SECTION 5

BRAKES

CONTENTS

SECTION 5A

HYDRAULIC BRAKES

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

CONTENTS

CAUTION: When servicing wheel brake parts, do not create dust by grinding or sanding brake linings or by cleaning wheel brake parts with a dry brush or with compressed air. Many wheel brake parts contain asbestos fibers which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm. A water-dampened cloth or water-based solution should be used to remove any dust on brake parts. Equipment is commercially available to perform this washing function. These wet methods will prevent asbestos fibers from becoming airborne.

INTRODUCTION

DESCRIPTION

The system uses hydraulic foundation brakes with two wheel cylinders in each brake. The brake booster is a vacuum-loaded servo-type similar to automotive applications.

The vehicle is equipped with a Load-Sensing Proportioning Valve (LSPV) that redistributes hydraulic pressure/braking force to the front and rear axle based on the vehicle load.

HYDRAULIC BRAKE FLUID

Brake fluid is a specially blended liquid which provides a means of transmitting hydraulic pressure between the booster and the wheel cylinders. Brake fluid is one of the most important parts of the hydraulic system. Do not reuse drained brake fluid.

Refer to MAINTENANCE AND LUBRICATION (SEC. 0B) in this manual for description of brake fluid.

BRAKE SYSTEM DIAGNOSIS

ROAD-TESTING BRAKES

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 so that tires do not grab the road equally. Testing will also be adversely affected if the roadway is crowned so as to throw the weight of the vehicle toward the wheels on one side or if the roadway is so rough that the wheels tend to bounce.

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

External Conditions That Affect Breake Performance

- **Tires**–Tires having unequal contact and grip on the road will cause unequal braking. Tires must be equally inflated and tread pattern of the right and left tires must be approximately equal.
- **Vehicle Loading**–When the vehicle has unequal loading, the most heavily loaded wheels require more braking power than others. A heavily loaded vehicle requires more braking effort.
- **Front Wheel Bearing** –A loose front wheel bearing permits the drum and wheel to tilt and have spotty contact with the brake linings causing erratic brake action.
- **Front End Alignment**–Misalignment of the front end will cause the brakes to pull to one side.

BRAKE SYSTEM DIAGNOSIS CHART

PROBLEM	POSSIBLE CAUSE	CORRECTION
No Brakes	1. Restricted tubing or hose. 2. Brakes out of adjustment. 3. No fluid.	1. Replace defective parts. 2. Adjust.
Insufficient Brakes	1. Pedal improperly adjusted. 2. Worn linings or drums. 3. Plugged, crimped, restricted lines.	1. Adjust. 2. Replace as necessary. 3. Repair or replace.
Slow Brake Application	1. Pedal binding. 2. Wheel cylinder piston sticking. 3. Restriction in the lines. 4. Worn linings or drums.	1. Lubricate pivot pin, clean-check for foreign objects. 2. Repair the wheel cylinder. 3. Remove the restriction or replace the line. 4. Replace as necessary.
Uneven Braking (Front or Rear Brakes not Working)	1. Damaged hydraulic lines. 2. No brake fluid at the master cylinder.	1. Repair or replace. 2. Check for plugged, kinked or damaged hose to the reservoir.
Wet Weather: Brakes Grab or won't Hold	1. Linings too sensitive to water. 2. Dirty brakes. 3. Bent mounting plate – opening. 4. Scored drums.	1. Replace in axle sets. 2. Clean out. 3. Replace. 4. Machine in pairs. Replace if necessary.
Brakes Squeak	1. Mounting plate bent or shoes twisted. 2. Metallic particles or dust imbedded in the lining. 3. Lining rivets loose or lining not held tightly against the shoe at the ends. 4. Drums distorted tapered, or not square. 5. Incorrect lining. 6. Mixed size linings. 7. Weak or broken return spring. 8. Loose wheel bearings. 9. Loose mounting plate, drum, wheel cylinder. 10. Linings located wrong on the shoes. 11. Linings worn out. 12. Linings glazed. 13. Cracked or threaded drums.	1. Replace damaged parts. 2. Replace the linings in axle sets. 3. Replace the rivets and/or tighten the lining by riveting. 4. Machine or replace drums. 5. Replace the linings in axle sets. 6. Use all standard or oversize linings in a brake. 7. Replace the return spring. 8. Tighten to the proper setting. 9. Tighten. 10. Install the linings correctly. 11. Reline the brakes. 12. Replace. 13. Replace in axle pairs.
Brakes Chatter	1. Incorrect lining to drum clearance. 2. Loose mounting plate. 3. Grease, fluid, road dust on the lining. 4. Weak or broken return spring. 5. Loose wheel bearings. 6. Drums out-of-round. 7. Cocked or distorted shoes.	1. Adjust to specification. 2. Tighten securely. 3. Clean or reline. 4. Replace the return spring. 5. Readjust. 6. Machine the drums in axle sets. 7. Straighten or replace.

