

SECTION : 4A

HYDRAULIC BRAKES

CAUTION : Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

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SPECIFICATIONS

GENERAL SPECIFICATIONS

2.0 DOHC Engine		
Application	Millimeters	Inches
Front Brake Rotors:		
Discard Thickness	22.00	0.87
Lateral Runout (Installed)	0.03	0.001
Rotor Diameter	256.00	10.08
Rotor Thickness (New)	24.00	0.95
Thickness Tolerance	0.03	0.001
Rear Brake Rotors:		
Discard Thickness	8.0	0.314
Lateral Runout (Installed)	0.03	0.001
Rotor Diameter	258.00	10.16
Rotor Thickness (New)	10.40	0.41
Thickness Tolerance	0.03	0.001
Master Cylinder:		
Bore Diameter (Nominal)	23.81	0.94
Bore Diameter (Maximum)	23.862	0.942
Caliper:		

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Application	Millimeters	Inches
Minimum Piston Diameter (Front)	57.00	2.24
Minimum Piston Diameter (Rear)	35.00	1.38

DIAGNOSIS

BRAKE SYSTEM TESTING

Brakes should be tested on a dry, clean, reasonably smooth and level roadway. A true test of brake performance cannot be made if the roadway is wet, greasy, or covered with loose dirt which can cause tires not to grip the road unequally. Testing also will be inaccurate on a crowned roadway because the wheels tend to bounce.

Test the brakes at different vehicle speeds with both light—and heavy—pedal pressure; however, avoid locking the brakes and sliding the tires. Locked brakes and sliding tires do not indicate brake efficiency since heavily braked but turning wheels will stop the vehicle in less distance than locked brakes. More tire-to-road friction is present with a heavily braked, turning tire than with a sliding tire.

Because of the high deceleration capability, a firmer pedal may be felt at higher deceleration levels.

There are three major external conditions that affect brake performance:

- Tires having unequal contact and grip of the road will cause unequal braking. Tires must be equally inflated, and the tread pattern of the right and the left tires must be approximately equal.
- Unequal loading of the vehicle can affect the brake performance since the most heavily loaded wheels require more braking power, and thus more braking effort, than the others.
- Misalignment of the wheels, particularly conditions of excessive camber and caster, will cause the brakes to pull to one side.

To check for brake fluid leaks, hold constant foot pressure on the pedal with the engine running at idle and the shift lever in NEUTRAL. If the pedal gradually falls away with the constant pressure, the hydraulic system may be leaking. Perform a visual check to confirm any suspected leaks.

Check the master cylinder fluid level. While a slight drop in the reservoir level results from normal lining wear, an abnormally low level indicates a leak in the system. The hydraulic system may be leaking either internally or externally. Refer to the procedure below to check the master cylinder. The system may appear to pass this test while still having a slight leak. If the fluid level is normal, check the vacuum booster pushrod length. If an incorrect pushrod length is found, adjust or replace the rod.

Check the master cylinder using the following procedure:

- Check for a cracked master cylinder casting or a brake fluid leak around the master cylinder. Leaks are indicated only if there is at least one drop of fluid. A damp condition is not abnormal. table.
- Check for a binding pedal linkage and for an incorrect pushrod length. If both of these parts are in satisfactory condition, disassemble the master cyl-

inder and check for an elongated or swollen primary cylinder or piston seals. If swollen seals are found, substandard or contaminated brake fluid should be suspected. If contaminated brake fluid is found, all the components should be disassembled and cleaned, and all the rubber components should be replaced. All of the pipes must also be flushed.

Improper brake fluid, or mineral oil or water in the fluid, may cause the brake fluid to boil or cause deterioration of the rubber components. If the primary piston cups in the master cylinder are swollen, the rubber parts have deteriorated.

If deterioration of the rubber is evident, disassemble all the hydraulic parts and wash the parts with alcohol. Dry these parts with compressed air before reassembly to keep the alcohol out of the system. Replace all the rubber parts in the system, including the hoses. When working on the brake mechanisms, check for fluid on the linings. If excessive fluid is found, replace the linings.

If the master cylinder piston seals are in satisfactory condition, check for leaks or excessive heat conditions. If these conditions are not found, drain the fluid, flush the master cylinder with brake fluid, refill the master cylinder, and bleed the system.

BRAKE HOSE INSPECTION

The hydraulic brake hoses should be inspected at least twice a year. The brake hose assembly should be checked for road hazard damage, cracks, chafing of the outer cover, and for leaks or blisters. Inspect the hoses for proper routing and mounting. A brake hose that rubs on a suspension component will wear and eventually fail. A light and a mirror may be needed for an adequate inspection. If any of the above conditions are observed on the brake hose, adjust or replace the hose as necessary.

BRAKE LAMP WARNING CIRCUIT

Diagnostic Aids

The BRAKE lamp glows brightly when the ignition is ON and either the parking brake lever switch or the brake fluid level switch is closed. If neither switch is closed, the BRAKE lamp receives a ground through the generator, and it glows dimly when the ignition is ON and the engine is off. When the engine starts, the generator creates voltage. With voltage on both sides of the lamp, the lamp turns off.

Test Description

The numbers below refer to steps in the diagnostic table.

1. This step begins the test sequence for a BRAKE warning lamp that stays on when the engine is running.
2. This step begins the test sequence for a BRAKE warning lamp that never turns on.

