SECTION 5

BRAKES

CONTENTS

NOTES

SECTION 5A

HYDRAULIC BRAKES

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

CAUTION: When servicing brake parts, do not create dust by grinding or sanding brake linings, by cleaning brake parts with a dry brush or with compressed air. Many earlier model or aftermarket brake parts may 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 fibers from becoming airborne.

NOTICE: Always use the correct fastener in the correct location. Use the correct fastener part number to replace a fastener. If the correct fastener part number is not available, a fastener of equal size and strength may be used. Do not use a fastener that is stronger when the correct fastener part number is not available in the following applications:

- *Some bolts are designed to permanently stretch, and if a stronger fastener is used, the part will not be tightened correctly. These permanently stretching bolts will be called out. The correct part number fasteners must be used to replace this type of fastener because there is no available equivalent.*
- *Other bolts are designed to break if over tightened to prevent part damage. If a stronger fastener is used part damage may occur.*

Fasteners that need to be replaced when removed will be called out. Fasteners that require thread lockers or thread sealant will be called out. The correct tightening specification and sequence must be used when installing fasteners. Part or system damage may occur if the above instructions are not followed.

CONTENTS

CONTENTS (cont'd)

GENERAL DESCRIPTION

FLUID AND FLUID HANDLING

CAUTION: Brake fluid may be irritating to skin or eyes. In case of contact, take the following actions:

- **Eye contact - rinse eyes thoroughly with water.**
- **Skin contact - wash skin with soap and water.**

NOTICE: Brake fluid will damage electrical connections and painted surfaces. Use shop cloths, suitable containers, and fender covers to prevent brake fluid from contacting these areas. Always re-seal and wipe off brake fluid containers to prevent spills.

Use Delco Supreme 11 Brake Fluid (GM P/N 1052535) or an equivalent DOT-3 motor vehicle brake fluid.

Brake fluid should always be stored in a closed, sealed container. Never use previously opened containers of stored brake fluid. Always use new fluid from a sealed container. Re-seal brake fluid containers immediately after use. Brake fluid left in an open or improperly sealed container will absorb moisture. This can lower the fluid's boiling point and result in system contamination, corrosion, or deterioration of rubber components.

SUBSTANDARD OR CONTAMINATED BRAKE FLUID

NOTICE: Power steering fluid and brake fluid cannot be mixed. If brake seals contact power steering fluid or steering seals contact brake fluid, seal damage will result.

No special fluids are used in this system. However, care must be taken to use the correct fluids. The master cylinder and brake system uses brake fluid, while the hydraulic booster system uses power steering fluid.

Improper fluid, water, or any other contaminants in the fluid may cause the brake fluid to boil or rubber components to deteriorate in the hydraulic system.

Swollen master cylinder piston seals show that rubber deterioration has occurred. This deterioration is also shown by swelling of wheel cylinder boots, caliper boots, or master cylinder reservoir diaphragm.

If rubber deterioration is found, replace all rubber parts in the system, including the hoses. Check for fluid on the brake linings. If any is found, replace the linings.

If the brake fluid is contaminated and the master cylinder piston seals are satisfactory, check for leaks or excessive heat conditions. If no leaks or excessive heat conditions are found, flush the system.

FLUSHING THE SYSTEM

Flushing the brake hydraulic system involves running new brake fluid through the system until the fluid at each bleeder valve comes out clear. This is the only way to clean contaminated fluid out of the system.

The brake hydraulic system should be flushed with clean brake fluid any time new hydraulic parts are installed. Flushing is also recommended if there is any question of contamination, the grade of fluid in the system, or mineral oil in the fluid.

HEIGHT-SENSING BRAKE PROPORTIONING VALVE

The height-sensing brake proportioning valve regulates fluid pressure to the rear brakes according to the load in the rear of the vehicle (figure 1). It is located just in front of the rear axle. Linkage connects the valve lever to the frame of the vehicle. The lever moves as the load in the rear of the vehicle changes. The valve allows less fluid with a light load and more fluid with a heavy load. This helps provide the right amount of rear brake performance based on the load the vehicle is carrying.

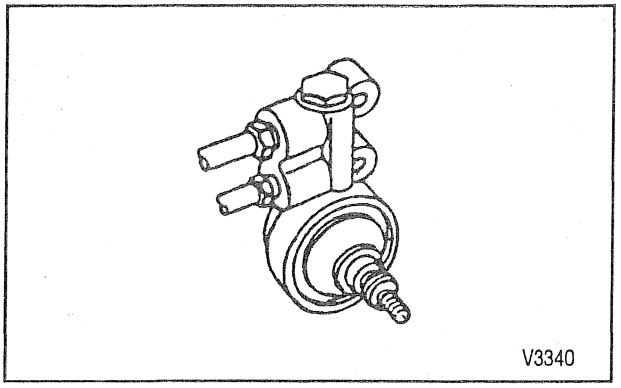


Figure 1—Height-Sensing Brake Proportioning Valve

COMBINATION VALVE

The combination valve has three sections (figure 2). Each section serves a different function.

The metering or hold off section (A) limits pressure to the front brakes until a predetermined input pressure is reached. This should be enough pressure to overcome the rear brake shoe springs. There is no restriction to inlet pressures below 200 kPa (30 psi). This allows for pressure equalization during no apply periods.

The pressure differential warning switch (B) constantly compares front and rear brake pressures from the master cylinder. If the front or rear brake systems malfunction, it energizes the warning lamp on the dash. The switch latches in the "warning" position after a malfunction occurs. The only way to turn the lamp off is to repair the malfunction and apply enough pedal force to develop about 3100 kPa (450 psi) line pressure.

The proportioning section (C) limits pressure to the rear brakes after a predetermined rear input pressure has been reached. This prevents rear wheel lock-up on vehicles with light rear wheel loads.

The combination valve includes a "by-pass" feature. This ensures full system pressure to the rear brakes in the event of a front brake malfunction or full system pressure to the front brakes in the event of a rear brake malfunction.

STOPLAMP SWITCH

The zero adjust stoplamp switch design eliminates the need for stoplamp switch adjustment because the switch is installed along with the brake push rod and held by a single retainer.

WARNING/INDICATOR LAMP OPERATION

"BRAKE" LAMP

The "BRAKE" warning lamp in the instrument cluster warns the driver of either a loss of hydraulic fluid pressure, parking brake operation, or a possible malfunction in the antilock brake system. The "BRAKE" lamp will illuminate when ground is supplied from either the combination valve switch, parking brake switch and brake pressure modulator valve (4WAL).

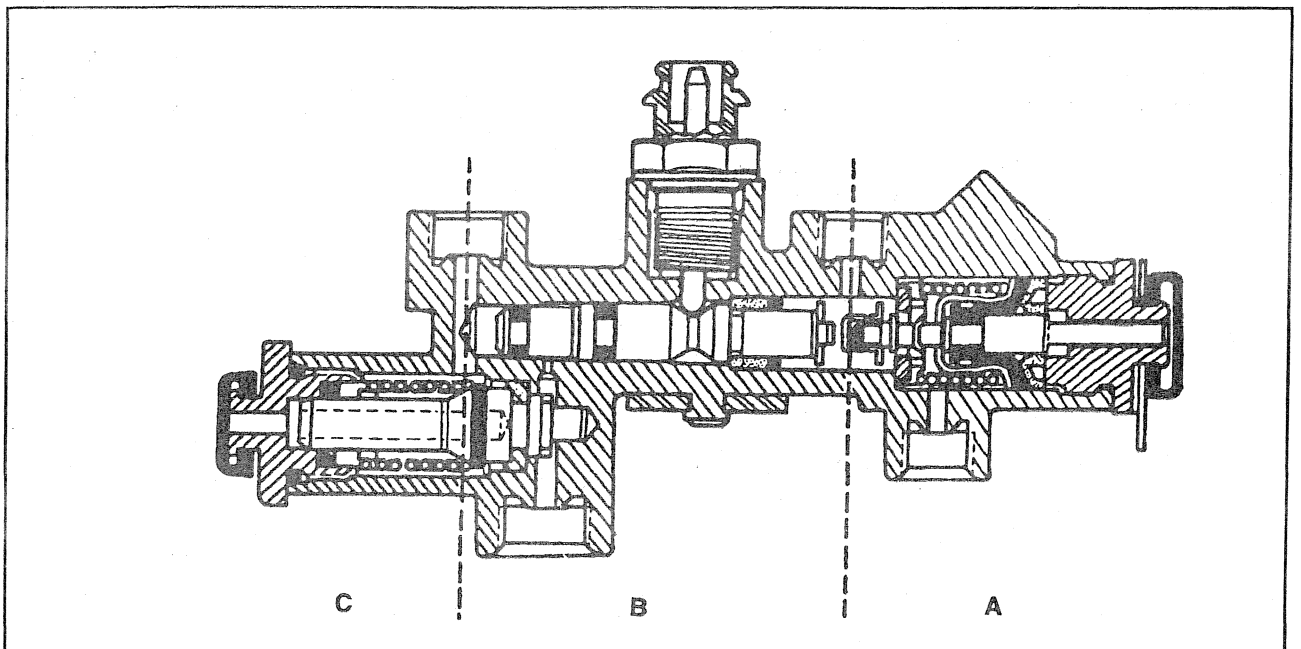


Figure 2—Combination Valve

"ANTILOCK" LAMP

The "ANTILOCK" indicator lamp in the instrument cluster is only used on models with four wheel antilock brakes. This lamp informs the driver of antilock system operation and malfunctions. When a malfunction occurs, the brake pressure modulator valve completes the circuit to the lamp. The lamp may remain illuminated or turn back off depending on the nature of the malfunction. For additional information, refer to SECTION 5E1. The "BRAKE" lamp serves as a backup if a malfunction occurs in this circuit.

DIAGNOSIS

BRAKE SYSTEM TESTING

Important

- If the vehicle pulls to one side during braking, make sure the front end alignment is correct before assuming the condition relates to a brake system malfunction.

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. These conditions prevent the tires from gripping the road equally. A crowned roadway also affects brake testing by throwing the weight of the vehicle toward the wheels on one side. Roadway rough enough to cause the wheels to bounce also affects this test.

Test the brakes at different vehicle speeds with light and heavy pressure. Avoid locking the wheels and sliding the tires on the roadway. Locked wheels and sliding tires do not indicate brake efficiency. Heavily braked 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 a sliding tire.

EXTERNAL CONDITIONS THAT AFFECT BRAKE PERFORMANCE

1. **Tires**--Tires with unequal contact and grip on the road will cause unequal braking. The inflation and tread pattern of the right and left tires must be about equal.
2. **Vehicle Loading**--When the vehicle has unequal loading, the most heavily loaded wheels require more braking force than the others.
3. **Front Wheel Bearings**--Loose front wheel bearings permit the rotor to tilt and have spotty contact with the linings. This causes erratic braking.
4. **Front End Alignment**--Misalignment of the front end, particularly camber and caster, causes the brakes to pull to one side.

BRAKE PEDAL TRAVEL

Tool Required:
Brake Pedal Effort Gage, such as J 28662

At frequent intervals, brake pedal travel should be checked (figure 3). Travel is the distance the pedal moves toward the floor from a full released position. This check should be made with the brakes cold and about 445 N (100 lbs.) of force on the pedal using a brake pedal effort gage, such as J 28662.

1. Apply the brake pedal at least five times with the engine off to remove vacuum from the booster before making the check.
2. Measure the distance from the bottom of the steering wheel to the brake pedal.
   A. Take the first measurement (A) with the brake pedal released.
   B. Take the second measurement (B) after applying the brake pedal with about 445 N (100 lbs.) of force using a brake pedal effort gage, such as J 28662.
   C. Subtract measurement A from measurement B.
   D. Compare the measurement with the specifications below:
      Vacuum Booster.....80 mm (3.1 inches)
      Hydraulic Booster ..... 110 mm (4.3 inches)
      Four-Wheel Disc Brakes .. 102 mm (4 inches)
   E. If brake pedal travel is excessive, refer to the brake system diagnostic chart.

BRAKE FLUID LEAKS

With the engine at idle and the transmission in "Neutral," apply and hold constant foot pressure on the brake pedal. If the pedal gradually falls away, the hydraulic system may have external leakage, internal leakage, or incorrect component adjustment. Begin by performing a visual inspection of the hydraulic system.

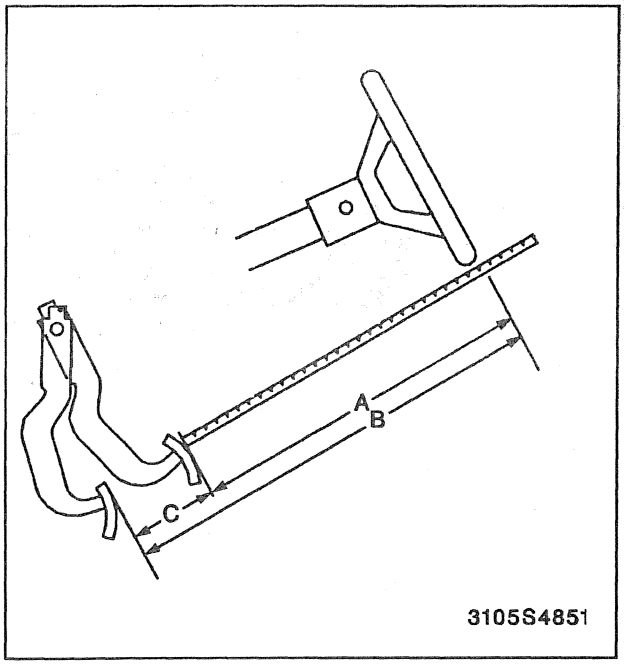


Figure 3—Checking Brake Pedal Travel

Check the master cylinder fluid level. A slightly low brake fluid level in either reservoir can result from normal lining wear. An abnormally low fluid level indicates a leak in the system. A full master cylinder does not always mean there is no leakage. Slight leakage can occur and not appear as a fluid level condition.

- For information on master cylinder fluid levels, refer to SECTION 5A1.

If no external leaks are found, an internal leakage condition may be the cause. This relates to an internal master cylinder condition. To diagnose internal leakage, the master cylinder will require disassembly. Refer to the Light Duty Truck Unit Repair Manual.

BRAKE HOSE AND PIPE INSPECTION

Brake hoses and pipes should be inspected at least twice a year for any signs of road damage, cracks, and chafing of the outer cover. Check for fluid leaks and damage at the brake hose and pipe connections. If any of these conditions are visible, replace the hose or pipe. Make sure all mounting hardware is in place and secure. Repair these as needed.

COMBINATION VALVE CIRCUIT TEST

To test the combination valve switch circuit, refer to figure 4.

COMBINATION VALVE WARNING SWITCH TEST

To test the combination valve warning switch, refer to figure 5.

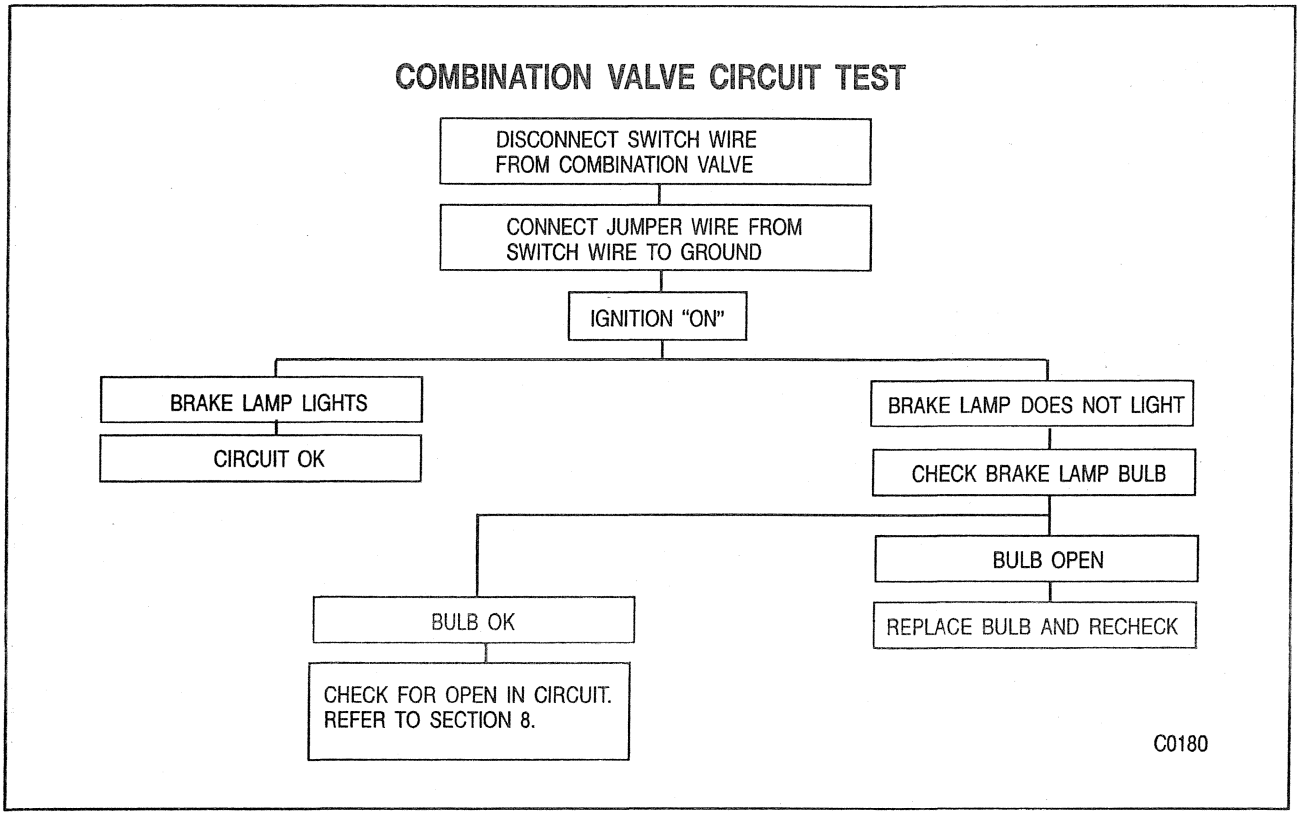


Figure 4—Combination Valve Circuit Test

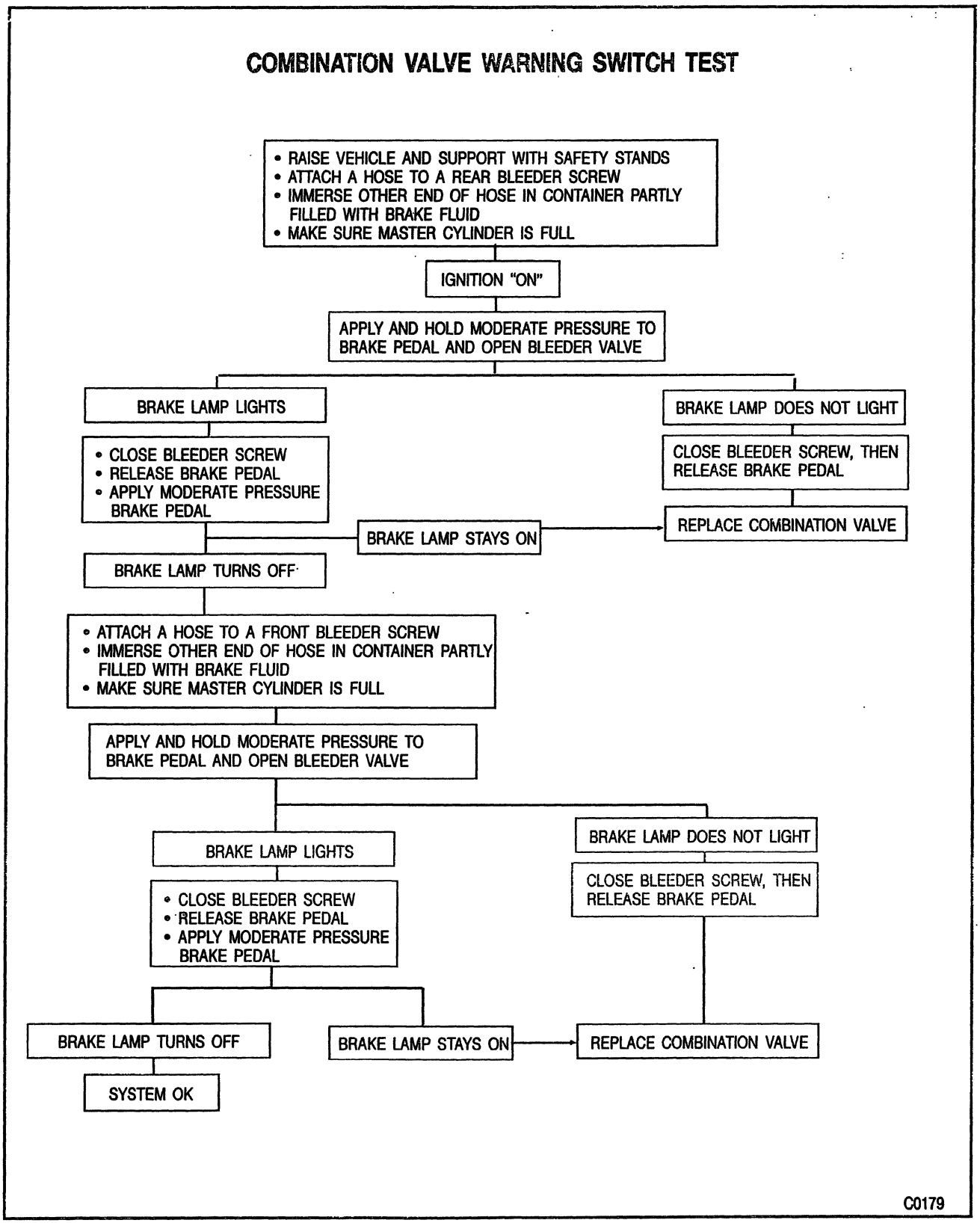


Figure 5—Combination Valve Warning Switch Test

BRAKE SYSTEM DIAGNOSIS

For diagnosis of the brake system, refer to figure 6.

ON-VEHICLE SERVICE

FILLING MASTER CYLINDER RESERVOIR

For information on filling the master cylinder reservoir, refer to SECTION 5A1.

BRAKE PEDAL

Remove or Disconnect (Figure 7 and 8)

1. Electrical connector from stoplamp switch.
2. Retainer.
3. Bushing.
4. Pushrod.
5. Nut.
6. Bolt.
7. Bushings and spacer.
8. Brake pedal.

Install or Connect (Figure 7)

1. Brake pedal.
2. Bushings and spacer.
3. Bolt.
4. Nut.

Tighten

- Bolt to 47 N·m (35 lbs. ft.).

5. Pushrod.
6. Bushing.
7. Retainer.
8. Electrical connector.

STOPLAMP SWITCH

For further information on stoplamp circuit diagnosis, refer to SECTION 8B and the Driveability, Emissions, and Electrical Diagnosis Manual, GMT/95-CK-2.

Remove or Disconnect (Figure 8)

1. Negative battery cable. Refer to SECTION 0A.
2. Retainer from brake pedal pin.
3. Switch by unsnapping from pushrod.
4. Electrical connector from switch.

Install or Connect (Figure 8)

1. Electrical connector into switch.
2. Switch by snapping it onto pushrod.
3. Retainer onto brake pedal pin.
4. Negative battery cable.

PIPES, HOSES, AND FITTINGS

PIPE REPLACEMENT

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 correcrt 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 brake system failure.

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

HOSE REPLACEMENT

Clean

- Dirt, grease, and other foreign material from the hose fittings at both ends.

Remove or Disconnect (Figure 9)

1. Steel pipe.
2. Clip or nut.
3. Bolt.
4. Washers.
5. Hose.

Install or Connect (Figure 9)

- Use new copper washers when installing the hose.

1. Hose.
   - The hose must not be twisted or contact any suspension components.
2. Washers.
3. Bolt.
4. Clip or nut.
5. Steel pipe.
6. Bleed brakes. Refer to "Bleeding Brake Hydraulic System."

COMBINATION VALVE

NOTICE: Brake fluid can damage electrical connections and painted surfaces. Use shop cloths, suitable containers, and fender covers to prevent brake fluid from contacting these areas. Always re-seal and wipe off brake fluid containers to prevent spills.

CAUSES / SYMPTOM	EXCESSIVE BRAKE PEDAL TRAVEL	BRAKE PEDAL TRAVEL GRADUALLY INCREASES	EXCESSIVE BRAKING ACTION	BRAKES SLOW TO RESPOND	UNEVEN BRAKING ACTION	BRAKES DRAG	SCRAPING NOISE (SIDE TO SIDE)	BRAKES SQUEAK (FRONT TO REAR)	BRAKES SQUEAK DURING APPLICATION	BRAKES SQUEAK DURING STOP	BRAKES CHATTER (ROUGHNESS)	BRAKES GROAN AT END OF STOP	"BRAKE" WARNING LAMP GLOWS	DIAGNOSIS SECTION
LEAKING BRAKE PIPE, HOSE, OR CONNECTION	X	XX						X					XX	5A
LEAKING PISTON SEAL	X	XX						X					X	5B,5C
LEAKING MASTER CYLINDER	X	XX						X					X	5A1
AIR IN BRAKE SYSTEM	XX							X					XX	5A
CONTAMINATED OR IMPROPER BRAKE FLUID	X				X	X	X	X	X				X	5A
LEAKING BOOSTER SYSTEM			XX		X									5D1,5D2
RESTRICTED PASSAGE IN BOOSTER		X	X		XX	X								5D1,5D2
DAMAGED BOOSTER		X	X	X	X	XX								5D1,5D2
WORN OUT BRAKE LINING -REPLACE			X	X				X	X	X	X	X	X	5B,5C
UNEVEN LINING WEAR—REPLACE OR CORRECT	X			X				X	X	X	X	XX	X	5B,5C
GLAZED BRAKE LINING			XX		X			X	X		X	X		5B,5C
INCORRECT LINING MATERIAL—REPLACE			X	X				X	X		X	X		5B,5C
CONTAMINATED BRAKE LINING—REPLACE			X					XX	XX	X	X	X		5B,5C
LININGS DAMAGED BY ABUSIVE USE—REPLACE			X	XX				X	X	X	X	X	X	5B,5C
HEAT SPOTTED OR SCORED DISCS				X				X	X		X	X	XX	5B1,5B2
IMPROPER THICKNESS VARIATION	X	X											XX	5B,5C
EXCESSIVE LATERAL RUN—OUT	X	X											X	5B,5C
BRAKE ASSEMBLY ATTACHMENTS—MISSING OR LOOSE	X			X			X	X	X	X		X	X	5B,5C
RESTRICTED BRAKE FLUID PASSAGE		X	X		X	X	X	X	X					5A
IMPROPERLY ADJUSTED STOP LAMP SWITCH OR CRUISE CONTROL VACUUM DUMP							X							5A
BRAKE PEDAL LINKAGE INTERFERENCE OR BINDING			X		X	XX	XX							5A
IMPROPERLY ADJUSTED PARKING BRAKE							X	X	X					5F
INCORRECT FRONT END ALIGNMENT								XX						3A
INCORRECT TIRE PRESURE								X						0A
LOOSE FRONT SUSPENSION ATTACHMENTS							X	X		XX			X	3C
OUT-OF-BALANCE WHEEL ASSEMBLIES													XX	3E
OPERATOR RIDING BRAKE PEDAL			X				X							-
STICKING CALIPER OR CALIPER PISTONS					X	X	XX	X	X					5B1,5B2
PARK BRAKE SWITCH CIRCUIT GROUNDED													XX	8A
PARK BRAKE NOT RELEASING						X		X					XX	5F
ROTOR OR DRUM SURFACE FINISH			X											5B,5C

XX — INDICATES MORE PROBABLE CAUSE(S)
X — INDICATES OTHER CAUSE(S)

Figure 6—Brake System Diagnosis

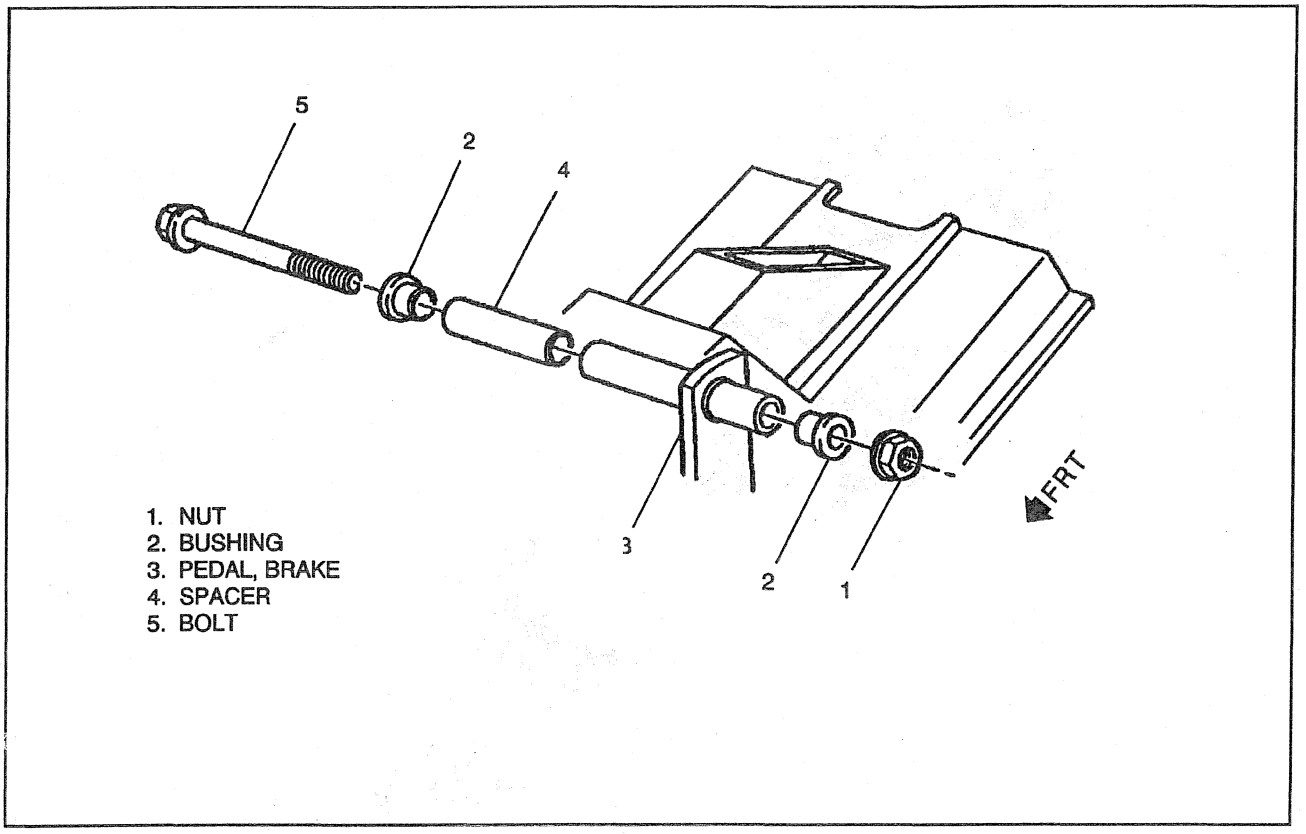


Figure 7—Brake Pedal

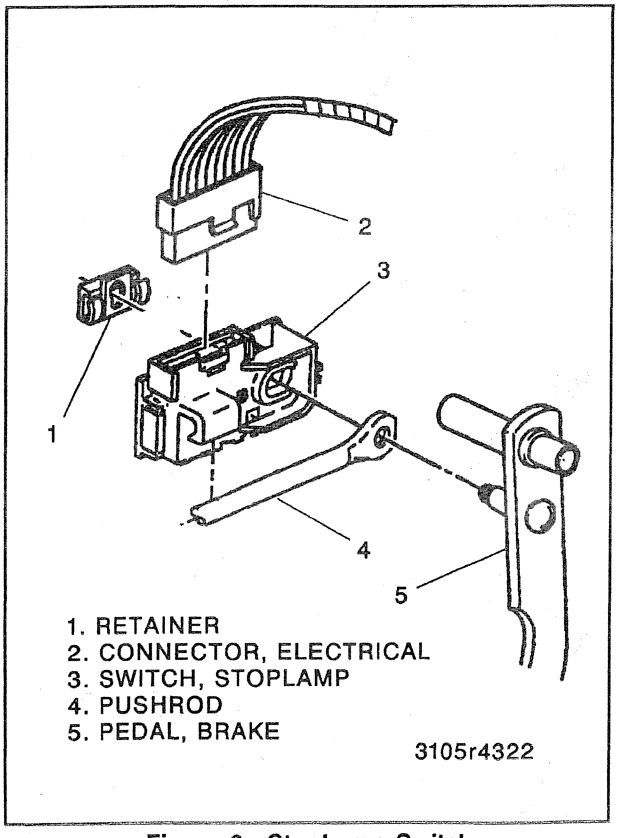


Figure 8—StopLamp Switch

Remove or Disconnect (Figure 10)

- The combination valve is not repairable and must be replaced as an assembly.

1. Hydraulic pipes.
   - Plug the pipes to prevent the loss of fluid or entrance of dirt.
2. Warning switch connector.
3. Electric brake control module if used.
4. Bolts.
5. Antilock pressure valve if used.
6. Nuts.
7. Bracket and combination valve.

Install or Connect (Figure 10)

1. Bracket and combination valve.
2. Nuts.

Tighten

- Nuts to 36 N·m (26 lbs. ft.).

3. Antilock pressure valve if used.
4. Bolts.

Tighten

- Bolts to 29 N·m (21 lbs. ft.).

5. Electric brake control module if used.
6. Warning switch connector.
7. Hydraulic pipes.

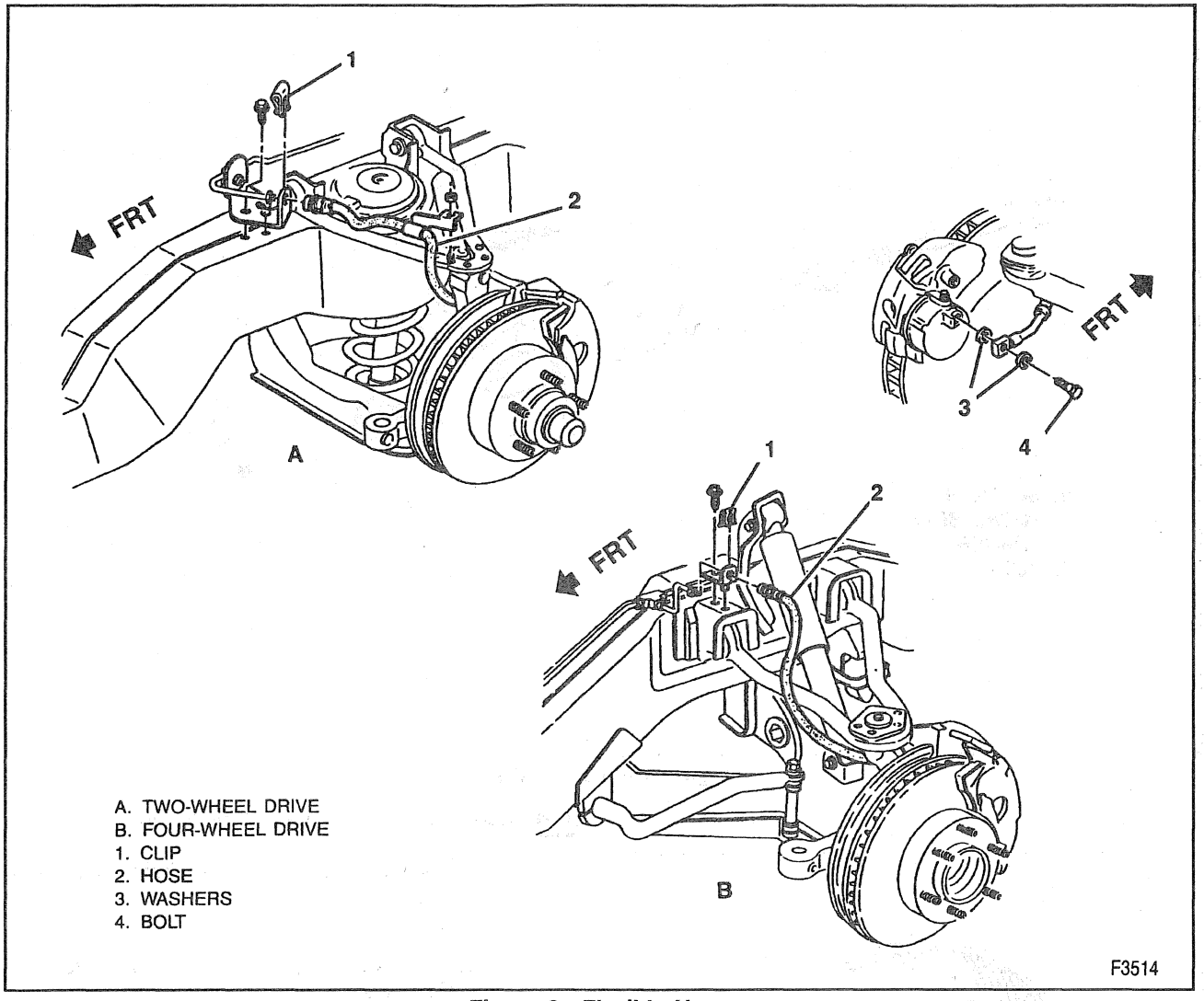


Figure 9—Flexible Hose

Tighten

- Fittings to 24 N·m (18 lbs. ft.).

8. Bleed system. Refer to "Bleeding Brake Hydraulic System."

HEIGHT-SENSING BRAKE PROPORTIONING VALVE

Remove or Disconnect (Figure 11)

1. Raise vehicle and support it at suitable frame locations to allow rear axle to hang freely.
2. Height sensing bracket from bracket assembly.
3. Nut.
4. Lever assembly from valve assembly.
5. Brake pipes.
6. Bolts and washers.
7. Valve assembly.

Install or Connect (Figure 11)

1. Valve assembly.
2. Bolts and washers.

Tighten

- Bolts to 27 N·m (20 lbs. ft.)

3. Brake pipes.

Tighten

- Fittings to 24 N·m (18 lbs. ft.)

Important

- The rear axle must be hanging freely or the valve adjustment will be incorrect.

Adjust

- Valve Assembly. Refer to "Height-Sensing Brake Proportioning Valve Adjustment."

4. Bracket to height sensing bracket assembly.
5. Bleed brakes. Refer to "Bleeding Brake Hydraulic System."
6. Lower vehicle and test brakes.

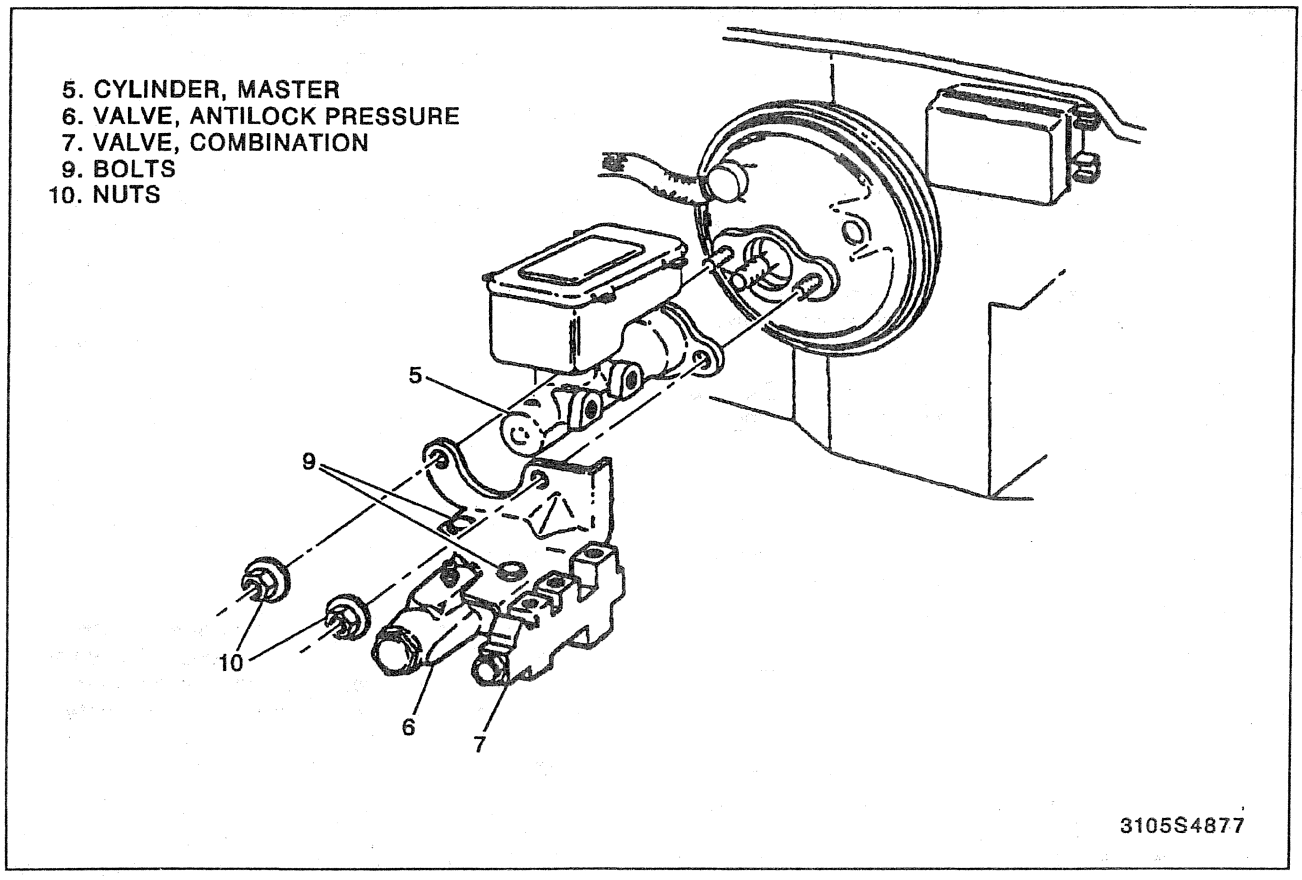


Figure 10—Combination Valve

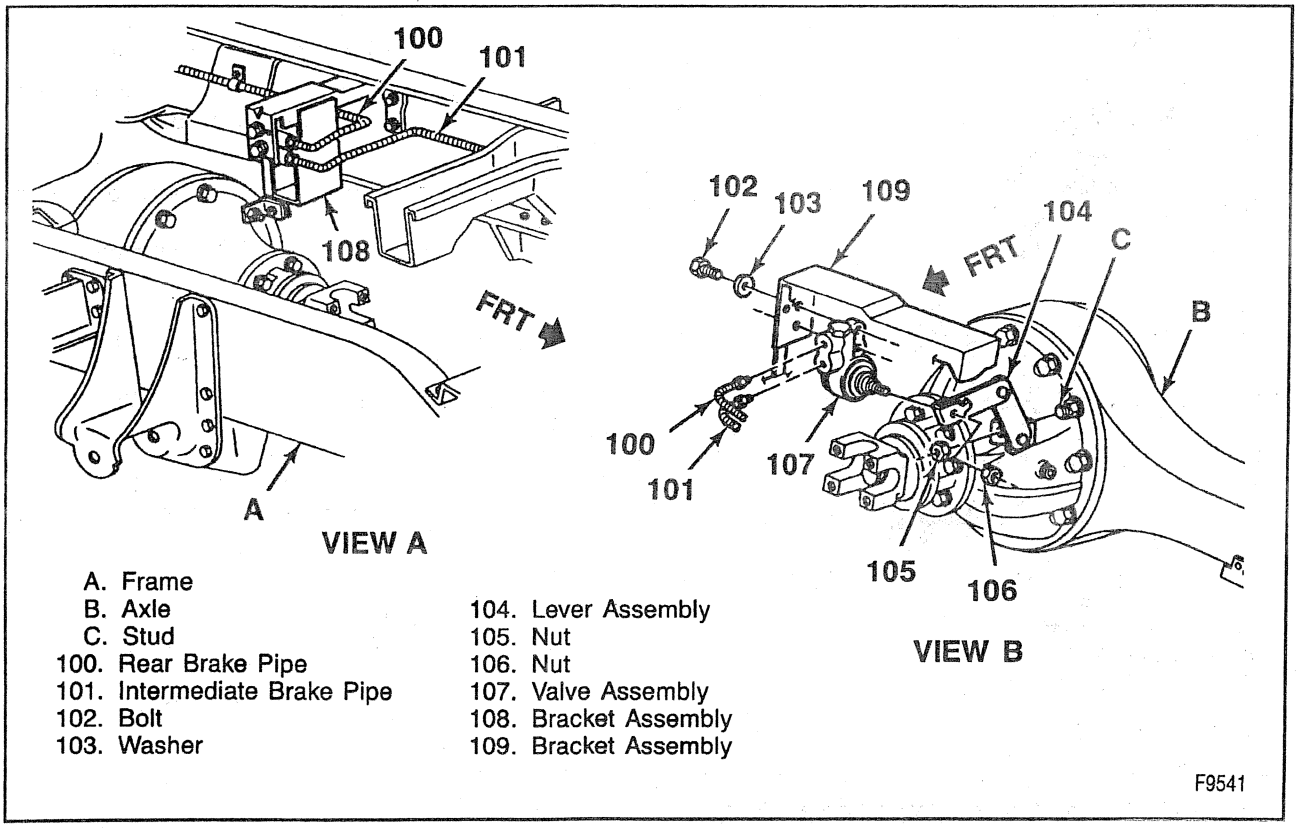


Figure 11—Height-Sensing Proportioning Valve

HEIGHT-SENSING BRAKE PROPORTIONING VALVE ADJUSTMENT

Refer to figure 12.

1. Raise vehicle.
   - Allow axle to hang freely.
2. Remove nut and lever assembly from valve.
3. Rotate valve shaft to allow installation of plastic adjustment gage (GM P/N 15592484).
   - The "D" shaped center hole must seat over valve shaft and gage tang must be positioned in valve mounting hole.
4. Install lever assembly to valve shaft with a C-clamp or locking pliers to seat lever nylon bushing on serrated valve shaft.

Important

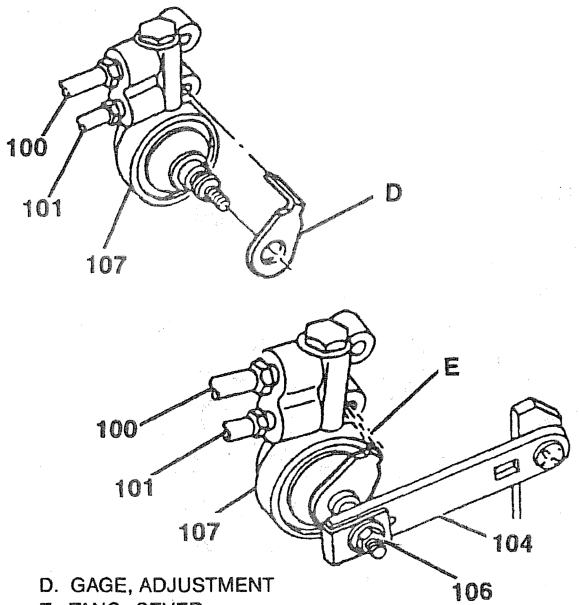
- Do not install the lever using the attaching nut. Doing so can result in improper valve adjustment.

5. Install valve shaft nut.

Tighten

- Nut to 9 N.m (80 lbs. in.)

6. Cut tang from body of adjustment gage to allow valve to rotate freely.
7. Lower vehicle and test brakes.



D. GAGE, ADJUSTMENT
E. TANG, SEVER
100. PIPE, REAR BRAKE
101. PIPE, INTERMEDIATE BRAKE
104. ASSEMBLY, LEVER
106. NUT
107. ASSEMBLY, VALVE

V2667

Figure 12—Height-Sensing Proportioning Valve Adjustment

BLEEDING BRAKE HYDRAULIC SYSTEM

Bleeding is necessary if air has entered the hydraulic brake system.

It may be necessary to bleed the system at all four wheels if a low fluid level allowed the air to enter the system or the brake pipes have been disconnected at the master cylinder or combination valve. If a pipe is disconnected at one wheel, then bleed only that wheel.

The time required to bleed the hydraulic system when the master cylinder is removed can be reduced by bench bleeding the master cylinder before installing it on the vehicle.

MANUAL BLEEDING

If the vehicle is equipped with a vacuum booster, relieve the vacuum reserve by applying the brakes several times with the engine off.

NOTICE: Brake fluid will damage electrical connections and painted surfaces. Use shop cloths, suitable containers, and fender covers to prevent the brake fluid from contacting these areas. Always re-seal and wipe off brake fluid containers to prevent spills.

1. Fill the master cylinder reservoir with Delco Supreme No. 11 Hydraulic Brake Fluid (GM P/N 1052535) or an equivalent DOT 3 motor vehicle brake fluid.
   - Maintain the fluid level during bleeding.
2. If the master cylinder is suspected to have air in the bore, bleed it before any wheel cylinder or caliper.
   A. Disconnect the forward brake pipe connection at the master cylinder.
   B. Allow the brake fluid to flow from the connector port.
   C. Connect the brake pipe but do not tighten.
   D. Slowly apply the brake pedal and allow the air to bleed from the loose fitting.
   E. Tighten the fitting before releasing the pedal.
   F. Wait 15 seconds.
   G. Repeat this sequence, including the 15-second wait, until all air is purged from the bore.
   H. After all air has been removed from the forward connection, repeat this procedure for the rear pipe.
3. If the BPMV of the 4WAL system is replaced or suspected to have air trapped inside, it must be bled next. Refer to SECTION 5E1.
4. Bleed each wheel in the following sequence:
   A. Right rear.
   B. Left rear.
   C. Right front.
   D. Left front.

5. Attach a hose to the wheel cylinder/caliper bleeder valve.
   - Immerse the opposite end of the hose into a container partially filled with clean brake fluid (figure 13).
6. Slowly apply the brake pedal one time and hold.
7. Loosen the bleeder valve to purge the air from the wheel cylinder/caliper.
8. Tighten the bleeder valve to 7 N·m (62 lbs. in.) and slowly release the pedal.
9. Wait 15 seconds.
10. Repeat this sequence, including the 15-second wait, until all air is purged from the wheel cylinder/caliper.
11. Repeat steps 5 through 10 at each wheel until the system is bled.
12. Check the brake pedal for "sponginess" and the brake warning lamp for an indication of unbalanced pressure. Repeat the bleeding procedure to correct either of these conditions.

PRESSURE BLEEDING

A diaphragm type pressure bleeder must be used. It must have a rubber diaphragm between the air supply and brake fluid to prevent air, moisture, oil, and other contaminants from entering the hydraulic system.

NOTICE: Brake fluid can damage electrical connections and painted surfaces. Use shop cloths, suitable containers, and fender covers to prevent brake fluid from contacting these areas. Always re-seal and wipe off brake fluid containers to prevent spills.

Tools Required:
J 29567 Brake Bleeder Adapter (Plastic Reservoir)
J 23518-01 Brake Bleeder Adapter (Cast-Iron Reservoir)
J 39177 Combination Valve Pressure Bleeding Tool

1. Fill the pressure tank at least 2/3 full of brake fluid.
   - The bleeder must be bled each time fluid is added.
2. Charge the bleeder to 140-170 kPa (20-25 psi).
3. Use J 39177 to depress and hold the valve stem on the combination valve (figure 14).
4. Install the bleeder adapter (figure 15).
5. If the BPMV of the 4WAL system is replaced or suspected to have air trapped inside, it must be bled next. Refer to SECTION 5E1.

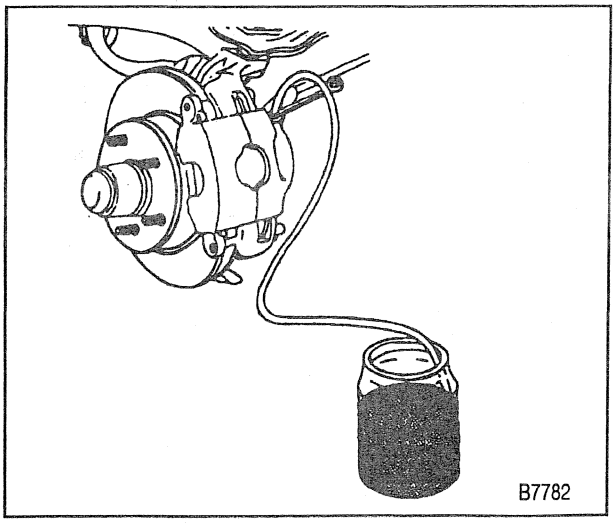


Figure 13—Immersing the Bleeder Hose

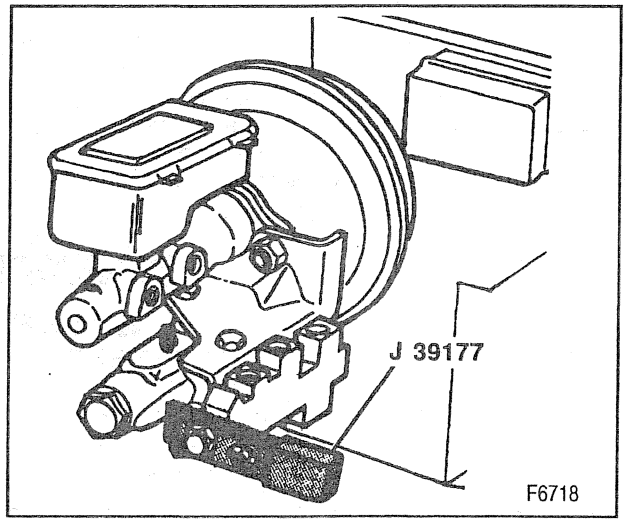


Figure 14—Combination Valve Pressure Bleeding Tool

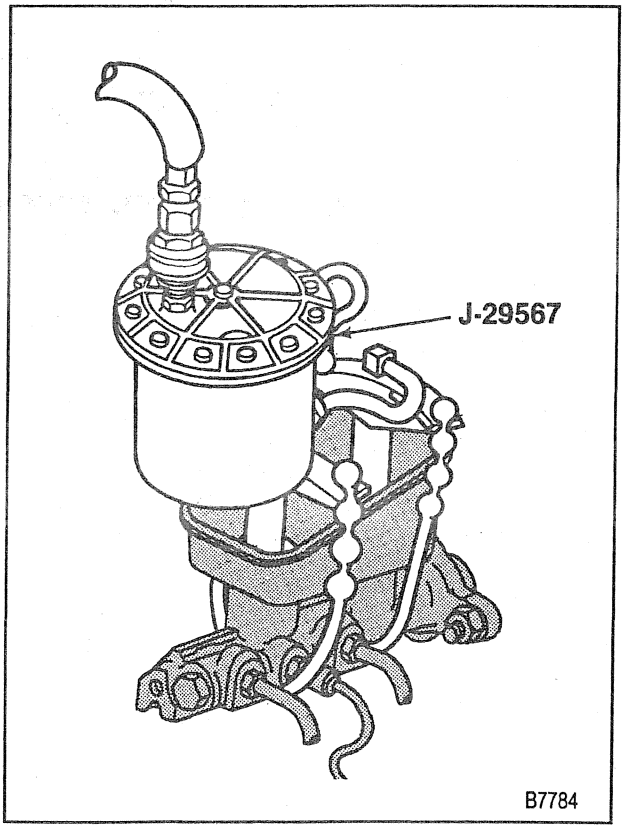


Figure 15—Reservoir Bleeder Adapter

6. Bleed each wheel in the following sequence:
   A. Right rear.
   B. Left rear.
   C. Right front.
   D. Left front.
7. Connect the hose from the bleeder to the adapter at the master cylinder.
8. Open the tank valve.
9. Attach a hose to the bleeder valve.
   - Immerse the opposite end of the hose into a container partially filled with clean brake fluid.
10. Open the bleeder valve at least 3/4 of a turn and allow the fluid to flow until no air is seen in the fluid.
11. Tighten the bleeder valve to 7 N·m (62 lbs. in.).
12. Repeat steps 9 through 11 at all wheels.
13. Check the brake pedal for "sponginess."
    - Repeat the entire bleeding procedure if this condition is found.
14. Remove J 39177.
15. Disconnect the hose from the bleeder adapter.
16. Remove the bleeder adapter.
17. Fill the master cylinder to the proper level.

FLUSHING BRAKE HYDRAULIC SYSTEM

Flushing is done at each bleeder valve similar to the bleeding procedure. The difference is that the bleeder valve is opened 1 1/2 turns and fluid is forced through the pipes, hoses, and bleeder valves until it comes out clear in color. Refer to "Bleeding Brake Hydraulic System."

Check the master cylinder fluid level after flushing at each bleeder valve and refill as required. After flushing, make sure the master cylinder reservoir is filled to the correct level.

SPECIFICATIONS

BRAKE SYSTEMS

SYSTEM	FRONT BRAKES	REAR BRAKES	BRAKE ASSIST
JB5	Disc 11.57-inch x 1.25-inch	254 mm x 57 mm (Leading/Trailing)	Vacuum
JD5			Hydraulic
JB6	Disc 11.57-inch x 1.25-inch	11.15-inch x 2.75-inch (Duo-Servo)	Vacuum
JD6			Hydraulic
JB7	Disc 12.5-inch x 1.26-inch	13.00-inch x 3.5-inch (Duo-Servo)	Vacuum
JD7			Hydraulic
JB8 Single Rear Wheel	Disc 12.5-inch x 1.26-inch	13.00-inch x 3.5-inch (Duo-Servo)	Hydraulic
JB8 Dual Wheel	Disc 12.5-inch x 1.50-inch	13.00-inch x 3.5-inch (Duo-Servo)	Hydraulic
JF9	Disc 14.25-inch x 1.54-inch	Disc 13.75 inch x 1.54 inch	Hydraulic

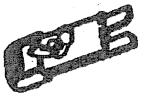
T2112

FASTENER TIGHTENING SPECIFICATIONS

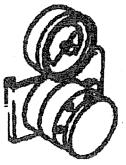
	N·m	Lbs. Ft.	Lbs. In.
Antilock Pressure Valve Bolts	29	21	—
Brake Pedal Through Bolt	47	35	—
Brake Pipe Clip Bolts	17	13	—
Brake Pipe Fittings	24	18	—
Bleeder Valves	7	—	62
Front Brake Hose to Caliper Bolt	44	32	—
Height-Sensing Proportioning Valve Lever Nut	9	—	80
Height-Sensing Proportioning Valve Mounting Bolts	27	20	—
Master Cylinder Mounting Nuts	36	26	—

T2113

SPECIAL TOOLS

1.  J 39177

2.  J 29567

3.  J 28662

4.  J 28434

1. COMBINATION VALVE PRESSURE BLEEDING TOOL
2. BRAKE BLEEDER ADAPTER
3. BRAKE PEDAL EFFORT GAGE
4. WHEEL CYLINDER BLEEDER WRENCH

NOTES

SECTION 5A1

MASTER CYLINDER

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: Always use the correct fastener in the correct location. Use the correct fastener part number to replace a fastener. If the correct fastener part number is not available, a fastener of equal size and strength may be used. Do not use a fastener that is stronger when the correct fastener part number is not available in the following applications:

- ***Some bolts are designed to permanently stretch, and if a stronger fastener is used, the part will not be tightened correctly. These permanently stretching bolts will be called out. The correct part number fasteners must be used to replace this type of fastener because there is no available equivalent.***
- ***Other bolts are designed to break if over tightened to prevent part damage. If a stronger fastener is used part damage may occur.***

Fasteners that need to be replaced when removed will be called out. Fasteners that require thread lockers or thread sealant will be called out. The correct tightening specification and sequence must be used when installing fasteners. Part or system damage may occur if the above instructions are not followed.

CONTENTS

GENERAL DESCRIPTION

MASTER CYLINDER

The master cylinder (figure 1) is designed for a system using low-drag calipers. In addition to the standard master cylinder functions, a quick take-up feature is included on models with a vacuum booster. This provides a large volume of low pressure fluid to the wheels with the initial brake application. The large volume of fluid helps overcome the clearance created by the caliper pistons and rear brake shoes retracting.

RESERVOIR AND COVER

The reservoir and cover used on these models are made of plastic. The cover snaps onto the top of the reservoir. A seal is located between the cover and reservoir to keep contaminants out of the brake fluid.

The master cylinder reservoir must be kept properly filled. This ensures adequate reserve fluid and prevents air from entering the hydraulic system. Fluid expansion due to heat absorbed from the brakes and engine makes it important that the reservoirs not be overfilled.

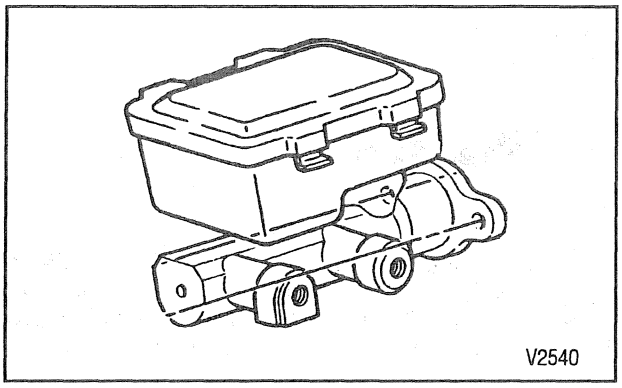


Figure 1—Master Cylinder

FLUID AND FLUID HANDLING

CAUTION: Brake fluid may be irritating to skin or eyes. In case of contact, take the following actions:

- **Eye contact - rinse eyes thoroughly with water.**
- **Skin contact - wash skin with soap and water.**

NOTICE: Brake fluid will damage electrical connections and painted surfaces. Use shop cloths, suitable containers, and fender covers to prevent brake fluid from contacting these areas. Always re-seal and wipe off brake fluid containers to prevent spills.

Use Delco Supreme 11 Brake Fluid (GM P/N 1052535) or an equivalent DOT-3 motor vehicle brake fluid.

Brake fluid should always be stored in a closed, sealed container. Never use previously opened containers of stored brake fluid. Always use new fluid from a sealed container. Re-seal brake fluid containers immediately after use. Brake fluid left in an open or improperly sealed container will absorb moisture. This can lower the fluid's boiling point and result in system contamination, corrosion, or deterioration of rubber components.

SUBSTANDARD OR CONTAMINATED FLUID

NOTICE: Power steering fluid and brake fluid cannot be mixed. If brake seals contact power steering fluid or steering seals contact brake fluid, seal damage will result.

No special fluids are used in this system. However, care must be taken to use the correct fluids on models with a hydraulic booster. The master cylinder and brake system uses brake fluid, while the hydraulic booster system uses power steering fluid.

Improper fluid, water, or any other contaminants in the fluid may cause the brake fluid to boil or rubber component deterioration in the hydraulic system.

Swollen master cylinder piston seals show that rubber deterioration has occurred. Rubber deterioration is also shown by swollen wheel cylinder boots, caliper boots, or the master cylinder reservoir diaphragm.

If rubber deterioration is found, replace all rubber components in the system, including the hoses. Also check for fluid on the brake linings. If any is found, replace the linings.

If the brake fluid is contaminated and the master cylinder piston seals are satisfactory, check for leaks or excessive heat conditions. If no leaks or excessive heat conditions are found, flush the system. Refer to SECTION 5A for the procedure.

DIAGNOSIS

MASTER CYLINDER

These tests will not find all master cylinder malfunctions. If the cause is not found with these tests, refer to the brake system diagnostic chart in SECTION 5A for additional information.