BRAKE SYSTEM DIAGNOSIS CHART (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Brakes Chatter (Cont.)	8. Distorted, tapered, or barrel-shaped drums. 9. Incorrect lining material. 10. Linings worn out. 11. Linings loose on the shoes. 12. Foreign material imbedded in the linings. 13. Cracked or threaded drums.	8. Machine drums in pairs. Replace if necessary. 9. Reline with correct linings. 10. Reline the brake. 11. Rerivet the linings to the shoes. Replace if necessary. Check for damaged or distorted shoes. 12. Replace the linings in axle sets. 13. Replace in axle pairs.
Shoe Click	1. Return springs weak. 2. Shoe bent.	1. Replace the spring. 2. Straighten or replace.
Noise and Chatter Squealing, clicking, or scraping sound upon brake application	1. Bent, damaged or incorrect shoes. 2. Worn out lining. 3. Foreign material embedded in the lining. 4. Broken shoe return spring. 5. Cracked or threaded drums (lathe marks). 6. Mixed size linings.	1. Replace with the correct shoes and lining. Always replace in axle sets. 2. Replace the shoes and lining in axle sets. 3. Replace the shoes and lining in axle sets. 4. Replace the return spring. 5. Replace the drums in axle sets. 6. Use all standard or oversize linings in a brake.
Pulls to One Side	1. Grease or fluid soaked lining. 2. Loose wheel bearings, loose (or distorted) mounting plate on the rear or front axle or loose spring bolts. 3. Linings not of the recommended kind. 4. Tires not properly or evenly inflated or unequal wear of tread. Different tread non-skid design. 5. Water, mud, etc., in the brakes. 6. Wheel cylinder sticking. 7. Weak or broken shoe return spring. 8. Out-of-round drums or different sized drums on the same axle.	1. Replace in axle sets. 2. Adjust the wheel bearing, tighten (or replace) the mounting plate to the axle and tighten the spring bolts. 3. Install recommended linings. Install the shoes correctly. 4. Inflate the tires to recommended pressures. Rearrange the tires so that a pair of non-skid tread surfaces of similar design and equal wear will be installed on the front wheels, and another pair with like tread will be installed on the rear wheels. 5. Remove any foreign material from all of the brake parts and inside of the drums. 6. Repair or replace the wheel cylinder. 7. Check the spring–replace distorted, open coiled, or cracked spring. 8. Refinish or replace the drums in axle pairs.

BRAKE SYSTEM DIAGNOSIS CHART (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Pulls to One Side (Cont.)	9. Brake dragging. 10. Weak chassis springs, loose U-bolts, loose steering gear, etc. 11. Loose steering. 12. Unequal camber. 13. Restricted brake line or hose. 14. Wheel cylinder size different on opposite sides. 15. Loose kingpin. 16. Distorted, damaged, or scored drum. 17. Front end alignment. 18. Excessively worn lining. 19. Mixed size linings. 20. Water/wet linings.	9. Check for loose lining. Adjust. (Refer to "DRAGGING BRAKES".) 10. Replace the spring, tighten the U–bolts, adjust the steering gear, etc. 11. Repair and adjust. 12. Adjust to "Specifications". 13. Check for soft hose or damaged lines. Replace as necessary. 14. Replace with the correct cylinders. 15. Replace the kingpins or bushing. 16. Refinish the drums in axle pairs. Replace if necessary. 17. Align the front end. 18. Replace in axle sets. 19. Use all standard or oversize linings in a brake. 20. Apply the brakes a few times while moving at a slow speed to dry the linings.
One Wheel Locks	1. Gummy lining. 2. Tire tread slick. 3. Brake adjustment not correct. 4. Restricted brake line or hoses. 5. Incorrect linings. 6. Grease or fluid soaked lining. 7. Foreign material in the brakes. 8. Mixed size linings.	1. Replace in axle sets. 2. Match up tire treads from side to side. 3. Adjust the brakes. 4. Check for soft hoses or damaged lines. Replace as necessary. 5. Replace. Linings must be the same on the axle. 6. Replace in axle sets. 7. Remove the material. 8. Use all standard or oversize linings.
Light Pedal Pressure-Brakes too Severe (Grabby Brakes)	1. Brake adjustment not correct. 2. Loose mounting plate on the front axle. 3. A small amount of grease or fluid on the lining. 4. Incorrect lining. 5. Wheel bearings loose. 6. Lining loose on the shoe. 7. Excessive dust and dirt in the drum. 8. Out-of-round drum.	1. Adjust the brakes. 2. Tighten the plates. 3. Replace the linings. 4. Install factory specified linings. 5. Adjust the wheel bearings. 6. Replace the lining or the shoe and lining. 7. Clean and sand the drums and linings. 8. Turn the drums in pairs or replace.
Low Pedal or Pedal Goes to Floor	1. Excessive clearance between the linings and drum. 2. Pedal stop not adjusted, or missing. 3. Weak brake hose. 4. Leaking wheel cylinder.	1. Adjust the brakes. 2. Adjust or install the pedal stop. 3. Replace with new hose. 4. Clean and rebuild.

BRAKE SYSTEM DIAGNOSIS CHART (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Low Pedal or Pedal Goes to Floor (Cont.)	5. Air in the hydraulic system. 6. Improper brake fluid (low boiling point). 7. Low fluid level. 8. Bent or distorted brake shoes. 9. Leaks at hydraulic line connections.	5. Bleed the hydraulic system. 6. Flush the system and refill with recommended brake fluid. 7. Fill the reservoir with brake fluid; check for leaks and bleed system. 8. Replace in axle sets. 9. Check for hydraulic leaks and repair.
Slow Brake Release	1. Foot pedal binding. 2. Restriction in the line. 3. Weak shoe return spring.	1. Lubricate the pivot pin; clean-check for foreign objects. 2. Remove the restriction or replace line. 3. Replace the spring.
Poor Assist or Loss of Assist	1. Low brake fluid level. 2. Air in the hydraulic system. 3. Weak brake hose. 4. Loss of vacuum. 5. No brake fluid at the master cylinder.	1. Fill the reservoir to the proper level. Bleed the system. 2. Locate the source of the air leak and repair. Bleed the system. 3. Replace. 4. Inspect for vacuum leaks or malfunctioning pump. Repair or replace as necessary. 5. Check for plugged, kinked, or damaged hose to the reservoir.
Brake Fade	1. Incorrect lining. 2. Poor lining contact. 3. Thin drum. 4. Dragging brakes. 5. All conditions listed under "PULLS TO ONE SIDE".	1. Replace with recommended lining. 2. Grind the lining to the proper radius; adjust. 3. Replace the drum. 4. Adjust. 5. All corrections listed under "PULLS TO ONE SIDE".
All Brakes Drag when Adjustment is Known to be Correct	1. Pedal does not return to stop. 2. Improper fluid. 3. Use of incorrect rubber parts.	1. Lubricate the pedal linkage; adjust the pedal. 2. Replace rubber parts and fill with the recommended brake fluid. 3. Install the proper parts.
One Wheel Drags	1. Weak or broken shoe return spring. 2. Brake shoe to drum clearance too small. 3. Loose wheel bearings. 4. Wheel cylinder piston cups swollen and distorted or piston stuck. 5. Pistons sticking in the wheel cylinder. 6. Drum out-of-round. 7. Restricted brake line or hose.	1. Replace the return spring. 2. Adjust to specification. 3. Adjust or replace the wheel bearings. 4. Rebuild the cylinders. Flush the hydraulic system and fill with recommended fluid. 5. Clean or replace the pistons; clean the cylinder bore. 6. Machine the drum. 7. Check for soft hoses or damaged lines. Replace as necessary.