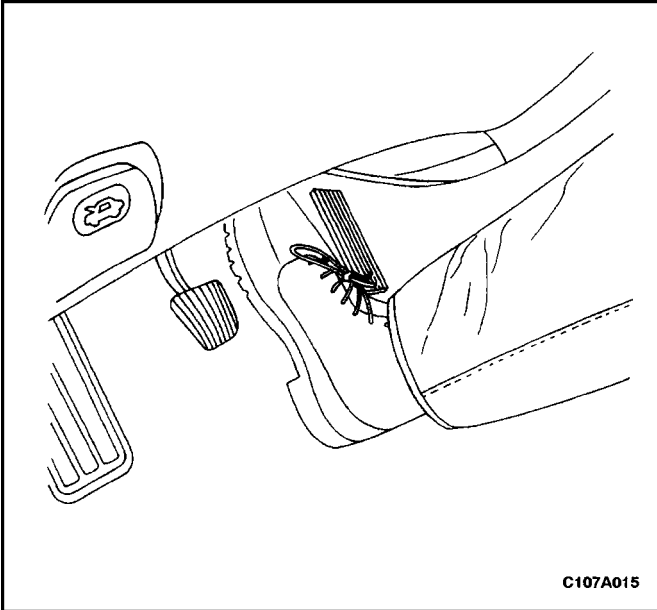
Brake Lamp Warning Circuit

Step	Action	Value(s)	Yes	No
1	Start the engine and leave it running. Does the BRAKE warning lamp stay on?		Go to <i>Step 2</i>	Go to <i>Step 10</i>
2	With the engine running, release the parking brake. Is the BRAKE warning lamp off?		System OK	Go to <i>Step 3</i>
3	Check the brake fluid level. Is the fluid level OK?		Go to <i>Step 5</i>	Go to <i>Step 4</i>
4	1. Fill the brake fluid reservoir with clean DOT–3 or DOT–4 hydraulic fluid. 2. Replace the cap on the fluid reservoir. 3. Start the engine and leave it running. Is the BRAKE warning lamp on?		Go to <i>Step 5</i>	System OK
5	Disconnect the wiring harness connector from the brake fluid level switch at the master cylinder reservoir. Is the BRAKE warning lamp on?		Go to <i>Step 7</i>	Go to <i>Step 6</i>
6	Replace the brake fluid level switch. Is the repair complete?		System OK	
7	1. Connect the brake fluid level switch. 2. Disconnect the parking brake lever switch. 3. Start the engine and leave it running. Is the BRAKE warning lamp on?		Go to <i>Step 9</i>	Go to <i>Step 8</i>
8	Replace the parking brake lever switch. Is the repair complete?		System OK	
9	Repair the short circuit in the instrument wiring harness between terminal A12 of the instrument cluster and ground. Is the repair complete?		System OK	
10	1. Disconnect the electrical connector from the fluid level switch at the master cylinder reservoir. 2. Connect a jumper wire between ground and terminal 1 of the fluid level switch harness connector. Does the BRAKE warning lamp turn on?		Go to <i>Step 11</i>	Go to <i>Step 13</i>
11	1. Disconnect the electrical connector from the fluid level switch at the master cylinder reservoir. 2. Connect a jumper wire between terminals 1 and 2 of the fluid level switch harness connector. Does the BRAKE warning lamp turn on?		Go to <i>Step 12</i>	Go to <i>Step 13</i>
12	Replace the brake fluid level switch on the master cylinder reservoir. The switch can be removed and replaced without draining the brake fluid from the reservoir. Is the repair complete?		System OK	
13	1. Turn the ignition ON. 2. Apply the parking brake. Does the BRAKE warning lamp turn on?		Go to <i>Step 27</i>	Go to <i>Step 14</i>

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Step	Action	Value(s)	Yes	No
14	Check fuse F18. Is fuse F18 blown?		Go to <i>Step 15</i>	Go to <i>Step 16</i>
15	1. Check for a short circuit and repair it, if necessary. 2. Replace fuse F18. Is the repair complete?		System OK	
16	1. Turn the ignition ON. 2. Check the voltage at F18. Is the voltage equal to the specified value?	11–14 v	Go to <i>Step 18</i>	Go to <i>Step 17</i>
17	Repair the power supply to fuse F18. Is the repair complete?		System OK	
18	1. Disconnect terminal B12 of the instrument cluster. 2. Turn the ignition ON. 3. Use a voltmeter to check the voltage at terminal B12. Is the voltage equal to the specified value?	11–14 v	Go to <i>Step 20</i>	Go to <i>Step 19</i>
19	Repair the open circuit between terminal B12 of the instrument cluster and fuse F18. Is the repair complete?		System OK	
20	1. Reconnect terminal B12 of the instrument cluster. 2. Turn the ignition ON. 3. Use a voltmeter to backprobe terminal A12 of the instrument cluster. Is the voltage equal to the specified value?	11–14 v	Go to <i>Step 24</i>	Go to <i>Step 21</i>
21	1. Remove the BRAKE warning lamp from its socket. 2. Test the BRAKE warning lamp. Is the BRAKE warning lamp OK?		Go to <i>Step 22</i>	Go to <i>Step 23</i>
22	Replace the instrument cluster. Is the repair complete?		System OK	
23	Replace the BRAKE warning lamp. Is the repair complete?		System OK	
24	1. Disconnect the parking brake switch connector. 2. Connect a jumper wire between the switch connector and ground. 3. Turn the ignition ON. Is the BRAKE warning lamp on?		Go to <i>Step 25</i>	Go to <i>Step 26</i>
25	Replace the BRAKE warning lamp switch. Is the repair complete?		System OK	
26	Repair the open circuit between the BRAKE warning lamp switch and terminal A12 of the instrument cluster. Is the repair complete?		System OK	

Step	Action	Value(s)	Yes	No
27	1. Disconnect the brake fluid level switch at the master cylinder reservoir. 2. Use an ohmmeter to check the resistance between terminal 2 of the switch connector and ground. Is the resistance equal to the specified value?	$\approx 0 \Omega$	Go to <i>Step 28</i>	Go to <i>Step 29</i>
28	Repair the open circuit between ground and the brake fluid level switch. Is the repair complete?		System OK	
29	Repair the open circuit between terminal 1 of the brake fluid level switch and terminal A12 of the instrument cluster. Is the repair complete?		System OK	



MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE MANUAL BLEEDING THE BRAKES

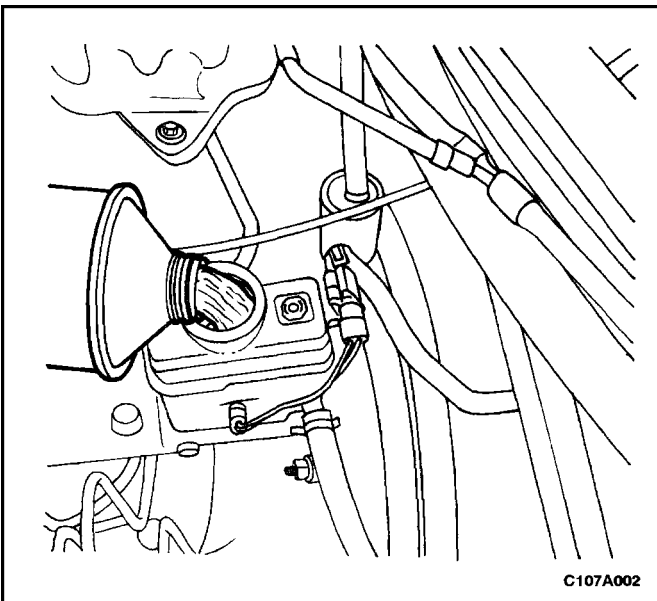
Important : Manual bleeding of the hydraulic modulator is not possible. If air enters the antilock brake hydraulic modulator, or if an unfilled modulator is installed, use the scan tool to bleed air out of the brake system. Replacement modulators are shipped already filled and bled. In normal on-vehicle service procedures involving the modulator, such as the procedure to replace the electronic brake control module, air will not enter the modulator. In such cases, use the bleeding procedure in this section.