1. Check for a cracked casting or brake fluid leaks around the master cylinder.
   - Leaks are indicated only if there is at least a drop of fluid. A damp condition is not abnormal.
2. Check for binding pedal linkage and incorrect pushrod length.
   - Disassemble the master cylinder if there is no brake pedal binding or improper brake pedal travel. Refer to the Light Duty Truck Unit Repair Manual.
3. Check the master cylinder for swollen or elongated primary piston seal(s).
   - If swollen seals are found, refer to "Substandard or Contaminated Fluid."

ON-VEHICLE SERVICE

FILLING MASTER CYLINDER RESERVOIR

NOTICE: Do not use fluid that has a petroleum base. Do not use a container that has been used for petroleum based fluids or is wet with water. Petroleum based fluids cause swelling and distortion of rubber parts in the hydraulic brake system and water lowers the brake fluid's boiling point. Keep all fluid containers capped to prevent contamination.

Thoroughly clean the top of reservoir cover before removal. This helps prevent dirt from getting into the reservoirs. Remove the cover and diaphragm and add fluid as required to bring the level to the full mark (typically located inside the reservoir). Use Delco Supreme No. 11 Hydraulic Brake Fluid (GM P/N 1052535) or an equivalent DOT 3 motor vehicle brake fluid.

MASTER CYLINDER ASSEMBLY

Remove or Disconnect (Figure 2 or 3)

- Apply parking brake.

1. Brake pipes.
   - Cover the ends of the pipes to prevent dirt from entering the system.
   - Do not allow brake fluid to fall on the EBCM, connectors, or wiring.
2. Nuts (1).
3. Master cylinder (3) and bracket (2).

Install or Connect (Figure 2 or 3)

- Prior to installation, refer to "Bench Bleeding."

1. Master cylinder (3) and bracket (2).
2. Nuts (1).

Tighten

- Nuts (1) to 36 N·m (27 lbs. ft.).

3. Brake pipes.

Tighten

- Brake pipe fittings to 27 N·m (20 lbs. ft.).

- Bleed brakes. Refer to SECTION 5.
- Release parking brake.

BENCH BLEEDING

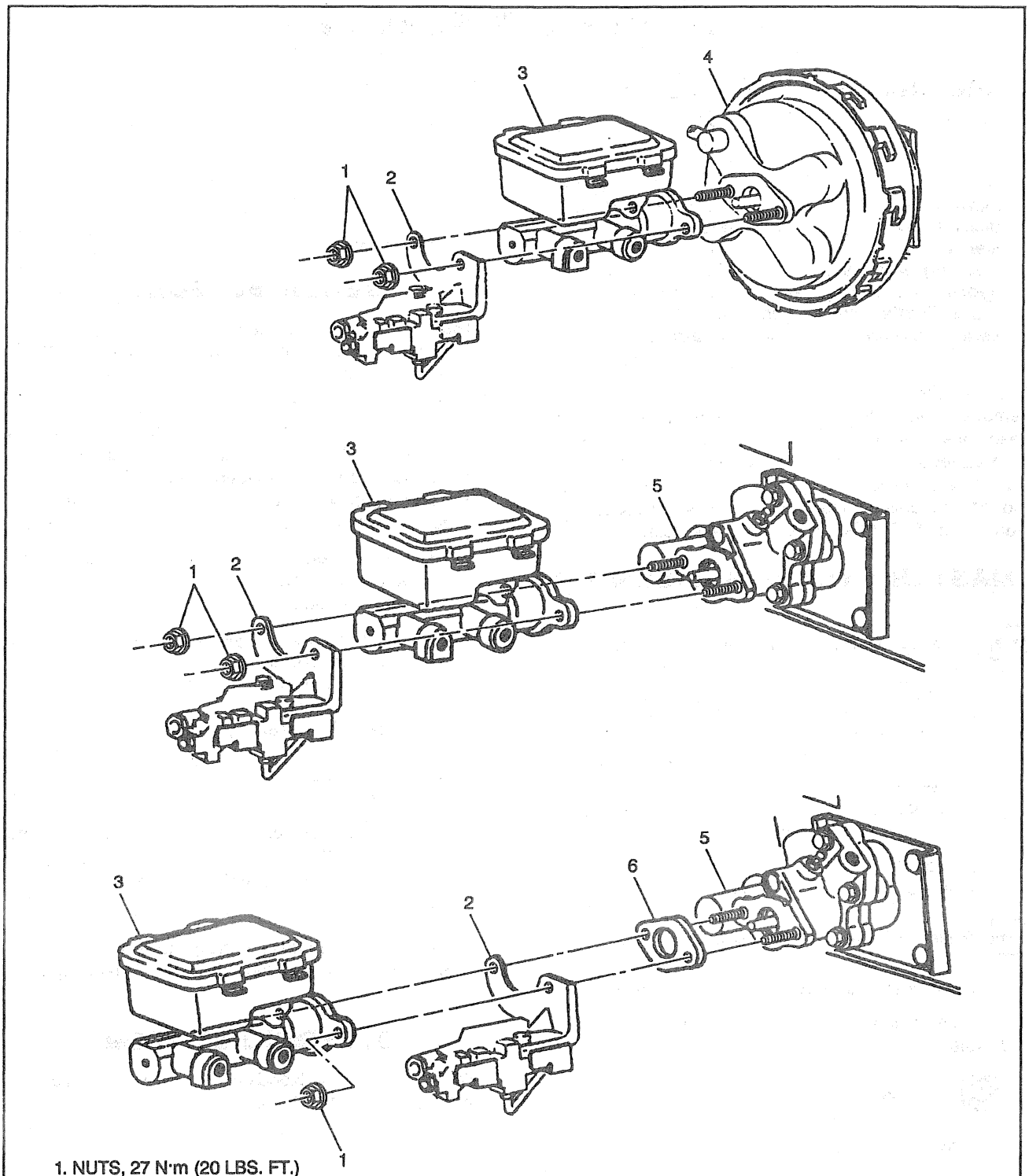
The purpose of bench bleeding the master cylinder is to remove the air from it prior to installation. This reduces the amount of bleeding needed after it is installed on the vehicle.

1. Plug the outlet ports and mount the master cylinder in a vise with the front end tilted slightly down.
2. Fill the reservoir with clean brake fluid.
3. Using a tool with a smooth rounded end, stroke the primary piston about 25 mm (1 inch) several times.
   - As air is bled from the master cylinder, the primary piston will not travel the full 25-mm (1-inch) stroke.
4. Reposition the master cylinder in the vise with the front end tilted slightly up.
5. Again stroke the primary piston about 25 mm (1 inch) several times.
6. Reposition the master cylinder in the vise to the level position.
7. Loosen the plugs one at a time and push the piston into the bore to force the air from the cylinder.
   - To prevent air from being sucked back into the cylinder, tighten the plug(s) before allowing the piston to return to its original position.
8. Fill the reservoir.

- Perform normal bleeding procedures after the master cylinder is installed. Refer to "Bleeding System."

BLEEDING SYSTEM

For information on bleeding the brake hydraulic system, refer to SECTION 5A.



1. NUTS, 27 N·m (20 LBS. FT.)
2. BRACKET
3. CYLINDER, MASTER
4. BOOSTER, VACUUM
5. BOOSTER, HYDRAULIC
6. SPACER

Figure 2—Master Cylinder

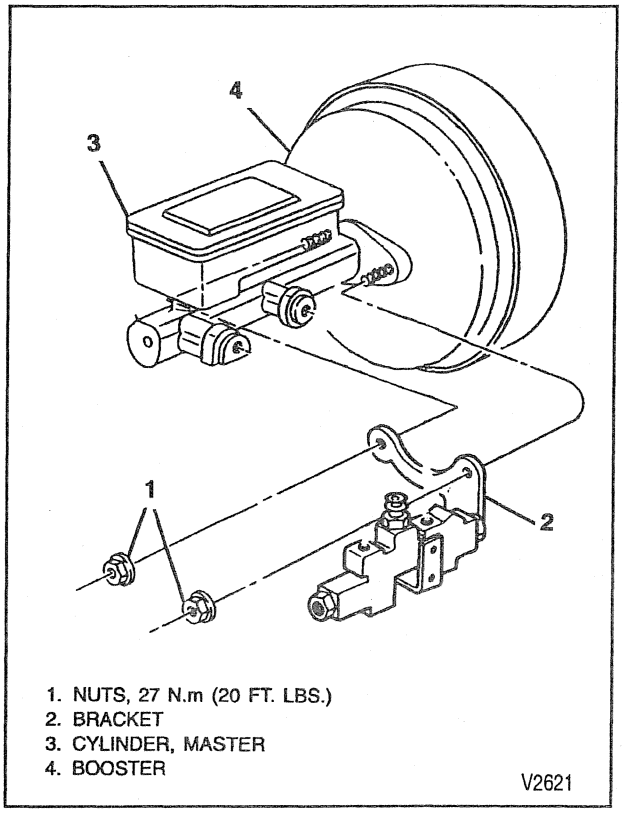


Figure 3—Master Cylinder

SPECIFICATIONS

BRAKE SYSTEMS

SYSTEM	FRONT BRAKES	REAR BRAKES	BRAKE ASSIST
JB5	Disc 11.57-inch x 1.25-inch	254 mm x 57 mm (Leading/Trailing)	Vacuum
JD5			Hydraulic
JB6	Disc 11.57-inch x 1.25-inch	11.15-inch x 2.75-inch (Duo-Servo)	Vacuum
JD6			Hydraulic
JB7	Disc 12.5-inch x 1.26-inch	13.00-inch x 3.5-inch (Duo-Servo)	Vacuum
JD7			Hydraulic
JB8 Single Rear Wheel	Disc 12.5-inch x 1.26-inch	13.00-inch x 3.5-inch (Duo-Servo)	Hydraulic
JB8 Dual Wheel	Disc 12.5-inch x 1.50-inch	13.00-inch x 3.5-inch (Duo-Servo)	Hydraulic
JF9	Disc 14.25-inch x 1.54-inch	Disc 13.75 inch x 1.54 inch	Hydraulic

T2112

FASTENER TIGHTENING SPECIFICATIONS

	N·m	Lbs. Ft.
Brake Pipe Fittings	27	20
Master Cylinder Mounting Nuts	36	27

T2905

NOTES

SECTION 5B1

FRONT DISC BRAKES

***CAUTION:** This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.*

***CAUTION:** When servicing brake parts, do not create dust by grinding or sanding brake linings, by cleaning brake parts with a dry brush or with compressed air. Many earlier models or aftermarket brake parts may 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 fibers from becoming airborne.*

***NOTICE:** Always use the correct fastener in the correct location. Use the correct fastener part number to replace a fastener. If the correct fastener part number is not available, a fastener of equal size and strength may be used. Do not use a fastener that is stronger when the correct fastener part number is not available in the following applications:*

- *Some bolts are designed to permanently stretch, and if a stronger fastener is used, the part will not be tightened correctly. These permanently stretching bolts will be called out. The correct part number fasteners must be used to replace this type of fastener because there is no available equivalent.*
- *Other bolts are designed to break if over tightened to prevent part damage. If a stronger fastener is used part damage may occur.*

Fasteners that need to be replaced when removed will be called out. Fasteners that require thread lockers or thread sealant will be called out. The correct tightening specification and sequence must be used when installing fasteners. Part or system damage may occur if the above instructions are not followed.

***NOTICE:** Any new rotor must have the protective coating removed from the friction surfaces before being placed in service. Use Goodwrench Brake Parts Cleaner (GM P/N 12345754) or equivalent, and wipe the surface clean with clean cloths. Do not use gasoline, kerosene, or other oil base solvents which may leave an oily residue. This residue is damaging to brake linings and flammable.*

CONTENTS

CONTENTS (cont'd)

GENERAL DESCRIPTION

The disc brake assembly consists of a caliper assembly, rotor, and pads mounted to the steering knuckle. The caliper mounts in a way that allows it to move laterally against the rotor. The caliper is a one-piece casting with the inboard side containing the piston bore. A square cut rubber seal fits in a groove in the piston bore to provide a hydraulic seal and return mechanism for the piston.

Applying the brake pedal causes hydraulic pressure to move the piston. The piston then forces the inboard brake pad against the inboard braking surface of the rotor. Increasing the force against the rotor causes the caliper assembly to move inboard. The outer brake pad then contacts the outboard braking surface of the rotor. The force of the two brake pads provides the desired clamping action on the rotor.

Releasing the brake pedal relieves the pressure applied to the piston. The square cut seal on the piston returns to its normal position, allowing a running clearance between the brake pads and rotor.

Servicing Information

- Replace all components included in the repair kits.
- Lubricate the parts as specified.
- Do not use lubricated shop air on brake parts. Rubber component damage may result.
- After any hydraulic component has been removed or disconnected, if necessary, bleed all or part of the brake system.
- Replace brake pads in axle sets only.
- The torques specified are for dry, unlubricated fasteners.
- Perform service operations on a clean bench free from mineral oil and any other contaminants.
- Use extreme care when doing any work around the antilock components to prevent damage or misalignment.
- Before moving the vehicle, pump the brake pedal several times to make sure it is firm. Do not move the vehicle until a firm pedal has been obtained. Check the brake fluid level in the master cylinder after pumping the brakes.

ROTOR

The front disc brakes use one of four different styles of rotors. The smaller two wheel drive models (C1, C2, and C3) use standard 1.250 inch rotors. The heavy duty two wheel drive model (C30 HD) has four wheel disc brakes with 1.5 inch rotors. The smaller four wheel drive models (K1 and K2) use a composite rotor. The composite rotor requires brake rotor turning tool J 39441 for refinishing. The larger four wheel drive models (K2 and K3) use 1.250 inch rotors on single wheel models and 1.5 inch rotors on dual wheel models. These are three-piece assemblies consisting of a rotor, bearings, and hub. Models with dual rear wheels (RO5) use a four-piece rotor assembly consisting of a rotor, bearings, hub, and extension.

CALIPER

Three different types of calipers are used on these models. Delco 3400 calipers with 75 and 80 mm single bores are used on models with a 9600 or lower GVW rating. Delco 3486 calipers with an 86 mm single bore is used on models with 10,000, 11,000, and 12,000 GVW ratings. A Bendix single bore caliper is used on the C30 HD model.

The Delco caliper mounts to the support bracket using two bolts. The Bendix caliper mounts to the support bracket using a support key, spring, and bolt assembly.

DIAGNOSIS

LINING INSPECTION

Inspect the brake linings every 6,000 miles and any time the wheels are removed (tire rotation, etc.). Check both ends of the outer lining by looking in at each end of the caliper (figure 1). These are the points where the highest rate of wear normally occurs. At the same time, check the thickness of the inner lining to make sure it has not worn prematurely. Some inboard shoe and linings have a thermal layer against the shoe, integrally molded with the lining. This extra layer should not be confused with uneven inboard-outboard lining wear. Look down through the inspection hole in the top of the caliper to view the inner lining. Replace disc brake shoe and lining assemblies whenever the thickness of any lining is worn to within 0.76 mm (0.030 in.) of the shoe. Replace riveted shoe and lining assemblies when the lining is worn to within 0.76 mm (0.030 in.) of any rivet head. Always replace disc brake shoe and lining assemblies as a complete axle set.

Check the flatness of the brake pads. Place the inboard and outboard lining surfaces together and check for a gap between the lining surfaces. The gap should not exceed 0.13 mm (.005 inch) at the middle of the lining surfaces. This measurement applies to new or used shoe and lining assemblies.

The disc brake shoe and lining assemblies on all models except 3500 HD, have wear indicators that contact the rotor and make noise when the linings wear to the point of needing replacement (figure 2). A loud scraping sound can be heard when this occurs.

On 3500 HD models, brake linings must be inspected through the caliper access hole.

ROTOR INSPECTION

ROTOR TOLERANCE AND SURFACE FINISH

During the manufacture of the brake rotor, tolerances of the braking surfaces for flatness, parallelism, and lateral runout are closely held. The maintenance of close tolerances on the shape of the braking surfaces is necessary to prevent brake roughness or pulsation.

In addition to these tolerances, the surface finish must be held to a specified range of 60 Ra roughness or less. The control of the braking surface finish is necessary to avoid problems of hard pedal apply, excessive brake fade, pulls, and erratic performance. In addition, control of the surface finish can improve lining life.

Light scoring of the rotor surfaces not exceeding 1.5 mm (0.06 in.) in depth is normal and not detrimental to brake operation.

THICKNESS VARIATION CHECK

Check thickness variation by measuring the rotor thickness at four or more points around the circumference of the rotor. Use a micrometer calibrated in ten-thousands of an inch. Make all measurements at the same distance in from the edge of the rotor.

A rotor that varies in thickness by more than 0.013 mm (0.0005 in.) can cause pedal pulsation and/or front end vibration during brake applications. A rotor that does not meet these specifications should be refinished or replaced.

LATERAL RUNOUT CHECK

The best way to check lateral runout is with the wheels still installed on the vehicle. This gives a much more accurate reading of the total indicated runout (T.I.R.) under real braking conditions. If equipment is not available to perform the check with the wheels installed, the next best reading can be made with the wheels removed but the caliper still installed.

1. Clean rotor surface.

Important

- If the wheel must be removed, reinstall the wheel nuts to retain the rotor. Tighten the wheel nuts to the correct torque specification following the wheel nut tightening sequence shown in SECTION 3E.

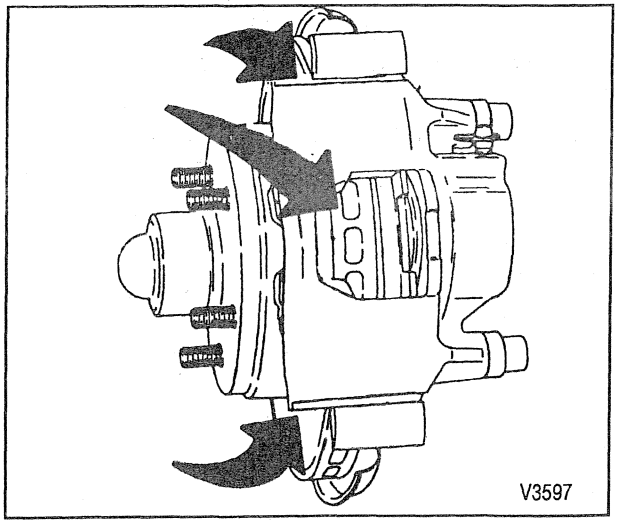


Figure 1—Lining Inspection Points

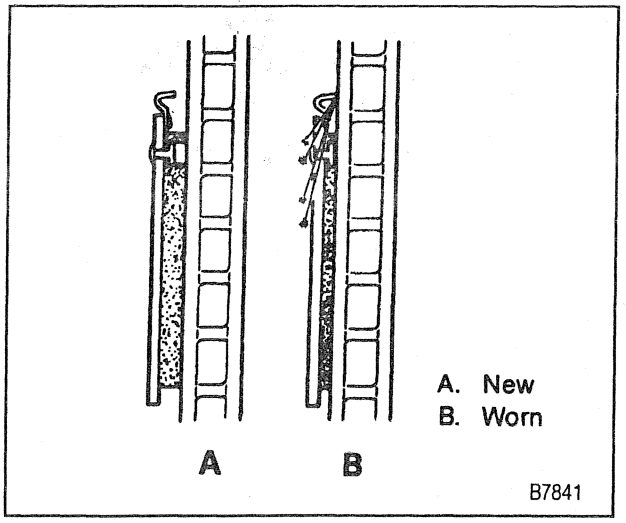


Figure 2—Wear Indicator

2. Fasten a dial indicator to the steering knuckle so the indicator button contacts the rotor surface about 13 mm (0.5 in.) from the outer edge (figure 3).
3. Set the dial indicator to zero.
4. Turn the wheel one complete revolution and observe the runout indicated on the dial.
5. The total indicated runout (T.I.R.) must not exceed 0.08 mm (0.003 in.).
6. If lateral runout is not within specifications, refinish or replace the rotor as necessary.

In some cases, excessive lateral runout can be improved by indexing the rotor on the hub one or two bolt positions from the original position. If lateral runout cannot be corrected by indexing the rotor, check the hub and bearing assembly for excessive lateral runout or looseness. If the hub and bearing assembly lateral runout exceeds 0.040 mm (0.0015 in.), repair or replace the hub and bearing assembly.

NOTICE: Any time the brake rotor has been separated from the wheel bearing flange, clean any rust or foreign material from the mating surfaces of the wheel bearing flange and rotor. Failure to do so can result in increased lateral runout and brake pulsation.

CALIPER INSPECTION

With the caliper removed, inspect the inside of the caliper assembly for signs of fluid leakage. If any is found, overhaul the caliper as outlined in "Unit Repair."

Inspect the mounting bolts and sleeves for corrosion. Replace any corroded bolts and sleeves. Do not attempt to polish away the corrosion.

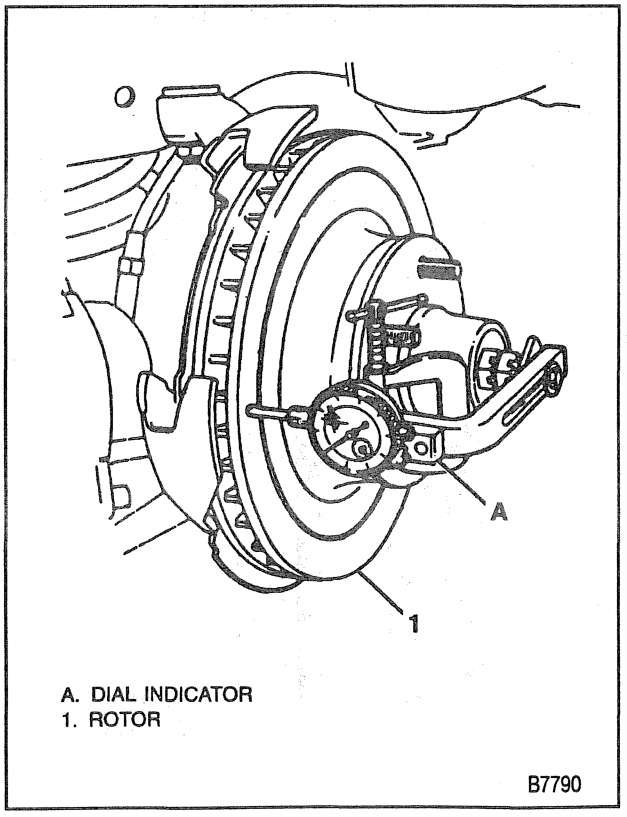
ON-VEHICLE SERVICE

CALIPER

DELCO

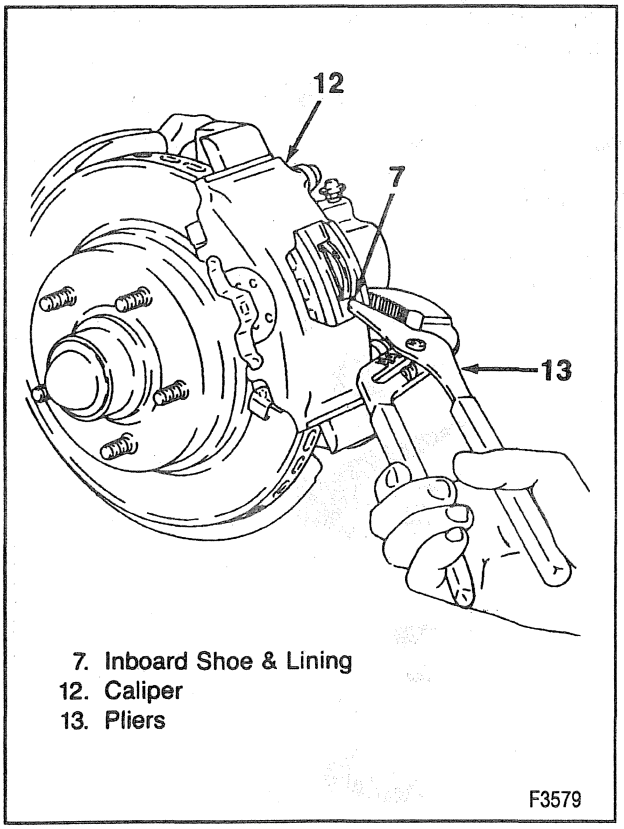
Remove or Disconnect (Figures 4 through 9)

1. Two-thirds of the brake fluid from master cylinder.
2. Raise vehicle and support with safety stands.
3. Tire and wheel. Refer to SECTION 3E.
   - On models with composite rotors, reinstall two lug nuts to retain rotor.
4. Compress piston using adjustable pliers over inboard lining (7) tab and caliper housing flange (12).
5. Brake hose from caliper by removing inlet fitting bolt (14).
6. Mounting bolts (2) (figure 5).
7. Bolt boots (1).
8. Caliper (12).
9. Mounting bolt seals (4) if used.
10. Bushings (3).



A. DIAL INDICATOR
1. ROTOR

Figure 3—Inspecting for Lateral Runout



7. Inboard Shoe & Lining
12. Caliper
13. Pliers

Figure 4—Compressing the Piston

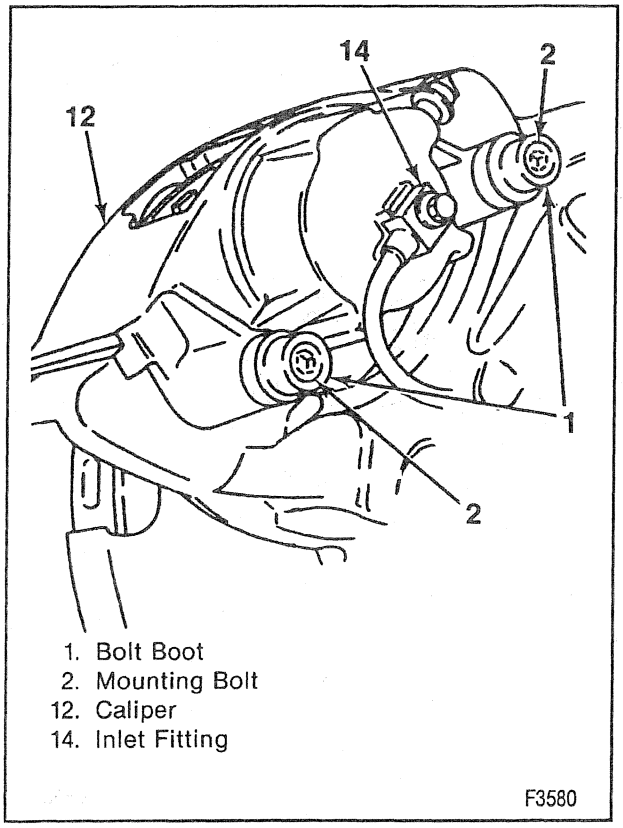


Figure 5—Caliper Attachment (Delco)

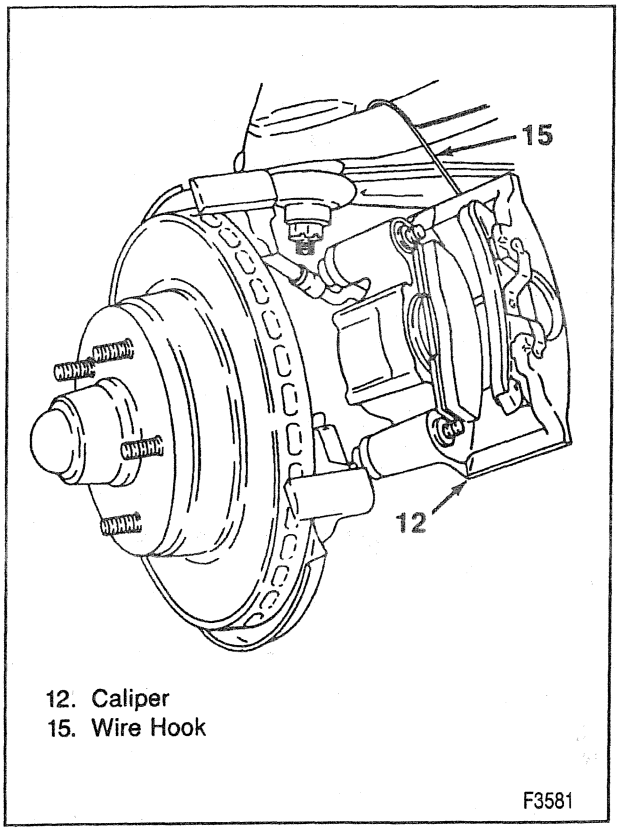


Figure 6—Suspending the Caliper

Inspect

- Mounting bolt and sleeve assemblies for corrosion. Replace if any is found.
  — Do not attempt to polish away corrosion.
- Bolt boots for nicks, cuts, or corrosion. Replace if any are found.

Important

- Clean the caliper assembly and install a new brake hardware kit any time it is removed from rotor.

Install or Connect (Figures 5 through 14)

1. New bushings (3) and bolt seals (4).
2. Lubricate bushings (3) and mounting bolt seals (4) with Delco Silicone Lube (GM P/N 18010909) or equivalent (figure 12 or 13).
3. New bolt boots (1).
4. Caliper (12).
   - Fill both housing cavities between bushings (3) with Delco Silicone Lube (GM P/N 18010909) or equivalent (figure 12 or 13).
5. Mounting bolt and sleeve assemblies (2).

Tighten

- Bolt (2) to 51 N·m (38 lbs. ft.).
  — The bolt boots (1) must remain secure after tightening bolts.

6. Brake hose to caliper.

Tighten

- Brake hose bolt to 45 N·m (33 lbs. ft.)

Measure (Figure 14)

- Clearance between caliper (12) and bracket stops (16).
- If necessary, remove caliper and file the ends of bracket (16) to obtain 0.26 to 0.60 mm (0.010 to 0.024 in.) total clearance. (Measure the clearances individually and add them together).

7. Tire and wheel. Refer to SECTION 3E.

Important

- Before moving the vehicle, pump the brake pedal several times to make sure it is firm. Do not move the vehicle until a firm pedal is obtained. Check the fluid level in the master cylinder after pumping the brakes.

BENDIX

Remove or Disconnect (Figures 15 through 19)

1. Two-thirds of the brake fluid from master cylinder.
2. Raise vehicle and support with safety stands.
3. Mark relationship of wheel to hub.
4. Tire and wheel. Refer to SECTION 3E.

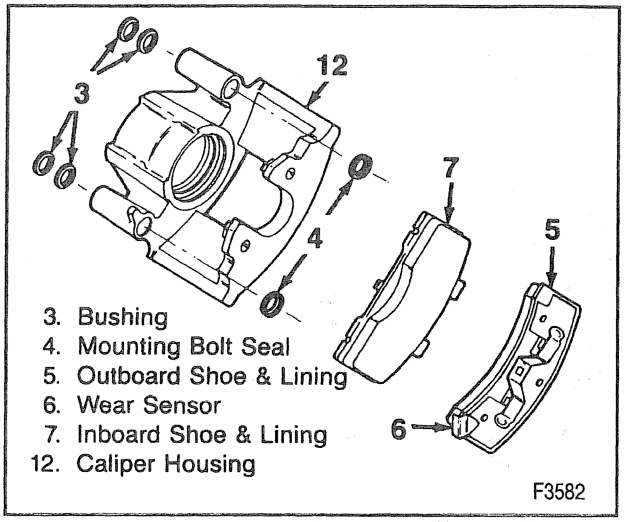


Figure 7—Delco Shoe and Lining Assembly (3400)

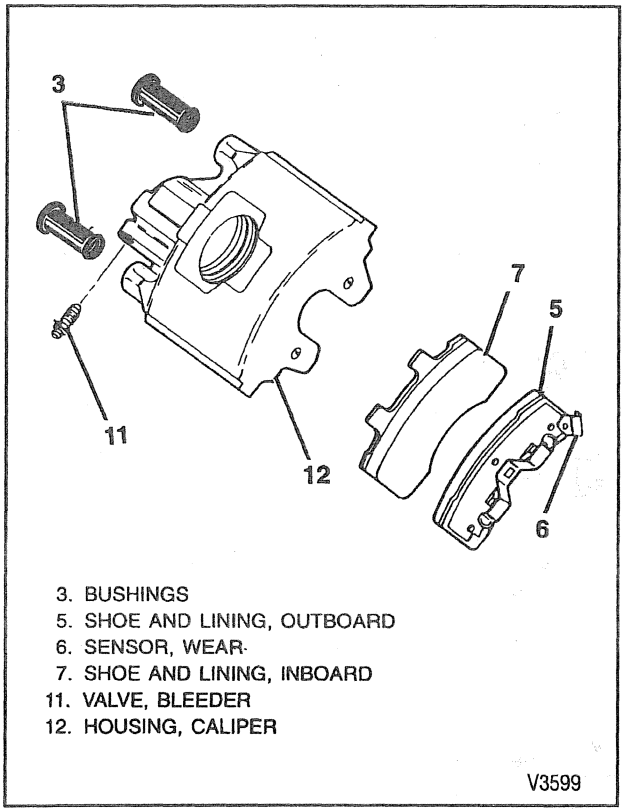


Figure 8—Delco Shoe and Lining Assembly (3486)

5. Position a C-clamp and tighten until piston bottoms in bore (figure 16).
6. C-clamp.
7. Brake hose.
8. Bolt (2).
9. Support key (3) and spring (4).
   - Use a brass punch and a hammer to drive the support key out (figure 18).
10. Caliper assembly (1).

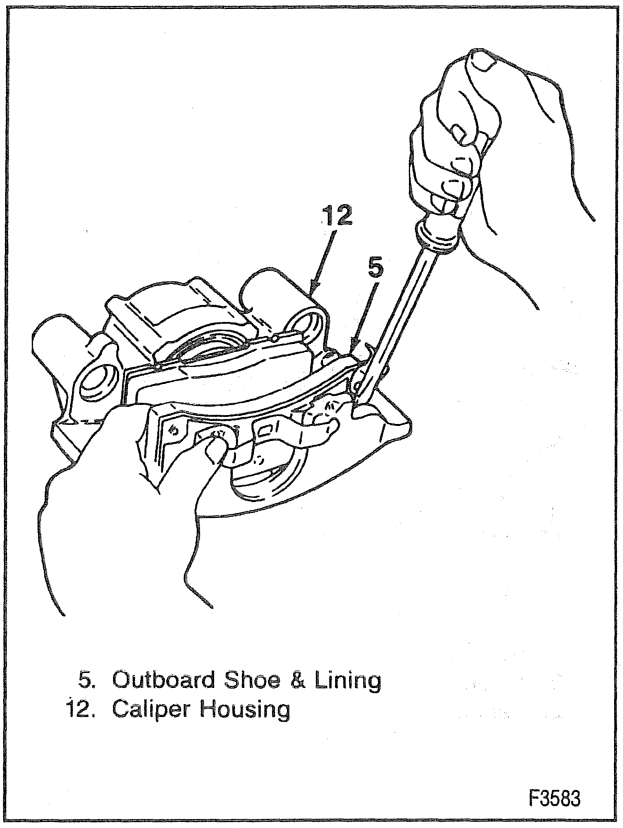


Figure 9—Removing the Outboard Shoe and Lining

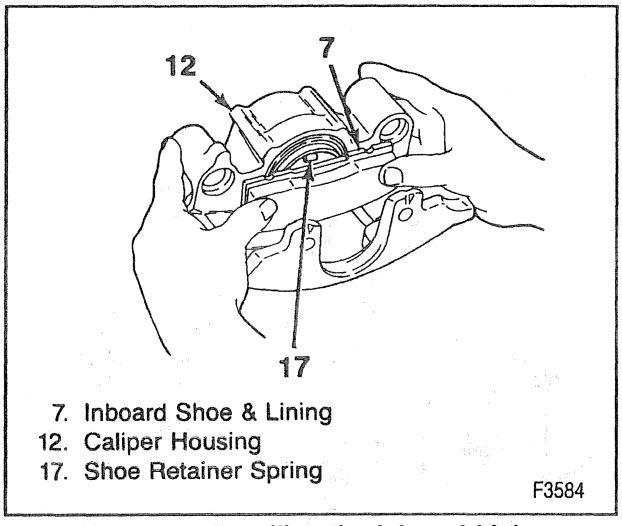


Figure 10—Installing the Inboard Lining

Inspect

- The inside of the caliper assembly for signs of fluid leakage. If any is found, refer to "Unit Repair."

Clean

- Use a wire brush to remove any corrosion from the machined surfaces of the anchor plate and caliper.

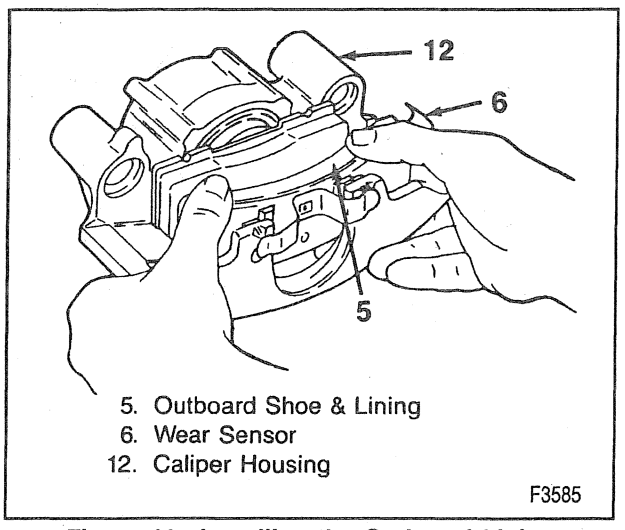


Figure 11—Installing the Outboard Lining

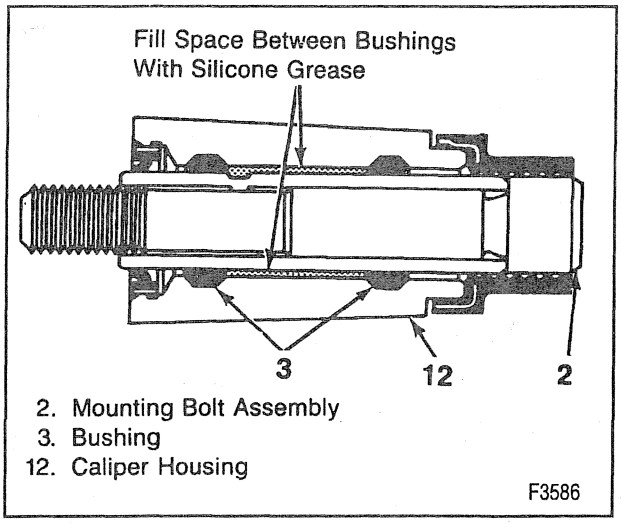


Figure 12—Mounting Bolt Lubrication (Delco 3400)

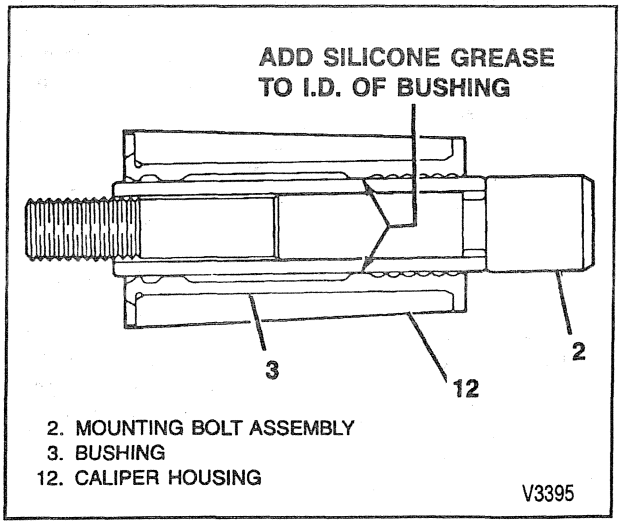


Figure 13—Mounting Bolt Lubrication (Delco 3486)

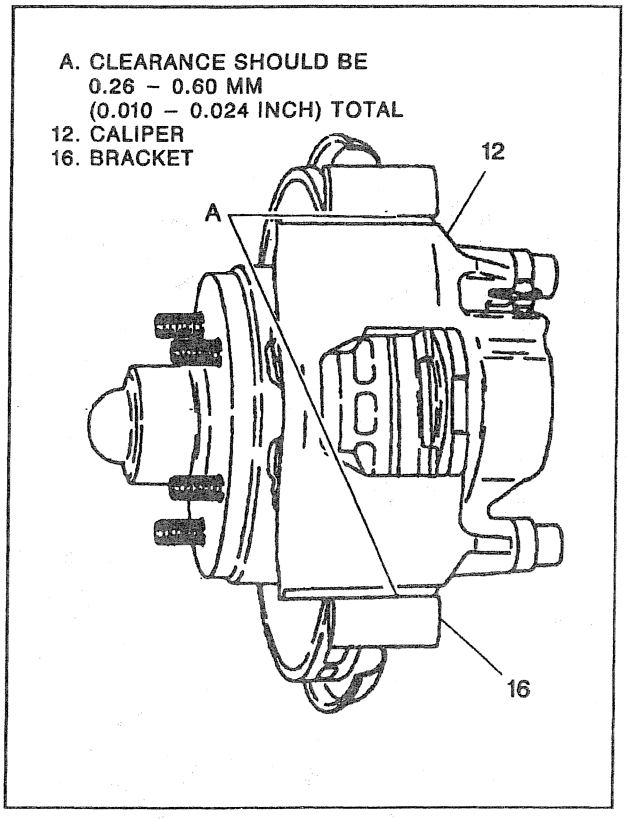


Figure 14—Caliper to Bracket Clearance

Install or Connect (Figures 15 through 20)

1. Lubricate caliper and anchor plate sliding surfaces Aeroshell #5 or equivalent.
2. Caliper assembly (1).

NOTICE: Make sure the brake hose is not twisted or kinked after installation. Damage to the hose could result.

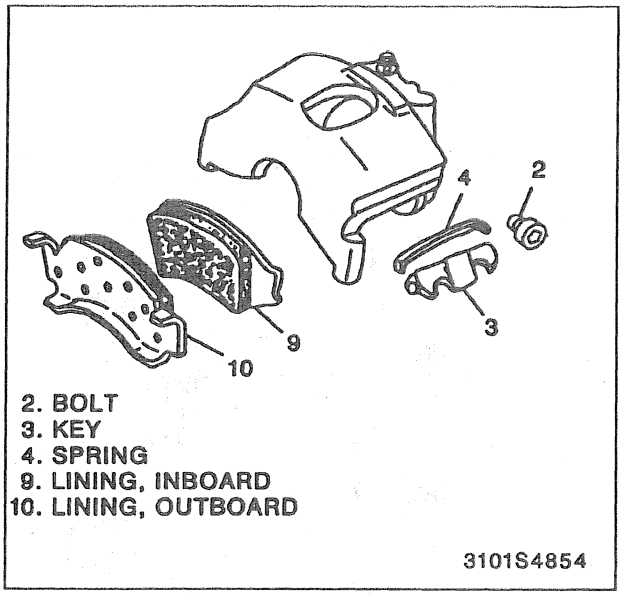


Figure 15—Bendix Shoe and Lining Assembly

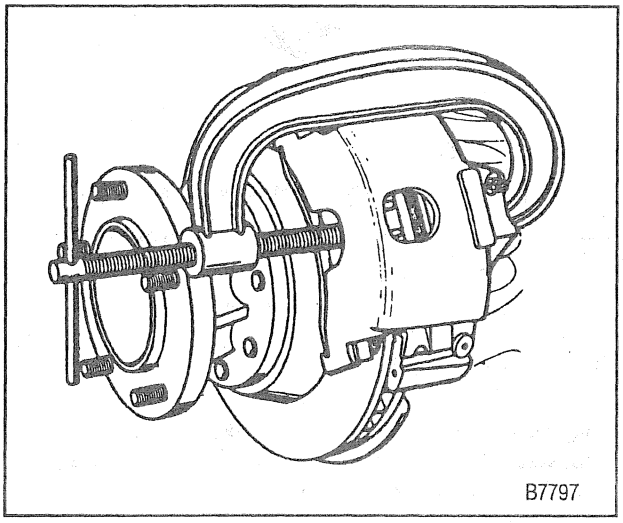


Figure 16—Compressing the Caliper Piston

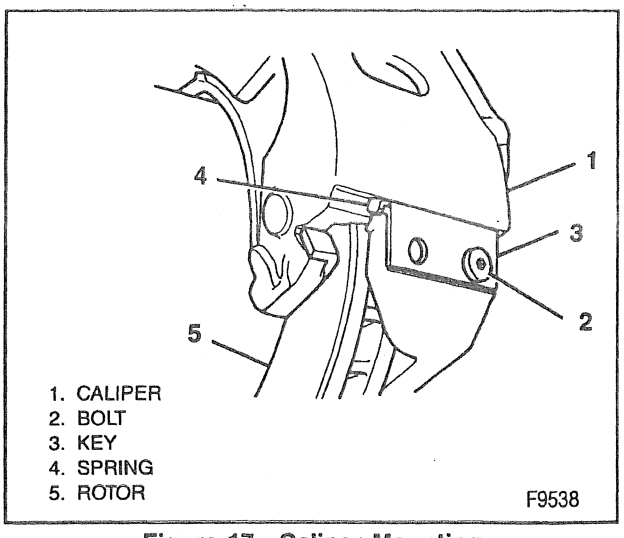


Figure 17—Caliper Mounting

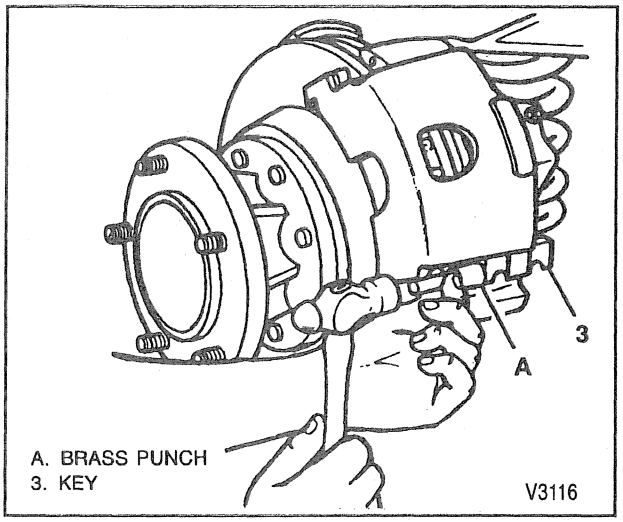


Figure 18—Removing the Caliper Support Key

3. Spring (4) and support key (3).
   - Use a brass punch and hammer to drive the support key in place (figure 20).
4. Bolt (2).
   - The boss on the bolt must fit into the circular cutout in the key.

Tighten

- Bolt (2) to 20 N·m (15 lbs. ft.).

5. Brake hose.

Tighten

- Brake hose bolt to 45 N·m (33 lbs. ft.)

6. Bleed brake system. Refer to SECTION 5A.
7. Tire and wheel. Refer to SECTION 3E.
8. Lower the vehicle.

Important

- Before moving the vehicle, pump the brake pedal several times to make sure it is firm. Do not move the vehicle until a firm pedal is obtained. Check the brake fluid level in the master cylinder after pumping the brakes.

LININGS

GM replacement brake lining material is recommended for all vehicles to maintain the balance between front and rear brake performance. GM replacement brake parts have been carefully selected to provide the proper brake balance for the purposes of stopping distance and control over the full range of operating conditions. Installation of front or rear lining material with performance different from that of GM replacement parts recommended for this vehicle can change the intended brake balance of this vehicle.

DELCO

Remove or Disconnect (Figures 6 through 14)

1. Caliper. Refer to "Caliper."
   - Suspend the caliper with a wire hook (figure 6).

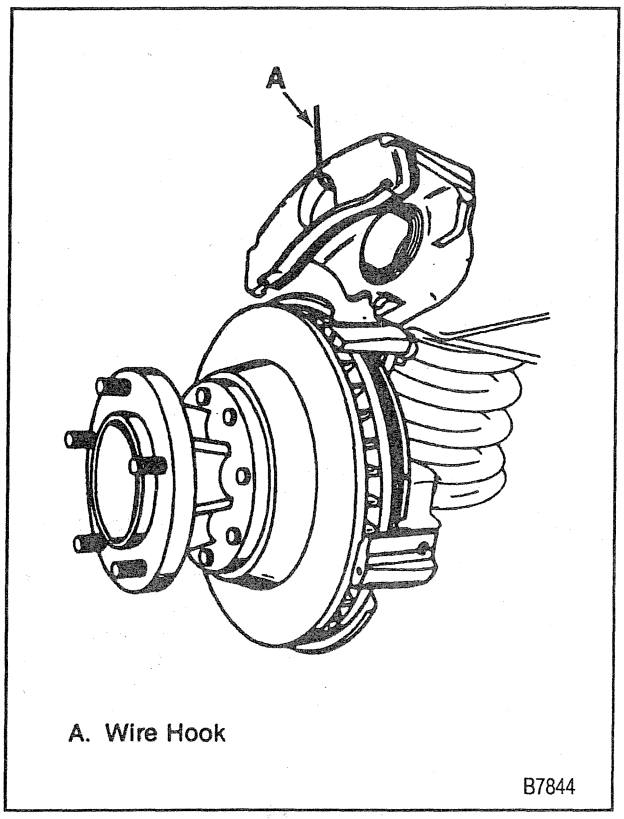


Figure 19—Suspending the Caliper

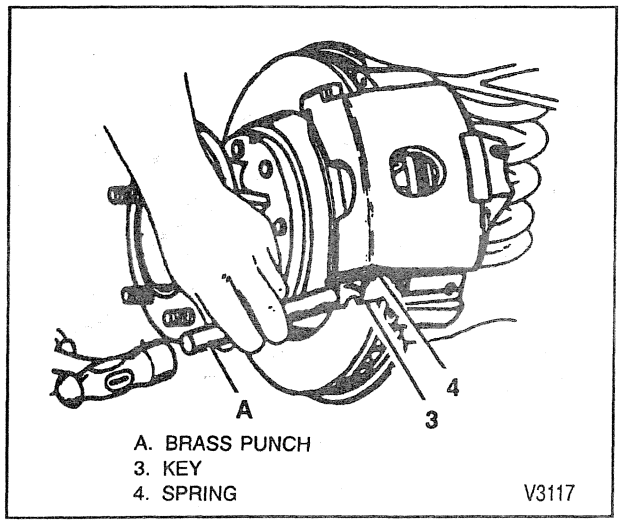


Figure 20—Installing the Caliper Support Key

2. Outboard shoe and lining (5) (figure 9).
   - Use a screwdriver to disengage the buttons on the pad from the holes in the caliper housing.
3. Inboard shoe and lining (7).
4. Bolt boots (1).
5. Mounting bolt seals (4).
6. Bushings (3).

Inspect

- Mounting bolts, key, spring, and sleeves for corrosion. Replace if any is found.
  — Do not attempt to polish away corrosion.
- Bolt boots for nicks, cuts, or corrosion. Replace if any are found.

Important

- Clean the caliper assembly and install a new brake hardware kit any time it is removed from the rotor.

Install or Connect (Figures 10 through 12)

1. Lubricate bushings (3) and mounting bolt seals (4) with Delco Silicone Lube (GM P/N 18010909) or equivalent.
2. New bushings (3) and bolt seals (4) (if used).
3. New bolt boots (1).
4. Inboard lining (7).
   - Snap retainer spring (17) into piston (9) (figure 10).
   - The pad retainer spring (17) is already staked to inboard shoe.
   - The pad must lay flat against piston.
5. Outboard lining (5) with wear indicator (6) at leading edge of pad during forward wheel rotation (figure 11).
   - The back of pad must lay flat against caliper.
6. Caliper (12). Refer to "Caliper."

Important

- Before moving the vehicle, pump the brake pedal several times to make sure it is firm. Do not move the vehicle until a firm pedal is obtained. Check the fluid level in the master cylinder after pumping the brakes.

BENDIX

Remove or Disconnect (Figure 15 and 19)

1. Caliper (1). Refer to "Caliper."
   - Suspend the caliper (figure 19).

NOTICE: Do not allow calipers to hang from the flexible hoses. Doing so can damage the hoses.

2. Inboard lining (9).
3. Outboard lining (10).

Inspect

- The inside of the caliper assembly for signs of fluid leakage. If any is found, refer to "Unit Repair."

Clean

- Use a wire brush to remove any corrosion from the machined surfaces of the steering knuckle and caliper.

Install or Connect (Figure 15)

1. Lubricate the caliper and steering knuckle (or support) sliding surfaces and spring with Aeroshell #5 or equivalent.
2. Inboard lining (9).
3. Outboard lining (10).
4. Caliper assembly (1). Refer to "Caliper."

Important

- Before moving the vehicle, pump the brake pedal several times to make sure it is firm. Do not move the vehicle until a firm pedal is obtained. Check the brake fluid level in the master cylinder after pumping the brakes.

BURNISHING LININGS AND ROTORS

After replacing brake linings and/or refinishing rotors, the new braking surface should be broken in, or "burnished." To do this, make 20 stops from 30 mph using medium to firm brake pedal pressure. During this procedure, use care to avoid overheating the brakes.

CALIPER AND ANCHOR PLATE WEAR ADJUSTMENTS

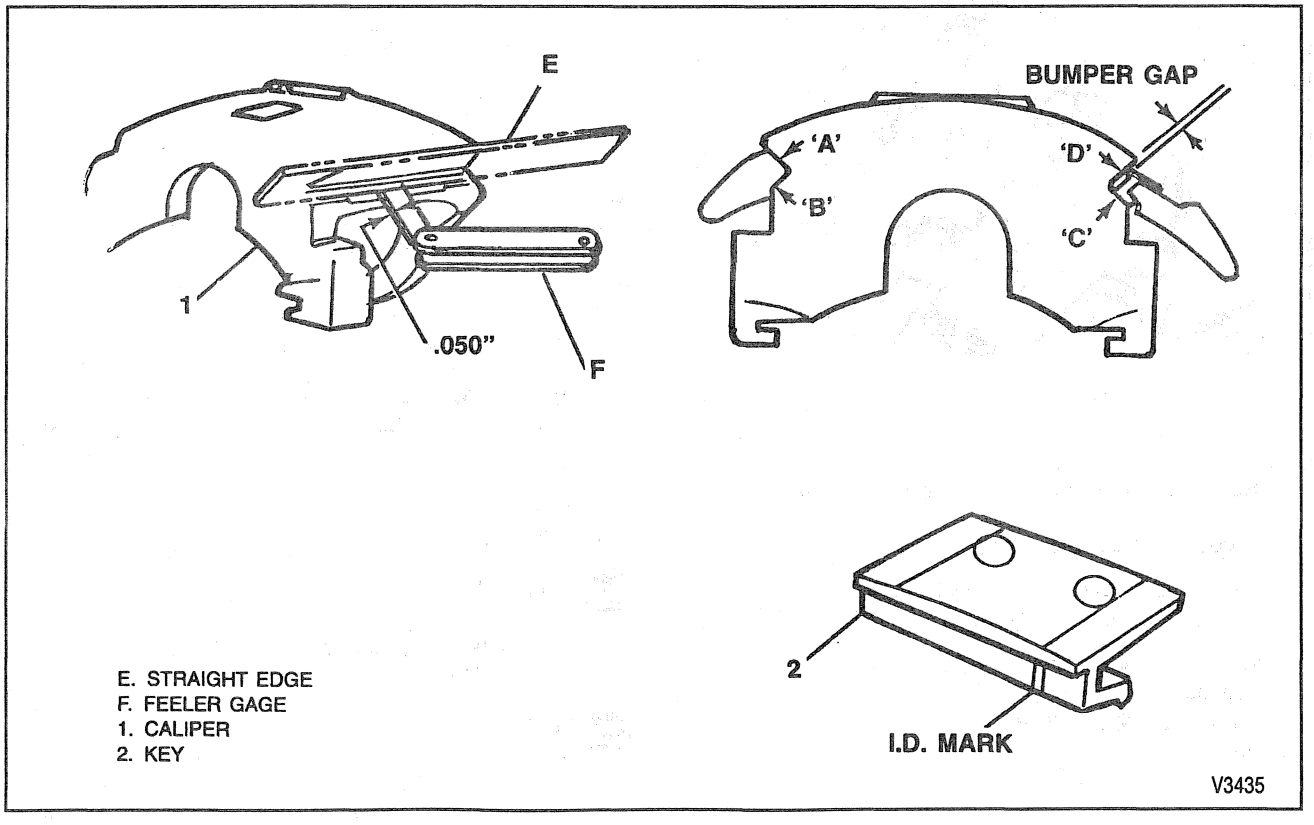
Bendix calipers have oversize replacement keys available to compensate for wear at the caliper to anchor plate contact points. The keys are identified by marks as indicated in figure 21. If wear is excessive, a rattle sound can be heard from the front brake area. Use the following procedure to measure and correct this condition.

Refer to figure 21.

1. Remove caliper. Refer to "Caliper."
2. Clean surfaces A, B, C, and D with a wire brush.
3. Smooth any deep nicks and/or gouges with a file.
4. Measure caliper contact surface for wear.
   A. Lay a straight edge across caliper surfaces "C" and "D."
   B. Measure the maximum depth of any wear on these surfaces using feeler gauges.
   C. Replace calipers worn to a depth of 0.050 inch or more.
5. Measure caliper to anchor plate wear.
   A. Install caliper back in the knuckle.
   B. Install a new standard size key without the spring.
   C. Install the key retention bolt.
   D. Insert a screw driver into the center of key bumper gap.
   E. Pry firmly to ensure that caliper is seated at surfaces "A," "B," and "C."
   F. Measure the bumper gap with largest feeler gauge(s) that will fit into the gap its full length.
   G. Select a replacement key according to the table in "Specifications."
6. Install caliper. Refer to "Caliper."

ANCHOR PLATE

For anchor plate on-vehicle service information, refer to SECTION 3C.



E. STRAIGHT EDGE
F. FEELER GAGE
1. CALIPER
2. KEY

Figure 21—Bendix Caliper Wear Adjustment

ROTOR

For rotor on-vehicle service information, refer to SECTION 3C.

UNIT REPAIR

REFINISHING BRAKE ROTORS

You do not need to refinish brake rotors when doing routine brake maintenance such as replacing worn brake shoe and lining assemblies. Refinish rotors only under the following circumstances:

1. There is a complaint of brake pulsation.
2. There are heat spots or excessive scoring.

Brake rotors have a minimum thickness dimension cast into them. This dimension is the minimum wear dimension and not a refinish dimension. Do not use a brake rotor that will not meet the dimensions shown in the specifications chart after refinishing. A rotor that is too thin will not have the proper heat transfer capabilities. Replace it with a new rotor. Refinishing composite rotors requires using rotor adapter tool J 39441 as a holding fixture for the brake lathe (figure 22).

Accurate control of rotor tolerances is necessary for the proper performance of disc brakes. Machining should be done only with precision equipment. Service the machining equipment on a regular basis following the manufacturer's recommended maintenance procedures.

When refinishing rotors, make sure the attaching adapters, tool holders, vibration dampeners, and tool bits are in good condition. Always use sharp cutting tools or bits and use only replacement cutting bits recommended by the equipment manufacturer. Dull or worn tools leave a poor surface finish that will affect initial brake performance. Always use vibration dampening attachments when refinishing braking surfaces. These attachments eliminate tool chatter to allow for a better surface finish. Make sure these adapters are clean and free of nicks.

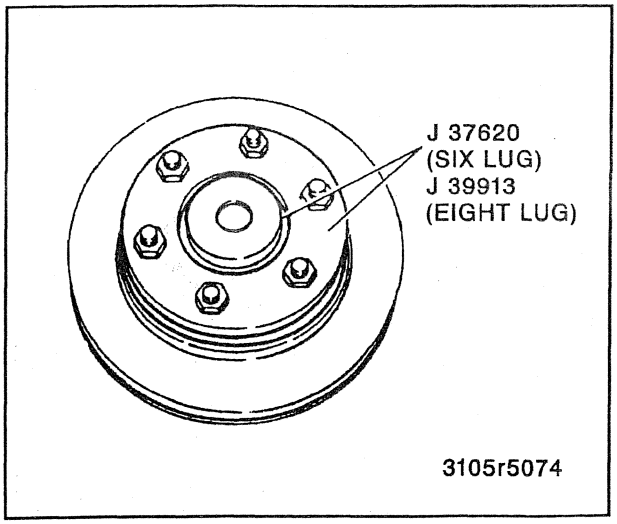


Figure 22—Rotor Adaptor Installed on the Rotor

Following are two recommended procedures that achieve adequate results using two different off vehicle drum/disc brake lathes. If any other lathe is used, follow that manufacturer's instructions and recommendations.

AMMCO BRAKE LATHE

	Rough Cut	Finish Cut
Spindle Speed	150 rpm	150 rpm
Depth of Cut (per side)	0.127 mm (0.005 in.)	0.051 mm (0.002 in.)
Total Cross Feed (per revolution)	0.152-0.254 mm (0.006-0.010 in.)	0.051 mm max. (0.002 in.)
Vibration Damp.	Yes	Yes
Swirl Pattern - 120 Grit	No	Yes

T2914

ACCU. TURN BRAKE LATHE, GM DEALER EQUIPMENT (One Cut Refinishing Procedure)

Spindle Speed	150 rpm
Tool Cross Feed (per rev.)	0.076 mm (0.003 in.)
Tool Bit Nose Radius	1/64
Vibration Damper	Yes
Swirl Pattern - 120 Grit	Yes

T2915

Locate the deepest score and turn the rotor micrometer knobs until the tool bit bottoms out at the deepest point of the score. Zero the scale and back out the tool bits. Advance the cutter hand-wheel until the bits have cleared the inner edge of the rotor face. Adjust the micrometer knobs for approximately 0.0127 mm (0.005 in.) more than the first reading. This will ensure clearing the rotor in one cut.

It is very important that you make the rotor surface non-directional by dressing the rotor surfaces with a sanding disc power tool such as Ammco 8350 Safe Swirl Disc Rotor Grinder using 120 grit aluminum oxide sandpaper. Sand each rotor surface using moderate pressure for a minimum of 60 seconds. An alternate method is to use a sanding block with 150 grit aluminum oxide sandpaper. With the rotor turning at approximately 150 rpm, sand each rotor surface using moderate pressure for a minimum of 60 seconds. After sanding the rotor, clean each surface with denatured alcohol or a suitable brake cleaner.

The finished rotor surface should be as close to that of a new rotor as possible. Failure to obtain the best possible rotor finish can affect initial braking performance.

CALIPER

DELCO

Remove or Disconnect (Figures 23 through 28)

1. Fluid from the caliper.
2. Pad the interior of the caliper with clean shop towels.

CAUTION: Do not place your fingers in front of the piston in an attempt to catch or protect it when applying compressed air. This could result in serious injury.

NOTICE: Use just enough air to ease the piston out of the bore. If the piston is blown out, even with the padding, it can be damaged.

3. Piston (9).
   - Direct compressed air into caliper fluid inlet (figure 25).
   - Use just enough air pressure to ease piston out of bore.
4. Boot (8) (figure 26).
   - Use care not to scratch housing bore.
5. Piston seal (10).
   - Do not use any type of metal tool.
6. Bleeder valve (11).

Clean

- Bleeder valve, caliper bore, caliper passages, and piston with denatured alcohol. Use dry, filtered, compressed air to dry parts and blow out passages.

Inspect

- Piston for scoring, nicks, corrosion, wear, and damaged chrome plating. Replace piston if any of these are found.
- Caliper bore and seal groove for scoring, nicks, corrosion, or wear. Use crocus cloth to polish out any light corrosion. Replace caliper if corrosion cannot be removed.

