

BRAKES

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SECTION 5



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

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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 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.

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

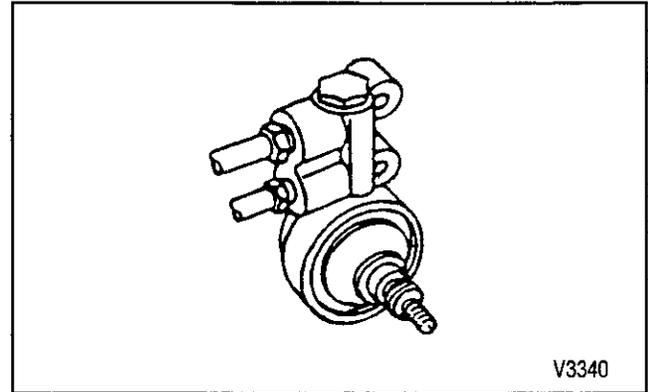
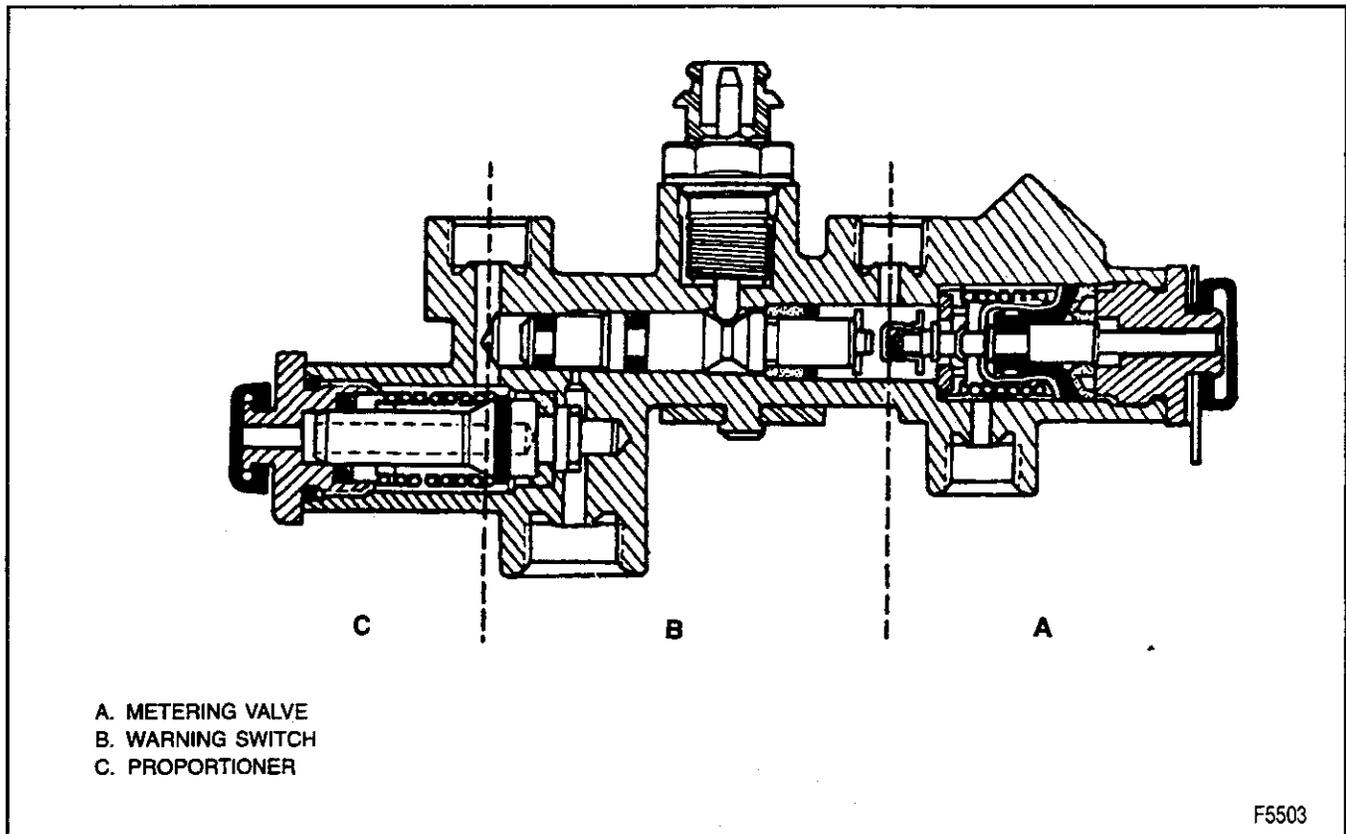


Figure 1—Height-Sensing Brake Proportioning Valve

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.



- A. METERING VALVE
- B. WARNING SWITCH
- C. PROPORTIONER

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Figure 2—Combination Valve

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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, brake pressure modulator valve (4WAL), or electric brake control module (RWAL).

"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

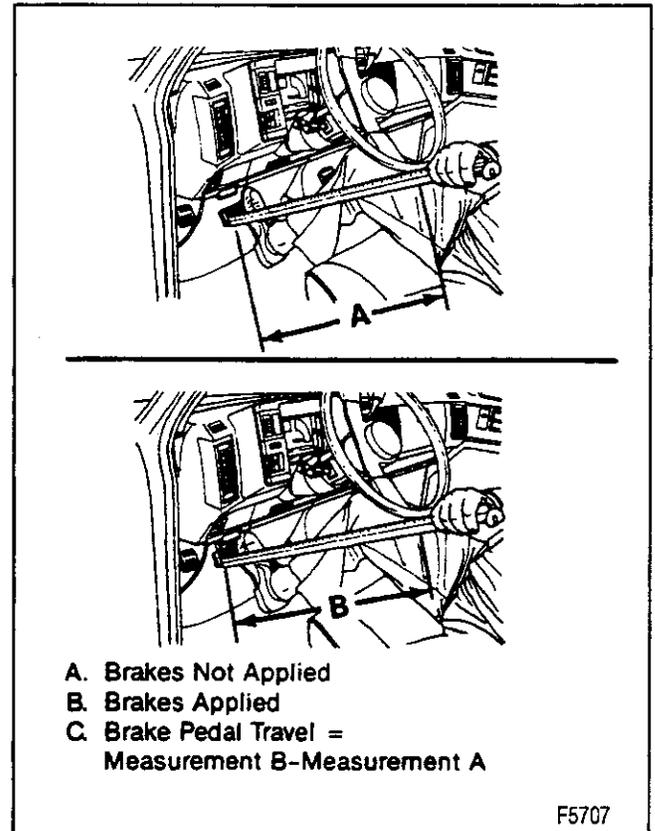


Figure 3—Checking Brake Pedal Travel

HYDRAULIC BRAKES 5-5

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.

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 5A.

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.

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COMBINATION VALVE CIRCUIT TEST

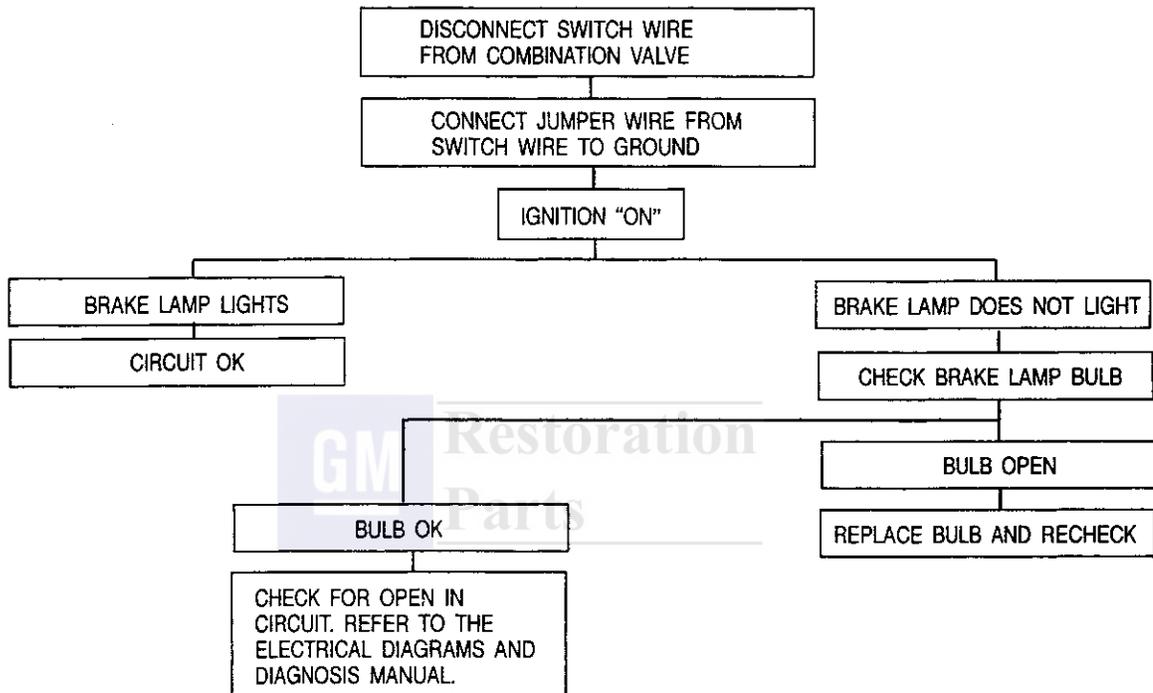


Figure 4—Combination Valve Circuit Test

COMBINATION VALVE WARNING SWITCH TEST

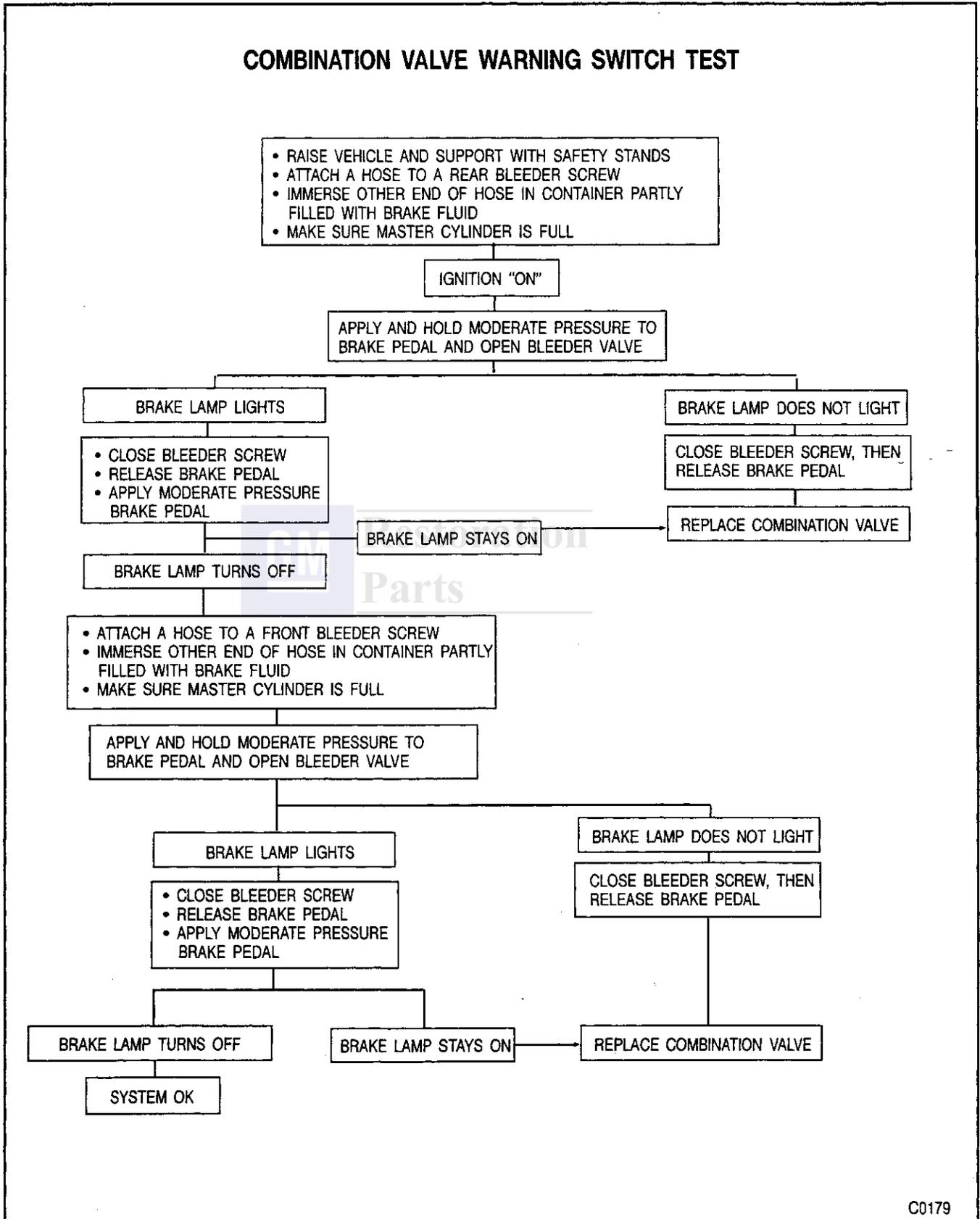


Figure 5—Combination Valve Warning Switch Test

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BRAKE SYSTEM DIAGNOSIS

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

BRAKE SYSTEM DIAGNOSIS													
CAUSES	DIAGNOSIS SECTION												
	BRAKE PEDAL TRAVEL EXCESSIVE BRAKING ACTION SYMPTOM	EXCESSIVE BRAKE GRADUALLY INCREASES	BINDING HYDRO BOOSTER	UNEVEN BRAKING EFFORT	UNEVEN BRAKING ACTION	SCRAPING NOISE ACTION (SIDE TO SIDE)	BRAPES CHATTER (FRONT TO REAR)	"BRAKE" WARNING LAMP (ON)	BRAPES GROAN AT END OF STOP	BRAPES SQUEAK	BRAPES CHATTER (ROUGHNESS)	BRAPES CHATTER (ROUGHNESS)	
LEAKING BRAKE PIPE, HOSE, OR CONNECTION	X	XX							X			XX	5
LEAKING PISTON/AXLE SEAL	X	XX							X			X	5B,5C
LEAKING MASTER CYLINDER (INTERNAL)	X	XX							X		X	X	5A
CONTAMINATED POWER STEERING FLUID										XX			3B
AIR IN BRAKE SYSTEM		XX							X			XX	5
CONTAMINATED OR IMPROPER BRAKE FLUID	X				X	X			X	X	X	X	5
LEAKING BOOSTER/VACUUM 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	5B,5C
UNEVEN LINING WEAR—REPLACE AND CORRECT CAUSE	X			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	5B,5C
LININGS DAMAGED BY ABUSIVE USE—REPLACE			X	XX					X	X	X	X	5B,5C
HEAT SPOTTED OR SCORED DISCS				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	5B,5C
RESTRICTED BRAKE FLUID PASSAGE		X	X		X	X			X	X	X		5
IMPROPERLY ADJUSTED CRUISE CONTROL VACUUM DUMP									X				5
BRAKE PEDAL OR LINKAGE INTERFERENCE (BINDING)			X		X	XX	XX						5
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		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						X	X		X	5B,5C
IMPROPER REAR BRAKE ADJUSTMENT	X								X				5C
LOW ENGINE VACUUM			X		X								6A
DAMAGED COMBINATION VALVE					X				X			X	5
RESTRICTED POWER STEERING HOSE TO BOOSTER				X									5D2
VEHICLE LOADING	X	X								XX			5
ANTILOCK BRAKE SYSTEM INVOLVEMENT	XX	X							X		X	XX	5E

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Figure 6—Brake System Diagnosis

ON-VEHICLE SERVICE

FILLING MASTER CYLINDER RESERVOIR

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

BRAKE PEDAL

↔ Remove or Disconnect (Figure 7)

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.

NOTICE: Refer to "Notice" on page 5-1.

4. Nut.



Tighten

- Bolt to 47 N·m (35 lbs. ft.).

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

STOPLAMP SWITCH

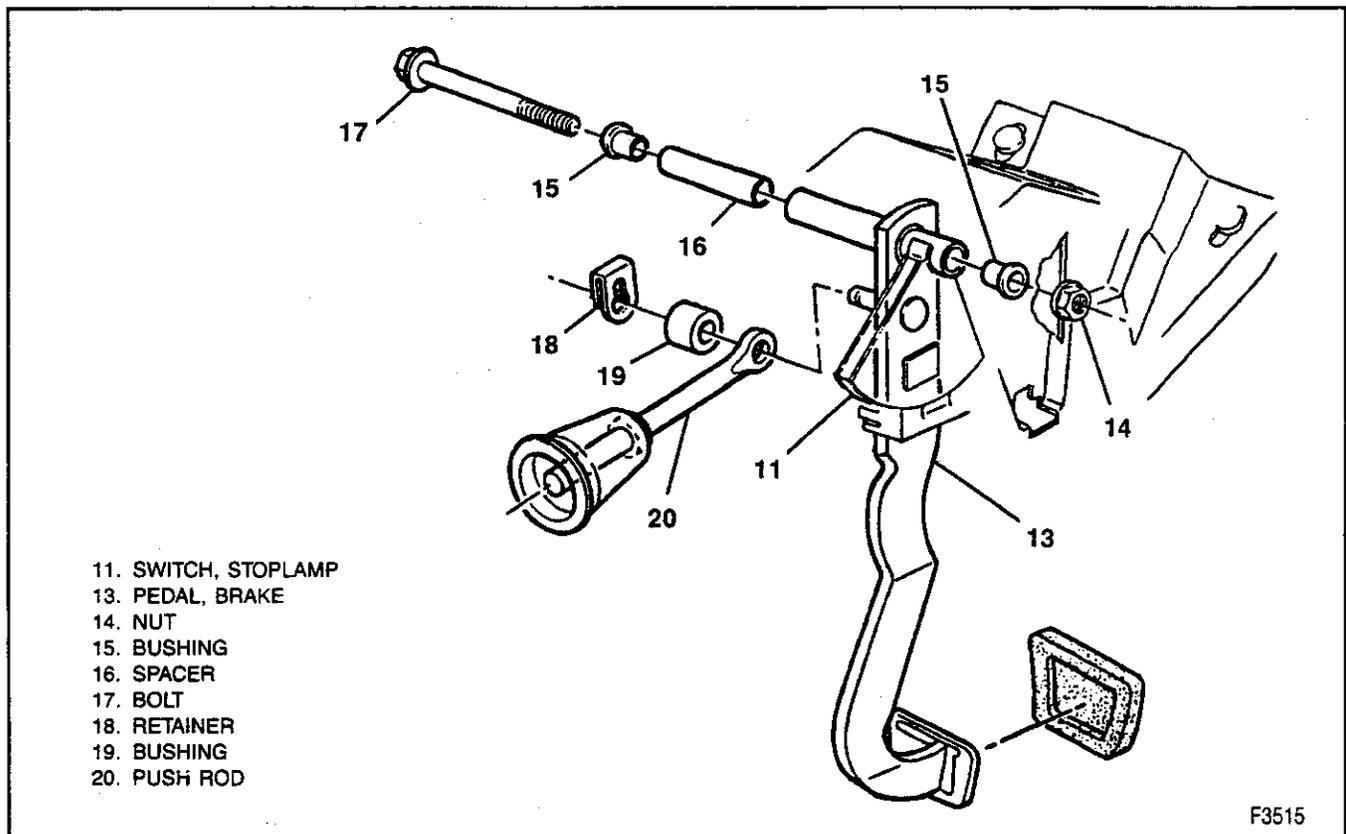
For further information on stoplamp circuit diagnosis, refer to SECTION 8B and the Driveability, Emissions, and Electrical Diagnosis Manual, NATP-9442.

↔ 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.



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Figure 7—Brake Pedal

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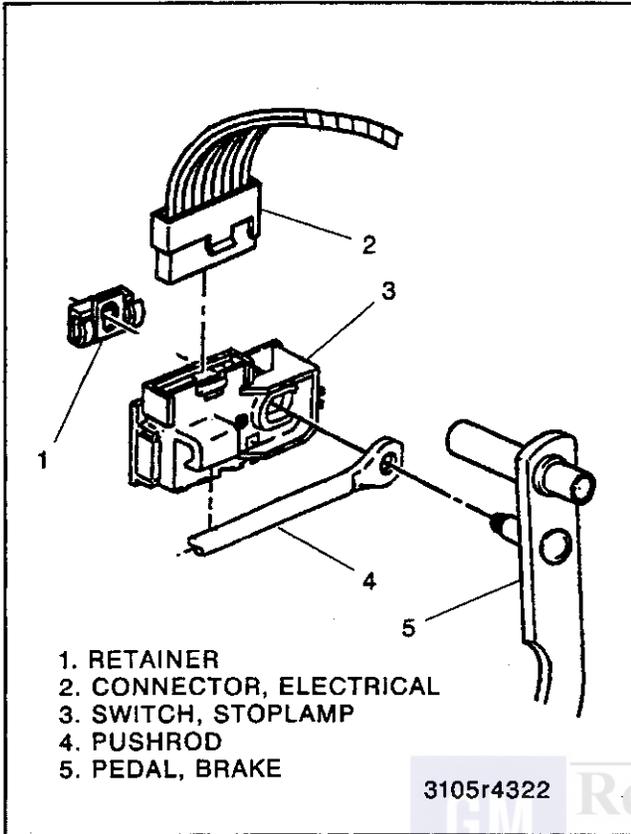


Figure 8—StopLamp Switch

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 correct fasteners and the original location for replacement brake pipes. Failure to properly route and retain brake pipes may cause damage to the brake pipes and 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.



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)

NOTICE: For steps 2, 4, and 7, refer to "Notice" on page 5-1.

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.



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.

NOTICE: Refer to "Notice" on page 5-1.

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.)

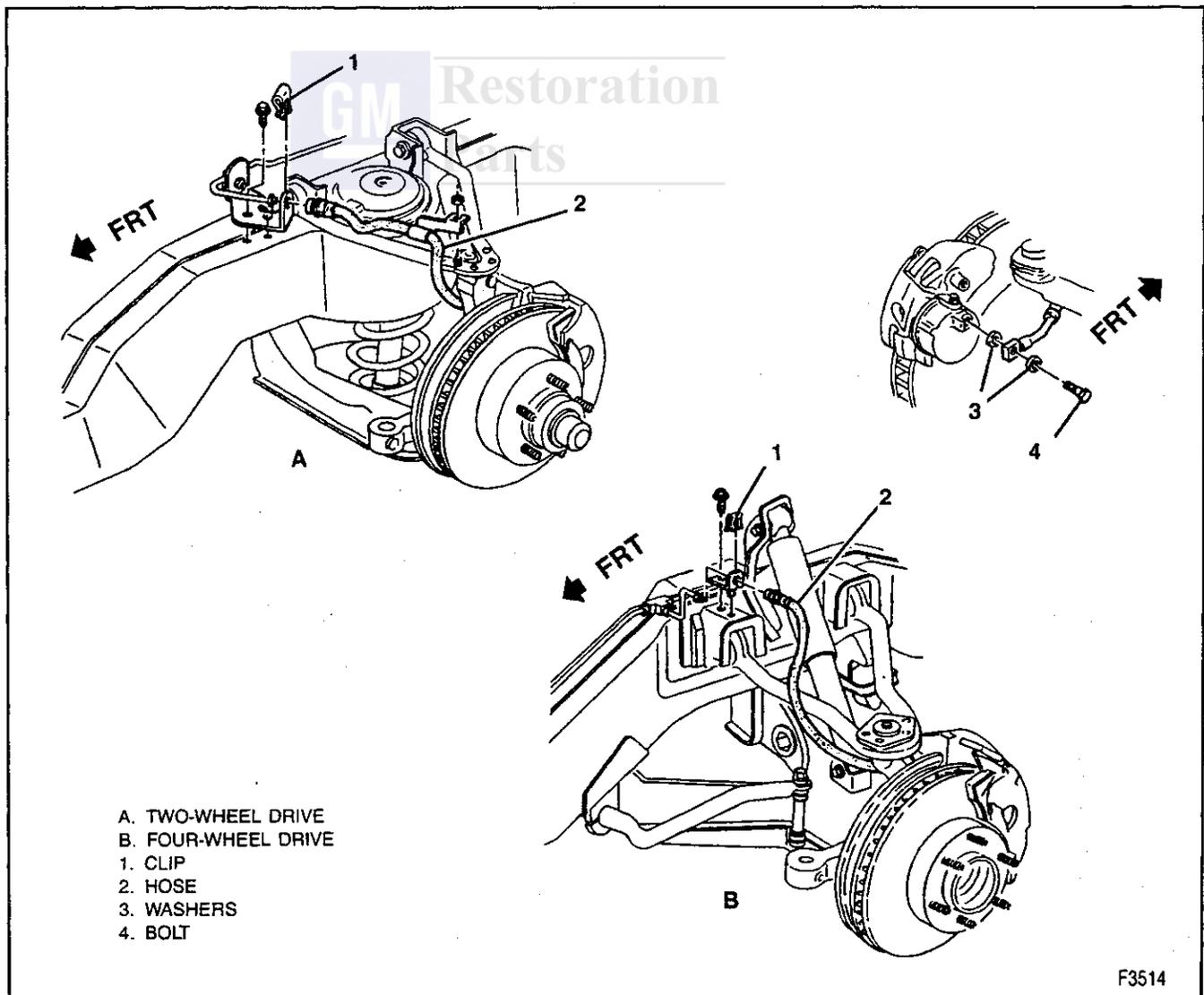
! Important

- 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.



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Figure 9—Flexible Hose

5-12 HYDRAULIC BRAKES

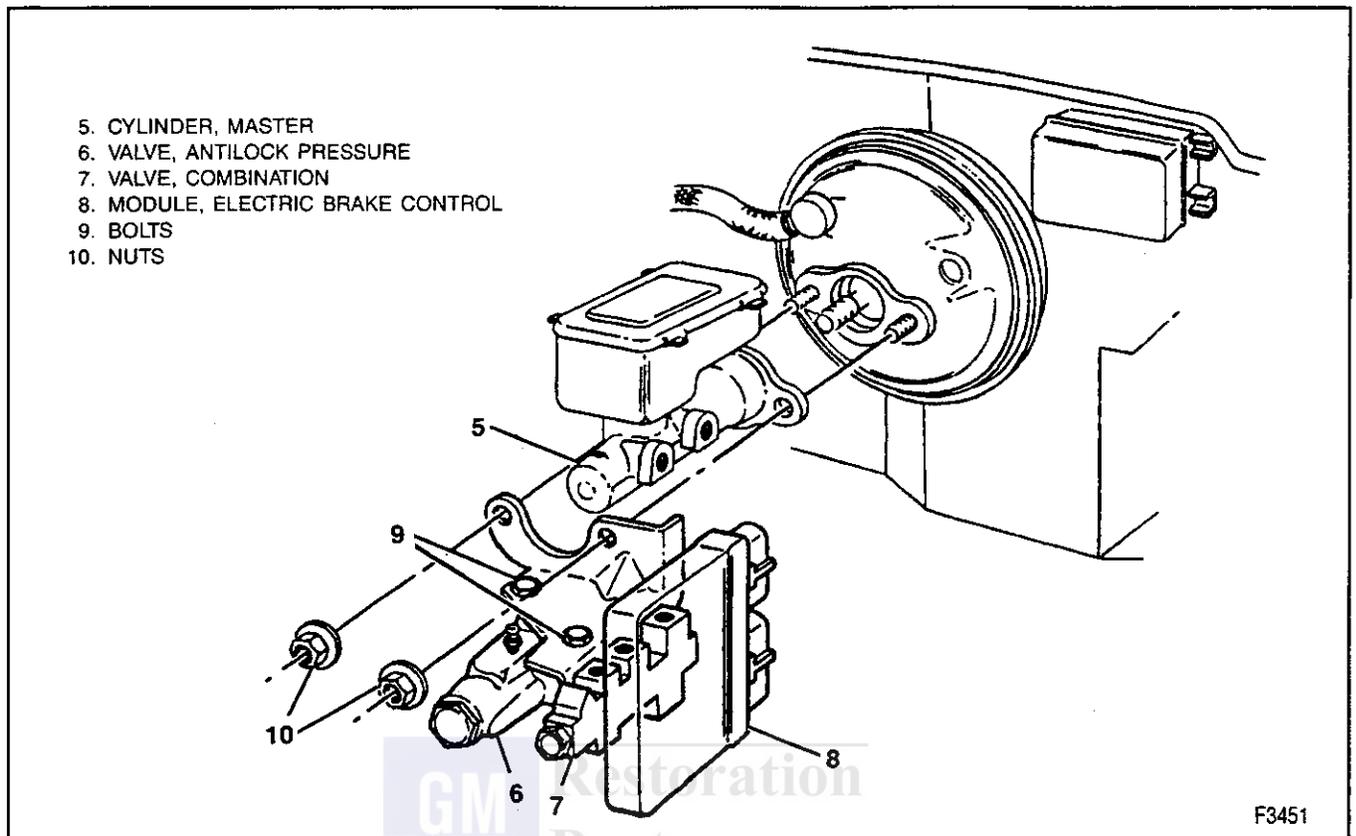


Figure 10—Combination Valve

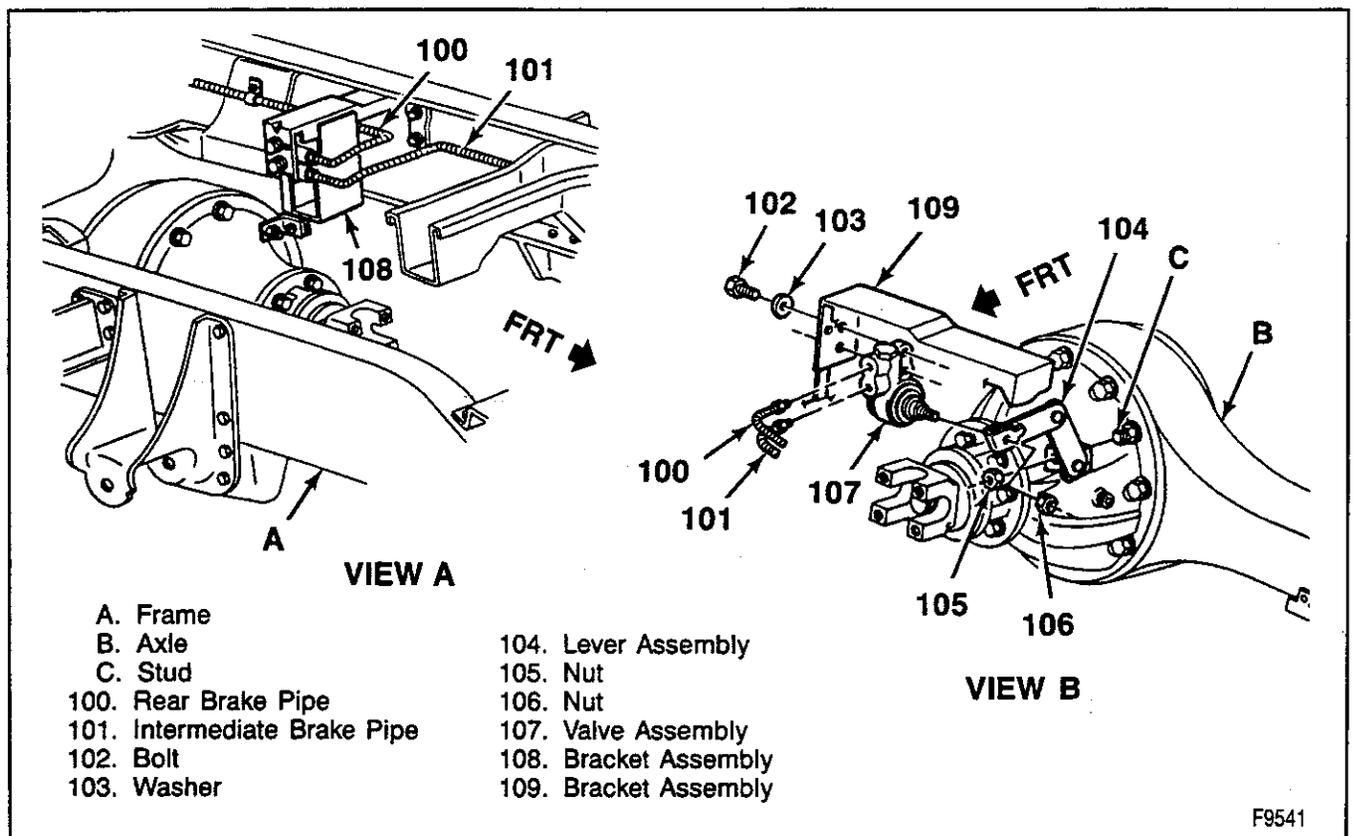


Figure 11—Height-Sensing Proportioning Valve

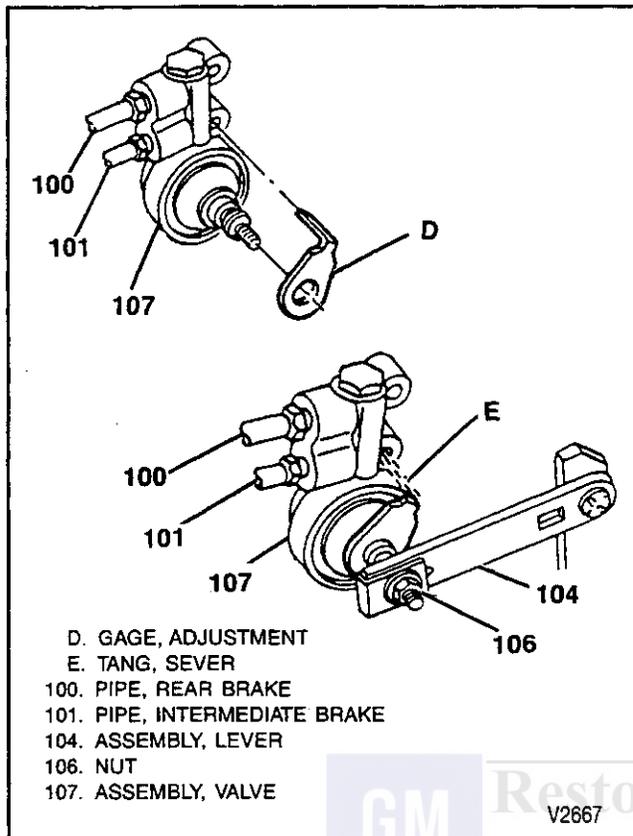


Figure 12—Height-Sensing Proportioning Valve Adjustment

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.

NOTICE: Refer to "Notice" on page 5-1.

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.

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.

5-14 HYDRAULIC BRAKES

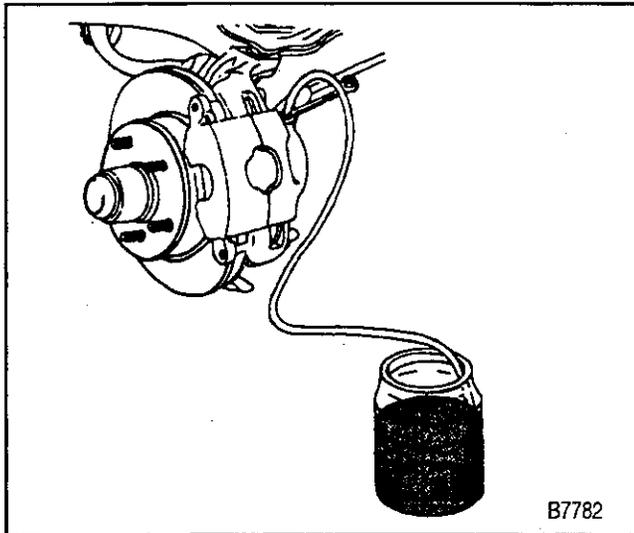


Figure 13—Immersing the Bleeder Hose

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.

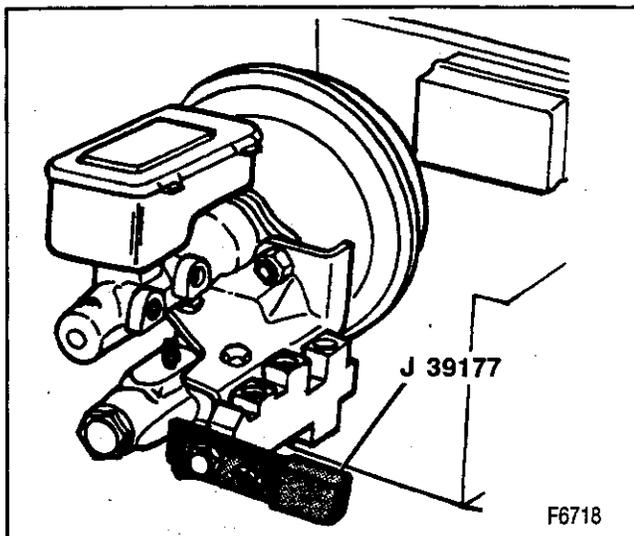


Figure 14—Combination Valve Pressure Bleeding Tool

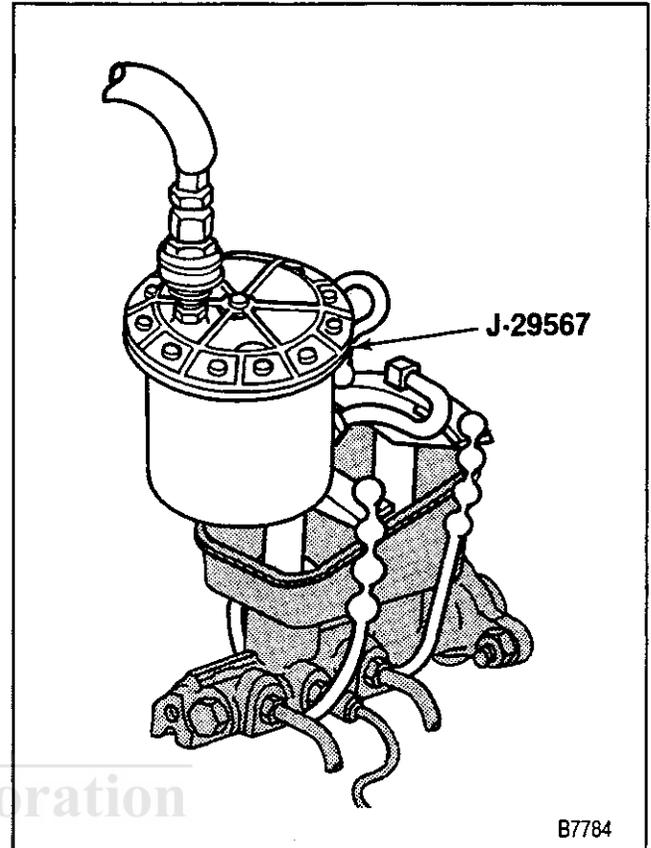


Figure 15—Reservoir Bleeder Adapter

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.
 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 2.5-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

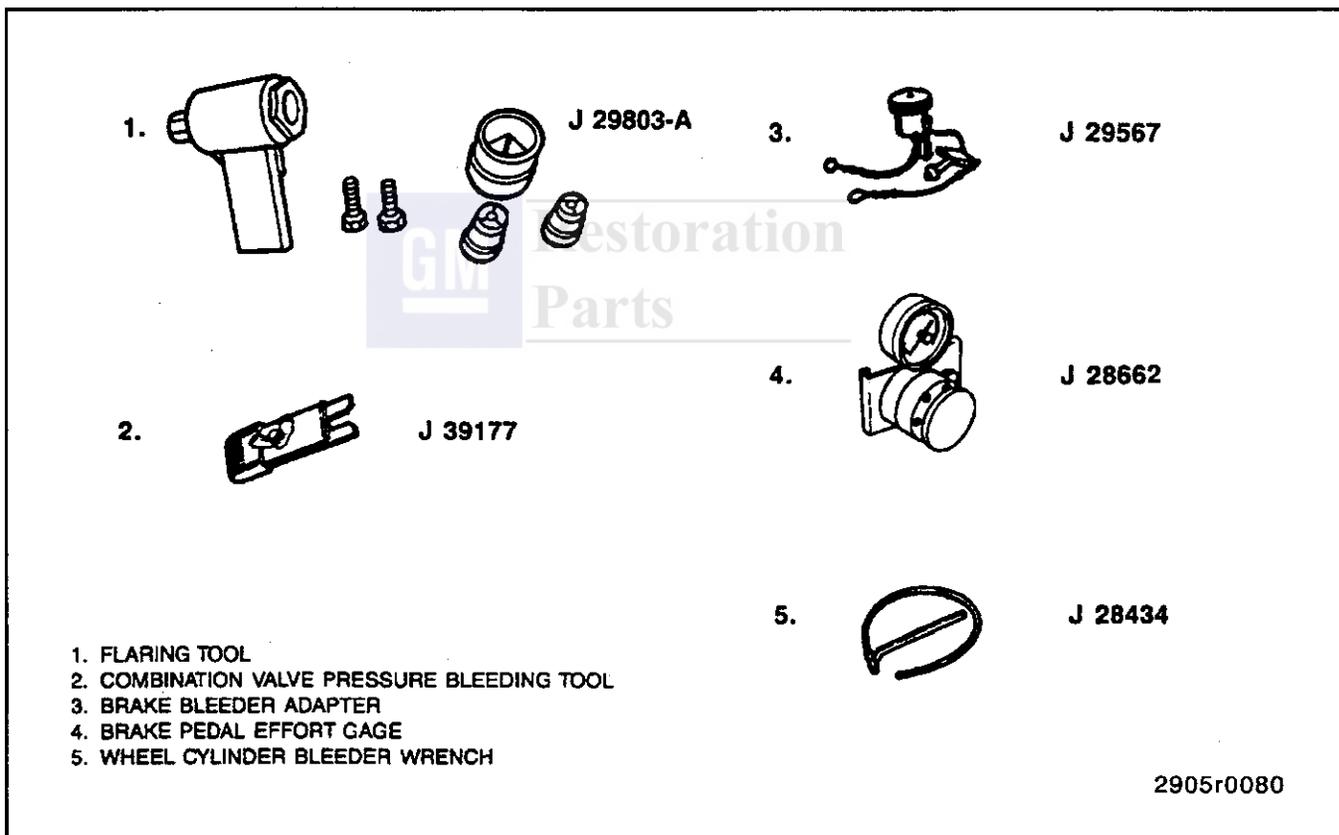
FASTENER TIGHTENING SPECIFICATIONS

	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

5-16 HYDRAULIC BRAKES

SPECIAL TOOLS



SECTION 5A

MASTER CYLINDER

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

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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

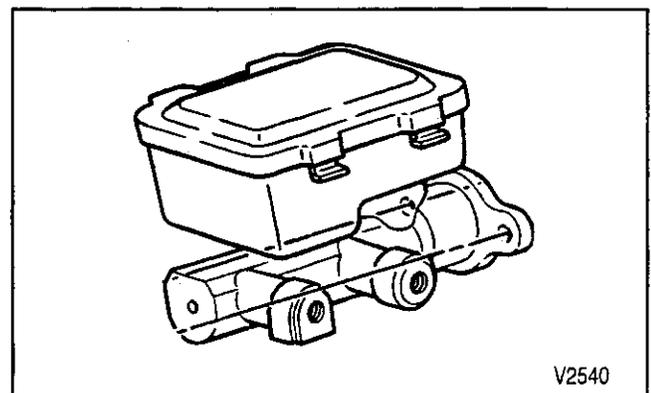
The reservoir and cover used on these models are made of plastic. The cover snaps onto the top of the reservoir. A seal is located between the cover and reservoir to keep contaminants out of the brake fluid.

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.

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.



V2540

Figure 1—Master Cylinder

5A-2 MASTER CYLINDER

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 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 parts 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 5 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 5 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 push-rod 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



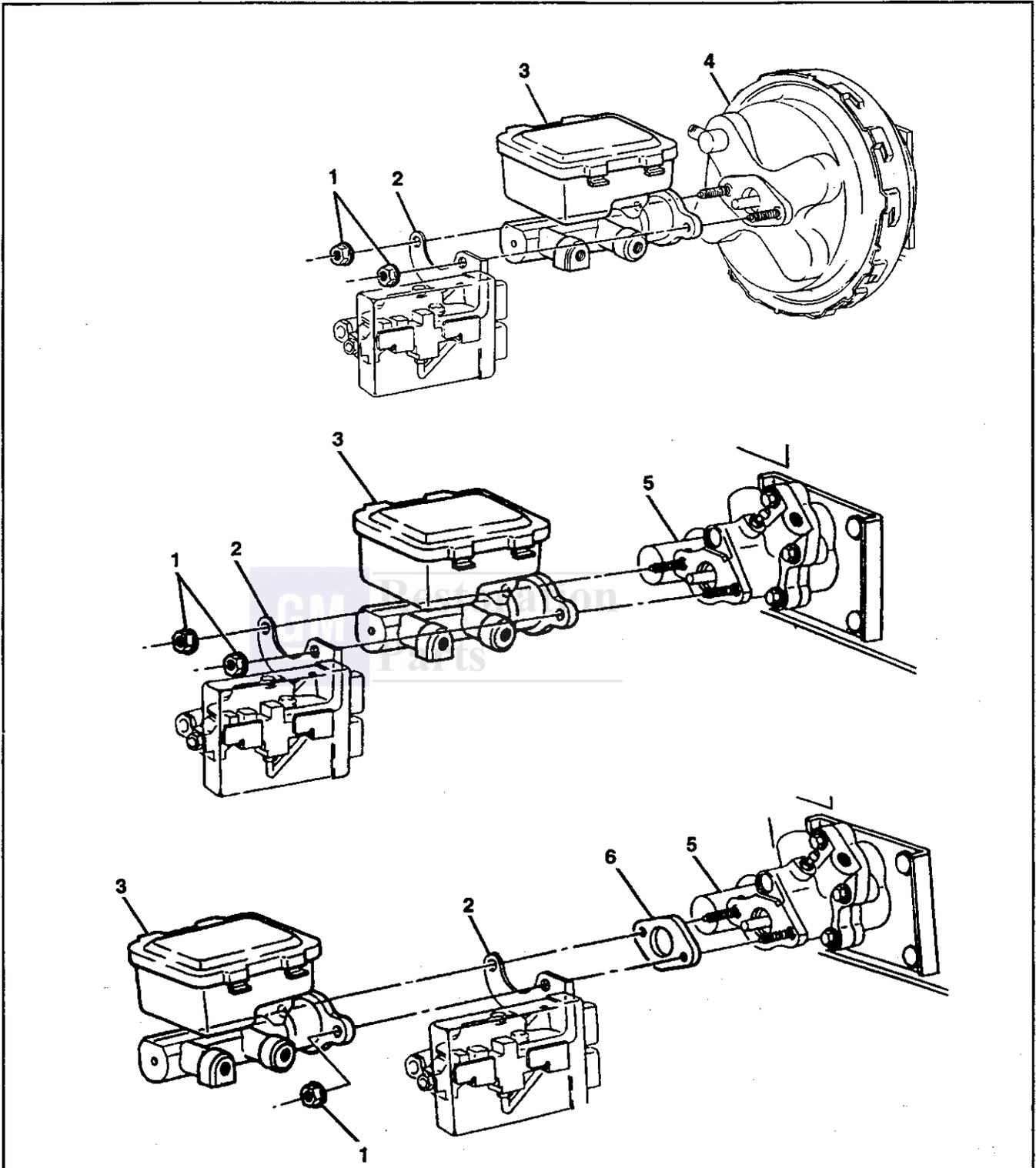
Remove or Disconnect (Figure 2 or 3)

- 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 (vehicles with RWAL brakes only).
 2. Nuts (1).
 3. Master cylinder (3) and bracket (2).



Install or Connect (Figure 2 or 3)

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



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

Figure 2—Master Cylinder (RWAL)

5A-4 MASTER CYLINDER

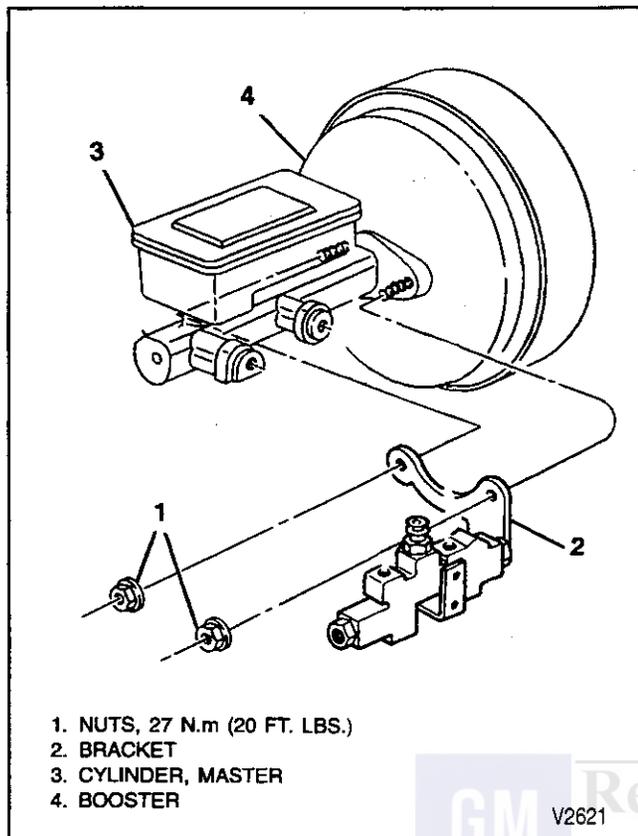


Figure 3—Master Cylinder (4WAL)

- 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 5.

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 2.5-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

SECTION 5B1

FRONT DISC BRAKES

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

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.



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5B1-2 FRONT DISC BRAKES

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 have a wear indicator that contacts the rotor to make noise when the linings wear to the point of needing replacement (figure 2). A loud scraping sound can be heard when this occurs.

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.

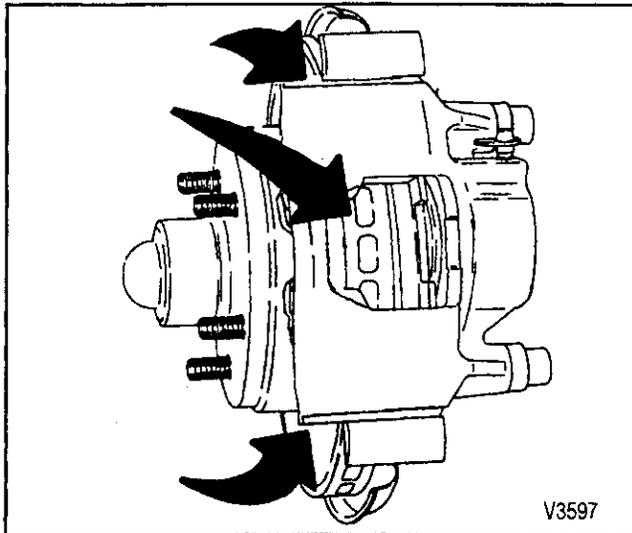


Figure 1—Lining Inspection Points

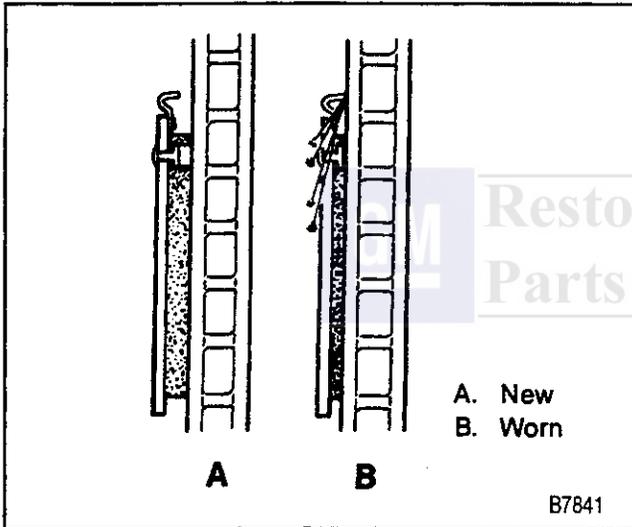


Figure 2—Wear Indicator

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.

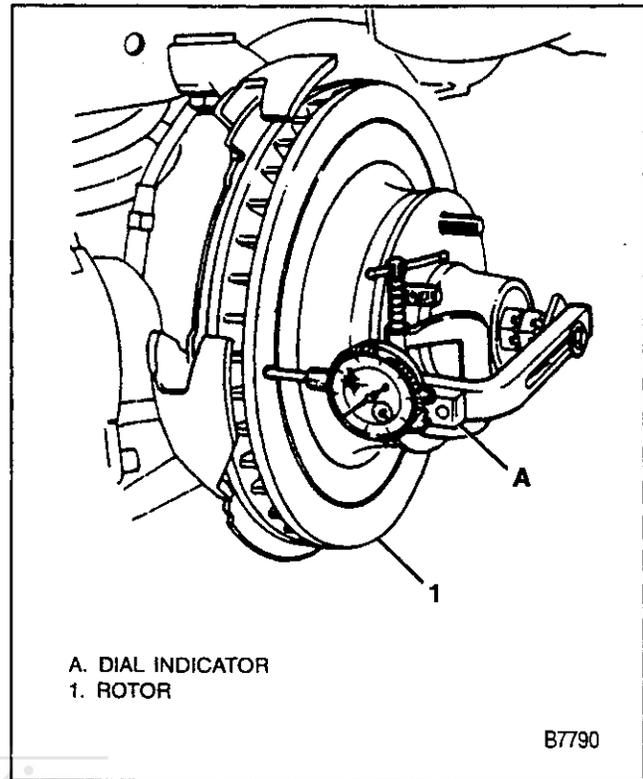


Figure 3—Inspecting for Lateral Runout

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 (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.

5B1-4 FRONT DISC BRAKES

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.

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

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).

 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.

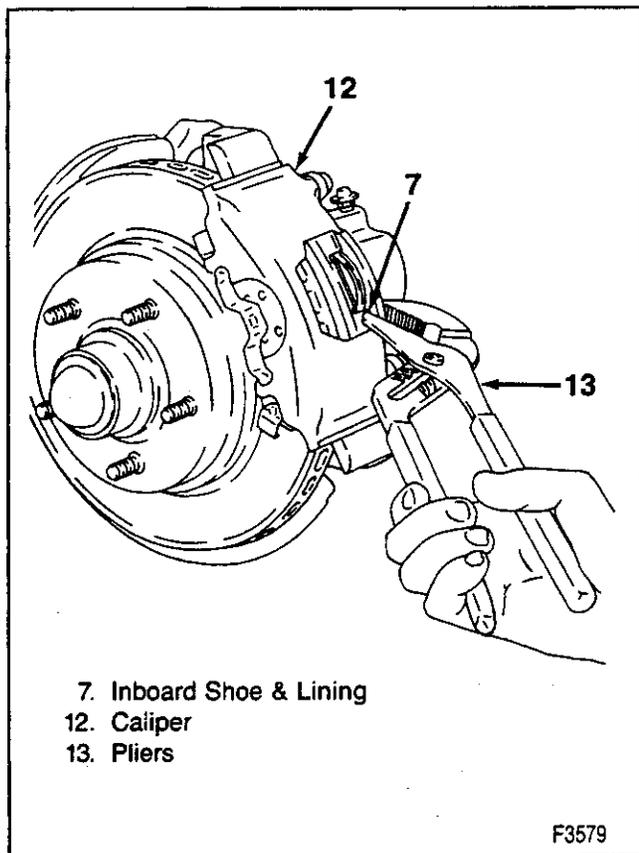


Figure 4—Compressing the Piston

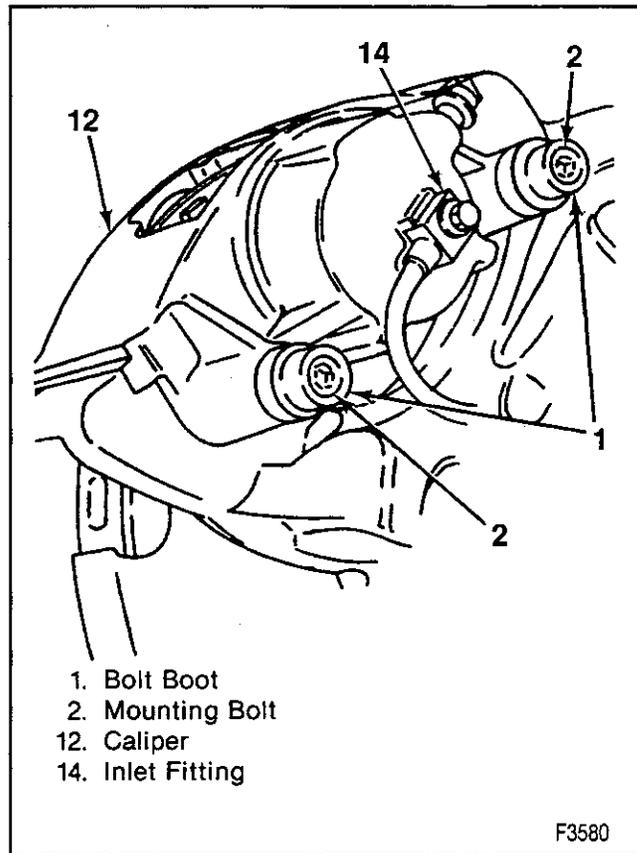
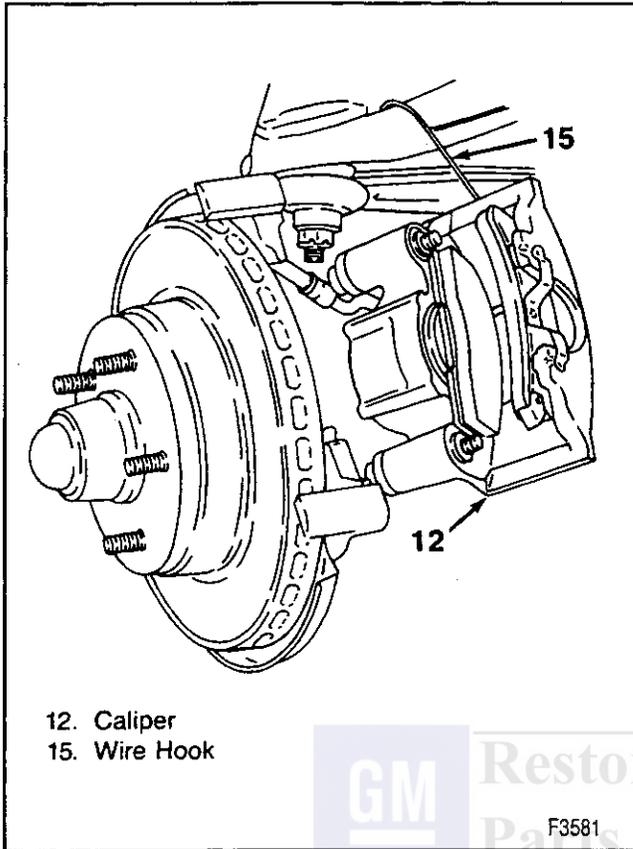


Figure 5—Caliper Attachment (Delco)

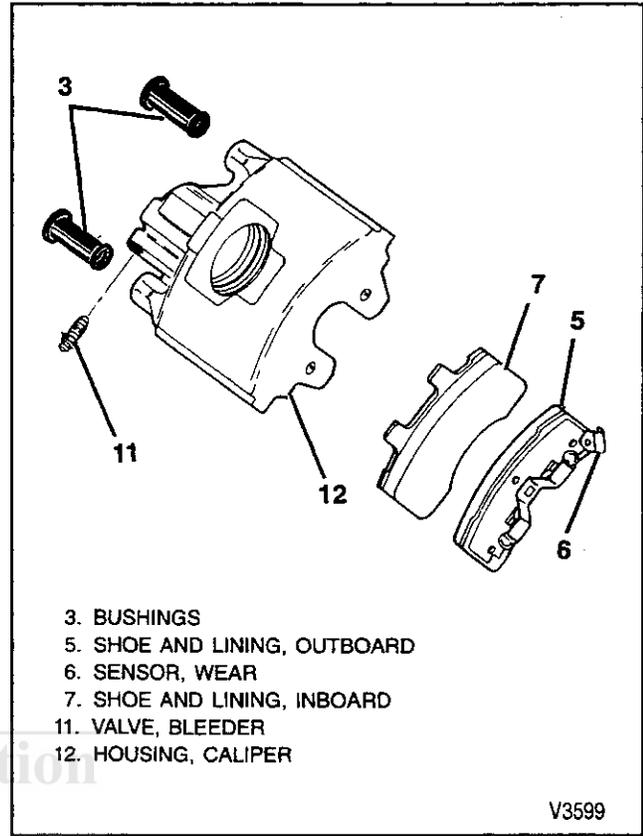
FRONT DISC BRAKES 5B1-5



- 12. Caliper
- 15. Wire Hook

F3581

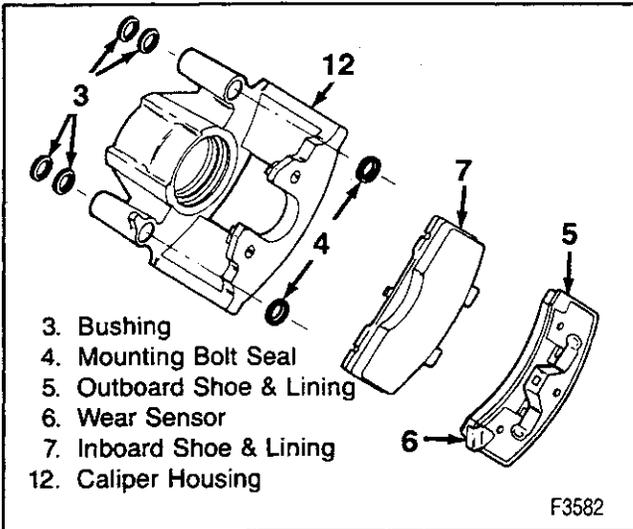
Figure 6—Suspending the Caliper



- 3. BUSHINGS
- 5. SHOE AND LINING, OUTBOARD
- 6. SENSOR, WEAR
- 7. SHOE AND LINING, INBOARD
- 11. VALVE, BLEEDER
- 12. HOUSING, CALIPER

V3599

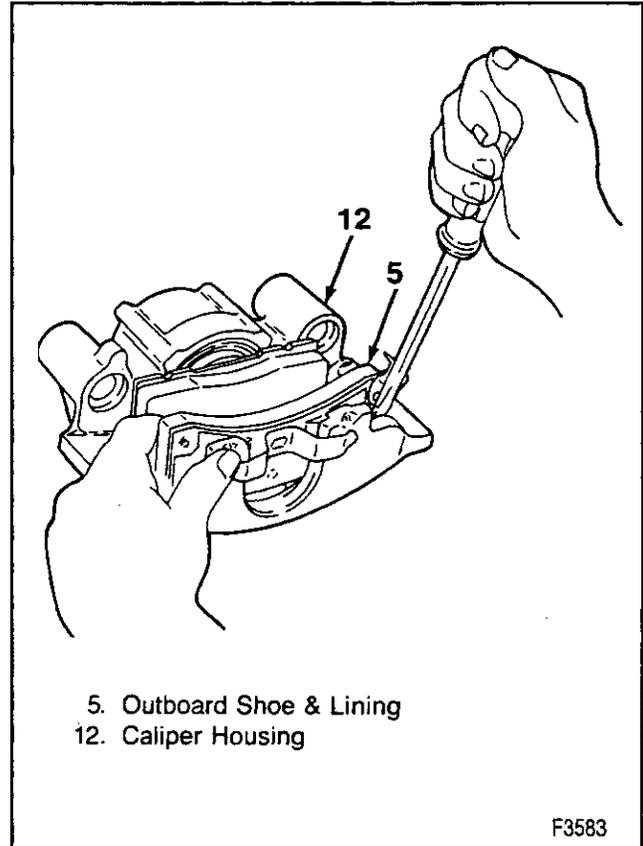
Figure 8—Delco Shoe and Lining Assembly (3486)



- 3. Bushing
- 4. Mounting Bolt Seal
- 5. Outboard Shoe & Lining
- 6. Wear Sensor
- 7. Inboard Shoe & Lining
- 12. Caliper Housing

F3582

Figure 7—Delco Shoe and Lining Assembly (3400)



- 5. Outboard Shoe & Lining
- 12. Caliper Housing

F3583

Figure 9—Removing the Outboard Shoe and Lining

5B1-6 FRONT DISC BRAKES

Install or Connect (Figures 5 through 14)

NOTICE: For steps 5 and 6, refer to "Notice" on page 5B1-1.

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 0.13 to 0.30 mm (0.005 to 0.012 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.

