect the park brake switch. 2. Turn the ignition switch to the RUN position. Is the brake warning indicator still on?	—	Go to Step 5	Go to Step 10
5	Determine if this vehicle is either of the following types: • Domestic • Gulf States Is the vehicle one of the above types?	—	Go to Step 6	Go to Step 7
6	1. Disconnect the daytime running lights (DRL) module. 2. Turn the ignition switch to the RUN position. Is the brake warning indicator on?	—	Go to Step 7	Go to Step 11
7	Test for and repair a short to ground in circuit 33. Refer to <i>Circuit Testing</i> and <i>Wiring Repairs</i> in Wiring Systems. Did you find and repair a short?	—	Go to Step 13	Go to Step 8
8	Replace the instrument cluster. Refer to <i>IP Cluster Replacement</i> in Instrument Panel, Gauges, and Console. Did you complete the replacement?	—	Go to Step 13	—
9	Replace the brake fluid level indicator sensor. Did you complete the replacement?	—	Go to Step 13	—
10	Replace the park brake switch. Did you complete the replacement?	—	Go to Step 13	—
11	Test for and repair a short to ground in circuit 1134. Refer to <i>Circuit Testing</i> and <i>Wiring Repairs</i> in Wiring Systems. Did you find and repair a short?	—	Go to Step 13	Go to Step 12
12	Replace the DRL module. Refer to <i>Daytime Running Lights (DRL) Control Module Replacement</i> in Lighting. Did you complete the replacement?	—	Go to Step 13	—
13	Operate the system in order to verify the repair. Did you correct the condition?	—	System OK	Go to Step 3

Brake Warning Indicator Inoperative

Step	Action	Value(s)	Yes	No
1	Did you review the system operation and perform the necessary inspections?	—	Go to Step 2	Go to Symptoms - Hydraulic Brakes
2	1. Turn the ignition to the RUN position. 2. Set the park brake. Does the brake warning indicator illuminate?	—	Go to Testing for Intermittent and Poor Connections in Wiring Systems	Go to Step 3
3	Did the brake warning indicator illuminate for the bulb test and then turn off?	—	Go to Step 4	Go to Step 10
4	1. Disconnect the brake fluid level indicator sensor. 2. Connect a 10A fused jumper from the brake fluid level indicator sensor connector terminal A to terminal B. Refer to <i>Circuit Testing</i> in Wiring Systems. 3. Turn the ignition switch to the RUN position. Is the brake warning indicator on?	—	Go to Step 5	Go to Step 7
5	Test for and repair a poor connection at the brake fluid level indicator sensor. Refer to <i>Testing for Intermittent and Poor Connections</i> and <i>Connector Repairs</i> in Wiring Systems. Did you find and repair a poor connection?	—	Go to Step 23	Go to Step 6
6	Replace the brake fluid level indicator sensor. Refer to <i>Master Cylinder Fluid Level Sensor Replacement</i> . Did you complete the replacement?	—	Go to Step 23	—
7	1. Connect a 10A fused jumper from the brake fluid level indicator sensor terminal A to ground. Refer to <i>Circuit Testing</i> in Wiring Systems. 2. Turn the ignition switch to the RUN position. Is the brake warning indicator on?	—	Go to Step 8	Go to Step 9
8	Repair the open in circuit 150 between the brake fluid level indicator sensor terminal B and S155. Refer to <i>Wiring Repairs</i> in Wiring Systems. Did you complete the repair?	—	Go to Step 23	—
9	Repair the open or poor connection in circuit 33 between the brake fluid level indicator sensor terminal A and S228. Refer to <i>Wiring Repairs</i> or <i>Connector Repairs</i> in Wiring Systems. Did you complete the repair?	—	Go to Step 23	—
10	Replace the instrument cluster. Refer to <i>IP Cluster Replacement</i> in Instrument Panel, Gauges, and Console. Did you complete the replacement?	—	Go to Step 23	—
11	1. Disconnect the park brake switch connector. 2. Connect a 10A fused jumper from the park brake switch connector to ground. Refer to <i>Circuit Testing</i> in Wiring Systems. 3. Turn the ignition switch to the RUN position. Is the brake warning indicator on?	—	Go to Step 12	Go to Step 15
12	Test for and repair a poor connection at the park brake switch. Refer to <i>Testing for Intermittent and Poor Connections</i> and <i>Connector Repairs</i> in Wiring Systems. Did you find and repair a poor connection?	—	Go to Step 23	Go to Step 13

Brake Warning Indicator Inoperative (cont'd)

Step	Action	Value(s)	Yes	No
13	Test and repair a poor connection at the park brake switch ground. Refer to <i>Testing for Intermittent and Poor Connections</i> and <i>Connector Repairs</i> in Wiring Systems. Did you find and repair a poor connection?	—	Go to Step 23	Go to Step 14
14	Replace the park brake switch. Did you complete the replacement?	—	Go to Step 23	—
15	Determine if this vehicle is either of the following types: • Domestic • Gulf States Is the vehicle one of the above types?	—	Go to Step 16	Go to Step 19
16	1. Leave the 10A fused jumper connected between the park brake switch connector and ground. 2. Disconnect the daytime running lights (DRL) module connector C2. 3. Connect a fused jumper between the DRL module connector C2 terminal D and terminal E. Refer to <i>Circuit Testing</i> in Wiring Systems. 4. Turn the ignition switch to the RUN position. Is the brake warning indicator on?	—	Go to Step 21	Go to Step 17
17	1. Connect a 10A fused jumper from the DRL module connector C2 terminal D to the ground. Refer to <i>Circuit Testing</i> in Wiring Systems. 2. Turn the ignition switch to the RUN position. 3. Is the brake warning indicator on?	—	Go to Step 18	Go to Step 19
18	Repair the open in circuit 1134 between the DRL module connector C2 terminal E and the park brake switch. Refer to <i>Wiring Repairs</i> in Wiring Systems. Did you complete the repair?	—	Go to Step 23	—
19	Test for and repair a poor connection at the instrument cluster connector terminal A5. Refer to <i>Testing for Intermittent and Poor Connections</i> and <i>Connector Repairs</i> in Wiring Systems. Did you find and repair a poor connection?	—	Go to Step 23	Go to Step 20
20	Repair the open in circuit 33 between the instrument cluster connector terminal A5 and the DRL module connector C2 terminal D (Domestic or Gulf States) or the park brake switch (Europe or Japan). Refer to <i>Wiring Repairs</i> in Wiring Systems. Did you complete the repair?	—	Go to Step 23	—
21	Test for and repair a poor connection at the DRL module connector C2 terminal D and terminal E. Refer to <i>Testing for Intermittent and Poor Connections</i> and <i>Connector Repairs</i> in Wiring Systems. Did you find and repair a poor connection?	—	Go to Step 23	Go to Step 22
22	Replace the DRL module. Refer to <i>Daytime Running Lights (DRL) Control Module Replacement</i> in Lighting. Did you complete the replacement?	—	Go to Step 23	—
23	Operate the system in order to verify the repair. Did you correct the condition?	—	System OK	Go to Step 3

Brake System Testing

Test the brakes on a roadway that meets all of the following conditions:

- Dry
- Clean
- Reasonably smooth
- Level

Test the brakes at different vehicle speeds with both light and heavy brake pedal force.

Do not test the brakes on a roadway with the following conditions because the tires will not grip the road equally:

- Wet
- Greasy
- Covered with loose dirt

Do not test the brakes on a crowned roadway because the weight of the vehicle will be thrown toward the wheels on one side.

Do not test the brakes on a rough roadway because the wheels will tend to bounce.

Brake Pedal Travel**Tools Required**

J 28662 Brake Pedal Effort Gauge

One of the following conditions may be the cause of most low brake pedal problems:

- Air in the brake system. Bleed the system until the air is purged. Refer to *Hydraulic Brake System Bleeding (Manual Bleeding)* or *Hydraulic Brake System Bleeding (Pressure Bleeding)*.
- Misadjusted rear drum brakes. Inspect the rear brake adjustment.

The following conditions may be other less frequent causes of excessive brake pedal travel:

- Incorrect pushrod length
- Malfunctioning rear brake shoe adjusters
- Excessively worn pads
- Brake hydraulic system leakage

One of the following conditions is usually the cause of high brake pedal effort problems:

- Low engine vacuum
- Vacuum leak
- Improperly functioning vacuum booster

1. Install the *J 28662* onto the brake pedal.
2. Hook the end of the tape measure over the top edge of the pedal.
3. Measure the distance from the top edge of the pedal to the rim of the steering wheel.
4. Block the tires and the wheels.
5. Run the engine at idle.
6. Put the range selector lever in NEUTRAL.
7. Apply 445 N (100 lb) of force to the brake pedal.
8. Remeasure the distance from the top edge of the pedal to the rim of the steering wheel. The difference between both of the readings is the actual brake pedal travel. The brake pedal travel should be between 51–89 mm (2.0–3.5 in).

Brake Fluid Leak

1. Run the engine at idle.
2. Put the range selector lever in NEUTRAL.
3. Depress the brake pedal. Hold the brake pedal with constant foot pressure.
4. If the pedal gradually falls away with constant pressure, the brake hydraulic system may be leaking. Inspect the hydraulic system for any suspected leaks.
5. Inspect the master cylinder fluid level.
 - A slight drop in the master cylinder reservoir level results from normal pad wear. The reservoir may be as low as 25.4 mm (1.0 in) from the top if the pads are worn. This condition is not abnormal.
 - An abnormally low level in the reservoir indicates a leak in the system. The brake hydraulic system may be leaking either internally or externally. Refer to *Hydraulic Brake Diagnostic System Check*. The system may appear to pass this test but still have a slight leakage.
6. Inspect the brake pipe and the brake hose connections for brake fluid leaks.
7. If any leaks are found, replace the hose or the pipe.
8. If any hoses or pipes are replaced, inspect the connecting brake component for damage. If damage is found, rebuild or replace the component.
9. Inspect the brake caliper boots and rear wheel cylinder boots for leaks.
10. If any leaks are found, rebuild or replace the part in question. Refer to Disc Brakes.

Brake Hose and Pipe Inspection

Notice: Do not allow components to hang from the flexible brake hoses as damage to the hoses may occur. Some brake hoses have protective rings or covers to prevent direct contact of the hose with other chassis parts. Besides causing possible structural damage to the hose, excessive tension could cause the hose rings to move out of their proper locations.

Inspect the brake hoses at least twice a year for the following conditions:

- Road hazard damage
- Cracks
- Chafing of the outer cover
- Leaks
- Blisters

Use a light and a mirror for an adequate inspection. Replace any hoses with any of the above conditions.

Master Cylinder Diagnosis

Notice: Avoid spilling brake fluid on any of the painted vehicle's surfaces, wiring, cables or electrical connectors. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, immediately flush the area with water to minimize potential for damage.

Visual Inspection

- Check for a cracked casting or brake fluid leaks around the master cylinder. A leak will have at least one drop of fluid. A damp condition is normal.
- Check the pedal linkage for binding and for incorrect pushrod length. Disassemble the master cylinder if you do not find improper brake pedal travel or brake pedal binding.
- Check the master cylinder for swollen or elongated primary piston seals. If you find swollen seals, refer to *Brake Fluid and Brake Fluid Handling*.

Low Pressure Check

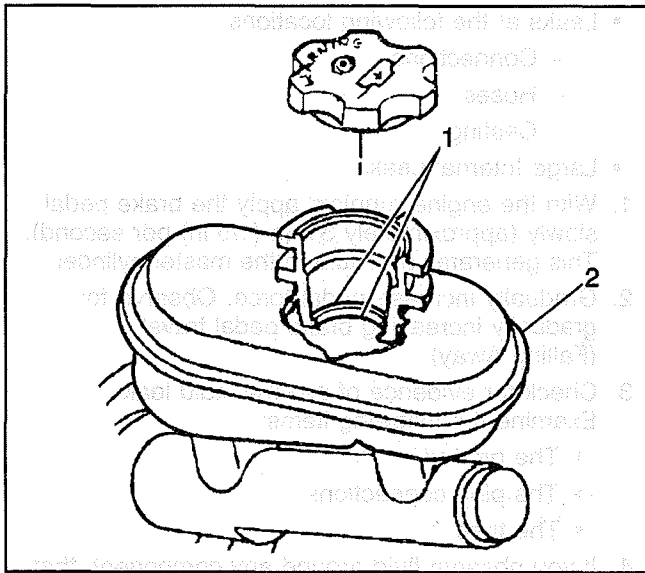
This procedure inspects the following conditions:

- Internal seal damage
 - Porosity
 - Component bore integrity
1. With the ignition switch in the OFF position, pump the brake pedal in order to relieve the vacuum.
 - Pump the brake pedal five times for vacuum-assisted brakes.
 - Pump the brake pedal twenty-five times for hydraulic-assisted brakes.
 2. Apply the brake pedal slowly (approximately 3 mm {1/8 in} per second). This generates pressure in the master cylinder.
 3. Gradually increase pedal force. Observe for gradually increasing brake pedal travel (Falling Away).
 4. If the brake pedal travel tends to gradually increase, perform the High Pressure Check.
 5. If the High Pressure Check does not locate a leak, then the master cylinder has an internal leak.

High Pressure Check

This procedure tests for the following conditions:

- Leaks at the following locations:
 - Connections
 - Hoses
 - Casting
 - Large Internal Leaks
1. With the engine running, apply the brake pedal slowly (approximately 3 mm {1/8 in} per second). This generates pressure in the master cylinder.
 2. Gradually increase pedal force. Observe for gradually increasing brake pedal travel (Falling Away).
 3. Check for evidence of external fluid leaks. Examine the following items:
 - The ground
 - The pipe connections
 - The tires
 4. If you observe fluid around any component, that component has failed and needs to be replaced.
 5. If you find a leak at a connection, tighten the connection to specification, Refer to *Fastener Tightening Specifications*.
 6. Perform the High Pressure Check again.



182425

Repair Instructions

Master Cylinder Reservoir Filling

Filling The Master Cylinder Reservoir

Caution: Use only **SUPREME 11** or equivalent DOT 3 brake fluid from a clean, sealed container. Do not use fluid from an open container that may be contaminated with water. Improper or contaminated fluid will result in damage to components or loss of braking, with possible personal injury.

Ensure that the master cylinder reservoir (2) is kept properly filled. An adequate reserve of brake fluid will prevent air from entering the brake hydraulic system. However, because heat absorbed from the brakes and the engine expands the brake fluid, do not overfill the reservoir.

A drop in the brake fluid level is normal as the pads wear. If the master cylinder reservoir is filled before new pads are installed, brake fluid may spill over once the new pads are in place. Unless there is a leak in the brake hydraulic system, or the brake hydraulic system has been serviced, do not top off the master cylinder reservoir.

Clean the master cylinder reservoir cap thoroughly before removal in order to avoid contaminating the reservoir. Remove the reservoir cap and the reservoir diaphragm.

Add brake fluid to the reservoir in order to bring the fluid level to the fill line. The fill line is located on the side of the reservoir.

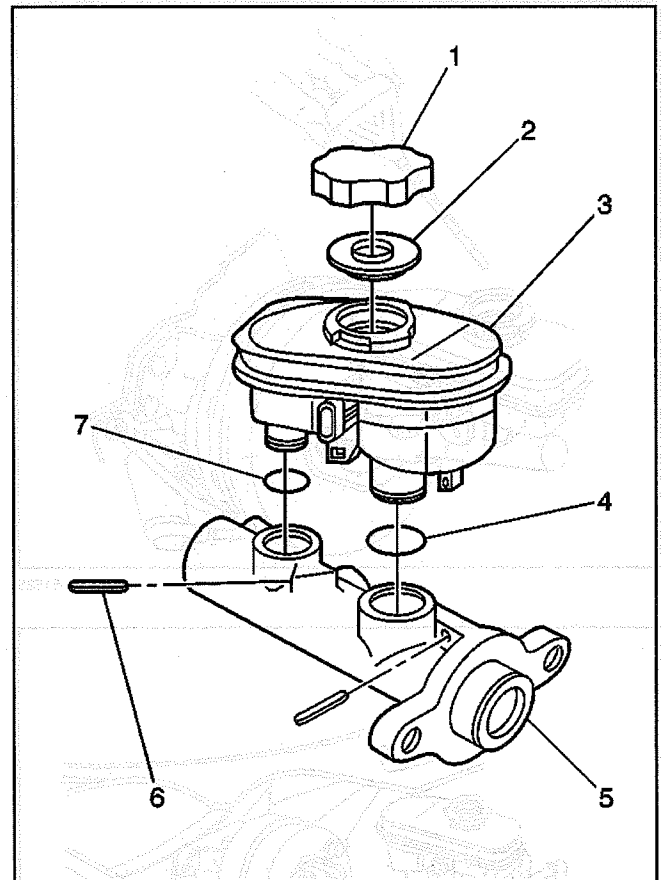
Master Cylinder Reservoir Replacement

Removal Procedure

1. Remove the master cylinder (5). Refer to *Master Cylinder Replacement*.

Notice: Do not overtighten vise, or damage to the master cylinder will result.