Install or Connect (Figures 23 through 28)

Tools Required:
J 36474—75 mm Boot Seal Installer or
J 36475—80 mm Boot Seal Installer or
J 38453—86 mm Boot Seal Installer

1. Lubricate new piston seal, caliper bore, and piston with clean brake fluid.
2. Piston seal (10).
   - Use care not to twist the seal.
3. Boot (8) on piston (9) (figure 27).
4. Piston (9) and boot into caliper bore.
   A. Push piston to the bottom of bore.
   B. Seat boot in housing using J 36474, J 36475, or J 38453 (figure 27).

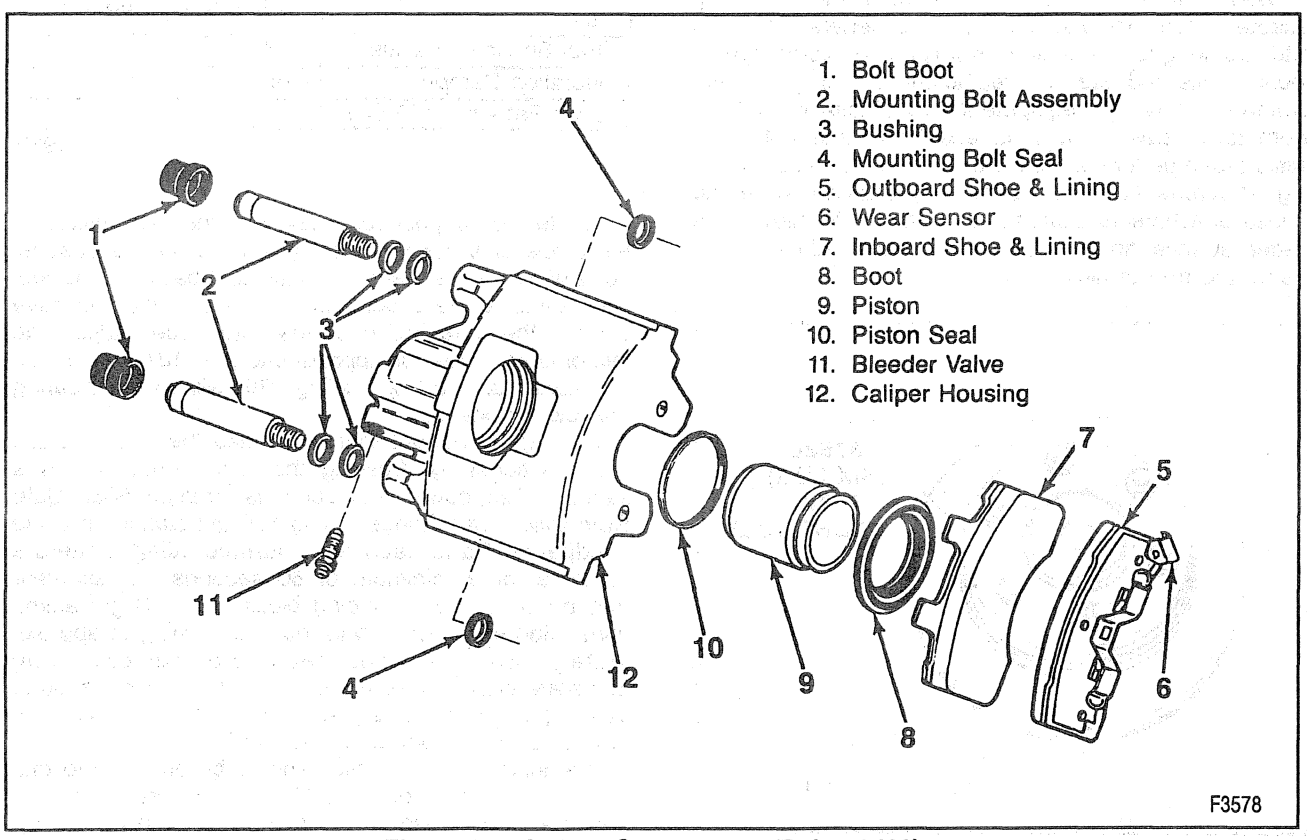


Figure 23—Caliper Components (Delco 3400)

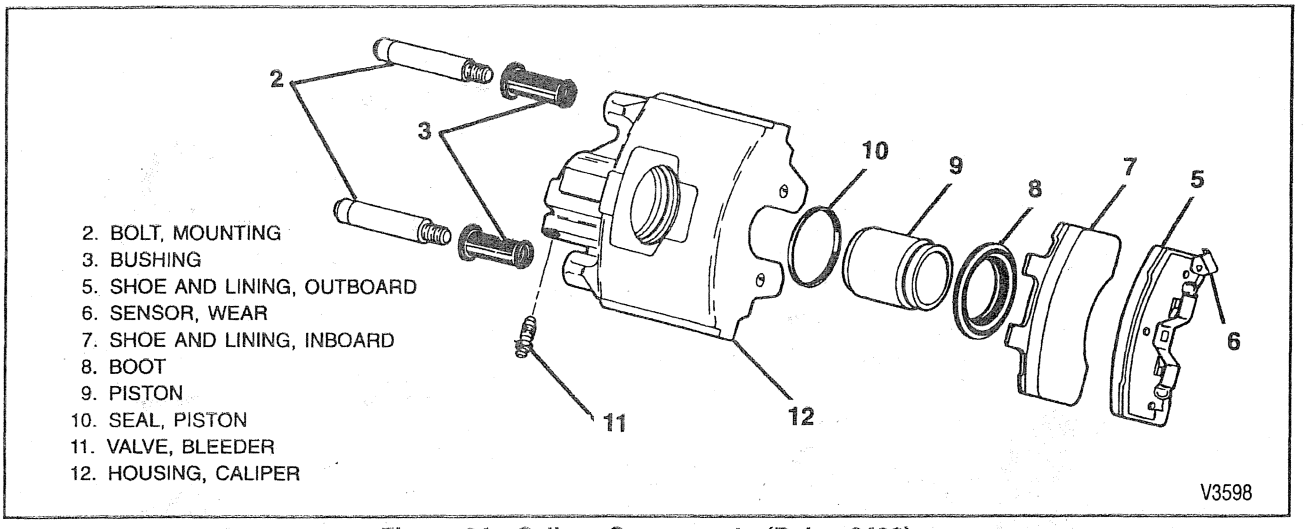


Figure 24—Caliper Components (Delco 3486)

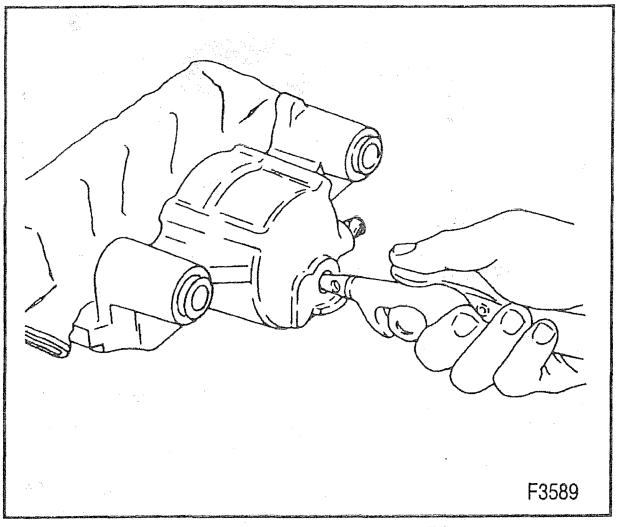


Figure 25—Removing the Piston

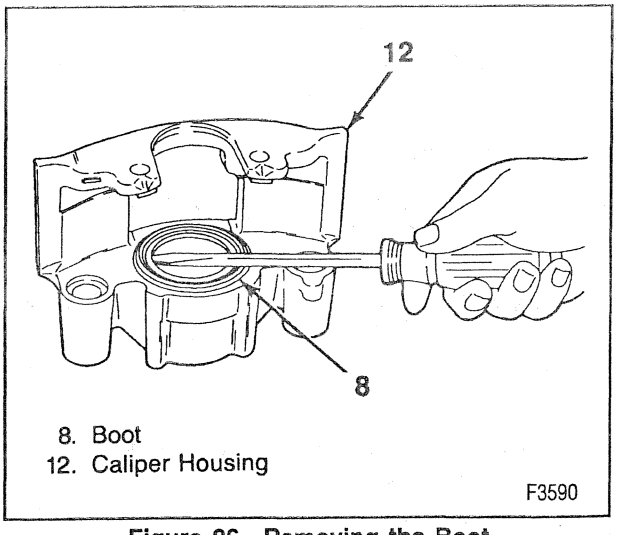


Figure 26—Removing the Boot

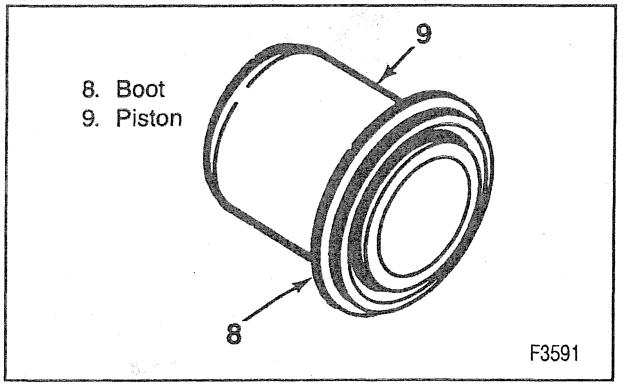


Figure 27—Installing the Boot on the Piston

5. Bleeder valve (11).

Tighten

- Bleeder (11) to 13 N·m (115 lbs. in.).

BENDIX

Remove or Disconnect (Figures 29, 30, and 31)

1. Fluid from caliper.
2. Pad interior of caliper with clean shop towels.

CAUTION: Do not place your fingers in front of the piston in an attempt to catch or protect it when applying compressed air. This could result in serious injury.

NOTICE: Use just enough air to ease the piston out of the bore. If the piston is blown out, even with the padding, it can be damaged.

3. Piston (22).
   - Direct compressed air into caliper fluid inlet (figure 30).
4. Boot (23) (figure 31).
5. Piston seal (21).

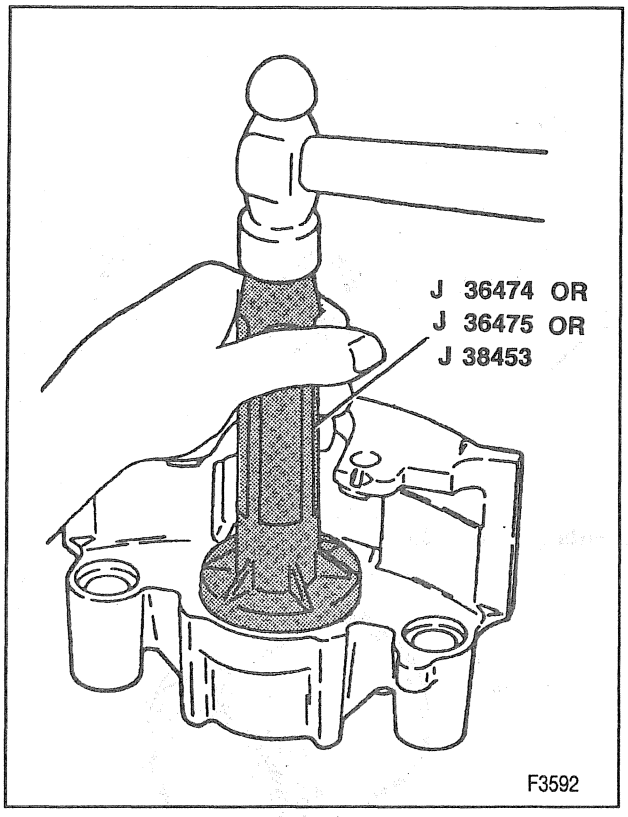


Figure 28—Seating the Boot in the Housing

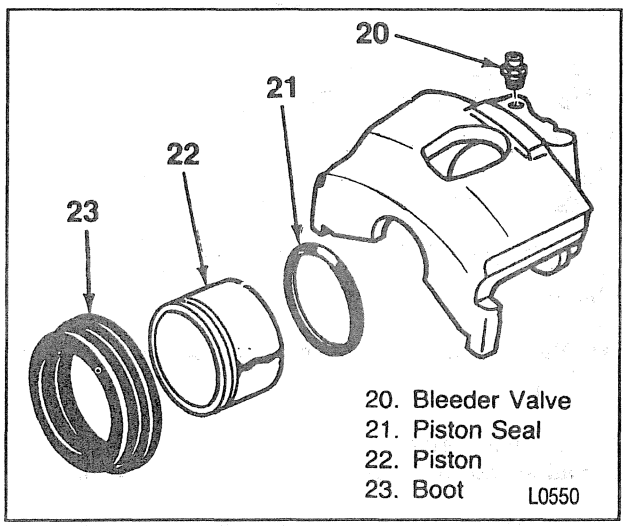


Figure 29—Caliper Components (Bendix)

- Do not use any type of metal tool.

6. Bleeder valve (20).

Clean

- Bleeder valve, caliper bore, caliper passages, and piston with denatured alcohol. Use dry, filtered, compressed air to dry parts and blow out passages.

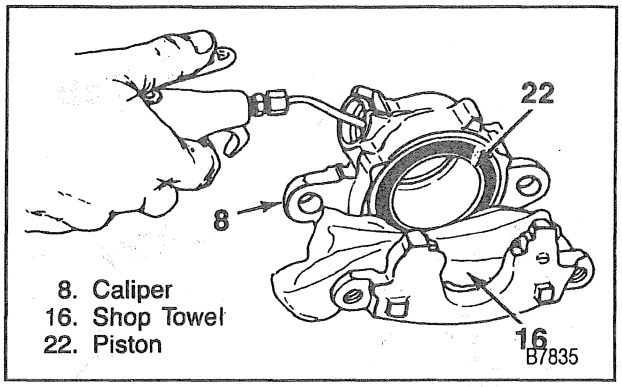


Figure 30—Removing the Piston

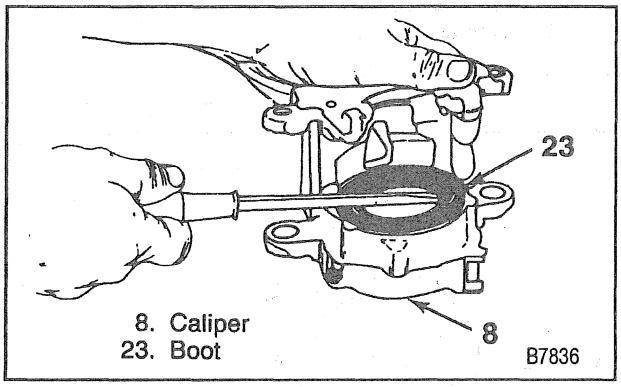


Figure 31—Removing the Boot

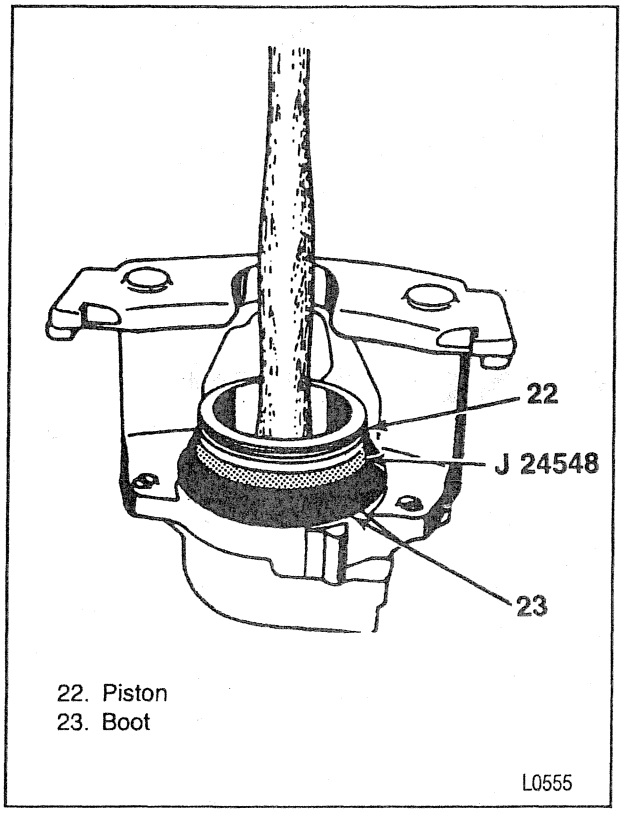
Inspect

- Piston for scoring, corrosion, and damage to the chrome plating. Replace it if any of these conditions are found.
- Caliper bore for scoring, pitting, or corrosion. Use crocus cloth to polish out any light corrosion. Replace the caliper if the corrosion cannot be removed.

Install or Connect (Figure 29 and 32)

Tool Required:
J 24548 Piston Seal Installer

1. Lubricate new piston seal, caliper bore, piston, and seal lips on boot with clean brake fluid.
2. Piston seal (21).
   - Make sure seal is not twisted in caliper bore groove.
3. Boot (23) on J 24548.
   A. Place large diameter of boot over tool first and carefully work smaller diameter onto tool.
   B. Slide large diameter of boot off tool.
4. Large lip of boot in caliper bore groove.
   - Lip of boot must firmly seat in groove.



22. Piston
23. Boot

Figure 32—Installing the Piston

5. Piston (22) inside J 24548 (figure 32).
6. Piston halfway into bore.
   A. Remove J 24548.
   B. Make sure boot is firmly seated.
7. Bleeder valve (20).

Tighten

- Bleeder valve to 7 N·m (62 lbs. in.).

SPECIFICATIONS

BRAKE SYSTEMS

SYSTEM	FRONT BRAKES	REAR BRAKES	BRAKE ASSIST
JB5	Disc 11.57-inch x 1.25-inch	254 mm x 57 mm (Leading/Trailing)	Vacuum
JD5			Hydraulic
JB6	Disc 11.57-inch x 1.25-inch	11.15-inch x 2.75-inch (Duo-Servo)	Vacuum
JD6			Hydraulic
JB7	Disc 12.5-inch x 1.26-inch	13.00-inch x 3.5-inch (Duo-Servo)	Vacuum
JD7			Hydraulic
JB8 Single Rear Wheel	Disc 12.5-inch x 1.26-inch	13.00-inch x 3.5-inch (Duo-Servo)	Hydraulic
JB8 Dual Wheel	Disc 12.5-inch x 1.50-inch	13.00-inch x 3.5-inch (Duo-Servo)	Hydraulic
JF9	Disc 14.25-inch x 1.54-inch	Disc 13.75 inch x 1.54 inch	Hydraulic

T2112

ROTOR THICKNESS

ORIGINAL	THINNEST (REFINISHING)	REPLACEMENT (DISCARD)
31.75 mm (1.25 in.)	31.25 mm (1.23 in.)	30.86 mm (1.215 in.)
32 mm (1.26 in.)		
38.10 mm (1.50 in.)	37.59 mm (1.480 in.)	37.21 mm (1.465 in.)
36.26-36.64 (1.428-1.443 in.)	35.1 mm (1.382 in.)	34.7 mm (1.366 in.)

T2697

BENDIX CALIPER REPLACEMENT KEY SPECIFICATIONS

Bumper Gap	Replacement Key	P/N
0.0 - 0.060	Std. Size - I	14023439
0.061 - 0.100	0.040 Oversize - II	14026793
0.101 - 0.140	0.080 Oversize - III	14026794
0.141 - 0.180	0.120 Oversize - IIII	14026795
0.181 - 0.220	0.160 Oversize - IIIII	14026796
0.221 -	Replace Caliper and Anchor Plate or Steering Knuckle	

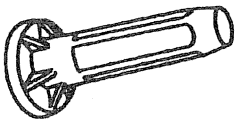
T2961

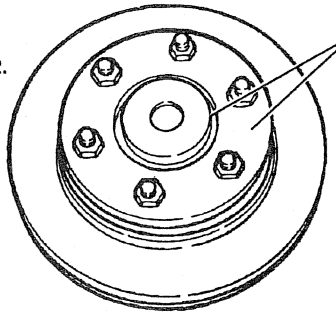
FASTENER TIGHTENING SPECIFICATIONS

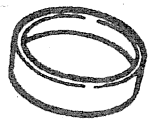
ITEM	N·m	Lbs. Ft.	Lbs. In.
Bleeder Valve (Bendix)	7	—	62
Bleeder Valve (Delco)	13	—	115
Brake Hose to Caliper Bolt	45	33	—
Caliper Lock Mounting Bolt (C3500 HD)	20	15	—
Caliper Mounting Bolt (Delco)	51	38	—
Front Anchor Plate to Knuckle Nut (C3500 HD)	257	190	—
Front Rotor to Hub Bolt (C3500 HD)	237	175	—
Front Splash Shield Bolt (C3500 HD)	16.5	12	—
Rear Anchor Plate to Axle Flange Nut (C3500 HD)	105	78	—
Splash Shield to Knuckle Bolt	26	19	—
Support Key Bolt (Bendix)	20	15	—

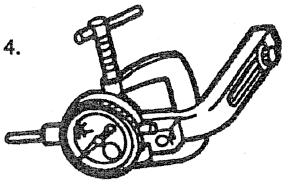
T2959

SPECIAL TOOLS

1. 
J 36474 OR
J 36475 OR
J 38453

2. 
J 37620
(SIX LUG)
J 39913
(EIGHT LUG)

3. 
J 24548

4. 
J 24548

1. 75, 80, OR 86MM BOOT SEAL INSTALLER
2. BRAKE ROTOR TURNING TOOL
3. PISTON SEAL COMPRESSOR
4. DIAL INDICATOR

3105r5073

NOTES

SECTION 5B2

REAR DISC BRAKES

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

CAUTION: When servicing brake parts, do not create dust by grinding or sanding brake linings, by cleaning brake parts with a dry brush or with compressed air. Many earlier models or aftermarket brake parts may 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 fibers from becoming airborne.

NOTICE: Always use the correct fastener in the correct location. Use the correct fastener part number to replace a fastener. If the correct fastener part number is not available, a fastener of equal size and strength may be used. Do not use a fastener that is stronger when the correct fastener part number is not available in the following applications:

- *Some bolts are designed to permanently stretch, and if a stronger fastener is used the part will not be tightened correctly. These permanently stretching bolts will be called out. The correct part number fasteners must be used to replace this type of fastener because there is no available equivalent.*
- *Other bolts are designed to break if over tightened to prevent part damage. If a stronger fastener is used part damage may occur.*

Fasteners that need to be replaced when removed will be called out. Fasteners that require thread lockers or thread sealant will be called out. The correct tightening specification and sequence must be used when installing fasteners. Part or system damage may occur if the above instructions are not followed.

NOTICE: A new rotor must have the protective coating removed from the friction surfaces before being placed in service. Use Goodwrench Brake Parts Cleaner (GM P/N 12345754) or equivalent, and wipe the surface clean with clean cloths. Do not use gasoline, kerosene, or other oil base solvents that can leave an oily residue. This residue is damaging to brake linings and flammable.

CONTENTS

CONTENTS (cont'd)

GENERAL DESCRIPTION

The disc brake assembly consists of a caliper assembly, rotor, linings, and anchor plate. Applying the brake pedal causes hydraulic pressure to move the piston. The piston then forces the inboard brake lining against the inboard braking surface of the rotor. Increasing the force against the rotor causes the caliper assembly to move inboard. The outer brake lining then contacts the outboard braking surface of the rotor. The force of the two brake linings provides the desired clamping action on the rotor.

Releasing the brake pedal relieves the pressure applied to the piston. The square cut seal on the piston returns to its normal position, allowing a running clearance between the brake linings and rotor.

Servicing Information

- Replace all components included in the repair kits.
- Lubricate the parts as specified.
- Do not use lubricated shop air on brake parts. Rubber component damage may result.
- After any hydraulic component has been removed or disconnected, if necessary, bleed all or part of the brake system.
- Replace shoes and linings in axle sets only.
- The torques specified are for dry, unlubricated fasteners.
- Perform service operations on a clean bench free from mineral oil and any other contaminants.
- Use extreme care when doing any work around the antilock components to prevent damage or misalignment.
- Before moving the vehicle, pump the brake pedal several times to make sure it is firm. Do not move the vehicle until a firm pedal has been obtained. Check the brake fluid level in the master cylinder after pumping the brakes.

ROTOR

The rear disc brakes use a combination rotor and hub assembly. The rotor is integral with the rear hub. During operation, the rotor turns between the linings and basically free-wheels until the linings begin to apply a clamping action on it. The vented area between the rotor braking surfaces allows for efficient heat dissipation.

CALIPER

The rear disc brakes use a Bendix caliper. The caliper mounts to the anchor plate in a way that allows the caliper to move laterally against the rotor. The caliper is a one-piece casting with the inboard side containing a piston bore. A square-cut rubber seal fits in a groove in the piston bore to provide a hydraulic seal between the piston and caliper bore.

DIAGNOSIS

LINING INSPECTION

Inspect the brake linings every 6,000 miles and any time the wheels are removed (tire rotation, etc.). Check both ends of the outer lining by looking in at each end of the caliper (figure 1). These are the points where the highest rate of wear normally occurs. At the same time, check the thickness of the inner lining to make sure it has not worn prematurely. Some inboard shoe and linings have a thermal layer against the shoe, integrally molded with the lining. This extra layer should not be confused with uneven inboard-outboard lining wear. Look down through the inspection hole in the top of the caliper to view the inner lining. Replace shoe and lining assemblies whenever the thickness of any lining is worn to within 0.76 mm (0.030 in.) of the shoe. Replace riveted shoe and lining assemblies when the lining is worn to within 0.76 mm (0.030 in.) of any rivet head. Always replace disc brake shoe and lining assemblies as a complete axle set.

Check the flatness of the linings. Place the inboard and outboard lining surfaces together and check for a gap between the surfaces. This gap should not exceed 0.13 mm (0.005 inch) at the center of the lining surfaces. This applies to new or used shoe and lining assemblies.

The shoe and lining assemblies have a wear indicator that makes noise when the linings are worn and need replacement (figure 2).

ROTOR INSPECTION

ROTOR TOLERANCE AND SURFACE FINISH

During the manufacture of the brake rotor, tolerances of the braking surfaces for flatness, parallelism, and lateral runout are closely held. The maintenance of close tolerances on the shape of the braking surfaces is necessary to prevent brake roughness or pulsation.

In addition to these tolerances, the surface finish must be held to a specified range of 60 Ra roughness or less. The control of the braking surface finish is necessary to avoid problems of hard pedal apply, excessive brake fade, pulls, and erratic performance. In addition, control of the surface finish can improve lining life.

Light scoring of the rotor surfaces not exceeding 1.5 mm (0.06 in.) in depth is normal and not detrimental to brake operation.

THICKNESS VARIATION CHECK

Check thickness variation by measuring the rotor thickness at four or more points around the circumference of the rotor. Use a micrometer calibrated in ten-thousands of an inch. Make all measurements at the same distance in from the edge of the rotor.

A rotor that varies in thickness by more than 0.013 mm (0.0005 in.) can cause pedal pulsation and/or front end vibration during brake applications. A rotor that does not meet these specifications should be refinished to specifications or replaced.

LATERAL RUNOUT CHECK

The best way to check lateral runout is with the wheels still installed on the vehicle. This gives a much more accurate reading of the total indicated runout (T.I.R.) under real braking conditions. If equipment is not available to perform the check with the wheels installed, the next best reading can be made with the wheels removed but the caliper still installed.

1. Clean rotor surface.

Important

- If the wheel must be removed, reinstall the wheel nuts to retain the rotor. Tighten the wheel nuts to the correct torque specification following the wheel nut tightening sequence shown in SECTION 3E.

2. Fasten a dial indicator to the steering knuckle so the indicator button contacts the rotor surface about 13 mm (0.5 in.) from the outer edge.
3. Set the dial indicator to zero.
4. Turn the wheel one complete revolution and observe the runout indicated on the dial.
5. The total indicated runout (T.I.R.) must not exceed 0.08 mm (0.003 in.).
6. If lateral runout is not within specifications, refinish or replace the rotor as necessary.

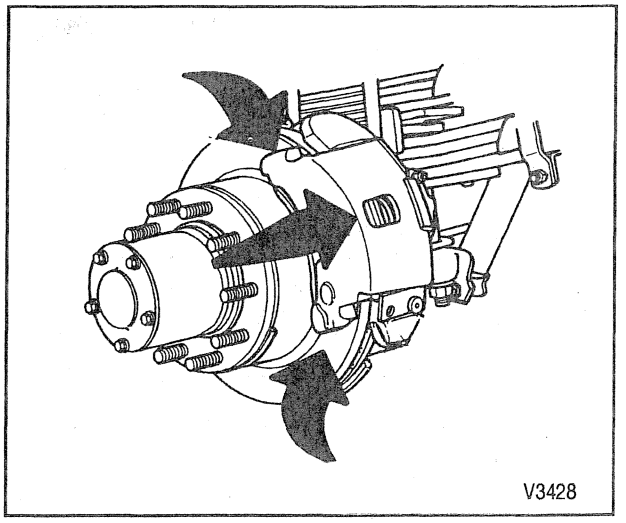


Figure 1—Lining Inspection Points

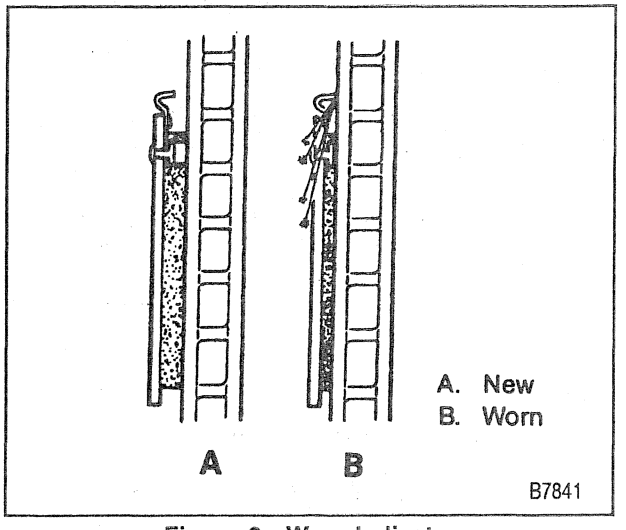


Figure 2—Wear Indicator

In some cases, excessive lateral runout can be improved by indexing the rotor on the hub one or two bolt positions from the original position. If lateral runout cannot be corrected by indexing the rotor, check the hub and bearing assembly for excessive lateral runout or looseness. If the hub and bearing assembly lateral runout exceeds 0.040 mm (0.0015 in.), repair or replace the hub and bearing assembly.

NOTICE: Any time the brake rotor has been separated from the wheel bearing flange, clean any rust or foreign material from the mating surfaces of the wheel bearing flange and rotor. Failure to do so can result in increased lateral runout and brake pulsation.

CALIPER INSPECTION

With the caliper removed, inspect the inside of the caliper assembly for signs of fluid leakage. If any is found, overhaul the caliper as outlined in "Unit Repair."

Inspect the mounting bolts and sleeves for corrosion. Replace any corroded bolts and sleeves. Do not attempt to polish away the corrosion.

ON-VEHICLE SERVICE

CALIPER

Remove or Disconnect (Figures 3 and 4)

1. Two-thirds of the brake fluid from master cylinder.
2. Raise vehicle and support with safety stands.
3. Mark relationship of wheel to hub.
4. Tire and wheel. Refer to SECTION 3E.

CAUTION: Refer to "Caution" on page 5B1-1.

5. Position a C-clamp and tighten until piston bottoms in bore (figure 5).
6. C-clamp.
7. Brake hose.
8. Bolt (2).
9. Support key (3) and spring (4) (figures 3 and 4).
   - Use a brass punch and a hammer to drive the support key out (figure 7).
10. Caliper assembly (1) (figure 7).

Inspect

- The inside of the caliper assembly for signs of fluid leakage. If any is found, refer to "Unit Repair."

Clean

- Use a wire brush to remove any corrosion from the machined surfaces of the anchor plate and caliper.

Install or Connect (Figures 3 and 4)

1. Lubricate caliper and anchor plate sliding surfaces with Aeroshell Grade 5 lubricant or equivalent.
2. Caliper assembly (1).

NOTICE: Make sure the brake hose is not twisted or kinked after installation. Damage to the hose could result.

3. Spring (4) and support key (3) (figure 8).
   - Use a brass punch and hammer to drive the support key in place.
4. Bolt (2).
   - The boss on the bolt must fit into the circular cutout in the key.

Tighten

- Bolt (2) to 20 N.m (15 lbs. ft.).

5. Brake hose.

Tighten

- Brake hose bolt to 45 N.m (33 lbs. ft.)

6. Bleed system. Refer to SECTION 5.
7. Tire and wheel. Refer to SECTION 3E.
8. Lower the vehicle.

Important

- Before moving the vehicle, pump the brake pedal several times to make sure it is firm. Do not move the vehicle until a firm pedal is obtained. Check the brake fluid level in the master cylinder after pumping the brakes.

LININGS

GM replacement brake lining material is recommended for all vehicles to maintain the balance between front and rear brake performance. GM replacement brake parts have been carefully selected to provide the proper brake balance for the purposes of stopping distance and control over the full range of operating conditions. Installation of front or rear lining material with performance different from that of GM replacement parts rec-

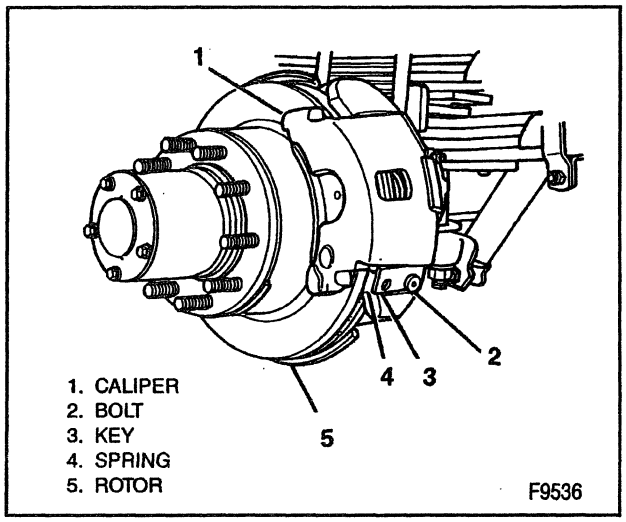


Figure 3—Disc Brake Assembly

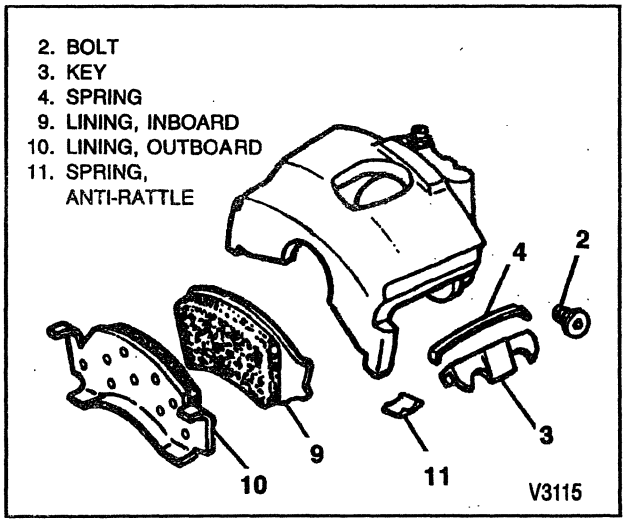


Figure 4—Replacing the Disc Brake Pads

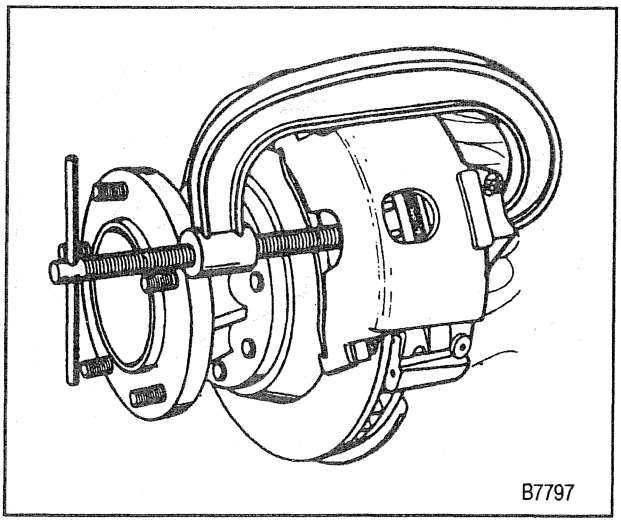


Figure 5—Compressing the Caliper Piston

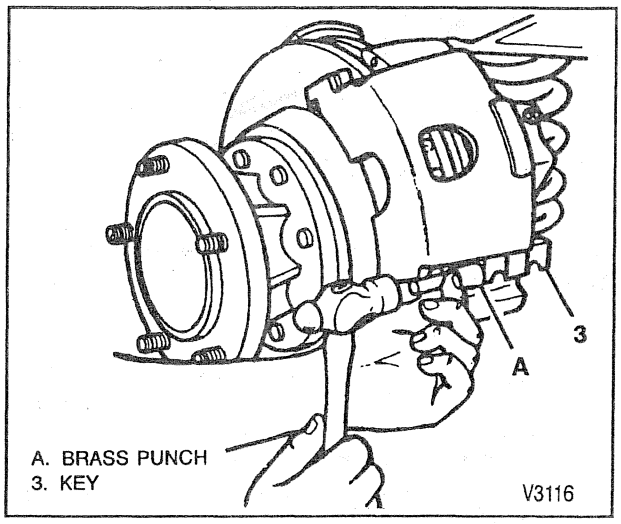


Figure 6—Removing the Caliper Support Key

ommended for this vehicle can change the intended brake balance of this vehicle.

Remove or Disconnect (Figures 4 and 7)

1. Caliper. Refer to"Caliper."
   - Suspend the caliper (figure 7).

NOTICE: Do not allow calipers to hang from the flexible hoses. Doing so can damage the hoses.

2. Inboard lining (9).
3. Anti-rattle spring (11).
4. Outboard lining (10).

Clean

- Use a wire brush to remove any corrosion from the machined surfaces of the steering knuckle and caliper.

Install or Connect (Figure 4)

1. Inboard lining (9) and anti-rattle spring (11).
2. Outboard lining (10).

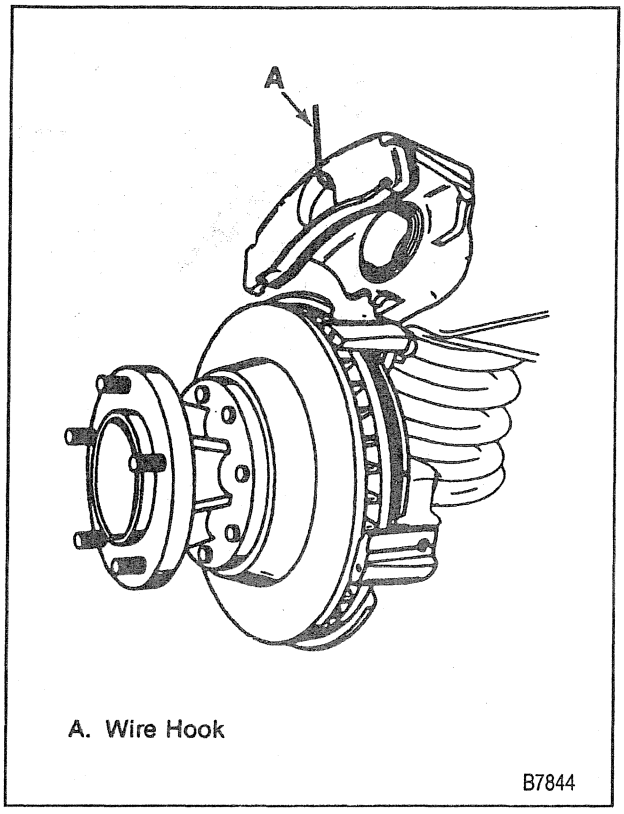


Figure 7—Suspending the Caliper

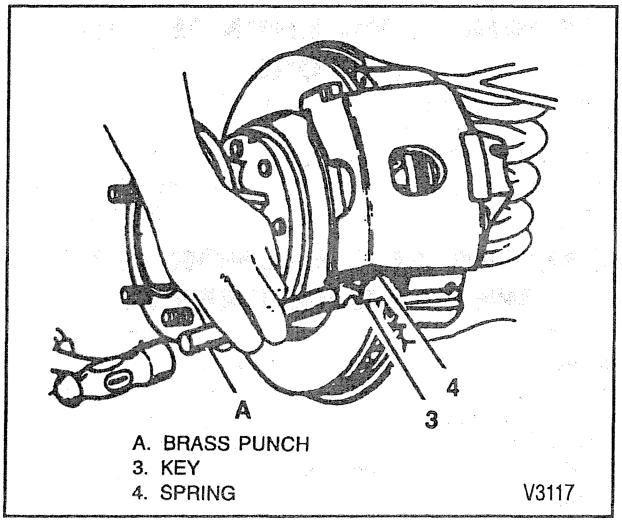


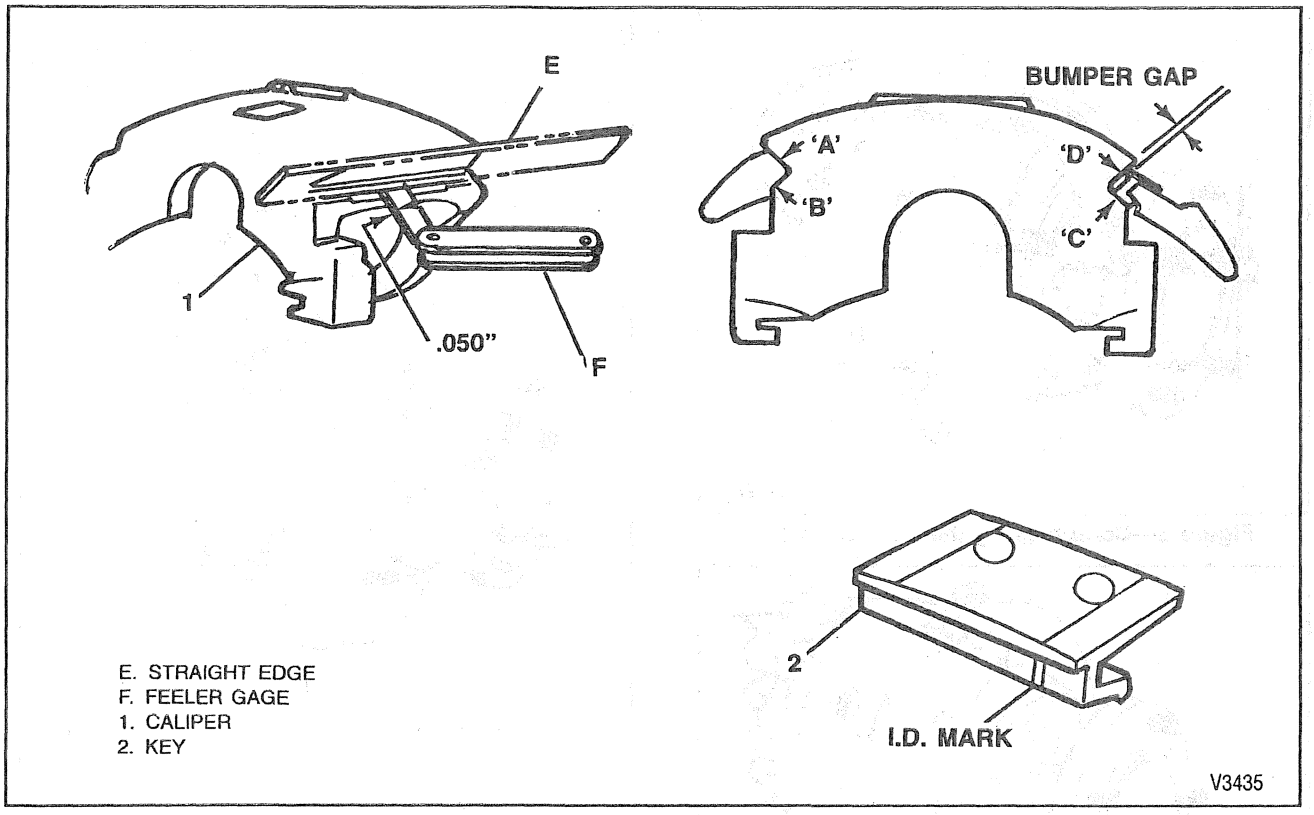
Figure 8—Installing the Caliper Support Key

3. Caliper assembly. Refer to "Caliper."

NOTICE: Make sure the brake hose is not twisted or kinked after installation or damage to the hose could result.

Important

- Before moving the vehicle, pump the brake pedal several times to make sure it is firm. Do not move the vehicle until a firm pedal is obtained. Check the brake fluid level in the master cylinder after pumping the brakes.



E. STRAIGHT EDGE
F. FEELER GAGE
1. CALIPER
2. KEY

Figure 9—Bendix Caliper Wear Adjustment

BURNISHING LININGS AND ROTORS

After the brake linings are replaced and/or the rotors refinished, the new braking surface should be broken in, or "burnished." To do this, make 20 stops from 30 mph using medium to firm brake pedal pressure. During this procedure, use care to avoid overheating the brakes.

CALIPER AND ANCHOR PLATE WEAR ADJUSTMENTS

Bendix calipers have oversize replacement keys available to compensate for wear at the caliper to anchor plate contact points. The keys are identified by marks as indicated in figure 9. If wear is excessive, a rattle sound can be heard from the front brake area. Use the following procedure to measure and correct this condition.

Refer to figure 9.

1. Remove caliper. Refer to "Caliper."
2. Clean surfaces A, B, C, and D with a wire brush.
3. Smooth any deep nicks and/or gouges with a file.
4. Measure caliper contact surface for wear.
   A. Lay a straight edge across caliper surfaces "C" and "D."
   B. Measure the maximum depth of any wear on these surfaces using feeler gauges.
   C. Replace calipers worn to a depth of 0.050 inch or more.
5. Measure caliper to anchor plate wear.
   A. Install caliper back in the knuckle.
   B. Install a new standard size key without the spring.
   C. Install the key retention bolt.
   D. Insert a screw driver into the center of key bumper gap.
   E. Pry firmly to ensure that caliper is seated at surfaces "A," "B," and "C."
   F. Measure the bumper gap with largest feeler gauge(s) that will fit into the gap its full length.
   G. Select a replacement key according to the table in "Specifications."
6. Install caliper. Refer to "Caliper."

ANCHOR PLATE

For information on anchor plate service, refer to SECTION 4B1.

ROTOR

For information on rotor removal and installation, refer to SECTION 4B1.

PARKING BRAKE ADJUSTMENT

For information on adjusting the parking brake, refer to SECTION 5F.

UNIT REPAIR

REFINISHING BRAKE ROTORS

You do not need to refinish brake rotors when doing routine brake maintenance such as replacing worn brake shoe and lining assemblies. Refinish rotors only under the following circumstances:

1. There is a complaint of brake pulsation.
2. There are heat spots or excessive scoring.

Brake rotors have a minimum thickness dimension cast into them. This dimension is the minimum wear dimension and not a refinish dimension. Do not use a brake rotor that will not meet the dimensions shown in the specifications chart after refinishing. A rotor that is too thin will not have the proper heat transfer capabilities. Replace it with a new rotor.

Accurate control of rotor tolerances is necessary for the proper performance of disc brakes. Machining should be done only with precision equipment. Service the machining equipment on a regular basis following the manufacturer's recommended maintenance procedures.

When refinishing rotors, make sure the attaching adapters, tool holders, vibration dampeners, and tool bits are in good condition. Always use sharp cutting tools or bits and use only replacement cutting bits recommended by the equipment manufacturer. Dull or worn tools leave a poor surface finish that will affect initial brake performance. Always use vibration dampening attachments when refinishing braking surfaces. These attachments eliminate tool chatter to allow for a better surface finish. Make sure these adaptors are clean and free of nicks.

Following are two recommended procedures that achieve adequate results using two different off-vehicle drum/disc brake lathes. If any other lathe is used, follow that manufacturer's instructions and recommendations.

AMMCO BRAKE LATHE

	Rough Cut	Finish Cut
Spindle Speed	150 rpm	150 rpm
Depth of Cut (per side)	0.127 mm (0.005 in.)	0.051 mm (0.002 in.)
Total Cross Feed (per revolution)	0.152-0.254 mm (0.006-0.010 in.)	0.051 mm max. (0.002 in.)
Vibration Damp.	Yes	Yes
Swirl Pattern - 120 Grit	No	Yes

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ACCU. TURN BRAKE LATHE, GM DEALER EQUIPMENT (One Cut Refinishing Procedure)

Spindle Speed	150 rpm
Tool Cross Feed (per rev.)	0.076 mm (0.003 in.)
Tool Bit Nose Radius	1/64
Vibration Damper	Yes
Swirl Pattern - 120 Grit	Yes

T2915

Locate the deepest score and turn the rotor micrometer knobs until the tool bit bottoms out at the deepest point of the score. Zero the scale and back out the tool bits. Advance the cutter hand-wheel until the bits have cleared the inner edge of the rotor face. Adjust the micrometer knobs for approximately 0.0127 mm (0.005 in.) more than the first reading. This will ensure clearing the rotor in one cut.

It is very important that you make the rotor surface non-directional by dressing the rotor surfaces with a sanding disc power tool such as Ammco 8350 Safe Swirl Disc Rotor Grinder using 120 grit aluminum oxide sandpaper. Sand each rotor surface using moderate pressure for a minimum of 60 seconds. An alternate method is to use a sanding block with 150 grit aluminum oxide sandpaper. With the rotor turning at approximately 150 rpm, sand each rotor surface using moderate pressure for a minimum of 60 seconds. After sanding the rotor, clean each surface with denatured alcohol or a suitable brake cleaner.

The finished rotor surface should be as close to that of a new rotor as possible. Failure to obtain the best possible rotor finish can affect initial braking performance.

CALIPER

Remove or Disconnect (Figure 10)

1. Fluid from caliper.

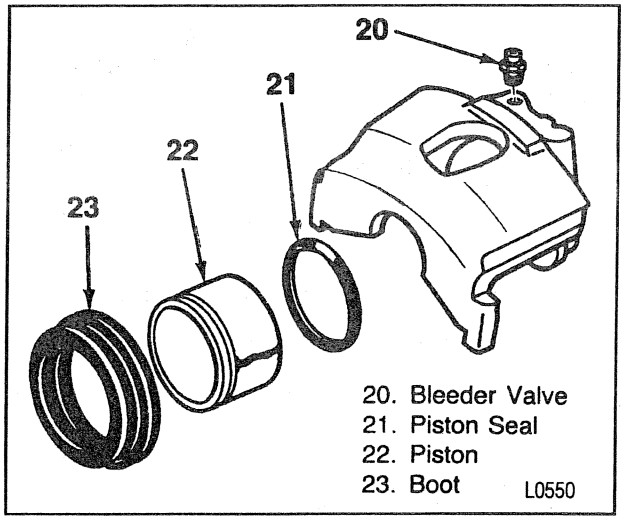
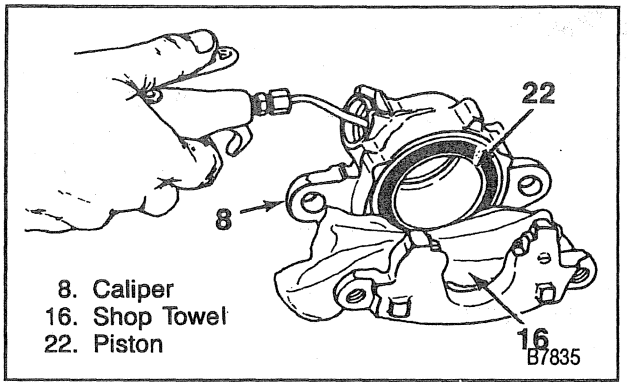
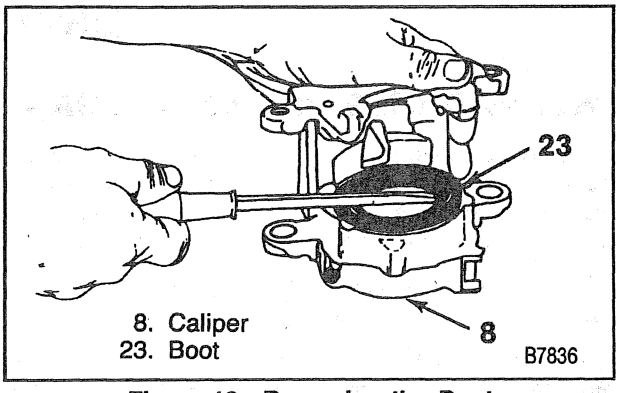


Figure 10—Caliper Components



8. Caliper
16. Shop Towel
22. Piston

Figure 11—Removing the Piston



8. Caliper
23. Boot

Figure 12—Removing the Boot

2. Pad interior of caliper with clean shop towels.

CAUTION: Do not place your fingers in front of the piston in an attempt to catch or protect it when applying compressed air. This could result in serious injury.

NOTICE: Use just enough air to ease the piston out of the bore. If the piston is blown out, even with the padding, it can be damaged.

3. Piston (22).
   - Direct compressed air into caliper fluid inlet (figure 11).
4. Boot (23) (figure 12).
5. Piston seal (21).
   - Do not use any type of metal tool.
6. Bleeder valve (20).

Clean

- Bleeder valve, caliper bore, caliper passages, and piston with denatured alcohol. Use dry, filtered, compressed air to dry parts and blow out passages.

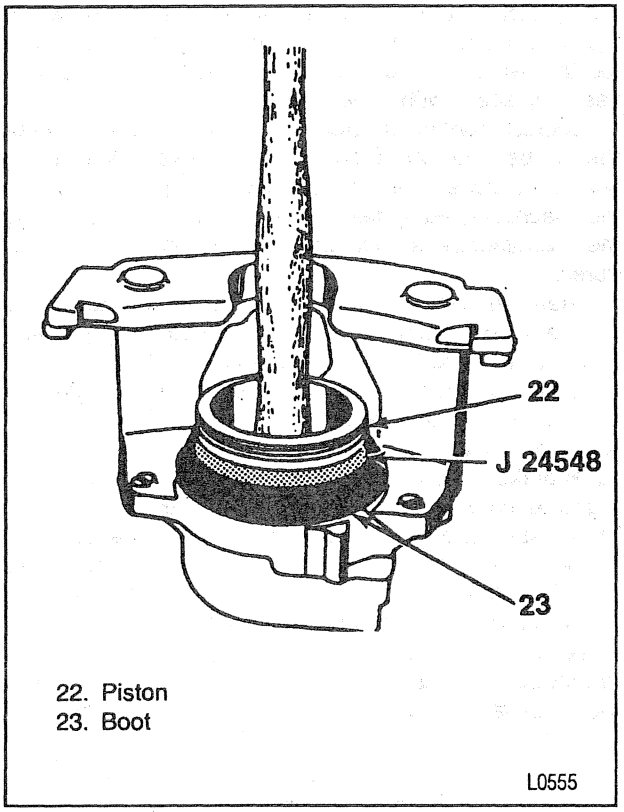
Inspect

- Piston for scoring, corrosion, and damage to the chrome plating. Replace it if any of these conditions are found.
- Caliper bore for scoring, pitting, or corrosion. Use crocus cloth to polish out any light corrosion. Replace the caliper if the corrosion cannot be removed.

Install or Connect (Figure 10)

Tool Required:
J 24548 Piston Seal Installer

1. Lubricate new piston seal, caliper bore, piston, and seal lips on boot with clean brake fluid.
2. Piston seal (21).
   - Make sure seal is not twisted in caliper bore groove.
3. Boot (23) on J 24548.
   A. Place large diameter of boot over tool first and carefully work smaller diameter onto tool.
   B. Slide large diameter off tool.



22. Piston
23. Boot

Figure 13—Installing the Piston

4. Large lip of boot in caliper bore groove.
   - Lip of boot must firmly seat in groove.
5. Piston (22) inside J 24548 (figure 13).
6. Piston halfway into bore.
   A. Remove J 24548.
   B. Make sure boot is firmly seated.
7. Bleeder valve (20).

Tighten

- Bleeder valve to 7 N·m (62 lbs. in.)

SPECIFICATIONS

BRAKE SYSTEMS

SYSTEM	FRONT BRAKES	REAR BRAKES	BRAKE ASSIST
JB5	Disc 11.57-inch x 1.25-inch	254 mm x 57 mm (Leading/Trailing)	Vacuum
JD5			Hydraulic
JB6	Disc 11.57-inch x 1.25-inch	11.15-inch x 2.75-inch (Duo-Servo)	Vacuum
JD6			Hydraulic
JB7	Disc 12.5-inch x 1.26-inch	13.00-inch x 3.5-inch (Duo-Servo)	Vacuum
JD7			Hydraulic
JB8 Single Rear Wheel	Disc 12.5-inch x 1.26-inch	13.00-inch x 3.5-inch (Duo-Servo)	Hydraulic
JB8 Dual Wheel	Disc 12.5-inch x 1.50-inch	13.00-inch x 3.5-inch (Duo-Servo)	Hydraulic
JF9	Disc 14.25-inch x 1.54-inch	Disc 13.75 inch x 1.54 inch	Hydraulic

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ROTOR THICKNESS

ORIGINAL	THINNEST (REFINISHING)	REPLACEMENT (DISCARD)
31.75 mm (1.25 in.)	31.25 mm (1.23 in.)	30.86 mm (1.215 in.)
32 mm (1.26 in.)		
38.10 mm (1.50 in.)	37.59 mm (1.480 in.)	37.21 mm (1.465 in.)
39.11 mm (1.54 in.)		

T2697

BENDIX CALIPER REPLACEMENT KEY SPECIFICATIONS

Bumper Gap	Replacement Key	P/N
0.0 - 0.060	Std. Size - I	14023439
0.061 - 0.100	0.040 Oversize - II	14026793
0.101 - 0.140	0.080 Oversize - III	14026794
0.141 - 0.180	0.120 Oversize - IIII	14026795
0.181 - 0.220	0.160 Oversize - IIIII	14026796
0.221 -	Replace Caliper and Anchor Plate or Steering Knuckle	

T2961

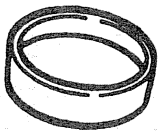
FASTENER TIGHTENING SPECIFICATIONS

Item	N·m	Ft. Lbs.	In. Lbs.
Anchor Plate Mounting Bolt	240	177	—
Bleeder Valve	7	—	62
Brake Hose to Caliper Bolt	45	33	—
Caliper Support Key Bolt	20	15	—

T2948

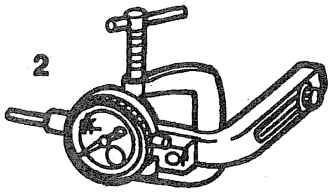
SPECIAL TOOLS

1

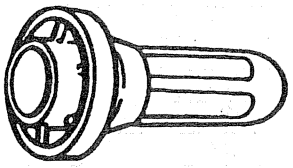


J 24548

2



3



J 28735-A

1. Piston Seal Compressor
2. Dial Indicator
3. Piston Seal Installer

V2292

SECTION 5C1

LEADING/TRAILING DRUM BRAKES

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

CAUTION: When servicing brake parts, do not create dust by grinding or sanding brake linings, by cleaning brake parts with a dry brush or with compressed air. Many earlier models or aftermarket brake parts may 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 fibers from becoming airborne.

NOTICE: Always use the correct fastener in the correct location. Use the correct fastener part number to replace a fastener. If the correct fastener part number is not available, a fastener of equal size and strength may be used. Do not use a fastener that is stronger when the correct fastener part number is not available in the following applications:

- *Some bolts are designed to permanently stretch, and if a stronger fastener is used the part will not be tightened correctly. These permanently stretching bolts will be called out. The correct part number fasteners must be used to replace this type of fastener because there is no available equivalent.*
- *Other bolts are designed to break if over tightened to prevent part damage. If a stronger fastener is used part damage may occur.*

Fasteners that need to be replaced when removed will be called out. Fasteners that require thread lockers or thread sealant will be called out. The correct tightening specification and sequence must be used when installing fasteners. Part or system damage may occur if the above instructions are not followed.

NOTICE: Any new drum must have the protective coating removed from the friction surface before being placed in service. Use Goodwrench Brake Parts Cleaner (GM P/N 12345754) or equivalent, and wipe the surface clean with clean cloths. Do not use gasoline, kerosene, or other oil base solvents which may leave an oily residue. This residue is damaging to brake linings and flammable.

CONTENTS

CONTENTS (cont'd)

GENERAL DESCRIPTION

Leading/trailing drum brakes are used on vehicles with a 6400 pound GVW rating. Both brake shoes are held against the wheel cylinder pistons by the upper return spring and the fixed anchor plate by the lower return spring. Applying the brakes causes the wheel cylinder pistons to move both shoes out to contact the drum. With forward wheel rotation, the forward brake shoe wraps into the drum and becomes self-energized. With reverse wheel rotation, the rear brake shoe is self-energized. Force from the brake shoes is transferred to the anchor plate, through the backing plate, and finally to the axle flange. Adjustment is automatic and occurs on any brake application. It is normal for the front (leading) shoe and lining assembly to wear faster than the rear (trailing) shoe and lining assembly.

DIAGNOSIS

LINING INSPECTION

Inspect the linings every 6,000 miles and any time the wheels are removed (tire rotation, etc.). Inspect the shoe and lining assemblies for wear by removing the brake drum. Replace shoe and lining assemblies when the thickness of any lining is worn to within 0.76 mm (0.030 in.) of the shoe. Replace riveted shoe and lining assemblies when the lining is worn to within 0.76 mm (0.030 in.) of any rivet head. Always replace shoe and lining assemblies as a complete axle set.

DRUM INSPECTION

Any time you remove the brake drums, thoroughly clean and inspect them for cracks, scores, deep grooves, and out-of-round.

SURFACE FINISH

Slight scoring can be cleaned up with fine emery cloth. Heavy or extensive scoring causes excessive lining wear. The drum braking surface will need machining to remove these scores.

If the drum is grooved and the linings are slightly worn, the drum should not be machined. Instead, polish the drum braking surface with fine emery cloth. Eliminating all of the drum grooves and ridges on the lining would require removing too much metal and lining material. The grooves and ridges match and satisfactory service can be obtained by leaving them alone.

INSIDE DIAMETER CHECK

Measure the inside diameter of the brake drum at two or more places around the circumference of the braking surface. The measurements must be made at the same distance in from the the edge of the drum. Compare the results with the wear specifications at the end of this section in "Unit Repair."

TAPER CHECK

Measuring a drum for taper involves taking measurements at the inner and outer edges of the machined surface at two or more places around the drum. These measurements should be equal.

ON-VEHICLE SERVICE

DRUM

For brake drum on-vehicle service procedures, refer to SECTION 4B1.

LININGS

GM replacement brake lining material is recommended for all vehicles to maintain the balance between front and rear brake performance. GM replacement brake parts have been carefully selected to provide the proper brake balance for the purposes of stopping distance and control over the full range of operating conditions. Installation of front or rear lining material with performance different from that of recommended GM replacement parts can change the intended brake balance of this vehicle.

Remove or Disconnect (Figure 1)

1. Raise vehicle and support with safety stands.
2. Mark relationship of wheel to hub.
3. Tire and wheel. Refer to SECTION 3E.