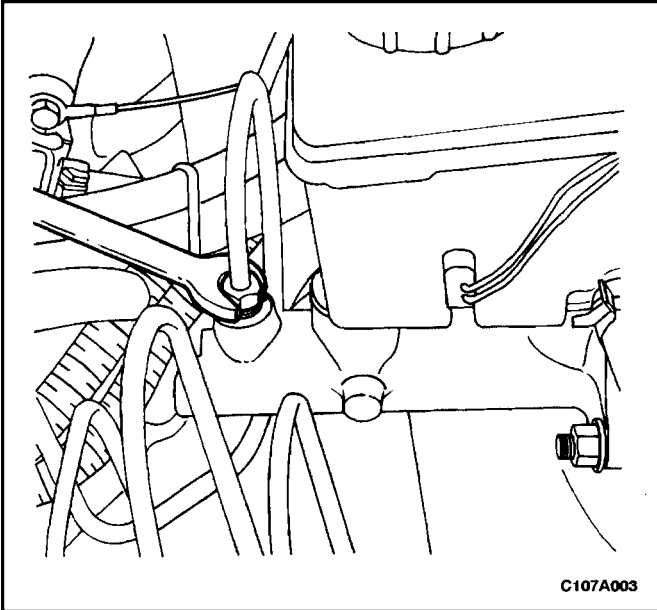
1. Remove the booster reserve by applying the brakes several times with the engine off, until all the reserve is depleted.

Important : If no air is suspected to be in the master cylinder, begin the bleeding procedure at Step 12. If it is suspected that air is in the master cylinder bore, then the master cylinder must be bled, beginning with Step 2.

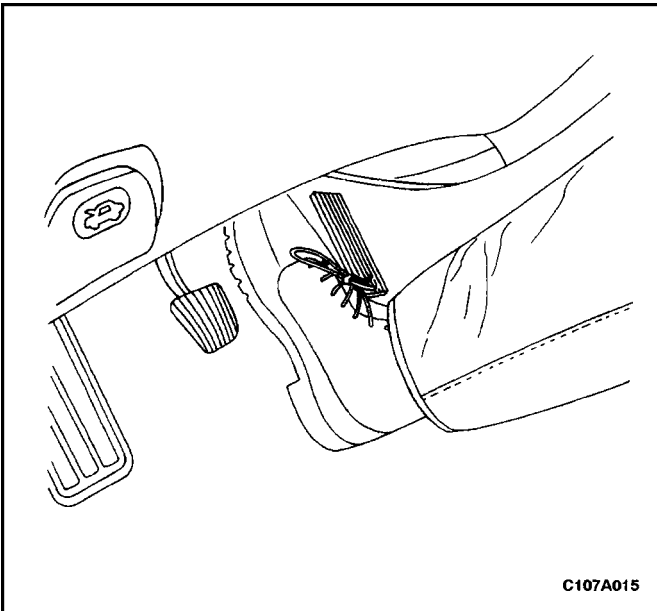
Notice : Keep brake fluid away from painted surfaces because brake fluid will damage the paint finish.

2. Fill the master cylinder reservoir with brake fluid. Keep the master cylinder reservoir at least one-half full during the bleeding operation.

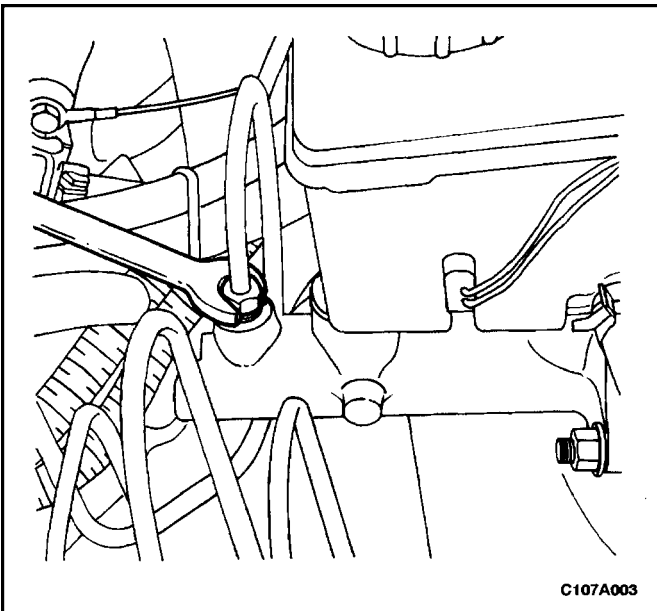




3. Disconnect the brake line at the top of the master cylinder.
4. Allow the brake fluid to fill the master cylinder until it begins to flow from the port.
5. Reconnect the brake line at the top of the master cylinder.



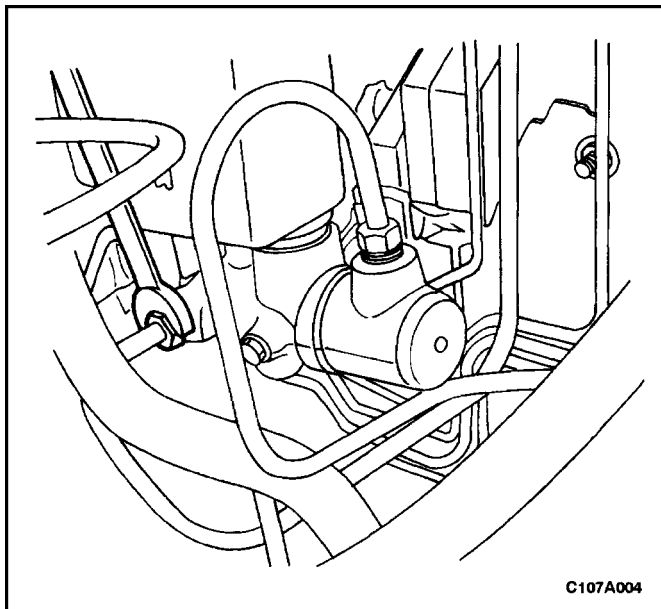
6. Slowly push and hold the brake pedal.



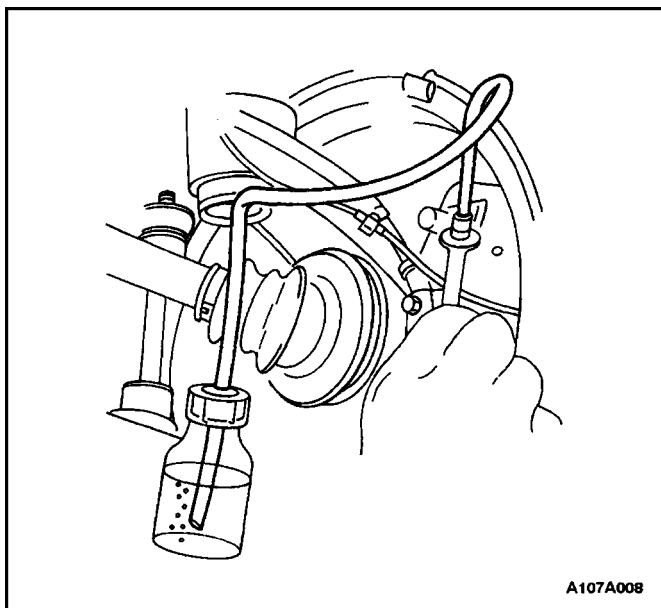
7. While the brake pedal is pushed down, loosen the brake fitting at the top of the master cylinder to purge the air from the cylinder.
8. Slightly tighten the brake fitting. Then release the brake pedal slowly. Wait 15 seconds before continuing with the next step.
9. Repeat Steps 6–8 until all of the air is removed from the master cylinder bore.
10. Tighten the brake line fitting.