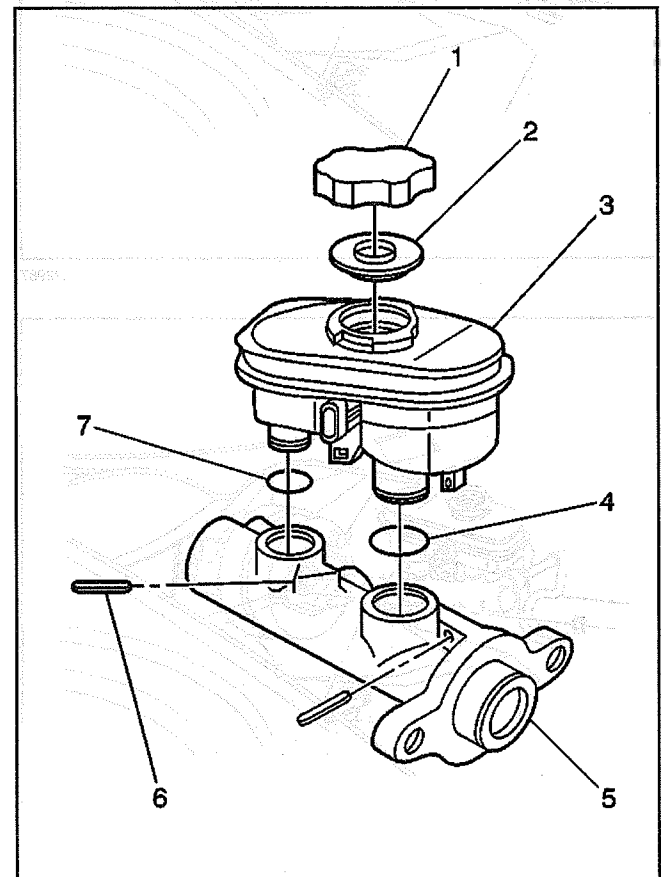
2. Clamp the flange on the master cylinder body in a vise.
3. Drive out the master cylinder reservoir pins (6). Use a 1/8-inch punch.
4. Remove the master cylinder reservoir (3) by pulling the reservoir straight up and away from the cylinder body.
5. Remove the master cylinder reservoir grommets (4 and 7) from the grooves in the reservoir. Discard the grommets.
6. Inspect the reservoir for cracks or deformation. Replace the reservoir if necessary.
7. Use clean denatured alcohol to clean the reservoir.
8. Use non-lubricated compressed air to dry the reservoir.



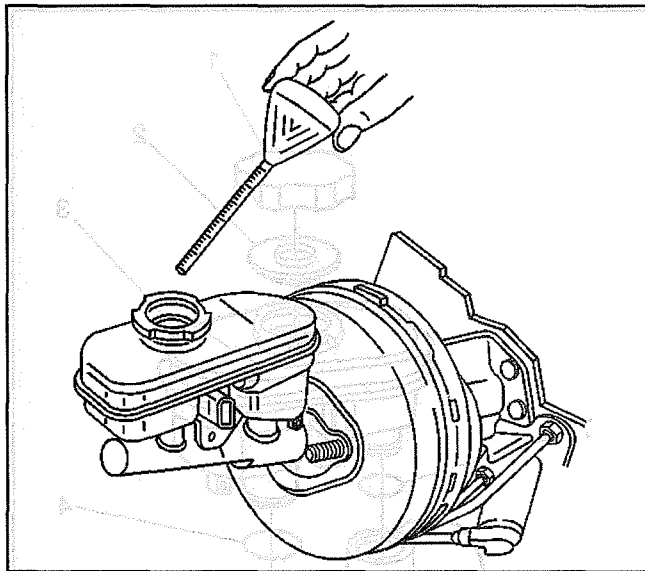
182445

Installation Procedure

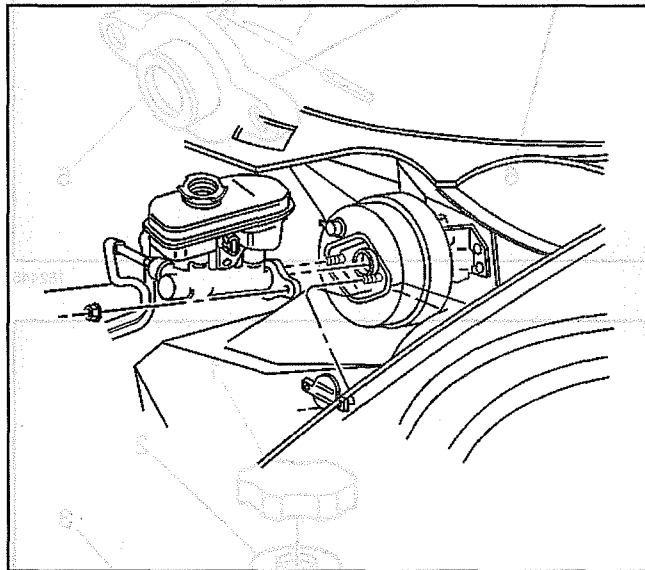
1. Use clean brake fluid to lubricate the new grommets (4 and 7) and the grooves in the reservoir.
2. Insert the grommets into the grooves in the reservoir. Verify that the grommets are properly seated.
3. Connect the reservoir (3) to the master cylinder body (5). Use your hand in order to press the reservoir straight down into the cylinder body.
4. Drive in the master cylinder reservoir pins (6) in order to retain the reservoir.
5. Install the master cylinder. Refer to *Master Cylinder Replacement*.



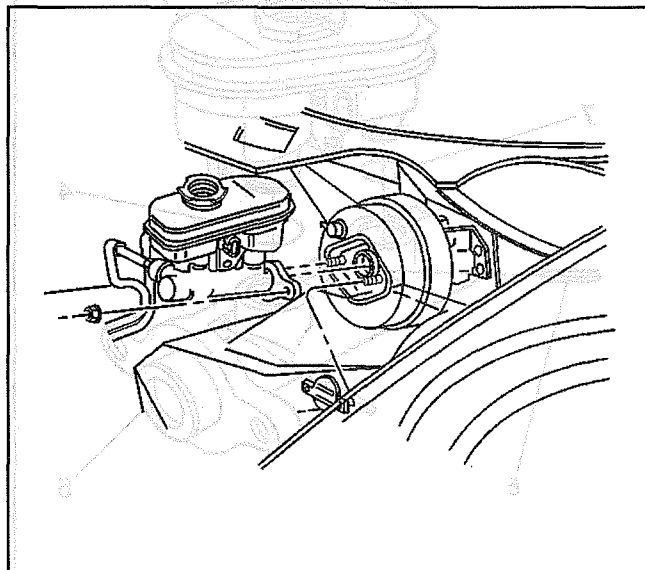
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Master Cylinder Replacement

Removal Procedure

1. Remove and discard the brake fluid from the reservoir.
2. Remove the combination valve pipes in order to prevent fluid loss and contamination.
3. Disconnect the brake fluid level sensor connector.
4. Remove the master cylinder nuts.
5. Remove the master cylinder.

Installation Procedure

1. Bench bleed the master cylinder. Refer to *Master Cylinder Bench Bleeding*.
2. Install the master cylinder.

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

3. Install the master cylinder nuts.

Tighten

Tighten the master cylinder nuts to 29 N·m (21 lb ft).

4. Fill the master cylinder reservoir. Refer to *Master Cylinder Reservoir Filling*.
5. Install the brake combination valve pipes onto the master cylinder one at a time. Complete the following steps:
 - 5.1. Remove the locally fabricated plugs.
 - 5.2. Install the brake pipe fitting finger tight.

- 5.3. Have an assistant depress the brake pedal in order to remove air at the loose brake pipe fittings.

Tighten

Tighten the combination valve pipe fittings to 32 N·m (24 lb ft).

- 5.4. Have an assistant quickly release and pump the brake pedal several times.

- 5.5. If the brake pedal remains high and firm, start the vehicle. If the brake pedal still feels firm, test drive the vehicle.

If the brake pedal feels soft or spongy, bleed the entire brake hydraulic system.

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

6. Connect the brake fluid level sensor connector.

Master Cylinder Bench Bleeding

Tools Required

- One 11 x 1.5 mm tube fitting nut
- One 12 x 1.0 mm tube fitting nut
- Two pieces of 4.75 mm (0.187 in) brake pipe, approximately 50 mm (1.969 in) long

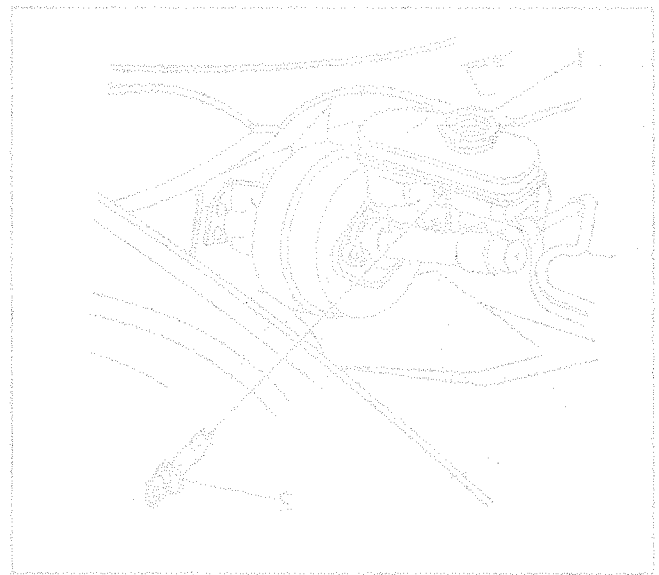
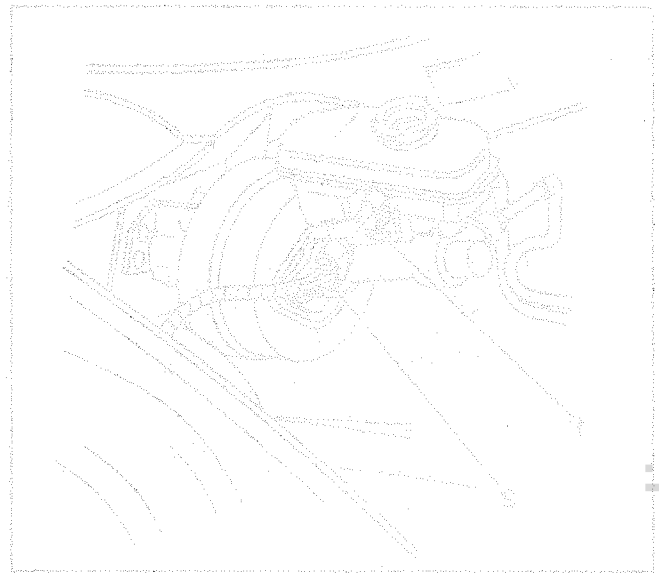
1. Fabricate two plugs in order to plug the master cylinder outlet ports. Use the following procedure:
 - 1.1. Fashion two ISO flares on one end of each tube.
 - 1.2. Install the nuts onto the flared tubes.
 - 1.3. One at a time, place approximately 13 mm (0.51 in) of the unflared tube end in a vise.
 - 1.4. Compress the end of the tube with the vise in order to collapse the tube.
 - 1.5. Bend the tube to a 90 degree angle.
 - 1.6. Remove the tube from the vise.
 - 1.7. Put the tube back in the vise. Fold the tube end against itself in order to form an air-tight seal.
2. Plug the master cylinder outlet ports with the fabricated plugs.

Notice: Do not overtighten vise, or damage to the master cylinder will result.

3. Place shop towels around the master cylinder in order to absorb the bled fluid.
4. Mount the master cylinder in a vise. Tilt the front end of the master cylinder down slightly.
5. Fill the master cylinder with clean brake fluid.

Important: As air bleeds from the brake master cylinder, resistance to primary piston strokes will increase, not allowing a full stroke.

6. Using a tool with a smooth, rounded end, stroke the primary piston about 25 mm (0.948 in) several times.
7. Reposition the master cylinder in the vise. Tilt the master cylinder slightly up.



8. Stroke the primary piston several times.
9. Reposition the brake master cylinder in the vise. Level the master cylinder.
10. Loosen the fabricated plugs one at a time.
11. Push the primary piston into the master cylinder bore in order to force the air out of the master cylinder.

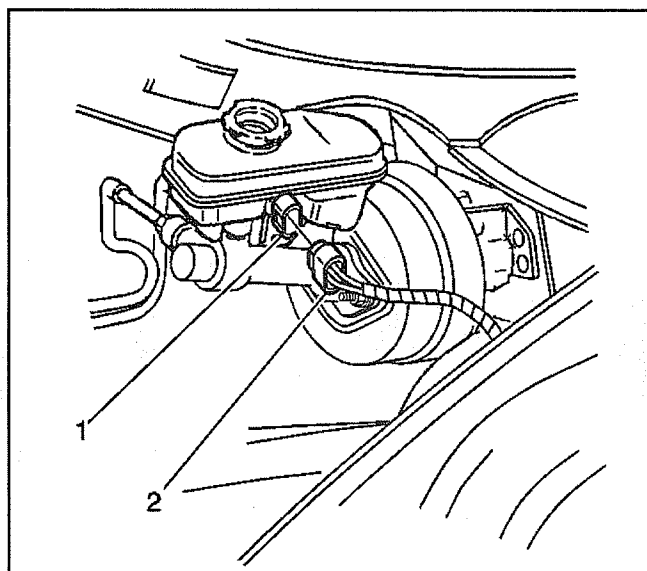
Important: In order to prevent air from sucking back into the master cylinder, tighten the fabricated plugs before allowing the primary piston to return to its original position.

12. Repeat the previous 6 steps until no air escapes past the plugs.
13. Install the master cylinder into the vehicle. Refer to *Master Cylinder Replacement*.

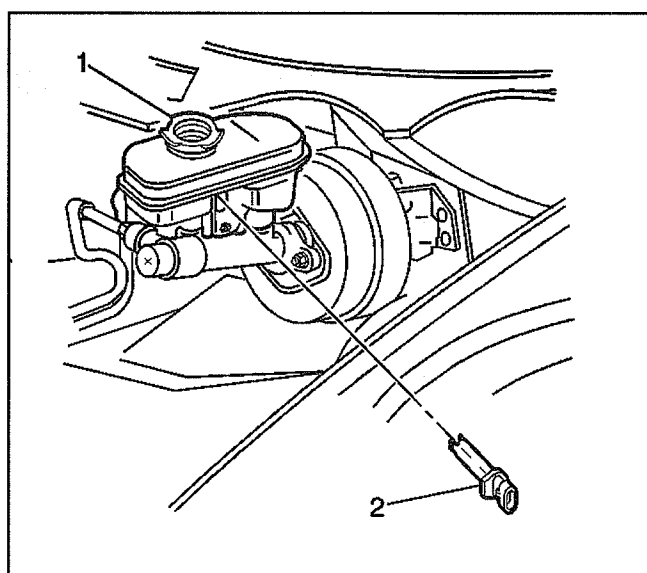
Master Cylinder Fluid Level Sensor Replacement

Removal Procedure

1. Disconnect low brake fluid sensor electrical connector (2) from the sensor (1).



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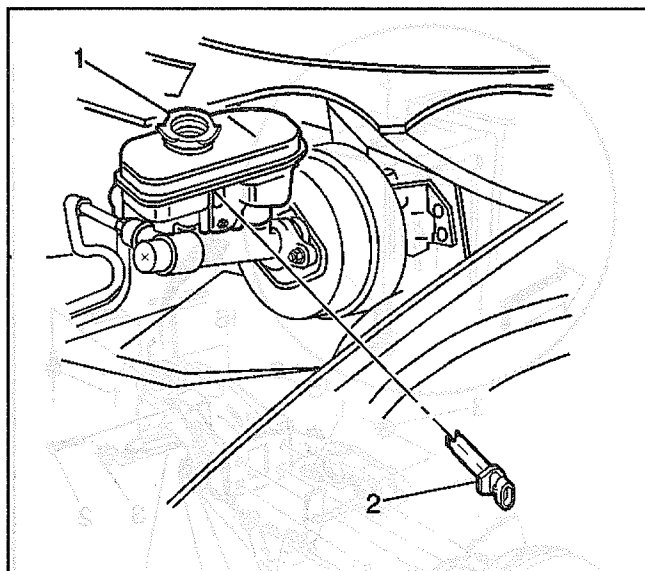
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Important: If the sensor is being replaced, remove and replace the sensor float that resides within the master cylinder reservoir.

2. Using needle-nose pliers, remove the sensor (2) from the reservoir (1) by squeezing the outer tangs together and removing the sensor by hand.

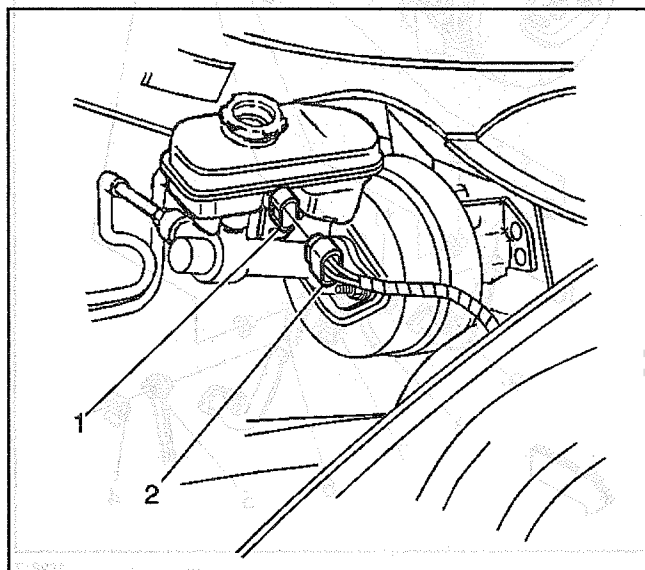
Installation Procedure

1. Insert the low brake fluid sensor (2) and float sensor if removed, into reservoir (1) cavity ensuring it is fully seated. Sensor should "snap" into position as the tangs engage.