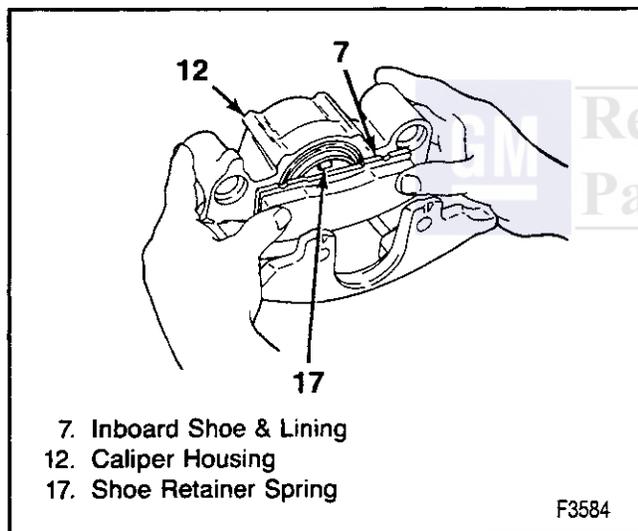


Figure 10—Installing the Inboard Lining

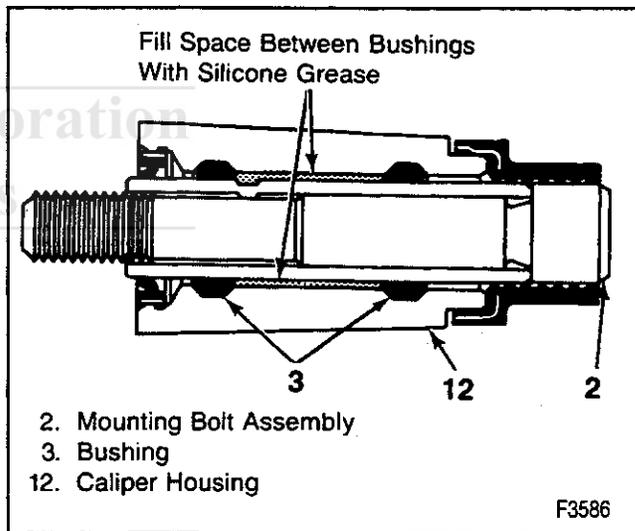


Figure 12—Mounting Bolt Lubrication (Delco 3400)

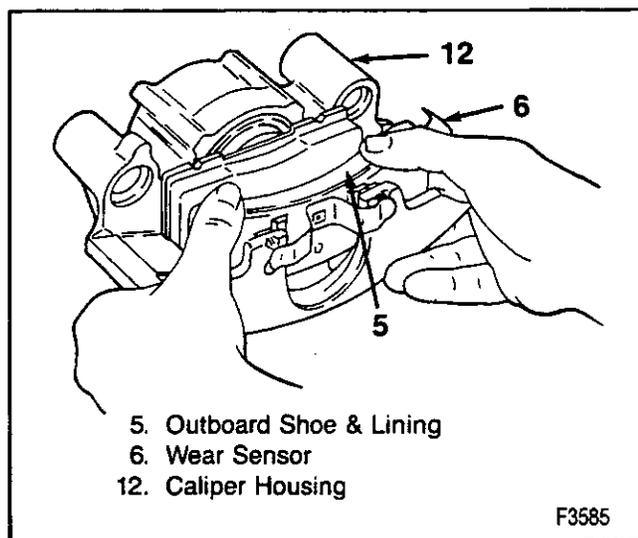


Figure 11—Installing the Outboard Lining

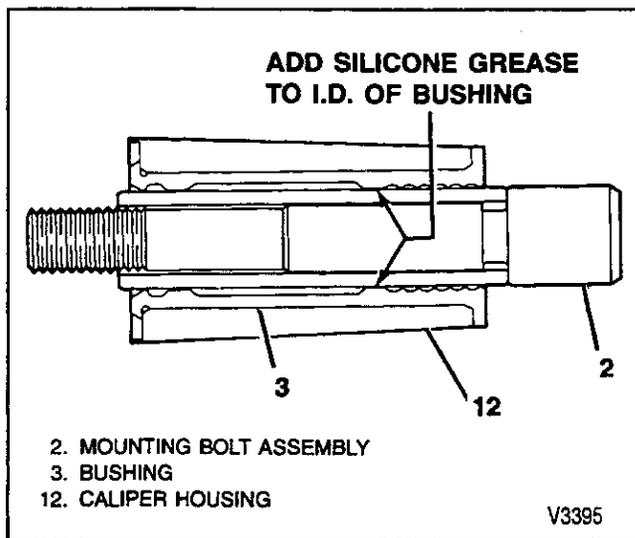


Figure 13—Mounting Bolt Lubrication (Delco 3486)

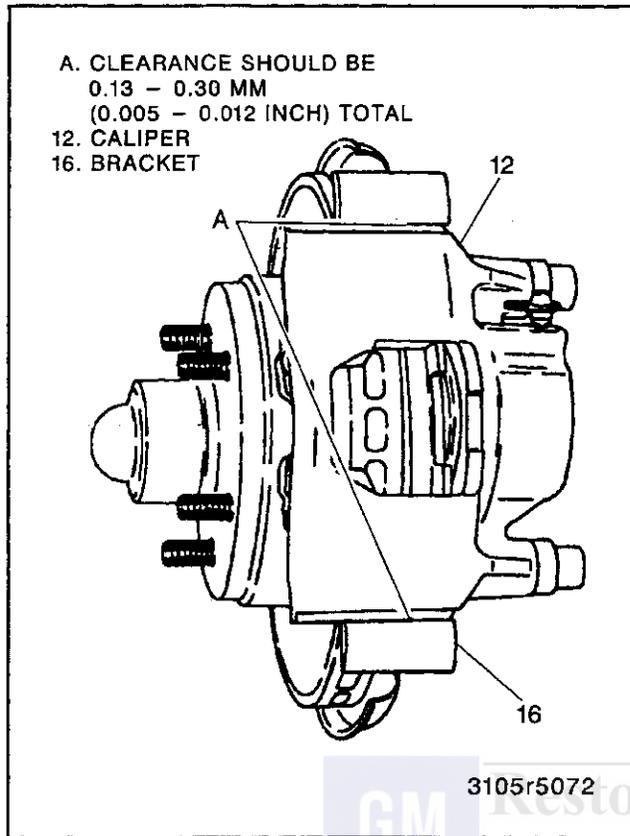


Figure 14—Caliper to Bracket Clearance

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.

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

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).

 **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.

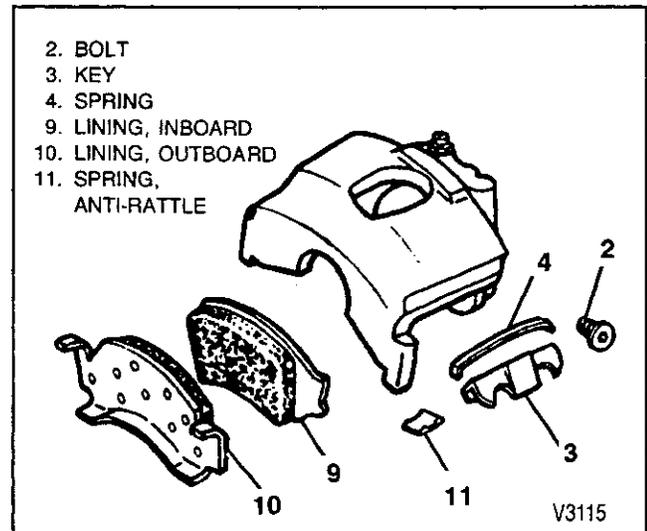


Figure 15—Bendix Shoe and Lining Assembly

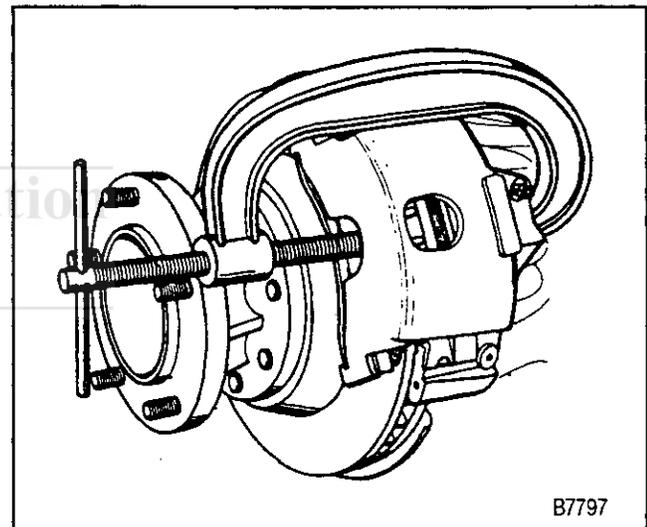


Figure 16—Compressing the Caliper Piston

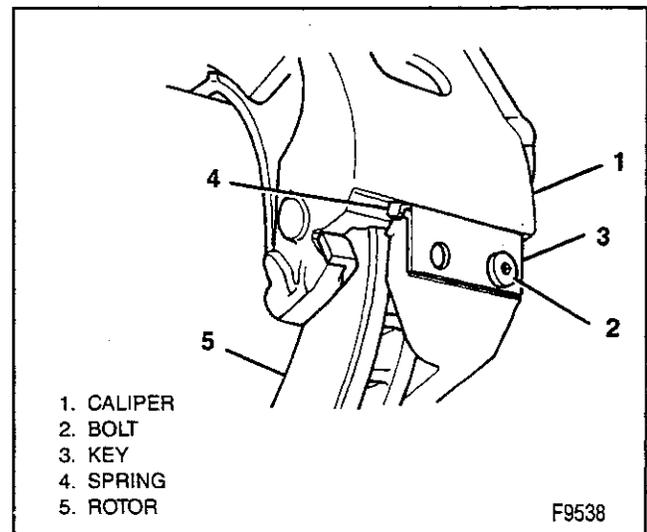


Figure 17—Caliper Mounting

5B1-8 FRONT DISC BRAKES

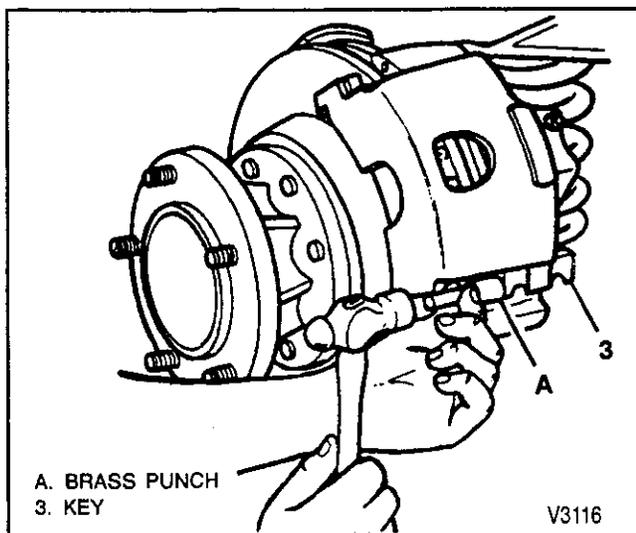


Figure 18—Removing the Caliper Support Key

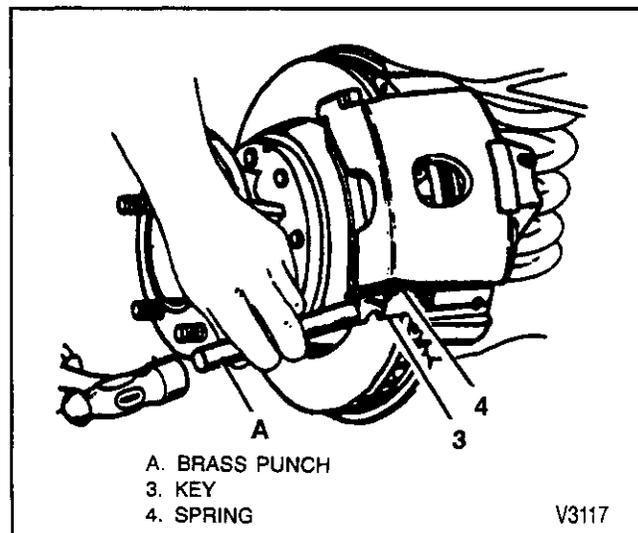


Figure 20—Installing the Caliper Support Key

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

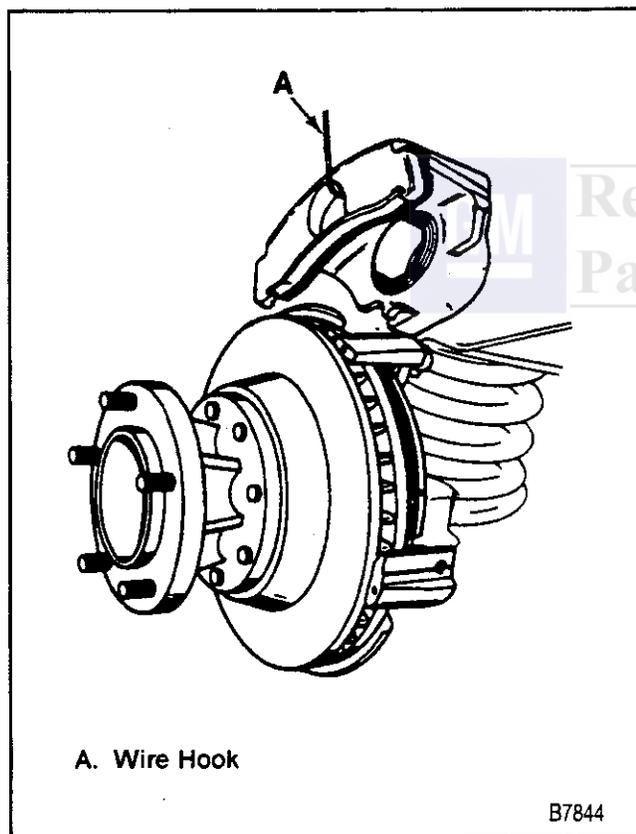


Figure 19—Suspending the Caliper

 Install or Connect (Figures 15 through 20)

NOTICE: For steps 4 and 5, refer to "Notice" on page 5B1-1.

1. Lubricate caliper and anchor plate sliding surfaces with Delco Silicone Lube (GM P/N 18010909) or equivalent.
2. Caliper assembly (1).

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 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 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).
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. Anti-rattle spring (11).
4. 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 Delco Silicone Lube (GM P/N 18010909) or equivalent.
2. Inboard lining (9) and anti-rattle spring (11).
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.

5B1-10 FRONT DISC BRAKES

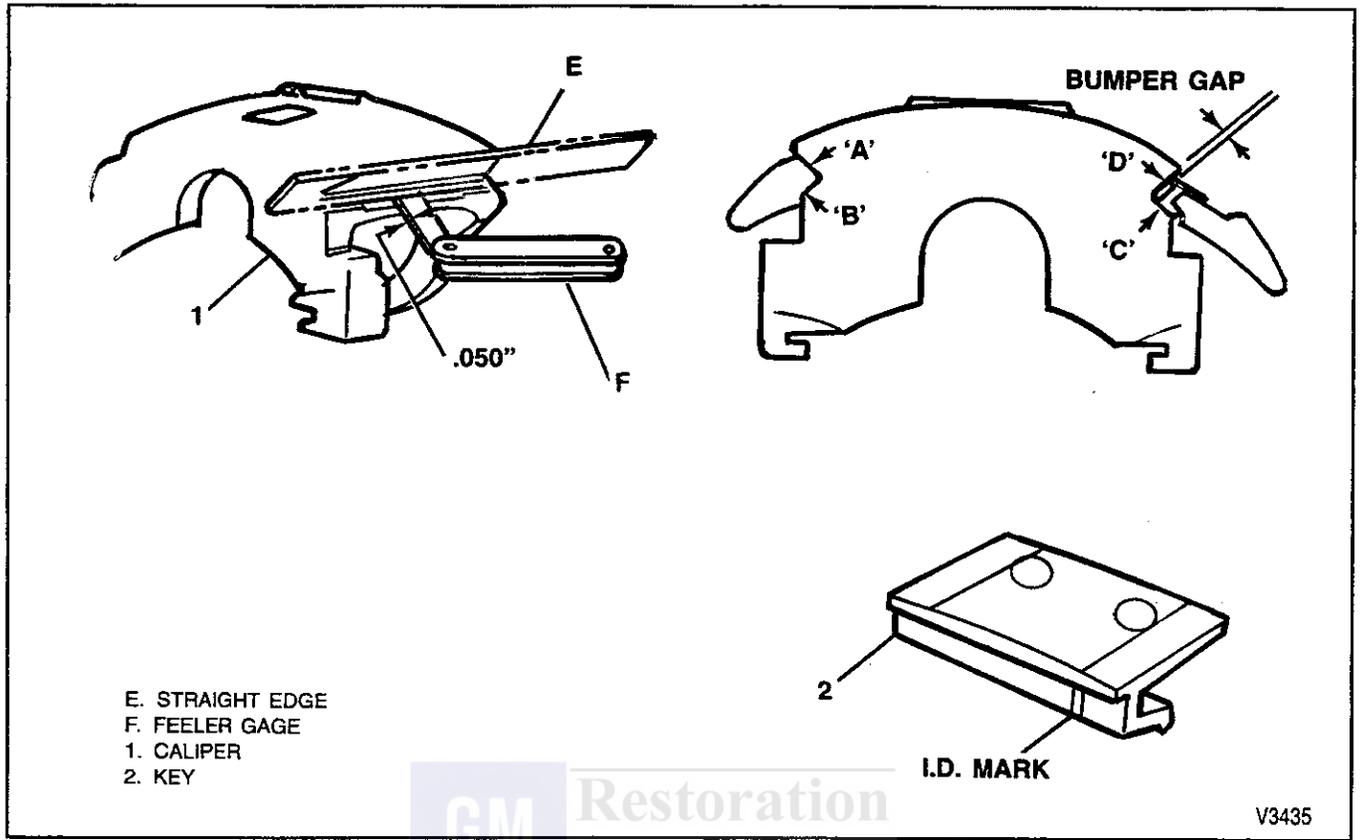


Figure 21—Bendix Caliper Wear Adjustment

- 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.

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).

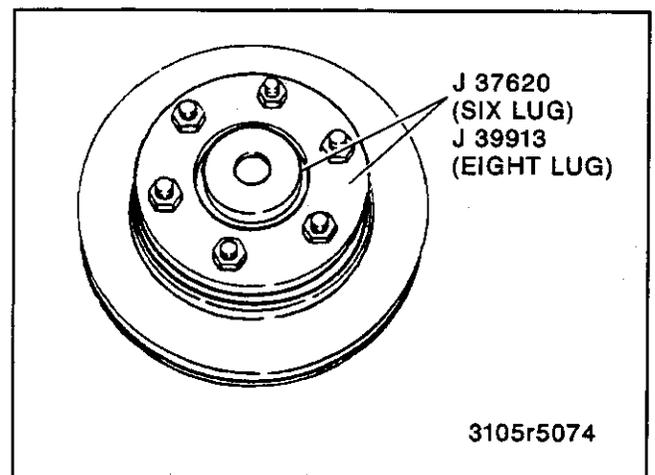


Figure 22—Rotor Adaptor Installed on the Rotor

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 adapters 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

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.

5B1-12 FRONT DISC BRAKES

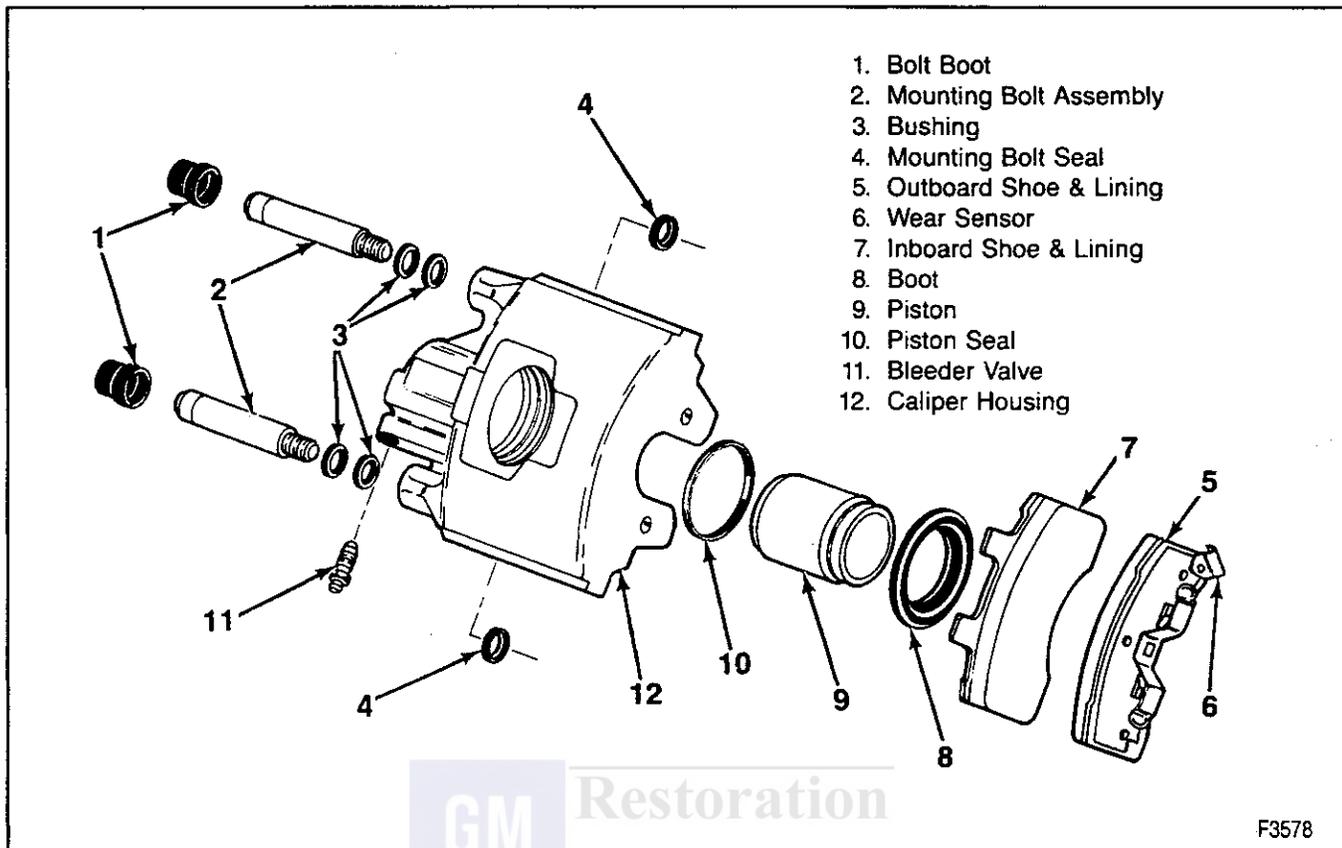


Figure 23—Caliper Components (Delco 3400)

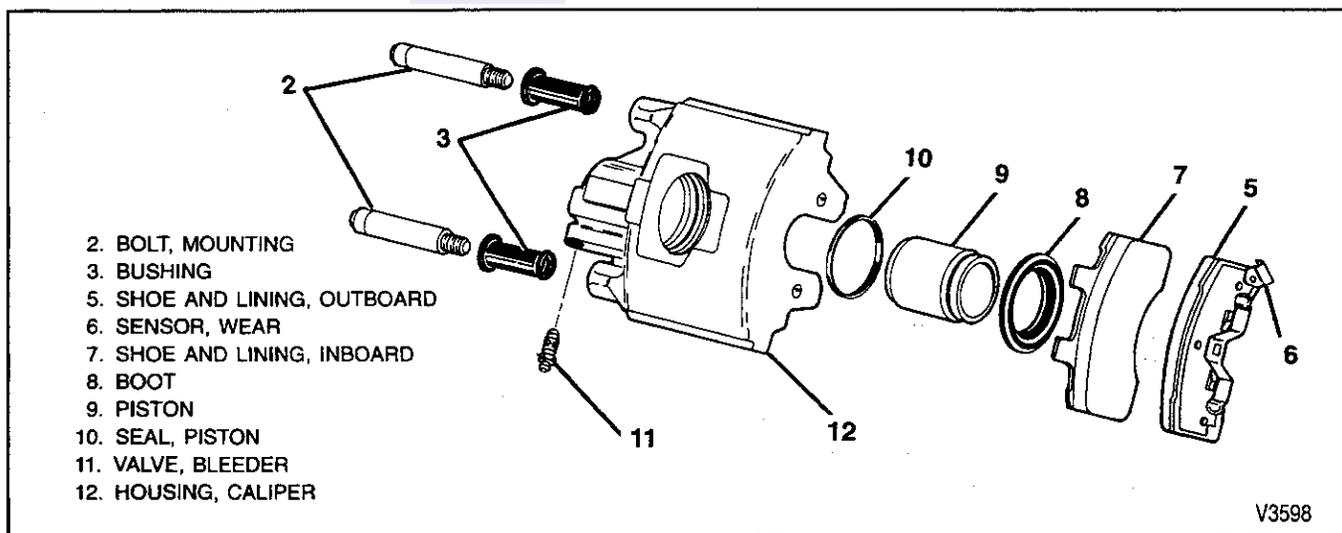


Figure 24—Caliper Components (Delco 3486)

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).

5. Bleeder valve (11).

NOTICE: Refer to "Notice" on page 5B1-1.

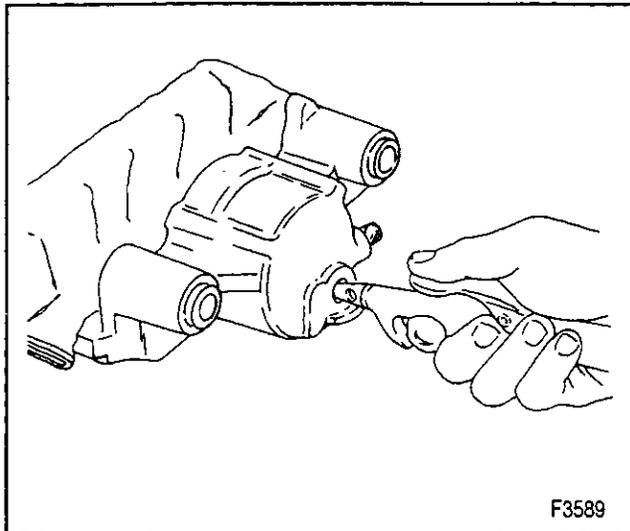


Figure 25—Removing the Piston

F3589

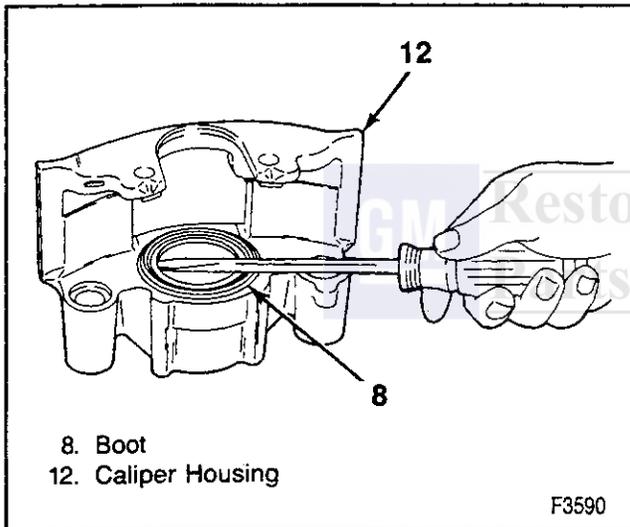


Figure 26—Removing the Boot

F3590



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.

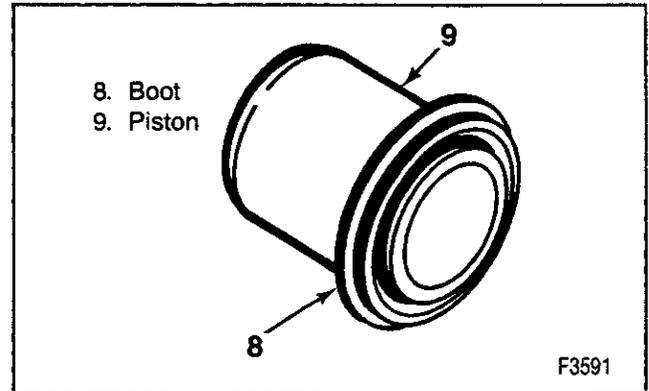


Figure 27—Installing the Boot on the Piston

F3591

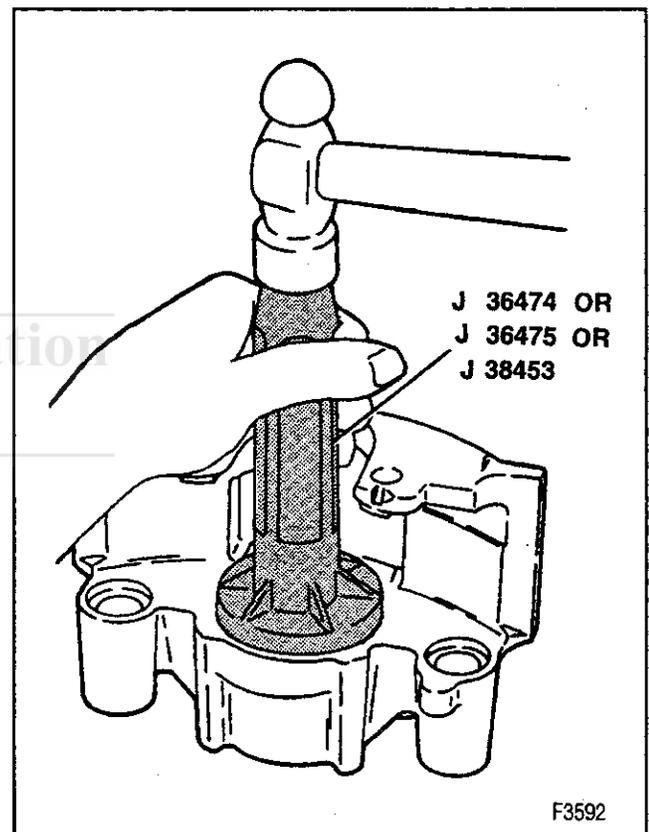


Figure 28—Seating the Boot in the Housing

F3592

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

5B1-14 FRONT DISC BRAKES

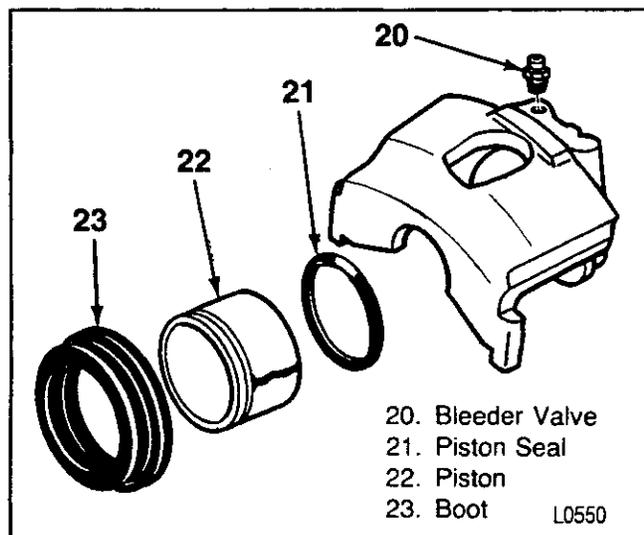


Figure 29—Caliper Components (Bendix)

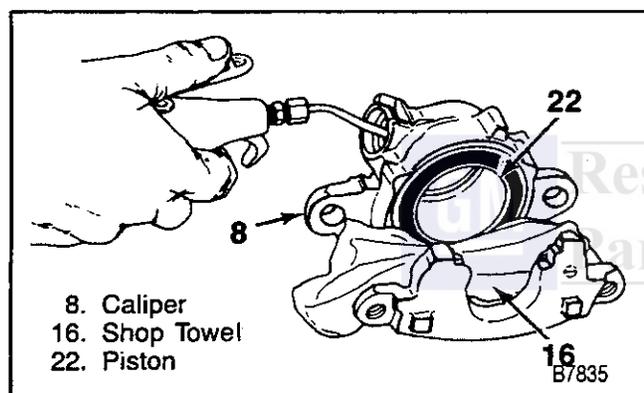


Figure 30—Removing the Piston

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

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

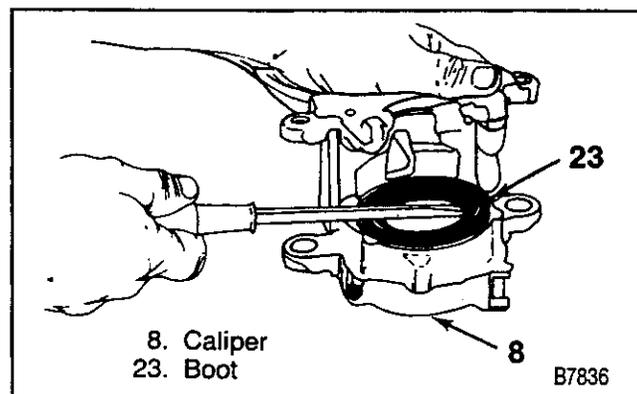


Figure 31—Removing the Boot

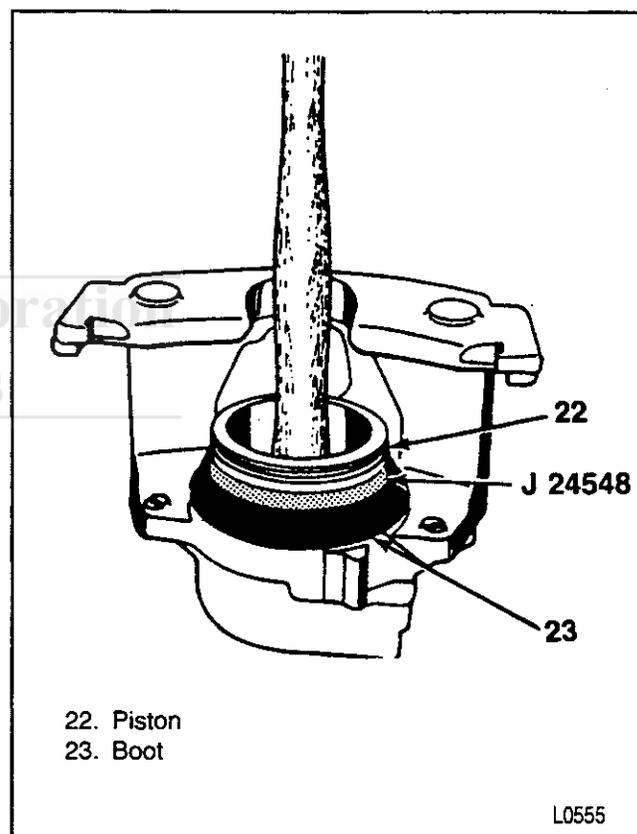


Figure 32—Installing the Piston

- Piston (22) inside J 24548 (figure 32).
- Piston halfway into bore.
 - Remove J 24548.
 - Make sure boot is firmly seated.

NOTICE: Refer to "Notice" on page 5B1-1.

- Bleeder valve (20).

Tighten

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

FRONT DISC BRAKES 5B1-15

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 2.5-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.)
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

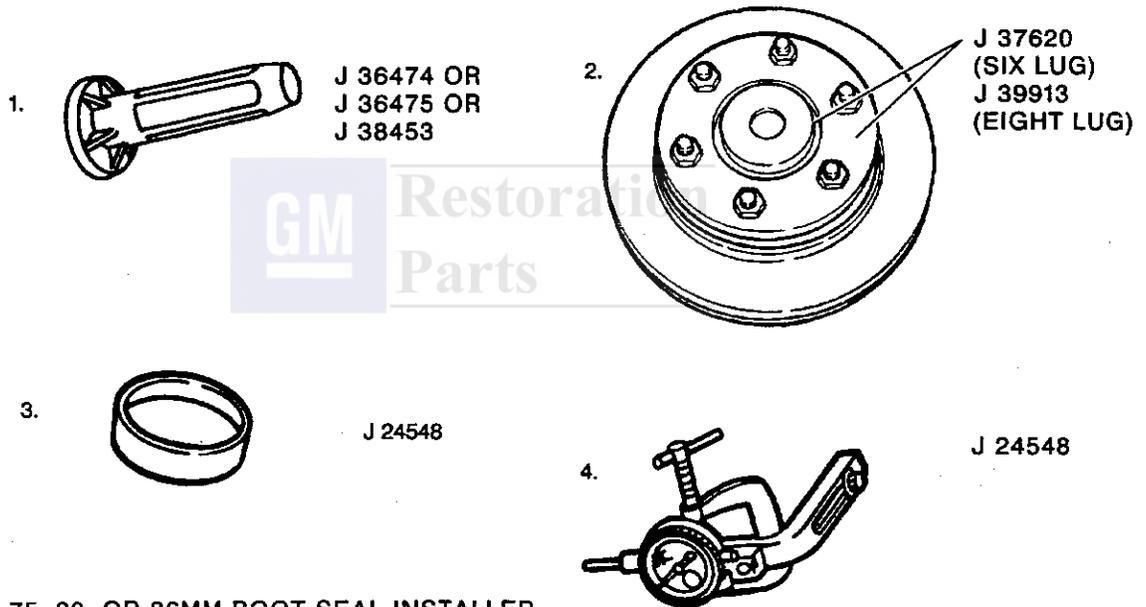
FASTENER TIGHTENING SPECIFICATIONS

ITEM	N-m	Ft. Lbs.	In. Lbs.
Bleeder Valve (Bendix)	7	—	62
Bleeder Valve (Delco)	13	—	115
Brake Hose to Caliper Bolt.....	45	33	—
Caliper Mounting Bolt (Delco).....	51	38	—
Splash Shield to Knuckle Bolt.....	26	19	—
Support Key Bolt (Bendix)	20	15	—

T2959

5B1-16 FRONT DISC BRAKES

SPECIAL TOOLS



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

3105r5073

SECTION 5B2

REAR DISC BRAKES

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

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.



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5B2-2 REAR DISC BRAKES

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.

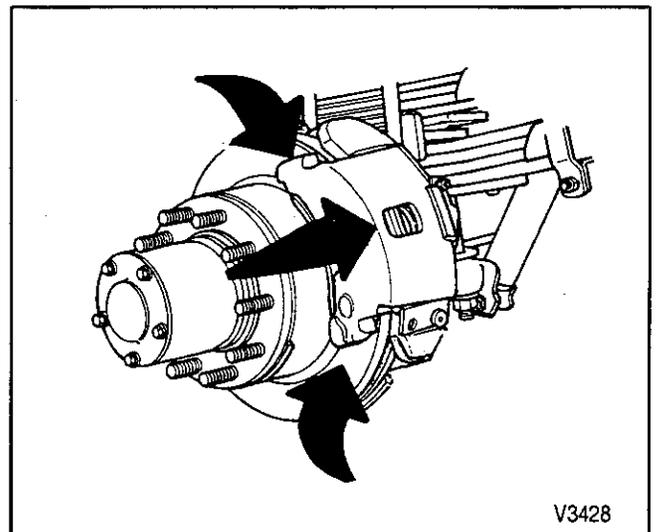


Figure 1—Lining Inspection Points

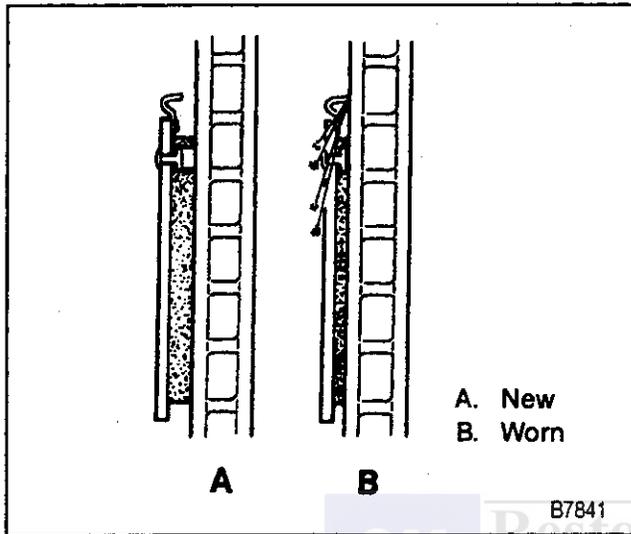


Figure 2—Wear Indicator

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.

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.

5B2-4 REAR DISC BRAKES

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) (figure 6).
 - Use a brass punch and a hammer to drive the support key out (figure 7).
10. Caliper assembly (1).

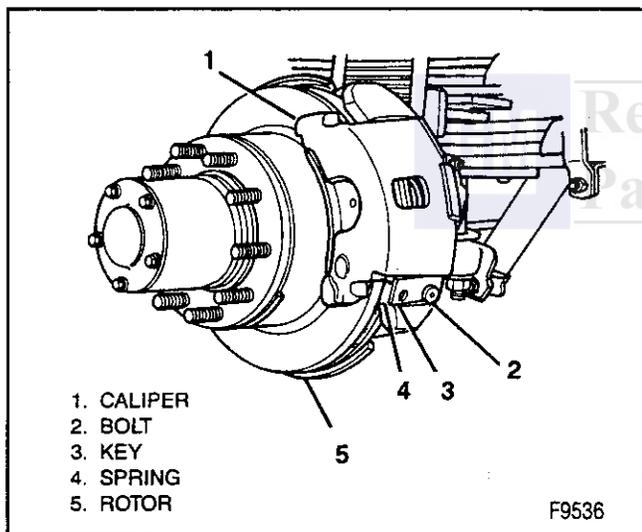


Figure 3—Disc Brake Assembly

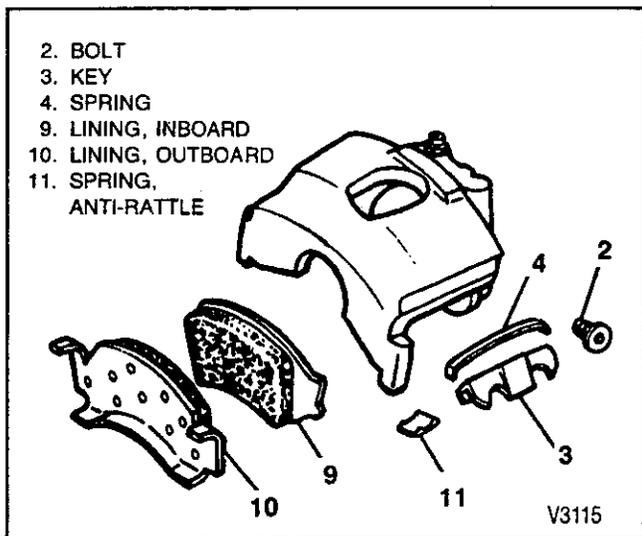


Figure 4—Replacing the Disc Brake Pads

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)

NOTICE: For steps 4 and 5, refer to "Notice" on page 5B2-1.

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

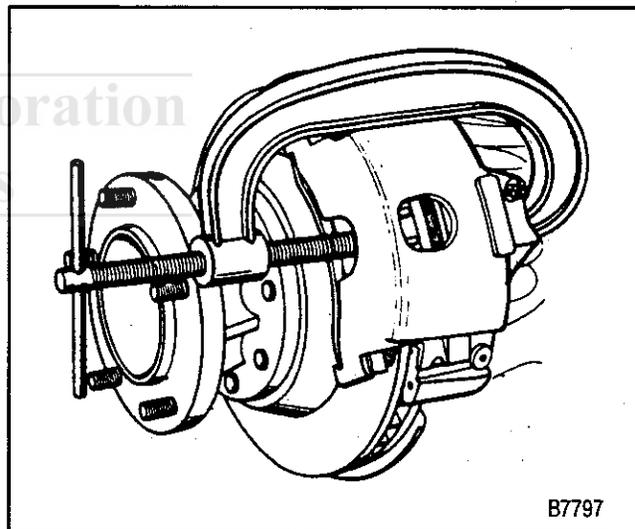


Figure 5—Compressing the Caliper Piston

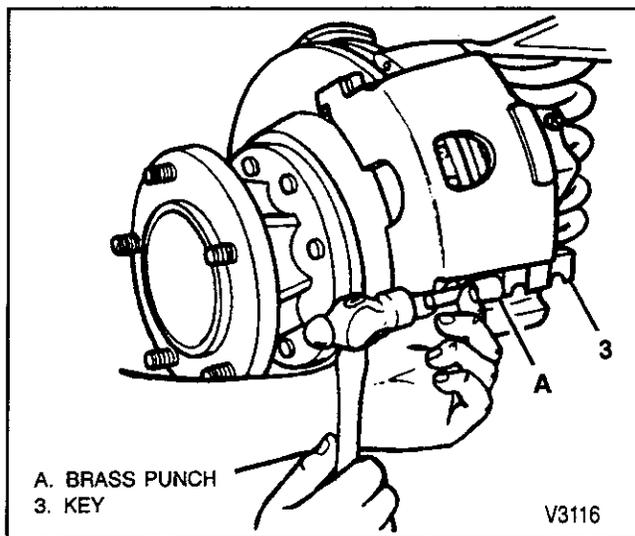


Figure 6—Removing the Caliper Support Key

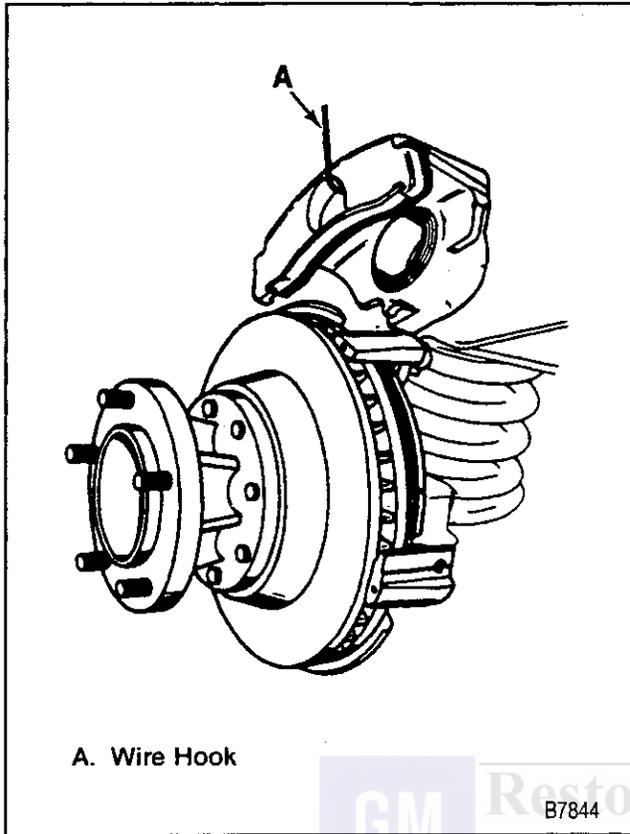


Figure 7—Suspending the Caliper

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.

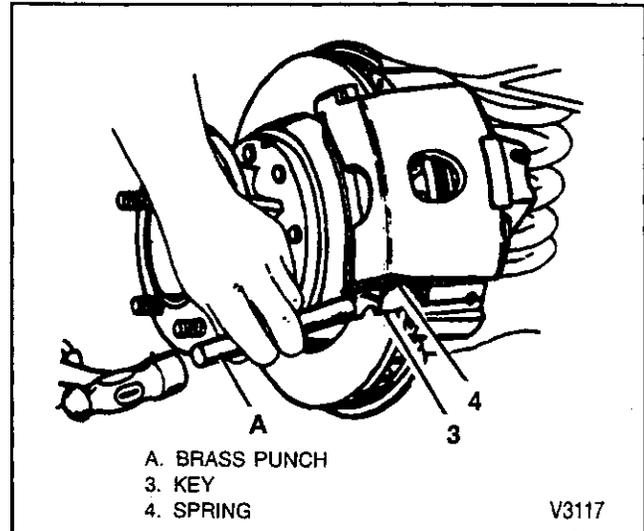


Figure 8—Installing the Caliper Support Key

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 (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).
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.

5B2-6 REAR DISC BRAKES

! 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 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.

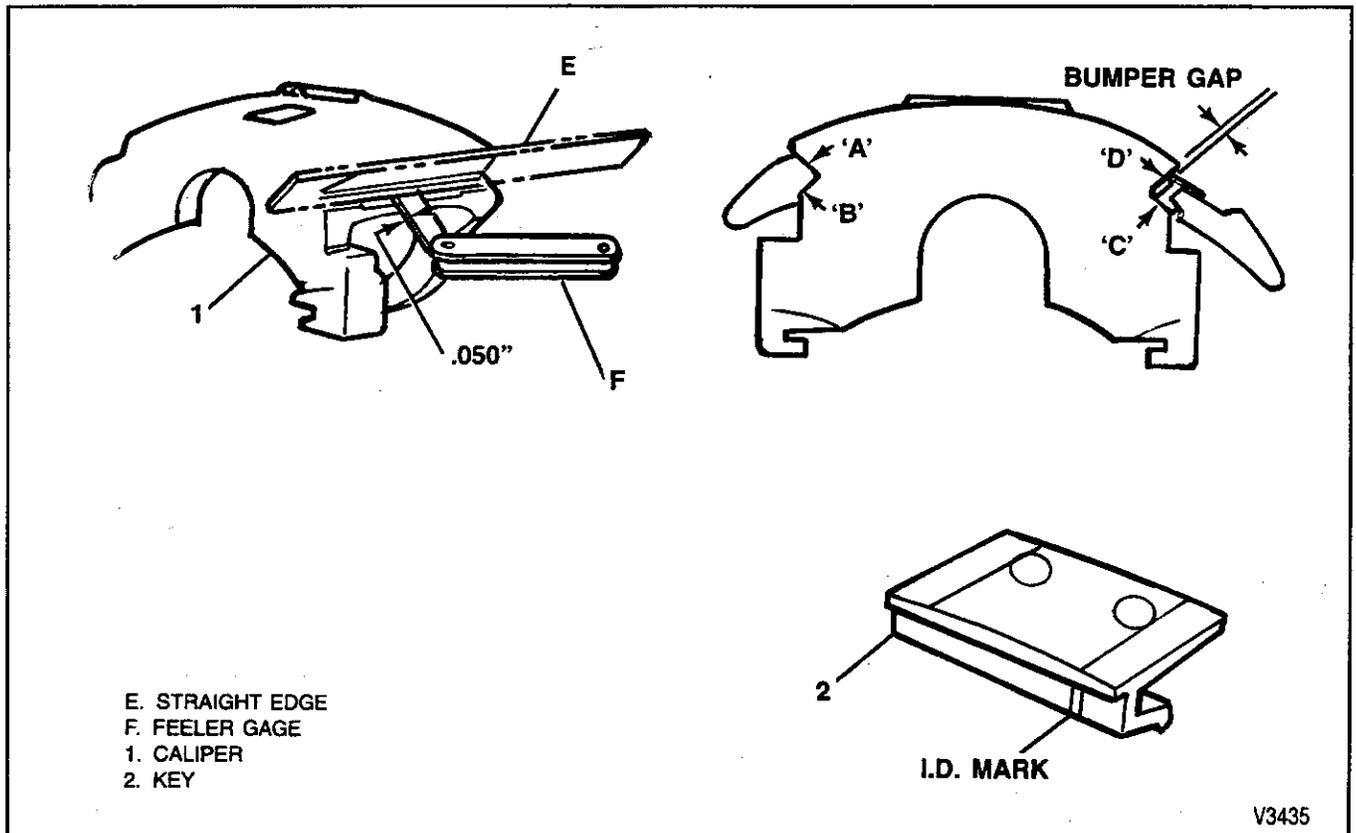


Figure 9—Bendix Caliper Wear Adjustment

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 adapters 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

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



Remove or Disconnect (Figure 10)

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.

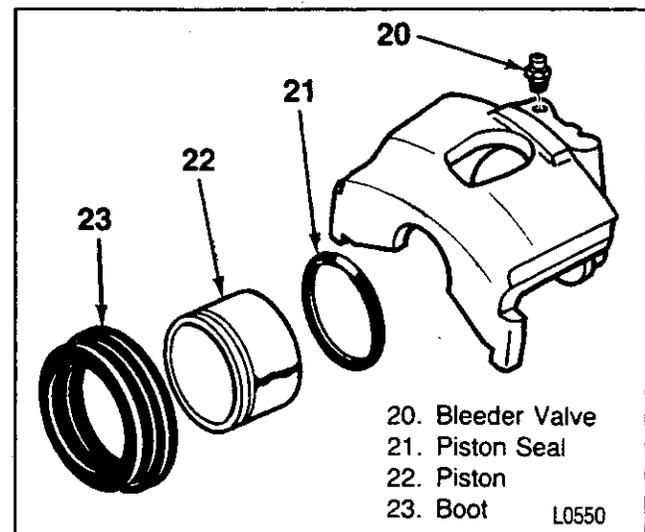


Figure 10—Caliper Components

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5B2-8 REAR DISC BRAKES

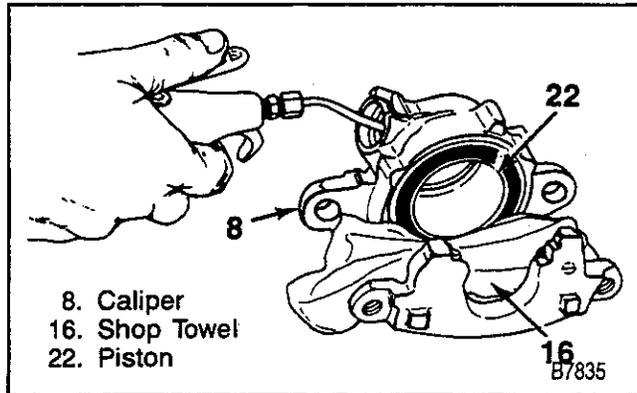


Figure 11—Removing the Piston

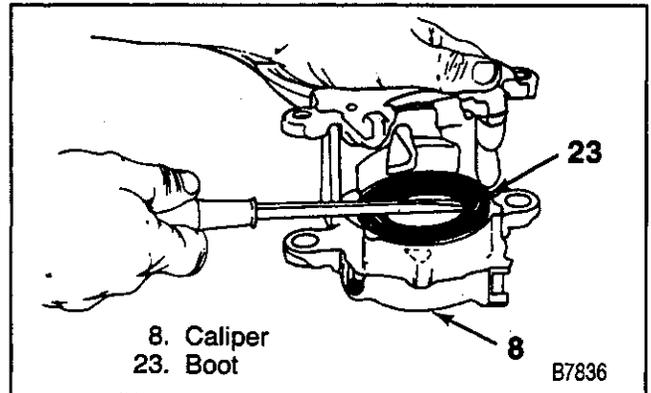


Figure 12—Removing the Boot

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.
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).

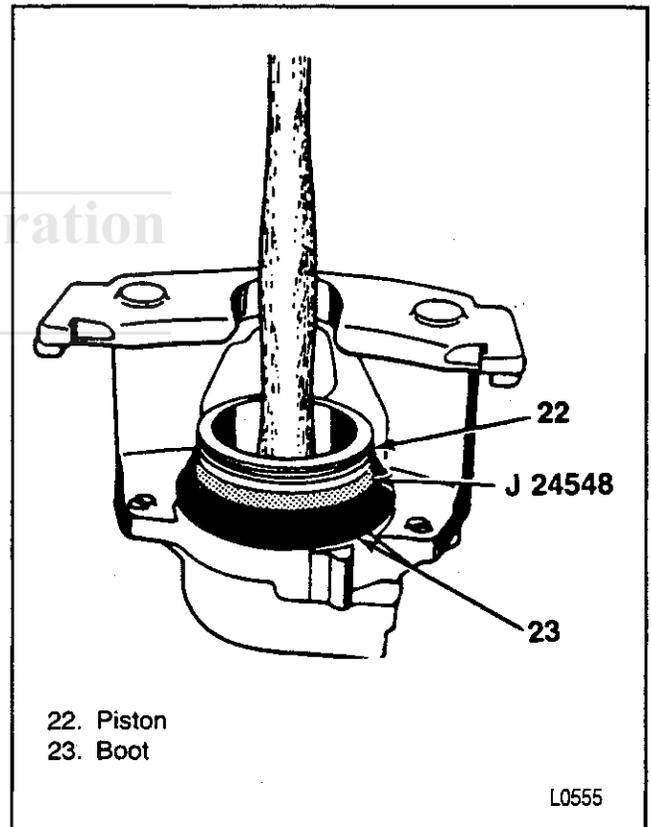


Figure 13—Installing the Piston

6. Piston halfway into bore.
 - A. Remove J 24548.
 - B. Make sure boot is firmly seated.

NOTICE: Refer to "Notice" on page 5B2-1.

7. Bleeder valve (20).



Tighten

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

REAR DISC BRAKES 5B2-9

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 2.5-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.)
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

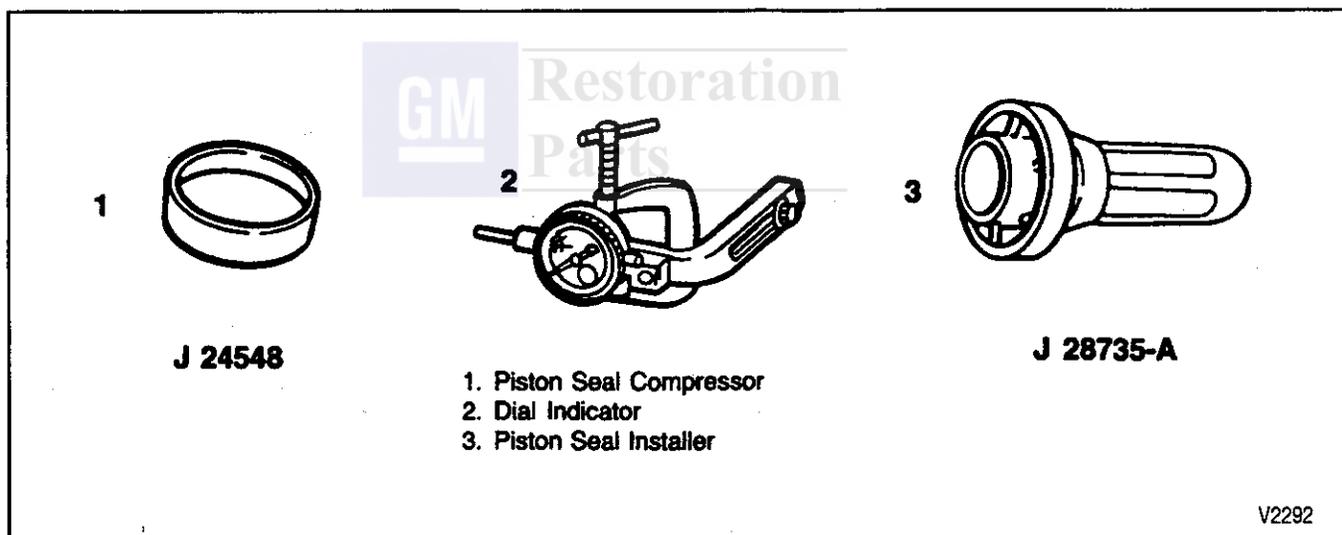
FASTENER TIGHTENING SPECIFICATIONS

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

5B2-10 REAR DISC BRAKES

SPECIAL TOOLS



SECTION 5C1

LEADING/TRAILING DRUM BRAKES

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

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.



Parts

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5C1-2 LEADING/TRAILING DRUM BRAKES

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.

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

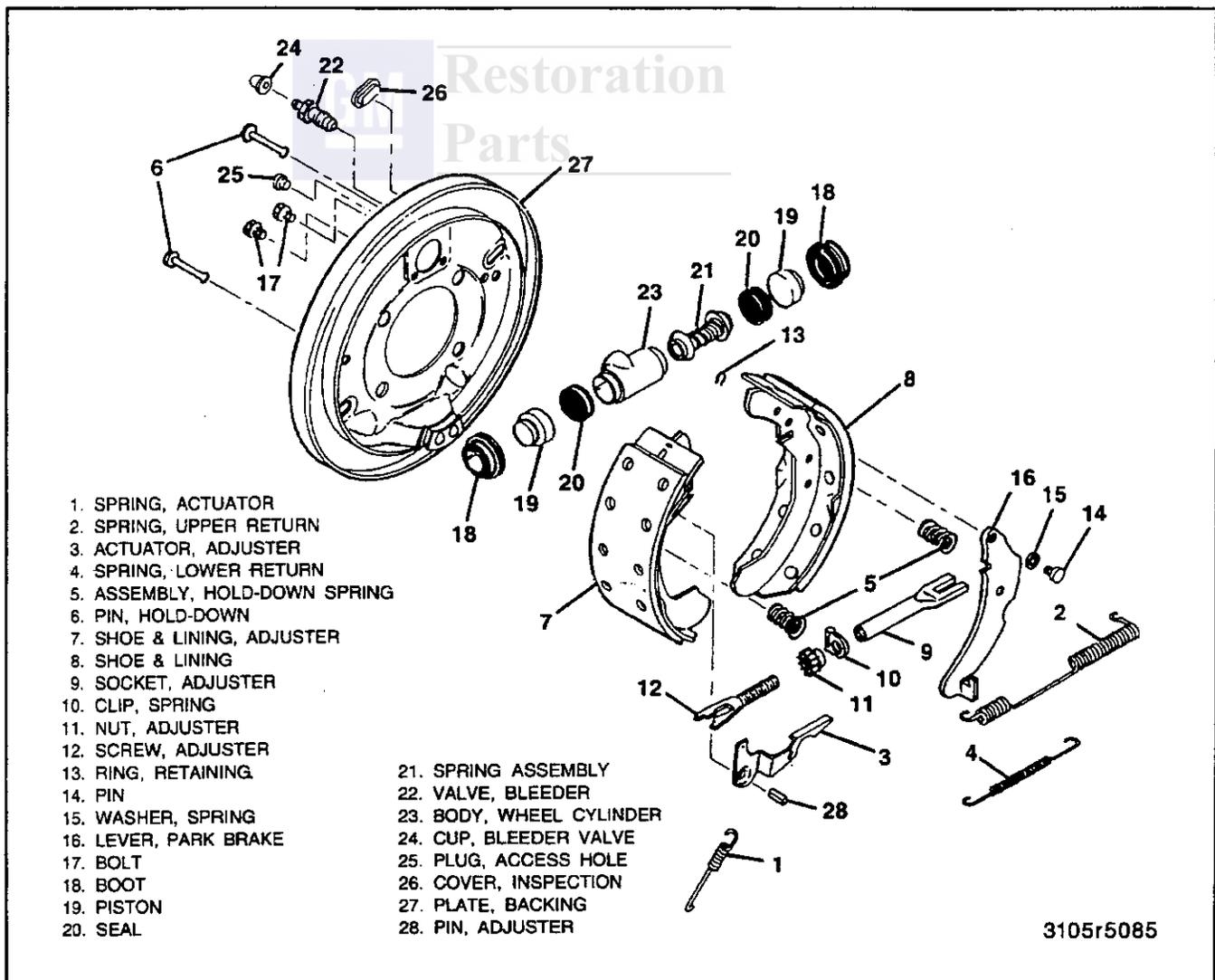
4. Mark relationship of drum to axle.
5. Drum. Refer to SECTION 4B1.

• 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).



3105r5085

Figure 1—Leading/Trailing Drum Brake

5C1-4 LEADING/TRAILING DRUM BRAKES

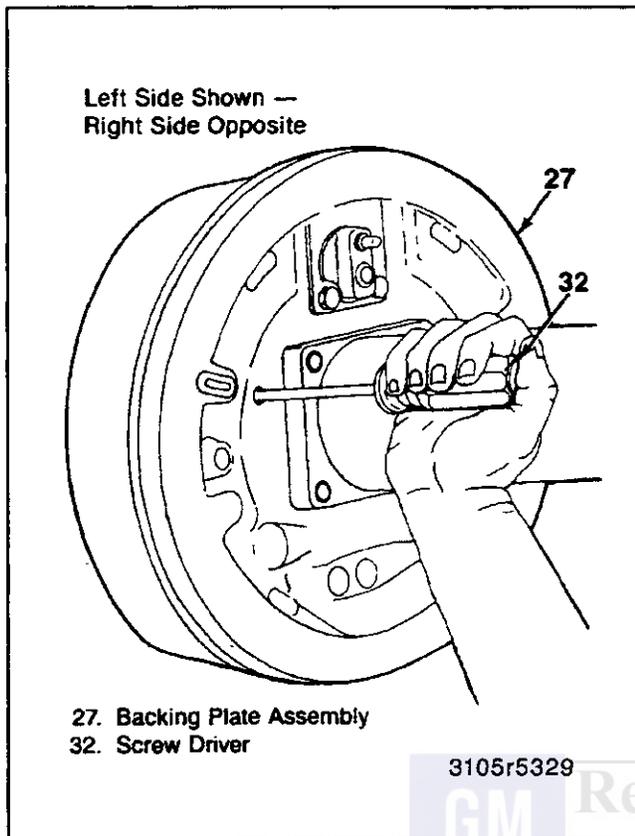


Figure 2—Pushing the Parking Brake Lever Off its Stop

- 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).

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.