Tighten

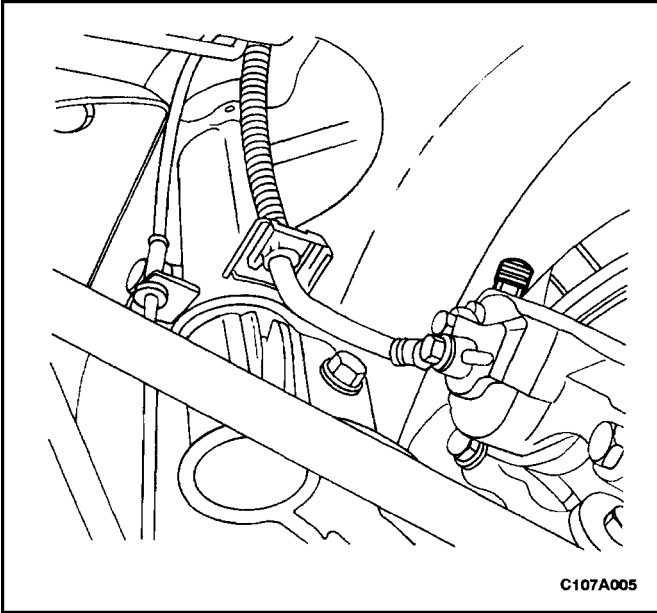
Tighten the brake line fitting to 16 N•m (12 lb–ft).



11. After the air has been bled at the top connection, bleed the master cylinder at the side connection using the same sequence as with the top connection.



12. Attach a transparent tube over the rear bleeder valve at the right rear caliper. Allow the tube to hang submerged in the brake fluid in a transparent container. (After the right rear caliper is bled in the following steps, use this procedure at the left front, the left rear, and the right front bleeder valves.)



13. Slowly push and hold the brake pedal. Avoid rapid pumping of the brake pedal.
14. While the brake pedal is pushed down, loosen the bleeder valve to purge the air from the caliper.
15. After the air bubbles have escaped into the container of brake fluid, slightly tighten the rear bleeder valve.
16. Slowly release the brake pedal. Wait 15 seconds before proceeding with the next step.

Notice : Keep brake fluid away from painted surfaces because brake fluid will damage the paint finish.

17. Repeat Steps 13–16 until all of the air is removed. You will know all of the air is removed when no bubbles appear in the container when the bleeder valve is loosened. Keep the master cylinder reservoir at least one-half full during the bleeding operation.
18. Tighten the bleeder valve.

Tighten

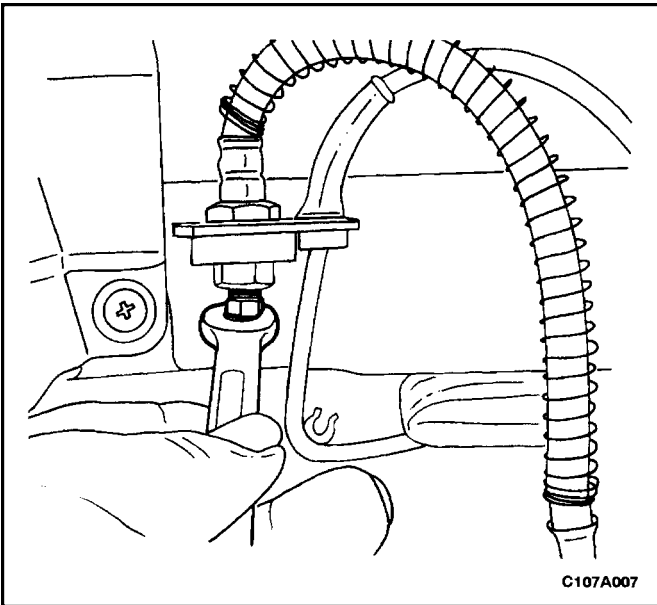
Tighten the bleeder valve to 6 N•m (53 lb-in)

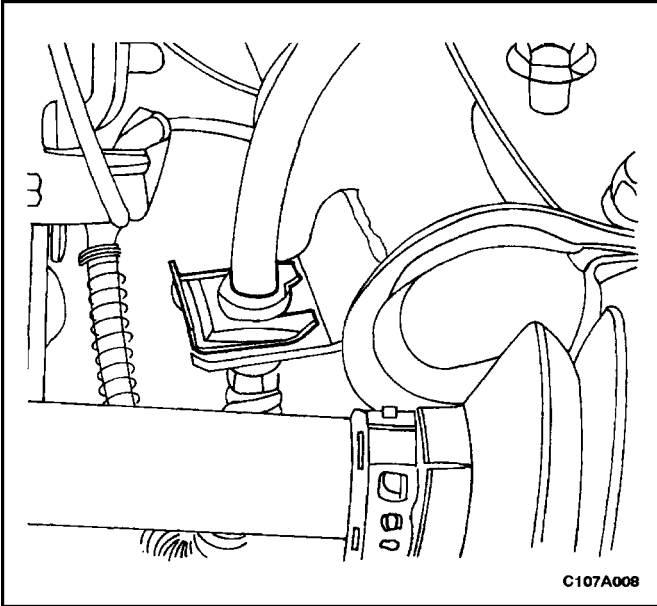
19. Bleed the remaining calipers in the following order: left front, left rear, and right front. Use the procedure in Steps 12–17.
20. After all calipers have been bled, check the brake pedal for sponginess. If the brake pedal is not firm, repeat the entire bleeding procedure to correct this condition.

BRAKE HOSE REAR

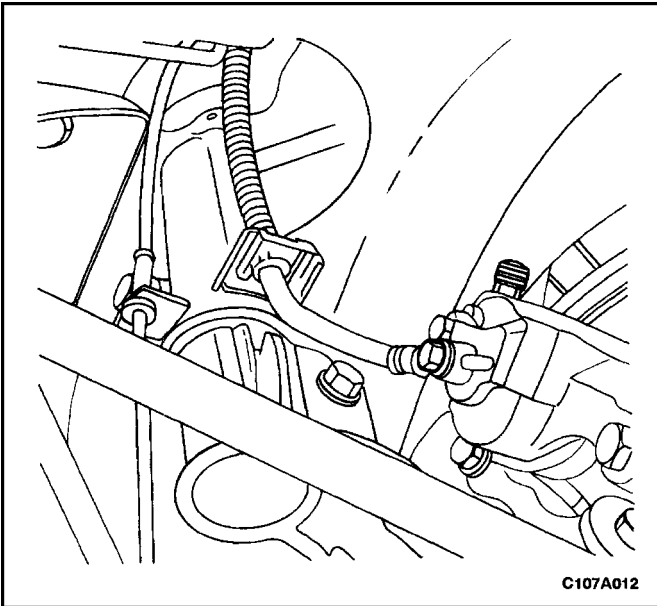
Removal Procedure

1. Raise and suitably support the vehicle.
2. Disconnect the brake line from the disc brake hose at the wheel housing bracket on each side of the vehicle.
3. Remove the brake hose retainer.