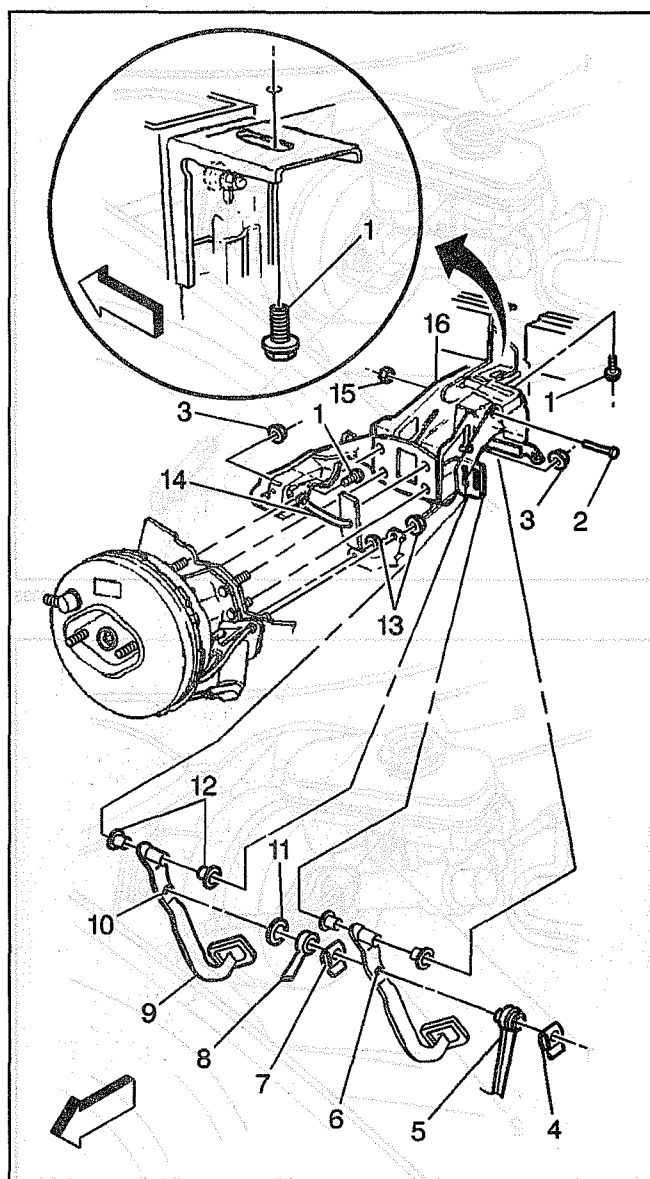


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2. Connect the low brake fluid sensor electrical connector (2) to the sensor (1).



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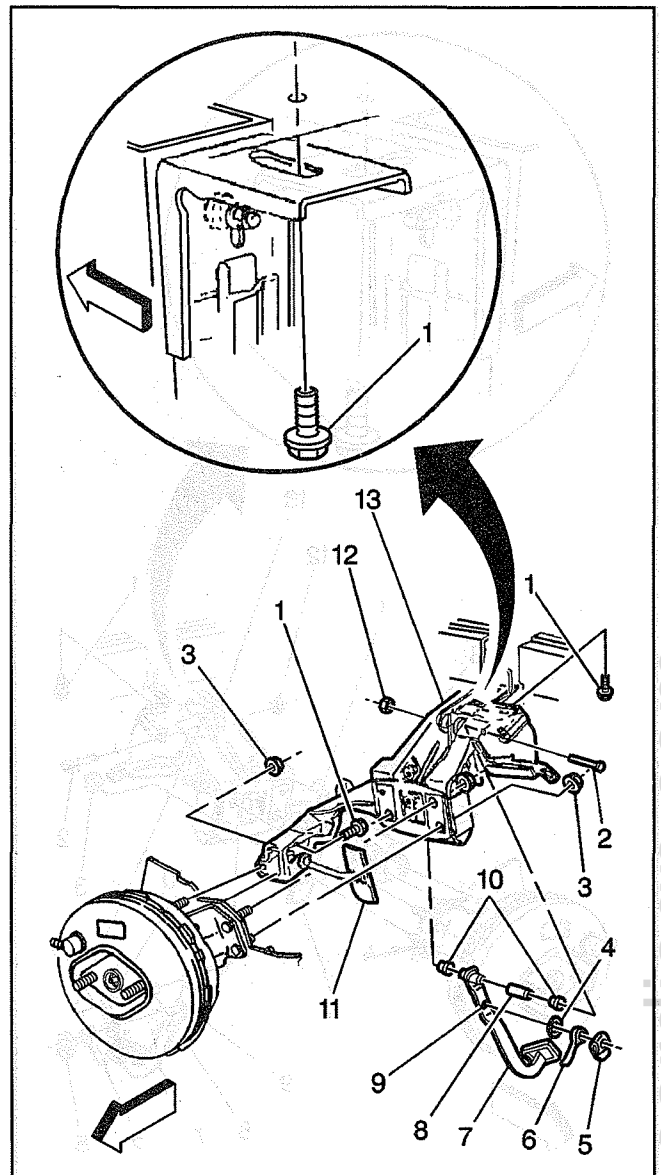
Brake Pedal Replacement

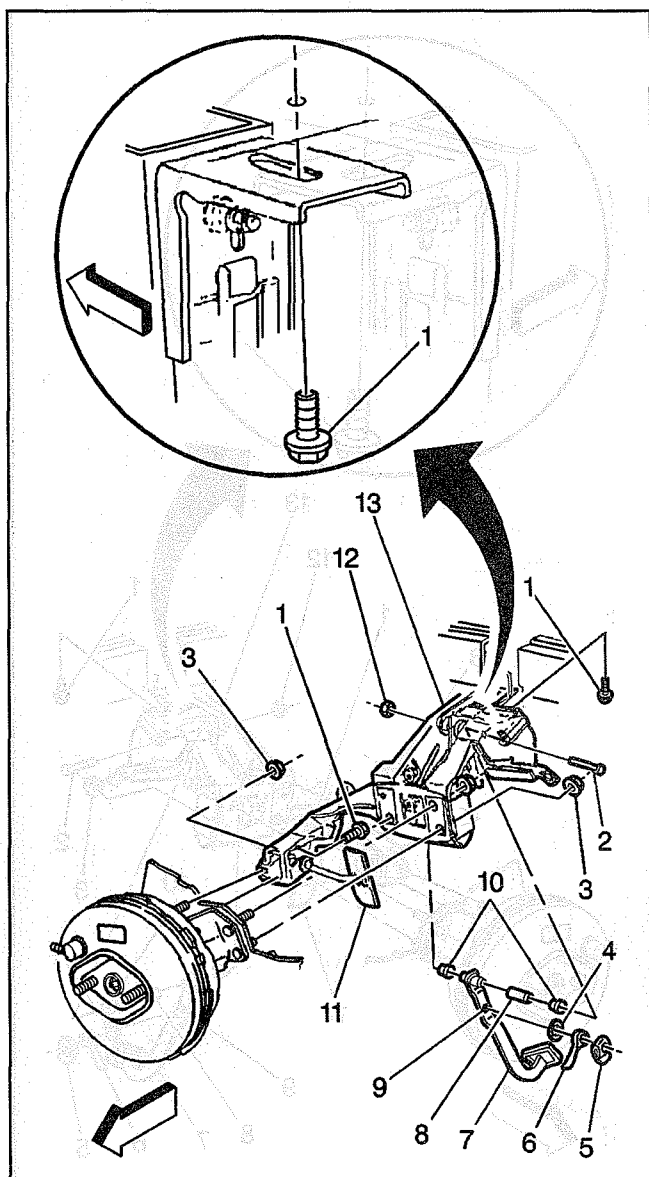
Removal Procedure

Caution: Refer to **Battery Disconnect Caution** in **Cautions and Notices**.

1. Disconnect the negative battery cable.
2. Remove the left side instrument panel insulator. Refer to *Closeout/Insulator Panel Replacement - Left* in Instrument Panel, Gauges and Console.
3. Remove the following components from the brake pedal pin (10):
 - The brake pedal pushrod pin retainer (7)
 - The brake pedal pushrod (8)
 - The brake pedal pushrod washer (11)

4. Remove the brake pedal pivot nut (12).
5. Slide out the brake pedal pivot bolt/screw (2) partway in order to give enough clearance in order to remove the brake pedal (7).
6. Remove the brake pedal (7).
7. Remove the brake pedal pivot bushings (10) from the brake pedal (7), if necessary.
8. Remove the brake pedal pivot spacer (8) from the brake pedal (7), if necessary.
9. Clean all the components with a suitable solvent.
10. Inspect all the components for wear. Repair or replace the components as needed.





182814

Installation Procedure

1. Install the brake pedal pivot spacer (8) to the brake pedal (7), if removed.
2. Install the brake pedal pivot bushings (10) to the brake pedal (7), if removed.
3. Install the brake pedal (7).
4. Lubricate the brake pedal pivot bolt/screw (2) with chassis lubricant.

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

5. Install the brake pedal pivot bolt/screw (2) and the brake pedal pivot nut (12).

Tighten

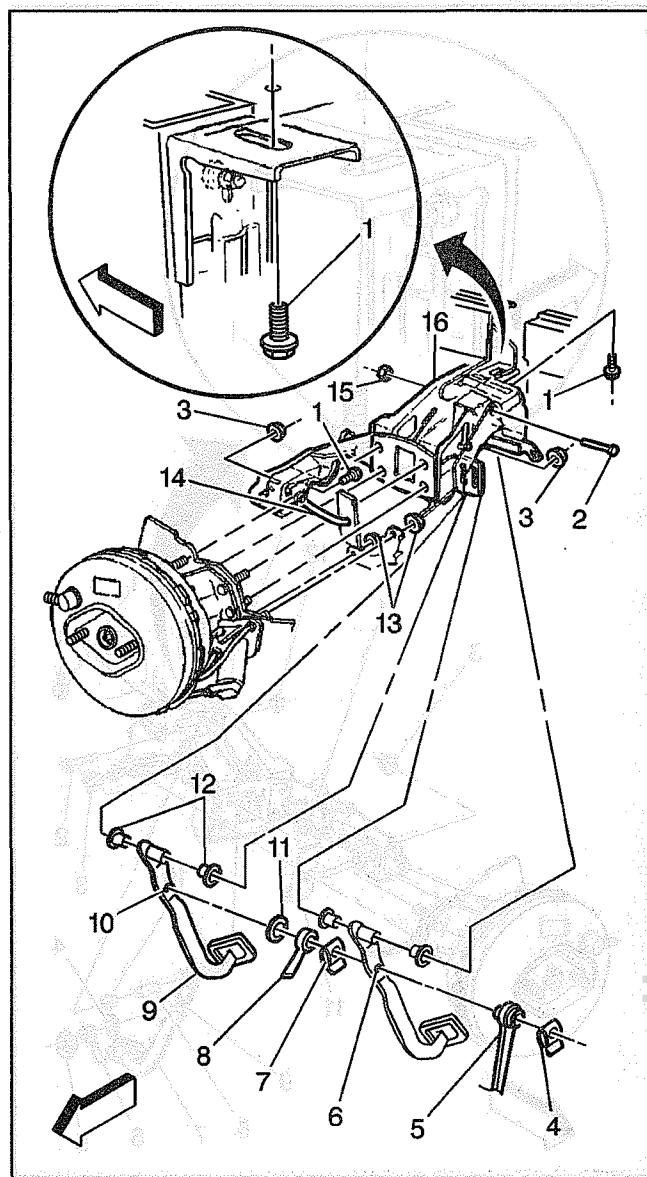
Tighten the brake pedal pivot nut (12) to 54 N·m (40 lb ft).

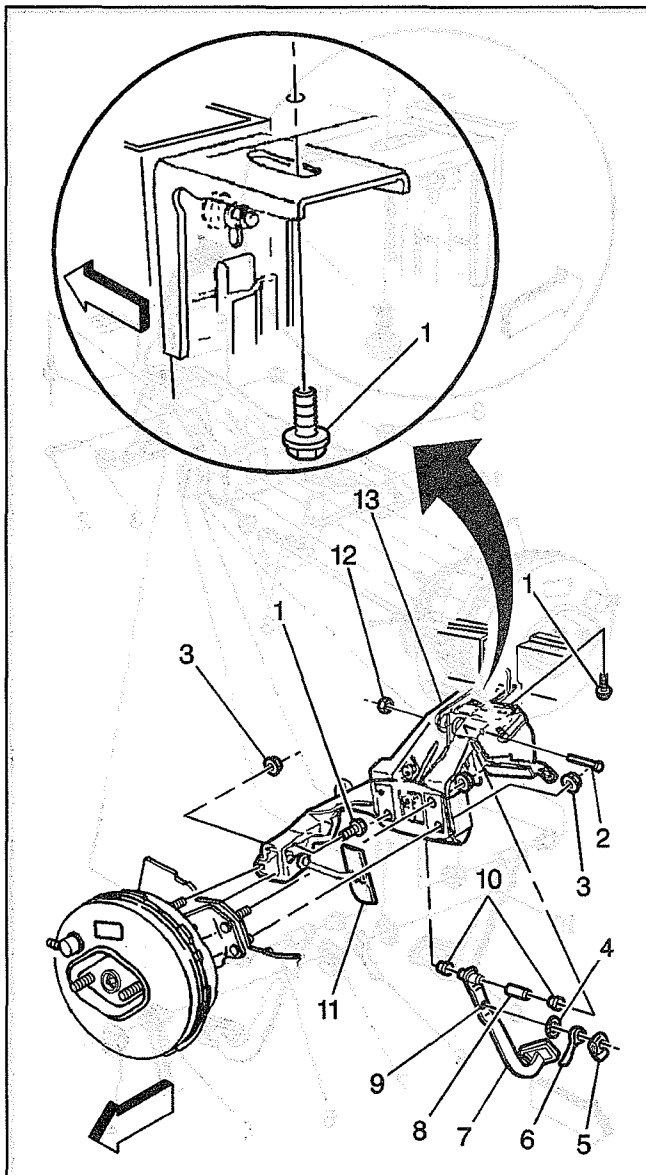
6. Lubricate the brake pedal pin (10) with chassis lubricant.
7. Install the following components to the brake pedal pin (10):
 - The brake pedal pushrod pin retainer (7)
 - The brake pedal pushrod (8)
 - The brake pedal pushrod washer (11)
8. Install the left side instrument panel insulator.
Refer to *Closeout/Insulator Panel Replacement - Left* in Instrument Panel, Gauges and Console.
9. Connect the negative battery cable.

Tighten

Tighten the negative battery cable to 15 N·m (11 lb ft).

10. Adjust the following components. Refer to *Stoplamp Switch Adjustment*.
 - Cruise control release switch
 - Stoplamp and TCC switch
 - Cruise control clutch switch or cruise control clutch anticipate switch





182814

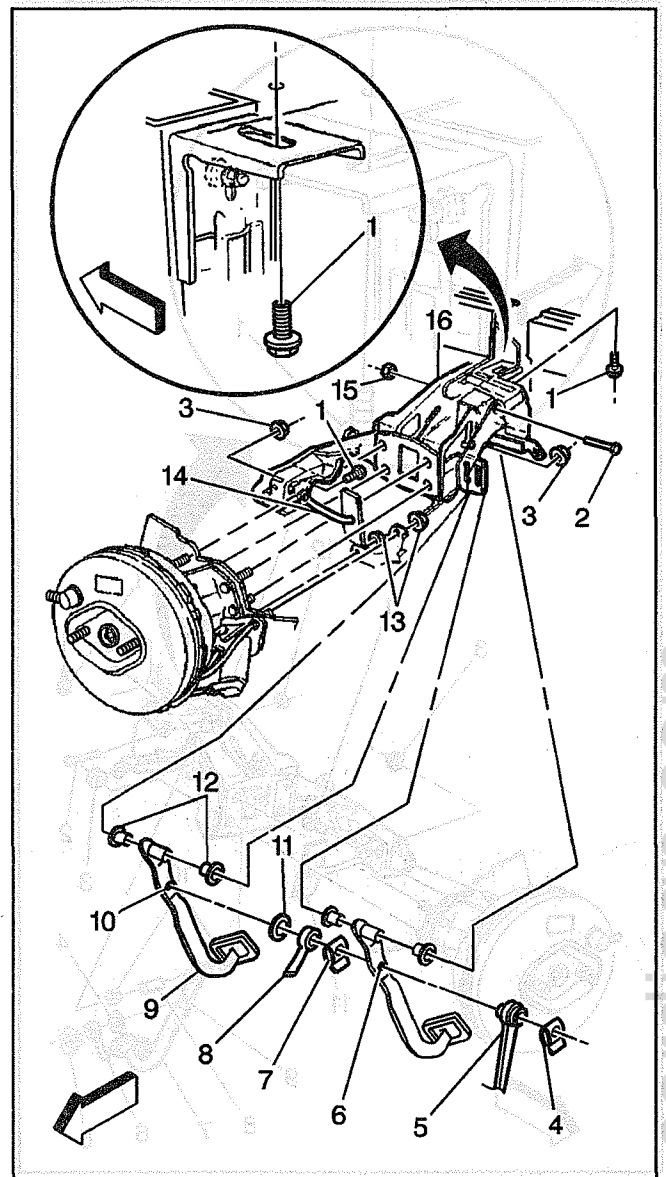
Brake Pedal Bracket Replacement

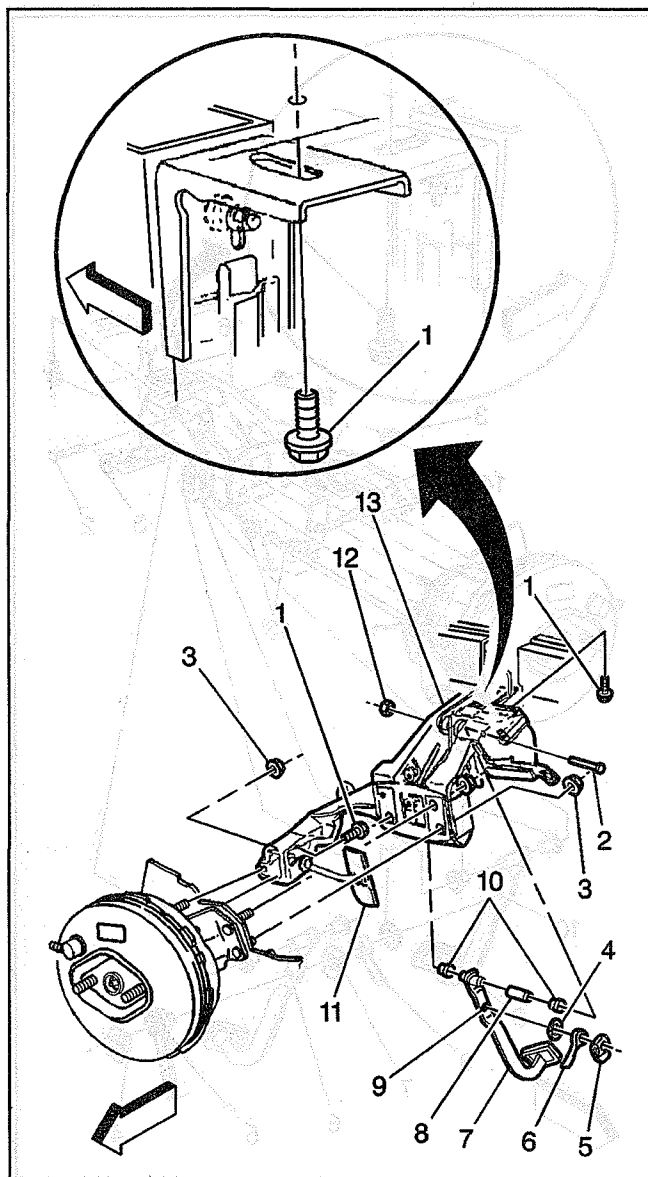
Removal Procedure

Caution: Refer to *Battery Disconnect Caution in Cautions and Notices.*

1. Disconnect the negative battery cable.
2. Remove the left side instrument panel insulator. Refer to *Closeout/Insulator Panel Replacement - Left* in Instrument Panel, Gauges and Console.
3. Remove the following components from the pedal with the bracket. Refer to *Stoplamp Switch Replacement.*
 - Cruise control release switch
 - Stoplamp and Torque Converter Clutch (TCC) switch
 - Cruise control clutch switch or cruise control clutch anticipate switch
4. Remove the clutch start switch from the brake pedal with the bracket, if equipped with a manual transmission.
5. Remove the accelerator pedal (11).
6. Remove the following components from the brake pedal pin (9):
 - The brake pedal pushrod pin retainer (5)
 - The brake pedal pushrod (6)
 - The brake pedal pushrod washer (4)