BRAKE SYSTEM DIAGNOSIS CHART (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
One Wheel Drags (Cont.)	8. Distorted shoe. 9. Defective lining. 10. Loose or bent mounting plate.	8. Replace. 9. Replace with the recommended lining. 10. Tighten the fasteners; replace the plate.
Dragging Brakes	1. Improper fluid. 2. Brake pedal adjustment incorrect. 3. Incorrect shoe return spring. 4. Brake pedal linkage interference or binding. 5. Incorrect lining. 6. All conditions listed under "ONE WHEEL DRAGS".	1. Flush the hydraulic system and fill with recommended brake fluid, and replace rubber components. 2. Adjust the pedal. 3. Replace the shoe return spring. 4. Free the linkage and lubricate. 5. Replace the linings. 6. All corrections under "ONE WHEEL DRAGS".

BRAKE LINING DIAGNOSIS CHART

PROBLEM	POSSIBLE CAUSE	CORRECTION
Poor Contact at the Center of Shoe	1. Bell-mouthed drum. 2. Distorted mounting plate. 3. Bent brake shoe. 4. Undersize linings. 5. Loose wheel bearing.	1-5. Repair or replace as required.
Unequal Wear on the Shoes in the Same Brake	1. Brake linings not a balanced set. 2. Sticking wheel cylinder piston.	1-2. Repair or replace as required.
Material at the Center of the Shoe Excessively Thin	1. Undersize linings. 2. Oversize drum.	1-2. Repair or replace as required.
Lining Tapered across the Width	1. Bell-mouthed drum. 2. Bent shoe. 3. Distorted mounting plate.	1-3. Repair or replace as required.
Lining Worn at One End	Bent mounting plate.	Repair or replace as required.
Linings Glazed	1. Grease on lining. 2. Wrong type lining for service involved.	1-2. Repair or replace as required.
Rivets Tear Loose	1. Improper set rivet. 2. Improper setting of the rivet. 3. Enlarged rivet holes in the shoe.	1-3. Repair or replace as required.

BRAKE LINING DIAGNOSIS CHART (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Unequal Wear Opposite Brakes, Same Axle	1. Weak shoe return spring. 2. Obstructed hydraulic line. 3. Stuck wheel cylinder piston. 4. Brake drum surface in poor condition. 5. Loose wheel bearing.	1-5. Repair or replace as required.
Linings at Scored	1. Scored drum. 2. Abrasive material between the lining and drum.	1-2. Repair or replace as required.
Cracks at Bolt Holes or Rivet Holes	1. Overtightening bolts. 2. Wrong type rivets or bolts. 3. Rivets not properly set. 4. Dirt or rust on the shoe table. 5. Too thick a shim under the lining. 6. Wrong size lining.	1-6. Repair or replace as required.
Elongation of the Bolt Holes or Rivet Holes	1. Loose rivets or bolts. 2. Wrong size rivets.	1-2. Repair or replace as required.
Wear on the Edge of the Lining	1. Wrong width lining. 2. Holes improperly drilled. 3. Loose wheel bearing. 4. Bent shoe.	1-4. Repair or replace as required.
Groove on the Edge of the Lining	1. Lining too wide. 2. Worn drum.	1-2. Repair or replace as required.

BRAKE DRUM DIAGNOSIS CHART

PROBLEM	POSSIBLE CAUSE	CORRECTION
Brake Drum Heat Checked in Spots	1. Out-of-round brake drum. 2. Eccentric mounting of the drum. 3. Loose wheel bearing.	1-3. Repair or replace as required.
Drum Uniformly Heat Checked	1. Improper friction materials. 2. Overworked brake. 3. Driver abuse.	1-3. Repair or replace as required.
Excessive Scoring of the Drum	1. Improper friction materials. 2. Overworked brake. 3. Abrasive material between the lining and drum. 4. Soft drum. 5. Bent or warped shoe.	1-5. Repair or replace as required.
Excessive Drum Cracks	1. Driver abuse. 2. Weak drum. 3. Wrong friction material. 4. Overworked brake.	1-4. Repair or replace as required.

INSPECTION AND REPAIR

SYSTEM INSPECTION

- Maintain proper level of brake fluid in reservoir. Refer to MAINTENANCE AND LUBRICATION (SEC. 0B) in this manual for the recommended fluid and checking intervals.
- Adjust the brake shoes at regular intervals. After two or three adjustments, check the brake lining for wear. Reline the brakes before the lining is worn sufficiently to permit the rivets to damage the brake drums.
- Keep the pedal pivot and roller pins lubricated to assure free movement and rapid release of the brakes. DO NOT over-lubricate.
- Inspect the entire brake system regularly for fluid and vacuum leakage. Correct the leakage immediately.
- Be sure the brake shoes are free on their mounting and that the shoe return spring is not weak, distorted, or broken. Also check that the mounting is not sprung, cracked or loose on the axle or steering knuckle.
- Observe the BRAKE warning light and make checks and repairs as indicated.