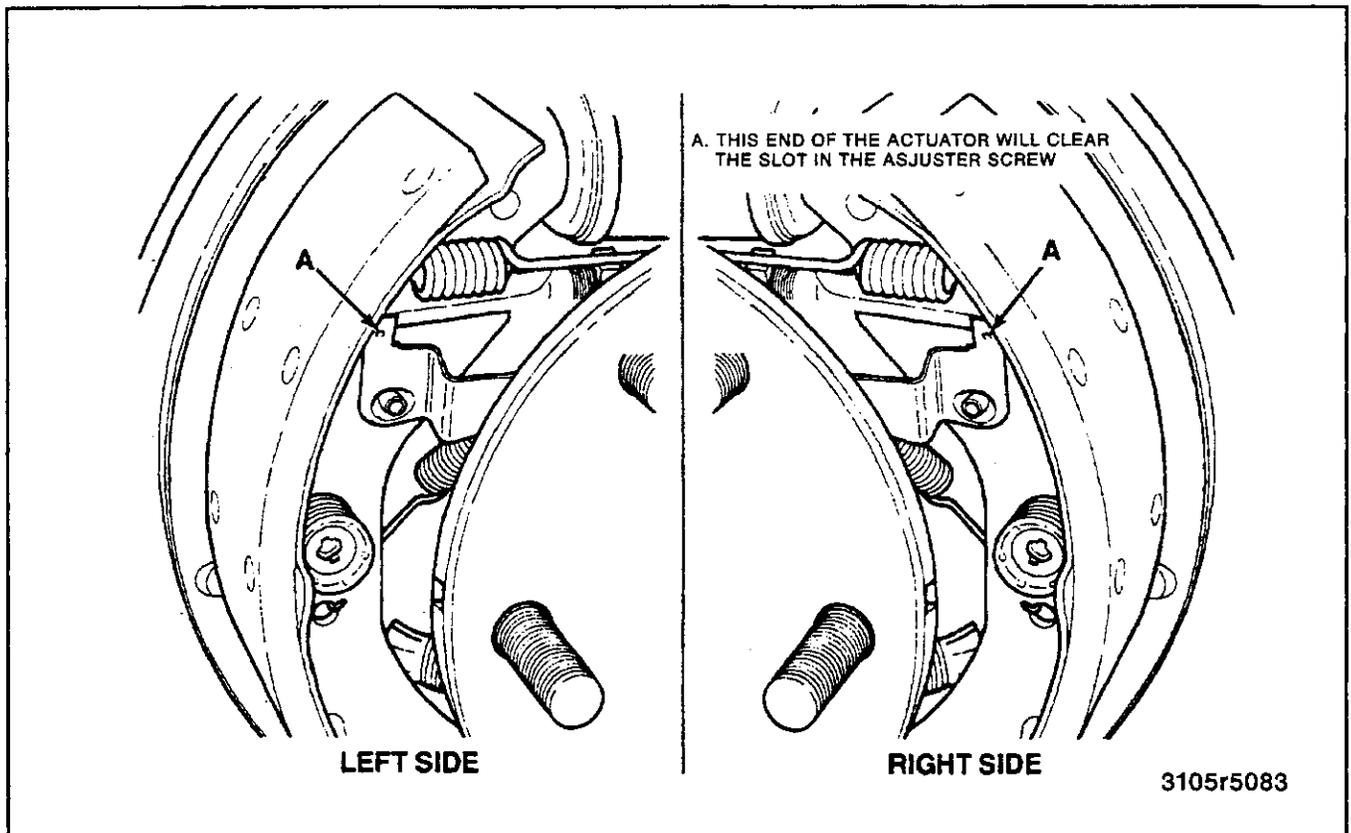


Figure 3—Removing the Adjuster Actuator

LEADING/TRAILING DRUM BRAKES 5C1-5



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.
 - 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.

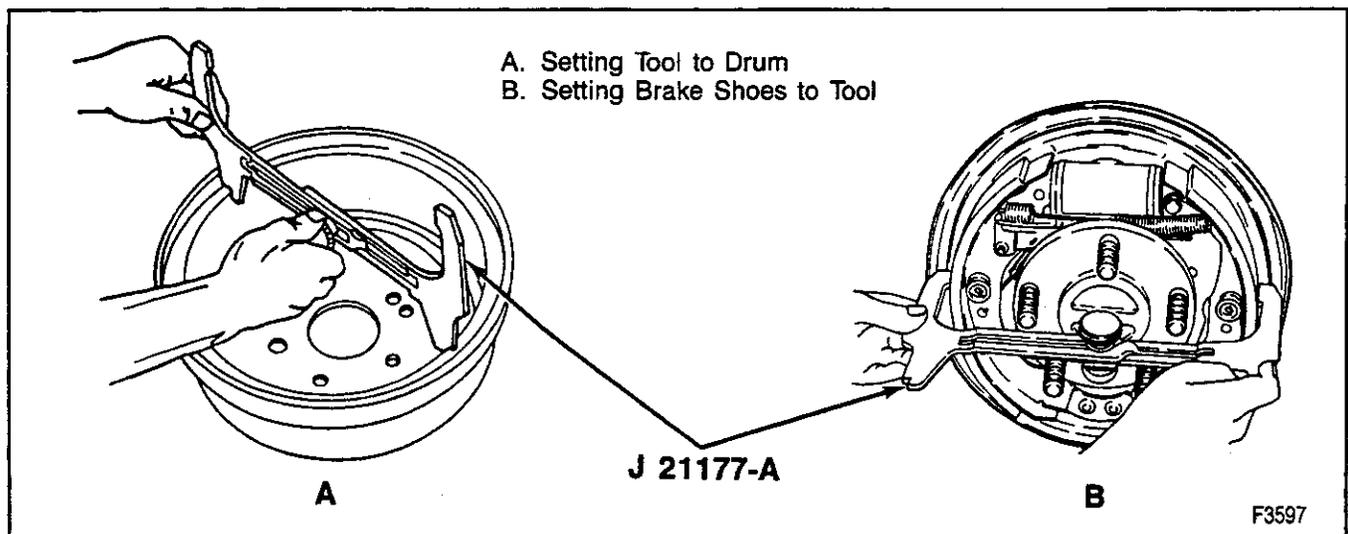


Figure 4—Measuring the Drum and Shoes for Adjustment

5C1-6 LEADING/TRAILING DRUM BRAKES

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)

NOTICE: For steps 2 and 3, refer to "Notice" on page 5C1-1.

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



Tighten

- Bolts (22) to 20 N.m (15 lbs. ft.).
3. Inlet pipe.



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.

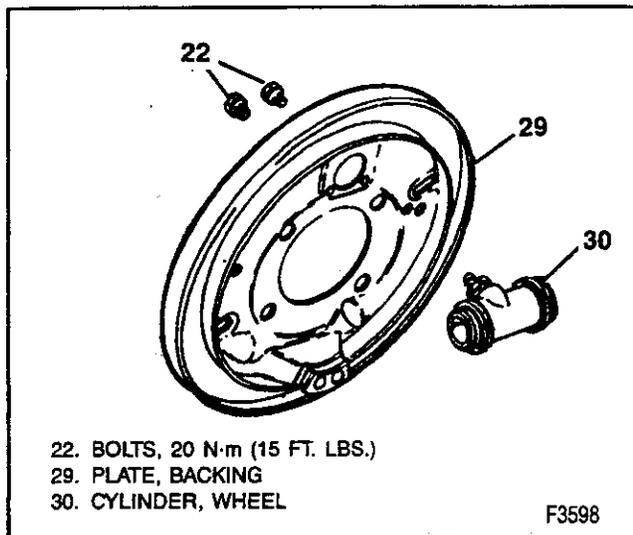


Figure 5—Wheel Cylinder Replacement

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).

NOTICE: Refer to "Notice" on page 5C1-1.

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.

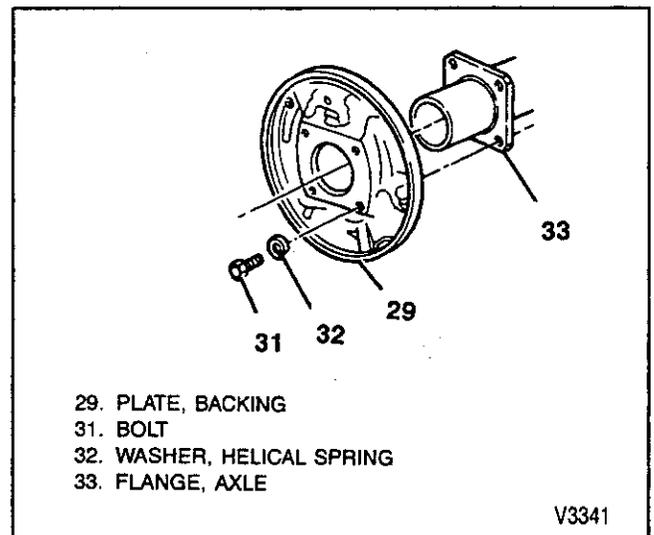


Figure 6—Backing Plate Replacement

LEADING/TRAILING DRUM BRAKES 5C1-7

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 "Specifica-

tions" 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.

5C1-8 LEADING/TRAILING DRUM BRAKES

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).

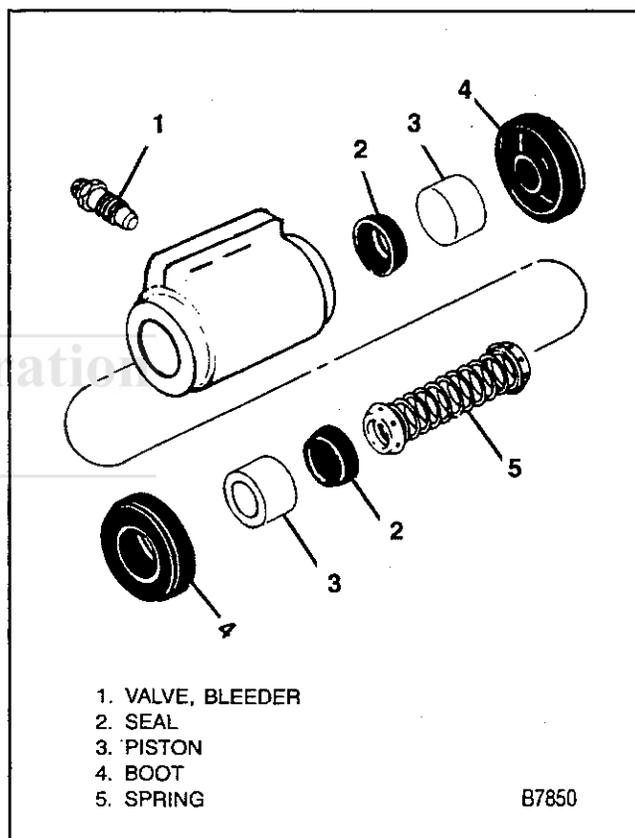


Figure 7—Wheel Cylinder Components

Tighten

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

LEADING/TRAILING DRUM BRAKES 5C1-9

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 2.5-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

5C1-10 LEADING/TRAILING DRUM BRAKES

NOTES



SECTION 5C2

DUO-SERVO DRUM BRAKES

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

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.

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5C2-2 DUO-SERVO DRUM BRAKES

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.

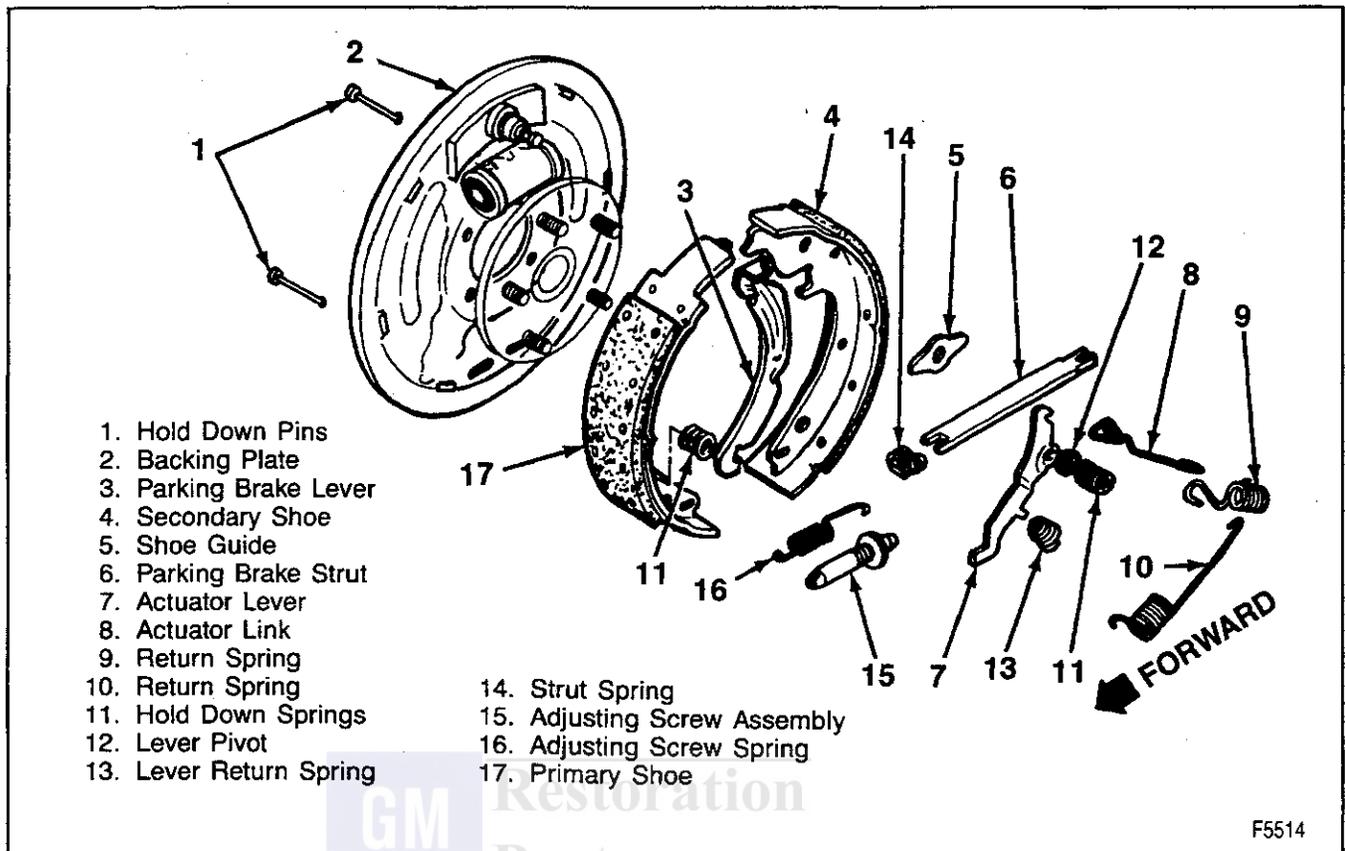


Figure 1—Duo-Servo Drum Brake Components

- Wheel cylinder for signs of leakage. If any is found, refer to "Wheel Cylinder."
- Brake drum for scoring and machining tolerance. Refer to "Refinishing."

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

- Align the marks made during disassembly.

16. Adjust brakes. Refer to "Adjustment."

Install or Connect (Figure 1)

- Lubricate shoe pads and adjusting screw threads with a thin coat of white lithium grease or equivalent.
- 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.

Important

- Do not interchange right and left adjusting screws.

- Shoe assembly to the backing plate.
- Parking brake lever (3).
- Strut spring (14) onto the parking brake strut (6).
- Parking brake strut (6).
- Actuator lever (7) and lever pivot (12).
- Actuator link (8).
- Lever return spring (13).
- Hold down pins (1).
- Hold down springs (11).
- Shoe guide (5).
- Return springs (9 and 10).
- Drum.

- Align the marks made during disassembly.

WHEEL CYLINDER

Remove or Disconnect (Figure 2)

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

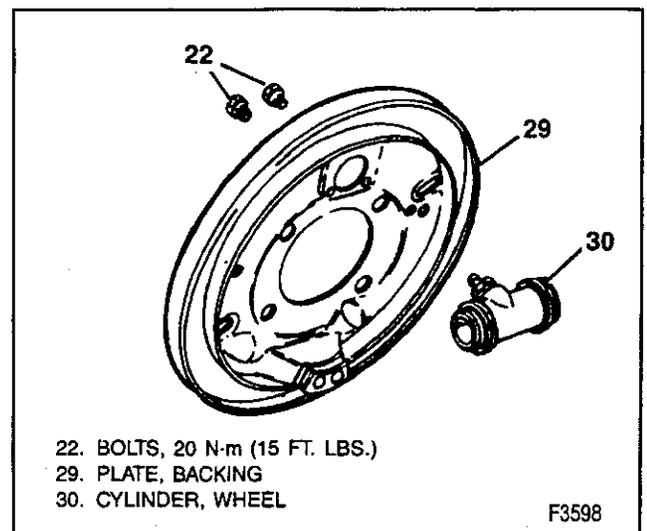


Figure 2—Wheel Cylinder Replacement

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F3598

5C2-4 DUO-SERVO DRUM BRAKES

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

Install or Connect (Figure 2)

NOTICE: For steps 2 and 3, refer to "Notice" on page 5C2-1.

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).

NOTICE: Refer to "Notice" on page 5C2-1.

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.

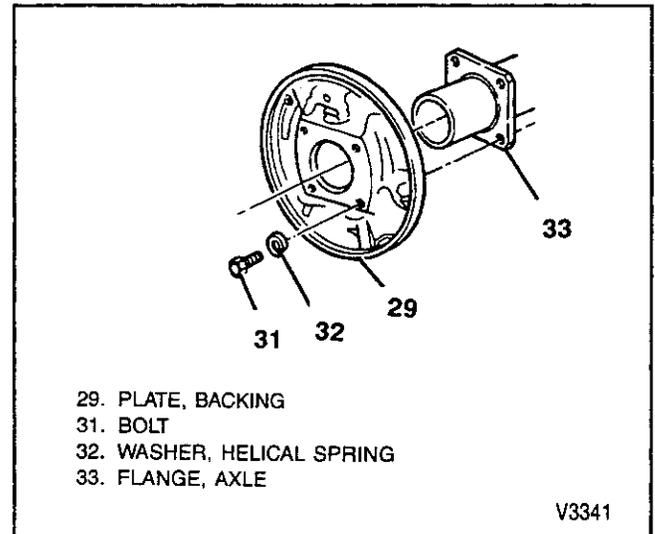


Figure 3—Backing Plate Replacement

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.
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)

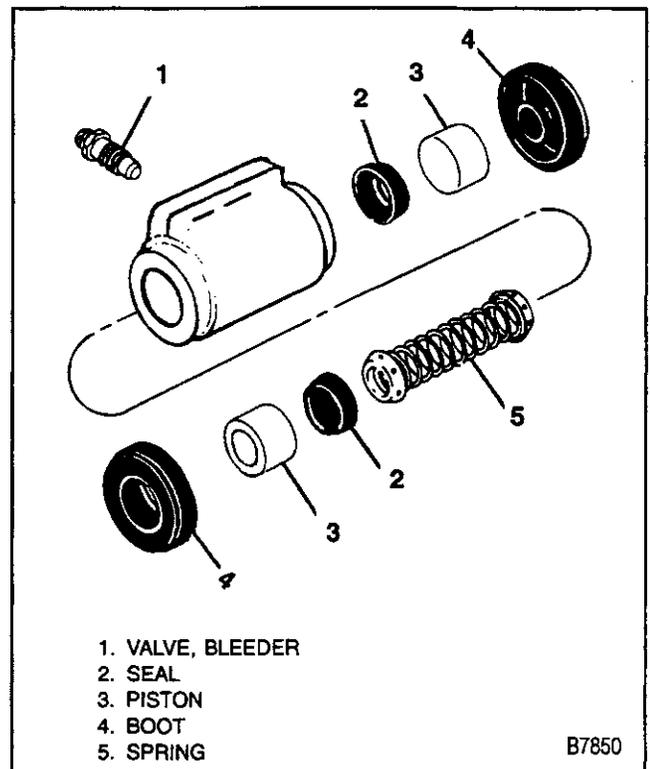
1. Lubricate the seals and cylinder bore with clean brake fluid.
2. Spring (5).
3. Seals (2).
4. Pistons (3).
5. Boots (4).

NOTICE: Refer to "Notice" on page 5C2-1.

6. Bleeder valve (27).

Tighten

- Bleeder valve (27) to 7 N·m (62 lbs. in.)
- 7. Links (21).



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

B7850

Figure 4—Wheel Cylinder Components

5C2-6 DUO-SERVO DRUM BRAKES

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 2.5-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

SECTION 5D1

VACUUM BOOSTER SYSTEM

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

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Specifications	5D1-4
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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.

5D1-2 VACUUM BOOSTER SYSTEM

DIAGNOSIS OF THE VACUUM BOOSTER

PROBLEM	POSSIBLE CAUSE	CORRECTION
Hard Pedal	<ol style="list-style-type: none"> 1. Broken or damaged hydraulic brake pipes and hoses. 2. Faulty vacuum check valve or grommet. 3. Collapsed or damaged vacuum hose. 4. Plugged or loose vacuum fitting. 5. Faulty air valve seal or support plate. 6. Damaged floating control valve. 7. Bad stud welds on front or rear housing or power head. 8. Faulty booster diaphragm. 9. Restricted air filter element. 10. Worn or distorted reaction plate or levers. 11. Cracked or broken power pistons or retainer. 	<ol style="list-style-type: none"> 1. Inspect and replace as necessary. 2. Replace. 3. Replace hose. 4. Clean or tighten. 5. Replace. Refer to the Light Duty Truck Unit Repair Manual. 6. Replace. Refer to the Light Duty Truck Unit Repair Manual. 7. Replace unless easily repaired. 8. Replace. Refer to the Light Duty Truck Unit Repair Manual. 9. Replace. 10. Replace plate or levers. Refer to the Light Duty Truck Unit Repair Manual. 11. Replace power pistons and piston rod retainer. Refer to the Light Duty Truck Unit Repair Manual.
Grabby Brakes (Apparent Off-On Condition)	<ol style="list-style-type: none"> 1. Broken or damaged hydraulic brake pipes and hoses. 2. Low fluid level in the master cylinder. 3. Faulty master cylinder seals. 4. Cracked master cylinder casing. 5. Leaks in front calipers or rear wheel cylinders or in pipes or connections. 6. Air in hydraulic system. 	<ol style="list-style-type: none"> 1. Inspect and replace as necessary. 2. Fill reservoirs with proper brake fluid. Check for leaks. 3. Repair or replace as necessary. 4. Replace. 5. Inspect and repair as necessary. 6. Bleed system.
Brakes Fail to Release	<ol style="list-style-type: none"> 1. Blocked passage in power piston. 2. Air valve sticking shut. 3. Broken piston return spring or air valve spring. 4. Tight brake pedal linkage. 5. Misadjusted stoplamp or cruise control switches. 	<ol style="list-style-type: none"> 1. Inspect and repair or replace as necessary. Refer to the Light Duty Truck Unit Repair Manual. 2. Check for proper lubrication of air valve O-ring seal. Refer to the Light Duty Truck Unit Repair Manual. 3. Replace. Refer to the Light Duty Truck Unit Repair Manual. 4. Repair or replace as necessary. 5. Readjust switches.

D0106

ON-VEHICLE SERVICE

BOOSTER ASSEMBLY

 Remove or Disconnect (Figures 1 and 2)

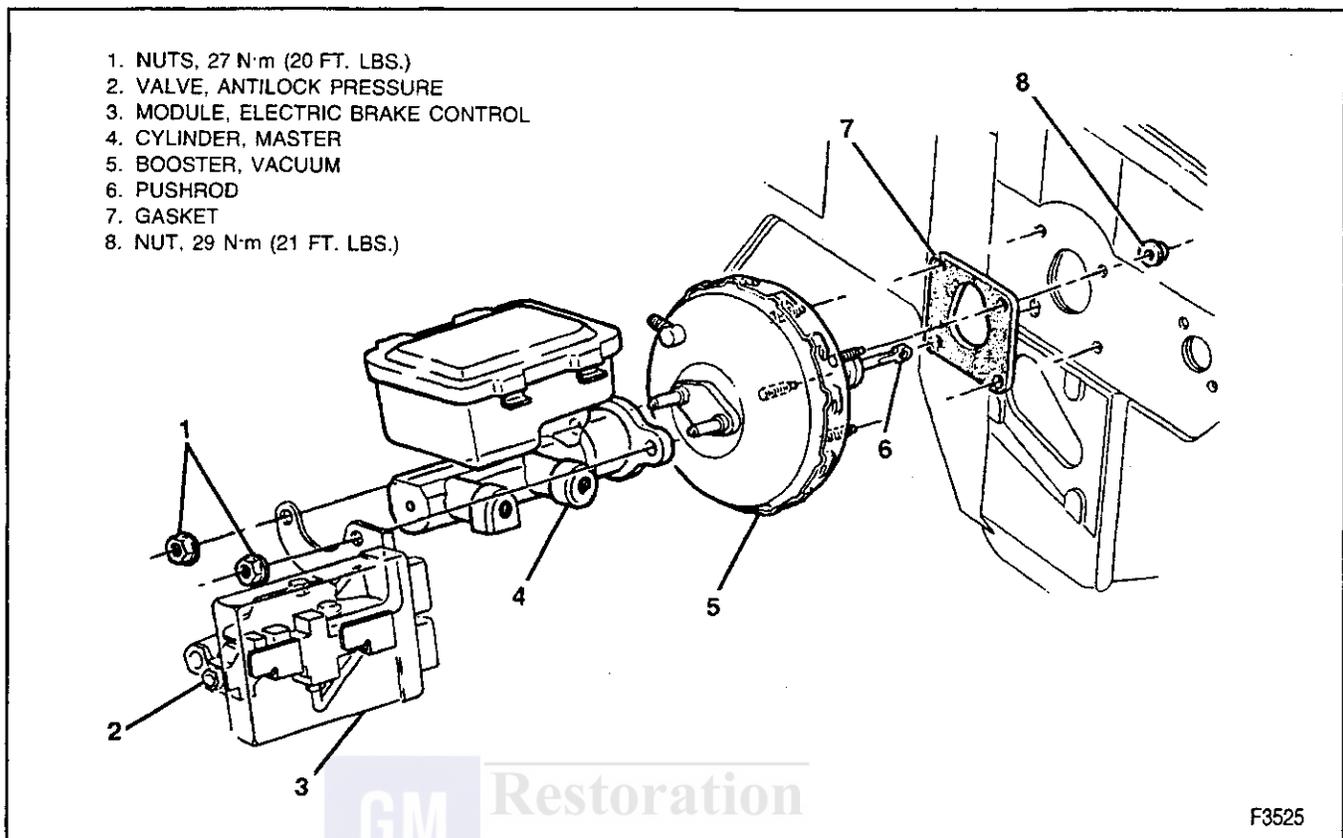
1. Apply parking brake.
2. Nuts (1).
3. Master cylinder (4) and combination valve bracket (as used).
 - Support the master cylinder.
4. Vacuum hose.
5. Retainer (13) and washer (14).
6. Pushrod (6).

7. Nuts (8).
8. Booster assembly (5).
9. Gasket (7).

 Install or Connect (Figures 1 and 2)

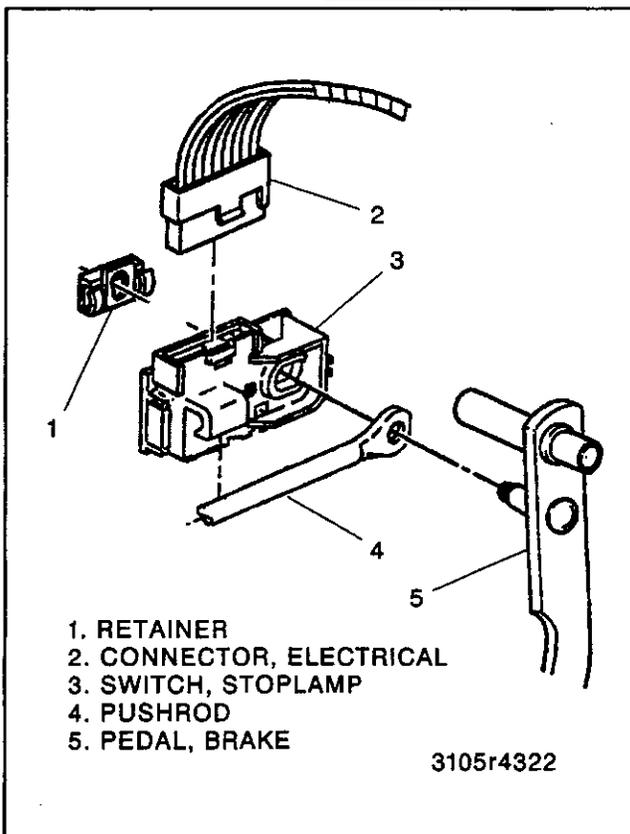
NOTICE: For steps 3 and 8, refer to "Notice" on page 5D1-1.

1. Gasket (7).
2. Booster assembly (5).



1. NUTS, 27 N·m (20 FT. LBS.)
2. VALVE, ANTILOCK PRESSURE
3. MODULE, ELECTRIC BRAKE CONTROL
4. CYLINDER, MASTER
5. BOOSTER, VACUUM
6. PUSHROD
7. GASKET
8. NUT, 29 N·m (21 FT. LBS.)

Figure 1—Vacuum Booster



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

3105r4322

Figure 2—Booster Pushrod

3. Nuts (8).



Tighten

- Nuts (8) to 29 N·m (21 lbs. ft.).

4. Pushrod (6).
5. Washer (14) and retainer (13).
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.

5D1-4 VACUUM BOOSTER SYSTEM

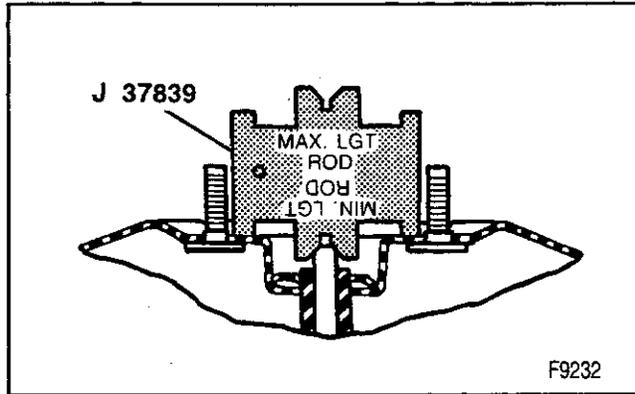


Figure 3—Gaging the Piston Rod

CHECK VALVE HOSE AND ROUTING

Vacuum hose routing is shown in figure 4.

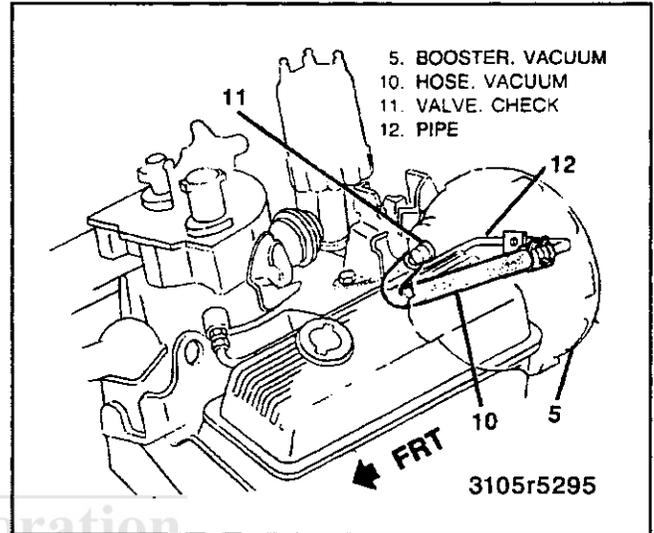


Figure 4—Vacuum Hose Routing

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

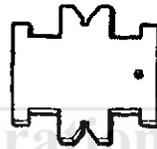
ITEM	N·m	Ft. Lbs.
Booster Mounting Nuts	29	21
Master Cylinder Mounting Nuts	27	20

T2744

VACUUM BOOSTER SYSTEM 5D1-5

SPECIAL TOOLS

1.



J 37839

1. Power Brake Push Rod Height Gage _____

V1377

5D1-6 VACUUM BOOSTER SYSTEM

NOTES



SECTION 5D2

HYDRAULIC BOOSTER SYSTEM

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

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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.

5D2-2 HYDRAULIC BOOSTER SYSTEM

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.

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.

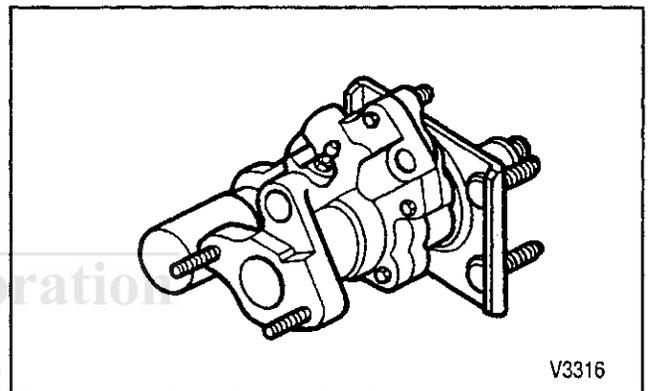


Figure 1—Hydraulic Booster Assembly

DIAGNOSIS OF THE HYDRAULIC BOOSTER SYSTEM

PROBLEM	POSSIBLE CAUSE	CORRECTION
Slow Brake Pedal Return	<ol style="list-style-type: none"> Excessive seal friction in booster. Faulty spool action. Restriction in return hose from booster to pump reservoir. Damaged input rod end. 	<ol style="list-style-type: none"> Overhaul with new seal kit. Flush steering system while pumping brake pedal. Replace hose. Replace input rod and piston assembly.
Grabby Brakes-Booster Chatters - Pedal Vibrates	<ol style="list-style-type: none"> Faulty spool action caused by contamination in system. Power steering pump belt slips. Low fluid level in power steering pump. 	<ol style="list-style-type: none"> Flush steering system while pumping brake pedal. Refer to SECTION 6B1. Fill reservoir and check for external leaks.
Accumulator Leak-Down System Does Not Hold Charge	<ol style="list-style-type: none"> Contamination in steering or booster system. Internal leakage in accumulator system. 	<ol style="list-style-type: none"> Flush steering system while pumping brake pedal. Overhaul unit using accumulator rebuild kit and seal kit.
Brakes Self-Apply When Steering Wheel Turned	<ol style="list-style-type: none"> Contamination in steering or booster system. Restriction in return hose from booster to pump reservoir. 	<ol style="list-style-type: none"> Replace hydraulic booster. Flush complete system. Replace hose.

**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.

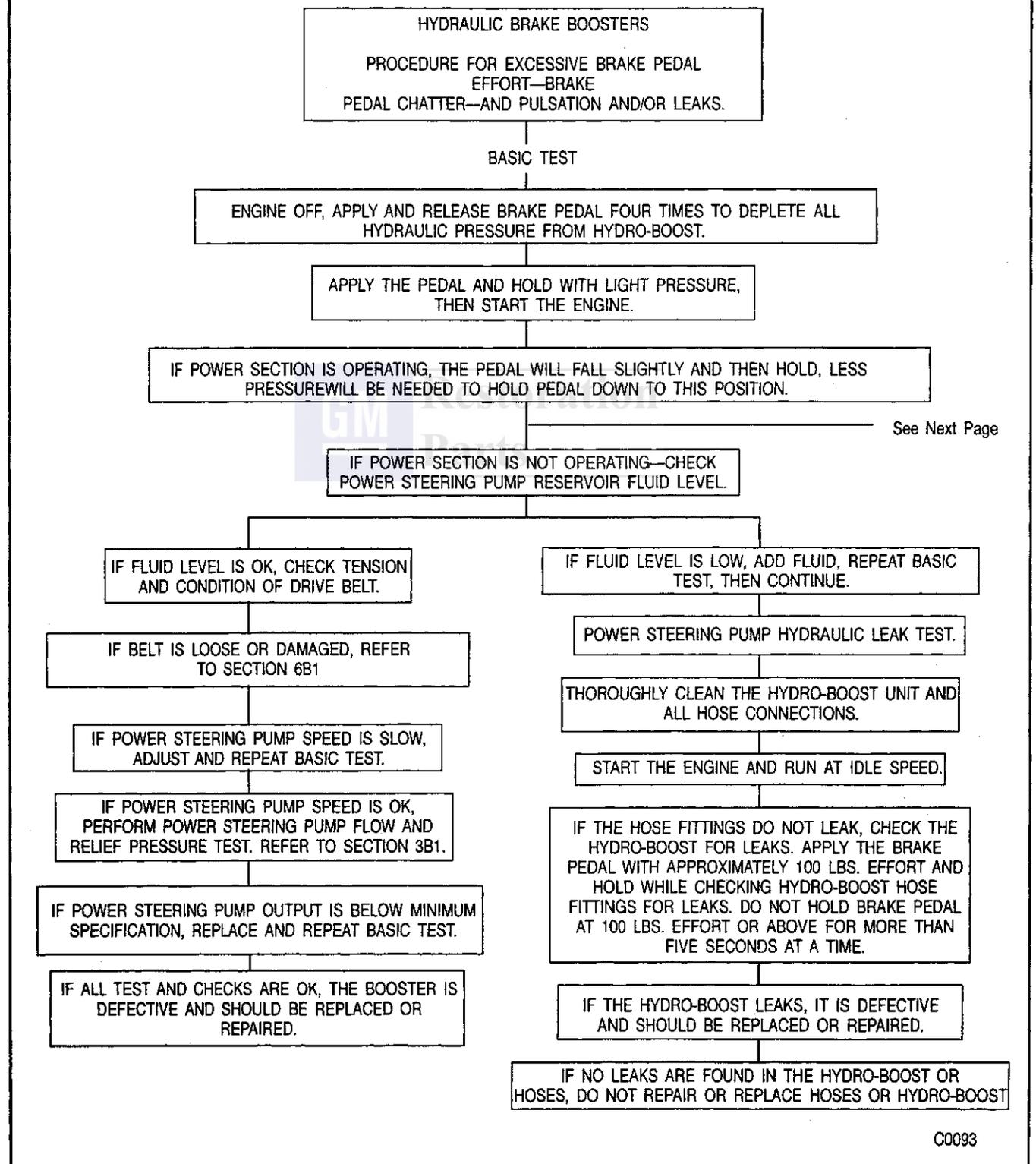
IF THE PEDAL IS FREE OF ANY BINDING
CONDITION, AND THERE ARE NO OBSTRUCTIONS
IN THE RETURN HOSE, REMOVE THE MASTER
CYLINDER RESERVOIR COVER.

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 5A.

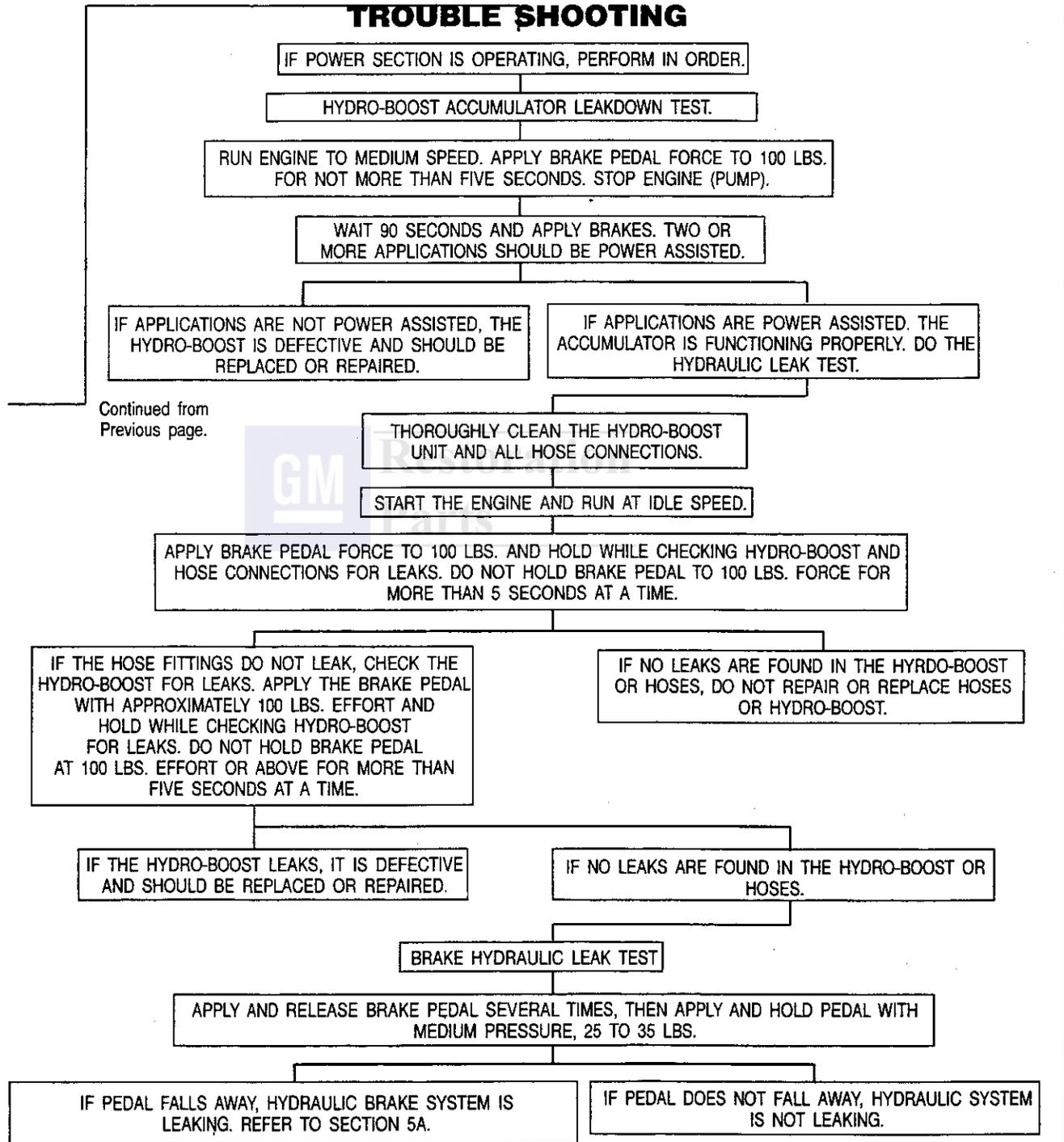
5D2-4 HYDRAULIC BOOSTER SYSTEM

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



**POWER BRAKE UNITS
BENDIX HYDRO-BOOST
(Cont.)**

TROUBLE SHOOTING



Continued from
Previous page.



5D2-6 HYDRAULIC BOOSTER SYSTEM

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.

HYDRAULIC BOOSTER SYSTEM 5D2-7

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 reduc-

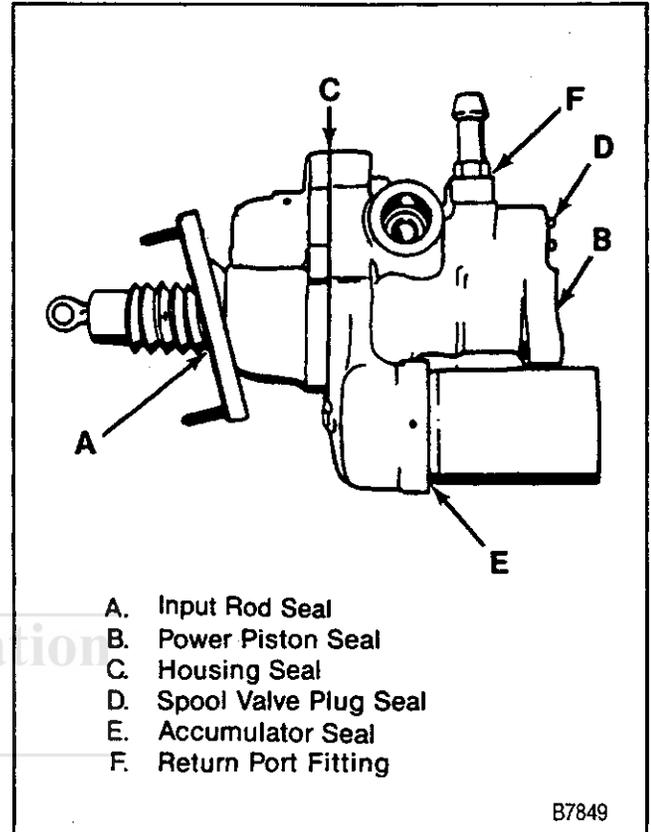


Figure 2—Seal Leak Diagnosis

tion 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.

- 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.

5D2-8 HYDRAULIC BOOSTER SYSTEM

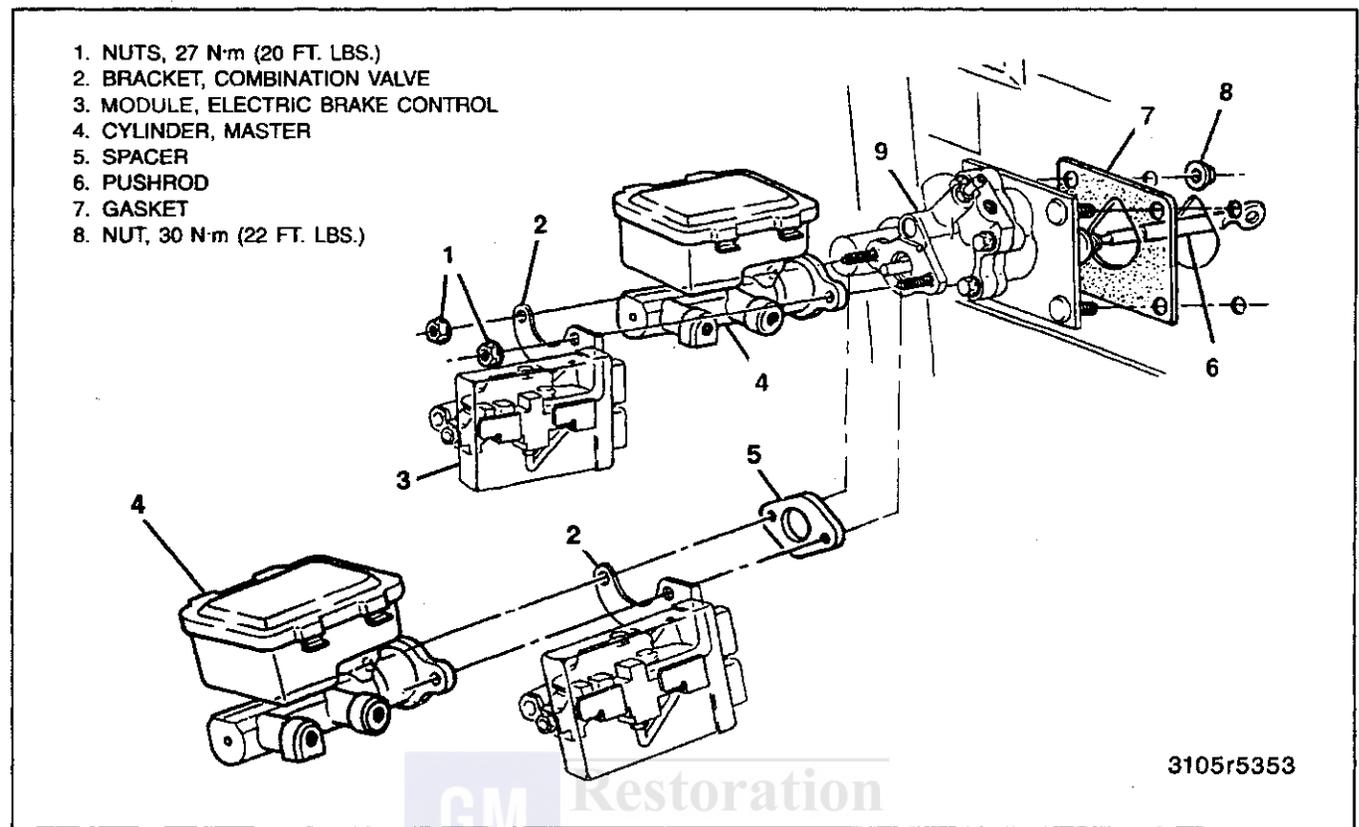


Figure 3—Booster Replacement

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. Combination valve bracket (2) and master cylinder (2).
 - Support the master cylinder.
5. Retainer (13) and washer (14).
6. Pushrod (6).
7. Nuts (8).
8. Booster assembly (9).
9. Gasket (7).

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

NOTICE: For steps 3, 7, and 8, refer to "Notice" on page 5D2-1.

1. Gasket (7).
2. Booster assembly (9).
3. Nuts (4).

 Tighten

- Nuts (4) to 30 N·m (22 lbs. ft.).

HYDRAULIC BOOSTER SYSTEM 5D2-9

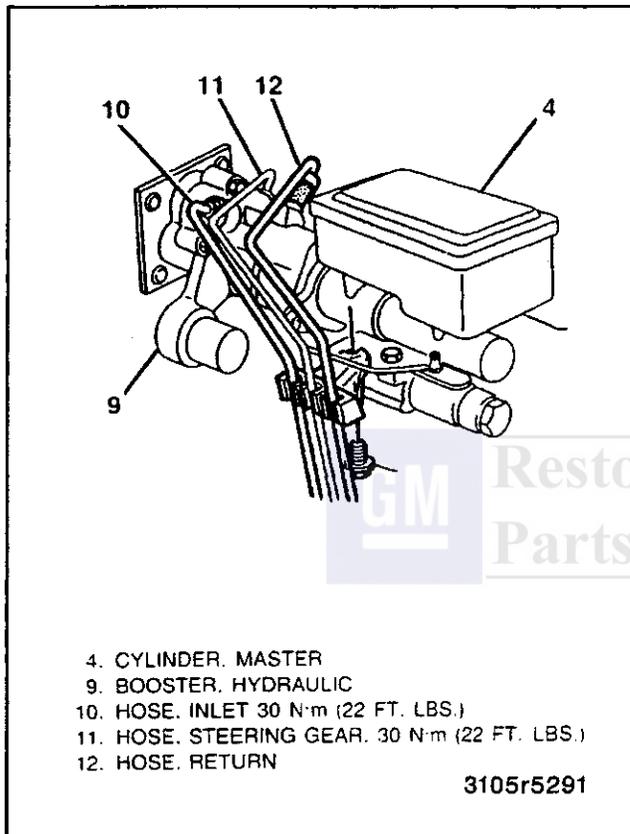


Figure 4—Booster Hoses

4. Pushrod (6).
5. Washer (14) and retainer (13).
6. Master cylinder (4) and combination valve bracket (2).
7. Nuts (1).

 Tighten

- Nuts (1) to 27 N·m (20 lbs. ft.).
8. Return (12), steering gear (11), and inlet (10) hoses.

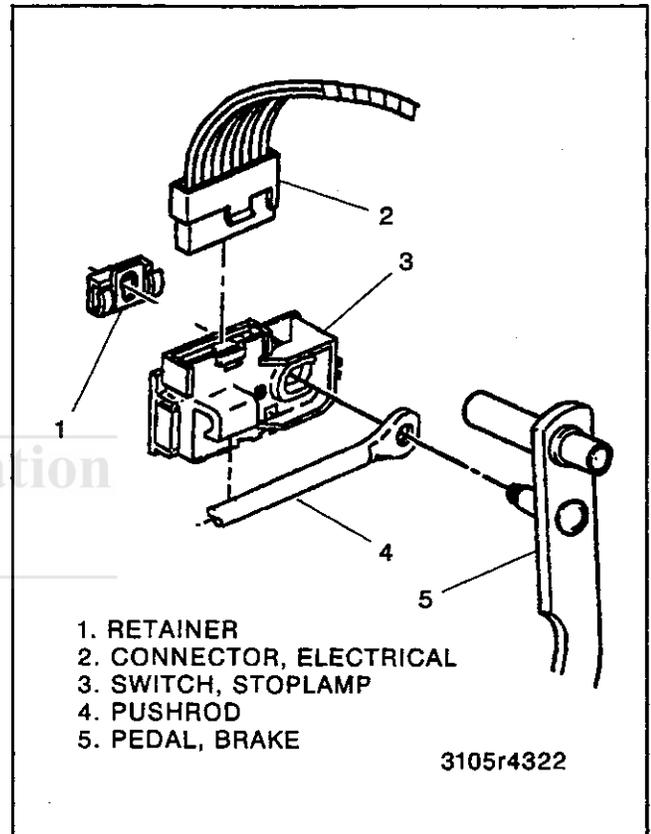


Figure 5—Pushrod Mounting

 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.

5D2-10 HYDRAULIC BOOSTER SYSTEM

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

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

SECTION 5E1

FOUR WHEEL ANTILOCK BRAKE SYSTEM

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

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5E1-2 FOUR WHEEL ANTILOCK BRAKE SYSTEM

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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 does this by regulating 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
DVM.....	Digital Volt Meter
4WAL.....	Four Wheel Antilock
4WD.....	Four Wheel Drive
PWM.....	Pulse-Width Modulation
2WD.....	Two Wheel Drive
VSS.....	Vehicle Speed Sensor
WSS.....	Wheel Speed Sensor

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 Tech 1 scan tool and the RWAL/4WAL cartridge used with it.
- How to use jumper wires to test circuits.

SYSTEM OPERATION

The brake pressure modulator valve (BPMV) receives input signals from the vehicle speed sensor (VSS) calibrator for the rear wheels, wheel speed sensors (WSS) located at each front wheel, brake switch, and transfer case switch on 4WD models.

BASE BRAKING MODE

Applying the brake pedal causes the brake switch to open the circuit to the BPMV. When the BPMV loses the signal from the brake switch, it begins to monitor the signals from the VSS calibrator and WSSs for a departure from vehicle speed. It remains in this standby mode until it sees one speed signal indicating a lockup condition or the brake switch indicates braking has stopped. The BPMV does not affect the front or rear brake hydraulic channels at this time.

ANTILOCK BRAKING MODE

When the BPMV sees a change in the speed signals that indicate one or more wheels is locking up, it takes control of the hydraulic channel to the affected wheel(s). The system has the ability to quickly control hydraulic pressure to the left front and right front wheels independently and the rear wheels together. It cycles the solenoids for the affected wheel to maintain, decrease, or increase hydraulic pressure until the speed signal stabilizes with the other speed inputs.

FOUR WHEEL ANTILOCK BRAKE SYSTEM 5E1-3

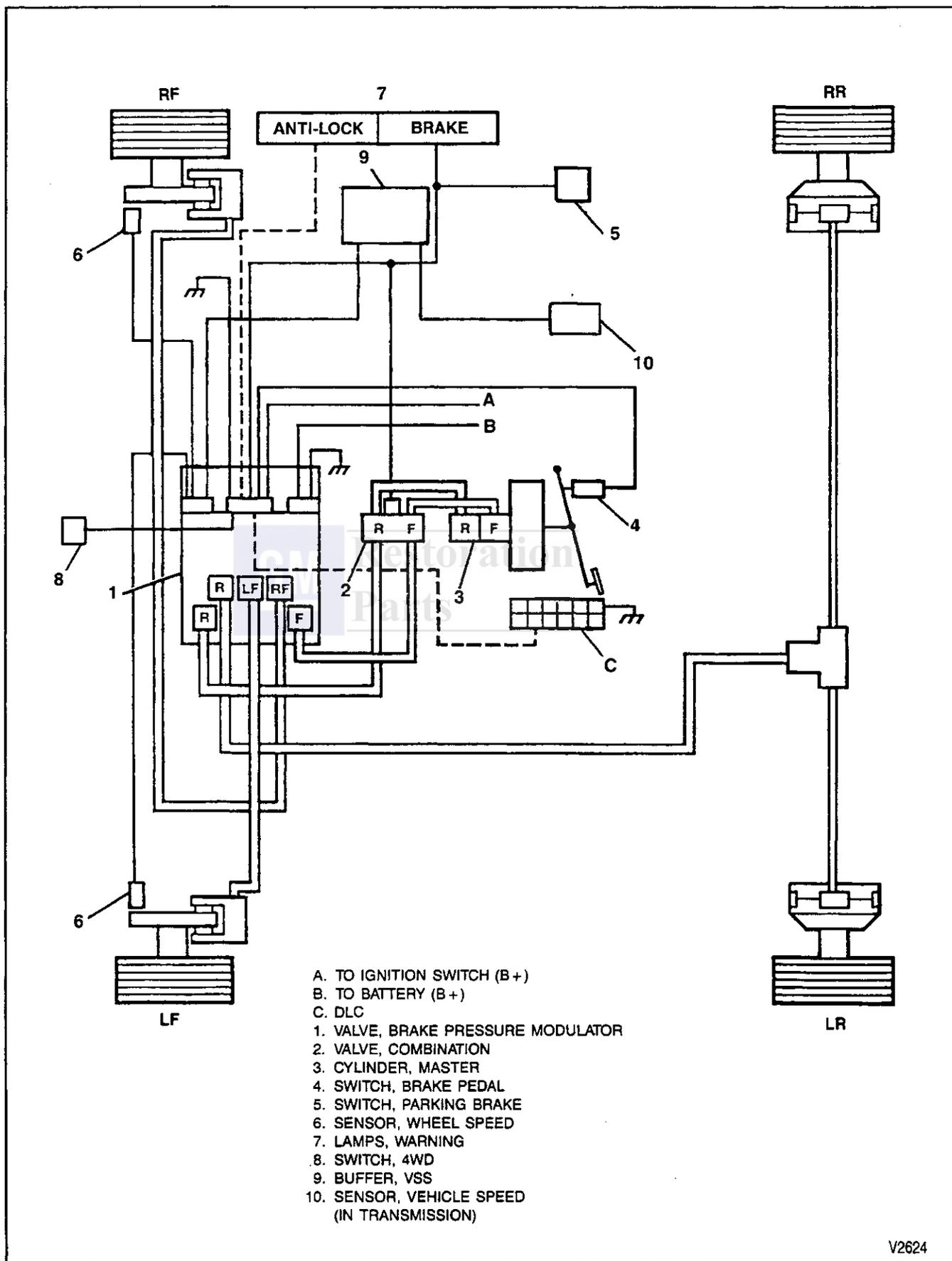


Figure 1—Four Wheel Antilock Brake System

5E1-4 FOUR WHEEL ANTILOCK BRAKE SYSTEM

Brake pedal pulsation and occasional tire "chirping" are normal during an antilock stop. The road surface and severity of the braking maneuver determine how much these will occur.

System Self-Test

The first time the vehicle speed reaches approximately 12.9 km/h (8 mph) after an ignition cycle, the BPMV performs a system self-test. It checks its internal and external circuit and performs a function test by cycling the pump motor, isolation solenoids, and PWM solenoids. During this self-test some noise may be heard from the area of the BPMV. This is normal during the self-test cycle. The BPMV then begins its normal operation if no malfunctions are detected.

TIRES AND 4WAL

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 (VSS) calibrator, must be replaced when the rear axle ratio or tire size is changed. For additional information, refer to SECTION 8C.

WARNING/INDICATOR LAMP OPERATION

The 4WAL system uses an "ANTILOCK" indicator lamp in the instrument panel to show system operation and malfunctions. Should a malfunction occur in the "ANTILOCK" lamp circuit, the "BRAKE" warning lamp serves as a back up.

Normal Lamp Operation

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

SYSTEM COMPONENTS

BRAKE PRESSURE MODULATOR VALVE

The brake pressure modulator valve (BPMV) is located on the left inner fender and regulates hydraulic pressure in the brake system during an antilock stop (figure 2).

The BPMV is split into three hydraulic channels; right front, left front, and rear brakes. Each channel has an isolation valve, pulse-width modulation (PWM) valve, and reset switch. The isolation valves maintain pressure and the PWM valves reduce or increase pressure to each front wheel separately and the rear wheels combined. These valves are controlled by a microprocessor in the BPMV. During a severe brake application, the

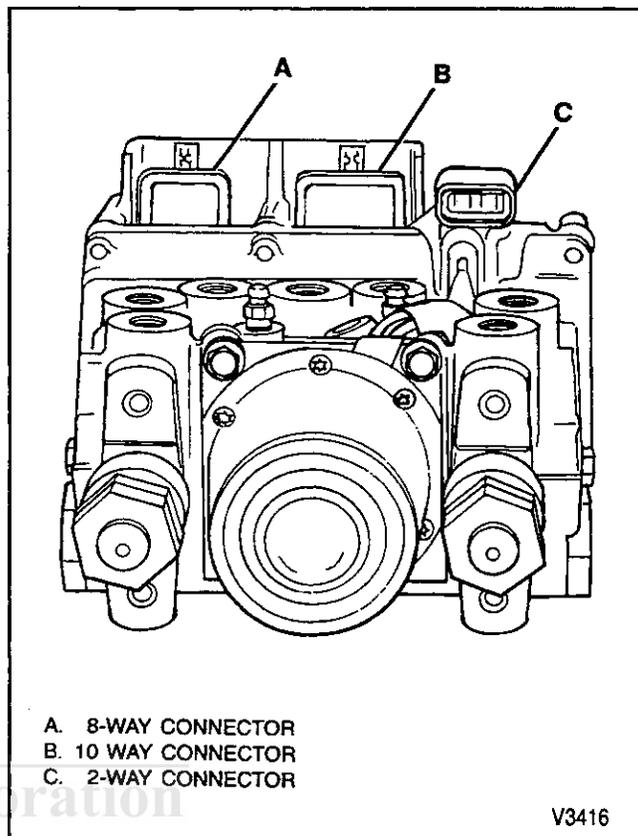


Figure 2—Brake Pressure Modulator Valve

BPMV operates the valves to do one of three functions or a combination of all three. The BPMV allows the valves to either maintain, reduce, or increase hydraulic pressure. The BPMV has low pressure and high pressure accumulators. The low pressure accumulators temporarily store the fluid relieved during the pressure decrease cycle. The high pressure accumulators store fluid under pressure from the pump for use during the pressure increase cycle. The high pressure accumulator fills when the module in the BPMV commands the pump to turn on during an antilock stop.

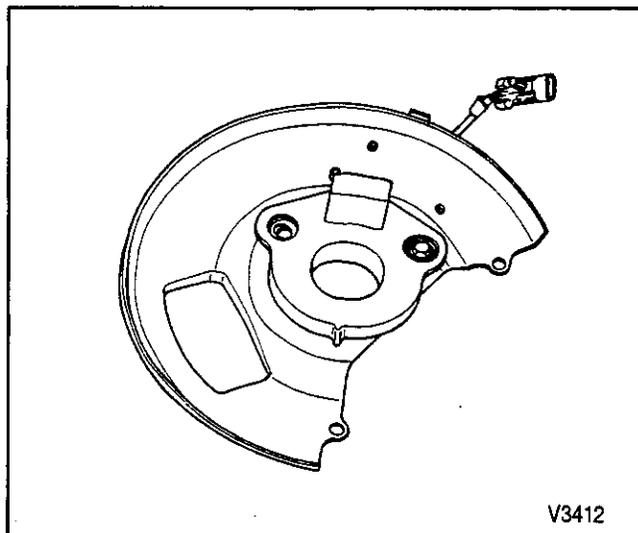


Figure 3—Front Wheel Speed Sensor (2WD)

FOUR WHEEL ANTILOCK BRAKE SYSTEM 5E1-5

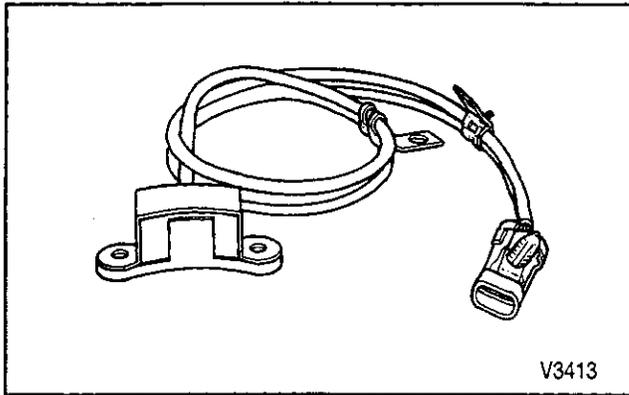


Figure 4—Front Wheel Speed Sensor (4WD)

FRONT WHEEL SPEED SENSOR

The front wheel speed sensor (WSS) is a magnetic/coil pickup that mounts to the front steering knuckle (figures 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 BPMV through the 8-pin connector. On 2WD models, the WSSs mount to the dust shields. On 4WD models, the WSSs are separate from the dust shield and are located on the inboard side of the steering knuckle.

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. The tone wheels are attached to the rotor on 2WD models and the front drive axle assembly on 4WD models.

VEHICLE SPEED SENSOR

The vehicle speed sensor (VSS) is located in the left rear of 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

The VSS sends its signal to the vehicle speed sensor (VSS) calibrator located behind the instrument panel storage compartment. The VSS calibrator changes the AC sine-wave signal from the VSS to a DC square-wave signal. If the axle ratio or tire size is changed, it will be necessary to replace the VSS calibrator. Refer to "Speedometer Calibration."

COMPONENT LOCATION VIEWS

For component location views, refer to figure 5.

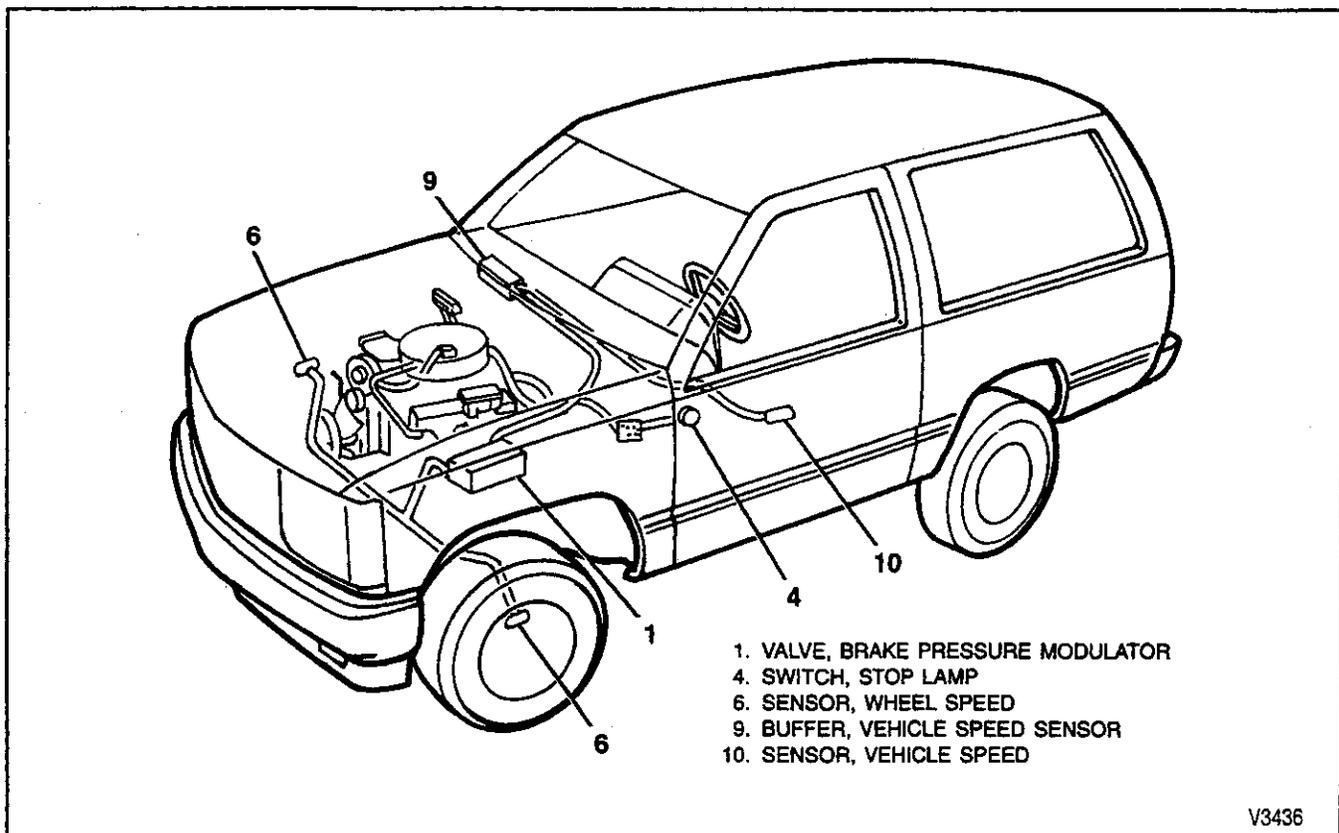


Figure 5—Component Location Views

5E1-6 FOUR WHEEL ANTILOCK BRAKE SYSTEM

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 the speed of approximately 12.9 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.