7. Remove the clutch pedal lever pin retainer (4) and the clutch pushrod (5) from the clutch pedal pin (6), if equipped with a manual transmission.
8. Remove the brake pedal nuts (3) and the brake pedal bracket bolts/screws (1).
9. Remove the clutch master cylinder nuts (13), if equipped with a manual transmission.
10. Remove the brake pedal with the bracket (16).





182814

Installation Procedure

Important: When installing the brake pedal with the bracket, ensure that the dash panel insulator material does not get pinched between the brake pedal and the dash panel.

1. Install the brake pedal with the bracket (13).

2. Install the clutch master cylinder nuts (13), if equipped with a manual transmission.

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

3. Install the brake pedal nuts (3) and brake pedal bracket bolts/screws (1).

Tighten

- Tighten the clutch master cylinder nuts (13) to 27 N·m (20 lb ft), if equipped with a manual transmission.
- Tighten the brake pedal bracket bolts (1) to 25 N·m (18 lb ft).
- Tighten the brake pedal nuts (3) to 20 N·m (15 lb ft) in the following sequence:

- 3.1. Inboard upper
- 3.2. Outboard lower
- 3.3. Outboard upper
- 3.4. Inboard lower

4. Install the accelerator pedal (14).

5. Lubricate the clutch pedal pin (6) with chassis lubricant.

6. Install the clutch pedal lever pin retainer (4) and the clutch master cylinder pushrod (5) to the clutch pedal pin (6), if equipped with a manual transmission.

7. Lubricate the brake pedal pin (10) with chassis lubricant.

8. Install the following components to the brake pedal pin:

- The brake pedal pushrod pin retainer
- The brake pedal pushrod
- The brake pedal pushrod washer

9. Install the following components to the pedal with the bracket (16). Refer to *Stoplamp Switch Replacement*.

- Cruise control release switch
- Stoplamp and TCC switch
- Cruise control clutch switch or cruise control clutch anticipate switch

10. Install the clutch start switch to the brake pedal with the bracket, if equipped with a manual transmission.

11. Adjust the following components. Refer to *Stoplamp Switch Adjustment*.

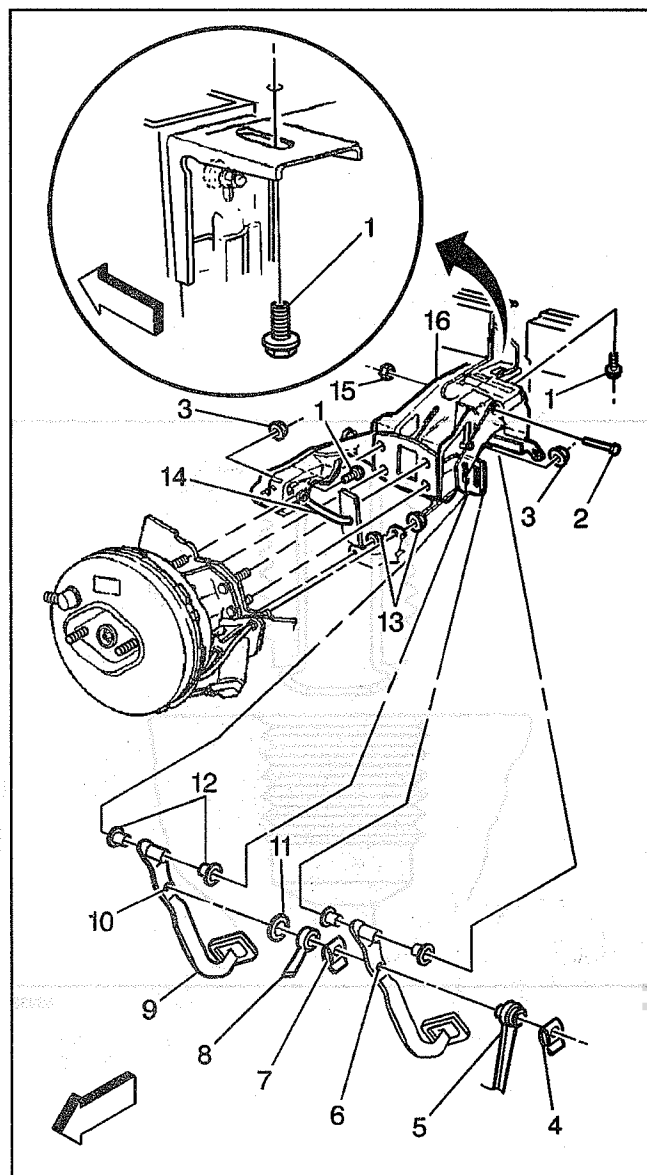
- Cruise control release switch
- Stoplamp and TCC switch
- Cruise control clutch switch or cruise control clutch anticipate switch

12. Install the left side instrument panel insulator. Refer to *Closeout/Insulator Panel Replacement - Left* in Instrument Panel, Gauges and Console.

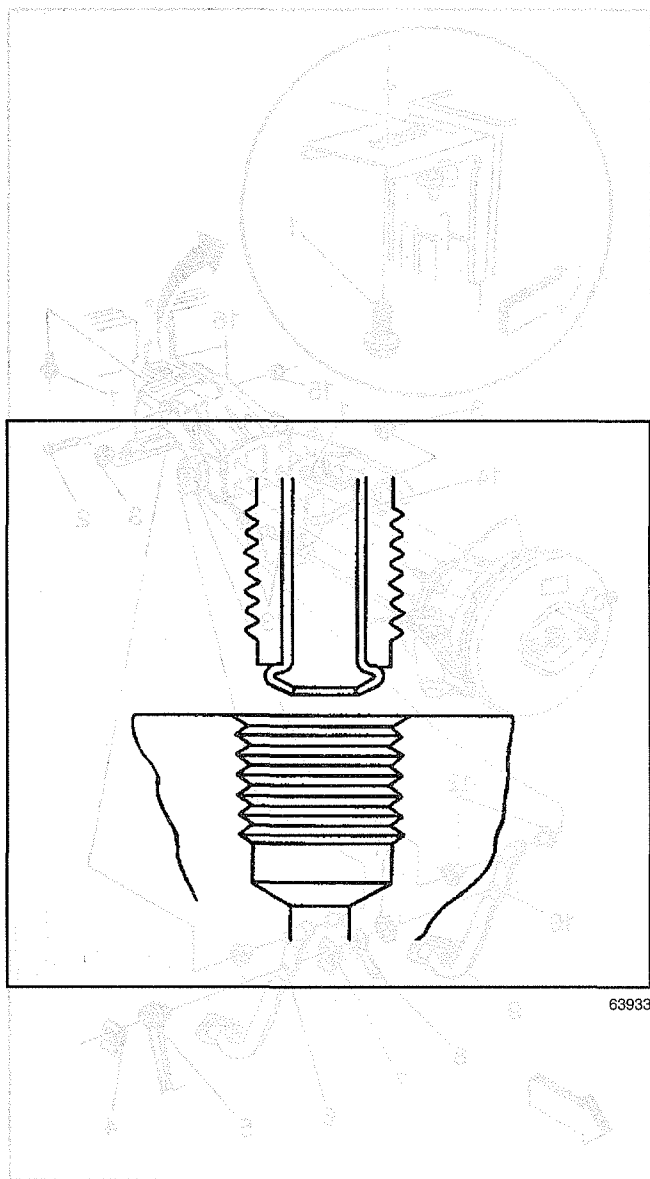
13. Connect the negative battery cable.

Tighten

Tighten the negative battery cable to 15 N·m (11 lb ft).



182817



Brake Pipe Replacement

Important: Do not use ISO flares for the rear brake pipe connections to the rear wheel cylinders.

- Refer to *Master Cylinder Description* for an illustration depicting the brake pipe layout and locations. Brake pipes that are to be locally fabricated, should only be ISO flared, and not double lap flared.
- Rear brake front pipes (mid) should not be locally fabricated. These pipes should be ordered through your GM parts dealer.

ISO Flares Replacement

Tools Required

J 29803-A ISO Flaring Kit

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.

Notice: Do not use single lap flaring tools. Double lap flaring tools must be used to produce a flare strong enough to hold the system pressure. Using single lap flaring tools could cause system damage.

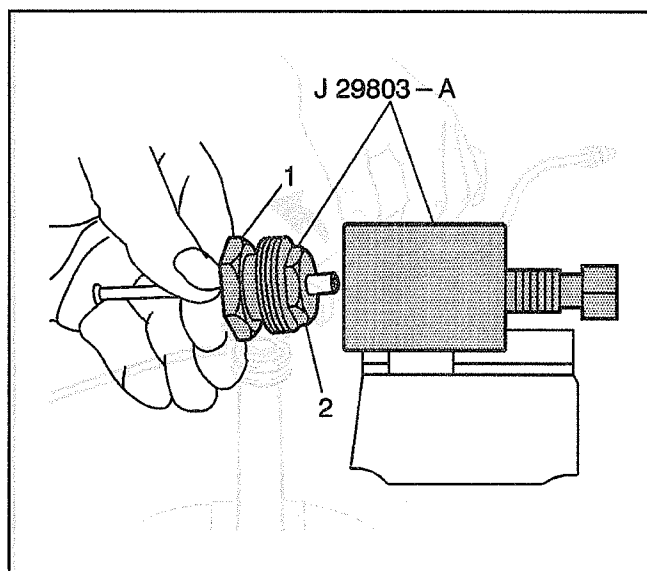
1. Obtain the correct size pipe and the correct size steel fitting nuts.
Use the outside diameter of the pipe in order to specify the size.
2. Cut the pipe to the correct length using a pipe cutter.
Advance the tool only a small amount per turn of the tool. Do not force the cutter.
3. Measure the old pipe in order to determine the correct length of the pipe. Use a string in order to measure, and add 3.2 mm (0.125 in) for each ISO flare.
4. Install the fittings before starting the flare.
5. Chamfer the inside and the outside diameter of the pipe using a de-burring tool.
6. Remove all traces of lubricant from the brake pipe and the J 29803-A.

7. Clamp the *J 29803-A* in a vise.
8. Select the correct size collet (2) and forming mandrel for the pipe size used.

• Maintain the minimum clearance of 19 mm (0.75 in) to all moving components.

• Maintain the minimum clearance of 19 mm (0.50 in) to all vibrating components.

• Maintain the minimum clearance of 1 mm (0.04 in) to any shielded lines, unless clipped to a component.



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9. Insert the properly formed mandrel (3) into the *J 29803-A*.
10. Hold the forming mandrel (3) in place using your finger.
11. Thread in the forcing screw (2) until contact is made and the screw begins to move the forming mandrel (3).

• Check for damage at the brake hose connections.

• Check that all hose and pipe mounting hardware is securely in place. Repair the mounting hardware as needed.

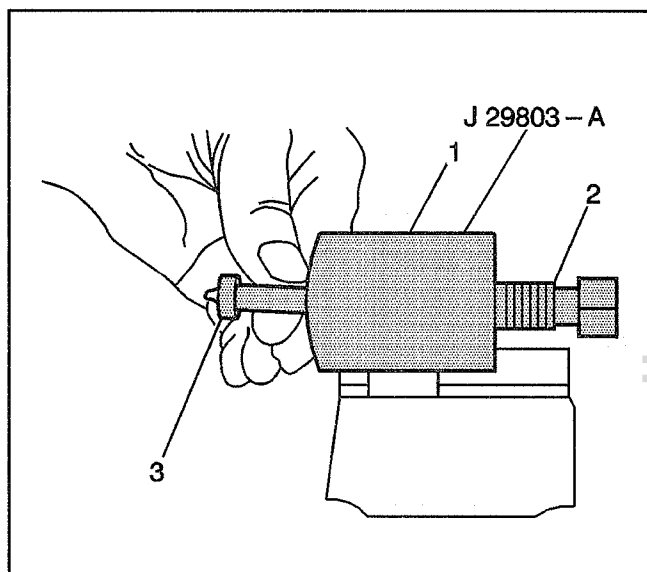
• Make sure all mounting hardware is in place and secure.

• Replace or repair any parts as necessary.

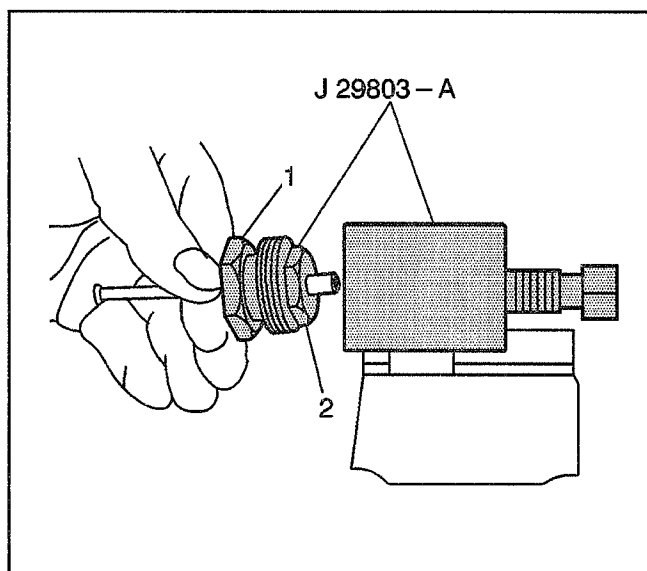
Power Brake Booster Hoses, Pipes And Fittings

Check all pipes, hoses and fittings for leaks at regular intervals. Make sure the fittings are tight. Make sure all clamps, clips and unions supporting the pipes and hoses are in place and properly secured. Make sure the pipes are supported properly.

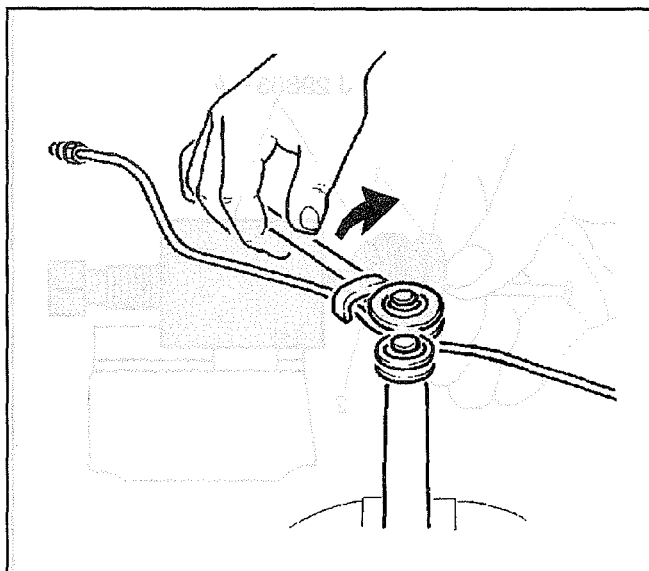
12. Turn the forcing screw back one complete turn.
13. Slide the clamping nut over the brake pipe.
14. Insert the prepared brake pipe into the correct collet (2). Leave approximately 19 mm (0.750 in) of tubing extending out of the collet. Insert the assembly into the *J 29803-A*. Ensure that the brake pipe end contacts the face of the forming mandrel.
15. Tighten the clamping nut (1) into the *J 29803-A* body tightly in order to ensure that the pipe will not push out.
16. Wrench tighten the forcing screw until the screw bottoms. Do not over tighten the forcing screw or the flare may become oversized.
17. Back the clamping nut (1) out of the *J 29803-A*.
18. Disassemble the clamping nut (1) and the collet assembly.
19. The flare is now ready for use.