CONTAMINATION OF BRAKE SYSTEM

If the brake fluid becomes contaminated, it will lose some of its original qualities and cause rubber parts to deteriorate.

Use only hydraulic brake fluid recommended in MAINTENANCE AND LUBRICATION (SEC. 0B) in this manual. When other than recommended fluid has been used, drain and flush the entire hydraulic system, using only new, clean brake fluid as a cleaning agent. Disassemble, clean, and inspect the hydraulic units.

Replace all rubber parts. Refill the system with recommended fluid, from a sealed container.

Flush the brake system until all old fluid is removed when performing major brake work. Old fluid should be bled from the system and replaced with clean brake fluid if any of the hydraulic system parts are corroded or the fluid is discolored or dirty. If any of the rubber parts of the hydraulic system are soft or swollen, old fluid should be removed and the hydraulic system should be flushed with clean brake fluid. Do not reuse old brake fluid at any time.

In the event that improper fluid has entered the system, it will be necessary to service the system as follows:

1. Drain the entire system
2. Thoroughly flush the system clean with brake fluid.

   NOTICE: Use only brake fluid when flushing a system. Usage of other fluids may contribute to contamination and possible failure of rubber components in the system.

3. Replace all rubber parts of the system, including brake hoses and seals.
4. Refill the system with recommended fluid.
5. Bleed the system.

FLUSHING BRAKE SYSTEM

NOTICE: Do not use alcohol for flushing the system or cleaning assemblies where alcohol could be trapped and subsequently contaminate the brake fluid.
Contaminated fluid may then cause eventual failure of rubber components in the system.

It is recommended that the entire hydraulic system be thoroughly flushed with clean brake fluid whenever new parts are installed in the hydraulic system.

Flushing is also recommended if there is any doubt as to the grade of fluid in the system or if fluid has been used which contains even the smallest trace of mineral oil. Flush the system whenever there is any question of contamination.

Flushing is performed at each bleeder valve in turn, and in the same manner as the bleeding operation, except that the bleeder valve is opened 1-1/2 turns and fluid is forced through the lines and bleeder valves until it emerges in color. Approximately two or three quarts of fluid is required to flush the hydraulic system thoroughly.

Check reservoir fluid level after flushing at each valve and replenish if required. When flushing is completed at all bleeder valves, make certain the reservoir is filled to the proper level.

BLEEDING BRAKES

Use only hydraulic brake fluid recommended in MAINTENANCE AND LUBRICATION (SEC. 0B) of this manual when replacing fluid lost during bleeding procedures.

The presence of air in the system is a result of low fluid in the reservoir, or of some part of the system having been disconnected. Bleeder valves are provided on the wheel cylinders.

Bleeding Sequence

It may be necessary to bleed the hydraulic system at all four wheels if air has been introduced through low fluid level or by disconnecting the brake lines. If a brake line is disconnected at the wheel cylinder, then that wheel cylinder only needs to be bled. If brake lines are disconnected at any fitting located between the master cylinder and wheel cylinders, then all the wheel cylinders served by the disconnected line must be bled.

Bleeding of the brake hydraulic circuit should be performed in the following sequence:

- Right rear wheel–Lower bypass valve–Right front wheel–Left front wheel–Upper bypass valve
- Right rear wheel–Lower bypass valve–Left front wheel–Right front wheel–Upper bypass valve

Bleeding Procedure

The vehicle engine must be running to bleed the brakes. Apply the parking brake and block the vehicle wheels.

Fluid in the reservoir must be checked after bleeding it at each valve (bleeder screw) and replenished if required. Brake pedal should be pumped up and down slowly and should be on the downstroke as the valve is closed.

1. Fill the reservoir with recommended brake fluid and keep at least one-half full of fluid during the bleeding operation (figure 1).

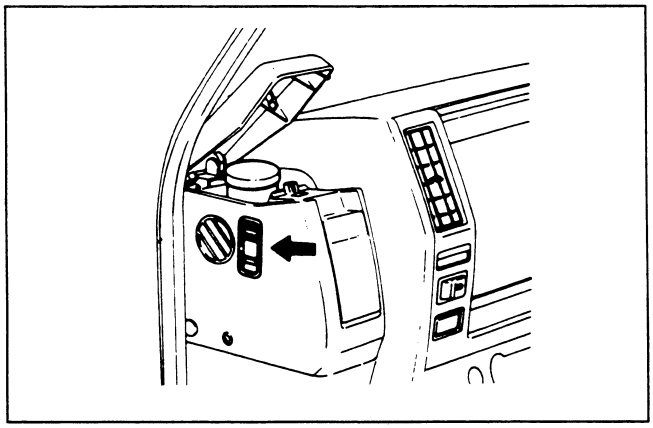


Figure 1. Brake Fluid Reservoir

2. Bleed in the sequence recommended previously.
3. Remove the bleeder screw valve cap.
4. With the proper size box end wrench over the bleeder screw, attach a hose over the screw and allow the end to hang in a glass jar containing enough brake fluid to cover the end of the hose (figure 2).