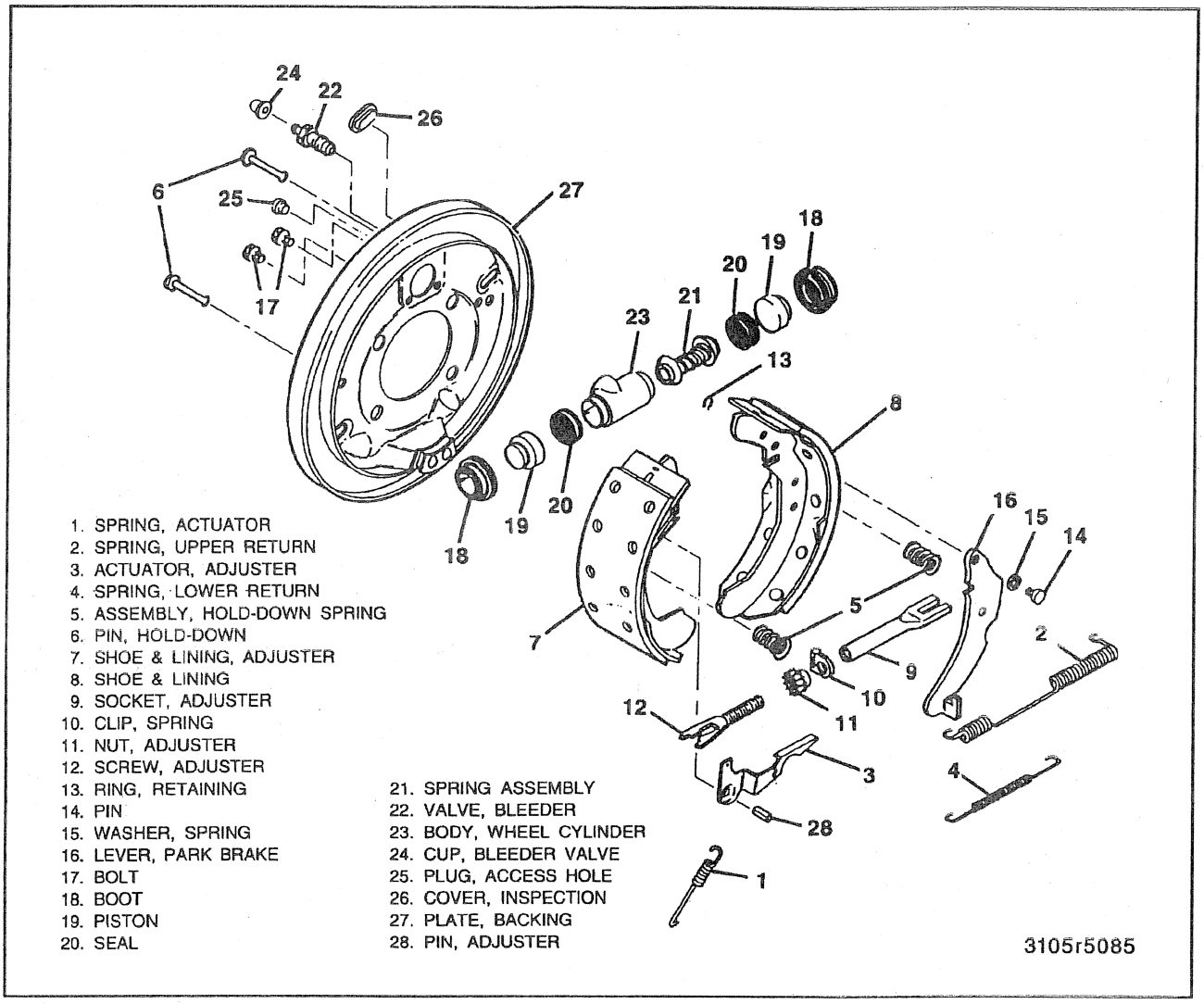


Figure 1—Leading/Trailing Drum Brake

CAUTION: Refer to "Caution" on page 5C1-1.

4. Mark relationship of drum to axle.
5. Drum. Refer to SECTION 4B1.
   - If the drum is difficult to remove:
     A. Make sure the parking brake is released.
     B. Back off the parking brake cable adjustment.
     C. Remove the access hole plug (25) from the backing plate and insert a screwdriver through the hole to push the parking brake lever off its stop (figure 2).
     D. Use a rubber mallet to tap gently on the outer rim of the drum and/or around the inner drum diameter. Be careful to not deform the drum by excessive beating.
6. Actuator spring (1) and adjuster actuator (3).
   A. Raise the lever arm of the actuator (3) until the upper end is clear of the slot in the adjuster screw (12) (figures 2 and 3).
   B. Slide the actuator (3) off of the adjuster pin (28).
   C. Disconnect the actuator spring (1) from the shoe (7).
7. Hold-down spring assemblies (5) and pins (6).
8. Lower return spring (4).
   A. Pull the bottom ends of the shoes apart.
   B. Lift the lower return spring (4) over the anchor plate.
   C. Allow the shoe ends to come together and release the spring.
9. Shoe and lining assemblies (7 and 8) along with the upper return spring (2) and adjusting screw assembly.
   A. Be careful not to damage the wheel cylinder boots.
   B. Bring the bottom ends of the shoes together (overlap if necessary) so the upper shoe ends clear the wheel cylinder boots.
   C. Spread the bottom of the assembly to clear the axle flange.
10. Upper return spring (2) and adjusting screw assembly from the shoes.
11. Retaining ring (13), pin (14), spring washer (15), and parking brake lever (16).

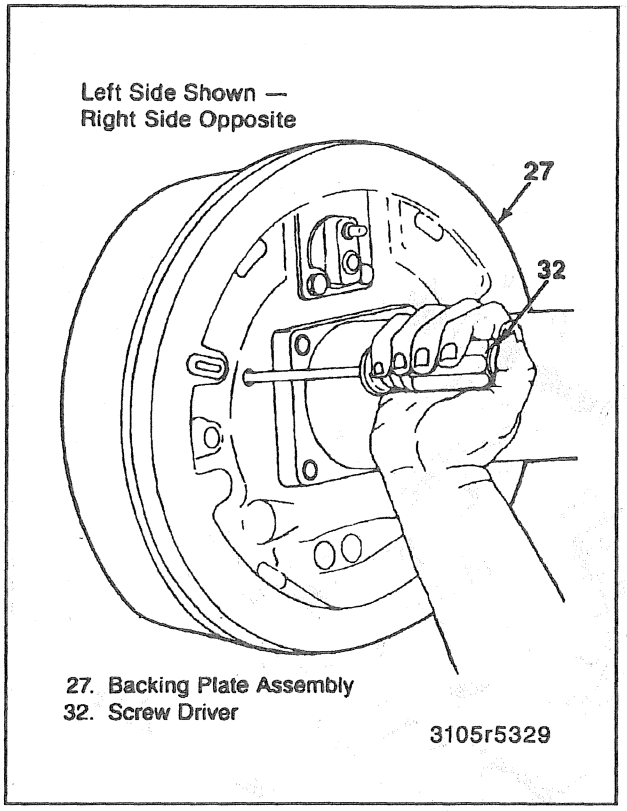


Figure 2—Pushing the Parking Brake Lever Off its Stop

Inspect

- If any parts show signs of discoloration from heat, over-stress, or wear, replace them.
- Threads of the adjuster screw (12) for smooth rotation over the full length.

Clean

- Adjuster screw (12), nut (11), spring clip (10), and adjuster socket (9) in denatured alcohol.

Install or Connect (Figures 1 and 4)

1. Parking brake lever (16), spring washer (15), pin (14), and retaining ring (13).
   - The concave side of the spring washer should face the parking brake lever.
2. Adjuster pin (28) in the shoe (7) so the pin projects 6.8 to 7.0 mm (0.268 to 0.276 inch) from the side of the shoe web where the adjuster actuator is installed.
3. Brake lubricant (GM P/N 5450032) or equivalent to the threads of the adjuster screw (12) and inside diameter and face of the socket (9).
   - Adequate lubrication is achieved when there is a continuous bead of lubricant at the open end of the adjuster nut (11) and socket (9) when the threads are fully engaged.
4. Upper return spring (2).
   A. Lay the shoes (7 and 8) on a clean, flat work surface in the position they will be in when installed on the backing plate.

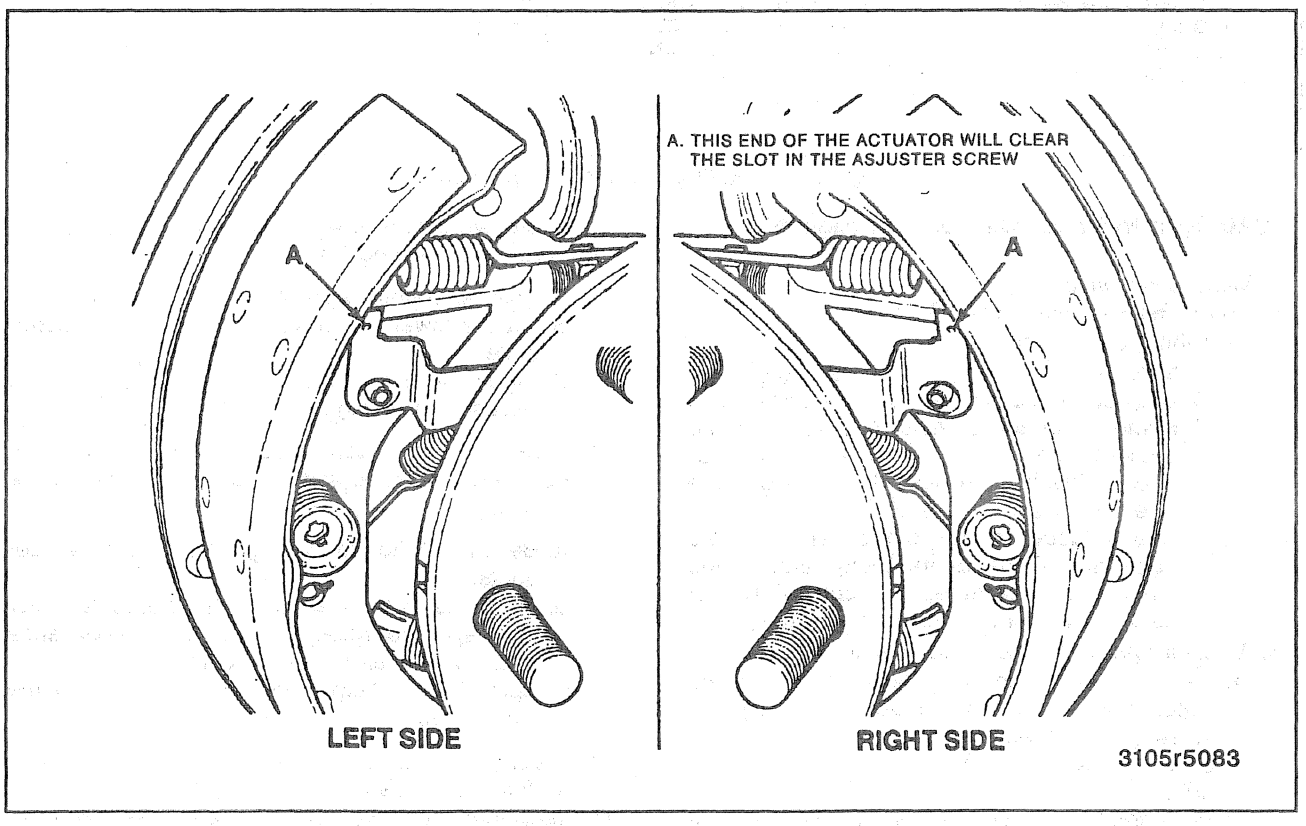


Figure 3—Removing the Adjuster Actuator

B. The shoe with the parking brake lever goes to the rear of the vehicle.

NOTICE: Do not over-stretch the upper return spring. Damage can occur if it is stretched to more than 204.2 mm (8.04 inches).

5. Adjusting screw assembly.
   - The adjusting screw assembly should engage the adjuster shoe (7) and parking brake lever (16) respectively.
   - Make sure the spring clip (10) faces the backing plate.
6. Lubricate the shoe pads on the backing plate with a thin coat of white lithium grease.
7. Shoe and lining assemblies (7 and 8), upper return spring (2), and adjusting screw assembly.
   A. Be careful not to damage the wheel cylinder boots.
   B. Overlap the bottoms of the shoes so the upper shoe ends clear the wheel cylinder boots.
   C. Make sure the upper shoe ends rest on the wheel cylinder piston ends.
   D. Do not place the lower shoe web ends under the anchor plate until the lower return spring is installed.

NOTICE: Do not over-stretch the lower return spring. Damage can occur if it is stretched to more than 107.3 mm (4.22 inches).

8. Lower return spring (4).
   A. Bring the ends of the shoe and lining assemblies (7 and 8) together over the anchor plate.
   B. Hook the spring ends to the shoe web holes.
   C. Spread the lower ends of the shoe and lining assemblies to clear the anchor plate.
   D. Position the shoes against the backing plate and release them.
   E. Pull the spring into the groove at the bottom of the anchor plate.
9. Hold-down pins (6) and spring assemblies (5).
10. Adjuster actuator (3) over the end of the adjuster pin (28) so the top leg engages the notch in the adjuster screw (figure 3).

NOTICE: Do not over-stretch the actuator spring (1). Damage can occur if it is stretched to more than 83 mm (3.27 inches).

11. Actuator spring (1).
    - Make sure the free end of the adjuster actuator (3) engages the notch of the adjuster nut.
12. Parking brake cable to the parking brake lever (16).

Adjust

- Parking brake. Refer to SECTION 5F.

13. Drum.
    - Align the marks made during disassembly.
14. Tire and wheel. Refer to SECTION 3E.
    - Align the marks made during disassembly.

WHEEL CYLINDER

Remove or Disconnect (Figure 5)

1. Shoes and linings. Refer to "Linings" in this section.

Clean

- Dirt and foreign material from around the wheel cylinder.

2. Inlet pipe.
   - Plug the pipe to prevent fluid loss and contamination.
3. Bolts (22).
4. Wheel cylinder (30).

Install or Connect (Figure 5)

1. Wheel cylinder (30).
2. Bolts (22).

Tighten

- Bolts (22) to 20 N·m (15 lbs. ft.).

3. Inlet pipe.

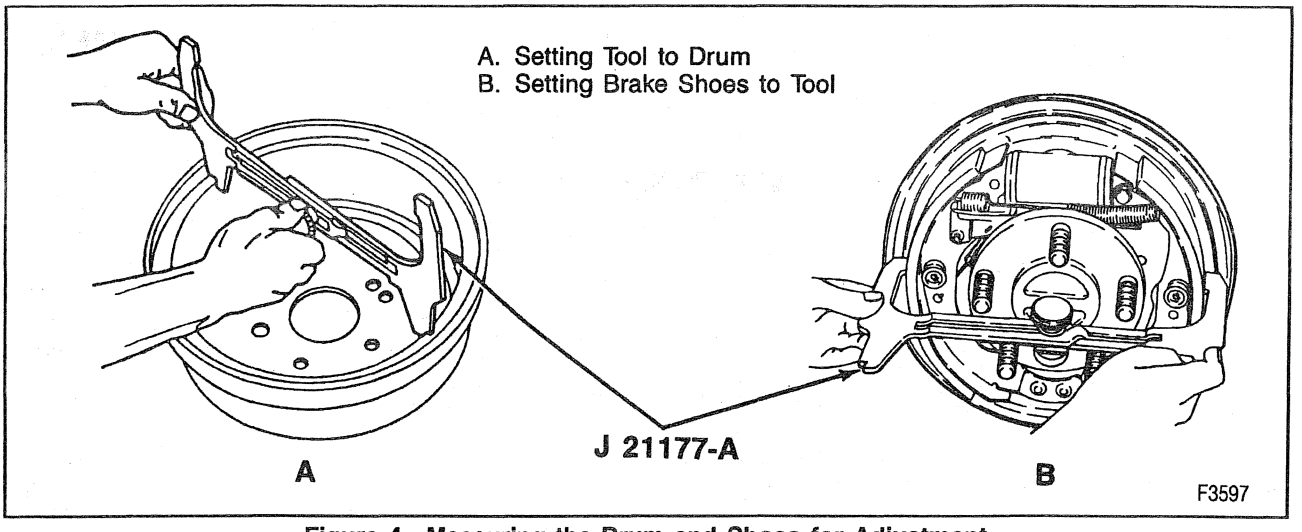
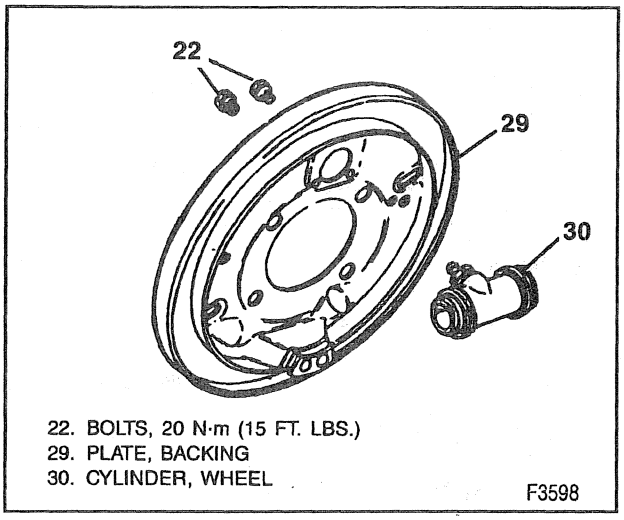


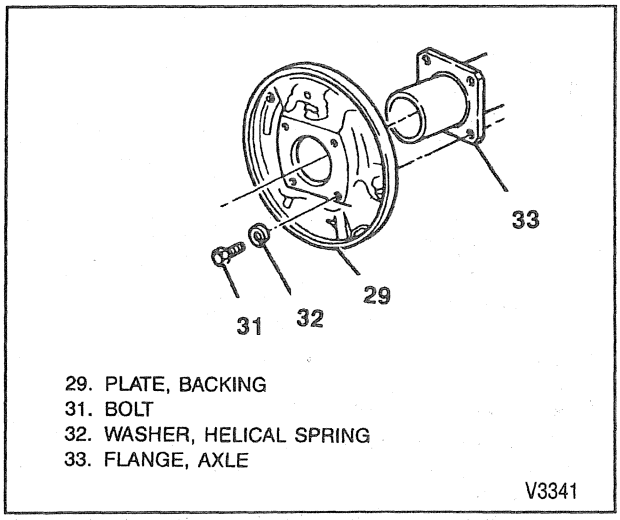
Figure 4—Measuring the Drum and Shoes for Adjustment



22. BOLTS, 20 N·m (15 FT. LBS.)
29. PLATE, BACKING
30. CYLINDER, WHEEL

F3598

Figure 5—Wheel Cylinder Replacement



29. PLATE, BACKING
31. BOLT
32. WASHER, HELICAL SPRING
33. FLANGE, AXLE

V3341

Figure 6—Backing Plate Replacement

Tighten

- Fitting to 17 N·m (13 lbs. ft.).

4. Shoes and linings. Refer to "Linings" in this section.
5. Bleed brake system. Refer to SECTION 5.

BACKING PLATE

Remove or Disconnect (Figure 6)

CAUTION: Refer to "Caution" on page 5C1-1.

1. Linings. Refer to "Linings" in this section.
2. Wheel cylinder. Refer to "Wheel Cylinder" in this section.
3. Bolts (31) and washers (32).
4. Backing plate (29).

Install or Connect (Figure 6)

1. Backing plate (29).
2. Bolts (31) and washers (32).

Tighten

- Bolts (31) to 70 N·m (52 lbs. ft.)

3. Wheel cylinder. Refer to "Wheel Cylinder" in this section.
4. Linings. Refer to "Linings" in this section.
5. Adjust brakes. Refer to "Adjustment" in this section.
6. Bleed brakes. Refer to SECTION 5.

ADJUSTMENT

A manual adjustment of the rear drum brakes is required after replacing the rear linings.

CAUTION: Refer to "Caution" on page 5C1-1.

1. Remove the lanced area in the backing plate.
2. Turn the adjusting screw until the wheel can just be turned by hand.
3. The brake drag should be equal at both wheels.
4. Back off the adjusting screw 20 notches.

- Brakes should have no drag after the adjusting screw is backed off about 10 notches. If a heavy drag is still present, refer to SECTION 5F.

5. Install an adjusting hole cover in the backing plate.
6. Check the parking brake adjustment. Refer to SECTION 5F.

PARKING BRAKE ADJUSTMENT

For information on adjusting the parking brake, refer to SECTION 5F.

UNIT REPAIR

DRUMS

CRACKED, SCORED, OR GROOVED

A cracked drum is unsafe for further service and must be replaced. Do not attempt to weld a cracked drum.

Smooth up any slight scores. Heavy or extensive scoring will cause excessive lining wear, and it may be necessary to resurface the drum braking surface.

If the linings are slightly worn (but still reusable) and the drum is grooved, polish the drum with fine emery cloth but do not refinish. Eliminating all grooves in the drum and smoothing the ridges on the lining would require removing too much metal and lining. If left alone, the grooves and ridges match and satisfactory service can be obtained.

If replacing the brake linings, always refinish a grooved drum. Using a grooved drum with new linings will wear the linings and make proper brake performance difficult to obtain.

OUT-OF-ROUND OR TAPERED

An out-of-round or tapered drum prevents accurate brake shoe adjustment and is likely to cause excessive wear of other brake parts due to its eccentric action. An out-of-round drum can also cause severe and irregular tire tread wear as well as a pulsating brake pedal. When the drum exceeds the specification limits in taper and/or out-of-round, refinish the drum to true up the braking surface. Out-of-round and taper can be accurately measured with an inside micrometer and extension rods.

When measuring a drum for out-of-round and taper, take measurements at the open and closed edges of the machined surface and at right angles to each other.

REFINISHING

If you determine a drum needs refinishing, remove only enough metal to obtain a true, smooth braking surface. If a drum does not clean up when refinished to the maximum refinish diameter, as shown in "Specifications" at the end of this section, replace it. Removal of more metal will affect heat dissipation and can cause drum distortion.

All brake drums have a maximum diameter cast into them. This diameter is the maximum wear diameter and not a refinish diameter. Do not refinish a brake drum that will not meet the "Specifications" at the end of this section; instead, replace it.

When refinishing a brake drum, resurface the drum to a dimension no more than 0.76 mm (0.030 inch) less than the discard diameter. The refinish diameter is the maximum diameter the drum can be refinished to and still allow safe braking action. If you exceed this diameter, the brake drum will wear beyond the discard diameter during normal brake use.

Always use sharp cutting tools or bits. Dull or worn tools leave a poor surface finish that will affect initial braking performance. Always use vibration dampening attachments when you refinish braking surfaces. These attachments eliminate tool chatter so you can obtain a better surface finish.

The best speed for refinishing braking surfaces is a spindle speed of 150 rpm. Crossfeed for rough cutting should range from 0.15 to 0.25 mm (0.006 to 0.010 inch) per revolution. Finish cuts should be made at crossfeeds no greater than 0.05 mm (0.002 inch) per revolution.

New Replacement Drum Refinishing

When installing new brake drums, do not refinish the braking surface. These parts are already at the correct level of surface finish.

BALANCE

During manufacturing, weights are used to balance brake drums. Do not remove these weights.

After you refinish brake drums, or when maintaining wheel balance is difficult, check the drums for balance. They can be checked on most off-vehicle balancers. If found to be out of balance, replace the drum.

WHEEL CYLINDER

Remove or Disconnect (Figure 7)

1. Bleeder valve (1).
2. Boots (4).
3. Pistons (3).
4. Seals (2).
5. Spring assembly (5).

Inspect

- Cylinder bore for scoring and corrosion.
- Spring assembly for signs of discoloration due to heat. Replace if necessary.

Clean

- Inside the cylinder bore with crocus cloth. If the bore is still scored, replace the wheel cylinder.
- Cylinder bore with clean brake fluid.

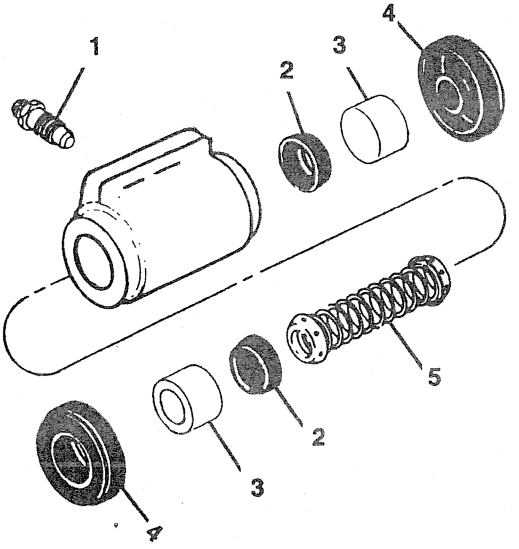
Install or Connect (Figure 7)

- Lubricate pistons, seals, and cylinder bore with clean brake fluid.

1. Spring assembly (5).
2. Seals (2).
3. Pistons (3).
4. Boots (4).
5. Bleeder valve (1).

Tighten

- Bleeder valve to 7 N·m (62 lbs. in.).



1. VALVE, BLEEDER
2. SEAL
3. PISTON
4. BOOT
5. SPRING

B7850

Figure 7—Wheel Cylinder Components

SPECIFICATIONS

BRAKE SYSTEMS

SYSTEM	FRONT BRAKES	REAR BRAKES	BRAKE ASSIST
JB5	Disc 11.57-inch x 1.25-inch	254 mm x 57 mm (Leading/Trailing)	Vacuum
JD5			Hydraulic
JB6	Disc 11.57-inch x 1.25-inch	11.15-inch x 2.75-inch (Duo-Servo)	Vacuum
JD6			Hydraulic
JB7	Disc 12.5-inch x 1.26-inch	13.00-inch x 3.5-inch (Duo-Servo)	Vacuum
JD7			Hydraulic
JB8 Single Rear Wheel	Disc 12.5-inch x 1.26-inch	13.00-inch x 3.5-inch (Duo-Servo)	Hydraulic
JB8 Dual Wheel	Disc 12.5-inch x 1.50-inch	13.00-inch x 3.5-inch (Duo-Servo)	Hydraulic
JF9	Disc 14.25-inch x 1.54-inch	Disc 13.75 inch x 1.54 inch	Hydraulic

T2112

DRUM DIAMETERS

ORIGINAL	MAXIMUM (REFINISH)	REPLACEMENT (DISCARD)
254 mm (10 in.)	255.30 mm (10.05 in.)	356.30 (10.09 in.)
283.21 mm (11.15 in.)	284.73 mm (11.21 in.)	285.50 (11.24 in.)
330.20 mm (13 in.)	331.72 mm (13.06 in.)	332.49 (13.09 in.)

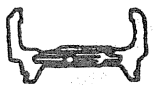
T2216

FASTENER TIGHTENING SPECIFICATIONS

ITEM	N·m	Ft. Lbs.	In. Lbs.
Backing Plate Mounting Bolts	70	52	—
Bleeder Valve	7	—	62
Pipe Fitting	17	13	—
Wheel Cylinder Mounting Bolts	20	15	—

T2953

SPECIAL TOOL

1.  J 21177-A

1. DRUM TO BRAKE SHOE CLEARANCE GAGE

3105r5084

SECTION 5C2

DUO-SERVO DRUM BRAKES

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

CAUTION: When servicing brake parts, do not create dust by grinding or sanding brake linings, by cleaning brake parts with a dry brush or with compressed air. Many earlier models or aftermarket brake parts may 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 fibers from becoming airborne.

NOTICE: Always use the correct fastener in the correct location. Use the correct fastener part number to replace a fastener. If the correct fastener part number is not available, a fastener of equal size and strength may be used. Do not use a fastener that is stronger when the correct fastener part number is not available in the following applications:

- *Some bolts are designed to permanently stretch, and if a stronger fastener is used the part will not be tightened correctly. These permanently stretching bolts will be called out. The correct part number fasteners must be used to replace this type of fastener because there is no available equivalent.*
- *Other bolts are designed to break if over tightened to prevent part damage. If a stronger fastener is used part damage may occur.*

Fasteners that need to be replaced when removed will be called out. Fasteners that require thread lockers or thread sealant will be called out. The correct tightening specification and sequence must be used when installing fasteners. Part or system damage may occur if the above instructions are not followed.

NOTICE: A new drum must have the protective coating removed from the friction surface before being placed in service. Use Goodwrench Brake Parts Cleaner (GM P/N 12345754) or equivalent and wipe the surface clean with clean cloths. Do not use gasoline, kerosene, or other oil base solvents that can leave an oily residue. This residue is damaging to brake linings and flammable.

CONTENTS

CONTENTS (cont'd)

GENERAL DESCRIPTION

This section covers service procedures for duo-servo drum brakes. Applying the brakes cases the wheel cylinder piston to force the leading edge of the primary shoe and lining assembly to contact the rotating drum. The shoe tries to rotate with the drum and transfers force to the secondary shoe and lining assembly through the star-wheel adjuster. The secondary shoe's lining leading edge "bites" into the drum and tries to rotate, just like the primary shoe. Since the shoes cannot rotate, they wedge themselves into the drum. The rotating torque from the shoes increases the braking force applied by the wheel cylinder. Because of this wedging action, the design is a duo-servo, as opposed to a single-servo design where the wheel cylinder pressure alone is the source of braking force.

The torque from the brake shoes is transferred through the backing plate to the axle flange. Brake adjustments are automatic and occur during reverse brake applications.

DIAGNOSIS

LINING INSPECTION

Inspect the linings every 6,000 miles and any time the wheels are removed (tire rotation, etc.). Inspect the shoe and lining assemblies for wear by removing the brake drum. Replace shoe and lining assemblies when the thickness of any lining is worn to within 0.76 mm (0.030 in.) of the shoe. Replace riveted shoe and lining assemblies when the lining is worn to within 0.76 mm (0.030 in.) of any rivet head. Always replace shoe and lining assemblies as a complete axle set.

DRUM INSPECTION

Any time you remove the brake drums, thoroughly clean and inspect them for cracks, scores, deep grooves, and out-of-round.

SURFACE FINISH

Slight scoring can be cleaned up with fine emery cloth. Heavy or extensive scoring causes excessive lining wear. The drum braking surface will need machining to remove these scores.

If the drum is grooved and the brake linings are slightly worn, the drum should not be machined. Instead, polish the drum braking surface with fine emery cloth. Eliminating all of the drum grooves and ridges on the lining would require removing too much metal and lining material. The grooves and ridges match and satisfactory service can be obtained by leaving them alone.

INSIDE DIAMETER CHECK

Measure the inside diameter of the brake drum at two or more places around the circumference of the braking surface. The measurements must be made at the same distance in from the the edge of the drum. Compare the results with the wear specifications at the end of this section in "Unit Repair."

TAPER CHECK

Measuring a drum for taper involves taking measurements at the inner and outer edges of the machined surface at two or more places around the drum. These measurements should be equal.

ON-VEHICLE SERVICE

DRUM

For brake drum on-vehicle service procedures, refer to SECTION 4B1.

LININGS

GM replacement brake lining material is recommended for all vehicles to maintain the balance between front and rear brake performance. GM replacement brake parts have been carefully selected to provide the proper brake balance for the purposes of stopping distance and control over the full range of operating conditions. Installation of front or rear lining material with performance different from that of GM replacement parts recommended for this vehicle can change the intended brake balance of this vehicle.

Remove or Disconnect (Figure 1)

1. Raise vehicle and support with safety stands.
2. Mark relationship of wheel to hub.
3. Tire and wheel. Refer to SECTION 3E.
4. Mark relationship of drum to axle.

CAUTION: Refer to "Caution" on page 5C2-1.

5. Drum.
6. Return springs (9 and 10).
7. Shoe guide (5).
8. Hold down springs (11).
9. Hold down pins (1).
10. Actuator lever (7) and lever pivot (12).
11. Lever return spring (13).
12. Actuator link (8).
13. Parking brake strut (6) and strut spring (14).
14. Parking brake lever (3).
15. Shoes (17 and 4).
16. Adjusting screw assembly (15).
17. Adjusting screw spring (16).

Inspect

- All parts for discoloration due to heat or stress. Replace as needed.
- All parts for signs of wear. Replace as needed.
- Wheel cylinder for signs of leakage. If any is found, refer to "Wheel Cylinder."
- Brake drum for scoring and machining tolerance. Refer to "Refinishing."

Install or Connect (Figure 1)

1. Lubricate shoe pads and adjusting screw threads with a thin coat of white lithium grease or equivalent.
2. Adjusting screw assembly (15) and adjusting screw spring (16) to both shoes (17 and 4).
   - The coils of the adjusting screw spring must not touch the adjusting screw.

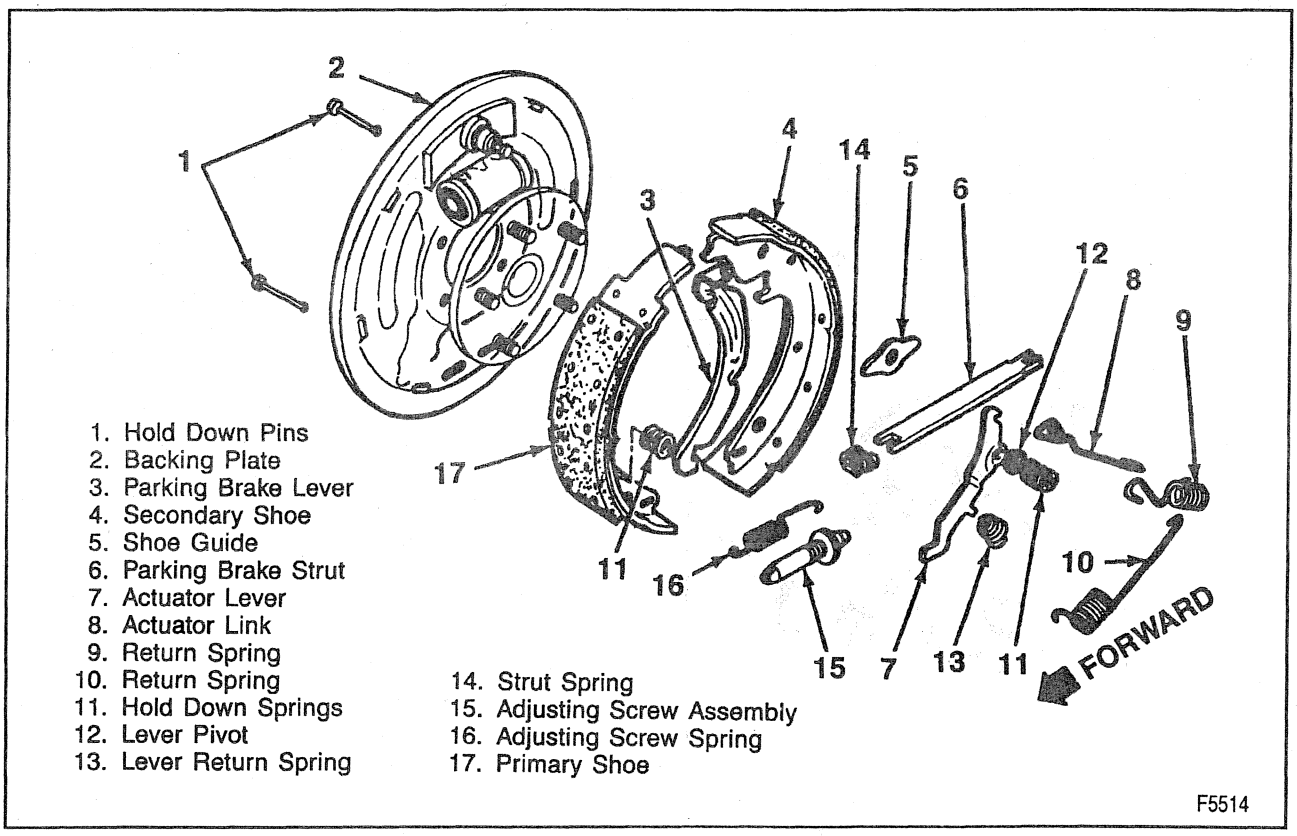


Figure 1—Duo-Servo Drum Brake Components

Important

- Do not interchange right and left adjusting screws.

3. Shoe assembly to the backing plate.
4. Parking brake lever (3).
5. Strut spring (14) onto the parking brake strut (6).
6. Parking brake strut (6).
7. Actuator lever (7) and lever pivot (12).
8. Actuator link (8).
9. Lever return spring (13).
10. Hold down pins (1).
11. Hold down springs (11).
12. Shoe guide (5).
13. Return springs (9 and 10).
14. Drum.
    - Align the marks made during disassembly.
15. Tire and wheel. Refer to SECTION 3E.
    - Align the marks made during disassembly.
16. Adjust brakes. Refer to "Adjustment."

WHEEL CYLINDER

Remove or Disconnect (Figure 2)

CAUTION: Refer to "Caution" on page 5C2-1.

1. Linings. Refer to "Linings" in this section.
2. Brake pipe.
3. Bolts (22).
4. Wheel cylinder (30).

Install or Connect (Figure 2)

1. Wheel cylinder (30).
2. Bolts (22).

Tighten

- Bolts (22) to 20 N·m (15 lbs. ft.).

3. Brake pipe.

Tighten

- Brake pipe fitting to 17 N·m (13 lbs. ft.)

4. Linings. Refer to "Linings" in this section.
5. Bleed brake system. Refer to SECTION 5.

BACKING PLATE

Remove or Disconnect (Figure 3)

CAUTION: Refer to "Caution" on page 5C2-1.

1. Linings. Refer to "Linings" in this section.
2. Wheel cylinder. Refer to "Wheel Cylinder" in this section.
3. Bolts (31) and washers (32).
4. Backing plate (29).

Install or Connect (Figure 3)

1. Backing plate (29).
2. Bolts (31) and washers (32).

Tighten

- Bolts (31) to 160 N·m (118 lbs. ft.)

3. Wheel cylinder. Refer to "Wheel Cylinder" in this section.
4. Linings. Refer to "Linings" in this section.
5. Adjust brakes. Refer to "Adjustment" in this section.
6. Bleed brake system. Refer to SECTION 5.

ADJUSTMENT

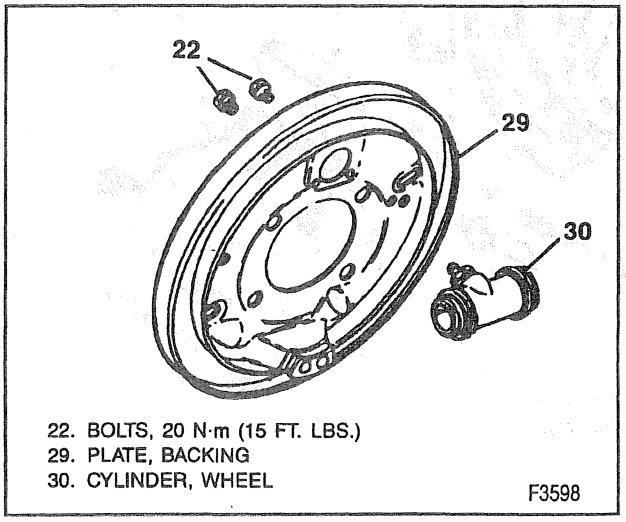
CAUTION: Refer to "Caution" on page 5C2-1.

Adjust

1. Remove the adjusting hole cover in the backing plate.
2. Turn adjusting screw until the wheel can just be turned by hand.
   - The brake drag should be equal at both wheels.
3. Back off the adjusting screw 33 notches.

Important

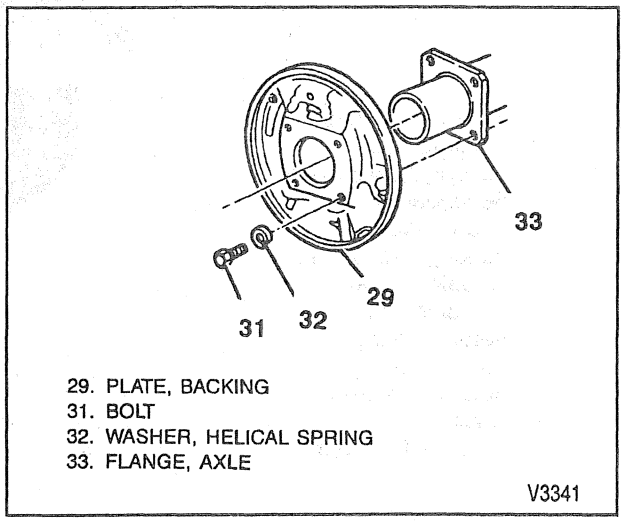
- Brakes should have no drag after the screw has been backed off about 15 notches. If a heavy drag is present, refer to SECTION 5F.



22. BOLTS, 20 N·m (15 FT. LBS.)
29. PLATE, BACKING
30. CYLINDER, WHEEL

F3598

Figure 2—Wheel Cylinder Replacement



29. PLATE, BACKING
31. BOLT
32. WASHER, HELICAL SPRING
33. FLANGE, AXLE

V3341

Figure 3—Backing Plate Replacement

4. Install an adjusting hole cover in the backing plate.
5. Check the parking brake adjustment. Refer to SECTION 5F.

PARKING BRAKE ADJUSTMENT

For information on adjusting the parking brake, refer to SECTION 5F.

UNIT REPAIR

DRUMS

CRACKED, SCORED, OR GROOVED

A cracked drum is unsafe for further service and must be replaced. Do not attempt to weld a cracked drum.

Smooth up any slight scores. Heavy or extensive scoring will cause excessive lining wear, and it may be necessary to resurface the drum braking surface.

If the linings are slightly worn (but still reusable) and the drum is grooved, polish the drum with fine emery cloth but do not refinish. Eliminating all grooves in the drum and smoothing the ridges on the lining would require removing too much metal and lining. If left alone, the grooves and ridges match and satisfactory service can be obtained.

If you are replacing the brake linings, always refinish a grooved drum. Using a grooved drum with new linings will wear the linings and make proper brake performance difficult to obtain.

OUT-OF-ROUND OR TAPERED

An out-of-round or tapered drum prevents accurate brake shoe adjustment and is likely to cause excessive wear of other brake parts due to its eccentric action. An out-of-round drum can also cause severe and irregular tire tread wear as well as a pulsating brake pedal. When the drum exceeds the specification limits in taper and/or out-of-round, refinish the drum to true up the braking surface. Out-of-round and taper can be accurately measured with an inside micrometer and extension rods.

When measuring a drum for out-of-round and taper, take measurements at the open and closed edges of the machined surface and at right angles to each other.

REFINISHING

If you determine a drum needs refinishing, remove only enough metal to obtain a true, smooth braking surface. If a drum does not clean up when refinished to the maximum refinish diameter, as shown in "Specifications" at the end of this section, replace it. Removal of more metal will affect heat dissipation and can cause drum distortion.

All brake drums have a maximum diameter cast into them. This diameter is the maximum wear diameter and not a refinish diameter. Do not refinish a brake drum that will not meet the "Specifications" at the end of this section; instead, replace it.

When you refinish a brake drum, resurface the drum to a dimension no more than 0.76 mm (0.030 inch) less than the discard diameter. The refinish diameter is the maximum diameter the drum can be refinished to and still allow safe braking action. If you exceed this diameter, the brake drum will wear beyond the discard diameter during normal brake use.

Always use sharp cutting tools or bits. Dull or worn tools leave a poor surface finish that will affect initial braking performance. Always use vibration dampening attachments when you refinish braking surfaces. These attachments eliminate tool chatter so you can obtain a better surface finish.

The best speed for refinishing braking surfaces is a spindle speed of 150 rpm. Crossfeed for rough cutting should range from 0.15 to 0.25 mm (0.006 to 0.010 inch) per revolution. Finish cuts should be made at crossfeeds no greater than 0.05 mm (0.002 inch) per revolution.

New Replacement Drum Refinishing

When installing new brake drums, do not refinish the braking surface. These parts are already at the correct level of surface finish.

BALANCE

During manufacturing, weights are used to balance brake drums. Do not remove these weights.

After you refinish brake drums, or when maintaining wheel balance is difficult, check the drums for balance. They can be checked on most off-vehicle balancers. If found to be out of balance, replace the drum.

WHEEL CYLINDER

Remove or Disconnect (Figure 4)

1. Bleeder valve (1).
2. Boots (4).
3. Pistons (3).
4. Seals (2).
5. Spring (5).

Inspect

- Cylinder bore for scoring and corrosion.
- Spring assembly for signs of discoloration due to heat. Replace if necessary.

Clean

- Inside the cylinder bore with crocus cloth. If the bore is still scored, replace the cylinder.
- Cylinder with clean brake fluid.

Install or Connect (Figure 4)

1. Lubricate the seals and cylinder bore with clean brake fluid.
2. Spring (5).
3. Seals (2).
4. Pistons (3).
5. Boots (4).
6. Bleeder valve (27).

Tighten

- Bleeder valve (27) to 7 N·m (62 lbs. in.)

7. Links (21).

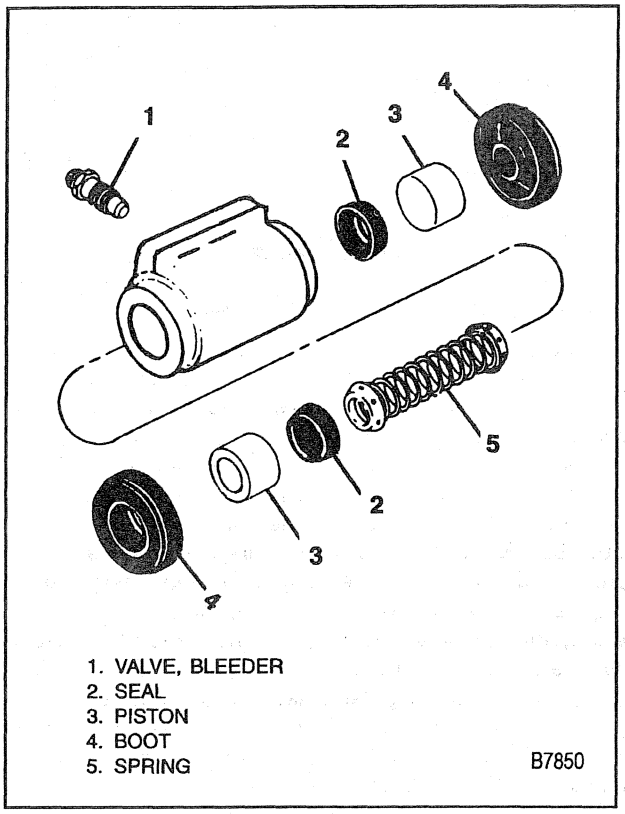


Figure 4—Wheel Cylinder Components

SPECIFICATIONS

BRAKE SYSTEMS

SYSTEM	FRONT BRAKES	REAR BRAKES	BRAKE ASSIST
JB5	Disc 11.57-inch x 1.25-inch	254 mm x 57 mm (Leading/Trailing)	Vacuum
JD5			Hydraulic
JB6	Disc 11.57-inch x 1.25-inch	11.15-inch x 2.75-inch (Duo-Servo)	Vacuum
JD6			Hydraulic
JB7	Disc 12.5-inch x 1.26-inch	13.00-inch x 3.5-inch (Duo-Servo)	Vacuum
JD7			Hydraulic
JB8 Single Rear Wheel	Disc 12.5-inch x 1.26-inch	13.00-inch x 3.5-inch (Duo-Servo)	Hydraulic
JB8 Dual Wheel	Disc 12.5-inch x 1.50-inch	13.00-inch x 3.5-inch (Duo-Servo)	Hydraulic
JF9	Disc 14.25-inch x 1.54-inch	Disc 13.75 inch x 1.54 inch	Hydraulic

T2112

DRUM DIAMETERS

ORIGINAL	MAXIMUM (REFINISH)	REPLACEMENT (DISCARD)
254 mm (10 in.)	255.30 mm (10.05 in.)	356.30 (10.09 in.)
283.21 mm (11.15 in.)	284.73 mm (11.21 in.)	285.50 (11.24 in.)
330.20 mm (13 in.)	331.72 mm (13.06 in.)	332.49 (13.09 in.)

T2216

FASTENER TIGHTENING SPECIFICATIONS

Item	N·m	Lbs. Ft.	Lbs. In.
Anchor Pin (JB5)	430	317	—
Anchor Pin Nut (JB7, JB8)	310	228	—
Backing Plate Mounting Bolt (JB5)	55	40	—
Backing Plate Mounting Bolt (JB7, JB8)	160	118	—
Bleeder Valve	7	—	62
Pipe Fitting	17	13	—
Wheel Cylinder Mounting Bolt	25	18	—

T2947

NOTES

SECTION 5D1

VACUUM BOOSTER SYSTEM

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: Always use the correct fastener in the correct location. Use the correct fastener part number to replace a fastener. If the correct fastener part number is not available, a fastener of equal size and strength may be used. Do not use a fastener that is stronger when the correct fastener part number is not available in the following applications:

- ***Some bolts are designed to permanently stretch, and if a stronger fastener is used, the part will not be tightened correctly. These permanently stretching bolts will be called out. The correct part number fasteners must be used to replace this type of fastener because there is no available equivalent.***
- ***Other bolts are designed to break if over tightened to prevent part damage. If a stronger fastener is used part damage may occur.***

Fasteners that need to be replaced when removed will be called out. Fasteners that require thread lockers or thread sealant will be called out. The correct tightening specification and sequence must be used when installing fasteners. Part or system damage may occur if the above instructions are not followed.

CONTENTS

GENERAL DESCRIPTION

BOOSTER ASSEMBLY

The vacuum booster is a tandem diaphragm vacuum suspended unit. During normal operation, with the brake pedal released, manifold vacuum is applied to both sides of the diaphragms. Applying the brakes allows air at atmospheric pressure to enter one side of each diaphragm. This pressure difference provides the power assist.

The booster assembly is located on the left front cowl and serves as the mounting surface for the master cylinder.

CHECK VALVE HOSE AND ROUTING

Vacuum is supplied to the booster by a pipe located on the left side of the intake manifold. A flexible hose connects the pipe to the booster check valve. The check valve is mounted in a grommet on the front of the booster assembly.

DIAGNOSIS OF THE VACUUM BOOSTER

PROBLEM	POSSIBLE CAUSE	CORRECTION
Hard Pedal	1. Broken or damaged hydraulic brake pipes and hoses.	1. Inspect and replace as necessary.
	2. Cracked, open, or loose vacuum hose.	2. Inspect and replace as necessary.
	3. Faulty vacuum check valve or grommet.	3. Replace.
	4. Collapsed or damaged vacuum hose.	4. Replace hose.
	5. Plugged or loose vacuum fitting.	5. Clean or tighten.
	6. Faulty air valve seal or support plate.	6. Replace. Refer to the Light Duty Truck Unit Repair Manual.
	7. Damaged floating control valve.	7. Replace. Refer to the Light Duty Truck Unit Repair Manual.
	8. Bad stud welds on front or rear housing or power head.	8. Replace unless easily repaired.
	9. Faulty booster diaphragm.	9. Replace. Refer to the Light Duty Truck Unit Repair Manual.
	10. Worn or distorted reaction plate or levers.	10. Replace plate or levers. Refer to the Light Duty Truck Unit Repair Manual.
	11. Cracked or broken power pistons or retainer.	11. Replace power pistons and piston rod retainer. Refer to the Light Duty Truck Unit Repair Manual.
Grabby Brakes (Apparent Off-On Condition)	1. Broken or damaged hydraulic brake pipes and hoses.	1. Inspect and replace as necessary.
	2. Low fluid level in the master cylinder.	2. Fill reservoirs with proper brake fluid. Check for leaks.
	3. Faulty master cylinder seals.	3. Repair or replace as necessary.
	4. Cracked master cylinder casing.	4. Replace.
	5. Leaks in front calipers or rear wheel cylinders or in pipes or connections.	5. Inspect and repair as necessary.
	6. Air in hydraulic system.	6. Bleed system.
Brakes Fail to Release	1. Blocked passage in power piston.	1. Inspect and repair or replace as necessary. Refer to the Light Duty Truck Unit Repair Manual.
	2. Air valve sticking shut.	2. Check for proper lubrication of air valve O-ring seal. Refer to the Light Duty Truck Unit Repair Manual.
	3. Broken piston return spring or air valve spring.	3. Replace. Refer to the Light Duty Truck Unit Repair Manual.
	4. Tight brake pedal linkage.	4. Repair or replace as necessary.
	5. Misadjusted stoplamp or cruise control switches.	5. Readjust switches.
		D0106

ON-VEHICLE SERVICE

BOOSTER ASSEMBLY

Remove or Disconnect (Figures 1 and 2)

1. Apply parking brake.
2. Nuts (1).
3. Master cylinder (4) and combination valve bracket (as used).
   - Support the master cylinder.
4. Vacuum hose.
5. Retainer and washer.
6. Pushrod (6).
7. Nuts (8).
8. Booster assembly (5).
9. Gasket (7).

Install or Connect (Figures 1 and 2)

1. Gasket (7).
2. Booster assembly (5).
3. Nuts (8).

Tighten

- Nuts (8) to 29 N·m (21 lbs. ft.).

4. Pushrod (6).

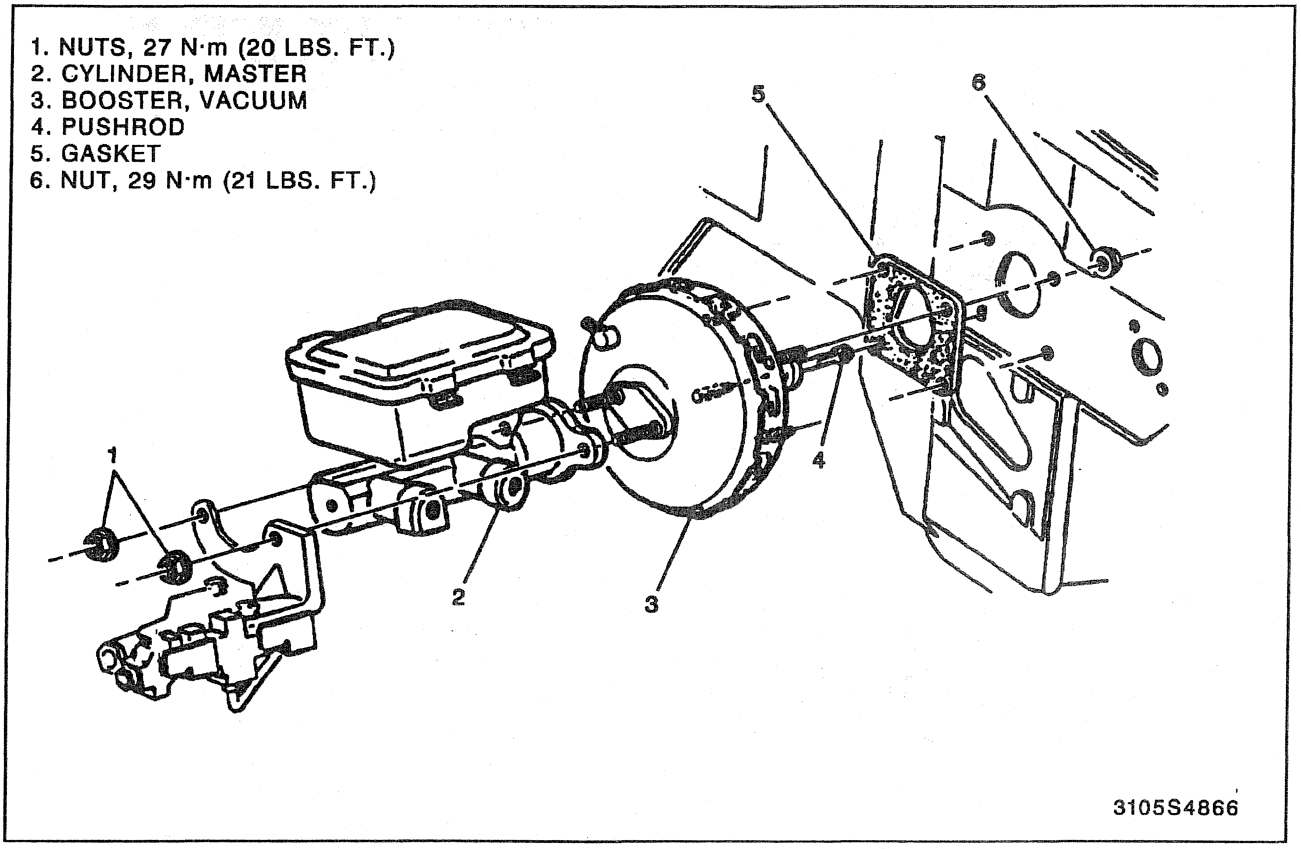


Figure 1—Vacuum Booster

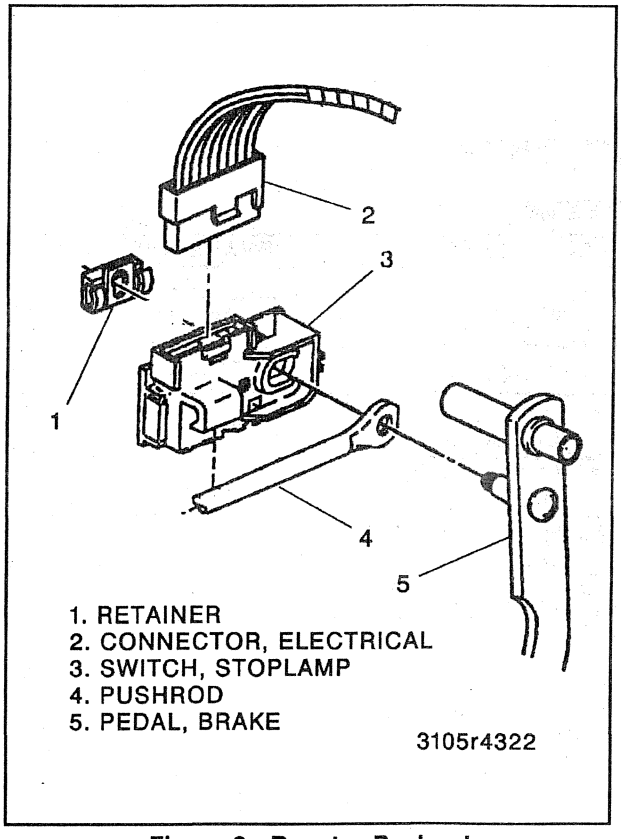


Figure 2—Booster Pushrod

5. Washer and retainer.
6. Vacuum hose.

Measure

- Gage the booster pushrod. Refer to "Gaging Procedure" in this section.

7. Master cylinder (4) and combination valve bracket (as used).
8. Nuts (1).

Tighten

- Nuts (1) to 27 N·m (20 lbs. ft.).

9. Release parking brake.

GAGING PROCEDURE

Tool Required:
J 37839 Pushrod Height Gage

1. Gage the piston rod using J 37839 (figure 3).
   A. Gage the booster with 85.0 kPa (25 in. Hg) vacuum or maximum engine vacuum.
   B. Check maximum and minimum rod lengths.
2. If the piston rod is not within limits, obtain a service adjustable piston rod and adjust the rod to the correct measurement.

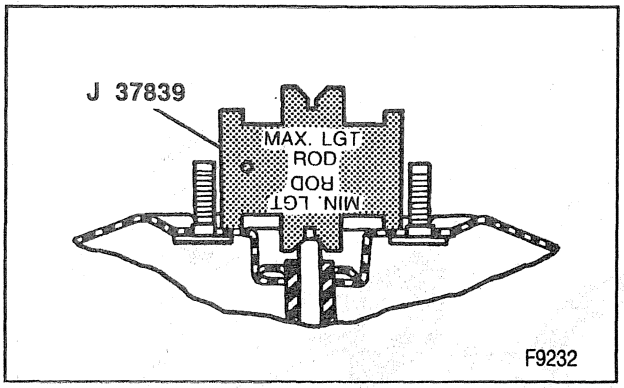


Figure 3—Gaging the Piston Rod

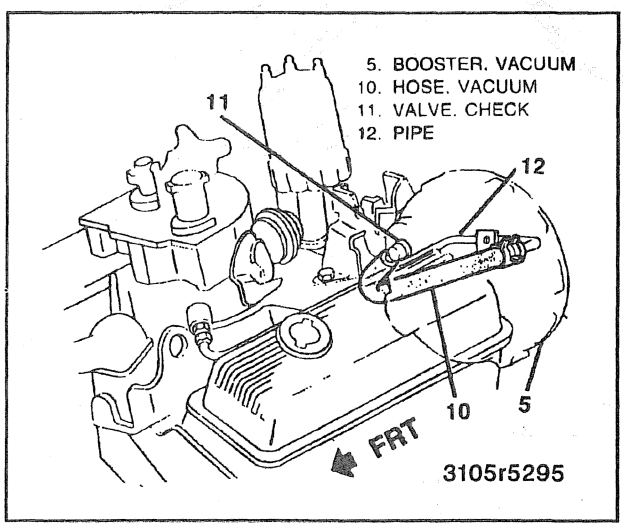


Figure 4—Vacuum Hose Routing

CHECK VALVE HOSE AND ROUTING

Vacuum hose routing is shown in figure 4.

SPECIFICATIONS

BRAKE SYSTEMS

SYSTEM	FRONT BRAKES	REAR BRAKES	BRAKE ASSIST
JB5	Disc 11.57-inch x 1.25-inch	254 mm x 57 mm (Leading/Trailing)	Vacuum
JD5			Hydraulic
JB6	Disc 11.57-inch x 1.25-inch	11.15-inch x 2.75-inch (Duo-Servo)	Vacuum
JD6			Hydraulic
JB7	Disc 12.5-inch x 1.26-inch	13.00-inch x 3.5-inch (Duo-Servo)	Vacuum
JD7			Hydraulic
JB8 Single Rear Wheel	Disc 12.5-inch x 1.26-inch	13.00-inch x 3.5-inch (Duo-Servo)	Hydraulic
JB8 Dual Wheel	Disc 12.5-inch x 1.50-inch	13.00-inch x 3.5-inch (Duo-Servo)	Hydraulic
JF9	Disc 14.25-inch x 1.54-inch	Disc 13.75 inch x 1.54 inch	Hydraulic

T2112

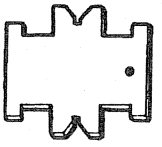
SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

ITEM	N·m	Ft. Lbs.
Booster Mounting Nuts	29	21
Master Cylinder Mounting Nuts	27	20

T2744

SPECIAL TOOLS

1.  J 37839

1. Power Brake Push Rod Height Gage

V1377

NOTES

SECTION 5D2

HYDRAULIC BOOSTER SYSTEM

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: Always use the correct fastener in the correct location. Use the correct fastener part number to replace a fastener. If the correct fastener part number is not available, a fastener of equal size and strength may be used. Do not use a fastener that is stronger when the correct fastener part number is not available in the following applications:

- *Some bolts are designed to permanently stretch, and if a stronger fastener is used, the part will not be tightened correctly. These permanently stretching bolts will be called out. The correct part number fasteners must be used to replace this type of fastener because there is no available equivalent.*
- *Other bolts are designed to break if over tightened to prevent part damage. If a stronger fastener is used part damage may occur.*

Fasteners that need to be replaced when removed will be called out. Fasteners that require thread lockers or thread sealant will be called out. The correct tightening specification and sequence must be used when installing fasteners. Part or system damage may occur if the above instructions are not followed.

CONTENTS

GENERAL DESCRIPTION

BOOSTER ASSEMBLY

Some C/K Models use a hydraulic booster to provide power assist (figure 1). The hydraulic booster uses fluid pressure from the power steering pump to provide the power assist. The booster assembly is located on the left front cowl and serves as the mounting surface for the master cylinder.