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20. Use a tube bender in order to bend the new pipe to match the old pipe.
21. Maintain the following clearances:
 - Maintain the minimum clearance of 19 mm (0.75 in) to all moving components.
 - Maintain the minimum clearance of 13 mm (0.50 in) to all vibrating components.
 - Maintain the minimum clearance of 7 mm (0.25 in) to any shielded lines, unless clipped to a component.

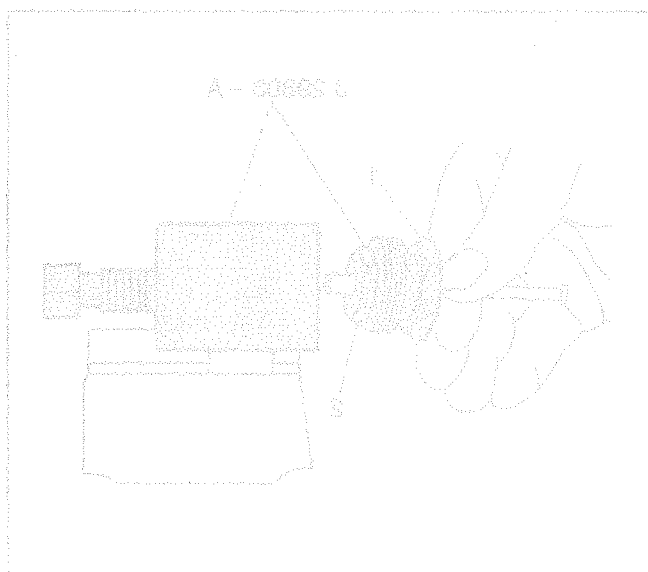
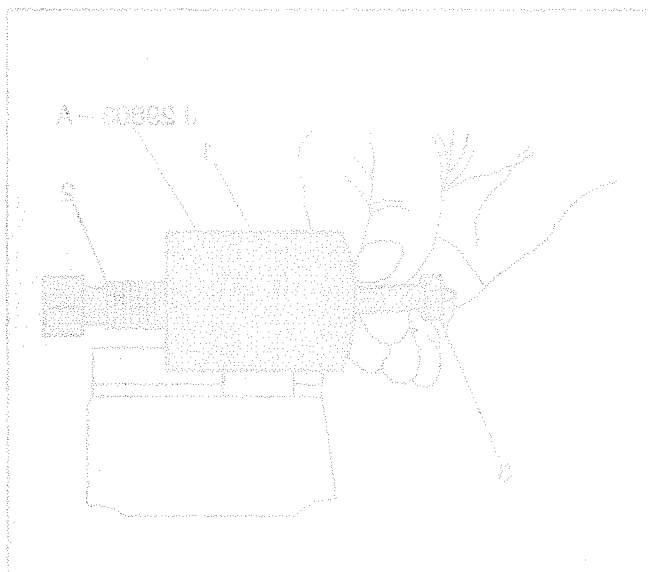
Brake Hose Inspection

Inspect the brake hoses and the brake pipes at least two times a year for the following problems:

- Check the outer cover for road damage.
- Check for fluid leaks.
- Check for damage at the brake hose and pipe connections.
- Check that all hose and pipe mounting hardware is securely in place. Repair the mounting hardware as needed.
- Make sure all mounting hardware is in place and secure.
- Replace or repair any parts as necessary.

Power Brake Booster Hoses, Pipes And Fittings

Check all pipes, hoses and fittings for leaks at regular intervals. Make sure the fittings are tight. Make sure all clamps, clips and unions supporting the pipes and hoses are in place and properly secured. Make sure all hoses are installed in a matter that does not cause chafing or wear on the hoses. Check for leaks by wiping the suspected area clean. Spotting leaking fluid is easier when the suspected area is clean. When fluid leaks appear, tighten, repair or replace nearby fittings and bolts.



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Brake Hose Replacement - Front

Removal Procedure

1. Remove the tire and wheel. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
 2. Clean all dirt and foreign material from the front brake hose and the front brake hose fitting (4).
 3. Remove the front brake pipe from the front brake hose.
 - Use a backup wrench on the hose fitting.
 - Do not bend the front brake hose bracket (2) or front brake pipe.
 4. Remove the brake hose retainer from the hose fitting at the brake hose bracket.
 5. Remove the brake hose (5) from the brake hose bracket (3).
 6. Remove the following components from the front brake caliper (4):
 - The brake hose fitting (2)
 - The brake hose clip bolt (1)
 - Two brake hose fitting gaskets
- Discard the two old brake hose fitting gaskets.

Installation Procedure

1. Lubricate the brake hose bolt (1) threads with clean brake fluid.
2. Install the following components to the front caliper (4):
 - The brake hose fitting (2)
 - The brake hose clip bolt (1)
 - Two new brake hose fitting gaskets

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

3. Ensure that the hose fitting flange engages the front caliper orientation ledge.

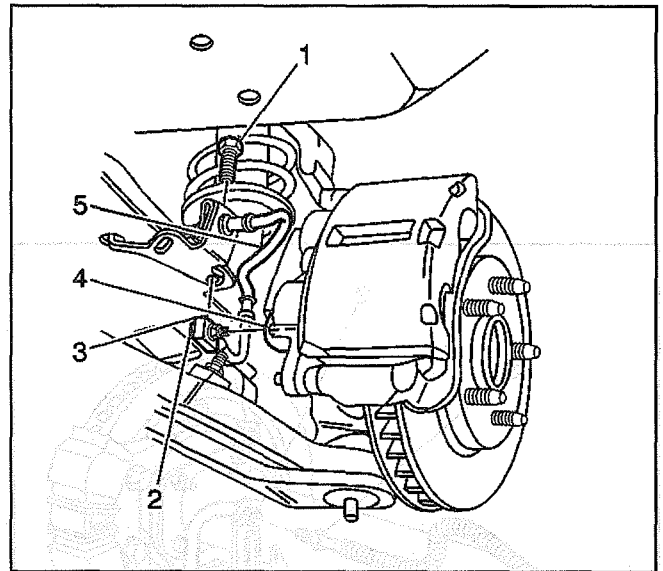
Tighten

Tighten the front brake hose fitting to 40 N·m (30 lb ft).

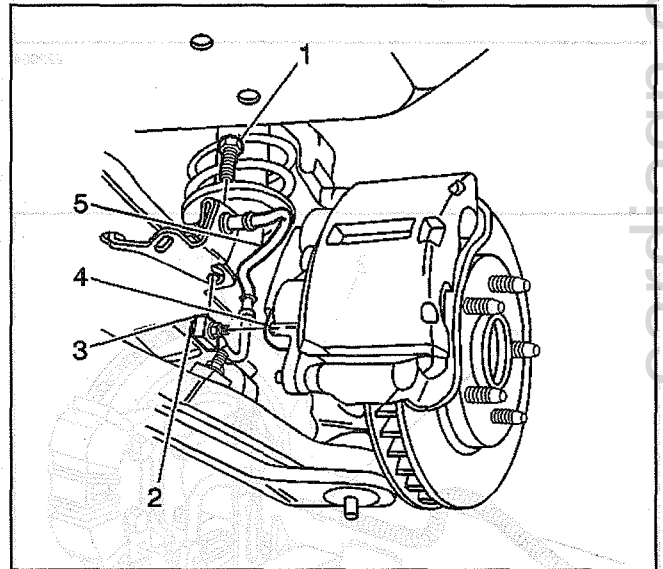
4. Install the brake hose (5) into the brake hose bracket (3). Ensure that there are no kinks in the brake hose.
5. Install the brake hose retainer at the brake hose bracket.
6. Install the front brake pipe to the brake hose.
7. Install the brake hose retainer.
8. Secure the retainer to the brake hose bracket using the screw.
 - Use a backup wrench on the hose fitting.
 - Ensure that the brake hose does not contact any part of the suspension.
 - Inspect the hose in the extreme right and extreme left turn conditions.

Tighten

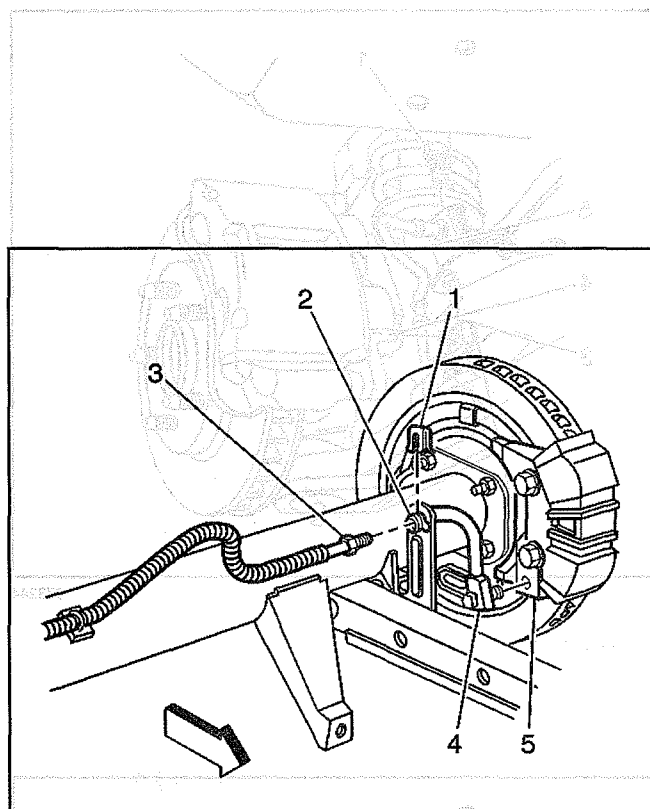
Tighten the front brake hose clip bolt (1) to 13 N·m (115 lb in).



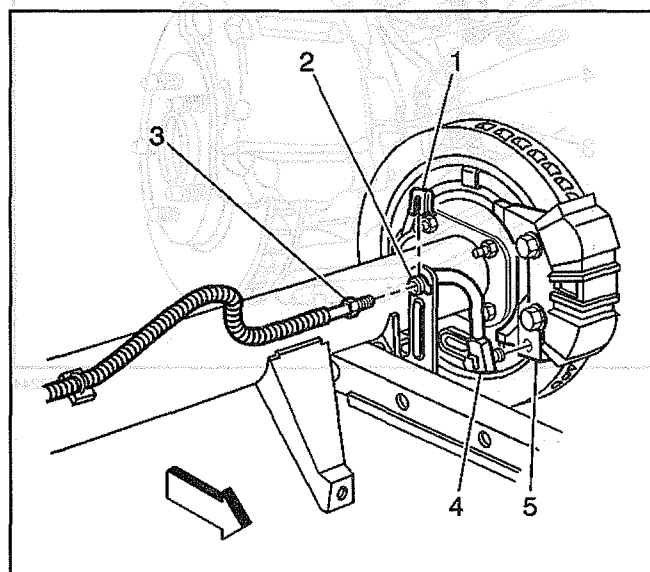
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9. Bleed the brake hydraulic system. Refer to *Hydraulic Brake System Bleeding (Manual Bleeding)* or *Hydraulic Brake System Bleeding (Pressure Bleeding)*.
10. Install the tire and the wheel. Refer to *Tire and Wheel Removal and Installation* in Tires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

Brake Hose Replacement - Rear (To Brake Caliper)

Removal Procedure

1. Remove the wheel and the tire. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
2. Clean all dirt and foreign material from the hose and fitting (4).
3. Remove the rear brake hose (2) from the rear brake pipe (3).
 - Use a backup wrench on the hose fitting (2).
 - Do not bend the rear brake hose bracket or the rear brake pipe (3).
4. Remove the rear brake hose retainer (1) from the brake hose bracket and the rear brake hose (2).
5. Remove the following components from the rear brake caliper (5):
 - The brake hose fitting bolt (4)
 - Two brake hose fitting gaskets.
 Discard the brake hose fitting gaskets.
 - The rear brake hose (2)

Installation Procedure

1. Lubricate the bolt fitting threads. Use clean brake fluid.
2. Install the following components to the rear brake caliper (5):
 - The brake hose fitting (4)
 - Two new brake hose fitting gaskets
 - The rear brake hose (2)

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

3. Ensure that the hose fitting flange engages the caliper orientation ledge.

Tighten

Tighten the rear brake hose fitting (4) to 45 N·m (33 lb ft).

4. Install the rear brake hose retainer (1) to the brake hose bracket and the brake hose (2).
5. Install the rear brake hose (2) to the rear brake pipe (3).
 - Use a backup wrench on the hose fitting (2).
 - Do not bend the brake hose bracket or the brake pipe (3).

Tighten

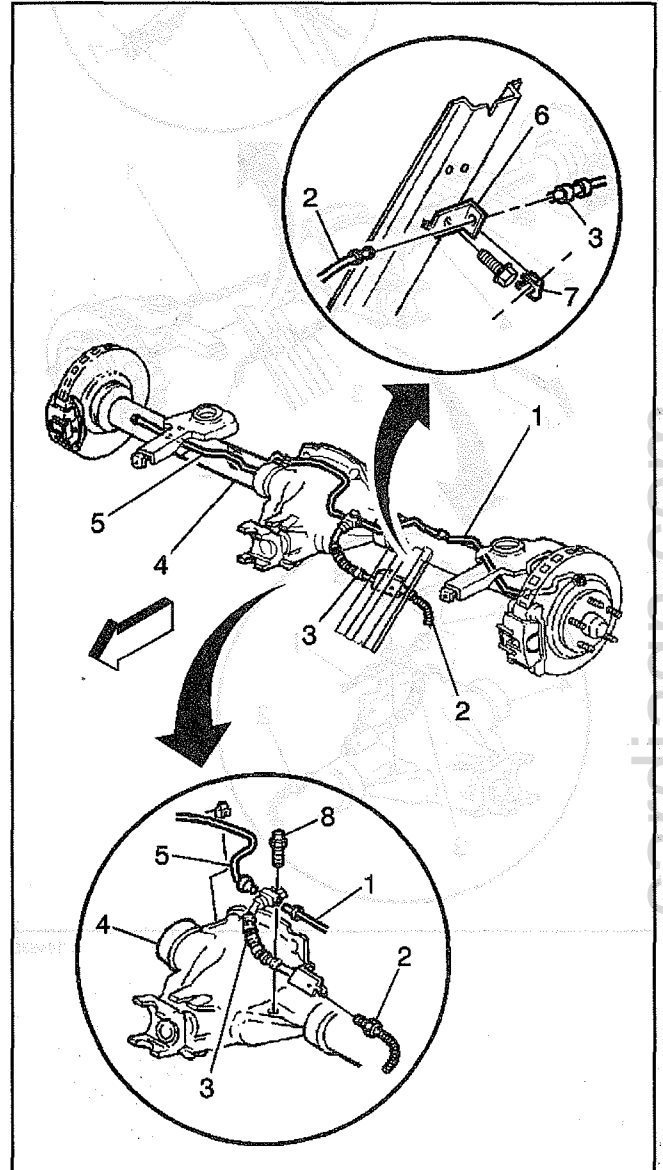
Tighten the rear brake pipe (3) to the brake hose (2) to 15 N·m (11 lb ft).

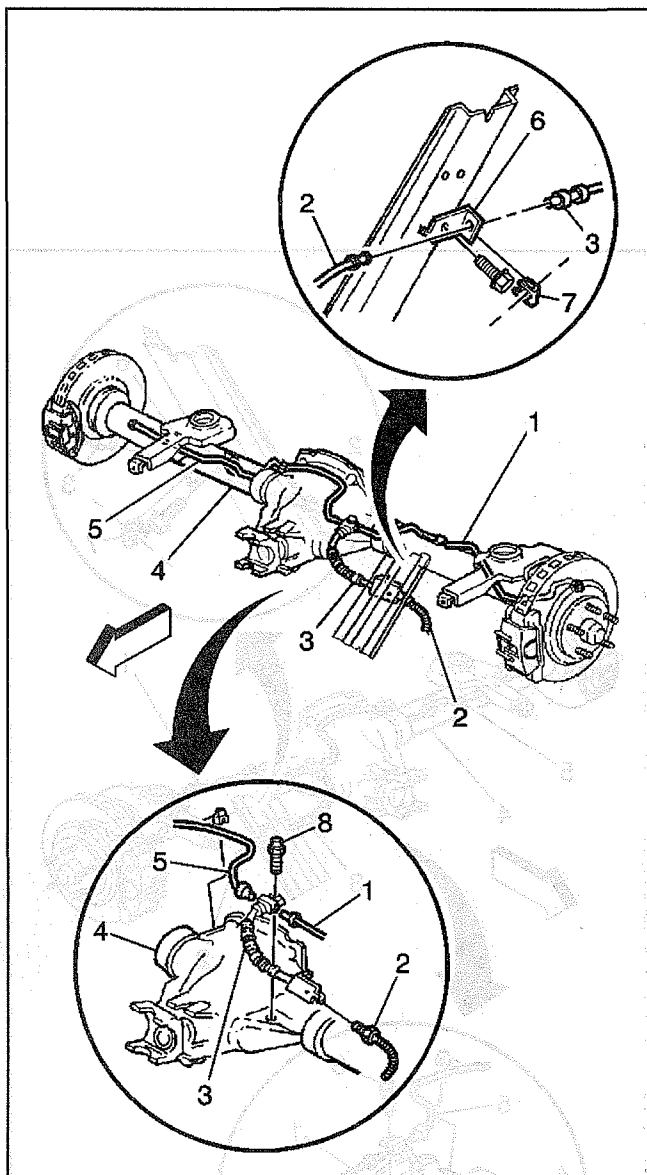
6. Bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding (Manual Bleeding)* or *Hydraulic Brake System Bleeding (Pressure Bleeding)*.
7. Install the wheel and the tire. Refer to *Tire and Wheel Removal and Installation in Tires and Wheels*.