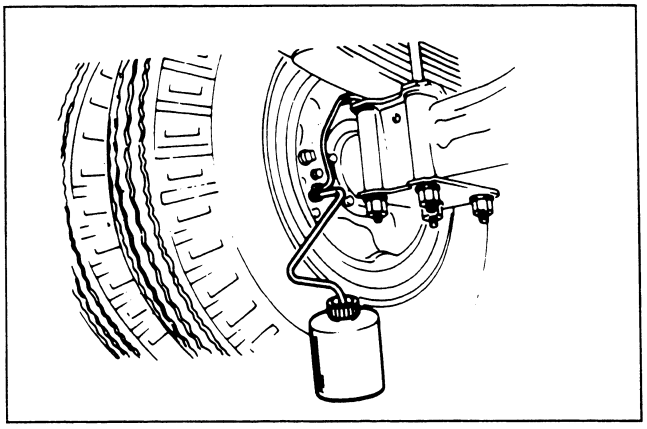


Figure 2. Brake Bleeding Setup

5. Pump the brake pedal two or three times and then hold down.
6. Open the bleeder screw about one-half turn and fully depress the brake pedal (figure 3). Observe flow from the hose.

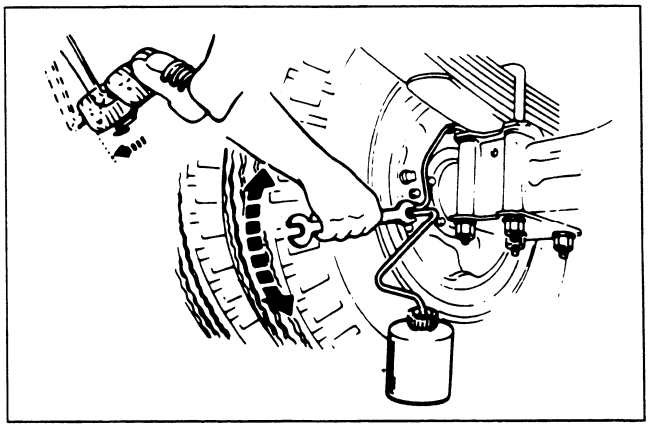


Figure 3. Bleeding Brakes

7. Close the bleeder screw as soon as bubbles stop and the fluid flows in a solid stream. Release the brake pedal after closing the bleeder screw.
8. Repeat at the same bleeder until bubbles stop.
9. Repeat at the other bleeder screws in the proper sequence.
10. Replace the bleeder cap.
11. When the bleeding is complete on each wheel, check the level of brake fluid in the reservoir and replenish as necessary.

LOAD-SENSING PROPORTIONING VALVE (LSPV) ADJUSTMENT

This adjustment should be performed with battery voltage applied to the valve.

1. Adjust the rear axle weight by loading the rear body.

kg (lb)

MODEL (WHEEL BASE) mm / in	GVWR 5,012 (11,050)	
	Front drum brake	Front disc brake
NPR 653 (2,765/108.9)	890 (1,962)	
NPR 655 (3,365/132.5)	710 (1,565)	
NPR 656 (3,815/150.2)	720 (1,587)	
NPR Flat Low Models	700 (1,543)	900 (1,984)

kg (lb)

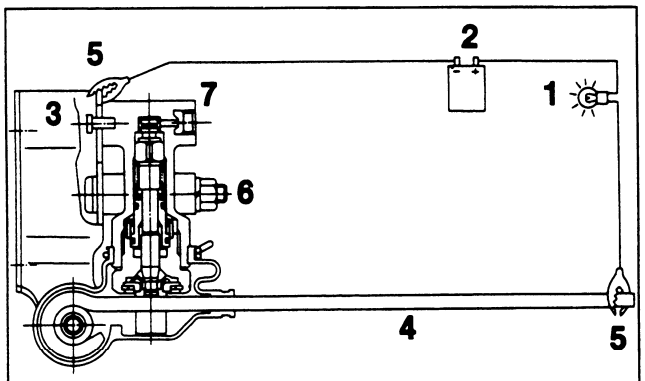
MODEL	GVWR 6,010 (13,250)	
	Front drum brake	Front disc brake
All Models except Flat Low Model	1,700 (3,748)	1,600 (3,527)

kg (lb)

MODEL	GVWR 6,460 (14,250)
	Front drum brake
All Model except Flat Low Model	1,400 (3,086)

Important

- The rear axle weight should be adjusted to the specified value with a driver seated in the driver seat.



1. Test Light
2. Battery
3. Valve Bracket
4. Linkage
5. Clip
6. Nut
7. Valve Assembly

Figure 4. Load-Sensing Proportioning Valve Adjustment

2. Connect a test light (1) to the battery (2). Clip one end of the test light to the valve bracket (3) and the other clip to the linkage (4) (figure 4).

Important

- The linkage is coated with insulation. Turn the clip (5) two or three turns to break the insulation.

NOTICE: See "NOTICE" on page 5A-1 of this section.

3. Loosen the nut (6) and raise the valve assembly (7). Then, lower the valve assembly and tighten the nut when the test light turns on (figure 4).

Tighten

- Nut to 18 N·m (13 lb·ft).

Important

- If the test light goes out as the nut is tightened, lower the valve assembly slightly until the light again lights and then retighten the nut.

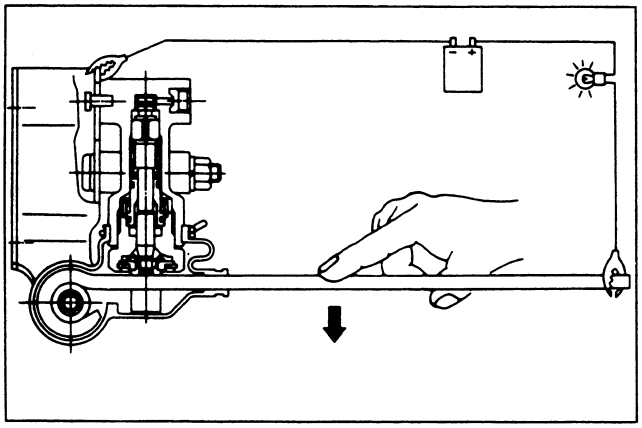


Figure 5. Depressing Linkage

4. Depress the linkage near the valve assembly with your finger and check if the test light goes out (figure 5).
   - If the light goes out, the adjustment is complete.
   - If the light remains on, repeat the adjustment in step 3.
5. Inspect the brake fluid level and fill if necessary.
6. Adjust the rear axle weight as specified in step 1. Install a pressure gage on the bleeder screws on the front and rear brakes.
7. • When GVWR 5,012 kg (11,050 lb) Depress the brake pedal and take reading of the pressure gages. The brake fluid pressure is normal if the pressure of fluid within the rear wheel cylinders is within the range of A when pressure of fluid within the front wheel cylinders reachers B.