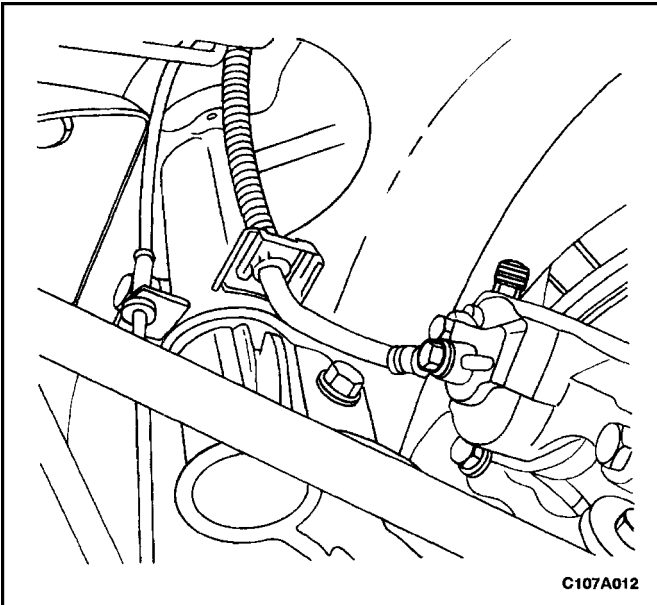




4. Remove the rear disc brake hose retainer and the brake hose from the bracket on the steering knuckle shaft.



5. Remove the rear disc brake hose from the caliper.

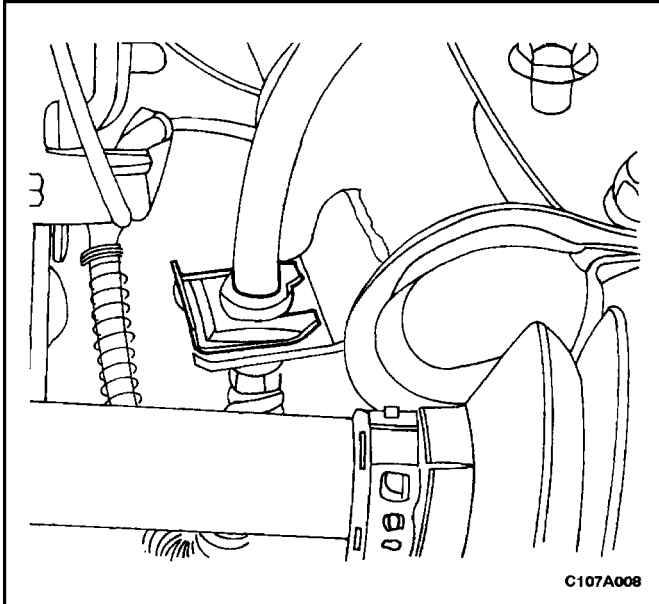


Installation Procedure

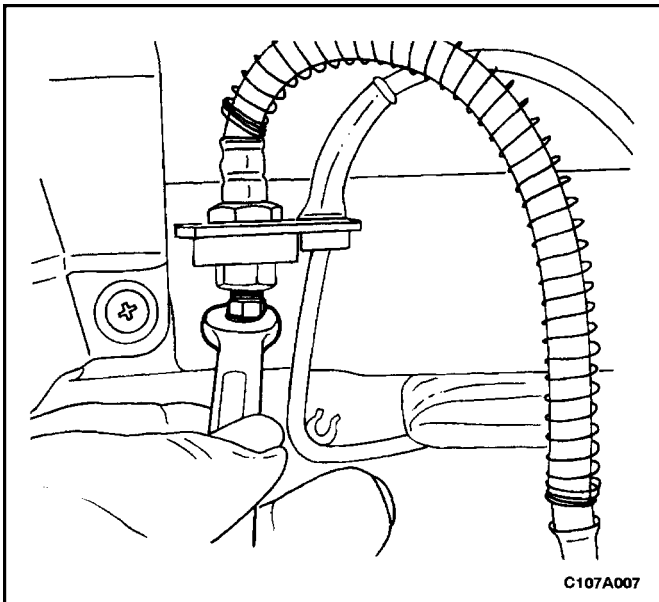
1. Install the rear disc brake hose to the caliper.

Tighten

Tighten the rear disc brake hose-to-caliper bolt to 32 N•m (24 lb-ft).



2. Install the rear disc brake hose and the retainer on the bracket on the steering knuckle shaft.

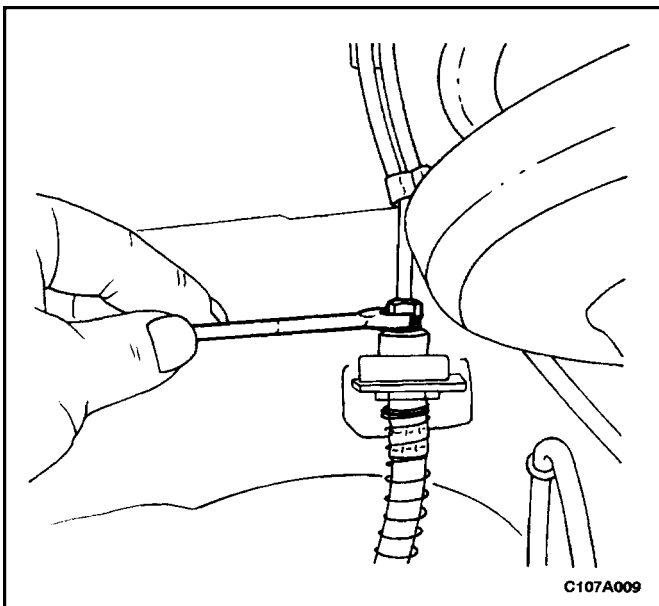


3. Install the rear disc brake line to the brake hose on the wheel housing bracket.

Tighten

Tighten the brake line to fittings 16 N•m (12 lb–ft).

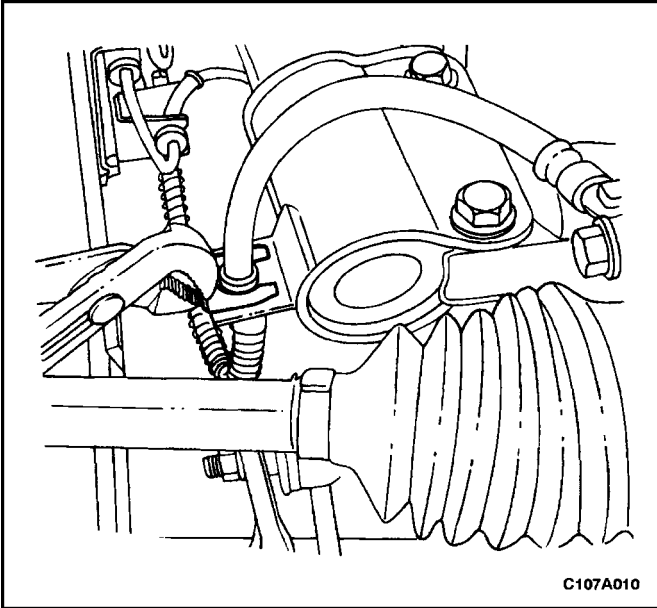
4. Lower the vehicle.
5. Bleed the brake system. Refer to "Manual Bleeding the Brakes" in this section.
6. Check the brake system for leaks.