POWER STEERING PUMP

The power steering pump supplies hydraulic pressure to operate the brake booster. The pump is belt driven and mounts to the engine. The power steering pump provides a continuous flow of fluid to the booster any time the engine is running.

PIPES, HOSES, AND FITTINGS

Three flexible hoses route the power steering fluid through the hydraulic booster system. One hose supplies pressurized fluid from the power steering pump. Another hose routes pressurized fluid from the booster to the steering gear for the purpose of power steering. The last hose returns fluid to the power steering pump.

FLUID AND FLUID HANDLING

This system uses no special fluids. However, care must be taken to use the correct fluids. The master cylinder and brake systems use brake fluid, while the hydraulic booster uses power steering fluid.

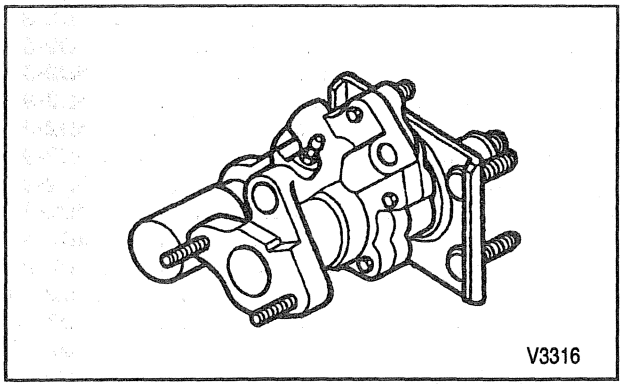


Figure 1—Hydraulic Booster Assembly

SUBSTANDARD OR CONTAMINATED FLUID

NOTICE: Hydraulic brake systems use two distinct and incompatible fluids. Power steering fluid is used in the hydraulic brake booster system. Brake fluid is used in the master cylinder and brake pipes. Use extreme care when selecting brake system fluids or seal damage can result. Refer to SECTION 0B to select the correct fluid.

Do not reuse brake system fluids. Do not mix power steering fluid with brake fluid. Swelling and deterioration of rubber parts may result from fluid contamination. This can lead to reduced brake performance and the eventual loss of braking capability.

If contamination occurs, flush the hydraulic booster system with clean power steering fluid. Refer to "Flushing the Hydraulic Booster System" in this section.

Booster component bench servicing should be done in a clean work area separate from the brake servicing area. Wash hands before changing between brake and booster work areas. Do not use the same containers for brake and power steering fluids.

FLUSHING THE HYDRAULIC BOOSTER SYSTEM

Flushing is required when the fluid in the power steering/hydraulic booster system becomes contaminated. Contaminated fluid in the booster system can cause rubber deterioration. This involves draining the old fluid and replacing it with clean fluid. For the procedure to flush the system, refer to SECTION 3B.

DIAGNOSIS OF THE HYDRAULIC BOOSTER SYSTEM

PROBLEM	POSSIBLE CAUSE	CORRECTION
Slow Brake Pedal Return	1. Excessive seal friction in booster. 2. Faulty spool action. 3. Restriction in return hose from booster to pump reservoir. 4. Damaged input rod end.	1. Overhaul with new seal kit. 2. Flush steering system while pumping brake pedal. 3. Replace hose. 4. Replace input rod and piston assembly.
Grabby Brakes-Booster Chatters - Pedal Vibrates	1. Faulty spool action caused by contamination in system. 2. Power steering pump belt slips. 3. Low fluid level in power steering pump.	1. Flush steering system while pumping brake pedal. 2. Refer to SECTION 6B1. 3. Fill reservoir and check for external leaks.
Accumulator Leak-Down System Does Not Hold Charge	1. Contamination in steering or booster system. 2. Internal leakage in accumulator system.	1. Flush steering system while pumping brake pedal. 2. Overhaul unit using accumulator rebuild kit and seal kit.
Brakes Self-Apply When Steering Wheel Turned	1. Contamination in steering or booster system. 2. Restriction in return hose from booster to pump reservoir.	1. Replace hydraulic booster. Flush complete system. 2. Replace hose.
		D0015

POWER BRAKE UNITS
BENDIX HYDRO-BOOST TROUBLESHOOTING

HYDRAULIC BRAKE BOOSTERS
PROCEDURE FOR NOISE—SLOW OR INCOMPLETE BRAKE PEDAL RETURN—OVERSENSITIVE BRAKING—SELF-APPLYING BRAKES

NOISY BRAKE BOOSTER

VERIFY COMPLAINT
1. TYPE OF NOISE.
2. WHEN IT OCCURS.

IF THE NOISE OCCURS DURING
- HIGH BRAKE PEDAL EFFORTS.
- QUICK PEDAL RELEASE

SEE NORMAL OPERATION NOISES AND COMPARE WITH A KNOWN ACCEPTABLE SYSTEM

HYDRO-BOOST BRAKE NOISE CHARACTERISTICS.
NORMAL OPERATING NOISES.

NORMAL HYDRO-BOOST UNITS PRODUCE CERTAIN CHARACTERISTIC BOOSTER NOISES. THESE NOISES OCCUR, FOR THE MOST PART, WHEN THE BRAKE PEDAL IS MANIPULATED IN A MANNER NOT ASSOCIATED WITH EVERYDAY BRAKING OR DRIVING HABITS. THE GENERAL CATEGORIES OF NORMAL OPERATING NOISES ARE (1) HISSING NOISES AND (2) CLUNK/CLICK/CLATTER NOISES.

THE HYDRO-BOOST WILL EMIT NORMAL HISSING NOISES WHEN ABOVE NORMAL BRAKE PEDAL EFFORTS ARE APPLIED (60 LBS. PEDAL EFFORT AND UP). THE HISS SOUNDS ARE PARTICULARLY NOTICEABLE WITH THE VEHICLE MOTIONLESS AND WILL INCREASE IN INTENSITY AS PEDAL PRESSURE INCREASES ABOVE 60 LBS. AND SYSTEM OPERATING TEMPERATURE INCREASES. LOUD HISSING SOUNDS AT OR BELOW NORMAL (20-25 LBS.) PEDAL EFFORT WARRANTS INVESTIGATION.

CLUNK, CLATTER, OR CLICKING NOISES WILL BE HEARD WHEN THE BRAKE PEDAL IS QUICKLY RELEASED FROM HARD (50-100 LBS.) PEDAL EFFORTS.

IF THE NOISE OCCURS DURING:
- LOW BRAKE PEDAL EFFORT
- ENGINE IDLE—NO PEDAL EFFORT.
- NORMAL DRIVING CONDITIONS.

RUN THE ENGINE UNTIL IT IS AT NORMAL OPERATING TEMPERATURE

DUPLICATE THE OPERATING CONDITION ABOVE AND LISTEN FOR THE NOISE.

COMPARE RESULTS WITH A KNOWN ACCEPTABLE SYSTEM

ERRATIC OPERATION, STICKS, BINDS, OR GRABS

RUN ENGINE AT FAST IDLE

PULL THE BRAKE PEDAL REARWARD WITH APPROXIMATELY 10 POUNDS OF FORCE. RELEASE THE PEDAL AND MEASURE THE DISTANCE TO THE FLOOR BOARD

MAKE A 100 LB. BRAKE APPLICATION. RELEASE THE BRAKE PEDAL AND AGAIN MEASURE THE PEDAL TO FLOOR BOARD DISTANCE. THE PEDAL SHOULD RETURN TO ITS ORIGINAL POSITION

IF THE PEDAL DOES NOT RETURN PROPERLY, CHECK THE PEDAL TO BE SURE IT IS OPERATING FREELY. CORRECT ANY STICKING OR BINDING AS NECESSARY.

IF BRAKES SELF-APPLY AND PEDAL IS FREE, CHECK FOR OBSTRUCTION IN THE RETURN LINE OR KINKED CONNECTIONS BETWEEN HYDRO-BOOST AND POWER STEERING PUMP RESERVOIR.

REMOVE OBSTRUCTION OR REPLACE LINE AS REQUIRED. IF CONDITION REMAINS, CHECK FOR A DAMAGED REACTION END. IF DAMAGED, HYDRO-BOOST SHOULD BE REPLACED OR REPAIRED.

IF THE PEDAL IS FREE OF ANY BINDING CONDITION, AND THERE ARE NO OBSTRUCTIONS IN THE RETURN HOSE, REMOVE THE MASTER CYLINDER RESERVOIR COVER.

OBSERVE THE BRAKE FLUID IN THE RESERVOIR WHILE RAPIDLY APPLYING THE BRAKE PEDAL ONE INCH.

FLUID SURFACE SHOULD HAVE SOME MOVEMENT OR SPOUT IN THE FORWARD RESERVOIR. IF NO MOVEMENT OR SPOUTING OCCURS, EITHER THE HYDRO-BOOST UNIT IS DEFECTIVE AND MUST BE REPLACED OR REPAIRED, OR THE MASTER CYLINDER IS DEFECTIVE. REFER TO SECTION 5A1.

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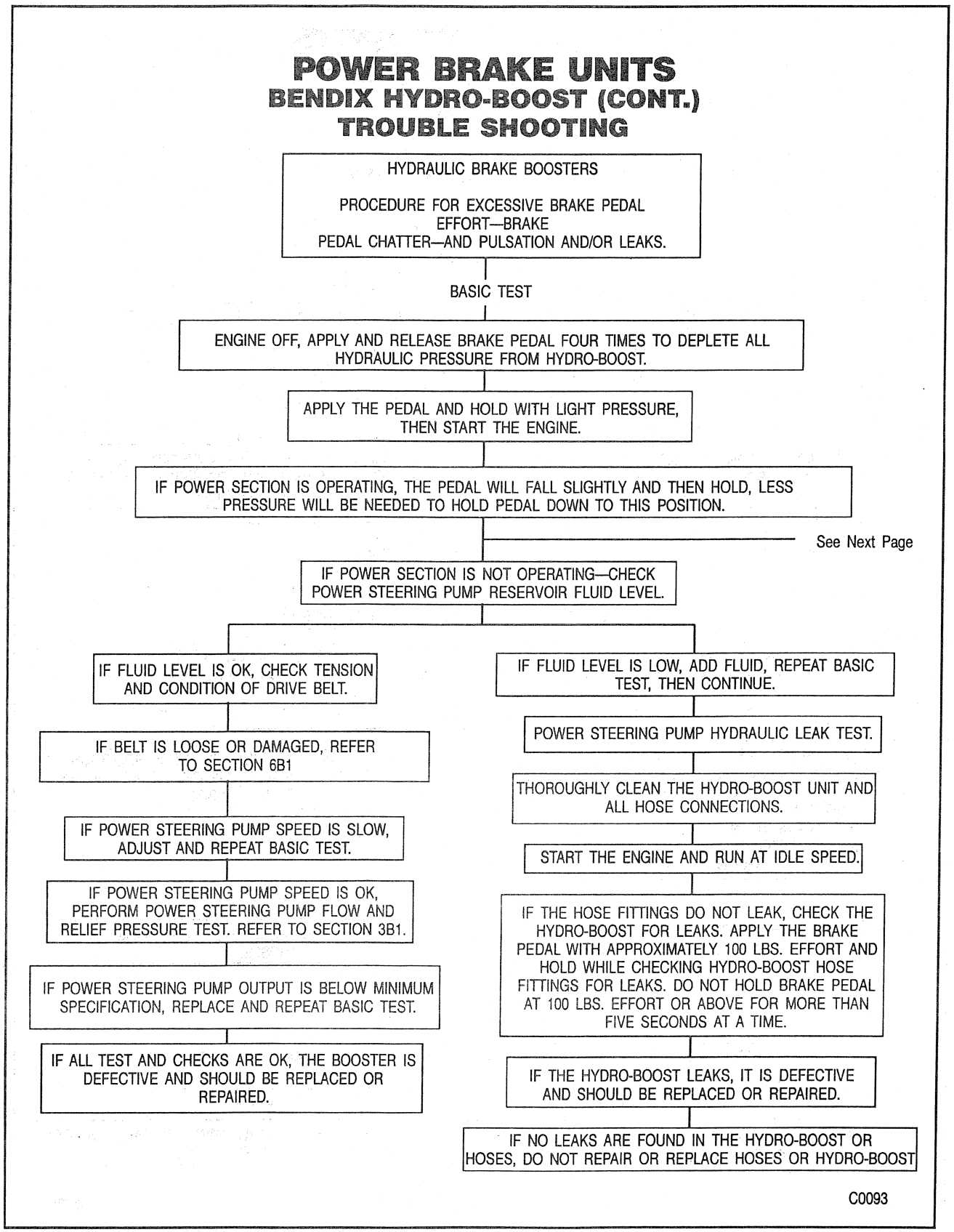
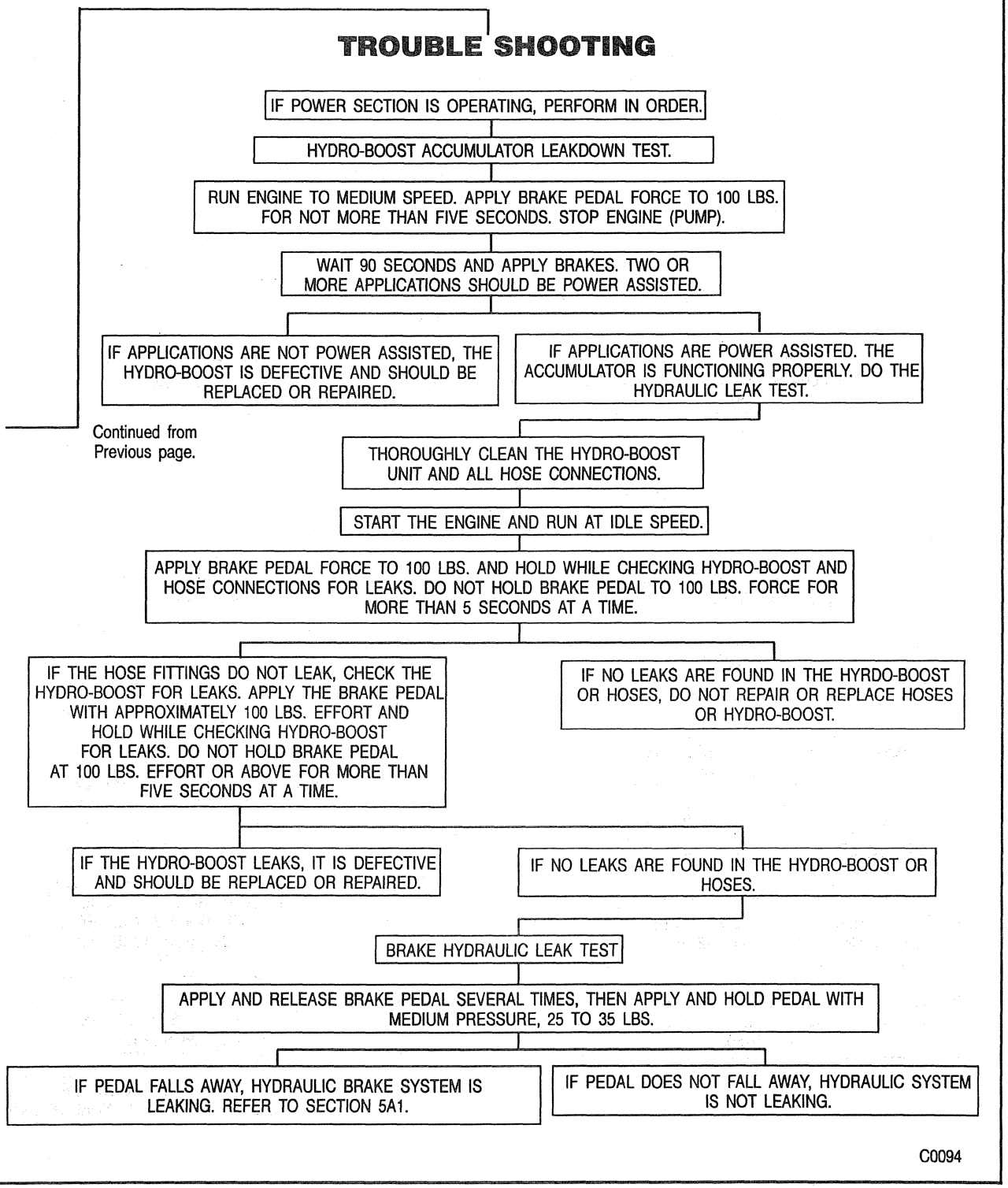
POWER BRAKE UNITS
BENDIX HYDRO-BOOST (CONT.)
TROUBLE SHOOTING



POWER BRAKE UNITS

BENDIX HYDRO-BOOST (Cont.)

TROUBLE SHOOTING



HYDRAULIC SYSTEM FLUID LOSS

NOTICE: Do not run the engine without fluid in the power steering pump reservoir. Doing so could damage the pump bearings and seals. The belt that drives the power steering pump also drives the coolant pump and other components. Do not disconnect the belt and run the engine. A malfunctioning power steering pump and/or system still serves as an idler pulley for the belt. If the pump is allowed to run without fluid in it, the bearings will seize up and cause the coolant pump to stop. This can cause damage to the engine.

If the hydraulic booster system fails due to a loss of fluid, the following steps should be taken before starting the vehicle.

- If the failed part is not the power steering pump, route the pressure pipe back to the fluid reservoir.
- Make all necessary repairs. Fill and bleed the power steering system. Refer to SECTION 3B.

The hydraulic booster system should be cleaned and flushed when the power steering pump is replaced. Metal shavings from a worn power steering pump often contaminate the system. The booster head should be disassembled, cleaned, and have all seals and O-rings replaced. Pipes and hoses should be removed and blown clean of all metal shavings. Refer to SECTION 3B for information on flushing and "Booster Assembly" in this section.

BELT TENSION

When servicing any part of the brake system, check the power steering pump belt tension and condition. The serpentine belt is not adjustable. Refer to SECTION 6B1.

FLUID LEVEL INSPECTION

When servicing any part of the brake system, check the level in the power steering fluid reservoir. The fluid level in the reservoir should be checked at regular intervals and added as needed. Refer to SECTION 0B.

PIPES, HOSES, AND FITTINGS

All pipes, hoses, and fittings should be inspected for leaks at regular intervals. The fittings must be tight and all clips, clamps, and unions supporting the pipes and hoses must be in place and properly secured. Make sure all hoses and tubes are installed so they do not contact parts of the vehicle that could cause chafing or wear on the hoses.

Check for leaks by wiping the suspected area clean. Leaking fluid can be easily spotted when the suspected area is clean. When fluid leaks appear, tighten, repair, or replace nearby fittings and bolts.

SYSTEM TESTS

The hydraulic booster system works with fluid pressure from the power steering system. Therefore, a malfunctioning power steering system can affect the booster, just as a booster malfunction can affect the steering system. Before extensive testing, the following checks must be made:

1. Check all the power steering and brake pipe connections for leaks or restrictions.

NOTICE: Power steering fluid and brake fluid cannot be mixed. If brake seals contact power steering fluid or steering seals contact brake fluid, seal damage will result.

2. Check and fill the master cylinder with brake fluid.
3. Check and fill the power steering pump reservoir with power steering fluid. If the power steering fluid contains air, refer to SECTION 3B for further diagnosis.
4. Check the power steering pump belt for wear and tension. Refer to SECTION 6B1.
5. Check power steering pump pressure. Refer to SECTION 3B.

NOISE DIAGNOSIS

Noise from the relief valve is normal when the brakes are applied. Firmly applying the brake pedal when the vehicle is parked also causes noise. These noises are caused by the air that temporarily gets in the fluid during these conditions. Power steering pump noise can be confused with transmission, rear axle, or generator noise.

The following noises are associated with the hydraulic booster and may or may not be cause for a customer complaint. Some noises are normal and temporary in nature. Other noises can be a sign of wear or air in the hydraulic booster or steering system.

1. A moan or low frequency hum usually accompanied by a vibration in the brake pedal or steering column may be noticed during parking or other low speed maneuvers. This may be caused by a low power steering fluid level or air in the fluid. Holding the power steering pump at relief pressure (steering wheel held all the way in one direction) for more than 5 seconds causes air to enter the system. Check the fluid level and fill as needed. The system must then sit for one hour with the engine off to remove the air. If the condition persists, refer to SECTION 3B for further diagnosis.
2. A high-speed fluid noise may be heard when the brake pedal is applied fully. This condition is normal.
3. A slight hiss may be noticed when the accumulator pressure is used. It is the sound of the hydraulic fluid escaping through the accumulator valve. This condition is normal.
4. If the accumulator is empty and the engine is started, another hissing sound may be heard during the first brake application or steering maneuver. This is caused by fluid rushing through the accumulator charging orifice. It is normal and should only be heard once after the accumulator is emptied. If this sound continues, even though no apparent accumulator pressure assist was made, it could be an indication that the accumulator is not holding pressure and should be checked. Refer to the "Accumulator Leakdown Test" in this section.

FUNCTIONAL TEST

With the ignition switch in the "OFF" position, apply the brake pedal several times to empty the accumulator. Apply the brake pedal using 180 N (40 lbs.) of force and start the engine. The pedal should fall away and then push back against your foot.

ACCUMULATOR LEAKDOWN TEST

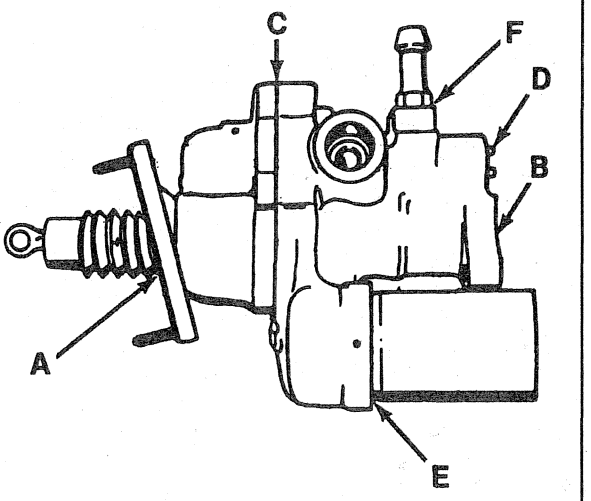
1. Start the engine and charge the accumulator by applying the brake pedal or turning the steering wheel from stop to stop.
2. Turn the engine off and let the vehicle sit for one hour.
3. After one hour there should be at least two power assisted applications with the engine off.
4. If the accumulator will not hold a charge for one hour, but functions normally after charging, the accumulator valves are the cause.
   - To repair this condition, the booster must be disassembled and the accumulator valves replaced. Refer to the Light Duty Truck Unit Repair Manual.
5. If the accumulator can be heard charging and discharging, but it does not hold a charge, the accumulator valves are the cause.
   - To repair this condition, the booster must be disassembled and the accumulator valves replaced. Refer to the Light Duty Truck Unit Repair Manual.
6. Empty the accumulator by pressing the brake pedal several times.
7. If the accumulator has lost its gas charge, the accumulator can will rotate or wobble. Repairing this requires replacing the accumulator assembly.

SEAL LEAK DIAGNOSIS

Refer to figure 2.

A. **INPUT ROD SEAL** A damaged input rod seal will show as a fluid leak from the mounting bracket vent hole. The booster must be removed and disassembled. Check the input rod bore for any scratches that may cause the leak. If scratches are present, the housing cover must be replaced. If no excessive scratches are present, replace all seals using the booster seal kit.

B. **POWER PISTON SEAL** Power piston seal damage is noticed by fluid leaking at the common master cylinder brake booster vent and a possible reduction in power assist. The booster must be removed and disassembled. Check the piston for any scratches that may be the cause of the leak. If no scratches are present, replace all seals using the booster seal kit.



A. Input Rod Seal
B. Power Piston Seal
C. Housing Seal
D. Spool Valve Plug Seal
E. Accumulator Seal
F. Return Port Fitting

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Figure 2—Seal Leak Diagnosis

C. **HOUSING SEAL** If the housing seal is damaged, fluid will leak between the two housings. The booster must be removed and disassembled. The booster seal kit should be used to replace the housing, input rod, and power piston seals.

D. **SPOOL VALVE PLUG SEAL** Damage to this seal causes fluid to leak past the plug. This seal can be replaced with the booster on the vehicle.

E. **ACCUMULATOR SEAL** Damage to this seal causes fluid to leak past the accumulator cap. This seal can be replaced with the booster on the vehicle.

F. **RETURN PORT FITTING** Tighten the fitting to 10 N·m (88 lbs. in.). If the leak continues, replace the seal ring under the fitting.

ON-VEHICLE SERVICE

SERVICE PRECAUTIONS

NOTICE: Hydraulic brake systems use two distinct and incompatible fluids. Power steering fluid is used in the hydraulic brake booster system. Brake fluid is used in the master cylinder and brake pipes. Use extreme care when selecting brake system fluids or seal damage can result. Refer to SECTION 0B to select the correct fluid.

CHECKING AND ADDING FLUID

For information on checking and adding fluid to the hydraulic booster system, refer to SECTION 3B.

BLEEDING THE HYDRAULIC BOOSTER SYSTEM

Refer to the bleeding procedure in SECTION 3B.

FLUSHING THE HYDRAULIC BOOSTER SYSTEM

Refer to the flushing procedures in SECTION 3B.

PIPES, HOSES, AND FITTINGS

For on-vehicle service, refer to SECTION 3B.

BOOSTER ASSEMBLY

Remove or Disconnect (Figures 3, 4, and 5)

1. Apply parking brake.
2. Inlet (10), steering gear (11), and return (12) hoses.
3. Nuts (1).
4. Master cylinder (2).
   - Support the master cylinder.
5. Retainer (1).
6. Pushrod (4).
7. Nuts (5).
8. Booster assembly (6).
9. Gasket (4).

Install or Connect (Figures 3, 4, and 5)

1. Gasket (4).
2. Booster assembly (6).
3. Nuts (5).

Tighten

   - Nuts (8) to 30 N·m (22 lbs. ft.).

4. Pushrod (4).
5. Retainer (1).
6. Master cylinder (2).

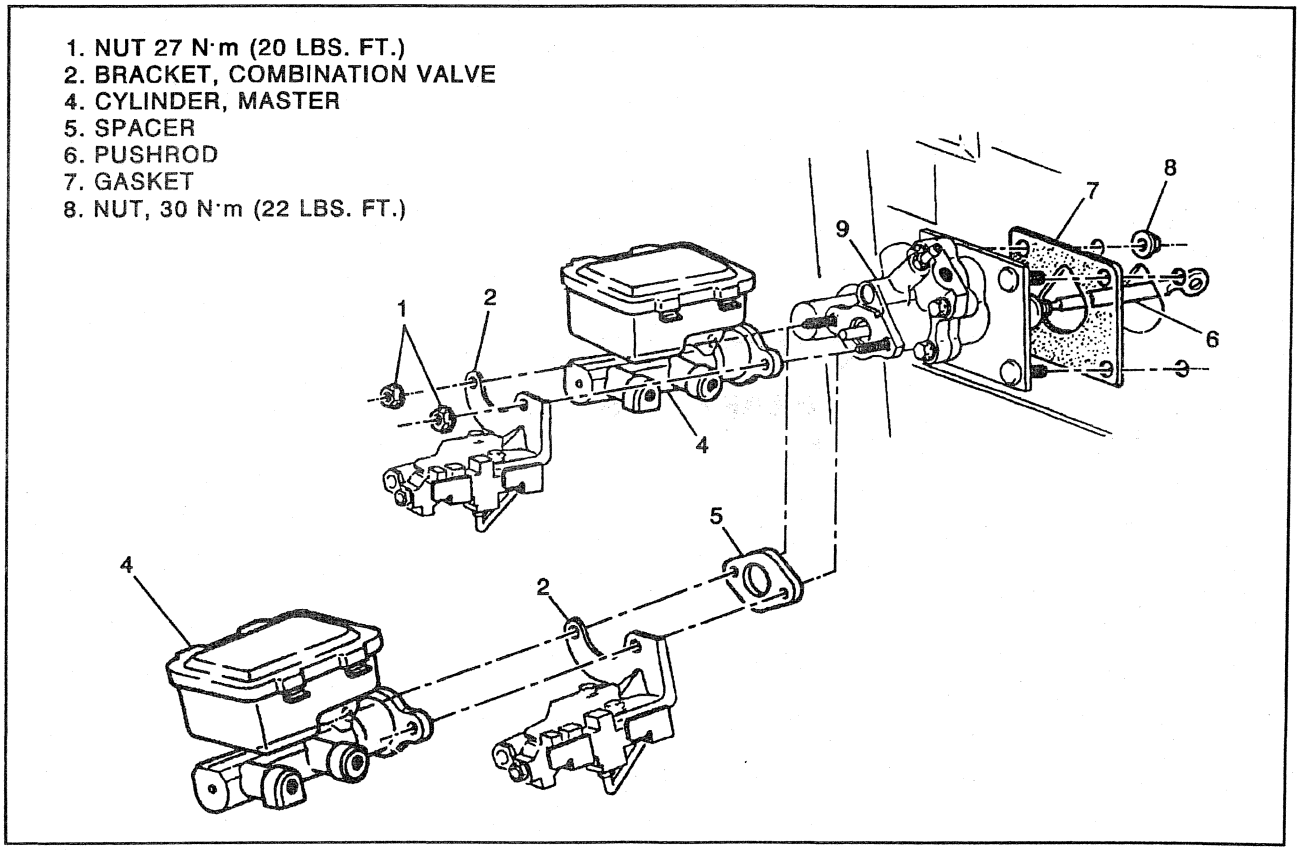
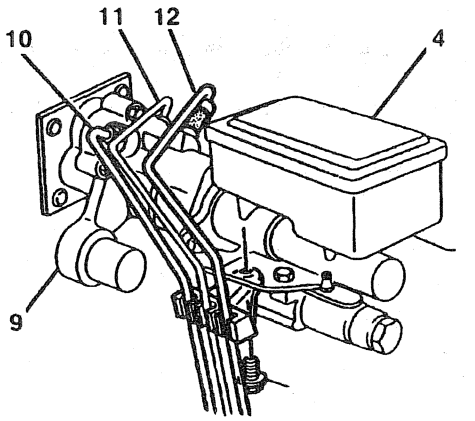


Figure 3—Booster Replacement



4. CYLINDER, MASTER
9. BOOSTER, HYDRAULIC
10. HOSE, INLET 30 N·m (22 FT. LBS.)
11. HOSE, STEERING GEAR, 30 N·m (22 FT. LBS.)
12. HOSE, RETURN

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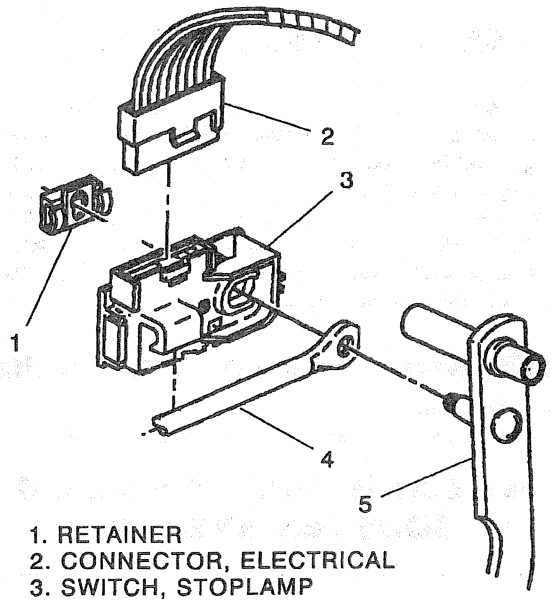
Figure 4—Booster Hoses



1. RETAINER
2. CONNECTOR, ELECTRICAL
3. SWITCH, STOPLAMP
4. PUSHROD
5. PEDAL, BRAKE

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Figure 5—Pushrod Mounting

7. Nuts (1).

Tighten

- Nuts (1) to 27 N·m (20 lbs. ft.).

8. Return (12), steering gear (11), and inlet (10) hoses.

Tighten

- Hose fittings to 30 N·m (22 lbs. ft.)

9. Bleed booster. Refer to SECTION 3B.

POWER STEERING PUMP

For power steering pump on-vehicle service, refer to SECTION 3B.

SPECIFICATIONS

BRAKE SYSTEMS

SYSTEM	FRONT BRAKES	REAR BRAKES	BRAKE ASSIST
JB5	Disc 11.57-inch x 1.25-inch	254 mm x 57 mm (Leading/Trailing)	Vacuum
JD5			Hydraulic
JB6	Disc 11.57-inch x 1.25-inch	11.15-inch x 2.75-inch (Duo-Servo)	Vacuum
JD6			Hydraulic
JB7	Disc 12.5-inch x 1.26-inch	13.00-inch x 3.5-inch (Duo-Servo)	Vacuum
JD7			Hydraulic
JB8 Single Rear Wheel	Disc 12.5-inch x 1.26-inch	13.00-inch x 3.5-inch (Duo-Servo)	Hydraulic
JB8 Dual Wheel	Disc 12.5-inch x 1.50-inch	13.00-inch x 3.5-inch (Duo-Servo)	Hydraulic
JF9	Disc 14.25-inch x 1.54-inch	Disc 13.75 inch x 1.54 inch	Hydraulic

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POWER STEERING FLUID RECOMMENDATIONS

Power Steering Fluid Requirements (All Vehicles) ..... GM Power Steering Fluid (Part No. 1050017) or equivalent

T2644

FASTENER TIGHTENING SPECIFICATIONS

ITEM	N·m	Ft. Lbs.
Booster Mounting Nuts	30	22
Hose Fittings	30	22
Master Cylinder Mounting Nuts	27	20

T2945

NOTES

SECTION 5E1

FOUR WHEEL ANTILOCK BRAKE SYSTEM

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in SECTION 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

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 earlier model or aftermarket brake parts may 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 should be used to remove any dust on brake parts. Equipment is commercially available to perform this washing function. These wet methods will prevent fibers from becoming airborne.

NOTICE: Always use the correct fastener in the correct location. Use the correct fastener part number to replace a fastener. If the correct fastener part number is not available, a fastener of equal size and strength may be used. Do not use a fastener that is stronger when the correct fastener part number is not available in the following applications:

- *Some bolts are designed to permanently stretch, and if a stronger fastener is used, the part will not be tightened correctly. These permanently stretching bolts will be called out. The correct part number fasteners must be used to replace this type of fastener because there is no available equivalent.*
- *Other bolts are designed to break if over tightened to prevent part damage. If a stronger fastener is used part damage may occur.*

Fasteners that need to be replaced when removed will be called out. Fasteners that require thread lockers or thread sealant will be called out. The correct tightening specification and sequence must be used when installing fasteners. Part or system damage may occur if the above instructions are not followed.

CONTENTS

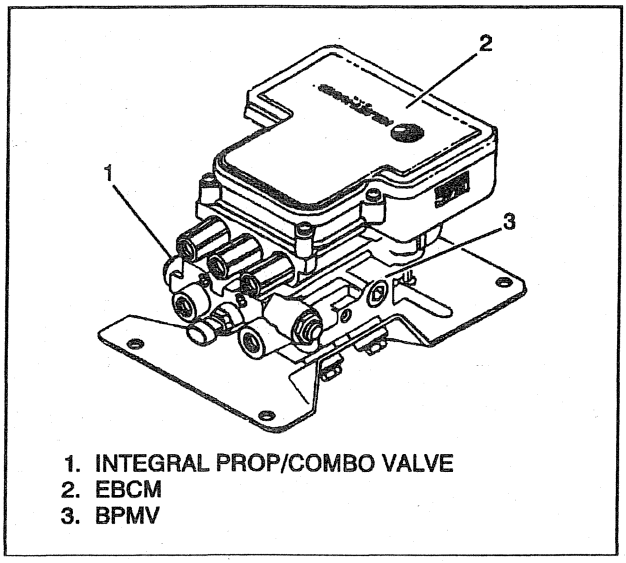
CONTENTS (cont'd)

GENERAL DESCRIPTION

This section covers diagnostic and service procedures for the four wheel antilock brake system (4WAL). These models use the three sensor 4WAL system. Speed information is obtained using a wheel speed sensor (WSS) at each front wheel and the vehicle speed sensor (VSS) for rear wheel speed information. 4WAL reduces the occurrence of wheel lockup during severe brake applications. The system regulates hydraulic pressure to all four wheels. The pressure is regulated by the brake pressure modulator valve (BPMV) located on the left inner fender (figure 1).

ABBREVIATIONS/DEFINITIONS

BPMV	Brake Pressure Modulator Valve
CKT	Circuit
DLC	Data Link Connector
DTC	Diagnostic Trouble Code
DUMP	Dump Valve (Cartridge)
DVOM	Digital Volt Ohm Meter
EBCM	Electronic Brake Control Module
EHCU	Electro-Hydraulic Control Unit
4WAL	Four Wheel Antilock
4WD	Four Wheel Drive
ISO	Isolation Valve (Cartridge)



1. INTEGRAL PROP/COMBO VALVE
2. EBCM
3. BPMV

Figure 1—Electro-Hydraulic Control Unit (EHCU)

LPA .....Low Pressure Accumulator
2WD ..... Two Wheel Drive
VSS..... Vehicle Speed Sensor
WSS.....Wheel Speed Sensor

The BPMV is defined as the lower, hydraulic control portion of the antilock assembly. This component includes the internal control cartridges, electric motor and pumps. It does not include the EBCM or combination valve.

The EHCU is the entire unit, including the EBCM, BPMV and combination valve.

The EBCM is the electronic control portion of the antilock assembly. It mounts to the top of the BPMV and is housed in aluminum with a black plastic top.

BASIC KNOWLEDGE REQUIRED

Diagnosing the 4WAL system requires a good understanding of electrical system basics and the use of circuit testing tools. Without this basic knowledge you will find it difficult to use the diagnostic procedures detailed in this section.

Some electrical basics, basic troubleshooting procedures and hints, and the use of circuit testing tools are discussed in the Driveability, Emissions, and Electrical Diagnosis Manual. You will need to know:

- BASIC ELECTRICAL CIRCUITS
  - — The basic theory of electricity, series and parallel circuits, and voltage drops across series and parallel resistor systems.
  - — The meaning of volts (voltage), amps (current), and ohms (resistance).
  - — What happens in a circuit with an open wire or a wire shorted to ground or battery.
  - — How to read and understand a wiring diagram.
- USE OF CIRCUIT TESTING TOOLS
  - — How to use a digital volt meter (DVM) to measure voltage, current, and resistance.
  - — Be aware that when DVM use is requested, the first terminal listed in the check is intended to be connected to the positive (usually red) DVM lead.
  - — The operation and capabilities of the scan tool and the RWAL/4WAL cartridge used with it.
  - — How to use jumper wires to test circuits.

WARNING/INDICATOR LAMP OPERATION

The 4WAL system uses an "ANTILOCK" indicator lamp in the instrument cluster to show system operation and malfunctions.

Normal Lamp Operation

A bulb check occurs each time the ignition switch is turned to the "ON" position. The "ANTILOCK" and "BRAKE" lamps should turn on, remain on for about two seconds, then turn off. The "ANTILOCK" lamp also indicates 4WAL system malfunctions. When the EBCM detects a malfunction in the system, it turns the "ANTILOCK" and sometimes the "BRAKE" lamp on. The lamp may remain on or turn off depending on the malfunction. To determine the specific cause of the malfunction, refer to "Functional Test."

TIRES AND 4WAL

Correct tire size, proper inflation, accurate alignment and even wear are needed for good brake performance. These items are essential for proper antilock performance.

Spare Tire

Using the spare tire supplied with the vehicle will not affect the performance of the 4WAL system.

Replacement Tires

Replacement tires should be the same size, load range, and construction on all four wheels. Failure to comply with this can affect the performance of the 4WAL system.

Speedometer Calibration

The vehicle speed sensor calibrator module must be replaced when the rear axle ratio or tire size is changed. The tire size calibration in the EBCM must also be corrected whenever the tires or axle ratio(s) are changed.

ANTILOCK BRAKE SYSTEM INTRODUCTION

ABS is designed to provide the average driver with:

- Optimal steering control and stability by enabling the vehicle to move in a driver controlled direction during braking.
- Optimal braking performance by making the most of the available traction (on most road surfaces).

WHEEL SLIP

How well a vehicle can stop is related to how well the tire contact patch grips the road surface. At 0% slip, the tire rotates freely. At 100% slip the tire and wheel are locked and the momentum of the vehicle pushes the locked tires along. Stopping distance increases and steering control lessens.

If the tires grip well (10%-20% slip), vehicle stopping distance will be as short as possible and steering control will be at its best. Some slip is necessary to stop the wheel and achieve maximum braking.

When ABS operation occurs, the driver of the vehicle should always continue to push hard on the brake pedal. **NEVER PUMP ABS BRAKES.** The ABS system will automatically modulate the brakes to keep the tires in contact with the road.

STEERING CONTROL

Steering control, like braking, also depends on tire traction: a locked tire in a 100% slip condition delivers less than optimum braking and directional control. Thus some tire rotation is desirable for steering control. The tires must regain traction before steering control is restored to the vehicle.

ABS SYSTEM OPERATION

SELF-TESTS

The ABS system performs two system self-tests automatically:

- The first self-test is performed when the ignition is turned on. Both the ABS indicator lamp and the "BRAKE" warning lamp will turn on for a few seconds, then they will turn off one at a time. If one of the lights stays on, it could indicate that either the ABS system or base brake system needs attention.
- The second self-test is performed when the vehicle begins to move and the EBCM cycles the hydraulic portion of the ABS system. A noise from the BPMV may be noticed when this function occurs.

NORMAL BRAKING MODE

During normal braking, pressure is applied through the brake pedal. Fluid comes from the master cylinder, through the combination valve and into the BPMV. The fluid travels through the normally-open isolation cartridge, past the normally-closed dump cartridge and out into the brakes.

During normal braking, the pump is not turned on. The low pressure accumulators and attenuators are empty with only residual pressure stored in them.

Even though the ABS is passive during normal braking, the EBCM constantly monitors wheel sensor inputs for rapid deceleration. **If the ABS system becomes disabled for any reason, the driver will always have foundation brakes.** The normally-open ISO cartridge and normally-closed dump cartridge will remain in these positions to allow normal fluid pressure to the wheels.

ABS however, **will not operate** without seeing brake switch activation and wheel slip. The vehicle must be going at least 8 mph to begin ABS operation.

ABS BRAKING MODE

The antilock brake system will work together with the foundation brake system to monitor the wheel speed sensors and control the sequence of pressure changes until the vehicle has come to a complete stop or the brake pedal has been released.

The 4WAL system operates through a four step process:

- Pressure Isolate/Maintain
- Pressure Decrease
- Pressure Increase
- Brake Release (fluid return)

SEQUENCE OF EVENTS

1. With the vehicle at speed, the driver depresses the brake pedal.
2. The brake switch opens and the wheel speeds begin to decrease as the master cylinder and brake pressure increases.
3. As the wheel's speed continues to depart further from true vehicle speed, the "normally-open" isolation cartridge for the affected channel is closed to disallow the buildup of additional pressure at the wheel. The master cylinder pressure continues to increase as the driver presses the pedal, but the wheel pressure is now limited to the ABS system pressure.
4. When the controller determines that the wheel departure is significant, the "normally-closed" dump cartridge is opened. This bleeds off some of the pressure at the wheel cylinder or caliper, to allow the wheel to return to a speed closer to the true vehicle speed.
5. The dump cartridge is again closed and the isolation cartridge remains closed to allow the wheel speed to completely recover from the departure.
6. Once the wheel has recovered from the departure, the isolation cartridge is momentarily pulsed open to allow master cylinder pressure and pump pressure to reach the brakes. This controlled pressure rise continues until the wheel is at optimum brake output or until the brake pressure is brought up to master cylinder output pressure. The ABS allows the brake fluid to flow to the wheel, to build pressure and to try to force another departure, repeating steps 3-6.

ISOLATION MODE (PRESSURE MAINTAIN)

The EBCM is "armed" when the driver applies the brakes and sends a signal to the module to prepare for a possible antilock stop. Isolation will occur when the driver applies excessive braking for the given road conditions, causing the wheel(s) to decelerate at a rate greater than the vehicle is capable of.

If the information from the wheel speed sensors indicate excessive wheel deceleration (immanent lockup), the first step in the antilock sequence is to isolate the brake pressure being applied by the driver.

The EBCM sends a voltage to the coil to energize and close the isolation cartridge by pulling down on the armature with a magnetic force. This will prevent any additional brake pressure applied by the driver from reaching the wheel. Though each channel of this 3 channel system can operate independently, once any front channel (brake) sees excessive deceleration, both front ISO cartridges are energized and closed. Thus, with the isolation cartridges closed, further unnecessary increases in brake pressure will be prohibited.

DUMP MODE (PRESSURE DECREASE)

Once the pressure is isolated, it must be reduced to get the wheels rolling once again. This is accomplished by dumping a portion of the brake fluid pressure into a low pressure accumulator (LPA).

The EBCM energizes the dump cartridge coil(s) to open the dump cartridge, allowing fluid from the wheels

dumped into the LPA. This is done with very short activation pulses opening and closing the dump cartridge passageway. Brake pressure is lowered at the wheel and allows the affected wheel to begin rolling again.

The fluid taken from the wheels forces a spring back and is stored in the LPA at approximately 150 psi. A portion of the fluid also primes the pump so it can begin building reapply pressure. The dump cartridges are opened independently to control the deceleration of the wheel.

REAPPLY MODE (PRESSURE INCREASE)

The reapply sequence is initiated to obtain optimum braking at each wheel. The ISO cartridge is momentarily pulsed open to allow master cylinder and pump pressure to reach the brakes. This controlled pressure rise continues until the wheel is at optimum brake output or until the brake pressure is brought up to the master cylinder output pressure.

If more pressure is required, more fluid is drawn from the master cylinder and applied to the brakes. **The driver will feel pedal pulsations, or pedal drop. This is normal and expected when in the antilock mode.**

As fluid is reapplied to the wheels, they begin to slow down at the optimum rate. If they approach immanent lockup again, the module will isolate, dump and reapply. These control cycles (isolation, dump and reapply) occur in millisecond intervals, allowing several cycles to occur each second. It occurs much faster and more controlled than pumping the brake pedal.

BRAKE RELEASE

At the end of the antilock stop, when the driver releases the brake pedal, the motor will remain on for a short time to help drain any fluid left in the LPA. As the fluid drains back into the system, the spring force in the LPA pushes the piston to the home position. When the brake switch closes, the isolation cartridge is turned off and fluid may return through the isolation orifice.

SYSTEM COMPONENTS

BRAKE PRESSURE MODULATOR VALVE

The brake pressure modulator valve (BPMV) is located on the inner left fender and regulates hydraulic pressure in the brake system during an antilock stop (Figure 1).

The BPMV is split into 3 hydraulic channels; right front, left front and rear brakes. Each channel has an isolation valve and a dump valve. The front channels share a low pressure accumulator, attenuator and pump. The rear channel also has a low pressure accumulator, attenuator and a pump. The rear brake channel of the BPMV controls both rear wheels simultaneously.

FRONT WHEEL SPEED SENSOR

The front wheel speed sensor (WSS) is a magnetic coil/pickup that mounts to the front steering knuckle (Figures 2, 3, and 4). It produces an AC voltage signal to tell the BPMV how fast the wheel is turning. The faster the wheel turns, the greater the frequency of pulses the sensor produces. The WSSs connect to the EBCM through the 5-pin connector. On 2WD models, the WSSs mount to the dust shields. On 4WD models,

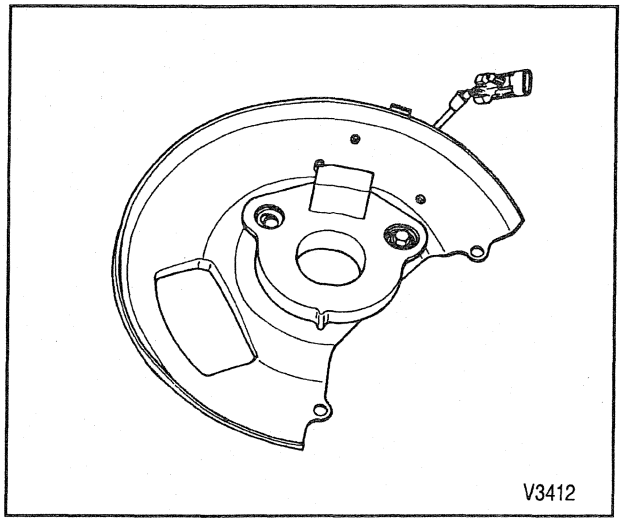


Figure 2—Front Wheel Speed Sensor (2WD)

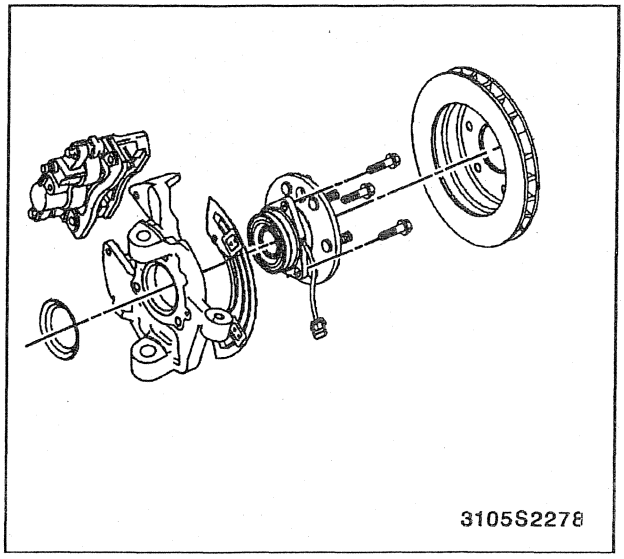


Figure 3—Front Wheel Speed Sensor (4WD)

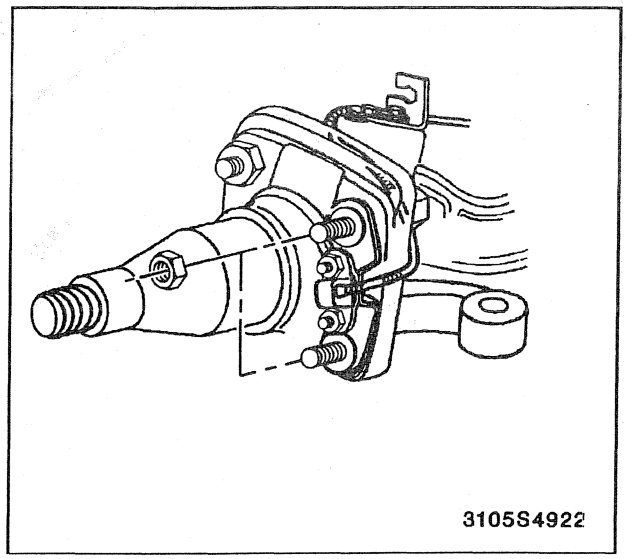


Figure 4—Front Wheel Speed Sensor (3500 HD)

the WSSs are integrated into the front wheel bearing along with the tone rings. Wheel speed sensor windings have a resistance value of 1000 to 3000 ohms on 2WD models. Four wheel drive sensor values are listed on the "Integral Speed Sensor Resistance Values" chart at the back of this section.

FRONT WHEEL SPEED SENSOR TONE WHEELS

The front WSSs use tone wheels to produce an AC voltage signal. Tone wheels are metal rings with teeth on the outside diameter. The AC voltage is produced as the teeth come into and leave alignment with the sensor magnet. The tone wheels are attached to the rotor on 2WD models and are integral with the wheel bearing on 4WD models. Any imperfections in the tone rings, such as a broken or missing tooth, can cause an inaccurate wheel speed reading on the affected wheel.

WHEEL SPEED SENSOR CALIBRATION

The 4WAL EBCM is capable of accepting wheel speed signals from several different size tire and wheel combinations. All vehicles are preprogrammed from the factory with the proper front tire size calibration. Whenever the 4WAL EBCM is replaced and/or the tire size is changed, it is necessary to reset the tire size calibration in the EBCM. Once programmed, this calibration will remain even if the battery is disconnected or the EBCM is removed from the vehicle.

NOTICE: If the tire size or axle ratio are changed, always recalibrate the VSS Calibrator Module and the tire size calibration in the EBCM.

VEHICLE SPEED SENSOR

The vehicle speed sensor (VSS) is located on the transmission on 2WD models and the transfer case for 4WD models. The VSS produces an AC voltage signal that varies in frequency according to output shaft speed. The resistance value of the VSS winding should be 900 to 2000 ohms.

VEHICLE SPEED SENSOR CALIBRATOR MODULE

The VSS sends its signal to the vehicle speed sensor (VSS) calibrator module located behind the instrument panel storage compartment. The VSS calibrator module changes the AC sine-wave signal from the VSS to a DC square-wave signal. The resulting square wave is sent to the EBCM through the 10 pin connector. If the axle ratio or tire size is changed, it will be necessary to replace the VSS calibrator module.

COMPONENT LOCATION VIEWS

For component location views, refer to figure 5.

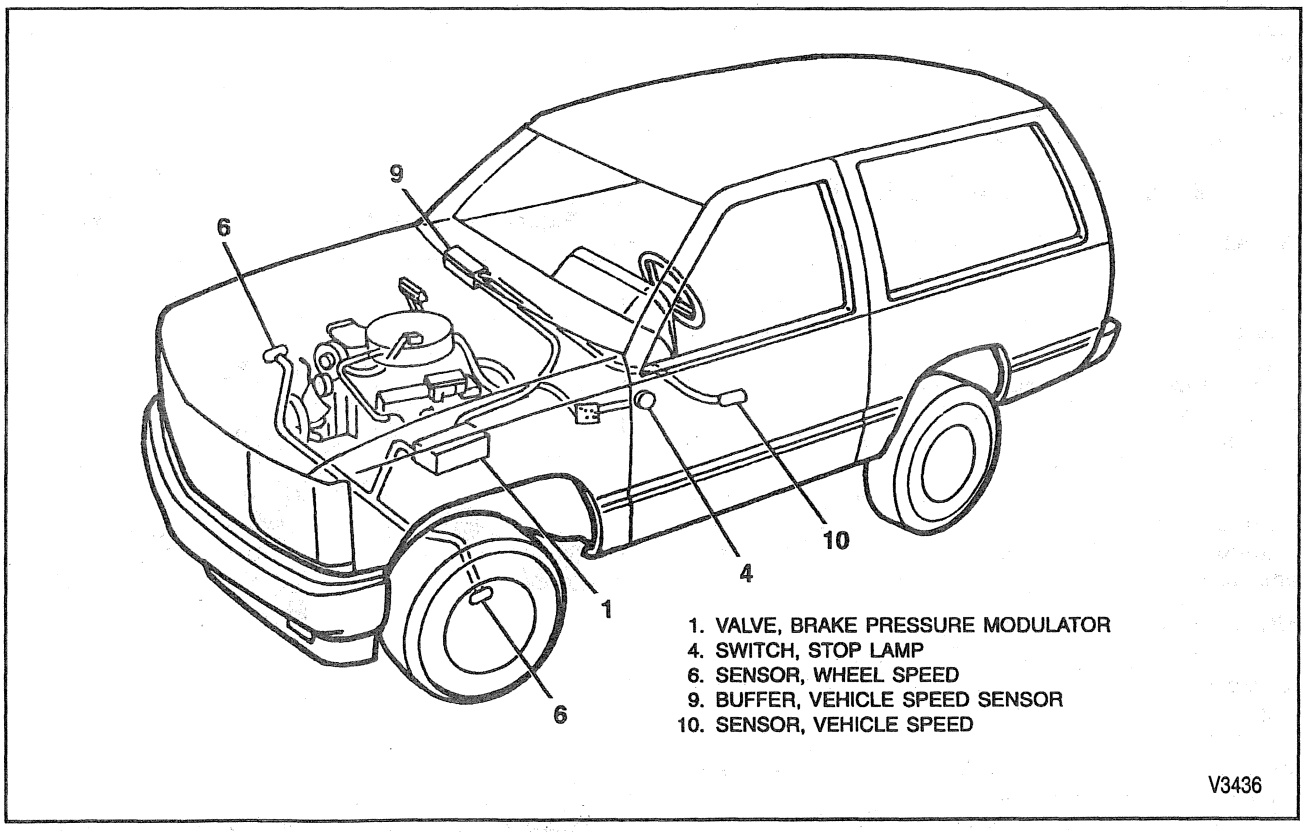


Figure 5—Component Location Views

DIAGNOSIS

DIAGNOSTIC PROCESS

Before beginning diagnosis on the 4WAL system, you need a detailed description of when the condition occurred from the owner. This information can be useful in duplicating the condition. Always begin diagnosis with a visual inspection of all connectors, wiring, wire routing and retention, and system components. Many times a disconnected or loose connector, blown fuse, corroded terminal, or miss-routed wire is the cause of a malfunction.

If a visual inspection does not reveal the cause of a malfunction, perform the "Functional Test" in this section. **Always start with the Functional Test.** This is a critical step in the quick and accurate diagnosis of any malfunction. It will direct you to the specific system area that is malfunctioning and verify that the diagnostic system is functioning properly. Correct system diagnosis cannot be ensured without starting diagnosis with the Functional Test.

SELF-DIAGNOSTICS

The BPMV performs self-diagnostics and can detect and often isolate system failures. When a malfunction is detected, the BPMV sets a diagnostic trouble code (DTC) that represents the malfunction, turns on the "ANTILOCK" lamp (in most instances), and disables the 4WAL functions while the "ANTILOCK" lamp is on.

The BPMV performs an automatic self-test the first time the vehicle reaches approximately 13 km/h (8 mph) after an ignition cycle. The BPMV cycles the pump motor and each valve to check component operation. If it detects an error, it sets a DTC as described above.

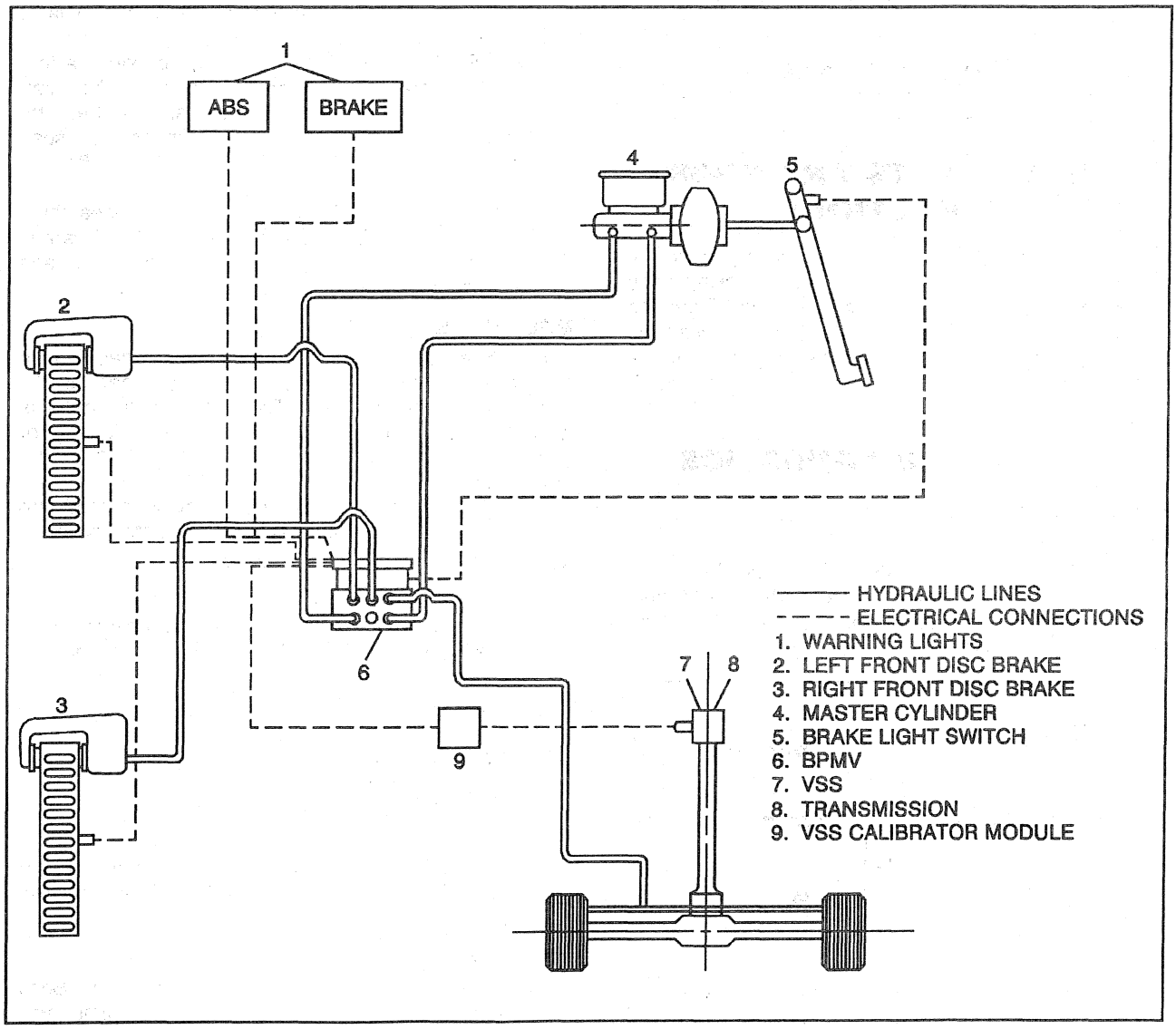


Figure 6—Four Wheel Antilock Brake System

DISPLAYING DIAGNOSTIC TROUBLE CODES

Diagnostic trouble codes (DTCs) can be read with a scan tool or by jumping terminal "H" to terminal "A" of the data link connector (DLC) (figure 7) and counting the "ANTILOCK" lamp flashes. The terminals must be jumped for a few seconds before the DTC will begin to flash. The "ANTILOCK" lamp displays DTCs in the same manner as the malfunction indicator lamp for the fuel and emissions system.

CLEARING DIAGNOSTIC TROUBLE CODES

If the "ANTILOCK" indicator lamp is staying on, the DTCs can be cleared with a scan tool or by performing the following procedure. (An engine remote starter can be used in place of the jumper wire for this procedure).

1. Turn the ignition switch to the "ON" position.
2. Use a jumper wire to ground DLC terminal "H" to "A" for 2 seconds.
3. Remove the jumper wire for 1 second.
4. Repeat the grounding for 2 seconds.
5. An indication of success is when the "ANTILOCK" and "BRAKE" lamps turn on and then turn off.

INTERMITTENTS AND POOR CONNECTIONS

Most intermittent faults are caused by a faulty electrical connection or wiring, although a sticking relay or solenoid can occasionally be at fault. Refer to "Intermittents and Poor Connections" in the Driveability, Emissions, and Electrical Diagnosis Manual for a detailed explanation of how to locate and repair intermittent conditions.

SCAN TOOL DIAGNOSTICS

Important

- Refer to the Brake System Cartridge Operator's Manual or Mass Storage Cartridge Owner's Manual for additional information about the scan tool and the various mode uses.