Brake Hose Replacement - Rear (Without Traction Control)

Removal Procedure

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Clean all dirt and foreign material from the brake hose (3) and the brake pipe fittings.
3. Remove the rear brake front pipe (2) from the brake hose (3).
 - Use a backup wrench on the brake hose fitting.
 - Do not bend the brake hose bracket (6) or the brake front pipe (2).
4. Remove the brake hose retainer (7) from the brake hose bracket (6) and the brake hose (3).
5. Remove the rear brake hose (3).
6. Remove the left rear pipe (1) and the right rear pipe (5) from the hose (3). Do not bend the left rear pipe (1) or the right rear pipe (5).
7. Note the position of the brake hose (3) for proper location during installation.
8. Remove the rear brake hose fitting bolt (8) and the brake hose (3) from the rear axle (4).





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Installation Procedure

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

1. Install the brake hose (3) and the brake hose fitting bolt (8) to the rear axle (4).

Tighten

Tighten the rear brake (center) hose fitting bolt (8) to 21 N·m (15 lb ft).

2. Install the left rear pipe (1) and the right rear pipe (5) to the brake hose (3).

Tighten

- Tighten the left rear pipe (1) and the right rear pipe (5) at the rear brake (center) hose (3) to 24 N·m (18 lb ft).
- Tighten the left rear pipe (1) and the right rear pipe (5) at the left hand brake hose to 15 N·m (11 lb ft).

3. Install the brake hose (3) into the brake hose bracket (6). Ensure that the brake hose (3) is properly seated and not twisted.
4. Install the rear brake hose retainer (7) to the rear brake hose bracket (6) and the brake hose (3).
5. Install the rear brake front pipe (2) to the brake hose (3).

- Use a backup wrench on the brake hose (3).
- Do not bend the brake hose bracket (6) or the rear brake front pipe (2).

Tighten

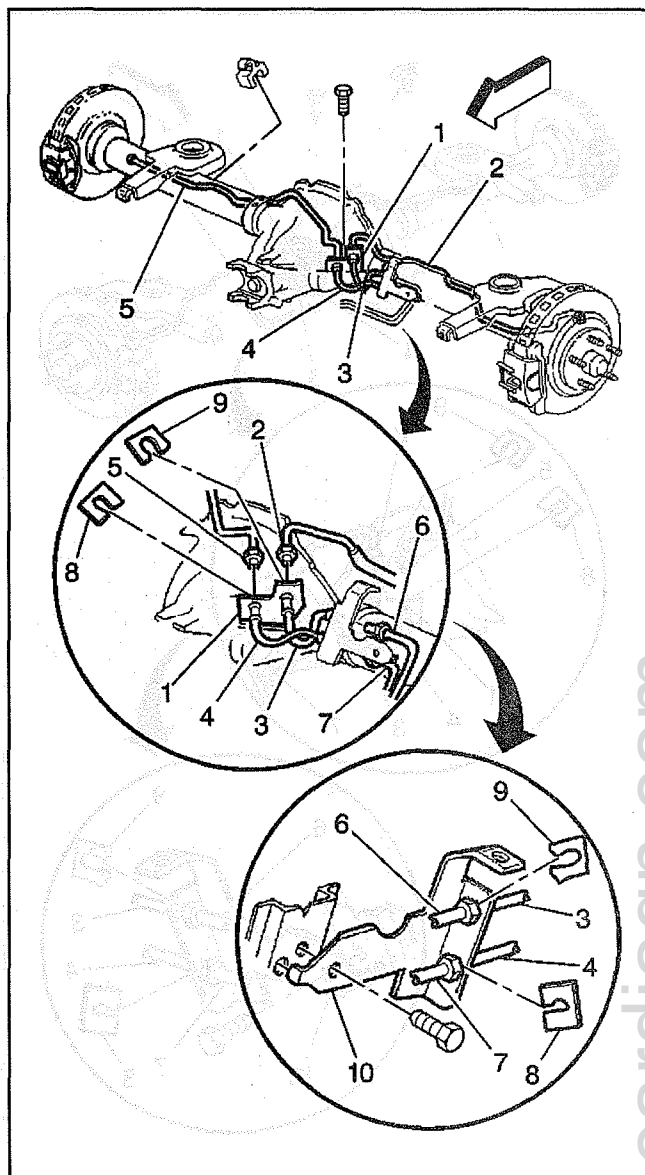
Tighten the rear brake front pipe (2) to the rear brake (center) hose (3) to 15 N·m (11 lb ft).

6. Bleed the brake hydraulic system. Refer to *Hydraulic Brake System Bleeding (Manual Bleeding)* or *Hydraulic Brake System Bleeding (Pressure Bleeding)*.
7. Lower the vehicle.

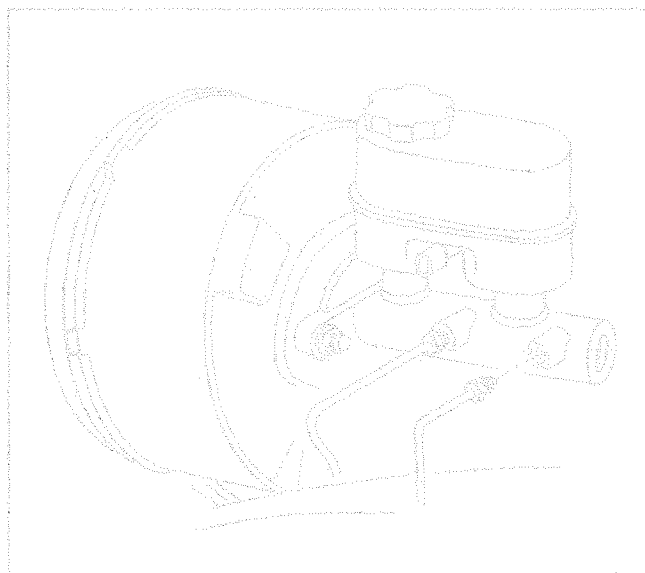
Brake Hose Replacement - Rear (With Traction Control)

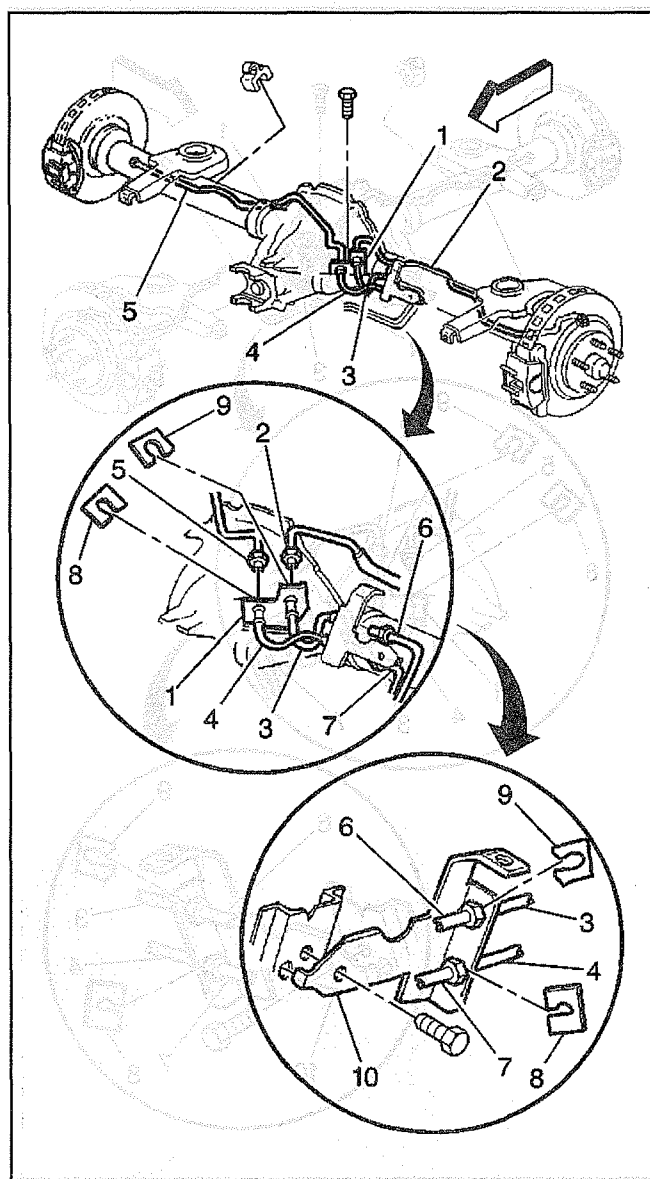
Removal Procedure

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Clean all dirt and foreign material from the brake hose and the brake pipe fittings.
3. Remove the right rear brake pipe (6) or the left rear brake pipe (7) from the rear brake hoses (3 or 4).
 - Use a backup wrench on the brake hose fittings.
 - Do not bend the rear brake hose bracket (10) or the brake pipes (6 or 7).
4. Remove the rear brake pipe clips (8 or 9) from the brake hose bracket (10) and the rear brake hoses (3 or 4).
5. Remove the left rear brake pipe (2) or the right rear brake pipe (5) from the rear brake hoses (3 or 4).
 - Use a backup wrench on the brake hose fittings.
 - Do not bend the rear brake hose bracket (1) or the rear brake pipes (2 or 5).
6. Remove the rear brake pipe clips (8 or 9) from the brake hose bracket (1) and the rear brake hoses (3 or 4).
7. Remove the rear brake hoses (3 or 4).



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Installation Procedure

1. Install the rear brake hose (3 or 4).
2. Install the rear brake pipe clips (8 or 9) to the brake hose bracket (1) and the rear brake hoses (3 or 4). Ensure that the rear brake hoses (3 or 4) are properly seated and not twisted.

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

3. Install the rear brake pipes (2 or 5) to the rear brake hoses (3 or 4).
 - Use a backup wrench on the brake hose fittings.
 - Do not bend the bracket (1) or the rear brake pipes (2 or 5).

Tighten

Tighten the rear brake pipes (2 or 5) to the rear brake hoses (3 or 4) to 15 N·m (11 lb ft).

4. Install the rear brake pipe clips (8 or 9) to the rear brake hose bracket (10) and the rear brake hoses (3 or 4). Ensure that the rear brake hoses (3 or 4) are properly seated and not twisted.
5. Install the right rear brake pipe (6) or the left rear brake pipe (7) to the rear brake hose (3 or 4).
 - Use a backup wrench on the brake hose fittings.
 - Do not bend the rear brake hose bracket (10) or the brake pipes (6 or 7).

Tighten

Tighten the right rear brake pipe (6) or the left rear brake pipe (7) to the rear brake hoses (3 or 4) to 15 N·m (11 lb ft).

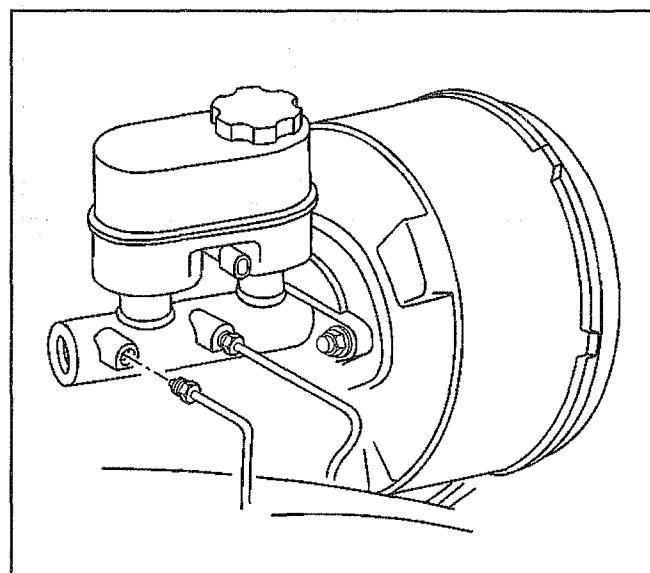
6. Bleed the brake hydraulic system. Refer to *Hydraulic Brake System Bleeding (Manual Bleeding)* or *Hydraulic Brake System Bleeding (Pressure Bleeding)*.
7. Lower the vehicle.

Hydraulic Brake System Bleeding (Manual Bleeding)

The time required to bleed the hydraulic system can be reduced if the master cylinder reservoir is filled with brake fluid and as much air as possible is expelled before the master cylinder is installed on the vehicle. Pumping the piston can evacuate the air from the piston cavities.

Power brakes require the vacuum reserve be depleted by applying the brakes several times with the engine off. Care must be taken to prevent brake fluid from contacting any painted surface.

1. Fill the master cylinder reservoir with brake fluid and keep the reservoir at least half full of fluid during the bleeding operation.



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2. If the master cylinder is known or suspected to have air in the bore, then it must be bled in the following manner, before bleeding any caliper:

- 2.1. Disconnect the forward (blind end) brake pipe connection at the master cylinder.
- 2.2. Allow the brake fluid to fill the master cylinder piston bore until it begins to flow from the forward pipe connector port.
- 2.3. Connect the forward brake pipe to the master cylinder and tighten.

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

- 2.4. Depress the brake pedal slowly one time and hold. Loosen the forward brake pipe connection at the master cylinder to purge air from the bore. Tighten the connection and then release the brake pedal slowly. Wait 15 seconds. Repeat the sequence, including the 15 second wait, until all air is removed from the bore.

Tighten

Tighten the brake pipe tube nut to 16 N·m (12 lb ft).

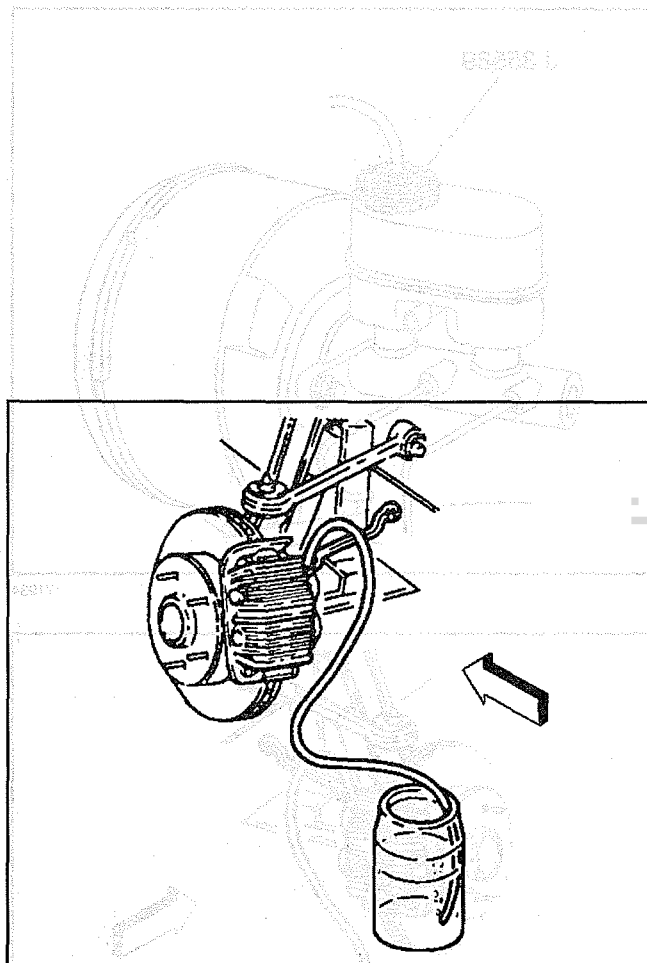
- 2.5. When clear fluid flows from the forward connection, repeat steps 1 and 2 to bleed the master cylinder at the rear (cowl) connection.
3. Individual brake calipers are bled only after all air is removed from the master cylinder. If it is known that the brake calipers do not contain any air, then it will not be necessary to bleed them.

- 3.1. Place a proper size box end wrench, or equivalent, over the brake caliper bleed screw.
- 3.2. Attach a clear tube over the screw.
- 3.3. Submerge the other end of the tube in a clear container partially filled with brake fluid.
- 3.4. Depress the brake pedal slowly one time and hold.
- 3.5. Loosen the brake caliper bleed screw to purge the air from the cylinder.
- 3.6. Tighten the brake caliper bleed screw and slowly release the pedal. Wait 15 seconds.

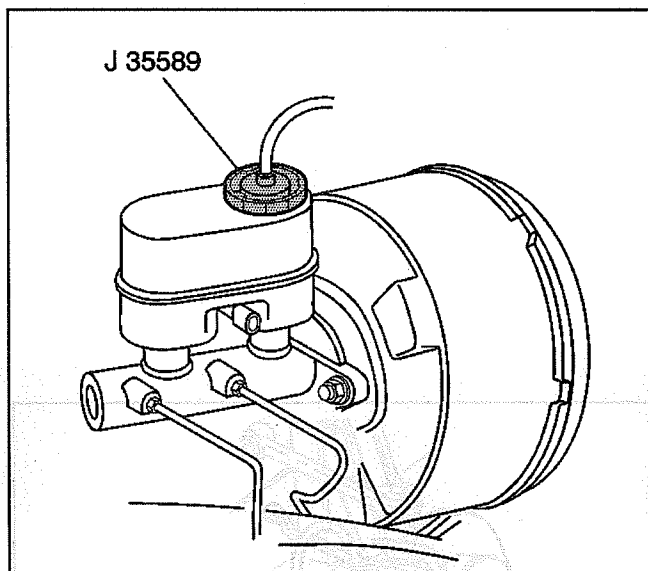
Tighten

Tighten the brake caliper bleed screw to 12 N·m (106 lb in).