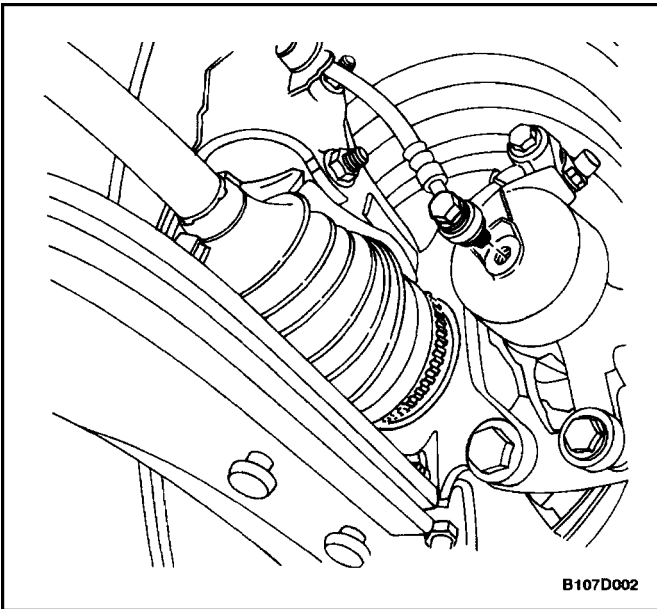
BRAKE HOSE FRONT

Removal Procedure

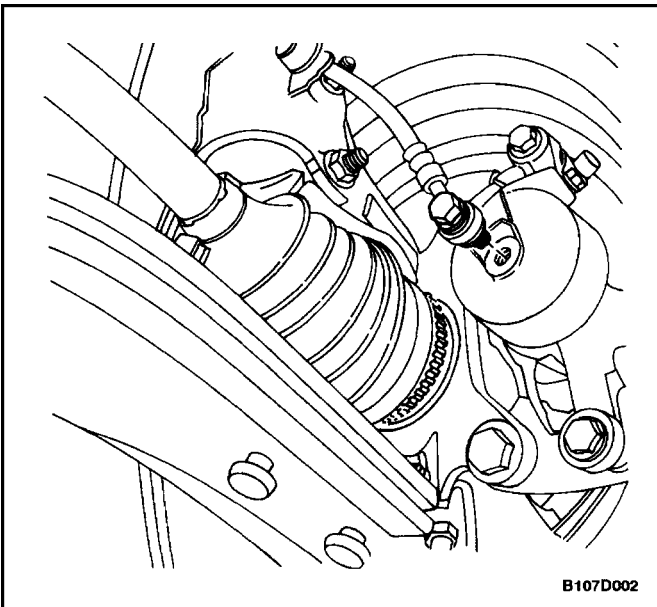
1. Raise and suitably support the vehicle.
2. Disconnect the brake line from the brake hose support bracket on the wheel housing on each side of the vehicle.
3. Remove the retainer.
4. Remove the brake hose from the wheel housing bracket.



5. Remove the retainer and disconnect the brake hose at the steering knuckle shaft bracket.



6. Remove the bolt from the brake caliper.
7. Remove the ring seals and the disc brake hose.

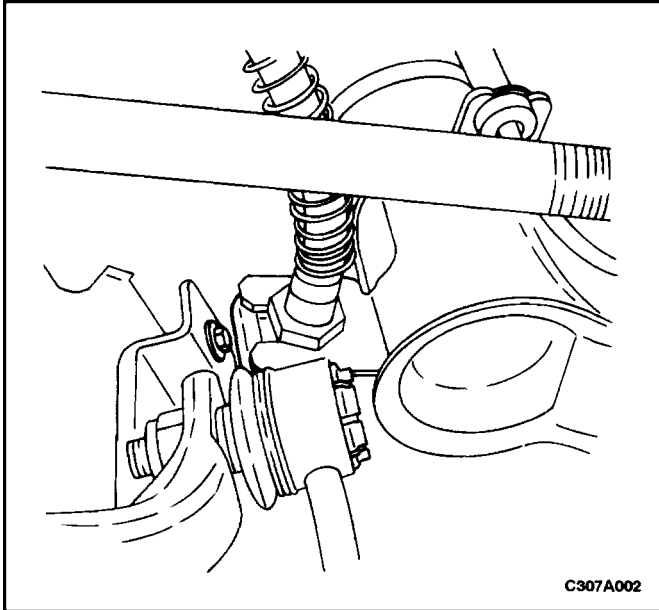


Installation Procedure

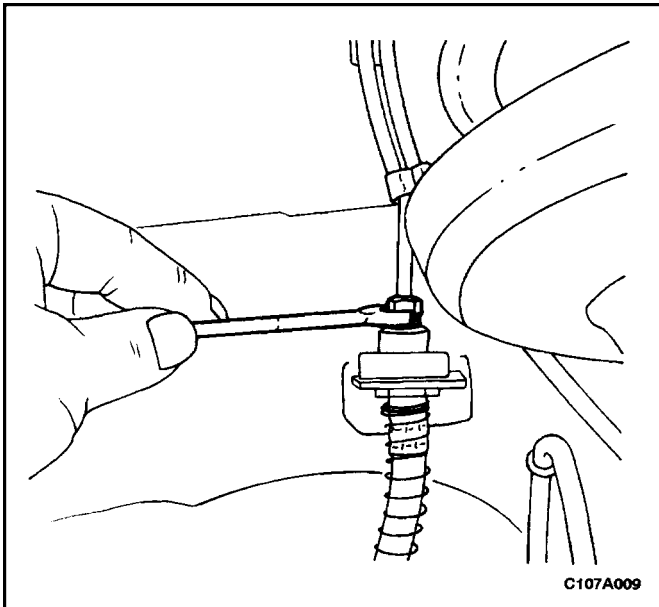
1. Install the new disc brake hose to the caliper with the new seal rings and the bolt.

Tighten

Tighten the front disc brake hose-to-caliper bolt to 40 N•m (30 lb–ft).



2. Connect the brake hose at the steering knuckle shaft bracket and install the retainer.

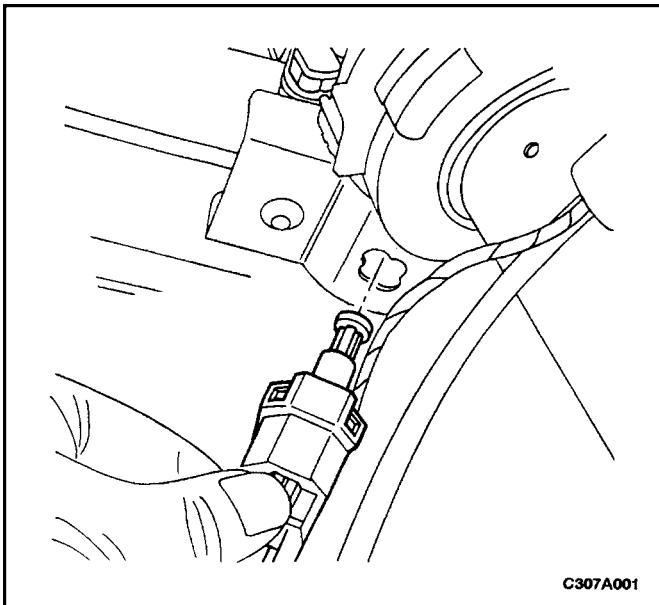


3. Connect the brake line to the brake hose on the wheel housing bracket on each side of the vehicle and install the retainer.