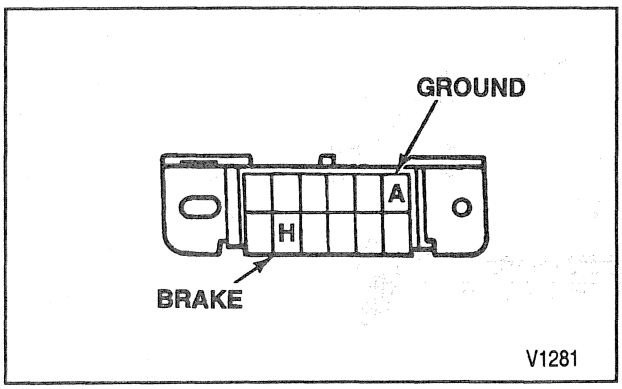


Figure 7—Data Link Connector

The scan tool has five modes to assist in diagnosing 4WAL system malfunctions. After selecting 4WAL from the select system menu, the scan tool will automatically display the Select Mode menu. From here you can select one of five test modes by pressing the appropriate key:

- MODE F0: DATA LIST This mode allows continuous monitoring of 4WAL parameters. The scan tool displays data parameters in pairs. The display window tells you which parameters are being displayed and the value for them. The scan tool can be programmed to display specific pairs of parameters by following the screen commands. This allows you to monitor specific values that are not normally displayed together.
- MODE F1: FUNCTION TEST This mode allows actuation of the 4WAL system. The scan tool will send a signal to the BPMV that causes it to cycle the system. For a short period, the BPMV will cycle the valve and activate the pump motor.
- MODE F2: TROUBLE CODE This mode allows access and clearing of DTCs. The screen will display the DTC and a brief description of what it represents.
- MODE F3: SNAPSHOT This mode provides a tool to help isolate an intermittent condition. You can specify a trigger condition or manually trap the data. No matter which trigger you choose, the scan tool captures and stores data before and after the trigger.
- MODE F4: MISC. TESTS This allows researching of the PROM ID to see which version of software is used in the BPMV, history data, history codes, and tire size calibration.

MODE F3 - SNAPSHOT

The "Snapshot" mode provides a tool to help isolate an intermittent condition. In this mode, you can specify a trigger condition and BPMV diagnostic data is automatically stored before and after the trigger occurrence. You can then display any or all of the stored data.

The operation of the Snapshot mode is divided into three phases; set-up, data capture, and data display.

Setup Phase

1. Press F3 to enter the "Snapshot" mode.
2. Select trigger options are displayed in a self-scrolling menu. Press the function key next to the desired trigger condition.
   - F0: Any Code
   - F1: Single Code
   - F2: Manual Trigger
   - F3: Soft Fault
   - F4: ABS Stop
   - F5: Replay Data
3. When triggering on a single DTC, the scan tool will ask you to enter the desired DTC. Enter the two digit DTC followed by the ENTER key.

Data Capture Phase

1. After you specify the trigger condition, the Scan Tool starts collecting data. During this time, you can examine all of the data the same way you do

in the Data List mode. The scan tool will display a "W" in the lower right-hand corner while it waits for the trigger condition to occur.

2. While the scan tool waits for the trigger, the stored data is organized as a number of "samples." The number and state of each parameter and all DTCs are saved for each sample. If more than half of the maximum number of samples occur before the trigger, the oldest data is discarded.
3. The snapshot data is triggered when the specified trigger condition occurs.
   - F0: Any Code - The trigger occurs when the scan tool determines a DTC is set. If a DTC is present at the start of the test, the trigger occurs immediately.
   - F1: Single Code - The trigger occurs when the scan tool determines the specified DTC is set.
   - F2: Manual Trigger - The scan tool waits until you press the ENTER, EXIT, or F9 key to take the snapshot.
   - F3: Soft Fault - The trigger occurs when the BPMV recognizes an intermittent fault. A soft fault is an occurrence like a poor electrical connection that breaks and makes contact again while driving over a rough road.
   - F4: ABS Stop - The trigger occurs when the brake, while driving, is applied hard enough to cause the 4WAL system to activate.

Important

- While the scan tool is waiting for any trigger, the ENTER, EXIT, or F9 key can always be used to force a trigger.

4. After the trigger occurs, the scan tool continues to save data samples until it's memory is full. The scan tool display shows the trigger occurred by replacing the "W" in the lower right hand corner with a "T." The "T" will change to a "0" when the memory is full. The data capture terminates automatically and the scan tool goes on to the Data Display phase.
5. Pressing EXIT ends the Data Capture phase and will display captured data.

Data Display Phase

1. The Data Display phase is indicated with a number (initially zero) in the lower right hand corner of the display. The number indicates which sample is being displayed. Use the arrow keys to sequence through the data.
   - Sample "-1" is the sample immediately before the trigger. Sample "+1" is the sample immediately after the trigger; and so on.
   - Press F4 to go to the earliest sample in memory or F6 to go to the latest sample.
   - Press F5 to return to the "0" sample.
2. Use the YES and NO keys to display the data parameters of the selected samples. If you want to see the DTCs for that sample, press the F2 key and the DTCs will be displayed.

MODE F4 - MISCELLANEOUS TESTS

This mode provides PROM ID, history data, history codes, and tire size calibration.

Prom ID

This function simply displays the version of 4WAL software in the BPMV being tested.

1. Select PROM ID by pressing F0.
2. The Scan Tool will prompt you to turn the ignition switch "OFF" then "ON."
3. The display will show the 4WAL unit software version.

History Data

This function identifies drive cycle (ignition counts) and 4WAL activation counts relative to when DTCs were stored. There are multiple blocks of history records.

1. Select HISTORY DATA by pressing F1.
2. The scan tool will prompt you to turn the ignition switch "OFF" then "ON."
3. The most recent history block will be displayed.
   - Use the arrow keys to scroll through the different data blocks. The most negative number being the oldest stored block.

History Code

This function identifies which DTCs are stored within each history block. This information is available in two ways. Stored Codes lists the block number and all DTCs stored in that block by number only. Enhanced Codes provides the DTC numbers and a description of the DTCs stored in the block.

1. Select HISTORY CODE by pressing F2.
2. Select F0 for stored codes or F1 for enhanced codes.
3. The scan tool will prompt you to turn the ignition switch "OFF" then "ON."
4. The display will show the block number and code information.

Tire Size Cal

This function has two options; read tire size cal and new tire size cal. Read tire size cal allows you to read the tire size calibration stored in the BPMV module. New tire size cal allows you to program a new tire size calibration into the BPMV module. Only predetermined tire sizes can be selected

1. Select TIRE SIZE CAL by pressing F3.
2. Use the arrow keys to scroll the available tire size options.
3. The arrow symbol indicates the current selected size.
4. After you select the correct size, press the ENTER key to program the new tire size calibration.

DIAGNOSTIC CHARTS

Refer to the Functional Test as a starting point for all diagnosis. Failure to perform the Functional Test may result in extended diagnostic time, incorrect diagnosis, and incorrect parts replacement. Refer to figures 8 and 9 for the wiring diagram and connector face views. Charts for symptom diagnosis follow.

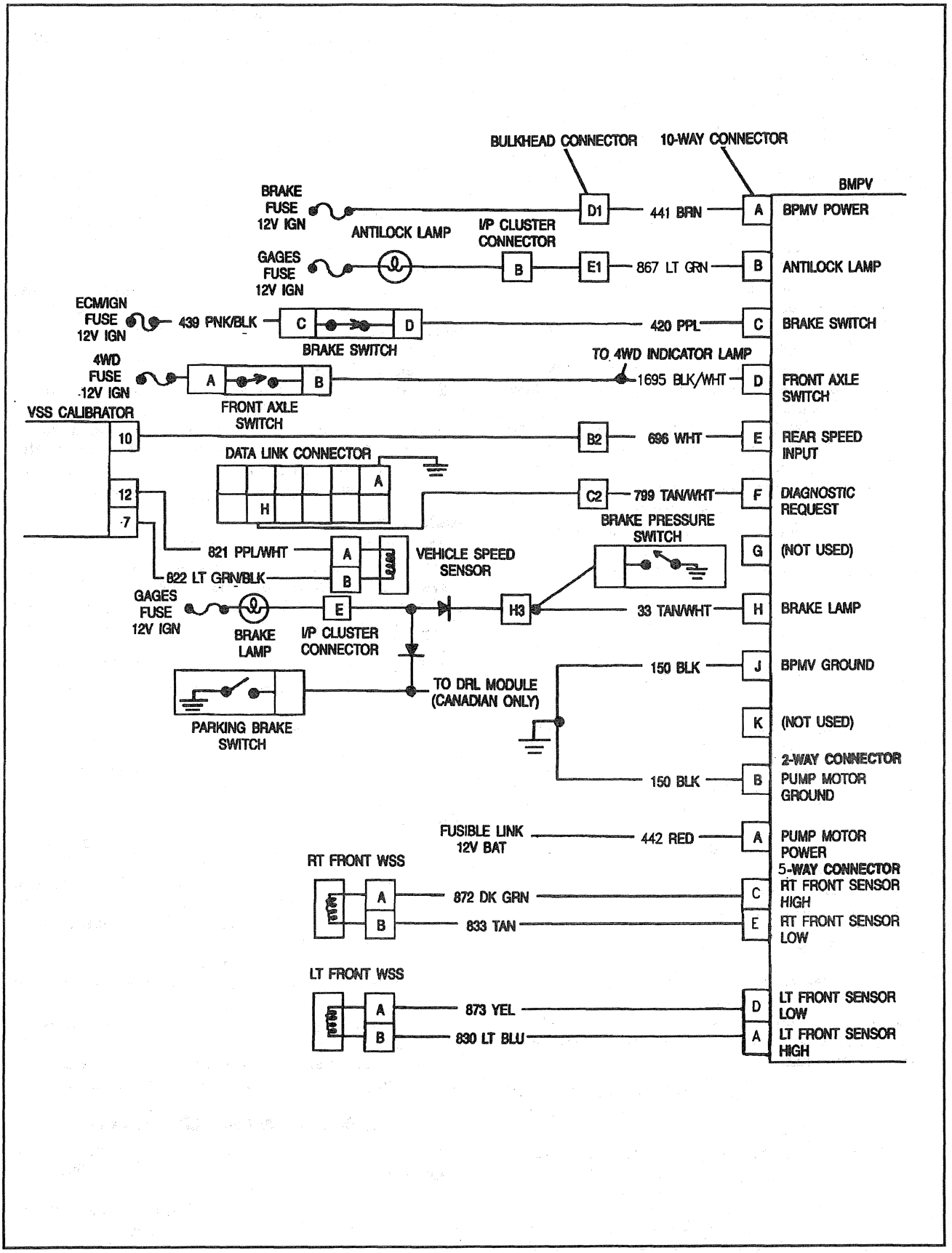


Figure 8—4WAL Wiring Diagram

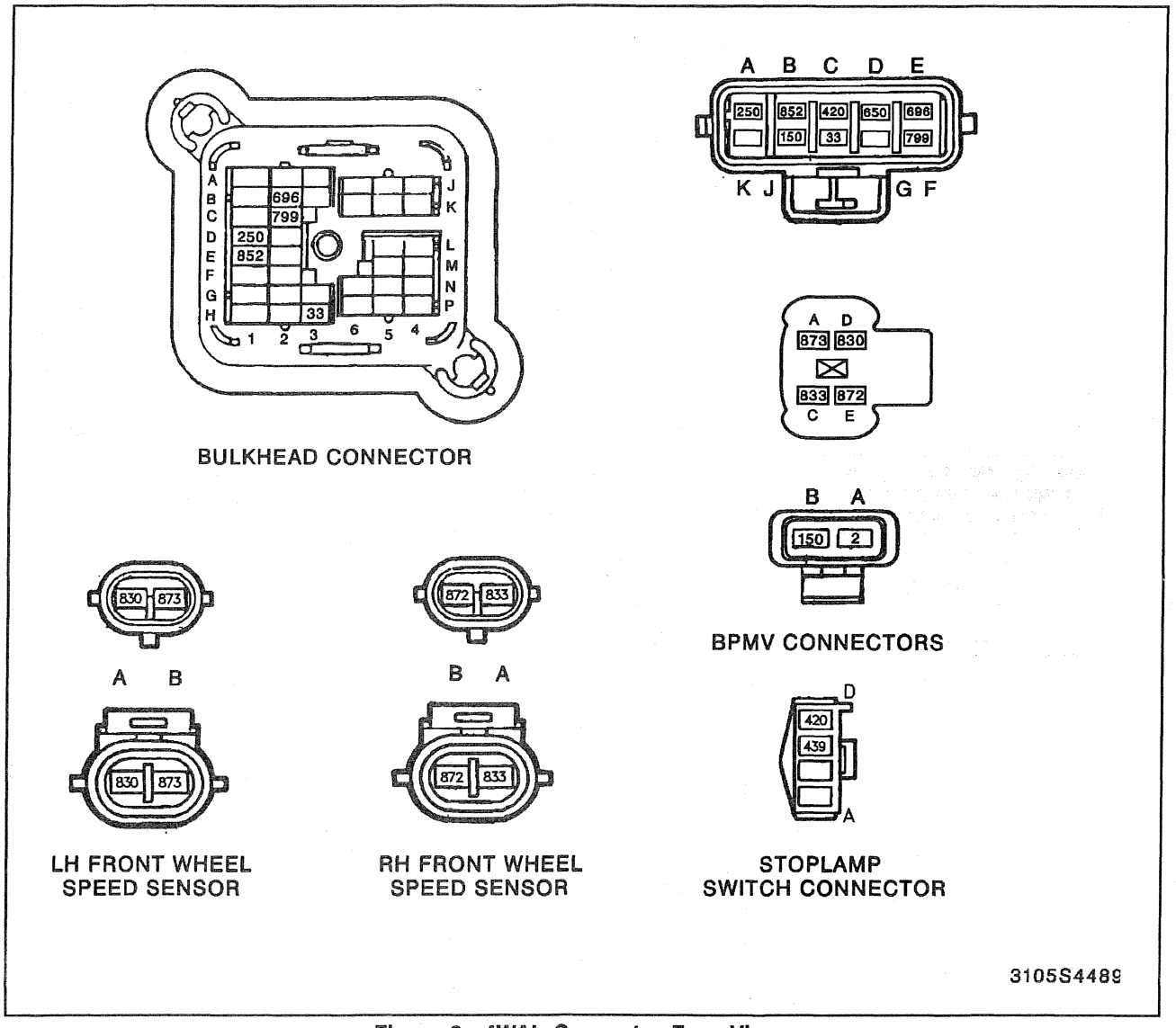
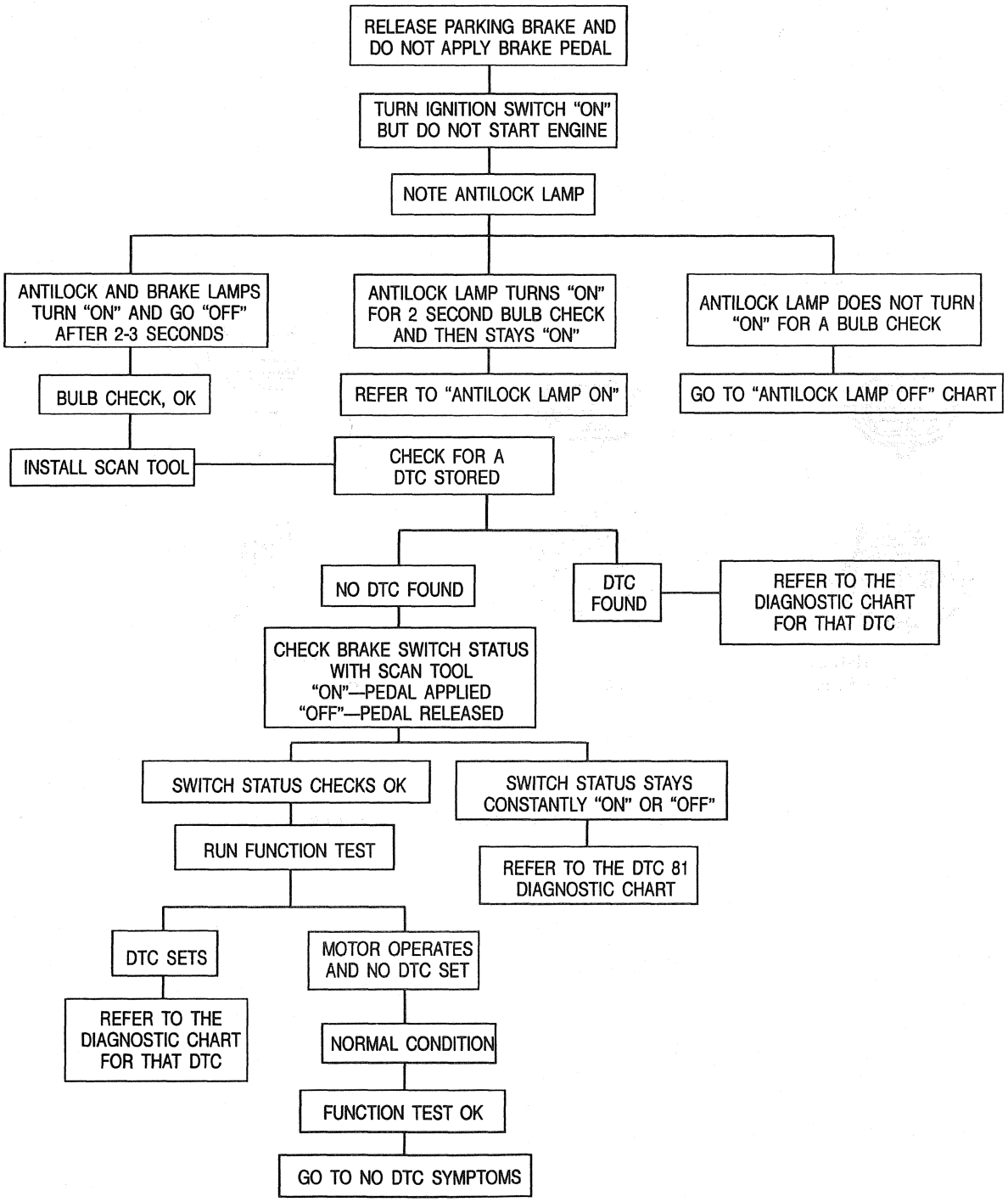


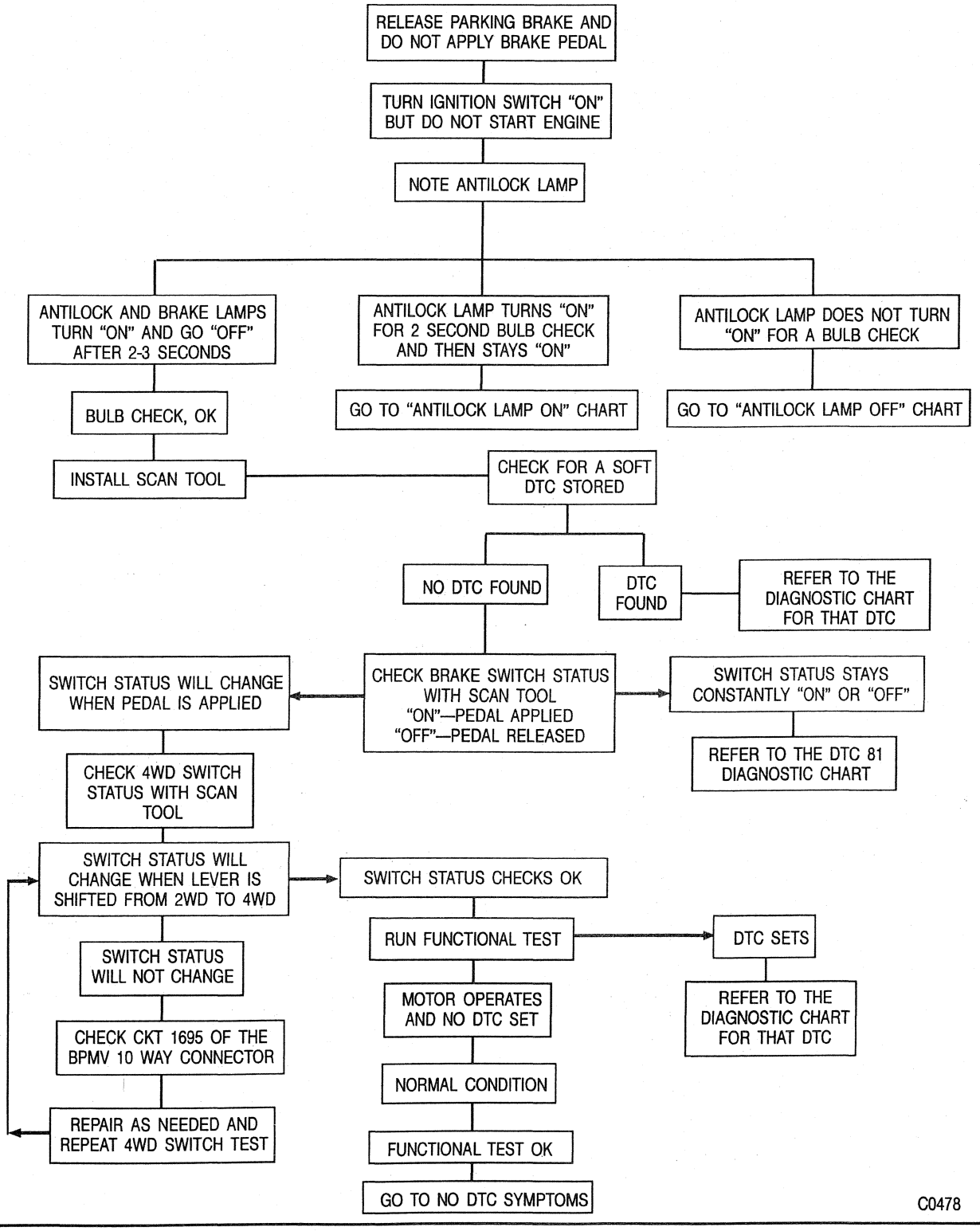
Figure 9—4WAL Connector Face Views

FUNCTION TEST
(2WD)



C0134

FUNCTIONAL TEST
(4WD)

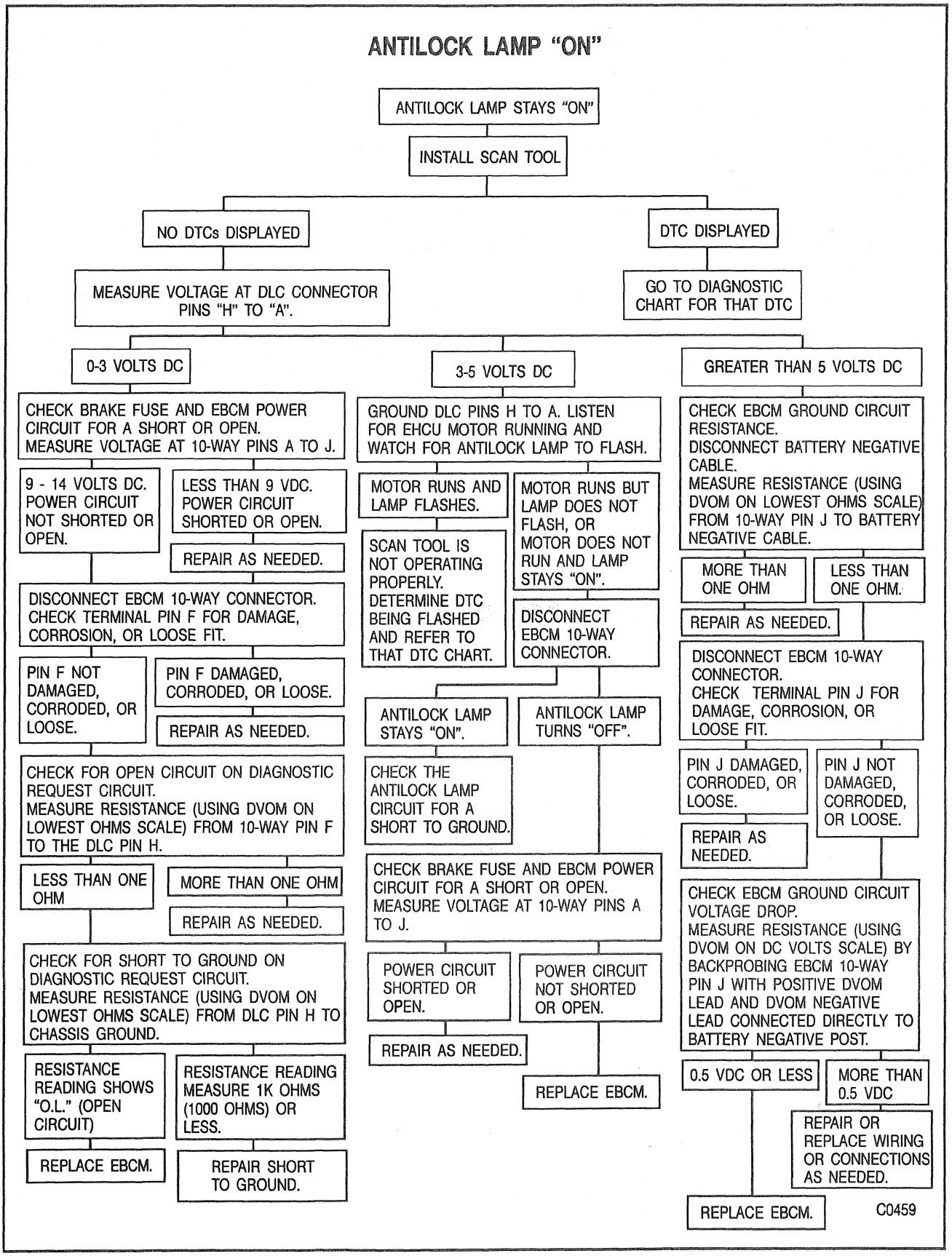


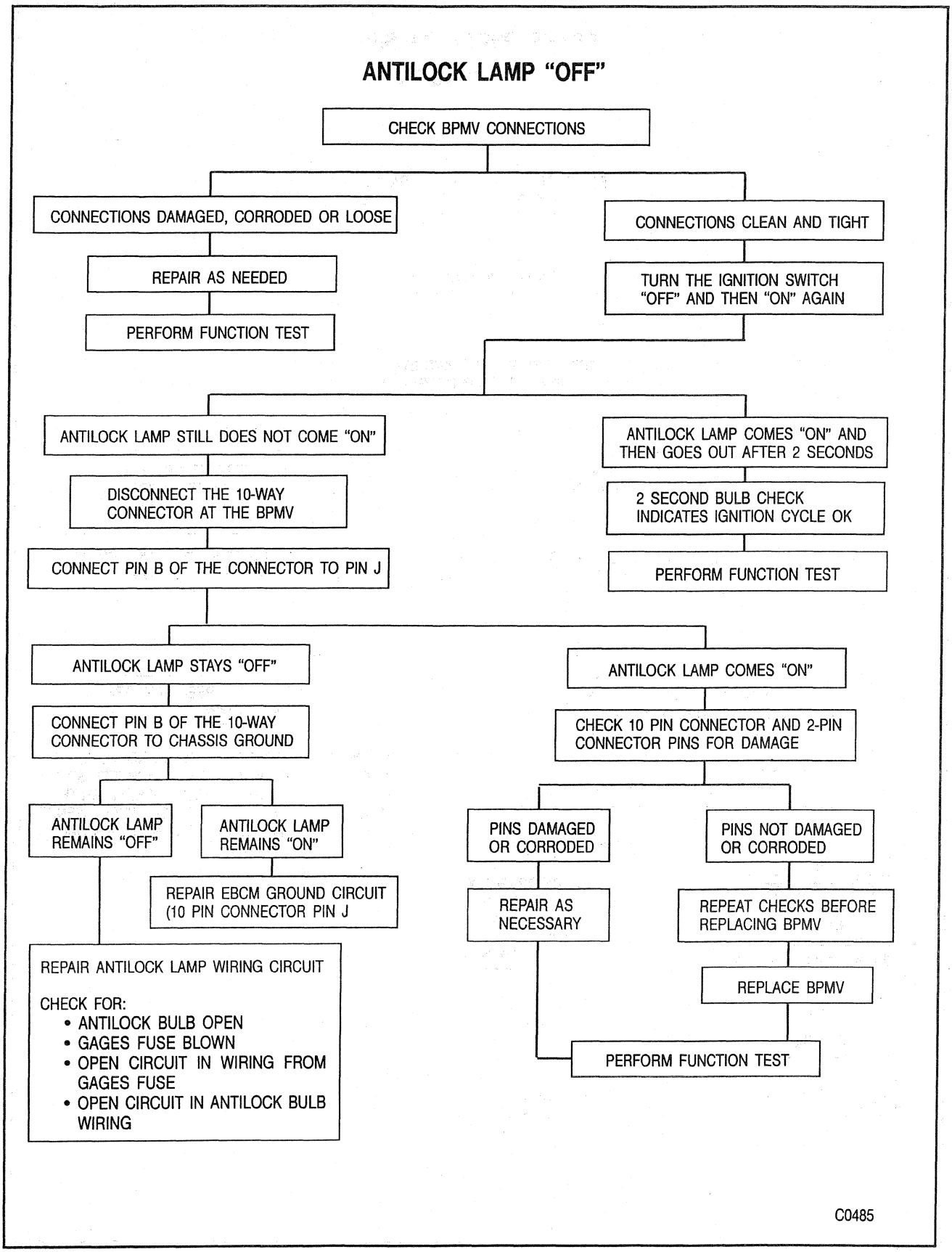
DIAGNOSTIC TROUBLE CODE AND SYMPTOM TABLE

Diagnostic Trouble Code	Description/Symptom	Fault Response Latch Type	ABS Response ON/OFF	Page #
—	Antilock Lamp "ON"			16
—	Antilock Lamp "OFF"			17
—	Brake Pedal Pulses			18
—	Wheel Pull During Hard Braking			19
*12	Normal System - 2WD Brake Pedal Released	None	ON	—
*13	Normal System - 2WD Brake Pedal Applied	None	ON	—
*14	Normal System - 4WD or AWD Brake Pedal Released	None	ON	—
*15	Normal System - 4WD or AWD Brake Pedal Applied	None	ON	—
21	Right Front Wheel Speed Sensor or Circuit Open (Static)	Condition	OFF/ON	20
22	Missing Right Front Speed Signal (Dynamic)	Condition	OFF/ON	22
23	Erratic Right Front Wheel Speed Sensor (Dynamic)	Ignition	OFF	24
25	Left Front Wheel Speed Sensor or Circuit Open (Static)	Condition	OFF/ON	26
26	Missing Left Front Wheel Speed Sensor (Dynamic)	Condition	OFF/ON	28
27	Erratic Left Front Wheel Speed Sensor (Dynamic)	Ignition	OFF	30
29	Simultaneous Drop-Out of Front Wheel Speed Sensors	Ignition	OFF	32
35	Open or Grounded Rear Speed Signal Circuit	Condition	OFF/ON	34
36	Missing Rear Speed Signal	Condition	OFF/ON	36
37	Erratic Rear Speed Signal	Ignition	OFF	38
38	Wheel Speed Error	Ignition	OFF	40
41-54	ISO/DUMP Coils Open or Shorted - Part of EBCM	Ignition	OFF	42
65-66	Open or Shorted Pump Motor Relay	Ignition	OFF	44
67	Open Motor Circuit or Shorted EBCM Output	Ignition	OFF	46
68	Locked Motor or Shorted Motor Circuit	Ignition	OFF	46
71-74	Memory Error (EBCM)	Permanent	OFF	48
81	Brake Switch Shorted or Open	Condition	OFF/ON	50
86	Shorted Antilock Indicator Lamp	Stored Code	ON	52
88	Shorted Brake Lamp Warning	Stored Code	ON	52
* Only Seen When Using Flash Codes by Grounding DLC				

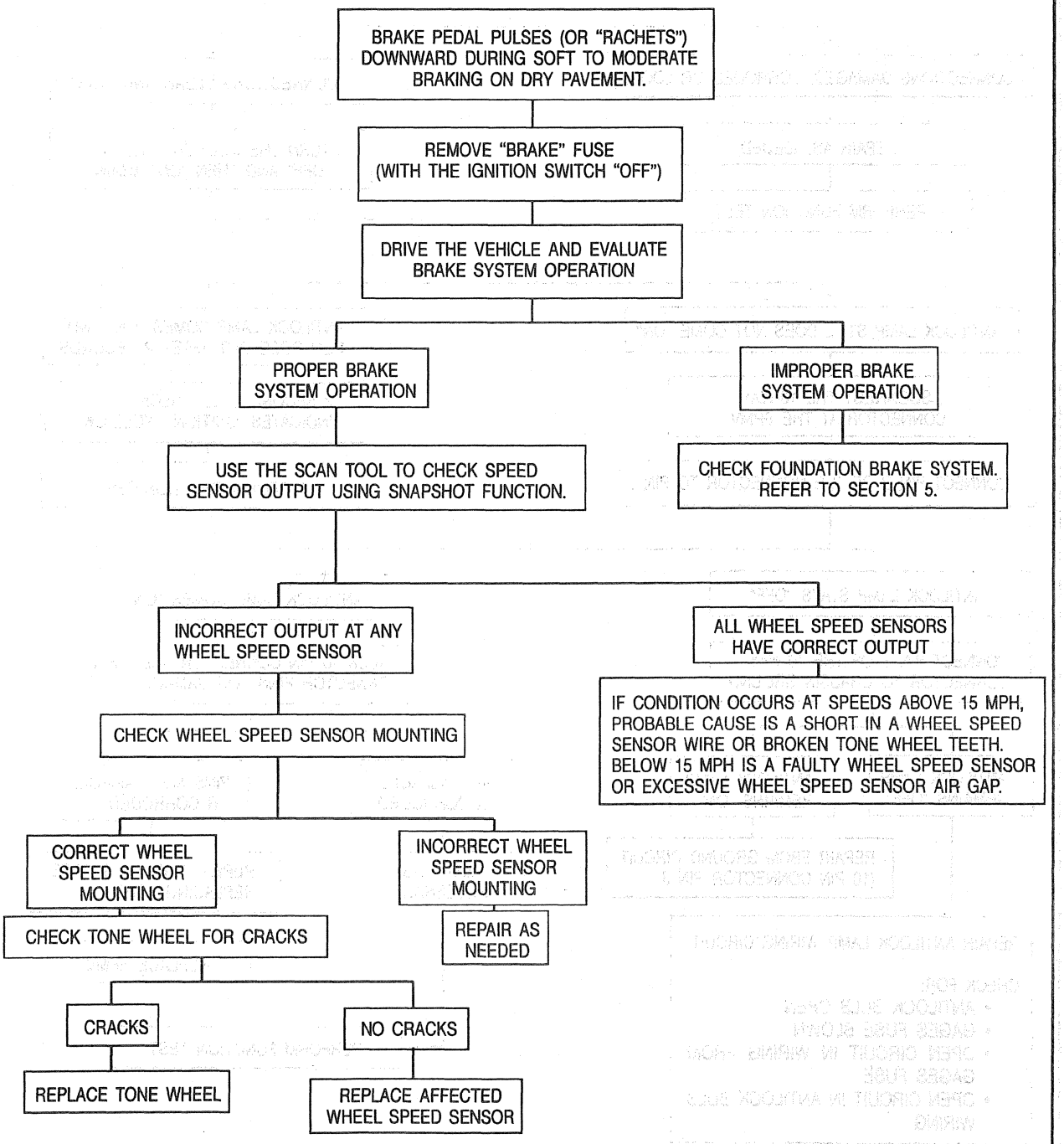
T3338

BLANK

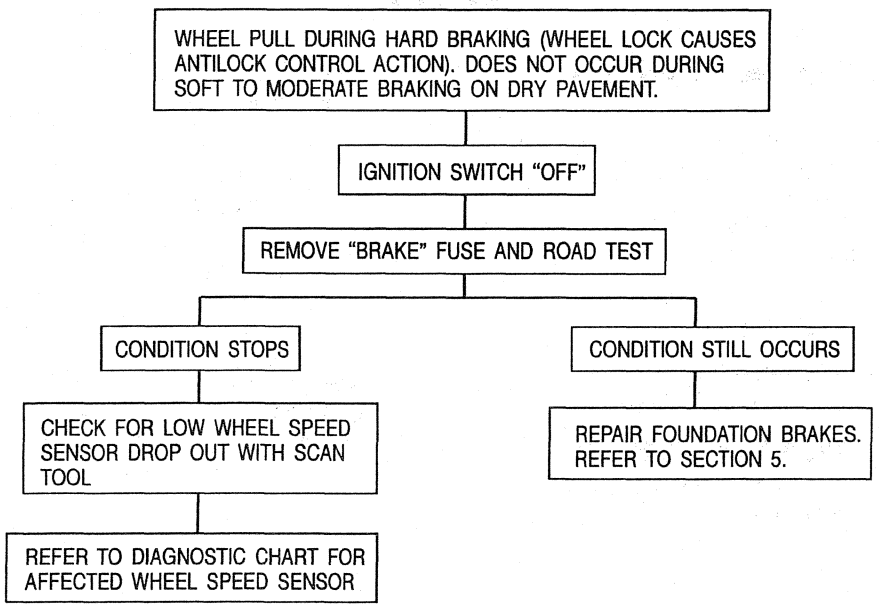

ANTILOCK LAMP "ON"
ANTILOCK LAMP STAYS "ON"
INSTALL SCAN TOOL
NO DTCs DISPLAYED
DTC DISPLAYED
MEASURE VOLTAGE AT DLC CONNECTOR PINS "H" TO "A".
GO TO DIAGNOSTIC CHART FOR THAT DTC
0-3 VOLTS DC
3-5 VOLTS DC
GREATER THAN 5 VOLTS DC
CHECK BRAKE FUSE AND EBCM POWER CIRCUIT FOR A SHORT OR OPEN. MEASURE VOLTAGE AT 10-WAY PINS A TO J.
9 - 14 VOLTS DC. POWER CIRCUIT NOT SHORTED OR OPEN.
LESS THAN 9 VDC. POWER CIRCUIT SHORTED OR OPEN.
REPAIR AS NEEDED.
DISCONNECT EBCM 10-WAY CONNECTOR. CHECK TERMINAL PIN F FOR DAMAGE, CORROSION, OR LOOSE FIT.
PIN F NOT DAMAGED, CORRODED, OR LOOSE.
PIN F DAMAGED, CORRODED, OR LOOSE.
REPAIR AS NEEDED.
CHECK FOR OPEN CIRCUIT ON DIAGNOSTIC REQUEST CIRCUIT. MEASURE RESISTANCE (USING DVOM ON LOWEST OHMS SCALE) FROM 10-WAY PIN F TO THE DLC PIN H.
LESS THAN ONE OHM
MORE THAN ONE OHM
REPAIR AS NEEDED.
CHECK FOR SHORT TO GROUND ON DIAGNOSTIC REQUEST CIRCUIT. MEASURE RESISTANCE (USING DVOM ON LOWEST OHMS SCALE) FROM DLC PIN H TO CHASSIS GROUND.
RESISTANCE READING SHOWS "O.L." (OPEN CIRCUIT)
RESISTANCE READING MEASURE 1K OHMS (1000 OHMS) OR LESS.
REPLACE EBCM.
REPAIR SHORT TO GROUND.
GROUND DLC PINS H TO A. LISTEN FOR EHCU MOTOR RUNNING AND WATCH FOR ANTILOCK LAMP TO FLASH.
MOTOR RUNS AND LAMP FLASHES.
MOTOR RUNS BUT LAMP DOES NOT FLASH, OR MOTOR DOES NOT RUN AND LAMP STAYS "ON".
SCAN TOOL IS NOT OPERATING PROPERLY. DETERMINE DTC BEING FLASHED AND REFER TO THAT DTC CHART.
DISCONNECT EBCM 10-WAY CONNECTOR.
ANTILOCK LAMP STAYS "ON".
ANTILOCK LAMP TURNS "OFF".
CHECK THE ANTILOCK LAMP CIRCUIT FOR A SHORT TO GROUND.
CHECK BRAKE FUSE AND EBCM POWER CIRCUIT FOR A SHORT OR OPEN. MEASURE VOLTAGE AT 10-WAY PINS A TO J.
POWER CIRCUIT SHORTED OR OPEN.
POWER CIRCUIT NOT SHORTED OR OPEN.
REPAIR AS NEEDED.
REPLACE EBCM.
CHECK EBCM GROUND CIRCUIT RESISTANCE. DISCONNECT BATTERY NEGATIVE CABLE. MEASURE RESISTANCE (USING DVOM ON LOWEST OHMS SCALE) FROM 10-WAY PIN J TO BATTERY NEGATIVE CABLE.
MORE THAN ONE OHM
LESS THAN ONE OHM.
REPAIR AS NEEDED.
DISCONNECT EBCM 10-WAY CONNECTOR. CHECK TERMINAL PIN J FOR DAMAGE, CORROSION, OR LOOSE FIT.
PIN J DAMAGED, CORRODED, OR LOOSE.
PIN J NOT DAMAGED, CORRODED, OR LOOSE.
REPAIR AS NEEDED.
CHECK EBCM GROUND CIRCUIT VOLTAGE DROP. MEASURE RESISTANCE (USING DVOM ON DC VOLTS SCALE) BY BACKPROBING EBCM 10-WAY PIN J WITH POSITIVE DVOM LEAD AND DVOM NEGATIVE LEAD CONNECTED DIRECTLY TO BATTERY NEGATIVE POST.
0.5 VDC OR LESS
MORE THAN 0.5 VDC
REPAIR OR REPLACE WIRING OR CONNECTIONS AS NEEDED.
REPLACE EBCM.
C0459


ANTILOCK LAMP "OFF"
CHECK BPMV CONNECTIONS
CONNECTIONS DAMAGED, CORRODED OR LOOSE
REPAIR AS NEEDED
PERFORM FUNCTION TEST
CONNECTIONS CLEAN AND TIGHT
TURN THE IGNITION SWITCH "OFF" AND THEN "ON" AGAIN
ANTILOCK LAMP STILL DOES NOT COME "ON"
DISCONNECT THE 10-WAY CONNECTOR AT THE BPMV
CONNECT PIN B OF THE CONNECTOR TO PIN J
ANTILOCK LAMP COMES "ON" AND THEN GOES OUT AFTER 2 SECONDS
2 SECOND BULB CHECK INDICATES IGNITION CYCLE OK
PERFORM FUNCTION TEST
ANTILOCK LAMP STAYS "OFF"
CONNECT PIN B OF THE 10-WAY CONNECTOR TO CHASSIS GROUND
ANTILOCK LAMP REMAINS "OFF"
ANTILOCK LAMP REMAINS "ON"
REPAIR EBCM GROUND CIRCUIT (10 PIN CONNECTOR PIN J
REPAIR ANTILOCK LAMP WIRING CIRCUIT
CHECK FOR:
• ANTILOCK BULB OPEN
• GAGES FUSE BLOWN
• OPEN CIRCUIT IN WIRING FROM GAGES FUSE
• OPEN CIRCUIT IN ANTILOCK BULB WIRING
ANTILOCK LAMP COMES "ON"
CHECK 10 PIN CONNECTOR AND 2-PIN CONNECTOR PINS FOR DAMAGE
PINS DAMAGED OR CORRODED
REPAIR AS NECESSARY
PINS NOT DAMAGED OR CORRODED
REPEAT CHECKS BEFORE REPLACING BPMV
REPLACE BPMV
PERFORM FUNCTION TEST
C0485

BRAKE PEDAL PULSES
(NO DTC CONDITION)



WHEEL PULL DURING HARD BRAKING (NO DTC CONDITION)



DIAGNOSTIC TROUBLE CODE 21 RIGHT FRONT WHEEL SPEED SENSOR OR CIRCUIT OPEN

CIRCUIT DESCRIPTION:

A DTC 21 relates to an open condition in the right front WSS or circuit. This DTC is a soft fault and sets when the vehicle is at zero mph. The BPMV checks for the proper resistance in the right front WSS circuit. Any condition that creates excessive resistance or an open condition in the right front WSS circuit can cause this DTC to set.

Important

- Do not replace the BPMV for this DTC. A faulty BPMV will not cause this DTC to set.

TEST DESCRIPTION:

- Check BPMV 5-way connector pins C and E for looseness, corrosion, etc.
- Measure the resistance of BPMV 5-way connector pins C and E.
- Measure resistance at the right front WSS connector.
- Check right front WSS output using the scan tool.
- Check for intermittent opens in CKTs 833 and 872.

DIAGNOSTIC AIDS:

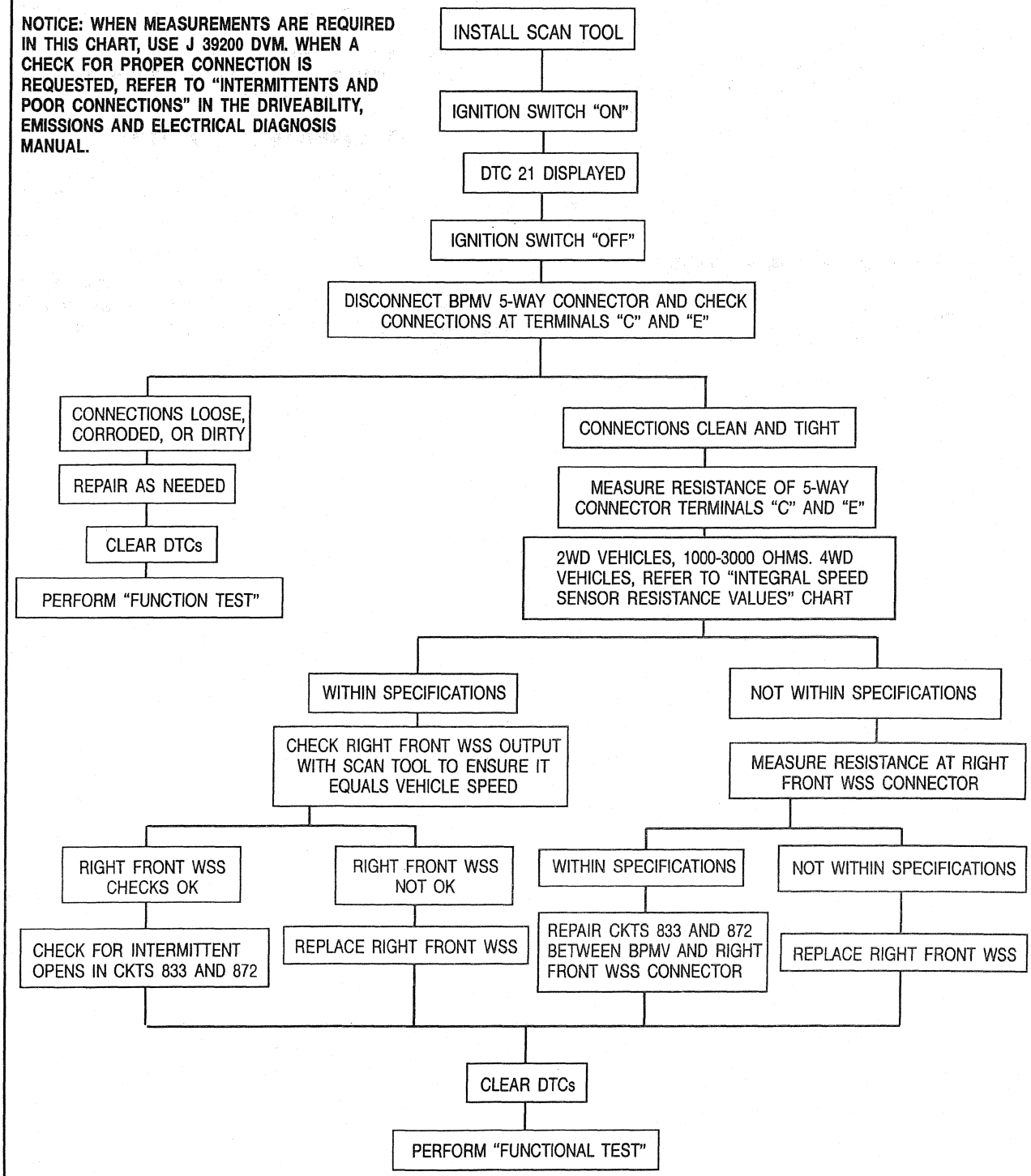
This DTC can only be set by a malfunction in the right front WSS and circuit.

This DTC can be caused by someone disconnecting one or more speed sensors to get the wiring out of the way while doing brake or suspension repairs and then forgetting to plug the connectors back together.

Do not pierce the electrical connectors, wires, seals, or insulation during testing. Doing so will break the seal and lead to corrosion and failure of the wiring and terminals.

DTC 21
RIGHT FRONT WHEEL SPEED SENSOR OR CIRCUIT OPEN

NOTICE: WHEN MEASUREMENTS ARE REQUIRED IN THIS CHART, USE J 39200 DVM. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED, REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN THE DRIVEABILITY, EMISSIONS AND ELECTRICAL DIAGNOSIS MANUAL.



C0484

DIAGNOSTIC TROUBLE CODE 22
MISSING RIGHT FRONT SPEED SIGNAL

CIRCUIT DESCRIPTION:

A DTC 22 relates to the BPMV losing the right front WSS signal for at least 5 seconds at speeds over 13 km/h (8 mph) with the brake pedal released. If a DTC 21 is also stored, use that diagnostic chart. This DTC can be caused by a faulty WSS, tone wheel, or a circuit condition.

Important

- Do not replace the BPMV for this DTC. A faulty BPMV will not cause this DTC to set.

TEST DESCRIPTION:

- Check for speed output from the right front WSS using the Scan Tool.
- Check BPMV 5-way connector pins C and E for looseness, corrosion, etc.
- Measure the resistance of BPMV 5-way connector pins C and E.
- Check connection at the right front WSS connector.
- Measure resistance at the right front WSS connector.
- Check wiring harness for chafing.
- Check if intermittent condition requires replacing the right front WSS or harness.

DIAGNOSTIC AIDS:

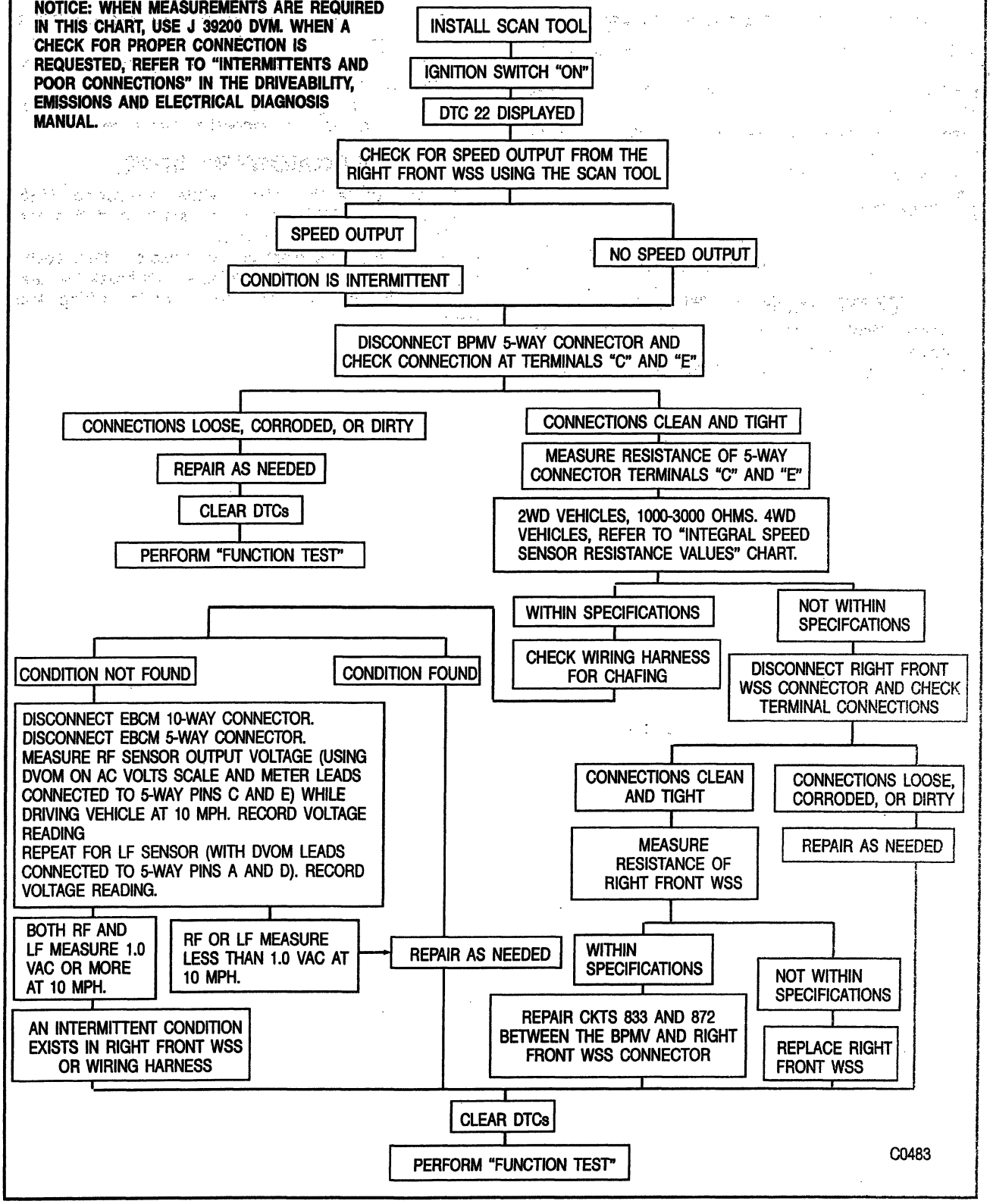
If a DTC 21 is also stored, refer to that diagnostic chart. If this DTC occurs on ice, check for brake drag or frozen brake components.

This DTC can only be set by a malfunction in the right front WSS and circuit.

Do not pierce the electrical connectors, wires, seals, or insulation during testing. Doing so will break the seal and lead to corrosion and failure of the wiring and terminals.

DTC 22
MISSING RIGHT FRONT SPEED SIGNAL

NOTICE: WHEN MEASUREMENTS ARE REQUIRED IN THIS CHART, USE J 39200 DVM. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED, REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN THE DRIVEABILITY, EMISSIONS AND ELECTRICAL DIAGNOSIS MANUAL.



DIAGNOSTIC TROUBLE CODE 23
ERRATIC RIGHT FRONT WHEEL SPEED SENSOR

CIRCUIT DESCRIPTION:

A DTC 23 relates to the BPMV receiving an erratic signal from the right front WSS. This DTC sets after the speed signal leaves and returns three times within one ignition cycle at speeds over 19 km/h (12 mph) (brake released) or 32 km/h (20 mph) (brake applied). A faulty right front WSS, tone wheel, electrical connector, or circuit can cause this DTC to set.

Important

- Do not replace the BPMV for this DTC. A faulty BPMV will not cause this DTC to set.

TEST DESCRIPTION:

- Check BPMV 5-way connector pins C and E for looseness, corrosion, etc.
- Measure the resistance of BPMV 5-way connector pins C and E.
- Measure resistance at the right front WSS connector.
- Check CKTs 833 and 872 for opens, shorts, or poor connections.
- Inspect the right front WSS and tone wheel for physical damage or excessive clearance.

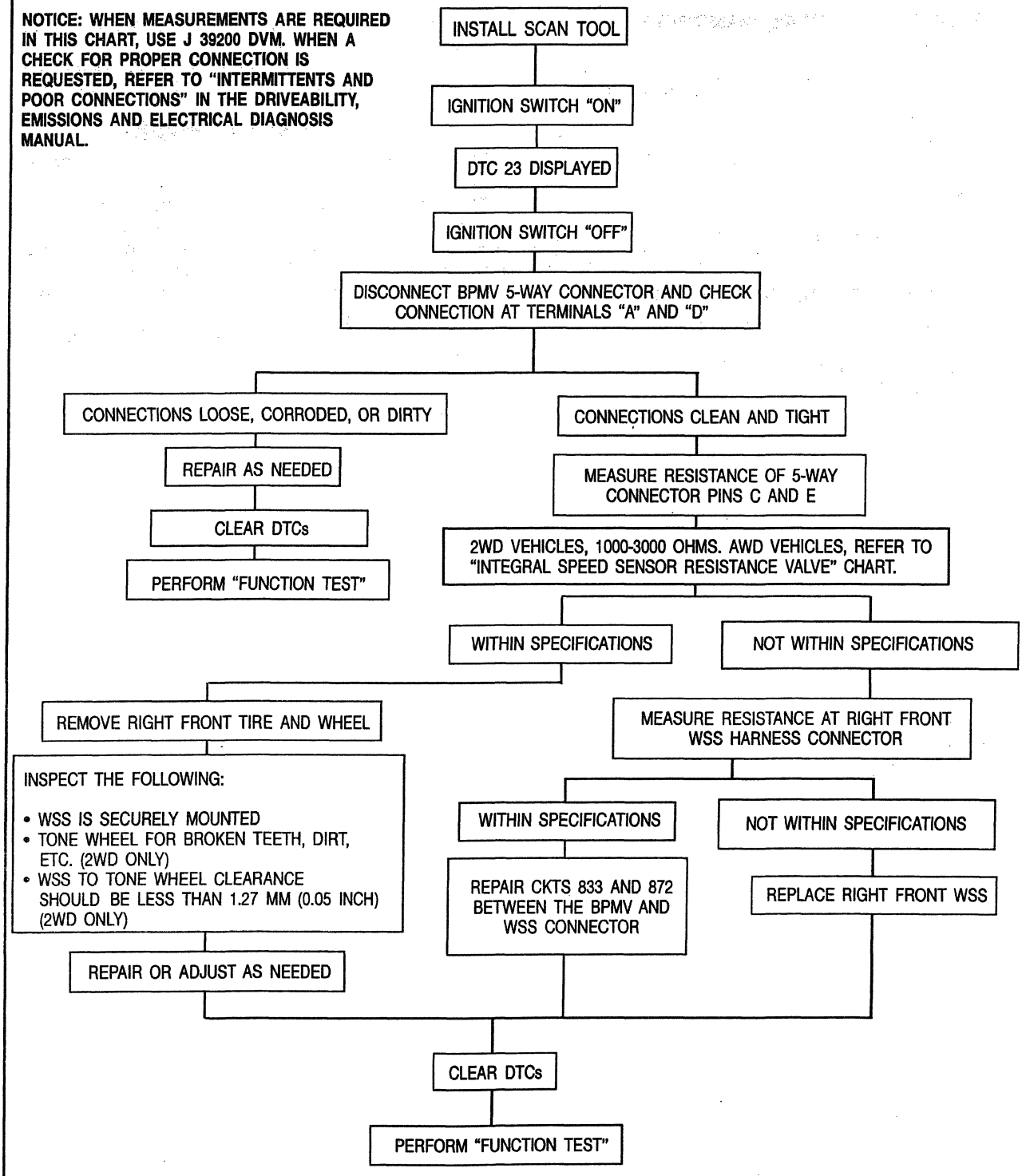
DIAGNOSTIC AIDS:

Do not rotate the wheel while measuring WSS resistance. This DTC can only be set by a malfunction in the right front WSS and circuit.

Do not pierce the electrical connectors, wires, seals, or insulation during testing. Doing so will break the seal and lead to corrosion and failure of the wiring and terminals.

DTC 23
ERRATIC RIGHT FRONT WHEEL SPEED SENSOR

NOTICE: WHEN MEASUREMENTS ARE REQUIRED IN THIS CHART, USE J 39200 DVM. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED, REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN THE DRIVEABILITY, EMISSIONS AND ELECTRICAL DIAGNOSIS MANUAL.



DIAGNOSTIC TROUBLE CODE 25 LEFT FRONT WHEEL SPEED SENSOR OR CIRCUIT OPEN

CIRCUIT DESCRIPTION:

A DTC 25 relates to an open condition in the left front WSS or circuit. This DTC is a soft fault and sets when the vehicle is at zero mph. The BPMV checks for the proper resistance in the left front WSS. Any condition that creates excessive resistance or an open condition in the left front WSS circuit can cause this DTC to set.

Important

- Do not replace the BPMV for this DTC. A faulty BPMV will not cause this DTC to set.

TEST DESCRIPTION:

- Check BPMV 5-way connector pins A and D for looseness, corrosion, etc.
- Measure the resistance of BPMV 5-way connector pins A and D.
- Measure resistance at the left front WSS connector.
- Check right front WSS output using the Scan Tool.
- Check for intermittent opens in CKTs 830 and 873.

DIAGNOSTIC AIDS:

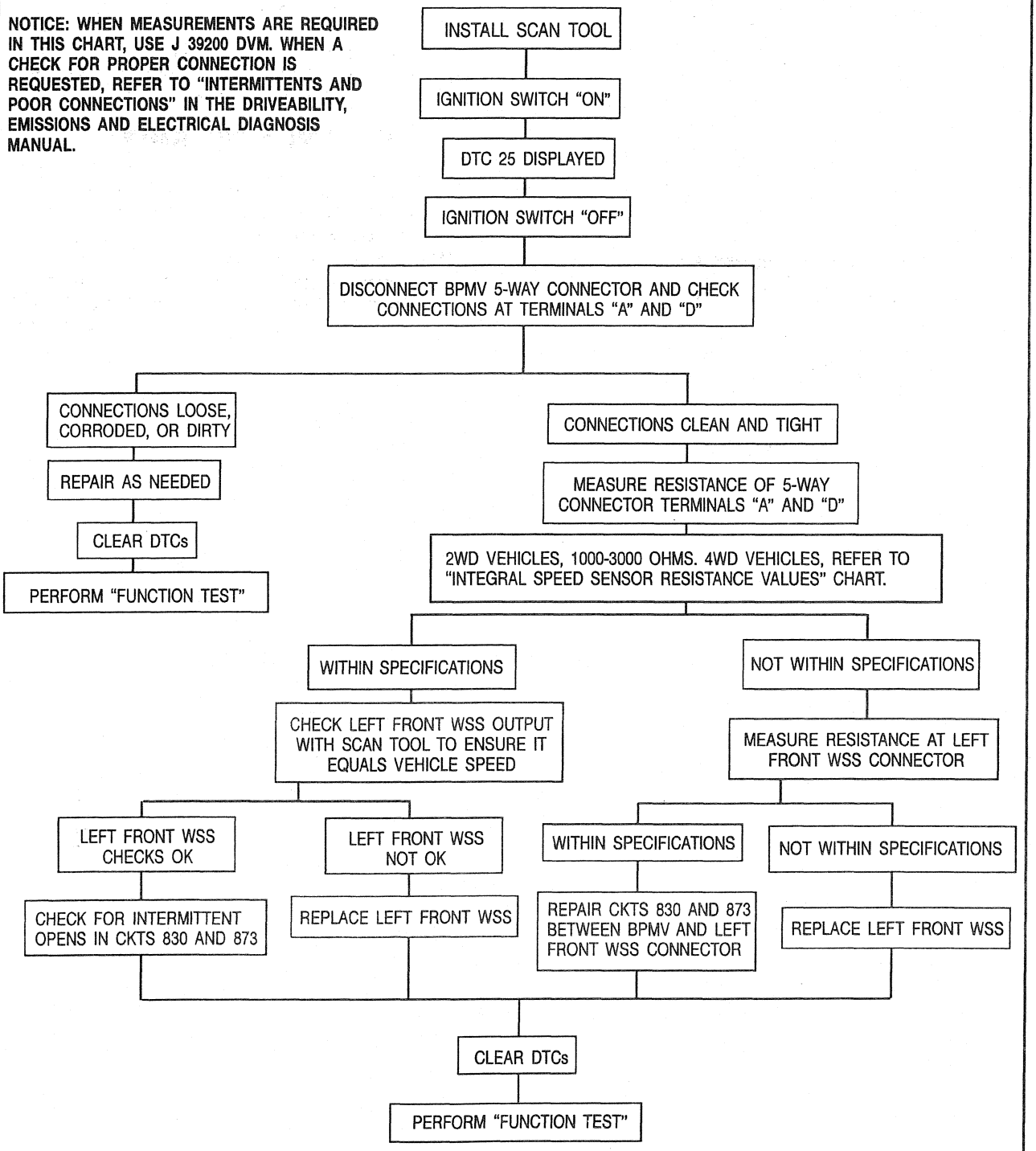
This DTC can only be set by a malfunction in the left front WSS and circuit.