Model	A	B
Base	4,295 ±588 kPa (623 ±85 psi)	4,903 kPa (711 psi)
Flat Low	5,031 ± 588 kPa (729 ±85 psi)	7,845 kPa (1,138 psi)

- When GVWR 6,010 kg (13,250 lb) Depress the brake pedal and take reading of the pressure gages. The brake fluid pressure is normal if the pressure of fluid within the rear wheel cylinders is within the range of $6{,}521^{+1{,}079}_{-785}$ kPa (946^{+156}_{-114} psi) when pressure of fluid within the front wheel cylinders reaches 7,845 kPa (1,138 psi).
- When GVWR 6,460 kg (14,250 lb). Depress the brake pedal and take reading of the pressure gages. The brake fluid within the rear wheel cylinders is within the range of 5,031±588 kPa (729±85 psi) when pressure of fluid within the front wheel cylinders reaches 7,845 kPa (1,138 psi).

Important

- The brake pedal should be depressed gradually until the specified pressure is reached without pumping or adjusting foot pressure.

BRAKE LINES

Brake system units are interconnected by flexible hose and special steel tubing. Flexible hose is used between the cab and frame connections, between the frame and front wheel cylinders and between the frame and rear axle brake line.

When the hydraulic lines have been disconnected for any reason, the brake system must be bled, after connecting the lines. Refer to "Bleeding Brakes" in this section.

CAUTION: Never use copper tubing for hydraulic brake lines because copper is subject to fatigue, cracking, and corrosion which could result in brake failure.

Flexible Hose

At the front wheel brakes, the hose is threaded into a frame junction and a banjo-type fitting is used at the wheel cylinder elbow. The banjo end and the frame end must be indexed properly to be installed. The line at the rear axle is similar in installation. Use new copper gaskets at the banjo ends at installation.

Remove or Disconnect (Figure 7)

- Clean the fittings (14) and connection.

1. Union nut (16).
2. Frame nut (15).
3. Pull the hose end from the frame bracket (17).
4. Special eye bolt (12) at the banjo end (11).

Install or Connect (Figure 7)

1. Special eye bolt (12) at banjo end (11).
2. Hose end to frame bracket (17).
3. Frame nut (15).
4. Union Nut (16).

Brake Hose Inspection

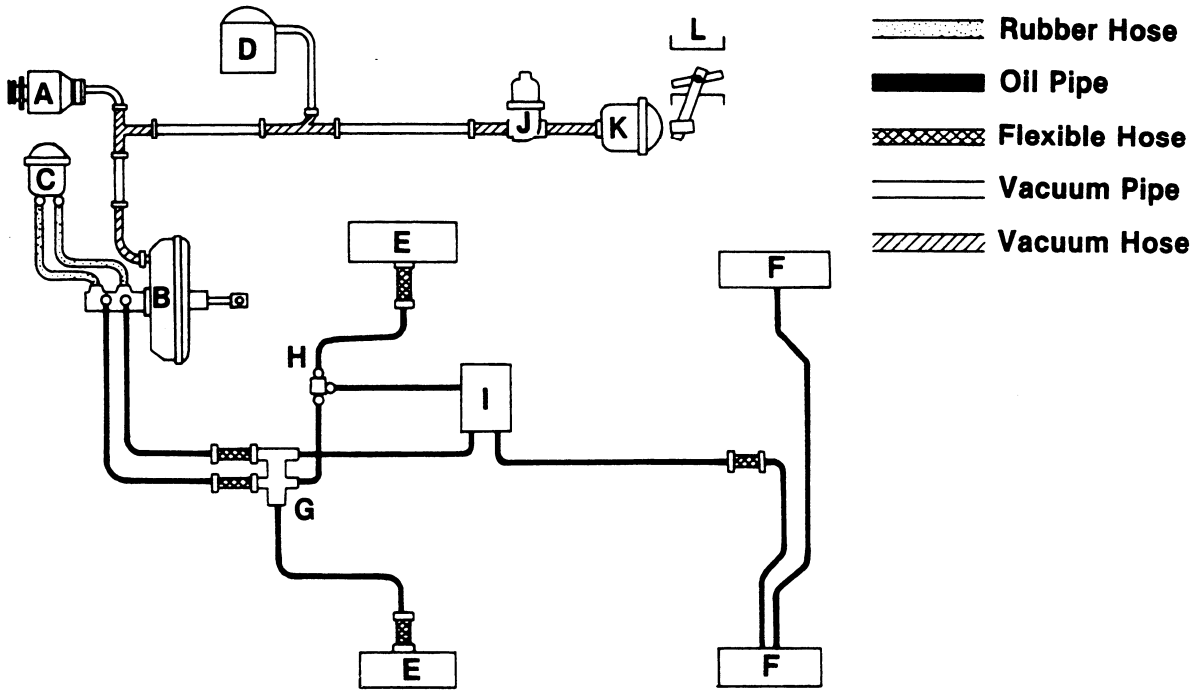
The flexible hydraulic brake hose should be inspected at least twice a year. The brake hose assembly should be checked for road hazard damage, for cracks and chafing of the outer cover, and for leaks and blisters. A light and mirror may be needed for adequate inspection. If any of the above conditions are observed on the brake hose, it will

be necessary to replace it.