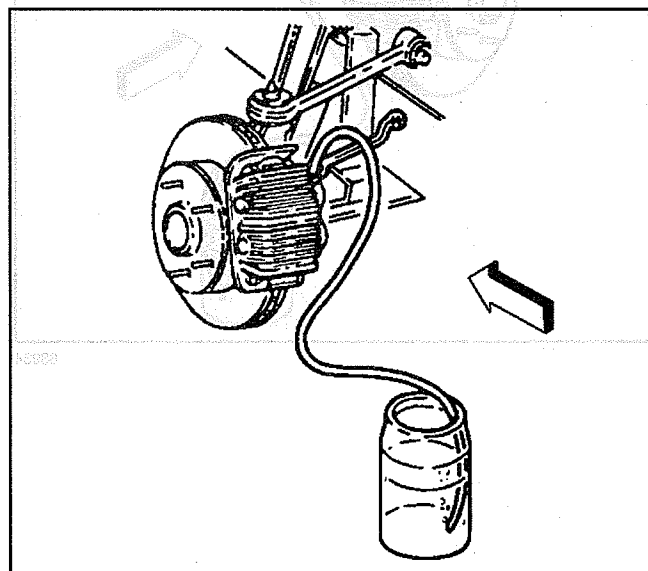
- 3.7. Repeat the sequence (including the 15 second wait), until all of the air is removed. It may be necessary to repeat the sequence ten or more times to remove all of the air.



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3.8. If it is necessary to bleed all of the brake calipers, the following sequence should be used:

3.8.1. Right rear

3.8.2. Left rear

3.8.3. Right front

3.8.4. Left front

3.9. Test drive the vehicle. Check the brake pedal for sponginess.

3.10. Ensure that vehicle exceeds 5 km/h (3 mph) for ABS modulator actuation (self-test). If after ABS modulation the brake pedal is spongy or soft, then re-bleed system until pedal is firm.

Hydraulic Brake System Bleeding (Pressure Bleeding)

Tools Required

J 35589 Pressure Bleeding Adapter

1. Remove the master cylinder reservoir cap. Replace it with J 35589.
 2. Charge the bleeder to 140–172 kPa (20–25 psi).
 3. Connect the hose to J 35589.
 4. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
 5. If it is necessary to bleed all of the brake calipers, the following sequence should be used:
 - 5.1. Right rear
 - 5.2. Left rear
 - 5.3. Right front
 - 5.4. Left front
 6. Place the proper size box end wrench, or equivalent, over the brake caliper bleed screw. Attach a clear tube over the screw and allow the tube to hang submerged in a clear container partially filled with brake fluid.
 7. Open the brake caliper bleed screw at least three quarters of a turn and allow the brake fluid flow to continue until no air is seen in the brake fluid. Apply intermittent pressure to the brake pedal while pressure bleeding.
- Notice:** Refer to *Fastener Notice* in Cautions and Notices.
8. Close the brake caliper bleed screw.
- Tighten**
Tighten the brake caliper bleed screw to 12 N·m (106 lb in).
9. Repeat steps 6 through 8 until all of the calipers have been bled.

10. Lower the vehicle.
11. Test drive the vehicle, checking for brake pedal for sponginess or softness. Ensure that vehicle exceeds 5 km/h (3 mph) for ABS modulator actuation (self-test) which will purge any air from the secondary circuit of the modulator. If after ABS modulator actuation the pedal is still soft or spongy, then re-bleed entire system.
12. Remove the brake bleeding equipment from the master cylinder.

Hydraulic Brake System Bleeding (When To Bleed)

A bleeding operation is necessary to remove air when it is introduced into the hydraulic brake system.

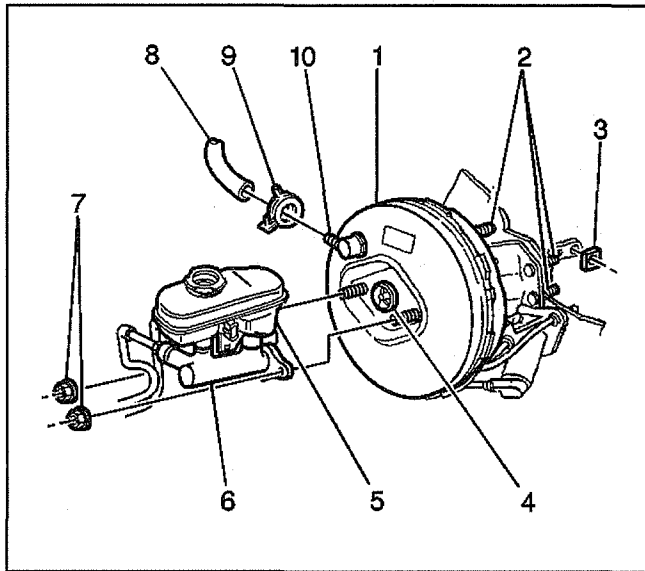
It may be necessary to bleed the hydraulic system at all four corners if air has been introduced through low fluid level or by disconnecting brake pipes at the master cylinder. If a brake hose is disconnected at one wheel, only that wheel caliper needs to be bled. If brake pipes or hoses are disconnected at any fitting located between master cylinder and brakes, then the brake system served by the disconnected pipe or hose must be bled.

Hydraulic Brake System Flushing

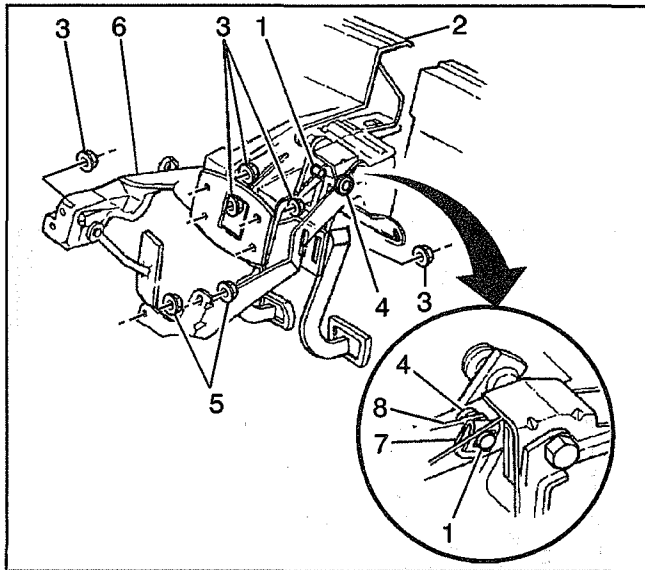
The entire hydraulic brake system should be thoroughly flushed with clean brake fluid if there is any doubt as to the grade of the fluid in the system or if the fluid used contains the slightest trace of mineral oil. All rubber parts which have been subjected to contaminated fluid must be replaced before flushing the system.

Flushing is performed at each wheel similarly to bleeding. The new fluid must be forced through the system until it emerges clear in color. Approximately one quart of new fluid is needed to flush the system.

After completing the flushing operation at all of the bleeder valves check that the master cylinder is filled to the correct level.



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Vacuum Brake Booster Replacement

Removal Procedure

1. Remove the hood rear seal. Refer to *Seal Replacement - Hood Rear* in Body Front End.
2. Remove the left side air inlet screen. Refer to *Air Inlet Grille Panel Replacement* in Body Front End.
3. Remove the brake booster vacuum hose (8) and clamp (9) from the check valve (10).
4. Remove the master cylinder from the brake booster. Refer to *Master Cylinder Replacement*.
5. Remove the left side I/P insulator. Refer to *Closeout/Insulator Panel Replacement - Left* in Instrument Panel, Gauges and Console.
6. Remove the brake pedal nuts (3) attaching the brake booster to the brake pedal with bracket (6).
7. On manual transmission equipped vehicles only, loosen the clutch master cylinder nuts (5).
8. Disconnect the brake booster pushrod (8) from the brake pedal lever pin.
 - 8.1. From inside the vehicle, remove the brake pedal pushrod retainer (7) and pushrod washer (4).
 - 8.2. Tilt the entire brake booster slightly in order to work the brake booster pushrod (8) off the brake pedal pin. Do not put undue side pressure on the pushrod.
9. Remove the power brake booster from the vehicle.

Installation Procedure

1. Install the power brake booster onto the vehicle.
2. Install the brake booster pushrod (8) to the brake pedal lever pin (1).
 - 2.1. Tilt the entire brake booster slightly in order to work the brake booster pushrod onto the brake pedal pin.
 - 2.2. From inside the vehicle, install the brake pedal pushrod washer (4) and retainer (7).

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

3. Install the brake pedal nuts (3) attaching the brake booster to the brake pedal with bracket (6).

Tighten

Tighten the brake pedal nuts to 20 N·m (15 lb ft) in the following sequence:

- 3.1. Inboard upper
 - 3.2. Outboard lower
 - 3.3. Outboard upper
 - 3.4. Inboard lower
4. On manual transmission equipped vehicles only, install the clutch master cylinder nuts (7).

Tighten

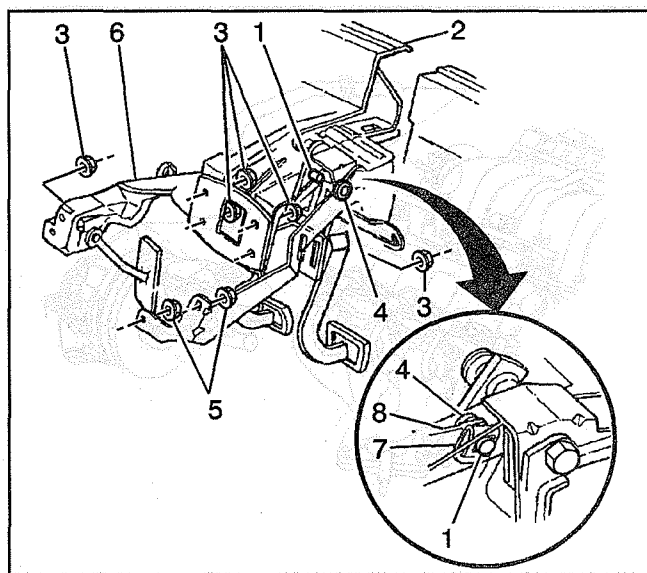
Tighten the clutch master cylinder nuts to 27 N·m (20 lb ft).

5. Install the master cylinder (6) onto the brake booster (1).
6. Install the master cylinder nuts (7) attaching the master cylinder to the brake booster.

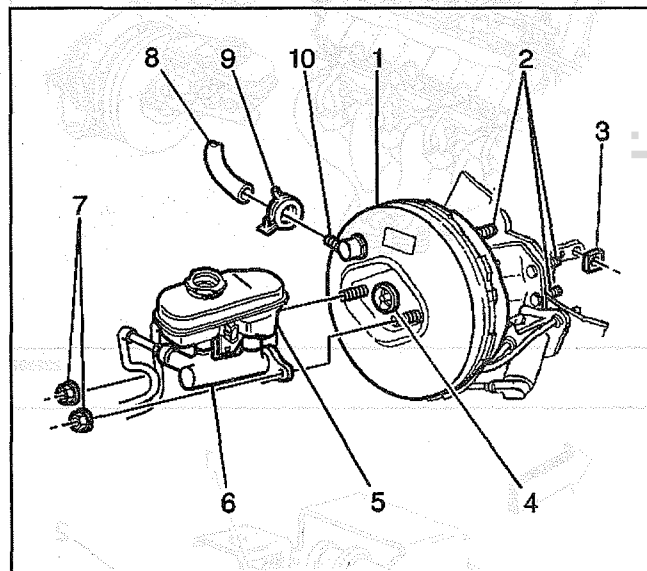
Tighten

Tighten the brake master cylinder nuts to 29 N·m (21 lb ft)

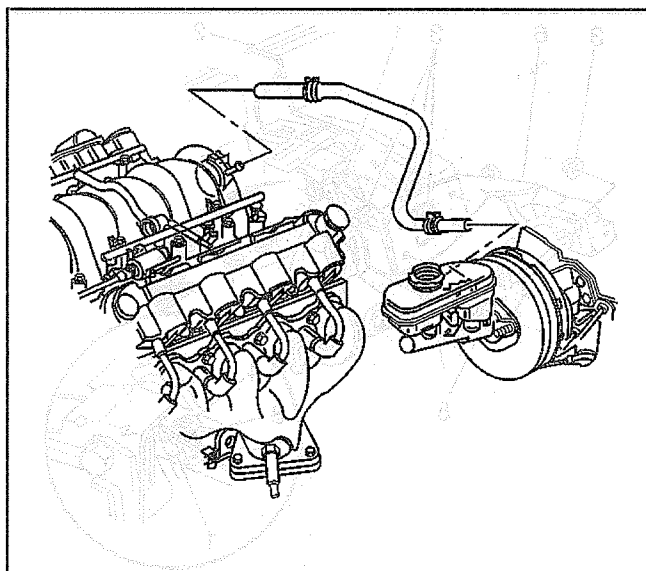
7. Connect the vacuum hose (8) and the clamp (9) to the check valve (10).
8. Install the left side instrument insulator. Refer to *Closeout/Insulator Panel Replacement - Left* in Instrument Panel, Gauges and Console.
9. Install the left side air inlet screen. Refer to *Air Inlet Grille Panel Replacement* in Body Front End.
10. Install the hood rear seal. Refer to *Seal Replacement - Hood Rear* in Body Front End.
11. Bleed the brakes. Refer to *Hydraulic Brake System Bleeding (Manual Bleeding)* or *Hydraulic Brake System Bleeding (Pressure Bleeding)*.



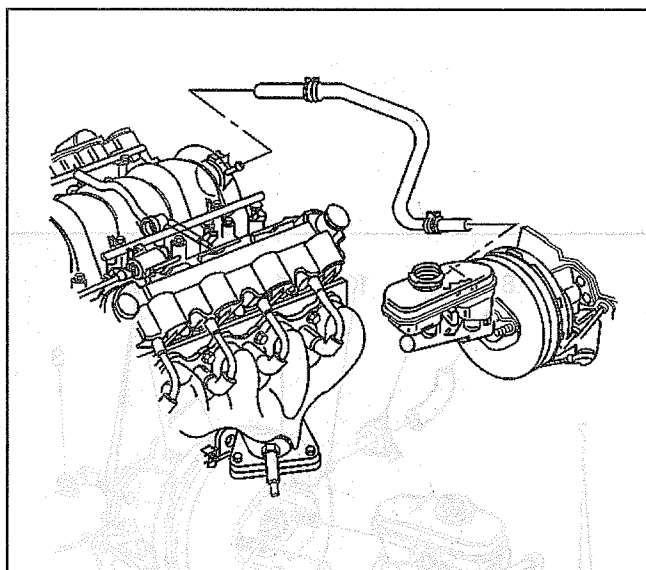
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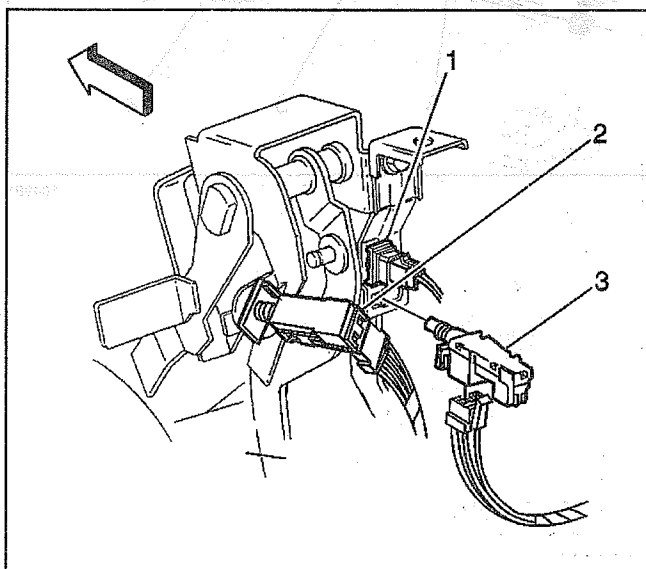
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Vacuum Brake Booster Hose Replacement

Removal Procedure

1. Reposition the vacuum brake booster hose clamps (V8 shown, V6 similar).
2. Reposition the hose clamp from the engine side of the vacuum hose.
3. Remove the vacuum brake booster hose from the engine fitting and the vacuum check valve.

Installation Procedure

1. Connect the vacuum brake booster hose to the engine fitting and the vacuum check valve.
2. Reposition the hose clamp to the engine side of the vacuum hose.
3. Reposition the vacuum brake booster hose clamp.

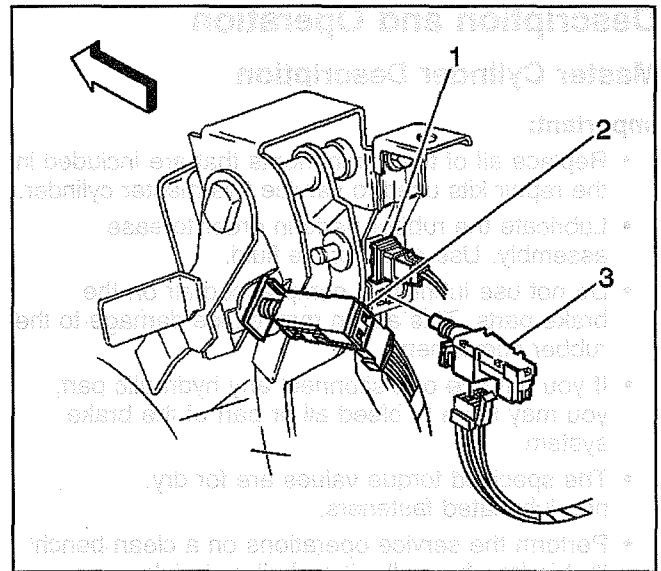
Stoplamp Switch Replacement

Removal Procedure

1. Remove the left side instrument panel insulator. Refer to *Closeout/Insulator Panel Replacement - Left* in Instrument Panel, Gauges and Console.
2. Disconnect the electrical connector from the switch.
3. Remove the Stoplamp and TCC switch (3) from the bracket (1).

Installation Procedure

1. Install the Stoplamp and TCC switch (3) to the bracket (1).
2. Connect the electrical connector to the switch.
3. Adjust the Stoplamp and TCC switch. Refer to *Stoplamp Switch Adjustment*.
4. Install the left side instrument panel insulator. Refer to *Closeout/Insulator Panel Replacement* - Left in Instrument Panel, Gauges and Console.