Tighten

Tighten the brake line fittings to 16 N•m (12 lb–ft).

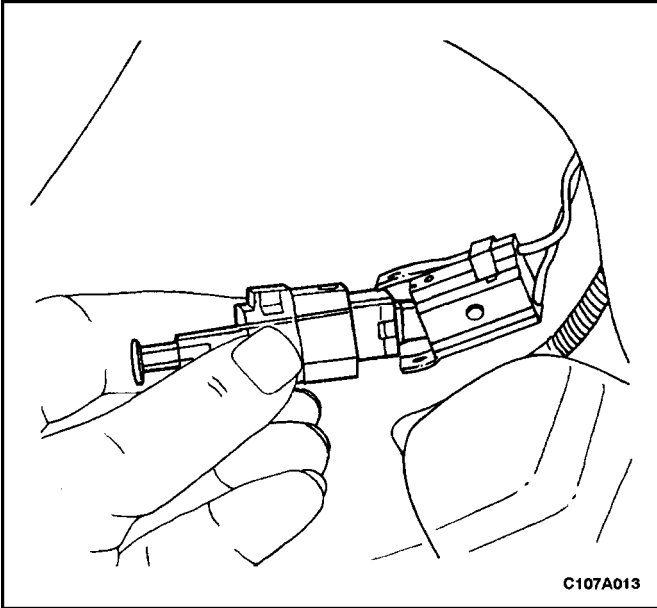
4. Lower the vehicle.
5. Bleed the brake system. Refer to "Manual Bleeding the Brakes" in this section.
6. Check the brake system for leaks.



STOPLAMP SWITCH

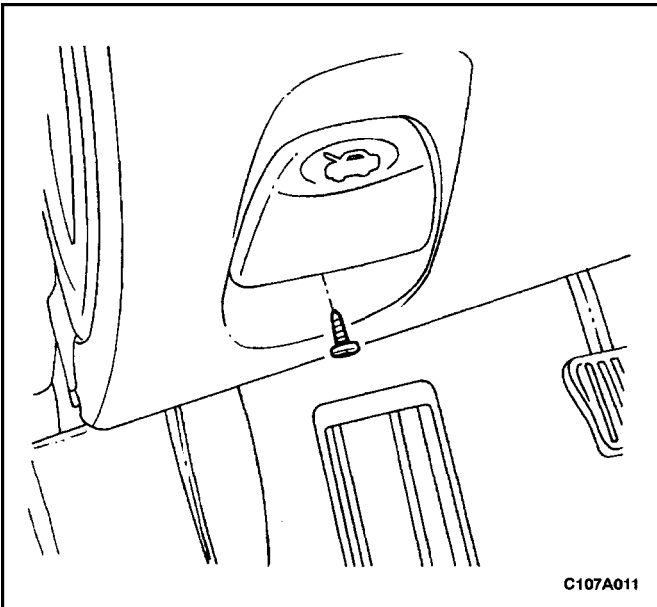
Removal Procedure

1. Turn the stoplamp switch connector assembly clock-wise and remove it from the brake pedal bracket.
2. Separate the stoplamp switch from the connector.



Installation Procedure

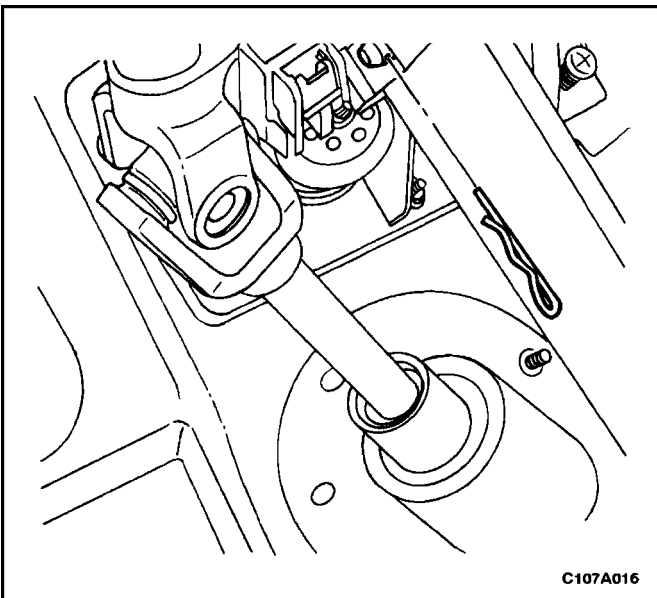
1. Place the stoplamp switch into the connector.
2. Twist the stoplamp switch connector assembly into the brake pedal bracket hole.