Metal Tubing

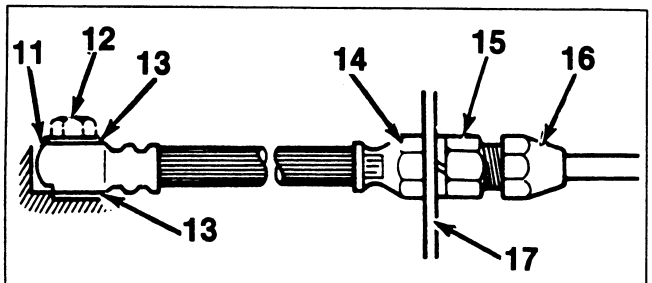
When necessary to replace metal brake line, always use special metal tubing which is designed to withstand high pressure and to resist corrosion. Ordinary copper tubing is not satisfactory for use as hydraulic brake lines. When replacing tubing, always use the same size as that removed.

Refer to the parts book for preformed lines and bulk brake line.



A. Vacuum Pump
B. Servo Unit
C. Oil Tank
D. Vacuum Tank
E. Front Wheel Cylinder
F. Rear Wheel Cylinder
G. 5-Way Connector
H. 3-Way Connector
I. Bypass Valve
J. Solenoid for Exhaust Brake
K. Power Chamber
L. Exhaust Brake Valve

Figure 6. Brake Line Diagram



11. Banjo End
12. Special Eye Bolt
13. Copper Gasket
14. Fitting
15. Frame Nut
16. Union Nut
17. Frame Bracket

Figure 7. Brake Hose

CAUTION: Never use copper tubing for hydraulic brake lines because copper is subject to fatigue, cracking, and corrosion which could result in brake failure.

Brake lines must have a minimum of 6 mm (1/4 in) clearance between lines.

Tube Flaring

In order to ensure a proper flare, a special flaring tool must be used. When using the tool, instructions furnished by the tool manufacturer should always be followed. Always inspect newly formed flares for cracks or malfunctions which might cause leaks.

Double Lap Flaring Kit J-23530 with Tube Cutter J-23533-01 and Metric Adapter J-34912 provides all the necessary components to double lap flare hydraulic brake line.After flaring,blow out the brake lines with compressed air before installing on vehicle.

NOTICE: Double lap flaring tool must be used, as single flaring tools cannot produce a flare strong enough to hold the necessary pressure.

Replacement

1. Clean dirt, grease, and other foreign material off the line fittings at both ends.
2. Procure the recommended steel tubing and fitting nuts to the correct size. (Outside diameter of the tubing is used to specify size.)
3. Cut the tubing to length. Correct length may be determined by measuring the old pipe using a cord and adding 3 mm (1/8 in) for each double flare.
4. Install the fitting before starting second flare.
5. Bend the tubing to match the old pipe using a tubing bender. A recommended clearance of 19 mm (3/4 in) should be maintained to all moving or vibrating parts when installed.

Brake Line Supporting Components

It is important that all brake line supports, clips, retainers, grommets, junctions, and supporting brackets be maintained to prevent unnecessary vibrations and eventual loosening or separation of the connections. Clamps are used on the same hoses at.the connections with metal lines and components. All clamps and brackets (when used) must be in place and tightened securely in position. Check for missing or deteriorated grommets or loom material. Replace as necessary. Bent, damaged, or missing components should be repaired or replaced.

BRAKE FLUID RESERVOIR

Remove or Disconnect

Important

- Use only DOT 3 brake fluid in this reservoir. Refer to MAINTENANCE AND LUBRICATION (SEC. 0B) in this manual for hydraulic brake fluid recommendations. Refer to "Bleeding Brakes" previously in this section for bleeding the hydraulic brake system.
- Block the vehicle wheels and apply the parking brake.
- Disconnect the battery ground cable.
- Lift up the access cover to the combination brake fluid/clutch fluid reservoir.

1. Attaching bolts.
2. Hose clamps and hoses.
3. Electrical connector.
4. Reservoir assembly.

Disassemble

- Cap.
- Filter holder.
- Filter.
- Baffle.
- Dust cover.

Inspect

- Filter.
- Reservoir tank.
  - — If the tank is damaged or the electrical switch is not operating, the assembly must be replaced.

Assemble

- Dust cover.
- Baffle.
- Filter.
- Filter holder.
- Cap.

Install or Connect

1. Clamp hose bands to reservoir.
2. Electrical connector.
3. Retaining bolts.
4. Battery ground cable.
5. Fill the reservoir. Note the warning on the reservoir cap. Fill to MAX on the tank.

Inspect

- Run the engine and bleed the brakes.
- Check for leaks.
- Remove the wheel blocks and check brake application.

LOAD-SENSING PROPORTIONING VALVE (LSPV)

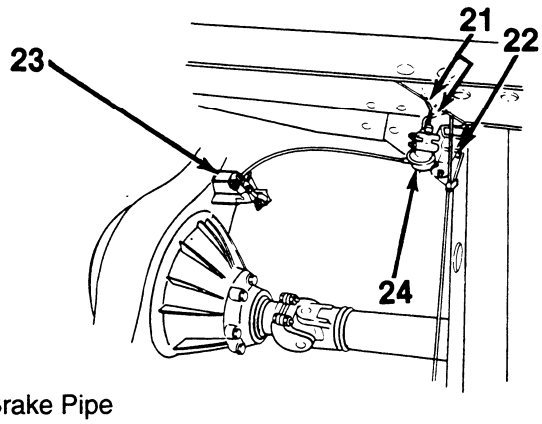
Remove or Disconnect (Figure 8)

1. Brake pipe (21).
2. Bolt (22).
3. Bolt (23).
4. LSPV assembly (24).

Install or Connect (Figure 8)

NOTICE: For steps 2, 3, and 4, see "NOTICE" on page 5A-1 of this section.