DISPLAYING DIAGNOSTIC TROUBLE CODES

Diagnostic trouble codes (DTCs) can be read with the Tech 1 scan tool or by jumping terminal "H" to terminal "A" of the data link connector (DLC) (figure 6) 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 similar to the malfunction indicator lamp for the fuel and emissions system.

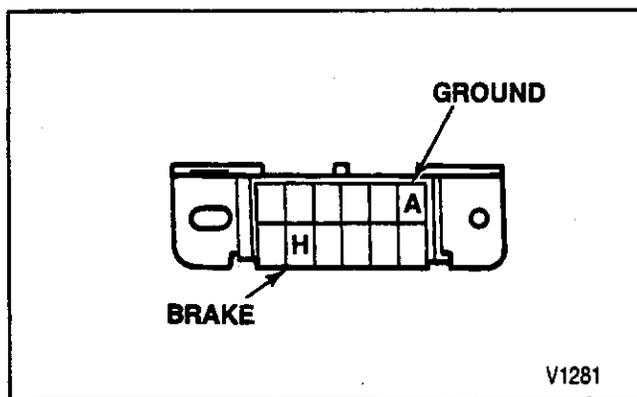


Figure 6—Data Link Connector

CLEARING DIAGNOSTIC TROUBLE CODES

If the "ANTILOCK" indicator lamp is staying on, the DTCs can be cleared with the Tech 1 scan tool or by doing 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 light 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.

TECH 1 DIAGNOSTICS



Important

- Refer to the Brake System Cartridge Operator's Manual or Mass Storage Cartridge Owner's Manual for additional information about the Tech 1 and the various mode uses.

The Tech 1 has five modes to assist in diagnosing 4WAL system malfunctions. After selecting 4WAL from the select system menu, the Tech 1 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 4WAL parameters. The Tech 1 displays data parameters in pairs. The display window tells you which parameters are being displayed and the value for them.

The Tech 1 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 Tech 1 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 Tech 1 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 is 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 Tech 1 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 Tech 1 starts collecting data. During this time, you can examine all of the data the same way you do in the Data List mode. The Tech 1 will display a "W" in the lower right-hand corner while it waits for the trigger condition to occur.
2. While the Tech 1 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 Tech 1 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 Tech 1 determines the specified DTC is set.
 - F2: Manual Trigger - The Tech 1 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 Tech 1 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 Tech 1 continues to save data samples until it's memory is full. The Tech 1 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 Tech 1 goes on to the Data Display phase.
 5. Pressing EXIT terminates 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 preceding 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 Tech 1 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 Tech 1 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.

5E1-8 FOUR WHEEL ANTILOCK BRAKE SYSTEM

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 Tech 1 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

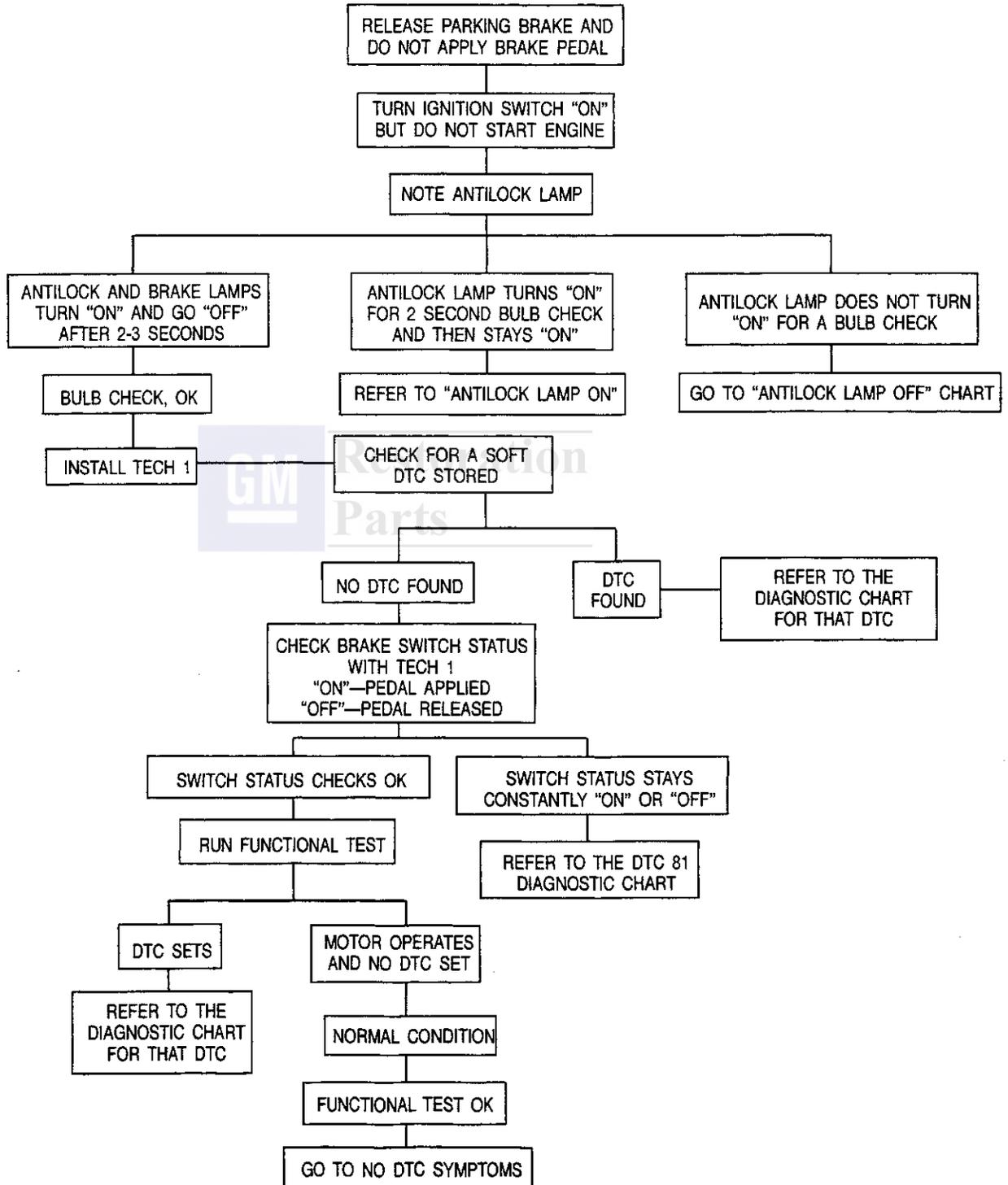
1. Select TIRE SIZE CAL by pressing F3.
2. Use the arrow keys to scroll the available tire size options.
3. The arrow symbol indicates the current selected size.
4. After you select the correct size, press the ENTER key to program the new tire size calibration.

DIAGNOSTIC CHARTS

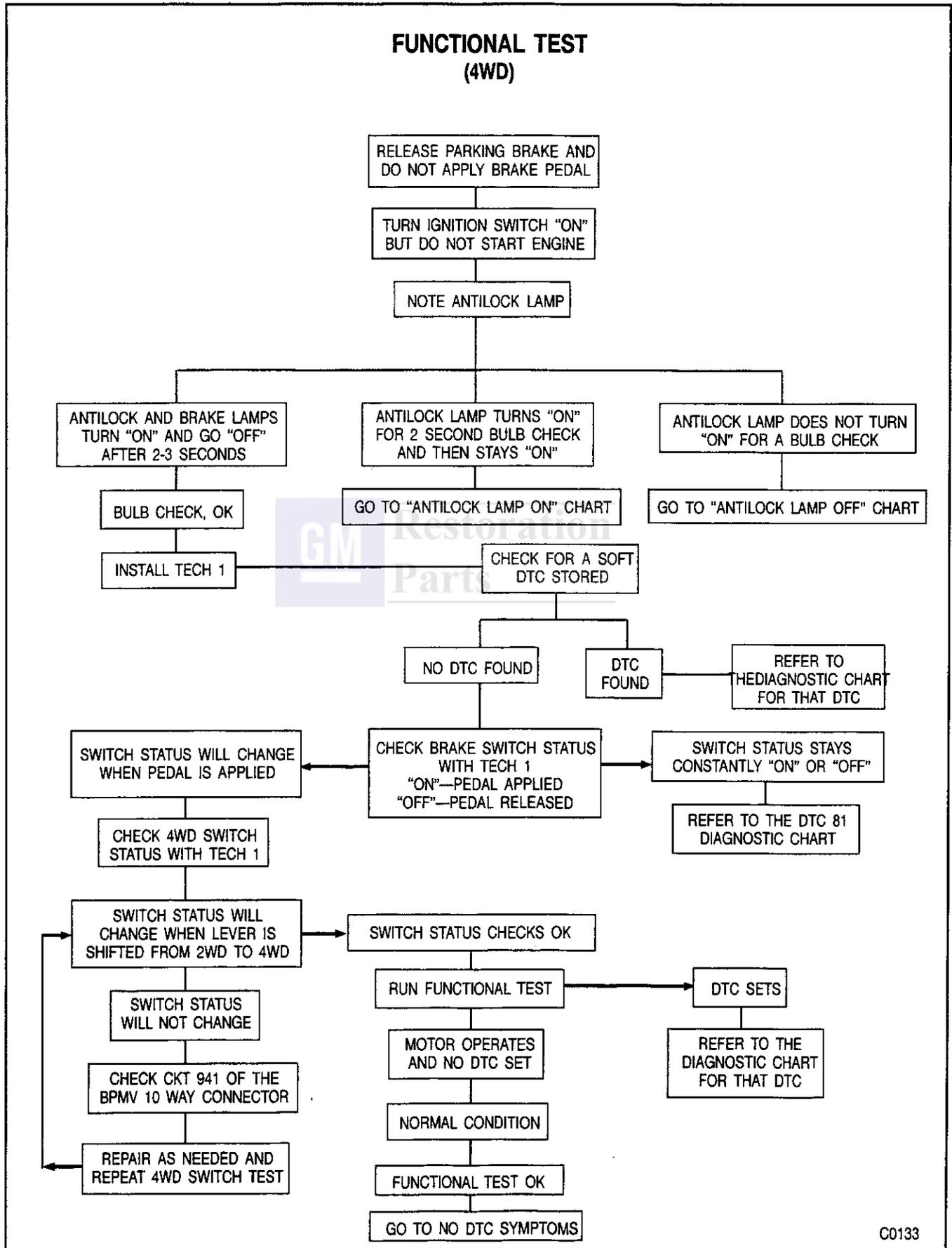
Refer to the Functional Test as a starting point for all diagnosis. Failure to perform the Functional Test may result in extended diagnostic time, incorrect diagnosis, and incorrect parts replacement. Refer to figures 7 and 8 for the wiring diagram and connector face views. Charts for symptom diagnosis follow.

FOUR WHEEL ANTILOCK BRAKE SYSTEM 5E1-9

FUNCTIONAL TEST (2WD AND AWD)



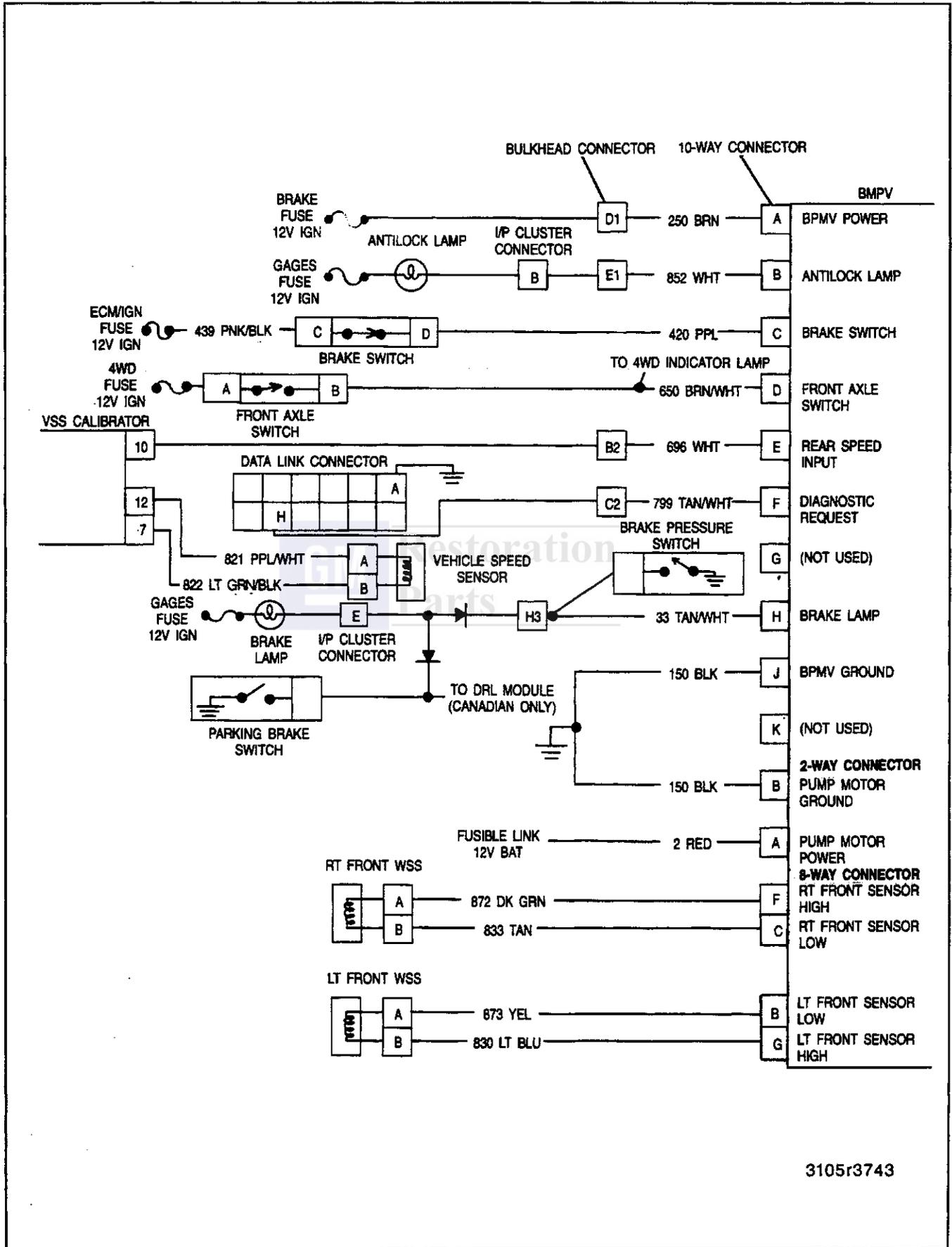
5E1-10 FOUR WHEEL ANTILOCK BRAKE SYSTEM



FOUR WHEEL ANTILOCK BRAKE SYSTEM 5E1-11

DIAGNOSTIC TROUBLE CODE AND SYMPTOM TABLE		
Diagnostic Trouble Code	Description/Symptom	Page #
—	Antilock Lamp "ON"	5E1-14
—	Antilock Lamp "OFF"	5E1-15
—	Brake Pedal Pulses	5E1-16
—	Wheel Pull During Hard Braking	5E1-17
21	Right Front Wheel Speed Sensor or Circuit Open	5E1-18
22	Missing Right Front Speed Signal	5E1-20
23	Erratic Right Front Wheel Speed Sensor	5E1-22
25	Left Front Wheel Speed Sensor or Circuit Open	5E1-24
26	Missing Left Front Speed Signal	5E1-26
27	Erratic Left Front Wheel Speed Sensor	5E1-28
29	Simultaneous Drop-Out of Front Wheel Speed Sensors	5E1-30
35	Open or Grounded Rear Speed Signal Circuit	5E1-32
36	Missing Rear Speed Signal	5E1-34
37	Erratic Rear Speed Signal	5E1-36
38	Wheel Speed Error	5E1-38
41-54	Control Valves	5E1-40
65-66	Open or Shorted Pump Motor Relay	5E1-42
67	Open Motor Circuit or Shorted BPMV Output	5E1-44
68	Locked Motor or Shorted Motor Circuit	5E1-44
71-74	Memory Errors	5E1-46
81	Brake Switch Circuit Shorted or Open	5E1-48
86	Shorted Antilock Indicator Lamp	5E1-50
88	Shorted Brake Warning Lamp	5E1-50

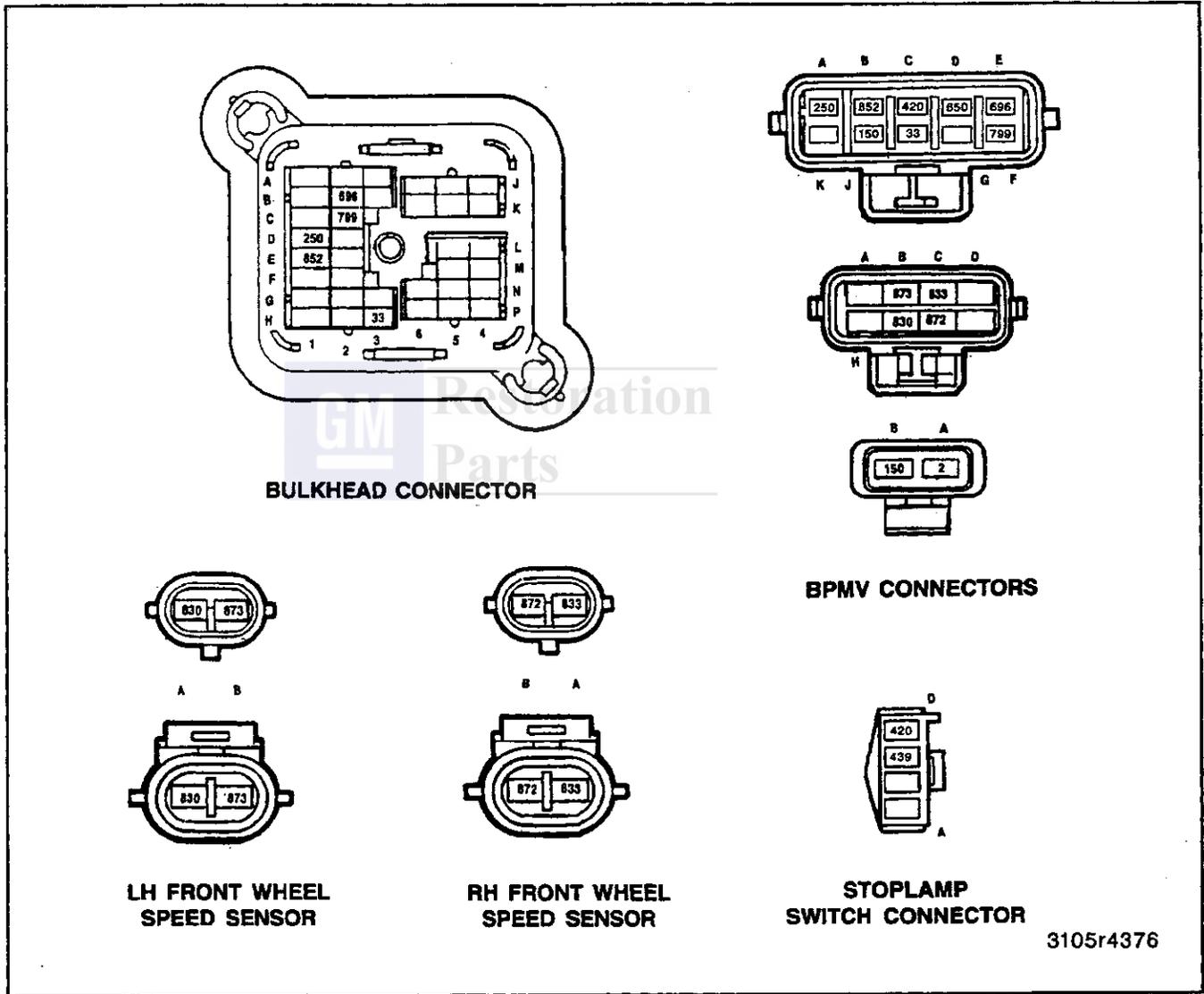
5E1-12 FOUR WHEEL ANTILOCK BRAKE SYSTEM



3105r3743

Figure 7—4WAL Wiring Diagram

FOUR WHEEL ANTILOCK BRAKE SYSTEM 5E1-13



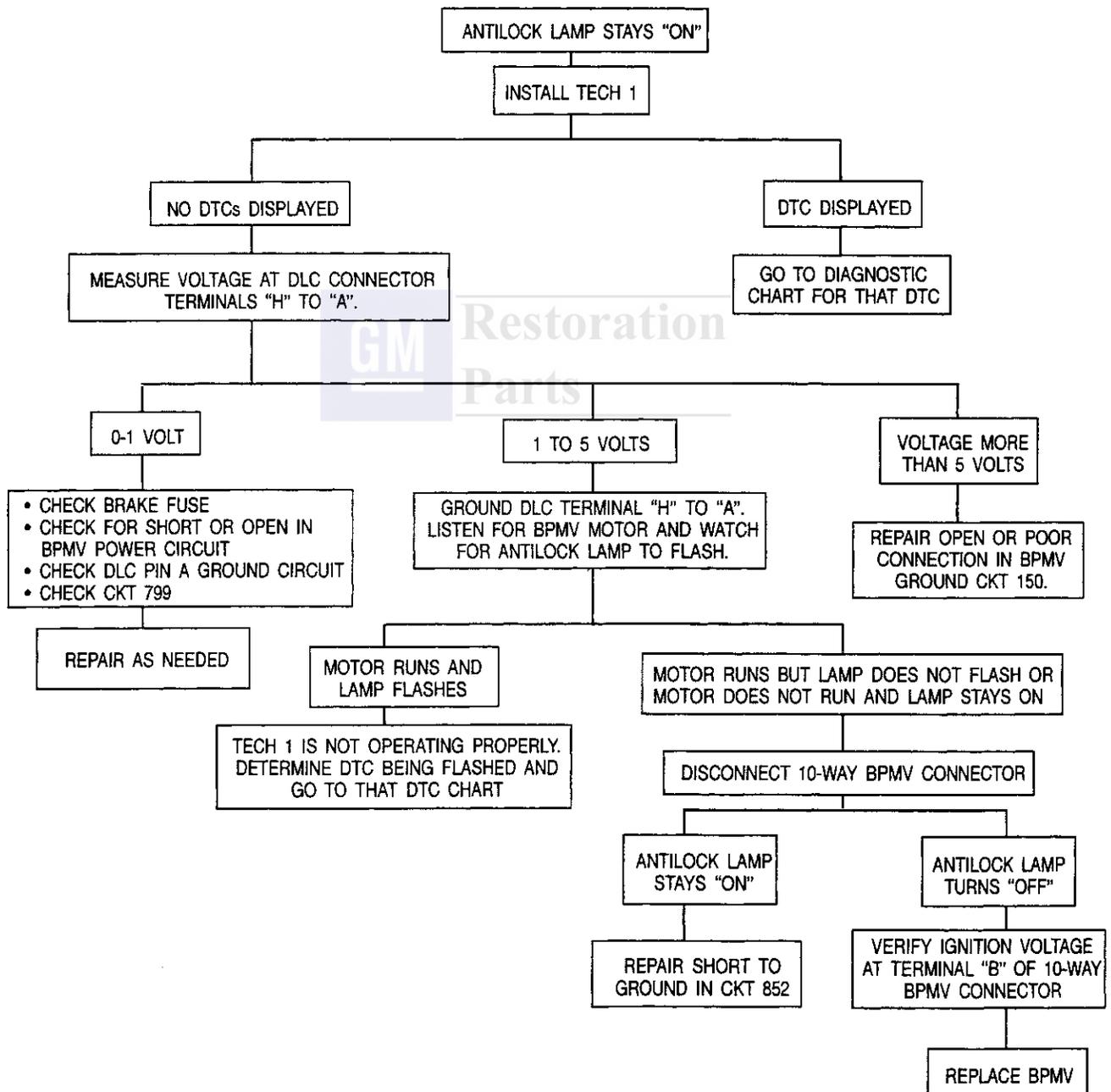
3105r4376

Figure 8—4WAL Connector Face Views

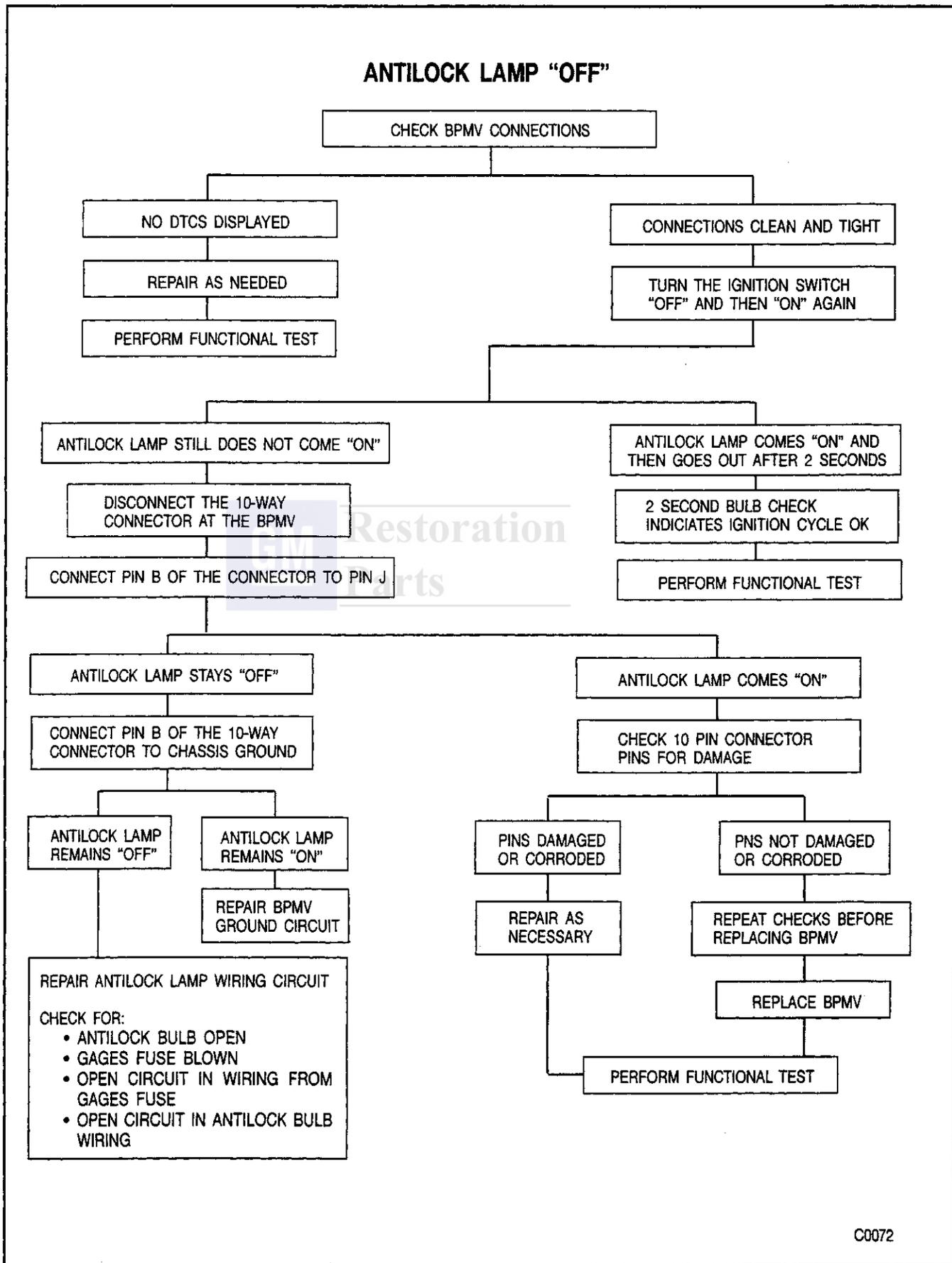
5E1-14 FOUR WHEEL ANTILOCK BRAKE SYSTEM

ANTILOCK LAMP "ON"

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.

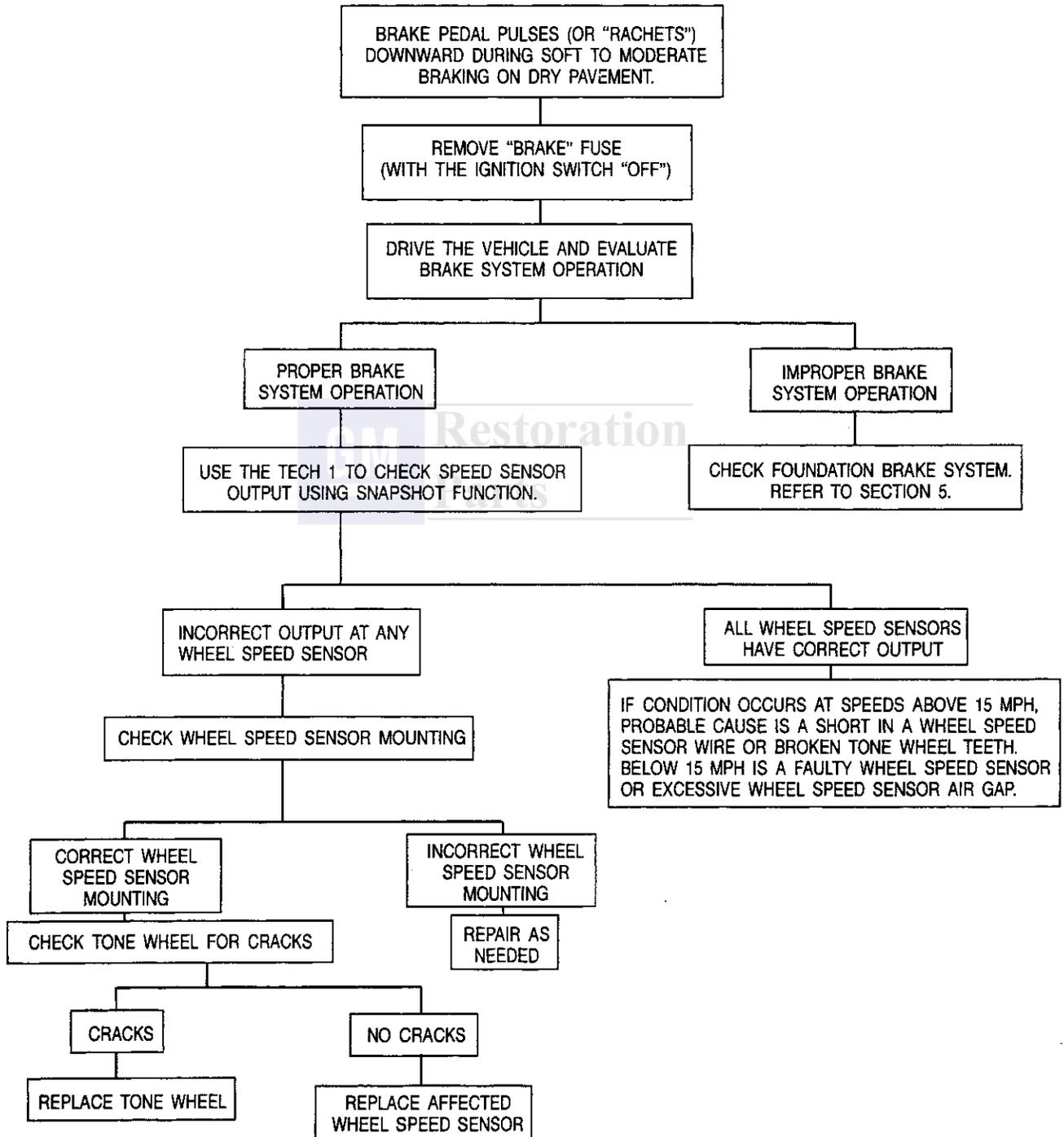


FOUR WHEEL ANTILOCK BRAKE SYSTEM 5E1-15



5E1-16 FOUR WHEEL ANTILOCK BRAKE SYSTEM

BRAKE PEDAL PULSES (NO DTC CONDITION)



FOUR WHEEL ANTILOCK BRAKE SYSTEM 5E1-17

WHEEL PULL DURING HARD BRAKING (NO DTC CONDITION)

WHEEL PULL DURING HARD BRAKING (WHEEL LOCK CAUSES ANTILOCK CONTROL ACTION). DOES NOT OCCUR DURING SOFT TO MODERATE BRAKING ON DRY PAVEMENT.

IGNITION SWITCH "OFF"

REMOVE "BRAKE" FUSE AND ROAD TEST

CONDITION STOPS

CHECK FOR LOW WHEEL SPEED
SENSOR DROP OUT WITH TECH 1

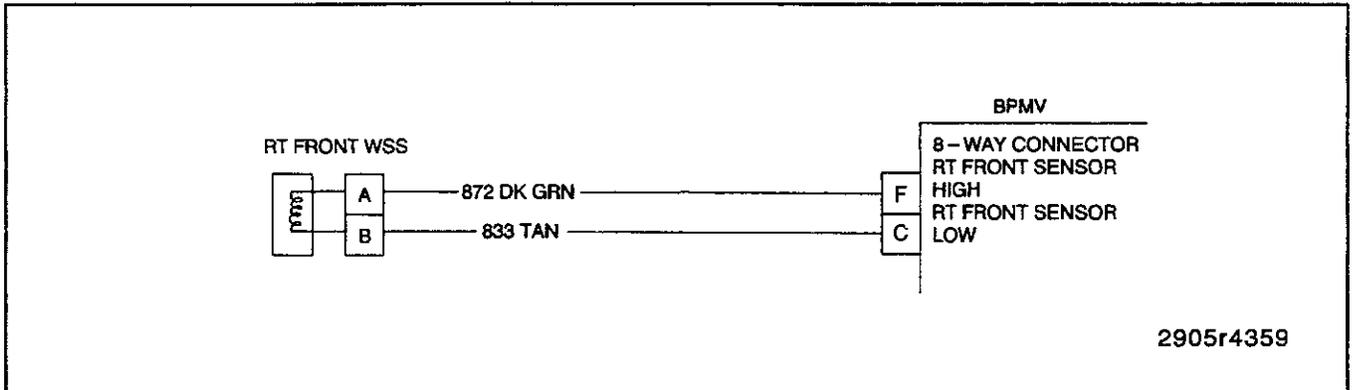
REFER TO DIAGNOSTIC CHART FOR
AFFECTED WHEEL SPEED SENSOR

CONDITION STILL OCCURS

REPAIR FOUNDATION BRAKES.
REFER TO SECTION 5.

C0089

5E1-18 FOUR WHEEL ANTILOCK BRAKE SYSTEM



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 8-way connector pins C and F for looseness, corrosion, etc.
- Measure the resistance of BPMV 8-way connector pins C and F.

- Measure resistance at the right front WSS connector.
- Check right front WSS output using the Tech 1.
- 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.

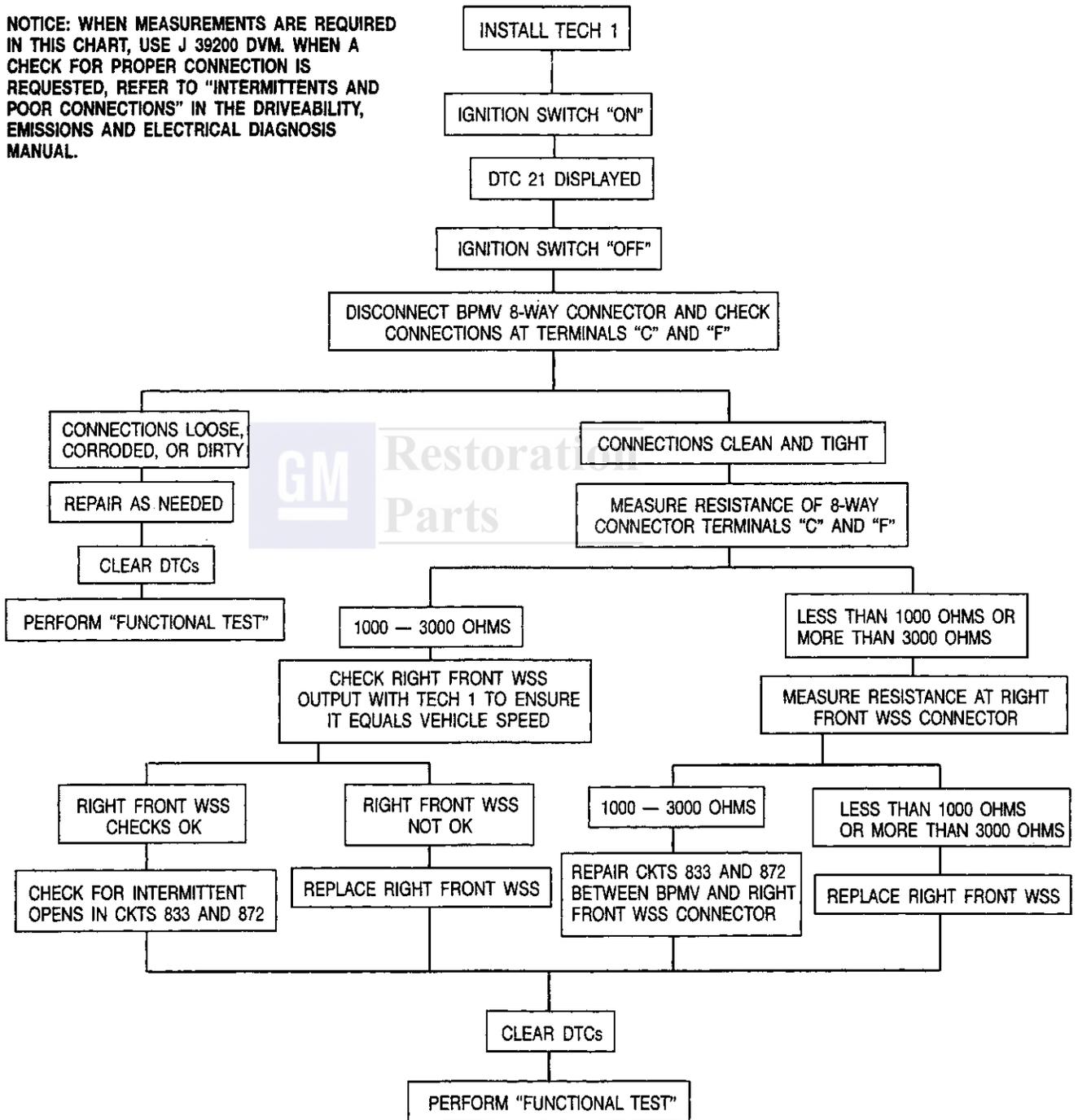
Do not pierce the electrical connectors, wires, seals, or insulation during testing. Doing so will break the seal and lead to corrosion and failure of the wiring and terminals.

FOUR WHEEL ANTILOCK BRAKE SYSTEM 5E1-19

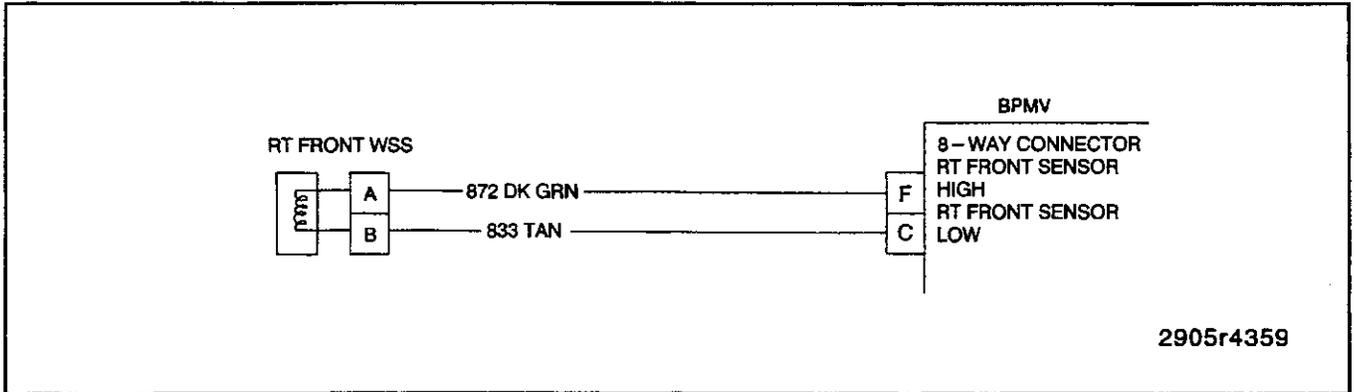
DTC 21

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.



5E1-20 FOUR WHEEL ANTILOCK BRAKE SYSTEM



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 Tech 1.
- Check BPMV 8-way connector pins C and F for looseness, corrosion, etc.

- Measure the resistance of BPMV 8-way connector pins C and F.
- 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.

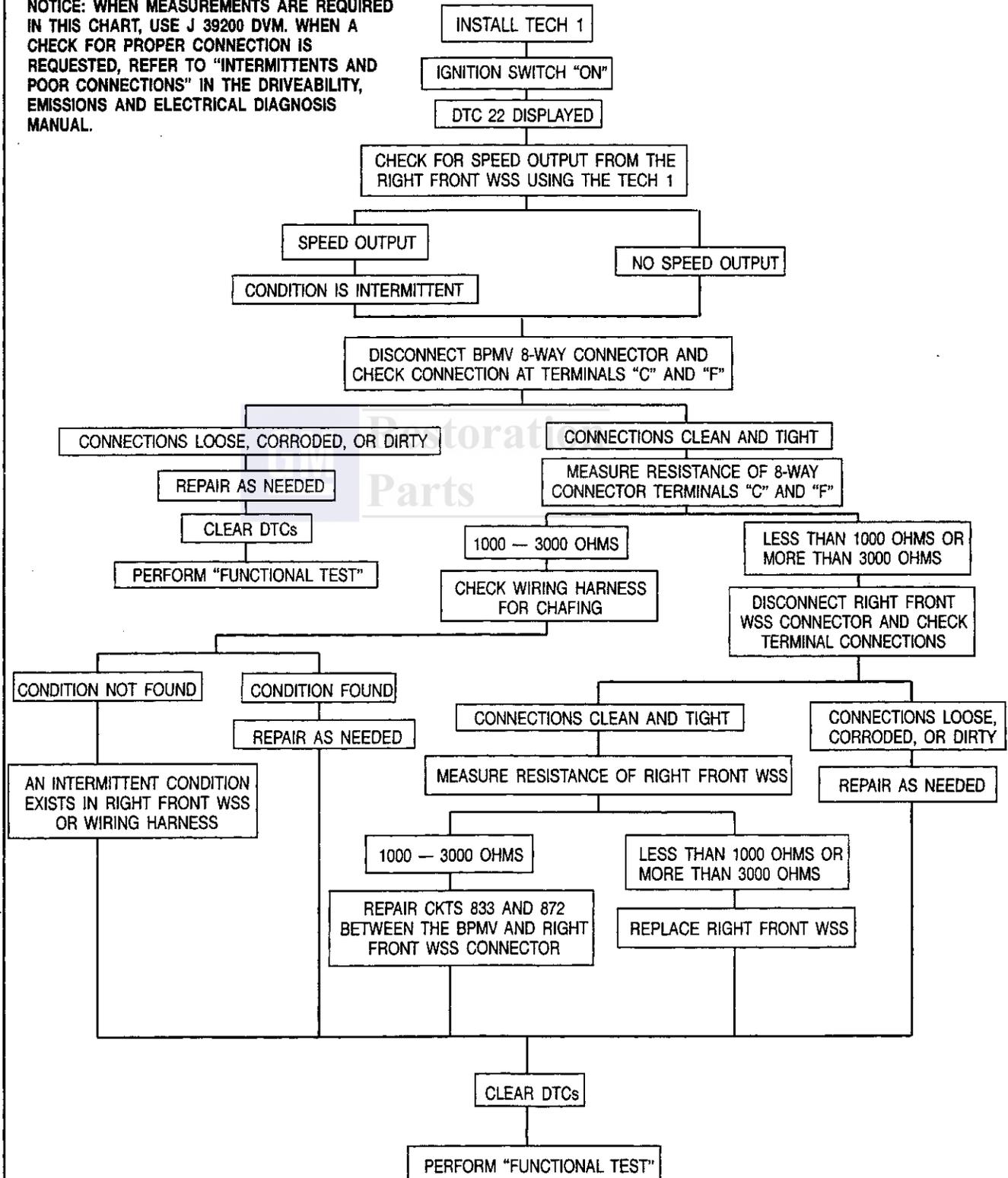
Do not pierce the electrical connectors, wires, seals, or insulation during testing. Doing so will break the seal and lead to corrosion and failure of the wiring and terminals.

FOUR WHEEL ANTILOCK BRAKE SYSTEM 5E1-21

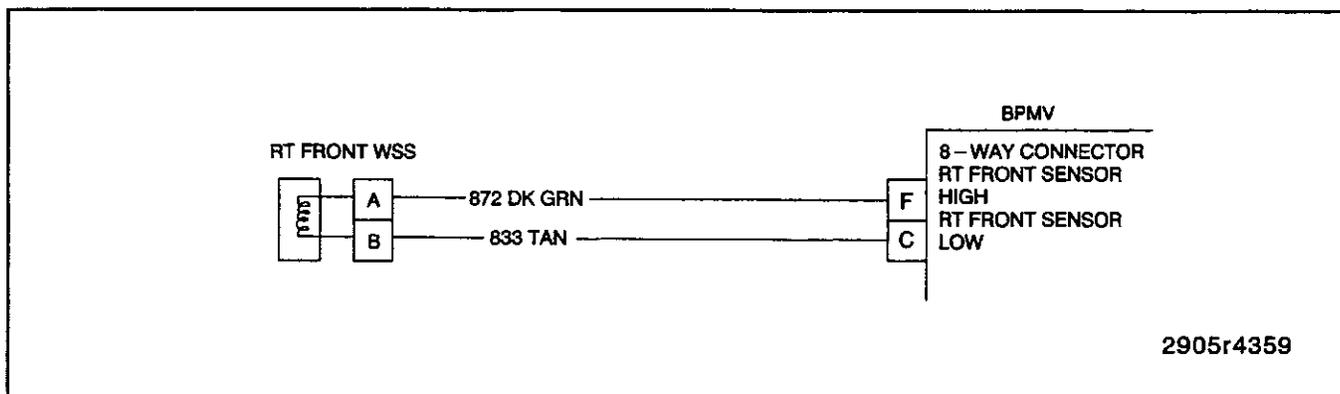
DTC 22

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.



5E1-22 FOUR WHEEL ANTILOCK BRAKE SYSTEM



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 8-way connector pins C and F for looseness, corrosion, etc.
- Measure the resistance of BPMV 8-way connector pins C and F.

- 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.

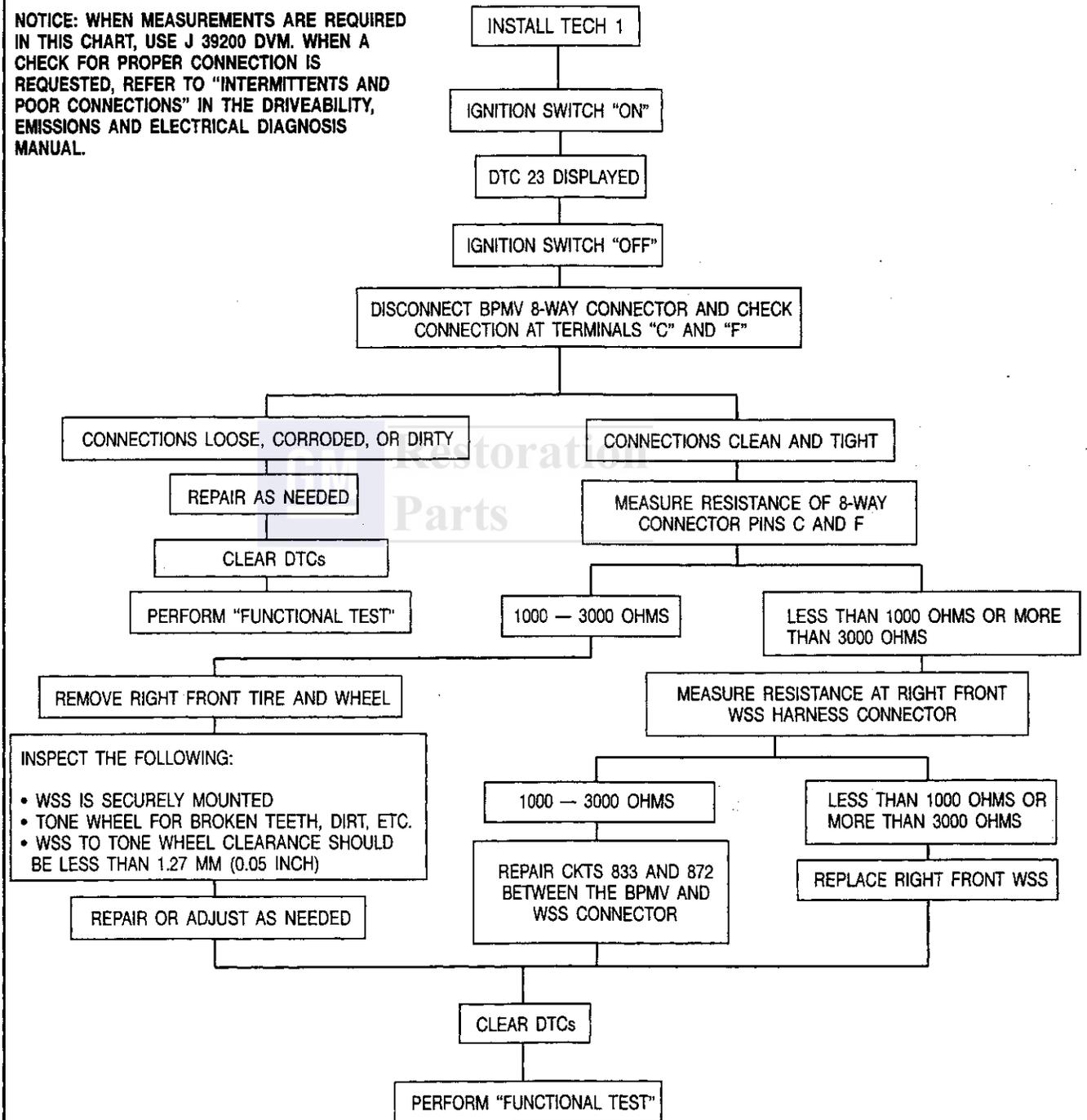
This DTC can only be set by a malfunction in the right front WSS and circuit.

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.

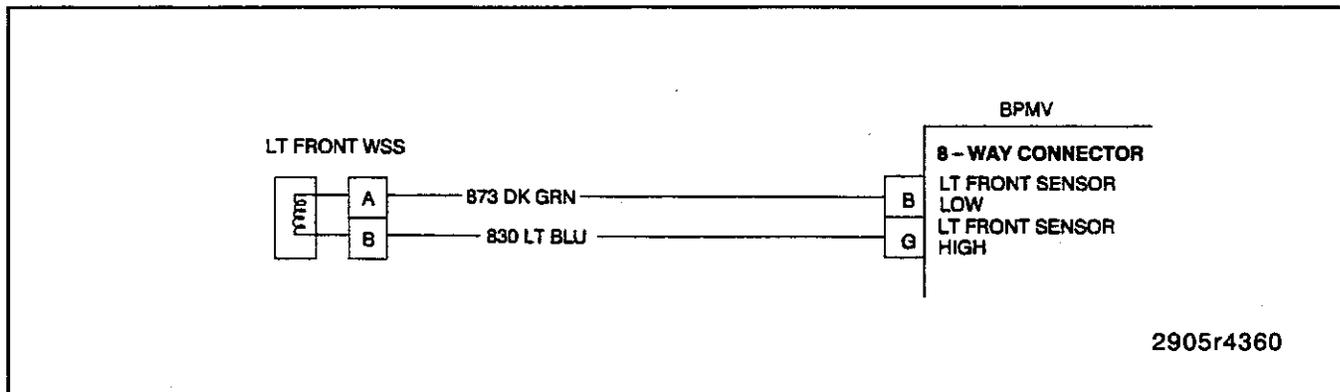
FOUR WHEEL ANTILOCK BRAKE SYSTEM 5E1-23

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.



5E1-24 FOUR WHEEL ANTILOCK BRAKE SYSTEM



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 8-way connector pins B and G for looseness, corrosion, etc.

- Measure the resistance of BPMV 8-way connector pins B and G.
- Measure resistance at the left front WSS connector.
- Check right front WSS output using the Tech 1.
- 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.

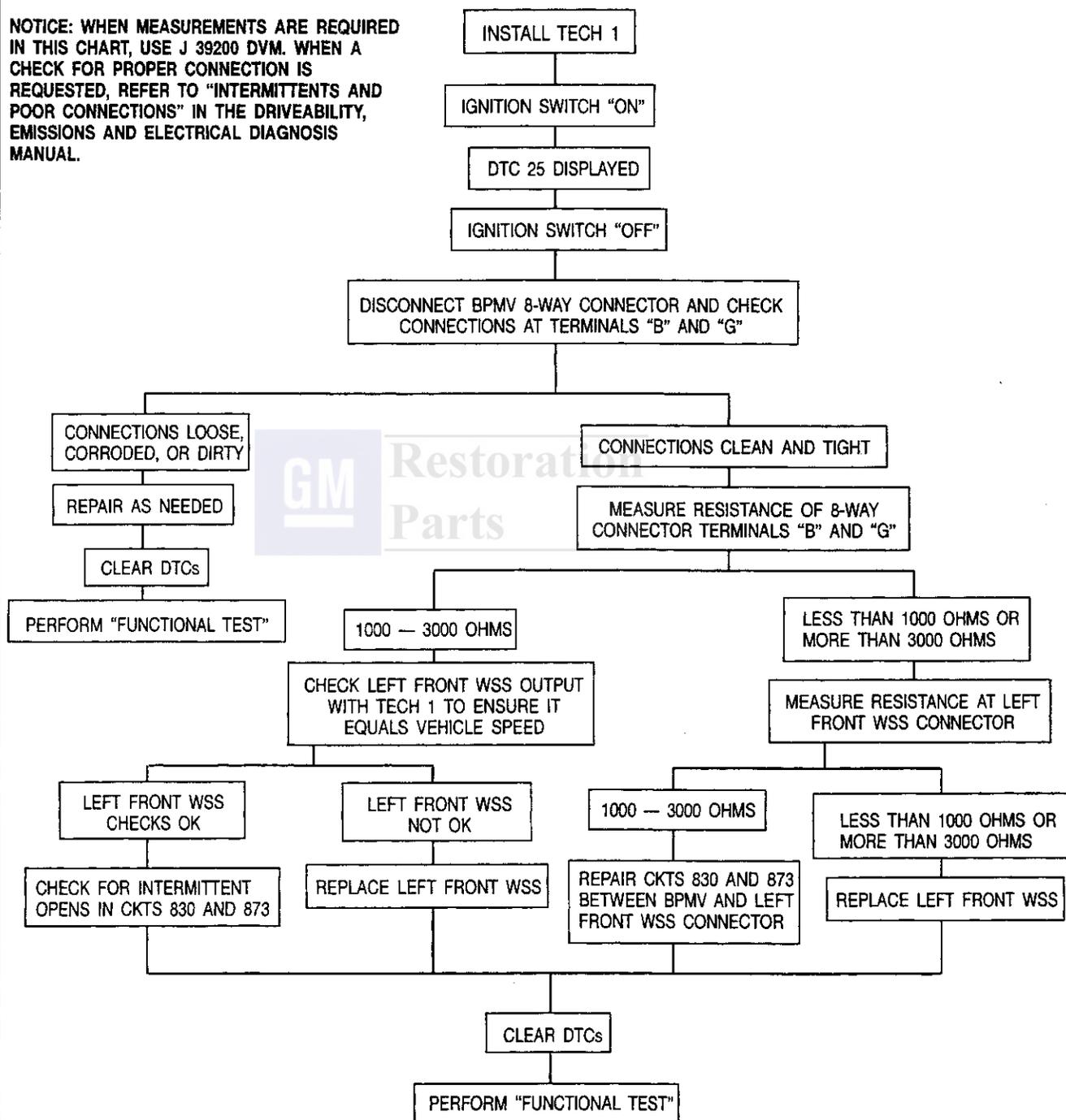
Do not pierce the electrical connectors, wires, seals, or insulation during testing. Doing so will break the seal and lead to corrosion and failure of the wiring and terminals.

FOUR WHEEL ANTILOCK BRAKE SYSTEM 5E1-25

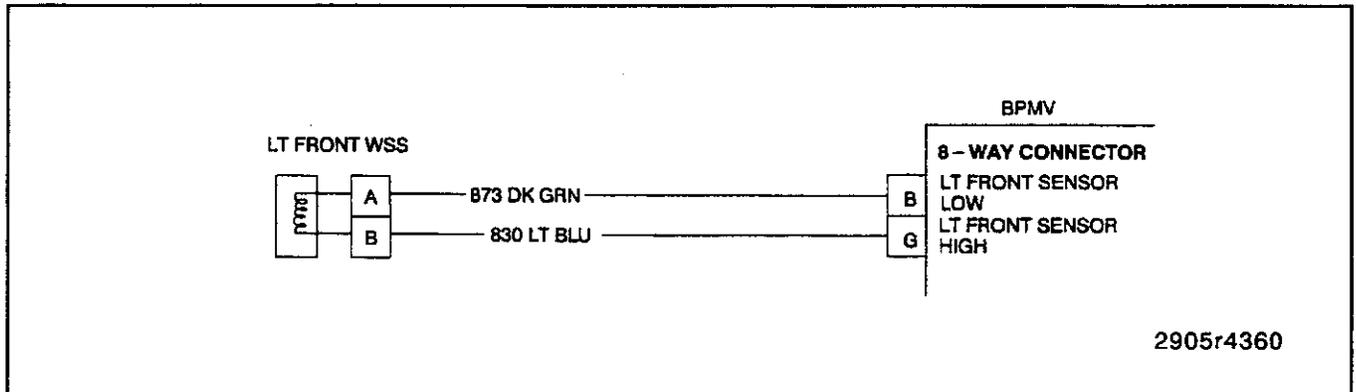
DTC 25

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.



5E1-26 FOUR WHEEL ANTILOCK BRAKE SYSTEM



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 Tech 1.
- Check BPMV 8-way connector pins B and G for looseness, corrosion, etc.

- Measure the resistance of BPMV 8-way connector pins B and G.
- 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.

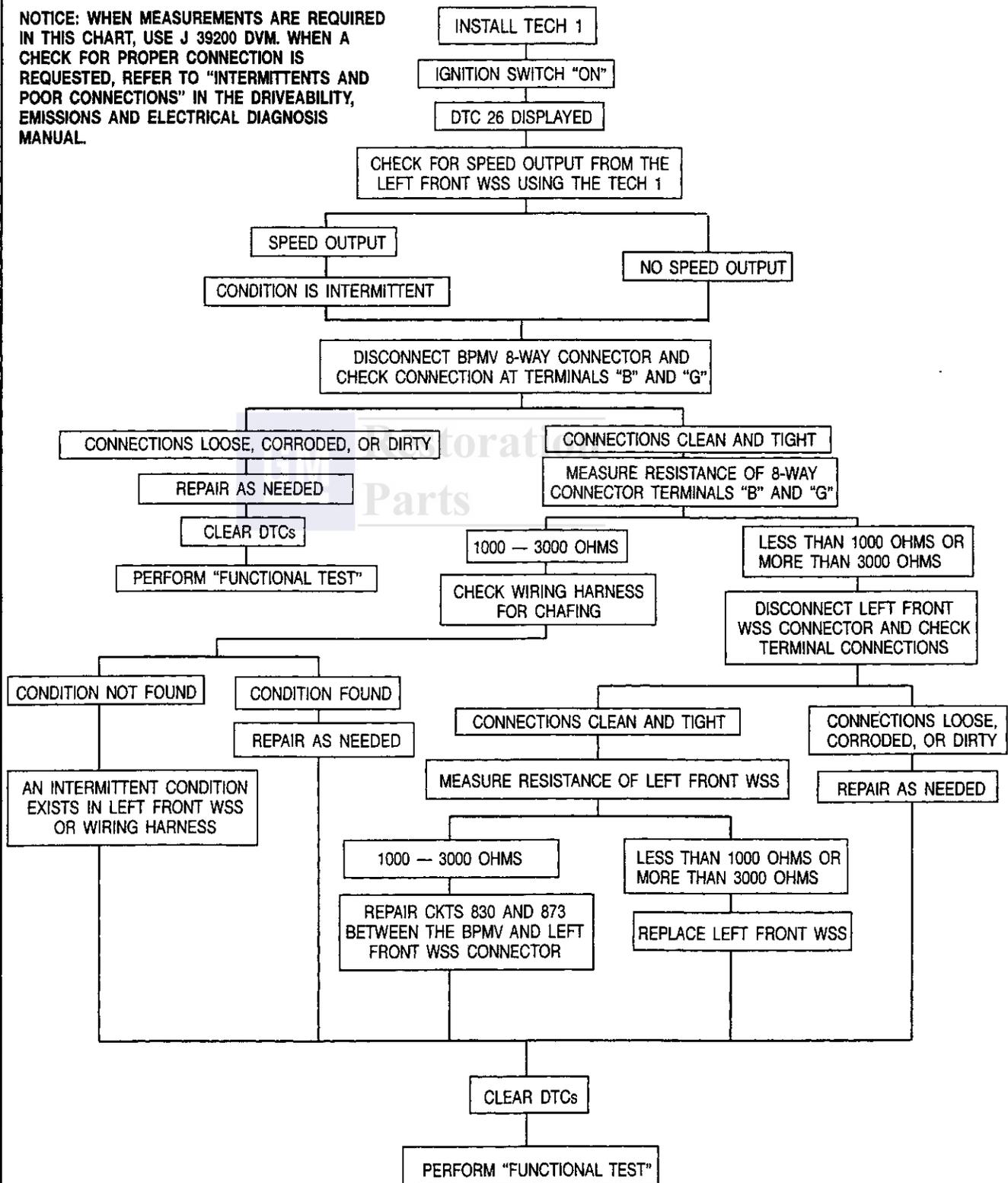
Do not pierce the electrical connectors, wires, seals, or insulation during testing. Doing so will break the seal and lead to corrosion and failure of the wiring and terminals.

FOUR WHEEL ANTILOCK BRAKE SYSTEM 5E1-27

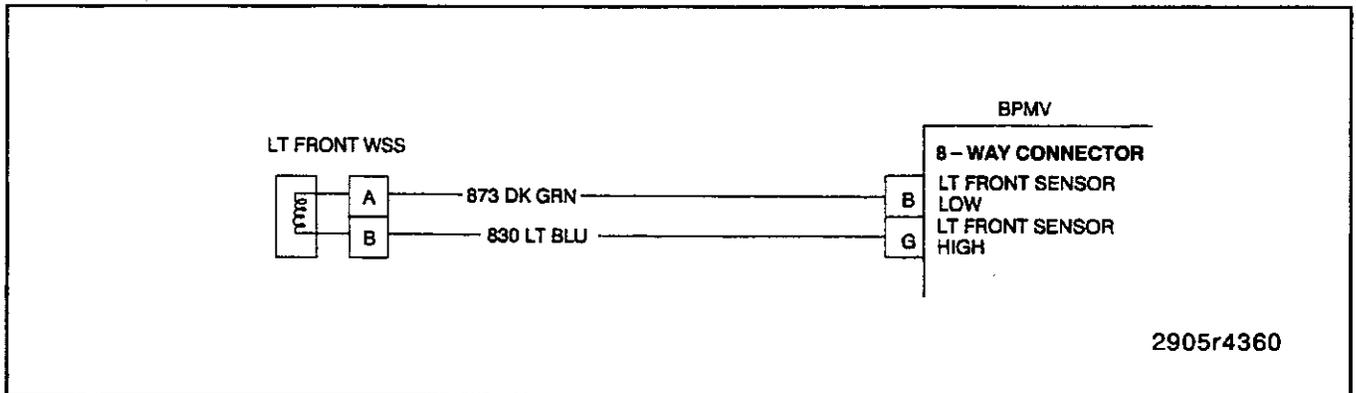
DTC 26

MISSING LEFT 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.