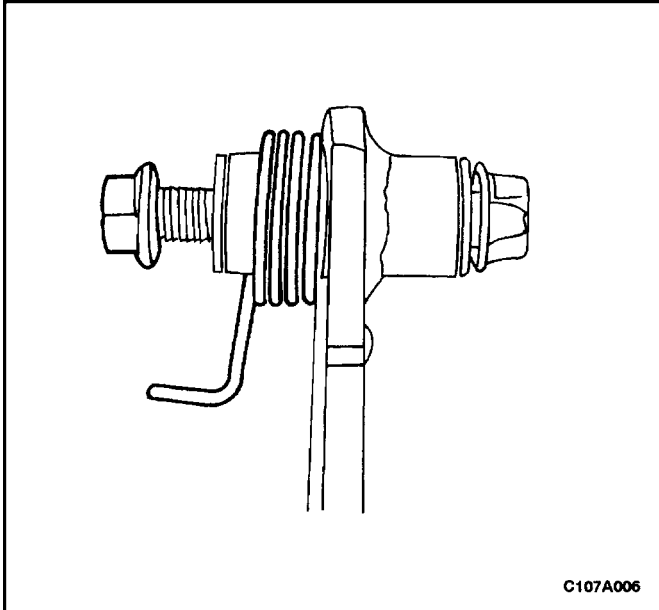


BRAKE PEDAL

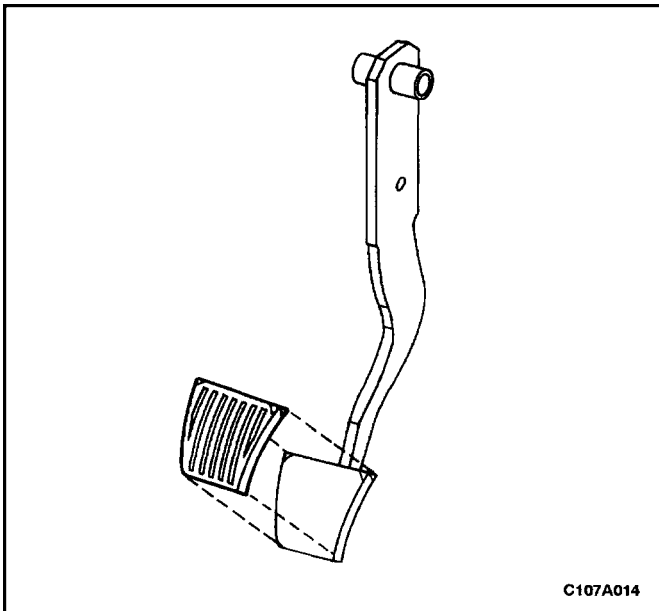
Removal Procedure

1. Remove the screws that hold the trim panel to the instrument panel.
2. Remove the trim panel.
3. Remove the driver's side knee bolster. Refer to *Section 9G, Interior Trim*.
4. Remove the stoplamp switch. Refer to "Stoplamp Switch" in this section.
5. Disconnect the spring retaining clip and the bolt from the pushrod clevis.

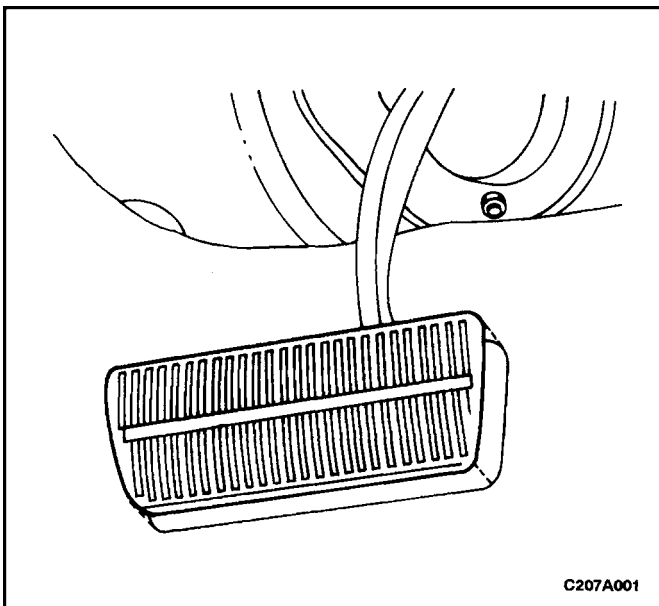




6. Remove the hex nut and the spring.
7. Remove the brake pedal and the bolt.

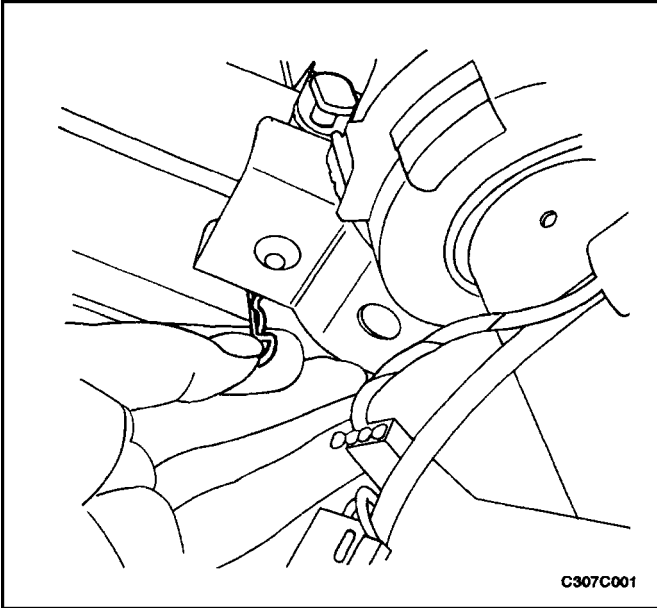


8. Remove the brake pedal cover (manual transaxle pedal shown).



Installation Procedure

1. Install a new pedal cover (automatic transaxle pedal shown), if needed.

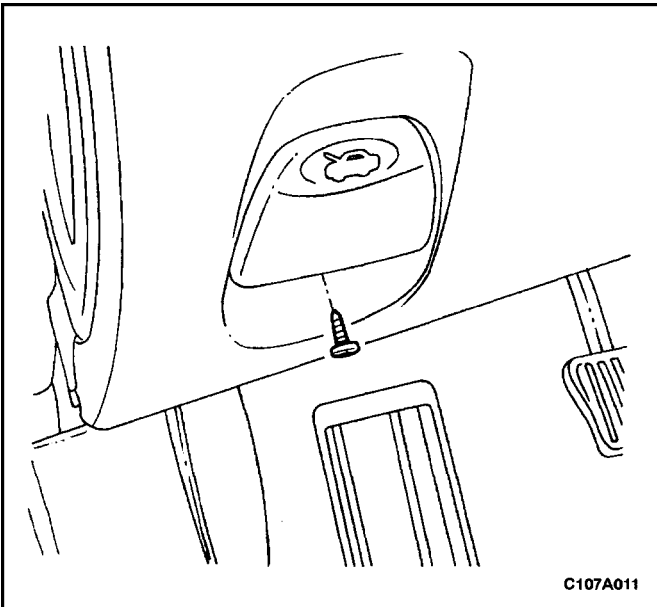


2. Coat the pedal shaft with grease.
3. Position the brake pedal on the pedal-to-dash panel bracket and the pedal bolt.
4. Place the hex nut and the spring on the pedal bolt.

Tighten

Tighten the brake pedal-to-pedal bracket hex nut to 18 N•m (13 lb–ft).

5. Install the pushrod clevis to the pedal with the bolt and the spring retaining clip.



6. Connect the stoplamp switch and connector assembly to the pedal bracket. Refer to "Stoplamp Switch" in this section.
7. Install the knee bolster. Refer to *Section 9G, Interior Trim*.
8. Install the trim panel with the screws.

Tighten

Tighten the trim panel screws to 3 N•m (27 lb–in).

GENERAL DESCRIPTION AND SYSTEM OPERATION

HYDRAULIC FLUID

Brake fluid should meet the DOT–3 specification. Use DOT–4 for heavy duty applications such as trailer towing or mountain driving. Use only clear fluid from a sealed container.

Fluid that is exposed to the air will absorb moisture. Water in the brake fluid will cause the fluid to boil and the rubber components to deteriorate. for leaks. Fix any leaks. Then refill the reservoir to the MAX indicator mark.

Thoroughly clean the master cylinder reservoir cap before removing it. Do not let any dirt or foreign material fall into the fluid reservoir.

There is a fluid level switch in the master cylinder reservoir. When the fluid level is low, the BRAKE lamp in the instrument cluster will turn on.

The correct brake fluid level is marked on the left side of the master cylinder reservoir. If the fluid level is below the MIN indicator mark, check the hydraulic brake system for leaks. Fix any leaks. Then refill the reservoir to the MAX indicator mark.