This DTC can be caused by someone disconnecting one or more speed sensors to get the wiring out of the way while doing brake or suspension repairs and then forgetting to plug the connectors back together.

Do not pierce the electrical connectors, wires, seals, or insulation during testing. Doing so will break the seal and lead to corrosion and failure of the wiring and terminals.

DTC 25
LEFT FRONT WHEEL SPEED SENSOR OR CIRCUIT OPEN

NOTICE: WHEN MEASUREMENTS ARE REQUIRED IN THIS CHART, USE J 39200 DVM. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED, REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN THE DRIVEABILITY, EMISSIONS AND ELECTRICAL DIAGNOSIS MANUAL.



DIAGNOSTIC TROUBLE CODE 26 MISSING LEFT FRONT SPEED SIGNAL

CIRCUIT DESCRIPTION:

A DTC 26 relates to the BPMV losing the left front WSS signal for at least 5 seconds at speeds over 13 km/h (8 mph) with the brake pedal released. If a DTC 25 is also stored, use that diagnostic chart. This DTC can be caused by a faulty WSS, tone wheel, or a circuit condition.

Important

- Do not replace the BPMV for this DTC. A faulty BPMV will not cause this DTC to set.

TEST DESCRIPTION:

- Check for speed output from the left front WSS using the Scan Tool.
- Check BPMV 5-way connector pins A and D for looseness, corrosion, etc.
- Measure the resistance of BPMV 5-way connector pins A and D.
- Check connections at the left front WSS connector.
- Measure resistance at the left front WSS connector.
- Check wiring harness for chafing.
- Check if intermittent condition requires replacing the left front WSS or harness.

DIAGNOSTIC AIDS:

If a DTC 25 is also stored, refer to that diagnostic chart. If this DTC occurs on ice, check for brake drag or frozen brake components.

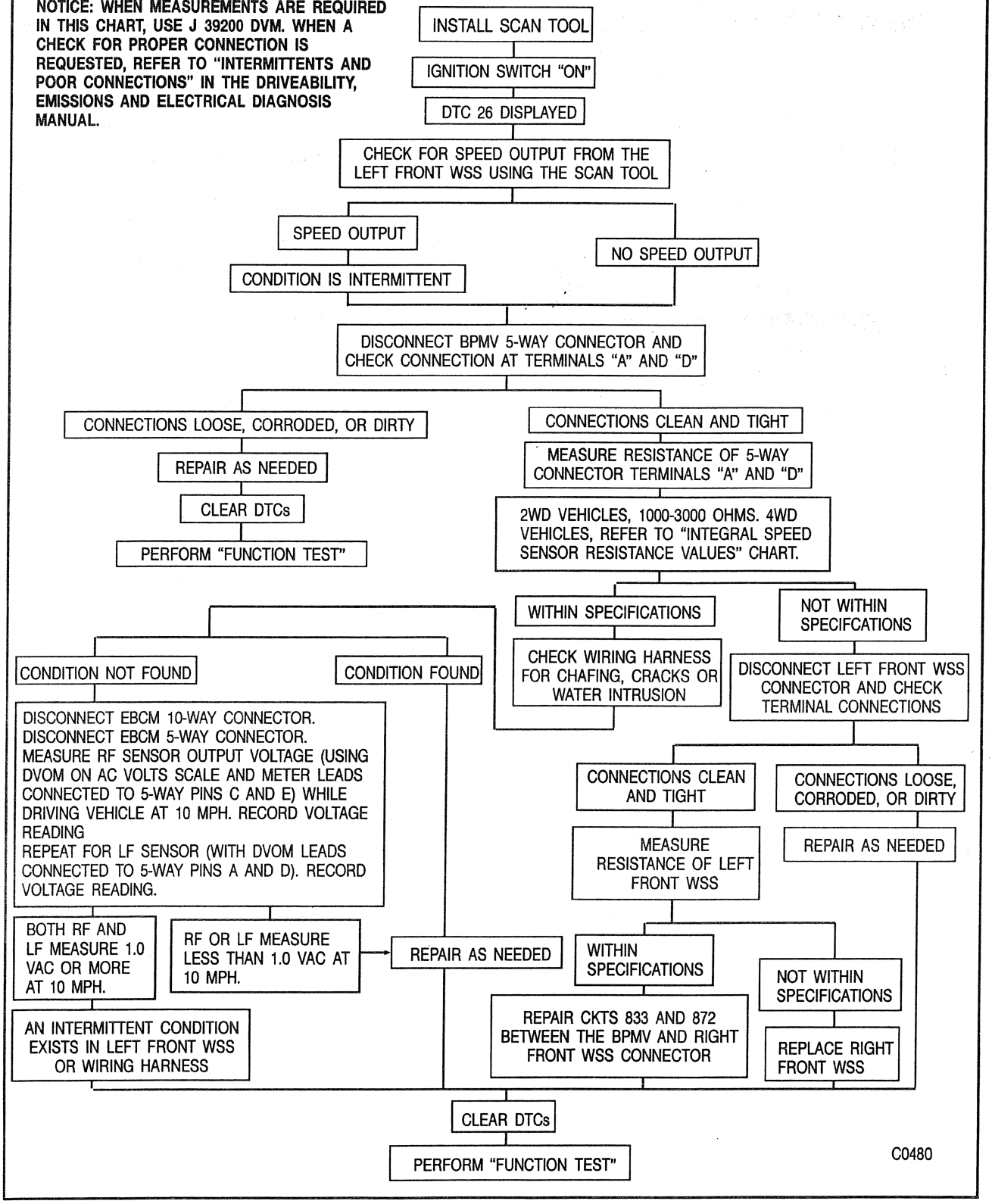
This DTC can only be set by a malfunction in the left front WSS and circuit.

Do not pierce the electrical connectors, wires, seals, or insulation during testing. Doing so will break the seal and lead to corrosion and failure of the wiring and terminals.

DTC 26

MISSING RIGHT FRONT SPEED SIGNAL

NOTICE: WHEN MEASUREMENTS ARE REQUIRED IN THIS CHART, USE J 39200 DVM. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED, REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN THE DRIVEABILITY, EMISSIONS AND ELECTRICAL DIAGNOSIS MANUAL.



DIAGNOSTIC TROUBLE CODE 27
ERRATIC LEFT FRONT WHEEL SPEED SENSOR

CIRCUIT DESCRIPTION:

A DTC 27 relates to the BPMV receiving an erratic signal from the left front WSS. This DTC sets after the left front speed signal leaves and returns three times within one ignition cycle at speeds over 19 km/h (12 mph) (brake released) or 32 km/h (20 mph) (brake applied). A faulty left front WSS, tone wheel, electrical connector, or circuit can cause this DTC to set.

Important

- Do not replace the BPMV for this DTC. A faulty BPMV will not cause this DTC to set.

TEST DESCRIPTION:

- Check BPMV 5-way connector pins A and D for looseness, corrosion, etc.
- Measure the resistance of BPMV 5-way connector pins A and D.
- Measure resistance at the left front WSS connector.
- Check CKTs 830 and 873 for opens, shorts, or poor connections.
- Inspect the left front WSS and tone wheel for physical damage or excessive clearance.

DIAGNOSTIC AIDS:

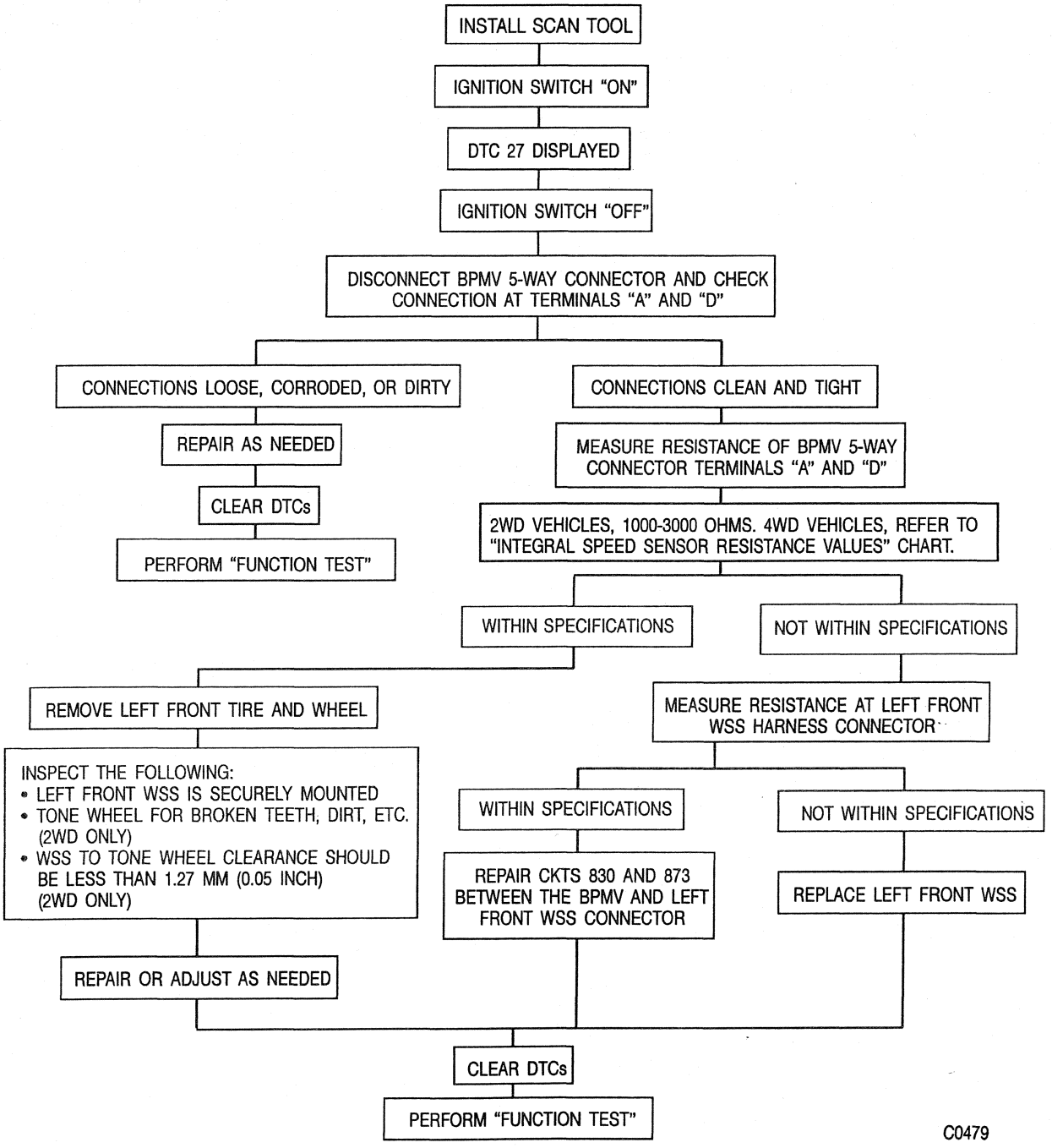
Do not rotate the wheel while measuring WSS resistance.

This DTC can only be set by a malfunction in the left front WSS and circuit.

Do not pierce the electrical connectors, wires, seals, or insulation during testing. Doing so will break the seal and lead to corrosion and failure of the wiring and terminals.

DTC 27
ERRATIC LEFT FRONT WHEEL SPEED SENSOR

NOTICE: WHEN MEASUREMENTS ARE REQUIRED IN THIS CHART, USE J 39200 DVM. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED, REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN THE DRIVEABILITY, EMISSIONS AND ELECTRICAL DIAGNOSIS MANUAL.



DIAGNOSTIC TROUBLE CODE 29 SIMULTANEOUS DROP-OUT OF FRONT WHEEL SPEED SENSORS

CIRCUIT DESCRIPTION:

A DTC 29 relates to the BPMV losing the signals from both front WSSs with the vehicle at speeds over 19 km/h (12 mph) (brake released) or 32 km/h (20 mph) (brake applied). The 5-way harness connector or the BPMV are the most probable causes for this DTC.

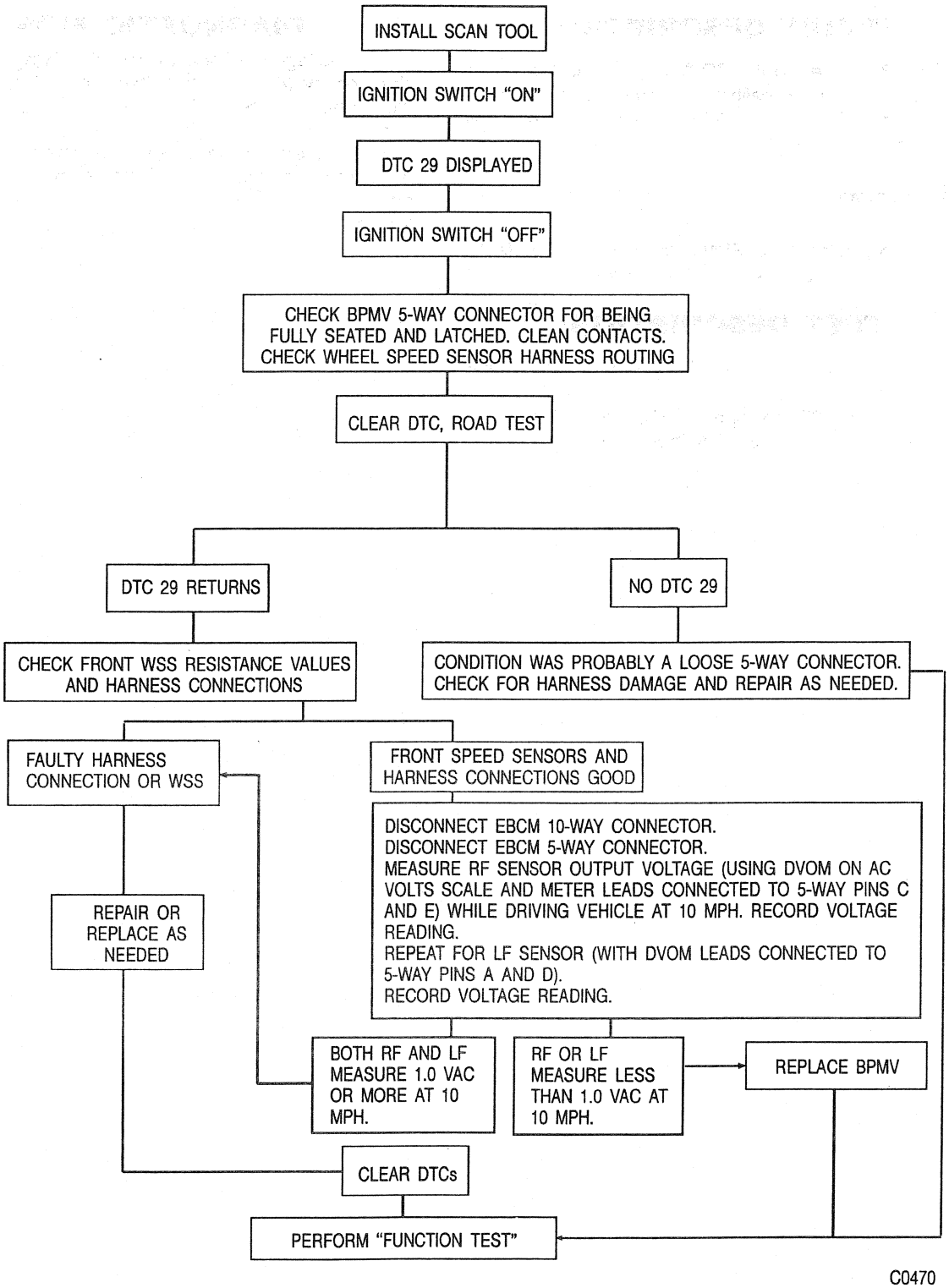
TEST DESCRIPTION:

- Check the condition of the BPMV 5-way connector and harness.
- Check all front WSS resistance values.

DIAGNOSTIC AIDS:

Do not rotate the wheel while measuring WSS resistance. Do not pierce the electrical connectors, wires, seals, or insulation during testing. Doing so will break the seal and lead to corrosion and failure of the wiring and terminals.

DTC 29
SIMULTANEOUS DROP-OUT OF FRONT WHEEL SPEED SENSORS



DIAGNOSTIC TROUBLE CODE 35
OPEN OR GROUNDED REAR SPEED SIGNAL CIRCUIT

CIRCUIT DESCRIPTION:

A DTC 35 relates to the BPMV not seeing the speed signal from the VSS calibrator module. A faulty VSS calibrator module or CKT 696 condition can cause this DTC to set.

Important

- Do not replace the BPMV for this DTC. A faulty BPMV will not cause this DTC to set.

TEST DESCRIPTION:

- Check the voltage at BPMV 10-way connector pins E and J.
- Check CKT 696 for open or short conditions.
- Check for a faulty VSS calibrator module.

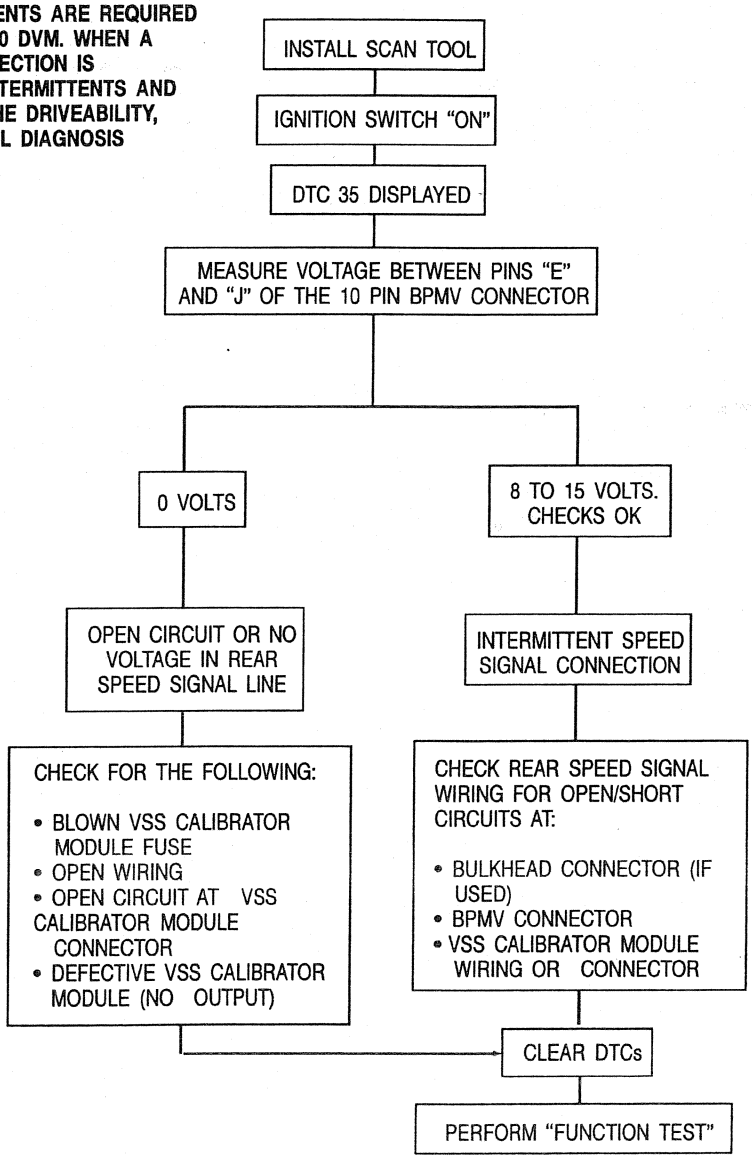
DIAGNOSTIC AIDS:

If the voltage readings are low or varying, the battery, charging system, or intermittent connections could be the cause. Check these areas before replacing any components.

Do not pierce the electrical connectors, wires, seals, or insulation during testing. Doing so will break the seal and lead to corrosion and failure of the wiring and terminals.

DTC 35
OPEN OR GROUNDED REAR SPEED SIGNAL CIRCUIT

NOTICE: WHEN MEASUREMENTS ARE REQUIRED IN THIS CHART, USE J 39200 DVM. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED, REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN THE DRIVEABILITY, EMISSIONS AND ELECTRICAL DIAGNOSIS MANUAL.



C0471

DIAGNOSTIC TROUBLE CODE 36 MISSING REAR SPEED SIGNAL

CIRCUIT DESCRIPTION:

A DTC 36 relates to the BPMV losing the VSS calibrator module signal for at least 5 seconds at speeds over 13 km/h (8 mph) with the brake pedal released. If a DTC 35 is also stored, use that diagnostic chart. This DTC can be set by a faulty VSS, VSS calibrator module, or circuit conditions in CKTs 696, 821, and 822.

Important

- Do not replace the BPMV for this DTC. A faulty BPMV will not cause this DTC to set.

TEST DESCRIPTION:

- Measure the resistance of the VSS.
- Measure the resistance of CKTs 821 and 822.
- Check the voltage applied to the BPMV through CKT 696.
- Check the connections in the VSS and VSS calibrator module circuits.

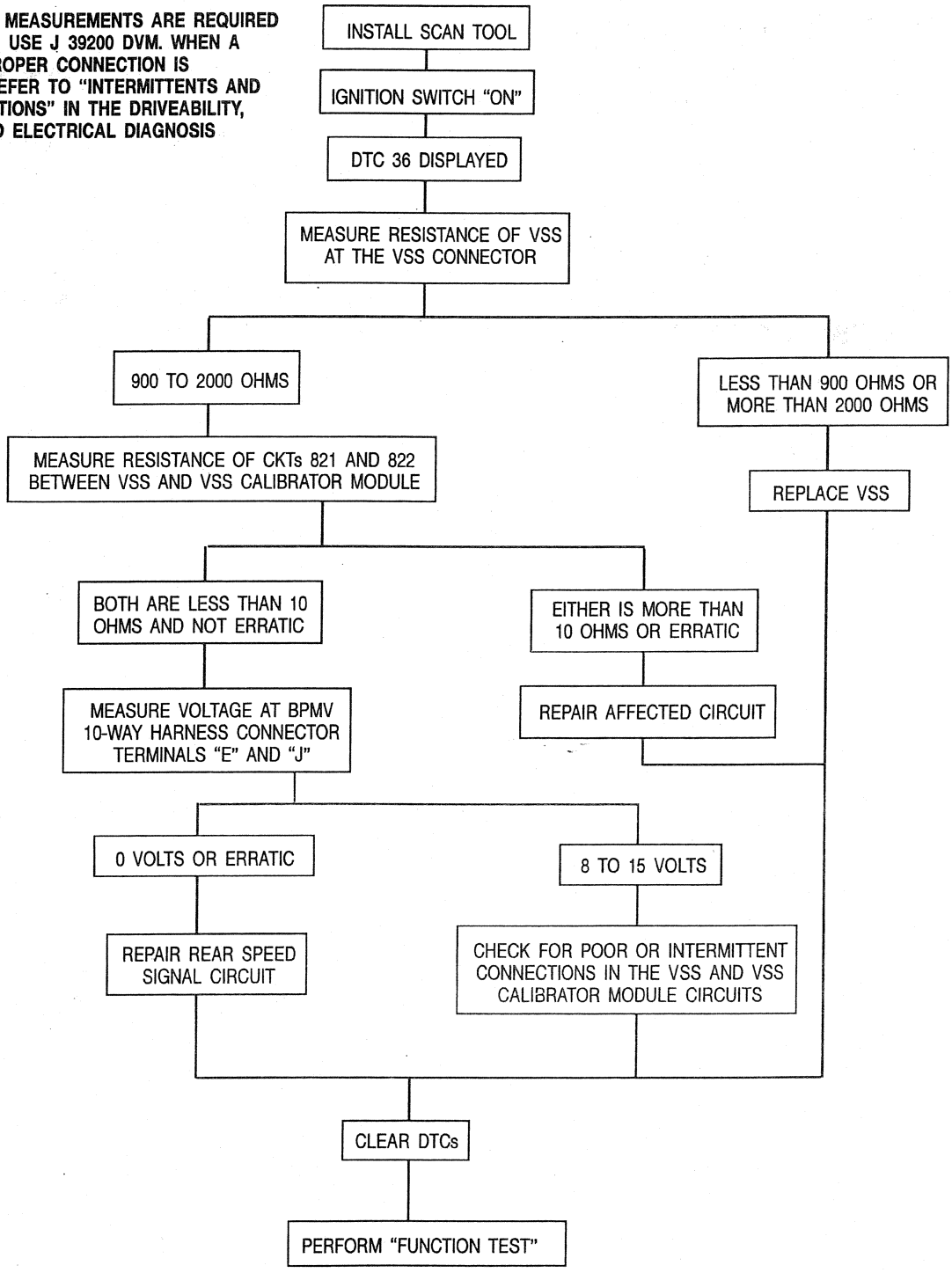
DIAGNOSTIC AIDS:

If the voltage readings are low or varying, the battery, charging system, or intermittent connections could be the cause. Check these areas before replacing any components.

Do not pierce the electrical connectors, wires, seals, or insulation during testing. Doing so will break the seal and lead to corrosion and failure of the wiring and terminals.

DTC 36
MISSING REAR SPEED SIGNAL

NOTICE: WHEN MEASUREMENTS ARE REQUIRED IN THIS CHART, USE J 39200 DVM. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED, REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN THE DRIVEABILITY, EMISSIONS AND ELECTRICAL DIAGNOSIS MANUAL.



C0208

DIAGNOSTIC TROUBLE CODE 37
ERRATIC REAR SPEED SIGNAL

CIRCUIT DESCRIPTION:

A DTC 37 relates to the BPMV seeing the rear speed signal line drop out and return. This DTC can be caused by a malfunction in the VSS, VSS calibrator module or CKT 696.

Important

- Do not replace the BPMV for this DTC. A faulty BPMV will not cause this DTC to set.

TEST DESCRIPTION:

- Check if all systems are receiving an erratic speed signal or if it is just the 4WAL system.
- Check the VSS output using the Scan Tool.
- Check the resistance of the VSS.
- Check for an open condition in CKTs 821 and 822.
- Check for excessive resistance in CKT 696.
- Measure voltage at BPMV 10-way connector pins E and J.

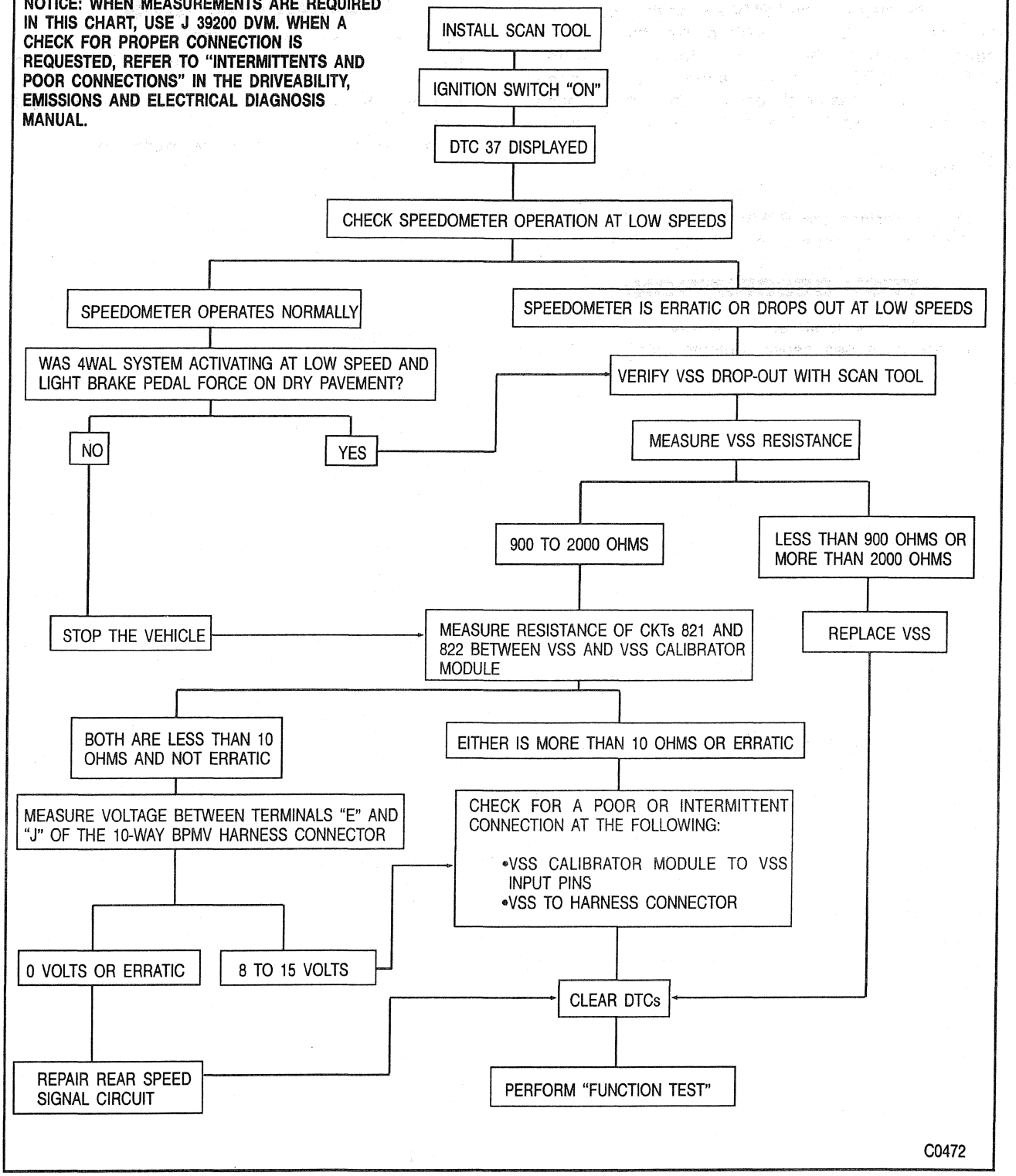
DIAGNOSTIC AIDS:

If the voltage readings are low or varying, the battery, charging system, or intermittent connections could be the cause. Check these areas before replacing any components.

Do not pierce the electrical connectors, wires, seals, or insulation during testing. Doing so will break the seal and lead to corrosion and failure of the wiring and terminals.

DTC 37
ERRATIC REAR SPEED SIGNAL

NOTICE: WHEN MEASUREMENTS ARE REQUIRED IN THIS CHART, USE J 39200 DVM. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED, REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN THE DRIVEABILITY, EMISSIONS AND ELECTRICAL DIAGNOSIS MANUAL.



DIAGNOSTIC TROUBLE CODE 38
WHEEL SPEED ERROR

CIRCUIT DESCRIPTION:

A DTC 38 relates to the BPMV seeing the signal from one sensor at more than double or less than half the frequency of the other sensors for a 12 second duration. This DTC also sets when all three speed inputs differ more than eight percent. The vehicle speed must be over 19 km/h (12 mph) for this DTC to set.

Important

- Do not replace the BPMV for this DTC. A faulty BPMV will not cause this DTC to set.

TEST DESCRIPTION:

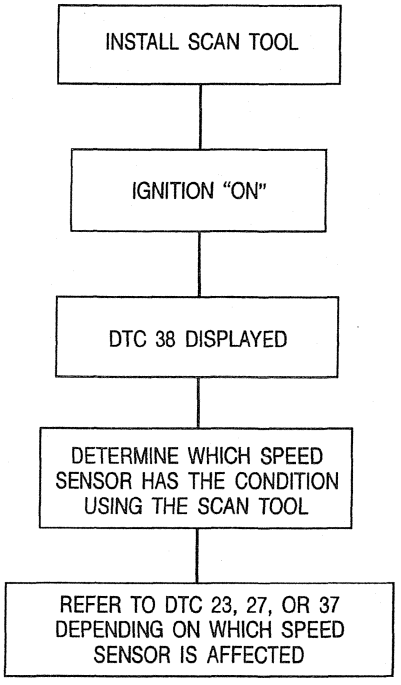
- Verify DTC 38 is stored in memory.
- Check all speed sensor outputs using the Scan Tool.
- Refer to "Erratic Sensor" chart 23, 27, or 37.

DIAGNOSTIC AIDS:

The following could set this DTC:

- Three or four **significantly** different size tires on the vehicle.
- Wrong VSS calibrator module and different front wheel sizes.
- Wrong number of teeth on the exciter rings.

DTC 38
WHEEL SPEED ERROR



C0473

DIAGNOSTIC TROUBLE CODES 41 THROUGH 54 BPMV CONTROL VALVES

CIRCUIT DESCRIPTION:

DTCs 41 through 54 relates to the isolation and dump valves inside the EBCM. The various DTC numbers indicate either short or open conditions in the solenoids or module. No parts in the EBCM are serviceable. After verifying the DTC is consistent, the EBCM must be replaced.

TEST DESCRIPTION:

- Verify a DTC 41 through 54 is stored.
- Clear DTCs.
- Check history and run several function tests using the Scan Tool.
- Check EBCM power and ground circuits.

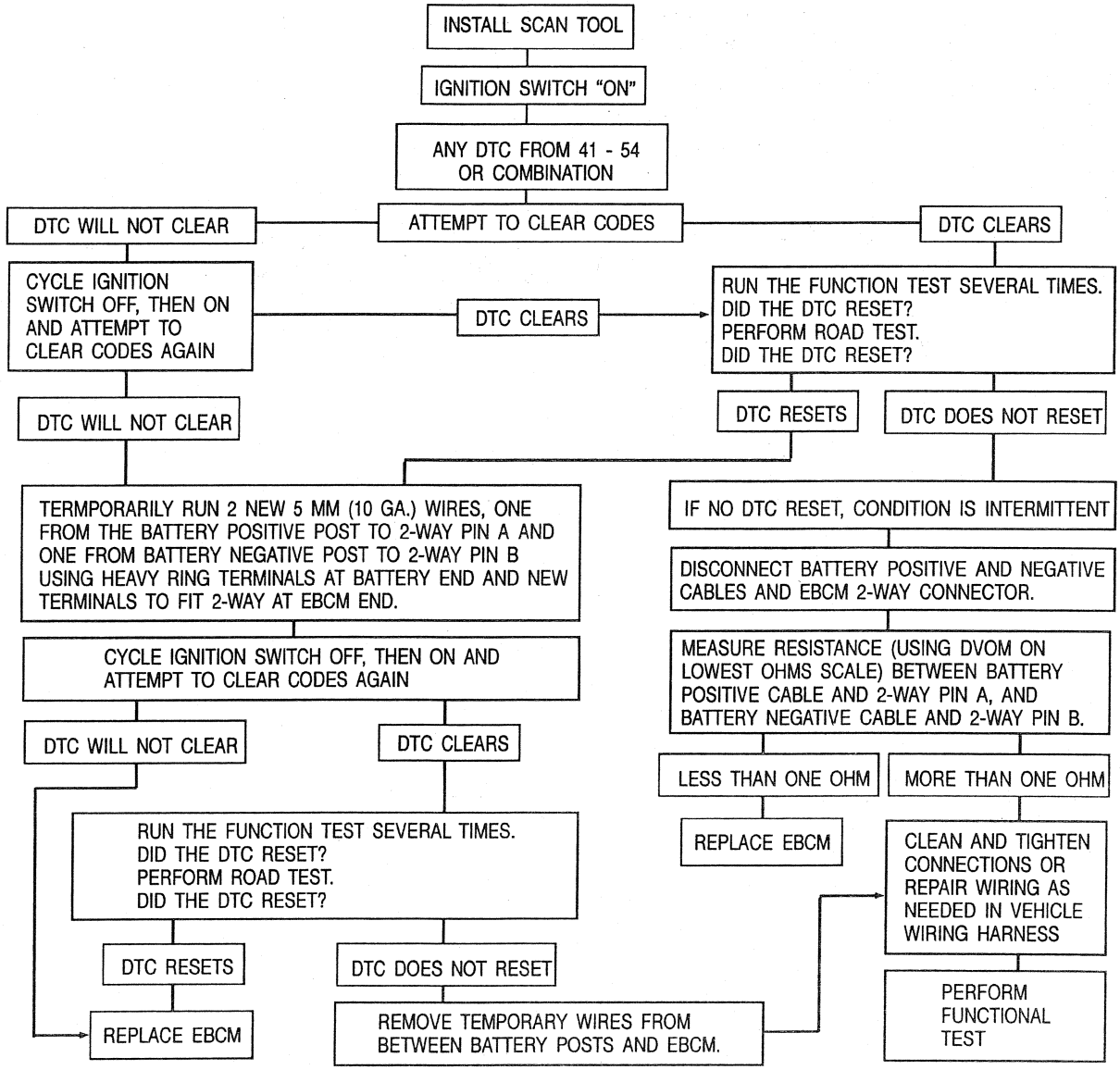
DIAGNOSTIC AIDS:

If DTC 41 through 54 sets with other DTCs, check for a poor EBCM ground or power feed.

Do not pierce the electrical connectors, wires, seals, or insulation during testing. Doing so will break the seal and lead to corrosion and failure of the wiring and terminals.

DTCS 41 THROUGH 54

BPMV CONTROL VALVES



C0462

DIAGNOSTIC TROUBLE CODE 65 OR 66 OPEN OR SHORTED PUMP MOTOR RELAY

CIRCUIT DESCRIPTION:

DTCs 65 and 66 relate to the pump motor relay in the EHCU. The relay is located inside the EBCM and cannot be serviced. The EBCM must be replaced if these tests show the relay has failed. If testing shows that the motor has failed, the BPMV must be replaced. These DTCs can be set by poor power and ground at the 2-way connector or applying the brakes during an erratic speed signal.

TEST DESCRIPTION:

- Check the various conditions that can cause these DTCs.
- Check if DTCs will clear.
- Check if DTC resets after several function tests with the Scan Tool.

DIAGNOSTIC AIDS:

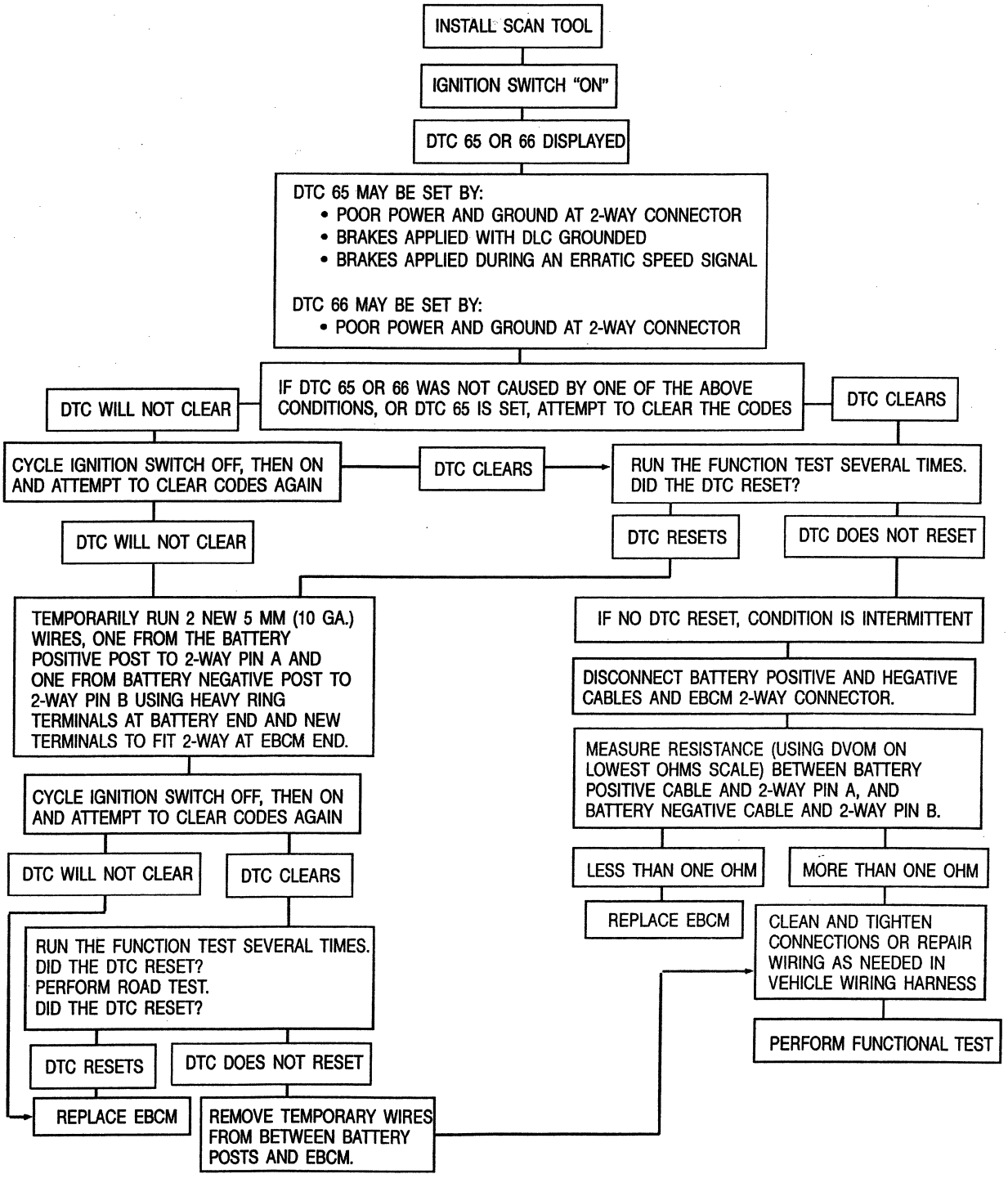
A DTC 65 relates to the 12-volt side of the two-way connector.

If DTC 65 appears with other DTCs, first repair the other DTCs, clear DTCs, and run three function tests with the Scan Tool. If DTC 65 resets, refer to this diagnostic chart.

If a DTC 66 sets with other DTCs, check for a poor ground in the two-way connector harness.

Do not pierce the electrical connectors, wires, seals, or insulation during testing. Doing so will break the seal and lead to corrosion and failure of the wiring and terminals.

DTC 65 OR 66
OPEN OR SHORTED PUMP MOTOR RELAY



DIAGNOSTIC TROUBLE CODE 67
OPEN MOTOR CIRCUIT OR SHORTED BPMV OUTPUT
DIAGNOSTIC TROUBLE CODE 68
LOCKED MOTOR OR SHORTED MOTOR CIRCUIT

CIRCUIT DESCRIPTION:

DTCs 67 and 68 relate to the pump motor and circuit in the BPMV. The motor and pumps are integral with the BPMV and cannot be serviced. The BPMV must be replaced if these tests show the motor or internal circuitry have failed. These DTCs can be caused by poor power and ground at the 2-way connector or motor harness on the BPMV.

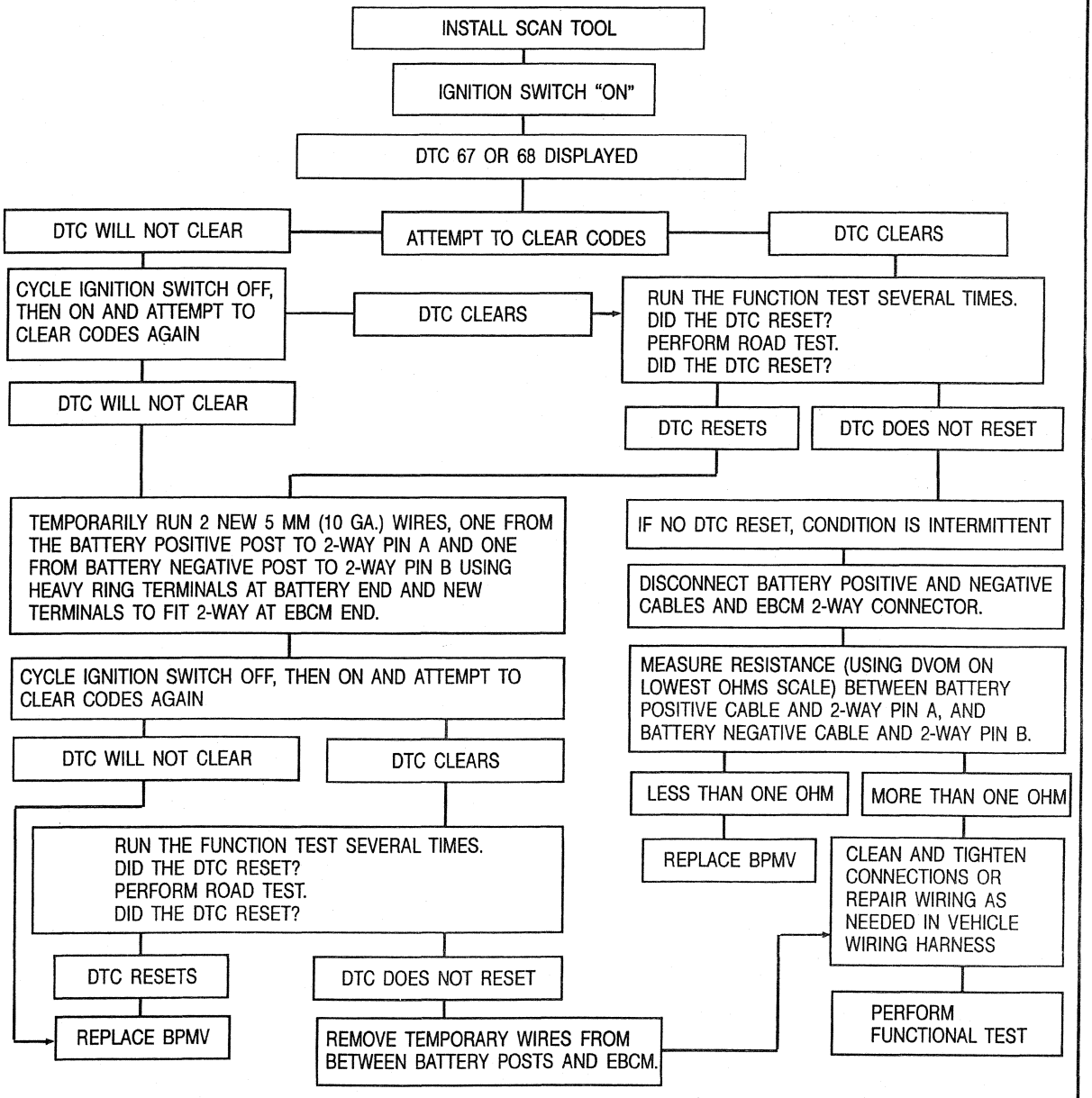
TEST DESCRIPTION:

- Check the voltage and ground circuits at the BPMV 2-way connector.
- Check the motor harness and connector for damage.
- Check CKT 450 for a good ground.
- Check if DTC returns after being cleared.

DIAGNOSTIC AIDS:

Do not pierce the electrical connectors, wires, seals, or insulation during testing. Doing so will break the seal and lead to corrosion and failure of the wiring and terminals.

DTC 67
OPEN MOTOR CIRCUIT OR SHORTED BPMV OUTPUT
DTC 68
LOCKED MOTOR OR SHORTED MOTOR CIRCUIT



DIAGNOSTIC TROUBLE CODES 71 THROUGH 74 BPMV MEMORY ERRORS

CIRCUIT DESCRIPTION:

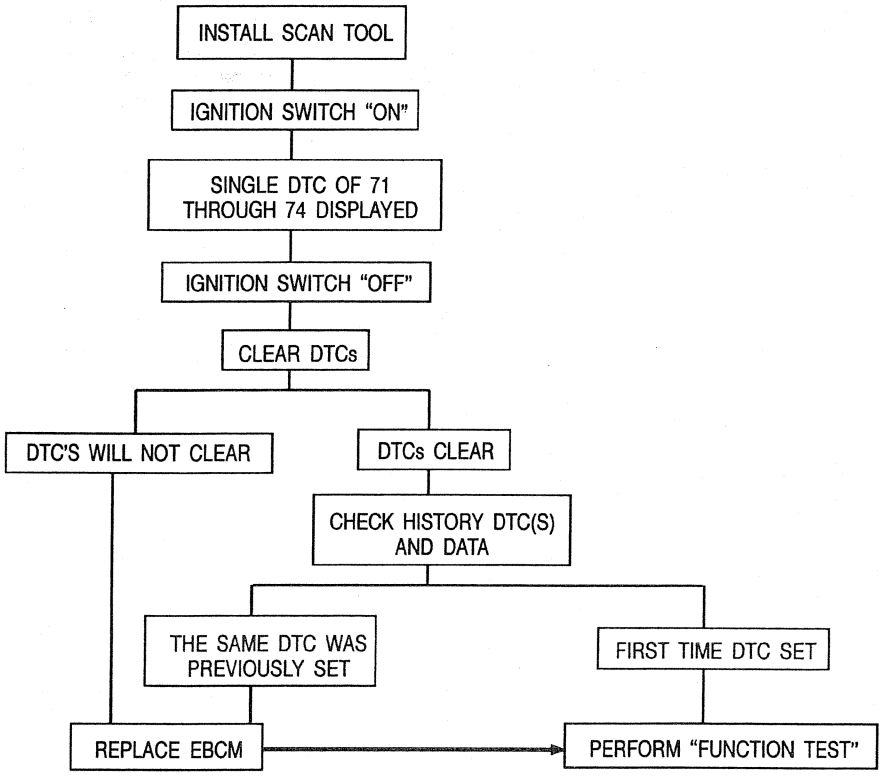
DTCs 71 through 74 relate to the module circuitry inside the EBCM. The module is integral with the EBCM and cannot be serviced. The EBCM must be replaced if these tests show the module circuitry has failed.

TEST DESCRIPTION:

- Check if BPMV will clear DTCs.
- Check if DTC has been set previously.

DTCS 71 THROUGH 74

BPMV MEMORY ERRORS



C0475

DIAGNOSTIC TROUBLE CODE 81 BRAKE SWITCH CIRCUIT OPEN OR SHORTED

CIRCUIT DESCRIPTION:

A DTC 81 relates to the EBCM not seeing the brake switch signal from start up until 10 seconds after the vehicle reaches speeds over 56 km/h (35 mph). An indication of an open brake switch circuit is the "ANTILOCK" lamp will turn on during acceleration at 24 km/h (15 mph) and turn off during deceleration at 24 km/h (15 mph). A faulty brake switch or circuit condition in CKT 420 can cause this DTC.

Important

- Do not replace the EBCM for this DTC. A faulty EBCM will not cause this DTC to set.

TEST DESCRIPTION:

- Check for a blown "BRAKE" fuse.
- Check brake switch status using the Scan Tool.
- Check CKT 420 for looseness or corrosion.

DIAGNOSTIC AIDS:

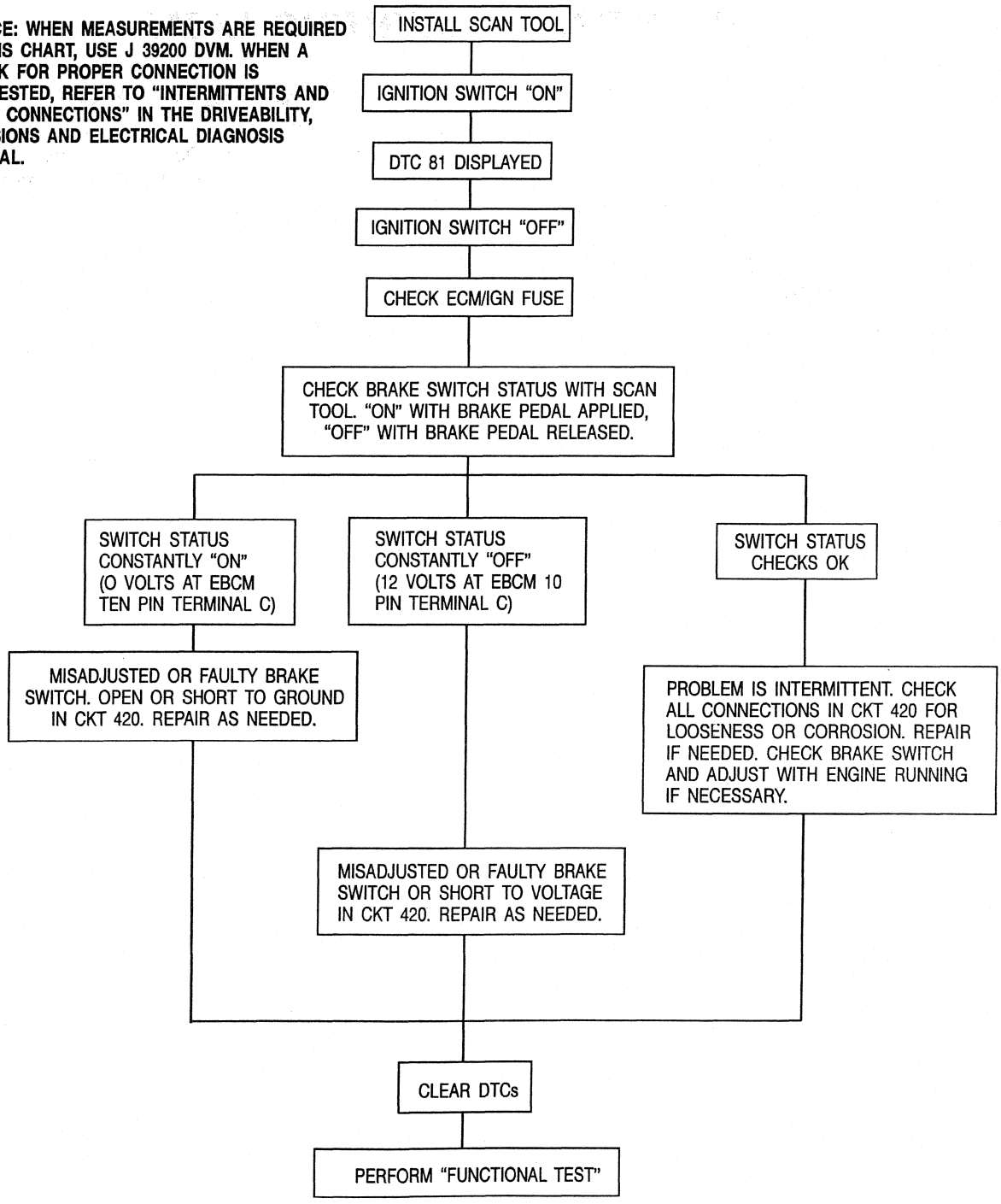
This DTC could be caused by the driver riding the brake pedal.

This DTC is a soft fault. The "ANTILOCK" lamp will not turn on until the vehicle reaches 24 km/h (15 mph).

Do not pierce the electrical connectors, wires, seals, or insulation during testing. Doing so will break the seal and lead to corrosion and failure of the wiring and terminals.

DTC 81
BRAKE SWITCH CIRCUIT SHORTED OR OPEN

NOTICE: WHEN MEASUREMENTS ARE REQUIRED IN THIS CHART, USE J 39200 DVM. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED, REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN THE DRIVEABILITY, EMISSIONS AND ELECTRICAL DIAGNOSIS MANUAL.



C0085

DIAGNOSTIC TROUBLE CODE 86
SHORTED ANTILOCK INDICATOR LAMP
DIAGNOSTIC TROUBLE CODE 88
SHORTED BRAKE WARNING LAMP

CIRCUIT DESCRIPTION:

DTCs 86 and 88 relate to malfunctions in the "ANTILOCK" and "BRAKE" lamp circuits.

Important

- Do not replace the EBCM for this DTC. A faulty EBCM will not cause this DTC to set.

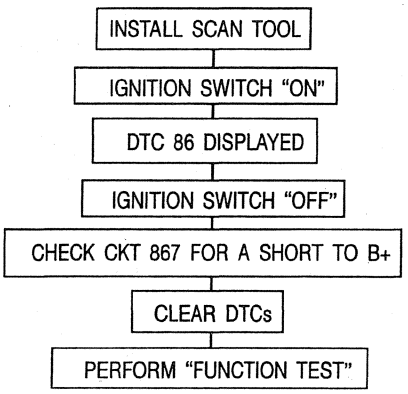
TEST DESCRIPTION:

- Check for a short to B+ in either CKT 852 or 33 depending on which lamp malfunctioned.

DIAGNOSTIC AIDS:

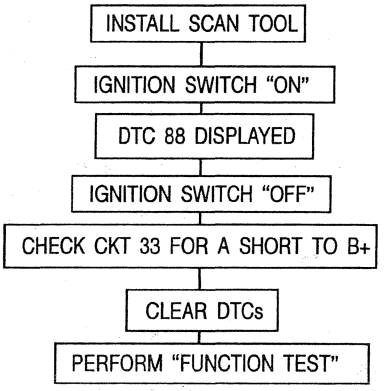
Do not pierce the electrical connectors, wires, seals, or insulation during testing. Doing so will break the seal and lead to corrosion and failure of the wiring and terminals.

DTC 86
SHORTED ANTILOCK INDICATOR LAMP



C0476

DTC 88
SHORTED BRAKE WARNING LAMP



C0477

ON-VEHICLE SERVICE

SERVICE PRECAUTIONS

The 4WAL system is basically maintenance free. When working on this system, observe the following:

- Before welding on the vehicle with an electric welding unit, turn the ignition switch "OFF" and disconnect the BPMV connectors.
- Do not use a fast charger for starting the engine.
- Disconnect the negative battery cable when fast charging. Refer to SECTION 0A.
- Never disconnect the battery from the vehicle electrical system with the engine running.
- Make sure all wiring harness connectors are securely connected.
- Always note the routing, position, mounting, and location of all components, wiring, connectors, clips, brackets, brake pipes, etc., when servicing the 4WAL system. Speed sensor wiring, routing, and retention is especially important to help prevent false signals due to electrical noise picked up by the wiring. Proper system operation can only be achieved if the system is restored to its original equipment condition.

The above mentioned items do not cover every possibility, but must be followed when working on 4WAL. When doing service work, become familiar with 4WAL, and how it interrelates with other components on the vehicle.

CHECKING AND ADDING FLUID

For information on checking and adding fluid to the brake hydraulic system, refer to SECTION 5A.

BLEEDING PROCEDURES

Important

- This procedure is valid for 1995 C/K models only.

Important

- Never pump the brake pedal. Fluid cavitation may occur.

NOTICE: Gravity and vacuum bleeding are not recommended for this ABS system.

TWO PERSON PROCEDURE (PREFERRED)

1. Raise the vehicle to gain access to the system bleed screws. Install clear tubing on the bleed screws so that air bubbles in the fluid can be seen.
2. Begin by bleeding the system at the right rear wheel, then the left rear, right front and left front.
3. Open one bleed screw at a time 1/2 to 1 full turn.
4. Slowly depress the brake pedal until it reaches its full travel and hold until the bleed screw has been tightened. Release the brake pedal and wait 10-15 seconds for the master cylinder to return to the home position.

Important

- Repeat steps 1 through 4 until approximately 1 pint of brake fluid has been bled from each wheel. Clean brake fluid should be present at each of the wheel bleed screws. Check the master cylinder fluid level every 4 to 6 strokes of the brake pedal to avoid running the system dry.

5. After bleeding all four wheels, use a Scan Tool to run 4 functional tests while applying the brake pedal firmly.
6. Rebleed all four wheels using steps 1 through 4 to remove the remaining air from the brake system.
7. Evaluate the brake pedal feel before attempting to drive the vehicle and rebleed as many times as necessary to obtain appropriate pedal feel.

PRESSURE BLEEDING (LOW PRESSURE)

1. Install pressure bleeder per instructions.
2. Install combination valve depressing tool J39177 if the vehicle is equipped with the metering portion of the combination valve. Remove both dust caps on the combination valve. Install the tool on the end of the combination valve with a brass center pin.
3. Bleed all four wheels beginning at the right rear wheel, then the left rear, right front and left front. Leave the bleed screws open until 1 pint of fluid has been bled out of each wheel.
4. After bleeding all four wheels, remove the combination valve clip. Use a Scan Tool to run 4 functional tests while applying the brake pedal firmly.
5. Repeat steps 1 through 3 then evaluate the pedal feel.
6. Rebleed the wheels as many times as necessary to obtain good pedal feel before attempting to drive the vehicle. A good bleed will use approximately 2 to 3 quarts of brake fluid.

Important

- Never reuse brake fluid after it has been bled through a brake system.

ELECTRONIC BRAKE CONTROL MODULE REPLACEMENT

Remove or Disconnect (Figure 10)

1. Negative battery cable. Refer to Section 0A.
2. Four electrical connectors.
3. Four T-25 Torx bolts.
4. EBCM from BPMV. A light amount of force may be necessary to remove the EBCM.

Important

- Do not pry on the EBCM or BPMV with a mechanical aid. Excessive force will cause damage to the EBCM.

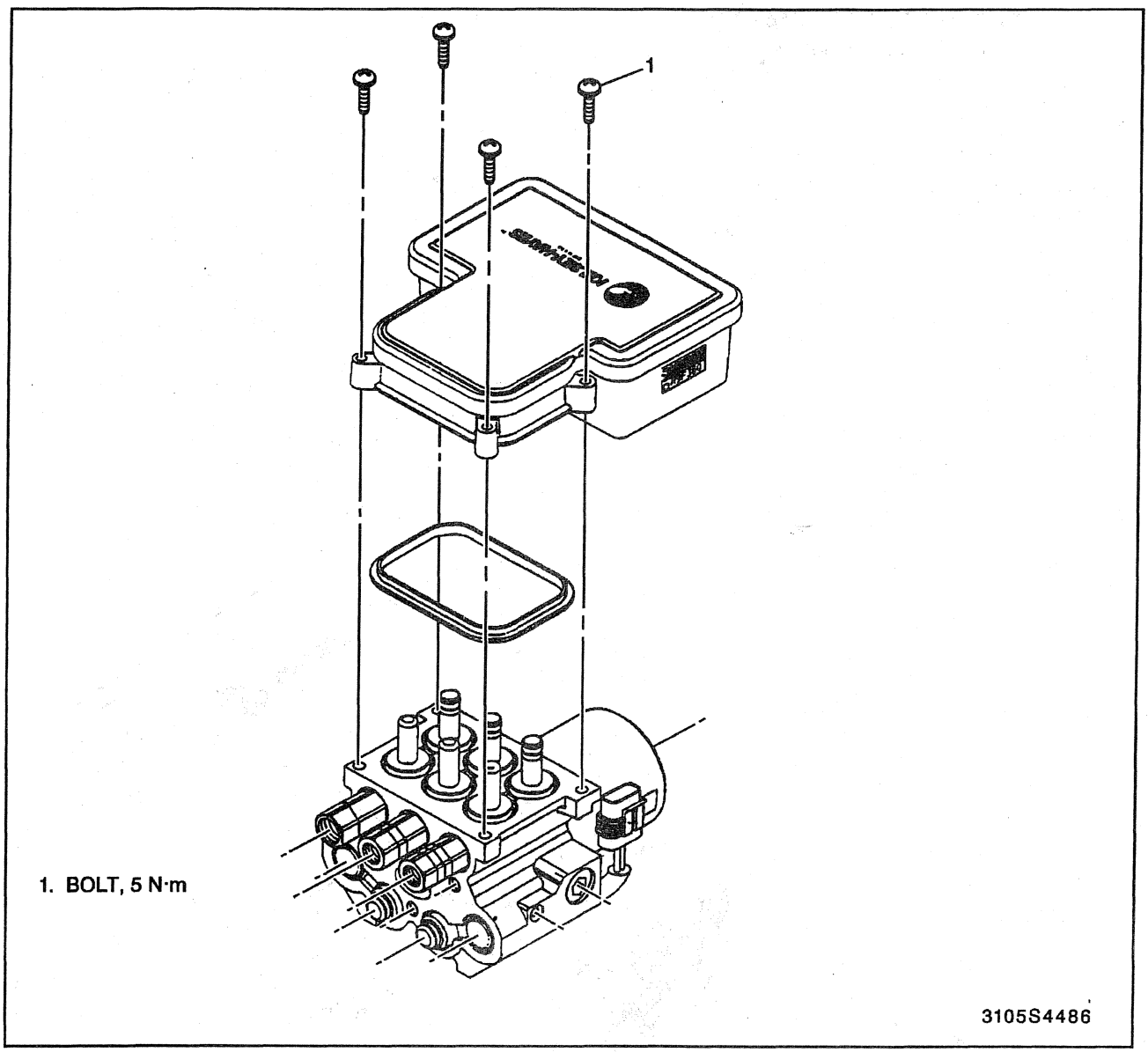


Figure 10—Electronic Brake Control Module (EBCM)

Important

- Do not reuse the EBCM gasket or mounting bolts. Always install a new gasket and mounting bolts with a new EBCM.