5E1-28 FOUR WHEEL ANTILOCK BRAKE SYSTEM



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 8-way connector pins B and G for looseness, corrosion, etc.

- Measure the resistance of BPMV 8-way connector pins B and G.
- 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:

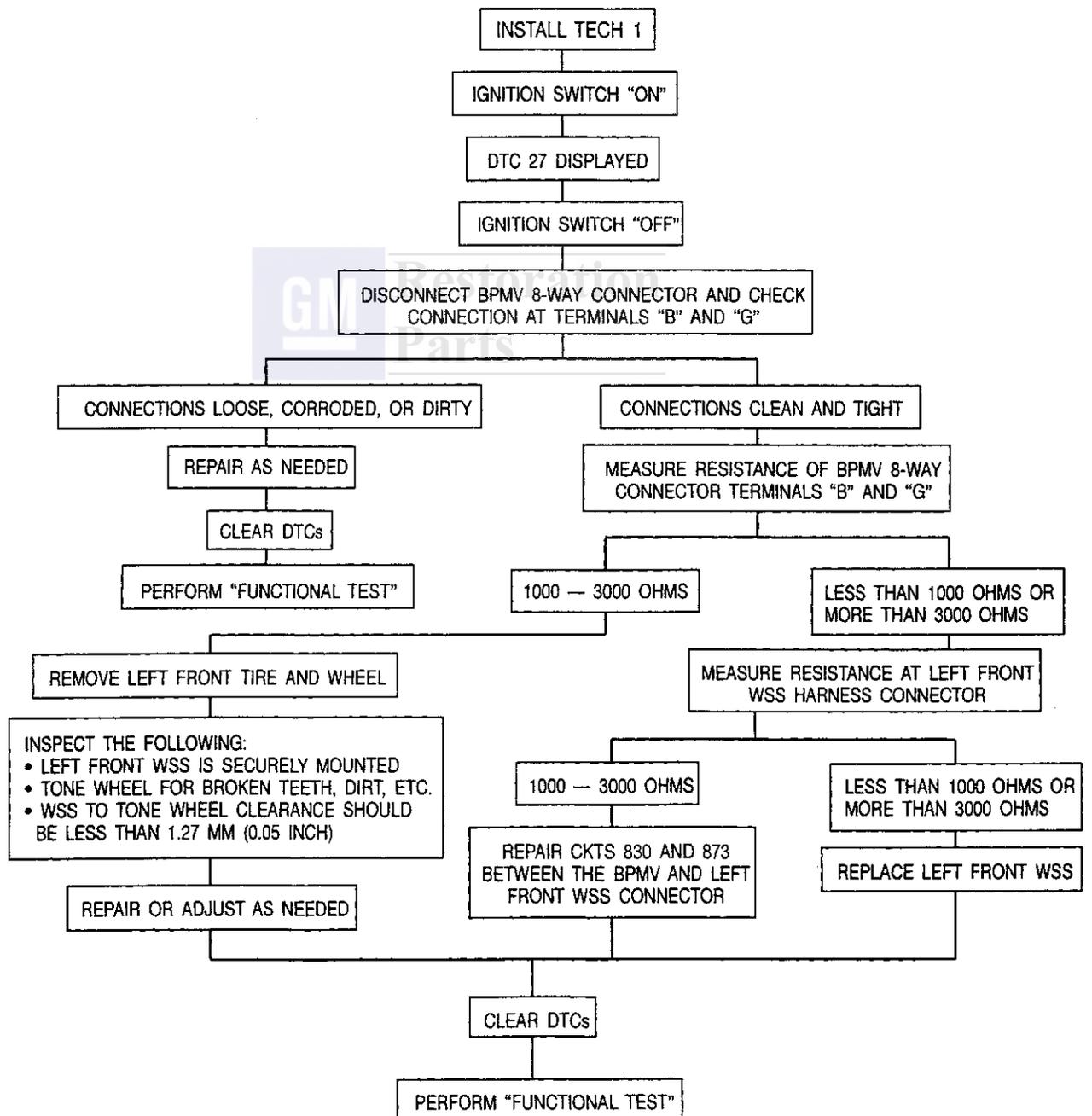
Do not rotate the wheel while measuring WSS resistance.

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

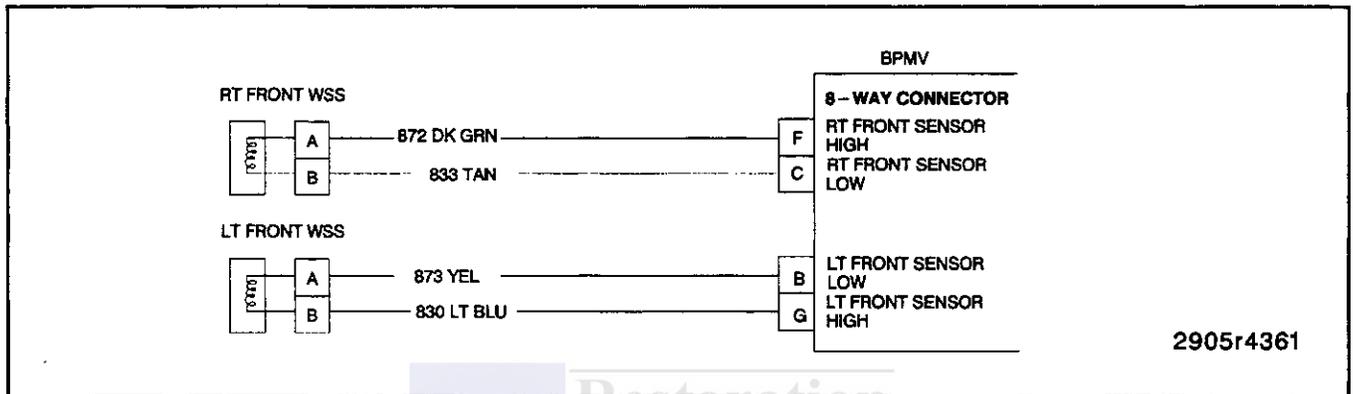
Do not pierce the electrical connectors, wires, seals, or insulation during testing. Doing so will break the seal and lead to corrosion and failure of the wiring and terminals.

**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.



5E1-30 FOUR WHEEL ANTILOCK BRAKE SYSTEM



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 8-way harness connector or the BPMV are the most probable causes for this DTC.

TEST DESCRIPTION:

- Check the condition of the BPMV 8-way connector and harness.
- Check all front WSS resistance values.

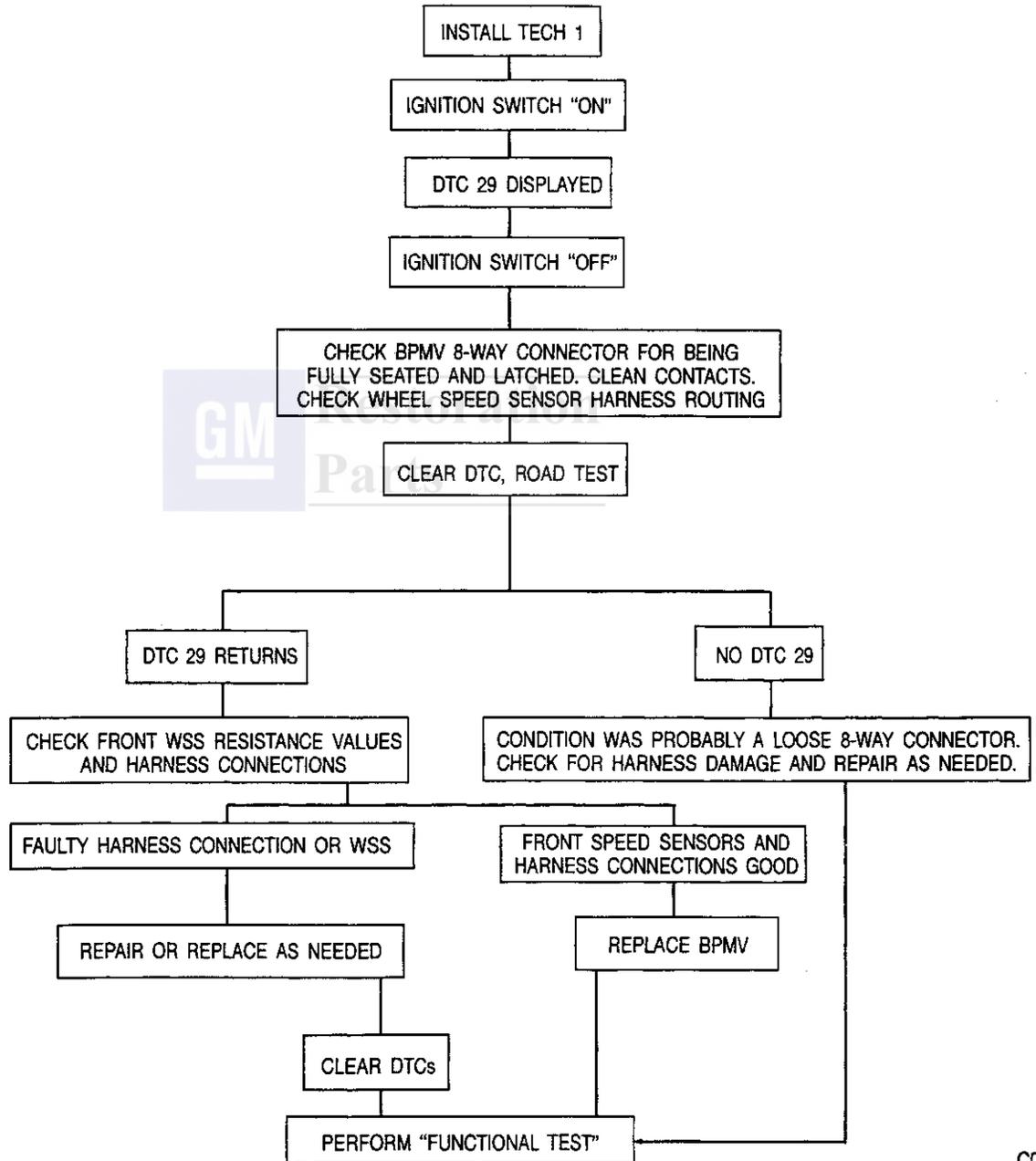
DIAGNOSTIC AIDS:

Do not rotate the wheel while measuring WSS resistance.

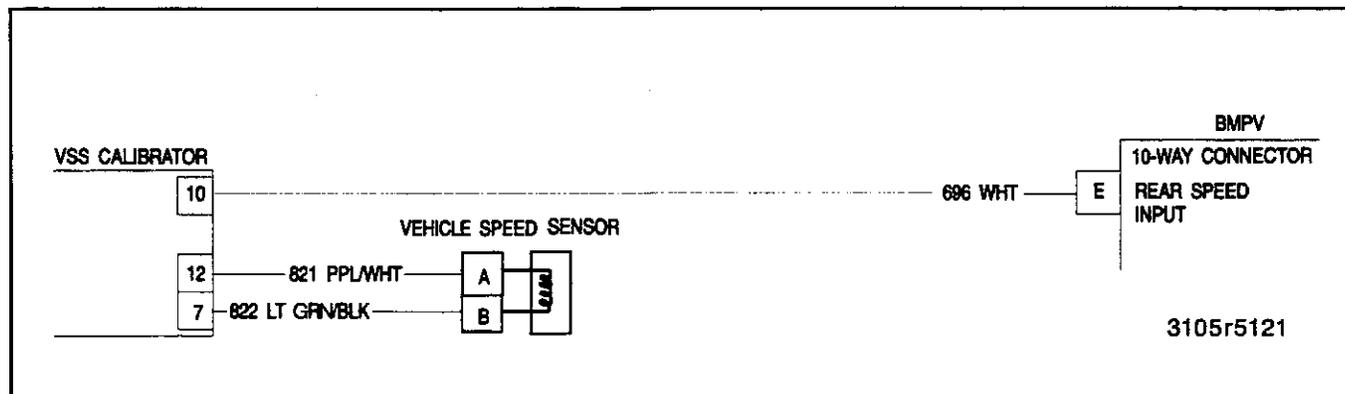
Do not pierce the electrical connectors, wires, seals, or insulation during testing. Doing so will break the seal and lead to corrosion and failure of the wiring and terminals.

FOUR WHEEL ANTILOCK BRAKE SYSTEM 5E1-31

DTC 29 SIMULTANEOUS DROP-OUT OF FRONT WHEEL SPEED SENSORS



5E1-32 FOUR WHEEL ANTILOCK BRAKE SYSTEM



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. A faulty VSS calibrator 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.

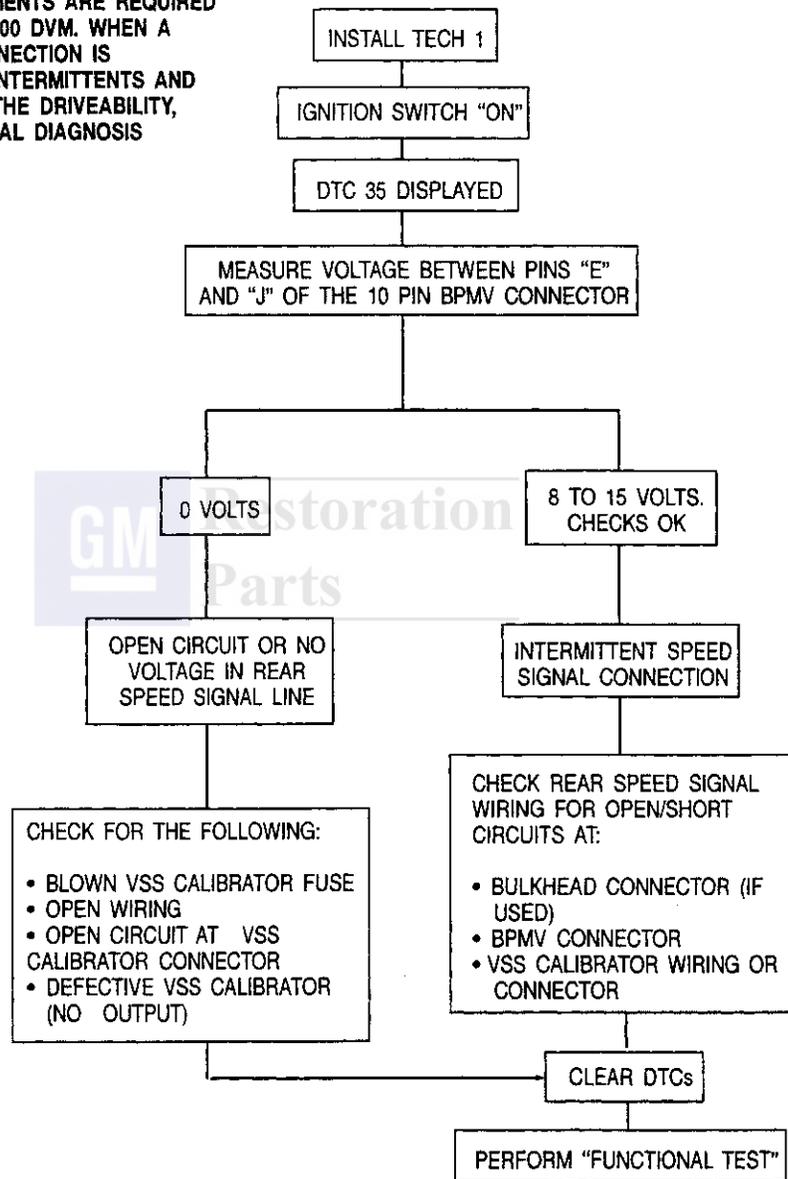
DIAGNOSTIC AIDS:

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.

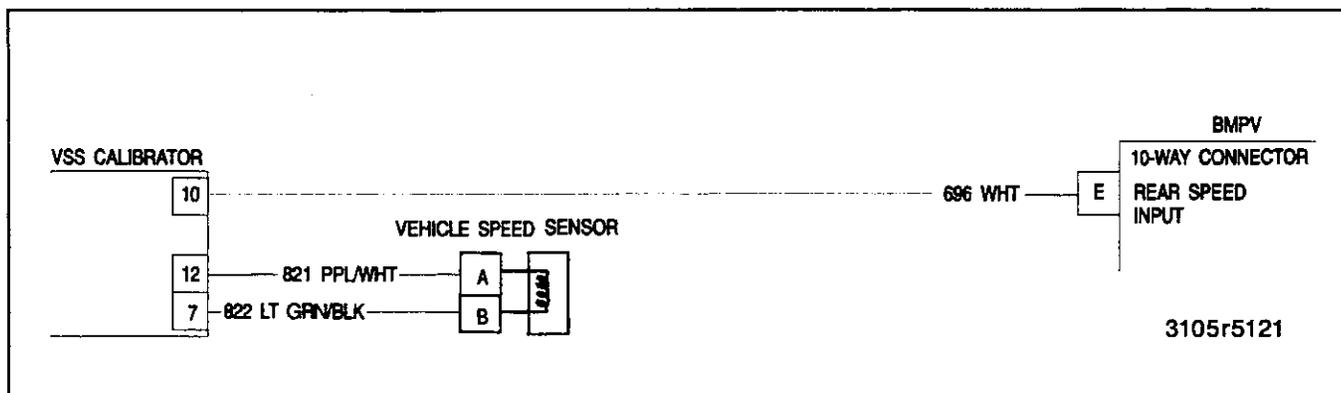
Do not pierce the electrical connectors, wires, seals, or insulation during testing. Doing so will break the seal and lead to corrosion and failure of the wiring and terminals.

**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.



5E1-34 FOUR WHEEL ANTILOCK BRAKE SYSTEM



DIAGNOSTIC TROUBLE CODE 36 MISSING REAR SPEED SIGNAL

CIRCUIT DESCRIPTION:

A DTC 36 relates to the BPMV losing the VSS calibrator 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, 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.

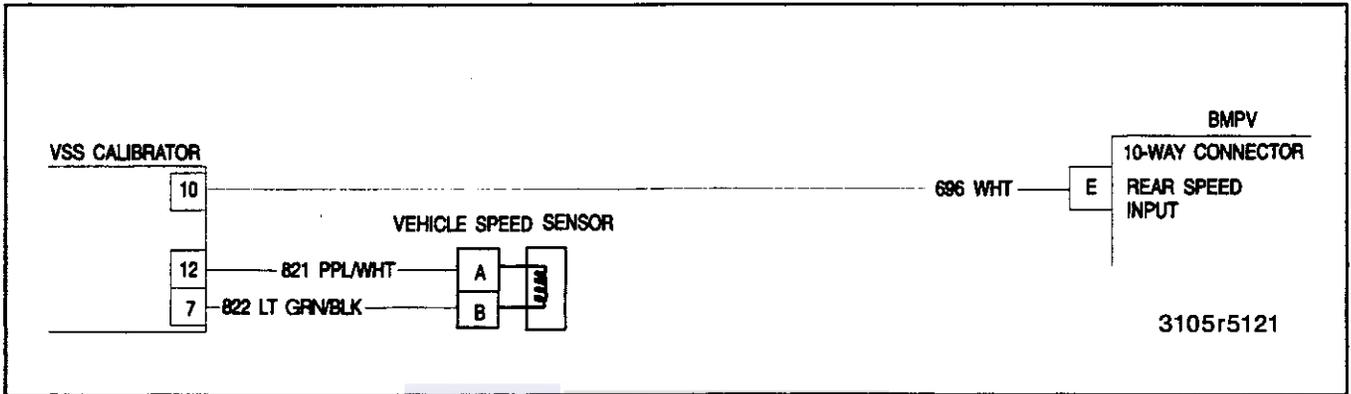
- Check the voltage applied to the BPMV through CKT 696.
- Check the connections in the VSS and VSS calibrator circuits.

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.

5E1-36 FOUR WHEEL ANTILOCK BRAKE SYSTEM



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 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 Tech 1.
- 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:

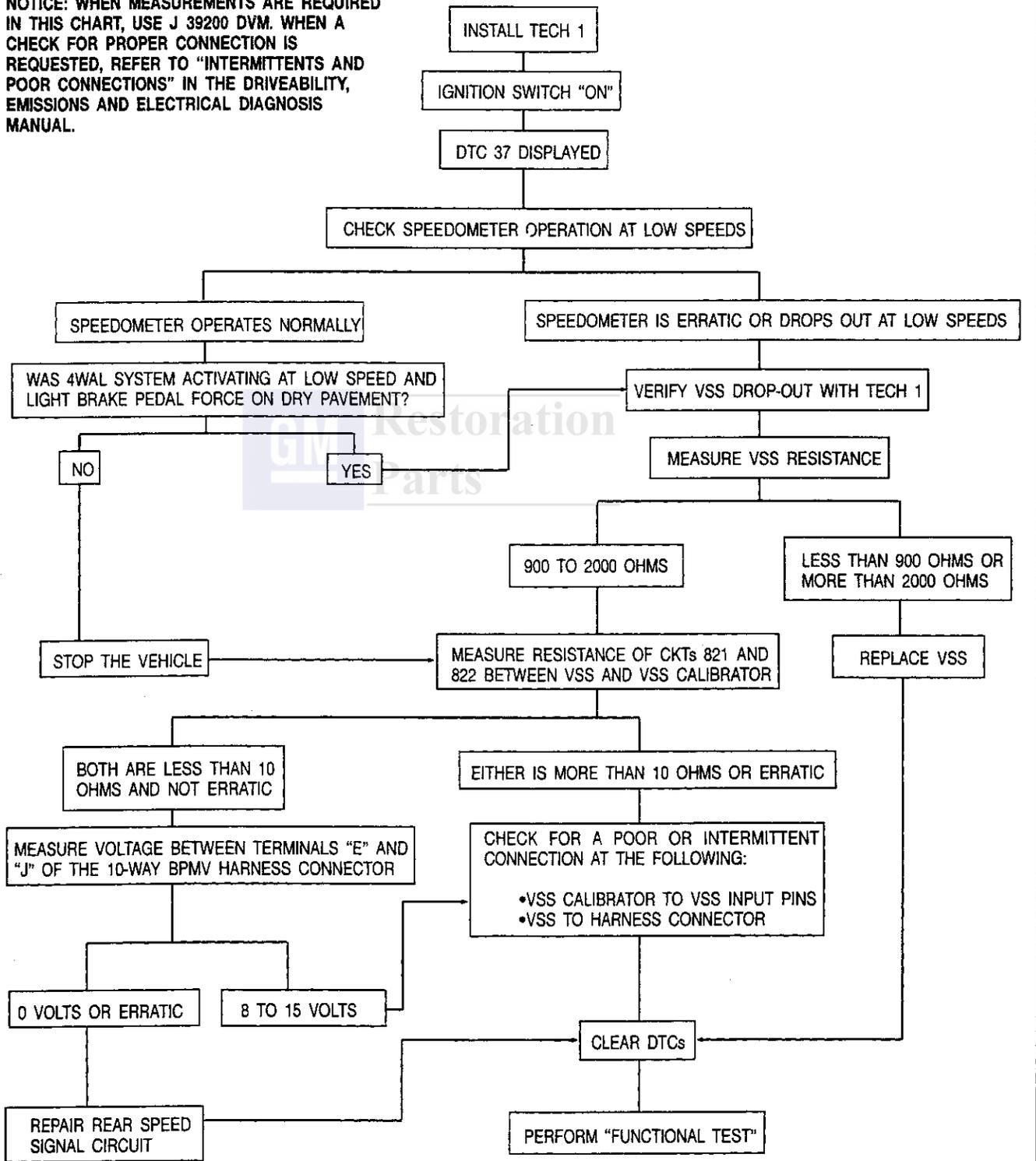
If the voltage readings are low or varying, the battery, charging system, or intermittent connections could be the cause. Check these areas before replacing any components.

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.

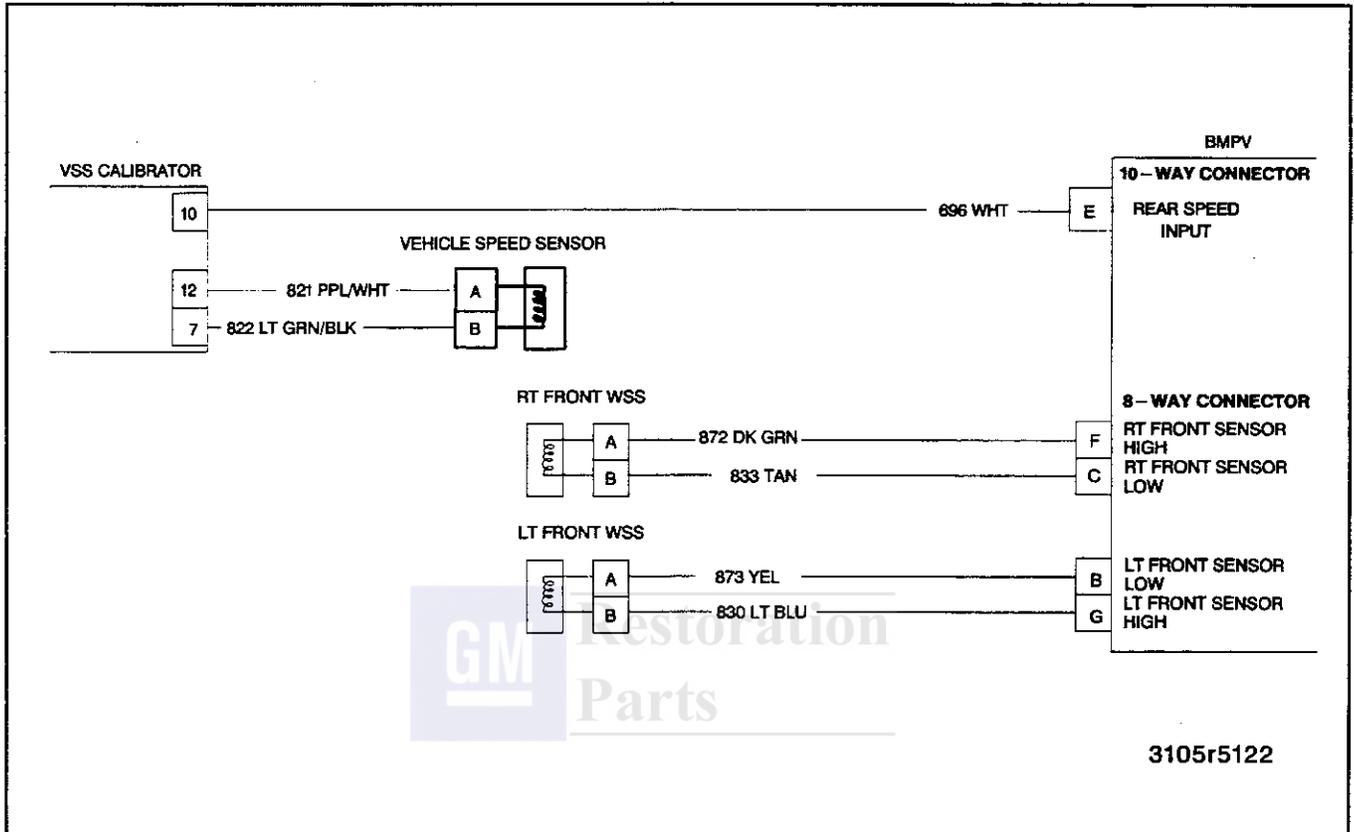
FOUR WHEEL ANTILOCK BRAKE SYSTEM 5E1-37

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.



5E1-38 FOUR WHEEL ANTILOCK BRAKE SYSTEM



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 Tech 1.
- Refer to "Erratic Sensor" chart 23, 27, or 37.

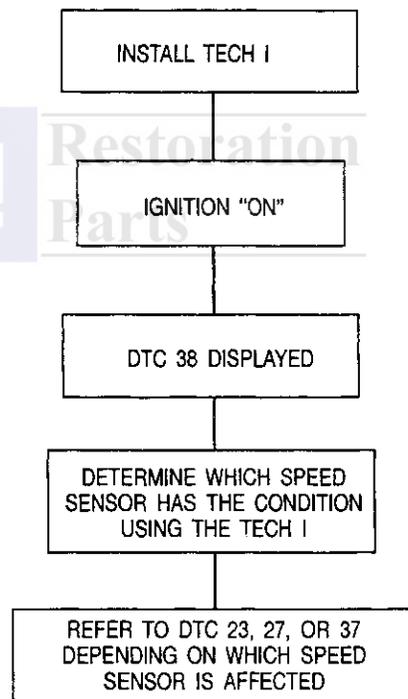
DIAGNOSTIC AIDS:

The following could set this DTC:

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

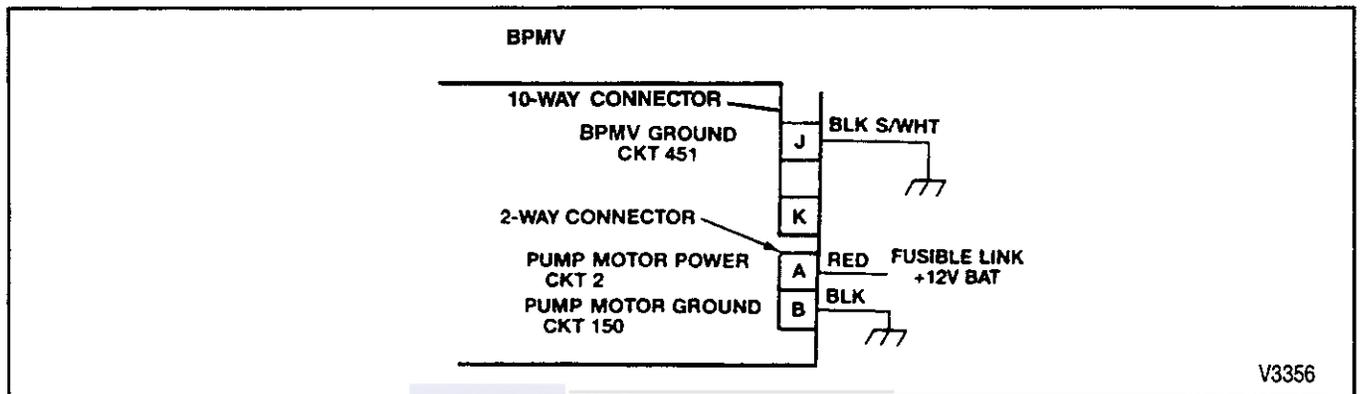
FOUR WHEEL ANTILOCK BRAKE SYSTEM 5E1-39

DTC 38 WHEEL SPEED ERROR



C0088

5E1-40 FOUR WHEEL ANTILOCK BRAKE SYSTEM



DIAGNOSTIC TROUBLE CODES 41 THROUGH 54 BPMV CONTROL VALVES

CIRCUIT DESCRIPTION:

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

TEST DESCRIPTION:

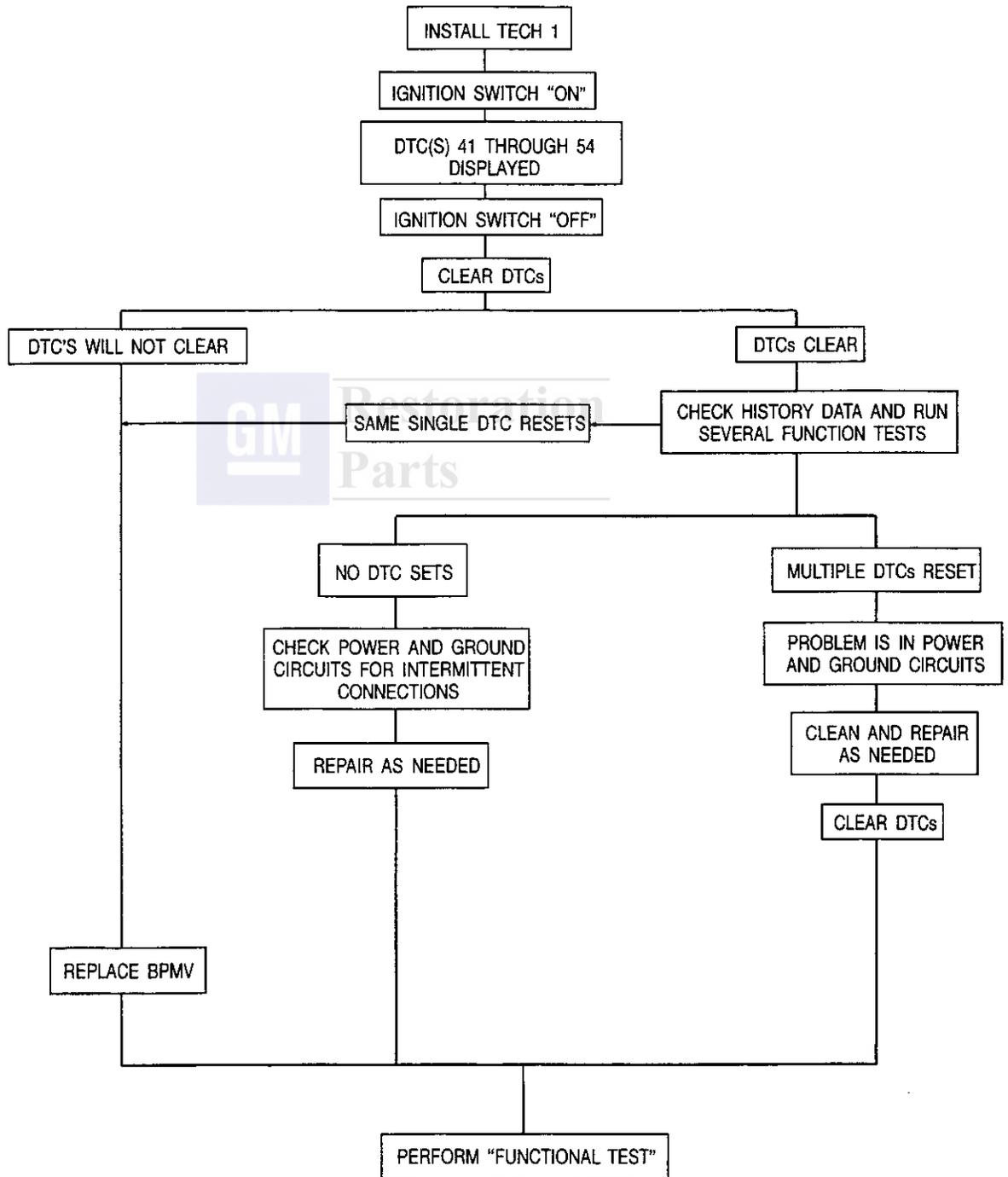
- Verify a DTC 41 through 54 is stored.
- Clear DTCs.
- Check history and run several function tests using the Tech 1.
- Check BPMV power and ground circuits.

DIAGNOSTIC AIDS:

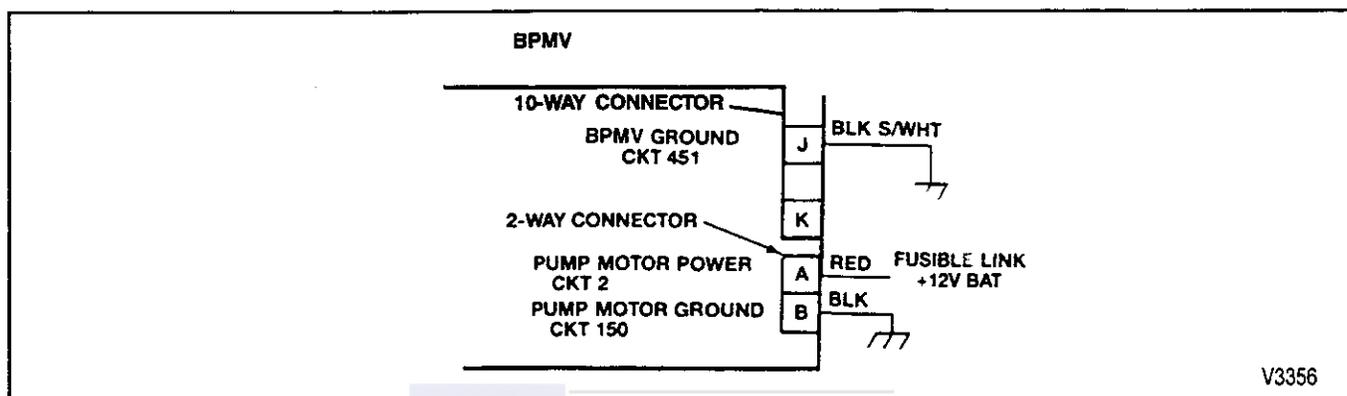
If DTC 41 through 54 sets with other DTCs, check for a poor BPMV ground or power feed.

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



5E1-42 FOUR WHEEL ANTILOCK BRAKE SYSTEM



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 BPMV. The relay is located inside the BPMV and cannot be serviced. The BPMV must be replaced if these tests show the relay has failed. 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 Tech 1.

DIAGNOSTIC AIDS:

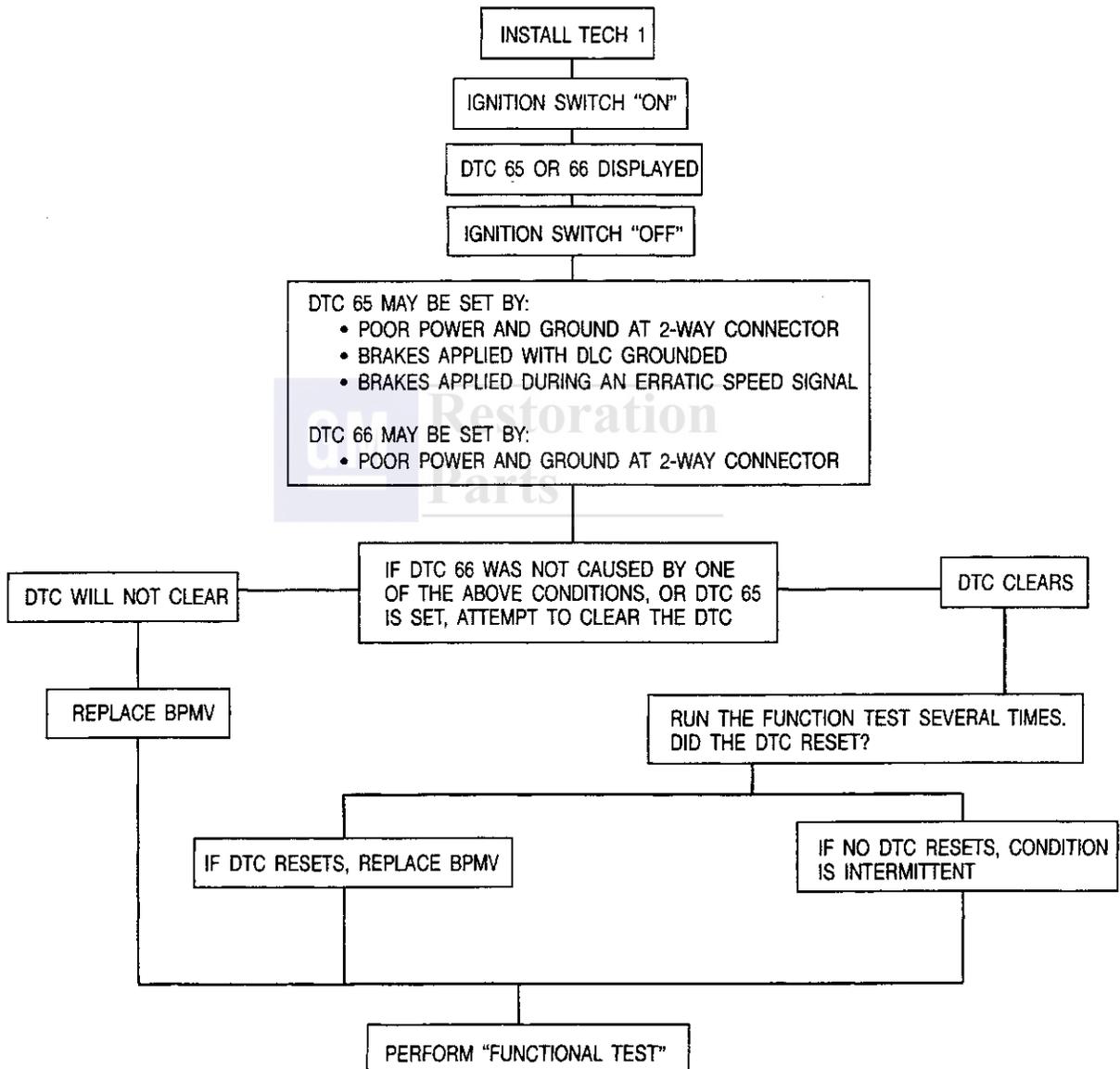
A DTC 65 relates to the 12-volt side of the two-way connector.

If DTC 65 appears with other DTCs, first repair the other DTCs, clear DTCs, and run three function tests with the Tech 1. If DTC 65 resets, refer to this diagnostic chart.

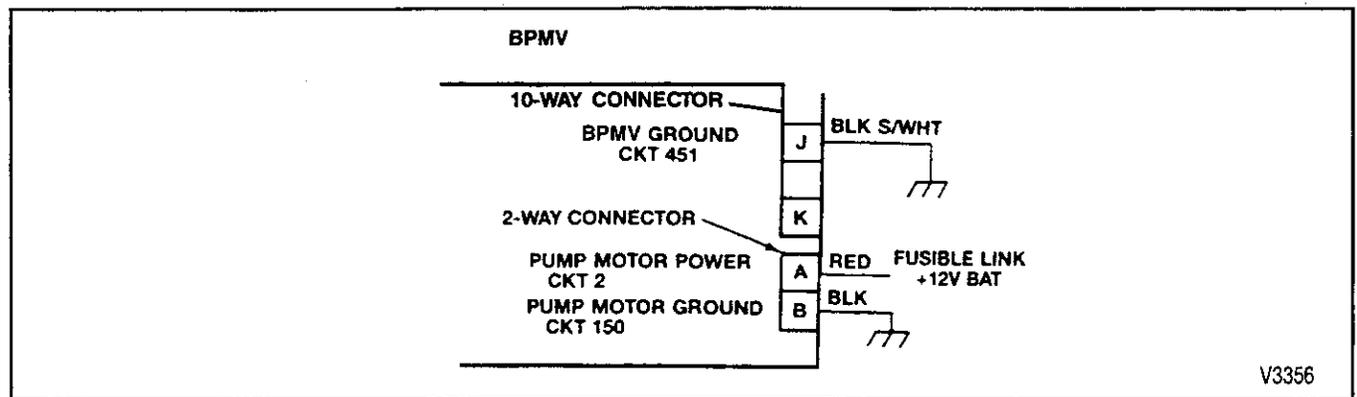
If a DTC 66 sets with other DTCs, check for a poor ground in the two-way connector harness.

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**



5E1-44 FOUR WHEEL ANTILOCK BRAKE SYSTEM



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.

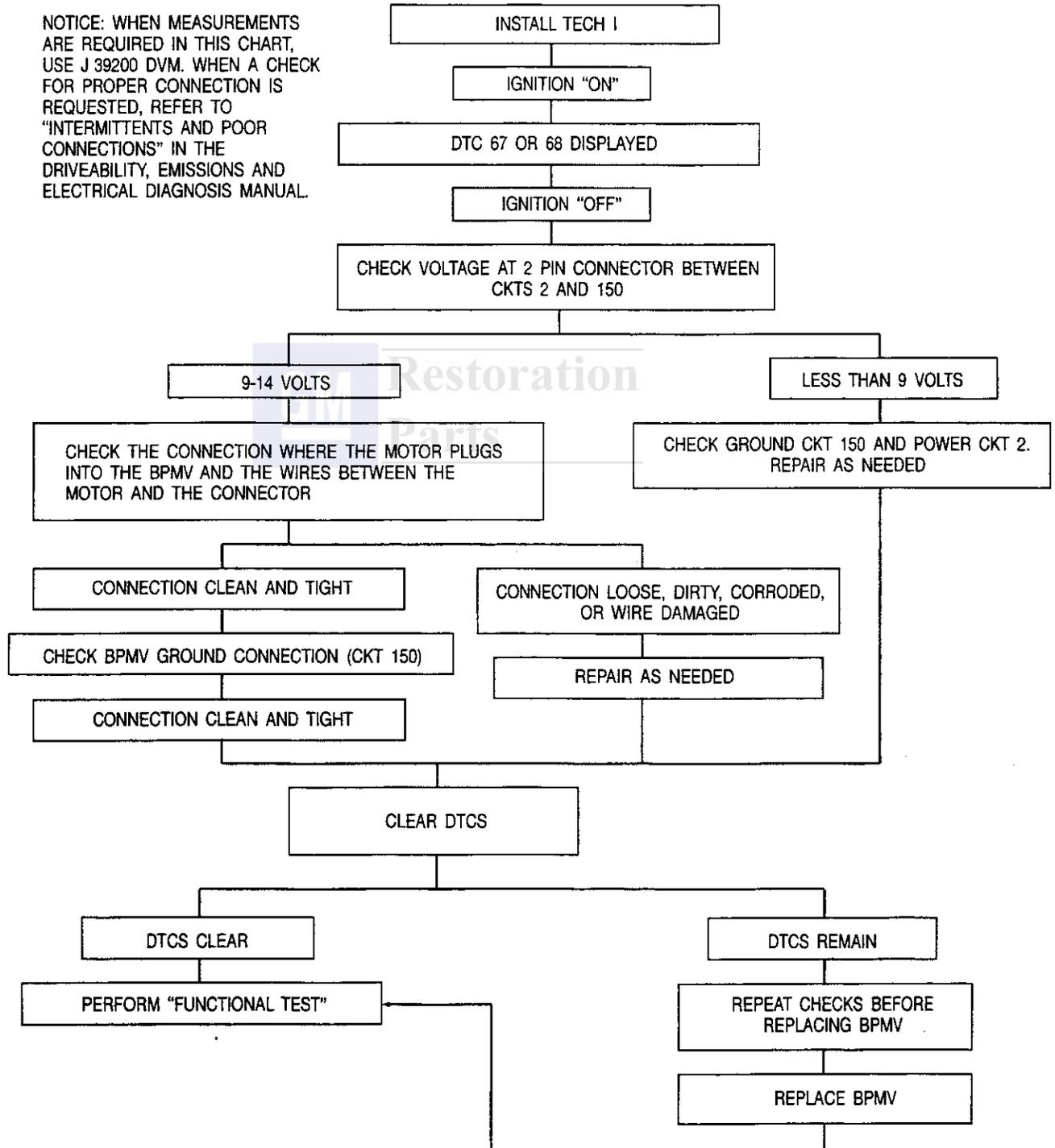
DIAGNOSTIC AIDS:

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.

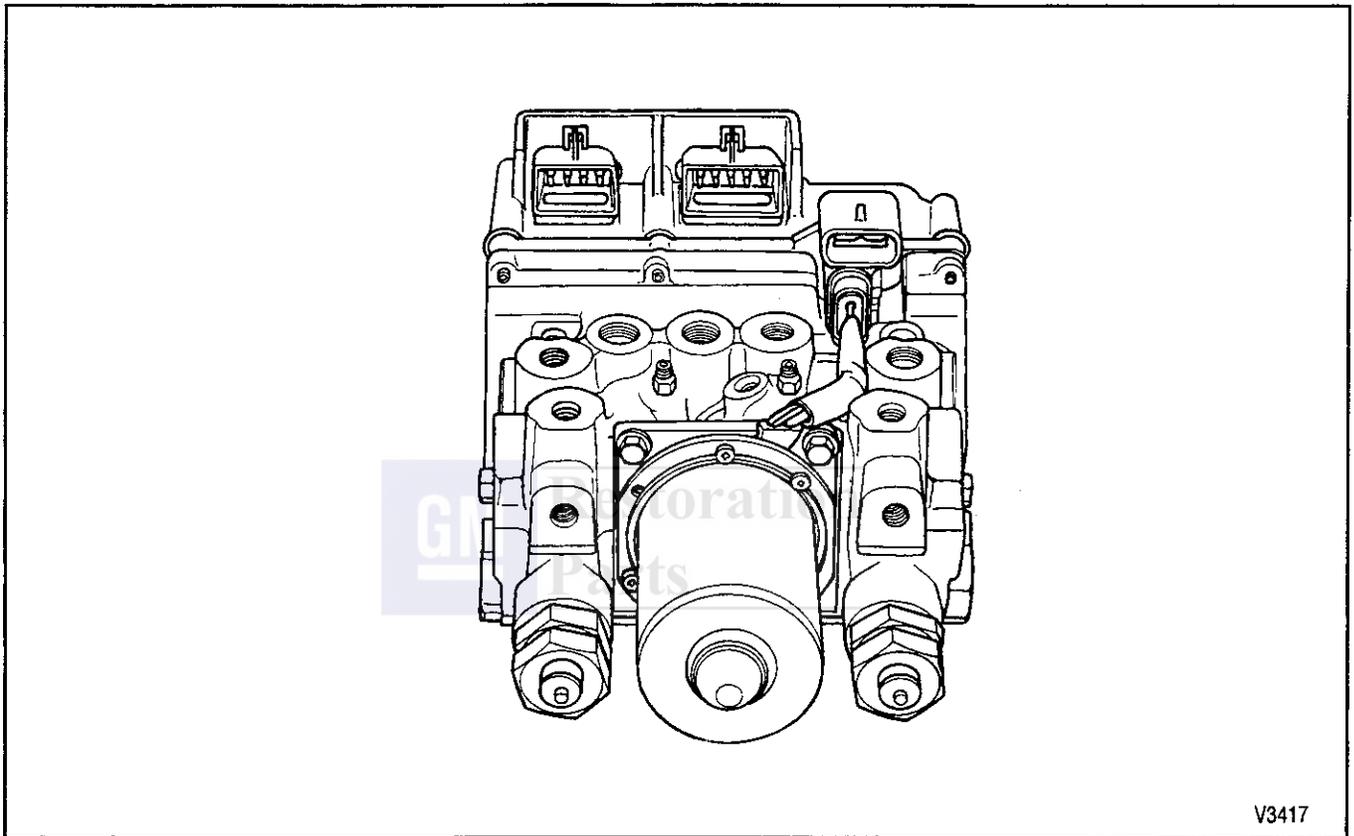
FOUR WHEEL ANTILOCK BRAKE SYSTEM 5E1-45

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



5E1-46 FOUR WHEEL ANTILOCK BRAKE SYSTEM



V3417

DIAGNOSTIC TROUBLE CODES 71 THROUGH 74 BPMV MEMORY ERRORS

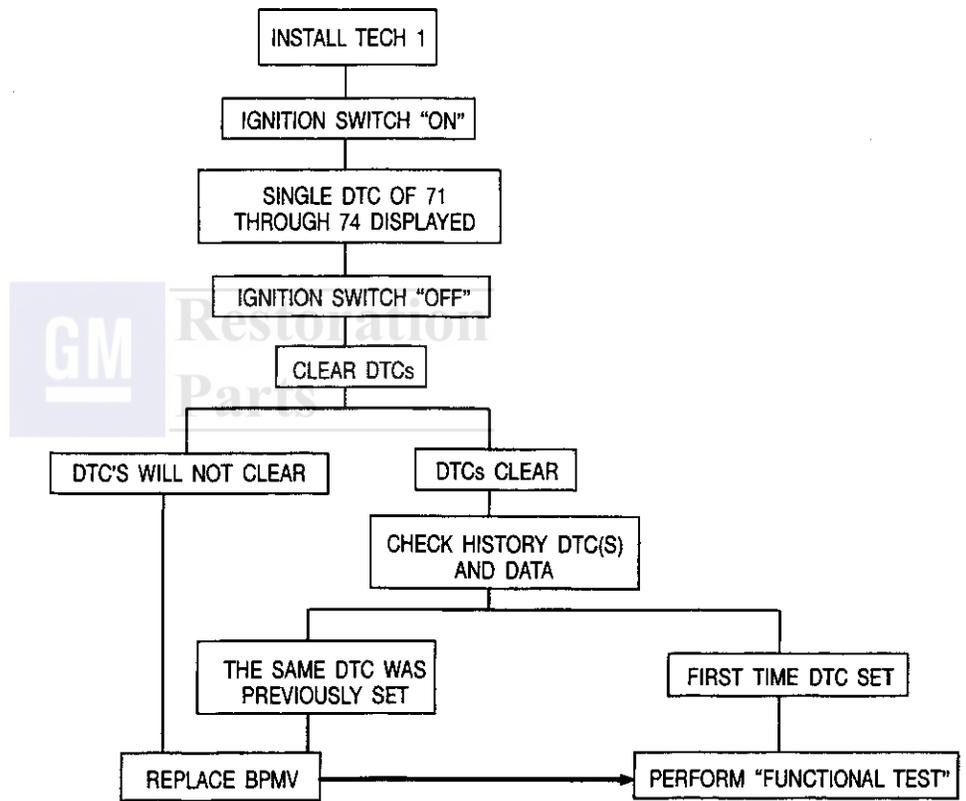
CIRCUIT DESCRIPTION:

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

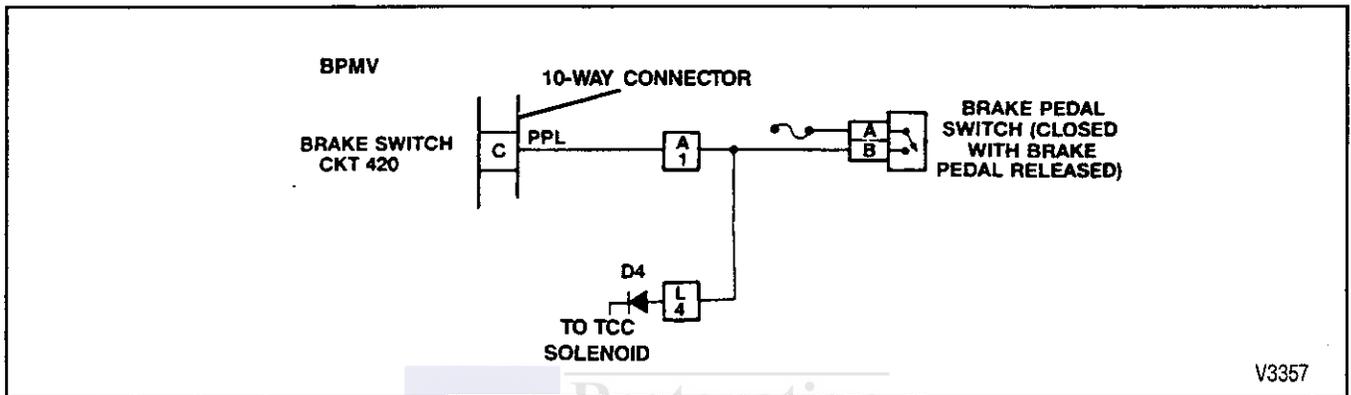
TEST DESCRIPTION:

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

**DTCS 71 THROUGH 74
BPMV MEMORY ERRORS**



5E1-48 FOUR WHEEL ANTILOCK BRAKE SYSTEM



DIAGNOSTIC TROUBLE CODE 81 BRAKE SWITCH CIRCUIT OPEN OR SHORTED

CIRCUIT DESCRIPTION:

A DTC 81 relates to the BPMV 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 BPMV for this DTC. A faulty BPMV will not cause this DTC to set.

TEST DESCRIPTION:

- Check for a blown "BRAKE" fuse.
- Check brake switch status using the Tech 1.
- Check CKT 420 for looseness or corrosion.

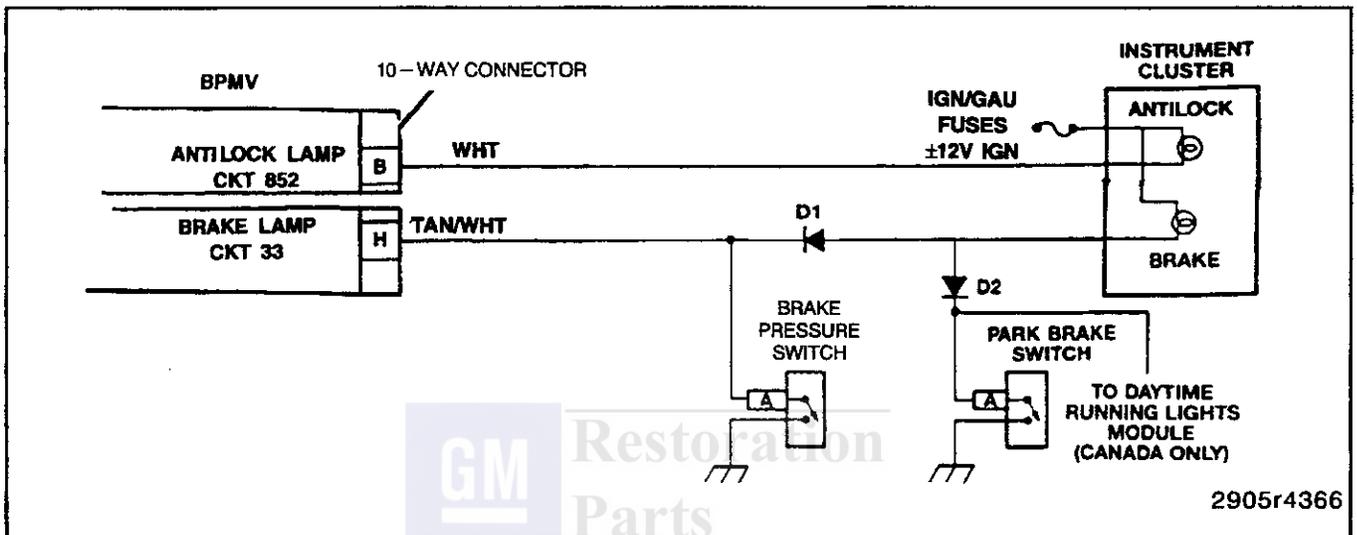
DIAGNOSTIC AIDS:

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

This DTC is a soft fault. The "ANTILOCK" lamp will not come 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.

5E1-50 FOUR WHEEL ANTILOCK BRAKE SYSTEM



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. When a malfunction occurs in the "ANTILOCK" lamp circuit, the BPMV uses the "BRAKE" lamp in its place.



Important

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

TEST DESCRIPTION:

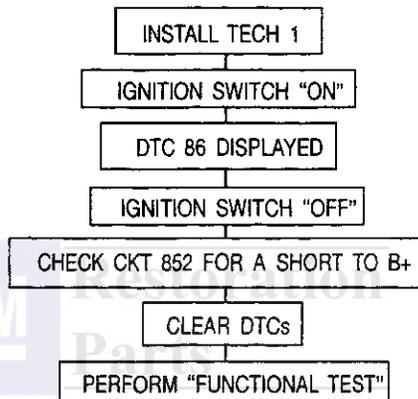
- Check for a short to B+ in either CKT 852 or 33 depending on which lamp malfunctioned.

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.

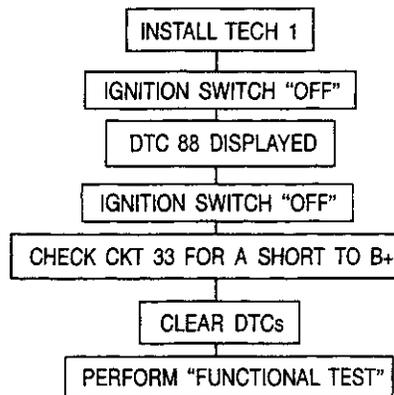
FOUR WHEEL ANTILOCK BRAKE SYSTEM 5E1-51

DTC 86 SHORTED ANTILOCK INDICATOR LAMP



C0083

DTC 88 SHORTED BRAKE WARNING LAMP



C0084

5E1-52 FOUR WHEEL ANTILOCK BRAKE SYSTEM

ON-VEHICLE SERVICE

SERVICE PRECAUTIONS

The 4WAL system is basically maintenance free. When doing work on this system, the following must be observed:

- Before doing welding work 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 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 SYSTEM

The 4WAL brake pressure modulator valve (BPMV) should be bled after replacement or if air is trapped in it. Bleeding should not be necessary if the fluid is not contaminated or no air is in the BPMV. There are internal bleed valves on each side of the BPMV that open internal channels. Open the internal bleed valves (item A, figure 9) 1/4 to 1/2 turn before bleeding. Should the module need bleeding, it must be bled after the master cylinder and before the wheel cylinders and calipers.

NOTICE: The ignition switch must be in the "OFF" position or false trouble codes could be set to memory.

Tools Required:

- J 39177 Combination Valve Pressure Bleeding Tool (Three required)
- TK 00000 Tech-1 Scan Tool
- TK 02650 RWAL/4WAL Cartridge Kit or 3000003 Mass Storage Cartridge

You can also use a modified J 35856 Combination Valve Pressure Bleeding Tool in place of J 39177 providing you remove the dimple from it first.

! Important

- You can expect to use two quarts of brake fluid to thoroughly bleed the system.

1. Open the internal bleed valves on the sides of the BPMV 1/4 to 1/2 turn each (A).
2. Install J 39177 on the left high pressure accumulator bleed stem (C) of the BPMV (figure 9).
3. Install J 39177 on the right high pressure accumulator bleed stem (C) of the BPMV (figure 9).
4. Install J 39177 on the combination valve (figure 10).
5. Check the master cylinder reservoir fluid level and fill if needed.
6. Bleed the brakes as described in SECTION 5.
7. Close the internal bleed valves.

⊞ Tighten

- Internal bleed valves (A) to 7 N·m (60 lbs. in.).
8. Remove the three J 39177 Combination Valve Pressure Bleeding Tools.
 9. Check the master cylinder reservoir fluid level and fill if needed.
 10. With the ignition switch "ON" and the engine off, do six function tests with the Tech-1 scan tool.
 11. Repeat the wheel cylinder and caliper bleed procedure to remove the air that purged from the BPMV during the function tests.

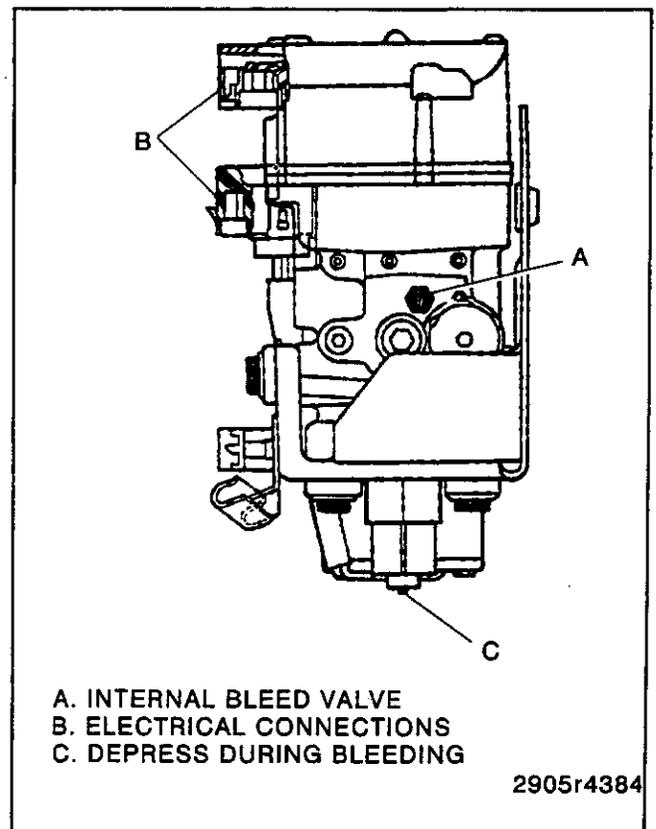


Figure 9—Bleeding the BPMV

12. Apply firm pressure to the brake pedal and evaluate brake pedal feel.
13. Repeat the bleed procedure if needed.
 - Make sure you have a good, hard brake pedal before starting the engine and moving the vehicle.

BRAKE PRESSURE MODULATOR VALVE

↔ Remove or Disconnect (Figures 11 and 12)

1. Electrical connectors from BPMV.
2. Brake pipes from BPMV.
3. Bolts (11).
4. BPMV and bracket assembly.
5. Bolts (12).
6. BPMV (1) from mounting bracket (13).

↔ Install or Connect (Figures 11 and 12)

NOTICE: For steps 2, 4, and 5 refer to "Notice" on page 5E1-1.

1. BPMV to mounting bracket.
2. Six bolts (12).

Tighten

- Bolts (12) to 7 N.m (60 lbs. in.). Over tightening these bolts could result in excessive noise transfer from the BPMV.
3. BPMV and bracket assembly.