1. LSPV assembly (24).
2. Bolt (23).



21. Brake Pipe
22. Bolt
23. Bolt
24. LSPV Assembly

Figure 8. LSPV Assembly

Tighten

- Bolt to 20 N·m (14 lb·ft)

3. Bolt (22).

Tighten

- Bolt to 20 N·m (14 lb·ft)

4. Brake pipe (21).

Tighten

- Brake pipe to 15 N·m (11 lb·ft)

Adjust

- LSPV Refer to "Load-Sensing Proportioning Valve Adjustment" in this section.

MASTER CYLINDER

Remove or Disconnect (Figure 9)

- Clamp brake fluid reservoir hoses to prevent spillage.

1. Hose joint clamp (31).
2. Hose joint (32) and plug hoses.
3. Brake pipes.

NOTICE: Avoid clamping master cylinder hard with pliers or warpage will result.

4. Nuts (38) mounting cylinder body to servo.
5. Cylinder body (37).
6. Stopper screw and gasket (33).
7. Snap ring (34).
8. Primary piston assembly (35).
9. Secondary piston assembly (36).

Inspect

- All parts for wear, distortion or other conditions and replace as needed.
- Piston clearance should be between 0.11 and 0.195 mm (0.004 to 0.008 in).
- Return port for clogging. If necessary, clean the port with a wire tag and blow away foreign matter with compressed air.

Install or Connect (Figure 9)

NOTICE: For steps 4, 5, 7 and 8, see "NOTICE" on page 5A-1 of this section.

31. Hose Joint Clamp
32. Hose Joint
33. Stopper Screw and Gasket
34. Snap Ring
35. Primary Piston Assembly
36. Secondary Piston Assembly
37. Cylinder Body
38. Nuts

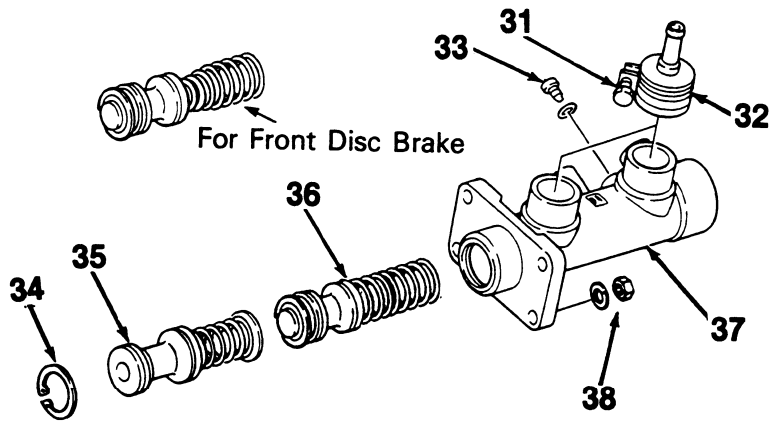


Figure 9. Master Cylinder Assembly

Important

- Prior to installing the primary and secondary pistons, lubricate the piston cups with clean brake fluid. When installing the parts, take care not to cause damage to the lipped portion of the piston cup.

1. Secondary piston (36).
2. Primary piston (35).
3. Snap ring (34).
4. Stopper screw and gasket (33).

Tighten

- Stopper screw to 3 N·m (26 lb·in).

5. Cylinder body (37) and nuts (38).

Tighten

- Nuts to 13 N·m (113 lb·in).

6. Hose joint (32).
   - Set the hose clamp in position.
   - Dip the hose joint in hot water (60–80°C/140–176°F) for several minutes.
   - Remove the hose joint and immediately blow the water off.
   - Install hose joint.
7. Hose joint clamp (31).

Tighten

- Clamps to 3 N·m (26 lb·in).

8. Brake pipes.

Tighten

- Brake pipes to 15 N·m (11 lb·ft).

9. Bleed the brake system.

SPECIFICATIONS

LOAD SENSING PROPORTIONING VALVE (LSPV) ADJUSTMENT

GVWR kg (lb)	MODEL (WHEEL BASE) mm/in	Rear Axle Set Load kg (lb)		Fluid pressure kPa (psi)	
		Front Drum Brake	Front Disc Brake	Rear Wheel Cyl.	Front Wheel Cyl.
5,012 (11,050)	NPR653 (2,765/108.9)	890 (1,962)		4,295±588 (623±85)	At 4,903 (711)
	NPR655 (3,365/132.5)	710 (1,565)			
	NPR656 (3,815/150.2)	720 (1,587)			
	NPR Flat Low Models	700 (1,543)	900 (1,984)	5,031±588 (729±85)	At 7,845 (1,138)
6,010 (13,250)	All Models (Except Flat Low)	1,700 (3,748)	1,600 (3,527	6,521 $^{+1,079}_{-785}$ (946 $^{+156}_{-114}$)	At 7,845 (1,138)
6,460 (14,250)	All Models (Except Flat Low)	1,400 (3,086)	—	5,031±588 (729±85)	At 7,845 (1,138)

FASTENER TORQUES

LSPV Nut ..... 18 N·m (13 lb·ft)
LSPV Shackle Bracket Bolt ..... 20 N.m (14 lb·ft)
LSPV Bracket Bolt ..... 20 N·m (14 lb·ft)
Brake Pipe to LSPV ..... 15 N·m (11 lb·ft)
Master Cylinder Stopper Screw ..... 3 N·m (26 lb·in)
Master Cylinder Nut ..... 13 N·m (113 lb·in)
Reservoir Hose Clamp Bolt ..... 3 N·m (26 lb·in)
Brake Pipe ..... 15 N·m (11 lb·ft)