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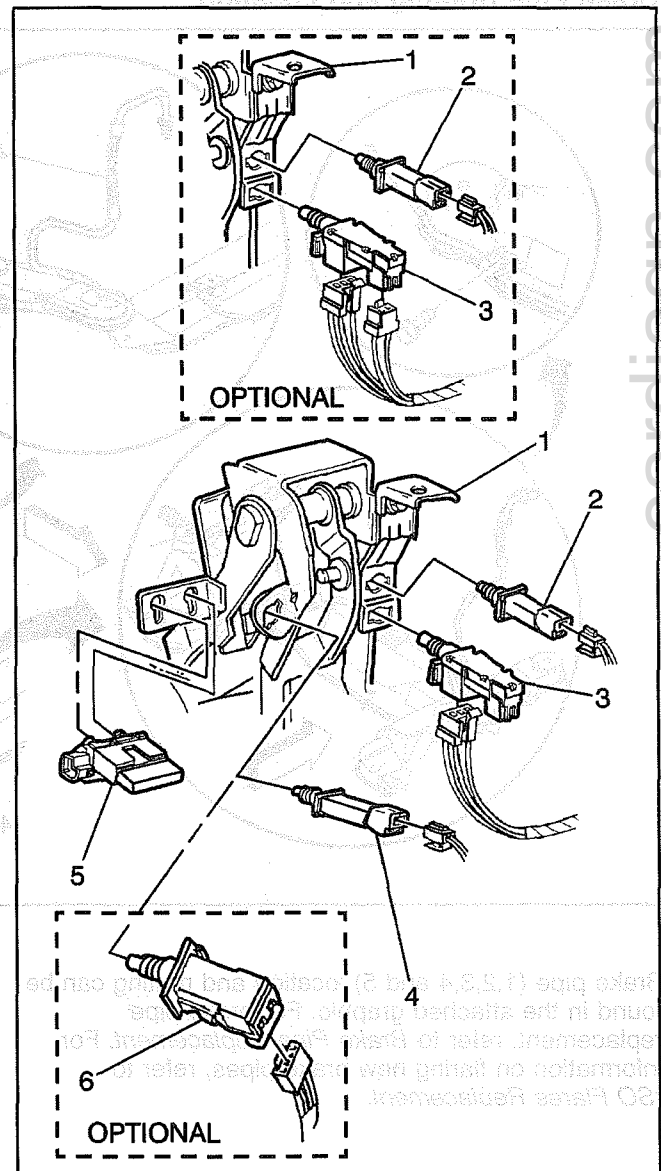
Stoplamp Switch Adjustment

Notice: Proper stoplamp switch adjustment is essential. Improper stoplamp switch adjustment may cause brake drag, heat buildup and excessive brake lining wear.

1. Adjust the cruise control release switch (2) and the stoplamp and Torque Converter Clutch (TCC) switch (3) at the same time.
2. Adjust the cruise control clutch switch (4) or the cruise control clutch anticipate switch (6) if equipped after the clutch pedal is installed.
3. Depress the brake or the clutch pedal.
4. Insert the following switches into the pedal with the bracket until the retainers on the switches are fully seated:
 - Cruise control release switch (2)
 - Stoplamp and TCC switch (3)
 - Cruise control clutch switch (4) or cruise control clutch anticipate switch (6) if equipped.

Important: Apply the proper amount of force to the brake pedal during adjustment.

- Too much force may damage the vacuum booster.
 - Too little force may cause the brakes to drag.
5. Slowly pull the brake or clutch pedal rearward with a force of 222 N (50 lbs) until clicking sounds are no longer heard. At this point, the retainers on the switches will be adjusted.
 6. Measure the cruise control release switch (2).
 7. Measure the stoplamp and TCC switch (3).
 8. The switch contacts should be open at 25.4 mm (1.0 in) or less of pedal travel. The switch contacts should occur at the same time or before the onset of braking. The brake pedal travel can be up to 25.4 mm (1.0 in) before the cruise control system disengages.



182813

Description and Operation

Master Cylinder Description

Important:

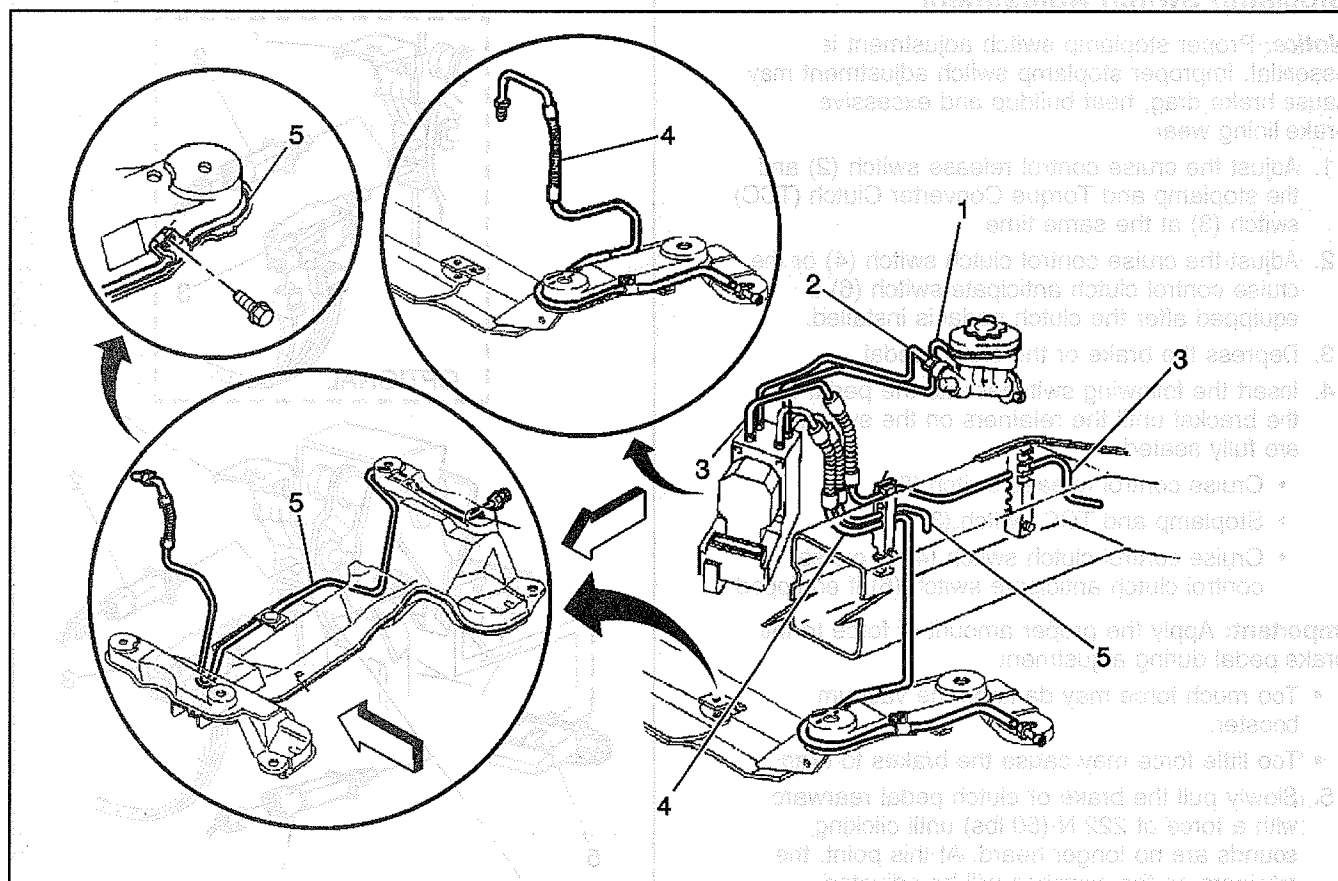
- Replace all of the components that are included in the repair kits used to service this master cylinder.
- Lubricate the rubber parts in order to ease assembly. Use clean brake fluid.
- Do not use lubricated compressed air on the brake parts. This action may cause damage to the rubber components.
- If you remove or disconnect any hydraulic part, you may have to bleed all or part of the brake system.
- The specified torque values are for dry, non-lubricated fasteners.
- Perform the service operations on a clean bench that is free from all mineral oil materials.

The master cylinder has an aluminum body and a plastic reservoir. The brake system is a conventional front-to-rear split system. The master cylinder primary piston provides the fluid pressure to the front disc brakes. The secondary piston provides the fluid pressure to the rear disc brakes. If pressure is lost from either system, the remaining system will function in order to stop the vehicle.

Brake Master Cylinder Reservoir

The reservoir has a maximum fluid level indicator mark. The fluid level indicator mark is located on the side of the reservoir.

Brake Pipe Routing and Location



Brake pipe (1,2,3,4 and 5) location and routing can be found in the attached graphic. For brake pipe replacement, refer to *Brake Pipe Replacement*. For information on flaring new brake pipes, refer to *ISO Flares Replacement*.

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Brake Fluid and Brake Fluid Handling

Caution: Use only **SUPREME 11** or equivalent **DOT 3** brake fluid from a clean, sealed container. Do not use fluid from an open container that may be contaminated with water. Improper or contaminated fluid will result in damage to components or loss of braking, with possible personal injury.

Notice: Avoid spilling brake fluid on any of the vehicle's painted surfaces, wiring, cables, or electric connectors. Brake fluid will damage the paint and the electrical connections. If any fluid is spilled on the vehicle, flush the area to lessen the damage.

Important:

- Do not re-use fluid accumulated during brake hydraulic system bleeding.
- Store brake fluid in a closed container.
- Reseal brake fluid containers immediately after use.
- Do not use fluid left in an open or improperly sealed container. Fluid left in an open or improperly sealed container absorbs moisture and may become contaminated.

If rubber deterioration is evident, complete the following procedure:

1. Disassemble all hydraulic parts.
2. Wash all the hydraulic parts with alcohol.
3. Dry the parts with non-lubricated compressed air before reassembly in order to keep alcohol out of the system.
4. Replace all the rubber parts in the system, including the following components:
 - Brake hoses
 - Master cylinder rubber parts
 - Brake caliper boots and seals
 - Wheel cylinder boots and seals
5. Replace the combination valve and the brake pressure modulator valve. Both valves have rubber components inside which are not serviceable.
6. Inspect the pads for brake fluid. If excessive brake fluid is present, replace the pads.

Substandard or Contaminated Brake Fluid

Caution: Use only **SUPREME 11** or equivalent **DOT 3** brake fluid from a clean, sealed container. Do not use fluid from an open container that may be contaminated with water. Improper or contaminated fluid will result in damage to components or loss of braking, with possible personal injury.

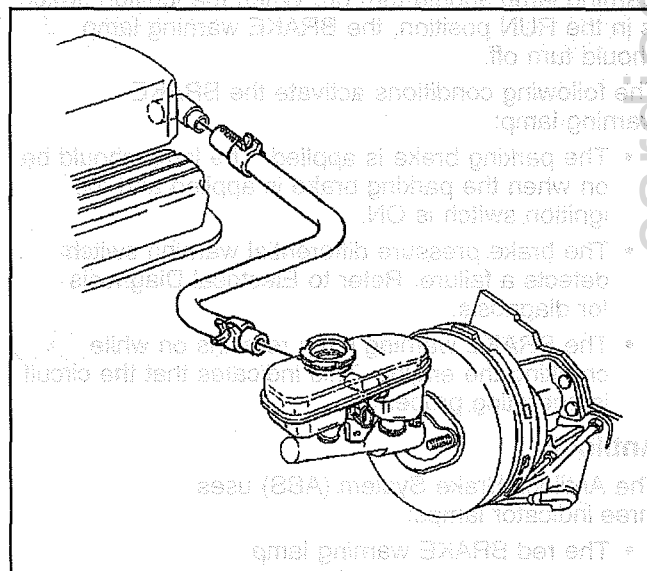
Vacuum Brake Booster Description

Important:

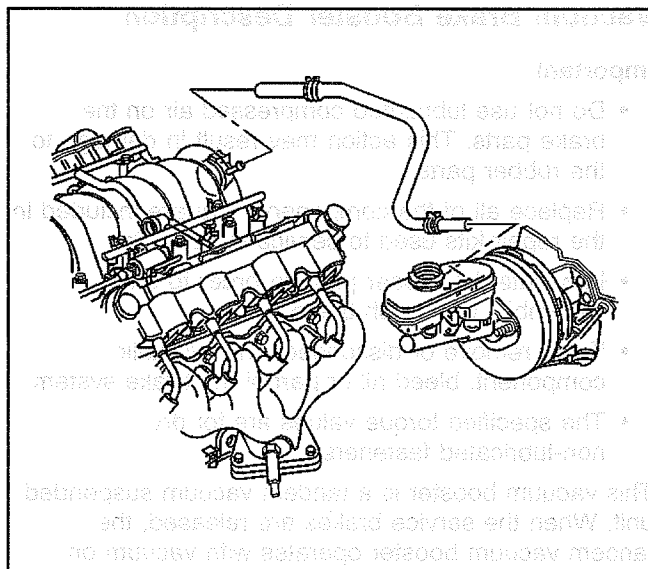
- Do not use lubricated compressed air on the brake parts. This action may result in damage to the rubber parts.
- Replace all of the components that are included in the repair kits used to service this booster.
- Lubricate the rubber parts in order to ease assembly. Use fresh brake fluid.
- If you remove or disconnect any hydraulic component, bleed all or part of the brake system.
- The specified torque values are for dry, non-lubricated fasteners.

This vacuum booster is a tandem vacuum suspended unit. When the service brakes are released, the tandem vacuum booster operates with vacuum on both sides of the diaphragm. When the brakes are applied, air at atmospheric pressure is admitted to one side of the diaphragm. This draws air from the booster through the vacuum check valve to the vacuum source. The internal components of this booster cannot be serviced. Do not unstack and separate the housing. Separating the housing will cause permanent deformation of the booster and prevent the booster from holding the proper volume.

Routing



Power brake booster vacuum hose routing on the 3800 V6 series engine.



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Power brake booster vacuum hose routing on the 5.7L V8 series engine.

Brake Warning System Description

Brake

The brake system uses a single red BRAKE warning lamp located in the instrument cluster. When the ignition switch is in the START position, the BRAKE warning lamp should turn on. When the ignition switch is in the RUN position, the BRAKE warning lamp should turn off.

The following conditions activate the BRAKE warning lamp:

- The parking brake is applied. The lamp should be on when the parking brake is applied and the ignition switch is ON.
- The brake pressure differential warning switch detects a failure. Refer to Electrical Diagnosis for diagnosis.
- The BRAKE warning lamp remains on while cranking the engine. This indicates that the circuit is operating properly.

Antilock

The Antilock Brake System (ABS) uses three indicator lamps:

- The red BRAKE warning lamp
- An amber ABS INOP indicator lamp
- An amber LOW TRAC indicator lamp

The lamps operate normally under the following conditions:

- When the ignition is turned to the RUN position, prior to starting the engine, the amber ABS INOP indicator lamp should turn on and the red BRAKE warning lamp should flash.
- While the engine is cranked, the red BRAKE warning lamp and the amber ABS INOP indicator lamp should turn on. The amber LOW TRAC indicator lamp may turn on and off.

- When the engine is started, the amber ABS INOP lamp and the red BRAKE lamp should turn off. The amber LOW TRAC indicator lamp may turn on and off.

The operation of the three lamps is an important part of the Antilock Brake System (ABS) diagnosis. A malfunction is present if the warning/indicator lamps turn on while driving the vehicle. If the warning lamps do not turn on under normal conditions as described above, service the lamps as soon as possible. For further information regarding the operation of the warning/indicator lamps for the Antilock Brake System (ABS), refer to Antilock Brakes.

Brake Warning System Circuit Description

Circuit Operation

The brake warning indicator on the instrument cluster illuminates under the following conditions:

- The instrument cluster bulb test is occurring.
- The park brake is set.
- The master cylinder brake fluid level is low.
- The electronic brake control module sends a Class 2 message to the instrument cluster.

These conditions are explained in detail below. In all cases positive voltage is applied to the brake warning indicator through circuit 39.

Instrument Cluster Bulb Test

When the ignition switch is turned to the RUN position, the instrument cluster performs an internal bulb test on the brake warning indicator. The indicator illuminates for approximately 3 seconds and then turns off.

Park Brake

The park brake switch closes when the park brake is set. On Domestic and Gulf States vehicles, ground is applied through circuit 1134, the DRL module and circuit 33 to the instrument cluster. The brake indicator illuminates. On Europe and Japan vehicles, ground is applied through circuit 33 to the cluster.

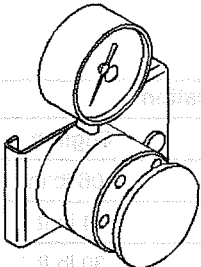
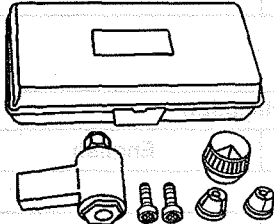
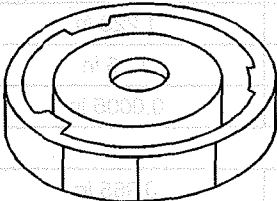
Brake Fluid Level

When the brake fluid level in the master cylinder is low, the brake fluid level indicator sensor closes. Ground is applied through the sensor and circuit 33 to the instrument cluster. The brake indicator illuminates.

EBCM Class 2

The brake indicator is also controlled by the ABS system through the class 2 serial data line. The electronic brake control module (EBCM) sends a class 2 message to illuminate the brake indicator. The indicator warns the customer that a problem exists in the ABS system. Refer to ABS brakes for further information.

Special Tools and Equipment

Illustration	Tool Number/Description
 1006	J 28662 Brake Pedal Effort Gauge
 1089	J 29803-A ISO Flaring Kit
 153149	J 35589 Bleeding Adapter