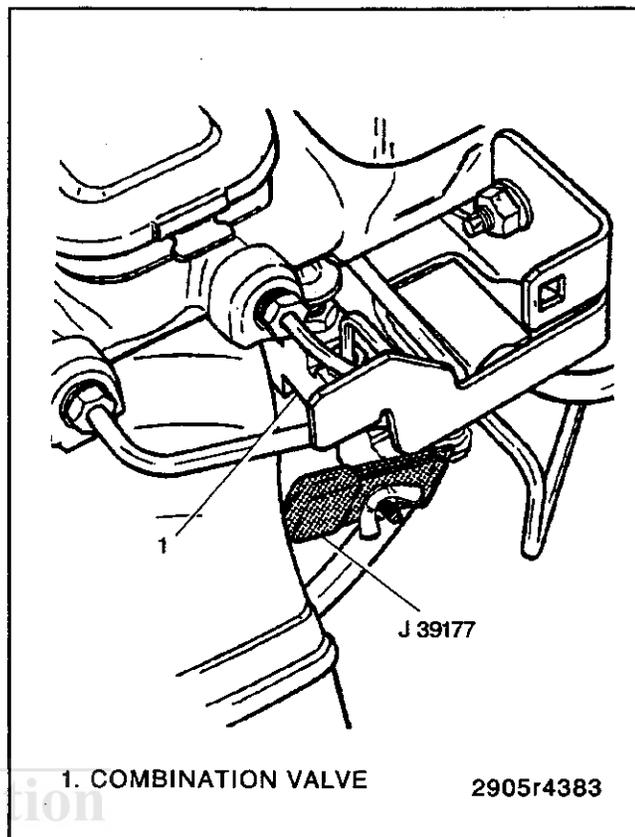


Figure 10—Depressing Combination Valve

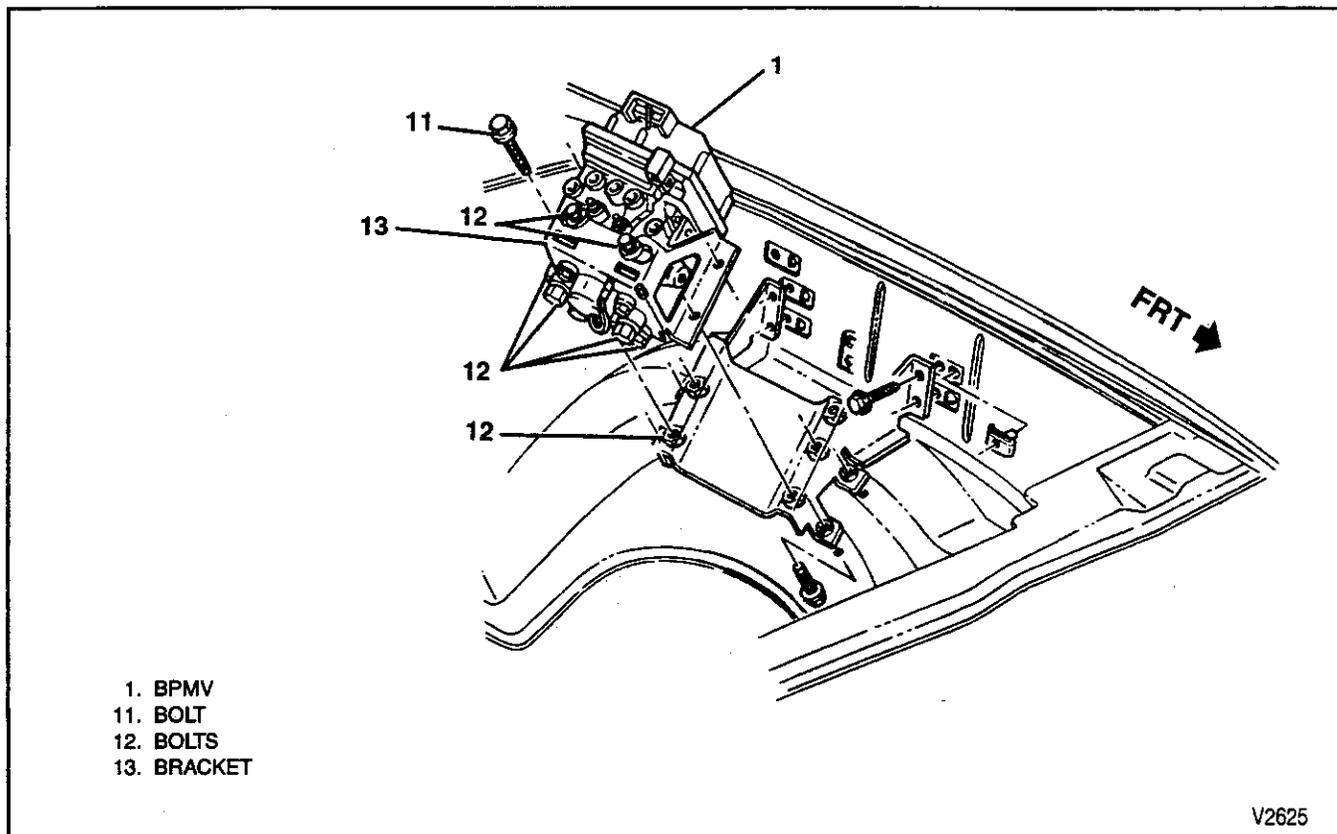


Figure 11—Brake Pressure Modulator Valve Mounting

5E1-54 FOUR WHEEL ANTILOCK BRAKE SYSTEM

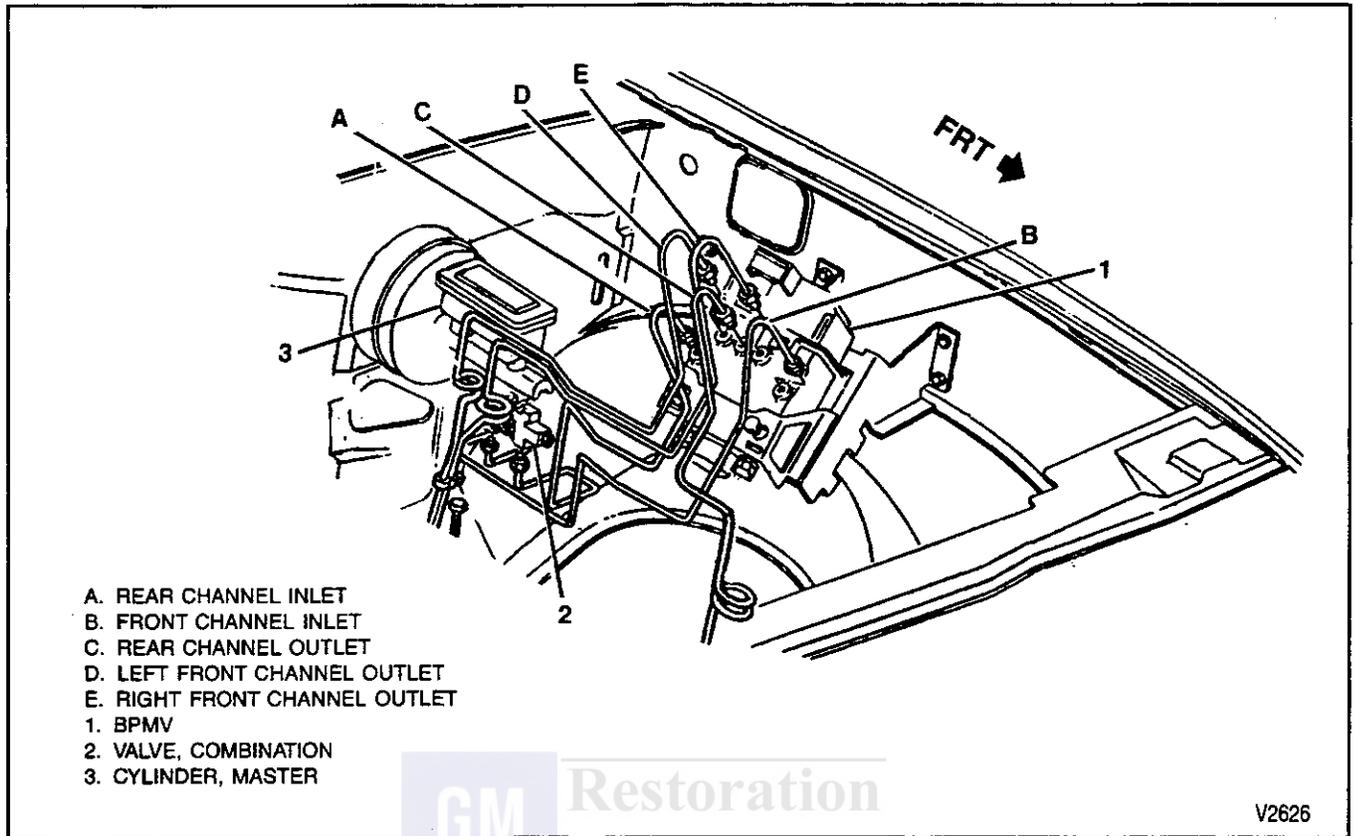


Figure 12—BPMV Brake Line Connections

4. Bolts (11).



- Bolts (11) to 27 N·m (20 lbs. ft.).

5. Brake pipes to BPMV.



- Brake pipe fittings to 25 N·m (16 lbs. ft.).

6. Electrical connectors to BPMV.

7. Bleed brake system. Refer to "Bleeding System."

FRONT WHEEL SPEED SENSOR

TWO WHEEL DRIVE



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.

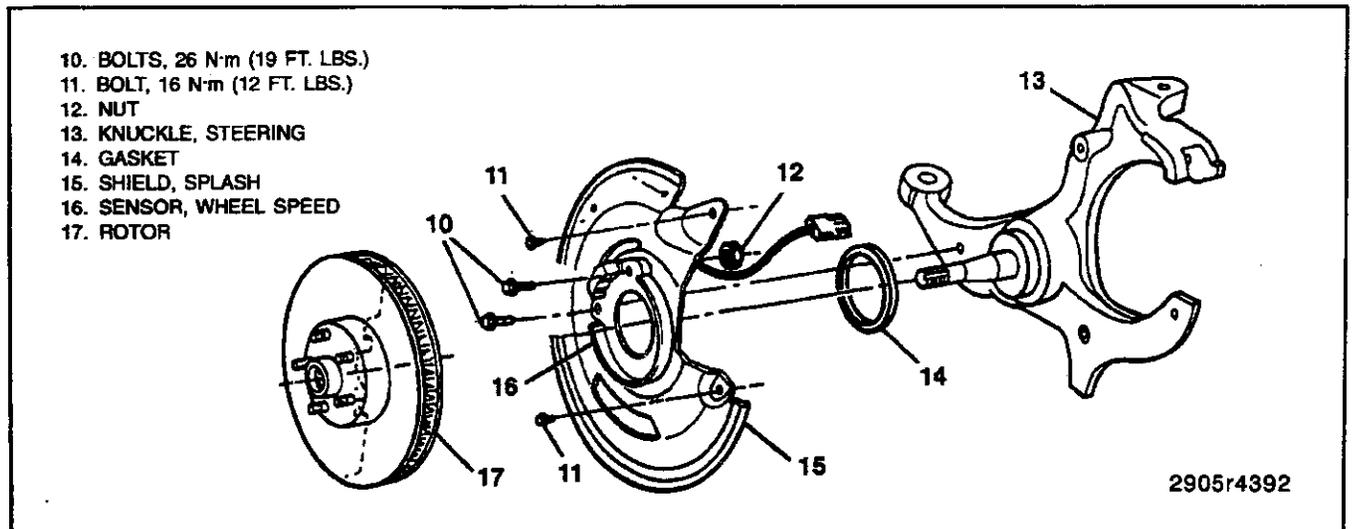


Figure 13—Front Wheel Speed Sensor (2WD)

FOUR WHEEL ANTILOCK BRAKE SYSTEM 5E1-55

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.

⌚ Tighten

- Splash shield mounting 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.
2. Electrical connector.
3. Sensor wire from clips on upper control arm.
4. Bolt (18).
5. Bolts (15).
6. Sensor (6).

↔ Install or Connect (Figure 14)

1. Sensor (6).

NOTICE: Refer to "Notice" on page 5E1-1.

2. Bolts (15).

⌚ Tighten

- Bolts (15) to 15 N.m (11 lbs. ft.)
3. Sensor wire to clips on upper control arm.
 4. Bolt (18).
 5. Electrical connector (16).
 6. Wheel and tire assembly.

FRONT WHEEL SPEED SENSOR TONE WHEELS

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

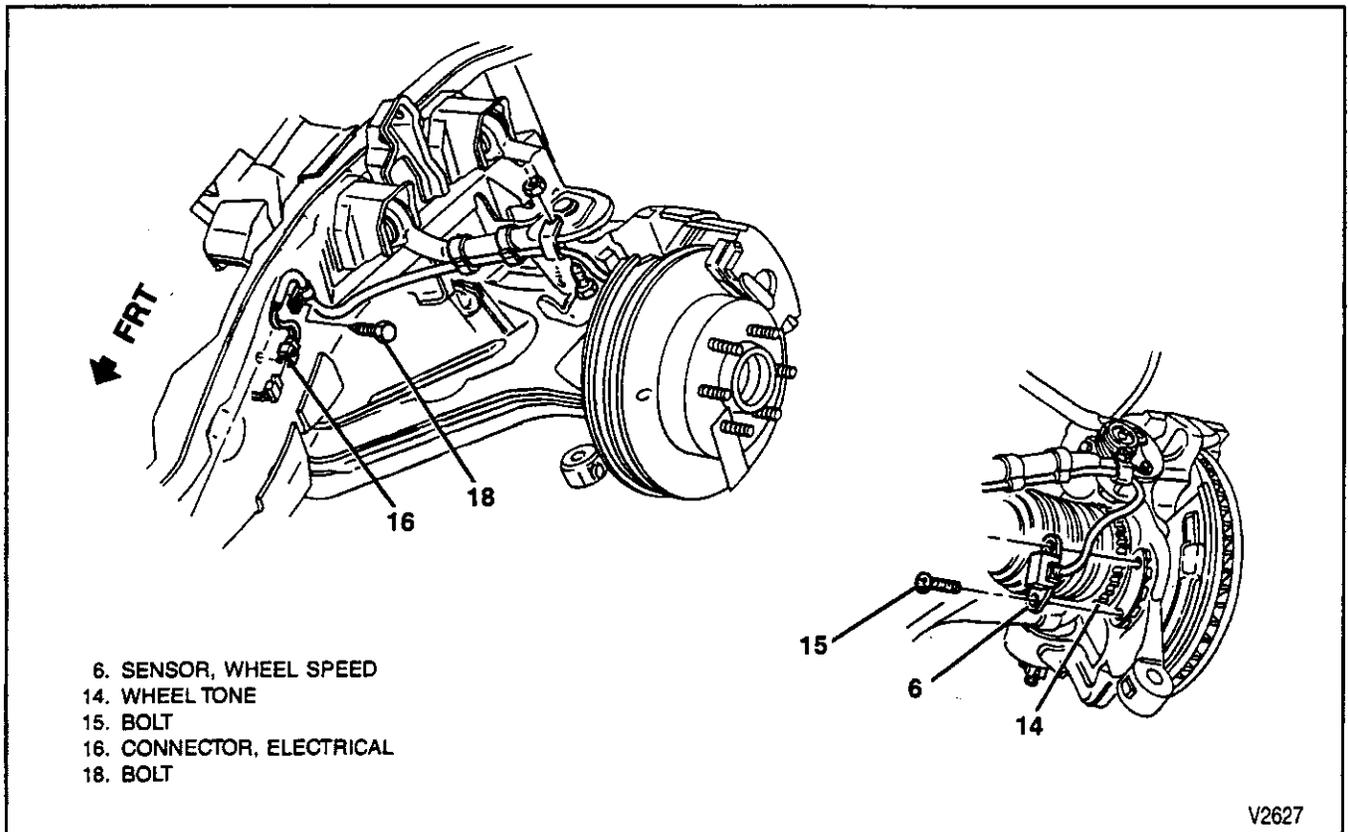


Figure 14—Front Wheel Speed Sensor (4WD)

5E1-56 FOUR WHEEL ANTILOCK BRAKE SYSTEM

VEHICLE SPEED SENSOR

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

VEHICLE SPEED SENSOR CALIBRATOR

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

WARNING/INDICATOR LAMPS

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



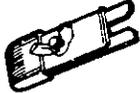
FASTENER TIGHTENING SPECIFICATIONS

ITEM	N·m	Lbs. Ft.	Lbs. In.
BPMV to Bracket Bolts	9	—	84
BPMV Bracket Mounting Bolts	27	20	—
Brake Pipe Fittings to BPMV.....	25	16	—
Brake Pipe Fittings to Combination Valve	20	15	—
Front Wheel Speed Sensor Mounting Bolts (2WD)	26	19	—
Front Wheel Speed Sensor Mounting Bolts (4WD)	10	—	89
Internal Bleed Valves	7	—	60
Splash Shield Mounting Bolts (2WD).....	16	12	—

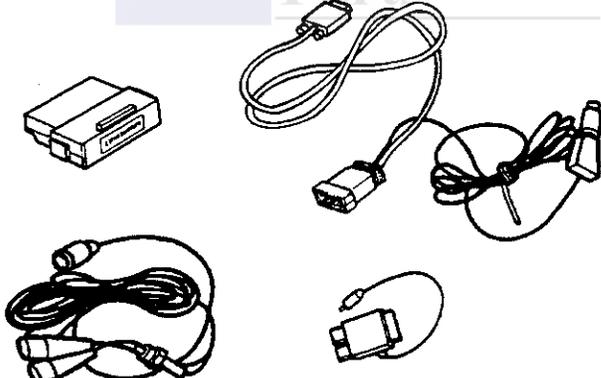
T2958

FOUR WHEEL ANTILOCK BRAKE SYSTEM 5E1-57

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

2905r9080

5E1-58 FOUR WHEEL ANTILOCK BRAKE SYSTEM

NOTES



SECTION 5E3

REAR WHEEL ANTILOCK BRAKE SYSTEM

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

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5E3-2 REAR WHEEL ANTILOCK BRAKE SYSTEM

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GENERAL DESCRIPTION

This section covers diagnosis and service procedures for rear wheel antilock brake systems (figure 1). Two different systems are used on these models, rear wheel antilock (RWAL) and zero pressure rear wheel antilock (ZPRWAL). These systems reduce the occurrence of rear wheel lock-up during a severe brake application. They do this by regulating hydraulic pressure in the rear brake lines.

There are two major differences between RWAL and ZPRWAL:

1. The EBCM is different for each system.
2. The method for clearing diagnostic trouble codes is different.

Care must be used when servicing these systems to make sure the correct EBCM and procedure for clearing diagnostic trouble codes are used.

ZPRWAL is used on the 3500 HD model. The ZPRWAL system is used on rear disc brake systems because of the large volume of fluid the disc brake calipers need. The accumulator for this system is much larger than the RWAL system. The electric brake control modules (EBCM) (figure 2) are identical in size and mounting configuration. The only noticeable difference is the color of the electrical connector. **The RWAL EBCM has a black electrical connector and the ZPRWAL EBCM has a gray electrical connector.**

RWAL is used on all models with rear drum brakes except for four wheel antilock (4WAL) applications.

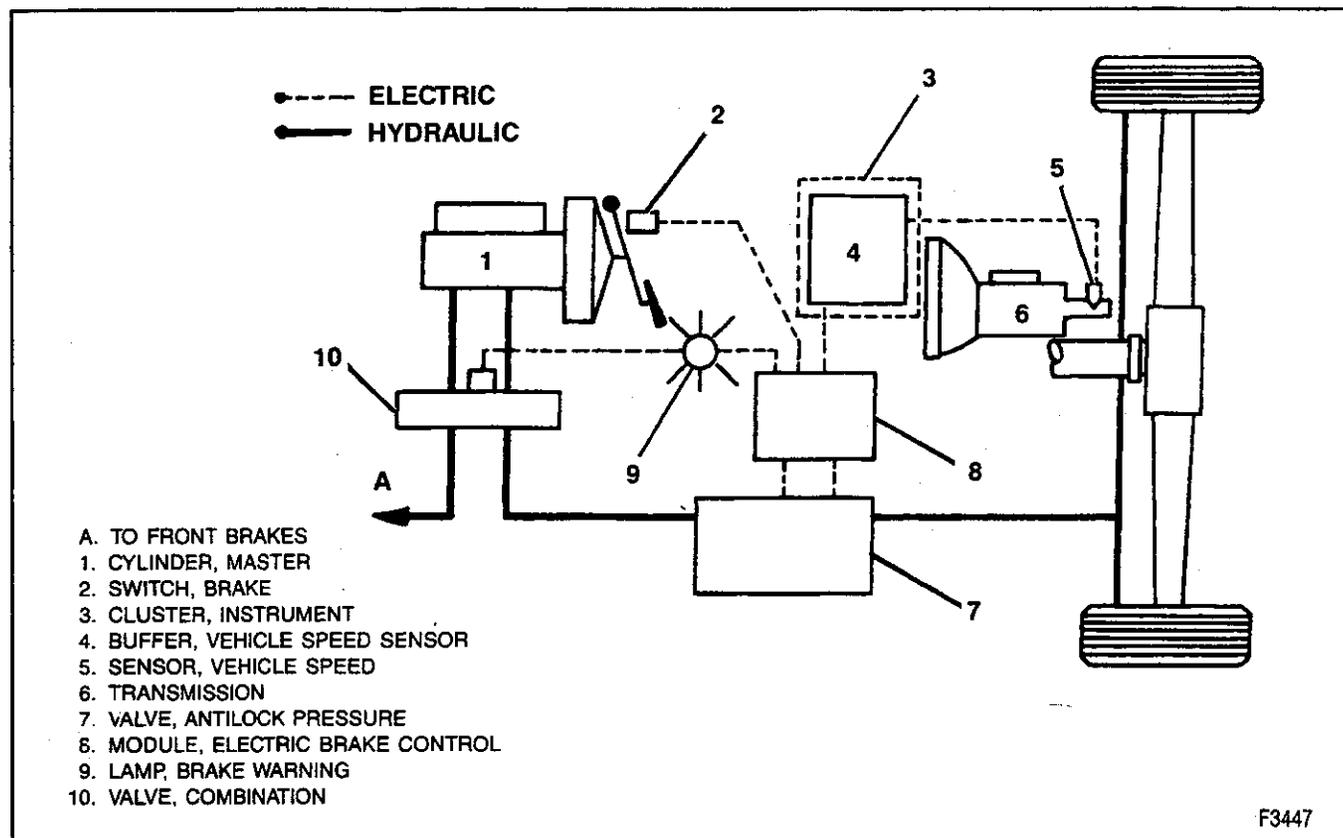


Figure 1—Rear Wheel Antilock Brake System

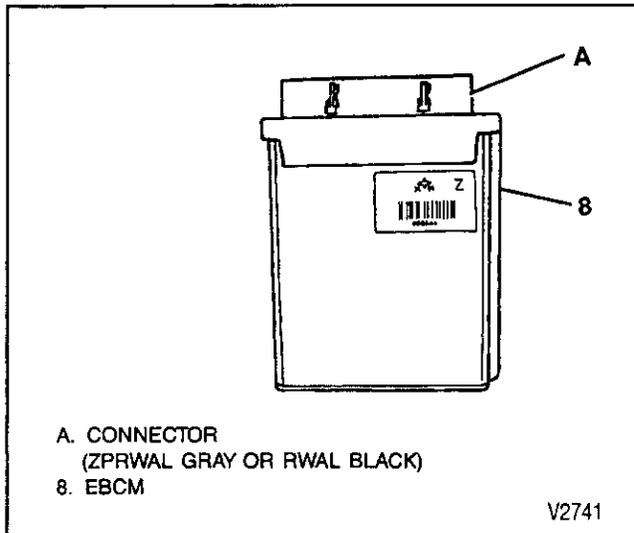


Figure 2—Electric Brake Control Module

ABBREVIATIONS/DEFINITIONS

APV.....	Antilock Pressure Valve
CKT.....	Circuit
DLC.....	Data Link Connector
DTC.....	Diagnostic Trouble Code
DVM.....	Digital Volt Meter
EBCM.....	Electric Brake Control Module
4WD.....	Four Wheel Drive
RWAL.....	Rear Wheel Antilock
VSS.....	Vehicle Speed Sensor
ZPRWAL.....	Zero Pressure Rear Wheel Antilock

BASIC KNOWLEDGE REQUIRED

Before attempting to diagnose the RWAL or ZPRWAL systems you must have a good understanding of electrical system basics and the use of circuit testing tools. Without this basic knowledge it will be 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 the following:

- **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 Tech 1 scan tool and the RWAL/4WAL cartridge used with it.
 - How to use jumper wires to test circuits.

SYSTEM OPERATION

The purpose of the Rear Wheel Antilock (RWAL) and Zero Pressure Rear Wheel Antilock (ZPRWAL) brake systems is to maintain vehicle stability under severe braking conditions on most road surfaces. The RWAL and ZPRWAL systems monitor the speed of the rear wheels during a braking maneuver. The electric brake control module (EBCM) processes these values to produce command controls to prevent the rear wheels from locking.

BASE BRAKING MODE

During normal braking, the EBCM receives a signal from the stop lamp switch and begins to monitor the vehicle speed line. The isolation valve is open and the dump valve is seated. This allows fluid under pressure to pass through the APV and travel to the rear brake channel. The reset switch does not move because hydraulic pressure is equal on both sides.

ANTILOCK BRAKING MODE

During a brake application the EBCM compares vehicle speed to the program built into it. When it senses a rear wheel lockup condition, it operates the antilock pressure valve to keep the rear wheels from locking up. To do this the EBCM uses a three step cycle:

- Pressure Maintain
- Pressure Decrease
- Pressure Increase

Pressure Maintain

During pressure maintain the EBCM energizes the isolation solenoid to stop the flow of fluid from the master cylinder to the rear brakes. The reset switch moves when the difference between the master cylinder line pressure and the rear brake channel pressure becomes great enough. If this happens, it grounds the EBCM logic circuit.

Pressure Decrease

During pressure decrease the EBCM keeps the isolation solenoid energized and energizes the dump solenoid. The dump valve moves off its seat and fluid under pressure moves into the accumulator. This action reduces rear pipe pressure preventing rear lockup. The reset switch grounds to tell the EBCM that pressure decrease has taken place.

Pressure Increase

During pressure increase the EBCM de-energizes the dump and isolation solenoids. The dump valve reseats and holds the stored fluid in the accumulator. The isolation valve opens and allows the fluid from the master cylinder to flow past it and increase pressure to the rear brakes. The reset switch moves back to its original position by spring force. This action signals the EBCM that pressure decrease has ended and driver applied pressure resumes.

Accumulator Bleed-Down

When the brake pedal is released, the accumulator spring and piston push the stored fluid back to the master cylinder past a lip seal on the dump valve.

System Self-Test

When the ignition switch is turned "ON," the EBCM performs a system self-test. It checks its internal and external circuit and performs a function test by cycling

5E3-4 REAR WHEEL ANTILOCK BRAKE SYSTEM

the isolation and dump valves. The EBCM then begins its normal operation if no malfunctions are detected.

Brake pedal pulsation and occasional rear tire "chirping" are normal during RWAL or ZPRWAL operation. The road surface and severity of the braking maneuver determine how much these will occur. Since these systems only control the rear wheels, it is still possible to lock the front wheels during certain severe braking conditions.

TIRES AND RWAL

Spare Tire

Using the spare tire supplied with the vehicle will not affect the performance of the RWAL or ZPRWAL systems.

Replacement Tire

Tire size can affect the performance of the RWAL or ZPRWAL systems. Replacement tires must be the same size, load range, and construction on all four wheels.

Speedometer Calibration

The vehicle speed sensor (VSS) buffer must be replaced when the rear axle ratio or tire size is changed. Refer to SECTION 8C.

WARNING LAMP OPERATION

"BRAKE" Lamp

The RWAL system uses the existing "BRAKE" warning lamp in the instrument panel to indicate system operation and malfunctions. The "BRAKE" lamp is also used to show a hydraulic system pressure differential condition and parking brake operation.

Normal Operation

A bulb check occurs each time the ignition switch is turned "ON." The "BRAKE" lamp should light, remain on for about 2 seconds, then turn off. When system malfunctions occur, the "BRAKE" lamp will turn on and stay on until the malfunction is corrected. To determine the specific cause of a malfunction, refer to "Functional Test."

The "BRAKE" lamp will also light when the parking brake is applied or the combination valve switch is activated. Do not confuse these functions with an RWAL system malfunction.

SYSTEM COMPONENTS

ELECTRIC BRAKE CONTROL MODULE

The electric brake control module (EBCM) mounts to a bracket next to the master cylinder. It contains a microprocessor and the software for system operation. During a severe brake application the EBCM controls the antilock pressure valve (APV) to prevent the rear

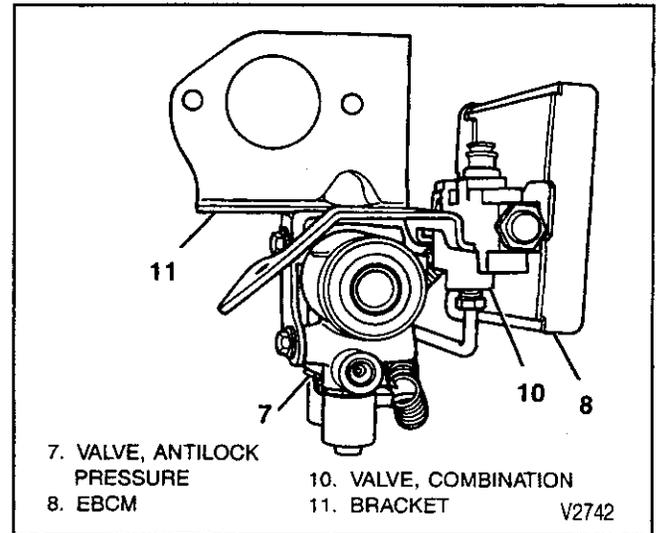


Figure 3—Antilock Pressure Valve and EBCM

wheels from locking up. The EBCM receives input signals from the vehicle speed sensor (VSS) buffer, stop lamp switch, and front axle switch on 4WD applications.

NOTICE: Be sure to use the correct EBCM for the system being serviced. The 3500 HD uses the ZPRWAL EBCM with the gray electrical connector. All other models use the RWAL EBCM with the black electrical connector. Failure to use the correct EBCM will result in a system malfunction.

ANTILOCK PRESSURE VALVE

The antilock pressure valve (APV) mounts to the combination valve under the master cylinder. The APV has an isolation valve to maintain or increase hydraulic pressure, a dump valve to reduce hydraulic pressure, and an accumulator to store brake fluid during the dump cycle. The EBCM uses the APV to control hydraulic pressure in the rear brake pipes. (figure 3)

VEHICLE SPEED SENSOR

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

VEHICLE SPEED SENSOR BUFFER

The VSS sends its signal to the vehicle speed sensor (VSS) buffer located behind the instrument panel storage compartment. The VSS buffer changes the AC sine-wave signal from the VSS to a DC square-wave signal. If the axle ratio or tire size is changed, it will be necessary to replace the VSS buffer. Refer to "Speedometer Calibration."

COMPONENT LOCATION VIEWS

For component location views, refer to figure 4.

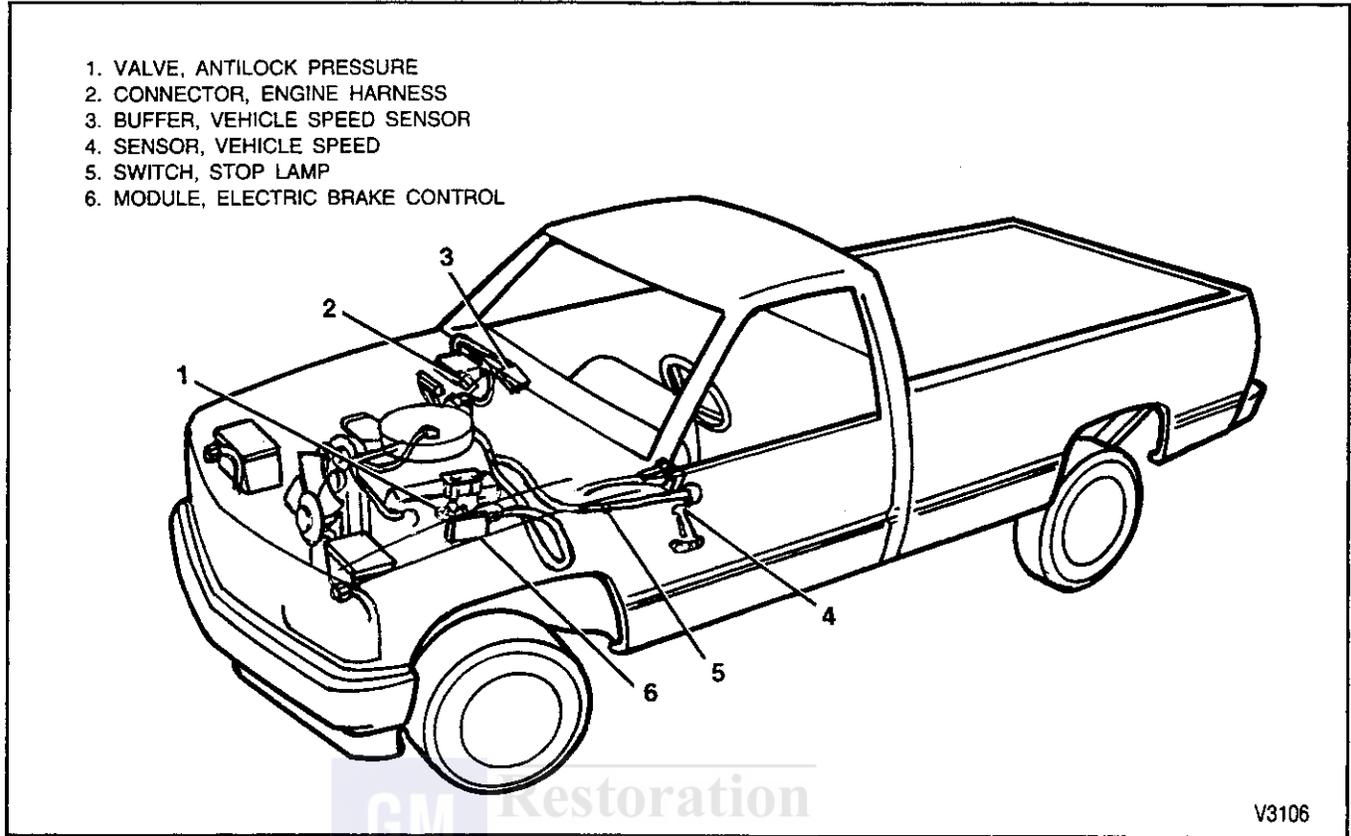


Figure 4—RWAL Component Location Views

DIAGNOSIS

DIAGNOSTIC PROCESS

Before beginning diagnosis on the RWAL or ZPRWAL systems, 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 misrouted 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 EBCM performs self-diagnostics and can detect and often isolate system failures. When a malfunction is detected, the EBCM sets a diagnostic trouble code (DTC) that represents the malfunction, turns on the BRAKE lamp (in most instances), and will disable RWAL functions as long as the BRAKE lamp remains on.

The EBCM performs an automatic self-test when the ignition switch is turned to the "ON" position. The EBCM cycles each valve to check component operation. If it detects an error, it sets a DTC as described above.

DISPLAYING DIAGNOSTIC TROUBLE CODES

Diagnostic trouble codes (DTCs) can be displayed using the Tech 1 scan tool or by manually grounding the data link connector (DLC) (figure 5). Ground terminal "H" to terminal "A" of the DLC and count the "BRAKE" lamp flashes. The terminals must be ground-

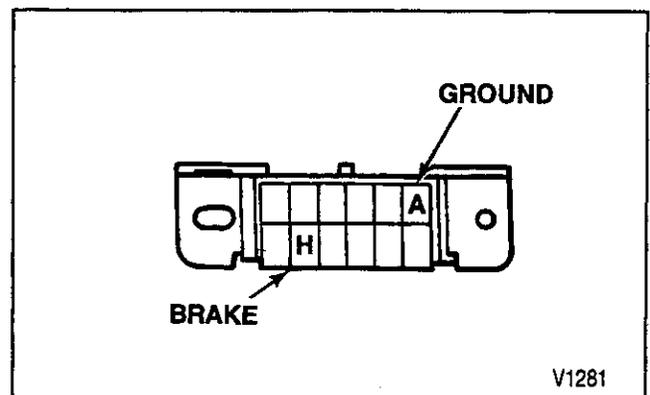


Figure 5—Data Link Connector (DLC)

5E3-6 REAR WHEEL ANTILOCK BRAKE SYSTEM

ed for about 20 seconds before the DTC will begin to flash. Count the number of short flashes starting from the long flash. Include the long flash as a count. Sometimes the first count sequence will be short. However, subsequent counts will be accurate. If a soft DTC is stored, only the last recognized DTC will be retained and displayed on the Tech 1.

Important

- Manual grounding should only be done when the "Brake" lamp is on.

NOTICE: DTCs 6, 9, and 10 will only turn the "Brake" lamp on while the fault exists. These are soft faults and can only be read with the Tech 1 scan tool. Do not manually ground terminal "H" to terminal "A" of the DLC if the "BRAKE" lamp is not on. Grounding the DLC with the "BRAKE" lamp off will set a false DTC 9. This will turn the "BRAKE" lamp on and disable the antilock system.

CLEARING DIAGNOSTIC TROUBLE CODES

ZPRWAL (30 SERIES HD MODELS)

The following procedure must be used to clear DTCs on vehicles with the ZPRWAL system.

1. Turn the ignition switch "OFF."
2. Pull the Stop/Hazard fuse.
3. Turn the ignition switch "ON."
 - If a DTC is stored, soft or hard, the "BRAKE" lamp will be on.
4. Do the following at the DLC.
 - A. Ground pin A to H for one second.
 - B. Remove the ground for one second.
 - C. Again ground pin A to H for one second.
 - D. Remove the ground.
5. The "BRAKE" lamp should turn off.
6. Turn the ignition switch "OFF."
7. Replace the Stop/Hazard fuse.
8. Verify no DTCs are stored.

RWAL (ALL OTHER MODELS)

To clear DTCs on all other models:

1. Make sure the ignition switch is "OFF."
2. Pull the Stop fuse.
3. Wait 5 seconds.
4. Reinstall the fuse.
5. Verify no DTCs are stored.

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.

TECH 1 DIAGNOSTICS

Important

- When using the Tech 1 for RWAL system testing, make sure you are using the RWAL/4WAL cartridge that includes the model year you are working on. Refer to the RWAL/4WAL Cartridge or Mass Storage Cartridge Operator's Manual for additional information about the cartridge.

The Tech 1 has 4 test modes for diagnosis of the RWAL systems. These test modes are:

- Mode F1: Function Test
This test mode is used to perform a functional test of the system. The Tech 1 will simulate an acceleration and deceleration signal that causes the EBCM to cycle the RWAL system. If the EBCM stores a DTC during the test, the Tech 1 will display it at the end of the test. If a DTC is set before you begin the test, the Tech 1 will display the DTC and you will not be able to continue until the DTC is cleared.
- Mode F2: Trouble Code
This mode allows you to access DTCs and offers some diagnostic information on the DTCs.
- Mode F3: Miscellaneous Test
This mode allows you to do specialized testing of the VSS Buffer (DRAC) and stop lamp switch (brake switch).
- Mode F4: VSS Monitor
This mode allows you to monitor the vehicle speed signal as the EBCM sees it.

MODE F3 - MISCELLANEOUS TEST

F0: DRA Check

This mode does not apply to any 1994 models.

F1: Brake Switch Test

This test allows you to determine if there is a malfunction in the stop lamp (brake) switch circuit. On 4WD vehicles, this mode will also allow you to check the front axle and transfer case switched circuits.

1. Select F3: Misc. Tests from main menu.
2. Select F1: Brake Switch Test.
3. Complete the test by following the direction of each screen.

MODE F4 - VSS MONITOR

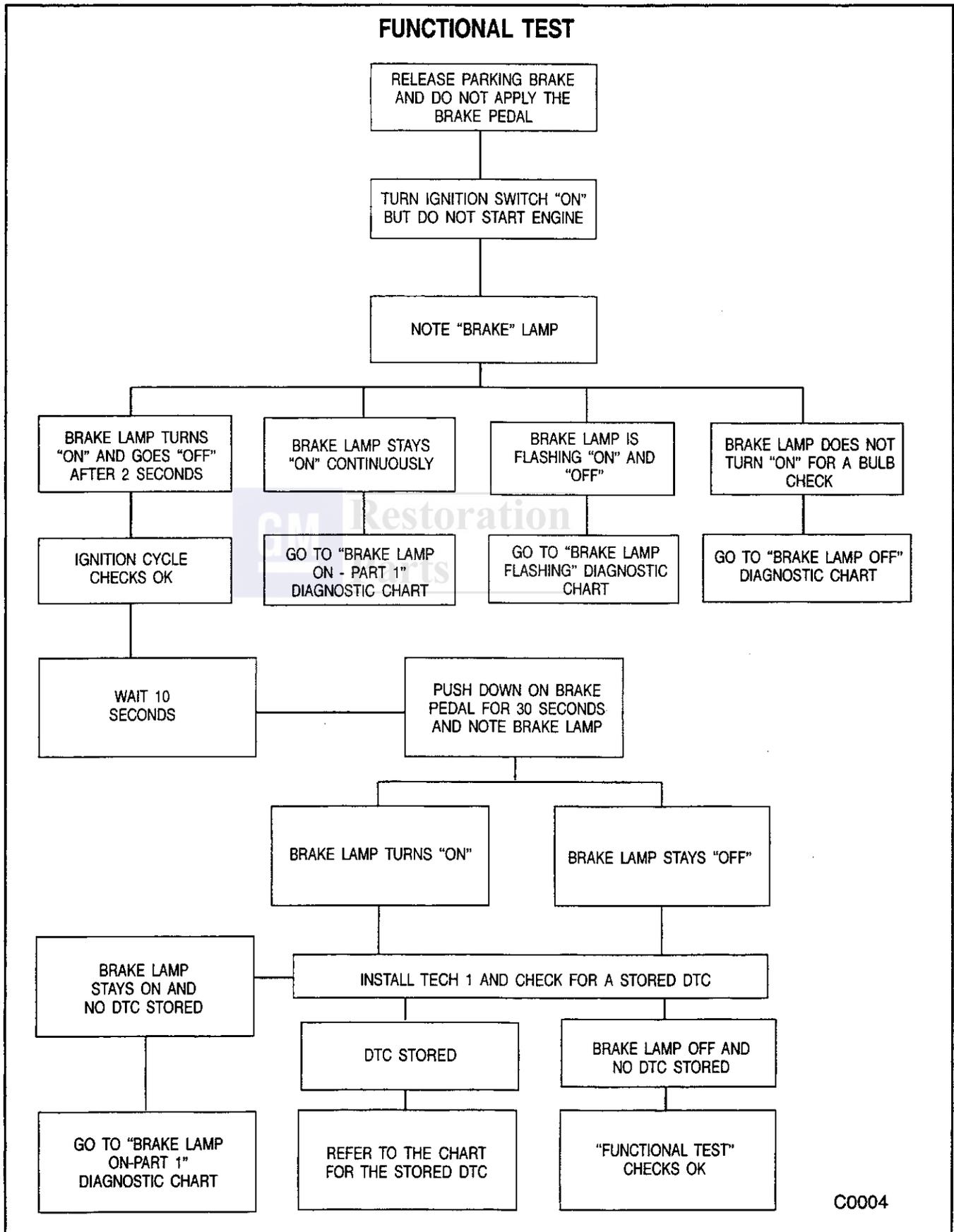
The VSS monitor mode allows you to see the speed signal as the EBCM sees it. This can help you determine if a malfunction relates to the speed signal.

1. Select F4: VSS Monitor from main menu.
2. Speed will be displayed MPH and KPH.

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 6 and 7 for the wiring diagram and connector face views. Diagnostic charts for symptom diagnosis and DTCs follow.

REAR WHEEL ANTILOCK BRAKE SYSTEM 5E3-7



5E3-8 REAR WHEEL ANTILOCK BRAKE SYSTEM

DIAGNOSTIC TROUBLE CODE AND SYMPTOM TABLE		
Diagnostic Trouble Code	Description/Symptom	Page #
—	Brake Lamp On - Part 1	5E3-11
—	Brake Lamp On - Part 2	5E3-12
—	Brake Lamp On - Part 3	5E3-13
—	Intermittent Brake Lamp	5E3-14
—	Brake Lamp Flashing	5E3-15
—	Brake Lamp Off	5E3-16
2	Open Isolation Solenoid or EBCM Malfunction	5E3-18
3	Open Dump Solenoid or EBCM Malfunction	5E3-20
4	Grounded Antilock Pressure Valve Reset Switch	5E3-22
5	Excessive Dump Valve Actuations During an Antilock Stop	5E3-24
6	Erratic Speed Signal	5E3-26
7	Shorted Isolation Solenoid or EBCM Malfunction	5E3-28
8	Shorted Dump Solenoid or EBCM Malfunction	5E3-30
9	Open or Grounded Speed Signal Circuit	5E3-32
10	Stop Lamp Switch Circuit	5E3-34
1, 11, 12	Invalid Diagnostic Trouble Codes	5E3-36
13, 14, 15	Electric Brake Control Module Malfunction	5E3-38

REAR WHEEL ANTILOCK BRAKE SYSTEM 5E3-9

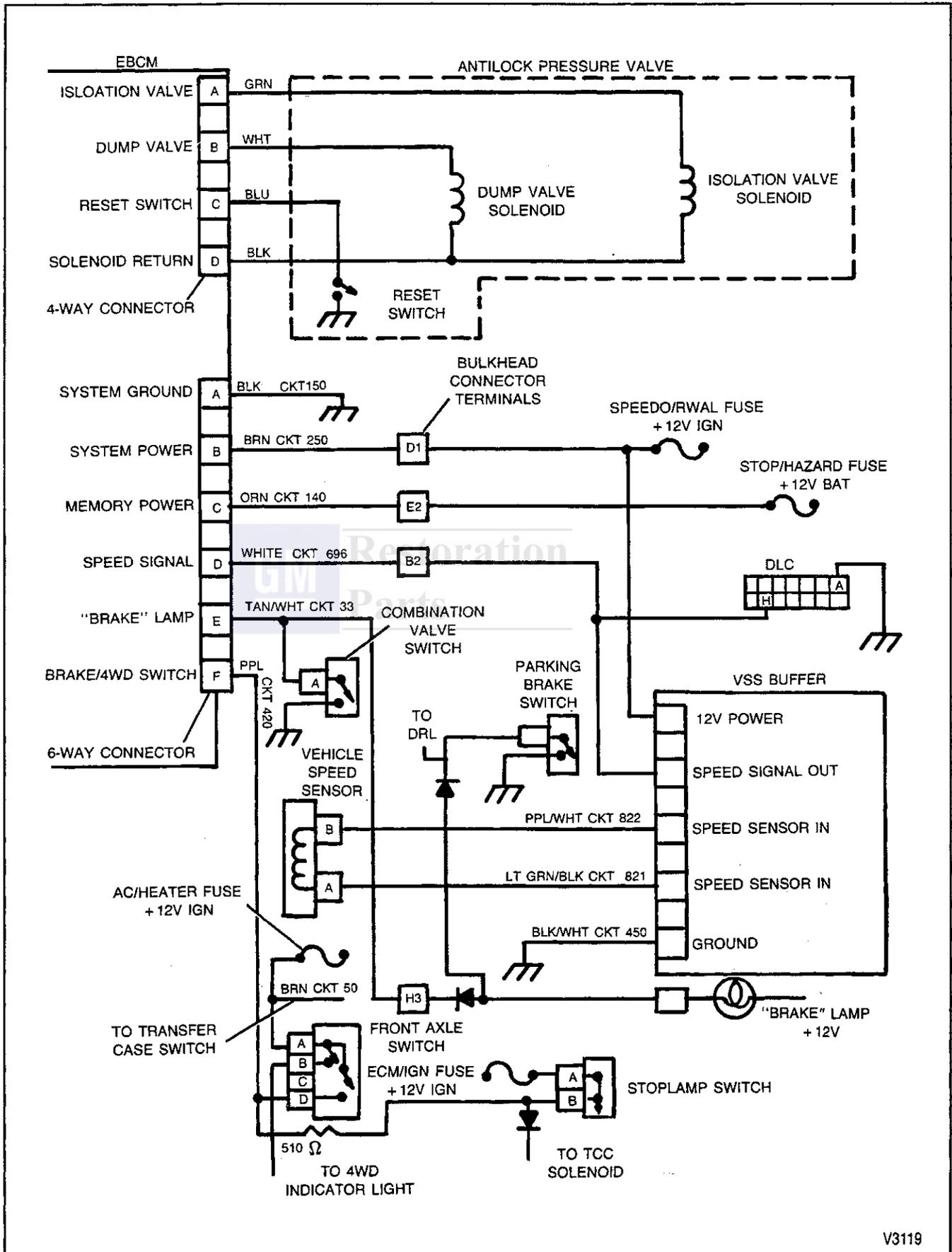
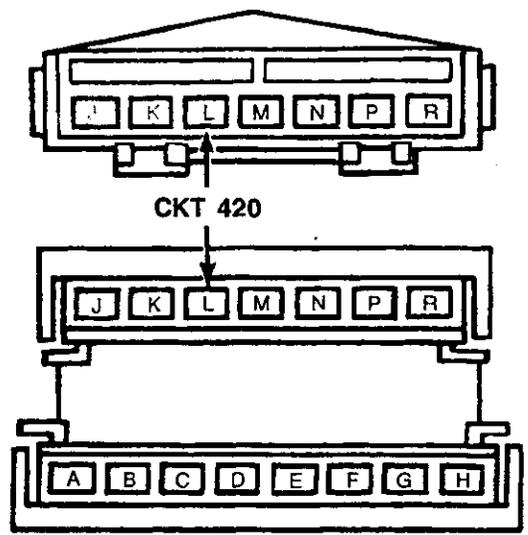
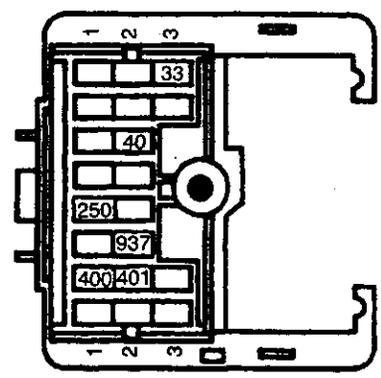


Figure 6—Wiring Diagram

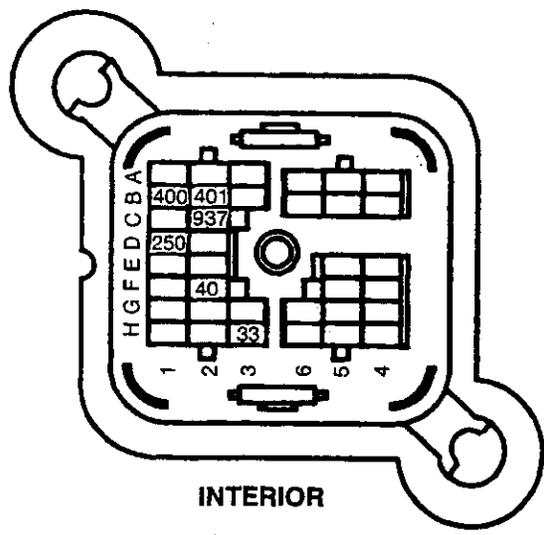
5E3-10 REAR WHEEL ANTILOCK BRAKE SYSTEM



ENGINE HARNESS CONNECTOR



EXTERIOR



INTERIOR

BULKHEAD CONNECTOR

Figure 7—Connector Face Views

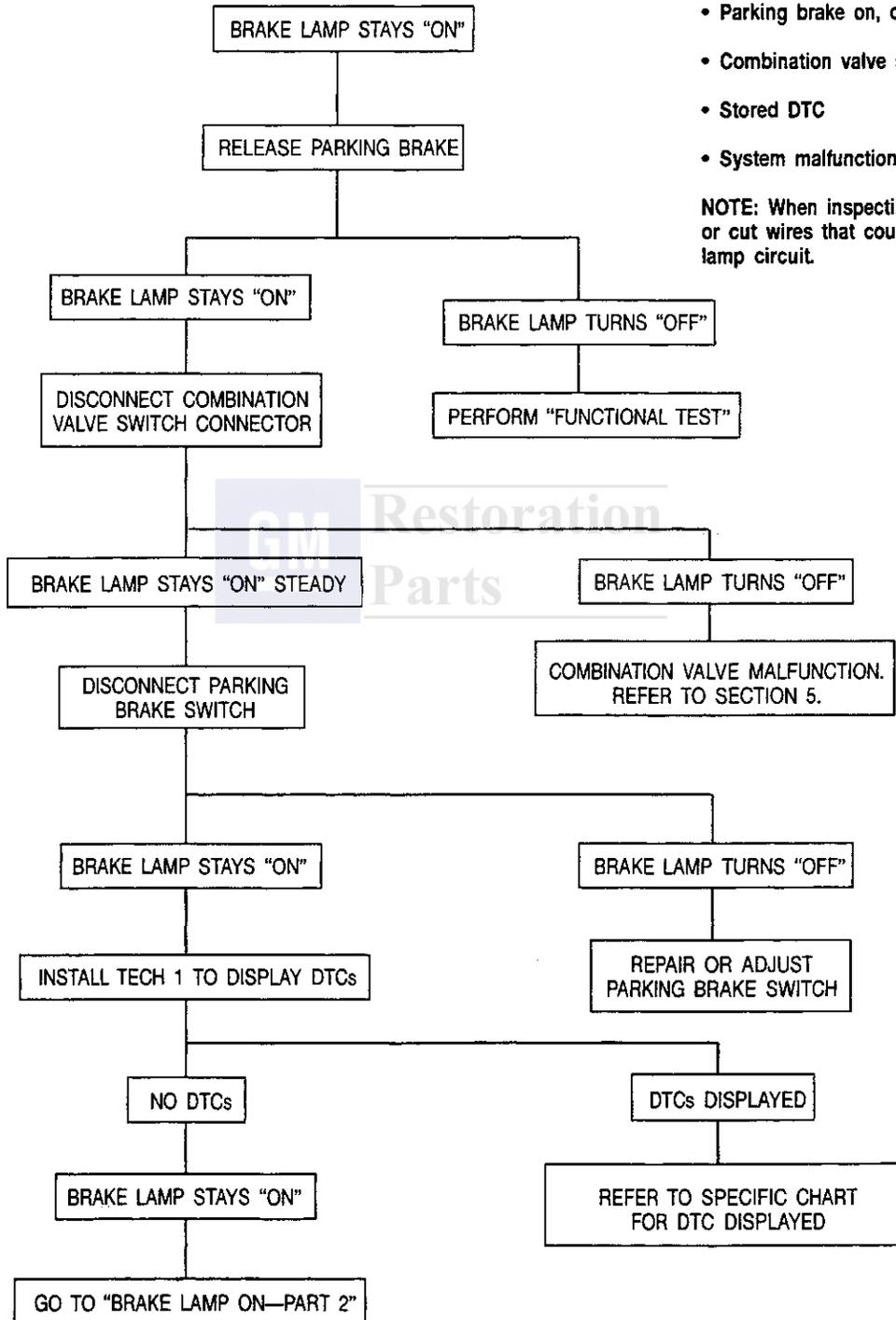
REAR WHEEL ANTILOCK BRAKE SYSTEM 5E3-11

BRAKE LAMP ON—PART 1

This diagnostic chart checks for the following causes:

- Parking brake on, circuit, or switch problem
- Combination valve switch closed
- Stored DTC
- System malfunction

NOTE: When inspecting circuit, check for chafed or cut wires that could be grounding the brake lamp circuit.



5E3-12 REAR WHEEL ANTILOCK BRAKE SYSTEM

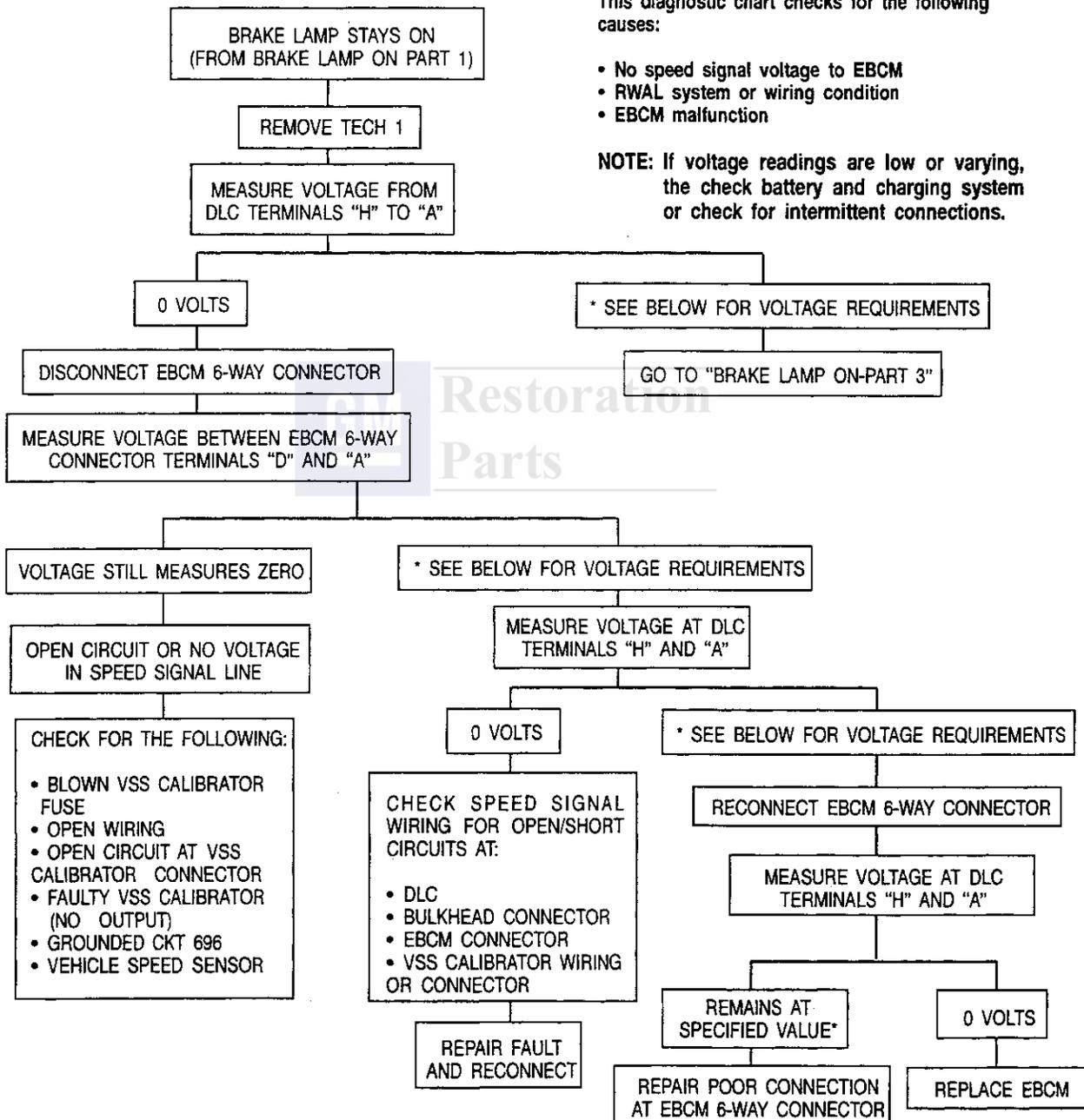
BRAKE LAMP ON—PART 2

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.

This diagnostic chart checks for the following causes:

- No speed signal voltage to EBCM
- RWAL system or wiring condition
- EBCM malfunction

NOTE: If voltage readings are low or varying, the check battery and charging system or check for intermittent connections.



- * RWAL AND ZPRWAL EBCMS HAVE DIFFERENT VOLTAGE REQUIREMENTS.
 —ZPRWAL (EBCM WITH GRAY CONNECTOR END — 30 SERIES HD) 6 TO 15 VOLTS
 —RWAL (EBCM WITH BLACK CONNECTOR END — ALL OTHER MODELS) 8 TO 15 VOLTS

BRAKE LAMP ON—PART 3

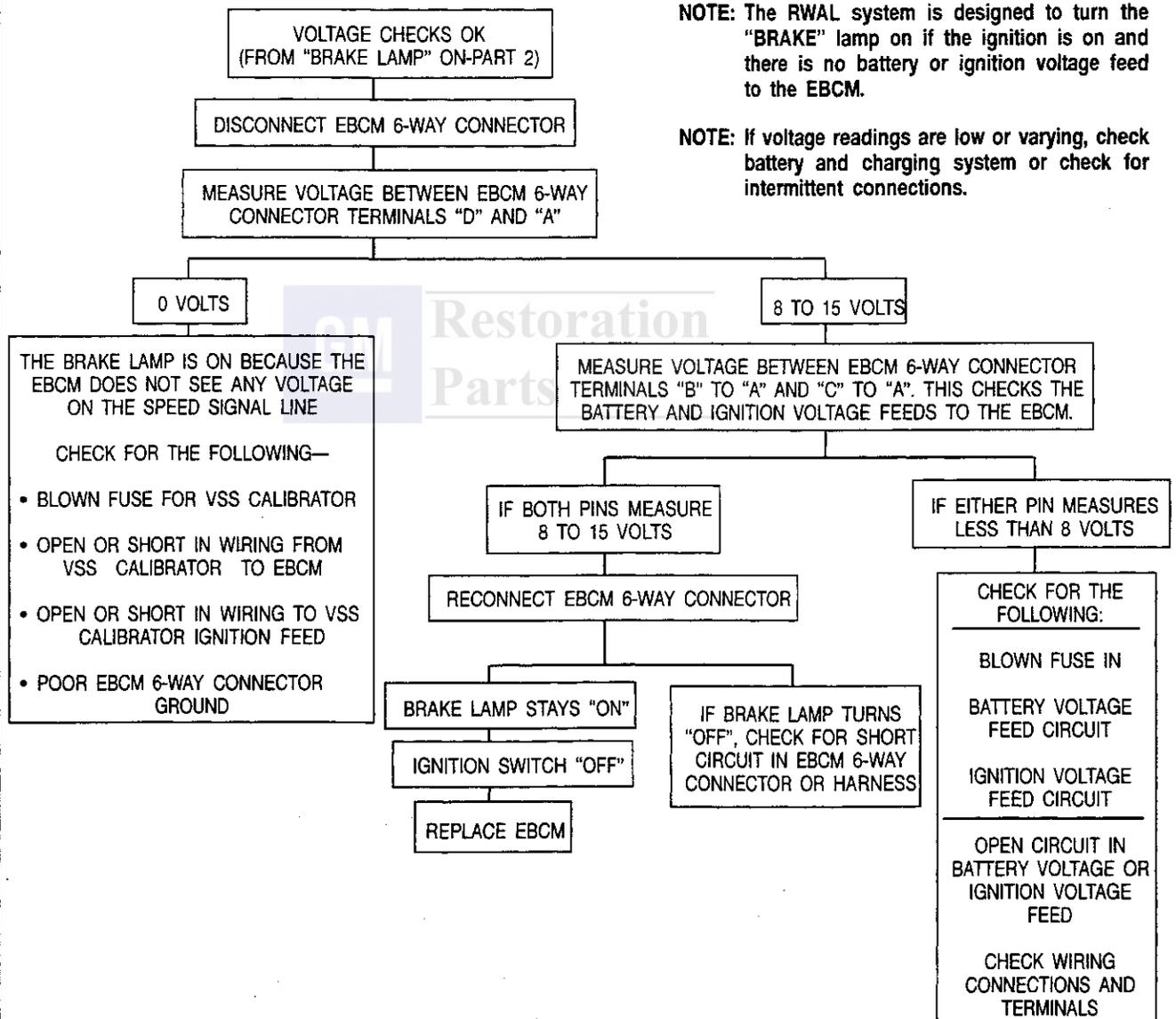
NOTICE WHEN MEASUREMENTS ARE REQUESTED IN THIS CHART, USE J 39200 DVM. WHEN A CHECK FOR PROPER CONNECTION IS REQUESTED, REFER TO "INTERMITTENTS AND POOR CONNECTIONS" IN THE DRIVEABILITY, EMISSIONS AND ELECTRICAL DIAGNOSIS MANUAL.