Clean

- Top of the BPMV with a clean, dry cloth.

Install or Connect (Figure 10)

1. New EBCM gasket onto BPMV.

Important

- Do not use RTV or any other type of sealant on the EBCM gasket or mating surfaces.

2. EBCM to BPMV.

Inspect

- Gasket for correct alignment.

3. Four new EBCM bolts.

Tighten

- Four bolts to 5 N·m (39 Lbs. In.) in an X pattern.

4. Four electrical connectors.
5. Negative battery cable.
6. Verify bulb check.
7. Revise tire calibration using Scan Tool.

COMBINATION VALVE REPLACEMENT

Inspect

- Prior to replacement of the combination valve, note the identification code on the valve (Figure 11). It is necessary to have the proper code when ordering a replacement valve.

Remove or Disconnect (Figure 11)

1. Electrical connector.
2. Front and rear brake pipes.
3. Three allen bolts.
4. Combination valve from BPMV.
5. Two transfer tubes.

Important

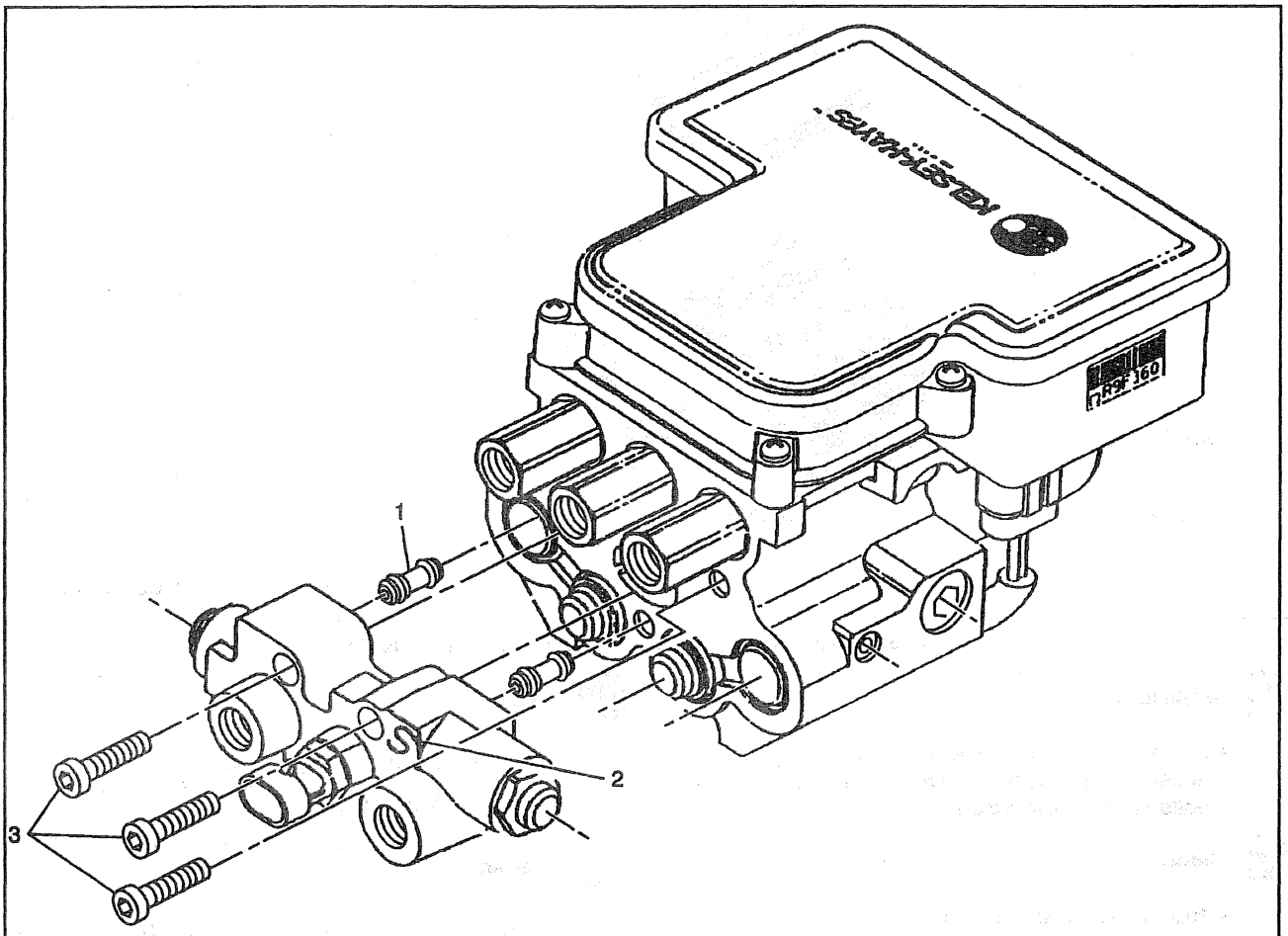
- Do not reuse the transfer tubes. Always install new transfer tubes with a new combination valve.

Inspect

- Verify that the replacement combination valve has the same pin punched identification code as previously noted on the old part.

Install or Connect (Figure 11)

1. Two new transfer tubes into the combination valve until fully seated.
2. Combination valve to BPMV.
3. Three combination valve bolts.



1. TRANSFER TUBE
2. IDENTIFICATION LETTERING
3. BOLTS, 16 N·m

3105S4487

Figure 11—Combination Valve

Tighten

- Bolts in two steps.
- First to 8 N·m (6 lbs. ft.)
- Second to 16 N·m (12 lbs. ft.)

4. Front and rear brake pipes to combination valve.

Tighten

- Brake pipe fittings to 24 N·m (18 lbs. ft.)

5. Electrical connector.
6. Bleed the system. Refer to "Bleeding Procedures" in this Section.

Important

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

BRAKE PRESSURE MODULATOR VALVE REPLACEMENT

Remove or Disconnect (Figure 12)

1. Negative battery cable. Refer to Section 0A.
2. Four electrical connectors from EBCM.
3. Electrical connector from combination valve.
4. Front and rear brake pipes from combination valve.
5. Three hydraulic line from the tube adapters on the BPMV.
6. Three 13mm bolts retaining BPMV to bracket.
7. EHCU assembly from vehicle.
8. Four T-25 Torx bolts from EBCM.
9. EBCM from BPMV. A light amount of force may be necessary to remove the EBCM.

Important

- Do not pry on the EBCM or BPMV. Excessive force will cause damage to the EBCM.

Important

- Do not reuse the EBCM gasket or mounting bolts. Always install a new gasket and new bolts.

10. Three allen bolts from the combination valve.
11. Combination valve from the EBCM.
12. Two transfer tubes.

Important

- Do not reuse the transfer tubes. Always install new transfer tubes.

Install or Connect (Figure 12)

1. New transfer tubes into the combination valve until fully seated.
2. Combination valve to BPMV.
3. Three allen bolts.

Tighten

- Bolts in two steps.
- First to 8 N·m (6 lbs. ft.)
- Second to 16 N·m (12 lbs. ft.)

4. New EBCM gasket to EBCM.

Important

- Do not use RTV or any other sealant on the gasket or mating surfaces.

5. EBCM to BPMV.

Inspect

- Gasket to verify proper alignment.

6. Four new EBCM Torx bolts.

Tighten

- Four bolts to 5 N·m (39 Lbs. In.) in an X pattern.

7. EHCU in vehicle.
8. EHCU to bracket retaining bolts.

Tighten

- Three 13mm bolts to 9 N·m (7 lbs. ft.)

9. Front and rear brake pipes to combination valve.

Tighten

- Brake pipe fittings to 24 N·m (18 lbs. ft.)

10. Three hydraulic lines to tube adapters on BPMV.
11. Differential switch electrical connector to combination valve.
12. Four electrical connectors.
13. Negative battery cable.
14. Verify bulb check.
15. Bleed the brake system. Refer to "Bleeding Procedures".

TUBE ADAPTERS

Remove or Disconnect (Figures 10 and 12)

1. Disconnect appropriate brake line from tube adapters.
2. Tube adapter(6).

Install or Connect (Figures 10 and 12)

1. Tube adapter(6).

Tighten

- Tube adapter to 31 N·m (23 lbs. ft.)

2. Brake line.
3. Bleed the system. Refer to "Bleeding Procedures".

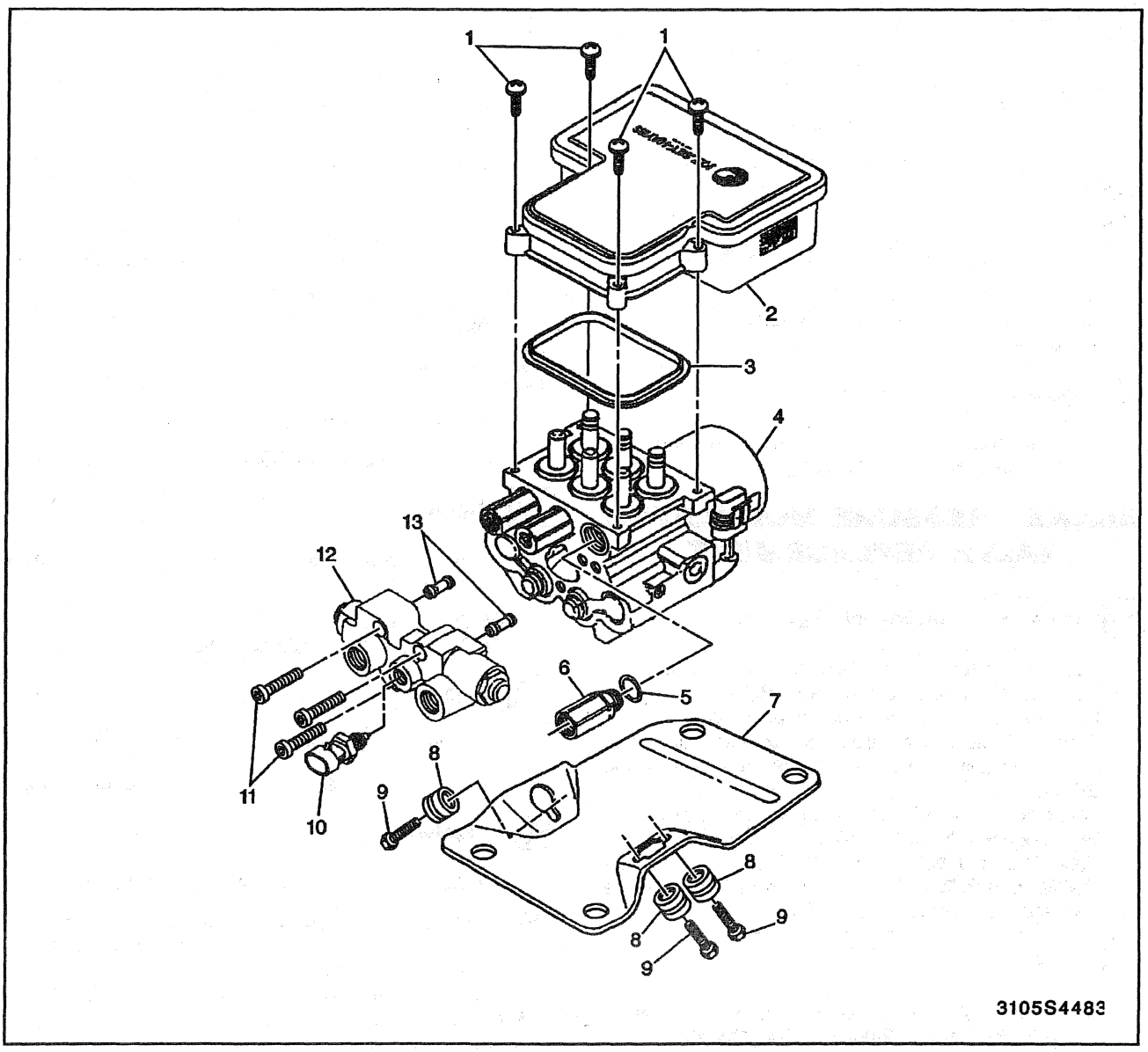


Figure 12—Electro-Hydraulic Control Unit (EHCU) Component Views

Important

- If more than one tube adapter is to be removed at one time, the BPMV should be stamped with a number (1, 2 or 3) to correspond with the number of grooves cut into the tube adapters (Figure 10). This will aid in proper reassembly.

FRONT WHEEL SPEED SENSOR REPLACEMENT

TWO WHEEL DRIVE

Remove or Disconnect (Figure 13)

1. Tire and wheel. Refer to SECTION 3C.
2. Brake caliper. Refer to SECTION 5B1.
3. Hub and rotor. Refer to SECTION 3C.
4. Wheel speed sensor electrical connector.
5. Wheel speed sensor harness clip rivets.
   - Use a 3/16 inch drill.
6. Clips from wheel speed sensor wire.
   - Save clips for new wheel speed sensor.
7. Wheel speed sensor mounting bolts and nut.
8. Splash shield mounting bolts.
9. Wheel speed sensor and splash shield.
10. Splash shield gasket.

Install or Connect (Figure 13)

NOTICE: For steps 3 and 4, refer to "Notice" on page 5E1-1.

1. Splash shield gasket.
2. Wheel speed sensor and splash shield.
3. Splash shield mounting bolts.

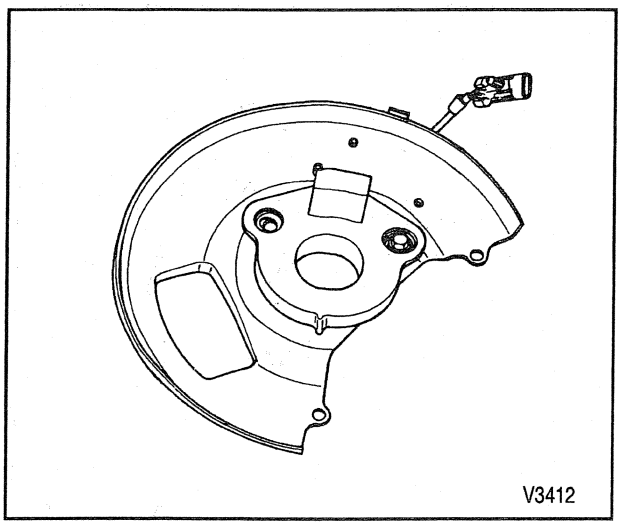


Figure 13—Front Wheel Speed Sensor (2WD)

Tighten

- Splash shield bolts to 16 N·m (12 lbs. ft.).

4. Wheel speed sensor mounting bolts and nut.

Tighten

- Wheel speed sensor mounting bolts to 26 N·m (19 lbs. ft.).

5. Harness clips on wheel speed sensor wire.
   - Locate clips at paint dots on wire.
6. Harness clips and 3/16 inch rivets.
7. Wheel speed sensor electrical connector.
8. Hub and rotor. Refer to SECTION 3C.
9. Brake caliper. Refer to SECTION 5B1.
10. Tire and wheel. Refer to SECTION 3C.

FOUR WHEEL DRIVE

Remove or Disconnect (Figure 14)

1. Tire and wheel. Refer to SECTION 3E.
2. Brake Caliper. Refer to SECTION 5B1.

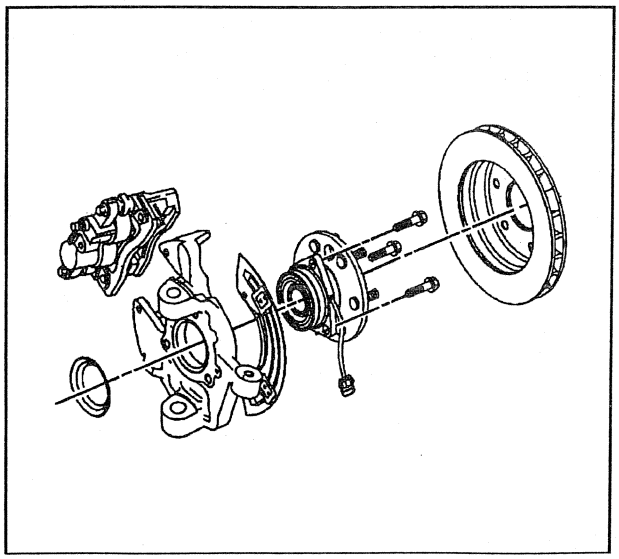


Figure 14—Front Wheel Speed Sensor (4WD)

3. Rotor. Refer to SECTION 3C.
4. Sensor wire mounting clip on the control arm.
5. Sensor wire mounting clip on the frame.
6. Sensor electrical connector.

Clean Area Thoroughly

Important

- The speed sensor mounts into a bore that leads to the center of the sealed bearing. Use caution when cleaning and working around the bore. Do not contaminate the lubricant inside the sealed bearing. Failure to do so can lead to premature bearing failure.

7. Sensor from hub and bearing assembly.

NOTICE: Carefully remove the sensor by pulling it straight out of the bore. DO NOT use a screwdriver, or other device, to pry the sensor out of the bore. Prying will cause the sensor body to break off in the bore.

Install or Connect (Figure 14)

Important

- The new speed sensor will have a new O-ring. Dispose of the old O-ring. Lubricate the new O-ring **lightly** with bearing grease prior to installation. You may also lubricate the sensor just above and below the O-ring. **DO NOT** lubricate the bore.

1. Sensor into hub and bearing assembly.

Tighten

- Sensor mounting bolt to 18 N·m (13 lbs. ft.)

Important

- The new speed sensor has new mounting clips already installed on the wire. **DO NOT** reuse the old clips.

2. Sensor electrical connector.
3. Sensor wire mounting clip to the frame rail.
4. Sensor wire mounting clip to the control arm.
5. Rotor. Refer to Section 3C.
6. Brake caliper. Refer to Section 5B1.
7. Tire and wheel. Refer to Section 3E.

3500 HD MODELS

Remove or Disconnect (Figure 15)

1. Tire and wheel. Refer to SECTION 3C.
2. Brake Caliper. Refer to SECTION 5B1. 3 Hub and rotor.
3. Electrical connector.
4. Two wheel speed sensor bracket retaining bolts.
5. Two wheel speed sensor retaining bolts.
6. Wheel speed sensor from knuckle.

Install or Connect (Figure 15)

NOTICE: For steps 2 and 3, refer to "Notice" on page 5E1-1.

1. Wheel speed sensor to knuckle.
2. Whell speed sensor bracket retaining bolts to knuckle.

Tighten

- Wheel speed sensor bracket bolt to 250 N.m

3. Wheel speed sensor retaining bolts to bracket.

Tighten

- Wheel speed sensor nuts to 11 N.m .

4. Wheel speed sensor harness retaining bolt.
5. Electrical connector.
6. Hub and rotor.
7. Brake caliper. Refer to SECTION 5B1.
8. Tire and wheel. Refer to SECTION 3C.

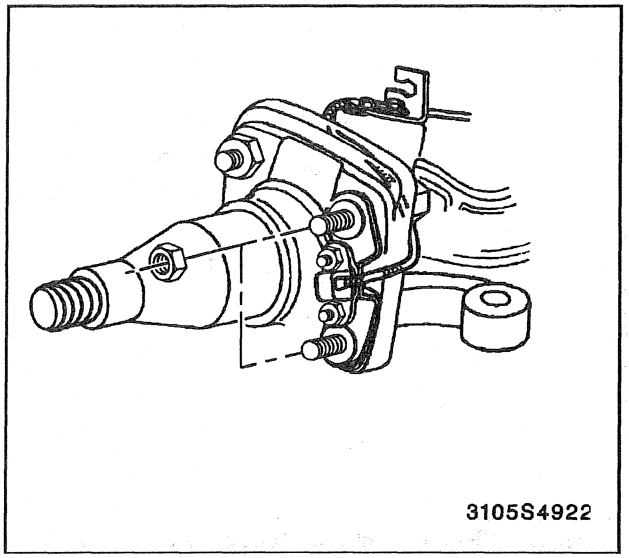


Figure 15—Front Wheel Speed Sensor (3500 HD)

FRONT WHEEL SPEED SENSOR TONE WHEELS

For on-vehicle service information, refer to SECTION 4C.

VEHICLE SPEED SENSOR

The resistance value of the VSS should be 900 to 2000 ohms. It is located o the transmission on 2WD models and on the transfer case on 4WD models. For replacement procedures refer to SECTION 7.

VEHICLE SPEED SENSOR CALIBRATOR MODULE

For vehicle speed sensor calibrator module on-vehicle service, refer to SECTION 8C.

WARNING/INDICATOR LAMPS

For warning/indicator lamp on-vehicle service, refer to SECTION 8C.

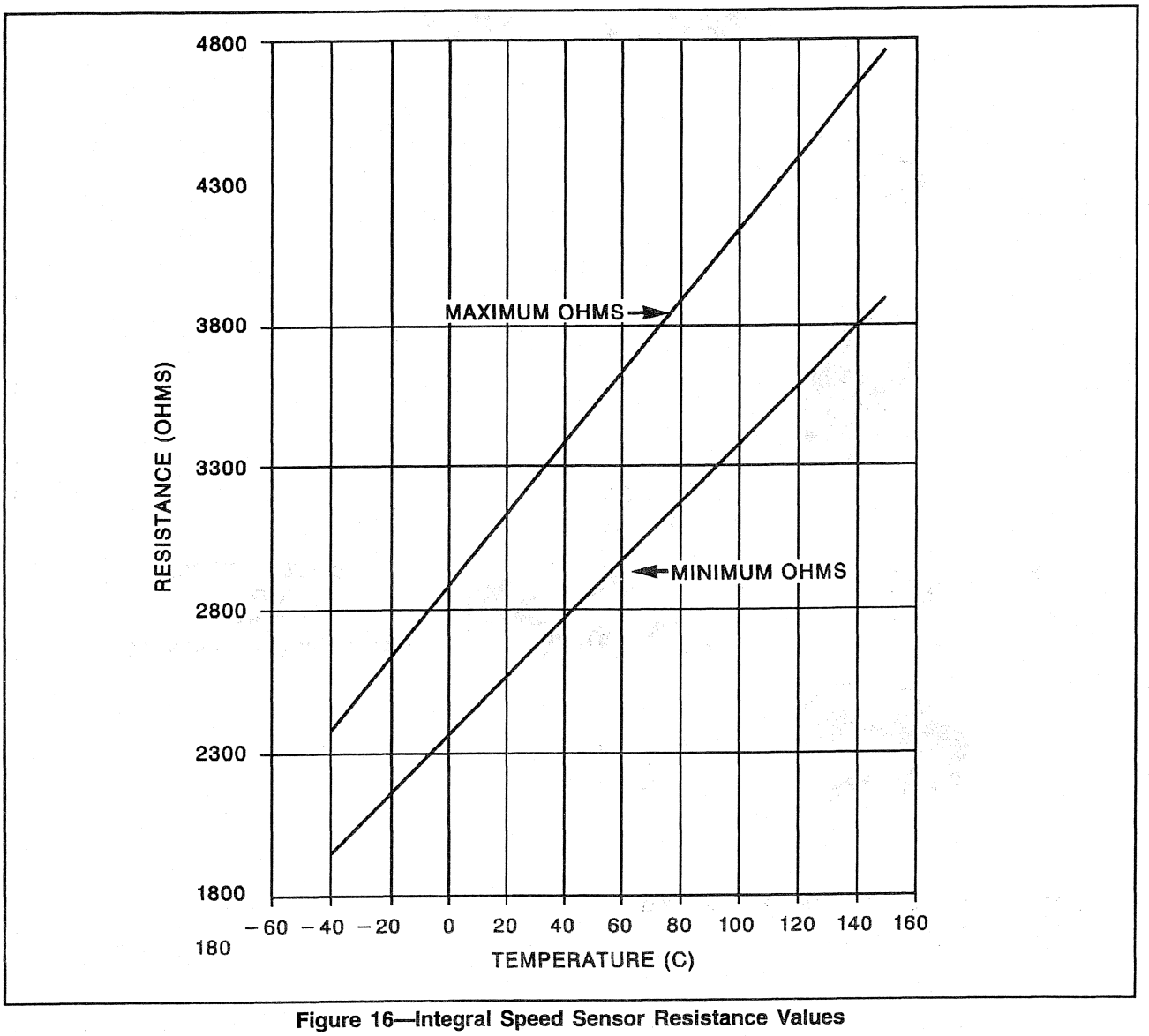


Figure 16—Integral Speed Sensor Resistance Values

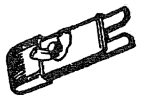
SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

ITEM	N·m	Lbs. Ft.	Lbs. In.
BPMV Bracket Mounting Bolts	24	18	—
Combination Valve to BPMV	16	12	—
EBCM to BPMV	5	—	39
EHCU to Bracket	9	7	—
Front Brake Line to Combination Valve	24	18	—
Front Wheel Speed Sensor Mounting Bolts (2WD)	26	19	—
Front Wheel Speed Sensor Mounting Bolts (4WD)	18	13	—
Rear Brake Line to Combination Valve	24	18	—
Splash Shield Mounting Bolts (2WD)	16	12	—
Tube Adapters to BPMV	31	23	—

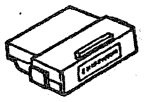
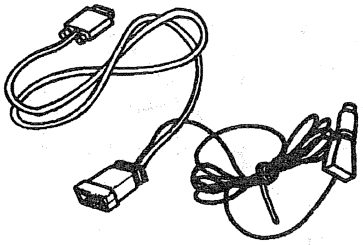
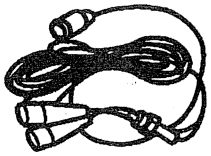
T2958

SPECIAL TOOLS

1.  J 39177

CP

2.  TK 00000

3.    

TK 02650 (4 PIECES)
OR
7000001
MASS STORAGE CARTRIDGE

1. COMBINATION VALVE PRESSURE BLEEDING TOOL
2. TECH-1 SCAN TOOL
3. RWAL/4WAL CARTRIDGE KIT

SECTION 5F

PARKING BRAKE

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

CAUTION: When servicing brake parts, do not create dust by grinding or sanding brake linings, by cleaning brake parts with a dry brush or with compressed air. Many earlier model or aftermarket brake parts may 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 fibers from becoming airborne.

NOTICE: Always use the correct fastener in the correct location. Use the correct fastener part number to replace a fastener. If the correct fastener part number is not available, a fastener of equal size and strength may be used. Do not use a fastener that is stronger when the correct fastener part number is not available in the following applications:

- ***Some bolts are designed to permanently stretch, and if a stronger fastener is used the part will not be tightened correctly. These permanently stretching bolts will be called out. The correct part number fasteners must be used to replace this type of fastener because there is no available equivalent.***
- ***Other bolts are designed to break if over tightened to prevent part damage. If a stronger fastener is used part damage may occur.***

Fasteners that need to be replaced when removed will be called out. Fasteners that require thread lockers or thread sealant will be called out. The correct tightening specification and sequence must be used when installing fasteners. Part or system damage may occur if the above instructions are not followed.

CONTENTS

CONTENTS (cont'd)

GENERAL DESCRIPTION

There are three basic types of parking brakes used on the C/K models. The lower GVW models use leading/trailing rear drum brakes. The higher GVW models use duo-servo rear drum brakes. The highest GVW model (C3HD) has a propeller shaft parking brake mounted on the transmission.

LEVER

The parking brake lever is located on the left side of the driver's compartment and is activated by foot pressure. The lever assembly has a ratchet mechanism in it to allow varying degrees of parking brake application. The parking brake handle on the instrument panel allows the driver to release the parking brake.

CABLE SYSTEM

The cable system will vary depending on the type of parking brake system used.

Models with rear drum brakes used a system that includes one front cable and two rear cables. The front cable connects to the lever on one end and the equalizer on the other end. The rear cables attach to the equalizer on one end and the parking brake struts in the drum brakes on the other end.

Models with a propeller shaft parking brake use a one-cable system. The cable connects to the front lever on one end and the rear lever on the other end.

"BRAKE" LAMP

The "BRAKE" warning lamp on the instrument cluster turns on when the parking brake is applied. The BRAKE lamp can also be turned on by the switch in the combination valve and the antilock brake system.

PARKING BRAKE SWITCH

The parking brake switch is located on the lever assembly. The switch serves as the device to turn on the "BRAKE" lamp when the parking brake is applied and turn it off when the parking brake is released.

DAYTIME RUNNING LIGHTS

Canadian vehicles use a daytime running light (DRL) system. This system uses the parking brake switch to turn the headlamps off when the ignition switch is "ON" and the parking brake applied. For more information on DRL, refer to SECTION 8B.

DIAGNOSIS

CABLE INSPECTION

Check the parking brake for free operation. The brake lever must return to the released position without sticking or binding. If a problem is present, check the cable routings for kinks or binding.

LINING INSPECTION

Replace brake shoe and lining assemblies whenever the thickness of any lining is worn to within 0.76 mm (0.030 in.) of the shoe. For riveted shoe and lining assemblies, replace when the lining is worn to within 0.76 mm (0.030 in.) of any rivet head.

DRUM INSPECTION

Any time the parking brake drum is removed, thoroughly clean and inspect it for cracks, scores, deep grooves, and out-of-round.

SURFACE FINISH

Slight scoring can be cleaned up with fine emery cloth. Heavy or extensive scoring causes excessive brake lining wear. The drum braking surface will need machining to remove these scores.

If the drum is grooved and the brake linings are slightly worn, the drum should not be machined. Instead, polish the drum braking surface with fine emery cloth. Eliminating all of the drum grooves and ridges on the lining would require removing too much metal and lining material. The grooves and ridges match and satisfactory service can be obtained by leaving them alone.

INSIDE DIAMETER CHECK

Measure the inside diameter of the brake drum at two or more places around the circumference of the braking surface. The measurements must be made at the same distance in from the the edge of the drum.

TAPER CHECK

Measuring a drum for taper involves taking measurements at the inner and outer edges of the machined surface at two or more places around the drum.

ON-VEHICLE SERVICE

LUBRICATION

Clean and lubricate the parking brake assembly and cables with Lubriplate (GM P/N 1050109) or equivalent. Do not allow the lubricant to contact the drum or lining surfaces.

LEVER

Remove or Disconnect (Figure 1)

- The C3HD lever looks the same as the other models, but uses a different torque applying lever assembly.
- The parking brake must be fully released.

1. Lower instrument panel section. Refer to SECTION 10A4.
2. Connector from parking brake switch.
3. Release cable (2).
4. Handle (3).
5. Bolts (4).
6. Lever assembly (1).

Install or Connect (Figure 1)

1. Lever assembly (1).
2. Bolts (4).

Tighten

- Bolts (4) to 24 N·m (18 lbs. ft.).

3. Handle (3).
4. Release cable (2).
5. Connector to parking brake switch.
6. Dash assembly. Refer to SECTION 8C.

Adjust

- Refer to "Adjustment" in this section.

CABLES

FRONT CABLE

Remove or Disconnect (Figure 2)

1. Raise vehicle and support with safety stands.
2. Loosen adjusting nut at equalizer (5) (figure 3).
3. Connector (8).
4. Cable (5) from parking brake lever (1).
   - Bend in the retaining fingers (6) at the frame bracket.
5. Front cable (5).

Install or Connect (Figure 2)

1. Front cable (5).
2. Cable (5) to parking brake lever (1).
   - Make sure all retaining fingers (6) are through the hole.
3. Connector (8).

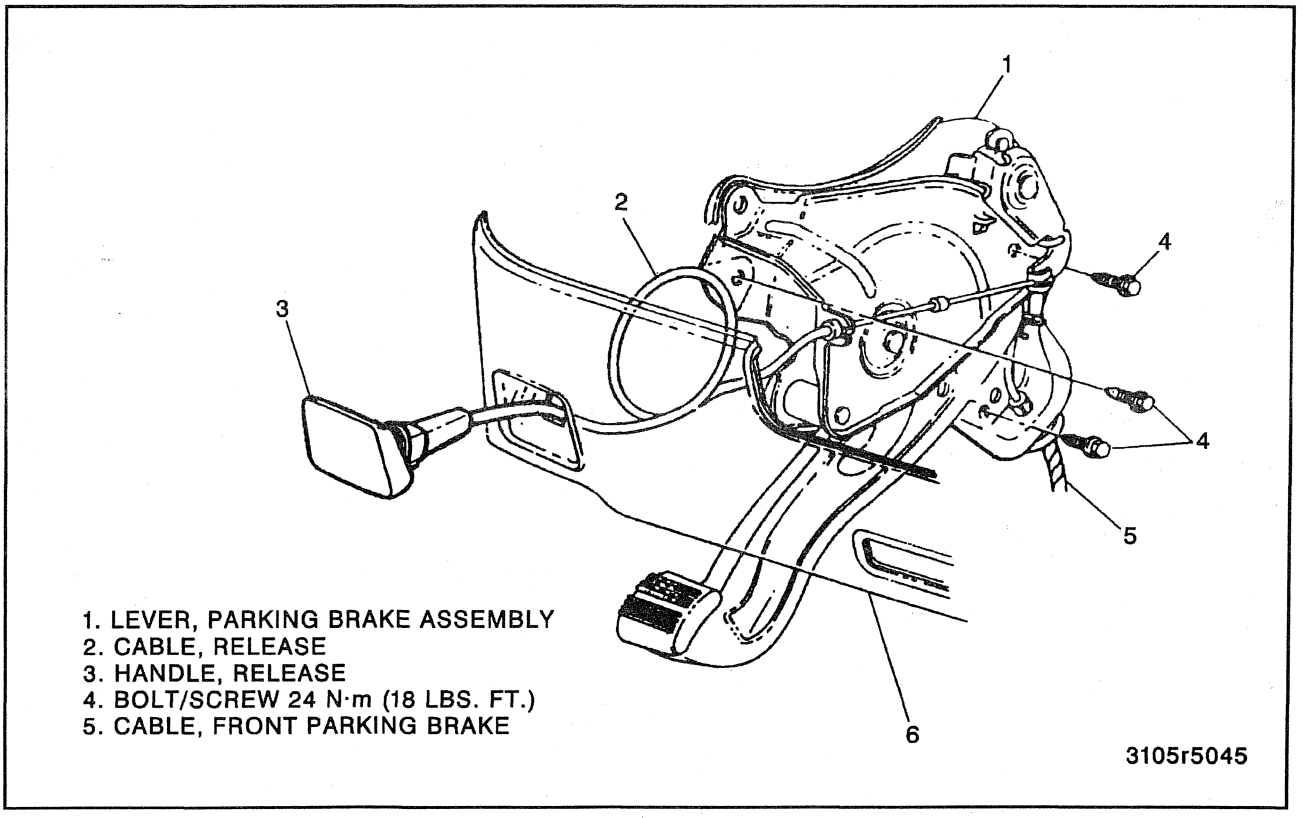


Figure 1—Parking Brake Lever

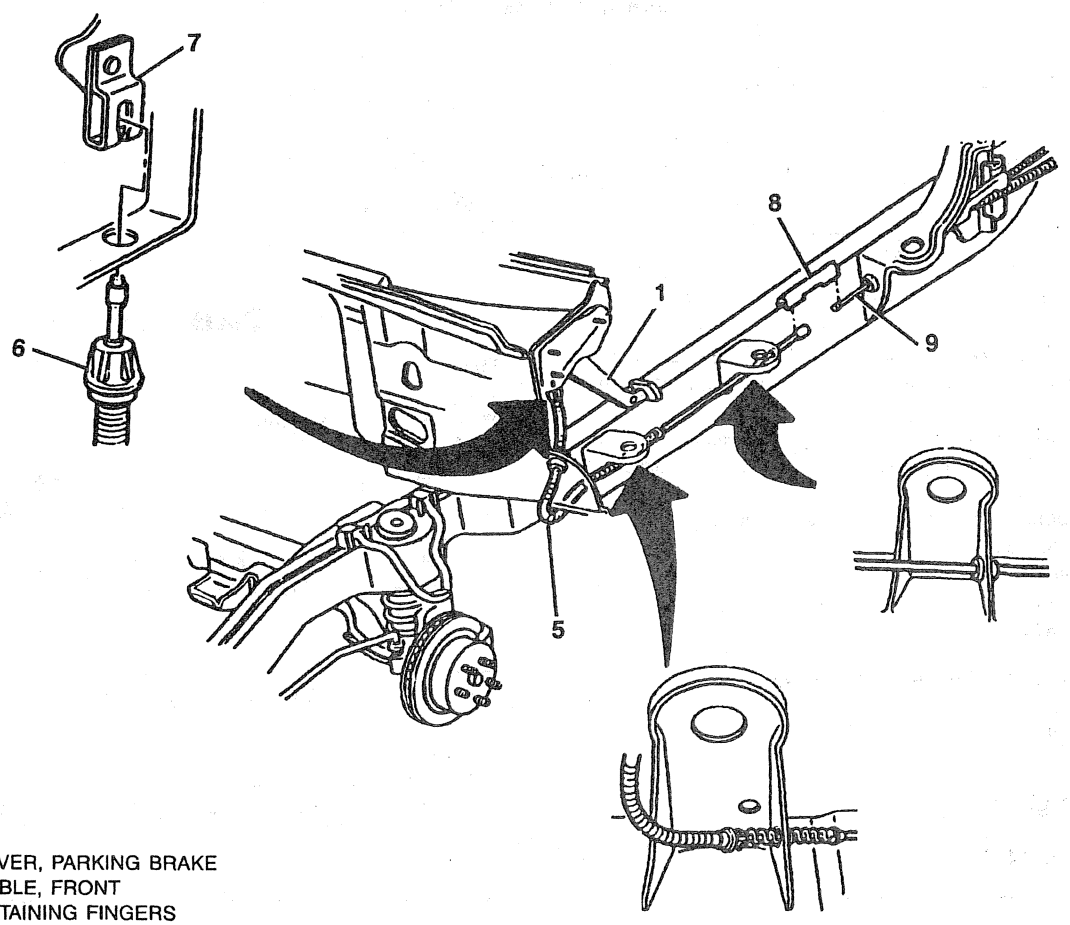


Figure 2—Front Parking Brake Cable

Adjust

- Refer to "Adjustment" in this section.

REAR CABLES

Remove or Disconnect (Figure 3)

1. Release parking brake.
2. Raise vehicle and support with safety stands.
3. Loosen nut at the equalizer (5).
4. Connector (8).
5. Rear brake assembly. Refer to SECTION 5C1 or 5C2.
6. Bend in the retaining fingers at the backing plate.
7. Cable (1 or 3).

Install or Connect (Figure 3)

1. Cable (1 or 3).
2. Cable end into backing plate.
   - Make sure all retaining fingers are completely through the backing plate.
3. Rear brake assembly. Refer to SECTION 5C1 or 5C2.
4. Connector (8).

Adjust

- Refer to "Adjustment" in this section.

ADJUSTMENT

The parking brake must be adjusted any time the parking brake cables are serviced, or the holding ability is not adequate. Before adjusting the parking brake, check the condition of the service brakes. The service brakes must be adjusted properly before adjusting the parking brake. Refer to SECTION 5C1 or 5C2.

The C3HD has a propeller shaft mounted parking brake and does not affect the service brakes.

Adjust (Figures 3 and 4)

1. Block the front wheels.
2. Raise the vehicle and support with safety stands.
3. Loosen the adjusting nut at the equalizer (5).

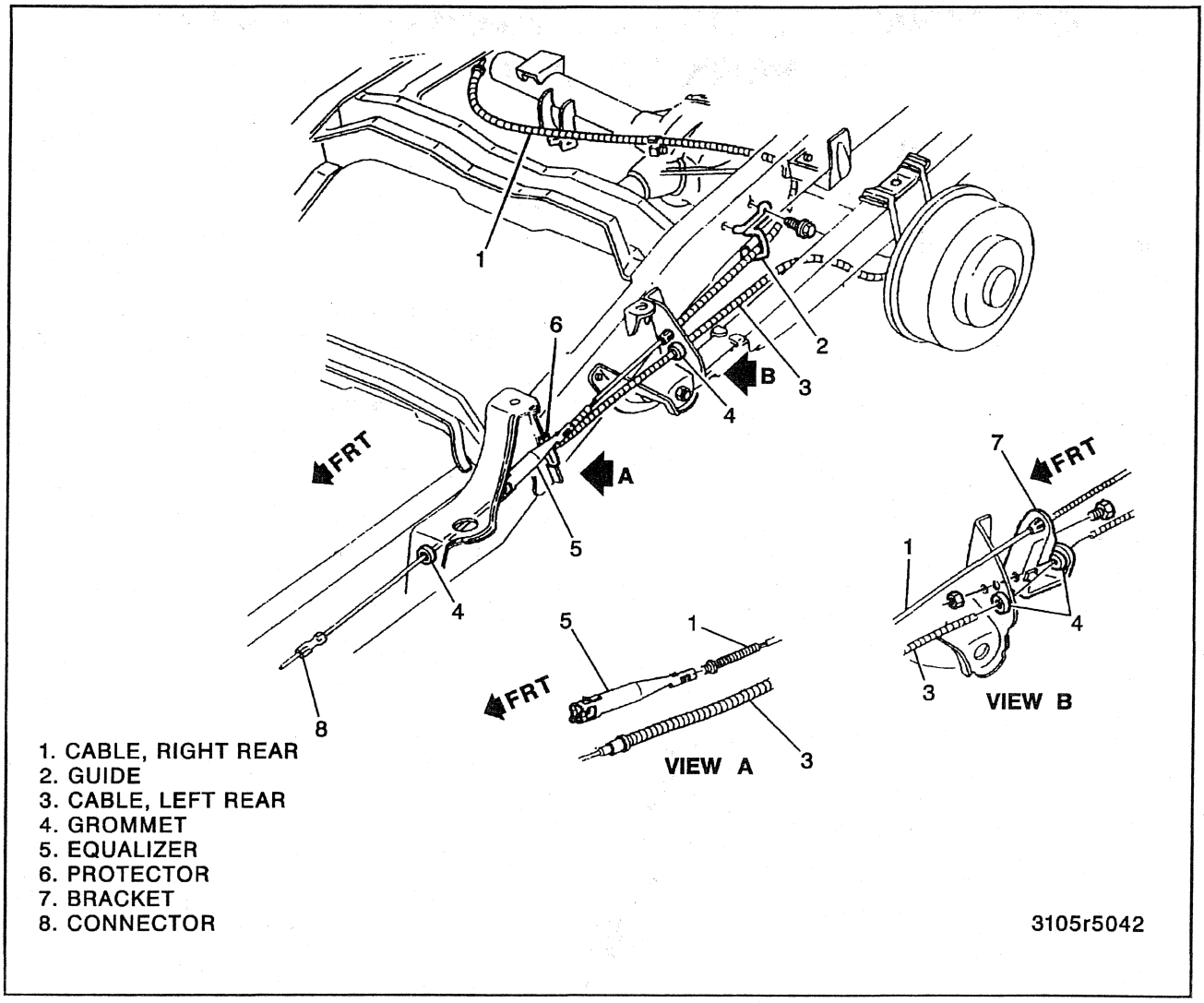


Figure 3—Rear Parking Brake Cable

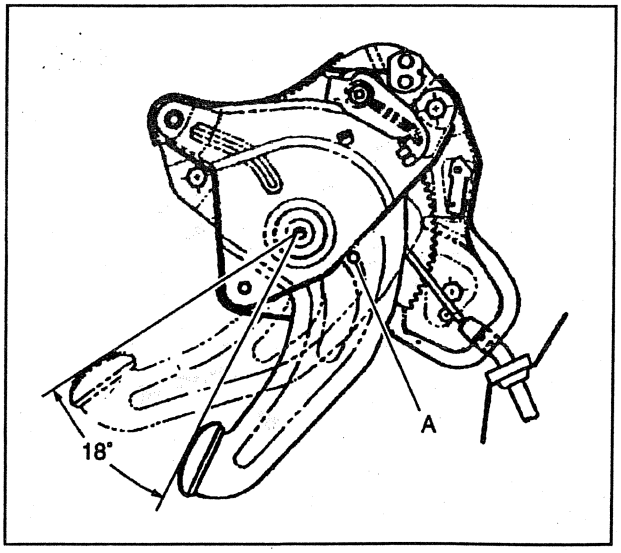


Figure 4—Parking Brake Adjustment Setting

4. Set the parking brake by pushing the pedal down 18 degrees.
   - Insert a 3 mm (.125 in.) pin into locating hole (A) in the pedal assembly (figure 4). Push the pedal downward until the pin contacts the parking brake outer flange.
5. Turn adjusting nut until wheels rotate forward with moderate drag.
6. Release parking brake and rotate rear wheels.
   - There should be no drag.
7. Lower the vehicle and unblock front wheels.

"BRAKE" LAMP

For "BRAKE" lamp on vehicle service, refer to SECTION 8C.

ON-VEHICLE SERVICE: PROPELLER SHAFT PARKING BRAKE

CABLE

Remove or Disconnect (Figure 5)

1. Release the parking brake.
2. Raise the vehicle and support with safety stands.
3. Cotter pin (4) and clevis pin (3).
4. Clevis (5) and nut (6) from cable.
5. Grommet (7) from bracket.
6. Bolt (8) and clip (9).
7. Cable end from lever (13).
8. Retaining fingers (12) from lever (13).
9. Cable assembly (10).

Install or Connect (Figure 5)

1. Cable assembly (10).
2. Retaining fingers (12) to lever (13).
3. Cable end to lever (13).
4. Grommet (7) to bracket.
5. Clip (9) and bolt (8).

Tighten

- Bolt (8) to 10 N·m (88 lbs. in.).

6. Nut (6) and clevis (5) to cable, finger tight.
7. Adjust. Refer to "Adjustment" in this section.
8. Lower the vehicle.

ADJUSTMENT

Adjust (Figures 4, 5 and 6)

Tool Required:
J 35999 Tension Scale

1. Remove clevis pin (3) from lever (2) (figure 5).

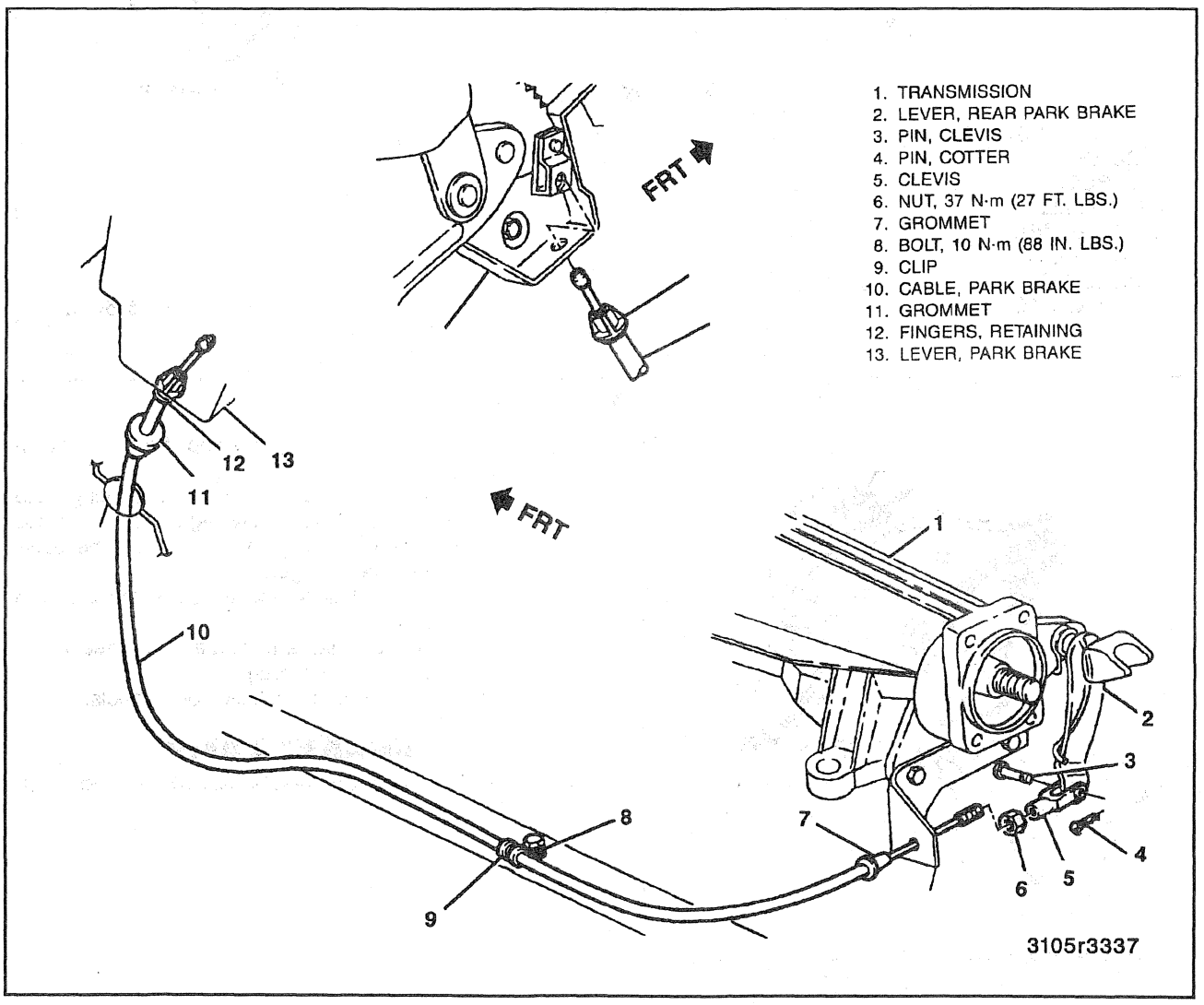


Figure 5—Parking Brake Cable

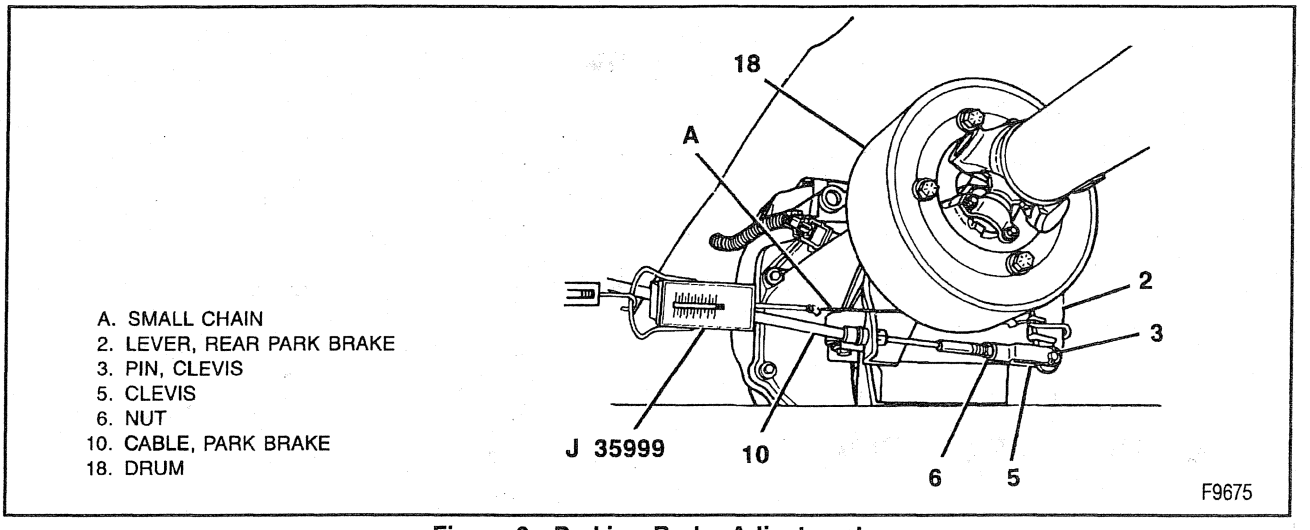


Figure 6—Parking Brake Adjustment

2. Set parking brake by pushing the pedal down 18 degrees.
   - Insert a 3 mm (.125 in.) pin into locating hole (A) in the pedal assembly (figure 4). Push the pedal down until the pin contacts the parking brake outer flange.
3. Install J 35999 with a small length of cable or chain, and a tightening device (like a turn buckle) on the frame (figure 6).
4. Install a small chain (A) on the lever (2) near the spring (23) on the bottom of the lever.
5. Tighten the tightening device until J 35999 is at 222 N (50 lbs.).
6. Loosen nut (6) and turn the clevis (5) until the pin (3) slides freely in the lever (2) with all slack removed from the cable.
7. Install clevis pin (3) and cotter pin (4).

Tighten

- Nut (6) to 37 N·m (27 lbs. ft.)

8. Remove J 35999 and all extensions used.
9. Release the parking brake.
10. Rotate the drum to make sure that there is no drag.

DRUM REPLACEMENT

Remove or Disconnect (Figures 7 and 8)

1. Release the parking brake.
2. Raise the vehicle and support with safety stands.
3. Propeller shaft. Refer to SECTION 4A.
4. Nut (14) or bolt (17) and washer (15 or 16).
5. Drum and yoke assembly (18).
6. Bolts (22) and washers (21).
7. Drum (18) from yoke (20).

Install or Connect (Figures 7 and 8)

1. Drum (18) to yoke (20).
2. Bolts (22) and washers (21).

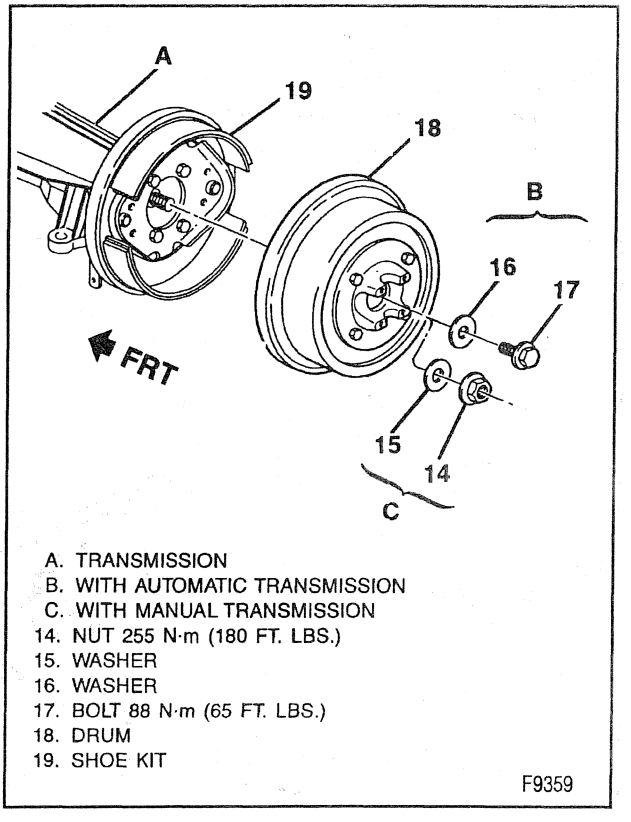


Figure 7—Drum Replacement

Tighten

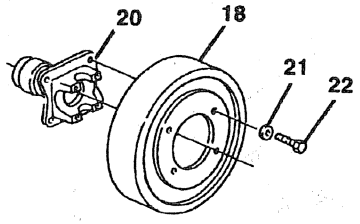
- Bolts (22) to 37 N·m (27 lbs. ft.)

3. Drum and yoke assembly.
4. Washer (15 or 16) and nut (14) or bolt (17).

Tighten

- Nut (14) to 255 N·m (180 lbs. ft.).
- Bolt (17) to 88 N·m (65 lbs. ft.).

5. Propeller shaft. Refer to SECTION 4A.
6. Lower the vehicle.



18. DRUM
20. YOKE
21. WASHER, HELICAL SPRING
22. BOLT, 37 N·m (27 FT. LBS.)

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Figure 8—Drum and Yoke

LINING REPLACEMENT

Remove or Disconnect (Figures 9 and 10)

1. Drum. Refer to "Drum Replacement" in this section.
2. Bolts (26) and washers (25).
3. Support plate (24) and shoe kits (19).
4. Springs (27, 28, and 29).
5. Shoe kits (19).

Inspect

- Springs for signs of wear or excessive heat. Replace as needed.
- Support plate friction points for wear. Replace if wear is excessive.

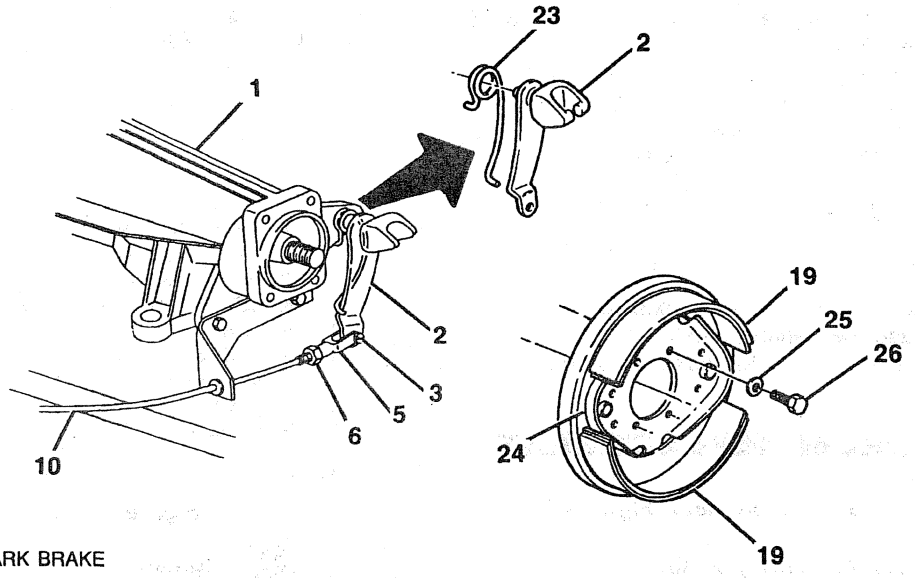
Install or Connect (Figures 9 and 10)

1. Shoe kits (19) to support plate (24).
2. Springs (27, 28, and 29).
3. Support plate (24) and shoe kits (19).
   - Index lever (2) between shoes.
4. Bolts (26) and washers (25).

Tighten

- Bolts (26) to 105 N·m (77 lbs. ft.).

5. Drum. Refer to "Drum Replacement" in this section.



1. TRANSMISSION
2. LEVER, REAR PARK BRAKE
3. PIN, CLEVIS
5. CLEVIS
5. NUT
10. CABLE, PARK BRAKE
19. SHOE KIT
23. SPRING
24. PLATE, SUPPORT
25. WASHER
26. BOLT, 105 N·m (77 FT. LBS.)

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Figure 9—Parking Brake Components

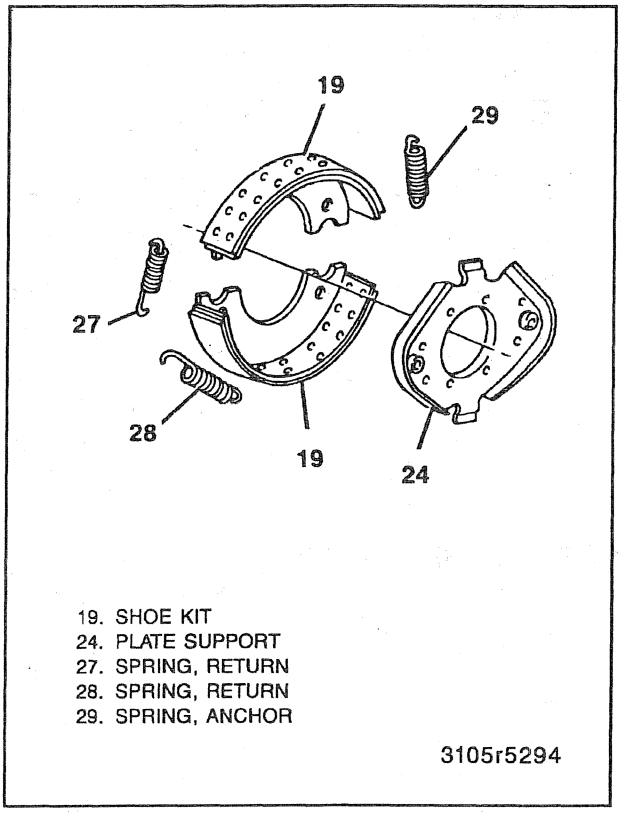

Figure 10—Lining Replacement

SPECIFICATIONS

BRAKE SYSTEMS

SYSTEM	FRONT BRAKES	REAR BRAKES	BRAKE ASSIST
JB5	Disc 11.57-inch x 1.25-inch	254 mm x 57 mm (Leading/Trailing)	Vacuum
JD5			Hydraulic
JB6	Disc 11.57-inch x 1.25-inch	11.15-inch x 2.75-inch (Duo-Servo)	Vacuum
JD6			Hydraulic
JB7	Disc 12.5-inch x 1.26-inch	13.00-inch x 3.5-inch (Duo-Servo)	Vacuum
JD7			Hydraulic
JB8 Single Rear Wheel	Disc 12.5-inch x 1.26-inch	13.00-inch x 3.5-inch (Duo-Servo)	Hydraulic
JB8 Dual Wheel	Disc 12.5-inch x 1.50-inch	13.00-inch x 3.5-inch (Duo-Servo)	Hydraulic
JF9	Disc 14.25-inch x 1.54-inch	Disc 13.75 inch x 1.54 inch	Hydraulic

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FASTENER TIGHTENING SPECIFICATIONS

Item	N·m	Ft. Lbs.	In. Lbs.
Cable Clevis Jam Nut	37	27	—
Cable Clip Bolt	10	—	88
Drum to Yoke Bolts	37	27	—
Parking Brake Lever Mounting Bolts	24	18	—
Support Plate Mounting Bolts	105	77	—
Yoke Shaft Bolt	88	65	—
Yoke Shaft Nut	255	180	—

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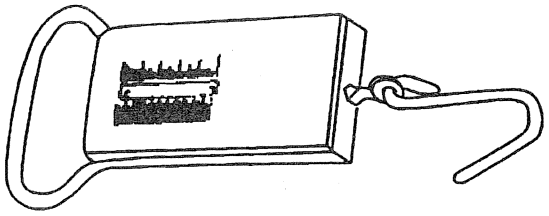
SPECIAL TOOLS

1. 

J 35999

1. TENSION SCALE