This diagnostic chart checks for the following causes:

- No Power to VSS calibrator
- No battery voltage feed to EBCM
- No Ignition voltage feed to EBCM
- EBCM malfunction

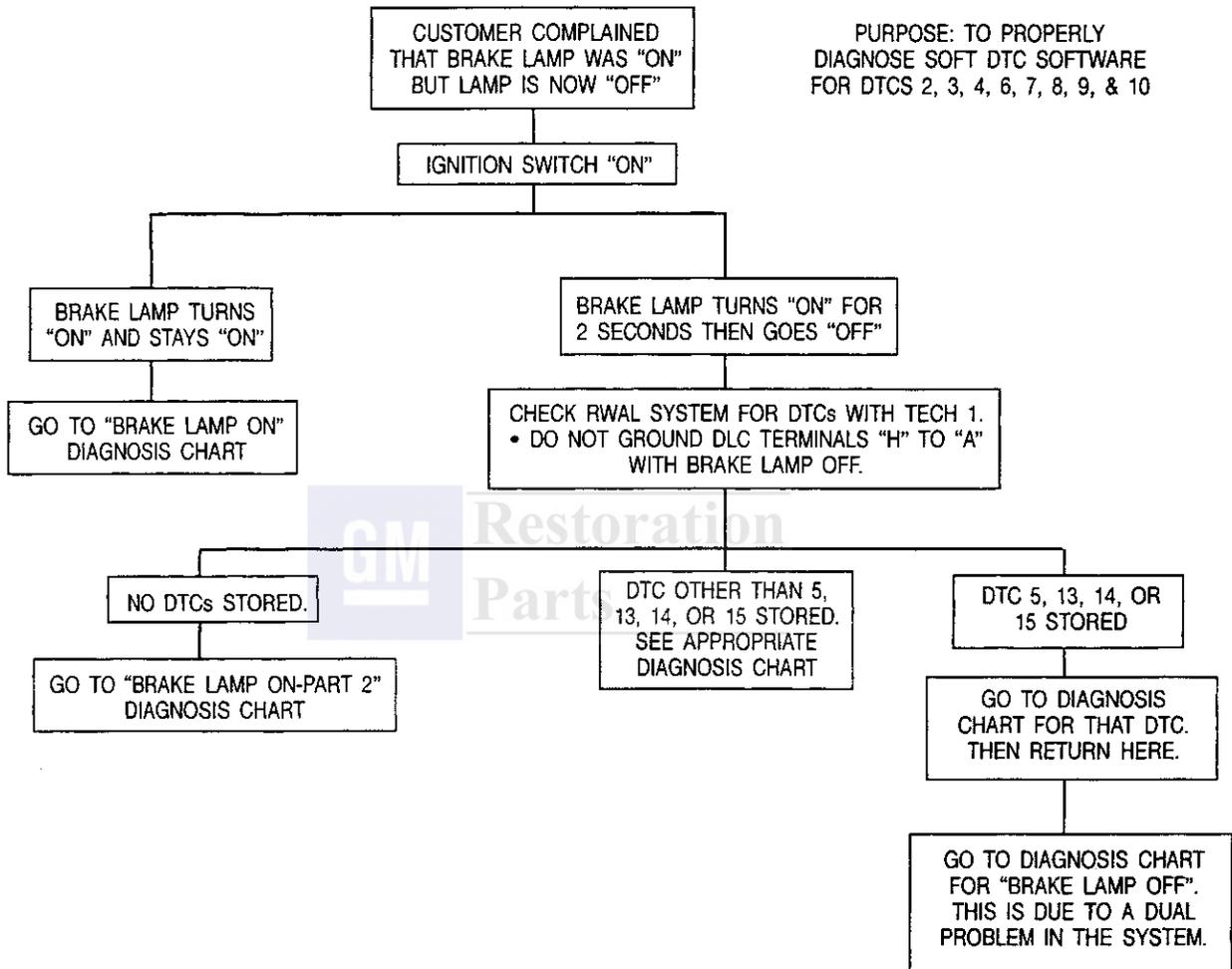
NOTE: The RWAL system is designed to turn the "BRAKE" lamp on if the ignition is on and there is no battery or ignition voltage feed to the EBCM.

NOTE: If voltage readings are low or varying, check battery and charging system or check for intermittent connections.



5E3-14 REAR WHEEL ANTILOCK BRAKE SYSTEM

INTERMITTENT BRAKE LAMP



- DO NOT ATTEMPT TO GROUND DLC TERMINALS "H" TO "A" WHEN THE BRAKE LAMP IS OFF. RESULT WILL BE A FALSE DTC 9 STORED.

- SOFT DTCS 2, 3, 4, 6, 7, 8, 9, & 10 HAVE BEEN INTRODUCED DUE TO INTERMITTENT CONNECTIONS. IF THE CONDITION GOES AWAY THE DTC WILL BE STORED TO AID IN DIAGNOSTICS. HOWEVER, THE BRAKE LAMP WILL BE TURNED OFF WITH THE NEXT TIME THE IGNITION SWITCH IS TURNED "OFF" AND THE BRAKE LAMP WILL BE TURNED OFF WITH DTC 10 WHEN THE EBCM SEES 12 VOLTS FROM THE BRAKE SWITCH.

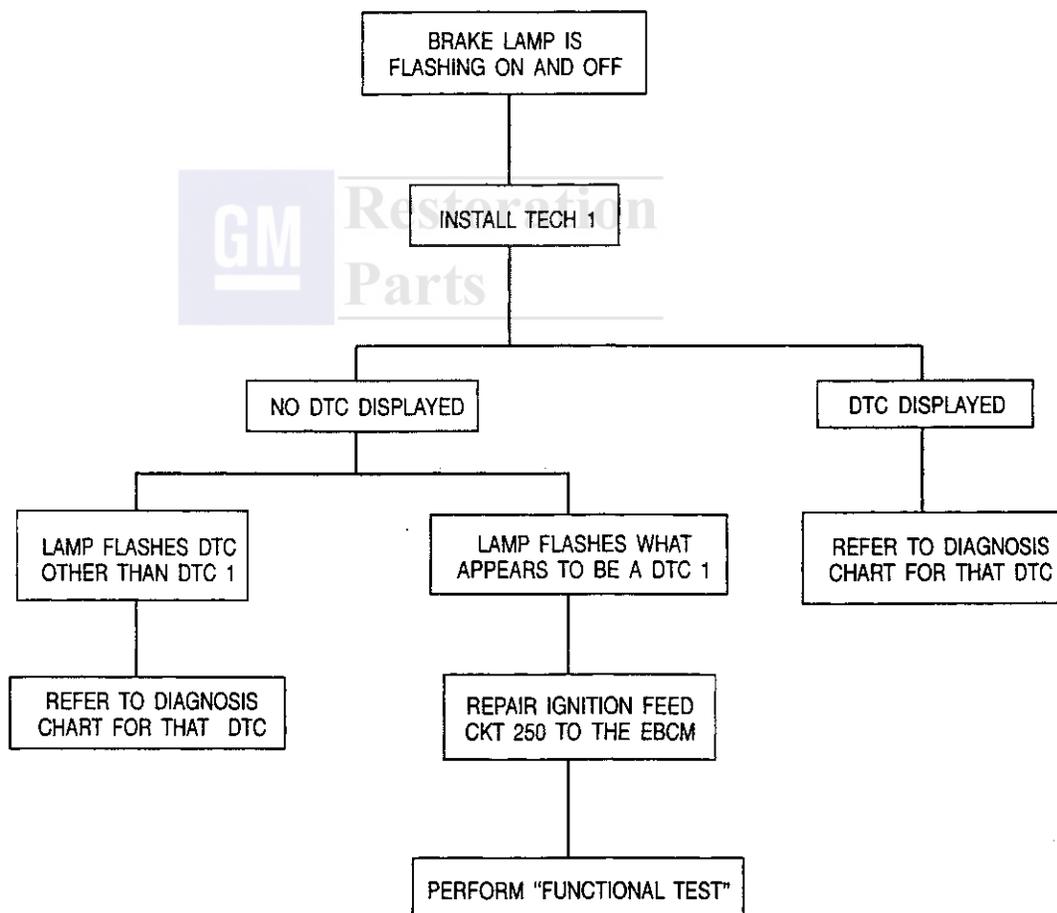
BRAKE LAMP FLASHING

THIS DIAGNOSTIC CHART CHECKS FOR THE FOLLOWING CAUSES:

- INTERMITTENT SPEED SIGNAL VOLTAGE TO THE EBCM
- SYSTEM MALFUNCTION (STORED DTC)

NOTE: IF VOLTAGE READINGS ARE TOO LOW OR VARYING, CHECK BATTERY AND CHARGING SYSTEM OR CHECK FOR INTERMITTENT CONNECTIONS.

NOTE: DTC MAY BE FLASHED OUT UNDER UNUSUAL CIRCUMSTANCES.

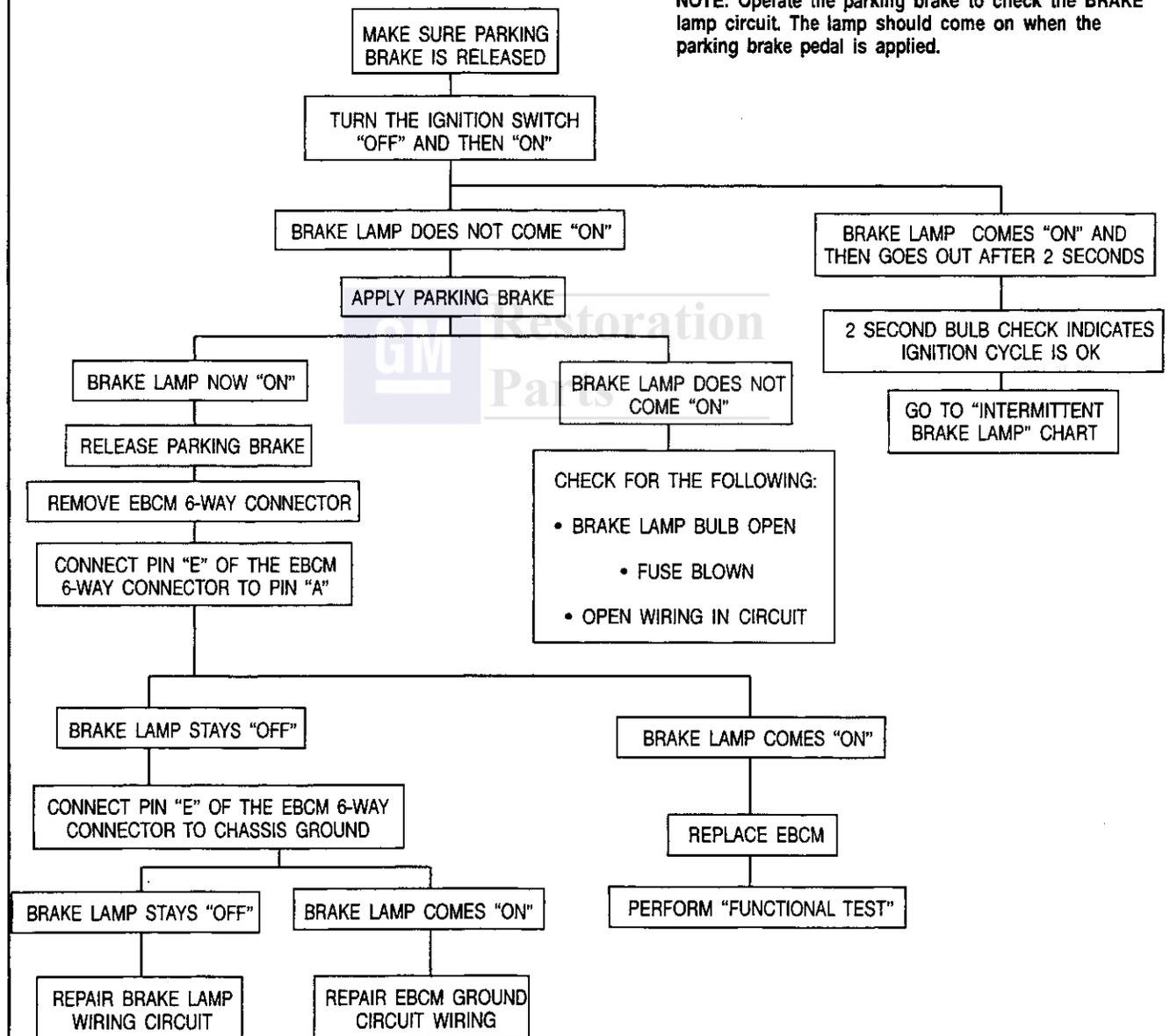


5E3-16 REAR WHEEL ANTILOCK BRAKE SYSTEM

BRAKE LAMP OFF

The EBCM should perform a BRAKE lamp check when the ignition switch is turned "ON". The EBCM turns the BRAKE lamp on for 2 seconds then turns it off. The Brake lamp going out after 2 seconds indicates that the EBCM ignition cycle checked ok.

NOTE: Operate the parking brake to check the BRAKE lamp circuit. The lamp should come on when the parking brake pedal is applied.

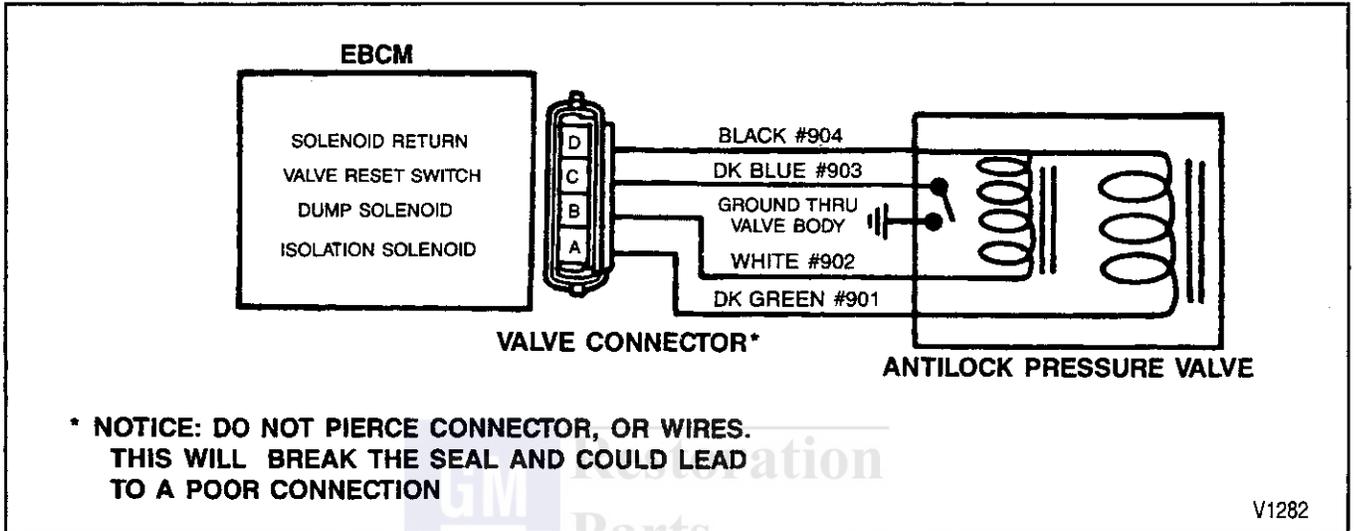


REAR WHEEL ANTILOCK BRAKE SYSTEM 5E3-17



BLANK

5E3-18 REAR WHEEL ANTILOCK BRAKE SYSTEM



DIAGNOSTIC TROUBLE CODE 2 OPEN ISOLATION SOLENOID OR EBCM MALFUNCTION

CIRCUIT DESCRIPTION:

A DTC 2 relates to an open in the APV isolation valve circuit. The EBCM uses the isolation valve to maintain and increase pressure in the brake pipes during an antilock stop. An open in the solenoid winding or circuit prevents the EBCM from controlling the rear wheels when a speed decrease is detected.

TEST DESCRIPTION:

- Check for continuity through the isolation solenoid winding.
- Check for a consistent DTC being set after clearing the memory.

- Check for corrosion or poor contact in the solenoid electrical terminals.
- Check the resistance of the solenoid after the terminal repair to see if it corrected the open condition.

DIAGNOSTIC AIDS:

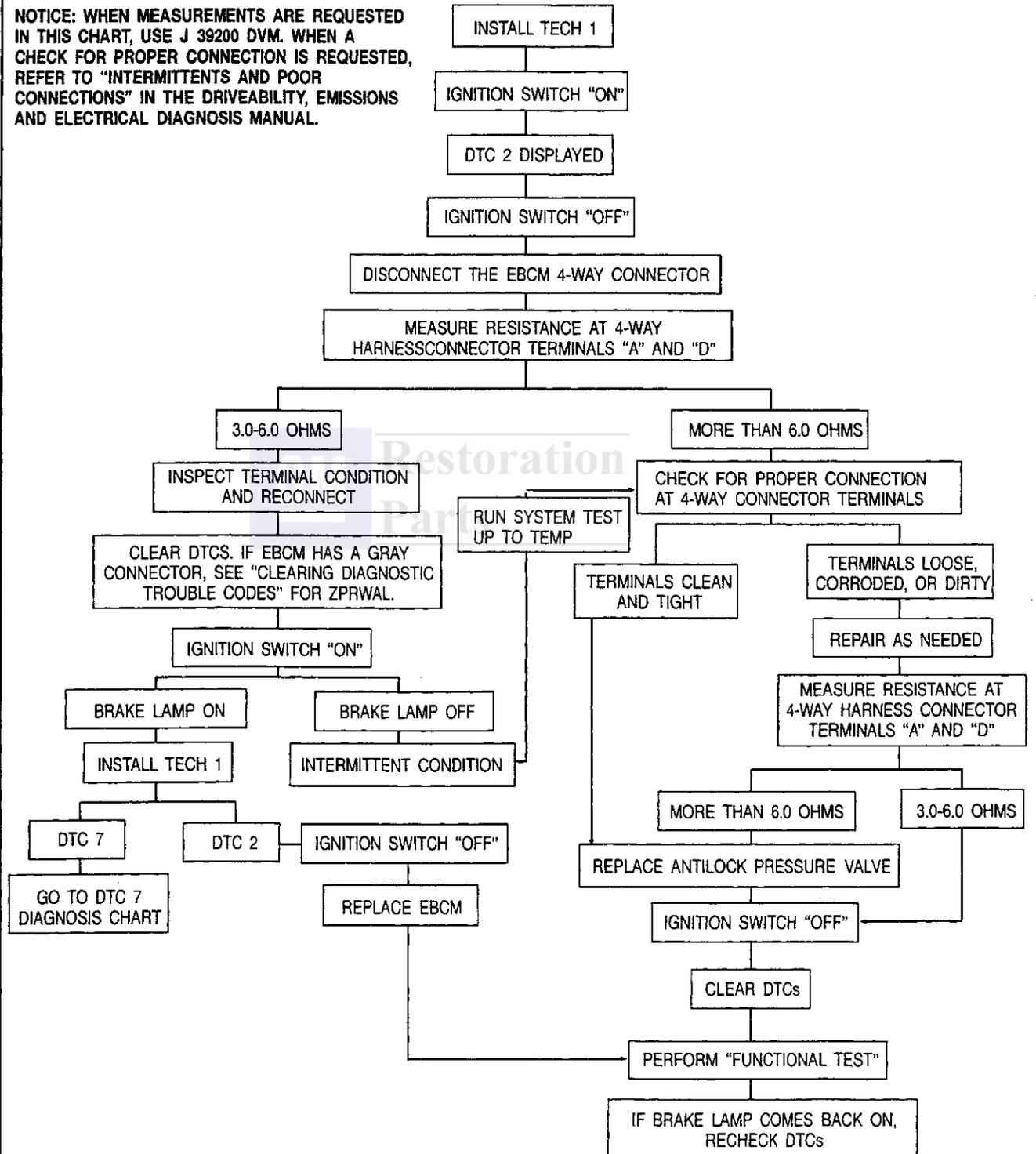
A DTC 2 will set if the 4-way connector is disconnected and the ignition switch is turned on or the 6-way connector is plugged in before the 4-way connector with the ignition switch on.

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.

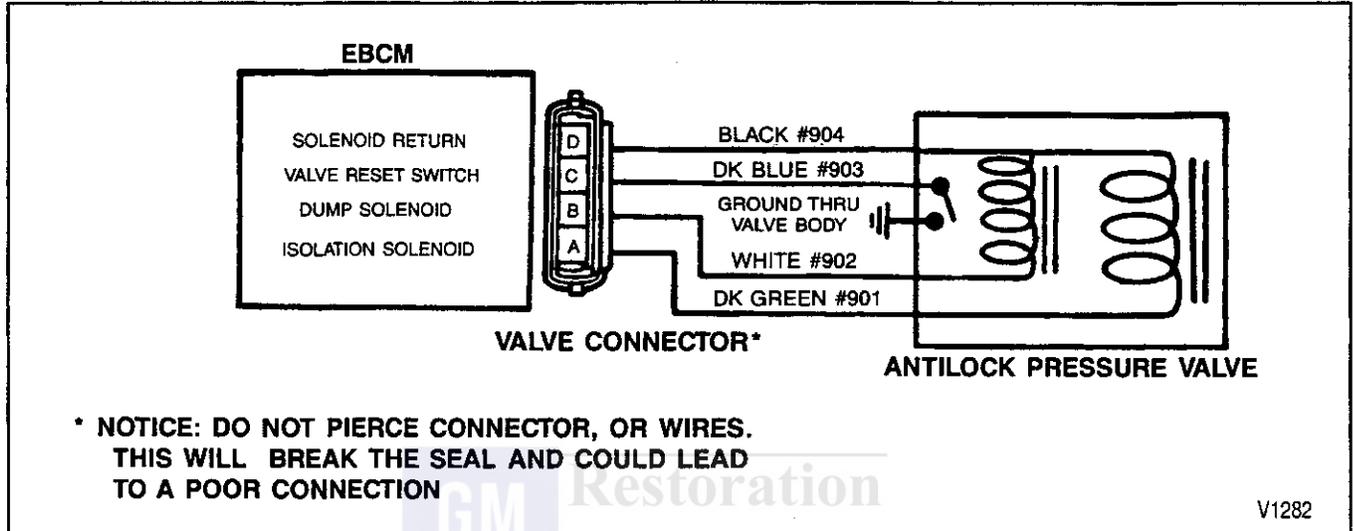
REAR WHEEL ANTILOCK BRAKE SYSTEM 5E3-19

DTC 2 OPEN ISOLATION SOLENOID OR EBCM MALFUNCTION

NOTICE: WHEN MEASUREMENTS ARE REQUESTED 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.



5E3-20 REAR WHEEL ANTILOCK BRAKE SYSTEM



DIAGNOSTIC TROUBLE CODE 3 OPEN DUMP SOLENOID OR EBCM MALFUNCTION

CIRCUIT DESCRIPTION:

A DTC 3 relates to an open in the APV dump valve circuit. The EBCM uses the dump valve to reduce fluid pressure in the brake lines when it senses the wheel is locking up. The fluid pressure is routed to an accumulator. An open dump solenoid prevents the EBCM from reducing the pressure and the wheel will continue to lock up.

TEST DESCRIPTION:

- Check for continuity through the dump solenoid winding.
- Check for a consistent DTC being set after clearing the memory.

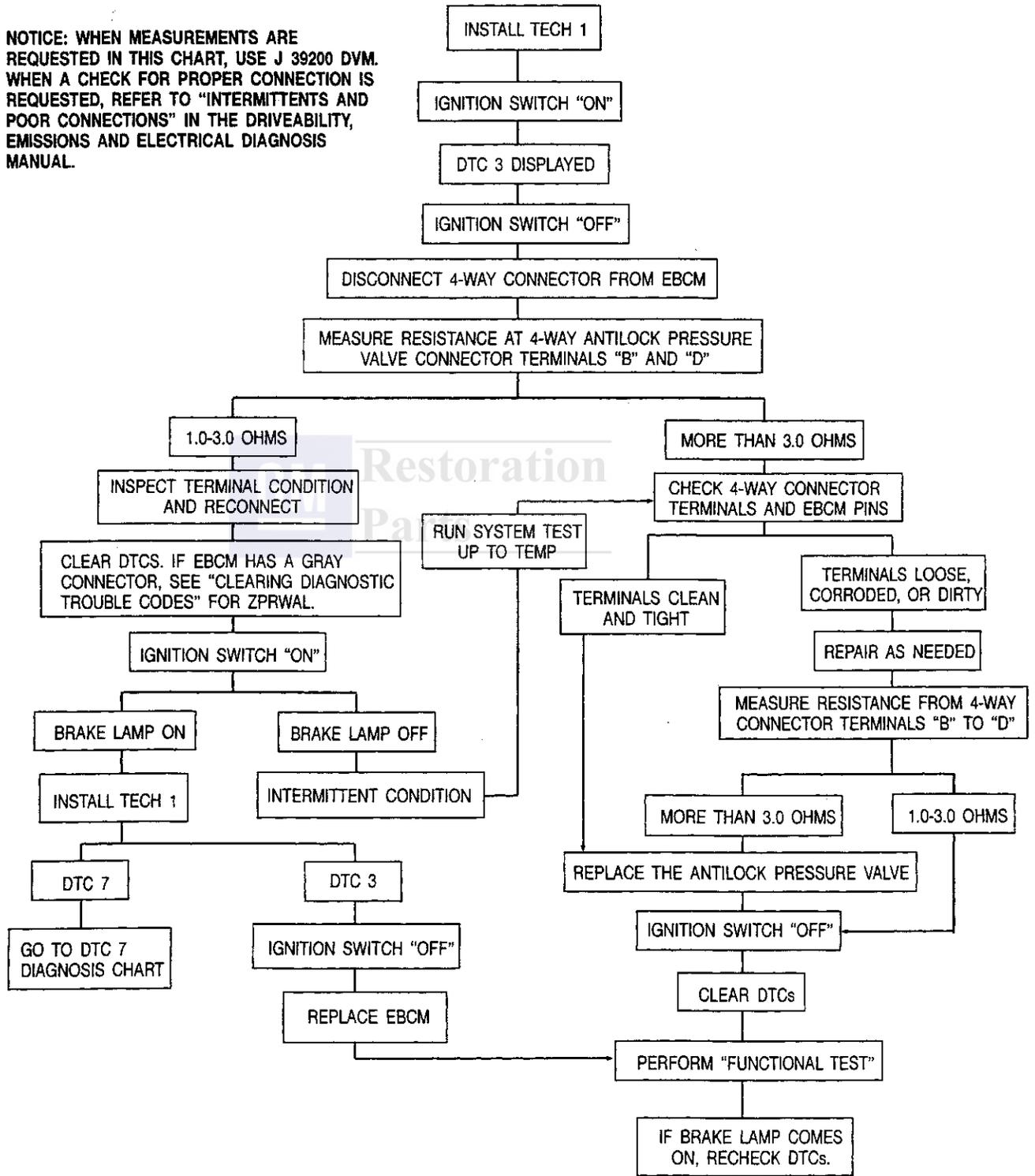
- Check for corrosion or poor contact in the solenoid electrical terminals.
- Check the resistance of the solenoid after the terminal repair to see if it corrected the open condition.

DIAGNOSTIC AIDS:

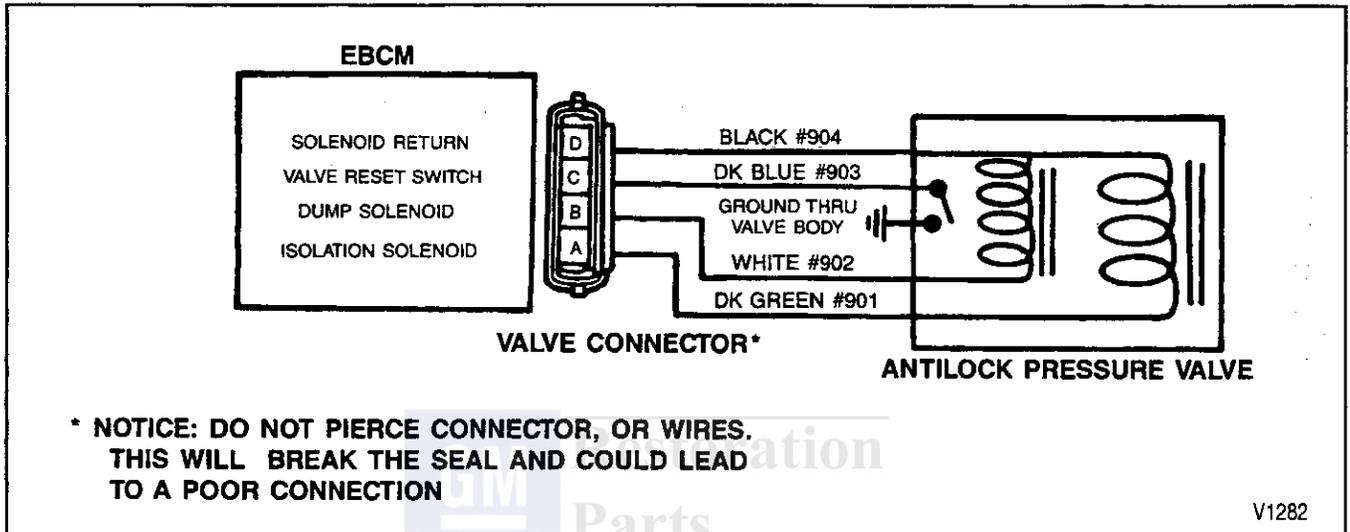
Do not pierce the electrical connectors, wires, seals, or insulation during testing. Doing so will break the seal and lead to corrosion and failure of the wiring and terminals.

DTC 3 OPEN DUMP SOLENOID OR EBCM MALFUNCTION

NOTICE: WHEN MEASUREMENTS ARE REQUESTED 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.



5E3-22 REAR WHEEL ANTILOCK BRAKE SYSTEM



DIAGNOSTIC TROUBLE CODE 4 GROUNDED ANTILOCK PRESSURE VALVE RESET SWITCH

CIRCUIT DESCRIPTION:

A DTC 4 relates to a grounded condition in the APV reset switch. The reset switch grounds pin C of the EBCM 4-way connector when there is a great enough difference between inlet and outlet pressure in the anti-lock pressure valve. An example of this is during a pressure decrease operation. With a grounded reset switch, the EBCM has no way of determining if pressure changes are occurring in the anti-lock pressure valve. The reset switch is constantly signaling that pressure decrease has occurred.

TEST DESCRIPTION:

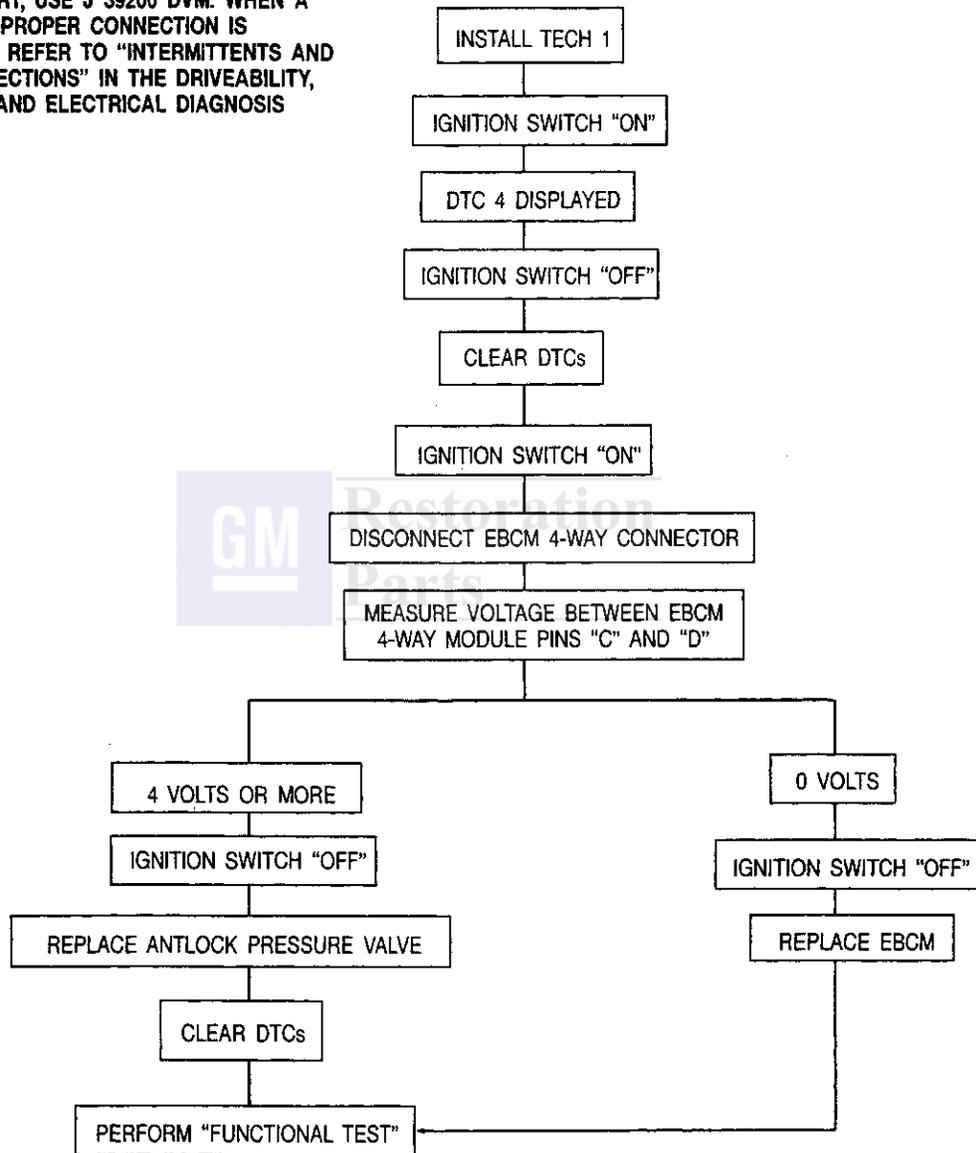
- Clear the DTCs in the EBCM memory.
- Check the voltage signal to the reset switch to see if the EBCM is operational.

DIAGNOSTIC AIDS:

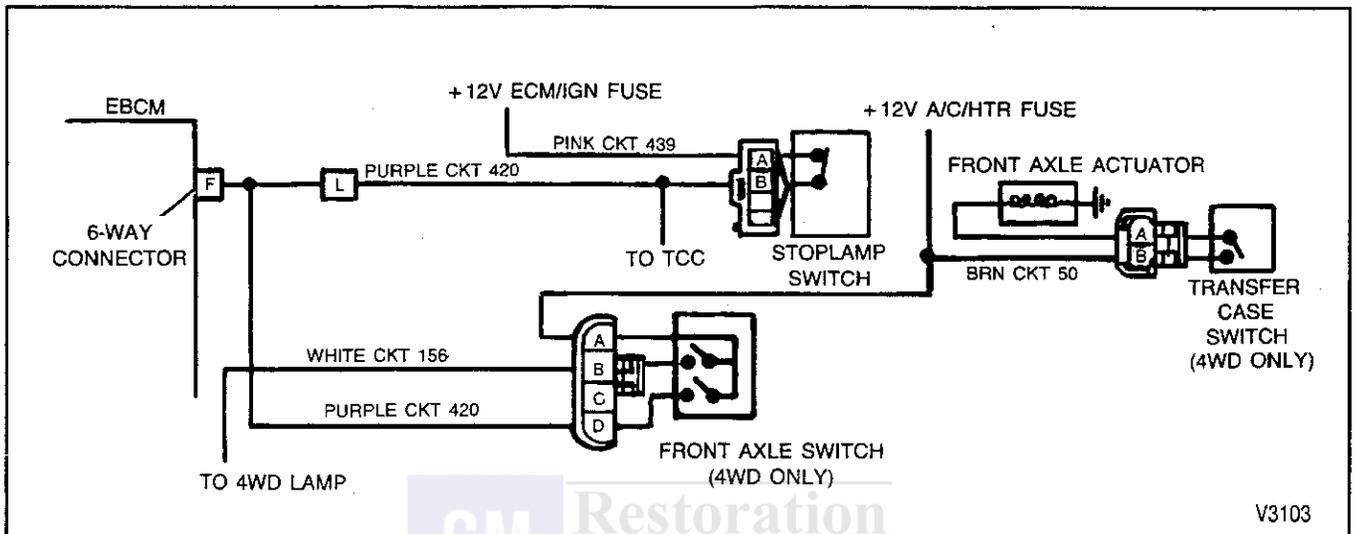
Do not pierce the electrical connectors, wires, seals, or insulation during testing. Doing so will break the seal and lead to corrosion and failure of the wiring and terminals.

**DTC 4
GROUNDED ANTILOCK PRESSURE VALVE RESET SWITCH**

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.



5E3-24 REAR WHEEL ANTILOCK BRAKE SYSTEM



DIAGNOSTIC TROUBLE CODE 5 EXCESSIVE DUMP VALVE ACTUATIONS DURING AN ANTILOCK STOP

CIRCUIT DESCRIPTION:

A DTC 5 relates to a condition where the EBCM is having to cycle the dump valve too many times during an antilock stop. A mechanical locking condition in the rear brakes or powertrain can cause this DTC to set. This DTC can also be set if the RWAL system is working with the vehicle in 4WD.

TEST DESCRIPTION:

- Check if the rear brakes or powertrain are causing the malfunction.
- This test only applies to vehicles with 4WD. Check if the front axle switch can turn on the 4WD indicator on the instrument cluster.

- Check if the voltage is present in CKT 420.
- Check the operation of the front axle switch.
- Check for the 4WD voltage signal at the EBCM.

DIAGNOSTIC AIDS:

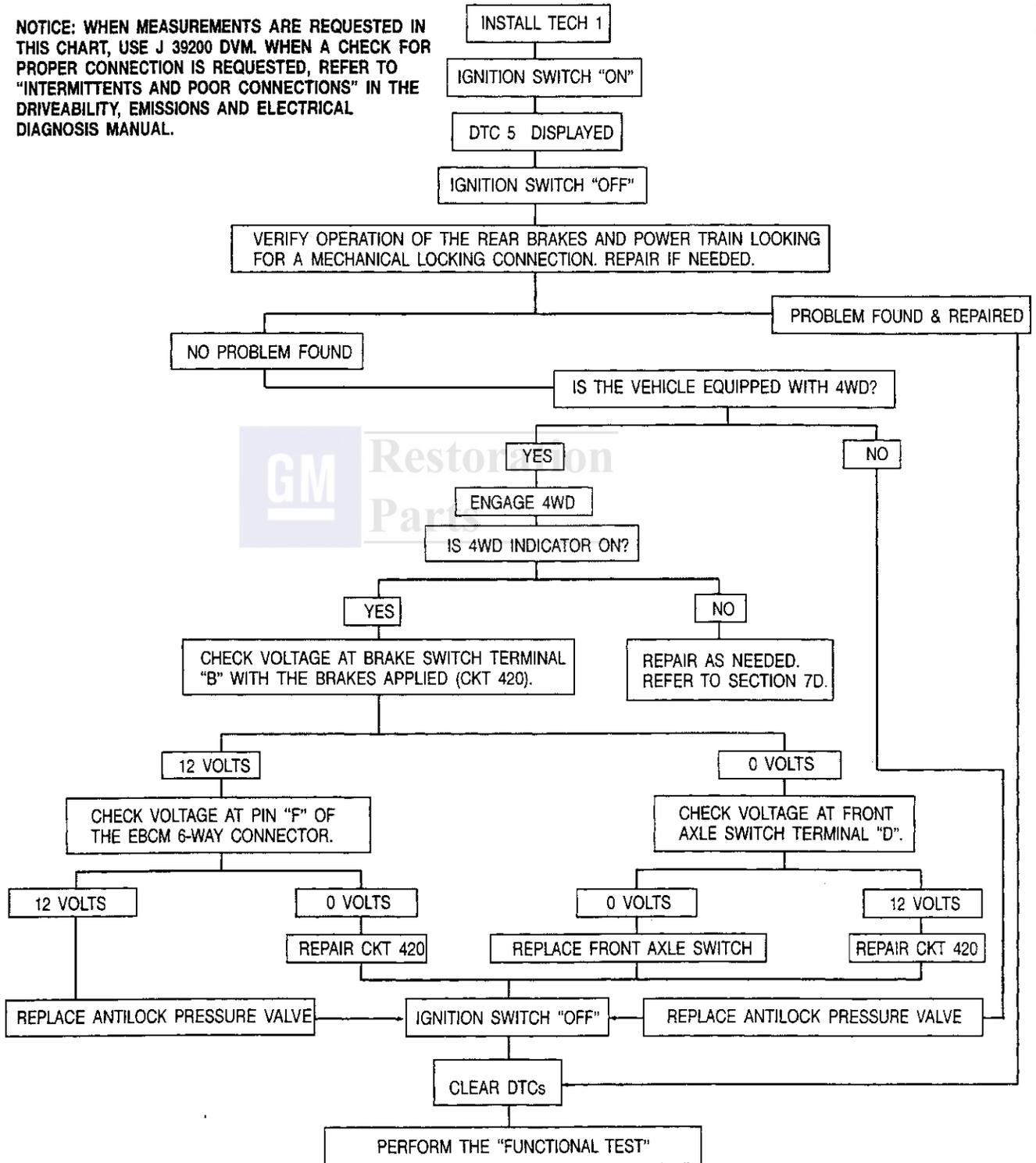
Do not pierce the electrical connectors, wires, seals, or insulation during testing. Doing so will break the seal and lead to corrosion and failure of the wiring and terminals.

V3103

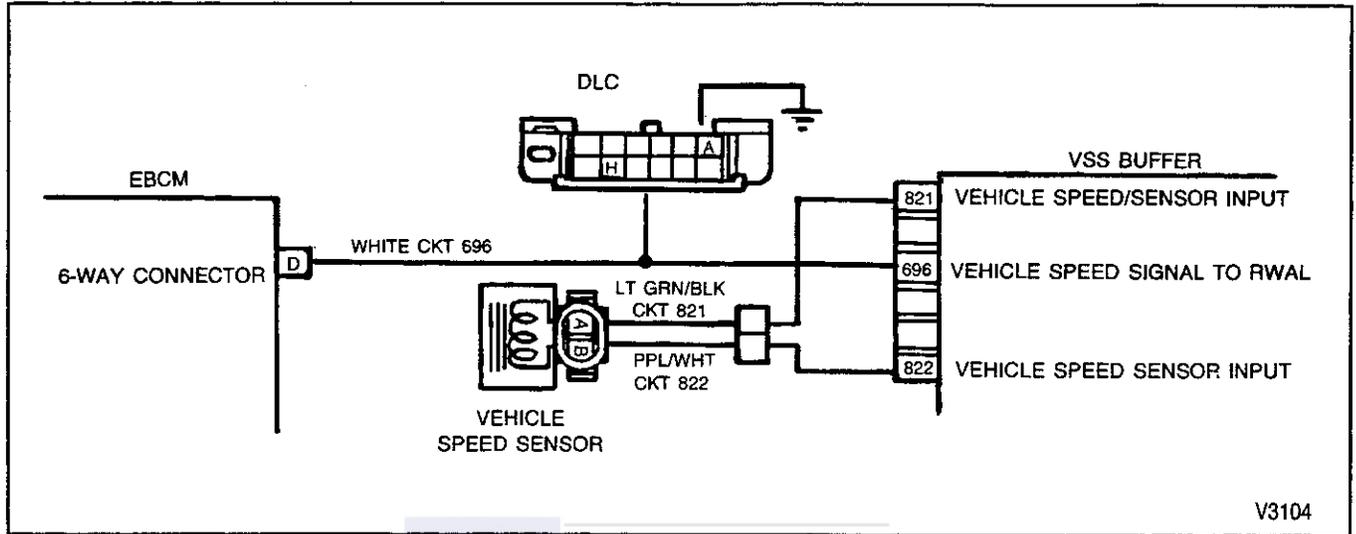
REAR WHEEL ANTILOCK BRAKE SYSTEM 5E3-25

DTC 5 EXCESSIVE DUMP VALVE ACTUATIONS DURING AN ANTILOCK STOP

NOTICE: WHEN MEASUREMENTS ARE REQUESTED 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.



5E3-26 REAR WHEEL ANTILOCK BRAKE SYSTEM



DIAGNOSTIC TROUBLE CODE 6 ERRATIC SPEED SIGNAL

CIRCUIT DESCRIPTION:

A DTC 6 is a soft fault. If the speed signal line to the EBCM drops out and returns often, this DTC is set in memory. The "BRAKE" lamp will illuminate when the DTC is set and turn off with the next ignition cycle. **Do not replace the EBCM to repair this DTC.** An erratic speed signal relates to a malfunction in either the VSS, VSS buffer, or speed signal circuit. It can be set by a poor connection in the speed signal line.

TEST DESCRIPTION:

- Check if all systems are receiving an erratic speed signal or if it is just the RWAL system.
- Check the VSS output using the Tech 1.
- Check the resistance of the VSS.
- Check for an open condition in CKT 822.
- Check for excessive resistance in CKT 696.

DIAGNOSTIC AIDS:

! Important

- Do not replace the EBCM for this DTC. An EBCM malfunction will not cause this DTC to set.

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.

This DTC is a soft fault and can be set with a 2WD transmission on ice wheel spins.

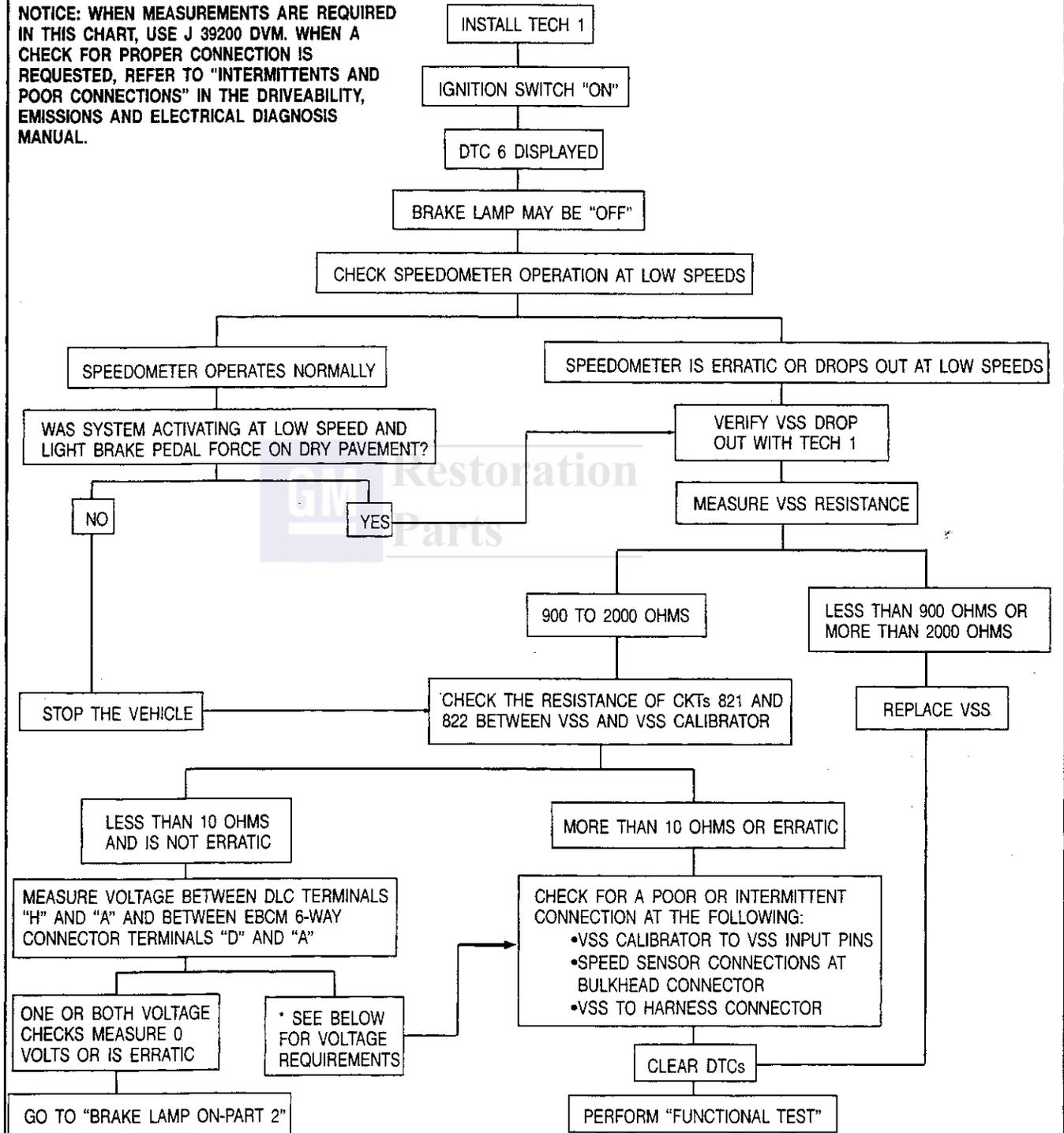
If the "BRAKE" lamp is not on, do not ground DLC terminals H to A. Doing so will set a false DTC 9.

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.

REAR WHEEL ANTILOCK BRAKE SYSTEM 5E3-27

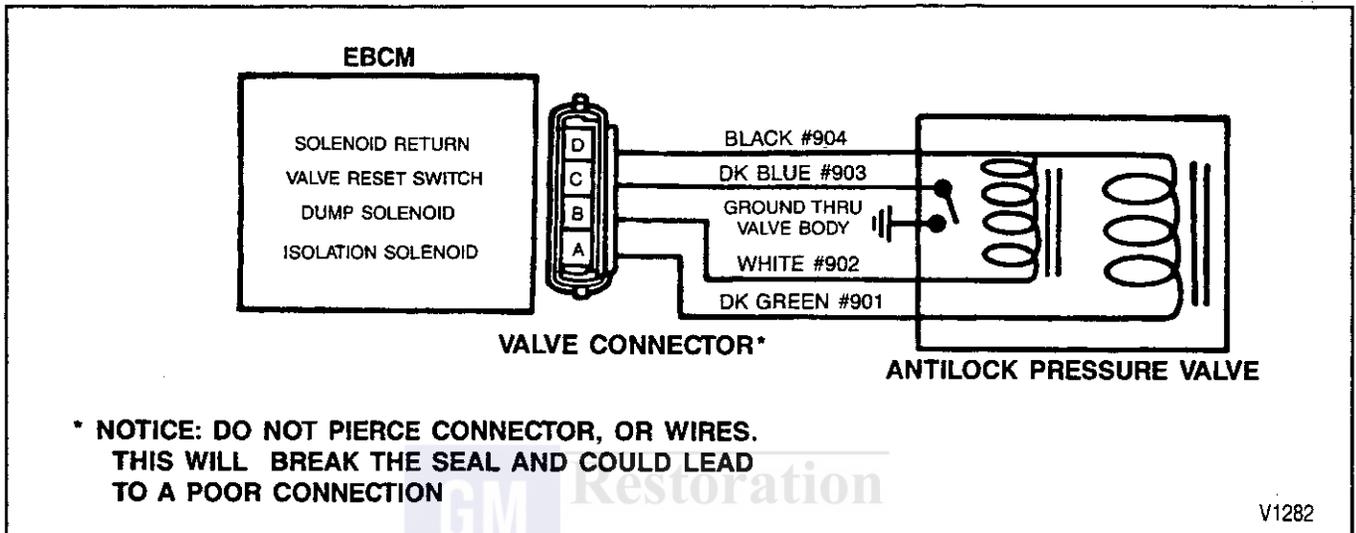
DTC 6 ERRATIC SPEED SIGNAL

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.



*RWAL AND ZPRWAL EBCMS HAVE DIFFERENT VOLTAGE REQUIREMENTS.
 —ZPRWAL (EBCM WITH GRAY CONNECTOR END — 30 SERIES HD) 6 TO 15 VOLTS
 —RWAL (EBCM WITH BLACK CONNECTOR END — ALL OTHER MODELS) 8 TO 15 VOLTS

5E3-28 REAR WHEEL ANTILOCK BRAKE SYSTEM



DIAGNOSTIC TROUBLE CODE 7 SHORTED ISOLATION SOLENOID OR EBCM MALFUNCTION

CIRCUIT DESCRIPTION:

A DTC 7 sets when the EBCM detects a short in the isolation valve solenoid or circuit. With the isolation valve shorted the EBCM cannot provide any of the pressure control functions. The short can be located in the APV, EBCM, or circuit between them.

TEST DESCRIPTION:

- Check the EBCM's internal circuitry for the isolation valve solenoid.
- Check the resistance of the isolation solenoid winding.

- Check if the connector repair corrected the condition.
- Check for a short to ground in the APV.

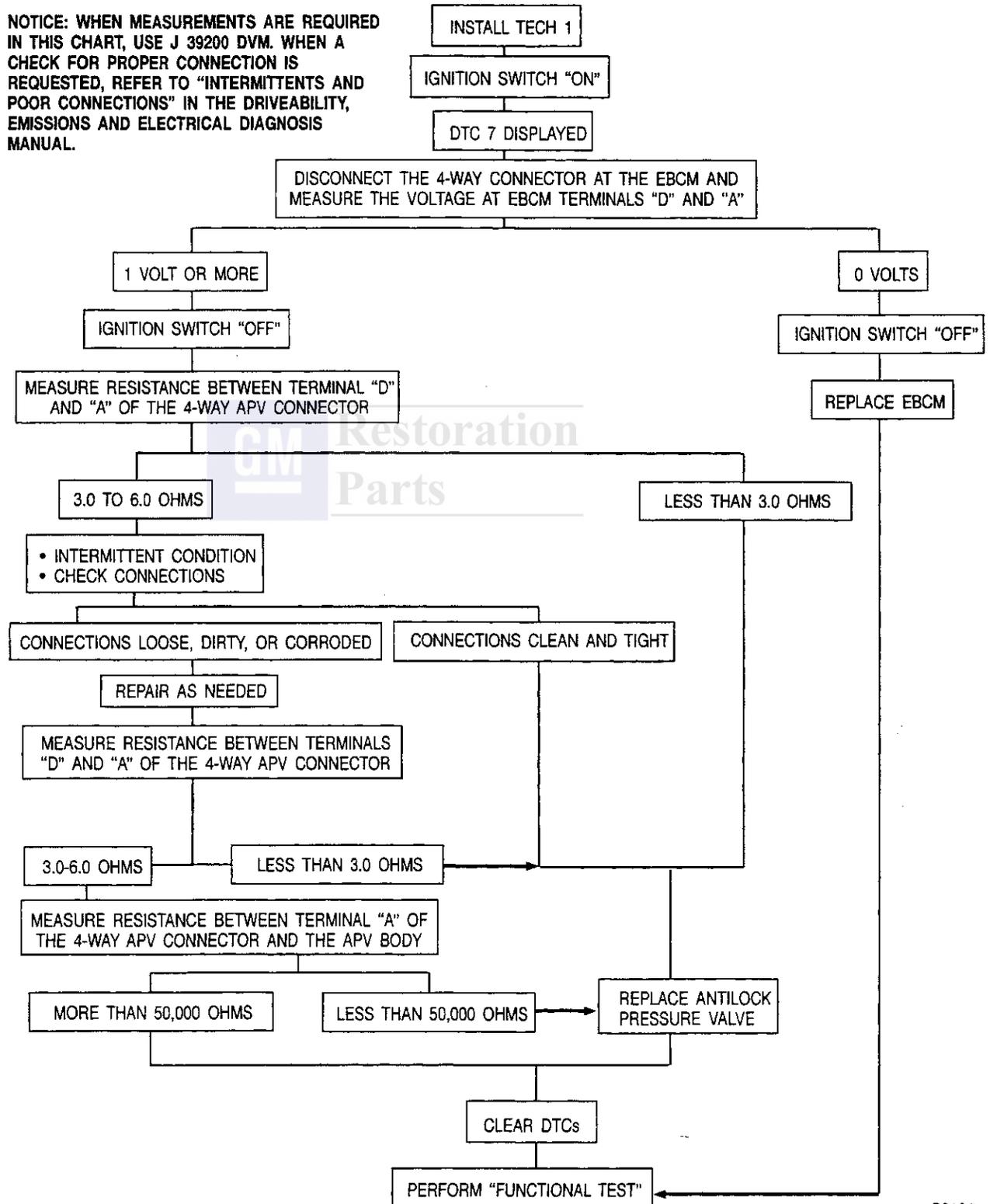
DIAGNOSTIC AIDS:

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.

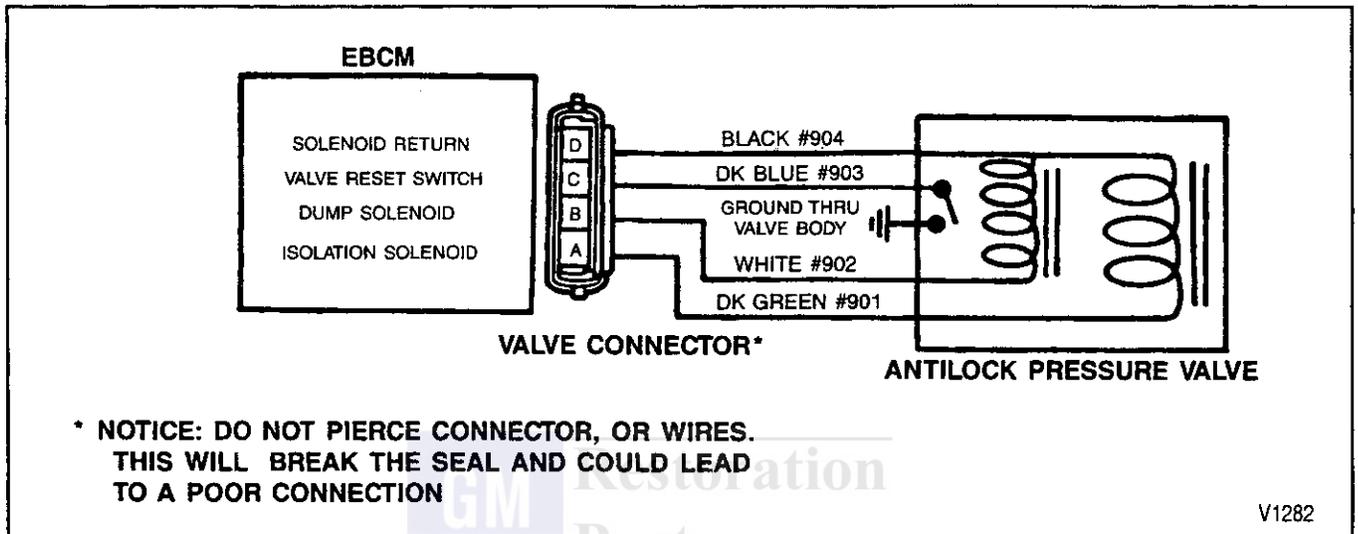
REAR WHEEL ANTILOCK BRAKE SYSTEM 5E3-29

DTC 7 SHORTED ISOLATION SOLENOID OR EBCM MALFUNCTION

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.



5E3-30 REAR WHEEL ANTILOCK BRAKE SYSTEM



DIAGNOSTIC TROUBLE CODE 8 SHORTED DUMP SOLENOID OR EBCM MALFUNCTION

CIRCUIT DESCRIPTION:

A DTC 8 sets when the EBCM detects a short in the dump valve solenoid or circuit. Without the use of the dump valve, the EBCM cannot allow a pressure decrease or relieve the brake fluid in the accumulator. This DTC can be caused by a short in the APV, EBCM, or circuit between them.

TEST DESCRIPTION:

- Check the resistance of the dump valve solenoid winding.
- Check for a short to ground in the anti-lock pressure valve.

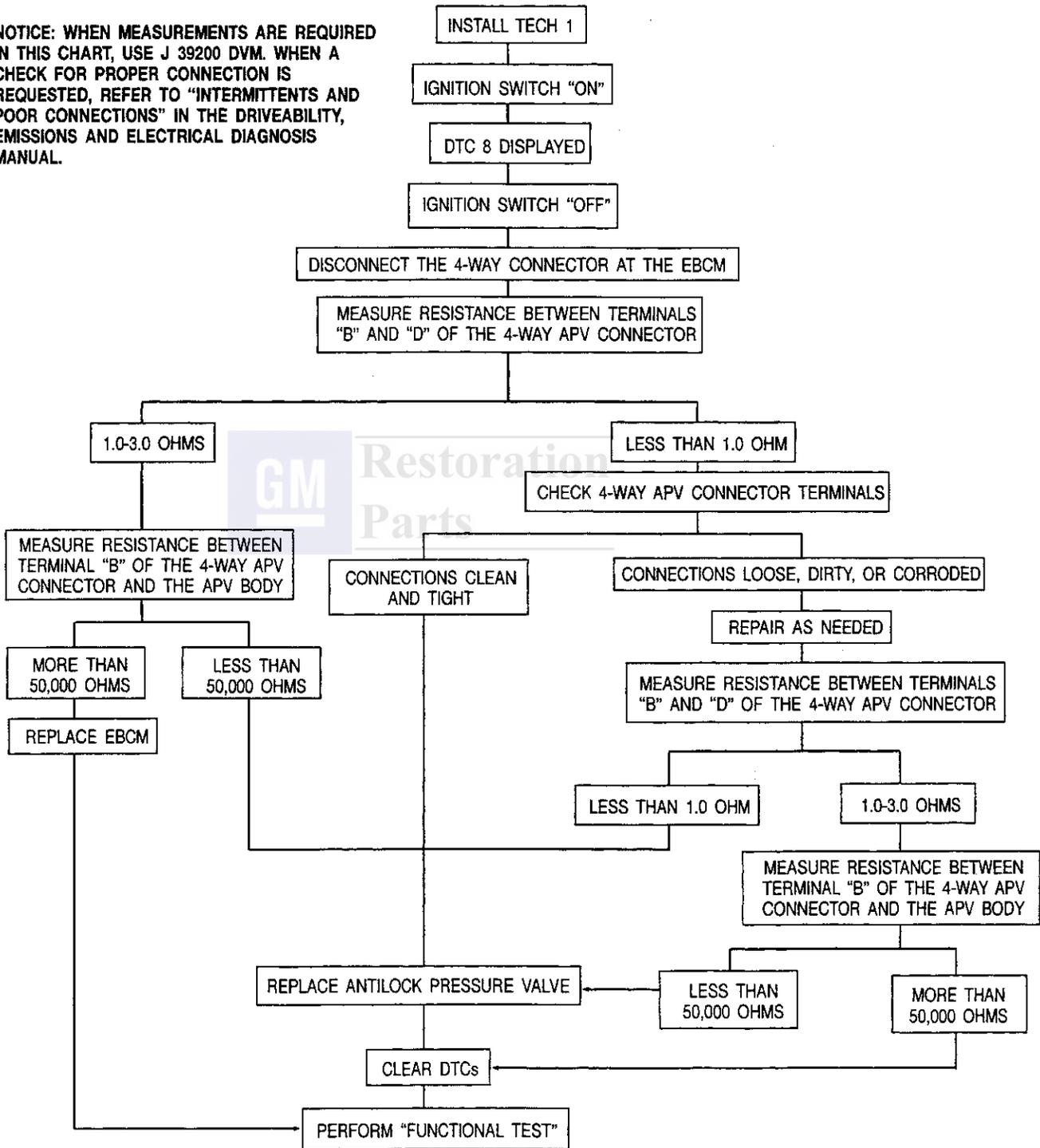
- Check if the connector repair corrected the condition.
- Check for a short to ground in the anti-lock pressure valve.

DIAGNOSTIC AIDS:

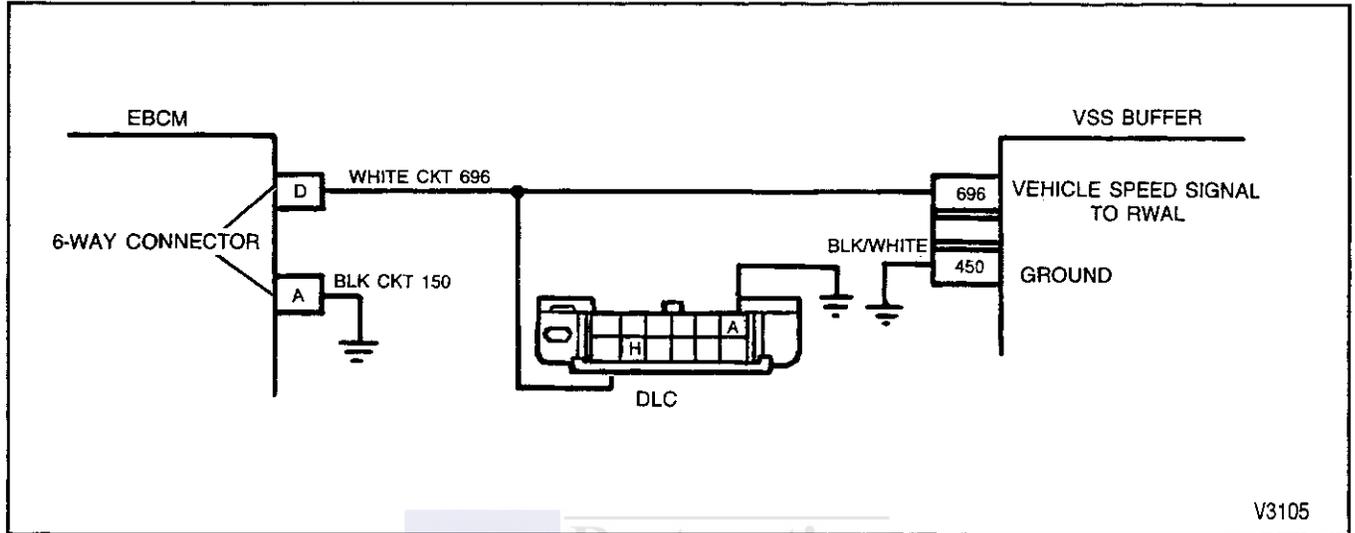
Do not pierce the electrical connectors, wires, seals, or insulation during testing. Doing so will break the seal and lead to corrosion and failure of the wiring and terminals.

**DTC 8
SHORTED DUMP SOLENOID OR EBCM MALFUNCTION**

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.



5E3-32 REAR WHEEL ANTILOCK BRAKE SYSTEM



DIAGNOSTIC TROUBLE CODE 9 OPEN OR GROUNDED SPEED SIGNAL CIRCUIT

CIRCUIT DESCRIPTION:

A DTC 9 is a soft fault. If the speed signal line to the EBCM drops out and returns, this DTC is set in memory. The BRAKE lamp will illuminate when the DTC is set and turn off with the next ignition cycle. An open or grounded speed signal relates to a malfunction in the VSS buffer or speed signal circuit (CKT 696). It can be set by a poor connection in the speed signal line.

TEST DESCRIPTION:

- Check the voltage in CKT 696.
- Check for an open in CKT 696, a blown VSS buffer fuse, or a malfunctioning VSS buffer.
- Check the voltage applied at the EBCM connector.
- Check for added resistance or an open in CKT 696.

DIAGNOSTIC AIDS:



Important

- Do not replace the EBCM for this DTC. An EBCM malfunction will not cause this DTC to set.

If the "BRAKE" lamp is not on, do not ground DLC terminals H to A. Doing so will set a false DTC 9.

This is a soft fault that keeps the "BRAKE" lamp illuminated until the next ignition cycle.

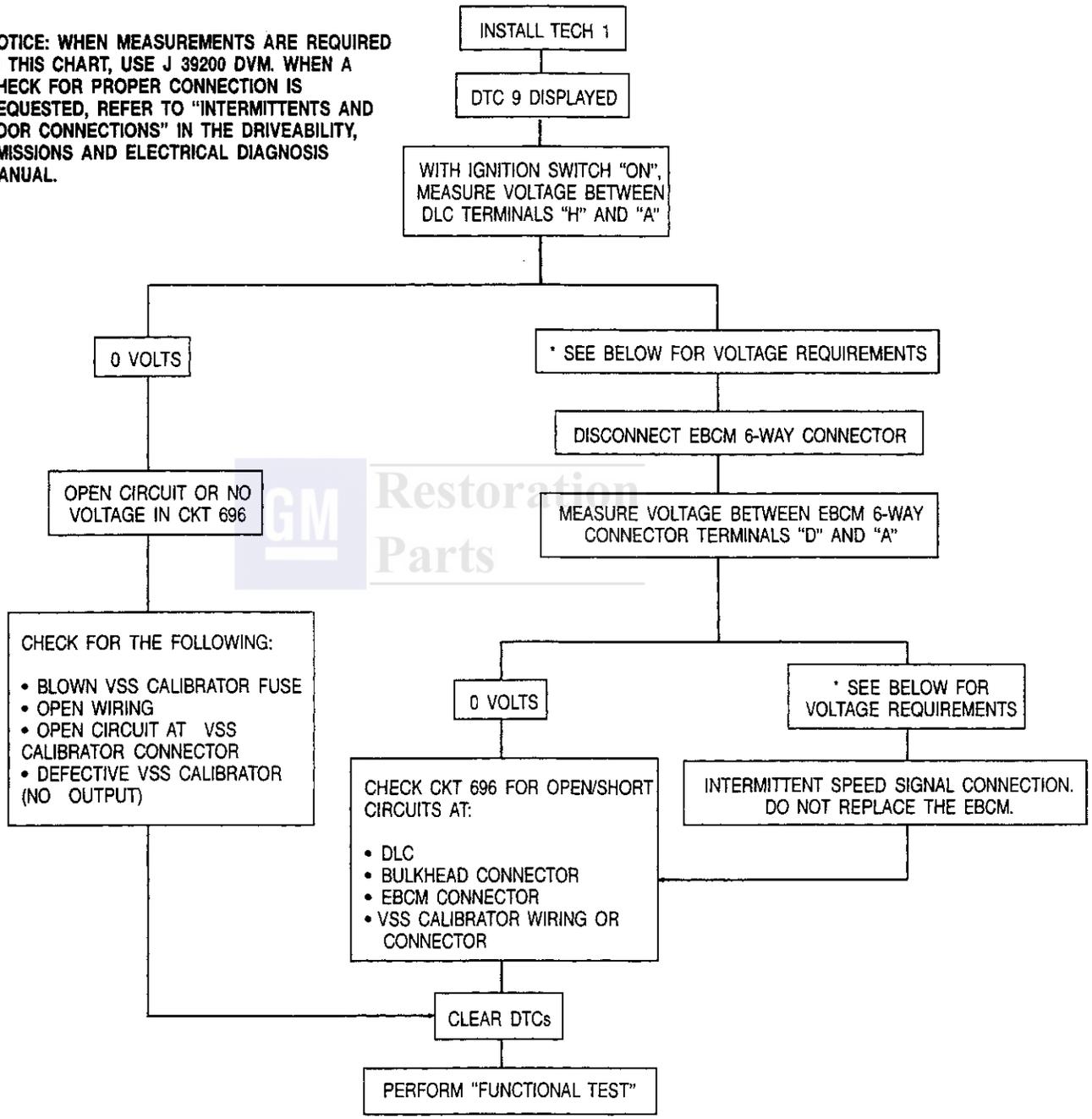
If voltage readings are low or varying, the battery, charging system, or intermittent connections could be the cause. Check these areas before replacing any components.

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.

REAR WHEEL ANTILOCK BRAKE SYSTEM 5E3-33

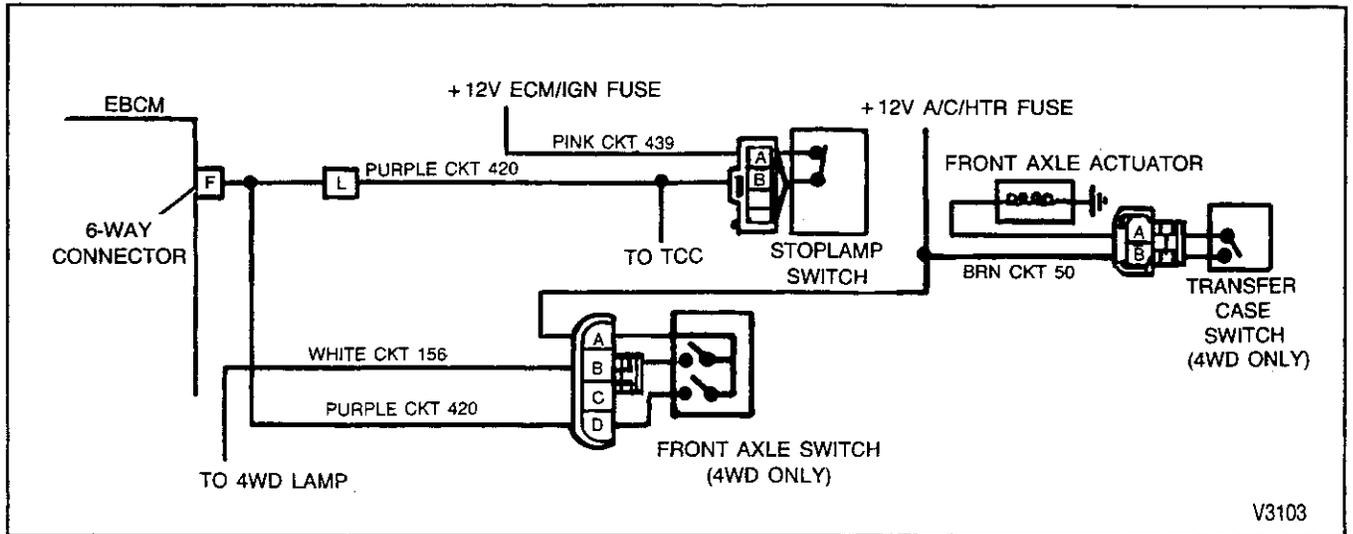
DTC 9 OPEN OR GROUNDED SPEED SIGNAL CIRCUIT

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.



* RWAL AND ZPRWAL EBCMS HAVE DIFFERENT VOLTAGE REQUIREMENTS.
 —ZPRWAL (EBCM WITH GRAY CONNECTOR END — 30 SERIES HD) 6 TO 15 VOLTS
 —RWAL (EBCM WITH BLACK CONNECTOR END — ALL OTHER MODELS) 8 TO 15 VOLTS

5E3-34 REAR WHEEL ANTILOCK BRAKE SYSTEM



DIAGNOSTIC TROUBLE CODE 10 STOP LAMP SWITCH CIRCUIT

CIRCUIT DESCRIPTION:

A DTC 10 relates to the 12-volt signal in the stoplamp switch circuit. The EBCM uses this circuit to prepare for a possible antilock stop. The stoplamp switch closes when the brake pedal is released sending 12 volts to terminal F of the EBCM. Applying the brake pedal causes this signal to drop to less than 1 volt. When the EBCM sees this drop it gets ready to control the antilock pressure valve if necessary.

TEST DESCRIPTION:

- Check if voltage is available at the stoplamp switch.
- Check if voltage is getting through the stoplamp switch with the brake pedal released.
- Check if voltage is reaching terminal F and ground potential is available at terminal A.
- Check the operation of the stoplamp switch during actual driving conditions. This helps determine if the DTC is intermittent.

DIAGNOSTIC AIDS:



Important

- Do not replace the EBCM or APV for this DTC. An EBCM or APV malfunction will not cause this DTC to set.

This DTC is set when the vehicle speed reaches 56 km/h (35 mph) or greater and there is no 12 volt signal from the stop lamp switch.

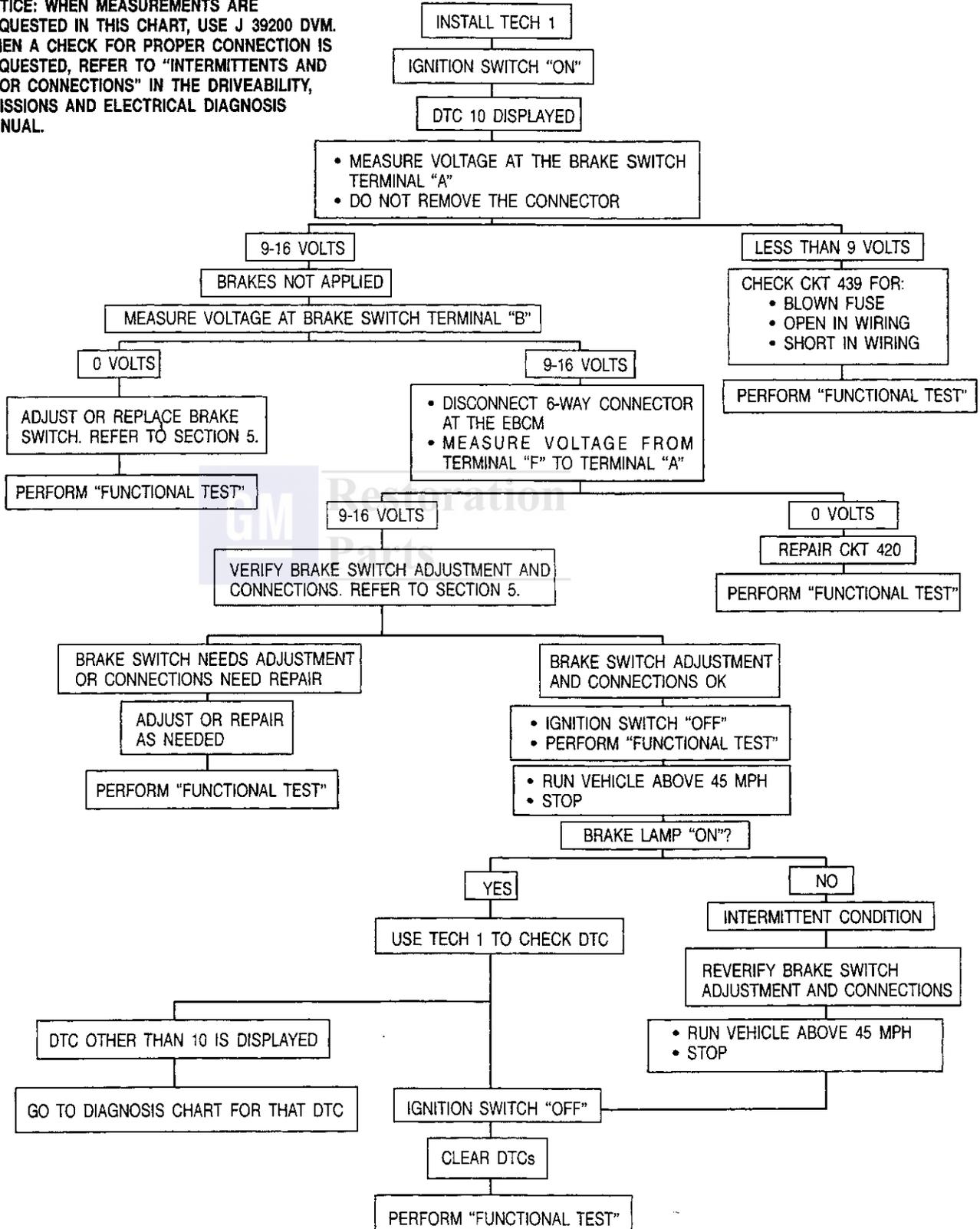
This DTC is a soft fault that turns on the "BRAKE" lamp until 12 volts is received from the stop lamp switch.

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.

REAR WHEEL ANTILOCK BRAKE SYSTEM 5E3-35

DTC 10-BRAKE SWITCH CIRCUIT

NOTICE: WHEN MEASUREMENTS ARE REQUESTED 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.



5E3-36 REAR WHEEL ANTILOCK BRAKE SYSTEM

DIAGNOSTIC TROUBLE CODES 1, 11, AND 12 INVALID DIAGNOSTIC TROUBLE CODES

CIRCUIT DESCRIPTION:

DTCs 1, 11, and 12 do not exist. They are the result of misreading the "BRAKE" lamp flashes. **The Tech 1 scan tool will not display these DTCs.** If these DTCs are encountered, review the procedure for manually reading DTCs.

TEST DESCRIPTION

1. Check DTCs by manually grounding terminals A and H of the DLC.
2. Verify the correct procedure was used.
3. Check DTCs using the Tech 1.

**DTCS 1, 11, AND 12
INVALID DIAGNOSTIC TROUBLE CODES**

- IGNITION SWITCH "ON"
- GROUND TERMINALS A AND H OF THE DLC

BRAKE LAMP FLASHES DTC 1, 11, OR 12

REVIEW PROCEDURE FOR IDENTIFYING
DTCs. 1, 11, OR 12 ARE FALSE DTCs.

RECHECK DTCs USING TECH 1

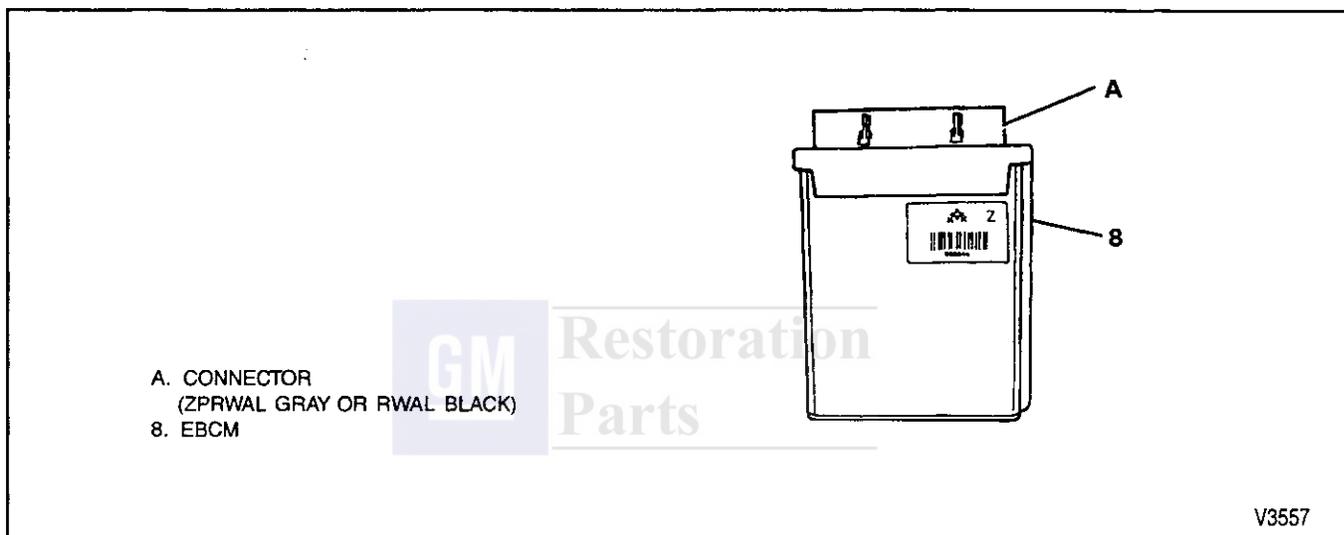
REFER TO DTC STORED

IGNITION SWITCH "OFF"

CLEAR DTCs

PERFORM "FUNCTIONAL TEST"

5E3-38 REAR WHEEL ANTILOCK BRAKE SYSTEM

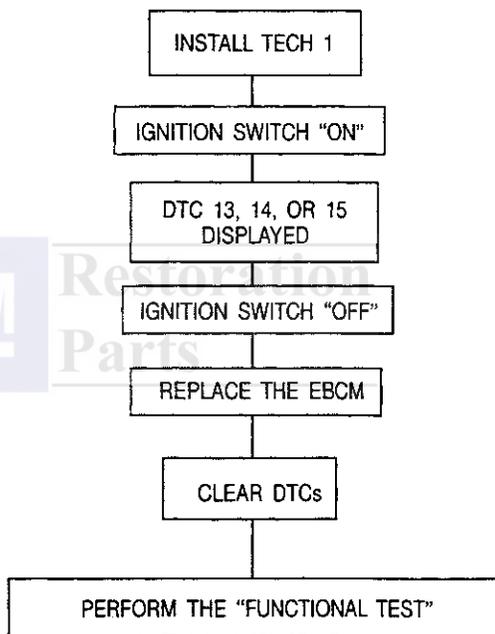


DIAGNOSTIC TROUBLE CODES 13, 14, AND 15 EBCM MALFUNCTION

CIRCUIT DESCRIPTION:

These DTCs relate to internal malfunctions in the EBCM. If the Tech 1 displays any of these DTCs, replace the EBCM. There are no tests to perform due to these DTCs being internal to the EBCM.

**DTC 13, 14, OR 15
EBCM MALFUNCTION**



ON-VEHICLE SERVICE

SERVICE PRECAUTIONS

The RWAL and ZPRWAL systems are basically maintenance free. When doing work on these systems, the following must be observed:

- Before doing welding work on the vehicle with an electric welding unit, turn the ignition switch "OFF" and disconnect the EBCM 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 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 RWAL or ZPRWAL systems. 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 RWAL or ZPRWAL. When doing service work, become familiar with RWAL, ZPRWAL, and how they may be interrelated 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 SYSTEM

NOTICE: The ignition switch must be in the "OFF" position or false DTCs could be set to memory.

Tools Required:

- J 39177 Combination Valve Pressure Bleeding Tool
- 7000001 Mass Storage Cartridge
- TK 00000 Tech-1 Scan Tool
- TK 02650 RWAL/4WAL Cartridge Kit or
- 7000001 Mass Storage Cartridge

1. Install J 39177 on the combination valve.
2. Check the master cylinder reservoir fluid level and fill if needed.
3. Bleed wheel cylinders and calipers as described in SECTION 5.
4. Turn ignition switch "ON" and do three function tests with the Tech-1 scan tool.
5. Re-bleed the rear brakes. Refer to SECTION 5.
6. Evaluate brake pedal feel.
7. Repeat the bleed procedure if needed.

ELECTRIC BRAKE CONTROL MODULE

The electric brake control module (EBCM) is not serviceable. It should be replaced when the DTC charts show that it is the cause of a malfunction.

NOTICE: Be sure to use the correct EBCM for the system being serviced. The 3500 HD uses the ZPRWAL EBCM with the gray electrical connector. All other models use the RWAL EBCM with the black electrical connector. Failure to use the correct EBCM will result in a system malfunction.



Remove or Disconnect (Figure 8)

NOTICE: Do not touch the electrical connections and pins or allow them to come in contact with brake fluid as this will damage the EBCM.

1. Electrical connectors from the EBCM.
2. EBCM.
 - Pull the EBCM toward the front of the vehicle.



Install or Connect (Figure 8)

NOTICE: Do not touch the electrical connections and pins or allow them to come in contact with brake fluid as this will damage the EBCM.

1. EBCM.
 - Slide the EBCM into the bracket until the tab locks in the hole.
2. Electrical connectors to the EBCM.
 - If there is brake fluid on the connectors, clean them with water followed by denatured alcohol.

ANTILOCK PRESSURE VALVE

The antilock pressure valve is not serviceable. It should be replaced when the DTC charts show that it is the cause of a malfunction.



Remove or Disconnect (Figure 8)

1. Brake pipe fittings from the antilock pressure valve.
2. Bottom electrical connector from the EBCM.
 - Do not allow the antilock pressure valve to hang by the wiring harness.

NOTICE: Do not touch the electrical connections and pins or allow them to come into contact with brake fluid as this will damage the EBCM.

3. Antilock pressure valve mounting bolts.

REAR WHEEL ANTILOCK BRAKE SYSTEM 5E3-41

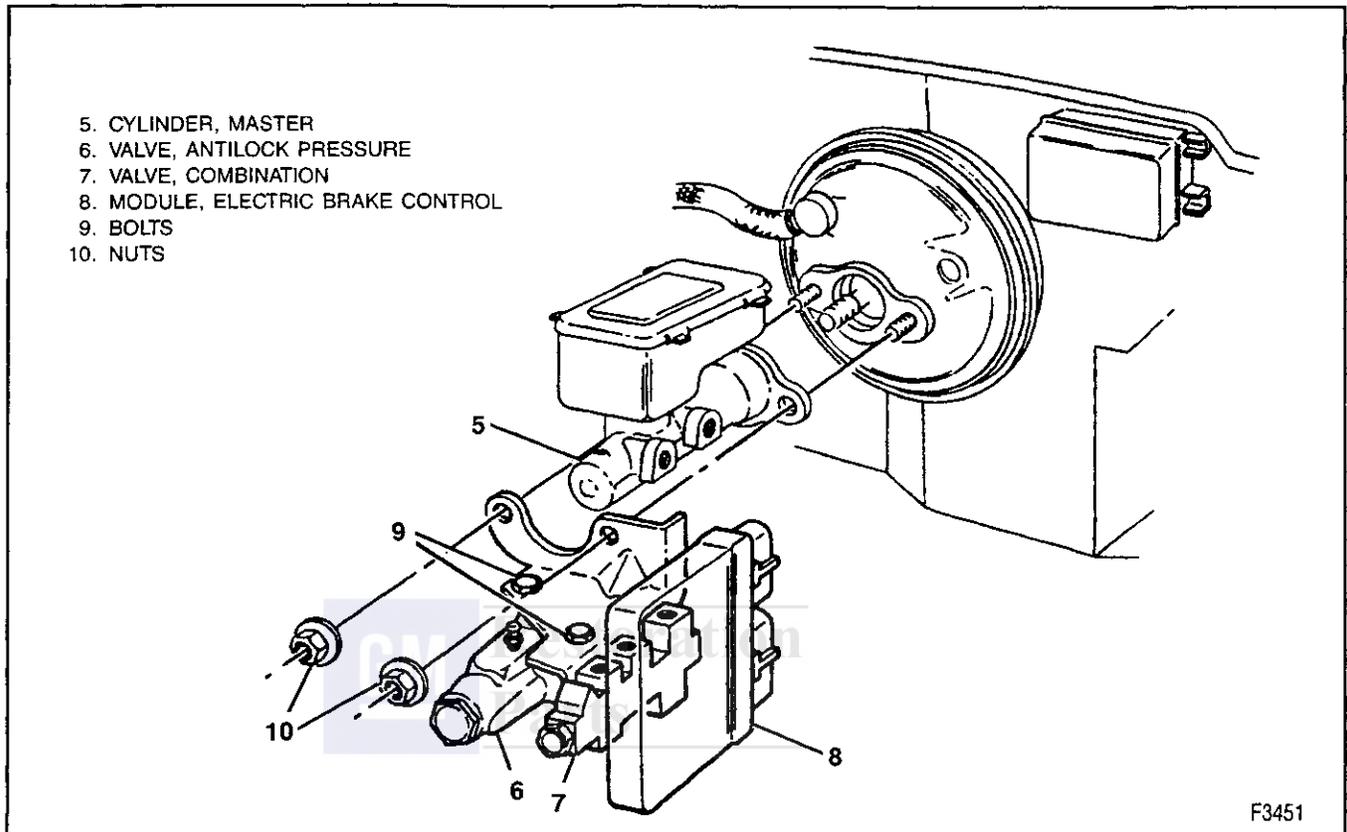


Figure 8—EBCM and Antilock Pressure Valve

4. Antilock pressure valve.

Install or Connect (Figure 8)

1. Antilock pressure valve.

NOTICE: Refer to "NOTICE" on page 5E3-1.

2. Antilock pressure valve mounting bolts.

Tighten

- Antilock pressure valve mounting bolts to 29 N.m (21 lbs. ft.).

NOTICE: Do not touch the electrical connections and pins or allow them to come into contact with brake fluid as this will damage the EBCM.

3. Electrical connector to the EBCM.

- If there is brake fluid on the connectors, clean them with water followed by denatured alcohol.

4. Brake pipes to the antilock pressure valve.

Tighten

- Antilock pressure valve brake pipe fittings to 24 N.m (18 lbs. ft.).
5. Bleed the system. Refer to "Bleeding System."

VEHICLE SPEED SENSOR

The vehicle speed sensor (VSS) is not serviceable. It should be replaced when necessary. Refer to SECTION 7 for replacement procedures.

WARNING LAMP

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

5E3-42 REAR WHEEL ANTILOCK BRAKE SYSTEM

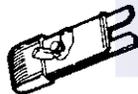
SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

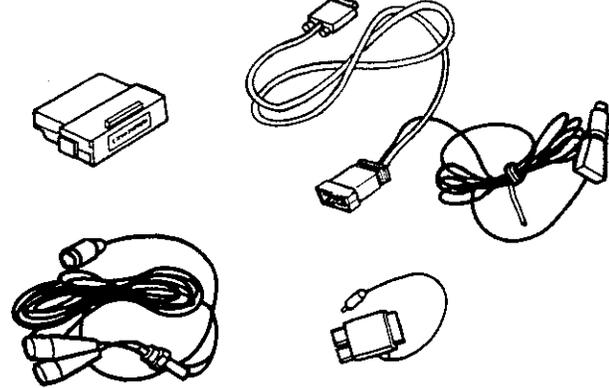
	N·m	Ft. Lbs.
Antilock Pressure Valve Mounting Bolts	29	21
Brake Pipe Fittings.....	24	18
		T2566

SPECIAL TOOLS



1.  J 39177

2.  TK 00000

3.  TK 02650 (4 PIECES)

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

F9080

SECTION 5F

PARKING BRAKE

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

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5F-2 PARKING BRAKE

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).

NOTICE: Refer to "Notice" on page 5F-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 (13) at equalizer (12) (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).

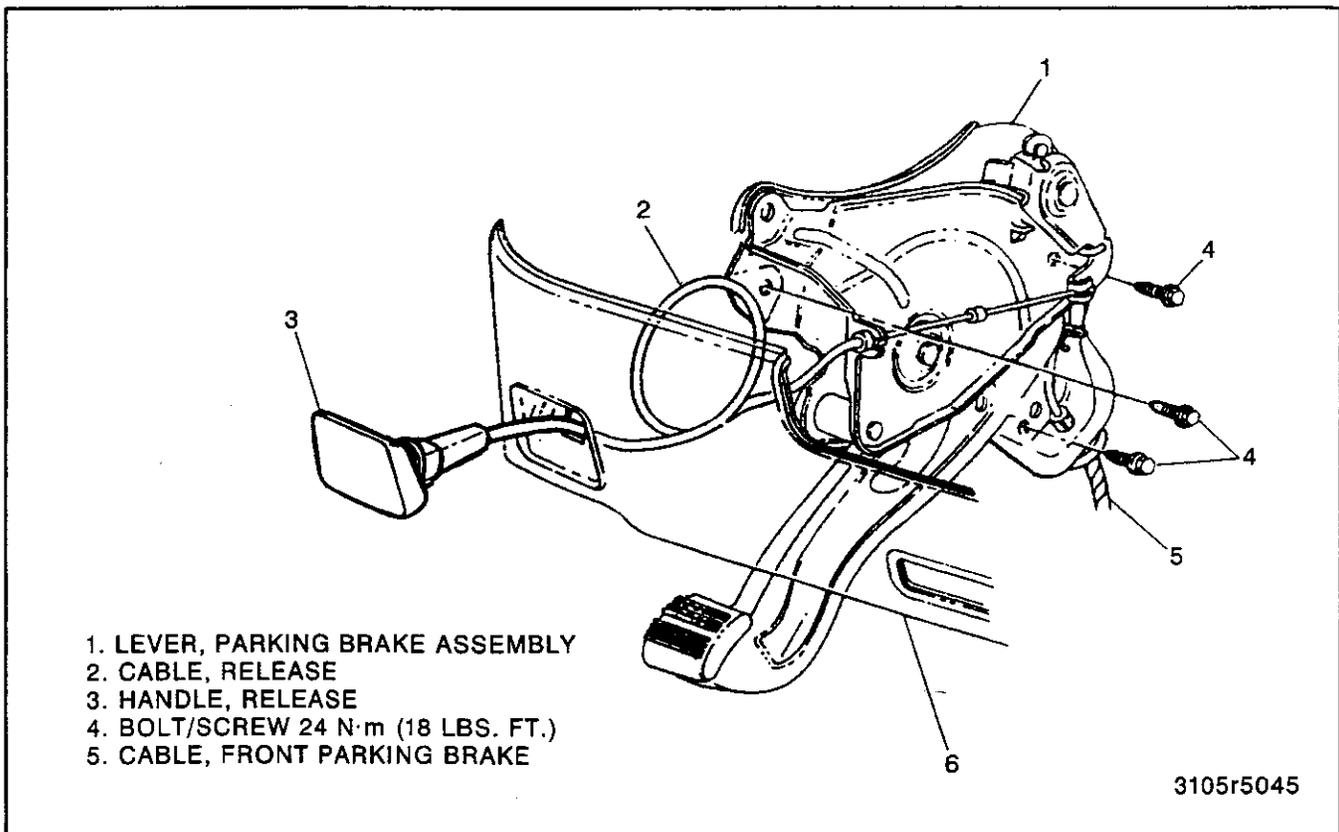
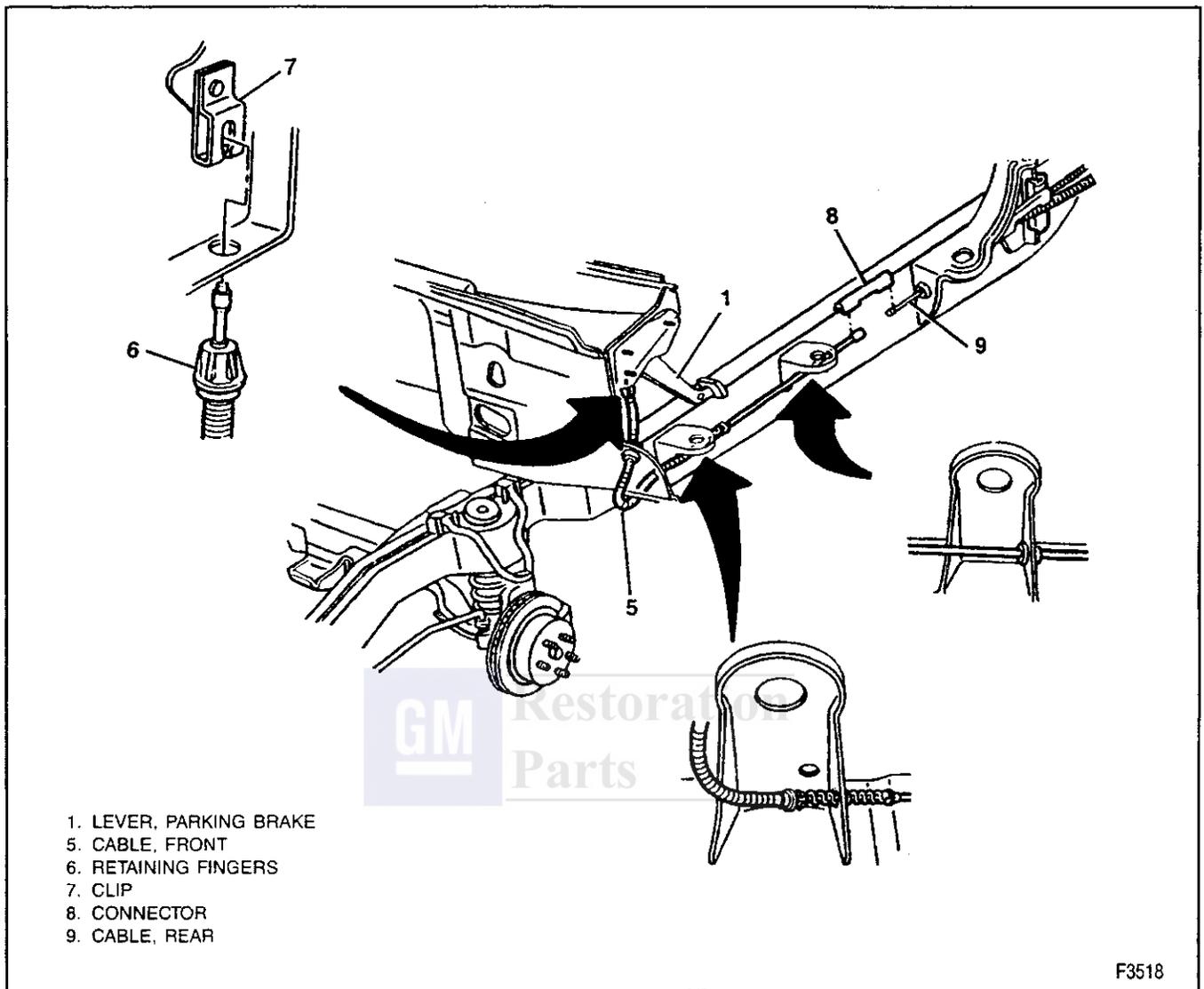


Figure 1—Parking Brake Lever

5F-4 PARKING BRAKE



- 1. LEVER, PARKING BRAKE
- 5. CABLE, FRONT
- 6. RETAINING FINGERS
- 7. CLIP
- 8. CONNECTOR
- 9. CABLE, REAR

F3518

Figure 2—Front Parking Brake Cable

↔ 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).

🔧 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 (13) at equalizer (12).
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 (10 or 11).

↔ Install or Connect (Figure 3)

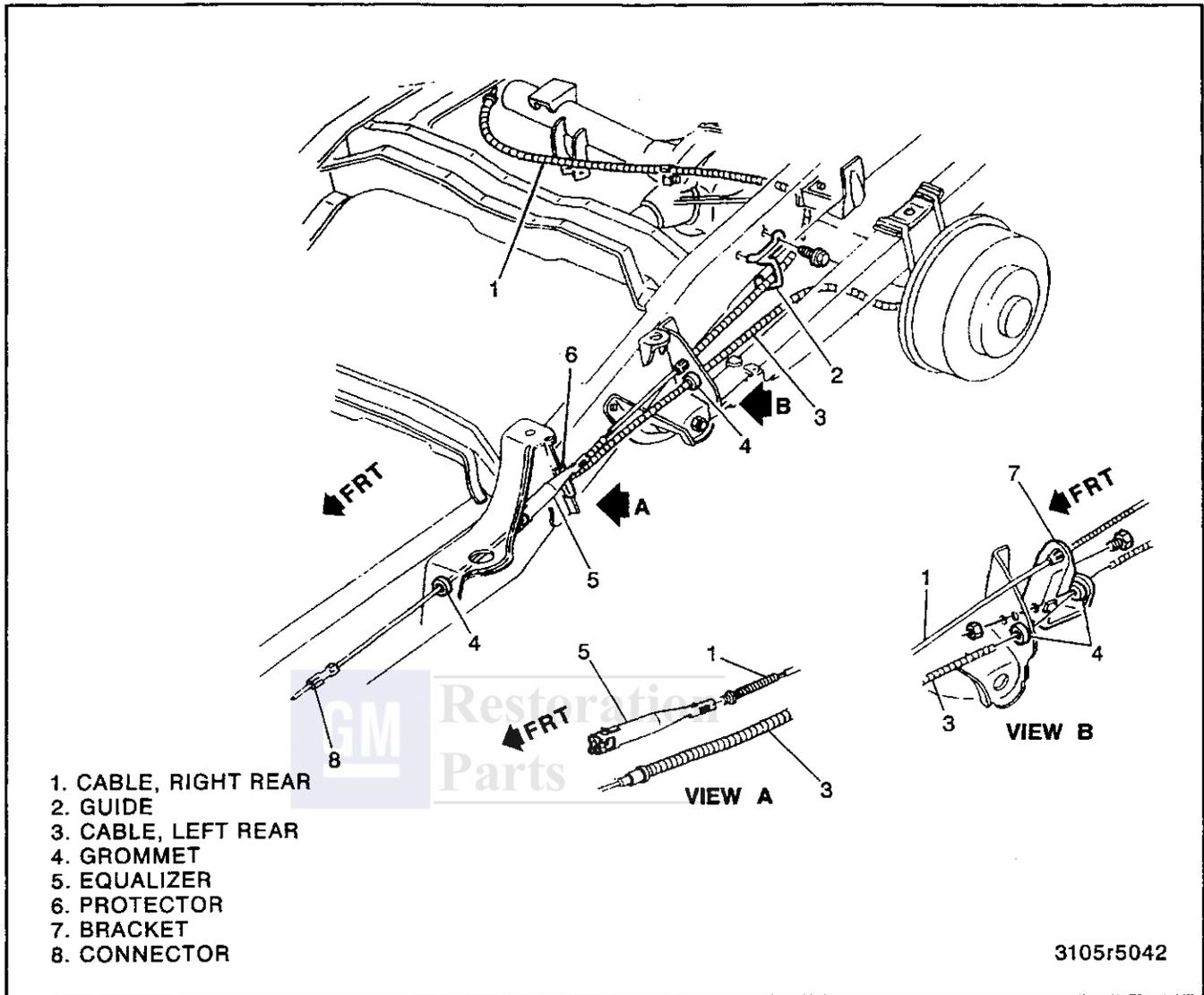
1. Cable (10 or 11).
2. Cable end into backing plate.
 - Make sure all retaining fingers are completely through the backing plate.
3. Rear brake assembly. Refer to SECTION 5C1 or 5C2.
4. Connector (8).

🔧 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.



- 1. CABLE, RIGHT REAR
- 2. GUIDE
- 3. CABLE, LEFT REAR
- 4. GROMMET
- 5. EQUALIZER
- 6. PROTECTOR
- 7. BRACKET
- 8. CONNECTOR

3105r5042

Figure 3—Rear Parking Brake Cable

The C3HD has a propeller shaft mounted parking brake and does not affect the service brakes.

DUO-SERVO DRUM BRAKES

 **Adjust (Figure 3)**

1. Block the front wheels.
2. Raise the vehicle and support with safety stands.
3. Loosen the adjusting nut (13).
4. Set the parking brake by pushing the pedal down 22 degrees.
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.

LEADING/TRAILING DRUM BRAKES

 **Remove or Disconnect (Figures 4, 5, and 6)**

Tool Required:
J 21177-A Drum to Brake Shoe Clearance Gage

1. Block the front wheels.
2. Raise the vehicle and support with safety stands.
3. Mark the relationship of the wheel to the axle flange.
4. Remove the wheel and tire.
5. Mark the relationship of the drum to the axle flange.
6. Remove the drum.
7. Measure the drum's inside diameter (A) using J 21177-A (figure 6).
8. Turn adjuster nut (23) until lining diameter is 0.254 to 0.508 mm (0.010 to 0.020 in.) less than drum ID (B) for each rear wheel.
9. Make sure the stops on the park brake levers are against the edge of the shoe web.
 - If the parking brake cable is holding the stops off the edge of the shoe web, loosen the parking brake cable adjustment.
10. Tighten the parking brake cable adjuster nut until the lever stops begin to move off the shoe webs.

5F-6 PARKING BRAKE

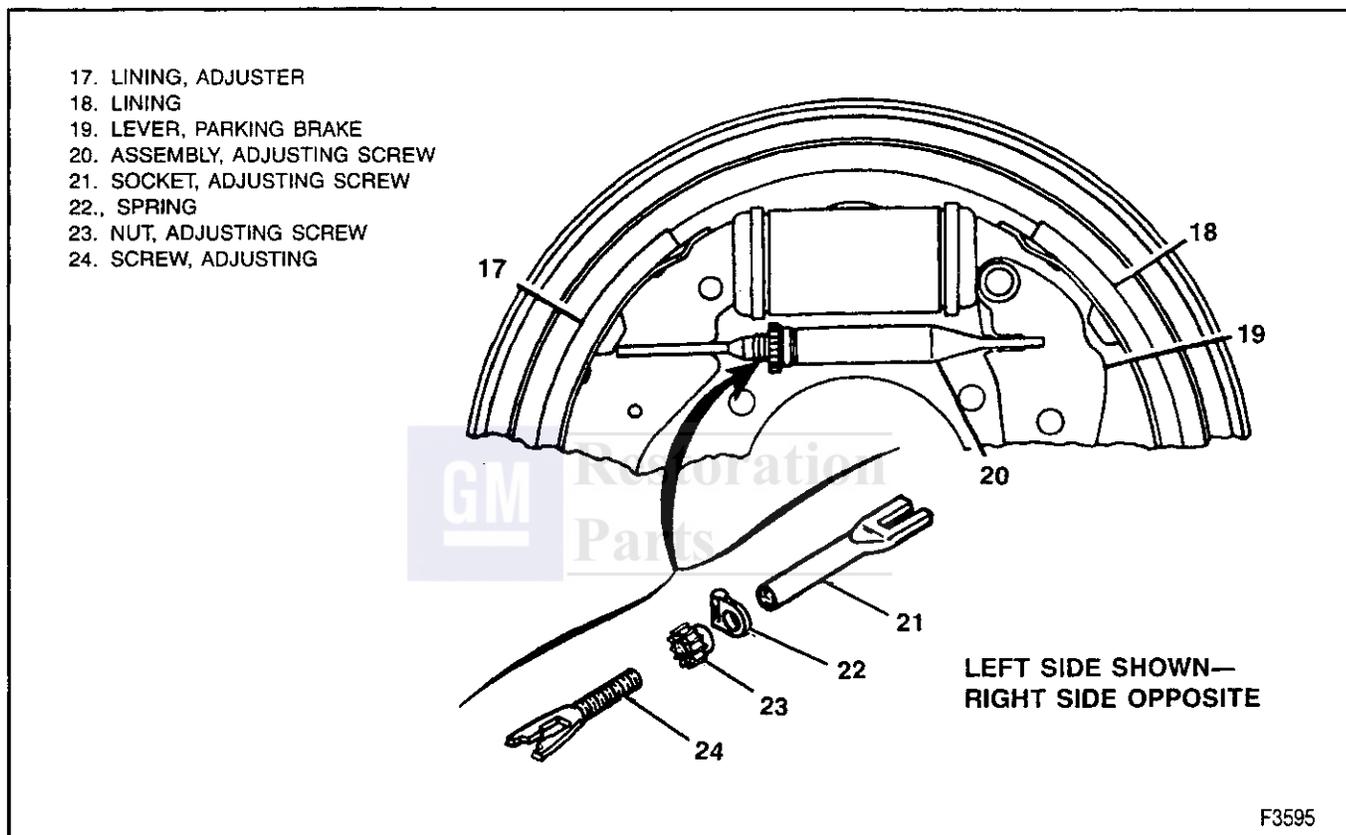
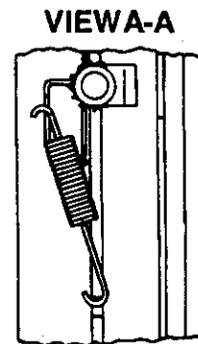
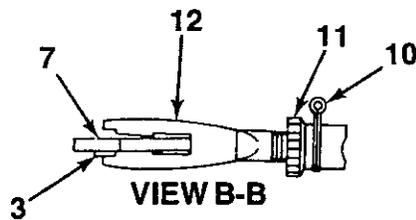
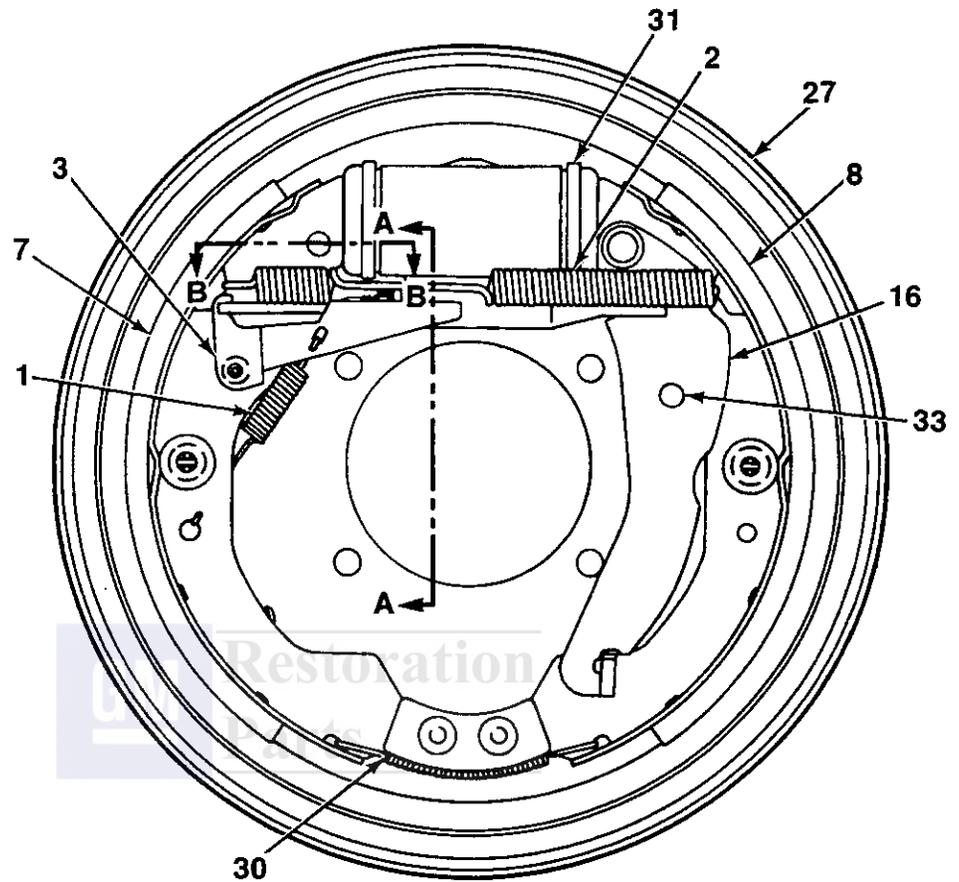


Figure 4—Adjusting Screw Assembly (Leading/Trailing)

11. Loosen the adjuster nut until the lever stops move back to barely touch the shoe webs.
 - There should be no more than 0.5 mm (0.020 in.) clearance between stops and either web.
12. Install drums and wheels, aligning the previous marks.
13. Apply and release the service brake pedal 30 to 35 times with normal pedal force.
 - Pause about one second between pedal applications.
14. Apply parking brake.
 - The rear wheels should not rotate.
15. Release parking brake and check for free wheel rotation.
16. Lower the vehicle.
17. Tighten lug nuts. Refer to SECTION 3E.

“BRAKE” LAMP

For “BRAKE” lamp on vehicle service, refer to SECTION 8C.



- | | |
|------------------------|-----------------------------|
| 1. Actuator Spring | 12. Adjuster Screw |
| 2. Upper Return Spring | 16. Park Brake Lever |
| 3. Adjuster Actuator | 27. Backing Plate |
| 7. Shoe & Lining | 30. Anchor Plate |
| 8. Shoe & Lining | 31. Wheel Cylinder Assembly |
| 10. Spring Clip | 33. Lever Stop |
| 11. Adjuster Nut | |

Figure 5—Parking Brake Adjustment (Left Leading/Trailing)

5F-8 PARKING BRAKE

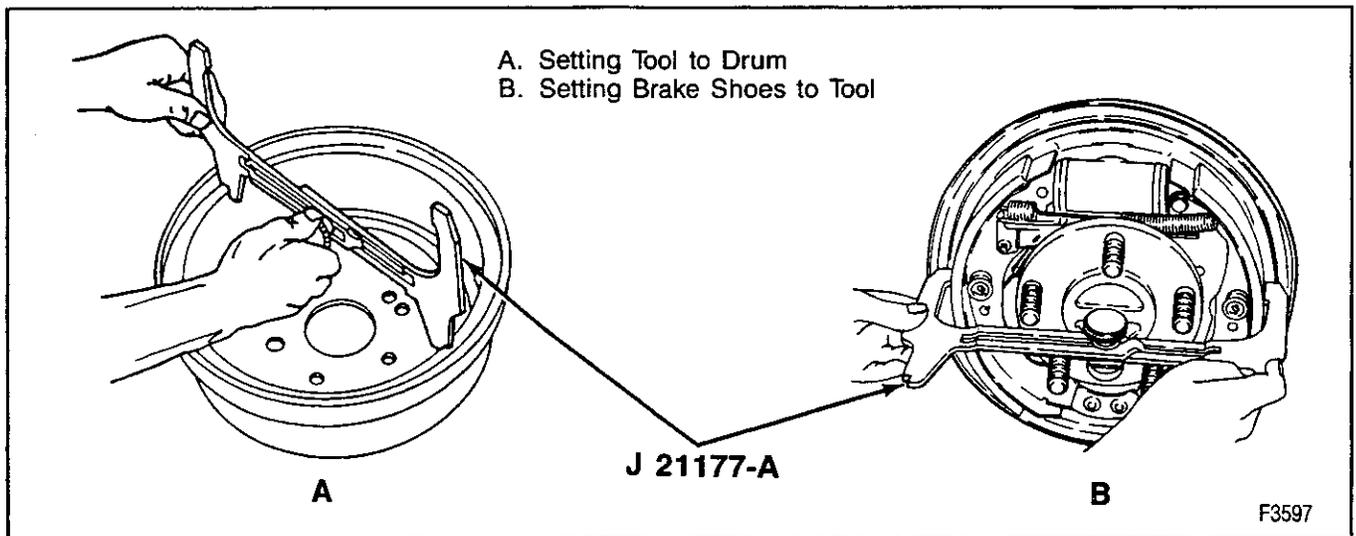


Figure 6—Measuring the Drum for Fit (Leading/Trailing)

ON-VEHICLE SERVICE: PROPELLER SHAFT PARKING BRAKE

CABLE

←→ Remove or Disconnect (Figure 7)

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 7)

1. Cable assembly (10).
2. Retaining fingers (12) to lever (13).
3. Cable end to lever (13).
4. Grommet (7) to bracket.

NOTICE: Refer to "Notice" on page 5F-1.

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 7 and 8)

Tool Required:
J 35999 Fish Scale

1. Remove clevis pin (3) from lever (2).
2. Set parking brake by pushing the pedal down 22 degrees.
3. Install J 35999 with a small length of cable or chain, and a tightening device (like a turn buckle) on the frame.
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.

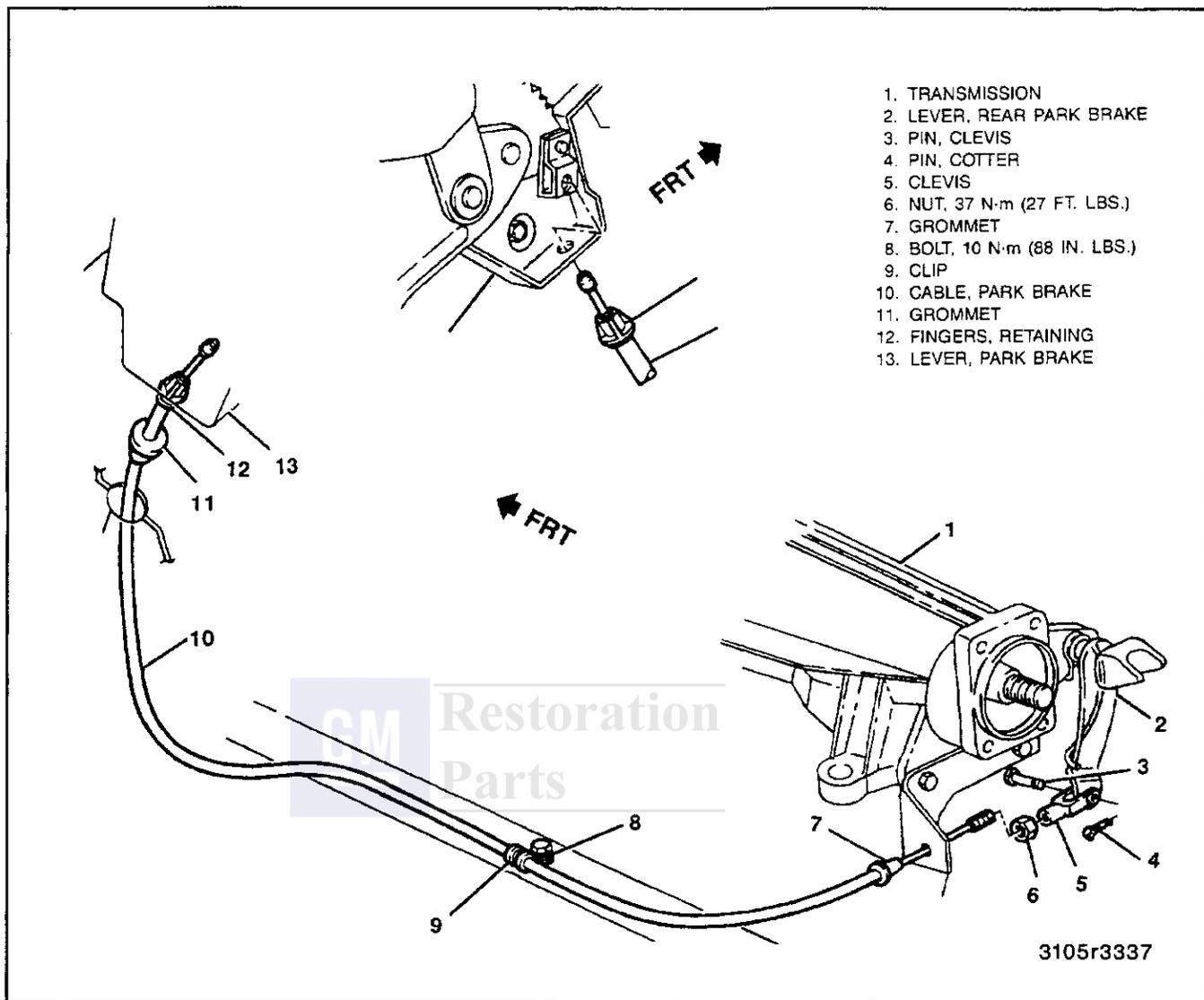
DRUM REPLACEMENT

←→ Remove or Disconnect (Figures 9 and 10)

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 9 and 10)

NOTICE: For steps 2 and 4, refer to "Notice" on page 5F-1.



1. TRANSMISSION
2. LEVER, REAR PARK BRAKE
3. PIN, CLEVIS
4. PIN, COTTER
5. CLEVIS
6. NUT, 37 N·m (27 FT. LBS.)
7. GROMMET
8. BOLT, 10 N·m (88 IN. LBS.)
9. CLIP
10. CABLE, PARK BRAKE
11. GROMMET
12. FINGERS, RETAINING
13. LEVER, PARK BRAKE

Figure 7—Parking Brake Cable

1. Drum (18) to yoke (20).
2. Bolts (22) and washers (21).

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.

LINING REPLACEMENT

Remove or Disconnect (Figures 11 and 12)

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 11 and 12)

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.

NOTICE: Refer to "Notice" on page 5F-1.

4. Bolts (26) and washers (25).

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5F-10 PARKING BRAKE

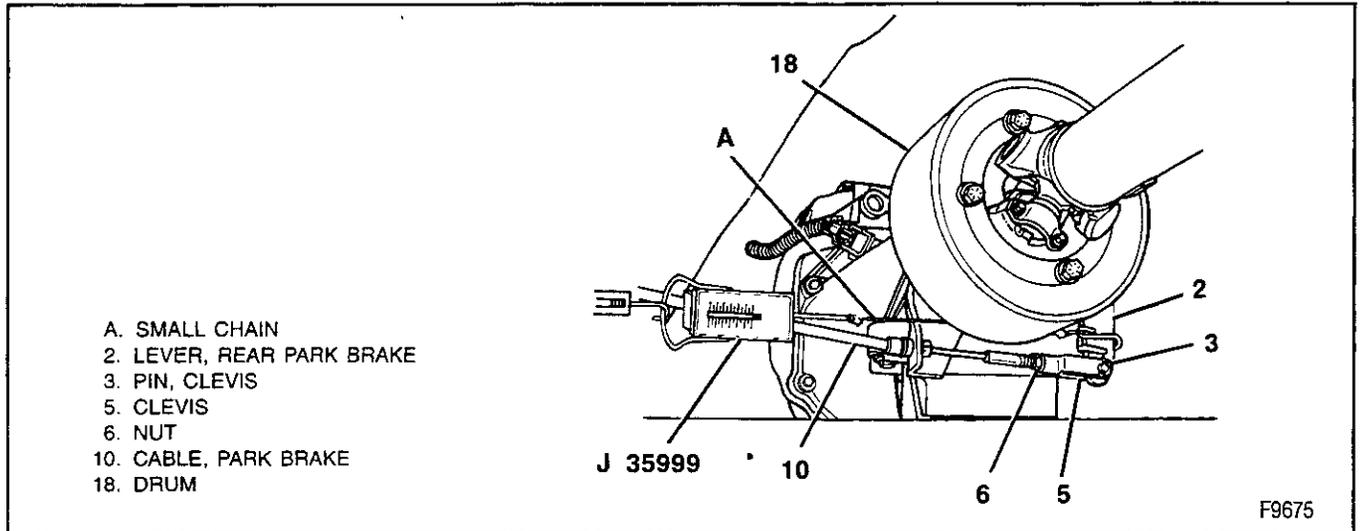


Figure 8—Parking Brake Adjustment

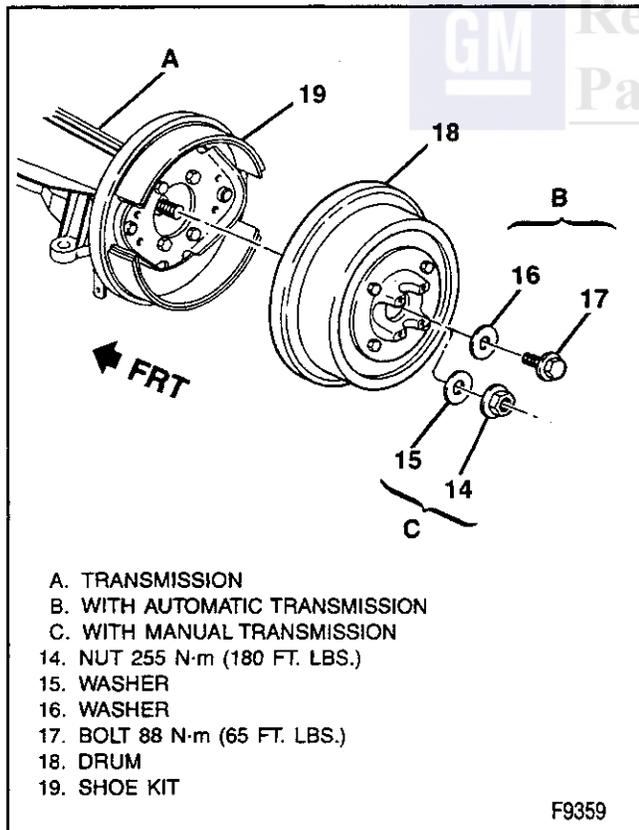


Figure 9—Drum Replacement

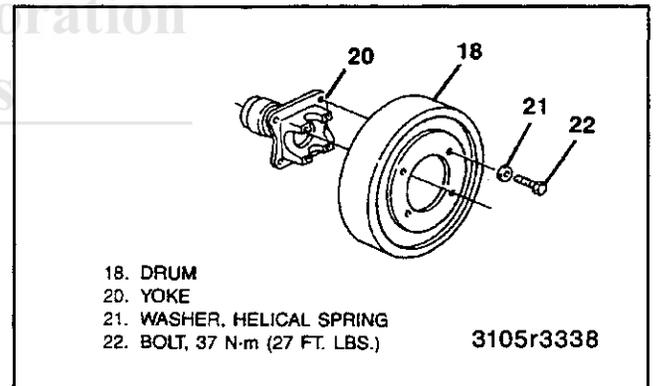


Figure 10—Drum and Yoke



- Tighten**
- Bolts (26) to 105 N·m (77 lbs. ft.).
 - 5. Drum. Refer to "Drum Replacement" in this section.

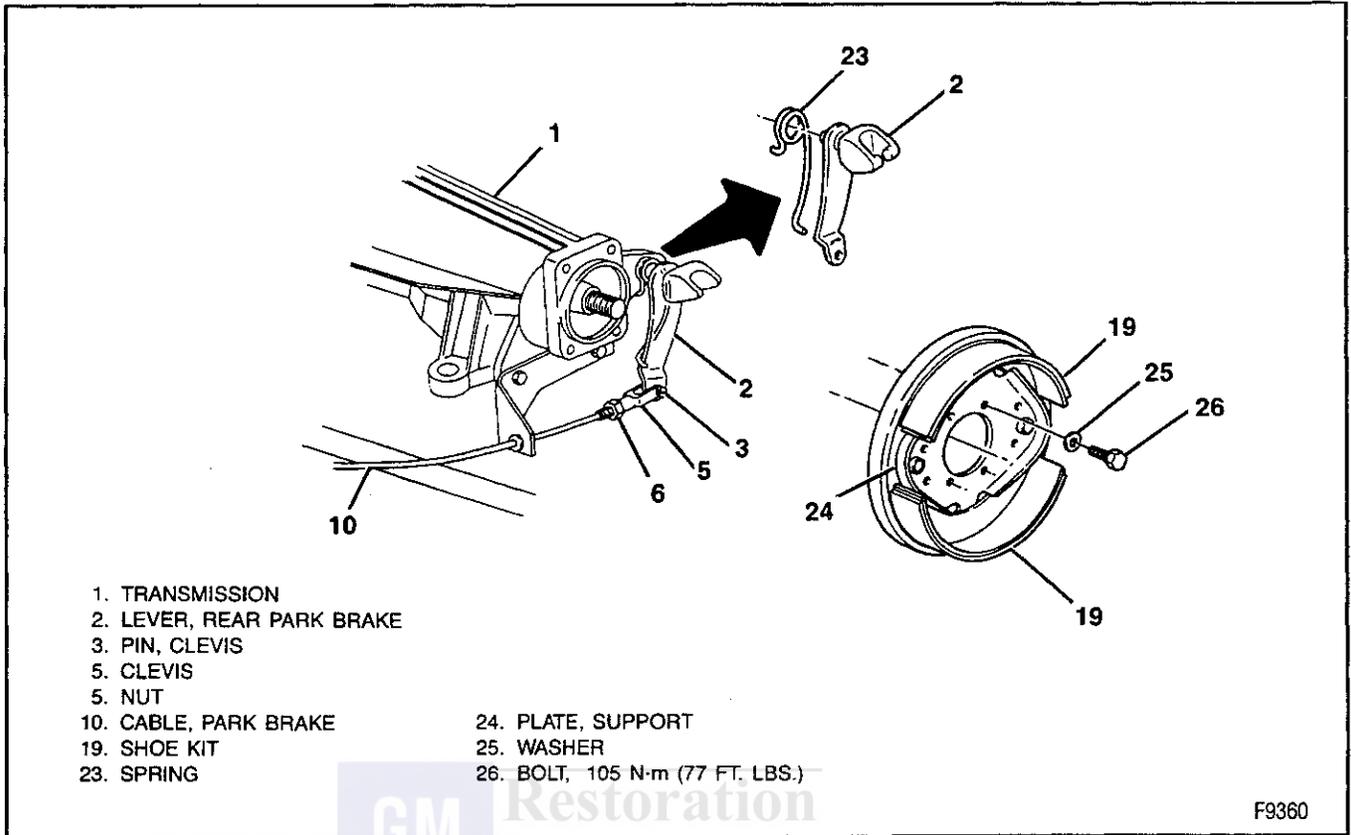


Figure 11—Parking Brake Components

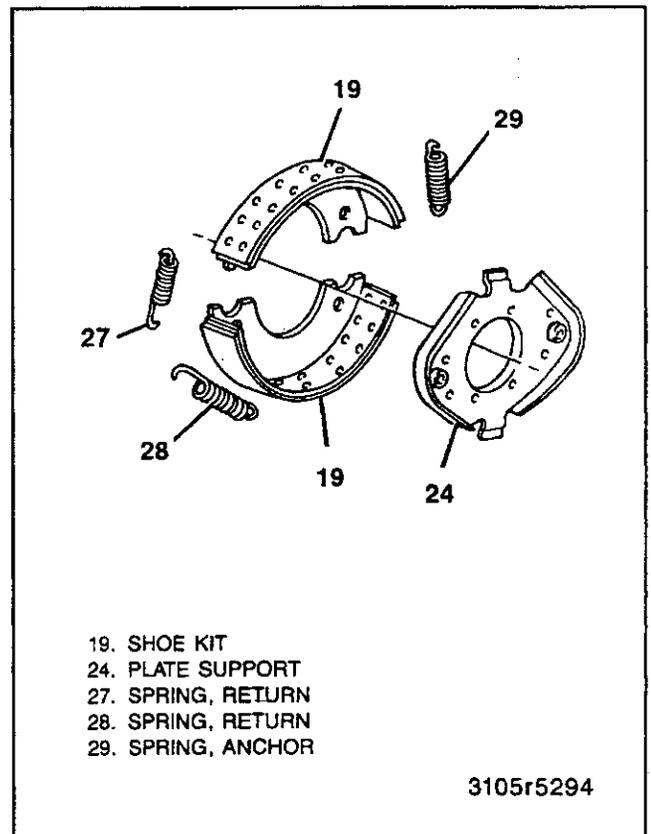


Figure 12—Lining Replacement

5F-12 PARKING BRAKE

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

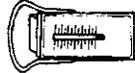
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FASTENER TIGHTENING SPECIFICATIONS

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	—

T2946

SPECIAL TOOLS

1.		J 21177-A	2.		J 35999
<p>1. Drum to Brake Shoe Clearance Gage 2. Fish Scale</p>					
F9793					